IDO/78-1701.b.1.1.
Distribution Category UU-66
ESL-9

STRATIGRAPHY AND ALTERATION, 15 SHALLOW THERMAL GRADIENT HOLES, ROOSEVELT HOT SPRINGS KGRA AND VICINITY, MILLARD AND BEAVER COUNTIES, UTAH

Jeffrey B. Hulen

EARTH SCIENCE LABORATORY
UNIVERSITY OF UTAH RESEARCH INSTITUTE
391-A Chipeta Way
Salt Lake City, Utah 84108

Date Published - September, 1978

Prepared for the
DEPARTMENT OF ENERGY
DIVISION OF GEOTHERMAL ENERGY
UNDER CONTRACT EG-78-C-07-1701

DISCLAIMER

NOTICE

This report was prepared to document work sponsored by the United States Government. Neither the United States nor its agent, the United States Department of Energy, nor any Federal employees, nor any of their contractors, subcontractors or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

NOTICE

Reference to a company or product name does not imply approval or recommendation of the product by the University of Utah Research Institute or the U.S. Department of Energy to the exclusion of others that may be suitable.

CONTENTS

ILLUSTRATIONS

ABSTRACT

Fifteen shallow thermal gradient drill holes were recently completed by Geothermal Power Corporation (GPCR) in the vicinity of the Roosevelt Hot Springs KGRA. Five holes penetrated Tertiary granitic rocks and Precambrian gneiss east of the KGRA. Seven holes completed entirely in alluvium near the southwestern corner of the KGRA encountered a near-surface marker horizon of Pleistocene pumice and perlite. Maximum calculated alluvial sedimentation rates since initial deposition of this pumice and perlite range from 1 foot in 12,500 years to 1 foot in 2,300 years. Three holes east of the Mineral Mountains penetrated late Cenozoic basaltic andesite beneath a thin veneer of alluvium.

Tertiary granitic and Precambrian gneissic bedrock penetrated by the GPCR holes is pervasively but weakly altered. Alteration products in the bedrock consist of trace to minor amounts of clay and sericite after plagioclase and potassium feldspar, chlorite after mafic minerals, and erratically distributed calcite and epidote after plagioclase and leucoxene (± calcite) after sphene. Alluvial grains derived from the bedrock are similarly altered. Unaltered Pleistocene pumice and perlite coexist in the alluvium with altered bedrock grains, indicating that alteration in these grains antedates alluvial deposition and therefore antedates the presently active geothermal system.

Calcite cement is abundant in nearly all alluvium penetrated by the GPCR holes. In several of the holes at the southwestern corner of the KGRA, much of the alluvium seems to have been firmly indurated by the cement. This cemented alluvium may function locally as a caprock preventing fluid and heat

loss from the active geothermal system.

Manganese and iron oxides occur in highly variable amounts in samples from all the GPCR holes. Dendritic films and crusts of manganese oxide in alluvium postdate carbonate cement and may be genetically related to the presently active geothermal system. Disseminated and veinlet-controlled manganese oxide in bedrock is of uncertain age relative to the geothermal system. Most of the iron oxides were formed after sample collection by oxidation of drill steel and of steel lids on sample jars.

All 15 GPCR drill holes appear to be peripheral to a central zone of anomalously high thermal gradient and low resistivity delineated by previous investigations. GPCR-8 and -14, however, are characterized by high heat flow and relatively abundant manganese oxide mineralization, which may reflect a favorable hydrologic system controlling thermal fluid flow at depth. These holes thus seem most encouraging for discovery of a deeper high-temperature geothermal resource.

INTRODUCTION

Fifteen shallow thermal gradient holes were drilled adjacent to the Roosevelt Hot Springs KGRA (Fig. 1, 2a, 2b) by Geothermal Power Corporation of Novato, California, during mid-and late 1977 and early 1978. By contract between Geothermal Power and the U.S. Energy Research and Development Administration (now Department of Energy), cuttings from these holes were subsequently delivered to the Earth Science Laboratory (ESL). As part of a current effort by ESL to further characterize the active geothermal system at Roosevelt, the lithology, alteration, and mineralization of these cuttings have been examined in detail for the present report.

GEOLOGIC SETTING

The Roosevelt Hot Springs KGRA is situated along the west-central flank of the Mineral Mountains, the easternmost fault-block mountains at this latitude in the Basin-Range province. The range is dominantly underlain by granitic rocks of the Mineral Mountains pluton (Fig. 2), which is no older than 35 m.y. (Lipman, et al., 1978) and may be as young as 15.5 ± 1.5 to 9.2 m.y. (K-Ar; Park, 1968; Armstrong, 1970; Bowers, 1978). This pluton intrudes a variety of older rocks along the margins of the Mineral Mountains. The oldest of these are high-grade biotite-and/or hornblende-bearing gneisses of Precambrian age which crop out primarily within and near the KGRA (Nielson, et al., in prep.). Cambrian quartzites and marine carbonates occupy the northern margin of the range; marine and terrestrial sedimentary rocks of Permian

through Cretaceous age occur along the south-central and southern margins (Liese, 1957; Parry, et al., 1977).

The Mineral Mountains locally flanked and overlain by diverse volcanic and sedimentary rocks of late Cenozoic age. The volcanics include Pliocene rhyolite just south of the KGRA, Quaternary basaltic flows which form a broad, thin sheet adjacent to and east of the range, and the Pleistocene (0.8-0.5 m.y.) rhyolite domes, flows and associated pyroclastic deposits of the central portion of the range (Parry, et al., 1977; Lipman, et al., 1978). The sediments comprise fan gravels shed from existing highlands, lacustrine deposits of Pleistocene Lake Bonneville west of the KGRA, and the varied lithologies of the Pliocene Sevier River Formation to the east and northeast (Zimmerman, 1961; Hintze, 1963, 1975). The Sevier River Formation consists dominantly of fanglomerates, conglomerates, sandstones, siltstones, and marls with locally interbedded lacustrine limestone, diatomite, and volcanic rocks.

Principal structures mapped to date within and near the KGRA (excluding pre-Cenozoic folding) are northerly trending high-angle normal faults of late Cenozoic age and west-northwest to east-west trending high-angle faults of uncertain age and displacement (Petersen, 1975; Evans, 1977).

Nearly all known hot spring deposits, surface alteration, and associated mineralization at Roosevelt are confined to a 3 1/2 x 1/4 mile belt centered on and parallel to the Dome fault, a north-northeast trending structure with recent normal offset (Parry, et al., 1977). Spring deposits within the belt consist of opaline sinter mounds and associated opal-cemented alluvium. These siliceous deposits are accompanied by alteration of alluvium to opal, alunite,

and clay. The sinter and cemented or altered alluvium, all of which are commonly sulfur-bearing, are locally stained or impregnated with hematite or dark manganese oxides (Nielson, et al., in prep.).

Subsurface alteration and mineralization at Roosevelt have been explored in three shallow drill holes along the Dome fault (UU751A, UU751B, UU761A), and to a depth of 6100 feet in Thermal Power Corporation drill hole 14-2 (Fig. 2a, 2b). Near-surface opal-alunite alteration penetrated by the three shallow holes (maximum depth 231') grades successively downward through zones characterized by the assemblages alunite-kaolinite, alunite-kaolinite-montmorillonite, and muscovite-pyrite (± marcasite) (Parry, et al., 1976; Bryant and Parry, 1977). Alteration in drill hole 14-2 is generally weak and controlled by fractures in biotite monzonite of the Mineral Mountains pluton (Ballantyne and Parry, 1978). Sericite, montmorillonite and mixed layer clays are the most common alteration products in the hole to a depth of 2350 feet, below which various combinations of chlorite, calcite, sericite, and minor potassium feldspar predominate.

METHODS AND PROCEDURES

Water-saturated samples of drill cuttings from Geothermal Power Corporation's fifteen thermal gradient holes--generally collected at 10-foot intervals--were delivered to the Earth Science Laboratory in mason jars with steel lids. Oxidation of these lids, and probably of drill steel in many of the samples, resulted in contamination of the cuttings with newly-formed iron

oxides. The samples were washed to remove drilling mud and other foreign material, then dried and examined with a conventional binocular microscope at 10x-40x magnification.

STRATIGRAPHY

Of the fifteen shallow thermal gradient holes, six (GPCR 1 through 4, 6, 14) are collared in Quaternary alluvium near the southwest corner of the KGRA (Fig. 2a, 2b). Another five (GPCR 5, 7 through 10) are situated in or very near bedrock along the flanks of the Mineral Mountains. GPCR 11 through 13 and 18 are collared in alluvium east of the mountains.

Drill holes GPCR-1, 2, 4, 6 and 14, and the upper 100' of GPCR-5 penetrated arkosic alluvium (Fig. 2a, 2b, 3; Appendix 1). The clastic component of the alluvium consists of subangular to subrounded grains up to 25 mm. (avg. about 2 mm.) in diameter derived from the Mineral Mountains. The grains are predominantly Tertiary lithic and crystal fragments from granitic rocks and Precambrian(?) gneisses but also include silicic volcanic rocks, including pumice, perlite, rhyolite, and minor obsidian.

Pumice and perlite form a prominent marker horizon in the alluvium penetrated by GPCR-1, 5, 6, and 14 (Fig. 3). This marker horizon is arbitrarily defined as greater than 10% pumice plus perlite to avoid confusion through contamination by caving. The base of the marker horizon occurs at known depths ranging from approximately 40 feet in GPCR-5 to 117 feet in GPCR-1, and 218 feet in GOC-52-21, a deep geothermal well (Fig. 2a, 2b, 3;

Appendix 1). The pumice and perlite are derived from silicic volcanic centers in the Mineral Mountains which have been dated by K-Ar methods at roughly 800,000 to 500,000 years (Lipman, et al., 1978). A maximum alluvial sedimentation rate since initial depositon of the pumice and perlite can thus be calculated. This rate ranges from roughly one foot in 12,500 years in GPCR-5 to one foot in 2,300 years in GOC-52-21.

Rhyolite and porphyritic rhyolite grains are concentrated in the upper portion of the alluvium penetrated by GPCR 2, 3 and 4, situated just outside the southern border of the KGRA (Fig. 2a, 2b, 3; Appendix 1). These grains can be tentatively correlated with the Corral Canyon rhyolite ("Tr" Fig. 2a) which crops out about one mile upstream from GPCR-2 and has yielded a K-Ar date of 8.02 ±0.3 m.y. (Lipman et al., 1978). These older rhyolite grains occur at the same stratigraphic horizon in the alluvium as the Pleistocene pumice and perlite encountered in GPCR-1, 5, 6 and 14. This relationship suggests that the Corral Canyon rhyolites may have been uplifted contemporaneously with the emplacement of the Pleistocene silicic volcanic centers of the central Mineral Mountains.

Drill hole GPCR-5 (Fig. 2a, 2b, 3; Appendix 1) encountered biotite-hornblende gneiss beneath alluvium at a depth of 110 feet. The biotite-hornblende gneiss is a medium- to coarse-crystalline rock with up to 10% (avg. 7%) hornblende, 1-2% biotite, and 1% sphene. Outcrops of this rock type north of GPCR-5 are moderately well foliated (Nielson, et al., in prep.), but foliation is difficult to discern in drill cuttings. Drill holes GPCR-7, 8 and 9 were completed primarily in coarse-crystalline granitic rocks of the

Mineral Mountains pluton--biotite quartz monzonite in GPCR-8 and 9, and biotite granite in GPCR-7. In drill hole 9, the quartz monzonite is contaminated with cuttings of fine- to medium-crystalline biotite- and hornblende-bearing gneiss.

Although collared immediately adjacent to bedrock on the northeastern flank of the Mineral Mountains, GPCR-10 penetrated approximately 180' of arkosic alluvium before encountering rhyolite porphyry bedrock. This anomalous alluvial thickness suggests that the contact between alluvium and bedrock immediately north of the drill site may be fault controlled. The rhyolite porphyry at the base of GPCR-10 consists of sparse potassium feldspar and quartz phenocrysts (commonly bipyramidal) embedded in a light-gray microcrystalline matrix. Alluvium above the rhyolite is dominated by grains and fragments of biotite-hornblende quartz monzonite or granodiorite similar to the biotite-hornblende gneiss penetrated by GPCR-5.

Drill holes GPCR-11, 12, 13, and 18 intersected different thicknesses of arkosic alluvium before encountering the basaltic andesite flows extensively exposed east of the Mineral Mountains (Fig. 2a, 2b, 3; Appendix 1). The flows are medium to dark gray, microcrystalline to aphanitic, commonly porphyritic, vesicular basaltic andesites containing minor pyroxene and olivine. Drill holes 11 and 18 bottomed in these flows. Drill holes 12 and 13 penetrated subjacent arkosic alluvium. In GPCR-13, the alluvium above the basaltic andesite is rich in pumice and perlite shed from Pleistocene rhyolite domes to the west, while the alluvium below the andesite is devoid of these materials. This andesite therefore predates Pleistocene rhyolitic volcanism in adjacent portions of the Mineral Mountains.

ALTERATION

Alteration in granitic and metamorphic rock fragments and grains in alluvium penetrated by the GPCR holes is similar to that observed in granitic and metamorphic bedrock of the Mineral Mountains (refer to following paragraph and Appendix 1). This alteration antedates alluvial deposition. The altered granitic and metamorphic alluvial grains, which commonly display a dull weathering patina, coexist in the alluvium with fresh Pleistocene silicic pumice and perlite--a condition which could not prevail had alteration of these fragments post-dated deposition of the alluvium.

Bedrock of the Mineral Mountains penetrated by four widely-spaced GPCR holes (5, 7, 8, 9) is pervasively but weakly altered. The alteration is similar to that documented in the upper 2350 feet of Thermal Power drill hole 14-2, a producing geothermal well (Fig. 2a, 2b; Ballantyne and Parry, 1978). The alteration is characterized by trace to minor amounts of clay and sericite after feldspar (particularly plagioclase), with erratically distributed chlorite after mafic minerals (especially hornblende), calcite and rare traces of epidote after plagioclase, and leucoxene ± calcite after sphene. Rare microveinlets and veinlet fragments consisting of various combinations of quartz, chlorite, epidote, calcite, and powdery brick-red to maroon hematite are locally present. Trace to minor amounts of goethite- and manganese oxide-bearing silicified microbreccia occur in cuttings from GPCR-8. Calcite occurs as microveinlets in rhyolite porphyry penetrated by GPCR-10.

Calcite cement is present in all alluvium cut by GPCR-1, 2, 3, 4, 6, and 14 near the southwestern corner of the KGRA (Fig. 2a, 2b, 3; Appendix 1). The

cement is a cryptocrystalline light-gray to buff material which incorporates silt- and clay-size particles.

Basaltic andesite penetrated by drill holes GPCR-11, 12, and 18 is cut by calcite veinlets and microveinlets. In GPCR-12 and 18, vesicles in the andesite are partially lined with calcite. The andesite encountered in GPCR-13 is unaltered (Fig. 2a, 2b, 3; Appendix 1).

Two textural varieties of manganese oxide occur in the GPCR drill holes. In bedrock, manganese oxide, commonly admixed with minor goethite and quartz, occurs as disseminated irregular patches and clots, as veinlets and microveinlets, and as a pervasive stain associated with mafic minerals. This variety of manganese oxide is most common in drill hole GPCR-8, in which it averages roughly 0.5% by volume of all cuttings and locally exceeds 2%. In alluvium, manganese oxide occurs as detrital grains of this first textural variety but also as dendritic films and crusts coating alluvial grains and carbonate cement. This late-stage manganese oxide is relatively rare in the cuttings and is concentrated between 320 and 410 feet in drill hole GPCR-14 (Fig. 2a, 2b, 3; Appendix 1).

DISCUSSION AND CONCLUSIONS

All 15 shallow GPCR drill holes at Roosevelt appear to be peripheral to a central zone of anomalously high near-surface thermal gradient and low resistivity (Ward and Sill, 1976; Sill and Bodell, 1977). Of the holes nearest this zone, GPCR-8 and GPCR-14 seem most encouraging for discovery of

deeper high-temperature thermal waters. Both holes, in addition to being characterized by high heat flow (up to 12 HFU in 14; Geothermal Power Corporation, 1978), encountered relatively strong manganese oxide mineralization which may reflect a favorable hydrologic system controlling thermal fluid flow at depth.

Dendritic manganese oxide mineralization in GPCR-14 postdates alluvial deposition and is probably related to the presently active geothermal system. The relative age of strong manganese oxide mineralization in GPCR-8 is unknown. Although it does reflect a favorable permeable fracture network, it may represent "fossil" mineralization totally unrelated to the geothermal system.

Alteration in Tertiary granitic and Precambrian gneissic bedrock penetrated by the GPCR holes, as well as in alluvial grains derived from this bedrock, probably antedates the geothermal system. Alteration of the type and low intensity affecting these rocks and alluvial grains is erratically distributed throughout the central and northern Mineral Mountains (Liese, 1957; Evans, 1977; Nielson, et al., in prep.). Altered gneissic and granitic grains commonly display a dull weathering patina and coexist in the alluvium with unaltered, glassy rhyolitic grains. This relationship indicates that the alteration preceded alluvial deposition and therefore also preceded the present geothermal system.

Cryptocrystalline calcite cement is present in all alluvium penetrated by the GPCR holes except 13. It is particularly abundant in the holes clustered near the southwestern corner of the KGRA. In this area, much of the alluvium

may be firmly indurated by the cement and therefore might function locally as an effective caprock preventing fluid and heat loss from the geothermal system.

ACKNOWLEDGEMENTS

This work was funded by the Department of Energy, Division of Geothermal Energy under Contract No. EG-78-C-07-1701.

Careful review of the manuscript by D. L. Nielson, J. N. Moore, H. P. Ross and J. Stringfellow is gratefully acknowledged. Discussions with B. S. Sibbett and D. B. McKinney led to a clearer understanding of the geologic setting of the Roosevelt KGRA. The manuscript was illustrated by Doris Cullen and John Lopez, and typed and prepared for publication by Susan Moore and Susan Keller.

REFERENCES

Armstrong, R. L., 1970, Geochronology of Tertiary igneous rocks, eastern Basin and Range province, western Utah, eastern Nevada and vicinity, U.S.A.: Geochem. et Cosmochim. Acta, v. 34, p. 203-232.

Ballantyne, J. M., and Parry, W. T., 1978, Hydrothermal alteration at the Roosevelt Hot Springs thermal area, Utah: Petrographic characterization of the alteration of 2 kilometers depth: Univ. of Utah Dept. of Geol. and Geophysics Tech. Rpt. 78-1701-a.1.1, DOE/DGE Contract No. EG-78-C-07-1701.

Bowers, D., 1978, Potassium-argon age dating and petrology of the Mineral Mountains pluton, Utah: Univ. of Utah Dept. of Geol. and Geophysics, Unpubl. M.S. Thesis.

Bryant, N. L., and Parry, W. T., 1977, Hydrothermal alteration at Roosevelt Hot Springs KGRA--DDH 1976-1: Univ. of Utah Dept. of Geol. and Geophysics, Tech. Rpt. v. 77-5, DOE/DGE contract EY-76-S-07-1601.

Evans, S. H., Jr., 1977, Geologic map of the central and northern Mineral Mountains, Utah: Univ. of Utah Dept. of Geol. and Geophysics Tech. Rept., v. 77-7, DOE/DGE contract EY-76-S-07-1601.

Hintze, L. F., 1963, Geologic map of southwestern Utah: Utah State Land Board Map.

Hintze, L. F., 1975, Geologic highway map of Utah: Brigham Young Univ., Spec. Publ. 3.

Liese, H. C., 1957, Geology of the northern Mineral Range, Millard and Beaver Counties, Utah: Univ. of Utah Dept. of Geol., Unpubl. M.S. Thesis.

Lipman, P. W., Rowley, D. D., Mehnert, H. H., Evans, S. H., Nash, W. P. and Brown, F. H., 1978, Pleistocene rhyolite of the Mineral Range, Utah: geothermal and archaeological significance: Jour. Research U.S. Geol. Survey, v. 6, no. 1, p. 133-147.

Nielson, D. L., Sibbett, B. S., McKinney, D. B., Hulen, J. B., Moore J. N., and Samberg, S. M. (in prep.), The geology of the Roosevelt Hot Springs KGRA, Beaver Co, Utah: Univ. of Utah Research Inst., Earth Science Laboratory Rept., DOE Contract EG-78-C-07-1701.

Park, G. M., 1968, Some geochemical and geochronologic studies of the beryllium deposits in western Utah: Univ. of Utah Dept. of Geology, Unpubl. M.S. Thesis.

Parry, W. T., 1978, Hydrothermal alteration at the Roosevelt Hot Springs thermal area, Utah: Univ. of Utah Dept. of Geol. and Geophysics Tech. Rept., DOE/DGE Contract EG-78-C-07-1701.

Parry, W. T., Benson, N. L., and Miller, C. D., 1976, Geochemistry and hydrothermal alteration at selected Utah hot springs: Univ. of Utah Dept. of Geol. and Geophysics, Final Rept., v. 3, NSF grant GI-43741.

Parry, W. T., Nash, W. P., Bowman, J. R., Ward, S. H., Whelan, J. A., Bryant, N. L., Dedolph, R. E., Evans, S. H. and Bowers, D., 1977, Geology and geochemistry of the Roosevelt Hot Springs thermal area, Utah - A summary: Univ. of Utah Dept. of Geol. and Geophysics, Final Rept. DOE/DGE Contract EY-76-S-07-1601 (pt. 1).

