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JUNE 1949

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
J. A. KRUG, SECRETARY

*J. P. HART*

BUREAU OF MINES  
JAMES BOYD, DIRECTOR

REPORT OF INVESTIGATIONS

INVESTIGATION OF VIRGIN RIVER MANGANESE  
DEPOSIT, CLARK COUNTY, NEV.



BY

WILLIAM H. KING, JOHN H. SOULE', AND RUSSELL R. TRENGOVE

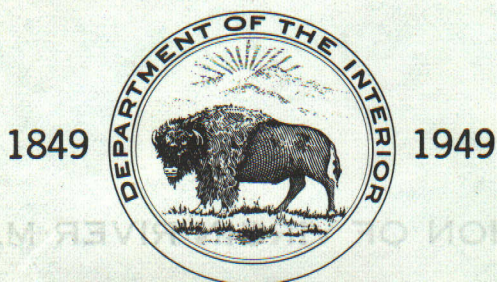


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## A Century of Conservation



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WILLIAM H. KING, JOHN H. SOULE, AND RUSSELL B. TRENDLOVE



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UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

INVESTIGATION OF VIRGIN RIVER MANGANESE DEPOSIT, CLARK COUNTY, NEV.<sup>1/</sup>

By William H. King<sup>2/</sup>, John H. Soule<sup>2/</sup>, and Russell R. Trengove<sup>2/</sup>

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INTRODUCTION

Preliminary examination of the Virgin River manganese deposit was made by C. H. Johnson, Bureau of Mines engineer, in March 1941. During April and May 58 trenches were dug, a 48-foot inclined shaft was sunk, and 719 linear feet of channel samples were cut. McKelvey and Wiese, of the Federal Geological Survey, completed mapping the deposit, including the entire area of overlying formations comprising the point of land between the outcrop and Lake Mead.

The geologic maps, assay maps, and ore estimates resulting from these examinations formed the basis for a preliminary report by C. H. Johnson, who recommended further exploration by diamond drilling.

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<sup>1/</sup> The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Report of Investigations 4471."

<sup>2/</sup> Mining engineer, Bureau of Mines, U. S. Department of the Interior.



Drilling started on October 11, 1941, and was completed by January 31, 1942. Eighteen holes comprising a total of 4,277 feet were drilled to determine the extent of the manganese ore bodies exposed by the outcrop and to discover others that might be present at moderate depths.

#### ACKNOWLEDGMENTS

This paper describes the project work on the Virgin River manganese deposit in Clark County, Nev. The exploration was started and completed under the late Charles F. Jackson, chief of the Mining Division, and E. D. Gardner, supervising engineer for the Western States. Acknowledgment is also due to the late E. S. Leaver, supervising engineer, and staff of the Rare and Precious Metals Station at Reno, where the samples were analyzed.

Acknowledgment is made to V. E. McKelvey, John H. Wiese, and Vard H. Johnson, who mapped the area and assisted in interpreting the geology.

Officials of the Bureau of Reclamation and the National Park Service supplied helpful information and assistance in starting the project. Chief ranger Carl E. Lehnert, of the National Park Service, installed the radio-phone at the camp and placed the station on the regular Park Service radio schedule, an extremely helpful service.

The report was prepared by the Reno Branch, Mining Division, A. C. Johnson, chief.

#### LOCATION AND PHYSICAL FEATURES

The Virgin River manganese deposit is situated in secs. 13, 14, and 22, T. 20 S., R. 64 E., M.D.B.&M., St. Thomas Mining District, Clark County, Nev. It is on the Virgin River arm of Lake Mead, 5 miles from Bonelli's Point, which was formerly the junction of the Virgin and Colorado Rivers, and 26 miles from the Boulder City boat landing (fig. 1). This deposit is within the Boulder Dam National Recreational Area and subject to supervision by the Bureau of Reclamation, National Park Service, and Biological Survey (Fish and Wild Life Div.). The highest elevation of the Virgin River deposit is about 1,730 feet, 500 feet above the maximum flow-line elevation of Lake Mead.

The property can be reached by traveling 6 miles from Boulder City on a hard-surfaced road to the Boulder City boat landing on Lake Mead, then traveling by boat through Boulder Canyon, a distance of 26 miles on Lake Mead.

The manganese horizon outcrops in two fairly straight lines (fig. 2). One limb, for a distance of about a mile, follows the course of a wash draining eastward into the Virgin River arm of Lake Mead. The most eastern exposure is 1 mile from the lake. The other, or south limb, is also a mile long but bears north and south. It runs from a point 2,000 feet southwest of the west end of the east limb, southward to within a mile of the main body of Lake Mead.



