GEOGRPH-105

CALIFORNIA GEOGRAPHY

CALIFORNIA GEOGRAPHY

An Open Educational Resources Publication by
College of the Canyons

Authored and compiled by Professor Jeremy Patrich MA
Reader & Revision Editor: Professor Mary Bates MA
Video Producer & Editor: Nicole VanBroekhuizen

Version 1.2

2024

ZERO TEXTBOOK COST

ACKNOWLEDGEMENTS

We would like to extend appreciation to the following people and organizations for allowing this textbook to be created:

California Community Colleges Chancellor's Office
Chancellor Dianne G. Van Hook
Santa Clarita Community College District
College of the Canyons Online Education Office

Written & Compiled by:
Professor Jeremy Patrich MA

Jeremy Patrich is a California based physical and cultural geographer; whose academic adventure began at College of the Canyons. After earning his bachelor's and master's degrees in geography at Cal State Northridge, he then completed a GIS program at the University of North Dakota. More recently, he completed a bachelor's degree in geology at the University of Florida. He is honored to be part of the faculty at College of the Canyons as a professor of geography and geology.

www.BackyardGeographer.com

This book is dedicated to my students and colleagues, past and present, that continue to inspire me, and teach me that no day is complete without learning something new. Each unit has been carefully curated to showcase the incredible diversity found in California and includes experiential multimedia that brings the geography of California to life, unlike any textbook has offered before. This project would never have been possible without the incredible support of Nicole VanBroekhuizen, Ruben Aguao and my family.

I am so excited for you to embark on this journey— Let's explore the geography of California.

PREFACE

Welcome to California Geography.

This textbook was designed especially for Community College students, as a resource to instill the knowledge and adventure that the discipline of geography holds for so many of us. The following units will cover a wide array of topics such as: California's water resources, geology, weather, climate, culture, architecture, and agriculture.

As you will see, the geography of California is diverse; geographically, geologically, and culturally. This text explores these avenues and more by providing Case Studies and highlighting the unsung people, locations, and narratives of the State.

Throughout the text, you will find further opportunities to explore the content by using QR codes that are linked to short videos by Professor Patrich. These include traditional College level lectures, explore the outdoors with the 'Out in the Field' experiences and lean about unique California artifacts from 'Out of the Collection'.

I am looking forward to sharing my passion of geography with you—and I hope that this text instills the love I have for the Golden State, and provides a narrative of inclusivity, diversity, and equity.

MULTIMEDIA… AUTHOR'S YOUTUBE CHANNEL

Professor Jeremy Patrich has shared his chapter reviews and course lectures on his YouTube channel. Scan the QR code or visit:

https://www.youtube.com/channel/UC22lvRmcfY7OYNqCVY5EbKQ/

Figure 1.1: An Early Map of California, Circa 1650.[1]

UNIT 1: THE GOLDEN STATE

Goals & Objectives of this unit

- Identify the characteristics, symbology and boundaries that define California as a state, culturally and physically.
- Determine the ways in which geographers observe and interpret California.
- Examine and identify primary events that define California's history.

INTRODUCTION TO THE STATE

California is a state in the Western United States, located along the Pacific Coast. With nearly 39.2 million residents, as of 2024, across a total area of approximately 163,696 square miles (423,970 km2), it is the most populous U.S. state and the 3rd largest by area. The Greater Los Angeles area and the San Francisco Bay Area are the nation's second and fifth most populous urban regions respectively, with the former having more than 18.7 million residents and the latter having over 9.6 million. Sacramento is the state's capital, while Los Angeles is the most populous city in the state and the second most populous city in the country. San Francisco is the second most densely, (which is a calculation of how many people per square mile or kilometer) populated major city in the country. Los Angeles County is the country's most

[1] Map by Johannes Vingboons is in the public domain

populous, while San Bernardino County is the largest county by area in the country. California borders Oregon to the north, Nevada and Arizona to the east, the Mexican state of Baja California to the south; and has a coastline along the Pacific Ocean to the west.

The economy of the state of California is the largest in the United States, with a $3.4 trillion gross state product (GSP) as of 2022. It is the largest sub-national economy in the world. If California were a sovereign nation, it would rank as the world's fifth-largest economy as of 2022.

Prior to European colonization, California was one of the most linguistically diverse areas in pre-Columbian North America and contained the highest Native American population density north of what is now Mexico. European exploration in the 16th and 17th centuries led to the colonization of California by the Spanish Empire. In 1804, it was included in Alta California province within the Viceroyalty of New Spain. The area became a part of Mexico in 1821, following its successful war for independence, but was ceded to the United States in 1848 after the Mexican American War. The California Gold Rush started in 1848, only 9 days after Mexico signed over the greater part of California in the Treaty of Guadalupe, which led to dramatic social and demographic changes, including large-scale immigration into California, a worldwide economic boom, and the California genocide of indigenous people. The western portion of Alta California was then organized and admitted as the 31st state on September 9th, following the Compromise of 1850.

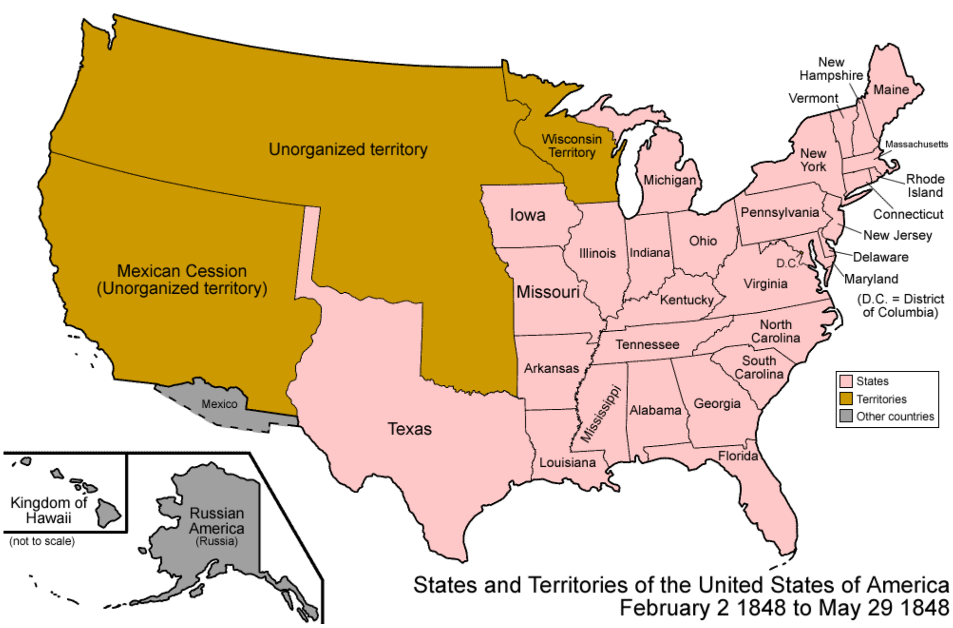


Figure 1.2: Map of the United States Post Treaty of Guadalupe Hidalgo, in 1848. [2]

[2] Map by Golbez is used under a CC BY-SA 3.0 license.

The state's extremely diverse physical geography ranges from the Pacific Coast and metropolitan areas in the west to the Sierra Nevada mountains in the east, and from the redwood and Douglas fir forests in the northwest to the Mojave Desert in the southeast. The Central (or often referred to as the Great) Valley, a major agricultural area, dominates the state's center. California is well known for its warm Mediterranean climate and monsoon seasonal weather. The large size of the state results in climates that vary from moist temperate rainforest in the north to arid desert in the interior, as well as snowy alpine in the mountains.

California is home to the world's oldest, tallest, and largest trees—it also has the highest and lowest point in the lower 48 states. The geography and geology provide tourists the opportunity to go skiing and surfing in the same day, while driving by some of the tallest and lowest elevations on the continent. No other location has the cultural and spatial diversity, grandeur, and geological variety than California. The best way to understand what California 'is', would be to start with the story of the Isle of California.

CALAFIA & THE FIRST PEOPLE TO SEE HER

The fabled "Isle of California" was first described in the 16th century Spanish romance novel, *Las Sergas de Esplandián.* This mystical island was to be found in the South Seas, placed next to the Terrestrial Paradise, or the Garden of Eden. Calafia was the Queen of the Island, the ruler of many beautiful Amazonian women with griffins, and countless treasures. Calafia and her people may be a narrative legend; however, the idea of her island is probably the mistake of early explorers mis-identified the Baja California Peninsula as a massive island, these are the stories in which legends are made.

Figure 1.3: The Mythical Queen Calafia, From Which California Earned its Name. [3]

[3] Image is in the public domain.

For more than two hundred years, there was a difference of opinion as to whether this land which we now know as Lower California was an island or a part of the mainland. In a book published in London in 1725 entitled, *Map of The World*, California is described and mapped as a large island extending north to the Straits of Anián, today known as Puget Sound in Washington state.

In that book, all that is known of California is given in one paragraph, a part of which reads as follows:

> *"This island was formerly esteemed a peninsula, but now found to be entirely surrounded with water. Its north part was discovered by Sir Francis Drake, Anno 1577, and by him called New Albion, where, erecting a pillar, he fastened thereto the arms of England. The inland parts were afterward searched into and are found to be only a dry, barren, cold country. Europeans were discouraged from sending colonies to the same so that it still remains in the hands of the natives."*

After the establishment, of the first of the missions, in 1769, within the boundaries of the present State, the northern portion of that indefinite area to which the name California had been given came to be known as New, or Upper California, while the older known peninsula was called Old, or Lower California.

It was not until after the war with Mexican-America War of 1846-1848, that the boundaries of Upper California became clearly defined, although on the north the forty-second parallel had been previously recognized by the Adams-Onís Treaty with Spain in 1818, as separating it from the Oregon territory.

As one result of the Mexican War, California came into possession of Lower as well as Upper California, but a treaty of peace finally established the southern boundary of the present State near the thirty-second parallel, the Treaty of Guadalupe Hidalgo in 1848. The original draft of the treaty included the mouth of the Colorado River in the United States and should have been ratified as it was, for it would have avoided disputes as to the use of the river and saved an arbitrary boundary line across its great and fertile delta. The land that the Treaty of Guadalupe Hidalgo brought into the United States became all or part of nine states: California (1850), Nevada (1864), Utah (1896), and Arizona (1912), as well as, depending upon interpretation, the entire state of Texas (1845), which then included part of Kansas (1861); Colorado (1876); Wyoming (1890); Oklahoma (1907); and New Mexico (1912).

The eastern boundary of California, during Mexican rule, was quite indefinite. It was held, on the one hand, that the summit of the Sierra Nevada or Snowy Mountains was the eastern limit, while on the other, the country as far east as Colorado was included in the territory. The line as finally established, however, followed a middle course, including a strip of the desert country east of the Sierra which geographically belongs to Nevada.

The only natural features, then, which sharply separated California from the adjacent regions are the Pacific Ocean upon the west, and the Colorado river upon the southeast. The coastal region and the Great, or Central Valley with its tributary slopes are so isolated by mountains and deserts that with the primitive means of travel in the early days they were extremely difficult to reach.

The influence of the waterways upon the discovery and settlement of California was much less than is usually the case with new countries. The Colorado River was practically useless because of the great canyon in which it is buried throughout most of its course. In addition, its lower portion is shallow and its mouth is in such a remote and inaccessible region that it was almost unused in the early days. No other streams were available for those attempting to cross the continent. Although, for some years before Fremont's explorations, it was erroneously supposed, and this error crept into the maps of that time, that a great river known as the Buenaventura rose in a lake in the Rocky Mountains and flowed westerly into San Francisco Bay. Fremont attempted to find this supposed river when caught in the deserts of northern Nevada with winter coming on, and nearly perished in the snows of the Sierra Nevada range which was found to lie directly across the path of the imaginary stream.

With California hemmed in by mountains and deserts upon the land side, it would surely seem that in the Pacific Ocean, which borders it for such a long distance, we would find an easy way of approach the coast. However, the records of the various exploring expeditions which visited the Pacific coast of North America show that they were repeatedly driven southward by the northwesterly winds and storms. Time and again the expeditions sent north from Mexico were beaten back and disabled. Parties traveling by land made better time and encountered fewer difficulties than those upon the ocean. The difficulty of exploring the coast by sea caused both Drake and Visciano to sail past the entrance to San Francisco Bay without seeing it, due to the thick fog, and led to its interesting discovery by a land expedition under Portola.

HOW GEOGRAPHERS STUDY CALIFORNIA

Geography is a spatial science, a systematic study of the Earth, its features, and phenomena that take place on it. For something to fall into the domain of geography, it generally needs some sort of spatial component that can be placed on a map, such as coordinates, place names, or even addresses. This has led to geography being associated with cartography and place names. Geographers study the Earth's spatial and temporal distribution of phenomena, processes, and features as well as the interaction of humans and their environment. Because space and place affect a variety of topics, such as economics, health, climate, plants, human societies, lifestyles, and animals, geography is highly interdisciplinary. The interdisciplinary nature of the geographical approach depends on an attentiveness to the interactive relationships between physical and human phenomena and their spatial patterns.

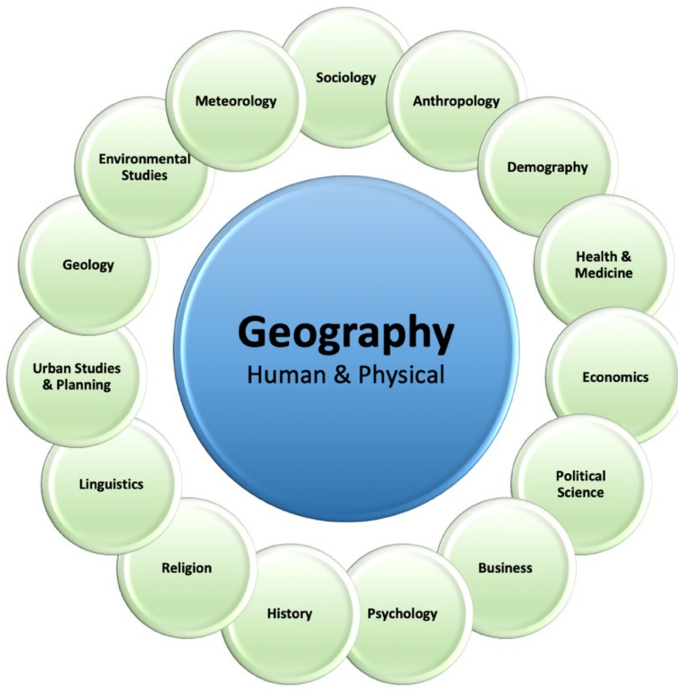


Figure 1.4: Chart of the Interdisciplinary Topics & Nature of the Geographic Approach. [4]

Geography as a discipline can be split broadly into two main branches: human geography and physical geography. Human geography largely focuses on the built environment and how humans create, view, manage, and influence space. Physical geography examines the natural environment, and how organisms, climate, soil, water, and landforms produce and interact. The difference between these approaches led to the development of integrated geography, which combines physical and human geography and concerns the interactions between the environment and humans.

Geographic Inquiry

Geography is the study of the physical distribution of, and cultural environments of the earth. What makes geography different from other disciplines is its focus on spatial inquiry and analysis. Geographers also try to look for connections between things such as patterns,

[4] Graphic by Jeremy Patrich

movement and migration, trends, and so forth. This process is called either geographic or spatial inquiry. To do this, geographers go through a geographic methodology that is quite like the scientific method, but again with a geographic or spatial emphasis.

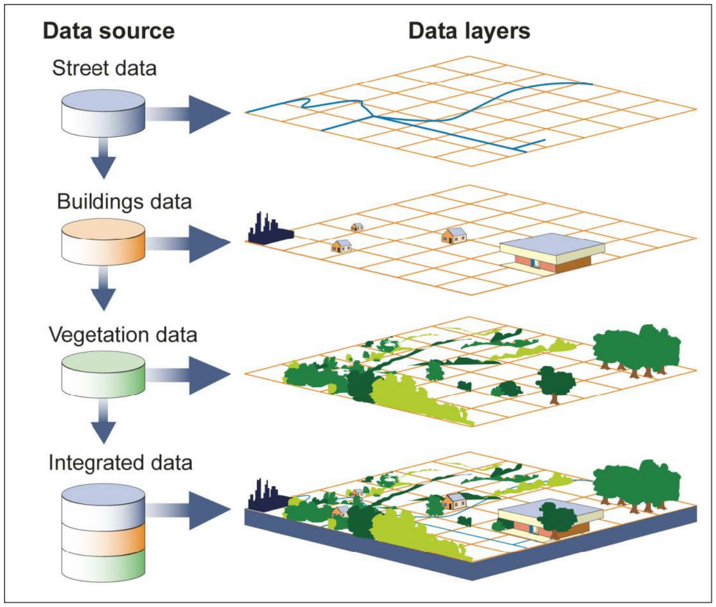
1. **Ask a geographic question**. Ask questions about spatial relationships in the world around you, such as the location of your college as it pertains to your home, high school, or work.
2. **Acquire geographic resources.** Identify data and information that you need to answer your question.
3. **Explore geographic data.** Turn the data into maps, tables, and graphs, and look for patterns and relationships by utilizing geospatial computer programs and statistics.
4. **Analyze geographic information.** Determine what the patterns and relationships mean concerning your question. This is where critical thinking comes to play; once observing the results you then begin to develop future work or perhaps ask even more questions.

Geospatial Technology

There are two basic types of data: spatial and non-spatial data. Spatial data, also called geospatial data, is data that can be linked to a specific location on Earth. Geospatial data is becoming "big business" because it isn't just data, but data that can be located, tracked, patterned, and modeled based on other geospatial data. Census information that is collected every 10 years is an example of spatial data. Non-spatial data is data that cannot be specifically traced to a specific location. This might include the true number or ethnicities of people living in a household, enrollment within a specific course, or even gender information. But non-spatial data can become spatial data if it can be linked in some way to a location. An example of this could be assigning an orange tree in Ventura County a latitude and longitude.
Geospatial technology specialists use a method called geocoding that can be used to give non-spatial data a geographic location. Once data has a spatial component associated with it, the type of questions that can be asked dramatically changes.

Lecture Time: Intro to California's Geography

Want to learn more? Either scan the QR code or visit this link to watch a lecture that introduces California, and how geographers study the state. (Video length: 19min).



Source: GAO.

Figure 1.5: Visual Representation of Themes in a GIS. [5]

Remote Sensing

Remote sensing can be defined as the ability to study objects without being in direct physical contact with them. For example, your eyes are a form of passive remote sensing because they are "passively" absorbing electromagnetic energy within the visible spectrum from distant objects and your brain is processing that energy into information. Satellite imagery is a type of remotely sensed imagery taken of the Earth's surface, which is produced from orbiting satellites that gather data via electromagnetic energy. Next is aerial photography, which is film-based or digital photographs of the Earth, usually from an airplane or non-piloted drone. Images are either taken from a vertical or oblique position. The third is radar, which is an interesting form of remote sensing technology that uses microwave pulses to create imagery of features on Earth. This can be from a satellite image or ground-based Doppler radar for weather forecasting. Finally, a fast-growing realm of remote sensing is called Light Detection and Ranging or Lidar, which is a form of remote sensing that measures the distance of objects using laser pulses of light. In 2023 a next-generation Subsea lidar was used to collect incredibly precise data about subfloor characteristics.

[5] Image by the U.S. Gov't Accountability Office is in the public domain


Figure 1.6: Remote sensing of the environment. [6]

Global Positioning Systems
Another type of geospatial technology, and a key technology for acquiring accurate control points on Earth's surface, is global positioning systems (GPS). To determine the location of a GPS receiver on Earth's surface, a minimum of four satellites are required using a mathematical process called triangulation. Normally the process of triangulation requires a minimum of three transmitters, but because the energy sent from the satellite is traveling at the speed of light, minor errors in calculation could result in large location errors on the ground. Thus, a minimum of four satellites is often used to reduce this error.

There is a technology that can bring together remote sensing data, GPS data points, spatial and non-spatial data, and spatial statistics into a single, dynamic system for analysis, and that is a geographic information system (GIS). A GIS views the world by overlaying physical or cultural layers, each with quantifiable data that can be analyzed. A single GIS map of a national forest could have layers such as elevation, deciduous trees, evergreens, soil type, soil erosion rates, rivers and tributaries, major and minor roads, burn areas, regrowth, animal species type, trails, and more. Each of these layers would contain a database of information specific to that layer.

The Geography of Humans
Human geography is the branch of geography that studies spatial relationships between human communities, cultures, economies, and their interactions with the environment, examples of which is studied in schools are urban sprawl, urban redevelopment etc. It analyzes spatial interdependencies between social interactions and the environment through qualitative and

[6] Image used with permission from gisgeography.com

quantitative methods. This text will reference this perspective, of human geography, to better understand the intrarelationships between California and its people. This geographic lens becomes particularly helpful when evaluating both natural and human landscapes.

Cultural

Cultural geography is the study of cultural processes, identities, and norms - their variation across spaces and places, as well as their relations. It focuses on describing and analyzing the ways language, religion, economy, government, and other cultural phenomena vary or remain constant from one place to another and on explaining how humans function spatially.

Economic

Economic geography is the subfield of human geography which studies economic activity and factors affecting them. It can also be considered a subfield or method in economics. There are four branches of economic geography. There are: Primary sector, Secondary sector, Tertiary sector, & Quaternary sector.

Historical

Historical geography is the study of the human, physical, fictional, theoretical, and "real" geographies of the past. Historical geography studies a wide variety of issues and topics. A common theme is the study of the geographies of the past and how a place or region changes through time. Many historical geographers study geographical patterns through time, including how people have interacted with their environment, and created the cultural landscape.

Political

Political geography is concerned with the study of both the spatially uneven outcomes of political processes and the ways in which political processes are themselves affected by spatial structures. Conventionally, for the purposes of analysis, political geography adopts a three-scale structure with the study of the state at the center, the study of international relations (or geopolitics) above it, and the study of localities below it. The primary concerns of the subdiscipline can be summarized as the inter-relationships between people, state, and territory.

Population

Population geography relates spatial variations in the distribution, composition, migration, and growth of populations to the terrain. Population geography involves demography in a geographical perspective. Demography is the study of human statistics and distributions, that often involves factors such as where population is found and how the size and composition of these population is regulated by the demographic processes of fertility, mortality, and migration.

Urbanism

Urban geography is the study of cities, towns, and other areas of relatively dense settlement. Two main interests are site (how a settlement is positioned relative to the physical environment) and situation (how a settlement is positioned relative to other settlements). Another area of interest is the internal organization of urban areas about different demographic groups and the layout of infrastructure. This subdiscipline also draws on ideas from other branches of Human Geography to see their involvement in the processes and patterns evident in an urban area.

DEFINING THE BOUNDARIES & SYMBOLS

As we will see later in this text, California can be viewed several ways; political, economic, cultural, geographically, and even linguistically. As mentioned earlier, the earlier boundaries of California were defined by Spanish claims of Mexico as part of the province of Alta California. The northern boundary of Spanish claims was set at 42°N latitude by the Adams–Onis Treaty of 1819. The states of Nevada and Utah, also originally part of Alta California, also use that line for their northern boundaries. The southern boundary, between California and Mexico, was established by the Treaty of Guadalupe Hidalgo that ended the Mexican-American War in 1848. The line is about 30 miles north of the former Alta California southern boundary. The eastern boundary consists of two straight lines: a north–south line from the northern border to the middle of Lake Tahoe, and a second line angling southeast to the Colorado River. From that point, 14 miles (23 km) south-southwest of Davis Dam on Lake Mohave, the southeast boundary follows the Colorado River to the international border west of Yuma. The eastern and south-eastern boundaries were decided upon during the debates of the California Constitutional Convention in 1849.

The following image, figure 1.7, identifies some of the landform divisions that have helped define not just the physical boundaries, but the greater regions within our state. In future units, the text will define each region of the state, including the physical, geological, cultural and in many instances even specific case studies of towns and people within that region.

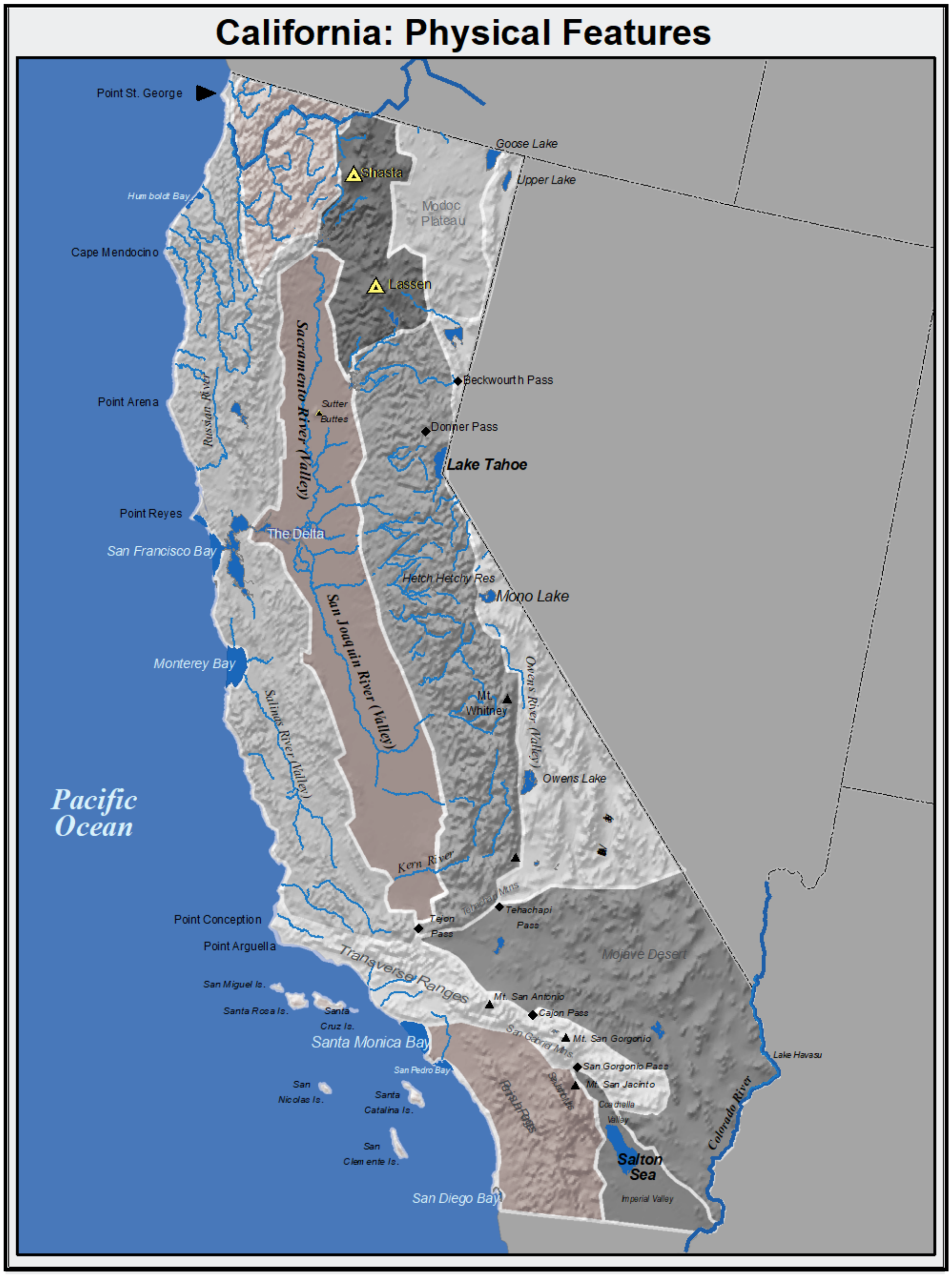


Figure 1.7: A Map of California's Physical Features & Select Points of Interest. [7]

The Symbols of California

The Great Seal of the State of California was adopted at the California state Constitutional Convention of 1849, (figure 1.8), and has undergone design changes since then, the last being the standardization of the seal in 1937, in which the current seal still resembles (figure 1.9).

[7] California State University, Northridge. (2011). California: Physical Features. csun.edu. Retrieved 6/15/2023 from: http://www.csun.edu/~cfe/maps/?C=N;O=A

Most recent seal shows Athena, (original named Minerva) in Greek mythology, the Goddess of wisdom and war, as she was born an adult. A California grizzly bear, the official state animal, feeding on grape vines, representing California's wine production; a sheaf of grain, representing agriculture; a miner, representing the California Gold Rush and the mining industry; and sailing ships, representing the state's economic power. The word Eureka (εύρηκα in Greek), meaning "I have found it", is the California state motto.

Figure 1.8: The Original California State Coat of Arms, 1876. [8]

So how did we get to the current seal? It all started in 1928, due to the number of incorrect details that had appeared in the seal over the years, state printer Carroll H. Smith was authorized to prepare a new and correct seal. This seal was drawn by Los Angeles heraldic artist Marc J. Rowe who, among other corrections, narrowed the growing break in the mountains so that it appeared to be the Sacramento River, fringed by snow-capped Sierra, and not an arm of San Francisco Bay, as the 1876 seal made it appear. Nine years later, the 1937 standardized seal once again featured a widened gap of Golden Gate proportions, although it did keep Rowe's snow-capped Sierra Nevada that had replaced the barren foothills of previous editions of the seal. Both features have stayed in the official seal.

The 1937 standardization came about when state employees, wishing to print the seal on blotters for the State Fair, could not find any official design of the seal. This prompted a new law which established for the first time a definite pictured design with which the master die was 'substantially' to conform, and at the same time established the legality of all previous seals which were essentially the same as this one.

[8] Illustration by Henry Mitchell is in the public domain.

Figure 1.9: The Modern-Day Adoption of the 1849 Great Seal of California. [9]

The symbols found within the Seal are often easily recognized, such as the State motto. Other symbols become just common knowledge such as the nickname, the Golden State. Other lesser-known symbols of California range from the state amphibian to the state vegetable. This text will continue to celebrate the diversity of California; however, it seems appropriate to list some the more obscure and trivial designated symbols of California.

Table 1.1: California State Symbols

Symbol	California State
Amphibian	California Red-Legged Frog
Animal	California Grizzly Bear
Bird	California Quail
Colors	Blue & Gold
Dance	West-Coast Swing
Dinosaur	*Augustynollphus*
Fabric	Denim
Fish	Golden Trout
Flower	California Poppy

[9] Fichier d'origine is in the public domain

Symbol	California State
Fossil	*Smilodon Californicus*
Fruit	Avocado
Gemstone	Benitoite
Gold Rush Town	Bodie
Mineral	Gold
Outdoor Play	The Ramona Pageant
Reptile	Desert Tortoise
Rock	Serpentine
Silver Ghost Town	Calico
Soil	San Joaquin
Sport	Surfing
Theater	Pasadena Playhouse
Trees	Costal Redwood & The Giant Sequoia
Vegetable	Artichoke

Figure 1.10 List of California State Symbols. [10]

[10] Table by Jeremy Patrich

Figure 2.1: Zabriskie Point, Death Valley- California.[11]

UNIT 2: CALIFORNIA'S GEOLOGY

Goals & Objectives of this unit

- Describe the Eons, Eras, and Periods in California's geologic time.
- Identify California's Physiographic Regions.
- Isolate the regions and reasons for California's faults.
- Outline the general geologic formation of California and the San Andreas fault.
- Define the origin and narrative of gold and The California Gold Rush.

INTRODUCTION

The traveler passing through California encounters the most remarkable diversity of scenery, as well as of climate and of nature. Nowhere else in the United States is there to be found in an equal area so many interesting landforms, and nowhere else is shown so clearly the influence which these exert upon climate and life. Within the bounds of California are found nearly all the different types of physical features which make up the surface of the earth. We have, then, in our study of California geography, a most remarkable opportunity to learn how human life is so completely influenced upon the conditions surrounding it, and how this life has been modified by these conditions.

[11] Photo by Jeremy Patrich is licensed under CC BY 4.0

The geology of California is highly complex, with numerous mountain ranges, substantial faulting and tectonic activity, rich natural resources, and a history of both ancient and comparatively recent intense geological activity. As the text will cover, California formed as a series of small island arcs, deep-ocean sediments and mafic oceanic crust accreted to the western edge of North America, producing a series of deep basins and high mountain ranges.

One of the most important episodic events was the advent of the San Andreas Fault around 29 million years ago in the Oligocene, when the region subducted a spreading center and its offsets in the East Pacific Rise. This produced major crustal stretching, volcanism, and lateral displacement of up to 350 miles.

GEOLOGY & GEOLOGIC TIME

Geology describes the structures of the Earth at and beneath its surface, and the processes that have shaped that structure. It also provides tools to determine the relative and absolute ages of rocks found in each location, and to describe the histories of those rocks. By combining these tools, geologists can chronicle the geological history of the Earth as a whole, and to demonstrate the age of Earth. Geology provides the primary evidence for plate tectonics, the evolutionary history of life, and the Earth's past climates.

Geology often applies information from physics and chemistry to the natural world, like understanding the physical forces in a landslide or the chemical interaction between water and rocks. The term comes from the Greek word geo, meaning Earth, and logos, meaning to think or reckon with.

Geologic Time Scale

William “Strata” Smith worked as a surveyor in the coal mining and canal-building industries in southwestern England in the late 1700s and early 1800s. While doing his work, he had many opportunities to look at the Paleozoic and Mesozoic sedimentary rocks of the region, and he did so in a way that few had done before. Smith noticed the textural similarities and differences between rocks in different locations, and more importantly, he discovered that fossils could be used to correlate rocks of the same age. Smith is credited with formulating the principle of faunal succession (the concept that specific types of organisms lived during different time intervals), and he used it to great effect in his monumental project to create a geological map of England and Wales, published in 1815.

Geologic Time has been subdivided into a series of divisions by geologists. Eon is the largest division of time, followed by era, period, epoch, and age. The partitions of the geologic time scale are the same everywhere on Earth; however, rocks may or may not be present at a given location depending on the geologic activity going on during a particular period. Thus, we have the concept of time vs. rock, in which time is an unbroken continuum but rocks may be missing and/or unavailable for study. The figure of the geologic time scale represents time flowing continuously from the beginning of the Earth, with the time units presented in an unbroken sequence. But that does not mean there are rocks available for study for all these time units, since erosion has removed much of the depositional sequences.

Geological Time has been divided into four eons: Hadean, Archean, Proterozoic, and Phanerozoic, and as shown below, the first three of these represent almost 90% of Earth's history. The last one, the Phanerozoic (meaning "visible life"), is the time that we are most familiar with because Phanerozoic rocks are the most common on Earth, and they contain evidence of life forms that we are all somewhat familiar with.

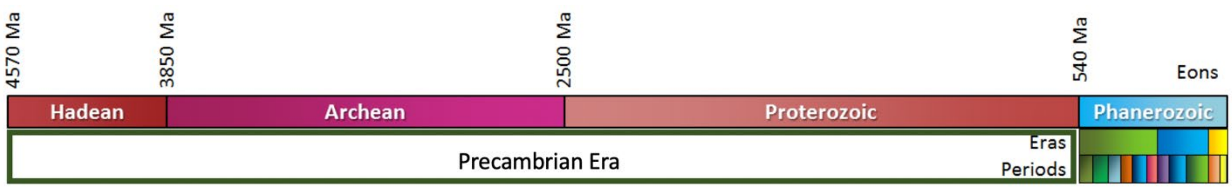


Figure 2.2: The Eons of Earth's History.[12]

The Phanerozoic, the past 540 Ma of Earth's history, is divided into three eras: the Paleozoic ("early life"), the Mesozoic ("middle life"), and the Cenozoic ("new life"), and each of these is divided into several periods. Most of the organisms that we share Earth with, evolved at various times during the Phanerozoic.

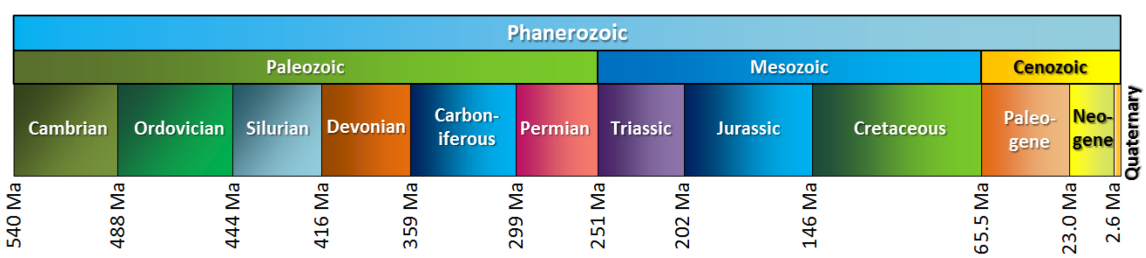


Figure 2.3: The Eras and Periods of the Phanerozoic.[13]

[12] Image is used under a CC-BY 4.0 license.
[13] Image is used under a CC-BY 4.0 license.

The Cenozoic, which represents the past 65.5 Ma, is divided into three periods: Paleogene, Neogene, and Quaternary, and seven epochs. Dinosaurs became extinct at the start of the Cenozoic, after which birds and mammals radiated to fill the available habitats. Earth was very warm during the early Eocene and has steadily cooled ever since. Glaciers first appeared in Antarctica in the Oligocene and then in Greenland in the Miocene and covered much of North America and Europe by the Pleistocene. The most recent of the Pleistocene glaciations ended around 11,700 years ago. The current epoch is known as the Holocene. Epochs are further divided into ages or stages.

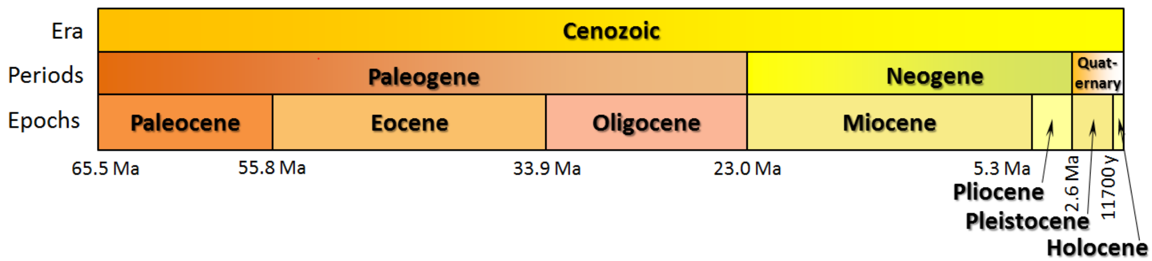


Figure 2.4: The Periods and Epochs of the Cenozoic.[14]

Most of the boundaries between the periods and epochs of the geological time scale have been fixed based on significant changes in the fossil record, due to significant geologic events that significantly changed the environments. For example, as already noted, the boundary between the Cretaceous and the Paleogene coincides exactly with the extinction of the dinosaurs. That's not a coincidence. Many other types of organisms went extinct at this time, and the boundary between the two periods marks the division between sedimentary rocks with Cretaceous organisms below and Paleogene organisms above.

CALIFORNIA'S GEOLOGIC HISTORY

Through its history, California has transitioned from a passive continental margin, before the breakup of Pangae, to an active margin with the transition to subduction zone activity and the formation of the Cordilleran volcanic chain. The Cordilleran Ranges is the name for the volcanic arc that formed the Sierra Nevada Range and the Peninsular Ranges extending south into Baja California. Subduction ended when the ancient Farallon Plate was overrun as North America moved westward, overriding the northern end of the spreading center in the Eastern Pacific

[14] Image is used under a CC-BY 4.0 license.

basin. This led to the formation to the modern transform plate boundary associated with the San Andreas and the opening of the Gulf of California.

Lecture Time: California's Geology

Watch a lecture video that introduces the basic geology of California's dynamic past and future. (Video length is 38:40).

The Farallon Plate

The Farallon Plate was an ancient oceanic plate. It formed one of the three main plates of Panthalassa, alongside the Phoenix Plate and Izanagi Plate, which were connected by a triple junction. The Farallon Plate began subducting under the west coast of the North American Plate—then located in modern Utah—as Pangaea broke apart and after the formation of the Pacific Plate at the center of the triple junction during the Early Jurassic. It is named for the Farallon Islands, which are located just west of San Francisco, California (figure 2.5).

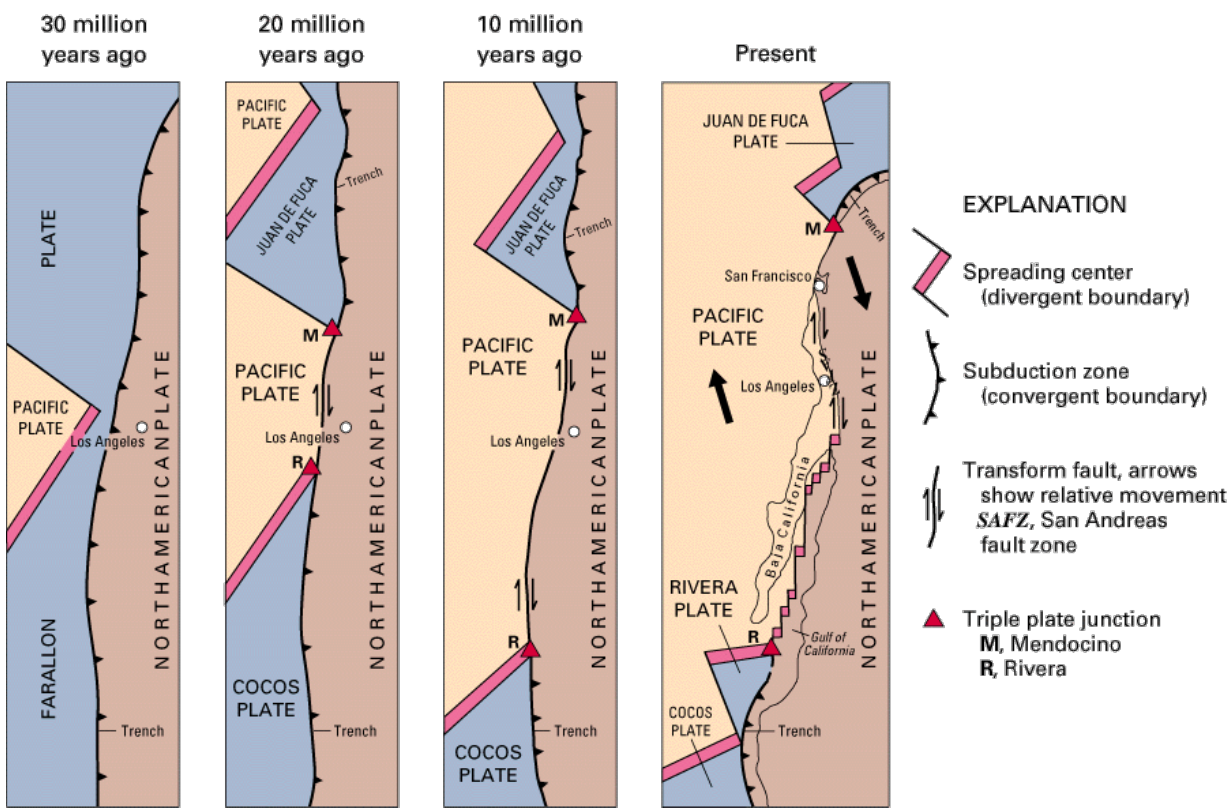


Figure 2.5: Illustrating the Shrinking of the Farallon Plate Beneath the North Americana & Caribbean Plates.[15]

[15] Image is used under a CC-BY 4.0 license.

Over time, the central part of the Farallon Plate was completely subducted under the southwestern part of the North American Plate. The remains of the Farallon Plate are the Juan de Fuca, Explorer, and Gorda Plates, subducting under the northern part of the North American Plate; the Cocos Plate subducting under Central America; and the Nazca Plate subducting under the South American Plate.

The Farallon Plate is also responsible for transporting old island arcs and various fragments of continental crustal material rifted off from other distant plates and accreting them to the North American Plate. These fragments from elsewhere are called terranes. Much of western North America is composed of these accreted terranes.

California's Geologic Timeline

The oldest rocks in California, a marble, date back 1.8 billion years to the Proterozoic and are found in the San Gabriel Mountains, San Bernardino Mountains, and Mojave Desert. The rocks of eastern California formed a shallow continental shelf, with massive deposition of limestone during the Paleozoic, and sediments from this time are common in the Sierra Nevada, Klamath Mountains, and eastern Transverse Range.

Active subduction began in the Triassic during the Mesozoic, producing large granite intrusions and the beginning of the Nevadan Orogeny as well as more dryland conditions and the retreat of the ocean to the west. Throughout the Jurassic the Nevadan Orogeny accelerated with large-scale granitic intrusions and erosion into deep marine basins. These basins steadily filled with sediment, with one famous example preserved as the Great Valley beds in the Coast Ranges. Simultaneously island arcs and small sections of continental crust grafted onto the edge of North America, building out the continent.

During the Cenozoic, the volcanic and deep-water sedimentary Franciscan rocks were accreted to the edge of California and vast areas of marine sedimentary rocks deposited in the Central Valley and what would become the Transverse and Coast Ranges. Examples of filled basins included the Los Angeles Basin, the Eel River Basin around Eureka, and the 50,000-foot-thick sedimentary sequences of the Ventura Basin. As stated earlier, the San Andreas Fault became most active after the Miocene, during the Oligocene, resulting in up to 350 miles of offset in some locations.

Field Trip: California's Oldest Rocks

Let's head on a field trip to find some of the oldest rocks in California! Either scan the QR code or visit this link to join Professor Patrich as he searches for the oldest rocks near Mecca, California. (Video length: 3min).

California's Geologic Faults

The Pacific Plate is a major section of the Earth's crust, gradually expanding by the eruption of magma along the East Pacific Rise to the southeast. It is also being subducted far to the northwest into the Aleutian Trench, and trenches along Japan, Kamchatka, Philippines and Hawaiian (figure 2.6). In California, the plate is sliding northwestward along a transform boundary, the San Andreas Fault, toward the subduction zone. At the same time, due to divergence along the Mid Atlantic Ridge, the North American Plate is moving southwestward relative to the Earth's core, but southeastward relative to the Pacific Plate, due to the latter's much faster northwestward motion. The westward component of the North American Plate's motion results in some compressive force along the San Andreas and its associated faults, thus helping lift the Pacific Coast Ranges and other parallel inland ranges to the west of the Central Valley, in this region most notably the Diablo Range (figure2.8). The Hayward Fault shares the same relative motions of the San Andreas. As with portions of other faults, a large extent of the Hayward Fault trace is formed from a narrow complex zone of deformation which can span hundreds of feet in width.

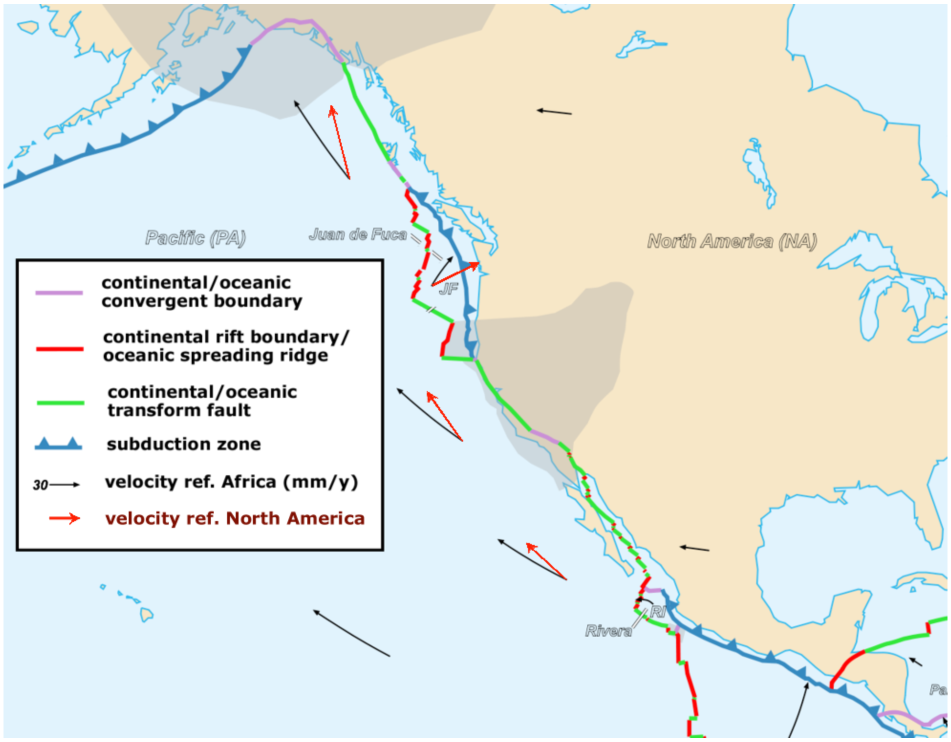


Figure 2.6: Relative Plate Motions of Western Portion of North America.[16]

Central & Northern California Faults | The Hayward Fault Zone

The Hayward Fault Zone is a right-lateral strike-slip geologic fault zone capable of generating destructive earthquakes. This fault is about 119 km (74 mi) long, situated mainly along the western base of the hills on the east side of San Francisco Bay. It runs through densely populated areas, including Richmond, El Cerrito, Berkeley, Oakland, San Leandro, Castro Valley, Hayward, Union City, Fremont, and San Jose.

The Hayward Fault is parallel to the San Andreas Fault, which lies offshore and through the San Francisco Peninsula. To the east of the Hayward Fault lies the Calaveras Fault. In 2007, the Hayward Fault was discovered to have merged with the Calaveras Fault east of San Jose at a depth of 6.4 kilometers (4.0 mi), with the potential of creating earthquakes much larger than previously anticipated. Some geologists have suggested that the Southern Calaveras should be renamed as the Southern Hayward

While the San Andreas Fault is the principal transform boundary between the Pacific Plate and the North American Plate, the Hayward-Rodgers Creek Fault takes up its share of the overall displacement of the two plates (Figure 2.7).

[16] Image is used under a CC BY-SA 3.0 license.

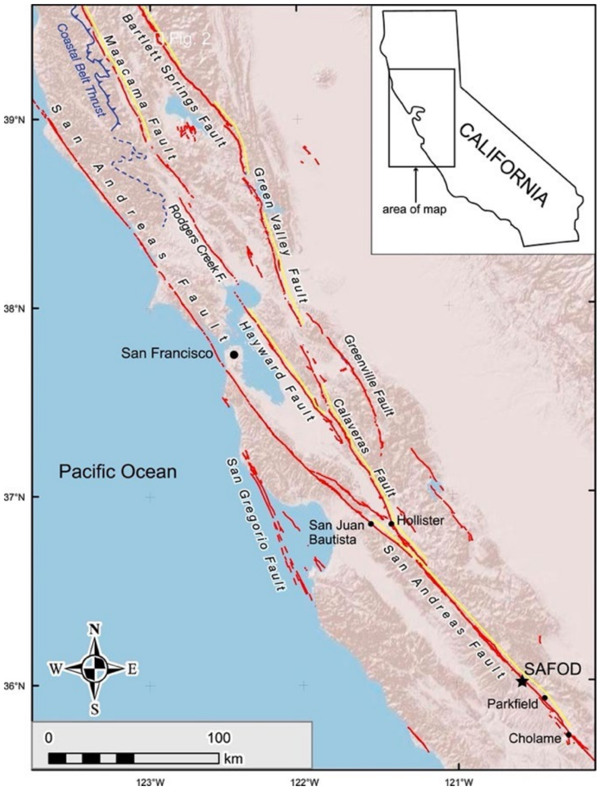


Figure 2.7: Map of Central & Northern California's Faults. [17]

Southern California Faults

Most of central and northern California rests on a crustal block (terrane) that is being torn from the North American continent by the passing Pacific plate comprised of oceanic crust. Southern California lies at the southern end of this block, where the Southern California faults create a complex and even chaotic landscape of seismic activity. About two-thirds of this movement occurs on the San Andreas fault and some parallel faults- -- the San Jacinto, Elsinore, and Imperial faults (figure 2.8). Over time, these faults produce about half of the significant earthquakes of our region, as well as many minor earthquakes.

[17] Image is in the public domain.

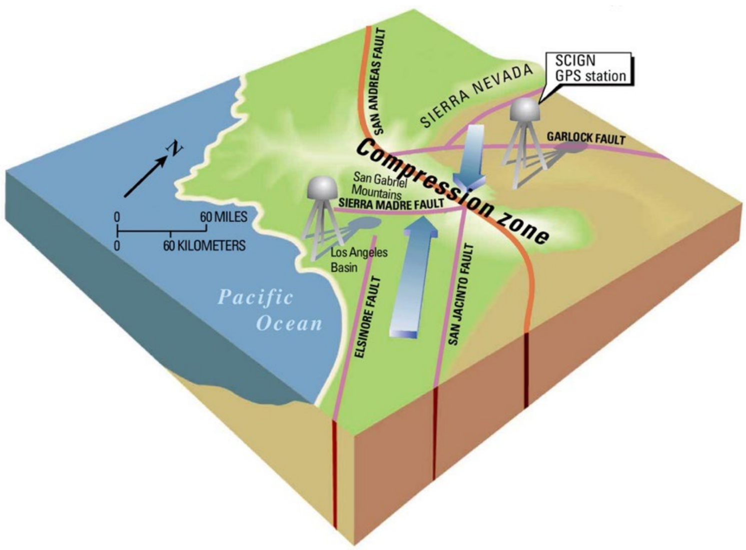


Figure 2.8: Model of Southern California Showing the Motion of the Pacific & North American Plates. [18]

The last significant earthquake on the Southern California stretch of the San Andreas fault was in 1857, and there has not been a rupture of the fault along its southern end from San Bernardino to the Salton Sea since 1690. It is still storing energy for some future earthquake.

But we don't need to wait for a "big one" to experience earthquakes. Southern California has thousands of smaller earthquakes every year. A few may cause damage, but most are not even felt. And most of these are not on the major faults listed above. The earthquake map below, figure 2.9, shows that earthquakes can occur almost everywhere in the region, on more than 300 additional faults that can cause damaging earthquakes, and countless other small faults.

This is mostly due to the "big bend" of the San Andreas fault, from the southern end of the San Joaquin Valley to the eastern end of the San Bernardino mountains. Where the fault bends, the Pacific and North American plates push into each other, compressing the earth's crust into the mountains of Southern California and creating hundreds of additional faults (many more than shown in the fault map). These faults produce thousands of small earthquakes each year, and the other half of our significant earthquakes. Examples include the 1994 Northridge and 1987 Whittier Narrows earthquakes.

[18] Graphic by the USGS is in the public domain.

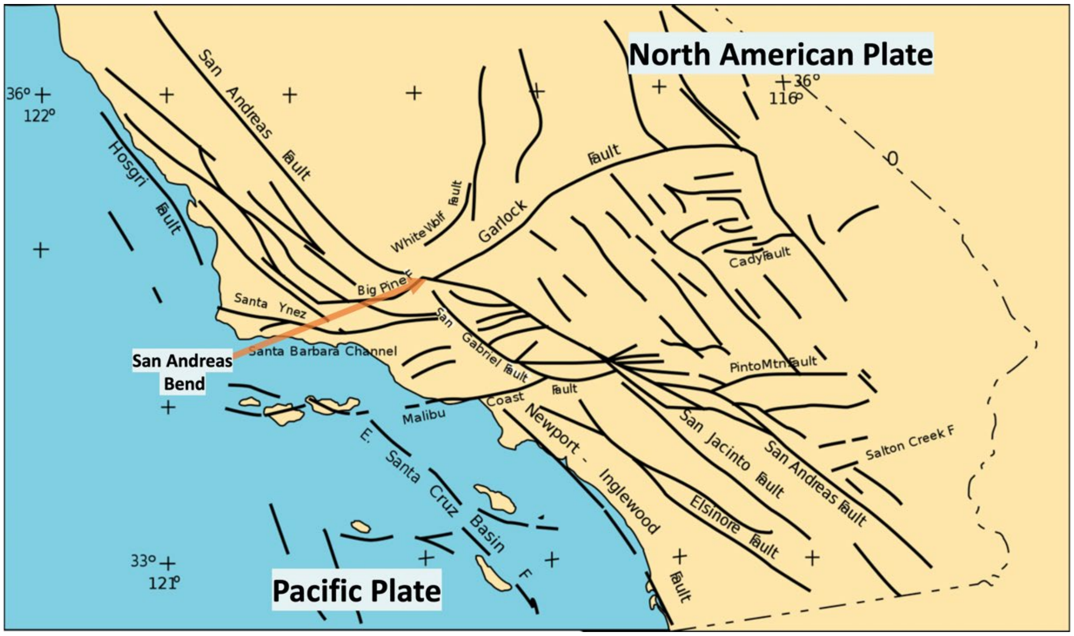


Figure 2.9: Southern California's Fault names and locations. [19]

Field Trip: The Geology of the Calico

Let's head on a field trip to the Calico Ghost Town in Yermo, California. Either scan the QR code or visit this link to join Professor Patrich as he explores and shares the geology of this iconic place! (Video length: 3min).

The Evolution of the San Andreas Fault

The San Andreas Fault System has gradually evolved since middle Tertiary time, around 28 million years ago. The San Andreas Fault System grew as a remnant of an oceanic crustal plate and its spreading ridge, was beginning to reach the subduction zone off the western coast of North America. The result was the development of a crustal fracture zone with right-lateral offset that propagated along the continental margin. This action also slivered off pieces of the North American Plate and added them to the Pacific Plate. In the San Francisco Bay Area, much of the offset along the San Andreas Fault System has occurred along the East Bay faults, Calaveras and Hayward fault, rather than along the San Andreas Fault itself in the Peninsula region.

[19] Image by BrucePL is used under a CC BY-SA 4.0 license.

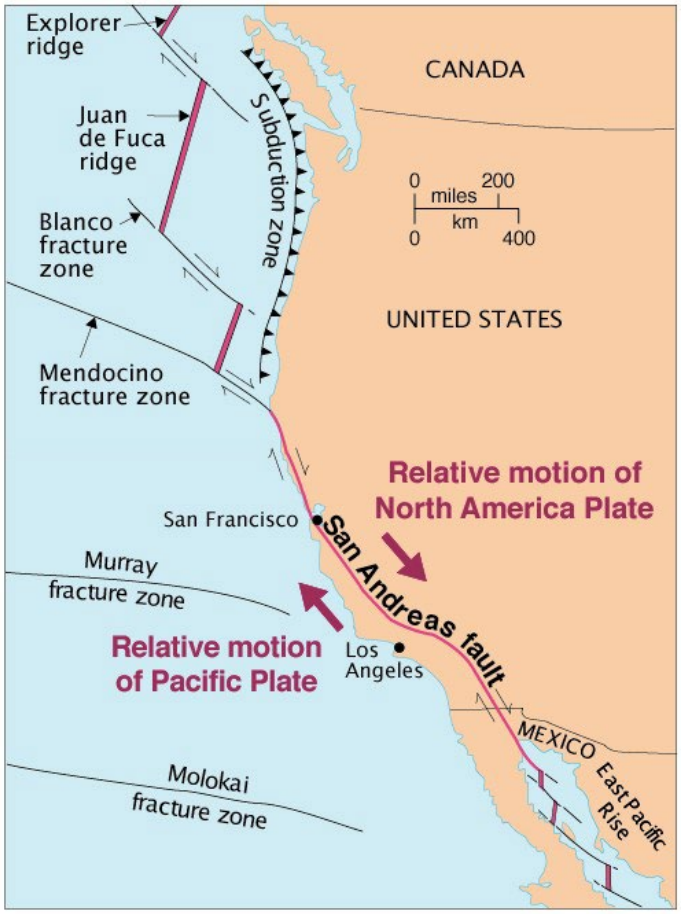


Figure 2.10: The San Andreas Fault. [20]

A series of block diagrams seen in figure 2.7, shows how the subduction zone along the west coast of North America transformed into the San Andreas Fault over the period from 30 million years ago to the present. Starting at 30 million years ago, the westward-moving North American Plate began to override the spreading ridge between the Farallon Plate and the Pacific Plate. This action divided the Farallon Plate into two smaller plates, the northern Juan de Fuca Plate (JdFP) and the southern Cocos Plate (CP). By 20 million years ago, two triple junctions began to migrate north and south along the western margin of the west coast. [Triple junctions are intersections between three tectonic plates; shown as red triangles in the diagrams.] The change in plate configuration as North American Plate began to encounter the Pacific Plate resulted in the formation of the San Andreas Fault. The northern Mendocino Triple Junction (M) migrated through the San Francisco Bay region roughly 12 to 5 million years ago and is presently located off the coast of northern California, roughly midway between San Francisco (SF) and Seattle (S). The Mendocino Triple Junction represents the intersection of the North American, Pacific, and Juan de Fuca plates. The southern Rivera Triple Junction (R) is

[20] Image by the USGS is in the public domain.

presently located in the Pacific Ocean between of Baja California (BC) and Manzanillo, Mexico (MZ).

Evidence of the migration of the Mendocino Triple Junction northward through the San Francisco Bay region is preserved as a series of volcanic centers that grow progressively younger toward the north. Volcanic rocks in the Hollister region are roughly 12 million years old whereas the volcanic rocks in the Sonoma-Clear Lake region north of San Francisco Bay ranges from only a few million to as little as 10,000 years ago. Both volcanic areas, as well as older volcanic rocks in the region, are offset by the modern regional fault system.

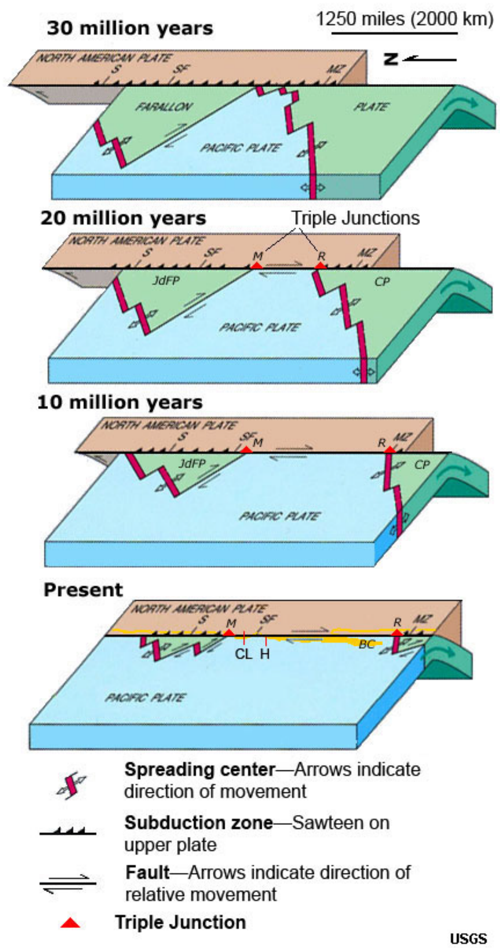


Figure 2.11: Assembling California Over the Past 30 Million Years. [21]

[21] Image by the USGS is in the public domain.

CALIFORNIA'S GOLD RUSH

Gold is present in very small amounts in literally all rocks and even in ocean water; but to be mined economically, it must be concentrated. Even so, the richest gold deposits may contain only a fraction of an ounce per ton.

At various times between 400 and 200 million years ago, titanic crustal forces caused the offshore islands to collide with the American continent, crushing and folding the rocks derived from the sea floor and volcanoes (Keep in mind that this was still a slow process, with movements of only a few inches per year). The rocks, scraped off the sea floor and collected from innumerable volcanic eruptions, became the metamorphic rocks that make up the bedrock of the Mother Lode region.

Beginning about 200 million years ago, massive shifts of the tectonic plates that encircle Earth caused the sea floor crust to be pushed beneath the American continent, where it heated up and melted into huge molten masses of magma. These subduction zones are, in modern times, responsible for the volcanoes and sometimes violent earthquakes of the Cascade and Andes mountain ranges. The molten rock forced its way upward into the crust and slowly cooled to become the granitic rock that makes up most of the Sierra Nevada today.

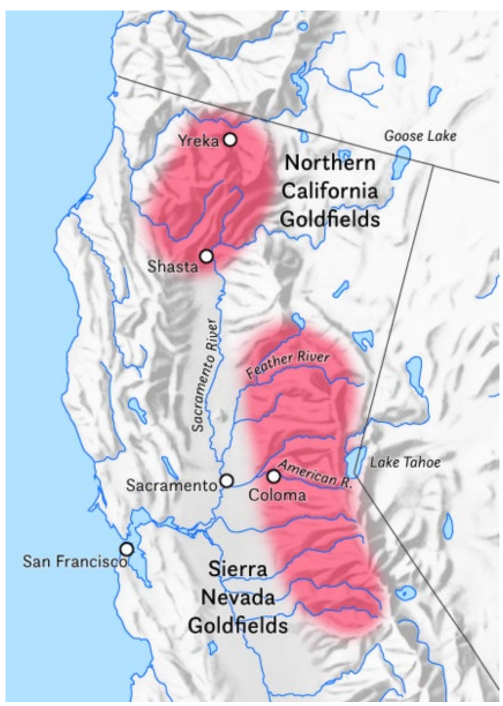


Figure 2.12: California Goldfields (Red) in the Sierra Nevada & Northern California. [22]

[22] Map is used under a CC BY-SA 4.0 license.

Water, derived from rain and melted snow, percolated into the ground in the Mother Lode region. Following fractures and cracks left by millions of years of geologic mayhem, the water came closer and closer to the hot molten magmas. At these elevated temperatures, water dissolved otherwise stable materials including quartz, gold, silver, copper and zinc.

The History

Gold was discovered in California as early as March 9, 1842, at Rancho San Francisco, in the mountains north of present-day Los Angeles. Californian native Francisco Lopez was searching for stray horses and stopped on the bank of a small creek (in today's Placerita Canyon), about 3 miles (4.8 km) east of present-day Newhall, California, and about 35 miles (56 km) northwest of Los Angeles. While the horses grazed, Lopez dug up some wild onions and found a small gold nugget in the roots among the bulbs. He looked further and found more gold. Lopez took the gold to authorities who confirmed its worth. Lopez and others began to search for other streambeds with gold deposits in the area. They found several in the northeastern section of the forest, within present-day Ventura County. In November, some of the gold was sent to the U.S. Mint, although otherwise attracted little notice. In 1843, Lopez found gold in San Feliciano Canyon near his first discovery. Mexican miners from Sonora worked the placer deposits until 1846. Minor finds of gold in California were also made by Mission Indians prior to 1848. The friars instructed them to keep its location secret to avoid a gold rush.

The California Gold Rush (1848-1855)

The California Gold Rush began on January 24, 1848, when gold was found by James W. Marshall at Sutter's Mill in Coloma, California. The news of gold brought approximately 300,000 people to California from the rest of the United States and abroad. The sudden influx of gold into the money supply reinvigorated the American economy; the sudden population increase allowed California to go rapidly to statehood in the Compromise of 1850. The Gold Rush had severe effects on Native Californians and accelerated the Native American population's decline from disease and starvation.

Figure 2.13: California Gold Miners, Circa 1850-1852. [23]

Indigenous societies were attacked and pushed off their lands by the gold-seekers, called "forty-niners" (referring to 1849, the peak year for Gold Rush immigration). Outside of California, the first to arrive were from Oregon, the Sandwich Islands (Hawaii) and Latin America in late 1848. Of the approximately 300,000 people who came to California during the Gold Rush, about half arrived by sea and half came overland on the California Trail and the Gila River trail; forty-niners often faced substantial hardships on the trip. While most of the newly arrived were Americans, the gold rush attracted thousands from Latin America, Europe, Australia and China. Agriculture and ranching expanded throughout the state to meet the needs of the settlers. San Francisco grew from a small settlement of about 200 residents in 1846 to a boomtown of about 36,000 by 1852. Roads, churches, schools and other towns were built throughout California. In 1849 a state constitution was written. The new constitution was adopted by referendum vote; the future state's interim first governor and legislature were chosen. In September 1850, California became a state. California’s statehood was unique for several reasons, first was the fact that it was never a territory, and that it was a free, no slavery, state—due to the money generated by the Gold Rush.

At the beginning of the Gold Rush, there was no law regarding property rights in the goldfields and a system of "staking claims" was developed. Prospectors retrieved the gold from streams and riverbeds using simple placer mining techniques, such as panning. Another form of mining, known as hard-rock mining, which included hydraulic mining, which caused environmental harm. More sophisticated methods of gold recovery were developed and later adopted around the world. New methods of transportation developed as steamships came into regular service.

[23] Photo by George H. Johnson is in the public domain.

By 1869, railroads were built from California to the eastern United States. At its peak, technological advances reached a point where significant financing was required, increasing the proportion of gold companies to individual miners. Gold worth tens of billions of today's US dollars was recovered, which led to great wealth for a few, though many who participated in the California Gold Rush earned little more than they had started with.

The Forty-Niners

The first people to rush to the goldfields, beginning in the spring of 1848, were the residents of California themselves—primarily agriculturally oriented Americans and Europeans living in Northern California, along with Native Californians and some Californios (Spanish-speaking Californians; at the time, commonly referred to in English as simply 'Californians'). These first miners tended to be families in which everyone helped in the effort. Women and children of all ethnicities were often found panning next to the men. Some enterprising families set up boarding houses to accommodate the influx of men; in such cases, the women often brought in steady income while their husbands searched for gold.

Word of the Gold Rush spread slowly at first. The earliest gold-seekers were people who lived near California or people who heard the news from ships on the fastest sailing routes from California. The first large group of Americans to arrive were several thousand Oregonians who came down the Siskiyou Trail. Next came people from the Sandwich Islands, and several thousand Latin Americans, including people from Mexico, from Peru and from as far away as Chile, both by ship and overland. By the end of 1848, some 6,000 Argonauts had come to California.

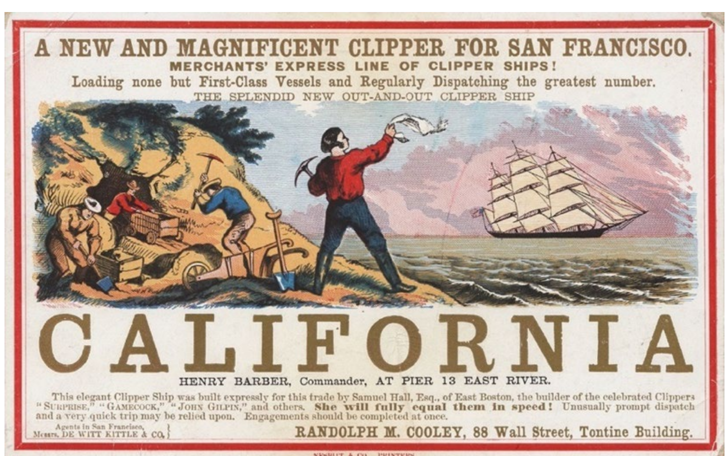


Figure 2.14: Advertisement About Sailing to California's Gold Rush, Circa 1850. [24]

[24] Image by G.F. Nesbitt & Co. is in the public domain.

Only a small number (probably fewer than 500) traveled overland from the United States that year. Some of these "forty-eighters", as the earliest gold-seekers were sometimes called, were able to collect large amounts of easily accessible gold—in some cases, thousands of dollars' worth each day. Even ordinary prospectors averaged daily gold finds worth 10 to 15 times the daily wage of a laborer on the East Coast. A person could work for six months in the goldfields and find the equivalent of six years' wages back home. Some hoped to get rich quick and return home, and others wished to start businesses in California.

By the beginning of 1849, word of the Gold Rush had spread around the world, and an overwhelming number of gold-seekers and merchants began to arrive from virtually every continent. The largest group of forty-niners in 1849 were Americans, arriving by the tens of thousands overland across the continent and along various sailing routes (the name "forty-niner" was derived from the year 1849). Many from the East Coast negotiated a crossing of the Appalachian Mountains, taking to riverboats in Pennsylvania, poling the keelboats to Missouri River wagon train assembly ports, and then traveling in a wagon train along the California Trail. Many others came by way of the Isthmus of Panama and the steamships of the Pacific Mail Steamship Company. Australians and New Zealanders picked up the news from ships carrying Hawaiian newspapers, and thousands, infected with "gold fever", boarded ships for California.

Forty-niners came from Latin America, particularly from the Mexican mining districts near Sonora and Chile. The first immigrants from Europe, reeling from the effects of the Revolutions of 1848 and with a longer distance to travel, began arriving in late 1849, mostly from France, with some Germans, Italians, and Britons.

It is estimated that approximately 90,000 people arrived in California in 1849—about half by land and half by sea. Of these, perhaps 50,000 to 60,000 were Americans, and the rest were from other countries. By 1855, it is estimated at least 300,000 gold-seekers, merchants, and other immigrants had arrived in California from around the world. The largest group continued to be Americans, but there were tens of thousands each of Mexicans, Chinese, Britons, Australians, French, and Latin Americans, together with many smaller groups of miners, such as African Americans, Filipinos, Basques, and Turks.

People from small villages in the hills near Genova, Italy were among the first to settle permanently in the Sierra Nevada foothills; they brought with them traditional agricultural skills, developed to survive cold winters. A modest number of miners of African ancestry (probably less than 4,000) had come from the Southern States, the Caribbean and Brazil.

Several hundred Chinese arrived in Gum San ("Gold Mountain"), the name given to California in Chinese, in 1849 and 1850, and in 1852 more than 20,000 landed in San Francisco. Due to the growing population, Joss Houses, which were small temples to server the religious needs of the Chinese miners and residences. Their distinctive dress and appearance was highly recognizable in the goldfields (figure 2.15). Chinese miners suffered enormously, enduring violent racism from white miners who aimed their frustrations at foreigners. Further animosity toward the Chinese led to legislation such as the Foreign Miners Tax,1850, which only taxed Chinese, and the Chinese Exclusion Act nearly 30 years later in 1882.

Figure 2.15: An 1852 Photograph Captions,' The Heathen Chinee Prospecting', Indicating Prejudice Against the Chinese Gold Miners. [25]

There were also women in the Gold Rush. However, their numbers were small. Of the 40,000 people who arrived by ship to the San Francisco Bay in 1849, only 700 were women (including those who were poor, wealthy, entrepreneurs, prostitutes, single, and married). They were of various ethnicities including Anglo-American, African-American, Hispanic, Native, European, Chinese, and Jewish. The reasons they came varied: some came with their husbands, refusing to be left behind to fend for themselves, some came because their husbands sent for them, and others came (singles and widows) for the adventure and economic opportunities. On the trail many people died from accidents, cholera, fever, and myriad other causes, and many women became widows before even setting eyes on California. While in California, women became widows quite frequently due to mining accidents, disease, or mining disputes of their husbands. Life in the goldfields offered opportunities for women to break from their traditional work.

[25] Photo by Eadweard Muybridge is in the public domain.

Figure 3.1: Mammatus Clouds, Lone Pine- California.[26]

UNIT 3: CALIFORNIA'S WEATHER & CLIMATE

Goals & Objectives of this unit

- Describe the various aspects and elements of weather & differentiate between weather and climate.
- Identify the major climate control factors at play in California.
- Recognize climate change, and the effects it has on the California landscape.
- Characterize the five general types of climate as defined by the Köppen climate classification found in California.

INTRODUCTION

The climate of California varies widely from hot desert to alpine tundra, depending on latitude, elevation, and proximity to the Pacific Coast. California's coastal regions, the Sierra Nevada foothills, and much of the Central Valley have a Mediterranean climate, with warmer, drier weather in summer and cooler, wetter weather in winter. The influence of the ocean generally

[26] Image by Jeremy Patrich is used under a CC-BY 4.0 license.

moderates temperature extremes, creating warmer winters and substantially cooler summers in coastal areas.

OVERVIEW OF WEATHER & CLIMATE

In seeking to learn the climate of a country we first think of its latitude, since that is usually the most important factor. In the case of California, however, this inquiry does not help us very much. California has a coastline nearly 1000 miles in length, reaching through ten degrees of latitude, and we would expect that its northern part, which is nearly the latitude of Chicago, would be cold in winter, and that the southern part, which reaches to about the latitude of Savannah Georgia, would be very warm, but there is, near the coast, only a few degrees difference in temperature between the north and the south. Spring fruits appear first, and oranges ripen earlier in Northern rather than in Southern California.

Lecture Time: Intro to Weather & Climate

Want to learn more? Either scan the QR code or visit this link to watch a lecture that introduces the basics of California's weather & climate (Video length: 23min).

Regarding the small range in temperature as we go north or south along the coast, the temperature of the ocean changes but little from winter to summer. The California current is a cold ocean current, which makes the west coast of the USA much drier than coasts with warm oceans. We also know that California, being in the temperate zone, is situated in the belt of prevailing westerly winds. The temperature of the air over the ocean is determined, to a large extent, by that of the water, and since the ocean varies but little throughout the year, and the winds blow mostly from the ocean toward the land, the latter is going to be cooler in summer and warmer in winter than it otherwise would be.

If not for mountain barriers, the cool ocean winds would sweep far inland and temper the climate of the whole State. The fact that there are mountain ranges lying close to and parallel to the coast has resulted has aided in making the climate of the interior subject to much greater extremes of temperature, as well as decreasing its rainfall. By the time the winds have passed the Coast Ranges their moisture and coolness have been greatly reduced, while still farther eastward, on the opposite side of the Sierra Nevada, the summers are not only extremely hot, but the lack of moisture makes the region a desert.

During the summer, except for the thunderstorms in the mountains, it is very rare that rain falls over most of the State, although the air sweeping in from the sea is saturated with moisture, as shown by the fog it bears, but if the Pacific had warmer ocean waters and currents—like the Gulf of Mexico or Atlantic, California would experience more rain in the summer, as warmer water provides more humidity than colder water. To have rain, air must not only be cooled to the dew point, but below that point, and the only thing which will do that is exemplified in those irregular and violent disturbances of the atmosphere which set up currents carrying the moisture-laden air to a great elevation where the temperature is sufficiently low to bring this about.

Many storms that pass across Northern California fail to reach the southern portion, and they also usually decrease in intensity toward the south, so that outside of the mountain districts the southern portion of the State has a very light rainfall. The influence of mountains on precipitation is extremely important because of the low temperature of their lofty tops. In the case of many storms in Southern California which pass over the lowland regions with but a slight rainfall, when they encounter the mountains there is a heavy fall of snow or rain. It is because of this fact that we find such great differences in the rainfall during a few miles.

During the summer there generally exists an area of low air pressure over the Gulf of California, and here originates the "Sonora" (so-called from the province of Sonora, in Mexico) storms which bring frequent rains to Southern Arizona and New Mexico. These storms sometimes reach into Southern California and give heavy summer rains in the mountains and in the deserts. In fact, the heaviest rainfall of the whole year may occur in the Colorado desert during summer.

Summer thunderstorms are frequent in all the higher mountain regions of the State. They are partly due to the low-pressure areas just mentioned and in part to the influence of the cool mountain tops on the upward-moving air currents. They add quite substantially to the summer water supply, and some monsoonal moisture from the south.

During the clear cool periods of winter, a heavy blanket of fog, known as "tule fog," occurs in nearly all the lowland valleys to a greater or less extent. This generally breaks away during the day, but in the lower San Joaquin-Sacramento Valley, it may last continuously for weeks at a time, completely shutting out the sun. The name is derived from its prevalence in the tule region of the district just mentioned. This fog is the result of the settling of the heavier and cooler air into the hollows of the land, where the evaporation from the moist earth following the early winter rains finally produces a saturated condition.

Destructive winds of cyclonic character are rarely known in California. The most disagreeable, as well as harmful, winds occur in the spring and fall. They are dry and hot, and from their direction are known as ‘northers"’ or diablo winds. In Southern California, this wind is locally known as the ‘Santa Ana’. During its occurrence, the air is filled with dust, and for this reason, is often called a dust storm in the drier parts of the State.

ELEMENTS OF WEATHER

Understanding the weather requires considering a whole picture. Think of it like describing your day to someone – you wouldn't just say ‘hot’ or ‘rainy.’ You'd mention the temperature, humidity, wind, and maybe even if it's cloudy or raining. The key factors that make up weather are air temperature, humidity, wind speed, cloud types, and precipitation.

The big difference between weather and climate is time. Weather is what's happening outside right now – it can change quickly from sunny to stormy. Climate, on the other hand, is the average weather conditions in a place over a long period, minimally 30 to 100 years. Think of it as a region's usual weather patterns. Similar to weather, climate is influenced by factors like the sun's angle, cloud cover, and air pressure, but these factors affect the average energy an area receives over time. That's why climates tend to be steady and change very slowly.

Temperature

Within the boundaries of the state are to be found areas of moderate temperatures and other places where temperatures reach extreme values of either heat or cold. On the coast the small range in temperature from day to night and from winter to summer produces an unusually equitable regime. Since water heats and cools 5 times faster/slower than land, respectively, coastal locations’ climates are moderate with a smaller temperature range. With increasing distance from the coast, depending to some extent upon the amount of marine influence experienced, temperature ranges become wider. Higher elevations in the mountains also experience large temperature variations.

The lowest temperature recorded in the state was in the city of Boca, in Nevada County at the mouth of the Little Truckee River, when a reading of minus -45°F was observed on January 20, 1937. Here at Boca where sub-freezing temperatures have been recorded in every month of the year, the long-term average minimum for January is only 8°F. Furnace Creek Ranch in Death Valley, on the other hand, at an elevation of 168 feet below sea level, has reported a maximum temperature of 134°F This is the highest temperature observed anywhere in the United States and occurred on July 10, 1913. This is an area where temperatures are persistently high throughout the summer, though they are comfortably cool in winter. In the summer of 1917, there were 43 consecutive days with maximum readings of 120°F or higher at Furnace Creek Ranch (Figure 3.2).

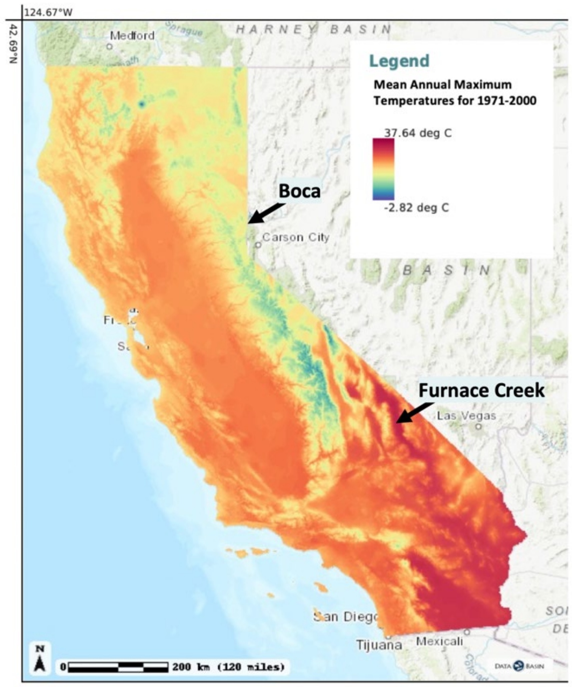


Figure 3.2: California's Mean Annual Maximum Temperatures for 1971 - 2000.[27]

Precipitation

Precipitation is an extremely important part of the weather. The most common precipitation comes from clouds. Rain or snow droplets grow as they ride air currents in a cloud and collect other droplets. They fall when they become heavy enough to escape from the rising air currents that hold them up in the cloud. Millions of cloud droplets will combine to make only one raindrop. If temperatures are cold, the droplet will crystallize into a solid, and then will become heavy enough to fall to the ground as a snowflake.

In meteorology, the various types of precipitation often include the character or phase of the precipitation which is falling to ground level. There are three distinct ways that precipitation can occur. Convective precipitation is generally more intense, and of shorter duration, than

[27] Image by Jeremy Patrich is used under a CC-BY 4.0 license.

stratiform precipitation (arranged in layers). Orographic precipitation occurs when moist air is forced upwards over rising terrain, such as a mountain.

Precipitation can fall in either liquid or solid phases, or transition between them at the freezing level. Liquid forms of precipitation include rain and drizzle and dew. Rain or drizzle which freezes on contact within a subfreezing air mass gains the preceding adjective "freezing", becoming known as freezing rain or freezing drizzle. Frozen forms of precipitation include snow, ice crystals, ice pellets (sleet), hail, and graupel. Their respective intensities are classified either by rate of fall or by visibility restriction.

