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GEOLOGY OF THE MARBLE EXPLORATION HOLE 4, NEVADA TEST SITE, NYE COUNTY, NEVADA

By F. A. McKeown, and V. R. Wilmarth

Trace Elements Memorandum Report 1036

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October 1959

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This report is preliminary and has not been edited for conformity with Geological Survey format and nomenclature.

*This report concerns work done on behalf of Albuquerque Operations Office, U. S. Atomic Energy Commission.

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GEOLOGY OF THE MARBLE EXPLORATION HOLE 4, NEVADA TEST SITE, NYE COUNTY, NEVADA

By F. A. McKeown and V. R. Wilmarth

INTRODUCTION

The Marble exploration hole 4 was drilled to determine the chemical and physical properties of marble from the surface to depth of about 1,200 feet. The drill hole is in the north-central part of the Tippipah Spring quadrangle, approximately 40 miles north of Mercury, Nev. The collar of the hole is at an elevation of 5,490.28 feet and has the Nevada State grid coordinates of N. 904,480.13 and E. 637,758.38. The hole is accessible by a graded dirt road, easily traversed by heavy construction equipment, that connects to the highway between Mercury and Groom Lake.

The hole was core drilled by Minerals Engineering Company, Grand Junction, Colo., with a 2,000-foot capacity Portadrill drilling rig and conventional NX coring equipment. Drilling was started July 13, and completed August 30, 1959. The drilling fluid was water for most of the hole. At some places in the hole, where loss of drilling fluid was high, the water was thickened with bentonitic mud. At 1,103 feet, presumed caving of the hole caused the drill stem to stick so that it could not be withdrawn; subsequently about 920 feet of the drill stem was recovered. The hole was then reamed to 800 feet and cemented from 785 to 855 feet. A whipstock was emplaced at depth of 805 feet so that the hole, which was vertical to this depth, would be deflected 4° from the vertical. Core was recovered for this part of the hole from 1,088 to 1,187 feet, the total depth. Seven feet of 8-inch outside diameter casing was set from the collar.

This report summarizes the information obtained during preparation of the lithologic log of the core and presents results of chemical analyses of marble samples collected from surface near the drill hole. The report was prepared by the U.S. Geological Survey on behalf of the Albuquerque Operations Office, U.S. Atomic Energy Commission.

The writers acknowledge the assistance of Mr. John Foster, drilling foreman for Minerals Engineering Company, and Mr. Walter A. Johnson, field engineer for Holmes and Narver, Inc., the engineering-contracting firm.

STRATIGRAPHY AND STRUCTURE

The Marble exploration hole 4 penetrated marble from the surface to 1,173 and granodiorite from 1,173 to bottom of the hole at 1,187. A detailed lithologic log of the core from hole is given in table 1.

Marble

The marble is part of the metamorphosed limestone and dolomite of the Pogonip group of Ordovician age that crops out in a north-trending area 2 miles long and about 1 mile wide on the west side of the Climax stock. The marble is generally massive, hard, and tough with some friable zones, which are exposed about 400 feet northeast of the collar of the hole. A massive tactite bed as much as 12 feet thick formed from the marble crops out 200 to 225 feet west of the hole. Bedding is indicated by layers

(Text continued on p. 12)

Table 1.--Lithologic log of core from Marble exploration hole 4, Nevada Test Site, Nye County, Nev.

Logged by D. D. Dickey, F. A. McKeown, and V. R. Wilmarth
July and August 1959

Interval (feet)	Description
0-13.6	No core.
13.6-36.3	Marble, dolomitic, finely crystalline, dominantly light to dark gray, white from 13.5 to 15; distinct bedding dips 45°; calcite-filled fractures as much as one-eighth inch wide.
36.3-40.3	Core lost.
40.3-52	Marble, dolomitic, finely crystalline, white to light-gray mottled orange from 44 to 50 and dark-gray from 50 to 52. Calcite-filled fractures as much as one-fourth inch wide.
52-62.5	Marble, dolomitic, finely crystalline, dark-gray. Calcite-filled fractures are common.
62.5-66.5	Fault zone, highly fractured, dark-gray to brown, dolomitic marble containing hematite- and clay-filled fractures as much as one-fourth inch wide. Vugs as much as 0.3 inch across are lined with coarse calcite and occur in some fractures.
66.5-80	Marble, dolomitic, finely crystalline, white to light-gray, and mottled brown; most fractures are filled with calcite, many are open.

Table 1.--Lithologic log of core from Marble exploration hole 4, Nevada Test Site, Nye County, Nev.--Continued.

