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GEOLOGY OF ROOSEVELT HOT SPRINGS KGRA, BEAVER COUNTY, UTAH

Dennis L. Nielson, Bruce S. Sibbett, D. Brooks McKinney,
Jeffrey B. Hulen, J. N. Moore, and Susan M. Samberg

December, 1978

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EARTH SCIENCE LABORATORY
University of Utah Research Institute
Salt Lake City, Utah

Prepared for
U.S. Department of Energy
Division of Geothermal Energy

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ABSTRACT

The Roosevelt Hot Springs KGRA is located on the western margin of the Mineral Mountains in Beaver County, Utah. The bedrock geology of the area is presented in this report. It is dominated by metamorphic and plutonic rocks of Precambrian age as well as felsic plutonic phases of the Tertiary Mineral Mountains Pluton. Rhyolite flows, domes, and pyroclastics reflect igneous activity between 0.8 and 0.5 million years ago. All lithologies present in the map area are described in detail with an emphasis on characteristics which will allow them to be distinguished in drill cuttings.

The geothermal system at Roosevelt Hot Springs KGRA is structurally controlled with reservoir rocks demonstrating little primary permeability. The structure is mainly a result of low-angle normal faulting which has produced low-angle, westward dipping mylonites, steeply dipping, northwest-trending mylonites, and brecciation localized in the hanging wall of the principal low-angle fault. These mylonites are up to 15 m thick and they are silicified and retrograded to greenschist facies assemblages. East-west faulting is also present and has been produced by deep-seated regional zones of weakness. North to north-northeast trending faults are the youngest structures in the area, and they control present fumarolic activity and recent hot spring activity which has deposited opaline and chalcedonic sinters. It is proposed here that the geothermal reservoirs are controlled primarily by intersections of the principal zones of faulting. This conclusion is supported by the configurations of the fault patterns. It indicates the importance of regional geologic mapping and structural analysis in the exploration for hydrothermal resources.

Logs from Thermal Power Utah State 72-16, Getty Oil Utah State 52-21, and six shallow thermal gradient holes drilled by the University of Utah are presented in this report and have been utilized in the construction of geologic cross sections of the geothermal field.

INTRODUCTION

The Roosevelt Hot Springs Known Geothermal Resource Area (KGRA) is located in Beaver County, in west-central Utah on the western flank of the Mineral Mountains (Fig. 1). The KGRA was named for a small area of hot springs which discharged silica-rich waters until about 1966 when the flow stopped. The area now contains active fumaroles which are depositing sublimates and which bear a slight odor of hydrogen sulfide.

Geothermal exploration was initiated in 1968 by Dr. Eugene Davies of Milford. Dr. Davies drilled a well on the eastern flank of the Opal Mound (Plate I) which discharged steam from a depth of about 82 m. The well is currently leaking small amounts of water and vapor with a smell of hydrogen sulfide.

Intensive commercial exploration was initiated in 1975 by Phillips Petroleum Company. Other lease holders in the KGRA are Geothermal Power Corporation, Getty Oil Company, Thermal Power Company and O'Brien Resources Inc., Geothermal Exploration Company, American Geological Enterprises, and the City of Bountiful, Utah. At present, seven producing wells have been completed in the field. Ward and others (1978) indicate that the average well has a potential fluid production of 4.5×10^5 kg/hr at shut-in bottom hole temperatures around 260°C. Plans have been announced for the construction of two 55 MWe power plants which are expected to be on line by 1982.

The present study was undertaken as part of the Industry Coupled Case Studies Program of the Department of Energy, Division of Geothermal Energy. The objectives of this study are to: 1) develop a detailed geologic base to

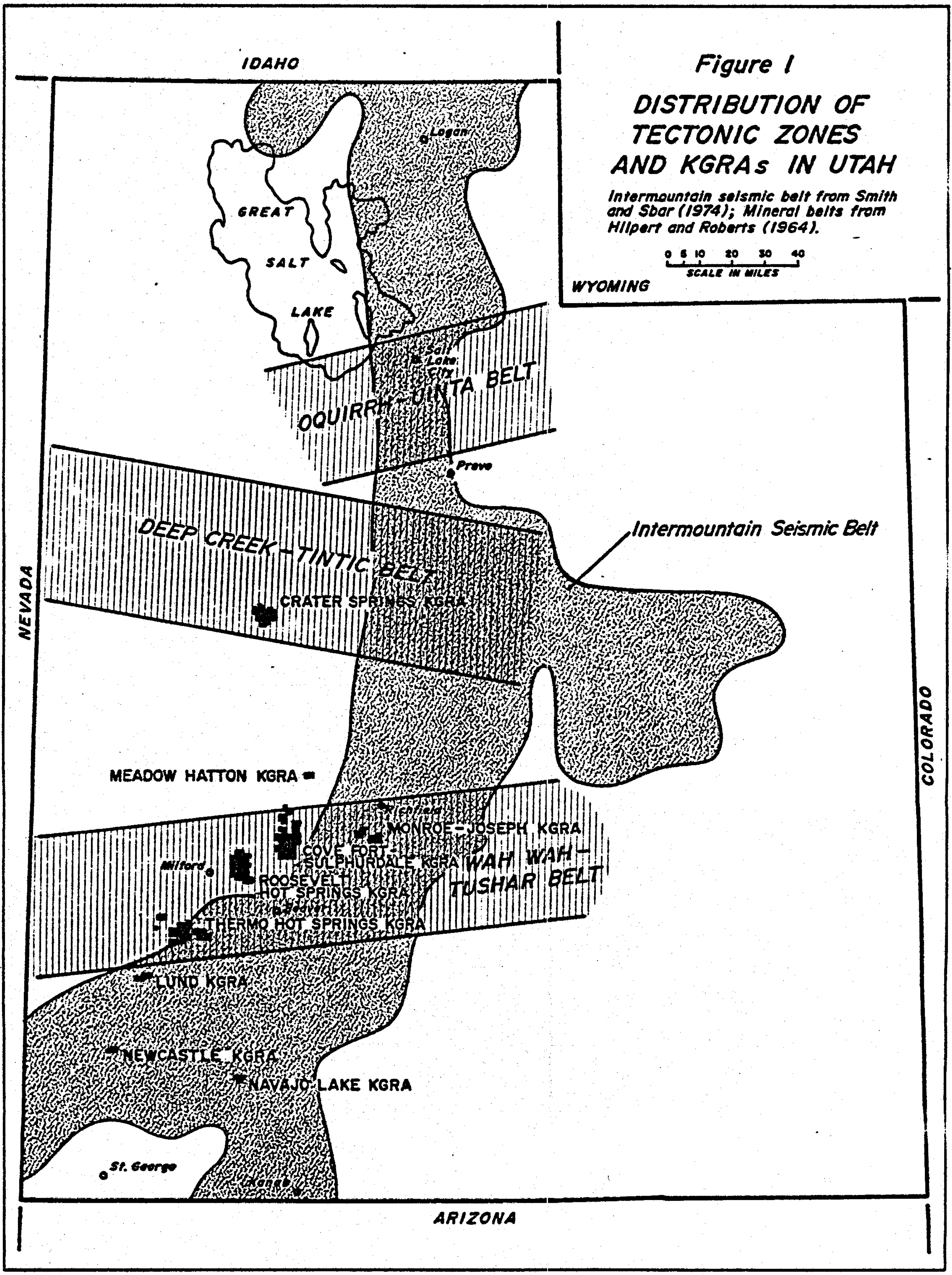

Figure 1
DISTRIBUTION OF TECTONIC ZONES AND KGRAs IN UTAH

Intermountain seismic belt from Smith and Sbar (1974); Mineral belts from Hilpert and Roberts (1964).

facilitate further industrial exploration and the interpretation of geophysical and geochemical data, 2) define the lithologic and structural controls of the Roosevelt Hot Springs geothermal field, and 3) establish a sample library to aid companies in the interpretation of drilling information. With respect to this last objective, hand samples, thin sections, and artificial cuttings of the lithologic units discussed in this report are stored in the Geothermal Sample Library at the Earth Science Laboratory and are available for public use. Near-term use of this geologic data base by ESL will be useful in helping to formulate a case study of the Roosevelt Hot Springs area.

Previous geologic work available to the public in the Roosevelt Hot Springs KGRA has been conducted largely by the Department of Geology and Geophysics at the University of Utah under DOE/DGE and NSF sponsorship and has been summarized by Ward and others (1978). McKinney (1978) has compiled an annotated bibliography of the Roosevelt Hot Springs KGRA and vicinity. The authors are continuing the geologic mapping program within the Mineral Mountains. In addition, on site magnetic susceptibility studies are planned to aid in the interpretation of magnetic data. Subsequent reports will present results from continuing and planned work.

GEOLOGY

Regional Setting

The location of Roosevelt Hot Springs and eight other KGRAs in Utah are shown in Figure 1. The Roosevelt Hot Springs KGRA is located in Beaver County on the western flank of the Mineral Mountains. The Utah state geologic map locates the Mineral Mountains on the northern edge of the Marysvale volcanic pile. The range represents a structural high which is demonstrated by the presence of Precambrian rocks and the occurrence of the largest exposed intrusive body in the state, the Mineral Mountains Pluton.

Shown in Figure 1 are the mineral belts of Utah as proposed by Hilpert and Roberts (1964) and Stokes (1968). These belts have accounted for 95 percent of Utah's base metal and gold production. The belts are the location of repeated Tertiary intrusive episodes and probably reflect deep-seated structural zones. The coincidence of KGRAs with the Wah Wah - Tushar Belt is impressive.

Figure 1 also illustrates the position of the KGRAs of Utah with respect to the trend of the Intermountain Seismic Belt (ISB) of Smith and Sbar (1974). The ISB is a belt of shallow earthquakes with focal depths of generally less than 15 km and is interpreted to be a boundary between two subplates of the North American Plate. The Roosevelt Hot Springs KGRA is located to the northwest of the ISB in an area where the ISB shows a clear change in orientation. At approximately the same location as the offset in the ISB, Cook and others (1975) have shown a major gravity linear which they feel represents a relict transform fault.

General Geology of the Mineral Mountains

The geology of the Mineral Mountains has been discussed by Liese (1957), Earll (1957), and Condie (1960). Petersen (1975) has published a map of the Roosevelt Hot Springs area that includes much of the KGRA. Evans (1977) has presented a compilation of previous and some new work. The geologic documentation and structural interpretations of the present study differ from all previous work.

The Mineral Mountains Pluton and highly deformed Precambrian rocks underlie the central portion of the Mineral Mountains. The lithologies and geologic relationships of these rocks will be discussed in greater detail in a subsequent section of this report. The northern portion of the Mineral Mountains (Liese, 1957) is underlain by a dark gray unfossiliferous limestone, the Prospect Mountain Quartzite, and the Pioche Formation, all of Cambrian age. Several outcrop areas of the Indianola Formation, a conglomerate of Cretaceous age, overlie the Cambrian section.

The southern portion of the Mineral Mountains, the Bradshaw Mountain area, contains Precambrian metamorphic rocks which are overlain by lower Paleozoic limestones and dolomites, Mississippian limestones of the Topache Formation, the Coconino and Kaibab Formations of Permian age, the Navajo Sandstone and Carmel Limestone of Jurassic age, and Tertiary volcanics of andesitic to latitic composition (Earll, 1957). Most of the mining activity in the range is confined to the Bradshaw Mountain area where gold, silver, lead, copper, and tungsten have been produced from contact metamorphic deposits and associated veins.

Lithologies of the Roosevelt Hot Springs KGRA

The geology of the Roosevelt Hot Springs KGRA is characterized by metasedimentary and plutonic rocks of Precambrian age, intrusive rocks of Tertiary age, and flows, pyroclastics, and domes of Pleistocene age. Siliceous sinter and silica-cemented alluvium represent recent hydrothermal activity.

PRECAMBRIAN

Banded gneiss (P€bg)

The banded gneiss (P€bg) is the oldest unit exposed in the KGRA. It crops out along the western margin of the Mineral Mountains from Ranch Canyon northward to Negro Mag Wash. North of Negro Mag Wash the banded gneiss is found as large inclusions within Tertiary plutonic rocks. The banded gneiss is intruded by the hornblende gneiss (P€gn) and the Tertiary plutonic phases. Lithologically the unit is highly variable and consists of interlayered gneiss, schist, and migmatite. Small quartzite lenses have also been observed, and they are described in a separate section.

Outcrops of the banded gneiss are typically non-resistant and weather to dark colors. Jointing, shearing, or brecciation are rare within the unit. Typical outcrops are conspicuously banded with alternating light and dark layers 1 to 10 cm thick. Single homogenous layers of 3 or 4 m have also been observed but are uncommon. The color differences which distinguish these layers reflect differences in biotite and hornblende contents. In addition to this small-scale banding, the banded gneiss also exhibits a large-scale layering. Layers 20-100 m thick and sufficiently biotite-rich to be classified as schist are interlayered with biotite-poor gneisses. Thick mafic-rich layers within the banded gneiss are often migmatitic and contain ptygmatically folded felsic dikelets and pods.

Outcrops of the banded gneiss exhibit a number of penetrative deformational features. Schistosity is well developed, and small-scale isoclinal folding has produced strong NE-plunging lineations on schistosity planes. A few widely scattered outcrops show gentle cylindrical refolding of the isoclinal folds along flat-lying east-west axes. Figure 2 is a plot of 51 poles to schistosity measurements from the banded gneiss. The diagram shows an average N 10-30^{o}E striking and 30^{o}-70^{o}E dipping orientation. The marked scattering in this diagram may reflect the gentle refolding mentioned above. A similar relationship can be observed in Figure 3, a plot of fold axes and lineations from the banded gneiss.

In hand specimen, the banded gneiss is typically fine- to medium-grained and consists of biotite, hornblende, feldspar, and quartz in highly variable ratios. Leucocratic layers are typically coarser grained and may contain small amounts of muscovite. In thin section the unit is equigranular with K-feldspar, plagioclase, quartz, biotite, and hornblende as the principal mineral components. Preferentially oriented biotites and elongated stressed quartz grains mark the schistosity. Light colored layers often consist of subequal amounts of quartz and K-feldspar with only minor amounts of the other components, while dark layers are predominantly plagioclase, biotite, and hornblende with lesser amounts of quartz and K-feldspar. In both light and dark layers biotites often appear to rim the K-feldspars. Rounded zircon

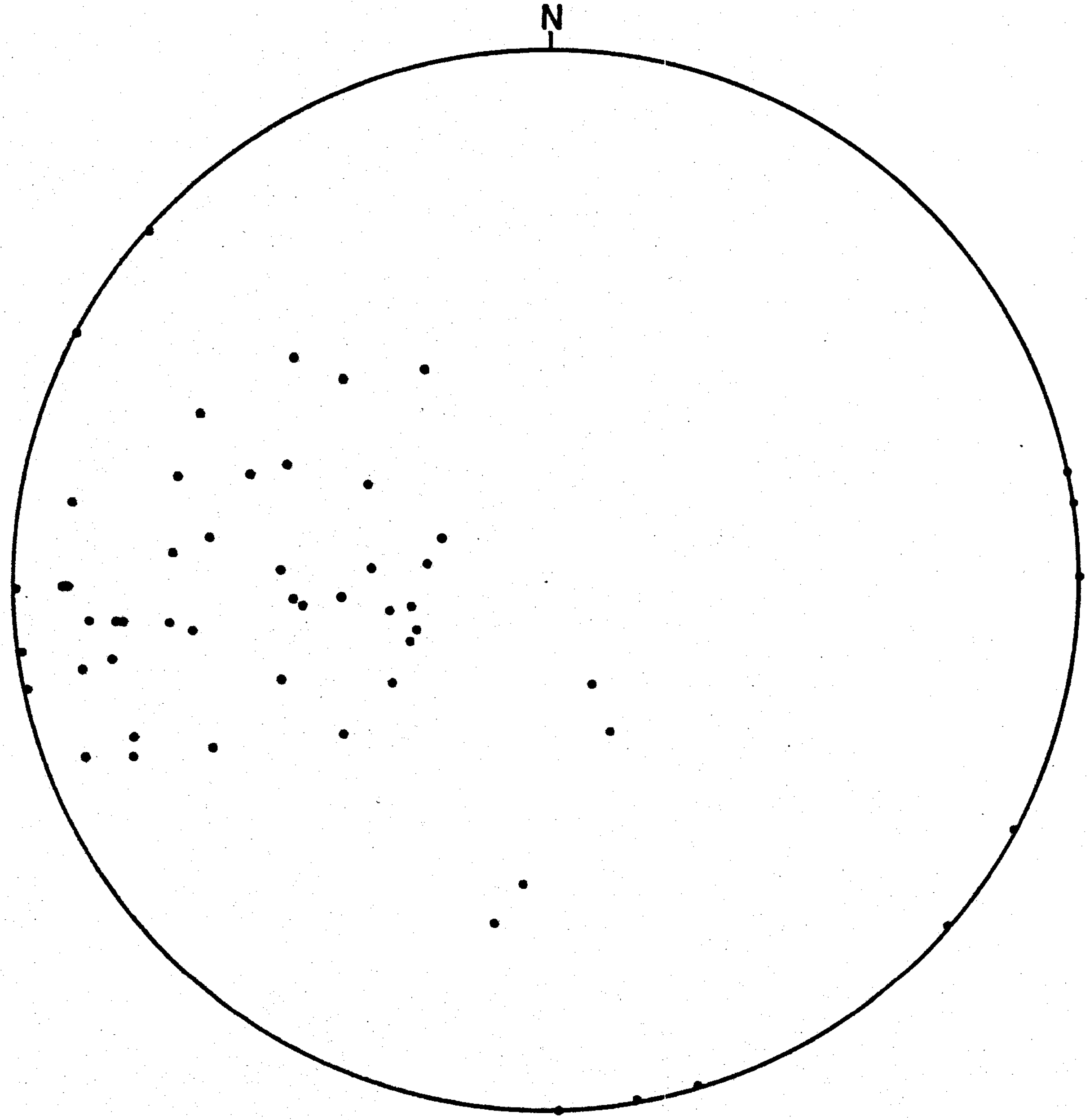

Fig. 2 - Point diagram of poles to foliation of the banded gneiss (P€bg) plotted on the lower hemisphere (51 poles).

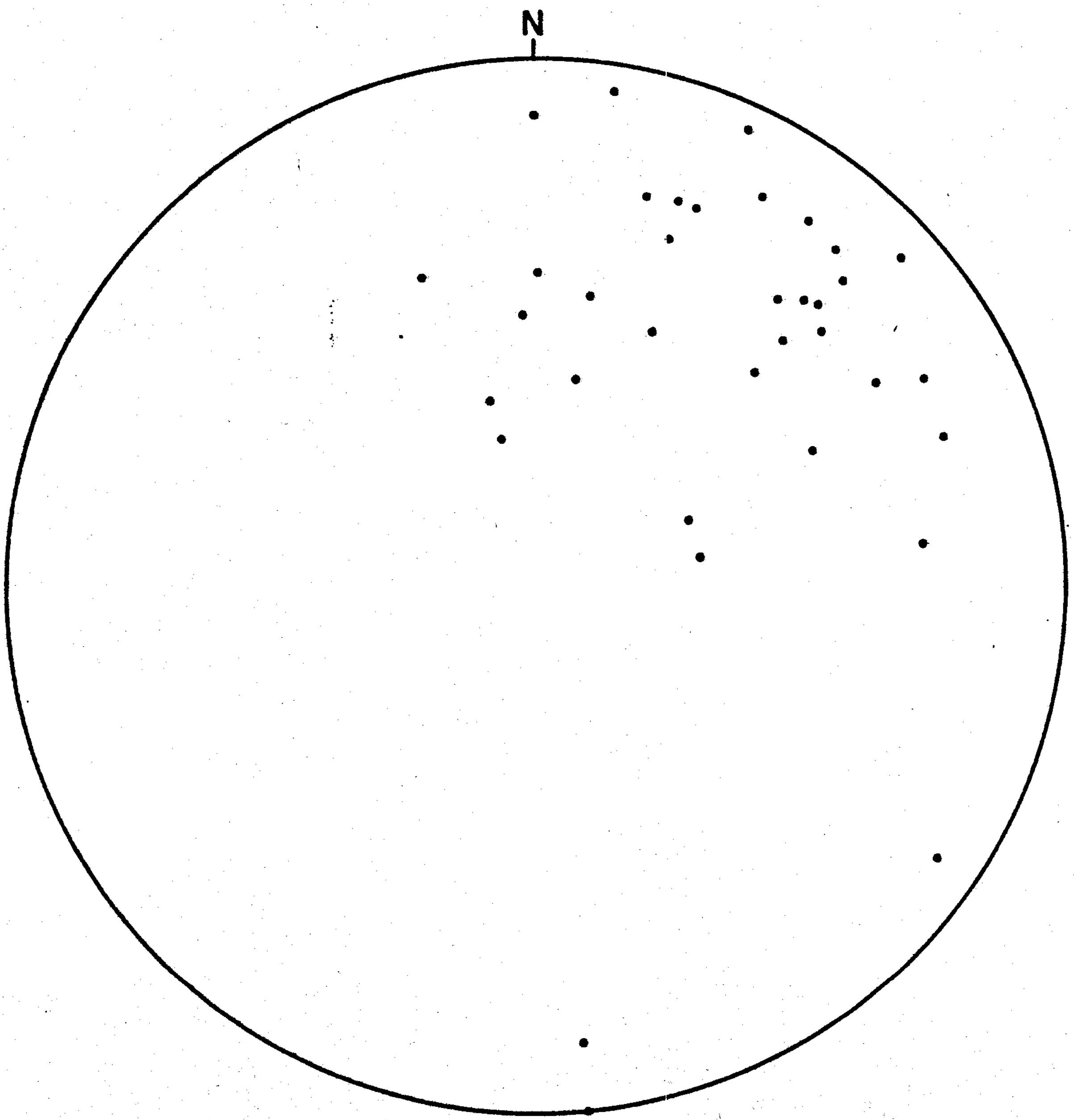

Fig. 3 - Point diagram of fold axes and lineations from the banded gneiss (P€bg).

grains are a very common accessory, particularly as inclusions within biotite. Apatite is also an abundant accessory. Sphene is generally uncommon. In addition to this typical mineralogy, one outcrop of a very distinctive sillimanite-cordierite-corundum-biotite schist was discovered just south of Wildhorse Canyon. This small 2-3 m layer demonstrates both a compositional variability within the banded gneiss and a lack of diffusion within the metamorphic system. This suggests that the banding within the gneiss reflects original sedimentary layering.

It is suggested in this paper that the banded gneiss is Precambrian in age. A K-Ar date of 10.7 ±0.2 my (Bowers, 1978) has been obtained for the banded gneiss; however, lithologic and metamorphic evidence suggests that this date does not represent the age of the banded gneiss. The banded gneiss represents quartzo-feldspathic sedimentary rocks that have undergone upper amphibolite facies metamorphism during an orogenic event that also produced isoclinal folding. In contrast, the Paleozoic and Mesozoic rocks in the area are predominantly carbonates and exhibit only contact metamorphic effects. Thus the regional metamorphism and folding of the rocks took place in Precambrian time. In terms of metamorphic grade and structural style, a probable equivalent of the banded gneiss is the Farmington Canyon Complex of northern Utah. Bowers (1978) suggests that the date on these rocks reflects resetting by the intrusion of the Mineral Mountains Pluton. As an alternative possibility, we suggest that the date may be produced by loss of Ar during rapid uplift of the range. It is clear, however, that additional radiometric dating is required to decipher the age and thermal history of these rocks.

Metaquartzite (P€q)

A distinctive white metaquartzite (P€q) crops out only in the area south of Wildhorse Canyon. It occurs as a series of small lenses within the banded gneiss (P€bg) and as two large, oriented inclusions within the hornblende gneiss (P€gn). These separate outcrops are very similar and may represent either a single folded and boudinaged quartzite bed or a series of disconnected quartzite pods. The metaquartzite, with a maximum thickness of approximately 35 m, is highly resistant to weathering in spite of a strong fracturing. Bedding is well developed and parallels the schistosity of both the surrounding banded gneiss and hornblende gneiss. A NE-plunging lineation is well developed in all outcrops. In hand specimen the unit is very massive, and no original grain boundaries are visible. Small equant feldspar grains and strongly aligned biotites are present in very limited quantities. The feldspars are particularly noticeable because of their chalky white color and their tendency to weather out, leaving small pits. In thin section the metaquartzite displays a well developed ribbon structure with strong undulatory extinction. Approximately 5 percent feldspar, primarily plagioclase, is present as small equant grains, and all of the feldspars are sericitized. Accessory minerals include biotite and chlorite, which are aligned along schistosity, and widely scattered apatite.

Sillimanite schist (P€s)

The sillimanite schist (P€s) is confined to a small area between Wildhorse and Ranch Canyons. It occurs as a small number of inclusions within a Tertiary porphyritic granite (Tpg) along the contact of the Tertiary granite with the hornblende gneiss (P€gn). In outcrop the schist is a massive dark gray to green fine-grained rock with subtle 0.5 to 1 cm layering. Outcrops that consist of a breccia of the unit are common. In hand specimen the unit is rich in fibrolitic sillimanite. Small garnets are aligned along thin, widely separated layers.

In thin section the rock is a conspicuously layered sillimanite-biotite-quartz schist. Both fibrous and prismatic sillimanite are abundant, growing within or around irregular biotites. The biotite and sillimanite are in distinct 2-5 mm layers. The sillimanite-biotite layers are separated from each other by quartz layers of similar size. Plagioclase is common within these quartzose layers but its abundance appears variable. Highly irregular muscovite grains occur throughout the rock but are very uncommon. Where present, garnets are usually less than 0.5 cm in diameter and are always associated with biotite. Accessory minerals include abundant small, rounded opaques and moderate amounts of apatite. In the outcrops along the bottom of Wildhorse Canyon, the sillimanite schist develops coarse-grained segregations with large garnet porphyroblasts. Garnets up to 2 cm in diameter are surrounded with a rim of intergrown biotite and muscovite.

Biotite gneiss (P€n)

The biotite gneiss (P€n) is a massive medium-grained rock which occurs primarily as inclusions within the hornblende gneiss (P€gn) and Tertiary plutonic rocks. These inclusions occur throughout the Roosevelt Hot Springs KGRA but the largest are found in the Ranch Canyon-Wildhorse Canyon area, the southern half of the KGRA. While this unit is highly variable, it is typically a massive to weakly foliated, biotite-rich gneiss containing recognizable hornblende grains and abundant sphene.

In hand specimen the biotite gneiss is typically a medium-grained, equigranular, dark gray rock with abundant biotite and lesser hornblende forming the mafic components and plagioclase the predominant felsic component. Fine-grained interstitial quartz and K-feldspar are visible on cut and stained surfaces. Euhedral sphene grains up to 2 mm long are common. Foliation is very difficult to distinguish in hand specimen. K-feldspar porphyroblasts up to 2 cm long were observed in some inclusions of the biotite gneiss.

Thin sections show a granular texture with highly irregular grain boundaries. Biotites were observed replacing both orthoclase and hornblende. Anhedral to subhedral twinned hornblende grains contain irregular intergrowths of quartz. Plagioclase grains are irregularly zoned, often with strongly sericitized cores. K-feldspar and quartz are relatively minor components and occur as anhedral interstitial grains. The abundant sphene grains commonly surround or enclose opaques. Apatite is common. Both quartz and feldspar display strong undulatory extinction. Modes for three samples of the biotite gneiss are given in Table 1.

Hornblende gneiss (P€gn)

The hornblende gneiss (P€gn) is a coarse-grained granitic gneiss that crops out in the western foothills of the Mineral Mountains south of Negro Mag Wash. It intrudes the banded gneiss to the west, is intruded by Tertiary plutonic rocks to the east, and also occurs as large inclusions within Tertiary plutonic rocks near Negro Mag Wash. The largest outcrop area of hornblende gneiss centers around Wildhorse Canyon.

Table 1 - Modal Analysis of Biotite Gneiss (p€n)
on the basis of 1000 point counts.

Sample No. UT/MM-78-X	22	142	144	Average
Alkali feldspar	16.1	10.1	29.2	18.5
Plagioclase	40.8	42.9	20.5	34.7
Quartz	10.4	21.9	35.8	22.7
Biotite	16.8	13.2	9.8	13.3
Hornblende	9.2	6.6	---	5.2
Sphene	3.1	1.0	0.9	1.7
Opaques	2.4	1.2	2.1	1.9
Chlorite	0.5	0.1	0.2	0.3
Apatite	0.4	1.2	0.8	0.8
Zircon	0.3	Trace	Trace	0.1
Epidote	Trace	---	---	---
Sericite	---	1.8	0.7	0.8
% Anorthite	27	35	35	32

Sample site locations:

UT/MM-78-22	SE1/4, SE1/4, sec. 3, T. 27 S., R. 9 W.
UT/MM-78-142	NE1/4, NE1/4, SW1/4, sec. 34, T. 27 S., R. 9 W.
UT/MM-78-144	NE1/4, NE1/4, SW1/4, sec. 34, T. 27 S., R. 9 W.

Outcrops of the hornblende gneiss are typically very massive and only weakly foliated, weather to dark gray or brown colors; elsewhere the foliation is strong and exhibits strong lineations produced by the alignment of hornblende grains. The gneiss is not commonly jointed, but along faults exposed north of Wildhorse Canyon it is strongly brecciated and cut by well developed mylonites. The development of schistosity is variable throughout the gneiss. Figure 4 is an equal area plot of poles for 41 schistosity measurements covering the outcrop area of the gneiss. The poles form a poorly defined girdle with the greatest concentration clustered around a N-S strike with moderate dips to the east. This pattern corresponds well with that obtained for the banded gneiss.

As the contact of the two gneisses is approached, the hornblende gneiss changes character; the amount of biotite increases and the rock becomes porphrytic, with 1-2 cm K-feldspar phenocrysts increasingly common toward the contact. With this change, schistosity becomes more strikingly apparent and is approximately parallel to that within the banded gneiss. The contact between the gneisses exhibits both parallel and crosscutting relations. As shown in Plate I, the contact south of Wildhorse Canyon is subparallel with the schistosity or layering within the banded gneiss, while north of Wildhorse Canyon the contact truncates the schistosity within the banded gneiss.

Several types of oriented inclusions occur within the hornblende gneiss. The most common of these are of the well-foliated, medium-grained biotite gneisses (P€n). These inclusions vary greatly in size and appear to have gradational contacts with the enclosing gneiss. Much less abundant are unfoliated mafic inclusions that consist of small brecciated and elongated

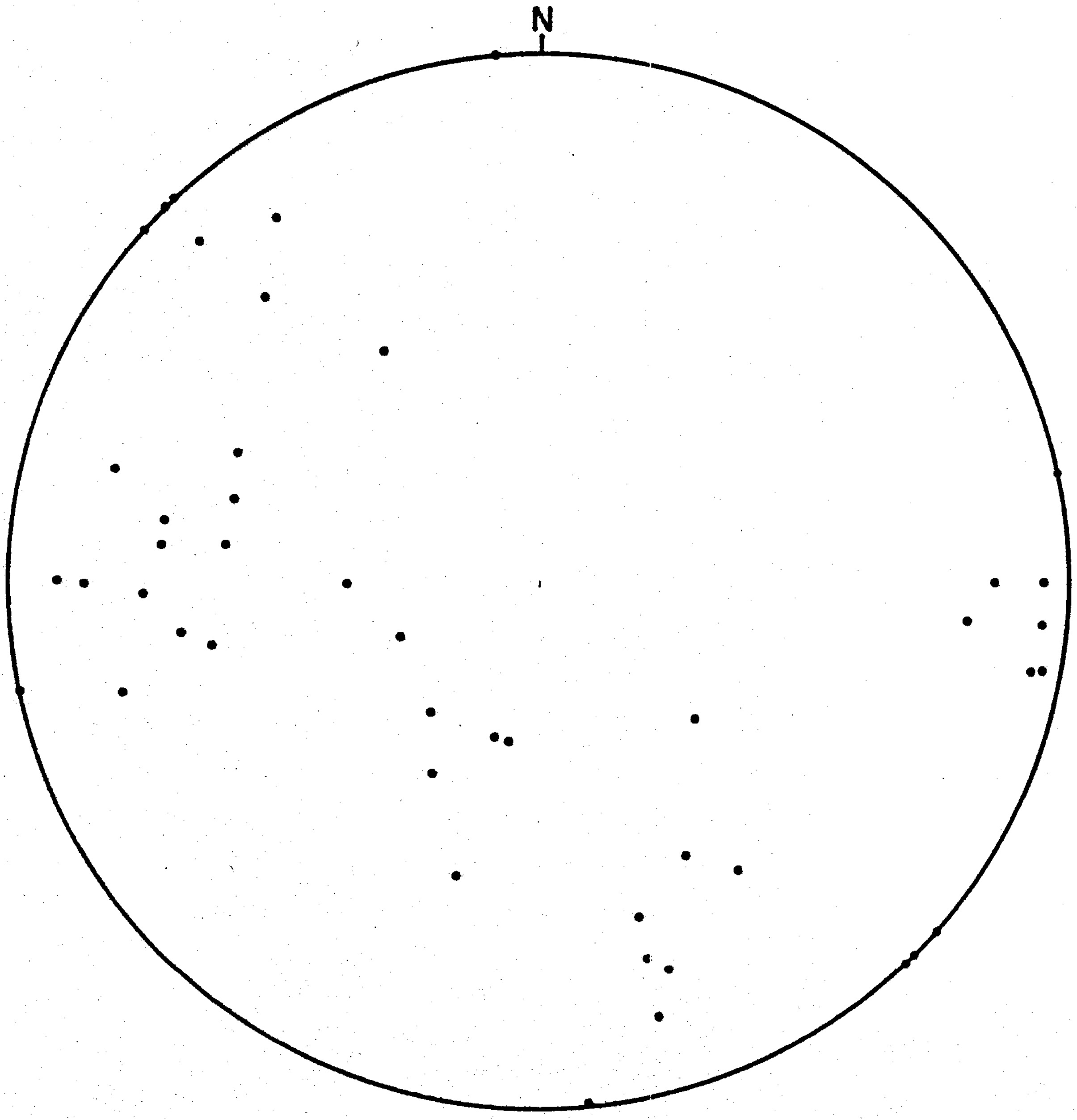

Fig. 4 – Point diagram of poles to foliation of the hornblende gneiss (P€gn) plotted on the lower hemisphere (41 poles).

mafic clots which are parallel to the schistosity. These inclusions are commonly the site of later diking by aplites.

In hand specimen the hornblende gneiss is a light gray, coarse-grained rock with 1 cm hornblende crystals, often surrounded by biotite and set in a matrix of coarse feldspars and finer grained quartz. The quartz is often difficult to recognize. Sphene is a common accessory.

In thin section the hornblende gneiss appears as a xenomorphic granular intergrowth of anhedral K-feldspar and plagioclase, with finer grained, highly stressed quartz, small unoriented or weakly oriented clots of biotite, and subhedral hornblende. Plagioclase from all sections examined falls within the range An_{26}-An_{32}. Hornblende in some of the samples mantles relict clinopyroxene and in nearly all of the samples can be seen reacting to form biotite. Accessory and opaque minerals are typically clustered within small biotite clots. Some samples contain widely spaced, large, polysynthetically twinned sphene grains, some of which are broken. Minor epidote, chlorite, sericite and actinolite also occur. Modes obtained by counting over 1000 points per section for three samples of the hornblende gneiss are given in Table 2.

Table 2 - Modal Analysis of Hornblende Gneiss (P€gn) on the basis of 1000 point counts.

Sample No. UT/MM-78-X	21	104	128	Average
Alkali feldspar	19.9	31.7	30.0	27.2
Plagioclase	36.2	18.7	21.8	25.6
Quartz	14.9	22.4	26.2	21.2
Hornblende	14.2	7.6	4.7	8.9
Biotite	9.5	9.8	8.3	9.2
Opaques	1.1	1.9	1.8	1.6
Clinopyroxene	---	1.3	---	.4
Apatite Zircon Sphene	1.3	1.3	0.8	1.1
Actinolite	2.1	---	---	.7
Epidote	0.1	---	---	---
Chlorite	0.6	0.6	0.7	.6
Sericite	0.1	4.7	5.7	3.5
% Anorthite	31	29	35	32

Sample site locations:

UT/MM-78-21	NE1/4, SE1/4, sec. 10, T. 27 S., R. 9 W.
UT/MM-78-104	SW1/4, SE1/4, sec. 22, T. 27 S., R. 9 W.
UT/MM-78-128	NE1/4, SE1/4, sec. 27, T. 27 S., R. 9 W.

TERTIARY

Tertiary plutonic rocks of the Mineral Mountains Pluton underlie most of the central portion of the Mineral Mountains. This study has identified five major felsic phases of the pluton and, where possible, the age relationships have been documented on the basis of cross-cutting relationships. Potassium-argon dates on the felsic phases show ages between 9 and 15 million years, with numerous dates in the range of about 10 to 12 million years (Park, 1968; Armstrong, 1970; Bowers, 1978). A Rb-Sr whole rock isochron of the batholith shows poor reliability but suggests an age of approximately 35 my (Lipman and others, 1978). It is possible that the Miocene dates represent argon loss resulting from tectonic activity rather than the actual time of crystallization of the plutonic phases. Again, however, additional data are needed.

The major phases of the batholith are, in chronologic order: quartz monzonite (Tqm), porphyritic granite (Tpg), syenite (Ts), granite (Tg), and fine-grained granite (Tgr). Dikes of microdiorite, diabase, and rhyolite are often found in a broad contact zone between the Precambrian and Tertiary rocks. The principal felsic plutonic phases display strong textural and compositional affinities. Often, because of these similarities, individual samples cannot be assigned with certainty to one of the mapped units. The plutonic phases are typically medium to coarse grained. Biotite and hornblende are the only ferromagnesian minerals present. Sphene, apatite, magnetite, and ilmenite are characteristic accessories of most of the units studied.

Generally, the major felsic phases of the pluton form rounded outcrops and weather to grus. Alteration of the phases is minor with most thin sections showing some formation of sericite associated with feldspars and some chlorite after biotite.

Hornblende Diorite (Td)

A medium-grained hornblende diorite is exposed as xenoliths in the northern portion of the map area. The age of the unit is not known, but it is not foliated, suggesting that it is younger than Precambrian. It is found as a xenolith in quartz monzonite, demonstrating that it is older than the principal phases of the Mineral Mountains Pluton.

The unit is characterized by hornblende phenocrysts up to 1 cm long which often contain relict pyroxene grains. Contact effects have produced some tremolite and altered much of the plagioclase to clay. Apatite makes up about 3 percent of the rock.

Biotite Quartz Monzonite (Tqm)

A coarse-grained biotite quartz monzonite is the principal phase of the Mineral Mountains Pluton exposed in the Roosevelt Hot Springs KGRA, and it underlies the northern part of the map area. The unit intrudes the Precambrian gneisses and is in turn intruded by all the other Tertiary phases described in this report with the exception of the hornblende diorite. The quartz monzonite is massive with few joints. However, as the contact with the Precambrian rocks is approached, the unit picks up numerous xenoliths, becomes porphyritic, and takes on a shear foliation which generally trends north-south.

Modal analyses of the quartz monzonite are presented in Table 3. In general, the rock is poor in biotite, but around xenoliths of Precambrian rock the biotite often increases to 15 or 20 percent of the rock.

Porphyritic Granite (Tpg)

A porphyritic biotite granite crops out in the southern portion of the map area. It intrudes Precambrian rocks on the west and contains numerous xenoliths of the Precambrian throughout its area of exposure. This unit has a variable texture even within individual outcrops. Where porphyritic, K-feldspar forms phenocrysts 1 to 3 cm long in a medium-grained matrix. The finer grained portions of the unit are best exposed along the western contact of the unit in Ranch Canyon.

The K-feldspar content of the granite varies from 40 to 65 percent (Table 4). The plagioclase is anhedral, zoned, and constitutes 9 to 19 percent of the rock. The plagioclase has an average anorthite content of 21 percent, which is higher than the other phases of the Tertiary pluton. The granite is 20 to 36 percent quartz and 4.3 to 11.5 percent biotite. The rock contains about one half of one percent each of opaques and apatite with traces of sphene and zircon. Alteration of feldspars and biotite to sericite and chlorite is very minor.

The porphyritic granite intrudes the Precambrian rocks and a dike of porphyritic granite intrudes the quartz monzonite on the ridge north of Negro Mag Wash. Dikes of the fine-grained granite and other dike units intrude the porphyritic granite. The age of the porphyritic granite relative to that of the syenite and of the coarse-grained granite could not be determined in the field.

Table 3 - Modal Analysis of Quartz Monzonite (Tqm)
on the basis of 1000 point counts.

Sample No. UT/MM-78-X	4	16	30	315	Average
Microcline	36.9	49.0	40.5	37.4	41.2
Plagioclase	26.1	30.6	36.0	28.9	30.5
Quartz	28.0	14.7	10.5	26.4	19.9
Biotite	3.9	2.8	6.0	4.4	4.3
Hornblende	1.9	---	---	---	---
Sphene	1.5	1.4	2.7	0.9	1.7
Opaques	0.4	1.0	2.1	1.4	1.2
Chlorite	0.7	Trace	Trace	---	0.2
Apatite	0.1	Trace	0.7	0.6	0.4
Zircon	0.1	Trace	Trace	Trace	Trace
Sericite	0.4	0.5	1.1	Trace	0.5
Epidote	---	---	0.4	---	0.1
% Anorthite	16-17	10-13	10-13	14	13

Sample site locations:

UT/MM-78-4	SW1/4, NW1/4, NW1/4, sec. 11, T. 27 S., R. 9 W.
UT/MM-78-16	SE1/4, SW1/4, sec. 36, T. 26 S., R. 9 W.
UT/MM-78-30	SW1/4, SE1/4, SE1/4, sec. 36, T. 26 S., R. 9 W.
UT/MM-78-315	SW1/4, SW1/4, SE1/4, sec. 27, T. 26 S., R. 9 W.

Table 4 - Modal Analysis of the Porphyritic Granite (Tpg) on the basis of 1000 point counts.

Sample No. UT/MM-78-X	27	105	124	160	Average
Alkali feldspar	53.0	40.7	40.1	64.9	49.7
Plagioclase	19.4	11.5	12.0	8.8	12.9
Quartz	20.0	34.2	36.2	19.3	27.4
Biotite	4.3	11.5	8.6	4.9	7.3
Sphene	1.2	---	---	Trace	0.3
Opaques	0.9	0.6	0.4	0.4	0.6
Chlorite	0.5	0.3	0.4	0.1	0.3
Apatite	0.7	0.4	0.4	0.4	0.5
Zicron	Trace	Trace	Trace	Trace	Trace
Sericite	---	0.8	1.9	1.2	1.0
% Anorthite	23	24	24	12	21

Sample site locations:

UT/MM-78-27	SW1/4, SE1/4, sec. 36, T. 26 S., R. 9 W.
UT/MM-78-105	NW1/4, NW1/4, NE1/4, sec. 27, T. 27 S., R. 9 W.
UT/MM-78-124	SE1/4, SE1/4, NE1/4, sec. 27, T. 27 S., R. 9 W.
UT/MM-78-160	SE1/4, SE1/4, NW1/4, sec. 25, T. 27 S., R. 9 W.

Syenite (Ts)

An elongate syenite stock crops out between the main exposure of the quartz monzonite on the east and the quartz monzonite Precambrian contact on the west. Smaller areas of syenite are exposed near the mouth of Ranch Canyon and in the upper portion of Wild Horse Canyon. Few xenoliths or dikes are found within the unit. The syenite intrudes the biotite quartz monzonite and is itself intruded by coarse-grained granite (Tg).

The syenite is medium-grained xenomorphic granular. Modal analyses are presented in Table 5. Quartz content is generally less than 10 percent, which serves to distinguish this rock from the granite (Tg) that intrudes it. The high sphene content of the syenite is noteworthy.

Granite (Tg)

A medium- to coarse-grained granite crops out to the east and south of Big Cedar Cove, in Upper Wild Horse Canyon, and to the northeast of Roosevelt Hot Springs (Plate 1). The unit has the same textural and outcrop characteristics as the syenite and is distinguished from that unit only by the abundance of quartz. The granite intrudes the syenite and is intruded by dikes of fine-grained granite (Tgr), diabase, and microdiorite.

Modes of the granite are presented in Table 6. In addition to quartz content, the rock is distinguished petrographically by a pronounced normal zoning of plagioclase with cores of An_{11} to An_{15} and rims of An_4 to An_{10}.

Fine-Grained Granite (Tgr)

A fine- to medium-grained granite occurs as a major dike-forming unit within the KGRA. The fine-grained granite is the major unit in the ridge

Table 5 - Modal Analysis of Syenite (Ts) on the basis of 1000 point counts.

Sample No. UT/MM-78-X	8	14A	31	35	Average
Microcline	73.0	67.6	55.4	48.9	61.2
Plagioclase	16.9	20.8	20.2	41.2	24.8
Quartz	7.2	6.0	5.0	---	4.6
Biotite	1.1	1.8	11.5	---	3.6
Hornblende	0.2	---	1.4	---	0.4
Sphene	0.7	1.0	3.4	1.0	1.5
Opaques	0.6	0.9	1.2	0.3	0.8
Chlorite	Trace	0.4	Trace	4.0	1.1
Apatite	0.1	0.2	0.9	0.2	0.35
Zircon	Trace	0.2	0.4	---	0.15
Sericite	0.2	0.4	0.6	2.6	1.0
Hematite	---	0.2	Trace	---	Trace
Leucoxene	---	0.4	---	---	0.1
Epidote	---	0.1	---	---	---
Calcite	---	---	---	1.8	0.4
% Anorthite	10-11	8-12	12	9	10

Sample site locations:

UT/MM-78-8	SE1/4, NW1/4, sec. 11, T. 27 S., R. 9 W.
UT/MM-78-14A	SE1/4, SE1/4, SE1/4, sec. 35, T 26 S., R. 9 W.
UT/MM-78-31	SE1/4, SW1/4, sec. 12, T. 27 S., R. 9 W.
UT/MM-78-35	NW1/4, SW1/4, sec. 31, T. 26 S., R. 8 W.

Table 6 - Modal Analysis of the Coarse-Grained Granite (Tg) on the basis of 1000 point counts.

Sample No. UT/MM-78-X	18	25	26	29	Average
Microcline	48.5	48.7	59.5	58.7	53.8
Plagioclase	17.9	19.0	14.6	13.1	16.2
Quartz	23.2	23.8	24.9	21.5	23.4
Biotite	6	5.6	Trace	3.1	3.7
Sphene	1.5	1.5	0.1	1.2	1.1
Opaques	1.2	0.9	0.2	1.0	0.8
Chlorite	0.1	---	0.5	0.3	0.2
Apatite	0.4	0.1	Trace	0.7	0.3
Zircon	Trace	Trace	0.2	Trace	Trace
Sericite	1.2	0.4	Trace	0.4	0.5
% Anorthite	15	4-11	10-11	13	11.5

<u>Sample site locations:</u>

UT/MM-78-18	SE1/4, NE1/4, sec. 34, T. 26 S., R. 9 W.
UT/MM-78-25	NE1/4, NW1/4, sec. 13, T. 27 S., R. 9 W.
UT/MM-78-26	SW1/4, NW1/4, NW1/4, sec. 24, T. 27 S., R. 9 W.
UT/MM-78-29	NE1/4, SE1/4, sec. 34, T, 26 S., R. 9 W.

north of Negro Mag Wash and forms most of the crest of that ridge (Plate 1) with dikes spreading north and south. The unit forms resistant, jointed outcrops, with blocky to rounded talus. Limonite staining up to one half inch into the rock is common on joints and fractures. The staining is heaviest, and most wide spread, on the ridge north of Negro Mag Wash. Some of the smaller dikes of this unit are very leucocratic, with less than 1 percent biotite, and these dikes sometimes grade into or include small pegmatites.

The fine-grained granite is xenomorphic granular. The average crystal size is less than 1 mm, but a few K-feldspar crystals are 1.5 mm. Modal analyses are given in Table 7.

Microdiorite (Tmd)

The microdiorite forms thin dikes averaging one to four meters thick. Many of the dikes are localized along fault zones, and some have been brecciated by subsequent movement along these zones. The microdiorite dikes are one of the youngest of the Tertiary units, cutting every rock type with which they are in contact including the fine-grained granite.

The dikes typically have a subdiabasic texture. Average modes are given in Table 8. Metamorphism of some dikes by subsequent dike intrusions has produced tremolite, actinolite, sericite, chlorite, and epidote.

Diabase (Tds)

Diabase dikes occur along the western margin of the Mineral Mountains from Big Cedar Cove to a point east of Roosevelt Hot Springs. These northerly trending dikes are two to four meters in thickness and generally dip steeply to the west. The dikes cut all major phases of the Mineral Mountains Pluton

Table 7 - Modal Analysis of the Fine-Grained Granite (Tgr) on the basis of 1000 point counts.

Sample No. UT/MM-78-X	12	28	Average
Alkali feldspar	56.6	57.5	57.1
Plagioclase	6.8	10.6	8.7
Quartz	30.2	27.9	29.0
Biotite	3.8	2.0	2.9
Sphene	0.1	Trace	Trace
Opaques	0.8	1.1	1.0
Chlorite	0.8	0.4	0.6
Sericite	0.9	0.5	0.7
Epidote	Trace	---	---
Apatite	0	Trace	---

Sample site locations:

UT/MM-78-12	SW1/4, NW1/4, NE1/4, sec. 3, T. 27 S., R. 9 W.
UT/MM-78-28	NE1/4, NW1/4, NE1/4, sec. 3, T. 27 S., R. 9 W.

Table 8 - Modal Analysis of the Microdiorite (Tmd) and Diabase (Tds) on the basis of 1000 point counts.

Sample No. UT/MM-78-X	Microdiorite 6	7	9	Average	Diabase 3
Plagioclase	42.6	38.3	44.6	41.9	70.7
Alkali feldspar	---	5.7	3.7	3.1	1.2
Quartz	---	1.3	11.2	4.2	2.0
Hornblende	28.7	21.6	17.0	22.4	---
Actinolite	11.6	17.5	---	9.7	---
Biotite	2.5	9.2	18.6	10.1	---
Sphene	1.4	0.6	2.0	1.3	---
Opaques	4.1	1.3	0.7	2.0	3.4
Apatite	2.1	1.8	0.6	1.5	0.8
Chlorite	2.8	---	0.4	1.1	16.7
Sericite	1.1	1.4	0.6	1.0	1.8
Epidote	1.4	0.6	0.5	0.8	0.1
Hematite	---	---	0.1	---	3.3
Orthopyroxene	---	0.7	---	0.3	---
Clay	1.7	---	---	0.6	---
% Anorthite	45	38			35

Sample site locations:

UT/MM-78-6	NE1/4, NW1/4, sec. 11, T. 27 S., R. 9 W.
UT/MM-78-7	NE1/4, NW1/4, sec. 11, T. 27 S., R. 9 W.
UT/MM-78-9	NE1/4, SW1/4, SW1/4, sec. 11, T. 27 S., R. 9 W.
UT/MM-78-3	NW1/4, NE1/4, sec. 10, T. 27 S., R. 9 W.

but are not in contact with the microdiorite or rhyolite. Hence, the relative age of the diabase with respect to these latter intrusives is not known. The diabase dikes are fine grained, and modal compositions are given in Table 8. Deuteric alteration has affected all primary minerals of the diabase; phases include sericite, chlorite, clays, and limonite.

Rhyolite dikes (Trd)

Several rhyolite dikes have been mapped in the area south of Wildhorse Canyon. These dikes cut both Precambrian rocks and the Tertiary porphyritic granite (Tpg). The dikes are cut by faults which do not cut the Quaternary rhyolites. This, coupled with the glassy appearance of the dikes, has led to their classification as the youngest Tertiary unit. These dikes are resistant to weathering and form distinctive linear ridges.

The rhyolite dikes are typically one to twenty meters wide and consist of a gray aphanitic matrix with approximately 10 percent 2-4 mm clots of feldspar phenocrysts, 5-7 percent anhedral quartz phenocrysts, and approximately 3 percent biotite flakes. The dikes are often strongly foliated with alignment of the biotite. In thin section the rhyolite dikes consist of a fine-grained silicified groundmass with strongly sheared and sericitized clots of feldspars and multicrystal quartz grains with well developed ribbon structure. Biotite grains have well developed reaction rims.

QUATERNARY

Rhyolites (Qrd, Qrf, Qra)

From 800,000 to 500,000 years ago, the Mineral Mountains were the site of rhyolitic volcanism which produced flows, pyroclastic rocks, and domes. It has been hypothesized by Smith and Shaw (1975) that young rhyolites such as these may indicate the presence of an upper level magma chamber which could serve as a heat source for the geothermal system. Certainly they do provide 'prima facie' evidence for high thermal gradients in the recent geologic history of an area.

Studies of the rhyolites of the Roosevelt Hot Springs KGRA have been summarized in Lipman and others (1978), and Ward and others (1978). Specific studies on the petrology and petrochemistry of the rhyolites have been presented by Nash (1976), Nash and Smith (1977), and Evans and Nash (1975, 1978). Much of the following summary was taken from these papers, and the reader is referred to them for a more detailed presentation.

The oldest Pleistocene rhyolites are the non-porphyritic flows of Bailey Ridge and Wildhorse Canyon. These flows are obsidian-rich, but commonly have devitrified central portions. A single K-Ar date on the Bailey Ridge flow indicates an age of 0.79±.08 my (Lipman and others, 1978).

Subsequent to the formation of the rhyolite flows, pyroclastic eruptions resulted in the deposition of air-fall and some water-lain tuffs in addition to non-welded ash flow tuffs. These rocks generally contain microphenocrysts of sanidine as well as quartz fragments and rare hornblende phenocrysts. As shown in Plate I, the pyroclastic rocks are principally exposed in Ranch Canyon. A K-Ar date on a contained obsidian clast gives a maximum age for the pyroclastics of 0.70 ±.04 my (Lipman and others, 1978).

Evans and Nash (1978) have determined equilibration temperatures using the iron-titanium oxide geothermometer of Buddington and Lindsley (1964). The results indicate temperatures of 740-785°C for the rhyolite flows and

635-665^{o}C for the later rhyolite domes. This is confirmed by the two-feldspar geothermometer. It is hypothesized by Evans and Nash (1978) that the domes and flows are genetically related and that the rhyolite of the domes was derived by differentiation of the rhyolite that produced the flows.

Hot Spring Deposits (Qs and Qcal)

Hot spring deposits in the KGRA have been mapped as both siliceous sinter (Qs) and as silica-cemented alluvium (Qcal). The principal areas of hot spring deposition are along the Opal Mound Fault and in the Roosevelt Hot Springs area. In both these areas the deposits consist of both opaline and chalcedonic sinter. A detailed discussion of the phases associated with the sinter has been presented by Bryant and Parry (1977) and summarized in Ward and others (1978). These hot spring deposits imply the presence of a high temperature water-dominated geothermal system (White and others, 1971).

Subsurface Information

IDENTIFICATION OF CUTTINGS

Several mapped rock types in the KGRA, although readily recognized in outcrop and hand specimen, may be confused with one another when examined as drill cuttings with hand lens or binocular microscope. The small size of these cuttings, averaging roughly 2-3 mm in maximum dimension, commonly obscures diagnostic larger scale textural characteristics of rocks. Reliable identification in such cases requires careful petrographic examination. The following discussion will outline the important features of cuttings identification.

Three Tertiary plutonic phases, quartz monzonite (Tqm), coarse-grained granite (Tg), and porphyritic granite (Tpg), are nearly identical in appearance when reduced to drill cuttings. All are coarse crystalline, quartz rich, and contain minor biotite. Hornblende is absent in the two granites and generally missing from the quartz monzonite. By contrast with these three phases, Tertiary syenite is medium grained, quartz deficient, and may contain abundant honey-colored sphene. It is distinguished from the coarser plutonic phases by grain size, and from the fine-grained granite (Tgr) by grain size and composition. Aplitic and pegmatitic phases of the fine-grained granite contain little or no mafic minerals, and may contain muscovite.

Because of its highly variable composition and banded or layered aspect, portions of the Precambrian banded gneiss may be mistaken in drill cuttings for several other rock units within the KGRA. Felsic layers and migmatitic segregations in the banded gneiss are poorly to non-foliated, and may closely resemble Tertiary granitic intrusives. Mafic portions of the gneiss are rich in biotite and hornblende and are almost always foliated even in cuttings. These mafic portions, where relatively rich in hornblende, are finer grained than the Precambrian hornblende gneiss.

Foliation in the Precambrian hornblende gneiss is generally discernible only with difficulty in drill cuttings. A relatively high hornblende and biotite content, however, distinguishes the hornblende gneiss from coarse-crystalline Tertiary intrusives. The hornblende gneiss differs from Tertiary (?) hornblende diorite by being generally coarser-crystalline, by containing biotite and sphene, and by containing much less hornblende (average 9 percent compared to 50 percent).

Lithologic units in the wells Utah State 72-16, 52-21, and 14-2 have been correlated with the units mapped in the KGRA. Detailed logs of Utah State 72-16 and Utah State 52-21 are presented in Appendix I and II respectively. A lithologic log of Thermal Power's Utah State 14-2 is presented by Ballantyne and Parry (1978). These holes are shown on Plate I and are included in the cross-sections of Plate II. In addition, six shallow thermal gradient holes have been logged and these are presented in Appendix III and briefly summarized in the following sections.

THERMAL POWER COMPANYS UTAH STATE 72-16

Thermal Power's Utah State 72-16, located in the central portion of the Roosevelt Hot Springs KGRA (Plate I), penetrated to a depth of 379 m (1244 feet). The lithologic log of this hole is presented in Appendix I. The well intersected hot water entries at 95 m (312 feet), 152 m (500 feet), 191 m (625 feet), and at the base of the hole. Below a thick alluvial section, the hole consists primarily of interlayered poorly to well foliated gneisses. On the basis of lithological similarities, units within Utah State 72-16 have been correlated with the hornblende and banded gneisses mapped on the western flank of the Mineral Mountains. The complex geological relationships suggest that Utah State 72-16 is located near the contact zone between the banded gneiss and the intrusive hornblende gneiss.

Dikes of coarse-grained mafic-poor granite and microdiorite cut both the banded and hornblende gneisses. The granite forms numerous thin dikes which are widely distributed throughout the drill hole. The microdiorite occurs only between 192 m (630 feet) and 195 m (640 feet) where it is intensely altered.

Alteration assemblages in Utah State 72-16 consist primarily of various proportions of pyrite, hematite, quartz, carbonate, and clays. Petrographic observations suggest that hematite + carbonate were deposited after pyrite, and quartz appears to have been precipitated with both pyrite and hematite. The distribution of alteration assemblages is illustrated in Appendix 1. Similar alteration assemblages have been observed in sporadically distributed fragments throughout the alluvium, so at least some of the alteration predates deposition of the alluvium (see also Hulen, 1978).

GETTY OIL COMPANY UTAH STATE 52-21

Getty Oil Company's Utah State 52-21 (Appendix II), collared approximately 1.7 km south of Utah State 72-16, was completed at a depth of 2281 m (7478 feet). In spite of its proximity to 72-16, 52-21 did not encounter commercially extractable fluids. Utah State 52-21 penetrated alluvium to a depth of 167 m (548 feet). The alluvium consists of subrounded to angular grains of fine- to coarse-crystalline Tertiary granitic rocks, Precambrian gneisses, and Pleistocene pumice and perlite. The pumice and perlite, derived from 0.8 to 0.5 my old (K-Ar; Lipman and others, 1978) silicic volcanic centers in the Mineral Mountains, are confined to the upper 66 m (218 feet) of alluvium where they commonly account for greater than 50 percent of samples from specific horizons. Maximum calculated alluvial sedimentation rate at the site of Utah State 52-21 since initial deposition of the pumice and perlite may be as much as 1 m in 700 years (Hulen, 1978).

From 167 m (548 feet) to the final depth of 2281 m (7478 feet), Utah State 52-21 intersected primarily a thick sequence of crudely to moderately well foliated gneiss which is correlated with the banded gneiss (PCbg) mapped at the surface. In this hole, the gneisses are fine to medium grained and consist of biotite ± hornblende, feldspar, and quartz in highly variable ratios, commonly with minor sphene and/or fibrolite, and rarely with traces of zircon, cordierite(?), and garnet. The gneisses commonly display a distinctive "salt-and-pepper" texture. Thin zones of well foliated medium- to coarse-grained biotite schist are locally present.

The banded gneiss in Utah State 52-21 is intruded by several thick zones and a few narrow dikes or sills of medium- to coarse-grained biotite-hornblende quartz monzonite to granodiorite gneiss (P€gn). Foliation in the gneiss in drill cuttings is discernible only with difficulty. Its correlation with outcropping hornblende gneiss is based on petrographic examination and on comparision of the cuttings with outcrop samples crushed to simulate drill chips.

Dikes of leucocratic medium-grained biotite granite and rare alaskite intrude the banded gneiss and hornblende gneiss throughout the drill hole. These dikes are most common below 1830 m (6000 feet) where they form more than 50 percent of the rock intersected. Most of the dikes, particularly where abundant in the lower portion of the hole, can probably be correlated with Tertiary fine-grained granite (Tgr) mapped at the surface. Many, however, cannot be confidently distinguished in drill cuttings from felsic migmatitic differentiates within the banded gneiss.

Biotite-hornblende quartz microdiorite occurs as a 40-foot intercept intruding leucocratic granite between 619 m (2028 feet) and 631 m (2068 feet). The microdiorite also forms numerous narrow dikes, generally less than 2-3 percent of a ten-foot chip sample, above 1922 m (6300 feet). The principal microdiorite dike and most of the smaller dikes are intensely hydrothermally altered and commonly contain abundant disseminated pyrite.

Preliminary examination of geophysical well logs for Utah State 52-21 by W. E. Glenn (personal communication, 1978) suggests the following major zones of probable structural disruption: at least 616 m (2019 feet, bottom of casing) to roughly 884 m (2900 feet), 1067-1073 m (3498-3518 feet), 1884-1915 m (6178-6278 feet), 2083-2107 m (6828-6908 feet), and 2186-2269 m (7168-7438 feet). These zones generally correlate well with an increase in gouge chips in corresponding drill cuttings.

Alteration is generally very weak in Utah State 52-21, but is intense in restricted intervals. It is particularly intense between roughly 610 m (2000 feet) and 671 m (2200 feet) where it is apparently centered on the microdiorite dike described above. The alteration is characterized by chloritization of biotite and hornblende, sericitization and calcite alteration of feldspars, particularly plagioclase, and leucoxene (± calcite) after sphene. Calcite veinlets and microveinlets and calcite-altered gouge occur along the entire length of the hole but are most common below 1220 m (4000 feet). Microveinlets of chlorite (± calcite, quartz, sericite) appear in the microdiorite at 619 m (2028 feet) and erratically persist to the bottom of the hole. Traces of epidote occur locally throughout the hole as microveinlets (± chlorite, quartz) and as small patches replacing feldspar.

Disseminated pyrite is erratically distributed in trace to minor amounts in all rock types along the entire depth of Utah State 52-21. It is commonly accompanied by traces of texturally similar chalcopyrite. These sulfides are typically associated with an increase in chlorite-calcite-sericite (±leucoxene) alteration of their host rocks. Pyrite is notably concentrated in altered microdiorite dikes, particularly between 619 m and 631 m (2028 and 2068 feet), where it forms one percent of the rock by volume. Although predominantly disseminated, pyrite and chalcopyrite also occur as rare local microveinlets, generally in combination with one or more of the minerals chlorite, calcite, and quartz.