Annual precipitation totals more than 50 inches per year are characteristic of the west slope of the Sierra Nevada north of Stockton, the west slope of the Coast Range from Monterey County northward, and parts of the Cascades, (Mt Shasta and Mt. Lassen). The exception to this are totals that decrease to about 20 inches in the Monterey Bay area and parts of the San Francisco Bay Area. In the lee of the Coast Range, annual precipitation drops off to 15 inches in parts of the Sacramento Valley and to less than eight inches over most of the San Joaquin Valley. The northeast interior portion of the state receives from 15 to 18 inches of moisture in a year (Figure 3.3)

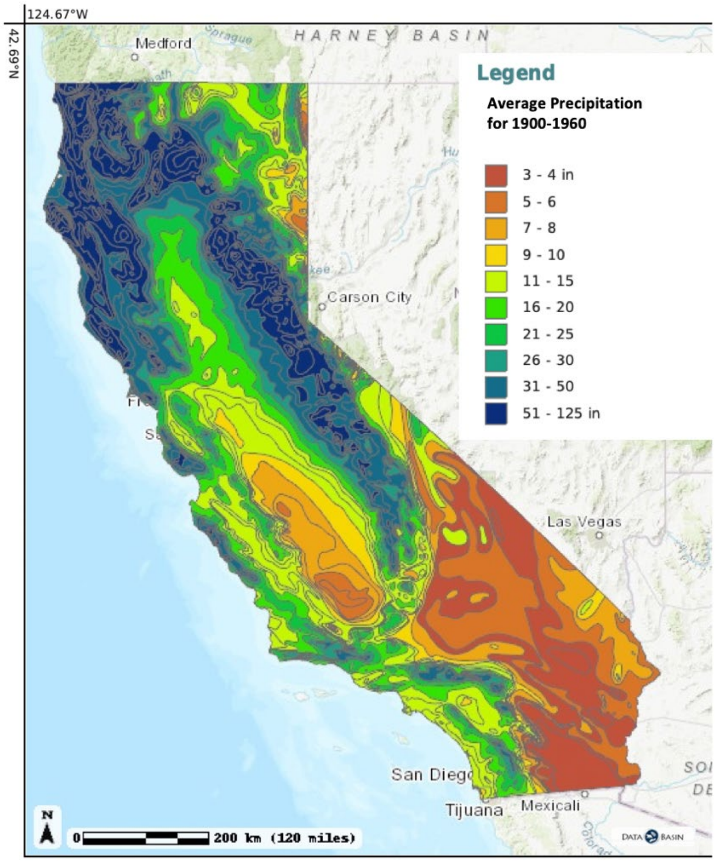


Figure 3.3: California's Annual Precipitation for 1900-1960.[28]

Snow has been reported at one time or another in nearly every part of California, but it is very infrequent west of the Sierra Nevada, except at high elevations of the Coast Range and the Cascades, (Mt. Shasta and Mt. Lassen). In the Sierra Nevada, snow in moderate amounts is reported nearly every winter at elevations as low as 2,000 feet. Amounts and intensities increase with elevation to around 7,000 or 8,000 feet. Above 4,000 feet in elevation, snow remains on the ground for appreciable lengths of time each winter. Highways are closed for periods of a few hours to two or three days at a time because of blowing and drifting snow. East of the Sierra Nevada at elevations of 4,000 feet, or higher, most winter precipitation is in the form of snow, but amounts are usually quite light.

CALIFORNIA FLOODS

In southern California, most flooding is the result of heavy precipitation over periods of one or two days. The short streams and steep watersheds emptying onto lowlands that may be heavily populated, produce large volumes of water within short periods and damage is often severe.

[28] Image by Jeremy Patrich is used under a CC-BY 4.0 license.

The problem is sometimes compounded by the denuding of large areas of the watershed by fire during the previous season. The Mediterranean climate what often experiences drought, results in sparse vegetation and thinner soils, so mudslides, flashfloods and mass wasting is more prevalent.

The west slopes of the coastal ranges in the central and northern parts of the state also experience flooding because of heavy precipitation over a period of only a few days. These streams are usually longer than those of southern California and require a longer time to build up a flood potential. The Eel and Klamath Rivers, as well as others in the northwestern part of California, are larger rivers than most found in the state, like the Los Angeles or Kern Rivers. The Klamath drains a basin of more than 12,000 square miles. In these streams, a flood buildup may extend over a period of a week or longer.

The streams of the Sierra Nevada and Cascades overflow either because of rainfall or snowmelt, or from a combination of these. With the construction of more dams and reservoirs on these streams, the frequency of damaging floods decreases. Most of the streams are still capable, however, of causing occasional major damage along their downstream reaches. The extreme southern portion of the San Joaquin Valley has no direct drainage to the sea. Excessive runoff from the southern Sierra Nevada into this area can result in the temporary enlargement of Buena Vista Lake and Tulare Lake, which is often helpful towards irrigation for agriculture.

The Los Angeles flood of 1938 is often used as a case study when reviewing extreme weather events. The Los Angeles flood of 1938 was one of the largest floods in the history of Los Angeles, Orange, and Riverside Counties in southern California. The flood was caused by two Pacific storms that swept across the Los Angeles Basin in February-March 1938 and generated almost one year's worth of precipitation in just a few days. Between 113–115 people were killed by the flooding. The Los Angeles, San Gabriel, and Santa Ana Rivers burst their banks, inundating much of the coastal plain, the San Fernando and San Gabriel Valleys, and the Inland Empire. Flood control structures spared parts of Los Angeles County from destruction, while Orange and Riverside Counties experienced more damage.

Figure 3.4: Aftermath of Flood Waters Draining in the Pacific Ocean, Near Malibu, California- 1938.[29]

Winds

California lies within the zone of prevailing westerlies and on the east side of the semi-permanent high-pressure area of the northeast Pacific Ocean. The basic flow in the free air above the state, therefore, is from the west or northwest during most of the year. The several mountain chains within the state, however, are responsible for deflecting these winds and, except for the immediate coast, wind direction is likely to be more a product of local terrain than it is of prevailing circulation.

During the winter, storm tracks move further south. Wind direction and speed are modified by migratory pressure centers. With a strong high-pressure area over the Great Basin and an intense low-pressure area approaching the coast from the west, strong and sometimes damaging winds occur, usually from an easterly or southeasterly direction, especially along the coast and in the coastal mountains. As the storms move inland the winds veer to southerly and southwesterly directions, and high wind speeds may occur anywhere within the state with the greatest velocities at high elevations.

Under a slightly different configuration of these pressure systems, winds tend to flow out of the deserts of the Great Basin towards and into California's Central Valley, the Southeastern Desert

[29] Image by Los Angeles Department of Water and Power is in the public domain.

Basin, and the South Coast. Such wind situations are identified in southern California by the name Santa Ana Wind. The air is typically very dry and originated from high pressure systems over the desert regions of the southwest, bringing in northwestern winds to Southern California. The winds are strong and gusty, sometimes exceeding 100 MPH, particularly near the mouth of canyons oriented along the direction of airflow. It is a situation that occasionally leads to serious fire suppression problems and often results in the temporary closing of sections of main highways to campers, trucks, and light cars.

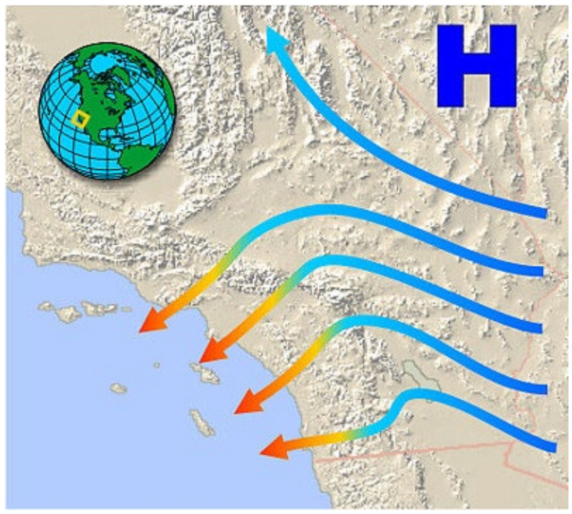


Figure 3.5: Illustration of the Santa Ana Winds.[30]

A similar circulation pattern creates the Diablo Winds of the Sacramento and San Joaquin Valleys. As a result of compressional heating of air flowing out of the Great Basin this situation results in pronounced heat waves in summer. In winter, the result is usually a rather mild temperature accompanied by a dry, persistent wind that many persons find unpleasant.

The typical northwest wind of summer is reinforced by the dynamics of the thermal low-pressure area located over the Central Valley and the Southeastern Desert area. In the San Francisco Bay Area, there is a marked diurnal pattern in the strength of the wind even though an onshore circulation tends to continue throughout the 24-hour period. This helps to carry locally produced air pollution products away from the Bay Area but creates problems for the regions immediately south and east of the source area.

In the Los Angeles area, however, the Basin is almost completely enclosed by mountains on the north and east. Coupled with this is a characteristic of the air along most of the coastal area of California. The vertical temperature structure (inversion) tends to prevent vertical mixing of the

[30] Map by the NOAA's National Weather Service is in the public domain.

air through more than a shallow layer (1,000 to 2,000 feet deep). The geographical configuration and the southerly location of the Basin permit a regular daily reversal of wind direction—offshore at night and onshore during the day. With the concentrated population and industry, pollution products tend to accumulate and remain within this circulation pattern.

Another local characteristic of the northwest wind alongshore is the creation of a jet effect in the vicinity of some of the more prominent headlands. The most outstanding of these currents of air is found off and to the south of Point Arguello. Here a strong jet of air is projected southward past San Miguel and San Nicholas Islands, driving a huge eddy as much as 200 miles in diameter. The air swings eastward near San Diego then northward and westward along the coast to rejoin the southward flowing air at the west end of the Santa Barbara Channel. Similar but smaller eddies form in the vicinity of the Golden Gate, just south of Point Reyes, and south of Monterey Bay around Point Surr. Wind speeds in the immediate vicinity of these major headlands can be two or three times as great as the wind flow at nearby points.

During periods of moderate to strong westerly flow at upper levels over the central part of the state, particularly during the winter and spring, the well-known 'Sierra Wave' is created in the Eastern Sierre area. Although this phenomenon is particularly useful to sailplane enthusiasts, it can also be a hazard to the unwary pilot.

ELEMENTS OF CLIMATE

People often confuse weather and climate; they are not identical. According to the American Meteorological Society (AMS), the weather is defined as the state of the atmosphere at some place and time, usually expressed in terms of temperature, air pressure, humidity, wind speed and direction, precipitation, and cloudiness. Meteorologists study the atmosphere, processes that cause weather, and the life cycle of weather systems. Climate is defined in terms of the average (mean) of weather elements (such as temperature and precipitation) over a specified period. (The World Meteorological Organization defines the typical time of time as 30 years). Climate also encompasses weather extremes for a particular place.

Scientists have developed a variety of ways for classifying climate. In the early 20th century, a German scientist named Vladimir Köppen developed one of the most widely used classification systems. The Köppen system categorizes climate into five main types, which can be further divided into subcategories.

Table 3.1: Basic Characteristics of the Köppen Climate Classification

Type of Climate	Characteristics
Tropical (A)	Average temperature of 18 °C (64.4 °F) or higher every month of the year, with significant precipitation (very humid).
Dry (B)	Evaporation exceeding precipitation with constant water deficiency throughout the year. Average temperature greater than 10 °C (50 °F)
Temperate (C) **(Northern Hemisphere Mid-Latitude)**	Humid and warm or hot summers, and mild or dry winters, with average temperatures between -3°C (27°F) and 18°C (64°F)
Continental (D) **(Northern Hemisphere Mid-Latitude)**	At least one month averaging below 0 °C (32 °F) (or −3 °C (27 °F)) and at least one month averaging above 10 °C (50 °F).
Polar (E)	Freezing winters and an average temperature of the warmest summer month below 10°C (50°F)

The planet's climate has changed many times over Earth's long geologic history. For example, over the past million years, Earth has experienced several glacial periods interspersed with interglacial (warmer) periods. The relatively constant and favorable interglacial period of climate experienced over the past 8,000 years has made human civilization's advancement possible.

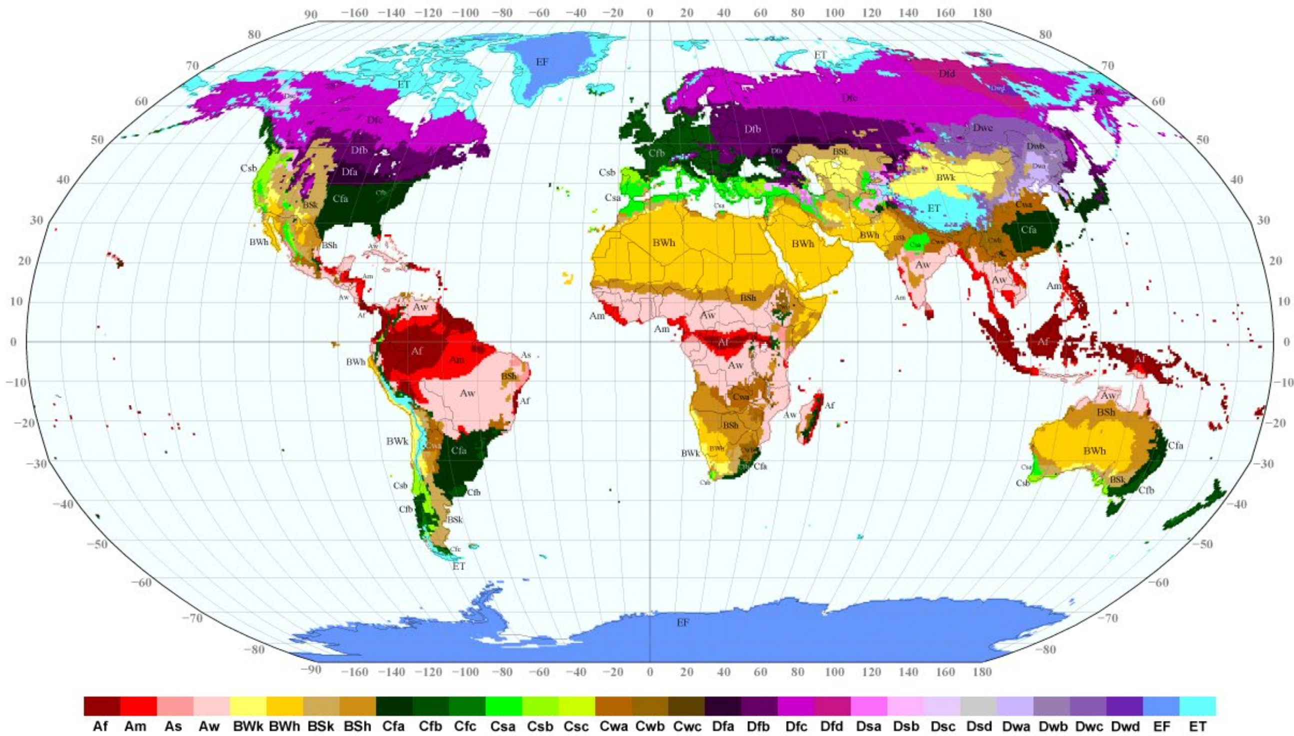


Figure 3.6: Köppen-Geiger Climate Subdivisions.[31]

Climate Change

Climate change refers to a significant and sustained (over decades or longer) change from one climatic condition to another. The term "global warming" refers to a specific kind of climate change in which Earth's average temperature is increasing. Of growing concern is what is known as abrupt climate change. According to the National Oceanic and Atmospheric Administration (NOAA), abrupt climate change is a relatively new area of scientific research whose formal definition is still being developed, but it refers to a sudden, rapid transition from one climate state to another (over a period of years rather than centuries or millennia).

Meteorologists focus primarily on real-time (current) data to predict local or regional atmospheric conditions for the hours, days, or weeks ahead. Thus, weather prediction tends to be more local and relates to conditions in the immediate future from days to weeks.

[31] Image by NOAA is in the public domain.

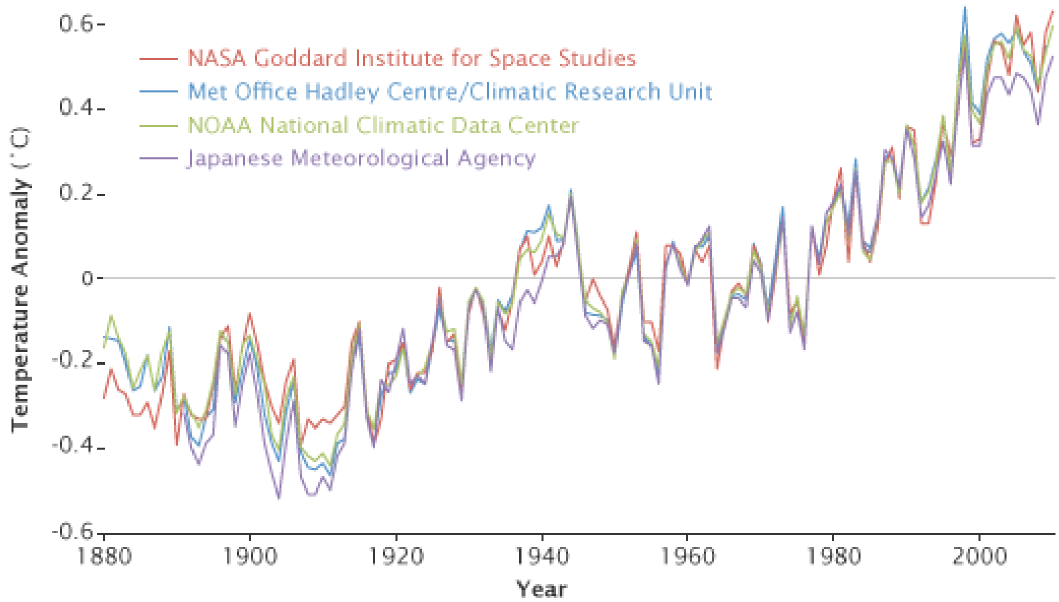


Figure 3.7: Annual Temperatures During 1880-2018. Notice the Winter/Summer Patterns—& Then the Overall Dramatic Increase of The Patterns During the Past 20 Years.[32]

Climate scientists or climatologists, on the other hand, look at atmospheric conditions in terms of averages and trends (patterns) that have occurred over many decades, centuries, and millennia. Weather is variable but can be averaged over time to indicate climate trends. Therefore, climate scientists can use weather data plus proxy data, (reconstructed paleo climates) to help them identify previous trends and improve their predictions of future trends.

Meteorologists and climate scientists use similar tools. Weather balloons, satellites, uniquely designed airplanes, and radar and other ground-based data collection instruments (to measure wind speed, precipitation, air temperature, humidity levels, etc.) are all good examples. These methods and tools have enabled humans to collect reliable atmospheric data on a consistent basis since the mid-1800s. They have grown increasingly more precise and sophisticated over time, to such an extent that meteorologists can now consistently provide reasonably accurate near-term (1 week or less) weather forecasts.

Climate monitoring requires data covering all areas of the planet over a much longer time. Sophisticated Earth-observing satellites equipped with remote-sensing equipment circle the globe. With each pass, they can record sea surface and other temperatures, measure atmospheric gases and rainfall amounts, take visible and infrared photos of Earth's surface, and calculate Earth's outgoing infrared and reflected solar radiation.

[32] Image by NASA is in the public domain.

Climate Change & Fires?

The year 2020 will be remembered for many things, not the least of which was a series of devastating fires around the globe that bear the fingerprints of climactic change. From Australia and South America's Amazon and Pantanal regions, to Siberia and the U.S. West, wildfires set new records and made news year-round.

It was an especially bad year for wildfires on the U.S. West Coast. Five of California's 10 largest wildfires on record happened in 2020, and the state set a record for acres burned. According to CAL FIRE, the state's Department of Forestry and Fire Protection, more than 9,600 wildfires burned nearly 4.2 million acres through mid-December, causing more than 30 fatalities and damaging or destroying nearly 10,500 structures.

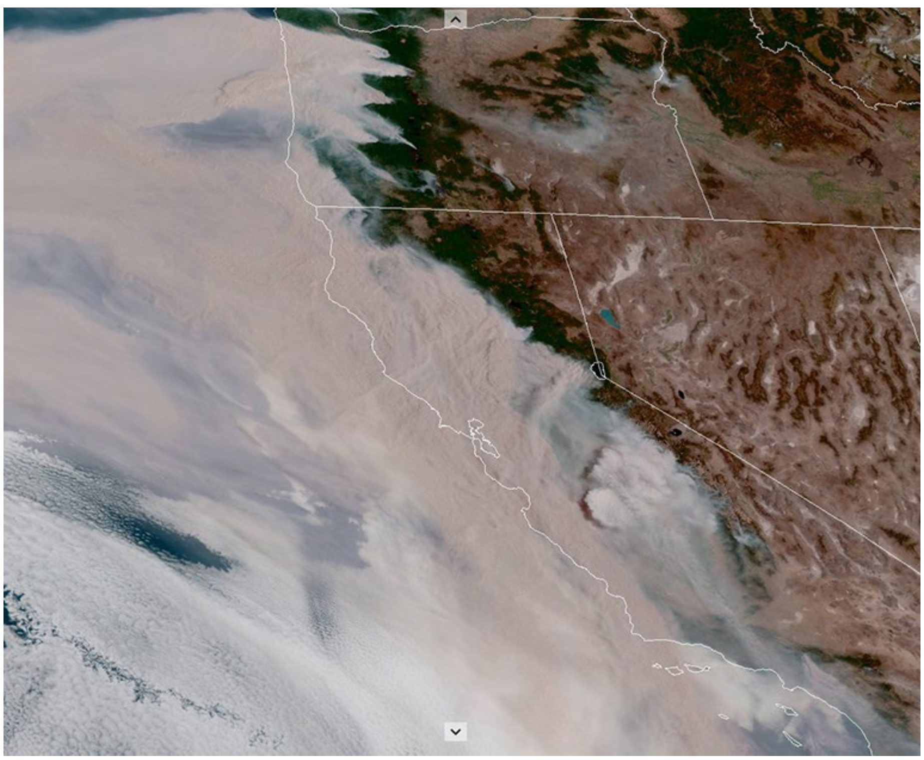


Figure 3.8: Smoke from numerous wildfires obscures much of California and Oregon on September 9, 2020.[33]

It was the fire equivalent of a perfect storm. Record drought conditions across the Western United States over many decades prior and were followed by the hottest summer on record in the Northern Hemisphere. Poor forest growth management, increased powerlines to remote areas, unusually dry air, strong wind events, and an outbreak of summer thunderstorms in Northern California in August, and conditions were ripe for a dangerous fire season.

[33] Image by NOAA is in the public domain.

In recent decades, the U.S. West has warmed, and the frequency and severity of heat waves and droughts has increased. According to the National Oceanic and Atmospheric Administration (NOAA), temperatures in California have increased approximately 2 degrees Fahrenheit (1.1 degrees Celsius) since the beginning of the 20th century. This has dried out the air. Fire seasons are also starting earlier and ending later each year, while snowpack's are shrinking, leading to earlier spring snowmelt and longer, more intense dry seasons.

Effect of General Circulation on Climate

A dominating factor in the weather of California is the semi-permanent high-pressure area of the north Pacific Ocean. This pressure center moves northward in summer, holding storm tracks well to the north, and as a result California receives little or no precipitation from this source during that period. In winter, the Pacific high retreats southward permitting storm centers to swing into and across California. These storms bring widespread, moderate precipitation to the state. Some of them travel far enough to the south to spread moisture beyond the Mexican border. When changes in the circulation pattern permit storm centers to approach the California coast from a southwesterly direction, copious amounts of moisture are carried by the northeastward streaming air. This results in heavy rains and often produces widespread flooding during the winter months.

There is another California weather characteristic that results from the location of the Pacific high. The steady flow of air from the northwest during the summer helps to drive the California Current of the Pacific Ocean as it sweeps southward almost parallel to the California coastline. However, since the mean drift is slightly offshore, there is a band of upwelling immediately off the coast as water from deeper layers is drawn into the surface circulation. The water from below the surface is colder than the semi-permanent band of cold water just offshore, which ranges from 25 to 50 miles in width.

The temperature of water reaching the surface from deeper levels varies from about 49°F in winter to 55°F. in late summer along the northern California coast, and from 57° to 65°F on the southern California coast. At 200 to 300 miles offshore, surface water temperatures range from 51° to 65°F in the north and from 60° to 67°F in the south. Thus, the water near the coastline is as much as 10°F colder during the summer than is the water farther west into the Pacific Ocean.

Comparatively warm, moist Pacific air masses drifting over this band of cold water form a bank of fog which is often swept inland by the prevailing northwest winds out of the high-pressure center. In general, heat is added to the air as it moves inland during these summer months, and the fog quickly lifts to form a deck of low clouds that extend inland only a short distance before evaporating completely. Characteristically, this deck of clouds extends inland further during the night and then recedes to the vicinity of the coast during the day. This layer of maritime air is usually from 1,500 to 2,000 feet deep, while above this layer the air is relatively warm, dry, and cloudless.

Extreme Weather

All-weather events that cause loss of life, disrupt normal human activities, and result in property damage appear extreme. It is a question of perspective: How do today's severe weather events compare to severe weather events in the recent and distant past? The resolution of Global Climate Models can complicate making direct comparisons between past and present events. For example, since 1986 the global human population has grown by approximately 2 billion. Simply said, there are more people than ever living in formerly unpopulated or sparsely populated areas. Comparing death tolls, between recent and past events may not be the most meaningful indicator of a particular weather event's intensity.

Nonetheless, the growing body of meteorological data indicates an increase in the number of extreme weather events occurring here in the United States since 1980, and the number of extreme events also appears to be rising worldwide.

2022-2023 California Floods

Periods of heavy rainfall caused by multiple atmospheric rivers in California between December 31, 2022 and January 25, 2023 resulted in floods that affected parts of Southern California, the California Central Coast, Northern California, and Nevada. The flooding resulted in property damage and at least 22 fatalities.

At least 200,000 homes and business lost power because of the storm and 6,000 individuals were ordered to evacuate. The floods were widely reported by media as an example of how climate change is increasing extreme changes in weather, especially cycles of precipitation and drought. Scientists interviewed by Los Angeles Times said that further study is needed to determine the connection and California has recorded similar events almost every decade since records started in the 19th century. Other scientists have emphasized that floods were caused by ocean warming, directly related to climate change. Scientist Kevin Trenberth declared that "the interaction between the warming ocean and the overlying atmosphere (...) is producing these prodigious rainfalls that have occurred in so many places around the world recently". Climate change is intensifying the water cycle. This brings more intense rainfall and associated flooding, as well as more intense drought in many regions. It has been both predicted by scientists and observed in the last years and documented by the IPCC (International Panel for

Climate Change 6th assessment report). Before the rains started, California had been in an extreme drought.

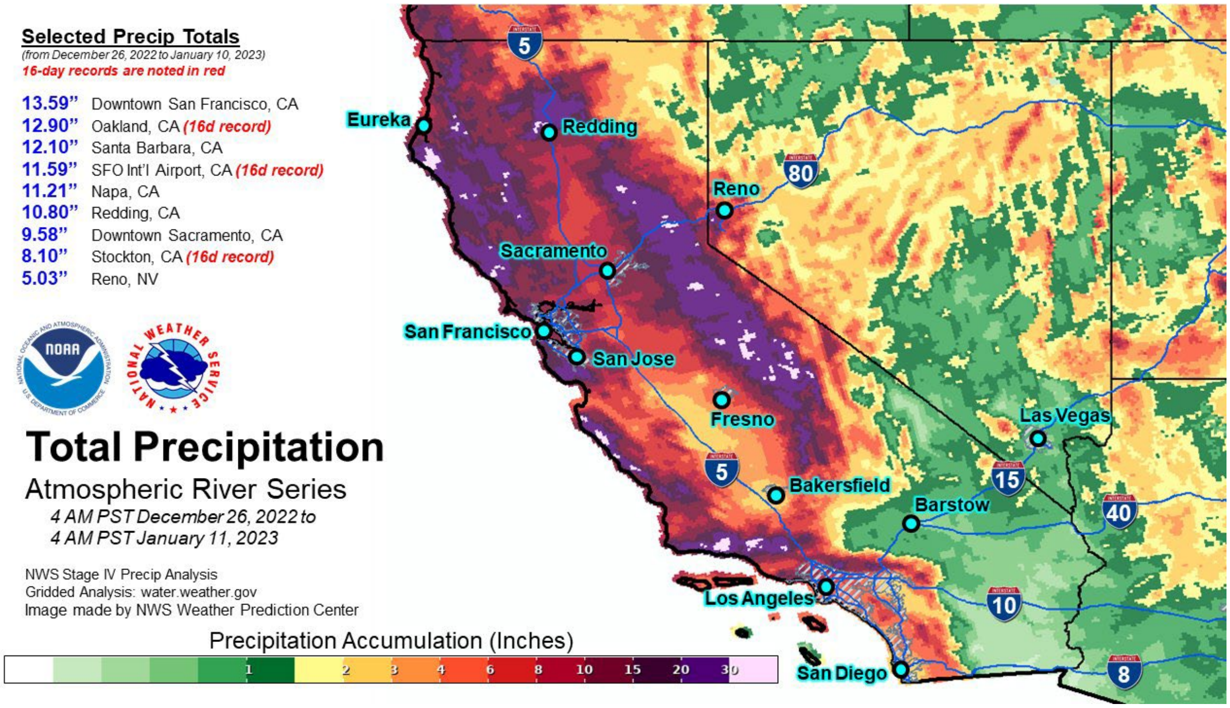


Figure 3.9: Precipitation Totals from December 26th- January 10th, 2023.[34]

[34] Image by NOAA is in the public domain.

Figure 4.1: Bristlecone Pine, Inyo Forest-California.[35]

UNIT 4: HISTORIC & PRESENT BIOGEOGRAPHY

Goals & Objectives of this unit

- Introduction to California's fossil record and regions that are rich with this record.
- Understand the importance and development of California's soil and how it is a primary factor in the flora and fauna found.
- Examine California's State Soil and understand its general formation and contribution to the success of agriculture in the Central Valley.
- Identify the major flora and fauna found in regions throughout the state.

---

[35] Image by Jeremy Patrich is used under a CC-BY 4.0 license.

INTRODUCTION

Biogeography is the study of the distribution of species and ecosystems in geographic space and through geological time. Organisms and biological communities often vary in a regular fashion along geographic gradients of latitude, elevation, isolation, and habitat area.

Knowledge of spatial variation in the numbers and types of organisms is as vital to us today as it was to our early human ancestors, as we adapt to heterogeneous but geographically predictable environments. Biogeography is an integrative field of inquiry that unites concepts and information from ecology, evolutionary biology, taxonomy, geology, physical geography, paleontology, and climatology.

Modern biogeographic research combines information and ideas from many fields, from the physiological and ecological constraints on organismal dispersal to geological and climatological phenomena operating at global spatial scales and evolutionary time frames.

The short-term interactions within a habitat and species of organisms describe the ecological application of biogeography. Historical biogeography describes the long-term, evolutionary periods of time for broader classifications of organisms. Early scientists, beginning with Carl Linnaeus and Alexander von Humboldt, have contributed to the development of biogeography as a science.

As we will see, the biogeography of California includes the flora & fauna of California's past and present, while understanding the soils that provide these systems the environment to have thrived.

CALIFORNIA'S FOSSIL RECORD

The fossil record is the set of all fossils - and it just happens to chart the course of evolution through time. It is one of the most significant pieces of supporting evidence for the idea that evolution is a rational and real explanation for the origin of the diversity of species. In general, the term "fossil record" refers to all fossils that have been excavated, examined, and characterized so far by thousands of hardworking scientists and paleontologists over the last few hundred years. The fossil record is used as evidence for many of things, including for common descendants, mass extinctions, the Cambrian explosion and for the fact that Earth is considerably older than 6000 years (in fact, its 4.6 billion years old).

Paleobiogeography

Paleobiogeography goes one step further to include paleogeographic data and considerations of plate tectonics. Using molecular analyses and corroborated by fossils, it has been possible to demonstrate that perching birds evolved first in the region of Australia or the adjacent Antarctic (which at that time lay somewhat further north and had a temperate climate). From there, they spread to the other Gondwanan continents and Southeast Asia – the part of Laurasia then closest to their origin of dispersal – in the late Paleogene, before achieving a global distribution in the early Neogene (figure 4.2). Not knowing that at the time of dispersal, the Indian Ocean was much narrower than it is today, and that South America was closer to the Antarctic, one would be hard pressed to explain the presence of many "ancient" lineages of perching birds in Africa, as well as the mainly South American distribution of the suboscines.

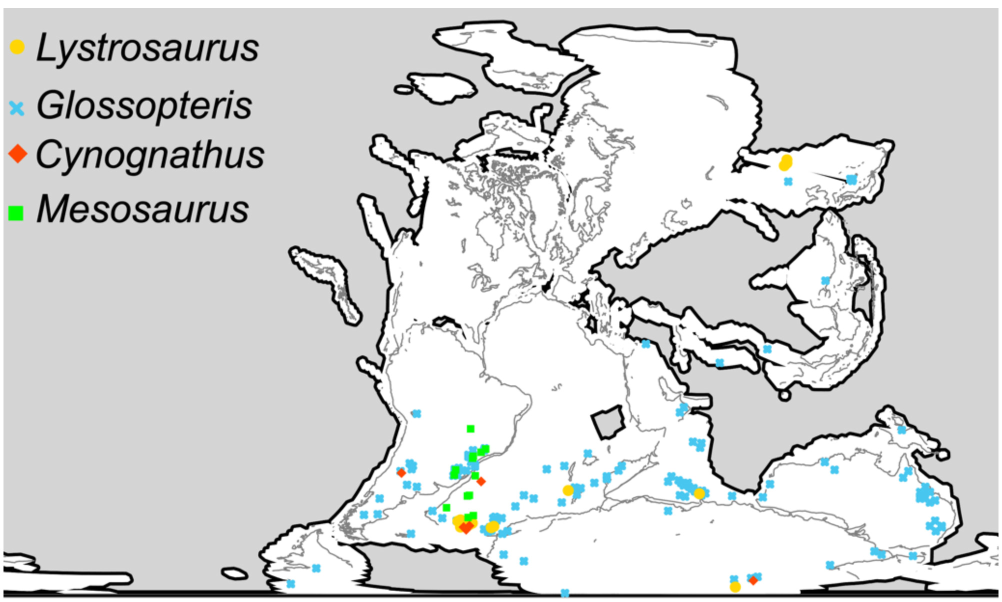


Figure 4.2: Distribution of Four Fossil Groups During the Super Continent Gondwanaland.[36]

The science of paleobiogeography helps us understand the history of where different species lived and how they got there. This knowledge is particularly useful for figuring out when major events like vicariance (splitting populations) or geodispersal (spread of organisms) happened in the past. It also sheds light on how regional groups of plants and animals formed.

For instance, by looking at the genes and geographic distribution of different fish species in the Amazon, scientists can tell that these fish didn't all appear suddenly in a burst of evolution. Instead, the vast diversity of Amazonian fish built up gradually over tens of millions of years. This process, called allopatric speciation, occurs when populations become isolated from each

[36] Image by Wikimedia is licensed under the CC-BY-SA 4.0 license.

other (often due to geographic changes) and eventually evolve into separate species. This contrasts with some island ecosystems, where new species can quickly arise from a single ancestor due to the unique pressures of their isolated environment (like the famous finches of the Galapagos Islands).

For animals that live in freshwater like fish, their world is naturally divided into separate watersheds like individual "bowls." These "bowls" can be temporarily separated by land and then reconnected by erosion over long periods. However, in places like the Amazon basin, where the land is very flat, the many rivers have a complex history of connections. Here, a process called stream capture becomes important for how fish evolve and where they live. Stream capture happens when part of one river system gets "stolen" by another, often due to land movements or erosion. This can significantly change the distribution of fish species in the area.

The California State Fossil | The Smilodon

The Smilodon, often referred to as the Saber-Toothed Cat, is one of the best-known saber-toothed predators and most famous prehistoric mammals. The Smilodon lived in the Americas during the Pleistocene epoch (2.5 mya – 10,000 years ago). The genus was named in 1842 based on fossils from Brazil; the generic name means "scalpel", or "two-edged knife" combined with "tooth". Three species are recognized today: *S. gracilis, S. fatalis,* and *S. populator*. The two latter species were probably descended from *S. gracilis*, which itself probably evolved from Megantereon. The hundreds of individuals obtained from the La Brea Tar Pits in Los Angeles constitute the largest collection of Smilodon fossils.

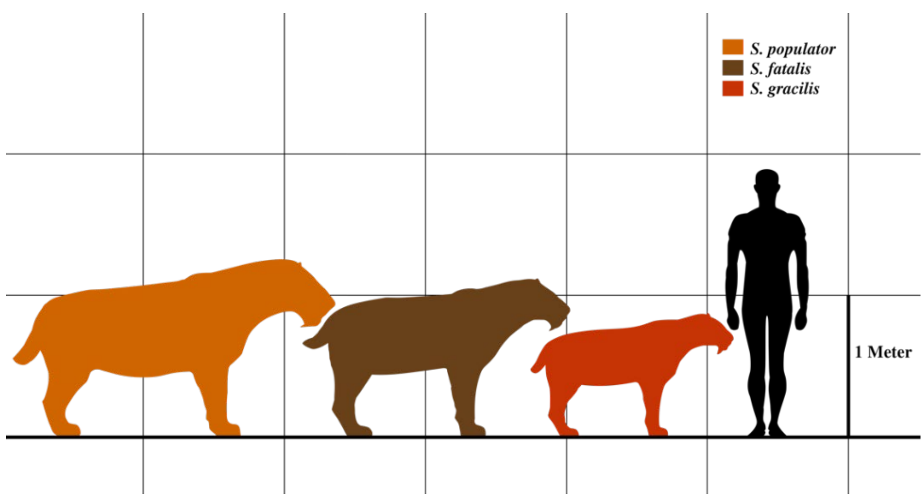


Figure 4.3: Size Comparison of All Members of the Smilodon Genus.[37]

[37] Image by Alhadis is licensed under CC BY-SA 4.0.

Overall, Smilodon was more robustly built than any current species (extant) of cat, with particularly well-developed forelimbs and exceptionally long upper canine teeth. Its jaw had a bigger gape than that of modern cats, and its upper canines were slender and fragile, being adapted for precision killing. *S. gracilis* was the smallest species at 55 to 100 kg (120 to 220 lb.) in weight. *S. fatalis* had a weight of 160 to 280 kg (350 to 620 lb.) and height of 100 cm (39 in). Both species are mainly known from North America but remains from South America have also been attributed to them. The *S. populator* from South America was the largest species, at 220 to 436 kg (485 to 961 lb.) in weight and 47 in (120 cm) in height and was among the largest known felids. The coat pattern of Smilodon is unknown, but it has been artistically restored with plain or spotted patterns.

In North America, Smilodon hunted large herbivores such as bison and camels, and it remained successful even when encountering new prey species in South America. Smilodon is thought to have killed its prey by holding it still with its forelimbs and biting it, but it is unclear in what manner the bite itself was delivered. Scientists debate whether Smilodon had a social or a solitary lifestyle; analysis of modern predator behavior as well as of Smilodon's fossil remains could be construed to lend support to either view. Smilodon probably lived in closed habitats such as forests and bushes, which would have provided cover for ambushing prey. Smilodon died out while most North and South American megafauna disappeared, about 10,000 years ago. Its reliance on large animals has been proposed as the cause of its extinction, along with climate change and competition with other species.

Out of the Collection: Smilodon & Skull

Want to learn more about the Smilodon, the California State Fossil? Either scan the QR code or visit this link to see Professor Patrich share his museum replica of an actual Sabretooth Cat skull (Video length: 5min).

Case Study | The Pygmy Mammoth

The pygmy mammoth or Channel Islands mammoth (*Mammuthus exilis*) is an extinct species of dwarf elephant descended from the Columbian mammoth (*M. columbi*) of mainland North America. During glacial periods, the mammoths swam from the mainland to Pleistocene Santa Rosae Islands. During interglacial sea level rise isolated those as the original Sant Rosae island became 4-5 islands, later to know as the Channel Islands. Natural selection favored smaller mammoths- restricted from food sources, ultimately becoming pygmies.

This species became extinct during the Quaternary in which many megafauna species became extinct due to changing conditions to which the species could not adapt. A case of island or insular dwarfism, from a recent analysis in 2010 it was determined that *Mammuths exilis* was on average, 1.72 m (5.6 ft) tall at the shoulders and 760 kg (1,680 lb.) in weight, in stark contrast to its 4.3 m (14 ft) tall, 9,070 kg (20,000 lb.) ancestor.

Discovery

Mammoth remains have been known on the northern Channel Islands of California since 1856. They were first reported in scientific literature in 1873. In 1994 the National Park Service called in scientists to inspect an uncovered, unidentified skeleton found on the northeast coast of Santa Rosa Island. They found bones of the axial skeleton of a large land vertebrate and decided to excavate and dig up the skeleton. They recovered 90% of a mature male pygmy mammoth's skeleton. The mammoth was about 50 years old when it died. The small bones were preserved in life position, which represented that it had died where it was found rather than being scattered around the island. The bones were returned to the Santa Barbara Museum of Natural History. After the discovery of the skeleton, a pedestrian survey of the island began. This resulted in the discovery of 160 new locations of mammoth remains, the vast majority being found on Santa Rosa Island. This was the first discovery of a nearly complete specimen of the pygmy mammoth. Fortunately, the skeleton was only missing a foot, a tusk, and a couple of vertebrae. The remains were covered by a sand dune, which prevented the bones from scattering and kept them intact.

Figure 4.4: Excavation of a Pygmy Mammoth Skeleton on Santa Rosa Island, California.[38]

Habitat

Remains of *M. exilis* have been discovered on three of the northern Channel Islands of California since 1856: Santa Cruz, Santa Rosa, and San Miguel, which together with Anacapa

[38] Image by Wikimedia is licensed under CC BY-SA 4.0

were the highest portions of the now mostly submerged super island of Santarosae. The late Pleistocene elephant appears to have survived on the islands until the arrival of the humans associated with Arlington Springs Man around 13,000 years ago and the last known mammoth occurrence was 13–12.9 thousand years ago which predates the later Chumash people's arrival during the early Holocene, between 10,800 and 11,300 years ago. Radiocarbon dating indicates *M. exilis* existed on the island for at least 47,000 years prior.

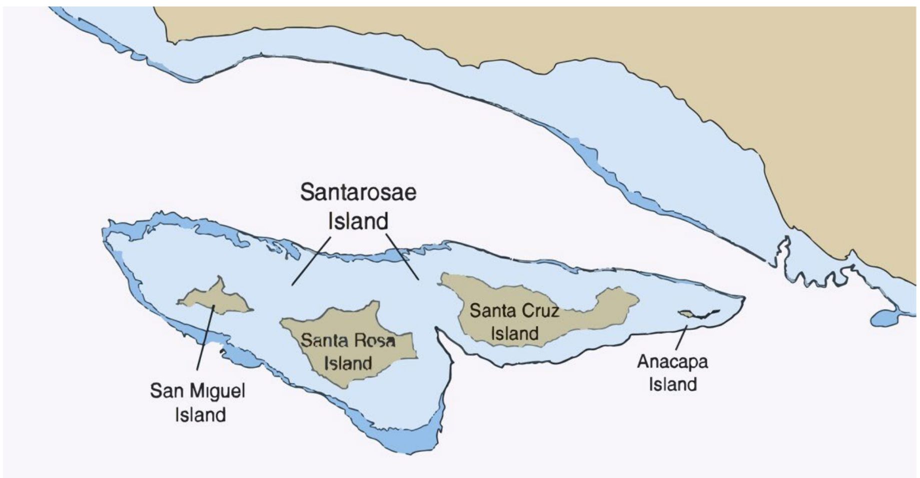


Figure 4.5: A Map of Santarosae Island, around 15,000 years ago, which today makes up the Channel Islands, California.[39]

Modern elephants are excellent swimmers, and the ancestors of *M. exilis* swam the 4 mi (6.4 km) to Santa Rosae. As the population of mammoths increased, the lack of large predators such as the dire wolf, Smilodon and the American lion and the loss of habitat caused by the rise of sea levels at the end of the ice age as Santa Rosae split into four islands favored smaller animals. Because of this, the pygmy mammoths began evolving through generations as a survival mechanism to stay alive on the ever-shrinking Santa Rosa Island; their body size became smaller because it required less food and resources to remain energized and alive. After this evolutionary period, the mammoth had become a distinct species, the pygmy mammoth.

The pygmy mammoth was able to thrive in all the many different ecosystems found on Santa Rosae, such as high elevation plateaus, to dune, grassland, riparian, and steppe-tundra ecosystems. Their fossils are found in the Channel Islands and in the California Channel. The evidence of their habituation in all those diverse dwellings is revealed by the pollen and plant pieces found in sediments and in dung. In addition, each habitat has a specific isotope mark from the unique types of soil, plants, and water. These mammoths sometimes modified their

[39] Image by University of Nebraska, Lincoln Digital Commons is in the public domain.

habitats, specifically in Channel Islands, where they created more spacious grassland as a result of their roaming.

Evolution

Land bridges were once theorized to have connected the northern Channel Islands to the mainland, because it was assumed the mammoths could not swim. A land bridge between the mainland and Santa Rosae did not exist during the Quaternary; however, the distance to the mainland was reduced to 7 kilometers (4.3 mi). When the Ice Age caused the sea levels to lower, the four northern Channel Islands formed a single island that was closer to the mainland and larger in size. Also, their mainland predators such as the dire wolves, the Smilodon and the American lion were not present. After this evolutionary period, the mammoth had become a distinct species, the pygmy mammoth. The pygmy mammoth's evolution on Santa Rosae took over 30,000 years.

Extinction

A single cause of extinction of the pygmy mammoth is unknown, as it could have been caused by over-hunting by humans, wildfires, climate change, or some combination thereof.

- Human interference often has a greater effect on island species than on continental species, and there is evidence that Native Americans hunted the pygmy mammoth on Santa Rosa. Mammoths were still extant on the islands when humans arrived, and mammoth remains were associated with charcoal of the same radiocarbon date. Two mammoth skulls with the brain removed were found adjacent to a fire pit, of the 100 fire pits at least a third contained mammoth bones.
- A shift in sea level driven by climate change likely played a part in the extinction: as the sea level rose, about 61% of the island landmass was submerged. Some 4,000 years prior to extinction the island had an area of roughly 1,900 square kilometers (730 sq mi). Further increase in sea levels left four smaller islands with nearly eighty percent less total landmass.

Out of the Collection: The Mammoth

Come check out these incredible pieces of California history! Either scan the QR code or visit this link to see Professor Patrich share a real piece of a California mammoth bone, & real woolly mammoth hair!
(Video length: 6min).

CALIFORNIA STATE SOIL

Many states have a designated state bird, flower, fossil, mineral, etc. In California the state bird is the California Valley Quail, the state flower is the Golden Poppy, the state fossil is the Saber-toothed Cat, and the state mineral is Native Gold. Many states also have a state soil – one that has significance or is important to the state. The San Joaquin is the official state soil of California. Let's explore how the San Joaquin is important to California and even the entire world.

The Formation of Soil

Weathering is a key part of the process of the soil formation, and the soil is critical to our existence on Earth. In other words, we owe our existence to weathering, and we need to take care of our soil.

Soil forms through the accumulation and decay of organic matter and both mechanical and chemical weathering processes described below. The factors that affect the nature of the soil and the rate of its formation include climate (average temperature and precipitation), the consequent types of vegetation the type of parent rock material, the slope of the surface, and the amount of time available.

Climate

Soils develop because of the weathering of materials on Earth's surface, including the mechanical breakup of rocks, and the chemical weathering of minerals. Soil development is facilitated by the downward percolation of water. Soil forms most readily under warm temperate to tropical conditions (not cold) and where precipitation amounts are moderate (not dry, but not too wet). Chemical weathering reactions (especially the formation of clay minerals) and biochemical reactions proceed fastest under warm conditions, and plant growth is enhanced in warm climates. Too much water (e.g., in rainforests) can lead to the leaching of important chemical nutrients and hence to acidic soils. In humid and poorly drained regions, swampy conditions may prevail, producing soil that is dominated by organic matter. Too little water (e.g., in deserts and semi-deserts), results in very limited downward chemical transportation and the accumulation of salts and carbonate minerals (e.g., calcite) from upward-moving water. Soils in dry regions also suffer from a lack of organic material.

Parent Material

Soil parent materials can include all different types of bedrock and any type of unconsolidated sediments, such as glacial deposits and stream deposits. Soils are described as residual soils if they develop on bedrock, and transported soils if they develop on transported material such as glacial sediments. But the term “transported soil” is misleading because it implies that the soil itself has been transported, which is not the case. When referring to such soil, it is better to be specific and say, “soil developed on unconsolidated material,” because that distinguishes it from soil developed on bedrock.

Soil Horizons

The process of soil formation generally involves the downward movement of clay, water, and dissolved ions, and a common result of that is the development of chemically and texturally different layers known as soil horizons (figure 4.6). The typically developed soil horizons are:

- O: the layer of organic matter
- A: the layer of partially decayed organic matter mixed with mineral material
- E: the eluviated (leached) layer from which some of the clay and iron have been removed to create a pale layer that may be sandier than the other layers
- B: the layer of accumulation of clay, iron, and other elements from the overlying soil
- C: the layer of incomplete weathering
- R: the parent material or bedrock

Another type of layer that develops in hot arid regions (such as in the Mojave Desert) is known as caliche (pronounced *ca-lee-chee*). It forms from the downward (or in some cases upward) movement of calcium ions, and the precipitation of calcite within the soil. Well-developed caliche may cement the surrounding material together to form a layer that has the consistency of concrete.

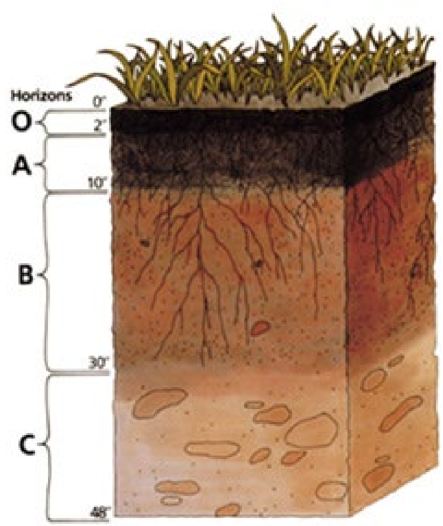


Figure 4.6: Soil Horizons. The R Horizon Would be Below the C Horizon.[40]

[40] Image by United States Department of Agriculture is in the public domain.

Like all geological materials, the soil is subject to erosion, although, under natural conditions on gentle slopes, the rate of soil formation either balances or exceeds the rate of erosion. Human practices related to home building, forestry and agriculture have significantly upset this balance.

Soils are held in place by vegetation. When vegetation is removed, either through cutting trees or routinely harvesting crops and tilling the soil, that protection is either temporarily or permanently lost. The primary agents of the erosion of unprotected soil are water and wind.

Case Study | The San Joaquin Series

The San Joaquin soil was initially documented and officially established in California in 1900 and therefore is the oldest, continuously recognized soil series within the state. The process of establishing the San Joaquin as the official state soil in California began with the Professional Soil Scientists Association of California (PSSAC).

Inspired by a visit to the USDA offices in Madera and Hanford, California, science teacher Alex Lehman envisioned a project to connect students and the public with soil conservation. This project, titled "Proposing a California State Soil—Preserving a Legacy and a Commitment to Future Generations," sparked a unique learning experience for students at Martin Luther King, Jr. Middle School in Madera.

Students embraced a cross-disciplinary approach, integrating science, math, English, social studies, and history with conservation education. Social studies classes delved into the lawmaking process, English classes saw students crafting proposals and poems about soil, science and art classes collaborated on science fair displays, and music classes even produced an official state soil song.

The San Joaquin Soil Series became the official state soil of California on August 20, 1997. It was the culmination of the efforts by students and teachers, natural resources professionals, the PSSAC, state legislators, and various state universities.

What is the San Joaquin Soil?

Every soil can be separated into three separate particle size fractions called sand, silt, and clay, which makes up the soil texture. In addition, the arrangement of soil horizons can tell you a lot about the age of a soil and how it developed over time. Some common horizon designations are A, E, B, and C or combinations of those.

Figure 4.7: Soil Profile of the San Joaquin Soil.[41]

Typically, San Joaquin soils have a brown to reddish brown surface or surface soil horizon with a loam (a combination of sand, silt, and clay) texture that has an accumulation of organic matter. The next underlying horizon is similar in soil texture to the surface horizons; however, it does not have an accumulation of organic matter. Iron oxides released in this horizon are not masked so much by the organic matter and impart a redder hue to the soil when moist. This horizon rests on a brown or reddish-brown clay or clay loam horizon that has a distinctive prismatic structure (soil broken up into pillar like structures) with cracks between the prisms. This horizon, with a dramatic increase in clay which restricts root and water penetration, is about 15 to 30 inches 38 to 76 cm (38 to 76 cm) from the surface of the soil.

The first characteristic in a San Joaquin soil that people notice is a distinctive soil horizon (layer) known as a duripan to soil scientists and generally as "hardpan" to many people. It is extremely hard, and it can be chipped with mechanical means or through use of a pick or very strong, heavy shovel. However, there is much more to the San Joaquin soil than just the duripan.

---

[41] Image by United States Department of Agriculture is in the public domain.

Finally, the fourth horizon is the brown to reddish brown silica cemented duripan. The duripan has an abrupt upper boundary at a depth of 50 to 101 cm (20 to 40 inches) and is impervious to roots and water. The duripan often continues to a depth of 152 cm (60 inches) or more.

NATIVE & UNIQUE FLORA

California native plants are plants that existed in California prior to the arrival of European explorers and colonists in the late 18th century. California includes parts of at least three phytochoria. The largest is the California Floristic Province, a geographical area that covers most of California, portions of neighboring Oregon, Nevada, and Baja California, and is regarded as a "world hotspot" of biodiversity.

The California Floristic Province (CFP)

The California Floristic Province (CFP) stretches along the Pacific Coast, encompassing most of California and spilling into parts of Oregon, Nevada, and Baja California (see figure 4.8). This region boasts a distinctive plant life like areas with Mediterranean climates, characterized by wet winters and dry summers.

In 1996, the CFP earned recognition as a global biodiversity hotspot due to its exceptional concentration of unique plant species. Conservation International estimates the CFP to be home to over 8,000 plant species, with a staggering 60% found nowhere else on Earth (endemic). Despite its incredible biodiversity, the CFP faces a significant challenge: habitat loss. Sadly, over 70% of its original vegetation has disappeared. This loss is primarily driven by human activities like large-scale agriculture and urban expansion.

Recognizing the urgency, Conservation International proposed a strategy in 1998 to prioritize areas within the CFP most affected by human impact. The goal is to minimize threats to this vital ecosystem. Several factors contribute to the CFP's vulnerability, including population growth, habitat destruction, unsustainable resource use, and invasive species.
By understanding these threats, conservation efforts can be targeted more effectively to protect this irreplaceable treasure trove of plant life.

The California Floristic Province is a floristic province with a Mediterranean-type climate located on the Pacific Coast of California with a distinctive flora like other regions with a winter rainfall and summer drought climate like the Mediterranean Basin (figure 4.8). In 1996, the province was designated as a biodiversity hotspot allowing it to join ranks among 33 other areas in the world with many endemic species, as it is known for being the home of the Sierran giant sequoia tree and its close relative the coast redwood. The CFP is home to over 3,000 species of vascular plants, 60% of which are endemic to the province.

Figure 4.8: Map of California's Floristic Province.[42]

Climate & Topography

The California Floristic Province is one of the five biodiversity hotspots with Mediterranean climates, and it is characterized by hot, dry summers and cool, wet winters. Many parts of the coastal areas of this hotspot, being moderated by the ocean, experience cool summers due to the regular occurrence of ocean fog, which sustains redwood forests amongst other communities.

In California, the province includes most of the state excluding the Modoc Plateau, Great Basin, and deserts in the southeastern part of the state. In Oregon, the province includes the coastal mountains south of Cape Blanco and most of the Rogue River watershed.

In Baja California, the province includes the forest and chaparral belts of the Sierra Juarez and the Sierra San Pedro Mártir (but excluding their desert slopes to the east), coastal areas south to about El Rosario, and Guadalupe Island.

[42] Image by California Department of Forest and Fire Protection is in the public domain.

Parts of the following mountain ranges are included in the province:

- The Klamath Mountains
- The Cascade Range
- The Coast Ranges
- The Sierra Nevada
- The Transverse Ranges
- The Peninsular ranges south into Baja California
- The Great Central Valley

Case Study | The Ancient Bristlecone Pine

The term 'bristlecone pine' covers three species of pine tree (family Pinaceae, genus *Pinus*, subsection *Balfourianae*). All three species are long-lived and highly resilient to harsh weather and traditionally poor soils. One of the three species, *Pinus longaeva*, is among the longest-lived life forms on Earth. The oldest of this species is more than 4,800 years old, making it the oldest known individual of any species.

Bristlecone pines grow in isolated groves just below the tree line, between 5,600 and 11,200 ft (1,700 and 3,400 m) elevation on dolomitic soils. The trees grow in soils that are shallow lithosols, usually derived from dolomite and sometimes limestone, and occasionally sandstone or quartzite soils. Dolomitic soils are alkaline, high in calcium and magnesium, and low in phosphorus. Those factors tend to exclude other plant species, allowing bristlecones to thrive. Because of cold temperatures, dry soils, high winds, and short growing seasons, the trees grow very slowly.

The bristlecone pines root system is mostly composed of highly branched, shallow roots, while a few large, branching roots provide structural support. The bristlecone pine is extremely drought tolerant due to its branched shallow root system. The tree's waxy needles, and thick needle cuticles also aid in water retention.

The pine needles, which grow in bunches of five and can remain on the tree for forty years, give the twisted branches a bottle-brush appearance. The needles of the tree surround the branch to an extent of about one foot near the tip of the limb. The name bristlecone pine refers to the dark purple female cones that bear incurved prickles on their surface. The dark color of these cones helps to absorb heat. After maturity, which takes about two years, the cones will become brown in color. These ancient trees have a gnarled and stunted appearance, especially those found at high elevations, and have reddish-brown bark with deep fissures. As the tree ages, much of its vascular cambium layer may die. In very old specimens, often only a narrow strip of living tissue connects the roots to a handful of live branches. Even though the trees' needles may age, they remain functional in regulating water and by their ability to photosynthesize.

The wood is very dense and resinous, and thus resistant to invasion by insects, fungi, and other potential pests. The tree's longevity is due in part to the wood's extreme durability. While other species of trees that grow nearby suffer rot, bare bristlecone pines can endure, even after death, often still standing on their roots, for many centuries. Exposed wood on living and dead trees does not rot, but rather erodes like stone due to wind, rain, and freezing, which creates unusual forms and shapes.

The bristlecone pine has an intrinsically low rate of reproduction and regeneration, and many believe under present climatic and environmental conditions the rate of regeneration may be insufficient to sustain its population.

Field Trip: The Bristlecone Pine

Let's head on field trip to visit some of the oldest trees on Earth! Either scan the QR code or visit this link to see Professor Patrich explore The Ancient Bristlecone Pines, in the White Mountains, California. (Video length: 9min).

THE FAUNA OF CALIFORNIA

The fauna of the State of California may be the most diverse in the United States of America. Of the lower 48 conterminous states. California also has the greatest diversity in climate, terrain, and geology in general. The state's six life zones are the lower Sonoran (desert); upper Sonoran (foothill regions and some coastal lands); transition (coastal areas and moist northeastern counties); and the Canadian, Hudsonian, and Arctic zones, comprising California's highest elevations. California's diverse geography gives rise to dozens of different ecosystems, each of which has its own unique native plants and animals. California is a huge state, the 3rd largest in the U.S., and can range broadly in habitat type.

Earth scientists typically divide California into eleven distinct geomorphic provinces with clearly defined boundaries. They are, from north to south, the Klamath Mountains, the Cascade Range, the Modoc Plateau, the Basin and Range, the Coast Ranges, the Central Valley, the Sierra Nevada, the Transverse Ranges, the Mojave Desert, the Peninsular Ranges, and the Colorado Desert. Here, the Los Angeles Basin, the Channel Islands, and the Pacific Ocean are treated as distinct regions.

Common animals that live throughout all the state, and its coasts, include raccoons, weasels, otters, beavers, hawks, lizards, owls, coyotes, skunks, snakes, cougars, black bears, deer, squirrels, and whales. As of 2024, there are 685 bird species on the official California checklist but the California Birds Records Committee, ten of which are introduced species which are not native to the state. The California quail, the official state bird, has a breeding habit of mainly shrubby areas and open woodland. Another bird which winters in California is the American white pelican, which is a large seabird, with a wingspan reaching up to 110 inches (280 cm).

Venomous spiders in California include Arizona recluse, Baja recluse, Chilean recluse, desert recluse, Martha's recluse, Russell's recluse, brown widow, and western black widow.

Northern California

The forests in northern parts of California have an abundant fauna, which includes for instance the black-tailed deer, black bear, gray fox, North American cougar, bobcat, and Roosevelt elk. Garter snakes and rattlesnakes are common, as are such amphibians as the mudpuppy and redwood salamander. The kingfisher, chickadee, towhee, and hummingbird represent the bird life of this region. There are an estimated 3,487 wild horses in Northern California as of 2024, according to the Bureau of Land Management. Gray wolves began repopulating California in 2011 as they entered Lassen, Siskiyou, and Plumas Counties from the Cascade Range of Oregon.

Case Study | Sierra Nevada

Mammals of the Canadian zone include the snowshoe hare, mountain chickadee, and several species of chipmunk. Conspicuous birds include the blue-fronted jay, hermit thrush, American dipper, and Townsend's solitaire. Birds become scarcer as one ascends to the Hudsonian zone, and the wolverine is now regarded as rare. The only bird native to the high Arctic region is the gray-crowned rosy finch, but others often visit, including the Anna's hummingbird and Clark's nutcracker.

Principal mammals of this region are also visitors from other zones; the Sierra coney and white-tailed jackrabbit make their homes here. The bighorn sheep also live in this mountainous terrain; the bighorn sheep was listed as endangered by the US Fish and Wildlife Service. Some animals in the Yosemite Valley include bobcats, mountain lions, ring-tailed cats, the Steller's jay, California ground squirrels and the American black bear.

Southern California

Southern California constitutes one of the more varied collections of geologic, topographic, and natural ecosystem landscapes in a diversity outnumbering other major regions in the country. The region spans from Pacific Channel Islands, shorelines, beaches, and coastal plains, through the Transverse and Peninsular Ranges with their peaks, into the large and small interior valleys, to the vast deserts of California.

Several varieties of rattlesnakes are indigenous to the region. While only the Pacific Northwest rattler makes its home in Northern California, almost a dozen rattlesnakes make their home in the deserts of Southern California, including the western diamondback and the Mojave rattlesnake. Birds in the region include the Anna's hummingbird, acorn woodpecker, northern flicker, California towhee, California vulture, red-tailed hawk and many more.

Case Study | Mojave Desert

The Mojave Desert appears to have little in the way of wildlife but has large, diverse populations. The extremely warm desert environment has animals that have adapted to their environment with each filling an important niche in the desert ecosystem. Animals in the Mojave Desert include the Mohave rattlesnake, desert tortoise, glossy snake, common side-blotched lizard, California kingsnake, giant hairy scorpion, stripe tailed scorpion and the desert iguana. One of the more iconic 'trees' of the region are the Joshua trees. Joshua trees are succulents, a type of plant known for storing water in their leaves or stems. Despite their tree-like appearance with a single trunk and branches, they belong to the yucca family. The story behind their name is quite interesting. Legend has it that 19th-century Mormon settlers, traversing the harsh desert, saw the tree's outstretched limbs resembling a biblical figure, Joshua, raising his arms in prayer. This association led to the name "Joshua tree."

Coastal California

Along the coast of California is the California sea lion, which can grow up to seven feet long and can be found in shallow ocean water, near beaches, and among rocks. In the open ocean is the northern elephant seal, which grows up to a massive 14 feet (4.3 meters) and has a population of just over 150,000. The California ocean is home to six species of seals: Guadalupe fur seal, northern fur seal, northern sea lion, California sea lion, northern elephant seal and harbor seal.

California waters are also home to eleven species of dolphins, including the short-beaked common dolphin and the Pacific white-sided dolphin. A dozen species of whales live in California, including the killer whale and the gray whale. At least 34 species of shark have been recorded off the California Coast, including the great white shark and tiger shark.

Case Study | Channel Islands

More than 2000 species of plants and animals can be found within the Channel Islands National Park, which consists of five out of the eight islands that compromise the California Channel Islands. Three mammals are endemic to the archipelago: The Channel Islands fox, the deer mouse and the Channel Islands spotted skunk. Introduced mammal species include feral pigs, cats, rats, deer, cattle, the Santa Cruz sheep, and the Catalina Island bison herd.

Other mammals include the harvest mouse, the ground squirrel, and the ornate shrew. Other animals in the islands include island fence lizard, island scrub jay, harbor seal, California sea lion, island night lizard, barn owl, bald eagles, American kestrel, horned lark and meadowlark and California brown pelican. One hundred and forty-five of these species are unique to the islands and found nowhere else in the world. Marine life ranges from microscopic plankton to the endangered blue whale, the largest animal ever to live on earth. The oceans surrounding the islands have a rich marine life; species include orcas, swellshark, bat ray, California moray, great white shark, and sea lions.

Figure 5.1: Borax Mules Pulling Aqueduct Pipes for Installation in the Owens Valley.[43]

UNIT 5: WATER AS A RESOURCE & AS A CONFLICT

Goals & Objectives of this unit

- Identify the major sources of water California.
- Recognize California's fluctuating water supply.
- Identify the major concerns related to California's water sources.
- Understand a brief history of the Los Angeles Aqueduct & Water Wars.

INTRODUCTION

California will always be inextricably linked to its water resources. Water continues to shape the state's development and no resource is as vital to California's urban centers, farms, industry, recreation, scenic beauty, and environmental preservation. As of 2023, California's

[43] Image by Los Angeles Department of Water and Power is in the public domain.

interconnected water system serves over 39 million people and irrigates over 5,680,000 acres of farmland. As the world's largest, most productive, and potentially most controversial water system, it manages over 40 million acre-feet (49 km^3) of water per year.

Water and water rights are among the state's divisive political issues. Due to the lack of reliable dry season rainfall, water is limited in the most populous U.S. state. Among all the effects of climate change, changes in precipitation will be the hardest to predict. Studies conducted by the California Natural Resources Agency suggest that there will be more dry days and years in the future with occasional downpours. It is also estimated that the southern and inland regions of the state that are already dry to become more arid over time while the northern part of the state that currently receives much of the state's rainfall will continue to get wetter with the onset of climate change. Additionally, the intense drawdown of groundwater to support the growing urban expansion also impacts the deep roots of trees, and lowering the overall water table.

An ongoing debate is whether the state should increase the redistribution of water to its large agricultural and urban sectors or increase conservation and preserve the natural ecosystems of the water sources. Other conversations involve the building of large home developments in impacted areas, such as the 21,000-home development behind Six Flags Magic Mountain in the city of Santa Clarita that began construction in late 2020.

SOURCES FOR CALIFORNIAS WATER

California's limited water supply comes from two main sources: surface water, or water that travels or gathers on the ground, like rivers, streams, and lakes; and groundwater, which is water that is pumped out from the ground. The primary contributor for these sources is rainfall and California's snowpack. Because both surficial and ground water are becoming either unreliable or depleted, California has had to begin producing a small amount of desalinated water, water that was once sea water, but has been purified. As an example, Catalina Island's water comes from combination of underground aquifers and a desalination plant. While that plant helps supplement the lack of natural water supply, Catalina is still unable to meet the annual water needs of the island – making a steady supply of rain essential.

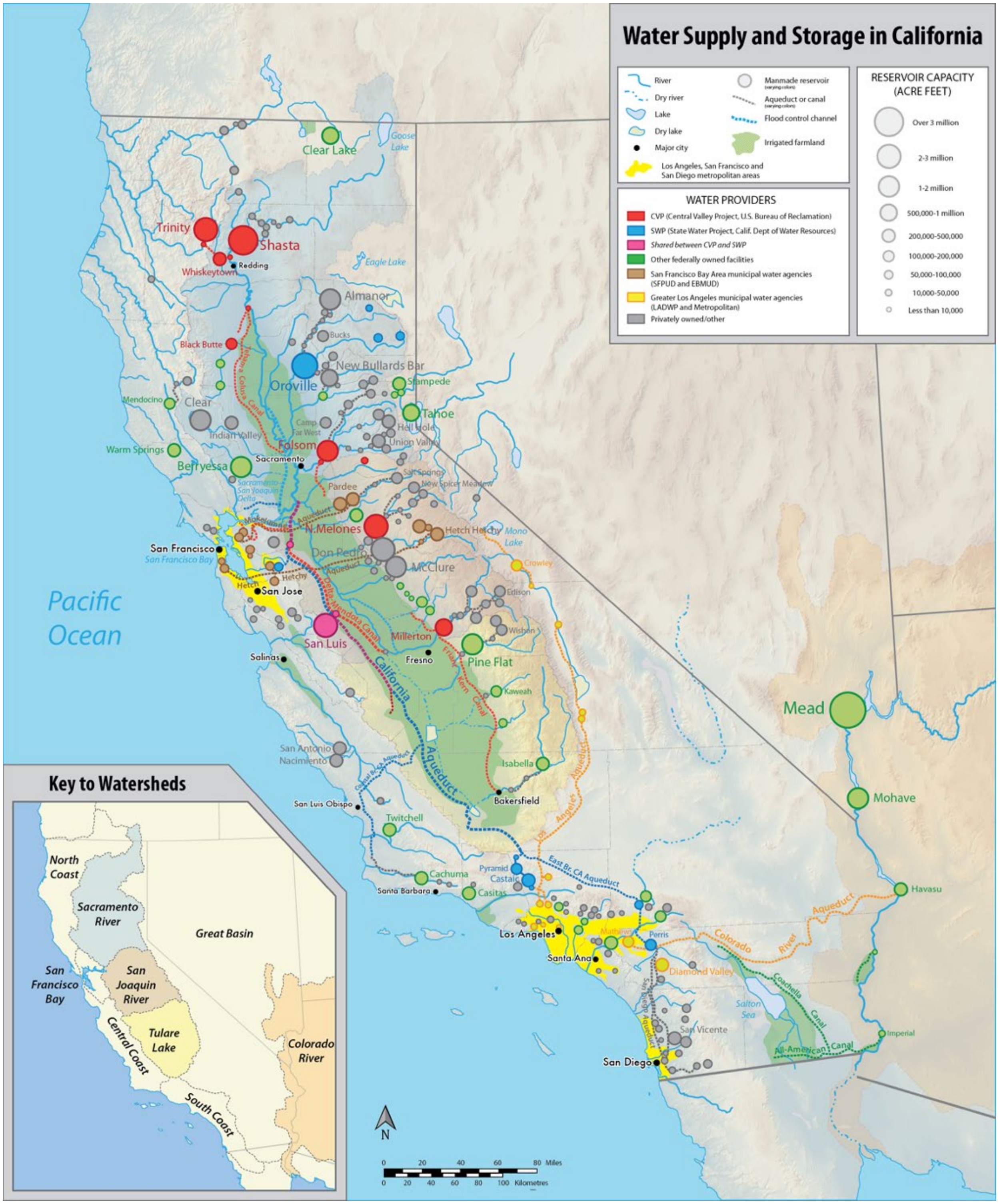


Figure 5.2: A Map of Water Storage, Watersheds, Rivers, & Delivery Facilities.[44]

[44] Image by Wikimedia is licensed under a CC-BY-SA 4.0 license.

Ground Water

Groundwater is a critical component for California's water supply. During a normal year, 30% of the state's water supply originates from groundwater (underground water). In times of intense drought, groundwater consumption can rise to 60% or more. Over 850,000,000 acre-feet (276,973,717,105,760 gallons) of water is stored in California's 450 known groundwater reservoirs; however, not all the water is usable. California's water situation presents a complex challenge. Groundwater, despite its wider distribution compared to surface water concentrated in the north, faces significant limitations. Firstly, over half is unusable due to poor quality, potentially from natural minerals or accumulated pollutants. Secondly, centuries of rapid extraction have caused saltwater intrusion, contaminating remaining water with salt, and making it unsuitable for many uses. Finally, pumping groundwater, especially from deeper wells, can be expensive due to the high energy demands. These limitations highlight the need for a balanced approach to water management in California.

The largest groundwater reservoirs are found in the Central Valley. The majority of the supply there is in the form of runoff that seeps into the aquifer. Freshwater is usually found in deposits of gravel, silt, and sand. Below these deposits lies a layer of deep sediment, a relic of the era when the Pacific Ocean covered the area.

The large quantity of water beneath the surface has given rise to the misconception that groundwater is a sort of renewable resource that can be limitlessly tapped. Calculations assuming that groundwater usage is sustainable if the rate of removal equals the rate of recharge are often incorrect because of ignoring changes in water consumption and water renewal.

While the volume of groundwater in California is very large, aquifers can be over drafted when groundwater is removed more rapidly than it is replenished. Overdraft occurs where the average annual amount of groundwater extraction exceeds the long-term average annual supply of water to the basin. Effects of overdraft can include seawater intrusion, land subsidence, groundwater depletion, and/or chronic lowering of groundwater levels. In 1999, it was estimated that the average annual overdrafting was around 2,200,000 acre-feet (716,873,150,156 gallons) across the state, with 800,000 acre-feet (260,681,145,511 gallons) in the Central Valley. Since 1999, overdrafting has significantly increased, causing further strain and concern for California's water storage. Satellite measurements found that in just the combined Sacramento and San Joaquin River basins, including the Central Valley, overdrafting between 2011 and 2014 was 12,000,000 acre-feet (3,910,217,182,669 gallons) of water per year… that is nearly 4 trillion gallons of water.

Groundwater-related subsidence is the subsidence (or the sinking) of land resulting from groundwater extraction. It is a growing problem in the developing world as cities increase in population and water use, without adequate pumping regulation and enforcement. One estimate has 80% of serious U.S. land subsidence problems associated with the excessive extraction of groundwater, making it a growing problem throughout the world. Groundwater can be considered one of the last free resources, as anyone who can afford to drill can usually draw up merely according to their ability to pump (depending on local regulations). However, as seen in the figure, pumping-induced drawdown causes a depression of the groundwater surface around the production well. This can ultimately affect a large region by making it more difficult and expensive to pump the deeper water. Thus, the extraction of groundwater becomes a tragedy of the commons, with resulting economic consequences.

Figure 5.2: An Image of Maximum Subsidence in the San Joaquin Valley from 1925 to 1977.[45]

The arid areas of the world are requiring more and more water for growing populations and agriculture. In the San Joaquin Valley of California, groundwater pumping for crops has occurred for generations. This has resulted in the entire valley sinking an extraordinary amount, as much as 28 feet, as shown in figure 5.2. This has not come without consequences. Any large-scale change of topography, no matter how slight it may seem, has the potential to drastically change the surface-water hydrology. This has happened in the Joaquin Valley and other regions of the world, such as New Orleans and Bangkok.

[45] Image by Wikimedia is licensed under a CC-BY-SA 4.0 license.

Surficial Water

California has ten major drainage basins defined for convenience of water management. These basins are divided from one another by the crests of mountains. From north to south the basins are: North Coast, Sacramento River, North Lahontan, San Francisco Bay, San Joaquin River, Central Coast, Tulare Lake, South Lahontan, South Coast, and Colorado River regions. Each region incorporates watersheds from many rivers of similar clime. Many of the drainage basins are extremely altered, with hydroelectric power generation happening in much of the upper portion of these watersheds.

Figure 5.2: A Map of Major Rivers in California.[46]

[46] Image by Wikimedia is licensed under a CC-BY-SA 4.0 license.

The Central Valley watershed, which incorporates the Sacramento River, San Joaquin River, and Tulare Lake regions, is the largest in California, draining over a third of the state – 60,000 square miles (160,000 km2) – and producing nearly half the total runoff. The Sierra Nevada snowpack feeds Central Valley River systems and is a critical source of water in the state's long dry season when little if any precipitation falls. Up to 30 percent of California's water supply is from snowpack, and most of the California's hydroelectricity is also generated from the Sierra Nevada snowpack. More generally, in the US one of the largest uses of fresh water is withdrawal for the energy sector. Much of California's extensive reservoir and aqueduct system is designed to store and capture runoff from the Central Valley watershed. As this infrastructure ages, dam removal in California has become more widespread—a process that has been largely successful. The Sacramento and San Joaquin Rivers converge at the Sacramento–San Joaquin River Delta, a large fresh-water estuary where much of the state's water supply is withdrawn. The Central Valley watershed provides most of the water for Northern and Central California, as well as a significant chunk of Southern California's usage.

A proposed project by the Project Authority aims to divert water from the Sacramento River, upstream of the Delta, for storage in a new reservoir located 14 miles away. Existing canals would be used to transport the water. Construction is tentatively scheduled to begin in mid-2024, with operations targeted to start by 2030. The estimated cost of $3.9 billion would be funded through a combination of local, state, and federal public money. Significantly, the project has already secured funding from California's Proposition 1 water bond ($816 million) and the U.S. Department of Agriculture ($449 million). The U.S. Bureau of Reclamation is also a key partner.

The new reservoir would be incorporated into the existing California State Water Project (SWP). While economic benefits are estimated around $260 million annually, operation costs are projected to be between $10 million and $20 million. Based on a "beneficiary pays" principle, approximately 30 public water agencies, irrigation districts, counties, and cities in California have expressed tentative financial commitment to the project.

The North Coast watershed receives the highest annual precipitation of any California watershed. It incorporates many large river systems such as the Klamath, Smith, Trinity, and Eel, and produces over a third of the runoff in the state. With the notable exceptions of the Trinity Dam complex that transfers water from the Trinity River into the Sacramento River and Scott Dam that transfers water from the Eel River into the Russian River, most of the North Coast watersheds are relatively undeveloped, some have federal Wild and Scenic status that protect them from development; the northern coastal rivers provide water for salmonid habitat, carbon-sequestering forests, and local communities; some are within the influence of tribal water and fishing rights. Water flowing in these watersheds and into the Pacific Ocean is critical for sensitive, threatened, and endangered salmonids. There have been proposals to create additional inter-basin transfers from North Coast rivers to increase water supplies in the rest of California, but these projects have been rejected due to presumed environmental harm. The Colorado River originates more than 1,000 miles (1,600 km) from California in the Rocky Mountains of Colorado and Wyoming and forms the state's southeastern border in the Mojave Desert. Unlike the other California watersheds, essentially all the water flowing in the Colorado River originates outside the state. The Colorado River is a critical source of irrigation and urban water for southern California, providing between 55 and 65 percent of the total supply.

The Central and South Coast watersheds include the most populous regions of California – the San Francisco Bay Area, Los Angeles, and San Diego – but have relatively little natural runoff, requiring the importation of water from other parts of the state.

Rivers of the Lahontan watersheds in eastern California are part of the high desert Great Basin and do not drain to the Pacific. Most of the water is used locally in eastern California and western Nevada for irrigation. The Owens River of the South Lahontan region, however, is a principal source of water for Los Angeles.

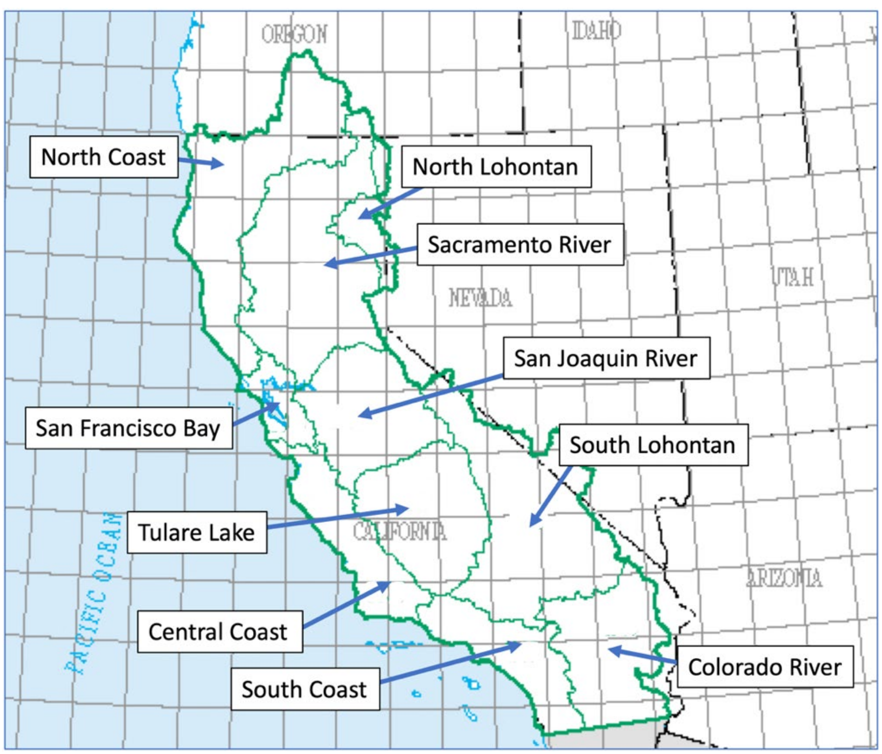


Figure 5.3: California's Main Watersheds. [47]

[47] Graphic by Jeremy Patrich

Table 5.1: 10 Main California Watersheds

Hydrologic Region	Annual Precipitation	Annual Runoff
North Coast	55,900,000 acre-feet (69.0 km^3)	28,900,000 acre-feet (35.6 km^3)
Sacramento River	52,400,000 acre-feet (64.6 km^3)	22,400,000 acre-feet (27.6 km^3)
North Lahontan	6,000,000 acre-feet (7.4 km^3)	1,900,000 acre-feet (2.3 km^3)
San Francisco Bay	5,500,000 acre-feet (6.8 km^3)	1,200,000 acre-feet (1.5 km^3)
San Joaquin River	21,800,000 acre-feet (26.9 km^3)	7,900,000 acre-feet (9.7 km^3)
Central Coast	12,300,000 acre-feet (15.2 km^3)	2,500,000 acre-feet (3.1 km^3)
Tulare Lake	13,900,000 acre-feet (17.1 km^3)	3,300,000 acre-feet (4.1 km^3)
South Lahontan	9,300,000 acre-feet (11.5 km^3)	1,300,000 acre-feet (1.6 km^3)
South Coast	10,800,000 acre-feet (13.3 km^3)	1,200,000 acre-feet (1.5 km^3)
Colorado River	4,300,000 acre-feet (5.3 km^3)	200,000 acre-feet (0.25 km^3)

Figure 5.4: California's Main Watersheds & Annual Precipitation/Runoff Rates. [48]

Rain & Snowfall

Rain typically falls in California mostly during the winter and spring months, from October through May, with more rain falling on the northern half of the state than the southern. Approximately 75 percent of the total precipitation volume occurs north of Sacramento, while 75 percent of the total water demand is in the south. With very rare exceptions, summers are dry throughout the state. Precipitation falling as snow in the Sierra and other mountain ranges feeds the network of reservoirs and surface water sources that supply the state; a low rainfall or light snowfall year can result in drought.

[48] Graphic by Jeremy Patrich

Rivers in northern and coastal California are mainly rain fed, peaking from January to April and falling to very low levels between June and November. Snowmelt has a significant influence on the Sierra Nevada rivers from east of Sacramento to east of Bakersfield, which typically peak between April and July. Snowmelt is also the primary water source for the Colorado River which supplies southern California.

Annual precipitation in California is highly variable, with a statewide average of 22.9 inches (58.2 cm) of precipitation per year. However, recorded precipitation totals can fluctuate heavily from year to year because of atmospheric conditions and climate change. El Niño–Southern Oscillation often has a significant effect on the state's precipitation, with generally higher precipitation during El Niño periods. In addition, climate change has impacted California's precipitation patterns in recent years with effects including more rapid snowmelt, more frequent heatwaves, and drier conditions across the state. California precipitation and snowpack are measured by the state of California by "water year", which runs from October 1 to September 30.

