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Item 12

MACKAY SCHOOL OF MINES

HIGH SCHOOL TRIP TO ANACONDA OPERATIONS, YERINGTON, NEV.

Following is a brief summary of what you will see on this trip.

GEOLOGY

On the trip to Yerington, you will see a variety of geologic formations and types of rocks. These will include metamorphic, igneous and sedimentary rocks ranging in age from over 200 million years to quite recent rocks.

The older rocks include sediments deposited in a shallow ocean that extended over most of western Nevada 150 to 200 million years ago. The younger rocks are predominantly of igneous origin and include several kinds of volcanic rocks.

Examples of various ages and types of rocks will be pointed out to you on the bus trip. (See road log at back).

MINING

The deposit is mined by open-pit methods, using electric shovels and truck haulage. Twenty-five foot benches are used, and the pit will have a final slope of 1 to 1. The over-all waste-ore ratio was about 1.7:1.

Vertical, 7 3/8-inch holes are drilled to 3 to 5 feet below the next bench level. The holes are loaded with an ammonium nitrate-diesel oil mixture at the rate of one pound of ANFO per five tons of rock to be broken. An average blast consists of three rows of ten holes spaced on 20- to 22-foot centers, the outer row set back 25 feet from the toe of the bench, with the rows 25 feet apart.

Five 6-yard shovels load into 35- and 40-ton trucks, some 12 trucks being used to keep each shovel busy. The average haul to the primary crusher is over 1 1/2 miles of roads having a maximum grade of 8 percent. Waste containing less than 0.1% copper is hauled to waste dumps; oxide ore containing 0.1 to 0.25% copper is segregated in separate dumps from which the copper will be later leached. The oxide ore averages about 0.7% copper. At present 25,000 tons of ore and 40,000 tons of waste are mined daily.

Two types of copper ore are mined: (1) carbonate copper, (2) sulfide copper. The carbonate copper mineral is predominantly chalcopyrite $CuFeS_2$, a brassy-colored mineral. Malachite is soluble in dilute sulfuric acid, while chalcopyrite is not soluble in dilute sulfuric acid. Therefore, these two deposits

the carbonate near the surface of the ore deposit, and the sulfide deeper down, have to be mined, crushed and stored separately, and treated by totally different processes, as described under "Metallurgy".

METALLURGY

Two distinct and different processes are used in the treatment of the two ores -- carbonate copper ore is treated chemically to produce "cement" copper (finely divided copper metal), while the sulfide ore is treated by the flotation process, involving surface chemistry to produce a copper sulfide concentrate for shipment to a smelter. These two processes are described briefly below:

(a) Leaching of copper carbonate ore consists of dissolving the malachite with dilute sulfuric acid, separation of the solution from the waste rock, and precipitation of the copper from this solution by contacting it with scrap iron. Iron displaces copper from this solution, the copper settling out as finely-divided copper metal, called cement copper, while the iron goes into solution.

Leaching is done in a number of large concrete tanks, or vats, each tank holding about 11,000 dry tons of ore. These tanks are 120 x 135 x 20 feet in size. The ore is crushed so that it is all less than 3/8" in size before being placed in these tanks. It remains in the tanks for about five days, in contact with the acid solution, in order to get about 90% of the copper into solution. The tanks have filter bottoms so that the solutions may be drained out and changed.

When the strong copper solution is contacted with iron (old tin cans supply the iron) over 99% of the copper is precipitated as cement copper. The grade of cement copper will be approximately 85% copper. This is dried and shipped to the smelter at Anaconda, Montana.

(b) Concentration of the sulphide copper ore is done by what is known as the flotation process. The chalcopyrite has a natural tendency not to be wetted by water, while the waste rock is readily wetted by water. This property is enhanced by adding small amounts of chemicals, which attach to the surface of any sulfide minerals.

First, however, the ore has to be ground very fine, in big rotating ball mills so that the chalcopyrite is broken off from the waste, or gangue, materials. Then additions of small amounts of special organic reagents, as little as 1/10th of a pound per ton of ore, are added to make the chalcopyrite even more water "repellant". If air is then pumped or bubbled through this mixture of ore and water, the sulfide minerals, trying to get away from the water, will attach to the air bubbles, and will rise to the top of the flotation machines as a layer of froth.