Earthy iron oxides are present in Utah State 52-21 to a depth of roughly 762 m (2500 feet) but are concentrated between 110 m and 336 m (360 to 1100 feet). These iron oxides, dominantly brick-red to maroon hematite with minor goethite and jarosite, occur as irregular films and crusts on detrital grains in alluvium and as microveinlets in subjacent bedrock. They also occur as a light stain around mafic minerals and as rare pseudomorphs of primary pyrite grains. Above 214 m (700 feet), the iron oxides are accompanied by local traces of dendritic manganese oxide.

UNIVERSITY OF UTAH THERMAL GRADIENT HOLES

Lithologic logs for six thermal gradient holes drilled by the University of Utah are presented in Appendix III. The locations of these holes are listed in Appendix III and, where possible, shown on Plate I. Core is stored in the sample library of the Department of Geology and Geophysics, University of Utah.

Alteration

Surface hydrothermal alteration at the Roosevelt Hot Springs KGRA is minimal and confined to areas of recent hot spring activity, fault zones, joint surfaces, and zones of base metal mineralization. Alteration in many of the holes drilled in the district and surface alteration associated with hot spring activity have been described by Bryant and Parry (1977), Ballantyne and Parry (1978), Parry (1978), and Hulen (1978). The results of many of the above alteration studies have been summarized in Ward and others (1978). Hulen (1978) has documented the coexistence of altered and unaltered clasts in alluvium, indicating that hydrothermal processes have been active in the past.

Intense faulting within the Roosevelt Hot Springs KGRA was accompanied by hydrothermal alteration. In general, the mylonite zones display assemblages which are characteristic of the greenschist facies of metamorphism or the propylitic alteration facies. Epidote, chlorite, magnetite, hematite, and leucoxene are developed. The zones are commonly silicified, and occasional pods of bull quartz have formed along the faults. The silicification produces a rock which is quite resistent to weathering and is brittle as well as being relatively impermeable. The zones thus form conspicuous jagged outcrops along ridge crests. Rocks adjacent to the mylonites are often strongly jointed but not silicified, however, it is common to find that the amphiboles and biotites in these rocks have been altered to chlorite.

Structure

The Roosevelt Hot Springs KGRA contains a structurally controlled geothermal system. The following presentation emphasizes the field relationships in the KGRA and their importance as exploration criteria. As noted earlier, there are no units, except the Recent alluvium, which possess sufficient primary permeability to serve as production aquifers. Indeed, even in fields which produce from stratigraphic reservoirs, much of the production comes from permeable fault zones (Muffler, 1975).

FAULTS

As illustrated in Plate I, the Roosevelt Hot Springs KGRA is dominated by four major fault systems. These are, in order of probable age, 1) large-scale faults which dip at shallow angles to the west, 2) northwest-trending fault zones which are probably related to the low-angle faults, 3) east-west steeply dipping structures, and 4) north to northeast-trending normal faults which often localize hot spring activity. The faults shown cutting bedrock on Plate I are identified in the field on the basis of either zones of mylonite or demonstrable offset of geologic units. Faults mapped within the alluvium are recognized on the basis of siliceous sinter deposits, linears produced by minor offset, or alignment of vegetation. Many of the air photo linears examined within the range show no indication of movement or cataclasis and are thus not mapped as faults.

A major low-angle fault has been traced from Ranch Canyon on the south to Negro Mag Wash on the north (Plate I). The fault zone is marked by intense brecciation up to 15 m thick, and its geometry is illustrated on cross-sections B-B' and C-C' (Plate II). Reconnaissance indicates continuation of the fault zone south of the area shown on Plate I, where it was recognized by Condie (1960). In the area between Ranch Canyon and Wild Horse Canyon, the offset of lithologies indicates normal movement with a displacement of approximately 610 m (2000 feet) in a S 80°W direction. As illustrated in cross section C-C' (Plate II), the fault plane in this area dips approximately 15°W. To the north, the zone steepens and dips approximately 65°W at the eastern margin of Little Cedar Cove. Reconnaissance work on the probable continuation of the fault zone along Upper Ranch Canyon Road shows that the zone is approximately 15 m thick and dips 10°W. Thus there is consistent evidence that the dip of the zone steepens to the north.

Other low-angle fault zones have been mapped in the KGRA, but these are less continuous and of more limited distribution than the fault described above. Three low-angle zones have been mapped in sec. 36 (T. 26 S., R. 9 W.) and sec. 31 (T. 26 S., R. 8 W.). These zones are marked by mylonites and dip 9-48° to the west and northwest. It was not possible to trace the zones any farther than is shown in Plate I because of development of residual soils. A major low-angle fault zone has also been mapped in sec. 24 (T. 26S., R. 9 W.). This zone trends approximately N 70°W and dips 40°S. It is cut off on the north by a high-angle east-west fault zone and disappears beneath alluvium on the south. Additional mapping within the Mineral Mountains will result in a more coherent picture of the interrelationships of these discontinuous low-angle features.

The low-angle fault zones are similar to those described as denudation faults (Armstrong, 1972). Normal offset and a probable Tertiary age indicate that the faulting is unrelated to Sevier (Cretaceous) thrusting. The faults were formed during the uplift of the Mineral Mountains, but the depth at which they formed is at present unknown and remains under investigation.

The upper plate of the major low-angle fault contains a family of northwest-trending high-angle faults found principally in the hills south of Big Cedar Cove (Plate I, Plate II, B-B'). These faults are accompanied by several east-west and northeast-trending systems. The northwest-trending zones dip steeply to the east and west. Some have dips that flatten downward and represent a rotational offset. Silicified mylonite zones up to 4 m thick are common along these zones. Because of the absence of marker horizons, the direction of displacement and the total amount of offset on these structures cannot be documented. In the vicinity of Ranch Canyon (Plate I) it is apparent that high-angle northwest-trending faults are present in the hanging wall of the major low-angle fault but not in the foot wall. This implies that the northwest-trending faults were developed in the upper plate in response to the low-angle faulting. Thus the mylonite zones were formed by differential movement between relatively rigid blocks of the hanging wall during low-angle faulting. Supporting evidence for this interpretation is that the northwest fault direction is at approximately right angles to the direction of movement inferred by realigning the geology of the upper and lower plates.

The distribution of faults on Plate I indicates a much greater intensity of faulting in the Precambrian hornblende gneiss than in adjacent units, particularly the Precambrian banded gneiss. This is largely a function of mechanical properties of the lithologies. Mylonite zones which are well developed in the hornblende gneiss often disappear when the faults enter the banded gneiss. Thus it is probable that the northwest faulting does continue through the banded gneiss but, due to the character of the outcrops, these faults were not recognized. These high-angle fault zones are commonly the site of microdiorite dikes. Often both brecciated and non-brecciated dikes occupy the same zone, suggesting several periods of dike intrusion and implying several periods of movement on the same faults.

A steeply dipping east-west fault system has been identified in the KGRA. These structures are probably more numerous than are shown in Plate I. It is thought that east-west valleys along the western flank of the Mineral Mountains are structurally controlled, but Quaternary rhyolites and Recent alluvium cover the structures. One of the best exposed east-west faults is the Negro Mag Fault system. The offset along this zone is probably normal with the north side down-faulted; this sense is opposite that proposed on the basis of gravity data (Crebs and Cook, 1976). Another east-west fault, mapped in the northern extent of Plate I, also shows normal offset with down-faulting to the north.

The youngest faults in the KGRA trend north to north-northeast and dip at high angles. The most conspicuous of these is the Opal Mound Fault and associated siliceous sinter deposits. Reports on the subsurface relationships (Geothermex, 1977) show that the Opal Mound Fault is an eastward-dipping normal fault bounding a graben on the east and a narrow horst on the west. Gravity models (Ward and others, 1978) show repeated down-faulting to the west of the Opal Mound Fault which, together with a tilted bedrock surface, results in a maximum depth to bedrock of 1.4 km in the center of the Milford Valley.

The Opal Mound Fault can be traced northward to Negro Mag Wash. Although there are faults evident to the north of the wash, correlation with the Opal Mound Fault becomes speculative. A resistivity low follows the Opal Mound

Fault south of Negro Mag Wash, but to the north the resistivity trends northwest (Ward and Sill, 1976). This suggests either a change in trend of the system of faults associated with the Opal Mound Fault or a separate northwest trend controlling geothermal fluids.

JOINTS

Joints which increase the permeability of otherwise impermeable rocks may be of importance in localization of geothermal reservoirs. Joint directions measured in the Roosevelt Hot Springs KGRA are plotted in Figure 5. This diagram indicates a strong vertical to near-vertical joint trend which strikes east-west to N 70^{O}W. A second maxima occurs at N 25^{O}W to N 55^{O}W with dips of 30^{O} to 50^{O}W. The north-west trends may be related to the low-angle faulting discussed in the previous section. A more complete analysis of the joint trends in the KGRA will be presented by Yusas and Bruhn (in preparation).

DISCUSSION

Available information indicates that the principal producing wells in the geothermal field are Phillips Petroleum Co. wells Utah State 3-1, 54-3, and 13-10, and Thermal Power Co. wells Utah State 14-2 and 72-16 (Geothermex, 1977). In addition, Phillips wells Utah State 25-15 and 12-35 are potential producers but are reported to have shallow, cool water contamination (Geothermex, 1977). These producing wells are plotted on Plate I and coincide with an area of high thermal gradients (Sill and Bodell, 1977; Ward and others, 1978). The geothermal field at Roosevelt Hot Springs is bounded by the range front on the east and the Opal Mound Fault on the west. Present

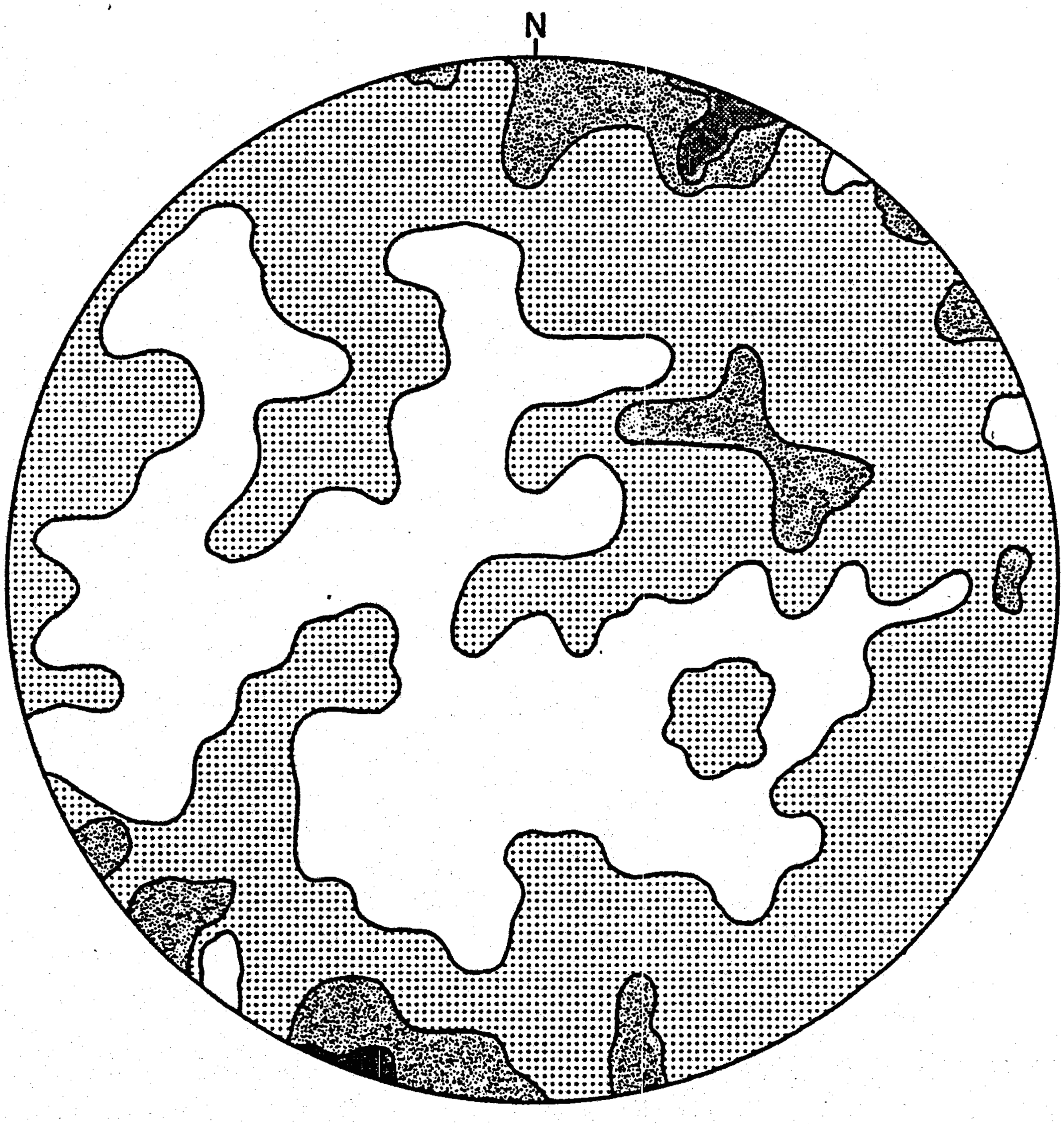

Fig. 5 - Equal area projection on the lower hemisphere of joints from the Roosevelt KGRA. Contoured by the Schmidt method with contours at 1%, 3%, and 5% of 1% area (190 poles).

drilling data indicate that the geothermal field may be abruptly terminated between Utah State 52-21 and 72-16. A major structural feature, which can be interpreted as a fault, has been identified from electrical resistivity data in this area (Ward and Sill, 1978), but efforts to locate this structure where it intersects the range front have been unsuccessful.

Buried structures which control the geothermal reservoir can be postulated by extrapolation from faults mapped in the adjacent range. Zones of intense northwest faulting are localized within the central portion of the map area (Plate I). These zones project directly into the southern portion of the geothermal reservoir. The northern portion of the known geothermal field lies along the continuation of the Negro Mag Fault zone (Phillips 3-1, 54-3; Thermal Power 14-2).

It is proposed that the geothermal reservoir is controlled by the intersections of two or three principal fault zones recognized in the Mineral Mountains. The shallow- and steep-dipping mylonite zones which result from low-angle faulting and the steep mylonite zones produced by east-west faulting are largely impermeable because of silicification. However, these rocks are quite brittle and could form permeable reservoirs if intersected by later faults. In addition, strongly fractured rocks adjacent to the mylonite zones may develop reservoir potential during initial or subsequent faulting. It is also possible to have permeability developed by recurrent movement on any of these fault zones.

Cross-sections A-A' and B-B' (Plate II) are drawn through areas of documented hydrothermal production. Where available, data from production wells have been incorporated into these sections. Although Phillips' Utah

State 54-3 is shown in section A-A', no geologic information was available to the authors. The relationships shown for Utah State 54-3 are based on geologic mapping and cuttings logs of Utah State 14-2. Section A-A' is drawn subparallel to the Negro Mag Fault zone and is probably within that zone in the western half of the cross section. The intercepts with that zone are not shown in section A-A'. It is proposed that production from this area taps a structural reservoir created by the intersection of the Negro Mag zone with faults parallel to the Opal Mound Fault and to low-angle faults.

Structural control of the southern portion of the geothermal field is illustrated in cross-section B-B'. Northwest-trending mylonites and mylonites formed along the low-angle faults are intersected by structures forming the complex graben between the range front and the Opal Mound Fault.

In summary, the bedrock geology adjacent to the producing geothermal field at Roosevelt Hot Springs is unique in that it contains a family of northwest-trending mylonite zones which developed through the brecciation of the upper block of a low-angle normal fault. The intersection of these zones with the Opal Mound and Negro Mag Fault zones is believed to produce the open fractures which control the hydrothermal reservoir. Thus the denudation faulting was essentially a ground preparation phase where tectonic milling and fluid-rock interaction produced brittle, impermeable mylonites flanked by well-brecciated zones.

The presence of low-angle faults in the Roosevelt Hot Springs KGRA suggests a number of possibilities that can be of importance in the continued development of the Roosevelt Hot Springs KGRA in particular, and exploration in other KGRAs in the Basin and Range in general. These possibilities are speculative and there is no confirmation that they have been developed.

1. The presence of low-angle faults indicates that structural reservoirs in crystalline rocks may be covered by impermeable upper plates which mask high convective heat flow and eliminate near-surface resistivity responses to altered brine-saturated rocks.

2. There is a possibility that crystalline rocks may overlie pre-fault volcanics and clastic sediments which may provide a stratigraphic control for much of the hydrothermal reservoir. Again, the crystalline cover may mask the presence of that reservoir.

3. Low-angle faults may channel hydrothermal fluids away from reservoirs so that hot spring and alteration evidence of these reservoirs is displaced relative to the reservoirs themselves.

ACKNOWLEDGEMENTS

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APPENDIX I

LITHOLOGIC LOG OF THERMAL POWER COMPANY

UTAH STATE 72-16

THERMAL POWER WELL 72-16
ROOSEVELT HOT SPRINGS KGRA
LITHOLOGY, ALTERATION AND MINERALIZATION LOG

EXPLANATION

▨ ARKOSIC ALLUVIUM. SUBROUNDED TO ANGULAR FRAGMENTS AND GRAINS OF SILT TO FINE GRAVEL SIZE DOMINATED BY LEUCOCRATIC GRANITE AND ITS CRYSTAL CONSTITUENTS, WHICH COMPRISE MICROCLINE, ORTHOCLASE, PERTHITE, PLAGIOCLASE, AND TRACES OF SPHENE, APATITE, AND ZIRCON BECOME PROGRESSIVELY MORE CONSOLIDATED WITH DEPTH.

▨ SILICIFIED ARKOSIC ALLUVIUM SAME AS ABOVE EXCEPT CEMENTED WITH SILICA (OPAL, CHALCEDONY, QUARTZ) AND PYRITIZED.

▨ LEUCOCRATIC BIOTITE GRANITE FINE-MED.-XLINE, SUBEQUIGRANULAR. 50-60% POTASSIUM FELDSPAR (MICROCLINE PLUS ORTHOCLASE, 15-20% PERTHITE, 15-20% OLIGOCLASE, 10-15% QUARTZ, 1% BIOTITE, TR. ZIRCON, TR. APATITE, TR.-0.1% ALLANITE, TR. MAGNETITE/ILMENITE, LOCAL TR. SCHEELITE MYRMEKITIC INTERGROWTHS COMMON.

▨ BIOTITE-HORNBLENDE QUARTZ MONZONITE GNEISS, MED. CRS. XLINE. 30-35% ORTHOCLASE, 1-2% MICROCLINE, 20-25% OLIGOCLAS, 10-15% QUARTZ, 15-20% MED.-DARK GREEN AMPHIBOLE (PROBABLY HORNBLENDE), 2% SPHENE, 2% DARK OPAQUE MINERALS (MAGNETITE-ILMENITE), TR. APATITE, TR. ZIRCON, HORNBLENDE AND QUARTZ COMMONLY OCCUR AS WORMY INTERGROWTHS. QUARTZ COMMONLY STRAINED.

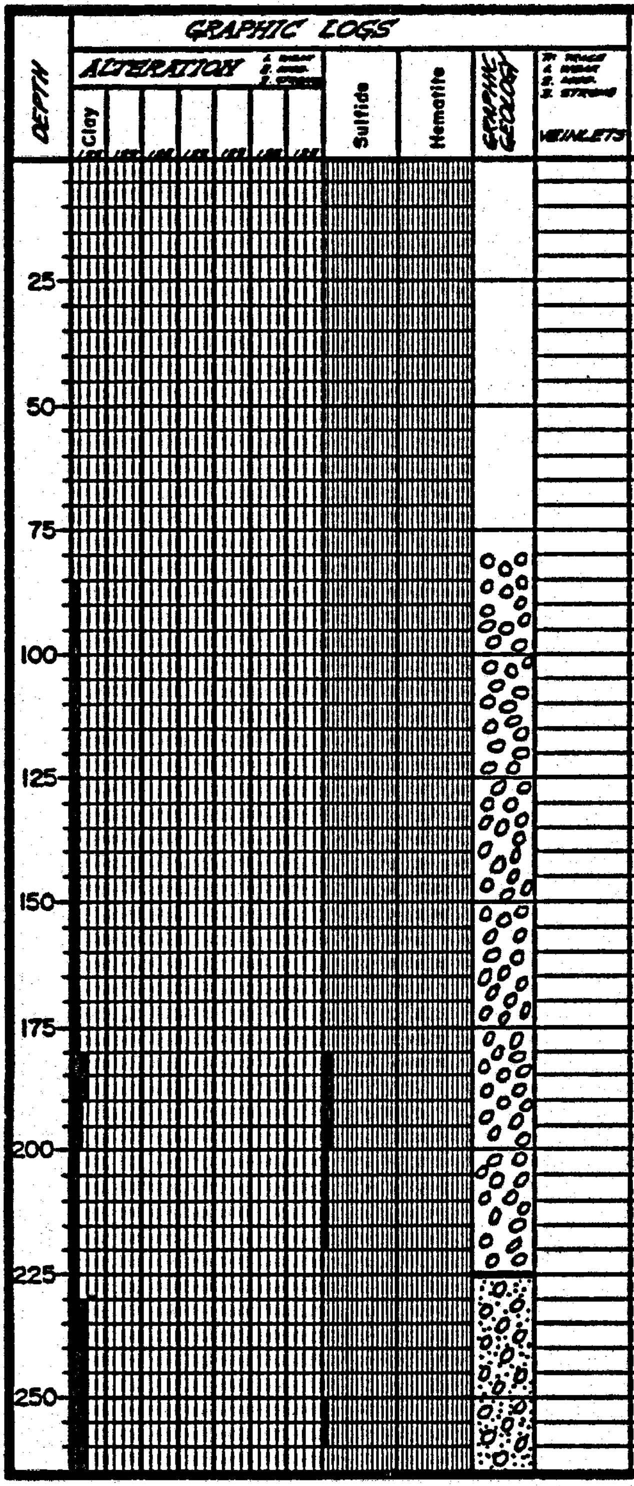
▨ APATITE-RICH BIOTITE HORNBLENDE PLAGIOCLASE GNEISS FINE-MED. XLINE, MOD. WELL-FOLIATED. 45-50% PLAG., COMMONLY ZONED, 5-7% STRAINED QUARTZ, 5-7% ORTHOCLASE, 3-7% APATITE, 2-3% SPHENE, 0.1-0.3% ZIRCON, 10-15% BIOTITE, 15-20% HORNBLENDE.

▨ FAULT GOUGE AND BRECCIA

ABBREVIATIONS

MED. - MEDIUM
XLINE - CRYSTALLINE
TR. - TRACE
CRS. - COARSE
DK. - DARK
MOD. - MODERATE (LY)
DISS. - DISSEMINATED
QTZ. - QUARTZ

LOGGED BY J. N. MOORE
AND J. B. HULEN
JUNE 1978



DESCRIPTIONS

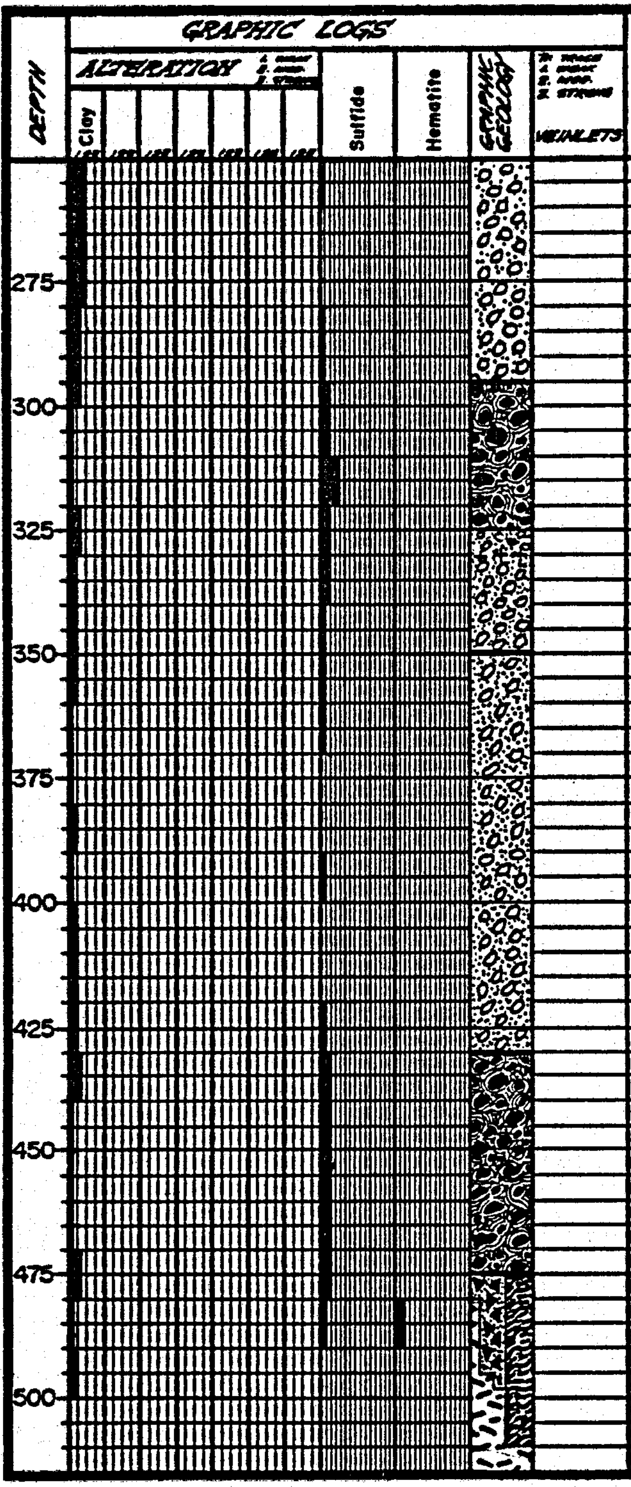
0-85': NO SAMPLE

85-230': UNCONSOLIDATED ALLUVIUM, ARKOSIC. SUBROUNDED TO ANGULAR GRAINS UP TO 10 mm. (AVG. 2-3 mm.) IN DIAMETER DOMINATED BY TERTIARY GRANITIC INTRUSIVE ROCKS WITH MINOR PRECAMBRIAN GNEISS AND TRACES PLEISTOCENE SILICIC VOLCANIC ROCKS. *TRACES EARTHY GOETHITE & BRICK RED HEMATITE AS STAIN ON SCATTERED GRAINS. WEAK ARGILLIC ALTERATION. Tr.-0.2% disseminated pyrite from 180-200'*

225-295': POORLY CONSOLIDATED ARKOSIC ALLUVIUM. OTHERWISE SAME AS 85-225'. *ARGILLIC ALTERATION SLIGHTLY MORE INTENSE. 0.1% diss. pyrite 250-260'*

DRILL HOLE THERMAL POWER 72-16
LOCATION ROOSEVELT H.S. KGRA

LOGGED BY J.N. MOORE
J.B. HULEN



DESCRIPTIONS

295-320': SILICIFIED ARKOSIC ALLUVIUM. SAME AS 85-295' EXC. CEMENTED WITH OPAL, CHALCEDONY & QUARTZ. ARGILLIC ALTERATION DECREASES. Up to 0.4% diss pyrite. Tr. azurite. Tr. earthy goethite and hematite.

320-430': WELL-CONSOLIDATED ARKOSIC ALLUVIUM. OTHERWISE SIMILAR TO 85-295'. ARGILLIC ALTERATION GENERALLY WEAK, LOCALLY MODERATELY INTENSE. 0-0.1% diss. pyrite, texturally similar to superjacent intervals.

430-475': SILICIFIED ARKOSIC ALLUVIUM, SAME AS 295-320'. 0.2% pyrite, almost all disseminated; rarely in microveinlets with silica

475-585': DOMINANTLY BIOTITE HORNBLENDE QUARTZ MONZONITE GNEISS WITH MINOR BIOTITE-HORNBLENDE -

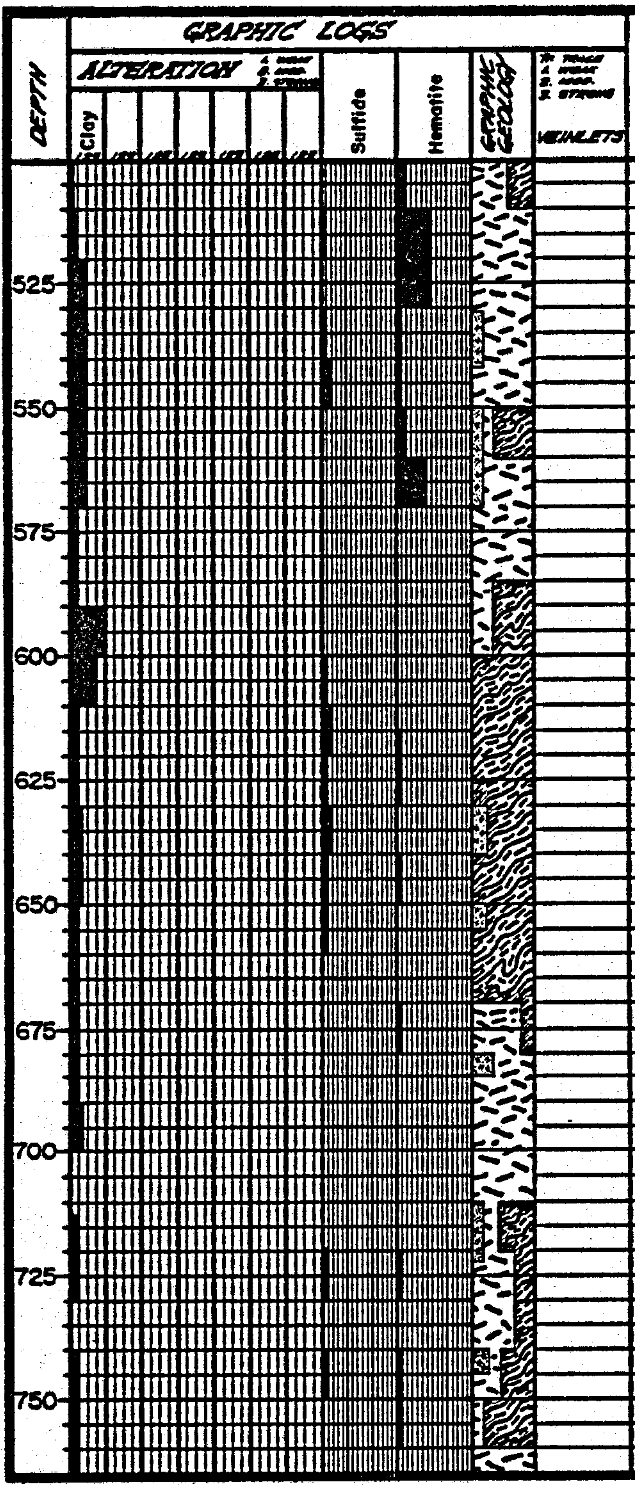
(continued)

DRILL HOLE THERMAL POWER 72-16

LOCATION ROOSEVELT HOT SPRINGS KGRA

LOGGED BY J.N. MOORE

J.B. HULEN



DESCRIPTIONS

continued from previous page

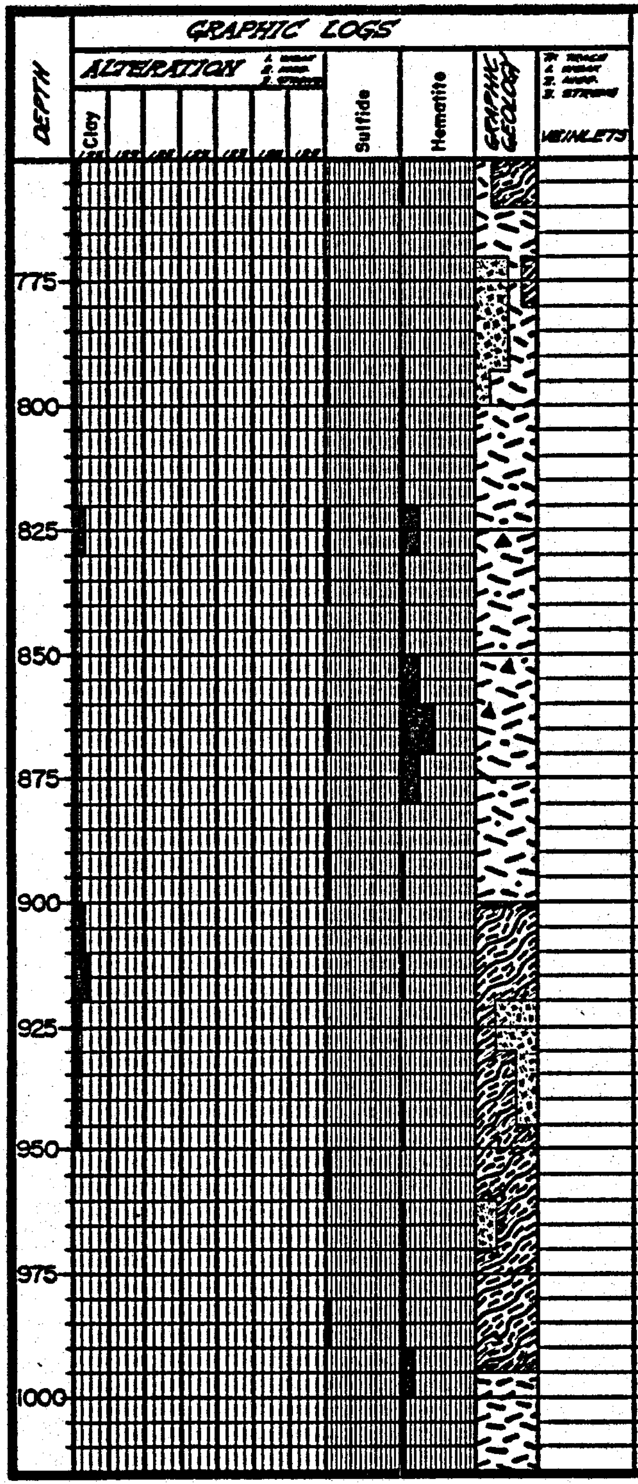
-PLAGIOCLASE GNEISS AND LEUCOCRATIC BIOTITE GRANITE (REFER TO EXPLANATION FOR LITHOLOGIC DESCRIPTIONS). DISTINCTIVE CHIPS OF FAULT GOUGE & BRECCIA APPEAR IN THE CUTTINGS FROM 475-500'. *WEAK-MODERATE ARGILLIC ALTERATION. MAFIC MINERALS PARTIALLY CHLORITIZED. 0-0.2% diss. pyrite. Up to 0.7% submetallic maroon hematite, occurring primarily as the dominant constituent of microveinlets, generally in combination with quartz and/or calcite.*

585-670': DOMINANTLY BIOTITE-HORNBLENDE-PLAGIOCLASE GNEISS WITH MINOR LEUCOCRATIC BIOTITE GRANITE. *ALTERATION AS ABOVE WITH MORE INTENSE ARGILLIC ALTN. 590-610'.* 10-15% BIOTITE-HORNBLENDE MICRODIORITE 620-640'. *Disseminated pyrite, up to 0.2%, confined to 600-660'. Hematite microveinlets rare, same as 475-585'.*

670-800': MIXED ZONE. BIOTITE-HORNBLENDE QUARTZ MONZONITE GNEISS, BIOTITE-HORNBLENDE-PLAGIOCLASE GNEISS, LEUCOCRATIC BIOTITE GRANITE. *ALTERATION AND MINERALIZATION SAME AS ABOVE, BUT LESS INTENSE.*

DRILL HOLE THERMAL POWER 72-16
LOCATION ROOSEVELT HOT SPRINGS KGRA

LOGGED BY J. N. MOORE
J. B. HULEN



DESCRIPTIONS

800-900': BIOTITE-HORNBLENDE QUARTZ MONZONITE GNEISS. *ALTERATION & MINERALIZATION SAME AS ABOVE EXCEPT HEMATITE (± QUARTZ, CALCITE) VEINLETS RELATIVELY ABUNDANT FR. 820-830' & 850-880'.*

900-995': BIOTITE-HORNBLENDE-PLAGIOCLASE GNEISS WITH MINOR LEUCOCRATIC BIOTITE GRANITE. *ALTERATION SAME AS ABOVE EXC. MUCH LESS INTENSE BELOW 950'. Disseminated pyrite and hematite (± quartz, calcite) microveinlets same as above.*

995-1100': BIOTITE-HORNBLENDE QUARTZ MONZONITE GNEISS W/MINOR (cont'd.)

DRILL HOLE THERMAL POWER 72-16

LOCATION ROOSEVELT HOT SPRINGS KGRA

LOGGED BY J.N. MOORE
J.B HULEN

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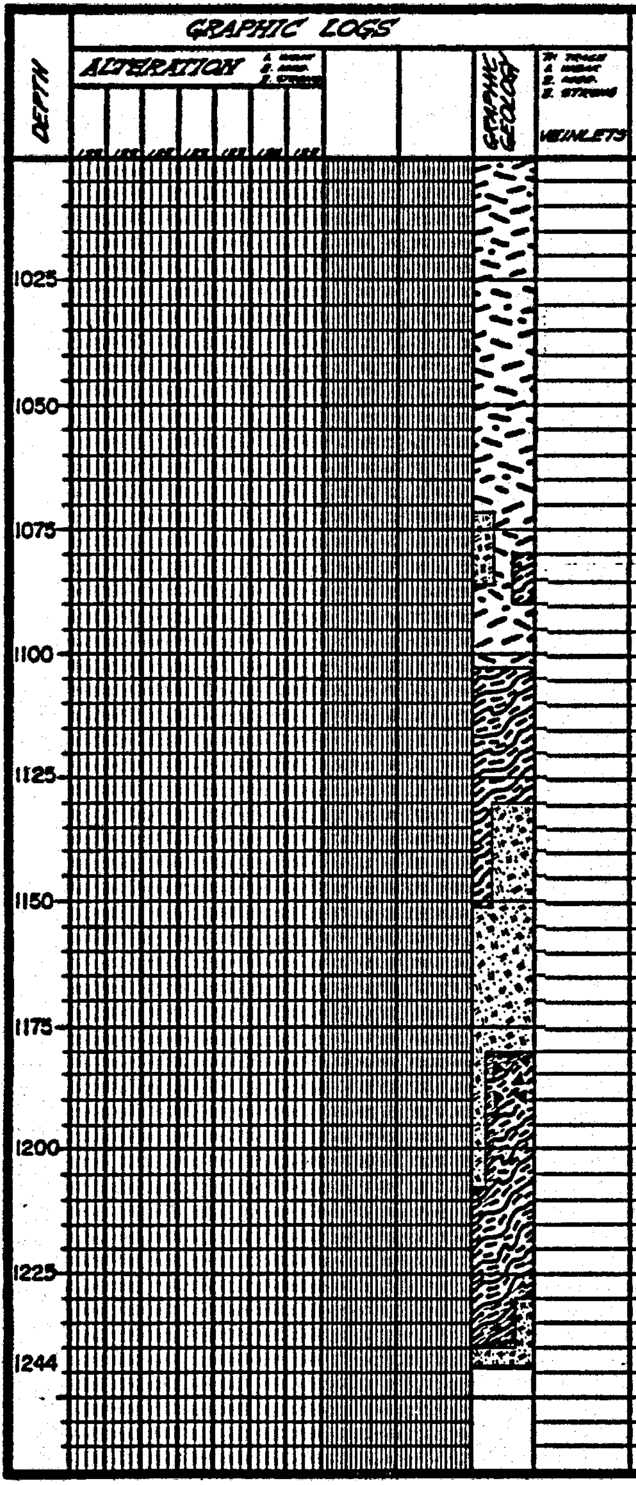

DESCRIPTIONS

BIOTITE-HORNBLENDE PLAGIOCLASE GNEISS & LEUCOCRATIC BIOTITE GRANITE. PROBABLE FAULT AT 1100'. *ALTERATION SAME AS ABOVE, BUT QUITE WEAK. Scattered disseminated pyrite, up to 0.1%, and hematite (± qtz, calcite) microveinlets, same as above.*

1100-1130': BIOTITE-HORNBLENDE PLAGIOCLASE GNEISS. *ALTERATION AND MINERALIZATION SAME AS ABOVE*

1130-1180': DOMINANTLY LEUCOCRATIC MED-GRAINED BIOTITE GRANITE WITH MINOR BIOTITE-HORNBLENDE-PLAGIOCLASE GNEISS. *ALTERATION AND MINERALIZATION SAME AS ABOVE.*

1180-1244': DOMINANTLY BIOTITE-HORNBLENDE-PLAGIOCLASE GNEISS WITH MINOR LEUCOCRATIC BIOTITE GRANITE. *ALTERATION SAME AS ABOVE — WEAK TO MODERATE. Scattered disseminated pyrite and hematite microveinlets as above. Abundant fault breccia 1180-1190'.*

DRILL HOLE THERMAL POWER 72-16
LOCATION ROOSEVELT HOT SPRINGS KGRA

LOGGED BY J. N. MOORE
J. B. HULEN

APPENDIX II

LITHOLOGIC LOG OF GETTY OIL COMPANY

UTAH STATE 52-21

GETTY OIL CO. DRILL HOLE 52-21
LITHOLOGY, ALTERATION AND MINERALIZATION LOG
"EXPLANATION"

▨	PUMICEOUS AND PERLITIC ALLUVIUM	SUBROUNDED TO ANGULAR GRAINS UP TO AN OBSERVED DIAMETER OF 15 MM. (AVG. 2-3 MM.) CONSISTING OF PLEISTOCENE PUMICE, PERLITE, AND OBSIDIAN; TERTIARY GRANITIC ROCKS; AND PRECAMBRIAN GNEISSES. SILICIC VOLCANIC COMPONENT ACCOUNTS FOR UP TO 80 VOL.% OF SPECIFIC HORIZONS.
▨	ALLUVIUM	SAME AS ABOVE EXCEPT LITTLE OR NO SILICIC VOLCANIC COMPONENT.
▨	DACITE PORPHYRY	UP TO 7% EUHEDRAL PLAGIOCLASE LATHS, UP TO 1 X 0.3 MM, EMBEDDED IN A DENSE, DARK GRAY APHANITIC MATRIX. GENERALLY ASSOCIATED WITH MICRODIORITE, AS DESCRIBED BELOW.
▨	BIOTITE HORNBLENDE MICRODIORITE TO QUARTZ MICRODIORITE.	MICROCRYSTALLINE. SUBDIABASIC TEXTURE, 50-55% SUBHEDRAL-EUHEDRAL PLAGIOCLASE, 15-20% (?) SUBHEDRAL HORNBLENDE, 5-10% SUBHEDRAL BIOTITE, 2-3% APATITE, 2-3% SPHENE/LEUCOXENE, 1-2% DARK OPAQUE MINERALS, MINOR QUARTZ & POTASH FELDSPAR. COMMONLY INTENSELY HYDROTHERMALLY ALTERED & SULFIDE-BEARING.
▨	LEUCOCRATIC BIOTITE GRANITE, ALASKITE, AND GRANITIC SEGREGATIONS IN PRECAMBRIAN GNEISS, UNDIVIDED.	GENERALLY MEDIUM-CRYSTALLINE, LESS COMMONLY FINE-CRYSTALLINE. GENERALLY LESS THAN 0.5 VOLUME PER CENT BIOTITE and LESS THAN 0.5 VOLUME PER CENT DARK OPAQUE MINERALS. PROBABLY INCLUDES ONE OR MORE PHASES OF THE MINERAL MOUNTAINS PLUTON (TERTIARY) AND GRANITIC GNEISSES AND FELSIC MIGMATITIC DIFFERENTIATES OF PRECAMBRIAN AGE.
▨	BIOTITE HORNBLENDE QUARTZ MONZONITE TO GRANODIORITE GNEISS.	GENERALLY MEDIUM-CRYSTALLINE, BUT VARIES FROM FINE TO COARSE-CRYSTALLINE. SUBHEDRAL HORNBLENDE VARIES FROM 7 TO 30% (AVG. ABT. 20%); BIOTITE FROM <1 TO 20% (AVG. ABT. 7%). UP TO 2% SPHENE AND 2% DARK OPAQUE MINERALS. FOLIATION GENERALLY NOT DISCERNIBLE IN DRILL CUTTINGS. PROBABLY CORRELATES WITH "HORNBLENDE GNEISS" (p€gn) MAPPED AT THE SURFACE (NIELSON, ET AL., 1978).
	FELDSPAR-QUARTZ-BIOTITE (± HORNBLENDE) GNEISS*	FINE TO MEDIUM-CRYSTALLINE. HIGHLY VARIABLE FELSIC TO MAFIC RATIO (DENSITY OF PATTERNING APPROXIMATELY REPRESENTS MAFIC MINERAL PERCENTAGE). MAY CONTAIN ONE OR MORE OF THE MINERALS SILLIMANITE, SPHENE, ZIRCON, CORDIERITE, AND GARNET. UP TO 2% DARK OPAQUE MINERALS (ALL THESE MINERALS LISTED IN DESCRIPTIONS OF INDIVIDUAL 10-FOOT CHIP SAMPLES). BIOTITE-RICH INTERVALS COMMONLY WELL-FOLIATED AND MAY ACTUALLY BE SCHISTS. BIOTITE VARIES FROM 5 TO 50%; HORNBLENDE FROM 0 TO 25%. PROBABLY CORRELATES WITH "BANDED GNEISS" (p€bg) MAPPED AT THE SURFACE (NIELSON ET AL., 1978).
▨	*With biotite & hornblende*	
▨	*With biotite & garnet (generally w/sillimanite)*	
▨	*With biotite*	
	* *(density of patterning reflects mafic mineral %)*	
▨	INFERRED MINOR FAULT	

"ABBREVIATIONS"

AB., ABUND	ABUNDANT
ABT. ~	ABOUT
ALT.	ALTERED
ALTN.	ALTERATION
ARG.	ARGILLIZATION
AVG.	AVERAGE
Bn	BORNITE
BRN.	BROWN
BTE.	BIOTITE
Ⓒ	CORDIERITE PRESENT
CHL.	CHLORITE
CHLTZN.	CHLORITIZATION
CONT.	CONTAMINATION
CORD.	CORDIERITE
CPY	CHALCOPYRITE
CRS.	COARSE (-CRYSTALLINE)
DIA.	DIAMETER
DISS.	DISSEMINATED
EXC.	EXCEPT
F.	FINE (-CRYSTALLINE)
FLT.	FAULT
FRAG.	FRAGMENT
FSP.	FELDSPAR
Ⓖ	GARNET PRESENT
GNT.	GARNET
GR.	GRANITE
HEM.	HEMATITE
HBL.	HORNBLENDE
K-SPAR	POTASSIUM FELDSPAR
LEUC.	LEUCOCRATIC
LEUCOX.	LEUCOXENE

LT.	LIGHT
M. MED	MEDIUM (-CRYSTALLINE)
MM.	MILLIMETER
MAG.	MAGNETITE
MINRLZN.	MINERALIZATION
μVNLT.	MICROVEINLET
MINRLZD.	MINERALIZED
MOD.	MODERATE
MUSC.	MUSCOVITE.
PERL.	PERLITE
PLAG.	PLAGIOCLASE
PPY.	PORPHYRY
PY	PYRITE
PUM.	PUMICE
Qal	QUATERNARY ALLUVIUM
QTZ.	QUARTZ
QTZ. MONZ.	QUARTZ MONZONITE
RHY.	RHYOLITE
Ⓢ	SILLIMANITE PRESENT
SER.	SERICITE
SERCTZN.	SERICITIZATION
SILL.	SILLIMANITE
Tr.	TRACE
TL.	TOTAL
V.	VERY
W/	WITH
VNLT.	VEINLET
WKLY.	WEAKLY
XL.	CRYSTAL
XLN.	CRYSTALLINE

f	ALTERATION MINERAL REPLACES PLAGIOCLASE & ORTHOCLASE
g	ALTERATION MINERAL REPLACES FAULT GOUGE
h	ALTERATION MINERAL REPLACES HORNBLENDE.
v	ALTERATION MINERAL OCCURS AS A CONSTITUENT OF VEINLETS & MICROVEINLETS
⧄	HOST MINERAL WHICH ALTERATION MINERAL REPLACES DOES NOT OCCUR IN SAMPLE.
①	WEAK ALTERATION
②	MODERATE ALTERATION
③	STRONG ALTERATION

TOTAL DEPTH 7500'
(7478' BELOW GROUND LEVEL)

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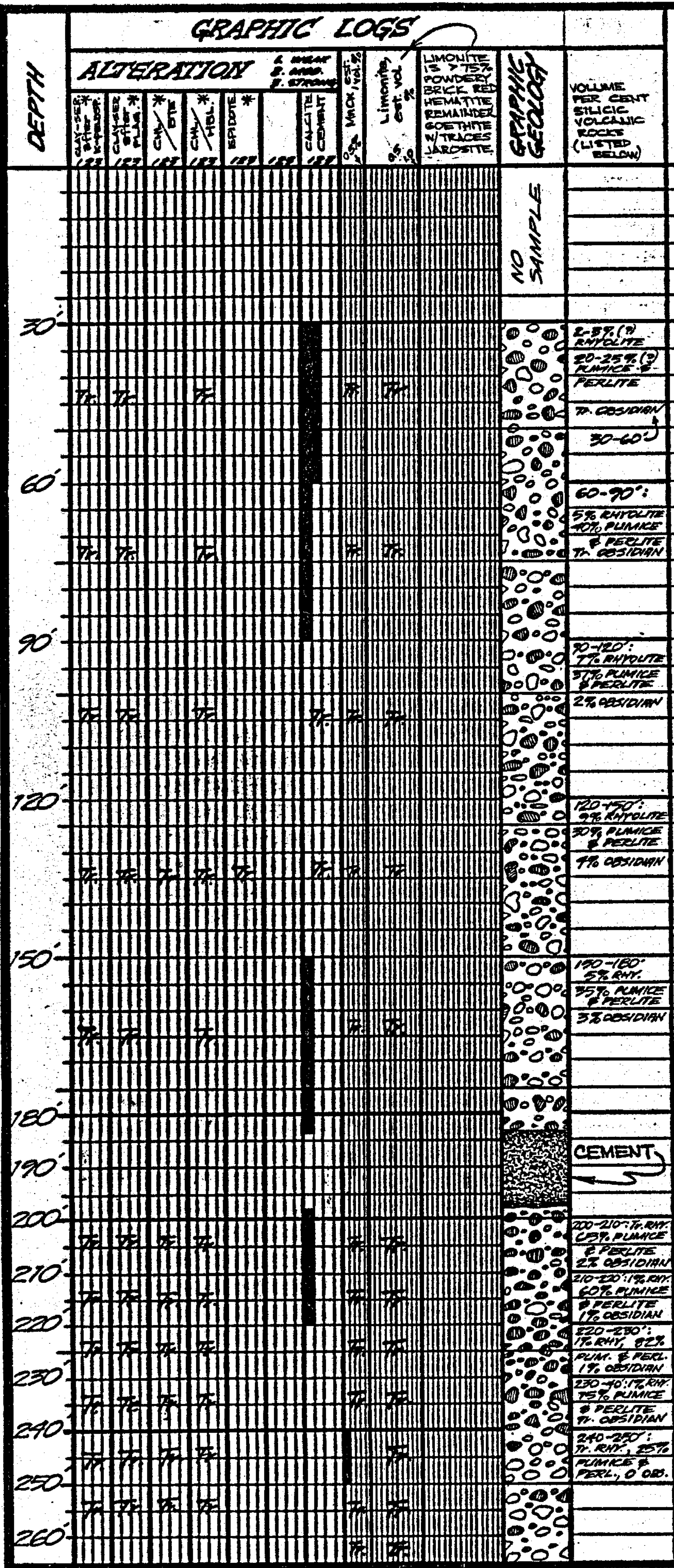
PAGE 1.



DESCRIPTIONS

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0-30' NO SAMPLE

30-180': ALLUVIUM. SUBANGULAR TO SUBROUNDED GRAINS UP TO 15 mm. IN DIA. (AVG. ~ 2-3 mm.) CONSISTING OF BTE. QTZ. MONZ., BTE. GRANITE, BTE.-HBL. QTZ. MONZONITE GNEISS, FINE-XLINE. QTZ-FSP-BTE. GNEISS W/ "SALT-AND-PEPPER" APPEARANCE, AND ABUNDANT PUMICE & PERLITE W/ MINOR OBSIDIAN.

PUMICE, PERLITE, AND OBSIDIAN ARE UNALTERED. FSPS. IN OTHER GRAINS (& INDIVIDUAL FSP. GRAINS & FRAGS) ARE SOMEWHAT CLOUDY, PROBABLY DUE TO INCLUDED TRACES OF CLAY & SERICITE. BTE. GEN. FRESH, BUT LOCALLY W/ TRACES CHLORITE. HBL. PARTIALLY CHLORITIZED. SPHENE FRESH TO V. WKLY. ALT. TO LEUCOXENE. Tr.-MOD. CALCITE CEMENT, BUFF, CRYPTOCRYSTALLINE. ALTERATION (EXC. FOR CALCITE CEMENT) PREDATES ALLUVIAL DEPOSITION (COEXISTING FRESH GLASS & ALTERED FSP. IN OTHER ROCK TYPES)

Trace limonite (dominantly hematite) stain & dendritic MnOx throughout interval

180-200': 35% ALLUVIUM, SAME AS 30-180'. 65% CEMENT LT. GRAY SPECKLED W/ WHITE—"SPECKLES" ARE PUMICE AND PERLITE ADDITIVE. A FEW CHIPS LITHIC-RICH WELDED ASH-FLOW TUFF, LT. PINKISH-BROWN WHICH MAY BE DERIVED FROM RHYOLITIC CENTERS IN THE MINERAL RANGE TO THE EAST.

200-240': ALLUVIUM, SAME AS 30-180'. BASE OF ABUNDANT GLASSY COMPONENT AT 240'

240-265': ALLUVIUM, SAME AS 30-180', EXC. LITTLE OR NO GLASSY COMPONENT.

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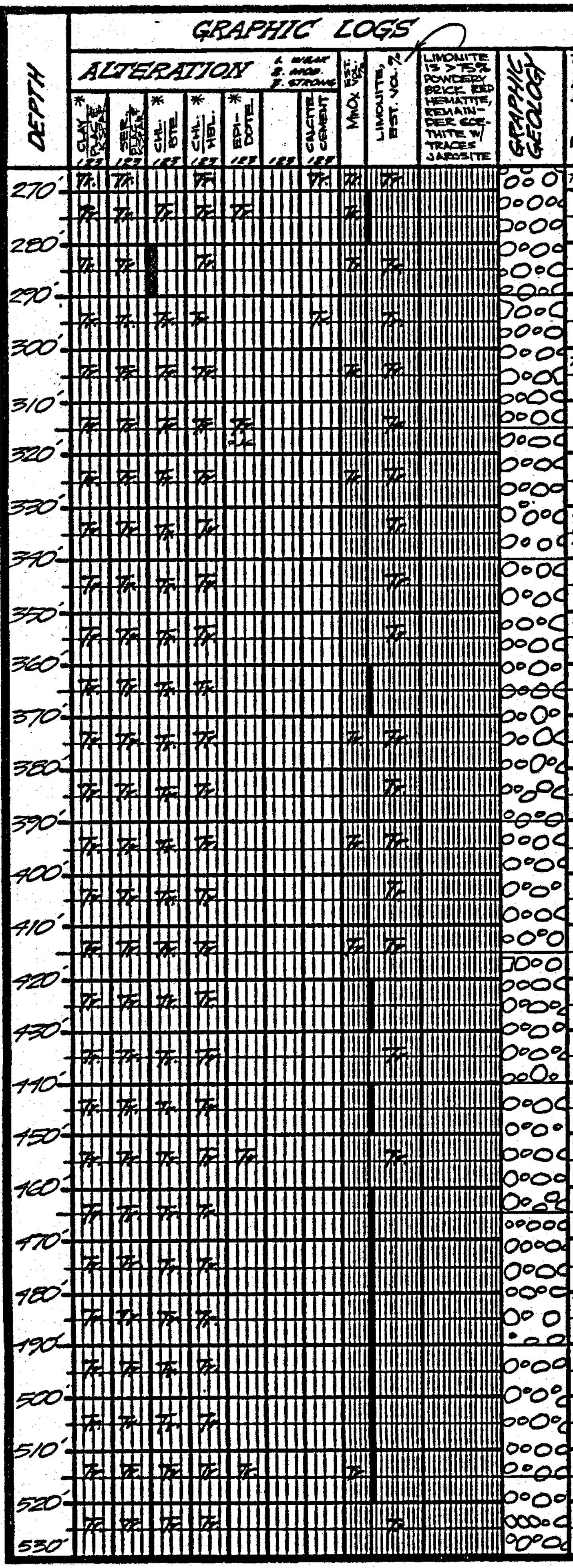
ROOSEVELT HOT SPRINGS KGRA

* PREDATES ALLUVIAL DEPOSITION

NOTE: DEPTHS SHOWN ARE BELOW KELLY BUSHING, 22 FEET ABOVE GROUND LEVEL.



DESCRIPTIONS

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Tr. TRACE 1. WEAK 2. MOD. 3. STRONG * VEINLETS	
Tr. QTZ-GOETH *	265-270': Φal (ALLUVIUM), SAME AS 240-265 (NO GLASSY COMPONENT)
	270-280': Φal, AS ABOVE. A FEW DISS. POROUS EARTHY GOETH. CLOTS IN SCATTERED GRAINS.
	280-290': Φal, AS ABOVE. 2 CHIPS CHL. SCHIST. (CHL./BTE?) Tr. HEMATITE (EARTHY) AS IRREG. FILMS ON A FEW GRAINS. Tr. DISS. GOETH. IN SCATTERED GRAINS, SAME AS 270-280'
Tr. CHL. *	300-310': Φal, SAME AS ABOVE, EXC. 2 CHIPS ANDESITE
	310-320': Φal, SAME AS 280-290', EXC. NO DISS. LIMONITE. ALL OCCURS AS FILMS ON SCATTERED GRAINS
	320-330': Φal, SAME AS 270-280'
Tr. POWDERY BRICK-RED HEMATITE *	330-340': Φal, also including minor hbl. gneiss, bte. qtz. monz., bte. granite BY BTE. GNEISS & ITS XL CONSTITUENTS, ESSENTIALLY UNALTERED. TR. DISS. EARTHY BRICK-RED HEMATITE IN A FEW GRAINS. Tr FILMS OF GOETH. & HEM. ON SCATTERED GRAINS
	340-350': Φal, SAME AS 330-340'
SAME AS *, 330-340'	350-360: Φal, SAME AS 330-340
	360-370': Φal, SAME AS 330-340, EXC. SL. INCREASE IN HEMATITE
	370-380': Φal, SAME AS 330-340, EXC <1% FINE-XLINE BTE. SCHIST.
	380-390': Φal, SAME AS 330-340'
	390-400': Φal, SAME AS 330-340'
	400-410': Φal, SAME AS 330-340', EXC. ONE FRAG. QTZ-CLAY-SER. ROCK W/ MINOR DISS. GOETH.
	410-420': Φal, SAME AS 330-340'.
	420-430': Φal, SAME AS 330-340', EXC. SL. INCREASE IN LIMONITE — PARTICULARLY HEMATITE.
	430-440: Φal, SAME AS 430-340'
	440-450': Φal, SAME AS 430-440', EXC INCREASE AGAIN IN DISS. & STAIN HEMATITE
ONE 3 mm. DIA. EPI-* DOTE CHUNK	450-460': Φal, SAME AS 330-340', EXC 2 FRAGS. ANDESITE PPY.
	460-470': Φal, SAME AS 330-340', EXC. FINE-XLINE BTE GRANITE FORMS LARGER COMPONENT. INCREASE IN DISS. & FILMY LIMONITE (>90% POWDERY BRICK RED HEM., REMAINDER GOETHITE.
	470-480': Φal, SAME AS 460-470'
Tr. POWDERY BRICK RED HEMATITE *	480-490': SAME AS 460-470', EXC. SOME CAVING— UP TO 3% PORPHYRITIC TUFF, SAME AS 180-200', AND Tr. ASH-FLOW TUFF FROM SAME INTERVAL. A FEW FRAGS STRONGLY CLAY-SERICITIZED.
	490-500': SAME AS 480-490'
	500-510': SAME AS 460-470'
Tr. YELLOWISH-GRAY CLAY * IN ONE FRAGMENT	510-520': SAME AS 460-470'
	520-530': SAME AS 460-470', EXC. LESS HEM.