From late 2022 through spring 2024, California experienced a relentless barrage of atmospheric rivers. These concentrated bands of moisture in the atmosphere unleashed record-breaking rainfall, causing widespread problems. Excessive rain overwhelmed rivers and streams, triggering extensive flooding in the Central Valley, Salinas Valley, and the Santa Cruz Mountains.

Desalinization

In response to water shortages in the state, some water districts are looking to desalination to provide water for residents. Supporters view seawater desalination as a more reliable water source, since it draws its water from the ocean and thus, is not affected by periods of drought like other sources of water are. Another incentive for desalination is the ability for localities to be more self-sufficient with their water supply, thus improving their drought resilience. However, desalination has been the subject of scrutiny by opponents, who believe that the costs and possible environmental effects of desalination are indicators that California should continue to pursue other alternatives.

Below is a photo of the desalination plants on Catalina Island, which produce 40% of the island’s drinking water.

Figure 5.5: Catalina Islands Desalinization Plant. Image Source:[49]

Although the response to desalination has been mixed, some areas of California are moving forward with seawater desalination. As an example, in December 2015, Poseidon Water completed the construction of the Claude "Bud" Lewis Carlsbad Desalination Plant, in Carlsbad California. This facility, which was approved by the San Diego Water Authority, is responsible for providing water for about 8% of San Diego County's water by the year 2020. The facility cost $1 billion to build and is the largest desalination facility in the Western Hemisphere producing up to 50 million gallons (190,000 m3) of water per day. This plans also uses approximately 35 megawatts (MW) to produce 50 million gallons of water per day. This translates to roughly 246,156 megawatt hours (MWh) of electricity used per year. As of December 2015, there are 6 additional seawater desalination plants currently in operation in the state of California. As of 2022, there are 12 active desalination plants.

CALIFORNIA WATER WARS

The California Water Wars were a series of political conflicts between the city of Los Angeles and farmers and ranchers in the Owens Valley of Eastern California over water rights.

As Los Angeles expanded during the late 19th century, it began outgrowing its water supply. Between 1909 and 1928, Los Angeles grew from 61 square miles to over 440 square miles, and the population nearly tripled from 300,000 to over 1.2 million. Fred Eaton, the mayor of Los Angeles and William Mulholland, the Los Angeles Water Department Supervisor, encouraged a plan to redirect water from Owens Valley to Los Angeles via an aqueduct. Before construction

[49] Photo by Jeremy Patrich is licensed under CC BY 4.0

could begin, the ownership of the water rights needed to be secured, which was the beginning of these conflicts over water.

Owens Valley Before the Water Wars

The Owens Valley is an arid valley along the Eastern Sierra that is located to the east of the Sierra Nevada, west of the White Mountains and Inyo Mountains, and north of the Mojave Desert. The mountain peaks on the West side (including Mount Whitney) reach above 14,000 feet (4,300 m) in elevation, while the floor of the Owens Valley is about 4,000 feet (1,200 m), making the valley the deepest in the United States, thus being greatly influenced by the rain shadow effect.

Found at the southern tip of the valley is Owens Lake, a desiccating Salt Lake that has been both naturally and anthropogenically drying up since the 1900s. During the Late Pleistocene, the lake was at its maximum covering 200 square miles in size (520 km2) and reaching a depth of 200 feet (61 m).

Between 1838 and 1902, the average rainfall near Owens Lake was less than 3” per year. As of 2023 it is just less than 6” per year.

Documentation published in 1906, seven years before the Los Angeles Aqueduct opened, stated, ‘during the last 10 years the surface of the lake lowered 16’, and in 1904 it lowered 2.5 feet alone’.

Record of precipitation at Keeler, Inyo County, Cal. [a]

[Lat., 36° 35′; long., 117° 50′; elevation, 3,622 feet. Authority, Southern Pacific Railroad.]

Year.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Total.
1883-84	......	......	......	......	......	......	......	0.20	1.60	0.80	0	0.20	[b] 2.80
1884-85	0	0	0	0.70	0	0	0.12	.82	0	.08	0	.11	1.83
1885-86	0	0.25	0.65	.36	0.49	0.14	.60	.40	0	0	.14	.08	3.11
1886-87	0	.01	.08	0	T.	.93	0	1.14	.04	T.	.52	0	2.72
1887-88	1.08	.84	.01	.48	.70	1.21	.30	.12	.30	.20	.17	.10	5.51
1888-89	.06	0	1.68	.82	.04	T.	.52	.12	.06	.01	0	T.	3.31
1889-90	.08	.56	.05	.56	.42	.01	T.	.10	.20	0	T.	1.71	3.69
1890-91	.93	.03	.12	.22	0	1	2.01	0	.37	.30	.06	.02	5.06
1891-92	.19	.04	0	.31	.26	.19	.32	0	.56	T.	0	0	1.87
1892-93	T.	.81	.11	.54	.71	.75	1.50	0	T.	0	1.41	T.	5.83
1893-94	T.	T.	.03	1.48	T.	.29	.01	T.	T.	T.	.11	0	1.92
1894-95	0	0	0	1.05	.35	1.15	T.	.25	T.	T.	T.	T.	2.80
1895-96	T.	0	0	T.	.45	0	T.	T.	.15	T.	.25	1.42	2.27
1896-97	.50	T.	0	.25	.10	.27	.13	0	T.	0	0	.19	1.44
1897-98	.14	.15	T.	T.	0	0	0	.05	0	0	0	0	.34
1898-99	T.	0	T.	.30	.40	.45	0	.01	T.	.50	T.	T.	1.66
1899-1900	0	T.	1.75	T.	T.	0	.16	1.25	.23	T.	.10	T.	3.49
1900-1901	.35	.09	.45	0	.75	.25	0	T.	.40	0	0	.90	3.19
1901-2	0	.50	0	0	T.	.25	1.25	0	0	0	T.	T.	2
18-year mean.	......	......	......	......	......	......	......	......	......	......	......	......	2.89

Figure 5.6: A Table of Annual Precipitation Rates I Owens Valley- 1883-1902. Image Source: DWP.[50]

Due to the limited rain the valley, populated by Paiute natives in the early 1800s, used irrigation channels to grow crops. The valley's soil conditions are inferior to those on the west side of the Sierra Nevada range, and runoff from the surrounding mountains is absorbed into the arid desert ground. After the United States gained control of California in 1848, the first public land survey conducted by A.W. von Schmidt from 1855 to 1856 was an initial step in securing government control of the valley. Von Schmidt reported that the valley's soil was not good for agriculture except for the land near streams.

In 1861, Samuel Bishop and other ranchers started to raise cattle on the luxuriant grasses that grew in the Owens Valley. The ranchers came into conflict with the Paiutes over land and water use, and most of the Paiutes were driven away from the valley by the U.S. Army in 1863 during the Owens Valley Indian War.

Many settlers came to the area for the promise of riches from mining. The availability of water from the Owens River made farming and raising livestock attractive. The Homestead Act of 1862 gave pioneers five years to claim and take title of their land for a small filing fee and a charge of $1.25 per acre. The Homestead Act limited the land an individual could own to 160 acres to create small farms.

[50] Image by Los Angeles Department of Water and Power is in the public domain.

The amount of public land settled by the late 1870s and early 1880s was still relatively small; however, the Desert Land Act of 1877 allowed individuals to acquire more area, up to 640 acres (259.0 ha), in hopes of drawing more settlers by giving them enough land to make their settlement and land expenses worthwhile, but "included no residency requirements". By 1886, rapid acquisition of land had begun and by the mid-1890s, most of the land in the Owens Valley had been claimed.

Figure 5.7: Map of the Owens River & Lake Watershed.[51]

Before the Los Angeles Aqueduct, most of the 200 miles (320 km) of canals and ditches that constituted the irrigation system in the Owens Valley were in the northern valley, while the southern region of the valley was mostly inhabited by people raising livestock. The irrigation systems were necessary as the amount of precipitation was not enough to sustain any form of agriculture unless it was alongside the tributaries of the Owens River.

Repurposing the canals and irrigation channels that the Paiute had originally created, as well as the addition by ditch companies, did not have adequate drainage and as a result oversaturated the soil to the point where crops could not be raised. The irrigation systems also limited the

[51] Image by Wikimedia is licensed under a CC-BY-SA 4.0 license.

amount of water draining to the terminal Owens Lake. At the start of the 20th century, the northern part of the Owens Valley turned to growing strawberries, cantaloupes, grapes, 33,000 fruit bearing trees, over 40,000 grape vines, apple trees and grazing pastures

The Los Angeles Aqueduct

Frederick Eaton and William Mulholland were two of the more visible principals in the California water wars. They were friends, having worked together in the private Los Angeles Water Company in the 1880s. In 1886, Eaton became City Engineer and Mulholland became superintendent of the Water Company. In 1898, Eaton was elected mayor of Los Angeles and was instrumental in converting the Water Company to city control in 1902. When the company became the Los Angeles Water Department, Mulholland continued to be superintendent, due to his extensive knowledge of the water system.

Eaton and Mulholland had a vision of a Los Angeles that would become far larger than the Los Angeles of the start of the 20th century. The limiting factor of Los Angeles's growth was the water supply. "If you don't get the water, you won't need it," Mulholland famously remarked. Eaton and Mulholland realized that the Owens Valley had a large amount of runoff from the Sierra Nevada, and a gravity-fed aqueduct could deliver the Owens water to Los Angeles.

Obtaining Water Rights | 1902–1907

At the start of the 20th century, the United States Bureau of Reclamation, at the time known as the United States Reclamation Service, was planning on building an irrigation system to help the farmers of the Owens Valley, which would block Los Angeles from diverting the water.

From 1902 to 1905, Eaton used underhanded methods to obtain water rights and block the Bureau of Reclamation. The regional engineer of the Bureau, Joseph Lippincott, was a close associate of Eaton; Eaton was a nominal agent for the Bureau through Lippincott, so Eaton had access to inside information about water rights and could recommend actions to the Bureau that would be beneficial to Los Angeles. In return, while Lippincott was employed by the Bureau, he also served as a paid private consultant to Eaton, advising Los Angeles on how to best obtain water rights. In addition to, President Theodore Roosevelt determined the East flanks of the Sierra to be the National Forest, so that land could not be purchased for land rights.

To help acquire water rights in 1905, Eaton made high offers to purchase land in Owens Valley. Eaton's eagerness aroused suspicion in a few local Inyo County people. Eaton bought land as a private citizen, hoping to sell it back to Los Angeles at a tidy profit. Eaton claimed in an interview with the Los Angeles Express in 1905 that he turned over all his water rights to the City of Los Angeles without being paid for them, "except that I retained the cattle which I had been compelled to take in making the deals ... and mountain pastureland of no value except for grazing purposes". Eaton moved to the Owens Valley to become a cattle rancher on the land he purchased. Eaton always denied that he acted in a deceptive manner.

By 1907, Eaton was busy acquiring key water rights and traveling to Washington to meet with advisers of Theodore Roosevelt to convince them that the water of the Owens River would do more good flowing through faucets in Los Angeles than it would if used on Owens Valley fields and orchards.

The dispute over the Owens River water became a political dispute in Washington. Los Angeles needed rights of way across federal land to build the aqueduct. California Senator Frank Flint sponsored a bill to grant the rights of way, but Congressman Sylvester Smith of Inyo County opposed the bill. Smith argued that irrigating Southern California was not more valuable than irrigating Owens Valley. While a compromise was being negotiated, Flint appealed to President Roosevelt. Roosevelt met with Flint, Secretary of the Interior Ethan A. Hitchcock, Bureau of Forests Commissioner Gifford Pinchot, and Director of the Geological Survey Charles D. Walcott. In this meeting, Roosevelt decided in favor of Los Angeles.

The aqueduct was sold to the citizens of Los Angeles as vital to the growth of the city. Unknown to the public, the initial water would be used to irrigate the San Fernando Valley to the north, which was not at the time a part of the city. From a hydrological point of view, the San Fernando Valley was ideal: its aquifer could serve as free water storage without evaporation. One obstacle to the irrigation was the Los Angeles City Charter, which prohibited the sale, lease, or other use of the city's water without a two-thirds approval by the voters. This charter limitation would be avoided through the annexation of a large portion of the San Fernando Valley to the city. The annexation would also raise the debt limit of Los Angeles, which allowed the financing of the aqueduct.

The San Fernando land syndicate were a group of wealthy investors who bought up large tracts of land in the San Fernando Valley with secret inside information from Eaton. The syndicate included friends of Eaton, such as Harrison Gray Otis and Henry E. Huntington. This syndicate made substantial efforts to support passage of the bond issue that funded the aqueduct. These efforts are reported to have included the dumping of water from Los Angeles reservoirs into the sewers (thereby creating a false drought) and by publishing scare articles in the Los Angeles Times, which Otis published. Remi Nadeau, a historian, and author disputed that water was dumped from reservoirs, because the sewer system may not have been connected to the reservoirs. The syndicate did unify the business community behind the aqueduct, and its purchases were public by the time the vote on the aqueduct was taken.

Construction of the Aqueduct | 1908–1928

From 1907 through 1913, Mulholland directed the building of the aqueduct. The 233-mile (375 km) Los Angeles Aqueduct, inaugurated in November 1913, required more than 2,000 workers and the digging of 164 tunnels. Mulholland's granddaughter has stated that the complexity of the project was comparable to the building of the Panama Canal. Water from the Owens River reached a reservoir in the San Fernando Valley on November 5, 1913. At a ceremony that day, nearly 30,000 Angelinos showed up for this event, in fact, the Southern Pacific Rail offered round trip tickets to the event from Downtowns for $1. At this event, Mulholland spoke his famous words about this engineering feat: "There it is… Mr. Mayor, Take it."

Figure 5.8: William Mulholland Addressing the Crowd at the Opening of the Aqueduct.[52]

After the aqueduct was completed in 1913, the San Fernando investors demanded so much water from the Owens Valley that it started to transform from "The Switzerland of California" into a desert. Mulholland was blocked from obtaining additional water from the Colorado River, so he decided to take all available water from the Owens Valley.

[52] Image by Los Angeles Department of Water and Power is in the public domain.

Out of the Collection: Los Angeles Aqueduct Souvenir Bottle

Want to learn more about the Los Angeles Aqueduct? Either scan the QR code or visit this link to see Professor Patrich share a rare piece of California history, an original souvenir bottle from the opening of the aqueduct. (Video length: 4min).

In 1923, farmers and ranchers formed an irrigation cooperative headed by Wilfred and Mark Watterson, owners of the Inyo County Bank. By exploiting the personal bitterness of some of the farmers, Los Angeles managed to acquire some of the key water rights of the cooperative. After these water rights were secured, inflows to Owens Lake were heavily diverted, which caused the lake to dry up by 1924.

By 1924, farmers and ranchers rebelled. A series of provocations by Mulholland were, in turn, followed by corresponding threats from local farmers, and the destruction of Los Angeles property. Finally, a group of armed ranchers seized the Alabama Gates and dynamited part of the system, letting water return to the Owens River.

Dynamite found during sabotage incidents of Owens Valley Aqueduct, circa 1924

In August 1927, when the conflict was at its height, the Inyo County bank collapsed, which massively undermined valley resistance. An audit revealed that there were shortages in both cash in the vault and amounts shown on the books. The Watterson brothers were indicted for embezzlement, then tried and convicted on thirty-six counts. Since all local business had been transacted through their bank, the closure left merchants and customers with little more than the small amount of money they had on hand. The brothers claimed that the fraud was done for the good of the Owens Valley against Los Angeles, and this excuse was generally believed to be true in Inyo County. The collapse of the bank wiped out the lifetime savings of many people, including payments gained from the sale of homes and ranches to Los Angeles.

In the face of the collapse of resistance and of the Owens Valley economy, the attacks on the aqueduct ceased. The City of Los Angeles sponsored a series of repair and maintenance programs for aqueduct facilities that stimulated some local employment, and the Los Angeles water employees were paid a month in advance to bring some relief. But it was impossible to prevent many businesses from closing their doors due to the collapse of the bank.

The City of Los Angeles continued to purchase private land holdings and their water rights to meet the increasing demands. By 1928, Los Angeles owned 90 percent of the water in Owens Valley.

Case Study | The St. Francis Dam Failure

With the early success of the Los Angeles Aqueduct, Los Angeles experiencing a population boom. This influx of residents put immense strain on the city's existing water infrastructure. William Mulholland, the city's Chief Engineer, spearheaded the search for new water sources. He identified the San Francisquito Canyon as a potential location for a dam to capture water from the Los Angeles River tributaries.

Construction of the St. Francis Dam began in 1924 under the sole supervision of Mulholland and the Los Angeles Bureau of Waterworks & Supply. From the outset, the project was marred by critical flaws. Geologists warned of the site's instability – the underlying rock formations were a mix of weak sedimentary and fractured metamorphic rock, unsuitable for such a massive structure. However, Mulholland was advised to dismiss these concerns, to prioritizing speed, and cost-effectiveness over sound engineering practices.

The construction process itself was riddled with problems. To save time and money, substandard materials were used. In addition to, the Los Angeles Bureau of Waterworks and Supply ignored the recommendations of Mulholland to increase the volume of the water—without making additional adaptations to the dam’s structure. Cracks began appearing in the dam's structure as early as 1926, raising red flags about potential weaknesses. These concerns were also downplayed by Mulholland, who attributed the cracks to the "settling" of the concrete.

On the cold night of March 12, 1928, disaster struck. Just before midnight, the St. Francis Dam catastrophically failed. The 200-foot-tall structure crumbled, unleashing a torrent of water estimated at 12 billion gallons. This wall of water surged down the canyon at speeds exceeding 60 miles per hour (pushing a 6ft wall of water from the Dam site, along the Santa Clara River towards the Pacific Ocean in Ventura).

Figure 5.9: The Aftermath of the St. Francis Dam Collapse, 1928.[53]

The consequences of the dam failure were horrific. The floodwaters roared through the valley, wiping out towns, farms, and infrastructure in its path. Over 55 miles of land were inundated, leaving a trail of destruction. Lives were tragically lost – estimates suggest over 431 people perished in the flood, many swept away in their sleep.

In the aftermath of the disaster, a state commission was established to investigate the St. Francis Dam failure. The commission concluded that the collapse was a direct result of a combination of factors: an unsuitable geological site, flawed design, poor construction practices, and a disregard for warnings and safety concerns.

The St. Francis Dam disaster remains a stark reminder of the importance of responsible engineering. The tragedy led to significant changes in dam safety regulations in California and across the United States. Today, rigorous geological surveys, robust engineering assessments, and stringent construction protocols are essential prerequisites for dam construction.

---

[53] Image by Los Angeles Department of Water and Power is in the public domain.

Figure 6.1: Example of California Floriculture, in Fillmore.[54]

UNIT 6: CALIFORNIA'S AGRICULTURE

Goals & Objectives of this unit

- Identify regions of California agriculture, livestock, and floriculture.
- Recognize California's importance in supporting the world with fresh produce.
- Identify Several specific primary crops that are produced in California.
- Understand the environmental and social effects of drought in California.

INTRODUCTION

Agriculture is a significant sector in California's economy, producing nearly $55 billion in revenue in 2023. There are more than 400 commodity crops grown across California, including a significant portion of all fruits, vegetables, and nuts for the United States. In 2017, there were 77,100 unique farms and ranches in the state, operating across 25.3 million acres (102,000 square kilometers) of land. The average farm size was 328 acres, significantly less than the average farm size in the U.S. of 444 acres.

[54] Image by Jeremy Patrich is used under a CC BY 4.0 license.

Because of its scale, and the naturally arid climate, the agricultural sector uses about 40% of California's water consumption. Along with the positives, the agricultural sector is also connected to negative environmental and the health impacts, including being one of the principal sources of water pollution.

CALIFORNIA'S AGRICULTUAL PAST

In recent years, California has accounted for over one-tenth of the value of the entire U.S. agricultural output. Perhaps more impressive than the value of farm output is the great diversity of crops, the capital intensity, the high yields, and the special nature of the state's agricultural institutions. California's agriculture evolved differently from what was found in the home states and countries of the immigrants who settled and farmed its soils. These differences were not just an outcome of the state's distinct geoclimatic features; they were molded by the farmers, laborers, researchers, railroad barons, and policy- makers who interacted to create one of the most productive and dynamic agricultural-industrial complexes in the world.

Lecture Time: California's Agriculture

Want to learn more? Either scan the QR code or visit this link to watch a lecture that introduces the history and future of California's agriculture. (Video length: 27min).

The Beginning - 1850

There's been a long-standing debate about whether pre-contact California societies practiced agriculture. Europeans typically defined agriculture by plowing fields, planting crops in rows, and raising domesticated animals. While California's Indigenous peoples didn't follow this model, relying more on hunting and gathering, the argument is that their practices still constituted a form of agriculture.

This perspective hinges on the idea that Indigenous Californians actively managed the ecosystem to maximize resource output. They used fire management techniques to manipulate the land and focused on cultivating specific native plants. In this sense, their approach can be seen as a form of resource management, even if it differed vastly from the European model of intensive agriculture.

Some California hunter-gatherer tribes, including the Owens Valley Paiute, developed irrigation. Native Californians were skilled at gathering resources from plants at all times of the year, allowing the consistent plethora of materials in all seasons. Depending on when the succulents, flowers, and trees bloomed or became ripe, different aspects of the plant could be accessed or harvested by Native California peoples.

Native Californians also developed strategies when it came to competing with animals for resources. The Kashaya Pomo, for example, timed their harvest of dogwood to be before insects and worms would be able to access the inner parts of the plant. Indigenous Californians also developed strategies for acquiring black oak acorns directly from tree branches using a long pole, increasing harvest yields that would otherwise have been disturbed by animals.

Black oak acorn harvests were further increased by cultural burning, which stimulated acorn growth and increased biodiversity in the area. Cultural burning was commonly practiced by throughout California to maintain a healthy landscape that produced quality resources. The Karuk, Yurok, Hupa peoples all regularly burned areas of bear grass and California hazelnut and to encourage the growth of stronger stems that could be used for basketry.

In the late 1700s, Franciscan missionaries established Spanish missions in California. Like earlier Spanish missions established in Baja California, these missions were surrounded by agricultural land, growing crops from Europe and the Americas, and raising animals originating from Europe. Indigenous workers from Baja California made up a large part of the initial labor force on California missions. In the early 1800s, this flow of laborers from Baja California had largely stopped, and the missions relied on converts from local tribes. By 1806, over 20,000 Mission Indians were "attached" to the California missions. As missions were expected to become largely self-sufficient, farming was a critically important Mission industry. George Vancouver visited Mission San Buenaventura in 1793 and noted the wide variety of crops grown: apples, pears, plums, figs, oranges, grapes, peaches, pomegranates, plantain, banana, coconut, sugar cane, indigo, various herbs, and prickly pear. Livestock was raised for meat, wool, leather, and tallow, and for cultivating the land. In 1832, at the height of their prosperity, the missions collectively owned over 150,000 cattle and over 120,000 sheep. They also raised horses, goats, and pigs.

While the Spanish were the most successful farmers active in California in the early 1800s, they were not the only ones. In 1812, the Russians established Fort Ross in what is now Sonoma County, California, and intended the fort in part as an agricultural supply point for other Russian activity on the west coast, such as collecting otter pelts. Despite Russian plans for the colony, agriculture at Fort Ross had low yields, significantly lower than the California missions.

Inefficient farming methods, labor shortages, coastal fog, and rodents all contributed to limit agriculture at the fort.

The Spanish (1784–1810) and Mexican (1819–1846) governments gifted many land grants to private individuals from 1785 to 1846. These ranchos included land taken from the missions following government-imposed secularization in 1833, after which the missions' productivity declined significantly. The ranchos were focused on cattle, and hides and tallow were their main products. There was no market for large quantities of beef (before refrigeration and railroads) until the California Gold Rush.

1850–1900

In 1848, before the Gold Rush, the population of CA was approximately 15,000, not counting Native Americans. By 1852, there were over 250,000 people in the state, and by 1870, 560,000 people. This rapid population growth drove an increase in importation of agricultural products, and, within a few years, a massive growth in in-state agriculture. These early settlers found an ideal environment for raising wheat: great expanses of fertile soil and flat terrain combined with rainy winters and hot, dry summers. By the mid-1850s, the state's wheat output exceeded local consumption, and California's grain operations began to evolve quite differently from the family farms of the American North. The image is vast tracts of grain grown on huge bonanza ranches in a countryside virtually uninhabited except at harvest and plowing times. California grain farms were very large for the day and used labor-saving and scale-intensive technologies, pioneering the adoption of labor-saving gang plows, large headers, and combines. Californians vigorously pursued the development of technologies and production practices suited to early California's economic and environmental conditions. This search for large-scale, labor-saving technologies culminated in the perfection of the world's first commercially successful combined grain harvesters by the Holt Manufacturing Company and other local manufacturers in the early 1880s. Combines became common in the California grain fields by 1890), when California was the second largest wheat-producing state, following only Minnesota.

Some bonanza farms planted thousands of acres and were far larger than Midwestern operations. They would establish many precedents. Most of the wheat and barley was shipped to European markets, setting a pattern of integration into world markets that has characterized California agriculture to the present. Their size, the extent of mechanization, and a reliance on hired labor would also become hallmarks of the state's farm sector.

In the first years of the gold rush, the state relied on agricultural imports arriving by ship, from Australia, Chile, and Hawaii. During these years, there was rapid growth in vegetable farming for local markets. This was followed by an expansion of grain farming. A shift in the economic dominance of grain farming over cattle raising was marked by the passage of the California "No-Fence Law" of 1874. This repealed the Trespass Act of 1850, which had required farmers to protect their planted fields from free-ranging cattle. The repeal of the Trespass Act required that ranchers fence livestock in, rather than farmers fencing cattle out. The ranchers were faced with either the high expense of fencing large grazing tracts or selling their cattle at ruinous prices. By the 1890s, California was second in US wheat production, producing over one million tons of wheat per year, but monocrop wheat farming had depleted the soil in some areas resulting in reduced crops.

Irrigation was almost nonexistent in California in 1850, but by 1899, 12 percent of the state's improved farmland was irrigated.

1900–1950

The 1902 Newlands Reclamation Act funded irrigation projects on arid lands in 20 states including California.

In 1905, the California legislature passed the University Farm Bill, which called for the establishment of a farm school for the University of California (at the time, Berkeley was the sole campus of the university). The commission took a year to select a site for the campus, a tiny town then known as Davisville. UC Davis opened its doors as the "University Farm" to 40-students (all male) from UC Berkeley in January 1909.

In 1919, the California Department of Food and Agriculture was established. The department covers state food safety, state protection from invasive species, and promoting the state's agricultural industry.

In 1933, the state saw several agricultural labor strikes, with the largest actions against cotton growers. Cherry, grape, peach, pear, sugar beet, and tomato workers were also involved.

The Dust Bowl of the 1930s drove many people from the American prairie, and a significant number of these economic migrants relocated to California. Poor migrants from Oklahoma and nearby states were sometimes referred to as Okies, generally a pejorative term. Another turning point in California's agriculture came during World War I when high prices of cotton, coupled with government research and promotional campaigns, encouraged farmers in the Imperial, Coachella, and San Joaquin Valleys to adopt cotton as a primary crop. The tremendous absolute increase in California's cotton acreage from the 1920s to 1980 contrasts with the absolute decline nationally. California's acreage in cotton ranked 14th out of 15 cotton-producing states in 1919; by 1959 it ranked only behind Texas.

In 1942, the United States began the Bracero program. Lasting until 1964, this agreement established decent living conditions and a minimum wage for Mexican workers in the United States.

Also in 1942, the Incarcerated Japanese Americans in California during World War II played a crucial role in growing food for the internment camps. Forced to abandon their farms upon being placed in camps, many internees possessed valuable agricultural skills. The camps, aiming for some level of self-sufficiency, turned to farming to provide food for the internees themselves. Despite the challenging conditions and limited resources, the internees adapted by cultivating vegetables suited to the local climate. Their success in producing a significant portion of the camps' vegetables, with some even having surpluses sent elsewhere, highlights both the resilience of Japanese Americans and the disruption they faced during this period (Figure 6.2)

Figure 6.2: Young Japanese Internee Driving Farm Equipment in Stockton, California- Circa 1942.[55]

1950–2000

In 1965, the Williamson Act became law, providing property tax relief to owners of California farmland and open-space land in exchange for agreement that the land will not be developed.

[55] Image by Jeremy Patrich is used under a CC BY 4.0 license.

The 1960s and 1970s saw major farm worker strikes including the 1965 Delano grape strike and the 1970 Salad Bowl strike. In 1975, the California Agricultural Labor Relations Act of 1975 was enacted, establishing the right to collective bargaining for farmworkers in California, a first in U.S. history. Individuals with prominent roles in farm worker organizing in this period include Cesar Chavez, Dolores Huerta, Larry Itliong, and Philip Vera Cruz.

In the late 1980s the Ives flower ranch was the site of a notorious employment case. This ranch was in Ventura and involved Mixtec farm workers (from the Oaxaca state of southern Mexico) and illegal employment conditions. The ranch paid $1.5 million in unpaid wages and fines.

Through 1995 there were 50,000 Mixtec's every year in California agriculture. They were about 70% of the 10,000 agricultural laborers in San Diego County and had been spreading northwards to also work in Oxnard, Santa Maria, and Madera County, and even into Oregon and Washington. They were usually not the only indigenous Mexican ethnic groups – Zapotecs and Mayans were also usually working the same jobs. In the 1990s it was common to arrive in Arizona first, work on an Arizonan farm, and then move here.

Dairy and poultry operations represent exceptions to the general pattern of slow growth of livestock farming in the first decades of the twentieth century. These activities steadily expanded, primarily to serve the state's rapidly growing urban markets. In 1993, California replaced Wisconsin as the nation's number one milk producer

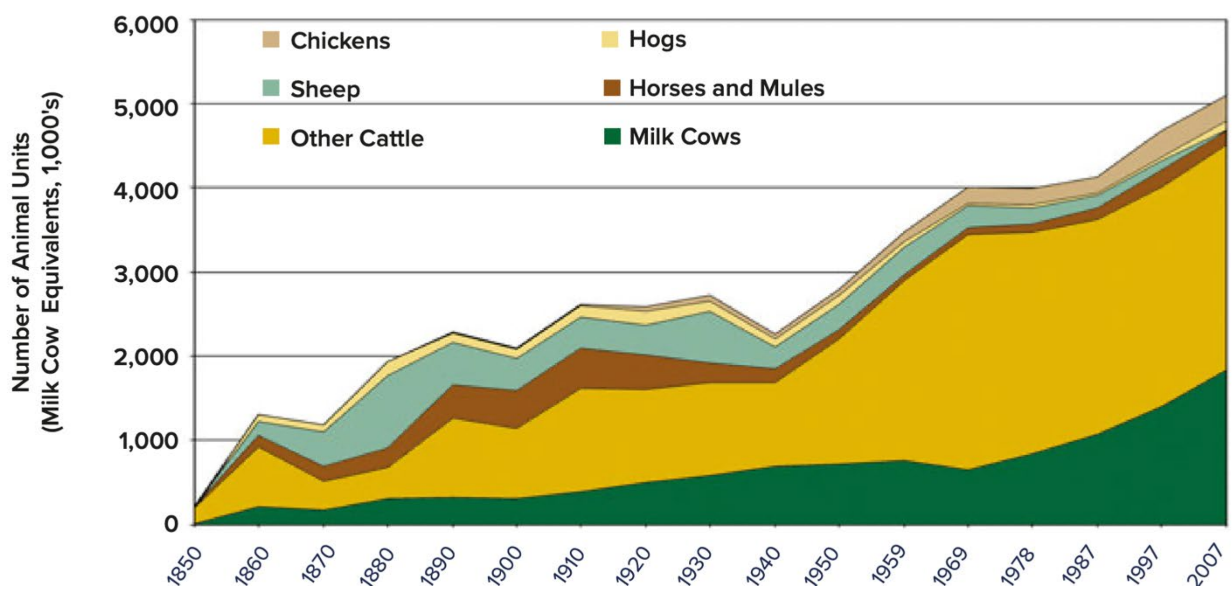


Figure 6.3: Livestock Inventories in California from 1850-2007. [56]

[56] Livestock Inventories Chart is licensed under

2001–Present

In the 2000s and 2010s, Californians voted for propositions which established new protections for farm animals. 2008 California Proposition 2 and 2018 California Proposition 12 both established minimum requirements for farming egg-laying hens, breeding pigs, and calves raised for veal. Few veal and pig factory farm operations exist in California, so these propositions mostly affect farmers who raise California's 15 million egg-laying hens.

CITRUS KING & SELLING THE CALIFORNIA DREAM

California has had a very rich and colorful citrus history, seen in counties all over the southern part of the state, (Orange, Riverside, Venture and even Los Angeles). With over 400 varieties of oranges grown, the Washington Seedless Navel (from Washington DC), and the Valencia variety are the true King and Queen of citrus.

Field Trip: In Search for California's Oldest Naval Orange Tree

Let's head on a field trip in search for the oldest naval orange tree in California! Either Scan the QR code or visit this link to learn the history of the Eliza Tibbets California Naval Orange in Riverside, California. (Video length: 5min).

Case Study | Orange County

Once upon a time in Orange County, money grew on trees. Citrus was the crop that made Orange County orange. Citrus - primarily Valencia oranges - once cascaded in green and gold down out of the mountains and along the rich coastal plain in neat, orderly rows, divided by windbreaks of eucalyptus trees. Sixty ago, much of central Orange County was a vast orchard, dotted with little towns like Santa Ana, Tustin, Anaheim, and, of course, Orange. The crop fueled the local economy for decades, creating an Easterner's image of paradise: a sunny, fertile land, where health grew on trees.

The first small seedling groves were planted here in the early 1870s, at a time when scores of new crops were being tried - most unsuccessfully. In 1875, the first commercial grove of hearty, spring-ripening Valencia oranges was planted by R. H. Gilman on what is now the Cal State Fullerton campus.

In those days, the biggest crop in the area was grapes, grown for wine or raisins. But in the 1880s, local vineyards were ravaged by a mysterious blight, clearing the way for thousands of new citrus plantings.

“Very naturally,” wrote Fullerton grower C. C. Chapman in 1911, “an occupation which is so attractive as citrus culture soon interested many enterprising men.” And among the enterprising men it interested was C. C. Chapman himself, who grew rich growing and packing his Old Mission brand oranges. But for every large operation like Chapman’s, there were dozens of other local ranchers with five-, 10- and 20-acre groves of their own. And the groves meant work for more than just the growers. There were fumigators, pickers, teamsters, packers, and sundry other tradesmen living on the wealth of the groves. For example, the Orange City Directory for 1919 shows perhaps one-third of the local workforce employed in some aspect of the citrus industry.

Figure 6.4: Early 1900’s Citrus Packing Label.[57]

Over the decades, the citrus industry employed many immigrant workers, both in the groves and in the packing houses. First (in the late 19th century) the Chinese, and later (especially after 1910) Mexican-Americans. But labor relations were not always cordial. In the big strike of 1936,

[57] Old Mission orange crate label courtesy Orange County Archives, licensed under CC BY 2.0

hundreds of citrus workers walked out at the height of the Valencia season. Tensions ran high over the next four weeks as worker meetings were broken up by armed men, and replacement workers were attacked by strikers. In the end, the workers received a slight increase and pay, and some improvements in working conditions, but their biggest goal – union recognition – went unfulfilled. When World War II pulled many Mexican-Americans into the service, or other war work, the Federal government launched the Bracero program, to bring temporary workers up from Mexico. Until the 1960s, they worked side by side with the local Hispanic population.

By 1915, there were over 20,000 acres of orange groves in Orange County. By 1936, when Orange County supplied one-sixth of the nation's Valencia crop, there were 64,000 acres, and the citrus industry was generating two-thirds of the county's agricultural income. As late as 1948 there were still 67,263 acres of Valencia's - more than five million trees. And that didn't even include other citrus crops, such as navel oranges, limes, grapefruit, and lemons.

Also, about the same time, the greater San Fernando Valley began seeing an influx of orange groves because of the development of reliable water access by the Los Angeles Aqueduct and the ideal climate for citrus fruits. Prior to this period, the valley was primarily used for livestock grazing. At its peak in the 1930s, there were over 15,000 acres of oranges in the valley, but post WWII when people were moving back into the valley, the groves would quickly be replaced by an urban landscape. In fact, by the 1970s, only 350 acres or orange groves remained, and as of 2024 only 40 acres remain, including the original 7-acre grove found at Cal State Northridge.

But in 1949, nearly 7,000 acres of oranges disappeared. The post-war migration to Southern California had begun in earnest, and each year more and more trees fell as housing tracts began to blanket Orange County. By 1985, there were less than 4,000 acres of Valencia's in the county, primarily on the Irvine Ranch. Twenty years later, less than 100 acres survived.

Today, the old packing houses are best known for their colorful and distinctive advertising labels that were pasted on the ends of each wooden crate of fruit until the introduction of the cardboard box in the mid-'50s. Many featured idyllic scenes or lovely maidens or promoted their place of origin. There were brands like Rooster, and Bird Rocks, and Cleopatra, and Atlas, and Jim Dandy, and any of a hundred others. Each was unique. They had to be, for their main purpose was to make each packing houses' fruit instantly recognizable to wholesale buyers at Eastern auction markets.

The real marketing, though, was carried on by the old Southern California Fruit Exchange, which after several name changes finally became Sunkist Growers in 1952. Over the years, Sunkist launched vast national marketing campaigns, which promoted Southern California almost as much as they touted its golden fruit.

The Villa Park Orchards Association was the last of Orange County's packing houses to go. Founded by local growers in 1912, they moved their operation to the old Santiago Orange Growers packing house in Orange in 1978, and operated there until 2006, when they moved to Ventura County.

THE CALIFORNIA HASS AVOCADO

The California Avocado is a native American plant with a long, distinguished history. Today, the most popular variety is the Hass. The mother tree of all Hass Avocados was born in a backyard in La Habra Heights, California

Avocado History

The avocado (*Persea Americana*) originated in south-central Mexico, sometime between 7,000 and 5,000 B.C. But it was several millennia before this wild variety was cultivated. Archaeologists in Peru have found domesticated avocado seeds buried with Incan mummies dating back to 750 B.C. and there is evidence that avocados were cultivated in Mexico as early as 500 B.C.

Spanish conquistadores loved the fruit but couldn't pronounce it and changed the Aztec word to a more manageable aguacate, which eventually became avocado in English. The first English-language mention of avocado was by Sir Henry Sloane in 1696.

California's Cash Crop

Fast forward to 1871, when Judge R.B. Ord of Santa Barbara successfully introduced avocados to the U.S. with trees from Mexico. By the early 1900s, growers were seeing the avocado's commercial potential and ever since, growers, enthusiasts and researchers have been hunting for improved varieties. A search through the industry's foremost annals, in particular the California Avocado Society Yearbook, reveals that many new selections of avocado were made in the industry's infancy and over subsequent years, but few had commercial significance. By the 1950s around 25 different varieties of avocados were being commercially packed and shipped in California, with 'Fuerte' accounting for more than two-thirds of the production. Even though 'Hass' was discovered in the late 1920s and patented by Rudolph Hass in 1935, it was not until large-scale industry expansion occurred in the late 1970s that 'Hass' replaced 'Fuerte' as the leading California variety.

Today, California is the leading producer of domestic avocados and home to about 90 percent of the nation's crop. Most California Avocados are harvested on approximately 50,000 acres from Monterey through San Diego by about 3,000 growers. Ventura and San Diego top the list of avocados producing counties in California.

California Avocados are grown year-round. A single California Avocado tree can produce up to 200 pounds of fresh fruit each year, approximately 500 pieces, although most average around 60 pounds or 150 pieces of fruit.

The Hass Avocado – A California Native

In 2002, the tree to which every Hass Avocado in the world can trace its lineage finally succumbed to root rot at the ripe old age of 76. Her offspring account for 95 percent of the avocados grown in California, and the fruit of her labor resulted in one of the state's most important industries. Yet, despite speculation to the contrary, nobody knows what variety of seed produced the original Hass Mother Tree.

The tree began life as lucky-find; a simple seed planted by A.R. Rideout of Whittier. Rideout, an innovator and pioneer in avocados, was always searching for new varieties and tended to plant whatever seeds he could find, often along streets or in neighbors' yards.

In the late 1920s, Mr. Rudolph Hass, a postman, purchased a seed from Rideout, and planted it in his new orchard. He planned to graft another variety on it, but when repeated grafts didn't take, he planned to cut the tree down. Fortunately for avocado lovers everywhere, Hass's children talked him out of it. They preferred the taste of the tree's fruit to that of the Fuerte, the predominant variety and industry standard in those days.

Since the quality was high and the tree gave a good yield, Hass named the variety after himself and took out a patent in 1935. That same year, he signed an agreement with Harold Brokaw, a Whittier nurseryman, to grow and promote the Hass Avocados. They would split the gross income: 25 percent for Hass and 75 percent for Brokaw.

Brokaw began to propagate the rough, black Hass exclusively and promote it in favor of the standard varieties of the day. It made sense. The Hass was a far better bearer than the Fuerte and it matured at a different time of year. Because of the seasonal advantage, Brokaw was successful to the point of yearly sellouts of his nursery crops.

The patent expired in 1952, the same year Rudolph Hass died. But by then, the bumpy black avocado that bore his name was rapidly gaining in popularity on the smooth green Fuerte. Consumers preferred its richer, nuttier taste, while grocers favored it for its durability and longer shelf life. Today, the Hass accounts for about 80 percent of all avocados eaten worldwide and generates more than $1 billion a year in revenues in the United States alone.

The tree that launched an avocado revolution lived out her days in suburban La Habra Heights. Harold Brokaw's nephew Hank nursed her through more than a decade, trying to save her from root fungus. Hank lost the fight in 2002, and the tree's wood is currently in storage in a Ventura nursery awaiting the decision on a fitting commemoration of the original Hass Mother Tree.

CALIFORNIAS OTHER FARMING PRODUCTS

California's agricultural abundance includes more than 400 commodities. Over a third of the country's vegetables and three-quarters of the country's fruits and nuts are grown in California. California's top 10 valued commodities for the 2023 crop/production year are:

- Dairy Products, Milk — $10.4 billion
- Grapes — $5.54 billion
- Cattle and Calves — $3.63 billion
- Almonds — $3.52 billion
- Lettuce — $3.15 billion
- Strawberries — $2.68 billion
- Pistachios — $1.86 billion
- Broilers (Chicken) — $1.59 billion
- Tomatoes — $1.46 billion
- Carrots — $1.11 billion

According to the California Department of Food and Agriculture, our state produces nearly half of US-grown fruits, nuts, and vegetables. Several crops enjoyed across the country are produced exclusively in California. To learn more about the crops that grown in California, check out https://learnaboutag.org/resources/fact/.

Floriculture

Nursery and floral production are an important component of California's overall agricultural output and annual farm income. California's nursery and flower crops returned average cash revenues of over $3.73 billion annually for the five crop years 2013 through 2017. Only three California crops exceeded this annual average for the 5-year period: dairy and milk, $7.18 billion; almonds, $6.08 billion; and, all grapes, $5.51 billion. Overall, the annual nursery and floral share of total agricultural sales ranged between 6.2 to 7.5 percent from 2013 to 2017, with a 5-year average of 6.9 percent. Nursery and flower production is located throughout California, with at least one farm operation reported in 56 of 58 counties. The industry has a definite urban orientation, with most production taking place in the most populated counties. The following table provides an overview of the wholesale value of California s floral and nursery products in 2001, 2008 and 2017 (Figure 6.5).

Floral Products	2001 Value	2008 Value	2017 Value
		($ Thousands)	
Cut Flowers and Cut Greens	383,102	505,036	413,709
Flower Seeds	5,831	7,932	4,682
Christmas Trees	10,686	6,547	4,954
Floral Products Total	399,618	519,515	423,345
Nursery Products			
Potted Plants and Flowering Foliage	615,772	677,820	624,911
Bulbs, Corm, Roots and Tubers	10,295	10,456	6,737
Flowering Propagative Materials	75,590	61,0112	53,517
Bedding Plants	465,045	438,602	418,810
Rose Plants	45,936	45,704	18,903
Woody, Deciduous and Evergreen Ornamentals	772,006	1,239,919	947,101
Herbaceous Perennials	30,069	46,135	25,270
Turf and Sod	42,750	124,708	36,298
Nursery Stock Other than Ornamentals	639,509	817,324	1,273,956
Nursery Products Total	2,696,974	3,461,678	3,405,503
Grand Total	3,096,592	3,981,193	3,828,848

Sources: California Department of Food and Agriculture *Value of Nursery Products*, Fiscal Year; CDFA Nursery Program, Nursery Advisory No.01-2002, Nursery Advisory No. 01-2009, January 16, 2009, and Nursery Advisory No. 01-2019, April 30, 2019

Figure 6.5: Wholesale Value of California Floral & Nursery Products, 2001, 2008 & 2017.

IRRIGATION

Just as there were major investments in mechanical technologies to increase the productivity of labor, there were also substantial investments to increase the productivity of California's land. These included agro-chemical research, biological learning concerning appropriate crops and cultural practices, and land clearing and preparation; but the most notable were investments in water control and provision. These took two related forms. The first consisted of measures primarily intended to drain and protect agricultural land from flooding. In this realm, Californians literally re- shaped their landscape as individual farms leveled the fields and constructed thousands of miles of ditches. In addition, individual farms, reclamation districts, and the Army Corps of Engineers built several thousand miles of major levees to tame the state's inland waterways. Without these investments, much of the Central Valley's land could not have been planted in intensive crops.

The second form consisted of a variety of measures to supply the state's farms with irrigation water. Expansion occurred in two main waves: the first lasting from 1900 through the 1920s and the second, linked to the Central Valley Project, during the decade after World War II. Much of the historical growth of irrigation was the result of small-scale private initiatives rather than large-scale public projects that have attracted so much scholarly attention. Up until the 1960s, individuals and partnerships were the leading forms of organization supplying irrigation water. These forms accounted for roughly one-third of irrigated acres between 1910 and 1930, and over one-half by 1950.

These small-scale irrigation efforts were closely associated with the rising use of groundwater in California over the first half of the twentieth century. Between 1902 and 1950, the acreage irrigated by groundwater sources increased more than thirty-fold, whereas that watered by surface sources only tripled. Groundwater, which had supplied less than 10 percent of irrigated acreage in 1902, accounted for over 50 percent of the acreage by 1950. This great expansion was reflected in the growing stock of pumping equipment in the state. Significant technological changes in pumping technology and declining power costs underscored this growth. During the 1910s and 1920s, the number of pumps, pumping plants, and pumped wells doubled each decade, rising from roughly 10,000 units in 1910 to just below 50,000 units in 1930. Pumping capacity increased two-and-one-half to three times per decade over this period. Expansion stalled during the Great Depression but resumed in the 1940s with the number of pumps, plants, and wells rising to roughly 75,000 units by 1950. Individuals and partnerships dominated pumping, accounting for about 95 percent of total units and approximately 80 percent of capacity over the 1920–50 period.

Irrigation Districts

Since the 1950s, there has been a shift away from individuals and partnerships, as well as from groundwater sources. By the 1970s, irrigation districts—public corporations run by local landowners and empowered to tax and issue bonds to purchase or construct, maintain, and operate irrigation works—had become the leading suppliers. The district organization rapidly rose in importance over two periods. In the first, lasting from 1910 to 1930, acreage supplied by irrigation districts increased from one-in-fifteen to approximately one-in-three. Much of this growth came at the expense of cooperative and commercial irrigation enterprises. Between 1930 and 1960, the district share changed little. During the 1960s, the district form experienced a second surge growth, which was due in part to the rising importance of large-scale federal and state projects, which distributed water through these organizations. By 1969, irrigation districts supplied more than 55 percent of all irrigated acreage.

As with so many other areas of California agriculture, success in managing water heavily depended on cooperative action, rather than just individual initiative. Water access has often been contentious, pitting farmers against urban interests and farmers against farmers. Everyone involved attempted to capture government to gain an advantage. Part of the problem is that historically, property rights in water were less well defend than in most private goods and assets, and rights based on location or historic conditions invariably led to inefficient patterns of use.

Adverse Consequences

Moreover, with few restraints on farmers' use of private pumps, individual farmers have predictably depleted aquifers, leading to deeper and more expensive wells and higher energy costs. In addition, decades of irrigation, along with the use of fertilizers and chemicals to control weeds and pests, have contaminated the soil with salts, selenium, and other chemicals. As one sign of the problem in the 1980s, the drainage of farm water into the Kesterson National Wildlife Refuge, located in the San Joaquin Valley, resulted in widespread birth defects in birds and fish from selenium poisoning. More troubling, many have noted high incidents of environmentally related health problems of agricultural workers. The long-run survival of the current agricultural system is now being questioned. One thing seems certain, especially considering global warming ushering in an era of hotter and more variable climatic conditions: dealing effectively with these problems will require more regulation to preserve aquifers, use water wisely, and limit harmful practices.

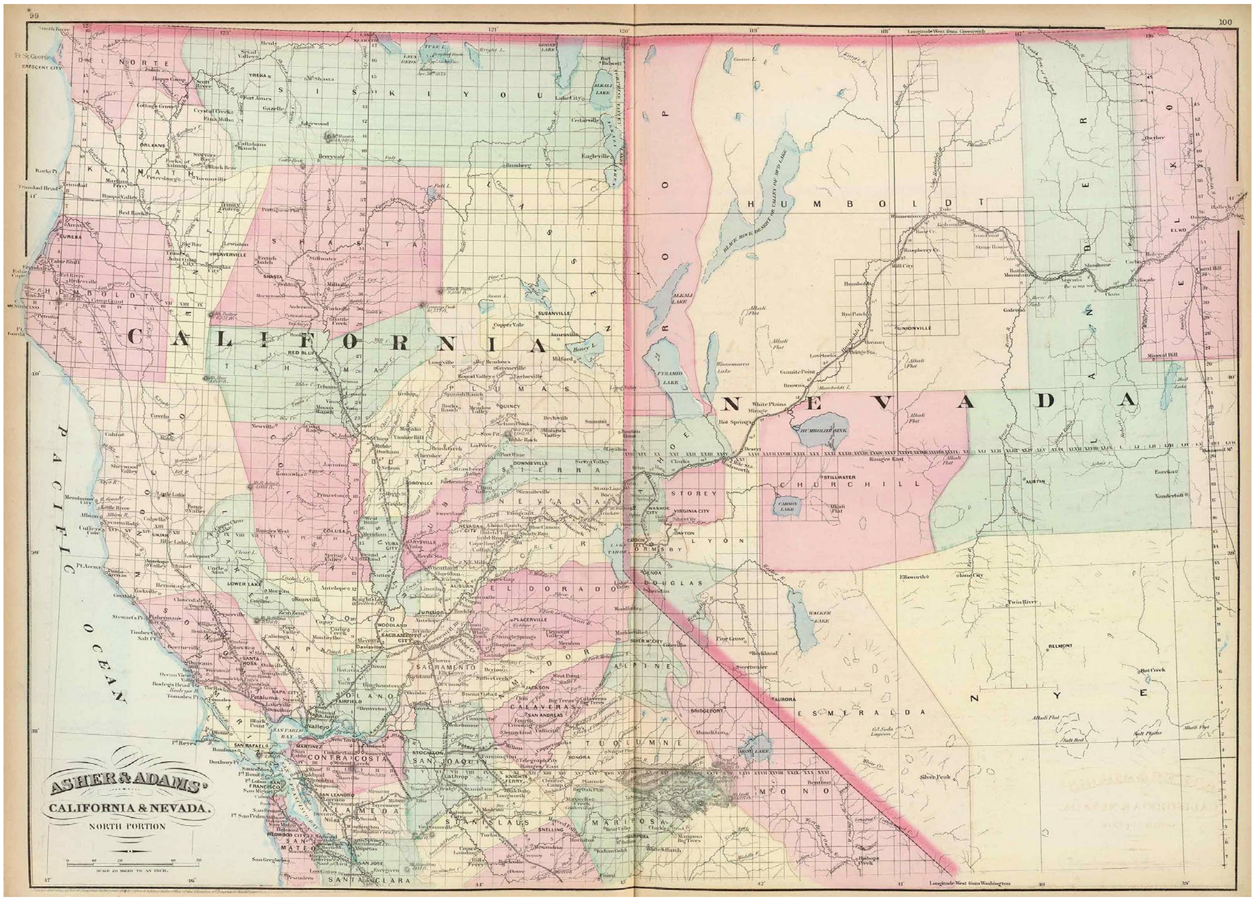


Figure 7.1: An 1874 Atlas Map of Northern California & Nevada.[58]

UNIT 7: CALIFORNIA'S REGIONS & PROVINCES

Goals & Objectives of this unit

- Classify California's Physiographic regions.
- Understand California's subdivision by tribal regions and political geography.
- Identify and locate the 11 geomorphic provinces in California.

---

[58] 1874 map of California and Nevada by Asher & Adams is in the public domain.

INTRODUCTION

California can be subdivided using several different lenses such as political, geographical, and even geological. This unit will discuss the different regions and provinces within the state, and why these boundaries exist. This unit will also set the foundation of how the next few units have subdivided certain regions of the state.

Although they share their similarities, regions and provinces are very different. A region is an area that is divided by physical, human, and environmental characteristics or boundaries. Provinces are an administrative division, meaning that boundaries are set and bound. Many of the regions in California are also provinces, and many provinces may have several regions within.

CALIFORNIA'S COUNTIES

On January 4, 1850, a committee of California's first constitutional convention, chaired by General Mariano Vallejo, recommended the creation of eighteen counties. They were Benicia, Butte, Fremont, Los Angeles, Mariposa, Monterey, Mt. Diablo, Oro, Redding, Sacramento, San Diego, San Francisco, San Joaquin, San Jose, San Luis Obispo, Santa Barbara, Sonoma, and Sutter.

Between January 4 and February 18, 1850, the California legislature added nine counties to the list recommended by General Vallejo's committee, some of the changes based on additional recommendations by the committee. The nine added counties were Branciforte, Calaveras, Coloma, Colusi, Marin, Mendocino, Napa, Trinity, and Yuba. This brought the total number of counties to 27. The legislature also approved several name changes. Benicia was renamed El Dorado, Fremont was renamed Yola, Mt. Diablo was renamed Contra Costa, San Jose was renamed Santa Clara, Oro was renamed Tuolumne, and Redding was renamed Shasta.

Effective February 18, 1850, twenty-seven counties were created in California. The new counties were Branciforte, Butte, Calaveras, Colusi, Contra Costa, El Dorado, Los Angeles, Marin, Mariposa, Mendocino, Monterey, Napa, Sacramento, San Diego, San Francisco, San Joaquin, San Luis Obispo, Santa Barbara, Santa Clara, Solano, Sonoma, Sutter, Trinity, Tuolumne, Yola, and Yuba.

In early 1850, not long after the legislature adopted its first statute creating counties, new statutes were adopted changing some county names. Branciforte was changed to Santa Cruz, Colusi was changed to Colusa, and Yola was changed to Yolo. By 1960 these were further sub-divided to form sixteen additional counties, making 43 in total. Another fourteen counties were formed through further subdivision from 1861 to 1893, and most recent county to form was Imperial County, in 1907. California is currently divided into 58 counties.

California is home to San Bernardino County, the largest county in the contiguous United States, as well as Los Angeles County, the most populous county in the United States.

Figure 7.2: California's Counties Grouped by Economic Regions.[59]

California counties are general law counties which means that they operate within the framework of general laws passed by the state legislature and signed by the governor. These laws dictate many aspects of county government, but may be chartered as provided in Article

[59] California economic regions map (labeled and colored) by Wikimedia Users Thadius856 and Optigan13 is in the public domain.

XI, Section 3 of the California Constitution. A charter county is granted limited home rule powers. Of the 58 counties in California, 14 are governed under a charter. They are Alameda, Butte, El Dorado, Fresno, Los Angeles, Orange, Placer, Sacramento, San Bernardino, San Diego, San Francisco, San Mateo, Santa Clara, and Tehama.

A fun fact; nine counties in California are named for Saints, tied with Louisiana for the largest number.

Defunct Counties

The current county names in California have historical and cultural meaning, lest we do not forget the defunct counties that have historical importance as well. Here is a list of forgotten counties that either were merged, cut, or renamed.

- Branciforte County was the original name of Santa Cruz County in 1850. The county was given the name of "Branciforte" after the Spanish pueblo founded there in 1797. A major watercourse in the county, Branciforte Creek, still bears this name. Less than two months later, on April 5, 1850, the name was changed to Santa Cruz, meaning "Holy Cross".
- Klamath County was created in 1851 from the northern half of Trinity County. Part of the county's territory went to Del Norte County in 1857, and in 1874 the remainder was divided between Humboldt and Siskiyou counties.
- Pautah County, California was created in 1852 out of territory which, the state of California assumed, was to be ceded to it by the United States Congress from territory in what is now the state of Nevada. When the cession never occurred, the California State Legislature officially abolished the never-organized county in 1859.
- Buena Vista County was created in 1855 by the California State Legislature out of the southeastern territory of Tulare County on the west of the Sierra Nevada but was never officially organized. The south of Tulare County was later organized as Kern County in 1866, with additions from Los Angeles and San Bernardino counties.
- Coso County was created in 1864 by the California State Legislature out of territory of Mono County and Tulare County on the east slope of the Sierra Nevada but was never officially organized. The region was later organized in 1866 as Inyo County with additions from Los Angeles and San Bernardino counties.
- Roop County, Nevada encompassed much of Lassen County, including the Honey Lake Valley and the community of Susanville, California; ambiguous organic legislation of Nevada Territory led to confusion about the geographic extent of Nevada's western border. This was later clarified, with the portions of Roop County in California being assigned to Lassen County; the remaining, sparsely portions of Roop County were eventually combined with Washoe County, Nevada.

CALIFORNIA'S TRIBAL GROUPS

Indigenous peoples of California (also known as Native Californians) are a diverse group of nations and peoples that are Indigenous to the geographic area within the current boundaries of California before and after the arrival of Europeans. There are currently 109 federally recognized tribes in the state and over forty tribes or tribal bands that have applied for federal recognition. California has the second-largest Native American population in the United States.

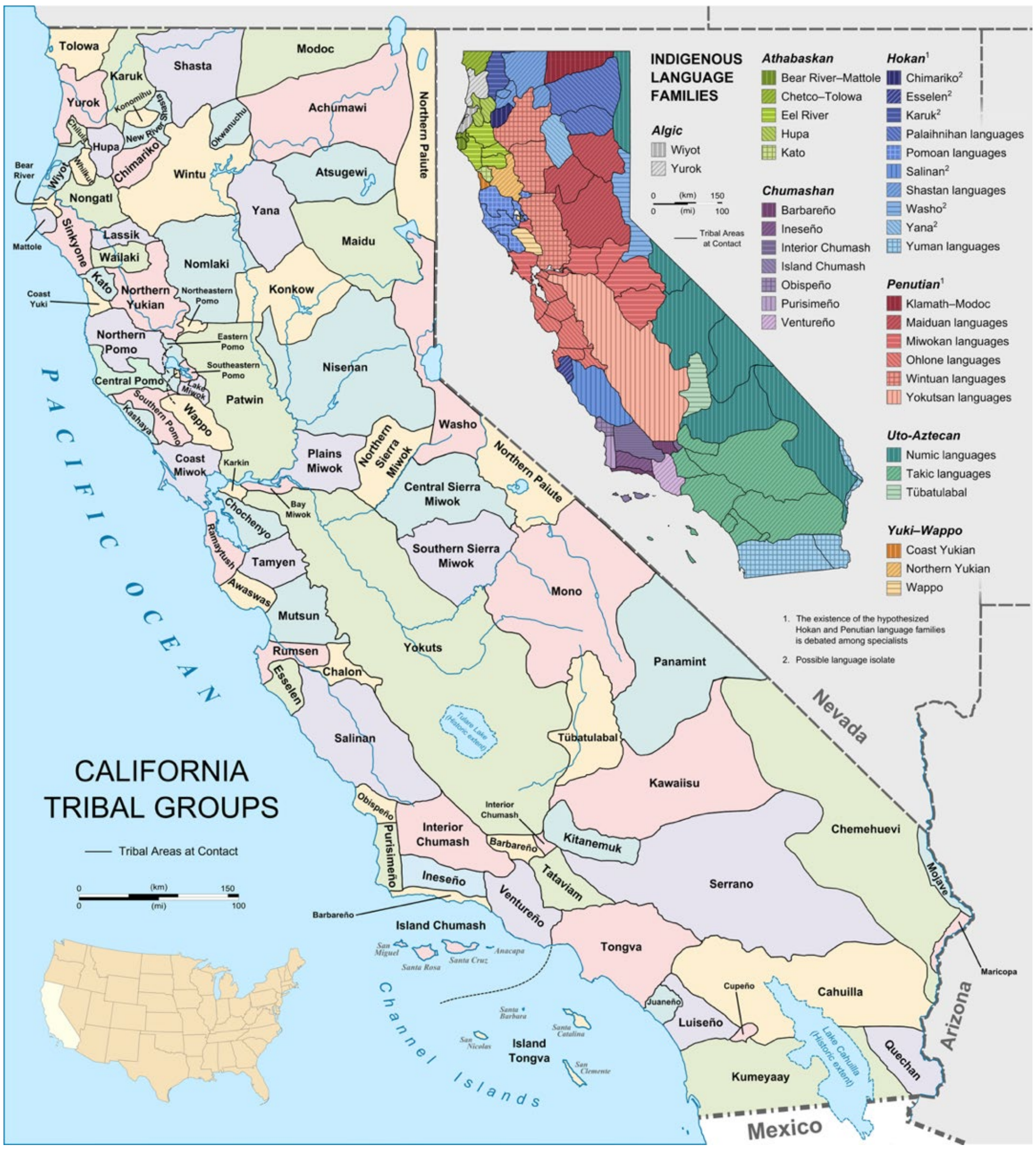


Figure 7.3: Map of California Tribal Areas & Languages at the Time of European Contact.[60]

---

[60] California tribes & languages at contact by Wikimedia User Concerto is licensed under CC BY-SA 3.0.

CALIFORNIA'S POLITICAL GEOGRAPHY

California has an idiosyncratic political culture compared to the rest of the country and is sometimes regarded as a trendsetter. In socio-cultural mores and national politics, Californians are perceived as more liberal than other Americans, especially those who live in the inland states. In the 2016 United States presidential election, California had the third highest percentage of Democratic votes behind the District of Columbia and Hawaii.

Among the political idiosyncrasies, California was the second state to recall their state governor (the first state being North Dakota in 1921), the second state to legalize abortion, and the only state to ban marriage for gay couples twice by vote (including Proposition 8 in 2008). Voters also passed Proposition 71 in 2004 to fund stem cell research, making California the second state to legalize stem cell research after New Jersey, and Proposition 14 in 2010 to completely change the state's primary election process. California has also experienced disputes over water rights; and a tax revolt, culminating with the passage of Proposition 13 in 1978, limiting state property taxes. California voters have rejected affirmative action on multiple occasions, most recently in November 2020.

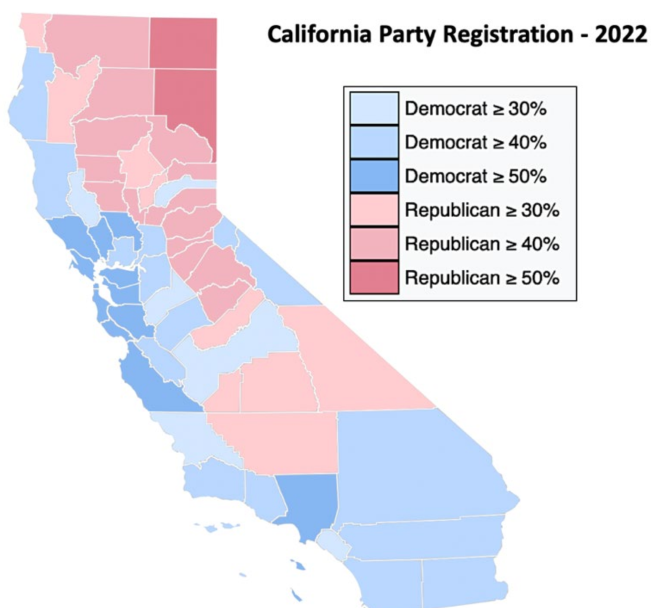


Figure 7.4: Map of California Party Registration, October 2022. [61]

[61] California party registration by county by Wikimedia User Kingofthedead is licensed under CC BY-SA 4.0.

The state's trend towards the Democratic Party and away from the Republican Party can be seen in state elections. From 1899 to 1939, California had Republican governors. Since 1990, California has generally elected Democratic candidates to federal, state, and local offices, including current Governor Gavin Newsom; however, the state has elected Republican Governors, though many of its Republican Governors, such as Arnold Schwarzenegger, tend to be considered moderate Republicans and more centrist than the national party.

THE 11 GEOMORPHIC PROVINCES

California's geomorphic provinces are naturally defined geologic regions that display a distinct landscape or landform. Earth scientists recognize eleven provinces in California. Each region displays unique, defining features based on geology, faults, topographic relief, and climate. These geomorphic provinces are remarkably diverse. They provide spectacular vistas and unique opportunities to learn about earth's geologic processes and history.

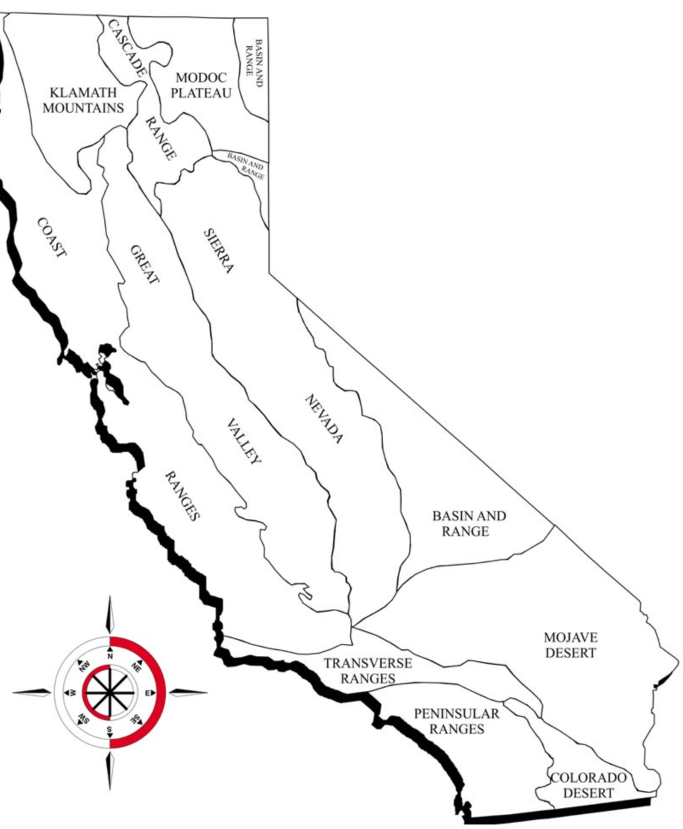


Figure 7.5: California's 11 Geomorphic Provinces.[62]

[62] Note 36 California Geomorphic Provinces by California Department of Conservation, California Geological Survey is used with permission.

The Great (Central) Valley

The Great Valley, also known as the Central Valley, is an alluvial plain about 50 miles wide and 400 miles long in the central part of California. Its northern part is the Sacramento Valley, drained by the Sacramento River and its southern part is the San Joaquin Valley drained by the San Joaquin River. The Great Valley is a trough in which sediments have been deposited almost continuously since the Jurassic (about 160 million years ago). Great oil fields have been found in southernmost San Joaquin Valley and along anticlinal uplifts on its southwestern margin. In the Sacramento Valley, the Sutter Buttes, rise above the valley floor ad are remnants of an isolates Pliocene volcano.

During the Jurassic, many sediments shed into the region from the rising proto-Sierra Nevada. For much of the Cenozoic, the region was filled with lakes and brackish swamps. Thick Miocene sediments formed in narrow seaways from the Pacific. The Stockton fault and White Wolf fault by Bakersfield are both major tectonic features. The 7.6 magnitude 1952 Kern County earthquake was one of the most powerful in California in the 20th century. The subsurface is well known for oil deposits and oil fields are bounded in the east by the Kern Front fault. A small andesitic dome near Marysville is the only example of volcanic rocks in the valley exposed near the surface.

Figure 7.6: The Great Valley Geomorphic Province.[63]

[63] Note 36 California Geomorphic Provinces by California Department of Conservation, California Geological Survey is used with permission.

Modoc Plateau

The Modoc Plateau is a volcanic table land (elevation 4,000- 6,000 feet above sea level) consisting of a thick accumulation of lava flows and tuff beds along with many small volcanic cones. Occasional lakes, marshes, and sluggishly flowing streams meander across the plateau. The plateau is cut by many north-south faults. The province is bound indefinitely by the Cascade Range on the west and the Basin and Range on the east and south.

The Warner Basalt is the most common rock in the plateau, bordered by the Surprise Valley fault zone that first became active in the Miocene 15 million years ago. The Surprise Valley fault zone within alluvial material, is still active. Despite low rainfall, the numerous lava tubes and volcanic fractures in the plateau produce the Fall River Springs, one of the largest springs in the US. Lava tubes are natural tunnels or caves formed by flowing lava from a volcanic eruption. At least 300 lava tubes are known in Lava Beds National Monument, some of which preserve ice year-round. The rugged terrain of the Modoc Plateau played an important role in the Modoc War. In 1873, 53 Modoc men held off 650 US troops, killing 70 of them in heavy weather in the lava plateau to the south of Tule Lake. The Modoc exploited collapsed pits and lava tunnels, turning to Tule Lake for food (subsequent drainage has reduced the lake shoreline).

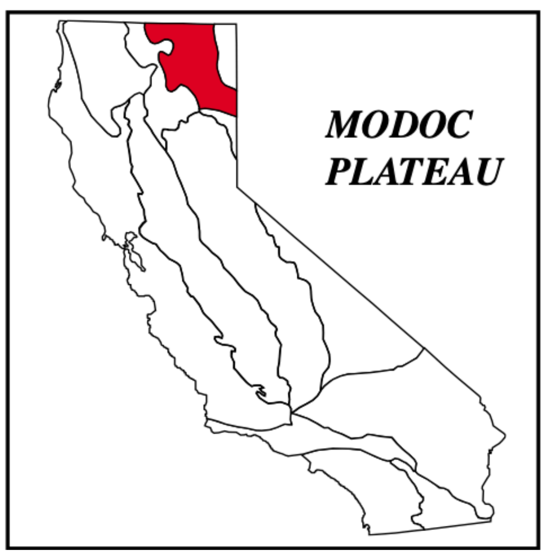


Figure 7.7: Modoc Plateau Geomorphic Province.[64]

[64] Note 36 California Geomorphic Provinces by California Department of Conservation, California Geological Survey is used with permission.

The Klamath Mountains

The Klamath Mountains have rugged topography with prominent peaks and ridges reaching 6,000-8,000 feet above sea level. In the western Klamath, an irregular drainage is incised into an uplifted plateau called the Klamath peneplain. The uplift has left successive benches with gold-bearing gravels on the sides of the canyons. The Klamath River follows a circuitous course from the southern part of the Cascade Range through the Klamath Mountains. The Cascade Range province is a northern extension of the Sierra Nevada.

Massive bodies of granite, called plutons, were formed during the Jurassic and Cretaceous periods. These plutons created rock formations like the Ironside Mountain diorite, which stretches for 37 miles, starting near the Orleans Mountain lookout tower and continuing until the border between Humboldt and Siskiyou Counties. Another example is the Shasta Bally batholith, visible west of Redding at Buckhorn Summit. A few batholiths may date earlier, like the 400-million-year-old Mule Mountain. During the Pleistocene, the mountains had many glaciers and cirques. Glacially carved U-shaped valleys are remaining features from that period. Large boulders have often eroded out of moraine deposits, coming to rest a few miles away. Fast flowing rivers resulted in very little accumulation of alluvium, except for a rare 400-foot-thick deposit in Scott Valley, southwest of Yreka, California.

Figure 7.8: Klamath Mountains Geomorphic Province.[65]

[65] Note 36 California Geomorphic Provinces by California Department of Conservation, California Geological Survey is used with permission.

Sierra Nevada

The Sierra is a tilted fault block nearly 400 miles long. Its east face is steep and high, with multiple rigged scarps, contrasting with the gentle western slope (about 2°) that disappears under sediments of the Great Valley. Deep river canyons are cut into the western slope. Their upper courses, especially in massive granites of the higher Sierra, were modified by glacial sculpturing, forming such scenic features as Yosemite Valley. The high crest culminates in Mt. Whitney, the highest elevation in the 48 contiguous United States, with an elevation of 14,508 feet above sea level near the eastern scarp.

The basement rocks of the Sierra Nevada date to the Paleozoic and include rocks in the Shoo Fly complex and Grizzly Formation. These deposited as part of a series of small island arcs, "rafted" upon the coast of the proto-North American continent Laurentia. The Bullpen Lake sequence has bedded cherts and pillow lava that closely resembles rocks found on flat-topped offshore volcanic guyots, suggesting a deep-sea origin for the base of the Sierras sometime before the Devonian. In the Triassic, the Paleozoic rocks of the Calaveras complex were heaved under the Shoo Fly complex by the Sonoma orogeny, which is preserved in roof pendants and country rock inclusions. During the Nevadan orogeny in the Jurassic, extensive folding and faulting altered the rocks and huge granite batholiths erupted.

The Foothill Metamorphic Belt likely came ashore as an island arc terrane, colliding with the edge of North America to the west of the current Melones fault zone. This added metavolcanic and metasedimentary rocks to the slowly building Sierras.

The geomorphology of the Sierra Nevada is comparatively recent, dating to as recently as the Quaternary. Movement along the Sierra Nevada fault helped to create the new Muir Crest and parts of the mountain range rose to 10,000 feet over the last three million years, creating a steep face of the Sierra, along the west of Owens Valley.

North of the San Joaquin River, the mountains have a tilted-block pattern caused by the Sierra Nevada fault, which is interpreted as being like the more common Basin and Range terrain to the east. However, the Greenhorn Fault system is more active to the south, extending to the Tehachapi Mountains and causing more plateau-like landforms.

Volcanic eruptions in the Miocene between 3.5 and 9.5 million years ago filled old, eroded canyons in parts of the Sierras with lava flows. The Kern River and San Joaquin River both run in valleys "refilled" with lava.

Rhyolite volcanic ash buried other streams during the Oligocene forming tuff that early miners needed to dig through to get at placer gold, and many old buildings in the region are made of blocks of tuff.

Figure 7.9: The Sierra Nevada Geomorphic Province.[66]

Transverse Ranges

Transverse Ranges are an east-west trending series of steep mountain ranges and valleys. The east-west structure of the Transverse Ranges is oblique to the normal northwest trend of coastal California, hence the name "Transverse." The province extends offshore to include San Miguel, Santa Rosa, and Santa Cruz islands. Its eastern extension, the San Bernardino Mountains, has been displaced to the south along the San Andreas Fault. Intense north-south compression is squeezing the Transverse Ranges. As a result, this is one of the most rapidly rising regions on earth. Great thicknesses of Cenozoic petroleum-rich sedimentary rocks have been folded and faulted, making this one of the important oil- producing areas in the United States.

The Santa Ynez Mountains extend up the coast of Santa Barbara County and contain Franciscan basement rocks (also referred to as the Franciscan basement complex) like the Coast Ranges. The California State Rock, serpentine, is part of this complex—having a deep-sea origin. These are Jurassic and Cretaceous age greywacke, chert, basalt, ultrabasic rocks, and serpentinite from modified oceanic crust. Subsequently, sand and mud that were deposited when the region was underwater, became sandstones and shale. Up to 10,000 feet of sandstone and red shale

[66] Note 36 California Geomorphic Provinces by California Department of Conservation, California Geological Survey is used with permission.

deposited during the Eocene, after which sea levels dropped in the Oligocene preserved the sand, gravel and silt of the Sespe Formation. Before the end of the Oligocene, sea levels rose again leaving behind the Vaqueros Formation and then the Miocene deep water silt and clay of the Rincon Formation.

As deep basins up to one mile deep formed in the Miocene and filled with thick sediments, volcanic eruptions near the San Andreas Fault led to rhyolite and basalt eruptions. All these rocks were uplifted in the Pleistocene at the same time as the Coast Range orogeny, formed an anticlinal arch or tilted block against the Santa Ynez fault in the north. Because the mountain range is young only a very narrow coastal plain has developed around Santa Barbara.

Similar rock formations and patterns are found throughout Ventura County, in the Topatopa Mountains and Pine Mountains. Thick Pliocene marine rocks up to 14,000 feet thick are found on the edges of the Santa Clara River Valley and parts of the San Fernando Valley, stretching to Fillmore. Major uplift was going on during the Pleistocene, with some marine terraces raised 1000 feet.

The Santa Monica Mountains and the Channel Islands are different than the mountains to the north because they have granitic and metamorphic basement rocks more like the Sierra Nevada. The oldest rock in this part of the range is the Santa Monica Slate. Thick sequences of marine rocks from the Late Cretaceous through the Paleocene and Eocene are common in the mountains and on San Miguel Island.

During the Miocene, a deep marine channel filled with up to 15,000 feet of sediment which is most of the rock exposed on the Channel Islands. Pillow lava structures from rapid cooling water indicate underwater volcanism that produced basalt, andesite, and diabase flows during the Miocene. In fact, volcanic rocks are 10,000 feet thick in the western part of the Santa Monica Mountains. The San Onofre Breccia also formed during this period with distinct glaucophane schist, gabbro, limestone and greenschist. The Transverse Ranges are poorly drained by streams, but subject to periodic intense flooding, typically every 20 to 25 years. In 1815, the Los Angeles River, which then drained to Long Beach, flooded so substantially that it changed course, joining Ballona Creek, and flowing to Santa Monica Bay, before another flood in 1825 redirected it back to Long Beach.

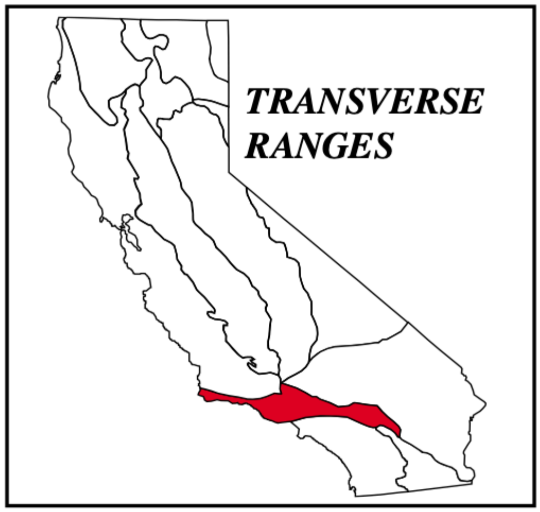


Figure 7.10: The Transverse Ranges Geomorphic Province.[67]

Cascade Range

The Cascade Range, a chain of volcanic cones, extends through Washington and Oregon into California. In California, it is dominated by Mt. Shasta, a glacier-mantled volcanic cone, rising 14,162 feet above sea level. The southern termination is Lassen Peak, which last erupted in the early 1900s. The Cascade Range is transected by deep canyons of the Pit River. The river flows through the range between these two major volcanic cones, after winding across interior Modoc Plateau on its way to the Sacramento River.

The Cascades are part of the Pacific Ocean's Ring of Fire, the ring of volcanoes and associated mountains around the Pacific Ocean. All the eruptions in the contiguous United States over the last 200 years have been from Cascade volcanoes. The two most recent were Lassen Peak from 1914 to 1921 and a major eruption of Mount St. Helens in 1980. Minor eruptions of Mount St. Helens have also occurred since, most recently from 2004 to 2008. The Cascade Range is a part of the American Cordillera, a nearly continuous chain of mountain ranges (cordillera) that form the western "backbone" of North, Central, and South America.

[67] Note 36 California Geomorphic Provinces by California Department of Conservation, California Geological Survey is used with permission.

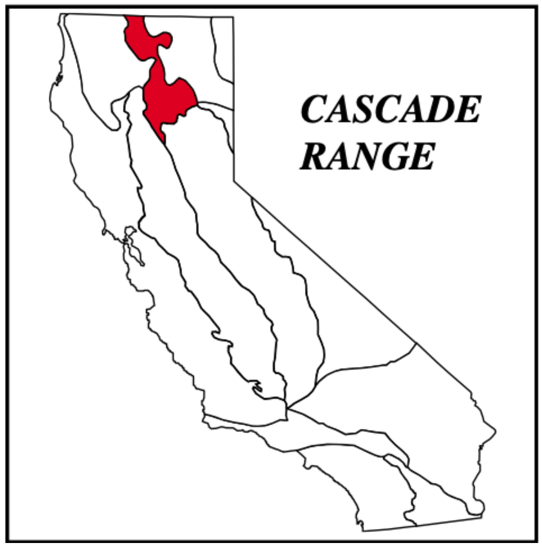


Figure 7.11: California's 11 Geomorphic Province.[68]

Coast Ranges

The Coast Ranges are northwest-trending mountain ranges (2,000 to 4,000, occasionally 6,000 feet elevation above sea level), and valleys. The ranges and valleys trend northwest, subparallel to the San Andreas Fault. In fact, the California State gem is found in San Benito County, called Benitoite. Strata dip beneath alluvium of the Great Valley. To the west is the Pacific Ocean. The coastline is uplifted, terraced and wavecut. The Coast Ranges are composed of thick Mesozoic and Cenozoic sedimentary strata. The northern and southern ranges are separated by a depression containing the San Francisco Bay. The northern Coast Ranges are dominated by irregular, knobby, landslide-topography of the Franciscan Complex. The eastern border is characterized by strike-ridges and valleys in Upper Mesozoic strata. In several areas, Franciscan rocks are overlain by volcanic cones and flows of the Quien Sabe, Sonoma and Clear Lake volcanic fields. The Coast Ranges are subparallel to the active San Andreas Fault. The San Andreas is more than 600 miles long, extending from Pt. Arena to the Gulf of California. West of the San Andreas is the Salinian Block, a granitic core extending from the southern extremity of the Coast Ranges to the north of the Farallon Islands.

Major geologic changes began in the Cenozoic with continued continental shelf deposition of shale, sandstone and clay as well as near-shore tropical coal deposits. During the Miocene, the Coast Ranges were flooded again, with underwater volcanic eruptions in the southern part of the range and deposition of fossil-rich shales like the Monterey formation. Uplift took place into the Pliocene and Pleistocene, slowly reducing sea levels by draining the Central Valley.

[68] Note 36 California Geomorphic Provinces by California Department of Conservation, California Geological Survey is used with permission.

The Coast Range is at even higher risk for damaging landslides than other parts of coastal California due to sheared serpentinite in Franciscan basement rocks.

Figure 7.12: The Coastal Ranges Geomorphic Province.[69]

Peninsular Ranges

A series of ranges is separated by northwest trending valleys, subparallel to faults branching from the San Andreas Fault. The trend of topography is like the Coast Ranges, but the geology is more like the Sierra Nevada, with granitic rock intruding the older metamorphic rocks. The Peninsular Ranges extend into lower California and are bound on the east by the Colorado Desert. The Los Angeles Basin and the island group (Santa Catalina, Santa Barbara, and the distinctly terraced San Clemente and San Nicolas islands), together with the surrounding continental shelf, which was cut by deep submarine fault troughs, are included in this province.

Like the Sierra Nevada, the Peninsular Ranges have gentle western slopes and steep eastern faces. The mountains are drained by the Santa Margarita, San Luis Rey, San Diego, and San Dieguito rivers, while San Felipe Creek in the east drains into the Salton Sea. The oldest "roof" rocks in the Peninsular Ranges date to the Paleozoic, such as limestone deposits near Riverside, quarried for the concrete industry. The oldest rocks are found in the San Jacinto and Santa Rosa mountains, with schist and gneiss that may be 22,000 feet thick.

[69] Note 36 California Geomorphic Provinces by California Department of Conservation, California Geological Survey is used with permission.