Interval (feet)	Description
80-112	Marble, dolomitic, finely crystalline, light- to dark-gray with irregular mottling along bed which dips 45°; abundant calcite-filled fractures one-eighth inch wide, some are open.
112-129.5	Marble, dolomitic, finely crystalline, dominantly white, with some dark-gray bands 1 inch thick. From 115 to 128 core badly broken with a 0.2-foot thick breccia zone at 128; breccia contains one-fourth-inch thick marble fragments in a calcareous hematitic, clayey matrix.
129.5-189.5	Marble, dolomitic, finely crystalline, light- to dark-gray irregularly mottled along bedding.
189.5-230	Marble, dolomitic, finely crystalline, light-gray to white with a dark-gray band from 221 to 222. White marble generally calcitic and medium grained.
230-374	Marble, dolomitic, finely crystalline, mostly light to dark gray. Calcitic from 264 to 270. Prominent color changes at: 270 to 271, brownish orange; 279 to 289, light gray to orange gray; 340 to 343, white.

Table 1.--Lithologic log of core from Marble exploration hole 4, Nevada Test Site, Nye County, Nev.--Continued

Interval (feet)	Description
	Red iron stain is common particularly along bedding(?) and as disseminated masses from 241 to 243, from 264 to 270, and from 309 to 309.5; and generally more abundant from 353 to 374. Bedding dips 40° from axis of core.
374-480	Marble, dolomitic, finely crystalline, light- to dark-gray. Rose-red calcareous iron oxide along fractures is common; some coarse calcite.
480-558	Marble, dolomitic, finely crystalline, generally light to dark gray, some mottled; much red and yellow iron stain along fractures and as disseminated masses from 516 to 520; abundant iron oxide stain 538 to 558. Vugs, one-fourth to one-half inch across, lined with calcite, are common; much dolomitic marble replaced with calcite. Hematite-rich dark-red clayey mud at 491 to 493, 550 to 550.5, 551 to 551.5, and 556 to 557. The mud may have filled solution cavities in the marble. Bedding dips 40° from axis of core.
558-674	Marble, dolomitic, finely crystalline, light- to dark-gray, locally white. Layers 1 inch thick and nodules 1.5 inches across of white calcite common particularly from 653 to 662 and from 640 to 642. Red and white kidney-shaped calcite nodules at 615. Much iron stain on fracture surfaces.

Table 1.--Lithologic log of core from Marble exploration hole 4, Nevada Test Site, Nye County, Nev.--Continued

Interval (feet)	Description
674-737	Marble, dolomitic, finely crystalline, light- to dark-gray, locally white and tan; pink and red hematite-rich irregular zones from 730 to 737; tan marble is calcite rich and brecciated; rose calcite seams present locally. Bedding dips 40° from axis of core.
737-840	Marble, dolomitic, finely crystalline, generally white to light gray with some local dark-gray mottling; white mottling in gray predominant from 780 to 805; white marble is more calcitic than gray marble. Abundant hematite in fractures from 747 to 748 and 837 to 838. Bedding dips 25° to 50° and averages about 35° from axis of core.
840-854	Marble, dolomitic, finely crystalline, generally dark gray, poorly laminated. Some pyrite along fractures. Bedding dips 25° to 35° and averages 30° from axis of core.
854-875	Marble, dolomitic to calcitic, finely crystalline, light-gray to white. Red, clayey fault(?) gouge at 870 to 871; shaly gouge 859 to 859.5. Abundant iron stain along fractures and as disseminated mass from 855 to 863 and 869 to 875. Attitude of bedding is indeterminate.

Table 1.--Lithologic log of core from Marble exploration hole 4, Nevada Test Site, Nye County, Nev.--Continued

Interval (feet)	Description
875-913	Marble, calcitic to dolomitic, finely crystalline, light-gray to white, locally dark gray. Hematite on fractures from 885 to 886. Some pyrite in black siliceous fracture fillings. Bedding dips 30° to 40° and averages 33° from axis of core.
913-951	Marble, calcitic to dolomitic, finely crystalline, light-gray, with dark-gray mottled and white zones about 1 foot thick; soft, banded zone with small seams of coarse calcite at 925 to 928. Abundant hematite as disseminated masses and in fractures from 921 to 922. From 922 to 932 calcite veins as much as one-half inch wide are common and locally contain vugs. Pyrite and black minerals in some fractures which are locally irregular. Bedding at 945 dips 30° from core axis.
951-988	Marble, calcitic to dolomitic, finely crystalline, predominantly light gray with some dark-gray mottling along seams; white from 954 to 960. Abundant fractures as much as one-half inch wide contain pyrite and black minerals. From 951 to 952 broken core with much iron oxide along fractures and as disseminated masses. Bedding at 965 dips 35°; at 978 dips 33° to 38°; and at 985 dips 46° from core axis.