This froth is skimmed off to form a concentrate, which may be refloated to increase its grade in copper. Ths final concentrate, after dewatering and drying, will assay about 26% copper. This is shipped to the Anaconda, Montana, smelter for further processing.

SULFURIC ACID PLANT

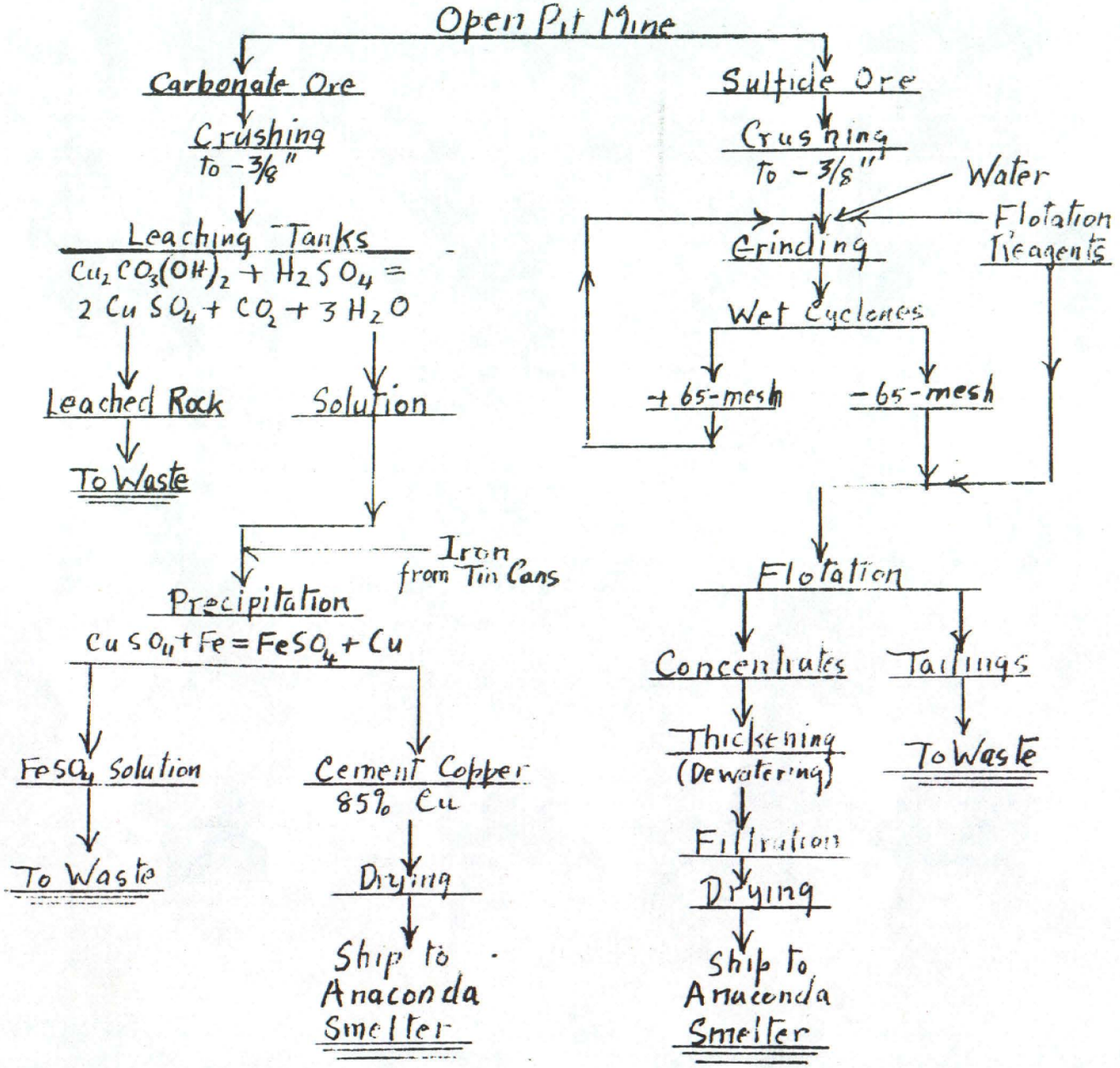
In addition to the leaching and flotation processes, the Anaconda Company at Weed Heights manufactures the sulfuric acid required for the leaching. This is done by burning sulfur ore or elemental sulfur with air in "fluosolids" roasters.