The Peninsular Ranges are primarily igneous in origin, during the Jurassic period, roughly 145 to 201 million years ago. There are also pockets of metasedimentary and metavolcanic rock. The Pala District in San Diego County has minerals like tourmaline and lepidolite, often found within pegmatites, a coarse-grained igneous rock. Geologists have classified the larger igneous bodies, or plutons, of the Peninsular Ranges as the Southern California batholith. This massive batholith encompasses several distinct and impressive plutons, including the San Marcos Gabbro, Woodson Mountain Granodiorite, and Bonsall Tonalite.

In the early Cenozoic, widespread erosion of crystalline rocks inland produced huge quantities of sediment which deposited on the Cretaceous rocks of the Peninsular Ranges. Examples include the Silverado Formation with 1400 feet of Paleocene sedimentary rock in the Santa Anas. The Poway Formation, which is also found on the Channel Islands, has rounded metavolcanic pebbles with no known source nearby, suggesting an original source somewhere in Sonora before a major offset to the north by faults. Pliocene terrestrial sedimentary rocks are also common in the northern Peninsular Ranges like the San Timoteo Canyon and Mount Eden conglomerate, sandstone and siltstone which are up to 7000 feet thick. Fossils are common in the marine rocks of the Pacific Beach and Mission Bay formation around San Diego.

The Peninsular Ranges were never glaciated during the Pleistocene. In the nineteenth century, mining began in the vicinity of Julian, extracting nickel and gold, in the Julian Schist. Hot springs including San Jacinto, Eden, Saboba and Gilman are active in the San Jacinto Mountains due to the presence of the San Jacinto fault zone and Elsinore was founded on its hot springs.

Figure 7.13: The Peninsular Ranges Geomorphic Province.[70]

[70] Note 36 California Geomorphic Provinces by California Department of Conservation, California Geological Survey is used with permission.

Basin & Range

The Basin and Range is the westernmost part of the Great Basin. The province is characterized by interior drainage with lakes and playas, and the typical horst and graben structure (subparallel, fault-bounded ranges separated by down dropped basins). Death Valley, the lowest area in the United States (280 feet below sea level at Badwater), is one of these grabens. Another graben, Owens Valley, lies between the bold eastern fault scarp of the Sierra Nevada and Inyo Mountains. The northern Basin and Range Province includes the Honey Lake Basin.

Figure 7.14: The Basin & Range Geomorphic Province.[71]

Mojave Desert

The Mojave is a broad interior region of isolated mountain ranges separated by expanses of desert plains. It has an interior enclosed drainage and many playas. There are two important fault trends that control topography a prominent NW-SE trend and a secondary east-west trend (apparent alignment with Transverse Ranges is significant). The Mojave province is wedged in a sharp angle between the Garlock Fault (southern boundary Sierra Nevada) and the San Andreas Fault, where it bends east from its northwest trend. The northern boundary of the Mojave is separated from the prominent Basin and Range by the eastern extension of the Garlock Fault.

The movement of the San Andreas Fault (sliding right) and the Garlock Fault (sliding left) during the Cenozoic Era played a role in creating the arid conditions. This squeezing of the Earth's crust

[71] Note 36 California Geomorphic Provinces by California Department of Conservation, California Geological Survey is used with permission.

near Gorman may have contributed to a rain shadow effect, blocking moisture from reaching the region. Precambrian and Proterozoic rocks, formed over 2.5 billion years ago, dominate the Mojave landscape. Examples include banded rock (granitic gneiss) and marble found in the Ord Mountains, and layered rock (schist) in the Old Woman Mountains. Some of these ancient formations were even intruded by younger igneous rock called porphyry.

The Marble Mountain Cambrian quartzite lies unconformably atop Proterozoic granites. During the Jurassic high sea levels retreated, switching to the deposition of the terrestrial Aztec sandstone. Volcanic rocks erupted around Barstow in the Triassic. Lake beds interbedded with volcanic ash are typical of the Cenozoic. Volcanism continued through the Holocene, forming the 300-foot-thick basalts of the Cima Volcanic Field or the Barstow-Amboy axis of volcanic craters, which have protected underlying granite from erosion. Unique geology in the region formed bastnaesite, which is used in cellphone technology, mined at the Mountain Pass rare earth mine. Additionally, borate was deposited during arid conditions, with mining after 1926.

Extremes in temperatures throughout the seasons characterize the climate of the Mojave Desert. Freezing temperatures as well as strong winds are not uncommon in the winter, as well as precipitation such as rain and snow in the mountains. In contrast, temperatures above 100 °F (38 °C) are not uncommon during the summer months. There is an annual average precipitation of 2 to 6 inches (51 to 152 mm), although regions at high altitudes such as the portion of the Mojave Desert in the San Gabriel mountains.

Figure 7.15: The Mojave Geomorphic Province.[72]

[72] Note 36 California Geomorphic Provinces by California Department of Conservation, California Geological Survey is used with permission.

Colorado Desert

Most of the Colorado Desert lies at a relatively low elevation, below 1,000 feet (305 m), with the lowest point of the desert floor at 275 feet (84 m) below sea level, at the Salton Sea. Although the highest peaks of the Peninsular Ranges reach elevations of nearly 10,000 feet (3,048 m), most of the region's mountains do not exceed 3,000 feet (914 m).

In this region, the geology is dominated by the transition of the tectonic plate boundary from rift to fault. The southernmost strands of the San Andreas Fault connect to the northernmost extensions of the East Pacific Rise. Consequently, the region is subject to earthquakes, and the crust is being stretched, which will result in a sinking of the terrain over time. The region is characterized by the ancient beach lines, silt deposits of extinct Lake Cahuilla as well as the mud pots. Mud pots are a unique way for geothermal energy to reveal itself on the surface, offering a window into the Earth's dynamic processes. The most famous examples are found near the Salton Sea, a remnant of a prehistoric lake. Interestingly, despite the harsh environment, some extremophile microorganisms even manage to thrive in the hot, sulfurous mud of these pots.

Figure 7.16: Colorado Desert Geomorphic Province.[73]

[73] Note 36 California Geomorphic Provinces by California Department of Conservation, California Geological Survey is used with permission.

Figure 8.1: Bear Mountain, & the Devils Punchbowl Tarn in the Siskiyou Wilderness—Part of the Klamath Mountains.[74]

UNIT 8: KLAMATH & THE MODOC PLATEAU

Goals & Objectives of this unit

- Identify the physical characteristics of the Klamath Mountains and Modoc Plateau provinces.
- Explore the cultural significance of the region, as well as the peoples who called this province their home over time.
- Explain the geology and formation of the volcanism historically and presently found within the Modoc Plateau.

INTRODUCTION

This unit will cover two regions of the state, the Klamath Mountain, and Modoc Plateau provinces. To begin, the Klamath Mountains are a rugged and lightly populated mountain range

[74] Image by Miguel Vieira is licensed under CC BY 2.0

in northwestern California and southwestern Oregon in the western United States. As a mountain system within both the greater Pacific Coast Ranges and the California Coast Ranges, the Klamath Mountains have a varied geology, with substantial areas of serpentinite and marble. Their climate characterized by moderately cold winters with very heavy snowfall and warm, very dry summers with limited rainfall, especially in the south. Because of the geology and soil types, the mountains harbor several endemic or near-endemic trees, forming one of the largest collections of conifers in the world. The mountains are also home to a diverse array of fish and animal species, including black bears, large cats, owls, eagles, and several species of Pacific salmon. Millions of acres in the mountains are managed by the United States Forest Service. The northernmost and largest sub-range of the Klamath Mountains are the Siskiyou Mountains.

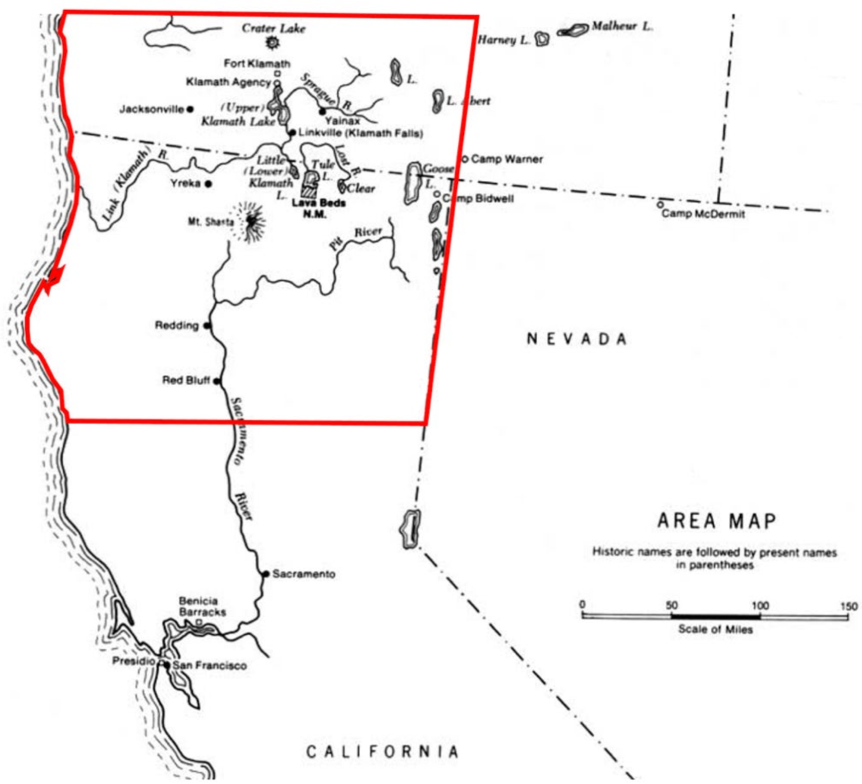


Figure 8.2: Area Map of the Klamath Mountains & Modoc Plateau Province Highlighted in Red.[75]

The ecoregion, also known as a geomorphic province, was unglaciated during the Pleistocene epoch, when it served as a refuge for northern plant species. Its mix of granitic, sedimentary, metamorphic, and extrusive rocks contrasts with the predominantly volcanic rocks of the Cascades ecoregion to the northeast. The mild, subhumid climate of the region is characterized

[75] Image by National Park Service is in the public domain.

by a lengthy summer drought. It supports a mosaic of both northern Californian and Pacific Northwestern conifers and hardwoods.
As for the Modoc Plateau, it lies in the northeast corner of California as well as parts of Oregon and Nevada. Nearly 1,000,000 acres (400,000 ha) of the Modoc National Forest are on the plateau between the Medicine Lake Highlands in the west and the Warner Mountains in the east.

The overall landform is volcanic table land ranging from 4,000 to 6,000 feet above sea level, cut by many north–south faults. Occasioned lakes, marshes, and sluggishly flowing streams meander across the plateau. It is a thick accumulation of lava flows and tuff beds, along with many small volcanic cones. It has cinder cones, juniper flats, pine forests, and seasonal lakes. The plateau is thought to have been formed approximately 25 million years ago as a southern extension of the Columbia Plateau flood basalts

KLAMATH MOUNTAINS

The Klamath Mountains, like the Sierra Nevada, San Gabriel, and San Bernardino ranges, were once much lower than they are now, and their surface features were quite tame and uninteresting. The rivers of that time flowed through broad valleys, portions of which remain as plateau-like shoulders overlooking the deep canyons of the present day.

Physical Geography

There came a time when the region began to rise, and with the increase of slope, the streams began to deepen their channels. Anyone looking at a relief map, may be puzzled to understand why the Klamath River leaves the broad Shasta Valley and flows through the mountains in a deep canyon directly to the sea. If we should fill up the canyon, the Klamath River would first form a lake in Shasta Valley and then break through the lowest point in the rim which leads in a southerly direction past Mt. Shasta to the Sacramento River.

The only way in which we can explain the peculiar features mentioned, is by the supposition that long ago, before the mountains had been elevated to their present height, the lowest outlet to the sea lay directly across the mountains where the river flows now, and that as they rose the movement was so slow that the river was able to cut its channel down, and so maintain its position, until the canyons became 2000 to 3000 feet (about 914 m) deep.

Only three valleys of any size are found within the whole Klamath Mountain region. The most important one is Scotts Valley, then Hay Fork Valley and, last, Trinity Valley. In addition, the canyons widen here and there sufficiently to give room for a little bottomland, and if the soil has not been washed away in hydraulic mining, we are likely to find little ranches. The rest of the surface is mostly made up of steep and rugged mountain slopes terminating in deep canyons.

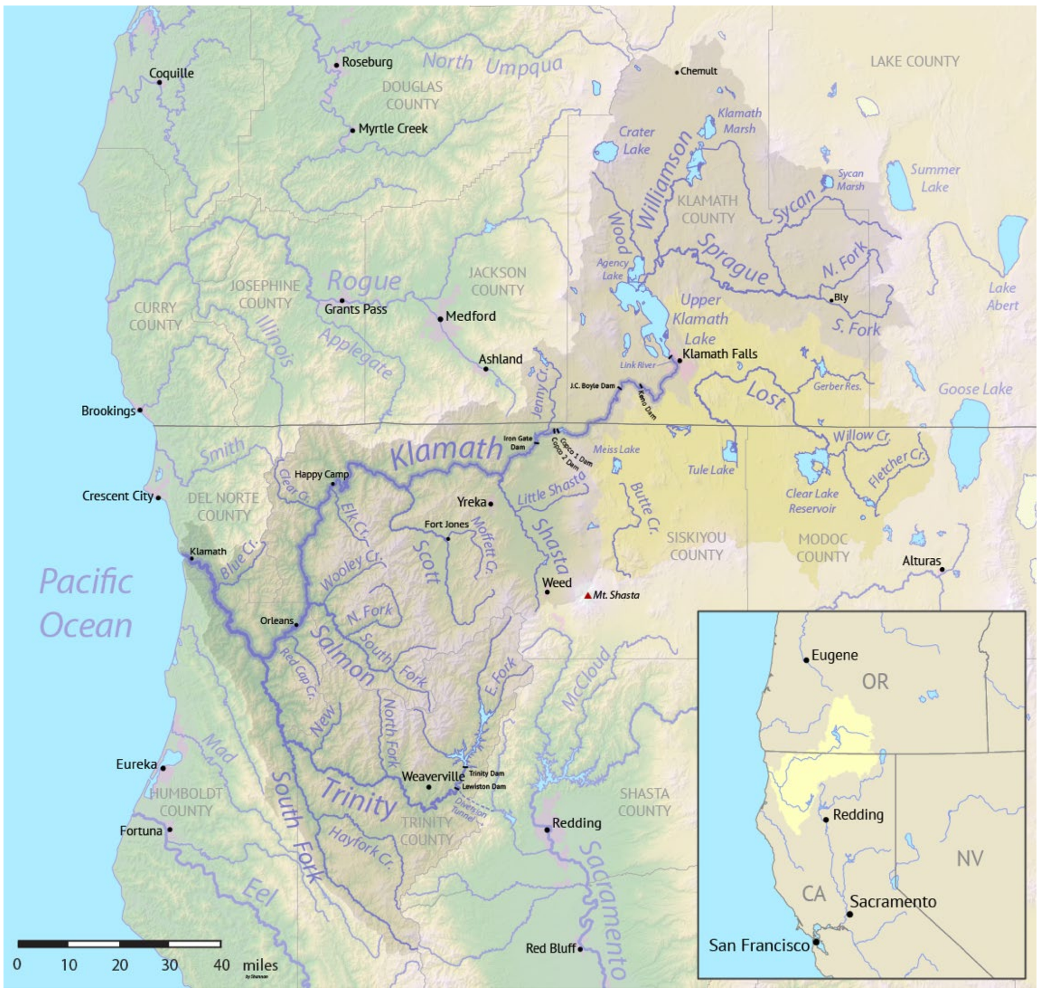


Figure 8.3: Map of the Klamath River Basin in California & Oregon. 2022.[76]

The Klamath Mountain group includes several distinct mountain ranges which form the watersheds of the different river basins. The highest and most picturesque of these is the Salmon Mountains, which constitute the divide between the Salmon and Trinity rivers. Several peaks have an elevation of over 9000 feet. This region, in common with the other higher mountain ridges of the Klamath Mountains, was once glaciated. There are, in consequence, numerous little alpine lakes very similar to those in the Sierra Nevada. The snowfall is heavy, and on the north slope of Thompsons Peak, which rises 9345 feet, there is a small glacier. Scotts Mountains lie between the head of the North Fork of Trinity River and the upper Sacramento. They include Castle Crags, widely known for their striking scenic features. The Siskiyou Mountains lie north of the Klamath River and partly in Oregon. They include several peaks about 9000 feet in height. The Trinity Mountains form a high, sharp divide between the Trinity River and the Sacramento River. They pass southward into the Yallo Bally Mountains, which lie at the extreme southern end of what we are calling the Klamath Mountains.

The Klamath is the largest river in Northern California, and its largest tributary is the Trinity River. The Klamath t rises in the lake region of Southern Oregon and flows a little south of west across a depression in the Cascade Range, or rather a volcanic plateau, as we shall call this part of it in the following pages, and directly into and through the Klamath Mountains, as we have already seen.

The Sacramento River also cuts across the Klamath Mountain region. Its main source is in large springs near the southwest base of Shasta and flows southerly through a picturesque canyon. Long ago a lava stream swept fifty miles down this canyon, burying the old riverbed. The present stream has cut down through the lava and exposed in some places the gravels of its former channel.

The McCloud River Basin is a smaller sub-section within the Sacramento River Watershed that specifically drains into the McCloud River before it joins the Sacramento River. The McCloud River origin begins with Subsequent lava flows from active volcanoes in the Cascade Range, Mount Shasta and surrounding volcanoes that left behind underground channels and chambers. Rainwater and snowmelt seep through the porous volcanic rock, filtering and collecting in underground reservoirs. These reservoirs eventually erupt as springs at the base of canyon walls, feeding the McCloud River with a constant flow of cool, clean water throughout the year.

The Klamath mountains were lifted to their present position in stages, and at each period of rest the streams, after having established a new grade and ceased to cut down, began to meander on their flood plains and widen their channels from canyons to valleys. Then, when the uplift was renewed, they began to cut down again. River terraces were formed this way, some of which are covered with gravel and are rich in gold.

Physical Geology

The rocks of the Klamath Mountains originated as island arcs and continental fragments in the Pacific Ocean. The island masses consisted of rifted fragments of pre-existing continents and volcanic island masses created over subduction zones. These island masses contain rocks as old as 500 million years, dating to the early Paleozoic Era. A succession of eight island terranes moved eastward on the ancient Farallon plate and collided with the North American plate between 260 and about 130 million years ago. Each accretion left a terrane of rock of a single age. During the accretion, subduction of the plate metamorphosed the overlying rock, as well as produced magma which intruded the overlying rock as plutons. Serpentinite, produced by the metamorphism of basaltic oceanic rocks, and intrusive rocks of gabbroic to granodiorite composition are common rocks within the Klamath terranes.

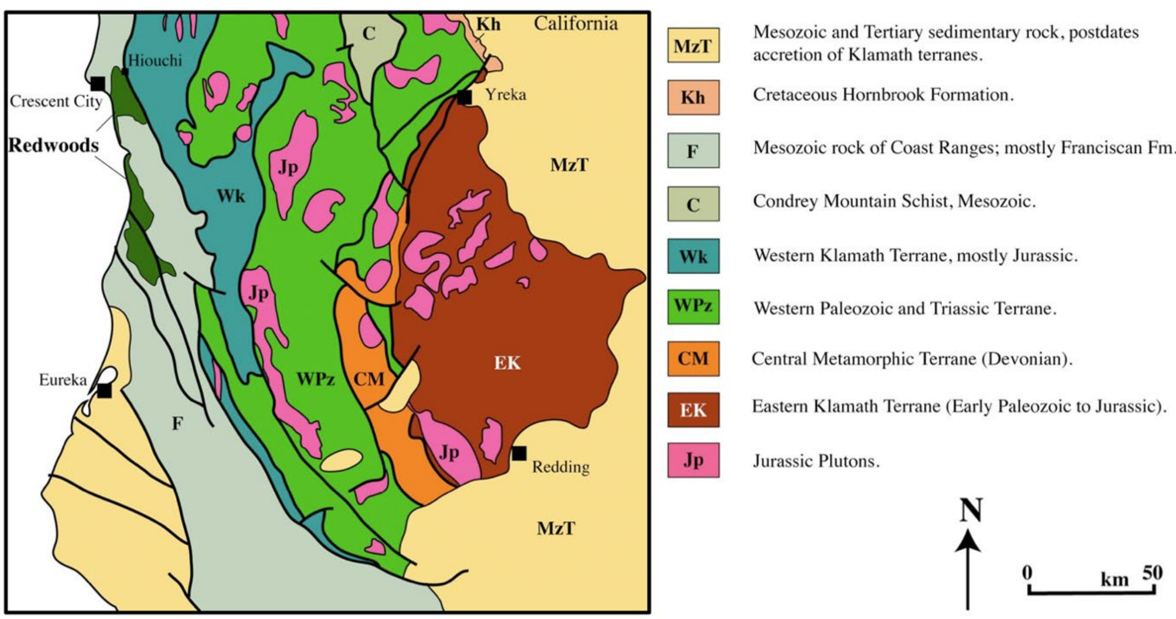


Figure 8.4: Geologic Map of the Klamath Mountains Region- California.[77]

The Klamath Mountains became known as a mining region, due to the placer sand and gravels, which proved to be very rich. Gold was found both in the gravels of the present streams and in the terrace remains of the older streams. The gravels were often so deep that they could not be worked by ordinary placer methods, so, the only recourse left was hydraulic operations. The gravel bars, as they are often called, are now largely worked out, but at one time hundreds of hydraulic hoses were hurling streams of water with terrific force at the gravel banks and washing their materials into long sluices where quicksilver was placed to catch the gold as it was swept along.

[77] Image by M.B. Miller is used by USDA and is in the public domain.

Case Study | Mt. Shasta

Mount Shasta is a volcano at the southern end of the Cascade Range in Siskiyou County. It is connected to its satellite cone of Shastina, and together they dominate the landscape. Shasta rises abruptly to tower nearly 10,000 feet (3,000 m) above its surroundings. On a clear winter day, the mountain can be seen from the floor of the Central Valley 140 miles (230 km) to the south.

About 593,000 years ago, andesitic lavas erupted in what is now Mount Shasta's western flank near McBride Spring. Over time, an ancestral Mount Shasta stratovolcano was built to a large but unknown height; sometime between 300,000 and 360,000 years ago the entire north side of the volcano collapsed, creating an enormous landslide or debris avalanche, 6.5 cu mi (27 km3) in volume. The slide flowed northwestward into Shasta Valley, where the Shasta River now cuts through the 28-mile-long (45 km) flow.

Figure 8.5: Aerial Photo of Mt. Shasta Taken from the International Space Station in 2022.[78]

What remains of the oldest of Mount Shasta's four cones is exposed at Sargents Ridge on the south side of the mountain. Lavas from the Sargents Ridge vent cover the Everitt Hill shield at Mount Shasta's southern foot. The last lavas to erupt from the vent were hornblende-pyroxene andesites with a hornblende dacite dome at its summit. Glacial erosion has since modified its shape. The next cone to form is exposed south of Mount Shasta's current summit and is called

[78] Image by NASA is in the public domain.

Misery Hill. It was formed 15,000 to 20,000 years ago from pyroxene andesite flows and has since been intruded by a hornblende dacite dome.

There are many buried glacial scars on the mountain that were created in recent glacial periods, of the Pleistocene and Wisconsianian ages. Most have since been filled in with andesite lava, pyroclastic flows, and talus from lava domes. Shastina, by comparison, has a fully intact summit crater without glacial erosion, indicating Shastina developed after the last ice age. Shastina has been built by mostly pyroxene andesite lava flows. Some 9,500 years ago, these flows reached about 6.8 mi (10.9 km) south and 3 mi (4.8 km) north of the area now occupied by nearby Black Butte. The last eruptions formed Shastina's present summit about 3,200 years ago. But before that, Shastina, along with the then forming Black Butte dacite plug dome complex to the west, created numerous pyroclastic flows that covered 43 sq mi (110 km2), including large parts of what is now Mount Shasta. Diller Canyon is 400 ft (120 m) deep and 0.25 mi (400 m) wide, is an avalanche chute that was probably carved into Shastina's western face by these flows.

The last to form, and the second highest cone at, the Hotlum Cone, formed about 8,000 years ago. It is named after the Hotlum glacier at 14,160 ft (4,317m) on its northern face; its longest lava flow, the 500-foot-thick (150-metre) Military Pass flow, extends 5.5 mi (8.9 km) down its northeast face. Since the creation of the Hotlum Cone, a dacite dome intruded the cone and now forms the summit. The rock at the 600-foot-wide (180-metre) summit crater has been extensively hydrothermally altered by sulfurous hot springs and fumaroles there (only a few examples remain).

During the last 10,000 years, Mount Shasta has erupted an average of every 800 years, but in the past 4,500 years the volcano has erupted an average of every 600 years.

Cultural Geography

The Klamath people are a Native American tribe of the Plateau culture area in Southern Oregon and Northern California. The Klamath people lived in the area around the Upper Klamath Lake and the Klamath, Williamson, Wood River and Sprague (Plaikni Kóke - “River Uphill”) rivers. They subsisted primarily on fish and gathered roots and seeds. While there was knowledge of their immediate neighbors, apparently the Klamath were unaware of the existence of the Pacific Ocean, and because of this, it caused the Klamath to live in prolonged cultural isolation. However, the Klamath were known to raid neighboring tribes, such as the Achomawi on the Pit River, and occasionally to take prisoners as slaves.

North of the Klamath tribe lived the Molala people. East of the Cascade Range, also known as the "Mountains of the Northerners," in the Rogue River Valley, lived the Rogue River Athabascan tribe. Further south, along the Pit River, called the "River of the Southern Dwellers," lived the Achomawi people. The Atsugewi tribe resided along the Scott River. In the west and northwest regions lived the Latgawa, known as the "Upland Takelma," and the Takelma/Dagelma, known as the "Lowland/River Takelma." There's a possibility that both these western/northwestern tribes shared the name "Rogue River People."

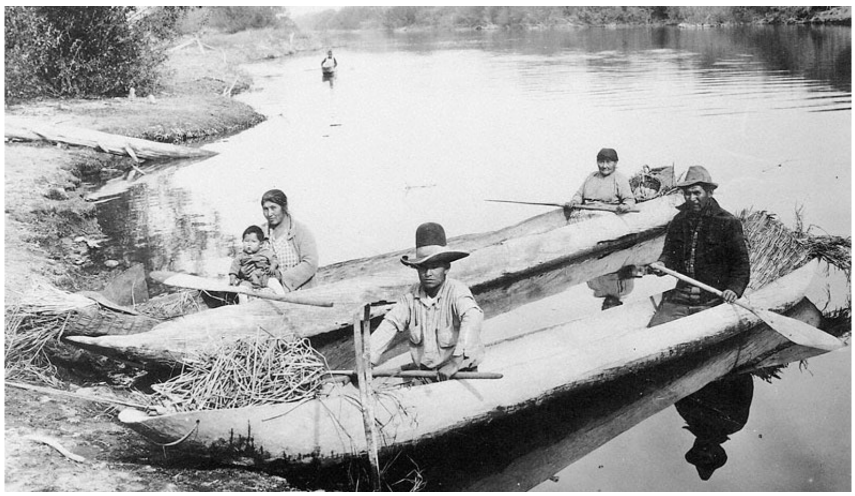


Figure 8.6: Photo of Klamath People in Dugout Canoes, Early 19th Century.[79]

The natives made southern Oregon their home for long enough to witness the eruption of Mount Mazama, around 7,700 years ago. After Mount Mazamas eruption, it would collapse within itself to create a caldera, which filled with rainwater to form Crater Lake.

MODOC PLATEAU

The Modoc Plateau is in the northeastern corner of the state, framed by and including the Warner Mountains and Surprise Valley along the Nevada border to the east and west to the edge of the southern Cascades Range. The area extends north to the Oregon border and south to include the Skedaddle Mountains and the Honey Lake Basin. While there have been volcanoes and lava flows in nearly all parts of California at various times in its geologic past, it is in the northeastern portion that we find the most extensive. One of the greatest lava floods of Earth's surface covers Eastern Oregon, Eastern Washington, Southern Idaho, Northern Nevada, and Northeastern California.

[79] Image by unknown author is in the public domain.

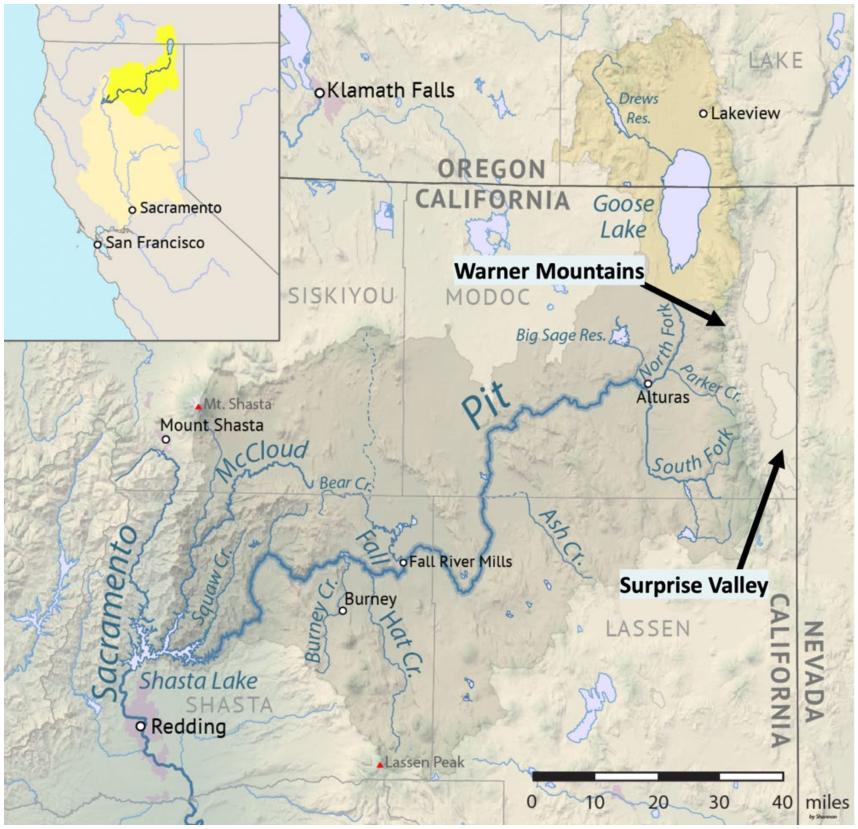


Figure 8.7: Map of the Put River, Warner Mountains & Surprise Valley, in California & Oregon. 2022.[80]

Physical Geography

The Modoc Plateau Province encompasses over 7 million acres in the far northeastern corner of California. This province is composed of two distinct geographic and ecological areas, the Modoc Plateau, and the Southern Cascades. Elevations in the province average higher than other provinces, ranging from 3,000 feet throughout the Modoc Plateau to over 14,000 feet on mountain peaks of the Southern Cascades. Northeastern California is an outstanding region for wildlife, providing habitat for mountain lion, black-tailed deer, mule deer, pronghorn, elk, yellow-bellied marmot, porcupine, greater sage-grouse, and the colorful waterfowl of the Pacific Flyway that funnel through the area during their annual migrations. Golden eagle, prairie falcon, cascade frog, southern long-toed salamander, Northern goshawk, Northern spotted owl, sooty grouse, greater sandhill crane, and American white pelican nest and hunt or forage in varied habitats in the province. Sharp-tailed grouse historically occurred in this province but have been extirpated. The varied aquatic habitats and natural barriers along the Pit River and Klamath River and their tributaries have allowed the evolution of several unique aquatic

[80] Image by Shannon1 is licensed under CC BY-SA 4.0

communities that include endemic fish and invertebrates in the Cascades and Modoc Plateau Province.

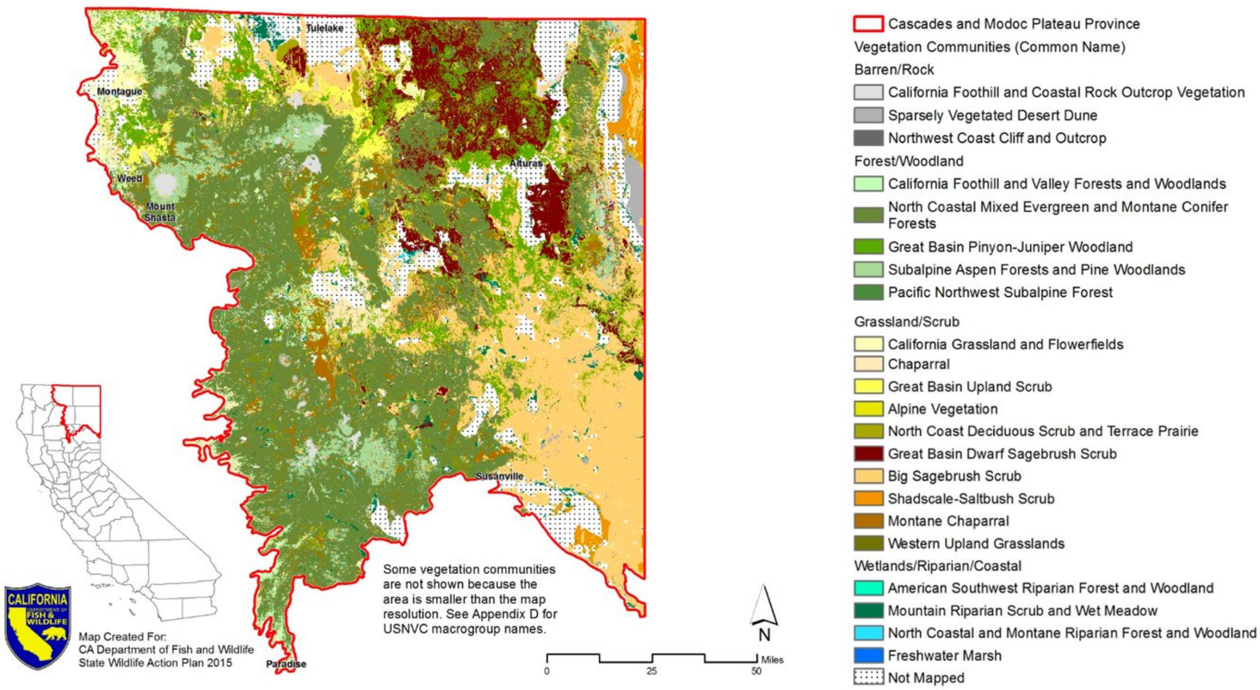


Figure 8.8: Map of the Cascade & Modoc Plateau.[81]

Physical Geology

A million years ago, layered lava flows formed the 4,000–5,000-foot elevation Modoc Plateau, separating the watersheds of the area from the Klamath drainage to the northwest. The waters of the western slope of the Warner Mountains and the Modoc Plateau carved a new course, the Pit River, flowing to the southwest through the Cascades and joining the Sacramento River at Lake Shasta. Many of the springs and creeks of northeastern California drain via the Pit River. Situated on the western edge of the Great Basin, the Modoc Plateau has supported high desert plant communities and ecosystems like that region—shrub-steppe, perennial grasslands, sagebrush, antelope bitterbrush, mountain mahogany, and juniper woodlands. Sagebrush plant communities are characteristic of the area, providing important habitat for sagebrush-dependent wildlife such as greater sage-grouse and pygmy rabbit. Conifer forests dominate the higher elevations of the Warner Mountains and the smaller volcanic mountain ranges and hills that shape the area. Wetland, spring, meadow, vernal pool, riparian, and aspen communities scattered across the rugged and otherwise dry desert landscape support diverse wildlife. The

[81] Image by USGS and CDFW is licensed under public domain.

area has varied aquatic habitats, from high mountain streams to the alkaline waters of Goose Lake and Eagle Lake to clear spring waters of Fall River and Ash Creek.

Case Study | Lava Beds National Monument

One of the most iconic geologic areas found within the plateau is the Lava Beds National Monument, which is geologically significant because of its wide variety of volcanic formations, including lava tubes, fumaroles, cinder cones, spatter cones, pit craters, hornitos, maars, lava flows, and volcanic fields.

Cinder cones are formed when magma is under great pressure. It is released in a fountain of lava, blown into the air from a central vent. The lava cools as it falls, forming cinders that pile up around the vent. When the pressure has been relieved, the rest of the lava flows from the base of the cone. Cinder cones are typically monogenetic, meaning that they are a volcano that erupts only once. These volcanoes are typically smaller and less complex than volcanoes that erupt repeatedly (polygenetic volcanoes).

The cinder cones of Hippo Butte, Three Sisters, Juniper Butte, and Crescent Butte are all older than the Mammoth and Modoc Crater flows, more than 30,000–40,000 years old. Eagle Nest Butte and Bearpaw Butte are 114,000 years old. Schonchin Butte cinder cone, figure 8.9) and the andesitic flow from its base were formed around 62,000 years ago. The flow that formed Valentine Cave erupted 10,850 years ago. An eruption that formed The Castles is younger than the Mammoth Crater flows. Even younger were eruptions from Fleener Chimneys, such as the Devil's Homestead flow, 10,500 years ago, and Black Crater 3,025 years ago. About 1,110 years ago, plus or minus 60 years, the Callahan flow was produced by an eruption from Cinder Butte. Though Cinder Butte is just outside the boundary of the monument, the Callahan flow is in Lava Beds and is the youngest flow in the monument.

Figure 8.9: Photo of Schonchin Butte Cinder Cone in Lava Beds National Monument - California.[82]

[82] Image by Beej71 is licensed under CC BY-SA 2.0

Spatter cones are built out of thicker lava. The lava is thrown out of the vent and builds, layer by layer, a chimney surrounding the vent. Fleener Chimneys and Black Crater are examples of spatter cones.

Roughly ninety percent of the lava in the Lava Beds Monument is basaltic. There are primarily two kinds of basaltic lava flows: pahoehoe and ʻaʻā. Pahoehoe is smooth, often ropy and is the most common type of lava in Lava Beds. ʻAʻā is formed when pahoehoe cools and loses some of its gases. ʻAʻā is rough, sharp, and jagged; an excellent example is the Devil's Homestead lava flow, which originated at Fleener Chimneys. Most of the rest of the lava in the monument is andesitic. Pumice, a rapidly cooled type of volcanic glass, also is found covering the monument; this rained down around 900 years ago during the eruption of Glass Mountain.

The flows from Mammoth and Modoc Craters comprise about two-thirds of the lava in the monument. Over 30 separate lava flows located in the park range in age from 2,000,000 years to 1,110 years years ago. Some of the major lava flows within Lava Beds National Monument include the Callahan Flow; Schonchin Flow; Mammoth Crater Flow; Modoc Crater Flow; and Devil's Homestead Flow (figure 8.11).

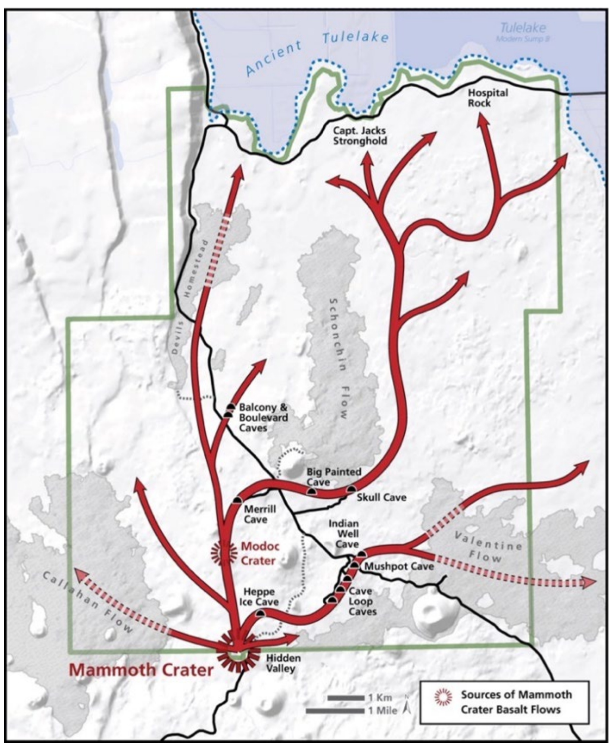


Figure 8.10: Lava Flow Map of Lava Beds National Monument- California.[83]

[83] Image by Rangerdavid is licensed under CC BY-SA 4.0

Lava Beds National Monument has the largest concentration of lava tubes in North America. Lava flows dated to about 30,000–40,000 years ago formed most of the lava tubes in the monument. As the hot basaltic lava flowed downhill, the top cooled and crusted over, insulating the rest of the lava, and forming lava tubes. Lavacicles on the ceiling of a lava tube were produced as the level of lava in the tube retreated and the viscous lava on the ceiling dripped as it cooled.

Cultural Geography | Case Study – The Modoc

The Modoc are an Indigenous American people who historically lived in the area which is now northeastern California and central Southern Oregon. Currently, they include two federally recognized tribes, the Klamath Tribes in Oregon, and the Modoc Tribe of Oklahoma, now known as the Modoc Nation. The Modoc, like the neighboring Klamath, spoke dialectic varieties of the Klamathan/Lutuamian language, a branch of the Plateau Penutian language family. Both peoples called themselves *maklaks*, meaning "people". To distinguish between the tribes, the Modoc called themselves *Moatokni maklaks,* from *muat* meaning "South". The Achomawi, a band of the Pit River tribe, called them *Lutuami*, meaning "Lake Dwellers".

Figure 8.11: Photo of Modoc Yellow Hammer- Circa 1904, California.[84]

[84] Image by Joseph Andrew Shuck is in the public domain.

CLIMATIC FEATURES

The climate of this region varies greatly in different parts. Upon the coast, it is extremely wet, and the temperature is mild, but as you move inland, the precipitation becomes less, the summers warmer and the winters colder. On the higher mountains, semi-arctic conditions prevail. Upon the eastern edge of the district, the rainfall is comparatively light.

Here, as in many other parts of the State, there is a remarkable vertical range exhibited by many plants and trees. The madrone ranges through 3000 feet, under the right conditions of slope exposure. On the dry, sunny slopes of some of the canyons occur such plants as the Spanish bayonet, which normally belongs in the semi-arid portions of the State.

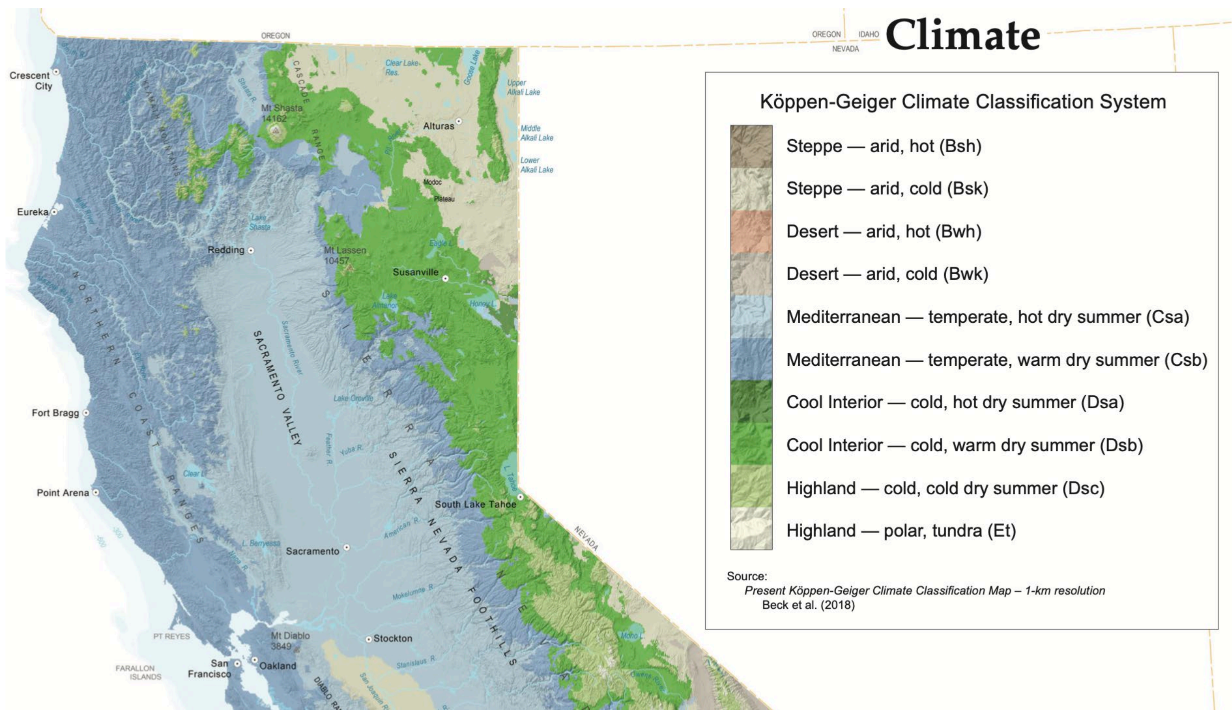


Figure 8.11: Köppen-Geiger Climate Classification Map of Northern California.[85]

[85] Image by California Coastal Commission is in the public domain.

Figure 9.1: Avila Beach in Santa Barbara- California.[86]

UNIT 9: CALIFORNIA'S COASTAL REGIONS

Goals & Objectives of this unit

- Define the boundaries of California's coastal regions, both physically and culturally.
- Explain the geomorphic development and formation of California's coastline and beaches.
- Assess the cultural influence and historical importance of California's coastal regions.
- Identify key events in Ventura Counties human, geographic and geologic past.

INTRODUCTION

As far as we can learn**,** John C. Fremont was the first to use the phrase 'Coast Ranges' for the mountains bordering the coast of California. Although mountains are practically continuous along the coast from Oregon to Southern California, yet, geographers have come to apply the

[86] Image by Jeremy Patrich is licensed under CC-BY 4.0.

term Coast Ranges much as Fremont used it, meaning that portion of the mountains bordering the Pacific Coast which lie between the Great Valley of California and the ocean.

The Coast Ranges are limited on the south by a line drawn westerly from the extreme southern end of the San Joaquin Valley, a line which closely accords with the northern boundary of Santa Barbara county. We find this marked topographically by the Cuyama Valley and the Santa Maria River, and further by the fact that to the south, the Transverse Ranges extend nearly east and west, while the Coast Ranges have a northwest and southeast direction.

The Coast Ranges do not constitute a simple mountain block like the main part of the Sierra Nevada. The folding of Earth's crust and the formation of fracture and earthquake lines in a general northwest and southeast direction have given origin to the series of parallel mountains and valleys. The disturbances of Earth's crust in this region have been many and severe, affecting different parts episodically.

At previous times, the Coast Ranges were submerged until nearly buried beneath the waters of the Pacific. They were then practically a group of islands and peninsulas separated from the Sierra Nevada by a broad, deep bay which occupied the Great Valley. Earthquakes and volcanic outbreaks, and changes in the level of the land seem never to have left the country at rest.

It was formerly believed that the Coast Ranges were newer than the Sierra Nevada and that the continent grew progressively westward from the Rocky Mountains. This is a mistake, for there was extensive land here long before there was any Sierra Nevada Range. The granite exposed in the Santa Lucia, Gavilan, and Santa Cruz Ranges, on the Farallon Islands and at Point Reyes, tells us there was land here long ago, and it was on this ancient land that the earliest known representatives of the Sequoia tree species flourished, as has already been mentioned.

The complexity of the geography of the Coast Ranges is increased by the fact that the underlying rocks vary greatly in their resistance to decay and erosion. Valleys may be formed where the rocks are soft, and peaks formed with more resistant rocks, as is illustrated in the case of the San Luis Buttes. These are the most striking mountain peaks, due to purely erosion effects. They represent ancient igneous eruptions that once emerged through the crust and now stand out because they are hard and the rocks around them are soft. They extend in a line from the town of San Luis Obispo northwesterly to the ocean and terminate in a great rock known as Morro Rock which rises bare and rugged to a height of nearly 600 feet.

NORTH COAST

The North Coast of California, also referred to as the Redwood Empire or the Redwood Coast, due to the dense redwood forests throughout the region, is a region in Northern California that lies along the Pacific coast between San Francisco Bay and the Oregon border. It commonly includes Mendocino, Humboldt, and Del Norte counties and sometimes includes two counties from the San Francisco Bay area, Marin and Sonoma.

Figure 9.2: Location of the North Coast in California.[87]

Physical Geography

The Pacific Ocean coast stretches from San Francisco Bay to Humboldt Bay and on to the border of Oregon. The coastline is often inaccessible, and includes rocky cliffs and hills, streams, and tide pools. The coastline from Centerville Beach near Ferndale to the mouth of the Klamath River is mostly beach accessible and there are many small towns and a few cities along Highway 101, the main route through the region. The sparsely populated interior territory further inland is characterized by rugged, often steep mountains, bisected by rivers and their typically narrow valleys and canyons, and dense redwood, Douglas fir, and oak forests. The climate can range from coast side lands drenched with fog in mild winters and summers to inland reaches baked

[87] Map of the North Coast region of California by Wikimedia User Cristiano Tomás is used under a CC BY-SA 4.0 license.

by hot sunshine on long summer days, which, at higher elevations, can be blanketed with snow in winter.

The southern portion of the North Coast is largely urbanized while the rest is mostly rural. The more remote northern areas are often referred to as being located "behind the Redwood Curtain." A segment of the coastline in Mendocino and Humboldt Counties is known as the Lost Coast and is only accessible by a few back roads. Notable seaside beaches can be found at Marin Headlands and Point Reyes National Seashore in the south, with innumerable examples of remote or less used beaches north of the San Francisco Bay area.

The grandeur of the redwoods can be experienced throughout the region because of the fog. With the westerly winds that bring onshore flow from the cold ocean over the warm land creates advection fog that provides the moisture needed for these trees to thrive. From the protected groves of Muir Woods National Monument and Armstrong Redwoods State Natural Reserve in the south to the massive forests of Humboldt Redwoods State Park along the Avenue of the Giants in the north. Other larger redwood parks include Prairie Creek Redwoods State Park, Del Norte Coast Redwoods State Park, Jedediah Smith Redwoods State Park and Redwood National and State Parks. In total, the redwood parks of the North Coast contain most of all remaining old-growth redwoods.

Physical Geology

The Mendocino Coast is relatively young and is still actively uplifting. Landforms such as sea caves, stacks, and arches are common due to the cliff and headland erosion. When the roof of a sea cave falls, a bowl-shaped formation result. Other portions of the coast have rocks that look like bowling balls and gargoyles! Additionally, marine terraces reveal evidence of the history of uplift and erosion.

A sea arch is a natural opening eroded out of a cliff face by the action of wind and water. Sea stacks represent remnants of sea arches that have collapsed because of a continued wave erosion.

Because the northern California coast faces the Pacific Ocean basin, where strong earthquakes occur frequently, tsunamis pose an additional hazard. Tsunamis can travel thousands of miles from their source, so even earthquakes in Japan or South America have potential to affect the northern California coast. Coastal development is commonly at risk because of cliff retreat and mass wasting events that undermine support for structures.

The San Andreas Fault in Mendocino County is located pretty much right at the coastline. The San Andreas fault runs offshore near the town of Point Arena to Cape Mendocino, where the San Andreas Fault ends at the "Triple Junction." The Triple Junction is where the American Plate, Pacific Plate, and the Gorda Plate meet. North of the Cape the offshore Gorda Plate glides under the North American Plate in what is called a subduction zone. This movement is what forms the northern Coast Range.

Figure 9.3: Map of the San Andreas Fault Near Tomales Bay.[88]

The mountains of the northern Coast Ranges are still rising due to continued plate movement at the Triple Junction. In the Mendocino area the land has been rising faster than the sea for thousands of years, resulting in marine terraces or steps. Because of continual uplift the terraces are elevated above sea level giving a staircase-like appearance. The result is an "ecological staircase." Each terrace, or step, represents approximately 100,000 years and possesses a distinctive vegetation type. A trail leads through these steps at Jughandle State Reserve. From the 2.5-mile trail, five terraces and approximately 650 feet of elevation increase can be viewed. The trail spotlights the different ecosystems from coastal scrub and grassland; through pine, redwood, fir, and spruce forests; then through Mendocino (pygmy) cypress groves; up to pine, fir, and Fort Bragg manzanita woodlands; and finally, the oldest, highest terrace represented by Douglas fir forest.

[88] Image by Jeremy Patrich is licensed under CC-BY 4.0.

The steep northern Coast Range intensifies rainfall due to the orographic effect. As Pacific storms hit the coast, air masses are forced up the steep mountainside. As the air rises, it cools, and water vapor condenses and concentrates rain on the coastal side of mountains.

Cultural Geography

The indigenous peoples of the Pacific Northwest Coast were composed of many nations and tribal affiliations, each with distinctive cultural and political identities. But they shared certain beliefs, traditions, and practices, such as the centrality of salmon as a resource and spiritual symbol. These nations had time and energy to devote to the establishment of fine arts and crafts and to religious and social ceremonies, compared to other inland nations since food was more plentiful and the climate was less extreme. The term “Northwest Coast”, or “North West Coast”, is used to refer to the groups of indigenous people residing along the coasts of British Columbia, Washington State, parts of Alaska, Oregon, and northern California.

The Pacific Northwest Coast at one time had the most densely populated areas of indigenous people. The mild climate and abundant natural resources, such as cedar and salmon, made possible the rise of a complex aboriginal culture. The indigenous people in this region practiced various forms of forest gardening and fire-stick farming in the forests, grasslands, mixed woodlands, and wetlands, ensuring that desired food and medicinal plants continued to be available using advanced farming techniques. Those involved in agricultural development would create low-intensity fires to prevent larger, catastrophic fires and sustain low-density agriculture in a loose rotation. This is what is known as permaculture, or any system of sustainable agriculture that renews natural resources and enriches local ecosystems.

SAN FRANCISCO BAY

The San Francisco Bay Area, often referred to as simply the Bay Area, is a populous region surrounding the San Francisco, San Pablo, and Suisun Bay estuaries in Northern California. The Bay Area is defined by the Association of Bay Area Governments to include the nine counties that border the estuaries: Alameda, Contra Costa, Marin, Napa, San Mateo, Santa Clara, Solano, Sonoma, and San Francisco. The core cities of the Bay Area are San Francisco, San Jose, and Oakland.

Home to approximately 7.76 million people, Northern California's nine-county Bay Area contains many cities, towns, airports, and associated regional, state, and national parks, connected by a complex multimodal transportation network. The Bay Area is known for its natural beauty, progressive politics, world-class universities, technology companies, and affluence. The larger federal classification, the combined statistical area of the region which includes fourteen counties, is the second largest in California (after the Greater Los Angeles area), the fifth largest in the United States, and the 41st-largest urban area in the world. The Bay Area's population is ethnically diverse: roughly three-fifths of the region's residents are Hispanic, Asian, African American, or Pacific Islander (with the other two-fifths being non-Hispanic White American), all of whom have a significant presence throughout the region.

Despite its urban character, the San Francisco Bay is one of California's most ecologically important habitats, providing key ecosystem services such as filtering pollutants and sediments from the rivers and supporting several endangered species. In addition, the Bay is known for its stands of coast redwoods, many of which are protected in state and county parks. The region is additionally known for the complexity of its landforms, the result of millions of years of tectonic plate movements. Because the Bay Area is crossed by six major earthquake faults, the region is particularly exposed to hazards presented by large earthquakes. The climate is temperate and generally very mild and is conducive to outdoor recreational and athletic activities such as hiking, running, and cycling. The Bay Area is host to six professional sports teams and is a cultural center for music, theater, and the arts. It is also host to higher education institutions, including research universities such as Stanford University and the University of California, Berkeley. Home to 101 municipalities and nine counties, governance in the Bay Area involves numerous local and regional jurisdictions, often with broad and overlapping responsibilities. Over time, droughts and wildfires have increased in frequency and become less seasonal and more year-round, further straining the region's water security.

The COVID-19 pandemic resulted in many tach career-based people leaving the area to live elsewhere, while working remotely. In fact, it was suggested by some that over 116,000 people moved within the first year of the Pandemic. One of the effects is empty residences, empty professional buildings, increased property rates, and increase homelessness. As of 2024, data is suggesting that the population decline may be leveling off, but the long-term impacts will be better known after the next Census.

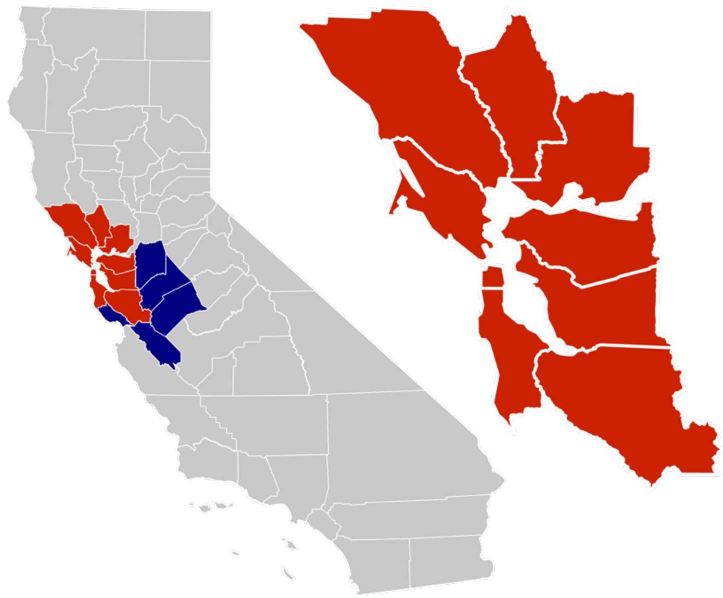


Figure 9.4: Location of the San Francisco Bay Region in California.[89]

Physical Geography

The Bay Area is in the warm-summer Mediterranean climate zone (Köppen Csb) that is a characteristic of California's coast, featuring mild to cool winters with occasional rainfall, and warm to hot, dry summers It is largely influenced by the cold California Current, which penetrates the natural mountainous barrier along the coast by traveling through various gaps. In terms of precipitation, this means that the Bay Area has pronounced seasons. The winter season, which roughly runs between November and March, is the source of about 82% of annual precipitation in the area. In the South Bay and further inland, while the winter season is cool and mild, the summer season is characterized by warm sunny days, while in San Francisco and areas closer to the Golden Gate strait, the summer season is periodically affected by fog

Due to the Bay Area's diverse topography, the result of the clashing tectonic plates, the region is home to numerous microclimates that lead to pronounced differences in climate and temperature over short distances Within the city of San Francisco, natural and artificial topographical features direct the movement of wind and fog, resulting in startlingly varied climates between city blocks. Along the Golden Gate Strait, oceanic wind and fog from the Pacific Ocean can penetrate the mountain barriers inland into the Bay Area. During the summer, rising hot air in California's interior valleys creates a low-pressure area that draws winds from the North Pacific High through the Golden Gate, which creates the city's characteristic cool winds and fog. The microclimate phenomenon is most pronounced during

[89] California Bay Area county map by English Wikipedia User GEreikat is in the public domain.

this time, when fog penetration is at its maximum in areas near the Golden Gate strait, while the South Bay and areas further inland are sunny and dry.

Along the San Francisco Peninsula, gaps in the Santa Cruz Mountains, one south of San Bruno Mountain and another in Crystal Springs, allow marine air into the interior, causing a cooling effect for cities along the Peninsula and even as far south as San Jose. This weather pattern is also the source for delays at San Francisco International Airport. In Marin county north of the Golden Gate strait, two gaps north of Muir Woods bring cold air across the Marin Headlands, with the cooling effect reaching as far north as Santa Rosa. Further inland, the East Bay receives the moderate effects of the ocean, that travels through the Golden Gate strait, and further diffuses that air through the Berkeley Hills, Niles Canyon and the Hayward Pass into the Livermore Valley and Altamont Pass. Here, the resulting breeze is so strong that it is home to one of the world's largest array of wind turbines. Further north, the Carquinez Strait funnels the marine air into the San Joaquin River Delta, causing a cooling effect in Stockton and Sacramento, so that these cities are also cooler than their Central Valley counterparts in the south.

Physical Geology

The Bay Area is well known for the complexity of its landforms that are the result of the forces of plate tectonics acting over millions of years, since the region is in the crux of a meeting point between two plates. Nine out of eleven distinct assemblages of rock types have been identified in a single county, Alameda. Diverse assemblages adjoin in complex arrangements due to offsets along the many faults (both active and stable) in the area. Therefore, many types of rock and soil are found in the region. The oldest rocks are metamorphic rocks that are associated with granite in the Salinian Block west of the San Andreas fault. These metamorphic rocks were formed from protolith of sedimentary rock of sandstones, limestones, and shales in uplifted seabeds. Volcanic deposits also exist in the Bay Area, displaced by the movement of the San Andreas fault, whose movement sliced a subduction plate and allowed magma to briefly flow to the surface

The region has considerable vertical relief in its landscapes, the topography, and geologic history, of the Bay Area can largely be attributed to the compressive forces between the Pacific Plate and the North American plate. The three major ridge structures in the Bay Area, part of the Pacific Coast Range, are all roughly parallel to the major faults. The Santa Cruz Mountains along the San Francisco Peninsula and the Marin Hills in Marin County follow the San Andreas fault, The Berkeley Hills, San Leandro Hills and their southern ridgeline extension through

Mission Peak roughly follow the Hayward fault, and the Diablo Range, which includes Mount Diablo and Mount Hamilton and runs along the Calaveras fault.

In total, the Bay Area is traversed by seven major fault systems with hundreds of related faults, all of which are stressed by the relative motion between the Pacific Plate and the North American Plate or by compressive stresses between these plates. The fault systems include the Hayward Fault Zone, Concord-Green Valley Fault, Calaveras Fault, Clayton-Marsh Creek-Greenville Fault, Rodgers Creek Fault, and the San Gregorio Fault. Significant blind thrust faults (faults with near vertical motion and no surface ruptures) are associated with portions of the Santa Cruz Mountains and the northern reaches of the Diablo Range and Mount Diablo. These "hidden" faults, which are not as well known, pose a significant earthquake hazard Among the more well-understood faults, as of 2014, scientists estimate a 72% probability of a magnitude 6.7 earthquake occurring along either the Hayward, Rogers Creek, or San Andreas fault, with an earthquake more likely to occur in the East Bay's Hayward Fault. Two of the largest earthquakes in recent history were the 1906 San Francisco earthquake and the 1989 Loma Prieta earthquake.

Cultural Geography

The earliest archaeological evidence of human settlements in the Bay Area dates to 8000–10,000 BCE (from shell mounds in the Coyote Hills). In 1769, the Bay Area was inhabited by Ohlone people when a Spanish exploration party led by Gaspar de Portolá entered the Bay – the first documented European visit to the Bay Area. After Mexico established independence from Spain in 1821, the region was briefly controlled by the Mexican government until the United States seized the territory in 1846 during the Mexican American War. Soon after, discovery of gold in California attracted a flood of treasure seekers, many using ports in the Bay Area as an entry point. During the early years of California's statehood, state legislative business rotated between three locations in the Bay Area before a permanent state capital was established in Sacramento. A major earthquake leveled the city of San Francisco and environs in 1906, but the region quickly rebuilt in time to host the 1915 Panama-Pacific Exposition. In fact, a lot of the debris from the 1906 earthquake was pushed offshore to help create a man-made extension of the San Francisco Harbor. During World War II, the Bay Area played a major role in America's war effort in the Asiatic-Pacific Theater, with the San Francisco Port of Embarkation, of which Fort Mason was one of fourteen installations and location of the headquarters, acting as a primary embarkation point for American forces. In 1945, the United Nations Charter was signed in San Francisco, establishing the United Nations, and in 1951, the Treaty of San Francisco re-established peaceful relations between Japan and the Allied Powers. Since then, the Bay Area has experienced numerous political, cultural, and artistic movements, developing unique local genres in music and art, and establishing itself as a hotbed of progressive politics. Economically, the post-war Bay Area saw huge growth in the financial and technology industries, creating an economy with a gross domestic product of over $700 billion, and home to the third-highest concentration of Fortune 500 companies in the United States (as of 2018).

According to the 2010 United States Census, the population of the nine-county Bay Area was 7.15 million, with 49.6% male and 50.4% female. The Bay Area cities of Vallejo, Suisun City, Oakland, San Leandro, Fairfield, and Richmond are among the most ethnically diverse cities in the United States.

Non-Hispanic whites form majorities of the population in Marin, Napa, and Sonoma counties. Whites also make up the majority in the eastern regions of the East Bay centered around the Lamorinda and Tri-Valley areas. San Francisco's North Beach district is considered the Little Italy of the city and was once home to a significant Italian-American community. San Francisco, Marin County and the Lamorinda area all have substantial Jewish communities.

The Latino population is spread throughout the Bay Area, but among the nine counties, the greatest number live in Santa Clara County, while Contra Costa County sees the highest growth rate. The largest Hispanic or Latino groups were those of Mexican (17.9%), Salvadoran (1.3%), Guatemalan (0.6%), Puerto Rican (0.6%) and Nicaraguans (0.5%) ancestry. Mexican Americans make up the largest share of Hispanic residents in Napa county, while Central Americans make up the largest share in San Francisco, many of whom live in the Mission District which is home to many residents of Salvadoran and Guatemalan descent.

The Asian-American population in the Bay Area is one of the largest in the United States. Asian-Americans make up the plurality in two major counties in the Bay Area: Santa Clara County and Alameda County. The largest Asian-American groups were those of Chinese (7.9%), Filipino (5.1%), Indian (3.3%), Vietnamese (2.5%), and Japanese (0.9%) heritage. Daly City has the highest proportion of Asian-American residents (58.4%) in a large U.S. city outside of Hawaii Asian Americans also constitute a majority in Cupertino, Fremont, Milpitas, Union City and significant populations in Dublin, Foster City, Hercules, Millbrae, San Ramon, Saratoga, Sunnyvale, and Santa Clara.

Pacific Islanders such as Samoans and Tongans have the largest presence in East Palo Alto, where they constitute over 7% of the population.

The African-American population of San Francisco was formerly substantial, had a thriving jazz scene and was known as "Harlem of the West." While black residents formed one-seventh of the city's population in 1970, today they have mostly moved to parts of the East Bay and North Bay, including Antioch, Fairfield and out of the Bay Area entirely. The South Park neighborhood of Santa Rosa was once home to a primarily black community until the 1980s, when many Latino immigrants settled in the area.

The Bay Area is the wealthiest region in the United States, due, primarily, to the economic power engines of San Jose, San Francisco, and Oakland. The Bay Area city of Pleasanton has the second-highest household income in the country after New Canaan, Connecticut. However, discretionary income is very comparable with the rest of the country, primarily because the higher cost of living offsets the increased income.

CENTRAL COAST

The Central Coast is an area of California, roughly spanning the coastal region between Point Mugu and Monterey Bay and is part of the Central Coast American Viticultural Area, which is often referred to as the 'Wine Country' of the state. It lies northwest of Los Angeles County and south of San Mateo and Santa Clara counties, and includes the rugged, undeveloped stretch of coastline known as Big Sur. From south to north, there are six counties that make up the Central Coast: Ventura, Santa Barbara, San Luis Obispo, Monterey, San Benito, and Santa Cruz.

Figure 9.5: Location of the Central Coast in California.[90]

[90] Map of the Central Coast region of California by Wikimedia User Cristiano Tomás is used under a CC BY-SA 4.0 license.

Physical Geography

Geographically, the actual midpoint of the California coast lies north of Santa Cruz, near Año Nuevo State Park in San Mateo County. Neither the popular use of the term Central Coast nor that of the California North Coast include the San Francisco Peninsula counties of San Mateo and San Francisco.

The region is known primarily for agriculture and tourism. Major crops include wine grapes, lettuce, strawberries, and artichokes. The Salinas Valley is one of the most fertile farming regions in the United States. Tourist attractions include Cannery Row in Monterey, the Monterey Bay Aquarium, the theatres, galleries and white sand beaches of Carmel-by-the-Sea, the golf courses of Pebble Beach and the Monterey Peninsula, the rugged coastline of Big Sur and Hearst Castle in San Simeon. Further south is Morro Rock and the port city of Morro Bay, which is adjacent to college town San Luis Obispo. The Santa Ynez Valley is home to the Central Coast Film Society, which celebrates filmmakers, cinema and media arts that are from the region, also known as "Hollywood's Backyard."

University of California campuses are found in Santa Barbara and Santa Cruz, near the south and north edges of the region respectively. California State University, Monterey Bay, founded in 1994, uses facilities donated when Fort Ord was converted from military to civilian uses. California Polytechnic State University, in San Luis Obispo, was founded in 1901. California State University Channel Islands opened in Camarillo in 2002, as the 23rd campus in the California State University system.

Field Trip: Morro Bay & Morro Rock

Let's head on field trip to Morro Bay and Morro Rock! Either scan the QR code or visit this link to see Professor Patrich explore Morro Bay in San Louis Obispo, California. (Video length: 6min).

Physical Geology | Case Study – Santa Barbara

The city of Santa Barbara is situated on a coastal plain between the Santa Ynez Mountains and the sea. This coastal plain consists of a complex array of Holocene and Pleistocene alluvial and colluvial deposits, marine terraces, debris flows, and estuarine deposits. Soils are mostly well drained brown fine sandy loam of the Milpitas series. Rapid geologic uplift is characteristic of the entire region, as evidenced by the coastal bluffs and narrow beaches that are present along most of the coastline.

Downtown Santa Barbara occupies a floodplain between two major geologic faults, the Mission Ridge Fault Zone to the north and the Mesa Fault to the south. The Mission Ridge Fault Zone runs along the range of hills known locally as the "Riviera", and the Mesa Fault defines the northern boundary of the band of hills called the "Mesa". These two faults converge near the Five Points Shopping Center at Los Positas and State Streets. Neither is well-exposed, with their locations being inferred from topography, springs, seeps, and well logs. The Mesa Fault continues southeast offshore into the Santa Barbara Channel; the portion of the fault offshore is believed to have been responsible for the destructive earthquake of 1925. The Mission Ridge Fault trends east–west, being named the More Ranch Fault west of Santa Barbara, and forms the northern boundary of the uplands which include Isla Vista, More Mesa, and the Hope Ranch Hills.

Figure 9.6: Mission Santa Barbra, After the Santa Barbra Earthquake in 1925[91]

Three major sedimentary bedrock units underlie the coastal plain: the Monterey Formation, the Sisquoc Formation, and the Santa Barbara Formation. The Santa Barbara Formation is one of the main units in the aquifer underlying the city. Its coarse-grained freshwater-bearing portion, much of which is below sea level, is protected from seawater intrusion by the More Ranch

[91] Mission Santa Barbara 1925 hosted on Wikimedia Commons in the public domain.

Fault, which has shielded it by uplifting less-permeable rocks between it and the sea. Most water wells in the Santa Barbara-Goleta area pull from this geologic unit.

The Santa Ynez Mountains to the north of the city consist of multiple layers of sandstone and conglomerate units dating from the Jurassic Age to the present, uplifted rapidly since the Pliocene, upended, and in some areas completely overturned. Rapid uplift has given these mountains their craggy, scenic character, and numerous landslides and debris flows, which form some of the urban and suburban lowland area, are testament to their geologically active nature.

Field Trip: Pillow Basalts in San Louis Obispo

Let's head on field trip to Avila Beach! Either scan the QR code or visit this link to see Professor Patrich explore pillow Basalts in San Louis Obispo, California. (Video length: 4min).

Cultural Geography | Santa Barbara Architecture

The first Monterey-style adobe in California was built on State Street of Santa Barbara by the wealthy merchant Alpheus Thompson. The dominant architectural themes of Santa Barbara are the Mediterranean Revival, Spanish Colonial Revival, and the related Mission Revival style, encouraged through design guidelines adopted by city leaders after the 1925 earthquake destroyed much of the downtown commercial district. Residential architectural styles in Santa Barbara reflect the era of their construction. Many late-1800s Victorian homes remain downtown and in the "Upper East" neighborhood. California bungalows are common, built in the early decades of the 20th century. Spanish Colonial Revival-style homes built after 1925 are common all over the city, especially in newer upscale residential areas like Montecito and Hope Ranch. Notable modernist and contemporary homes can be found as well.

Physical Geology | Case Study – Ventura County

Ventura county is on a tectonically active plate, since most of Coastal California is near the boundaries between the Pacific and North American Plates. The county of Ventura is made up of 10 incorporated cities: Camarillo, Fillmore, Moorpark, Ojai, Oxnard, Port Hueneme, Santa Paula, Simi Valley, Thousand Oaks, and San Buenaventura.

The San Andreas Fault, which demarcates this boundary, is about 40 miles away. One active fault that transverses the city of Oxnard is the Oak Ridge Fault, which straddles the Santa Clara

River Valley westward from the Santa Susana Mountains, crosses the Oxnard Plain through Oxnard, and extends into the Santa Barbara Channel. The coastline is subject to inundation by a tsunami up to 23 feet in height. The San Andreas has proven to be a significant contributor to seismic activity in the Oxnard region and beyond. The 6.7 Mw Northridge earthquake that occurred on January 17, 1994, is believed to have occurred in the Santa Clarita extension of the Oak Ridge Fault. Landslides and ridge-top shattering resulting from the Northridge earthquake were observed above Moorpark, a city 19.6 mi (31.5 km) east of Oxnard

Running through the middle of the county is the Ventura Oil Field, which is a large and currently productive oil field in the hills just north of the city center of Ventura. The Ventura field, the large-scale structural feature responsible for petroleum accumulation is the Ventura Anticline, an east-west trending geologic structure 16 miles (26 km) long, visible in the numerous rock outcrops in the rugged topography of the area. This anticline dips steeply on both sides, with the dip angle ranging from 30 to 60 degrees, resulting in a series of rock beds resembling a long house with a gabled roof, under which oil and gas collect in abundance.

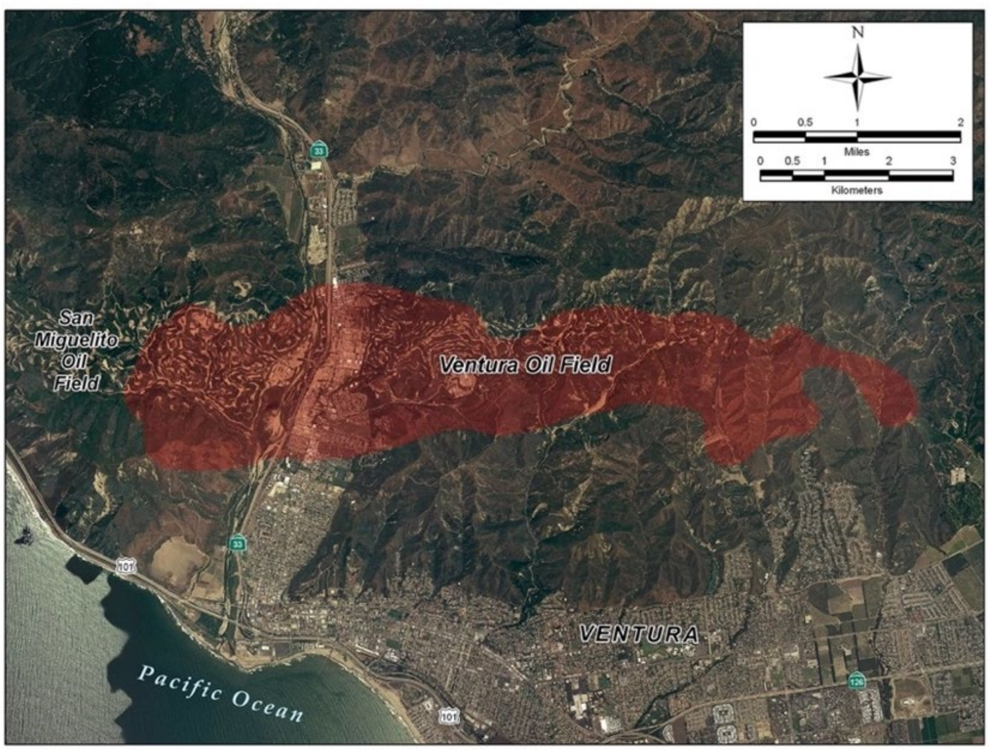


Figure 9.7: Map of the Ventura Oil Field[92]

[92] VenturaDetail by User:Antandrus is used under a CC BY-SA 3.0 license.

Within this feature, the primary petroleum-bearing unit is the Pico Formation, a sedimentary unit of turbidite sands of high porosity (16 to 20 percent). Additionally, oil is found in the underlying Santa Margarita Formation. Eight different oil-bearing zones have been identified by number, 1st through 8th based on depth, with the 2nd zone the first to be discovered, in March 1919 by the Shell Oil Company. The pools range in depth from 3,680 feet (1,120 m) to over 12,000 feet (3,700 m), although depth within each pool varies greatly; the discovery well into the 2nd zone, which has an average depth of 5,180 feet (1,580 m), had a total depth of only 3,500 feet (1,100 m).

The underlying Monterey Formation is presumed to be the source of the oil accumulations in the Ventura field, as well as the other two fields in the same geologic trend. The Monterey Formation is rich in organic matter, averaging 3-5 percent but reaching 23 percent in some areas. Oil likely migrated upwards during the late Pliocene, becoming trapped in the folds and structural traps of the higher rocks of the anticline which form an impermeable cap. Some of the oil-bearing zones, such as the 4th and 5th, are capped by the Barnard Fault, which provides an additional structural trap. Even with the impermeable caps and structural traps, there are enough breaks in the structure for significant natural tar seeps to occur; indeed, the entire region is riddled with natural seeps, and tar was used by the native Chumash peoples as a sealant for their watercraft.

Cultural Geography | Case Study – Ventura County

Pre-Colonial Period

Ventura County was historically inhabited by the Chumash people, who also settled much of Santa Barbara and San Luis Obispo Counties, with their presence dating back 10,000–12,000 years. The Chumash were hunter-gatherers, fishermen, and traders with the Mojave, Yokuts, and Tongva Indians. The Chumash are also known for their rock paintings and for their great basketry. The plank canoe, called a tomol in Chumash, was important to their way of life. Canoe launching points on the mainland for trade with the Chumash of the Channel Islands were located at the mouth of the Ventura River, Mugu Lagoon and Point Hueneme. This has led to speculations among archeologists of whether the Chumash could have had a pre-historic contact with Polynesians. According to diachronic linguistics, certain words such as tomolo'o (canoe) could be related to Polynesian languages. The dialect of the Chumash language that was spoken in Ventura County was Ventureño.

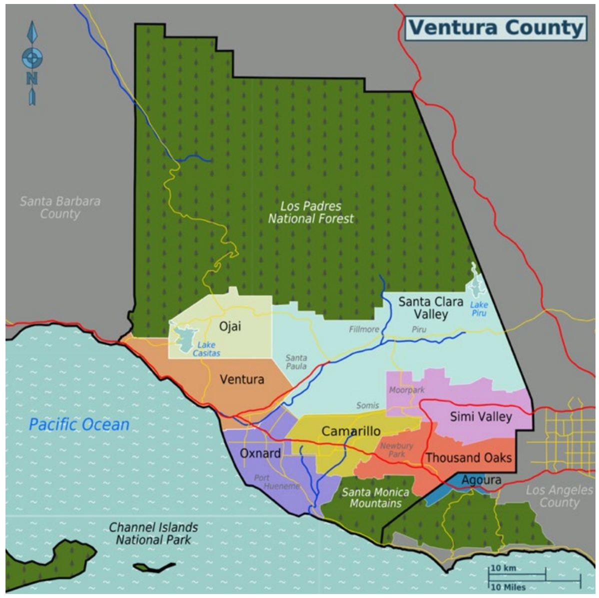


Figure 9.8: Physiographic Map of Ventura County with Place Names.[93]

Several place names in the county have originated from Chumash, including Ojai, which means moon, and Simi Valley, which originates from the word Shimiyi and refers to the stringy, thread-like clouds that typify the region, also known as cirrus clouds. Other names include Point Mugu from the word Muwu meaning “beach”, Saticoy from the word Sa’aqtiko’y meaning “sheltered for the wind”, and Sespe Creek from the word S’eqp’e meaning “kneecap”.

Spanish Period

Mission San Buenaventura is a Spanish mission founded in 1782 by the Franciscan order.
In October 1542, the expedition led by Juan Rodríguez Cabrillo anchored in an inlet near Point Mugu; its members were the first Europeans to arrive in the area that would become Ventura County.

Active occupation of California by Spain began in 1769. Gaspar de Portolà led a military expedition by land from San Diego to Monterey, passing through Ventura County in August of that year. A priest with the expedition, Father Juan Crespí, kept a journal of the trip and noted that the area was ideal for a mission to be established and it was a "good site to which nothing is lacking". Also on this expedition was Father Junípero Serra, who later founded a mission on this site.

On March 31, 1782, the Mission San Buenaventura was founded by Father Serra. It is named after Saint Bonaventure, one of the early intellectual founders of the Franciscan order. The

---

[93] Ventura County districts map on Wikimedia Commons is in the public domain

town that grew up around the mission was originally named San Buenaventura (and retains the name officially), it has been known as Ventura since 1891.

In the 1790s, the Spanish Governor of California began granting land concessions to Spanish Californians who were often retiring soldiers. These concessions were known as ranchos and consisted of thousands of acres of land that were used primarily as ranch land for livestock. In Ventura County, Rancho Simi was granted in 1795 and Rancho El Conejo in 1802. Fernando Tico was granted Ojai and part of Ventura by Gov. Alvarado.

Mexican Period

In 1822, California was notified of Mexico's independence from Spain and the Governor of California, the Junta, the military in Monterey and the priests and neophytes at Mission San Buenaventura swore allegiance to Mexico on April 11, 1822. California land that had been vested in the King of Spain was now owned by the nation of Mexico.

By the 1830s, Mission San Buenaventura was in a decline with fewer neophytes joining the mission. The number of cattle owned by the mission dropped from first to fifteenth ranking in the California Missions. The missions were secularized by the Mexican government in 1834. The Mexican governors began granting land rights to Mexican Californians, often retiring soldiers. By 1846, there were 19 rancho grants in Ventura County. In 1836, Mission San Buenaventura was transferred from the Church to a secular administrator. The natives who had been working at the mission gradually left to work on the ranchos. By 1839, only 300 Indians were left at the Mission and it slipped into neglect.

American Period

The Mexican-American War that began in 1846, had its’ effect in Ventura County. In January of 1847, when Captain John C. Frémont led the California Battalion into San Buenaventura, and found that the Europeans had fled, leaving only the Indians at the Mission. Fremont and the Battalion continued south to sign the Treaty of Cahuenga with General Andrés Pico. The Treaty of Guadalupe Hidalgo formally transferred California to the United States in 1848.

By 1849, California became a territory and was divided into 27 counties. The area that would become Ventura County was originally part of Santa Barbara County.

In the 1860s, the area experienced a drought and many of the ranchos were divided and sold. The town of San Buenaventura was incorporated in 1866, becoming the first officially recognized town in what would become Ventura County.

On January 1, 1873, Ventura County was officially split from Santa Barbara County. The Southern Pacific Railroad laid tracks through San Buenaventura in 1887. Other towns in the county were established in the late 19th century, including Oxnard, which was named after the Oxnard Brothers, who owned a sugar beet processing factory.

Other towns were starting in the county. A plan for Hueneme, later called Port Hueneme, was recorded in 1874, and Santa Paula's plan was recorded in 1875. The community of Nordhoff, later renamed Ojai, was started in 1874. Bardsdale, Fillmore, Piru, and Montalvo were established in 1887. 1892 saw Simi, later Simi Valley, Somis, Saticoy, and Moorpark. Oxnard was a latecomer, not being established until 1898.

The Southern Pacific Railroad laid tracks through San Buenaventura in 1887. For convenience in printing their timetables, Southern Pacific shortened San Buenaventura to Ventura. The Post Office soon followed suit. While the city remains officially known as San Buenaventura, it is more commonly referred to as Ventura. The rail line to Northern California originally went through Saugus, Fillmore, and Santa Paula, providing a boom to those communities along the line. In 1905, Tunnel #26 was completed between Chatsworth and Corriganville near Simi Valley, shortening the rail route. At a length of 7,369 feet (2,246 m), Tunnel #26 was the longest tunnel ever constructed in its day. This tunnel joined to the railroad spur coming the other direction from Montalvo through Camarillo, Moorpark, and Simi Valley, making the contemporary main line used today. One stop along the way, at a 90-degree turn, was at a sugar beet processing factory. The factory bore the name of its absentee owners, the Oxnard Brothers. A small community of farm and factory workers grew near the train stop. That community, now bearing the name of the factory shortened to the one-word train stop Oxnard, has become the largest city in Ventura County.

