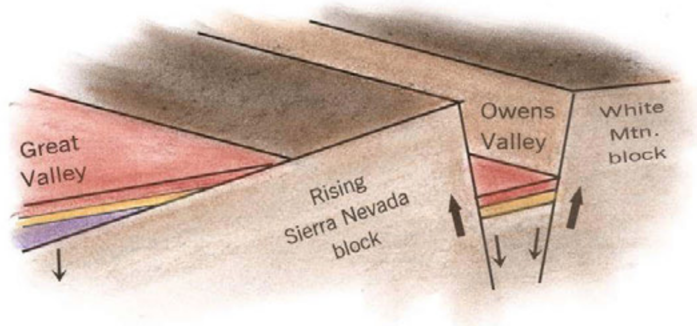
Chapter 25

The amazing Gold-Bearing Gravels of the Central Sierras

The Sierra Nevada Mountains of California represent a faulted block of mostly granite intrusions.[1] The fault lies on the east side of the block with the Owens Valley the downfaulted part of the block. The eastern Sierras are the highest mountains in the United States, outside of Alaska, and include the highest mountain, Mount Whitney. West of the Sierras, the top of the terrain gently slopes westward to the Great Valley (Figure 25.1), composed of the Sacramento Valley to the north and the San Joaquin Valley to the south.



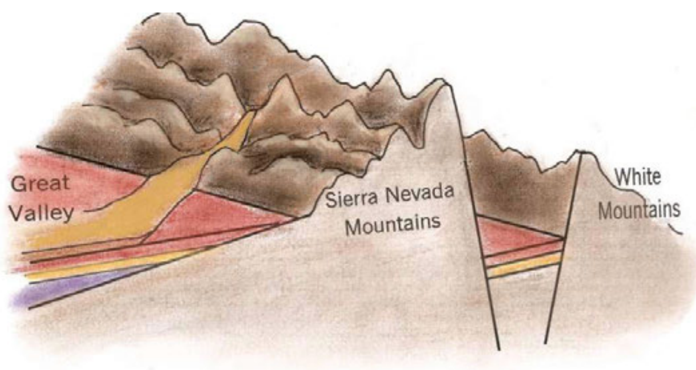


Figure 25.1. Block diagram of the uplift and tilting of the Sierra Nevada without the channelized dissection (redrawn from Unruh, 1991, p. 1,395, by Mrs. Melanie Richard).

Deep Western Valleys of the Sierra Nevada Mountains

The western slopes of the Sierra Nevada Mountains represent a planation surface, which was subsequently deeply dissected[2,3] (see Chapter 38 in volume II). The planation surface is not immediately obvious because of the erosion of the planation surface and the cutting of deep valleys. Sometimes you can see the eroded planation surface by looking at a large part of the western slope (Figure 25.2). The planation surface becomes more obvious as one drives to the foothills of the Sierras (Figure 25.3).

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1 Hill, M., 2006. *Geology of the Sierra Nevada*, revised edition, University of California Press, Los Angeles, CA.

2 Lindgren, W., 1911. The Tertiary Gravels of the Sierra Nevada of California, *U.S.G.S. Professional Paper 73*, Washington, D.C.

3 Wahrhaftig, C., 1965. Stepped topography of the southern Sierra Nevada, California. *GSA Bulletin* 76: 1,165–1,190.

Figure 25.2. Accordant summits of western Sierra Nevada Mountains at Vista Point (view west).

Figure 25.3. The dissected planation surface at about 1,800 feet (550 m) msl with an erosional remnant (arrow) from the lower foothills of the Sierras east of Sacramento.

The valleys of the western slope eroded canyons over 4,300 feet (1.3 km) deep.[4,5] The debris from all this erosion is not found in a huge alluvial fan in the western Sierra foothills, but instead appears to have almost completely disappeared:

> There is no evidence of this tremendous mass of detritus in the present [Sacramento] valley, for the bench gravels described above can account for only a small part of it. There are no debris fans in the valley corresponding to those resting in front of the desert ranges in the Great Basin, for instance.[6]

The eroded debris was either pulverized forming part of the thick sedimentary rocks of the Great Valley or it was swept off the continent into the ocean becoming part of the continental margin, or it could be both. This would be consistent with the Channelized Phase of the Flood.