The sulfur burns to sulfur dioxide gas. Dust and solid particles are removed by electrostatic precipitation. The clean gas is then dried by contacting it with concentrated sulfuric acid, which absorbs any moisture. The sulfur dioxide in the clean, dry gas when passed through a catalytic agent, is converted to sulfur trioxide gas. When this is passed through sulfuric acid of about 98% concentration, it forms more sulfuric acid by reaction of the sulfur trioxide gas with the 2% water in the 98% acid, sufficient being taken off each day for the leaching process.

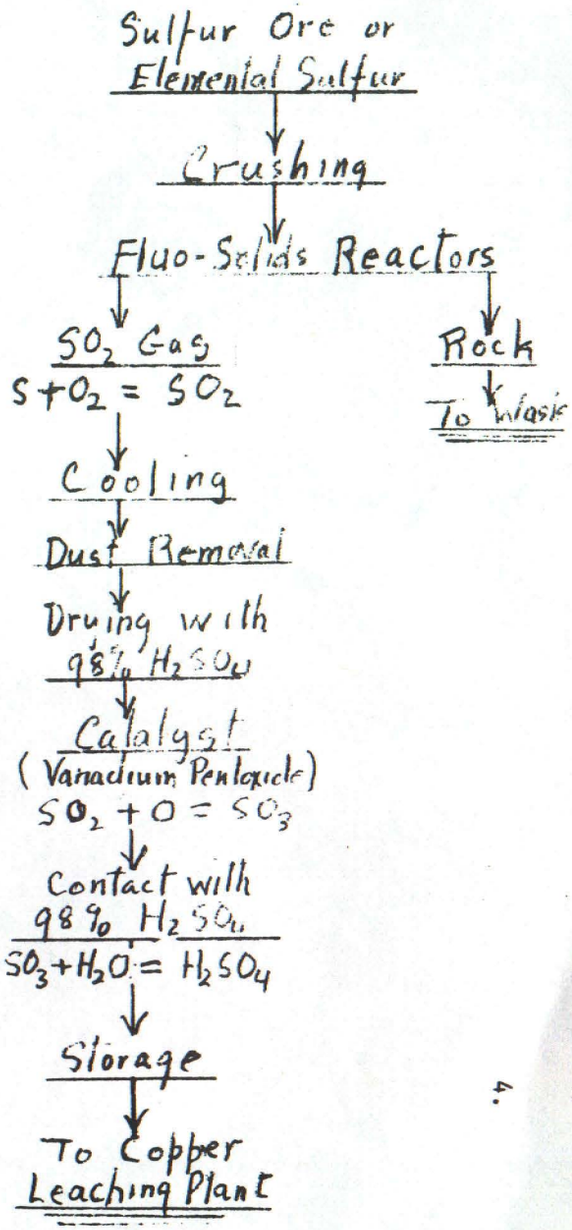
On the back is shown simple "flow sheets" of these three processes, with a few of the fundamental chemical reactions which take place.

Have a good trip and learn all you can about the mineral industry, how vitally important it is to all of us, and the many excellent opportunities for life careers in this field. Ask questions of your tour conductors.

