Malakoff Diggins State Historic Park

The Ancient Sierra Nevada

Between 65 and 34 million years ago, the ancestral Yuba River flowed down a much different course than today. The ancient river course has been inferred using remnant gravel deposits. The ancestral Yuba River was much larger than today, with a broad floodplain and thick gravel deposits between undulating hills. The river's grade was gentler than at present (up to 17 feet drop per mile, compared to today's average grades of up to 150 feet drop per mile). The white gold-bearing (auriferous) gravels in the lower half of the bluff were deposited during this time.

Features:
Archeology and paleo-geomorphology of paleo-placer gold, and auriferous gravels

Processes:
Erosion, deposition, tectonics

A Temperate Time

Besides gold, the auriferous gravels also contain an extensive array of plant and vertebrate fossils. Plant fossils indicate that during the time when the auriferous gravels were being deposited, the climate was mild—temperate to subtropical. The mean annual temperature was probably between 10 and 15 degrees Fahrenheit warmer than at present. Animal fossils include ancestors of the horse and camel, and turtles.

The Landscape Turned Upside-Down

Thirty-four million years ago marked the onset of volcanic activity in western Nevada. Volcanic eruptions associated with crustal extension in the Basin and Range geomorphic province filled the channels of the ancestral Yuba River with volcanic ash flows and lava flows. The volcanic flows buried and preserved the gravels by forming an erosion-resistant volcanic layer.

The brown or tan colored gravels in the upper half of the bluffs at Malakoff were deposited shortly before and during this period. The brown color comes from the volcanic rocks and detritus contained within these gravels.

The filling of the river valleys with volcanic mud flows diverted the streams, which began cutting new channels. As the Sierra Nevada once again began to rise, these new river channels were incised and the ancestral channels became perched on ridge tops, a characteristic known as inverted topography, i.e. the ancient valley bottoms are now the ridge tops.

Origin of the Gold

Gold-bearing rocks were first formed around hydrothermal vents on the sea floor at oceanic volcanic ridges. These deep-ocean gold-bearing crustal rocks were incorporated (accreted) onto the North American continent by plate tectonics. The

Why it's important: From a geologic perspective, the ancient river gravels are important in that they provide insight into the timing of the geologic events that gave rise to the current Sierra Nevada. From the human perspective, the gold in the gravels was a source of vast wealth that drove the development of early California.

What you can see: Near-vertical cliffs created by hydraulic mining of two different generations of ancestral Yuba River gravels demarcated by their white and brown colors, plant and animal fossils, differential erosion (waterfall), ground sluices, and a mine drain tunnel.

accreted ocean floor rocks were later intruded by the granitic magma (molten rock) of the Sierra Nevada. Super-heated fluids associated with the granitic intrusion dissolved, mobilized, and concentrated the gold into milky white quartz veins. The rocks containing the quartz veins and gold were weathered and eroded, liberating the gold and creating the white auriferous gravels.

Extracting the Gold from the Gravel

The hydraulic mining that created Malakoff Diggins was not the first method used to mine the auriferous gravels. Initially, the ancient gravel deposits were mined by tunneling, just like hard-rock mining. Miners soon discovered that the gold was concentrated at the bottom of the ancient river channels, just as in modern streams. They would sink a shaft until they hit the ancient bedrock that formed the bottom of the river channel and then tunnel along the channel bottom, scouring the bedrock.

Hydraulic mining was possible after a network of water diversions and ditches was constructed. Then, miners used huge water cannons called “monitors” to wash whole hillsides down into sluice boxes where the gold was recovered. The sluice boxes were embedded at the lowest level of the hydraulic pit, thus the name “ground sluice.”

As hydraulic mining progressed, the workings became a pit. Managing the sediment and water became a messy problem as the pit filled with water and mud. This problem was solved by excavating a drain tunnel through the bedrock below the gravels, and draining the pit to Humbug Creek at a lower elevation.

Drain tunnels were used at all the hydraulic mines not just at Malakoff. These mines dumped several cubic miles of sediment and debris into the Yuba and other rivers, aggrading (filling up) the channels and causing widespread flooding in the Sacramento Valley. The devastation from the flooding led to the creation of California’s first environmental law, the Sawyer Decision in 1884, which prohibited discharging mine debris into streams and rivers.

Final Thoughts

The pursuit of gold stimulated technological engineering and societal advances. The legacy of mineral recovery effects lingers, and Malakoff Diggins State Historic Park serves as a protected outdoor classroom or laboratory to better understand mining effects and ecological recovery.

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