ROAD LOG OF GEOLOGICAL SOCIETY OF NEVADA FIELD-TRIP TO STEAMBOAT SPRINGS, THE COMSTOCK LODE AND THE DAYTON IRON DEPOSIT

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Edited By

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In Part After V. P. Gianella (1956)

Note: The geological concepts and ideas in this road-log have been derived from the efforts of many geologists. In particular, the work of D. E. White in the Steamboat Springs area, of V. P. Gianella, G. A. Thompson and F. C. Calkins in the Virginia City area, and of D. I. Axelrod in the Chalk Hills area was utilized in the preparation of this road-log.

Special appreciation is also expressed to J. G. Roylance, Jr. and the Utah Construction and Mining Co. for arranging the visit to the Dayton Iron deposit.

STEAMBOAT SPRINGS

General relations: The springs emerge at northeast end of ENE-trending Steamboat Hills, up-faulted and up-warped in late Tertiary and early Quaternary time. On ridge south and west of springs, granodiorite overlain by pediment gravels, in turn overlain by late Pliocene or early Pleistocene basalt flow. A little hot spring sinter is earlier than basalt, much is early or middle Pleistocene; hot spring activity probably continuous since Sherwin glacial stage--sinter of High Terrace contemporaneous with probable Sherwin outwash.

Springs: Average discharge only about 50 gpm. Discharge at altitudes of 4667 or lower, 10' or more below crest of terrace (except for occasional geyser near crest). Deposit mud containing up to 1/3 oz. Au and 1 1/4 oz. Ag per ton, discharge up to 25 gpm; some geysers have erupted to 25'.

Total discharge of system: Natural springs, 50 gpm; erupting wells 300 gpm; subsurface escape into Steamboat Creek 350 gpm (determined by chloride in inventory). Total, 700 gpm.

Temperatures: Up to boiling in springs (94°C); t's increase with depth to about 350', 170°C. Five drill holes to greater depths and different structural circumstances encountered no significantly highers t's.

Isotopes: Stable isotopes and tritium prove water is dominantly meteoric, almost certainly no more than 5 to 10 percent volcanic.

Circulation: Meteoric water circulates to great depths (believed to be in order of 2 miles), is heated, and mixes with some volcanic steam. Mixing temp. of 700 gpm believed a little above 170°C. The hot water rises because of low density, probably with little loss of temperature until boiling occurs near surface with loss in pressure.

Heat flow: 700 gpm x 160 cal/gm (heat content above mean annual temp.) is 7 x 10° cal/sec. from 5 sq. km. of main thermal area. Equivalent to "normal" for 600 sq. km., or 120 x "normal".

Volcanic source demanded: Assuming magma will supply 175 cal/gm on crystallizing and cooling from 990°C to 500°C (heat of fusion 75 cal/gm; heat capacity 1/4 cal/gm/°C, Steamboat requires 1.3 x 10^6 met.tons magma per year; 50 km^3 or 12 mi^3 in 100,000 years.

Main Terrace. See flowing springs, fissure system. Latter are surface expression of minor faults in granitic bedrock, with total vertical displacement of bedrock surface not exceeding 50 ft. Faults and veins dip to east but may be in hanging wall of deeper west-dipping reverse fault. Open fissures have grown by acid attack and disintegration of walls of fractures, not by separation of walls.

GS-5 Typical drill hole. Drilled 575', maximum temp. 172°C. 0-84', sinter; 84-135', altered sand and gravel cemented by chalcedony and adularia; 135-154', altered Kate Peak lava; 154 to bottom, altered granodiorite except for dikes 465-546' and numerous quartz-chalcedony-calcite veins.

Stop: Silica Pit. Spectacular alteration of basalt flow, pre-basalt gravels, and granodiorite to white rocks of very similar appearance and chemical composition. Acid-sulfate alteration caused by oxidation of H_2S rising above water table, which is here about 110' below surface.

COMSTOCK-SILVER CITY EXCURSION

Mileage 0.0. Junction of Highway 395 and State Highway 17.

1.1/1.1--To the left 1/2 mile a rhyolitic dome can be seen rising above the alluvial fan.

0.9/2.0--To the left at the foot of the mountains, is a small area of granodiorite (Cretaceous) covered by a growth of Pinyon pine. Many spheroidally-weathered boulders differentiate the granodiorite from the overlying Alta Formation (Miocene) and the Kate Peak Formation (Mio-Pliocene). Here the highway ascends the Geiger Grade through many curves giving good views of the Truckee Meadows and also across the valley to the Carson Range, which forms the eastern front of the Sierra Nevada. Note the deeply weathered, and multi-colored Alta andesite. The vegetation consists mostly of pinyon juniper, and sagebrush. On the altered areas, where there is no soil, Yellow Pine (Pinus jeffreyi) grows to the exclusion of most other vegetation.

1.6/3.6--Here the Kate Peak Formation is faulted down to the west against the highly altered Alta Formation.

0.7/4.3--Landslide block to left front in canyon.