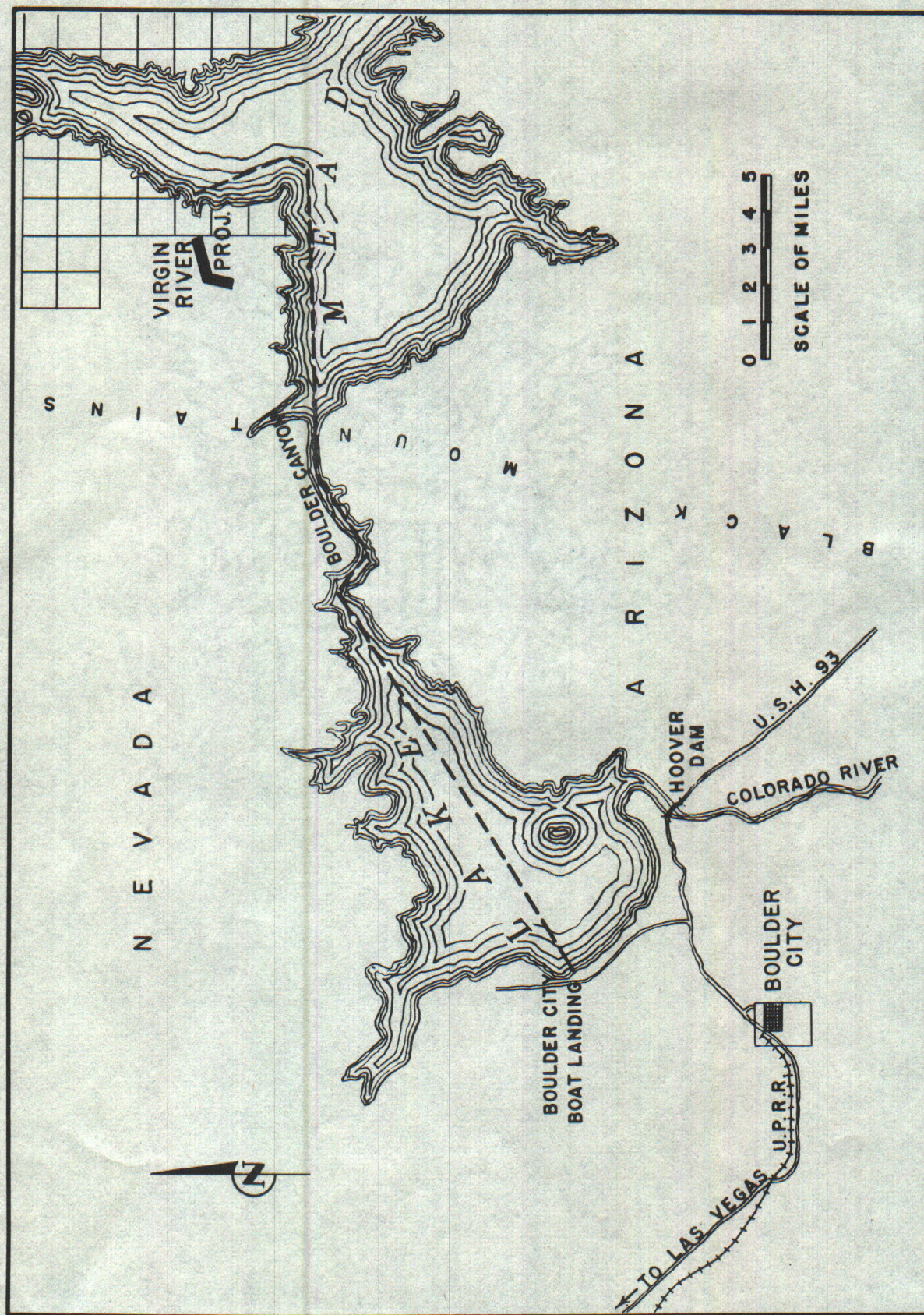


Figure 1. - Location map, Virgin River manganese deposit, Clark County, Nev.



