GEOLOGY AND SOILS OF LAS POSADAS STATE FOREST

by

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Las Posadas State Forest is located in the hills about four miles north and three miles east of St. Helena in Napa County. The area is drained by the upper tributaries of Moore Creek. This creek is a perennial stream although during the summer months the flow is small.

In the vicinity of the 4-H Club camp Moore Creek forms a distinct boundary between different geological formations. West of the Creek the entire area within the Forest is composed of Sonoma volcanics.

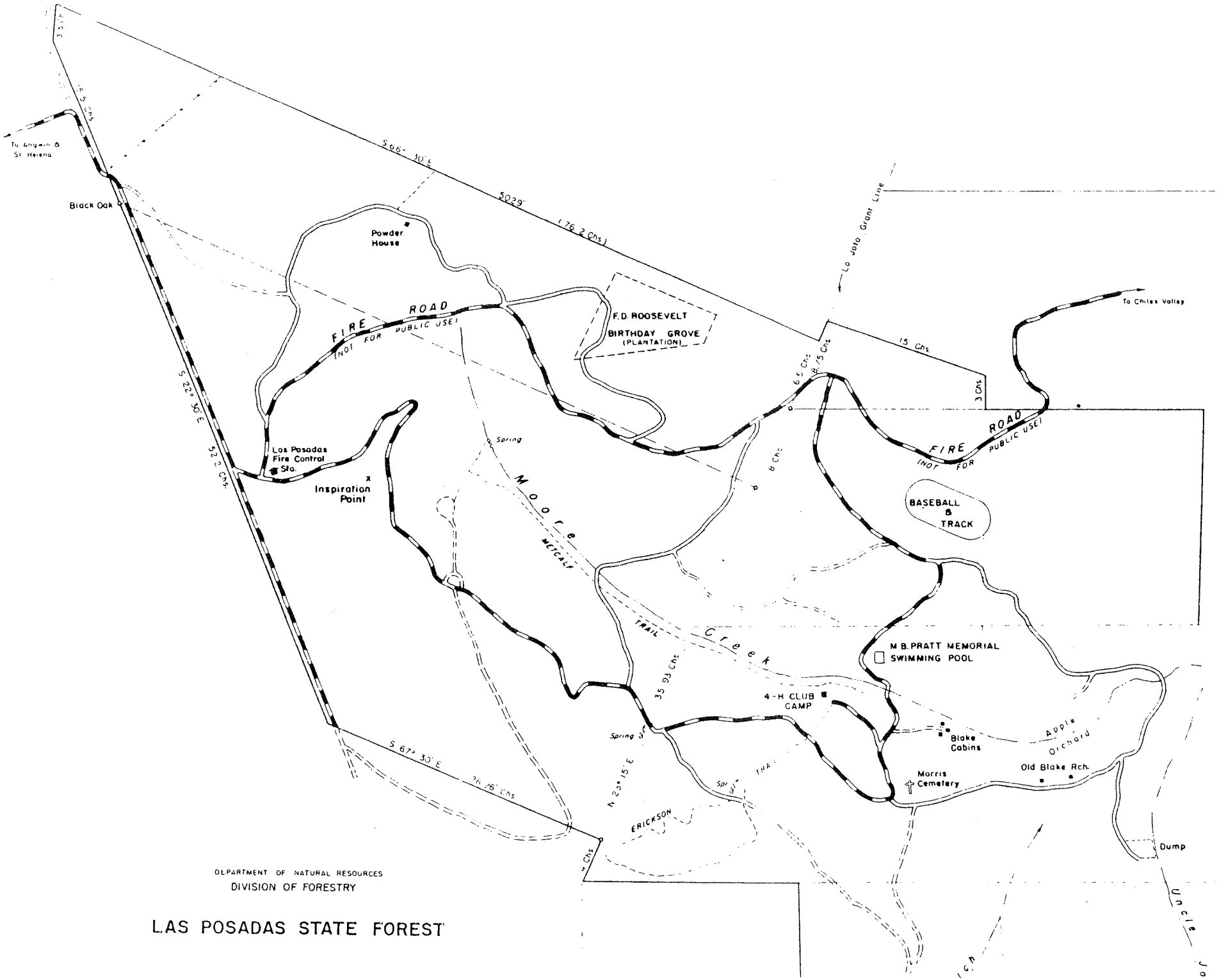
The rocks out of which Howell Mt. is carved belong to a series of volcanic flows, tuffs and interbedded sediments covering an area of about 350 square miles in the general vicinity. This series of flows, breccias and tuffs is the result of volcanic activity during the Pliocene era, some 2 to 4 million years ago. Apparently fissures and vents were opened up in the rocks which underlie these volcanics and masses of lava flowed from them quietly, something like thick molasses. Occasionally however these volcanos exploded and threw chunks of lava and pieces of the underlying rock into the air. This material, upon falling to the earth formed the tuff and breccias which as it cooled created what is now called the Sonoma volcanics. The tuffs are fine grained volcanic ash and the breccias are coarse grained rocks containing fragments of various kinds which probably were not heated to a molten stage at the time of their expulsion. The Sonoma formation contains a mixture of both the tuffs and breccias.

