GL02265

GEOLOGY AND MINERAL RESOURCES

OF

TOWNSHIP 32 NORTH

RANGES 45 AND 46 EAST

MOUNT DIABLO BASE AND MERIDIAN

LANDER COUNTY, NEVADA

E of Battle Mtn + W side Argenta Rim

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Date: January, 1960

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January 26, 1960

INTRODUCTION

Township 32 North, Ranges 45 and 46 East, MDBM., is located in the northern part of Lander County, Nevada. The town of Battle Mountain is in Sections 17 and 20, Twp. 32N., Rge. 45E. U. S. Highway 40 and the westbound line of the Southern Pacific and Western Pacific railroads cross both townships in a general east-west direction. The eastbound line of these railroads crosses the north-central part of the area.

The major portion of the mapped area lies in the broad, flat intermontane basin of the Humboldt River valley. The northwestern flank of the Soshone Range is located in the eastern and southeastern part of the area and Stony Point, the southernmost extension of the Sheep Creek Range, is located in the extreme northcentral portion.

CONCLUSIONS

Twp. 32N., Rge. 45E.

Mineral Rights Only Reserved by Southern Pacific Company

Sections - 30 and 31.

Section Evaluation

Sections - 30 and 31 - Potential sand and gravel deposits.
(See Construction Materials.)

Twp. 32N., Rge. 46E.

Mineral Rights Only Reserved by Southern Pacific Company

Sections - 13 (W½), 23 and 27.

Section Evaluation

Sections - 13 (W½) and 23 - Nonmineral.

Section 27 - Potential sand and gravel deposits.
(See Construction Materials)

TOPOGRAPHY AND ACCESSIBILITY

The topography, road systems, trails, and accessibility are shown on the geologic map, No. R 4546-32, which covers this area. The regional setting may be ascertained by inspection of the U.S. Geological Survey topographic sheets of the Battle Mountain (1957) and Dunphy (1957) quadrangles, both at a scale of 1:62,500 or the Winnemucca, Nevada (NK-11-11) sheet of the Army Map Service, published in 1958 at 1:250,000.

Ready access to this area is provided by U. S. Highway 40 and other roads. However, access to the central and northern portions of the area is quite limited owing to the swampy nature of most of the Humboldt River flood plain.

MINERAL RESOURCES

Metallic Deposits

There are no known deposits of metallic minerals within the mapped area that are of economic importance. During the course of this reconnaissance no new evidence was found that would indicate any metallic deposits.

Barite

Scattered deposits of barite occur in the Slaven chert of Devonian age in Section 35, Twp. 32N., Rge. 46E., and at the Argenta mine just over the township line in Section 19, Twp. 32N., Rge. 47E. (See Spurck, 1960).

The barite is in the form of thin beds or lenses ranging from a fraction of an inch up to several feet thick and up to several hundred feet long. According to Gianella (1940, p. 3) the barite has replaced gray limestone beds in the chert and is, therefore, epignetic.

Ketner (1959), however, believes that what appears to be replacement of both the limestone and chert is essentially syngenetic and that the barite is penecontemporaneous with the Slaven chert accumulations on the sea floor. In support of this theory he (Ketner) mentioned the unusually high concentration of barium in most of the Slaven chert which has been sampled. Insufficient sampling has been done to draw any definite conclusions at this time. If Ketner's theory is correct, there may not be any structural control in connection with the genesis of the barite deposits. At the Hilltop Barium mine and Bateman Canyon mine in Twp. 30N., Rge. 46E., a few miles south, there is strong evidence in support of structural control (Oesterling, 1960a).

Barite is widely distributed in Lander County and there are many producing mines. There are no producing mines within the mapped area. For further information on Nevada barite, including history of production, uses, value of the ore, ore genesis and reserves in the Battle Mountain area, see report on Twp. 30N., Rges. 45-46E., MDBM., by Oesterling (1960a).

Prospects in the W½ of R-35-32-46. Many shallow pits and small open cuts are located in Slaven chert in the central portion of the W½ of Section 35. The chert is highly fractured and contorted, but the general strike of the beds is roughly northeast and they dip about 25-50 degrees southeast. The prospect pits and open cuts are located on both sides of a narrow canyon. Immediately above the highest workings on the north is quartzite of Ordovician age that has been thrust over the Devonian chert. The barite appears to have partially replaced thin limestone lenses and chert beds in the Devonian rocks. A small amount of dark gray to black barite is exposed in most of the pits and cuts which average about 15 by 15 feet in size. Apparently a small amount of barite has been removed but actual production statistics are unknown. No work has been done on these prospects for several years, at least. These prospects have been locally referred to as the "Nevada barite mine" by the present operators of the Shelton mine in the adjoining township, but Gianella (1940, p. 3) used the term Nevada barite mine when referring to the Argenta mine in Section 19, Twp. 32N., Rge. 47E.

These prospects do not appear to have much economic potential at the present time because there is so little barite exposed, and that is in scattered and discontinuous lenses and beds. The country rock here is much more fractured and contorted and contains fewer limestone beds than the rock at the Argenta and Shelton barite mines in Twp. 32N., Rge. 47E.

Construction Materials

Sand and Gravel

Extensive deposits of sand and gravel occur in most of the mapped area in the Humboldt River valley beneath the silty alluvium of the central valley fill. Other extensive sand and gravel deposits occur in the older alluvium and alluvial fans along the flanks of the Shoshone Range in the eastern part of the area.

This material consists of unconsolidated silt, sand, cobbles and boulders, generally poorly sorted and crudely stratified. Coarse angular to subangular clasts predominate in the alluvial fans and in the older alluvium. This coarser material is overlain by a thin veneer of silty alluvium of the central valley fill over most of the mapped area.

Most of this coarse material is composed of hard, tough, angular to subangular fragments of chert, quartzite, andesite and basalt, with minor amounts of other hard rock types. Generally, this material contains no cracks nor soft enclosed materials, nor substances such as zeolites, opaline silica, et al., which are undesirable in portland cement concrete aggregate.

Because of their ready accessibility, these deposits have been extensively utilized in the construction of the present U. S. Highway 40, Nevada State Highway 8, other roads, the mainlines of the Southern Pacific and WesternPacific railroads, and the Lander County airport. Most of these deposits are overlain by a few feet of silty alluvium so that expensive removal of overburden is not a problem. Gravel is reported to extend from a few feet below the surface to a depth of 50-60 feet (Moody, 1914) and wells in the vicinity of Battle Mountain have reported sand and gravel at depths of up to several hundred feet. A well drilled by the U. S. Geological Survey in the SE$\frac{1}{4}$ of Section 11 of the east township encountered sand and gravel from 15-125 feet (Phoenix, 1949, p. 1). Gravel pits and quarries are located in Sections 19, 26, 27, 28, 34, 35 and 36 in Twp. 32N., Rge. 45E., and in Sections 14, 15, 22, 27, 28, 31, 32 and 34 in Twp. 32N., Rge. 46E.

The projected expansion of U. S. Highway 40 from 2 to 4 lanes will undoubtedly utilize much of these deposits immediately adjacent to the highway for road fill and bituminous or concrete aggregate. Since this highway crosses the extreme northwestern corner of Section 27, Twp. 32N., Rge. 46E., a section with the mineral rights only reserved by the Southern Pacific Company, this section could supply large quantities of sand and gravel for construction purposes.

Oil and Gas

Three miles southeast of Battle Mountain in the $N\frac{1}{2}$ of Section 34, Twp. 32N., Rge. 45E., are two abandoned test holes. No logs or other subsurface information are available. J. D. Blalock drilled the #1 Voorhees in 1956 to a total depth of 4,300 feet. No oil or gas shows were found and the lowest formation encountered was Tertiary (?) (Lintz, 1957, p. 245). According to local information, this test was abandoned when the drill stem twisted off and 600 feet of drill steel was left in the hole. A new location was made a short distance away and the hole was drilled to below 3,000 feet. This play was undertaken with little or no geologic advice, and no geophysical work was performed as an aid in well site location. The sole basis for this test was an erroneous attempt to project the dip of the Shoshone Range lava mesa and the Sheep Creek Range lava mesa into an anticline over the Humboldt River valley (Roberts, 1959). While some oil and gas shows have been encountered farther east near Elko and at other scattered locations in eastern Nevada, there does not appear to be any information that would indicate any oil or gas potential for this area at present, other than the possibility of favorable structure and source beds in the lower plate (eastern assemblage limestones) of the Roberts Mountains thrust, which should occur at an unknown depth in this area. These eastern assemblage carbonate rocks crop out a few miles south in the Goat Ridge window of Twp. 29N., Rge. 45E., MDBM. (Anctil and Olcott, 1960).

Water Resources

Surface Water

The Humboldt River and Rock Creek are the only perennial streams within the mapped area. These sluggish, meandering streams, currently at grade, flow in a westerly direction across the area. The Humboldt River is an antecedent stream, transverse to structure, which has held its course from an early stage in the geomorphic cycle of this area (Ferguson, et al., 1952). The many meander scars fill a belt several miles wide. Relatively recent aggradation is indicated by wells in the vicinity of Battle Mountain reported to have reached a depth of several hundred feet in river(?) gravel and sand. Several small dams have been constructed along the Humboldt River for irrigation and stock watering purposes. The flow of Rock Creek is comparable to that of the Humboldt River.

All the other streams in this area flow only during the snowmelt season in the spring and are commonly dry during most of the year. Reese River, generally an underground stream, flows north and joins the Humboldt near the center of Twp. 32N., Rge. 45E. Reese River flows nearly 150 miles from its headwaters in the Toiyabe Range south of Austin to a point many miles south of the mapped area where it disappears into the ground and likely continues its flow as a subsurface stream. In this area it is postulated to be a perennial underground river.

Several hot springs occur along Rock Creek in the SW$\frac{1}{4}$ of Section 6, Twp. 32N., Rge. 46E. Data on the amount of flow and the quality of these springs were not available. It is believed that the source areas of these hot springs lie to the north under the lavas of the Sheep Creek Range. The springs may be related to Recent faulting evident along the west flank of this range about 5 miles northwest of the springs. The scarplet in the alluvium here strikes southeastward towards the springs area. The springs possess enough latent heat to keep this portion of Rock Creek ice-free during the winter months.

Ground Water

The existence of a large artesian basin in the NW$\frac{1}{4}$ of Twp. 32N., Rge. 45E., has been known for many years. The first artesian well in the state was drilled at Battle Mountain in the 1870's (Moody, 1914). Many artesian wells are located in and north of Battle Mountain but it was impossible to obtain much subsurface information as no logs were kept of these wells. The bedrock configurations are unknown owing to the great thickness of the central valley fill. Upper levels of sand and gravel are reported to extend from 15 feet to a depth of 125 feet (Phoenix, 1949, p. 2). Below this is an alternating series of clay and river sand and gravel to a depth of about 200 feet (Ferguson, et al., 1952). Artesian strata occur at various depths up to 800 feet (Moody, 1914).

Phoenix (1949, p. 2) gives the following information in regard to the 6-inch well drilled by the U. S. Geological Survey in the SE$\frac{1}{4}$ of Section 11 of the west township:

> "Briefly, the material encountered consisted of loamy silt from the surface to a depth of 15 feet, water-worn, stream-laid gravel from 15 to 125 feet, yellow silt and fine sand from 125 to 150 feet, uniform fine to medium sand from 150 to 171 feet, and greenish-gray clay, locally known as "blue shale" from 171 feet to the bottom of the hole at 197 feet. Material similar to this last named is believed to persist to a depth of at least 900 feet and to contain few, if any permeable gravel aquifers. The two sand and gravel strata, from 15-125 feet and from150-171 feet, constitute the most important aquifers encountered in the drilling."

The report by Phoenix (1949) includes a detailed lithologic log of the material encountered in the 6-inch, 197-foot hole (well number 32/45-11D1) as follows:

Material	Thickness (feet)	Depth (feet)
Silt, gray to dark gray	15	15
Sand, medium to medium gravel; coarse sand to coarse gravel	10	25
Sand, coarse, to medium gravel, 70 percent of sample ..	15	40
Sand, fine, to coarse gravel; coarse sand to medium gravel, 70% of sample	10	50
Sand, fine to medium; no gravel	12	62
Sand, fine, to coarse gravel; coarse sand to medium gravel, 75% of sample	10	72
Sand, fine, to coarse gravel; medium sand to coarse gravel, 70% of sample	18	90
Clay, streak, light-yellow, less than 1 foot thick at 91 feet	1	91
Sand, fine, to medium gravel; medium sand to medium gravel, 70% of sample	4	95
Sand, fine, to coarse gravel; gravel to coarse sand at least 70% of sample; light yellow clay streaks at 97 to 107 feet	22	117
Sand, fine to medium gravel; medium sand to medium gravel, 70% of sample	8	125
Silt, yellowish-gray (5Y7/2);1/ recovering poor; stratum of sandy silt from 145 to 150 feet	25	150
Sand, fine, to medium gravel; fine to medium sand, 40% of sample	10	160
Sand, fine to medium; fine sand, 60% of sample	11	171
Clay, yellowish-gray (5Y7/2, 1/ mixed with greenish-gray clay (5GY7/2) 1/ (bluish cast when wet and designated locally as the "blue shale"); noticeable hydrogen sulfide odor. Yellowish clay may be zone of oxidation on top of the greenish-gray clay	7	178
Clay, greenish-gray (5GY6/1), 1/ in thin beds (?) ½ to 1 inch thick. Sand in samples probably from sand strata above (150-171 feet). Calcium carbonate abundant in clay	12	190
Clay, greenish-gray and yellowish-gray, in compact thin beds ½ to 1 inch thick. Calcium carbonate abundant in clay	7	197
Total depth		197

1/ Color identification from Rock-color chart, Nat. Research Council, 1948.

According to Phoenix (1949, p. 6), the six-inch well was tested for eight minutes during which 252 gallons (31.5 g.p.m.) were pumped. Draw-down was 39 feet, thus giving a specific capacity of less than 1 gallon per minute per foot. Alongside the 6-inch casing, a 2-inch casing was driven to 24 feet. The 2-inch casing was perforated in the bottom 4 feet, and was tapered to a point to facilitate driving it into the ground. The water level inside the 6-inch casing stood at -6.95 feet below the reference point, while the water outside of the 6-inch casing (inside the 2-inch casing) stood at -7.30 feet below the reference point (Phoenix, 1949, p. 6).

Phoenix (1949, p. 7) gives the analyses of two water samples from the 6-inch well as follows:

"Analyses of two water samples 1/
U. S. Geological Survey test well 32/45-11D1

Analysis number	Source	Date of Collection	Temperature (°F.)	Dissolved solids	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na and K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Hardness (as $CaCO_3$)	Specific conductance ($K \times 10^6$ at 25° C.)	Percent sodium
3174	15-125 feet	6-17-49	54	578	31	77	16	108	366	111	54	0.6	0.1	0.04	245	902	48
3175	158-171 feet	6-22-49	56	320	47	36	15	46	178	49	38	0.7	0.1	0.04	152	460	40

1/ Analyses by U.S. Geological Survey, Salt Lake City Laboratory

Phoenix (1949, p. 2), concludes:

"Analyses of these samples indicate that although the water contained in the two aquifers are of different quality, both are suitable for domestic or irrigation use."