After the valleys were cut by the retreating Floodwater, they filled with ice during the post-Flood rapid Ice Age.[7] The Ice Age left its mark by rounding the valleys into a U-Shape (Figure 25.4) and frequently scratching the bedrock (Figure 25.5). Yosemite Valley was deepened another 2,000 feet (600 meters), than is shown in Figure 25.4, by a long, channelized glacial erosion. During melting this overdeepened valley then filled with debris to form the flat-bottomed valley surrounded by very high cliffs.[8]

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4 Wakabayashi, J. and T.L. Sawyer, 2001. Stream incision, tectonics, uplift, and evolution of topography of the Sierra Nevada, California. *The Journal of Geology* 109:539–562.

5 Schweichert, R.A., 2009. Beheaded west-flowing drainages in the Lake Tahoe region, northern Sierra Nevada: implications for timing and rates of normal faulting, landscape evolution and mechanism of Sierran uplift. *International Geology Review* 51:997.

6 Lindgren, Ref. 2, p. 28.

7 Hill, Ref. 1, pp. 289–319.

8 Glazner, A.F. and G.M. Stock, 2010. *Geology Underfoot in Yosemite National Park*, Mountain Press Publishing Company, Missoula, MT, p.

Figure 25.4. U-shaped Upper Yosemite Valley, Yosemite National Park, California, from Glacier View with Half Dome on the right (view east).

Figure 25.5. Striated and polished pavement on Pothole Dome, Yosemite National Park.

Figure 25.6. Gravel layer in the western Sierras along I-80 east of Sacramento, California.

Figure 25.7. A large rounded rock within the auriferous gravel.

The Valleys North of Yosemite Partly Filled with Auriferous Gravel

The valleys north of Yosemite National Park and east of the Sacramento Valley are partly filled with coarse gravel (figure 25.6) that is well-rounded and large (Figure 25.7). Frequent basaltic lava flows flowed from the volcanic provinces that lie east and filled up the valleys, sometimes preserving the gravel. Later, in the broader river valleys, the basalt and gravel were partly eroded leaving a linear pattern of erosional remnants containing both gravel and basalt. In some locations, the gravel is still relatively thick and stands over 1,000 feet (300 m) above the rivers and has been extensively mined (Figure 25.8). The gravel is dated by uniformitarian scientists as Eocene which is early Cenozoic.

It is in the lower portions of this gravel that placer gold was discovered and extensively mined during the California Gold Rush of 1848 to 1855. The origin of the gold was from veins within a 190 mile (300 km) long belt of metamorphic rocks in the western

Figure 25.8. Malakoff Diggins open-pit mine in the auriferous gravel.

Sierra Nevada foothills.[9] The gold was then transported west during the erosion of the valleys and deposited with the gravel as a placer deposit. Because the gravels contain gold, they are called auriferous gravel.

Possible Channelized Flow from Nevada

Some geologists are coming to the conclusion the valleys of the western Sierra Mountains were not carved by normal streams flowing from the crest of the eastern Sierras. Instead, the valleys are believed to have once stretched much farther east and that the gravels came from western Nevada when it had a relatively high altitude, *before* the Sierra uplift.[10,11,12] Waldemar Lindgren noted back in 1911 that the auriferous gravel and their valleys extended eastward all the way to the crest of the mountains,[13] suggesting that the valleys must have once continued into Nevada. And along the crest, there are numerous wind gaps (major passes) where streams are believed to have once flowed but must have been later beheaded by Sierra uplift[12] (see Volume III for more information on wind

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9 Snow, C.A., D.K. Bird, J. Metcalf, and M. McWilliams, 2008. Chronology of gold mineralization in the Sierra Nevada foothills from 40Ar/39Ar dating of Mariposite. *International Geology Review* 50:503–518.

10 Henry, C.D., 2009. Uplift of the Sierra Nevada, California. *Geology* 37(6):575–576.

11 Henry, C.D., 2008. Ash-flow tuffs and paleovalleys in northeastern Nevada: implications for Eocene paleogeography and extension in the Sevier hinterland, northern Grand Basin. *Geosphere* 4(1):1–35.

12 Schweichert, R.A., 2009. Beheaded west-flowing drainages in the Lake Tahoe region, northern Sierra Nevada: implications for timing and rates of normal faulting, landscape evolution and mechanism of Sierran uplift. *International Geology Review* 51:994–1,033.