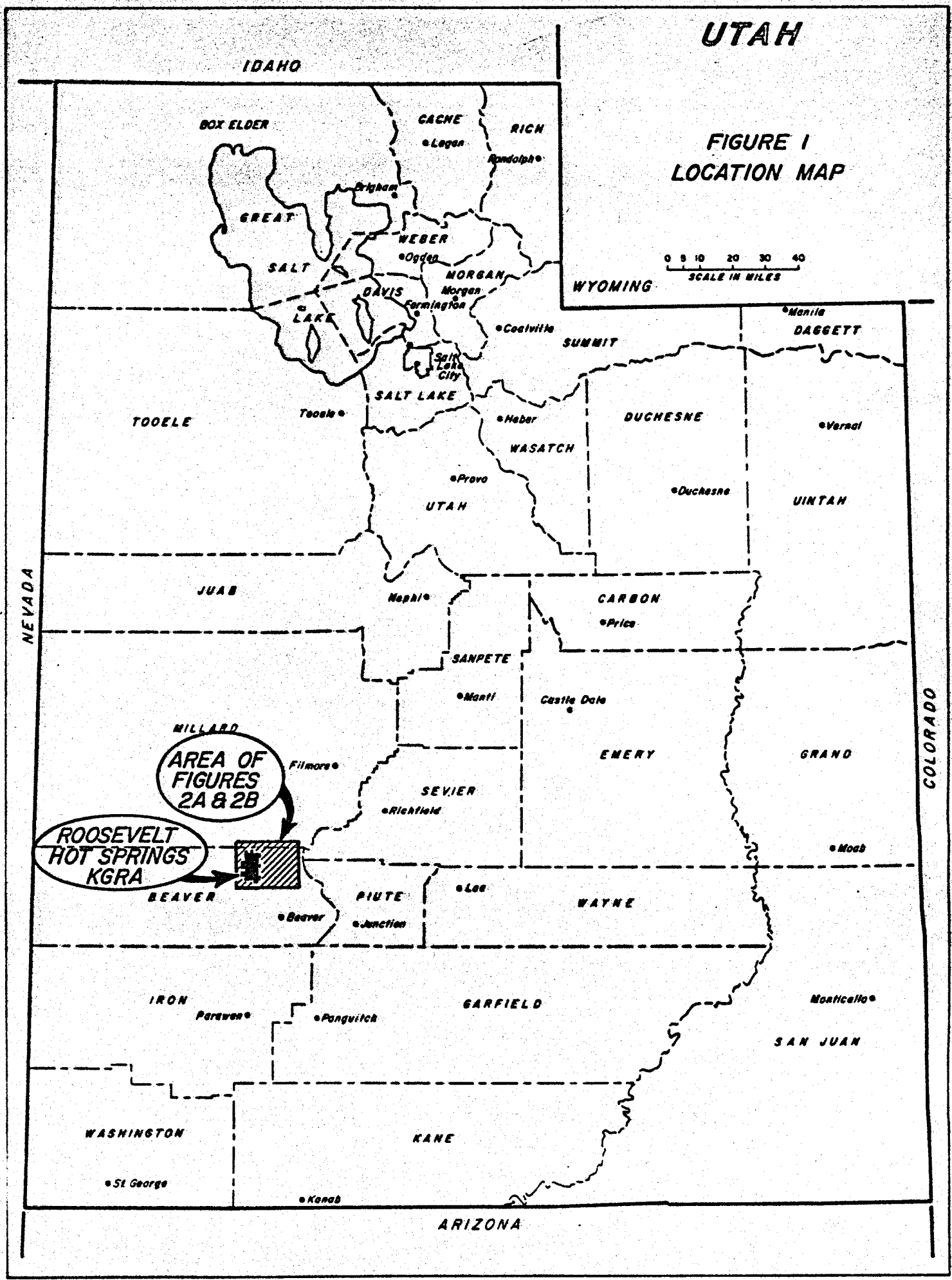
Petersen, C. A., 1975, Geology of the Roosevelt Hot Springs area, Beaver County, Utah: Utah Geol., v. 2, no. 2, p. 109-116.

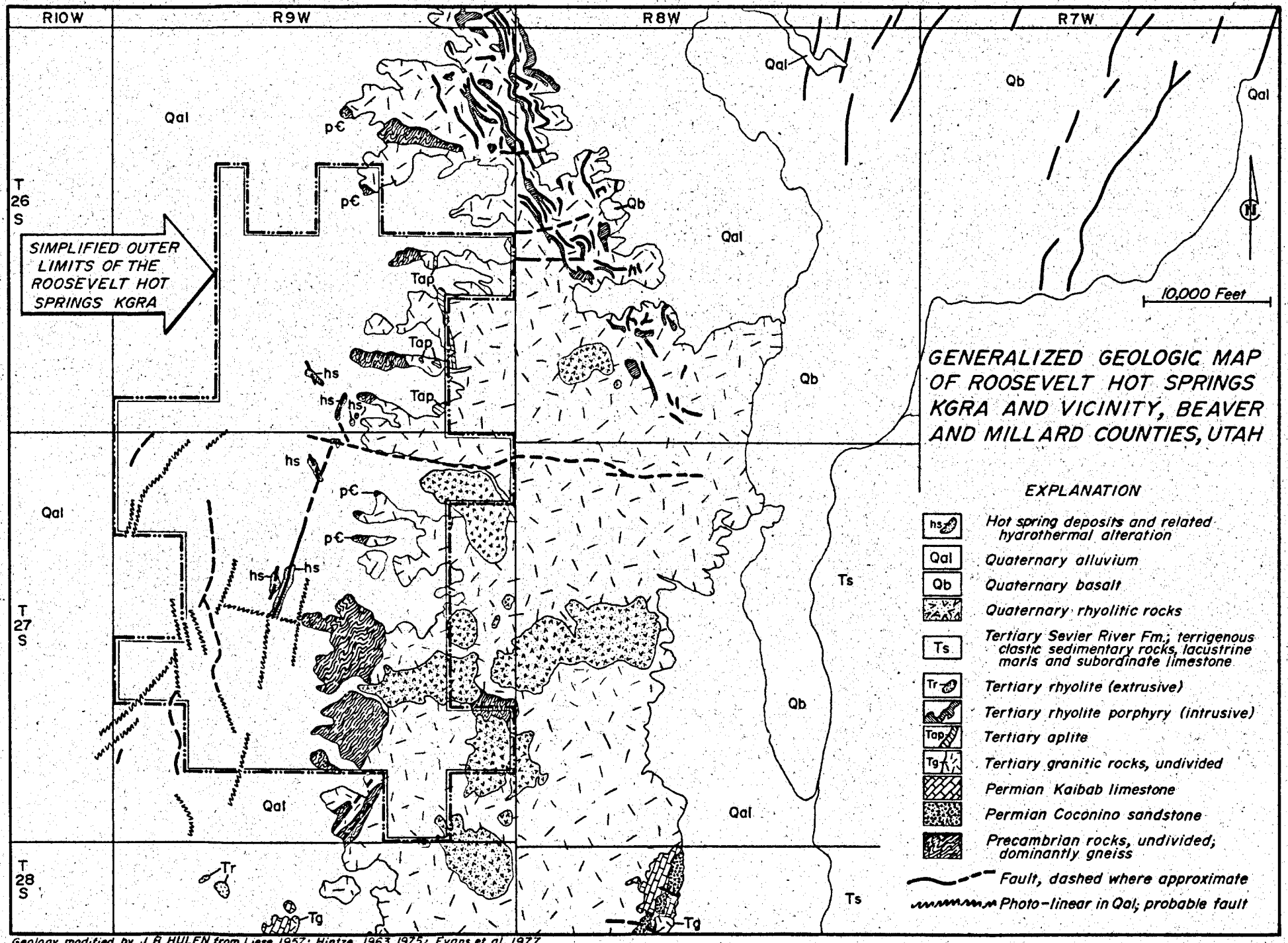
Sill, W. R., and Bodell, J., 1977, Thermal gradients and heat flow at Roosevelt Hot Springs: Univ. of Utah Dept. of Geol. and Geophysics, Tech. Rept., v. 77-3, ERDA Contract No. EY-76-S-07-1601.

Ward, S. H., and Sill, W. R., 1976, Dipole-dipole resistivity surveys, Roosevelt Hot Springs KGRA: Univ. of Utah Dept. of Geol. and Geophysics, Final Rept., v. 2, NSF grant GI-43741.

Ward, S. H., Parry, W. T., Nash, W. P., Sill, W. R., Cook, K. L., Smith, R. B., Chapman, D. S., Brown, F. H., Whelan, J. A., Bowman, J. R., 1978, A summary of the geology, geochemistry, and geophysics of the Roosevelt Hot Springs thermal area, Utah: Univ. of Utah Dept. of Geol. and Geophysics Report (reprint).

Zimmerman, J. T., 1961, Geology of the Cove Creek area, Millard County and Beaver County, Utah: Dept. of Geology, Univ. of Utah, Unpubl. M.S. Thesis.


UTAH
FIGURE 1
LOCATION MAP
0 5 10 20 30 40
SCALE IN MILES
IDAHO
WYOMING
NEVADA
COLORADO
ARIZONA
BOX ELDER
CACHE
RICH
Logan
Randolph
Brigham
GREAT
SALT
LAKE
WEBER
Ogden
MORGAN
Morgan
DAVIS
Farmington
Coalville
SUMMIT
Manila
DAGGETT
Salt Lake City
SALT LAKE
TOOELE
Tooele
Heber
DUCHESNE
Vernal
WASATCH
Provo
UTAH
Duchesne
UINTAH
JUAB
Nephi
CARBON
Price
SANPETE
Manti
Castle Dale
MILLARD
AREA OF FIGURES 2A & 2B
Filmore
EMERY
GRAND
SEVIER
Richfield
ROOSEVELT HOT SPRINGS KGRA
Moab
BEAVER
Beaver
PIUTE
Junction
Lee
WAYNE
IRON
Parowan
Panguitch
GARFIELD
Monticello
SAN JUAN
WASHINGTON
St George
KANE
Kanab



Geology modified by J. B. HULEN from Liese, 1957; Hintze, 1963, 1975; Evans et al, 1977

FIGURE 2A

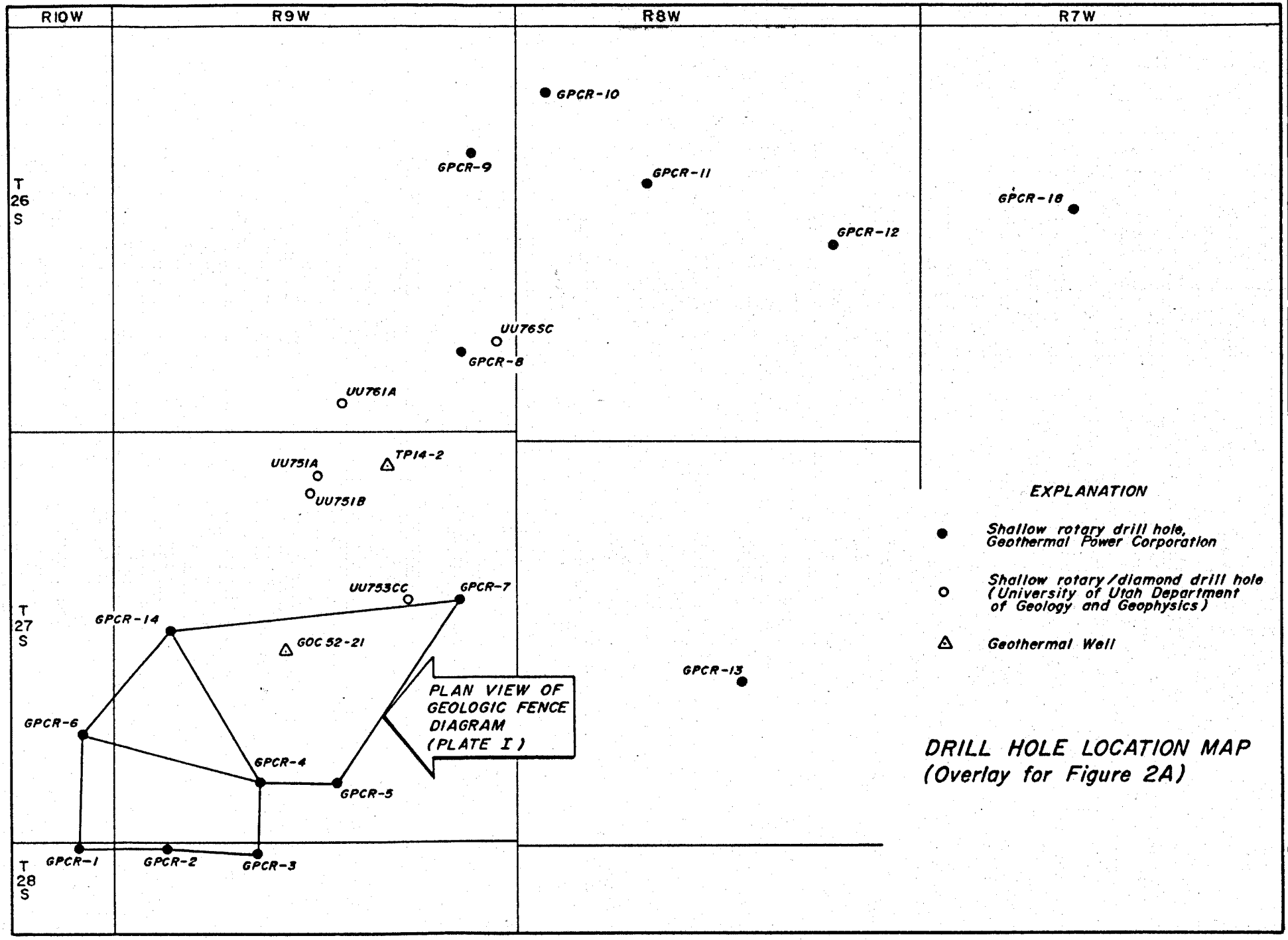

R10W
R9W
R8W
R7W
T 26 S
T 27 S
T 28 S
GPCR-10
GPCR-9
GPCR-11
GPCR-12
GPCR-16
UU765C
GPCR-8
UU761A
UU751A
TP14-2
UU751B
UU753CC
GPCR-7
GPCR-14
GOC 52-21
GPCR-13
GPCR-6
GPCR-4
GPCR-5
GPCR-1
GPCR-2
GPCR-3
PLAN VIEW OF GEOLOGIC FENCE DIAGRAM (PLATE I)
EXPLANATION
Shallow rotary drill hole, Geothermal Power Corporation
Shallow rotary/diamond drill hole (University of Utah Department of Geology and Geophysics)
Geothermal Well
DRILL HOLE LOCATION MAP
(Overlay for Figure 2A)

FIGURE 2B

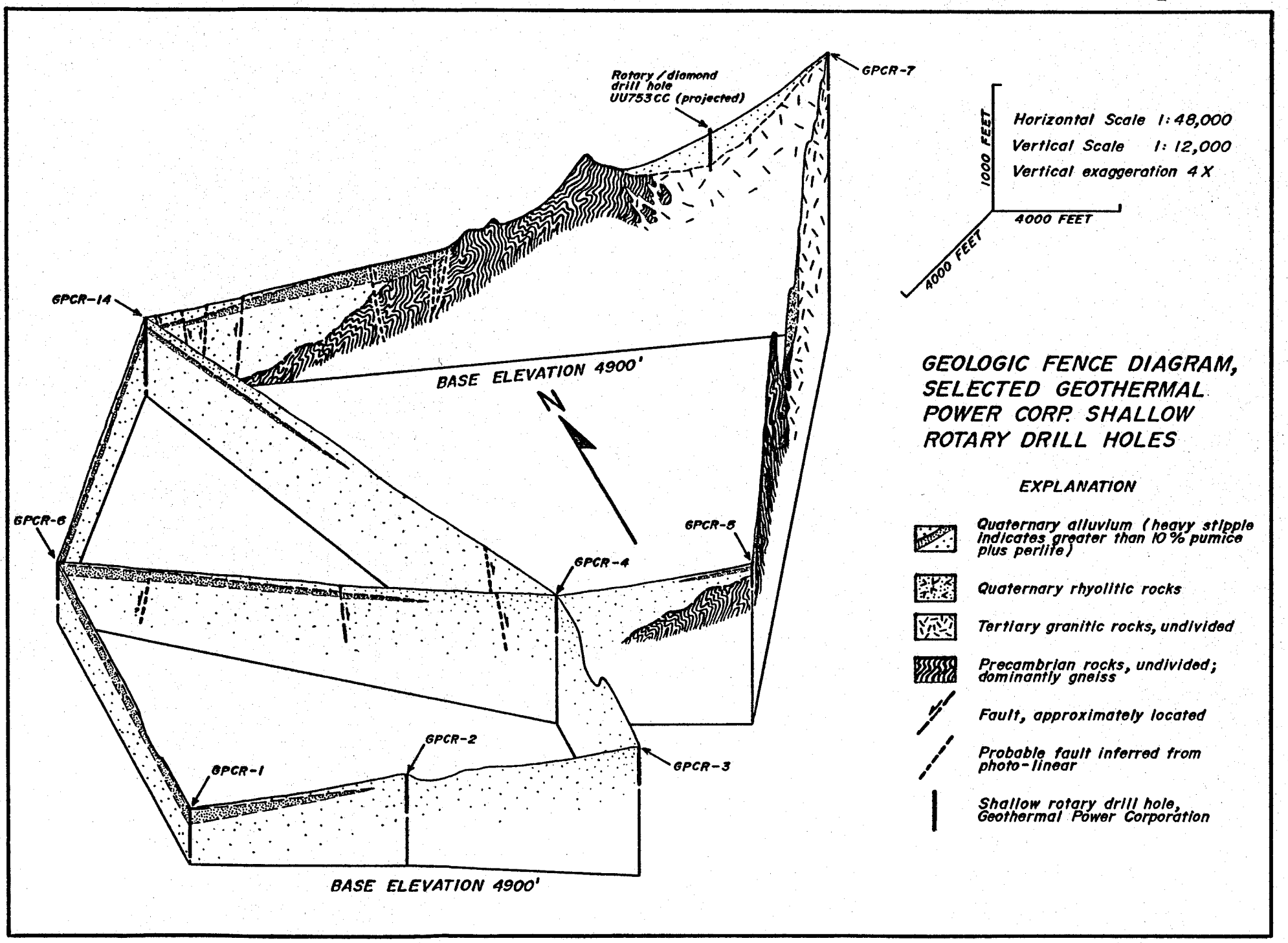
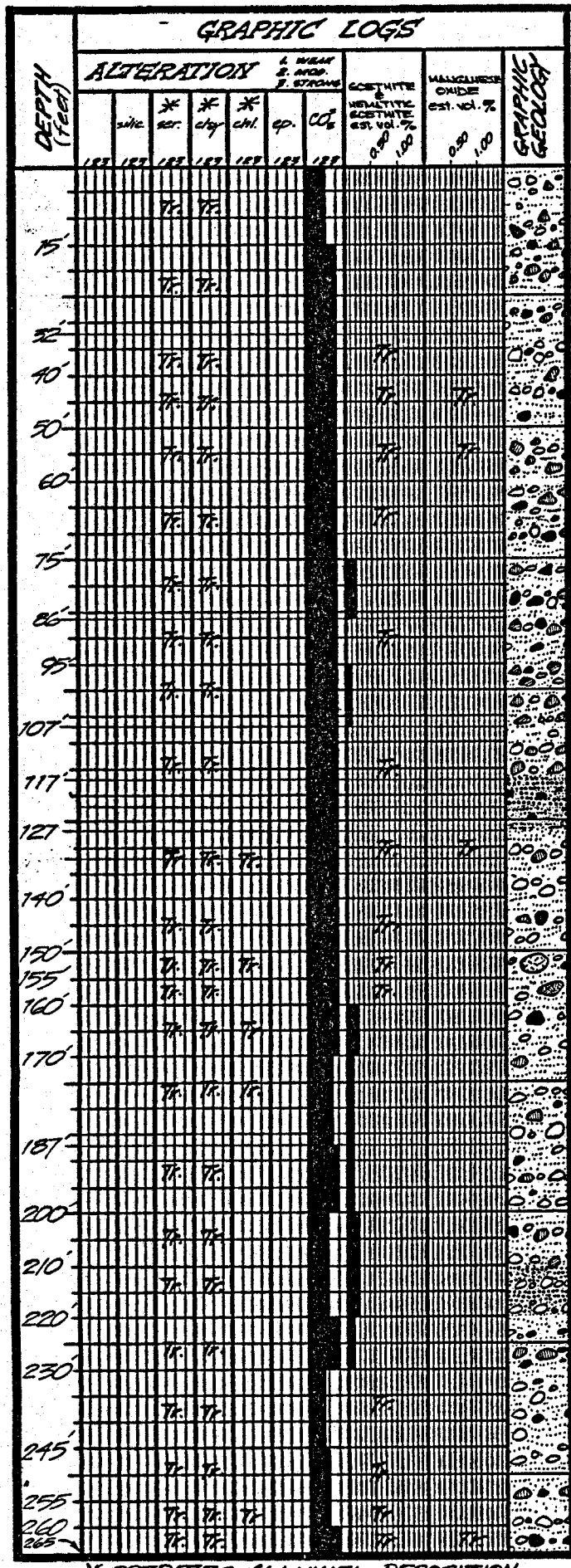

Rotary / diamond drill hole UU753CC (projected)
GPCR-7
GPCR-14
GPCR-6
GPCR-5
GPCR-4
GPCR-2
GPCR-1
GPCR-3
BASE ELEVATION 4900'
BASE ELEVATION 4900'
N
1000 FEET
4000 FEET
4000 FEET
Horizontal Scale 1:48,000
Vertical Scale 1:12,000
Vertical exaggeration 4X
GEOLOGIC FENCE DIAGRAM, SELECTED GEOTHERMAL POWER CORP. SHALLOW ROTARY DRILL HOLES
EXPLANATION
Quaternary alluvium (heavy stipple indicates greater than 10% pumice plus perlite)
Quaternary rhyolitic rocks
Tertiary granitic rocks, undivided
Precambrian rocks, undivided; dominantly gneiss
Fault, approximately located
Probable fault inferred from photo-linear
Shallow rotary drill hole, Geothermal Power Corporation

FIGURE 3

APPENDIX 1.

Geologic Logs (Lithology, Alteration and Mineralization), Geothermal Power Corporation Shallow Rotary Drill Holes (GPCR-1 through 14-18).



Refer to accompanying lithologic composition sheet for percentages of rock types in individual samples.

DESCRIPTIONS

logged by J. Hulen

0-155' CALCAREOUS ARKOSIC ALLUVIUM, SUBROUNDED TO ANGULAR GRAINS OF HBL-BTE- ± BTE QTZ MONZONITE W/ SUBORDINATE RHYOLITE, RHYOLITE PORPHYRY, PUMICE, PERLITE ± TRACES OF OTHER ROCK TYPES. GRAINS RANGE IN SIZE FROM <0.1 mm TO 15 mm., W/ AVG. n 2 mm. QTZ MONZ. CONSISTS OF QTZ, K-FELDSPAR, PLAG, BTE (Tr.–1%), HBL (0–0.5%), MAGNETITE (<0.1–1%), SPHENE (Tr–1%), ± Tr. ZIRCON. RHYOLITE MAY CARRY UP TO 1% BTE, 1% MAGNETITE

ALTERATION: CALCITE OCCURS AS IRREG. FRAGMENTS, AS IRREG. FILMS ± CRUSTS ON INDIVIDUAL GRAINS, AND AS CEMENT BINDING TWO OR MORE GRAINS TOGETHER. IT OCCURS AS A DENSE TO POROUS, LT. BUFF-COLORED, CRYPTOCRYSTALLINE MATERIAL APPARENTLY INCORPORATING DETRITAL CLAY & SILT PARTICLES. FELDSPARS ARE COMMONLY SOMEWHAT CLOUDY PROBABLY DUE TO TRACES OF CLAY ± SERICITE — THIS ALMOST CERTAINLY PREDATES ALLUVIAL DEPOSITION: GRAINS SO ALTERED COMMONLY SUBROUNDED & WEATHERED (ALSO, ONLY QTZ. MONZ. FSPS. ARE SO ALTERED W RHYS & PUMICE ARE FRESH). MAFICS GEN. FRESH BUT MAY BE LOCALLY WEAKLY CHLORITIZED. SPHENE GENERALLY FRESH, LOCALLY PARTIALLY ALTERED TO LEUCOXENE.

Mineralization: goethite and hematitic goethite occur as irregular films and crusts and commonly botryoidal clots adhering to individual grains and as cement binding two or more grains together. This material ranges from powdery through resinous, the latter dark brown in color... commonly associated w/ magnetic fragments. Also occurs as a light stain in and around mafic minerals. This iron oxide may be derived wholly or in part from rusting of steel lids on mason jars in which the samples were originally stored.