When this type of material is exposed to weathering in a climate such as that now found in the Posadas Forest area - that is, with a two season climate (distinctly wet and dry periods), a rainfall of 30 to 40 inches per year and moderate temperatures - the soils which are formed are known as the Butte Series. This is the soil which may be found along the road from the entrance to the Forest to the 4-H Club camp and makes up a large part of the soils found in the Forest. This is a light brownish-gray, friable stony loam, which is slightly acid in reaction (pH 5.5 to 6.0). It is a primary, or residual soil, having been formed in place through the weathering of the underlying rocks. The soil contains many angular, rock fragments which, together with the steep slopes on which it is found, make it of little agricultural value. Butte soils support a fair to heavy stand of timber consisting of fir, yellow pine, Digger pine, and oaks, as well as brush of the chaparral types. A rainfall of 40 inches a year is just about the lower limit of that necessary to produce commercial timber. A typical profile of Butte stony loam in Las Posadas Forest is as follows:

I. Soil Profile (Butte stony loam):
0 - 7" Light gray, friable, granular to gritty stony loam. (In virgin areas, such as those in the Las Posadas Forest, the surface is generally covered with a 1- or 2-inch layer of leaf mold, and forest litter, which darkens the immediate surface.) Slight acid reaction (pH 5.5 - 6.0).
7 - 20" Light brownish-gray stony loam that contains considerable partially disintegrated rock fragments. Slightly more acid at the surface; friable.
20"+ Light colored, rhyolitic tuff and breccia, often fractured to several feet.

II. Range in characteristics: Soils may vary in depth to bedrock over short distances. Steeper areas often have rock outcrop.

III. Topography: Rolling to steep.



DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FORESTRY

LAS POSADAS STATE FOREST

IV. Drainage: Surface runoff generally rapid; erosion severe on cleared areas; internal drainage moderate.

V. Vegetation: Varies from timber, in wetter and cooler areas, to chaparral in the dryer and warmer area.

In the vicinity of the camp site, on the east side of Moore Creek, there is a narrow band of sedimentary rock. This is a yellowish fine grained sandstone. This sedimentary or secondary rock is composed of material that was at one time soil but has since been subjected to pressure and probably some heating and was compressed into a hard rock. It is now exposed and again weathering into a soil. Under the climatic conditions found in the Las Posadas area, there would be formed a soil similar to that of the Hugo Series. The area of sedimentary rock in the Las Posadas is small and identification is somewhat uncertain.