Oil has been known in Ventura County since before the arrival of the Europeans. The first oil well in the county was drilled in 1914, but it was not until 1916 that the large South Mountain Oil Field was discovered. At its peak, the Ventura Avenue oilfield was producing 90,000 barrels of oil a day. Other oil fields came online in the 1920s and 1930s.

Modern Period

Ventura County can be separated into two major parts, East County and West County, which are divided by the Conejo Grade. East County consists of all cities east of the Conejo Grade. Geographically East County is the end of the Santa Monica Mountains, in which the Conejo Valley is located, and where there is a considerable increase in elevation. Communities which are in the East County are Thousand Oaks, Newbury Park, Lake Sherwood, Hidden Valley, Santa

Rosa Valley, part of Westlake Village, Oak Park, Moorpark, and Simi Valley. Most of these communities are in the Conejo Valley.

West County, which is everything west of the Conejo Grade, consists of communities such as Camarillo, Oxnard, Somis, Point Mugu, Port Hueneme, Ventura, Ojai, Santa Paula, and Fillmore. West County consists of some of the first developed cities in the county. The largest beach communities are in West County along the coastline between the Channel Islands Harbor and Ventura Harbor.

Starting in the mid-20th century, there was a large growth in population in the East County, moving from the San Fernando Valley in Los Angeles and west into the Conejo and Simi Valleys. Part of the Conejo Valley is situated in Los Angeles County. This part consists of Calabasas, Hidden Hills, Agoura Hills, Agoura, and Westlake Village. The other half of the Conejo Valley, which belongs to Ventura County, consists of Lake Sherwood, Hidden Valley, Oak Park, Thousand Oaks, and Newbury Park, which was formerly an unincorporated area that is now the most westerly part of Thousand Oaks. Many working-class people migrated to this area during the 1960s and 1970s out of East and Central Los Angeles. As a result, there was a large growth in population into the Conejo Valley and into Ventura County through the U.S. Route 101 corridor. Making the U.S. 101 a full freeway in the 1960s, and the expansions that followed, helped make commuting to Los Angeles easier and opened the way for development westward. The communities that have seen the most substantial development are Calabasas, Hidden Hills, Agoura Hills, Westlake Village, Thousand Oaks, and Newbury Park. The neighboring East County area of Simi Valley saw its already considerable population of nearly 60,000 inhabitants in 1970 grow to over 100,000 over the following two decades.

SOUTH COAST

The South Coast is a region of California, making up roughly the southernmost third of the Californian coast. It refers for the most part to the Southern California coastal counties of Ventura, Los Angeles, Orange, and San Diego due to the cosmopolitan "SoCal" atmosphere and location of major urban coastal centers. Of these counties only the western two-thirds of San Diego, coastal half of Ventura, most of Los Angeles and all of Orange are included.

Geologists consider the northern Channel Islands to be a westward extension of the Santa Monica’s into the Pacific Ocean. The range was created by repeated episodes of uplifting and submergence by the Raymond Fault, which created complex layers of sedimentary rock, some containing fossils of invertebrates and fish. Volcanic intrusions have been exposed, including the poorly named andesitic. "Sandstone Peak", which is the highest point in the range at 3,111 feet (948 m). Malibu Creek, which eroded its own channel while the mountains were slowly uplifted, bisects the mountain range.

However, some sources include the western part of Riverside, and southwestern part of San Bernardino Counties, and the northwestern corner of Baja California, because of their proximity to the Pacific Coast and because they are in the same bio-region and watershed.

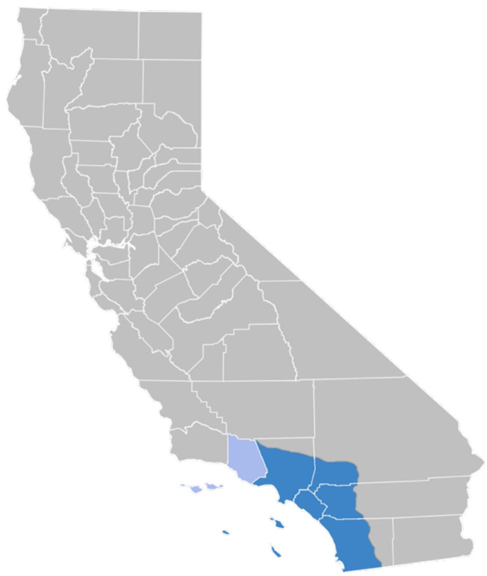


Figure 9.9: Location of the South Coast in California.[94]

Physical Geography

The Peninsular Ranges are a group of mountain ranges in the Pacific Coast Ranges, which stretch over 900 miles from southern California in the United States to the southern tip of Mexico's Baja California peninsula. They are part of the North American Coast Ranges that run along the Pacific coast from Alaska to Mexico. Elevations range from 500 ft to 11,500 ft (150 m to 3,500 m) and vegetation in these ranges varies from coastal sage scrub to chaparral, and from oak woodland to conifer forest.

The Peninsular Ranges of southern California include the Santa Ana Mountains, Santa Monica Mountains, San Jacinto Mountains, and the Laguna Mountains. The Peninsular Ranges of Baja

[94] Map of the South Coast region of California by Wikimedia User Cristiano Tomás is used under a CC BY-SA 4.0 license.

California include the Sierra Juarez, Sierra San Pedro Martir, Sierra de la Giganta, and Sierra de la Laguna. These ranges run from north to south.

The Santa Ana Mountains are the largest natural landscape along the coast of southern California. These mountains peak at about 5,689 feet, on Santiago Peak. This range starts in the north, in the Corona area heading southeast of the Puente Hills region.

The Santa Monica Mountains are approximately 40 miles (64 km) east-west from the Hollywood Hills in Los Angeles to Point Mugu in Ventura County. The western mountains, separating the Conejo Valley from Malibu, suddenly end at Mugu Peak as the rugged, nearly impassible shoreline gives way to tidal lagoons and coastal sand dunes of the alluvial Oxnard Plain. The mountain range contributed to the isolation of this vast coastal plain before regular transportation routes reached western Ventura County. The eastern mountains form a barrier between the San Fernando Valley and the Los Angeles Basin, separating "the Valley" on the north and west-central Los Angeles on the south. The Santa Monica Mountains are parallel to the Santa Susana Mountains, which are located directly north of the mountains across the San Fernando Valley.

The San Jacinto Mountains are in the desert areas in the north and east side of southern California. They peak at about 10,833 feet. They run from the San Bernardino Mountains southeast to the Santa Rosa Mountains. This mountain range is the northernmost part of the Peninsular Range.

The Santa Rosa Mountains are located at the southern end of the San Jacinto Mountains, where they connect to it. The range extends for approximately 30 miles (48 km) through Riverside, San Diego and Imperial counties, along the western side of the Coachella Valley, where they bound the Anza-Borrego portion of the Colorado Desert. The highest peak in the range is Toro Peak (8,717 feet).

The Laguna Mountains are in the eastern part of San Diego County. They range northwest to southeast for approximately 20 miles and peak at Cuyapaipe Mountain (6,378 feet). These mountains extend northwest about 35 mi (56 km) from the Mexican border at the Sierra de Juárez. The Sonora Desert lies to the east and the Santa Rosa Mountains are to the northwest.

Case Study – Balboa Island

Millions of years ago, powerful geological forces shaped the landscape we see today. The relentless pounding of the Pacific Ocean and the deposition of sediment by the Santa Ana River gradually formed a submerged sandbar off the coast of Newport Beach. This underwater feature, continuously evolving under the influence of tides and currents, eventually emerged above the waterline sometime between 1825 and 1865 as a small mudflat, that was surrounded by swampland. This newly formed sandbar laid the foundation for what would become Balboa Island.

Around 1860, James McFadden, a prominent Newport Beach landowner, envisioned transforming the undeveloped sandbar into a vibrant resort destination. In the early 1900s, W.S. Collins, a real estate developer, saw the potential of McFadden's vision. He purchased a significant portion of the land and began dredging the harbor to create a channel and further define the island's shape. This period also saw the construction of the Pacific Electric Red Car line, connecting Balboa Island to Los Angeles and making it a more accessible getaway for city dwellers.

The early 20th century marked a golden age for Balboa Island. The iconic Balboa Pavilion, originally built as a Victorian bathhouse, quickly transformed into a renowned entertainment venue, hosting dances, concerts, and other social gatherings. The construction of the Balboa Fun Zone, with its Ferris wheel, arcade games, and carnival atmosphere, further solidified the island's reputation as a premier leisure destination. The 1920s saw the development of unique "Nutcracker" houses, small, colorful cottages designed to maximize space. These charming dwellings remain a hallmark of the island's character.

Figure 9.10: Aerial Photo of Balboa Island, 1921[95]

During World War II, the island played a vital role in the war effort. The Balboa Yacht Basin served as a training ground for the US Navy, and the island's residents proudly supported the war cause. Following the war, Balboa Island experienced continued growth and development, maintaining its status as a beloved seaside escape.

[95] Image hosted on Wikimedia Commons in the public domain.

Figure 10.1: Yosemite Falls, Mariposa, California.[96]

UNIT 10: THE SIERRA NEVADA

Goals & Objectives of this unit

- Define the overall geologic development and formation of the Sierra Nevada.
- Identify key historical events within the Sierra, including culture, war and formation of the First State Park in the United States.
- Analyze the importance of the Sierra Nevada's glacial past, and how the erosion, transportation and deposition created iconic landscapes studied today.

INTRODUCTION

The Sierra Nevada is a mountain range in the Western United States, between the Central Valley of California and the Great Basin. Most of the range lies in the state of California, although the Carson Range spur lies primarily in Nevada. The Sierra Nevada is part of the

[96] Image by Jeremy Patrich is licensed under CC BY 4.0

American Cordillera, an almost continuous chain of mountain ranges that forms the western "backbone" of the Americas.

The Sierra runs 400 miles (640 km) north-south and its width ranges from 50 miles (80 km) to 80 miles (130 km) across east–west. Notable features include General Sherman, the largest tree in the world by volume; Lake Tahoe, the largest alpine lake in North America; Mount Whitney at 14,505 ft (4,421 m), the highest point in the contiguous United States; and Yosemite Valley sculpted by glaciers from one-hundred-million-year-old granite, containing high waterfalls. The Sierra is home to three national parks, twenty-six wilderness areas, ten national forests, and two national monuments. These areas include Yosemite, Sequoia, and Kings Canyon National Parks; and Devils Postpile National Monument.

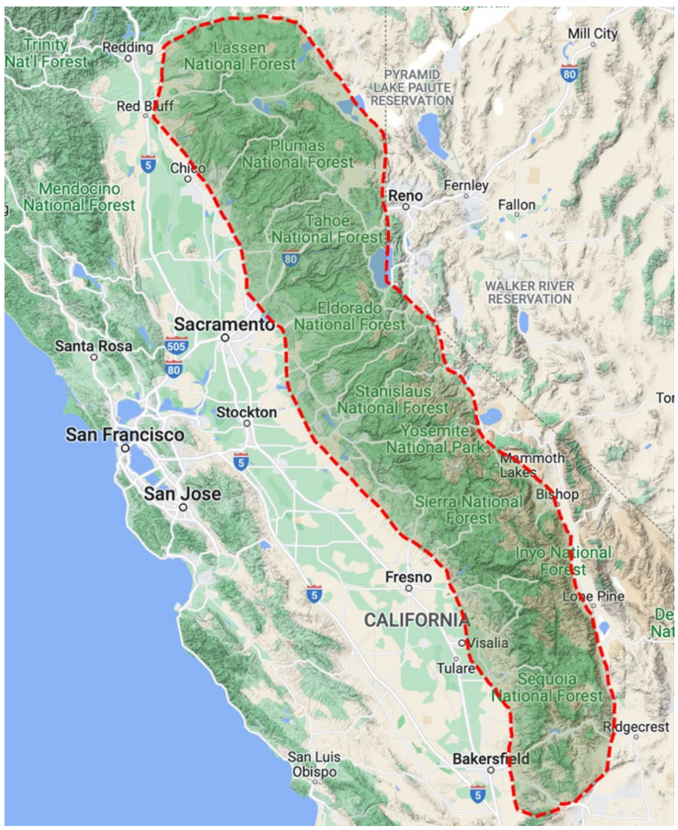


Figure 10.2: Map Outlining the Approximate Location of the Sierra Nevada Mountain Range.[97]

More than one hundred million years ago during the Nevadan orogeny, granite formed deep underground. The range started to uplift less than five million years ago, and erosion by glaciers exposed the granite and formed the light-colored mountains and cliffs that make up the range. The uplift caused a wide range of elevations and climates in the Sierra Nevada, which are

[97] Image by Author is licensed under CC BY 4.0

reflected by the presence of five life zones (areas with similar plant and animal communities). Uplift continues due to faulting caused by tectonic forces, creating spectacular fault block escarpments along the eastern edge of the southern Sierra.

The Sierra Nevada has played an important role in the history of California and the United States. The California Gold Rush occurred in the western foothills from 1848 through 1855. Due to its inaccessibility, the range was not fully explored until 1912

PHYSICAL GEOGRAPHY

The Sierra Nevada lies primarily in central and eastern California, with the Carson Range, a small but historically important spur, extending into Nevada. West-to-east, the Sierra Nevada's elevation increases gradually from 500 feet (150 m) in the Central Valley to more than 14,000 feet (4,300 m) atop the highest peaks of its crest 50–75 miles (80–121 km) to the east. The east slope forms the steep Sierra Escarpment. Unlike its surroundings, the range receives a substantial amount of snowfall and precipitation due to orographic lift.

The Sierra Nevada's irregular northern boundary stretches from the Susan River and Fredonyer Pass to the North Fork Feather River. Physiographically, the Sierra is a section of the Cascade–Sierra Mountains province, which in turn is part of the larger Pacific Mountain System physiographic division. The California Geological Survey states that "the northern Sierra boundary is marked where bedrock disappears under the Cenozoic volcanic cover of the Cascade Range". It is bounded on the west by California's Central Valley, on the east by the Basin and Range Province, and on the southeast by the Mojave Desert. The southern boundary is at Tehachapi Pass.

The Sierra is drained on its western slope by the Central Valley watershed, which discharges into the Pacific Ocean at San Francisco. The northern third of the western Sierra is part of the Sacramento River watershed (including the Feather, Yuba, and American River tributaries), and the middle third is drained by the San Joaquin River (including the Mokelumne, Stanislaus, Tuolumne, and Merced River tributaries). The southern third of the range is drained by the Kings, Kaweah, Tule, and Kern rivers, which flow into the endorheic basin of Tulare Lake, which rarely overflows into the San Joaquin during wet years. An endorheic basin is a drainage basin that normally retains water and allows no outflow to other, external bodies of water; instead, the water drainage flows into permanent and seasonal lakes and swamps that equilibrate through evaporation (figure 10.3).

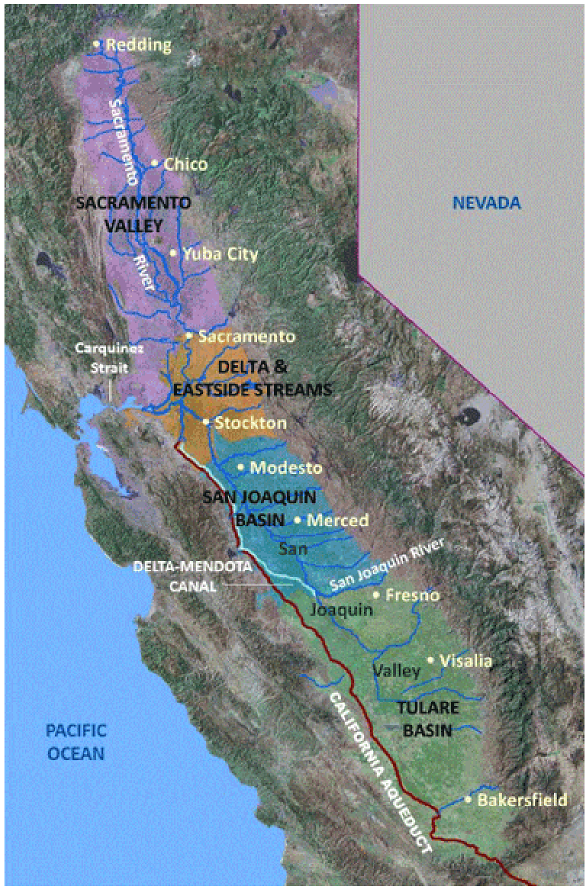


Figure 11.3 Map of California's Four Regions of the Central Valley.[98]

The eastern slope watershed of the Sierra is much narrower; its rivers flow out into the endorheic Great Basin of eastern California and western Nevada. From north to south, the Susan River flows into intermittent Honey Lake, the Truckee River flows from Lake Tahoe into Pyramid Lake, the Carson River runs into Carson Sink, the Walker River into Walker Lake; Rush, Lee Vining and Mill Creeks flow into Mono Lake; and the Owens River into dry Owens Lake. Although none of the eastern rivers reach the sea, many of the streams from Mono Lake southwards are diverted into the Los Angeles Aqueduct which provides water to Southern California.

Weather & Climate

The climate of the Sierra Nevada is influenced by the Mediterranean climate of California. During the fall, winter and spring, precipitation in the Sierra ranges from 20 to 80 in (510 to 2,030 mm) where it occurs mostly as snow above 6,000 ft (1,800 m). Precipitation is highest on

[98] Image is in the public domain.

the central and northern portions of the western slope between 5,000 and 8,000 feet (1,500 and 2,400 m) elevation, due to orographic lift. Above 8,000 feet (2,400 m), precipitation diminishes on the western slope up to the crest since most of the precipitation has been wrung out at lower elevations. Most parts of the range east of the crest are in a rain shadow and receive less than 25 inches of precipitation per year. While most summer days are dry, afternoon thunderstorms are common, particularly during the North American Monsoon in mid and late summer. Some of these summer thunderstorms drop over an inch of rain in a short period, and on hot days, dry lightning, can start fires. Summer high temperatures average 42–90 °F (6–32 °C). Winters are comparatively mild, and the temperature is usually only just low enough to sustain a heavy snowpack. For example, Tuolumne Meadows, at 8,600 feet (2,600 m) elevation, has winter daily highs about 40 °F (4 °C) with daily lows about 10 °F (−12 °C). The growing season of the Sierra Nevada lasts 20 to 230 days, strongly dependent on elevation. The highest elevations of the Sierra have an alpine climate.

The Sierra Nevada snowpack is the major source of water and a significant source of electric power generation in California. Many reservoirs were constructed in the canyons of the Sierra throughout the 20th century, such as the Hetch Hetchy, which supplies water to San Francisco. Several major aqueducts serving both agriculture and urban areas distribute Sierra water throughout the state. However, the Sierra casts a rain shadow, which greatly affects the climate and ecology of the central Great Basin. This rain shadow is largely responsible for Nevada being the driest state in the United States.

CULTURAL GEOGRAPHY

Native Americans

Archaeological excavations placed Martis people of Paleo-Indians in northcentral Sierra Nevada during the period of 3,000 BCE to 500 CE. The earliest sustaining indigenous people in the Sierra Nevada were the Northern Paiute tribes on the east side, with the Mono tribe and Sierra Miwok tribe on the western side, and the Kawaiisu and Tübatulabal tribes in the southern Sierra. Today, some historic intertribal trade route trails over mountain passes are known artifact locations, such as Duck Pass with its obsidian arrowheads. The California and Sierra Native American tribes were predominantly peaceful, with occasional territorial disputes between the Paiute and Sierra Miwok tribes in the mountains. Washo and Maidu were also in this area.

Initial European-American Exploration

American exploration of the mountain range started in 1827. Although prior to the 1820s there were Spanish missions, pueblos (towns), presidios (forts), and ranchos along the coast of California, no Spanish explorers visited the Sierra Nevada. The first Americans to visit the mountains were amongst a group led by fur trapper Jedediah Smith, crossing north of the Yosemite area in May 1827, at Ebbetts Pass.

In 1833, a subgroup of the Bonneville Expedition led by Joseph Reddeford Walker was sent westward to find an overland route to California. Eventually the party discovered a route along the Humboldt River across present-day Nevada, ascending the Sierra Nevada, starting near present-day Bridgeport, and descending between the Tuolumne and Merced River drainage. The group may have been the first non-indigenous people to see Yosemite Valley. The Walker Party probably visited either the Tuolumne or Merced Groves of giant sequoia, becoming the first non-indigenous people to see the giant trees, but journals relating to the Walker party were destroyed in 1839, in a print shop fire in Philadelphia.

Starting in 1841, emigrants from the United States started to move to California via Sonora and Walker Passes, and in the winter of 1844, Lt. John C. Frémont, accompanied by Kit Carson, was the first American to see Lake Tahoe. The Frémont party camped at 8,050 ft. Another iconic group of pioneers during this time were the Donner-Reed Party. The Donner-Reed Party embarked on a westward migration in 1846, but a series of misfortunes turned their journey into a chilling tragedy. Delayed by a late start and a challenging route, they found themselves trapped by heavy snow near Donner Lake, in the Sierra Nevada mountains, as winter arrived. Facing starvation and harsh conditions, some members resorted to unthinkable measures to survive. Eventually, relief parties reached the survivors, but many had already succumbed to starvation, disease, or exposure. The Donner-Reed Party's ordeal became a cautionary tale, forever etched in history as a symbol of the perils faced by 19th century pioneers venturing westward.

Gold Rush

The California Gold Rush began at Sutter's Mill, near Coloma, in the western foothills of the Sierra. On January 24, 1848, James W. Marshall, a foreman working for Sacramento pioneer John Sutter, found shiny metal in the tailrace of a lumber mill Marshall was building for Sutter on the American River. Rumors soon started to spread and were confirmed in March 1848 by San Francisco newspaper publisher and merchant Samuel Brannan. Brannan strode through the streets of San Francisco, holding aloft a vial of gold, shouting "Gold! Gold! Gold from the American River!"

On August 19, 1848, the New York Herald was the first major newspaper on the East Coast to report the discovery of gold. On December 5, 1848, President James Polk confirmed the discovery of gold in an address to Congress. Soon, waves of immigrants from around the world, later called the "forty-niners", invaded the Gold Country of California or "Mother Lode". Miners lived in tents, wood shanties, or deck cabins removed from abandoned ships. Wherever gold was discovered, hundreds of miners would collaborate to put up a camp and stake their claims.

Because the gold in the California gravel beds was so richly concentrated, the early forty-niners simply panned for gold in California's rivers and streams. However, panning could not take place on a large scale, and miners and groups of miners graduated to more complex placer mining. Groups of prospectors would divert the water from an entire river into a sluice alongside the river, and then dig for gold in the newly exposed river bottom.

By 1853, most of the easily accessible gold had been collected, and attention turned to extracting gold from more difficult locations. Hydraulic mining was used on ancient gold-bearing gravel beds on hillsides and bluffs in the gold fields. In hydraulic mining, a high-pressure hose directed a powerful stream or jet of water at gold-bearing gravel beds. It is estimated that by the mid-1880s, 11 million troy ounces (340 metric tons) of gold (worth approximately $16 billion in 2020 prices) had been recovered by hydraulic mining. A byproduct of these extraction methods was that large amounts of gravel, silt, heavy metals, and other pollutants went into streams and rivers. Even today, many areas still bear the scars of hydraulic mining since the resulting exposed earth and downstream gravel deposits do not support plant life.

It is estimated that by 1855, at least 300,000 gold-seekers, merchants, and other immigrants had arrived in California from around the world. The huge numbers of newcomers brought by the Gold Rush drove Native Americans out of their traditional hunting, fishing, and food-gathering areas. To protect their homes and livelihood, some Native Americans responded by attacking the miners, provoking counterattacks on native villages. The Native Americans, outgunned, were often slaughtered.

PHYSICAL GEOLOGY

The Sierra Nevada is a huge block of the earth's crust, composed of plutonic and metamorphic rocks of Paleozoic and Mesozoic age, that has been sharply uplifted and exposed on the east along the Sierra Nevada fault system and has been tilted westward. It is overlapped on the west by Upper Cretaceous and Cenozoic sedimentary rocks of the Great Valley and on the north by

Cenozoic volcanic sheets extending south from the Cascade Range. A blanket of volcanic material caps large areas in the northern part of the range. Most of the southern half of the Sierra Nevada and the eastern part of the northern half are composed of plutonic, primarily granitic, rocks of Mesozoic age. These rocks constitute the Sierra Nevada batholith, which is part of a continuous belt of plutonic rocks that extends from Baja, California, northward through the Peninsular Ranges and the Mojave Desert through the Sierra Nevada at an acute angle to the range, and into western Nevada. It may continue at depth beneath the volcanic rocks of the Snake River Plains and connect with the Idaho batholith.

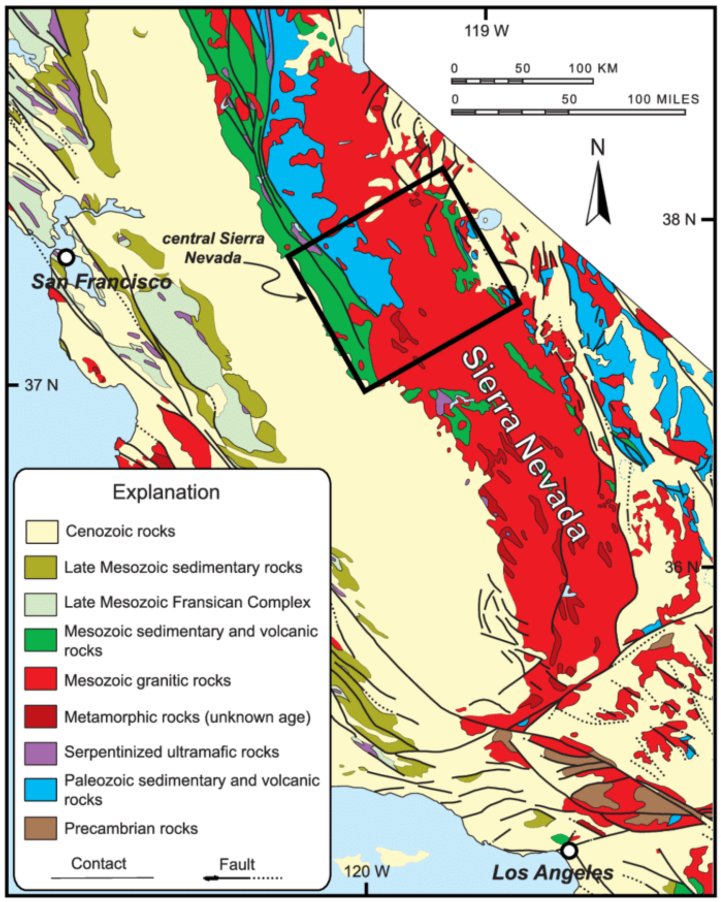


Figure 10.4: Geologic Map of The Sierra Nevada & Surrounding Areas.[99]

The Sierra Nevada batholith was emplaced into strongly deformed but weakly metamorphosed sedimentary and volcanic rocks of Paleozoic and early Mesozoic age, which can be referred to as the "framework" rocks. In the northern half of the range, the batholith is flanked on the west by the western metamorphic belt, which is the site of the famed Mother Lode. Farther south, scattered remnants of metamorphic rock are found within the batholith, especially in the

[99] Image by California Geological Survey is licensed under USGS.

western foot hills and along the crest in the east-central Sierra Nevada. The batholith extends eastward to the east edge of the range, but in the southern half one can look eastward across Owens Valley to the wall rocks on the east side of the batholith which here constitute the White and Inyo Mountains. The region in which the U.S. Geological Survey has concentrated its most recent studies is well situated for comparing and relating the rocks and structures on the two sides of the batholith, because the southern end of the western metamorphic belt and the northern end of the area of good exposures on the east side of the batholith overlap here.

Sierran Arc

In early Triassic time, an extensive volcanic arc system called the Sierran Arc began to develop along the western margin of the North American continent. In Southern California, this volcanic arc would develop throughout the Mesozoic Era to become the geologic regions known as the Sierra Nevada Batholith, the Peninsular Ranges Batholith, (in the Peninsular Ranges), and other plutonic and volcanic centers throughout the greater Mojave Desert region.

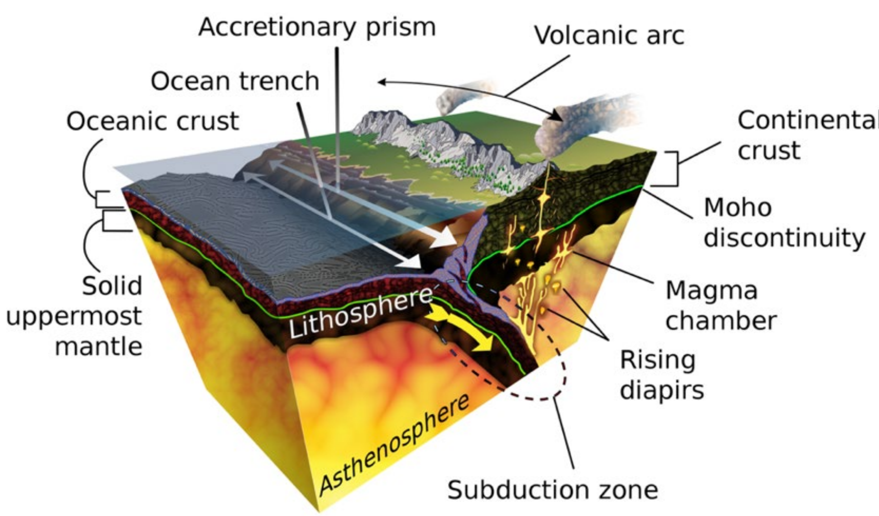


Figure 10.5: Diagram of the Geologic Process of Subduction.[100]

The first phase of regional plutonism started 210 million years ago in the late Triassic and continued throughout the Jurassic to about 150 million years BP. Also starting 150 million years ago was an increase in the westward drift rate of the North American Plate. The resulting orogeny (mountain-building event) is called the Nevadan orogeny by geologists. The resulting Nevadan mountain range (also called the Ancestral Sierra Nevada) was 15,000 feet (4500 m) high and was made of sections of seafloor and mélange. These massive belts of plutonic

[100] Subduction-en.svg from Wikimedia Commons by K. D. Schroeder is licensed under CC BY SA 4.0

(intrusive) and volcanic (extrusive) regional belts and isolated centers developed as plate convergence and subduction took place farther west along the western continental margin.

These rocks were later metamorphosed and today can be seen in the gold-bearing metamorphic belt of California's Mother Lode country. In the central Sierra region, these rocks are exposed along the Merced River and State Route 140. This was directly part of the creation of the Sierra Nevada Batholith, and the resulting rocks were mostly granitic in composition and emplaced about 6 miles (10 km) below the surface.

The second, major pluton emplacement phase lasted from about 120 million to 80 million years ago during the Cretaceous. This was part of the Sevier orogeny. All told there have been more than 50 plutons found in the central Sierra region. A few miles (several km) of material was eroded away, leaving the Nevadan mountains as a long series of hills a few hundred feet (tens of meters) high by 25 million years ago.

Volcanism

Starting 20 million years ago and lasting until 5 million years ago a now-extinct extension of Cascade Range volcanoes erupted, bringing large amounts of igneous material in the area. These igneous deposits blanketed the region north of the Yosemite area. Some lava associated with this activity poured into the Grand Canyon of the Tuolumne and formed Little Devils Postpile, a smaller but much older version of the columnar basalt palisades in nearby Devils Postpile National Monument in Mammoth.

In the late Cenozoic, extensive volcanism occurred east of the park area. Within the Yosemite region, andesitic lava flows and lahars flowed north of the Grand Canyon of the Tuolumne and volcanic dikes and plugs developed from faults on the flanks of Mount Dana. There is also evidence for a great deal of rhyolitic ash covering the northern part of the Yosemite region 30 million years ago. This and later ash deposits have been almost completely eroded away (especially during the ice ages).

Volcanic activity persisted past 5 million years before present, east of the current park borders in the Mono Lake and Long Valley areas. The most significant activity was the creation of the Long Valley Caldera about 700,000 years ago in which about 600 times as much material was erupted than in the 1980 eruption of Mt. Saint Helens. The most recent activity was the eruption of the Mono-Inyo Craters from 40,000 to 600 years ago.

Uplift & Erosion

10 million years ago, vertical movement along the Sierra fault started to uplift the Sierra Nevada. Subsequent tilting of the Sierra block and the resulting accelerated uplift of the Sierra Nevada increased the gradient of western-flowing streams. The streams consequently ran faster and thus cut their valleys more quickly. Tributary streams ran more-or-less in line with the Sierras, therefore not having their gradients increased. Thus, their rate of valley cutting was not significantly affected. The results were hanging valleys and cascading waterfalls where the tributaries met the main streams. Additional uplift occurred when major faults developed to the east, especially the creation of Owens Valley from Basin and Range-associated extensional forces. Uplift of the Sierra accelerated again about two million years ago during the Pleistocene. Evidence of glaciation is visible in the pattern of the tracks that lateral moraines deposited during different glacial periods.

The uplifting and increased erosion exposed granitic rocks in the area to surface pressures, resulting in exfoliation (responsible for the rounded shape of the many granite domes in the park) and mass wasting following the numerous fracture joint planes (cracks; especially vertical ones) in the now solidified plutons. Pleistocene glaciers further accelerated this process, and the larger ones transported the resulting talus and till from valley floors.

Numerous vertical joint planes controlled where and how fast erosion took place. Most of these long, linear and very deep cracks trend northeast or northwest and form parallel, often regularly spaced sets. They were created by uplift-associated pressure release and by the unloading of overlying rock via erosion. The great majority of Yosemite Valley's widening, for example, was due to joint-controlled rockfall. In fact, only 10% of its widening and 12% of its excavation are thought to be the result of glaciation. Large, relatively unjointed volumes of granite form domes such as Half Dome and monoliths like the 3,604 ft (1,098 m) high El Capitan. Closely spaced joints led to the creation of columns, pillars, and pinnacles such as Washington Column, Cathedral Spires, and Split Pinnacle.

CASE STUDY | YOSEMITE NATIONAL PARK

Yosemite National Park is an American National Park in California, surrounded on the southeast by Sierra National Forest and on the northwest by Stanislaus National Forest. The park is managed by the National Park Service and covers an area of 759,620 acres (1,187 sq mi; 3,074 km2) and sits in four counties – centered in Tuolumne and Mariposa, extending north and east to Mono and south to Madera County. Designated a World Heritage Site in 1984, Yosemite is internationally recognized for its granite cliffs, waterfalls, clear streams, giant sequoia groves, lakes, mountains, meadows, glaciers, and biological diversity. Almost 95 percent of the park is designated wilderness. Yosemite is one of the largest and least fragmented blocks in the Sierra Nevada, and the park supports a diversity of plants and animals.

The geology of the Yosemite area is characterized by granite rocks and remnants of older rock. About 10 million years ago, the Sierra Nevada was uplifted and tilted to form its unique slopes, which increased the steepness of stream and riverbeds, resulting in the formation of deep, narrow canyons. About two million years ago glaciers formed at higher elevations which eventually melted and moved downslope, cutting, and sculpting the U-shaped valley that attracts so many visitors to its scenic vistas.

European American settlers first entered Yosemite Valley itself in 1851. There are earlier instances of other travelers entering the Valley, but James D. Savage is credited with discovering the area that became Yosemite National Park. Despite Savage and other white men claiming their discovery of Yosemite, the region and Valley itself has been inhabited for nearly 4,000 years, although humans may have visited the area as early as 10,000 years ago.

Yosemite was critical to the development of the national park idea. Galen Clark and others lobbied to protect Yosemite Valley from development, ultimately leading to President Abraham Lincoln signing the Yosemite Grant of 1864 which declared Yosemite as federally preserved land. It was not until 1890 when John Muir led a successful movement which had Congress establish Yosemite Valley and its surrounding areas as a National Park. This helped pave the way for the National Park System. Yosemite draws about four million visitors each year, and most visitors spend most of their time in the seven square miles (18 km2) of Yosemite Valley. The park set a visitation record in 2016, surpassing five million visitors for the first time in its history. The park began requiring reservations to access the park during peak periods starting in 2020 as a response to the rise in visitors.

Geology

The first rocks were laid down in Precambrian times, when the area around Yosemite National Park was on the edge of a very young North American continent. The sediment that formed the area first settled in the waters of a shallow sea, and compressive forces from a subduction zone in the mid-Paleozoic fused the seabed rocks and sediments, appending them to the continent. Heat generated from the subduction created island arcs of volcanoes that were also thrust into the ancient area. In time, the igneous and sedimentary rocks of the area were later heavily metamorphosed.

Most of the rock now exposed in the park is granitic, having been formed 210 to 80 million years ago as igneous diapirs 6 miles (10 km) below the surface. Over time, most of the overlying rock uplifted along with the rest of the Sierra Nevada, was removed by erosion. This exposed the granitic rock to much lower pressure, which caused the rock to expand, joint and exfoliate.

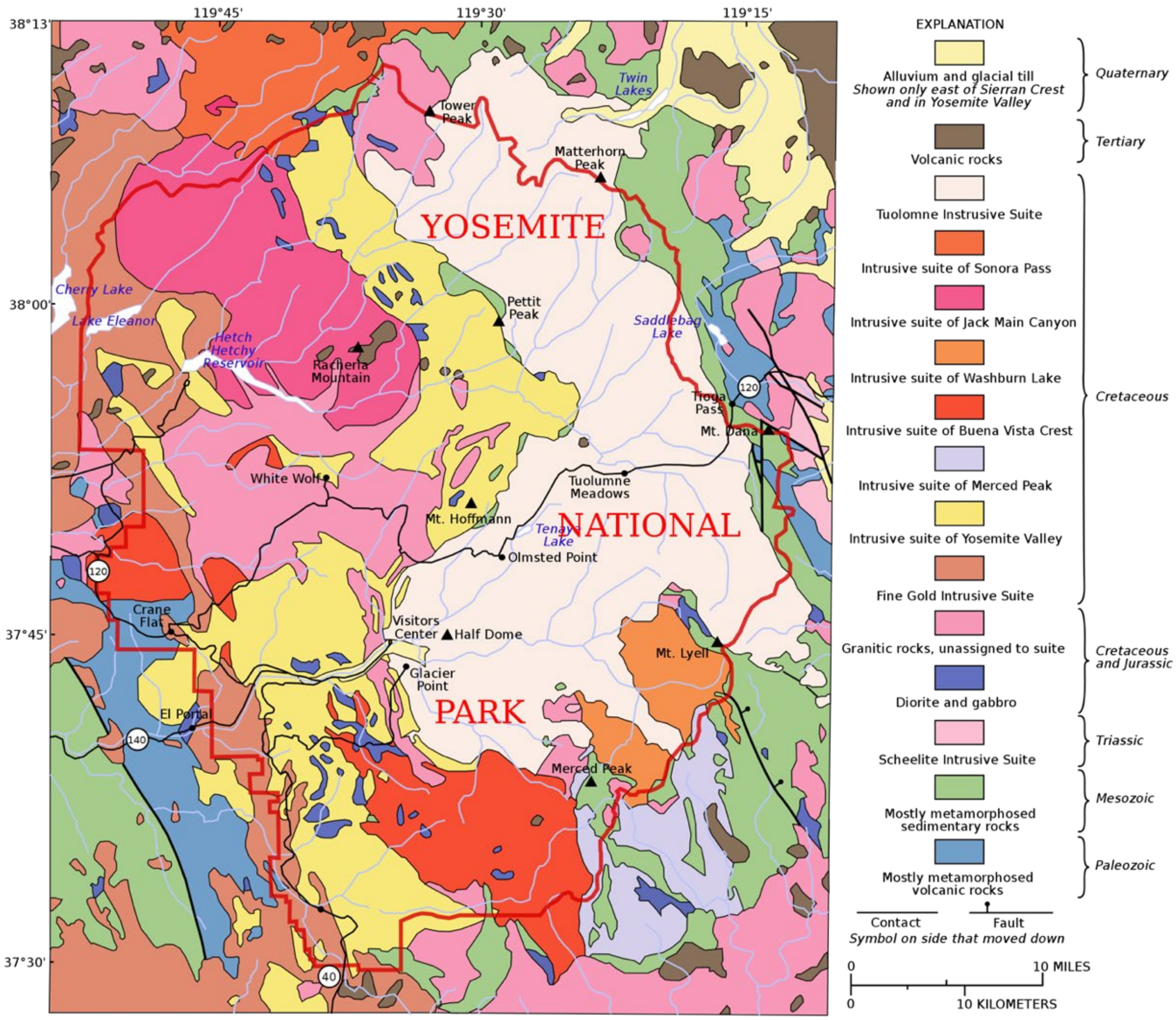


Figure 10.6: Geologic Map of Yosemite National Park- California.[101]

[101] Image by United States Geological Survey, remixed by Grandiose, licensed under CC BY-SA 3.0

Glaciations

Starting about 2 years ago a series of glaciations further modified the area by accelerating mass wasting through ice-wedging, glacial plucking, scouring/abrasion, and the release of pressure after the retreat of each glaciation. The glaciers tended to strip and transport topsoil and talus piles far down glacial valleys, while less-severe glaciations deposited a great deal of glacial till further up in the valleys.

At least 4 major glacial periods have occurred in the Sierra Nevada; locally called the Sherwin (also called the pre-Tahoe), Tahoe, Tenaya, and Tioga. The Sherwin glaciers were the largest, filling Yosemite and other valleys, while later stages produced much smaller glaciers. The Sherwin may have lasted almost 300 thousand years and ended about 1 million years ago. A Sherwin-age glacier was almost surely responsible for the major excavation and shaping of Yosemite Valley and other canyons in the area.

The Tahoe, Tenaya, and Tioga stages were part of the Wisconsinan glaciation. The Tahoe glacial stage is thought to have reached its maximum extent around 70,000 to 130,000 years ago; little is known about the more recent Tenaya. Evidence also suggests that the most recent local glacial stage, the Tioga, started about 28,000 cal (calibrated Radiocarbon dating) years ago, reached its maximum extent 20,000 to 25,000 cal years ago, and ended by ~15,000 cal yr ago. Glaciers reformed in the highest cirques during a minor late-glacial readvance, the Recess Peak event, between about 14,200 and 13,100 years ago.

Glacial systems reached depths of up to 4000 feet (1200 m) and left their marks in the Yosemite area. The longest glacier in the Yosemite area ran down the Grand Canyon of the Tuolumne River for 60 miles (95 km), passing well beyond Hetch Hetchy Valley. Merced Glacier flowed out of Yosemite Valley and into the Merced River Gorge. Lee Vining Glacier carved Lee Vining Canyon and emptied into Lake Russell (the much-enlarged ice age version of Mono Lake). Only the highest peaks, such as Mount Dana and Mount Conness, were not covered by glaciers. Retreating glaciers often left recessional moraines that impounded lakes such as Lake Yosemite (a shallow lake that periodically covered much of the floor of Yosemite Valley).

Some domes in the park were covered by glaciers and modified into roche moutonnées, which are characterized by having a smooth, rounded side and a steep face. The rounded side was where the glacier flowed over the dome and the steep side is where the glacier flowed away from it. The steepness is caused by glacial plucking of rock along fracture joints. Good examples in the park are Liberty Cap, Lembert Dome, Mount Broderick and Half Dome (figure10.7).

Figure 10.7: Sunset Over Half Dome, Yosemite National Park, California.[102]

Half Dome was created by a different process, since erosion acting on jointing planes was still the major factor. Half Dome is a quartz monzonite batholith at the eastern end of Yosemite Valley in Yosemite National Park, California. It is a well-known rock formation in the park, named for its distinct shape. One side is a sheer face while the other three sides are smooth and round, making it appear like a dome cut in half. It stands at nearly 8,800 feet above sea level and is composed of quartz monzonite, an igneous rock that solidified several thousand feet within the Earth. At its core are the remains of a magma chamber that cooled slowly and crystallized beneath the Earth's surface. The solidified magma chamber was then exposed and cut in half by erosion, therefore leading to the geographic name Half Dome.

Cultural History & Influence

Historically attested Native American populations, such as the Sierra Miwok, Mono and Paiute, belong to the Uto-Aztecan and Utian phyla. In the mid-19th century, a band of Native Americans called the Ahwahnechee lived in Yosemite Valley. The California Gold Rush greatly increased the number of non-indigenous people in the region. Tensions between Native Americans and white settlers escalated into the Mariposa War. As part of this conflict, settler James Savage led the Mariposa Battalion into Yosemite Valley in 1851, in pursuit of Ahwaneechees led by Chief Tenaya. The California state military forces burned the tribe's villages, destroyed their food stores, killed the chief's sons, and forced the tribe out of

[102] Photo by DAVID ILIFF is licensed under CC BY-SA 3.0

Yosemite. Accounts from the Mariposa Battalion, especially from Dr. Lafayette Bunnell, popularized Yosemite Valley as a scenic wonder.

Native Americans of Yosemite

Humans may have lived in the Yosemite area as long as 10,000 years ago. Habitation of the Yosemite Valley proper can be traced to about 3,000 years ago, when vegetation and game in the region was like that present today; the western slopes of the Sierra Nevada had acorns, deer, and salmon, while the eastern Sierra had pinyon nuts and obsidian. Native American groups traveled between these two regions to trade and raid.

Archaeologists divide the pre-European American contact period of the region into three cultural phases. The Crane Flat phase lasted from 1000 BCE to 500 CE and is marked by hunting with the atlatl and the use of grinding stones. The Tamarack phase lasted from 500 until 1200, marked by a shift to using smaller rock points, indicating development and use of the bow and arrow. The Mariposa phase lasted from 1200 until contact with European Americans.

Trade between tribes became more widespread during the Mariposa phase, and the diet continued to improve. Paiutes, Miwok, and Monos visited the area to trade; one major trading route went over Mono Pass and through Bloody Canyon to Mono Lake in Eastern California, (often acorns from the west with obsidian from the eastern side of the Sierra).

Figure 10.8: Group of Miwok in council by a Cedar Structure in Yosemite Valley Near the Merced River, June 1872.[103]

[103] Image by Eadweard Muybridge is in the public domain.

Paiutes were the primary inhabitants of the Yosemite area and the foothills to the east during the Mariposa and historic phases. The Central Sierra Miwoks lived along the drainage area of the Tuolumne and Stanislaus Rivers, while the Paiutes inhabited the upper drainage of the Merced and Chowchilla Rivers.

The Paiutes of Yosemite Valley called themselves the Ah-wah-ne-chee, meaning "dwellers in Ahwahnee." The Ahwahneechees were decimated by a disease in about 1800, and left the valley, although about 200 returned under the leadership of Tenaya, son of an Ahwahneechee chief.

Displaced Native Americans from the Californian coast moved to the Sierra Nevada during the early-to-mid-19th century, bringing with them their knowledge of Spanish food, technology, and clothing. Joining forces with the other tribes in the area, they raided land grant ranchos on the coast and drove herds of horses to the Sierra, where horse meat became a major new food source.

Then Mariposa Battalion & The First Tourists

The first non-Native Americans to see Yosemite Valley were probably members of the 1833 Joseph Walker Party, which was the first to cross the Sierra Nevada from east to west. The first descriptions of Yosemite, however, came nearly 20 years later. The 1849 California Gold Rush led to conflicts between miners and Native Americans, and the state formed the volunteer Mariposa Battalion as a punitive expedition against the Native Americans living in the Yosemite area. In 1851, the Battalion was led by Major Jim Savage, whose trading post on the Merced River the Awaneechee had raided. This and other missions (the Mariposa Wars) resulted in Chief Teneiya and the Awaneechee spending months on a reservation in the San Joaquin Valley. The band returned the next year to the Valley but took refuge among the Mono Paiutes after further conflicts with miners. Most of the Awaneechee (along with Teneiya) were chased back to the Valley and killed by the Paiutes after violating hospitality by stealing horses.

While the members of that first expedition of the Mariposa Battalion had heard rumors of what could be found up the Merced River, none were prepared for what they saw March 27, 1851, from what is now called Old Inspiration Point (close to the better-visited Tunnel View). Dr. Lafayette Bunnell later wrote:

> "The grandeur of the scene was but softened by the haze that hung over the valley – light as gossamer – and by the clouds which partially dimmed the higher cliffs and mountains. This obscurity of vision but increased the awe with which I beheld it, and as I looked, a peculiar, exalted sensation seemed to fill my whole being, and I found my eyes in tears with emotion."

Camping that night on the Valley floor, the group agreed with the suggestion of Dr. Bunnell to call it "Yo-sem-i-ty", mistakenly believing that was the native name. The term is from the Southern Sierra Miwok word Yohhe'meti, meaning "they are killers," which referred to the inhabitants of the place.

James Hutchings—who organized the first tourist party to the Valley in 1855—and artist Thomas Ayers generated much of the earliest publicity about Yosemite, creating articles and entire magazine issues about the Valley. Ayres' highly detailed angularly exaggerated artwork and his written accounts were distributed nationally, and an art exhibition of his drawings was held in New York City.

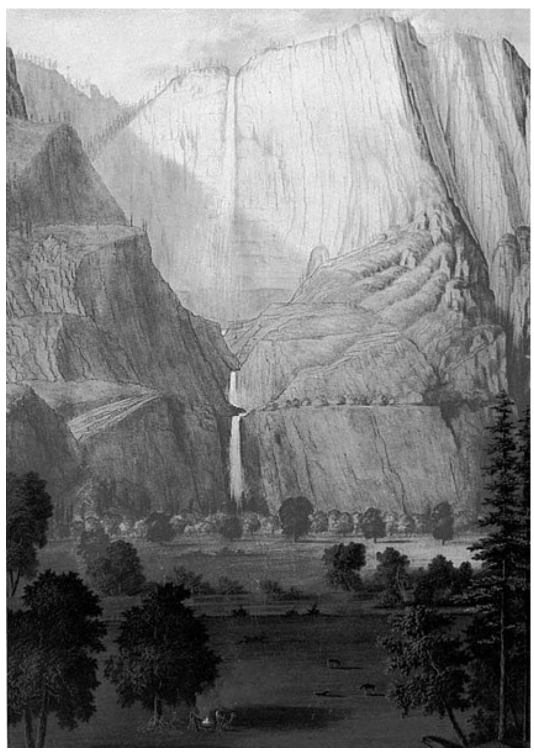


Figure 10.9: Drawing of Yosemite Falls by Artist Thomas Ayres, Circa 1855.[104]

Two of Hutchings' first group of tourists, Milton, and Houston Mann built the first toll route into the valley, with the development of the first hotels in the area and other trails quickly following. Many of the early pioneers in the valley of European descent, and a few Native Americans, are buried in Yosemite Cemetery.

[104] Image by Thomas Ayres is in the public domain.

The First Park

The work of Ayres gave Easterners an appreciation for Yosemite Valley and started a movement to preserve it. Influential figures such as Galen Clark, clergyman Thomas Starr King and leading landscape architect Frederick Law Olmsted were among those who urged Senator John Conness of California to try to preserve Yosemite.

President Abraham Lincoln signed a bill on June 30, 1864, granting Yosemite Valley and the Mariposa Grove of giant sequoias to the State of California "for public use, resort and recreation," the two tracts "shall be inalienable for all time". This was the first time in history that a federal government had set aside scenic lands simply to protect them and to allow for their enjoyment by all people.

Simply designating an area, a park isn't sufficient to protect it. California did not set up an administration for the park until 1866 when the state appointed Galen Clark as the park's guardian. An 11-year struggle followed to resolve homesteading claims in the valley. The challenge of increasing tourism, with the need to first build stagecoach roads, then the Yosemite Valley Railroad, along with hotels and other facilities in and around the Valley was met during the rest of the 19th century. But much environmental damage was caused to the valley itself at that time. The problems that Yosemite Park had under state control was one of the factors in establishing Yellowstone National Park as the first completely national park in 1872.

Due to the difficulty of traveling there, early visitors to the valley came for several weeks to a couple of months, often bringing entire families with many possessions. Early hotels were therefore set up for extended stays and catered primarily to wealthy patrons who could spend extended periods away from home. One of these hotels—the Wawona Hotel, built in the 1880s—still operates.

After the Valley became a park, the surrounding territory was still subject to logging, mining, and grazing. John Muir publicized the damage to the subalpine meadows that surround the Valley and in 1890, the government created a national park that included a much larger territory—enclosing Yosemite Valley and Mariposa Grove.

Figure 10.10: President Theodore Roosevelt & John Muir on Glacier Point in Yosemite, 1903.[105]

In May of 1903, U.S. President Theodore Roosevelt camped with John Muir near Glacier Point for three days. During that trip, Muir convinced Roosevelt to take control of the valley and the grove away from California and give it to the federal government. On June 11, 1906, Roosevelt signed a bill that did precisely that, and the superintendent's headquarters was moved from Wawona to Yosemite Valley.

To secure congressional and State of California approval for the plan, the size of the park was reduced by more than 500 square miles (1,300 km2), which excluded natural wonders such as the Devils Postpile and prime wildlife habitat. The park was again reduced in size in 1906, when logging began in an area around Wawona. Acting superintendent Major H. C. Benson said in 1908 that game is on the decrease. Each reduction of the park has cut another portion of the winter resort of game. The various changes meant that the park was reduced to two-thirds of its original size.

About 12,000 acres between the Tuolumne and the Merced big tree groves were added to the park in 1930 through land purchases by the federal government and matching funds provided by industrialist John D. Rockefeller. Another 8,765 acres near Wawona were added in 1932. The Carl Inn Tract, close to the Rockefeller purchase, was secured in 1937 and 1939.

[105] Image by Underwood & Underwood is in the public domain.

Figure 11.1: The Bakersfield Sign- Bakersfield, California.[106]

UNIT 11: THE CENTRAL VALLEY

Goals & Objectives of this unit

- Explain the purpose, history, and impact of the California Central Water Project.
- Identify the major immigrant groups that have worked in agriculture in the Central Valley.
- Describe the geological features and processes that have shaped the Central Valley of California.
- Identify the key characteristics of the Bakersfield Sound and explain how it emerged in the context of the California music scene in the mid-20th century.

INTRODUCTION

The Central Valley, also known as the Great Valley of California, covers about 20,000 square miles and is one of the more notable structural depressions in the world. Occupying a central position in California, it is bounded by the Cascade Range to the north, the Sierra Nevada to the east, the Tehachapi Mountains to the south, and the Coast Ranges and San Francisco Bay to the

[106] Image by Jeremy Patrich is used under a CC-BY 4.0 license.

west. The Valley is a vast agricultural region drained by the Sacramento and San Joaquin Rivers. The Valley averages about 50 miles in width and extends about 400 mi northwest from the Tehachapi Mountains to Redding. It covers approximately 18,000 sq mi (47,000 km2), about 11% of California's land area. Generally, most of the valley lies close to sea level and the land surface has very low relief but is higher along the valley margins.

The Central Valley can be divided into two large parts consisting of four regions: the northern one-third is known as the Sacramento Valley and the southern two-thirds is known as the San Joaquin Valley. The San Joaquin Valley can be split further into the San Joaquin Basin and the Tulare Basin. The San Joaquin and Sacramento Valleys meet in the Delta area where the combined discharge of the Sacramento and San Joaquin Rivers flows through the Central Valley's one natural outlet, the Carquinez Strait, on its way to San Francisco Bay and the Pacific Ocean. Just east of the Delta, several streams issue from the Sierra Nevada into the valley and flow to the Delta in an area referred to as the Eastside Streams.

Figure 11.2: Map of California's Four Regions of the Central Valley.[107]

The Central Valley is a region known for its agricultural productivity: it provides more than half of the fruits, vegetables, and nuts grown in the United States. More than 7,000,000 acres

[107] Image is in the public domain.

(28,000 km2) of the valley are irrigated via reservoirs and canals. The valley hosts many cities, including the state capital Sacramento, as well as Redding, Chico, Stockton, Modesto, Merced, Fresno, Visalia, and Bakersfield.

PHYSICAL GEOGRAPHY

The Central Valley is a vast, flat plain that contrasts with the rugged mountains that surround it. The valley floor is thought to have originated as an offshore area that was depressed by the subduction of the Farallon Plate beneath the North American Plate. The valley has no earthquake faults of its own but is surrounded by faults to the east and west.

The valley was enclosed by the uplift of the Coast Ranges, with its original outlet into Monterey Bay. Faulting subsequently moved the Coast Ranges, and a new outlet developed near what is now San Francisco Bay. Over time, the valley filled with sediment from the Coast Ranges and the Sierra Nevada, creating an extraordinary flatness just barely above sea level. In fact, thousands of years before California's flood control and aqueduct system was built, annual snow melt would turn much of the valley into an inland sea.

The one notable exception to the flat valley floor is Sutter Buttes, the remnants of an extinct volcano just to the northwest of Yuba City.

Another significant geologic feature of the Central Valley lies hidden beneath the delta. The Stockton Arch is an upwarping of the crust beneath the valley sediments that extends southwest to northeast across the valley.

Climate

The Central Valley is a large, flat plain in California that is home to a diverse range of ecosystems. The northern Central Valley has a hot Mediterranean climate (Köppen climate classification Csa), while the southern Central Valley is drier and has a Mediterranean steppe climate (BShs) or even low-latitude desert climate (BWh).

The Central Valley is very hot and dry during the summer, with daytime temperatures frequently surpassing 100°F (38°C). Common heat waves can bring temperatures exceeding 115°F (46°C). The rainy season is from mid-autumn to mid-spring, although during the late summer, southeasterly winds can bring tropical thunderstorms, mainly in the southern half of the San Joaquin Valley but occasionally to the Sacramento Valley.

The northern half of the Central Valley receives greater precipitation than the semidesert southern half. Frost occurs at times in the fall months, but snow is extremely rare.

Climate Data for Fresno, California | 1881-2020 (NOAA)													
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
All-Time Record High °F	78	84	91	101	110	112	115	113	114	102	90	77	115°F
All-Time Record Low °F	17	24	26	32	36	42	50	49	37	27	26	18	17°F
Average High °F	55	61	57	73	82	91	97	96	90	78	64	55	76°F
Average Low °F	40	43	47	50	57	63	69	67	63	54	45	39	53°F
Average Precipitation (in)	2.16	1.93	1.90	1.04	0.42	0.24	0.03	0.0	0.05	0.56	0.87	1.79	10.99in

Figure 11.3: Climate Date for Fresno, California (Data from NOAA.[108]

Low Clouds & Fog

Tule fog is a type of low cloud that is characteristically confined to the Central Valley of California. This is because the Central Valley is surrounded by mountains, which trap the cold air in the valley. Tule fog can be very dense and can last for days or even weeks at a time. It can also contain light drizzle or freezing drizzle. Tule fog can be seen from above by driving up into the foothills of the Sierra Nevada or Coast Ranges. Above the cold, foggy layer, the air is typically mild, dry, and clear. Once Tule fog has formed, turbulent air is necessary to break through the temperature inversion layer. Daytime heating can sometimes evaporate the fog in patches, but it reforms soon after sunset. Tule fog usually remains longer in the southern and eastern parts of the Central Valley, because winter storms with strong winds and turbulent air affect the northern Central Valley more often.

Figure 11.4 The Tule Fog, in the Central Valley, Captured by NASA's Terra Satellite.[109]

[108] Image by Jeremy Patrich is licensed under CC-BY 4.0.
[109] Image by NASA is in the public domain.

Flora & Fauna

The Central Valley is a vast grassland ecosystem that has been significantly altered by human activity. The dominant grass of the valley was Nassella pulchra, but today only 1% of the grassland in the valley is intact. Other grasses that can still be found in the valley include California poppy, lupins, and purple owl's clover. Riverside trees include willows, western sycamore, box elder, Fremont cottonwood, and the endemic valley oak.

The Central Valley was once home to a wide variety of wildlife, including pronghorn antelope, elk, mule deer, California ground squirrels, gophers, mice, rabbits, kangaroo rats, and San Joaquin kit foxes. The valley's wetlands are an important habitat for wintering waterbirds and migrating birds of other kinds. Reptiles and amphibians of the valley include the San Joaquin coachwhip snake, blunt-nosed leopard lizard, Gilbert's skink, and western aquatic garter snake. Endemic invertebrates are also present. The Central Valley is home to endemic fish species, including the Sacramento Pikeminnow, Sacramento Perch, Sacramento Blackfish, and Sacramento Splittail.

Figure 11.5: The California Poppy.[110]

Hydrography & The Central Valley Project

Two river systems drain and define the two parts of the Central Valley. The Sacramento River, along with its tributaries the Feather River and American River, flows southwards through the Sacramento Valley for about 447 miles (719 km). In the San Joaquin Valley, the San Joaquin

[110] Image by Jeremy Patrich is licensed under CC-BY 4.0.

River flows roughly northwest for 365 miles (587 km), picking up tributaries such as the Merced River, Tuolumne River, Stanislaus River and Mokelumne River. The Central Valley watershed encompasses over a third of California at 60,000 square miles (160,000 km2), with 46 percent draining into the Sacramento River, 26 percent into the San Joaquin, and 27 percent into Tulare Lake.

Aerial view of the Delta region, showing the Sacramento River (above) and the San Joaquin River (below).

Figure 11.6: An Aerial View of the Delta Region- Showing the Sacramento (Top) & San Joaquin (Below) Rivers.[111]

The Sacramento River carries far more water than the San Joaquin, with an estimated 22 million acre-feet (27 km3) of virgin annual runoff, as compared to the San Joaquin's approximately 6 million acre-feet (7.4 km3). Intensive agricultural and municipal water consumption decreased the rate of outflow to about 17 million acre-feet (21 km3) for the Sacramento and 3 million acre-feet (3.7 km3) for the San Joaquin. These figures vary widely from year to year. Over 25 million people, living in the valley and other regions of the state, rely on the water carried by these rivers (Figure 11.6).

[111] Image by Wikimedia is licensed under CC BY 2.0.

Figure 11.7: Map of the Sacramento River Drainage Basin.[112]

Central Valley rivers converge in the Sacramento-San Joaquin Delta, a network of marshy channels, distributaries, and sloughs that wind around islands mainly used for agriculture. There the rivers merge with tidewater, and eventually reach the ocean after passing through Suisun Bay, San Pablo Bay, upper San Francisco Bay, and finally the Golden Gate. Many of the islands lie below sea level because of intensive agriculture, and face a high risk of flooding, which would allow salt water to rush back into the delta, especially when too little fresh water is flowing in from the Valley (Figure 11.7).

[112] Image is in the public domain.

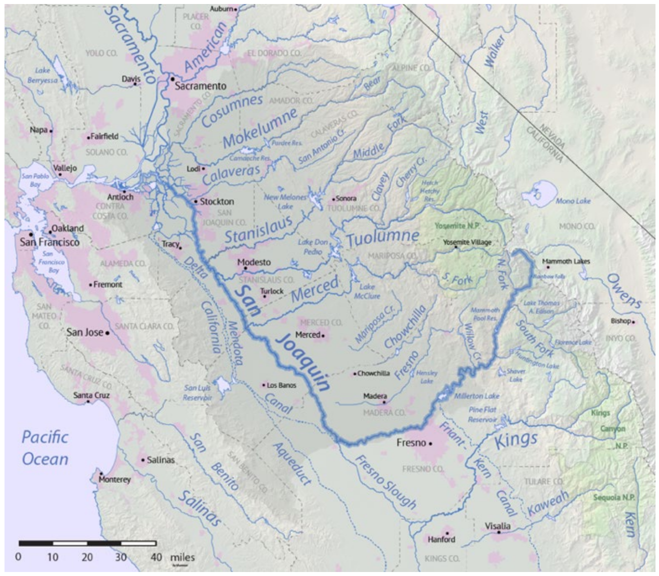


Figure 11.8: Map of the San Joaquin River Basin.[113]

In the south part of the San Joaquin Valley, the alluvial fans of the Kings River and Coast Ranges streams have created a natural divide. The dry Tulare basin of the Central Valley receives flow from four major Sierra Nevada rivers, the Kings, Kaweah, Tule, and Kern. This basin, usually endorheic, formerly filled during snowmelt and spilled out into the San Joaquin River. Called Tulare Lake, it is usually dry because the rivers feeding it have been diverted for agricultural purposes (Figure 11.8).

Figure 11.9: Map of Tulare Lake Basin.[114]

113 Image is in the public domain.

114 Image is in the public domain.

The 1933 Central Valley Project (CVP)

The Central Valley Project was the world's largest water and power project when undertaken during Franklin D. Roosevelt's New Deal public works agenda, which was designed for infrastructure development, economic stimulus and to ultimately employ millions of out-of-work Americans, due to the Great Depression. The Central Valley Project was the culmination of eighty years of political fighting over the state's most important natural resource - Water. The Central Valley of California lies to the west of the Sierra Nevada Mountains with its annual run-off draining into the Pacific Ocean through the Sacramento–San Joaquin River Delta. It is a large geological floodplain moderated by its Mediterranean climate of dry summers and wet winters that includes regular major drought cycles. At the time of its construction, the project was at the center of a political and cultural battle over the state's future. It intersected with the state's ongoing war over land use, access to water rights, impacts on indigenous communities, large vs. small farmers, the state's irrigation districts and public vs. private power. Its proponents ignored environmental concerns over its impacts, as long as the outcome did not damage the major stakeholders at that time.

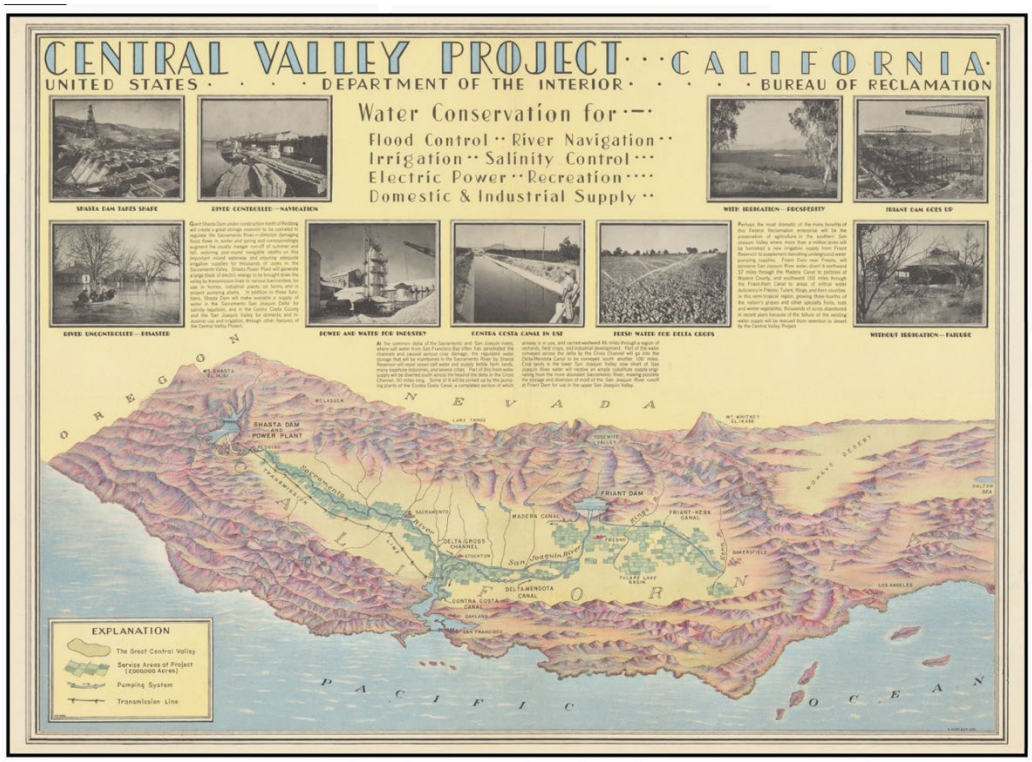


Figure 11.10: Central Valley Project Map -1938.[115]

[115] Image is in the public domain.

The Central Valley has gone through two distinct culturally driven land use eras. The first was the indigenous tribal period that lasted for thousands of years. Then came the arrival of Europeans, first by the Spanish colonial model of Catholic missions and ranchos (1772–1846). It was then followed by the current United States era. Due to its Mediterranean climate, the first cultural period was hunter-gatherer based. The Spanish missions' ranching and tanning business was built on the forced labor of California's tribes. Spain's model of land use with the grazing of livestock for meat, wool and leather started along Alta California's coast, eventually spreading inland. The U.S. era evolved from primarily ranching to large-scale plantations or more commonly known today as corporate farming that turned the Central Valley into the breadbasket of the U.S.

Following the 1848 California Gold Rush, large numbers of U.S. citizens came into the region and made attempts to practice rainfed agriculture, but most of the Central Valley land was taken up by large cattle ranchers like Henry Miller who eventually controlled 22,000 square miles of land. The large-scale levee construction by Chinese workers along the Delta was where limited irrigation for orchards first started.

Following the arrival of the Transcontinental railroad, immigration from Asia and the rest of the U.S. led to growing numbers of settlers in the region. Despite the rich soils and favorable weather of the 42,000-square-mile (110,000 km2) Central Valley, immigrants to the valley who were unfamiliar with its seasonal patterns of rainfall and flooding began to take up irrigation practices. Farmers soon found themselves troubled by frequent floods in the Sacramento Valley and a general lack of water in the San Joaquin Valley. The Sacramento River, which drains the northern part, receives between 60 and 75% of the precipitation in the Valley, despite the Sacramento Valley covering less area than the much larger San Joaquin Valley, drained by the San Joaquin River, which receives only about 25% of the rainfall. Furthermore, cities drawing water from the Sacramento-San Joaquin Delta faced problems in dry summer and autumn months when the inflowing water was low. To continue to sustain the valley's economy, there needed to be systems to regulate flows in the rivers and equally distribute water among the north and south parts of the valley.

In addition to water storage and regulation, the system has a hydroelectric capacity of over 2,000 megawatts and provides recreation and flood control with its twenty dams and reservoirs. It has allowed major cities to grow along Valley rivers which previously would flood each spring and transformed the semi-arid desert environment of the San Joaquin Valley into productive farmland. Freshwater stored in Sacramento River reservoirs and released downriver during dry periods prevents salt water from intruding into the Sacramento-San Joaquin Delta during high tide. There are eight divisions of the project and ten corresponding units, many of which operate in conjunction, while others are independent of the rest of the network. California agriculture and related industries now directly account for 7% of the gross state product for which the CVP supplied water for about half.

Figure 11.11: Map of the Central Valley Project & California Aqueducts[116]

---

[116] Image by Wikimedia is licensed under CC BY-SA 4.0.

PHYSICAL GEOLOGY

The San Joaquin Valley is a sediment-filled depression, called a basin, that is bound to the west by the California Coast Ranges, and to the east by the Sierra Nevada. The Great Valley Sequence of California is a 40,000-foot (12 km)-thick group of related geologic formations that are Late Jurassic through Cretaceous in age (150–65 Ma) on the geologic time scale. These sedimentary rocks were deposited during the late Mesozoic Era in an ancient seaway that corresponds roughly to the outline of the modern Great Valley (Central Valley) of California.

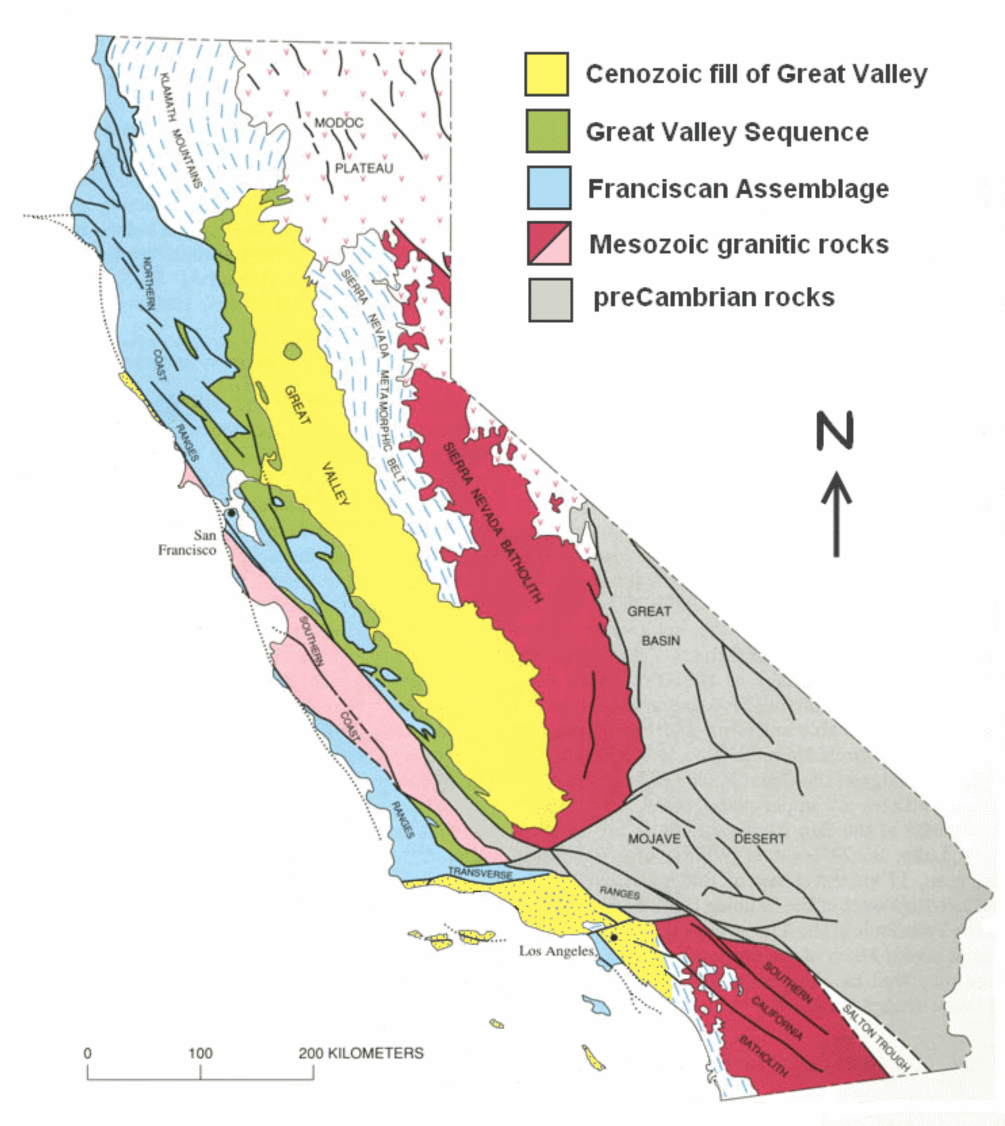


Figure 11.12: Geologic Map of the Great Valley Sequence.[117]

[117] Image is in the public domain.

The Valley dates back more than 65 million years to the Mesozoic, when subduction was taking place off the coast of California. However, the plate tectonic configuration of western North America changed during the Tertiary, and the ancient trench that once characterized offshore California was transformed into a zone of right-lateral strike-slip motion that we know today as the San Andreas fault. Nonetheless, the Valley still retains many features that characterized it prior to formation of the San Andreas transform.

Because the San Joaquin Valley is bound to the west by the California Coast Ranges, which represent a zone of folding and thrusting, such as an accretionary pris, associated with the ancient subduction zone, and bound to the east by the Sierra Nevada, which represent the eroded roots of an ancient volcanic arc that was also associated with the subduction zone, some call the valley a remnant arc-trench gap.

The tectonic processes by which this arc-trench gap formed are complicated, as are the events by which the ancient trench became the San Andreas fault.

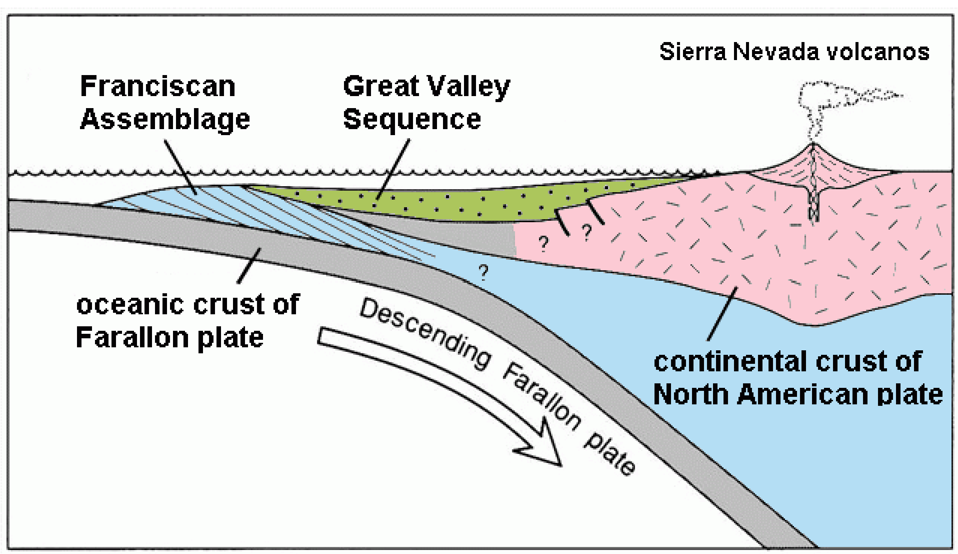


Figure 11.13: Image of Deposition in the Great Valley Sequence.[118]

When the San Joaquin Valley first formed, it was an inland sea between two mountain ranges. This configuration remained even after formation of the San Andreas fault (below). However, as the volcanic cover of the Sierras was eroded off, the resulting sediment was dumped into the Valley below. At the same time, The Coast Ranges were also being worn down and dumped into the valley. Thus, the inland sea was filled to create the continental basin we know today.

[118] Image is in the public domain.

When the basin was still an inland sea, diatoms and other plankton thrived in it, and when these marine organisms died, they accumulated on the basin floor to create organic-rich shales that include the Eocene Kreyenhagen, and Miocene Monterey Formations. The integrated effects of heat and time then acted on the buried organic matter within these shales to create oil, and the detritus eroded from the Coast Ranges and the Sierra Nevada provided reservoir rocks where the oil could accumulate

Tectonic Depositional Setting

The ancient marine basin that the Great Valley Sequence was deposited in very closely approximates the combined extent of the modern Sacramento Valley and San Joaquin Valley as delineated by the California Coast Ranges on the west side and the Sierra Nevada on the east. Geologists believe that the Great Valley Sequence represents the sedimentary fill of forearc basin formed along the convergent plate boundary that existed along the west coast of North America during the Jurassic and Cretaceous. During this time oceanic crust was being subducted beneath the continental margin prior to formation of the modern San Andreas Fault.

The eastern boundary of the forearc basin was a volcanic arc, a chain of ancient volcanoes located where the Sierra Nevada is today. Batholiths and metamorphosed volcanic rocks in the Sierra Nevada are the geologic record of this volcanic arc. As these ancient Sierran volcanoes were rapidly eroded they fed volcanic-derived sediment through submarine canyons westward to the ancient submarine fans of the Great Valley Sequence. Additional sediment was fed into the basin as the granitic roots of these volcanoes were uplifted and eroded. Therefore, the volcanic cover of the Sierra Nevada has been largely stripped off and used by nature to fill the Great Valley basin. Little sediment is believed to have been derived from the uplifted Franciscan rocks of the Coast Ranges.

The western boundary of this basin was created by the growth and uplift of an accretionary wedge consisting of sedimentary, volcanic, and metamorphic rocks scraped off the subducting plate. The uplift of this accretionary wedge acted like a dam to form the western side of a basin in which the Great Valley Sequence was deposited. The geologic record of this accretionary wedge are the metamorphic and sedimentary rocks of the Franciscan Assemblage that today make up much of the California Coast Ranges.

The Great Valley Sequence was largely deposited atop basaltic rocks representing a slab of oceanic crust of mid-Jurassic age which was incorporated into the North American continent and today is known as the Coast Range Ophiolite.

Morphology

The Great Valley Sequence contains several geologic formations. Because geologists studying this sequence in different areas have used different formation names over the years to describe the same packages of rocks, the nomenclature is complex and confusing. Parts of the sequence are well exposed at several places along a line of outcrops that extends for about 150 miles (241 km) along the west side of the Sacramento and San Joaquin valleys (both of which make up the Great Valley of California). These same rocks are also found in several deep wells in oil and gas fields located in the center of the valley. Geologists working these different areas independent of each other developed different sets of formation names for the different areas.

Some of the best outcrops for these rocks are on the west side of the southern Sacramento Valley at Putah Creek and Cache Creek canyons. The formation names used here extend to the subsurface where several gas wells in the center of the valley produce from the same rocks, and from younger rocks that overlie them. Although the younger rocks are not exposed in the canyons to the west, most geologists combine the formation names from the west side outcrops with the subsurface names from the gas fields to create a coherent set of names that is largely agreed upon for most of the Sacramento Valley.

Figure 11.14: Image of the Putah River in Northern Napa County.[119]

The same is not true for the San Joaquin Valley to the south, where another area of well-known outcrops is found in the hills to the west of Coalinga. This area uses a completely different set of

[119] Image by Wikimedia is licensed under CC BY-SA 4.0.

formation names for the same group of rocks as are found to the north. Yet another set of formation name is applied to Great Valley rocks penetrated by oil and gas wells in the subsurface northeast of Coalinga in the area near Stockton in the northern part of San Joaquin Valley. In addition, there are several lesser-known areas in the San Joaquin Valley that each have their own terminologies. All these names are firmly established in the geologic literature and attempts to set up a unified set of formation names have not met with success. An exception are the Jurassic-age rocks of the Great Valley Sequence, which most geologists assign to the Knoxville Formation, irrespective of location.

ENVIRONMENTAL ISSUES

Environmental issues are effects of human activity on the biophysical environment, most often of which are harmful effects that cause environmental degradation. Due to the dynamic range of environments found in California, environmentalism has been an important part of California's history since it became a US state. However, this history is more complex than you might expect. While California is home to abundant resources noted for their pristine quality, the resources must support the most populous state in the US. The struggle between respecting the natural beauty of the state and providing for the basic needs of its inhabitants has defined a great amount of California's past, just as it still defines California and likely will far into the future. Environment destruction caused by humans is a global, ongoing problem. Major current environmental issues may include climate change, drought, pollution, environmental degradation, and resource depletion.

Drought

Although drought is a common feature in a natural Mediterranean Climate, data shows that California can has had some very extreme droughts. Out of the past twenty-two years, California has experienced significant drought conditions for thirteen years. From 2000 to 2018 was the second driest period that California has ever experienced. The driest three-year period ever in California was from 2012 to 2014. Three-quarters of the state of California experienced extreme drought conditions. There are also multiple types of droughts such as agricultural droughts, meteorological droughts, snow droughts, and hydrological droughts. All these affect California in different ways. Droughts can damage forests and can worsen wildfires by drying the trees, which become fuel for fires. Dead trees result in wildfires. The U.S. drought monitor is released every Thursday, showing which parts of the U.S. are in a drought. It started in 2000, and since then the longest duration of a drought in California lasted a total of 376 weeks. It started on December 11, 2011 and ended on March 5, 2019. The most intense period captured on the drought monitor was on the week of July 29, 2014. It showed that 58.41% of California's land was affected by a drought. In 2014–2015, farm-related losses in California totaled $5 billion and 20,000 farmers also lost their jobs.

Figure 11.15: Lake Oroville Water Level Dropped 38% of Capacity. May 2021.[120]

Air Pollution

Air pollution is a growing problem that affects all the citizens in the Central Valley. Some reasons of poor air pollution in the Central Valley are due to agriculture and its geographical features.

Since the Central Valley consists mostly of farming land, a wide, flat valley, the emissions from the soil that is used for growing produce are released into the air. The soil exudes nitrous oxide, an odorless and colorless gas that can be harmful when exposed to it for a long period of time, and incorporates itself into the ozone layer located at ground level. Production of nitrous oxide in California has shown that the addition of soil and fertilization can emit about 161,100 metric tons per year. Long term effects that nitrous oxide can have on a human being is loss of blood pressure, fainting, anemia, or lung cancer.

