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GeothermEx, Inc.

SUITE 201
5221 CENTRAL AVENUE
RICHMOND, CALIFORNIA 94804

(415) 527-9876
CABLE ADDRESS: GEOTHERMEX
TELEX: 709152 STEAM UD
FAX: (415) 527-8164

SALTON SEA SCIENTIFIC DRILLING PROGRAM

GEOLOGIC INTERPRETATION

OF

WELL STATE 2-14

for

BECHTEL NATIONAL, INC.

SAN FRANCISCO, CALIFORNIA

Phase 1

by

GeothermEx, Inc

Richmond, California

June 1986

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1. GEOLOGIC SETTING

1.1 Introduction

Well State 2-14, drilled under the auspices of the Salton Sea Scientific Drilling Project (SSSDP), is located on the southeast shore of the Salton Sea in the SE quarter of Section 14, T. 11 S., R. 13 E. This is an area of intense seismic activity, recent earth movements, and high heat flow. Temperatures of 337°C were measured in the River Ranch #1 well, 0.8 km southeast of the SSSDP. The Salton Buttes, a chain of Quaternary rhyolite domes, lie 2 km to the northwest of the Project Area. The Salton Buttes area is a postulated "spreading center", a zone of crustal extension into which new molten material is being emplaced.

The Salton Trough is a Late Tertiary-quaternary sediment-filled extension of the Gulf of California rift, extending 300 km from the head of the Gulf to San Gorgonio Pass (figure 1). The trough contains the Imperial and Mexicali Valleys, the Coachella Valley, and the Salton Sea. The delta of the Colorado River crosses the trough from Yuma, Arizona, isolating its northwest portion from the Gulf of California. This closed sedimentary basin northwest of the delta crest is known as the Salton Basin. The Salton Trough is bounded by mountain ranges which consist mainly of Mesozoic and older plutonic, metasedimentary and metavolcanic rocks, locally overlain by Cenozoic lavas.

1.2 Sedimentary History

Sedimentation in the Salton Trough has been dominated throughout its Late Tertiary history by deposition in the Colorado River delta. The

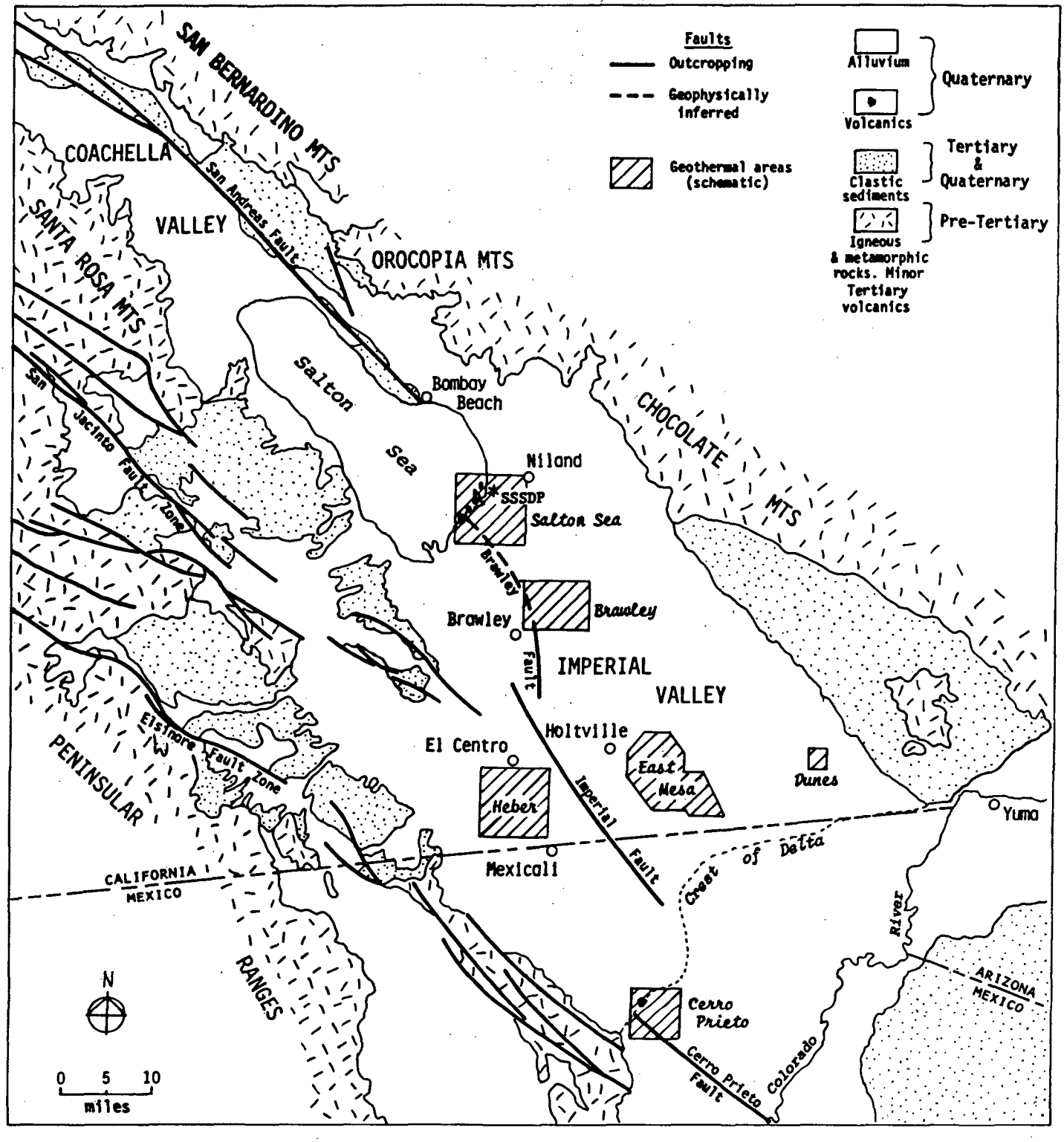

Figure 1. Generalized geology of the Salton Basin (after Robinson, et. al., 1976)

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sediments are a complex section comprised of intertonguing deposits of continental, marine, deltaic and lacustrine origin. Detailed stratigraphic relationships within the sedimentary section are poorly-known, due to the lack of useful fossils and the rapid facies changes which occur in this environment. The main lithologies in the axial part of the basin are claystone, siltstone, and sandstone.

The deepest well in the basin, Wilson #1, drilled to 4,097 m, 10 km southeast of Brawley, penetrated a sequence of fine sandstone to siltstone similar to modern Colorado River sediments (Muffler & Doe, 1968). Coarse clastic material occurs in great proportion toward the basin margins and southward toward the delta crest.

Maximum marine submergence occured during the Pliocene. In mid-Pleistocene, probably during low sea levels that characterized glacial epochs, the delta built across the trough, isolating the Salton Basin from the Gulf of California (Van DeKamp, 1973). At that time, the northern Salton Trough became a sub-sea level enclosed basin.

The Colorado River delta has alternately drained northward and southward. At times, its distributaries have emptied northward, filling the Salton Basin. When drainage has been to the south, into the Gulf of California, lakes in the Salton Basin have shrunk. Currently, the Colorado River drains southward, and under natural conditions the Salton Sea would evaporate. Instead, lake level is rising, due to the current influx of irrigation water.

Holocene sedimentary rocks in the Salton Basin can be divided into three facies (Van DeKamp, 1973). A central lacustrine facies consists of

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mud and silt, which become coarser-grained toward the basin margins. Evaporites are common, and bedding is often disturbed by animal burrows. Fluctuations in lake level caused intertonguing of the lacustrine materials with coarser basin margin sediments. Meandering stream channels formed sand and silt bodies within the lacustrine muds. Alluvial fans and braided streams deposit boulders and gravels at the base of the surrounding mountains, but grain size decreases rapidly toward the center of the basin. These locally derived sediments have compositions different from those deposited by the Colorado River.

The most significant features of the Holocene sediments are the abrupt facies changes and the variety of sedimentary environments present in small areas. These changes make correlating units difficult.

Before significant quantities of irrigation water began to enter the basin in 1901, the Salton Sea was a playa known as the Salton Sink. An uncontrolled diversion of the Colorado River in 1905-1907 raised the lake surface to -60 m, its highest modern level (Littlefield, 1966). The current lake level is about -70 m. Wave-cut terraces at elevations of +12 m were formed by Lake Cohuilla, the last natural basin-filling lake, which existed until about 300 years ago (Van DeKamp, 1973).

1.3 Quaternary Volcanism

Four small rhyolite domes known as the Salton Buttes are the only surfice evidence of recent volcanism in the Salton Basin. The domes are aligned along a 7 km long northeasterly trend. From the southwest they are: Obsidian Butte, Rock Hill, Red Hill, and Mullet Island. Red Hill is 2.9 km southwest of the SSSDP. A K-Ar age of 16,000 years was obtained from samples of Obsidian Butte. Three of the domes are discharging minor

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amounts of gas from cracks and joints (Muffler and White, 1969). Units of basaltic rocks are not exposed at the surface, but occur as xenoliths in the domes and as dikes or sills encountered in the State 2-14 and other wells.

1.4 Diagenesis, Metamorphism and Mineralization

Muffler and Doe (1968) identified the original detrital mineralogy of the Colorado River sediments as predominantly quartz, calcite, dolomite, plagioclase feldspar, K-feldspar, montmorillonite, illite and kaolinite.

Burial, heating and mineralizing fluids cause pronounced changes in sediments deposited in the Salton Basin. The first detailed work on alteration was done by Muffler and White (1969). Some of these changes are visible megascopically while others are not; their effects on the the geothermal reservoir are of great importance.

Diagenesis

Diagenesis is a process whereby detrital minerals are altered in place, at relatively low temperatures. The diagenetic process grades into metamorphism, but the term is generally applied to reactions taking place below 200°C.

Diagenesis is important in geothermal reservoirs because one of its products is secondary cement, which destroys the initial porosity of reservoir sands. In the Salton Basin, two main types of cement produce this "self-sealed caprock". Most important is calcite, which may be produced along with chlorite, at temperatures as low as 125°C (Muffler and White, 1969). A second diagenetic cement is pyrite, produced by reduction of iron from iron-bearing detrital minerals (McKibben & Elders, 1985).

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Temperatures in the 200-300°C range may destroy the diagenetic cement, producing secondry porosity in a "main reservoir" (McKibben and Elders, 1985). Pyrite cement breaks down and large pyrite porphyroblasts form at its expense. Calcite cement is destroyed by progressive decarbonation, producing CO_2 gas.

Metamorphism

Deeply buried sediments in the Salton Basin belong to the "greenschist metamorphic facies". In its strict sense, metamorphism is "isochemical"; that is, there is no change in the bulk composition of the rocks, and water serves only to break chemical bonds and speed up reactions.

In the Salton Sea field, the process is better referred to as "metasomatism" or "hydrothermal metamorphism". Major changes in bulk sediment composition are brought about by reaction with a hot, saline, metal-rich brine.

The major effect of temperatures above about 300°C is the gradual sealing of pores by new minerals and by silica overgrowths (McDowell and Elders, 1983). One destructive metamorphic mineral is epidote, which forms at the expense of calcite, at about 290°C (Muffler and White, 1969; Younker et al., 1982).

Metamorphism also produces progressive changes in mineralogy. The metamorphic mineral assemblage in a well may reveal the highest rock-fluid equilibrium temperature reached. This may not be the present temperature. McDowell & Elders (1980) have described mineral assemblages found in Elmore #1, 4.25 km south of State 2-14. The "dolomite-ankerite zone" is found at

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temperatures below 190°C. Minerals of the "calcite-chlorite zone" form between 190° and 325°C, and include calcite, quartz, epidote, pyrite, sphalerite and anhydrite. Biotite, quartz, epidote, actinolite, pyrite, anhydrite and sphalerite are found in the "biotite zone", at temperatures of 325°-360°C. In the "garnet zone", andradite garnet appears, at temperatures greater than 360°C. No garnets were observed in State 2-14, but if present, they probably would not be megascopically discernible.

Mineralization

Fracturing and vein-related mineralization are important in geothermal reservoirs because fractures are a "renewable" source of permeability. Deposition of vein minerals tends to seal fractures, but tectonic or hydraulic stresses can reactivate filled fractures, or open new ones. Below the depth at which epidote seals the pores in sandstones, fractures are the sole source of permeability.

McDowell and Elders (1985) have identified two main vein filling assemblages in Magmamax #2 and River Ranch #1. These are the "sulfide-carbonate-silicate" assemblage and the "hematite-silicate-sulfide-sulfate" assemblage. Their work suggests that the "hematite-silicate-sulfide-sulfate" is the younger, and is in equilibrium with the current geothermal brines at approximately 300°C. The first appearance of hematite in veins occurs between 3,075 and 3,600 feet (937-1,097 m) in Magmamax #1, Magmamax #2, River Ranch #1, Sportsman #1, IID #1, and IID #2 (McKibben and Elders, 1985). The first appearance of vein hematite in State 2-14 is at about 3,050 feet (930 m).

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1.5 Tectonics

The Salton Trough occupies a unique position in the zone of transition between the divergent plate margin of the East Pacific Rise and the strike-slip San Andreas Fault System on the continent. In the Gulf of California, short spreading centers are offset by right-stepping transform faults trending northwest. Lomnitz and others (1970) suggested that the tectonics of the Salton Trough could be viewed in the same context by assuming that the right-lateral faults were transforms, offsetting short spreading centers at Cerro Prieto and the Salton Buttes. Elders and others (1972) refined the model. They suggested that active spreading occurs in "tensional gaps" between offset segments of strike-slip faults. Such tensional gaps would be loci of volcanism, normal faulting and high heat flow. The Imperial Valley and Cerro Prieto lie between offset segments of major strike-slip faults (fig.1), and it has been suggested that there are spreading centers at the Salton Buttes, Brawley, and Cerro Prieto.

Accurate land surveying in the Imperial Valley began in 1934. Since then, there has been a total of about 2 m of right-lateral movement in the valley, and the valley floor has subsided by tens of centimeters (Elders, et al., 1972).

The southern Salton Basin has been the site of more small to moderate earthquakes than any other section of the San Andreas Fault System. Most of this activity has been on the Imperial, Brawley, and San Jacinto faults. Seismic activity has been conspicuously low eastward of the Imperial Fault (Hill, et al., 1975). In addition to lack of seismicity, no surface evidence for movement on the San Andreas Fault is found southward of Bombay Beach (Sharp, 1982).

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The proposed tensional gap between the San Andreas and Imperial Faults (figure 1) is, in fact, a region of high heat flow and recent volcanism, and it is also the site of the greatest seismic activity in the Imperial Valley. Known as the Brawley Seismic Zone, this locus of seismicity trends N20°W across the gap. Most of the motion along the N20°W trend appears to be right-lateral strike-slip.

Within the Brawley Seismic Zone, several short lineations trend northeastward, and involve normal faulting (Johnson & Hadley, 1975; Gilpin & Lee, 1978; Fuis, et al., 1982). These northeast-trending zones may be sites of extension and intrusion. One of these northeast lineations passes under Red Hill and near State 2-14.

The Brawley Fault (fig. 1) is defined by seismicity and by ground breakage during recent earthquakes. Motion on the Brawley Fault is predominantly right-lateral. Accurate triangulation indicates that during the period 1934-1972, the benchmark on Red Hill moved 15 cm south-southeastward, relative to the benchmark on Obsidian Butte (Savage, et al., 1974). Seismicity indicates that the north end of the Brawley Fault passes approximately through Obsidian Butte (Gilpin & Lee, 1978).

Folding is also common in the Imperial Valley, with the greatest deformation (for example, overturned folds) found near faults. Folded Late Cenozoic rocks are found on the East and West Mesas. On the margins of the southern Salton Sea, Pleistocene rocks are uplifted and eroded. Former shorelines of Lake Cahuilla are also warped, indicating that folding has continued into recent times.

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1.6 Geophysics

The Salton trough is characterized by a gravity high, despite its thick sedimentary fill. The low density fill in the upper part of the section is probably compensated for by alteration and by intrusion of mafic rocks and depth. Seismic refraction studies (Fuis, et al., 1982) reveal a sedimentary trough, 10-16 km deep at its axis. The upper 6 km appears to be normal to moderately altered sedimentary rocks, overlying a "basement" of sedimentary rocks thoroughly altered to greenschist facies metamorphic rocks. The whole sedimentary trough is apparently underlain by a "sub-basement" of mafic intrusive rock.

A prominent magnetic high trends northwestward from Calipatria, with a superimposed northeast-trending anomaly in the vicinity of the Salton Buttes. Griscom and Muffler (1971) believe the northwest-trending magnetic high represents intrusive rocks buried at least 2 km, while the northeast trend represents shallower dikes and sills.

A contour map of electrical conductance (Kasameyer et al., 1984) based on resistivity surveys by Meidav and others (1976) shows a high conductance (low resistivity) zone centered approximately on the Salton Buttes. Low resistivity results from saturation of porous rocks by high temperature and salinity brines.

1.7 Surface Manifestations of the Geothermal System

There are no surface manifestations for most of the geothermal fields in the Salton Trough. The Salton Sea and Cerro Prieto fields, however, are associated with Quaternary volcanoes, warm springs, and mud pots formed by escaping CO_2.

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Two areas of weak warm springs are aligned along northwest trends at the Salton Sea field. Major warm spring activity was centered 1.5 km southeastward of Mullet Island, but is now submerged by the Salton Sea. The SSSDP is approximately on this trend, 3.2 km southeastward of Mullet Island. The second alignment is northeastward, between the SSSDP and Niland, on the projection of the San Andreas fault. Both of these thermal areas are thought to represent warm waters ascending along faults. Mud pots are common in the area, and numerous abandoned carbon dioxide wells are found less than 3 km north of State 2-14.

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2. GEOLOGY OF WELL STATE 2-14

2.1 Introduction

Cuttings and cores were examined in the field and in the laboratory, using hand lens (10x) and binocular microscope (30x). Many detrital and metamorphic minerals are too small to be identified by these magnifications, but some important metamorphic processes can be recognized by color changes, or with simple chemical tests.

The stratigraphy based on cuttings was compared to a suite of geophysical logs covering the interval 1,032-6,000 feet. The geophysical logs suggest that sandstone may be slightly underestimated in cuttings descriptions, and claystone slightly overestimated.

GeothermEx geologists were on-site until 12/9/85, when the well reached a depth of 6,000 feet. Samples from below 6,000 feet were periodically shipped to the GeothermEx offices in Richmond, California, along with drilling supervisors' reports and mud logs. Interpretations from depths below 6,000 feet were difficult to confirm because no geophysical logs were available, some useful descriptions were not recorded in the field, and some samples had been mislabeled.

can be correct.?

2.2 Summary of Lithology

Only two major sedimentary rock intervals can be readily distinguished in the well section. The upper, consisting of poorly-indurated clay, silt, and sand, extends from the surface to about 1,100 feet depth. The detailed character of this interval is poorly-known, due

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to the limited sampling, lack of sample coherence, and the lack of geophysical log coverage. The lower unit, extending from a depth of about 1,100 feet to the total depth of the well, consists of an assemblage of alternating claystones, siltstones and sandstones. Many depositional and soft-sediment deformational structures are found throughout this section, consistent with deposition in a deltaic environment. No major stratigraphic breaks were observed in this section. Some of the most notable lithologic changes observed are those associated with changes in the intensity of alteration. Alteration is superimposed on, and partly controlled by, pre-existing sedimentary features. The following sub-divisions are based partly on variations in the original sedimentary rock, and partly on the character of the alteration.

180-1,100 feet: Clay, gray in color and calcareous. Occasional fragments of organic material and gastropod fossils. The clays are interbedded with minor fine sands and silts.

The effects of lithification were reflected in the drilling rate (Appendix C). In soft clays higher in the hole, the drilling rate often exceeded 400 ft/hr. By 900 feet depth, clays were compacted into claystones, and the drilling rate dropped to less than 100 ft/hr. Abrupt increases in drilling rate reflected operational conditions, rather than lithology.

Sediments in this interval appear to be equivalent to the Holocene lacustrine facies in the center of the basin.

1,100-2,630 feet: Lithology changed from lacustrine clays to siltstones and sandstones more characteristic of a fluvial-deltaic environment. The drilling rate increased from 100 ft/hr at 1,100 feet depth to 200 ft/hr at 1,120 feet depth, in response to the increase in sand content.

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The dominant lithology in cores 2 and 3 was calcareous medium gray claystone. Sandstone comprised 27 feet of the 30 foot length of core 3. The sandstone was calcareous and only slightly porous, apparently forming part of the "self sealed cap rock".

Minor veins were nearly vertical and less than 3 mm thick. Veins were either filled with calcite, or had calcite on vein walls, and sphalerite, galena and pyrite in the center.

The pit volume indicator was not operational until after the 13-5/8-inch casing point at 3,515 feet depth, but fluid losses were minor.

2,600-3,220 feet: Geophysical logs showed a change from claystone to siltstone or silty claystone at 2,600 feet depth, and a distinct drilling break occured at about the same depth. An increase in alteration accompanied the lithologic change. The most obvious change in the cuttings was color. Siltstones and silty claystones changed from gray to grayish green or green. Green siltstones were less calcareous than the gray. The color change is probably due to the formation of matrix chlorite too fine to be visible under the binocular microscope. Sandstones tended to be more friable than at shallower depths, apparently due to partial dissolution of calcite cement.

Traces of epidote were first seen in sandstones at 2,790 feet depth, while vein epidote first appeared at 2,760 feet depth. Depth to the first appearance of epidote in the Salton Sea field varies, from 2,660 feet in Magmamax #2 to 3,830 feet in Sportsman #1 (Younker, et al., 1982).

This altered zone marked the first appearance of major vein fillings. Vein filling above 2,630 feet depth was minor, and consisted of

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calcite ± sulfides. Vein fillings below 2,630 feet depth were more abundant, and in addition to calcite and sulfides, contained euhedral epidote, quartz and specular hematite.

Most veins were less than 1/2 inch (1 cm) thick, with attitude from vertical to steeply inclined. Commonly, the walls of the veins were epidote-lined, with calcite and sometimes sulfides, hematite or quartz in the center. This zoning may indicate reactivation of the fractures. The walls of some fractures were lined with epidote while the centers were partly filled with calcite and partly void. This suggests that (a) calcite vein filling postdates epidote vein filling, and (b) at least some fractures remain partly open.

Alteration was most developed in sandstones, with the calcite matrix partly dissolved and replaced by chlorite, epidote and sulfides. Apparently, mineralizing fluids rising along fractures had more access to the sand layers, due to their secondary porosity.

3,220-4,430 feet: The interval marked a return to non-permeable rocks, accompanied by a decrease in alteration. The most obvious evidence for the decrease in alteration was change in color, from green or greenish gray, back to gray. In core 6, the color change took place at 3,156 feet, where a dark gray claystone was separated from a green siltstone by a 37-foot thick sand layer. Geophysical logs showed a significant decrease in sand/silt content at depths varying from 3,220 to 3,250 feet. Claystone was the most common lithology in cuttings, with subordinate siltstones and sandstones. Core 8 contained a 10-foot sandstone layer, but most beds were less than one foot thick. Sedimentary structures were common and easily recognizable in the cores.

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Claystones and siltstones were calcareous and medium gray. Sandstones were tan to pale gray, with well developed calcite cement. Yellow-green patches in the matrix suggest alteration to epidote.

Fracture filling was scarce in cuttings. Rare calcite ± sulfide veins less than 1/4 inch (6 mm) thick were found in cores. Attitude of the veins ranged from near-vertical to horizontal. Minor vein epidote appeared in cores 10 and 11.

Circulation losses were nearly nil. The only measurable loss coincided with a sand layer at 4,150 feet depth. The lack of permeability reflects the scarcity of sandstone, the well-developed matrix cement, and the absence of fracturing.

4,430-5,150 feet: Basic lithology of cuttings remained the same as above; claystone with subordinate siltstone and fine sandstone. Geophysical logs showed interbedded claystone and siltstone, with a thick sandstone layer between 5,050 and 5,150 feet depth. The maximum thickness of sandstone seen in cores was 6 feet. There was a marked increase of vein filling and associated alteration from the last interval.

Claystone cuttings were light greenish gray, and slightly calcareous to non-calcareous. Sandstones were non-calcareous to slightly calcareous. Matrix alteration to epidote varied from partial to complete. Sandstones cut by veins showed the greatest alteration.

Fracture filling was found in all cuttings samples, and high-angle veins were pervasive in cores. Vein mineralogy was variable. Mineralogies included (a) epidote + calcite + specular hematitie ± chalcopyrite, (b) epidote + calcite, (c) specular hematite alone. Most veins were less than

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0.2 inches (5 mm) wide, with some up to 1 inch (2.5 cm) wide. Veins that appeared to be pure hematite cut epidote-bearing veins.

Small drilling breaks at depths of 4,470 to 4,490 feet and 5,020 to 5,080 feet coincided with fractured intervals. In spite of the evidence for pervasive fracturing, circulation losses were never more than 6 bbl/hr. An injection test was conducted on the interval 3,515 to 4,710 feet, with no evidence of significant permeability. Apparently the fractures are tightly sealed with vein minerals.

5,150-6,100: The section consisted of relatively slightly altered sediments. Claystones usually comprised over 70% of cuttings. On geophysical logs sands were subordinate, and present in beds less than 20 feet thick. A major sandy interval extended from 5,450 to 5,590 feet.

Claystones were light gray to greenish gray, and slightly calcareous. Sandstones showed more alteration, and were greenish-yellow and non-calcareous to slightly calcareous.

A one-foot thick layer of light gray, very fine grained material at 5,590 to 5,591 feet in core 16 has been tentatively identified as an air-fall tuff (J. Mehegan, personal communication). If confirmed, this may be a valuable stratigraphic marker within the basin.

Vein filling was scarce in cores. Most veins were less than 0.1 inch (22 mm) thick, and consisted of (a) epidote + hematite, (b) epidote + calcite, (c) calcite alone, (d) epidote alone. Cuttings from 5,450 to 5,470 feet depth had up to 10% epidote vein-filling material. Some of the epidote appeared to have grown into open vugs.

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Circulation losses were low. Penetration rates were constant at about 20 ft/hr, with a pronounced break to 80 ft/hr at 5,450 feet depth. Although epidote from this depth has grown into open vugs, the effect of the vugs on permeability is minor.

6,100-6,620: Cuttings from this interval were usually 70 to 100% hard, lithified claystones. Samples were medium gray to greenish gray, and slightly calcareous to non-calcareous. Sandstones were friable and usually non-calcareous. The matrix of most sandstones was variably altered to yellow-green epidote, and some contained euhedral epidote crystals in the matrix.

Cuttings from the interval 6,110 to 6,130 feet were as much as 40% open-textured, monomineralic masses of euhedral epidote. After the first flow test, pieces of the same material 0.75 inch (2 cm) in diameter were found 300 feet (100 m) beyond the end of the blooie line. This is the only porous interval between the flow test depth of 6,227 feet and the bottom of the 9-5/8-inch casing at 6,000 feet depth. The flow undoubtedly came from this epidote-rich zone.

Some circulation losses continued to 6,620 feet depth. Drilling breaks and minor zones of epidote veining indicated that additional fractures were present.

6,620-6,880: No returns. Core 19 consisted of gray claystone and non-calcareous sandstone. Both were cut by high-angle fractures filled with epidote + quartz $\pm$ chalcopyrite and pyrite.

Circulation loss at the top of the interval was due to fractures between 6,635 and 6,650 feet depth. An abrupt drilling break, from 30

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ft/hr, to 100 ft/hr and back to 30 ft/hr, coincided with the lost circulation zone.

6,880-8,090: Cuttings were over 90% claystones and silty claystones, except for the sandy interval between 7,380 to 7,410 feet depth. Vein filling was common between 7,730 and 7,900 feet depth, and consisted of epidote ± sulfide ± calcite ± fibrous white mineral which appears to be anhydrite. Cores 20 to 24 consisted almost entirely of argillized claystone, with high angle fractures filled with epidote and other minerals.

Fluid losses were variable. Loss rates of 80 bbl/hr between 7,000 and 7,110 feet depth were not accompanied by any drilling break or increase in vein filling. These losses may actually have been to the 6,635 to 6,650 foot lost circulation zone. Small fluid losses may have been associated with vein fillings at about 7,300 feet depth. Vein fillings of euhedral epidote appeared from 8,060 to 8,090 feet depth, and were probably associated with the loss of circulation at 8,090 feet depth.

8,090-8,160: No returns. Circulation was lost at the drilling break at 8,090 feet depth. The zone was not tested.

8,160-8,597: Lithologies in the upper part of this interval were predominantly metamorphosed claystones, gray to greenish-gray and non-calcareous. Sandstones increased below 8,280 feet depth, and are fine-grained, non-calcareous and non-porous. Several fracture filling mineral assemblages were found in the cuttings and in cores 25-27. These included (a) epidote + clear anhydrite ± chalcopyrite, (b) epidote + quartz, (c) epidote, (d) epidote + fibrous to earthy, white anhydrite(?), (e) quartz + clear anhydrite ± chalcopyrite.

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Mud losses were intermittant and variable, and were not associated with sand bodies or increases in vein filling. Complete loss of circulation accompanied a drilling break at 8,580 feet depth. Core 27 was cut with no returns, and gave no indication of the cause.

8,597-8,800: No returns. Mud losses were probably in a zone of rapid drilling between 8,580 and 8,825 feet depth.

8,800-8,920: Sample depths are questionable, as the samples sent to GeothermEx were mislabeled (see Appendix A). The interval appeared to be mostly metamorphosed claystones with subordinate fine sandstones. Fracture filling was minor. Increases in drilling rate depths of 8,830 and 8,880 feet may have represented short fractured intervals.