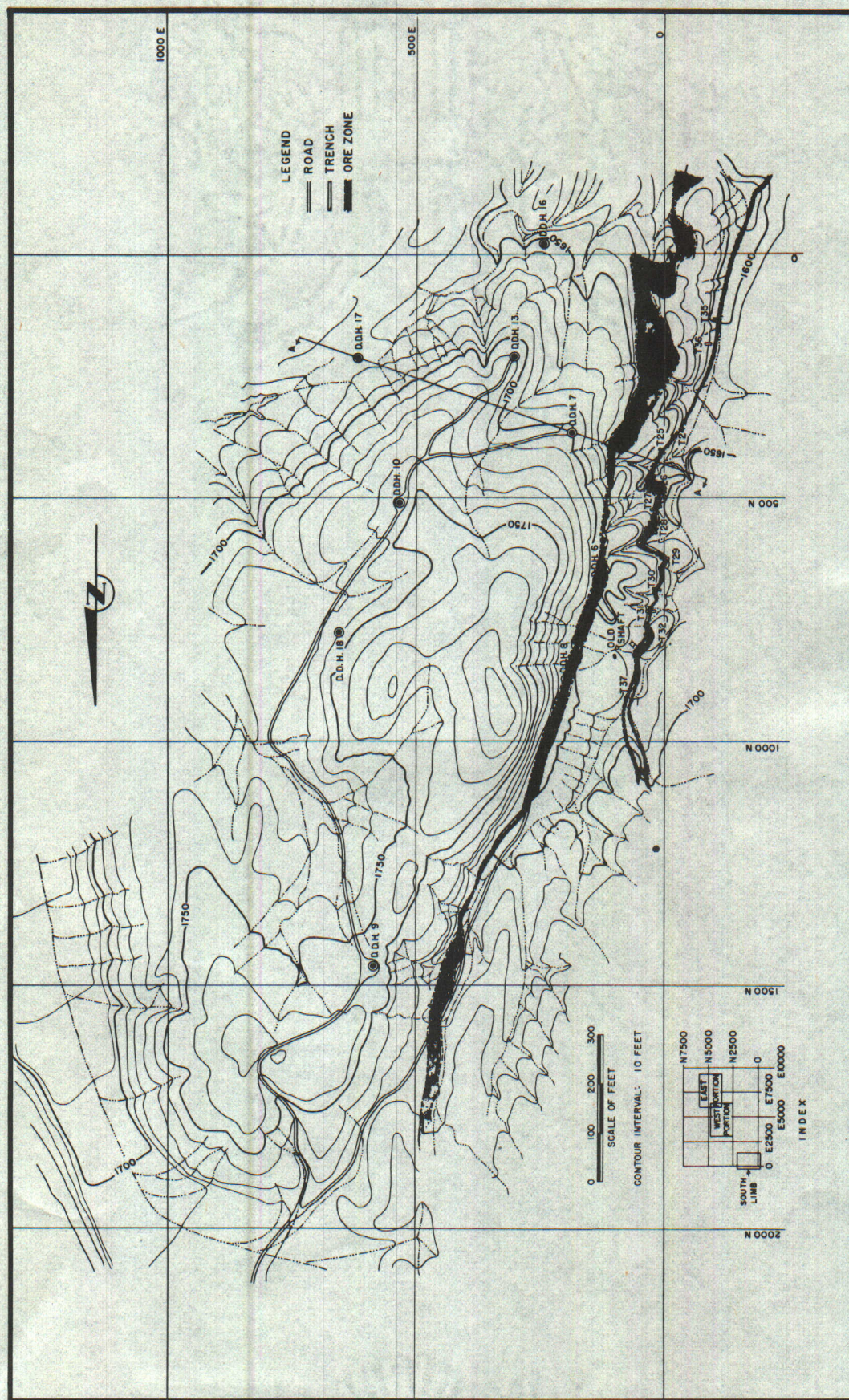


Figure 2. - Topographic map showing trenches of south limb, Virgin River manganese deposit, Boulder City, Nev.



Both outcrops are readily accessible from the lake. The trails follow gravel- and sand-floored washes, rising at an almost uniform grade of 7 feet in 100 or 350 feet to the mile from the water to the low saddle at the west end of the east limb.

The climate is arid; annual precipitation ranges from 3 inches to 10 inches. Most of the precipitation occurs in the winter and spring, with occasional thunderstorms in summer. The only source of water is Lake Mead.

Principal vegetation of the district is greasewood, a small brush, and dwarf sage. There is no timber.

A government camp was established and maintained on the shore of Lake Mead. The only road in the area is on the project and connects the camp site with parts of the outcrop and drill sites.

#### PROPERTY AND OWNERSHIP

John A. Lytle, of Boulder City, Nev., and John H. Perkins, of Overton, Nev., who are brothers-in-law, claim ownership of the property. They stated that "Old Man" Bonelli, the Swiss immigrant, who came to the Virgin Valley in the early 1860's, was the first locator of claims on this deposit. A brief note on these claims appeared in Mineral Resources, 1902, shortly before Bonelli's death.

Perkins located seven claims along the outcrop covering the most promising portions in 1918. In December 1940, Lytle located seven claims, posting notices on Perkins old monuments.

