NEVADA BUREAU OF MINES

Vernon E. Scheid, Director

BULLETIN 53
(Formerly University of Nevada Bulletin, Geology and Mining Series)

IRON ORE DEPOSITS OF NEVADA
(Prepared in cooperation with the United States Geological Survey)

PART A. GEOLOGY AND IRON ORE DEPOSITS OF
THE BUENA VISTA HILLS, CHURCHILL AND
PERSHING COUNTIES, NEVADA

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Price 50c

UNIVERSITY OF NEVADA
RENO, NEVADA
1955
STATE OF NEVADA
CHARLES H. RUSSELL, Governor

UNIVERSITY OF NEVADA
MINARD W. STOUT, President

NEVADA BUREAU OF MINES
VERNON E. SCHEID, Director

NOTICE

CHANGE IN TITLE OF BULLETIN SERIES

Since 1939, the reports of the Nevada Bureau of Mines and associated organizations (see list of publications in back) have been published as the Geology and Mining Series of the University of Nevada Bulletin. Although the Bureau's reports were separately numbered as issues of the Geology and Mining Series, this arrangement has not proved entirely satisfactory; for, they were a sub-series in a periodical that published predominantly administrative pamphlets; such as, the University of Nevada Catalogue and similar material.

To eliminate the bibliographic confusion resulting from this unnatural arrangement the Bureau will publish its reports in a series to be known as the NEVADA BUREAU OF MINES BULLETIN. University of Nevada Bulletin, vol. XLVII, No. 1 (Geology and Mining Series No. 51), January 1953, is the last Bureau report that will be published as part of the University of Nevada Bulletin.

The NEVADA BUREAU OF MINES BULLETIN will be numbered in numerical sequence with the issues of the discontinued Geology and Mining Series, and will start with Bulletin 52; which is now in preparation. The NEVADA BUREAU OF MINES BULLETIN will conform in general format and size with the issues of the discontinued Geology and Mining Series, and thus, may be bound conveniently with these earlier published reports.
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A cooperative program for mineral and geologic investigations and topographic and geologic mapping within Nevada was started in July 1951, between the United States Geological Survey and the Nevada Bureau of Mines. Because of the increasing importance of the production of iron ore in the mineral industry economy of the State, a study of the "Iron Ore Deposits of Nevada" was planned as part of the cooperative program, and was started in the summer of 1952.

Iron ore deposits have been known in Nevada since the late 1800's, but were exploited to a very limited extent before the early 1900's. Iron ore was mined in the decade prior to World War I and during World Wars I and II, but virtually none was mined in the period between the wars nor immediately following World War II. After the outbreak of the Korean War, demands for ore for domestic use and for export to Japan led to the resumption of mining, and in 1952 more than 1,000,000 tons of iron ore were mined in the State.

This report, "Geology and Iron Ore Deposits of the Buena Vista Hills, Churchill and Pershing Counties, Nevada," by Robert G. Reeves, Geologist, U. S. Geological Survey and Victor E. Kral, Mining Engineer, Nevada Bureau of Mines, covers one of the most important iron ore producing areas in the State. It is the first part to be completed of the bulletin that will cover the full study on "Iron Ore Deposits of Nevada." Additional reports, covering the iron ore deposits in other sections of the State, are in preparation and will be published by the Nevada Bureau of Mines as they are completed.

VERNON E. SCHEID, Director,
Nevada Bureau of Mines.

December 1954.
Mackay School of Mines,
University of Nevada.
GEOLOGY AND IRON ORE DEPOSITS OF THE
BUENA VISTA HILLS, CHURCHILL AND
PERSHING COUNTIES, NEVADA

By ROBERT G. REEVES and VICTOR E. KRAL

ABSTRACT
The Buena Vista Hills iron ore deposits are in southern Pershing and northern Churchill Counties, Nev., about 20 airline miles southeast of Lovelock in the Mineral Basin mining district. Iron ore was first mined in the area during the 1880's, but production was not appreciable before World War II. Approximately 563,000 tons of iron ore was produced to the end of 1952.

The main iron ore deposits are on the north, northwest, and southwest flanks of the Buena Vista Hills, a north-trending spur of the Stillwater Range (fig. 1). The oldest rocks in the area are a series of volcanic and sedimentary rocks that are tentatively correlated with the Leach formation of Pennsylvanian(? ) age. These rocks have been intruded and metamorphosed by a dioritic intrusive rock of Jurassic(?) age. The dioritic rock, which underlies most of the Buena Vista Hills area, has been altered to a scapolite-hornblende rock. Rhyolitic to latitic pyroclastic and flow rocks of Tertiary age overlie the scapolitized intrusive, and they are in turn overlain by basalt of late Tertiary or Quaternary age. A beveled rock surface, cut in the metamorphic and intrusive rocks and thinly veneered with gravel, surrounds the hills on the north and west. Elsewhere the hills are bordered by Quaternary alluvium and lake sediments.

The principal ore deposits are replacement bodies of magnetite in scapolitized diorite, although some are replacement bodies and veins in the metamorphic rocks and veins in the scapolitized diorite. The iron mineralization is thought to be genetically related to the scapolitization of the diorite. The deposits contain an estimated several hundred thousand tons of indicated ore, and well over a million additional tons may be inferred. Intensive prospecting and magnetic surveying have resulted in several significant ore discoveries.

Four mines were operating at the time of this study. Ore was produced at a daily rate of approximately 2,500 tons in June 1952, but production dropped to 1,500 tons per day by the end of January 1953.

GEOGRAPHY
The Buena Vista Hills are in southeastern Pershing County and northeastern Churchill County, Nev., approximately 20 airline miles southeast of Lovelock in the Mineral Basin mining district (fig. 1). The iron ore deposits are in three main areas of the Buena Vista Hills: the southwestern flank in T. 24 N., R. 34 E.; the northeastern flank in T. 25 N., R. 34 E.; and the northwestern flank in T. 26 N., R. 34 E., Mt. Diablo base and meridian (pl. 1). The deposits are readily accessible over a good graveled road, the Coal Canyon road, that leaves U. S. Highway 40 at a point 8 miles north of Lovelock (fig. 1). The Buena Vista mine is 26 miles, the
Iron Ore Deposits of Nevada

Segerstrom-Heizer mine 22 miles, and the Thomas mine 18 miles from the highway.

The Southern Pacific Railroad is parallel to U. S. Highway 40 north of Lovelock, and railroad company loading facilities are available at Woolsey, 3 miles north of the junction of Highway 40 and the road to the mines. In addition to the Woolsey siding, loading facilities have been constructed at the junction of the Coal Canyon road and Highway 40 by the two largest producing companies, Mineral Materials Co. and Dodge Construction Co.