(117-127') MODERATELY WELL-SORTED GRAVELLY SAND W/ n 2-3% DETRITAL MAGNETITE, n ½% DETRITAL SPHENE. SAND GRAINS COMMONLY WELL-ROUNDED

(140') SEVERAL BANDED CALCITE TABULAR FRAGMENTS — PROBABLY FROM VEINS

155-400' CALCAREOUS ARKOSIC ALLUVIUM

* PREDATES ALLUVIAL DEPOSITION

next page →

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 1
CHIP LOG Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA

logged by J. Hulen

GRAPHIC LOGS

ALTERATION 1. WEAK 2. MOD. 3. STRONG

DEPTH (feet)		silic.	* ser.	* clay	* chl.	ep.	CO_3	GOETHITE & HEMATITIC GOETHITE est. vol. % 0.50 1.00	MAGNETITE OXIDE est. vol. % 0.50 1.00	GRAPHIC GEOLOGY
	183	183	183	183	183	183	183			
265'			Tr.	Tr.	Tr.					
275'			Tr.	Tr.	Tr.			Tr.		
285'			Tr.	Tr.	Tr.			Tr.		
295'			Tr.	Tr.	Tr.					
305'			Tr.	Tr.	Tr.					
315'			Tr.	Tr.	Tr.			Tr.		
325'			Tr.	Tr.	Tr.			Tr.		
335'			Tr.	Tr.	Tr.				Tr.	
345'			Tr.	Tr.	Tr.					
350'			Tr.	Tr.	Tr.			Tr.		
365'			Tr.	Tr.	Tr.			Tr.		
380'			Tr.	Tr.	Tr.			Tr.		
390'			Tr.	Tr.	Tr.			Tr.		
400'										

DESCRIPTIONS

155-400' CONT'D. ... CALCAREOUS ARKOSIC ALLUVIUM, SAME AS 0-155', EXCEPT LESS RHYOLITE, PUMICE, PERLITE (265-400'); 1-3% APHANITIC TO MICROXLINE ΦTZ-CHL (± FSP, SER.) ROCK SOME OF WHICH MAY BE A VOLCANIC (PROPYLITIZED) & SOME OF WHICH MAY BE METAMORPHIC (HORNFELS) (BELOW 265'); Tr-1? APHANITIC ΦTZ-HEMATITE GRAINS, DETRITAL, SUBROUNDED TO ROUNDED. THESE MAY BE DERIVED FROM RHYOLITE, MUCH OF WHICH IS IRREGULARLY STAINED W/ REDDISH HEM. BELOW 265'

ALTERATION: SAME AS 0-155' — STRONG CALCITE AS CRUSTS, FILMS, GRAINS & CEMENT; WK. CLAY-SERICITIZATION OF FSPS. (PREDATING ALLUVIAL DEPOSITION), Tr. CHL./MAFICS (LOCALLY); LOCAL LEUCOXENE/SPHENE.

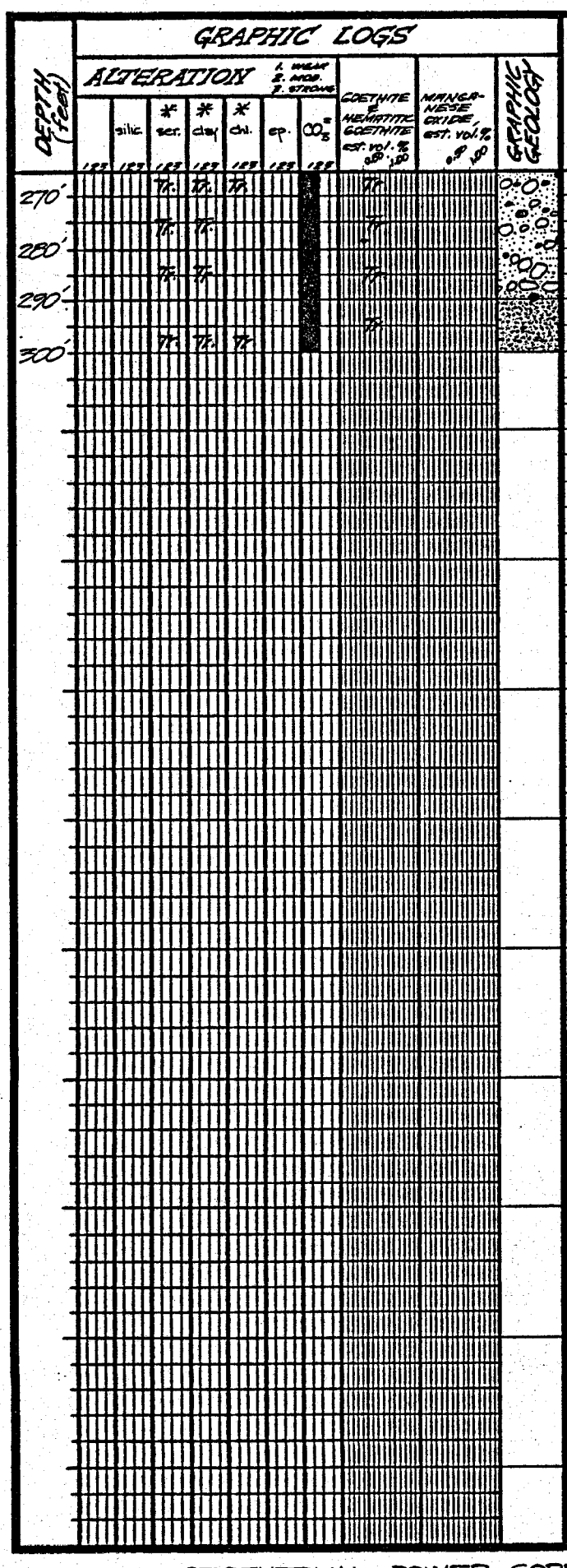
(220-230'): CALCITE CRUST ON ONE FRAGMENT HAS DISCONTINUOUS SELVAGE OF DISS. HEMATITE

210-220', 380-390': GRAVELLY SAND LAYER W/ ABUNDANT DETRITAL MAGNETITE & SPHENE.

⊛Note: Mineralization 155-400' same as 0-155'

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No 1
CHIP LOG Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA

* predates alluvial deposition



Refer to accompanying lithologic composition sheet for percentages of rock types in individual samples.

DESCRIPTIONS

logged by J. Hulen

Mineralization: goethite and hematitic goethite sporadically present throughout hole, primarily as powdery to resinous films and crusts and commonly botryoidal clots adhering to individual fragments and grains and as cement binding two or more grains together — also as a stain in and around mafic minerals. This iron oxide may be derived wholly or in part from rusting of steel lids on mason jars in which the samples were originally stored. Manganese oxide occurs in widely scattered samples as irregular or dendritic films on individual grains, except between 90' & 100', where it occurs as irreg. patches of dark stain only in rhyolite fragments.

ADDITIONAL NOTES: SINCE ANY ALTERATION OBSERVED IN THIS HOLE IS CONFINED TO NON-RHYOLITIC RX, THE ALTN. IS ALMOST CERTAINLY INHERITED FROM SOURCE OUTCROPS. ADDITIONAL EVIDENCE FOR THIS IS THE FACT THAT MANY WEAKLY CLAY-SERICITIZED GRAINS ARE SMOOTH, WELL-ROUNDED, & WEATHERED.

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 2
CHIP LOG Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA

* PREDATES ALLUVIAL DEPOSITION

DEPTH (feet)	HBL.-BTE. & BTE. QTZ. MONZ & INDIVIDUAL XL. FRAGS & GRAINS OF QTZ, K-FELDSPAR, PLAG., HBL. BTE., SPHENE, MAGNETITE.	FINE-XLINE. LEUCOCRATIC GRANITE	FINE-XLINE. BTE.-HBL. GRANODIORITE GNEISS (?)	APLITE & APLITE PORPHYRY		BIOTITE SCHIST & GNEISS	BIOTITE-SERICITE-SILLIMANITE SCHIST	RHYOLITE, RHYOLITE PORPHYRY & SMOKY QTZ. PHENOCRYSTS	PERLITE, PUMICE, OBSIDIAN		DACITE & ANDESITE & PORPHYRITIC EQUIVALENTS	DETRITAL APHANITIC QTZ.-HEMATITE GRAINS	APHANITIC QTZ.-CHL. ROCK (MYLONITE)	MICROBRECCIA	SLICKENSIDED CHL. SER. QTZ. CHIPS (fl. microflts.)
15'	90							5	5		Tr.				
32'	69	1	Tr.					10	20		Tr.			Tr.	
40'	81	Tr.	Tr.					7	12						
50'	85							5	10						
60'	53							7	40						
75'	60		Tr.				Tr.	10	30						
86'	78		Tr.				Tr.	15	7						
95'	70							20	10						
107'	63							12	25						
117'	71		Tr.					7	22						
127'	79		Tr.					12	9						
140'	84			1				6	9						
150'	91			1				1	7				Tr.		
155	80		7	tr.				4	9						1
160	85		1					7	7						
170'	89		3					3	5						
187'	85		Tr.	2				10	3						
200'	88			Tr.				5	7				Tr.		
210'	96							1	3				Tr.		
220'	97		Tr.					2	1				Tr.		
230'	85					Tr.		12	3?						
245'	90		Tr.					5	5				Tr. (w/ epidote)		
255'	94					1		5	Tr.				Tr.		
260'	96							3	1						
265'	98							1	1						
275'	93		Tr.			1		3	1			1	1		
285'	96		Tr.	1		2		1	Tr.			Tr.	Tr.		
295'	85			1				10	1			Tr.	3		
305'	88		Tr.	Tr.		1	Tr.	7	Tr.			1	3		
315'	87		2	Tr.		Tr.		7	Tr.			1	3		
325'	87		Tr.					10	2				1		
335'	88		Tr.			Tr.		7	3				2		
345'	87		1	Tr.		Tr.		7	2				3		
350'	83		2			Tr.		10	1			1	3		
365'	87		Tr.	Tr.				12	Tr.				1		
380'	98							1					1		
390'	91		Tr.					7				1	1		
400'	97		Tr.					2				Tr.	1		

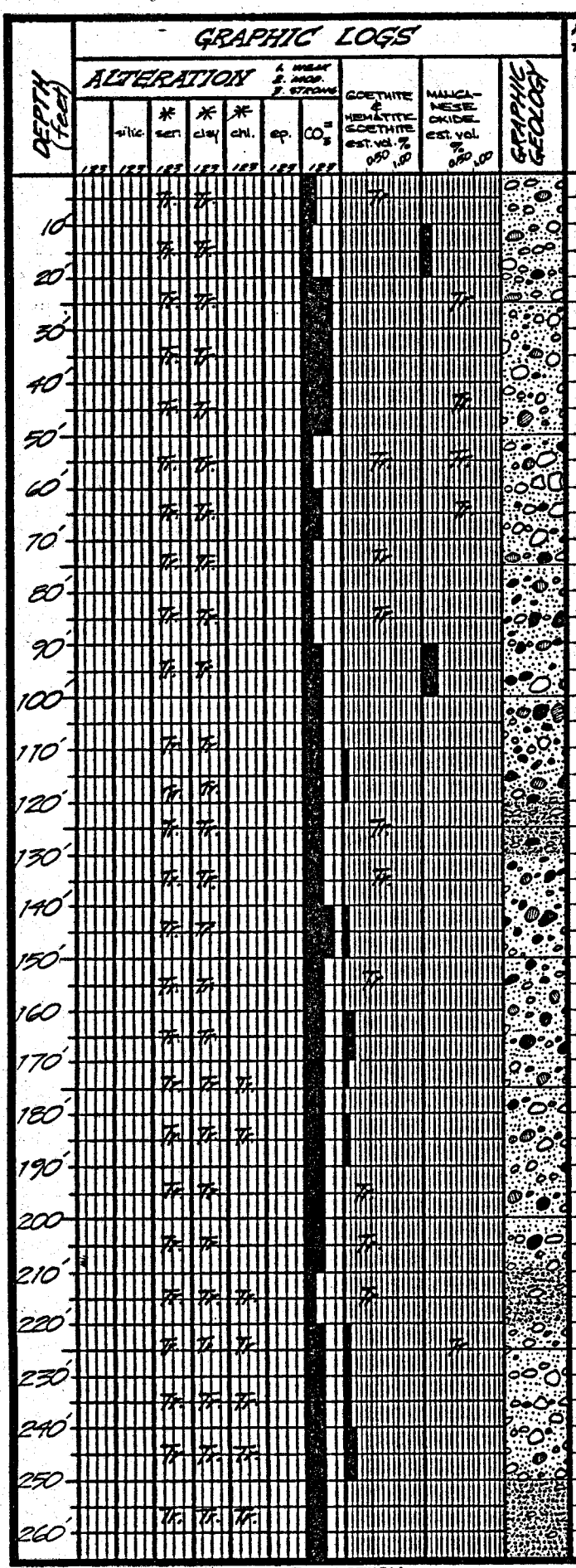
LITHOLOGY, ESTIMATED VOLUME PER CENT — logged by J. Hulen

ROOSEVELT HOT SPRINGS KGRA

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 1

ESTIMATED LITHOLOGIC COMPOSITION OF INDIVIDUAL SAMPLES

Binocular Microscopic Examination



Refer to accompanying lithologic composition sheet for percentages of rock types in individual samples.

DESCRIPTIONS

logged by J. Hulen

0-300' CALCAREOUS ARKOSIC & ARKOSIC-RHYOLITIC ALLUVIUM. SUB-ROUNDED TO ANGULAR GRAINS FROM <0.01 mm TO 15 mm. (AVG. 2 mm.) IN MAXIMUM DIMENSION. ARKOSIC COMPONENT CONSISTS OF HBL.-BTE.- & BTE. QTZ. MONZ. & INDIVIDUAL FRAGS. & GRAINS OF QTZ, K-SPAR, PLAG, BTE, HBL, SPHENE, MAGNETITE, POSSIBLY ILMENITE. QTZ. MONZ. IS MED.-CRS.-XLINE W/ 0-2% BTE, 0-1% HBL, 0-2% MAGNETITE, 0-0.5% SPHENE, TR. ZIRCON. RHYOLITIC COMPONENT OF ALLUVIUM CONSISTS OF RHYOLITE, PORPHYRITIC RHYOLITE, PUMICE, PERLITE & OBSIDIAN. PPYTIC RHYOLITE CONTAINS 1% 1-2 mm. ANHED. QTZ. PHENOS, 1% 1-3 mm. SUBHEDRAL SANIDINE PHENOS. (COMMONLY STUBBY LATH-SHAPED & CHATOYANT): RHY & PPYTIC. RHYOLITE CONTAIN TR.-0.5% 0.5 mm. EUH. BTE. PHENOCRYSTS & TRACES IN SOME FRAGS. OF 1.5X0.1 mm. (MAX.) EUH. DK. GRAY-GREEN NEEDLE-LIKE MINRL. (AMPHIBOLE) — also UP TO 0.5% DISS. MAGNETITE-ILMENITE.
(0-70'): 3-12% RHYOLITIC COMPONENT
(70-170'): 24-53% " "
(170-300'): 1-15% " "
(120-130', 210-220', 250-270', 290-300'): MODERATELY WELL SORTED GRAVELLY SAND W/ ABUNDANT SUBROUNDED-ROUNDED QTZ. GRAINS, 1-2% DETRITAL MAGNETITE, -ILMENITE.
ALTERATION: CALCITE OCCURS THROUGHOUT HOLE AS LIGHT BUFF CRYPTOCRYSTALLINE MATERIAL APPARENTLY INTERGROWN WITH CLAY & SILT-SIZE PARTICLES — AS IRREG. CRUSTS & FILMS ADHERING TO GRAINS. ESPS. THROUGHOUT HOLE ARE SOMEWHAT CLOUDY, PROBABLY DUE TO TRACES OF CLAY & SER. (*NOTE: THIS REFERS ONLY TO QTZ. MONZ. ESPS. — RHYOLITIC SANIDINE IS ABSOLUTELY FRESH) BTE. & HBL. ARE GEN. FRESH-(N) QTZ. MONZ., BUT MAY BE LOCALLY WEAKLY CHLORITIZED. MAFICS IN APHANITIC QTZ.-CHL. ROCK ARE TOTALLY CHLORITIZED. SPHENE IS GENERALLY FRESH, BUT MAY BE LOCALLY ALTERED IN PART TO LEUCOXENE.

Mineralization next page →

* PREDATES ALLUVIAL DEPOSITION

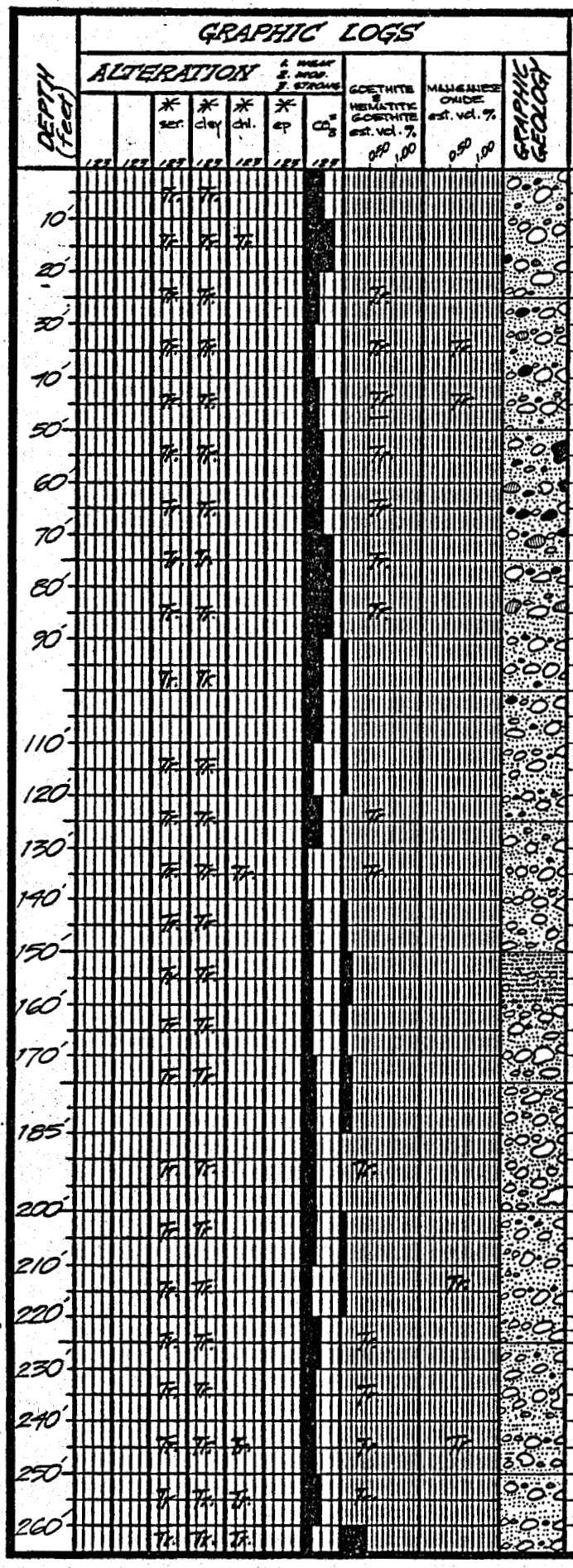
GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 2
CHIP LOG Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KERA

ULRI-ESL

LITHOLOGY, ESTIMATED VOLUME PER CENT — logged by J. Hulen

DEPTH (feet)	HBL.-BTE.- & BTE. QTZ. MONZ. & INDIVIDUAL XL. FRAGS. & GRAINS OF QTZ, FSP, BTE., HBL., MAGNETITE, SPHENE		FINE-XLINE BTE.-HBL. GRD. GNEISS (2-20? MMFOS	APLITE, APLITE PEGMATITE		BIOTITE SCHIST & GNEISS		RHYOLITE & ROMANITE & PYOLITE	PUMICE, PERLITE, OBSIDIAN		ANDESITE & PORPHYRITE SCORIA		APHANITIC GTZ-CHL. ROCK (HYALOMELANE)		
10'	97							3							
20'	99							1	Tr.						
30'	95							2	3						
40'	92							3	5						
50'	90							3	7						
60'	88			Tr.				5	7						
70'	90		1	1				5	3						
80'	99		Tr.	1		Tr.		45	5		1.?				
90'	45		1	1				50	3						
100'	72			1				25	2						
110'	51		Tr.	1				45	3						
120'	73		2	1				20	4						
130'	79							20	1						
140'	65		Tr.	Tr.		Tr.		30	5						
150	47			Tr.				50	3						
160'	47			Tr.		Tr.		50	3						
170'	62							37	3						
180'	84		1	Tr.		Tr.		10	5				Tr.		
190'	92		Tr.	Tr.				5	3				Tr.		
200'	85		Tr.	Tr.				10	5						
210'	86							12	2						
220'	93		1	Tr.		1		3	1				1		
230'	96		1	Tr.				2	1				Tr.		
240'	93		2	Tr.				2	2				1		
250'	97							2	1				Tr.		
270'	96			Tr.		Tr.		2	2				Tr.		
280	98							1	1						
290'	98							1	1						
300'	99							1	Tr.				Tr.		

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 2
ESTIMATED LITHOLOGIC COMPOSITION OF INDIVIDUAL SAMPLES
Binocular Microscopic Examination



Refer to accompanying lithologic composition sheet for percentages of rock types in individual samples.

DESCRIPTIONS

Logged by J. Hulen

0-300' CALCAREOUS ARKOSIC ALLUVIUM. GRAINS SUBROUNDED TO ANGULAR, FROM < 0.1 mm. TO 10 mm. (AVG. 2-3 mm) IN MAXIMUM DIMENSION. DOMINATED BY LEUCOCRATIC QTZ. MONZONITE & INDIVIDUAL XL. FRAGS. & GRAINS OF QTZ, KSPAR, PLAG, BTE, HBL, SPHENE, MAGNETITE/ILMENITE. QTZ. MONZ. IS MED-CRS.-XLINE W/ (LOCALLY) tr. HBL., tr-0.5% BTE, tr. 0.5% SPHENE, 0-2% MAGNETITE/ILMENITE, LOCAL TR. ZIRCON. ROCK MAY BE GRANITE RATHER THAN QTZ. MONZ.

(50-80'): PRONOUNCED INCREASE IN % RHYOLITE, PUMICE, PERLITE IN SAMPLE.

