

## TERTIARY ROCKS

As seen on the geologic map, most of the Tertiary rocks lie along the crest of the Sierra Nevada north of Lake Tahoe. These are mainly soft volcanic and sedimentary rocks, and are a small remnant of the Tertiary rocks that once covered most of the northern Sierra Nevada. Let's take a look at how these Tertiary rocks were formed.

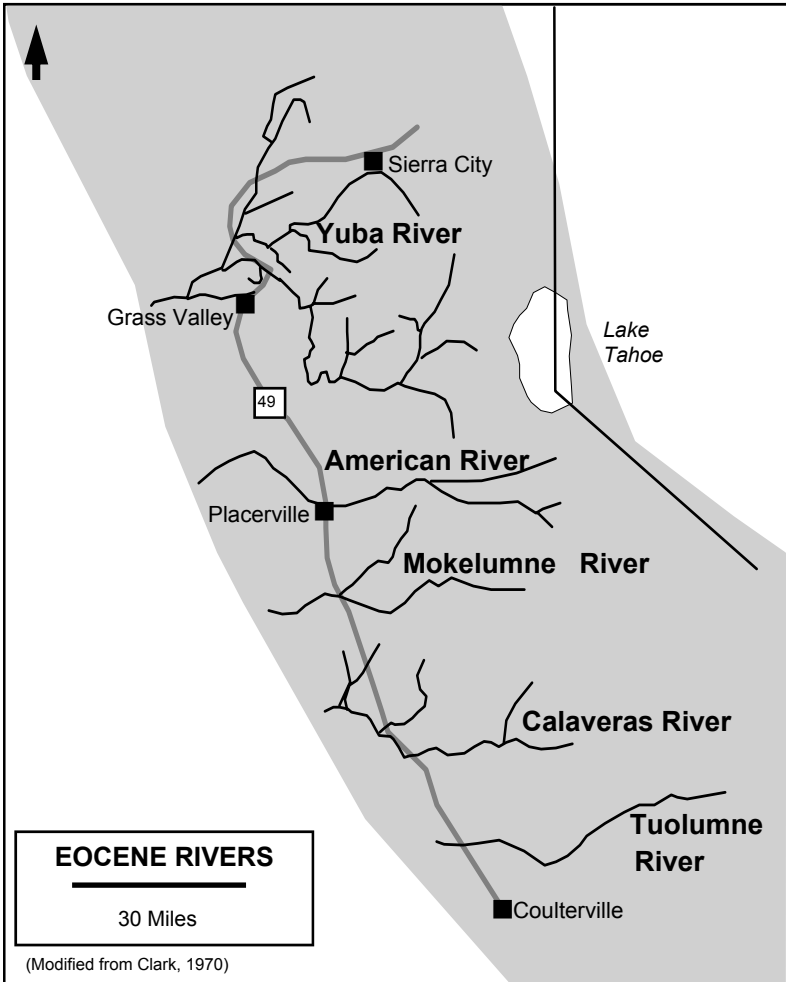
### **Eocene Erosion Surface**

During most of Cretaceous and Paleocene time, the Sierra Nevada was the site of a large mountain range that extended into Nevada and covered an area much larger than the present-day Sierra Nevada. The crest of these ancestral mountains was far east of the crest of the present-day Sierra. As the ancestral mountains were uplifted, they were also being eroded. Most of the erosion products from these ancestral mountains were carried into the Great Valley, where they formed thick layers of sedimentary rocks that now underlie much of the Great Valley.

By Eocene time, uplift of the ancestral Sierra had slowed down. However, erosion continued, and the ancestral mountains were deeply eroded to form a low range of hills with a gentle rolling landscape. This Eocene land surface was drained by a series of large rivers that flowed west into the Great Valley. Many of these rivers had their origin in Nevada, far to the east of the present-day Sierra rivers. Since this land surface was formed during Eocene time, it is generally referred to as the Eocene erosion surface. This erosion surface is marked in many areas by a thick zone of red soil that was formed by weathering in a humid climate during the long period of Eocene erosion. The Eocene erosion surface and its red soil are preserved in many places in the foothills of the northern Sierra and can be seen along much of Highway 49 from Placerville through Auburn to Camptonville.

### **Eocene River Gravels**

As described above, the low rolling hills of the Eocene erosion surface were drained by several large rivers that flowed west and northwest and emptied into the ocean that occupied the Great Valley at that time. Although these Eocene rivers had different courses from the present-day



ivers, most of the Eocene rivers are named from the nearby present-day rivers. From north to south, the major Eocene rivers are the Yuba, American, Mokelumne, Calaveras, and Tuolumne. Since these rivers had their headwaters east of the present-day Sierra and could not flow uphill to cross the Sierra, it is apparent that uplift of the present-day Sierra occurred after Eocene time.

We know much about these Eocene rivers, because the gravel in many of these rivers contained gold, and this gold has been extensively mined. You can see some of these gold mines at Gold Run on I-80 and at the Malakoff Diggins in the northern Sierra.