Hugo soils are grayish-brown, or dull grayish-brown, with a slight yellowish cast. They are derived from the weathering in place of secondary rocks, such as sandstone or shale. These soils are slightly to moderately acid in reaction, and are found in regions of moderate to high rainfall (30 to 60 inches). A typical profile description of Hugo soil is as follows:

I. Soil profile (Hugo clay loam):
0 - 8" Grayish-brown clay loam, which is granular or softly cloddy. The reaction is slightly acid. The immediate surface is usually somewhat darker due to a thin layer of litter or humus. This surface horizon grades gradually at
8 - 26" into a lighter-colored somewhat more yellow clay loam containing a few rock fragments. This layer is usually more compact and cloddy than the surface.
26 - 40" the soil becomes still lighter-colored, and grades gradually into disintegrated sandstone bedrock.

II. Range in characteristics: In this area, the steep slopes tend to erode and keep the soil from developing a deep profile.

III. Topography: Rolling to steep.

IV. Drainage: Surface runoff is rapid; internal drainage moderate to good.

V. Vegetation: In this area, virgin soils of the Hugo series produce a fair stand of timber, including yellow pine, oaks, chaparral and grass.

On the relatively flat area, on which the running track and baseball diamond are located, the soils are heavy-textured, dark-colored, shallow, and stony. These soils are derived from the weathering in place of serpentine, or serpentinized rocks and belong in the Montara Series.

Serpentine or serpentinized rocks, as found in the Coast Range hills and mountains of California, occupy the contact zone between sedimentary rocks and basalts. They are greenish in color, and have a slick soapy feel. They are sometimes called greenstone. These rocks have been altered by the pressure and heat which changed the sediments into sandstone.

Montara soils, which are normally found in areas of 15 to 35 inches of rainfall, are slightly acid to neutral in reaction. A typical profile description of Montarasoil is as follows:

I. Soil Profile (Montara stony clay loam):
0 - 6" Dark Grayish-brown, sticky clay loam with many rock fragments, and exposed serpentine bedrock.
6 - 15" Dark Grayish-brown clay, or heavy clay loam, with many rock fragments.
15"+ Greenish, slick, unweathered or slightly weathered serpentine rock.

II. Range in characteristics: There may be considerable range in the amount of broken rock in the profile, and in many areas the soil is not as deep as described above.

III. Topography: In this forest, Montara soils are found on relatively flat but irregular areas.

IV. Drainage: In this area, surface runoff is sluggish; subsoil drainage poor. Seepage areas are found in places.

V. Vegetation: Short grass; very seldom trees or dense brush. Montara soils are usually infertile, and poorly adapted to any kind of crops.

South of the Montara soils area and southeast of the swimming pool is a rounded, grass covered, hill composed of light reddish-brown or yellowish-red soils of the Auburn Series. Underlying this soil is a basic igneous rock from which the soil is derived by weathering. This rock is part of the lava flow which was pushed up through the vents or cracks in the base material during the time that this general area was experiencing volcanic activity. These lava flows were however not thrown into the air as was the material previously referred to as forming the tuffs and breccias. The fine grained texture of these basalts is due to the rapidity with which the material cooled. The igneous rocks which cooled most rapidly formed volcanic glass or obsidian which may possibly be found in the forest area. This is the material from which the Indians who lived in this vicinity made their arrow heads.

Auburn soils are derived from the weathering in place of basic igneous rocks such as amphibolite, schists, and diabase. They are usually shallow, and frequently contain a considerable amount of rock fragments. Rock outcrop may also be frequent. This soil is associated with, and closely resembles, the soils of the Aiken series which it differs in being less red in color, shallower, and less acid in reaction. Auburn soils are found in areas where the rainfall is normally 15 to 35 inches. This soil supports a cover of grass, grass-oak, or brush. A typical description of the Auburn soil is as follows:

I. Soil Profile (Auburn stony clay loam):
0 - 7" Light reddish-brown clay loam containing rock fragments, granular structure, friable when moist, hard when dry. Slightly acid in reaction.
7 - 14" Reddish-brown clay loam, slightly compact, little change in color; more rock fragments.
14 - 17" Brown, moderately compact, clay or heavy clay loam. Sticky and plastic when wet.
17"+ Fractured and partially decomposed basic igneous, and metamorphosed basic igneous rock.

