The San Joaquin Valley Through Time

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INTRODUCTION

Most of California is a relatively recent addition to the North American continent. From the Sierra Nevada Mountains westward, California is dominated by Mesozoic and Cenozoic Era rocks. This is particularly true of the San Joaquin Valley and the adjacent Temblor and Diablo Ranges, which lie to the west. Although glimpses of an older time can be seen in the Sierra Nevada Mountains to the east, the Sierra Nevada are dominated by Mesozoic plutonic and metamorphic rocks. The geology of these three geomorphic provinces are evidence of the complex structural relationships which occur at the boundaries of two or more colliding plates of the Earth's crust.

MESOZOIC ERA - Jurassic and Cretaceous Periods (208 to 65 million years ago)

The Sierra Nevada Mountains first formed during the Jurassic as an island arc volcanic system around 200 million years ago. Compression of an oceanic proto-Pacific plate against a continental North American plate occurred. As these two plates collided, the oceanic (western) plate subducted beneath the continental (eastern) plate. Subduction led to the Sierra Nevada area being uplifted and volcanoes spewed ash and lava throughout its entire length. Numerous batholiths formed beneath these volcanoes to fuel their violent activity. West of the Sierra, a deep-ocean trench formed above the oceanic crust. Most of the future San Joaquin Valley and Coast Ranges lay under thousands of feet of the Pacific Ocean waters. Tens of thousands of feet of sediments carried from the Sierra Nevada began to accumulate in the deep ocean waters of the trench. Parts of the oceanic plate were scraped from and "accreted" onto the North American continental plate. The tectonic dance of subduction, accretion, volcanic activity, uplift, erosion, and sediment deposition into the Pacific Ocean continued into the Late Cretaceous (65-75 mya). As volcanic activity slowed, erosion wore the Sierra mountains into low hills, and portions of the accretionary wedge began to poke above the ocean as islands of the future Temblor and Diablo ranges. The San Joaquin /Sacramento valleys began to be separate from the rest of coastal California. These valleys were one geologic "basin" of continuous marine deposition.

CENOZOIC ERA- Tertiary Period
(65 to 2 million years ago)

Paleocene Epoch
(65 to 53 million years ago)

The general structural form of the San Joaquin Basin had begun to take shape by the early Paleocene. The San Joaquin was bounded by upland areas to the west, east, and south. To the north, a subtle cross-valley uplift in the Stockton area became known as the Stockton Arch. This arch separated the San Joaquin Basin from the Sacramento Basin to the north. Deltas built out from upland areas (primarily the Sierra Nevada) to supply sediment to the San Joaquin Valley. Although subduction of the Proto-Pacific plate beneath the North American plate continued, volcanic activity was largely to the east of California.

Eocene Epoch
(53 to 39 million years ago)

Relative quiescence continued into the Eocene. Sea level changes, both local and worldwide, combined with tectonic and climatic changes to change the landscape . With sea level of the San Joaquin Valley being hundreds of feet rather than thousands of feet deep, small changes in sea level resulted in broad fluctuations in the postion of the Pacific Ocean shoreline around the San Joaquin Valley. A sub-tropical climate caused intense weathering and erosion.

In early Eocene, tectonic forces caused uplifts of the Diablo Range. These tectonic forces were in part related to the docking of the Salinia terrane, which moved in from the west. Erosion of this Salinia block provided a significant sediment source for the valley. Sea level dropped in the early Eocene, and deltas built westward from the Sierra Nevada. Parts of the San Joaquin Valley, particularly north of Coalinga, were above sea level for the first time.

In the Middle and Late Eocene, sea level rose dramatically, inundating the valley with deep marine waters. The Pacific-Farallon spreading center (ridge), the western edge of the proto-Pacific plate, approached from the west.

Oligocene Epoch
(39 to 23 million years ago)

Subduction of the proto-Pacific plate beneath the North American plate continued in the Oligocene, but the subduction angle may have steepened, reigniting volcanic activity in California. Although marine conditions continued to exist in the valley, the Early Oligocene was a time of shallowing ocean waters. This was in part due to an abundant sediment supply: continued or renewed uplift and erosion of the Sierra Nevada to

the east and the San Emigdio Mountains to the south, and the Stockton area to the north.