The water is usually under sufficient head to flow over the tops of the casings of the wells in the NW$\frac{1}{4}$ of the west township, and the flow from the upper artesian strata is generally sufficient for ordinary domestic purposes although for irrigation purposes it is necessary to pump water even from the deepest strata. The artesian water contains a comparatively low percentage of solids. Sulphur was reported from wells in Sections 8 and 16, Twp. 32N., Rge. 45E., at depths of 160 and 250 feet, respectively, and salt water was reported in one well west of Battle Mountain (Moody, 1914). Many wells in the vicinity of Battle Mountain supply water for local domestic needs.

Most of this water is doubtlessly derived from the Humboldt River and Rock Creek with a smaller percentage coming from the subsurface Reese River. There is a possibility that the artesian basin could be extended south of Battle Mountain for several miles. About 25 miles south, a group of Texans are drilling wells in an attempt to qualify lands in the Reese River valley for ownership under desert entry statutes. The discovery of artesian, or even sufficient irrigation water, would greatly enhance the value of all the lands in the Reese River valley. In 1914 the water table near the Reese River was only about 10 feet below the surface, although it was necessary to drill from 60-80 feet for water (Moody, 1914). The water table in the Humboldt River valley is only a few feet below the surface and in places it coincides with the surface as there are many large marshy and swampy areas in both townships. The shallowness of the water table and the recharging effect of the rivers practically assures sufficient water for local irrigation and stock-watering needs.

A well drilled in the extreme N½ of Section 27, Twp. 32N., Rge. 46E., about 1924 failed to produce sufficient water for irrigation purposes. This well was drilled to a depth of 615 feet to "bedrock" (Clark and Erskine, 1924) (see APPENDIX "A" for log).

Probably sufficient water for agricultural purposes could be developed almost anywhere within the Humboldt River valley on these two townships. For a brief discussion of water rights in Nevada see report on Twp. 30N., Rges. 45-46E. (Oesterling, 1960a).

GEOLOGIC SETTING

Various types of bedrock crop out over about 12 percent of the mapped area. The remaining 88 percent of the area is covered with surficial deposits of Quaternary age. Lower Paleozoic sedimentary rocks, Tertiary and Quaternary volcanic rocks, comprise the consolidated rock units.

Structural and stratigraphic relationships in north-central Nevada are exceedingly complex. Roberts et al. (1958) describe the regional structure and stratigraphy in detail. They state that there are three distinct sedimentary assemblages of pre-Late Mississippian age that were deposited in that portion of the Cordilleran geosyncline that extended for 335 miles west of Eureka, Nevada. These three assemblages consist of an eastern, western and transitional assemblage. The eastern miogeosynclinal assemblage consists of about 15,000 feet of predominantly limestone and dolomite, while the western eugeosynclinal assemblage consists of nearly 50,000 feet of clastic and volcanic rocks with large amounts of chert. Between these two, a third assemblage, the transitional, is locally recognized. This transitional assemblage belongs to neither the eastern nor the western types but contains elements of both. The broad geosyncline in which these three assemblages were laid down persisted until near the end of the Devonian Period, at which time the Antler orogenic belt, between the 116-118 degree meridians, was intensely folded and faulted. This orogeny culminated in the Roberts Mountains thrust fault in Late Devonian or Early Mississippian time that brought western assemblage rocks over transitional and eastern assemblage rocks. The Antler orogenic belt is approximately 80 miles wide and extends for over 150 miles north-northeast across central Nevada. Winnemucca is approximately on the western edge of the belt and a line through Mountain City, Carlin and Eureka marks the eastern edge of the folding. Subsequent to this orogeny a series of coarse clastic rocks was laid down over much of Nevada. These rocks range in age from Early Mississippian to Late Permian and are termed the overlap assemblage (Roberts, et al., 1958, p. 2820-2821, 2844-2846, 2852-2854).

Within the mapped area, only rocks of the western assemblage occur: the Valmy formation of Ordovician age and the Slaven chert of Devonian age.

Summary of Geologic History

The following tentative summary of the geologic history of north-centralNevada was compiled by W. A. Oesterling from published literature, especially Roberts (1951), Ferguson, Muller and Roberts (1951 and 1952), and Roberts Hotz, Gilluly and Ferguson (1958). The compilation is in part substantiated and augmented by the current mapping program of the mineral resources survey of the Southern Pacific Company. Episodes pertinent to the two townships of this area are indicated by an asterisk.

EPISODES			DESCRIPTION
Depositional	Tectonic	Intrusive	
Recent			Infrequent stream run-off*; stream aggradation, and accumulation of post-Lake Lahontan

EPISODES Depositional	Tectonic	Intrusive	DESCRIPTION
			alluvial fans;* Desiccation of intermontane lakes; formation of eolian deposits.
	Pleistocene (late) to Recent		Minor movements along normal faults, especially near margins of basins;* formation of scarplets in pre-Lake Lahontan alluvial deposits.
Pleistocene (late)			Abundant rainfall, active stream and sheet-wash erosion, accumulation and dissection of extensive pre-Lake Lahontan alluvial fans;* intermontane basins partly filled with water and lake sediment; Lake Lahontan reached a maximum elevation of about 4,400 feet.
Pliocene-Pleistocene			Basaltic lava flows.*
		Pliocene-Pleistocene	Dikes, largely basaltic and rhyolitic.*
	Pliocene-Pleistocene		Maximum development of basin-range block faulting along generally northerly trends;* (This episode is largely responsible for the major features of the present topography.)
Miocene-Pliocene			Extensive volcanic activity with deposition of tuff, tuffaceous sediments and intercalated lava of the Truckee and Humboldt formations; these formations probably accumulated in many separate basins developed by lava dams and faulting.
Oligocene (?)-Miocene			Lava flows, especially thick andesite.*
	Oligocene (?)		Initiation of basin-range block faulting.

-- Major erosional interval with probable intermittent uplift which prevented peneplanation; streams probably drained to the Pacific Ocean --

EPISODES Depositional	Tectonic	Intrusive	DESCRIPTION
		Cretaceous to Tertiary (early)	Emplacement of many widespread igneous intrusives of varied composition, but characterized by quartz monzonite to granodiorite; probably become progressively younger towards the east.
	Jurassic (late) to Cretaceous		Nevadan orogeny: west to east thrusts with local drag folds accompanied by regional dynamic metamorphism in region west of Winnemucca where vast areas of slate and phyllite were formed. East to west thrusts are indicated in some areas, e.g., west flanks of Sonoma and East Ranges.
Triassic to Jurassic			Two facies of marine deposits: Triassic conglomerate-carbonate sediments in the east (China Mt.-Augusta Mt. sequence of formations), and a tremendously thick section of Triassic-Jurassic argillaceous deposits west of a general north-south line through Winnemucca.
	Triassic (early)		Minor tectonic episode indicated by a slight angular unconformity between the Lower Triassic China Mountain formation and the Permian (?)-Triassic Koipato formation.
Permian (?) to Triassic			Lavas, pyroclastics and clastics of the Koipato formation.
	Permian (late)		Major orogeny: intense folding in the west and large-scale overthrusting developed during post-Havallah - pre-Koipato time; west to east thrusts carried Pumpernickel and Havallah formations into area from west of Winnemucca, and at least as far east as Shoshone Range; upper plate rocks closely folded, lower plate warped.

EPISODES Depositional	Tectonic	Intrusive	DESCRIPTION
	Pennsylvanian & Permian		Intermittent uplift and subaerial erosion indicated by disconformities between the formations of the overlap assemblage (Antler sequence of Roberts, Hotz, Gilluly and Ferguson, 1958).
Pennsylvanian & Permian			Deposition of Antler sequence of overlap assemblage within Antler orogenic belt; chert, sandstone and little lava of Havallah formation accumulated in eugeosyncline of western Nevada.
Pennsylvanian (early?)			Chert and intercalated andesite accumulated in the eugeosyncline of western Nevada to form Pumpernickel formation.
	Mississippian		Roberts Mountains overthrust culminated the Antler orogeny: chert, clastics and volcanics of western assemblage rocks were carried eastward over the transitional rocks and the carbonate and clastic sediments of the eastern assemblage.*
	Devonian (late) and Mississippian		Folding and uplift of Antler orogeny in western Nevada, warping and uplift in central Nevada.*
Cambrian, Ordovician, Silurian & Devonian			Marine deposition of eastern miogeosynclinal,* transitional and western eugeosynclinal assemblages of Roberts, Hotz, Gilluly and Ferguson (1958).

Lower Paleozoic Sedimentary Rocks

Rocks of the Western Assemblage of Roberts, et al. (1958)

Valmy Formation (Ovch, Ovssch, Ovg, Ovsg, Ovss, Ovls and Ovu on map)

Distribution. Rocks belonging to the Valmy formation crop out over large areas in the Shoshone Range in the eastern part of the mapped area.

Lithology. The Valmy formation consists largely of interbedded quartzite, chert and argillite, indurated quartzose sandstone, with a little intercalated limestone, sandstone, and siltstone. The strata strike north and northeast but dip determinations are impracticable owing to the intense deformation most of these rocks have undergone.

The quartzite is thick bedded to massive, fine to medium-grained, and ranges in color on a fresh surface from light bluish white to grayish-blue. It is normally much brecciated due to faulting and is highly resistant to weathering, forming rough, jagged topography. It generally weathers to a light grayish-brown.

The chert is thin-bedded, commonly in beds 1-4 inches thick, veriegated to black, highly contorted, and contains a few thin interbeds and partings of argillite and tan siltstone. Fresh and weathered colors are about the same. Locally, chert and tan, fine-grained sandstone occur in nearly equal proportions as alternating thin interbeds which were mapped as sandstone-chert (Ovssch on map).

The indurated quartzose sandstone is generally fine to medium-grained and ranges in color from light tan to brownish gray. It is fairly resistant to weathering and usually forms distinctive outcrops.

The sandstone is nearly always fine-grained, usually light tan, and weathers to small platy fragments. It is generally so intimately interbedded with chert that it is impractical to map it separately and, therefore, it was largely mapped as sandstone-chert (Ovssch on map). Fairly extensive exposures of sandstone-chert occur on the lower flanks of Argenta Point and in the E½ of Section 23, Twp. 32N., Rge. 46E.

A limestone bed approximately 50 feet thick was mapped on the crest of Argenta Point. This limestone is similar to the Devonian limestones in lithology. It is dark gray to black, massive to thick-bedded, dense and weathers to a dull brownish-gray.

The thickness of the Valmy formation is not known, but at least several thousand feet of strata are exposed within this area. Farther south in the Mount Lewis quadrangle and at the type locality in the N½ of the Antler Peak quadrangle to the west, the Valmy formation is much thicker ranging up to 7,000 feet or more (Roberts, et al., 1958, p. 2832).

Age and relation to other rocks. The Valmy formation is in fault contact with the Slaven chert of Devonian age. Most of these contacts are thrust faults where rocks of the Valmy formation have been thrust over Devonian rocks.

This formation was named by Roberts (1951) for a thick series of interbedded quartzite, chert, argillite, slate, and some intercalated greenstone exposed on North Peak in the N½ of the Antler Peak quadrangle about 25 miles west of the mapped area. The Valmy formation has been dated as Ordovician on the basis of contained graptolite faunas of Lower, Middle, and Upper Ordovician age collected from the northern Shoshone Range (Roberts, et al., 1958, p. 2833).

Slaven Chert (Dsch, Dsst, Dsls, and Dsu on map)

Distribution. The Slaven chert crops out over large areas in the Shoshone Range in the eastern part of the mapped area.

Lithology. This map unit consists largely of dark gray to black, thin-bedded, contorted chert with locally up to 50 percent argillite. Included in the chert are thin lenses and interbeds of dark gray to black limestone and tan to gray sericitic siltstone which weathers platy. The chert is commonly in beds 1 to 4 inches thick. In contrast to local chert in the Valmy formation, the Slaven chert is not highly colored and contains no quartzite or indurated quartzose sandstone. The fresh and weathered colors are the same. Locally, some of the limestone and chert have been partially replaced by dark gray to black barite. The thickness of the Slaven chert is unknown, but at the type locality in Slaven Canyon approximately 10 miles south of this area there are at least 4,000 feet of this unit exposed (Roberts, et al., 1958, p. 2837).

Age and relation to other rocks. Rocks of Ordovician age, the Valmy formation, have been thrust over the Slaven chert. Elsewhere the Slaven chert is in normal fault contact with the Valmy formation. In the extreme eastern part of the area the Slaven chert is unconformably overlain by Tertiary rhyolite, basalt and andesite.

The Slaven chert is a new formational name proposed by Gilluly (1959, oral communication) for a thick deposit of chert with minor amounts of limestone, shale and sandstone exposed in Slaven Canyon 10 miles south of the mapped area. This formation has been assigned to the Middle Devonian on the basis of ostracods and conodonts (Roberts, et al., 1958, p. 2837).

Tertiary Intrusive Rocks

Basalt Dikes (Tib on map)

Distribution. Thin, intrusive basalt dikes occur along north-south fractures in sedimentary rocks of Ordovician and Devonian age in the extreme southeastern part of the mapped area.

Lithology. This rock unit consists of fairly thin (up to 20-25 feet thick) dikes of dull greenish-gray to olive-gray basalt. These dikes have approximately the same composition as the contemporaneous basalt flows (Tb on map). They are composed of calcic plagioclase and pyroxene with minor amounts of apatite and magnetite. The basalt has a dense groundmass and it is rather deeply altered by weathering so that individual phenocrysts are unidentifiable.

<u>Age and relation to other rocks.</u> These basalt dikes occur along north-south fractures in Ordovician and Devonian sedimentary rocks, roughly parallel with the strike of the bedding. These dikes, together with the Older basalt flows, are probably closely related to other late Tertiary volcanic rocks in this general area of Nevada. For the purposes of this report, a tentative age of Miocene(?)-Pliocene(?) is assigned.

<u>Rhyolite Breccia</u> (Tirb on map)

<u>Distribution.</u> Intrusive rhyolite breccia crops out on the crest of a small hill on the section line between Sections 35 and 36, Twp. 32N., Rge. 46E.

<u>Lithology.</u> This rock unit consists of fine to medium-grained, light greenish-gray intrusive rhyolite breccia composed mainly of angular clasts of quartz and alkalic feldspar with minor amounts of accessory minerals. Fresh and weathered colors are the same. This rock is fairly resistant to weathering and forms a rough, jagged outcrop.

<u>Age and relation to other rocks.</u> This rhyolite breccia has intruded sedimentary rocks of Devonian age. It is probably related to other late Tertiary volcanic rocks in this general area of Nevada. For the purpose of this report, a tentative age of Miocene(?)-Pliocene(?) is assigned.