8,920-9,050: No samples received by GeothermEx (see Appendix A).

9,050-9,250: Predominantly metamorphosed claystones. A pronounced interval of fracture filling from 9,080(?) to 9,110 feet depth was composed of euhedral epidote with subordinate quartz. The exact upper boundary as seen in cuttings was uncertain, because of mislabeling. Drilling rates were high and variable from 9,095 to 9,125 feet depth, and probably represented the main fractured interval. Fragments of vein material in samples from 9,125 to 9,250 feet depth probably were also from this interval. Partial fluid losses occured in the interval.

9,250-9,440: The proportion of sandstone increased greatly, to approximately 50% sandstone and 50% claystone. The sands were hard, epidotized and non-porous.

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Mud losses were variable in the interval, and show no correlation with sand content and vein mineralogy. The well was flowing, probably from one of the higher fracture zones, during a trip from 9,254 feet depth.

9,440-9,580: Mafic intrusive rocks. Comparison of cores, cuttings and drilling rates indicated two intrusive bodies; one at 9,443 to 9,450 feet depth, and another at 9,505 to 9,520 feet depth. Both were cut by high angle veinlets of epidote + sulfide + quartz + dark green, prismatic actinolite(?). This was the first appearance of actinolite, indicating a temperature of at least 340°C (McDowell and Elders, 1980). A fibrous white mineral which may be tremolite appeared at a shallower depth (7,870 feet), but could not be identified with certainty.

9,580-10,460: The sequence continued to be predominantly metamorphosed claystones with beds of epidotized sand. Fracture fillings of euhedral epidote ± clear anhydrite were found at depths of 9,700 to 9,720 feet and 9,910 to 9,920 feet. Circulation losses were minimal. There appear to have been no losses in the two fracture zones. Loss of circulation was abrupt and total at 10,465 feet depth, and no lithologic information was available from 10,460 feet to the total depth of 10,554 feet.

2.3 Metamorphism and Vein Fillings

The literature contains many accounts of the mineralogical and textural changes accompanying metamorphism, as discussed in Section 1.4. Most of these changes take place on a scale too small to be directly observed without petrographic analysis. Many changes were observed indirectly in this well. The most obvious change is the increase in hardness accompanying lithification and metamorphism. The drilling rate in clays at 500

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feet depth was as high as 400 ft/hr, while in claystones at 1,000 feet depth it was 100 ft/hr. In argillites (the low-grade metamorphic eqivalents of claystones) at 10,000 feet depth, drilling proceeded at 10 ft/hr or less.

The appearance of claystones changes relatively little, because of their original fine grain size. With depth, claystones become harder, greener in color, and less calcareous. A dull sheen develops on broken surfaces, from the growth of micas.

Sandstones become dense, hard, non-porous and non-calcareous. Growth of epidote in the matrix gives sandstones a yellow-green color. Overgrowths of silica and other minerals, and the development of matrix epidote, reduce porosity.

Prograde metamorphic effects are overprinted by vein-related alteration. Sediments are more altered when crossed by veins, and more permeable rocks show a higher degree of alteration.

Vein mineralogy is complex in State 2-14. There are two general vein associations: (a) calcite $\pm$ sulfides (sphalerite, galena, chalcopyrite, pyrite, bornite(?), pyrrhotite) $\pm$ epidote; and (b) epidote + hematite $\pm$ sulfides $\pm$ calcite $\pm$ quartz $\pm$ anhydrite. The first seems to correspond to the "sulfide-carbonate-silicate" association of McKibben and Elders (1985). The second is probably equivalent to the "hematitie-silicate-sulfide-sulfate" association. Where samples are available, production zones seem to be associated with "hematite-silicate-sulfide-sulfate" veins.

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2.4 Structure

The generally thin veins seen in cores dip at high angles consistent with extension and normal faulting. No inferences about the orientation of the stress field are defensible without oriented cores. Some cores show brecciated zones, but these appear to be slump breccias, formed in the original sedimentary environment.

Bedding dips are relatively low, usually less than 25°. Initial dip may not be separable from tectonic dip. The consistently low overall inclination, however, indicates that the tectonic component of dip is low. There is a slight tendency for dip to increase with depth, from less than 20° at shallow depths to about 35° at 9,000 feet depth. This increase is consistent with the location of State 2-14 in a subsiding sedimentary basin.

Some sand layers have higher dips, possibly 60° or greater in core 30. Isolated sand bodies with steep dips may be clastic dikes. Bedding in core 30 shows consistently high dips, but dips in cores 29 and 31 are about 30°. This suggests that the increased dip in core 30 is due to local slumping, rather than tectonism.

The general structural regime indicated in State 2-14 is one of extension and subsidence, but without extreme tectonic deformation. Correlations discussed below support this conclusion.

Preliminary correlations were made between the geophysical logs of State 2-14 (to 6,000 feet depth) and those available from the nearby wells River Ranch #1, Hudson #1, Sportsman #1 and IID #1. State 2-14 was used for the type section. Correlation was best with River Ranch #1, the nearest well, while no reliable correlations were established with IID #1.

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Given the rapid thickening and thinning of sedimentary units in a deltaic environment, it is not surprising that correlation with more distant wells was poor. Major lithologic breaks do correlate, with varying degrees of certainty, between State 2-14 and River Ranch #1, Hudson #1 and Sportsman #1. They show that stratigraphic markers in State 2-12 are approximately 100 feet higher than in River Ranch #1, 70 feet higher than in Sportsman #1, and 170-200 feet higher than in Hudson #1.

These variations could be due to thickening and thinning of beds, and the dip as seen in cores. The data do not require any faults between the wells. Some faulting is probably present, but the data do not suggest any large vertical offsets.

The altered zone from 2,630 to 3,160 feet depth in State 2-14 seemed to correlate with a similar zone of alteration and production at about 2,900 to 3,800 feet depth in River Ranch #1. The significance of this correlation is questionable, and there was no correlation between deeper production zones.

Given that fluid entries in State 2-14 come from high-angle fractures whose distribution is unpredictable, it is unlikely that production zones would correlate with other wells. Intergranular porosity in the "main reservoir" might be correlated, but its significance in State 2-14 is unclear.

2.5 Interpretation of the Reservoir

Most discussions of the Salton Sea field divide the geothermal reservoir into three parts: (a) the cap rock, (b) the main reservoir, and (c) the altered reservoir (McKibben and Elders, 1985; Younker et al., 1982; Tewhey, 1977).

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The cap rock is divided into a "depostional cap", composed of impermeable lacustrine clays, and a "self-sealed cap", sealed with diagenetic cement. The cap may be from 1,100 to 1,900 feet thick, depending mainly on the thickness assigned to the self-sealed cap.

The main reservoir is also referred to as the "slightly altered reservoir" or the "unaltered reservoir". Permeability results from variation in the amount of calcite cement. The main reservoir is thought to extend down to about 3,000 feet depth.

Below about 3,000 feet, intergranular permeability is destroyed by metamorphic minerals. In the altered reservoir, permeability is entirely due to fracturing.

Below the depositional cap, the cap rock zones are often shown as thick, laterally continuous layers, parallel to isotherms. The zones cut across sedimentary units, which are correlatable over distances of several km (Younker et al., 19820.

Several features of the idealized reservoir model were found in State 2-14. Lacustrine clays formed a depositional cap 1,100 feet thick, and no significant sand layers were encountered until 1,380 feet depth.

Sandstones in core #1 appeared to be well-cemented, calcareous and non-permeable, and might be described as part of a "self sealed cap". The next sand layer cored was from 2,448 to 2,456 feet depth, in core #3. While still hard and calcareous, it readily absorbed water. In the altered interval 2,600 to 3,220 feet depth, some sands were noticeably softer and more friable, and contained epidote in the matrix. Dissolution of calcite cement must have been a gradational process, and it was impossible to make

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fine distinctions in the field. It did appear that some degree of secondary porosity was being developed by dissolution of calcite. Only one sandstone layer, at 4,155 to 4,200 feet depth on geophysical logs, correlated with measured lost circulation. Without continuous records of fluid loss above 3,515 feet depth, no further conclusions may be drawn. Apparently, below 4,200 feet depth, all circulation losses were fracture related.

All production came from steeply dipping fracture zones, probably less than 20 feet thick, and partially filled with epidote $\pm$ other minerals. McKibben and Elders (1985) inferred that the "hematite-silicate-sulfide-sulfate" vein association was in equilibrium with modern geothermal brines. Association of circulation losses with this type of vein, and textural evidence from samples, appears to confirm this.

The major departure of State 2-14 from the idealized reservoir was in the distribution of alteration. This model involves concentric zones of steadily increasing metamorphic grade, oriented parallel to isotherms. In State 2-14, at least one zone of increased alteration occured between sequences of less altered rock. It appears that permeability, as well as temperature, controls metamorphism. In State 2-14, sandstones were more altered than claystones, and claystones associated with sandstones were more altered than those which were not.

Several aspects of permeability probably have been involved. The greenish, altered rocks at 2,600-2,900 feet were somewhat siltier than those above and below them. They also overlie a porous sandstone unit 320 feet thick, while sandstones in the unaltered zones were less than 50 feet thick. Finally, fracturing was much more common in the altered interval.

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There seems to be a complex interplay of permeability and temperature effects. Areas of intense alteration related to permeability appear to cut across the normal zonation metamorphism related to depth and temperature.

2.6 Summary of Possible Production Zones

Permeability in geothermal wells is controlled by lithology and fracturing. Stratigraphic (intergranular) permeability depends on the lithology of the original rock. In the Salton Sea field, intergranular permeability is secondary, created by the dissolution of diagenetic cements from sandstones. Some sandstone cores from State 2-14 showed minor development of secondary porosity, but its effect on the reservoir as a whole is minimal. A continuous record of fluid losses was not kept until below 3,515 feet depth. Below this depth only a minor fluid loss at 4,150 to 4,170 feet depth clearly coincided with a sandy interval.

Fractures tend to seal themselves with epidote, calcite and other minerals, but may be re-opened by tectonic or hydraulic stresses. All of the major fluid loss zones in State 2-14 are fracture related.

Recognition of possible production zones during the drilling process is very important, and several lines of evidence are used. These include: mineralogy, lost circulation, drilling rate, mud return temperatures, mud resistivity and dissolved gases (especially CO_2). We identified several potential production zones, using a combination of these criteria.

2,619-3,160 feet: Vein filling, including some void spaces, is common in cuttings and cores. Drilling rates were variable; peaks at 2,850

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and 2,890 feet depth may represent fractures. The pit volume indicator was not operational, but fluid losses were minor. No changes were observed in resistivity, dissolved gases or mud temperature. No injectivity tests were done because temperatures were deemed to be much cooler than in the River Ranch #1 well, and too low for production. GeothermEx questioned the validity of the downhole temperature measurements, and believed from geological evidence that temperatures were probably at least as high as those in River Ranch #1.

An injectivity test was performed over the open interval from depths of 3,515 to 5,422 feet. Injectivity over the interval was nil.

5,450-5,460 feet: A sharp drilling break and the presence of euhedral epidote in cuttings suggest a fracture zone. No other evidence indicates possible production. The interval was not tested.

6,110-6,130 feet: Tested during the first flow test. Abundant vein filling epidote in monominerallic, open-textured masses was found in cuttings. Fluid losses were significant, but not total. Mud resistivity showed a slight decrease. The difference between temperature out and temperature in showed a slight increase. There were no gas shows.

6,635-6,650 feet: Circulation loss was abrupt and total. A sharp drilling break indicated fractures. No changes in circulation, mud temperature, dissolved gase or mineralogy occurred before the loss. The interval was not tested.

8,090-8,100 feet: A gradual circulation loss became total at 8,090 feet depth, coincident with a small drilling break. The amount of epidote

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vein filling had been increasing prior to the loss. No changes in gas content, resistivity or mud temperature were observed prior to the loss. The well flowed several times between 8,126 and 8,133 feet depth, and had to be killed. One cement plug was lost entirely at this depth. The interval was not tested.

8,580 feet: An abrupt and total circulation loss at 8,580 feet depth. Drilling was rapid between 8,575 and 8,625 feet depth. Mud loggers reports show an increase in vein filling epidote between 8,560 and 8,580 feet depth, but this was not observed in the samples sent to GeothermEx. No gas or mud temperature anomalies were observed. Resistivity out decreased before loss of circulation. Regaining circulation after this loss zone was extremely difficult. This zone was not tested.

8,950 feet: An abrupt and total loss of circulation was coincident with a sharp drilling break at 8,950 feet depth. Another drilling break occurred at 9,000 feet depth. No cuttings or fluid were returned, and the zone was not tested.

9,095-9,125 feet: Samples sent to GeothermEx, including some which were mislabeled, show abundant epidote vein filling between 9,080(?) feet and 9,100 feet depth. The drilling rate was high and variable from 9,095 feet to 9,125 feet depth, with circulation losses beginning at 9,050 feet depth. The well flowed at 9,248 and 9,273 feet depths, probably at least partly from this zone. No gas kicks or mud temperature shifts occurred. Resistivity readings are missing from 9,030 to 9,100 feet depth. When restored, resistivity out is extremely variable, but higher than at 6,227 feet depth. Information sent to GeothermEx suggested that the change in resistivity may have been due to mud conditioning activities. This zone was not tested.

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10,475 feet: No cuttings or fluids were returned. This zone was flow tested, but it appears that at least some of the production came from shallower zones behind the 7-inch liner.

2.7 Evaluation of Permeability

Circulation losses are the best indicators of significant permeability. Total circulation loss is not a requirement, and losses were only partial at the first flow test zone. Circulation losses must be interpreted with care. Fluid losses may occur up-hole, in zones which were temporarily plugged with LCM or cement.

Vein filling mineralogy was abundant at 6,110 feet to 6,130 feet depth, the depth of the first flow test, and in other loss zones. The important factor in vein permeability is the degree to which fractures are sealed by secondary minerals. Monominerallic masses of euhedral epidote crystals projecting into void spaces characterized the interval of the first flow test.

Abrupt increases in drilling rate, especially when followed by a return to a lower rate, indicate fracture zones. These are often associated with circulation loss. The lack of a drilling break at 6,110 to 6,130 feet depth is probably due to the directional drilling process.

Mud return temperatures showed a slight increase between 6,110 feet and 6,130 feet depth. Temperature kicks are usually obscured by the use of mud coolers. This is especially true when more than one cooler is in operation.

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Mud resistivity results are variable. Slight resistivity decreases occurred at 6,110 to 6,130 feet and at 8,580 feet depths. A significant increase in resistivity at 9,100 feet depth probably does not indicate a different brine at depth.

Carbon dioxide trip gas was produced in varying amounts, with the greatest kicks below 8,000 feet depth. Apparently the heavy mud keeps CO_2 in solution until agitation or swabbing occurs during a trip.

A detailed evaluation of geophysical logs would assist in defining potential reservoir zones. This analysis is beyond the scope of work assigned to GeothermEx.

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APPENDIX A

Sample Descriptions

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APPENDIX A

SAMPLE DESCRIPTIONS

Depth (feet)	Description
180	Clay, light-medium gray and tan. Trace of very fine-grained, colorless, detrital mica; moderately calcareous.
210	Clay, as above. Trace of detrital mica, as above. Trace of carbonaceous material. Moderately calcareous.
240	80% Clay, as above, with minor yellow limonite-stained clay spots; moderately calcareous. 20% Sand, poorly-sorted, coarse to very coarse and pebble-size, subrounded to rounded; may be in clay material. Clasts are light green altered volcanic rock, medium brown tuff(?), white chalcedony. All appear to be from a volcanic source. Trace of microscopic gastropods and carbonaceous material.
270	90% Clay, as above, no limonite spots. Moderately calcareous. Trace of carbonaceous material. 10% Sand, poorly sorted, fine to granule sizes, mainly subrounded. Clasts are medium brown tuff(?), pink altered volcanic rock, quartz, and fine mica.
300	Clay, as above. Calcareous. Trace of fine detrital colorless mica.

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Depth (feet)	Description
330	Clay, as above. Calcareous, sandy and pebbly. Clasts % uncertain. Pebbles subrounded fine-grained, red, grey and green volcanic clasts. Large fragments of hard calcareous fine-grained well-sorted sandstone present, either as clasts or thin cemented layers. Sand grains are fine, well-sorted, subangular, mainly quartz.
360	Clay, as above, light to medium gray with minor yellowish olive green, slightly indurated clay. Calcareous. Trace of carbonaceous material. Slightly sandy. Sand % uncertain but perhaps 10%. Sand grains moderately sorted, subangular. Clasts mainly quartz with trace of mica and colored rock fragments.
390	Clay, as above. Calcareous, sandy and pebbly. Clast % uncertain. Pebbles subrounded fine-grained red, gray and green volcanic clasts. Large fragments of hard calcareous fine-grained well-srted sandstone present, either as clasts or thin cemented layers. Sand grains are fine, well-sorted, subangular, mainly quartz.
420	Clay, as above. Calcareous, sandy and pebbly. Clast % uncertain but probably low. Clasts, as above, except very fine grained.
450	Clay, as above. Calcareous, sandy. Clast % uncertain. Clasts fine to very fine grained, moderate- to well-sorted, subangular; mostly quartz, trace of light-colored mica and carbonaceous material.
480	Clay, as above. Calcareous, sandy and pebbly. Clasts mainly fine to very fine grained quartz with trace of light colored mica and carbonaceous material.

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FAX: (415) 527-8164

Depth (feet)	Description
510	Clay, as above. Calcareous, sandy. Thin hard calcareous sandstone layers occur; grains are very fine to fine grained, subrounded, moderately sorted.
540	Clay, as above. Moderately calcareous. May have lower sand and pebble content than above.
570	Clay, as above. Moderately calcareous. Less sandy than above.
600	Clay, as above. Moderately calcareous. Contains thin interbed of sandstone, light gray, very fine grained, slightly indurated.
630	Clay, as above. Moderately calcareous. Trace of sand, fine to very fine grained, as above.
660	Clay, as above. Moderately calcareous. Minor sand, as above.
690	Clay, as above. Moderately calcareous. Trace of sand, as above.
720	Clay, as above. Moderately calcareous. Contains thin interbeds of weakly indurated sand, light gray, very fine grained, moderately well-sorted, as above, but softer than at 600 feet.
750	Clay, as above. Moderately calcareous. Contains thin sandstone interbeds, weakly indurated, as at 600 feet.
780	Clay, as above. Moderately calcareous. Contains thin hard calcareous sandstone layers, as above.
810	Clay, as above. Moderately calcareous. Contains thin, weakly-cemented sandstone layers, as above, probably less than 10% of unit.

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Depth (feet)	Description
840	Clay, as above. Moderately calcareous. Contains thin beds of hard, calcareous sandstone, light gray, very fine-grained.
860	Clay, as above. Moderately calcareous. Contains thin beds of sandstone, moderately well-cemented, but similar to above.
870	Clay, as above. Moderately calcareous. Contains thin beds of hard, calcareous, very fine-grained sandstone, as above.
890	Clay, as above, but more silty or sandy. Moderately calcareous. Contains thin interbeds of very fine silty sandstone, similar to above.
900	Clay, as above. Moderately calcareous. Contains thin beds of sandstone, weakly indurated, as at 810 feet, and softer than 870 feet.
930	Clay, as above. Moderately calcareous. Contains thin beds of sandstone, weakly-inudurated, as above. Percent sandstone uncertain.
1000	Clay, silty and sandy, as above, light to medium gray. Slightly calcareous. Percent sand and silt uncertain. Material is weakly-indurated.
1000-1010	Clay, medium grey and tan, sandy and silty, calcareous. Minor thin beds of sand, light gray, very fine-grained, well-sorted, partly cemented by calcite to form hard sandstone.
1010-1020	Clay, as above, sandy and calcareous. Minor thin calcareous sandstone, as above.

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Depth (feet)	Description
1020-1030	Clay, as above, sandy and silty, calcareous. Minor thin calcareous sandstone, as above.
1060	Sandstone, light gray, very fine-grained, silty and weakly-indurated, non-calcareous. Subordinate clay, medium gray, sandy. Trace of carbonaceous material.
1090	Clay, light gray, calcareous with sand/sandstone, weakly-indurated, very fine-grained, silty, non-calcareous.
1120	Sand, light gray, very fine-grained, silty, clayey, calcareous. Trace of weak induration; with clay, light gray, as above. Trace of calcareous material.
1150	Sand/sandstone, weakly-indurated sandstone, light gray, calcareous; with clay, light gray, silty, sandy, calcareous.
1210	Clay, light gray, sandy, silty, calcareous, with about equal sand/sandstone, weakly-indurated, very fine-grained, silty, calcareous, and sandstone, medium to coarse-grained, hard. Trace of interstitial pyrite.
1240	Sand/sandstone, light gray, weakly-indurated, with a few hard, well-cemented fragments. Grain size varies from fine to very fine, silty. Calcareous, trace of interstitial pyrite; with about equal amounts of clay, light gray, weakly-indurated, calcareous, silty.
1270	Clay/claystone, light gray, weakly-indurated, silty, calcareous. Trace of carbonaceous laminae; with nearly equal sand/sandstone, weakly-indurated to locally hard and well-cemented, fine to very fine-grained, calcareous.

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Depth (feet)	Description
1300	Claystone, light gray, silty, weakly-indurated, calcareous with subordinate sandstone, light gray, very fine-grained, soft to hard, calcareous, with trace of pyrite. Trace of carbonaceous material on partings.
1330	Sandstone, light gray, fine-grained, calcareous, hard and soft, trace of interstitial pyrite; trace of carbonaceous material; with claystone, light gray, weakly-indurated, calcareous, silty.
1360	Sandstone, as above, trace of interstitial pyrite; with claystone, silty, as above.
1390	Sandstone, light gray, fine to very fine-grained, hard, calcareous. With about equal amounts of claystone, light gray, silty, calcareous, weakly-indurated.
1420	Sandstone, as above, but varying from soft to hard. About equal amount of claystone, light gray, silty, calcareous, weakly to moderately indurated.
1450	Sandstone, as above, with about equal amounts of claystone, weakly-indurated, with disseminated very small pyrite crystals.
1480	Sandstone, light gray, fine-grained, subangular, fair sorting, calcareous cement, hard. Trace of black brittle grains (lignite?) and trace of disseminated pyrite.
1510	Sandstone, light gray, fine to very fine-grained, subangular, fair sorting, calcareous cement, hard. Trace of black grains (lignite?) in laminae.
1540	Sandstone, light gray, very fine-grained, calcareous, as above; with minor claystone, light gray, calcareous, silty, soft.

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Depth (feet)	Description
1570	Claystone, silty, medium gray, calcareous, poorly indurated; with minor sandstone, fine to very fine-grained, calcareous, moderately hard, probably in thin beds. Trace of vitreous carbonaceous material. Traces of very fine-grained pyrite crystals.
1600	Claystone, silty, medium to light gray, calcareous. Trace of very fine disseminated pyrite crystals with minor sandstone, probably in thin beds, as above. Clay has trace of relatively large pyrite crystals and trace of black carbonaceous material; with minor sandstone, light gray, fine to very fine-grained, calcareous, moderately hard.
1630	Claystone, medium to light gray, as above, with minor sandstone, hard, as above. Trace of large pyrite crystals and carbonaceous material.
1660	Sandstone, light gray, very fine-grained, variable induration; with claystone, light to medium gray, calcareous, silty. Trace of moderately large pyrite crystals.
1690	Sandstone, light gray, very fine-grained, silty, moderately hard, calcareous, increasing pyrite crystals, increasingly large. Trace of carbonaceous material. Subordinate amount of claystone, silty, light to medium gray, calcareous.
1720	Sandstone, as above, with large pyrite crystals. Trace of black, nitreous, carbonaceous material. Subordinate amount of claystone, silty, as above.
1750	Siltstone/claystone, light to medium gray, sandy, clayey, calcareous. Trace of white, granular, soft anhydrite(?). Trace of carbonaceous fragments. Trace of pyrite.

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Depth (feet)	Description
1780	Claystone, silty, medium gray, sandy. Calcareous. Trace of white granular, soft, crystalline material in small (2mm ±) nodules (anhydrite?).
1810	Claystone, as above, silty and trace of sand, calcareous. Trace of white, soft, granular mineral in small nodules (anhydrite?).
1840	Claystone, as above, calcareous. Trace of granular crystalline anhydrite. Trace of disseminated pyrite crystals; with minor sandstone, fine to medium-grained, pyritic and anhydritic.
1870	Claystone, as above. Trace of anhydrite(?), as above. Trace of pyrite. Minor sandstone, very fine-grained, hard.
1900	Sample washed more than above. Large chips may be slough. Claystone, light greenish-gray, calcareous with subordinate sandstone, very fine-grained, hard, anhydrite(?). Trace of massive granular crystalline mineral (anhydrite?). Trace of large pyrite crystals.
1930	Sample, as above; large chips, may be slough. Sandstone, light gray, very fine-grained, hard, calcareous, anhydritic(?). Subordinate claystone, light greenish-gray, as above.
1960	Sample washed on finer screen. Two chip sizes. Larger may be slough. Claystone, light green-gray and gray, calcareous, moderate trace of disseminated pyrite. Minor sandstone, light-gray, very fine-grained, pyritic, anhydritic(?). Trace of anhydrite, white, granular, crystalline. Trace of black carbonaceous material.

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Depth (feet)	Description
1980	Sample washed as above (small cuttings). Sandstone/siltstone, light gray to greenish gray, argillaceous, hard. Laminations of pyrite along bedding plane and in streaks; anhydritic(?). Subordinate claystone, light greenish-gray, silty. Trace of large lignite fragments. Trace of white granular anhydrite lumps.
2010	80% Claystone, light to medium greenish-gray, calcareous, trace of disseminated fine pyrite. 20% Sandstone, light gray, very fine-grained, hard, slightly calcareous to possibly anhydritic or quartzitic. Trace of white, compact, granular anhydrite.
2040	80% Claystone, as above. 20% Sandstone, as above. Trace of hairline calcite vein with minor galena (silver-gray).
2060	80% Claystone, as above. 20% Sandstone, as above, or siltstone. Trace of disseminated pyrite or lumpy aggregate of pyrite. Trace of sphalerite.
2080	60% Claystone, as above. 40% Sandstone, light gray, very fine-grained. Cement? Trace of anhydrite(?). Trace of sphalerite.
2100	60% Claystone, as above. 40% Siltstone, light to medium gray, hard, argillaceous. Trace of pyrite. Trace of sphalerite.
2120	60% Sandstone, light gray, very fine-grained, hard. Cement? Trace of pyrite crystal aggregates in matrix. 40% Claystone, as above. Trace of anhydrite. Trace of sphalerite.

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Depth (feet)	Description
2140	80% Claystone, as above. 20% Sandstone, as above, hard, calcareous. Trace of pyrite in interstices.
2160	80% Claystone, as above. Trace of pyrite crystals. 20% Sandstone, as above. Trace of pyrite in interstices. Trace of galena and sphalerite.
2180	Claystone, light to medium greenish-gray, moderately indurated, calcareous. Altered very small white crystals or aggregates (identity?), give claystone a speckled appearance. Trace of hairline calcite veinlets. Trace of disseminated pyrite. Trace of open calcite crystal-lined vein.
2200	90% Claystone, as above, with disseminated white crystals and trace of pyrite. 10% Sandstone, light gray, very fine-grained, trace of pyrite. Trace of galena.
2220	90% Claystone, as above, with disseminated white crystals and trace of pyrite. 10% Sandstone, as above.
2240	80% Sandstone, light gray, fine to very fine-grained, hard, calcareous. Trace of interstitial pyrite. 20% Claystone, as above.
2260	50% Sandstone, as above. Local aggregates of interstitial pyrite. 50% Claystone, spotted, as above.
2280	50% Sandstone, as above, with trace of pyrite. Trace of black grains, carbonaceous. 50% Claystone, as above, spotted. Trace of disseminated pyrite.

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Depth (feet)	Description
2300	60% Claystone, as above. Spotted. Common disseminated pyrite (more abundant than usual). 40% Sandstone, as above. Trace of interstitial pyrite.
2320	80% Claystone, spotted, as above; pyritic (less than at 2300). 20% Sandstone, as above.
2340	40% Claystone, light green-gray, speckeled with white mineral, calcareous. Trace of fine disseminated pyrite. 40% Claystone, medium gray, spotted, as above. Trace of disseminated pyrite. 20% Sandstone, as above. Trace of pyrite in laminae. Trace of white, granular anhydrite (caving?)
2360	60% Claystone, light greenish-gray, as above. Spotted with white. Trace of fine disseminated pyrite. 20% Claystone, gray, as above. 20% Sandstone, as above. Trace (1 fragment) sphalerite.
2380	60% Sandstone, light gray, fine to very fine-grained, calcareous, hard. Trace of interstitial pyrite and red hematite. 20% Claystone, light green-gray, as above. 20% Claystone, gray, as above. Occasional vein-like masses of pyrite.
2400	50% Sandstone, as above. Trace of interstitial pyrite. Trace of interstitial galena and sphalerite. 50% Claystone, light greenish gray, calcareous, occasional white crystalline spots. Trace of disseminated pyrite. Trace of black opaque mineral, interstitial in sandstone.