FIGURE 1. Index map showing location and principal mines in the Buena Vista Hills area, Churchill and Pershing Counties, Nev.

The Buena Vista Hills are a well-defined spur about 9 miles long and 3 miles wide that juts north from the northwest-trending Stillwater Range. The hills form a low divide that separates the Buena Vista Valley on the northeast from the Carson Sink on the southwest. They stand out as a moderately rugged land form rising above the valley floor, whose altitude is 4,100 feet. They are separated into northern and southern parts by a west-trending valley, which is 1 to 1 1/2 miles wide in most places and over three-fourths of a mile wide at its narrowest point. The highest point of the hills is in the northern part, slightly more than 5,200 feet above sea level. Several other points in both the northern and the southern parts exceed 5,000 feet in altitude.

The hills are flanked by an outward-sloping beveled rock surface or pediment, covered with a thin veneer of sand and gravel, that extends more than a mile from the hills and disappears under Quaternary lake sediments and alluvium. Iron ore outcrops in the pediment are small and inconspicuous, but several deposits have been found under the pediment gravels by magnetic surveys.

The annual precipitation, mainly from winter snow storms and summer thunder showers, averages about 6 inches and will support desert brush and scattered small sage. Water from wells drilled in the valleys surrounding the Buena Vista Hills is suitable only for mining and road watering; a content of more than 1 percent soluble material, mainly sodium chloride, makes it impotent and unsatisfactory for cooling systems. Domestic water could be developed in the Stillwater Range, about 8 miles to the east; at present, however, water for drinking and use in cooling systems is hauled from Lovelock.

Summer temperatures may reach 100° F. Although freezing temperatures prevail during the winter, the snowfall is light and seldom impedes mining operations.

The mine area is uninhabited; the nearest ranches are 20 miles to the north, in Buena Vista Valley. Most mine workers live in Lovelock and commute to the mines in private buses and cars.

HISTORY AND PRODUCTION

The iron ore deposits are not mentioned by Raymond (1870) in the earliest known reference to the district, although the conspicuous black outcrops may well have been observed by the early immigrants on their way to California. The first recorded production of iron ore was in the late eighties (Vanderberg, 1936), when 500 tons was shipped to the Union Iron Works in San Francisco by the Reid brothers of Lovelock; however, as most of the ore...
was found to occur on land belonging to the Central Pacific (now Southern Pacific) Railroad, operations were suspended. The important production from this area began with the demand for highgrade iron ore for metallurgical use and for permanent ballast by the ship-building industry during World War II (Allen and Kral, 1945). With the end of the war, the demand tapered off and production dropped.

A shortage of “hard-lump” open hearth ore in the eastern United States, expansion of the western United States steel industry, and a need for iron ore by the rehabilitated Japanese steel industry after the end of World War II led to the resumption of iron mining in the Buena Vista Hills area in 1950. The Buena Vista Hills iron ore producers, unable to furnish blast furnace ore to domestic markets because of the expensive rail haul and higher cost of mining the small deposits, could supply the Japanese market so long as a premium price prevailed. Approximately 90 percent of the iron ore produced in Nevada during 1952 was shipped to Japan. The iron content of this ore was 57 percent or higher. This ore had a value of approximately $5 per ton at the railroad siding, and the cost at the Japanese smelters was about $25 per ton. The Japanese demand diminished early in 1953, but the domestic market for open hearth ore increased.

Total iron ore production from the Lovelock area to the end of 1952 was 563,000 tons, of which an estimated 30,000 to 40,000 tons was consumed domestically as open hearth ore. Production figures of mines of the Buena Vista Hills are summarized in table 1.

**TABLE 1. BUENA VISTA HILLS PRODUCTION, IN LONG TONS, 1943-1952**

<table>
<thead>
<tr>
<th>Year</th>
<th>Buena Vista mine</th>
<th>Segerstrom-Heizer mine</th>
<th>Thomas mine</th>
<th>American Ore Co. mine (Stoker-Marker; Parker Bros.)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1943</td>
<td>none</td>
<td>4,449</td>
<td>none</td>
<td>*2,009</td>
<td>6,500</td>
</tr>
<tr>
<td>1944</td>
<td>none</td>
<td>48,690</td>
<td>none</td>
<td>48,900</td>
<td></td>
</tr>
<tr>
<td>1945</td>
<td>none</td>
<td>5,386</td>
<td>none</td>
<td>5,386</td>
<td></td>
</tr>
<tr>
<td>1946</td>
<td>none</td>
<td>3,342</td>
<td>none</td>
<td>3,342</td>
<td></td>
</tr>
<tr>
<td>1947</td>
<td>none</td>
<td>8,822</td>
<td>none</td>
<td>8,822</td>
<td></td>
</tr>
<tr>
<td>1948</td>
<td>none</td>
<td>1,080</td>
<td>none</td>
<td>1,080</td>
<td></td>
</tr>
<tr>
<td>1949</td>
<td>none</td>
<td>600</td>
<td>none</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>1950</td>
<td>none</td>
<td>none</td>
<td>*4,000</td>
<td>*4,000</td>
<td></td>
</tr>
<tr>
<td>1951</td>
<td>10,000</td>
<td>153,600</td>
<td>15,975</td>
<td>10,000</td>
<td>22,000</td>
</tr>
<tr>
<td>1952</td>
<td>*233,000</td>
<td>235,200</td>
<td>*12,000</td>
<td>*12,000</td>
<td>*652,000</td>
</tr>
<tr>
<td>Total</td>
<td>*286,000</td>
<td>235,200</td>
<td>*12,000</td>
<td>*652,000</td>
<td></td>
</tr>
</tbody>
</table>

1 Data obtained from company records and published with permission of the owners.
2 From October 1951 to December 11, 1952.

GEOLOGY

Volcanic and sedimentary rocks of Pennsylvanian (?) age have been intruded and metamorphosed by diorite of Jurassic (?) age. Most of the Buena Vista Hills area is underlain by the diorite. Lamprophyre dikes cut the intrusive rock but are abundant only in the southwestern part of the area. Tertiary pyroclastic and flow rocks are exposed along the eastern side of the Hills. Quaternary alluvium and lake sediments surround the Hills on the north, east, and west. The low hills that form the northwestern extremity of the Buena Vista Hills are composed mainly of metamorphic and intrusive rocks, in places capped by basalt of late Tertiary and Quaternary age.

