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DIVISION OF GEOLOGY
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Report of Investigations
No. 7

CHARACTER AND TONNAGE
OF THE
TURK MAGNESITE DEPOSIT

By
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INTRODUCTION

For more than a decade the possibilities of large-scale use of magnesium in light-metal construction has stimulated the consideration of adequate sources of raw materials. Continuous production of magnesite in Stevens County, Washington, since 1916 naturally focused attention on this area, and all available information was studied for clues as to the reserve tonnage that might be present for large-scale operations.

Prior to 1934 calculations of reserves failed to take into consideration certain essential geologic features of the magnesite deposits and so could be considered but little better than guesses. In an attempt to improve this situation the Division of Geology began in 1934 a study of the known magnesite deposits and of the Stensgar formation in which they lie.

Both field and laboratory studies were carried on for a few weeks in both 1934 and 1935. The investigation was resumed in 1941, and the preliminary results appeared in Report of Investigations No. 5, published that year. Early in the spring of 1942 the Washington State Planning Council provided funds for the testing of certain State land in the vicinity of Turk, Stevens County, where the earlier study had shown the probability of commercial amounts of high-grade magnesite. The actual planning of the project as well as the task of following it through was assigned to the Department of Conservation and Development.

The rocks in the area selected for the investigation are relatively well exposed in natural outcrops and show little of the structural complexities which characterize the rocks of Stevens County generally. In addition, near the north limits of the area an abandoned mining adit and three drifts provided access to approximately 350 feet of the formation, some 75 feet below the surface. These features simplified the task of planning the drilling program and permitted efficient use of the funds provided.

A 10-foot contour map on a scale of 50 feet to the inch was made as a base for subsequent operations. This appears as plate 1 accompanying this report. The datum used was carried by altimeter from a highway bench mark near Columbia River and is probably within 100 feet of sea level datum. Roads and drill-hole locations as well as areal geology, including structural data, were mapped on this base.

In the course of the work about 5,000 feet of core drilling in nineteen holes provided material for geologic and chemical examination. The core was uniformly of 1¼-inch diameter except in the more friable upper portions of the magnesite bodies where a core of larger diameter was necessary in some holes. In a few instances sludge samples were taken where core was not recovered, but in the main, loss of water prevented this mode of recovery. Examination of plate 1 will show that the holes were mainly in two groups at the north and south ends of the area examined. From surface indications the intermediate zone seemed likely to contain less high-grade magnesite, and such tests as were made subsequently bore this out.

Cores were taken to the laboratory of the Division of Geology at Pullman where they were first measured, then broken into 1-foot lengths and split. Each core was next logged on the basis of lithologic character and behavior in acid, and finally sacked, foot by foot, for transmission to the chemical laboratory. Thin sections were prepared for a number of core samples to permit essential petrographic examination. On the basis of the geologic features, particularly color, texture, reaction to acid, and freedom

from obvious impurities, the desired compositing of samples was indicated for the chemist. In addition to the core samples a complete set of samples from all outcrops was made and these together with channel samples every 5 feet along the north wall of the adit provided valuable additions to the core samples submitted to the chemist.

In the chemical laboratory each sacked sample was course-ground separately, rolled long enough to provide thorough mixing, and quartered twice. A measured amount of each foot-sample thus prepared was selected for making the composites, and each composite sample was then ground to under 65 mesh and again rolled for thorough mixing before the final sample for analysis was taken. This mode of preparation permitted retention of half of the original core as split, together with about three-fourths of each foot-sample in course-ground form and most of each composite sample in fine-ground form. This material is on file in the Division laboratory.

ACKNOWLEDGMENTS

The project was initiated by the State Planning Council with an appropriation of $15,000.00, and to Mr. Ben Kizer, Chairman, and Mr. P. Hetherton, Executive Secretary, is due much credit for help in the undertaking. Mr. Sheldon L. Glover, Supervisor of the Division of Mines and Mining, who had charge of the project from the beginning, selected the driller, made all preliminary arrangements and planned the work besides making valuable suggestions while it was under way. Doctor R. R. Sayers, Director of the United States Bureau of Mines, kindly consented to the plan by which Mr. W. F. Holbrook of the Pullman Laboratory of the Bureau undertook direct supervision of the analytical work. The actual analysis was largely by Mark Adams, chemist, although the later analyses were run by Robert E. Stevenson of the Geology Division staff. Much credit for the arduous and painstaking work of preparation of samples for analysis must go to Jack Lang and his assistants as well as to members of the staff of the Division of Geology. Especial credit is due Stephen H. Green and Ward Carithers who checked and boxed the cores at the drill site. The whole task was greatly facilitated by the whole-hearted cooperation of the State College of Washington, particularly by members of the staffs of the departments of Chemistry and Mining.

GEOLOGY

GENERAL FEATURES

The rocks in the vicinity of the Turk magnesite deposit are slates with the interbedded Stensgar dolomite and upper quartzite members, all part of the Deer Trail group. They have been sharply folded, so as to be slightly overturned, and have been intruded by a small granitic mass, which probably is connected with a more extensive body at a relatively shallow depth. A more complete account of the regional geology has been given in previous reports;[1] only the dolomite will be considered here.

STENSGAR DOLOMITE

That part of the Stensgar which contains the Turk magnesite deposit lies in the SE¼SW¼ sec. 36, T. 30 N., R. 37 E., W.M. (See pl. 1.) The outcrop is about 1,000 feet long in a northeasterly direction, parallel to the strike of the beds, some 600 feet wide at the south along the section line, and about 300 feet wide at the north where the formation passes under Alder Creek.

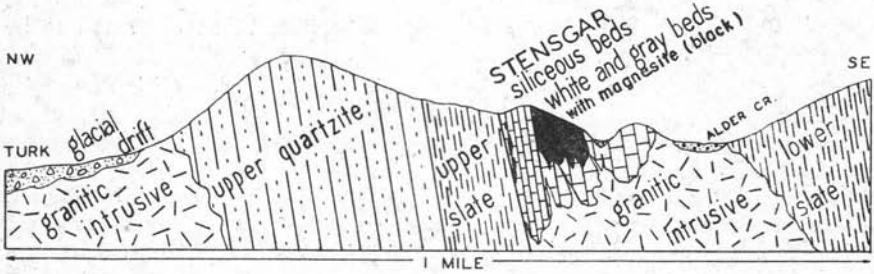

FIGURE 1—Diagrammatic section across the Turk area showing the formations associated with the Stensgar, which comprises two zones, a siliceous phase on the northwest and a true dolomite, carrying the magnesite, on the southeast.

In figure 1 a cross-sectional view is presented showing the stratigraphic and structural relations of the Stensgar to adjacent formations, as well as sedimentary zones in the formation itself. Eastward from what is probably a fault contact with the overlying slates the Stensgar, west of Alder Creek, comprises the following units, from the top:

Siliceous dolomite and dolomite	120 feet
Dull, thin-bedded siliceous dolomite	100 feet
White, coarsely crystalline dolomite	80 feet
Gray, fine to medium crystalline dolomite	300 feet

Although some magnesite occurs in the upper 120 feet of beds, the main bodies lie in the lower 380 feet of white and gray dolomite.

[1] Bennett, W. A. G., Preliminary report on magnesite deposits of Stevens County, Washington: Wash. Div. Geol. Rept. of Inv. 5, 1941. Culver, Harold E., Some geologic aspects of the magnesite deposits of Washington: Wash. State Coll. Eng. Exp. Sta., Eng. Bull. 61, pp. 19-26, 1939. Weaver, Charles E., The mineral resources of Stevens County: Wash. Geol. Survey Bull. 20, 1920.

As shown in figure 1 the Stensgar and other strata stand nearly vertical, having been overturned from an original horizontal position, so that the outcropping beds now dip 80°-85° SE., trending about N. 20° E. Either at the time of folding or later, the rocks were faulted and thoroughly fractured. One fault, dipping steeply southeastward, is followed for 75 feet by the third drift off the main adit. (See pl. 1.) Another fault is inferred at the contact between the Stensgar and overlying slate. It has sliced the dolomite beds diagonally across the strike, and is apparently followed by the mapped gully which trends N. 30°-35° E. It thus appears that the narrowing of the dolomite outcrops from 600 feet at the south to 300 feet at the north results in part from erosion by Alder Creek and in part from the slicing effect of the fault.

The dolomite shows alteration by thermal metamorphism indicated by course texture and the presence of olivine, pyroxene, amphiboles, biotite, quartz, and talc, and a few sulphides, pyrite, pyrrhotite, and arsenopyrite.

THE MAGNESITE

The drilling shows that the magnesite occurs in two apparently separate masses, at the north and south ends of the Stensgar outcrop. Some small pockets of magnesite lie in the upper part of the Stensgar between the siliceous zone and the west contact but they appear to be too small to be economically important.

Both the north and south bodies contain masses of dolomitic magnesite and dolomite as have been found in other magnesite deposits in the Stensgar formation. Determination of their exact size, form, and position can be made only on the basis of mining and quarrying operations. So far as can be judged from present drilling data and all other available information, these dolomite zones are neither numerous nor unduly large. Microscopic examination of the magnesite as well as of the dolomite shows more or less olivine. In places it shows alteration to serpentine, but in general serpentine is restricted to dolomite, particularly siliceous dolomite.

NORTH BODY

This mass has an intermittent outcrop extending some 150 feet northeastward from the portal of the adit (see pl. 1), then 180 feet northwestward, and then some 300 feet southwestward, past station T 8, to a point some 50 feet east of station T 6.

The mass underground as shown by the drilling is roughly a block 200 by 250 feet on the surface, and 280 feet deep. It underlies an area shown on the map (pl. 1), by a shaded pattern, which should have been extended 300 feet southwestward. Its stratigraphic position is between 200 and 450 feet below the top of the Stensgar dolomite.