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Depth (feet)	Description
2420	50% Sandstone, as above, very fine-grained. 50% Claystone, silty, light to medium-gray and greenish-gray. Trace of disseminated pyrite and pyritic streaks.
2440	70% Claystone, light to medium gray and greenish-gray, with scattered pyrite. 30% Sandstone, as above. Trace of very hard, conchoidal fracturing; silicified sandstone. Trace of anhydrite in lumps.
2460	60% Sandstone, as above, with trace of interstitial pyrite and trace of black sulfide, rimming pyrite. Minor detrital muscovite. 40% Claystone, light gray, calcareous. Trace of pyrite. Trace of sphalerite.
2480	70% Claystone, as above; trace of pyrite aggregate. 30% Sandstone, as above; trace of interstitial pyrite. Trace of sphalerite and galena.
2500	80% Claystone and silty claystone, as above. Trace of pyrite. 20% Sandstone, as above; trace of pyrite. Minor detrital muscovite.
2520	80% Claystone and silty claystone; trace of disseminated pyrite, as above. 20% Sandstone, light gray, very fine-grained, calcareous, as above. Trace of interstitial pyrite. Minor detrital muscovite. Trace of anhydrite, probably caving.

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Depth (feet)	Description
2540	70% Claystone and silty claystone, light greenish-gray and gray, calcareous; slight increase in pyrite; spotted with unidentified white authigenic mineral (anhydrite?). 30% Sandstone, light gray, very fine-grained. Trace of interstitial pyrite. Trace of granular, white, crystalline anhydrite.
2560	40% Claystone, light green-gray, calcareous, spotted. Trace of pyrite. Trace of anhydrite(?). 40% Siltstone, light gray, hard, calcareous, pyritic. 20% Sandstone, light gray, very fine-grained, calcareous, pyritic. Trace of anhydrite in granular fragments.
2580	50% Siltstone, as above. Trace of disseminated pyrite. 30% Sandstone, as above. Trace of interstitial pyrite. 20% Claystone, as above.
2600	50% Siltstone, as above, possibly cemented with anhydrite, glassy, crystalline. Trace of disseminated pyrite. 40% Sandstone, very fine-grained, silty. Possible anydrite veinlets and cement. Trace of interstitial pyrite and pyrite laminae. 10% Claystone, as above.
2620	80% Siltstone, as above. Anhydritic(?). Trace of disseminated pyrite. Trace of calcite vein material. 20% Sandstone, as above, anhydritic(?).

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Depth (feet)	Description
2640	80% Siltstone, light green-gray, calcareous, hard; trace of pyrite in laminae; veinlets or laminae of clear calcite(?). 20% Sandstone, light gray, very fine-grained; trace of disseminated pyrite.
2670	80% Siltstone, as above. More abundant pyrite, disseminated and in laminae. Hairline clear anhydrite or calcite veinlets (colorless, glassy). 20% Sandstone, as above.
2700	80% Siltstone, as above, calcareous. Trace of clear, glassy anhydrite laminae or veinlets; trace of pyrite. Trace of sphalerite in laminae(?) 20% Sandstone, as above. Trace of pyrite. Large glassy blobs of anydrite(?). Trace of sphalerite with black metallic mineral.
2730	80% Siltstone, as above. 10% Claystone, light green-gray, silty, calcareous. 10% Sandstone, as above; patches of anhydrite(?) Trace of sphalerite.
2760	40% Siltstone, light green, calcareous, hairline veinlets of anhydrite, glassy, patches. Pyritic. 40% Siltstone, light gray, with glassy anhydrite (skeletal crystals?). Pyritic. 20% Sandstone, as above. Pyritic. Trace of sphalerite. Fragments of calcite, glassy. Trace of yellow-green glassy mineral (epidote?) in veinlets, associated with calcite, as very small prismatic crystals.

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Depth (feet)	Description
2790	30% Siltstone, light green, as above; trace of epidote on fracture. 30% Siltstone, light gray, as above. Pyritic. 20% Sandstone, light green, very fine-grained, calcareous; trace of epidote in cement; slightly friable. Pyritic. 20% Sandstone, light gray, very fine-grained, pyritic; possible blobs of anhydrite. Trace of calcite vein.
2810	60% Siltstone, light green, as above. Trace of disseminated pyrite. 40% Siltstone, light gray, as above.
2820	60% Siltstone, light gray, as above. Trace of disseminated pyrite. 40% Siltstone, light green, as above. Trace of disseminated pyrite. Trace of epidote.
2830	70% Siltstone, light gray, as above; white spotted. Trace of disseminated pyrite. 30% Siltstone, light green, as above. Trace of sandstone, light green, very fine-grained, pyritic.
2860	50% Siltstone, light gray, spotted, as above. Trace of disseminated pyrite. 40% Siltstone, light green, as above. Trace of epidote in fracture. 10% Sandstone, light green, very fine-grained, pyritic. Slightly friable.
2890	50% Sandstone, light green, very fine-grained, calcareous, slightly friable, pyritic. Trace of chlorite (chloritized detrital mica?). 30% Siltstone, light gray, as above, spotted. 20% Siltstone, light green, as above. Trace of sphalerite.

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Depth (feet)	Description
2920	60% Siltstone, light to medium green, spotted with white authigenic mineral, calcareous, argillaceous; trace of disseminated pyrite. 20% Siltstone, light gray, as above. Trace of epidote on fracture. 20% Sandstone, light green, as above. Trace of disseminated pyrite. Possible glassy anhydrite crystals in matrix. Trace of epidote in cement.
2950	50% Siltstone, light green, white spotted, argillaceous, calcareous, as above. Trace of pyrite-epidote-calcite vein. 30% Siltstone, light gray, spotted, pyritic. 20% Sandstone, light gray and green, fine to very fine-grained; trace of epidote in cement; trace of disseminated pyrite.
2970	50% Siltstone, gray, spotted, argillaceous, calcareous, as above; trace of disseminated pyrite. 30% Siltstone, light green, as above. 20% Sandstone, very fine-grained, as above, slightly friable. Trace of disseminated pyrite. Trace of large chlorite flakes (chloritized detrital mica?).
3040	50% Siltstone, light green, argillaceous, spotted with small white authigenic mineral. Less calcareous than above, hard; trace of disseminated pyrite. 50% Sandstone, light green and light gray, very fine to fine-grained, hard and some friable, very little calcareous cement; trace of pyrite, chlorite and epidote in interstices. Trace of black, shiny mineral (specular hematite?) in very fine grains in sandstone. Trace vein calcite and chalcopyrite. Trace of claystone, light to medium gray.

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Depth (feet)	Description
3060	40% Siltstone, light green, as above, very slightly calcareous. 40% Sandstone, fine to very fine-grained, slightly calcareous to non-calcareous, chloritic, trace of epidote, pyrite and black (hematite?) mineral. 20% Siltstone, light gray, slightly calcareous. Trace of vein calcite.
3070	60% Siltstone, light green, as above, spotted, hard. 30% Siltstone, light gray, argillaceous, calcareous, spotted (may be caving). 10% Sandstone, as above, chloritic, trace of epidote, hard, non-calcareous.
3100	90% Siltstone, medium green, hard, non-calcareous. 10% Sandstone, light green, very fine-grained, hard non-calcareous; trace of disseminated pyrite. Trace of calcite and epidote vein material. Cavings of claystone, medium gray, calcareous, and dark metal.
3107-3167	Core #6 - see core description. (REC. 54.7 feet)
3180	50% Sandstone, light green to light gray, fine and very fine-grained, some slightly calcareous and some slightly friable. Trace of interstitial pyrite and black soft carbonaceous fragments. Trace of epidote in interstices. 30% Siltstone, light green, slightly calcareous, hard, spotted with white authigenic mineral; trace of strata-bound pyrite laminae. 20% Siltstone or claystone, medium to light gray, slightly calcareous, spotted with white authigenic mineral. Several components in this sample may be cavings.

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Depth (feet)	Description
3200	50% Siltstone, light green, spotted, as above. 30% Sandstone, as above, chloritic. 20% Siltstone or claystone, medium gray, spotted, as above, laminated. Trace of stratiform pyrite aggregates. Trace of sphalirite and chalcoyrite(?) in vein fragment.
3220	50% Siltstone or claystone, medium gray, spotted, as above, slightly calcareous (caving?). 30% Siltstone, light green, spotted, as above. 20% Sandstone, light green, slightly chloritic. Trace of carbonaceous(?) mineral on partings. Trace of disseminated pyrite and stratiform pyrite. Slightly calcareous.
3240	Claystone or siltstone, medium gray, spotted; trace of pyrite on laminae; calcareous. With trace of green siltstone, as above, and sandstone, as above. Amount of caving uncertain.
3260	60% Claystone, medium gray, spotted with white, moderately hard, calcareous to non-calcareous; trace of stratiform pyrite. 20% Siltstone, light green, hard, spotted. 20% Sandstone, white to light green, very fine-grained, slightly calcareous; trace of interstitial pyrite. Trace of vein calcite.
3280	60% Claystone, medium gray, calcareous, as above. 20% Siltstone, light gray, spotted, calcareous. 20% Sandstone, white, very fine-grained, calcareous, only a trace of chlorite. Trace of intestitial pyrite. Trace of vein calcite. Trace of green siltstone.

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Depth (feet)	Description
3300	60% Claystone, medium gray, spotted, calcareous, as above. 40% Sandstone, white to pale green, very fine-grained, calcareous. Trace of interstitial pyrite.
3320	60% Claystone, gray, spotted, calcareous, as above. 40% Sandstone, light gray to light green, calcareous, as above. Trace of disseminated pyrite.
3340	50% Claystone, medium gray, spotted, calcareous, as above. 40% Sandstone, light gray, fine to very fine-grained, as above. 10% Sandstone, white to light green, fine to medium-grained, slightly calcareous; trace of chlorite, some quartz overgrowth. Trace of vein calcite. Trace of spherulitic iron sulfide.
3380	60% Claystone, light to medium gray, spotted, calcareous, as above. 20% Sandstone, light gray, very fine-grained; trace of interstitial pyrite, as above. 20% Claystone, light green, calcareous, spotted; trace of stratiform pyrite. Trace of vein calcite. Trace of medium-grained sandstone, as above.
3400	60% Claystone, medium gray, spotted, calcareous, as above. 20% Claystone or siltstone, light green-gray, calcareous. 20% Sandstone, light green-gray, very fine-grained, calcareous. Trace of disseminated pyrite, some in stratified aggregate.

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Depth (feet)	Description
3420	50% Claystone, medium gray, spotted, as above, calcareous. 30% Siltstone, light green-gray, calcareous, as above. 20% Sandstone, very fine-grained, light gray, as above. Trace of disseminated pyrite.
3440	60% Sandstone, light green-gray, calcareous, very fine-grained or siltstone; trace of disseminated pyrite. 40% Claystone, medium gray, spotted, calcareous, as above. Trace of siltstone, light green, calcareous.
3460	60% Claystone, medium gray, spotted, calcareous, as above. 40% Sandstone, light gray, very fine-grained or siltstone; trace of disseminated pyrite.
3470	60% Claystone, medium gray, spotted, calcareous, as above. 40% Sandstone, light green-gray, very fine-grained, calcareous.
3500-3510	90% Claystone, medium to dark gray, spotted with white microscopic authigenic mineral, as above, calcareous. 10% Sandstone, light gray, fine-grained, calcareous; trace of pyrite on laminae and interstitial.
3510-3530	Cement
3530-3540	90% Sandstone, fine-grained, light gray, calcareous. Sparse disseminated pyrite. 10% Claystone, medium to dark gray, spotted with white mineral, calcareous. Trace calcite vein material.

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Depth (feet)	Description
3540-3550	60% Sandstone, as above. 40% Claystone, as above. Bands of pyrite.
3550-3560	90% Claystone, as above. 10% Sandstone, as above.
3560-3570	10% Claystone, as above. 90% Sandstone, light gray, calcareous. Sparse dissemianted pyrite. Irregular patches of yellowish green epidote in matrix. flecks of darker green, apparent chlorite.
3570-3580	80% Claystone, medium dark gray, calcareous, "spotted", as above. 20% Sand, as above, but without epidote and chlorite.
3580-3590	60% Claystone, medium gray, as above. 30% Claystone, greenish-gray, otherwise identical to above. 10% Sandstone, as above.
3590-3600	50% Claystone, as above, medium gray to greenish-gray; some pyrite on bedding surface. 50% Sandstone, pale gray, fine-grained, calcareous.
3600-3610	85% Claystone, medium dark gray, spotted. 15% Sandstone, as above. A few flakes of chlorite.
3610-3620	95% Claystone, as above. 5% Sandstone, as above.
3620-3630	95% Claystone, medium dark gray, slightly greenish, white "splotches", as above, calcareous. Very little pyrite. 5% Sandstone, as above. No chlorite or epidote. Disseminated pyrite.

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Depth (feet)	Description
3630-3640	60% Claystone, greenish-gray with white splotches, calcareous. 30% Claystone, medium dark gray with white splotches, calcareous. Layers of fine-grained pyrite. 10% Sandstone, pale gray, fine-grained, calcareous. Disseminated pyrite.
3640-3650	70% Sandstone, light gray, fine-grained, calcareous. Disseminated pyrite. 30% Claystone, gray to greenish gray, as above.
3650-3660	40% Claystone, medium dark gray, "splotchy", calcareous; bedded pyrite. 40% Siltstone, medium gray, calcareous. 20% Sandstone, as above. Trace chunks of clear calcite vein filling.
3660-3670	20% Claystone, medium dark gray to greenish-gray, as above. 80% Sandstone, light gray, fine-grained, calcareous. Disseminated pyrite. Trace of clear calcite vein filling.
3670-3680	20% Claystone, medium dark gray, as above, splotchy. 70% Siltstone, greenish-gray. 10% Sandstone, pale gray, fine-grained. Matrix often stained yellow/green by epidote. Trace clear calcite veins.
3680-3690	10% Claystone, medium dark gray, as above, calcareous. 80% Siltstone, pale greenish-gray with fine sand, calcareous. 10% Sandstone, pale gray, fine-grained, calcareous. Diffuse patches of epidote in groundmass.

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Depth (feet)	Description
3690-3700	10% Silty claystone, medium gray, calcareous; strings of fine pyrite. 85% Claystone, medium greenish-gray, calcareous; "splotches" appear to be feldspar. 5% Sandstone, pale gray, fine-grained. Matrix is a mixture of calcite and epidote.
3700-3710	95% Claystone, as above, calcareous. 2½% Silty claystone, as above, calcareous. 2½% Sandstone, as above.
3710-3720	80% Claystone, as above, calcareous. 15% Silty claystone, as above, calcareous. 5% Sandstone, as above, calcareous.
3720-3730	60% Claystone, medium dark gray, with white splotches; with strabound and disseminated pyrite, calcareous. 30% Claystone, pale greenish-gray, contains white splotches, fewer but larger than dark gray claystone, calcareous. 10% Sandstone, pale gray, fine-grained; disseminated pyrite, calcareous cement.
3730-3740	25% Claystone, medium dark gray, as above. 50% Claystone, pale greenish-gray, as above. 25% Sandstone, pale gray, as above.
3740-3750	25% Claystone, medium dark gray, calcareous; dissemianted pyrite, approx. 0.5 mm. 50% Claystone, pale greenish-gray, calcareous; fine disseminated pyrtie. 25% Sandstone, pale gray, fine-grained, calcareous; fine disseminated pyrite.
3750-3760	40% Claystone, medium dark gray, as above. 40% Claystone, pale greenish-gray. 20% Sandstone, pale gray, very fine-grained, calcareous. Pyrite very sparse.

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Depth (feet)	Description
3760-3770	20% Claystone, medium dark gray with white splotches, calcareous. 60% Claystone, pale greenish-gray with white splotches, calcareous. 20% Sandstone, pale gray, as above.
3770-3780	30% Claystone, medium dark gray, as above. 60% Claystone, pale greenish-gray. 10% Sandstone, pale gray, as above.
3780-3790	60% Claystone, medium gray to greenish-gray, colors appear gradational, calcareous. 40% Sandstone, pale gray, very fine-grained, calcareous; pyrite very sparse.
3790-3800	90% Claystone to siltstone, medium gray to grayish-green, calcareous. Very fine disseminated pyrite. 10% Sandstone, pale gray, very fine-grained calcite cement. Unaltered occasional minor epidote in matrix.
3800-3810	40% Siltstone, medium gray, calcareous. 50% Claystone, greenish-gray, calcareous. Some cut by veins of pyrite. 10% Sandstone, pale gray, very fine, calcareous, unaltered.
3810-3820	As above. A few pieces of anhydrite.
3820-3830	As above.
3830-3840	30% Siltstone, medium dark green, calcareous. 60% Claystone, greenish-gray, calcareous. 10% Sandstone, as above.
3840-3850	As above.
3850-3860	Claystone, as above.
3860-3870	Claystone, as above.

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Depth (feet)	Description
3870-3880	Sedimentary breccia, greenish-gray. Angular clasts of claystone up to 3mm in a matrix of greenish clay and calcite. Thin calcite veins. Disseminated pyrite.
3880-3890	As above.
3890-3900	As above.
3900-3910	90% Sedimentary breccia, as above. 10% Siltstone, medium gray, calcareous, as above.
3910-3920	10% Breccia, as above. 80% Claystone, pale greenish-gray, calcareous. 10% Sandstone, pale gray, fine-grained, calcareous.
3920-3930	50% Silty claystone, medium gray, calcareous, with veins of pyrite. 40% Claystone, pale greenish-gray, calcareous. 10% Sandstone, pale gray, very fine-grained, calcareous.
3930-3940	As above. Free chunks of pyrite are common.
3940-3950	50% Silty claystone, medium gray, calcareous. 20% Claystone, as above. 30% Sandstone, pale gray, calcareous, sparse pyrite and flecks of chlorite(?).
3950-3960	10% Silty claystone, as above. 85% Claystone, pale greenish-gray, as above. 5% Sandstone, as above.
3960-3970	45% Silty claystone, as above. 50% Claystone, pale greenish-gray, as above. 5% Sandstone, as above.
3970-3980	10% Silty claystone, medium gray, as above. 85% Claystone, greenish-gray, as above. 5% Sandstone, as above.

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Depth (feet)	Description
3980-3990	60% Silty claystone, as above. 40% Claystone, greenish-gray. A few pieces of sedimentary breccia, as in 3870-3910.
3990-4000	As above.
4000-4010	80% Claystone, pale greenish-gray, calcareous. 20% Claystone, medium gray, cut by veins of pyrite. Minor pieces of anhydrite.
4010-4020	As above.
4020-4030	As above. Pieces of vein anhydrite.
4030-4040	Claystone, pale greenish-gray, calcareous. Sparse pyrite (most in the medium gray). Few pieces of calcite vein material.
4040-4050	Claystone, pale greenish, calcareous, as above.
4050-4060	As above.
4060-4070	As above.
4070-4080	As above.
4080-4100	As above.
4100-4120	Claystone, pale gray, calcareous, spotted. No pyrite or vein filling.
4120-4140	As above.
4140-4150	As above. Thin veins filled with calcite.
4150-4160	Sandstone, light gray to pale greenish-gray. Calcite cement. Disseminated pyrite and matrix epidote common.

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Depth (feet)	Description
4160-4170	60% Sandstone, as above. 40% Claystone, greenish-gray, as above.
4170-4180	As above.
4180-4190	Siltstone/claystone, medium gray, calcareous. Disseminated pyrite spotted with some unidentifiable darker material.
4190-4200	60% Siltstone, as above. 40% Claystone, pale greenish-gray, calcareous. Very finely spotted. Very sparse pyrite.
4200-4210	50% Siltstone, medium gray, calcareous. Some with pieces of vein-composed of epidote and quartz. 30% Claystone, greenish-gray, as above. 20% Sandstone, light gray, very fine-grained, with disseminated pyrite and epidote.
4210-4220	80% Siltstone, medium gray, as above. 10% Claystone, greenish-gray, as above. 10% Sandstone, pale gray, very fine-grained. Matrix stained with epidote. Trace pieces of calcite vein filling and crystals of sphalerite.
4220-4230	As above.
4230-4240	As above. No sphalerite observed.

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Depth (feet)	Description
4340-4350	80% Siltstone, medium dark gray to pale gray, calcareous, spotted with unidentifiable white material. Light gray appears to be bleached version of the dark. Sparse disseminated pyrite. Pieces of chalcopyrite vein filling. 15% Sandstone, light gray, calcareous. Matrix often spotted with epidote. Sparse pyrite and some flakes of chlorite. Some have darker green matrix. 5% Claystone, pale greenish-gray, calcareous, spotted.
4350-4360	As above.
4360-4370	As above. Sulfides sparse.
4370-4380	80% Siltstone, as above. 20% Sandstone. Matrix variably altered to yellowish-green. Disseminated pyrite.
4380-4390	70% Siltstone, medium dark gray to pale gray, as above. 30% Sandstone, pale gray, calcareous. Matrix essentially unaltered.
4390-4400	90% Siltstone, as above. 10% Sandstone, as above.
4400-4410	90% Siltstone or silty claystone, as above. 10% Sandstone, as above. Trace of claystone, pale greenish-gray.
4410-4420	As above.
4420-4430	90% Silty claystone, as above. 10% Sandstone, as above.
4430-4440	50% Silty claystone, as above. 45% Siltstone, pale gray. 5% Sandstone. Trace pieces of epidote vein filling.

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Depth (feet)	Description
4440-4450	50% Siltstone, medium gray, as above. 40% Claystone, pale greenish-gray. 10% Sandstone. <1% Epidote vein material. Some silica vein filling.
4450-4460	70% Claystone, light greenish-gray, spotted, non-calcareous. 20% Siltstone, medium to light gray, slightly calcareous. 10% Sandstone, matrix non-calcareous. Increasing amounts of epidote vein filling.
4460-4470	80% Claystone, as above. 15% Siltstone, as above; sparse sulfides. 5% Sandstone and increasing epidote vein filling.
4470-4480	85% Claystone, as above. 10% Siltstone. 3% Sandstone. 2% Epidote vein filling.
4480-4490	95% Claystone, pale greenish-gray, calcareous. 3% Epidote vein fillings. 2% Sandstone, fine-grained.
4490-4500	95% Claystone, as above. 4% Siltstone, as above. 1% Epidote vein filling.
4500-4510	Claystone, light gray to greenish-gray, calcareous; sparse disseminated pyrite.
4510-4520	Claystone, medium gray to nearly white, non-calcareous; disseminated pyrite. Trace of epidote vein filling.
4520-4530	As above. Trace of epidote/calcite vein filling.
4530-4540	As above.

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Depth (feet)	Description
4540-4550	95% Claystone, as above. 5% Fine sandstone, matrix partly altered to epidote.
4550-4560	40% Claystone, as above. 60% Sandstone, pale gray, very fine, matrix altered to epidote. Minor disseminated sulfides.
4560-4570	As above.
4570-4580	As above. Some sandstone matrix completely altered to epidote.
4580-4590	80% Sandstone, as above. 20% Claystone.
4590-4600	50% Claystone. 50% Sandstone, as above.
4600-4610	25% Claystone, medium gray to green gray, spotted, slightly calcareous. 25% Siltstone, light to medium gray, non-calcareous. 50% Sandstone, pale gray, non-calcareous, fine-grained. Matrix mottled with yellow-green epidote.
4610-4620	30% Claystone, medium gray to greenish-gray, spotted, calcareous. 40% Siltstone, light gray, non-calcareous. 30% Sandstone, pale gray to yellow-green, very fine-grained, non-calcareous. Trace of calcite vein material, epidote vein.
4620-4630	As above.
4630-4640	As above.

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Depth (feet)	Description
4640-4650	50% Claystone, medium gray to greenish-gray, spotted, calcareous. 40% Siltstone, pale gray, calcareous. 10% Sandstone, pale gray, fine-grained, calcareous. Trace pieces of chalcopyrite, calcite vein and epidote vein.
4650-4660	90% Claystone, medium gray to greenish-gray, spotted, non-calcareous, sparse disseminated sulfide. 3% Siltstone, as above. 2% Sandstone, as above. Trace epidote/calcite vein filling, cubes of pyrite up to 1mm.
4660-4670	90% Claystone, greenish-gray, non-calcareous, spotted. 5% Siltstone, light gray, non-calcareous. 5% Sandstone, light gray, non-calcareous, fine-grained. 2% Epidote/calcite vein filling.
4670-4680	As above.
4680-4690	As above. Trace of specular hematite flakes.
4690-4700	As above.
4700-4710	As above. Vein fillings of epidote, epidote + calcite, epidote + calcite + specular hematite.
4710-4720	80% Claystone, light greenish-gray, spotted, non-calcareous; cut by veinlets of epidote and calcite. Very sparse disseminated sulfides. 20% Siltstone, light greenish-gray, non-calcareous. Matrix spotted (with epidote?).

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Depth (feet)	Description
4720-4730	75% Claystone, as above. 20% Siltstone. 3% Claystone, light gray to medium dark gray, calcareous. 1-2% Vein filling epidote, clear vein calcite. Trace of specular hematite.
4730-4740	As above, but without the gray calcareous claystone.
4740-4750	75% Claystone, gray/green-spotted, non-calcareous; very sparse, disseminated pyrite. 20% Siltstone, light green/gray. Non-calcareous. 3% Sandstone, light yellow-green. Matrix replaced by epidote.
4750-4760	80% Claystone, gray/green, non-calcareous, as above. Cut by calcite-epidote-hematite veins. 15% Siltstone, as above. 3% Sandstone, very fine-grained, altered to yellow-green. 2% Epidote-calcite-hematite vein material. Pieces of clear calctie vein. Few pieces of chalcopyrite.
4760-4770	As above.
4770-4780	As above.
4780-4790	As above.
4790-4800	As above.
4800-4810	As above.
4810-4820	As above.

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Depth (feet)	Description
4820-4830	40% Claystone, greenish-gray, spotted, non-calcareous. 30% Claystone, medium gray to medium dark gray, spotted, non-calcareous. 25% Claystone, light gray, spotted, calcareous. 3% Sandstone, yellow-green, very fine-grained, non-calcareous. 2% Epidote-calcite-hematite vein filling.
4830-4840	30% Claystone, greenish-gray, spotted, non-calcareous. 50% Claystone, light to medium gray, spotted, non-calcareous. 15% Claystone, medium dark gray to dark gray spotted, non-calcareous. 3% Sandstone, yellow-green, very fine-grained, non-calcareous. 2% Vein fillings, epidote and calcite, with minor hematite.
4840-4850	As Above.
4850-4860	25% Claystone, greenish-gray, as above. 70% Claystone or silty claystone, light gray grading to medium dark gray, non-calcareous. 4% Sandstone, yellow-green to spotty light gray, very fine-grained, non-calcareous. 1% Vein filling of calcite-epidote. Trace of siltstone, oolitic-appearing. Dark gray matrix with 50% tiny white spherical bodies <0.02 mm diam. Some appear to have a concentric structure.
4860-4870	As above. Calcite-epidote vein fillings decrease.
4870-4880	Claystone to silty claystone, medium gray to medium dark gray, spotted, non-calcareous; cut by minor calcite-epidote veins. Trace of dark gray "oolite".

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Depth (feet)	Description
4880-4890	70% Claystone, greenish-gray, spotty, non-calcareous. 20% Claystone, light to medium dark gray, spotty, non-calcareous, cut by epidote calcite veins. 7% Sandstone, yellow-green, non-calcareous, very fine-grained. 3% Epidote-calcite vein filling.
4890-4900	70% Claystone, greenish-gray, spotted, non-calcareous. Common disseminated pyrite and chalcopyrite. 20% Claystone, light to medium dark gray, spotty, non-calcareous; cut by epidote-calcite veins. 7% Sandstone, yellow-green, non-calcareous, very fine-grained. 3% Epidote-calcite vein filling
4900-4910	As above.
4910-4920	As above, with pyrite cubes, 1 mm diam.
4920-4930	As above.
4930-4940	As above.
4940-4950	90% Claystone, medium gray to greenish-gray, spotted, non-calcareous; cut by epidote veinlets. Disseminated pyrite confined to the greenish type. 10% Sandstone, very fine-grained to siltstone. Matrix yellow-green, non-calcareous. Trace of vein epidote, cubes of pyrite up to 1.5 mm.
4950-4960	90% Claystone, light gray to greenish gray, spotted, non-calcareous; cut by epidote veinlets. Very sparse disseminated pyrite. 10% Sandstone, very fine-grained, to siltstone. Matrix yellow-green, non-calcareous. Trace vein epidote, cubes of pyrite up to 1.0 mm.

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Depth (feet)	Description
4960-4970	As above.
4970-4980	As above.
4980-4990	As above. (Most cuttings are rather large; may represent sloughed material). Trace vein epidote, cubes of pyrite, few flakes of hematite.
4990-5000	85% Claystone, greenish-gray, as above. 15% Sandstone and siltstone, as above. Trace of vein epidote.
5000-5010	85% Claystone, greenish-gray to medium gray, spotted, non-calcareous. Minor disseminated pyrite. 14% Sandstone. Matrix white spotted with yellowish green, fine to very fine-grained, non-calcareous, with disseminated pyrite. 1% pieces of epidote vein filling, sparry calcite, pyrite cubes 1.5 mm diam.
5010-5020	As above. Sandstone with a few flecks of dark green chlorite(?).
5020-5030	80% Claystone, as above. 20% Sandstone, as above. Trace epidote and sparry calcite vein filling, cubes of pyrite.
5030-5040	As above.
5040-5050	As above. Some pieces of claystone cut by epidote veins. Pieces of vein filling may be epidote, epidote + calcite, epidote + pyrite, or sparry calcite alone.
5050-5060	As above. Sand approx. 10%.
5060-5070	As above. 20% Sandstone. Trace of specular hematite in epidote veins.