METAMORPHIC ROCKS

The oldest rocks (table 2) exposed in the Buena Vista Hills are metamorphosed volcanic and sedimentary rocks that are tentatively correlated with the Leach formation of Pennsylvanian (?) age. The Leach formation is exposed in the East Range to the northeast, and in the Stillwater Range to the east. The nearest recorded exposure is 20 miles northeast of the area mapped in this study (Muller, Ferguson, and Roberts, 1951).

| Table 2. Stratigraphic Sequence of the Buena Vista Hills |
|-----------------|-----------------|-----------------|
| Age             | Formation       | Character       |
| Quaternary      | Alluvium and Lake | Alluvial detritus, sand, gravel, and calcareous tufa. |
|                  | Lahontan sediments |                |
| 7.7-3.3         | Extrusive rock   | Basalt.         |
| Tertiary        | Pyroclastic and flow | Rhyolite—lattice and perlite. |
| Jurassic (?)    | Dikes           | Lamprophyre dikes. |
| Jurassic (?)    | Intrusive rock  | Diorite, scapolitized. |
| Pennsylvanian (?)| Leach (?) formation | Metamorphic rocks, silicified limestone and quartzite. |

The metamorphic rocks have wide areal distribution around the flanks of the Buena Vista Hills (pl. 1). They crop out in the vicinity of the Thomas mine and Ford prospect, east and southeast of the Segerstrom-Heizer mine, and in the vicinity of the Buena Vista mine. The metavolcanic rocks have more numerous exposures and underlie a much larger area than the metasedimentary rocks. Many roof pendants of the metamorphic rocks are found in the intrusive, particularly near its borders. The contact between
the intrusive body and the metamorphic rocks dips gently, especially in the southern part of the Hills, which, combined with rolling topography, makes the outcrop of the contact very irregular.

The metavolcanic rocks are dark green, gray-green, or gray and are most commonly fine grained and even textured; though some are porphyritic. They are probably equivalent to the metavolcanic members of the Leach formation exposed in the East Range. A distinctive porphyritic member composed of large white tabular phenocrysts with subparallel orientation in a fine-grained groundmass is exposed in the northwestern part of the Hills, southeast of the Ford prospect, and north and east of the Thomas mine. The best exposures of the metavolcanic rocks are in the canyons in the southern part of the Buena Vista Hills.

The fine-grained metavolcanic rock is composed principally of albite with small amounts of interstitial augite, chlorite, biotite, hornblende, magnetite, and hematite. Magnetite and hematite are abundant locally and may amount to as much as 10 percent of the rock. Some of the rocks contain remnants of pyroxene (?) crystals, now outlined by magnetite and replaced by magnetite, chlorite, or scapolite (figs. 2 and 3). Many of the albite crystals have been sericitized. Calcite veinlets cut the rock, and calcite has replaced the other minerals of the rock locally (fig. 4). In some places, calcite has been replaced by sphene and magnetite, which are also abundant accessory minerals in some specimens.

The porphyritic metavolcanic rock consists of large andesine (An₉₅) to labradorite (An₃₅) phenocrysts in a fine-grained groundmass. The groundmass is composed largely of sericitized albite with minor amounts of augite, hornblende, chlorite, and magnetite. A few relic phenocrysts of pyroxene, almost completely altered to chlorite, can be seen.

The dominant metamorphism of the Leach (?) formation was albitization and probably occurred as a result of the same igneous activity responsible for the emplacement of the dioritic intrusive. Near the contact with the intrusive and along faults through which solutions could circulate, the rocks of the Leach (?) formation were partly recrystallized iron, phosphorus, titanium, lime, carbon dioxide, and chlorine were introduced to form scapolite, sphene, calcite, apatite, and magnetite.

A light-colored metasedimentary rock is exposed on the west flank of Chocolate Butte, the basalt-capped hill east of the Segerstrom-Heizer mine. This member consists of interbedded silicat
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10

limestone and quartzite. Bedding and other primary structures have been largely destroyed by deformation.

The stratigraphic position of the metasedimentary member could not be determined with certainty due to lack of exposures of its contact with the metavolcanic member, but it appears to overlie the metavolcanic member. No attempt has been made to map the metavolcanic and metasedimentary members separately.

The silicated limestone contains hedenbergite, oligoclase-andesine (An₄₅), actinolite-tremolite, calcite, scapolite, ilmenite, and leucoxene. The rock is fine to medium grained with large areas composed of hedenbergite grains that range in length from 0.02 to 2 mm, plagioclase grains as much as 0.5 mm long, and amphibole grains as much as 1 mm long.

The quartzite consists of small subrounded to angular quartz grains, 0.05 to 0.4 mm in diameter, cemented by quartz. Quartz overgrowths are found on many of the grains. Fine-grained aggregates of other minerals, magnetite partly altered to limonite (?), rutile partly altered to leucoxene (?), calcite, apatite, and clay minerals are scattered through the rock.

DIORITE

Most of the Buena Vista Hills area is underlain by a dioritic intrusive rock (pl. 1). The diorite has been altered to a rock composed principally of scapolite and hornblende, except in a small area northeast of the Thomas mine. This unaltered diorite is light to dark gray-green and medium- to coarse-grained and is composed of large plagioclase laths and interstitial augite and hornblende. Many of the crystals are more than 5 mm wide and as much as 10 mm long.

The unaltered diorite is composed of 60 to 65 percent plagioclase that ranges in composition from andesine (An₄₅) to labradorite (An₂₅), 25 to 30 percent hornblende, and 10 to 15 percent augite. Minor constituents are biotite, sphene, magnetite, and apatite. The texture is intersertal; large laths of plagioclase enclose grains of augite and hornblende. All specimens examined showed some scapolitization and sericitization of the plagioclase (fig. 5). Some of the hornblende appears to be primary, but most is secondary after pyroxene. Part of the hornblende has been altered to a sodic hornblende, and both the augite and hornblende are partly altered to chlorite. Calcite veinlets cut the rock.

Two varieties of scapolitized rock can be recognized, based on the nature of the scapolite crystals and their relationship to the hornblende. The first variety resembles the unaltered intrusive but is composed mainly of scapolite and hornblende. The second variety consists of large bladed scapolite crystals poikilitically enclosing smaller hornblende grains. The latter are recognizable with the unaided eye and give the rock a dusty appearance. Less hornblende is present than in the first variety, and locally the rock appears to be composed entirely of scapolite. The scapolite crystals commonly form radiating clusters that weather out as nodules from 1 to 2 inches in diameter. The scapolite of both varieties is extremely poikilitic, with many inclusions of chlorite, hornblende, and magnetite. Index determinations place the scapolite near the sodium-chlorine bearing end member marialite.