* PREDATES ALLUVIAL DEPOSITION

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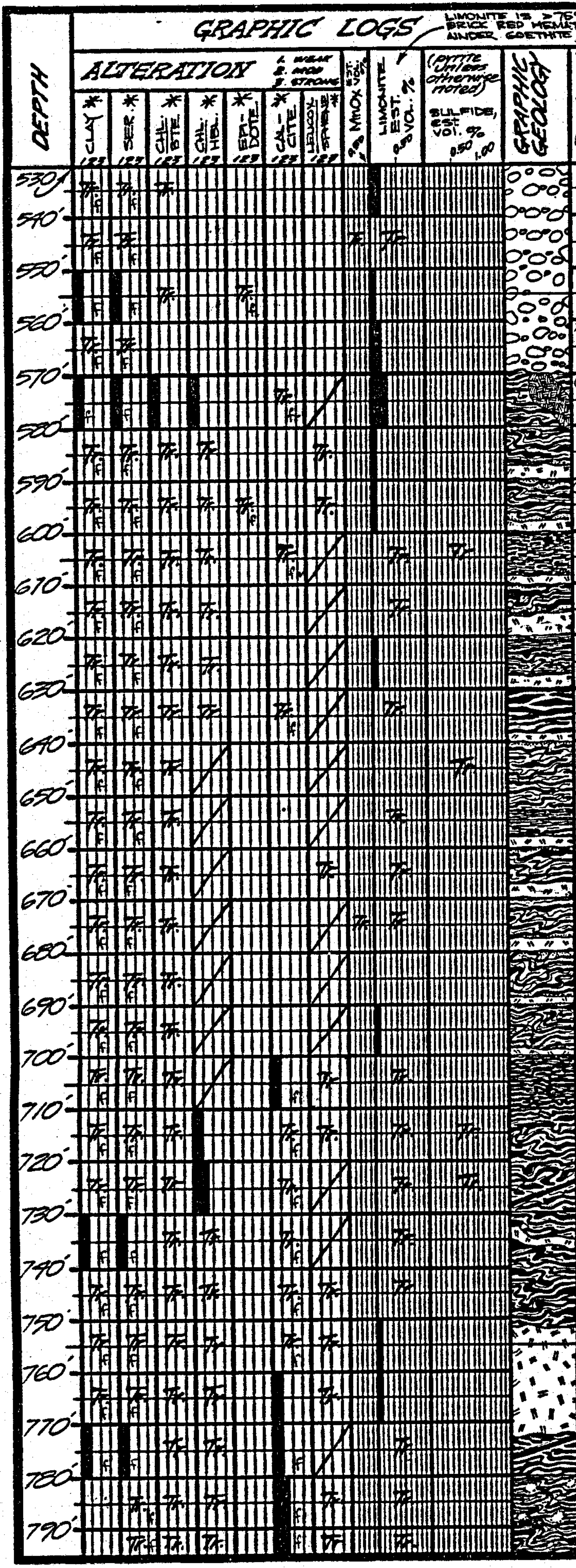
ROOSEVELT HOT SPRINGS KGRA



DESCRIPTIONS

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Tr. TRACE 1. WEAK 2. MOD. 3. STRONG * VEINLETS	DESCRIPTIONS
	530-540': Φ81, MOSTLY BTE. GNEISS & BTE. GRANITE, FINE-MED.-XLINE. 0.2% EARTHY REDDISH HEM. AS POROUS IRREG. DISS. GRAINS < 1mm. IN SOME FRAGS. ALSO AS STAIN ON SOME GRAINS
Tr. MnOx	540-550': Φ81, SAME AS 530-540', EXC. LESS POWDERY REDDISH HEM.
	550-560': Φ81, SAME AS 530-540'
Tr. EARTHY BRICK RED & MAROON HEMATITE	560-570': Φ81, SAME AS ABOVE.
	ALSO 5-7% MED. XLINE ⊛. LEUCOCRATIC GRANITE
① EARTHY BRICK RED HEMATITE	570-580': BEDROCK: 65% OF SMPL. IS FSP.-QTZ-BTE GNEISS (± HBL.), FINE-MED. XLINE W/ "SALT & PEPPER" APPEARANCE. 35% IS MICRODIORITE. RX. ARE PTL. ALTERED (CHL./MAFICS, CLAY-SER/FSP). — ALL FRAGS. HEM. STAINED
Tr. ″	580-590': FSP.-QTZ.-BTE GNEISS, SAME AS 570-580' W/ 20-25% LEUCOCRATIC F-M. XLN. BTE. GRANITE. Tr. MICRODIORITE.
① ″	590-600': GNEISS, SAME AS 570-580' – 80% 20% GRANITE (?), MED. XLINE. LEUC. ⊛
	Tr. SILLIMANITE
PYRITE (< 0.2 mm. WIDE ON ONE FRAGMENT	also calcite-pyrite veinlet < 0.1mm. wide ⑮ 600-610': GNEISS, QTZ-FSP-BTE-HBL. W/MINOR SPHENE (35-37% HBL.!) & 15% MED. XLINE LEUC. BTE. GRANITE ⊛ ⑤
Tr. EARTHY BRICK RED HEMATITE	610-620': 30-35% GRANITE, AS ABOVE ⊛ REMAINDER F-MED. XLINE FSP.-QTZ-BTE. GNEISS W/MINOR HBL.
Tr. ″ &	620-630': 25% OF SMPL. FINE-XLINE BTE. SCHIST. 50-55% FSP-QTZ.-BTE GNEISS, SAME AS 610-620'
Tr. CLAY-HEM. (HEM [illegible])	Tr. SILLIMANITE. REMAINDER → 20-25% FINE-XLINE BTE. GR⊛ also poss. Tr. cordierite. ⑤
Tr. EARTHY BRICK-RED HEMATITE	630-640': GNEISS, SAME AS 570-580' W/15-20% GRANITE, SAME AS ABOVE ⊛ ⑤
Tr. ″	640-650': GNEISS, SAME AS 570-580' W/7-10% GRANITE ⊛
	650-660': 75% OF SMPL. SAME AS 640-650' — REMAINING 25% MED.-CRS.-XLINE BTE. SCHIST W/7 90% BTE 15-20% GRANITE ⊛
	660-670': FSP.-QTZ.-BTE GNEISS, SAME AS 640-650' W/25-30% GRANITE ⊛
	670-80': FSP.-QTZ.-BTE GNEISS, AS ABOVE, W/20-25% GRANITE ⊛ Tr. SILLIMANITE, CORDIERITE ⑤
Tr. GOETHITE	680-90': GNEISS, AS ABOVE, W/10-15% GRANITE ⊛
① EARTHY RED HEM. (± GOETH.)	690-700': GNEISS, AS ABOVE, W/10% GRANITE
Tr. HEM.—CALCITE IN BTE. SCHIST.	700-710': FINE XLINE BTE GNEISS, V. DK. GRAY, POORLY FOLIATED 90% + BTE. INCR. IN DISS. SPHENE. SOME FRAGS HAVE SPOTTED APPEARANCE — SPOTS LT. W/SPHENE CENTERS. A FEW CALC. & CALC.-HEM. VNLTS. < 0.1 mm. WIDE
	710-720': 20% OF SMPL. SAME AS ABOVE. REMAINDER FSP.-QTZ.-BTE GNEISS SAME AS 570-580' W/MINOR HBL. ONE GRAIN DISS. PY. — 5-7% GRANITE ⊛ Tr. SILL, CORD. Tr. DISS. PY ⑤
MINOR FLT.? MINOR HBL.	720-730': FSP.-QTZ.-BTE GNEISS, SAME AS 570-580'. Tr. HBL., WKLY. CHLORITIZED. FEW CHIPS SPECKLED WHITE & GRN. CATACLASITE — SEMI-LITHIFIED ROCK FLOUR (SMALL FLT?) ALSO 5-7% GRANITE ⊛ Tr. DISS. PY
① EARTHY REDDISH-BROWN HEMATITE	730-740': SAME AS ABOVE, EXC. 10% OF SMPL. IS MED. XLINE GRANITE ⊛ MAYBE 15%! GNEISS CARRIES 7-9% HORNBLENDE. Tr. SILL. Tr. CORD. ⑤
Tr. ″	740-750': FSP.-QTZ.-BTE GNEISS, FINE-XLINE., SAME AS 570-580' — 2-3% DISS. HONEY-COLORED SPHENE. 5-7% GRANITE. ⑤
① ″	750-760': 20% OF SAMPLE SAME AS ABOVE. 80% IS FINE-XLINE BTE. GRANITE W/7-10% BTE, Tr. HBL. A FEW EARTHY RED HEM. MICROVNLTS. HEM. ALSO OCCURS AS STAIN, ESP. AROUND MAFIC MINRLS.
① ″	760-770': ALL GRANITE, SAME AS ABOVE, W/7-10% GNEISS, ALSO AS ABOVE.
MINOR FLT.? Tr. ″	770-780': 10-15% GRANITE, AS ABOVE, REMAINDER FSP.-QTZ.-BTE GNEISS, SAME AS 570-580'. Tr. SILL., Tr. CORD(?) ? ⑤?
ALSO 5-7% HBL.	780-790: FSP.-QTZ.-BTE GNEISS, FINE-XLINE, W/5% SPHENE, AROUND WHICH PLAG. HAS GROWN, FORMING "SPOTS" UP TO 2 MM. IN DIA. ALSO 5-7% MED. XLINE BTE.-HBL. QTZ.-MONZ. GNEISS
	790-800': SAME AS ABOVE WITH 7-10% GRANITE ⊛

* PREDATES ALLUVIAL DEPOSITION → ALSO: LEUCOXENE ALTN. OF SPHENE RECORDED ONLY IN BEDROCK

⊛ COULD BE MIGMATITE.

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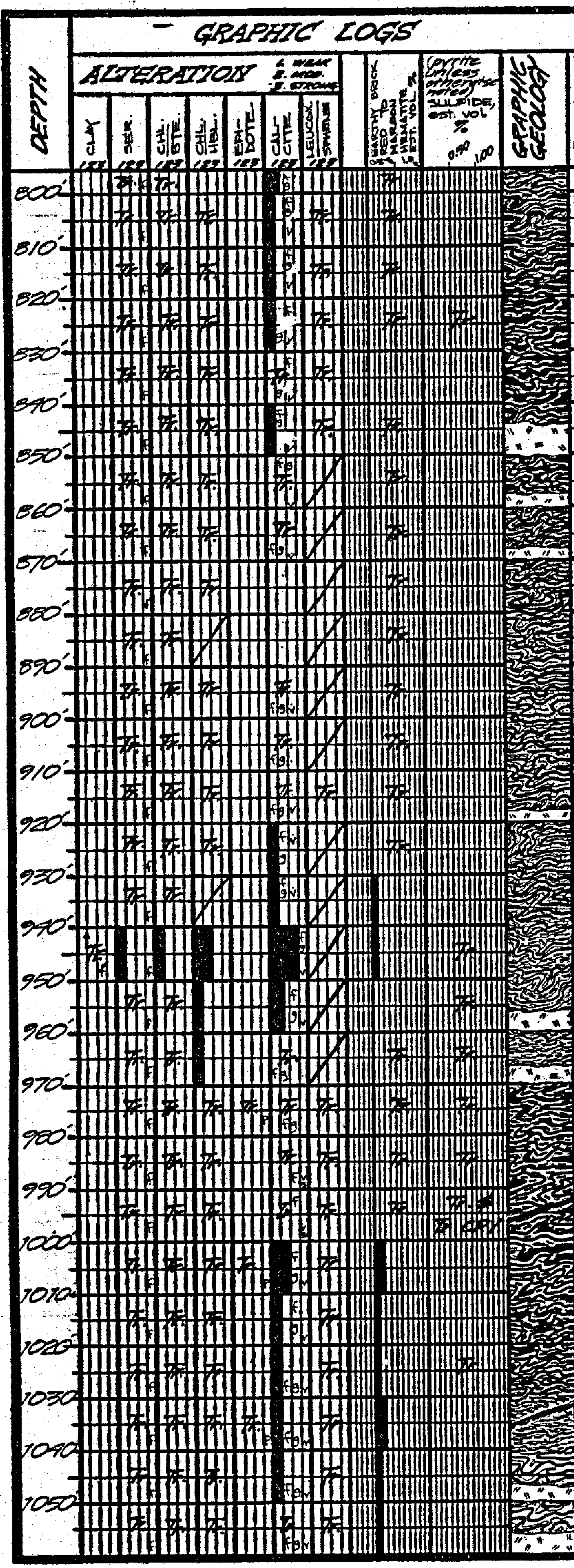

DESCRIPTIONS

LOGGED BY J.B. HULEN
JULY 1978

Tr. TRACE
1. WEAK
2. MOD.
3. STRONG

VEINLETS	
Tr. CALCITE Tr. HEM.	800-810: FSP.-QTZ.-BTE. GNEISS, FINE-MED. XLINE. CHIPS VARY GREATLY W/RESPECT TO BTE. CONTENT.
Tr. EARTHY RED HEM.	(<10->75%) MOST BTE. IN SMPL. IS MED.-XLINE.
Tr. HEM-CALCITE	810-820': SAME AS ABOVE. BULK OF SMPL. MED.-XLINE.
Tr. CALCITE	W/MINOR HBL.
Tr. CALCITE	820-830': FSP-QTZ-BTE. GNEISS, FINE-XLINE, "SALT & PEPPER" APPEARANCE, CRUDELY FOLIATED. HEM-CAL-
Tr. HEM.-CALCITE	CITE VNLTS. ARE PINK TO EARTHY-RED. 2-3% MED. XLN. GRNT. Ⓖ Tr. ROUNDED PINK < 0.5 mm. DIA.
Tr. CALCITE	830-840': SAME AS ABOVE. NO ZIRCON W/7-10% MED.-XLINE LEUC. BTE. GRANITE.
Tr. CALCITE	840-850': 65% GRANITE REMAINDER FSP-QTZ-BTE. GNEISS } AS ABOVE.
"	850-860': SAME AS 800-810' W/ 25-30% MED-XLINE LEUCOCRATIC BTE. GRANITE.
	TR. PINKISH-ORANGE GARNET ? Ⓖ
" &	860-870': FSP.-QTZ.-BTE. GNEISS, FINE-XLINE, "SALT & PEPPER" APPEARANCE. TRACE
Tr. HEM.-CALCITE	TRANSPARENT PINKISH-ORANGE GARNET → < 0.5 mm. DIA., SUBHEDRAL. 10-15% MED.-XLINE. LEUC. BTE GRANITE ⒼⓈ
Tr. HEM.	870-880': SAME AS ABOVE W/5-10% GRANITE.
	ⒼⓈⒸ?
Tr. HEM.	880-890': SAME AS ABOVE W/7-10% GRANITE
	ⒼⓈ
Tr. CALCITE-HEMATITE	890-900': SAME AS ABOVE W/5% GRANITE
	ⒼⓈ
	900-910: " W/5-7% GRANITE
	1% GARNET ⒼⓈ
Tr. CALCITE-HEMATITE	910-920': SAME AS ABOVE. 15-20% GRANITE
	ⒼⓈⒸ
"	920-930': SAME AS ABOVE. CONTAMINATED W/ CEMENT SAME AS 180-200' (2%) 7-10% GRANITE
	ⒼⓈ
"	930-940: SAME AS ABOVE. " (1%) 7-10% GRANITE
	ⓈⒼ
① HEM-CALCITE ① CALCITE	940-950': QTZ-FSP.-HBL.-BTE GNEISS, FINE-MED. XLINE. 50% TOTAL MAFICS. MOST ALTERED INTERVAL
	TO DATE, BUT STILL QUITE FRESH. HEM.-CALC. VNLT. UP TO 0.5 mm. WIDE. MOST ARE ∥ VNLTS.
① CALCITE	950-960': SAME AS ABOVE W/30-40% MED-XLINE
	LEUC. BTE. GRANITE
	960-970: SAME AS ABOVE W/ 25-30% GRANITE
	970-980': GNEISS, SAME AS 860-870' Tr. DISS. EPIDOTE IN PLAGIOCLASE OF
	3% SPHENE! ONE CHIP. ALSO CONTAMINATED W/ Tr. 180-200' (7% OF CHIPS). 1% GRANITE.
Tr. HEM.-CALCITE	980-990': SAME AS ABOVE.
	5-7% SPHENE. Tr. GRANITE
"	990-1000: SAME AS ABOVE, EXC. ABUNDANT (7%) CATACLASITE CHIPS, MANY SLICKENSIDED.
MINOR FAULT	3% SPHENE 1-3% GRANITE.
② CALCITE-HEMATITE	1000-1010: SAME AS 940-950', CALCITIC ALTERATION & CALCITE-HEM. VNLTS.
① CALCITE	INCREASE
"	1010-1020': SAME AS ABOVE.
"	1020-1030': SAME AS ABOVE 1-3% MED. XLINE LEUC. BTE. GRANITE
MINOR FLT. "	1030-1040': SAME AS ABOVE, EXC. INCREASE IN HBL. & IN CATACLASITE CHIPS. SOME OF THESE ALTERED
	TO CHL. W/MINOR SPEC. HEM.
"	1040-1050': QTZ-FSP-BTE GNEISS, SAME AS 860-870'. W/20-25% MED. XLINE GRANITE
	(LEUCOCRATIC, <0.5% BTE. 1-3% CEMENT CONTAMINATION
" &	1050-1060': SAME AS ABOVE, EXC. 7% PORPHYRITIC TUFF CHIPS, SAME AS 180-200'.
Tr. CALCITE-GOETH-HEM.	W/35-40% MED.-XLINE LEUCOCRATIC BTE. GRANITE

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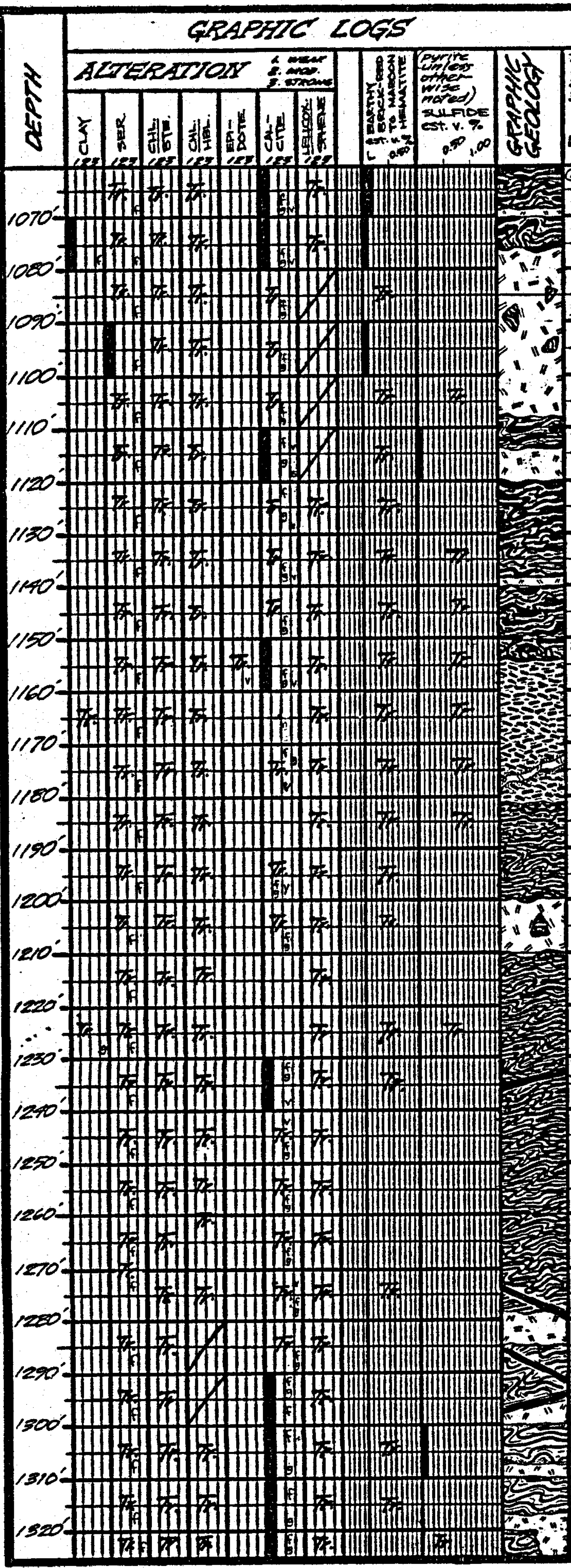
NOTE: MUCH OF THE GRANITE COULD BE FELSIC MIGMATITIC DIFFERENTIATE.



DESCRIPTIONS

LOGGED BY J. HULEN
JULY 1978

Tr. TRACE 1. WEAK 2. MOD. 3. STRONG VEINLETS	DESCRIPTIONS
① CALCITE-HEMATITE	1060-70': QTZ-FSP.-BTE GNEISS, MAFIC-RICH, FINE-XLINE. CUT BY FINE-BRICK RED CALCITE-HEM. VNLTS. UP TO 1.5 MM. WIDE. SPHENE UNALTERED. MINOR HBL. 7-10% MED.-XLN. GRANITE. FOLIATION CRUDELY DEVELOPED.
"	1070-80: SAME AS ABOVE, W/20% OF SMPL. FINE-XLINE. LEUCOCRATIC BTE. GRANITE, AS BELOW
	1080-90': LEUCOCRATIC BTE. GRANITE, FINE-XLINE 1.5% BTE 1% MAGNETITE, WKLY. HEMATITE STAINED. 10% OF CHIPS ARE QTZ-FSP. BTE. GNEISS
	1090-1100': SAME AS ABOVE.
	1100-1110': 75% OF CHIPS SAME AS ABOVE; 25% QTZ-FSP.-BTE GNEISS, SAME AS 1060-1070'; TR. DISS. PYRITE
Tr. HEM.-CALCITE	1110-20': SAME AS ABOVE W/60% GRANITE, STRONGER CALCITE ALTN.
Tr. "	1120-30': QTZ-FSP.-HBL.-BTE. GNEISS, FINE-MED XLINE., W/40-45% TOTAL MAFICS, 5-10% HBL., V. UNALTERED EXC. FOR CALCITE-HEM. VNLTS. 1-3% GRANITE, AS ABOVE
Tr. HEM.-CALCITE	1130-1140': SAME AS ABOVE W/7-10% GRANITE
	1140-50': SAME AS ABOVE, EXC. Tr. DISS. PY. IN PLAG.
Tr. HEM.-CALCITE Tr. EPIDOTE	1150-60': SAME AS ABOVE 30-40%, + 60-70% MED.-XLINE BTE.-HBL. QTZ. MONZ. GNEISS W/ 20-25% HBL, 5-10% BTE., 2-3% SPHENE.
Tr. CLAY-HEM.	1160-70': SAME AS ABOVE { 10% F. XLN. FSP-QTZ-HBL-BTE. GNEISS. 5% MED. XLN. LEUC. GRANITE. REMAINDER M. XLN. BTE. HBL. QTZ. MONZ. GNEISS
Tr. HEM. CALCITE	1170-80': SAME AS ABOVE { 10% GRANITE. 5% FSP-QTZ-HBL-BTE. GNEISS REMAINDER QTZ MONZ GNEISS
	1180-1190': QTZ-FSP-HBL-BTE. GNEISS, FINE-XLINE W/ ~ 45% BTE. FOLIATION CRUDELY DEVELOPED. Tr. DISS. PY. IN PLAG. ALSO ~ 10% MED-XLN FSP-QTZ-HBL-BTE. GNEISS
① HEM-CALCITE W/ Tr. GOETH.	1190-1200': SAME AS ABOVE W/ ~ 5% GRANITE.
	1200-1210': 90% OF CHIPS FINE-XLINE BTE GRANITE, SAME AS 1080-1090'. REMAINDER QTZ.-FSP.-BTE. GNEISS, SAME AS 1180-1190'.
	1210-1220': QTZ-FSP-HBL-BTE. GNEISS, FINE-XLINE, DK. BROWNISH-GRAY W/40% BTE., MINOR HBL (7-9%) SPHENE UNALTERED. 5-7% GRANITE, AS ABOVE.
	1220-1230': SAME AS ABOVE PYRITE DISS. IN ARGILLIZED CATACLASITE (GOUGE)
MINOR FLT. Tr. HEM-CALCITE	1230-1240': SAME AS ABOVE
"	1240-1250': SAME AS ABOVE W/5-7% MED.-XLINE LEUCOCRATIC BTE. GRANITE.
	1250-1260': SAME AS ABOVE TR. CEMENT, SAME AS 180-200'
	1260-1270': SAME AS ABOVE. 2-3% GRANITE
Tr. HEM-CALCITE MINOR FLT.	1270-1280' SAME AS ABOVE FOR 50% OF CHIPS. QTZ.-FSP.-BTE. GNEISS W/ ONLY 25% BTE., OTHERWISE SAME AS ABOVE SPHENE UNALTERED. 15% MED.-XLN. LEUC. GR.
	1280-1290': SAME AS ABOVE (QTZ-FSP.-BTE GNEISS, FINE-XLINE W/25% BTE. 5% GOUGE CHIPS, WHITE SPECKLED W/GREEN (CHL.) PROBABLE MINOR FAULT 50% GRANITE, AS ABOVE.
MINOR FLT.	1290-1300': SAME AS ABOVE W/30-55% MED.-XLINE LEUC. BTE. GRANITE. SILLIMANITE APPEARS FIBROLITE → (S)
	1300-1310': SAME AS ABOVE W/ 25-30% GRANITE. (S)(C)?
	1310-1320: SAME AS ABOVE. W/ 30-35% GRANITE. (S)(C)?
	1320-1330': SAME AS ABOVE, EXC. INCREASE IN MAFICS TO 30%. 40-45% GRANITE (S)(C)

NOTE: MUCH OF THE GRANITE COULD BE FELSIC MIGMATITIC DIFFERENTIATE.

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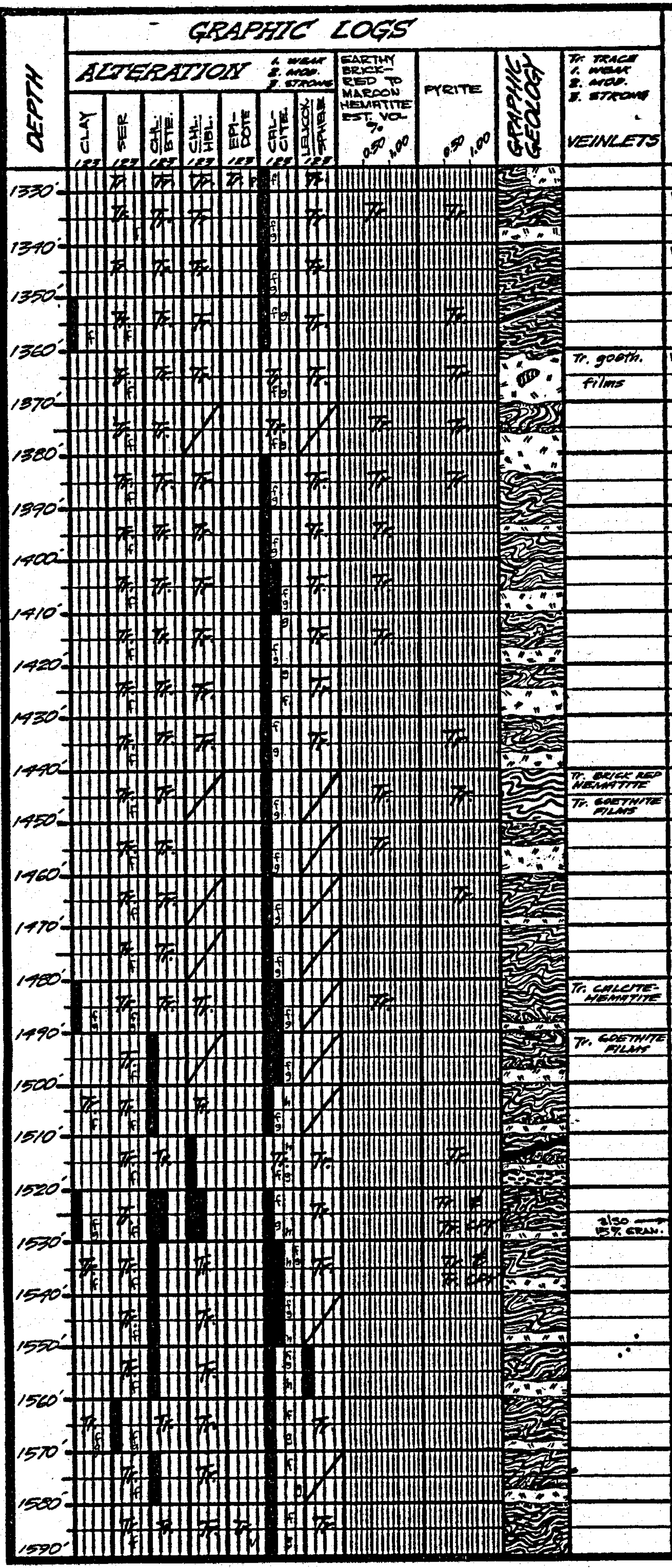

DESCRIPTIONS

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1330-40': 20-25% MED.-XLINE. LEUCOCRATIC BTE. GRANITE, REMAINDER F-M. XLINE FSP.-QTZ.-BTE. GNEISS W/ MINOR HBL., TR. SPHENE — CRUDELY FOLIATED Tr. ⑤

1340-50': MAFIC-RICH FINE-XLINE FSP-QTZ-HBL.-BTE. GNEISS W/ABUNDANT SPHENE ~50% TL. MAFICS. 2-3% GRANITE.

1350-60': SAME AS ABOVE.

1360-1370': 10% OF SMPL. IS FINE-XLINE. FSP-QTZ-BTE. SCHIST OR GNEISS, . 90% IS MED.-XLINE LEUCOGRANITE W/ < 2-5% BTE. THIS MAY BE SIMPLY A QUARTZOFELDSPATHIC DIFFERENTIATE OF THE GNEISS ⑥ ⑤

1370-80': SAME AS ABOVE, EXC. 40-45% SMPL. IS LEUCOGRANITE. ? Ⓒ⑤

1380-90': ", EXC. ~30-35% IS LEUCOGRANITE.

1390-1400': 15% LEUCOGRANITE, 5% FINE-XLINE MED. GRAYISH-BROWN QTZ-FSP.-BTE. GNEISS, FOLIATION CRUDE TO MOD. WELL-DEVELOPED ? Ⓒ?⑥?

1400-1410': SAME AS ABOVE W/40-45% GRANITE

1410-20': SAME AS ABOVE. W/30-35% GRANITE ALSO 5% CEMENT SAME AS 180-200'. (CAVING) ⑤

1420-30': SAME AS ABOVE 50-60% (??) MED-XLINE LEUC. GRANITE. REMAINDER FELSIC FINE-XLN. FSP-QTZ-BTE. GNEISS W/ONLY 12-15% TL. BTE. DIFF. OCC. TO TELL GNEISS FR. GRANITE.

1430-40': SAME AS ABOVE W/30-35% GRANITE (OR FELSIC MIGMATITIC DIFFERENTIATE). ⑤ Ⓒ?

1440-50': SAME AS ABOVE. XL. SIZE DIMINISHES — V.V. F.XLN. — NO HBL OR SPHENE ⑤

1450-60': SAME AS ABOVE. 55-60% MED.-XLN. LEUC. GRANITE. REMAINDER F.-MED. XLN FSP.-QTZ.-BTE GNEISS W/MINOR HBL.

1460-70': SAME AS ABOVE W/ 15% GRANITE ABUNDANT FIBROLITE. ⑤ Ⓒ

1470-1480': SAME AS ABOVE W/ 5-10% GRANITE SILL-QTZ-FSP.-BTE GNEISS SILLIMANITE XLS. IN BTE. COMMON Tr. MICRODIORITE ⑤ Ⓒ?

1480-90': SAME AS ABOVE; WK. ARG. OF SCATTERED PLAG. XLS. ~15% GRANITE, REMAINDER GNEISS. ⑤

1490-1500': SAME AS ABOVE 20-25% GRANITE REMAINDER FSP-QTZ-BTE. GNEISS

1500-1510': SAME AS ABOVE EXC. TR. HBL. ~20% GRANITE. ⑤

1510-20': 25-30% F-M. XLINE BTE. HBL. QTZ. MONZ. GNEISS W/20-30% HBL., 5-10 BTE. ~15% GRANITE. & REMAINDER F.-M. XLN. FSP.-QTZ.-BTE. GNEISS Tr. DISS. PY. " & CPY, WHICH IS TEXTURALLY SIMILAR

1520-1530': FSP-QTZ-BTE.-HBL. GNEISS, F-M. XLN V. DISTINCTIVE UNIT. & WK. ARG. OF SCATTERED PLAG. XLS. & HBL. PTLY. ALTERED TO ACTINOLITE

1530-1540': SAME EXC. 4% HBL. " 15-20% GRANITE.

1540-1550': " < 1% HBL. 15-20% GRANITE ABUNDANT FIBROLITE. ⑤

1550-60': " HBL. ~30% GRANITE. ABUND. FIBROLITE ⑤

1560-70': QTZ-FSP.-BTE GNEISS, FINE-XLINE, MED. BROWNISH-GRAY, "SALT-AND-PEPPER" APPEARANCE ABUNDANT FIBROLITE, MOSTLY / BTE. // ~15% GRANITE ⑤

1570-80': SAME AS ABOVE. ~25% GRANITE ⑤

1580-90': " F XLN. FSP-QTZ-HBL-BTE GNEISS W/MINOR SPHENE & SILLIMANITE >50% TL. MAFICS 1-3% GRANITE ⑤⑥

NOTE: MUCH OF THE GRANITE COULD BE FELSIC MIGMATITIC DIFFERENTIATE

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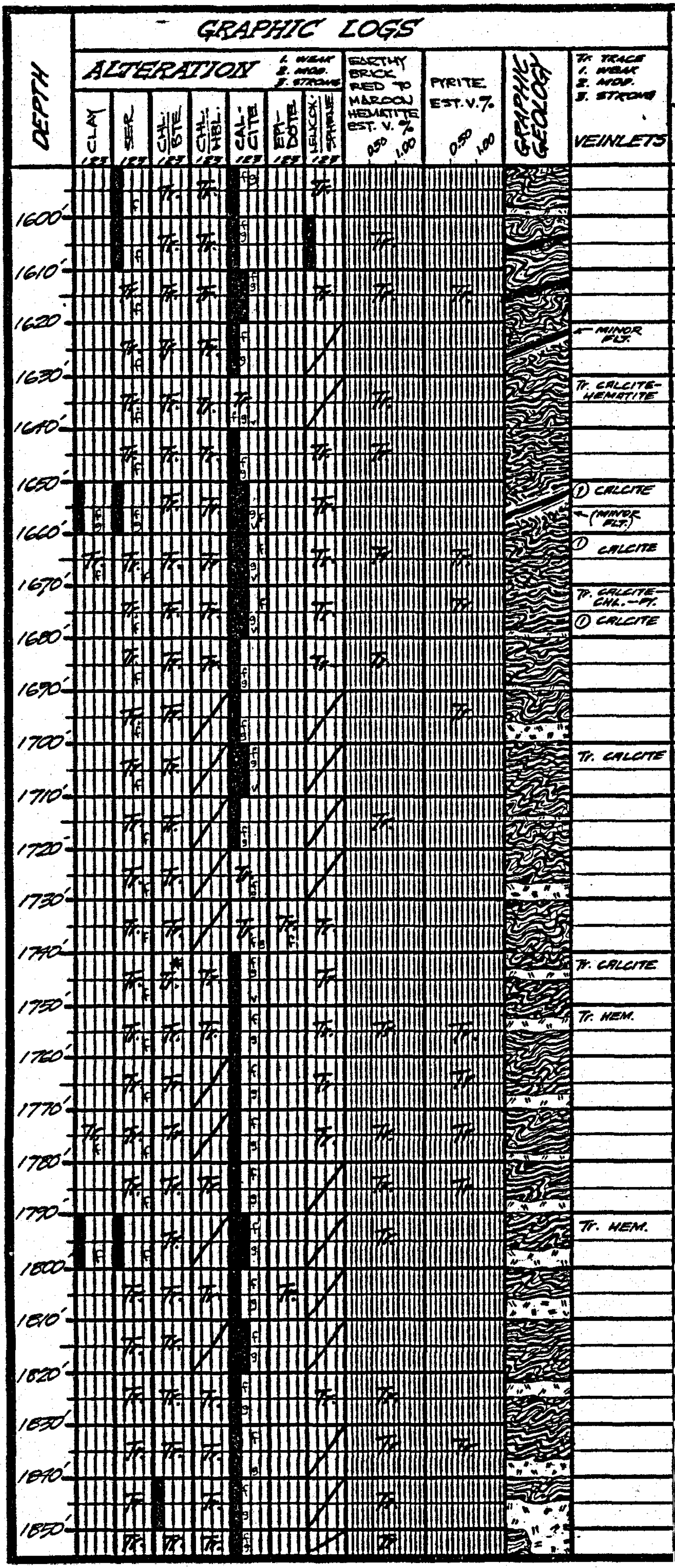

DESCRIPTIONS

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1590-1600': QTZ-FSP-BTE GNEISS, FINE-XLINE, MED. BROWNISH GRAY, "SALT & PEPPER" APPEARANCE IN CUTTINGS

CRUDELY- TO MODERATELY WELL-FOLIATED
~ 10% GRANITE, MED.-XLINE, LEUCOCRATIC

1600-1610': SAME AS ABOVE W/Tr. GRANITE.

also 7-10% GRANITE.

1610-20': " SL. INCREASE IN CALCITE
ABUNDANT FIBROLITE. ALTN. OF PLAG.

(also Tr. TRANSP. LT. RED GARNET <0.5 mm. DIA.) & Tr. CORDIERITE Tr. DISS. PY. ⓖⓢⓒ?

1620-30': " W/ ~ 12-15% GRANITE | ABUNDANT GOUGE CHIPS, MANY SLICKENSIDED — PROBABLE

Tr. GARNET ABUNDANT FIBROLITE MINOR FAULT ‖ Tr. MICRODIORITE ⓖⓢⓒ?

1630-40': " W/ 5-10% GRANITE. HBL. APPEARS (1%) | UNIT 13: MED-CRS. XLN.

Tr. GARNET. ABUNDANT (>20%) FIBROLITE ⓖⓢⓒ?

1640-50': F.M.-XLN FSP-QTZ-HBL.-BTE GNEISS, V. MAFIC (~50%) W/ ABUND. SPHENE. Tr. SILL., CORDIERITE IN FRAGS

W/VERY LITTLE HBL. Tr.→ⓢⓒ?

1650-1660': SAME AS ABOVE ABUNDANT GOUGE CHIPS, MANY SLICKENSIDED — PROBABLE

1-3% GRANITE MINOR FAULT.

1660-1670': SAME AS ABOVE W/5-10% GRANITE.

Tr. DISS. PY

1670-80': SAME AS ABOVE, HBL. DECREASING ~10% GRANITE

FIBROLITE REAPPEARS Tr. DISS. PY. ⓢ

1680-90': SAME AS ABOVE W/ ABOUT 10% GRANITE

Tr. GARNET, SAME AS 1610-20' ⓖⓢ

1690-1700': 60-65% F-M. XLINE FSP-QTZ-BTE GNEISS W/ ABUNDANT FIBROLITE, MINOR CORDIERITE,

Tr. GARNET. 30-35% MED.-XLN. LEUCOCRATIC BTE. GRANITE ⓖ?ⓢ

700-1710: SAME AS 1690-1700': F-MED. XLINE FSP-QTZ-BTE GNEISS W/ ABUNDANT FIBROLITE. 5-10% MED. XLINE LEUCOCRATIC GRANITE. ⓢⓒ?

1710-20': " W/ ~ 10% GRANITE AS ABOVE ABUNDANT FIBROLITE

ⓢⓒ?

1720-30': SAME AS ABOVE W/ 25-30% GRANITE
POSS. TR. CORDIERITE — ABUNDANT FIBROLITE.

ⓖⓢⓒ?

1730-1740': SAME AS ABOVE. W/7-10% GRANITE

ABUNDANT FIBROLITE, MINOR CORDIERITE ⓢⓒ?

1740-1750': SAME AS ABOVE W/ ~15% GRANITE

* also TR. CHL./PLAG. ⓢⓒ?

1750-60': SAME AS ABOVE W/20-25% GRANITE

ⓢⓒ?

1760-70': SAME AS ABOVE W/20-25% GRANITE

ⓢⓒ?

1770-80': " W/10-15% GRANITE

Tr. HBL. APPEARS
Tr. TRANSP. LIGHT RED GARNET <0.3 mm. DIA. ⓖⓢⓒ?

1780-90': " W/ 20-25% GRANITE

Tr. GARNET, AS ABOVE. ⓖⓢⓒ?

1790-1800': " W/30-35% GRANITE. W/ WK-MOD. CLAY-CALCITE-SER.

ALTN. OF FSPS. IN 10% OF THE CHIPS ACCOMPANIED BY TR. HEMATITE. ⓢ

1800-1810': SAME AS 1690-1700' W/ ~ 40% MED.-XLN. LEUCOCRATIC BTE. GRANITE

ⓢ

1810-20': SAME AS 1690-1700' W/ 30% GRANITE

FIBROLITE DECREASING ⓢ

1820-30': SAME AS 1690-1700' W/20-25% GRANITE

FIBROLITE CONTINUES TO DECREASE. ⓢ

1830-40': SAME AS 1690-1700' W/ 30-35% GRANITE
also 3-5% DK. GRAY DACITE PPY., V. DENSE
W/ ~ 15-20% PLAG. LATHS AVG. < 0.3 mm. LONG. ⓢ

1840-50': SAME AS 1690-1700', EXC. SILLIMANITE DECREASED

50-55% OF SMPL. IS MED. XLINE LEUCOCRATIC BTE. GRANITE. ⓢ

1850-60': SAME AS ABOVE, EXC. 65-70% GRANITE. Tr. ⓢ

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NOTE: MUCH OF THE GRANITE COULD BE FELSIC MIGMATITIC DIFFERENTIATE.

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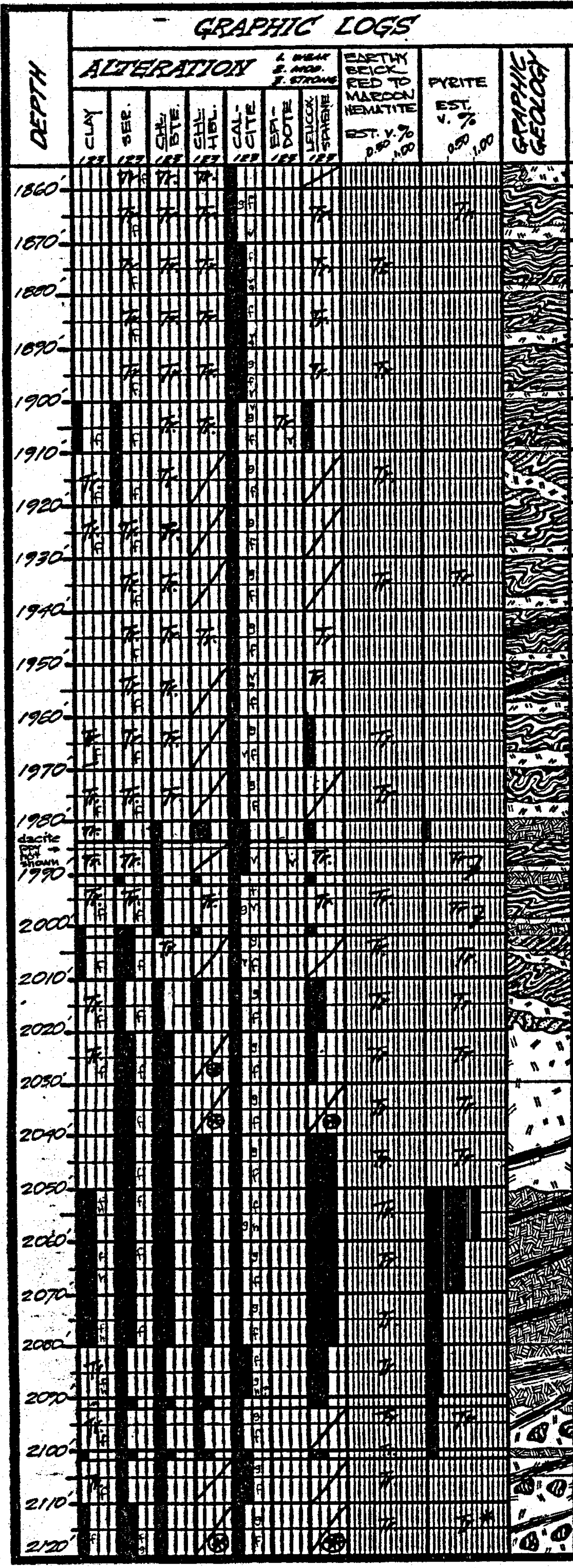

Tr. TRACE
1. WEAK
2. MOD.
3. STRONG

DESCRIPTIONS

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VEINLETS	
	HBL.
	1860-70': QTZ-FSP.-BTE GNEISS, FINE-XLINE* MED. BROWNISH-GRAY "SALT & PEPPER" APPEARANCE
	~25% M.XLN. LEUC. GRANITE Tr. DISS. PYRITE (* RARELY TO MED-XLINE
Tr. CALCITE	1870-80': 15% SAME AS ABOVE. REMAINDER F.XLN. FSP-QTZ-BTE GNEISS W/ MINOR SILLIMANITE (FI-
	15% GRNT. AS ABOVE BROLITE, Tr. CORDIERITE(?) ?Ⓒ Ⓢ
Tr. CALCITE	1880-90': SAME AS ABOVE W/ 25% MED.-XLINE LEUC. BTE. GRANITE
Tr. CALC.-QTZ-CHL.	
Tr. CALCITE	1890-1900': " W/15-20% GRANITE
	Tr. FIBROLITE Ⓢ
Tr. CALCITE	1900-1910': " W/ 10% GRANITE.
	1910-1920': 25% OF SMPL. IS MED.-XLINE LEUCOCRATIC GRANITE, REMAINDER SAME AS ABOVE, EXC.
	MAFICS DECREASE.
Tr. CHL-CLAY	1920-1930': SAME AS ABOVE . A FEW SCATTERED BTE. XLS. UP TO 4 mm. IN DIA.
	PROB 15% GRANITE → THIS INTERVAL MAY INCLUDE SOME FINE-XLINE BTE. GRANITE (TEXTURALLY IDENTICAL
	1930-40': SAME AS ABOVE . W/20-25% (?) GRANITE
	Tr. FIBROLITE Ⓢ
	1940-50': SAME AS ABOVE . W/15-20% (?) GRANITE.
MINOR FLT.?	Tr. FIBROLITE Ⓢ
Tr. CALCITE-HEMATITE	1950-60': SAME AS ABOVE W/ 20-25% (?) GRANITE
	Tr. FIBROLITE. Ⓢ
Tr. CALCITE	1960-70': SAME AS ABOVE . W/ 20-25% (?) GRANITE
	Tr. FIBROLITE Ⓢ
Tr. CHL Tr. QTZ.	1970-80': SAME AS ABOVE. W/25-30% (?) GRANITE.
	Tr. FIBROLITE Poss. Actinolite after Hbl. ? PORPHYRY Ⓢ
Tr. CALCITE	1980-90': 35-40% BTE. HBL. QTZ. MICRODIORITE (20-25% SUBH-EUH. PLAG. LATHS UP TO 0.5X0.2 mm. IN MICROXLINE MATRIX!
Tr. CALCITE-HEMATITE	MATRIX VARIES IN XL. SIZE AS DO NO. OF PHENOCRYSTS). 5-7% DK. GRY DACITE PPY W/7-10% PLAG. PHENOS. SAME AS MICRODIORITE. 10%
Tr. CALCITE-CHLORITE	1990-2000': 25% QTZ MICRODIORITE PPY., 5-7% GRANITE. REMAINDER GNEISS AS ABOVE (W/FIBROLITE) ?Ⓒ Ⓢ
Tr. CALCITE	DACITE PPY., 10% GRANITE, REMAINDER F XLN FSP-QTZ-BTE. GNEISS W/ MINOR FIBROLITE Ⓢ
	2000-2010': 20% LEUC. GRANITE, SAME AS 2010-20' (below) REMAINDER GNEISS, SAME AS 1860-70'.
Tr. CALCITE	15-20% QTZ. MICRODIORITE PORPHYRY, 1% DACITE PPY ?Ⓒ Ⓢ
Tr. CHLORITE-CALCITE	2010-20': 20% OF SMPL. IS LEUCOCRATIC GRANITE, F. XLINE REMAINDER QTZ.-FSP.-BTE. GNEISS, SAME AS 1860-70' EXC.
	FOR 5-7% QTZ. MICRODIORITE PORPHRY AS ABOVE (SIMILARLY ALTERED) ONE CHIP CHLTZED, SERCTZD. GNEISS W/5% DISS. PY
	2020-30': LEUCOCRATIC GRANITE, FINE-MED.-XLINE BTE. CHLTZED. FSPS. SERICITIZED
	1-2% MICRODIORITE, SAME AS BELOW (2050-60'). 5-7% FSP-QTZ. BTE. GNEISS
	2030-40': SAME AS ABOVE W/3-5% GNEISS.
Tr. EARTHY	2040-2050': SAME AS ABOVE W/5-7% GNEISS, <1% QTZ. MICRODIORITE PPY., AS ABOVE
RED HEM.	15% CONTAMINATED FR. 180-200' PORPHYRY SEE 1980-90'
② CHLORITE	2050-2060': BIOTITE HORNBLENDE QUARTZ MICRODIORITE APPARENT DIABASIC TEXTURE; HBL. ALT. TO CHL & CLAY
also 5-7% GRANITE	FSPS. SERICITIZED, ARGILLIZED, BTE. FRESH TO TOTALLY CHLTZD., CHL VNLTS. COMMON. 0.7% DISS. PYRITE
① CHLORITE	2060-70': SAME AS ABOVE. PY GRAINS ANH.-SUBH., AVG. < 0.3 mm. DIA., REACH ONE MM. HERE & ABOVE
Tr. PYRITE	~2% SPHENE, MOSTLY ALTERED TO LEUCOXENE ALSO 5-7% GRANITE, AS ABOVE 2-7% CEMENT
① CHLORITE	2070-80': SAME AS ABOVE.
FLT.	2080-90': SAME AS ABOVE EXC. 5-10% OF CHIPS APHANITIC DENSE, PPYTIC, DK. GRAY (BORDER PHASE?)
Tr. CHL.	5-7% MED. XLN. LEUCOCRATIC GRANITE < DACITE PPY AS ABOVE.
FLT.?	2090-2100': 15% MICRODIORITE, AS ABOVE, 10% GOUGE, Tr. DACITE PPY.
	20% QTZ-FSP-BTE. GNEISS (SAME AS 1860-70'), 55% LEUCOCR. F. XL. GR. — ONLY MICRODIORITE ALTERED MOD.
Tr. PYRITE FLT.	2100-2110': 15% MICRODIORITE, Tr. DACITE PPY, 7% GOUGE, 15% GNEISS (?), GRANITE
Tr. CHL. IN MICRODIOR.	5% TUFF CONTAMINATION (SEE 180-200')
FLT. "	2110-20': 5% MICRODIORITE, AS ABOVE (CAVING?) 7% GOUGE SOME SERTZD 15% GNEISS 65% GRANITE
	* PYRITE ONLY IN MICRODIORITE Tr. CEMENT CONTAM. Ⓢ (SEE 180-200')

NOTE: PLACEMENT OF FLTS., XENOLITHS, DIKES IS SCHEMATIC.

NOTE: MUCH OF THE GRANITE COULD BE A FELSIC MIGMATITIC DIFFERENTIATE.

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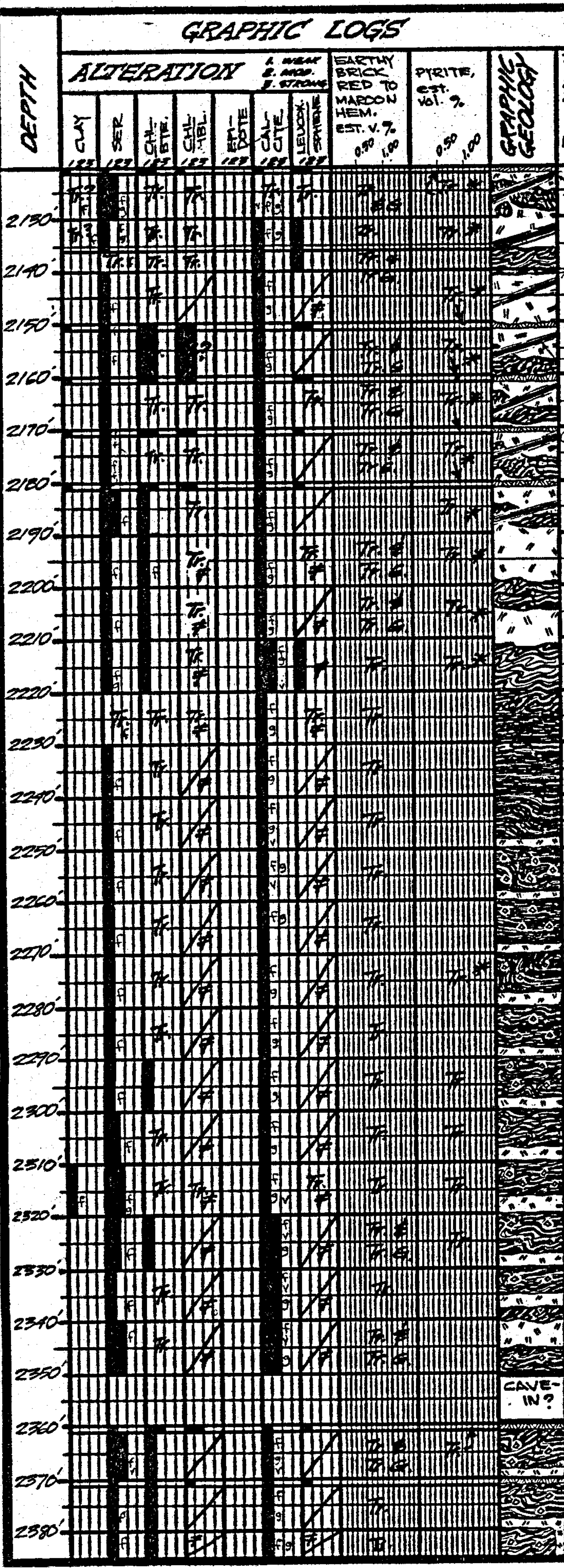
● STRONG SPHENE ALT. (TO LEUCOXENE) IN MICRODIORITE PPY.
" HBL. ALT (TO CHL. & ACTINOLITE) " " "



DESCRIPTIONS

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JULY 1978

Tr. TRACE 1. WEAK 2. MOD. 3. STRONG VEINLETS	DESCRIPTIONS
FLT.?	10% MICRODIORITE 45% QTZ.-FSP.-BTE GNEISS. 7% GOUGE & BX 35% FINE-MED. XLINE LEUCOCRATIC
Tr. CALCITE Tr. CHLORITE	GRANITE & BTE (<1%) GRANITE. * DISS. PY ONLY IN MICRODIORITE
w/MINOR HBL	2130-40': 50% F. XL. QTZ.-FSP.-BTE-GNEISS, MED. BROWNISH-GRAY, SPHENE-BEARING; 4-5% GOUGE,
	Tr. MICRODIORITE 45% F. XLINE BTE. GRANITE * PYRITE ONLY IN MICRODIORITE
Tr. QTZ-CHL.-GOETHITE	2140-50': 3% MICRODIORITE, 10% QTZ-FSP.-BTE. GNEISS,
	7% GOUGE & BX., 80% GRANITE * PYRITE ONLY IN MICRODIORITE.
Tr. HEM. IN MICROD.	2150-60': 10% MICRODIORITE, 7% GOUGE & BX LEUC.? 50% (?) QTZ-FSP-BTE-HBL GNEISS 30% (?) GRANITE Ⓢ?
FLT.? ① CHL.	3% DACITE PPY. * PYRITE ONLY IN MICRODIORITE. HBL. PTLY. ALTERED TO TREMOLITE-ACTINOLITE.
Tr. CHL. IN MICROD.	2160-70': SAME AS ABOVE EXC. GNEISS IS F. XLN. FSP-QTZ-BTE W/MINOR SPHENE.
	Ⓢ
① CHL. IN MICROD.	2170-80': 7% MICRODIORITE, 7% GOUGE, 40% QTZ.-FSP.-BTE GNEISS, 46% GRANITE
	* PYRITE ONLY IN MICRODIORITE
Tr. "	2180-90' SAME AS ABOVE, EXC. 30% GNEISS, 56% GRANITE, Ⓢ
	Tr. FIBROLITE Tr. DACITE PPY. (?) SAME ALTN., MINRLZ. AS ABOVE.
	2190-2200': 5% MICRODIORITE, 5% GOUGE, 10% (?) QTZ-FSP. BTE. GNEISS, 80% F-M. XLINE GRANITE (?)
← MICROD. NOT ILLUSTR.	"GRANITE" COULD BE QUARTZOFELDSPATHIC SEGREGATION IN GNEISS.
Abundant Fibrolite	2200-2210': 5% MICRODIORITE (NOT ILLUSTRATED) 7% CONTAMINATION W/ CEMENT SAME AS 180-200' 3% GOUGE,
	40% QTZ-FSP.-BTE. GNEISS, W/ ABUND. MED.-XLINE. BTE XLS., 45% LEUC. MED. XLINE GRANITE. Ⓢ
Tr. CALCITE	2210-2220': 7% MICRODIORITE, Tr. DACITE OR ANDESITE PPY., 5% GOUGE, 10% (?) GRANITE, 78% GNEISS
	7% CEMENT CONTAMINATION ABUNDANT FIBROLITE Ⓢ
	2220-30': 35% MED.-XLINE BTE. SCHIST (? 95% DK. BRN. BTE. & 5% QTZ. + FSP) WELL-FOLIATED
Abundant Fibrolite →	3% MICRODIORITE W/ ABUNDANT FREE BTE. FLAKES. 7% CONT., AS ABOVE, 5% GOUGE, 50% GNEISS, 5% GR. (?) Ⓢ
Abundant	2230-40': 50% BTE SCHIST & BTE. FLAKES, AS ABOVE; 2% MICROD., 1% GOUGE, 2% (?) GRANITE, REMAINDER FN.
Fibrolite & minor cordierite	XLINE QTZ.-FSP.-BTE. GNEISS W/ SALT & PEPPER APPEARANCE. ALTN. HAS DECREASED MARKEDLY ? ⒸⓈ
Tr. CALCITE	2240-50': SAME AS ABOVE — ROCK PROB. CONSISTS
	OF ALTERNATING BANDS OF BTE. SCHIST & GNEISS ALSO 15% MED-XLINE LEUCOCRATIC GRANITE ⒸⓈ
"	2250-2260': SAME AS ABOVE; 5% CONTAMINATION
	V. ABUND. FIBROLITE SAME AS 2210-20'. MINOR REDDISH-BROWN ? GARNET W/ SILL, CORD ⒼⓈⒸ
	2260-70': SAME AS ABOVE, EXC. ONLY Tr. MICRODIORITE.
	PROBABLY 15% GRANITE ⒼⓈⒸ?
	2270-80': SAME AS ABOVE W/ 2% MICRODIORITE (W/ Tr. * DISS. PY. *) & 20-25% MED.-XLINE LEUC.
	GRANITE. V. ABUND. SILLIMANITE ⒼⓈⒸ?
	2280-90': SAME AS ABOVE, EXC. MED. XLINE BTE DECREASING. 10-15% GRANITE
	1-3% GARNET. RED-BROWN. 2% CONTAMINATION, SAME AS 2210-20' ⒼⓈⒸ
	2290-2300': SAME AS ABOVE W/ ABUNDANT SILLIMANITE POSS. TR. CORUNDUM. ALTN. NOT PER-
	1-3% GARNET Ab. Fibrolite VASIVE, BUT CONFINED TO SCATTERED CHIPS. ~20% GRANITE ⒼⓈⒸ?
	2300-2310': QTZ-FSP.-BTE. GNEISS, SPECKLED DK. BROWN & WHITE, FINE-MED. XLINE; ABUNDANT SILLIMANITE, 4%
	BROWN GARNET (?); 2% MICRODIORITE, ONE CHIP W/ Tr. PY. ALTN. SPOTTY 25-30% GRANITE ⒼⓈⒸ?
Tr. CALCITE	2310-20': SAME AS ABOVE. — BTE. & SILL. DECREASE; NO MICRODIORITE. Tr. DACITE PPY
	Tr. HBL. Tr. GARNET AS ABOVE. CHLTZN. SPOTTY, SER/FSPS. NEAR-PERVASIVE ⒼⓈⒸ?
① CALCITE	2320-30': SAME AS ABOVE — MORE INTENSE ALTN. Tr. MICRODIORITE Tr. DACITE PPY
	1-3% RED-BROWN GARNET, AS ABOVE 20-25% GRANITE ⒼⓈ
① CALCITE	2330-40': SAME AS ABOVE. W/ 5-7% MICRODIORITE, Tr. DACITE PORPHYRY 20-25% MED. XLINE LEUCOCRATIC GRANITE.
	1-3% RED-BROWN GARNET, ANH., <0.5 mm. DIA. ABUNDANT FIBROLITE. ALTN. IN MICRODIORITE DECREASING. ⒼⓈⒸ?
① CALCITE	2340-50': 35% F. XL. LEUC. GRANITE, 2% MICRODIORITE, 2% GOUGE, REMAINDER QTZ.-FSP.-BTE GNEISS W/ SILLIMANITE.
	~1% RED-BROWN GARNET, AS ABOVE. Tr. DACITE PPY ⒼⓈ
	2350-60': PROBABLE CAVE-IN: 35% CEMENT, REMAINDER A MIXTURE OF GNEISS, GRANITE, BTE SCHIST
	FSPS. ARE MOD. SERCTZD. & MICRODIORITE.
	2360-70': 15% MICRODIORITE, A FEW CHIPS OF WHICH ARE PYRTZD. AND ALTERED. (PY ONLY IN MICRODIORITE) 15% GRANITE.
Tr. SERICITE Tr. CALCITE	REMAINDER QTZ-FSP-BTE GNEISS, SAME AS ABOVE W/ MINOR SILLIMANITE, GARNET, Tr. CORDIERITE ⒼⓈⒸ?
	2370-80': SAME AS ABOVE EXC. 10% MICRODIORITE, Tr. DACITE PPY.
	 DACITE PPY. — MICRODIORITE (ONE CHIP) 15% GRANITE. 1% RED-BRN. GARNET ⒼⓈ
	2380-90' SAME AS ABOVE W/ · MICRODIORITE, 15% GRANITE. ⒼⓈⒸ?

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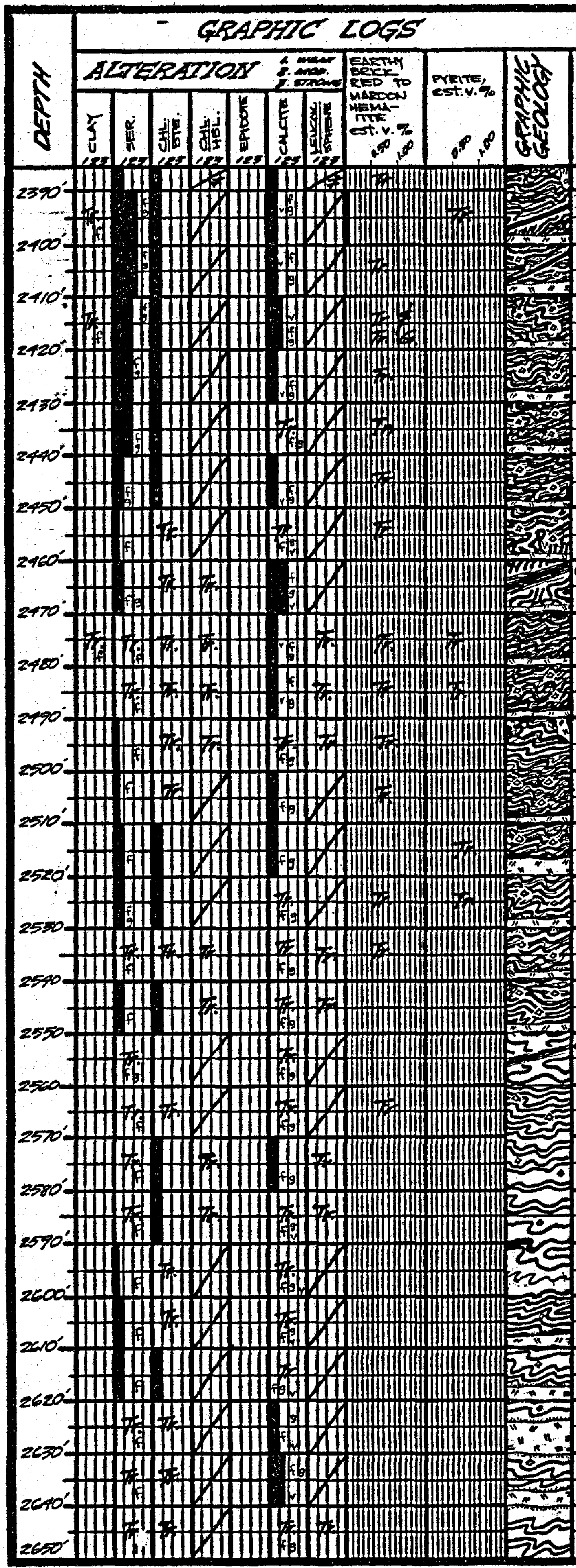
* WEAK TO MOD. ALTN. IN QTZ. MICRODIORITE PPY. CHL/HBL. & SPHENE TO LEUCOXENE.