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Depth (feet)	Description
5070-5080	As above. Trace of specular hematite.
5080-5090	As above.
5090-5100	95% Claystone, as above. 5% Sandstone, as above. Trace of vein filling epidote, calcite, specular hematite and pyrite.
5100-5110	Claystone, medium gray to greenish-gray, non-calcareous, spotted. Very sparse disseminated pyrite Trace of sandstone, as above, and vein material. * Chips are large, 5-7 mm. May not represent the true lithology at bottom.
5110-5120	90% Claystone, light gray to greenish-gray, non-calcareous, spotted. Small disseminated pyrite and chalcopyrite, cut by epidote veins. 10% Sandstone, yellowish green to dark green with yellowish green blotches. Fine disseminated pyrite and chalcopyrite. Trace of epidote, calcite, pyrite vein fillings. * High proportion of large chips.
5120-5130	As above.
5130-5140	As above.
5140-5150	40% Claystone, greenish-gray, spotted, non-calcareous, no sulfides. 50% Claystone, medium dark gray, spotted, non-calcareous. No sulfides. 10% Sandstone. Matrix mottled white and yellow green. Fine to very fine-grained, non-calcareous, unmineralized. Trace of epidote, calcite, pyrite vein fillings.

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Depth (feet)	Description
5150-5160	As above.
5160-5170	Claystone, medium gray to medium dark gray, calcareous, spotted. Minor disseminated pyrite. Shows indistinct cleavage and sheen on cleavage surfaces. 2% Sandstone, as above. Probably sloughed.
5170-5180	As above. Trace of sandstone, as above.
5180-5190	40% Claystone, medium dark gray, spotted, slightly calcareous, indistinct cleavage, with faint sheen on cleavage surface. Rare thin laminations of pyrite. 60% Claystone, medium gray, calcareous.
5190-5200	30% Claystone, medium dark gray, spotted, as above. 70% Claystone, medium gray, as above.
5200-5210	50% Claystone, medium dark gray, as above. 50% Claystone, medium gray, as above.
5210-5220	20% Claystone, medium dark gray, slightly calcareous, as above. Small pyrite lenses. 80% Silty claystone, light gray, calcareous.
5220-5230	10% Claystone, medium dark gray, spotted, slightly calcareous. 90% Silty claystone, light greenish gray, calcareous, spotted.
5230-5240	30% Claystone, medium gray, somewhat silty, spotted, slightly calcareous. Minor pyrite lenses. 40% Claystone, slightly silty, light greenish gray, calcareous. 30% Silty claystone, light gray, calcareous. Disseminated pyrite common.

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Depth (feet)	Description
5240-5250	50% Claystone, medium gray, somewhat silty, spotted, slightly calcareous. Thin lenses of pyrite. 20% Claystone, light greenish-gray, somewhat silty, calcareous. 30% Silty claystone, light gray, calcareous. Common disseminated pyrite.
5250-5260	60% Claystone, gray, calcareous, spotted, as above. 40% Claystone, light gray-green, as above. Trace of disseminated pyrite. Trace of sandstone, light gray, very fine-grained. Trace of disseminated pyrite.
5260-5270	60% Claystone, gray, as above. Trace of stratabound pyrite. 40% Claystone, gray-green, as above. Trace of sandstone, medium-grained, angular, arkosic. Trace of disseminated pyrite. Trace of sandstone with epidote in matrix.
5270-5280	70% Claystone, gray, as above. 30% Claystone, gray-green, as above. Trace of epidote in calcite veinlet.
5280-5290	70% Claystone, light gray-green, as above; minor granular pyrite. 30% Claystone, light to medium gray. Trace of disseminated pyrite. Trace of sandstone, light gray, fine-grained, arkosic. Trace of disseminated pyrite. Trace of calcite veinlet.
5290-5300	70% Claystone, light gray-green, as above. 30% Claystone, light to medium gray, as above. Trace of sandstone, light gray, fine-grained, arkosic, as above.
5300-5310	70% Claystone, light gray-green, as above. 30% Claystone, light to medium gray, as above. Trace of sandstone, very fine-grained, light gray, arkosic(?).

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Depth (feet)	Description
5310-5320	70% Claystone, light gray-green, as above. 25% Claystone, light to medium gray, as above. 5% Sandstone, yellow green and gray, fine-grained, arkosic. Abundant yellow-green epidote, partly replacing feldspar in arkose. Trace of disseminated pyrite. Trace of dark-green epidote veinlets. Trace of calcite veinlets.
5320-5330	80% Claystone, light gray-green, as above; trace of granular stratiform pyrite. 20% Claystone, medium gray, as above. Trace of sandstone with epidote in matrix. Trace of epidote veinlets. Trace of calcite veinlets.
5330-5340	85% Claystone, light gray-green, as above. 10% Claystone, medium gray, as above. 5% Sandstone, yellow-green and gray, very fine to fine-grained, abundant epidote and trace of pyrite. Trace of epidote veinlets with clear anhydrite(?) blobs.
5340-5350	90% Claystone, light gray-green, as above. 5% Claystone, gray, as above. 5% Sandstone, with pyrite and epidote, as above. Trace of epidote veinlets.
5350-5360	60% Claystone, light gray-green, as above. 40% Claystone, medium gray, as above. Trace of sandstone with epidote, as above. Trace of stratabound, granular pyrite.
5360-5370	60% Claystone, light gray-green, as above. 40% Claystone, medium gray, as above. Trace of sandstone with epidote and pyrite.
5370-5380	50% Claystone, light gray-green, as above. 50% Claystone, light to medium gray, as above.

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Depth (feet)	Description
5380-5390	50% Claystone, light gray-green, as above. 50% Claystone, medium gray, as above.
5390-5400	70% Claystone, light gray-green, as above. 30% Claystone, medium gray, as above. Trace of sandstone, very fine-grained, with epidote in matrix. Trace of disseminated pyrite.
5400-5410	80% Claystone, light gray-green, as above. 20% Claystone, medium gray, as above. Trace of sandstone, yellow-green, very fine-grained to fine-grained, with abundant epidote matrix. Trace of disseminated pyrite.
5410-5420	90% Claystone, light gray-green, as above. 10% Claystone, medium gray, as above. Trace of disseminated pyrite. Trace of sandstone, very fine-grained, with epidote in matrix.
5420-5430	70% Claystone, silty, light gray-green, calcareous, trace of pyrite in patches. 30% Claystone, medium gray, calcareous. Trace of sandstone, very fine-grained, yellow-green, epidote-rich. Trace of epidote veinlets.
5430-5440	60% Claystone, silty, light gray-green, as above. 40% Claystone, medium gray, spotted, as above. Trace of pyrite on laminae. Trace of epidote veinlet.
5440-5450	70% Claystone, silty, light gray-green, calcareous; trace of epidotization. 30% Claystone, gray, spotted, as above. Trace of sandstone, fine and very fine-grained, light yellow-green, abundant matrix epidote and trace of pyrite. (Sandstone and epidote slightly more abundant than above.)

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Depth (feet)	Description
5450-5460	50% Claystone, silty, light green, spotted, calcareous, with trace of lenses of fine-grained pyrite. 25% Sandstone, yellow-green, fine to very fine-grained, arkosic, epidotized, trace of chlorite. Trace of epidote veinlets. Trace of large pyrite crystals. 15% Claystone, medium gray, spotted, as above. 10% Epidote, probably vein fragments, some open crystal-lined vugs.
5460-5470	50% Claystone, silty, light green, as above. 25% Claystone, medium gray, as above, with lenses of granular pyrite. 20% Sandstone, very fine to fine-grained, epidotized, as above. 5% Epidote, mainly from veins.
5470-5480	70% Claystone, light green, as above. Trace of thin epidote and specular hematite veinlets and pyrite. 20% Sandstone, very fine-grained, epidotized with trace coarse pyrite crystals and minor specular hematite. 10% Claystone, medium gray, as above. Trace of vein epidote with open crystal-lined areas.
5480-5490	60% Claystone, light green, as above. 30% Sandstone, yellow-green, very fine-grained, epidotized, with trace of large pyrite porphyroblasts. 10% Claystone, medium gray, as above. Trace of vuggy epidote veinlets and epidote-calcite veinlets.
5490-5500	70% Claystone, light green, spotted, as above, with trace of pyrite porphyroblasts. 25% Sandstone, very fine-grained, epidotized. 5% Claystone, medium gray, as above. Trace of epidote veinlets, minor open vugs. Trace of calcite veinlets. Trace of specular hematite veinlet.

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Depth (feet)	Description
5500-5510	70% Claystone, light to medium gray-green, as above, spotted with white authigenic mineral. Trace of pyrite porphyroblasts. 20% Sandstone, yellow-green, very fine-grained, epidotized, trace of pyrite porphyroblasts. 10% Claystone, medium gray, as above. Trace of epidote veinlets. Trace of granular, specular hematite.
5510-5520	60% Claystone, light gray-green, as above. 40% Sandstone, yellow-green, fine to very fine-grained, as above. Trace of interstitial specular hematite. Minor pyrite porphyroblasts. Trace of epidote veinlets. Trace of dark red-brown hematite(?).
5520-5530	70% Claystone, light to medium green, as above, spotted, with stratabound granular pyrite laminae, pyrite porphyroblasts and thin epidote veinlets. 30% Sandstone, yellow-green very fine-grained, as above. Epidotized. Trace of disseminated specular hematite. Increasing (trace) of dark red-brown translucent hematite (in thin bladed crystals).
5530-5540	80% Claystone, light to medium green, as above, with granular pyrite laminae and rare pyrite porphyroblasts. Trace of epidote veinlets. 20% Sandstone, yellow-green, epidotized, as above, with epidote veinlets. Trace of claystone, gray, calcareous, spotted.
5540-5550	80% Claystone, silty or siltstone, light to medium green, few epidote veinlets. Trace of granular pyrite. 20% Sandstone, yellow-green, as above, epidotized. Trace of hematite, dark red-brown, translucent on thin edges.

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Depth (feet)	Description
5550-5560	90% Claystone or siltstone, light to medium green and gray-green; trace of stratabound granular pyrite. Trace of epidote veinlets. 10% Sandstone, yellow-green, epidotized, as above. Trace of intergranular chalcopyrite. Trace of quartz-epidote veinlet. Trace of red-brown hematite (as above). Possible trace of red-brown sphalerite.
5560-5570	80% Claystone, light to medium green and gray-green, as above. Trace of calcite and epidote veinlets, some open and crystal-lined. Masses of granular, stratiform(?) pyrite. Trace of pyrite porphyroblasts. 20% Sandstone, yellow-green, epidotized, as above. Trace of intergranular specular hematite. Trace of pyrite porphyroblasts. Trace of epidote veinlets, partly open, crystal-lined. Trace of dark, red-brown hematite(?) veinlet.
5570-5580	90% Claystone, light to medium gray-green, slightly calcareous, spotted. 10% Sandstone, yellow-green, very fine-grained, epidotized. Trace of specular hematite veinlet. Trace of epidote veinlet.
5580-5590	90% Claystone, light and dark green, as above. 10% Sandstone, yellow-green, epidotized, as above. Trace of dark-green epidote veinlet.
5590-5600	40% Claystone(?), white, bleached, altered; trace of granular pyrite aggregate. 30% Claystone, light to medium gray-green, as above; trace of pyrite porphyroblasts. 30% Claystone, medium gray, slightly calcareous, spotted, white. Trace of sandstone, yellow-green, as above, with trace of pyrite porphyroblasts. Trace of epidote veinlet.

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Depth (feet)	Description
5600-5610	45% Claystone, medium gray, spotted, as above. 45% Claystone, light to medium green, spotted, as above. 10% Claystone/argillite, white, as above. Trace of sandstone, yellow-green, epidotized, as above. Trace of epidote veinlet.
5610-5620	90% Claystone, light to medium green; trace of granular pyrite aggregates; trace of epidote veinlet. 10% Claystone, medium gray, as above. 10% Claystone, white, bleached, as above. Trace of sandstone, yellow-green, very fine-grained, epidotized, as above. Trace of epidote veinlet.
5620-5630	80% Claystone, light gray-green, as above. Trace of epidote veinlets and granular pyrite aggregates. 15% Claystone, medium gray, spotted, as above. 5% Sandstone, very fine-grained, yellow-green, epidotized. Trace of white, altered claystone. Trace of calcite-sphalerite (dark red-brown) veinlet. Trace of specular hematite.
5630-5640	60% Claystone, light green, as above. 20% Claystone, light gray, bleached, as above. 20% Claystone, medium to dark gray, as above. Trace of sandstone, yellow-green, epidotized.
5640-5650	80% Claystone, light to medium gray-green, as above. 20% Claystone, medium to dark gray, as above. Trace of sandstone, yellow-green, epidotized.
5650-5660	80% Claystone, light gray-green, as above. 15% Claystone, light to medium gray, as above. 5% Sandstone, yellow-green, fine-grained, as above. Epidotized. Trace of granular stratabound pyrite.

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Depth (feet)	Description
5660-5670	80% Claystone, light gray, calcareous, spotted, as above. 20% Claystone, light gray-green, as above. Trace of sandstone, yellow-green, epidotized.
5670-5680	Claystone, light to medium gray, as above. Trace of sandstone, yellow-green, epidotized.
5680-5690	80% Claystone, light gray, as above. 20% Claystone, light green-gray, as above. Trace of claystone, dark gray. Trace of sandstone, very fine-grained, white, moderately friable.
5690-5700	80% Claystone, light gray and light to medium gray, as above. 20% Claystone, light gray-green. Trace of sandstone, white, as above. Trace of calcite-pyrite veinlet.
5700-5710	90% Claystone, light to medium gray, as above. 10% Sandstone, white to light gray, very fine-grained, slightly friable. Trace of sandstone, yellow-green, epidotized. Trace of epidote veinlet. Trace of granular pyrite aggregate.
5710-5720	80% Claystone, light to medium gray, as above. 10% Claystone, light gray-green, as above. 10% Sandstone, white, as above. Trace of sandstone, yellow-green, epidotized. Trace of pyrite porphyroblasts (loose).
5720-5730	80% Claystone, light gray, as above. 10% Claystone, light gray-green, as above. 10% Sandstone, white to light gray, as above. Trace of sandstone, epidotized. Trace of granular pyrite in claystone.
5730-5740	80% Claystone, light to medium gray, as above. 10% Claystone, light gray-green, as above. 5% Sandstone, white, as above, with disseminated pyrite. 5% Sandstone, light yellow-green, fine to very fine-grained; trace of epidote stain.

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Depth (feet)	Description
5740-5750	As above.
5750-5760	As above.
5760-5780	80% Claystone, medium to dark gray, as above. 10% Claystone, light gray-green, as above. 10% Sandstone, light gray and yellow-green, partly epidotized, with trace of pyrite porphyroblasts.
5780-5790	80% Claystone, medium to dark gray, as above. 15% Claystone, light gray-green, as above. 5% Sandstone, white and yellow-green, as above.
5790-5800	90% Claystone, light to medium gray, as above. 10% Sandstone, light yellow-green to light gray, epidotized; trace of pyrite porphyroblasts.
5800-5810	50% Claystone, medium and dark gray, as above. 30% Claystone, light gray to green-gray, as above; trace of granular pyrite aggregates. 20% Sandstone, light gray and yellow-green, mostly epidotized; trace of pyrite porphyroblasts. Trace of red-brown, transparent mineral in matrix (sphalerite).
5810-5820	80% Claystone, light to medium gray, as above. 10% Siltstone, light gray, hard. 10% Sandstone, light gray to yellow-gren, partly epidotized. Porphyroblasts of pyrite; trace of red-brown sphalerite(?).
5820-5830	90% Claystone, medium to dark gray, as above. 10% Sandstone, light gray with minor yellow-green, very fine-grained, minor epidotization. Trace of pyrite porphyroblasts. Trace of light green claystone. Trace of chalcopyrite(?).
5830-5840	45% Claystone, light to medium gray, as above. 45% Claystone, light gray-green, trace of granular pyrite aggregates. 10% Sandstone, white and yellow-green, minor epidotization, as above.

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Depth (feet)	Description
5840-5850	30% Claystone, medium gray, as above. 30% Claystone, light gray, as above. 30% Claystone, light gray-green, as above. 10% Sandstone, yellow-green and white, partly epidotized; trace of pyrite porphyroblasts.
5850-5860	50% Claystone, light gray-green, spotted, slightly calcareous to non-calcareous. Trace of granular aggregates of pyrite. Trace of epidote veinlet. 40% Claystone, medium to dark gray, spotted, calcareous. 10% Sandstone, white with trace of yellow-green epidotization, very fine-grained.
5860-5870	45% Claystone, light gray-green, as above. 45% Claystone, light and medium gray, as above. 5% Sandstone, white with common epidote in matrix, very fine-grained; pyrite porphyroblasts. 5% Epidote vein fragments with minor pyrite. Crystal-lined cavities indicate some vein porosity. Some veins may exceed 0.25" width.
5870-5880	80% Claystone, medium to dark gray, as above. 20% Claystone, light gray-green, as above. Trace of sandstone, epidotized. Trace of vein epidote and pyrite.
5880-5890	70% Claystone, medium to dark and light gray, as above. Trace of granular pyrite aggregates, some stratabound. 30% Claystone, light gray-green, as above. Trace of vein epidote.
5890-5900	60% Claystone, medium to dark gray, as above, with granular pyrite, as above. 40% Claystone, light gray-green, as above. Trace of sandstone, yellow-green, epidotized, with trace of pyrite porphyroblasts and shalerite (red-brown) in matrix.

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Depth (feet)	Description
5900-5910	80% Claystone, medium to dark gray, as above. 20% Sandstone, white, fine to very fine-grained. Trace of pyrite and dark red sphalerite(?) in matrix. Sphalerite(?) occasionally surrounds pyrite. Trace of green claystone. Trace of anhydrite(?) veinlet (white, crystalline, moderately soft, no reaction with HCl; pyritic). Trace of epidote veinlet.
5910-5920	90% Claystone, medium to dark gray, as above. 10% Sandstone, white, very fine-grained, as above. Trace of intergranular pyrite and sphalerite.
5920-5930	40% Claystone, medium to dark gray, as above. Trace of granular pyrite. 30% Claystone, light gray, similar to above. 20% Sandstone, white, very fine-grained, as above. 10% Claystone, medium green, spotted.
5930-5940	50% Claystone, dark gray, as above. 30% Claystone, light gray, as above. 20% Sandstone, white, fine to very fine-grained; trace of intergranular pyrite and red sphalerite.
5940-5950	50% Claystone, light gray, as above. 40% Claystone, dark gray, as above; trace of granular pyrite. 10% Sandstone, light gray to white, as above. Trace of intergranular pyrite and sphalerite.
5950-5960	80% Claystone or siltstone, light gray, hard, slightly calcareous. 15% Claystone, medium gray, as above. 5% Sandstone, white, as above.

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Depth (feet)	Description
5960-5970	45% Claystone or siltstone, light to medium gray, as above. 45% Claystone, medium to dark gray, as above. 10% Sandstone, white, as above, with trace of pyrite, epidote and red-brown sphalerite in matrix. Sandstone is slightly friable.
5970-5980	75% Claystone, dark gray, as above. Trace of calcopyrite(?). 20% Claystone or siltstone, light gray, as above. Trace of calcite-sphalerite filled hairline fracture. 5% Sandstone, white, slightly friable, as above. Trace of secondary feldspar(?) euhedra in sandstone.
5980-5990	45% Claystone, medium gray, as above, with trace of granular pyrite aggregates. 40% Claystone or siltstone, light gray, hard, with trace of fine granular pyrite. 15% Sandstone, white, fine to very fine-grained, slightly friable. Trace of green claystone, epidote fragment and epidotized sandstone.
5990-6000	60% Claystone, light to medium gray, as aboe. 30% Claystone, light gray-green, slightly calcareous, spotted, silty(?). Trace of granular pyrite aggregates. 10% Sandstone, very fine-grained, white, as above; a few chips contain epidote. Trace of epidote veinlet. Trace of sphalerite in calcite veinlet.
6000-6010	40% claystone, light to medium gray. Slightly calcareous. Spotted with irregular white patches less than 0.5 mm diameter. Fine sparse disseminated pyrite. 55% claystone, light greenish gray. Moderately calcareous. Irregular white patches as above. Sparse fine disseminated pyrite.

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Depth (feet)	Description
6400-6410	90% Claystone, medium gray to greenish gray, hard, non-calcareous. Minutely specked with white. Sparse vein fillings of epidote, pyrite and calcite. 10% Sandstone, very fine-grained. Matrix altered yellow-green. Non-calcareous. Sparse sulfides.
6410-6420	As above.
6420-6430	95% Claystone, predominantly greenish-gray. Hard, non-calcareous, finely specked with white. Cut by thin veins of epidote. 5% Sandstone, very fine-grained. Matrix altered to yellow-green. Non-calcareous, non-friable.
6430-6440	As above. Iron staining and cementing of cuttings apparently due to metal fragments.
6440-6450	As above.
6450-6460	95% Claystone, greenish gray with minor medium gray. Hard, non-calcareous, finely specked with white. 5% Sandstone, as above. Trace of epidote vein fillings, pyrite fragments.
6460-6470	50% Claystone, greenish-gray, as above. 45% Claystone, medium gray to medium dark gray; otherwise as above. 5% Sandstone, very fine-grained. Matrix only partly altered to light yellow. Non-calcareous. Sparse disseminated pyrite.
6470-6480	As above. Traces of vein pyrite and epidote. Trace of sandstone, very fine-grained. Matrix altered yellow-green.
6480-6490	As above.

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Depth (feet)	Description
6490-6500	95% Claystone, medium greenish-gray, as above. Sparse disseminated pyrite. Trace of sandstone, as above.
6500-6510	As above.
6510-6520	60% Claystone, greenish-gray, as above. 38% Claystone, medium dark gray, as above. <2% Sandstone, very fine-grained. Matrix altered to yellow-green, non-calcareous, non-friable.
6520-6530	As above.
6530-6540	As above. Trace of epidote and epidote + specular hematite vein filling.
6540-6550	As above. Vein fillings of epidote, epidote + euhedral pyrite. Sparse disseminated pyrite and chalcopyrite.
6550-6560	96% Claystone, greenish-gray, hard, non-calcareous, finely speckled with white. 3% Sandstone, very fine-grained. Matrix pale yellow to yellowish-green. Trace of epidote and epidote + sulfide vein filling. Pieces of vein filling specular hematite.
6560-6570	As above.
6570-6580	As above.
6580-6590	60% Claystone, greenish-gray, as above. 40% Claystone, medium gray; otherwise identical to green. Trace of sandstone, very fine, as above. Trace of epidote vein fillings.
6590-6600	As above.

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Depth (feet)	Description
6600-6610	As above.
6610-6620	90% Claystone, dark gray, friable. Non-calcareous. Minor lenses of pyrite, spotted with irregular white patches. 10% Claystone, greenish-gray, friable. Non-calcareous. Irregular white patches. Trace of very fine sandstone, as above.
6620-6770	NO RETURNS
6770-6780	80% Claystone, as above, predominantly greenish-gray. 20% Claystone to silty claystone, friable, non-calcareous. Unidentifiable silt-sized clasts are clear to dark. Possibly an air-fall tuff.
6780-6880	NO RETURNS
6880-6890	Claystone, pale grayish-green, friable, slightly calcareous. Thin lenses of minute sulfides. Irregular spots of white. Sample is badly contaminated with lost circulation material.
6890-6900	As above.
6900-6910	90% Claystone, pale grayish-green, as above. 10% Claystone, identical except for light gray color.
6910-6920	80% Claystone, medium to dark gray, friable, calcareous, spotted with irregular white patches. Thin lenses of minute sulfides. 20% Claystone, pale grayish-green, as above.
6920-6930	10% Claystone, medium to dark gray, as above. 90% Claystone, grayish-green, as above.
6930-6940	As above.
6940-6950	Claystone, plae grayish-green, slightly calcareous, irregular white spots, minor sulfides.

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Depth (feet)	Description
6950-6960	Claystone, as above. Minor lenses of sulfide less than 0.5 mm thick. Sample contaminated with LCM.
6960-6970	As above.
6970-6980	As above.
6980-6990	Claystone, greenish-gray, as above. Trace of sandstone, white, very fine grained.
6990-7000	Claystone, greenish-gray, as above.
7000-7010	Claystone, greenish-gray to light gray.
7010-7020	40% Claystone, greenish-gray, slightly calcareous, as above. 60% Silty claystone, light gray, calcareous.
7020-7030	40% Claystone, greenish-gray, as above. A few thin laminations of fine sand. 60% Silty claystone, light gray, calcareous.
7030-7040	70% Claystone, greenish-gray, as above. 30% Silty claystone, as above.
7040-7050	As above.
7050-7060	As above.
7060-7070	As above. Trace of sparry calcite vein material.
7070-7080	As above.
7080-7090	As above. Trace of specular hematite vein filling.
7090-7100	Claystone and silty claystone, as above.
7100-7110	As above.

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Depth (feet)	Description
7110-7120	50% Claystone, greenish-gray, as above. 50% Claystone, light gray, calcareous, flecks of irregular white.
7120-7130	As above.
7130-7140	As above.
7140-7150	As above.
7150-7160	As above.
7160-7170	As above.
7170-7180	As above.
7180-7190	As above.
7190-7200	As above.
7200-7210	As above.
7210-7220	As above.
7220-7230	As above.
7230-7240	As above.
7240-7250	As above.
7250-7260	As above.
7260-7270	As above.
7270-7280	As above.
7280-7290	As above.
7290-7300	98% Claystone to silty claystone, greenish-gray, as above. 2% Fine sandy claystone, greenish-gray, non-calcareous.

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Depth (feet)	Description
7300-7310	As above.
7310-7320	Claystone, greenish-gray, non-calcareous, friable. Minor disseminated sulfides spotted with irregular white patches.
7320-7330	95% Claystone, greenish-gray, as above. 5% Sandstone, very fine-grained, non-calcareous, matrix white, patchily altered to greenish-yellow epidote.
7330-7340	As above.
7340-7350	95% Claystone, greenish-gray, as above. 5% Claystone, dark gray, friable, minute linear calcareous zones suggest fracture fillings. Irregular white patches show a preferred orientation, appears to be foliated when seen in 3 dimensions.
7350-7360	98% Claystone, greenish-gray, as above. 2% Sandstone, very fine-grained, non-calcareous. Matrix patchily altered to yellow epidote.
7360-7370	As above.
7370-7380	As above.
7380-7390	50% Claystone, as above. 50% Sandstone, fine-grained, non-calcareous. Patchy alteration of matrix to yellow epidote.
7390-7400	90% Claystone, as above. 10% Sandstone, as above.
7400-7410	20% Claystone, as above. 80% Sandstone, as above. Yellow alteration of matrix is minor.
7410-7420	Claystone, medium gray, calcareous. Minor disseminated sulfides spotted with irregular white patches.

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Depth (feet)	Description
7420-7430	80% Claystone, medium gray to greenish-gray, as above. 20% Sandstone, as above.
7430-7440	As above.
7440-7450	As above.
7450-7460	As above.
7460-7470	Claystone, medium greenish-gray, slightly calcareous.
7470-7480	Claystone, as above, medium gray to greenish-gray.
7480-7490	Claystone, as above.
7490-7500	As above. Trace of epidote vein filling.
7500-7510	As above.
7510-7520	As above.
7520-7530	50% Claystone, medium greenish-gray, non-calcareous, speckled white. 40% Clayey siltstone, light gray, calcareous. 10% Sandstone, very fine-grained, non-calcareous. Matrix partially altered to yellow.
7530-7540	50% Claystone, as above. 30% Clayey siltstone, as above. 20% Sandstone, as above.
7540-7550	As above.
7550-7560	Claystone, medium greenish-gray, calcareous. Spotted with irregular white patches.
7560-7570	As above.

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Depth (feet)	Description
7570-7580	95% Claystone, medium gray to greenish-gray, as above. 5% Sandstone, very fine-grained, non-calcareous. Matrix partly altered to yellow.
7580-7590	Claystone, medium dark gray, calcareous, spotted with irregular white patches.
7590-7600	As above.
7600-7610	50% Claystone, medium dark gray, as above. 50% Claystone, greenish-gray, calcareous. Spotted with irregular white patches.
7610-7620	95% Claystone, medium gray to greenish-gray, as above. 5% Sandstone, very fine-grained, non-calcareous. Matrix partly altered yellow.
7620-7630	As above.
7630-7640	95% Claystone, medium dark gray, as above. 5% Siltstone, light gray, slightly calcareous. Trace of disseminated sulfides.
7640-7650	As above.
7650-7660	98% claystone, dark gray. Non-calcareous. Friable. Minute white flecks sometimes show a hint of lineation. Matrix minutely "sugary". Tabular bodies of pyrite up to 1 mm thick. Very thin veinlets filled with calcite. Trace of calcite and specular hematite veining. 2% very fine sandstone matrix, white to yellowish. Calcareous. Variable amounts of disseminated sulfite.
7660-7670	As above.
7670-7680	20% claystone. Dark gray as above. 80% claystone, medium grayish green. Minute white flecks. Very thin calcite veinlets.

