Geologic History of South Yuba River State Park

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Dark colored dike that intruded light-colored plutonic rock

All of the bedrock at South Yuba River State Park is considered by geologists to belong to the Smartville Complex, an assemblage of genetically related rocks formed late in the Jurassic period, about 160 million years ago (Day and Bickford, 2004). The oldest rocks of the Smartville Complex are volcanic, although remnants of actual volcanoes are not preserved. These rocks were subsequently intruded (invaded from below) by plutons (large bodies of buoyant molten rock). As the plutons were emplaced into the Earth's crust, the overlying (older) rocks fractured. Magma was then able to further rise, filling the fractures, and cool. Rocks formed in this way are called dikes. The plutons and dikes are also considered to be part of the Smartville Complex.

The Smartville Complex is part of a group of complexes that are now located west of what was the western North American continental margin during the Jurassic period. An important unresolved question about the Smartville Complex is whether it formed separately from North America (i.e. it is an "exotic terrane" that collided with western North America, driven by plate tectonics) or whether it formed essentially "in place" along the western continental margin. The Smartville Complex could represent a section of oceanic crust that formed at a mid-ocean ridge; this interpretation would be consistent with the "exotic terrane" explanation above. Or, the Smartville Complex could represent an extended volcanic terrane (crustal thinning with associated volcanism); this interpretation would be more consistent formation in place near western North America. Early researchers (Hamilton, 1969; Moores, 1970) favored the former explanation, however Day and Bickford (2004) recently documented evidence best explained by the latter.

The area now bounded by South Yuba River State Park was an important gold-bearing locality during the California Gold Rush in the 1850's and again in the 1930's during the Great Depression. The ore deposits are much younger than the Smartville Complex. They formed during the Cretaceous Period (120 to 100 million years ago) at the margins of granitic plutons during the emplacement of the Sierra Nevada Batholith, when gold-bearing fluids filled rock fractures and cooled to form gold-rich veins. Weathering freed gold from the veins, and erosion then transported the gold eventually to creeks, streams and the Yuba River. In the South Yuba River State Park area, the river emerged from the steep gorge upstream, and, as it slowed, it dropped much of its suspended load (including relatively heavy gold particles), forming so-called auriferous gravels. Gold deposits formed by these processes are known as placer deposits. Gold can be separated from placer deposits and concentrated using various methods, including gold panning.

Summary

The rocks exposed at South Yuba River State Park are considered by geologists to be part of the Smartville Complex and are about 160 million years old (Jurassic). The oldest Smartville Complex rocks are volcanic; plutons and associated dikes subsequently intruded them. Geologists currently believe that the Smartville Complex formed along the (Jurassic) western margin of North America, but the details of that process remain controversial and an area of active research. Gold deposits in the area formed as a result the Cretaceous (120 to 100 million years ago) emplacement of the Sierra Nevada batholith. Weathering and erosion produced placer gold deposits along the South Yuba River.

Walking Tour of SYRSP Rocks

Starting from the parking lot just north of the South Fork bridge and hiking East along the Buttermilk Bend trail, rocks belonging to the Smartville Complex can be examined. Just beyond Signposts 13 and 14, on your left (North side of the trail) is a rock grotto with a bench (Figure 1). This outcrop consists of weathered, metamorphosed (subjected to heat and pressure) granitic rocks. They are texturally similar to fresh granite, such as at Yosemite National Park, but metamorphism and weathering have given them a brownish, greenish appearance. The relatively coarse grains (easily visible with the naked eye) indicate that these rocks are plutonic (see above), having cooled slowly at considerable depth within the Earth's crust. Looking up-river from here toward Buttermilk Bend (Figure 2), notice that the rocks exposed at river elevation appear bluish compared to the brownish, greenish rocks above.

Figure 1.

Figure 2.