Table 1.--Lithologic log of core from Marble exploration hole 4, Nevada Test Site, Nye County, Nev.--Continued

Interval (feet)	Description
988-1,025	Marble, dolomitic to calcitic, finely crystalline, predominantly light gray, locally grades to dark-gray from 993 to 1,016, mottled with light gray from 1,018 to 1,025, white from 1,016 to 1,018. From 988 to 1,010 massive to poorly bedded, from 1,010 to 1,025 good bedding dips 27° to 33° from core axis. Black and green minerals as fracture filling are common. Sparse hematite in fractures; at 1,002 is 2-inch zone rich in hematite.
1,025-1,062	Marble, predominantly calcitic, finely crystalline, and light-gray; white from 1,055 to 1,062. Fault zone from 1,042 to 1,055 heavily mineralized with iron oxide, garnet(?) and ankerite(?). Pyrite, green and black minerals common as fracture fillings from 1,030 to 1,041 and 1,055 to 1,062. Marble well-bedded from 1,025 to 1,035 with beds dipping 25° to 30° from core axis; poorly bedded from 1,035 to 1,062.
1,062-1,103	Marble, calcitic, finely crystalline, white, locally light gray to gray. Iron stain at 1,064. Pyrite, green and black minerals common as fracture fillings and are abundantly disseminated in the marble from 1,076 to 1,077.5. Marble poorly bedded.

Table 1.--Lithologic log of core from Marble exploration hole 4, Nevada Test Site, Nye County, Nev.--Continued

Interval (feet)	Description
1,103-1,173	Marble, calcitic, generally finely crystalline, locally white parts are coarsely crystalline and calcitic, white to light-gray and light-green. Green minerals abundant along fractures and disseminated in zones parallel to bedding(?). Black minerals and pyrite common as fracture fillings. Local oxidation of pyrite and other iron minerals common in highly fractured zones. Calcite common as fracture filling particularly on fractures nearly parallel to axis of core. Bedding is indistinct and dips about 40° from core axis.
1,173-1,187	Granodiorite, coarse, equigranular, medium-gray. Pyrite and bleaching common along fractures. Chlorite(?) on fractures, particularly near contact with the overlying marble.

ranging from a few inches to several feet thick of gray and white marble. The beds commonly have gradational contacts and at many places bedding has been obliterated by metamorphism and structural deformation. Both at outcrop and in the core interval from the surface to a depth of about 850 feet, the marble is light to dark gray, locally grayish brown to orange, finely crystalline and predominantly dolomitic. In this interval some irregular masses and beds as much as 2 feet thick are composed of white, coarsely crystalline calcite. From 850 to 1,173 feet the marble is generally white to light gray with some dark-gray layers and mottling, and is more calcitic.

At the drill site the marble has an average strike of N. 15° E. and dips 60° to 75° NW. The dip of the bedding in the core from the surface to depth of about 800 feet averages 45° and from 800 to 1,173 feet ranges from 50° to 60°.

The marble is broken by faults and two well-developed sets of joints. On outcrop, about 50 percent of the joints trend north and dip 20° to 50° E. Joints of the other set strike northwest to northeast and dip at angles greater than 60° to the northeast or northwest. Many joints contain silicate minerals, iron oxides, and calcite. Two faults with apparent vertical displacement of about 50 feet are exposed near the drill hole and their trace is indicated by abundant quartz and iron oxide minerals. One fault strikes N. 75° W. and dips 75° NE. and is exposed about 150 feet north of the hole. The other fault strikes N. 80° W., dips steeply northeast, and is exposed about 100 feet southeast of the drill hole. If this fault continues on the same strike it may be present about 30 feet south of the hole.

In the core, the number, width, inclination to core axis, types of minerals present and other features for all fault zones and joints were measured and the data summarized in figures 1, 2, and 3.

Distribution of fractures including faults and open and healed joints was compiled for each 20 feet of core (fig. 1B). In the marble, the number of fractures measured per core interval ranges from 14 to 172 and are most abundant in the interval from 1,020 to 1,040. Figure 2 shows the actual number as well as the theoretical number of fractures in each 15° class interval of dip per 100 feet of core. The theoretical number of fractures per 100 feet of core was computed so that the relative abundance of fractures in each class interval as shown on figure 2 could be compared on an equal basis with each other. A drill hole does not intersect fractures of different dip angles with equal probability. Therefore, if it is assumed in any volume of rock that all fractures are equally spaced, a drill hole will intersect a greater number of fractures that are normal to the hole than those parallel to the hole. The probability of a drill hole intersecting a particular set (or class interval) of fractures is a function of the angle that the set of fractures makes with the drill hole. This function can be geometrically shown to be the cosecant of the angle. The number of fractures counted in each class interval shown on figure 2 was therefore multiplied by the cosecant of the midpoint of the class interval. The theoretical number of fractures thus obtained is represented by the diagonal-lined patterns on figure 2 and are believed to represent a close approximation to the number of fractures actually present in an equidimensional volume of rock whose dimensions are 100 feet on each side.