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Depth (feet)	Description
7680-7700	As above. Minor chalcopyrite bodies in the green claystone.
7700-7710	Claystone, pale grayish-green, non-calcareous, friable. Lacks white flecks.
7710-7720	Claystone, light gray, friable, non-calcareous. Some slightly silty. No white flecks. Trace of earthy white anhydrite.
7720-7730	As above. Minor calcite and chalcopyrite veining.
7730-7740	98% Claystone, medium gray to grayish-green, non-calcareous, friable. Minute irregular white flecks. 2% Sandstone, very fine-grained, non-calcareous. Matrix altered to yellowish. Trace of earthy white anhydrite. Trace of epidote + sulfide vein filling.
7740-7750	95% Claystone, as above. 5% Siltstone to fine sandstone, non-calcareous, yellowish matrix. Trace of epidote + calcite + pyrite vein filling.
7750-7760	As above.
7760-7770	95% Claystone, medium gray to greenish-gray, as above. Silty in part. 5% Sandstone, very fine to fine-grained, non-calcareous. Matrix white to yellowish. Trace of vein filling epidote or epidote + calcite.
7770-7780	As above.
7780-7790	Claystone, medium gray to greenish-gray, non-calcareous, friable. Speckled with minute white flecks. Trace of very fine sandstone, as above. Trace of epidote vein filling.

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Depth (feet)	Description
7790-7800	Claystone to slightly silty claystone. Light gray, friable, non-calcareous, without white flecks. Minor disseminated sulfides. Hairline fractures filled with calcite. Trace of epidote + calcite vein fillings. Trace of very fine sandstone, as above.
7800-7810	As above.
7810-7820	As above.
7820-7830	10% Claystone, as above. 85% Claystone, green to medium gray, speckled with irregular white patches cut by minute calcite-filled veinlets. 5% Sandstone, fine to very fine, non-calcareous. Matrix yellow. Trace of vein filling - calcite + pyrite + epidote.
7830-7840	80% Claystone, green to medium gray, friable, non-calcareous. Abundantly speckled with irregular white patches. Cut by thin epidote veins. 20% Sandstone, very fine to fine. Matrix yellow. Non-calcareous, disseminated pyrite. Vein filling of euhedral epidote, sometimes associated with white, fibrous mineral, with a pearly luster. Possibly anhydrite or tremolite fibers, very fine and asbestoform, up to 2mm long.
7840-7850	90% Claystone, as above. 10% Sandstone, as above. Vein filling of euhedral epidote + calcite + pyrite. Asbestoform white mineral absent.
7850-7860	80% Claystone, as above. Minor epidote vein filling. 20% Sandstone, as above.

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Depth (feet)	Description
7860-7870	80% Claystone, as above. 20% Sandstone, as above. Many sandstone chips have one surface coated with mats of white asbestiform mineral. Fibers up to 2mm long, apparently along fractures.
7870-7880	60% Claystone, as above. 40% Sandstone, as above. Mats of abestiform white tremolite or anhydrite appears to be filling fractures.
7880-7890	80% Claystone, as above. 20% Sandstone, as above. Fractures in claystone and sandstone lined with epidote ± white asbestiform mineral.
7890-7900	95% Claystone, green to grayish-green, as above. 5% Sandstone, as above. Minor fracture filling of epidote ± pyrite ± white asbestiform mineral.
7900-7910	98% Claystone, greenish, as above. Calcareous along hairline fractures. Layers of sulfides. 2% Sandstone, very fine to fine, non-calcareous. Matrix white, variably altered to yellow.
7910-7920	Claystone, grayish-green, friable, calcareous in patches and along hairline cracks. Disseminated pyrite and veinlets of epidote less than 0.1 mm thick grades to silty claystone at times. Few flakes of green chlorite(?).
7920-7930	Claystone to silty claystone, grayish-green, as above. No veining.
7930-7940	97% Claystone, green to medium gray, non-calcareous, variably spotted with irregular white patches. 1% Siltstone, light gray, calcareous. 2% Sandstone, very fine to fine. Matrix white, mostly altered to yellow. Non-calcareous.

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Depth (feet)	Description
7940-7950	As above.
7950-7960	Claystone, green to medium gray, non-calcareous, variably speckled. Sparse sulfides. Minor to very fine sandstone.
7960-7970	As above.
7970-7980	As above.
7980-7990	As above.
7990-8000	Claystone, as above, with minor epidote veining and a slight increase in disseminated pyrite.
8000-8010	Claystone, as above. Veins of calcite + chalcopyrite less than 0.5 mm thick.
8010-8020	Claystone, as above.
8020-8030	As above.
8030-8040	As above.
8040-8050	As above.
8050-8060	Lost circulation material and large pieces of claystone, probably sloughed from above.
8060-8070	96% Claystone, green to medium-gray, as above. 2% Siltstone, light gray, calcareous. 2% Sandstone, very fine to fine. Non-calcareous. Matrix altered yellow. Trace of euhedral epidote vein filling.
8070-8080	As above. Minor calcite vein filling. Euhedral epidote vein filling.
8080-8090	As above.
8090-8160	NO RETURNS

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Depth (feet)	Description
8160-8170	Claystone to silty claystone, green to medium gray. Silty claystones are slightly calcareous. Minor disseminated sulfides.
8170-8180	As above.
8180-8190	As above.
8190-8200	As above.
8200-8210	As above.
8210-8220	95% Claystone, as above. 5% Sandstone, very fine to fine. Matrix partly altered from white to yellowish.
8220-8230	Claystone, as above.
8230-8240	As above.
8240-8250	Claystone, as above. Trace of vein filling, consisting of epidote and clear anhydrite (soft, non-calcareous, appears to have 3 cleavages).
8250-8260	As above.
8260-8270	Mostly lost circulation material, with some claystones, as above.
8270-8280	98% Claystone, as above, light gray to green to white in color. 2% Sandstone, fine grained, slightly calcareous. Matrix altered to yellowish.
8280-8290	50% Claystone, as above. 50% Sandstone, very fine, non-calcareous. Matrix white with sporadic alteration to yellow.
8290-8300	As above, with more yellow alteration of sandstone matrix.
8300-8310	As above.

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Depth (feet)	Description
8310-8320	As above.
8320-8330	20% Claystone, green, friable, non-calcareous. Irregularly spotted with white. 10% Silty claystone, light gray, calcareous. 70% Sandstone, fine grained, non-calcareous. Framework of quartz grains which seem to have silica overgrowths. Matrix white, with sporadic alteration to yellowish.
8330-8340	40% Claystone, as above. 30% Silty claystone to siltstone, as above. 30% Sandstone, as above.
8340-8350	20% Claystone, as above. 70% Siltstone to clayey siltstone, as above. 10% Sandstone, as above.
8350-8360	60% Claystone, green to medium gray, as above. 35% Siltstone to clayey siltstone, medium gray, non-calcareous. 5% Sandstone, as above.
8360-8370	50% Claystone, green to medium gray, non-calcareous. Variably spotted white. 50% Clayey siltstone to very fine sandstone, medium gray, non-calcareous.
8370-8380	As above.
8380-8390	90% Claystone, dark gray, friable, non-calcareous, speckled with irregular white patches. 5% Claystone, green, otherwise as above. 5% Siltstone, light gray, calcareous.
8390-8400	Most of sample consists of large fragments sloughed from above. Remainder is similar to above. Trace of clear, soft, non-calcareous vein filling. 3 cleavages at right angles - anhydrite(?). Flakes of green chlorite(?).

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Depth (feet)	Description
8400-8410	80% Claystone, as above. 5% Siltstone, as above. 15% Sandstone, very fine to fine, non-calcareous. Matrix white. Trace of fibrous white material as first seen at 7830. Trace of epidote + sulfide vein material.
8410-8420	20% Claystone, as above. 80% Sandstone, very fine to fine, friable, non-calcareous. Matrix white, occasionally altered to yellow. Very sparse disseminated sulfides.
8420-8430	As above.
8430-8440	50% Claystone, as above. 45% Siltstone to very fine sandstone, light gray, slightly calcareous. 5% Sandstone, fine-grained, non-calcareous. Matrix white.
8440-8450	60% Claystone, as above. 40% Siltstone to very fine sandstone, as above.
8450-8460	20% Claystone, medium gray to green, friable, non-calcareous. Rare sulfides. 5% Siltstone, light gray, slightly calcareous. 75% Sandstone, fine grained, non-calcareous. Framework predominantly quartz. Matrix white, altering to yellow. Sulfides absent.
8460-8470	As above.
8470-8480	15% Claystone, as above. 85% Sandstone, fine to very fine, cut by scarce epidote veins les than 0.5 mm thick.
8480-8490	As above.
8490-8500	As above. Trace of epidote vein filling.

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Depth (feet)	Description
8500-8510	10% Claystone, as above. 90% Sandstone, as above.
8510-8520	50% Claystone, as above. 50% Sandstone, as above.
8520-8530	As above.
8530-8540	90% Claystone to silty claystone, medium gray to green, friable, non-calcareous. 10% Sandstone, fine to very fine, non-calcareous, variably speckled with white.
8540-8550	60% Claystone, green to grayish green, non-calcareous, variably speckled with white. 40% Sandstone, very fine, to siltstone, white to pale gray. Sulfides absent.
8550-8560	80% Claystone, as above. 20% Sandstone, as above.
8560-8570	20% Claystone, as above. 80% Sandstone, fine to very fine, non-calcareous. Matrix white, variably altered to yellow. Some flakes of green chlorite(?).
8570-8580	10% Claystone, as above. 90% Sandstone, fine grained, non-calcareous. Matrix white, variably altered to yellow. Flakes of green chlorite(?).
8580-8800	NO RETURNS
8800-8810	20% Claystone, pale greenish-gray. Brittle, non-calcareous. Spotted with minute, irregular white flecks. Essentially barren of sulfides. 50% Silty claystone, medium gray, brittle, non-calcareous, spotted with minute white flakes. 20% Siltstone, medium gray, brittle, calcareous, non-mineralized. 10% Euhedral epidote vein filling. Trace of silica + chalcopyrite vein filling.

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Depth (feet)	Description
8810-8820	5% Claystone, pale greenish-gray, brittle, non-calcareous. Spotted with minute white flecks. 75% Silty claystone, medium gray, brittle, non-calcareous, sparse minute sulfides. 20% Very fine sandstone, pale gray, calcareous. Mineralogy mainly quartz with some unidentifiable dark grains. Trace of epidote vein filling, as above.
8820-8830	80% Silty claystone, medium gray, as above. 20% Very fine sandstone, as above.
8830-8840	As above.

NOTE: GeothermEx received no cuttings identified as coming from 8,840-8,900 feet, although cuttings were returned from this interval.

8900-8910	80% Claystone, greenish-gray, brittle, non-calcareous. Spotted with irregular white flecks. 15% Silty claystone, light gray, brittle, non-calcareous. 5% Very fine sandstone, yellow matrix, non-calcareous. No sulfides. Trace of epidote and silica vein fillings.
8910-8920	As above.

NOTE: GeothermEx received cuttings identified as coming from 8,920-9,000 feet, although ExLog Smith reported no returns from 8,920-9,020 feet. Cuttings are described as received by GeothermEx. On the composite stratigraphic column/mud log, however, cuttings identified as being from 8,950-9,000 feet are shown in the 9,050-9,100 feet positions. This matches a highly mineralized interval labeled as 8,980-9,000(?) with one at 9,100-9,110, and is more consistent with reported lost circulation. Similarly, the interval identified as 8,900-8,950 falls in a reported lost circulation zone, as is shown in the 8,840-8,890 position.

8920-8930	80% Claystone, medium greenish-gray, brittle, slightly calcareous along veinlets. Variably spotted with white. 20% Very fine sandstone. Matrix soft, cloudy white and slight calcareous. Minor patchy alteration to yellow epidote.

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Depth (feet)	Description
8930-8940	40% Claystone, as above. 60% Very fine sandstone. Mineralogy predominantly quartz. Matrix cloudy white to yellow. Both are non-calcareous. Samples with white matrix are softer and less brittle. Trace of epidote vein filling.
8940-8950	80% Claystone, medium greenish-gray, brittle, non-calcareous. Few disseminated euhedral pyrite cubes. Variably spotted with white. 20% Very fine sandstone, as above.
8950-8960	85% Claystone, as above, medium greenish-gray to pale greenish gray. 15% Very fine sandstone, as above. Matrix yellow to white.
8960-8970	75% Claystone, as above. 25% Very fine sandstone, as above, with a few tiny flecks of dark green chlorite(?).
8970-8980	70% Claystone, as above. Some fragments show veinlets less than 0.1 mm thick, filled with epidote. 30% Very fine sandstone, as above.
8980-8990	Large percentage of sample is LCM. 40% Claystone, as above. 20% Very fine sandstone, as above. 40% Vein filling, euhedral epidote with minor silica.
8990-9000	As above.
9000-9100	NO SAMPLES?
9100-9110	30% Claystone, medium gray to light greenish-gray, non-calcareous. Variably spotted with white. 30% Very fine sandstone. Matrix white, variably altered to yellow, non-calcareous, brittle. The only identifiable mineral is quartz. 40% Vein filling, euhedral epidote with minor clear quartz.

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Depth (feet)	Description
9110-9120	20% Claystone, as above, with minor disseminated pyrite cubes. 75% Sandstone, as above. 5% Vein filling, as above.
9120-9130	30% Claystone, as above. 70% Sandstone, as above. Trace of vein filling, euhedral epidote
9130-9140	As above.
9140-9150	50% Claystone, as above. 50% Very fine sandstone, as above.
9150-9160	Sample has a high proportion of LCM 50% Claystone, as above. 45% Very fine sandstone, as above. 5% Flakes of biotite up to 1 mm in diameter, some altered to green chlorite. A few pieces of what appear to be mica schist. Unlike anything previously seen; they either represent a new rock type or foreign material introduced into the well. Trace of vein fillings of epidote and clear silica.
9160-9170	70% Silty claystone, medium dark gray, slightly calcareous, widely disseminated euhedral pyrite cubes. 20% Claystone, medium to light greenish-gray, non-calcareous. Variably spotted with white. A few fragments cut by epidote veinlets <0.1 mm thick. 10% Very fine sandstone, as above. Trace of vein fillings, fragments of clear quartz in excess of epidote.
9170-9180	Sample has high proportion of LCM 60% Silty claystone, medium dark gray, as above. 35% Claystone, as above. 5% Very fine sandstone, as above. Trace of vein filling, as above.

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Depth (feet)	Description
9180-9190	75% Claystone, medium to light greenish-gray, non-calcareous. Variably spotted with white. 25% Very fine sandstone. White matrix variably altered to yellow. Non-calcareous, brittle. Mineralogy: quartz with minor flakes of green chlorite. Trace of vein filling, both euhedral epidote and clear quartz. Trace of biotite flakes and shistose rock with biotite.
9190-9200	Silty claystone, medium gray, slightly calcareous. Widely scattered sulfide grains appear to be chalcopyrite.
9200-9210	As above.
9210-9220	As above. Fragments frequently cut by epidote veinlets. Some veinlets with earthy white anhydrite(?) on surfaces.
9220-9230	10% Silty claystone, as above. 70% Claystone, medium greenish-gray, non-calcareous. Irregularly spotted with white. Cut by veinlets of epidote ± sulfide. 20% Very fine sandstone, white, variably altered to yellow matrix, non-calcareous. Trace of clear quartz, looks like vein filling, but never seen attached to rock fragments. May be foreign material. Trace of flakes of biotite still common.
9230-9240	Claystone, medium greenish-gray, non-calcareous. Variably spotted with white. Minor disseminated sulfides. Trace pieces of clear quartz and biotite of questionable origin.
9240-9250	60% Claystone, as above. 40% Very fine sandstone. White matrix, variably altered to green, non-calcareous. Trace of vein fillings of euhedral epidote. Trace of quartz and biotite fragments, as above.

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Depth (feet)	Description
9250-9260	40% Claystone, as above. 45% Very fine sandstone, as above. 15% Vein filling, epidote ± sulfide (apparently pyrite)
9260-9270	30% Claystone, as above. Sparse disseminated pyrite cubes. 70% Very fine sandstone. Matrix white to eyllow, non-calcareous. Sparse pyrite cubes. Trace of vein fillings of epidote.
9270-9280	5% Claystone, as above. A few pieces cut by anhydrite veinlets. 95% Very fine sandstone, as above.
9280-9290	40% Claystone, medium to light greenish-gray, brittle, non-calcareous. Variably spotted with white. 60% Very fine sandstone, as above.
9290-9300	20% Claystone, as above. 80% Very fine sandstone, as above.
9300-9310	5% Claystone, as above. 95% Very fine sandstone, as above.
9310-9320	As above.
9320-9330	40% Claystone, medium to light greenish-gray, as above. 60% Very fine sandstone, as above.
9330-9340	As above, both cut by veinlets of epidote or anhydrite.
9340-9350	As above. Sparse disseminated sulfides in sandstones.
9350-9360	Large proportion of the sample is LCM. 90% Claystone, as above. 10% Very fine sandstone, as above.
9360-9370	10% Claystone, as above. 90% Very fine sandstone, as above.

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Depth (feet)	Description
9370-9380	90% Claystone, as above. Few disseminated chalcopyrite. 10% Very fine sandstone, as above.
9380-9390	As above.
9390-9400	As above.
9400-9410	60% Claystone, as above, cut by sparse veinlets of epidote + anhydrite. 40% Very fine sandstone, as above.
9410-9420	75% Claystone, as above. 25% Very fine sandstone, as above.
9420-9430	Claystone, medium greenish-gray, brittle, non-calcareous. Sparse tiny grains, apparently sulfides. Trace of vein filling of euhedral epidote.
9430-9440	Claystone, as above. A few pieces cut by veinlets of epidote + chalcopyrite.
9440-9450	50% Mafic intrusive rock, phaneritic, fine-grained. Medium gray with prismatic pyroxenes altered to dark green. Plagioclase are earthy white. Rock is relatively little altered. Texturally, the rock could probably be called a diabase. 30% Altered claystone, as above. 18% Very fine sandstone, as above. Some fracture surfaces covered with fibrous white anhydrite(?). 2% Vein filling: predominantly epidote, with minor anhydrite and sulfides.
9450-9460	90% Altered claystone, medium greenish-gray, brittle, non-calcareous. Minutely blotched with white, tiny disseminated grains of sulfide. Fragments often cut by veins of epidote + anhydrite + brassy yellow chalcopyrite.
9460-9470	85% Altered claystone, as above. 10% White clay additive, as above.

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RICHMOND, CALIFORNIA 94804
(415) 527-9876
CABLE ADDRESS: GEOTHERMEX
TELEX: 709152 STEAM UD
FAX: (415) 527-8164

Depth (feet)	Description
	3% Very fine sandstone: greenish-yellow matrix, hard, non-calcareous. Visible clasts are light colored, but unidentifiable. 1% Diabase, as above. 1% Vein filling: epidote + anhydrite ± chalcopyrite.
9470-9480	As above.
9480-9490	35% Diabase, as above, except greenish alteration is more pervasive. 20% Very fine sandstone, as above. 30% White clay additive, as above. 10% Altered claystone, as above. 5% Vein filling, as above.
9490-9500	50% Claystone, as above. 20% Very fine sandstone, as above. 10% Tuff, as above. 20% Diabase, as above.
9500-9510	50% Claystone, as above. 20% Very fine sandstone, as above. 30% Diabase, as above.
9510-9520	10% Claystone, as above, cut by few veinlets of epidote and anhydrite. 90% Diabase, fine-grained, as above. No evidence of mineralization.
9520-9530	50% Claystone, as above. 50% Diabase, as above.
9530-9540	90% Claystone, as above. 5% Very fine sandstone. Matrix white to yellowish, non-calcareous. 5% Diabase, as above.
9540-9550	50% Claystone, medium greenish-gray to light greenish-gray, non-calcareous. Variably spotted with white. Cut by veinlets of epidote or anhydrite. 50% Very fine sandstone, as above. Cut by a few epidote veins. Trace of diabase, as above.

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Depth (feet)	Description
9550-9560	60% Claystone, as above. 40% Very fine sandstone, as above.
9560-9570	95% Claystone, as above. 5% Very fine sandstone, as above.
9570-9580	As above.
9580-9590	As above.
9590-9600	Claystone, as above.
9600-9610	Claystone, light greenish-gray, brittle, non-calcareous, but by a few veinlets of epidote. Fibrous white anhydrite(?) on some broken surfaces.
9610-9620	95% Claystone, as above. No fibrous anhydrite. 5% Very fine sandstone. Matrix yellow, non-calcareous.
9620-9630	As above.
9630-9640	As above.
9640-9650	As above.
9650-9660	90% Claystone, as above. Epidote and anhydrite fillings. 10% Very fine sandstone, as above.
9660-9670	As above.
9670-9680	70% Claystone, as above. 25% Sandstone, as above. 5% Diabase, fine grained.
9680-9690	As above.
9690-9700	80% Claystone, as above. 10% Very fine sandstone, as above. 10% Vein filling, euhedral epidote $\pm$ anhydrite.

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Depth (feet)	Description
9700-9710	70% Claystone, as above, cut by epidote ± anhydrite veins. 15% Tuff(?), cream-colored, friable, slightly calcareous. Contains tiny dark flecks too small to identify. Looks identical to that seen at 9460'. 10% Vein filling: euhedral epidote with minor anhydrite. 5% Drilling material(?), medium to light brown, soft, calcareous with dark brown wood fragments. Appears to be cut by epidote veins in spots, but this is probably pieces of epidote vein filling physically pressed onto it.
9710-9720	30% Claystone, as above, cut by veins of epidote + pyrite. 30% Fine sandstone. Matrix white or yellow, non-calcareous. Contains quartz and unidentifiable dark minerals. 25% Altered fine-grained plutonic rock of intermediate composition or altered medium-grained arkosic sandstone. Color is greenish with equant white patches and some flakes of dark mica. 5% Vein filling: euhedral epidote. 5% Schistose material: thin laminae of bronze, flaky mica, dark green and aphanitic between.
9720-9730	30% Claystone, as above. 40% Fine sandstone. Matrix white, variably altered to yellow, non-calcareous. Mineralogy mainly equant quartz with unidentifiable dark fragments. 20% Altered plutonic rock or arkosic sandstone, as above. Some fragments are cut by epidote veinlets. One similar appearing, but finer-grained fragment shows apparent laminations of claystone. Exact nature cannot be determined from megascopic examination of cuttings. Most likely origin is sand-sized plutonic rock fragments altered after deposition. 5% Schistose material, as above. 5% Vein filling: euhedral epidote.

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Depth (feet)	Description
9730-9740	30% Claystone, as above. 60% Fine sandstone, white to yellow, as above. 5% Plutonic rock fragments or arkosic sand, as above. 5% Schistose material, as above. Trace vein filling: euhedral epidote.
9740-9750	85% Claystone, dark greenish-gray, brittle, non-calcareous. Variably spotted with minute white flecks. 15% Fine sandstone, white to yellow, as above. Trace of vein filling: euhedral epidote.
9750-9760	As above.
9760-9770	95% Claystone, as above. Patches of minute sulfide grains. 5% Fine sandstone, as above.
9770-9780	As above.
9780-9790	As above.
9790-9800	As above. Both claystone and sandstone cut by veinlets of epidote + anhydrite.
9800-9810	As above.
9810-9820	As above.
9820-9830	50 Claystone. As above. Dark greenish gray to olive gray. 20% fine sandstone. Matrix white to yellow, non-calcareous. Mineralogy mostly quartz with subordinate dark specks. 15% Sandstone. Medium grained. Equant quartz grains with foliated structure due to flakes of bronze-colored mica. Unlike the above, mica-sandstones never contain epidote. Trace vein filling: clear anhydrite and pyrite. 15% schist. Bodies of bronze mica. Micas look like those seen in the mica-sandstones, but the two never occur together in a given fragment.

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Depth (feet)	Description
9830-9840	As above.
9840-9850	90% Claystone. Medium greenish gray, brittle, non-calcareous. Minutely spotted with white. Soft, pale green crumbly material seems to be altered portions of same. 5% Medium sandstone. Micaceous as above. 5% Schist. Bronze colored, as above.
9850-9860	80% Claystone. As above. 20% Fine sandstone. Matrix white to yellow. Non-calcareous.
9860-9870	As above.
9870-9880	10% Claystone. As above. 90% Fine sandstone. White to pale yellow matrix. Non-calcareous. Mineralogy predominately equant quartz with clear overgrowths, a few earthy white feldspar remnants. No mafic minerals.
9880-9890	As above.
9890-9900	As above.
9900-9910	95% Claystone. As above. 5% Fine sandstone. As above.
9910-9920	80% Claystone. As above. One piece with specular hematite. 5% Fine sandstone. As above. 15% Vein filling. Euhedral epidote.
9920-9930	95% Claystone. As above. 5% Fine sandstone. As above. Trace vein filling. Euhedral epidote.
9930-9940	20% Claystone. As above. 80% Fine sandstone. White to pale yellow matrix. Non-calcareous. Equant quartz with clear overgrowths. A few earthy white feldspar remnants. No mafic minerals.
9940-9950	85% Claystone. Medium gray to pale greenish gray, brittle, non-calcareous variably spotted with white flecks.

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Depth (feet)	Description
	15% Fine sandstone. As above.
9,950-9960	5% Claystone. As above. 95% Fine sandstone. As above.
9,960-9,970	As above.
9,970-9,980	10% Claystone, as above. 40% Siltstone, medium grayish-green, non-calcareous. Sparse tiny disseminated sulfides. 50% Very fine sandstone, white matrix, non-calcareous.
9,980-9,990	As above.
9,990-10,000	As above.
10,000-10,010	10% Claystone, grayish-green, as above. 5% Very fine sandstone, as above. 85% Claystone, medium olive brown, harder than steel probe, brittle, non-calcareous. Sparse veinlets lined with clear anhydrite. No identifiable minerals.
10,010-10,020	30% Claystone, grayish-green, as above. 70% Claystone, olive brown, as above.
10,020-10,030	60% Claystone, greenish-gray, as above. 40% Claystone, olive brown, as above.
10,030-10,040	30% Claystone, greenish-gray, as above. 70% Fine to very fine sandstone, white to pale yellow, non-calcareous.
10,040-10,050	60% Claystone, greenish-gray. 30% Claystone, olive brown. 10% Fine sandstone, as above.
10,050-10,060	10% Claystone, greenish-gray. 90% Claystone, olive brown.
10,060-10,070	Claystone, brownish-gray, hard, non-calcareous.
10,070-10,080	As above.

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Depth (feet)	Description
10,080-10,090	Claystone, olive brown to brownish gray.
10,090-10,100	30% Claystone, greenish-gray, as above. Some veinlets of epidote + sulfide. 40% Claystone, olive brown, as above. 20% Fine sandstone, matrix white to yellowish. 10% Fine sandstone(?), non-calcareous, with flakes of brown mica.
10,100-10,110	As above.
10,110-10,120	20% Claystone, greenish-gray. 30% Claystone, olive brown. 40% Very fine sandstone, white to yellow matrix, non-calcareous. Mineralogy mostly quartz with a few tiny dark flecks. 10% Schist(?), foliated masses of bronze mica.
10,120-10,130	80% Claystone, greenish-gray, as above. 10% Claystone, olive brown. 10% Very fine sandstone, as above.
10,130-10,140	As above.
10,140-10,150	30% Claystone, as above. 70% Fine to very fine sandstone, matrix white with patches of epidote, non-calcareous.
10,150-10,160	As above.
10,160-10,170	As above.
10,170-10,180	10% Claystone, as above. 90% Sandstone, as above.
10-180-10,190	As above.
10,190,10,200	As above.
10,200-10,210	80% Claystone, altered to argillite: light grayish-green, brittle, hardness >5.5, non-calcareous. Minutely speckled with irregular white blotches. Sparse idiomorphic pyrite grains. Fracture surfaces covered with earthy anhydrite. A few pieces of dark green vein filling amphibole.

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Depth (feet)	Description
	10% Siltstone, altering to argillite: medium grayish-green, hard, non-calcareous. Tiny flecks of green chlorite(?) and a few flecks of sulfides. 10% Claystone/argillite: light brown, hard, non-calcareous, variably speckled with irregular white blotches. Trace of earthy white anhydrite vein filling.
10,210-10,220	Sample contaminated with lignite and LCM. 60% Claystone to silty claystone: altering to argillite, medium grayish-green to light grayish-green, brittle, hard, non-calcareous. Minutely speckled with irregular white blotches. Scattered tiny idiomorphic pyrite. Fractures lined with anhydrite or epidote. 40% Claystone/argillite: olive brown to light brownish gray in color, otherwise similar to the greenish claystone. Trace of vein filling: earthy anhydrite or epidote. Trace of schistose material: foliated biotite flecks, with a clear non-calcareous mineral which appears to be harder than 5.5.
10,220-10,230	70% Claystone to silty claystone, altering to argillite: greenish, as above. 20% Claystone/argillite: brown-colored, as above. 10% Very fine sandstone: white, hard, non-calcareous. Essentially barren of sulfides. Trace of vein filling, as above.
10,230-10,240	Sample contaminated with lignite. As above.
10,240-10,250	As above.
10,250-10,260	As above. Some vein fillings of silky, fibrous, white anhydrite or tremolite.

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Depth (feet)	Description
10,260-10,270	20% Claystone/argillite: grayish-green, brittle, hard, non-calcareous, as above. 60% Siltstone to very fine sandstone: grayish-green, hard and brittle, non-calcareous. A few flecks of chalcopyrite. 20% Claystone/argillite: brown-colored, as above.
10,270-10,280	As above.
10,280-10,290	20% Siltstone: grayish-green, hard and brittle, non-calcareous, as above. 80% Claystone/argillite: olive brown to dark brownish-gray, as above.
10,290-10,300	As above.
10,300-10,310	50% Claystone to silty claystone: medium grayish-green to pale grayish-green, as above. 40% Claystone/argillite: olive brown, as above. 10% Very fine sandstone: white, hard and brittle, non-calcareous. Trace of vein filling: earthy white anhydrite or euhedral epidote.
10,310-10,320	40% Claystone/argillite: pale grayish-green, as above. 40% Siltstone, grayish-green, as above. 20% Claystone/argillite: brown in color, as above. Trace of vein filling: earthy white anhydrite or euhedral epidote.
10,320-10,330	As above.
10,330-10,340	70% Claystone/argillite: pale greenish-gray, as above. 20% Siltstone: grayish-green, as above. 10% Claystone/argillite: brown in color, as above. Trace of vein filling: epidote + fibrous anhydrite or earthy white anhydrite.