NOTE: MED-XLINE GRANITE DESCRIBED ABOVE COULD BE FELSIC MIGMATITIC DIFFERENTIATE IN PART.



Tr. TRACE 1. WEAK 2. MOD. 3. STRONG VEINLETS	DESCRIPTIONS LOGGED BY J. HULEN JULY 1978
	also 15% MED. XLN. LEUCOCRATIC GRANITE Abundent Fibrolite
Tr. SPEC. HEM. Tr. SERICITE	2390-2400': ΦTZ-FSP-BTE GNEISS, FINE-MED. XLINE, MED. BROWNISH-GRAY, SPECKLED; 5% SERCTZD. GOUGE; 5%
Tr. CALCITE	MED.-XLINE CHL.-SER. CHIPS; TR. MICRODIORITE; CHLTZN. SPOTTY SERCTZN. PERVASIVE. PROB. SOME PRIM. MUSC. Ⓢ? Ⓒ
	2400-2410': SAME AS ABOVE W/ ABUNDANT FIBROLITE, 1%
Tr. CALCITE	BROWN ANH. GARNET < 0.5 mm · DIA: 20% GRANITE ⒼⓈⒸ?
Tr. CHL/GOUGE	2410-20': SAME AS ABOVE EXC. ABUND. SILLIMANITE & 2% PINK-REDDISH-BRN. GARNET INTERGROWN W/ BTE.
Tr. CALCITE	10-15% GRANITE ⒼⓈ
	2420-30': SAME AS 2390-2400' W/ ABUND. SILLIMANITE
Tr. CALCITE	15-20% GRANITE ⒼⓈ
	2430-2440': SAME AS ABOVE W/ 15-20% GRANITE Tr. DACITE PPY.
	1-3% BROWN, RED-BROWN, & PINK GARNET ANH., < 0.5 mm. DIA. ⒼⓈ
Tr. CALCITE	2440-50': SAME AS ABOVE. CHLTZN. ERRATIC. SERCTZN. MORE PERVASIVE.
	1-3% RESINOUS BROWN GARNET, AS ABOVE. 10% GRANITE. ABUNDANT FIBROLITE ⒼⓈ
Tr. CALCITE-HEMATITE	2450-60': MED.-XLINE BTE MARKEDLY DECREASES — FINE-XLINE "SALT & PEPPER" GNEISS INCREASES — ALTN
	NOTICEABLY LESS INTENSE. 10% GRANITE. Tr. GARNET ABUNDANT FIBROLITE. ⒼⓈ
(1-2) CALCITE	2460-70': SAME AS ABOVE EXC. 15% GOUGE, MUCH OF WHICH IS SLICKENSIDED. GARNET DROPS OUT.
	10% (?) GRANITE. GNEISS IS POORER IN MAFICS. Ⓢ
Tr. CALCITE	2470-80': SAME AS 2450-60': HBL. & SPHENE APPEAR. ONLY Tr. FIBROLITE
	15% GRANITE ONE GRAIN PY 1½ MM. DIA.—SUBH. Tr. Ⓢ
Tr. CHL.	2480-90': SAME AS 2420-2430' SILLIMANITE INCREASES FR. 2470-80'.
Tr. CALCITE	10-15% GRANITE (ABUNDANT SILLIMANITE — Tr.-1% RED-BROWN GARNET ⒼⓈ
Tr. CHL.-HEM	2490-2500': ΦTZ-FSP.-BTE GNEISS, FINE-XLINE, MED. BROWNISH-GRAY. SPECKLED "SALT & PEPPER" APPEARANCE
	A FEW CHIPS MED.-XLINE W/ ABUND. BIOTITE & SILLIMANITE 1-2% CHLTZED. MICRODIORITE 7-10% GRANITE Ⓢ
	2500-2510': SAME AS ABOVE, BUT WELL-FOLIATED, SCHISTOSE
	10% GRANITE. ABUNDANT FIBROLITE ⒼⓈ
Tr. ΦTZ-SER-HEM.	2510-20': SAME AS ABOVE. Tr. RED-BROWN GARNET
	30-35% MED. XLINE LEUC. BTE. GRANITE Tr. ALTERED MICRODIORITE W/ Tr. DISS. PY. ⒶⓈ
Tr. ΦTZ-CHL.-	2520-30': SAME AS 2490-2500': 1% CHL-SER. CHIPS (FROM FAULT?)
SER.-HEM.	15-20% GRANITE. ≠ Tr. ALTERED MICRODIORITE W/ Tr. DISS. PYRITE ⒼⓈ
	2530-40': SAME AS ABOVE (ALL) Tr. ALTERED MICRODIORITE
	10-15% MED.-XLINE. LEUC. BTE. GRANITE. ⒼⓈ
TR. BRICK-RED HEM.	2540-50': SAME AS ABOVE.
	~15% GRANITE ⒼⓈ
MINOR FLT.	2550-2560': Tr. SILLIMANITE F. XLINE FSP-ΦTZ-BTE GNEISS W/ "SALT
	~6-7% GRANITE & PEPPER" TEXTURE. Tr. Ⓢ
	2560-2570': SAME AS ABOVE W/ 27% BTE. TR. ANH. RED-BROWN GARNET < 0.5 mm. DIA.
	5-10% GRANITE. TR. FIBROLITE ⒼⓈ
	2570-2580': SAME AS ABOVE
	5-7% GRANITE Tr. ⒼⓈ
Tr. CALCITE	2580-2590': SAME AS ABOVE
	~10-15% GRANITE Tr. ⒼⓈ
Tr. CALCITE	2590-2600': SAME AS 2550-2560'
	~5-7% (?) GRANITE Tr. Ⓢ
	2600-2610': SAME AS 2550-2560 ΦTZ-FSP-BTE. GNEISS W/ SILLIMANITE 5% RED-BRN. GARNET
	SERCTZN. OF FSPS. ERRATIC —— ALSO 15% 20% MED-XLINE ΦTZ. & KSP. PROB. FROM LEUCOGRANITE ⒼⓈ
	2610-20': SAME AS ABOVE. CHLORITIZATION ALSO ERRATIC
Tr. CALCITE	20-25% MED-XLN. LEUC. GRANITE. 5% GARNET, AS ABOVE ⒼⓈ
	2620-30': SAME AS 2550-2560' W/ 65-70% LEUC. MED-XLN. GRANITE OR FELSIC MIGMATITIC SEGREGATION
Tr. CALCITE	REMAINDER FSP-ΦTZ-BTE. GNEISS Tr. ⒼⓈ
	2630-40': SAME AS ABOVE W/ ~30% (?) GRANITE.
Tr. CALCITE	Traces ⒼⓈⒸ?
	2640-50': SAME AS 2550-60'; DISTINCTIVE LT. BROWN COLOR. Tr. LT. GRAY DACITE PPY.
	~5% GRANITE Tr. Ⓢ

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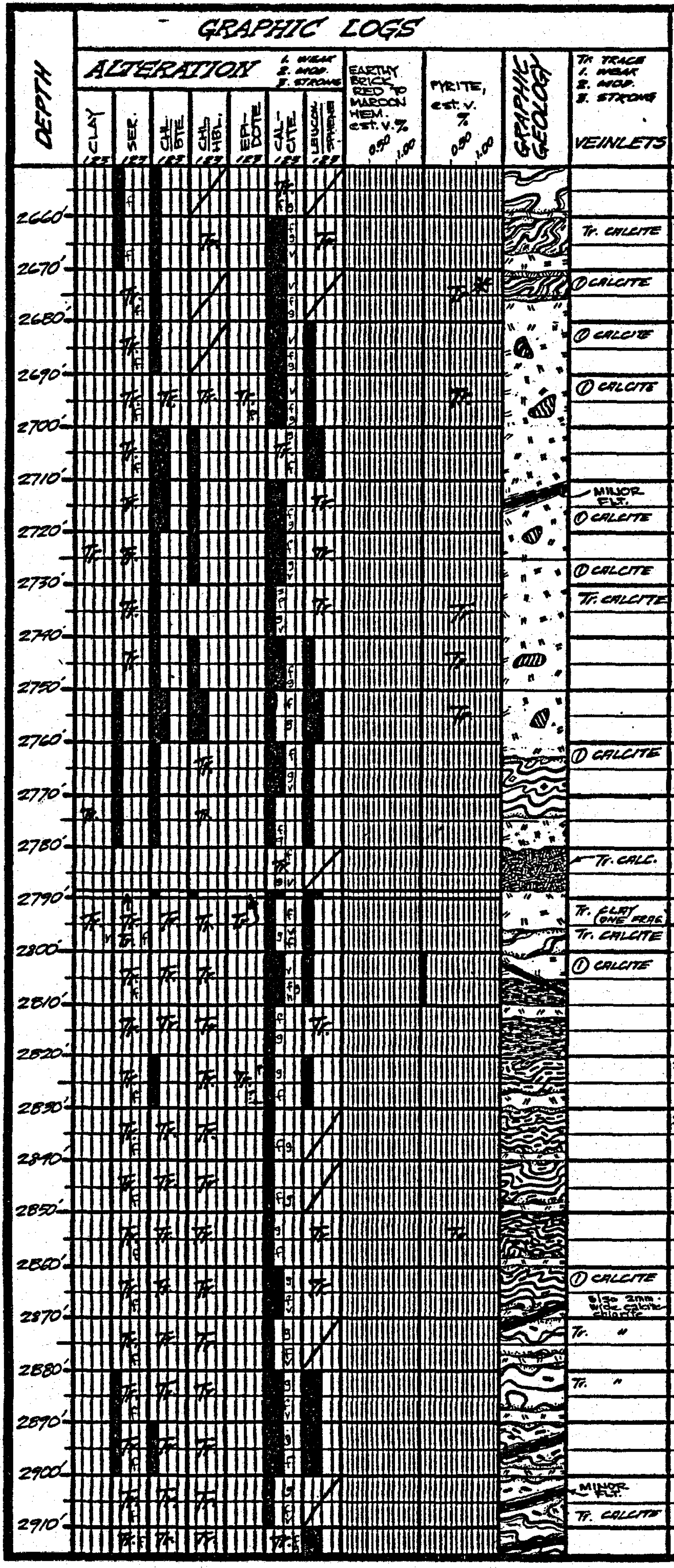
NOTE: MUCH OF THE MED.-XLINE LEUCOCRATIC GRANITE DESCRIBED ABOVE COULD BE FELSIC MIGMATITIC DIFFERENTIATE.

≠ SEE PRECEDING PAGE.



DESCRIPTIONS

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2650-60': 10% MED. XLINE LEUCOGRANITE OR ALASKITE, REMAINDER F. XLN FSP-QTZ-BTE. GNEISS W/"SALT AND-PEPPER TEXTURE.
Tr. SILLIMANITE. Tr. ⑤

2660-70': 30% LEUCOGRANITE, REMAINDER GNEISS, AS ABOVE"
Tr. ⑤

2670-80': 7% MICRODIORITE, MOSTLY UNALTERED. 40% LEUCOCRATIC BTE. GRANITE. REMAINDER F.XLN. FSP-QTZ-BTE. GNEISS, AS ABOVE
ABUND. FIBROLITE Tr. RED-BROWN GARNET. Tr ⑥ ⑤

2680-90': 90% F-M. XLN. LEUCOCRATIC BTE. GRANITE W/<0.5% BTE, <0.5% MAGNETITE, <0.5% SPHENE.
REMAINDER F. XLN. FSP.-QTZ-BTE. GNEISS
TR. MICRODIORITE. Tr. DACITE PPY Tr ⑤

2690-2700': SAME AS ABOVE W/3% MICRODIORITE
Tr. ⑤

2700-10': SAME AS ABOVE — FOLIATION VAGUELY DISCERNIBLE ??
<3% GNEISS. & Tr. HBL. APPEARS — UNIT V. QTZ RICH

2710-20': SAME AS ABOVE W/ABUND. FLT. GOUGE

2720-30' SAME AS ABOVE (2680-90') W/ 7% FSP-QTZ-BTE GNEISS.
Tr HBL. IN INTRUSIVE. Tr ⑤

2730-40': SAME AS ABOVE — Tr. QTZ.-FSP.-BTE GNEISS
HBL. IN INTRUSIVE INCREASES. — 1-1.5% BTE, 0.5% HBL, <0.5% SPHENE.

2740-50': SAME AS ABOVE
5-7% FSP-QTZ.-BTE. GNEISS. Tr. ⑤

2750-60': SAME AS ABOVE.
ALTN. INCREASES. Tr ⑤

2760-70': 20% SAME AS ABOVE, 80% QTZ-FSP-BTE. GNEISS W/ ~ 15-20% BTE. 2% (?) HBL
MINOR FIBROLITE & GARNET (RED-BROWN, TRANSL., ANH., <0.5 mm.) ⑥ ⑤

2770-80': V. MIXED SMPL., W/ 3-5% MED.-CRS.-XLINE BTE, 3% MICRODIORITE, REMAINDER 65-70% GRANITE.
SAME AS ABOVE W/ 4% GOUGE. PROBABLY EXTENSIVE CAVING THIS INTERVAL. ⑤

2780-90': 33% DK. GRAY DACITE PPY REMAINDER MED.-XLINE LEUC. GR. W/ TR. GNEISS
REMAINDER AS 2670-2760'. GRANITE IS HEAVILY ALT. TO CALCITE, DACITE PPY QUITE FRESH ⑤

2790-2800': 60% (?) MED.-XLN. LEUC. BTE. GRANITE. REMAINDER F-M. XLN FSP-QTZ-BTE. GNEISS, MUCH OF WHICH IS EASILY CONFUSED W/THE GRANITE (FELSIC PORTIONS)
also 15% GNEISS, AS ABOVE

2800-2810': 50% OF SMPL. IS F. XLINE BTE-HBL. GNEISS W/>50% HBL, MOD. WELL-FOLIATED. REMAINDER IS QUARTZ-FSP. FRAGS WHICH MAY BE QUARTZOFELDSPATHIC DIFFERENTIATE OR LEUCOCRATIC GRANITE? POSS. PY.

2810-20' (?) 20-25% GRANITE. 5-10% FSP-QTZ-BTE. GNEISS, SAME AS 2790-2800 (W/ MINOR FIBROLITE. REMAINDER BTE.-HBL. GNEISS AS ABOVE ⑤
also Tr. MICRODIORITE

2820-30': 75% F. XLN. QTZ-FSP-HBL-BTE. GNEISS W/"SALT & PEPPER" TEXTURE, 25 V. % MAFICS. REMAINDER F. XL. BTE. GRANITE (?) W/ < 1% BTE. Tr. M-XLN BTE-HBL. QTZ. MONZ. GNEISS & CHIPS (<1/2%) F. XLN. CHL.-EP. AGGR. W/ QTZ, CALCITE

2830-40': F. XL FSP-QTZ-HBL-BTE. GNEISS, 25% TL. MAFICS, "SALT & PEPPER" TEXTURE, CRUDE FOLIATION, MED. GRAYISH-BROWN. 10-15% (?) MED.-XLINE. LEUC. BTE. GRANITE. Tr. BTE-HBL QTZ. MONZ. GNEISS

2840-50': SAME AS ABOVE ~ POSS. W/ ... LEUC. F. XLINE GR. (MAY BE QUARTZOFELDSPATHIC DIFFERENTIATE).

2850-60': SAME AS ABOVE, BUT GNEISS CONTAINS 7 TO 10% HBL. 15% MED-XLN. LEUC. GRANITE

2860-70': SAME AS 2830-40': ~ 15% F.-MED.-XLINE LEUC. GR. OR ALASKITE

2870-80': SAME AS ABOVE W/ DIMINISHED MAFIC CONTENT (<15%)
PERHAPS 10-15% GRANITE, BUT DIFF. TO DISTINGUISH FROM THIS GNEISS.

2880-90': SAME AS ABOVE. 20% (??) GRANITE ?

2890-2900': SAME AS ABOVE - 15% (?) GRANITE ?

2900-2910': SAME AS 2830-40' - 10% (?) GRANITE?

2910-20': SAME AS ABOVE - 10% (?) GRANITE?
TR. FIBROLITE. ⑤

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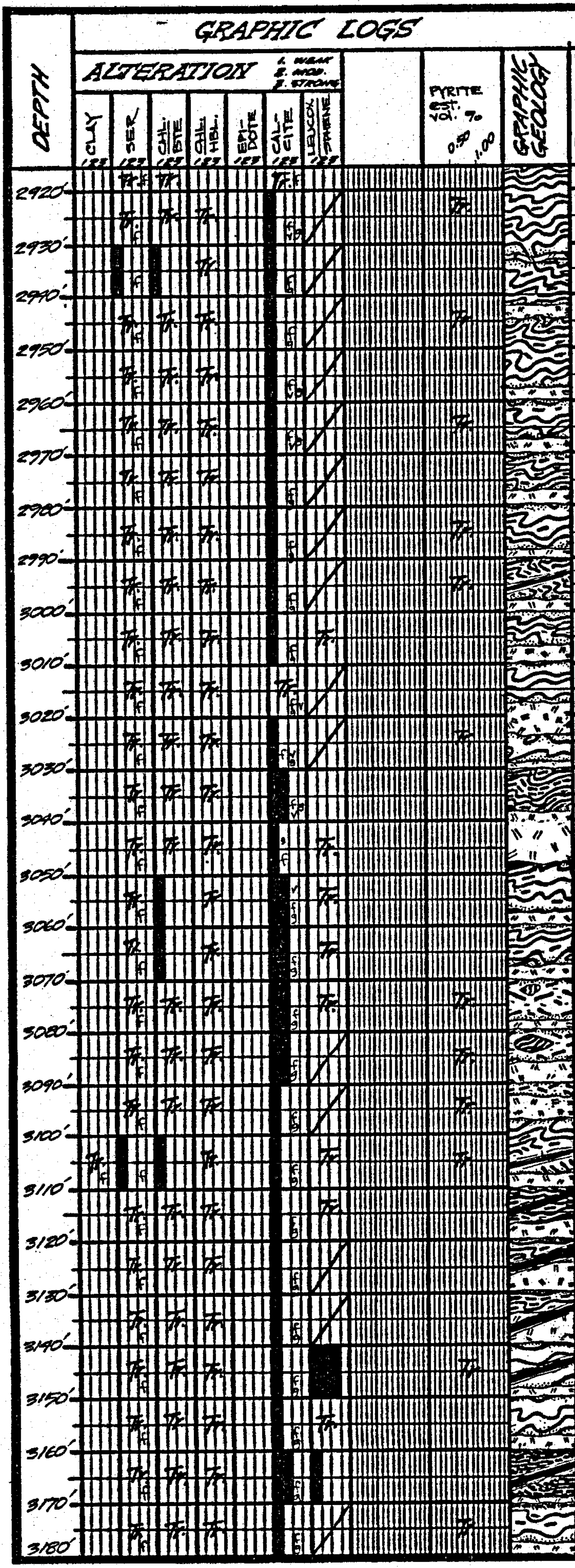

DESCRIPTIONS

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Tr. TRACE 1. WEAK 2. MOD. 3. STRONG VEINLETS	DESCRIPTIONS
Tr. SER.-PYRITE	2920-30'; QTZ.-FSP.-BTE. GNEISS, MED. GRAYISH-BRN, "SALT-AND PEPPER" TEXTURE, CRUDE FOLIATION, FINE-XLINE
(ONE VNLT.) Tr. CO₃	MED.-XLINE HBL SOME CHIPS. 5-7% MED XLINE LEUC. GRNT.
	2930-40': 90% SAME AS ABOVE. 10% PROBABLE MED. XLINE LEUCOCRATIC GRANITE. Tr. DARK GRAY
	DACITE PPY. TR. MICRODIORITE
	2940-50': SAME AS ABOVE, EXC. NO DACITE PPY. OR MICRODIORITE. Tr. DISS. PYRITE
	20% GRANITE
	2950-60': SAME AS ABOVE 15-20% GRANITE
Tr. CALCITE	
	2960-70': SAME AS ABOVE. Tr. DISS. PY.
Tr. "	20-25% GRANITE
	2970-80': SAME AS 2930-40' W/25% GRANITE 75% GNEISS
	Tr. MICRODIORITE.
	2980-90': SAME AS 2920-30'. W/ ~15% GRANITE.
	Tr. FIBROLITE Tr.Ⓢ
← MINOR FLT.	2990-3000': SAME AS ABOVE. GOUGE & BX INCREASE TO 7% OF SMPL.
	15-20% GRANITE
	3000-3010': SAME AS 2920-30' W/ 25-30% GRANITE
	Tr. FIBROLITE. Tr.Ⓢ
Tr. CALCITE	3010-20': SAME AS ABOVE W/ 20-25% GRANITE.
Tr. "	3020-30': SAME AS ABOVE W/ PERHAPS 5% MED.-XLINE ALASKITE (?) — THIS MAY BE JUST A QUARTZOFELDSPATHIC AGGREGATE.
① CALCITE	3030-40': QTZ-FSP.-HBL.-BTE. GNEISS, SAME AS 2820-30'. EXC. W/15-20% GRANITE
	ABUND. HBL. Tr.Ⓢ
	3040-50': 75% FINE-MED. XLINE LEUCOCRATIC GRANITE (OR QUARTZOFELDSPATHIC SEGREGATION IN GNEISS). REMAINDER SAME AS ABOVE (2920-30')
Tr. CALCITE	3050-60' SAME AS 2920-30' W/20% GRANITE
	Tr. FIBROLITE Tr.Ⓢ
① CALCITE	3060-70': SAME AS ABOVE, EXC 5-8% HBL. APPEARS
	20% MED.-XLINE LEUCOGRANITE.
① CALCITE	3070-80': ~10% SAME AS ABOVE. REMAINDER BTE-HBL QTZ. MONZ., POSS. METAMORPHOSED, MED.-XLINE, W/ 7-10% HBL., ~3% FINE-XLN. BTE. 0.5-1% SPHENE (HONEY-YELLOW) PERHAPS 10-15% LEUCOGRANITE, AS ABOVE.
① CALCITE	3080-90': SAME AS ABOVE W/ PERHAPS 35-40% LEUCOGRA-
	NITE (FSP. & QTZ. CHIPS, HOWEVER, ALMOST CERTAINLY PARTLY DERIVED FROM QTZ. MONZ. GNEISS.
	3090-3100': 20% (?) SAME AS ABOVE: REMAINDER
	40% MED.-XLINE LEUCOGRANITE. W/ F.XL. FSP-QTZ.-BTE GNEISS Tr. FIBROLITE. Tr.Ⓢ
← MINOR FLT.	3100-3110': QTZ.-FSP.-BTE. GNEISS, SAME AS 2920-30', W/ 3% (?) HBL., TR. DISS. PY.
Also tr. Fibrolite →	Tr. MICRODIORITE, Tr. CEMENT. 20% MED.-XLINE LEUC. GRNT. Tr.Ⓢ
← MINOR FLT.	3110-20': SAME AS ABOVE, BUT RICHER IN HBL. &
	30-35% GRANITE TOTAL MAFICS. Tr. FIBROLITE Tr.Ⓢ
← MINOR FLT.	3120-30': SAME AS ABOVE: HBL. DECREASES
	55-60% MED.-XLINE LEUCOGRANITE Tr.Ⓢ
← MINOR FLT.	3130-40': SAME AS ABOVE
	55-60% MED-XLINE LEUCOGRANITE.
← MINOR FLT.	3140-50': SAME AS ABOVE
	15-20% LEUC. GRANITE. HBL. DECREASES
	3150-60': SAME AS ABOVE POSS. TR. RED. GARNET Tr.Ⓢ?
	25-30% MED.-XLINE LEUC. GRANITE
← MINOR FLT.	3160-70': QTZ-FSP-BTE. HBL. GNEISS, F. XLINE, 40% TL MAFICS (30% HBL)
	7% MED.-XLINE. LEUC. GRANITE.
	3170-80': SAME AS 3110-3120' 2-3% SAME AS ABOVE.
	15-20% MED-XLINE LEUC. GRANITE

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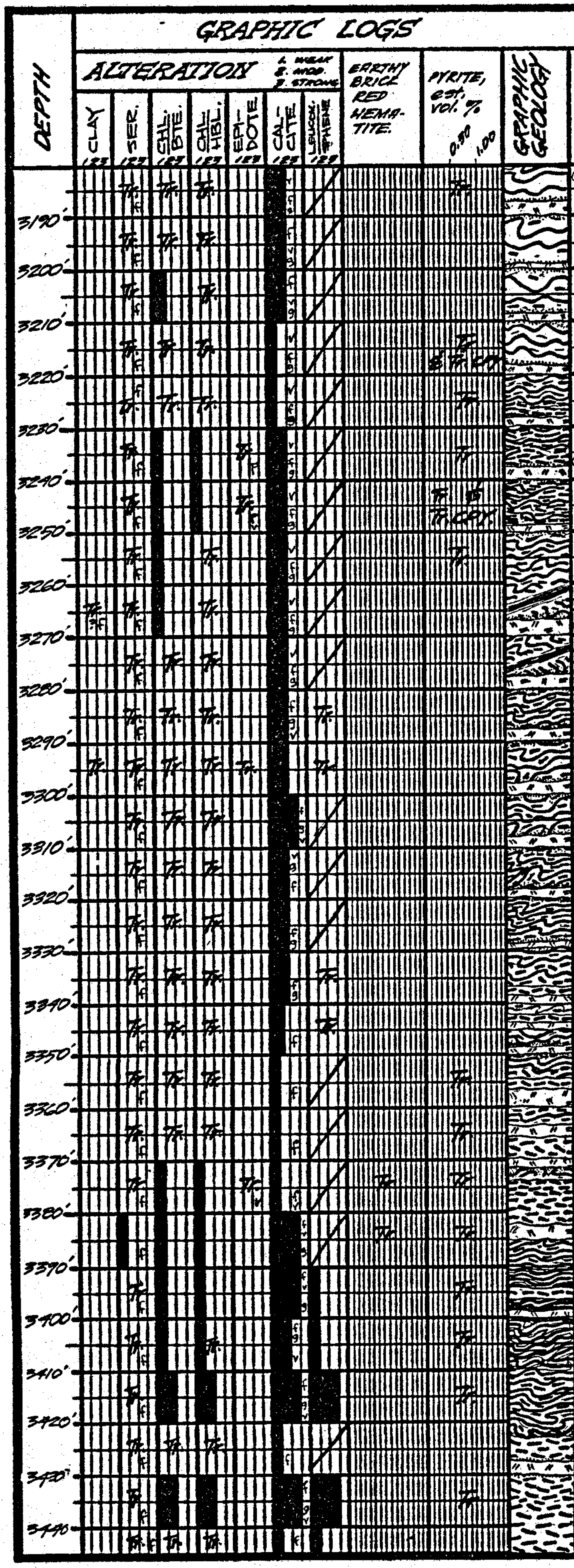
NOTE: MUCH OF THE MED-XLINE LEUCOCRATIC GRANITE DESCRIBED THIS PAGE COULD BE FELSIC MIGMATITIC DIFFERENTIATE.



DESCRIPTIONS

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JULY 1978

Tr. TRACE 1. WEAK 2. MOD. 3. STRONG VEINLETS	
① CALCITE	3180-90': QTZ-FSP-BTE. GNEISS, F. XLN., "SALT & PEPPER" APPEARANCE, LOW MAFIC CONTENT, RELATIVELY
	FRESH EXC. FOR CALCITIC ALTN. OF FSPS. & GOUGE. 20-25% MED. XLINE LEUC. GRANITE.
① CALCITE	3190-3200': SAME AS ABOVE. ~10% GRANITE.
Tr. CHL FSP	1-3% MED. XLN. BTE. HBL QTZ. MONZ. GNEISS.
① CALCITE	3200-10': SAME AS ABOVE, EXC. INCR. MAFICS & HBL. — THESE ARE WKLY. CHLTED. — CHL. ALSO APPEARS
Tr. CHL FSP.	TO REPLACE SOME PLAG CHIPS & XLS. — ALSO A FEW F. XL. CHIPS OF PURE FLAKY CHL.
Tr. CALCITE	3210-20': SAME AS ABOVE. 10-15% MED. XLINE LEUC. GR.
	7-10% MED. XLN. BTE. HBL. QTZ. MONZ. GNEISS W/ 10% (±) HBL.
Tr. CALCITE	3220-30': SAME AS ABOVE, EXC. INCR. HBL. (7 VOL. %). 20% OF CHIPS ARE MED.-XLN. W/ ONLY HBL AS
15% GRANITE	MAFIC — THESE MAY BE BTE.-HBL. QTZ. MONZ. GNEISS, SAME AS 3070-90'.
Tr. CHL.	3230-40' QTZ-FSP-BTE.-HBL. GNEISS, FINE-MED.-XLINE. DIFFERS FROM 3070-90 IN HAVING NO SPHENE
① CALCITE	(QTZ. MONZ. GNEISS?) (10% OF SMPL. IS QTZ-FSP.-BTE. GNEISS, SAME AS 3180-90' 15-20% GRANITE, AS ABOVE.
Tr. CHL.-EP.	3240-50': SAME AS ABOVE. CHL. ALSO SEEMS TO REPLACE PLAG. (A FEW HAVE A CLOUDY
① CALCITE	Tr. QTZ MICRODIORITE PY GRAYISH-GREEN APPEARANCE). 10% MED. XLN. LEUC. GR. ALSO: Tr. EPIDOTE.
	3250-60': SAME AS 3180-90 W/ APPEARANCE OF SOME SILLIMANITE & 20% TOTAL MAFICS.
① CALCITE	Tr. PY. 7-10% GRANITE ALSO: 10% SAME AS IMMEDIATELY ABOVE. Tr. ③
MINOR FLT.	3260-70': SAME AS ABOVE — 1% MICRODIORITE, (FSP-QTZ.-BTE GNEISS) Tr. DACITE
① CALCITE	25-30% MED.-XLN. LEUC. GRANITE. Tr. ③
MINOR FLT.	3270-80': SAME AS ABOVE W/ NO SILLIMANITE OR DACITE.
	20-25% MED.-XLN. LEUC. GRANITE also 5-7% FSP-QTZ-BTE HBL. GNEISS, AS 3230-50'.
① CALCITE	3280-90': SAME AS ABOVE — 3% GRANITE, MED.-XLINE, W/ <1% CHLTED. BTE.
	56% F-M XLN. FSP-QTZ-BTE-HBL. GNEISS, / SAME AS 3230-50' REM. F-M. XLN FSP-QTZ-BTE GNEISS. Tr. ③
① CALCITE	3290-3300': SAME AS ABOVE W/ 20-25% GRANITE. ONE CHIP QTZ — CLAY. / ONE FRAG. OF
Tr. QTZ-CHLOR.	20-25% GRANITE GNEISS TOTALLY (FSPS.) SERICITIZED. 3-5% FSP-QTZ-BTE. HBL GNEISS Tr. ③
① CALCITE	3300-10': SAME AS ABOVE
Tr. CHL.	
① CALCITE	3310-20': SAME AS ABOVE W/ SLIGHTLY MORE CHL. 40% (?) MED. XLINE BTE HBL. QTZ. MONZ GNEISS (AS 3230-50')
	(QTZ-FSP.-HBL.-BTE. GNEISS) REMAINDER // 10-15% (?) MED XLINE GRANITE. ③ Tr
① CALCITE	3320-30': SAME AS ABOVE, W/ 10% (?) MED.-XLN. GRANITE. FSP-QTZ-BTE.-HBL. GNEISS W/ 17-22% TL. MAFICS.
① CALCITE	3330-40': 10-15% MED. XLINE BTE-HBL QTZ. MONZ. GNEISS
	10-15% LEUC. GRANITE., M. XLN. REMAINDER F-M. XLN. FSP-QTZ-HBL-BTE GNEISS!
① CALCITE.	3340-50': 10-15% MED-XLINE BTE. HBL. QTZ. MONZ. GNEISS W/ 10%
	REMAINDER F.-M. XLINE FSP-QTZ-HBL-BTE. GNEISS HBL 10-15% GRANITE (??)
	3350-60': SAME AS ABOVE. FOR REMAINDER. 15-20% (?) M. XLN. BTE. HBL. QTZ. MONZ. GNEISS W
	~30% MED. XLINE LEUC. GRANITE. 10-15% HBL. 5% BTE.
	3360-70': SAME AS ABOVE. 40-45% BTE.-HBL. QTZ. MONZ. GNEISS W/ 10-15% HBL, <5% BTE., MED.
	XLINE. 20% LEUC. GRANITE (?) REMAINDER. F-M. XLINE FSP-QTZ-HBL-BTE. GNEISS
Tr. CHL-HEM.	3370-80': SAME AS ABOVE W/ 17-20% LEUC. MED.-XLN. GRANITE. 20-25% (?) MED.-XLN. BTE.-HBL. QTZ
Tr. CALCITE	(VARIABLE MAFIC CONTENT) MONZ. GNEISS & REMAINDER F-M. XLN. FSP-QTZ-HBL-BTE. GNEISS Tr ③
Tr. HEM. Tr. CHL-SER	3380-90': SAME AS ABOVE — ALTN. INCREASING, AS WELL AS % POWDERY BRICK-RED HEM.
② CALCITE	20-25% MED. XLN. GRANITE Tr. MICRODIORITE. ~15% BTE-HBL. QTZ-MONZ. GNEISS Tr ③
Tr. CHL.	3390-3400' QTZ-FSP.-BTE. GNEISS, F. XLN. "SALT & PEPPER" TEXTURE W/ 2% HBL. — ROCK IS DK. GRAYISH
② CALCITE	10% QTZ MONZ. GNEISS, AS ABOVE. TO GREENISH-BROWN : 10-15% MED.-XLINE LEUCOCR. GRANITE
Tr. QTZ-CHL-PYRITE	3400-10': SAME AS ABOVE W/ FEWER MAFICS, NO GR.
Tr. CHL.	7-10% GRANITE CHL. ALSO REPLACES SOME PLAG. GRAINS.
① CHL ② CALCITE	3410-20': SAME AS ABOVE, ALTN. INCREASES
Tr. QTZ-CALC.-SER.	5-7% GRANITE. Tr. QTZ. MONZ. GNEISS CHL/PLAG.
Tr. CHL.	3420-30': 20-25% MED. XLN. LEUC. GRANITE. 50-60% M-CRS. XLN. BTE. HBL.
	QTZ. MONZ. GNEISS W/ 15-20% HBL, 5-10% BTE. REM. F. XLN. FSP-QTZ-HBL-BTE GNEISS
① CHL ② CALCITE	3430-40' 80% BTE, HBL, QTZ. MONZ. GNEISS. 7-10% M. XLINE. LEUC.
	GRANITE? REMAINDER F. XLN. FSP-QTZ. BTE. GNEISS. Tr. ③
	3440-50': BTE-HBL. QTZ. MONZ. GNEISS, AS ABOVE, W/ 10-12% HBL, 5% BTE. 5-7% (?) LEUCOGRANITE ??

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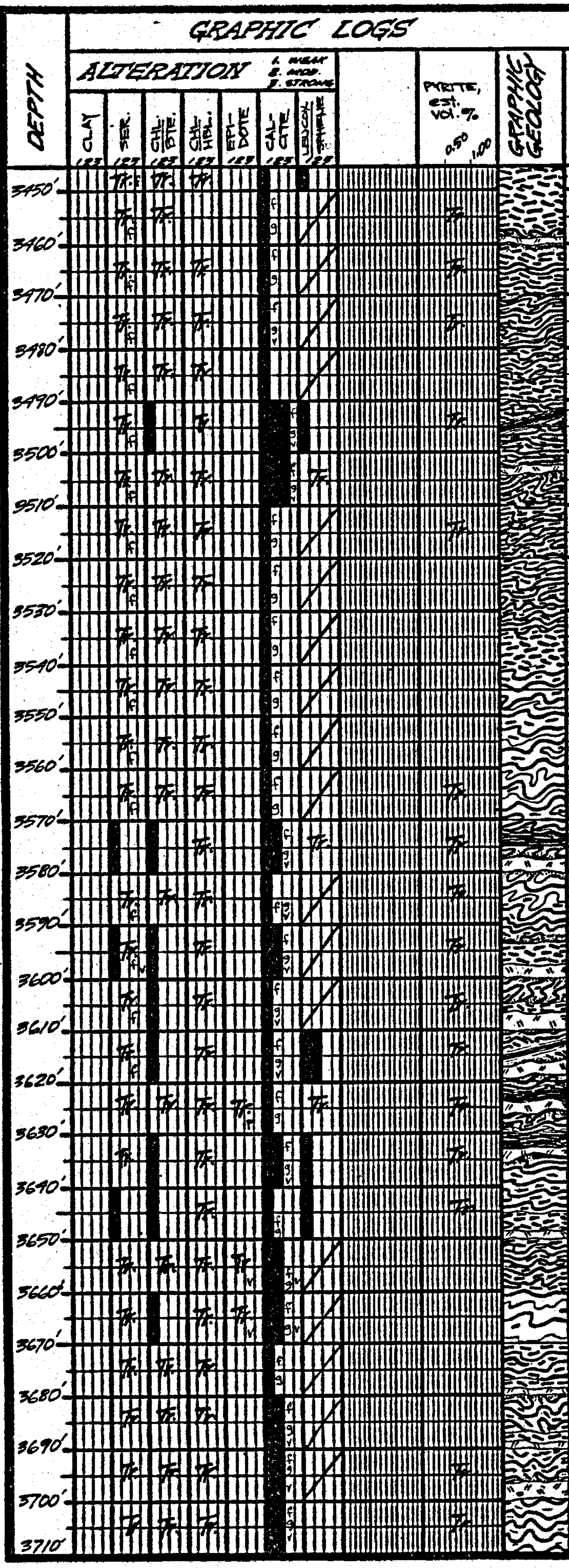

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AUGUST 1978

Tr. TRACE 1. WEAK 2. MOD. 3. STRONG VEINLETS	DESCRIPTIONS
	SEE PRECEDING PAGE.
	3450-60' GNEISS, FINE-XLINE, "SALT & PEPPER" TEXTURE, MED BROWNISH-GRAY OVERALL,
	K-15% M.XLN. LEUCOGRANITE BARELY DISCERNIBLE FOLIATION. 70% M.XLN. BTE. HBL. QTZ. MONZ. GNEISS.
	3460-70': VERY MIXED ZONE.
	10% LEUCOGRANITE. 20-25% (??) M.XLN. BTE. HBL. QTZ. MONZ. GNEISS REMAINDER F-M. XLN. FSP-QTZ-BTE. HBL. GNEISS
Tr. CALCITE	3470-80': SAME AS ABOVE W/ POSS. 5-7% MED.-XLINE ALASKITE OR QTZ-FELD. DIFFERENTIATE
	F-M. XLN. FSP-QTZ.-HBL.-BTE. GNEISS W/ ~ 20% TL. MAFICS — MAY BE QTZ. MONZ. GNEISS IN PART, AS ABOVE. ??
	3480-90': SAME AS ABOVE. ~5% GRANITE (?) PROB. ~
MIXED ZONE	25-30% M. XLN. BTE. HBL. QTZ. MONZ. GNEISS. REMAINDER F. MXL. FSP.-QTZ.-BTE.-HBL. GNEISS W/ 20% MAFICS, 50% HBL.
② CALCITE	3490-3500': SAME AS 3450-60': ALTN. INCREASES
Tr. CHLORITE	5-10% (?) QTZ. MONZ. GNEISS 5-10% MED. XLN. LEUCOGRANITE
② CALCITE	3500-3510': SAME AS ABOVE W/ 10% F.-MED. XLINE. ALASKITE (?) OR GRANITE.
Tr. CALCITE-CHL.	REALLY SEEMS TO BE A ZONE OF QTZ. MONZ. GNEISS GRADING INTO FSP-QTZ-HBL. BTE. GNEISS (XENOLITHS?)
	3510-20': SAME AS ABOVE — 10% GRANITE.??
	POSSIBLY 7-10% BTE. HBL. QTZ. MONZONITE GNEISS Tr. FIBROLITE AFTER BTE. Tr.③
	3520-30': SAME AS ABOVE —
	3530-40': 55-60% M. XLN. BTE. HBL. QTZ. MONZ. GNEISS W/ 20-25% HBL., <5% BTE. POSS. 5-7%
	LEUCOGRANITE (??). REMAINDER F.-M. XLINE FSP-QTZ-BTE. HBL. GNEISS W/ 20% TL. MAFICS.
	3540-50': W/ Tr. DK. GRAY MICRODIORITE.
	<5% MED.-XLINE. LEUCOGRANITE. Tr. BTE. HBL. QTZ MONZ. GNEISS. REM. FELSIC FSP-QTZ-BTE GNEISS (11-15% MAFIC)
Tr. CHL.	3550-60': SAME AS ABOVE
	GNEISS HAS BECOME V. FELSIC
	3560-70': SAME AS ABOVE.
① CALCITE Tr. CALC.-CHL.	3570-80': SAME AS ABOVE, SOMEWHAT MORE COARSELY XLINE. 25-30% MED.-XLINE LEUC. GRNT. 5%
	25-30% 15 M.XLN. QTZ. SCHIST MICRODIORITE. MAY BE CONTAMINATION IN PART. 2% DRILL STEEL. Tr. HEM. ③
CORE	SAME AS 3450-60' (V. FELSIC GNEISS
	Tr. FIBROLITE W/5% MED-XLN. LEUC. GR. Tr. ⑤
Tr. CALC.-CHL.	3590-3600' MIXED ZONE AGAIN. PROB. ~40% MED-XLN. BTE.
Tr. QTZ-SER-CHL	HBL QTZ. MONZ. GNEISS, SAME AS 3530-40'. 20% (?) M. XLN. LEUC. GRANITE. REMAINDER F XLN FSP-QTZ-HBL. BTE. GNEISS. Tr.③
Tr. CHL.-CALCITE-PY-	3600-10': SAME AS ABOVE W/30% (?) LEUCOCR. GRANITE. 20% QTZ. MONZ. GNEISS, REMAINDER
RITE	MIXED ZONE FSP-QTZ-HBL-BTE. GNEISS. Tr.③
Tr. CHLORITE-	3610-20': SAME AS ABOVE — 20% GRANITE, Tr MICRODIORITE
CALCITE	APPARENTLY NO QTZ. MONZ. GNEISS, AS ABOVE. Tr.⑤
←? (SCHIST)	3620-30': APPEARANCE OF 20% FREE MED-CRS.-XLINE BTE. NONE OF THIS IN ROCK CHIPS — PROB. FR. A
Tr. CALCITE	~15% QTZ MONZ. GNEISS MED.-CRS.-XLINE BTE SCHIST (?)(?). ALSO 10% GRANITE REMAINDER SAME AS ABOVE.
Tr. CALCITE-CHLORITE	3630-40': SAME AS ABOVE — Tr. MICRODIORITE
	Tr.③
Tr. QTZ-CALCITE	3640-50': 15% GRANITE, MED.-XLINE., & REMAINDER SAME AS 3450-60' i.e. 25-30% M. XLN. BTE. HBL.
Tr. CHL.	QTZ. MONZ. GNEISS W/ 50-55% F-M. XLN. FSP-QTZ-HBL-BTE. GNEISS. 1% ALT. MICRODIORITE. Tr③
Tr. QTZ-CHL-EP.	3650-60': 5% GRANITE, OTHERWISE SAME AS ABOVE.
① CALCITE	SEEMS TO BE A MIXED ZONE OF THE QTZ MONZ. GNEISS GRADING INTO FSP-QTZ-HBL-BTE GNEISS (XENOLITHS OF LATTER?)
Tr. QTZ-CHL-EP.	3660-70': LIGHT GRAY, F XLINE, FELSIC QTZ-FSP-BTE. GNEISS
Tr. CALCITE	5-7% QTZ. MONZ. GNEISS W/ONLY 10% TL. MAFICS. PROB. ~3% LEUCOCRATIC GRANITE.
	3670-80': SAME AS : W/ PROBABLY 10-15% M.XLN. BTE. HBL. QTZ. MONZ. GNEISS, AS ABOVE. ALSO
	10-15% MED. XLN. LEUC. GRANITE.
① CALCITE	3680-90': SAME AS ABOVE
Tr. CALCITE-CHLOR.	
	3690-3700': SAME AS ABOVE W/ ~ 25-30% MED-XLINE LEUCOCRATIC GRANITE.
① CALCITE	PERHAPS 30% BTE-HBL. QTZ. MONZ GNEISS. THIS GRADES INTO F-M XLINE BTE-HBL-FSP-QTZ-GNEISS. Tr③
	3700-3710': SAME AS ABOVE
① CALCITE	

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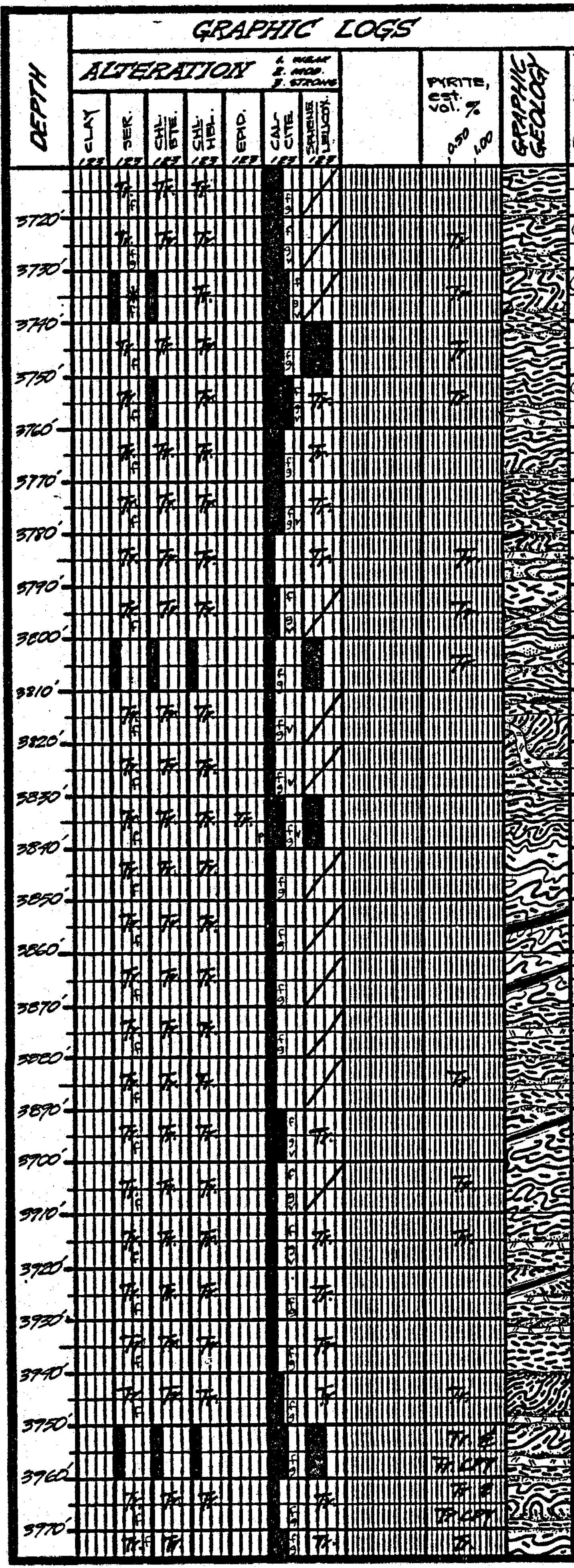

DESCRIPTIONS

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AUGUST 1978

Tr: TRACE 1. WEAK 2. MOD. 3. STRONG VEINLETS	
	3710-20': FSP-QTZ.-HBL.-BTE GNEISS F.-MED. XLINE, "SALT & PEPPER" TEXTURE, MOSTLY UNALT. EXC. FOR CALCITE.
	POSS. TR. SILLIMANITE. 15-20% (?) BTE. HBL. QTZ. MONZ GNEISS, M. XLINE Tr.③
① CALCITE	3720-30': 15-20% NO SILL. ONE FRAG QTZ-SERICITIZED FLT. GOUGE
Tr. ALT. MICRODIORITE	BTE-HBL. QTZ. MONZ. GNEISS, MED.-XLINE, W/ 15-18% HBL, 3-5% BTE. NO SPHENE.
② CALCITE	3730-40': SAME AS ABOVE, EXC. ~7% LEUC. MED.-XLINE GRANITE. ONE 7 mm. CHIP MOSTLY CHLORI-
	~15% FSP.-QTZ-BTE-HBL. GNEISS TIZED MED.-XLINE BTE. + CHLTZD. AMPHIBOLE. PLAG. IN GRANITE SELECTIVELY SERICITIZED. *
	3740-50': SAME AS 3710-20': NO SILL. APPEARANCE Tr.⑤
	W/10-15% QTZ MONZ. GNEISS? OF SPHENE, MOSTLY ALT. TO LEUCOXENE & CALCITE.
② CALCITE	3750-60': SAME AS ABOVE— MORE MAFIC RICH—. SPHENE FRESHER.
Tr. PYRITE.	15% MED.-XLN. LEUC. GRANITE ONE GRAIN PYRITE 2 mm. DIA. Tr.③
	3760-70: SAME AS ABOVE W/ 5-7% MED.-XLN. LEUC. GRANITE.
	~10% MED.-XLN. BTE. HBL. QTZ MONZ GNEISS, AS 3720-30'
① CALCITE	3770-80': SAME AS ABOVE W/ 2-3% AVG. MICRODIORITE, 5-7% LEUC. GRANITE.
	20% BTE-HBL QTZ. MONZ. GNEISS XL SIZE OF GNEISS APPARENTLY INCREASING. Tr.⑤
	3780-90': 30% BTE-HBL-QTZ-MONZ. GNEISS, 35% QTZ.-FSP-BTE GNEISS, REMAINDER F.-XLN. GRANITE.
	Tr.⑤
① CALCITE	3790-3800': 25% BTE.-HBL.-QTZ MONZ. GNEISS, MED-CRS XLN. 10% LEUC. FN.-MED. XLINE GRANITE. 2%
	MICRODIORITE, REMAINDER QTZ.-FSP-BTE GNEISS, SAME AS 3710-20'.
	3800-10': 15% BTE.-HBL. QTZ MONZ. GNEISS. Tr.-1% MICRODIORITE. REMAINDER SAME AS
	3710-20' WELL-DEVELOPED SILLIMANITE (FIBROLITE) PRESENT. Tr.③
	3810-20': 10% F.-MED. XLINE GRANITE OR ALASKITE. Tr. MICRODIORITE. 12-13% BTE. HBL. QTZ. MONZ.
Tr. CALCITE	Tr. MICRO-DIORITE GNEISS. REM. SAME AS 3710-20'. Tr.⑤
	3820-30': SAME AS ABOVE, W/ 20-25% MED. XLINE LEUCOCRATIC GRANITE, / 15% QTZ. MONZ. GNEISS
Tr. CALCITE	Tr. MICRODIORITE.
① CALCITE-	3830-40': 15% GR., OTHERWISE SAME AS ABOVE, W/ ~10% QTZ. MONZ. GNEISS
1 frag 1.5 mm. wide	Tr.③
	3840-50': LT. COLORED, F-XLN., QTZ.-FSP.-BTE GNEISS W/12-15% TL MAFICS, CRUDE FOLIATION
	POSS. Tr. LEUC. F.-XLN. GRANITE
	3850-60': SAME AS ABOVE. W/ SLIGHTLY MORE HBL. (1-3%?)
	5% MXL. GRANITE. Tr. RED-BROWN TRANSLUCENT GARNET <1 mm. DIA. Tr.⑥
← MINOR FLT.	3860-70': SAME AS ABOVE W/ 25-30% MED-XLINE QTZ. & KSPAR CHIPS (FROM LEUCOGRANITE?)
	3870-80': SAME AS ABOVE FOR 50% OF SAMPLE. THEN MAYBE 10-15% GRANITE & 40-35%
	MED. XLINE BTE, HBL QTZ. MONZ. GNEISS. W/ 15% (?) HBL & <3% BTE.
	3880-90': SAME AS ABOVE, EXC. MAFICS INCREASING. 20-25% (?) QTZ. MONZ. GNEISS
	15% (??) GRANITE REMAINDER FELSIC GNEISS
① CALCITE	3890-3900': SAME AS ABOVE. W/ 5-7% (?) QTZ MONZ. GNEISS
	5-7% GRANITE, MED.-XLINE
	3900-3910': SAME AS ABOVE, PROB W/ ~5% F.-M XLN. LEUCOCRATIC GRANITE
Tr. CALCITE	PERHAPS 10% QTZ. MONZ. GNEISS
	3910-20': SAME AS ABOVE W/ 20-25% (?) M-XLN. BTE. HBL QTZ MONZ GNEISS, SAME AS 3720-30'.
	Tr. ALT. MICRODIORITE 10-15% (??) GRANITE, AS ABOVE. REMAINDER F-M. XLINE FSP-QTZ-HBL-BTE. GNEISS
← MINOR FLT.	3920-30': SAME AS ABOVE.
Tr. QTZ-HEM-SER	3930-40': 70% MED.-XLINE BTE. HBL. QTZ. MONZONITE GNEISS, SAME AS 3790-3800'. Tr. MICRODIO-
	POSS. TR BM IN HBL GNEISS RITE. 10% (?) GRANITE, REMAINDER F-XLN QTZ.-FSP-BTE-HBL. GNEISS. SAME AS 3710-20'
Tr. QTZ.-CHL.-PYR.	3940-50': SAME AS 3710-20', BUT MORE GNEISS MAFIC-RICH (30-40%)
(BANDED)	10% LEUC. MED-XLINE GRANITE.
	3950-60': SAME AS 3940-50' W/ ~15% GRANITE (BTE GR, F. XL LEUC.) Tr. MICRODIORITE.
	15% MED-XLINE BTE-HBL. QTZ. MONZ. GNEISS, SAME AS 3720-30' REM. FSP-QTZ-HBL.-BTE GNEISS
	3960-70': SAME AS ABOVE. 10% QTZ. MONZ. GNEISS. 5-7% MED-XLINE. LEUC. GRANITE
	Tr. MICRODIORITE, REMAINDER F-M. XLINE FSP-QTZ-HBL.-BTE GNEISS.
	3970-80': SAME AS ABOVE. V. FELSIC (11-13% MAFICS) FSP-QTZ-BTE. GNEISS. 5% GRANITE

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NOTE: MUCH OF THE MED.-XLINE GRANITE DESCRIBED ABOVE IS PROBABLY A FELSIC MIGMATITIC DIFFERENTIATE. SOME OF THE QTZ & KSPAR CHIPS COULD ALSO COME FROM COEXISTING BTE.-HBL. QTZ. MONZ. GNEISS

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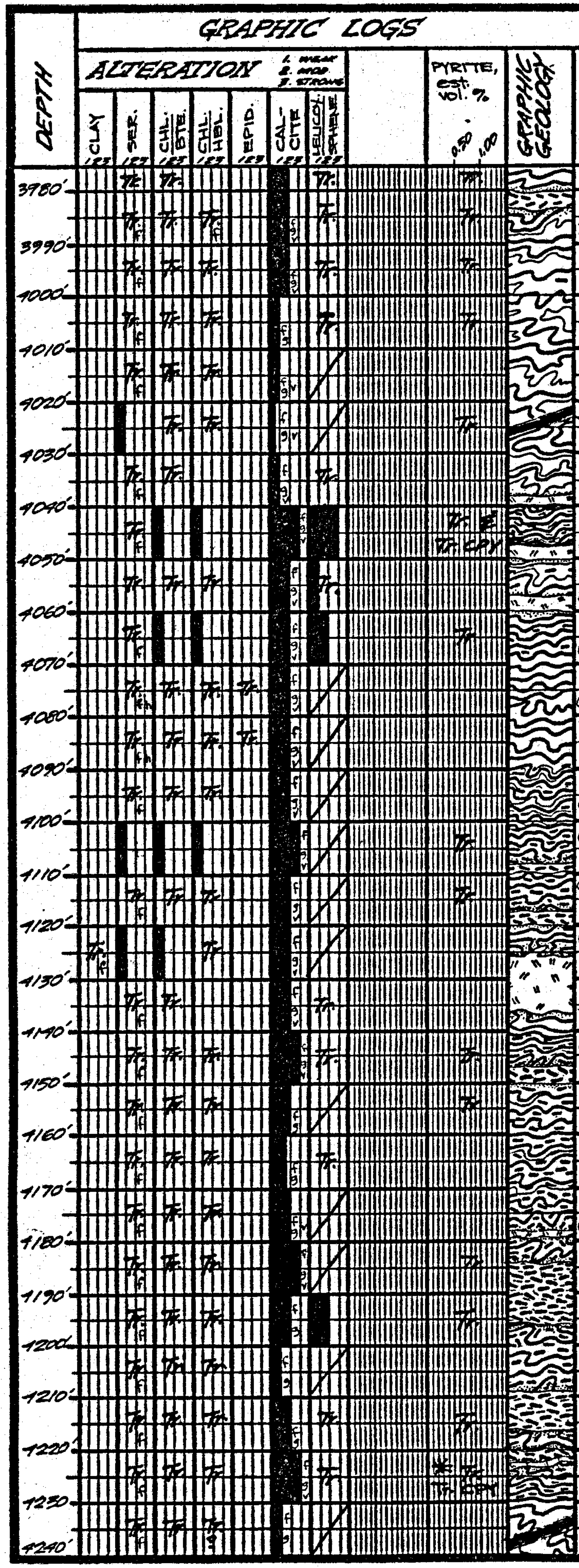

Tr. TRACE 1. WEAK 2. MOD. 3. STRONG VEINLETS	DESCRIPTIONS LOGGED BY J. B. HULEN AUGUST 1978
	3980-90': 35% (?) FINE-MED. XLN. BTE HBL QTZ. MONZ. GNEISS W/ AT LEAST 20% HBL, 5% BTE., Tr. SPHENE.
Tr. CALCITE	REMAINDER QTZ.-FSP.-BTE GNEISS W/ 15% TOTAL MAFICS — EX. 15 F. XLN. W/ "SALT & PEPPER" TEXTURE.
	3990-4000': QTZ-FSP.-BTE GNEISS W/ MINOR HBL., F XLN.,
Tr. CALCITE	<10% MAFICS CRUDELY FOLIATED, "SALT & PEPPER" TEXTURE
	4000-4010' SAME AS ABOVE. FELSIC — <10% MAFICS.
	4010-20': SAME AS ABOVE W/ 1-2% BTE-HBL. QTZ MONZ. GNEISS. 5-7% MED.-XLINE LEUC. GRANITE.
Tr. CALCITE	Tr. FIBROLITE. Tr. ⑤
MINOR FLT.?	4020-30': SAME AS ABOVE. ONE FRAG. TOTALLY SERCTZD.
Tr. CALCITE	Tr. FIBROLITE 5-7% M. XLN. BTE. HBL. QTZ. MONZ. GNEISS. 10% (??) M. XLN. LEUC. GRANITE Tr. ⑤
	4030-40': SAME AS ABOVE W/ 10-15% (?) M. XLN. LEUC. GRANITE
Tr. CALCITE	
	4040-50': SAME AS ABOVE, BUT MUCH MORE MAFIC-RICH (27-30%). CALCITE ALTN. INCREASES.
② CALCITE	ALSO W/ 20-25% MED-XLN. LEUC. GRANITE (?) Tr. FIBROLITE ONE SAMPLE. Tr. ⑤
	4050-60': SAME AS 4030-40'. FELSIC-RICH AGAIN (9-11% MAFICS — 1-3% HBL. POSS. Tr. M. XLN.
② CALCITE	BTE. HBL. QTZ. MONZ. GNEISS. 20% (??) MED. XLN. LEUC. GRANITE.
	4060-70': SAME AS 4030-40', BUT W/ 20% TL. MAFICS,
① CALCITE	5-7% QTZ. MONZ. GNEISS \ WHICH ARE MORE STRONGLY CHLTZD.
Tr. CALCITE-EPIDOTE	4070-80': SAME AS ABOVE. IN A FEW FRAGS HBL.
① CALCITE	APP. ALT. TO CHL.-SER PERHAPS 5-7% GRANITE Tr. ⑤
Tr. EPIDOTE-CALCITE	4080-90': SAME AS ABOVE. PERHAPS 5-7% M. XLN BTE.
Tr. CALCITE	HBL. QTZ MONZ. GNEISS, 5-7% GRANITE
Tr. CALCITE-HEMATITE	4090-4100': SAME AS ABOVE W/ Tr. MICRODIORITE (SELECTIVELY CHLTZD. & SERICITIZED) & 5% MED.
(IN MICROD.)	5-7% QTZ. MONZ. GN. | 5-10%? -XLINE QTZ-KSPAR PEGMATITE OR ALASKITE.
② CALCITE	4100-4110': SAME AS ABOVE W/ 3%? MED.-XLINE GRANITE(?) OR QUARTZOFELDSPATHIC
	DIFFERENTIATE. & ~10% MED-XLN. BTE HBL. QTZ. MONZ. GNEISS, SAME AS 3980-3990
① CALCITE	4110-20': SAME AS ABOVE. PYRITE DISS., ASSOC. W/
SEE 3980-3990 →	15-20% QTZ. MONZ. GNEISS CHLTZN. OF BTE. / 5-7% MXL. LEUC. GRANITE.
① CALCITE	4120-30': 40% MED.-XLINE LEUCOCR. GRANITE OR ALASKITE (?) OR MAY BE QUARTZOFELD- Tr. ⑤
	SPATHIC DIFFERENTIATE IN GNEISS. REMAINDER FELSIC F. XLN QTZ.-FSP.-BTE GNEISS
① CALCITE	4130-40': SAME AS ABOVE W/ ~60% GRANITE(?)
	Tr. ⑤
① CALCITE	4140-50': GNEISS, F. XLN., "SALT & PEPPER" TEXTURE, W/ MINOR HBL. PERHAPS 3%
	15-20% QTZ. MONZ. GNEISS SAME AS 3980-90' | MED.-XLINE LEUC. GRANITE.
	4150-60': SAME AS ABOVE. SOME CHIPS QUITE RICH
	~17% MAFIC IN HBL. — PERHAPS MINOR GRANITE & MINOR BTE. HBL. QTZ. MONZ. GNEISS.
	4160-70': SAME AS ABOVE. F-M XLN. FSP-QTZ-HBL-BTE. GNEISS ~17% TL. MAFICS.
	5% (??) M. XLN. LEUCOGRANITE ?
	4170-80': SAME AS ABOVE W/ PERHAPS 10% LEUCOGRANITE,
① CALCITE	5-10% BTE. HBL. QTZ. MONZ. GNEISS, SAME AS 3980-90' DIFF. TO DISTINGUISH FR OTHER GNEISS
① CALCITE	4180-90': SAME AS ABOVE. INCREASING MAFIC % (20%) 60-70% M. XLN. BTE. HBL. QTZ. MONZ. GNEISS W/ ~25% HBL.
	5-10% BTE. REMAINDER F.-M. XLN. FSP-QTZ. HBL BTE GNEISS, SAME AS 4160-70'
	4190-4200': SAME AS ABOVE, SPHENE Tr. ALT. TO LEUCOX.
	4200-10': SAME AS ABOVE W/ 10% QTZ MONZ GNEISS, 5% (?) M. XLN. LEUCOGRANITE. REMAINDER F-M. XLN.
	FSP-QTZ-HBL. BTE. GNEISS.
	4210-20': SAME AS ABOVE W/ 50-60% M XLN. BTE HBL. QTZ. MONZ. GNEISS, SAME AS 4180-90'. REMAIN-
	DER F-M. XLN. FSP-QTZ-HBL-BTE. GNEISS, SAME AS ABOVE.
Tr. CALCITE.	4220-30': 7% MED.-XLN. LEUCOGRANITE, Tr. APLITE, REMAINDER SAME AS ABOVE W/ 15% QTZ MONZ.
	GNEISS — 78% F-M. XLN FSP-QTZ-BTE GNEISS. * ALSO TR. BORNITE IN QTZ. MONZ. GNEISS
	4230-40': QTZ-FSP.-BTE GNEISS, F. XLN., SAME AS 4140-4150'.
	<1% HBL, 15-18% TL. MAFICS. DISTINCTIVE "SALT & PEPPER TEXTURE

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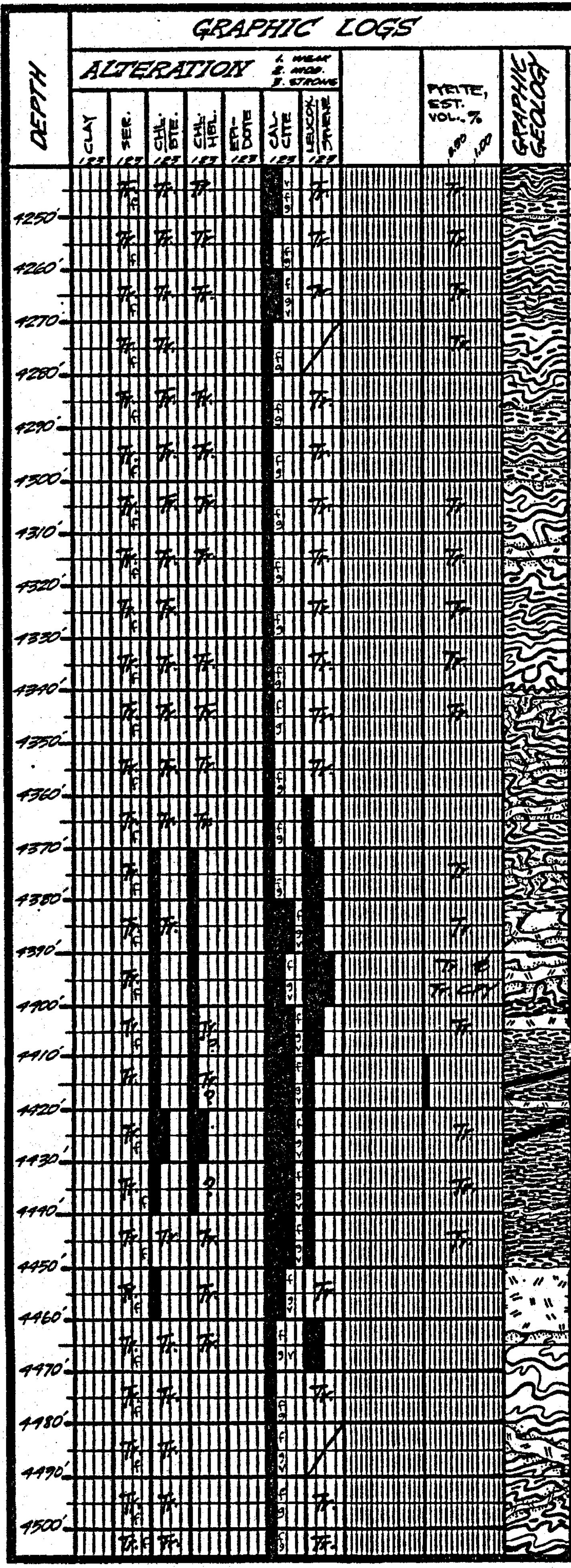
NOTE: MUCH OF THE MED.-XLINE LEUCOCRATIC GRANITE DESCRIBED ABOVE COULD BE A FELSIC MIGMATITIC DIFFERENTIATE.