#### GEOLOGY

The Virgin River manganese deposits are manganiferous portions of beds of fine sandstone and siltstone members of the Muddy Creek formation. Figure 3 shows a variation in the geologic section in the various holes, but the bed that contains the principal ore horizon is underlain in most localities by basalt flows and overlain by beds of gypsum, in which other basalt flows occur. Dips range from 20 to 45 degrees where the ore outcrops.

Exposed on the slopes a few hundred feet north of the outcrop of the east limb of the ore horizon are volcanics (andesite), the lowest and oldest rocks in the vicinity. Upon these rests a series of sedimentary rocks comprising conglomerates, sandstones, and siltstones, with included basalt flows. The column ranges in thickness from 100 to 250 feet and dips 15 to 35 degrees to the southeast. The principal ore horizon, a bed of fine sandstone or silt a few feet to 25 feet thick, is at the top of this column and in most places is underlain by basalt.

Above the foregoing rocks lie a 300- to 1,200-foot thickness of gypsiferous formations, which comprise dense, massive gypsum, gypsum beds containing large proportions of basalt fragments, numerous basalt flows, and a few beds of sandstone and tuff. Still higher are gypsum beds that are weakly manganiferous in many places. These, in turn, are capped by conglomerate



and sandstones that form the impressive cliffs south of the main east draw near the lake; an unconformity cuts out these beds to the west.

Extensive thick basalt flows overlie the foregoing conglomerates and sandstone and in turn are covered by other conglomerates, which are the top formations in the area. These two formations, which aggregate 500 to 1,000 feet in thickness, cover almost all the southeastern half of the point of land between the manganese outcrops and the lake.

The foregoing description applies to the east limb of the deposit. The structural geology of the south limb is similar, except that there are two ore horizons separated by a basalt flow 25 to 100 feet thick.

#### ORE DEPOSIT

Fine to coarse soft manganese oxide occurs wherever the ore horizon is exposed. Here and there are small nodules and sizable masses of crystalline oxides (psilomelane). These appear to contribute little to the total manganese but form a conspicuous float, which in places gives the outcrop a misleading appearance of richness. Specimens of such material may contain 45 percent or more manganese. In exceptional cases, beds 6 inches to 3 feet thick appear to contain high-grade oxides (wad), but a specimen was analyzed and assayed 40 percent manganese.

The thickness and manganese content of the ore bed varies considerably within a few feet, and extreme changes occur within distances of 50 to 100 feet.

#### EXPLORATION BY THE BUREAU OF MINES

Work preliminary to the diamond drilling comprised surveying and mapping the area, excavating trenches and an incline, and channel sampling. McKelvey and Wiese, of the Federal Geological Survey, did the surveying and mapping.

A sampling crew of 15 men with John H. Soule as foreman began work April 22 and broke camp May 14. In this period, 58 trenches were dug, a 48-foot incline was sunk, and 719 linear feet of channel samples were cut. This work formed the basis for the diamond drill program.

The Mineral Materials Co., 1100 Westminster Ave., Alhambra, Calif., was awarded the contract to build roads in the area. These were necessary to move the diamond drill and equipment from the boat landing on the project to the various drill sites.

A contract for the diamond drilling was awarded to the Diamond Drill Contracting Co., of 1825 East Slauson Ave., Los Angeles, Calif. Their men and equipment arrived at Boulder City on October 9, 1941, and were transported with their equipment on a barge. Hole 1 was started October 11. All holes were drilled vertically.