Miocene Epoch
(23 to 5 million years ago)

Early Miocene tectonics and paleogeography was largely a continuation of Late Oligocene conditions. In the early Miocene the marine embayment was similar to the Oligocene embayment. However, the interaction between plate boundaries was changing. The Proto-Pacific plate disappeared as its spreading center dived beneath the North American plate.The Pacific/North American plate interaction was no longer subduction, but rather transpression. The Pacific plate began sliding northwest relative to the North American plate. The surface expression of this boundary became the San Andreas Fault. Volcanism ceased from south to north as subduction of the proto-Pacific plate ceased. A cross-valley structural high, the Bakersfield Arch, formed, separating the southern San Joaquin into two depocenters: the Buttonwillow depocenter and the deeper Maricopa/Tejon depocenter.

By the Middle Miocene, marine deposition was restricted to the central and southern San Joaquin Valley. On the west side, however, the entire Diablo Range and the Temblor Range north of McKittrick underwent significant uplift. Deltas brought significant amounts of Sierran sediments into the east side of the San Joaquin Valley. During the Middle Miocene, excellent condtions existed to support abundant flora and fauna in the marine embayment, as evidenced by vertebrate fossils from the Sharktooth Hill area near Bakersfield. Renewed uplift and volcanism began in the Sierra Nevada 10-12 million years ago.

Ocean waters deepened in most of the central and southern San Joaquin Valley in the Late Miocene. Marine deposition extended as far north as Chowchilla. In the Late Miocene and Pliocene, the valley oceanic embayment began to fill with tremendous amounts of sediment-the most rapid sedimentation the southern valley had yet seen. Tens of thousands of feet of sediment accumulated in the two depocenters in just a few million years.

As movement on the San Andreas Fault continued, shallowing and deepening of the seaway connections between the San Joaquin Valley and the Pacific Ocean occurred. This is because these seaways crossed the fault. Two of the better known seaways are: 1) between Coalinga and Monterey Bay, and 2) the area between McKittrick and the western San Emigdio Range, which connected with the Salinas and Cuyama Valleys.

Pliocene Epoch
(5 to 2 million years ago)

The heyday of marine deposition in the San Joaquin Valley was rapidly coming to a close. Tremendous sediment volumes continued to come into the valley from all directions, while the seaways connecting the valley to the Pacific Ocean were being cutoff. By the Late Pliocene brackish waters and non-marine deposits filled the embayment. By the end of the Pliocene, the marine outlets were completely closed.

In the Late Pliocene, major deformation of the Coast Ranges and adjacent parts of the San Joaquin Valley occurred. Surface anticlines such as Elk Hills, Kettleman Hills, and Wheeler Ridge quickly became major surface features rising from the valley floor. This deformation and uplift continues today, and is measured at places such as Buena Vista Hills. Extensive compression in the Transverse Ranges such as the San Emigdio Mountains caused major uplift.

Quaternary Period- Pleistocene Epoch
(2 million years ago to 10,000 years ago)

Rapid filling of the San Joaquin Valley with sediment continued. The Sierra Nevada Mountains arched skyward with renewed uplift, and glaciation began to occur. These glaciers have given us some of the spectacular geomorphic features we see today, such as Yosemite Valley. As glaciation ebbed and flowed, the valley floor filled with freshwater lakes. The last widespread lake to fill the valley did so 700,000 years ago. It is known as Lake Corcoran or Lake Clyde.

Holocene Epoch
(10,000 years ago to present)

The San Joaquin Valley completely filled with sediment, and most of the valley is now a few hundred feet above sea level. Remnants of the deepest parts of the Buttonwillow and Maricopa/Tejon depocenters became small, freshwater lakes: Tulare Lake, Buena Vista Lake, and Kern Lake. Due to man's activities, only one of these lakes remains. Today's buena Vista lake covers only a fraction of the area it covered a 150 years ago.

If all the ice tied up in worldwide glaciers were to melt, the San Joaquin Valley would once again become an oceanic embayment.