The scapolitized diorite is cut by veins of scapolite that appear to have formed along preexisting joints and fractures. The veins
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contain well-developed crystals oriented normal to the walls (figs. 6 and 7). In the area north of the Buena Vista mine (pl. 2), this development of scapolite crystals has worked outward from the veins and changed the scapolitized diorite to a coarse-grained rock composed almost entirely of scapolite.

Petrographic study of the scapolitized diorite shows that most of the plagioclase has been altered to scapolite, though the conversion is generally not complete (fig. 8), and even the most highly altered diorite may show relic outlines of plagioclase laths. Small inclusions of amphibole and chlorite are seen in the scapolite (fig. 9), and calcite has cut and partly replaced the rock.

Scapolite has been replaced by magnetite oriented along crystallographic directions of the scapolite. In addition, magnetite commonly separates scapolite crystals (fig. 10). Hornblende is abundant and often comprises 30 percent of the rock. Minor though important accessory minerals are sphene and apatite.

Near the magnetite bodies the altered dioritic rock has undergone further intense hydrothermal alteration. Much of the scapolite has been altered to sericite and clay minerals, and the ferromagnesian minerals have been altered to chlorite. The resultant rock is light to dark green and is composed mainly of sericite and chlorite with a large amount of disseminated magnetite.
No definite age can be assigned to the diorite on evidence found in this area. The Buena Vista Hills are a north-trending spur of the Stillwater Range to the south. From a study of aerial photographs the Buena Vista Hills appear to have been downthrown with respect to the main range by northeast-trending faults. The northern and central parts of the Stillwater Range are underlain by a diorite batholith of Jurassic (?) age, which intrudes upper Triassic rocks (Muller, Ferguson, and Roberts, 1951; Schrader, 1947). The diorite of the Buena Vista Hills is believed to be an outlier of this batholith and is therefore dated as Jurassic (?). The Buena Vista Hills diorite intrudes rocks of Pennsylvanian (?) age.

DIKE ROCKS

Lamprophyre dikes cut the diorite in the vicinity of the Buena Vista mine in the southern part of the hills but are not found elsewhere in the area studied. The dikes are dark colored and fine-grained, and except where altered are easily distinguished from the diorite. In the ore zone, where chloritization, kaolinization, and sericitization are prevalent, it is generally not possible to distinguish between the dikes and the diorite. Dikes within or near the ore zone are scapolitized, but no scapolite was found in many dikes elsewhere in the southern part of the Buena Vista Hills.

Most of the dikes trend northwest, with steep or vertical dips. They commonly occur as parallel swarms with the dikes 2 to 20 feet apart. The dikes are from a foot to approximately 4 feet wide; some are traceable for nearly 1,000 feet, but most can be traced only 400-600 feet. The dike rock consists largely of plagioclase laths in a groundmass of hornblende and chlorite. The laths of plagioclase, mainly oligoclase, have a subparallel orientation. Most laths are 0.2 to 0.3 mm long, a few are as much as 0.5 mm long, and some are short and stubby. Remnants of ferromagnesian crystals, now almost completely altered to chlorite, calcite, and magnetite, are common. Secondary hornblende crystals have formed in the centers of many of the chlorite crystal clusters. The secondary hornblende also shows the effects of chloritization, and all gradations from fresh hornblende to chlorite are present.

TERTIARY VOLCANIC ROCKS

Volcanic rocks dated as Tertiary by Louderback (1904) crop out below the crest of Chocolate Butte (east of the Segerstrom-Heizer mine) and in the southeastern area of the northern part of the Buena Vista Hills (pl. 1). The volcanic rocks are mainly...
tuff and have a bedded appearance; the glass shards in some of the members are welded, indicating that the pyroclastic rocks are terrestrial deposits. Their color ranges from light gray-brown to buff, with the exception of two dark obsidian flows.

The lowermost member of the Tertiary volcanic series is an andesite tuff that crops out in the bottom of a west-trending canyon 1½ miles south of the Segerstrom-Heizer mine. Overlying this andesite tuff is a series of flow rock, tuff, and glass that ranges in composition from rhyolite to latite. The uppermost member is a welded latite tuff, now almost completely devitrified. At least one bed of perlite glass that may be of commercial value is included in the volcanic series.

Several specimens taken at random from various localities were examined microscopically. All specimens examined present a porphyritic appearance, though most are tuffaceous. The glasses of these tuffs range in refractive index from 1.498 to 1.515, indicating a rhyolitic to latitic composition. The mineral composition indicates most of these volcanic rocks are latite. Orthoclase (sanidine) and plagioclase are present in about equal amounts; the plagioclase ranges from albite \( (A_n\) to \( (A_{n_0}) \). Some of the rocks contain as much as 3 to 4 percent of biotite. Glass amounts to 70 to 90 percent of the rock.

The larger plagioclase crystals are zoned and range from bytownite \( (A_{n_0}) \) to andesine \( (A_{n_2}) \); most of the plagioclase is labradorite \( (A_{n_70}) \).

The olivine is altered to iddingsite along fractures and around the rims of the individual crystals. Many of the small crystals have been entirely replaced by iddingsite. Most of the magnetite is primary although a small amount is an alteration product of the ferromagnesian minerals.

No evidence found in the area permits the precise dating of the basalt. Louderback (1904), on the basis of structural and stratigraphic relationships elsewhere in the Humboldt and Stillwater Ranges, dated the basalt, including that in the Buena Vista Hills area, as Pliocene and Pleistocene.

### SURFICIAL DEPOSITS

Sediments consisting of sand, gravel, and tufa of Quaternary age border the Buena Vista Hills on the north and west. These sediments were deposited in glacial Lake Lahontan, which occupied the northwestern part of Nevada and which bordered the Buena Vista Hills on the north and west. The gravel is composed of well-rounded pebbles and cobbles of metamorphic rocks and basalt, and some boulders of magnetite. The pebbles and cobbles range from less than an inch to about 6 inches in diameter. The gravels are well graded in thin beds. Sand layers from several inches to several feet thick are interbedded with the gravel beds. Locally the sand contains a high proportion of magnetite. Calcareous tufa, a soft yellowish-gray porous rock, forms a thin shell over many of the outcrops, particularly in the northern part of the Buena Vista Hills.

Alluvium covers the floor of the small valley between Chocolate Butte and the Segerstrom-Heizer mine, and the floor of the valley between the northern and southern parts of the Buena Vista Hills. The alluvium is poorly sorted angular detrital material that ranges in size from sand to boulders several feet in diameter. It has been derived from the disintegration of the surrounding hills, but erosion and deposition has not been sufficiently rapid to produce the familiar alluvial cones at the mouths of canyons.