The physical geographical attributes can also contribute to the air pollution quality. The Central Valley is surrounded by mountain ranges which can capture the pollution coming from the agricultural farming, preventing it from dispersing from the other areas in California.

[120] Image is in the public domain.

The Central Valley is also expanding in the number of people that coincide in that area, so it increases the number of cars which can also contribute to the amount of emission that is in the air.

Health Geography

The valley gives its name to Valley Fever, which is primarily a disease of the lungs that is common in the southwestern United States and northwestern Mexico. It is caused by the fungus *Coccidioides immitis*, which grows in soils in areas of low rainfall, high summer temperatures, and moderate winter temperatures. These fungal spores become airborne when the soil is disturbed by winds, construction, farming, or earthquakes. This illness frequently takes weeks or months to resolve. Occasionally Valley Fever is life-threatening or even fatal. Due to the agricultural industry's significant presence in the Valley, pesticide drift and leaching have become concerns. Residents risk contamination when living in proximity to application sites.

Economic Geography | Agriculture

The Central Valley is one of the world's most productive agricultural regions. More than 230 crops are grown there. On less than 1 percent of the total farmland in the United States, the Central Valley produces 8 percent of the nation's agricultural output by value: US$43.5 billion in 2013. California's farms and ranches earned almost $50 billion in 2018. The valley's productivity relies on irrigation from surface water and badly depleted underground aquifers. About one-sixth of the US' irrigated land is in the Central Valley.

Virtually all non-tropical crops are grown in the Central Valley, which is the primary source for produce throughout the United States, including tomatoes, grapes, cotton, apricots, and asparagus. Six thousand almond growers produced more than 600 million pounds (in 2000, about 70 percent of the world's supply and nearly 100 percent of domestic production.

The US' top four counties in agricultural sales are in the Central Valley

- Fresno County | $3.7 Billion
- Tulare County | $3.3 Billion
- Kern County | $3.2 Billion
- Merced County | $2.3 Billion

Figure 11.16: Almonds Maturing in the Central Valley.[121]

Early farming was concentrated close to the Sacramento-San Joaquin Delta, where the water table was high year-round and water transport was readily available. Subsequent irrigation projects brought many more parts of the valley into productive use. The even larger California State Water Project was formed in the 1950s and construction continued over the following decades.

CULTURAL GEOGRAPHY

The Central Valley has a tremendous cultural history that dates back for thousands of years; however, the author wanted to spend some time discussing the cultural groups that migrated to the Central Valley at the turn of the last century who influenced the agricultural shift that leads California to this day.

After the Chinese Exclusion Act of 1882, Japanese immigrants were recruited to work in the fields of California. They were initially welcomed because they did not replace white workers and were willing to do the most difficult jobs. The Japanese were instrumental in establishing new crop industries, such as rice, which is now a $600 million industry in California.

[121] Image is in the public domain.

Figure 11.16: Mexican Workers Heading to Harvest Peas Near Bakersfield, California, 1936.[122]

By 1910, Japanese workers made up nearly 42% of the farm labor force in California. However, they soon faced competition from other immigrant and emigrating groups, including South Asians, Greeks, Mexicans, Koreans, Filipinos and African Americans from the Southern States of the US.

Waves of African Americans came to Central California in search of a better life. They often arrived in boxcars, old buses, and flatbed trucks, hoping to escape the economic and social repression of the South. However, the reality of life in California was often harsh. African American workers faced discrimination and exploitation, and they were often paid lower wages than other workers.

Following World War I, a large influx of Mexican migrants began to supply labor to California farms. The Bracero Program, which allowed Mexican workers to come to the United States as temporary guest workers, was established in 1942. Braceros were not allowed to organize or demand better wages, and they were often subjected to poor working conditions and discrimination.

[122] Image is in the public domain.


Figure 11.17: An Auto Camp in Bakersfield in 1940.[123]

The civil rights movement of the 1960s brought attention to the plight of farmworkers, and Cesar Chavez, Dolores Huerta, and Larry Itliong led a successful movement to organize farmworkers and improve their wages and working conditions. However, the gains made by the farmworker movement have been eroded in recent years, and farmworkers continue to face low wages, poor working conditions, and discrimination.

Case Study | Bakersfield

Bakersfield is a city in Kern County, California, situated near the southern "horseshoe" end of the San Joaquin Valley. The city is surrounded by mountains, including the Sierra Nevada to the east, the Greenhorn Mountains to the northeast, the Tehachapi Mountains to the south, and the Temblor Range to the west. The Temblor Range is about 35 miles (56 km) from Bakersfield across the valley floor. Bakersfield is located about 110 miles (180 kilometers) north of Los Angeles and about 275 miles (443 kilometers) southeast of Sacramento. The city is served by the Bakersfield Municipal Airport and the Bakersfield Amtrak station.

The city has a total area of 143.6 square miles (372 square kilometers), of which 142.2 square miles (368 square kilometers) are land and 1.4 square miles (3.6 square kilometers) are water. The city's population was 385,783 at the 2020 census.

Bakersfield has a hot arid climate (Köppen BWh), with very hot, dry summers, and winters that consist of mild days with chilly/cold nights. Rainfall is low in the city, averaging only 6.36 inches (161.5 mm) annually, with most of it falling in the winter. Bakersfield averages about 191 clear

[123] Image is in the public domain.

days a year. The climate makes the region suitable for growing crops ranging from carrots to citrus and almonds. Aside from agriculture, Bakersfield is also known for its oil and gas fields, (which is a primary factor in the air quality of the region).

Cultural Geography | The Bakersfield Beat

The Bakersfield sound is a subgenre of country music that emerged in the mid-to-late 1950s in and around Bakersfield, California. It is characterized by its influences of rock and roll and honky-tonk style country, and its heavy use of electric instrumentation and backbeats. The Bakersfield sound was a reaction against the slickly produced, orchestra-laden Nashville sound, which was becoming popular in the late 1950s. The culture influence of the Bakersfield Beat came from the people that migrated to Bakersfield during the Dust Bowl. Bakersfield, known mainly for agriculture and oil production, was the destination for many Dust Bowl migrants and others from Oklahoma, Texas, Arkansas, and parts of the Midwest. The mass migration of "Okies" to California also meant their music would follow and thrive, finding an audience in California's Central Valley.

Although the Bakersfield sound was pioneered by Wynn Stewart, who was known for his energetic live performances and his use of electric guitars and drums, artists such as Buck Owens, Merle Haggard, and Tommy Collins helped to popularize the Bakersfield sound, which became one of the most popular and influential country genres of the 1960s.

The Bakersfield sound influenced a wide range of country and music artists, including later country rock and outlaw country musicians, as well as progressive country artists. Another iconic musical group hailing from Bakersfield, California, was Korn. Forming in 1993, they emerged as pioneers of the nu-metal genre. Nu-metal blended elements of grunge, heavy metal, and hip-hop, creating a unique and often aggressive sound. Korn's signature style featured downtuned guitars, Jonathan Davis's anguished vocals that shifted between rapping and singing, and a focus on dark themes like alienation and anger. Their music resonated with a generation grappling with similar emotions, propelling them to mainstream success in the late 90s and early 2000s.

The California 'Okie'

An Okie is a person identified with the state of Oklahoma, or their descendants. This connection may be residential, historical, or cultural. For most Okies, several (or all) of these connections exist and are collectively the source of their being Oklahoman. While not an official demographic used or recognized by the United States Census Bureau, Okies, due to various factors, have developed their own distinct culture within larger social groupings both akin to and separate from Midwestern and Southern influences. Included are their own dialect, music, and Indigenous-derived folklore.

Figure 11.18: Migrant 'Okie' Youth in a Kern County Potato Field. 1940.[124]

In California, the term came to refer to very poor migrants from Oklahoma coming to look for employment. The Dust Bowl and the "Okie" migration of the 1930s brought in over a million migrants, many headed to the farm labor jobs in the Central Valley. A study in the 1990s indicated that about 3.75 million Californians were descendants of this population. By 1950, four million individuals, or one quarter of all persons born in Oklahoma, Texas, Arkansas, or Missouri, lived outside the region, primarily in the West.

Prominent Okies included singer/songwriter Woody Guthrie and country musician Merle Haggard. John Steinbeck wrote about Okies moving west in his Pulitzer Prize-winning 1939 novel The Grapes of Wrath, which was filmed in 1940 by John Ford.

Buck Owens

Buck Owens and his band, the Buckaroos, further developed the Bakersfield sound by incorporating different styles of music to fit Owens' musical tastes. The resulting music style is characterized by its use of twin Fender Telecasters, a big drumbeat, fiddle, and pedal steel

[124] Image is in the public domain.

guitar. The Telecaster was originally developed for country musicians to play Texas/Western swing music, and the Bakersfield sound is a continuation of this tradition. Buck Owens and is Buckaroos had 21 number-one singles on the Billboard Hot Country Songs chart, more than any other artist in the history of the chart. Some of his most popular songs include: Act Naturally, Under Your Spell Again and Together Again.

The Bakersfield sound is a more raw and rebellious style of country music than the Nashville sound, which was popular at the time. It is also more dependent on the individual talents of the musicians, rather than the elaborate orchestral production of Nashville-style country music.

Buck Owens was not only a pioneer of the Bakersfield sound, but he also helped to preserve its history. In 1996, he opened the Buck Owens Crystal Palace in Bakersfield, which served as both a nightclub for country music performers and as a museum of the history and sound of country music, including the Bakersfield sound. Owens regularly performed at the Crystal Palace until his death in 2006.

Figure 11.19: Jimmy Dean, (Left) & Buck Owens (Right) Singing on the Jimmy Dean Show, in 1965.[125]

Merle Haggard

Merle Haggard, a Country Music Hall of Fame inductee, was one of the most well-known artists involved in the development of the Bakersfield Sound. He was born into a family of Dust Bowl migrants, who lived in a boxcar in Oildale, and spent his childhood listening to country music. His music often reflected his own experiences and those of the people he grew up with. He sang about outlaw living, the struggles of working-class people, and the pride of being an Okie.

[125] Image is in the public domain.

His most famous song, "Mama Tried," is based on his own experiences of being a rebellious child and going to prison.

Haggard's music is considered to have kept the spirit of the Central Valley alive. Bakersfield author Gerald Haslam said that Haggard "is most a representative of The Other California" because he "offers glimpses into lives lived out of the mainstream." Haggard's music gave voice to the people who were often ignored or forgotten, and he earned the nickname "The Poet of the Common Man."

Figure 11.20: Merle Haggard, Circa 1971.[126]

Physical Geology

The Kern River Beds Formation is a crescent-shaped belt of non-marine sedimentary rocks that crops out in the Kern River area of the San Joaquin Valley. It is about 12 miles wide and 50 miles long, and ranges in thickness from 500 to 2,600 feet. The formation is composed mostly of pale-yellow to light-brown sandstone and conglomerate, with interbeds of greenish-gray or greenish-brown siltstone and mudstone.

The Kern River Beds Formation was deposited during the Neogene Period of the Cenozoic Era, and preserves fossils of plants and animals that lived during that time. The formation is an

[126] Image is in the public domain.

important source of oil and gas, and wells in the Kern River Oil Field are located on a section of the formation north of the Kern River Bluffs and Bakersfield.

The formation is divided into two units: the upper Kern River Beds Formation and the lower Chanac Formation. The wedge of the Etchegoin Formation is found in the central and western sections of the formation.

The producing interval in the Kern River Formation of the Kern River oil field has been divided into two zones separated by water-bearing sand lentils. The lower producing zone is called the China Grade Zone, and the upper is the Kern River Zone.

The Kern River Beds Formation is a valuable resource for understanding the geology and history of the San Joaquin Valley. It is also an important economic resource, providing oil and gas that is essential to the region's economy. Want to learn more? Visit the West Kern Oil Museum in Taft, 1168 Wood Street in Taft, California.

Economic Geography

Bakersfield's economy is historically and primarily based on the oil and agriculture industries. Kern County, of which Bakersfield is the county seat, is the most oil-productive county in the United States. The county is also a major agricultural producer, ranking in the top five most productive agricultural counties in the nation. Major crops grown in Kern County include grapes, citrus, almonds, carrots, alfalfa, cotton, and roses.

Bakersfield is home to the corporate and regional headquarters of many companies involved in the oil and agriculture industries. Two of the top four employers in Bakersfield are farms, each employing between 2,000 and 3,000 people.

In recent years, Bakersfield has also seen growth in its manufacturing and distribution sectors. Several companies have moved to Bakersfield due to its inexpensive land and proximity to international ports in Los Angeles and Oakland. Other companies have opened regional offices in Bakersfield because of the city's business-friendly policies, such as no local utility or inventory taxes. Products manufactured in Bakersfield include ice cream (the world's largest ice cream plant), central vacuums, highway paint, and stock racing cars.

The city's economy is diverse and continues to grow; however, it seems the oil industry is weakening. Due to increasing state regulations, the oil and energy sectors are seeing a decline in production, jobs, and investments. California today has six times more clean-energy as oil-related jobs.

Environmental Issues

Air quality in Bakersfield is generally poor, especially in the fall and winter. This is due to a combination of factors, including the California wildfire season, the formation of inversion layers, and emissions from agriculture, industry, rail freight, and road traffic.

An inversion layer is a meteorological phenomenon in which warm air is trapped beneath cooler air. This can happen in the winter in the San Joaquin Valley, when the air temperature in the foothills is warmer than the air temperature in the valley floor. This traps pollutants in the valley, where they can accumulate to unhealthy levels.

The extraction of oil and gas is also a contributor to air pollution in Bakersfield. This is because the burning of fossil fuels, to generate electricity, releases pollutants into the air, including particulate matter, nitrogen oxides, and sulfur dioxide. One of the largest is the Kern River Cogeneration Facility, a 300-megawatt natural gas-fired power plant. These pollutants can cause a variety of health problems, including respiratory problems, heart disease, and cancer.

Figure 11.21: The Kern River Oil Field in Bakersfield Was is the 5th Largest Producer in the U.S. 2006.[127]

According to the EPA, Bakersfield had 28 days of "Unhealthy" and 1 day of "Very Unhealthy" air quality in 2015. This ranked 6th in the United States. In 2016, the city had 14 days with "Unhealthy" air quality, ranking 9th in the United States. And in 2017, Bakersfield had 23 days with "Unhealthy" air quality, 14 of which were caused by the Thomas Fire.

---

[127] Image by Wikimedia is licensed under CC BY-SA 3.0.

Figure 12.1: Salt Flats in Bad Water Basin, Death Valley.[128]

UNIT 12: THE GREAT BASIN

Goals & Objectives of this unit

- Compare and contrast several different arid regions found in California.
- Understand basic rock distributions in The Great Basin- and its geologic past.
- Connect tectonic events and geologic areas with natural resource distributions in California
- Review basic geomorphology topics... weathering, erosion, and deposition

INTRODUCTION

The Great Basin is the largest area of contiguous endorheic watersheds, those with no outlets to the sea, in North America. It spans nearly all of Nevada, much of Utah, and portions of California, Idaho, Oregon, Wyoming, and Baja California. It is noted for both its arid climate and the basin and range topography that varies from the North American low point at Badwater Basin in Death Valley to the highest point of the contiguous United States, less than 100 miles (160 km) away at the summit of Mount Whitney. The region spans several physiographic divisions, biomes, ecoregions, and deserts.

The term "Great Basin" is applied to hydrographic, biological, floristic, physiographic, topographic, and ethnographic geographic areas. The name was originally coined by John C.

[128] Image by Jeremy Patrich is licensed under a CC-BY 4.0.

Frémont, who, based on information gleaned from Joseph R. Walker as well as his own travels, recognized the hydrographic nature of the landform as having no connection to the ocean. The hydrographic definition is the most used and is the only one with a definitive border. The other definitions yield not only different geographical boundaries of "Great Basin" regions but regional borders that vary from source to source.

Figure 12.2: Map of California's Great Basin Desert & Basin Range.[129]

The Great Basin Desert is defined by plant and animal communities, and, according to the National Park Service, its boundaries approximate the hydrographic Great Basin but exclude the southern "panhandle". The Great Basin Floristic Province was defined by botanist Armen Takhtajan to extend well beyond the boundaries of the hydrographically defined Great Basin: it includes the Snake River Plain, the Colorado Plateau, the Uinta Basin, and parts of Arizona north of the Mogollon Rim.

The indigenous peoples of the Great Basin, or The Great Basin Culture Area, is a cultural classification of indigenous peoples of the Americas and a cultural region located between the Rocky Mountains and the Sierra Nevada. The culture area covers approximately 400,000 square miles (1,000,000 km2), or just less than twice the area of the hydrographic Great Basin.

---

[129] Image by Wikimedia is licensed under CC BY-SA 3.0.

NORTHERN BASIN | MONO-INYO CRATERS

The Mono–Inyo Craters are a volcanic chain of craters, domes and lava flows in Mono County, Eastern California. The chain stretches 25 miles (40 km) from the northwest shore of Mono Lake to the south of Mammoth Mountain. The Mono Lake Volcanic Field forms the northernmost part of the chain and consists of two volcanic islands in the lake and one cinder cone volcano on its northwest shore. Most of the Mono Craters, which make up the bulk of the northern part of the Mono–Inyo chain, are phreatic (steam explosion) volcanoes that have since been either plugged or over-topped by rhyolite domes and lava flows. The Inyo volcanic chain form much of the southern part of the chain and consist of phreatic explosion pits, and rhyolitic lava flows and domes. The southernmost part of the chain consists of fumaroles and explosion pits on Mammoth Mountain and a set of cinder cones south of the mountain; the latter are called the Red Cones.

In hydrothermal systems, the circulation of ground water is driven by a combination of topography and geothermal heat sources. The system in the Long Valley Caldera is recharged primarily from snowmelt in the highlands around the western and southern rims of the caldera. The meltwater infiltrates to depths of a few kilometers (or miles), where some is heated to at least 430 °F (220 °C) by hot rock near the Inyo craters. The heated water, kept from boiling by high pressure, still has lower density than cold water, and it rises along steeply inclined fractures to depths of 0.3–1.25 miles (0.48–2.01 km). It then flows eastward through rock layers to hydrothermal vent discharge points at the surface along Hot Creek, around Crowley Lake and in Mammoth. The water temperature declines eastward because of heat loss and mixing with cold water, and in the springs near Crowley Lake temperatures are at only about 125 °F (50 °C).

Figure 12.3: Geothermal Springs at Hot Creek. California.[130]

[130] Image by Jeremy Patrich is licensed under a CC-BY 4.0.

Volcanic eruptions along the narrow fissure system under the chain began in the west moat of Long Valley Caldera 400,000 to 60,000 years ago. Mammoth Mountain was formed during this period. Multiple eruptions from 40,000 to 600 years ago created the Mono Craters and eruptions 5,000 to 500 years ago formed the Inyo volcanic chain. Lava flows 5,000 years ago built the Red Cones, and explosion pits on Mammoth Mountain were excavated in the last 1,000 years. Uplift of Paoha Island in Mono Lake about 250 years ago is the most recent activity. These eruptions most likely originated from small magma bodies rather than from a single, large magma chamber like the one that produced the massive Long Valley Caldera eruption 760,000 years ago. During the past 3,000 years, eruptions have occurred every 250 to 700 years. In 1980, a series of earthquakes and uplift within and south of Long Valley Caldera indicated renewed activity in the area.

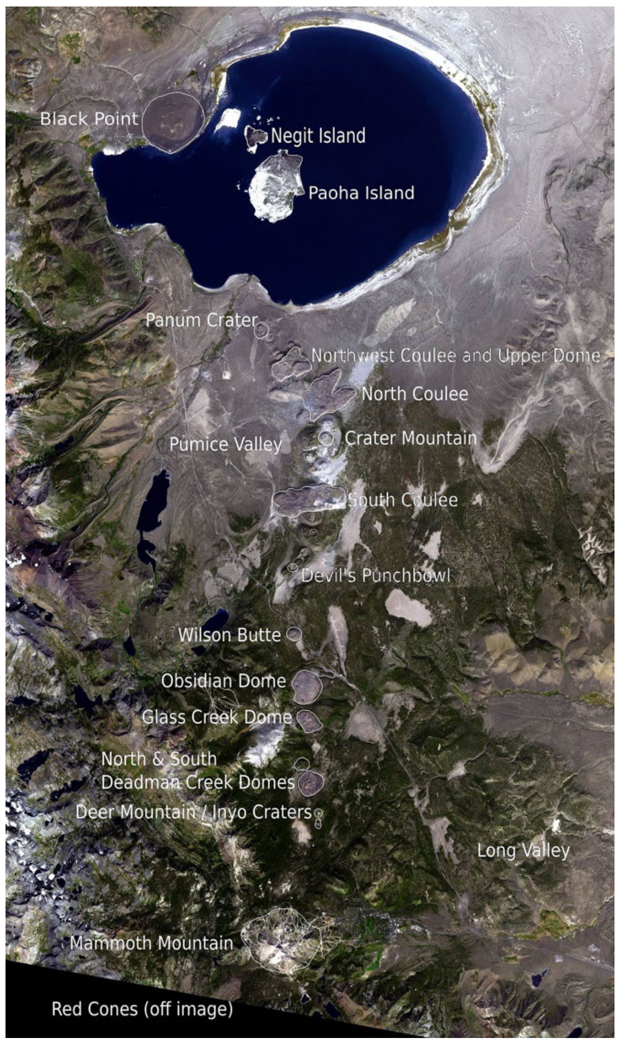


Figure 12.4: Satellite Photo of the Mono-Inyo Craters& Mammoth Mountain, California.[131]

[131] Image is in the public domain.

The region has been used by humans for centuries. Obsidian was collected by Mono Paiutes for making sharp tools and arrow points. Glassy rock continues to be removed in modern times for use as commercial scour and yard decoration. Mono Mills processed timber felled on or near the volcanoes for the nearby boomtown Bodie in the late 19th to early 20th centuries. Water diversions into the Los Angeles Aqueduct system from their natural outlets in Mono Lake started in 1941 after a water tunnel was cut under the Mono Craters.

Physical Geography

The Mono–Inyo Craters form a volcanic chain in Eastern California that sits along a narrow north–south-trending fissure system extending from the north shore of Mono Lake through the western Long Valley Caldera, south of Mammoth Mountain. The chain is within the Inyo National Forest and Mono County; the nearest incorporated community is Mammoth Lakes. The craters are in the Great Basin geographic area.

Mono Craters

The Mono Craters are a 10.5-mile (17 km) chain of at least 27 volcanic domes, three large glass flows called coulees and various explosion pits and other associated volcanic features. The domes of the chain lie on a roughly north–south-trending arc that is concave to the west and located south of Mono Lake. The highest of the Mono Craters domes is Crater Mountain (elevation 9,172 feet or 2,796 m), which rises 2,400 feet (730 m) above Pumice Valley to the west. Associated volcanic features are in Mono Lake (Paoha and Negit Islands) and on its north shore (Black Point). The coulees cluster north and south of the overlapping chain of domes.

Figure 12.5: Map of Mono & Long Valley Calderas.[132]

[132] Image is in the public domain.

Inyo Volcanic Chain

The Inyo volcanic chain stretches 6 miles (10 km) from Wilson Butte to the Inyo Craters, proper. The Inyo Craters are open pits in a forested area that are about 600 feet (180 m) across and 100 to 200 feet (30 to 60 m) deep, each with small ponds covering their floors. A quarter mile (half kilometer) north of these is another explosion pit on top of Deer Mountain. Farther north of these craters are five lava domes, including Deadman Creek Dome, Glass Creek Dome, Obsidian Dome, and Wilson Butte. These domes are composed of gray rhyolite, frothy pumice, and black obsidian. The Inyo volcanic chain extends into Long Valley Caldera but is not related to the caldera's volcanism.

Figure 12.6: An Aerial Photo of the Mono Craters—With Panum Crater in the Middle.[133]

Red Cones

South of the Inyo volcanic chain are other features related to the dike system responsible for creating the craters, volcanoes, and lava flows. These include a north–south trend of fault scarps up to 20 feet (6 m) high and pull-apart cracks or fissures in the earth. These fissures are not technically faults because little or no vertical or horizontal movement has occurred along them. Most notable among these is "Earthquake Fault", a fissure up to 10 feet (3 m) wide that cuts 60 to 70 feet (18 to 21 m) into glassy rhyolite lava flows. The fissure was formed by stretching induced by the intrusion of the Inyo dike. Stairs to the bottom of the fissure were removed after being damaged by earthquakes in 1980. Several Mono–Inyo-related explosion

[133] Image is in the public domain.

pits are on Mammoth Mountain. The Red Cones, south of Mammoth Mountain, are basaltic cinder cones and are the southernmost part of the Mono–Inyo Craters volcanic chain.

Case Study | Panum Crater

Panum Crater is a volcanic cone that is part of the Mono–Inyo Craters. Panum Crater is between 600 and 700 years old, and it exhibits all the characteristics of the textbook rhyolitic lava dome. Rhyolitic volcanoes are characterized by having large amounts of silica (quartz) in their lava. The content of silica at Panum is about 76 percent. It makes the lava very viscous, or thick, and very glassy. Products of this rhyolitic eruption are pumice and obsidian, the volcanic glass that Native Americans used to make arrow points and scrapers.

Panum Crater formed in a sequence of events. The first event was caused by magma rising from deep within the Earth's crust. When this extremely hot, liquid rock contacted water just below the surface, the water expanded into steam and a large, violent eruption occurred. The material that was thrown into the air by the steam, mainly old lake bottom sediments, was deposited around the new vent in little mounds. So much debris was blown out that a gaping crater was left behind.

Once this debris was blown out, a fountain of cinders shot up a great distance into the sky. As this huge amount of ash and pumice began to fall back towards the earth, it formed a pumice ring, or cinder cone, about the original vent. This cinder cone is still visible today.

Figure 12.7: Birdseye View of Panum Crater, Near Mono Lake.[134]

[134] Image is in the public domain.

Following the violent eruptions of the first two phases, the remainder of the thick magma slowly rose to the surface in a series of domes. Each dome began with an outpouring of the viscous, rhyolitic lava which hardened and formed a cap over the vent. As magma continued to push up, the cap (or dome) shattered and fell to the outside of the newly formed dome. This happened so many times that a new mountain was created out of these broken pieces, called crumble breccia. The mountain continued to build in this manner until the force within the volcano weakened and no more new domes formed. The final one still stands today.

As the final dome hardened, a period of spire building began. Thick lava pushed up through cracks of the hardening dome and formed castle-like spires. The formation of the spires was analogous to toothpaste squeezing through the opening of a tube and forming a small tower before it topples over. Most of the spires at Panum Crater fell over and broke because of their rapid cooling and because of many small explosions at their bases. Most of the rocky debris at the top of the dome is the remains of spires that have crumbled.

The central lava dome was erupted from degassed material and is made up of pumice and obsidian of the same composition. The difference between the two has to do with gas escaping as the magma cooled. The magma that created the dome had dissolved gas in it, like a bottle of seltzer water. As the magma rose towards the surface where there was less pressure on it than at depth, the gas expanded producing the holes or bubbles in the pumice. The magma that remained pressurized while it cooled quickly or that had already lost its gas, formed the obsidian.

Field Trip: Panum Crater

Let's head on a field trip to explore a Panum Crater, near Mono Lake, California. Either scan the QR code or visit this link to join Professor Patrich for a lecture at the 700-year-old volcanic crater. (Video length: 5min).

Weather & Climate

The Mono–Inyo Craters are in the Central Basin and Range ecoregion of the North American Desert. The desert environment of Mono Basin receives about 14 inches (36 cm) of precipitation a year. Annual precipitation around Mammoth Lakes, which is close to the Inyo volcanic chain, is about 23 inches (58 cm). Moisture travels over the Sierra crest from the Pacific Ocean through the San Joaquin Gap. Temperatures in Mono Basin range from average winter lows of 20 to 28 °F (−7 to −2 °C) to average summer highs of 75 to 84 °F (24 to 29 °C). Temperatures near the Inyo volcanic chain and Mammoth Lakes area range from winter average lows of 16 to 21 °F (−9 to −6 °C) to summer average highs of 70 to 78 °F (21 to 26 °C).

Flora & Fauna

Most of the surface of the Mono Craters is barren but its slopes are covered by the world's largest Jeffrey Pine Forest, and partial greenery. Pumice Valley, directly to the west, is covered by sagebrush scrubland. The soil consists primarily of deep pumice, which does not hold water well. Mycorrhizal fungi in the soil invade the roots of Jeffrey pine trees in a symbiotic relationship that helps the pine absorb water and provides nutrients to the fungi. Jeffrey pine forests also surround the Inyo volcanic chain and Mammoth Mountain. Mule deer, coyotes, black bears, yellow-bellied marmots, raccoons, and mountain lions all have ranges that are coincident with forests that cover parts of the Mono–Inyo craters.

As a remnant of Pleistocene Lake Russel, Mono Lake has hypersalinity and high alkalinity (pH=10 or equivalent to 4 milligrams of NaOH per liter of water). This means that no fish are native to the lake. However, the whole food chain of the lake is based on the high population of single-celled planktonic algae present in the photic zone of the lake. These algae reproduce rapidly during winter and early spring after winter runoff brings nutrients to the surface layer of water. By March the lake is "as green as pea soup" with photosynthesizing algae.

The lake is famous for the Mono Lake brine shrimp, *Artemia monica*, a tiny species of brine shrimp, no bigger than a thumbnail, that are endemic to the lake. During the warmer summer months, an estimated 4–6 trillion brine shrimp inhabit the lake. Brine shrimp have no food value for humans but are a staple for birds of the region. The brine shrimp feed on microscopic algae.

Figure 12.8: A Brine Shrimp from Mono Lake.[135]

Mono Lake is a vital resting and eating stop for migratory shorebirds and has been recognized as a site of international importance by the Western Hemisphere Shorebird Reserve Network. Nearly 2,000,000 waterbirds, including 35 species of shorebirds, use Mono Lake to rest and eat for at least part of the year. Some shorebirds that depend on the resources of Mono Lake include American avocets, killdeer, and sandpipers. One to two million eared grebes and phalaropes use Mono Lake during their long migrations.

[135] Image by Wikimedia is licensed under CC BY 2.0.

Late every summer tens of thousands of Wilson's phalaropes and red-necked phalaropes arrive from their nesting grounds, and feed until they continue their migration to South America or the tropical oceans respectively.

Physical Geology

The Mono–Inyo chain of craters lies in east-central California, roughly parallel to the eastern escarpment of the Sierra Nevada mountain range. Volcanism and seismic activity in eastern California are a result of three major geologic processes: northwest movement of the Pacific Plate with respect to the North American Plate along the San Andreas Fault system near the coast, and east–west extension of the crust that formed the Basin and Range Province, and in the Long Valley region, where the craters are located, basin and range extension encroaches onto the thick and stable crust of the Sierra Nevada.

About an hour south it the Owens Valley is a graben—a down-dropped block of land between two vertical faults—the westernmost in the Basin and Range Province. It is also part of a trough which extends from Oregon to Death Valley called the Walker Lane.

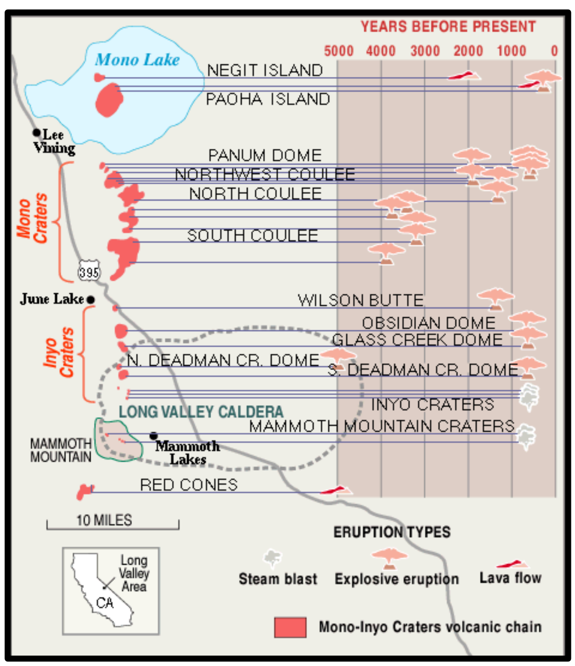


Figure 12.9: Map of Volcanoes Between Mono Lake & the Long Valley Caldera.[136]

Basement rock under the Mono–Inyo chain consists of the same granitic and metamorphic rock that make up the Sierra Nevada. Above that layer are basaltic grading to rhyolitic volcanic rocks

[136] Image is in the public domain.

that are 3.5 million to less than 760,000 years old. Volcanism occurred north of the chain, in the Bodie Hills, as far back as 28 million years. Nearly all the rock east of the Sierra Nevada in the Mono Basin area is volcanic in origin.

Volcanoes erupted from 3.6 to 2.3 million years ago near what is now Long Valley. Rhyolitic eruptions occurred in and around Glass Mountain in the same area from 2.1 to 0.8 million years ago. Volcanic ash from the massive (600 cubic kilometers or 140 cubic miles of ejecta) eruption of Long Valley Caldera some 760,000 years ago is preserved in the thick Bishop Tuff that covers much of the region.

Eruptions of basalt and andesite 400,000 to 60,000 years ago in the west moat of Long Valley Caldera were the first activity associated with the Mono–Inyo Craters system. Eruptions around 300,000 years ago filled the west moat with 800 feet (240 m) of basaltic lava. Basaltic and andesitic eruptive activity then moved to Mono Basin and lasted from 40,000 to 13,000 years ago.

The recent eruptions of the Mono Craters have been similar in volume and nearly identical in composition ("crystal-poor high-silica rhyolite") to those of Glass Mountain that preceded the Long Valley Caldera-forming eruption.

Case Study | Mono Lake Tufa Towers

Many columns of limestone rise above the surface of Mono Lake, yet were, and only can be formed underwater. These limestone towers consist primarily of calcium carbonate minerals such as calcite ($CaCO3$). This type of limestone rock is referred to as tufa, which is a term used for limestone that forms in low to moderate temperatures.

Mono Lake is a highly alkaline lake, or soda lake. Alkalinity is a measure of how many bases are in a solution, and how well the solution can neutralize acids. Carbonate and bicarbonate are both bases. Hence, Mono Lake has a very high content of dissolved inorganic carbon. Through supply of calcium ions, the water will precipitate carbonate-minerals such as calcite. Subsurface waters enter the bottom of Mono Lake through small springs. High concentrations of dissolved calcium ions in these subsurface waters cause huge amounts of calcite to precipitate around the spring orifices. As mentioned earlier, the tufa only forms at the bottom of the lake. It took many decades or even centuries to form the well-recognized tufa towers. When lake levels fell, the tufa towers came to rise above the water surface and stand as the pillars seen today.

Figure 12.10: Tufa Towers at the Southern Edge of Mono Lake.[137]

Field Trip: Mono Lake

Let's head on a field trip to explore the tufa towers at Mono Lake, California. Either scan the QR code or visit this link to join Professor Patrich for a lecture at the southern edge of the lake. (Video length: 7min)

Cultural Geography

The current tribal name "Mono" is a Yokutsan loanword from the tribe's western neighbors, the Yokuts, who however designated the Owens Valley Paiutes as the southernmost Northern Paiute band living around Owens and Mono Lakes as *monachie/monoache* ("fly people") because fly larvae was their chief food staple and trading article.This "Kucadikadi Northern Paiute Band", whose autonym *Kutsavidökadö/Kutzadika'a* means "eaters of the brine fly pupae", are also known as Mono Lake Paiute or Owens Valley Paiute, a holdover from early anthropological literature, and are often confused with the non-Northern Paiute ethnic group of the Western mono "Mono".

---

[137] Image by Jeremy Patrich is licensed under CC-BY 4.0.

Figure 12.11: An Early Photo of Mono People with Their Baskets of Acorns, Circa 1920.[138]

CENTRAL BASIN | THE OWENS VALLEY

The Owens Valley is a geologically young valley, having formed only about 10 million years ago. The valley was formed by a combination of faulting and erosion. Initially, the Sierra Nevada mountains were formed by the subduction of the Pacific Plate beneath the North American Plate. This subduction caused the Earth's crust to buckle, fold, and uplift, forming the Sierra Nevada mountains. The Owens Valley was formed as a down dropped graben in the basin, between the Sierra Nevada mountains and the Inyo-White Mountains. As for the uplift of the Inyo-White mountains, that was the direct result of the stretching of the Basin and Range.

Owens Valley, the largest except for the Imperial Valley of the Great Basin region, is an arid valley of the Owens River in eastern California. The valley occupies what is known as a fault block valley, which is between the rugged Sierra to the west, and the Inyo- White Mountain Range to the east. The highest peak of the White Mountains has an elevation of 14,252 feet, while on the opposite side of the trough rises the lofty escarpment of the Sierras, with peaks culminating in Mt. Whitney, 14,508 feet. The length of Owens Valley is about seventy miles and an average width of ten miles. It is due to the dropping of the earth between the two mountain ranges and is formed of two main blocks, the eastern one of which is occupied by the lowlands along Owens's river, while the western one is higher, and is best exemplified in the Alabama

[138] Image is in the public domain.

Hills, near the town of Lone Pine. The great Owens Valley earthquake of 1872 was the result of movement between these two earth blocks.

Physical Geography

The Owens River is the main river in the valley and is a popular destination for outdoor recreation. The Alabama Hills are a range of hills and rock formations located near the eastern slope of the Sierra Nevada mountains and are a popular destination for rock climbing, hiking, and filming.

In addition to these notable features, the Owens Valley is also adjacent to a variety of other unique physical geography features, such as the Saline Valley, Searles Borax Marsh, and the Trona Pinnacles. Saline Valley is a desert valley located east of the Inyo-White Mountains and is characterized by its steep mountain walls and dry lakebed. Searles Borax Marsh is a basin located at the southern end of the Owens Valley and is home to a variety of borate minerals, which are used to make a variety of products, including detergents, glass, and fertilizers. Lastly, the Trona Pinnacles are a series of tall, thin rock formations made of trona, a mineral used to make soap and other products.

Weather & Climate

Most of the Owens Valley have a high desert climate (Köppen climate classification: BWk) characterized by hot summers and cold winters. January temperatures range from the middle fifties °F (+12 °C–+15 °C) to the upper twenties °F (-4 °C–-1 °C) and July temperatures range from the upper nineties °F (35 °C–37 °C) to the lower sixties °F (15 °C–18 °C). Low humidity is prevalent, with average annual precipitation averaging less than 6 inches (150 mm), due to being in the rainshadow of the Sierra Nevada. Snowfall varies greatly from year-to-year, averaging only 5 inches (130 mm) annually. The nearest official National Weather Service co-operative weather station is in Independence where records date back to 1893.

Climate Data for Mount Whitney, California | 1991-2020 (NOAA)													
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Average High °F	25.2	23.0	25.8	31.2	38.	48.9	55.2	54.5	49.6	41.5	31.9	24.3	37.5
Average Low °F	6.0	3.3	5.4	8.0	13.4	21.6	27.2	26.5	24.1	19.2	11.6	6.2	14.1
Average Precipitation (in)	8.37	8.88	5.79	3.94	1.92	0.51	0.31	0.19	0.27	1.9	2.51	7.91	42.5in

Figure 12.12: Climate Date for Mount Whitney, California (Data from NOAA).[139]

[139] Image by Jeremy Patrich is licensed under CC-BY 4.0.

Owens Lake

Owens Lake, located in the Owens Valley of California, is a unique and important body of water with a rich history. The lake was originally named Patsiata by the Nüümü (Owens Valley Paiute), but was renamed Owens Lake by explorer John C. Frémont in honor of one of his guides, Richard Owens.

Before the diversion of the Owens River, Owens Lake was a large and thriving body of water, up to 12 miles long and 8 miles wide, covering an area of up to 108 square miles. The lake had an average depth of 23 to 50 feet and sometimes overflowed to the south, flowing into the Mojave Desert. Even earlier, in the late Pleistocene, about 11–12,000 years ago Owens Lake was even larger still, covering nearly 200 square miles (520 km2) and reaching a depth of 200 feet (61 m). The increased inflow from the Owens River, from melting glaciers of the post-Ice Age Sierra Nevada, caused Owens Lake to overflow south through Rose Valley into another now dry lakebed, China Lake.

In 2023, the lake flooded for the first time in over 100 years due to the numerous storms that struck California during the first three months of 2023. Further information on Owens Lake can be found in the, 'Water as a Resource' unit from the text.

Physical Geology

As previously discussed, in Unit 10, Around 200 million years ago, the ancient oceanic Farallon Plate began to subduct beneath the North American Plate. As the Farallon moved eastward, it was overridden by the North American, and the moisture within it was figuratively baked out of the rock before the crust melted into magma. As it began to cool, a large mass of igneous rock was created and is now visible as the granite domes of the Sierra Nevada Batholith. Batholiths are large masses of igneous rock that form deep below the surface, and they are thought to be the "roots" of subduction-zone volcanoes. After the below-surface formation of the granite, processes such as uplift and erosion eventually expose it to the surface.

The western flank of much of the valley has large glacial moraines coming off the Sierra Nevada. These unsorted piles of rock, boulders, and dust were pushed to where they are by glaciers during the last ice age.

The graben was formed by a long series of earthquakes, such as the 1872 Lone Pine earthquake, that have moved the graben down and helped move the Sierra Nevada up. The graben is much larger than the depth of the valley suggests; gravity studies suggest that 10,000 feet (3,048 m) of sedimentary rock mostly fills the graben and that a very steep escarpment is buried under the western length of the valley. The topmost part of this escarpment is exposed at Alabama Hills.

The Owens Valley has many mini volcanoes, such as Crater Mountain in the Big Pine volcanic field. Smaller versions of the columnar jointed basalts, similar to Devils Postpile, can be found by Little Lake and Fossil Falls.

On March 26, 1872, at 2:30 am, Lone Pine experienced a violent earthquake that destroyed most of the town. At the time, the town consisted of 80 buildings made of mud and adobe; only 20 structures were left standing. As a result of the quake, which formed a sag pond called Diaz Lake, a total of 26 people lost their lives. A mass grave located just north of town commemorates the site of the main fault. One of the few remaining structures pre-dating the earthquake is the 21-inch (53 cm)-thick "Old Adobe Wall" located in the alley behind the Lone Star Bistro, a coffee house.

Field Trip: 1872 Lone Pine Earthquake

Let’s head on a field trip to learn about one of California’s biggest earthquakes! Either scan the QR code or visit this link to join Professor Patrich for a lecture at the actual fault scarp. (Video length: 3min).

Case Study | Mount Whitney

In July 1864, the members of the California Geological Survey named the peak after Josiah Whitney, the state geologist of California and benefactor of the survey. In 1881, Smithsonian Astrophysical Observatory founder Samuel Pierpont Langley remained on the summit for some time, making daily observations of the solar heat. Accompanying Langley in 1881 was another party consisting of Judge William B. Wallace of Visalia, W. A. Wright, and Reverend Frederick Wales. In his memoirs, Wallace wrote, "The Pi Ute [Paiute] Indians called Mount Whitney *Too-man-i-goo-yah,* which means 'the very old man.' They believe that the Great Spirit who presides over the destiny of their people once had his home in that mountain."

Mount Whitney's summit is on the Sierra Crest and the Great Basin Divide. It lies near many of the Sierra Nevada's highest peaks. The peak rises dramatically above the Owens Valley, sitting 10,778 feet (3,285 m) or just over 2 mi (3.2 km) above the town of Lone Pine 15 mi (24 km) to the east, in the Owens Valley.

Figure 12.13: Sunset Behind the Sierra Nevada[140]

The mountain is partially dome-shaped, with its famously jagged ridges, due to frost wedging, extending to the sides. Mount Whitney is above the tree line and has an alpine climate and ecology. Very few plants grow near the summit: one example is the sky pilot, a cushion plant that grows low to the ground. The only animals are transient, such as the butterfly *Parnassius phoebus* and the gray-crowned rosy finch.

Whitney's eastern slope is far steeper than its western slope because the Sierra Nevada is the result of a fault block that is analogous to a cellar door: the door is hinged on the west and is slowly rising on the east.

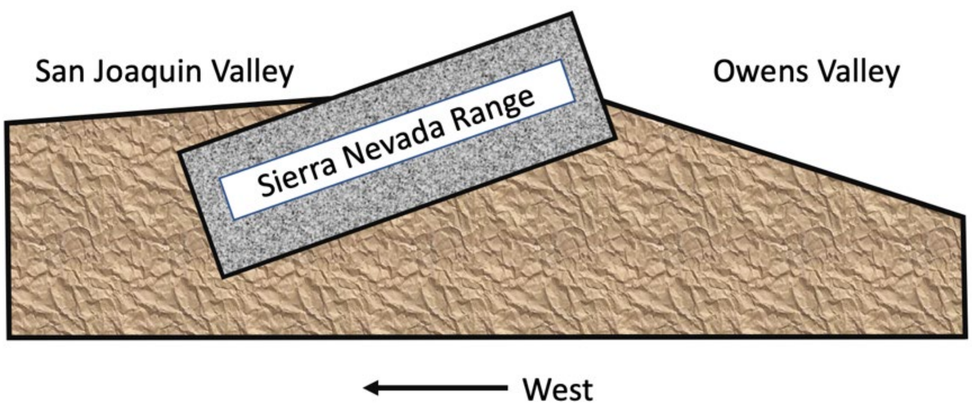


Figure 12.14: Schematic of the Sierra Nevada Fault Block.[141]

The rise is caused by a fault system that runs along the Sierra's eastern base, below Mount Whitney. Thus, the granite that forms Whitney is the same as that which forms the Alabama

[140] Image by Jeremy Patrich is licensed under a CC-BY 4.0.

[141] Image by Jeremy Patrich is licensed under CC-BY 4.0.

Hills, thousands of feet lower down. The raising of Whitney (and the downdrop of the Owens Valley) is due to the same geological forces that cause the Basin and Range Province: the crust of much of the intermontane west is slowly being stretched and extended.

The granite that forms Mount Whitney is part of the Sierra Nevada Batholith. In Cretaceous time, masses of molten rock that originated from subduction rose underneath what is now Whitney and solidified underground to form large expanses of granite. In the last 2 to 10 million years, the Sierra was pushed up, enabling glacial and river erosion to strip the upper layers of rock to reveal the resistant granite that makes up Mount Whitney today.

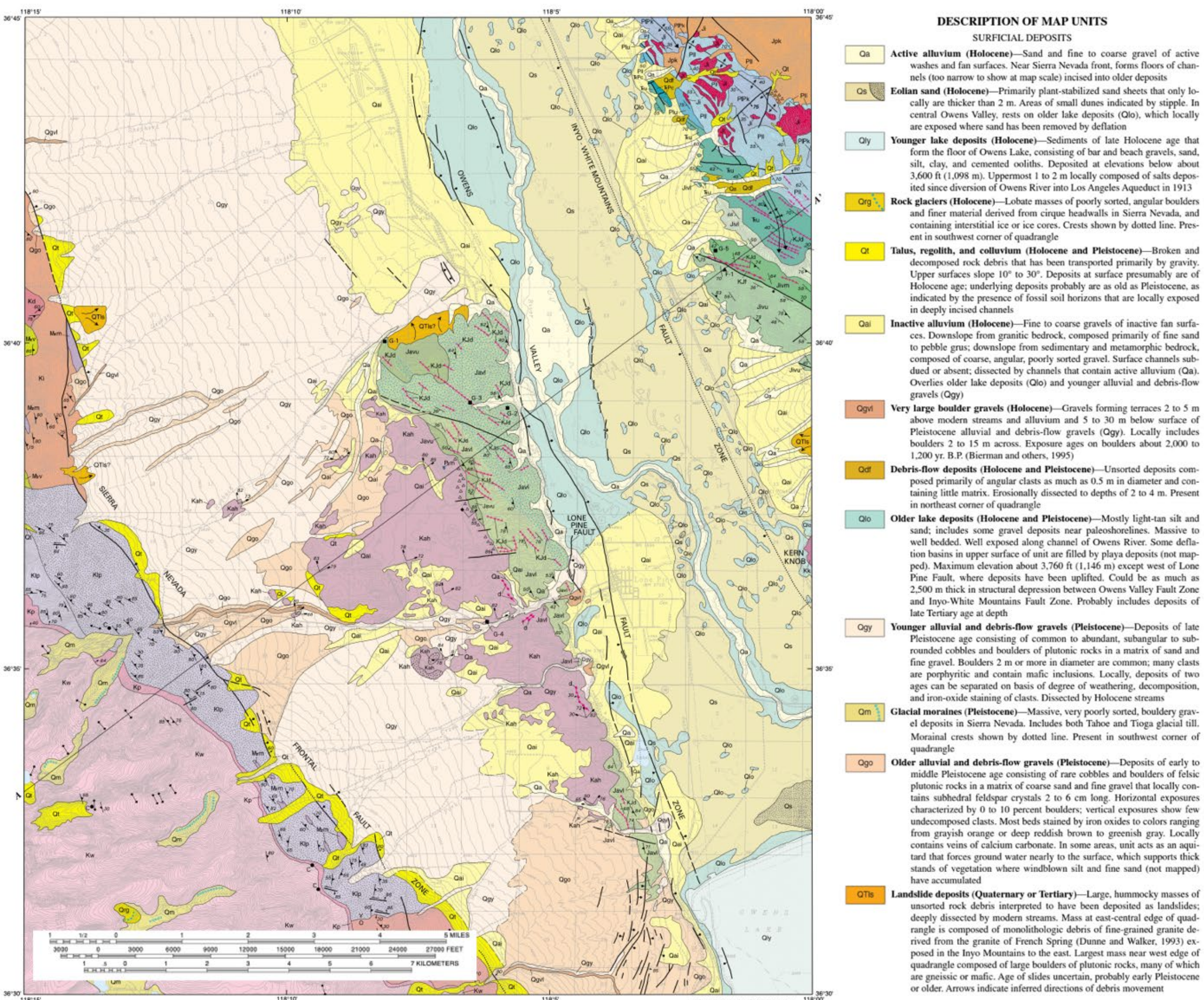


Figure 12.15: Geologic Map for Mount Whitney, California (USGS).[142]

[142] Image is in the public domain.

Case Study | The Alabama Hills

The Alabama Hills are a range of hills and rock formations located near the eastern slope of the Sierra Nevada in the Owens Valley, California. They are geologically part of the Sierra Nevada, but they differ in appearance due to different patterns of erosion, (such as iron staining due to the warmer climate). The Alabama Hills are home to a variety of unique geological features, including dozens of natural arches, potato-shaped boulders, and a steep escarpment that may have been created by earthquakes.

One of the most striking features of the Alabama Hills is their rounded contours, which contrast with the sharp ridges of the Sierra Nevada to the west. This difference in appearance is since the Alabama Hills are made up of different types of rock. A common rock type is a weathered metamorphosed volcanic rock that is 150–200 million years old. This rock, found along the eastern edge, is relatively soft and easily eroded, which is why the Alabama Hills have such rounded contours.

The most common rock type in the Alabama Hills is biotite monzogranite, which is 82–85 million years old. This rock is much harder and more resistant to erosion than the metamorphosed volcanic rock. As a result, the biotite monzogranite in the Alabama Hills often weathers into potato-shaped boulders. Many of these boulders stand on end due to spheroidal weathering, a process that creates concentric shells of rock that eventually peel away, leaving behind a rounded core.

Figure 12.16: Mobius Arch in the Alabama Hills, California.[143]

[143] Image by Jeremy Patrich is licensed under CC-BY 4.0.

The Alabama Hills are also home to a variety of natural arches. These arches are formed when erosion weakens the rock at their base, causing them to collapse. The most famous natural arch in the Alabama Hills is Mobius Arch, which is a complete loop. Other notable arches include Lathe Arch, the Eye of Alabama, and Whitney Portal Arch.

In addition to their geological significance, the Alabama Hills are also culturally important. The hills have been used as a filming location for hundreds of movies and television shows, including many Westerns. The Alabama Hills are also a sacred place for the Paiute people, who have lived in the Owens Valley for centuries.

Field Trip: Mobius Arch | Alabama Hills

Let's head on a field trip to learn about the geology and formation of the Mobius Arch in the Alabama Hills. Either scan the QR code or visit this link to join Professor Patrich for a lecture at the arch. (Video length: 5min).

Cultural Geography

The Paiute Indians inhabited the Owens Valley area from prehistoric times. These early inhabitants are known to have established trading routes which extended to the Pacific Central Coast, delivering materials originating in the Owens Valley to such tribes as the Chumash.

During the 1870s, Lone Pine was an important supply town for several nearby mining communities, including Kearsarge, Cerro Gordo, Keeler, Swansea, and Darwin. The Cerro Gordo mine high in the Inyo Mountains was one of the most productive silver mines in California. The silver was carried in ore buckets on a strong cable to Keeler, and then transported 4 miles (6.4 km) northwest to smelter ovens at Swansea. To supply the necessary building materials and fuel for these operations, a sawmill was constructed near Horseshoe Meadows by Colonel Sherman Stevens that produced wood for the smelters and the mines. The wood was moved by flume to the valley, where it was burned in adobe kilns to make charcoal, which was then transported by steamships across Owens Lake to the smelters at Swansea, about 12 miles (19 km) south of Lone Pine.

Railroads played a major role in the development of Lone Pine and the Owens Valley. In 1883, the Carson and Colorado Railway line was constructed from Belleville, Nevada, across the White Mountains to Benton, and then down into the Owens Valley where it ended in Keeler. The arrival of the C&C rail line, with its engine "The Slim Princess", and the stagecoach in Keeler were a major economic boost for the area. Twice a week, passengers arrived on the evening train, spent the night at the Lake View Hotel (later renamed the Hotel Keeler), and then took the stage the following morning to Mojave. A short line to the north connected with the Virginia and Truckee Railroad line at Mound House, Nevada.

Case Study | Lone Pines Cinematic History

Lone Pine and the Alabama Hills quickly became one of the most popular filming locations for Western films because of several factors, including its diverse landscape, its proximity to Los Angeles. The scenic location quickly caught the attention of other filmmakers, and in the coming decades, over 400 films, 100 television episodes, and countless commercials have been shot in Lone Pine and the Alabama Hills.

In 1920, the town's history was forever altered when a movie production company came to film the silent film The Round-Up. The film's success quickly caught the attention of other filmmakers, and Lone Pine and the Alabama Hills quickly became one of the most popular filming locations in the world.

In the early days, Lone Pine was primarily used as a backdrop for Western films. Notable Westerns filmed in Lone Pine during the 1920s and 1930s include Riders of the Purple Sage (1925), The Enchanted Hill (1926), Somewhere in Sonora (1927), Blue Steel (1934), Hop-Along Cassidy (1935), The Charge of the Light Brigade (1936), Oh, Susanna! (1936), Rhythm on the Range (1936), The Cowboy and the Lady (1938), Under Western Stars (1938), and Gunga Din (1939).

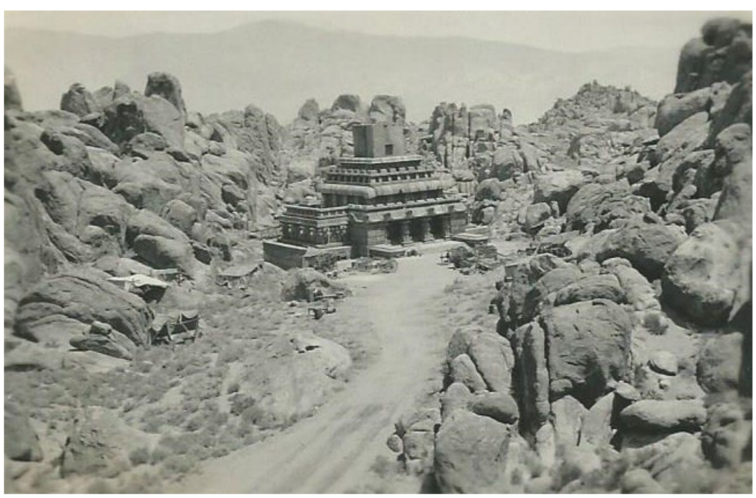


Figure 12.17: Movie Set of Gunga Din, Alabama Hills, California- Circa 1937.[144]

[144] Image by Wikimedia is licensed under CC BY-SA 4.0.

In the coming decades, Lone Pine continued to be used as a setting for Western films, but it also became a popular location for a variety of other genres, including science fiction, fantasy, and action films. Some notable examples include Alfred Hitchcock's Saboteur (1942), Samson and Delilah (1949), Star Trek V: The Final Frontier (1989), Tremors (1990), The Postman (1997), Gladiator (2000), Iron Man (2008), Cowboys & Aliens (2011), Django Unchained (2012), The Lone Ranger (2013), and Once Upon a Time in Hollywood (2019). Want to learn more? Be sure to check out the Museum of Western Film, located in Lone Pine.

SOUTHERN MOJAVE BASIN

The Mojave Desert is a desert in the rain shadow of the southern Sierra Nevada mountains and Transverse Ranges in the Southwestern United States. It is named for the indigenous Mojave people. It is located primarily in southeastern California and southwestern Nevada, with small portions extending into Arizona and Utah.

The Mojave Desert, together with the Sonoran, Chihuahuan, and Great Basin deserts, forms a larger North American Desert. Of these, the Mojave is the smallest and driest. The Mojave Desert displays typical basin and range topography, generally having a pattern of a series of parallel mountain ranges and valleys. It is also the site of Death Valley, which is the lowest elevation in North America. The Mojave Desert is often colloquially called the "high desert", as most of it lies between 2,000 and 4,000 feet (610 and 1,220 m).

Figure 12.18: Photo of the Cima Volcanic Field Near Baker, California.[145]

[145] Image by Jeremy Patrich is licensed under CC-BY 4.0.

The 20 million acres (81,000 km2; 31,000 sq mi) desert supports several human activities, including recreation, ranching, and military training. The Mojave Desert also contains various silver, tungsten, iron, borax, and gold deposits.

Physical Geography

The Mojave Desert is a desert bordered to the west by the Sierra Nevada mountain range and the California montane chaparral and woodlands, and to the south and east by the Sonoran Desert. The boundaries to the east of the Mojave Desert are less distinctive than the other boundaries because there is no presence of an indicator species, such as the Joshua tree (Yucca brevifolia), which is endemic to the Mojave Desert. The Mojave Desert is distinguished from the Sonoran Desert and other deserts adjacent to it by its warm temperate climate, as well as flora and fauna such as ironwood (*Olneya tesota*), blue Palo Verde (*Parkinsonia florida*), and the chuparosa (*Justicia californica*). Along with these other factors, these plants differentiate the Mojave from the nearby Sonoran Desert.

The Mojave Desert is bordered by the San Andreas fault to the Southwest and the Garlock fault to the North. The mountains elevated along the length of the San Andreas fault provide a clear border between the Mojave Desert and the coastal regions to the West. The Garlock fault separates the Mojave Desert from the Sierra Nevada and Tehachapi mountains, which provide a natural border to the Mojave Desert. There are also abundant alluvial fans, which are called bajadas, that form around the mountains within the Mojave Desert and extend down toward the low altitude basins, which contain dried lake beds called playas, where water generally collects and evaporates, leaving large volumes of salt. These playas include Rogers Dry Lake, and China Lake. Dry lakes are a noted feature of the Mojave landscape. The Mojave Desert is also home to the Devils Playground, about 40 miles (64 km) of dunes and salt flats going in a northwest-southeasterly direction. The Devil's Playground is a part of the Mojave National Preserve and is between the town of Baker, California, and Providence Mountains. The Cronese Mountains are within the Devil's Playground.

There are very few surface rivers in the Mojave Desert, even given the low precipitation level: two major rivers generally flow underground. The intermittent Mojave River, which begins in the San Bernardino mountains and disappears underground in the Mojave Desert. The Amargosa River also flows partly underground through the Mojave Desert along a southward path. The Manix, Mojave, and the Little Mojave lakes are all large but shallow. Soda Lake is the principal saline basin of the Mojave Desert. Natural springs are typically rare throughout the Mojave Desert, however, there are two notable springs, Ash Meadows, and Oasis Valley. Ash

Meadows is formed from several other springs, which all draw from deep underground. Oasis Valley draws from the nearby Amargosa River.

Weather & Climate

According to the Köppen climate classification system, Death Valley National Park has a hot desert climate (BWh). Extremes in temperatures throughout the seasons characterize the climate of the Mojave Desert. Freezing temperatures as well as strong winds are not uncommon in the winter, as well as precipitation such as rain and snow in the mountains. In contrast, temperatures above 100 °F (38 °C) are not uncommon during the summer months. There is an annual average precipitation of 2 to 6 inches (51 to 152 mm), although regions at high altitudes such as the portion of the Mojave Desert in the San Gabriel mountains may receive more rain. Most of the precipitation in the Mojave comes from the Pacific Cyclonic storms that are generally present passing Eastward in November to April. Such storms generally bring rain and snow only in the mountainous regions, because of the effect of the mountains, which creates a drying effect on its leeward slopes.

During the late summer months, there is also the possibility of strong thunderstorms, which bring heavy showers or cloudbursts. These storms can result in flash flooding.

Climate Data for Death Valley National Park | 1911-2020 (NOAA)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
All-Time Record High °F	90	97	103	113	122	128	134	130	125	113	98	89	134°F
All-Time Record Low °F	15	20	26	35	42	49	62	65	41	32	24	19	15°F
Average High °F	67.2	73.7	82.6	91	100.7	111.1	117.4	115.9	107.7	93.3	77.4	65.6	92°F
Average Low °F	42.5	49	57.1	64.8	75	84	91	88.7	79.1	64.4	50.5	41.1	65.6°F
Average Precipitation (in)	0.37	0.52	0.25	0.1	0.03	0.05	0.1	0.1	0.2	0.12	0.1	0.26	2.2in

Figure 12.19: Climate Date for Death Valley National Park (Data from NOAA).[146]

Field Trip: Badwater Basin

Let's head on a field trip to one of the hottest places on Earth! Either scan the QR code or visit this link to see Professor Patrich explore Badwater Basin in Death Valley, California. (Video length: 4min).

[146] Image by Jeremy Patrich is licensed under CC-BY 4.0.

Flora & Fauna

The flora of the Mojave Desert consists of various endemic plant species, notably the Joshua Tree, which is a notable endemic and indicator species of the desert, (which unlike most plants, is pollinated by moths, not bees or birds). There is more endemic flora in the Mojave Desert than almost anywhere in the world. Mojave Desert flora is not a vegetation type, although the plants in the area have evolved in isolation because of the physical barriers of the Sierra Nevada and the Colorado Plateau. Predominant plants of the Mojave Desert include creosote bush (*Larrea tridentata*), brittlebush (*Encelia farinosa*), desert holly (*Atriplex hymenelytra*), white burrobush (*Hymenoclea salsola),* and most notably, the Joshua tree (*Yucca brevifolia).*

Figure 12.20: Joshua Tree National Park.[147]

Additionally, the Mojave Desert is also home to various species of cacti, such as silver cholla (*Cylindropuntia echinocarpa*), Mojave prickly pear (*O. erinacea*), beavertail cactus (O*. basilaris*), and many-headed barrel cactus (*Echinocactus polycephalus*). The Mojave Desert is generally abundant in winter annuals. The plants of the Mojave Desert each generally correspond to an individual geographic feature. As such, there are distinctive flora communities within the desert.

[147] Image by Wikimedia is licensed under CC BY-SA 4.0.

Notable species of the Mojave Desert include bighorn sheep (Ovis canadensis), mountain lions (Puma concolor), black-tailed jackrabbits (*Lepus californicus),* and desert tortoises (*Gopherus agassizii*). Various other species are particularly common in the Mojave Desert, such as the LeConte's thrasher (*Toxostoma lecontei),* banded gecko (*Coleonyx variegatus*), desert iguana (*Dipsosaurus dorsalis*), chuckwalla (*Sauromalus obesus),* and regal horned lizard (*Phrynosoma solare).* Species of snake include the rosy boa (*Lichanura trivirgata*), Western patch-nosed snake (*Salvadora hexalepis*), and Mojave rattlesnake (*Crotalus scutulatus*). These species can also occur in the neighboring Sonoran and Great Basin deserts.

The animal species of the Mojave Desert have generally fewer endemics than its flora. However, endemic fauna of the Mojave Desert includes Kelso Dunes jerusalem cricket (*Ammopelmatus kelsoensis),* the Kelso Dunes shieldback katydid (*Eremopedes kelsoensis*), the Mohave ground squirrel (*Spermophilus Mohavensis*) and Amargosa vole (*Microtus californicus scirpensis).* The Mojave fringe-toed lizard (*Uma Scoparia*) is not endemic, but almost completely limited to the Mojave Desert. There are also aquatic species that are found nowhere else, such as the Devils Hole pupfish, limited to one hot spring near Death Valley.

Figure 12.21: A Spawning Pair of Salt Creek Pupfish, Death Valley.[148]

Physical Geology

The rock that underlies the Mojave Desert was likely created under shallow water in the Precambrian. Sedimentary processes left large deposits of limestones, silicates, and dolomites. During the Paleozoic era, the area that is now the Mojave was again likely submerged under a greater sea. During the Mesozoic era, major tectonic activities such as thrust faulting and

[148] Image is in the public domain.

folding resulted in distinctive shaping as well as intrusion by magma. During the Cenozoic, more tectonic deformation occurred whilst the Mojave was partly submerged. Major volcanic activity is thought to have occurred during the Oligocene. Large downpours during the Miocene likely significantly eroded the rock in the Mojave and accelerated deposition.

The Mojave Desert is a source of various minerals and metallic materials due to magma instusion. Due to the climate, there is an accumulation of weathered bedrock, fine sand, and silt, both sand and silt sediments becoming converted into colluvium. The deposits of gold, tungsten, and silver have been mined frequently prior to the Second World War. Additionally, there have been deposits of copper, tin, lead-zinc, manganese, iron, and various radioactive substances but they have not been mined for commercial use.

Case Study | The Geology of Death Valley

The park has a diverse and complex geologic history. Since its formation, the area that comprises the park has experienced at least four major periods of extensive volcanism, three or four periods of major sedimentation, and several intervals of major tectonic deformation where the crust has been reshaped. Two periods of glaciation (a series of ice ages) have also added drainage of water into the area, although no glaciers ever existed in the ranges now in the park.

Little is known about the history of the oldest exposed rocks in the area due to extensive metamorphism (alteration of rock by heat and pressure). Radiometric dating gives an age of 1,700 million years for the metamorphism during the Proterozoic. About 1,400 million years ago a mass of granite now in the Panamint Range intruded this complex. Uplift later exposed these rocks to nearly 500 million years of erosion, yet dating them to 1.8 billion years of age.

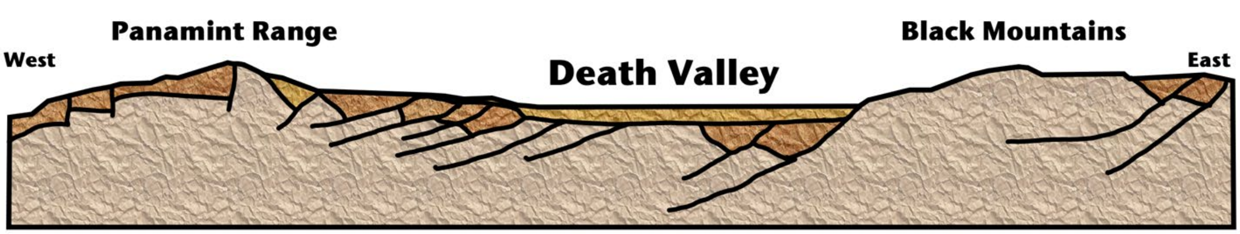


Figure 12.22: Long Valley Basin Cross-Section.[149]

The Proterozoic sedimentary formations of the Pahrump Group were deposited on these basement rocks. This occurred following uplift and erosion of any earlier sediments from the Proterozoic basement rocks. The Pahrump is composed of arkose conglomerate (quartz clasts

[149] Image by Jeremy Patrich is licensed under CC-BY 4.0.

in a concrete-like matrix) and mudstone in its lower part, followed by dolomite from carbonate banks topped by algal mats as stromatolites, and finished with basin-filling sediment derived from the above, including possible glacial till from the hypothesized Snowball Earth glaciation. The very youngest rocks in the Pahrump Group are basaltic lava flows.

Basement & Pahrump Group

A rift opened and subsequently flooded the region as part of the breakup of the supercontinent Rodinia in the Neoproterozoic (by about 755 million years ago) and the creation of the Pacific Ocean. A shoreline like the present Atlantic Ocean margin of the United States lay to the east. An algal mat-covered carbonate bank was deposited, forming the Noonday Dolomite. Subsidence of the region occurred as the continental crust thinned and the newly formed Pacific widened, forming the Ibex Formation. An angular unconformity (an uneven gap in the geologic record) followed.

A true ocean basin developed to the west, breaking all the earlier formations along a steep front. A wedge of clastic sediment then began to accumulate at the base of the two underwater precipices, starting the formation of opposing continental shelves. Three formations developed from sediment that accumulated on the wedge. The region's first known fossils of complex life are found in the resulting formations. Notable among these are the Ediacaran fauna and trilobites, the evolution of the latter being part of the Cambrian Explosion of life.

The sandy mudflats gave way about 550 million years ago to a carbonate platform (like the one around the present-day Bahamas), which lasted for the next 300 million years of Paleozoic time Death Valley's position was then within ten or twenty degrees of the Paleozoic equator. Thick beds of carbonate-rich sediments were periodically interrupted by periods of emergence. Although details of geography varied during this immense interval of time, a north-northeastern coastline trend generally ran from Arizona up through Utah. The resulting eight formations and one group are 20,000 feet (6 km) thick and underlay much of the Cottonwood, Funeral, Grapevine, and Panamint ranges.

Rifting & Deposition

In the early-to-mid- Mesozoic the western edge of the North American continent was pushed against the oceanic plate under the Pacific Ocean, creating a subduction zone. A subduction zone is a type of contact between different crustal plates where heavier crust slides below lighter crust. Erupting volcanoes and uplifting mountains were created as a result, and the coastline was pushed to the west. The Sierran Arc started to form to the northwest from heat and pressure generated from subduction, and compressive forces caused thrust faults to develop.

A long period of uplift and erosion was concurrent with and followed the above events, creating a major unconformity, which is a large gap in the geologic record. Sediments worn off the Death Valley region were carried both east and west by wind and water No Jurassic- to Eocene-aged sedimentary formations exist in the area, except for some possibly Jurassic-age volcanic rocks.

Compression & Uplift

Basin and Range-associated stretching of large parts of crust below southwestern United States and northwestern Mexico started around 16 million years ago and the region is still spreading. This stretching began to affect the Death and Panamint valleys area by 3 million years ago. Before this, rocks now in the Panamint Range were on top of rocks that would become the Black Mountains and the Cottonwood Mountains. Lateral and vertical transport of these blocks was accomplished by movement on normal faults. Right-lateral movement along strike-slip faults that run parallel to and at the base of the ranges also helped to develop the area. Torsional, or twisting forces, probably associated with northwesterly movement of the Pacific Plate along the San Andreas Fault (west of the region), is responsible for the lateral movement.

Igneous activity associated with this stretching occurred from 12 million to 4 million years ago. Sedimentation is concentrated in valleys (basins) from material eroded from adjacent ranges. The amount of sediment deposited has roughly kept up with this subsidence, resulting in the retention of the same valley floor elevation over time.

The Spillover Theory

Pleistocene ice ages started 2 million years ago and melt from alpine glaciers on the nearby Sierra Nevada Mountains fed a series of lakes that filled Death and Panamint valleys and surrounding basins (see the top of the timescale image). The lake that filled Death Valley was the last of a chain of lakes fed by the Amargosa and Mojave Rivers, and the Owens River.

The end-basin in a chain of lakes that began with Mono Lake, in the north, and continued through basins down the Owens River Valley, through Searles and China Lakes and the Panamint Valley, to the immediate west. Lake Manly, formed in Death Valley. The lake was nearly 100 miles (160 km) long and 600 feet (180 m) deep.

The large lake that covered much of Death Valley's floor, which geologists call Lake Manly, started to dry up 10,500 years ago. Salt pans and playas were created as ice age glaciers retreated, thus drastically reducing the lakes' water source. Only faint shorelines are left.

As the area turned to desert, the water evaporated, leaving an abundance of evaporitic salts, such as common sodium salts and borax, which were later exploited during the modern history of the region, primarily 1883 to 1907.

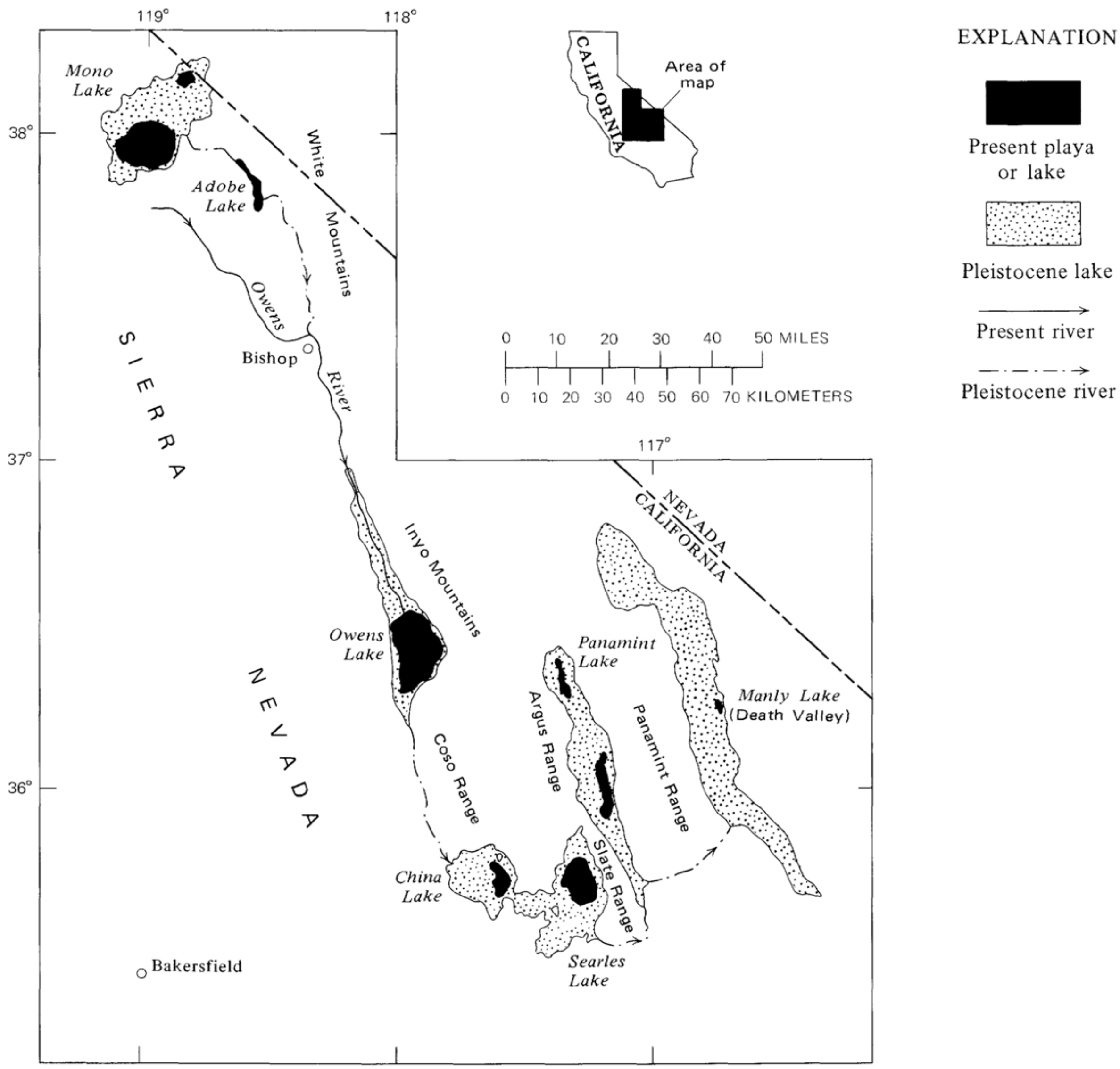


Figure 12.23: Map Showing the System of the Pleistocene Lakes in Eastern California.[150]

Zabriskie Point

Millions of years prior to the actual sinking and widening of Death Valley and the existence of Lake Manly, another lake covered a large portion of Death Valley including the area around Zabriskie Point (the location was named after Christian Brevoort Zabriskie, vice-president and

[150] Image is in the public domain.

general manager of the Pacific Coast Borax Company in the early 20th century). This ancient lake began forming approximately nine million years ago. During several million years of the lake's existence, sediments were collecting at the bottom in the form of saline muds, gravels from nearby mountains, and ashfalls from the then-active Black Mountain volcanic field. These sediments combined to form what we today call the Furnace Creek Formation. The climate along Furnace Creek Lake was dry, but not nearly as dry as in the present. Camels, mastodons, horses, carnivores, and birds left tracks in the lakeshore muds, along with fossilized grass and reeds. Borates, which made up a large portion of Death Valley's historical past were concentrated in the lakebeds from hot spring waters and alteration of rhyolite in the nearby volcanic field. Weathering and alteration by thermal waters are also responsible for the variety of colors represented there.

Figure 12.24: The Badlands, at Zabriskie Point in Death Valley.[151]

Regional mountains building to the west influenced the climate to become more and more arid, causing the lake to dry up, and creating a dry lake. Subsequent widening and sinking of Death Valley and the additional uplift of today's Black Mountains tilted the area. This provided the necessary relief to accomplish the erosion that produced the badlands we see today. The dark-colored material capping the badland ridges (to the left in the panoramic photograph) is lava from eruptions that occurred three to five million years ago. This hard lava cap has retarded erosion in many places and possibly explains why Manly Beacon, the high outcrop to the right, is much higher than other portion of the badlands. (Manly Beacon was named in honor of

[151] Image by Jeremy Patrich is licensed under CC-BY 4.0.

William L. Manly, who along with John Rogers, guided members of the ill-fated party of Forty-niners out of Death Valley during the California Gold Rush of 1849.)

The primary source of borate minerals gathered from Death Valley's playas is Furnace Creek Formation. The Formation is made up of over 5000 feet (1500 m) of mudstone, siltstone, and conglomerate. The borates were concentrated in these lakebeds from hot spring waters and altered rhyolite from nearby volcanic fields.

Field Trip: Zabriskie Point

Let's head on a field trip to one of the most majestic views in all of Death Valley National Park! Either scan the QR code or visit this link to join Professor Patrich for a lecture at Zabriskie Point in Death Valley, California. (Video length: 3min).

Cultural Geography

Much of early Mojave history remains unrecorded in writing since the Mojave language was not written in precolonial times. They depended on oral communication to transmit their history and culture from one generation to the next. Disease, outside cultures and encroachment on their territory disrupted their social organization. Together with having to adapt to a majority culture of another language, this resulted in interrupting the Mojave transmission of their stories and songs to the following generations.

In the 1880s, extracting borax, a valuable mineral, from this remote location demanded a robust transportation system. Traditional mule teams proved inadequate for the 165-mile trek, so Francis Marion Smith pioneered the twenty-mule team in 1883. These specially bred animals, arranged in ten pairs, pulled massive wagons laden with borax ore. The critical water wagon, holding 1,200 gallons, ensured survival in the harsh environment. Skilled "mule skinners" navigated treacherous terrain and managed the demanding animals on ten-day round trips battling extreme heat and flash floods.

The twenty-mule team revolutionized borax transportation, enabling large-scale mining by significantly reducing costs. It became a symbol of American industrial prowess. However, the discovery of richer deposits closer to rail lines and the arrival of the "Death Valley Scotty" railroad in 1889 marked the team's decline. The final official trip occurred in 1898.

Figure 13.1: Disneyland, One Week After Reopening After COVID-19.[152]

UNIT 13: SOUTHERN CALIFORNIA

Goals & Objectives of this unit

- Identify the major physical features of Southern California, including its mountains, valleys, deserts, and coastline.
- Explain the geological forces that have shaped Southern California's landscape, including plate tectonics, earthquakes, faults, and volcanism.
- Identify and describe the major cultural influences on Southern California, including its Spanish, Mexican, and Native American heritage.
- Examine the interrelationships between the physical geography, ethnic diversity, cultural influences, and weather and climate of Southern California.

INTRODUCTION

Southern California (commonly shortened to SoCal) is a geographic and cultural region that generally comprises the southern portion of the U.S. state of California. It includes the Los

[152] *Image by Jeremy Patrich is used under a CC-BY 4.0 license.*

Angeles metropolitan area, the second most populous urban agglomeration in the United States. The region generally contains ten of California's 58 counties: Imperial, Kern, Los Angeles, Orange, Riverside, San Bernardino, San Diego, Santa Barbara, San Luis Obispo, and Ventura counties.

Beyond the physical realm SoCal is at the hearth of innovation, and with this come global influence, such as Disneyland, Hollywood, Fast-food, Surf Music, architecture, and even Knotts Berry Farm. Much of this will be covered, but a more in-depth study will be presented in another unit that showcases the iconic California landscapes. Nonetheless, it is also important to note that SoCal is also the third most populated megalopolis in the United States, after the Great Lakes Megalopolis and the Northeast Megalopolis. Much of Southern California is famous for its large, spread-out, suburban communities and use of automobiles and highways.

PHYSICAL GEOGRAPHY

The definition of Southern California is geographically complex and has been shaped by both natural and political forces. The region is generally considered to encompass the area south of the 35°45' latitude, but its northern boundary is not a straight line. Instead, it follows the northern boundaries of San Luis Obispo, Kern, and San Bernardino counties, or alternatively, Point Conception and the Tehachapi Mountains.

Following the acquisition of California by the United States, pro-slavery politicians attempted to divide the state at 36°30', the line of the Missouri Compromise. This would have created a separate slave state in the southern half of California. However, the Compromise of 1850 admitted California to the Union as a free state, preventing the division of the state. Despite the abolition of slavery, tensions between Northern and Southern California persisted. In the 1850s, Californians (dissatisfied with inequitable taxes and land laws) and pro-slavery Southerners in the lightly populated "cow counties" of southern California attempted three times to achieve a separate statehood or territorial status separate from Northern California. The last attempt, the Pico Act of 1859, was passed by the California State Legislature and approved by nearly 75 percent of voters. However, the secession crisis following the election of Abraham Lincoln in 1860 and the subsequent American Civil War led to the proposal never coming to a vote.

The complex history of Southern California's definition reflects the region's unique geographical and cultural identity. The region has been shaped by a diversity of influences, including its mountains, dry climate, its proximity to Mexico, and its role as the center of the American film industry.

Climate

Despite the popular image of California as a place of sunshine and perfect weather, the local climate can be very diverse, with some areas experiencing more extreme conditions. However, the weather in the region is usually mild, especially in the winter, and dry, with rainfall ranging from moderate in the coastal regions to almost none in the desert.

Around the coastal areas, the weather does not vary as dramatically as it does inland. Climate is affected by factors such as latitude, topography, and proximity to water masses - primarily the cold currents along the coast of the Pacific Ocean, and southern California's mountain ranges. The Transverse Ranges and the Peninsular Ranges are key players in the region's climate.

Essentially, the mountain ranges separate southern California into two distinct climatic regions: The heavy-populated coastal area west of these mountains is the one most associated with the term "southern California" and is characterized by pleasant weather all-year round, without frequent heat spells in the summer and without low temperatures in winter. By comparison, the area east of the ranges, between the mountains and the borders with Nevada and Arizona, is dominated by the Sonoran Desert and the Mojave Desert and tends to be more arid and register more extreme temperatures in both summer and winter.