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Depth (feet)	Description
10,340-10,350	As above.
10,350-10,360	As above. Amount of epidote vein filling increasing.
10,360-10,370	As above, with very minor vein filling. Trace of schistose material: dense, foliated masses of some flaky bronze to dark gray material.
10,370-10,380	50% Claystone to silty claystone, altering to argillite: medium grayish-green, hard and brittle, non-calcareous. No visible sulfides. Siltier fragments contain some tiny grains of flaky-appearing dark green chlorite(?). 30% Claystone/argillite: brown, hard and brittle, non-calcareous. No visible sulfides. Some fragments are granular-appearing, but too fine to determine if this is due to recrystallization or original texture. 20% Sand-sized plutonic rock fragments(?). Appear to be from hypabyssal instrusive. Equant clear quartz, cloudy feldspar(?), and green altered mafics. Might also be an altered fine sandstone instead of altered intrusive rock. Trace of vein filling: epidote and earthy white anhydrite.
10,380-10,390	40% Claystone/argillite: medium grayish-green, as above. 50% Claystone/argillite: brown, as above. 10% Sandstone or intrusive(?): as above.
10,390,10,400	60% Claystone/argillite to silty claystone: grayish-green, as above, cut by veins of epidote + anhydrite. 20% Claystone/argillite: brown, as above. 20% Claystone to silty claystone: pale green to white, hard and brittle, non-calcareous. Some fragments are gradational to darker green and some are cut by epidote veinlets. This suggests that these may be bleached variants of the green claystone.

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Depth (feet)	Description
10,400-10,410	As above.
10,410-10,420	80% claystone/argillite: brown, "sugary" texture, hard. Translucent edges. 20% Claystone/argillite: pale gray to greenish-gray, as above. Minor sulfides. Trace of epidote vein filling.
10,420-10,430	As above, with slightly more epidote vein filling.
10,430-10,440	40% Claystone/argillite: brown, as above. 30% Claystone/argillite: greenish-gray, as above. 30% Fine sandstone: non-calcareous, matrix white, with occasional yellow patches. Only identifiable clasts are quartz.
10,440-10,450	60% Claystone/argillite: brown, as above. 30% Claystone/argillite: greenish-gray, as above. 10% Fine sandstone, as above. Trace of epidote vein filling.
10,450-10,460	60% Claystone/argillite, brown, as above. 40% Claystone/argillite, greenish-gray, as above.

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APPENDIX B

Core Descriptions

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APPENDIX B

CORE DESCRIPTIONS

Depth (feet)	Description
CORE #1 (1,553-1,577) Rec. 24' (Hand lens examination of exterior of core)	
1,553-1,553.5	Sandstone, medium gray, medium-grained, fair sorting, hard, calcareous. Cross-bedded. Carbonaceous partings. Irregular contact with underlying claystone due to soft sediment deformation.
1,553.5-1,558	Claystone, dark gray, silty, calcareous, moderately indurated, with thin (2" - <1/2") interbedded sandstone, light gray, very fine-grained, micro-cross bedding and cut-and-fill structures. Abundant soft sediment deformation, including load deformation, slump folds, pinch and swell of sandstone layers. Bedding dips are variable in amount and direction, range up to 20° but generally are 10° or less. Most of this dip is initial dip. Detailed analysis is required to determine the amount of deformational dip, but it seems to be less than 10°.
1,558-1,570	Claystone, as above. Sandstone layers decrease in abundance and thickness to very thin laminae occasionally rhythmically interbedded with claystone.
1,570-1,577	Claystone, as above. Sandstone layers decrease further to scarce fine laminae. Thin tabular crystals of some white authigenic mineral (probably anhydrite) occur at 1,571-1,577 feet.

CORE #2 (1,983-2,012.2) Rec. 29.2' = 100% (Actually, recovery is hard to determine because core is rather broken up.)

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Depth (feet)	Description
CORE #2 (continued)	
1,983-1,987	Conglomerate or breccia of predominantly claystone clasts with minor hard sandstone (fine to very fine-grained). This may be a slump breccia as many of the clasts are angular. Clasts float in a claystone matrix. Common small pyrite crystals are disseminated in the matrix. Clasts generally pebble-sized, with one large angular sandstone fragment (2 x 3 inches).
1,987-1,988	Claystone, dark gray, calcareous, interlayered with thin beds (down to thin laminae) of sandstone, very fine-grained, calcareous, hard. Attitude of layers is variable, up to about 30°, mostly initial dip. Soft sediment deformation features common.
1,988-1,991	Claystone, alternating medium and light gray colors, rhythmically layered, blocky, calcareous.
1,991-1,995	Claystone, medium gray, lacks lamination of previous segment. Very fine disseminated pyrite.
1,995-1,996.5	Claystone, light to medium gray, massive, grading into claystone-sandstone interlaminated section. Sandstone is light gray, very fine-grained, cross-bedded and showing soft-sediment deformation.
1,996.5-2,000	Claystone, light to medium gray colors interlaminated, calcareous, blocky.
2,000-2,012.2	Claystone, as above, with thin (1/2"-2") layers of sandstone, very fine-grained, calcareous. Long high-angle to vertical fractures occur throughout the core, lined with calcite on the wall or filled with calcite. The veins are

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Depth (feet)	Description
CORE #2 (continued)	
	generally only 1/8-inch wide or less. Small patches of sulfide minerals occur in the center of the veins, including amber sphalerite, galena, chalcopyrite(?), bornite(?), and pyrite.
CORE #3 (2,448-2,478) Rec. 30'	
2,448-2,456	Sandstone, light gray, very fine-grained, subangular, fair to good sorting, calcareous, porous, in layers ranging from about 4 inches down to laminations less than 1/10 of an inch thick. The sandstone is interlayered with subordinate amounts of claystone and silty claystone, dark gray, calcareous. This interval shows extreme soft sediment deformation (contorted bedding, sediment dikes, slump breccia, penecontemporaneous "faulting", etc.). Some of the slump faults are healed with calcite and the same ore minerals found in Core 2. However, traces of sphalerite occur at 2449.8 feet along a bedding plane in sandstone. Pyrite is present as very small crystals disseminated in the sandstone and claystone.
2,456-2,475	Sandstone and claystone as above but with less slump folding and breccia. Common small-scale offset of layers is present, probably slump or compaction faulting. Many sedimentary structures are present (cross-bedding, rhythmic bedding, etc.). Sandstone is more abundant than claystone. The dip on the least-disturbed layers is about 20°, some part of which may be initial dip of the sediments. Pyrite is present as disseminated crystals in the sandstone and as disseminated crystals and

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Depth (feet)	Description
CORE #3 (continued)	
	aggregates along bedding planes in claystone. A thin stratiform band of sphalerite occurs at 2,469 feet.
2,475-2,478	Claystone, dark gray, and silty claystone, light gray, are rhythmically interbedded in this interval. Pyrite occurs as disseminated crystals in both. Many sealed hairline fractures, both high and low angle, occur. At least part of these appear to be penecontemporaneous slump or compaction fractures.
CORE #4 (2,970-3,028.4) Rec. 58.4'	
2,970-2,982	Siltstone, medium green-gray, calcareous, interlayered with thin beds and laminae of siltstone, medium gray, and thin layers of sandstone, very fine-grained to laminated, calcareous, silty. The sandstone is cross-bedded. Disseminated pyrite is present throughout. Calcite veinlets at 2,970.5 and 2,981 feet also contain epidote and pyrite. Much soft sediment deformation present.
2,982-2,992	Sandstone, light green, very fine-grained, porous, cross-bedded, with calcite cement. Traces of epidote in cement. Trace of disseminated pyrite. Trace of sphalerite in thin calcite veinlet at 2,987 feet. Sandstone has a few green claystone and siltstone partings.
2,992-2,995.5	Claystone, medium gray, silty, calcareous, spotted with white mineral floating in claystone. Mineral has blocky prismatic crystal from, in part, with epidote core (authigenic anhydrite?; feldspar?; or detrital feldspar?). This is similar to the speckled siltstone and claystone seen in cuttings.

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Depth (feet)	Description
CORE #4 (continued)	
	Thin irregular layers of white crystalline mineral (anhydrite?) at 2,991.9.
2,995.5-3,028.4	Siltstone, dark gray-green, interlayered with minor dark gray argillaceous siltstone partings. Grades down to sandy siltstone below 3,004 feet. Blobs of partly leached-out anhydrite(?) at 3,014.9 feet. Long vertical fractures occur from 3,015 to 3,028 feet, lined with epidote on the wall, then calcite inboard. Sections of the vein contain fine large chalcopyrite crystals, with minor sphalerite and crusts of sooty-black, unidentified mineral. The most spectacular mineralization is in that part of the vein cutting as sandstone layers about 2 feet thick (3,015-3,107 feet).

CORE #5 This has been designated Core #5. Description of "Junk Basket Core" obtained while milling and recovering bit cores. The hole was deepened from 3,078-3,087 feet during this operation. Two junk basket runs were made in which large core pieces were recovered, as follows: The actual sample depths are somewhat uncertain but all of the material seems to come from this 9-foot interval:

3,078-3,080	No recovery.
Run 1 - 3,080,3,083	Sandstone, medium green, orginally fine-grained, with common euhedral quartz overgrowth, minor film of green clay-like mineral in interstices. Minor interstitial pyrite euhedra. Trace of calcite cement. Rock is hard but slightly friable. Fractures (vertical) occur, about 0.1 inch width, both open and calcite-filled. Traces of specular hematite, pyrite and chalcopyrite occur in the

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Depth (feet)	Description
CORE #5 (continued)	
	veinlets and very small euhedral quartz crystals grow into the fractures. (Same size crystals as the grain overgrowths).
Run 2 - 3,083-3,087	Sandstone, medium green, very fine-grained, silty(?), finer than in Run 1. The rock is hard but slightly friable, non-calcareous. Quartz overgrowths visible on some grains. Trace of black hematite(?) and pyrite. Occasional hard claystone fragments, dark green-gray, non-calcareous, up to 1.5 inches across, "float" in the sandstone. These are probably "rig-up" mud chips.
CORE #6 (3,107-3,167) Rec. 54.7' (91%).	
3,107-3,114	Siltstone, dark green-gray, argillaceous, hard, non-calcareous, with thin laminae and thin beds of sandstone, very fine-grained, non-calcareous, light gray, with small-scale cross-bedding. Pyrite disseminated and in stratabound aggregates. Some soft-sediment deformation structures (especially sedimentary dikes). A few very thin high-angle fractures lined with epidote and filled with calcite with a trace of chalcopyrite. A large fracture (1/4"-1/2" wide) occurs at 3,112'±. Some open, vuggy areas in siltstone are lined with pyrite euhedra. (These look like leached out areas rather than fractures and are irregular, subparallel to bedding.) Thin laminar partings of dark gray silty claystone occur throughout.
3,114-3,115	Slump breccia(?) composed of angular clasts of siltstone and sandstone (pebble-granule size) floating in siltstone matrix. Some of this appears to be squeezed between larger (up to 1 foot long) slump blocks.

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Depth (feet)	Description
CORE #6 (continued)	
3,115-3,119	Siltstone, dark green, interlayered and interlaminated with sandstone, fine to very fine-grained; and with thin laminae of claystone, dark gray, non-calcareous. Abundant soft-sediment deformation features (slump faulting, load features, etc.). Abundant dissemianted pyrite. Few fractures, one of which is up to 1/2" wide (3,116-3,117), lined with epidote, partly filled with calcite rhombohedra(?) and partly open.
3,119-3,144	Sandstone, medium green, very fine to medium-grained, interlaminated and interbedded in thin beds with minor siltstone and a few partings of dark gray claystone. The fine and medium-grained sandstone shows abundant quartz overgrowths. Pyrite present in stratiform accumulations along bedding planes and in a few thin vertical fractures located about 2" apart, partly open and partly calcite-filled. Few claystone "mud chips" in sandstone.
3,144-3,147	Sandstone, medium-grained, non-calcareous, common quartz overgrowths, friable, porous. Thinly laminated, carboncaeous fragments common on bedding planes.
3,147-3,148	Siltstone, dark green-gray, interlaminated with dark gray claystone and green siltstone. Non-calcareous, hard. Common disseminated pyrite.
3,148-3,156	Sandstone, fine-grained, medium green, slightly friable, thinly-bedded, with minor gray siltstone laminae. Much soft-sediment deformation.
3,156-3,161.7	Claystone, dark gray, non-calcareous, moderately hard; thinly interlaminated with siltstone and very fine-grained sandstone. A few thin vertical fractures lined with calcite

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Depth (feet)	Description
CORE #6 (continued)	
	and pyrite (0.1" wide). No epidote on fractures. NOTE: dips on most bedding planes are low - about 5°.
CORE #7 (3,470-3,505) Rec. 34 ft (Run aborted when core barrel jammed.)	
3,470-3,505	Claystone, medium gray, silty, calcareous, hard, interlaminated with light and dark gray claystone, siltstone and light gray, very fine-grained sandstone, hard, calcareous. Traces of very small pyrite crystals occur along bedding planes, especially in sandstone, along microfractures and disseminated in all lithologies. Many sedimentary structures are present such as, micro-crossbedding, cut and fill, sedimentary dikes and associated breccias, penecontemporaneous slump faulting, rhythmic bedding, etc. The relative proportions of claystone, siltstone and sandstone vary throughout the core, but claystone appears to be more abundant from 3,490'-3,504', than above. Reflective luster on claystone bedding planes suggests incipient mica development (sericite?). Fractures are scarce, dip about 60° from horizontal, are calcite-filled, narrow (<1/4"), with trace of pyrite. No epidote, chlorite or ore minerals were observed.
CORE #8 (3,790-3,850) Recovered 56.6 ft. (94%)	
3,790-3,795	Sedimentary breccia. Greenish-gray. Subangular granules of claystone in a clay

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Depth (feet)	Description
CORE #8 (continued)	
	matrix. Cut by thin calcite veins. Fine disseminated pyrite. Patchy anhydrite up to 2" diam.
3,795-3,797	Claystone, medium dark greenish-gray, structureless. Very fine disseminated pyrite. Minor fractures filled with calcite.
3,797-3,807	Sandstone, light gray, very fine-grained, well-cemented with calcite, non-mineralized. Bedding 20° from horizontal. Approx. 20% siltstone, medium gray, beds 0.25-2" thick.
3,807-3,809	Siltstone, pale gray, structureless. Laminations of medium gray claystone, non-mineralized, calcareous.
3,809-3,813	Claystone, medium dark gray, calcareous. Interbedded with stringers of sand. Stratiform beds of pyrite and cross-cutting veinlets of calcite and pyrite.
3,813-3,816	Sedimentary breccia, subangular clasts up to 0.25" diam. Clasts of claystone, sandstone in a matrix of calcareous clay. Patches of anhydrite appear to have grown in place.
3,816-3,817	Claystone, medium dark gray. Fracture surfaces covered with calcite-pyrite.
3,817-3,821	Sandstone, pale gray, very fine-grained, calcareous cement. Non-mineralized interbedded claystone in beds <6" thick.
3,821-3,826	Interbedded claystone, medium dark gray, and siltstone, light gray.
3,826-3,828	Siltstone intruded by clastic dikes of fine sandstone.
3,828-3,834	Claystone and siltstone. Sand content increases downward.

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Depth (feet)	Description
CORE #8 (continued)	
3,834-3,840	Sandstone, light gray, calcareous cement. Non-mineralized. Few thin beds of claystone <0.25".
3,840-3,846.5	Very fine calcareous sandstone interbedded with medium gray claystone. Very fine disseminated pyrite. Siltstone content increases downward. Large piece of fracture filling epidote at bottom of core.
CORE #9 (4,007-4,069)	
4,007-4,015	Claystone, medium dark gray, calcareous. Fine white specks of possible anhydrite or feldspar. Fine disseminated pyrite. Seams of pyrite and ovoid "nodules" of same are oriented parallel to bedding. Vertical fractures with calcite.
4,015-4,016	Sandstone, pale gray. Fine to very fine-grained, slightly porous. Calcareous cement. Cross-bedded. Sinusoidal-shaped laminae of gray claystone.
4,016-4,019	Claystone, medium dark gray, calcareous. Pyrite tends to occur in equant clots up to 3mm diam. Disseminated pyrite less than above. Ovoid bodies of anhydrite less than 1 cm diam. in stratiform zones inclined at about 20° from the horizontal. Small normal faults dip at approx. 60°.
4,019-4,020	Sandstone, as above. Some layers of intraformational breccia.
4,020-4,021	Sedimentary breccia. Subangular to subrounded granules of greenish-gray claystone in a matrix of same. Stratiform anhydrite clots and veins of calcite are subhorizontal.

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Depth (feet)	Description
CORE #9 (continued)	
4,021-4,050	Claystone, greenish gray, calcareous. Spotted with tiny anhydrite or feldspar. Disseminated fine pyrite and thin stratiform seams of same. Near vertical anastamosing veins of calcite <1mm thick common around 4,025'. Sporadic vertical breccia zones. Matrix of breccia is clay. Bands of anhydrite interbedded with claystone at 4,045.
4,050-4,053	Claystone.
4,053-4,060	Breccia. Subangular to subrounded clasts of claystone up to 4 mm in a matrix of clay. Clastic dike altered to spheroidal anhydrite extends up to 4,052'. No offset along contact.
4,060-4,069	Claystone, medium greenish-gray, calcareous, spotted with anhydrite or feldspar. Pyrite disseminated or in thin stratiform bands.
CORE #10 (4,241-4,299.4) (97°10)	
4,241-4,247	Siltstone, medium dark gray, calcareous, and sandstone, light gray, very fine-grained with calcareous matrix. Sandstone cross-bedded and ripple marked. Near vertical vein up to 5 mm thick. Vein assemblage calcite>sphalerite>chalcopyrite>>pyrrohotite. Walls of smaller veins lined with epidote, calcite in center.
4,247-4,257	Sandstone, light gray, very fine-grained, calcareous, laminated. Load cast and flame structures at the base of sandstone laminae.
4,257-4,265	Sparse thin veins <1 mm, lined with calcite, sphalerite, chalcopyrite and pyrrhotite.

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Depth (feet)	Description
CORE #10 (continued)	
4,265-4,267	Sandstone, light gray, very fine-grained, non-mineralized. Interbedded with clay laminae. Flames and load casts at base of sand layers.
4,267-4,278	Claystone to silty claystone, medium gray with flecks of white. Disseminated fine sulfides with some in stratiform bodies of chalcopyrite. Thin horizontal veins of calcite + chalcopyrite + sphalerite(?).
4,278-4,288	Sandstone, light gray, very fine-grained, slightly porous, calcareous, cut by thin (<2 mm) vertical veins of calcite + epidote and calcite + chalcopyrite. Matrix variably altered to yellow-green epidote, especially near bottom. Claystone rip-ups near bottom.
4,288-4,291	Claystone, medium gray to greenish-gray. Color change seems gradational and patchy from alteration.
4,291-4,299	Sandstone, as above. Very little matrix alteration. Tends to break along thin laminations of claystone.
CORE #11 (4,301-4,336)	
4,301-4,305	80% Sandstone, light gray, very fine-grained, calcareous. Sparse disseminated pyrite in complex soft-sediment deformation with 20% claystone, medium gray, calcareous, spotted.
4,305-4,310	Claystone to silty claystone, medium gray, calcareous, spotted with fine white mineral. Vertical fractures lined with calcite and minor sphalerite.
4,310-4,317	Claystone, as above. Veins, up to 5 mm thick, vertical, anastamosing, epidote + calctie + chalcopyrite + sphalerite + galena.

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Depth (feet)	Description
CORE #11 (continued)	
4,317-4,329	Claystone laminated with fine sandstone disrupted by vertical clastic dikes. 20% Sandstone, very fine-grained, light gray, in laminae <3 mm thick. 80% Claystone.
4,329-4,336	Claystone, medium dark gray, calcareous, spotted; very sparse disseminated pyrite. Two sets of thin (<1 mm) fractures filled with calcite - one horizontal, one vertical. Horizontal band of anhydrite clots at 4,335', apparently from diagenesis of sandy layer. Other anhydrite(?) follows polygonal fracture pattern. Sand increases toward bottom.
CORE #12 (4,643-4,681) (100%)	
4,643-4,650	Silty claystone, medium dark gray, slightly calcareous. Patches of matrix altered to yellow-green epidote. Small disseminated pyrite in matrix. Cut by high-angle veins less than 5 mm thick. Veins filled with epidote and minor calcite.
4,650-4,654	Silty claystone, as above. Highly brecciated. Fractures 2 cm wide make up 50% of volume. Larger veins of epidote + pyrite + chalcopyrite.
4,654-4,658	Silty claystone, as above, cut by veins of specular hematite. Hematite decreases downwards.
4,658-4,664	Sandstone, yellow-green. Matrix replaced by epidote, low porosity, fine to very fine-grained, cut by thin (<1 mm) veins of epidote + calcite.

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Depth (feet)	Description
CORE #12 (continued)	
4,664-4,678	Claystone to silty claystone, cut by high angle veins of epidote + calcite + specular hematite ± chalcopyrite. Some pure hematite veins are 1 cm diam.
4,678-4,681	Badly broken core. Appears to be about 2 ft of sandstone, greenish-yellow, fine-grained. Matrix replaced with epidote. Only minor mineralization.
4,681-4,681.5	Claystone to silty claystone, as above.
CORE #13 (4,681.5-4,683 - app. 2.5 ft)	
4,681.5-4,682	Sandstone, yellow-green, fine-grained. Matrix replaced by epidote. Thin, high angle veins of epidote cut by high angle hematite veins 2 cm thick. Alteration of country rock to epidote is greatest marginal to hematite veins. Hematite veins cut epidote + calcite veins.
4,682-4,683	Claystone, greenish-gray. Matrix non-calcareous. Disseminated crystalline epidote in matrix. Stratiform streaks of very fine light-colored sulfide. Thin veins of epidote + quartz + chalcopyrite + hematite.
CORE #14 (4,718-4,718.5). (Core #14 was recovered from junk basket during a fishing and milling run. "Core" consists of variably-sized pieces from the interval 4,710-4,722).	
4,710-4,722	Silty claystone: light greenish-yellow matrix is non-calcareous. Widely disseminated fine sulfides. Claystone is cut by thin, high-angle fractures. Fractures lined with epidote, specular hematite, and calcite.

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Depth (feet)	Description
CORE # 15 (5,188-5,218 ft) (100% recovered)	
5,188-5,204	Argillite, medium dark gray, calcareous. Displays some fracture cleavage, but no slaty cleavage. Micaceous sheen on fracture surfaces. Contains a few stratiform lenses of pyrite less than 2 mm thick. Irregular, sinuous, vertical bodies of pyrite less than 2 cm long appear to be worm burrows. Rare small patches of calcite + chalcopyrite + sphalerite(?) are less than 1 mm in diameter and arranged in bands dipping at about 10°. Thin laminations of sandstone, medium gray, very fine-grained, calcareous. Dip at about 12°, and make up <<1% of the rock.
5,204-5,211	Claystone, medium gray, calcareous. Similar to above, but lighter in color and lacking fracture cleavage and sheen on fracture surfaces. Thin laminations of siltstone inclined at about 10°.
5,211-5,218	Silty claystone, light gray, calcareous. Rare disseminated pyrite less than 0.5 mm diam. Minor thin laminations of claystone, light gray, calcareous. Stratiform bodies of pyrite + minor calcite up to 2x8 cm found below 5,215'. Individual pyrite cubes 5 mm diam. Rare ovoid bodies of anhydrite up to 2 cm diameter appear to cut across stratification.
CORE #16 (5,574-5,591) rec. 17' (Much of core was in fragments - exact recovery uncertain.)	
5,574-5,575	Sandstone, medium green, very fine-grained, cross-bedded on small scale. Abundant disseminated pyrite and stratabound pyrite laminae. Common epidote-hematite veinlets 0.1" wide. Minor dark gray claystone laminae.

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Depth (feet)	Description
CORE #16 (continued)	
5,575-5,576.3	Claystone, dark green, cut by breccia zone dipping 60°. Breccia lined with epidote-hematite veinlets, with chalcopyrite.
5,576.3-5,580	Claystone, medium dark green-gray. Common microfractures dipping 45°-90°. Trace of epidote and calcite on fracures.
5,580-5,582	Claystone, dark gray-green, with thin laminae of sandstone, very fine-grained. Sandstone is epidotized and pyritic. Few high-angle fractures filled with calcite or epidote.
5,582-5,590	Claystone, dark gray, with interlaminates of medium gray, silty claystone. Minor granular stratabound pyrite. Common high-angle fractures filled with calcite. Dip of laminae 5°±.
5,590-5,591	Tuff or tuffaceous claystone: light gray to white with pyritic laminae and patches of epidote lining microfractures. Thin section examination indicates that this zone is predominantly an air fall tuff of felsic composition. The tuff was probably reworked, but the degree of reworking cannot be determined.
CORE #17 (6,026-6,040.8)	
6,026-6,029	Claystone, massive, medium dark gray, slightly calcareous. Minutely speckled with irregular white patches. Rare minute disseminated sulfides.
6,029-6,030	Clayey sandstone, very fine-grained, pale gray, calcareous. Shows cut-and-fill structures and possible slumps. Sparse disseminated pyrite. Vertical veinlets less than 0.2 mm thick filled with calcite.

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Depth (feet)	Description
CORE #17 (continued)	
6,030-6,033.2	Claystone, massive, medium dark gray, slightly calcareous. Minutely speckled with irregular white patches. Rare minute disseminated sulfides.
6,033.2-6,035.4	Claystone, as above, laminated with very fine sandy claystone, slightly calcareous.
6,035.4-6,035.8	Sandstone, fine grained, calcareous. Matrix white, variably altered to yellow in irregular patches. Sparse disseminated pyrite and flakes of dark green chlorite(?) less than 0.5 mm diam. Porosity low (does not absorb water drops on surface).
6,035.8-6,037	Claystone, medium dark gray, slightly calcareous, laminated with very fine clayey sandstone, calcareous.
6,037-6,037.6	Sandstone, very fine to fine-grained, calcareous. Matrix white, variably altered to irregular patches of yellow. Low porosity.
6,037.6-6,040.8	Very fine sandy claystone, medium gray, calcareous. Laminated with claystone, irregularly spotted with white patches. Rare minute disseminated sulfides.
CORE #18 (6,506-6,517)	
6,506-6,506.3	Claystone, massive, medium greenish-gray, friable, non-calcareous, non-mineralized.
6,506.3-6,507.2	Silty claystone, light gray, calcareous, matrix patchily altered to yellow.
6,507.2-6,507.5	Sandstone, very fine grained, slightly calcareous, non-porous. Bedding dips at 15°.

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Depth (feet)	Description
CORE #18 (continued)	
6,507.5-6,510.5	Silty claystone, light gray, calcareous, matrix patchily altered to yellow laminated with dark gray claystone.
6,510.5-6,511.8	Sandstone, very fine-grained, non-calcareous. Matrix altered to yellow epidote(?). Non-mineralized.
6,511.8-6,514	Claystone, massive, medium greenish-gray, non-calcareous. Fractures to irregular, sharp-edged blocks. Lenses of very fine sandstone less than 1 cm thick make up approx. 5% of interval.
6,514-6,517	Claystone, massive, dark gray, non-calcareous. Fractures to irregular, sharp-edged blocks. Lenses of very fine sandstone less than 1 cm thick make up approx. 5% of interval.
CORE #19 (6,758-6,766)	
6,758-6,758.7	Claystone, medium gray, non-calcareous. Laminations of very fine sandstone less than 5 mm dip at 25°.
6,758.7-6,760.5	Very fine sandy claystone, light gray, non-calcareous. Matrix white, partially altered to yellow. Laminated with medium gray, non-calcareous claystone. High angle fractures less than 2 mm thick filled with epidote + chalcopyrite + pyrite + quartz.
6,760.5-6,766	Very fine sandstone, non-calcareous. Matrix pale gray, patchily latered to yellow. Laminations of claystone less than 5 mm thick dip at 20°. High angle fractures lined with epidote + quartz + pyrite. Fractures dip 70°.

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Depth (feet)	Description
CORE #20 (6,880-6,889)	
6,880-6,880.4	Silty claystone, medium gray, slightly calcareous. Thin silty claystone laminations. Laminations of earthy white anhydrite less than 5 mm thick. Laminations dip at 20°.
6,880.4-6,880.8(?)	Broken fragments of claystone, as above.
6,880.8(?)-6,889(?)	Broken fragments of claystone, medium gray, non-calcareous. Thin laminations of silty claystone and earthy white anhydrite are less than 1 mm thick.
CORE #21 (7,100-7,109)	
7,100-7,109	Broken pieces of claystone: medium greenish-gray to dark gray, slightly calcareous. Laminated with light gray siltstone near the top of the core. Siltstone showing cut and fill structures. A 6-inch-thick unbroken section has laminations less than 1 mm thick containing anhydrite and pyrite. The laminations dip at 20°. Fragments near the bottom of the core show two sets of veinlets (0.2 mm thick, filled with calcite).
CORE #22 (7,300-7,311.1)	
7,300-7,300.4	Claystone, greenish-gray, non-calcareous. Sub-horizontal and nearly vertical fractures less than 0.5 mm thick filled with calcite + epidote.
7,300.4-7,301	Sandstone, very fine-grained, non-calcareous. Matrix yellowish-gray and non-calcareous. Porous, absorbs water readily.