### IRON ORE DEPOSITS

The principal deposits of iron ore are found in three main areas of the Buena Vista Hills: the northwestern flank, the northeastern flank, and the southwestern flank. Less important deposits are found within the hills, elsewhere on the flanks, and in the pediment surrounding the hills.

The ore bodies are in, or closely associated with, the scapolitized diorite rock. The two largest ore bodies are in the diorite, but
several important though smaller bodies are in the metavolcanic 
rocks. Some of the ore bodies are veins, but the most important 
deposits are replacement bodies that were formed in breccia zones 
along faults.

Structural control by faults has played the major part in local-
izing the deposits. The prominent trends of the faults in the 
Buena Vista Hills are northwest and northeast. Many have served 
as channelways for the mineralizing solutions. The major faults 
show more than one period of movement, with post-mineral move-
ment responsible for displacement of the ore bodies. Where post-
mineral displacements could be calculated, they were from a few 
feet to a few tens of feet.

FORM OF THE DEPOSITS
The replacement bodies are irregular in detail, although control 
by faults and shear-zones imparts definite trends to them. These 
deposits are particularly irregular at the Buena Vista mine where 
milling has exposed the tops of ore bodies that did not crop out. 
This irregularity, together with much post-mineral faulting, both 
normal and high-angle reverse, has increased the difficulty of 
milling. Some of the rock in the ore bodies is a mixture of mag-
netite and gangue minerals, mainly chlorite, and locally some 
large zones of relatively unaltered host rock are found within the 
ore bodies.

The replacement bodies were most commonly formed in 
brecci-
ated areas such as at the intersection of two faults. Individual 
replacement deposits are as much as 150 feet wide and 500 feet 
long. In the Buena Vista mine area the mineralized zone is 500 
feet wide and 1,200 feet long.

The vein deposits, which are considered to be tabular replace-
ment bodies along faults and fractures rather than open-space 
fissure fillings, range from a few inches to more than 10 feet in 
width; most have a strike length of less than 500 feet. Their 
vertical extent is unknown, as they are nearly everywhere too 
narrow to mine profitably, and very little exploration has been 
done on them. Most of the veins have dips greater than 60°.

MINERALOGY
The principal ore mineral is magnetite that has been partly 
replaced by hematite. In places, however, this replacement is 
almost complete. Studies of polished sections show that the hema-
tite replaces magnetite along crystallographic directions (fig. 11). 
Where replacement has been only slight, the magnetite contains 
microscopic lamellae, rods, and small specks of hematite in a fine 
network that reflects the crystallographic structure of the host. 
Specimens in advanced stages of replacement are composed mostly 
of hematite enclosing residual islands of magnetite.

Within the ore bodies all the minerals of the scapolitized dior-
ite have either been removed or altered as a result of the intense 
hydrothermal alteration. The principal gangue minerals are chlor-
ite, calcite, apatite, sphene, and actinolite-tremolite; chlorite and 
calcite are the most abundant. Minor amounts of pyrite and marcasite are associated with the magnetite and hematite in 
places.

The mineralogy of the vein and the replacement deposits is the 
same, but the proportions of gangue minerals differ. The veins 
contain little except magnetite and hematite, whereas the replace-
ment deposits contain more gangue minerals and may also con-
tain unreplace or partly replaced country rock. Much of the 
chlorite gangue probably was formed by alteration of the ferro-
magnesian minerals of the country rock. Apatite is usually more 
abundant in the replacement bodies than in the vein deposits and 
commonly is concentrated in zones near the edges of the deposits. 
Nearly perfect crystals of apatite, some almost 1 inch in diameter, 
are found in many outcrops of replacement bodies.

Studies of polished sections show that calcite and sphene were 
deposited, at least in part, before the magnetite. These minerals 
are euhedral and are embayed and veined by magnetite. Appar-
ently apatite was formed essentially simultaneously with the 
magnetite; in some specimens magnetite partly replaces apatite, 
but in places apatite veinlets cut the magnetite. Chlorite and 
tremolite-actinolite are more or less contemporaneous with mag-
netite. Pyrite and marcasite originated later.

ORIGIN OF THE DEPOSITS
The deposition of magnetite, widespread scapolitization, and 
metamorphism of the volcanic and sedimentary rocks of the 
Leach (?) formation are regarded as related stages accompanying 
the emplacement of the Jurassic (?) diorite stock that underlies 
most of the Buena Vista Hills area. Field and microscopic studies 
indicate that scapolitization was dominantly a late magmatic pro-
cess essentially contemporaneous with the deposition of the mag-
netite.

The Buena Vista Hills iron ore deposits were formed by the 
derosion of magnetite in fractures and by the replacement of 
the rock adjacent to the fractures. Zies (1929, p. 7–10), Wells

Iron Ore Deposits of Nevada

Buena Vista Hills, Churchill and Pershing Counties
(1938, p. 498-506), and others have shown that iron probably is transported as the chlorides (FeCl₂ and FeCl₃) and is deposited as magnetite by reaction with steam or oxygen.

Scapolitization was the most pronounced metamorphic effect and caused profound changes in the intrusive body and in the invaded rock near its contact with the intrusive rock. Scapolitization is generally thought to be due to the permeation of rock by magmatic solutions or vapors carrying chlorine and carbon dioxide (Sundius, 1915; Turner and Verhoogen, 1951, p. 492; Buddington, 1939; Holser, 1950, p. 1086). Chlorine carried by fluids from magma in the unsolidified core of the diorite body during the latter or waning stages of the igneous activity permeated the already solidified outer shell and adjacent invaded rock and reacted with the feldspar to form scapolite. During the same period of alteration secondary hornblende was formed from the primary augite and hornblende.

Not all of the scapolite was necessarily formed by the chlorine-rich magmatic fluids that preceded and probably accompanied the iron-bearing fluids; probably some of the chlorine responsible for the scapolitization was released by the reactions that accompanied the deposition of magnetite.

Two stages of scapolitization are indicated in the Buena Vista Hills area: first, the widespread scapolitization that formed the scapolite-bearing diorite; and second, the cutting of the scapolitized diorite by scapolite veins. Scapolitization, in part at least, preceded the deposition of magnetite, as shown by veinlets of magnetite separating crystals of scapolite and growing along the crystallographic directions of the scapolite (fig. 10). Scapolite is not an indicator of ore, as nearly all of the diorite has been scapolitized; however, no ore is found in unscapolitized rock.