The form of the magnesite body is imperfectly revealed by the drilling, but its irregular character can hardly be overemphasized. The mass is not a sedimentary bed since it cuts across the bedding of the enclosing dolomite in all directions. South of the adit the junction with dolomite is abrupt and diagonal to the strike. However, the west side or foot wall is a relatively straight surface determined by the barren siliceous dolomite zone. Consequently, as depth is gained the west limit of the body will be found to lie

eastward about 15 feet horizontally for every 100 feet of depth. This north body of magnesite as a whole also shows an inclination northeastward at a steep angle, roughly 65°.

The magnesite shown in holes 13, 15, and 16 and in the adit for the first 110 feet is light gray to yellowish, and medium crystalline. In holes 14 and 17 it is predominantly white since these holes pass through the white dolomite zone of the Stensgar and enter the siliceous dolomite at about 120 and 127 feet respectively. Magnesite in the cores as well as in the adit shows only occasional banding, being for the most part massive. Bedding features that are probably preserved from the original dolomite appear north of the portal of the adit along the east edge of the outcrop.

SOUTH BODY

The outcrop of the south body starts at hole 4 (see pl. 1) and extends about 130 feet down hill southeastward with an average width of about 50 feet, and ends at a narrow ledge of dolomite. The south edge ends near the floor of the gully, which contains many quartzite boulders.

The magnesite underground as revealed by holes 4, 5, 7, 8, 9, and 10 is roughly 240 feet square in ground plan and 220 feet deep. It lies between 200 and 440 feet below the top of the Stensgar dolomite, essentially the same as the north body.

It seems to have a greater regularity of form than the north body. The same straight west wall is shown by holes 5 and 10, since they passed through the siliceous dolomite beds in the same stratigraphic position from the top of the Stensgar as holes 3, 12, and 14. The general form is that of a lens whose axis lies apparently parallel to the strike of the Stensgar, and whose continuation may be found in sec. 1 to the south. Holes 4, 7, 9, and 11 ended in lamprophyric or dioritic intrusives, suggesting a bottom to the ore body around their locus. The probability of a greater depth southward is suggested by hole 8, which ended near the section line in magnesite of high grade.

The magnesite of the south body shows a medium coarse texture throughout. It is gray in holes 8 and 9, and white to grayish white in holes 5 and 10, which pass through the white dolomite zone of the Stensgar and enter the siliceous beds at 120 and 135 feet respectively, essentially the same as holes 14 and 17 at the north.

ORIGIN

Drilling has shown that the magnesite is irregular in form and that in places it contains small masses of dolomite, magnesitic dolomite, and dolomitic magnesite. These masses may be either inclusions, wholly surrounded by magnesite, or interfingering wedge-like projections around the margin of the magnesite bodies. The boundary between the magnesite and dolomite is usually sharp but appears to be gradational in places due to a mixture of magnesite crystals in dolomite. These features characterize other magnesite deposits in the Stensgar and have been pointed out as evidence favoring an alteration genesis.[1]

[1] Culver, Harold E., Some geologic aspects of the magnesite deposits of Washington: Wash. State Coll. Eng. Exp. Sta., Eng. Bull. 61, pp. 21-22, 1939.

A feature in which the Turk deposit differs from others in the magnesite belt is the comparative uniformity in grain size of the magnesite and the enclosing dolomite. Both carbonates contain scattered crystals of olivine. Many vein-like masses of serpentine occur, but most if not all of them are in the dolomite, particularly the siliceous dolomite.

The two main bodies of magnesite making up the Turk deposit occupy the same stratigraphic zone, lying immediately beneath the high silica zone, in the Stensgar formation.

Structural features characterizing the magnesite and dolomite are not easily singled out as having genetic significance. It cannot be stated on the basis of present information that the dolomite was more permeable in some places than in others. Faults, if crossed by the holes, have not been observed in the cores except near the bottom of hole 3 where the dolomite exhibits a brecciated phase together with extreme serpentinization. The fault exposed in the third drift off the main adit shows hydrothermal alteration of wall rock and marks the west border of magnesitized rock in the main adit.

Fractures presumably were abundant and open enough in the dolomite to permit permeation by solutions which formed the magnesite. The alteration of the dolomite together with the formation of serpentine veins suggest hydrothermal solutions of magmatic origin. At the border of the magnesite in hole 14 serpentine and olivine occur in parallel veinlets. The olivine veinlets resemble dunite in thin section, but their irregular shape in the core shows definitely that they are a product of hydrothermal metamorphism and not of igneous origin. The occurrence of olivine in the Turk magnesite appears to be unusual. The high concentration of olivine in the magnesite on the one hand and of veins of serpentine and olivine in the dolomite on the other definitely suggest a common hydrothermal origin for not only the magnesian silicates but for the magnesite as well.

If it be assumed that magnesian solutions entered a dolomite low in silica, then some of the magnesia of the solutions may have combined with the available silica to form olivine, while the rest of the magnesia replaced the calcium to form magnesite. In the siliceous dolomite where there was an abundance of silica the available magnesium may have been used up in the formation of serpentine and olivine with none left over for replacement of the calcium. This may explain why the magnesite is relatively free of serpentine and olivine while the siliceous zone is rich in those minerals but essentially free of magnesite. The net result of the combination of these two processes would have been a selective replacement of the Stensgar dolomite.

The magnesitization was brought about under conditions of advanced temperature though probably not of a high order since minerals denoting a higher temperature than olivine have so far not been found. The recent investigations of Bowen[1] on the metamorphism of siliceous dolomite are particularly well exemplified in the Turk deposit.

In conclusion it may be pointed out that the metamorphic conditions under which the Stensgar was recrystallized and under which the magnesite was formed obtained at the time of the intrusion of granitic batholiths in the Deer Trail area.

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[1] Bowen, Norman L., Progressive metamorphism of siliceous limestone and dolomite: Jour. Geology, vol. 48, p. 260, 1940.

DRILLING AND CHEMICAL DATA

About 450 analyses have been made of carbonate rocks and a few of silicate rocks from the Turk deposit cores. Analyses were also made of surface outcrops (numbers SS 1-17 on plate 1) and of channel samples that were taken along the north wall of the adit.

ANALYTICAL PROCEDURE

Material for analysis, weighing 1 gram, was first calcined at a temperature of 950°C. for about 10 hours, which expelled the carbon dioxide and water. Its loss in weight, expressed in percent, is represented in the column headed "ignition loss". The soluble oxides were next dissolved in concentrated hydrochloric and perchloric acids, and the amount of silica and insoluble silicates determined, and included in the column labeled "insoluble". The precipitated iron and alumina are represented under the heading "R_2O_3". Calcium was determined by double precipitation, and finally the magnesia by subtraction from 100 percent. Magnesia was determined by precipitation for only a few analyses as a check on the amount by subtraction; these results are usually only a little less than those by subtraction, and have not been included in the tables which follow. The percentage of magnesia determined by either method may be greater by a fraction to a few percent than that which is available from only the carbonates. Since the lime and magnesia are often too great to combine with the carbon dioxide reported in the ignition loss, magnesian silicates have probably been dissolved and their magnesia reported with that from the carbonates.

In the following table of logs and analyses some parts of the cores are not represented. These were eliminated by inspection and are either impure dolomite or dike rocks.

DEFINITION OF TERMS

A chemical classification based on percent of magnesia has been adopted to designate the carbonate rocks included in the column headed "lithology". Thus a carbonate is classed as **dolomite** if its percentage of magnesia is 21.5 or less and it shows nearly the lime to magnesia ratio of dolomite. A carbonate containing more than 21.5 but less than 25.0 percent of magnesia is classed as **magnesitic dolomite**; one containing 25.0 and less than 35, **dolomitic magnesite**; and one containing 35 or more, **magnesite.** Some carbonates classed as magnesitic that are high in insoluble matter may be siliceous dolomites with some serpentine or olivine.

LOGS AND ANALYSES OF CORES

HOLE 1

Depth in feet	Feet in sample	Recovery in feet	Lithology	Ignition loss	Insoluble	R_2O_3	CaO	MgO (calc.)	Lab. no.
0–4	4	.....	No core	.....	.....	.....	.....	.....	.....
4–10	6	2	White and light-gray magnesite	49.19	3.31	1.12	3.67	42.71	105
10–16½	6½	¼	White magnesite	47.85	4.05	.81	9.95	37.34	84
16½–21	4½	.....	No core	.....	.....	.....	.....	.....	.....
21–26	5	½	Yellow, green, and pink dolomite	42.87	9.76	1.40	25.22	20.75	85
26–41	15	1	Brown and gray magnesitic dolomite	44.53	3.36	.77	27.33	24.01	86
41–44	3	2	Gray and white dolomitic magnesite	45.41	4.52	.86	23.58	25.63	87
44–47	3	½	Gray dolomitic magnesite	44.34	3.55	1.04	23.72	27.35	88
47–49	2	1	White and gray magnesitic dolomite	46.04	5.71	.57	25.76	21.92	89
49–53	4	4	White, gray, and brown magnesitic dolomite	47.04	.53	.46	30.42	21.55	90
53–58	5	5	Gray magnesitic dolomite	45.88	1.52	.41	30.17	22.02	91
58–65	7	7	White to gray magnesitic dolomite	44.81	3.06	.46	29.42	22.25	92
65–69	4	4	Yellowish and light-gray dolomite	44.96	2.36	.51	30.93	21.24	93
69–71	2	2	White to light-gray magnesitic dolomite	45.05	2.28	.58	30.50	21.59	94
71–72	1	1	Gray magnesitic dolomite	44.39	2.96	.50	28.51	23.64	95
72–78	6	6	White and gray magnesitic dolomite	44.83	2.80	.43	30.20	21.74	96
78–80	2	2	White and gray dolomite	42.20	5.46	.99	20.68	20.67	97
80–85	5	1	Dark-gray dike	.....	.....	Not an	alyzed	.....	.....
85–87	2	2	Light-gray dolomite	45.38	3.17	1.03	29.67	20.75	98
87–92	5	2½	Gray to light-gray dolomite	43.60	4.60	.76	30.37	20.67	99
92–94	2	1	Light-gray to gray dolomite	44.62	4.08	.77	29.44	21.09	100
94–101	7	6	Gray dolomite	42.32	5.35	.88	30.02	21.43	101
101–108	7	7	Gray to light-gray dolomite	37.88	13.58	1.46	27.10	19.98	102
108–126	18	18	Gray magnesitic dolomite	35.37	10.71	1.73	30.10	22.09	104
126–129	3	3	Gray and light-gray magnesitic dolomite	40.26	5.94	1.47	29.73	22.60	116
129–140	11	11	Gray magnesitic dolomite	42.04	4.45	1.34	29.98	23.19	117
140–150	10	10	Light-gray magnesitic dolomite	42.55	4.51	1.07	30.10	21.77	118
150–152	2	1	White dolomite	43.92	3.38	.97	30.65	21.08	119
152–155.	3	3	Gray magnesitic dolomite	43.18	3.49	1.01	30.45	21.87	120
155–156½	1½	1½	White magnesitic dolomite	44.79	2.64	.71	30.16	21.70	121
156½–170	13½	13½	Gray magnesitic dolomite	44.03	2.90	.64	30.57	21.68	122
170–180	10	9	Gray and white dolomite	45.64	2.44	.75	30.44	20.73	123
180–181	1	0	Dark-brown soft dike	.....	.....	Not an	alyzed	.....	.....
181–191	10	9⅛	Gray magnesitic dolomite	41.47	5.00	1.00	30.72	21.81	124
191–204	13	13	Gray magnesitic dolomite	42.88	3.95	.82	30.66	21.69	125
			Bottom of hole						