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Depth (feet)	Description
CORE #22 (continued)	
7,301-7,305	Claystone, medium greenish-gray, hard, non-calcareous. Beds of fine sandstone less than 2 cm thick dip 15°. Sandstone contains common disseminated sulfides. Laminations of anhydrite less than 2 mm thick dip 15°. Vertical fractures less than 2 mm thick lined with epidote + anhydrite (clear, soft, 3 cleavages at 90°, non-calcareous).
7,305-7,306.4	Silty claystone, medium greenish-gray, non-calcareous. Widely disseminated minute sulfides. Fractures less than 1 mm thick dip at 45° and are lined with epidote.
7,306.4-7,308(?)	Broken fragments: claystone, dark greenish-gray, non-calcareous. Thin high angle fractures filled with epidote.
7,308(?)-7,308.5(?)	Claystone, as above.
7,308.5(?)-7,309.5(?)	Broken fragments of claystone, as above. Open textured veins up to 1 mm thick filled with brecciated claystone and euhedral epidote.
7,309.5(?)-7,310.2(?)	Claystone, dark greenish-gray, non-calcareous. High angle fractures less than 2 mm thick filled with epidote + silica + specular hematite. Fractures dip 70°.
7,310.2(?)-7,311.1(?)	Claystone, as above. Interlaminated with fine sandstone, non-calcareous, matrix replaced by yellow epidote. Sandstone laminations less than 5 mm thick, and dip at 15°. Lenticular zones of anhydrite in earthy white rosettes are less than 1 cm thick and parallel sandstone bedding, as do lenticular concentrations of disseminated sulfides. Thin, near-vertical fractures lined with epidote + silica + specular hematite.

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Depth (feet)	Description
CORE #23 (7,547-7,574.5)	
7,547-7,548.6	Broken pieces: claystone, medium greenish-gray, non-calcareous, speckled with irregular white flecks. Rare disseminated sulfides. Veinlets <0.5 mm thick are filled with calcite.
7,548.6(?)-7,549.3(?)	Claystone, as above. Silt content increases toward bottom of interval.
7,549.3(?)-7,550(?)	Silty claystone, medium gray, non-calcareous. Thin lenses of fine epidotized sandstone.
7,550(?)-7,550.4(?)	Sandstone, fine-grained, non-calcareous. Matrix altered to yellowish epidote. Non-mineralized, non-porous, dips 20°. Near-vertical fractures less than 2mm thick filled with calcite + epidote.
7,550.4(?)-7,551.7(?)	Claystone to silty claystone, medium gray, slightly calcareous. Interlaminated with fine-grained epidotized sandstone containing disseminated pyrite. Irregular rosettes of earthy white anhydrite distributed parallel to bedding. Dip 15-20°.
7,551.7(?)-7,571.5(?)	Claystone, dark greenish-gray, slightly calcareous. Broken surfaces show a sheen probably due to incipient recrystalization. Fracture surfaces coated with calcite + chalcopyrite. 4 cm-thick bands of earthy white anhydrite + pyrite dipping at 15° found at approximately 7,556.2 and 7,568.2 ft.
7,571.5(?)-7,574.5(?)	Broken fragments: claystone, dark greenish-gray, as above.

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Depth (feet)	Description
CORE #24 (7,708-7.738)	
7,708-7,711	Claystone, medium greenish-gray, calcareous. Minor thin laminations of silty claystone less than 0.1 mm thick. 7,708.9 feet: band of earthy white anhydrite, 2 cm thick, dips 20°. Minute disseminated sulfide grains are concentrated on margins of anhydrite band.
7,711-7,711.9	50% bands of anhydrite, as above, less than 0.5 cm thick. 50% Claystone, as above.
7,711.9-7,713	Claystone, medium greenish-gray to dark gray, calcareous. Color differences occur in irregular patches which are otherwise indistinguishable.
7,713-7,713.2	Anhydrite, earthy white, in convoluted, lenticular bodies with claystone between. Chalcopyrite in irregular patches. Dips 15°.
7,713.2-7,718.6	Claystone, dark gray, slightly calcareous. Vertical veins less than 3 mm thick filled with calcite or calcite + pyrite.
7,718.6-7,718.8	Anhydrite, earthy white, in convolute, lenticular bodies and thin pyrite lenses. Dips 15°.
7,718.8-7,723.3	Claystone, dark gray, slightly calcareous.
7,723.3-7,723.4	Band of anhydrite with pyrite lenses. Dips 15°.
7,723.4-7,725.2	Claystone, medium greenish-gray, slightly calcareous. Vertical veins less than 2 mm thick are filled with calcite.
7,725.2-7,725.3	Band of earthy white anhydrite + sulfide. Dips 10°.

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Depth (feet)	Description
CORE #24 (continued)	
7,725.3-7,727.1	Claystone, medium greenish-gray, slightly calcareous.
7,727.1-7,731	Claystone, as above, with occasional bands of anhydrite + pyrite, less than 1 cm thick.
7,731-7,773	Claystone, medium greenish-gray, slightly calcareous. Anhydrite + pyrite banding greater than last interval. Bands range in thickness from 3 mm to 4 cm and comprise about 10% of interval. Dip about 15°.
7,773-7,735.3	Claystone, as above, with only minor anhydrite.
7,735.3-7,735.6	Anhydrite, earthy white, in lenticular patches on the order of 2 cm x 1/2 cm. Orientation bands dipping 15°, with the long axis of patches parallel to the dip. Scattered lenses of pyrite less than 3 mm thick.
7,735.6-7,738(?)	Broken fragments: claystone, medium greenish-gray, slightly calcareous. Laminations of darker gray claystone concentrate pyrite.
CORE #25 (8,133-8,161)	
8,133-8,133.2	Sandstone, fine grained, non-calcareous, slightly porous. Matrix white, altering to yellow epidote in irregular patches. Euhedral disseminated chalcopyrite up to 1 mm diameter.
8,133.2-8,146.5	Mudstone, dark gray, calcareous. Exhibits a dull sheen on broken surfaces, often thinly laminated with the laminations appearing subhorizontal. Some of the laminations are replaced by minute sulfides.

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Depth (feet)	Description
CORE #25 (continued)	
8,146.5-8,150	Silty claystones interbedded with fine sandstone. Claystones are medium gray and slightly calcareous. Sandstones are fine-grained, non-calcareous, with white to yellow matrix and sparse disseminated sulfides. Sand layers average 4" thick, siltstones about 1". Section is approx. 80% sand. Bedding dips at about 25°.
8,150-8,152	Claystone, medium gray, hard, non-calcareous. Fine disseminated sulfides appear to be chalcopyrite. Irregular bodies of epidote sometimes localized along brecciated zones dipping at high angles. Isolated ovoid bodies of epidote + chalcopyrite + fibrous anhydrite are usually less than 0.1" diam. These appear to replace pre-existing sand bodies.
8,152-8,156	Interbedded claystones and fine sandstones. Dipping about 20°. Sandstone layers are 0.2 to 7" thick. Sandstone layers contain irregular bodies of earthy anhydrite. Section is approx. 90% sandstone.
8,156-8,161	Claystone, massive, dark greenish-gray, calcareous. Isolated concentrations of minute sulfides. Sparse darker green flecks may be chlorite. Laminations of granular anhydrite less than 0.5" thick increase near bottom.
CORE #26 (8,395-8,400)	
8,395-8,395.3	Siltstone, light gray, calcareous, slightly porous. Sulfides absent.
8,395.3-8,399.5(?)	Broken pieces of claystone: massive, dark gray, friable, calcareous. Very sparse minute

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Depth (feet)	Description
CORE #26 (continued)	
	disseminated sulfides. Some lensoid bodies of euhedral pyrite. Fractures filled with clear quartz, clear anhydrite and bodies of chalcopyrite up to 1" in diam. Quartz seems to be confined to fracture walls, with anhydrite in the center (if present).
8,399.5(?)-8,400(?)	Broken pieces of argillized claystone, dark gray, hard, non-calcareous. Rock has a tendency to break along parallel planes, and surfaces have a pronounced sheen. Fractures lined with euhedral epidote and soft white material. White mineral is sometimes massive, sometimes in radiating fibrous bunches; probably anhydrite.
CORE #27 (8,585-8,597)	
8,585-8,594(?)	Broken pieces: sandstone, very fine to fine-grained, massive, non-calcareous, very low porosity. No sulfides. Matrix white, variably altered to irregular patches of yellow epidote. High angle fractures lined with epidote + quartz.
8,594(?)-8,597(?)	Broken pieces: fine sandstone as above, interbedded with light gray silty claystone, non-calcareous. Sandstone layers 0.5-6" thick. Claystone layers usually less than 0.5". Sandstone is approximately 75% of section. Bedding dips approx. 30°.
CORE #28 (8,800-8,805)	
8,800-8,805(?)	Broken pieces: claystone, massive, dark gray, non-calcareous. Minutely speckled with white.

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Depth (feet)	Description
CORE # 28 (continued)	
	Breaks into irregular blocks with a slight sheen on surfaces. Occasional cross laminations of siltstone. Nearly vertical veinlets less than 1 mm thick filled with calcite + minor chalcopyrite. Sedimentary structures not offset across veinlets.
CORE #29 (9,004-9,009)	
9,004-9,009(?)	Badly broken pieces: claystone, medium gray, massive, non-calcareous. Fracture surfaces covered with anhydrite + epidote ± chalcopyrite ± specular hematite. Where present, hematite and chalcopyrite are found along the walls of veins, with anhydrite in the center. Diamond-shaped bodies of anhydrite are common, and up to 0.75" long. Sandstone bodies up to 0.2" thick increase toward bottom of sequence. Matrix of sandstone layers is replaced by yellow epidote. Common stratiform bands of chalcopyrite and specular hematite less than 2 mm thick.
CORE #30 (9,095-9,098)	
9,095-9,098	Claystone: medium gray, hard, non-calcareous. Has a blocky fracture pattern with a dull sheen on broken surfaces. Minor, very thin beds of fine, non-calcareous sandstone. Core cut by common open fractures at high angles. Fracture segments usually less than 2 cm long and 5 mm wide. Orientation of fractures irregular. Fractures partially filled with euhedral quartz, epidote and pyrite.

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Depth (feet)	Description
CORE #31 (9,248-9,251.5)	
9,248-9,251.5	Argillite: dark greenish-gray, non-calcareous, hardness greater than 5.5. Breaks into irregular blocks with a dull sheen on fracture surfaces. Very sparse, minute disseminated sulfides appear to be pyrite. Laminations of very fine sandstone <3 mm thick dip at 30°. Matrix of sandstone replaced by green epidote. Irregular body of very fine sandstone oriented at a high angle to original bedding. Sandstone matrix replaced by epidote and a trace of hematite.
CORE #32 (9,453-9,455.5)	
9,453-9,455.5	Diabase: relatively fresh, fine-grained. Crystals of green clinopyroxene, equant olivine and plagioclase show diabasic texture. Grain size does not vary noticably across cored interval. Neither upper or lower contact visible. Cut by a thin fracture dipping 75° to the core axis. Fracture lined with quartz + pyrite + epidote + a dark prismatic mineral, possibly an amphibole.
CORE #33 (9,458-9,463)	Box 307 labeled as 9,458-9,461, but core marked 9,456 11" below top. Depths in description are those marked on core.
9,455-9,456.3	Diabase, fine grained, greenish with earthy white feldspars. Cut by near vertical, anastamosing veinlets. Maximum width of veinlets is 7 mm, but most are 2 mm or less. Walls of veinlets are lined with white material which appears to be bleached diabase, rather than a deposit. Center of bleached

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Depth (feet)	Description
CORE #33 (continued)	
	zones contain discontinuous seam of epidote + chalcopyrite + darker green prismatic amphibole(?).
9,456.3-9,456.6	Argillized claystone, dark green, non-calcareous. Cut by thin (<1 cm) wedge-shaped stringers of diabase projecting down from intrusion above. Diabase stringers often have bands of chalcopyrite along margins.
9,456,6-9,463(?)	Argillized claystone, dark green, non-calcareous. Thinly laminated with siltstone, laminations dipping 30°. Bodies of epidotized very fine sandstone less than 2 cm thick dip 30°. Sand bodies approx. 30% of section. Thin veinlets (<2mm) dip at 80° and are filled with anhydrite + epidote. Core is broken up, but this vein set is not seen cutting the diabase.
CORE #34 (9,473-9,475)	
9,473,9,475	Claystone, altering to argillite: medium gray, non-calcareous, easily scratched by knife. Small disseminated sulfide grains.
CORE #35 (9,694-9,696.7)	
9,694-9,696.7	Siltstone, light gray, non-calcareous. Matrix spottily altered to yellow epidote. Layers of fine sand less than 1" thick dip 30°. Sand layers have matrix altered yellow, with clots of green epidote crystals. A few thin fractures dip at 55° and are lined with epidote + clear anhydrite.

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Depth (feet)	Description
CORE #36 (9,907-9,912)	
9,907,9,912(?)	Broken pieces: argillite, dark greenish-gray, non-calcareous. Hardness >5.5. Sheen on broken surfaces. A few thin fractures dip at 60°, and are filled with epidote.

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APPENDIX C

Lithology of Cuttings and Drilling Conditions

APPENDIX C

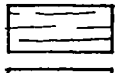
Lithology of Cuttings and Drilling Conditions

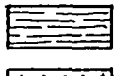
Secondary minerals:

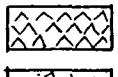
S	= Sulfide (undifferentiated)
Ch	= Chlorite
H	= Specular Hematite
Sph	= Sphalerite
Ep	= Epidote
An	= Anhydrite
Gal	= Galena
Cc	= Calcite
-	= Mineral trace
2	= Percentage mineral content (typical)

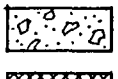
Lithology:


Sandstone

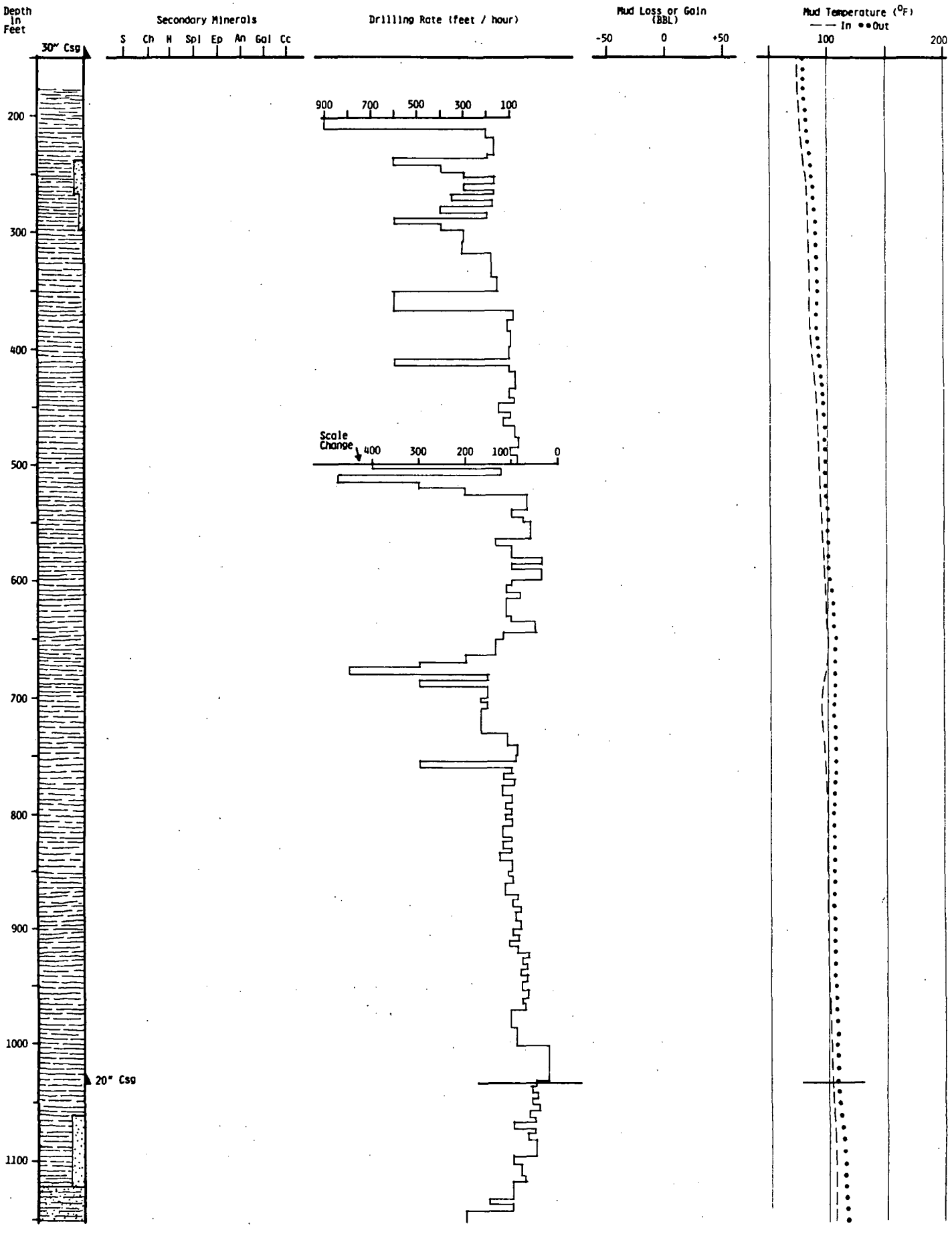

Siltstone to clayey siltstone

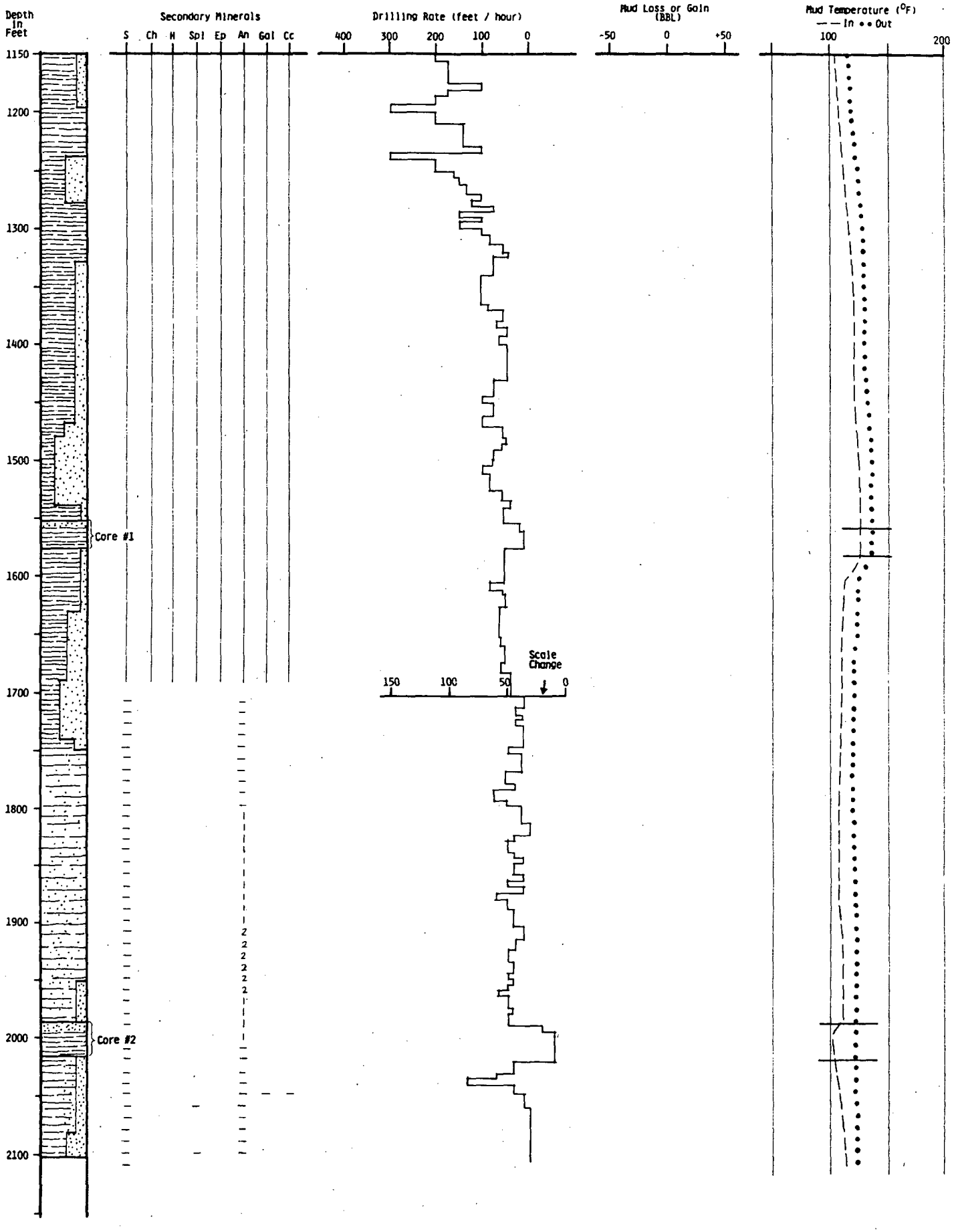

Clay, claystone or argillite

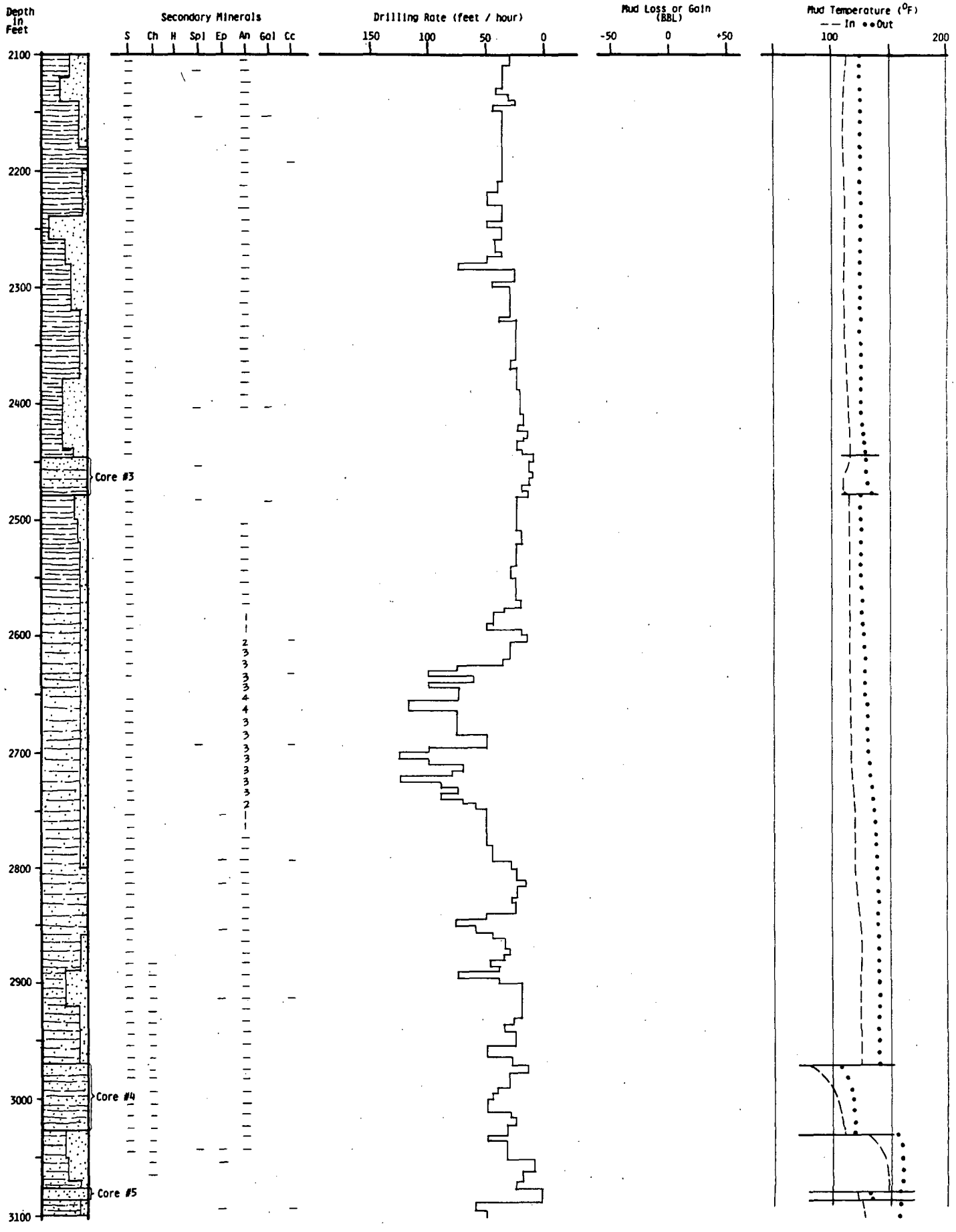

Mafic intrusive

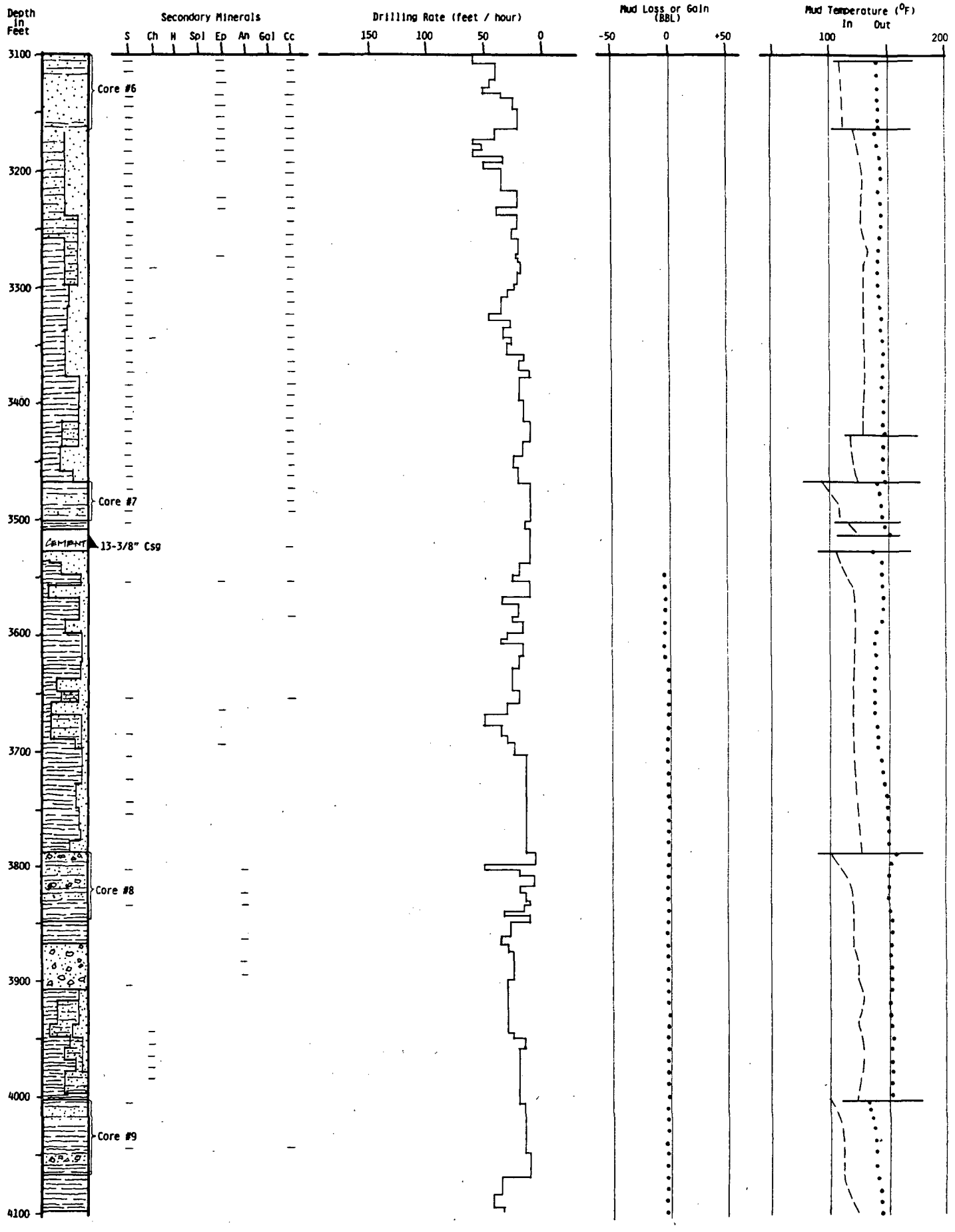

Sedimentary breccia

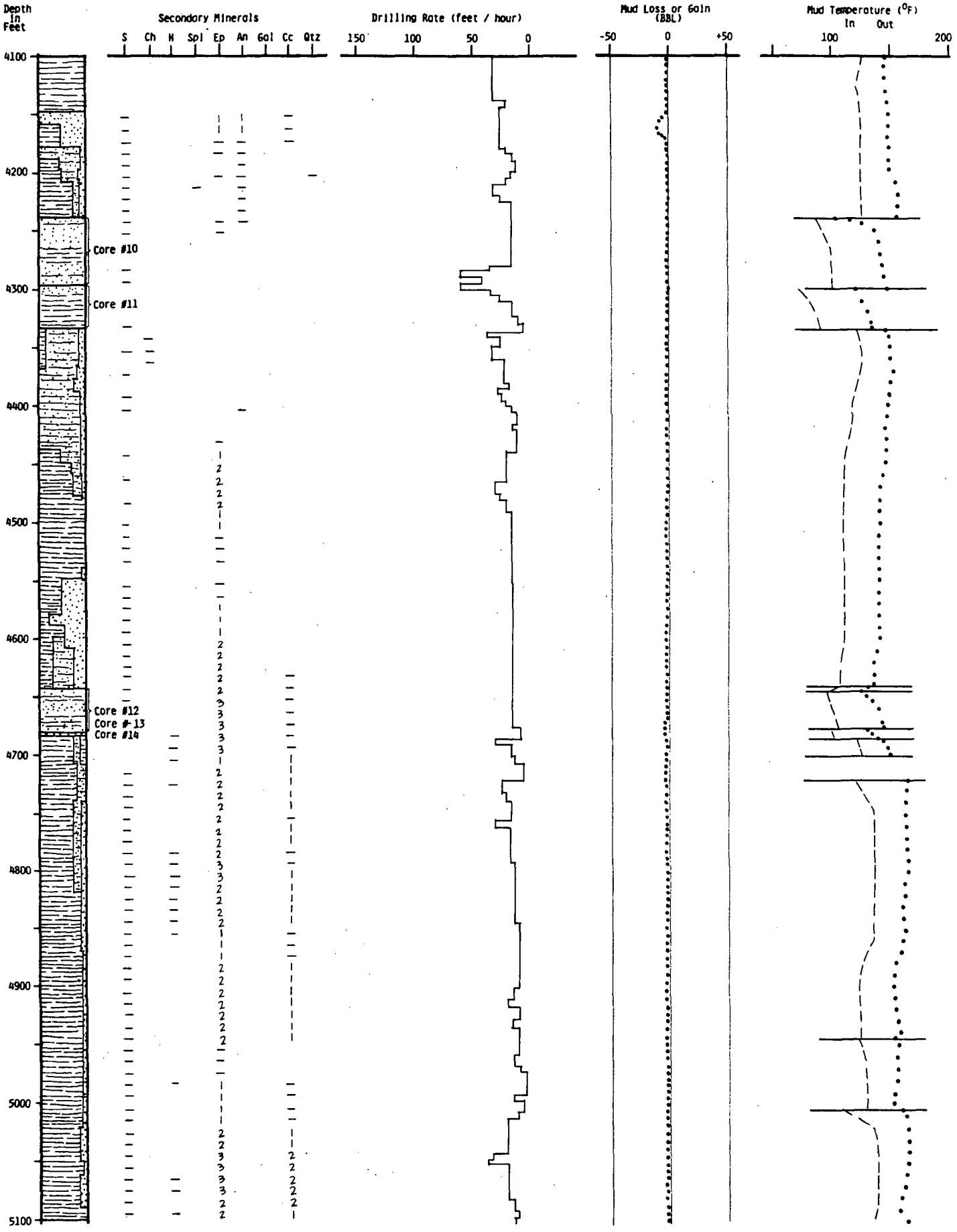

Mineralized zone

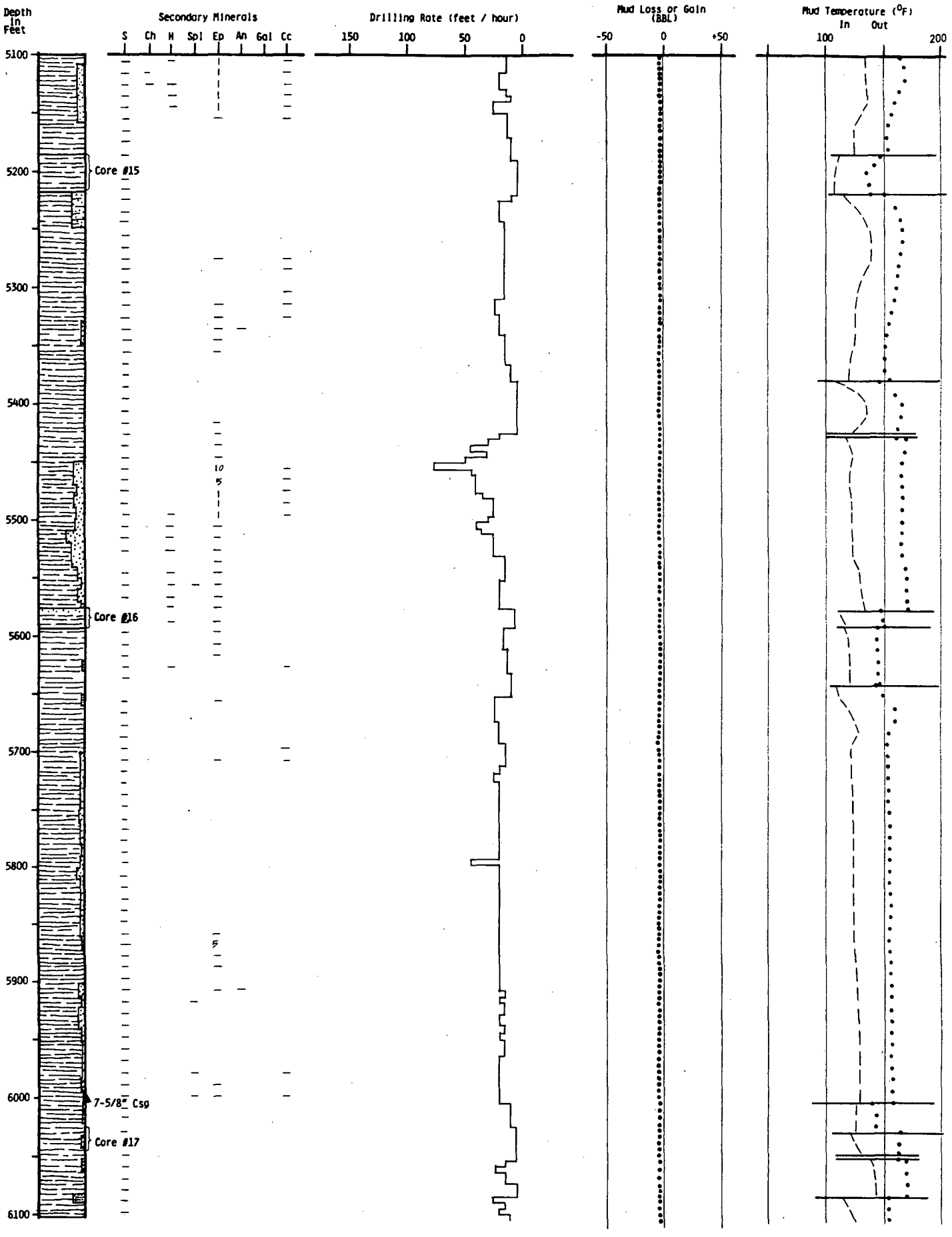

Depth in Feet
Secondary Minerals
S Ch H Spl Ep An Gal Cc
Drilling Rate (feet / hour)
Mud Loss or Gain (BBL)
-50 0 +50
Mud Temperature (°F)
— — In •• Out
100 200
30" Csg
200
300
400
500
600
700
800
900
1000
1100
900 700 500 300 100
Scale Change
400 300 200 100 0
20" Csg

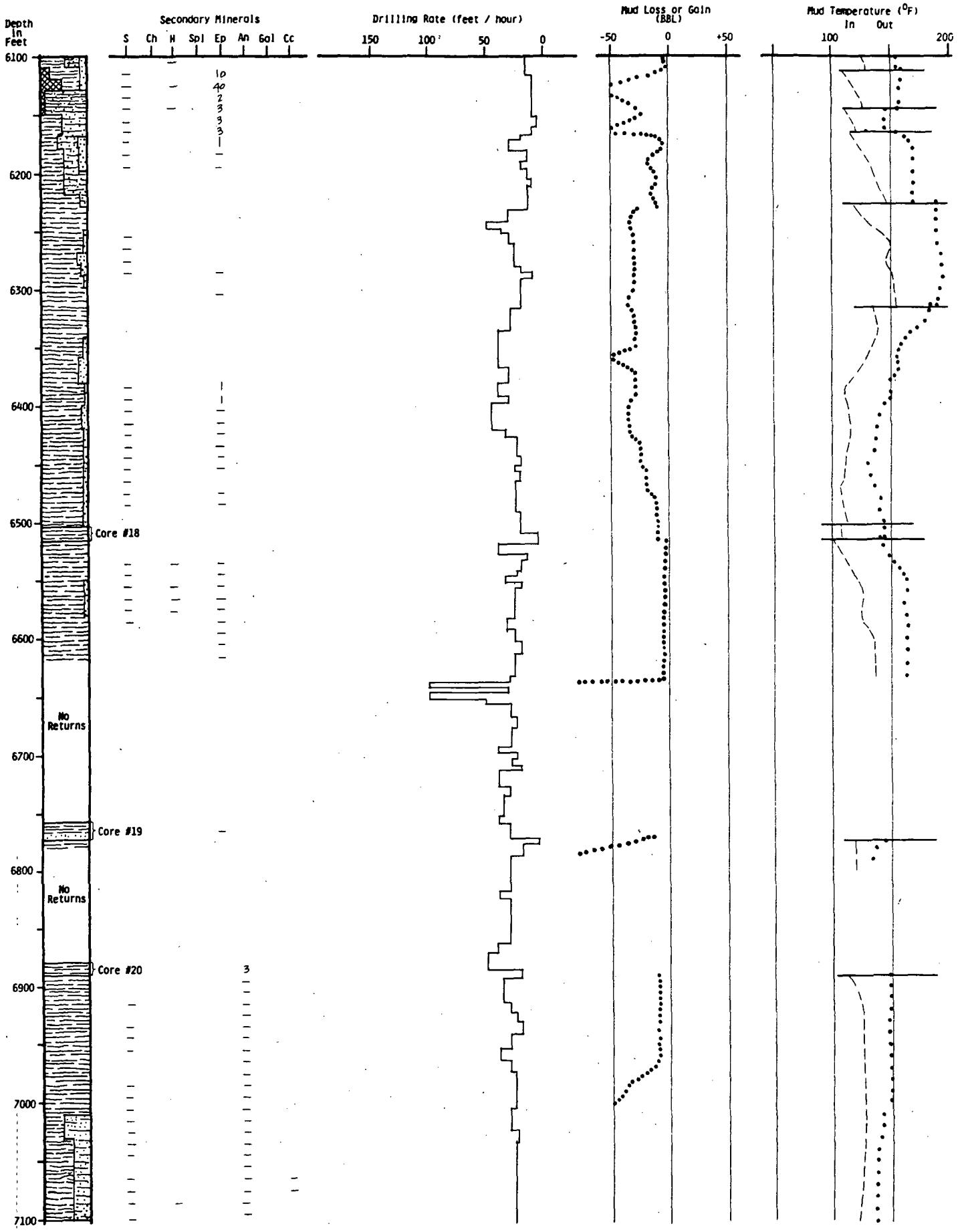

Depth in Feet
1150
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
Secondary Minerals
S
Ch
H
Spl
Ep
An
Gal
Cc
Core #1
Core #2
Drilling Rate (feet / hour)
400
300
200
100
0
Scale Change
150
100
50
0
Mud Loss or Gain (BBL)
-50
0
+50
Mud Temperature (°F)
In
Out
100
200

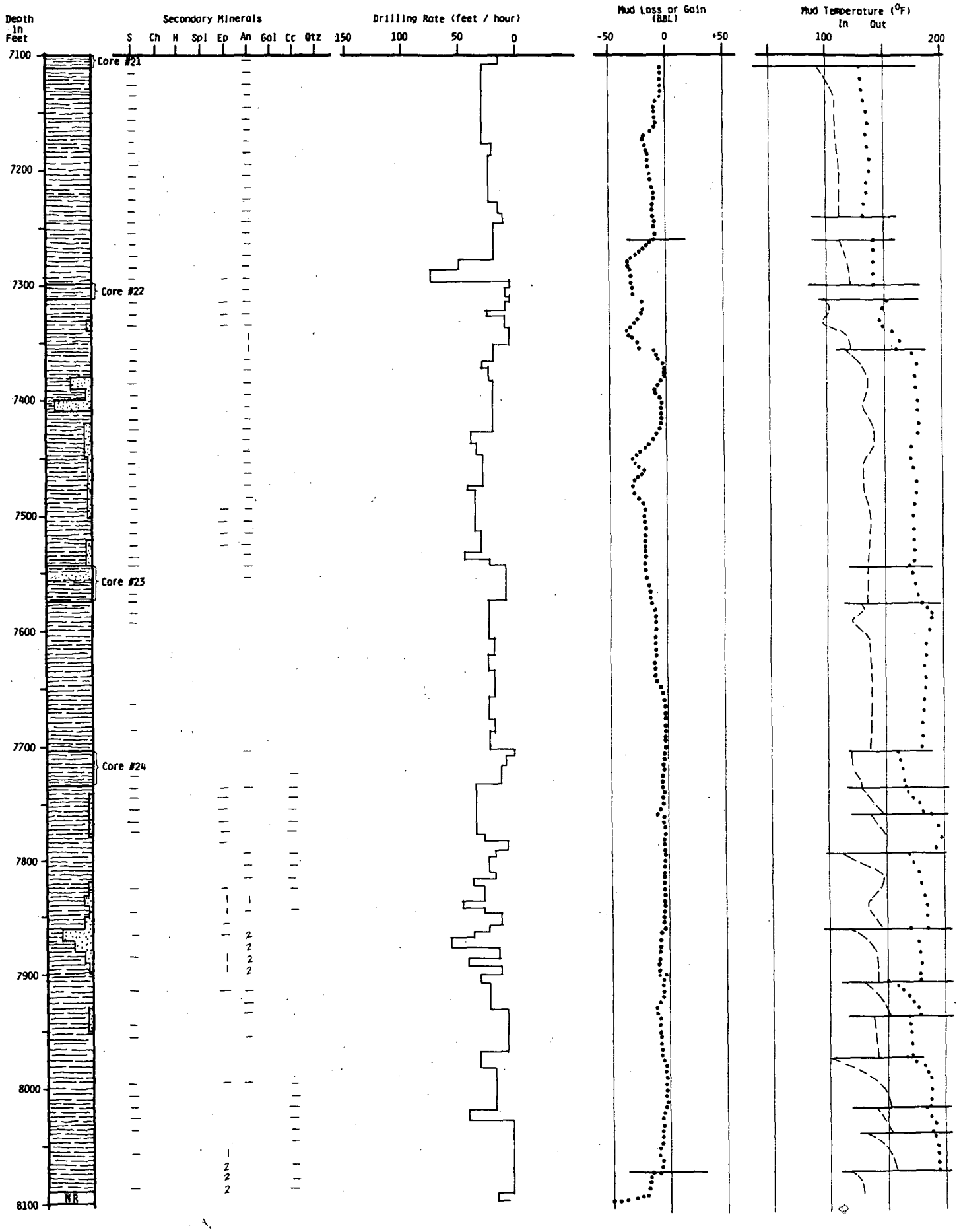

Depth in Feet
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
3100
Core #3
Core #4
Core #5
Secondary Minerals
S Ch H Spl Ep An Gal Cc
Drilling Rate (feet / hour)
150 100 50 0
Mud Loss or Gain (BBL)
-50 0 +50
Mud Temperature (°F)
— — In •• Out
100 200

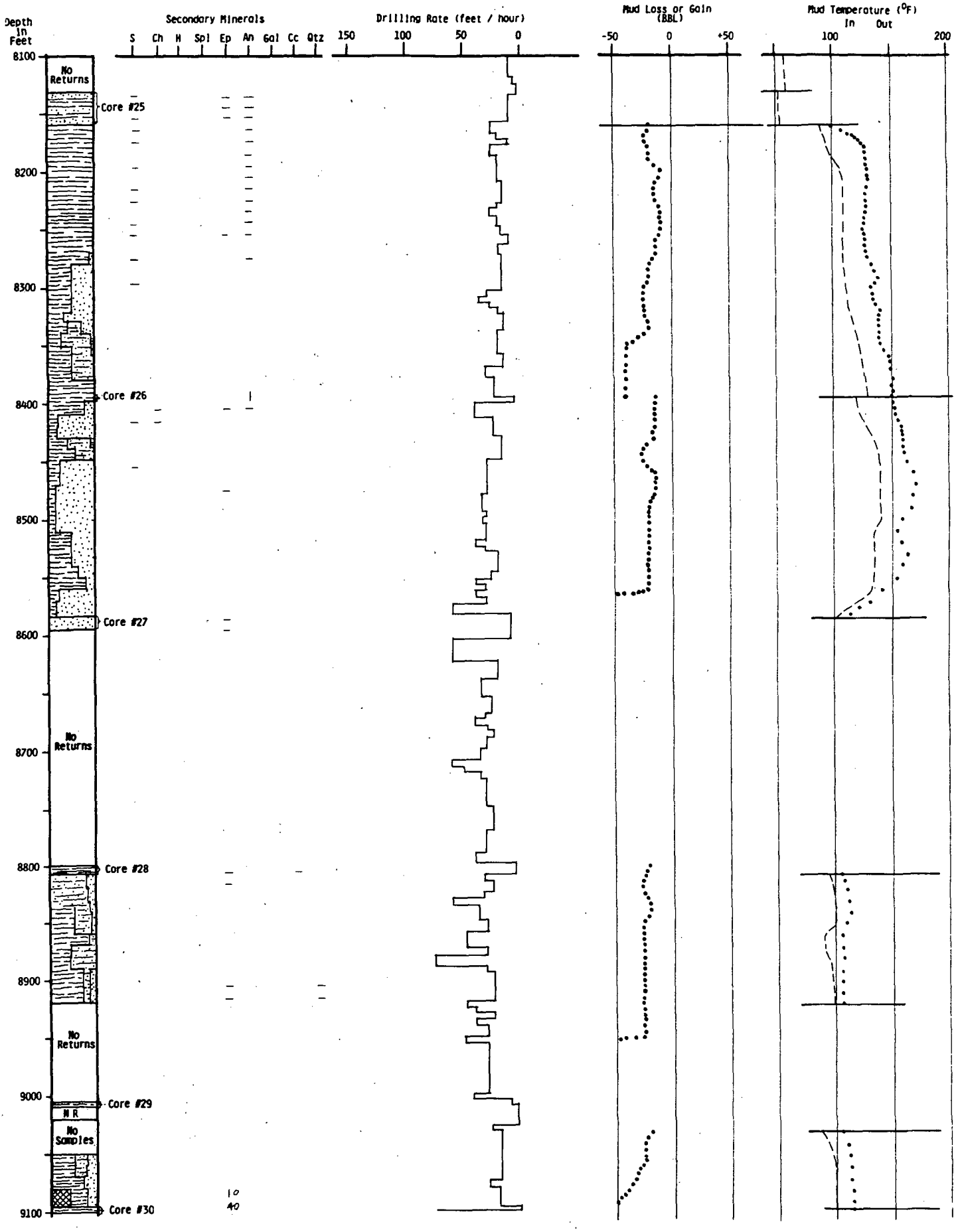

Depth in Feet
Secondary Minerals
S Ch H Spl Ep An Gal Cc
Drilling Rate (feet / hour)
150 100 50 0
Mud Loss or Gain (BBL)
-50 0 +50
Mud Temperature (°F)
In Out
100 200
3100
3200
3300
3400
3500
3600
3700
3800
3900
4000
4100
Core #6
Core #7
CEMENT
13-3/8" Csg
Core #8
Core #9

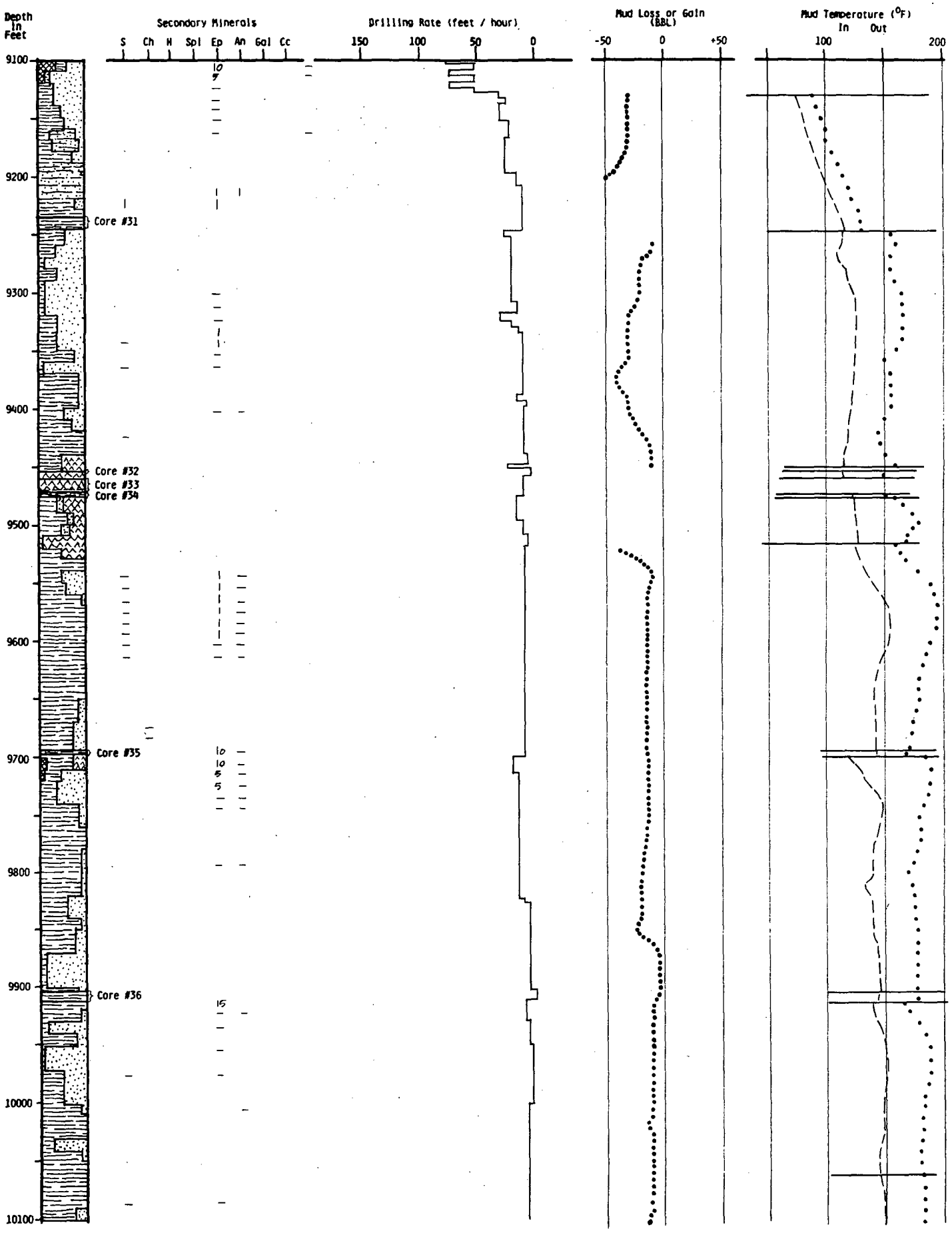

Depth In Feet
4100
4200
4300
4400
4500
4600
4700
4800
4900
5000
5100
Core #10
Core #11
Core #12
Core #13
Core #14
Secondary Minerals
S Ch H Spl Ep An Gal Cc Qtz
Drilling Rate (feet / hour)
150 100 50 0
Mud Loss or Gain (BBL)
-50 0 +50
Mud Temperature (°F)
In Out
100 200

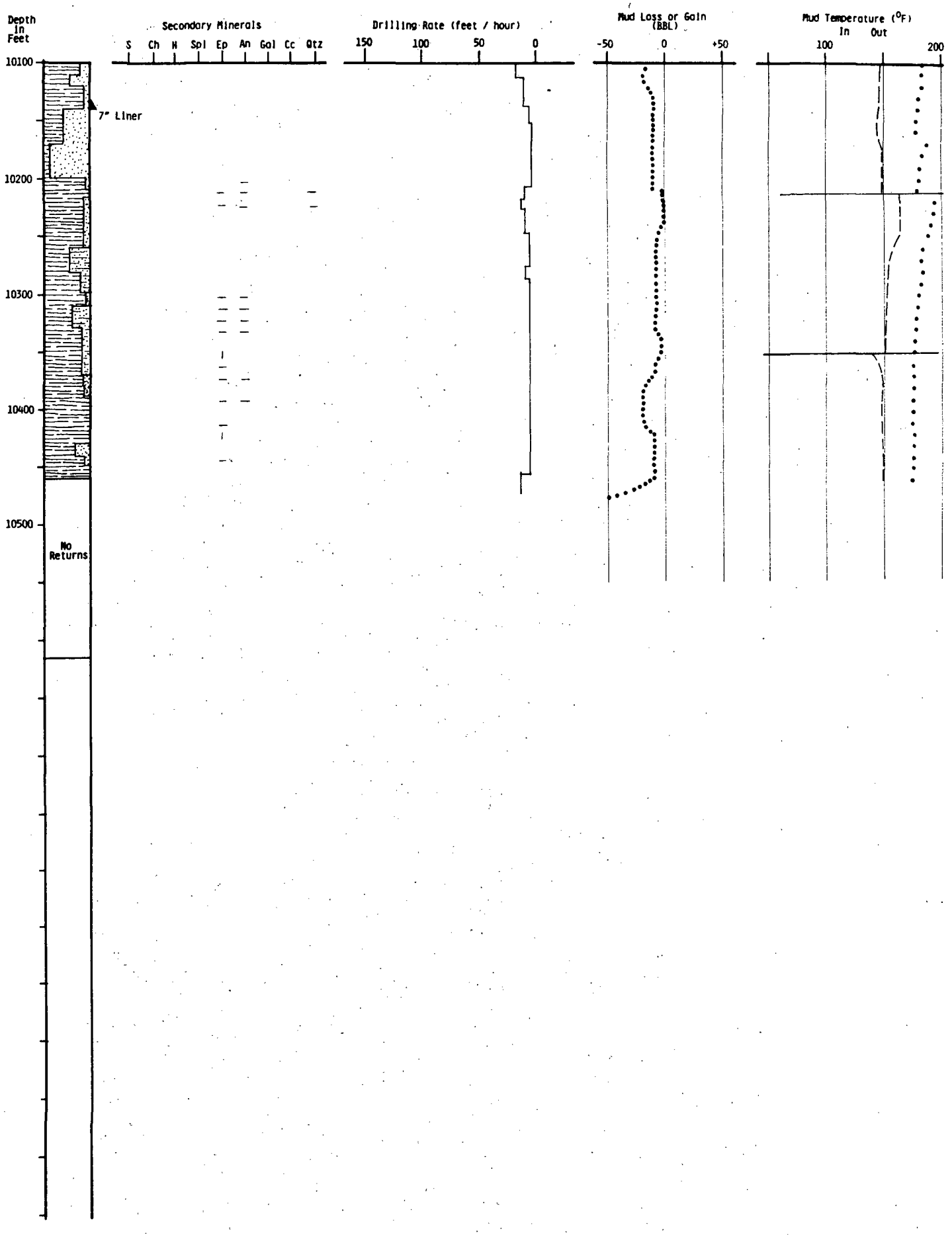

Depth in Feet
Secondary Minerals
S Ch H Spl Ep An Gal Cc
Drilling Rate (feet / hour)
150 100 50 0
Mud Loss or Gain (BBL)
-50 0 +50
Mud Temperature (°F)
In Out
100 200
5100
5200
5300
5400
5500
5600
5700
5800
5900
6000
6100
Core #15
Core #16
7-5/8" Csg
Core #17


Depth in Feet
6100
6200
6300
6400
6500
6600
6700
6800
6900
7000
7100
Secondary Minerals
S Ch H Spl Ep An Gal Cc
Core #18
No Returns
Core #19
No Returns
Core #20
Drilling Rate (feet / hour)
150 100 50 0
Mud Loss or Gain (BBL)
-50 0 +50
Mud Temperature (°F)
In Out
100 200


Depth in Feet
Secondary Minerals
S Ch H Spl Ep An Gal Cc Qtz
Drilling Rate (feet / hour)
150 100 50 0
Mud Loss or Gain (BBL)
-50 0 +50
Mud Temperature (°F)
In Out
100 200
7100
7200
7300
7400
7500
7600
7700
7800
7900
8000
8100
Core #21
Core #22
Core #23
Core #24
NR


Depth in Feet
Secondary Minerals
S Ch H Spl Ep An Gal Cc Qtz
Drilling Rate (feet / hour)
150 100 50 0
Mud Loss or Gain (BBL)
-50 0 +50
Mud Temperature (°F)
In Out
100 200
8100
8200
8300
8400
8500
8600
8700
8800
8900
9000
9100
No Returns
Core #25
Core #26
Core #27
No Returns
Core #28
No Returns
Core #29
N R
No Samples
Core #30
10
40


Depth In Feet
Secondary Minerals
S Ch H Spl Ep An Gal Cc
Drilling Rate (feet / hour)
150 100 50 0
Mud Loss or Gain (BBL)
-50 0 +50
Mud Temperature (°F)
In Out
100 200
9100
9200
9300
9400
9500
9600
9700
9800
9900
10000
10100
Core #31
Core #32
Core #33
Core #34
Core #35
Core #36


Depth In Feet
10100
10200
10300
10400
10500
7" Liner
No Returns
Secondary Minerals
S Ch H Spl Ep An Gal Cc Qtz
Drilling Rate (feet / hour)
150 100 50 0
Mud Loss or Gain (BBL)
-50 0 +50
Mud Temperature (°F)
In Out
100 200