Continuing East along the trail, 60 ft. past the grotto, on your left (North side of the trail) is an outcrop of relatively light-colored rock with a prominent dark, vertical band (Figure 3). The lighter-colored rock unit of this outcrop appears to be more of the granitic, plutonic rock just seen at the grotto. The prominent darker-colored, vertical rock unit is not only darker-colored than the plutonic rock, it is also finer- (smaller-) grained. These observations suggest that the darker-colored rock has a different composition (more iron- and magnesium-rich) and formed in a different environment (closer to the Earth's surface where it would have cooled more rapidly) compared to the lighter-colored rock. The darker-colored rock appears to have cut through (intruded) the lighter-colored rock. Geologically, the darker-colored rock is known as a dike. The darker-colored dike must be younger than the lighter-colored host rock.

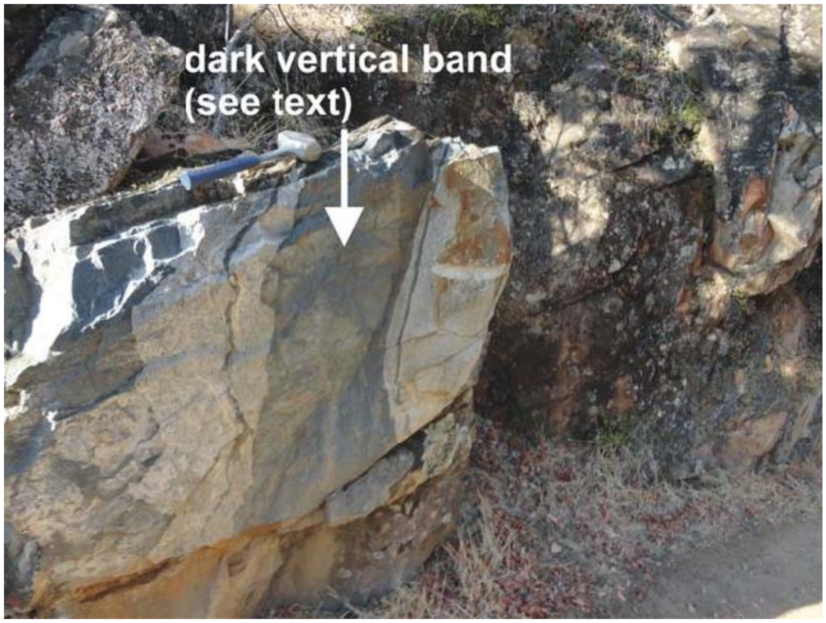

Figure 3.

A little further along the trail, 50 ft. past Signpost 16, on your left (North side of the trail) is an outcrop (Figure 4) of what appears to be the darker-colored, finer grained rock unit seen at the previous outcrop. This type of rock is known as diabase.

Figure 4.

Just before Signpost 17 is a set of rock steps leading down toward the river. Below the steps is a fairly steep dirt and rock slope to the river, which can be difficult to descend. If necessary, easier access to the river can be found further along the trail in the vicinity of Buttermilk Bend. Once at the river, the bluish rocks seen previously from the grotto can be examined in detail. Texturally, these rocks are similar to the plutonic rocks seen at the grotto (coarse-grained). The erosional power of the river has scoured and polished the rocks, giving them a smooth, bluish appearance (Figure 5). Also seen here are many intersecting whitish veins cutting through the rocks (Figure 6). A nearby dike consisting of this vein material is of Cretaceous age (Day and Bickford, 2004; sample 86-2), so these veins and the dike are likely to be associated with the Cretaceous emplacement of the Sierra Nevada Batholith.

Figure 5.

Figure 6.

References

Day, Howard W. and Bickford, M.E., 2004, Tectonic Setting of the Jurassic Smartville and Slate Creek complexes, northern Sierra Nevada, California: Geological Society of America Bulletin, v. 116, p. 1515-128.

Hamilton, W., 1969, Mesozoic California and the underflow of Pacific mantle: Geological Society of America Bulletin, v. 80, p. 2409-2430.

Moores, E.M., 1970, Ultramafics and orogeny, with models for the U.S. Cordillera and the Tethys: Nature, v.228, p. 837-842.