HOLE 2

0–26	26	½	White dolomitic magnesite	47.44	.78	.81	25.31	25.66	127
26–40	14	.....	No core	.....	.....	.....	.....	.....	.....
40–45	5	½	White magnesitic dolomite	46.15	1.64	.60	20.86	22.75	128
45–50	5	.....	No core	.....	.....	.....	.....	.....	.....
50–54	4	½	White magnesitic dolomite	47.22	.63	.67	28.30	23.18	129
54–58	4	1½	White magnesite	49.77	.33	.77	10.72	38.41	130
58–59	1	½	White magnesitic dolomite	46.96	.36	.48	30.56	21.64	131
59–67	8	8	White magnesitic dolomite with chalcedony	46.92	.77	.42	29.59	22.30	132
67–68	1	1	Brown and white magnesite	50.77	.32	.85	3.63	44.43	133
68–72½	4½	4½	White magnesitic dolomite	46.93	.33	.45	30.07	22.22	134
72½–73½	1	1	White dolomite with serpentine	42.81	4.98	.78	30.99	20.44	135
73½–75	1½	1½	White magnesitic dolomite	46.79	.53	.53	30.29	21.86	136
75–84	9	1	Red-brown pyrite-bearing dike	4.64	64.58	15.95	1.15	13.68	137
84–88	4	3½	White magnesitic dolomite with green silicate	46.15	1.41	.66	28.14	23.64	138
88–106	18	18	White magnesitic dolomite	46.68	.83	.30	30.24	21.95	139
106–108	2	2	White magnesitic dolomite	46.21	1.49	.32	30.05	21.93	140
108–112	4	3	White magnesitic dolomite	46.57	.74	.31	30.23	22.15	141
112–114	2	2	Impure white dolomite	45.32	3.90	.42	30.12	20.24	142
114–124	10	10	White dolomitic magnesite	46.26	1.38	.30	26.88	25.18	143
124–134	10	10	White magnesitic dolomite with chalcedony	44.92	3.72	.29	29.51	21.56	144
134–142	8	2½	Salmon-colored dolomite	42.57	8.80	.65	28.08	19.30	145
142–147	5	3	White, light-green, and pink dolomite	44.73	4.63	.46	29.39	20.59	146

HOLE 2 (Continued)

Depth in feet	Feet in sample	Recovery in feet	Lithology	Ignition loss	Insoluble	R_2O_3	CaO	MgO (calc.)	Lab. no.
147–150	3	3	Pink dolomite with brown chalcedony	38.42	17.04	1.19	25.30	18.05	147
150–152	2	1	White dolomite and chalcedony	40.84	11.90	1.22	26.52	19.52	148
152–154	2	1½	Dark-brown dolomite and chalcedony	30.36	32.20	2.72	19.87	14.85	149
154–155	1	½	Dolomite, chalcedony, and olivine	23.05	52.41	1.58	11.58	11.38	150
155–156	1	1	Brown and pink dolomite and chalcedony	35.32	22.93	2.37	22.50	16.88	151
156–158	2	1	Chalcedony with a little dolomite	23.15	45.23	5.28	14.80	11.54	152
158–159½	1½	1	Brown micaceous dike	15.67	43.47	18.18	6.88	15.80	153
159½–170	10½	10	White magnesitic dolomite, chalcedony, and olivine	44.11	3.50	.78	29.97	21.64	154
170–171	1	1	Dark-gray magnesitic dolomite with serpentine	43.97	4.10	.63	27.90	23.40	155
171–176	5	5	Gray magnesitic dolomite	43.67	3.64	.54	29.05	23.10	156
176–181½	5½	5½	Light-gray magnesitic dolomite	41.54	5.92	.40	30.00	22.14	157
181½–182	½	½	White dolomite with serpentine vein	24.54	32.54	.80	24.22	17.90	158
182–183	1	1	Light-gray magnesitic dolomite	37.03	10.26	.48	30.50	21.73	159
183–183½	½	½	White silicate, serpentine, and dolomite	11.20	69.88	.63	10.37	7.92	160
183½–186½	3	3	Light-gray dolomite with serpentine	34.68	20.45	.30	24.87	19.70	161
186½–189	2½	2½	White silicate	1.32	96.82	.27	.45	1.14	162
189–190	1	1	White silicate	.90	95.38	.27	1.40	2.05	163
190–192½	2½	2½	White silicate	2.64	88.10	.75	.57	7.94	164
192½–193½	1	1	Serpentine	12.33	43.85	1.82	.13	41.87	165
193½–196½	3	3	Serpentine and white silicate	6.02	71.41	1.25	3.56	17.76	166
196½–198	1½	1½	White silicate and calcite	19.25	52.40	.46	23.95	3.94	167
198–200	2	2	White silicate with quartz	.24	98.50	.45	.33	.48	168
200–208½	8½	8½	White silicate with quartz	.....	.....	Not an	alyzed	.....	.....
208½–214	5½	5½	Gray magnesitic dolomite	46.22	1.29	.58	29.66	22.25	171
214–215⅔	1⅔	1⅔	White silicate	11.27	72.18	.43	8.23	7.89	172
215⅔–226	10⅓	10⅓	White to dark-gray magnesitic dolomite	45.96	1.47	.65	29.40	22.52	173
226–228	2	2	White to gray magnesitic dolomite	46.76	.51	.65	30.23	21.85	193
228–242	14	14	Gray dolomite	46.80	4.84	.85	27.59	19.92	194
242–244½	2½	2½	Light-gray dolomitic magnesite	32.90	8.07	.81	31.31	26.91	195
244½–246½	2	2	Gray dolomite, serpentine, and white silicate	23.12	35.08	.73	22.42	18.65	196
246½–259	12½	12½	Light-gray to gray magnesitic dolomite	37.20	9.25	.90	30.90	22.75	197
259–275	16	16	Gray magnesitic dolomite	41.99	4.49	.72	29.52	23.28	199
275–293	18	18	Gray magnesitic dolomite	42.30	4.09	.62	29.93	23.06	200
293–303	10	10	Light-gray to gray magnesitic dolomite	44.62	2.13	.55	29.90	22.80	201
303–306	3	3	Dark-gray dolomitic magnesite	45.10	2.43	.49	26.65	25.33	202
306–337	31	31	Light-gray to gray magnesitic dolomite	41.76	4.67	.75	29.41	23.41	203
337–341	4	4	Light-gray magnesitic dolomite	42.57	4.10	.62	28.95	23.76	204
341–396	55	53	Light-gray to gray magnesitic dolomite	42.92	3.55	.66	30.09	22.78	218
396–403	7	7	Light-gray to gray magnesitic dolomite	41.97	4.17	.86	30.38	22.62	219
			Bottom of hole						

HOLE 3

0–18	18	18	White dolomitic magnesite	45.53	6.28	.83	14.06	33.30	220
18–23	5	5	Light-tan magnesitic dolomite	45.66	2.40	.54	27.78	23.62	221
23–29	6	6	White to light-tan magnesitic dolomite	46.03	1.39	.40	30.18	22.00	222
29–43	14	5	Light-gray magnesitic dolomite	46.22	1.40	.67	29.85	21.86	223
43–61	18	2½	White and gray magnesitic dolomite	45.02	2.92	.97	28.88	22.21	224
61–65	4	2	White and light-gray magnesitic dolomite	45.65	2.57	.99	28.08	22.71	225
65–70½	5½	5¼	Dark-gray with brown dolomitic magnesite	42.32	5.86	1.41	22.51	27.90	226
70½–73	2½	2½	Tan magnesite and a little serpentine	43.28	7.08	1.33	5.22	43.09	227
73–76	3	1½	White and brown dolomitic magnesite	29.82	20.20	1.93	19.67	28.38	228
76–81½	5½	4½	Multicolored dolomite and serpentine	14.05	56.05	2.04	12.58	15.28	300
81½–93	11½	10	Gray and brown dolomite with serpentine	32.11	19.60	1.36	27.32	19.61	289

HOLE 3 (Continued)