II. Range in characteristics: Rather wide variation in depth to rock; rock outcrop occurs frequently, especially in very shallow types.

III. Drainage: Surface runoff rapid; subsoil drainage usually good.

IV. Vegetation: In this Forest, the native cover ranges from grass-oak to brush and small shrubs.

In portions of the Las Posadas Forest area the soils of the Konokti series are found. These soils are derived from basic igneous rocks, such as andesites, rhyolites, and andesitic tuff. These soils are reddish-brown, and appear in roadcuts as being more pronounced brown than those of the Auburn series, and distinctly different from those of the Butte series. In this area, the Konokti soils are shallow and there are many rock fragments near the surface. There is very little difference between this soil and the shallow types of Auburn.

I. Soil Profile (Konokti stony clay loam)
0 - 5" Reddish-brown clay loam containing many rock fragments; granular structures porous and friable.
5 - 10" Slightly redder in color, but otherwise similar to the surface. There is no noticeable change in texture.
10"+ Many rock fragments, and disintegrating bedrock; porous.

II. Range in characteristics: These soils range in depth from 10 to 30 inches. The shallow types of Konokti, in this area, differ only slightly (mainly color) from the shallow types of Auburn.

III. Drainage: Good to excessive in both surface and subsoil.

IV. Vegetation: Most of the Konokti soils support a more dense growth of trees and less grass than the Auburn.

ROCKS OF THE HOWELL MT. AREA

SONOMA VOLCANICS Pliocene

This group of rocks is named from the Sonoma Mountain. These volcanic rocks are composed of a complex series of lava flows and tuff beds that are in certain areas interbedded with sandstone and conglomerate.

The lava flows make up approximately 60% of the total. These flows are largely andesitic, but are very close to basalt in composition. The lava flows show great variation in form and structure over very short distances. Changing in thickness from a few feet to several hundred, and in texture from dense and fine-grained to vesicular and agglomeratic.

The Sonoma Volcanics occupy today five separate areas that total over 350 square miles in area, but it is probable that originally they formed one continuous series of surface flows poured out onto an older eroded surface that cut the underlying folded Franciscan Group rocks.

The most common variety of andesite is a porphyry which when fresh, is a dense, massive, dark-gray to black rock with conspicuous phenocrysts of light and dark colored minerals. Often these phenocryts as set in a fine, glassy groundmass which often shows flow structure.

A dense, light brownish to reddish-gray laminated basalt is common near the middle of sequence. Between many of the lava flows are beds of tuff consisting of fine to coarse-grained brownish fragments of volcanic ash and lava. Some of the lavas show vesicular layers between the dense portions.

The St. Helena Rhyolite member of the Sonoma Volcanics occurs near the top of the sequence. These rhyolites are of three kinds:

1. The most common is a bluish-gray, coarse textured, porphyry showing well defined banding and flow structure.
2. A creamy-white, dense, vitreous rock in which the crystals are invisible to the unaided eye.
3. Pitchstone and Obsidian in flows and as pumice.

All of these volcanic rocks are involved in the folding that produced the Napa valley. Near the camp they are nearly flat lying and are resting on the upturned edges of much older rocks (Franciscan Group). Since their folding and uplift they have been deeply eroded so that only patches remain. At the camp the erosion of Moore Creek has cut through to the older bedrock.

FRANCISCAN GROUP Jurassic ?

This group is widespread throughout the Coast Ranges and is the underlying bedrock in the Howell Mt. area. The group is largely sandstone with some shale, limestone, chert, together with metamorphic rocks, such as actinolite and glaucophane schists. Contemporaneous with the sandstones and shales are volcanic rocks (basalt). There are also intrusive sills of coarse-grained, dark colored igneous rocks such as gabbro, pyroxenite, and peridotite. These dark colored rocks are often altered to serpentine and are associated with the above mentioned metamorphic rocks.