The genetic history of the iron ore deposits may have been as follows:

1. Intrusion of dioritic magma into the rocks of the Leach (?) formation, with metamorphism of the Leach (?) rocks.
2. Cooling and solidification of the outer shell of the stock, with the development of tension fractures. As the core of the stock continued to crystallize the residual magmatic liquid was progressively enriched in volatile constituents such as chlorine, fluorine, carbon dioxide, and water, as well as in compounds of sodium, iron, phosphorous, and titanium.
3. Injection of dikes into the solidified outer shell of the stock. As the dikes have essentially the same composition as the diorite, they were probably derived from the same magma chamber.

4. Escape of the volatile constituents through the fractured hood of the stock, with alteration of the diorite, dioritic dike rocks, and the metavolcanic rocks adjacent to the stock, followed by deposition of magnetite and further scapolitization.

RESERVES

The Buena Vista Hills iron ore deposits contain an estimated several hundred thousand tons of indicated ore, and well over a million additional tons may be inferred. The iron content is estimated to range from slightly more than 50 to slightly more than 60 percent (table 3).

<table>
<thead>
<tr>
<th>TABLE 3. PARTIAL ANALYSES OF BUENA VISTA HILLS</th>
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<tr>
<td>Buena Vista mine¹ (Replacement deposit)</td>
<td>Segerstrom-Heizer mine² (Replacement and vein deposit)</td>
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<tr>
<td>Fe</td>
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<tr>
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<tr>
<td>MgO</td>
<td>2.3</td>
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<tr>
<td>Insoluble</td>
<td>14.0</td>
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</table>

¹Krol, 1947a, p. 4. ²Krol, 1947b, p. 4. ³Information supplied by H. S. Thomas, owner, and published with his permission.

MINES AND PROSPECTS

At the beginning of this study, in June 1952, the Buena Vista, Segerstrom-Heizer, Thomas, and American Ore mines were operating. By January 1953, however, the operators of the Buena Vista mine had fulfilled their contract with the Japanese ore purchasers and ceased operations. Vigorous prospecting by both professional and “Sunday” prospectors, followed by magnetic surveys and diamond drilling, has led to several new discoveries, the most important of which were the Ford and Beacon Hill prospects.

BUENA VISTA MINE

The Buena Vista mine (pl. 3) is in secs. 3, 4, 5, 8, 9, and 10, T. 24 N., R. 34 E., Churchill County, Nev., on the southwestern flank of the Buena Vista Hills (pl. 2). The 16 original claims were located in 1898 by John T. Reid of Lovelock. Patent No. 33481 was granted in 1901.² C. W. Dunton and A. S. Vinnel of Alhambra, Calif., associated as the Mineral Materials Co., purchased the claims from Reid in 1941. Additional claims have since been located.

²From plats of U. S. Min. Surveys No. 1831-34 and files of the U. S. Bureau of Land Management.
Although iron ore was shipped from several of the deposits in the Buena Vista Hills during World War II, none was shipped from the Buena Vista mine. Iron ore shipments to Japan commenced in October 1951 and terminated upon fulfillment of contract in January 1953 when operations ceased. During this 15-month period 283,000 long tons, exceeding 57 percent Fe, were shipped.

During the last months of mining for export, small shipments were made to the Kaiser steel plant at Fontana, Calif., to furnaces in the Pacific Northwest, and to small consumers in southern California; these shipments were continued by Roy Blair, a lessee, from the Iron Horse ore body northeast of the main deposit.

Mining was from open pits using 20-foot benches (fig. 12). Ten different levels were mined at various times. Wagon drills were used to drill both blast and exploration holes. Three shovels, one of 2½-yard capacity, one of 1½-yard capacity, and one of ¾-yard capacity, were in use in the mining operation. Eight-yard dump trucks were used to haul ore and waste from the pit and to stock-pile intermediate grade ore (47-57 percent iron) for possible future use.

Ore was crushed to between minus 10-inch and plus ½-inch in a crushing plant installed at the mine in 1951. The flow sheet of the crushing plant is: mine-run ore to 42-inch by 12-inch pan feeder, to 42-inch by 36-inch jaw crusher, to ½-inch vibrating screen. The plus ½-inch is carried by conveyer belt to a stock pile having a truck-loading tunnel, and the minus ½-inch is trucked to a nearby stock pile.

Trucking to the loading ramp at the Colado West siding, on the Southern Pacific Railroad at the junction of the Coal Canyon road and Highway 40, 26 miles distant, was by hopper type bottom dump and end dump semi-trailers and tractor trucks having capacities of 30 to 35 tons. The trucks dumped into a bin from which railroad cars were loaded by a 36-inch by 8-foot pan feeder and conveyer belt.

The Buena Vista deposit was explored by the U. S. Bureau of Mines in 1945. The exploration indicated an ore body containing about 350,000 tons of iron ore averaging about 54 percent Fe, 0.04 percent S, and 0.49 percent P (Kral, 1947a). Recent mining has shown the ore to have a higher iron content than the drilling indicated.

An extensive exploration program has been conducted by the
Mineral Materials Co. at the Buena Vista mine. The principal part of the property was mapped magnetically in 1951 and 1952 (pl. 2). Traverse lines were commonly spaced 100 feet apart, with stations at 50-foot intervals except over magnetic bodies where the interval was reduced to 25 feet or less.

Simultaneously with mining, ore bodies were delineated with 20-foot wagon drill holes, which were preserved and used for blasting when possible. Samples were collected with a flat pan, 30 inches in diameter with a 6-inch hole in the center through which the drilling was done. Experience proved the sampling results reliable. The pan was emptied at all apparent changes in the color of the cuttings. One of the wagon drills was modified to allow deeper drilling by extending the drill track to allow 10-foot changes. By the use of sectional steel, holes could be drilled to a depth of 100 feet. Small size tungsten-carbide bits gave the most satisfactory results. Preliminary exploration on the outlying deposits was by bulldozer and rooter and was followed by wagon drill holes where warranted.

The Buena Vista mine is underlain by partly scapolitized diorite, which, along the southern border of the mine, is in contact with metavolcanic rocks of the Leach (?) formation (pl. 2). North of the mine workings alteration of the diorite is more complete, with the development of scapolite crystals an inch or more across and the almost complete removal of the ferromagnesian minerals. The boundaries of the area of coarse-grained scapolite are gradational and indefinite; many smaller areas are found within the medium-grained scapolitized intrusive.