DESCRIPTIONS

LOGGED BY
J.B. HULEN
AUGUST 1978

Tr. TRACE 1. WEAK 2. MOD. 3. STRONG VEINLETS	DESCRIPTIONS
① CALCITE	4240-50': FSP-QTZ-HBL-BTE. GNEISS, F. XLN., "SALT-AND-PEPPER" TEXTURE; MINOR HBL.; CRUDELY FOLIATED. 5-7% OF SMPL. IS MED.-CRS. XLINE LEUCOCRATIC GRANITE (OR QTZOFLDSPTHC. DIFF.) W/ ~ 20-25% QTZ. MONZ. GN.
	4250-60': F. XLN. FSP-QTZ-BTE GNEISS W/ ~ 20% MAFIC (1-3% HBL)
① CALCITE	4260-70': SAME AS ABOVE W/ GREATER TL. MAFICS & HBL. 7-10% MED-XLN. LEUC GRANITE. ~5% QTZ. MONZ. GNEISS
	4270-80': SAME AS ABOVE, BUT ONLY 1-3% HBL. 2% GRANITE OR QF DIFFERENTIATE.
Tr. CHLOR.	4280-90': SAME AS 4240-50'; NO GRANITE & 20-25% QTZ. MONZ. GNEISS (SEE IMM. BELOW)
	4290-4300': SAME AS 4240-50'; " W/ ~ 15% BTE-HBL-QTZ. MONZ GNEISS, M. XLN., W/ ~ 25% HBL, 5% BTE.
	4300-10': SAME AS ABOVE W/ 1-3%? QTZ. MONZ. GNEISS. PROB. 5-7%.
	4310-20': 20% MED.-XLINE. GRANITE OR ALASKITE 5-10% BTE HBL. QM GNEISS REMAINDER SAME AS ABOVE
	4320-30': 5% GRANITE. REMAINDER SAME AS ABOVE. W/ 5-10% QTZ. MONZ. GNEISS (SEE 4290-4300')
	4330-40': SAME AS ABOVE W/ ~ 15% QTZ. MONZ. GNEISS
	4340-50': 7-10% GRANITE (?) OR ALASKITE OR QUARTZOFELDSPATHIC METAMORPHIC DIFFERENTIATE. 5% QTZ. MONZ. GNEISS. REMAINDER SAME AS ABOVE.
	4350-60': SAME AS ABOVE.
	4360-70': SAME AS ABOVE, EXC. 15% GRANITE (SEE 4340-50')
	4370-80': SAME AS ABOVE W/ 10% GRANITE (SEE 4340-4350')
Tr. CHLORITE ② CALCITE	4380-90': SAME AS ABOVE EXC. STRONG INCREASE IN CALCITIC ALTN. (SEE 4340-50') 15% QTZ. MONZ. GNEISS
 ① CALCITE	4390-4400': SAME AS ABOVE W/ 20% GRANITE (SEE 4340-50') ~25% QTZ. MONZ. GNEISS. CHALCOPYRITE EMBEDDED IN HBL CRYSTAL IN QTZ. MONZ. GNEISS
Tr. PYRITE ② CALCITE Tr. CHL.	4400-10': 25% MED.-XLINE GRANITE (LEUCO-) OR ALASKITE OR QUARTZOFELDSPATHIC METAMORPHIC DIFF. both vnlt. & diss. pyrite ~25% MED-CRS.-XLINE BTE. HBL. QTZ. MONZ., SAME AS 4290-4300. REMAINDER FSP-QTZ-BTE-HBL. GNEISS.
② CALCITE Tr. PYRITE Tr. CHL.	4410-20': SAME AS ABOVE W/ 10% GRANITE, REMAINDER A GRADATION BETWEEN BTE. HBL. QTZ. MONZ. (M.-CRS XLN) → GNEISS AND FSP-QTZ-BTE. HBL. GNEISS (
② CALCITE ① CHL.	4420-30'. SAME AS ABOVE W/ 3-5% GRANITE
① CALCITE	4430-40'. SAME AS ABOVE. 90% OF SMPL. IS F-M XLN MAFIC RICH BTE-HBL. GNEISS W/ 35-40% HBL., 10-12% BTE. 10% OF SMPL. IS F XLN. FSP QTZ-BTE GNEISS W/ ONLY ~ 11-13% MAFICS.
① CALCITE	4440-50': SAME AS ABOVE, EXC. W 10-15% M.-CRS. XLINE BTE-HBL. QTZ. MONZ. GNEISS, AS 4290-4300
② CALCITE	4450-60': >90% MED.-XLINE GRANITE (LEUCO-) OR ALASKITE. REMAINDER F-XLN. QTZ.-FSP.-BTE. (W/HBL) GNEISS, SAME AS ABOVE
Tr. CALCITE	4460-70': 25% GRANITE, SAME AS ABOVE. REMAINDER F. XLN. FELSIC (7% MAFICS) QTZ.-FSP.-BTE. GNEISS.
	4470-80': GNEISS, SAME AS ABOVE W/ 10-15% GRANITE 5-10% BTE-HBL. QTZ. MONZ. GNEISS
 Tr. CALCITE	4480-90': 20% GRANITE OR ALASKITE, SAME AS 4400-10' REMAINDER F. XLN. QTZ.-FSP.-BTE. GNEISS.
	4490-4500': SAME AS ABOVE W/ 10% GR. OR ALASKITE.
	4500-10': FELSIC, F.-XLN., QTZ-FSP.-BTE GNEISS QTZ-RICH, DISTINCTLY FOLIATED

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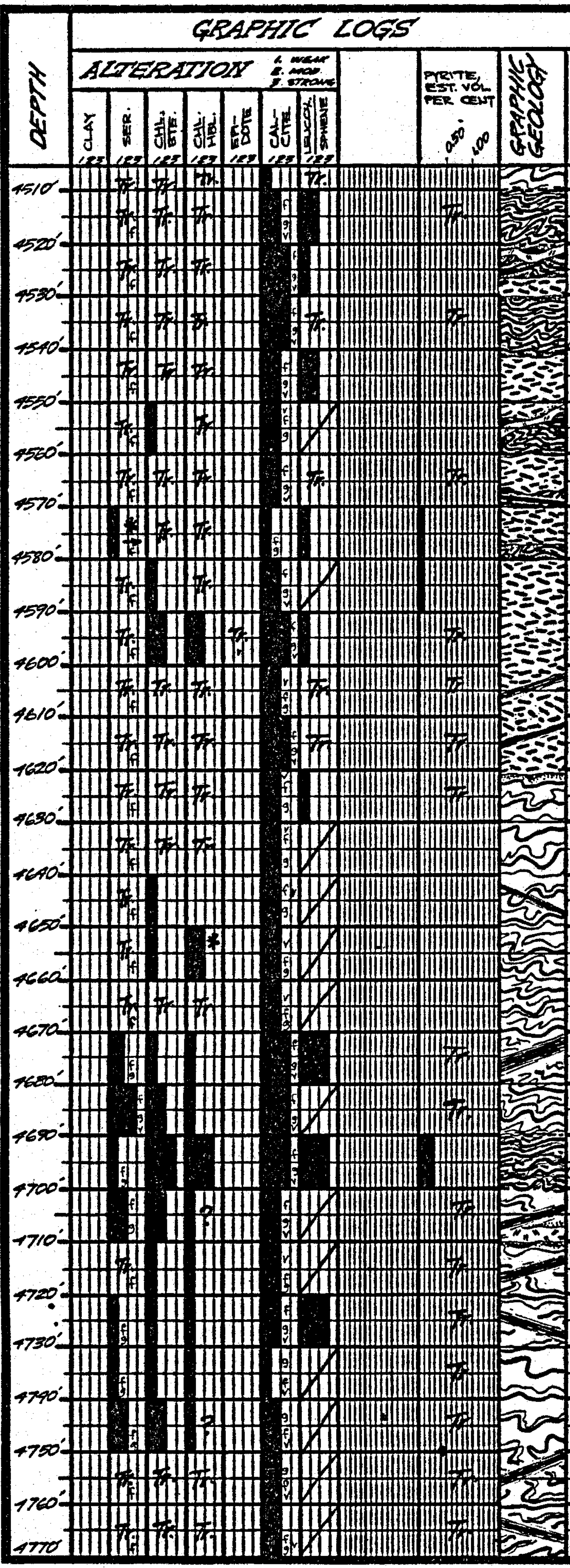
ROOSEVELT HOT SPRINGS KGRA

NOTE: MUCH OF THE MED.-XLINE LEUC. GRANITE DESCRIBED ABOVE COULD BE A FELSIC MIGMATITIC DIFFERENTIATE.

PAGE 18.



DESCRIPTIONS

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AUGUST 1978

Tr. TRACE 1. WEAK 2. MOD. 3. STRONG VEINLETS	DESCRIPTIONS
	HBL.
① CALCITE	4510-20': FINE-MED.-XLN. QTZ-FSP.-BTE. GNEISS W "SALT-AND PEPPER" TEXTURE; CRUDELY FOLIATED,
Tr. CHL.	5-7% QTZ MONZ. GNEISS. W/ ~1% SPHENE PTLY. ALT. TO LEUCOXENE & CALCITE
① CALCITE	4520-30': SAME AS ABOVE W/ ~10% MED.-XLINE GRANITE
Tr. CHL.	15-20% QTZ MONZ. GN. (LEUCOGR.) OR ALASKITE (OR QUARTZOFELDSPATHIC METAMORPHIC DIFFERENTIATE.
Tr. CHL-SER Tr. QTZ-CHL.	4530-40': FINE-MED. XLINE QTZ-FSP.-HBL-BTE. GNEISS ESSENTIALLY SIMILAR TO 4510-20'. 5%
Tr. CHL. ② CALCITE	GRANITE, SAME AS ABOVE.
	4540-50': 15% QTZ-FSP-HBL.-BTE. GNEISS, AS ABOVE, W/"SALT-AND PEPPER" TEXTURE. REMAINDER BTE.-HBL-
① CALCITE	QTZ. MONZ. GNEISS(?), MED.-XLINE, W/<5% BTE, ~25% HBL. 1% SPHENE ALT. TO LEUCOXENE
① CALCITE	4550-60': 25% QTZ. MONZ. GNEISS, AS ABOVE. 10% LEUCO-GRANITE OR ALASKITE, SAME AS 4520-30'.
	REMAINDER "SALT-AND-PEPPER" QTZ-FSP-BTE. GNEISS, SAME AS 4510-20'
Tr. BANDED QTZ.-CAL-	4560-70': 65% BTE.-HBL.-QTZ. MONZ. GNEISS, SAME AS 4540-50'; APP. NO SPHENE, HOWEVER
CITE-HEMATITE	5-7% GRANITE, SAME AS 4520-30': REMAINDER F.-XLN. QTZ.-FSP.-BTE GNEISS.
↖FLT.?	4570-80': 5-7% GRANITE. 75%(?) BTE.-HBL. QTZ. MONZ. GNEISS. REMAINDER F.XLN. QTZ-FSP.-BTE.-HBL.
	"SALT-AND-PEPPER" GNEISS. Tr. HEMATITE STAIN. * FSPS. IN LEUCOGRANITE SELECTIVELY SERICITIZED.
	4580-90': 95% BTE-HBL. QTZ MONZ. GNEISS, SAME AS 4540-50'. REMAINDER F. XLN. QTZ-FSP-BTE
Tr. CALCITE	GNEISS, SAME AS 4510-20'.
① CHL. ② CALCITE.	4590-4600' 90% BTE.-HBL QTZ. MONZ. GNEISS, SAME AS 4540-50'. 5% GRANITE, SAME AS 4520-30'.
Tr. CHL-EP	REMAINDER F.-MED. XLINE QTZ-FSP. BTE. GNEISS, SAME AS 4510-20'.
Tr. PYRITE	4600-4610': >90% QTZ. MONZ. GNEISS, SAME AS 4540-50'
① CALCITE	
	4610-20' 50-60% QTZ. MONZ. GNEISS, SAME AS 4540-50' 5-7% GRANITE, SAME AS 4520-30'
② CALCITE	ALSO MINOR ~XLN BTE XLS REMAINDER F.-MED. XLINE QTZ-FSP.-BTE GNEISS W/"SALT & PEPPER" TEXTURE.
① CALCITE	4620-30': LITH. CHANGE: ALL F. XLN., FELSIC, "SALT &
	PEPPER QTZ-FSP-BTE GNEISS, SAME AS 4510-20, BUT W/ FEW MAFICS ([illegible] T.)
① CHL. ① CALCITE	4630-40': SAME AS ABOVE W/ ~3-5% MED.-XLINE GRA-
MINOR CHL PLAG.→	Tr. BTE-HBL QM GNEISS NITE OR ALASKITE. MINOR CHL./PLAG(?)
① CALCITE	4640-50': SAME AS ABOVE W/7-10% GRANITE.
① CALCITE	4650-60': SAME AS ABOVE W/<1% BTE. HBL. QTZ. MONZ GNEISS SAME AS 4540-50'
Tr. CHL	* <0.5% HBL. IN ROCK
① CALCITE	4660-70': SAME AS ABOVE. 7-10%(?) MED.-XLN. LEUC. GR.
Tr. CHL.	3-5% BTE. HBL. QTZ. MONZ. GNEISS.
① CALCITE	4670-80': SAME AS 4620-30'. FAIRLY STRONG SERICITIZATION OF FLT. GOUGE. STRONG CALCITIC
Tr. CHL-SER.	ALTERATION.
	4680-90': SAME AS ABOVE. BTE. APPEARS TO BE PARTIALLY SERICITIZED AS WELL AS
① CALCITE	CHLORITIZED. Tr. DISS. PY.
① CHL.	4690-4700': F. XLN. QTZ-FSP.-HBL.-BTE. GNEISS W/"SALT & PEPPER" TEXTURE. STRONGLY ALTERED
② CALCITE	W/ ABUND. (RELATIVELY) DISS. PYRITE. ASSOC. MOSTLY W/ STRONGEST) ALTN.
Tr. CHL.	4700-4710': SAME AS 4620-30'. STILL STRONGLY
① CALCITE	20-25% LEUCOGRANITE? ALTERED.
① CALCITE	4710-20': SAME AS ABOVE
	F-M XLN FSP-QTZ-BTE GNEISS W/MINOR HBL (~15% TOTAL MAFICS
① CHL.-CALCITE	4720-30': SAME AS ABOVE W/ 5% MED.-XLINE. LEUCOCRATIC GRANITE/ OR ALASKITE
① CALCITE	
	4730-40': SAME AS ABOVE. 5-7% MXLN. BTE. HBL. QTZ. MONZ. GNEISS, SAME AS 4540-50'
Tr. CALCITE	ALSO 10%(?) MED. XLN. LEUCOCRATIC GRANITE.
	4740-50': SAME AS ABOVE W/ Tr. GRANITE, SAME AS
Tr. CALCITE	4720-30'. & Tr. QTZ MONZ. GNEISS.
	4750-60'. SAME AS ABOVE. ALTN. DECREASING.
① CALCITE	Tr. QTZ. MONZ. GNEISS
	4760-70': SAME AS ABOVE. 5% MED-XLN. LEUCOGRANITE.
① CALCITE	

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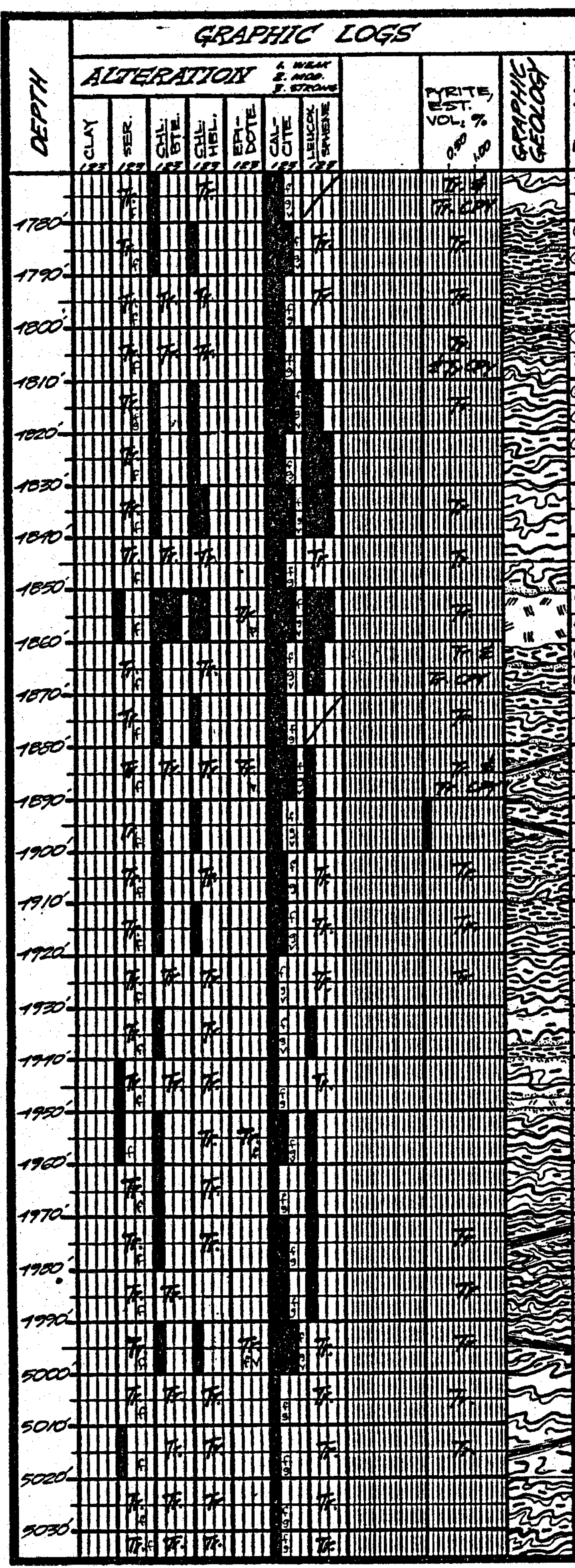
NOTE: MUCH OF THE GRANITE DESCRIBED ABOVE COULD BE A FELSIC MIGMATITIC. DIFFERENTIATE.



Tr. TRACE
1. WEAK
2. MOD.
3. STRONG

DESCRIPTIONS

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J. B. HULEN
AUGUST 1978

VEINLETS	DESCRIPTIONS
Tr. CHL.	4770-80': SAME AS 4760-70': F. XLN. QTZ.-FSP. BTE GNEISS
Tr. CHL.-CALC.	
① CHL.	4780-90': 5-7% MED.-XLINE LEUC. GRANITE. REMAINDER F.M. XLINE BTE-HBL-FSP.-QTZ. GNEISS GRADING INTO
② CALCITE Tr. QTZ.	also tr. calcite-hem. M. XLINE BTE-HBL. QTZ MONZ. GNEISS W/ 25% HBL, 5-10% BTE. ARBITRARILY ≈ 40% OF LATTER
	4790-4800': QTZ-FSP.-BTE.-HBL. GNEISS, FINE-XLINE, W % BTE, % HBL. THIS GRADES INTO
	also: 3-5% MXL. LEUCOG. MED-XLINE BTE-HBL. QTZ. MONZ. GNEISS W/ 20-25% HBL., 5-10% BTE. SAY 40% LATTER.
② CALCITE	4800-4810': 60% SAME AS ABOVE } 1% SPHENE ALT. 40% SAME AS 4760-70' } TO LEUCOXENE.
Tr. PYRITE.	
② CHLORITE-CALCITE	4810-20': SAME AS 4770-80'. ALTN. AS ABOVE.
① CALCITE	F.M XLINE FSP-QTZ-HBL.-BTE GNEISS W/ 11-13% BTE., 1-3% HBL. 3-10% BTE. HBL. QTZ. MONZ. GNEISS Tr. ⑤
① CALCITE	4820-30': SAME AS 4770-80': F. XLN. "SALT & PEPPER"
Tr. CHLORITE	5-7% QTZ MONZ GNEISS } QTZ.-FSP.-BTE. GNEISS. ALTN. AS ABOVE.
Tr. CAL-CITE	4830-40': SAME AS ABOVE. TR. DISS. PY.
	5-10% MXLN. BTE. HBL. QTZ. MONZ. GNEISS 5% (??) LEUCOGRANITE.
Tr. CHL.	4840-50': SAME AS ABOVE W/ 2-3% MED.-XLINE GRANITE OR ALASKITE.
	APPARENTLY NO QTZ. MONZ GNEISS.
① CHLORITE	4850-60': 10% SAME AS ABOVE. REMAINDER. FINE-MED. XLINE BTE. GRANITE. GR. CONTAINS 3-5%
② CALCITE	FLAKY BTE. TOTALLY ALT. TO CHL. TR. BRICK RED HEM. IN FLT. GOUGE.
① CALCITE	4860-70': 5-7% BTE. GRANITE, AS ABOVE. 15-17% (?) BTE-HBL QTZ. MONZ. GNEISS, MED. XLINE., W/ 20-30%
① CHL. } Tr. Chl-Hem.	HBL. — REMAINDER SAME AS 4820-30' PYRITE & CHALCOPYRITE ASSOC. W/ CHLTED. BTE & CHL. VNLTS.
	4870-80': 15% BTE.-HBL.-QTZ. MONZ. GNEISS, AS ABOVE. Tr. MICRODIORITE W/ ONLY SLTN. CHLTZN. OF MA-
Tr. CHL.-HEM.	FICS. Tr. DK. PURPLISH-GRAY DACITE OR ANDESITE PPY. REMAINDER SAME AS 4820-30'.
① CALCITE	4880-90': 55% MED.-XLN. BTE.-HBL. QTZ. MONZ. GNEISS, AS ABOVE (LG, CLEARLY RECOGNIZABLE FRAGS)
Tr. QTZ-EP.	Tr. MICRODIORITE. REMAINDER SAME AS 4820-30'.
	4890-4900': 50% MED XLINE BTE.-HBL. QTZ. MONZ. GNEISS 5% (?) MED.-XLINE GRANITE. REMAINDER
① CALCITE	sulf. assoc. w/chlorite F. XLINE QTZ-FSP.-HBL.-BTE GNEISS W/ "SALT & PEPPER" TEXTURE.
	4900-4910': 55% QTZ. MONZ. GNEISS, AS ABOVE. 3-5% GRANITE. REMAINDER SAME AS 4820-30'
Tr. CALCITE	4910-20': 30% QTZ. MONZ. GNEISS, AS ABOVE. REMAINDER SAME AS 4820-30'
Tr. CALCITE-CHLORITE	
Tr. CALCITE	4920-30: SAME AS 4820-30 W/ 19% TL. MAFICS. ALTN. HAS DECREASED.
Tr. CHL.-CALCITE	
Tr. CHL.	4930-40': SAME AS ABOVE W/ 5-7% MED-XLINE LEUCOCRATIC GRANITE.
Tr. CHL.-CALCITE	ALSO 15-20% MED-XLINE BTE-HBL. QTZ. MONZ. GNEISS.
	4940-50': QTZ-FSP.-BTE GNEISS, F. XLINE, "SALT & PEPPER TEXTURE (11% TL. MAFICS) QUITE FEL-
	SIC. 20% MED.-XLN. LEUCOCRATIC GR. Tr. UNALTERED MICRODIORITE.
	4950-60': GNEISS, SAME AS ABOVE. SERICITIZATION IN
	LEUCOX. ASSOC. W/CHLTZN. MORE THAN TRACES CONFINED TO <2% OF CHIPS. ≈5% QM. GNEISS
	4960-70': GNEISS, AS ABOVE. 1% MICRODIORITE, MOST UNALTERED (1 CHIP CHLTED.) 5-10% MXLN. BTE.
	HBL. QTZ. MONZ. GNEISS & 15-20% (??) MED-XLN. LEUCOGRANITE.
	4970-80': GNEISS, AS ABOVE. 7% GOUGE & BRECCIA
	3-7% QTZ. MONZ. GNEISS
	4980-90': GNEISS, AS ABOVE. Tr. UNALT. MICRODIORITE W/ 5-7% QTZ MONZ. GNEISS, 7-10% LEUCOGR.
	Tr. MICRODIORITE
① CALCITE	4990-5000': GNEISS, AS ABOVE. Tr. UNALT. MICRODIORITE 1% SPHENE—MOSTLY FRESH W/ MINOR ALTN.
Tr. CHL.	TO LEUCOXENE (W/ 20-25% BTE-HBL. QTZ. MONZ. GNEISS) & 7-10% LEUCOGRANITE
	5000-5010': "SALT-AND-PEPPER" QTZ.-FSP.-BTE. GNEISS FRESH SPHENE. 13% TL. MAFICS.
	Tr. QTZ MONZ. GNEISS | 5-7% MED.-XLINE LEUCOCRATIC GRANITE OR ALASKITE.
	5010-20': GNEISS, SAME AS ABOVE. Tr. MED.-XLINE BTE-HBL. QTZ. MONZ. GNEISS, SAME AS 4860-70'.
	Tr. UNALT. MICRODIORITE. Tr. ③
	5020-30': SAME AS ABOVE. W/ 5-10% MXLN. BTE., HBL. QTZ. MONZ. GNEISS, SAME AS 4790-4800'.
	Tr. FIBROLITE ONE CHIP. 1-3% LEUCOGRANITE. Tr. ③
	5030-40': SAME AS ABOVE. Tr. UNALT. MICRODIORITE. 5-10% QTZ MONZ GNEISS.

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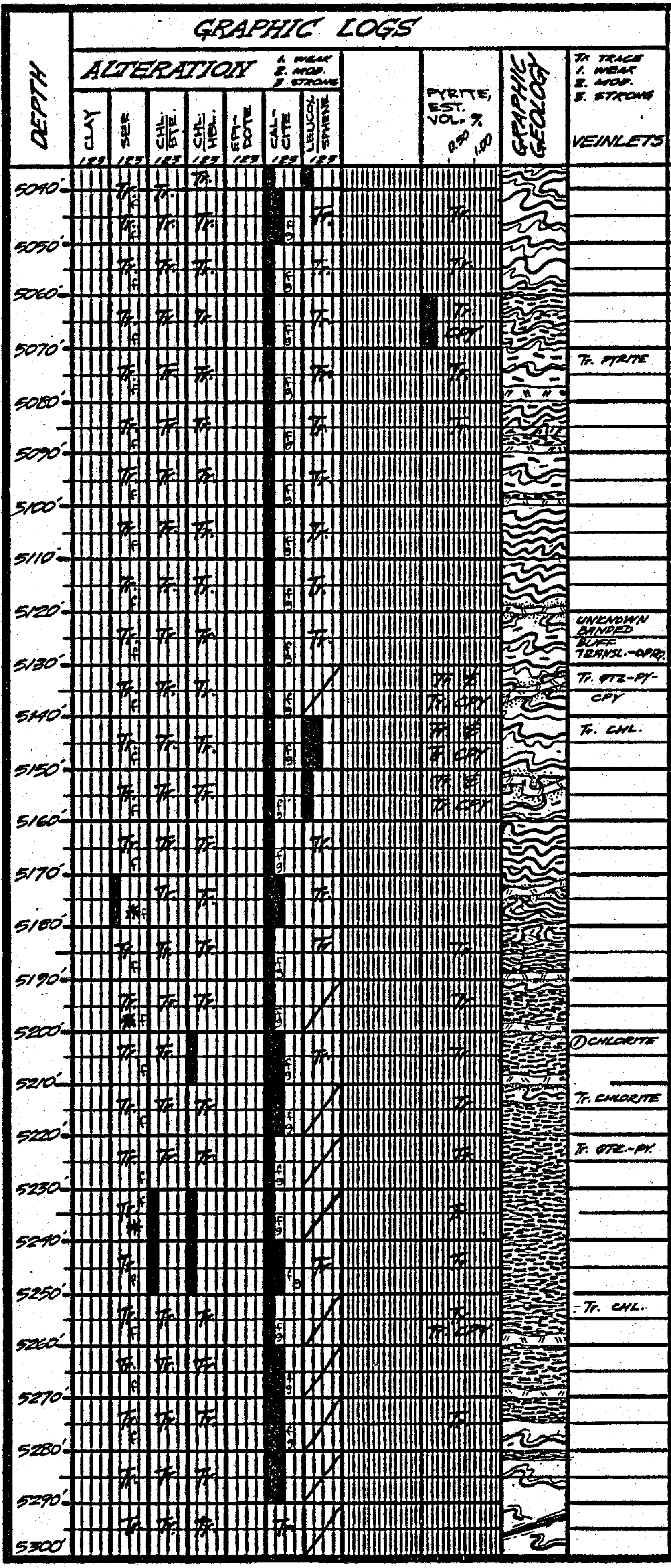
NOTE: MUCH OF THE MED-XLINE LEUCOGRANITE DESCRIBED ABOVE COULD BE A FELSIC MIGMATITIC DIFFERENTIATE.



DESCRIPTIONS

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5040-5050': QTZ-FSP.-BTE. GNEISS, FINE-XLN., "SALT-AND PEPPER" TEXTURE. 15% BTE. Tr. CHLTED. TO FRESH MICRODIORITE. POSS. 2-3% MED.-XLN. LEUC. GR. OR QTZOFELDSPATHIC DIFF.

Sphene ptly alt. to Leucox.

5050-60': SAME AS ABOVE (GNEISS ONLY). SPHENE MOSTLY FRESH.
3-5% M.XLN. BTE-HBL. QTZ. MONZ. GNEISS

5060-70': GNEISS, SAME TEXTURE AS ABOVE, EXC. MORE MAFIC-RICH W/APPEARANCE OF 7% HBL. SPHENE FRESH— (QTZ-FSP-HBL.-BTE. GNEISS)

COULD BE F.XL. EQUIV. OF BTE. HBL. QTZ MONZ. GNEISS IN PART

5070-80': SAME AS 5040-50' W/ 20-25% ? MED-XLINE LEUCOGRANITE, 5-10% M. XLINE BTE. HBL. QTZ. MONZ. GNEISS.

5080-90': GNEISS, SAME AS 5060-70 W/ 4% HBL. SPHENE FRESH. Tr. CHLTED. MICRODIORITE.

10-15% QTZ. MONZ. GNEISS

10% MXL. LEUCOGR.

10% MXL. BTE. HBL. QTZ. MONZ. GNEISS
10% (?) LEUCOGRANITE

5090-5100': SAME AS 5040-50' (GNEISS) SPHENE FRESH.

5100-10': SAME AS 5040-50'. 3-5% (?) GRANITE
Tr. FIBROLITE.
Tr ③

5110-20: GNEISS, SAME AS 5040-50' W/ 10% MED-XLN. LEUCOCRATIC GRANITE OR ALASKITE (OR QF DIFFERENTIATE.
Tr ③

5120-30': SAME AS ABOVE W/ 7% GRANITE
POSS 1-5% BTE-HBL. QTZ. MONZ. GNEISS
Tr ③

5130-40': SAME AS ABOVE W/ 10-15% GRANITE.
Tr. FIBROLITE. Tr. MICRODIORITE
Tr. ③

5140-50': SAME AS ABOVE W/ 10% GRANITE. (1?),
Tr. FIBROLITE. Tr. MICRODIORITE
Tr. ③

5150-60': SAME AS ABOVE W/ 10-15% (?) GRANITE

5160-70': SAME AS ABOVE W/ 5-7% GRANITE. Tr. CHLTED. MICRODIORITE

5170-80': SAME AS ABOVE W/ ~10% GRANITE. Tr. CHLORITIZED MICRODIORITE.
* fsps. in granite selectively sericitized—many moderately so

5180-90': 20% F.XLN. "SALT & PEPPER" GNEISS, AS ABOVE. REMAINDER MED.-XLINE MAFIC-RICH FSP-QTZ HBL-BTE. GNEISS NO DISCERNIBLE FOLIATION ~20% HBL., 20% BTE, but NO SPHENE

0-15% MXL. LEUCOGR.

5190-5200' SAME AS ABOVE. 20% "SALT-AND-PEPPER" GNEISS F.XLN. 10-15% (??) M.XLN. LEUCOGRANITE? REMAINDER MXL. BTE HBL. QTZ. MONZ. GNEISS, V. MAFIC
Tr ③

20-25% HBL.
15-20% BTE

5200-10': SAME AS ABOVE. QTZ. MONZ. GNEISS SHOWS CRUDE FOLIATION. 1% MICRODIORITE PORPHYRY & MICRODIORITE—½ CHIPS FRESH, ½ CHLTED., ARGILLIZED (?). POSS. TR. GRANITE.
Tr. ③

5210-20': 55% "SALT & PEPPER" GNEISS, AS ABOVE. 1% MICRODIORITE, CHLTED. W/ 1% DISS. PY. IN SEV. CHIPS. REMAINDER MED.-XLINE BTE. HBL. QTZ. MONZ. GNEISS, SAME AS 5180-90'.
Tr. ③

5-7%?? LEUCOGRNT.

5220-30': HBL. BTE. QTZ. MONZ → GNEISS (?) SAME AS 5180-90' EXC. RICHER IN TL. MAFICS. <5% "SALT. & PEPPER" GNEISS. Tr. CHLTED. MICRODIORITE W/ DISS. PY

5-7%? LEUCOGRANITE

5230-40': SAME AS ABOVE. PY ASSOC. W/ CHLTED & SERCTED. CHIPS. → BUT F-M. XLINE >65% TL MAFICS.
* <1% OF CHIPS STRONGLY SERICITIZED.
5-7% (?) LEUCOGRANITE

5240-50': SAME AS ABOVE W/ 7-10% QTZ & KSPAR CHIPS WHICH COULD COME FROM THE GNEISS OR FROM A LEUCOGRANITE. EST. 25-30% HBL. 20-25% BTE.

5250-60': SAME AS ABOVE. W/ 15% LEUCOGRANITE (?)
Tr. MICRODIORITE.

5260-70': SAME AS ABOVE. A FEW CHIPS SHOW EXCELLENT FOLIATION.

5270-80': 40% (?) SAME AS ABOVE. REMAINDER QTZ-RICH QTZ.-FSP.-BTE GNEISS W/ 5-7% BTE, >50% QTZ., F. XLN.

5280-90': 10-15% BTE-HBL. QM. GNEISS, SAME AS 5180-90'. REMAINDER SAME AS ABOVE W/ Tr. CHLTED. MICRODIORITE.

5290-5300': 90% FELSIC GNEISS (??) EXTR. QTZ.-RICH ROCK W/ MINOR FSP & MAGNETITE, BIOTITE — F.XLINE
Tr BTE-HBL. GNEISS, AS 5180-90'. REMAINDER BK "SALT-AND-PEPPER" QTZ-FSP.-BTE GNEISS.

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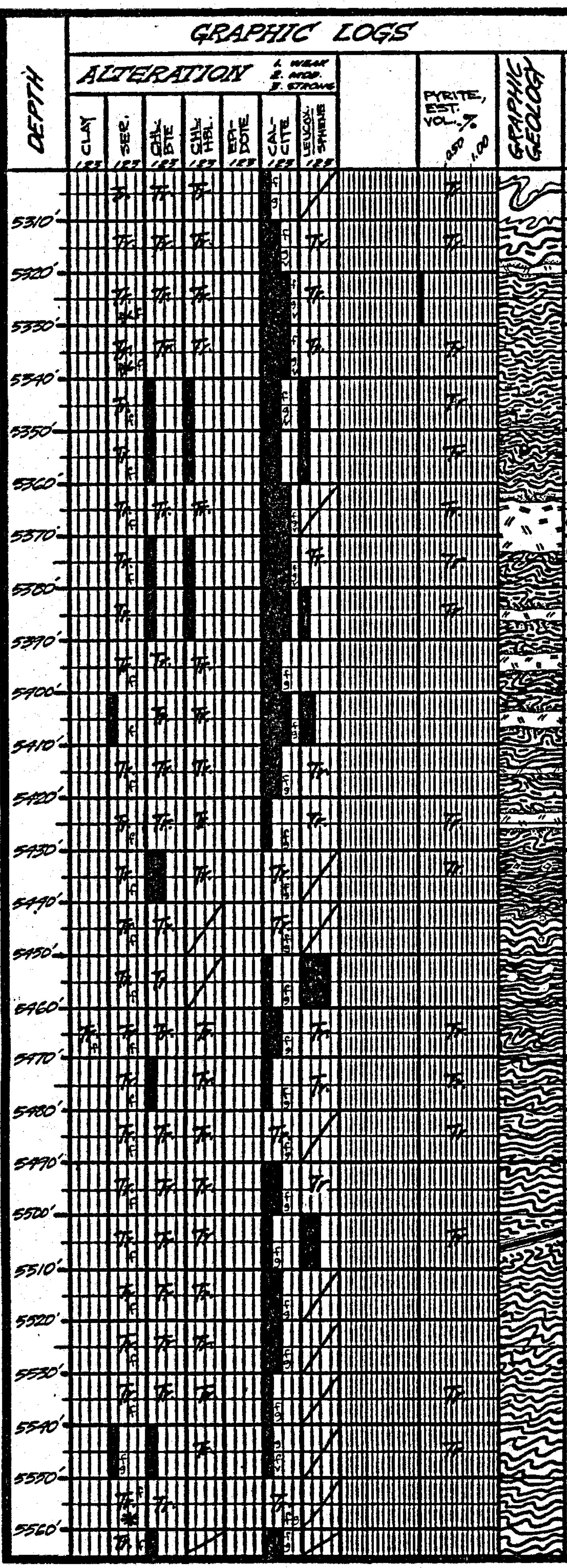

DESCRIPTIONS

LOGGED BY
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AUGUST 1978

Tr. TRACE
1. WEAK
2. MOD.
3. STRONG

VEINLETS	DESCRIPTIONS
	5300-5310': SAME AS 5300-5290 — TOO QTZ-RICH TO BE GRANITE 5-7% BTE HBL. QTZ. MONZ. GNEISS, AS 5180-5190
① CALCITE	5310-20' SAME AS ABOVE EXC. MAFICS INCREASE ALSO 10-15% GRANITE Tr Ⓢ
① CALCITE	5320-30': 7-10% SAME AS 5300-5310'. 5-7% MED.-XLINE GRANITE OR ALASKITE, REMAINDER IS F. XLINE QTZ-FSP-HBL.-BTE. GNEISS W/≈30% TL. MAFICS, ABUND. SPHENE Tr. Cordierite ? Tr. MICRODIORITE. 0.1% DISS. PYRITE Tr. Ⓢ
① CALCITE	5330-40' SAME AS ABOVE—ALL RX TYPES & PERCENTAGES * A FEW CHIPS GRANITE (?) STRONGLY SERICITIZED. Tr. Ⓢ
Tr. CALCITE	5350-40': SAME AS ABOVE Tr. Ⓢ
Tr. CHL.	5350-60': SAME AS ABOVE EXC. MORE MAFIC, REL MORE HBL. SPHENE DIMINISHES. NO GRANITE.
① CALCITE	5360-70': 30% F. XLN. QTZ-FSP-HBL-BTE GNEISS, SAME AS 5320-30'. TR. CHLTZD. MICRODIORITE – 2 CHIPS W/1-2% DISS. PYRITE. 10% MED. XLINE BTE & HBL. 60% MED. XLINE QTZ, KSPAR, PLAG (LEUCOGRANITE ?)
② CALCITE Tr. CHL.	5370-80'. 30% MED.-XLINE GRANITE (CHIPS OF QTZ, KSP. PLAG. W/Tr. BTE MAGNETITE). TR. CHLTZD. MICRODIORITE, REMAINDER FINE-MED. XLINE QTZ-FSP-HBL.-BTE GNEISS.
② CALCITE Tr. CHL.	5380-90': 20% GRANITE, 80% GNEISS, Tr. MICRODIORITE, AS ABOVE.
Tr. CHL.-HEM. ① CALCITE	5390-5400': 30% GRANITE, 69% GNEISS, 1% MICRODIORITE, AS ABOVE. ALSO Tr. DACITE (?) PPY., DK PURPLISH-GRAY W/5% EUH. PLAG. PHENOS AVG. <0.2 MM. LENGTH
	5400-10': SAME AS ABOVE
	5410-20': 10% GRANITE, Tr. MICRODIORITE, 70% GNEISS, AS ABOVE, EXC. REL. % HBL. DECREASING, XL. SIZE DECREASING. Tr. Ⓢ
Tr. PYRITE	5420-30': 30% GRANITE. Tr. MICRODIORITE. REMAINDER QTZ-FSP-HBL.-BTE. GNEISS, AS ABOVE. Tr. Ⓢ
	5430-40': CHANGE: MED.-CRS. XLINE BTE GNEISS W/30% TL. MAFIC — 7% CRS-XLINE LT. GREEN MUSCOVITE(?) POSS. MINOR GREENISH CORDIERITE, Tr. GARNET. NO SPHENE. ⒼⓈⒸ?
	5440-50'; MED-XLN. QTZ-FSP.-BTE GNEISS W/Tr. SILLIMANITE. PROB. 1% CORDIERITE. NO HBL. OR SPHENE. PROB. 5-7% GRANITE, MED-XLINE, LEUCOCRATIC. ⓈⒸ?
	5450-60': SAME AS 5430-40', EXC. NO OBVIOUS CORDIERITE. ⒼⓈ
Tr. CHL. HBL. APPEARS AGAIN	5460-70': SAME AS 5430-40', EXC. MORE FINELY XLINE, & W/MINOR FRESH SPHENE. ≈5% MED-XLN GRANITE (LEUC.) OR ALASKITE OR QTZOFELDSPATHIC METAMORPHIC DIFFERENTIATE. ⒼⓈ
Tr. CHL.	5470-80': SAME AS ABOVE. MINOR CHLTZN. OF FSPS. SEVERAL COARSE SILLIMANITE XLS. Tr. MICRODIORITE (ONLY DISS. PY.) Ⓢ
	5480-90': SAME AS ABOVE W/1% MICRODIORITE Ⓢ
	5490-5500': SAME AS ABOVE W/5% HBL., 30% BTE, 1% SPHENE Tr. DK. PURPLE-GRAY DACITE PPY. Tr. MICRODIORITE Ⓢ
(TO MED.-XLINE)	5500-10': FINE-XLN. QTZ-FSP.-BTE GNEISS W/"SALT & PEPPER" TEXTURE. 3% LG. PCS. FAULT GOUGE W/CHLORITE. MINOR MED-CRS. XLINE BTE. Tr. GREENISH-GRAY CORDIERITE.
Tr. CHL.	5510-20': SAME AS ABOVE 3-5% MED.-XLINE. GR.
Tr. CHL.	5520-30': SAME AS ABOVE. 3-5% MED.-XLINE GR Ⓒ?
	5530-40': SAME AS ABOVE.
	5540-50': SAME AS ABOVE. Tr. CHLTZD. MICRODIORITE. 5% MED.-XLINE GRANITE. (LEUCOCRATIC) Ⓢ
	5550-60': SAME AS ABOVE EXC. ABUNDANT SILLIMANITE. * <0.5% OF CHIPS STRONGLY SERICITIZED. Ⓢ
Tr. CHL.-SER.	5560-70': SAME AS ABOVE Ⓢ

GETTY OIL CO. 52-21
ROOSEVELT HOT SPRINGS KGRA

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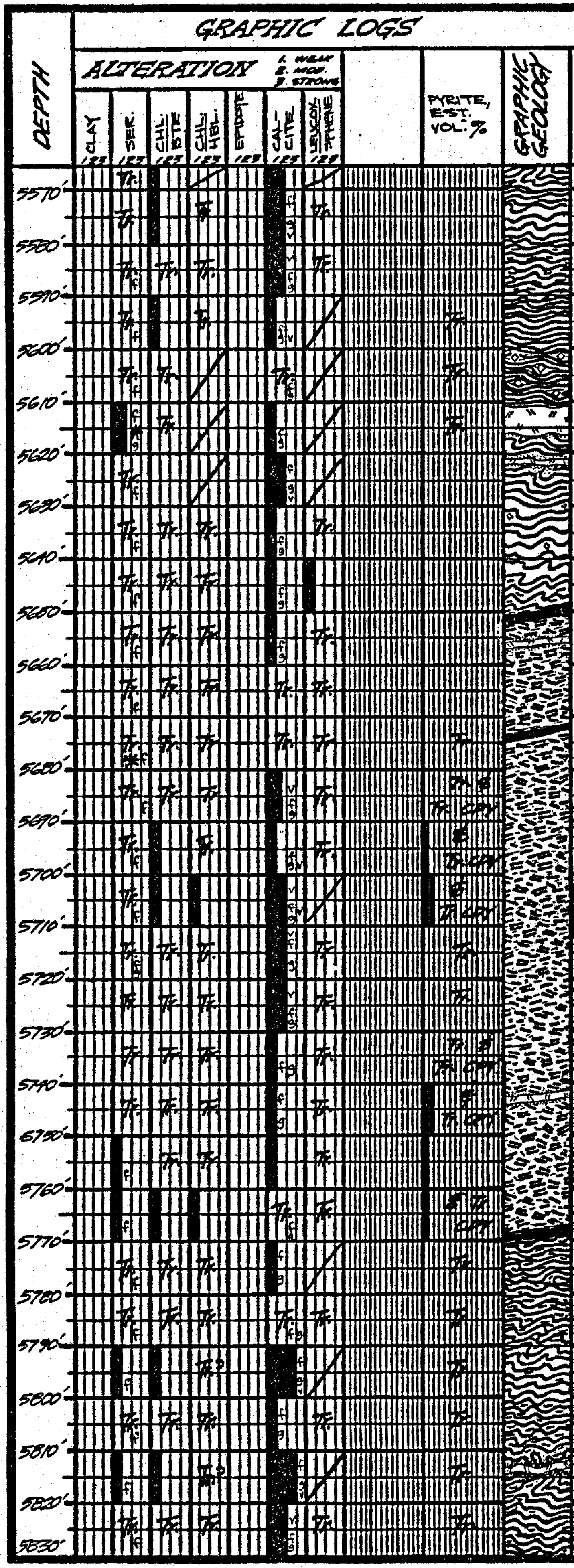
GRAPHIC LOGS



DESCRIPTIONS

LOGGED BY
J.B. HULEN
AUGUST 1978

Tr. TRACE
1. WEAK
2. MOD.
3. STRONG

VEINLETS	DESCRIPTIONS
① CALCITE	5570-80' : SAME AS 5560-70'
	⑤
① CALCITE	5580-90': QTZ-FSP-BTE GNEISS, F. XLN., "SALT & PEPPER" TEXTURE, 7% HBL. ABUNDANT SPHENE.
	3% MED-XLINE LEUC. GRANITE OR ALASKITE. ONE CHIP CRS.-XLN. CHL-SER(MUSC)-SILL. SCHIST. ⑤
Tr. CALCITE	5590-5600': SAME AS ABOVE EXC. NO SPHENE. ABUND. SILLIMANITE. PROB. MINOR CORDIERITE.
	Chl. ALSO AFTER FSPS. ⑤
	5600-10': SAME AS ABOVE W 3% TRANSL. BROWNISH-RED SUBHEDRAL GARNET UP TO 2 mm DIA.—AVG.
	<0.3 mm. STILL ABUND. SILLIMANITE. ⑤⑥
	5610-20': 60% MED-XLINE. FRAGS OF QTZ, KSPAR—COULD BE LEUC. GRANITE OR ALASKITE OR
* mostly in granite	FELSIC DIFFERENTIATE IN GNEISS. Tr. MICRODIORITE. REST F.XL. QTZ-FSP-BTE ⑤
Tr. CALCITE	5620-30': 10% GRANITE. 1% CHLTZD. MICRODIORITE. REMAINDER F.XLN. QTZ-FSP-BTE "SALT & PEP-
	PER" GNEISS W/ Tr. SILLIMANITE & CORDIERITE ⑤
	5630-40': QTZ-FSP-BTE GNEISS, F-M-XLN.
	Tr SILLIMANITE & RED-BROWN GNT. <0.1 mm ⑤⑤
	5640-50': SAME AS ABOVE W/ 10% GRANITE SAME AS
	5610-20'. Tr. CHLTZD. MICRODIORITE ⑤⑥
	5650-60': 10% GRANITE SAME AS 5610-20'. REMAINDER F-M. XLINE BTE. HBL. QTZ MONZ. GNEISS
	POSS. FLT. CONTACT WITH QTZ-FSP-BTE. GNEISS ABOVE (HIGH % GOUGE & BX. CHIPS IN SMPL.
	5660-70': SAME AS ABOVE W/ < 3% GRANITE
	5670-80': SAME AS ABOVE.
	* A FEW GR. CHIPS MOD. SERCTZD.
Tr CALCITE	5680-90': SAME AS ABOVE, EXC. HBL. DECREASING.
	7% GRANITE OR FELSIC DIFFERENTIATE. Tr. ⑤
Tr. CAL-CITE	5690-5700': SAME AS 5650-60'. HBL. INCREASING RELATIVE TO IMMED. ABOVE.
Tr. CHL.	1% CHLTZD. MICRODIORITE REL. % BTE. VS. HBL. VARIES WIDELY WITH INDIVIDUAL FRAGS. (2 BX. TYPES?) Tr. ⑤
Tr. CALCITE	5700-5710': SAME AS ABOVE W/ 25% HBL, 12% BTE.
Tr. CHLOR.	<0.5% CHLTZD. MICRODIORITE. INCR. IN DISS. SULFIDES. 4% MED-XLINE LEUC. GRANITE.
	5710-20'. SAME AS ABOVE. NO μDIORITE. 1% GRANITE
① CALCITE	Tr. ⑤
	5720-30': SAME AS ABOVE. TOTAL MAFICS DECREASING.
④ CALCITE	Tr. MICRODIORITE.
	5730-40': SAME AS ABOVE W/ 5-7% GRANITE (SEE BELOW)
	5740-50'. SAME AS ABOVE W/ ~ 10% LEUCOCRATIC GR., MED.-XLINE, Tr. MICRODIORITE.
	Tr. ⑤
	5750-60': SAME AS ABOVE. 5% GRANITE. Tr. MICRO-
	DIORITE. INCR. IN SERCTZN. (GRANITE FRAGS SELECTIVELY SERCTZD.)
	5770-80': (CHANGE) QTZ-FSP-BTE. GNEISS, F.-M.-XLINE, "SALT & PEPPER" TEXTURE. SPHENE
	DROPS OUT. ALTN. DECREASES.
	5780-90': SAME AS ABOVE.
	Tr. ⑤
① CALCITE	5790-5800'. SAME AS ABOVE, INCR. IN ALTN.
Tr. CHL.	Tr. ⑤
	5800-10': SAME AS ABOVE. HBL. INCREASING.
	Tr. ⑤
② CALCITE	5810-20': SAME AS ABOVE. FeOX STAIN FROM ABUNDANT DRILL CUTTINGS Tr. ⑤
Tr. CHL.	Tr. MICRO-DIORITE 10% LEUCOCRATIC MED. XLINE GRANITE CHIPS. THESE SELECTIVELY MORE INTENSELY SERCTZD.
① CALCITE	5820-30': SAME AS ABOVE. 2-3% GRANITE.

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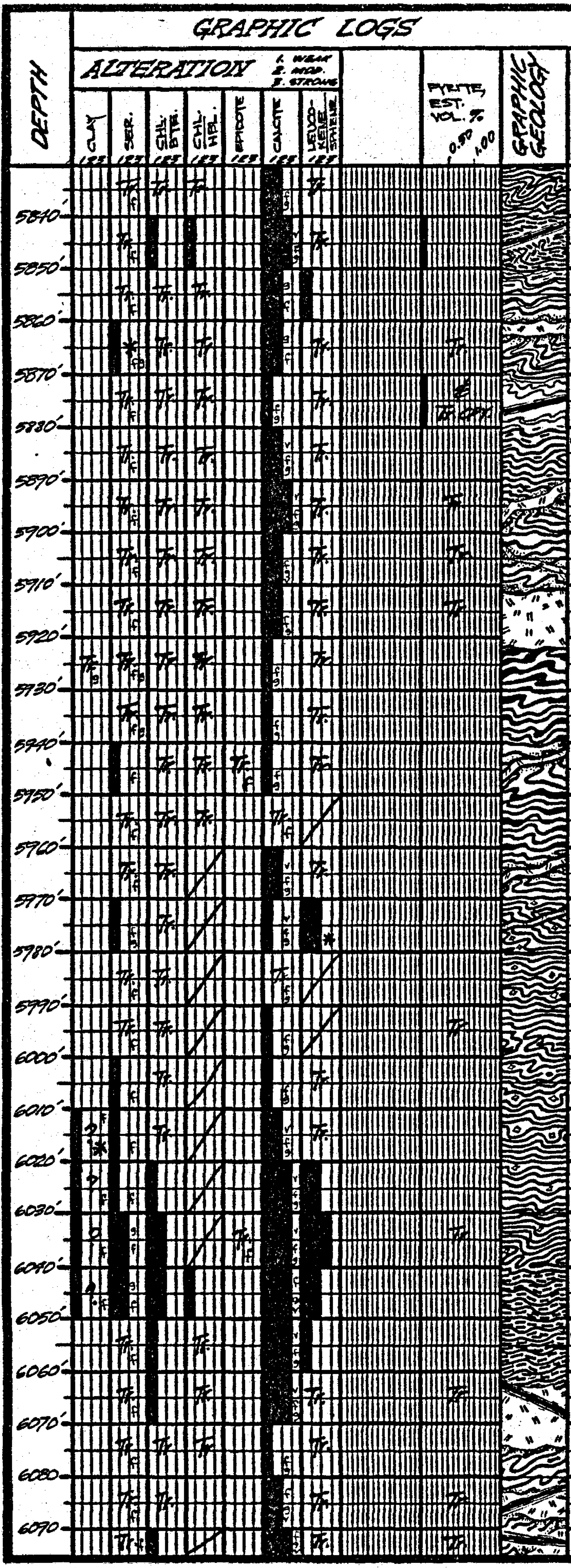
ROOSEVELT HOT SPRINGS KGRA

NOTE: MUCH OF THE MED-XLINE LEUCOCRATIC GRANITE DESCRIBED ABOVE COULD BE A FELSIC MIGMATITIC DIFFERENTIATE.

GRAPHIC LOGS



DESCRIPTIONS

LOGGED BY J. HULEN
AUGUST 1978

Tr. TRACE 1. WEAK 2. MOD. 3. STRONG VEINLETS	
	5830-40': QTZ.-FSP.-BTE GNEISS, F. XLINE. "SALT & PEPPER" TEXTURE, 40% TL. MAFICS. 5% MED.-XLINE LEUC. GRANITE OR FELSIC DIFFERENTIATE IN GNEISS. Tr. CHLTED. MICRODIORITE.
② CALCITE	5840-50': SAME AS ABOVE, EXC. HBL.-RICH (SAME AS 5650-5770'. 10% GRANITE
	5850-60': SAME AS 5830-40'. 10% GRANITE (?)
	5860-70': 25% MED.-XLINE LEUC. GRANITE OR ALASKITE. Tr. MICRODIORITE, CHLTED, W/MINOR DISS. PY. REMAINDER SAME AS 5830-40'.
	5870-80': CHANGE: V. FELSIC F-XLINE QTZ.-FSP.-BTE GNEISS W/ONLY 7% BTE. CRUDE FOLIATION APPARENT. Tr. DISS. PY. & CPY.
① CALCITE	5880-90': MAFIC INCREASE (TO 35%) IN GNEISS. 5-7% GRANITE, AS 5860-70'.
② CALCITE	5890-5900': SAME AS ABOVE W/ 15% GRANITE.
	5900-5910': SAME AS ABOVE W/ 10% GRANITE
Tr. POWDERY MAROON HEMATITE	5910-20': 10% SAME AS 5830-40' (GNEISS). REMAINDER. F.-MED.-XLN. LEUCOCRATIC BTE. GRANITE. Tr.③ (< 0.5% BTE.). CRUDE FOLIATION APPARENT— MAY BE FELSIC METAMORPHIC DIFFERENTIATE.
Tr. CHL.	5920-30': 15% GRANITE, AS ABOVE. Tr. MICROXLINE LT. GRAY RHYOLITE. REMAINDER MED.-CRS. XLINE Tr.⑤ QTZ-RICH QTZ-FSP-BTE. GNEISS W/ ABUNDANT FREE BTE. XLS., SOME REPLACED W/ FIBROLITE.
	5930-40': SAME AS ABOVE EXC. SL. DECREASE IN GRAIN SIZE. REMAINS V. QTZ. RICH. Tr.⑤ A FEW FRAGS W/ JUST HBL. AS MAFIC. THESE ALSO REL. RICH IN SPHENE (ANOTHER RX. TYPE?)
	5940-50': GNEISS, QTZ.-RICH, SAME AS 5920-30', EXC. F-MED. XLINE & MUCH LESS BTE. Tr.⑤ 10% (?) GRANITE, SAME AS 5910-20'.
	5950-60': SAME AS ABOVE. GRAIN SIZE HIGHLY VARIABLE. ONE GRAIN W/ 1 mm. BRIGHT Tr.⑤⑥ PINK ZIRCON. POSS. Tr. < 1 mm. RED-BROWN GARNET. POSS 5-7% GRANITE
① CALCITE	5960-70': QTZ-FSP.-BTE. GNEISS, F.-MED. XLINE, QTZ-RICH MUCH W/ A "SALT & PEPPER" TEXTURE. Abund. Fibrolite 15% LEUC. BTE. GRANITE, SAME AS 5910-20' ⑤
Tr. CALCITE	5970-80': SAME AS ABOVE. ABUND. SILLIMANITE & ~ 1% ANH.-SUBH. RED-BROWN GARNET. Abundant Fibrolite 10% GRANITE * SPHENE IN ONLY 2 FRAGMENTS ⑤
	5980-90': SAME AS 5970-80'. POSS. TR. CORDIERITE. 0.5% GARNET ⑥ ⑤
	5990-6000': SAME AS 5970-80' — NO GARNET ⑤
	6000-6010': SAME AS 5970-80': Tr. CORDIERITE (TRANSL. BLUISH-GRAY, ANH., < 1 mm) 0.5% GARNET ⑥⑤
① CALCITE	6010-20': SAME AS 5970-80': FSPS. ALT. (NOT ALL FSPS.) TO LT. GRAY-GREEN WAXY MATERIAL — PROB. SER. W/MINOR CHL., POSS. CLAY Tr. GARNET ⑥⑤ * — "CLAY" MAY BE F. XLN. SER.
② CALCITE	6020-30': SAME AS ABOVE. 5-7% GRANITE, AS 5910-20' Tr. GARNET ⑥⑤
② CALCITE	6030-40': SAME AS ABOVE. ROCK HAS CLOUDY GRAY-GREEN ASPECT. Tr. GARNET. ⑥⑤
② CALCITE	6040-50': QTZ.-FSP.-HBL.-BTE. GNEISS, F.-M. XLINE., "SALT & PEPPER" TEXTURE. BTE = HBL. TL. MAFICS 35%. ALTN. SAME AS 6010-20'. 3-5% GR.
② CALCITE	6050-60': SAME AS ABOVE W/ HBL. > BTE. ALTN. DECREASING
Tr. CALC.-HEM.	6060-70': 30% SAME AS ABOVE. REMAINDER GRANITE, SAME AS 5910-20'. STILL MINOR CHL/PLAG.
Tr. QTZ.-CHL-HEM.	6070-80': 40% GRANITE, AS ABOVE, REMAINDER F. XLN. REL. FELSIC QTZ.-FSP.-BTE GNEISS, SAME AS 5960-70'. Tr. DK. GRAY DACITE (?)
Tr. CHL. Tr. CALCITE	6080-90': 30% GRANITE, AS ABOVE, REMAINDER GNEISS, ALSO AS ABOVE.
② CALCITE	6090-6100': 55-60% GRANITE, AS ABOVE; REMAINDER GNEISS, AS ABOVE.