Copper Flow Sheets



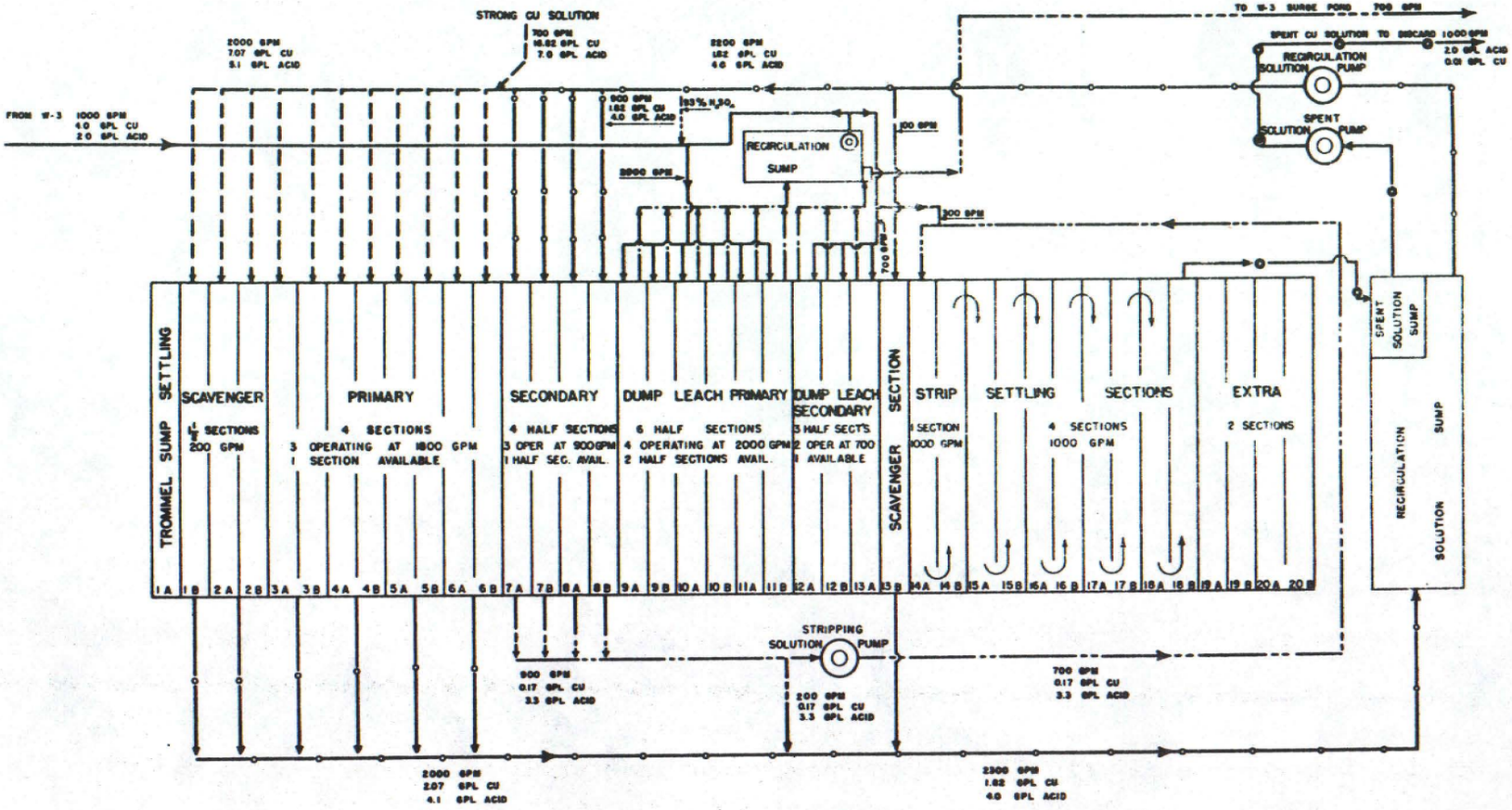
Sulfuric Acid Flow Sheet



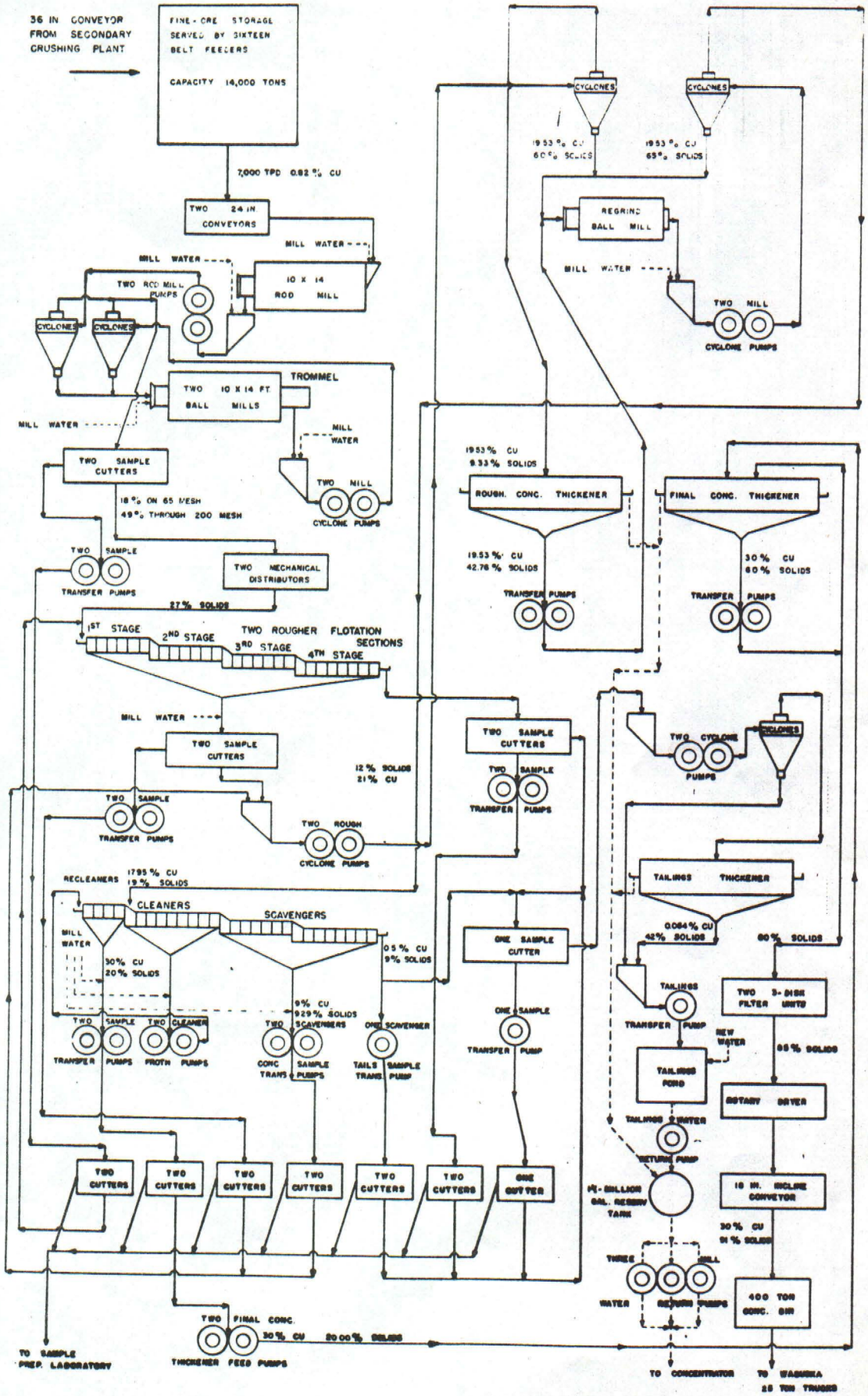
THE ANACONDA COMPANY WEED HEIGHTS, NEVADA

SOLUTION FLOWSHEET CEMENTATION LAUNDERS

AVERAGE SOLUTION ASSAY & FLOW BALANCE FOR 4,300,000 LBS. CU PRECIPITATED PER MONTH



YERINGTON 7000 TPD SULPHIDE CONCENTRATOR



ROAD LOG

Mileage		
	0.0	Junction of U. S. Highways 40 and 395 at Fourth and Virginia Streets, Reno. (Elevation 4,500 feet). Proceed east on
2.1		Fourth Street (U. S. Highway 40).
	2.1	Entering Sparks, leaving Reno.
1.9		
	4.0	Leaving Sparks, beginning of limited access Interstate 80 (U. S. 40). This is the Truckee Meadows, a low marshy area along the Truckee River; ahead is the Virginia Range.
2.3		The Truckee River existed before faulting uplifted the Virginia Range; apparently as uplifting took place the river downcut at about the same rate, and no deep lake was formed in the Truckee Meadows area.
	6.3	Entering the Truckee Canyon and Virginia Range.
		The U. S. Army Corps of Engineers has deepened the channel of the Truckee River in this area in order to lessen the backing-up of flood waters and to lower the water table in the swampy Truckee Meadows. The Truckee Canyon has been used since the days of the 49ers as one of the main routes to and from California. The first continental
3.3		railroad, the Central Pacific (now the Southern Pacific Railroad) follows the canyon.
		Triassic (?) andesite metavolcanic rocks are exposed for the next 3 miles. Farther east in the canyon a complex of Pliocene and Miocene tuffaceous and diatomaceous sediments and interbedded rhyodacitic to basaltic flows are the main types of bedrock. Locally these rocks are covered by Pleistocene lava flows and lake beds. There has been considerable controversy about the dating and correlation of the various units in this complex.
	9.6	Happy Valley exit. Abandoned tuff-stone quarry to the right on the south side of the Canyon. The tuff at one time was made into blocks for use in building construction,
1.1		but could not compete with cinder blocks.
		For the next 8 miles, Pliocene tuffaceous and diatomaceous sediments of the Truckee Formation and intertonguing dacitic and rhyodacitic flows of the Kate Peak Formation are the main rock types.
	10.7	Mustang exit. In this area Pleistocene basalt and andesite flows cover the Miocene rocks.
7.0		