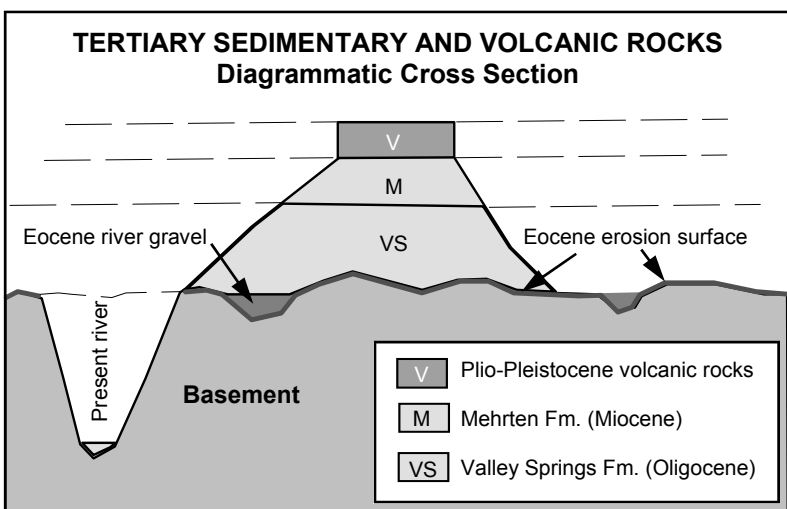
### Valley Springs Formation

During Oligocene time there was intense volcanic activity in the Sierra Nevada and surrounding areas. Although the present-day Sierra had not yet been uplifted, a number of the volcanic centers lie along what is now the crest and east slope of the Sierra Nevada. Great quantities of tuffs and lava flows were ejected from these volcanic centers. Most of these rocks were rhyolitic in composition. This volcanic material rapidly covered the Eocene river gravels and filled the Eocene river valleys. These early Tertiary rhyolitic volcanic rocks are commonly referred to as the Valley Springs Formation. There are good exposures of the Valley Springs Formation near Sugar Bowl on the west side of Donner Pass.

### Mehrten Formation

During Miocene time, volcanic material continued to be ejected from volcanic centers along the crest of the Sierra. Eventually, the central and northern Sierra Nevada was covered with a thick blanket of andesitic volcanic rocks known as the Mehrten Formation. These rocks include andesite conglomerates, welded tuffs, lava flows and lahars. While the Mehrten Formation was being deposited, new river channels were formed from time to time in the thick blanket of volcanic rocks that covered the Sierra. The positions of these channels changed often as the old channels were clogged by new volcanic rocks.

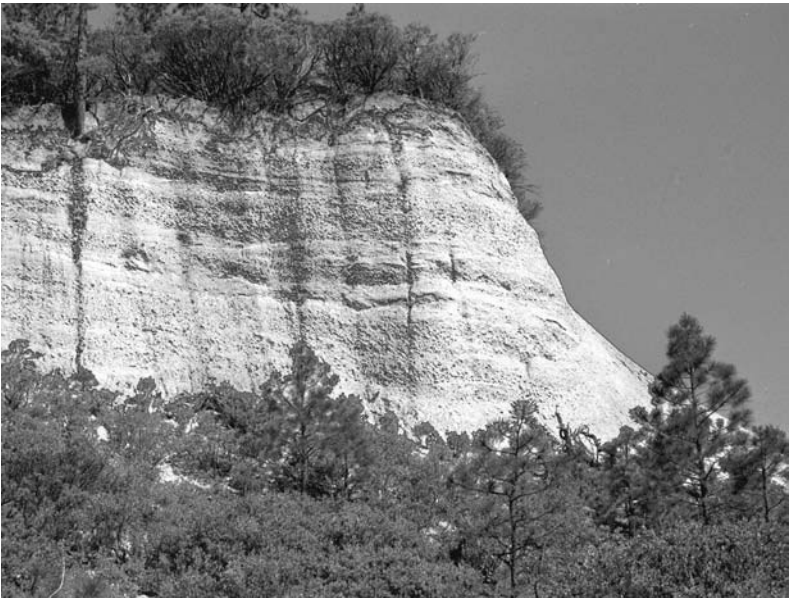
By late Miocene time, the Eocene erosion surface had been buried under a thick blanket of the sedimentary and volcanic rocks of the



Valley Springs and Mehrten Formations. When uplift of the present-day Sierra began in Pliocene time, the Tertiary rocks began to be rapidly eroded. The Tertiary rocks were soft and easily removed from the Eocene erosion surface. The Tertiary rocks that remain are mainly found along the ridges and crest of the northern Sierra, where erosion has not yet reached the soft rocks.

### **Plio-Pleistocene Volcanic Rocks**

Volcanic rocks of Plio-Pleistocene age occur in many places along the eastern slope of the Sierra Nevada from Bishop to Mono Lake, and also in the area north of Lake Tahoe. Most of these volcanic rocks occur along faults and fractures that were formed during the Plio-Pleistocene uplift of the Sierra Nevada. The crustal rocks were weak in these intensely faulted areas and magma from deep in the earth worked its way to the surface along these weak rocks. The volcanism began in late Pliocene time and continues to the present day. The volcanic rocks erupted from volcanoes, domes, and fissures, and include basalt, rhyolite, obsidian, pumice, tuff, and ash. There are excellent exposures of these rocks in the Mammoth and Mono Lake areas.



This cliff at the Malakoff Diggins is formed from Eocene river gravel that was deposited in a channel of the Eocene Yuba River. The cliff has been exposed by hydraulic mining for the gold in gravel. Note the layers of coarse river gravel exposed in the cliff.