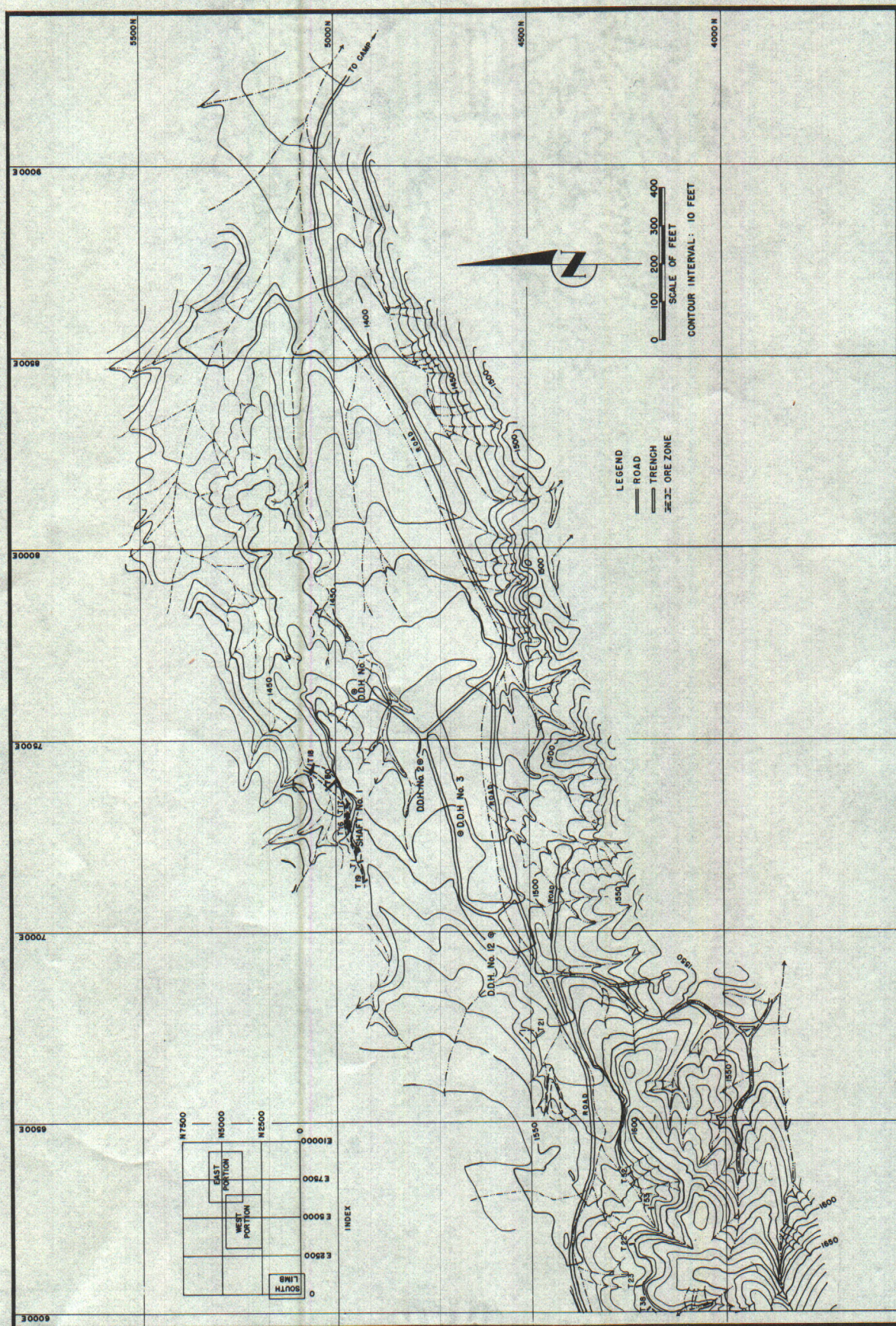


Figure 2A. - Topographic map showing trenches and diamond drill holes, east portion of east limb, Virgin River manganese deposit, Clark County, Nev.