(150-160', 280-300'): WELL-SORTED MED-CRS. SAND W/ ANOMALOUS % QTZ. GRAINS & DETRITAL MAGNETITE/ILMENITE

ALTERATION: WK-MOD. CALCITE THROUGHOUT HOLE AS LIGHT BUFF-COLORED CRYPTOCRYSTALLINE MATERIAL APPARENTLY INTERGROWN WITH CLAY & SILT-SIZE PARTICLES. $CO_3^=$ OCCURS AS IRREGULAR CRUSTS & FILMS ADHERING TO INDIVIDUAL GRAINS & AS CEMENT BINDING TWO OR MORE GRAINS TOGETHER. FELDSPARS THROUGHOUT HOLE ARE SOMEWHAT CLOUDY, PROBABLY DUE TO WK. CLAY-SERICITIZATION (NOTE: ESPS. IN RHYOLITE ARE FRESH). BTE FRESH TO LOCALLY CHLORITIZED. HBL INVARIABLY PARTIALLY CHLORITIZED. SPHENE FRESH TO PARTIALLY ALTERED TO LEUCOXENE. ALTERATION (EXCEPT CALCITE CEMENT) PREDATES ALLUVIAL DEPOSITION: IN SAME SAMPLE, RHYOLITE FRAGS. ARE FRESH, QTZ. MONZ. ALTERED; IN ADDITION, MANY ALTERED QTZ. MONZ. GRAIN ARE WEATHERED & PARTIALLY COVERED WITH A FINE GRAY-BROWN FILM.

Mineralization: (FeOH) Goethite and hematitic goethite sporadically present throughout hole, primarily as powdery to resinous films, crusts and clots (commonly botryoidal) adhering to individual fragments & grains

continued next page →

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 3
CHIP LOG, Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA

* predates alluvial deposition

GRAPHIC LOGS

ALTERATION (1. WEAK 2. MOD. 3. STRONG)

DEPTH (Feet)	* ser.	* clay	* chl.	* ep	$CO_3^=$	GOETHITE & HEMATITE & GOETHITE est. vol. % (0.0 – 1.00)	MANGANESE OXIDE, est. vol. % (0.0 – 1.00)	GRAPHIC GEOLOGY
265'	Tr.	Tr.	Tr.					
280'	Tr.	Tr.						
290'	Tr.	Tr.	Tr.	Tr.			Tr.	
300'								

Refer to accompanying lithologic composition sheet for percentages of rock types in individual samples

DESCRIPTIONS

logged by J. Huleh

and as cement binding two or more of these grains together. FeOx also occurs as a stain in and around mafic minerals. FeOx may be derived wholly or in part from rusting of steel lids on mason jars in which samples were originally stored — also from rusting of magnetic frags (many of the botryoidal FeOx dots have partially rusted magnetic fragments within). Trace MnOx in widely scattered samples as irregular or dendritic films on individual grains & fragments — locally also on $CO_3^=$ cement, suggesting it is at least partially post-alluvial in origin.

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 3
CHIP LOG Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA

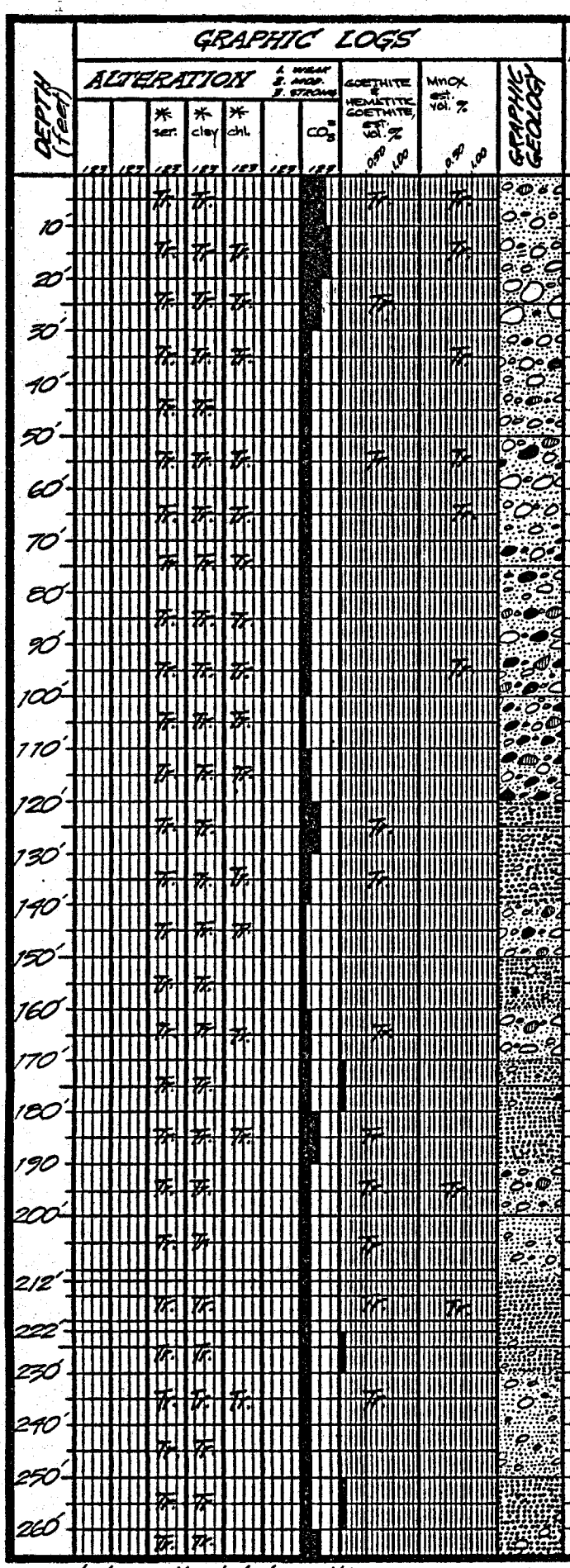
* predates alluvial deposition

LLLRI-ESL
Logged by J. Hulen

DEPTH (Feet)	LITHOLOGY, ESTIMATED VOLUME PER CENT HBL. BTE. QTZ. MONZ. & INDIVIDUAL XL. FRAGS. & GRAINS OF QTZ, KSPAR, PLAG, BTE., HBL., SPHENE, MAGNETITE, TR. ZIRCON		FINE-XLINE BTE.-HBL. GRD. GNEISS	APLITE APLITE PORPHYRY		BIOTITE SCHIST & GNEISS		RHYOLITE & PORPHYRITIC RHYOLITE	PUMICE, PERLITE, OBSIDIAN	FELSIC TUFF					
10'	98							2	Tr.	Tr.					
20'	96		Tr.	2				2	Tr.						
30'	91		1	2				5	1						
40'	93		1	1				2	3						
50'	95		Tr.	1				3	1						
60'	86		Tr.	Tr.		Tr.		12	2						
70'	60		1	1				35	3						
80'	84		Tr.	1				10	5						
90'	91		Tr.			Tr.		7	2						
110'	92			1				7	1						
120'	90		Tr.	Tr.				9	1						
130'	92			Tr.		Tr.		7	1						
140'	100		Tr.	Tr.		Tr.		Tr.	Tr.						
150'	100		Tr.	Tr.											
160'	97		1	1				2	Tr.						
170'	96		1	1		Tr.		1	1						
185'	100			Tr.				Tr.	Tr.						
200'	99		Tr.					1							
210'	98							1	1						
220'	98		1					1	Tr.						
230'	99		1					Tr.							
240'	99		1	Tr.		Tr.		Tr.							
250'	99		Tr.	Tr		Tr.		1	Tr.						
260'	97		2	Tr.		Tr.		1							
267'	98		2	Tr.		Tr.		Tr.							
280'	100		Tr.					Tr.							
290'	100		Tr.					Tr.							
300'	100		Tr.	Tr.		Tr.									

ROOSEVELT HOT SPRINGS KGRA

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR NO. 3
ESTIMATED LITHOLOGIC COMPOSITION OF INDIVIDUAL SAMPLES
Binocular Microscopic Examination



Refer to attached lithologic composition sheet for percentages of rock types in individual samples.

DESCRIPTIONS

logged by J. Hulen

0-300' CALCAREOUS ARKOSIC ALLUVIUM AND CALCAREOUS ARKOSIC-RHYOLITIC ALLUVIUM. SUBROUNDED TO ANGULAR GRAINS FROM < 0.1 - 10 mm. MAXIMUM DIMENSION. ARKOSIC COMPONENT CONSISTS OF BTE-HBL. QTZ. MONZONITE & INDIVIDUAL FRAGMENTS & GRAINS OF ITS CRYSTAL CONSTITUENTS, WHICH COMPRISE QTZ, KSPAR, PLAG, BTE, HBL., SPHENE, MAGNETITE/ILMENITE. QTZ. MONZ IS MED.-CRS.-XLINE W/ tr.-1.5% BTE, 0.5-1.5% HBL, tr-0.05% SPHENE, tr-1.5% MAGNETITE/ILMENITE. RHYOLITIC COMPONENT OF ALLUVIUM CONSISTS OF RHYOLITE, PORPHYRITIC RHYOLITE, PUMICE, PERLITE & OBSIDIAN.

(90-140'): RHYOLITIC COMPONENT ACCOUNTS FOR ≥ 20% OF SAMPLE.

(120-140', 150-160', 170-190', 212-230', 250-260', 260-290??): MOD WELL SORTED, SLIGHTLY GRAVELLY MED.-CRS. SAND IN WHICH SUBROUNDED QTZ. GRAINS & DETRITAL INDIVIDUAL GRAINS OF MAGNETITE/ILMENITE AND SPHENE ARE ANOMALOUSLY ABUNDANT

ALTERATION: CALCITE DISTRIBUTED THROUGHOUT HOLE AS LIGHT BUFF CRYPTOCRYSTALLINE MATERIAL PROBABLY INTERGROWN WITH DETRITAL CLAY & SILT-SIZE PARTICLES— AS IRREGULAR CRUSTS & FILMS ADHERING TO INDIVIDUAL GRAINS AND AS CEMENT BINDING TWO OR MORE GRAINS TOGETHER. FSPS. IN OR DERIVED FROM QTZ. MONZ. ARE CLOUDED BY TRACES OF CLAY-SER. (RHYOLITIC SANIDINE IS FRESH). MAFICS MAY BE LOCALLY CHLORITIZED, BUT ARE GENERALLY FRESH. SPHENE FRESH TO LOCALLY PARTIALLY ALTERED TO LEUCOXENE.

Mineralization: FeOx (goethite and hematitic goethite sporadically present throughout hole, primarily as powdery to resinous films and crusts

cont'd. next page →

* predates alluvial deposition

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 9
CHIP LOG Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA

GRAPHIC LOGS

DEPTH (Feet)

ALTERATION — 1. WEAK 2. MOD. 3. STRONG

* ser.	* clay	* chl.		$CO_3^=$
123	123	123	123	123

GOETHITE & HEMATITE & GOETHITE, est. vol. % 0.50 1.50

MnOx est. vol. % 0.50 1.00

GRAPHIC GEOLOGY

Refer to attached lithologic composition sheet for percentages of rock types in individual samples.

DESCRIPTIONS

logged by J. Hulen

CHIP SAMPLES 240-290'

290'

300'

and commonly botryoidal clots adhering to individual grains & fragments and as cement binding two or more of these together — also rarely as a stain in and around mafic minerals. FeOx clots commonly have partially oxidized magnetic cores. FeOx may also be derived partially from rusting of steel lids on mason jars in which samples were originally stored. Local traces dark brownish-gray MnOx as irregular or dendritic crusts & films on individual grains

* predates alluvial deposition

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 4
CHIP LOG Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA

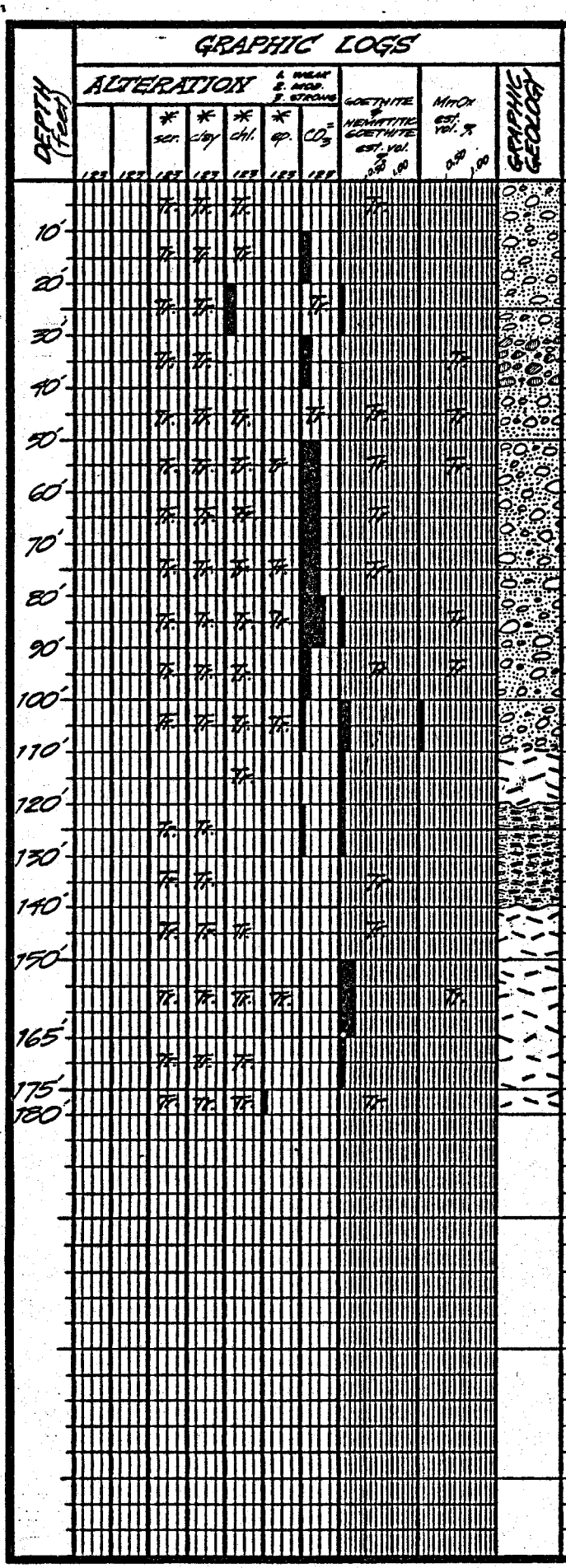
UURI-ESL

LITHOLOGY, ESTIMATED VOLUME PER CENT — Logged by J. Hulen

DEPTH (Feet)	HBL.–BTE. QTZ. MONZ. & INDIVIDUAL XL. FRAGS OF QTZ., KSPAR, PLAG., BTE., HBL., SPHENE, MAGNETITE/ILMENITE	FINE-XLINE LEUCOCRATIC GRANITE	FINE-XLINE BTE.–HBL. GRANODIORITE GNEISS			BIOTITE SCHIST & GNEISS	BIOTITE SILLIMANITE SCHIST	RHYOLITE & PORPHYRITIC RHYOLITE	PERLITE, PUMICE, OBSIDIAN						
10'	98					Tr.		Tr.	2						
20'	98					Tr.		1	1						
30'	86		5			1?		7	1						
40'	86	1	3			1?		7	2						
50'	90		2			1		4	3						
60'	88		2			Tr.		9	1						
70'	88	2	3			1		5	1						
80'	80	4	3			1		10	2						
90'	81	3	1			2		10	3						
100'	68	2	3			2		22	3						
110'	54	1	2			1		37	5						
120'	55		1			2		35	7						
130'	80		Tr.			Tr.		11	9						
140'	71	1	1			2		16	0						
150'	84	Tr.	1			1		10	4						
160'	81	Tr.	1			1?		8	9						
170'	90		1			1		3	5						
180'	93		Tr.			Tr.		2	5						
190'	88		Tr.			Tr.		3	9?						
200'	88		1			1		5	5?						
212'	84		Tr.			Tr.		7	9						
222'	95							Tr.	5						
230'	96		Tr.			1		1	2						
240'	100					Tr.		Tr.	Tr.						
250'	96		1?			3		Tr.	Tr.						
260'	97		1?			1		1							
290'	96		Tr.			1		Tr.	3						
300'	97		Tr.			Tr.	Tr.	2	1						

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 4
ESTIMATED LITHOLOGIC COMPOSITION OF INDIVIDUAL SAMPLES
Binocular Microscopic Examination

ROOSEVELT HOT SPRINGS KGRA



Refer to accompanying lithologic composition sheet for percentages of rock types in individual samples

DESCRIPTIONS

Logged by J. Hulen

0-110': ALLUVIUM. SUBROUNDED TO ANGULAR GRAINS <0.1 TO 25 mm IN MAX DIMENSION (AVG ≈ 2-3 mm). DOMINATED BY HBL-BTE BTE. MONE. & BTE.-HBL. GNEISS & INDIVIDUAL GRAINS & FRAGMENTS OF BTE, HBL., QTZ., FSP., SPHENE, & MAGNETITE-ILMENITE. GNEISS(?) CONTAINS 7-10% HBL, 1-2% BTE.

(30-40'): DISTINCTIVE PUMICE-RHYOLITE HORIZON W/ 80% PERLITE & PUMICE, 10% RHYOLITE & PORPHYRITIC RHYOLITE.

ALTERATION: CALCITE OCCURS SPORADICALLY THROUGHOUT INTERVAL AS LIGHT BLUE CRYPTOCRYSTALLINE MATERIAL APPARENTLY INTERGROWN WITH CLAY & SILT-SIZE PARTICLES. THIS MATERIAL OCCURS AS IRREGULAR FILMS & CRUSTS ADHERING TO INDIVIDUAL GRAINS AND AS CEMENT BINDING TWO OR MORE GRAINS TOGETHER. FSPS. FRESH TO V. SLIGHTLY CLOUDY. PROBABLY WEAKLY CLAY-SERICITIZED. HBL. FRESH TO PARTIALLY CHLORITIZED. BTE. FRESH IN BTE. MONE. BUT MAY BE CHLORITIZED IN SCHIST FRAGMENTS. A FEW FRAGMENTS CUT BY MICRO-VEINLETS OF QTZ-CHL. ± HEMATITE & OR EPIDOTE.

Mineralization: FeOx (goethite and hematitic goethite) occur sporadically as powdery to resinous irregular films and crusts and commonly botryoidal slabs clinging to individual grains and as a cement binding two or more grains together. Much of this material contains partially rusted (oxidized) magnetic grains. Some of the FeOx may be derived from rusting of steel lids on mason jars in which samples were originally stored. TRACES MnOx scattered throughout interval as dark, brownish-gray irregular films on grain surfaces. Magnetite in some chltzd. schist frags. partially altered to maroon hematite.

110-120': BTE-HBL. GNEISS ⟶ SAME AS FRAGS. OF SAME DESCRIBED ABOVE. MINRLZ SAME AS ABOVE EXC. NO MnOx. ALTN. SAME AS ABOVE EXCEPT NO CLAY-SER. IN FSPS. NO EP. (HBL.—)

120-140': BIOTITE-QTZ-PLAG. (+ KSP?) GNEISS, FINE-XLINE, "SALT & PEPPER" TEXTURE. 10-12% HBL., 7-10% BTE, 2% SPHENE, 1% MAGNETITE/ILMENITE. HBL. FRESH TO PARTIALLY CHLTED., BTE. FRESH, SPHENE FRESH, MAG/ILM. FRESH, FSPS. FRESH TO V.V. WKLY CLAY-SERICITIZED, LOCALLY W/ TRACES CALCITE. MINRLZ. SAME AS IN FRAGS 0-110', EXC. NO MnOx.

140-180': BTE. HBL. GNEISS ⟶ SAME AS 110-120'

(175-180') SLIGHT INCREASE IN QTZ-CHL-EP. VNLTS. & SMALL FRAGS. OF THESE VEINLETS, OTHERWISE ALTN. & MINRLZ. SAME AS 0-110'

*** CRITERIA FOR ALLUVIUM-BEDROCK CONTACT:

1. GRAINS (FRAGMENTS) BECOME MORE ANGULAR & RAGGED
2. CALCITE CEMENT DROPS OUT
3. CLAY-QTZ.-SER. ± CHL. CHIPS (SLICKENSIDED) APPEAR. THESE PROBABLY DISINTEGRATE RAPIDLY IN TRANSPORT.

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 5
CHIP LOG ⟷ Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA

* predates alluvial deposition

U.U.R.I. EARTH SCIENCE LAB

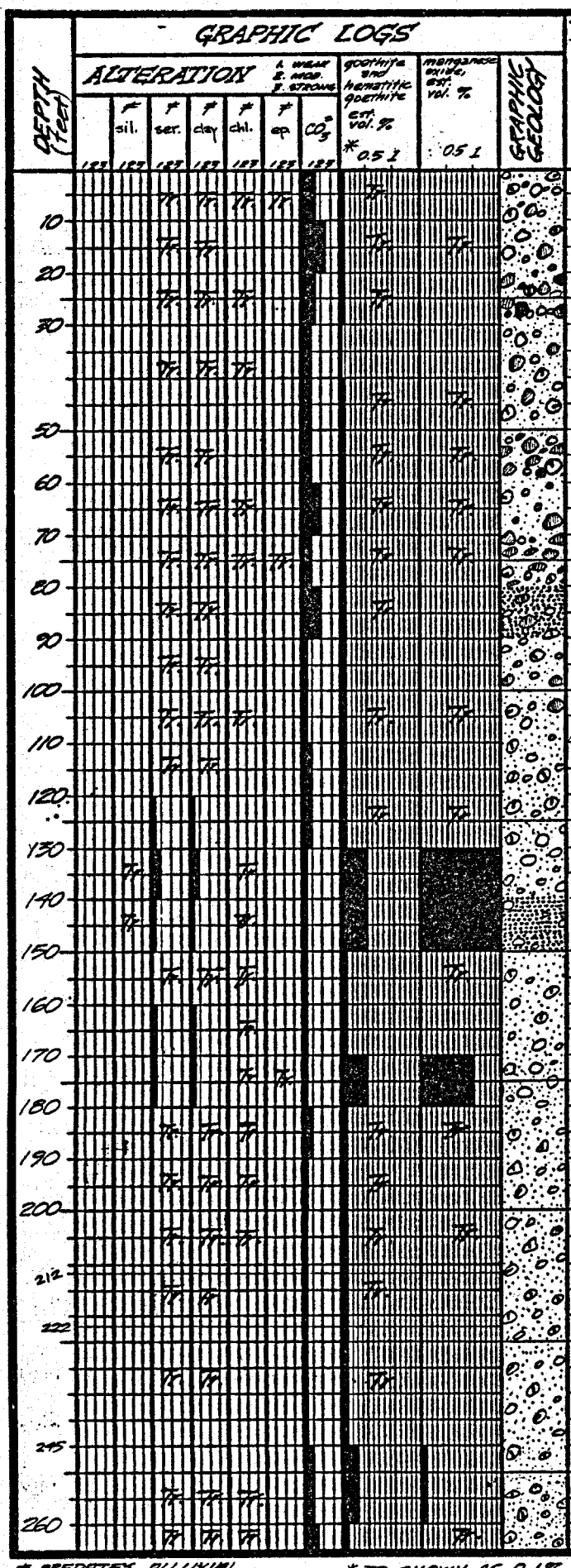
LITHOLOGY, ESTIMATED VOLUME PER CENT — Logged by J. Hulen

DEPTH (Feet)	BTE. HBL. GNEISS # HBL. BTE. QTZ. MONZ. & GRAINS & FRAGS. OF HBL, BTE, QTZ, FSP, SPHENE, & MAGNETITE-ILMENITE	MESA-CRS. XLINE BTE HBL GNEISS (?)	FINE-XLINE LEUCOCRATIC GRANITE	FINE-XLINE HBL-BTE. GRANODIORITE GNEISS	APLITE & APLITE PORPHYRY		BIOTITE SCHIST & GNEISS	BIOTITE-SILLIMANITE SCHIST & GNEISS	RHYOLITE & PORPHYRITIC RHYOLITE	PERLITE, PUMICE, OBSIDIAN			(MYLONITE)	ARGILLITIC BTE-CHL. ROCK (# HEMATITE	MICROBX.	SLICKENSIDED CLAY-BEAR-BTE CHIPS (# APHs)
10'	96		1				1		1	1						
20'	92			*1			2	5	Tr.	Tr.				Tr.		
30'	96			2	1		1		Tr.	Tr.				Tr.		
40'	10			Tr.	Tr.		Tr.		10	80						
50'	73				7				Tr.	Tr.						
60'	90		1	1	4		Tr.		3	1						
70'	91		3	Tr.	3		Tr.	Tr.	2	1						
80'	97		1		2			Tr.						Tr.		
90'	90		Tr.	1	1		1	5	1	1						
100'	92		Tr.?	Tr.	5			3	2	Tr.						
110'	91			2	3		1	2	Tr.						1	
120'		99														1
130'		15	1		Tr.		84		Tr.	Tr.						
140'		12	Tr.		Tr.		87			Tr.						1
150'		95					5									1
165'		96			1		Tr.			1						2
175'		95			Tr.		2.?									3
180'		97			2		1.?									3

* THIS IS PROBABLY A LESS FOLIATED VARIETY OF BIOTITE SCHIST

ROOSEVELT HOT SPRINGS KGRA

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No 5
ESTIMATED LITHOLOGIC COMPOSITION OF INDIVIDUAL SAMPLES
Binocular Microscopic Examination



Refer to accompanying lithologic composition sheet for percentages of rock types in individual samples.