Lamprophyre dikes, found in the Buena Vista Hills only in the Buena Vista mine area, are usually parallel and typically occur in swarms. Where the rocks are essentially unaltered the dikes are easily identified as they are much finer grained and more even textured than the diorite, but in the pit areas the dikes are highly altered and consequently are extremely difficult to recognize. No dikes were found in the metavolcanic rock of the Leach (?) formation or in the diorite near its contact with the metavolcanic rock.

The principal ore bodies are replacements of the diorite, though minor replacement bodies are found in the metavolcanic rock. The ore bodies are found in a mineralized zone about 500 feet wide and 2,000 feet long. Cross faulting that formed brecciated zones in the host rock was an important factor in localizing the ore deposits. As exposed on the surface, the individual deposits are from 50 to 150 feet wide and as much as 500 feet long. However, what appear to be individual deposits may be the surface expression of an underlying continuous ore body. This sporadic lateral and vertical distribution is due to uneven mineralization around the edges coupled with post-mineral faulting of the ore bodies (pl. 3).

The principal ore mineral is magnetite that locally has been replaced by small amounts of hematite. Gangue minerals in the estimated order of abundance are chlorite, calcite, quartz, apatite, and sphene. Apatite is found widely distributed in small amounts throughout the ore bodies but commonly is more abundant around the periphery of the bodies or localized along faults within them.

Well-developed sphene crystals are found in the magnetite as well as in the scapolitized diorite, and the mineral is believed to be earlier than, or contemporaneous with, the magnetite. The country rock has been highly chloritized around the ore deposits, and magnetite is disseminated throughout the altered zones.

**SEGERSTROM-HEIZER MINE**

The Segerstrom-Heizer mine (pl. 5) is in sec. 15, T. 25 N., R. 34 E., on the northern edge of the Buena Vista Hills (pl. 4). The altitude of the main workings is about 4,300 feet. The property was located in 1941 by Edwin Marker and Lyle and Wayne Stoker, of Lovelock, Nev., who leased it to Charles H. Segerstrom, Jr., and John M. Heizer, also of Lovelock. A survey showed the major ore bodies to be on land belonging to the Southern Pacific Land Co., from whom Segerstrom and Heizer then leased the property.

Production of iron ore, mainly for use as concrete aggregate for ship ballast, was started in 1943 by Oliver Evans, followed by A. Brattan and R. S. Blair, all of whom subleased the property from Segerstrom and Heizer. In 1944 the major part of the property was subleased to the Dodge Construction Co. of Fallon, Nev.; Brattan and Blair continued their sublease on part of the property until 1949. By the end of 1945, when the war-inspired demand for the ore virtually ceased, nearly 60,000 tons had been produced. During the latter part of 1945 production dropped to 300 tons per month, consumed largely by the Pacific Coast steel industry. An estimated 18,000 tons was produced for this purpose. Production ceased entirely in 1949. Total production to the end of 1949 was 72,000 tons. The demand for iron ore for shipment to Japan for use by the Japanese iron and
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The steel industry led to a resumption of mining by the Dodge Construction Co. in 1951, and total production to the end of 1952 was 236,000 long tons.¹

The property was investigated during World War II by the U. S. Bureau of Mines. This investigation included a magnetometer survey (pl. 5), made in the fall of 1943 and the summer of 1944, and core-drilling and outcrop sampling in 1944-5. The results of the diamond drilling and surface sampling were published by the U. S. Bureau of Mines (Kral, 1947a).

The ore is mined from an open pit (fig. 13). Wagon drills are used to drill test- and blast-holes. Ore is loaded with a 2½-yard power shovel into 6-yard dump trucks and hauled to a crushing plant where it is crushed to minus 8 inches by a 42-by-36-inch jaw crusher. The crushed ore is stockpiled and loaded by a 1½-yard shovel into large dump trucks to be hauled to the railroad loading ramps at the Colado East siding where the ore is dumped directly into cars. Hauling from the mine to the railroad, a distance of 23 miles, is under contract to several trucking companies.

The ore deposit is in scapolitized diorite, which, in the vicinity of the magnetite bodies, has undergone intense hydrothermal alteration to a chlorite-sericite-magnetite rock. The ore is in irregular masses and in veins that have formed as replacement bodies in the scapolitized intrusive (pl. 5). The principal ore mineral is magnetite, partly replaced by hematite. Pyrite and marcasite are present in small amounts. Gangue minerals include chlorite, calcite, apatite, and actinolite-tremolite.

The main ore body was localized by a northeast-trending fault system that dips 70° NW. Other faults crossing this system formed brecciated zones, amenable to replacement, in which irregular masses of magnetite were formed. Adjacent to and south of the main ore body an intricate stockwork of magnetite veins, from an inch to a foot in width, cuts the country rock. A magnetite vein, 5 to 10 feet wide, trends eastward from the main ore zone here.

East-trending magnetite veins are found southwest and south of the main ore body. The veins are a foot to as much as 10 feet wide and dip steeply. The ore is nearly pure magnetite. As most of the veins are too narrow for profitable mining and no deep drilling has been done, little is known about the depth of the ore. Adjacent to the magnetite bodies the diorite is dark green and is composed mainly of chlorite with a large amount¹

¹Production data published with permission of the owners.
of disseminated magnetite. A large roof pendant of metavolcanic rock is exposed south of the Segerstrom-Heizer pit, and metavolcanic rock crops out southeast of the pit (pl. 4).

THOMAS MINE

The Thomas mine (pl. 7) is in sec. 29, T. 26 N., R. 34 E., Pershing County, Nev., on the west flank of the northwestern part of the Buena Vista Hills, on land belonging to the Southern Pacific Land Co. (pl. 1). It was from here that the iron ore was shipped in the early nineteen forties, which resulted in a Nevada "iron boom." Oliver Evans, of Winnemucca, who was a scrap iron dealer, found that his west coast markets would accept high-grade iron ore as a substitute for scrap iron. In 1942 he shipped a small amount of ore from this property. No further work was done until 1950, when H. S. Thomas and Roy S. Blair formed a partnership, the Nevada Iron Ore Co., obtained a lease from the Southern Pacific Land Co., and began shipments. The partnership was dissolved late in 1952, and H. S. Thomas continued the operation of the property. Production to the end of 1952 was 31,000 tons of iron ore, which averaged 62 percent iron. Owing to its high iron and low impurities content, the entire production has been used domestically as "hard-lump" ore by the Ford Motor Co. of Dearborn, Mich., and consumers on the west coast.