Depth in feet	Feet in sample	Recovery in feet	Lithology	Ignition loss	Insoluble	R_2O_3	CaO	MgO (calc.)	Lab. no.
93–100	7	6	White with multicolored dolomite	23.72	36.32	1.20	19.75	19.01	290
100–111	11	8	White dolomite with dark-gray dike	16.71	48.02	2.36	14.86	18.05	291
111–127	16	12½	Banded argillaceous dolomite	.....	.....	Not an	alyzed	.....	.....
127–175	48	48	Banded argillaceous dolomite	.....	.....	Not an	alyzed	.....	.....
175–184½	9½	9½	Light-gray to white magnesite	27.64	20.15	.80	15.21	36.20	292
184½–196	11½	11½	Banded siliceous dolomite and dike	.....	.....	Not an	alyzed	.....	.....
196–201	5	5	Light-brown siliceous dolomite	.....	.....	Not an	alyzed	.....	.....
201–205	4	3¾	Dark-gray dolomite with serpentine	.....	.....	Not an	alyzed	.....	.....
205–229	24	24	Gray and white magnesitic dolomite	40.30	8.13	.74	29.24	21.59	293
229–249	20	20	Banded siliceous dolomite	.....	.....	Not an	alyzed	.....	.....
249–252	3	3	White magnesite and a little serpentine	34.30	15.62	.80	12.21	37.07	294
252–258½	6½	6½	White and gray dolomite and serpentine	.....	.....	Not an	alyzed	.....	.....
258½–259	½	½	White dolomitic magnesite	17.17	43.09	.73	3.48	35.53	295
259–270	11	11	White dolomite and serpentine	.....	.....	Not an	alyzed	.....	.....
270–278	8	8	White and multicolored dolomitic magnesite	39.54	19.10	1.97	8.58	30.81	296
278–284	6	6	Dark-gray argillite	.....	.....	Not an	alyzed	.....	.....
			Bottom of hole						

HOLE 4

0–12	12	8	White, brown, and gray magnesite	46.95	3.94	.89	3.90	44.32	229
12–15	3	3	Brown and gray magnesite	46.87	4.42	1.07	.55	47.09	230
15–16	1	1	Brown magnesite	47.65	3.47	1.17	.26	47.45	231
16–20	4	4	Dark-gray magnesite	47.63	3.75	.95	1.06	46.61	232
20–22	2	2	Brown magnesite	48.65	3.24	.89	1.68	45.54	233
22–29½	7½	7½	Dark-gray magnesite	47.75	3.60	1.00	.02	47.63	234
29½–32	2½	2½	Light-brown magnesite	47.48	3.96	1.11	.11	47.34	235
32–57	25	25	Light- to medium-gray magnesite	46.23	4.91	.89	.14	47.83	236
57–70	13	13	Light-gray magnesite	46.36	5.73	.75	.65	46.51	237
70–103	33	33	Pale-gray magnesite	43.61	7.83	.75	1.82	45.99	238
103–111	8	2	Green silicate mineral	33.22	25.58	.97	10.55	29.68	239
111–113	2	1½	Light-gray dolomitic magnesite	47.43	1.99	1.82	14.22	34.54	240
113–118	5	¾	Dike rock	.....	.....	Not an	alyzed	.....	.....
118–121	3	3	Gray magnesite	40.29	10.82	1.57	2.00	45.32	241
121–123	2	2	Light-brown magnesite	46.72	4.29	1.27	1.05	46.67	242
123–137	14	14	White and gray magnesite	47.73	3.49	1.07	1.19	46.52	243
137–140	3	3	Light-brown magnesite	49.56	2.08	.94	1.06	46.36	244
140–170	30	30	Medium- to dark-gray magnesite	42.83	7.77	1.08	.86	47.46	245
170–200	30	30	Medium- to dark-gray magnesite	45.69	5.21	.97	2.33	45.80	246
200–219½	19½	19½	Medium-gray magnesite	44.57	5.92	1.04	4.22	44.25	247
219½–237	17½	17½	Dark basic dike rock	.....	.....	Not an	alyzed	.....	.....
			Bottom of hole						

HOLE 5

0–35	35	8	White friable dolomitic magnesite	42.65	9.18	.54	17.89	29.74	248
35–46	11	2	White friable dolomitic magnesite	48.01	1.45	.43	18.79	31.32	249
46–59	13	7	White friable magnesite	51.00	.54	.68	2.78	45.00	250
59–66	7	6½	White and light-brown magnesite	43.14	8.76	.71	1.93	45.46	251
66–71	5	4½	White magnesite and serpentine	31.39	28.00	.72	3.47	36.42	252
71–111	40	32	White friable magnesite	46.81	5.24	.93	5.01	42.01	271
111–113½	2½	2	Dark-gray magnesite	47.24	4.24	.99	.78	46.75	272
113½–117	3½	3	Brown magnesite	45.44	5.40	1.05	5.47	42.61	273
117–120	3	3	White magnesite	42.17	9.81	.84	3.70	43.48	274
120–124	4	3½	Green serpentine and dolomitic magnesite	38.07	13.42	1.29	17.55	29.67	275
124–128	4	3½	Carbonate and silicate mixture	19.80	39.77	3.17	18.90	18.36	276
128–134	6	4½	Gray dolomite and serpentine	39.84	9.95	.74	29.13	20.34	277
134–144½	10½	10	Dolomite, serpentine, and white silicate	.....	.....	Not an	alyzed	.....	.....
144½–154	9½	2½	Dark-brown dike rock	.....	.....	Not an	alyzed	.....	.....
154–161	7	6	Dolomite bands and dike rock	.....	.....	Not an	alyzed	.....	.....
161–194	33	27	Banded serpentine and dolomite	.....	.....	Not an	alyzed	.....	.....
194–209½	15½	15	Serpentine and dolomite	.....	.....	Not an	alyzed	.....	.....
209½–210½	1	1	White magnesite	33.14	14.80	1.05	15.00	36.01	278
210½–222	11½	11½	White dolomite and serpentine	.....	.....	Not an	alyzed	.....	.....
222–231	9	9	White magnesitic dolomite	45.13	2.85	.40	29.58	22.04	279

HOLE 5 (Continued)

Depth in feet	Feet in sample	Recovery in feet	Lithology	Ignition loss	Insoluble	R_2O_3	CaO	MgO (calc.)	Lab. no.
231–245	14	14	White dolomite and serpentine	.....	.....	Not an	alyzed	.....	.....
245–250	5	5	White magnesite	40.21	9.57	.73	3.56	45.93	280
250–258	8	8	White dolomite	.....	.....	Not an	alyzed	.....	.....
258–259	1	1	White magnesite	31.90	14.74	.83	8.00	44.53	281
259–266	7	7	White dolomite and serpentine	.....	.....	Not an	alyzed	.....	.....
266–267	1	1	White magnesite	47.13	3.80	.89	4.70	43.48	282
267–275	8	8	Serpentine and argillite	.....	.....	Not an	alyzed	.....	.....
			Bottom of hole						

HOLE 6

0–24	24	.....	No core	.....	.....	.....	.....	.....	.....
24–55	31	1	Light-gray magnesite	47.74	3.62	.70	7.47	40.47	327
55–76	21	13	Dolomite	.....	.....	.....	.....	.....	.....
			Bottom of hole						

HOLE 7

0–48	48	1½	Friable white magnesite	47.33	3.98	.91	2.58	45.20	253
48–64	16	7	Light-gray friable magnesite	46.22	5.80	.82	6.17	40.99	254
64–82	18	3	Bluish-gray friable magnesite	45.97	4.82	.70	3.62	44.89	255
82–86	4	4	Bluish-gray to brown magnesite	46.41	4.62	.90	2.84	45.23	256
86–104	18	8	Light-gray friable dolomitic magnesite	47.04	2.96	.86	14.38	34.76	268
104–122	18	6½	Light-tan magnesitic dolomite	44.15	3.03	.60	30.70	21.52	269
122–136	14	14	Light- to dark-gray magnesitic dolomite	42.50	4.32	.69	30.06	22.43	270
136–187	51	10½	Dark dike rock	.....	.....	Not an	alyzed	.....	.....
			Bottom of hole						

HOLE 8

0–19	19	.....	(Sludge) white sandy magnesite	48.08	3.55	.83	1.53	46.01	257
19–39	20	15	Gray partly friable magnesite	48.07	3.63	.85	.80	46.65	258
39–67	28	27	Tan to nearly white magnesite	48.32	3.67	.75	.74	46.52	259
67–94	27	25	Gray and brown banded magnesite	47.81	3.67	.90	.80	46.82	260
94–100	6	5	Dirty white magnesite	48.88	3.76	.66	1.12	45.58	261
100–115	15	13½	Gray and brown magnesite	46.76	4.65	.79	1.56	46.24	262
115–123	8	3	White fractured magnesite	47.44	5.65	.79	3.67	42.45	263
123–147	24	21	Gray and tan sugary magnesite	47.03	4.39	.80	1.53	46.25	264
147–182	35	32½	Gray and tan magnesite	46.11	4.75	.88	3.04	45.22	265
182–219½	37½	24	Mainly serpentine with dolomite	.....	.....	Not an	alyzed	.....	.....
219½–240	20½	20½	Gray to white magnesite	50.75	.75	.71	2.03	45.76	266
240–284	44	41	Gray to white magnesite	49.39	2.02	.89	2.09	45.61	267
			Bottom of hole						

HOLE 9

0–32	32	27½	Dark-gray and tan magnesite	47.05	4.07	1.00	2.27	45.61	283
32–64	32	32	Dark-gray and tan magnesite	47.68	3.48	.97	1.03	46.84	284
64–98	34	20⅔	Dark-gray, tan, and white magnesite	47.57	4.10	.78	.62	46.93	285
98–122	24	21¼	Dark-gray, tan, and white magnesite	47.33	4.21	.76	4.02	43.68	286
122–132	10	4¼	Light-gray dolomitic magnesite	45.87	4.92	.64	17.98	30.59	287
132–144	12	11⅞	Light-gray with tan magnesite	45.33	4.32	1.02	12.66	36.67	288
144–156	12	6½	Gray, tan, and light magnesite and serpentine	45.99	4.58	1.74	7.78	39.91	316
156–174	18	6¼	Dark-gray fine-grained rock	.....	.....	Not an	alyzed	.....	.....
174–184	10	10	Gray magnesite	47.57	3.34	.87	4.26	43.96	317
184–213	29	29	Gray magnesite	45.08	5.77	.93	1.86	46.36	318
213–233	20	20	Dark-gray with tan magnesite	46.58	4.50	.79	2.37	45.76	319
233–250	17	17	Dark-gray and light-gray magnesite	43.03	6.95	1.38	7.65	40.99	320
250–336	86	86	Dark-gray fine-grained rock	.....	.....	Not an	alyzed	.....	.....
			Bottom of hole						