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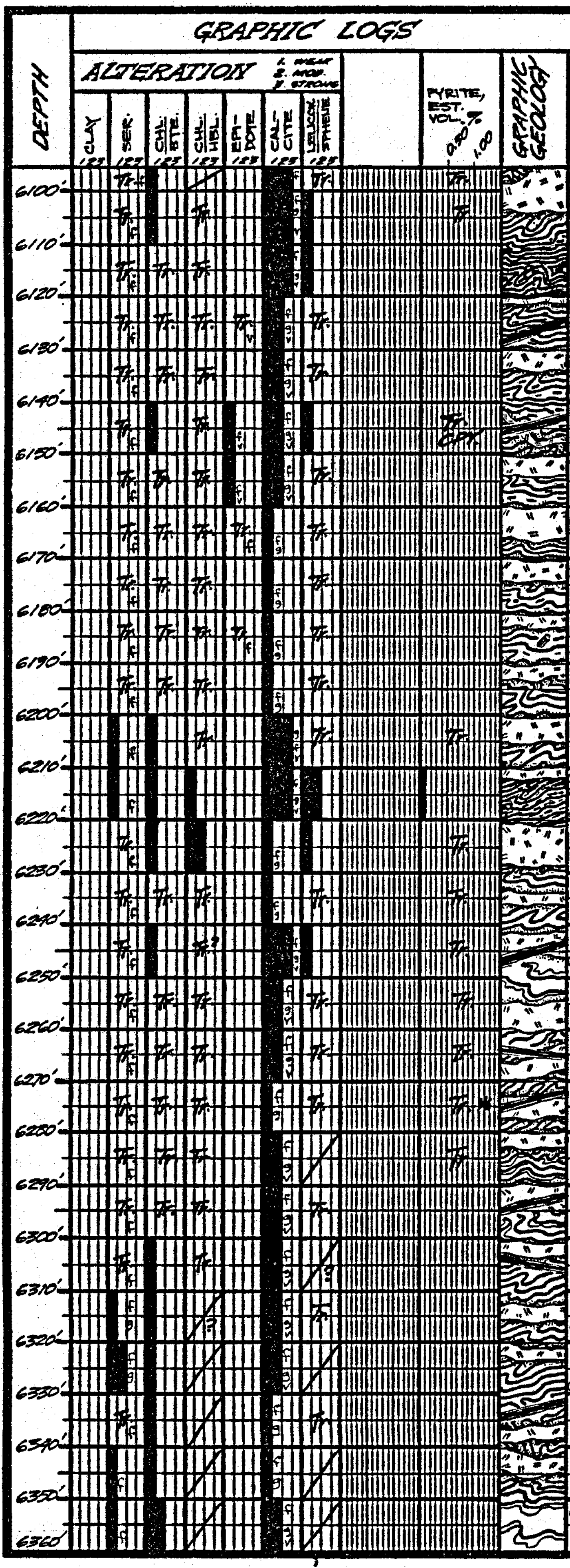
ROOSEVELT HOT SPRINGS KGRA

NOTE: MUCH OF THE LEUCOCRATIC GRANITE DESCRIBED ABOVE COULD BE A FELSIC MIGMATITIC DIFFERENTIATE.



DESCRIPTIONS

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AUGUST 1978

Tr. TRACE 1. WEAK 2. MOD. 3. STRONG VEINLETS	DESCRIPTIONS
① QTZ.-CHL. ② CALCITE	6100-10': 35% LEUCOGRANITE, MED.-XLINE, W/<0.5% BTE. REMAINDER QTZ.-FSP-BTE GNEISS W/MINOR
Tr. HEM.	HBL — F. MED. XLINE — MANY PCS. HAVE "SALT & PEPPER" APPEARANCE.
① CALCITE	6110-20': 5% GRANITE, AS ABOVE. REMAINDER GNEISS, AS ABOVE EXC. MUCH MORE
Tr. CHL.	MAFIC-RICH, & W/MORE HBL. (5%)
Tr. CHL.-EPIDOTE	6120-30': 10-12% GRANITE REMAINDER GNEISS } AS ABOVE
① CALCITE	
Tr. CHL.	6130-40': 30-35% GRANITE REMAINDER GNEISS } AS ABOVE.
① CALCITE	
Tr. CHL.	6140-50': 10-12% GRANITE (?), REMAINDER FELSIC QTZ.-FSP.-BTE GNEISS W/MINOR HBL.
① CALCITE Tr. EPIDOTE	STRONGEST EPIDOTE YET ENCOUNTERED — THIS PREF. DEVELOPED IN GRANITE FRAGS.
Tr. CHL. Tr. CALCITE	6150-60': 35-40% GRANITE, SAME AS 6100-10': REMAINDER GNEISS, SAME AS 6100-10'.
① EPIDOTE ←	ALSO TR. CALCITE-HEM.
Tr. CHL.	6160-70': 60-65% GRANITE REMAINDER GNEISS EXC. } SAME AS 6100-6110'
	Tr. CHLTZD. MICRODIORITE.
Tr. CHL.	6170-80': 40-45% GRANITE REMAINDER GNEISS } SAME AS 6100-6110'
	Tr. SILLIMANITE & GARNET Tr. MICRODIORITE ⑥⑤
Tr. CHL.	6180-90': 25% GRANITE REMAINDER GNEISS } SAME AS 6100-6110'. ⑥⑤
	Tr. MICRODIOR. Tr. SILL, GARNET, 1 .5X1 mm. GRAY-GREEN (?) CORUNDUM. ○
Tr. HEM.	6190-6200': ALL SAME AS ABOVE. EXC. 1% MICRODIORITE
ON MICRO-DIORITE	ONE PC. UNALT., OTHERS CHLTZD., SERCTZD. ⑤
② CALCITE	6200-10': 50% GRANITE, SAME AS 6100-10'. REMAINDER QTZ-FSP-BTE GNEISS, SAME AS
Tr. CHL.	6100-10' W/NO HBL. (OR ONLY TRACES). SOME CHL. AFTER PLAG. ⑤
② CALCITE ① CALC.-HEM.-CHLORITE ① CHLORITE	6210-20': 15% GRANITE. 1% MICRODIORITE. REMAINDER F. XLN. QTZ.-FSP.-BTE GNEISS W/MINOR HBL. & REL. ABUND. SPHENE (5%) ALTN. IN CHIPS VARIES FROM WK.-STRONG. V. STRONG CALCITE ALTN. IIII ⑤
	6220-30': 80% GRANITE, SAME AS 6100-10'. 1% MICRODIORITE. Tr. DACITE PPY. REMAINDER SAME AS ABOVE.
	ONE CHIP ⇒ MICROD → DACITE PPY. 4mm ⑤
Tr. CHL.-SER.	6230-40': 20% GRANITE REMAINDER QTZ-FSP-BTE GNEISS, REL. FELSIC
	(15% MAFICS), F. XLN., "SALT-AND-PEPPER" TEXTURE. Tr. SILLIMANITE IN CRS.-XLINE BTE. ⑤
Tr. CHL-SER	6240-50': ?~30% GRANITE. REMAINDER GNEISS, AS ABOVE.
② CALCITE	⑤
① CALCITE	6250-60': 30% GRANITE. Tr. MICRODIORITE. REMAINDER F.-MED. XLINE QTZ-FSP.-BTE. GNEISS W/HIGHLY
Abund. Fibrolite →	(IRON-STAINED) VARIABLE TOTAL MAFIC CONTENT. ONE ROUNDED ALLUVIAL GRAIN. ABUNDANT RUSTED STEEL. ⑤
① CALCITE	6260-70': SAME AS ABOVE W/40% GRANITE, 60% GNEISS
Abund. → Fibrolite	(IRON STAINED) ⇒ FR. RUSTING OF DRILL STEEL. ⑤
	6270-80': 30% GRANITE 1% MICRODIORITE } AS ABOVE (& Tr. DACITE PPY)
Abund. Fibrolite →	(IRON-STAINED) REMAINDER GNEISS MINOR CRS.-XLINE SILLIMANITE. ⑤
① CALCITE	6280-90': SAME AS IMMEDIATELY ABOVE.
Abund. → Fibrolite	(IRON-STAINED) ⑤
① CALCITE	6290-6300': 30% GRANITE Tr. MICRODIORITE } SAME AS ABOVE
Abund. Fibrolite →	(IRON-STAINED) REMAINDER QTZ-FSP-BTE. GNEISS — MINOR CRS.-XLN. SILLIMANITE. ⑤
① CALCITE	6300-10': 20% GRANITE, Tr. MICRODIORITE REMAINDER GNEISS } SAME AS ABOVE.
Abund. → Fibrolite	(IRON-STAINED) ⇒ ABUND. RUSTED DRILL STEEL. ⑤
Abund. Fibrolite	6310-20': ALL SAME AS ABOVE
① CALCITE ↳	(IRON-STAINED) INCREASE IN SERICITIZATION ⑤
Abund. Fibrolite	6320-30': 20% GRANITE. REMAINDER GNEISS, AS ABOVE, EXC. V. STRONG SILLIMANITE. CONTAMINATED
① CALCITE ↳	(IRON-STAINED) W/ABUNDANT CRS.-XLINE. WHITE MICA AND RUSTED DRILL STEEL. ⑤
Tr. CHL-SER.	6330-40': SAME AS DIRECTLY ABOVE
	(IRON-STAINED) ⑤
	6340-50': 35-40% (?) GRANITE REMAINDER GNEISS } SAME AS 6100-10'.
Abund. Fibrolite →	(IRON-STAINED) ⑤
① CALCITE	6350-60': 5-7% (?) GRANITE, REMAINDER FELSIC QTZ.-FSP. BTE. GNEISS W/5-7% BTE. — V. QTZ.-RICH
	⑤

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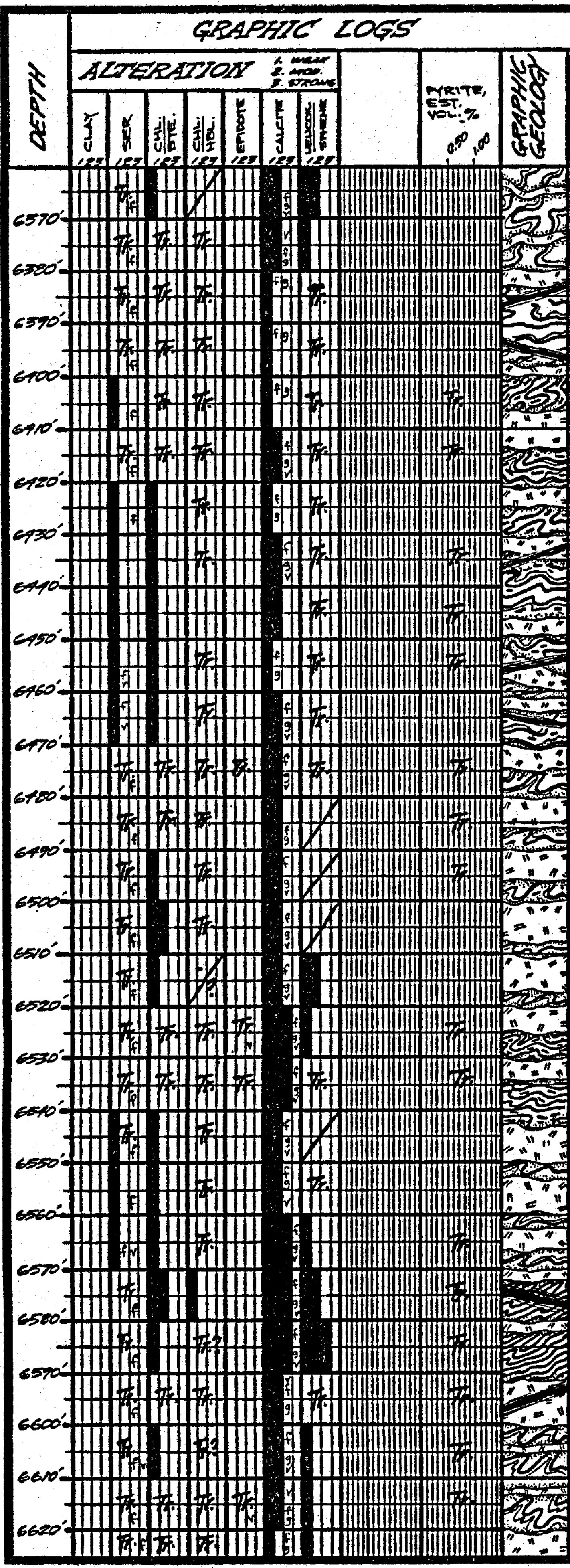

DESCRIPTIONS

LOGGED BY
J.B. HULEN
AUGUST 1978

VEINLETS Tr. TRACE 1. WEAK 2. MOD. 3. STRONG	DESCRIPTIONS
Tr. CALCITE	6560-70': 15% (?) MED. XLN. LEUCOCRATIC BTE. GRANITE W/<0.5% BTE. REMAINDER F.-MED.-XLINE QTZ-FSP-BTE
	GNEISS, FELSIC (7% BTE), QTZ-RICH. MINOR MED-CRS. XLN. BTE. WHITE MICA CONTAM. ⑤
① CALCITE	6570-80': ? 10-15% GRANITE REMAINDER GNEISS } AS ABOVE
	Tr. MICRODIORITE. MUSC. CONTAM. ⑤
	6580-90': 30% (?) GRANITE REMAINDER GNEISS } SAME AS 6360-70'.
	MUSCOVITE CONTAM. VARIABLE MAFIC CONTENT IN GNEISS. FEW CHIPS MED.-CRS.-XLINE BTE. W/ SILLIMANITE ⑤
	6390-6400': 15-20% (?) GRANITE REMAINDER GNEISS } SAME AS 6360-70'.
	MUSCOVITE CONTAMINATION (LOST CIRCULATION MATERIAL)
	6400-10': 50% GRANITE, SAME AS 6360-70'. 70% F. XLINE QTZ-FSP.-BTE GNEISS W/ MINOR HBL. — "SALT &
	MUSCOVITE CONTAM. PEPPER TEXTURE". FSPS. IN GRANITE SELECTIVELY SERICITIZED.
Tr. SER.	6410-20': 35-40% GRANITE REMAINDER GNEISS } SAME AS 6400-10'. ⑤
① CALCITE	MUSCOVITE CONTAM.
	6420-30': SAME AS ABOVE. MAFICS DECREASING IN GNEISS.
	MUSCOVITE CONTAM. ⑤
Tr. SER.	6430-40': SAME AS ABOVE
Tr. CHL. ① CALCITE	MUSCOVITE CONTAM. ⑤
	6440-50: SAME AS ABOVE
	MUSC. CONT ⑤
Tr. SER.	6450-60': SAME AS ABOVE.
Tr. CHL.	MUSC. CONT. ⑤
Tr. SER.	6460-70': 25% GRANITE, Tr. MICRODIORITE, REMAINDER GNEISS, SAME AS 6400-6410'. RATIO OF
① CALCITE	MUSC. CONT. HBL. TO BTE. IS HIGHLY VARIABLE, BUT OVERALL BTE >> HBL.
① QTZ-HEM.	6470-80': 40% GRANITE, REMAINDER GNEISS, SAME AS ABOVE. NO SILL.
Tr. CALCITE	MUSC. CONT.
	6480-90': 60% GRANITE, REMAINDER GNEISS, AS ABOVE.
Tr. CALCITE	MUSC. CONT.
	6490-6500': SAME AS ABOVE.
① CALCITE	MUSC. CONT.
Tr. QTZ-CHL.	6500-6510'. 70% MED-XLINE BTE. GRANITE W/< 0.5% BTE. REMAINDER, F-M. XLN QTZ-FSP-BTE GNEISS
Tr. CHL.	MUSC. CONT. W/ MINOR HBL. — QUITE FELSIC (<15% TL. MAFICS — "SALT & PEPPER TEXTURE.
① CALCITE	6510-20': SAME AS ABOVE
	MUSC. CONT. ⑤
② CALCITE	6520-30': 50% GRANITE, SAME AS 6500-10' REMAINDER F. XLN. QTZ-FSP-HBL.-BTE GNEISS
Tr. CHL.-SER Tr. EPID.	MUSC. CONT. V. SIMILAR TO GNEISS FR. 6500-10 BUT W/ GREATER MAFIC %.
② CALCITE	6530-40': SAME AS ABOVE W/ 40% GRANITE (SOME W/ MED. XLINE, RANDOMLY-ORIENTED BTE (ACCESSORY))
Tr. EPIDOTE	MUSC. CONT. REMAINDER GNEISS, AS ABOVE.
① CALCITE	6540-50'. SAME AS 6500-6510' W/ 65-70% GRANITE,
	MUSC. CONT. REMAINDER GNEISS. Tr. MICRODIORITE.
① CALCITE	6550-60': SAME AS ABOVE. 2/30 Tr. APLITE
	MUSC. CONT.
① CALCITE	6560-70': 40% GRANITE, 60% GNEISS, AS ABOVE.
Tr. CHL-SER.	MUSC. CONT. VARIABLE MAFIC CONTENT IN GNEISS.
② CALCITE	6570-80': 20% GRANITE. REMAINDER, MAFIC-RICH QTZ-FSP-BTE GNEISS W/ABUND. SPHENE,
	MUSC. CONT. F. XLN, CRUDELY FOLIATED
② CALCITE	6580-90': SAME AS ABOVE.
	MUSC. CONT.
① CALCITE	6590-6600'. 80% GRANITE (W/BTE), MED. XLINE, AS ABOVE.
	REMAINDER F. XLN. QTZ.-FSP-BTE. GNEISS, AS 6500-6510' (FELSIC) MUSC. CONT.
Tr. CHL.	6600-10': 15% GRANITE, REMAINDER FINE-MED. XLINE QTZ-FSP-BTE GNEISS W/ VARIABLE
① CALCITE	MUSC. CONT. FELSIC/MAFIC RATIO
Tr. QTZ-CHL.-EPIDOTE	6610-20': SAME AS ABOVE, EXC. ~10-15% GRANITE
① CALCITE	MUSC. CONT.
	6620-30: 80% GRANITE, SAME AS ABOVE. REMAINDER GNEISS. ALSO AS ABOVE.

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ROOSEVELT HOT SPRINGS KGRA

NOTE: MUCH OF THE GRANITE DESCRIBED ABOVE COULD BE A FELSIC MIGMATITIC DIFFERENTIATE AND/OR A FELSIC GRANITIC GNEISS.

NOTE: MUCH OF THE GRANITE DESCRIBED BELOW COULD BE A FELSIC MIGMATITIC DIFFERENTIATE.

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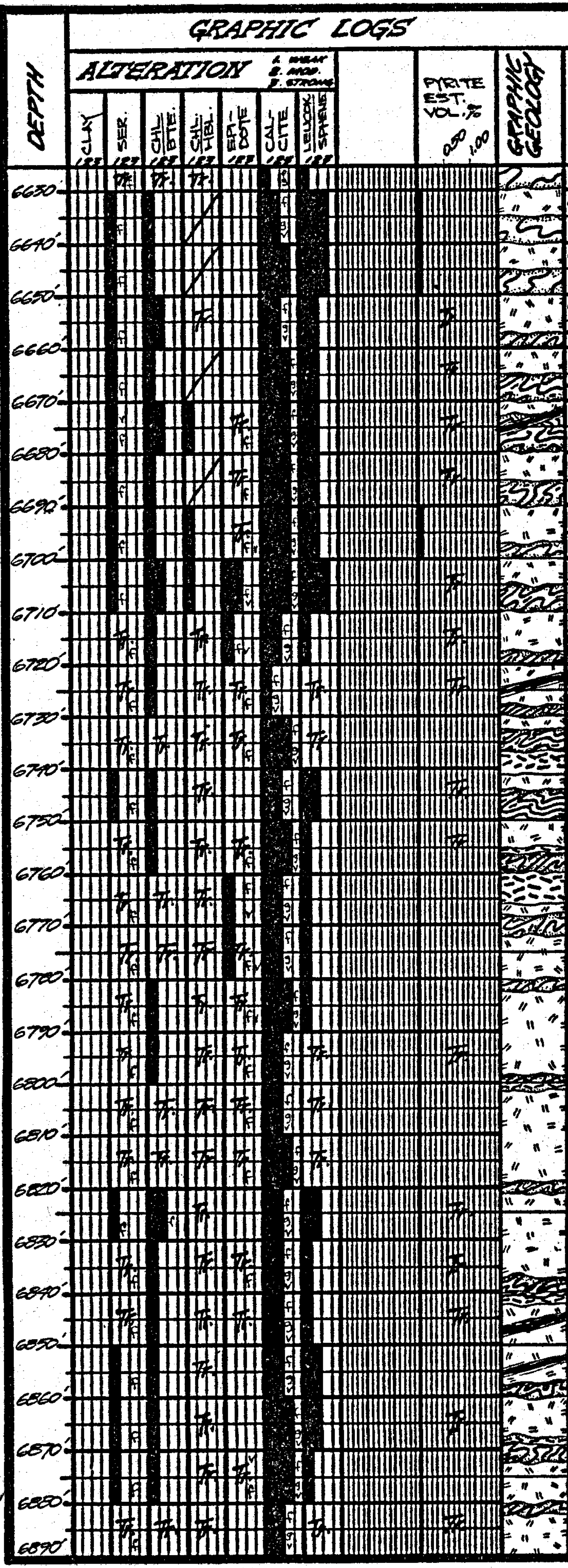


DESCRIPTIONS

NOTE: ALL SAMPLES THIS PAGE CONTAMINATED W/ COARSE-XLINE MUSCOVITE (LOST CIRCULATION MATERIAL)

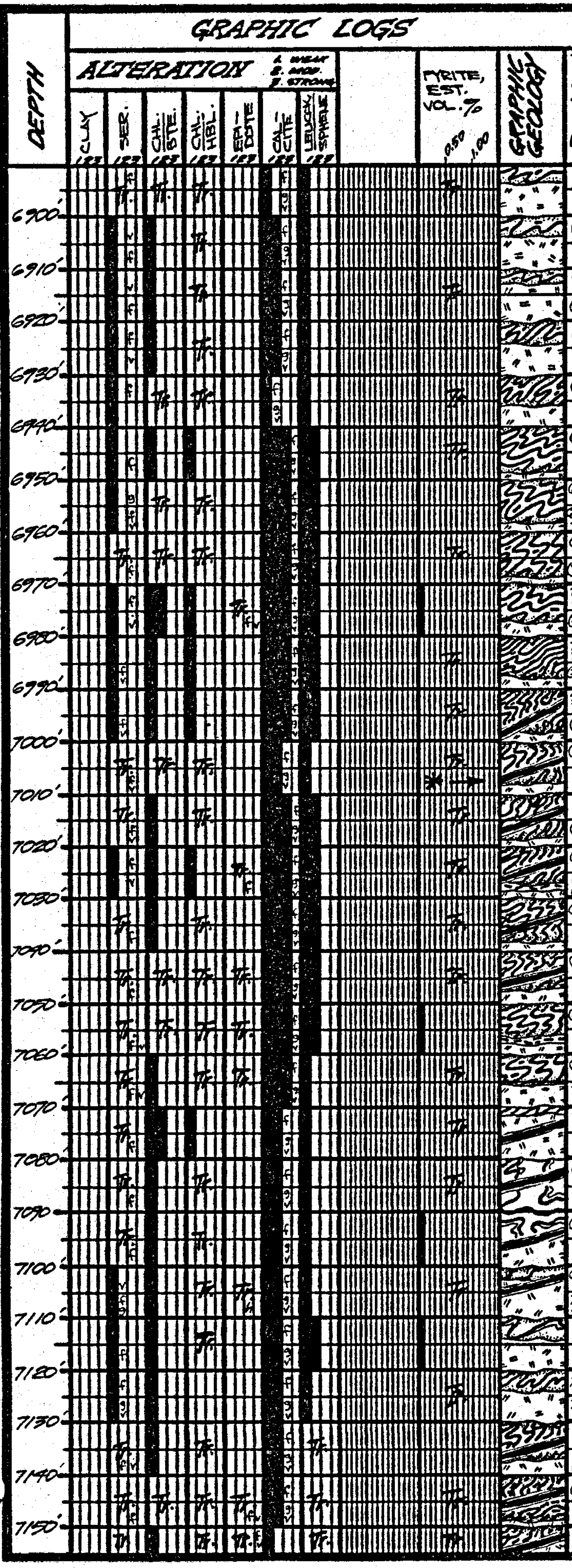
Tr. TRACE 1. WEAK 2. MOD. 3. STRONG VEINLETS	DESCRIPTIONS
① CALCITE	6630-40': 50% MED.-XLN. LEUCOCRATIC BTE. GRANITE (<0.50% BTE.). REMAINDER FELSIC FINE-
Tr. QTZ-CHL.	XLN. QTZ.-FSP.-BTE. GNEISS W/"SALT & PEP-PER TEXTURE. ALTN. & PYRITE INCREASE.
② CALCITE	6640-50': SAME AS ABOVE; GNEISS HAS VARIABLE
Tr. PYRITE Tr. QTZ.-CHL.	FELSIC/MAFIC RATIO. SOME CHLTZN. OF FSP
① CALCITE	6650-60': SAME AS ABOVE W/ 70% GRANITE, 30% GNEISS
① CHLORITE	
① QTZ.-CHL.	6660-70': SAME AS 6630-40'. 50% GRANITE 50% GNEISS
① CALCITE	A FEW FRAGS OF QTZ.-CHL. VEINLET HAVE EUHEDRAL WATER-CLEAR QTZ. XLS (<0.5mm.)
② CALCITE Tr. SER.	6670-80'. SAME AS 6630-40': GNEISS 30% GRANITE
Tr. QTZ-CHL.	80%
① QTZ-CHL.	6680-90': SAME AS 6630-40'. 50% GRANITE 50% GNEISS
② CALCITE	STRONG MUSCOVITE CONTAMINATION. SPHENE ALTN. VARIABLE.
Tr. QTZ-CHL-PYRITE	6690-6700': SAME AS 6630-40': 70% GRANITE 30% GNEISS
② CALCITE	SPHENE ALTN. VARIABLE.
① EPIDOTE ② CALCITE	6700-10': SAME AS 6630-40: 50% GRANITE 50% GNEISS
Tr. CHL.	STRONGEST EPIDOTE IN HOLE THUS FAR
Tr. EPIDOTE	6710-20': SAME AS 6630-40: 70% GRANITE
① CALCITE	30% GNEISS
Tr. EPIDOTE	6720-30': SAME AS ABOVE
① CALCITE	
② CALCITE	6730-40': 25% GRANITE, 40% QTZ-FSP.-BTE GNEISS, SAME AS 6680-90'. REMAINDER MED.-XLN
	BTE. HBL. QTZ. MONZ. GNEISS W/~20% HBL.
① CALCITE ① CALC.-CHL.	6740-50'. 10% BTE. HBL. QTZ. MONZ. GNEISS 30% GRANITE } AS ABOVE
Tr. CHL.	REMAINDER QTZ-FSP.-BTE GNEISS
② CALCITE	6750-60': 50% GRANITE 10% QTZ. MONZ. GNEISS
Tr. CHL.	SPHENE ALTN. VARIABLE 40% QTZ.-FSP.-BTE GNEISS, } AS ABOVE
① CALCITE	6760-70': 60% BTE. HBL. QTZ MONZ. GNEISS 25% GRANITE
① EPIDOTE Tr. CHL	15% GNEISS, AS ABOVE (F.XL. QTZ-FSP.-BTE.)
① CALCITE	6770-80': 7% BTE. HBL. QTZ. MONZ. GNEISS 10% F.XL. QTZ.-FSP-BTE GNEISS } AS ABOVE.
Tr. EPID. Tr. CHL	REMAINDER MED.-XLINE LEUC.GR.
② CALCITE	6780-90': 5% QTZ. MONZ. GNEISS 20% F.XL. QTZ.-FSP.-BTE GNEISS } SAME AS ABOVE
Tr. CHL.-SER Tr. EPIDOTE	REMAINDER GRANITE
① CALCITE	6790-6800': 1-2% QTZ MONZ. GNEISS 7-10% QTZ-FSP-BTE GNEISS } AS ABOVE
Tr. CHL.	REMAINDER GRANITE.
① CALCITE	6800-10': 7% BTE. HBL. QTZ MONZ. GNEISS 3-5% QTZ.-FSP.-BTE GNEISS
Tr. CHL.	REMAINDER. MED. XLN. LEUCOCRATIC BTE. GRANITE } AS ABOVE.
② CALCITE	6810-20': 1-3% BTE. HBL. QTZ MONZ. GNEISS 10% F.XL. QTZ.-FSP.-BTE. GNEISS } AS ABOVE
	REMAINDER GRANITE
① CALCITE	6820-30': 10% QTZ.-FSP.-BTE. GNEISS } AS ABOVE
Tr. CHL.	REMAINDER GRANITE (TR. QTZ. MONZ. GNEISS)
① CALCITE	6830-40': 3% QTZ. MONZ. GNEISS (SEE 6760-70') 20% QTZ.-FSP.-BTE. GNEISS } AS ABOVE
	Tr. HEM.-MAG. REMAINDER GRANITE
① CALCITE	Tr. HI 6840-50': 10% BTE. HBL. QTZ. MONZ. GNEISS 15% QTZ.-FSP.-BTE GNEISS
Tr. CHL.	Tr. HEM.-MAG. REMAINDER GRANITE.
① CALCITE	6850-60': 25% F.XL. QTZ-FSP.-BTE. GNEISS, Tr. QTZ. MONZ. GNEISS
Tr. CHL.	REMAINDER GRANITE, AS ABOVE.
Tr. CHL. Tr. QTZ.-CHL.	6860-70': 7-10% BTE-HBL QTZ. MONZ. GNEISS 15-20% QTZ.-FSP.-BTE. GNEISS } AS ABOVE.
Tr. QTZ-CALC. ② CALCITE	REMAINDER MED.-XLINE LEUCOCRATIC GR.
② CALCITE	6870-80': 5% BTE.-HBL. QTZ. MONZ. GNEISS 20% QTZ.-FSP.-BTE. GNEISS } AS ABOVE
Tr. EPIDOTE	Tr. HEM.-PY REMAINDER GRANITE
① CALCITE	6880-90': Tr. QTZ MONZ. GNEISS 20-25% F-M-XLN. QTZ.-FSP.-BTE. GNEISS
	REMAINDER M-XLN LEUCOCRATIC BTE. GRANITE.

DRILL HOLE GETTY OIL CO. DRILL HOLE 52-21

LOCATION ROOSEVELT HOT SPRINGS KGRA

LOGGED BY J.B. HULEN

AUG. 1978



Tr. TRACE
1. WEAK
2. MOD.
3. STRONG

DESCRIPTIONS

ALL SAMPLES CONTAMINATED W/ CRS.-XLINE MUSCOVITE

NOTE: MUCH OF THE MED-XLN. GRANITE DESCRIBED BELOW COULD BE A FELSIC MIGMATITIC DIFFERENTIATE

VEINLETS	DESCRIPTIONS
Tr. CALCITE	6870-6900': 35-40% (?) F.-M.-XLN. QTZ-FSP-BTE. GNEISS W/MINOR HBL — "SALT & PEPPER TEXTURE.
Tr. CHLORITE	REMAINDER MED.-XLN. LEUCOCRATIC BTE. GRANITE.
① CALCITE	6900-10': SAME AS ABOVE W/~3% MED.-XLN. BTE-HBL.
Tr. SERICITE	QTZ. MONZ. GNEISS (20-25% HBL, 1% SPHENE)
Tr. SER.	6910-20': 30% F-M. XLN. QTZ-FSP-BTE GNEISS W/ MINOR HBL. TRACES SILLIMANITE. 3% QTZ. MONZ.
① CALCITE Tr. ~-HEM.	Tr. HEM./MAG. GNEISS (BTE.-HBL.). REMAINDER GRANITE, AS ABOVE. (SILLIMANITE APPEARS) ⑤
① CALCITE Tr. SER	6920-30': 40% F-M. XLN. QTZ-FSP.-BTE. GNEISS (Tr. SILLIM.) REMAINDER MED.-XLN. LEUCOCRATIC BTE. GR. ⑤
	SPHENE ALTN. VARIES FR. V. WK. TO TOTAL LEUCOXENE, BUT WEAK OVERALL (ST. SPH. ALTN. ASSOC. W/ CHLTZN. MAFICS)
① CALCITE	6930-40': 60% QTZ.-FSP-BTE. GNEISS (Tr. SILL.) Tr. M. XLN. BTE. HBL. QTZ. MONZ. GNEISS } AS ABOVE
	REMAINDER GRANITE (Py ASSOC.) W/ SER & CHL. ⑤
① CALCITE	6940-50': 15% (?) M. XLN. BTE. GRANITE. 2-3% M. XLN. BTE.-HBL. QTZ. MONZ. GNEISS.
	REMAINDER F-M. XLN. QTZ.-FSP.-BTE GNEISS W/ MINOR HBL., VARIABLE FELSIC TO MAFIC RATIO. — Tr. SILLIMANITE ⑤
① QTZ-CHL-SER ± HEM	6950-60': ALL SAME AS ABOVE.
② CALCITE Tr. CHL.	⑤
① QTZ-CHL.	6960-70': ALL SAME AS ABOVE
② CALCITE	⑤
Tr. QTZ-CHL-SER ± HEM.	6970-80': 25% MED.-XLN. LEUCOCRATIC BTE. GRANITE. 1-3% MED. XLN. BTE. HBL. QTZ. MONZ. GNEISS.
② CALCITE Tr. EPIDOTE	Tr. QTZ. MICRODIORITE REMAINDER F-M. XLN. QTZ-FSP-BTE GNEISS W/ ABUND. SILLIMANITE. MINOR PINK ZIRCON. ⑤
Tr. QTZ-SER Tr. QTZ-CHL	6980-90': 20% GRANITE, AS ABOVE. REMAINDER F-M. XLINE QTZ-FSP-BTE GNEISS W/MINOR HBL., Tr. GARNET ?,
② CALCITE Tr. HEM.	& CORDIERITE, ABUNDANT SILLIMANITE. ⑤ⒼⒸ
Tr. SER ± QTZ. Tr. CHL.	6990-7000': 15% GRANITE, AS ABOVE REMAINDER F-M. XLN QTZ.-FSP.-BTE GNEISS
② CALCITE	Tr. HEM./MAG. W/MINOR HBL. & SILLIMANITE ⑤
① CALCITE ① CHL.	7000-7010': 20% MED. XLN. LEUCOCRATIC BTE. GRANITE (SILL.) 5-7% MED-CRS.-XLN BTE-HBL. QTZ. MONZ
Tr. SER	POSS. BORNITE GRAIN IN HBL. GNEISS. GNEISS W/ LG. HONEY YELLOW SPHENE. REMAINDER F.-M. XLN. QTZ.-FSP-BTE (± HBL) GNEISS ⑤
Tr. SER.	7010-20': 10-15% GRANITE 5-7% BTE. HBL. QTZ. MONZ. GNEISS NO SILL.
② CALCITE ① CHL.	SPHENE ALTN. VARIABLE REMAINDER F-M. XLN. QTZ.-FSP.-BTE GNEISS (ALL AS ABOVE) ⑤
② CALCITE Tr. CALC-	7020-30': 10-15% GRANITE 10-15% BTE.-HBL. QTZ. MONZ. GNEISS
QTZ.-HEM. ① CHL. Tr. Fe	Tr. HEM./MAG. REMAINDER F.-M. XLN. QTZ.-FSP.-BTE. GNEISS W/MINOR HBL. & SILLIMANITE & MUSCOVITE ⑤
① CALCITE Tr. CHL.	7030-40': 10-15% GRANITE 5-7% BTE-HBL. QTZ MONZ. GNEISS (AS ABOVE)
	REMAINDER F.-M. XLN. QTZ-FSP-BTE. ± HBL. GNEISS W/ Tr. SILLIMANITE ⑤
② CALCITE Tr. CHL.	7040-50': 20-25% GRANITE, MED.-XLN 1-3% BTE.-HBL. QTZ. MONZ. GNEISS, M. XLN.
	REMAINDER F-M. XLN. FSP-QTZ.-BTE. GNEISS W/MINOR HBL. & SILLIMANITE. ⑤
② CALCITE ① CHL ± QTZ.	7050-60': 15-20% MED. XLINE GRANITE 10-15% (?) MED.-XLINE. BTE. HBL. QTZ. MONZ. GNEISS
Tr. SERICITE	REMAINDER F-M. XLN. QTZ.-FSP-BTE. GNEISS W/MINOR HBL. & SILLIMANITE. ⑤
② CALCITE Tr. SER-CHL	7060-70': 45% GRANITE Tr. QTZ. MONZ. GNEISS } AS ABOVE
Tr. QTZ-CHL Tr. EPIDOTE	Tr. HEM./MAG. REMAINDER F.-M. XLN. QTZ-FSP.-BTE. GNEISS ⑤
Tr. CHL Tr. CALC.	7070-80': 15% F-M. XLN. FSP-QTZ-BTE GNEISS REMAINDER M. XLN. LEUCOCRATIC GRANITE
	(<0.5% BTE.) ⑤
① CALCITE	7080-90': 30-35% (?) FELSIC QTZ-FSP.-BTE. GNEISS, SAME AS ABOVE EXC ONLY 11-15% MAFICS — RESEMBLES
	Tr. SILL. IN BTE-RICH FRAGS. GRANITE IN SMALLER PCS. REMAINDER GRANITE MED.-XLN., AS ABOVE. ⑤
① CALCITE	7090-7100': ALL SAME AS ABOVE EXC. GNEISS EVEN MORE FELSIC —→
	40-45% GNEISS & REMAINDER GRANITE (?) ⑤
① CALCITE Tr. SER.	7100-10': SAME AS ABOVE. 75% (?) GRANITE 25% (?) QTZ-FSP.-BTE GNEISS
Tr. CHL.-HEM. CALCITE	DIFFICULT TO DISTINGUISH GRANITE CHIPS FR. MAFIC-POOR GNEISS CHIPS (W/ Tr. SILLIMANITE & GARNET) Ⓖ⑤
① CALCITE	7110-20': SAME AS ABOVE EXC. 55-60% GRANITE (?) REMAINDER GNEISS (?)
Tr. HEM-CALCITE	⑤
Tr. SER ± CHL	7120-30': 60% M. XLN LEUCOCRATIC BTE. GRANITE. Tr. MED-XLN. BTE.-HBL QTZ. MONZ. GNEISS. REMAINDER
Tr. CHL ① CALCITE	F.-MED. XLN. QTZ-FSP.-BTE GNEISS, CRUDELY FOLIATED W/ VARIABLE MAFIC CONTENT Tr. SILL. ⑤
Tr. QTZ-SER	7130-40': 25% GRANITE, AS ABOVE. REMAINDER F.-MED. XLINE QTZ-FSP.-BTE. GNEISS W/MINOR HBL
Tr. CHL. ① CALCITE	Tr. SILLIMANITE — VARIABLE MAFIC/FELSIC RATIO IN GNEISS CHIPS. ⑤
① CALCITE Tr. EPIDOTE	7140-50': 10% GRANITE. REMAINDER F.-M. XLN. QTZ-FSP.-HBL-BTE GNEISS W/MINOR SPHENE & SILLIMANITE.
Tr. CHL.	⑤
	7150-60': 65% (GRANITE, MED. XLN., LEUC.) REMAINDER GNEISS SAME AS IMMEDIATELY ABOVE. ⑤

DRILL HOLE GETTY OIL 52-21
LOCATION ROOSEVELT HOT SPRINGS KGRA

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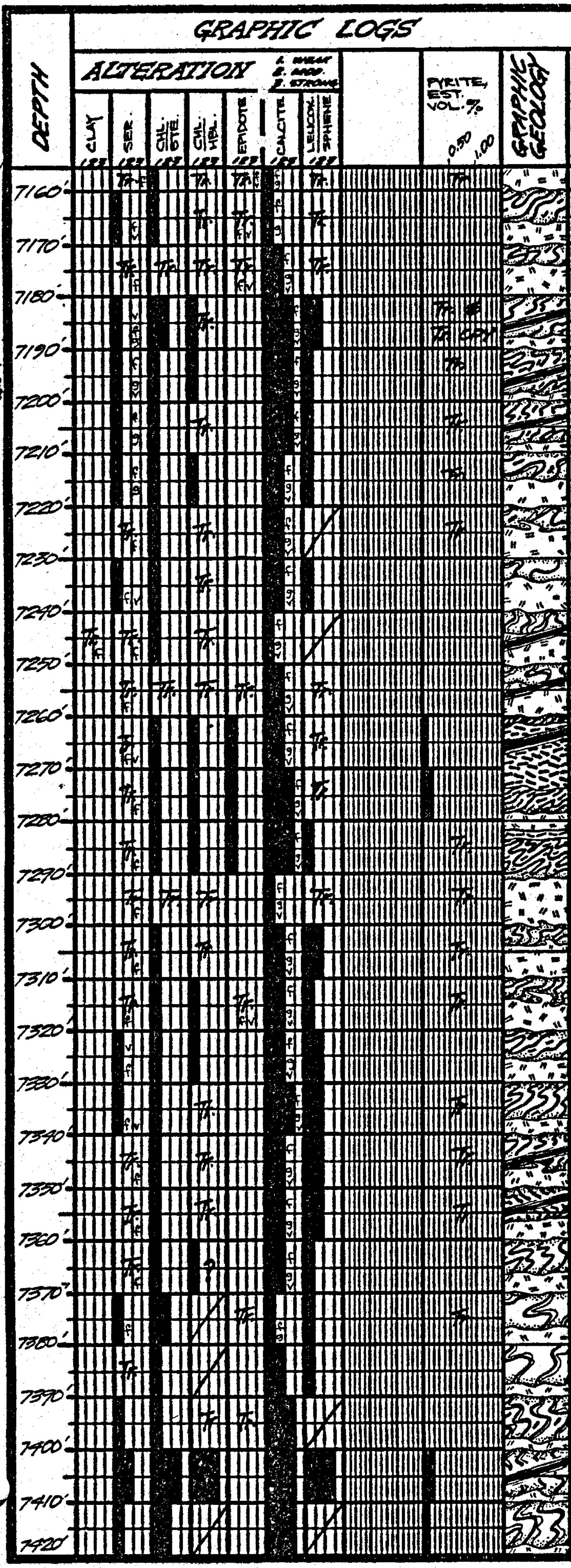


Tr. TRACE
1. WEAK
2. MOD.
3. STRONG

DESCRIPTIONS

ALL SAMPLES CONTAMINATED W/MUSCOVITE (LOST CIRCULATION MATERIAL.

NOTE: MUCH OF THE MED.-XLN GRANITE DESCRIBED BELOW COULD BE A FELSIC MIGMATITIC DIFFEREN.

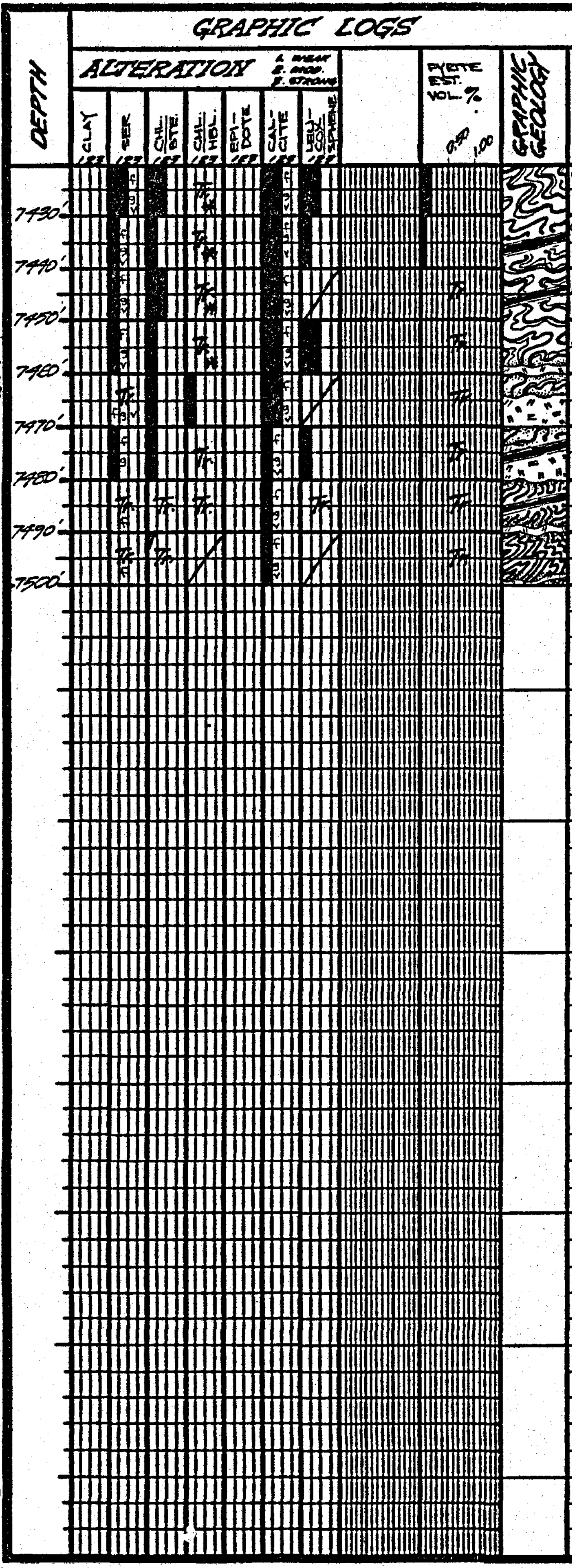
VEINLETS	DESCRIPTIONS
	?
Tr. SER. Tr. CHL.	7160-70': 40% MED. XLINE LEUCOCRATIC BTE. GRANITE. REMAINDER F.-M. XLINE FSP.-QTZ-BTE GNEISS W/MINOR HBL.,
Tr. EP.-CHL.	SPHENE, TR. SILLIMANITE, CORDIERITE, GARNET. LATTER LT. RED, CLEAR. ⒼⓈⒸ?
Tr. EP. Tr. CHL.-①	7170-80': ?50-60% MED.-XLN. LEUC. BTE. GRANITE REMAINDER GNEISS AS ABOVE W/ TR. SILL. & GNT.
Tr. CALC.-①	ⓈⒼ
② CALCITE Tr. CHL-SER	7180-90': 20-25% MED.-XLN. LEUCOCRATIC GRANITE. 5-7% (??) MED-XLN. BTE.-HBL. QTZ. MONZ. GNEISS
① CHL.	REMAINDER F.-M. XLN. FSP.-QTZ-BTE GNEISS W/ MINOR HBL. & SPHENE, Tr. SILLIMANITE. Ⓢ
② CALCITE Tr. CHL.	7190-7200': 10-15% GRANITE REMAINDER QTZ-FSP-BTE GNEISS } AS ABOVE.
Tr. SER.	
② CALCITE	7200-10': ALL SAME AS ABOVE. PYRITE ASSOC. W/ CHLTZN. OF MAFICS & SERCTZN. OF FSPS.
① CALCITE	7210-20': ~50% (?) MED.-XLN. LEUC. BTE. GRANITE. REMAINDER F.-M.-XLN. QTZ-FSP-BTE GNEISS W/
Tr. CHL.	Tr. HEM MAG & PY MINOR SPHENE — HIGHLY VARIABLE FELSIC TO MAFIC RATIO BUT AVG. ~13%
① CALCITE	7220-30': SAME AS ABOVE EXC. 60-65% (?) GRANITE.
Tr. CHL.	SOME APPARENT ALTN. OF PLAG. TO CHL.
① CALCITE	7230-40': SAME AS ABOVE ⓈⒸ?
Tr. QTZ-SER-CHL.	
Tr. CHL.	7240-50': SAME AS ABOVE. V. DIFFICULT TO DISTINGUISH GRANITE FROM MUCH OF GNEISS, ESP. MORE
Tr. CALCITE	FELSIC CHIPS.
Tr. CHL	7250-60': 60-65% GRANITE. Tr. MED-XLINE SPHENE-RICH BTE-HBL QTZ.
① CALCITE	MONZ. GNEISS. REMAINDER F.-M. XLN. QTZ-FSP-BTE GNEISS W/MINOR HBL. & SPHENE.
① CALCITE	7260-70': 5-7% MED. XLINE. LEUC. GRANITE. 15% (?) F. XLINE FSP-QTZ.-BTE. GNEISS
Tr. SER. Tr. CHL. ←	.25' QTZ.-CHL.-EP. REMAINDER F.-M. XLN BTE-HBL. QTZ. MONZ. GNEISS W/PROMINENT SPHENE, 25% (?) TL. MAFICS
Tr. QTZ-CHL-PYRITE	7270-80' 10-15% MED.-XLINE LEUC. BTE. GRANITE. ⓈⒸⒼ 20-35% F.-M. XLINE BTE. HBL. QTZ. MONZ. GNEISS
② CALCITE ←	Tr. QTZ-CHL.-EP. REMAINDER F-M. XLINE FSP-QTZ-BTE GNEISS W/MINOR HBL., SPHENE, TR. SILL. & CORD., GNT.
Tr. QTZ-CHL-EPIDOTE	7280-90': ?10-15% MED.-XLN. BTE. HBL. QTZ. MONZ. GNEISS 10-15% MED-XLN. LEUC. BTE. GRNT. Ⓢ
② CALCITE ① CHL.	REMAINDER F. XLN. FSP-QTZ-BTE GNEISS W/ MINOR HBL. SPHENE
Tr. CALCITE	7290-7300': 7-10% F-XLN, FSP-QTZ.-BTE. GNEISS W/VARIABLE FELSIC/MAFIC RATIO, AVG. 11-15%
DEFINITE GRANITE —	LARGE GR. CHIP 1% MED.-XLN. SPHENE-RICH BTE HBL. QTZ. MONZ. GNEISS. REM. MED. XLN. LEUC. GRANITE. Ⓢ
① CALCITE Tr. CHL.	7300-10': 60-65% GRANITE Tr. QTZ. MONZ. GNEISS ⓈⒸⒼ
Tr. CHL.-CALCITE-HEM.	REMAINDER F.-M. XLN FSP-QTZ-BTE GNEISS W/ Tr. SILL. & CORD. & GARNET
① CALCITE ① CHLORITE	7310-20': SAME AS ABOVE EXC. 2-3% QTZ. MONZ. GNEISS
Tr. EP.-CHL.	ⓈⒸ?
① CALCITE	7320-30': 35-40% LEUC. MED. XLINE BTE. GRANITE. 1-3% MED. XLINE BTE. HBL. QTZ. MONZ. GNEISS
Tr. CHL. Tr. CHL.-SER.	1 0.3 mm PINK GARNET(?) REMAINDER F.-M. XLINE FSP.-QTZ.-BTE. GNEISS W/ MINOR HBL., SPHENE, Tr. SILL., CORD. ⓈⒸ
② CALCITE ① CHL.	7330-40': SAME AS ABOVE EXC. 25-30% GRANITE.
Tr. SER.	Ⓢ
① CALCITE Tr. CHL.	7340-50': SAME AS 7320-30'
	Ⓢ
① CALCITE	7350-60': SAME AS ABOVE.
Tr. CHL.	Ⓢ
① CALCITE ① CHLORITE	7360-70': SAME AS 7320-30'
-	Ⓢ
Tr. CHL.	7370-80': SAME AS 7320-30, EXC. 25-30% GRANITE.
Tr. EP. Tr. CAL.-CHL.-HEM.	FEWER MAFICS IN GNEISS. Abundant Fibrolite Ⓢ
① CALCITE	7380-90': SAME AS ABOVE.
	Ⓢ
Tr. CHL.-EP.	7390-7400': SAME AS 7320-30', EXC. 20-25% GRANITE
② CALCITE	Ⓢ
② CHL. ② CALCITE	7400-7410': SAME AS ABOVE EXC. STRONG ALTN.
① SER.	& DISS. PY. Ⓢ
② CALCITE ① CHL.	7410-20': SAME AS ABOVE. ALTN. & MINRLZ. DECREASE.
Tr. SER.	Ⓢ

DRILL HOLE GETTY OIL 52-21
LOCATION ROOSEVELT HOT SPRINGS KGRA

LOGGED BY J.B. HULEN
AUG. 1978

ALL SAMPLES CONTAMINATED W/ MUSCOVITE, CRS.-XLINE (LOST CIRCULATION MATERIAL)

PAGE 27.



Tr. TRACE
1. WEAK
2. MOD.
3. STRONG

DESCRIPTIONS

* ONLY TRACES HBL.—MAY BE CONTAMINATION IN ONE OR TWO FRAGS.

VEINLETS	DESCRIPTIONS
① CALCITE Tr. CHL.	7420-7430' 95% F-M.XLN. FSP.-QTZ-BTE. GNEISS W/ MINOR SILLIMANITE. CRUDELY FOLIATED. / 5% MED.-
Tr. SER. Tr. CHL-SER.	* 0.2% DISS. PYRITE XLN. LEUCOCRATIC GRANITE, <0.5% BTE. SMPL. MOD. ALT. & MINRLZD. * HBL. ONLY IN ONE CHIP. ⑤
① CALCITE ① CHL.	7430-40': SAME AS ABOVE. Tr. REDDISH-BRN. ANHEDRAL
Tr. CHL-SER.	GARNET < 0.3 mm. DIA. ⑥⑤
① CALCITE ① CHL.-SER.	7440-50': SAME AS ABOVE
Tr. CHL.	②
Tr. CHL ① QTZ-SER	7450-60': SAME AS ABOVE, EXC. PROBABLY 10-15% GRANITE(?) ABUNDANT SILLIMANITE.
Tr. CHL-SER. ① CALCITE	* ONE QTZ-SER. VEIN FRAGMENT WITH 2X0.5 mm. TERMINATED EUHEDRAL QTZ XL — OTHERS SMALLER. ⑤
Tr. SER.	7460-70': 50-60% MED.-XLINE. LEUC. BTE. GRANITE W/ <0.5% BTE. REMAINDER F-M. XLN FSP-QTZ-BTE.
Tr. CHL. ① CALCITE	GNEISS W/ MINOR HBL. NO SILLIMANITE THIS SAMPLE.
Tr. CALCITE	7470-80': SAME AS ABOVE.
Tr. CHL.	
	7480-90': 15% MED. XLN. LEUC. GRANITE. REMAINDER F.-M. XLINE FSP.-QTZ-BTE GNEISS W/ MINOR
Tr. CALCITE	SILLIMANITE, Tr. GARNET. ②⑤
	7490-7500': 5% MED. XLINE LEUC. GRANITE (?)—MAY BE FELSIC MIGMATITIC DIFFERENTIATE. REMAINDER
Tr. CALCITE	②⑤ F.-M. XLN. FSP.-QTZ.-BTE. GNEISS W/ MINOR SILLIMANITE, Tr. GARNET. VARIABLE MAFIC CONTENT.

NOTE: MUCH OF THE MED. XLN. LEUCOCRATIC GRANITE DESCRIBED ABOVE COULD BE A FELSIC MIGMATITIC DIFFERENTIATE.

DRILL HOLE ROOSEVELT HOT SPRINGS

LOCATION ROOSEVELT HOT SPRINGS KGRA

LOGGED BY J. B. HULEN

APPENDIX III

LITHOLOGIC LOGS OF SIX UNIVERSITY OF UTAH THERMAL GRADIENT HOLES

HOLE #	LOCATION
-UU 76 SC (3HF)	SW 1/4, SW 1/4, SE 1/4, Sec. 25, T26S, R9W.
-UU 76-1	NW 1/4, NE 1/4, SW 1/4, Sec. 34, T26S, R9W.
-UU 1A	NE 1/4, NE 1/4, SE 1/4, Sec. 4, T27S, R9W.
-UU 1B	NE 1/4, SE 1/4, SE 1/4, Sec. 4, T27S, R9W.
-UU 76 BS (1 HF)	NW 1/4, NE 1/4, NE 1/4, Sec. 8, T27S, R9W.
-UU TGS (#5?)	NE 1/4, NE 1/4, SE 1/4, Sec. 14, T26S, R9W.

UURI EARTH SCIENCE LAB

SHEET No. 1 OF 8

PROJECT ROOSEVELT KGRA
DRILL HOLE UU76SC (3HF)
DEPOSIT TYPE
LOGGED BY SUSAN SAMBERG

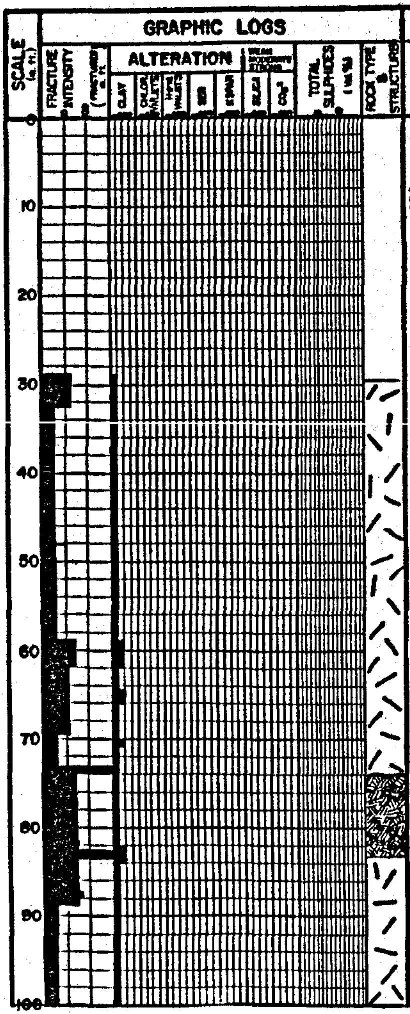
DATE STARTED
DATE COMPLETED
DRILLING CO. Jensen Drilling Co.
FINAL DEPTH 6410.7' (m, ft.)
COLLAR ELEV. 6900' (m, ft.)
CO-ORDINATES LAT.
LON.
GRID N E
T. 26S R. 9W SEC. 25DCA

CORE SIZE (mm, in.)	FROM (m, ft.)	TO
NX		

GEOPHYSICAL LOGS

LOG RUN	DEPTH (m, ft.)	DATE	COMPANY

GRAPHIC LOGS



GEOLOGIC NOTES (Use also for general comments)

DOWN HOLE LOCATION: DISTANCE DOWN HOLE (m, ft.)	ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION Massive, Disseminated, Veinfill, Replacement. TYPE Hypogene, Supergene, Ore and Limonite Mineralogy	STRUCTURE: DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)
			0 to 29' no core 29-489' quartz monzonite, except for dike as noted.		
29'-74'		Hbl-bte quartz monzonite (Tqm)	coarse crystalline plagioclase partially altd to wh - lt gray clay and sericite(?) K-spar fresh to partially altd to white clay bte mostly fresh to partially chloritized (~15%) hbl(?) totally altd to lt grn chlorite magnetite ~1% diss grains and aggregates of the grains up to 5mm in diameter 59'-62': increase clay on fractures 67.2': P6bg granulite: ~30mm Fe in bte appears leached out 66'-67.5': vnlet vertical to core axis qtz-clay-chl(?)	Black MnOx as patches and spots along fractures - some spots are dendritic Fe oxide stain along fractures and diss through rk Trace hematite on fractures (powdery maroon) and diss through rock 73'-73.3': Fault breccia stained w/Fe Oxide and MnOx	Rock not strongly fractured avg 5-7/m Fracture increase at 73'-73.3': core strongly fracture and faulted 29'-32': Fracture Intensity avg ~20-25/m ~59'-69.6' Fracture intensity ~20-25/m
74'-83.7'		Micro-diorite	Med-dk gray fine grain altd porphyritic microdiorite diked Plag phenocrysts altd to wh soapy clay (Kaolin?) 81.7'-82.8': rock becomes finer grained 82.8'-83.7': Fault zone: faulted qtz monz	Goethite Clay-MnOx coverings along fractures Fe appears leached out of dk mins 82.8'-83.7': Faulted mafic strongly stained w/Fe Oxide and MnOx	Fracture intensity avg ~ 25-30/m 82.8'-83.7 faulted microdiorite dike

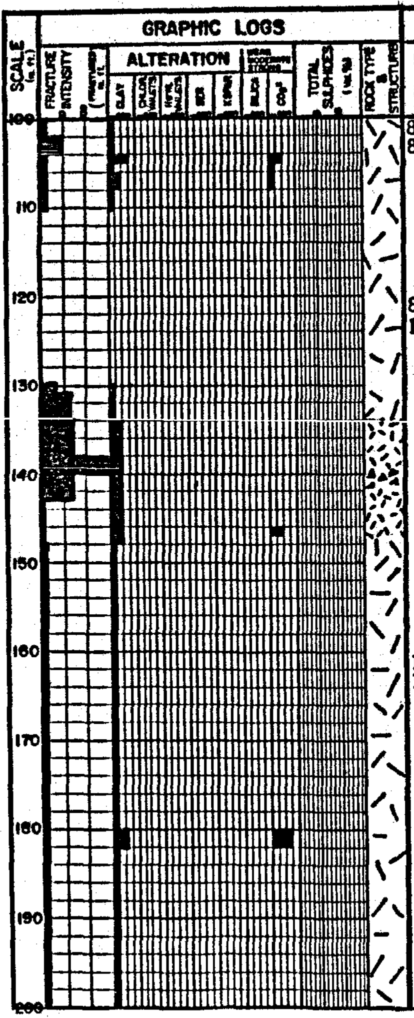
UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT KGRA
DRILL HOLE UU76SC (3HF)
DEPOSIT TYPE
LOGGED BY SUSAN SAMBERG

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m. ft.)
COLLAR ELEV. (m. ft)
CO-ORDINATES LAT. LON.
GRID N E
T. R. SEC.