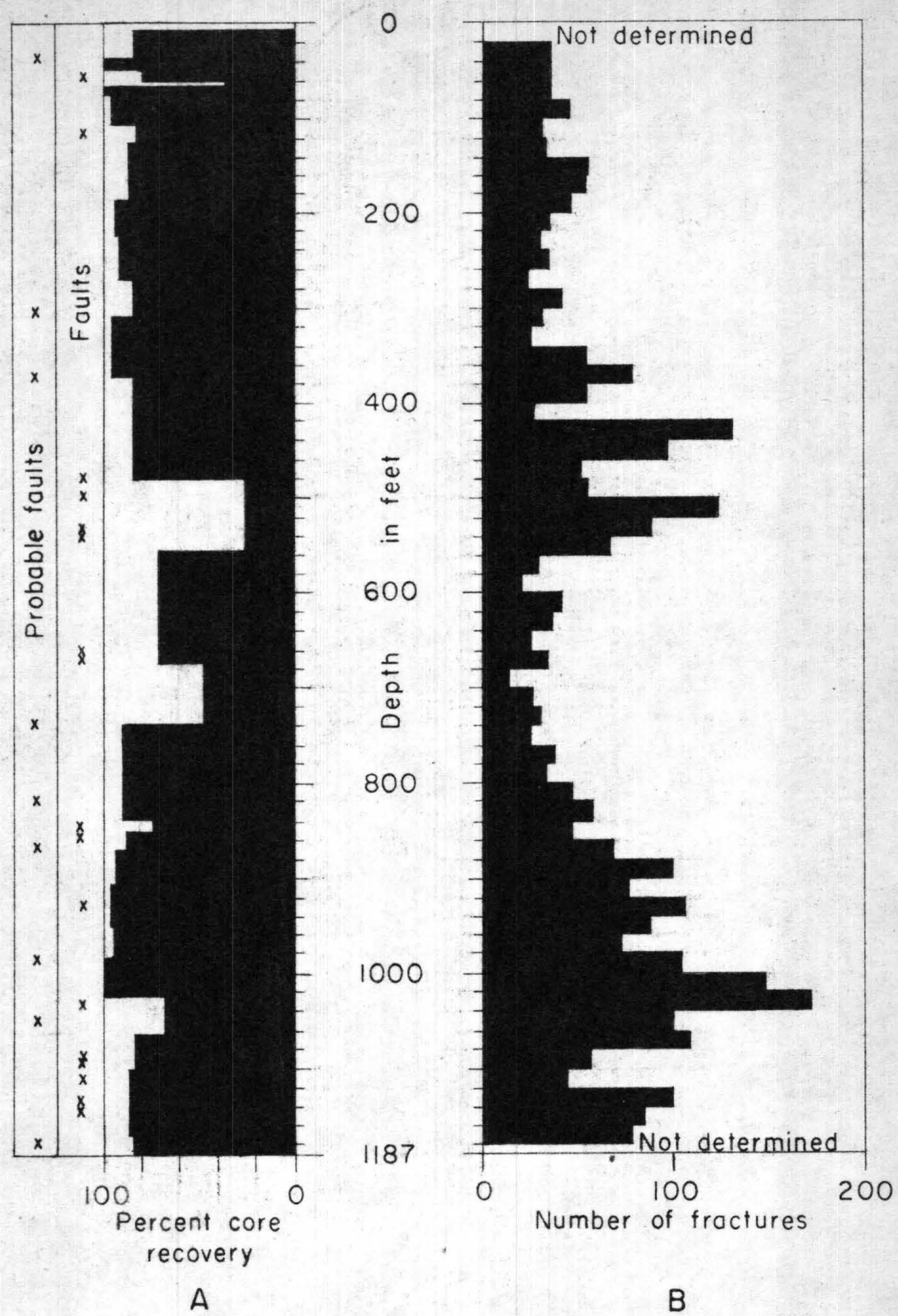