The sandstones when fresh are dark gray with a greenish tint. They are hard, dense, medium to coarse-grained which on weathering become a yellowish brown.

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The sandstones when fresh are dark gray with a greenish tint. They are hard, dense, medium to coarse-grained which on weathering become a yellowish brown.

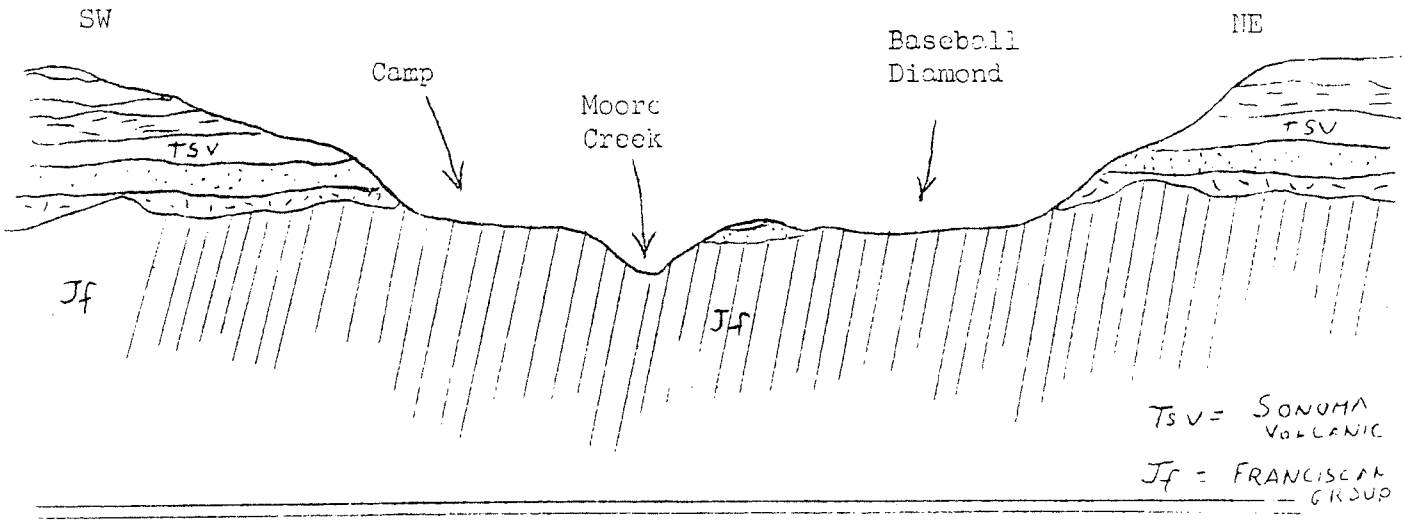
The cherts are found in small lenses or patches of closely bedded (1-4 inches) layers separated by thin partings of shale. Usually they are highly folded and are of a reddish brown, gray, white and sometimes green or black color.

When the sandstones and shales (along with the cherts) were being deposited the dark colored basalts flowed out over these deposits and hardened. Subsequently the basalt was covered by later sandstones and shales. Today these basalt inclusions often appear on hilltops because they are more resistant to erosion.

Wherever the intrusive sills of dark colored rocks such as peridotite are found intruding the sandstones and shales there is usually a large amount of metamorphism. These intrusions occured after the deposition of the sandstones and shales.

In the area of the 4-H Camp these Franciscan Group rocks are found in the bottoms of the stream valleys or in areas where the overlying volcanic rocks have been stripped off by erosion. Thus you will find the best exposures of this rock down in the creek bed. Where the lava of the Sonoma Volcanics flowed out over the eroded upturned edges of these Franciscan rocks there is a certain amount of baking that turns the older rocks a dark red and makes them much harder.