HOLE 10

Depth in feet	Feet in sample	Recovery in feet	Lithology	Ignition loss	Insoluble	R_2O_3	CaO	MgO (calc.)	Lab. no.
0–3	3	3	White and brown magnesite	46.67	4.54	.96	3.33	44.50	322
3–25	22	3	Brown dolomitic magnesite	21.78	35.92	2.21	7.04	33.05	323
25–48	23	10	Light-gray and white magnesite	49.58	1.80	.78	2.11	45.73	324
48–67	19	7¾	White with gray magnesite	50.45	1.26	.87	.74	46.68	325
67–74	7	6	White and multicolored magnesite	32.12	22.74	1.48	5.15	38.51	326
74–100	26	21	White, gray, and brown magnesite	44.64	8.05	1.00	2.94	43.27	327
100–115	15	13	Gray, brown, and white magnesite	48.08	3.56	1.00	.82	46.54	328
115–134	19	14⅙	Gray, brown, and white magnesite	45.98	6.23	.86	2.87	44.06	329
134–150	16	15¾	Multicolored magnesitic dolomite	26.87	29.10	1.64	20.89	21.50	331
150–161	11	11	Multicolored dolomite and serpentine	21.28	37.46	2.27	19.27	19.72	332
161–206	45	37	Serpentine, dolomite, and dike rock	.....	.....	Not an	alyzed.	.....	.....
206–222	16	12	Gray and white banded dolomitic magnesite	18.70	36.24	2.27	11.29	31.50	333
222–224	2	2	White argillaceous dolomite	.....	.....	Not an	alyzed.	.....	.....
224–234	8	10	White to gray dolomite	22.93	36.68	.96	17.98	21.45	334①
234–239	5	5	Dark-gray fine-grained rock	.....	.....	Not an	alyzed.	.....	.....
239–244	5	5	Grayish-white dolomite	30.14	27.27	.72	24.13	17.74	335
244–259	15	15	Grayish magnesitic dolomite and serpentine	44.87	1.98	.54	30.42	22.19	336
259–263	4	4	Gray magnesitic dolomite	40.86	6.79	.59	30.02	21.74	337
263–270	7	7	Gray and white dolomite and serpentine	.....	.....	Not an	alyzed.	.....	.....
270–280	9	10	White and gray dolomitic magnesite and serpentine	35.93	15.91	.70	13.24	34.22	338②
280–289½	9½	8½	Gray and white dolomite and serpentine	.....	.....	Not an	alyzed.	.....	.....
289½–293	3½	3½	White with gray magnesite	36.33	12.70	1.09	10.31	39.57	339
293–295	2	2	Dark-gray and green rock	.....	.....	Not an	alyzed.	.....	.....
295–297	2	2	Dark-gray and white magnesite	27.50	18.94	2.13	11.88	39.55	340
297–321	24	24	White and gray dolomite and serpentine	.....	.....	Not an	alyzed.	.....	.....
321–322½	1½	1½	White and light-gray dolomite	36.20	13.04	.55	31.63	18.58	341
322½–326	3½	1½	Dark-gray fine-grained rock	.....	.....	Not an	alyzed.	.....	.....
			Bottom of hole						

① Dark-gray rock (226-228) not included in sample No. 334.
② Gray and white rock (275-276) not included in sample No. 338.

HOLE 11

0–63	63	.....	Slope-wash, no core	.....	.....	.....	.....	.....	.....
63–68	5	3½	Gray dolomite	15.05	57.89	3.55	12.67	10.84	367
68–71	3	3	Dark dolomite and serpentine	25.62	34.19	2.24	29.53	8.42	350
71–74	3	1½	White serpentinized dolomite	.....	.....	Not an	alyzed.	.....	.....
74–83	9	9	Gray-green dolomite with calcite	26.82	27.02	1.54	30.09	14.53	351
83–112	29	25⅙	Gray dolomite and serpentine	35.66	12.79	1.16	33.95	16.44	352
112–137	25	15⅓	Light-gray argillaceous dolomite	.....	.....	Not an	alyzed.	.....	.....
137–150	13	10⅚	Gray dolomite and serpentine	21.73	39.68	1.98	25.83	10.78	358
150–173	23	21⅙	Gray dolomite and a little serpentine	33.26	15.03	1.32	30.21	20.18	359
173–182	9	9	Gray dolomite	40.46	6.50	.87	31.58	20.59	360
182–186	4	2¼	Serpentine and light-gray dolomite	.....	.....	Not an	alyzed.	.....	.....
186–203	17	17	Light-gray dolomite	37.78	9.85	1.01	32.85	18.51	361
203–222	19	17	Dark-gray fine-grained rock	.....	.....	Not an	alyzed.	.....	.....
			Bottom of hole						

HOLE 12

0–12	12	.....	Slope-wash, no core	.....	.....	.....	.....	.....	.....
12–48	36	.....	(Sludge) white dolomite	44.72	2.95	.86	31.34	20.13	398
48–55	7	.....	(Sludge) tan dolomite	44.30	2.73	.77	32.00	20.20	369
55–77	22	.....	(Sludge) white dolomite	45.47	2.00	.64	30.93	20.96	370
77–95	18	8	Gray dolomite	45.24	2.26	.90	30.18	21.42	371
95–100	5	3	White to light-gray magnesitic dolomite	45.00	1.98	.78	30.46	21.78	372
100–107	7	6	Gray magnesitic dolomite with serpentine	40.10	5.80	1.48	30.00	22.62	373
107–123	16	15⅙	Dark-gray magnesitic dolomite	41.91	4.45	1.15	30.47	22.02	374
123–137	14	14	Dark-gray magnesitic dolomite	42.26	4.20	1.02	29.98	22.54	375

HOLE 12 (Continued)

Depth in feet	Feet in sample	Recovery in feet	Lithology	Ignition loss	Insoluble	R_2O_3	CaO	MgO (calc.)	Lab. no.
137–154	17	17	Dark-gray magnesitic dolomite with calcite	43.16	3.75	.78	30.36	21.95	376
154–157	3	3	Light-gray dolomite with calcite	43.77	5.53	.72	28.97	21.01	377
157–177	20	20	Dark-gray magnesitic dolomite with calcite	42.65	4.05	.85	30.32	22.13	378
177–184	7	7	Dark-gray magnesitic dolomite	43.24	3.55	.74	30.25	22.22	379
184–205	21	21	Dark-gray magnesitic dolomite	43.41	3.72	.57	30.26	22.04	380
205–216	11	11	Dark-gray magnesitic dolomite	41.83	5.05	.47	30.50	22.15	381
216–229	13	13	White dolomite with serpentine	28.17	32.92	.41	20.92	17.58	382
229–237	8	8	White magnesitic dolomite	43.38	3.42	.28	30.76	22.16	383
237–239	2	2	White magnesitic dolomite with asbestos	46.71	.20	.25	30.70	22.14	384
239–262	23	23	White magnesitic dolomite with asbestos	46.58	.55	.19	30.55	22.13	385
262–268	6	6	Gray magnesitic dolomite	41.28	6.32	.35	30.28	21.77	386
268–274	6	6	Banded dolomite	31.82	20.92	.64	26.48	20.14	387
274–284	10	10	Gray and white magnesitic dolomite	44.00	2.48	.48	30.76	22.28	388
284–303	19	18⅓	Dark-gray magnesitic dolomite	40.70	5.56	1.20	30.57	21.97	389
303–305	2	2	Dark-gray and white magnesitic dolomite	44.48	2.60	.74	30.37	21.81	390
305–318	13	13	Gray with white magnesitic dolomite	42.27	4.29	.94	30.37	22.13	391
318–322	4	4	White magnesitic dolomite	40.26	6.28	.82	29.97	22.67	392
322–327	5	5	Banded dolomite	11.26	55.47	3.21	9.96	20.10	393
327–334	7	7	White with banded dolomite	33.02	19.00	1.08	27.02	19.88	394
334–349	15	15	Brown and white dolomite and serpentine	16.93	48.23	1.41	16.15	17.28	395
349–365	16	15	White dolomite and serpentine	8.71	66.07	2.72	8.00	14.50	396
365–398	33	32	Banded dolomite	.....	.....	Not an	alyzed	.....	.....
398–403	5	5	Banded dolomitic magnesite	27.96	21.17	1.33	21.43	28.11	397
403–409	6	6	Banded argillaceous dolomite and serpentine	.....	.....	Not an	alyzed	.....	.....
409–414	5	5	White dolomite with serpentine	22.34	40.05	.88	18.72	18.01	398
414–419½	5½	5½	Brown and gray rock	.....	.....	Not an	alyzed	.....	.....
419½–422	2½	2½	White dolomite with serpentine	21.71	42.77	.74	18.1	16.68	399
422–429	7	7	Gray and white dolomite	40.03	9.03	.83	28.73	21.38	401
			Bottom of hole						