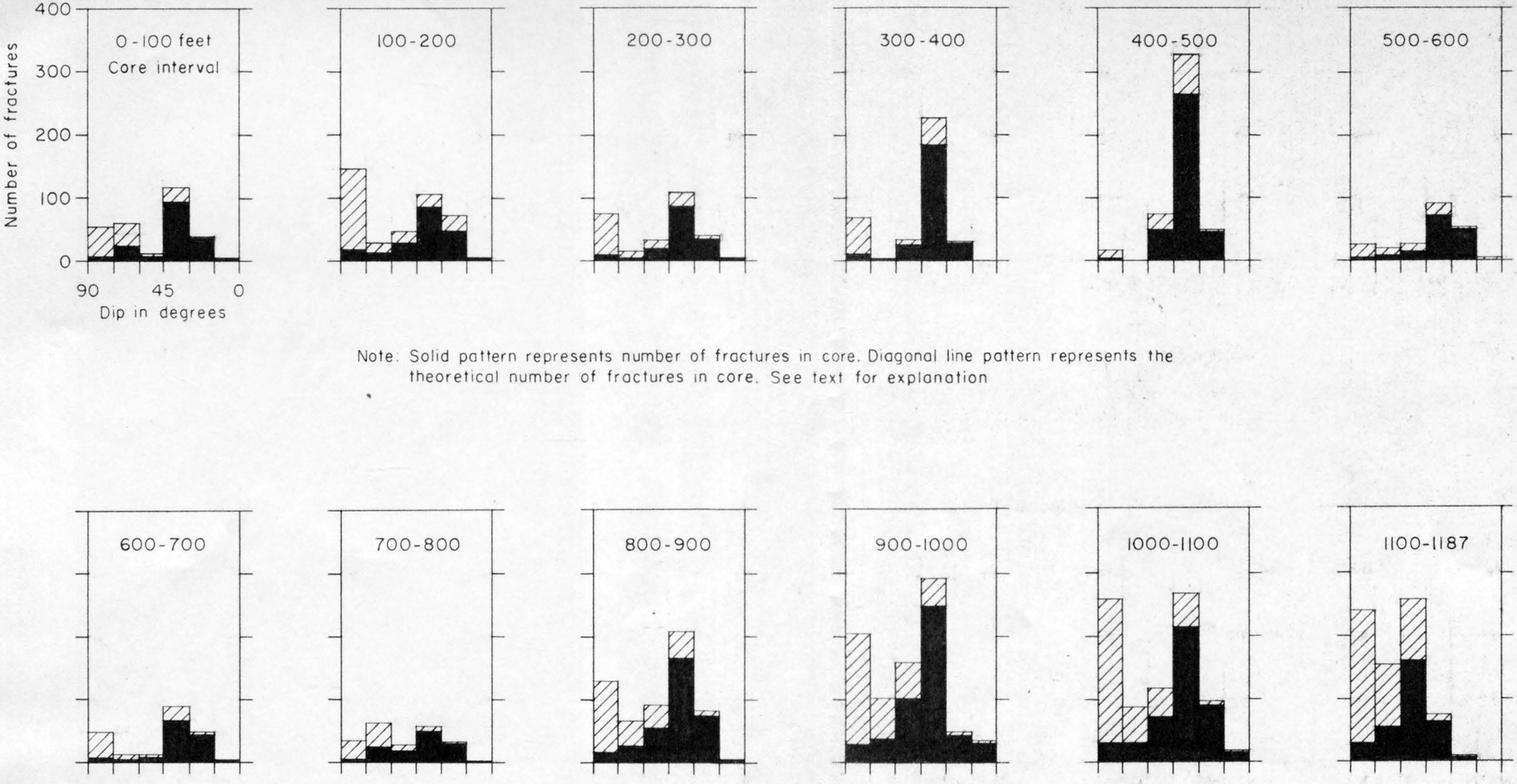