Tertiary Volcanic Rocks

Rhyolite (Tr on map)

Distribution. This map unit crops out over a small area in the NE¼ of Section 24, Twp. 32N., Rge. 46E.

Lithology. This rock unit consists of a thin (30-foot) flow of white to light yellowish-gray, very fine-grained rhyolite composed principally of quartz and alkalic feldspar. This rock is fairly hard and resistant to weathering. Fresh and weathered colors are the same. The rhyolite fractures easily into slabby or platy fragments. No flow-banding was observed, but this flow appeared to be horizontal.

Age and relation to other rocks. This rhyolite unconformably overlies sedimentary rocks of Devonian age. It is apparently conformably overlain by basalt of probable Miocene age. This rhyolite, together with the overlying basalt, is probably related to other late Tertiary volcanic rocks in this general area of Nevada. Ferguson, et al. (1952) mapped similar rhyolite flows in the Golconda quadrangle approximately 35 miles northwest of this area as Tertiary, possibly Miocene, in age. Ferguson, et al. (1951), Roberts (1951), and Muller, et al. (1951) mapped somewhat similar rhyolite flows in the Mount Moses, Antler Peak and Mount Tobin quadrangles, respectively, as Miocene(?)-Pliocene(?) in age.

Older Basalt (Tb on map)

Distribution. This map unit crops out over scattered areas in the Shoshone Range in the extreme eastern part of the mapped area.

Lithology. This rock unit consists of a series of older flows of dull greenish-gray to black basalt. It is composed of calcic plagioclase and pyroxene with lesser amounts of apatite and magnetite. These flows have approximately the same composition as the contemporaneous basalt dikes (Tib on map). The basalt has a dense groundmass and is rather deeply weathered so that the individual phenocrysts are unidentifiable. Bedding is generally obscure, but in Section 24, Twp. 32N., Rge. 46E., these flows strike north-northeast and dip 25 degrees southeast.

The thickness of these flows is unknown, but it probably does not exceed a few hundred feet.

Age and relation to other rocks. These basalt flows apparently unconformably underlie the Shoshone andesite of Miocene(?) age and unconformably overlie sedimentary rocks of Devonian age. In Section 24, Twp. 32N., Rge. 46E., Older basalt conformably overlies a 30-foot bed of white rhyolite and caps the ridge extending south and southwest.

These flows, together with the intrusive basalt dikes, are probably closely related to other late Tertiary volcanic rocks in this general area of Nevada. Muller, et al. (1951) mapped similar basalts in the Mount Tobin quadrangle, approximately 30 miles to the southwest, as Tertiary. For the purposes of this report, a tentative age of Miocene(?) is assigned on the basis of the Miocene(?) age for the overlying andesite.

Shoshone Andesite (Tsa on map)

Distribution. This map unit crops out over a small area in the extreme eastern part of the map area.

Lithology. These andesitic flows have been given the name Shoshone andesite for the purposes of this report because of the extensive exposures in the Shoshone Range a few miles east of this area. The andesite typically forms sheer cliffs.

This rock unit consists of a thick series of flows of very fine-grained to cryptocrystalline, grayish-brown to maroon andesite. It is composed mainly of sodic plagioclase with unknown amounts of one or more of the following mafic minerals: pyroxene, hornblende and biotite. Locally the rock ranges in composition from latite to trachyte, but the bulk of these flows is considered to be andesite.

The andesite is hard and dense with a fairly smooth fracture. It is highly resistant to weathering and typically weathers into small platy fragments that ring when struck with a hammer. Locally, the andesite is porphyritic and has a slightly pitted surface, probably due to the leaching of some of the more soluble constituents. Locally, it is vesicular. It weathers to a typical dull reddish-brown and in many places to slightly more vivid shades of red.

The total thickness of these andesitic flows is unknown but at least 1,600 feet are exposed along the north side of Argenta Rim a few miles east of the mapped area. It is possible that these flows have been repeated by step faults and that the normal thickness is much less than 1,600 feet.

Age and relation to other rocks. The andesite unconformably overlies Tertiary basalt and undifferentiated Devonian rocks. Farther east, outside of the mapped area, this andesite is conformably overlain by a thin vesicular basalt flow which caps Shoshone Range mesa.

The Shoshone andesite is lithologically similar to, and probably correlative with, much thinner (600 feet thick, or less) andesitic flows in the eastern part of the Sheep Creek Range, reported by Oesterling (1960b). Along Rock Creek of the Sheep Creek Range there is evidence that the andesite is of Miocene age, or slightly older (Oesterling, 1960b). Here the andesite is conformably overlain by a vitric tuff unit of the "Humboldt" formation and the tuff is nonconformably overlain by basalt of probable Pleistocene age. According to Van Houten (1956, p. 2801 and 2817), this vitric tuff unit is upper Miocene to middle Pliocene in age. Van Houten (1956, p. 2820) states:

> "Meanwhile, in early and middle Miocene time, outpouring of thick basaltic to andesitic lava flows covered vast areas of the northwestern part of the Basin-and-Range Province in Idaho and Oregon, as well as in north-central and northwestern Nevada."

On the basis of the above evidence the Shoshone andesite is thought to be of Miocene age.

Pleistocene Rocks

Basalt (Qb on map)

Distribution. Thick flows of vesicular basalt crop out in the north-central part of the mapped area at Stony Point in the southern part of the Sheep Creek Range. Similar basalt flows cap the Shoshone Range mesa in the adjoining townships to the east (Twp. 32N., Rges. 47 and 48E.).

Lithology. This rock unit consists of thick flows of black to bluish-black, vesicular basalt. It is composed mainly of calcic plagioclase and pyroxene with minor amounts of apatite and probably magnetite. The basalt is generally vesicular or scoriaceous, but is locally dense. Locally, crude columnar jointing was observed.

Generally, the basalt weathers to a dull black or grayish-black color. Locally, however, it weathers to a dull reddish-brown, especially the vesicular varieties, owing to a possible excess of included iron constituents. The basalt is quite resistant to weathering and the older alluvium surrounding the flanks of Stony Point is mainly composed of cobbles and boulders of basalt.

Age and relation to other rocks. These basalt flows unconformably overlie the Miocene(?) Shoshone andesite in the townships to the east (Twp. 32N., Rges. 47 and 48E.). Tuff of the "Humboldt" formation has been removed by erosion prior to the extrusion of the basalt. In the northern part of Section 6, Twp. 32N., Rge. 46E., the basalt unconformably overlies chert of the Ordovician Valmy formation. The basalt is unconformably overlain by older alluvium and recent surficial deposits.

This basalt is probably related to other Pleistocene volcanic rocks in this general area of Nevada. Ferguson, et al. (1952), Muller, et al. (1951), and Roberts (1951) mapped similar basalts in the Golconda, Mount Tobin and Antler Peak quadrangles west and southwest of this area as Plio-Pleistocene in age. Ferguson, et al. (1951b) states:

> ".... basalt is the youngest volcanic rock and appears to have been erupted through a considerable interval, possibly beginning in the late Tertiary and continuing to the late Pleistocene."

Thus, these basalt flows may represent several episodes of eruption. Along the west side of the Sheep Creek Range, north of the Izenhood Ranch in Twp. 35N., Rge. 45E., similar basalt was considered by Ferguson to be "possibly Pleistocene in age" (Fries, 1942, p. 285). Along Rock Creek of the Sheep Creek Range similar basalt, which caps the mesa, is separated from underlying tuff of late Miocene to early Pliocene(?) age by an angular unconformity (Oesterling, 1960).

Older Alluvium and Alluvial Fans (Qoal and Qf on map)

This map unit includes coarse to fine clastic rock detritus derived from the mountainous areas during periods of heavy rainfall and erosion during the Pleistocene epoch. These deposits accumulated in the form of alluvial fans for the most part, and were formed by various processes of sheetflood and sheetwash erosion and deposition. This older alluvium is composed of angular to subrounded clasts varying in size from silt through coarse sand to large pebbles, with rare cobbles and boulders. This unconsolidated material is crudely stratified and poorly sorted and forms fairly flat and low-lying, rounded topography which has been moderately dissected by unnumerable enmeshed bifurcating stream channels.

The older alluvial fans are overlain in the eastern part of the mapped area by the silty flood-plain alluvium of the Humboldt River valley. Around Stony Point in the northern part of the area the older alluvium occurs on the flanks of the hills and is overlain by flood-plain deposits.

The older alluvium and older alluvial fans elsewhere, especially in the Winnemucca area, are obviously of Pleistocene age as they are marked by distinct shoreline features of Pleistocene Lake Lahontan.

RECENT DEPOSITS

These unconsolidated deposits include alluvium (Qal) and silty alluvium (Qsa) of the Humboldt River flood plain. The above deposits are all approximately contemporaneous, although part of the flood-plain deposits are slightly older than the other types.

The alluvium (Qal on map) is composed of poorly sorted, rounded to subrounded clasts varying in size from silt to boulders. As mapped, the alluvium is restricted to the present stream channel. There is an increase in the degree of fineness and the perfection of the sorting downstream away from the mountain front where it grades imperceptibly into the silty flood-plain deposits.

The flood plain of the Humboldt River covers over 80 percent of the mapped area. A thin veneer of sandy silt, overlying 50-60 feet or more of gravel, forms the bulk of these deposits. North of the railroad, most of the flood plain contains a wide belt of meander scars of former channels which are bordered by willow trees. Relatively recent aggradation of the Humboldt River is indicated by wells in the vicinity of Battle Mountain reported to have reached a depth of several hundred feet in river sand and gravel (Moody, 1914, and Dumble, 1914). These sand and gravel deposits underlying the silty alluvium have been utilized locally in the construction of the present U. S. Highway 40 and other roads in the area.

STRUCTURAL FEATURES

Faults

All of the formations in the Shoshone Range are cut by numerous normal faults, and locally, rocks of Ordovician age have been thrust over Devonian rocks. The entire western flank of the Shoshone Range is bounded by a north and northeast-trending fault. This fault is downthrown at least as much as the present relief of 1,600 feet, and probably more than this on the west and north sides. Prominent triangular facets on the western flank of the range form a most distinctive fault scarp. This major fault is slightly older than the other basin and range normal faults in this general area as it has been offset nearly one mile by two north-northeast-trending faults in the township to the east.

A second major normal fault trends northeast and has cut off the thrust plate of Ordovician quartzite on the crest of Argenta Point in the extreme east-central part of the area. This fault continues northeast into the adjoining township where it forms the contact between Ordovician and Devonian rocks. A third major normal fault trends east-west across Sections 23 and 24, Twp. 32N., Rge. 46E., and the eastern one mile of this fault forms the contact between Ordovician sediments and the Slaven chert of Devonian age.

Most of the other normal faults in this part of the Shoshone Range trend northwest with a few trending northeast. They occur mostly in rocks of Ordovician age in the northwestern part of the range. The throw and relative displacements on nearly all of these faults is not known owing to the homogeneous nature of the country rock.

All of these normal faults are closely related to the major basin and range block faults which formed the Shoshone Range. These block faults, which are largely responsible for the present major features of the topography of the range, are Plio-Pleistocene in age. Probably minor movements along a few of these faults occurred in late Pleistocene time.

Several erosional remnants of the thrust plates (klippen) associated with the Roberts Mountains thrust occur in Sections 35 and 36, with smaller klippen in Sections 13, 23, 24, 25, and 26, Twp. 32N., Rge. 46E. These thrust faults are related to the Roberts Mountains thrust which culminated the Antler orogeny in Late Devonian or Early Mississippian time, and which carried the Valmy and Slaven chert formations into this area from western Nevada.

Folds

The Ordovician and Devonian rocks have been so intensely deformed and fragmented by faulting that individual folds are no longer recognizable.

FIELD WORK

Approximately five field days were spent mapping Twp. 32N., Rges. 45 and 46E., MDM., during December, 1959.

Geophysics

Selected hand specimens collected from these two townships and adjacent areas were checked with an ultraviolet light. No economic minerals were noted. No other geophysical work was performed.

RECOMMENDATIONS

Sizeable deposits of sand and gravel in the alluvial fans, older alluvium, and at shallow depths in the flood-plain deposits in these two townships could supply large quantities of material for future highway construction in this immediate area. The projected expansion of U. S. Highway 40 from 2 to 4 lanes will, undoubtedly, utilize much of these deposits immediately adjacent to the highway for road fill and bituminous or concrete aggregate. Since this highway crosses the extreme northwestern corner of Section 27, Twp. 32N., Rge. 46E., a Section with the mineral rights only reserved by the Southern Pacific Company, this Section could supply large quantities of sand and gravel for construction purposes.

No other deposits of economic minerals of importance were noted and it is recommended that no further work be done on these two townships.

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APPENDIX "A"

LOG OF WATER WELL DRILLED IN N½ OF R-27-32-46

Depth in feet	Remarks
0-25	Silt.
25-156	Sand of varying coarseness containing silt.
156-459	Alternating layers of clayey sand, clayey gravel, cemented sand and cemented gravel.
459-465	White clay.
465-485	Blue clay.
485-490	Yellow clay.
490-615	Alternate layers of cemented sand, loose sand and gravel below.
615 TD	Bedrock.

Drilled before 1924. No data available, but well did not provide sufficient water for irrigation. Now abandoned.

Data from: Clark and Erskine, 1924.

GEOLOGY AND MINERAL RESOURCES

OF

TOWNSHIP 32 NORTH

RANGES 47 AND 48 EAST

MOUNT DIABLO BASE AND MERIDIAN

LANDER AND EUREKA COUNTIES

NEVADA

Eastern 3/4 of Argenta Rim + dip slope

N 1/2 Dunphy 15' Quad

Geology and Report by:

Walter H. Spurck,
Field Geologist

Date: January, 1960

INTRODUCTION

Township 32 North, Ranges 47 and 48 East, MDBM., is located in the northern end of the Shoshone Range in Lander and Eureka Counties, Nevada. The town of Battle Mountain is located 13 miles west of the western border of the mapped area. Beowawe, a station on the Southern Pacific and Western Pacific railroads, is located about one mile east of the extreme southeastern corner of the area. U. S. Highway 40 and the westbound line of the Southern Pacific and Western Pacific railroads cross the northern part of the mapped area.

The major portion of the mapped area is occupied by the Shoshone Range. The Humboldt River valley is located in the extreme northern and northwestern part of the area, and the broad, flat playa of Whirlwind Valley is located in the southeastern part of the mapped area.

CONCLUSIONS

Twp. 32 N., Rge. 47 E.

Fee Ownership by Southern Pacific Company

Sections 1 (part south of railroad), 7, 11, 13, 17 (W½), 23, 25 and 35.

Section Evaluation

Sections 11 (except NW¼), 13, 23, 25 and 35 -- Nonmineral.

Sections 7 (N½) and 11 (NW¼) -- Potential sand and gravel deposits (see Construction Material)

Section 7 (S½) -- Potential construction stone.