DESCRIPTIONS

Logged by J. Hulen

0-110' SANDY GRAVEL & GRAVELLY SAND CONSISTING OF SUBRND—SUBANGULAR GRAINS & ANGULAR FRAGMENTS OF HBL-BTE QTZ MONZ AND ITS CRYSTAL CONSTITUENTS (QTZ, KFSPAR, PLAG, BTE, HBL, SPHENE, MAGNETITE) & SUBORDINATE RHYOLITE, RHYOLITE PPY, PUMICE, PERLITE, OBSIDIAN, SCHIST (BTE-SILLIMANITE-SERICITE [?])
- REFER TO ATTACHED LITHOLOGIC SHEET FOR PERCENTAGES OF VARIOUS ROCK TYPES—
QTZ. MONZ. IS MAFIC-POOR. (< 1% TOTAL MAFICS AVG.) GENERALLY UNALTERED EXC. FOR OCCASIONAL WK. CLAY-SERICITIZATION OF ISOLATED FELDSPARS; WK. CHLORITIZATION (W/GRAY-GREEN CLAY) OF HBL. CALCITE THROUGHOUT INTERVAL AS IRREG. BUFF TO LIGHT GRAY FILMS AND CRUSTS ON GRAINS AND AS CEMENT BINDING GRAINS.
80-110': Trace goethite and hematitic goethite as irreg. crusts & patches & botryoidal clots on isolated grains and as cement binding 2 or more grains
110-130': SAME AS 0-110', EXC. ALMOST ENTIRELY HBL. BTE. QTZ. MONZ. & ITS XL. CONSTITUENTS; WEAK PERVASIVE CLAY—SERICITIZATION OF FSPS. BELOW 120'
130-150': ALTERED SANDY GRAVEL & GRAVELLY SAND SAME COMP. AS 110-130, FSPS. WKLY CLAY-SERICITIZED, 0.5% goethite and hematitic goethite, same as 0-110'; 1-1.5% MnOx as discrete microcline grains, as vnlts, patches, irreg. crusts & stains; ≈0.1% discrete grains of microxline specular hematite —— note MnOx seems to be intergrown w/ a little FeOx —— HBL. THIS INTERVAL ALT TO WAXY GREENISH-GRAY CLAY, BTE APPEARS TO BE FRESH.
150-170': SAME AS 110-130'
170-180': SAME AS 130-150'
180-300': SAME AS 110-130; ALMOST ENTIRELY HBL. BTE. and BTE QTZ. MONZONITE AND INDIVIDUAL XL FRAGMENTS AND GRAINS OF KSPAR, PLAG, BTE, HBL, MAGNETITE & SPHENE— ALSO TRACES OF RHYOLITE, PUMICE, PERLITE, MELANOCRATIC HBL GRD., BIOTITE SCHIST, SILLIMANITE-BEARING SCHIST; FSPS. GENERALLY FRESH, BUT ISOLATED GRAINS MAY BE WEAKLY CLAY-SERICITIZED; BTE. GEN. FRESH, BUT A FEW GRAINS & XLS. PARTIALLY CHLORITIZED; HBL. FRESH OR PARTIALLY TO COMPLETELY ALTERED TO CHL. & WAXY GREENISH-GRAY CLAY. Note: This alteration probably predates deposition of gravels —— grains so altered are commonly subrounded with smooth weathered outer surfaces.

† PREDATES ALLUVIAL DEPOSITION

* TR. SHOWN AS 0.1% PLUS "Tr" FOR GOETHITE & HEMATITIC GOETHITE.

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR-6
CHIP LOG Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA

GRAPHIC LOGS

ALTERATION 1. WEAK 2. MOD. 3. STRONG

DEPTH (Feet)	123	123	≠ ser. 123	≠ clay 123	≠ chl. 123	≠ ep. 123	CO_3 123	goethitic and/or hematitic goethite est. vol. % * 0.5 1	manganese oxide, est. vol. % * 0.5 1	GRAPHIC GEOLOGY
270'			Tr.	Tr.	Tr.			Tr.		
			Tr.	Tr.						
280'								Tr.		
									Tr.	
290'			Tr.	Tr.	Tr.					
			Tr.	Tr.	Tr.			Tr.		
300'										

Refer to accompanying lithologic composition sheet for percentages of rock types in individual samples

DESCRIPTIONS

Logged by J. Hulen

270-290': dominantly med. coarse sand size fragments & grains

Additional notes: ① Predominant rock type in this hole is a med.-crs. xline hbl.-bte qtz. monz. w/ 4 1% total mafics overall

② 130-150' rich in detrital magnetite grains (2-3%) —— also: most of the MnOx this interval occurs as detrital grains.

≠ PREDATES DEPOSITION ALLUVIAL

* TRACE SHOWN AS 0.1% PLUS "Tr." FOR GOETHITE & HEMATITIC GOETHITE

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 6
CHIP LOG Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA

LITHOLOGY, ESTIMATED VOLUME PER CENT — Logged by J. Hulen

DEPTH (feet)	HBL. BTE. QTZ. MONZ. (<1% TOTAL MAFICS) & INDIVIDUAL XL. FRAGMENTS OF QTZ, FSP (KSP & PLAG) BTE, HBL, SPHENE, MAGNETITE				BTE.-HBL. GRANODIORITE, GNEISS	BIOTITE SCHIST & GNEISS	SILLIMANITE-BEARING SCHIST WITH BTE ± SPR.	RHYOLITE, RHYOLITE PORPHYRY	PUMICE, PERLITE	APHANITIC INTERM. VOLCANIC	FELSIC TUFF	OBSIDIAN		(?) dk. maroon & green hem. & chl.-bearing phyric aphanitic rock	
10	97							1	2						
20	95							3	2	tr	tr.				
30	41							9	50	tr.					
40															
50	78					tr.		7	15						
60	65							5	30						
70	91				tr.			7	2						
80	68							7	25			tr.			
90	73				tr.			7	20						
100	85				tr.			3	12						
110	79				tr.	tr.	3	3	15			tr.			
120	96						tr.	1	3			tr.			
130	100					tr.		tr.	tr.						
140	100					tr		tr.	tr.						
150	100					tr.		tr.	tr.						
160	97				3	tr.	tr	tr.	tr.			tr.			
170	98				2	tr.	tr.								
180	100					tr									
190	100					tr.	tr.	tr.						tr.	
200	99					tr.		1	tr.						
212	100				tr.	tr.		tr.							
222	100				tr.	tr		tr.							
245	99					tr.									
260	100				tr.	tr.?									
270	100					tr.	tr.?								
280	100				tr.	tr.?		tr.							
290	100				tr.										
300	100					tr.									

ROOSEVELT HOT SPR. KGRA

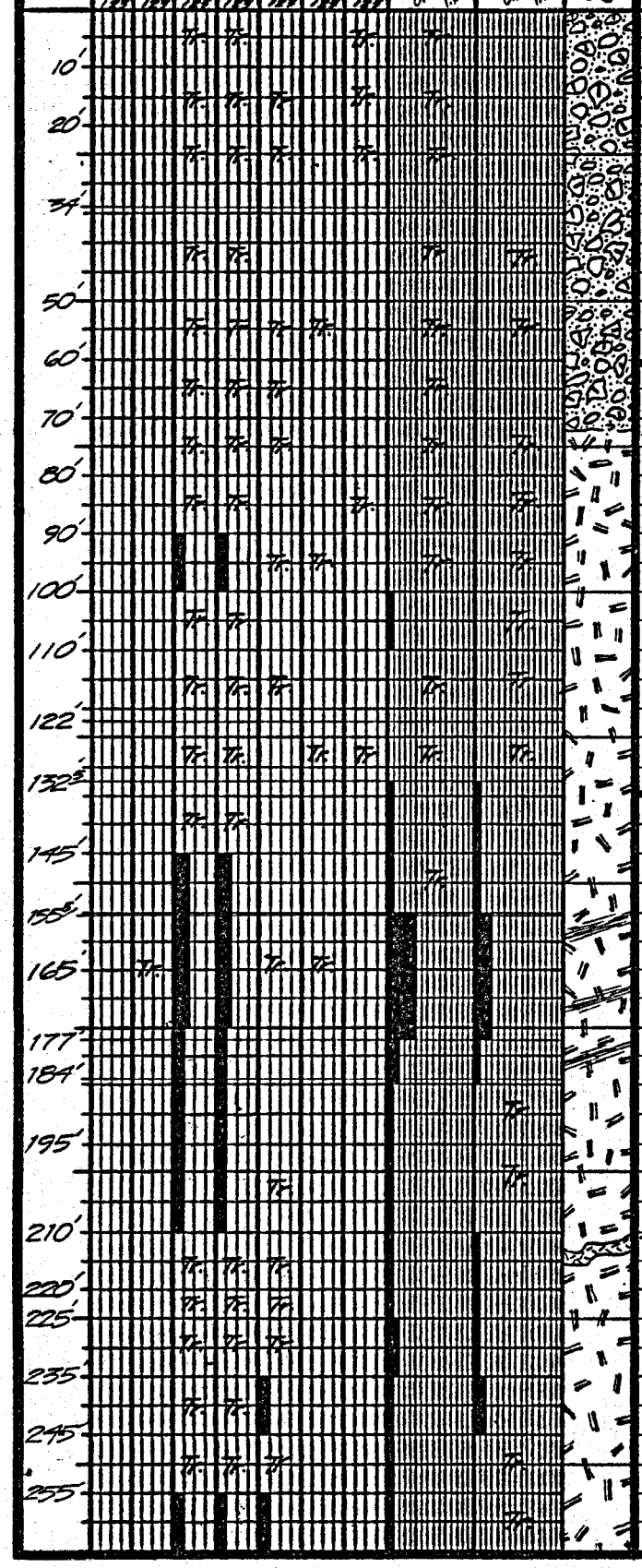
GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 6
ESTIMATED LITHOLOGIC COMPOSITION OF INDIVIDUAL SAMPLES
Binocular Microscopic Examination

GRAPHIC LOGS

Refer to accompanying lithologic composition sheet for percentages of rock types in individual samples.

logged by J. Hulen

DESCRIPTIONS



0-300' SUBANG.-ANG. CHIPS OF BIOTITE GRANITE & INDIVIDUAL XLS. OF QTZ, K-FELDSPAR, PLAGIOCLASE, BTE, HBL., MAGNETITE, SPHENE. GRANITE IS MED-CRS. XLINE W/<1-5% BTE, TR-0.5% HBL, 1-3% (AVG ≈ 0.5%) MAGNETITE, 1-2% SPHENE, TR. ZIRCON. ALL CHIPS ARE SUBANG-ANGULAR, SO HOLE PENETRATES EITHER BEDROCK OR ALLUVIUM V. CLOSE TO ITS SOURCE.

0-145' ESPS. CLOUDY, PROB DUE TO TRACES OF CLAY-SERICITE. HBL. GENERALLY PARTIALLY ALTERED TO CLAY-CHL. AGGREGATES. BTE. GENERALLY FRESH, LOCALLY ALTERED PARTIALLY TO GRAY-GREEN CHL. SPHENE GEN. FRESH, LOCALLY ALTERED TO LEUCOXENE IN PART. MAGNETITE GENERALLY FRESH, LOCALLY PARTIALLY COATED W/ HEMATITIC GOETHITE POWDER. Traces goethite and hematitic goethite throughout interval, generally as a stain in and around mafic minerals, but below 122', as resinous to powdery very rare botryoidal patches on individual grains and as cement binding one or more grains together.

Note: Probable Alluvium &/or decomposed granite to 72', below which "hard drilling" begins (Geothermal Power Co. field log)

135-145' 3% MAGNETITE

145-184' SLIGHT INCREASE IN INTENSITY OF CLAY-SERICITIZATION OF ESPS. Increase in FeOx and appearance of MnOx below 155.5'. FeOx as a stain in and around mafic minerals as powdery to resinous irregular, commonly botryoidal crusts on individual grains and as cement binding one or more grains together. MnOx as discrete microcrystalline grains, up to 3 mm. dia, as irregular microcrystalline masses replacing all fsps., qtz., & mafics, as microvnlts., as stain in and around mafic minerals — may also be intergrown w/ FeOx. SPHENE COMMONLY ALTERED TO LEUCOXENE THIS INTERVAL.

FINE XLINE HBL-BTE GNEISS

184-300' SAME ALTN. and mineralization AS 0-145', I.E. V. WK CLAY-SERICITIZATION OF ESPS., LOCAL CHLTZ. OF MAFICS, traces FeOx, local traces MnOx. SPHENE MAGNETITE ESPS. FRESH BELOW 265'.

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR NO. 7
CHIP LOG Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA

UURI—EARTH SCI. LAB

logged by J. Hulen

GRAPHIC LOGS

ALTERATION 1. WEAK 2. MOD. 3. STRONG

DEPTH (feet)	sil. 1 2 3	ser. 1 2 3	chy 1 2 3	chl. 1 2 3	ep. 1 2 3	$CO_3^=$ 1 2 3	GOETHITE & HEMATITIC GOETHITE est. vol. % 0.5 1.0	MANGANESE OXIDE est. vol. % 0.5 1	GRAPHIC GEOLOGY
275'		Tr.	Tr.	Tr.	Tr.		Tr.		
		Tr.	Tr.	Tr.			Tr.	Tr.	
286'		Tr.	Tr.				Tr.	Tr.	
295'		Tr.	Tr.	Tr.				Tr.	
300'									

DESCRIPTIONS

ADDITIONAL NOTES: POSSIBLE FAULT ZONE BETWEEN 155'–184': 1–2% MICROBRECCIA CHIPS CONSISTING OF GRANITE FRAGS. OR FRAGS. OF ITS XL. CONSTITUENTS EMBEDDED IN MATRIX OF $FeOx$ &/OR $MnOx$, PROBABLY W/ QTZ., SER, CLAY

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR NO. 7
CHIP LOG Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA

UURI—EARTH SCI. LAB

logged by J. Hulen

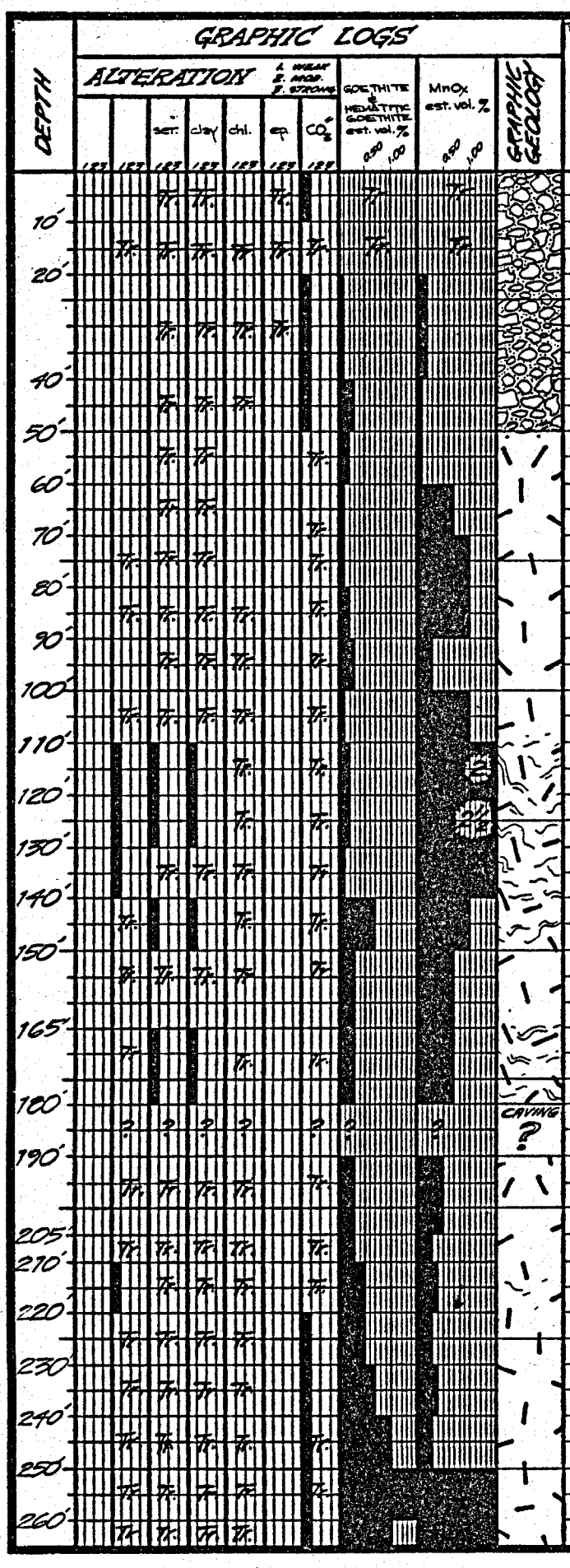
DEPTH (Feet)	HBL. BTE. GRANITE & INDIVIDUAL XL. FRAGS. & GRAINS OF QTZ., KFSP, PLAG., HBL., BTE., MAGNETITE, SPHENE, ZIRCON		FINE-XLINE HBL.-BTE GNEISS	APLITE		QTZ.-FSP.-BIOTITE GNEISS & SCHIST								MICROBRECCIA: frags cemented with FeOx, MnOx, perhaps silica	SLICKENSIDED CLAY-SER-QTZ (± CHL.) CHIPS (fr. microfaults?)
10'	100														
20'	100														
34'	100														Tr.
50'	100														Tr.
60'	100														
70'	100					Tr.									Tr.
80'	100														
90'	100														
100'	100														Tr.
110'	100														Tr.
122'	100														
132.5'	100														
145'	100														Tr.
155.5'	100														Tr.
177'	98													2?	Tr.
184'	99			Tr.										1?	Tr.
195'	100														Tr.
210'	100														Tr.
220'	85		15												Tr.
235'	100														Tr.
245'	100														Tr.
255'	100														Tr.
265'	100														Tr.
275'	100														Tr.
286'	100														Tr.

ROOSEVELT HOT SPRINGS KGRA

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR NO. 7

ESTIMATED LITHOLOGIC COMPOSITION OF INDIVIDUAL SAMPLES

Binocular Microscopic Examination



Refer to accompanying lithologic composition sheet for percentages of rock types in individual samples.

DESCRIPTIONS

Logged by J. Hulen

0-50(?)' ALLUVIUM ±/OR DECOMPOSED QTZ. MONZ — SEE BELOW for DESCRIPTION. ALLUVIUM (?)/BEDROCK CONTACT BASED ON DISAPPEARANCE OF PERVASIVE CARBONATE (+SILT) CEMENT. THIS CONTACT, HOWEVER, IS HIGHLY QUESTIONABLE SINCE ALLUVIUM ± BEDROCK ARE SAME ROCK TYPE. — NO RHYOLITIC COMPONENT TO ALLUVIUM, AS IN VALLEY-FILL TO THE WEST.

50-360': HBL. BTE QTZ. MONZ (APPEARS TO BE SAME ROCK TYPE AS IN GPCR-7) ...IS MED.-CRS.-XLINE, CONTAINS 1-7% BTE, Tr-0.5% HBL, Tr-1% SPHENE, Tr. ZIRCON, AVG. 3% MAGNETITE/ILMENITE (LOCALLY UP TO 7% OF INDIVIDUAL SAMPLES) SAMPLES ACTUALLY CONSIST OF CHIPS OF THE QTZ. MONZ. AS WELL AS ITS XL. CONSTITUENTS

ALTERATION: FELDSPARS, PARTICULARLY PLAG. LOCALLY WEAKLY CLAY-SERICITIZED OVERALL (W/A FEW CHIPS COMPLETELY CLAY-SERICITIZED). FSPS ARE GENERALLY SOMEWHAT CLOUDY EVEN WHERE NOT OBVIOUSLY CLAY-SERICITIZED, PROB. DUE TO INCLUDED TRACES OF THESE MINERALS. BTE GENERALLY FRESH, LOCALLY WKLY CHLORITIZED. HBL. GENERALLY ALTERED TO WAXY GREENISH-GRAY MATERIAL — PROB. CLAY/SER. PLUS CHL. SPHENE FRESH TO ALTERED TO LEUCOXENE ± CALCITE. SILICIFICATION: OCCURS AS F. XLINE QTZ. INTERGROWN W/FeOx ±/OR MnOx IN DENSE DK. BROWN TO GRAY BROWN DISCRETE CHIPS & INTERGROWN WITH FeOx IN MATRIX OF MICROBRECCIAS. THE DK. BROWNISH-GRAY MATERIAL IS COMMONLY ASSOCIATED WITH MORE INTENSE CLAY-SERICITIZATION. EPIDOTE LOCALLY PRESENT AS IRREG. CLOTS REPLACING PLAG. & AS DISCRETE GRAINS, A FEW OF WHICH ARE TABULAR AND PROBABLY ARE FROM VEINLETS. CALCITE TO 50' OCCURS AS A CREAM-COLORED CRYPTOCRYSTALLINE MATERIAL INTERGROWN WITH SILT-SIZE PARTICLES AS FILM AND CRUSTS ON GRAINS. Tr CALCITE BELOW 50' REPL. PLAG.