13 Lindgren, Ref. 2, p. 42.

gaps). Rocks from Nevada would then have flowed west in these ancient channels. A certain volcanic rock provides evidence of its origin in Nevada.[10,14]

Gravel Laid Down in Torrential Flows

Considering the size of the boulders in the auriferous gravels, it took much energy to transport them. Some boulders were several feet (about one m) in diameter and well rounded.[15] Lindgren states: "…the coarseness [up to boulder sizes] of the deep gravels and the deep narrows that occur here and there clearly point to streams of considerable power of transportation."[16] Lindgren also thought it strange the gold was deposited in the middle of the wide valley flood plain: "It must be remembered that under ordinary conditions it is not possible for grains of gold of even moderate coarseness to be carried out into the middle of broad flood plains."[16]

While examining the auriferous gravels, creation geologist Tom Ballard from Sacramento and I found large quartzite rocks with percussion marks (Figure 25.9). The quartzites probably came from local quartzite beds or they could have been transported from

Figure 25.9. Percussion marks on quartzite within the auriferous gravel.

[14] Cassel, E.J., A.T. Calvert, and S.A., Graham, 2009. Age, geochemical composition, and distribution of Oligocene ignimbrites in the northern Sierra Nevada, California: implications for landscape morphology, elevation, and drainage divide geography of the Nevadoplano. *International Geology Review* 51:723–742.

[15] Lindgren, Ref. 2, p. 29.

[16] Lindgren, Ref. 2, p. 45.

the mountains of Nevada, where bedded quartzite is generally abundant. Percussion marks are evidence of extreme turbulence in flowing water—in water that flows much faster than rivers or even flash floods run today. Even secular geologists admit:

> The scars [percussion marks] are evidence of ferocious pounding against other boulders as it [a large quartzite boulder in the northwest Teton Mountains] was carried along by a swift, powerful river…[17]

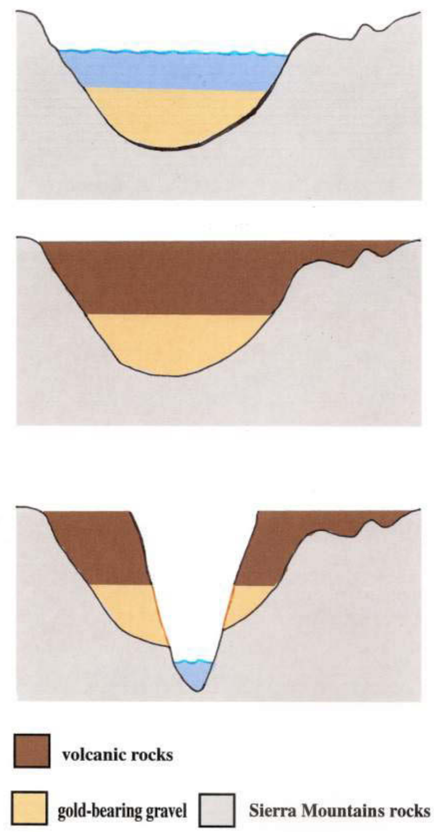

Figure 25.10. Schematic of the deposition of auriferous gravel and basalt lava during channelized Flood runoff (drawn by Mrs. Melanie Richard).

Powerful Late Flood Channelized Currents Explain the Geomorphology

Based on the data, it is highly probable the valleys of the western Sierras were carved out by channelized Floodwater flowing from Nevada. The valleys were deeply carved. The torrential flow deposited cobbles and boulders thickly in places. The rocks included certain volcanic rocks and possibly quartzite from Nevada. The percussion marks on the quartzites indicate the water flowed at a tremendous velocity from or through the Sierras, much stronger than ever observed today. During the Channelized Phase of the Flood, basalt filled up the valleys and both basalt and gravel were then mostly re-eroded.

Then the Sierra Nevada Mountains uplifted on the east side cutting off the channelized flow from Nevada and causing a stronger flow down the western valleys of the rising Sierras. This channelized flow eroded both basalt lava and auriferous gravel, leaving the present drainage much as we see today. Post-Flood glaciation modified the valleys after the Flood. Figure 25.10 shows a schematic of late Flood events.

[17] Love, J.D., J.C. Reed, Jr., and K.L. Pierce, 2007. *Creation of the Teton Landscape: A Geological Chronicle of Jackson Hole & the Teton Range*, Grand Teton Association, Moose, WY, p. 59.