Oil and Gas Rights Only Reserved by Southern Pacific Company

Section 33 (S½) -- No potential for oil or gas.

Twp. 32 N., Rge. 48 E.

Fee Ownership by Southern Pacific Company

Sections 1 (except $SE\frac{1}{4}$ and that part of $NE\frac{1}{4}$ that lies east of railroad), 3, 5, 7, 9, 11, 13 (part), 15, 17, 19, 21, 23 (except $E\frac{1}{2}SE\frac{1}{4}$), 27 (part), 29, 31 and 33.

Section Evaluation

Sections 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 27, 29, 31 and 33 -- Nonmineral.

Oil and Gas Rights Only Reserved by Southern Pacific Company

Sections 13 ($SE\frac{1}{4}NW\frac{1}{4}$), 23 ($NE\frac{1}{4}SE\frac{1}{4}$) and 27 (most of $SE\frac{1}{4}$) -- No potential for oil or gas

TOPOGRAPHY AND ACCESSIBILITY

The topography, road systems, trails, and accessibility are shown on the geologic map No. R 4748-32 which covers this area. The regional setting may be ascertained by inspection of the U. S. Geological Survey topographic sheet of the Dunphy quadrangle, scale 1:62,500 (1957). The northern part of the area is readily accessible via U. S. Highway 40 and the extreme southeastern part of the area in Whirlwind Valley is easily reached via dirt roads from Beowawe and U. S. Highway 40. The remainder, and major portion of the area is accessible only on foot or horseback.

MINERAL RESOURCES

Metallic Deposits

There are no known deposits of metallic minerals within the mapped area that are of economic importance. During the course of this reconnaissance no new evidence was uncovered that would indicate any metallic mineral deposits. There has been no production of metallic minerals from these two townships to the knowledge of the writer.

Nonmetallic Deposits

Barite

Fairly extensive deposits of barite occur in the Slaven chert of Devonian age along the extreme western edge of the mapped area. The barite is in the form of thin beds or lenses ranging in thickness from a fraction of an inch up to several feet, and in length up to several hundred feet. According to Gianella (1940, p. 3) the barite has replaced gray limestone beds in the chert and is, therefore, epigenetic. Ketner (1959, oral communication), however, believes that what appears to be replacement of both limestone and chert is essentially syngenetic and that the barite is penecontemporaneous with the Slaven chert accumulations on the sea floor. In support of this theory Ketner mentioned the unusually high concentrations of barium in most of the Slaven chert which has been sampled. If Ketner is correct, there is not any structural control in connection with the formation of the barite deposits. However, there have not been a sufficient number of samples analyzed to date to make any definite conclusions in regard to ore genesis. Furthermore, there is strong evidence indicating definite structural control in the barite deposits at the Bateman canyon and Hilltop Berium mines in Twp. 30N., Rge. 46E., (Oesterling, 1960a).

Barite is widely distributed in Lander County and there are many producing mines. The only currently producing mine, the Shelton mine, located within the mapped area is discussed below. For further information on Nevada barite, including history of production, uses, value of the ore, ore genesis and reserves for the Battle Mountain area, see report on Twp. 30N., Rge. 45-46E., MDM. by Oesterling (1960a).

Argenta Mine in the NW$\frac{1}{4}$NW$\frac{1}{4}$ of Sec. 19, Twp. 32N., Rge. 47E. The Argenta mine ("Nevada barite mine") is a group of open cuts located at an elevation of about 6,000 feet on the west side of Mosquito Canyon in the extreme northwestern corner of Section 19, nearly on the township line. The barite has replaced thin, dark gray limestone and chert beds in the Slaven chert of Devonian age. The strike of these beds here is north to north-northwest and they dip 25-30 degrees to the east, although locally much steeper dips are encountered owing to intense folding and faulting. About one-half mile north of this mine, the Slaven chert strikes north-northwest and dips 70-80 degrees to the west. Approximately 150 feet above the uppermost mine workings the chert ridge is capped unconformably by a thin white rhyolite which, in turn, is conformably overlain by Tertiary basalt.

Barite has been produced from an area 500-700 feet wide and nearly one-half mile long in a mineralized zone trending north and north-northwest along the strike. Thin, dark gray limestone and chert beds appear to have been replaced in part by dark gray to black barite. Few barren chert nodules are discarded during mining. This ore is said to contain about 90 percent barium sulphate (barite) and a little barium carbonate (witherite) (Gianella, 1940, p.3).

The Argenta mine consists of several separate workings. The main working is a north-south open cut 40-50 feet in width and about 200 feet long with three additional open cuts extending west from this main cut into the ridge. About 150 feet north of the main working is another large open cut in the east side of the ridge.

This working is approximately 40 by 40 feet and 10-20 feet deep. A considerable, but unknown, quantity of barite has been removed from all of these open cuts. The bedding has been so disturbed and contorted that it is very difficult to obtain precise structural information in the cuts themselves. No faults were noted but the general contorted and homogeneous nature of the country rock may effectively mask many fractures.

Several smaller prospect cuts lie a few hundred feet farther north of the main workings. One in the extreme SW$\frac{1}{4}$SW$\frac{1}{4}$ of Section 18, Twp. 32N., Rge. 47E., and another in the extreme SE$\frac{1}{4}$SE$\frac{1}{4}$ of Section 13, Twp. 32N., Rge. 46E. A small amount of barite appears to have been produced from each of these smaller cuts. According to Gianella (1940, p. 3) the largest barite production in Lander County came from the Argenta mine. The mine has been idle for some years, but there is a possibility that it might be reopened at a future date by the current operators of the nearby Shelton mine.

Shelton mine in the center of Sec. 18, Twp. 32N., Rge. 47E. The Shelton mine is located at an elevation of about 5,500 feet on the crest of the north-trending ridge on the east side of Mosquito Canyon about one-half mile northeast of the Argenta mine. This mine is currently active and operations consist of open-cut strip mining of thin veins of barite enclosed in chert and limestone of Devonian age. At the time of this visit (1959), an area of approximately 300 by 500 feet was being mined using bulldozers and scrapers, front-end loaders and trucks. The ore is trucked to Argenta siding on the Southern Pacific main line, a distance of about three miles. About six men are employed at this mine.

Many shallow cuts and prospect pits are located in Mosquito

Canyon along the west side of the central spur. An unknown amount of barite has been produced from some of these.

A few hundred feet south of the main mine workings is a cap of Tertiary basalt unconformably overlying the Devonian chert. In the vicinity of the mine the strata are contorted so that accurate strike and dip measurements are not possible. The beds generally strike north. No faults were observed in this immediate area, but again the contorted nature of the strata may possibly conceal many unknown faults.

Prospects in the SW¼ of Sec. 31, Twp. 32N., Rge. 47E. Several shallow prospect pits are located in the Slaven chert in the SW¼ of Section 31. The general strike of the chert beds is northeast, and the dip is about 25 degrees southeast. The barite appears to have partially replaced several thin limestone lenses and chert beds in the Devonian formation. There is very little barite exposed and no work has been done on these prospects for some time. No barite appears to have been produced from this property.

Construction Materials

Sand and Gravel

Extensive deposits of sand and gravel occur in the older alluvium and alluvial fans along the northern flank of the Shoshone Range south of U.S. Highway 40. This material consists of unconsolidated silt, sand, and boulders, generally poorly sorted and crudely stratified. Coarse, angular to subangular clasts predominate in the alluvial fans and in the older alluvium. This coarser material is overlain north of the highway by an increasingly thick veneer of silty alluvium of the central valley fill. Gravel is reported to extend from a few feet below the surface to at least

50-60 feet in the area near Battle Mountain (Moody, 1914).

Most of this coarse material is composed of hard, tough, angular to subangular fragments of dense andesite derived from the Shoshone Range except in the N½ of Section 7, Twp. 32N., Rge. 47E., where most of the coarse material consists of chert and quartzite with minor amounts of andesite and basalt. Generally this material contains no cracks or soft enclosed materials nor substances such as zeolites, opaline silica, et al., which are undesirable in portland cement concrete aggregate and asphalt concrete.

Because of their ready accessibility these deposits have been locally utilized in the construction of the present U. S. Highway 40 and in the main lines of the Southern Pacific and Western Pacific railroads. Gravel quarries are located in Sections 3, 6 and 10, Twp. 32N., Rge. 47E., with only one being more than a few hundred feet from the highway.

The projected expansion of U. S. Highway 40 from 2 to 4 lanes will, undoubtedly, utilize large amounts of these deposits immediately adjacent to the highway for road fill and asphalt or concrete aggregates. Southern Pacific Company-owned sections in Twp. 32N., Rge. 47E. that could supply large quantities of sand and gravel are 1, 11 (NW¼) and 7 (N½).

The S½ of Section 7 may have a potential value for construction materials from the chert and quartzite of the Valmy and Slaven chert formations. These resistant rocks may be ideally suited for this use, especially "recrystallized chert in metamorphic terranes".

The chert and quartzite deposits are ideally located for quarrying operations along both sides of the Mosquito Canyon access road and are only one-half to one mile from U. S. Highway 40 and the westbound line of the Southern Pacific railroad.

Water Resources

Surface Water

The Humboldt River is the only perennial stream within the mapped area. This sluggish, meandering stream, currently at grade, flows in a westerly direction across the area and through a gap in the hills in the extreme northeastern part of the map area, swings around Shoshone Point and then flows across the extreme northern and northwestern portions of the area. This river is an antecedent stream, transverse to structure, which has held its course from an early stage in the geomorphic cycle, (Ferguson, et al., 1952). The many meander scars fill a belt several miles wide extending north of the present river. Relatively recent aggradation is indicated by wells in the vicinity of Battle Mountain reported to have reached a depth of several hundred feet in river gravel and sand. Several small dams have been constructed along the Humboldt River for irrigation and stock-watering purposes.

All the other streams, such as Coyote Creek and the small streams in Water, Mosquito, and Deer Canyons, flow only during the snow-melt season in the spring and are commonly dry during most of the year.

In addition to these small ephemeral streams there are several small seeps or springs scattered over the area. These commonly have a flow of less than 0.5 gal./min. Most of these springs occur in Twp. 32N., Rge. 47E., in Sections 1, 8, 17, 29, 31, 32 and 33. One small spring occurs in Section 10, Twp. 32N., Rge. 48E. In a few cases, especially in Sections 8, 17 and 31, Twp. 32N., Rge. 47E., these springs provide a limited amount of water for grazing cattle.

Ground Water

Water for cattle is provided by windmills and troughs in Sections 12 and 32, Twp. 32N., Rge. 48E. The depths of these wells are unknown, but they probably do not exceed 200 feet. Two other wells located in Whirlwind Valley are in Section 25 and just south of the township line in Section 1, Twp. 31N., Rge. 48E.

Sufficient water for cattle could probably be developed by shallow wells almost anywhere in the valley fill of the Humboldt River and probably nearly everywhere in the Whirlwind Valley playa to the southeast. For a report on wells and ground water of the adjacent part of Humboldt Valley to the east. (See report on Twp. 32N., Rges. 45 and 46E., MDM. by Spurck, 1960.)

The subsurface bedrock configurations are not known, but the general shallowness of the water table in the Humboldt River valley and the recharge from the river itself practically assures a sufficient supply of water for limited agricultural purposes.

Beowawe Geyser Area

The Beowawe geyser area lies about 2½ miles south of the mapped area largely within the NW¼ of Section 17, Twp. 31N., Rge. 48E. Numerous geysers, vents and fumeroles occur along an east-northeast-trending fault that has been downthrown about 400 feet on the north forming a rhyolite bench with geyserite. Other geysers and vents occur at scattered points below this bench. The Nevada Thermal Power Company recently drilled a test hole near the base of the bench in an attempt to develop sufficient steam pressure for conversion to electric power through steam turbines. For a log of the hole see APPENDIX "A". The hole has been abandoned and no further information is available at this time, although it has been reported that this Company plans to drill other test holes here. For a more complete description of the geyser area see Nolan and Anderson (1934). This report was unavailable to the writer. (See also, special report on the Beowawe Geyser Area by Oesterling, 1960c.)

GEOLOGIC SETTING

Various types of bedrock crop out over more than 85 percent of the mapped area. The remaining 15 percent of the area is covered with surficial deposits of Quaternary age. Tertiary volcanic rocks which crop out over nearly all of the northern end of Shoshone Range, with smaller exposures of Lower Paleozoic rocks, comprise the major consolidated rock units.

Structural and stratigraphic relationships in north-central Nevada are exceedingly complex. Roberts, et al. (1958, p. 2816-2821) describe the regional structure and stratigraphy in detail. They state that there are three distinct sedimentary assemblages of pre-Late Mississippian age that were deposited in that portion of the Cordilleran geosyncline that extended for 335 miles west of Eureka, Nevada. These three assemblages consist of an eastern, western and transitional assemblage. The eastern miogeosynclinal assemblage consists of about 15,000 feet of predominantly limestone and dolomite, while the western eugeosynclinal assemblage consists of nearly 50,000 feet of clastic and volcanic rocks with large amounts of chert. Between these two, a third assemblage, the transitional, is locally recognized. This transitional assemblage belongs to neither the eastern nor western types, but contains elements of both. The broad geosyncline in which these three assemblages were laid down persisted until the end of Devonian time, at which time the Antler orogenic belt, between the 116-118 degree meridians, was intensely folded and faulted. This orogeny culminated in the Roberts Mountains thrust fault in Late Devonian or Early Mississippian time that brought western assemblage rocks over transitional and eastern assemblage rocks. The Antler orogenic belt is approximately 80 miles wide and it extends over 150 miles north-northeast across central Nevada. Winnemucca is approximately on the western edge of the belt and a line through Mountain City, Carlin and Eureka marks the eastern edge of the folding. Subsequent to this orogeny a series of coarse clastic rocks was laid down over much of Nevada. These rocks range in age from Early Mississippian to Late Permian and are termed the overlap assemblage (Roberts, et al., 1958, p. 2820-2821, 2844-2846, 2852-2854).

Within the mapped area only rocks of the western assemblage occur: the Valmy formation of Ordovician age and the Slaven chert of Devonian age.

Summary of Geologic History

The following tentative summary of the geologic history of north-central Nevada was compiled by W. A. Oesterling from published literature, especially Roberts (1951), Ferguson, Muller and Roberts (1951 and 1952) and Roberts, Hotz, Gilluly and Ferguson (1958). The compilation is in part substantiated and augmented by the current mapping program of the mineral resources survey of the Southern Pacific Company. Episodes pertinent to the two townships of this area are indicated by an asterisk.