SHEET NO 2 OF 8

CORE SIZE (mm. in.)	FROM (m. ft.)	TO	GEOPHYSICAL LOGS LOG RUN	DEPTH (m. ft.)	DATE	COMPANY
NX						



GEOLOGIC NOTES (Use also for general comments)

DOWN HOLE LOCATION: DISTANCE DOWN HOLE (m. ft.)	ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION Massive, Disseminated, Veinfill, Replacement. TYPE Hypogene, Supergene, Ore and Limonite Mineralogy	STRUCTURE: DOWN HOLE DIST. (m. ft.)	FOLIATION ∢ WITH CORE	BEDDING ∢ WITH CORE	FRACTURE ∢ WITH CORE	DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)	FRACTURE INTENSITY (NO PER METRE)	DOWN HOLE SURVEY DATA: DEPTH (m. ft.)	INCLINATION	BEARING	THIN & POLISHED SECTIONS: DEPTH (m. ft.)	SAMPLE NUMBER
83.7'- 88.6'		Hbl-bte qtz monz	Same as 29'-74' Altn same as 29'-74'	Stronger MnOx and Fe oxide spots and patches on fractures					Fracture intensity avg ~25-30/m						
				86.1': Incr. patches of MnOx on fractures and Fe Oxide					Increase fracture intensity at 87'-87.8' ~35/m						
				Wk Fe Oxide and MnOx diss through rk; tr hematite											
88.6'- 131.5'		Hbl-bte qtz monz	Same as 29'-74'	Same as 29'-74'					Fracture intensity decr to 0-7/m						
			95.6'-clay-chlorite-qtz vnlet ~2 mm w/MnOx patches FeOx	Fe oxide and MnOx diss through rock					~102'-104.4': Fracture intensity incr avg >10/m						
			98.6'-101' core & fractures 104.9'-107.5' calcitic	104.4'-104.9': Dendritic MnOx and Fe Oxide on fractures											
			104.4'-104.9': pegmatitic intergrowth w/fine gr hbl-bte qtz monz	Tr hematite on fractures and through rock											
				89.6': Incr patch MnOx											
			104.9'-107.5'- Fractures wkly calcitic												
			105.6'-105.8'- Fine grain granulite w/leucoxene												
131.5'- 134.6'		Hbl-bte qtz monz	Same as 29'-74' Altn same as 29'-74'	Same as 29'-74'					Fracture intensity incr. to ~20/m						
			Bte mostly fresh also Fe leached on fractures												

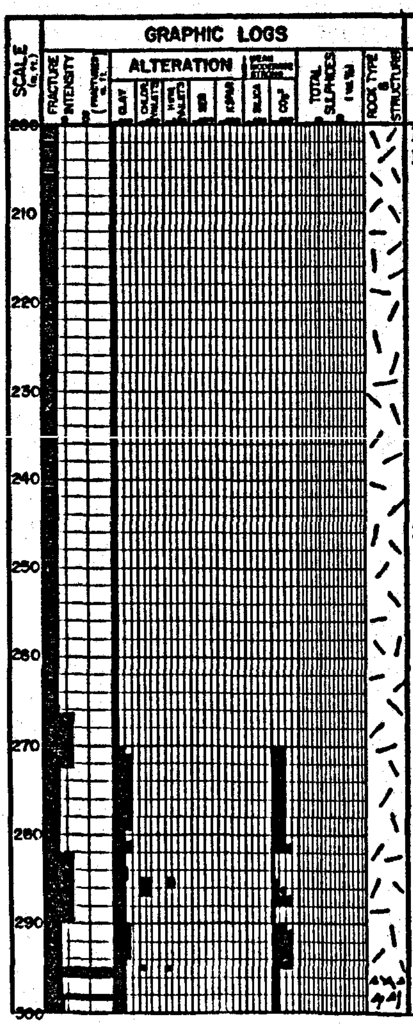
UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT KGRA
DRILL HOLE UU76SC (3HF)
DEPOSIT TYPE
LOGGED BY SUSAN SAMBERG

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m. ft.)
COLLAR ELEV. (m. ft)
CO-ORDINATES LAT. LON.
GRID N E
T. R. SEC.

SHEET No. 3 OF 8

CORE SIZE (mm. in.)	FROM (m. ft.)	TO	GEOPHYSICAL LOGS LOG RUN	DEPTH (m. ft.)	DATE	COMPANY
NX						



GEOLOGIC NOTES (Use also for general comments)

DOWN HOLE LOCATION Distance down hole (m. ft.)	ELEVATION	ROCK TYPE	DESCRIPTION Mineralogy, alteration, textures, grain size, fragment size.	MINERALIZATION Distribution / Type	STRUCTURE Description of structures Post or Pre-Ore (Evidence)
134.6'- 147.3'		Aplite	Fine-med even grain lt gray aplite fsps are fresh to partially altd to wh clay (and sericite?) bte (~5%) fresh to partially altd Fe appears leached out along fractures	MnOx spots along fractures: 141-141.5: dendritic (and diss thru rk) Wk Fe Oxide staining along fractures and diss through rk Trace hematite as powdery red spots diss through rock and along fractures 135.3'-136.2': Strong Fe oxide and MnOx patches on fractures 138.3: possible vnlet(?) or coating ~1.5 mm of Fe oxide MnOx-Clay 138.4'-139.5': Very weak MnOx and Fe staining on breccia	Contact betwn monz and aplite ~45° Fracture intensity avg ~30-35/m 138.4'-139.5': fault zone 143.7'-147.3': Fracture intensity avg ~3/m
147.3'- 298.9'		Hbl-bte qtz monz	Same as 29'-74' Altn same as 29'-74' 183.3'-183.5': fine grain 225.7'-225.8' granulite ~Increase clay (calcitic) on fractures: Ylw-wh soapy clay as patches and coverings on fractures after fsps or vnlets (montmorillonite) 146', 180', 271'-281.3 290.3'-294.6' (wk calcite in core) Clay-chl-hematite vnlet 282.4'-283' (~ 45° to core axis) ~1 mm lacing interval 284.3'-285' wh-ylw clay vnlet which continues at 285'-285.6' to clay-chl-hematite vnlet (~ 75°) : Incr clay and hem on fractures (wkly calcitic)	Same as 29'-74' Fe appears leached from bte Incr. Fe Oxide and Mnox 172.3'-172.9', 264, 267.9'-269.5 Vnlets or coatings of Goethite-MnOx-Clay on fractures Fractures extremely calcitic w/more clay: 285.8'-287.3 295.3': clay-chl-qtz vnlet w/MnOx and Fe Oxide staining and hematite Fault zone: wk MnOx spot and Fe staining	Fracture intensity 3-7/m Fracture intensity incr 15/m: 267.9'-273.5'; 282'-288.4' Fault zones: 295.7'-296' 298.4'-298.9'

DOWN HOLE SURVEY DATA: DEPTH (m. ft.) INCLINATION BEARING
THIN & POLISHED SECTIONS: DEPTH (m. ft) SAMPLE NUMBER

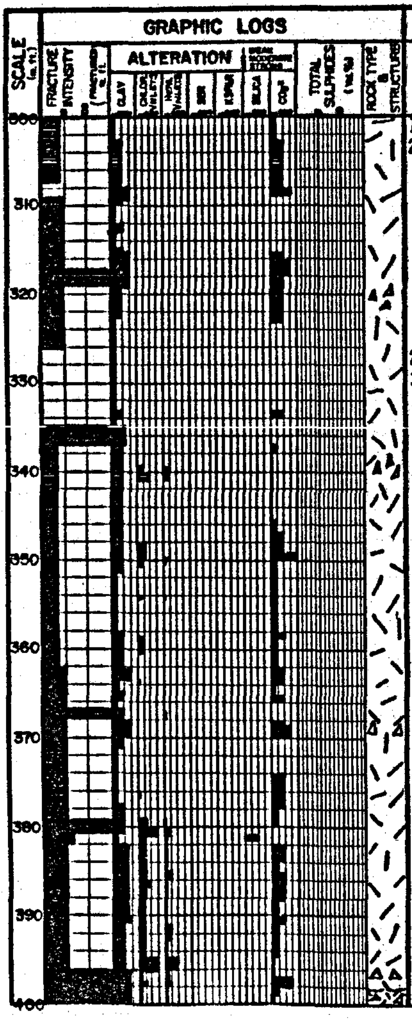
UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT KGRA
DRILL HOLE UU76SC (3HF)
DEPOSIT TYPE
LOGGED BY SUSAN SAMBERG

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m. ft.)
COLLAR ELEV. (m. ft.)
CO-ORDINATES LAT.
LON.
GRID N E
T. R. SEC.

SHEET No. 4 OF 8

CORE SIZE (mm. in.)	FROM (m. ft.)	TO	GEOPHYSICAL LOGS LOG RUN	DEPTH (m. ft.)	DATE	COMPANY
NX						



GEOLOGIC NOTES (Use also for general comments)

DOWN HOLE LOCATION: DISTANCE DOWN HOLE (m. ft.)	ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION Massive, Disseminated, Veinfill, Replacement / TYPE Hypogene, Supergene, Ore and Limonite Mineralogy	STRUCTURE: DOWN HOLE DIST. (m. ft.)	FOLIATION ∠ WITH CORE	BEDDING ∠ WITH CORE	FRACTURE ∠ WITH CORE	DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)	FRACTURE INTENSITY (# PER METRE)	DOWN HOLE SURVEY DATA: DEPTH (m. ft.)	INCLINATION	BEARING	THIN & POLISHED SECTIONS: DEPTH (m. ft.)	SAMPLE NUMBER
147.3'- 298.9'			285.8'-287.3': Clay-chl-qtz vnlets (<1 mm) lacing interval 295.3'-295.7: Incr amt of clay chlorite-qtz vnlets to fault zone Fault zones: strongly brecciated qtz monz: 295.7'-296' 298.4'-298.9												
298.9'- 339'		Hbl-bte qtz monz	Same as 29'-74' Altn same as 29'-74' Vnlets lacking Fracture surfaces cov'd by calcitic ylw-wh clay (after fsps or as vnlets) ~55° w/core axis 307.3'-308.6' Rock alternate 328.8'-329.7' between/aplite (as described in 134.6'-143.7') and qtz monz (described above) 315'-319': strong clay altn (refer to 147.3'-298.9') Med grain granulite xenoliths: 333.2'-333.3', 333.7'-333.8'	Weak Fe oxide and MnOx at 290'				75°	Fracture Interval avg 7-10/m No fractures: 307.3'-308.6' 326.5'-335.3' 317.6'-319': interval faulted except for 2 large solid blocks (avg 7/10" each) 335.3'-337.3' same as above						
339.5'- 358.9'		Hbl-bte qtz monz	Same as 29'-74' altn same as 29'-74' Clay-Chlorite-Qtz vnlets 1-4mm w/red staining (hematite?) lacing core: 339.5' 340'-340.3' 348.8'-349.9' .. calcititic filling ~1mm	No Fe or MnOx on fractures 348.8'-349.9', 350.3': hem. staining on fractured vnlet					Fracture Intensity avg 5-7/m						

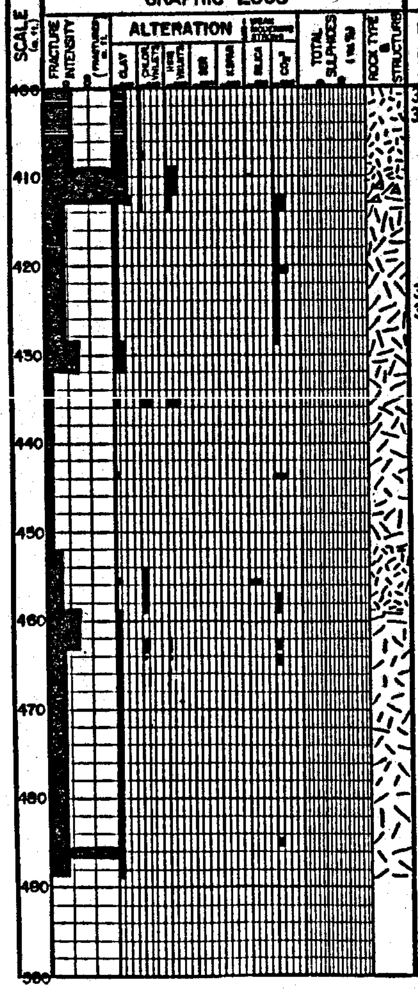
UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT KGRA
DRILL HOLE UU76SC (3HF)
DEPOSIT TYPE
LOGGED BY SUSAN SAMBERG

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m. ft.)
COLLAR ELEV. (m. ft.)
CO-ORDINATES LAT.
LON.
GRID N E
T R SEC.

SHEET No. 5 OF 8

CORE SIZE (mm. in.)	FROM (m. ft.)	TO	GEOPHYSICAL LOGS LOG RUN	DEPTH (m. ft.)	DATE	COMPANY
NX						



GEOLOGIC NOTES (Use also for general comments)

DISTANCE DOWN HOLE (m. ft.)	ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION Massive, Disseminated, Veinfill, Replacement; TYPE Hypogene, Supergene, Ore and Limonite Mineralogy	STRUCTURE: DOWN HOLE DIST. (m. ft.)	FOLIATION ∠ WITH CORE	BEDDING ∠ WITH CORE	FRACTURE ∠ WITH CORE	DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)	FRACTURE INTENSITY	DOWN HOLE SURVEY DATA: DEPTH (m. ft.)	INCLINATION	BEARING	THIN & POLISHED SECTIONS: DEPTH (m. ft.)	SAMPLE NUMBER
358.9'- 362.4'		Hbl-bte qtz monz	Same as 29'-74' Altn same as 29'-74' Clay-Chl-Qtz vnlets ~1mm lacing interval Fractures are calcitic (refer to accompanying graphic log)	FeOx staining and MnOx on fractures: 359.9' and 360.1'					Fracture intensity avg ~7/m						
362.4'- 398.2'		Hbl-bte qtz monz	Same as 29'-74' Altn same as 29'-74' Stronger altn of fsps to clay Clay-chlorite-qtz vnlets ~1-5mm lacing rock: 379'-395 376.5' 395.4' 363.9' 382.4'-399.2': core strongly laced w/clay-chl-qtz vnlts and w/hem-clay vnlets 381.1'-381.4 - massive fine grain xtalline lt gray qtz vnlet w/~3 mm clay-chl-qtz vnlet and smaller vnlets of the above and hem-vnlets lacing interval Most fractures w/ylw-wh clay are calcitic (refer to graphic log)	Same as 29'-74' 362.4'-363.3'-Strong MnOx (dendritic) and Fe oxide Vnlets and fractured vnlets stained w/FeOxide, MnOx, and hematite Wk Fe oxide stains and MnOx spots on fractured vnlets (382.4'-399.2') Fault zones (refer to structure) Show wk Fe oxide and MnOx on breccia					Fracture intensity avg ~10-15/m core broken by faults 367.6'-368' 379.1'-381' 396.2'-396.9' 397'-397.6' 398'-398.2' Strong brecciation and fault gauge 381.1'-381.4'- fracture intensity of aplite ~20-25/m 381.1'-381.4' - Qtz vnlet appears brecciated, cemented, then rebrecciated by chl-clay-qtz vnlets Hem veinlets running through chl-clay-qtz Hem vnlets formed after clay-qtz-chl qtz xtals appear to be growing into surrounding hem. Qtz xtals appear to be brecciated and "floating" in hem vnlets (~395.4')						

UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT KGRA
DRILL HOLE UU76SC (3HF)
DEPOSIT TYPE
LOGGED BY SUSAN SAMBERG

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m. ft.)
COLLAR ELEV. (m. ft.)
CO-ORDINATES LAT. LON.
GRID N E
T R SEC.

SHEET No. 6 OF 8

CORE SIZE (mm. in.)	FROM (m. ft.)	TO	GEOPHYSICAL LOGS LOG RUN	DEPTH (m. ft.)	DATE	COMPANY
NX						

GEOLOGIC NOTES (Use also for general comments)

DOWN HOLE LOCATION DISTANCE DOWN HOLE (m. ft.)	ELEVATION	ROCK TYPE	DESCRIPTION MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION DISTRIBUTION Massive, Disseminated, Veinfill, Replacement / TYPE Hypogene, Supergene, Ore and Limonite Mineralogy	STRUCTURE DOWN HOLE DIST. (m. ft.)	FOLIATION ∢ WITH CORE	BEDDING ∢ WITH CORE	FRACTURE ∢ WITH CORE	DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)
398.2'- 411.2'		Aplite	Fine grain lt gray - wh aplite Same as 134.6'-143.7' 409.7'-409.9' Aggregate of euhedral qtz crystals ~30m and spherulitic gypsum Laced w/hem-clay vnlets and chl-clay-qtz vnlets (~1-4mm) (refer to graphic log)	Wk Fe oxide staining and MnOx spots along fractures Incr Fe staining 409.7'-409.9'					Fracture intensity avg 10-15/m Fault zone: 399'-399.5' ~409'-411'
411.2'- 412.3'		Hbl-bte qtz monz	Fault zone: Qtz monz and chl-qtz vnlets bte and hbl totally chloritized fsps strongly altd fsps strongly altd to wh clay	Breccia and fractures show hematite spots and coverings					Fractured and brecciated qtz monz
412.3'- 428.6'		Hbl-bte qtz monz	Same as 29'-74' Altn same as 29'-74' 412.3'-414.5'; Vnlet of chl-clay-hem avg ~1mm 414.5'-426.1'-wk calcite on fractures; none along fresh core 420'-420.5' - (refer to struct) Wh-lt yellow clay (refer to 147.3'-298.9') is highly calcitic occurs as coatings along fractures	Same as 29'-74' Fractures largely fresh w/wk Fe 420'-420.5'; Inc. Fe oxide staining and MnOx stain; tr hematite (as above)				~80°	Fracture intensity avg 0-7/m 420'-420.5'
428.6- 431'		Hbl-bte qtz monz	Same as 29'-74' Altn same as 29'-74'	Strong MnOx spots and coverings on fractures Fe oxide coating on fractures strong at 429.8'-431' tr hem on fractures as red powder				75°	Fracture intensity ~avg 12/m

UURI EARTH SCIENCE LAB

SHEET No. 7 OF 8

PROJECT ROOSEVELT KGRA
DRILL HOLE UU76 SC (3HF)
DEPOSIT TYPE
LOGGED BY SUSAN SAMBERG

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m. ft.)
COLLAR ELEV. (m. ft.)
CO-ORDINATES LAT.
LON.
GRID N E
T. R. SEC.

GEOPHYSICAL LOGS

CORE SIZE (mm. in.)	FROM (m. ft.)	TO	LOG RUN	DEPTH (m. ft.)	DATE	COMPANY

SCALE (m. ft.)	GRAPHIC LOGS	DOWN HOLE LOCATION		GEOLOGIC NOTES (Use also for general comments)			STRUCTURE						DOWN HOLE SURVEY DATA			THIN & POLISHED SECTIONS	
		DISTANCE DOWN HOLE (m. ft.)	ELEVATION	ROCK TYPE	DESCRIPTION MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION DISTRIBUTION Massive, Disseminated, Veinfill, Replacement. TYPE Hypogene, Supergene, Ore and Limonite Mineralogy	DOWN HOLE DIST. (m. ft.)	FOLIATION ∢ WITH CORE	BEDDING ∢ WITH CORE	FRACTURE ∢ WITH CORE	DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)	FRACTURE INTENSITY	DEPTH (m. ft.)	INCLINATION	BEARING	DEPTH (m. ft.)	SAMPLE NUMBER
		431'-		Hbl-bte	Same as 29'-74'	Same as 29'-74'					Fracture intensity						
		452.2'		qtz monz	Altn same as 29'-74'						decreases avg 0-1/m						
					Altn of bte and fsps decreases	Vnlets and fractures spotted											
						and cov'd w/MnOx Fe oxide, and					435.1'						
					Chl-clay-qtz vnlet ~2mm stained	hematite				45°	443.3'-443.6'						
					w/hem ;435.1'												
					436.5'-437' - aplite as des-												
					cribed in 134.6'-143.7'												
					443.3'-443.6' - mod calcitic												
					ylw-wh clay on fractures (refer												
					to 147.3'-298.9'												
		452.2'-		Aplite	Same as 134.6'-143.7'	Fe oxide and MnOx on fractures				55°	Contact betwn/aplite						
		458.6'			Altn same as 134.6'-143.7'						and qtz monz ~45° at						
											452.2'						
					Slightly coarser grain												
										55°	Fracture intensity						
					454.5'-458.6': laced w/clay-qtz						avg ~5-7/m						
					vnlets ~1mm at 55° w/core:												
					also contain sm amt chlorite					55°	455.3'-455.9' -						
											Crypto-xtalline sili-						
					455.3'-455.9': vnlet ~1-3mm						ceous filled crack						
					w/large amt massive qtz and						Fractured into 4						
					~2% fsp altd to wh clay						pieces ~30mm ea						
		458.1'-		Hbl-bte	Same as 29'-74' (Inc.gr size)	Same as 29'-74'					Contact betwn/aplite						
		463.7'		qtz monz	Altn same as 29'-74'						and qtz monz ~55° to						
						Hematitic staining on vnlets					core axis from 458.6'						
					Laced w/qtz-chl-clay vnlets						-458.8'						
						Goethite patches and hematite											
					462.9'-463.7'-Fractured vnlets	staining on fractured vnlets					Fracture intensity						
					appear as clay-chl-qtz vnlets						avg ~20-25/m						
					Sphene alt leucoxene and clay												
					w/qtz epidote(?) diss through												
					rock												

SHEET NO. 8 OF 8

UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT KGRA
DRILL HOLE UU76SC (3HF)
DEPOSIT TYPE
LOGGED BY SUSAN SAMBERG

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m. ft.)
COLLAR ELEV. (m. ft.)
CO-ORDINATES LAT. LON.
GRID N E
T. R. SEC.

GEOPHYSICAL LOGS

CORE SIZE (mm. in.)	FROM (m. ft.)	TO	LOG RUN	DEPTH (m. ft.)	DATE	COMPANY
NX						

SCALE (m. ft.)	GRAPHIC LOGS: FRACTURE INTENSITY	GRAPHIC LOGS: ALTERATION	GRAPHIC LOGS: TOTAL SULPHIDES (vol %)	ROCK TYPE & STRUCTURE	DOWN HOLE LOCATION: DISTANCE DOWN HOLE (m. ft.)	DOWN HOLE LOCATION: ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION Massive, Disseminated, Veinfill, Replacement. TYPE Hypogene, Supergene, Ore and Limonite Mineralogy	STRUCTURE: DOWN HOLE DIST. (m. ft.)	STRUCTURE: FOLIATION ∢ WITH CORE	STRUCTURE: BEDDING ∢ WITH CORE	STRUCTURE: FRACTURE ∢ WITH CORE	DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)	FRACTURE INTENSITY	DOWN HOLE SURVEY DATA: DEPTH (m. ft.)	DOWN HOLE SURVEY DATA: INCLINATION	DOWN HOLE SURVEY DATA: BEARING	THIN & POLISHED SECTIONS: DEPTH (m. ft.)	THIN & POLISHED SECTIONS: SAMPLE NUMBER
					458.1'		Hbl-bte qtz monz	Same as 29'-74' Altn same as 29'-74'	Fe staining through core stronger: 463.7'-464.7'					Fracture intensity avg ~5-7/m						
								Fractures at 15° < w/core axis generally fresh w/partially altd fsp to wh clay Not calcitic	Fractures at 15° < w/core show wk Fe oxide staining and tr hematite					Fault zone: 485.6'-486.3'						
								464.8'-465': bottom contact of altd fracture chl-clay-qtz vnlet; wkly calcitic	464.8'-465': Vnlet stained w/Fe oxide, hematite, and tr MnOx spots											
								485.6'-486.3': Faulted qtz monz (described above)	Fault breccia strongly stained w/Fe oxide Wk MnOx and tr hem											

GEOLOGIC NOTES (Use also for general comments)

UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT
DRILL HOLE UNIV. of UTAH 76-1
DEPOSIT TYPE GEOTH.
LOGGED BY J.B. HULEN JULY 1977

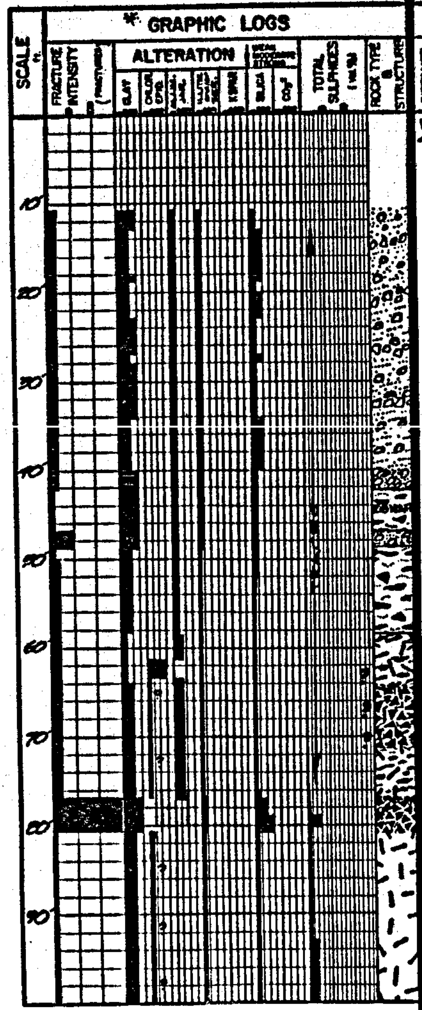
DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (~~m.~~ ft.)
COLLAR ELEV. (~~m.~~ ft.)
CO-ORDINATES LAT. LON.
GRID 5620 m N 600 m E
T 26S R 9W SEC. 34 (SW¼)

CORE SIZE (~~mm.~~ in.)	FROM (~~m.~~ ft.)	TO
NX	10⁸'	201⁴'

GEOPHYSICAL LOGS

LOG RUN	DEPTH (~~m.~~ ft.)	DATE	COMPANY

SHEET NO. 1 OF 9



DOWN HOLE LOCATION — DISTANCE DOWN HOLE ft.: 10⁸ - 128' — ELEVATION

* GEOLOGIC NOTES (Use also for general comments)

ROCK TYPE: ALTERED ALLUVIUM (Largely granitic fragments as near as the logger can tell (also misc. lithic frags [volc.] + obsidian)

DESCRIPTION (MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.)

SILTY TO SANDY GRAVEL; ANG - SUBANG. FRAGS FR. <<1 mm. TO AT LEAST 30 cm. MAX DIMENSION; CRUDE BEDDING LOCALLY APPARENT; POROSITY 7-25% (MAX. IN COARSER GRAVEL LAYERS) IRREG., ELONGATE VUGS (SECONDARY) (UP TO 15 mm. MAX DIMENSION)

"ROCK" IS LIGHT-COLORED, W/ OVERALL PUNKY, CRUMBLY, VUGGY CHARACTER, BUT IS LOCALLY PORCELLANEOUS (ALUNITE?); OVERALL, APPEARS TO BE A FINE-XLINE AGGREGATE OF QTZ (+ OPAL), CLAY, ALN, FINE WHITE MICA (ILLITE? BLEACHED CHL.?)

- RARE PARTIALLY UNALTERED FSP. BELOW 31.5'

- THROUGHOUT: HYALITE-CLAY VNLTS. AT ALL ∡'S TO CORE AXIS; IRREG., AVG. ≈ 1 mm. WIDE (UP TO 7 mm.); VUGGY (VUGS UP TO 25 X 7 mm. IN X-SECT) - VUGS LINED W/ BOTRYOIDAL HYALITE; EST AVG. 7-10 VNLTS/m

- 23½-25', 26-27', 36.5-38': UNKNOWN GRAYISH TO GREENISH-YELLOW MINL, (MAY BE NATIVE SULFUR IN PART) LOCALLY UP TO 1%, AS DISS., IRREG MASSES UP TO 5 mm. DIA. W/ OPAL (HYALITE), ALUNITE, CLAY, RARELY LIMONITE; ALSO PARTIALLY LINING VUGS & W/ ABOVE MINERALS IN SCATTERED VNLTS; TRACES OF As_2S_3 W/ THE SULFUR

- SPHENE IN GRANITIC FRAGS. ALT. TO PAPERY BUFF-COLORED BOXWORKS OF UNKNOWN MINL.

MINERALIZATION (DISTRIBUTION: Massive, Disseminated, Veinfill, Replacement; TYPE: Hypogene, Supergene, Ore and Limonite Mineralogy)

- OVERALL: 3-4% GOETHITIC TO HEMATITIC (largely the latter) LIMONITE AS:
  - ① DISS IRREG GRAINS AVG ≤ 0.1 mm. DIA IN BOTH MATRIX AND FRAGS.
  - ② AS PARTIAL VUG LININGS W/ MINERALS DESCRIBED TO THE LEFT
  - ③ W/ ABOVE MINERALS IN VNLTS.
- OVERALL FORMER SULFIDE CONTENT 3-4%, BUT IN VUGGY, GRAVEL LAYERS UP TO 7-9%
- RARE, SCATTERED 'ISLANDS', UP TO 10 MM. DIA, OF UNOXIDIZED PYRITE BELOW 128'

STRUCTURE

BEDDING ∡ WITH CORE: 60-70° — FRACTURE ∡ WITH CORE: 10-80°

DESCRIPTION OF STRUCTURES (Post or Pre-Ore (Evidence)): "ROCK" TENDS TO CRUMBLE, RATHER THAN FRACTURE; FRACTURES → 3?

W.R. SILL SAMPLES (Core Intact)

$21^{50}-21^{85}$'
$24-24^{50}$'
$26^{50}-27^{0}$'
$42^{50}-43^{00}$'
$50^{70}-50^{80}$'
$58^{30}-58^{77}$'
$73-73^{50}$'
$88-88^{30}$'
$100^{50}-101^{20}$'
$108^{50}-109$'
$112^{70}-113^{05}$'
$124^{40}-125^{05}$'
$155-155^{45}$'
$199^{15}-200^{00}$'

DOWN HOLE SURVEY DATA: DEPTH ft. — INCLINATION — BEARING

THIN & POLISHED SECTIONS: DEPTH ft. — SAMPLE NUMBER

* NOTE: GEOLOGIC NOTES & GRAPHIC LOGS NOT AT SAME SCALE.

UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT
DRILL HOLE UNIV of UTAH 76-1
DEPOSIT TYPE GEOTH.
LOGGED BY J.B. HULEN JULY 1977

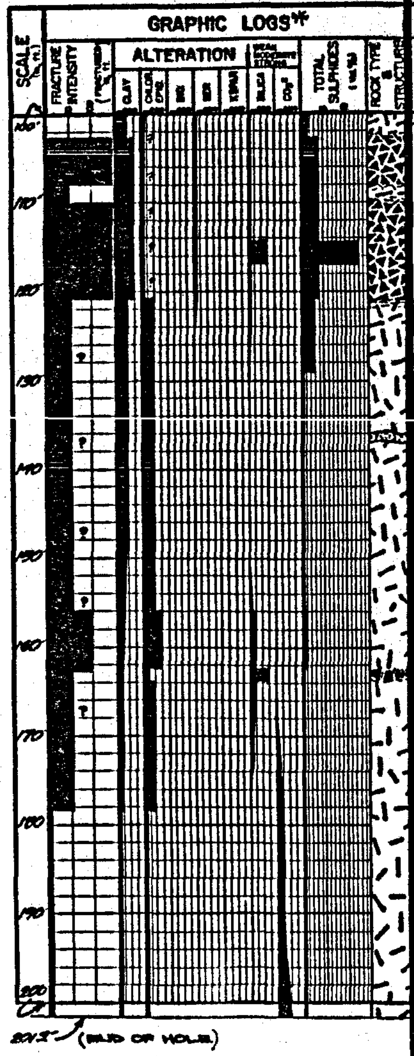
DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m. ft.)
COLLAR ELEV. (m. ft.)
CO-ORDINATES LAT. LON.
GRID 5620 m N 600 m E
T 26S R 9W SEC. 39 (SW¼)

SHEET NO. 2 OF 4

GEOPHYSICAL LOGS

CORE SIZE (mm. in.)	FROM (m. ft.)	TO	LOG RUN	DEPTH (m. ft.)	DATE	COMPANY

GRAPHIC LOGS*



GEOLOGIC NOTES* (Use also for general comments)

DOWN HOLE LOCATION: DISTANCE DOWN HOLE (m. ft.)	ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION (Massive, Disseminated, Veinfill, Replacement) / TYPE (Hypogene, Supergene, Ore and Limonite Mineralogy)	STRUCTURE: DOWN HOLE DIST. (m. ft.)	FOLIATION ∢ WITH CORE	BEDDING ∢ WITH CORE	FRACTURE ∢ WITH CORE	DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)	FRACTURE INTENSITY	DOWN HOLE SURVEY DATA: DEPTH (m. ft.)	INCLINATION	BEARING	THIN & POLISHED SECTIONS: DEPTH (m. ft.)	SAMPLE NUMBER
42^{3}–47'		ALTERED TUFF (?) (Air Fall?)	... PUNKY, V. LT. GRAY; 10% ANGULAR FRAGS. & PROB. BROKEN XLS., ERRATICALLY DISTRIBUTED, SET IN A V. FINE-XLINE MATRIX; FRAGS UP TO 15 mm. DIA. (AVG 5 mm.) ALTN. ESS. SAME AS 10^{8}–42^{3}', EXC. PROB. MUCH LESS OR NO ALUNITE	(~5% fragments at top of interval to 15% at base) (fragments commonly porous, vuggy — may be pumice in part)					44-45': GOUGE & BX.						
47–49^{2}'		ALTERED ALLUVIUM(?) (May be fragment-rich, altered tuff)	... ESSENTIALLY IDENTICAL TO 10^{8}–42^{3}'; HEMATITE-JAROSITE-CLAY-OPAL VNLT. UP TO 10 mm. WIDE, SUB-// TO CORE AXIS ENTIRE LENGTH OF INTERVAL (POSS W/ SOME NATIVE S)	SAME AS 10^{8}–42^{3}' LIMONITE IS PREDOMINANTLY BRICK RED TO MAROON PULVERULENT HEMATITE W/ MINOR YELLOWISH-GRAY-BROWN JAROSITE											
49^{2}–50^{2}'		ALTERED TUFF (?)	... SAME AS 42^{3}–47', EXC. RICHER IN FRAGS, LESS ALTERED (SOME RELICT FSP)(SANIDINE?)												
50^{2}–50^{4}'		ALTERED LITHIC TUFF (?)	... SAME AS 42^{3}–47' EXC. RICHER IN OBVIOUS GRANITIC FRAGMENTS; SCATTERED RELICT FSP	additional notes: overall 30-35% fragments up to at lst. 30 mm. dia.											
50^{4}–80'		ALTERED GRANITIC ROCK (PROBABLY BTE. QTZ. MONZ.)	CRS-XLINE; PRONOUNCED CATACLASTIC (?) FOLIATED ASPECT HIGHLIGHTED BY CRUDELY SUBPARALLEL ELONGATE VUGS (SUB// TO "CATACLASTIC" FOLIATION) UP TO 15X5 mm. X-SECT. (AVG. ~ 3X1 mm.), ACCOUNTING FOR 7-10 VOL. % OF ROCK. VUGS ARE COMMONLY PARTIALLY TO COMPLETELY LINED W/ CLAY, MINOR OPAL, DRUSIES OF TINY WHITE XLS (ZEOLITE?) — STR. CHL. ALTN. 61^{3}–64' (MASSES OF FINE-XLINE CHL. THIS INTERVAL UP TO 15 mm. DIA.	OBVIOUS SULFIDES BEGIN TO APPEAR AT ~ 75'; THESE OCCUR MAINLY AS DISS. IRREG. GRAINS <<0.1 mm. (may be present, but unrecognized higher in hole); ALSO OCCUR BELOW 77' AS RARE AGGREG. OF THESE GRAINS UP TO 5 mm. DIA. MANY GRAINS & GRAIN AGGREGATES ARE DULL BROWNISH & SUBMETALLIC (MAY BE SPHALERITE IN PART). SULF. ALSO OCCUR IN PART AS IRREG. GRAINS & GRAIN AGGREGATES ALONG CLAY-SILICA VNLTS.					69-71(?)' (MUCH LOST CORE THIS INTERVAL): FLT. ZONE W/ GOUGE & BRECCIA. 77-80': SILICIFIED FLT. ZONE						

77-80': HEAVILY ARGILLIZED & SILICIFIED PORTION OF FLT. ZONE — 5-7% DIS. BROWNISH-GRAY SUBMETALLIC MINRL. (W/ SOME OBVIOUS PYRITE) IN STRINGY SUB/ BANDS @~40° TO CORE AXIS,

* NOTE: GRAPHIC LOGS & GEOLOGIC NOTES NOT AT

UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT
DRILL HOLE UNIV. of UTAH 76-1
DEPOSIT TYPE GEOTHERMAL
LOGGED BY J.B. HULEN JULY 1977

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m/ft.)
COLLAR ELEV. (m/ft.)
CO-ORDINATES LAT. LON.
GRID 5620 m. N 600 m. E
T. 26S R. 9W SEC. 34 (SW¼)

SHEET NO. 5 **OF** 7

CORE SIZE (mm/in.)	FROM (m/ft.)	TO	GEOPHYSICAL LOGS LOG RUN	DEPTH (m/ft.)	DATE	COMPANY

GRAPHIC LOGS* (SCALE (m/ft.); FRACTURE INTENSITY; ALTERATION: CLAY, CHLOR. EPID., SER., KSP, BIO., SILICA, CO₂; TOTAL SULFIDES (Vol. %); ROCK TYPE & STRUCTURE)

GEOLOGIC NOTES* (Use also for general comments)

DISTANCE DOWN HOLE (m/ft.)	ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION (Massive, Disseminated, Veinfill, Replacement); TYPE (Hypogene, Supergene, Ore and Limonite Mineralogy)	STRUCTURE: DOWN HOLE DIST. (m/ft.)	FOLIATION ∢ WITH CORE	BEDDING ∢ WITH CORE	FRACTURE ∢ WITH CORE	DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)	FRACTURE INTENSITY	DOWN HOLE SURVEY DATA: DEPTH (m/ft.)	INCLINATION	BEARING	THIN & POLISHED SECTIONS: DEPTH (m/ft.)	SAMPLE NUMBER
80^{2}-72^{8}'		ALTERED GRANITIC ROCK	... SAME AS 58^{1}-80^{2}', EXC. TR. OR NO ILLITE (BLCHD. CHL.?) (check)	DISS. PY. ~ 0.1%, TEXTURALLY SIMILAR TO 58^{1}-80^{2}'											
72^{8}-102^{8}		ALTERED GRANITIC ROCK	... SAME AS 58^{1}-80^{2}' 5-7% IRREG. VUGS, AVG. ~ 2mm. MAX DIMENSION; THESE MAY BE LINED OR PARTIALLY LINED W/ VARIOUS ALTN. MINRLS. SAME AS 58^{1}-80^{2}'; FOLIATED ASPECT SOMEWHAT MORE VAGUE. CLAY VNLTS. UP TO 2mm WIDE (AVG. ≤ 1mm), FROM ⊥ TO SUB∥ TO CORE AXIS ~ OTHERWISE CLAY ALTN. AFFECTS MAINLY SMALLER FSP XLS. (LARGER XLS. COMMONLY UNALTERED)	OVERALL ~ 1±%, BUT ERRATICALLY DISTRIBUTED FROM <0.5->5%; OCCURS AS DISS. IRREG. GRAINS, AVG. ~ 0.1mm DIA, AND RARE AGGREGATES OF THESE GRAINS UP TO 10mm DIA. SOME DISS. BROWNISH-BRONZY MATERIAL, TEXTURALLY SIMILAR TO ABOVE, WHICH MAY BE PYRITE IN PART; ALL SULF. PARTIALLY & ERRATICALLY ALTERED TO BRICK-RED PULVERULENT HEMATITE.				10-55	FRACTURES RARE — REACTIVATED, FOLLOWING CLAY VNLTS.	1-2/m ?					
102^{8}-120^{7}		ALTERED GRANITIC GOUGE & BRECCIA (FLT. ZONE)	... DEGREE OF COMMINUTION HIGHLY VARIABLE; FINELY GROUND TO 108', RELATIVELY UNBROKEN 108-110'; THOROUGHLY CRUSHED 110-120^{7}'; RELICT BIO. APPEARS AT 112^{7}' ~ NONTRONITE (W/ SOME CHL.?) AT 115' — LATTER OCCURS AS FILMY FRACTURE COATINGS & INTERGROWN W/ RELICT BIO.	SAME AS ABOVE EXCEPT AVG. 4% TOTAL SULFIDE OVERALL ~ PARTIALLY ALTERED TO BRICK-RED HEMATITE; GRAIN SIZE OF SULF. MAY REACH 1mm. 114^{5}-117': 12-15% DISS. PYRITE IN STRONGLY SILICIFIED PORTION OF FAULT ZONE (30° ∢ W/ CORE AXIS)					GOUGE & BX.						
120^{7}-128^{2}		ALTERED BIOTITE GRANITE	... CRS-XLLINE; KSP. REL. FRESH; PLAG. ALTERED; BIO. PARTIALLY TO TOTALLY REPLACED W/ VARIOUS MIXTURES OF CHLORITE, NONTRONITE(?) & PYRITE-HEMATITE; PAPERY BUFF-COLORED BOXWORKS REPLACING SPHENE (~2-3%) CHL-CLAY VNLTS. COMMON	SAME AS 102^{8}-120^{7}'; ALSO OCCURS W/ CHL. & CLAY (& HEM.) IN VNLTS. ~2% ALSO ~ 1% DISS. HEM. TEXTURALLY SIMILAR TO PYRITE, PROBABLY PARTIALLY AFTER ORIG. ROCK MAGNETITE (also minor hem. vnlts.)					? ? VARIABLE: AVG PERHAPS 15-20/m STKWK. — ALONG PRE-EXISTING VNLTS. FIGURE MAY BE LOW BECAUSE MANY VNLTS. FAIL WHEN SUBJECTED TO MODERATE PRESSURE	←					

* NOTE: GRAPHIC LOGS & GEOLOGIC NOTES NOT AT SAME SCALE

UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT
DRILL HOLE UNIV. of UTAH 76-1
DEPOSIT TYPE GEOTH.
LOGGED BY J.B. HULEN JULY 1977

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m/ft.)
COLLAR ELEV. (m/ft.)
CO-ORDINATES LAT.
LON.
GRID 5620 m N 600 m E
T 26S R 9W SEC. 34 (SW¼)

SHEET NO. 1 OF 1

CORE SIZE (mm/in.)	FROM (m/ft.)	TO	GEOPHYSICAL LOGS LOG RUN	DEPTH (m/ft.)	DATE	COMPANY

GRAPHIC LOGS* — SCALE (ft.); FRACTURE INTENSITY (fractures/ft.); ALTERATION: CLAY, CHLOR EPID., BI, SER, K-SPAR, SILICA, $CO_3^=$ (weak, moderate, strong); TOTAL SULFIDES (vol.%); ROCK TYPE & STRUCTURE

GEOLOGIC NOTES* (Use also for general comments)

DOWN HOLE LOCATION: DISTANCE DOWN HOLE (ft.)	ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION (Massive, Disseminated, Veinfill, Replacement) / TYPE (Hypogene, Supergene, Ore and Limonite Mineralogy)	STRUCTURE: DOWN HOLE DIST. (m/ft.)	FOLIATION ∠ WITH CORE	BEDDING ∠ WITH CORE	FRACTURE ∠ WITH CORE	DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)	FRACTURE INTENSITY	DOWN HOLE SURVEY DATA: DEPTH (ft.)	INCLINATION	BEARING	THIN & POLISHED SECTIONS: DEPTH (ft.)	SAMPLE NUMBER
128^{2}-178^{3}		ALTERED BIOTITE QTZ. MONZ.	... SAME AS 120^{7}-128^{2}' TEXTURALLY; 5-7% DISS. IRREG. MASSES FINE-XLINE BTE., PARTIALLY-TOTALLY ALTERED TO CHL, MONTM(?), & HEMATITE; 2-3% PAPERY BOXWORKS PSEUDOMORPHING SPHENE; CLAY OCCURS AS IRREG. PATCHES PARTIALL TO TALLY REPLACING FSP. & BTE., and IN VNLTS W/CHL, HEM., RARE PYRITE, MINOR FUH. GYPSUM; CHL PARTIALLY REPLACES BTE. AND OCCURS IN THE VNLTS. DESCRIBED ABOVE (VNLTS avg. <0.5 MM. DIA., OCCUR AT ALL ∠S TO CORE AXIS, BUT SL. PREDOMINANCE OF 20°-30° VNLTS) —OVERALL CLAY MOD TO ~145', BECOMING PROG. WKR. DOWNHOLE —A FEW IRREG. scattered DISC. QTZ. VNLTS. APPEAR BELOW 163^{2}' —WK. $CO_3^=$ PRED./SPHENE, APPEARS BELOW /170' (some relict sphene below 170') 156-162^{2}': ABUND. QTZ-CHL-CLAY-HEM-(GYP) VNLTS; SUB// TO CORE PREDOM. ORIENTATION 136-137': APLITE DIKE 160^{3}-163^{2}': STRONGLY BXTED & SILICIFIED ZONE CUT BY CHL-HEM. VNLTS	PYRITE: 0.1-0.3% OVERALL, TEXTURALLY SIMILAR TO 120^{7}-128^{2}', EXC. GREATER TENDENCY TO OCCUR W/CHL, CLAY, HEM, GYP. IN VNLTS. HEMATITE: ① ~1% 2% DISS. IRREG. GRAINS TEXTURALLY SIMILAR TO DISS. PY. PROB. REPLACING ORIG. ROCK MAGNETITE IN PART? (BOTH POWDERY & DK. GRAY METALLIC) ② W/CHL, CLAY, GYP. IN VNLTS. ③ AS DISCRETE HAIRLINE VNLTS., COMMONLY ALONG CLEAVAGE PLANES & CRYSTAL BOUNDARIES (esp. Kspar) * Also much less hem. overall				STG.-WK.	SAME AS 120^{7}-128^{2} BUT ABUNDANT HAIRLINE STONE HEM. VNLTS. COMMONLY WILL BREAK W/ ONLY MODERATE PRESSURE, SO 15-20/M. MAY BE A LOW FIGURE. ALSO: FRAC. DENSITY VARIABLE ALONG THE LENGTH OF THIS INTERVAL FROM <15/M TO (LOCALLY) >100/M.	15-20.					
178^{3}-201^{2}		BTE. QTZ MONZ, SLIGHTLY ALTERED	—Same as above except much fresher — all primary minerals only partially altered, commonly apparently unaltered; chl.-clay-gyp.-hem. vnlts. persist, but are less common. — Primary magnetite appears at 178^{3}' — Vuggy, 2 mm-wide qtz.-chl.-calcite vnlt. at 201.4'	Same as above, except hem. is both pulverulent & specular variety, implying that much of the hematite seen above this interval is not derived from primary sulfide oxidation.				STG.-WK.	BREAK ALONG PRE-EXISTING VNLTS	1-3/m.					

* NOTE: GRAPHIC LOGS & GEOLOGIC NOTES NOT AT SAME SCALE

UURI EARTH SCIENCE LAB

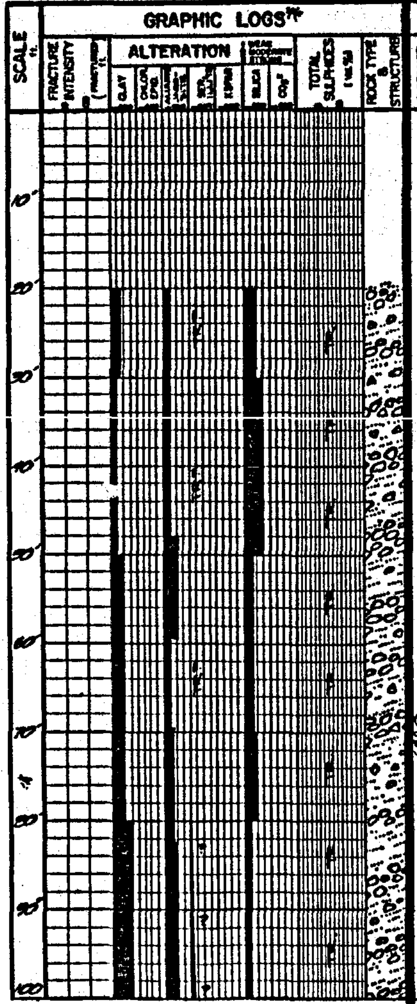
PROJECT ROOSEVELT
DRILL HOLE UNIV. of UTAH DDH 1A
DEPOSIT TYPE GEOTH.
LOGGED BY J.B. HULEN JULY, AUG. 1977

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m/ft.)
COLLAR ELEV. (m/ft.)
CO-ORDINATES LAT. LON.
GRID 3866 m N 24 m E
T 27S R 9W SEC. 4

SHEET No. 1 OF 5

CORE SIZE (mm/in.)	FROM (m/ft.)	TO	GEOPHYSICAL LOGS LOG RUN	DEPTH (m/ft.)	DATE	COMPANY

GRAPHIC LOGS*



GEOLOGIC NOTES* (Use also for general comments)

DOWN HOLE LOCATION: DISTANCE DOWN HOLE ft.	ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION (Massive, Disseminated, Veinfill, Replacement) / TYPE (Hypogene, Supergene, Ore and Limonite Mineralogy)	STRUCTURE: DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)	DOWN HOLE SURVEY DATA
0-20'		Qal?	NO CORE	20- APP. 38': MINOR, ERRATICALLY DISTRIBUTED NATIVE SULFUR (W/TR. REALGAR).	ALTERED ALLUVIUM TENDS TO CRUMBLE RATHER THAN FRACTURE	
20-59^{2}'		ALTERED ALLUVIUM	SILTY TO SANDY GRAVEL; ANGULAR-SUBANG. FRAGS OF ALT. FSP, QTZ, GRANITIC RX., & POSS. VOLC. RX (INTENSITY OF ALTN. PRECLUDES ACCURATE I.D.) FR. <<1 mm. TO AT LEAST 5 cm. MAX. DIMENSION; OVERALL BLEACHED,PUNKY, CRUMBLY ASPECT; LOCALLY DENSE AND PORCELLANEOUS IN IRREGULAR PATCHES; APPEARS TO BE A V. FINE-XLINE. AGGREGATE OF SILICA, CLAY (AND POSS. TR. ILLITE) W/ALUNITE; POROSITY VARIABLE FR. <1%-20%—VUGS ARE IRREG., TEND TO BE ELONGATE, UP TO 15 mm. MAX. DIMENSION, COMMONLY PARTIALLY LINED W/BOTRYOIDAL OPAL & CLAY (OCC. W/TR. S & As_2S_3); A FEW (10/meter?) VUGGY, IRREGULAR CLAY-OPAL VNLTS. UP TO 20 mm. WIDE (AVG. ~1½ mm. WIDE)	SULFUR OCCURS AS: ① DISS., IRREG. MASSES OF SUBHEDRAL XLS. AVG. 1 mm. DIA. (UP TO 3 mm. DIA.)—COMMONLY INTERCONNECTED BY TINY VNLTS. ② SUBH. XLINE CRUSTS ON AND INTERGROWN WITH OPAL & CLAY IN VNLTS. & PARTIALLY LINING VUGS —REALGAR APPEARS TO BE CRYPTOXLINE. OCCURS IN AMORPHOUS CLOTS & STAINS AVG <1 mm. DIA. (UP TO 2 mm. DIA.) —RARE RELICT PYRITE GRAINS LOCALLY PRESENT	½ core intact 201-201[illegible]	W.R. 3/11 (*) SAMPLES (core intact) 25[illegible]-26[illegible]' 80[illegible]-81[illegible]' 99[illegible]-99[illegible]' 125-125[illegible]' 155[illegible]-155[illegible]' 167[illegible]-168[illegible]' 192[illegible]-192[illegible]' 208[illegible]-208[illegible]' 211-211[illegible]' A. TRIPP SAMPLES (core missing) 69[illegible]-70' 118[illegible]-118[illegible]' 165-165[illegible]' 201-202[illegible]' 210[illegible]-211'
59^{2}-64^{8}' (50% CORE RECOVERY)		ALTERED ALLUVIUM	SAME AS ABOVE, EXC. 15-20% POROSITY, PRIMARILY DUE TO SOLN. OF FSP. FRAGS. & FSP. PORTIONS OF GRANITIC FRAGS, RATHER THAN IRREG. VUGS AS ABOVE. frothy, porous-looking fsp. xl. (silica-clay bxwork)	1% LIMONITE, PREDOMINANTLY POWDERY REDDISH-BRN. HEMATITE W/MINOR GOE. & HEM., AS: ① DISS. ANH. GRAINS, AVG. <0.1 mm. DIA. ② AS DENSE TO LOOSE AGGREGATES OF THESE GRAINS UP TO 30 mm. (AVG ~2 mm) MAX. DIMENSION. ③ AS RARE IRREG., DISCONTINUOUS VNLTS. SUB// TO BEDDING, UP TO 10 mm. (AVG. <1 mm) WIDE COMPOSED OF THE MASSES DESCRIBED ABOVE.		

THIN & POLISHED SECTIONS: DEPTH ft. / SAMPLE NUMBER

* NOTE: GRAPHIC LOGS & GEOLOGIC NOTES NOT AT SAME SCALE

(*) THERMAL CONDUCTIVITY

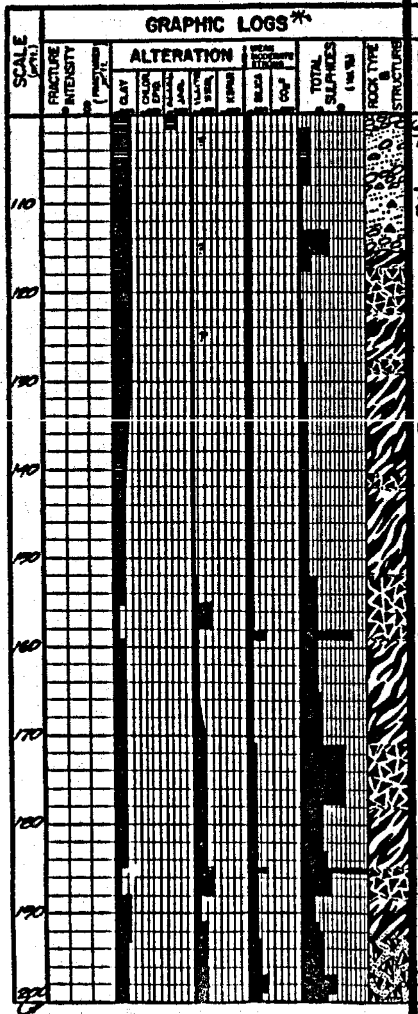
UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT
DRILL HOLE UNIV. OF UTAH DDH 1A
DEPOSIT TYPE GEOTH.
LOGGED BY J. B. HULEN

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (~~m~~ ft.)
COLLAR ELEV. (~~m~~ ft.)
CO-ORDINATES LAT.
LON.
GRID 3866 m. N 24 m. E
T. 27S. R. 9W. SEC. 4

SHEET NO. 2 OF 5

CORE SIZE (~~mm.~~ in.)	FROM (~~m.~~ ft.)	TO	GEOPHYSICAL LOGS LOG RUN	DEPTH (~~m.~~ ft.)	DATE	COMPANY



GEOLOGIC NOTES* (Use also for general comments)

DOWN HOLE LOCATION: DISTANCE DOWN HOLE (~~m~~ ft.)	ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION (Massive, Disseminated, Veinfill, Replacement); TYPE (Hypogene, Supergene, Ore and Limonite Mineralogy)	STRUCTURE: DOWN HOLE DIST. (m. ft.)	STRUCTURE: FOLIATION ∢ WITH CORE	STRUCTURE: BEDDING ∢ WITH CORE	STRUCTURE: FRACTURE ∢ WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)	FRACTURE INTENSITY	DOWN HOLE SURVEY DATA: DEPTH (~~m~~ ft.)	DOWN HOLE SURVEY DATA: INCLINATION	DOWN HOLE SURVEY DATA: BEARING	THIN & POLISHED SECTIONS: DEPTH (~~m~~ ft.)	THIN & POLISHED SECTIONS: SAMPLE NUMBER
69.5–71.5'		ALTERED ALLUVIUM	SAME AS 59^{5}–69^{5}'	SAME AS 59^{5}–69^{5}', EXC. ~0.3% HEMATITIC LIMONITE											
71^{5}–82^{1}'		ALTERED ALLUVIUM	SAME AS 59^{5}–69^{5}', EXC. TO 80' ROCK IS HARDER, MORE DENSE, W/ MORE OBVIOUS PORCELLANEOUS ALUNITE. ~15-20% POROSITY TO 78^{1}'; <5% TO 82^{1}'.	LIMONITE, SAME AS 59^{5}–69^{5}', EXC. GOETHITE AND JAROSITE MORE ABUNDANT — PATCHES OF HEM. AND OF GOE-JAR. TEND TO BE MUTUALLY EXCLUSIVE 79–82^{1}': 7% LIMO. 71^{5}–79': 3% LIMO. (LOCAL BANDS & PATCHES W/ UP TO 20% LIMO)											
82^{1}–90^{6}'		ALTERED ALLUVIUM	SAME AS 20–59^{5}' EXC. 4-5% POROSITY, AVG. 4-5% (UP TO 10%) LT. YELLOWISH-GRAY PULVERULENT TO PORCELLANEOUS JAROSITE-ALUNITE, ALMOST TOTALLY INTERSTITIAL TO LARGER FRAGMENTS	≤0.1% HEM, TR. GOE. TEXTURALLY SIMILAR TO 59^{5}–69^{5}'											
90^{6}–101^{7}'		ALTERED ALLUVIUM	SAME AS ABOVE, EXC. FSP FRAGS ARE EXTENSIVELY STAINED PINK TO MAROON BY FINELY DIVIDED HEMATITE; RARE RELICT FRESH FSP. LOCALLY PRESENT — OVERALL AVG. 7% JAROSITE-ALUNITE (VARIES FR. <1-10%)												
101^{7}–108' (16% CORE REC.)		ALTERED ALLUVIUM	SAME AS 20–59^{5}', EXC. NO ALUNITE, ~2% POROSITY, MOSTLY UNOXIDIZED	PYRITE 3%, TEXTURALLY SIMILAR TO HEMATITE FR. 59^{5}–69^{5}', EXC. GRAINS ARE PREDOMINANTLY SUBHEDRAL, AVG. ~0.1 mm.											
108–113' (10% CORE REC.)		ALTERED ALLUVIUM	SAME AS 20–59^{5}' EXC. NO ALUNITE, ~2% POROSITY, MOSTLY UNOXIDIZED	SAME AS ABOVE, EXC. <1% PY., ~1% JAROSITE TEXTURALLY SIMILAR TO PYRITE											

* NOTE: GRAPHIC LOGS & GEOLOGIC NOTES NOT AT SAME SCALE

SHEET No. 3 OF 5

UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT
DRILL HOLE UNIV. of UTAH DDH 1A
DEPOSIT TYPE GEOTH
LOGGED BY J. B. HULEN

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m/ft.)
COLLAR ELEV. (m/ft.)
CO-ORDINATES LAT.
LON.
GRID 3866 m N 29 m E
T. 27S R. 9W SEC. 4

GEOPHYSICAL LOGS

CORE SIZE (mm/in.)	FROM (m/ft.)	TO	LOG RUN	DEPTH (m/ft.)	DATE	COMPANY

SCALE (feet)	DISTANCE DOWN HOLE ft.	ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION (Massive, Disseminated, Veinfill, Replacement) / TYPE (Hypogene, Supergene, Ore and Limonite Mineralogy)	STRUCTURE: DESCRIPTION OF STRUCTURES (Post or Pre-Ore (Evidence))	FRACTURE INTENSITY (per meter)
	113–115^{8}		ALTERED ALLUVIUM	SAME AS 20–59⅞ EXC. NO ALUNITE, ~2% POROSITY, MOSTLY UNOXIDIZED	SAME AS 101⅞–106', EXC. 7% PYRITE		
210	115^{8}–117^{5}		ALTERED GNEISS (BTE–QTZ–FSP. PROMINENTLY BANDED)	...FINE–MED. XLINE; LENSOID MASSES OF PARTIALLY–TOTALLY ALTERED FLAKY BIOTITE, UP TO AT LEAST 60 MM. X 15 MM. IN X–SECTION; PROMINENT STREAKY TEXTURE LOCALLY PRESERVED; UNOXIDIZED TO 117^{5}', PARTIALLY OXIDIZED & BLEACHED TO 117^{5}'; FSP. THROUGHOUT ALT. TO MONTM.–KAOLINITE.	OVERALL 3% PY, TEXTURALLY SIMILAR TO 101⅞–106'; SLIGHT OXDN. OF PY. TO GOE. – JAR. BELOW ↓		>50?
217 END OF HOLE	117^{5}–122'		ALTERED FLT. GOUGE & BRECCIA	... CHAOTIC JUMBLE OF QTZ., ALT. FSP. & BTE. & GNEISSIC FRAGMENTS; THESE ALTERED TO CLAY (BTE. ONLY PARTIALLY ALTERED); RARE OPAL VNLTS. ≤ 1 MM. WIDE; >75% OXIDIZED TO 121'; SOMEWHAT LESS OXDN. TO 122'	~1% PY, AS ABOVE, TO 121'; 1½% PY TO 122'; PY IS PARTIALLY OXIDIZED TO GOETHITE		
	122–143^{5}		ALTERED GNEISS (BTE–QTZ–FSP. (PROMINENTLY BANDED)	SAME AS 115^{8}–117^{5}; ROCK IS OVERALL A FINE (<1 mm.) TO MED. (2-5 mm.) – XLINE AGGREGATE OF BTE. (PARTIALLY TO TOTALLY ARGILLIZED), FSP. (>95% ARGILLIZED & QTZ. W/ LOCALLY PROMINENT PRESERVED GNEISSIC TEXTURE; CLAYS APPEAR TO BE MONTM. & KAOLIN ① MONTM.(?) IS A WAXY YELLOWISH TO GREENISH VARIETY (-IES?) PARTIALLY REPLACING BIOTITE & FSP. IN IRREG. PATCHES ② KAOLIN IS PURE WHITE INTERGROWN W/ MONTM.(?) REPLACING FSPS. (MUCH RARER THAN MONT.) ③ ILLITE OR SER. (BLEACHED BIOTITE? INTERGROWN W/ BOTH TYPES OF CLAY BUT IRREGULARY DISTRIBUTED & UNCOMMON	OVERALL AVG. ~ 2% PYRITE, AS DISS., GENERALLY SUBH. GRAINS ≤ 0.1 MM. DIA., AND AS DENSE TO LOOSE AGGREGATES OF THESE GRAINS UP TO 5 MM. (AVG. <1 MM.) IN DIA. — ALSO AS SCATTERED GRAINS & GRAIN AGGREGATES W/ CLAY IN STKWK. VNLTS. PY IS COMMONLY TARNISHED TO DULL BRONZE, REDDISH–BRONZE, & BLUE TO GRAY (CC IN PART?)	DIFFICULT TO ESTIMATE FRACTURE DENSITY; CORE IS COATED W/ THICK CLAY JACKET, BUT PROB. >50 FRACS./M. FLTS. 128–129' 141–142' 143–143^{5}'	>50?