Mineralization following page →

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 8
CHIP LOG Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA

GRAPHIC LOGS

ALTERATION 1. WEAK 2. MOD. 3. STRONG

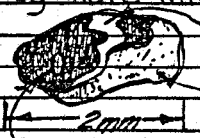
DEPTH (Feet)	sil.	ser.	clay	chl.	ep	CO_3	SMECTITE & HEMATITIC GOETHITE est. vol.% 0.50 1.00	MnOx est. vol.% 0.50 1.00	GRAPHIC GEOLOGY
270'	1	1	1	1					
280'	1	1	1	1	1				
290'				1					
300'	1	1	1	1	1				
310'	1	1	1	1					
320'	1	1	1	1	1				
330'	1	1	1	1					
340'	1			1					
350'	1	1	1	1	1				
360'									

Refer to accompanying lithologic composition sheet for percentages of rock types in individual samples.

DESCRIPTIONS

Logged by J. Hulen

Mineralization: Manganese oxide occurs throughout hole as dark gray to slightly brownish-gray material which is apparently intergrown w/ v.f. xline qtz and locally w/ FeOx: This material occurs as discrete grains, as irregular clots disseminated in grains of qtz monz. & its constituents, as rare veinlets cutting these grains. W/ qtz, MnOx also occurs ubiquitously as microvnlts, as coatings on fracture surfaces, as a stain in and around mafic minerals. Clots of MnOx are commonly accompanied by more intense clay-sericitization.



Goethite and hematitic goethite occur as powdery to resinous irregular films and crusts and commonly botryoidal clots adhering to individual grains and as cement binding two or more grains together. Many of these FeOx clots contain partially oxidized magnetic frags, so the "goethite and hematitic goethite" estimates may be somewhat high — and may include a substantial magnetic component. Much of this variety of FeOx may be derived in part from oxidation of steel lids on mason jars in which the samples were originally stored. Goethite also occurs intergrown with MnOx & qtz. in the dk. brownish-gray clots described above, and as a stain in and around mafic minerals. 2 chips fine-xline specular hematite between 40' & 50'.

* NOTE: A FEW LG ROUNDED CHUNKS OF CEMENTED SAND-SIZE MATERIAL BETWEEN 350' & 360'. — THE CEMENTING MATERIAL IS PROBABLY DRILLING MUD.

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 8
CHIP LOG Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA

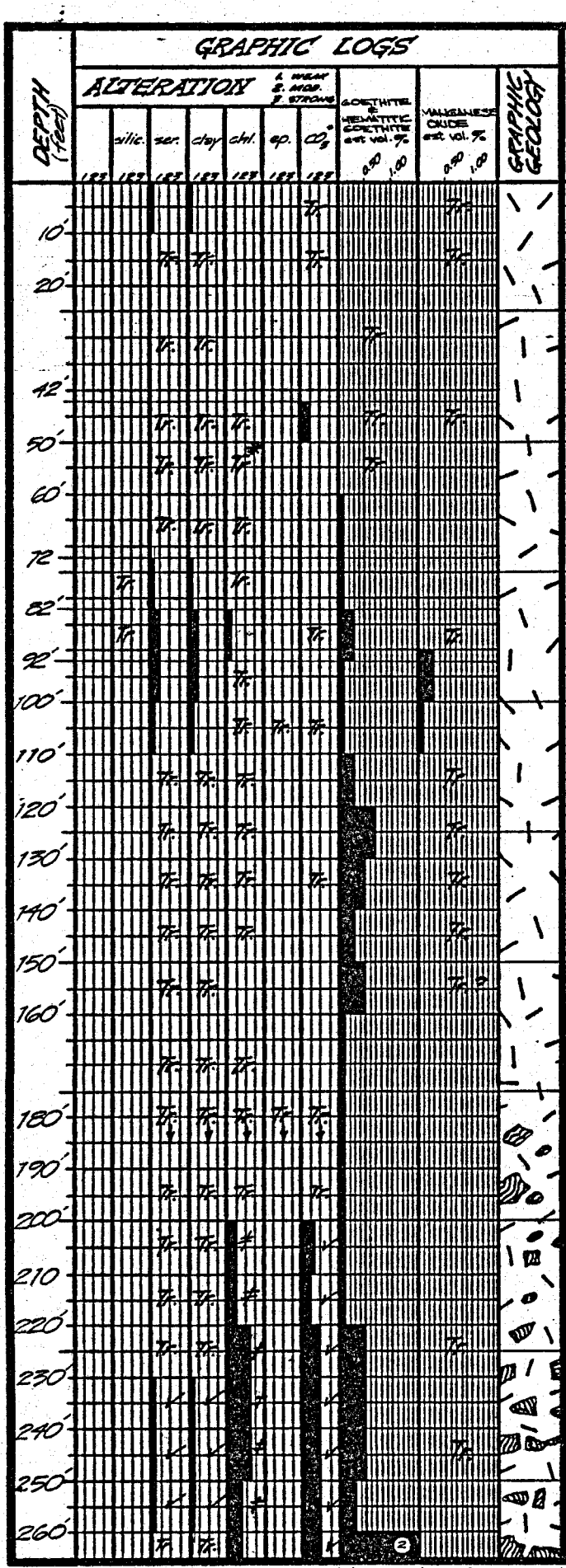
LITHOLOGY, ESTIMATED VOLUME PER CENT

DEPTH (feet)	HBL.-BTE. QTZ. MONZ. & INDIVIDUAL XLS. & GRAINS OF QTZ, KSP, PLAG, HBL., BTE, MAGNETITE, ILMENITE, SPHENE	FINE-LINE LEUCOCRATIC GRANITE & FR. BTE. CT.				ACIDIC SCHIST & GNEISS		RHYOLITE PORPHYRY			DACITE & ANDESITE & PORPHYRITIC EQUIVALENTS	(MYLONITE)	QTZ-CHERT ROCK	MICROBRECCIA QTZ-FELD. MATRIX	CLAY-QTZ.-SER. CHIPS, TABULAR, CONCHOIDAL FRACTURED
10'	100														
20'	100					Tr.					Tr.		Tr.	Tr.	
40'	also 2 spec. hem. chips 95	5									Tr.?		Tr.		
50'	93	7													
60'	98	2									Tr.?		Tr.	Tr.	Tr.
70'	90	10													Tr.
80'	95	5												Tr.	
90'	96	3												1	
100'	98	2												Tr.	Tr.
110'	99	1												Tr.	Tr.
120'	98	1												1	Tr.
130'	98	1												1	Tr.
140'	99	Tr.												1	Tr.
150'	100	Tr.												Tr.	Tr.
165'	100	Tr.												Tr.	Tr.
180'	100	Tr.												Tr.	Tr.
190'	?	?												?	
205'	100	Tr.												Tr.	Tr.
210'	100	Tr.												Tr.	Tr.
220'	100	Tr.												Tr.	Tr.
230'	100	Tr.												Tr.	Tr.
240	100	Tr.												Tr.	Tr.
250	100	Tr.												Tr.	Tr.
260'	98	1												1	Tr.
270'	97	2												1	Tr.
280'	99	Tr.												1	Tr.
290'	99	Tr.												1	Tr.
300'	99	Tr.												1	Tr.
310'	100													Tr.	Tr.
320'	100													Tr	Tr
330'	100										Tr. contam.			Tr.	Tr.
340'	99													1	Tr.
350'	100													Tr.	Tr.
360'		Tr.						5						Tr.	Tr.

* & dense qtz.-FeOx-MnOx fragments

ROOSEVELT HOT SPRINGS KGRA

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 8
ESTIMATED LITHOLOGIC COMPOSITION OF INDIVIDUAL SAMPLES
Binocular Microscopic Examination.



Refer to accompanying lithologic composition sheet for percentages of rock types in individual samples

logged by J. Hulen

DESCRIPTIONS

NOTE: POSSIBLE ALLUVIUM OR REGOLITH TO 60' ("EASY DRILLING" – GPCR FIELD LOG)

0-180' SUBANG-ANG CHIPS OF HBL, BTE, QTZ, MONZ AND INDIVIDUAL XLS OF QTZ, KSPAR, PLAG, BTE, HBL, MAGNETITE, SPHENE. QTZ MONZ IS MED.-CRS. XLINE W/ 1-5% BTE (VARIABLE W/ INDIVIDUAL SAMPLES), 0-1% HBL, 1-2% SPHENE, tr. ZIRCON, 1-3% MAGNETITE. ALSO 1-5% CHIPS OF FINE-XLN. HBL, BTE GRANODIORITE (PERHAPS GRANODIORITIC GNEISS?) W/ 10-15% TOTAL MAFICS, tr. APATITE & 1-3% SPHENE. INDIVIDUAL FRAGS. THIS INTERVAL RANGE FROM <0.5 mm. TO 15 mm. (AVG. ≈ 1-2). SINCE ALL CHIPS ARE SUB¢ TO ¢ NEAR TOP OF HOLE, HOLE IS COLLARED EITHER IN BEDROCK OR IN ALLUVIUM V. CLOSE TO ITS SOURCE.

ALTERATION: FELDSPARS THROUGHOUT INTERVAL ARE SOMEWHAT CLOUDY-APPEARING, PROBABLY DUE TO TRACES OF CLAY & SERICITE. CLAY-SERICITIZATION A LITTLE MORE INTENSE BETWEEN 72' & 110'. HBL COMMONLY ALT. TO LT. GREENISH-GRAY WAXY CLAY-CHL(?) AGGREGATES. BTE GEN. FRESH, BUT LOCALLY PARTIALLY CHLORITIZED. SPHENE GEN. FRESH, LOCALLY PTLY TO COMPLETELY ALT. TO LEUCOXENE. TRACES CALCITE REPLACING ESP. ¢ HBL. IN IRREG PATCHES. QTZ VNLT. IN ONE CHIP @ 72-82'

MINERALIZATION: Tr.-0.7% goethite and hematitic goethite as powdery to resinous crusts, films, & clots, the latter of which are commonly botryoidal, and, more rarely, as a cement binding small fragments together. Also as a stain concentrated in and around mafic minerals ——— FeOx particularly abundant between 110' & 160'. Traces Manganese oxide to 160', generally as films along fractures and weak stain visible in light-colored minrls. – also as rare irreg. clots in qtz-clay-ser chips.

180-220' SAME AS 0-180', EXC. 12-25% FINE-XLINE HBL, BTE, GRD. (GNEISS) ¢ APPEARANCE OF QTZ-PLAG-BTE-HBL GNEISS BELOW 200' (REFER TO 220-290' FOR DESCRIPTION)

220-290' SUBANGULAR - OF HBL, BTE, QTZ MONZ. (SAME AS 0-180') AND QTZ-PLAG-BTE-HBL GNEISS (3-35%) GNEISS (? MAY BE CRUDELY FLOW-FOLIATED PLUTONIC) CONSISTS OF 7-10% HBL, 3-7% BTE, AVG. ≈ 3% MAGNETITE (LOCALLY UP TO 5%) 1-2% SPHENE, 5-7% QTZ, tr.-0.5% APATITE, REMAINDER PLAGIOCLASE. (NEXT PAGE →)

* All mafics in hbl. microdiorite chloritized ¢ concentrated in mafics in qtz.-plag.-bte.-hbl. gneiss
✓ Mostly in plag. & mafics in qtz-plag-bte.-hbl. gneiss

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR NO. 9
CHIP LOG Binocular Microscopic Examination

GRAPHIC LOGS

Refer to accompanying lithologic composition sheet for percentages of rock types in individual samples.

logged by J. Hulen

DESCRIPTIONS

DEPTH	ALTERATION (1. WEAK 2. MOD. 3. STRONG) silic.	ser.	clay	chl.	ep.	$CO_3^=$	GOETHITE & HEMATITIC GOETHITE est. vol. % 0.00 1.00	MANGANESE OXIDE est. vol. % 0.00 1.00	GRAPHIC GEOLOGY
270'		Tr.	Tr.	1/2		1	2		
280'				1/2		1/2		Tr.	
290'									

220-290 CONTINUED: GNEISS (?) IS CRUDELY FOLIATED, BREAKS INTO ROUGHLY TABULAR FRAGMENTS.

ALTERATION: ... IN QTZ. MONZONITE SAME AS 0-180'. IN GNEISS: HBL. ± BTE MODERATELY TO STRONGLY CHLORITIZED PLAG. WKLY TO MODERATELY ALT. TO CALCITE (CALCITE ALSO PARTIALLY REPLACES HBL.) SPHENE ALMOST TOTALLY ALT. TO LEUCOXENE ± CALCITE. PLAG. ALSO WKLY CLAY-SERICITIZED

MINERALIZATION: STRONG OVERALL INCREASE IN GOETHITE ± HEMATITIC GOETHITE, SAME TEXTURE AS 0-180' — THIS CORRESPOND WITH AN INCREASE IN MAGNETITE. LOCAL TRACES MnOx, SAME AS 0-180'

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR NO. 9
CHIP LOG Binocular Microscopic Examination

UURI-ESL

Logged by J. Hulen

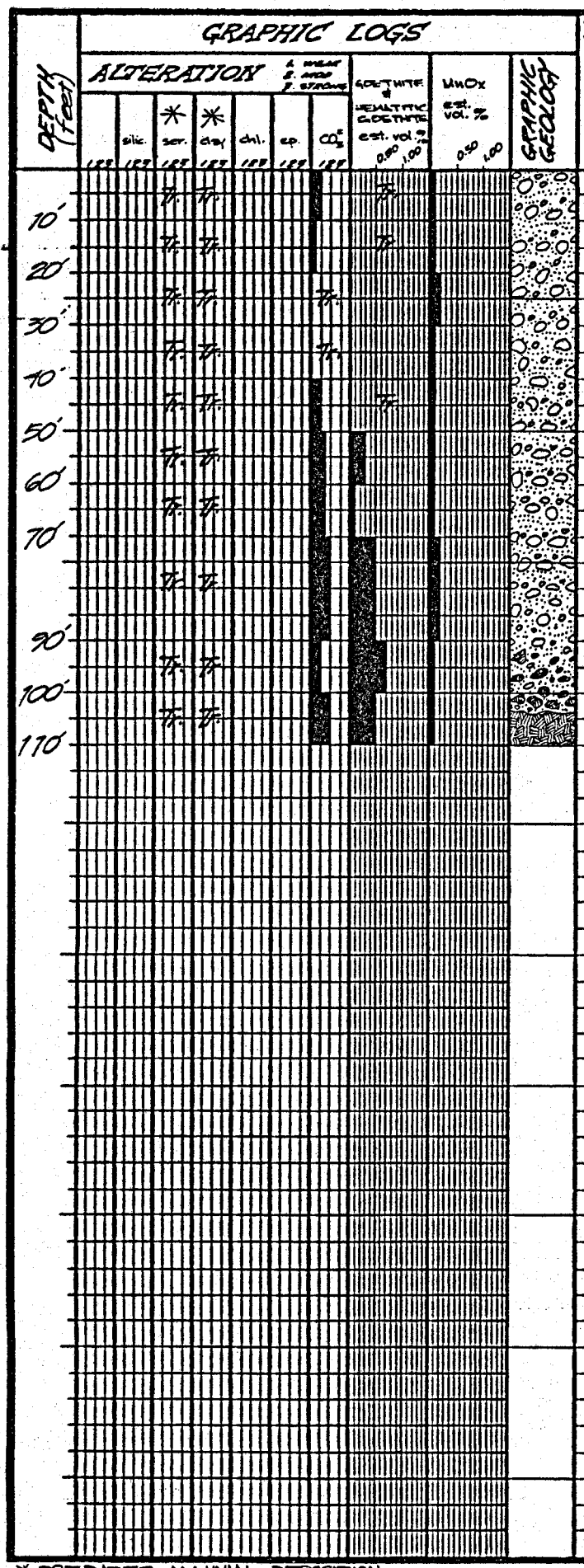
LITHOLOGY, ESTIMATED VOLUME PER CENT

DEPTH	HBL. BTE. QTZ. MONZ. & INDIVIDUAL XL. FRAGMENTS & GRAINS OF QTZ, KSPAR, PLAG, BTE., HBL., SPHENE, MAGNETITE		FINE-XLINE * HBL.-BTE. GRANODIORITE, LOWER TOTAL MAFICS ①	HBL MICRODIORITE		MED.-XLINE QTZ-PLAG-BTE-HBL GNEISS(?) ①					BASALT & PATTIC BASALT	ANDESITE & PATTIC EQUIVALENTS	ARGILLITIC QTZ-CHL. ROCK (MYLONITE)	MICROBRECCIA	SLICKENSIDED CLAY-SERICITE ± CHL. CHIPS (1/16 mm)
10'	95		5										Tr.		
20'	100		Tr.												
42'	100														
50'	99		Tr.									1			
60'	96			4											
72'	100														
82'	100		Tr.												Tr.
92'	99		1											Tr.	Tr.
100'	96		3												1
110'	92		7												1
120'	100		Tr.												
130'	98		2?												
140'	97		3								Tr.				
150'	98		2												Tr.
160'	95		5*												
180'	94		5												1
190'	87		12												1
200'	75		25											Tr.	Tr.
210'	86		7			7									Tr.
220'	92		5			3									Tr.
230'	89		1			10									Tr.
240'	87		3			10									Tr.
250'	80		3?			17					Tr.	Tr.			Tr.
260'	83		Tr.			17								1	Tr.
270'	75		Tr.			25?									Tr.
280'	65		1			35									
290'	75		Tr.			25								Tr.	Tr.

* MAY BE GRANODIORITIC GNEISS

① THESE MAY BE VARIATIONS OF THE SAME ROCK TYPE

GEOTHERMAL POWER CORPORATION DRILL HOLE GPOR NO. 9
ESTIMATED LITHOLOGIC COMPOSITION OF INDIVIDUAL SAMPLES
Binocular Microscopic Examination



REFER TO ACCOMPANYING LITHOLOGIC COMPOSITION SHEET FOR PERCENTAGES OF ROCK TYPES IN INDIVIDUAL SAMPLES

DESCRIPTIONS

Logged by J. Hulen

0-100'. ALLUVIUM. SUBRND.—SUB-ANGULAR GRAINS CONSISTING DOMINANTLY OF BTE. QTZ. MONZ. & INDIVIDUAL GRAINS & FRAGMENTS OF QTZ, KSPAR, BTE, PLAG, SPHENE, MAGNETITE-ILMENITE & Tr. ZIRCON. GRAINS RANGE IN SIZE UP TO 10 mm. DIMENSION. BASALTIC ANDESITE FRAGS APPEAR AT 60', FORM 35% OF SMPL. 90-100'.

ALTERATION: FSPS. WKLY CLAY-SERICITIZED, BTE FRESH, SPHENE FRESH. MINOR TO MOD. BUFF CALCITE CEMENT. ALL BUT CALCITE PREDATES ALLUVIAL DEPOSITION— CLAY-SERICITIZED FSP. & QTZ. MONZ. GRAINS COMMONLY HAVE DEVELOPED DULL WEATHERING PATINA— (COEXISTING RHYOLITIC RX., WHERE PRESENT, ARE ABSOLUTELY FRESH)

Mineralization: Weak dk. brownish-gray manganese oxide, dendritic, post-dates even $CO_3^=$ cement. Goethite & hematitic goethite films, crusts, & cement — probably post-dates sample collection.

100-110': 55% OF SAMPLE IS DK. GRAY PORPHYRITIC PYROXENE BASALTIC ANDESITE, UNALTERED — OTHERWISE SAME AS ABOVE. INTERPRETED AS PENETRATING BASALTIC ANDESITE BEDROCK LOWER 50% OF SMPL. (ALL FRAGS VERY ANGULAR)

* PREDATES ALLUVIAL DEPOSITION.

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 11
CHIP LOG & BINOCULAR MICROSCOPIC EXAMINATION
ROOSEVELT HOT SPRINGS KGRA

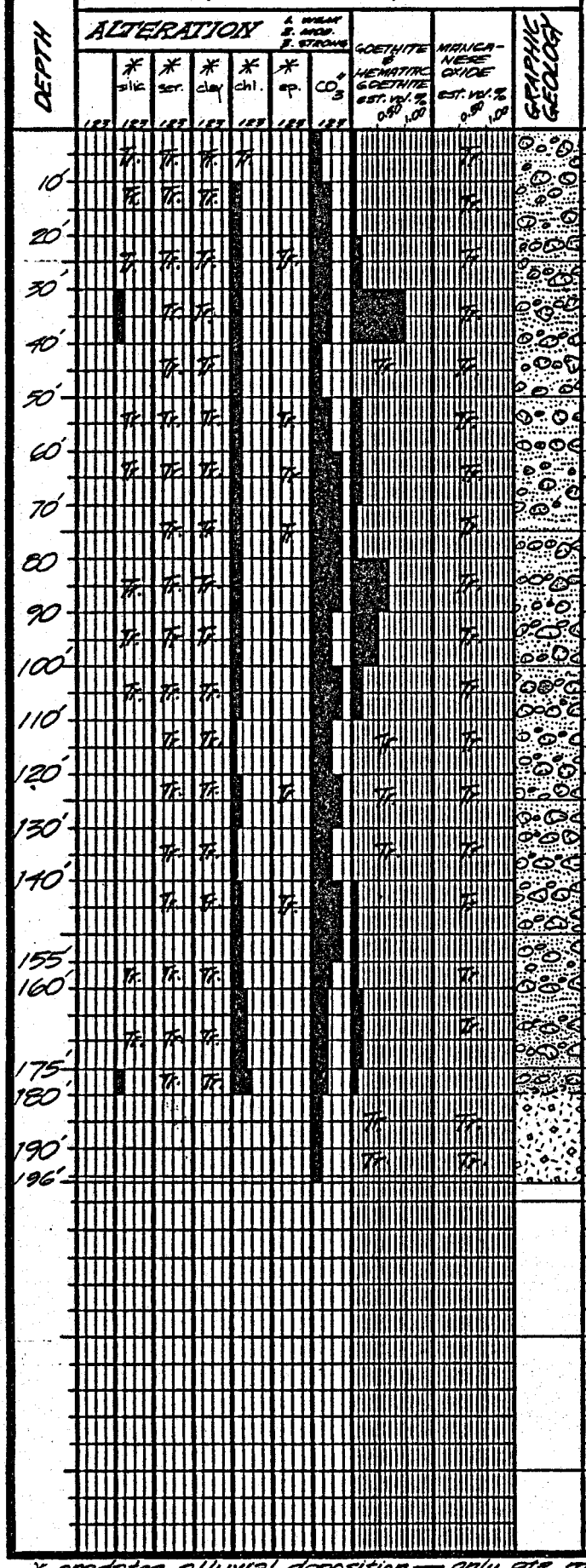
LITHOLOGY, ESTIMATED VOLUME PER CENT — Logged by J. Hulen

DEPTH (Feet)	BIOTITE QTZ. MONZ. & INDIVIDUAL GRAINS & FRAGS OF QTZ., K-SP., PLAG., BTE., SPHENE, & MAGNETITE-ILMENITE	FINE-X LINE LEUCO-CRATIC GRANITE	APLITE, APLITE PORPHYRY				RHYOLITE QTZ. LATITE, ALTERED, LIMONITE	RHYOLITE PERLITIC RHYOLITE		DACITE, ANDESITE & BASALTIC ANDESITE FRAGMENTS	BASALTIC ANDESITE				
10'	100														
20'	98		2												
30'	96		1				3	Tr		Tr.					
40'	99						1			1					
50'	97	1					1		1						
60'	97	Tr.	2				1								
70'	93		1				1				5				
90'	88	1	3				3			1	1				
100'	63	1					1				35				
170'	42		2				1				55				

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR. No. 11
ESTIMATED LITHOLOGIC COMPOSITION OF INDIVIDUAL SAMPLES
Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA

Logged by J. Hulen

GRAPHIC LOGS



DESCRIPTIONS

0–180': ALLUVIUM. SUBROUNDED TO ANGULAR GRAINS & FRAGMENTS FR. <0.1–20 MM. DIA. (AVG ≈ 3 mm.), MOST OF WHICH ARE BIOTITE-HORNBLENDE QTZ. MONZONITE. THIS ROCK IS MED.-XLINE, CONTAINS 5-10% (AVG 7) SUBH.–EUH. HBL., 1-2% SUBH.–EUH. BTE, 0.3-0.5% EUH. SPHENE, 0.5-1% MAGNETITE. ALSO A FEW GRAINS & FRAGMENTS OF RHYOLITE PORPHYRY (DESCRIBED 180-196')

100-110': 12% ANDESITE

ALTERATION: CALCITE OCCURS AS IRREGULAR CRUSTS & FILMS, APPARENTLY INTERGROWN WITH CLAY & SILT-SIZE PARTICLES, ADHERING TO INDIVIDUAL GRAINS & AS CEMENT BINDING TWO OR MORE GRAINS TOGETHER — ALSO OCCURS AS IRREG. PATCHES LOCALLY REPLACING PLAG. & HBL. ESPS. CLOUDY, PROBABLY DUE TO TRACES CLAY & SER. HBL. PARTIALLY ALT. TO FINE-XLINE CHL (± CLAY) (A FEW HBL. XLS. TOTALLY ALTERED). BTE. PARTIALLY ALT. TO FINE-XLINE CHL. SPHENE FRESH TO PARTIALLY ALTERED TO LEUCOXENE MAGNETITE FRESH TO PTLY ALT. TO POWDERY GOETHITE-HEMATITE. CHIPS IN SEVERAL INTERVALS CUT BY MICROXLINE QTZ-CHL. VEINLETS, A FEW OF WHICH CONTAIN POWDERY TO SUBMETALLIC MAROON HEMATITE &/OR TRACES OF EPIDOTE. CHIPS OF MICROBRECCIA COMMON THROUGHOUT HOLE — SOME OF THESE HAVE QTZ.-CHL. (± HEM.) MATRIX, SOME HAVE QTZ-FeOx MATRIX.