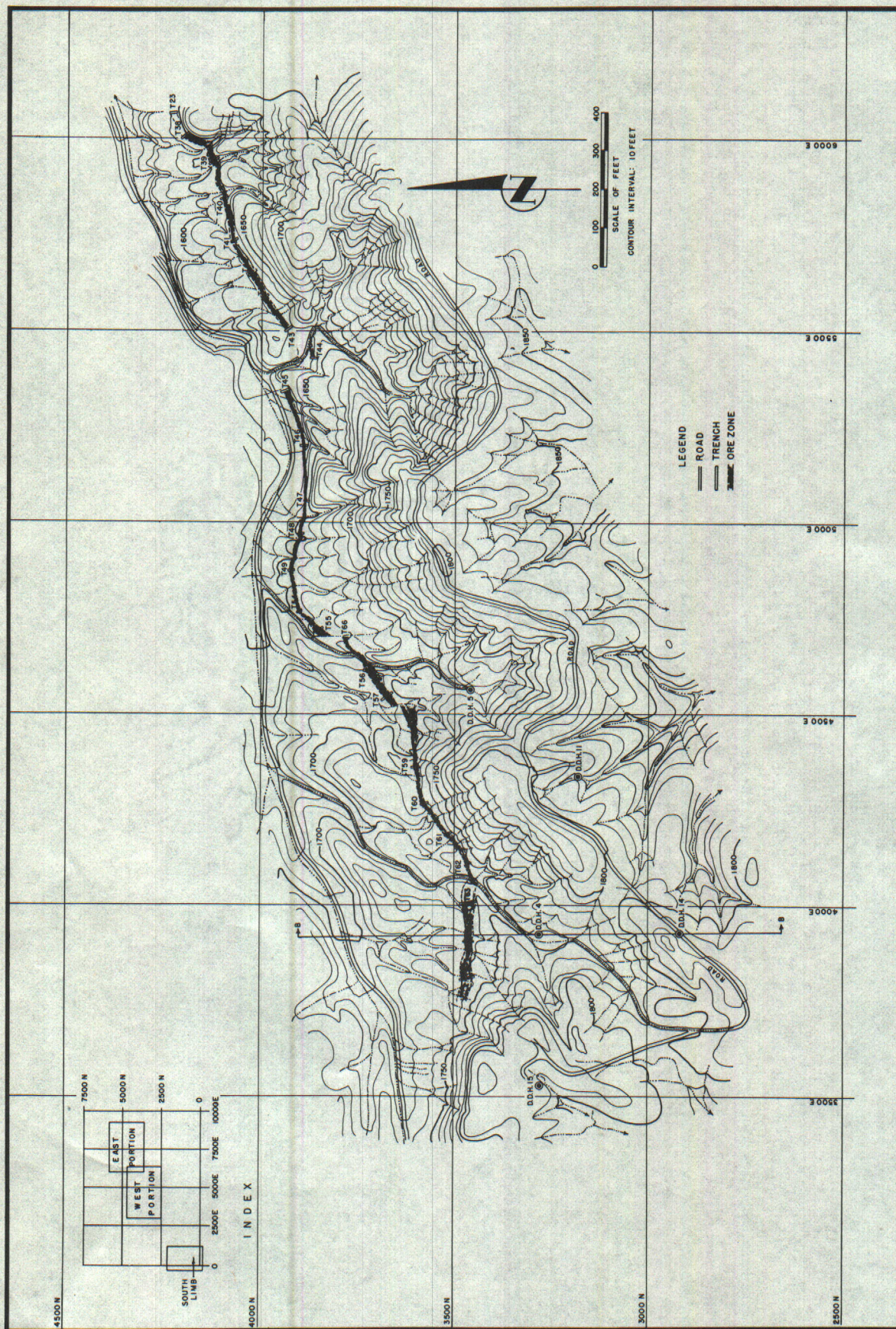


Figure 2B. - Topographic map showing trenches and diamond drill holes, west portion of east limb, Virgin River manganese deposit, Clark County, Nev.