AGE	UNIT	DESCRIPTION
Recent	alluvium	Stream, fan, slope wash, and lake deposits
Pleistocene	Lahontan alluvium	Lacustrine clay, silt, sand, and gravel Siltstone, sandstone, fanglomerate
--?---- Pliocene	volcanic rocks	Andesite and basalt flows, rhyolite domes and localized flows
Pliocene	Truckee & Coal Valley Formations	Diatomite, sandstone, shale, silicic tuff, basalt flows, agglomerate, and tuff
--?---- Miocene	Kate Peak Formation	Andesite to rhyodacite flows, breccias, agglomerates, and tuffs, dikes and plugs, diatomite lenses.
Miocene	Chloropagus Formation	Andesite and basalt flows, agglomerate, and breccias; interbedded tuff, sandstone, shale, and diatomite. Local propylitization
Miocene	Alta Formation	Andesite flows and breccias; lenses of tuff, shale, sandstone, and conglomerate Pervasive propylitic alteration, most intense in Virginia City area
	Hartford Hill Rhyolite Tuff	Multicolored ash-flow tuffs, in part welded. Pervasive propylitic alteration (K-Ar dates of 22-23 million years).
Jurassic Triassic	metamorphic rocks	Intertonguing metavolcanic and metasedimentary rocks andesite and rhyolite flows, rhyolite tuff and breccias, schist, slate, phyllite, hornfels, sandstone, conglomerate, limestone, and skarn.

Generalized Columnar Section for the Field Trips Area

--1000 ft.
|
|-500
|
|-0

thickness approximate only

Mileage	
17.7	At right; Sierra Pacific Power Company's Tracy power station. This steam generating plant normally uses natural gas as fuel, although fuel oil can be used if needed. The natural gas is supplied by the Southwest Gas Co., whose pipeline extends northeast into Idaho where it connects with an El Paso Natural Gas pipeline.
	Stone stripes are visible on the hills to the right and left.
1.2	At its highest level in Pleistocene time, Lake Lahontan extended up the Truckee Canyon to about this point. From this point eastward, flatlying, varved Lahontan lake sediments are exposed in road and railroad cuts and the canyon sides.
18.9	Clark Station exit. To the right, ahead; Eagle Picher's diatomite plant. Crushing, drying, grinding, calcining, and air classification sections in this plant prepare the diatomite for sale to customers in the United States and Canada. Products include absorbent, pozzuolan, and filler materials.
	For the next 8 miles Miocene (and Oligocene?) basaltic to rhyodacitic flows and interbedded tuffaceous to dia-
3.6	tomaceous sediments of the Chloropagus and Alta Formations are the predominate rock types.
22.5	The large river meander at this point was cut off by the new highway, a channel being cut between the highway and the railroad. More recently a new channel was cut elimin-
0.6	ating two railroad bridges which were trouble points during floods.
23.1	At right; Derby Dam. This small concrete and earthen structure is used to divert water from the Truckee River southeastward to Lahontan Reservoir on the Carson River. Lahontan and Derby Dams, and the connecting diversion canals, are parts of the Newlands Reclamation Project begun in 1903, the first U. S. Government project author-
2.8	ized under the Reclamation Act of 1902. In normal years, the project can provide over 90,000 acres with year-around irrigation.
25.9	High up, at right; waste dumps at the Celatom mine which supplies the diatomite processed in the Eagle Picher plant at Clark Station (see Industrial Minerals Field
2.9	Trip road log, mileage 25.3, for a description of the quarry). The white bank in the canyon wall is volcanic tuff, not the diatomite bed.