30-40': 25 mm. FRAG. QTZ-FeOx BX

Mineralization: goethite & hematitic goethite as stain in and around mafic minerals & as constituent of qtz.-chl. vnlts & microbx, as above. MnOx as stains & irreg. commonly dendritic crusts on grains & frags.

180-196': RHYOLITE PPY. ANG. CHIPS UP TO 15 mm. DIA. 3-5% SUBH.–EUH. QTZ. PHENOS (COMMONLY BIPYRAMIDAL), 1-2% SUBH.–EUH. K-SP. PHENOS, EMBEDDED IN WHITE TO LT. GRY MICROXLINE MATRIX — ALSO TR. BTE., MAGNETITE.

ALTERATION: ESPS. FRESH, BTE. FRESH–, TR. CALCITE ON A FEW GRAIN SURFACES.

Mineralization: Traces FeOx & MnOx, same as 0-180'.

* predates alluvial deposition — only qtz. mono. grains altered: rhy. ppy. fresh

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR. No. 10
CHIP LOG Binocular Microscopic Examination

LITHOLOGY, ESTIMATED VOLUME PER CENT — Logged by J. Hulen

DEPTH	BTE-HBL. QTZ. MONZ & INDIVIDUAL FRAGS. OF QTZ., K-SPAR, PLAG., HBL., MAG., SPHENE			RHYOLITE PORPHYRY		BIOTITE SCHIST/GNEISS		RHYOLITE & PORPHYRITIC RHYOLITE			ANDESITE & PORPHYRITIC EQUIVALENTS	(MYLONITE)	APHANITIC QTZ-CHL. ROCK(±HEM)	MICROBRECCIA	
10'	100					Tr.									
20'	97					Tr.					1?			2.?	
30'	97			1							1?			Tr.	
40'	93			2							Tr.?			5*	
50'	95			3							Tr.?			2*	
60'	95			5									Tr.	Tr.	
70'	99			1							Tr.		Tr.		
80'	93			4		3(qtz-chl)					Tr.		Tr.	Tr.*	
90'	84			11		2(?)					1		Tr.	2*	
100'	95			2										1*	
110'	84			3							12		Tr.	1*	
120'	90			10									Tr.		
130'	93			7									Tr.	Tr.	
140'	83			15		Tr.					2				
155'	100												Tr.		
160'	95			5									Tr.	Tr.	
175'	97			2										1	
180'	99			1									Tr.	Tr.	
190'	5			95											
196'	5			94							1				

* W/ BTE.-GOETHITE MATRIX

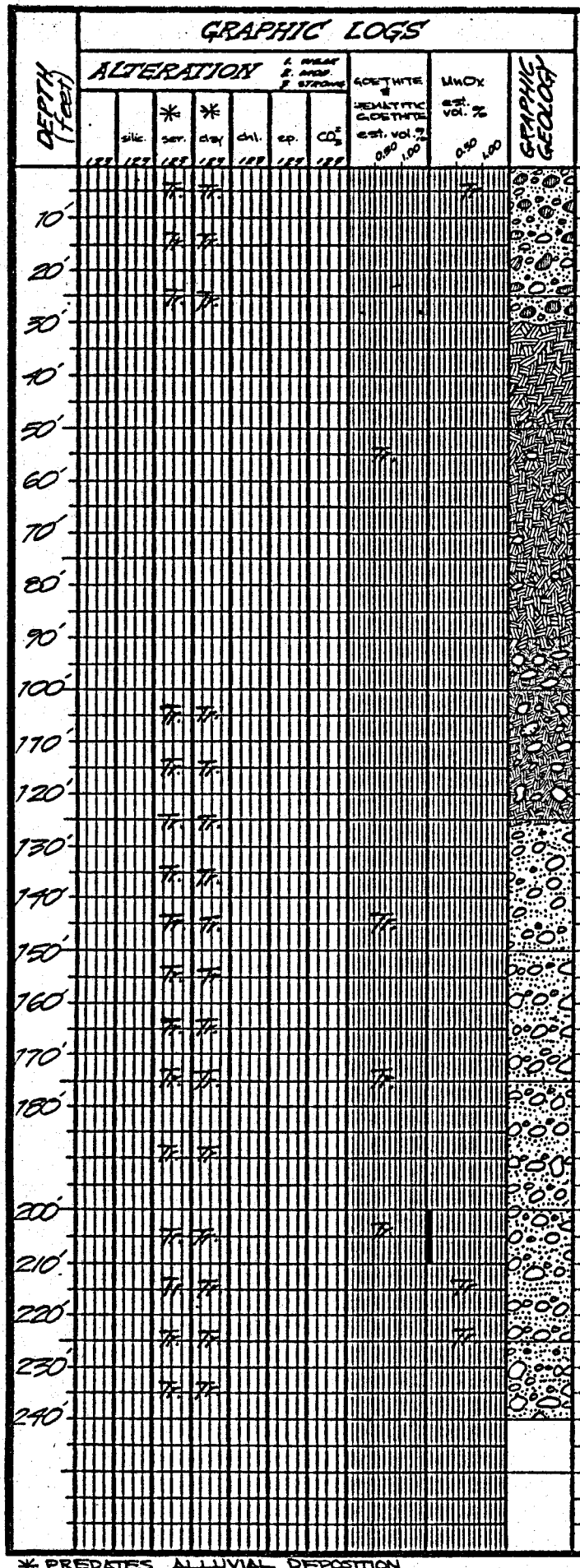
GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 10
ESTIMATED LITHOLOGIC COMPOSITION OF INDIVIDUAL SAMPLES
Binocular Microscopic Examination

LIDRI-E&L

LITHOLOGY, ESTIMATED VOLUME PER CENT — Logged by J. Hulen

DEPTH (feet)	HBL. BTE. QTZ. MONZ. & INDIVIDUAL GRAINS & FRAGS OF BTE, HBL., QTZ., EST., SPHENE, MAGNETITE/ILMENITE	FINE-XLINE LEUCOCR. GRANITE	APLITE & APLITE PORPHYRY					RHYOLITE & FELSITE	PERLITE & PUMICE	OBSIDIAN	ORTHO & ANDESITE & PORPHYRITIC EQUIVALENTS	BASALTIC ANDESITE & ANDESITE, HYPERSTHENE BEARING	BASALTIC ANDESITE & ANDESITE, HORNBLENDE BEARING		MICROPH.	
10'	60							2	37		1					
20'	44							1	55							
30'	44							1	50		1	7				
40'	1											99				
50'	1											99				
60'	3								5			92				
70'	1								1			98				
80'	Tr.								Tr.			100				
90'												100				
100'												60	40			
110'	17											7	76			
120'	55								10			5	30			
130'	86								Tr.			2	12			
140'	92		2									1	5			
150'	100												Tr.			
160'	95								5				Tr.			
170'	80	4							Tr.			5	7		4	
180'	86		1									5	8		Tr.	
200'	94	1	Tr.									1	4			
210'	90											2	8			
220'	84											1	15			
230'	97	2											1			
240'	99												1			

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR. No. 13
ESTIMATED LITHOLOGIC COMPOSITION OF INDIVIDUAL SAMPLES
Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA



REFER TO ACCOMPANYING LITHOLOGIC COMPOSITION SHEET FOR PERCENTAGES OF ROCK TYPES IN INDIVIDUAL SAMPLES

DESCRIPTIONS

Logged by J. Hulen

0-30': ALLUVIUM. SUBRND.-SUBANG. GRAINS CONSISTING OF HBL.-BTE. QTZ. MONZ. & ITS XL. CONSTITUENTS (QTZ, KSPAR, PLAG, BTE, SPHENE, MAGNETITE-ILMENITE, Tr. ZIRCON) AND GLASSY COMPONENT (PERLITE, PUMICE, OBSIDIAN). FSP. IN QTZ. MONZ. TRACES CLAY & SER., GLASSY COMPONENT FRESH. tr. DENDRITIC MnOx 0-10 FEET.

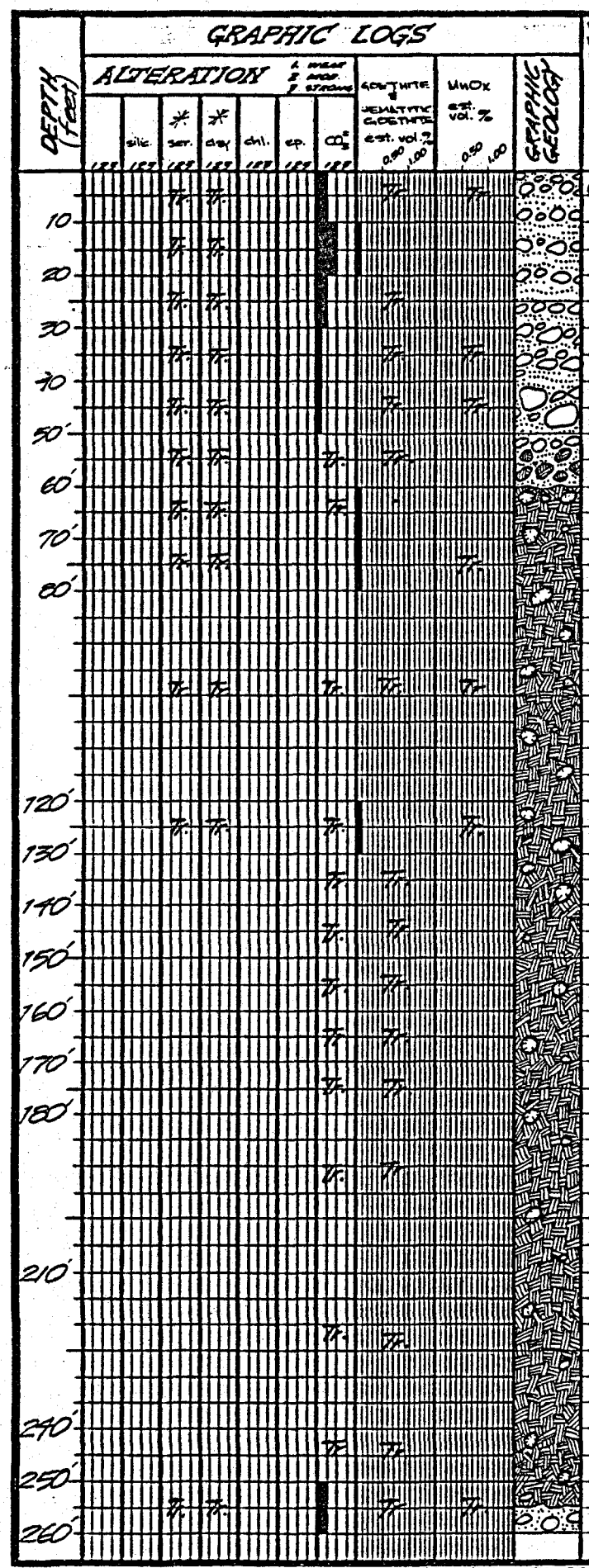
30-95': PORPHYRITIC OLIVINE PYROXENE BASALTIC ANDESITE, LOCALLY VESICULAR. 0.1-0.3 mm. OLIVINE PHENOS (tr.-12), 2% PYROXENE PHENOS, EUH.-SUBH., UP TO 1.5X 1 mm. 3% PLAG. PHENOS, SUBH-EUH. EMBEDDED IN MED-DK. GRAY MICROXLINE MATRIX CONSISTING IN PART OF FELTED PLAG. LATHS. UNALTERED. UNMINERALIZED EXC. FOR LOCAL BRICK-RED HEM. STAIN.

95'-125': SAME AS ABOVE, EXC. DENSE, APHANITIC MATRIX, ABUNDANT VESICLES, ABUNDANT BRICK-RED HEM. STAIN. MAY BE SEPARATE FLOW OR CHILLED LOWER PORTION OF ABOVE.

125-240': ALLUVIUM, SAME AS 0-30', EXCEPT NO GLASSY COMPONENT

* PREDATES ALLUVIAL DEPOSITION

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 13
CHIP LOG ↔ BINOCULAR MICROSCOPIC EXAMINATION
ROOSEVELT HOT SPRINGS KGRA



REFER TO ACCOMPANYING LITHOLOGIC COMPOSITION SHEET FOR PERCENTAGES OF ROCK TYPES IN INDIVIDUAL SAMPLES

DESCRIPTIONS

Logged by J. Hulen

0-60': ALLUVIUM. SUBRND-SUBANG GRAINS DOMINATED BY MED.-CRS.-XLINE BTE. ΦTZ. MONZ & ITS XL. CONSTITUENTS (SPHENE, Tr. ZIRCON, ΦTZ, KSPAR, PLAG, BTE [<0.3%]. 65% BASALTIC ANDESITE fr. 50 to 60'. ROCK IS UNALTERED EXC. FOR TR CLAY & SERICITE IN FSP.—THIS PREDATES ALLUVIAL DEPOSITION: GRAINS SO ALTERED COMMONLY HAVE DEVELOPED A DULL WEATHERING PATINA. V. WK-MOD. CALCITE CEMENT MNRLZ. CONFINED TO LOCAL TRACES DENDRITIC MANGANESE OXIDE & TRACES GOETHITE & HEMATITIC GOETHITE WHICH ALMOST CERTAINLY POST-DATE SAMPLE COLLECTION.

60-250': VESICULAR PORPHYRITIC OLIVINE (?)-PYROXENE BASALTIC ANDESITE. <1% SUBH.-EUH. PLAG. PHENOS. IN MED.-DK. GRAY MICROLINE GROUNDMASS CONSISTING IN PART OF FELTED PLAG. LATHS. ABT. 7% ROUNDED TO IRREGULAR VESICLES UP TO 10 MM. ACROSS. ROCK COMMONLY STAINED—AND VESICLES LINED—W/ BRICK RED HEMATITE FILMS. ROCK IS UNALTERED EXC. FOR TRACES CALCITE AS MICROVEINLETS AND VESICLE LININGS. MINERALIZATION SAME AS 0-60'

250-260': 50% SAME AS 0-60' & 50% SAME AS 60-250' (PROBABLE PENETRATION OF BASALT INTO SUBJACENT ALLUVIUM.

* PREDATES ALLUVIAL DEPOSITION & CONFINED TO ΦTZ. MONZ. FRAGS

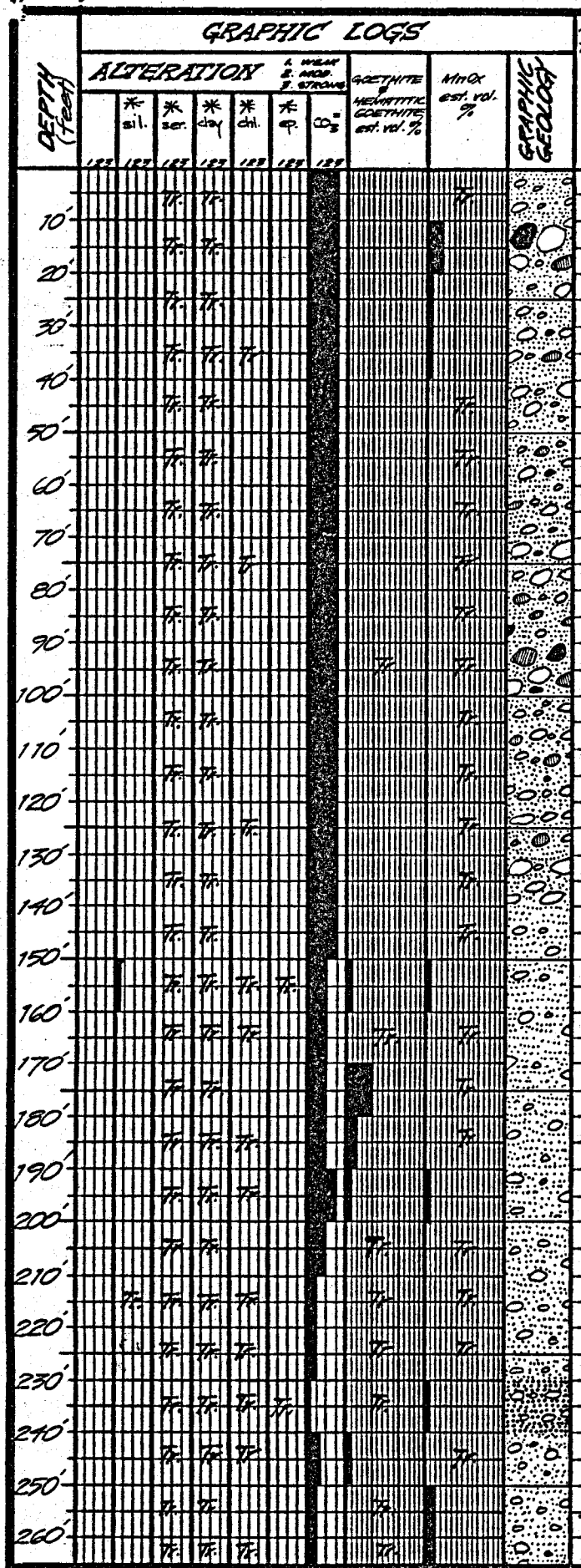
GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 12
CHIP LOG & BINOCULAR MICROSCOPIC EXAMINATION
ROOSEVELT HOT SPRINGS KGRA

UURI-EGL

LITHOLOGY, ESTIMATED VOLUME PER CENT — Logged by J. Hulen

DEPTH	BTE. QTE. MONZ. & INDIVIDUAL FRAGS. OF QTE, K-SPAR, PLAG., BIOTITE, SPHENE, MAGNETITE-ILMENITE						ANDESITE PORPHYRITE, QTE. & LATITE	PERLITES PUMICE, OBSIDIAN		BASALT, ANDESITIC ANDESITE & EQUIVALENTS						
10'	95							2		3						
20'	93									7						
30'	96						2	1		1						
40'	100							Tr.		Tr.						
50'	100															
60'	100									Tr.						
70	35									65						
80	17									83						
120'	12									88						
130'	12									88						
140'	5									95						
150'	7									93						
160'	1									99						
170'	3									97						
180'	4									96						
210'	2									98						
240'	6									94						
250'	8									92						
260'	50									50						

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR. No. 12
ESTIMATED LITHOLOGIC COMPOSITION OF INDIVIDUAL SAMPLES
Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA



Refer to accompanying lithologic composition sheet for percentages of rock types in individual samples.

DESCRIPTIONS

Logged by J. Hulen

0-540' CALCAREOUS ARKOSIC ALLUVIUM. SUBROUNDED TO ANGULAR GRAINS DOMINATED BY HBL.-BTE.- & BTE HBL. QTZ. MONZ. & ITS CRYSTAL CONSTITUENTS. GRAINS RANGE IN DIMENSION FR. < 0.1 mm TO 20 mm. (AVG. 1-3 MM.). QTZ. MONZ. IS CRS.-XLINE, CONSISTS OF QTZ., KSPAR, PLAG, BTE (Tr.-2%), HBL. (Tr.-3%), MAGNETITE/ILMENITE (Tr.-2%), SPHENE (Tr.-0.5) & ZIRCON (Tr.)