HOLE 13

0–9	9	8	White and light-gray magnesite	47.75	3.42	.88	1.26	46.69	403
9–15	6	4½	White and light-gray magnesite	48.00	3.25	.77	1.46	46.52	404
15–20	5	1	Light-brown magnesite	46.70	4.42	1.17	1.31	46.40	405
20–34	14	2	Light-brown with light-gray dolomitic magnesite	45.76	2.28	.94	24.45	26.57	406
34–53	19	6	White, gray, and brown magnesitic dolomite	46.04	1.15	1.31	29.70	21.80	407
53–61	8	3½	Gray and brown dolomitic magnesite	44.78	2.73	1.37	22.48	28.64	408
61–71	10	10	White to light-gray magnesite	44.95	5.70	1.10	1.65	46.60	409
71–78	7	7	Dark-gray and tan magnesite	45.20	3.78	1.16	14.48	35.38	410
78–82	4	4	Dark-gray magnesite with calcite	46.14	2.19	2.04	14.08	35.55	411
82–87	5	5	White, gray, and brown magnesitic dolomite	40.89	5.65	2.23	27.25	23.98	412
87–93	6	6	White dolomite and quartz	1.68	95.09	.43	1.55	1.25	413
93–100	7	7	Dark-gray dolomite	38.05	15.31	1.19	24.30	21.15	414
100–109	9	9	Dark-gray dolomitic magnesite with pyrite	39.62	1.95	4.17	29.00	25.26	415
109–119	10	10	Gray magnesitic dolomite	43.45	1.43	2.17	29.91	23.04	416
119–135	16	15	Gray magnesitic dolomite	43.70	1.97	1.82	29.30	23.21	417
135–139	4	4	Gray magnesite	45.44	5.00	1.33	2.55	45.68	418
139–140	1	1	Light-brown magnesite	48.94	1.96	1.36	4.02	43.72	419
140–143	3	3	Gray magnesite	45.87	4.70	1.40	1.10	46.93	420
143–144	1	1	White to light-gray magnesite	39.72	9.50	1.71	1.50	47.57	421
144–147	3	3	White and gray magnesite	49.18	1.90	1.10	1.95	45.87	422
147–150	3	3	Brown magnesite	50.44	.95	1.24	1.95	45.42	423
150–152	2	2	White and gray magnesite	49.20	1.65	1.79	1.95	45.41	424
152–155	3	3	White and gray magnesitic dolomite	43.60	2.84	1.66	28.10	23.80	425
155–157	2	2	White and gray dolomitic magnesite and serpentine	13.02	43.68	2.70	6.54	34.06	426
157–161	4	4	Dark-gray dolomitic magnesite	40.46	7.18	1.78	19.32	31.26	427

HOLE 13 (Continued)

Depth in feet	Feet in sample	Recovery in feet	Lithology	Ignition loss	Insoluble	R_2O_3	CaO	MgO (calc.)	Lab. no.
161–165	4	4	Dark-gray magnesite	47.90	3.04	1.35	1.38	46.33	428
165–168	3	3	Dark-gray magnesite	45.10	3.93	1.46	13.28	36.23	429
168–172	4	4	Dark-gray magnesite	47.36	3.56	1.27	2.15	45.66	430
172–180	8	8	Gray magnesite	47.28	3.82	1.12	1.00	46.78	431
180–184	4	4	Gray magnesite with calcite	45.15	4.15	1.28	10.44	38.98	432
184–196	12	12	Gray with white magnesite	45.58	5.14	1.03	1.67	46.58	433
196–206	10	8¼	Gray magnesite	42.90	6.56	1.17	8.61	40.76	434
206–214	8	8	Gray and white magnesite	40.45	8.89	1.30	1.55	47.81	435
214–222	8	8	Multicolored magnesite and serpentine	40.00	7.75	1.79	7.23	43.23	436
222–232	10	10	Gray and white magnesite and serpentine	31.88	19.47	1.74	10.73	36.18	437
			Bottom of hole						

HOLE 14

0–19	19	7	White iron-stained magnesite	46.83	3.00	.76	12.14	37.27	438
19–23	4	4	White magnesite	51.03	.47	.88	2.08	45.54	439
23–33	10	4	White and impure brown magnesitic dolomite	26.60	44.55	.96	3.12	24.77	440
33–50	17	16	White magnesite	49.90	1.75	.80	.47	47.08	441
50–58	8	5½	White magnesite	51.26	.40	.87	1.19	46.28	442
58–62	4	4	White magnesite	50.83	.24	.80	4.67	43.46	443
62–66	4	4	White magnesite	51.32	.36	.70	1.33	46.29	444
66–81	15	15	White, gray, and multicolored dolomitic magnesite	43.26	7.25	1.04	13.83	34.62	445
81–88	7	7	White and light-gray magnesite	41.89	8.90	1.04	3.42	44.75	446
88–97	9	9	Gray, brown, and white magnesite	43.70	6.06	1.30	8.13	40.81	447
97–102	5	5	Gray magnesite	47.40	3.79	.99	1.00	46.82	448
102–108	6	6	Gray magnesite	46.93	3.73	1.02	4.50	43.82	449
108–120	12	12	Gray with brown and white magnesite	44.36	5.37	1.17	10.01	39.09	450
120–136	16	16	White and impure gray dolomitic magnesite	23.10	28.48	5.12	14.16	29.14	451
136–157	21	21	Banded argillaceous dolomite	15.70	50.25	3.58	15.36	15.11	452
157–163	6	5	Banded dolomite with serpentine	3.23	79.20	2.74	2.91	11.92	453
163–172	9	6	Banded dolomite with serpentine	8.94	65.05	4.10	7.90	14.01	454
172–182	10	8	Banded impure dolomite	6.96	66.78	3.27	3.68	19.31	455
182–194	12	12	Banded impure dolomitic magnesite	21.32	28.75	3.00	11.18	35.75	456
194–196	2	2	Gray and white dolomitic magnesite	23.17	26.59	.57	15.41	34.26	457
196–203	7	5	Banded impure white dolomite	17.94	44.84	4.88	15.47	16.87	458
203–211	8	7	White dolomite and dark-gray rock	14.50	58.64	3.40	12.40	11.06	459
211–241	30	30	Gray and white magnesitic dolomite	33.97	15.45	2.18	26.76	21.64	460
241–249	8	8	Green and gray rock	.....	.....	Not analyzed.		.....	.....
			Bottom of hole						

HOLE 15

0–7	7	4	Brown and white dolomitic magnesite	46.17	1.60	.78	25.50	25.95	473
7–16	9	2	White, brown, and gray magnesite	49.53	1.00	.87	7.15	41.45	474
16–22	6	5½	Light-gray magnesite with calcite	48.51	3.05	.96	1.70	45.78	461
22–32	10	4½	Light-gray magnesite	42.38	7.43	1.04	8.07	41.08	462
32–46	14	11½	Light-gray magnesite and white magnesite	45.12	6.44	.92	1.60	45.92	463
46–53	7	6¾	Gray, white, and brown magnesite	45.00	4.83	.83	11.52	37.82	464
53–59	6	5	Dark-gray magnesite	44.85	6.38	1.00	1.25	46.52	465
59–61	2	1⅓	Gray with white magnesite	44.74	5.73	.87	10.95	37.71	466
66–68	7	6½	Light-gray magnesite	44.54	6.34	.84	2.68	45.60	467
68–78	10	5½	Light-gray magnesite	43.30	6.56	1.04	7.17	41.93	468
78–82	4	4	Light-gray magnesite	45.32	5.29	.88	3.44	45.07	469
82–84	2	2	Gray magnesite	45.32	4.08	1.07	11.52	38.01	470
84–90	6	6	Gray dolomitic magnesite	43.75	4.80	1.36	16.00	34.09	471
90–133	43	43	Dark-gray with white magnesite	46.10	4.54	.98	3.62	44.76	472
133–137	4	4	Dark-gray magnesite	43.50	5.77	1.38	7.46	41.89	475
137–147	10	10	Gray magnesite with serpentine	43.98	5.92	1.54	4.57	43.99	476
147–149	2	2	Light-gray dolomitic magnesite	37.24	9.36	1.77	21.44	30.19	477
149–186	37	37	Gray and white magnesite and serpentine	36.65	12.10	.24	8.67	42.34	478

HOLE 15 (Continued)

Depth in feet	Feet in sample	Recovery in feet	Lithology	Ignition loss	Insoluble	R_2O_3	CaO	MgO (calc.)	Lab. no.
186–194	8	8	White and light-gray magnesitic dolomite	33.98	16.12	.52	27.00	22.38	479
194–198	4	4	White and light-gray dolomite	16.73	53.58	.44	16.51	12.74	480
198–209	11	11	White and light-gray magnesitic dolomite	30.97	14.33	.87	30.23	23.60	481
209–217	8	8	Gray with white magnesitic dolomite	36.10	8.72	.87	30.58	23.73	482
217–232	15	15	Gray magnesitic dolomite and a little serpentine	38.95	6.90	.68	30.68	22.79	483
232–237	5	5	Light-gray magnesitic dolomite with green rock	33.16	12.10	.66	31.13	22.95	484
237–257	20	20	Dark-gray dolomite and serpentine. Bottom of hole	41.51	8.38	.54	28.85	20.72	485

HOLE 16

0–48	48	34½	Light-gray to white magnesite	47.01	4.20	1.05	1.77	45.97	486
48–52	4	3	Light-gray dolomitic magnesite	41.83	6.57	1.14	16.65	33.81	487
52–55	3	1	Light-gray magnesite	43.93	6.04	1.08	8.40	40.45	488
55–85	30	8	Light-gray and white dolomitic magnesite	44.77	4.34	1.00	15.99	33.90	489
85–113	28	15	Gray, white, and brown magnesite	45.56	4.71	1.08	6.88	41.77	490
113–120	7	3¾	Gray and white magnesite	43.43	6.07	1.54	5.76	43.20	491
120–122	2	1¼	Gray and white dolomitic magnesite	44.31	5.58	1.33	13.87	34.91	492
122–146	24	11½	Gray to white magnesitic dolomite	41.08	6.00	3.84	24.43	24.65	493
146–155	9	9	Gray magnesite	44.63	5.63	1.18	5.72	42.84	494
155–167	12	10	Gray magnesite	42.47	7.30	1.97	11.02	37.24	495
167–172	5	5	Gray, white, and brown dolomitic magnesite	40.28	6.55	3.83	22.45	26.89	496
172–207	35	35	Gray with white magnesite	47.08	3.39	1.09	7.37	41.07	497
207–225	18	18	White with light-gray magnesite	47.56	3.04	1.13	6.95	41.32	498
225–278	53	53	Gray magnesitic dolomite, calcite, and serpentine	42.53	5.07	1.05	28.44	22.91	499
278–285	7	7	Banded argillaceous dolomite	22.70	37.43	4.52	18.68	16.67	500
285–295	10	10	Banded magnesitic dolomite	42.22	5.16	1.40	29.14	22.08	501
295–301	6	5	Dark-gray fine-grained rock. Bottom of hole	.....	.....	Not an	alyzed	.....	.....