Mileage		
	28.8	A small body of quartz monzonite, intruding Mesozoic metasedimentary rocks, is exposed in the roadcut. A little tungsten (scheelite) was produced from contact deposits along the edge of the body.
3.3		At right, across valley: Lahontan-age (Pleistocene) lake sediments are exposed along the railroad and Derby Dam diversion canal above the railroad.
	32.3	Bridge over Truckee River. River flows 30 miles north-northwest into Pyramid Lake.
1.0		The roadcut ahead is in a sand dune, one of many in the surrounding area.
	33.3	Ahead, to the left: Nevada Cement Company's plant (see Industrial Minerals Field Trip roadlog, mileage 46.2, for a description of this plant).
0.3		
	33.6	Fernley exit. Turn right, through railroad underpass, to Fernley.
1.1		
	34.7	Enter Fernley (elevation 4,200 ft.). Aquafil Co. (recently acquired by Cyprus Mines Corp.) diatomite plant is located here; their main quarries are to the northeast and southeast.
0.4		
	35.1	Turn right at flashing light, onto U. S. 95. Continue south.
1.2		
	36.3	Cross diversion canal from Derby Dam to Lahontan Reservoir.
2.6		To the right, the white material is waste material from the Aquafil plant.
	38.9	At left; Nevada Cement's limestone quarry. (See description, Industrial Minerals Field Trip road log, mileage 25.3).
9.9		Rocks for the next 10 miles are mainly the same Pliocene-Miocene flows and interbedded sediments as those exposed in Truckee Canyon.
	46.6	Two miles to right; the Talapoosa mining district, which produced some $100,000 worth of gold and silver from epithermal veins in volcanic rocks.
2.2		
	48.8	Road begins descent into Carson Valley. Ahead, at left;

0.8 Lahontan Reservoir.

Mileage		
	49.6	Silver Springs (elevation 4,190 ft.). Intersection of U. S. 50 and 95; continue straight ahead on U. S. 95.
6.0		
	55.6	At right; Churchill Butte (the large mountain, not the smaller, more-butte-like hill). Mesozoic metamorphic rocks are exposed over much of the Butte; locally, Mesozoic quartz monzonite intrudes, and Tertiary basalt flows
2.4		cap, the metamorphic rocks.
	58.0	Side road to right; 1 mile to ruins of historic Ft. Churchill, established in 1860 to protect Virginia City and the surrounding area from Indian raids. Later, during the Civil War, troops were stationed here to discourage active support of the South by Confederate
0.3		sympathizers.
	58.3	Cross Southern Pacific Railroad's Mina branch line. Weeks, Nevada. Historic crossing of the Carson River used by the Pony Express and early freight and stage lines.
		For the next 10 miles our route crosses the same Pliocene-
3.1		Miocene volcanic rocks and interbedded sediments seen earlier in Truckee Canyon and between Fernley and Silver Springs.
	61.4	To right, 1/4-mile; diatomite deposit worked inter-
7.2		mittently by Aquafil Corp. (at Fernley).
	69.0	Road begins descent into the irrigated Mason Valley of the Walker River.
		Ahead to the left on the valley bottom, several hot springs. A 6- to 8-foot layer of sodium sulfate has been deposited by the hot spring waters. The American Sodium Co., using evaporating ponds, refined and shipped sodium
2.0		sulfate from here during the 1930's. Recently Magma Power Co. drilled here to test geothermal power possibil- ities, but temperatures encountered were too low to offer any potential.
	71.0	Wabuska. Railhead on the Southern Pacific Railroad Mina branch for the Weed Heights operations of the Anaconda Co. An electro-magnet crane (on the left) unloads tin cans which are hauled to Weed Heights in high-sides
8.0		trailer trucks for use in Anaconda's leaching plant.
		To the right is the Singatse Range, with the higher Pine Nut Mountains beyond.

Mileage		
	79.0	To the right, ahead; dumps, tailings ponds, and plant of Anaconda's Weed Heights operations.
2.2		
	81.2	Turn right, to Weed Heights.
1.2		
	82.4	STOP A: Weed Heights (Yerington) operations of Anaconda Company.