(230-240', 320-340', 430-450', 500-510'): MODERATELY WELL-SORTED MED-CRS. GRAVELLY SAND W/ ANOMALOUS % MAGNETITE/ILMENITE (UP TO 5%) AND SPHENE

(80-100'): ~ 20% OF FRAGMENTS ARE RHYOLITE, PPYTIC. RHYOLITE, PUMICE, PERLITE & (TR) OBSIDIAN

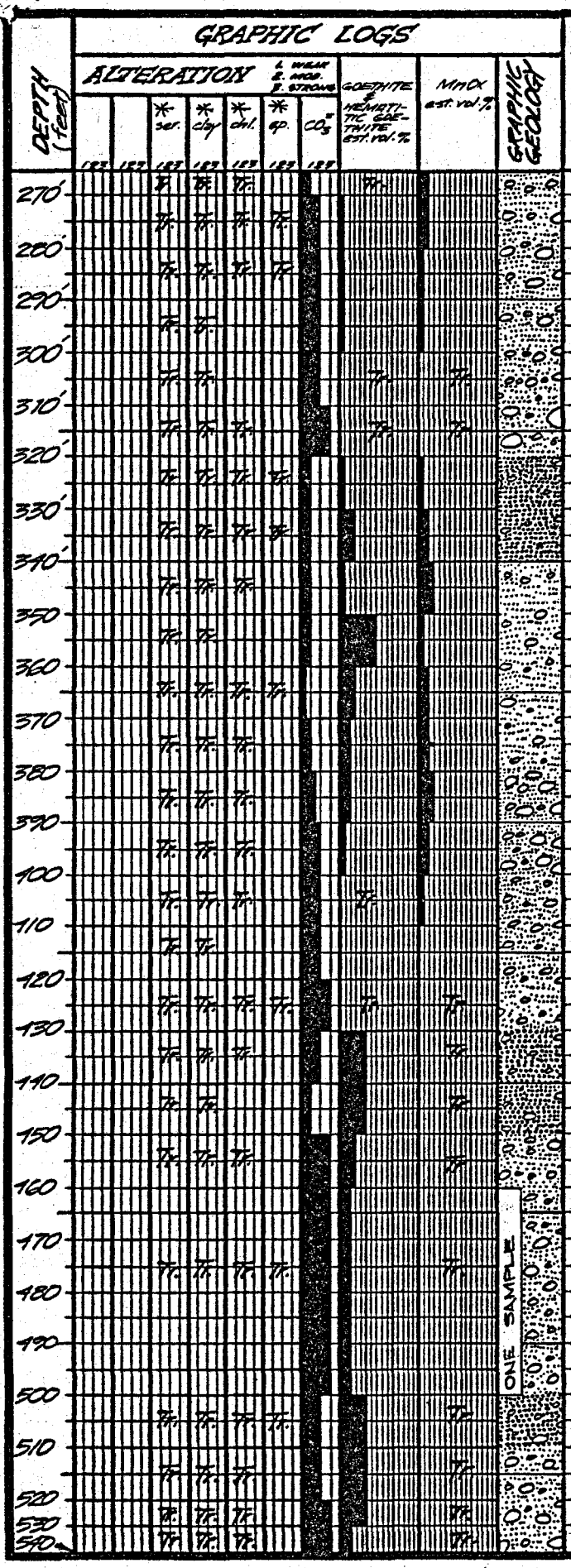
//NOTE// CALCITE CEMENT ADHERING TO OR COATING GRAINS COMMONLY PRECLUDES ACCURATE DETERMINATION OF PERCENTAGES & IDENTIFICATIONS OF ROCK TYPES IN INDIVIDUAL SAMPLES TO 150 FT.

ALTERATION: CALCITE THROUGHOUT HOLE AS LT. CREAM- TO BUFF-COLORED CRYPTOCRYSTALLINE MATERIAL INTERGROWN W/ CLAY & SILT-SIZE DETRITAL MATERIAL — OCCURS AS FILMS & CRUSTS ADHERING TO INDIVIDUAL GRAINS & CEMENT BINDING TWO OR MORE GRAINS TOGETHER. FELDSPARS THROUGHOUT HOLE ARE SLIGHTLY CLOUDY, NO DOUBT DUE TO TRACES OF CLAY AND SERICITE (EST. PHENOCRYSTS IN RHYOLITIC RX AND RHYOLITIC RX. THEMSELVES ARE FRESH. HBL. & BTE. FRESH TO PARTIALLY CHLORITIZED. SPHENE FRESH TO PARTIALLY ALTERED TO LEUCOXENE (& CALCITE?) A FEW CHIPS OF VEIN QTZ. W/ <0.5mm. WATER-CLEAR SINGLY-TERMINATED XLS. 150-160' & 210-220'. EPIDOTE OCCURS AS IRREGULAR CLOTS REPLACING PLAG & AS INDIVIDUAL GRAINS, SINGLY OR INTERGROWN WITH QTZ., SER. ALL ALTN. EXC. CALCITE CEMENT PREDATES ALLUVIAL DEPOSITION.

Mineralization: Manganese oxide throughout hole as irregular to dendritic films and crusts on individual

* PREDATES ALLUVIAL DEPOSITION

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 14
CHIP LOG Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA



Refer to accompanying lithologic composition sheets for percentages of rock types in individual samples.

DESCRIPTIONS

Logged by J. Hulen

grains and on calcite cement. MnOx post-dates alluvial deposition. Goethite and hematitic goethite occur as powdery to resinous films and crusts and commonly botryoidal crusts adhering to individual fragments and grains and as cement binding two or more grains together — also as a stain in and around mafic minerals. Larger clots of this FeOx commonly are magnetic — incorporate partially oxidized magnetic fragments. Some of the FeOx may be derived from rusting of steel lids on mason jars in which the samples were originally stored.

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 14
CHIP LOG Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA

* PREDATES ALLUVIAL DEPOSITION

UURI — EARTH SCI. LAB

LITHOLOGY, ESTIMATED VOLUME PER CENT — Logged by J. Hulen

DEPTH	BTE.-HBL. QTZ. MON. & INDIVIDUAL GRAINS AND FRAGMENTS OF QTZ, KSPAR, PLAG, BTE., HBL., MAGNETITE-ILMENITE & SPHENE		FINE-X'LINE BTE. HBL. GRD. GNEISS >15% HBL	APLITE & APLITE PORPHYRY		BIOTITE SCHIST & GNEISS	BIOTITE-SILLIMANITE SCHIST	RHYOLITE & PORPHYRITIC RHYOLITE	PERLITE, PUMICE, OBSIDIAN		ANDESITE & ANDESITE PORPHYRITIC EQUIVALENTS		QTZ.-CHT. ROCK		
10'	97					1		1	1						
20'				5		Tr.?		10	2						
30'	97							2	1						
40'	87		Tr	1		Tr.?		7	5						
50'	90		1	Tr.		1		5	3						
60'	89			1		4		5	1						
70'	95			Tr.		Tr.		3	2						
80'	92			Tr.		Tr.		3	5						
90'	78							7	15						
100'	79							7	12						
110'	94							3	3						
120'	95							2	3						
130'	87					4	1?	3	5						
140'	94		Tr.			Tr.		2	4						
150'	91		Tr.			3		4	2						
160'	93		3	Tr.?		1		1	2						
170'	93		2			2		1	2						
180'	95		1			1		1	2						
190'	96		Tr.			1	Tr.?	Tr.	3						
200'	96		Tr.			Tr.		1	3						
210'	99					1		Tr.	Tr.						
220'	97		1	Tr.		2			Tr.						
230'	97		2			1	Tr.				Tr.		Tr.		
240'	98		1			1					Tr.				
250'	97		Tr.			1		Tr.	2						
260'	99		1			Tr.			Tr.		Tr.		Tr.		
270'	99		Tr.			Tr.	Tr.		1						
280'	97		Tr.			1		Tr.	2?						
290'	98		1?			1	Tr.		Tr.?				Tr.		
300'	96		2?			1		Tr.	1						
310'	98		Tr.	Tr.		1	Tr.	1	Tr						
320'	100		Tr.			Tr.									
330'	100		Tr.			Tr.	Tr.	Tr.					Tr.		
340'	96		1	1		1	1		Tr.						
350'	99		Tr.	Tr.		Tr.	Tr.	Tr.	1						
360'	98			Tr.		1	Tr.	Tr.			1				
370'	99		Tr.			1	Tr.				Tr.				
380'	99		Tr.			1	Tr.		Tr.						
390'	99		1			Tr.	Tr.	Tr.	Tr.						
400'	90		2	1		1	Tr.	3	3		CAVE?				
410'	100		Tr.			Tr.		Tr.	Tr.						
420'	100		Tr.	Tr.		Tr.		Tr.	Tr.						
430'	100		Tr.			Tr.		Tr.	Tr.				Tr.		
440'	100					Tr.		Tr.							
450'	100		Tr.?			Tr.		Tr.?					Tr.		
460'	100		Tr.			Tr.		Tr.	Tr.				Tr.		
500'	98					1		1	Tr.				Tr.		
510'	100		Tr.			Tr.									
520'	99		1			Tr.		Tr.							
530'	96		2			1	Tr.	1	Tr.				Tr.		
540'	97		1			Tr.		2	Tr.				Tr.		

ROOSEVELT HOT SPRINGS KGRA

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 4
ESTIMATED LITHOLOGIC COMPOSITION OF INDIVIDUAL SAMPLES
Binocular Microscopic Examination

Logged by J. Hulen

GRAPHIC LOGS

DEPTH (Feet)

ALTERATION (1. WEAK 2. MOD. 3. STRONG): 1ST | 2ND | 3RD | 4TH | 5TH | 6TH | $CO_3^=$ 1ST

GOETHITE & HEMATITIC GOETHITE est. vol. % 0.50 1.00

POWDERY BRICK RED HEMATITE est. vol. % 0.50 1.00

GRAPHIC GEOLOGY

10' 20' 30' 40' 50' 60' 70' 80' 90'

DESCRIPTIONS

0-10': CALCAREOUS, SLIGHTLY SANDY TO GRAVELLY SILT. DOMINANTLY SILT PARTIALLY CEMENTED W/BUFF CRYPTO-CRYSTALLINE CALCITE. A FEW SAND- TO FINE GRAVEL-SIZE PARTICLES OF VESICULAR PPYTIC BASALTIC ANDESITE, AS WELL AS QTZ. & FSP DERIVED FROM QTZ. MONZ. (?) (TO SUBANGULAR)

10-90': VESICULAR PORPHYRITIC BASALTIC ANDESITE. ANGULAR FRAGMENTS UP TO 25 mm. DIA. CONSISTING OF 1-3% EUH.-SUBH. PLAG. PHENOS, 0-0.5% IRREG. QTZ. XENOCRYSTS (?) UP TO 3 mm. DIA. EMBEDDED IN MED.-DK. GRAY APHANITIC TO MICROCRYSTALLINE MATRIX WHICH APPEARS TO BE A FELTED MASS OF PLAG. LATHS. VESICULARITY HIGHLY VARIABLE, FR. 1% TO AT LEAST 40%. VESICLES ARE IRREGULAR TO ROUND (SPHERICAL) & ARE COMMONLY LINED W/EUH. TRANSP.-TRANSL. WHITE XLS. VESICLE % DIMINISHES IN GENERAL W/DEPTH, SUGGESTING THAT HOLE PENETRATES FROTHY UPPER PORTION OF FLOW, THEN ENTERS ITS DENSER INNER PORTION.* QTZ. XENOCRYSTS (?) COMMONLY SURROUNDED BY NARROW, IRREG. REACTION RIMS (?)

ALTERATION, MINERALIZATION: CALCITE OCCURS AS IRREG. CRUSTS & VNLTS. ON INDIVIDUAL FRAGMENTS & AS PARTIAL VESICLE FILLINGS NEAR OUTER SURFACE OF FRAGMENTS. GOETHITE & HEMATITIC GOETHITE OCCUR AS PARTIAL REPLACEMENTS OF MAGNETIC FRAGS. BRICK RED HEMATITE TOTALLY STAINS SOME FRAGS., PARTIALLY STAINS OTHERS, OCCURS AS A THIN FILM ON YET OTHERS.

*Alternatively, upper portion of drill hole could penetrate a cinder deposit.

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 18
CHIP LOG Binocular Microscopic Examination
ROOSEVELT HOT SPRINGS KGRA

UURI - EARTH SCI. LAB.

LITHOLOGY, ESTIMATED VOLUME PER CENT — Logged by J. Hulen

DEPTH (Feet)	QTZ. & FSP. GRAINS	UNIDENTIFIABLE CLAY & SILT-SIZE PARTICLES									PORPHYRITIC BASALTIC ANDESITE				
10'	5?	85									10?				
20'											100				
30'											100				
40'											100				
50'											100				
60'											100				
70'											100				
80'											100				
90'											100				

ROOSEVELT HOT SPRINGS KGRA

GEOTHERMAL POWER CORPORATION DRILL HOLE GPCR No. 18

ESTIMATED LITHOLOGIC COMPOSITION OF INDIVIDUAL SAMPLES

Binocular Microscopic Examination

DISTRIBUTION LIST

External

M.J. Adair	Bechtel, Inc., San Francisco, CA.
Usman Ahmed	Terra Tek, Salt Lake City, UT.
A.G. Alpha	Mobil Oil Corp., Denver, CO.
David N. Anderson	Geothermal Resources Council, Davis, CA.
R.J. Andrews	Rocky Mountain Well Log Services, Denver, CO.
James K. Applegate	Boise State University, Boise, ID.
Sam Arentz, Jr.	Steam Corporation of America, Salt Lake City, UT.
Ted Arnow	USGS, WRD, Salt Lake City, UT.
David J. Atkinson	Hydrothermal Energy Corp., Los Angeles, CA.
Carl F. Austin	Geothermal Technology, NWC, China Lake, CA.
Lawrence Axtell	Geothermal Services, Inc., San Diego, CA.
Charles Bacon	USGS, Menlo Park, CA.
Larry Ball	DOE/DGE, Washington, DC.
Ronald Barr	Earth Power Corporation, Tulsa, OK.
Michael L. Batzle	Massachusetts Institute of Technology, Cambridge, MA.
H.C. Bemis	Fluid Energy Corporation, Denver, CO.
Harry Beyer	Consultant, El Cerrito, CA.
Gene Bickham	Scientific Software Corp., Denver, CO.
Sv. Bjornsson	Science Institute, Univ. of Iceland, Reykjavik, Ice.
David D. Blackwell	Southern Methodist University, Dallas, TX.
Gunnar Bodvarsson	Oregon State University, Corvallis, OR.
C.M. Bonar	Atlantic Richfield Co., Dallas, TX.
David Boore	Stanford University, Stanford, CA.
Francis Bostick	University of Texas, Austin, TX.
W. Clifford Bourland	Phillips Petroleum Co., Bartlesville, OK.
Roger L. Bowers	Hunt Energy Corporation, Dallas, TX.
A.J. Brinker	Al-Aquitaine Exploration, Ltd., Denver, CO.
Gerald Brophy	DOE/DGE, Washington, DC.
Mark Brown	Mountain States Resources, Salt Lake City, UT.
William D. Brumbaugh	Conoco, Ponca City, OK.
Larry Burdge	EG&G Idaho, Idaho Falls, ID.
David R. Butler	Chevron Resources Co., San Francisco, CA.
Scott W. Butters	Terra Tek, Salt Lake City, UT.
John Callander	University of New Mexico, Albuquerque, NM.
Donald Campbell	Republic Geothermal, Inc., Santa Fe Springs, CA.
Glen Campbell	Gulf Min. Resource Company, Denver, CO.
Tom Campbell	Republic Geothermal, Inc., Santa Fe Springs, CA.
Tom Cassel	FELS Center of Govt., Univ. of Pa., Philadelphia, PA.
Harry M. Castrahtus	FMC Corp., Princeton, NJ.
Philip R. Chandler	Geoscientific Systems & Consulting, Playa del Rey, CA.
L. Chaturvedi	New Mexico State University, Las Cruces, NM.
H. T. Chiu	Chinese Petroleum Corp., Miaoli, Taiwan, Republic of China
Bob Christiansen	USGS, Menlo Park, CA.
Eugene V. Ciancanelli	Consulting Geologist, San Diego, CA.
Heber Cinco	Stanford University, Stanford, CA.
Jim Combs	Geothermal Services, Inc., San Diego, CA.

F. Dale Corman	O'Brien Resources, Inc., Kentfield, CA.
Ritchie Coryell	National Science Foundation, Washington, DC.
R. Corwin	University of California, Berkeley, CA.
James Cotter	DOE/NV, Las Vegas, NV.
R. A. Crewdson	Occidental Geothermal, Bakersfield, OK.
Gary Crosby	Phillips Petroleum Company, Bartlesville, OK.
Gustavo Cuellar	CEL, San Salvador, El Salvador
Charles G. Cunningham	USGS, Denver, Co.
K.R. Davis	Thermal Power Company, San Francisco, CA.
Ed Decker	University of Wyoming, Laramie, WY.
Jere Denton	Southland Royalty Company, Fort Worth, TX.
Jay D. Dick	Chaffee Geothermal, Ltd., Denver, CO.
William Dolan	Amax Exploration Inc., Denver, CO.
W. F. Downs	Idaho National Energy Lab., Idaho Falls, ID.
Earth Sciences Division Library	Lawrence Berkeley Laboratory, Berkeley, CA.
Robert C. Edmiston	Anadarko Production Co., Houston, TX.
Wilf Elders	University of California, Riverside, CA.
Samuel M. Eisenstat	Geothermal Exploration Company, New York, NY.
M.C. Erskine, Jr.	Eureka Resource Associates, Berkeley, CA.
Domenic J. Falcone	Geothermal Resources International, Marina del Rey, CA.
Glen Faulkner	USGS, Water Resources Division, Menlo Park, CA.
Val A. Finlayson	Utah Power and Light Company, Salt Lake City, UT.
Joseph N. Fiore	DOE/NV, Las Vegas, NV.
Milton Fisher	New York City, NY.
Robert T. Forest	Phillips Petroleum Company, Reno, NV.
Robert O. Fournier	USGS, Menlo Park, CA.
Frank Frischknecht	U.S. Geological Survey, Denver, CO.
Gary Galyardt	U.S. Geological Survey, Denver, CO.
N.E. Goldstein	Lawrence Berkeley Laboratory, Berkeley, CA.
Steven M. Goldstein	The Mitre Corporation, McLean, VA.
Bob Greider	Intercontinental Energy Co., Denver, CO.
John Griffith	DOE/ID, Idaho Falls, ID.
D. L. Gustafson	Homestake Mining Co., Reno, NV.
J.H. Hafenbrack	Exxon Co. USA, Denver, CO.
W.R. Hahman	Arizona Bureau of Geology & Mineral Technology Tucson, AZ.
Burns S. Hansen	General Electric Company, Salt Lake City, UT.
Dee C. Hansen	Utah State Engineer, Salt Lake City, UT.
V. Noble Harbinson	O'Brien Resources, Incorporated, Toronto, Ontario, Canada.
Norman Harthill	Group Seven, Incorporated, Golden, CO.
Charles E. Helsley	University of Hawaii, Honolulu, HI.
Margaret E. Hinkle	USGS-Exploration Research, Golden, CO.
David T. Hodder	Esca-Tech Corp, Playa del Rey, CA.
Albert T. Holmes	EMMA, San Francisco, CA.
Donald B. Hoover	USGS, Golden, CO.
John V. Howard	Lawrence Berkeley Laboratory, Berkeley, CA.
Don Hull	Oregon Dept. of Geology & Mineral Industries, Portland, OR.
Gerald W. Huttrer	Intercontinental Energy Corporation, Englewood, CO.

Joy Hyde	CER Corp., Las Vegas, NV.
William F. Isherwood	USGS, Menlo Park, CA.
Jimmy J. Jacobson	Battelle Pacific Northwest Labs., Richland, WA.
Laurence P. James	Consultant, Denver, CO.
Richard W. James	OIT/DOE, Klamath Falls, OR.
Allan Jelacic	DOE/DGE, Washington, DC.
George R. Jiracek	University of New Mexico, Albuquerque, NM.
Richard L. Jodry	Richardson, TX
William L. Jones	Logan, UT.
Lewis J. Katz	Utah Geophysical, Incorporated, Salt Lake City, UT.
Paul Kasameyer	Lawrence Livermore Laboratory, Livermore, CA.
George Keller	Colorado School of Mines, Golden, CO.
Paul Kintzinger	Los Alamos Scientific Laboratory, Jemez Springs, NM.
John W. Knox	Sunoco Energy Development Company, Dallas, TX.
James B. Koenig	Geothermex, Berkeley, CA.
Robert P. Koeppen	Oregon Institute Technology, Klamath Falls, OR.
Frank C. Kresse	Harding-Lawson Associates, San Rafael, CA.
Jay Kunze	EG&G, Idaho Falls, ID.
Mark Landisman	University of Texas, Dallas, Richardson, TX.
Art Lange	AMAX Exploration, Incorporated, Denver, CO.
D. Larsen	Consultant, Washington, DC.
A.W. Laughlin	Los Alamos Scientific Laboratory, Los Alamos, NM.
Guy W. Leach	Oil Development Company of Texas, Amarillo,TX.
Richard C. Lenzer	Phillips Petroleum Company, Salt Lake City, UT.
Linda Lewis	Mobil Oil Corp., Denver, CO.
Paul Lienau	OIT, Klamath Falls, OR.
Mark A. Liggett	Cyprus Georesearch Company, Los Angeles, CA.
Jack J. Loo	Dept. of Navy, San Bruno, CA.
Don Mabey	USGS, Salt Lake City, UT.
Martin Malloy	DOE/DGE, San Francisco, CA.
Larry D. Mann	U.S. DOE, Seattle, WA.
Skip Matlick	Republic Geothermal, Santa Fe Springs, CA.
Mark Matthews	Los Alamos Scientific Laboratory, Los Alamos, NM.
Mayor Duane May	City of Monroe, Monroe, UT.
James O. McClellan	Geothermal Electric Systems Corporation, Salt Lake City, UT.
Robert B. McEuen	Woodward Clyde Consultants, San Francisco, CA.
Don C. McMillan	Utah Geological & Mineral Survey, Salt Lake City, UT.
J.R. McNitt	Energy and Mineral Development Branch, United Nations, NY.
Tsvi Meidav	Consultant, Berkeley, CA.
Frank G. Metcalfe	Geothermal Power Corporation, Novato, CA.
Richard J. Miller	Pacific Resources Mgmt., Los Angeles, CA.
Roy Mink	DOE/ID, Idaho Falls, ID.
John Mitchell	Idaho Dept. of Water Resources, Boise, ID.
Charles Morse	System Development Corp., Santa Monica, CA.
L.J. Patrick Muffler	USGS, Menlo Park, CA.
Charles W. Naeser	USGS-DFC, Denver, CO.
Manuel Nathenson	USGS, FGG, Menlo Park, CA.
Clayton Nichols	DOE/ID, Idaho Falls, ID.

Dianne R. Nielson	Consultant, Salt Lake City, UT.
Dick Nielson	Anaconda-Mineral Resources Group, Denver, CO.
H.E. Nissen	Aminoil USA, Houston, TX.
Denis Norton	University of Arizona, Tucson, AZ.
William B. Nowell	Phillips Petroleum Co., Salt Lake City, UT.
Carel Otte	Union Oil Company, Los Angeles, CA.
G. Palmason	Orkustofun, Reykjavik, Iceland.
Richard H. Pearl	Colorado Geological Survey, Denver, CO.
Wayne Peeples	Southern Methodist University, Dallas, TX.
Dean Pilkington	AMAX Exploration Inc., Denver, CO.
R. E. Plumb	Mobil Oil Corp., Denver, CO.
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.
M.C. Smith	Los Alamos Scientific Laboratory, Los Alamos, NM.
H.W. Smith	University of Texas, Austin, TX.
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.
Thomas A. Stevens	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.
Bernard Tillement	Al-Aquitaine Company of Canada, Calgary, Canada.

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.
Gerald D. VanVoorhis	Bear Creek Mining Co., Tucson, AZ.
Jack Von Hoene	Davon, Inc., Milford, UT.
Anthony Veneruso	Sandia Laboratory, Albuquerque, NM.
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.
James A. Whelan	Naval Weapons Center, China Lake, CA.
J. H. Wherry	Author, Puyallup, WA.
Donald E. White	USGS, Menlo Park, CA.
Syd Willard	California Energy Commission, Sacramento, 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

W. Ursenbach	UURI, Salt Lake City, UT.
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.
D.L. Nielson	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.
Master Report File	ESL/UURI, Salt Lake City, UT.