EPISODES			DESCRIPTION
Depositional	Tectonic	Intrusive	
Recent			Infrequent stream run-off;* stream aggradation and accumulation of post-Lake Lahontan

EPISODES			DESCRIPTION
Depositional	Tectonic	Intrusive	
			alluvial fans;* desiccation of intermontane lakes; formation of eolian deposits.
	Pleistocene (late) to Recent		Minor movements along normal faults, especially near margins of basins;* formation of scarplets in pre-Lake Lahontan alluvial deposits.
Pleistocene (late)			Abundant rainfall, active stream and sheet-wash erosion, accumulation and dissection of extensive pre-Lake Lahontan alluvial fans;* intermontane basins partly filled with water and lake sediment; Lake Lahontan reached a maximum elevation of about 4,400 feet.
Pliocene-Pleistocene			Basaltic lava flows.
		Pliocene-Pleistocene	Dikes, largely basaltic and rhyolitic.
	Pliocene-Pleistocene		Maximum development of basin-range block faulting along generally northerly trends;* (This episode is largely responsible for the major features of the present topography.)
Miocene-Pliocene			Extensive volcanic activity with deposition of tuff, tuffaceous sediments and intercalated lava of the Truckee and Humboldt formations; these formations probably accumulated in many separate basins developed by lava dams and faulting.
Oligocene(?) Miocene			Lava flows; thick andesite and basalt.*
	Oligocene(?)		Initiation of basin-range block faulting.
-- Major erosional interval with probable intermittent uplift which prevented peneplanation; streams probably drained to the Pacific Ocean.			
		Cretaceous to Tertiary (early)	Emplacement of many widespread igneous intrusives of varied composition, but characterized

EPISODES Depositional	Tectonic	Intrusive	DESCRIPTION
			by quartz monzonite to granodiorite; probably become progressively younger towards the east.
	Jurassic (late) to Cretaceous		Nevadan orogeny: west to east thrusts with local drag folds accompanied by regional dynamic metamorphism in region west of Winnemucca where vast areas of slate and phyllite were formed. East to west thrusts are indicated in some areas, e.g., west flanks of Sonoma and East Ranges.
Triassic to Jurassic			Two facies of marine deposits: Triassic conglomerate - carbonate sediments in the east (China Mt., Augusta Mt. sequence of formations), and a tremendously thick section of Triassic-Jurassic argillaceous deposits west of a general north-south line through Winnemucca.
	Triassic (early)		Minor tectonic episode indicated by a slight angular unconformity between the Lower Triassic China Mountain formation and the Permian-Triassic Koipato formation.
Permian(?) to Triassic			Lavas, pyroclastics and clastics of the Koipato formation.
	Permian (late)		Major orogeny: Intense folding in western Nevada and large scale over-thrusting developed during post-Havallah - pre-Koipato time; west to east thrusts carried Pumpernickel and Havallah formations into area from west of Winnemucca, and at least as far east as Shoshone Range; upper plate rocks closely folded, lower plate warped.
	Pennsylvanian & Permian		Intermittent uplift and subaerial erosion indicated by disconformities between the formations of the overlap assemblage (Antler sequence of Roberts, Hotz, Gilluly and Ferguson, 1958).
Pennsylvanian & Permian			Deposition of Antler sequence of overlap assemblage within Antler

EPISODES			DESCRIPTION
Depositional	Tectonic	Intrusive	
			orogenic belt: chert, sandstone and little lava of Havallah formation accumulated in eugeosyncline of western Nevada.
Pennsylvanian (early /?)			Chert and intercalated andesite accumulated in the eugeosyncline of western Nevada to form Pumpernickel formation.
	Mississippian		Roberts Mountains overthrust culminated the Antler orogeny: chert, clastics and volcanics of western assemblage rocks were carried eastward over the transitional rocks and the carbonate and clastic sediments of the eastern assemblage.*
	Devonian (late) and Mississippian		Folding and uplift of Antler orogeny in western Nevada, warping and uplift in central Nevada.*
Cambrian, Ordovician, Silurian & Devonian			Marine deposition of eastern miogeosynclinal,* transitional and western eugeosynclinal assemblages of Roberts, Hotz, Gilluly and Ferguson (1958).

Lower Paleozoic Sedimentary Rocks

Rocks of the Western Assemblage of Roberts, et al. (1958)

Valmy Formation (Ovch, Ovsg, Ovg and Ovu on map)

Distribution. This formation crops out over small areas in the extreme northeastern and extreme northwestern portions of the mapped area.

Lithology. The Valmy formation consists largely of thin-bedded, highly contorted, variegated to black chert with interbeds of tan to gray, indurated quartzose sandstone and argillite in the extreme northeastern part of the area. The strata strike northeast and dip 30-50 degrees northwest. Fresh and weathered colors are about the same.

In the extreme western part of the area the Valmy formation consists largely of thick-bedded to massive, medium to coarse-grained bluish-white to grayish-blue quartzite with some interbedded dark gray to black chert. The quartzite is usually highly brecciated due to faulting and is very resistant to weathering, forming rough, jagged topography. It generally weathers to a light grayish-brown. The chert contains a few thin interbeds and partings of argillite. In the extreme northwestern part of the mapped area, the Valmy formation strikes in a general northeast direction, but dip measurements are not reliable owing to the highly contorted nature of the beds. The thickness of this formation is not known, but at least several thousand feet are exposed within this area. Farther south, in the Mount Lewis quadrangle, and at the type locality in the N½ of the Antler Peak quadrangle to the west, the Valmy formation is much thicker, ranging up to 7,000 feet or more (Roberts, et al., 1958, p. 2832).

Age and relation to other rocks. The Valmy formation is in fault contact with the Slaven chert of Devonian age in the extreme western part of the area. Locally it is in fault contact with the Shoshone andesite of Tertiary age. Elsewhere, and in the extreme northeastern part of the area, the Valmy formation is unconformably overlain by surficial deposits of Quaternary age.

This formation was named for a thick series of interbedded quartzite, chert, argillite, slate, and some intercalated greenstone exposed on North Peak in the N½ of the Antler Peak quadrangle about 25-30 miles west of the mapped area. The Valmy formation has been dated as Ordovician on the basis of contained graptolite faunas of Lower, Middle and Upper Ordovician age collected from the northern Shoshone Range (Roberts, et al., 1958, p. 2833).

Slaven Chert (Dsch, Dsls, Dsst and Dsv on map)

Distribution. The Slaven chert crops out in the extreme western part of the mapped area.

Lithology. This map unit consists largely of dark gray to black, thin-bedded, contorted chert with locally up to 50 percent argillite. Included in the chert are thin lenses and interbeds of dark gray to black limestone and tan to gray sericitic siltstone which weathers platy. The chert is commonly in beds 1 to 4 inches thick. In contrast to local chert of the Valmy formation, the Slaven chert is not highly colored and contains no quartzite or indurated quartzose sandstone. The fresh and weathered colors are the same. Locally some of the limestone and chert have been partially replaced by dark gray to black barite. The thickness of the Slaven chert is unknown but at the type locality in Slaven Canyon, approximately 10 miles south-southwest of this area, there are at least 4,000 feet of this unit exposed (Roberts, et al., 1958, p. 2837).

Age and relation to other rocks. Rocks of Ordovician age, (the Valmy formation) have been thrust over the Slaven chert in Sections 7 and 31 of the west township. Elsewhere the Slaven chert is in normal fault contact with the older Valmy formation. In the west part of the mapped area, the Slaven chert is unconformably overlain by Tertiary basalt and a little rhyolite, and by Tertiary andesite.

The Slaven chert is a new formational name proposed by Gilluly (1959, oral communication) for a thick deposit of chert with minor amounts of limestone, shale and sandstone exposed in the Slaven Canyon area 10 miles south-southwest of the mapped area. This formation has been assigned to the Middle Devonian on the basis of ostracods and conodonts (Roberts, et al., 1958, p. 2837).

Tertiary Intrusive Rocks

Basalt Dikes (Tib on map)

Distribution. Thin, intrusive basalt dikes occur along north-south fractures in Sections 7 and 18, Twp. 32N., Rge. 47E., about one-half mile north of the Shelton mine.

Lithology. This rock unit consists of fairly thin (up to 20-25 feet thick) dikes of dull greenish-gray to olive-gray basalt. These dikes have approximately the same composition as the contemporaneous basalt flows (Tb on map). They are composed of calcic plagioclase and pyroxene with minor amounts of apatite and magnetite. The basalt has a dense groundmass and it is rather deeply weathered so that individual phenocrysts are unidentifiable.

Age and relation to other rocks. These basalt dikes occur along north-south fractures in Ordovician and Devonian sedimentary rocks, roughly parallel with the strike of the bedding. These dikes, together with the older basalt flows, are probably closely related to other late Tertiary volcanic rocks in this general area of Nevada. For the purposes of this report, a tentative age of Miocene(?)-Pliocene(?) is assigned.

Tertiary Volcanic Rocks

Rhyolite (Tr on map)

Distribution. This map unit does not occur within these two townships. However, just across the township line in Section 24, Twp. 32N., Rge. 46E., a thin flow of rhyolite is exposed.

Lithology. This rock unit consists of a 30-foot-thick flow of white to light yellowish-gray, very fine-grained rhyolite composed principally of quartz and alkalic feldspar. This rock is fairly hard and resistant to weathering. Fresh and weathered colors are approximately identical. The rhyolite fractures easily into slabby and platy fragments. No flow-banding was observed, but this flow appeared to be horizontal.

Age and relation to other rocks. This rhyolite unconformably overlies sedimentary rocks of Devonian age. It is apparently conformably overlain by Tertiary basalt. This rhyolite, together with the overlying basalt, is probably related to other late Tertiary volcanic rocks in this general area of Nevada. Ferguson, et al. (1952) mapped similar rhyolite flows in the Golconda quadrangle approximately 35 miles northwest of this area as Tertiary, possibly Miocene, in age. Ferguson, et al. (1951b), Roberts (1951) and Muller, et al. (1951) mapped somewhat similar rhyolite flows in the Mount Moses, Antler Peak and Mount Tobin quadrangles respectively, as Miocene(?)-Pliocene(?) in age.

Older Basalt (Tb on map)

Distribution. This map unit crops out over a small area in the extreme western portion of the mapped area.

Lithology. This rock unit consists of a series of older flows of dull greenish-gray to black basalt. It is composed of calcic plagioclase and pyroxene with lesser amounts of apatite and magnetite. These flows have approximately the same composition as the contemporaneous basalt dikes (Tib on map). The basalt has a dense groundmass and is rather deeply weathered so that the individual phenocrysts are unidentifiable. Bedding is generally obscure, but in Section 19, Twp. 32N., Rge. 47E. these flows strike north-northwest and dip 20 degrees northeast.

The thickness of these flows is unknown, but it probably does not exceed a few hundred feet.

Age and relation to other rocks. These basalt flows apparently unconformably underlie the Shoshone andesite of Miocene(?) age and unconformably overlie sedimentary rocks of Devonian age. Just west of the township line in Section 24, Twp. 32N., Rge. 46E., basalt conformably overlies a 30-foot bed of white rhyolite and caps the ridge extending south and southwest.

These flows, together with the intrusive basalt dikes, are probably closely related to other late Tertiary volcanic rocks in this general area of Nevada. Muller, et al. (1951) mapped similar basalts in the Mount Tobin quadrangle, approximately 30 miles to the southwest, as Tertiary. For the purposes of this report a tentative age of Miocene(?) is assigned on the basis of the Miocene(?) age for the superjacent andesite.

Shoshone Andesite (Tsa on map)

Distribution. Because of the extensive exposures in the northern part of the Shoshone Range and at Shoshone Point, these andesitic flows have been named Shoshone andesite for the purpose of this report. This map unit is especially well exposed along Argenta rim in the northern part of the mapped area, where it forms a steep, north-facing escarpment nearly 1,800 feet high.

Lithology. This rock unit consists of a thick series of flows of very fine-grained to cryptocrystalline, grayish-brown to maroon andesite. It is composed mainly of sodic plagioclase with unknown amounts of one or more of the following mafic minerals: pyroxene, hornblende and biotite. Locally the rock ranges in composition from latite to trachyte, but the bulk of these flows is considered to be andesite.

The andesite is hard and dense with a fairly smooth fracture. It is very resistant to weathering and typically weathers into small platy fragments that ring when struck with a hammer. Locally the andesite is porphyritic and has a slightly pitted surface, probably due to the leaching of some of the more soluble constituents. Locally it is vesicular. It weathers to a rather distinctive dull reddish-brown and in many places to slightly more vivid shades of red.

The total thickness of these andesitic flows is unknown, but at least 1,600 feet are exposed along the north side of Argenta Rim. It is possible that these flows have been repeated by step faults and that the normal thickness is much less than 1,600 feet.

Age and relation to other rocks. The andesite is conformably overlain by a relatively thin vesicular basalt flow which caps the Shoshone Range mesa. In the eastern half of the mapped area the andesite and basalt flows are intercalated in thin beds near the top of the mesa rim. Along the western edge of the mapped area the andesite unconformably overlies Tertiary basalt and Devonian sedimentary rocks. Locally in Section 8, Twp. 32N., Rge. 47E., it is in fault contact with Ordovician quartzite, and in Section 11, Twp. 32N., Rge. 48E., it unconformably overlies Ordovician chert of the Valmy formation.

The Shoshone andesite is lithologically similar to, and probably correlative with, much thinner (600 feet thick, or less) andesitic flows in the eastern part of the Sheep Creek Range, reported by Oesterling (1960b). Along Rock Creek of the Sheep Creek Range, there is evidence that the andesite is of Miocene age, or slightly older (Oesterling, 1960b). Here the andesite is conformably overlain by a vitric tuff unit of the "Humboldt" formation, and the tuff is nonconformably overlain by basalt of probably Pleistocene age. According to Van Houten (1956, p. 2801 and 2817), this vitric tuff unit is upper Miocene to middle Pliocene in age. Van Houten (1956, p. 2820) states:

"Meanwhile, in early and middle Miocene time, outpouring of thick basaltic to andesitic lava flows covered vast areas of the northwestern part of the Basin-and-Range Province in Idaho and Oregon, as well as in north-central and northwestern Nevada."

On the basis of the above evidence the Shoshone andesite is thought to be of Miocene age.

Basalt (Tb on map)

Distribution. Thin flows of vesicular basalt cap the Shoshone Range mesa and crop out over extensive areas on these two townships.

Lithology. This rock unit consists of thin flows of black to bluish-black vesicular basalt. It is composed mainly of calcic plagioclase and pyroxene with minor amounts of apatite and probably magnetite. The basalt is generally vesicular, locally dense or scoriaceous with a dense groundmass. Locally, crude columnar jointing was observed, especially along Argenta Rim in the western part of the mapped area.

Generally the basalt weathers to a dull black or grayish-black color. Locally, however, it weathers to a dull reddish-brown, especially the vesicular varieties, owing to a possible excess of included iron constituents. The basalt is quite resistant to weathering and the older alluvium, especially in Sections 31 and 32, Twp. 32N., Rge. 48E., is locally composed mainly of cobbles and boulders of basalt.

These basalt flows, together with the underlying Shoshone andesite, form a large southeastward-dipping homocline that has been extensively block faulted by Plio-Pleistocene movements. The beds strike northeast and dip uniformly about 10 degrees southeast.