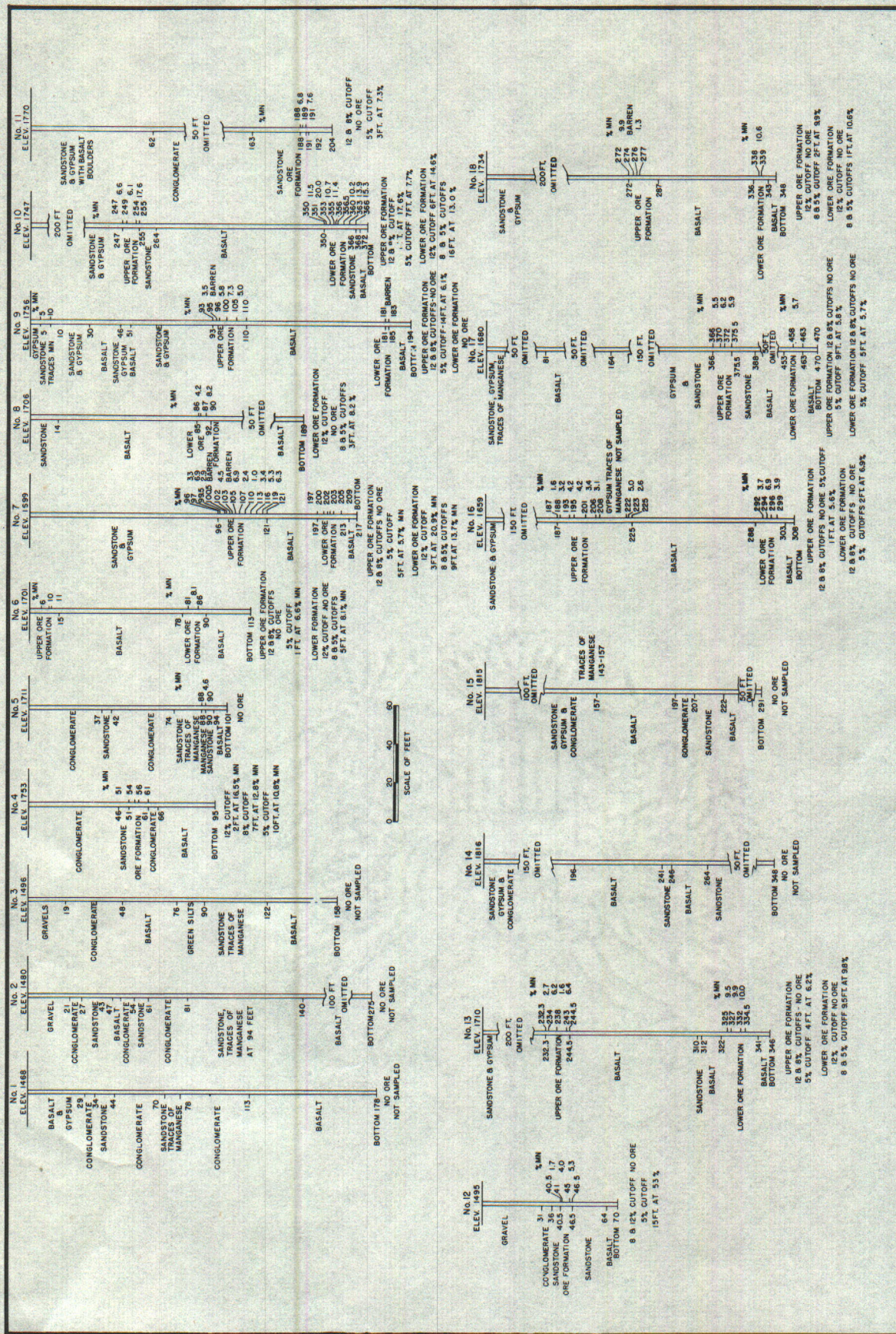


Figure 3. - Geology and sample analyses of diamond drill holes, Virgin River manganese deposit, Clark County, Nev.



East portion of east limb. - The east portion of the east limb was explored by holes 1, 2, 3, and 12 (fig. 2A), which were drilled to furnish information regarding the manganese-bearing bed at a distance of approximately 200 feet down the dip from the outcrop. Hole 2 was completed below any known manganese-bearing formations in the area. The information thus gained was used as a guide to determine the depth of all holes on the east limb. Figure 3 shows the formations drilled.

A trace of manganese was found in hole 2 at 94 feet in sandstone and siltstone and was correlated with the outcrop of the ore horizon. Similar conditions were found in holes 1 and 3. In hole 12, the best 1-1/2 foot portion of the ore bed assayed 5.3 percent. Other conditions were found to be similar to those found in holes 1, 2, and 3.

West portion of east limb. - Holes 4 and 5 (fig. 2B) explored this area 200 feet down the dip from the outcrop. The manganese-bearing sandstone and siltstone were found to be much thinner in this area than in the east portion of the east limb. In hole 4, the manganese-bearing bed, intersected 51 to 61 feet in depth, assayed 10.6 percent manganese. In hole 5 the best portion of the bed, from 88 to 90 feet, assayed 4.6 percent (See fig. 3.)

To determine the extension of the ore intersected in hole 4, hole 11 was located midway between holes 4 and 5 and 200 feet farther down the dip. The manganese-bearing bed intersected from 189 to 192 feet assayed 7.3 percent. (See fig. 3.)

Because of the results of hole 11, hole 14 was drilled 350 feet directly down the dip from hole 4. (See fig. 2B.) No manganese was found in this hole, although it is certain that the hole was drilled deeper than any possible extension of ore from hole 4.

Hole 15 was driven 400 feet west of hole 4, as that was the only possible direction in which the ore might extend (fig. 2B). Conditions similar to those in hole 14 were found to exist, except that traces of manganese were found in the sandstone immediately above the basalt and also in a sandstone within the basalt.

South limb, north portion. - There are two manganese horizons along the south limb. At the north end of the south limb, the outcrop of the upper bed is of a higher grade than elsewhere (figs. 2 and 3). Hole 9 was drilled to explore this area about 125 feet down the dip from the outcrop. The upper ore formation encountered from 93 to 110 feet assayed 6.1 percent, and the lower bed, from 181 to 183 feet, was barren.

South limb, south portion. - Results of the drilling indicate that the lower bed in this area is the best portion of the Virgin River manganese deposit. This area was explored by holes 6, 7, 8, 10, 13, 16, 17, and 18. (See figs. 2 and 3.) Holes 6 and 8 explored the beds about 100 feet down the dip from the outcrop; a slightly greater distance would have been preferred, but the steep slope east of the ore outcrop was inaccessible. Hole 7 was located about 200 feet from the outcrop. The results obtained from holes 6,



7, and 8 influenced location of the remaining holes in the area. Hole 6 intersected 5 feet of manganiferous sandstone that assayed 8.1 percent, and hole 8 had 3 feet assaying 8.2 percent (fig. 3). These results obviated the need for further investigation in that vicinity. Hole 7 intersected 9 feet of 13.7 percent material, which led to the location of hole 10, 375 feet farther down the dip, in which 16 feet of 13-percent material was found. Hole 13, about 200 feet southeast of hole 7 and 375 feet southwest of hole 10, intersected 9 1/2 feet of material averaging 9.8 percent manganese. Hole 16, intended to delimit the ore and drilled 230 feet south of hole 13, had only 2 feet of 6.9 percent material. Hole 17, about 300 feet east of hole 13, had only 5 feet of 5.7 percent material.