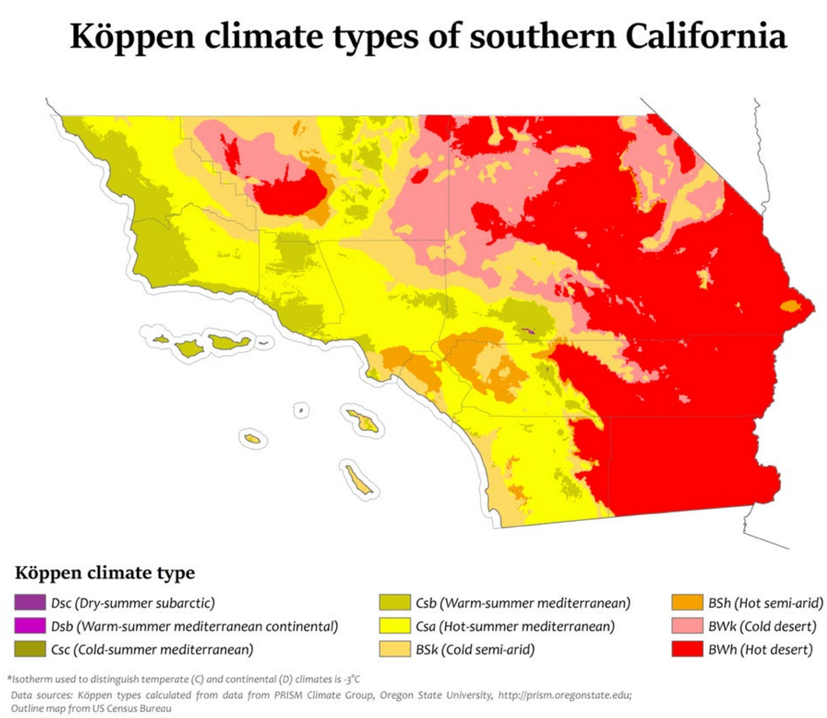


Figure 13.:2 Köppen Climate Types of Southern California.[153]

[153] Image by Wikipedia is licensed under CC BY-SA 4.0.

Low Clouds, "May Gray" & "June Gloom"

Low clouds and fog are common weather phenomena in Southern California. This is due to the region's topography and proximity to the Pacific Ocean. Coastal fogs are often created by the interaction of seasonal inversion layers and the coastal marine layer. These fogs can reach as far inland as 20 miles, butting up against inland mountains or coastal mountain ranges. Coastal fogs can vary in density, from light "ground fogs" to dense "Tule fog." Tule fog is most common in the winter and spring when cold air from the mountains interacts with warmer ocean air masses.

In recent decades, the prevalence of low clouds and fog on the California coast has decreased. This is due to a combination of urban heat and climate change. Scientists have found that stratus cloud cover has decreased between 25% and 50% since the 1970s.

In contrast with the sunny summer, late spring in southern California is often overcast, due to the marine onshore air. This period, known to the locals as "May Gray" and "June Gloom", dims the coastal skies of sunny southern California. During this time, the coastal clouds may remain all day, but often give way to some hazy afternoon sunshine. The number of gloomy days during this period vary from year to year. Years with warmer ocean temperatures, influenced by the broader El Niño weather pattern, may result in fewer gray days in June, whereas the cooler ocean temperatures associated with a La Niña pattern, usually foretell more gray days in the season.

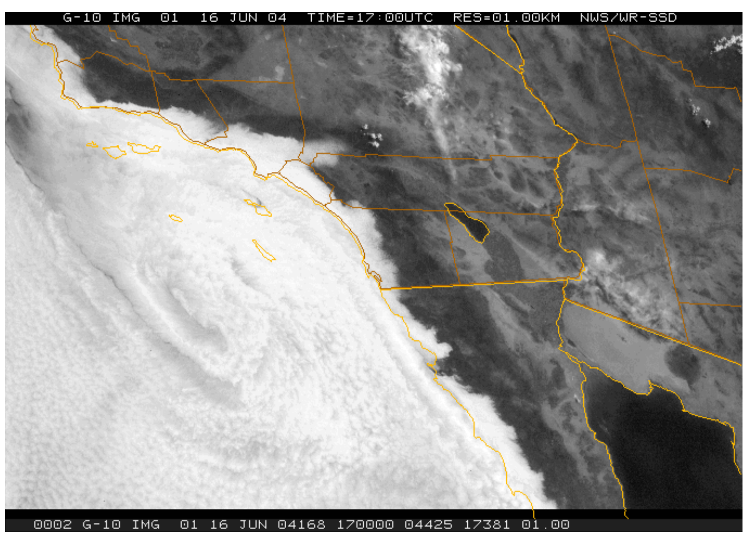


Figure 13.4: Satellite Image of a Strong June Gloom- Marine Layer in Southern California.[154]

[154] Image by Wikipedia is in the public domain.

June Gloom is caused by the interaction of the California Current and the marine layer. The California Current is a cold ocean current that flows southward along the coast of California. The marine layer is a layer of cool, moist air that sits on top of the ocean. When the marine layer spreads over the California Current, it cools down and condenses, forming low-altitude stratus clouds. These clouds then move inland, bringing overcast skies and cool temperatures to the coastal regions of California.

Wildfires

Because of the hot, dry, and windy nature of southern California, wildfires are common. While most of them only affect small areas, wildfire can quickly get out of control and spread across large areas of woodland, particularly when fanned by the Santa Ana winds. Hot and extremely dry, they are also known as "Devil winds", and move towards the coastal region from the continental interior of the American West, where high pressure systems over the southwestern deserts increase in temperature.

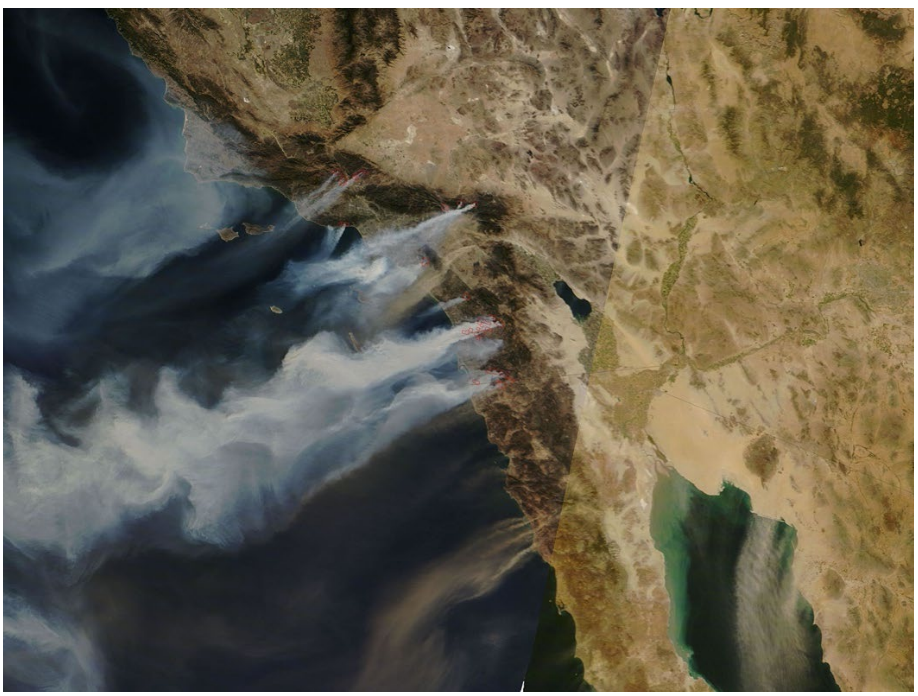


Figure 13.5: Satellite Image of Southern California Showing Nearly 30 Wildfire Being Fueled by Santa Ana Winds, on October 22nd, 2007.[155]

Because natural wildfires are more likely to appear towards the end of long, dry summers, they have become a more serious problem in recent years because of the changing climate, overpopulation and decreased controlled fires, which makes wildfires increasingly larger and

[155] Image by Wikipedia is in the public domain.

more frequent. Climate change has also widened the wildfire "season" from a few summer months to virtually the entire year.

CULTURAL GEOGRAPHY

Southern California is a region with a diverse and vibrant culture. Although other units showcase SoCal's cultural and ethnic influence, (car culture, indigenous, agriculture, food and more) the author would like to take a moment to highlight some other elements of Southern California's impressive and influential culture.

Surfing is one of the most iconic aspects of Southern California culture. The region is home to some of the best surf spots in the world, such as Trestles, Rincon, The Wedge, Huntington Beach, and Malibu. Surfing has also had a significant influence on car culture and music in Southern California. For example, the Beach Boys, Jan & Dean, Dick Dale, and the Ventures were all iconic Southern California artists who were inspired by surfing.

The Beach Boys, one of the most iconic bands of all time, had a profound influence on California culture. Their music captured the essence of the California lifestyle, with its sunny beaches, laid-back vibes, and endless summers. The Beach Boys' songs were played on radios all over the world, and their image helped to make California a symbol of youth, freedom, and fun. To list a few of their most iconic songs which are also considered as part of the 'Summer Sounds of California' are: "Surfin' USA," "Catch a Wave," and "Good Vibrations."

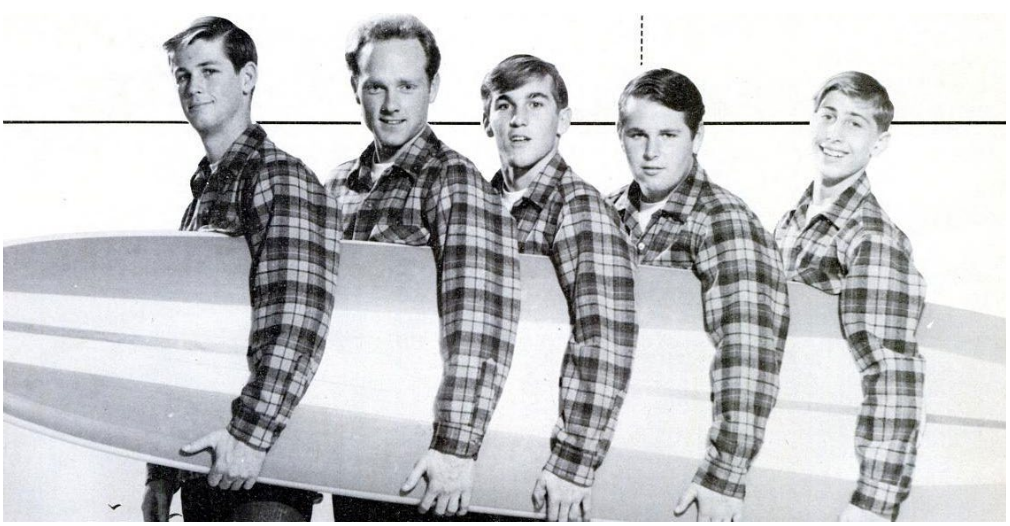


Figure 13.6: The Beach Boys- Circa 1963.[156]

[156] Image by Wikipedia is in the public domain.

Case Study | Disneyland

Walt Disney's conception of Disneyland originated during a visit to Griffith Park in Los Angeles with his daughters Diane and Sharon. Watching them ride the merry-go-round, he envisioned a place where adults and children could enjoy themselves together. Although his dream remained dormant for many years, the earliest documented draft of his plans was sent as a memo to studio production designer Dick Kelsey on August 31, 1948. Referred to as a "Mickey Mouse Park," the memo was inspired by notes Disney took during his and Ward Kimball's trip to the Chicago Railroad Fair the same month, which included a two-day stop at Henry Ford's Museum and Greenfield Village, a site with attractions like a Main Street and steamboat rides that Disney had visited eight years earlier.

Prompted by letters from fans inquiring about visiting the Walt Disney Studios, Disney realized that a functioning movie studio had little to offer visitors. He began to develop ideas for building a tourist attraction near the Burbank studios, eventually envisioning a small play park with a boat ride and other themed areas. Originally planned for an eight-acre plot to the south of the studio, across Riverside Drive, the initial park concept, the Mickey Mouse Park, was also influenced by Tivoli Gardens in Denmark, Knott's Berry Farm, Colonial Williamsburg, the Century of Progress in Chicago, and the New York's World Fair of 1939.

Although Walt's designers began working on concepts, the project quickly outgrew the available land. Disney hired Harrison Price from Stanford Research Institute to identify a suitable location for the planned theme park, based on projected future growth. Price's analysis led Disney to acquire 160 acres of orange groves and walnut trees in Anaheim, southeast of Los Angeles in neighboring Orange County.

Construction began on July 16, 1954, at a cost of $17 million (equivalent to $138 million in 2021). The park opened one year and one day later, just north of U.S. Route 101 (later Interstate 5), which was under construction at the time. In preparation for the anticipated traffic, two additional lanes were added to the freeway before opening day.

Figure 13.7: Walt Disney & Anaheim Dignitaries – Circa 1954.[157]

Opening Day

On July 17, 1955, Disneyland held an "International Press Preview" event for invited guests and the media. Although the event was intended for 11,000 people, over 28,000 attended the grand opening. Approximately half of those in attendance were either counterfeit ticket holders or trespassers. The event was televised nationwide, and viewers witnessed several embarrassing mishaps, including guests tripping over camera cables, a camera catching Bob Cummings kissing a dancer, and Walt Disney accidentally starting his dedication speech twice.

The following day, Disneyland opened to the public with twenty attractions. However, the park's debut was plagued with further problems. Traffic on the two-lane Harbor Boulevard was congested, and famous guests who were scheduled to appear over a two-hour period all arrived at once. The temperature reached an unusually high 101 degrees Fahrenheit, and due to a local plumbers' strike, Disney had to choose between running drinking fountains or toilets. He chose the latter, leaving many fountains dry. This decision generated negative publicity, as thirsty guests felt that Disney was cynically trying to sell soda. Other vendors also ran out of food, and the asphalt that had been poured that morning was soft enough to let women's high-heeled shoes sink into it. Some parents even threw their children over the crowd's shoulders to get them onto rides, such as the King Arthur Carrousel.

[157] Image by Wikipedia is licensed under CC BY 2.0.

Disney and his executives later referred to July 17, 1955, as "Black Sunday." After the extremely negative press from the preview opening, Disney invited attendees back for a private "second day" to experience Disneyland properly.

Despite its troubled opening, Disneyland quickly became a popular tourist destination. The park's success can be attributed in part to Disney's effective crisis management. He immediately acknowledged the problems that occurred on opening day and took steps to address them. For example, he hired additional staff to improve crowd control and cleanliness, and he installed more drinking fountains. Disney also apologized to guests for the inconvenience and offered them free admission to the park on a future date.

The case of Disneyland's opening day provides a valuable lesson in crisis management. By acknowledging the problem, taking steps to address it, and apologizing to those affected, Disney was able to mitigate the negative publicity and ensure the long-term success of his park.

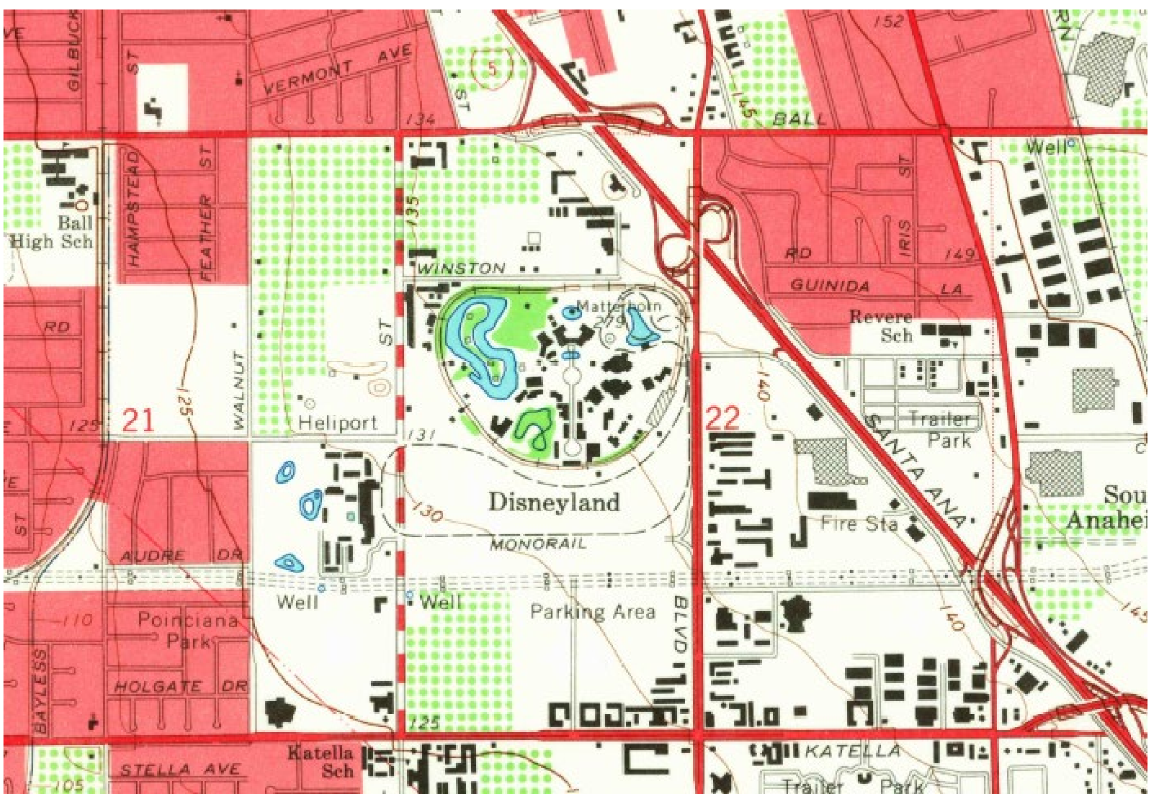


Figure 13.8: USGS Topographic Map of Disneyland- Circa 1959.[158]

[158] Image by Wikipedia is licensed under CC BY 2.0.

The 50s-70s

In September 1959, Soviet First Secretary Nikita Khrushchev spent thirteen days in the United States, with two requests: to visit Disneyland and to meet John Wayne, Hollywood's top box-office draw. Due to the Cold War tension and security concerns, he was famously denied an excursion to Disneyland. The Shah of Iran and Empress Farah were invited to Disneyland by Walt Disney in the early 1960s. There was moderate controversy over the lack of African American employees. As late as 1963, civil rights activists were pressuring Disneyland to hire black people, with executives responding that they would "consider" the requests. The park did however hire people of Asian descent, such as Ty Wong and Bob Kuwahara.

As part of the Casa de Fritos operation at Disneyland, "Doritos" (Spanish for "little golden things") were created at the park to recycle old tortillas that would have been discarded. The Frito-Lay Company saw the popularity of the item and began selling them regionally in 1964, and then nationwide in 1966.

Figure 13.9: Disneyland Skyway- Circa 1966.[159]

Despite the opening of the more expansive Walt Disney World resort in 1971, Disneyland continued to set attendance records and maintained its status as a major tourist attraction. In 1972, the Bear Country land was opened, and the Main Street Electrical Parade was introduced.

[159] Image is licensed under CC BY-SA 2.0.

Out of the Collection: MSEP – Disneyland

Want to learn more about the Main Street Electrical Parade (MSEP)? Either Scan the QR code or visit this link to see Professor Patrich's original lightbulb from the parade- and to learn more about its history! (Video length: 5min).

Disneyland underwent several changes in preparation for the United States Bicentennial. In 1974, Walt Disney's Carousel of Progress was replaced with America Sings, an audio-animatronic theater show featuring the history of American music. America on Parade debuted in 1975 and ran through 1976 in celebration of the bicentennial.

Several of the park's earliest attractions received major changes or were replaced in the mid-to-late 1970s. The Flight to the Moon attraction was rethemed as Mission to Mars in March 1975, five years after Apollo 11 had successfully landed humans on the moon. Construction of Space Mountain began that same year adjacent to the new Mission to Mars attraction but was delayed by El Niño-related weather complications. The ride opened in 1977 to much acclaim as lines would often stretch all the way to Main Street, U.S.A. The final major change of the decade came in 1977 when the slow-paced Mine Train Through Nature's Wonderland was closed and replaced by the similarly themed Big Thunder Mountain Railroad rollercoaster in 1979

The 80s- and Beyond

In 1982, Fantasyland was closed for refurbishment and reopened to the public in 1983 as "New Fantasyland." On December 5, 1985, to celebrate Disneyland's 30th year in operation, one million balloons were launched along the streets bordering Disneyland as part of the Skyfest Celebration.

America Sings, a bicentennial attraction that did not fit the theme of Tomorrowland, became misplaced after the bicentennial ended. Disney Imagineering began developing new ideas for Tomorrowland, including a new show in the carousel theater, and conceived of the idea for a log flume attraction, Splash Mountain. Knowing that America Sings would eventually close, Imagineers decided to move most of its Audio-Animatronic figures into Splash Mountain.

Figure 13.10: Disneyland Skyway- Circa 1966.[160]

Some Audio-Animatronic geese were removed from America Sings, their outer skin removed, and their heads replaced. They were then used as G2 droids in the queue to Star Tours, which opened in early 1987. One of them, named G2-9T, still sings a modified "I've Been Working on the Railroad" (retitled "I've Been Looking at the Same Bag") in Star Tours: The Adventures Continue. As a result, the geese quartets in Acts 1 and 2 of America Sings became trios until the attraction closed on April 10, 1988.

In the late 1990s, Disney began to expand the Disneyland Resort, which originally consisted of Disneyland Park, by introducing Mickeys Toontown in 1993, and major updates with the Disneyland Hotel. The expansion would also include the addition of Disney California Adventure Park, a shopping, dining, and entertainment complex named Downtown Disney, the construction of Disney's Grand Californian Hotel & Spa, and the acquisition and re-branding of the Pan Pacific Hotel as Disney's Paradise Pier Hotel. Because the existing parking lot was repurposed by these projects, a new six-level, 10,250-space parking structure was constructed in the northwest corner- which at that time was the largest parking garage in North America.

Out of the Collection: DCA Opening Day Map

Want to learn more about the history of Disney's California Adventure (DCA)? Either Scan the QR code or visit this link to see Professor Patrich's opening day Cast Member map, pin set, and a few fun facts! (Video length: 3min).

[160] Image by Wikipedia is in the public domain.

The "Happiest Homecoming on Earth" was an eighteen-month-long celebration (held through 2005 and 2006) of the fiftieth anniversary of Disneyland Park. In preparation for the celebration, the park underwent major renovations, restoring many attractions, including Space Mountain, Jungle Cruise, the Haunted Mansion, Pirates of the Caribbean, and Walt Disney's Enchanted Tiki Room. Attractions that had been in the park on opening day had one ride vehicle painted gold, and the park was decorated with fifty Golden Mickey Ears.

On January 27, 2023, Disneyland kicked off the year-long celebration of the centennial of The Walt Disney Company, Disney100. Disneyland Park introduced the Mickey & Minnie's Runaway Railway attraction and Wondrous Journeys fireworks show.

On April 13, 2023, it was announced that Disneyland would be holding its first official "Pride Nite" in support of the LGBTQ+ community. This comes 25 years after the first celebrated 'Gay Day' at Disneyland.

PHYSICAL GEOLOGY | MOUNTAIN RANGES

Other than the Pacific Coast, the Transverse Ranges and the Peninsular Ranges are the two most important physical landscapes in the region. Both ranges have their characteristics, from the trend of the mountains, to the different climates within each range.

The Transverse Ranges

As mentioned in unit 7, The Transverse Ranges are a group of mountain ranges of southern California, in the Pacific Coast Ranges physiographic region in North America. The name Transverse Ranges is due to their east–west orientation, making them transverse to the general northwest–southeast orientation of most of California's coastal mountains.

The ranges extend from west of Point Conception eastward approximately 500 kilometers into the Mojave and Colorado Desert. The geology and topography of the ranges express three distinct segments that have contrasting elevations, rock types, and vegetation. The western segment extends to the San Gabriel Mountains and San Gabriel fault. The central segment includes mountains that range eastward to the San Andreas fault. The eastern segment extends from the San Andreas fault eastward to the Colorado Desert. The central and eastern segments (near the San Andreas fault) have the highest elevations.

Most of the ranges lie in the California chaparral and woodlands ecoregion. Lower elevations are dominated by chaparral and scrubland, while higher elevations support large conifer forests. Most of the ranges in the system are fault blocks and were uplifted by tectonic movements late in the Cenozoic Era. West of Tejon Pass, the primary rock types are varied, with a mix of sedimentary, volcanic, and metamorphic rocks, while regions east of the pass are dominated by plutonic granitic and metasedimentary rocks.

Tectonics

The Transverse Ranges result from a complex of tectonic forces and faulting stemming from the interaction of the Pacific Plate and the North American Plate along the dextral (right slip) San Andreas Fault system. Their orientation along an east–west axis as opposed to the general northwest–southeast trend of most California ranges results from a pronounced left step in the San Andreas Fault that occurred in the Pliocene (4 million years ago) when southern reaches of the fault moved east to open the Gulf of California. The crust within the Pacific Plate south of the ranges cannot easily make the left turn westward as the entire plate moves northwestward, forcing pieces of the crust to compress and lift.

Figure 13.11: The San Andreas Fault & General Direction of Plate Movement.[161]

[161] Image by Wikipedia is in the public domain.

Prior to this shift of the fault to create the left bend, northwest–southeast trending rock belts in all the Transverse Ranges began to rotate clockwise in the right shear of Pacific Plate – North American Plate motion. This tectonic rotation began in Early Miocene Time and continues today. The total rotation is about 90° in the Western Transverse Ranges and less (about 40°) in the eastern ranges. Catalina Island shows the most rotation: almost 120°.

A mechanism proposed for the rotation event is capture of the subducting Monterey plate by the outboard Pacific plate. Because the Monterey plate was then beneath southern California, the capture resulted in pulling of the overlying crust out and northward from the rest of California.

The rocks of the Transverse Ranges exhibit extreme differences in geologic age and composition, varying from sedimentary rocks in the western Santa Ynez and volcanic rocks in the Santa Monica Mountains to primarily granitic and metamorphic rock in the central and eastern segments, including the San Gabriel and San Bernardino Mountains.

The oldest basement (deepest) rocks are of Proterozoic age and are found in the San Gabriel Mountains and the San Bernardino Mountains. The Jurassic-Cretaceous Franciscan Assemblage is found in the western section of the ranges and is the presumed basement in this segment. Exposed plutonic rocks from the Mesozoic, mostly granites, can be found on Mount Piños and generally in regions east of Tejon Pass. The youngest rocks are Cenozoic sedimentary and volcanic rocks that can be found throughout the ranges.

The western segment is distinctive for the large thickness of Cretaceous and Cenozoic sedimentary rocks, estimated to be up to 10 kilometers. The thickest deposits of these are in the Santa Barbara Channel and Ventura basin. These are mostly marine in origin with a marked change to red beds of river systems of Oligocene age in the western and central segments.

Limestones and dolomites of the marine Miocene Monterey Formation are found in the Santa Ynez Mountains and in the Coast Ranges to the north.

Faults

The distinctive feature of the Transverse Ranges besides their anomalous orientation is that they are bounded by east-west trending faults. Most are left slip, strike slip faults. In the western and central segments many of the faults are thrust faults. Faults in the Coast Ranges and Peninsular Ranges trend northwest-southeast and butt into the east-west trending faults of the Transverse Ranges. Because all these faults are considered active and seismic, but they do to cut each other, the only geometry that satisfies that observation is if the east-west faults and Transverse Ranges are rotating clockwise with respect to the faults outside that province.

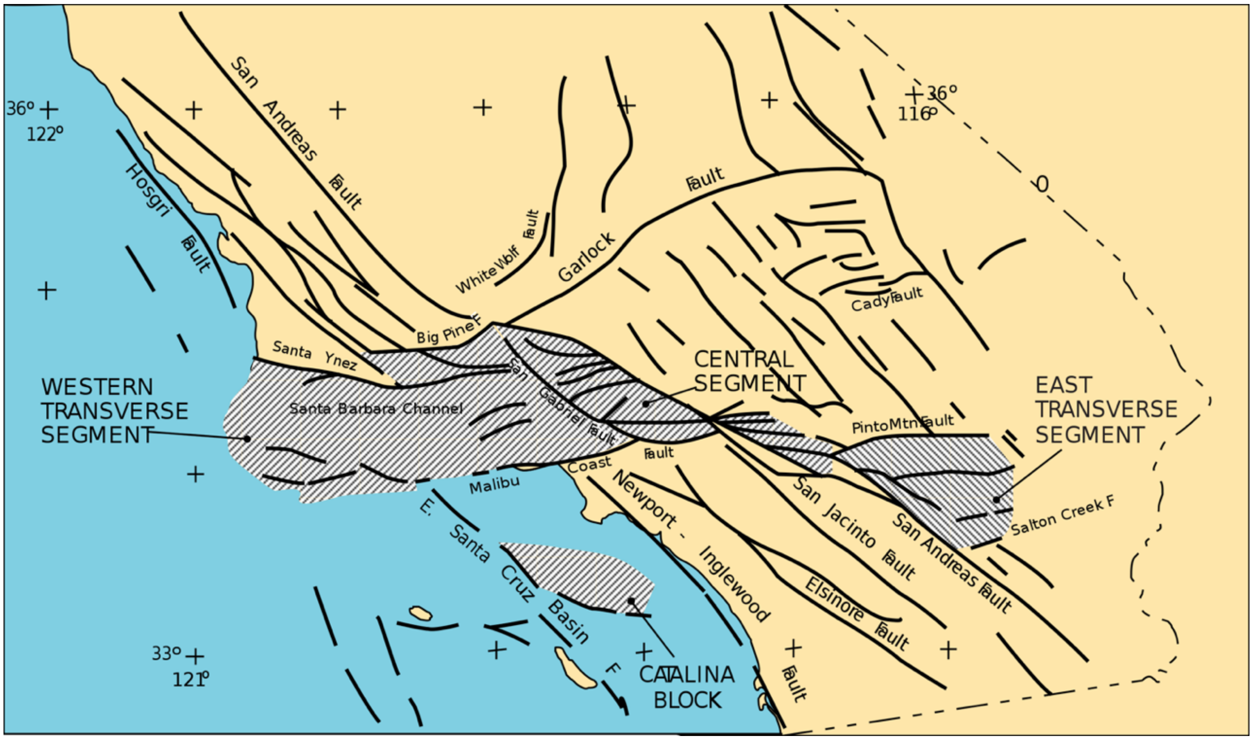


Figure 13.12: Map Faults in Southern California, as well as the Transverse Range.[162]

Between the western segment and the Peninsular Range to the south is the complex Malibu Coast—Santa Monica—Hollywood fault, which exists as the border between these two mostly geologically unitary provinces. These faults are part of the same thrust fault system south of the northern Channel Islands of San Miguel, Santa Rosa, and Anacapa Islands. North of the western segment the bounding faults are left slip Santa Ynez and Pine Mountain Faults. The San Gabriel Fault and San Andreas bound the central segment. The eastern segment is bounded by the Pinto Mountain Fault in the north and the Salton Creek Fault in the south.

Field Trip: Avenue S. & The San Andreas Fault

Let’s head on a field trip in search for San Andreas Fault! Either Scan the QR code or visit this link to learn more about the San Andreas Fault, and to visit the pressure ridge created by it in Palmdale, California. (Video length: 3min).

[162] Image by Wikipedia is licensed under CC BY-SA 4.0.

The Peninsular Ranges

The Peninsular Ranges are a group of mountain ranges in the Pacific Coast Ranges, which stretch over 900 miles from southern California in the United States to the southern tip of Mexico's Baja California peninsula. They are part of the North American Coast Ranges that run along the Pacific coast from Alaska to Mexico. Elevations range from 500 ft to 11,500 ft (150 m to 3,500 m) and vegetation in these ranges varies from coastal sage scrub to chaparral, and from oak woodland to conifer forest.

The Peninsular Ranges of southern California include the Santa Ana Mountains, San Jacinto Mountains, and the Laguna Mountains. The Peninsular Ranges of Baja California include the Sierra Juarez, Sierra San Pedro Martir, Sierra de la Giganta, and Sierra de la Laguna. These ranges run from north to south.

The Santa Ana Mountains are the largest natural landscape along the coast of southern California. These mountains peak at about 5,689 feet, on Santiago Peak. This range starts in the north, in the Corona area heading southeast of the Puente Hills region.

Geology

Rocks in the ranges are dominated by Mesozoic granitic rocks, derived from the same massive batholith which forms the core of the Sierra Nevada Mountains in California. They are part of a geologic province known as the Salinian Block which broke off the North American Plate as the San Andreas Fault and Gulf of California came into being.

Between this set of ranges and the Transverse Ranges is the complex Malibu Coast—Santa Monica—Hollywood fault, which exists as the border between these two mostly geologically unitary provinces.

A point of interest is the Pala District, which is just north of Escondido in the San Diego-Carlsbad area. After United States annexation of California following its victory in the Mexican–American War, Pala became known for its mineral resources, including gold and tourmaline. More than 20 gem mines were established in 1890s, which still produce tourmaline today, with the pink variety as the regional specialty.

China's Dowager Empress Cixi of Qing Dynasty highly prized the pink tourmaline mined in Pala. Under her influence, China's demand for this gem created a boom in the California tourmaline industry after 1902, particularly at the Himalaya mine. Demand fell off about 1911, declining after the Empress died in 1908.

Pala was the site where morganite beryl was first discovered. In 1902 it was found to have the first commercially significant deposit of kunzite, named after George F. Kunz, the godfather of gemology.

Peaks of the Peninsular Ranges

The San Jacinto Mountains are in the desert areas in the north and east side of southern California. They peak at about 10,833 feet. They run from the San Bernardino Mountains southeast to the Santa Rosa Mountains. This mountain range is the northernmost part of the Peninsular Range.

The Santa Rosa Mountains are located at the southern end of the San Jacinto Mountains, where they connect to it. The range extends for approximately 30 miles (48 km) through Riverside, San Diego, and Imperial counties, along the western side of the Coachella Valley, where they bound the Anza-Borrego portion of the Colorado Desert. The highest peak in the range is Toro Peak (8,717 feet).

The Laguna Mountains are in the eastern part of San Diego County. They range northwest to southeast for approximately 20 miles and peak at Cuyapaipe Mountain (6,378 feet). These mountains extend northwest about 35 mi (56 km) from the Mexican border at the Sierra de Juárez. The Sonora Desert lies to the east and the Santa Rosa Mountains are to the northwest.

Figure 13.13: Inspiration Peak in the Laguna Mountains- Looking Towards Anza Borrego Desert.[163]

[163] Image by Wikipedia is licensed under CC BY-SA 3.0.

Figure 14.1: Union Station of Los Angeles, The Largest Passenger Terminal in the Western U.S. (Circa 1930)[164]

UNIT 14: THE SHADES OF CALIFORNIA

Goals & Objectives of this unit

- Identify the different ethnic and cultural groups that have made up California's population over time.
- Describe the impact of European contact on the indigenous peoples of California.
- Explain the push and pull factors that have contributed to California's population growth.
- Analyze additional factors that influence California's diversity, such as language, religion, gender, and socioeconomic traits.

---

[164] Image by Tichnor Brothers, Boston Public Library, is in the public domain.

INTRODUCTION

California is the most populous state in the United States, and if it were an independent country, it would rank 34th in population in the world. The state has had a long history of immigration, with the first major wave occurring during the California Gold Rush of 1848-1849. This event attracted miners, businessmen, farmers, loggers, and their supporters from all over the world.

The Gold Rush also led to a significant gender imbalance in California, as there were far fewer women than men in the state. In 1850, there were only about 10,000 females in a total population of 120,000 residents. This imbalance persisted for over a century, as immigration from other states continued to favor men due to the nature of the labor force present.

In recent years, California's demographics have changed significantly. The state is now home to a large and growing Hispanic population, and in 2000, it became the second state in U.S. history (after Hawaii) to have a non-white majority when excluding Hispanic whites. In 2014, California also became the first state to have a Latino plurality, meaning that Latinos made up the largest single ethnic group in the state.

The future of California's demographics is uncertain, but the state will continue to be a diverse and dynamic place. The state's history of immigration has shaped its culture and identity, and it is likely that this trend will continue in the years to come.

INDIGENOUS CALIFORNIANS

The Indigenous peoples of California are a diverse group of nations and peoples who have inhabited the geographic area within the current boundaries of California for thousands of years. They are the second-largest Native American population in the United States, with over 100 federally recognized tribes and many more that have applied for federal recognition.

They have a rich and diverse culture, which is reflected in their language, art, music, and traditional practices. They have a deep connection to the land and its resources, and they have developed sustainable ways of living in harmony with the environment. In the 18th and 19th centuries, the Indigenous peoples of California were subjected to a series of violent and oppressive policies, including the Spanish missions, the California genocide, and the Indian boarding schools. These policies led to the decimation of the Native population, and they continue to have a legacy of trauma and discrimination.

In recent decades, there has been a resurgence of interest in Native American culture and history. This has led to several positive developments, including language revitalization, the Land Back movement, and the recognition of Native peoples' environmental knowledge.

The Indigenous peoples of California are a resilient and resourceful people. They have survived centuries of oppression, and they continue to fight for their rights and their homelands. They are an important part of the fabric of California, and their culture is an asset to the state.

Figure 14.2: Photograph of a Yokut Indian Women Making a Basket, Tule River Reservation, Circa 1900.[165]

[165] Image by George Wharton James is in the public domain.

The Early Boundaries

The traditional homelands of many tribal nations may not conform exactly to the state of California's boundaries. Many tribes on the eastern border with Nevada have been classified as Great Basin tribes, while some tribes on the Oregon border are classified as Plateau tribes. Tribes in Baja California who do not cross into California are classified as indigenous peoples of Mexico. The Kumeyaay nation is split by the Mexico-United States border.

Figure 14.3: A Map of California Tribal Areas & Languages at the Time of European Contact.[166]

[166] Image by Concerto is licensed under CC BY-SA 3.0

Earliest People of California

Evidence of human occupation of California dates from at least 19,000 years ago. Prior to European contact, indigenous Californians had 500 distinct sub-tribes or groups, each consisting of 50 to 500 individual members. The size of California tribes today is small compared to tribes in other regions of the United States. Prior to contact with Europeans, the California region contained the highest Native American population density north of what is now Mexico. Because of the temperate climate and easy access to food sources, approximately one-third of all Native Americans in the United States were living in California.

Early Native Californians were hunter-gatherers, with seed collection becoming widespread around 9,000 BCE. Due to the local abundance of food, tribes never developed agriculture or tilled the soil. Two early southern California cultural traditions include the La Jolla complex and the Pauma Complex, both dating from c. 6050–1000 BCE. From 3000 to 2000 BCE, regional diversity developed, with the peoples making fine-tuned adaptations to local environments. Traits recognizable to historic tribes were developed by approximately 500 BCE.

The indigenous people practiced various forms of sophisticated forest gardening in the forests, grasslands, mixed woodlands, and wetlands to ensure availability of food and medicine plants. They controlled fire on a regional scale to create a low-intensity fire ecology; this prevented larger, catastrophic fires and sustained a low-density "wild" agriculture in loose rotation. By burning underbrush and grass, the natives revitalized patches of land and provided fresh shoots to attract food animals. A form of fire-stick farming was used to clear areas of old growth to encourage new in a repeated cycle, a permaculture.

Contact with Europeans

Different tribes encountered non-Native European explorers and settlers at widely different times. The southern and central coastal tribes encountered European explorers in the mid-16th century. Tribes such as the Quechan or Yuman Indians in present-day southeast California and southwest Arizona first encountered Spanish explorers in the 1760s and 1770s. Tribes on the coast of northwest California, like the Miwok, Yurok, and Yokut, had contact with Russian explorers and seafarers in the late 18th century. In remote interior regions, some tribes did not meet non-natives until the mid-19th century.

Late 18th Century | Mission & Decline

At the time of the establishment of the first Spanish Mission in 1769, the most widely accepted estimates say that California's indigenous population was around 340,000 people and possibly more. The indigenous peoples of California were extremely diverse and made up of ten different linguistic families with at least 78 distinct languages. These are further broken down into many dialects, while the people were organized into sedentary and semi-sedentary villages of 400-500 micro-tribes.

The Spanish began their long-term occupation in California in 1769 with the founding of Mission San Diego de Alcalá in San Diego. The Spanish built 20 additional missions in California, most of which were constructed in the late 18th century. From 1769 to 1832, an estimated total of 87,787 baptisms and 24,529 marriages had been conducted at the missions. In that same period, 63,789 deaths at the missions were recorded, indicating the immense death rate. This massive drop in population has been attributed to the introduction of diseases, which rapidly spread while native people were forced into close quarters at the missions, as well as torture, overworking, and malnourishment at the missions.

The missions also introduced European invasive plant species as well as cattle grazing practices that significantly transformed the California landscape, altering native people's relationship to the land as well as key plant and animal species that had been integral to their ways of life and worldviews for thousands of years. The missions further perpetuated cultural genocide against native people through enforced conversion to Christianity and the prohibition of numerous cultural practices under threat of violence and torture, which were commonplace at the missions.

19th Century | Genocide

The population of Native California was reduced by 90% during the 19th century—from more than 200,000 in the early 19th century to approximately 15,000 at the end of the century. Most of this population decline occurred in the latter half of the century, under American occupation. While in 1848, the population of native people was about 150,000, by 1870 it fell to 30,000, and fell further to 16,000 by the end of the century.

The mass decline in population has been attributed to disease and epidemics that swept through Spanish missions in the early part of the century, such as an 1833 malaria epidemic. Other factors include state-sanctioned massacres that accelerated under Anglo-American rule.

Russian Contacts | 1812-1841

In the early 19th century, the Fur Rush (otter pelt) was usually associated with the activity of the Russian-American Company. A Russian explorer, Baron Ferdinand von Wrangell, visited California in 1818, 1833, and 1835. Looking for a potential site for a new outpost of the company in California in place of Fort Ross, Wrangell's expedition encountered the native people north of San Francisco Bay. He noted that local women, who were used to physical labor, seemed to be of stronger constitution than men, whose main activity was hunting. He summarized his impressions of the California Indians as a people with a natural propensity for independence, inventive spirit, and a unique sense of the beautiful.

Another notable Russian expedition to California was the 13 months long visit of the scientist Ilya Voznesensky in 1840–1841. Voznesensky's goal was to gather some ethnographic, biological, and geological materials for the collection of the Imperial Academy of Sciences. He described the locals that he met on his trip to Cape Mendocino as "the untamed Indian tribes of New Albion, who roam like animals and protected by impenetrable vegetation, keep from being enslaved by the Spanish".

Mexican Secularization | 1833-1848

After about a decade of conservative rule in the First Mexican Republic, which formed in 1824 after Mexico gained independence from the Spanish Empire in 1821, a liberal sect of the First Mexican Republic passed an act to secularize the missions, which effectively ended religious authority over native people in Alta California. The legislation was primarily passed from liberal sects in the Mexican government, including José María Luis Mora, who believed that the missions prevented native people from accessing "the value of individual property."

The Mexican government did not return the lands to tribes but made land grants to settlers of at least partial European ancestry, transforming the remaining parts of mission land into large land grants or ranchos. Secularization provided native people with the opportunity to leave the mission system, yet left many people landless, who were thus pressured into wage labor at the ranchos. The few Indigenous people who acquired land grants were those who have proven their Hispanicization and Christianization.

American Settler Colonialism | 1848-1850's

The first governor of California as a U.S. state was Peter Hardenman Burnett, who came to power in 1848 following the United States victory in the Mexican–American War. As American settlers came in control of California with the signing of the Treaty of Guadalupe Hidalgo, its administrators honored some Mexican land grant titles, but did not honor aboriginal land title.

The state formed various militia groups that were tasked with a "war of extermination" that authorized the murder of native people in exchange for payment for their scalps and heads. For example, the city of Shasta authorized "five dollars for every Indian head." In this period, 303 volunteer militia groups of 35,000 men were formed by the settlers.

In the fiscal year of 1851-1852, California paid approximately $1 million dollars toward the formation of militia groups who would eliminate native people. Volunteer militia groups were also subsidized by the U.S. federal government, who reimbursed money to the state toward this eliminatory objective. With this shift in power, the U.S. government instituted a policy of elimination toward indigenous people in California.

American Gold Rush & Forced Labor | 1848-1855

Most of inland California including California deserts and the Central Valley was in possession of native people until the acquisition of Alta California by the United States. The discovery of gold at Sutter's Mill in 1848 inspired a mass migration of Anglo-American settlers into areas where native people had avoided sustained encounters with invaders. The California Gold Rush involved a series of massacres and conflicts between settlers and the indigenous peoples of California lasting from about 1846 to 1873 that is generally referred to as the California genocide.

The negative impact of the California Gold Rush on both the local indigenous inhabitants and the environment were substantial, decimating the people remaining. 100,000 native people died during the first two years of the gold rush alone.

Settlers took land for their camps and to farm and supply food for their camps. The surging mining population resulted in the disappearance of many food sources. Toxic waste from their operations killed fish and destroyed habitats. Settlers viewed indigenous people as obstacles for gold, so they actively went into villages where they raped the women and killed the men.

Sexual violence against native women and young girls was a normal part of white settler life, who were often forced into prostitution or sex slavery. Kidnappings and rape of native women and girls was reported as occurring "daily and nightly." This violence against women often provoked attacks on white settlers by native men.

Forced labor was also common during the Gold Rush, permitted by the 1850 Act for the Government and Protection of Indians. Raids on native villages were common, where adults and children were threatened with fatal consequence for refusing what was essentially slavery. Although this was in legal terms illegal, the law was established not to help protect indigenous people, so there were rarely interventions to stop kidnappings and the circulation of stolen children into the market by law enforcement. What were effectively slave auctions occurred where laborers could be "purchased" for as low as 35 dollars.

A central location for auctions was Los Angeles, where an 1850 city ordinance passed by the Los Angeles City Council allowed prisoners to be "auctioned off to the highest bidder for private service." These auctions continued as a weekly practice for nearly twenty years, until there were no California native people left to sell.

California Genocide | 1846-1873

The California genocide continued after the California Gold Rush period. By the late 1850s, Anglo-American militias were invading the homelands of native people in the northern and mountainous areas of the state, which had avoided some earlier waves of violence due to their more remote locations. Near the end of the period associated with the California genocide, the final stage of the Modoc Campaign was triggered when Modoc men led by Kintpuash (also known as Captain Jack) murdered General Canby at the peace tent in 1873. However, it's not widely known that between 1851 and 1872 the Modoc population decreased by 75 to 88% because of seven anti-Modoc campaigns started by the whites.

There is evidence that the first massacre of the Modocs by non-natives took place as early as 1840. According to the story told by a chief of the Achumawi tribe (neighboring to Modocs), a group of trappers from the north stopped by the Tule lake around the year 1840 and invited the Modocs to a feast. As they sat down to eat, the cannon was fired, and many Indians were killed. The father of Captain Jack was among the survivors of that attack. Additionally, when in 1846 the Applegate Trail cut through the Modoc territory, the migrants and their livestock damaged and depleted the ecosystem that the Modoc depended on to survive.

20th Century: Forced Assimilation

By 1900, the population of native people who survived the eliminatory policies and acts carried out in the 19th century was estimated at about 16,000 people. Remaining native people continued to be the recipients of the U.S. policies of cultural forced assimilation throughout the 20th century. Many other native people would experience false claims that they were "extinct" as a people throughout the century.

Indian Removal in California (1903)

Although the American policy of Indian removal to force indigenous peoples off their homelands had begun much earlier in the United States in 1813, it was still being implemented as late as 1903 in Southern California. The last native removal in U.S. history occurred in what has been referred to as the Cupeño trail of tears, when the people were forced off their homeland by white settlers, who sought ownership of what is now Warner Springs. The people were forced to move 75 miles from their home village of Cupa to Pala, California. The forced removal under threat of violence also included Luiseño and Kumeyaay villages in the area.

Indian Boarding Schools in California (1892–1935)

During the end of the 19th century and the beginning of the 20th century, the federal government attempted to force indigenous peoples to further break the ties with their native culture and assimilate into white society. In California, such forms of education as the reservation day schools and American Indian boarding schools were established.

New students were customarily bathed in kerosene and their hair was cut upon arrival. Poor ventilation and nutrition and diseases were typical problems at these schools. In addition to that, most parents disagreed with the idea of their children being raised as Euro-Americans, with students being forced to wear European style clothes and haircuts, given European names, and strictly forbidden to speak indigenous languages. Sexual and physical abuse at the schools was common.

By 1926, 83% of all Native American children attended the boarding schools. Native people recognized the American Indian boarding schools as institutionalized forces of elimination toward their native culture. They demanded the right for their children to access public schools. In 1935, restrictions that forbid native people from attending public schools were removed.

It was not until 1978 that native people won the legal right to prevent familial separation that was integral to native children being brought to the boarding schools. This separation often occurred without knowledge by parents, or under white claims that native children were "unsupervised" and were thus obligated to the school, and sometimes under threatening circumstances to families.

21st Century: Recovery

California has the largest population of Native Americans out of any state, with 723,000 identifying an "American Indian or Alaska Native" tribe as a component of their race (14% of the nation-wide total). The Bureau of Indian Affairs, BIA, generally recognizes someone’s as Native American if they have at least on-fourth Native American blood, otherwise known as blood quantum. This population grew by 15% between 2000 and 2010, much less than the nation-wide growth rate of 27%, but higher than the population growth rate for all races, which was about 10% in California over that decade. Over 50,000 indigenous people live in Los Angeles alone.

According to the National Conference of State Legislatures, there are currently over one hundred federally recognized native groups or tribes in California including those that spread to several states.

CALIFORNIA'S ETHNIC & CULTURAL IDENTIY

According to the 2020 U.S. census, California's population was 34.7% Non-Hispanic White, 5.7% African American, 1.5% Native American, 16.1% Asian, 0.4% Pacific Islander, 13% two or more races, and 39.4% Hispanic or Latino of any race. Hispanics are the largest racial/ethnic group in California. Non-Hispanic whites have decreased from about 76.3 - 78% of the state's population in 1970 to 36.6% in 2018.While the population of minorities accounts for 100.7 million of 300 million U.S. residents, 20% of the national total live in California (2008).

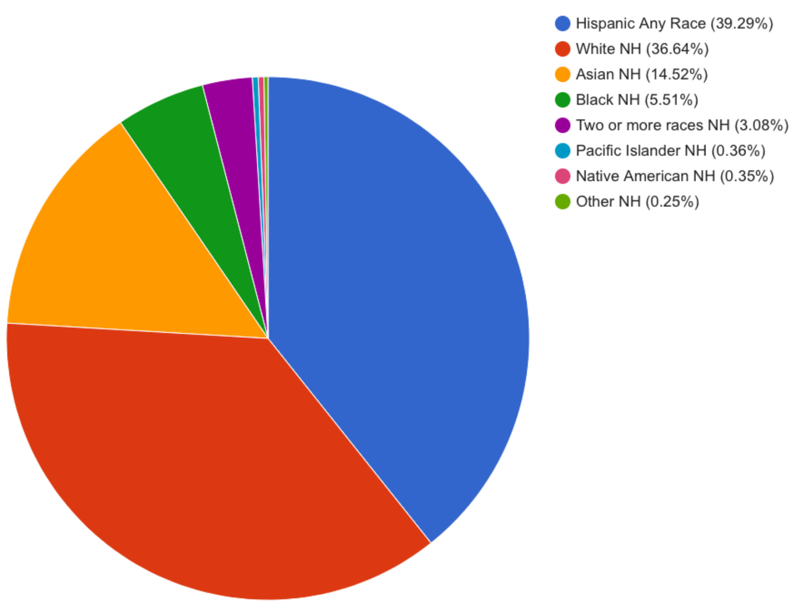


Figure 14.4: Pie Chart of Racial & Ethnic Makeup of California, Excluding Hispanics From Racial Categories (2018).[167]

[167] Image by AnotherToast is licensed under CC BY-SA 4.0

California has the highest number, and second highest percentage, of Asian Americans by state. Only Hawaii has a higher Asian American percentage than California. While New Mexico and Texas have higher percentages of Hispanics, California has the highest total number of Hispanics of any U.S. state. Hispanics are the largest single ethnic group in the state.

The largest named ancestries in California are Mexican (25%), German (9%), Irish (7.7%), English (7.4%), and Italian (5.8%); there are 65 other ethnicities with sizable populations in California including Arabs, Albanians, Australians, Brazilians, Canadians, Haitians, Iranians/Persians, and Somalis as examples. Both Los Angeles and San Francisco have large numbers of residents with English, French, Italian, Iranian/Persian, German, Russian, and Scandinavian ancestry.

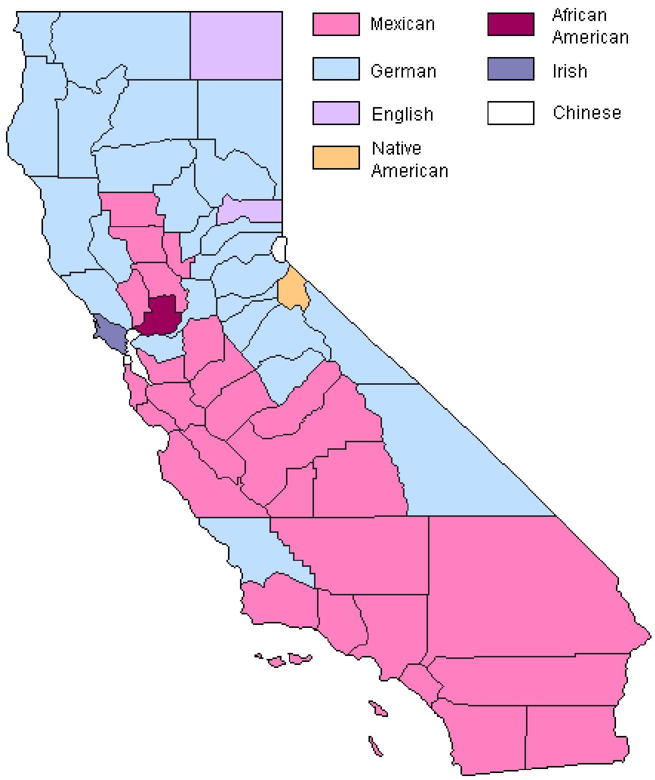


Figure 14.5: Map of Most Populus Ancestry Per County (2000).[168]

California has the largest population of white Americans in the U.S., totaling 21,453,934 residents as of the 2010 census. The state has the fifth largest population of African Americans in the U.S., an estimated 2,299,072 residents. California's Asian population is estimated at 4.9 million, approximately one-third of the nation's estimated 15 million Asian Americans. California's Native American population of 285,512 is the third largest of any state, behind Arizona and Oklahoma.

[168] Image by Socal gal at heart is in the public domain.

Since the 2000 U.S. census, California has been known as the second state in U.S. history (after Hawaii since its statehood in 1959) to have a non-white majority when excluding Hispanic whites, and since 2014, the first state to have a Latino plurality surpass other racial/ethnic groups. The media discussed the possibility of Latinos becoming a majority in the 21st century, for the first time since statehood (1850) when massive immigration of Anglo-Americans during the California Gold Rush of 1848-1849 reduced Spanish speakers to 20% of the population.

Native Americans | Indigenous Peoples of California

As of 2010, California's Native American population of 362,801 was the most of any state. It also has the most Native American tribes, indigenous to the state or not, but the majority of known Californian Indian tribes became extinct in the late 19th century. The U.S. Census includes Latin American Indian, especially immigrants who belonged to indigenous peoples or who have Amerindian heritage from North and South America.

The Cherokee Nation is the largest tribe in the state with a population of 22,000 in 2020, although the number of Cherokee descendants are at 110,000 in the earlier census taken in 2010 and any persons residing in California of Cherokee descent may surpass 600,000 according to demographers. Their tribal nation is in the northeast part of Oklahoma, but they live across the state and neighboring states. They are often descendants of Dust Bowl refugees in the 1930s and 1940s who migrated to the state's farming counties and urban areas for jobs. The largest urban American Indian communities are Los Angeles/Long Beach, San Francisco/Oakland, Sacramento, and San Diego areas.

California also has significant populations of the Apache, Chickasaw, Choctaw, Muscogee, Seminole, Hopi, Zuni, Navajo, Blackfeet, Shoshone, Paiute, Pueblo, Tohono O'odham, Cahuilla, Chumash, Karuk, Yurok, and Yokuts tribes. The Cahuilla in the Coachella Valley have profited from real estate land leases, and much of Indio and Palm Springs are tribal-owned lands under legal tribal jurisdiction.

European Americans

California has the largest population of European Americans of any state in the United States. This is due to several factors, including the state's history of immigration, its diverse geography, and its climate.

The state has been a major destination for immigrants from Europe since the early 19th century. In the 1840s, for example, California was home to many German, Irish, Italian, and English immigrants. These immigrants settled in cities like San Francisco, Los Angeles, and Sacramento, and they helped to shape the state's culture and identity.

Another factor contributing to California's large European American population is its diverse geography. The state is home to a variety of climates, from the Mediterranean climate of Southern California to the Mediterranean climate of Northern California. This diversity of climate has attracted immigrants from all over Europe, who have found places to settle in all parts of the state.

California also has the third largest Greek American population in the United States, behind New York and Massachusetts. The Los Angeles Harbor area of San Pedro has a sizeable Croatian American population. Small Amish/Mennonite colonies exist in an area bordered by the towns Oakdale, Riverbank and Ripon near Modesto and in Reedley, Sanger and Orange Cove near Fresno in the San Joaquin Valley.

Brief History

The first Europeans to arrive in California were the Spanish, and the area was under Spanish and Mexican rule for many years. The population was diverse, with people of White, Mestizo, African, and Indigenous ancestry. By 1846, more White Americans had begun to enter California, and they made up 10% of the non-Native population.

The California Gold Rush of 1848-1855 brought a massive influx of people to California, including many White Americans. By 1850, the non-Native population of California had grown to 92,597, and two-thirds of these new arrivals were Americans.

While Northern California became predominantly white by the mid-19th century, Southern California remained mainly Mexican until the 1880s. This changed after the Southern Pacific railroad reached Los Angeles, and Southern California's population grew rapidly. By 1920, the population of Southern California had reached 1.3 million, and white Americans made up most of the population.

In the 1930s, the Dust Bowl in the American Midwest caused many people to leave their homes and seek new opportunities in California. These migrants, known as Okies, were mostly white, and they helped to further diversify California's population.

By 1940, 90% of California's population identified as white. However, in recent decades, the state has become more diverse, and by 1990, the white non-Hispanic population had decreased to 43%. This is due to increased immigration from other countries, as well as higher birth rates among non-white Californians.

HISPANIC & LATINO AMERICANS

Latinos, mainly Mexican Americans, form major portions of the population of Southern California, especially in Los Angeles, as well as the San Joaquin Valley. The city of Los Angeles is often said to be the largest Mexican community in the United States. Census records kept track of the growth since 1850, but Mexicans and Mexican Americans have lived in California since Spanish colonial times. However, the number and percentage population of Latinos living in California increased rapidly in the late 20th century.

The Imperial Valley on the U.S.-Mexican border is about 70–75% Latino; communities with many Latinos can also be found in Riverside County, especially at its eastern end, and the Coachella Valley. The Central Valley has many Mexican American migrant farm workers. Latinos are the majority in 14 counties: Colusa, Fresno, Glenn, Imperial, Kern, Kings, Madera, Merced, Monterey, Napa, San Benito, Santa Cruz, Tulare, and Yolo counties.

Latinos make up at least 20% of the San Francisco Bay Area. Many live in San Mateo, Redwood City, Alameda, Contra Costa, and Santa Clara counties, as well in San Francisco. The Napa Valley and Salinas Valley have predominantly Latino communities established by migrant farm workers. San Jose is about 30–35% Latino, the largest Latino community in northern California, while the Mission District, San Francisco and Lower/West Oakland have barrios established by Mexican and Latin American immigrants. The Mexican American communities of East Los Angeles and Logan Heights, San Diego, as well the San Joaquin Valley are centers of historic Chicano and Latino cultures.

California also has the largest populations of Hispanics/Latinos in the country. Most of the state's Latinos have Mexican ancestry, having the largest Mexican population in the United States, making up about 31% of the state population. California has a large and diverse population, having the largest Central American, especially Salvadoran population in the United States. Guatemalan Americans are spread out in Southern California after previously being centered in Los Angeles between 1970 and 2010. California also has many Cuban Americans, Puerto Rican Americans, Honduran Americans, and Nicaraguan Americans, along with people of Chilean, Colombian, Peruvian, and other South American ancestry. Los Angeles has had the United States' largest Central American community, as well as the largest Mexican American community, since the 1910s. In fact, the 1900 census record finds 319 to 619 out of 100,000 residents in the city of Los Angeles were "Spanish" or "Mexican". Nearly 31% of Los Angeles itself is of Mexican descent, having the largest Mexican population of any city in the United States. 12,392 Belizeans also live in California.

In Mariposa County, there is a very small community of Californios or Spanish American people as they identify themselves, that dates back before the U.S. annexation of California. Hornitos is home to an estimated 1,000 people and many have Spanish heritage. The community's "Spanish" Californio culture is closely linked with Mexico and other Latin American nations.

Brief History

The Hispanic presence in California has a long and rich history. The first European explorer of the California coast was João Rodrigues Cabrilho (Juan Rodriguez Cabrillo) in 1542. He was commissioned by the Viceroy of New Spain (Mexico) and sailed into what is now San Diego, California. He continued north as far as Pt. Reyes, California.

California became part of the Spanish trading route, but it was not well explored due to its remoteness from Europe and challenging terrain. In the 1700s, Spain claimed California and divided it into two parts: Baja California and Alta California. Baja California consisted of the Baja Peninsula and terminated roughly at San Diego, California, where Alta California started. After the establishment of Missions in Alta California after 1769, the Spanish treated Baja California and Alta California as a single administrative unit, part of the Viceroyalty of New Spain, with Monterey, California, as its capital.

In 1821, Mexico gained its independence from Spain, and Alta California became one of the three interior provinces in the First Mexican Empire north of the Rio Grande, along with Texas and New Mexico. The Mexican government was unable to keep full control of its peripheral provinces, leading to the inundation of American immigrants inside its borders and the subsequent annexation of California by the United States in 1846.

During Mexican rule, California was sparsely populated, with only a few thousand Mexican residents, compared to tens of thousands of Native Americans, and a handful of Yankee entrepreneurs. At the time of the annexation, "foreigners already outnumbered Californians of Spanish ancestry 9,000 to 7,500". The advent of the California Gold Rush in 1848 led to a massive influx of settlers – including thousands of Mexican miners, but also tens of thousands of Americans from the East. Other substantial immigrant groups included Chileans, Peruvians, and Chinese people.

In the early 1930s, the US began repatriating those of Mexican descent to Mexico, of which 1/5th of California Mexicans were repatriated by 1932.

During the first half of the 20th century, Mexican-American workers formed unions of their own and joined integrated unions. The most significant union struggle involving Mexican Americans was the effort to organize agricultural workers and the United Farm Workers' long strike and boycott aimed at grape growers in the San Joaquin and Coachella valleys in the late 1960s. Leaders César Chávez and Dolores Huerta gained national prominence as they led a workers' rights organization that helped workers get unemployment insurance to an effective union of farmworkers almost overnight. The struggle to protect rights and sustainable wages for migrant workers has continued.

Dolores Huerta

Dolores Huerta is a labor leader and civil rights activist who, with Cesar Chavez, is a co-founder of the United Farm Workers of America (UFW). She was born on April 10, 1930, in Dawson, New Mexico but moved to Stockton, California, in the in 1933. Huerta is a tireless advocate for the rights of farmworkers, Mexican American immigrants, women, and LGBTQ populations. She has been arrested over 20 times for her activism, and she has received numerous awards for her work, including the Presidential Medal of Freedom. She is also known for inspiring the official motto of the Union Farm Workers of America, 'Sí, se puede'.

Figure 14.6: Photo of Dolores Clara Fernández Huerta, a California Civil Rights & Labor Activist.[169]

[169] Image by Tom Hilton is licensed under CC BY 2.0

AFRICAN AMERICANS

California has 2.3 million African Americans as of 2010, the largest population of black or African Americans of the Western U.S states, and the 5th largest black population in the United States. Cities that have the largest share of African Americans and have historically been black cultural centers include (11 largest in the state): Compton, Inglewood, Long Beach, Los Angeles, Oakland, Richmond, Riverside, Sacramento, San Bernardino, San Diego, and Vallejo.

Most African Americans in California have origins from Southern states like Louisiana, Texas, Arkansas, and Oklahoma.

There are many other cities and towns in the state with sizeable African American populations. These include:

- **Northern California**: Berkeley, Dublin, East Palo Alto, Emeryville, Fairfield, Hayward, Marin City, San Leandro, and Suisun City.
- **Central California**: Bakersfield, Fresno, Kings-Tulare counties, Merced, Modesto, and Stockton.
- **Southern California**: Adelanto, Altadena, Apple Valley, California City, Carson, Corona, Desert Hot Springs, Fontana, Gardena, Hawthorne, Lakewood, Lancaster, Lynwood, Moreno Valley, National City, Oceanside, Palmdale, Palm Springs, Pasadena, Perris, Pomona, Rialto, Twentynine Palms, and Victorville.

African Americans are approximately 7% of the state population. The state percentage has dropped in the 1990s and 2000s, though the state's overall number of African Americans has increased in that time. The black population in East and West Oakland and South-Central Los Angeles - places where they held the majority for decades - has greatly decreased as the black middle class has relocated to nearby suburbs, including those in the Inland Empire and Antelope Valley in Southern California and the Sacramento metropolitan area in Northern California. Many African Americans have also moved to the South, where their grandparents may have come from in the "Great Migration" of the mid-20th century.

African Americans have made important contributions to the state's hip-hop and R&B music culture. African American musical artists born and/or raised in California include: Snoop Dogg, Dr. Dre, Ice Cube, E-40, Nate Dogg, En Vogue, Tony! Toni! Tone!, Too Short, Eazy-E, N.W.A, Keyshia Cole, Digital Underground, JJ Fad, Barry White, The Pointer Sisters, Saweetie, Tyga, Doja Cat, Blueface, and Kendrick Lamar.

California has several West Indian (Afro-Caribbean American) and African immigrants from countries such as Cape Verde, Eritrea, Ethiopia, Ghana, Kenya, Nigeria, Senegal, Somalia, South Africa (including white South Africans), Tanzania, and Yemen across from the Horn of Africa. Immigrants from these countries have established communities in several cities in the state, such as Little Ethiopia in West Los Angeles. In addition to the Ethiopian community in Los Angeles, there is a significant Ethiopian population in Oakland/Berkeley. Nuer refugees from South Sudan have migrated to the Sacramento area. There are Cape Verdean communities in Solano County, the Santa Clara Valley, and the San Diego area. As of 2019, there are 13,061 Jamaicans in the state.

18th Century |Slavery in California

People of African descent first appeared in California from Mexico due to the Spanish Conquest. Spanish soldiers, priests, and settlers brought black slaves and free blacks into the state in the 18th-century. The settlers and escort soldiers who founded the towns of San José de Guadalupe (San Jose), Yerba Buena (San Francisco), Monterey, San Diego, and La Reina de Los Ángeles (Los Angeles) were primarily mestizo and of mixed Negro and Native American ancestry from the province of Sonora y Sinaloa in Mexico. There were also many mulattoes (part black, part Spanish) in Alta California.

19th Century | Resilience & Leadership

Influential people of African ancestry were among the earliest California settlers and landowners. Pío Pico was a Californio politician, ranchero, and entrepreneur of mixed race with African ancestry, he had served as the last governor of Alta California under Mexican rule (from 1845 until 1846). Juana Briones de Miranda was a Californio businesswoman of mixed race with African ancestry, she is considered the "Founding Mother of San Francisco", as an early settler of Yerba Buena (now San Francisco). William Leidesdorff was black and multi-racial, he was one another founder of San Francisco.

After the discovery of gold in California on January 24, 1848, African Americans in search of wealth, and freedom arrived in the state during the California Gold Rush seeking their own gold discoveries. Additionally, white Southerners brought black slaves into the California mines starting in 1849, and were primarily migrating from Texas, Mississippi, Missouri, and Arkansas. The Sweet Vengeance Mine was a gold mine in Browns Valley, discovered by African American miners during the Gold Rush. Moses Rodgers was considered one of the best miners in the state.

It is important to note here that when California became a state, it was a free, non-slavery state, by the Compromise of 1850.

Some of the oldest African American churches in California are the Saint Andrews African Methodist Episcopal Church of Sacramento (founded in 1850, formerly known as Bethel African Methodist Episcopal Church), the Third Baptist Church in San Francisco (founded in 1852), Bethel African Methodist Episcopal Church (Bethel AME Church) in San Francisco (founded in 1852), African Methodist Episcopal Zion Church (AME Zion Church) in San Francisco (founded in 1852), and the First African Methodist Episcopal Church of Los Angeles (founded in 1872). In the 1870s, Rev. Peter William Cassey helped form two new Black Episcopalian churches in San Francisco; "Christ's Mission Church" (or Christ Mission Church), and he worked closely with the congregation from what later became St. Cyprian's Church, however neither group had a building at that time.

Many of the earliest African Americans in the state held the California State Convention of Colored Citizens, a series of colored convention events active from 1855 to 1902. At the conventions they had elected delegates from the various counties and would discuss topics like slavery, public education, and voting rights.

Archy Lee had been formerly enslaved African-American and he was part of a series of notable 19th-century court cases that helped defined civil rights in the state by 1858. Edward Duplex was the first Black mayor in California, elected to office in Wheatland in 1888.

The first census recorded of African Americans in California appeared in 1850 with 962 people, and in 1860 with 4,086 people. Then, in 1910 the number rose to 22,000.

Case Study | Biddy Mason (c. 1818-1891)

Biddy Mason stands as a remarkable figure in California's history. Born into slavery in Georgia, she arrived in Los Angeles in the 1850s after a forced journey across the country with her enslaver Robert Smith. Despite facing the ongoing legal ambiguity of slavery in California, Mason successfully challenged Smith's claim of ownership in court, securing her freedom in a landmark 1856 case.

This legal victory not only secured her own liberty but also established a precedent for other enslaved people in California. Mason leveraged her newfound freedom to become a successful businesswoman, acquiring significant property holdings in what is now downtown Los Angeles. Her entrepreneurial spirit and financial acumen allowed her to transition from a life of forced labor to one of economic independence. In fact, at that time, Mason was one of the richest women in Los Angeles.

However, Mason's legacy extends far beyond personal achievement. Recognizing the importance of community and faith, she co-founded the First African Methodist Episcopal Church (FAME) in 1872, the oldest Black church in Los Angeles. This institution served not only as a spiritual center but also as a social hub for the burgeoning Black community, fostering a sense of belonging and support.

Beyond her own congregation, Mason became renowned for her philanthropy. She actively supported those in need, providing food, shelter, and financial assistance to the less fortunate. Her generosity earned her the affectionate title of "Aunt Biddy" within the Los Angeles community.

Figure 14.7: Photo of Biddy Mason, a California Pioneer & Los Angles Landowner Circa 1860.[170]

20th Century | The Second Great Migration

In the 1920s, San Francisco's Terrific Street was an entertainment district that was home to numerous black and tan clubs. These clubs were interracial and often highlighted African American culture.

African Americans migrated to California in large numbers during the Second Great Migration, which took place between 1940 and 1970. Many of these migrants were seeking to escape Jim

[170] Image by Miriam Matthews in the public domain.

Crow laws in the South, while others were drawn to California's job opportunities in the defense industry and shipyards.

By the end of World War II, the African American population in California had grown significantly. In 1910, there were only 21,645 African Americans living in the state, but by 1970, that number had increased to over 1.4 million.

Figure 14.8: Anna Bland, a Burner, Shown Working at the Richmond Shipyards, April 1943.[171]

In the late 1940s and early 1960s, a new style of jazz called West Coast jazz emerged in California. This genre was largely developed by African American musicians, and it helped to put the state on the map as a center for jazz. Some of the most important figures in West Coast jazz include John Coltrane, Miles Davis, and Etta James.

In 1991, Rodney King, an African American, was beaten by three Los Angeles Police Department (LAPD) officers during his arrest. The beating was caught on videotape, and it sparked outrage across the country. The acquittal of the officers led to the 1992 Los Angeles riots, which were some of the most destructive in U.S. history.

[171] Image by E.F. Joseph is in the public domain.

The African American experience in California has been a complex one, as is has been both a haven and a source of discrimination for African Americans. However, the state has also been home to some of the most important figures in African American history and culture.

21st Century | The New Migration

In the 2010s, California was a net loser of black migration for the first time in three decades. Most exiting California blacks are returning to Texas and the Atlanta metropolitan area. In 2018, there were Black neighborhoods and cities with Black populations surpassing 15% in Southern California like in Compton, South Los Angeles, and Inglewood, and in Northern California like Stockton, Oakland, and Vallejo. Oakland has been noted for being a center of Northern California's black population, with it being at least 25% black as of 2020. Many African Americans who settled in California, likewise in Oakland, worked on the railroad in Oakland and East Bay areas in the early-to-mid 1900s.

The Black Lives Matter movement has rippled through California, leaving its mark on social, educational, and political spheres. One significant impact is the renaming of streets, schools, and landmarks that previously honored slaveholders or figures associated with racism. This symbolic act aims to create a more inclusive public landscape that reflects the state's diverse history.

The movement has also spurred a shift in education, with a growing emphasis on incorporating Black history and culture into school curriculums and public institutions. This fosters a deeper understanding of the African American experience and its contributions to California's social fabric.

Beyond education, Black Lives Matter has significantly raised awareness of racial injustice, police brutality, and systemic racism faced by Black communities. This heightened awareness is a crucial step towards addressing these critical issues. The movement's influence extends to policy changes, potentially leading to reforms in areas like law enforcement practices and criminal justice

---

MIDDLE EASTERN AMERICANS

Little Arabia is an ethnic enclave in Orange County, California, the center for Orange County's Arab Americans, who number more than 24,000 (as of 2000). It is sometimes referred to as "Little Gaza" which was a play on the original designation of this area as the "Garza Island."

Little Arabia grew significantly in the 1990s with the arrival of immigrants from the Middle East and is the home to thousands of Arab Americans predominantly hailing from Egypt, Syria, Palestine, and Yemen.

More than 500,000 Iranian Americans live throughout Southern California, including about 20% of the population of Beverly Hills. Iranian American communities also flourish in the San Fernando Valley, Orange County, San Diego, and the San Joaquin Valley. The majority of Iranian Americans immigrated after the Pahlavi dynasty was overthrown in 1979.

California is also home to many Armenian Americans; the highest concentration of Americans of Armenian descent is in the Greater Los Angeles area, where 166,498 people have identified themselves as Armenian to the 2000 Census, comprising over 40% of the 385,488 people who identified Armenian origins in the U.S. at the time. Many of these live in Glendale north of Los Angeles, as well as a large community in Fresno. The size of the Armenian American population is disputed, however. According to a 1988 news article, California had about 500,000 ethnic Armenians with over half of them living in the Greater Los Angeles area.

More than 1,300,000 Jewish Americans live in California, the majority of whom are Ashkenazi Jews. In addition, there are more than 250,000 Israeli Americans live in the Los Angeles area, according to the Israeli American Council. There are also significant Israeli American populations in the Bay Area, San Francisco, and San Jose areas of Northern California. The largest Karaite Jewish population outside of Israel exists in the Bay Area, consisting of several hundred descendants of refugees from the Egyptian Karaite community, as well as some recent converts. Their community is centered around the only Karaite synagogue outside the Middle East, Congregation B'nai Israel, located in Daly City. The Moroccan Jewish community in California is one of the largest in North America, approximately 10,000 Moroccan Jews reside in the Greater Los Angeles area, mostly in Pico-Robertson, North Hollywood, and Beverly Hills. Many are the descendants of community members who first emigrated to the United States in the aftermath of World War II. Many others came later in the 20th century from Israel and beginning in the early 21st century from France due to increasing antisemitism there. The community has their own synagogues as well as a community center.

Over 50,000 Afghan Americans live in California, with large concentrations in the East Bay (primarily in Alameda County and its communities of Fremont and Hayward), Orange County, and Ventura County.

There is also a large population of Assyrian descent living in the Central Valley, with large communities in Modesto, Ceres, and Turlock. San Diego has one of the largest concentrations of Chaldean immigrants in the United States. There is about an estimated 3,000 Moroccan Americans are living in Los Angeles, Long Beach, and Santa Ana. Turkish Americans and Azerbaijani Americans form moderately sized communities in both Los Angeles and San Francisco.

EAST ASIAN AMERICANS

Chinese Americans are numerous in San Francisco, Oakland, the East Bay, South Bay, the Central Coast of California, Sacramento, San Diego, and the San Gabriel Valley region of Los Angeles County. The San Francisco Bay Area has a greater concentration of Cantonese-speaking Chinese than any other region in the United States. The Mexican border community of Calexico, California in addition to Mexicali has large numbers of Chinese Mexican Americans, that is, Mexican Americans of Chinese ancestry. Smaller Chinese communities can also be found in San Jacinto Valley, Lake Elsinore, and Victorville.

Figure 14.9: Old Chinatown Post a Police Raid on Gambling Dens, Los Angeles, 1938.[172]

Southern California has perhaps the largest Taiwan-born Chinese American community in the U.S., particularly in the San Gabriel Valley, such as, Walnut, Diamond Bar, Buena Park, Cerritos, West Covina, Irvine, communities in the South Bay, Los Angeles and southern Orange County.

[172] Image by the Los Angeles Times is licensed under CC BY-SA 4.0

Many minority groups from China also live in California, for example, there are Tibetan and Mongolian Americans concentrated in San Francisco, Oakland, San Jose, Orange County, and the Los Angeles/Long Beach area.

Large Korean American communities exist in the Koreatown area of Los Angeles, the eastern San Gabriel Valley, the San Fernando Valley, Cerritos/Long Beach, South Bay, Los Angeles, northern Orange County and San Diego area. There is another large Korean American population in the San Francisco Bay Area, and Koreans are growing in number in the suburban Inland Empire region, in cities such as Chino Hills, Corona, Desert Hot Springs, and Loma Linda south of San Bernardino. Since 1990, the Korean American and African American populations relocated westward and northward in the Los Angeles area.

The South Bay area and Little Tokyo have a large Japanese American community. Japanese Americans, however, are also concentrated in San Francisco and across the Bay Area, San Jose, the Salinas Valley and Santa Cruz County; and smaller communities in the Sacramento, Fresno, Bakersfield, Anaheim, San Diego, San Bernardino, Santa Barbara, and Stockton areas. Despite the presence of Japanese goods stores, media outlets and restaurants in the state, most "Little Tokyos" and "Japantowns" were evacuated during the forced relocation of Japanese Americans during World War II). As a result, most Japanese Americans in urban areas do not reside in historical Japanese communities.

Case Study | Manzanar Internment Camp

Manzanar is the site of one of ten American internment camps, where more than 120,000 Japanese Americans were incarcerated during World War II from March 1942 to November 1945. Although it had over 10,000 inmates at its peak, it was one of the smaller internment camps, situated on 6,200 acres. It is located at the foot of the Sierra Nevada mountains in California's Owens Valley, between the towns of Lone Pine to the south and Independence to the north, approximately 230 miles (370 km) north of Los Angeles. Manzanar means "apple orchard" in Spanish. The Manzanar National Historic Site, which preserves and interprets the legacy of Japanese American incarceration in the United States, was identified by the United States National Park Service as the best-preserved of the ten former camp sites.

Figure 14.10: Family in a Manzanar Relocation Camp Barrack Apartment, Owens Valley, 1938.[173]

The first Japanese Americans arrived at Manzanar in March of 1942, just one month after President Franklin D. Roosevelt signed Executive Order 9066, to build the camp their families would be staying in. Manzanar was in operation as an internment camp from 1942 until 1945. Since the last of those incarcerated left in 1945, former detainees and others have worked to protect Manzanar and to establish it as a National Historic Site to ensure that the history of the site, along with the stories of those who were incarcerated there, is recorded for current and future generations. The primary focus is the Japanese American incarceration era, as specified in the legislation that created the Manzanar National Historic Site.

SOUTH ASIAN AMERICANS

California has the largest Indian American population in the U.S. Many live in the Los Angeles Metropolitan Area, San Diego, and the San Francisco Bay Area. The Los Angeles suburbs of Artesia and Cerritos have large Indian American communities. San Jose, Fremont, and other Silicon Valley cities have many Indian Americans who are employed in the high-tech industry. Many Indian Americans are in Central Valley cities such as Stockton, Bakersfield, Fresno, Yuba City, and the Imperial Valley. Most South Asians in California are Indian American, but there are

[173] Image by Dorothea Lange is in the public domain.

also Pakistani Americans, Bangladeshi Americans, and Sri Lankan Americans concentrated in the San Gabriel Valley (Covina Valley) of the Los Angeles area. California is home to the unique Punjabi Mexican American community, mostly centered around Yuba City.

California is home to 200,000 Roma of the estimated one million in America. Romani Americans, also known pejoratively as American Gypsies, originated in India and came to the United States via Europe. There is a Romani community in Los Angeles and San Francisco.

SOUTHEAST ASIAN AMERICANS

California has the largest American population of Southeast Asians, concentrated in the Los Angeles-Long Beach, Sacramento, and Fresno areas. This includes the Hmong and Vietnamese, including Chinese Vietnamese. Long Beach has one of the largest Cambodian American communities in the United States. The neighboring cities of Westminster and Garden Grove have the largest Vietnamese American community outside of Vietnam and are often dubbed "Little Saigon". Vietnamese and Cambodian immigrants also settled in the San Francisco Bay Area, especially San Jose, Santa Clara, and Sunnyvale, as well across the San Joaquin Valley and in San Diego.

Filipino Americans are particularly numerous in Los Angeles, Sacramento, San Francisco, San Diego, San Mateo, and Solano counties, and in southern California communities such as Artesia, Baldwin Park, Carson, Cerritos, Covina, West Covina, and the Eagle Rock district of Los Angeles. In fact, since 2018, the Filipino population is over 1.6 million in California alone. Throughout San Diego, many Filipinos live in the communities of Mira Mesa, National City, and Chula Vista. Delano near Bakersfield, other towns in the San Joaquin Valley, the Inland Empire of Riverside-San Bernardino, Coachella Valley-Imperial Valley region, Salinas, Stockton and Lathrop, and the Santa Maria/San Luis Obispo area also have large Filipino American populations. Daly City south of San Francisco has a large Filipino population and is the largest percentage wise in the United States. As of the 1980s, Filipinos have been the largest population of Asians in California. Twenty percent of registered nurses, in 2013, in California are Filipino.

Over 6,000 Laotian Americans live in the Fresno area, including an even larger Hmong American community, the second largest of its kind. Other Hmong colonies in the Central Valley of California and Northern California developed since the end of the Vietnam war (1975–79).

California also has a Thai American community of over 250,000, concentrated in Southern California, with small Thai and Southeast Asian communities in Perris and Banning in the Inland Empire region. Los Angeles has the largest Thai population outside of Thailand and is also home to the world's first Thai Town. About 150,000 Indonesians live in Southern California, primarily the Los Angeles and San Diego areas.

PACIFIC ISLANDER AMERICANS

The state has 150,000 residents with Pacific Islander ancestry. Most, 80,000, are Native Hawaiians of measurable Polynesian ancestry; many also have Asian, European, or other ancestries. There are also 25,000 Samoan Americans originally from American Samoa or Western Samoa. Most live in Long Beach and the Los Angeles suburbs of Carson, Artesia, Cerritos, and Redondo Beach, Oceanside, and Upland. About 10,000 Chamorros from Guam and Northern Mariana Islands live in northern California, the largest Micronesian community in the mainland United States. An estimated 10,000 Tahitians from French Polynesia live in southern California.

There are also many Palauan Americans in southern California, specifically in the San Diego area. This includes Vista which has a population of 677 Palauan Americans according to the 2010 US Census. Members of the Palauan community often also have Malay, Indonesian, Micronesian, Melanesian, Japanese, and other East Asian ancestries. Many Chuukese or Trukese live in San Diego.

CALIFORNIA'S DEMOGRAPHICS & SPATIAL PATTERNS

The spatial distribution of a population and development are closely related to each other, especially in the context of sustainability. The challenges related to the spatial spread of a population include rapid urbanization and population concentration, rural population, urban management and poverty housing, displaced persons and refugees. Migration is a basic element in the spatial distribution of a population, and it may remain a key driver in the coming decades, especially as an element of urbanization in developing countries.

Languages

As of 2023, over 78% of California residents age 5 and older spoke English at home as a primary language. Many California residents also speak another language, such as Spanish (61%), Chinese, which includes Cantonese and Mandarin (48%), and many others (Tagalog, Vietnamese, Korean, Armenian, and Persian).

