GEOLOGY
OF
BRUSHY PEAK

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

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The Brushy Peak area is typical of a Central California landscape with its barren hills and grassy slopes but differs in the brush and tree covered sandstone outcrops. These rocks are of Cretaceous, lower Campanian age (80 to 85 my) and represent old coarse grained flows in the channel of a mid-sea fan.

Conglomerates are present at the base of individual sand events, and the pebbles and cobbles can reach fist-size. The pebbles include quartzite, granite, andesite, multicolored chert, black chert, sandstone, volcanics, metamorphics and igneous rocks, representing a diverse source area.

The ultimate source area lay to the east. The shoreline lay in the immediate vicinity of the Sierra foothills at the time and beyond were the source areas for the mighty rivers draining into central California from Nevada and Utah.

The Brushy Peak area lies on the west flank of the Mt. Diablo antiform. Its origin is partly due to each of the three major tectonic events in this part of California. These are: the Albian thrusting (~100 my) event of the Diablo Range, the uplift due to a moderate Oligo-Miocene (20-30 my) tectonic event, and the Pleistocene to Recent uplift, leading to its ultimate exposure.

The Albian thrusting of the Diablo Range, while not directly affecting the immediate area, did create highlands to the south and to the north. The Mt Diablo slide into the deep basin at this time influenced the location of the subsea flow into the area, as did the submerged, relatively high Diablo Range. A deep trough existed to the north, east of Mt. Diablo with two major bounding normal faults on its south side. The Kellogg Creek Fault bounded the deep hole on the south with an intermediate block between it and the Brushy Creek Fault. Splays from the Brushy Creek fault cross the Brushy Peak area and these down-dropped areas focused the sand channels into the area. Southward, rocks of equivalent age are predominantly shale, deposited at the edge of the mid-sea fan.
The Cretaceous fan was uplifted during the Oligo-Miocene event and the area was eroded and stripped down to the Campanian in this area and to the Turonian immediately to the west. No Coniacian, or Santonian sediments are known south of the Brushy Creek Fault. The Briones sand of Upper Miocene age (10 to 12 my) covered the Cretaceous, preserving it for later exposure.

The Mt. Diablo antiform rose in the Pleistocene as the area was passively uplifted on a west facing thrust fault (backthrust) as a wedge of older rocks were thrust eastward at depth along the sediment-basement boundary. The backthrust in this area is located along the Greenville fault zone and is difficult to define precisely. It dies out to the south as the antiform dies out.

Two minor backtrusts to the main backthrust occur in the Brushy Peak area. The one to the west repeats the sand section. The one to the east is fairly minor but does utilize two of the older normal faults as reactivated tear faults.

Two oil wells were drilled on the Mt. Diablo antiform, the Shell Nissen #1 and the Nissen #1. Both were dry holes, drilling through a predominant shale section.

WIND CAVES

The most interesting geologic feature in the area is the large number of "wind caves" which have been utilized for thousands of years.

Wind caves are hollowed out portions of massive sandstone bodies. They usually occur on thick ledges or steeply dipping sandstone bodies. Contrary to popular belief they are not formed by the wind.

The sandstones are composed of individual grains, usually of quartz, which are weakly cemented. In many cases this cement is calcite (CaCO3) which can be readily dissolved with the addition of water and carbon dioxide from the air. H2O & CO2 combine to form the weak acid, HCO3, which dissolves the calcite cement.

When water percolates downward through the sandstone, finding its own natural path in the labyrinth or network around the grains, the cement is gradually dissolved and the individual sand grains become loose. They are no longer bound to one another and are restricted in their movement by friction of grain boundary contacts.
When the very first sand grain breaks loose from the face of the rock, the water flows out through that opening. Other loose grains tumble down, under the influence of gravity, to the opening and fall out, enlarging the hole. Over a period of time, the hole can become quite large, often big enough to stand in.

The size of the opening is determined by the amount of water flowing through the rock and by the shape of the water's pathway. No cave forms within the rock itself. It must have the opening on the face, so the grains can be permanently removed. Often the area below a cave will have a thick mantle of sand mixed in with the surface vegetation.

Small holes can be seen in some of the rock faces. Some do apparently extend downward below the surface opening. The sand grains below the opening settle and are packed differently. Eventually the opening is enlarged and these grains too will fall out. A careful investigation inside the hole will often find a loose handful of sand at the bottom. The water in the bottom of the cavity has dissolved the cement and the water has been able to seep out to the rock face, but the grains can't squeeze out.

Several holes can form adjacent to one another, usually along a faint bedding plane, and these can merge with time to become larger. Check some of the larger caves and see whether they are due to one original cavity or to the merging of several.
VIEW FROM HILL OVERLOOKING DEL VALLE

This view site on top of the ridge to the south can be reached by foot along a regional trail from the parking lot of the newly opened EPRPD Arroyo Del Valle Park. Sycamore Grove Park of the Livermore Park and Recreation Department is immediately adjacent to the north. Wente Winery with its newly finished golf course is visible immediately to the north.

The hills to the west are composed of Briones sand dipping about 25 degrees to the NNW. The hills to the east are composed of Pliocene, Pleistocene and Quaternary gravels, collectively referred to as the Livermore gravels, dipping about 5 degrees to the NE. The extensive gravel pits in the valley near Pleasanton are located in this unit.

As we look along the ridge, Pliocene gravels unconformably overlie the Briones on the eastern side of the ridge. The Briones unconformably overlies the Cretaceous to the south with a difference of 90 degrees in the strike. The Cretaceous dips 30 to 45 degrees to the NE. On the east shore of Lake Del Valle, Pliocene unconformably overlies Cretaceous units. The west shore and most of the region to the south and west is composed of Cretaceous sands and shales. Stage age dating for these units is not known.

A fault cuts through the center of the lake and one splay displaces Pliocene sediments. Far to the south, serpentine is found along the entrance road to the Park and farther south of the lake. The California Division of Water Resources has an extremely detailed map of the dam site. They map a very complex area which includes granite outcrops. Much of the area appears to be an old landslide block with numerous faults. One of the real geologic puzzles is how this area fits into the regional geology inasmuch as the surrounding geology appears to be simple structurally and stratigraphically. A problem for the future!

In the southern part of the lake, the Hetch Hetchy Aqueduct (water tunnel) crosses the area. “Granite” is mapped under the surface gravels. Also in the shaft and tunnel at this location, Franciscan is mapped as thrust over Livermore Gravels. The tunnel is now sealed with cement and can no longer be examined. Both descriptions are true anomalies!

NO EXPLANATIONS ARE OFFERED.