FIGURE 1—HISTOGRAMS SHOWING NUMBER OF FRACTURES, PERCENT CORE RECOVERY AND FAULTS, MARBLE EXPLORATION HOLE-4, NEVADA TEST SITE, NYE COUNTY, NEVADA



Note: Solid pattern represents number of fractures in core. Diagonal line pattern represents the theoretical number of fractures in core. See text for explanation

FIGURE 2—HISTOGRAMS SHOWING DIP OF FRACTURES, MARBLE EXPLORATION HOLE-4, NEVADA TEST SITE NYE COUNTY, NEVADA

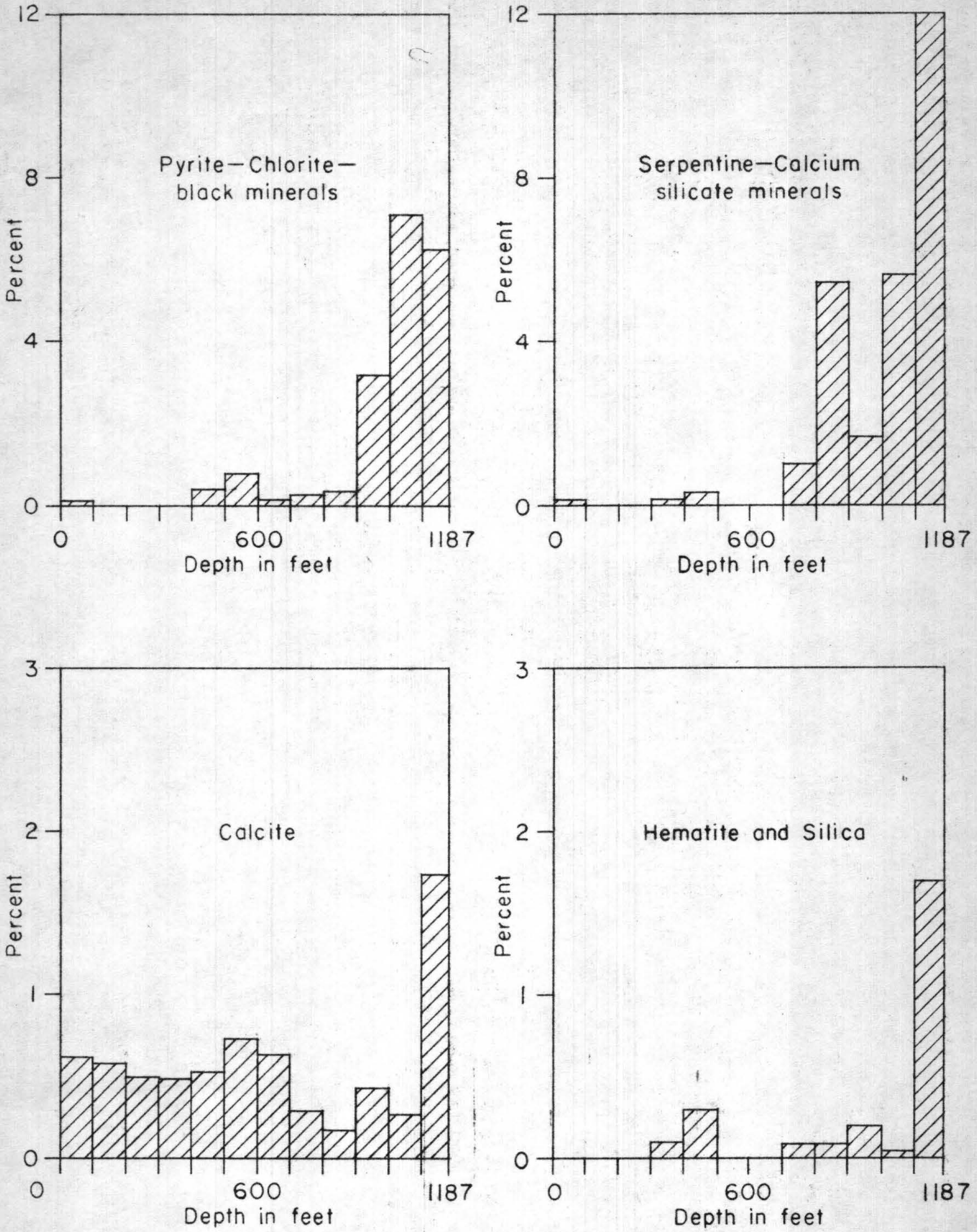


FIGURE 3—HISTOGRAMS SHOWING VOLUME PERCENT OF THE TYPES OF MINERALIZED FRACTURES, MARBLE EXPLORATION HOLE-4, NEVADA TEST SITE, NYE COUNTY, NEVADA

The dip, or inclination from horizontal, of fractures tends to have a bimodal frequency distribution (fig. 2). From the surface to a depth of 1,100 feet most fractures dip from 15° to 60°, and the maximum number is in the 30° to 45° class interval. At the surface near the drill hole, most fractures dip 20° to 50°. From 1,100 to 1,187 feet the maximum number of fractures dip 45° to 60°, an increase in dip angle of about 15° for most fractures. The apparent increase in this interval may have resulted from a change in direction of the drill hole or may be an effect of the intrusion of the granodiorite stock.

Fault zones were recognized or inferred in the core by the presence of gouge, abundant hematite-stained fractures, breccia, and slickensides on fractures surfaces. The location of the 23 actual and probably fault zones found in the core is shown on figure 1A. In general the fault zones are less than 2 feet in width. The amount and relative displacement as well as attitude of the faults could not be determined.

The marble adjacent to fractures and locally bedding planes has been replaced by a wide variety of silicate, sulfide, and oxide minerals. These minerals were grouped into four types that contain principally 1) pyrite, chlorite, and black unidentified minerals, 2) serpentine and calcium silicate minerals, 3) calcite, and 4) hematite and silica. The variation in volume percent of the four types with depth is shown by the histograms in figure 3. In general there is an increase in each of the four types and consequently an increase in total volume of mineralized marble with depth. A maximum of about 24 percent of the core volume from 1,100 to 1,187 was found to be mineralized, and of this amount serpentine and calcium silicate minerals make up as much as three-fourths of the total. Calcite is present throughout the core whereas the other types are more abundant in the lower 500 to 600 feet of the hole, especially near the granodiorite-marble contact at 1,173 feet.