These basalt flows are seldom over 50-75 feet thick in the eastern part of the area and gradually increase in thickness to about 350 feet on the western rim in Sections 16, 21 and 28, Twp. 32N., Rge. 47E.

Age and relation to other rocks. These basalt flows conformably overlie Miocene(?) andesite. The basalt is unconformably overlain by older alluvium and recent surficial deposits. In the eastern half of the mapped area, the basalt and andesite flows are intercalated in thin flows near and along the top of the mesa rim.

Because the basalt is intercalated with andesite of probable Miocene age, it is also considered to be of this age.

PLEISTOCENE DEPOSITS

Older Alluvium and Alluvial Fans (Qoal and Qf on map)

This map unit includes coarse to fine clastic rock detritus derived from the mountainous areas during periods of heavy rainfall and erosion during the Pleistocene epoch. These deposits accumulated in the form of alluvial fans, for the most part, and were formed by various processes of sheetflood and sheetwash erosion and deposition. This older alluvium is composed and sub-angular to sub-rounded clasts varying in size from silt to coarse sand to large pebbles, with fairly rare cobbles and boulders. This material is crudely stratified and poorly sorted and forms fairly flat and low-lying, rounded topography which has been moderately dissected by innumerable enmeshed, bifurcating stream channels.

The older alluvial fans are locally overlain by more recent alluvial deposits, including stream wash (Qal on map), playa deposits, Recent alluvial fans and the silty flood-plain deposits of the Humboldt River valley.

The older alluvium and older alluvial fans many miles to the west, in the areas occupied by Pleistocene Lake Lahontan, are obviously of Pleistocene age because they are marked by distinct shoreline features of Lake Lahontan.

Recent Deposits

These unconsolidated deposits include alluvium and stream wash (Qal on map), playa deposits (Qp on map), silty alluvium of the Humboldt River flood plain (Qsa on map), and volcanic talus (Qvt on map). The above deposits are all approximately contemporaneous in age, although part of the playa and flood-plain deposits are slightly older than the other types.

The alluvium (Qal) is composed of poorly sorted rounded to subrounded clasts varying in size from silt to boulders. As mapped, the alluvium is restricted to the present stream channels. There is an increase in the degree of fineness and in the perfection of the sorting downstream away from the mountains where the alluvium imperceptibly grades into alluvial fan material, playa, and silty flood-plain deposits.

The flood plain of the Humboldt River covers a small area along the northeastern and northern portions of the mapped area and a smaller portion in the extreme northeastern part of the area. A thin veneer of sandy silt, overlying 50-60 feet or more of gravel, forms the bulk of these deposits. Most of this flood plain contains meander scars of former stream channels which are bordered by willow trees. These deposits grade imperceptibly into the playa deposits of Whirlwind Valley in the eastern part of the mapped area.

The playa deposits consist of fine silt and clay with local small amounts of sand. On the aerial photographs these deposits appear white or light colored because there is some concentration of alkaline minerals, especially at or near the surface. In places these alkaline minerals form a white crust up to 1/4 inch thick.

Both the silty flood-plain alluvium and the playa deposits are locally overlain by more recent alluvial fan materials along the flanks of the Shoshone Range. These Recent alluvial fans (not differentiated) consist of subangular to subrounded, relatively unsorted clasts ranging in size from silt to cobbles. They are generally composed of finer-grained materials than the stream wash beyond the stream mouths. There is an increase in the degree of fineness and in the perfection of the sorting away from the mountain fronts toward the terminal edges of the fans. These fans have been only slightly dissected by sheetflood drainage along a wide system of shallow, enmeshed bifurcating channels.

Volcanic talus, mostly basalt, occurs on the eastern slope of the high hill located in the extreme SE$\frac{1}{4}$ of Section 12, Twp. 32N., Rge. 47E. The talus consists of large, angular to sub-angular fragments of basalt and masks the contact of the basalt with the underlying andesite.

STRUCTURAL FEATURES

Faults

With the possible exception of the extreme western edge of the mapped area, all of the bedrock formations are cut by numerous normal faults, many of which are of large throw. The entire northern flank of the Shoshone Range is bounded by a major fault trending northeast. This fault is downthrown at least as much as the present relief of 1,600 feet, and probably much more than this, on the north and northwest sides. Prominent triangular facets on the northern flank of the range form a most distinctive fault scarp. This fault is slightly older than the other basin-and-range normal faults in this area as it has been offset in the W½ of Twp. 32N., Rge. 47E. by two northeast-trending normal faults. The offset at one place is nearly one mile.

Most of the normal faults in this area trend northeast and are downthrown on the northwest, forming prominent fault scarps in the Tertiary volcanic rocks of the Shoshone Range mesa. A slightly smaller number of faults trend northwest and these are generally downthrown on the northeast except in the SW¼ of Twp. 32N., Rge. 47E., where they are downthrown on the south and southwest sides. The throw on all of these normal faults is about 50-100 feet, seldom exceeding that amount. A few faults trend roughly east-west. These are usually downthrown on the north, with one exception.

A second major fault trends roughly northwest across the center of the mapped area. This fault is downthrown on the west and is slightly older than the other faults as it has been offset by northeast and northwest normal faults at several places. All of these normal faults form prominent fault scarps and are closely related to the major basin-and-range faults which form the Shoshone Range. These block faults, which are largely responsible for the present major topographic features, are Plio-Pleistocene in age. Probably a minor amount of movement along a few of these faults occurred in late Pleistocene time.

In Section 31, Twp. 32N., Rge. 47E., a northeast-trending normal fault has offset Tertiary basalt of probable Miocene age while another northeast fault about 3/4 mile northwest has displaced Devonian rocks, but has not cut andesite of Miocene(?) age. A few other normal faults in Devonian strata are of uncertain age, but are probably related to the other basin-and-range faults in this general area.

In the extreme western part of the area, Ordovician quartzites belonging to the Valmy formation have been thrust over Devonian sedimentary rocks. These thrust faults are related to the Roberts Mountains thrust which culminated the Antler orogeny in Late Devonian or Early Mississippian time. Both the Valmy and the Slaven chert formations were carried into this area from western Nevada in the upper plate of this thrust.

Tilting

The Tertiary volcanic rocks of Argenta Rim and the Shoshone mesa form a large southeastward-dipping homocline that has been extensively block faulted by Plio-Pleistocene movements. This homocline dips uniformly about 10 degrees southeast so that the surface elevation of the basalt cap ranges from about 6,100 feet in Section 8, Twp. 32N., Rge. 48E., to about 4,800 feet in Section 27, Twp. 32N., Rge. 48E., a linear distance of about 3½ miles southeast.

Folds

No major folds were observed within the mapped area, although many small ones exist in the highly contorted Ordovician and Devonian strata.

Major folds, if present, are obscured by the contorted and fragmental character of the Paleozoic rocks.

FIELD WORK

Seven field days were spent in mapping Twp. 32N., Rges. 47 and

48E., MDM., between November 16 - December 8, 1959.

Geophysics

Selected hand specimens from these two townships and adjacent areas were checked with an ultraviolet light. No anomolous or economic minerals were noted. No other geophysical work was performed.

RECOMMENDATIONS

Sizeable deposits of sand and gravel in the alluvial fans, older alluvium, and at shallow depths in the flood-plain deposits in these two townships could supply large quantities of material for future highway construction in this immediate area. The projected expansion of U. S. Highway 40 from 2 to 4 lanes will undoubtedly utilize much of these deposits immediately adjacent to the highway for road fill and bituminous or concrete aggregate. Southern Pacific Company-owned sections in this area that could supply large quantities of sand and gravel are 1, 11 (NW$\frac{1}{4}$), and 7 (N$\frac{1}{2}$), Twp. 32N., Rge. 47E.

No other deposits of economic importance were noted and it is recommended that no further work be done on these two townships at the present time.

Walter H. Spurck

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APPENDIX "A"

*LOG OF BEOWAWE NO. 1 HOLE DRILLED FOR THE NEVADA THERMAL POWER COMPANY

by W.A. Oesterling, October 19, 1959

Location: Near center of NW$\frac{1}{4}$ of Sec. 17, Twp. 31N., Rge. 48E., MDM: on lower slope of geyserite terrace with active geysers and hot springs located from 1/8th to 1/4th mile south, west and north, and dormant geysers to the east. Est. 2,300 feet S45°W from 1/4 corner Secs. 8 and 17.

Elevation of Collar: about 4,900 feet (picked from Dunphy, Nevada quadrangle)

Well Started: September 30, 1959

Total Depth: As of October 19th the well bottomed at 1,919 feet; driller was whipstocking in attempt to drill -30° in southerly direction to test ground beneath the line of active geysers on the geyserite terrace (estimated 500 feet south of collar).

Results according to foreman: Some steam under pressure was obtained between 207-220 feet, but not in commercial quantity. No other steam was encountered to October 19th.

Depth in Feet	Remarks
0-30	Geyserite and spring sinter, siliceous, white and pink.
30-44	Geyserite and spring sinter as above with little rhyolite.
44-48	Geyserite (?) or opal, white, dense, siliceous.
48-70	Geyserite, siliceous and rhyolite.
70-80	Chert, brown, and geyserite, white.
80-90	Gouge and chert breccia with geyserite.
90-100	Sample missing.
100-120	Chert, opalescent, white, conchoidal fracture; with some pink jasperoidal chert and trace of rhyolite.
120-150	Chert, jasperoidal chert, geyserite and a little clayey gouge.
150-207	Shale or argillite, olive green and dark gray, hard, siliceous.

* - Prepared in the field with hand lens.

Log of Beowawe No. 1 (continued)

Depth in Feet	Remarks
207-220	Geyserite (?) gray, calcareous, fine-grained, can be broken with fingers, sticks to tongue.
220-240	Shale or argillite, olive green and dark gray, siliceous.
240-260	Shale or argillite as above with chert.
260-290	Shale or argillite as above, blue-gray at 290 feet.
290-340	Shale or argillite as above, mostly green and gray.
340-350	Shale or argillite as above, with clayey gouge (?).
350-360	Shale or argillite as above.
360-390	Shale or argillite as above, with more or less clayey gouge (?).
390-400	Shale or argillite as above, with blue-gray chert.
400-450	Chert and fine-grained sandstone, some breccia and gouge.
450-470	Siltstone, siliceous, shale, chert and fine sandstone with some clayey gouge (?).
470-490	Siltstone, greenish; may represent altered greenstone (meta-andesite). Some shale or argillite.
490-500	Siltstone, sandy, with argillite, commonly green.
500-550	Much as above with some maroon siltstone to claystone.
550-600	Shale or argillite, and siltstone, green, gray and maroon, with trace of chert.
600-680	Much as above with some maroon and brown chert below 620'.
680-710	Much as above with greenstone (meta-andesite).
710-730	Argillite and chert, gray, green, black.
730-750	Gouge and breccia of above rock types.
750-770	Chert, gray and maroon; greenstone; argillite and little fine-grained sandstone.
770-790	Much as above, with some amygdaloidal lava.
790-800	Chert and argillite, green and gray.

Log of Beowawe No. 1 (continued)

Depth in Feet	Remarks
800-820	Gouge and chert breccia.
820-860	Greenstone, amygdaloidal; some chert and argillite.
860-880	Breccia of chert and greenstone, with clayey gouge.
880-900	Chert, greenstone and argillite. Chert is variegated.
900-950	Much as above with little quartzite, gray, fine-grained; chert more abundant towards bottom.
950-990	Chert, dark gray, brown, and maroon.
990-1020	Much as above with little argillite.
1020-1030	Chert breccia and gouge.
1030-1040	Greenstone, chert and argillite.
1040-1060	Greenstone and chert breccia with a little gouge.
1060-1090	Much as above.
1090-1100	Much as above, with trace of vitreous quartzite.
1100-1110	Chert and quartzite breccia and gouge.
1110-1120	Chert.
1120-1130	Chert, argillite and trace of greenstone.
1130-1140	Chert, argillite and trace of sandstone.
1140-1150	Chert and little greenstone.
1150-1160	Gouge and breccia.
1160-1180	Geyserite (?), white, soft, fine-grained, sticks to tongue.
1180-1200	Claystone, brown.
1200-1240	Chert and argillite, siliceous, brown; some siltstone.
1240-1260	Metavolcanics, amygdaloidal.
1260-1270	Chert, brown; some greenstone and fine-grained sandstone.
1270-1320	Sandstone, brown, quartzitic, very fine-grained.

Log of Beowawe No. 1 (continued)

Depth in Feet	Remarks
1320-1340	Sandstone, as above, with chert, brown; some argillite.
1340-1380	Argillite and chert; trace of apple-green epidote (?).
1380-1400	Chert, brown and pink, with some rounded grains.
1400-1440	*Chert (?), brown; little siliceous argillite.
1440-1450	*Chert (?), brown; with metavolcanics (?).
1450-1480	*Chert (?), brown; with much metavolcanics (?).
1480-1570	*Chert (?), brown; with siliceous argillite; metavolcanics (?) increase with depth.
1570-1600	*Metavolcanics (?), siliceous, brown, dense.
1600-1860	*Metavolcanics (?), brown, siliceous, dense; with more or less chert.
1860-1870	Sandstone, brown, quartzitic, very fine-grained; with some argillite.
1870-1880	Chert (?), brown and tan.
1880-1910	Chert and quartzitic sandstone, with some argillite.
1910-1919	(No sample)

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* - May be dense rhyolite.

GEOLOGY AND MINERAL RESOURCES

OF

TOWNSHIP 31 NORTH

RANGE 49 EAST

MOUNT DIABLO BASE AND MERIDIAN

EUREKA COUNTY, NEVADA

Red Devil Mine + townships East along
Humboldt R. Beowawe Quad. 15

Geology and Report by:

Robert E. Willson
Field Geologist

Date: July 1960

INTRODUCTION

Township 31 North, Range 49 East, Mount Diablo Meridian is situated in the northern part of Eureka County, Nevada. The northern part of the area lies along the low, rolling foothills of the Tuscarora Mountains. The town of Beowawe, a railpoint on the Joint Southern Pacific and Western Pacific lines, lies in the northwestern part of the township.

Only the western half of T.31N., R.49E., was mapped due to limited S. P. Company ownership. Section 1, T.31N., R.50E., and the adjacent area is scheduled to be mapped at a later date as part of Project #20. This report concerns part of T.31N., R.49E., only, except for a summary of oil and gas potential.

CONCLUSIONS

Twp. 31 N., Rge. 49 E.

Fee Ownership - Southern Pacific Company

Sections 3 (NW$\frac{1}{4}$), 17 (W$\frac{1}{2}$), 19 (E$\frac{1}{2}$), 29 (W$\frac{1}{2}$), 31 (NE$\frac{1}{4}$) . . . Nonmineral.

Section 7 (E$\frac{1}{2}$) . . . Possible mineral with respect to the large quantities of available sand and gravel in the NE$\frac{1}{4}$, near railroad and highway.

Oil and Gas Rights Only Reserved by S. P. Company

Sections 7, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33 and 35 . . . Oil and gas is possible in the lower plate (eastern assemblage) rocks, none of which are exposed in this area, but are likely in subsurface.