CLAYS & ILLITE ALSO OCCUR IN COMMON STOCKWORK VNLTS. & FILMY FRACTURE COATINGS, WITH AND WITHOUT SULFIDES (PARAGENESIS UNCERTAIN)

*NOTE: GRAPHIC LOGS AND GEOLOGIC NOTES NOT AT SAME SCALE

UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT
DRILL HOLE UNIV. of UTAH DDH 1A
DEPOSIT TYPE GEOTH.
LOGGED BY J.B. HULEN

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m/ft.)
COLLAR ELEV. (m/ft)
CO-ORDINATES LAT. LON.
GRID 3866 m. N 24 m. E
T. 27S R. 9W SEC. 4

SHEET No. 4 OF 5

GEOPHYSICAL LOGS

CORE SIZE (mm. in.)	FROM (m. ft.)	TO	LOG RUN	DEPTH (m. ft.)	DATE	COMPANY

GRAPHIC LOGS* — SCALE ft.; FRACTURE INTENSITY; FRACTURED (ft.); ALTERATION: CLAY, CHLOR. EPID., SER., K-SPAR, SILICA, CO₃, WEAK MODERATE STRONG; TOTAL SULPHIDES (vol. %); ROCK TYPE & STRUCTURE

GEOLOGIC NOTES* (Use also for general comments)

DOWN HOLE LOCATION: DISTANCE DOWN HOLE ft.	ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION Massive, Disseminated, Veinfill, Replacement; TYPE Hypogene, Supergene, Ore and Limonite Mineralogy	STRUCTURE: DOWN HOLE DIST. (m. ft.)	FOLIATION ∢ WITH CORE	BEDDING ∢ WITH CORE	FRACTURE ∢ WITH CORE	DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)	FRACTURE INTENSITY	DOWN HOLE SURVEY DATA: DEPTH ft.	INCLINATION	BEARING	THIN & POLISHED SECTIONS: DEPTH ft.	SAMPLE NUMBER
143^{5}-152'		ALTERED GNEISS (BANDED)	SAME AS ABOVE, EXC. MINOR VUGGY, DISCONTINUOUS SILICA VNLTS, AVG. ≤1 MM. (UP TO 10 MM.) WIDE — VUGS IN THESE COMMONLY LINED WITH COLLOFORM WHITE MINERAL, THEN (ON WHITE MINERAL) TINY (≤0.1 MM. LONG) EUHEDRAL, WATER-CLEAR QTZ. XLS	SAME AS 122-143^{5}'					149^{8}-149^{9}': FLT. GOUGE & BX. OTHERWISE SAME AS 122-143^{5}'						
152-159'		FAULT GOUGE & BX. (ALTERED)	DEGREE OF COMMINUTION HIGHLY VARIABLE; STRONGLY SERICITIZED TO 158'; SILICA FLOODING W/ BLUISH-GRAY CHALCEDONY (?) 158-159'.	152-158': 4% PY, SAME AS 122-143^{5} 158-159': 12% PY IN SILICIFIED ZONE (BANDED 2 MM. SILICA-SULFIDE VNLT. AT 40° TO CORE AXIS, AT 158'					GOUGE & BX						
159-171'		ALTERED GNEISS (BANDED)	SAME AS 122-143^{5}, BT. IS ALMOST TOTALLY ALTERED TO WAXY GREENISH CLAY, BUT RELICT BT. IS LOCALLY PRESENT.	4% PY, SAME AS 122-143^{5}'					FRACS. SAME AS 122-143^{5}'						
171-177^{2}		ALTERED FLT GOUGE & BX.	... BLEACHED APPEARANCE, STRONGLY SERICITIZED WITH MINOR SILICA & CLAY	~10% PY, SAME AS 122-143^{5}; ALSO ≤0.1% RESINOUS BROWNISH-RED MINERAL (SP.?) TEXTURALLY SIMILAR TO PY, BUT INDIVIDUAL GRAINS SLIGHTLY LARGER					CRUSHED, BRXTD.						
177^{2}-185'		ALTERED GNEISS (BANDED)	... SAME AS 122-143^{5} EXC MORE STRONGLY SERICITIC. SER. INCREASING DOWNHOLE	5-7% PY, SAME AS 122-143^{5}'					FRACS.: SAME AS 122-143^{5}'						
185-188'		ALTERED FLT. GOUGE & BX.	... STRONGLY SERICITIZED	PY, SAME AS 122-143^{5}' 185-185^{8}': >25% 185^{8}-188': 5-10%											

* NOTE: GRAPHIC LOGS & GEOLOGIC NOTES NOT AT SAME SCALE

UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT
DRILL HOLE UNIV. of UTAH DDH 1A
DEPOSIT TYPE GEOTH.
LOGGED BY J.B. HULEN

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m; ft.)
COLLAR ELEV. (m; ft)
CO-ORDINATES LAT. LON.
GRID 5866 m. N 24 m. E
T 27S R 9W SEC. 4

GEOPHYSICAL LOGS SHEET No. 5 OF 5

CORE SIZE (mm; in.)	FROM (m; ft.)	TO	LOG RUN	DEPTH (m; ft.)	DATE	COMPANY

GEOLOGIC NOTES (Use also for general comments)

DOWN HOLE LOCATION: DISTANCE DOWN HOLE (m; ft.)	ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION (Massive, Disseminated, Veinfill, Replacement) / TYPE (Hypogene, Supergene, Ore and Limonite Mineralogy)	STRUCTURE: DOWN HOLE DIST. (m; ft)	FOLIATION ∢ WITH CORE	BEDDING ∢ WITH CORE	FRACTURE ∢ WITH CORE	DESCRIPTION OF STRUCTURES: Post or Pre-Ore (Evidence)	FRACTURE INTENSITY	DOWN HOLE SURVEY DATA: DEPTH (m; ft.)	INCLINATION	BEARING	THIN & POLISHED SECTIONS: DEPTH (m; ft)	SAMPLE NUMBER
188-192^{2}		ALTERED GNEISS (BANDED)	SAME AS 122-143^{5}	PY, 3%, TEXTURALLY SAME AS 122-143^{5}; ALSO POSS. TR. SP.					FRACTURING: SEE 122-143^{5}						
192^{2}-210^{2}		ALTERED FAULT GOUGE & BX.	... DEGREE OF COMMINUTION HIGHLY VARIABLE; SUBANG-ANG FRAGMENTS, UP TO AT LEAST 75 MM. MAX. DIMENSION, EMBEDDED IN SILICA-CLAY-SER-SULFIDE ROCK FLOUR, IN WHICH RELATIVE PROPORTIONS OF THESE 4 COMPONENTS VARY CONSIDERABLY ALONG THE LENGTH OF THE INTERVAL. FRAGMENTS ARE RICHER IN GREEN CLAY THAN MATRIX. MANY FRAGS. DISPLAY RELICT GNEISSIC TEXTURE	PY, OVERALL ~5%, SAME AS 122-143^{5}, EXC. SOME SULFIDE AGGREGATES MAY REACH 15 mm. MAX. DIMENSION					GOUGE & BX; SOME POST-SULFIDE MOVEMENT (SMEARED SULFIDE ON VNLTS.)						
210^{2}-217		ALTERED GNEISS (BANDED)	SAME AS 122-143^{5}, EXC. MORE COARSELY XLINE, MORE DISTINCT RELICT FOLIATION; RELICT BTE. COMMON	PY, SHARP DECREASE FROM 192^{2}-210^{2}; ~2%, TEXTURALLY SIMILAR TO 122-143^{5}					FRACS. ≤5/m.? (DIFFICULT TO DETERMINE — SEE 122-143^{5})						

UURI EARTH SCIENCE LAB

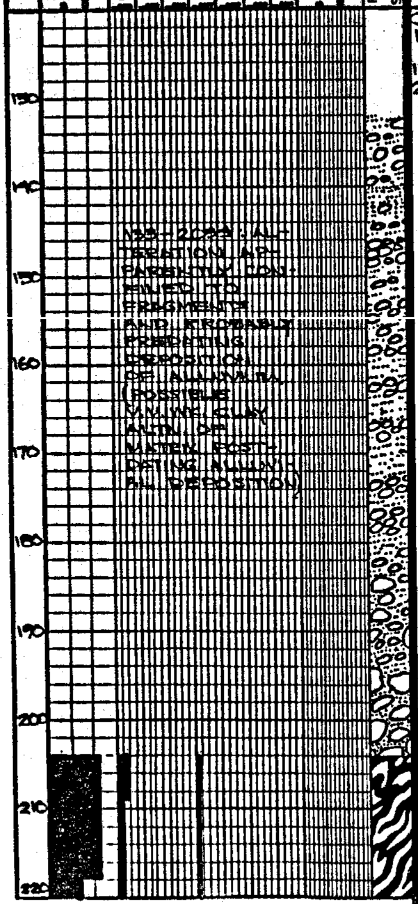
PROJECT ROOSEVELT
DRILL HOLE UNIV. OF UTAH DDH 1B
DEPOSIT TYPE GEOTH.
LOGGED BY J.B. HULEN JULY 1977

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (~~m~~ ft.)
COLLAR ELEV. (~~m~~ ft.)
CO-ORDINATES LAT.
LON.
GRID 3500 m N 150 m W.
T. 27S R. 9W SEC. 4 (SE¼, SE¼)

SHEET NO. 1 OF 2

CORE SIZE (~~mm~~ in.)	FROM (~~m~~ ft.)	TO	GEOPHYSICAL LOGS LOG RUN	DEPTH (~~m~~ ft.)	DATE	COMPANY

GRAPHIC LOGS *



135-204': ALTERATION APPARENTLY CONFINED TO FRAGMENTS AND PROBABLY PREDATING DEPOSITION OF ALLUVIUM (POSSIBLE MINOR CLAY ALTN. OF MATRIX POST-DATING ALLUVIAL DEPOSITION)

GEOLOGIC NOTES * (Use also for general comments)

DOWN HOLE DISTANCE (~~m~~ ft.)	ROCK TYPE	DESCRIPTION	MINERALIZATION	STRUCTURE – DESCRIPTION OF STRUCTURES
0-135'	Qal?	NO CORE		
135-204'	ARKOSIC ALLUVIUM	... OVERALL A SILTY TO SANDY ARKOSIC GRAVEL, SEMI-CONSOLIDATED, WITH NO READILY APPARENT BEDDING. ANGULAR & SUBANGULAR FRAGMENTS FROM << 1 mm TO AT LEAST 30 cm MAX. DIMENSION. THESE CONSIST OF VARIOUS TEXTURAL VARIETIES OF BTE. GRANITE, BTE-QTZ-FSP. GNEISS, FELSIC—INTERMEDIATE VOLCANIC RX. MANY OF THE FRAGMENTS ARE PARTIALLY ALTERED TO CLAY OR CLAY-SERICITE IN IRREG PATCHES & RARE VNLTS, BUT THE MATRIX APPEARS TO BE UNALTERED OR PERHAPS LOCALLY WEAKLY ARGILLIZED (VNLTS END ABRUPTLY WITHIN AND AT BOUNDARY OF FRAGMENTS) (STRONGLY BLEACHED & ARGILLIZED OR CLAY—SERICITIZED FRAGMENTS MAY BE EMBEDDED WITHIN BROWNISH, CRUMBLY, APPARENTLY UNALTERED SILT-CLAY MATRIX — 140-143.5': ALLUVIUM IS STAINED RED TO ORANGE-BRN.; COMPOSED PRIMARILY OF CLAY, SILT & FINE SAND-SIZE PARTICLES (POSS. W/ SOME ASH) — 145-149': > 95% OBVIOUS GRANITIC ROCK FRAGMENTS (DOMINANTLY GRAVEL-SIZE) FSPS. CLAY SERISITIZED IN FRAGS. — GRAVEL BECOMES DOMINANT CLASTIC COMPONENT BELOW 182'	(& IN THIN FILMS AROUND FRAGS.) MANY OF THE FRAGMENTS ARE STAINED W/ GOETHITIC LIMONITE IN IRREG. PATCHES; A FEW FRAGMENTS CONTAIN DISS. GOE. PSEUDOMORPHS/SULFIDE — THESE ARE ALSO PRESENT W/ CLAY, SER. & QTZ. IN VNLTS. CUTTING SOME FRAGMENTS (BUT NOT MATRIX) 172.5-173.5: STRONG GOETHITIC STAINING OF MATRIX & FRAGMENTS MATRIX OVERALL IS LIGHTLY STAINED DULL REDDISH TO BROWNISH-GRAY W/ FINELY DISS. FeOx	ALLUVIUM CRUMBLES RATHER THAN FRACTURES

* NOTE: GRAPHIC LOGS & GEOLOGIC NOTES ARE NOT AT SAME SCALE

UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT
DRILL HOLE UNIV. of UTAH DDH 1B
DEPOSIT TYPE GEOTH.
LOGGED BY J.B. HULEN

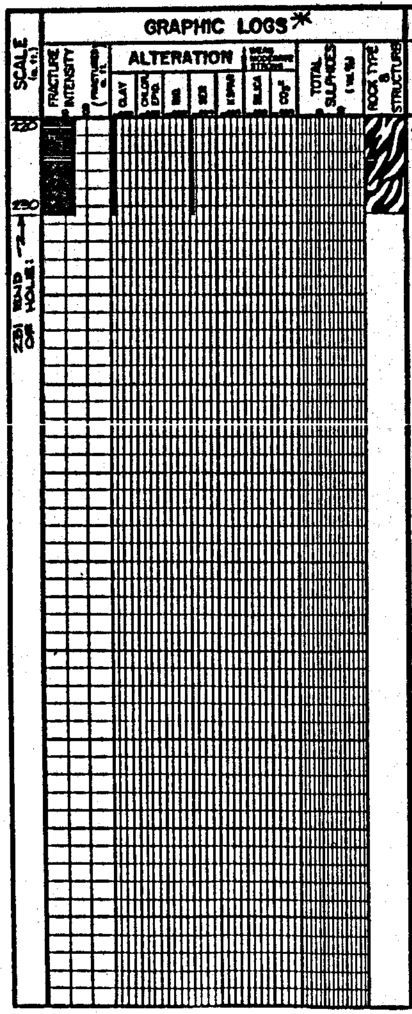
DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m. ft.)
COLLAR ELEV. (m. ft.)
CO-ORDINATES LAT.
LON.
GRID 8300 m. N 150 m. E
T. 27S R. 9W SEC. 4 (SE¼, SE¼)

GEOPHYSICAL LOGS

SHEET NO. OF

CORE SIZE (mm. in.)	FROM (m. ft.)	TO	LOG RUN	DEPTH (m. ft.)	DATE	COMPANY

GRAPHIC LOGS*



DOWN HOLE LOCATION

DISTANCE DOWN HOLE (m. ft.): 204–231'

ELEVATION

GEOLOGIC NOTES* (Use also for general comments)

ROCK TYPE: ALTERED BTE-QTZ-FSP. GNEISS (PROMINENTLY BANDED)

DESCRIPTION (MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.)

GEN. FINE-XLINE. - LOCALLY MORE CRSLY-XLINE.; PROMINENT STREAKY APPEARANCE DEFINED BY SEGREGATION OF BTE. AND LIGHT-COLORED CONSTITUENTS; INCIPIENT SILLIMANITE (?) PORPHYROBLASTS RARE, LOCALLY PRESENT

203½–209': ERRATIC, WK.-MOD. CLAY-SERICITIZATION (illite?) OF FSPS, BLEACHING OF BIOTITE

209–231': SAME AS ABOVE BUT LESS INTENSE — MUCH FRESH BTE.

OVERALL: THIN FILMS OF CLAY ON STONE. FRACTURES

MINERALIZATION (DISTRIBUTION: Massive, Disseminated, Veinfill, Replacement. TYPE: Hypogene, Supergene, Ore and Limonite Mineralogy)

2-3% LIMONITE, DOMINANTLY GOETHITE, PRIMARILY AS FILMS ON FRACTURE SURFACES, COMMONLY ADMIXED W/CLAY, BUT ALSO AS RARE (<0.1%) DISS. ANH. GOETHITE GRAINS AVG. < 0.1 mm. DIA.

& IRREG. TABULAR AGGREGATES

STRUCTURE

DOWN HOLE DIST. (m. ft.) | FOLIATION ∢ WITH CORE | BEDDING ∢ WITH CORE | FRACTURE ∢ WITH CORE: 0-60°

DESCRIPTION OF STRUCTURES (Post or Pre-Ore (Evidence)):

204–218' ⟶ >100
218–231' ⟶ <100

STOCKWORK, BOTH PRE- & POST ALTN.-MINRLZ. (SMEARED GOETHITE AGGREGATES)

A. TRIPP SAMPLES (core missing)

184^{80} – 185'
153 – 153^{18}'
172 – 172^{38}'
180^{60} – 180^{85}'
183^{30} – 183^{65}'
187^{30} – 188'
192 – 192^{80}'
198^{20} – 199^{00}'
200^{70} – 201^{28}'
203^{80} – 204^{00}'
209^{70} – 210^{10}'
225^{70} – 226^{80}'
227^{20} – 227^{80}'

FRACTURE INTENSITY (NO. PER METRE)

DOWN HOLE SURVEY DATA: DEPTH (m. ft.) | INCLINATION | BEARING

THIN & POLISHED SECTIONS: DEPTH (m. ft.) | SAMPLE NUMBER

* NOTE: GRAPHIC LOGS & GEOLOGIC NOTES NOT AT SAME SCALE

UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT KGRA
DRILL HOLE UU76BS (IHF)
DEPOSIT TYPE
LOGGED BY SUSAN SAMBURG

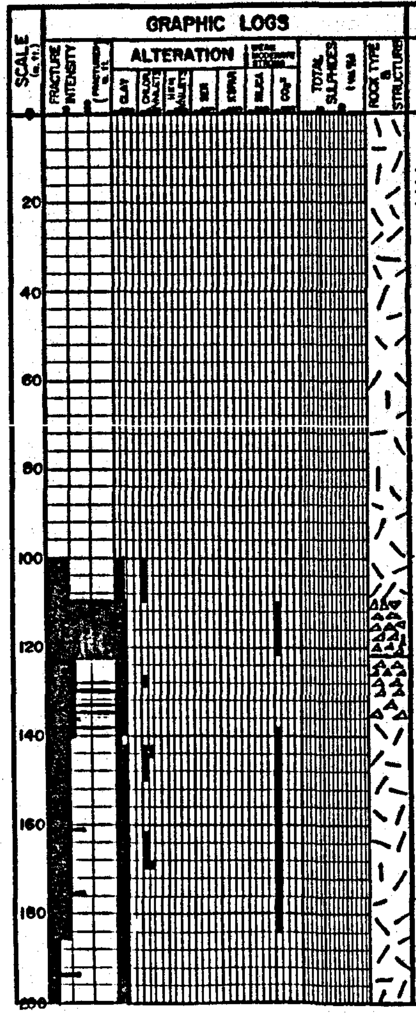
DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH 7196' (m. ft.)
COLLAR ELEV. 7700 (m. ft)
CO-ORDINATES LAT.
LON.
GRID N E
T 275 R 8N SEC. 8BAB

GEOPHYSICAL LOGS

SHEET No 1 OF 7

CORE SIZE (mm. in.)	FROM (m. ft.)	TO	LOG RUN	DEPTH (m. ft.)	DATE	COMPANY
NX						

GRAPHIC LOGS



GEOLOGIC NOTES (Use also for general comments)

DOWN HOLE LOCATION: DISTANCE DOWN HOLE (m. ft.)	ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION Massive, Disseminated, Veinfill, Replacement; TYPE Hypogene, Supergene, Ore and Limonite Mineralogy	STRUCTURE: DOWN HOLE DIST. (m. ft.)	FOLIATION ∠ WITH CORE	BEDDING ∠ WITH CORE	FRACTURE ∠ WITH CORE	DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)	FRACTURE INTENSITY	DOWN HOLE SURVEY DATA: DEPTH (m. ft.)	INCLINATION	BEARING	THIN & POLISHED SECTIONS: DEPTH (m. ft.)	SAMPLE NUMBER
			0-10, 7' no core 101.7'-503.9' qtz. monz to T.D.					~40°	Rock shows strong cataclastic deformation, strongly fractured, but fractures have been rehealed w/clay 7-10/m.poss qtz(?) also poss chl? Some post-healing fractures						
101.7'-110.9'		Hbl-bte qtz-monz (Iqm)	Hbl-bte qtz. monz crs xln magnetite 1-1.5%, mag as dism grains avg ~0.3mm diss and as loose aggregates of these grains up to 7mm in dia Plagioclase partially to totally altered to white to lt gray clay poss w/sericite K spar largely fresh to partially to totally altered to white to lt gray clay (w/ser?) Bte fresh to partially chloritized (10-15%) Hbl (?) totally alted to grayish-green clay (chl?) aggregate Rock is weakly laced with med dk gray-green qtz-clay (?) -chlorite veinlets up to ½" wide but averaging less than 1mm (randomly oriented to core axis)	Tr black MnOx as patches & spots along fracture surfaces Wk iron oxide stain diss through accompanied by stronger staining on rk fracture Gr hematite (powdery maroon) along fractures											
110.9'-122.2'		Hbl-bte qtz monz	Fault zone Fault breccia developed from qtz monz (as above abundant guage-strongly calcitic matrix) Altn of fsps and mafics same as 101.7'-110.9'	Wk iron oixde and MnOx same as above											
122.2'-138.5'		Hbl-bte qtz monz	Hbl-bte qtz monz same as 101.7'-110.9'-strongly fractured and faulted (see structure).	Same as 101.7'-110.9'					Rock is broken by numerous faults w/ strong brecciation, abundant gauge. Faults: 128.8'-128.7' 131.1'-132.8', 133.5'-133.7', 135.6'-136, 138.3'-138.6'						

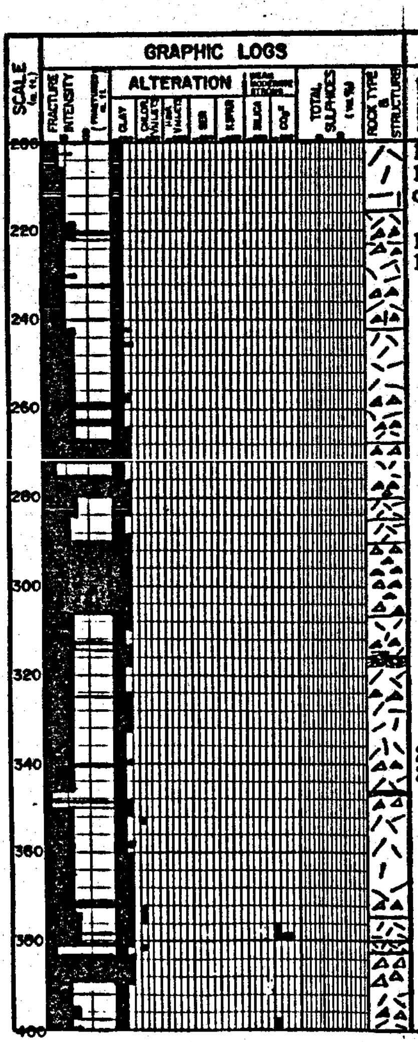
UURI EARTH SCIENCE LAB

SHEET NO. 2 OF 7

PROJECT ROOSEVELT KGRA
DRILL HOLE UU76BS (IHF)
DEPOSIT TYPE
LOGGED BY SUSAN SAMBERG

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m. ft.)
COLLAR ELEV. (m. ft.)
CO-ORDINATES LAT. LON.
GRID N E
T R SEC.

CORE SIZE (mm. in.)	FROM (m. ft.)	TO	GEOPHYSICAL LOGS LOG RUN	DEPTH (m. ft.)	DATE	COMPANY
NX						



GEOLOGIC NOTES (Use also for general comments)

DOWN HOLE LOCATION: DISTANCE DOWN HOLE (m. ft.)	ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION Massive, Disseminated, Veinfill, Replacement. TYPE Hypogene, Supergene, Ore and Limonite Mineralogy	STRUCTURE: DOWN HOLE DIST. (m. ft.)	FOLIATION ∠ WITH CORE	BEDDING ∠ WITH CORE	FRACTURE ∠ WITH CORE	DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)	FRACTURE INTENSITY	DOWN HOLE SURVEY DATA: DEPTH (m. ft.)	INCLINATION	BEARING	THIN & POLISHED SECTIONS: DEPTH (m. ft.)	SAMPLE NUMBER
122.2'-138.5' cont.		Hbl-bte qtz monz							fracture between faults: avg ~25-30/m						
138.5'-185.7'		Hbl-bte qtz monz	Hbl bte qtz monz same as 101.7'-110.9' Alteration same as 101.7'-110.9' Incr chloritization of bte White (sometimes Fe-stained cal-citic clay on fractures 143.6'-148'-clay-chl-qtz vnlets (~1÷5mm randomly lacing core)	Same as 101.7'-110.9' MnOx assoc w/goeth-clay frac-tures 161.2'-183.5' accompanied w/gypsum (?) 161.2'-161.9'					Rock fracture avg 10-12 ft Rock fracture 25-30/m 161.2'-161.9' 176'-176.6' 164'-181' - Rk appears to have been strongly fractured and re-cemented; refractured by chl-clay-qtz vnlets which contain brecciated qtz and strong MnOx and FeOx (Inc mafics ~20%) esp: 167.7'-168.3'						
		Hbl-bte qtz monz	Hbl bte qtz monz same as 101.7'-110.9' Altn same as 101.7'-110.9' At 205' fine xln gneiss w/ glomerophyric plag w/sphene centers (pCbg)	Same as 101.7'-110.9' MnOx patches along fractures Goeth-clay-MnOx patches and fracture coatings along 210.9'-213' Possible siderite w/goeth and MnOx :2mm wide vnlet at 193.2'				70° and 25°	Fracture intensity decreases avg 5-7/m Fracture zone 25-30/m 194.5'-195.7' 203.2'-203.8'						
215.3'-242'		Hbl-bte	Hbl-bte qtz monz Same as 101.7'-110.9' Altn Same as 101.7'-110.9' relict hbl completely chlor-itized	Same as 101.7'-110.9' Fe staining closely assoc w/bte aggregates as well as on fractures and diss thru rock 218-223. :goethite-MnOx-clay patches and fracture coatings particularly abundant				80° and 45°	Fracture intensity avg 7-10/m Fracture increase 218'-223.1' 229.3'-230' 25/m Fault zones: 220.8'-221.9' 222.4'-222.8' 223'-223.9' 239.8'-240.9'						

UURI EARTH SCIENCE LAB

SHEET NO. 3 OF 7

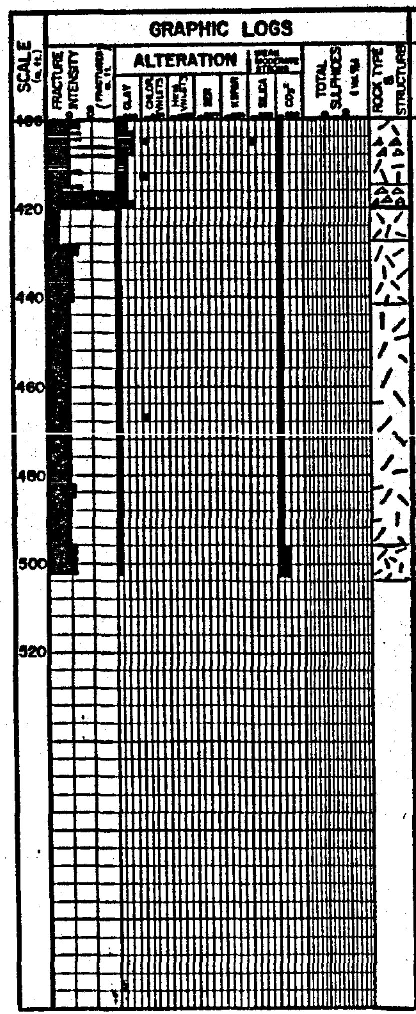
PROJECT ROOSEVELT KGRA
DRILL HOLE UU76BS (IHF)
DEPOSIT TYPE
LOGGED BY SUSAN SAMBERG

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m. ft.)
COLLAR ELEV. (m. ft.)
CO-ORDINATES LAT.
LON.
GRID N E
T. R. SEC.

GEOPHYSICAL LOGS

CORE SIZE (mm. in.)	FROM (m. ft.)	TO	LOG RUN	DEPTH (m. ft.)	DATE	COMPANY
NX						

GEOLOGIC NOTES (Use also for general comments)



DISTANCE DOWN HOLE (m. ft.)	ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION Massive, Disseminated, Veinfill, Replacement; TYPE Hypogene, Supergene, Ore and Limonite Mineralogy	STRUCTURE: DOWN HOLE DIST. (m. ft.)	FOLIATION ∢ WITH CORE	BEDDING ∢ WITH CORE	FRACTURE ∢ WITH CORE	DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)	FRACTURE INTENSITY	DOWN HOLE SURVEY DATA: DEPTH (m. ft.)	INCLINATION	BEARING	THIN & POLISHED SECTIONS: DEPTH (m. ft.)	SAMPLE NUMBER
242'- 267.4'		Hbl-bte qtz monz	Hbl-bte qtz-monzonite Same as 101.7'-110.9' Altn: same as 101.7'-110.9'	Goeth-MnOx-clay patches and fracture coating particularly abundant: 242'-242.9' 245.9'-248' 257'-257.6' 264.1'-264.9' 267.1'-267.2': goeth-MnOx-clay veinlet MnOx aggregates in these veinlets ~1-2mm Fault zones show Feoxide & MnOx					Fracture intensity increased avg 25/m Fault zones: 258.5'-260.2' 262.3'-264.7'						
267.4'- 280.1'		Hbl-bte	Fault zone: breccia developed from qtz monz Altn of feldspars and mafics: same as 101.7'-110.9' 279.6'-280.1' strong chloritization	275.9'-280.1'-Fault breccia shows weak Feoxide and MnOx Stronger staining (than above) 279.1'-279.6' Scattered spots MnOx along fracture surfaces 272.3'-274.9'					272.3'-275.9' Fault doesn't affect this interval. Fract Int 5-7/m otherwise strong brecciation and fault gauge						
280.1'- 284'		Hbl-bte qtz monz	Hbl bte qtz monz Same as 101.7'-110.9' Altn Same as 101.7'-110.9'	MnOx spots on fractures accom-with FeOxide for: 280.1'-281' Powdery red-maroon trace spots of hematite				~45°	Intense fracturing: 30-50/m avg						
284'- 289.4'		Hbl-bte qtz monz	Same as 101.7'-110.9' Altn same as 101.7'-110.9'	Refer to 101.7'-110.9'				~45°	Fracture intensity ~15-17/m						
289.4'- 275.3'		Hbl-bte qtz monz	Fault zone: breccia developed from qtz monz Altn of fsps & mafic same as 101.7'-110.9' Strong chloritization of bte 316.5'-318': Faulted micro diorite dike combined w/ qtz monz containg relict qtz 338.2': Incr chlorite patches on fractures; possible vnlet(?)	FeOxide and MnOx on fracture surfaces and erratically diss throughout rk 318'-322': Goeth-clay MnOx vnlet Fault zones wk stained w/FeOxide and MnOx 340.1'-341.2': strong Fe stain				~55° and ~35°	Fault zones: 314.6'-315.4' 316.8'-316.5' 325.9'-326.5' 340.1'-341.2' 349.1'-349.6' 350.2'-351.6' 371.2'-373' Fractures between faults avg 15-20/m						

UURI EARTH SCIENCE LAB

SHEET NO. 4 OF 7

PROJECT ROOSEVELT KGRA
DRILL HOLE UU76BS (IHF)
DEPOSIT TYPE
LOGGED BY SUSAN SAMBERG

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m. ft.)
COLLAR ELEV. (m. ft.)
CO-ORDINATES LAT. LON.
GRID N E
T R SEC.

CORE SIZE (mm. in.)	FROM (m. ft.)	TO	GEOPHYSICAL LOGS LOG RUN	DEPTH (m. ft.)	DATE	COMPANY
NX						

GEOLOGIC NOTES (Use also for general comments)

DOWN HOLE LOCATION DISTANCE DOWN HOLE (m. ft.)	ROCK TYPE	DESCRIPTION MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION DISTRIBUTION Massive, Disseminated, Veinfill, Replacement / TYPE Hypogene, Supergene, Ore and Limonite Mineralogy	STRUCTURE DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)
289.6'- 375.3' cont.	Hbl-bte qtz monz	346.6'-346.8': Highly fractured vuggy microdiorite altd to clay avg ~7-30mm 353.6': chl-clay-qtz vnlet(~1mm) at ~30⁰ to core axis 369.8'-370: fine Xtalline granulite xenolith w/Fe oxide and MnOx staining (possible banded gneiss) 373.4'-374': core weakly laced w/chl-qtz-clay vnlets and form fracture surface ~40⁰ w/core axis strong clay covering, ylw-wh non-calcitic clay (altn of fsps or rock flour?)		Microdiorite dike emplaced w/ renewed Slippage along fault zone: fracture intensity >50/m 346.8'-349.1': fracture intensity ~5/m
375.3'- 381.2'	Hbl-bte qtz monz	Hbl-bte qtz monzonite with minor fault zones (refer to struct) same as 109.7'-110.9' Altn same as 101.7'-110.9' 376.6'-380.6': Rehealed and brecciated core(refer to struct) wkly calcitic bte strongly altd to chlorite 379'-379.3' Strongly fractured and rehealed core cut by qtz-clay vnlets w/structure amt of euhedral qtz xtals in strongly calcitic matrix	Entire interval stained w/Fe Oxide and MnOx diss thru rock and on fractures 379.6'-376.9' - Goeth-FeOxide patches and along fracture surfaces 378'-378.4' - Strong goeth-Mn Ox clay patches and coatings	Rock appears strong brecciated and rehealed Fracture intensity avg 25-30/m Fault zones not rehealed: 380.8'-381.2' 378.3'-378.6'
381.2'- 382.5'	Hbl-bte qtz monz	Hbl-bte qtz monzonite same as 101.7'-110.9' Altn same as 101.7'-110.9'. (One chl-clay-qtz vnlet ~30⁰ to core axis)	381.9':Gray-grn qtz-clay-chlorite coating on fracture surface; spotted w/MnOx and stained w/FeOxide	Fracture density decreases to ~7/m except at fault zone 282.1'-282.5'

UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT KGRA
DRILL HOLE UU76BS (IHF)
DEPOSIT TYPE
LOGGED BY SUSAN SAMBERG

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m. ft.)
COLLAR ELEV. (m. ft.)
CO-ORDINATES LAT. LON.
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T R SEC.

SHEET No. 5 OF 7

GEOPHYSICAL LOGS

CORE SIZE (mm. in.)	FROM (m. ft.)	TO	LOG RUN	DEPTH (m. ft.)	DATE	COMPANY
NX						

GEOLOGIC NOTES (Use also for general comments)

DOWN HOLE LOCATION: DISTANCE DOWN HOLE (m. ft.)	ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION Massive, Disseminated, Veinfill, Replacement; TYPE Hypogene, Supergene, Ore and Limonite Mineralogy	STRUCTURE: DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)
382.5'-390.5'		Hbl-bte qtz monz	Fault zone: breccia and gauge developed from qtz monzonite	Fe Oxide and MnOx patches throughout breccia: accompanied by strong Fe Oxide at: 386.8'-387.1', 387.6'-388.3', 389.7'-389.9'	Strong brecciation and gauge
			Altn of fsps and mafics same as 101.7'-110.9'		
			Strong chloritization of bte	384.5'-384.9'-MnOx spots and FeOx stains on fracture surfs.	
390.5'-417'		Hbl-bte	Hbl-bte qtz monzonite alternating w/strongly fractured to faulted zones (refers to structure)	Same as 101.7'-110.9' Fe staining on fractures and diss throughout rock increases at: 394.9'-396.3' 403.9'-404.7' 411.6'-417.3' 413.5'-420.6' 416.8'-417'	Fracture intensity varies avg 10-12/m Fault zones (50/m) 392.4'-393.5' (strongly altd to clay w/ subhedral qtz xtals present) 392.4'-393.5' 398.4'-398.8' 406.2'-407 409'-409.7
			Same as 101.7'-110.9' Altn same as 101.7'-110.9'		
			404.6'-Dk gray qtz-clay vnlet ~3mm containing subhedral qtz xtals and strong MnOx coating	Breccia show Fe oxide and MnOx staining and spots	
			Contains two chl-clay-qtz vnlets ~4mm	405.6'-406.2': Strongly spotted w/Fe oxide and MnOx (dendritic) on fractures and diss through rock	Some intervals not faulted but strongly fractured (~25-30/m) 395.4'-397' 399.9'-402.7' 403.3'-404' 405.8'-406.2' 412'-413' 413.8'-415.6'
			Clay-chl-clay sm vnlets <1mm-2mm lacing core: ~ 412'-413.8'		405.6'-406.2'-Aplite contains lg (~2-3mm) qtz and fsp grains. Possibly breccia qtz monz followed by siliceous filling of fractures

UURI EARTH SCIENCE LAB

SHEET NO. 6 OF 7

PROJECT ROOSEVELT KGRA
DRILL HOLE UU76BS (IHF)
DEPOSIT TYPE
LOGGED BY SUSAN SAMBERG

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m. ft.)
COLLAR ELEV. (m. ft)
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CORE SIZE (mm. in.)	FROM (m. ft.)	TO
NX		

GEOPHYSICAL LOGS

LOG RUN	DEPTH (m. ft.)	DATE	COMPANY

GRAPHIC LOGS: SCALE (m. ft.) · FRACTURE INTENSITY · FRACTURES (m. ft.) · ALTERATION: CLAY, CHLOR, ALTS, SER, K SPAR, SILICA, CO_2 · TOTAL SULPHIDES (vol %) · ROCK TYPE & STRUCTURE

GEOLOGIC NOTES (Use also for general comments)

DISTANCE DOWN HOLE (m. ft.)	ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION Massive, Disseminated, Veinfill, Replacement / TYPE Hypogene, Supergene, Ore and Limonite Mineralogy	STRUCTURE: DOWN HOLE DIST. (m. ft.)	FOLIATION ∠ WITH CORE	BEDDING ∠ WITH CORE	FRACTURE ∠ WITH CORE	DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)	FRACTURE INTENSITY	DOWN HOLE SURVEY DATA: DEPTH (m. ft.)	INCLINATION	BEARING	THIN & POLISHED SECTIONS: DEPTH (m. ft)	SAMPLE NUMBER
417'- 420.6'			Fault zone: Fault breccia and gauge derived from qtz monz Altn of fsps and mafic same as 101.7'-110.9'	Med. Fe Oxide staining and Mn Ox spots on breccia Goeth-clay MnOx coating and vnlets on fractures (refer to structure)					Fault gauge and breccia Fracture intensity decreases from 417.7'-418.8' (avg ~7/m)						
420.6'- 428.9'		Hbl-bte qtz monz	Same as 101.7'-110.9' Altn same as 101.7'-110.9' but lacks qtz-clay-chlorite veinlets core mainly unaltd to partially altd., bte is fresh 420.6'-420.7': Fractured ~30mm (avg) pieces microdiorite, dike (refer to description 205')	Wk. Fe stain along fractures and diss through rk MnOx spots along fractures FeOxide-MnOx Clay-Chlorite patches covering fractures from 426.9'-428.9' 427.8' MnOx patches on fractures are dendritic				~25°	Fracture intensity low (~5/m) core doesn't appear to of undergone any cataclasis and recementing; rock appears weakly altd refer to discription and mineralization						
428.9'- 442.1'		Hbl-bte qtz monz	Same as 101.7'-110.9' Altn same as 101.7'-110.9' 431.6'-431.9' med grain p€bg granulite (same as 205')	MnOx-clay-chlorite patches on fractures accompanied w/weak FeOxide staining from 428.9'-430.8' accompanied w/increase FeOxide at 430.9'-431.9' 434.6'-435.2' Some fracture surfaces show no further altn on fractures other than weak MnOx spots 434.6'-434.8' (dendritic) 435.4'-440.5'				~25°	Fracture intensity avg ~12/m except for strong fracture zone at 428.9'-431.1' avg ~25/m						
442.1'- 496.9'		Hbl-bte qtz monz	Same as 101.7'-110.9' Altn same as 101.7'-110.9' p€bg granulite (same as 205') 466.7' ~25mm 485.6'-485.8' ~75mm dk gray-green qtz-clay-chlorite vnlet at 468' otherwise these vnlets are lacking	Same as 101.7'-110.9' Increase Fe staining at: 450.8' 456.6'-457.2' 485.1'-486.5'				~25° and ~75°	Fracture intensity avg ~10/m Same as 420.6'-428.9' 485.1'-487.5' Inc fracture ~ 15/m						

UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT KGRA
DRILL HOLE UU76BS (IHF)
DEPOSIT TYPE
LOGGED BY SUSAN SAMBERG

DATE STARTED
DATE COMPLETED
DRILLING CO.
FINAL DEPTH (m. ft.)
COLLAR ELEV. (m. ft.)
CO-ORDINATES LAT.
LON.
GRID N E
T R SEC.

SHEET NO. 7 OF 7

CORE SIZE (mm. in.)	FROM (m. ft.)	TO	GEOPHYSICAL LOGS LOG RUN	DEPTH (m. ft.)	DATE	COMPANY
NX						

GRAPHIC LOGS: SCALE (m. ft.) · FRACTURE INTENSITY · (FRACTURES m. ft.) · ALTERATION: CLAY · CHLOR. VNLETS · HEM. VNLETS · · · WEAK MODERATE STRONG: SILICA · CO₃ · TOTAL SULPHIDES (Vol. %) · ROCK TYPE & STRUCTURE

GEOLOGIC NOTES (Use also for general comments)

DOWN HOLE LOCATION: DISTANCE DOWN HOLE (m. ft.)	ELEVATION	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION: DISTRIBUTION Massive, Disseminated, Veinfill, Replacement	TYPE Hypogene, Supergene, Ore and Limonite Mineralogy	STRUCTURE: DOWN HOLE DIST. (m. ft.)	FOLIATION ∢ WITH CORE	BEDDING ∢ WITH CORE	FRACTURE ∢ WITH CORE	DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)	FRACTURE INTENSITY (# PER METRE)	DOWN HOLE SURVEY DATA: DEPTH (m. ft.)	INCLINATION	BEARING	THIN & POLISHED SECTIONS: DEPTH (m. ft.)	SAMPLE NUMBER
496.9' -		Hbl-bte	Strongly fractured hbl-bte	Same as 101.7'-110.9'					~25°	Fracture intensity						
503.9'		qtz monz	qtz monzonite	More clay appears on fractures					and	avg ~25-30/m						
			Same as 101.7'-110.9'						~75°							
			Altn same as 101.7'-110.9'													
			Moderately calcitic													
			No dk-grn qtz-clay-chlor vnlets													

UURI EARTH SCIENCE LAB

PROJECT ROOSEVELT KGRA
DRILL HOLE UUTGS
DEPOSIT TYPE
LOGGED BY SUSAN SAMBERG

DATE STARTED
DATE COMPLETED
DRILLING CO. Nortley Dr. Co.
FINAL DEPTH (m. ft.)
COLLAR ELEV. (m. ft)
CO-ORDINATES LAT.
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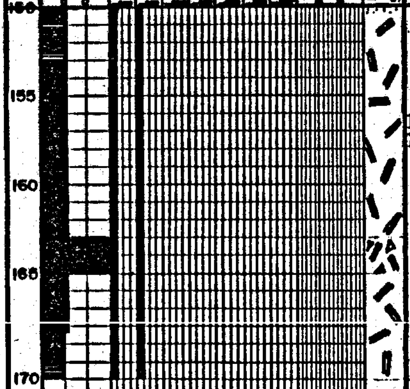
SHEET NO. 1 OF 1

CORE SIZE (mm. in.)	FROM (m. ft.)	TO	GEOPHYSICAL LOGS LOG RUN	DEPTH (m. ft.)	DATE	COMPANY
BX (1-1/4)	150'	- 170'				

GRAPHIC LOGS



GEOLOGIC NOTES (Use also for general comments)

DOWN HOLE LOCATION DISTANCE DOWN HOLE (m. ft.)	ELEVATION	ROCK TYPE	DESCRIPTION MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE.	MINERALIZATION DISTRIBUTION Massive, Disseminated, Veinfill, Replacement. TYPE Hypogene, Supergene, Ore and Limonite Mineralogy	STRUCTURE DOWN HOLE DIST. (m. ft.)	FOLIATION ∠ WITH CORE	BEDDING ∠ WITH CORE	FRACTURE ∠ WITH CORE	DESCRIPTION OF STRUCTURES Post or Pre-Ore (Evidence)	FRACTURE INTENSITY	DOWN HOLE SURVEY DATA DEPTH (m. ft.)	INCLINATION	BEARING	THIN & POLISHED SECTIONS DEPTH (m. ft.)	SAMPLE NUMBER
			0-150': alluvium 150-170': granite core/48% core recovery: samples not labeled clearly so exact intervals may be off												
150'-163'		Hbl-bte granite (Tgr)	med Xtalline lt. gray fine grained granite Bte: fresh to partially chloritized Hb: totally chloritized plagioclase and K-spar fresh to partially altd. wh. clay magnetite (~1-2%?) diss. through core and as aggregates of these grains (up to 2mm) Clay-chlorite-qtz vnlets weakly lacing rock ~ 1-2 mm at ~40° to core axis	Wk. Fe oxide diss. through rock and along fractures Increase Fe coating on fractures ~158'-163' Mn Ox spots and covering on fractures and diss through rock Tr. hematite as powdery red spots diss through rk on fractures				~45°	Fracture Intensity avg ~ 20-25/m						
163'-165'		Hbl-bte granite	Fault zone: Strongly fractured granite Altn. same as above	Fractured pieces and breccia stained w/Fe oxide and spotted w/MnOx Tr hematite also spotted on breccia											
165'-170'		Hbl-bte granite	Same as 150'-163' Altn same as 150'-163' No calcite 165.9'-166.3': Faulted 167.3'-167.7' qtz monz	Same as 150'-163' Same as 163'165				~45°	Fracture intensity avg. ~20-25/m cut by two faults 165.9'-166.3' 167.3'-167.7'						

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Harvey S. Price	Intercomp Resource Development & Engineering Inc. Houston, TX.
Vincent Radja	Indonesian State Electric Co., Bandung, Indonesia
Alan O. Ramo	Sunoco Energy Development Company, Dallas, TX.
Marshall Reed	DOE/DGE, Washington, DC.
Robert W. Rex	Republic Geothermal, Inc., Santa Fe Springs, CA.
J. D. Rimstidt	Penn. State University, University Park, PA.
Barbara Ritzma	Science & Engineering Department, University of Utah, Salt Lake City, UT.
John Rowley	Los Alamos Scientific Laboratory, Los Alamos, NM.
Peter D. Rowley	USGS, Denver, CO.
Jack Salisbury	DOE/DGE, Washington, DC.
Robert San Martin	New Mexico Energy Institute, Las Cruces, NM.
S.K. Sanyal	Stanford University, Stanford, CA.
Konosuke Sato	Metal Mining Agency of Japan, Minato-Ku, Tokyo.
C.E. Schubert	D'Appolonia, Pittsburgh, PA.
Robert Schultz	EG&G Idaho, Idaho Falls, ID.
John V.A. Sharp	Hydrosearch, Inc., Reno, NV.
Wayne Shaw	Getty Oil Company, Bakersfield, CA.
S. Shikinami	Consultant, Tokyo, Japan
R.C. Shopland	Western Geohysical Co., Houston, TX.
W.P. Sims	DeGolyer and MacNaughton, Dallas, TX.
Frank Smith	USGS, Menlo Park, CA.
H.W. Smith	University of Texas, Austin, TX.
M.C. Smith	Los Alamos Scientific Laboratory, Los Alamos, NM.
Robert L. Smith	USGS, National Center, Reston, VA.
John Sonderegger	Montana Bureau of Mines & Geology, Butte, MT.
Robert J. Sperandio	Hydro-Search, Inc., Reno, NV.
Neil Stefanides	Union Oil Company, Los Angeles, CA.
Ben Sternberg	Conoco, Ponca City, OK.
Thomas A. Steven	USGS, Denver, CO.
Marty Steyer	National Geothermal Information Resource, LBL, Berkeley, CA.
R.C. Stoker	EG&G Idaho, Idaho Falls, ID.

Reid Stone	USGS, Menlo Park, CA.
W.K. Summers	W.K. Summers & Associates, Socorro, NM.
Chandler Swanberg	New Mexico State University, Las Cruces, NM.
Charles M. Swift, Jr.	Chevron Oil Company, San Francisco, CA.
J.B. Syptak	Anadarko Production Company, Houston, TX.
Robert L. Tabbert	Atlantic Richfield Company, Dallas, TX.
David S. Tarbell	Energy Center, University of Penn., Phila., PA.
Leeland Teeples, Supt.	Sevier School District, Richfield, UT.
Ronald Toms	DOE/DGE, Washington, DC.
John Tsiaperas	Shell Oil Company, Houston, TX.
Prof. Richard E. Turley	University of Utah, Salt Lake City, UT.
Donald Turner	University of Alaska, Fairbanks, AL.
USGS Library	Menlo Park, CA.
	Denver, CO.
	Reston, VA.
Gerald D. VanVoorhis	Bear Creek Mining Co., Tucson, AZ.
Anthony Veneruso	Sandia Laboratory, Albuquerque, NM.
Jack Von Hoene	Davon, Inc., Milford, UT.
John Walker	DOE/DGE, Washington, DC.
D. Roger Wall	Aminoil USA, Inc., Santa Rosa, CA.
Paul Walton	American Geological Enterprises, Inc., Salt Lake City, UT.
Richard B. Weiss	Harding-Lawson Assoc., San Rafael, CA.
John Welsh	Consultant, Holladay, UT.
James A. Whelan	Naval Weapons Center, China Lake, CA.
J. H. Wherry	Author, Puyallup, WA.
Donald E. White	USGS, Menlo Park, CA.
Maggie Widmayer	DOE/ID, Idaho Falls, ID.
Gordon Wieduwilt	Mining Geophysical Surveys, Inc., Tucson, AZ.
Syd Willard	California Energy Commission, Sacramento, CA.
Barry Williams	Geothermal Services, San Diego, CA.
James Wilson	NARCO, San Diego, CA.
Paul Witherspoon	Lawrence Berkeley Laboratory, Berkeley, CA.
Harold Wollenberg	Lawrence Berkeley Laboratory, Berkeley, CA.
Dick Wood	DOE/DGE, Idaho Falls, ID.
William B. Wray, Jr.	VanCott, Bagley, Cornwall & McCarthy, Salt Lake City, UT.
B.J. Wynat	Occidental Geothermal, Inc., Bakersfield, CA.
Paul C. Yuen	University of Hawaii @ Manoa, Honolulu, HI.
S.H. Yungul	Chevron Resources Company, San Francisco, CA.
Eliot J. Zais	Elliot Zais & Associates, Corvallis, OR.
Ernst G. Zurflueh	International Energy Co., San Francisco, CA.

Internal

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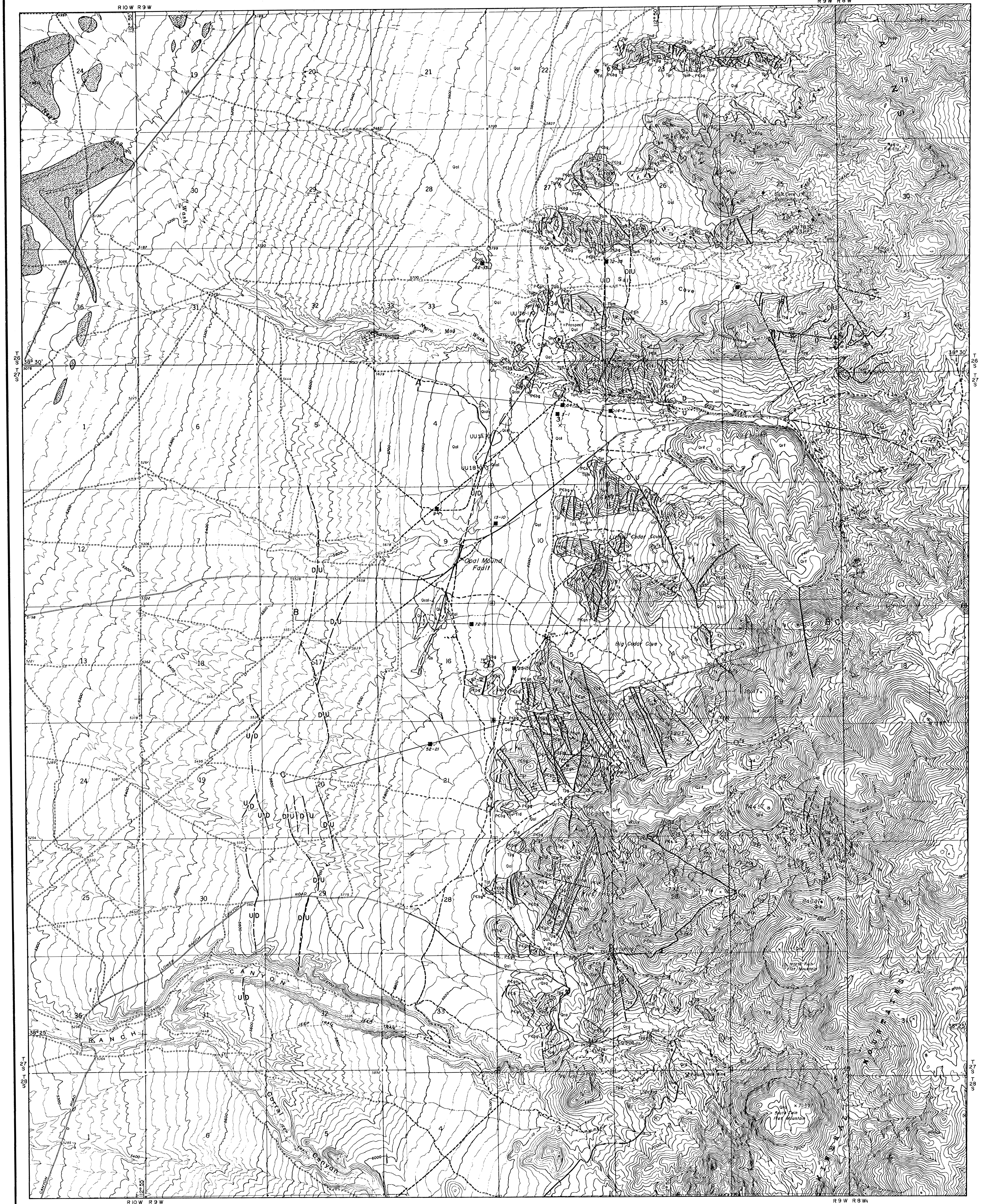
S.H. Ward (2)	UU/GG, Salt Lake City, UT.
P.M. Wright	ESL/UURI, Salt Lake City, UT.
H.P. Ross	ESL/UURI, Salt Lake City, UT.
R.W. Bamford	ESL/UURI, Salt Lake City, UT.
J.N. Moore	ESL/UURI, Salt Lake City, UT.
D. Foley	ESL/UURI, Salt Lake City, UT.
J.B. Hulen	ESL/UURI, Salt Lake City, UT.
R.L. Bruhn	UU/GG, Salt Lake City, UT.
D.S. Chapman	UU/GG, Salt Lake City, UT.
W.P. Nash	UU/GG, Salt Lake City, UT.
W.T. Parry	UU/GG, Salt Lake City, UT.
Master Report File	ESL/UURI, Salt Lake City, UT.

PLATE I



EXPLANATION

QUATERNARY	Qls	Landslide
	Qs	Opaline and Chalcedonic sinter
	Qcal	Silica-cemented alluvium
	Qh	Hematite-cemented alluvium
	Qm	Manganese-oxide cemented alluvium
	Qal	Alluvium
	Ord	Rhyolite Domes Glassy, 1-5 % phenochrysts, perlite and pumice mantles.
	Qra	Pyroclastics Air fall and non-welded ashflow tuff. White to light tan. Weakly consolidated.
	Qrf	Rhyolite Flow Non-porphyritic glassy, gray, flow banded lava and obsidian. Perlitic rubble on flow tops.
TERTIARY	Trd	Rhyolite Dikes Aphanitic, gray rhyolite dikes with approximately 5% orthoclase phenocrysts and minor biotite. Often silicified and typically strongly jointed.
	Tds	Diabase Dikes Aphanitic, light brown or light gray green, with 3% plagioclase phenocrysts. Typically strongly jointed.
	Tmd	Microdiorite Dikes Dark green, dark gray, or black fine-grained dikes, plagioclase phenocrysts often present.
	Tgr	Granite Dikes Fine-grained phaneritic, resistant, dark brown, closely joined outcrops, forming blocky to rouned talus. Joints are typically limonite-stained. Unlabeled dikes are Tgr.
	Tg	Granite Coarse to medium-grained, xenomorphic, even texture with 22% quartz. Forms massive rounded outcrops, weathers to grus.
	Ts	Syenite Medium-grained, xenomorphic, with 1 to 3% sphene. Forms white or very light brown stained, massive, rounded outcrops, weathers to grus.
	Tpg	Porphyritic Granite Porphyritic with 25% 1 to 3 cm microcline phenocrysts. Medium to coarse grained matrix. Forms resistant outcrops.
	Tqm	Quartz Monzonite Coarse grained, massive, rounded light brown outcrops. Flow foliation and mafic xenoliths typical in the contact zone. 1 to 2 cm anhedral to subhedral microcline crystals present in parts of the contact zone. Forms some talus in the contact zone, but weathers to grus in the interior of the pluton.
	Td	Diorite Medium-grained hornblende diorite.
PRECAMBRIAN	PЄgn	Hornblende Gneiss Medium-grained hornblende gneiss; weakly to strongly foliated. Forms resistant outcrops.
	PЄn	Biotite Gneiss Highly variable biotite and biotite-hornblende gneisses which occur as inclusions within younger units. Typically massive to weakly foliated, dark colored, sphene rich and medium-grained. Alkalai feldspar porphyroblasts are common.
	PЄs	Sillimanite Schist Dark gray to green fine-grained, finely laminated schist containing abundant biotite, fibrolitic sillimanite, and minor garnet porphyroblasts.
	PЄq	Quartzite White, bedded metaquartzite containing minor biotite and feldspar.
	PЄbg	Banded Gneiss Gray to white conspicuously layered biotite gneiss, schist and migmatite. Highly variable in composition. Well developed isoclinal and ptygmatic folding.

⁀ - -	Contact, dashed where approximate
—×—×—×—	Fault, intruded by microdiorite dike.
— - · ·	Fault, dashed where inferred, dotted where covered. Breccia zones shown where mappable.
— - — -	Fault, mapped from linears on areal photos, may have some topographic relief.
⟋ 40	Joints
⟍ 80°	Foliation
⟋ 40 70	Foliation with plunge of linear
41	Dip of dike, thickness not shown to scale. Unlabeled dikes are Tgr.
▲	Fumarole
§	Spring
■	Geothermal well
⌖	Thermal gradient hole
▨	Lake Bonneville shore features
⚒	Prospect pit
◪	Shaft
≻	Adit

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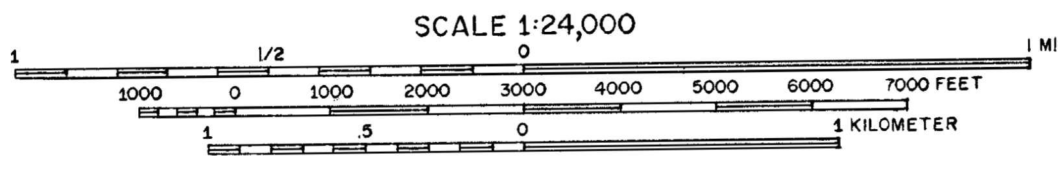
SCALE 1:24,000

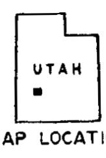


From: Nielson, D.L., Sibbett, B.S., McKinney, D.B, Hulen, J.B., Moore, J.N., & Samberg, S.M., 1978, Geology of Roosevelt Hot Springs KGRA, Beaver County, Utah: University of Utah Research Institute, Earth Science Laboratory Report, Department of Energy Contract Number EG-78-C-07-1701

GEOLOGIC MAP OF ROOSEVELT HOT SPRINGS KGRA
BEAVER COUNTY, UTAH

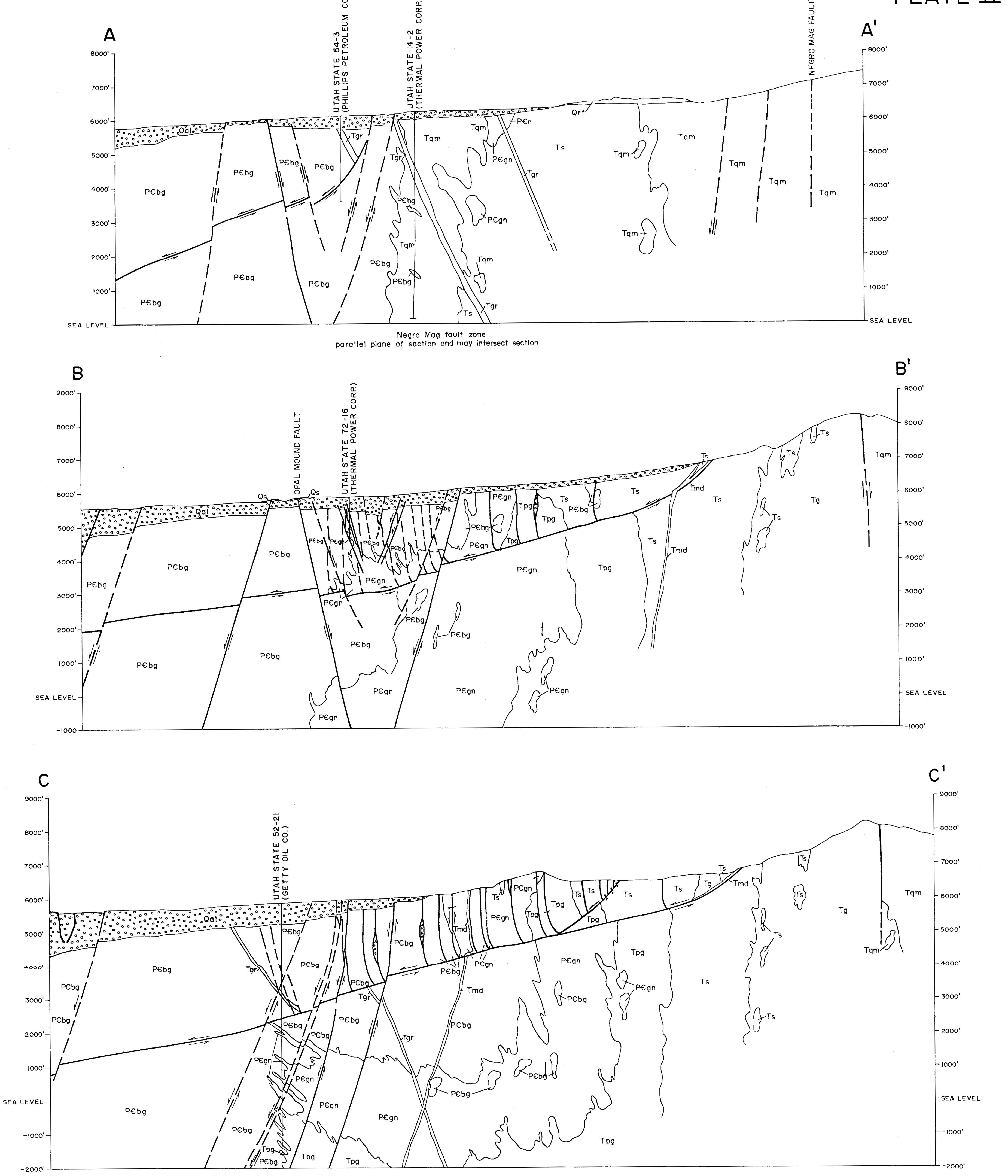
GEOLOGY, 1978, BY
DENNIS L. NIELSON, BRUCE S. SIBBETT, D. BROOKS McKINNEY
AND SUSAN M. SAMBERG

APPROXIMATE MEAN
DECLINATION, 1958



MAP LOCATION

PLATE II



SCALE 1:24,000

1 1/2 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

NO VERTICAL EXAGGERATION

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From: Nielson, D.L., Sibbett, B.S., McKinney, D.B., Hulen, J.B., Moore, J.N., & Samberg, S.M., 1978, Geology of Roosevelt Hot Springs KGRA, Beaver County, Utah: University of Utah Research Institute, Earth Science Laboratory Report, Department of Energy Contract Number EG-78-C-07-1701

CROSS SECTIONS OF ROOSEVELT HOT SPRINGS KGRA BEAVER COUNTY, UTAH

GEOLOGY, 1978, BY
DENNIS L. NIELSON, BRUCE S. SIBBETT, D. BROOKS McKINNEY,
JEFFREY B. HULEN, J.N. MOORE AND SUSAN M. SAMBERG