Granodiorite

The granodiorite penetrated from 1,173 to 1,187 feet is part of the Climax stock that is in contact with the marble at the surface about 1,300 feet east of the drill hole. In the core the granodiorite is equigranular, medium gray, and highly altered along fractures that dip predominantly 30° to 60°. Altered and bleached zones make up to about 10 percent of the core volume. Pyrite and a mixture of calcite and chlorite fill most of the fractures.

ANALYTICAL DATA

Samples of marble and tactite were collected prior to drilling from outcrops in the vicinity of Marble exploration hole 4 (tables 2 and 3). These samples represent part of the stratigraphic interval penetrated by the drill hole. Sample M-1 is equivalent to the marble at about 800 feet below the surface whereas M-2 and M-3 are probably representative of the marble at a depth of about 450 feet. Rocks from which samples M-4 and M-5 were collected are not present in the core.

Chemical analyses of the five samples are given in table 2. The principal oxides in samples M-1, M-2, and M-3 are CaO, MgO, and CO_2, and assuming all CO_2 is contained in dolomite, the marble contains 72

(Text continued on p. 23)

Table 2.--Chemical analyses in weight percent of samples from the vicinity of Marble exploration hole 4, Nevada Test Site, Nye County, Nev. 1/

Laboratory number	154482	154483	154484	154485	154486
Field number 2/	M-1	M-2	M-3	M-4	M-5
SiO_2	12.2	4.4	1.6	38.3	42.6
Al_2O_3	.30	.36	.06	10.5	6.7
Fe_2O_3	.25	.10	.00	10.9	1.3
FeO	.09	.08	.08	.53	.94
MgO	21.1	20.8	21.6	1.9	3.5
(MgO) 3/	(15.7)	(19.4)	(21.0)	--	--
CaO	29.7	30.5	30.2	30.0	34.8
(CaO) 3/	(24.4)	(30.3)	(32.8)	--	--
Na_2O	.07	.06	.05	.07	.18
K_2O	.04	.06	.01	.02	1.6
H_2O	1.6	.43	.07	1.9	.26
TiO_2	.01	.01	.00	.30	.24
P_2O_5	.00	.00	.00	.20	.26
MnO	.13	.08	.03	1.8	.12
CO_2	34.4	42.7	46.1	3.3	7.3
Sum	100	100	100	100	100
Percent dolomite Calculated from CO_2 content	72	89	96	Not determined	

Table 2.--Chemical analyses in weight percent of samples from the vicinity of Marble exploration hole 4, Nevada Test Site, Nye County, Nev.--Continued.

1/ Rapid rock analyses by Paul L. D. Elmore, Samuel D. Botts, and Ivan H. Barlow using methods similar to those described in USGS Bulletin 1036-C.

2/ Sample description and location in respect to drill hole as follows:

M-1	Light-gray to white hard marble; includes some silicate minerals on joints	350 feet E.
M-2	Medium-gray friable marble	400 feet, N. 55° E.
M-3	Medium-gray hard marble	Do
M-4	Platy tactite	220 feet, N. 10° W.
M-5	Platy siliceous marble	150 feet W.

3/ Calculated from percent dolomite which was calculated from CO_2.

Table 3.--Semiquantitative spectrographic analyses of samples from the vicinity of Marble exploration hole 4, Nevada Test Site, Nye County, Nev.

Laboratory number	272059	272060	272061	272062	272063
Field number	M-1	M-2	M-3	M-4	M-5
Ag	0	0	0	.0015	0
Ba	.00015	d	d	.003	.03
Be	0	0	0	.00015	.00015
Bi	0	d	0	0	.0015
Cd	0	0	0	<.05	0
Ce	<.05	<.05	<.05	<.05	<.05
Cr	.00015	.0007	.0003	.003	.003
Cu	.0007	.0007	.0007	.0015	.0003
Ga	0	0	0	.007	.0003
Ge	.0015	0	0	.003	0
Mo	.0015	.0007	0	.0015	0
Ni	0	0	0	.0007	.0007
Pb	d	.007	0	0	.007
Sc	0	0	0	.0015	.0007
Sn	0	0	0	.007	0
Sr	.003	.007	.003	.003	.03
V	.003	.0015	.0015	.015	.007
Y	0	0	0	d	d
Yb	0	0	0	.00015	0
Zn	0	0	0	.3	0
Zr	0	0	0	.007	.007

Table 3.--Semiquantitative spectrographic analyses of samples from the vicinity of Marble exploration hole 4, Nevada Test Site, Nye County, Nev.--Continued

Looked for but not found: As, Au, B, Co, Dy, Er, Eu, Gd, Hf, Hg, Ho, In, Ir, La, Li, Lu, Nb, Nd, Os, Pd, Pt, Re, Rh, Ru, Sb, Sm, Ta, Tb, Te, Th, Tl, Tm, U.

The number 0 also indicates looked for but not found.