HOLE 17

0–29	29	14	Brown, white, and light-gray magnesite	46.00	4.75	1.11	10.58	37.56	503
29–39	10	6	Light-gray with white magnesite	46.48	3.97	1.30	9.50	38.75	504
39–51	12	12	White magnesite with veinlets	50.00	1.07	1.08	5.04	42.81	505
51–58	7	7	White magnesite	50.66	.67	.90	3.16	44.61	506
58–81	23	22¼	White with gray magnesite	47.65	3.13	1.00	4.41	43.81	507
81–83	2	2	Light-gray magnesite	43.94	7.56	.96	.58	47.01	508
83–86	3	3	Gray, brown, and white magnesite	27.39	23.62	1.85	1.58	45.56	509
86–104	18	18	Gray, white, and brown magnesite	42.95	7.46	1.10	4.87	43.62	510
104–113	9	9	Gray magnesite with veinlets	43.27	7.10	1.28	4.75	43.60	511
113–116	3	3	Gray magnesite	45.40	5.38	1.34	2.58	45.30	512
116–127	11	11	Gray with a little brown magnesite	44.27	5.48	1.22	9.90	39.13	513
127–157	30	28	Gray and white banded magnesitic dolomite	30.27	24.33	2.05	19.57	23.78	514
157–211	54	50	Mottled, serpentinized dolomite	.....	.....	Not an	alyzed	.....	.....
211–219	8	8	Gray and brown banded magnesitic dolomite	20.10	34.11	3.51	17.32	24.96	515
219–222	3	3	White and gray dolomitic magnesite	31.66	15.28	1.08	21.60	30.38	516
222–224½	2½	2½	White dolomite with serpentine	28.90	21.83	1.01	29.06	19.20	517
224½–246½	22	21	Impure dolomite and mottled serpentine	.....	.....	Not an	alyzed	.....	.....
246½–252	5½	5½	White and gray dolomite and serpentine	42.42	4.97	1.06	35.58	15.97	518
252–269	17	17	Dark-green serpentine and asbestos	.....	.....	Not an	alyzed	.....	.....
269–271¼	2¼	2¼	Light-gray dolomitic magnesite with serpentine	43.80	3.59	1.31	20.76	30.54	519
271¼–300	28¾	26	Light- and dark-green serpentine	.....	.....	Not an	alyzed	.....	.....
300–305	5	2	Dense igneous rock. Bottom of hole	.....	.....	Not an	alyzed	.....	.....

HOLE 18

Depth in feet	Feet in sample	Recovery in feet	Lithology	Ignition loss	Insoluble	R_2O_3	CaO	MgO (calc.)	Lab. no.
0–21	21	19½	White, gray, and brown magnesite	46.88	4.04	1.60	8.38	39.10	520
21–31	10	7	White, gray, and brown dolomitic magnesite	45.22	3.52	1.39	18.32	31.55	521
31–35	4	.....	No core	.....	.....	.....	.....	.....	.....
35–53	18	5½	Friable gray and brown dolomitic magnesite	44.88	3.92	1.81	17.10	32.29	522
53–63	10	.....	(Sludge) brown dolomite	45.27	2.15	1.72	30.08	20.78	523
63–67	4	.....	No core	.....	.....	.....	.....	.....	.....
67–90	23	10	Brown and gray dolomitic magnesite	40.72	5.25	3.07	24.84	26.12	524
90–98	8	8	White and gray serpentinized dolomite	13.67	55.95	1.52	11.62	17.24	525
98–104	6	6	Gray dolomite and silicate minerals	29.13	28.01	1.74	22.98	18.14	526
104–108	4	4	Silicates	19.43	53.02	1.56	9.97	16.02	527
108–127	19	19	Gray and white dolomitic magnesite	46.66	2.25	1.53	15.47	34.09	528
127–143	16	16	Gray and brown dolomitic magnesite	46.54	1.54	1.32	23.07	27.53	529
143–156	13	13	White, gray, and brown magnesitic dolomite	46.59	.47	1.31	28.74	22.89	530
156–169	13	13	White, black, and gray dolomitic magnesite	45.77	2.75	1.67	15.72	34.09	531
169–187	18	18	Mottled dolomitic magnesite with serpentine	43.37	4.31	2.29	20.11	29.92	532
187–259	72	72	Serpentine and gneissoid dike rock. Bottom of hole	.....	.....	Not an	alyzed.	.....	.....

HOLE 19

0–25	25	16	Brown and gray magnesite	47.38	3.95	1.48	.82	46.37	533
25–39	14	14	White and gray magnesite	46.00	4.42	1.00	5.69	42.89	534
39–64	25	19	Gray and brown magnesite	47.11	2.90	1.32	9.42	39.25	535
64–82	18	14	Gray and brown magnesite	44.74	4.75	1.08	10.27	39.16	536
82–106	24	24	Light- and dark-gray dolomitic magnesite	44.72	3.97	1.16	15.36	34.79	537
106–128	22	22	Light- and dark-gray magnesite	44.58	5.41	1.28	5.59	43.14	538
128–150	22	22	Light- and dark-gray dolomitic magnesite with pyrite	42.54	4.32	.55	26.88	25.71	539
150–166	16	16	Dark-gray dolomitic magnesite	42.57	4.11	.75	27.56	25.01	540
166–180	14	14	Medium-gray magnesite	44.94	4.73	1.21	7.95	41.17	541
180–190	10	10	Medium-gray magnesite	46.72	4.39	1.35	1.07	46.47	542
190–213	23	23	Medium-gray magnesite with serpentine	44.26	6.04	.98	3.64	45.08	543
213–233	20	20	Gray and white magnesite	42.30	7.86	.89	1.48	47.47	544
233–248	15	15	Gray and white magnesite with serpentine	39.51	9.11	1.66	2.97	46.75	545
248–272	24	24	Light-gray and white magnesite	49.79	1.13	.75	5.04	43.29	546
272–281½	9½	9½	Light-gray and white magnesite with serpentine	46.89	3.50	.74	4.19	44.68	547
281½–310	28½	28½	White and gray magnesitic dolomite with serpentine	44.33	2.73	.60	29.17	23.17	548
310–321	11	11	Serpentine-carbonate rock	.....	.....	Not an	alyzed.	.....	.....
321–330	9	9	Dark-gray dolomite with pyrite	34.74	19.64	1.27	26.36	17.99	549
330–375	45	45	Mottled green serpentine rock. Bottom of hole	.....	.....	Not an	alyzed.	.....	.....

ANALYSES OF ADIT SAMPLES

Sample number	Feet from portal	Ignition loss	Insoluble	R_2O_3	CaO	MgO (calc.)	Lab. no.
U-1	25–30	44.53	6.28	1.12	2.96	45.11	181
U-2	30–40	46.38	5.16	1.25	1.82	45.39	182
U-3	40–45	46.98	4.80	1.14	.61	46.47	183
U-4	45–50	45.11	6.28	1.14	1.32	46.15	184
U-5	50–55	42.72	8.58	1.02	1.21	46.47	185
U-6	55–60	47.41	4.77	1.02	2.25	44.55	186
U-7	60–65	46.62	4.32	1.05	3.79	44.22	187
U-8	65–70	46.92	4.47	1.02	1.60	45.99	188
U-9	70–75	47.43	4.13	1.07	1.11	46.26	189
U-10	75–81	47.87	3.72	1.14	3.33	43.94	190
U-11	81–85	46.93	4.37	1.13	.16	47.41	191
U-12	85–90	46.00	5.47	1.21	.82	46.50	192
U-13	90–95	47.25	4.45	1.28	1.17	45.85	301
U-14	95–100	46.49	4.74	1.25	1.28	46.24	302
U-15	100–105	39.64	11.02	1.40	4.50	43.44	303
U-16	105–110	41.12	10.52	1.18	13.63	33.55	304
U-17	110–115	20.16	44.37	1.50	10.54	23.43	305
U-18	115–120	26.43	38.11	1.14	11.93	22.39	307
U-19	120–125	46.18	2.91	1.13	22.65	27.13	308
U-20, 21	125–135	47.30	2.16	1.06	19.52	29.96	309
U-22, 23	135–145	47.07	2.75	1.00	16.89	32.29	310
U-24, 25	145–155	43.27	6.62	.87	17.29	31.95	311
U-26-29	155–175	43.39	7.02	.83	27.11	21.65	312
U-30-33	175–195	45.56	4.30	1.31	23.07	25.76	313
U-34-37	195–215	36.09	17.09	2.32	16.15	28.35	314
U-38-41	215–235	16.93	48.43	2.27	14.65	17.72	315

ANALYSES OF SURFACE SAMPLES

Sample number	Ignition loss	Insoluble	R_2O_3	CaO	MgO (calc.)	Lab. no.
S.S.-1	45.31	6.00	.82	1.36	46.51	126
S.S.-2	46.66	.45	1.09	31.15	20.65	297
S.S.-3	46.68	4.82	1.15	.18	47.17	205
S.S.-4	45.11	6.08	1.09	.92	46.80	298
S.S.-5	45.39	5.67	1.07	.11	47.76	206
S.S.-6	12.59	57.22	2.98	12.01	15.20	207
S.S.-7	47.66	4.52	1.23	.86	45.73	208
S.S.-8	45.79	3.80	.96	14.24	35.21	209
S.S.-9	51.11	.64	.89	.68	46.68	210
S.S.-10	40.82	7.65	1.12	13.85	36.56	211
S.S.-11	46.08	5.08	.92	.42	47.50	212
S.S.-12	44.94	4.28	.99	24.47	25.32	213
S.S.-13	45.93	1.32	.27	30.84	21.64	214
S.S.-14	44.32	5.50	.56	29.34	20.28	215
S.S.-15	42.50	7.13	1.10	9.70	39.57	216
S.S.-16	42.30	5.30	.83	29.38	22.19	217
S.S.-17	44.40	3.11	.74	29.53	22.22	299

CALCULATION OF TONNAGES

The horizontal limits of the magnesite have been mainly determined by holes 14, 15, 16, 17, and 18 for the north body and holes 5, 7, 8, 9, and 10 for the south body. The lengths of these holes and the magnesite boundary in each have been projected vertically to the surface and plotted on the map. (See pl. 1.) The areas underlain by magnesite are shown on the map by a shaded pattern, which for the north body should have been extended 300 feet southwestward. Volumetric factors have been obtained by assuming a five-sided planimetric figure in ground plan whose corners are the projected limits of the magnesite in the holes mentioned. Each five-sided figure is further assumed to have solid dimensions determined by plane vertical sides whose average depth is the lower boundary of the magnesite in the vertical holes (holes 4 and 19 at the south and north respectively). For ease of calculation each five-sided area has been divided into triangles determined by any two inclined holes and the vertical holes 4 and 13. Vertical planes passed through the holes give triangular prisms. To convert volume of magnesite into short tons a factor of 0.092 tons per cubic foot has been used, which is the weight of a cubic foot of pure magnesite, specific gravity 2.96. The volume calculated includes some dolomite, magnesitic dolomite, and dikes, but to compensate for these an equal amount of magnesite is assumed to lie immediately outside the limits used for the calculations.