Twp. 31 N., Rge. 50 E.

Fee Ownership - Southern Pacific Company

Section 1 (to be mapped in Project #20)

Oil and Gas Rights Only Reserved by S. P. Company

Sections 7 (part), 9 (part), 11, 13, 15, 17 (part), 19, 21, 23, 25, 27 (part), 29, 31, 33, and 35 . . . Oil and gas is possible in the lower plate (eastern assemblage) rocks.

TOPOGRAPHY AND ACCESSIBILITY

The topography, road system, trails, and accessibility are shown on the geologic map No. R 4950-31, which covers this area. The topography and regional setting may be ascertained by inspection of the U. S. Geological Survey 15 minute Beowawe Quadrangle, Nevada, edition of 1957, at a scale of 1:62,500; and the Winnemucca, Nevada, NK 11-11 sheet of the Army Map Service, Corps of Engineers, published at a scale of 1:250,000, in 1958.

This area is accessible via Nevada Highway 21, which traverses the western part of the township from north to south and by several jeep trails.

MINERAL RESOURCES-EXAMINED

Metallic Deposits

Gold and Silver Prospect

No gold and silver mines or prospects of value were noted on the ground or reported in the literature. However, a small prospect pit on company-owned land in the NW¼NW¼ Sec. 3, was dug in quartzite near the contact of Tertiary andesite. Much limonite, but no sulfides or other mineralization was observed. A grab sample of the most favorable-appearing rock was assayed for gold and silver with the following results (Union Assay Office, Inc., 1960): R-03-31-49-lwi; gold - trace, silver - 0.20 oz. per ton. (See APPENDIX B).

Mercury Mine

The Red Devil mine in the SW¼SE¼, Sec. 6, is the only occurrence of commercial quantities of mercury in the mapped area. Mineralization in the form of cinnabar occurs as fracture fillings in the crushed, white chert, silicified conglomerate, and quartzite, and was apparently localized near the surface along and above the low-angle, northeasterly-trending fault, possibly a thrust, that cuts the strata. The economic-grade ore appears to be mined out and no extension in to the S. P. Company owned Section 7 seems likely. (For production, see "MINERAL RESOURCES-COMPILED").

A very small amount of cinnabar was observed in chert float in a prospect pit in the SW¼NW¼ Sec. 5. This mineralization was apparently along the same fault trend as that in Section 6, but does not appear to have any economic significance.

Nonmetallic Deposits

Sand and Gravel

Sand and gravel has been removed from a pit in the SE corner of Section 6, probably for construction of State Highway 21 and for local domestic purposes. This material appears to be of suitable quality, clean, well-sorted (up to 2"), well-rounded gravel with very little overburden. The same strata is present in the NE¼ Section 7 (Company-owned) and much of the eastern 2/3 of the township. Although there is a tremendous quantity of sand and gravel underlying this and adjacent townships, the favorable location of the Section 7 deposits, adjacent to the railroad and highway, and close to the town of Beowawe may some day make it a saleable product. This event awaits the development of a local demand for such material.

Water Resources

Surface Water

The only surface water observed on this township is the Humboldt River, which flows through Sections 4,5,9,10,11 and 12.

Ground Water

A cool, seeping spring in the E½ Section 36, T.31N., R.48E., apparently is the result of a Recent fault in the alluvium, making a channelway for subsurface water to reach the surface. This indicates that artesian water may be available in the valley, and this is substantiated by the fact that relatively shallow wells, both artesian and pumped, are being used for agricultural and domestic purposes a few miles to the southwest. It would seem likely that a good supply of ground water is available in most of the alluvium-covered area, should a need arise. A sample of this spring water, R-36-31-48-1Wi (Wa) was sent to the S.P. Co. laboratory in Sacramento for analysis. See APPENDIX "A" for analysis and report.

Water Rights

Oesterling (1960, p. 25) has outlined the existing situation with respect to water rights in Nevada and according to his findings:

> "It appears that the Southern Pacific Company does not necessarily hold ownership to the water resources upon and beneath its Nevada properties, except where the Company began using water before any other party."

MINERAL RESOURCES-COMPILED

Metallic Deposits

Mercury

Cinnabar was discovered in Section 6, prior to 1916 according to Anderson and Duberg (1916). Erskine and Lloyd (1925) state that:

> "A shaft is said to be on a 3-foot vein which assays 7% mercury. The vein ore is said to carry 6 to 20 ounces of silver and a small amount of gold. The silver is said to occur in the form of Tocornalite. The Cinnabar occurs in fracture zones in chert as incrustations around the fragmental material....No prospects or evidences of mineralization were observed on railroad lands and there is no reason to believe that any of the land is mineral."

According to Vanderburg (1938), Cinnabar was discovered on the Red Devil group of claims in the low hills one mile south of Beowawe in 1924. In 1928 the property was aquired by the Nevada-Mexico Mining Corporation, who erected a 30-ton-per-day rotary furnace and diesel power plant to treat the ore. The property closed down in 1929, with a total production of only 132 flasks of mercury. This was increased to 149 flasks by 1943, and the property has been idle since then. Bailey (1944) states:

> "The workings consist of a 150-foot shaft, about 2000 ft. of adits and crosscuts most of which are on two levels about 75 feet apart, and five small stopes which extend to a depth of only 60 feet below the surface. The ore occurs in a

silicified limestone conglomerate which strikes N25°E and dips 25° eastward. This bed, which is prominently exposed on the top of the ridge for a distance of over half a mile, is underlain by shale exposed only in the workings. A prominent flat-lying flow of andesite that caps the ridge to the west of the mine may have extended over the limestone during the period of mineralization. Cinnabar is concentrated along irregular vertical fractures and rubble zones that trend about N15°W through the silicified limestone conglomerate. Most of the cinnabar forms thin coatings on the rubble, but the mined ore consisted of conglomerate containing cinnabar veinlets and disseminated crystals. Most of the conglomerate is essentially barren, and the exhorbitant amount of development work done on the property was not justified by the surface showings."

Nonmetallic Deposits

Sand and Gravel

Sand and gravel have been removed from a pit in the southeast corner of Section 6 probably for construction of State Highway 21 and for local domestic purposes. No production records are available.

PREVIOUS INVESTIGATIONS

To the writer's knowledge, the only previous geologic work in this area was done by Anderson and Duberg, S. P. Company geologists, in 1916, who reported on Section 7, and a township report and map by Erskine and Lloyd, S. P. Company geologists, in 1925.

COMPILATION OF GEOLOGIC HISTORY

The following is a summary of the episodes of the complex geologic history of northcentral Nevada compiled by Oesterling (1960, p. 42-44). Episodes pertinent to this mapped area are indicated by an asterisk.

E P I S O D E S			D E S C R I P T I O N S
Depositional	Tectonic	Intrusive	
Recent			Infrequent stream runoff*; stream aggregation, and accumulation of post-Lake Lahontan alluvial fans;* desiccation of intermontane lakes;* formation of eolian deposits.
	Pleistocene (late) to Recent		Minor movements along normal faults, especially near range fronts;* formation of scarplets in pre-Lake Lahontan alluvial fans and Older alluvium.*

EPISODES			DESCRIPTIONS
Depositional	Tectonic	Intrusive	
Pleistocene (late)			Abundant rainfall, active stream and sheet-wash erosion, accumulation and dissection of extensive pre-Lake Lahontan alluvial fans;* [redacted] intermontane basins partly filled with water and lake sediment;* Lake Lahontan reached a maximum elevation of about 4,400 feet.
Pliocene-Pleistocene			Basaltic lava flows.
	Pleistocene		Dikes, largely basaltic and rhyolitic.
	Pliocene-Pleistocene		Maximum development of basin-range block faulting along general northerly trends;* this episode is largely responsible for the major features of the present topography.
Miocene-Pliocene			Extensive volcanic activity with deposition of tuff, tuffaceous and clastic sediments, and intercalated lava of the Truckee and Humboldt formations; deposition probably occurred in many separate basins developed by lava dams and normal faults.
Oligocene(?) to Miocene			Lava flows and agglomerates, largely andesite and basalt.*
	Oligocene(?)		Initiation of basin-range block faulting.

---Major erosional interval with intermittent uplift which prevented peneplanation; clayey fossil soil developed and coarse conglomerates were locally deposited; streams probably drained to the Pacific Ocean---

Depositional	Tectonic	Intrusive	Descriptions
		Cretaceous to Tertiary (early)	Emplacement of many widespread and varied igneous intrusives, commonly quartz monzonite to granodiorite; these intrusives may become progressively younger towards the east.
	Jurassic (late) to Cretaceous		Nevadan orogeny; west to east thrusts and regional dynamic metamorphism west of Winnemucca formed vast areas of phyllite and slate; east to west thrusts are indicated in some other areas, e.g, west flanks of Sonoma and East Ranges. (There is no evidence that this orogeny affected these two townships)

EPISODES			DESCRIPTIONS
Depositional	Tectonic	Intrusive	
Triassic to Jurassic			Two facies of marine deposits; Triassic conglomerate-carbonate facies in the east (Augusta sequence of overlap formations) and tremendously thick Triassic-Jurassic argillaceous deposit with some carbonates, west of a general north-south line through Winnemucca.
	Triassic (early)		Minor tectonic episode indicated by a slight angular unconformity between the Lower Triassic China Mountain formation and the Permian(?) - Triassic Koipato formation.
Permian(?) to Triassic			Accumulationsof lavas, pyroclastics, and clastic sediments of the Koipato formation, at least in part marine.
	Permian (late)		Major orogeny:1/ intense folding in western Nevada and large-scale west to east thrusts during post-Havallah-pre-Koipato time; these thrusts, probably including the Golconda thrust, carried highly folded Pumpernickel and Havallah formations into central part of the area from western Nevada, and at least as far east as the Shoshone Range; lower plate rocks were not greatly folded.
	Pennsylvanian & Permian		Intermittent uplift and subsidence indicated by disconformities between the various formations of the Antler sequence of overlap assemblage of Roberts, Hotz, Gilluly, and Ferguson (1958).
Pennsylvanian & Permian			Antler sequence of the overlap assemblage accumulated within Antler orogenic belt (Manhattan geanticline of Eardley) and the Eureka-Carlin sequence was deposited on the east side of the belt. Marine chert, sandstone, and local lavas of the Havallah formation accumulated in eugeosyncline of western Nevada.
Pennsylvanian(?) (early)			Chert and intercalated lavas of the Pumpernickel formation accumulated in the eugeosyncline of western Nevada.

1/ To be named "Sonoma orogeny" in a forthcoming publication by Norman J. Silberling and Ralph J. Roberts of the U. S. Geol. Survey, Menlo Park, Calif.

EPISODES	DESCRIPTIONS
Depositional Tectonic Intrusive	
Mississippian (early)	Roberts Mountains thrust fault culminated the Antler orogeny; chert, clastics and volcanics of western assemblage formations were carried eastward over the transitional assemblage and the carbonate and clastic sediments of the eastern assemblage.*
Devonian (late) & Mississippian	Folding and uplift of Antler orogeny in western Nevada, warping and uplift in central Nevada (Roberts, et al., 1958)*
Cambrian, Ordovician, Silurian & Devonian	Marine deposition of eastern miogeosynclinal,* transitional and western eugeosynclinal assemblages of Roberts, et al., (1958).

GENERAL GEOLOGIC SETTING

The western one-half of the township is situated in the low rolling hills on either side of the Humboldt River near the town of Beowawe and in the broad, low valley immediately to the south.

Rocks include Paleozoic Western assemblage sediments of unknown exact age, Tertiary andesitic flows and tuffs and Quaternary alluvial deposits.

Paleozoic Rocks

Western and Overlap Assemblage Strata (SU on map)

Nearly all of the sedimentary rocks cropping out north of the Humboldt River and a few small outcrops in Sections 5 and 6 south of it are of Paleozoic age. Although these rocks are similar lithologically to the Western assemblage Vinini of Ordovician age and the overlying Carboniferous-Permian Overlap assemblage rocks, no attempt was made to assign formational names to them as there was no fossil or other direct evidence to determine their exact stratigraphic position. To the writer's knowledge, there has been no detailed correlation or age determination done in this area.

The Paleozoic rocks consist of a series of interbedded, thin beds of dark chert, gray dolomite, dark gray, fine-grained quartzite, purple to gray, mottled, highly contorted mudstone and some soft, sandstone, siltstone, dark gray to black shale and possibly other slope forming units. These are overlaid nonconformably by lenses of highly silicified conglomerate composed of pebbles of the earlier units. The Paleozoic rocks as a whole are nearly horizontal, but locally are highly contorted and tightly folded. Individual beds have been mapped locally as separate units. The sediments are unconformably overlaid, in part, by andesitic flows and tuffs of Tertiary age.

Western Assemblage Rocks

Chert (ch on map)

The chert is commonly black to gray, but varies to white and pale green, thin-bedded (1" to 6"), contorted and generally interbedded with dolomite and/or dark shale. Although it is present in much of the Paleozoic outcrop area, it generally comprises only a small percentage of the outcrop. Consequently, the only areas that were mapped as chert are the white, thin-bedded outcrops at the Red Devil mine and a similar outcrop capping the hill about ½ mile to the northeast. These two chert outcrops are in fault contact with the underlying rocks and may be unrelated to the darker cherts north of the river. None are of sufficient size to be considered of economic significance.

Dolomite (dl on map)

The dolomite is gray to black, bedded (1" to 2"), interbedded with dark chert and/or variegated shale and mudstones. Beds are contorted and commonly have large cavities derived from weathered mud galls. Many scattered outcrops were noted and the larger one were mapped as separate units. Although no exact age relationship is known, it is believed that the dolomite beds lie near the top of the chert horizon. Dolomite beds are fairly thin and impure due to the interbedded material and it is believed that they are of insufficient size or quality to be considered of economic significance.

Quartzite (q on map)

Outcrops exhibit beds and lenses of light brown, gray and red, fine-grained, very hard, thin-bedded to massive, highly cemented quartzite. The outcrop in the NW¼ Section 4 has been quarried to a small extent, probably for ballast material. This and the outcrop in the SW¼ Section 3 are favorably situated with respect to the railroad, but are considered to be of insufficient quality for anything but ballast material. Very little quartzite crops out on Company-owned land.

Overlap Assemblage Rocks

Conglomerate (cg on map)

The conglomerate is a coarse to fine, angular-grained, highly silicified pebble conglomerate, derived from underlying Paleozoic chert, quartzite and dolomite. It is locally stained with red-brown and orange limonite and resembles the Battle conglomerate further west. Locally it is cemented with silica to a pebble quartzite. It may be equivalent to the Tonka formation of Miss.-Penna. age described from exposures in Carlin Canyon by Dott (1955, p. 2222-33).

Several prospect pits have been dug in and adjacent to the conglomerate outcrops, but no valuable minerals were observed in any of them. Conglomerate has been quarried in the NW¼ Section 2, probably for ballast. No economic significance is attached to this conglomerate.