Generalized Geologic Section: Las Posadas 4-H Camp



Geologic Time Table

Era	Period	Epoch		Approx. age in Million of years
CENOZOIC	Quaternary	Recent Pleistocene		15,000 to 25,000 years only. 1-2
	Tertiary	Pliocene 10) Miocene 15) Oligocene 10) Eocene 10)	60	Sonoma Volcanics
MESOZOIC	Cretaceous		80	
	Jurassic		35	Franciscan Group
	Triassic		25	
PALEOZOIC			350	

Agglomerate (or breccia): rocks formed of cinders, bombs or blocks thrown out by volcanic explosions. Called breccia if the fragments are angular and agglomerate if somewhat rounded.

Andesite: a lava, fine grains, ranging in color from white to black in some cases dark gray to greenish gray. Is similar to Rhyolite except it contains no quartz and the feldspar is plagioclase. Flow structures are common. Named after the Andes Mts.

Basalt: a lava, fine grained, medium-gray to black and dark brown. The world's most abundant lava.

Conglomerate: Cemented gravel. Rounded stream pebbles cemented together.

Dike: a rock, usually igneous, that intrudes and cuts across other rocks. The word means "wall" and since the molten rock follows cracks in the earth's crust the gradual removal of the surrounding rocks by erosion often leaves the dike standing as a "wall"

Extrusive: Igneous or molten rocks that have been cooled at the surface of the earth.

Gabbro: a dark colored, coarse-grained rock; intrusive rock, a dark form of granit

Granite: a light-colored, coarse-grained intrusive igneous rock. "salt & pepper"

Groundmass: The body of an igneous rock into which larger crystals are imbedded.

Igneous: rocks congealed from molten material

Intrusive: Igneous rocks that have cooled below the earth's surface.

Lava: Molten rock that has cooled at the surface. Usually in flows. Often with vesicles.

Metamorphic: A class of rocks that have undergone great change due to heat or pressure or both.

Peridotite: Granular igneous rock composed almost entirely of dark colored ferro-magnesium minerals and without feldspar or quartz. If the mineral olivine is a major constituent it would be called Peridotite, if pyroxine is the major mineral it would be called Pyroxenite.

Phenocryst: The large mineral crystals imbedded in the groundmass of a Porphyry.

Porphyry: A rock with a groundmass that is finer than the phenocrysts imbedded in the groundmass.

Pitchstone - Obsidian: Volcanic glass; rapidly cooled lavas with a glassy luster and without visible grains. When the luster is less glassy and tends to be dull it is called Pitchstone.

Pumice: Obsidian froth. Light-gray to white in color and abundant tiny bubbles are characteristic. The bubbles are so numerous that pumice will float on water. Pumice is common as the fragments in Tuffs and Breccias. It also may form distinct flows, or more commonly, it caps flows of obsidian or rhyolite, and grades downward into unfrothed lava beneath.

Rhyolite: Fine-grained, light-colored lava, generally peppered with phenocrysts of quartz and feldspar (orthoclase). Generally white or light shades of yellow, brown, or red. Often flow banded.

Scoria: The dark lava (basalt) froth. Similar to pumice except for color.

Serpentine: Peridotites that contain the mineral olivine are easily altered to a mixture of greenish colored hydrous minerals (contain water). Since serpentine is composed of minerals that are secondary (altered) to the original igneous it is often classed as a metamorphic rock. Serpentine forms sills, dikes and lenses. Usually dark green to light green with greasy feel.

Sill: an igneous intrusion which slides between layers of other rocks and hardens.

Tuff: (Volcanic Tuff) is a fine-grained deposit composed of fragments of obsidian (often in the form of pumice) broken chunks of lava, ash and anything thrown out by a volcanic eruption.

Vesicular: air and gas bubbles in lava. Usually found near the top of lava flows. Coarse bubbles compared to pumice. Will not float on water.

Volcanic Ash: Dust from a volcanic eruption that settles and forms fine-grained deposits. Similar to Tuff but has not chunks of rock or pumice, all fine material.