The letter d indicates barely detectable, concentration unknown.

Analyst: John C. Hamilton.

Figures reported to the nearest number in the series 7, 3, 1.5, 0.7, 0.3, 0.15, etc., in percent. These numbers represent midpoints of group data on a geometric scale. Comparisons of this type of semiquantitative results with data obtained by quantitative methods, either chemical or spectrographic, show that 60 percent of the quantitative values fall within the assigned semiquantitative group.

to 96 percent dolomite. In sample M-1, the presence of silicate minerals primarily along joints is indicated by the relative increase in SiO_2. Samples M-4 and M-5 contain 38.3 and 42.6 percent SiO_2 respectively in the form of garnet, quartz, and actinolite.

Chemical analyses of core samples are not available, but the analyses of samples M-1, M-2 and M-3 are probably representative of the range in composition that is expected in the core samples from surface to depth of 800 feet. Results of semiquantitative spectrographic analysis of samples M-1 through M-5 are given in table 3. The only abnormal concentration of an element noted is zinc in sample M-4. Preliminary microscopic study of the samples indicates the zinc probably occurs as sphalerite (ZnS).

CORE RECOVERY

The core recovery for the hole ranged from 26 to 100 percent and averaged about 80 percent (fig. 1A). Inasmuch as only 14 feet of the granodiorite was cored this average is representative of the core recovery in the marble. Comparison of the percent core recovery with the number of fractures measured in the core indicates a wide range in the degree of cementation of the fractures. The low core recovery (26 percent) from 480 to 558 feet is reflected in a relative increase in number of fractures which are poorly cemented. This interval also contains zones of friable marble, which were recovered from the core barrel as "sand." Examination of the "sand" with a hand lens shows that it is a medium-grained dolomite similar to the friable marble that crops out about 400 feet northeast of the hole. In the interval from about

750 feet to the bottom of the hole, core recovery is generally greater than 80 percent even though fractures are generally more abundant. The fractures, however, in this interval are well cemented, which acoounts for the good core recovery.

CALCULATED FRACTURE POROSITY

Porosity of a rock in situ is a measure of the amount of pore space and the number and width of open fractures that cut the rock. Some estimate of the porosity due to fractures can be made for the marble penetrated by hole 4 from the data presented in figures 2 and 3 and discussed earlier. In brief, fracture porosity was computed by using the total number of fractures in each 100-foot interval of drill core as given in figure 2 and an estimated average width of 0.003 foot for each fracture to determine the volume occupied by fractures for 100-foot intervals. This volume was then calculated in terms of percent of the volume of drill core in a 100-foot interval. Further, an estimate of the decrease in porosity due to an increase in the kind and percentage of minerals filling fractures was made. These minerals are principally the pyrite-chlorite-black minerals, calcite, and hematite and silica types shown in figure 3. The serpentine-calcium silicate minerals were not considered because they occur principally in the rock adjacent to fractures. The minerals that fill fractures average about 0.5 percent by volume of the core from 100 to 800 feet and from 800 to 1,187 feet they average about 2 percent, or a fourfold increase. As this increase is essentially all in fractures, the fracture porosity was decreased fourfold.

The fracture porosity was not calculated for the interval from the surface to depth of 100 feet because part of this interval was not cored; but from 100 to 1,187 feet, total depth of hole, the porosity was determined for each 100-foot core interval (table 4). The fracture porosity from depth of 100 to 800 feet ranged from 0.82 to 1.6 percent, and below 800 feet the corrected fracture porosity ranged from 0.5 to 0.8 percent. These data represent fracture porosity only and are a minimum porosity for the marble inasmuch as the inherent porosity of unfractured marble was not determined.

The porosity of unfractured marble probably ranges from about 0.4 to 2.1 percent (Birch and others, 1950, table 2.6). The total porosity therefore of the bulk of the rock, exclusive of fault zones, penetrated by Marble hole 4 probably ranges from about 1 to 4 percent.

REFERENCE CITED

Birch, Francis, Shairer, J. F., and Spicer, H. C., 1950, Handbook of physical constants: Geol. Soc. America Special Paper, no. 36.

Table 4.--Porosities of 100-foot intervals of core calculated from core recovery, and megascopic fractures and minerals, Marble exploration hole 4, Nevada Test Site, Nye County, Nev.

Core interval (feet)	Fracture porosity (percent)	Fracture porosity corrected for increased mineral filling (see text) (percent)
0- 100	Not calculated	Not pertinent
100- 200	1.6	Do
200- 300	0.82	Do
300- 400	1.2	Do
400- 500	1.6	Do
500- 600	1.3	Do
600- 700	0.9	Do
700- 800	0.9	Do
800- 900	1.9	0.5
900-1,000	2.7	0.7
1,000-1,100	3.0	0.8
1,100-1,187	2.5	0.6