Tertiary Volcanic Rocks

Tertiary Andesite and Tuff (Tv on map)

Tertiary volcanics crop out north of the Humboldt River in Sections 2, 3, 10 and 11. They are unconformable upon the folded Paleozoic strata in this area. The rock is gray, brown, to black, fine-grained to dense, massive, finely porphyritic andesite. It is highly weathered and commonly forms a smooth surface. It is closely associated with, and perhaps interbedded with, greenish-brown, earthy, tuffaceous material. The age of the volcanics is not known, but it is possibly equivalent to those described by Regnier (1958) a few miles to the east, near Palisade. Regnier (1958, p. 10) states:

> "Three miles northwest of Palisade, gently dipping andesite flows overly vertical silicified Paleozoic conglomerates, and along the eastern edge of the range the 'younger volcanics' underlie the upper Miocene Raine Ranch formation and the pre-upper Miocene Emigrant and Rand Ranch formations......The widespread volcanics of the Emigrant Pass are continuous with those south and west of Palisade. To judge from their state of folding and alteration and the presence of diorite intrusives, they are presumably the 'Older Volcanics' of Reeves and Shawe".

Reeves and Shawe (1956) consider these "Older Volcanics" to be of Eocene or Oligocene age. No economic significance is attached to these volcanics.

<u>Shoshone Andesite</u> (Tsa on map)

Shoshone andesite 1/ crops out as a lava cap on the mesa in the $S\frac{1}{2}$ of Section 6. Here it is typically a brown to lavender, platy, porphyritic andesite with small (up to 2 mm), honey-colored olivine and feldspar phenocrysts giving it a mottled appearance. It locally ranged from dacite to black vesicular basalts near the surface of the flow. No economic significance is attached to this unit.

TERTIARY ROCKS

Volcanic Rocks of the Cortez Mountains

The volcanic rocks of the Cortez Mountains are a series of flows, mostly of andesitic to dacitic composition, and pyroclastic rocks that overlie Paleozoic rocks unconformably. This volcanic series can further be subdivided into older and younger rocks separated by an angular unconformity. Rocks of this group are confined to the western township but extend in a wide belt, both north and south in adjacent parts of the Cortez Mountains.

1/ Not a published name. Used in S.P. Co. reports for correlative purposes.

Older Volcanics

All but a minor part of the formation consists of volcanic flows, which range in thickness from a few feet to several hundred feet. The reddish-brown and tannish weathering porphyritic flows that constitute the major part of the series are typically layered but are devoid of internal structure. In many localities visited by the writer, flow structure was not observed. Many of the finer grained flows of this lower member are black, gray, or maroon and weather to shades of brown and green; they appear to be less resistant to weathering than the bulk of the porphyritic flows so their topographic expression is mostly depressed.

According to Reeves and Shawe (1956, p. 1779), the older volcanic and pyroclastic rocks of the Cortez Mountains are at least 2,500 feet thick. The base is not exposed however.

Younger Volcanics

Unconformably overlying the older series is a younger sequence of similar lithology. Within the subject area, however, only dark, finely porphyritic andesite flows were mapped in this member. Reeves and Shawe (1956, p.) gave in adjacent areas, recorded in the younger series, interbedded tuff and flows of andesite to rhyolitic composition.

A fossil locality in Section 13, T.32N., R.50E., in a road out in the south side of U. S. Highway 40, has yielded fresh water gastropods of Cretaceous or early Tertiary age (Regnier, 1958, p. 11). Because of lithologic similarities of these rocks with others in the Basin-Range of early Tertiary age, an Eocene age is assigned volcanic rocks of the area.

Safford Canyon formation (Tsc on map)

The Safford Canyon formation crops out in Sections 1, 2, and 18 of T.31N., R.51E. It consists of approximately 700 feet of waterlaid tuffs, tuffaceous sandstones and conglomerates, which unconformably overlie the Older Volcanic rocks of the Cortez Mountains. The Safford Canyon is apparently overlaid by the Raine Ranch formation on the east and by the Palisade Canyon rhyolite on the north. Regnier (1960) described and named the Safford Canyon formation after a tributary of the [redacted] Humboldt River by the same name in the western part of this mapped area.

The lower 50 feet of this formation is a lenticular volcanic pebble-conglomerate derived from the volcanic rocks of the Cortez Mountains. The rest of the formation in this area consists of white to tan vitric interbedded tuff, conglomerate, thin limestone and sandstone. According to Regnier (1960, p. 1193-1194):

> "Most of the vitric tuffs are altered to heulandite and to green chert. Both types of alteration occur in the same beds. Fresh volcanic glass in two beds has an index of refraction which indicates a rhyolitic composition. Fine bedding, cross-lamination, and intraformational conglomerates indicate that the tuffs are water-laid. They are mixed with up to 20 percent volcanic sand."

This heulandite is not considered to be of economic importance because of thinness of the beds, the large percentage of impurities and the fact that there are no outcrops on Company-owned land. Although no fossils have been found in the Safford Canyon formation, Regnier (1960) considers it to be late Oligocene to early Miocene because of its stratigraphic position.

Pleistocene Surficial Deposits

<u>Older Alluvium</u> (Qoal on map)

Unconsolidated and generally stratified silt, sand and gravel covers most of the broad Crescent Valley and laps up on the lower slopes of the hills. This Older Alluvium is also present as river cut terraces or high-level gravels above the present Humboldt River flood plain in Sections 4 and 9. These deposits were derived from weathered bedrock in the mountainous areas and transported by stream action during periods of heavy rainfall in Pleistocene time. They have been tilted slightly by faulting and differential settling and later dissected by Recent stream erosion. These older deposits are overlaid by the Recent playa, fan, talus and other alluvial deposits which are being intermittently built up by silt-laden flood waters. There is a general sorting of these deposits, both vertically and horizontally, with the coarser material being deposited closer to the hills and at deeper horizons due to a decrease of slope and stream gradients.

Recent Sediments

<u>Silty Alluvium</u> (Qsal on map)

Recent clastic deposits consisting of clay, silt, and fine sand have been deposited for a width of approximately one mile along the Humboldt River as silty alluvium of the central valley fill. These flood-plain materials were mainly deposited by the meandering Humboldt River. They are approximately the same age as the playa deposits of Crescent Valley and are overlaid by the more recent alluvium, landslides and alluvial fans.

<u>Playa Deposits</u> (Qp on map)

The center of Crescent Valley has apparently been downfaulted and filled with Recent playa lake deposits consisting of clay, silt, and fine sand. These deposits are characterized by moderate to extreme alkali and efflorescent salt conditions. Vegetation is sparse and allows the surface to erode rapidly by wind and stream action. The outlines on the playa surface of an old meandering stream can be seen on the aerial photographs.

The deposits are approximately the same age as the silty alluvium of the central valley fill and are overlaid by the more recent alluvium and alluvial fans.

<u>Landslide Debris</u> (Qls on map)

Landslide debris forms the northwestern slope of the mesa in the western part of Section 6. The debris is predominantly crushed and broken Shoshone andesite from the mesa cap. The scarp is typical of a landslide with a depression at the base and the landslide rubble extends towards the valley.

Volcanic Talus (Qvt on map)

Andesite rubble covers the slopes of the lava-capped mesa in the SW$\frac{1}{4}$ of Section 6. This rubble is predominantly [redacted] crushed and broken Shoshone andesite and obscures the underlying formations.

Alluvium and Alluvial Fans (Qal and Qf on map)

The modern stream channels are lined with Recent alluvium consisting of unconsolidated silt, sand, gravel and boulders. Some of the finer particles are deposited at the mouth of these present streams in the form of alluvial fans.

STRUCTURAL FEATURES

The most prominent structural feature in this area is the north-easterly-trending range-front fault scarp in the northwest corner of the map, resulting from basin-range block faulting of late Pliocene to Pleistocene age. Hot springs in the adjoining township to the north are probably related to this fault and active geysers are directly associated with it a few miles to the southwest. However, there is no suggestion of thermal activity in this area.

A minor northeasterly-trending low-angle fault has cut and brecciated the Paleozoic sediments at the Red Devil mine in Section 6. The mineralization is apparently controlled by the fault. What may be a northeast extension of this fault trend separates the white, easterly-dipping chert from the westerly-dipping Paleozoic conglomerate in the NW$\frac{1}{4}$ of Section 5. This fault may be a thrust bringing older white cherts into contact with the younger Paleozoic strata. If so, this would account for the fact that the Red Devil ore was present only near the surface and apparently above the fault.

Several minor faults were observed cutting the alluvium in Crescent Valley. One such fault apparently dropped part of the valley floor down thus forming a Recent playa lake. These faults of Pleistocene to Recent age, are clearly identified on the aerial photographs. Displacement of the sediments can generally be seen, but some of the most recent small scarplets are indicated only as lineations of green vegetation due to the availability of water along the fault trace.

The Paleozoic sediments north of the Humboldt River are very locally contorted and highly folded, but no evidence was observed of any major folds in the area.

FIELD WORK

Seven man-days were spent in the field on this township during June, 1960.

RECOMMENDATIONS

No further work is recommended for this area at this time.

R. E. Willson

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Sacramento - August

SUBJECT: Analysis of Water from Land Department

Mr. Robert E. Willson:

Referring to your letters of June 29th and July 11th regarding six samples of water from Nevada.

The six samples of water were all received July 12th and results listed in the attached report.

Water R-36-31-48-lwi (Wa) Crescent Valley could be used for drinking water. However, the hydrogen sulfide would need be removed by either aeration or chlorination before delivering to the consumer.

The other water contain fluorides in excess or at the maximum of 1.5 ppm. Public Health Drinking Water Standards of 1946 states that fluoride in excess of 1.5 ppm shall constitute grounds for rejection. Water from R-17-28-49-lwi (Wa) Creek is at the upper limits. It is possible that another sample would be lower in fluorides.

Waters R-17-31-48, R-01-29-48, R-10-28-49 and R-33-29-49 are not suitable for drinking water.

With the exception of R-10-28-49-lwi (Wa), all the water could be used for irrigation. Water R-10-28-49-lwi (Wa) contains 5.0 ppm of boron which is injurious to crops.

J. G. Maurer

Attachment

cc: Mr. P. V. Garin
Mr. G. A. Kiersch

Results in PPM unless otherwise indicated.

	R-36-31-48-1wi (Wa) Crescent Valley	R-17-31 48-1wi (Wa) Beowawe	R-01-29 48-1wi (Wa) Crescent Valley
Silica Dioxide as SiO_2	70	263	50
Iron as Fe	0.1	0.2	None
Aluminum as Al	None	None	None
Calcium as Ca	13	None	31
Magnesium as Mg	2	None	44
Sodium as Na	81	203	300
Potassium as K	18	23	66
Lithium as Li	None	2.9	4.7
Ammonium as MH_4	None	None	None
Arsenic as As	0.01	0.05	0.01
Carbonates as CO_3	None	120	None
Bicarbonates as HCO_3	159	73	512
Sulfates as SO_4	53	122	121
Chlorides as Cl	44	52	50
Fluorides as F	0.9	12.6	6.0
Boron as B	None	None	None
Sulfur as H_2S	11	None	None
Mercury	None	None	None
Copper	.007	.008	None
Tungsten	None	Trace	None
Barium	None	None	None
Silver	None	None	None
Molybdenum	None	Trace	None
Alkalinity as $CaCO_3$	260	290	840
Selenium	None	Not Done	Not Done
Nitrogen as NO_3	None	None	None
Total Dissolved Solids by Evaporation	433	921	1157
Total Dissolved Solids by Analysis	452	871.75	1184.71
pH	6.9	9.3	6.6
Hardness, Grains/ Gal.	2.6	None	15
O.K. for Domestic Use	No	No	No

Results in PPM unless otherwise indicated.

	R-10-28-49-1wi (Wa) Hot Spring	R-33-29-49-1wi (Wa) Well	R-17-28 49-1wi (Wa) Creek
Silica Dioxide as SiO_2	174	14	27
Iron as Fe	0.1	0.2	2
Aluminum as Al	None	None	None
Calcium as Ca	2	42	28
Magnesium as Mg	4	11	38
Sodium as Na	280	24	54
Potassium as K	39	3.0	8
Lithium as Li	3.3	None	None
Ammonium as MH_4	None	None	None
Arsenic as As	0.03	0.01	0.01
Carbonates as CO_3	None	12	48
Bicarbonates as HCO_3	244	102	134
Sulfates as SO_4	148	58	94
Chlorides as Cl	88	50	34
Fluorides as F	11.4	1.8	1.5
Boron as B	5.0	None	None
Sulfur as H_2S	None	None	None
Mercury	None	None	None
Copper	.008	.005	.008
Tungsten	None	Trace	None
Barium	None	None	None
Silver	None	None	None
Molybdenum	None	None	None
Alkalinity as $CaCO_3$	423	190	300
Selenium	None	None	None
Nitrogen as NO_3	None	8	None
Total Dissolved Solids by Evaporation	980	362	468
Total Dissolved Solids by Analysis	998.83	318.0	468.51
pH	7.8	7.6	8.3
Hardness, Grains/Gal.	1.3	9	13.5
O.K. for Domestic Use	No	No	No

APPENDIX "B"

EMpire 3-3302 Hand Sample Serial 92002

ASSAY REPORT

UNION ASSAY OFFICE, Inc.

J. V. SADLER, President
W. C. WANLASS, Vice-Pres. & Treas.
LILY M. HOTTINGER, Secretary
Salt Lake City 10, Utah

Southern Pacific Land Company
65 Market Street Room 205
San Francisco 5, California

RESULTS PER TON OF 2000 POUNDS July 6, 1960

NO.	GOLD Ozs. per Ton	SILVER Ozs. per ton	LEAD Per Cent Wet	COPPER Per Cent	INSOL. Per Cent	ZINC Per Cent	SULPHUR Per Cent	IRON Per Cent	LIME Per Cent	Per Cent	Per Cent	VALUE GOLD
R-03-31-49-1Wi	Trace	0.20										

Remarks

Charges $ 2.00

W. C. Wanlass

Phone EMpire 3-3302 Hand Sample Serial 9200

Southern Pacific Land Company
65 Market Street Room 205
San Francisco 5, California

RESULTS PER TON OF 2000 POUNDS July 6, 1960

ASSAY REPORT

UNION ASSAY OFFICE, Inc.

J. V. SADLER, President
W. C. WANLASS, Vice-Pres. & Treas.
LILY M. HOTTINGER, Secretary

Salt Lake City 10, Utah

NO.	GOLD Ozs. per Ton	SILVER Ozs. per ton	LEAD Per Cent Wet	COPPER Per Cent	INSOL. Per Cent	ZINC Per Cent	SULPHUR Per Cent	IRON Per Cent	LIME Per Cent	Per Cent	Per Cent	VALUE GOLD
R-03-31-49-1Wi	Trace	0.20										

Remarks

Charges $ 2.00

W. C. Wanlass