NORTH BODY

Centering around hole 13 are five triangular prisms of magnesite whose average vertical dimension is the depth limit of the magnesite in hole 19. Two additional masses of magnesite have been calculated. One of these lies adjacent to the projected limit between holes 15 and 16. Its largest side is the plane joining the projected limits of the magnesite in those holes, and one other side includes the magnesite in the adit between 25 and 110 feet from the portal. The other mass is calculated as a pyramid whose base is the plane joining the projected limit of the magnesite in holes 14 and 15 and whose apex is the magnesite exposed on the surface about 50 feet east of station T 6. This mass includes the magnesitic rock encountered in the upper parts of holes 1, 2, and 3, and in the adit between 110 and 215 feet from the portal.

The dimensions in feet and estimates in short tons for the seven masses are as follows:

Between holes 14 and 17, $\frac{105 \times 74}{2} \times 280 \times 0.092 = 100{,}077$ tons.

Between holes 17 and 18, $\frac{85 \times 67}{2} \times 280 \times 0.092 = 73{,}351$ tons.

Between holes 16 and 18, $\frac{145 \times 60}{2} \times 280 \times 0.092 = 112{,}056$ tons.

Between holes 15 and 16, $\frac{225 \times 87}{2} \times 280 \times 0.092 = 252{,}126$ tons.

Between holes 14 and 15, $\frac{152 \times 95}{2} \times 280 \times 0.092 = 185{,}987$ tons.

Adjacent to holes 15 and 16, $\frac{225 \times 47}{2} \times 280 \times 0.092 = 136{,}206$ tons.

Adjacent to holes 14 and 15, $\frac{260 \times 120}{2} \times \frac{280}{2} \times 0.092 = 200{,}928$ tons.

Total for the north body, 1,060,731 tons.

SOUTH BODY

The south body also includes five masses, triangular in ground plan, around hole 4 and in addition an extension of those between holes 8 and 9 and holes 8 and 10. These additional masses are within the probable limits of the south body where it crosses the south line of sec. 36 into sec. 1. Hole 8, which ended in high-grade magnesite, did not extend to the south line of sec. 36, so that for calculations using this hole the magnesite boundary has been projected 15 feet beyond the hole to the section line.

The dimensions in feet and estimates in short tons for the seven bodies are as follows:

Between holes 5 and 7, $\frac{115 \times 80}{2} \times 220 \times 0.092 = 93{,}104$ tons.

Between holes 7 and 9, $\frac{160 \times 80}{2} \times 220 \times 0.092 = 129{,}536$ tons.

Between holes 8 and 9, $\frac{195 \times 140}{2} \times 220 \times 0.092 = 276{,}276$ tons.

Between holes 8 and 10, $\frac{180 \times 110}{2} \times 220 \times 0.092 = 200{,}376$ tons.

Between holes 5 and 10, $\frac{105 \times 100}{2} \times 220 \times 0.092 = 106{,}260$ tons.

Adjacent to holes 8 and 9, $\frac{180 \times 60}{2} \times 220 \times 0.092 = 109{,}296$ tons.

Adjacent to holes 8 and 10, $\frac{170 \times 150}{2} \times 220 \times 0.092 = 258{,}060$ tons.

Total for the south body, 1,172,908 tons.

EXTENSIONS OF TURK MAGNESITE

In addition to the volumes and tonnages of magnesite which have been calculated as indicated above, it appears highly probable from consideration of all geological factors that extensions of the magnesite bodies may confidently be anticipated.

For the north body the first of these to which attention may now be directed lies below the bottom of hole 19, which went out of magnesite at 280 feet. It seems probable that at that point the drill encountered the inclined south wall of the magnesite and that the mass continues to appreciably greater depths toward the northeast. The next extension, beyond the projected limits of holes 14 and 17, is from near station T 8 to a depth at least as great as that used for the calculations of the main north body.

For the south body, it will be noted that holes 4, 7, and 9 ended in intrusive igneous rock. It is quite possible that these are not large masses and that therefore the south body may have a total depth factor considerably greater than that used in the calculations of tonnages. Similarly, on the south side of this mass, adjacent to the section line, it is probable that the magnesite goes to greater depths than that used in the calculations.

The limited amount of drilling allotted to test the area between the north and south bodies of magnesite indicated the presence of dolomite instead of magnesite down to the level of Alder Creek. It is wholly probable that magnesite will be encountered at greater depth, but since the limits to be fixed for extraction are as yet unknown, this potential extension has not been given consideration.

SUMMARY

About 5,000 feet of drilling has been done in 19 holes on 12 acres of the Stensgar formation in the Turk area. Two bodies of magnesite each corresponding in volume to about a 230-foot cube have been shown to underlie 3 acres. The amount of magnesite calculated is about 2,200,000 short tons, containing more than 40 percent magnesia and less than 5 percent lime. This amount represents about 800,000 tons of magnesia, or about 500,000 tons of metallic magnesium. This figure does not take into consideration certain extensions of the magnesite beyond that revealed by drilling.

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION AND DEVELOPMENT
DIVISION OF GEOLOGY
HAROLD E. CULVER SUPERVISOR

REPORT OF INVESTIGATIONS
NUMBER 7 PLATE 1
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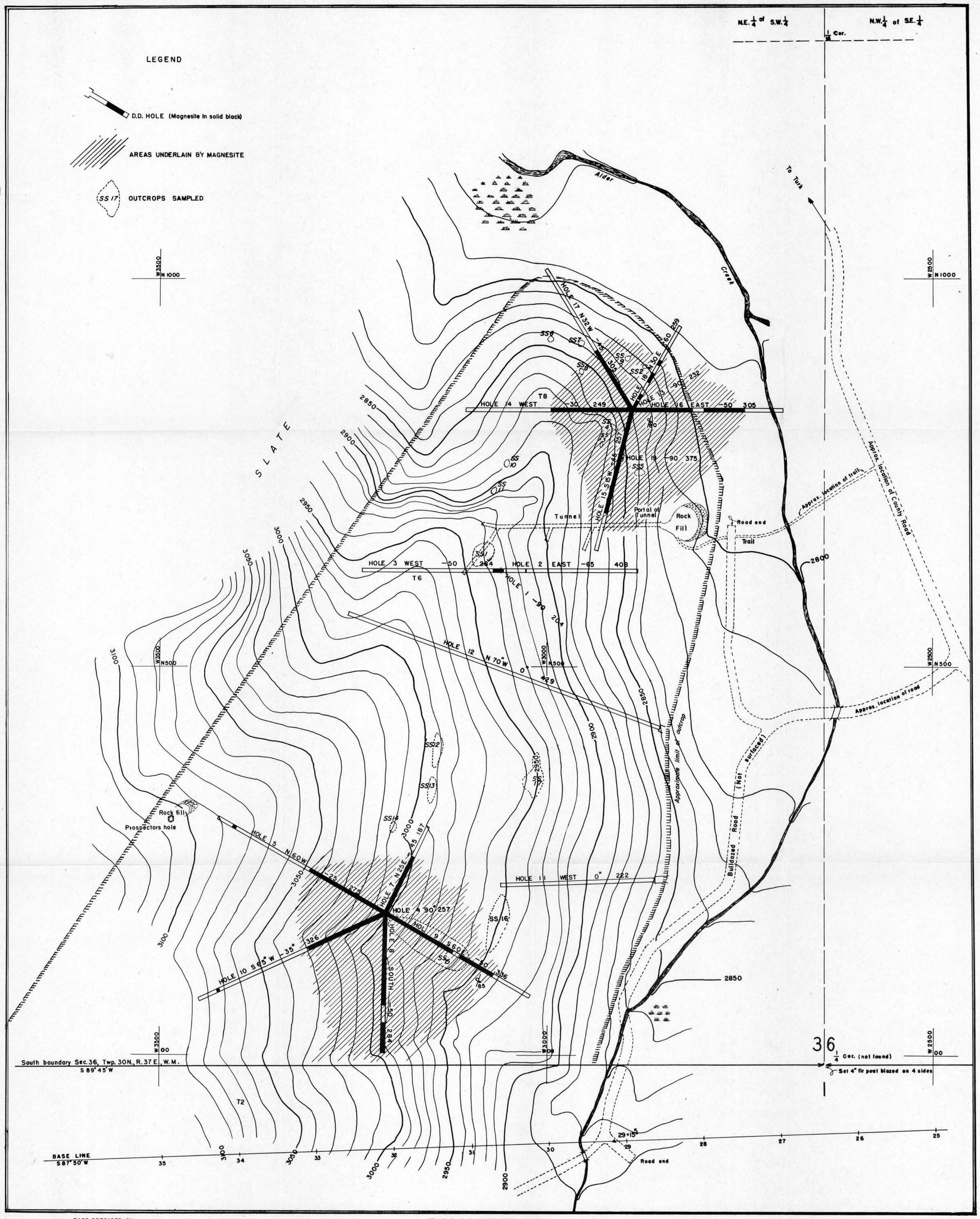

BASE PREPARED BY
DIVISION OF MINES AND MINING

TURK MAGNESITE AREA
STEVENS COUNTY WASHINGTON

0 50 100
SCALE IN FEET