Thomas is mining from an open pit. The ore bodies at the north end of the deposit have many horses of waste, and though ore and waste are broken as selectively as possible, they are often broken together, necessitating sorting by hand. Some later sorting is usually required. Broken ore and waste are loaded into 6-ton trucks by a ½-yard power shovel. Common practice is to have a waste and an ore truck alongside each other with the ore and waste sorted by hand into the separate trucks. An average of five men are usually used for the mining operation, and production rate is approximately one 50-ton car per day. The size of the product is minus 14-inch and is not crushed or screened; oversized pieces are broken either by secondary blasting or with a sledge. Ore is trucked directly from the pit to the railroad siding at Woolsey, a distance of 25 miles.

The ore here occurs in the metavolcanic rock (pl. 6), which in this area is difficult to distinguish from the scapolitized diorite. The phosphorus and sulfur content is extremely low

*Production data published with permission of the owners.

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dominant mineral; locally considerable calcite has been introduced. Minor amounts of bluish actinolitic amphibole are found in the sec. 10 ore zone. Fine-grained magnetite is disseminated throughout the wall rock as far as 25 feet from the ore body.

The deposit in sec. 10 is on a continuation of the main northeast-trending fault through the Segerstrom-Heizer pit, which is exposed in the sec. 10 pit. Mineralization probably has been localized by the intersection of this main fault with cross faults.

Minor occurrences of iron ore in secs. 16 and 22 have subparallel orientations in three directions, north, northwest, and west, indicating pre-mineral fracturing and faulting in these directions.

The deposits in sec. 32 (pl. 6) are in metavolcanic rock of the Leach (?) formation, which in most of the area surrounding the deposits is covered by 2 to 10 feet of Lake Lahontan sediments. The ore is in narrow veins and small replacement bodies, most of which have been offset by faults. The magnetite veins and replacement bodies are subparallel with a trend of west to slightly north of west. The veins dip steeply both north and south.

On January 1, 1953, Thomas subleased the southern part of the deposit to Parker Brothers of Marysville, Calif. In the first three months of 1953 Parker Brothers shipped approximately 16,000 tons of ore containing about 62 percent iron to the Youngstown Sheet and Tube Co., Youngstown, Ohio.

Parker Brothers are using a 2½-yard power shovel for loading both ore and waste; hauling is done with 10-ton trucks. All drilling is by wagon drills. The 16,000 tons was mined from the first lift (level) of about 18 feet; stripping has been done in preparation for mining a second lift (level) of equal depth. It is doubtful that more than the 36-foot depth will be economically feasible. The mined ore is crushed and screened to give a minus 10-inch plus one-inch product, in a crushing plant installed early in 1953.

FORD PROSPECT

The Ford prospect (pl. 8) is in sec. 6, T. 25 N., R. 34 E., Pershing County, Nev. (pl. 1). It consists of the Iron Horse group of ten claims, located in 1952 by C. W. Hunley and others of Lovelock, Nev. The Ford Motor Co. of Dearborn, Mich., obtained a lease on the claims immediately after their location. Diamond drilling, based on the results of a magnetic survey, disclosed ore bodies of commercial size.

Exploration consisted of a magnetic survey, diamond drilling, and bulldozer trenching. The magnetic survey consisted of 11,000 feet of traverse with traverse lines spaced 100 feet apart and stations at 50-foot intervals; except in the vicinity of the anomalies, where the interval was reduced to 25 feet. The magnetic anomaly of the southeastern ore zone exceeded 15,000 gammas, and the northwestern one exceeded 20,000 gammas.

Five diamond-drill holes were drilled on the magnetic anomalies; four on the northwest and one on the southeast. The holes were drilled at right angles to the strike of the ore zones as indicated by the anomalies. The inclination of four of the holes was 45°; that of the other was 35°. Ore bodies, ranging from 10 feet to 65 feet in width, were cut in all of the holes. Bulldozer and hand trenches were used to expose the ore on the surface.

The prospect is on the pediment west of the northwest part of the Buena Vista Hills. A thin blanket of Lake Lahontan sediments, through which only a very few outcrops penetrate, covers the underlying scapolitized intrusive rock. The pediment surface here slopes gently westward and is essentially devoid of relief.

The predominant ore mineral is magnetite; the ore contains few gangue minerals. The iron content is high and deleterious impurities such as sulfur and phosphorus are very low. Adjacent to the vein the wall rock has been moderately altered; some ferromagnesian minerals have been altered to chlorite, but the other minerals remain essentially unchanged. The deposit consists of several apparently separate steeply dipping veins in scapolitized diorite. The veins strike slightly north of west, dip 70° to 80° N., and are en echelon. Three veins appear to be wide enough to mine profitably under present conditions. The maximum width of ore cut by the diamond drilling is 65 feet, and the ore was penetrated at a maximum depth of 125 feet. A fourth ore zone, which is north of the southeast vein and which is indicated to be smaller than the others by its magnetic anomaly, has not been explored.

In 1952, prior to the exploration on the Ford prospect, the Ford Motor Co. had obtained a prospecting lease from the Southern Pacific Land Co. on several sections in which no ore was known to occur. Diamond drilling on a magnetic anomaly in sec. 27, T. 24 N., R. 34 E., found several small stringers of magnetite, but no ore bodies suitable for mining.

BEACON HILL PROSPECT

During the summer of 1952 Charles Dodgson, of Lovelock, found a magnetic anomaly with a dip needle in an area of deep overburden in sec. 32, T. 26 N., R. 34 E., north of the airway beacon (pl. 6). He located claims that were later purchased by
Mineral Materials Co. Bulldozer trenching over the anomaly in 1953 exposed an ore body 10 to 20 feet wide and approximately 150 feet long in metavolcanic rocks of the Leach (?) formation. The ore body was indicated to a depth of 70 feet by 19 long-hole drill holes.

CONCLUSIONS

Areas of exposed bedrock have been extensively prospected, and every known iron ore outcrop has had some work done on it. Most of the larger deposits are now being, or have been, mined; the others have been ear-marked for mining. In addition, several significant discoveries of iron ore have been made in areas in which outcrops were few or nonexistent. Any new discoveries will have to come either from exploration of small veins, by finding extensions of already known deposits, or by exploration of new areas in which bedrock is concealed by alluvium but where magnetic or other geophysical surveys indicate deposits of iron ore.

The pediment west and south of the Buena Vista Hills is considered to be a favorable area for systematic, detailed geophysical surveys. Reconnaissance magnetic surveys of much, but not all, of this area resulted in several discoveries. North and east of the Buena Vista Hills soil and alluvium probably are shallow. Magnetic surveys here might indicate new areas for physical exploration.

LITERATURE CITED

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