0.6/4.9--Geiger Lookout. A stop will be made to view various geological features, including the alteration of the andesite.

2.3/7.2--The old Geiger Grade can be seen in the deep canyon to the right. This road was built shortly after the discovery of the Comstock Lode. The present highway was constructed during the 1930's.

0.2/7.4--The highway leaves the canyon and crosses an old erosion surface probably formed during the Pliocene. Here we have a striking contrast with the youthful topography over which we have just passed.

2.1/9.5--Summit of Geiger Grade. The drainage to the west enters Steamboat Creek flowing northward through the Truckee Meadows and joins the Truckee River before it enters the canyon through the Virginia Range. Northward, and eastward the drainage is down Long Valley Creek to enter the Truckee River Canyon.

0.8/10.3--Stop. Remnants of the old erosion surface with drainage on gentle gradients are seen. The higher hills are commonly of Kate Peak andesite intrusive into the Alta Formation. The Highway passes along one of these intrusions a short distance directly ahead. As this intrusive is passed, a view to the north (left) is down Long Valley with the Flowery Range largely Mio-Pliocene andesites, along its eastern margin. In the distance the Chalk Hills composed of light colored sedimentary rocks of the Coal Valley Formation. Numerous fossil leaves have been collected here.

To the left of the Chalk Hills is a practically level-topped plateau underlain by Lousetown basalt which which unconformably overlies rocks of the Coal Valley Formation.

1.2/11.5--Divide between Long Valley and Seven Mile Canyon which drains to the Carson River.

The Flowery Range extends northwestward and southeastward, while a ridge of Alta Andesite and intrusive Davidson granodiorite trends southward south, to McClellan Peak, overlooking Washoe Valley.

The Comstock Lode trends north-south along the eastern foot of Mount Davidson. In another mile we will come to the north end of the lode.

To the right on the hillside are several dikes of Kate Peak andesite standing conspicuously above the general surface.

The northern part of the Comstock Lode is crossed by the highway. Directly ahead is Virginia City and Mount Davidson. Many of the old mine dumps form conspicuous features of the landscape.

1.8/13.3--Virginia City. Stop at picnic spot left (South) side of road.

GEOLOGIC FORMATIONS AND HISTORY OF THE COMSTOCK LODE

The oldest rocks exposed in the region is a series of sediments over-lain by meta-volcanics. These rocks were deformed and then intruded by Mesozoic granodiorite and quartz monzonite porphyry. The older rocks are probably of Triassic age, and have a thickness of at least 2,000 feet.

A long period of erosion followed before the Lower Miocene Hartford Hill Rhyolite was laid down. The bulk of this formation consists of welded ash-flow tuffs. It is approximately 800 feet thick in the vicinity of the Comstock Lode.

Lying on the Hartford Hill Rhyolite are the andesite flows and breccias of the Alta Formation of Miocene age. About 600 feet above the base is the Sutro Member composed of andesitic tuff and tuffaceous sediments. The Alta Formation is approximately 3,600 feet thick in the Comstock district.

All of the rocks mentioned above, were tilted and gently folded, prior to the intrusion of the Davidson granodiorite and andesite porphyry dikes.

The main displacement on the Comstock fault, along which the ore bodies of the district were deposited, occurred after the intrusion of the dikes and the Davidson granodiorite. The Comstock fault has a down-throw to the east of at least 2,300 feet.

The Kate Peak Formation, a sequence of over 1,200 feet of flows and breccias of andesite to rhyodacite composition unconformably overlies the Alta Formation. Intrusive phases of the Kate Peak Formation, dikes, and plugs, cut the flows and breccias as well as the older rocks of the district. The Kate Peak Formation is Mio-Pliocene in age.

Seven miles northeast of Virginia City in the Chalk Hills, sedimentary rocks of the Coal Valley Formation overlie the volcanics of the Kate Peak Formation with local unconformity. A fossil flora indicates that the Coal Valley beds are of lower Pliocene age in the Chalk Hills area.

The Lousetown Basalt, a sequence of basalt and basaltic andesite flows overlies the Coal Valley beds in the Chalk Hills. Recent radiometric dating indicates that the basaltic flows are Pliocene in age (approximately 7 m.y. old).

The Knickerbocker Andesite is present in the vicinity of American Flat where it occurs as flows and dikes. It is younger than the Kate Peak Formation, but its age relationship to the Lousetown Basalt is uncertain.

The youngest igneous rock in the immediate vicinity of the Comstock Lode is the McClellan Peak Olivine Basalt, which is Pleistocene in age. Remnants of a flow of the McClellan Peak Olivine Basalt are found on the McClellan Peak on American Flat and in American Ravine.

PERIOD OF MINERALIZATION IN THE COMSTOCK LODE DISTRICT

The age of the main period of mineralization in the Comstock Lode district has long been a subject of speculation among geologists. Gianella (1936) has given an excellent summary of the views of the early workers in the district. The consensus of these early views was that the mineralization of the Comstock Lode and the related veins in the district occurred in relatively late geologic time and is of Pleistocene or Recent age.