To further delimit the ore in hole 10, hole 18, 270 feet north and 125 feet east of hole 10, was drilled, and only 1 foot of 10.6 percent material was intersected.

A total of 4,277 linear feet of core drilling was completed on the project.



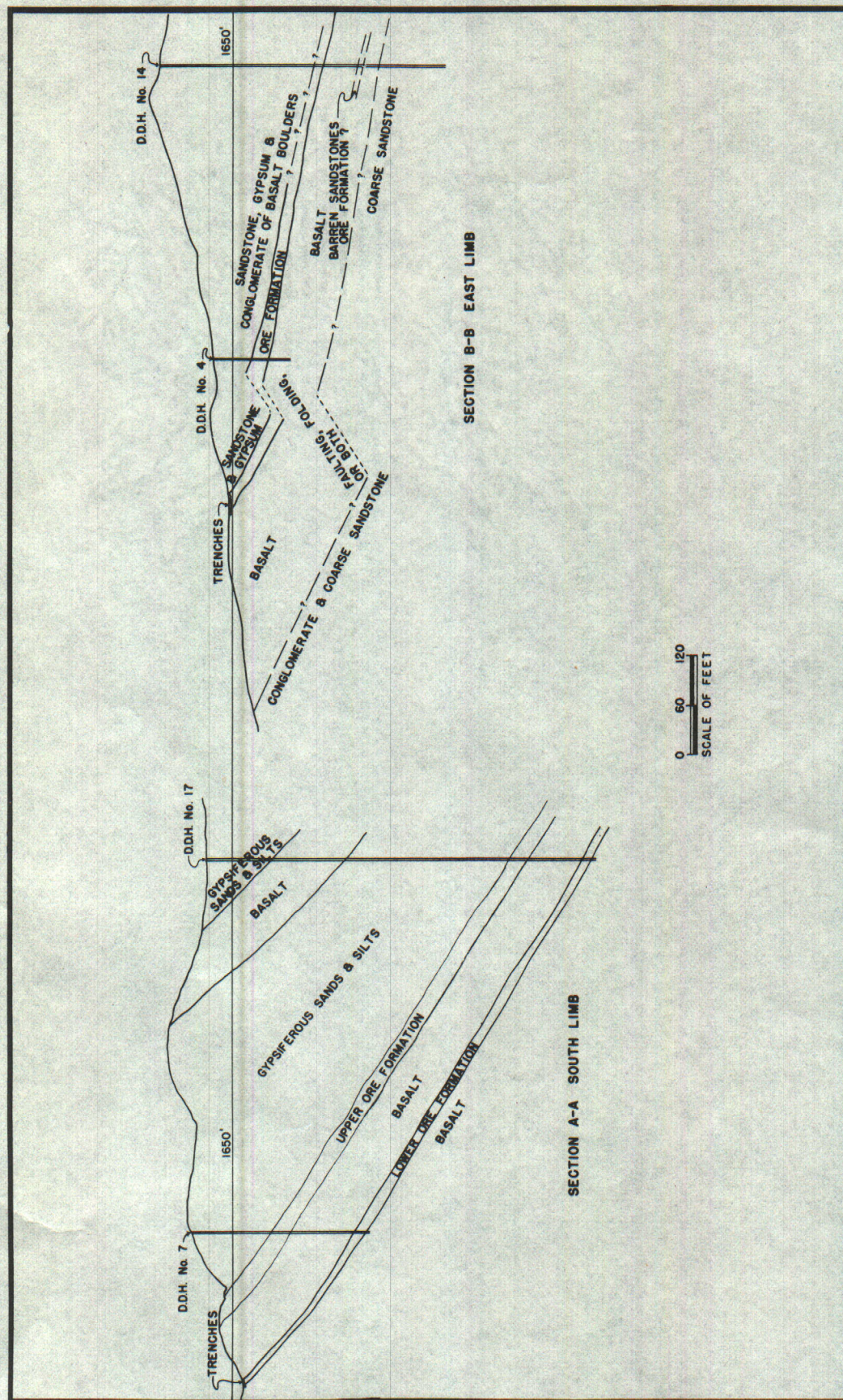


Figure 4. - Sections showing drill holes and geology, Virgin River manganese deposit, Clark County, Nev.