Comparatively, according to the 2007 American Community Survey, 42.6 percent of California's population older than five spoke a language other than English at home, with 73 percent of those also speaking English well or very well, while 9.8 did not speak English at all.

California had the highest concentration of Vietnamese or Chinese speakers in the United States, second highest concentration of Korean or Spanish speakers in the United States, and third highest concentration of Tagalog speakers in the United States. California was historically one of the most linguistically diverse areas in the world and is home to more than 70 indigenous languages derived from 64 root languages in 6 language families. A survey conducted between 2007 and 2009 identified 23 different indigenous languages of Mexico that are spoken among California farmworkers.

Over 200 languages are known to be spoken and read in California, with Spanish used as the state's "alternative" language. California has more than 100 indigenous languages, making California one of the most linguistically diverse areas in the world. All of California's indigenous languages are endangered, although there are now efforts toward language revitalization.

Top 10 Non-English Spoken Languages in California (as of 2010)	Percent of Population
Spanish	28.46%
Chinese | Including Cantonese & Mandarin	2.80%
Tagalog	2.20%
Vietnamese	1.43%
Korean	1.08%
Armenian	0.52%
Persian	0.52%
Japanese	0.43%
Russian	0.42%
Hindi	0.38%
Arabic	0.38%
French	0.36%

Figure 14.11: Table of the Top 10 Non-English-Speaking Languages in California, 2010.[174]

The official language of California has been English since the passage of Proposition 63 in 1986. However, many state, city, and local government agencies continue to print official public documents in numerous languages. For example, the California Department of Motor Vehicles offers the written exam for the standard C Class driver's license in 31 languages along with English, and the audio exam in 11 languages. The politics of language is a major political issue in the state, especially regarding language policy controlling the teaching and official use of immigrant languages.

As a result of the state's increasing diversity and migration from other areas across the country and around the globe, linguists began noticing a noteworthy set of emerging characteristics of spoken English in California since the late 20th century. This dialect, known as California English, has a vowel shift and several other phonological processes that are different from the dialects used in other regions of the country.

LGBTQA+ Communities

California is seen as one of the most liberal states in the U.S. regarding lesbian, gay, bisexual, transgender (LGBT) rights, which have received nationwide recognition since the 1970s. Same-sex sexual activity has been legal in the state since 1976. Discrimination protections regarding sexual orientation and gender identity or expression were adopted statewide in 2003.

[174] Table by Jeremy Patrich

Transgender people are also permitted to change their legal gender on official documents without any medical interventions, and mental health providers are prohibited from engaging in conversion therapy on minors.

Figure 14.12: California's Earliest LGBT Political Activist Harvey Milk, 1978.[175]

California became the first state in the U.S. to legalize domestic partnerships between same-sex couples in 1999. Same-sex marriage was legalized in 2008 for five months until voters approved a ban in November of the same year. After the U.S. Supreme Court refused to recognize the legal standing of same-sex marriage opponents on June 26, 2013, the ban was no longer enforceable, allowing same-sex marriages to recommence starting on June 28. Same-sex adoption has also been legal statewide since 2003, permitting stepchild adoption and joint adoption between same-sex couples.

In 2014, California became the first state in the U.S. to officially ban the use of gay panic and transgender panic defenses in murder trials. Public schools are also teaching about the history of the LGBTQ+ community, and transgender students can choose the appropriate restroom or sports team that match their gender identity. Most support for LGBTQ+ rights can be seen in the largest cities, such as Los Angeles, San Diego, and San Francisco, as well as many cities on the Pacific coast. A 2017 survey from the Public Religion Research Institute showed that 66% of Californians supported same-sex marriage. Since November 2022, 10% of the individuals within the California Legislature are LGBTQ+ members immediately after the elections - a record first for the United States. Modern diversity includes persons who are lesbian, gay, bisexual, and transgendered ("LGBT"). Del Martin and Phyllis Lyon met in 1949 in San Francisco.

---

[175] Image by Daniel Nicoletta is licensed under CC BY-SA 3.0

Case Study | Indigenous Peoples of California & LGBTQ+

Prior to European settlement and colonization in the 18th century, many Native American groups in California recognized a "third gender" role in their societies. These individuals, who were often referred to as "two-spirit," were not strictly male or female. They might take on the roles and responsibilities of both genders, and they were often respected and valued members of their communities.

Some of the terms used to refer to third gender individuals in California include:

- Tüdayapi (Northern Paiute)
- 'Aqi (Chumash)
- Wergern (Yurok)
- Í-wa-musp (Yuki)
- Brumaiwi (Astugewi)
- Musp-íwap náip (Yuki)
- T'wini:q (Klamath and Modoc)
- Tonoo'tcim (Kings River Yokuts)

This acceptance of third gender individuals is a testament to the cultural diversity and openness of Native American societies in California. It is a reminder that there is no one right way to be a man or a woman, and that gender is a spectrum.

Religion

California is a diverse state with a wide range of religious beliefs. The largest Christian denominations in California are the Catholic Church, the Church of Jesus Christ of Latter-day Saints, and the Southern Baptist Convention. California also has a large Jewish population, as well as significant populations of Hindus, Buddhists, and Muslims.

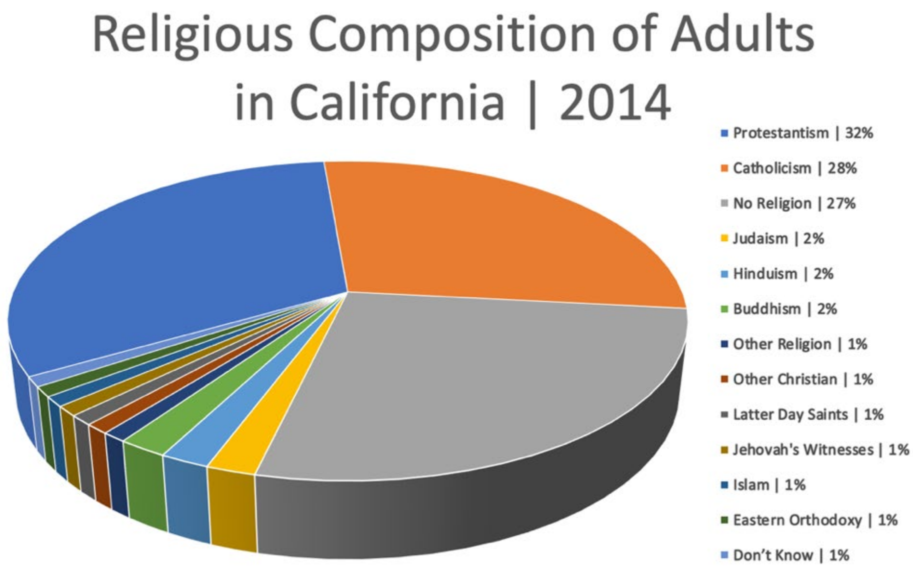


Figure 14.13: Pie Chart of Religions Composition of California Adults, as of 2014.[176]

The Catholic Church is the largest religious denomination in California, with over 10 million adherents. Most California Catholics are of Mexican, Central American, Irish, German, Italian, Vietnamese, Filipino, or Korean ancestry. The Catholic Church in California is organized into 12 archdioceses and 47 dioceses.

The Church of Jesus Christ of Latter-day Saints is the second-largest religious denomination in California, with over 500,000 adherents. The Latter-day Saints have played an important role in the settlement of California, and they have a significant presence in the state's history. The church's headquarters are in Salt Lake City, Utah, but it has a large presence in California, with over 1,400 congregations statewide.

The Southern Baptist Convention is the third-largest religious denomination in California, with over 400,000 adherents. The Southern Baptist Convention is a Protestant denomination that was founded in 1845. It is the largest Protestant denomination in the United States.

There is also a large Jewish population in the state, with over 1 million adherents. Most California Jews are of Ashkenazi Jewish ancestry, but there is also a significant Sephardic Jewish population. The Jewish community in California is concentrated in the Los Angeles area, but there are also significant Jewish communities in San Francisco, San Diego, and other parts of the state.

[176] Table by Jeremy Patrich

California has a growing Hindu population, with over 750,000 adherents. Most California Hindus are of Indian ancestry, but there is also a significant Sri Lankan Hindu population. The Hindu community in California is concentrated in the Los Angeles area, but there are also significant Hindu communities in the San Francisco Bay Area and other parts of the state.

California also has a growing Buddhist population, with over 600,000 adherents. Most California Buddhists are of Asian ancestry, but there is also a growing non-Asian Buddhist population. The Buddhist community in California is concentrated in the Los Angeles area, but there are also significant Buddhist communities in the San Francisco Bay Area and other parts of the state.

In addition to the major religious groups mentioned above, California is also home to several smaller religious groups, including Muslims, Sikhs, Jains, and Baha'is. The state also has a growing number of people who identify as non-religious or atheist.

A Pew Research Center survey revealed that California is less religious than the rest of the United States. The survey found that 62% of Californians say they are "absolutely certain" of the belief "in God or a universal spirit," while in the nation 71% say so. The survey also found that 48% of Californians say religion is "very important," while the figure for the U.S. in general is 56%.

California is a diverse state with a wide range of religious beliefs. The state's religious landscape is constantly changing, as new immigrants bring their faiths to California. The state's religious diversity is one of its many strengths, and it contributes to the state's rich cultural heritage.

Socioeconomic Factors

California's income distribution is quite broad compared to the country’s as a whole. Its proportions of residents with no income and of residents with income over $100,000 are both higher than the national average. This broad distribution combined with high housing and living costs give California an abnormally high poverty rate. The Census Bureau's Supplemental Poverty Measure, calculated by comparing household income to a locally adjusted poverty threshold, reports that 20.7% of California's population has income insufficient for their basic needs, as compared to 12.9% for the U.S. This calculation of income includes the benefits of California welfare programs such as food stamps and earned income tax credits — without these, the state's poverty rate would be 28%.

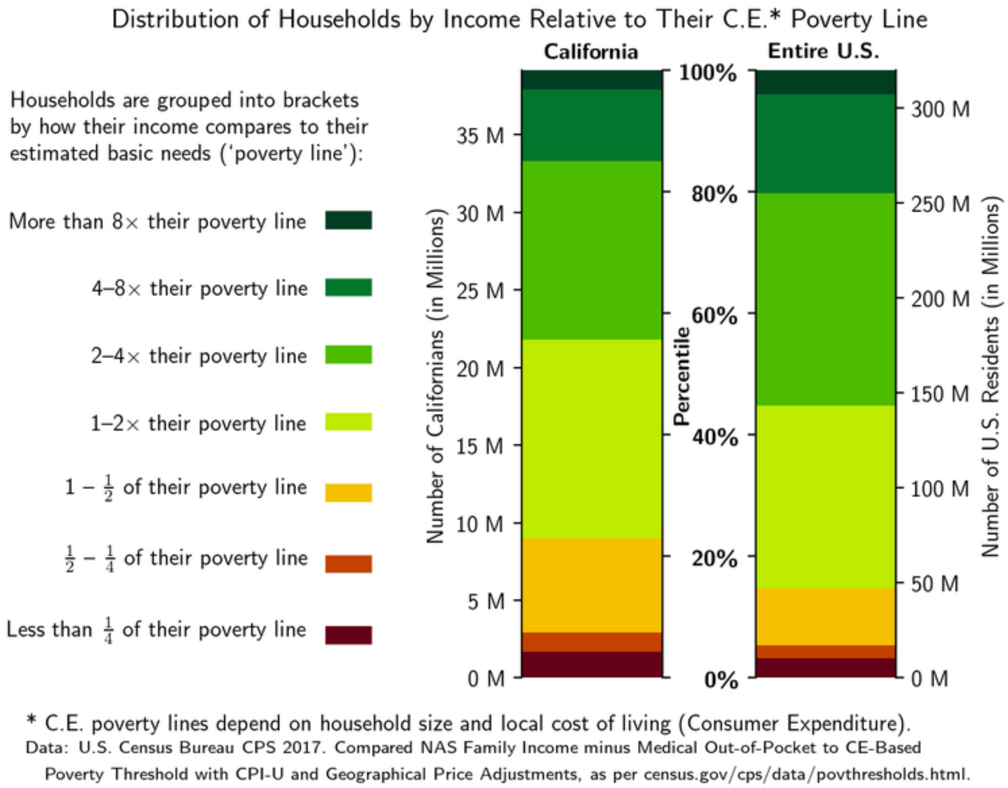


Figure 14.14: Distribution of Households by Income in California & The U.S. (2017).[177]

Increasing income inequality has had many effects on Californians' lives, including on life expectancy, which can be taken as a proxy for health or even general welfare. A study conducted by Clarke et al. related life expectancy to socioeconomic status (SES, an index including income and other related factors), finding that Californians in the top 20% by SES live on average six years longer than those in the bottom 20% (81 years, compared to 75). This disparity becomes even more pronounced when intersected with race: White males in the top 20% live 14 years longer than African American males in the bottom 20% (for females, the difference is 10 years).

The complexity of the state's low-income trends were visible when, in response to growing Chinese and Spanish-speaking populations, the city of Oakland implemented the nation's first policy of recruiting bilingual applicants for public-facing city jobs in 2001. This increased the employment of Hispanic and Chinese bilinguals throughout the public workforce, but also lowered (monolingual) Black employment.

---

[177] Image by Seaplant is licensed under CC BY 4.0

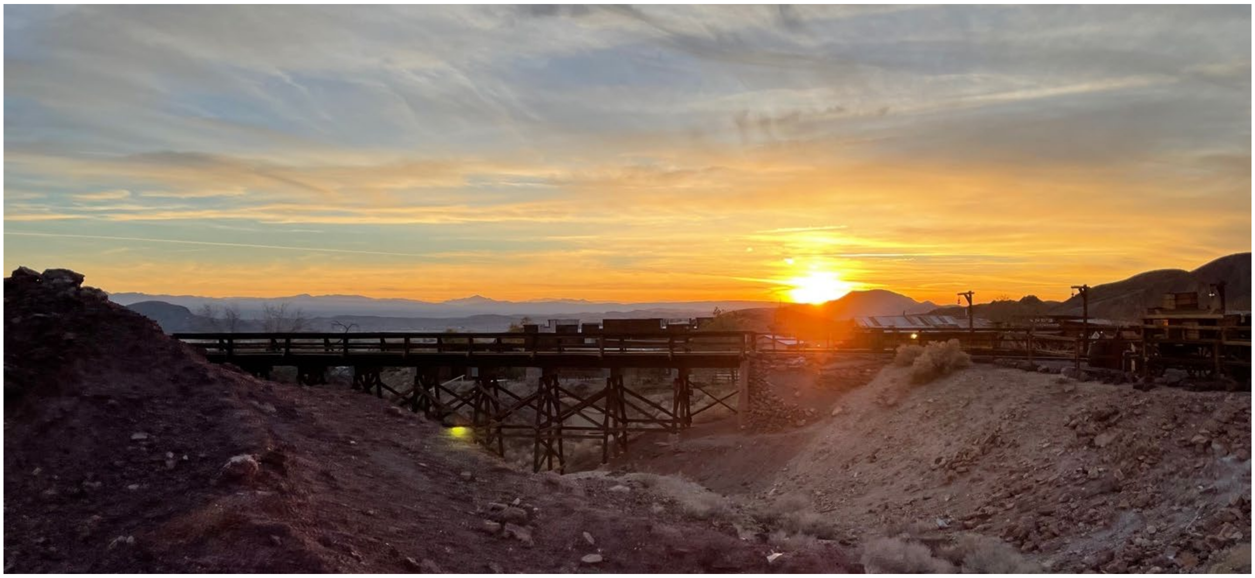


Figure 15.1: A Sunset at Calico Ghost Town, Home to the Silver Rush of 1881.[178]

UNIT 15: CALIFORNIA'S ECONOMY

Goals & Objectives of this unit

- Define the subject of economics.
- Outline the history of the discipline of economics as it is seen in California's history.
- Identify examples and definitions of the primary, secondary, and tertiary sectors.

INTRODUCTION

California's economic story emerges not from a singular point on a map, but from a vibrant tapestry woven from geography, resources, and a dynamic historical narrative. While its diverse landscape, from sun-drenched beaches to towering redwoods, embodies inherent abundance, it is the intersection of these elements with the spirit of its people – the pioneering audacity, the clash of cultures, and the insatiable thirst for innovation – that has propelled California from its humble beginnings to a global economic powerhouse. Throughout this text, we have explored a variety of economies that have built California, but this unit will define economics as a discipline, reobserve some economies and ultimately learn why California has the largest economy of the United States, with a $3.8 trillion gross state product (Fun Fact- if California were a sovereign nation, would rank as the worlds' 5th largest economy, behind Japan and ahead of India-as of 2023).

[178] Image by Jeremy Patrich is used under a CC BY 4.0 license.

WHAT IS ECONOMICS?

Forget stereotypes of money-obsessed businesspeople – economics is far richer than spreadsheets and stock exchanges. While money and commerce are part of the conversation, they're just the tip of a much larger iceberg. At its core, economics is a vibrant discourse, a continuous conversation about how societies function.

Imagine it as a grand discussion, hosted not just in academic halls but everywhere from government chambers to kitchen tables. Professors, policymakers, and even you and your friend comparing grocery prices – all engage in this ongoing dialogue about production, distribution, and ultimately, human well-being.

This "discourse definition" challenges the misconception that economics is merely about technical details. It recognizes that understanding social processes – how we produce, consume, and distribute goods and services – is crucial to understanding our own well-being. We ask how tax policies affect growth, how prices impact our choices, and ultimately, how these choices change the world we live in.

A Brief History of the Discipline of Economics

The discipline of economics, as we know it, is a teenager compared to other ancient disciplines like philosophy or even geography. While Greeks pondered grand questions of life, economics didn't exist as a distinct field until the 17th and 18th centuries. Back then, they called it "political economy" and considered it part of broader discussions about politics and morality.

So, why the late bloomer? A major transformation was brewing in Western Europe – the decline of the rigid feudal system. Kings ruled with God-given authority, peasants toiled on lands they didn't own, and life followed a set script. But then, markets and long-distance trade started bubbling up. Merchants peddled goods, individual property rights spread, and those with means began claiming land as their own. Serfs, forced off their ancestral soil, migrated to burgeoning cities, becoming wage laborers in factories and mines.

This shift to market capitalism, where private ownership ruled, was a game-changer. For the first time, most people's lives depended on the unpredictable movements of prices and wages. Suddenly, the way they produced, acquired, and consumed – things once intertwined with religion and tradition – seemed to have a life of its own. People were left bewildered, struggling to understand this "economy" thing, while at the same time, many benefitting from it—business, trade, etc.

Enter the scholars, the first "political economists." They grappled with these changes, seeking explanations, and offering theories. The most famous? Adam Smith, who, with his "invisible hand of the market," argued that individual self-interest, in an open market, surprisingly benefits everyone. David Ricardo followed, showing how even nations of unequal strength could win through trade. And then there was Karl Marx, who painted a bleaker picture, highlighting the potential for exploitation and conflict within the capitalist system.

These intellectual clashes and diverse perspectives are why calling economics a "discourse" feels fitting. It's a vibrant conversation, riddled with disagreements and competing viewpoints, just like any discussion about the complex workings of our societies. No easy answers, just exploration, debate, and ongoing quest to understand the economic pulse of our world.

CALIFORNIA’S ECONOMIC HISTORY

California has experienced waves of migration. Once the Treaty of Guadalupe Hidalgo of 1848 was coercively signed with Mexico, the US acquired the future states of California, Nevada, Utah, Arizona, New Mexico as well as the independent territory of Texas the newly acquired territories underwent rapid and extensive development. In 1847, California was controlled (with much difficulty due to deserters leaving to look for gold) by a U.S. Army-appointed military governor and an inadequate force of a little over 600 troops. After the finding of extensive gold deposits in California, the California gold rush started in 1848. Commerce and economic activity in California initially centered around the vastly expanded cities of San Francisco, San Jose, and Sacramento as they scrambled to supply the hordes of gold miners. Meanwhile, Los Angeles initially remained a less populated settlement with fewer than 5,000 residents, until the findings of borax in Death Valley (1881), and silver and lead in the Eastern Sierra (1866).

Lecture Time: California’s Economics

Want to learn more? Either scan the QR code or visit this link to watch a lecture that introduces the story sectors of California’s unique and fruitful economics. (Video length: 28min).

From Statehood to Higher Education to Agriculture

Soon after gaining statehood in 1850, the state required and paid through taxes for nearly universal elementary school education. Other private schools were founded and are still doing well. In the 1930s California was a leader in the high school movement to educate students beyond elementary school. State-subsidized college educations have a long history in California as well as many private elementary, middle, high schools, colleges, and universities. There are three public funded higher education systems in the state: the California State University (CSU) (founded 1857), the University of California (UC) system (founded 1868), and the California Community College System (CCCS) founded in 1967. CSU is the largest university system in the United States. CSU has 23 campuses and eight off-campus centers enrolling 437,000 students with 44,000 faculty members and staff, The University of California was founded in 1868 in Berkeley as a state supported university. The California Community College System consisting of 112 community colleges in 72 community college districts in California has over 1,800,000 students. California also has an extensive private college system of over 133 colleges and universities including California Institute of Technology (Caltech) and Stanford University.

About half the settlers coming to California after 1846 came by the wagon trains on the California Trail (a trip of about 140–160 days). The other half came by sea via paddle steamers going to and from the Isthmus of Panama or Nicaragua (about a 40+ day trip). The building of the Panama Railroad in 1855 made this a much more used route especially for passengers. The other main sailing ship route was going around Cape Horn, about a 120-day (via Clippers) or 200-day trip by regular sailing ship. Nearly all freight to California till 1869 took this long route around South America—shipping by ship has nearly always been relatively slow but cheap. Overland shipping was too difficult and took too long for nearly all cargo. The First Transcontinental Telegraph replaced the Pony Express in 1861 and established the first rapid communication with the east coast. The First transcontinental railroad was completed across the future states of Nebraska, Wyoming, Utah, and the new states of Nevada (est. 1864) and California in 1869 and cut this trip to about 7 days. This rail link tied California and the rest of the Pacific states firmly into the union and led to much more rapid and profitable commerce between the states. In 1886 the first refrigerated cars on the Southern Pacific Railroad entered operation. The loading of such cars with oranges, at Los Angeles on February 14, 1886, started an economic boom in the citrus industry of Southern California, by making deliveries of perishable fruits and vegetables to the eastern United States possible.

Early farming in the state was primarily concentrated near the coast, and the Sacramento–San Joaquin River Delta in the Central Valley. Winter wheat was an early crop that grew well without irrigation if planted in the fall and harvested in the spring. By the 1880s extensive grape fields for producing wine were being planted in many areas in California. Many of the vine stock originally came from France and other parts of Europe. Starting in the late 1880s, Chinese workers and other laborers were used to construct hundreds of miles of levees throughout the Sacramento–San Joaquin River Delta's waterways to control flooding, reclaim and preserve flooded land that could be converted into farmland. This area now often grows extensive rice crops. Subsequent irrigation projects have brought many more parts of the Central Valley into productive agriculture use. The Central Valley Project, formed in 1935 to redistribute water from northern California to the Central valley and Southern California helped develop more of the Central Valley.

California's location along the Pacific coast and its rapidly growing population initially led to the constructions of major seaports at San Francisco in the San Francisco Bay area and inland ports at Sacramento, etc. The first paddle steamer, the SS California, arrived in the port of San Francisco on February 28, 1849, with over 400 passengers trying to get to the gold rush territory. She left New York City October 6, 1848, before the gold discoveries were verified and the gold rush truly started. Shipment of passengers and freight to Sacramento was accomplished by off-loading the cargoes and passengers onto paddle steamers for transit up the Sacramento River to Sacramento, Stockton, etc. As the population spread out and grew ports were established up and down the California coast with other major ports in Long Beach, Los Angeles, and San Diego. The largest U.S. Naval base on the west coast is now in San Diego. The state's shipping industry evolved to handle cargoes to and from California to Europe and the eastern United States and help support the growing international trade with South America, Asia, and Oceania. During World War II, numerous military bases and various wartime industries were quickly established in the state to support the Pacific Ocean and Atlantic Ocean fleets—ships could use the Panama Canal to get from ocean to ocean. California led in the number of merchant ships built at the Kaiser shipyards in Richmond and the Los Angeles areas. Mare Island Naval Shipyard (now closed) in the San Francisco Bay built submarines as well as repaired many of the ships used by the U.S. Navy Pacific Fleet in World War II. The rapidly growing California aircraft industries was greatly expanded. Since then, these defenses connected industries have largely closed or moved to cheaper areas in the U.S.

Talkies to The Silicon Valley

With Thomas Edison's invention of the Kinetoscope (early movie camera) in 1894, California would become a leader when "talkies" were introduced in the sound film movie industry. The idea of combining motion pictures with recorded sound is nearly as old as film itself, but because of the technical challenges involved, synchronized dialogue was only made practical in the late 1920s with the perfection of the Audion amplifier tube and the introduction of the

Vitaphone system (we will learn more about why the Audion would help with computers later). After the release of The Jazz Singer in 1927, "talkies" became more and more commonplace. Within a decade, popular widespread production of silent films had ceased. Cheap land, good year-round climate and large natural spaces prompted the growing film industry to begin migrating to Southern California in the early part of the 20th century. The film patent wars of the early 20th century led to the spread of film companies across the U.S. Many worked with equipment for which they did not own the patent rights, and thus filming in New York was "dangerous"; it was too close to Edison's company headquarters, and to his agents which the company sent out to seize "illegal" cameras. By 1912, most major film companies had set up movie production facilities in Southern California near or in Los Angeles because of the region's favorable year-round weather and the rapidly growing supply of "talent" both before and behind the cameras. Since the 1920s California continues to be a major U.S. center for motion-picture shows, television shows, cartoons, and related entertainment industries, especially in Hollywood and Burbank areas.

Since 1945, manufacturing of electronic equipment, computers, machinery, transportation equipment, and metal products, has increased rapidly while aircraft and naval construction has largely ceased. Stanford University, its affiliates, and graduates played a major role in the development of California's electronics and high-tech industry. From the 1890s, Stanford University's leaders saw its mission as leading the development of the West and shaped the school accordingly. Regionalism helped align Stanford's interests with those of the Stanford area's high-tech firms for the first fifty years of Silicon Valley's development. During the 1940s and 1950s, Frederick Terman, as Stanford's dean of engineering and provost, encouraged faculty and graduates to start their own companies. He is credited with nurturing Hewlett-Packard, Varian Associates, Fairchild Semiconductor, Intel Corporation, and later other high-tech firms such as Apple Inc., Google, etc. in what would become Silicon Valley that grew up around the Stanford campus. Despite the development of other high-tech economic centers throughout the United States and the world, Silicon Valley continues to be a leading hub for high-tech innovation and development, accounting for one-third of all the venture capital investment in the United States. Geographically, Silicon Valley encompasses all the Santa Clara Valley, the southern Peninsula, and the southern East Bay. Several high-tech companies and small low-tech, often low-wage, companies are also located in Southern California.

California also pioneered numerous innovations in retailing during the mid-20th century, particularly fast-food restaurants, and credit cards. Nationwide fast food chains A&W Restaurants (1919), McDonald's (1940), Taco Bell (1961), and Panda Express (1983) were all founded in California. Visa Inc. (originally BankAmericard) was born from a 1958 experiment by Bank of America in Fresno, while MasterCard (originally Master Charge) was formed as the

Interbank Card Association in 1966 by a group of California banks to compete against BankAmericard.

CALFORNIA’S ECONOMIC SECTORS

Economics geography is based off three interconnected sectors: the primary, secondary, and tertiary. Each plays a distinct role in the production and consumption of progress and prosperity. First, let's delve into their unique contributions, understanding how their intricate interplay shapes the world around us- so we can learn how these sectors relate with five large areas of California’s overall economy (agriculture, Film & Television, Travel & Tourism, Tech, and Imports/Exports).

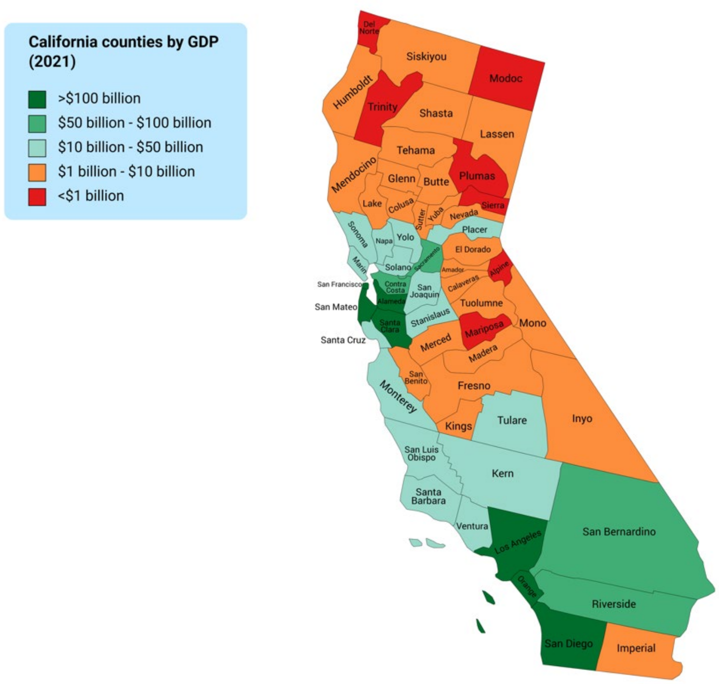


Figure 15.2: Map of California Counties by GDP (Gross Domestic Product). [179]

The primary sector provides the raw materials, the secondary sector crafts them into tangible goods, and the tertiary sector delivers the services that keep everything running smoothly. A farmer's crops nourish a truck driver who delivers manufactured goods to a restaurant where a

[179] California counties by GDP 2021 is licensed under CC BY-SA 4.0

chef uses them to prepare a meal served by a waiter. Each action ripples through the interconnected system, creating a symphony of economic activity.

However, the balance between these sectors is not static. Developed economies tend to shift towards a larger tertiary sector, focusing on services and knowledge-based industries. Meanwhile, developing economies often rely more heavily on the primary and secondary sectors for their economic engine. Understanding this dynamic interplay is crucial for navigating the complexities of our globalized world.

Lastly, we find that the GDP (Gross Domestic Product) is not equitable across all counties of the state. GDP or Gross domestic product is a monetary measure of the market value of all the final goods and services produced in a specific time. The following map identifies that seven counties that gross less than $1 Billion, and to put into perspective, Alpine counties GDP is less than $115,000 (2020), while Santa Clara, which is less than half the size of Modoc county has a $382 Billion GDP (2022).

Agriculture

Compared to other states, California has a large agriculture industry (including fruit, vegetables, dairy, and wine production), The total economic contribution is likely more than double this value. Airborne exports of perishable fruits and vegetables amounted to approximately $579 million in 2007. By way of comparison, California exported more agricultural products by air that year than 23 other states did by all modes of transport. Its agriculture is dependent on illegal immigrants.

According to the California Department of Food and Agriculture, "California agriculture is a $55 billion dollar industry”. Milk is California's number one farm commodity. The state's almond industry produces the most export value of any farm product, with $10.4 billion in sales in 2023. California leads the United States in strawberry production; due to its optimal climate and productive soil, the state is the source of over 80% of the nation's strawberry harvest.

For more information on California’s agriculture- see Unit 6- California’s Agriculture.

Film & Television

The silent film era blossomed in California, fueled by innovative filmmakers like D.W. Griffith and Cecil B. DeMille. Studios like Paramount Pictures and Metro-Goldwyn-Mayer sprung up, creating iconic stars like Douglas Fairbanks and Mary Pickford who captivated audiences worldwide. California's landscapes became backdrops for Westerns, historical epics, and romantic comedies, solidifying its connection with escapism and the American dream.

The advent of sound in the late 1920s presented both challenges and opportunities. Many silent stars struggled to adapt, but California remained a hub for innovation. Walt Disney pioneered animation in Burbank, while studios like RKO Pictures embraced new technologies like Technicolor, further cementing California's lead in the evolving entertainment industry. The Golden Age of Hollywood, roughly from the 1930s to the 1950s, cemented California's global cultural influence. Studios like Warner Bros. and 20th Century Fox churned out musicals, comedies, and genre films that entertained and inspired millions. Stars like Humphrey Bogart, Marilyn Monroe, and John Wayne became household names, embodying American archetypes and shaping cultural trends.

Out of the Collection: William S. Hart

Did you know that one of the highest-paid male actors of the Silent Era of film was a Cowboy? Either scan the QR code or visit this link to learn more about Santa Clarita’s Cowboy, and some of his famous friends! (Video length: 3min).

This era also saw the rise of television, with California at the forefront. Networks like CBS and NBC established their headquarters in Los Angeles, producing iconic shows like "I Love Lucy" and "The Mickey Mouse Club" that defined the medium for generations. California's beaches, mountains, and sprawling metropolises became backdrops for countless sitcoms and dramas, further blurring the lines between reality and the silver screen.

Figure 15.3: Publicity Photo of Lucille Ball & Desi Arnaz in I Love Lucy, California in 1956. [180]

The late 20th and early 21st centuries brought challenges to California's media dominance. Rising production costs, competition from international studios, and the fragmentation of the audience spurred consolidation and diversification. Smaller independent studios emerged, cable television thrived, and new giants like HBO and MTV rose to prominence.

The digital revolution brought even more profound changes. The rise of streaming services like Netflix and Amazon Prime Video challenged the traditional studio model, while social media platforms and user-generated content democratized storytelling. California, however, remained at the heart of this digital transformation, with Silicon Valley giants like Apple and Google playing key roles in shaping the future of media consumption.

Tourism | The County Fair

The seed of California's fair tradition was sown in 1850, a mere year after statehood. A vibrant editorial in the Daily Alta California envisioned an "exhibition that would astonish the world" – a celebration of California's burgeoning agriculture, industry, and natural wonders. Thus, the California State Fair was born, initially bouncing between Sacramento and San Francisco until finding its permanent home in Cal Expo in 1917.

For over a century, the California State Fair served as a grand stage for the state's progress. Farmers proudly displayed their prize crops, inventors unveiled their technological marvels, and

[180] Image by CBS Television is in the public domain.

artisans showcased their skills. The iconic Midway boomed with laughter and the scent of cotton candy, while livestock barns echoed with the mooing of prize-winning cows and the clucking of champion chickens. It was a microcosm of California's burgeoning identity, a melting pot of cultures and ambitions brought together in a festive atmosphere.

But as California's population boomed and cities sprawled, the centralized State Fair struggled to meet the needs of an increasingly diverse and geographically dispersed populace. This is where the story of county fairs takes a fascinating turn.

Fueled by local pride and a desire for smaller, more community-oriented celebrations, the first official California county fair, the Sonoma-Marin Fair, blossomed in 1906. Others quickly followed suit, sprouting like vibrant wildflowers across the state. By the 1930s, the network of county fairs had established its own identity, distinct from the grand spectacle of the State Fair.

These local fairs catered to the unique agricultural and cultural strengths of their respective regions. The El Dorado County Fair, steeped in mining history, celebrated lumberjacks and gold panners. The San Diego County Fair, with its proximity to the ocean, highlighted marine life and aquaculture. Each fair reflected the character and aspirations of its local community, fostering a sense of belonging and celebrating their unique stories.

Figure 15.4: Goats at the Ventura County Fair. [181]

As California continues to evolve, its county fairs adapt and innovate. There are 78 county fairs in California, which employ over 4,500 peoples and earn nearly $300,000,000 annually (almost half of this revenue alone is from the Los Angeles County Fair). Many have embraced green

[181] Image by Jeremy Patrich is used under a CC BY 4.0 license.

initiatives, showcasing sustainable agricultural practices and eco-friendly technologies. Others integrate educational exhibits and STEM programs, fostering a love for learning in young minds.

Tech

In the late 19th century, California's Stanford University emerged as a fertile ground for scientific exploration. Lee de Forest's invention of the audion in 1906, a precursor to the modern triode, planted the first seeds of what would become a technological revolution. World War II further accelerated innovation, with California companies playing key roles in radar and other wartime technologies. By the 1950s, the transistor, invented at Bell Labs, arrived in Silicon Valley, sparking a gold rush of sorts for semiconductors. Companies like Fairchild Semiconductor, founded in 1957, laid the groundwork for a burgeoning electronics industry.

However, hardware alone wasn't enough. In the 1960s, venture capital firms like Kleiner Perkins, fueled by post-war prosperity, began taking risks on fledgling tech companies. This symbiotic relationship between investors and innovators proved crucial, allowing companies like Hewlett-Packard, founded in a Palo Alto garage in 1939, to scale and flourish.
The 1970s ushered in the personal computer revolution. Silicon Valley was at the forefront, with companies like Apple and Atari creating iconic machines like the Apple II and the Atari 2600. These early computers, while primitive by today's standards, sparked a cultural shift, democratizing access to information and paving the way for the digital age.

Figure 15.5: The Apple I, The First Apple Product- 1976. [182]

At the heart of this revolution was Apple, founded in 1976 by Steve Jobs and Steve Wozniak. California's culture of collaboration and risk-taking proved fertile ground for their audacious vision of an accessible, user-friendly computer. Apple's focus on design, usability, and user

[182] Image by Apple is licensed under CC BY 4.0

experience, unlike the clunky, technical machines of the time, resonated deeply with consumers, propelling them to the forefront of the personal computer era.

Meanwhile, Silicon Valley's entrepreneurial spirit thrived, with companies like Intel and Cisco becoming household names. The region saw a constant churn of ideas, failures, and breakthroughs, fueled by a relentless pursuit of technological advancement.

The 1990s witnessed the rise of the internet, another revolution birthed in Silicon Valley. Netscape, co-founded by Marc Andreessen in 1994, created the first widely used web browser, opening the door to a vast, interconnected world of information. Soon, companies like Google, Ask Jeeves, and Yahoo! emerged, transforming how we accessed and processed information.

California's sunny disposition wasn't just metaphorical. Its mild climate and natural beauty attracted a diverse pool of talent, from engineers and programmers to artists and designers, creating a vibrant ecosystem of cross-pollination and innovation. This melting pot of minds fostered companies like Facebook and YouTube, pushing the boundaries of social media and online content creation.

The 21st century saw a shift toward cloud computing and mobile devices. Silicon Valley giants like Apple, with its groundbreaking iPhone, and Google, with its ubiquitous Android platform, redefined how we communicate, consume content, and navigate the world. The rise of venture capitalism on Sand Hill Road continued to fuel ambitious startups, from Uber disrupting transportation to SpaceX aiming for the stars.

Mining

California’s hidden wealth extends far beyond oil and gas. The Gold Rush of 1848-1855, the Silver Rush in the Calico Mountains in 1881, and others may seem like ages ago, but today, California’s still are on the hunt, and continuing to mine in ‘them thar hills.’ In fact, there are over 5,000 mining claims on public lands in California today. The California Geological Survey geologists map, analyze, and share crucial information about the Golden State's diverse mineral bounty, categorized into three main groups:

- Metals: Unearth the allure of gold, silver, iron, and copper, the backbone of various industries.
- Industrial Minerals: From the everyday marvels of clays and limestone to the high-tech wonders of rare-earth elements and boron compounds, discover the building blocks of everything from construction materials to cutting-edge electronics.
- Construction Aggregate: Build a solid foundation with sand, gravel, and crushed stone, the essential resources shaping California's infrastructure and landscapes.

Case Study | Boron

A large borax deposit was discovered in 1925 along a border of Kern and San Bernardino Counties, along State Route 58, and the mining town of Boron was established soon thereafter. This borax deposit is now the world's largest borax mine. It is owned by Rio Tinto Minerals (formerly U.S. Borax). It is operated as an open-pit mine, the largest open-pit mine in California.

Figure 15.6: The Rio Tinto Boron Mine, In Boron, California in 2012. [183]

This mine supplies nearly half of the world's supply of refined borates. Rio Tinto Minerals is Boron's primary employer, employing over 800 people. Today, borate minerals are used to make soaps, cellphone glass, fertilizers and even used to coat the ceramic tiles on the underside of space shuttles.

Case Study | Cerro Gordo

Cerro Gordo Mines, located in California's Inyo Mountains, were once a bustling hub for mining silver, lead, and zinc. Active from 1866 to 1957, these abandoned mines also produced smaller amounts of gold and copper. While some smelting happened on-site, larger smelters were built by Owens Lake to handle the workload. These smelting operations gave rise to the towns of Swansea and Keeler. Transporting the refined metals, mostly to Los Angeles, proved challenging, limiting the mines' overall success. The Cerro Gordo boom for silver and lead peaked in the 1880s, followed by another boom for zinc in the 1910s.

Here's a breakdown of what miners processed between 1789 and 1880:

- Ore: 4,223 short tons (roughly equivalent to 3,831 metric tons)
- Gold: $3,307 worth (roughly equivalent to $88,088 in today's dollars)
- Silver: $140,517 worth (roughly equivalent to $3,742,932 in today's dollars)

[183] Image by Marcin Wichary is licensed under CC BY-SA 2.0

Between 1865 and 1949, the mine also produced a massive amount of resources:

- Lead: Over 35,000 short tons (roughly equivalent to 32,000 metric tons)
- Silver: 4,400,000 troy ounces (roughly equivalent to 140,000 kilograms)
- Zinc: 11,800 short tons (roughly equivalent to 10,700 metric tons)

Figure 15.7: Overlook at the Mine Train & Cerro Gordo.[184]

Imports & Exports

The importing and exporting of materials is key for economic growth, and the best way to trade globally is to have a port. California has two primary ports for trade, the Port of Los Angeles and the Port of San Francisco. In 2022, the top three import origins of California were China ($148 Billion), Mexico ($60.5 Billion) and South Korea ($31.2 Billion). Also in 2022, the top three imports of California were petroleum oils ($28.9 Billion), medium sized cars ($20.2 Billion and portable computers ($18.2 Billion).

Exports in California reached $186 Billion, making it the largest exporter out of the 53 exports within the United States. The top three exports were aircraft parts (6.03 Billion), machines and apparatus ($5.47 Billion) and machine parts ($4.51 Billion).

Port of Los Angeles

The Port of Los Angeles was first documented by Portuguese explorer Juan Rodriguez Cabrillo, in 1542. Officerly founded in December of 1907, the use of this port has been constant- serving our communities, war effort and more. In fact, during WWII, the US military hired 90,000

[184] Image by Jeremy Patrich is used under a CC BY 4.0 license.

workers to produce military vessels. Today, the Port of Los Angeles is a seaport managed by the Los Angeles Harbor Department, a unit of the City of Los Angeles. It occupies 7,500 acres (3,000 ha) of land and water with 43 miles (69 km) of waterfront and adjoins the separate Port of Long Beach. Promoted as "America's Port", the port is in San Pedro Bay in the San Pedro and Wilmington neighborhoods of Los Angeles, approximately 20 miles (32 km) south of downtown.

Figure 15.8: Container Ship at The Port of Los Angeles, Circa 2021. [185]

The cargo coming into the port represents approximately 20% of all cargo coming into the United States. The port has 25 cargo terminals, 82 container cranes, 8 container terminals, and 113 miles (182 km) of on-dock rail.

In 2023, The port's top imports were furniture, automobile parts, apparel, and footwear. The top exports at this port were fabrics, animal feed, recycled materials, and paper.

Port of San Francisco

The Port of San Francisco was first documented by a Spanish supply ship in 1775, and later officially found founded 1863. It was designated to serve as the maritime commerce for the entire state and was California's first port. The port area under the commission's control comprises nearly eight miles of waterfront lands, commercial real estate, and maritime piers from Hyde Street on the north to India Basin in the southeast. The list of landmarks under port control include Fisherman's Wharf, Pier 39, the Ferry Building, Oracle Park (formerly AT&T Park, SBC Park and Pacific Bell Park), located next to China Basin and Pier 70 at Potrero Point. Huge, covered piers on piles jut out into San Francisco bay along much of the waterfront, bordered by the Embarcadero roadway.

[185] Image by Downtowngal is licensed under CC BY-SA 4.0

In 2023, The port's top imports were car parts (electric accumulators), batteries, automobiles (medium sized cars). The top exports at this port were nuts, gas, automobiles, and tar oil.

Case Study | Kaiser Steel

Born in the crucible of World War II, the Kaiser Steel Corporation emerged out of Fontana, California, in 1941 to address a critical need: supplying steel for Henry J. Kaiser's growing West Coast shipbuilding facilities. With costly eastern steel transportation disrupted by the war, Kaiser embarked on a $125 million venture (adjusted for inflation, a staggering $2.24 billion) to construct a mill in Fontana, California. While the government provided a sizable loan, Kaiser envisioned full ownership, unlike the post-war privatization of the Geneva plant in Salt Lake City, Utah. However, wartime concerns over coastal attacks led to a strategic inland location and restrictions on the mill's size, two hurdles that would hamper its future. Another important addition to this beginning would be the creation of Kaiser Permanente in 1945, an insurance program that would help prepay workers health needs… which later would turn would expand to a healthcare insurance and provider we see today.

Despite its limitations, Fontana quickly roared to life. From 1943 to war's end, it churned out over 1.2 million tons of steel ingots, powering the construction of 230 ships, and forging countless armaments. Its productivity even surpassed the larger Geneva plant. Yet, wartime success couldn't erase the inherent challenges - a location ill-suited for efficient transport and a capacity constrained by government lenders.

The peacetime era brought new struggles, while the Korean War production saw a temporary resurgence, the 1970s witnessed Kaiser Steel succumbing to the relentless tide of cheap imports from Japan and Korea. Open hearth furnaces, the technology of choice at the time of construction, proved increasingly outdated. In a last-ditch effort, Kaiser poured capital into modernizing the facility, adding basic oxygen furnaces, and doubling capacity.

Figure 15.9: The Interior of the Kaiser Steel Mill in Fontana, California in 1949. [186]

In a strategic pivot, Kaiser sought opportunities beyond domestic steelmaking. The early 1960s saw lucrative contracts with Japanese steel producers, securing long-term iron ore exports from California and Nevada. These deals, while generating significant revenue, couldn't compensate for the company's core struggles.

Despite the modernization efforts, Kaiser Steel couldn't escape the confluence of internal and external pressures. International competition, stringent environmental regulations, labor disputes, and corporate raiders all chipped away at its viability. Finally, in 1981, the inevitable arrived. Kaiser announced the phased closure of Fontana, marking the end of an era for American steelmaking on the West Coast.

Case Study | California Oil & Gas

California's oil and gas industry has been a dominant force for over a century, shaping the state's economic and cultural landscape. In the 19th century, oil played a limited role, primarily replacing whale oil for lamps with kerosene and providing lubricants for the burgeoning machine age. Large-scale oil production, however, hadn't yet arrived.

The 20th century ushered in a dramatic transformation. Major oil discoveries near Los Angeles and the San Joaquin Valley coincided with a surge in demand for gasoline fueled by the rise of automobiles and trucks. California rapidly ascended to become a major oil producer for the nation. Production skyrocketed from a mere 5% of the national supply in 1900 to a staggering 38% by 1914. This boom brought immense economic benefits. Kern County, the San Joaquin Valley, and the Los Angeles basin became hubs for oil drilling and production, creating jobs and

[186] Image by Los Angeles Daily News is licensed under CC BY 4.0

fostering rapid development. Offshore oil exploration also began, adding another dimension to the industry.

However, the industry's growth wasn't without consequences. The devastating 1969 Santa Barbara oil spill, where millions of gallons of crude oil poured into the Pacific Ocean, served as a stark reminder of the environmental dangers of offshore drilling. This disaster led to a permanent ban on new offshore oil and gas leases and platforms in both state and federal waters. While existing platforms can drill new wells, expansion possibilities are limited.

Today, California's oil production remains significant, but it contributes a smaller share of the national total compared to its peak. Additionally, the state imports most of its natural gas, another key component of the industry. California faces a complex challenge. Oil and gas continue to be a source of revenue and jobs, but environmental concerns and a shift towards renewable energy sources are pressing issues. The state is navigating ways to balance these competing forces, with a focus on stricter regulations and a gradual transition towards cleaner energy alternatives.

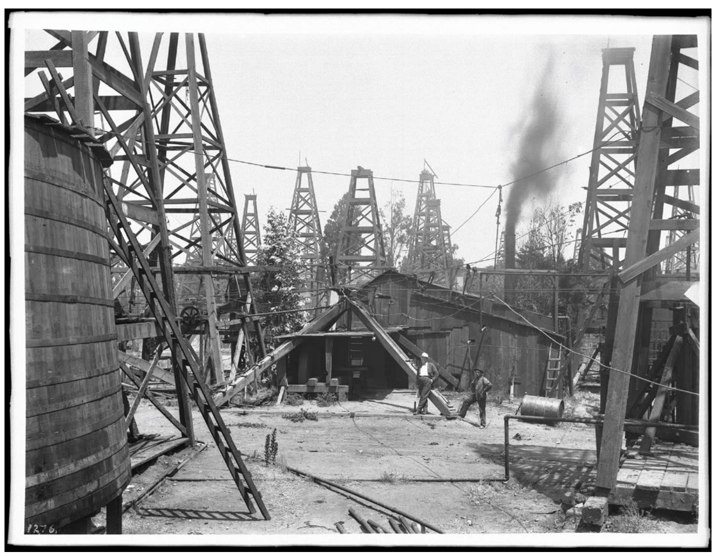


Figure 15.10: Two Men Standing Near a Wooden Shed Enveloped with Dozens of Oil Derricks in a Los Angeles Oil Field, California in 1904. [187]

[187] Image by California Historical Society is licensed under CC BY 4.0

Figure 16.1: The Pink Motel, San Fernando, California.[188]

UNIT 16: URBAN GEOGRAPHY & ICONIC CALIFORNIA LANDSCAPES

Goals & Objectives of this unit

- Understand the complex relations among government and private sector factors in California's urban systems
- Identify the urban planning models and to provide examples of each, while addressing gentrification.
- Explain the importance of California's Car Culture and the advent of fast-food.
- Define the influences and styles of California's unique architectural patterns.

INTRODUCTION

Urban geography is a subfield of geography that studies cities and urban areas. Urban geographers examine the physical, social, and economic dimensions of urban environments, and how they interact with each other. They also study the processes that shape urban

[188] Image by Jeremy Patrich is licensed under CC-BY 4.0.

development and evolution of them, and the impact of urbanization on the environment and society, (which includes ethnically and economically).

Urban geography is a broad field, and there are many different subtopics that urban geographer's study. Some of the most common subtopics include:

- **Urban Form:** This refers to the physical layout of cities, including the size and shape of streets, blocks, and buildings. Urban geographers study how urban form is influenced by factors such as history, culture, and economic development.
- **Urban Land Use:** This refers to the way that land is used in cities, such as for residential, commercial, or industrial purposes. Urban geographers study how urban land use is influenced by factors such as transportation, accessibility, and environmental concerns.
- **Urban Transportation:** This refers to the movement of people and goods within and between cities. Urban geographers study how urban transportation systems are designed and operated, and how they impact the environment and society.
- **Urban Social Geography:** This refers to the social characteristics of cities, such as population density, ethnicity, and income inequality. Urban geographers study how these social characteristics are distributed across urban space, and how they shape people's lives.
- **Urban Environmental Geography:** This refers to the environmental impacts of cities, such as air pollution, water pollution, and climate change. Urban geographers study how cities interact with their natural environment, and how they can be made more sustainable.

PATTERNS IN URBAN DESIGN

Urban geography is a rapidly growing field, as the world becomes increasingly urbanized. Urban geographers play an important role in understanding the challenges and opportunities of urbanization, and in developing solutions to the problems that cities face. In fact, most of these geographers are called urban planners. Urban planning is a technical and political process that is focused on the development and design of land use and the built environment, including air, water, and the infrastructure passing into and out of urban areas, such as transportation, communications, and distribution networks and their accessibility.

Urban planning answers questions about how people will live, work, and play in each area and thus, guides orderly development in urban, suburban, and rural areas. Although predominantly concerned with the planning of settlements and communities, urban planners are also responsible for planning the efficient transportation of goods, resources, people and waste; the distribution of basic necessities such as water and electricity; a sense of inclusion and opportunity for people of all kinds, culture and needs; economic growth or business development; improving health and conserving areas of natural environmental significance that actively contributes to reduction in carbon emissions as well as protecting heritage structures and built environments.

Although this field is used to develop or redevelop neighborhoods and communities, its science goes back to the 1800's with Johann Henrich von Thünen, and his model of agricultural land use. Thünen's model of agricultural land, created before industrialization, made the following simplifying assumptions:

- The city is located centrally within an "Isolated State."
- The Isolated State is surrounded by wilderness.
- The land is completely flat and has no rivers or mountains.
- Soil quality and climate are consistent.
- Farmers in the Isolated State transport their own goods to market via oxcart, across land, directly to the central city. There are no roads.
- Farmers behave rationally to maximize profits.

With this foundation, geographers were able to design urban models that maximize the value and use of that space, using the Central Place Theory. This is an urban geographical theory that seeks to explain the number, size, and range of market services in a commercial system or human settlements in a residential system. Let's view the three most common models.

Concentric Zone Model (1925)

This model of urban development suggests that cities grow in a series of concentric rings, with the Central Business District (CBD) in the middle and the suburbs on the outer edge. Based on human ecology theory done by Earnest Burgess, it was the first to give the explanation of distribution of social groups within urban areas. This concentric ring model depicts urban land usage in concentric rings: the CBD was in the middle of the model, and the city is expanded in rings with different land uses. It is effectively an urban version of Von Thünen's regional land use model developed a century earlier.

The zones identified are:

A. The center with the central business district,
B. The transition zone of mixed residential and commercial uses or the zone of transition,

C. Working class residential homes (inner suburbs), in later decades called inner city or zone of independent working men's home,
D. Better quality middle-class homes (outer suburbs) or zone of better housing,
E. Commuter zone, high-class homes on outskirts of outer suburbs - homeowner can afford to commute to central business district.

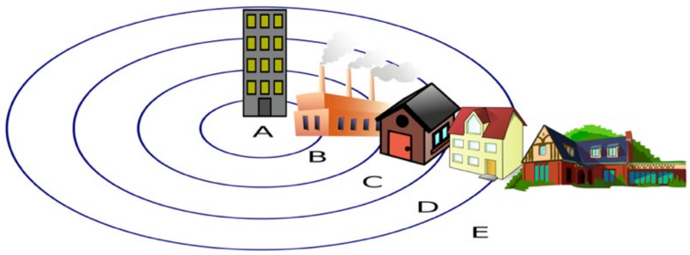


Figure 16.2: The Concentric Zone Model.[189]

Sector Model (1939)

This model of urban development suggests that cities grow in a series of sectors, with each sector representing a different type of land use, such as residential, commercial, or industrial. The theory is based on early twentieth-century rail transport and does not make allowances for private cars that enable commuting from cheaper land outside city boundaries. The theory also does not consider the new concepts of edge cities and boomburbs, which began to emerge in the 1980s, after the creation of the model. Since its creation, the traditional CBD has diminished in importance as many retail and office buildings have moved into the suburbs.

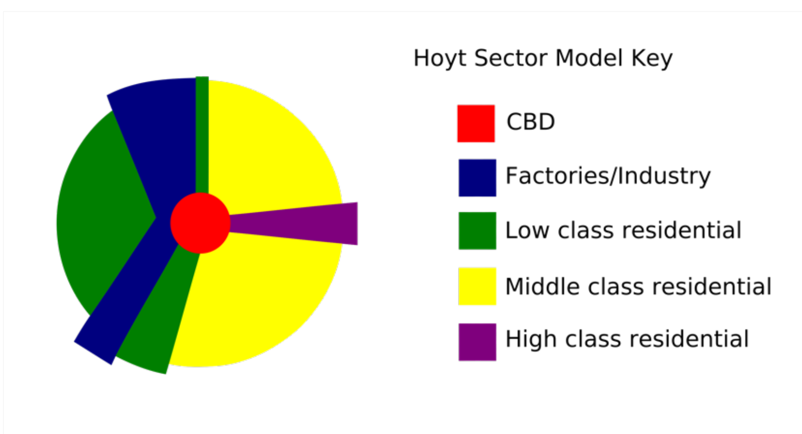


Figure 16.3: The Sector Model.[190]

[189] Image by Zeimusu (assumed original author) is in the public domain.
[190] Image by Cieran 91 is in the public domain.

Multiple Nuclei Model (1945)

This model of urban development suggests that cities have multiple centers, each of which serves a different function. This was modeled after the layout of Chicago. It says that even though a city may have begun with a single CBD, other smaller CBDs develop on the outskirts of the city near the more valuable housing areas to allow shorter commutes from the outskirts of the city. This creates nodes or nuclei in other parts of the city besides the CBD thus the name multiple nuclei model. The purpose was to produce a more realistic, if more complicated, model. The main goals in this were to:

- Move away from the concentric zone model
- Better reflect the complex nature of urban areas, especially those of larger size

The model assumes that:

- Land is not flat in all areas
- There is even Distribution of Resources
- There is even Distribution of people in Residential areas
- There is even Transportation Costs

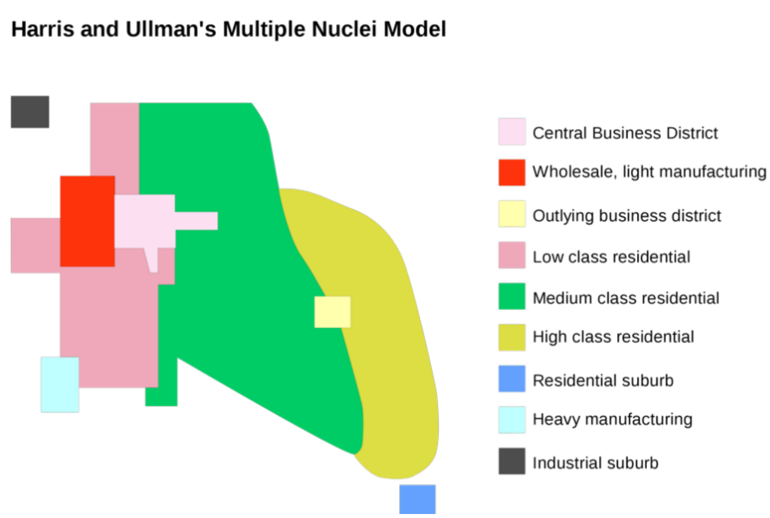


Figure 16.4: The Multiple Nuclei Model.[191]

Urban geography is a complex and fascinating field. It is a field that is constantly evolving, as new technologies and new ways of thinking about cities emerge. If you are interested in learning more about cities and how they work, then urban geography is a field that you should consider studying.

[191] Image by SuzanneKn, modified by 11gardir, is in the public domain.

DIVISION, REVISION & GENTRIFCATION

Cities, towns, and communities stand the test of time; however, as time pushes forward these communities need their infrastructure and often the local economics rejuvenated. From an economics perspective, this revision and reinvestment makes sense, but from a social standpoint these investments often divide or even displace people and their culture.

Reurbanization

Reurbanization is the process of people moving back into urban areas after a period of suburbanization. It is often driven by factors such as rising housing costs in the suburbs, the desire for a more urban lifestyle, and the availability of jobs and amenities in urban centers.
It is often seen that areas that experience reurbanization are subject to inner-city decline. Inner-city decline is a term used to describe the process of economic, social, and environmental decline in urban areas. It is often characterized by factors such as:

- **Depopulation**: Inner cities often experience a loss of population, as residents move to the suburbs or other areas in search of better job opportunities and a higher quality of life.
- **Deindustrialization**: Inner cities are often home to factories and other industrial businesses. However, many of these businesses have moved to the suburbs or overseas in search of lower labor costs. This has led to a loss of jobs and economic opportunities in inner cities.
- **Increased Crime**: Inner cities often have higher crime rates than other areas. This can be due to several factors, such as poverty, unemployment, and lack of opportunity.
- **Dilapidated Housing**: Inner cities often have a high concentration of dilapidated housing. This can be due to a lack of investment in housing, as well as the abandonment of homes by residents who can no longer afford to live in them.
- **Environmental Degradation**: Inner cities are often polluted and have poor air quality. This can be due to several factors, such as industrial pollution, traffic congestion, and the dumping of waste.

Gentrification

Gentrification is the process of renovating and improving a deteriorated urban area by means of private investment, typically to attract middle-class or affluent residents. It is a common and controversial topic in urban politics and planning. Gentrification often increases the economic value of a neighborhood, but the resulting demographic displacement becomes a major social issue. Gentrification often sees a shift in a neighborhood's racial or ethnic composition and average household income as housing and businesses become more expensive and resources that had not been previously accessible are extended and improved.

It is important to note that the impacts of gentrification can vary from neighborhood to neighborhood. The specific impacts of gentrification will depend on several factors, such as the demographics of the neighborhood, the pace of gentrification, and the policies and practices of local governments.

CASE STUDY | THE CHAVEZ RAVINE

Chavez Ravine is a shallow canyon in Los Angeles, California. It sits in a large promontory of hills north of downtown Los Angeles, next to Major League Baseball's Dodger Stadium. The origin of the name dates to Julian Chavez, a Los Angeles councilman, who purchased the land in 1884. There are no records of what Chavez did on his land, but during the 1850s and 1880s there were smallpox epidemics and Chavez Canyon was the location of a "pest house" which cared for Chinese-Americans and Mexican-Americans suffering from the disease.

Figure 16.5: The Chavez Ravine & Dodger Stadium.[192]

In addition to the notable Mexican-American presence, there was also a notable early Jewish-American presence in the neighborhood beginning in the 1850s. The First Jewish site in Los Angeles was a Jewish cemetery located in Chavez Ravine, which opened in 1855 and was owned by the Hebrew Benevolent Society of Los Angeles, a Jewish charity which was also the first charity in Los Angeles.

[192] Image by Jeremy Patrich is used under a CC-BY 4.0 license.

Chavez Ravine was once home to a Mexican-American community of about 1,800 people. In the early 1950s, the city of Los Angeles used eminent domain to evict the residents of Chavez Ravine and build Dodger Stadium. The forced removal of the Chavez Ravine residents is known as the "Battle of Chavez Ravine."

The Battle of Chavez Ravine is a controversial event in Los Angeles history. After nearly 10 years, by 1959 Manuel and Abrana Arechiga, with their daughter Aurora Vargas, were among the last of the tiny number of residents to hold out against the government land acquisition effort undertaken for the original public housing project. Forced removal by the Los Angeles County Sheriff's Department (LASD) on May 9, 1959, resulted in Vargas' arrest. Vargas was fined and briefly sent to jail for her resistance. Manuel Arechiga was the final holdout, living in a tent on the site of his demolished home for months. Many believe that the city of Los Angeles took advantage of the Mexican-American residents of Chavez Ravine and forced them out of their homes so that the Dodgers could build a stadium. Others believe that the city of Los Angeles was justified in using eminent domain to build a stadium that would bring economic benefits to the city.

Today, Dodger Stadium stands on the site of Chavez Ravine. The stadium is a popular tourist destination and home to the Los Angeles Dodgers baseball team. However, the Battle of Chavez Ravine continues to be a source of pain and resentment for many Mexican-Americans in Los Angeles.

The story of Chavez Ravine is just one example that reflects the history of race and class in Los Angeles. It is a story of displacement, injustice, and the struggle for power. It is also a story of resilience, community, and the power of baseball.

CAR CULTURES & FASTER FOOD

The rise of the car culture led to the development of new architectural styles that were designed to accommodate the needs of motorists. For example, drive-thru restaurants and car washes became popular, as did malls and buildings with large parking lots. Additionally, the use of glass and steel in architecture became more common, as these materials were seen as being more modern and car friendly.

California Car Culture

California has long been a car-centric state. The state's mild climate, vast open spaces, and love of the open road have all contributed to the rise of car culture in California. In fact, the automobile also influenced the advent of the Freeway. The Arroyo Seco Parkway, also known as the Pasadena Freeway, is one of the oldest freeways built in the United States, (the 110 Freeway would replace the California Cycleway, which was a 9-mile elevated bicycle tollway built in 1900). It connects Los Angeles with Pasadena alongside the Arroyo Seco seasonal river. It is notable not only for being an early freeway, mostly opened in 1940, but for representing the transitional phase between early parkways and modern freeways. It conformed to modern standards when it was built, but is now regarded as a narrow, outdated roadway. A 1953 extension brought the south end to the Four Level Interchange in downtown Los Angeles and a connection with the rest of the freeway system.

Figure 16.6: The Tunnels Through Elysian Park- Along the Arroyo Seco Freeway.[193]

In 1903, the first Model A Ford was produced in Detroit, Michigan. The Model A was an affordable and reliable car that was well-suited for the roads of California. As a result, the Model A quickly became popular in California.

In the 1920s, the popularity of car culture in California exploded. The state's population was growing rapidly, and new roads were being built all over the state. This made it easier for people to get around by car, and car ownership became increasingly common.

[193] Image by Gardner-Thompson Company and California Scenic Views, made available Copley Library, University of San Diego, allowed for non-commercial, personal, educational, and research use only.

The 1930s saw the rise of the "California Dream." This was the idea that California was a place where people could escape the hustle and bustle of the East Coast and start a new life. The California Dream was often associated with cars, as cars were seen as a symbol of freedom and mobility.

The 1940s and 1950s saw the golden age of car culture in California. The state's economy was booming, and new car models were being introduced all the time. Cars were becoming more affordable, and more people were able to own them. This led to a boom in car-related businesses, such as drive-in restaurants, motels, and gas stations.

Figure 16.7: The 1957 Chevy Belair- An Iconic Space Age Car.[194]

The 1960s saw the rise of the counterculture movement in California. This movement challenged the traditional values of American society, and cars were often seen as a symbol of the status quo. In fact, in 1960 it was estimated that in California alone, 31% households had two or more cars, while places like New York only had 12% of the households owning two or more cars. As a result, some members of the counterculture movement turned to motorcycles and vans as an alternative to cars.

The 1970s saw the oil crisis, which led to a decline in car culture in California in a few different ways. As gas prices rose, people started to drive less, and new car ownership began to decline as Californians were pushed to purchase fuel economic vehicles, rather than based on social class and design. However, car culture in California never fully disappeared. In fact, it has made a resurgence in recent years, as people have become more interested in classic cars and hot rods.

[194] Image by Chevrolet Pre-1978 is in the public domain.

U.S. Route 66 | The Will Rogers Memorial Highway

Route 66, also known as the "Mother Road," was one of the original highways in the United States Numbered Highway System. It was established on November 11th, 1926 and was officially designated as U.S. Route 66 in 1936. The highway was named after its designation as the 66th numbered highway in the system and was originally called the Will Rogers Highway, after the famous American actor and humorist. The highway ran for 2,448 miles (3,940 km) from Chicago, Illinois, to Santa Monica, California, passing through eight states: Illinois, Missouri, Kansas, Oklahoma, Texas, New Mexico, and Arizona.

Route 66 was featured in several films and television shows, and movies, including "The Grapes of Wrath," "Easy Rider," and "Cars." In the 1950s, the Interstate Highway System began to be built, and many of the original sections of Route 66 were bypassed by the new highways. As a result, Route 66 began to decline in popularity. However, the highway has since been designated as a National Historic Trail, and it is now a popular destination for Roadtrippers and history buffs.

Figure 16.8: The Wigwam Motels in Rialto California.[195]

The beginning of the decline of US Route 66 can be traced to 1956, when President Dwight D. Eisenhower signed the Interstate Highway Act. Many Disney historians believe that Walt Disney's vision of a futuristic highway system, as seen in the Autopia attraction at Disneyland, may have influenced the development of the Interstate Highway System. The similarities between the two projects suggest that Disney's ideas about how to move people around quickly and efficiently may have been shared by some of the architects of the Interstate

[195] Image by Carol M. Highsmith is in the public domain.

Highway System. This is especially likely given that the Autopia attraction opened in 1955, just one year before the act was signed.

Drive Thru & Fast-Food

The car culture also led to the development of fast food. Fast food restaurants were designed to be convenient for motorists, with drive-thru windows and parking lots that were easy to access. Additionally, fast-food restaurants often featured bright colors and simple designs that were meant to catch the attention of passing motorists.

Lecture Time: California's Fast-Food History

Want to learn more? Either scan the QR code or visit this link to learn about the influence California had on perfecting Fast-Food and the influence these establishments had on the landscape. (Video length: 10:34min).

California may not have invented fast food, but it certainly perfected it. The history of fast food can be traced back 1916, when the first White Castle opened in Wichita, Kansas. White Castle was a hamburger restaurant that served food quickly and cheaply. The novelty of getting food fast quickly caught on, and other fast-food restaurants began to open all over the country, including in California.

In the 1940s, two of the most iconic fast-food chains in the world were founded in California: McDonald's and In-N-Out Burger. McDonald's was founded in San Bernardino, California, in 1940 by brothers Maurice and Richard McDonald. The McDonald brothers' restaurant was a simple drive-thru operation that served hamburgers, fries, and shakes. In-N-Out Burger was founded in Baldwin Park, California, in 1948 by Harry and Esther Snyder. The restaurant was the first drive-thru hamburger stand in California, allowing drivers to place orders via a two-way speaker system. This was a new and unique idea, since in post-World War II California, carhops were used to take orders and serve food.

The 1950s saw the golden age of fast food in California. The state's population was growing rapidly, and new roads and freeways were being built all over the state. This made it easier for people to get around by car, and fast-food restaurants became increasingly popular.

By the 1960s, fast food continued to grow in popularity in California especially with the creation of chains, such as Taco Bell, Der Weinerschnitzel, Del Taco, and the International House of Pancakes (IHOP).

Today, fast food is still a major part of the California food landscape, culturally and architecturally, and it is often seen as a symbol of the state's car culture and diversity.

CASE STUDY | DEL TACO

The first Del Taco restaurant was opened by Ed Hackbarth and David Jameson in Yermo, California, on September 16, 1964 under the name "Casa Del Taco." On the first day of business, Del Taco made $169 ($1,595 in 2022 dollars). Success of the first restaurant led to two in Barstow (which is the oldest operating Del Taco in the world), one in Needles, and a fifth restaurant in Corona (the first Del Taco with a drive-through window).

Dick Naugle, who installed the kitchen equipment in the Corona store, was impressed by the design and joined Hackbarth and Jameson in the fledgling business. In 1966, the trio founded Red-E-Food Systems, Inc., with the idea of franchising the Del Taco brand. That same year, the original Del Taco sun logo was created. In 1967, Del Taco introduced their bean and cheese burrito with green or red sauce.

Figure 16.9: The 1st Del Taco, in Yermo California.[196]

---

[196] Image by Jeremy Patrich is licensed under CC-BY 4.0.

CALIFORNIA'S BUZZ & WOODY ERAS

The Buzz and Woody era were a period of architectural experimentation in California during the 1950s and 1960s. It was characterized using bold, geometric shapes and bright colors. Although it is not clear where the architectural term "Buzz and Woody" was coined, perhaps in the mid 1990s post Disney Pixar's Toy Story, but the names date back to the early 1950s when Walt and Roy Disney would partner with architect Buzz Price and manager Cornelius Wood (Woody) to help develop their dream of Disneyland. Nonetheless, the influence of television, movie theaters and even theme parks helped change the trajectory of architecture and car culture for the California, and the world.

Woody Arcitecture | The Suburban Cowtown

The Woody style was a direct result from the classic B Western films and popular television shows that depicted the American West. These shows often depicted idealized images of the American West, with rustic log cabins, grand ranches, and small towns. This idealized imagery captured the imagination of Americans and helped to popularize certain architectural styles such as ranches, log cabins and the mission style.

Although we see this design in suburban developments, (especially in Northridge, California) this themeing was key in the development of key restaurant and fast food developments in the 1950s-60s. An excellent example of this can still be seen today is the iconic Clearmans Northwoods Inn chain.

Figure 16.10: Clearman's Northwoods Inn, La Mirada, California.[197]

[197] Image by Jeremy Patrich is licensed under CC BY 4.0.

Clearman's Northwoods Inn is a chain of restaurants in California. The first Clearman's Northwoods Inn was opened in 1966 in San Gabriel, California. The restaurant was known for its rustic log cabin design and its menu of American comfort food. The restaurant was an immediate success and soon several more locations were opened throughout California. With its classic logcabin stlye, snow on the roof and peanut shells on the foor, Clearmans was an experience like no other, especially for those living in sunny southern California. Some of the earlier restaurant even had a small western villages attached that included a blacksmith and themed shopping.

Buzz Arcitecture | The Aerospace City

With the inspiration from space themed television shows of the 1950's and 60's, such as The Twilight Zone, Lost in Space and Star Trek, as well as the ever looming Cold War and Space Race, the space age was no longer a dream—but now a tangible and visible future. This inspiration was seen in the design of autombiles such as, The LeSabra (1951), Manta Ray (1953), and the DiDia 150 (1960). Aside the road, we also began seeing this futuristic design in our arcitecture.

Architects were inspired by the sleek, streamlined look of spacecraft and incorporated these elements into their buildings. For example, the Theme Building at the Los Angeles International Airport (LAX) is a prime example of futuristic architecture inspired by the space race (and one of the first). It features a soaring, cylindrical shape and a glass-enclosed observation deck that offers panoramic views of the airport and the surrounding area. Influenced by "Populuxe" architecture, it is an example of the Mid-century modern design movement later to become known as "Googie". The primary architect for the Theme Building in LAX was Paul R. Williams, who was the first African-American certified architect west of the Mississippi River.

Figure 16.11: The Theme Building at LAX, Circa 1960. [198]

[198] Image by Los Angeles World Airports is in the public domain.

Another way that highlighted the space inspired architecture in California was through the use of new materials. Architects began to experiment with new materials, such as fiberglass, aluminum and plastic, that were inspired by the materials used in spacecraft. These materials were often lightweight and strong and resilient to weathering, and they could be used to create new and innovative architectural designs. For example, the Spaceship Earth geodesic dome at Epcot in Walt Disney World is made from alucobond, an aluminum composite material (ACM) made of two thin sheets of aluminum bonded to a core of polyethylene.

CASE STUDY | A BRIEF HISTORY OF CALIFORNIA HOUSING ARCITECTURE

As mentioned earlier in the text, the urban landscapes in California are the direct result of the state's rich history and diverse population. There are several other factors that influence housing architecture, including climate, population density and budget. For example, homes in hot climates will often be designed with flatter roofs to reflect more solar radiation to keep the home cooler, while homes in cold climates will often have pitched or triangular roofs to prevent snow buildup. Human factors can also influence housing architecture, as different cultures have different ideas about what constitutes a comfortable and functional home, whether it be large one-story home with a large backyard, or stacked townhomes. Nonetheless, it is evident that California has the most diverse offerings of architectural design and has become the inspiration for the world.

1890s California Victorian

The California Victorian style is a unique architectural style that was developed in California during the late 19th century. It was influenced by several different architectural styles, including the Gothic Revival, the Italianate, and the Eastlake. The style was also influenced by the state's mild climate and its diverse population.

This style was first popularized in San Francisco in the 1850s. The city's rapid growth during the Gold Rush led to a demand for new homes, and the California Victorian style was seen to create homes that were both stylish and comfortable. The California Victorian style soon spread to other parts of California, and it became one of the most popular architectural styles in the state. By the early 20th century, there were thousands of California Victorian homes throughout the state, such as in Pasadena and atop Bunker Hill of Downtown Los Angeles.

Figure 16.12: The Historic Queen Anne Victorian Home, Arcadia California.[199]

[199] Image by Jengod is licensed under CC BY-SA 4.0.

1905 California Craftsman | The Bungalow

The American Craftsman is an American domestic architectural style, inspired by the Arts and Crafts movement, which included interior design, landscape design, applied arts, and decorative arts, beginning in the last years of the 19th century. Its immediate ancestors in American architecture are the Shingle style, which began the move away from Victorian ornamentation toward simpler forms, and the Prairie style of Frank Lloyd Wright.

The name Craftsman was appropriated from furniture-maker Gustav Stickley, whose magazine The Craftsman was first published in 1901. The architectural style was most widely used in small-to-medium-sized Southern California single-family homes from about 1905, so that the smaller-scale Craftsman style became known alternatively as "California bungalow". The style remained popular into the 1930s and has continued with revival and restoration projects through present times. It is characterized by its use of natural materials, such as wood and stone, and its simple, functional design. California Craftsman buildings are often found in residential neighborhoods, and they often feature front porches, gabled roofs, and exposed beams.

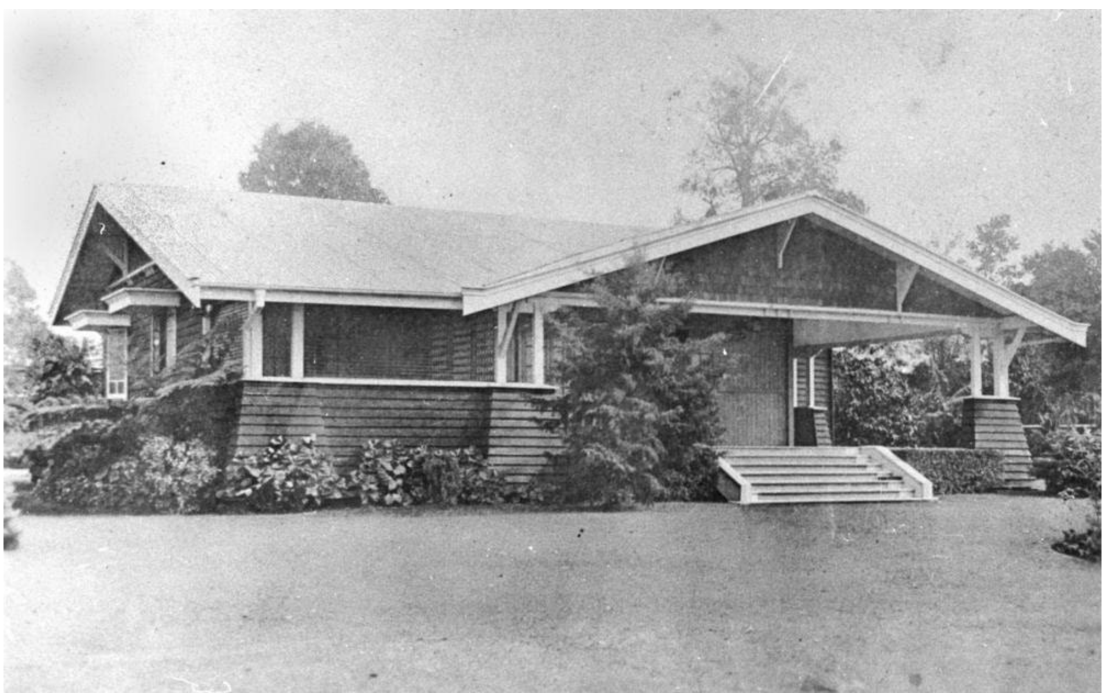


Figure 16.13: A California Bungalow, Circa 1919.[200]

[200] Image by unknown author is in the public domain.

1920s Art Deco

Art Deco was a popular architectural style in Los Angeles during the 1920s and 1930s. It was characterized by its geometric shapes, stylized ornamentation, and use of bright colors. The movement in Los Angeles was influenced by several factors, including the city's climate, its growing population, and its status as a center of commerce and entertainment. The mild climate of Los Angeles made it possible to build buildings with large glass windows and open floor plans, which were two of the hallmarks of Art Deco architecture. The city's growing population also created a demand for new buildings, and Art Deco was seen as a stylish and modern style that could meet the needs of a growing city.

Los Angeles was also a center of commerce and entertainment during the 1920s and 1930s, and Art Deco was seen to showcase the city's glamour and sophistication. Many of the city's most iconic Art Deco buildings were built during this time, including the Los Angeles Theater, and the Eastern Columbia Building.

Art Deco architecture in Los Angeles declined in popularity after World War II, but it has seen a resurgence in recent years. Many of the city's Art Deco buildings have been restored or renovated, and they are now recognized as important examples of the Art Deco movement.

Figure 16.14: The Eastern Building in Downtown Los Angeles. [201]

[201] Image by Andreas Praefcke is licensed under CC BY 3.0.

1930s Mission Revival

In the United States, the Panama-California Exposition of 1915 in San Diego, highlighting the work of architect Bertram Goodhue, is credited with giving the style national exposure. Embraced principally in California and Florida, the Spanish Colonial Revival movement enjoyed its greatest popularity between 1915 and 1931. Although examples are found throughout the state, some of the more iconic locations include the Mission Inn in Riverside, The Pasadena City Hall, and the Casa del Desierto train depot in Barstow. The Casa del Desierto, as seen blow in figure 16.15, note the Moorish Spanish arches and terracotta tiled roof. The city of Santa Barbara adopted the style to give it a unified Spanish character after widespread destruction in the 1925 Santa Barbara earthquake- which is why this architectural design is often referred to as the Santa Barbara Style.

Figure 16.15: The Casa del Desierto Harvey House, in Barstow California.[202]

[202] Image by Jeremy Patrich is licensed under CC BY 4.0.

1950s Modernism

California has had a significant influence on modernism and Mid-Century Modern architecture. The state's mild climate, its open spaces, and its diverse population all contributed to the development of this unique style. As seen earlier in the text with the Theme Building, this modern Googie architecture was a futuristic design that originated in California in the 1930s but became more prominent in the mid 1950s with its use of glass, steel, neon and geometric shapes and patterns.

California's mild climate allowed architects to experiment with new materials and designs. For example, they could use large glass windows and open floor plans, which were not possible in colder climates. This made California a hotbed of innovation, and many of the most iconic Mid-Century Modern buildings were built in the state.

Architects were inspired by the state's natural beauty, and they often incorporated elements of nature into their designs. For example, they might use sloping roofs that resemble hills or patios that overlook the ocean. This made Mid-Century Modern architecture feel more relaxed and informal than other styles of modernism.

Bright colors or geometric patterns that were inspired by Mexican or Asian art were often used in the design, which made Mid-Century Modern architecture feel more eclectic and interesting than other styles of modernism. Modernist buildings can be found throughout California, but they are especially common in Palm Springs, where the style was popularized by architects such as Richard Neutra and Rudolph Schindler.

Figure 16.16: The Kaufmann Desert House, Palm Springs, California.[203]

[203] Image by Pmeulbroek is licensed under CC BY 4.0.

1950s California Cinderella Style

California Cinderella style homes are a type of mid-century modern architecture that combines the clean lines and simple forms of modernism with the whimsical details of storybook architecture. They were first popularized in the 1950s by homebuilder Jean Vandruff, who built a community of these homes in Downey, California, just a few miles from Disneyland.

These homes are characterized by their use of wood and stucco, their simple lines, and their whimsical details. These details can include turrets, pointed roofs, gingerbread trimming, and arched doorways. The homes often have a fairy tale or storybook feel, and they are often decorated with flowers, vines, and other plants.

The Cinderella style homes were popular in California during the 1950s and 1960s, and they can still be found in many parts of the state. They are a unique and charming type of architecture that captures the spirit of the mid-century modern era.

Figure 16.17: Marketing for the Downey Cinderella Estates, California.[204]

[204] Image Vandruff Family Archives by is licensed under CC BY 4.0.

1960s California Ranch Style

Also known as the Rambler or California Ranch, is a domestic architectural style that originated in the United States. The ranch-style house is noted for its long, close-to-the-ground profile, and wide-open layout. The style fused modernist ideas and styles with notions of the American Western period of wide-open spaces to create a very informal and casual living style. While the original ranch style was informal and basic in design, ranch-style houses built in the United States (particularly in the Sun Belt region) from around the early 1960s increasingly had more dramatic features such as varying roof lines, cathedral ceilings, sunken living rooms, and extensive landscaping and grounds.

Although first appearing as a residential style in the 1920s, the ranch was extremely popular with the booming post-war middle class of the 1940s to the 1970s. The style is often associated with tract housing built at this time, particularly in the southwest United States, which experienced a population explosion during this period, with a corresponding demand for housing. The style was soon exported to other nations and became popular worldwide. Its popularity waned in the late 20th century as neo-eclectic house styles featuring historical and traditional decoration became more popular. A great example of this style of community would be along San Fernando Mission Blvd. in Northridge California.

Figure 16.18: A California Birdhouse Ranch Style Home.[205]

[205] Image by Jeremy Patrich is licensed under CC-BY 4.0.