The more recent work in the Comstock Lode district by Gianella (1936) and Thompson (1956) has resulted in the formulation of two distinct and opposing viewpoints on the age of the period of mineralization of the Comstock ore deposits. Gianella (1936, 1959) believes that the epithermal, precious-metal mineralization in the Comstock Lode district occurred after the intrusion of the Davidson Granodiorite and prior to the deposition of the Mio-Pliocene Kate Peak Formation. Gianella (1959) has stated: "A long period of erosion leveled the mineralized formations, and the Davidson Granodiorite rises as a monadnock above the erosion surface. The Kate Peak Formation lies upon that surface. It contains no quartz veins.

The ores were introduced after emplacement of the Davidson Granodiorite and before the deposition of the Kate Peak volcanic rocks. The mineralization occurred in Miocene time, probably Middle Miocene."

Thompson (1956) believes that the ore deposits of the Comstock Lode district are as young as the Kate Peak Formation, but are probably older than the Truckee (Coal Valley) Formation. Thompson states: "Quartz veins of the Comstock Lode cut dikes and other intrusions of biotite andesite porphyry that is regarded by the present writer as part of the Kate Peak Formation. The Kate Peak volcanics have been intensively altered over large areas, but the Truckee Formation and younger rocks have been altered hardly at all, except locally at Steamboat Springs, where the process of alteration is still going on. It seems possible that mineralization may have started as early as Oligocene and extended through the Miocene. Hot water, hydrogen sulfide, and carbon dioxide that were present in the Comstock mines might be regarded as an indication that processes associated with deposition of the Comstock ore did not stop in middle Tertiary time. The most productive deposits may have formed in the older Tertiary rocks for reasons of depth, temperature and pressure; or possibly because of the greater length of time these older rocks were subject to the process of mineralization."

Recently, radiometric methods employing the K-Ar technique were utilized to date the basal portion of the Kate Peak Formation, and adularia associated with the vein mineralization of the Occidental Lode in the Comstock Lode district. Two separate determinations on the adularia from the Occidental Lode gave ages of 11.6 ± 1.3 million years and 12.2 ± 0.6 million years. The radiometric age of the basal Kate Peak is 12.9 ± 0.8 million years. These results indicate that at least a portion of the vein mineralization in the Comstock Lode district occurred within the period of deposition of the Kate Peak Formation.

1.0/14.3--Junction Highway 17 with road to Gold Hill. Turn left.

Large Glory Hole on right at the base of Mount Davidson. In this excavation a large tonnage of ore was removed from the Comstock Lode. During this operation old mine workings were cut into, and, in places, the footwall of the lode was exposed. We continue on Highway 17 toward Silver City.

1.4/15.7--Turnoff to the Forman Shaft. Turn right.

0.6/16.3--Forman Shaft.

From this vantage point an exceptionally good view is had. Practically all of the major formations in the district can be seen as well as the Sierra Nevada to the south.

Return to Highway 17. Turn left.

0.7/17.0--Back to Junction with Highway 17. Turn left.

2.0/18.3--Junction of Highways 17 and 80 (Gold Hill road). Turn left on Highway 80. Go slowly, steep grade at Greiners bend.

1.1/19.4--Gold Hill Hotel, Yellow Jacket Mine on right.

0.8/20.2--New York Shaft on left. This mine is developed on the Silver City Fault.

0.3/20.5--Donovan's Pit (old Hartford Hill Mine) on Silver City fault. Metavolcanics overlain by Hartford Hill Rhyolite are in the foot wall of the fault. Alta Andesite forms the hanging wall across the road (E).

0.2/20.7--Slickensides on the Silver City fault in the pit to the right (W). The narrow portion of the canyon ahead is Devil's Gate. The rock on each side of the road is Hartford Hill Rhyolite.

1.0/21.7--Enter Silver City.

0.6/22.3--Highway 17 joins Highway 80 from left.

2.4/24.7--Workings to right in middle distance are at Mound House. The mine workings are in a diapiric intrusion of Triassic(?) gypsum.

0.6/25.3--Junction with U. S. Highway 50. Turn left.

0.9/26.4--Gravel piles to left front in middle distance are from placer workings in Gold Canyon.

3.0/29.4--Dayton. Dredge piles can be seen behind the town to the left.

2.0/31.4--Sutro. Entrance to Sutro tunnel to left.

4.2/37.6--Fort Churchill road to right. Workings on dome of pumiceous rhyolite to left front.

5.9/41.5--Black Hawk - Dayton iron property of Utah Construction Co. Turn left.

2.4/43.9--Dayton iron mine. A talk will be given here on the geology of the deposit.

2.4/46.3--Return to Highway 50. Turn right.

12.0/58.3--Dayton

4.0/62.3--Virginia City turn off. Turn right.

3.0/65.3--Highway 17. Turn right.

0.3/65.6--Exposures of Sutro tuff on right side of road.

3.0/68.6--Stop. Occidental Mine. A talk will be given on the age relations of mineralization here.

2.3/70.9--Virginia, City, Fourth Ward School.

END OF TRIP