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GEOTHERMAL POTENTIAL OF THE QUEST LEASEHOLD DIXIE VALLEY, NEVADA

for

Dow Chemical Company, U.S.A.

by

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December, 1976

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CONTENTS

GeothermEx 901 MENDOCINO AVE. BERKELEY, CA. 94707

JAMES B. KOENIG (415) 524-9242
MURRAY C. GARDNER (503) 482-2605

LIST OF ILLUSTRATIONS

Plates

JAMES B. KOENIG (415) 524-9242
MURRAY C. GARDNER (503) 482-2605

LIST OF ILLUSTRATIONS (Continued)

Plates

JAMES B. KOENIG (415) 524-9242
MURRAY C. GARDNER (503) 482-2605

TABLES

APPENDICES

Appendix

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GEOGRAPHY

Physiography

Dixie Valley is a low basin with interior drainage, and is flanked by two fault-block mountain ranges, the Stillwater Range on the west and the Clan Alpine Mountains on the east. Topography trends northeasterly.

Located in Churchill County, the leasehold includes parts of Dixie Valley and the Stillwater Range, and has a total area of some 23 square miles (Plate 1). It includes the Humboldt Salt Marsh, topographically the lowest area in both Dixie Valley and all of northern Nevada.

Elevations range from a low of 3,380 feet in the salt marsh to 6,000 feet on the east flank of the Stillwater Range; elevations rise to over 7,600 feet along the range crest, about 2 miles west of the leasehold's west side. Relief along the range flank is very steep, with slope grades exceeding 50 percent. Slopes on the alluvial fans at the base of the range are gentle and become flat in the marsh.

Drainage is toward the east, into Humboldt Salt Marsh. All streams are seasonal in nature. Although the marsh is indicated as dry on topographic maps, it is frequently wet just below the surface, and sometimes covered by water. When wet, the marsh is a treacherous bog of soft, sticky mud, and vehicular access is then limited to small, light-weight, wide-tired vehicles.

Climate

Climatically, the area is cool and semiarid. Mean annual temperature is about 50°F. Mean minimum January temperature is 16°F, and mean maximum July temperature is 90°F. These values characterize the valley, and become cooler with increasing elevation in the mountains. Annual precipitation is about 5 inches in the valley; most of this falls as rain during the period October through June.

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Land-Use

Access to the area is from U.S. Highway 50, from a point about 40 miles east of Fallon. From there, one drives 36 miles north on paved and well-maintained dirt roads, passing by the settlement of Dixie and several ranches.

Economic activity in Dixie Valley is limited to some raising of cattle and feed. No mines currently operate in the area, although the Dixie Comstock mine, near the center of the leasehold, produced some $293,000 in gold, silver, and lead during the period 1934 to 1941.

GEOLOGY AND GEOPHYSICS

Regional Setting

General geological and geophysical features of northern Nevada were described in an earlier report for Dow, entitled "Geothermal Resources of a Major Lineament in Northern Nevada," which is included here as Appendix 1. The reader is referred to it for description of the larger region.

In terms of its Late Cenozoic and contemporary volcano-tectonic setting, Dixie Valley is part of a uniquely situated area. This is formed by the intersection of the northeast-trending "northern Nevada lineament" (defined in Appendix 1) and the north-trending belt of intense historic faulting and seismicity that extends from Owens Valley, California to Pleasant Valley, Nevada. Thus, Dixie Valley is presently an area of quite high seismicity, active extensional faulting or rifting, high-temperature geothermal manifestations, and relatively intense late Tertiary silicic volcanism.

Seismic refraction data (Thompson and Burke, 1974) indicate that near Fallon the crust is only 24 km thick, which is the smallest value reported in the entire Basin and Range province. This fits with the concept that Dixie Valley is part of the area of most active mantle spreading and crustal rifting in northern Nevada. As such, Dixie Valley is thought to be an area of high geothermal potential. The geology of the Dixie Valley area has been well described by Willden and Speed (1974). Their report and map of Churchill County, Nevada, included here as Appendix 2, provides adequate regional geologic coverage. For the geology of the leasehold itself, Page's (1965) map of the Stillwater Range provides more detail; his map, enlarged by a factor of two, appears as Plate 2 of this report.

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Lithology and Stratigraphy

Basement rock in the northern Dixie Valley area is comprised by sedimentary, very low-grade metamorphic, and igneous rocks of Mesozoic age. In the leasehold and vicinity, these are chiefly Triassic slate and phyllite, and Jurassic hypabyssal intrusive rocks of gabbroic to dioritic composition, as well as their extrusive equivalents which include flows, tuffs, and breccias of basaltic andesite. Minor quartzite, quartz arenite, and limestone occur within the basement complex. Younger basalt and andesite flows and breccias, and granitic rocks have limited outcrops, and very uncertain age, ranging from Middle Jurassic to Miocene.

Major basement rock types are described in more detail in Table 1. The Upper Triassic slate and phyllite, mentioned above, occurs in the Stillwater Range, but its time-equivalent in the Clan Alpine Mountains occurs as an unmetamorphosed facies of siltstone and mudstone. The facies change must occur somewhere beneath Dixie Valley.

Younger rocks are made up chiefly of Tertiary volcanic units including tuffs, breccias, and flows of rhyolitic to basaltic composition. Their ages are uncertain, but range from latest Oligocene to Pliocene. Non-marine sedimentary rocks and tuffs are interbedded with the volcanics.

Youngest materials are the largely unconsolidated Quaternary basin-fill, composed of sand, gravel, silt, and clay deposited in lakes and streams.

Structure

Dixie Valley is a complex graben bounded by two large-displacement faults on the west, and by many sub-parallel, smaller-displacement faults on the east. Faulting was accompanied by westward tilting of the major fault blocks (i.e., ranges). The Stillwater Range is a major horst: depth of Cenozoic fill has been reported to reach 8,000 feet in Carson Sink, on the west, and 3,000 feet in Dixie Valley, based on seismic exploration. These features are shown on Plate 3, which incorporates results from geophysical studies, as presented below.

From their analysis of displacements on Late Cenozoic faults and of Pleistocene lake shorelines, Thompson and Burke (1974) concluded that the crustal spreading in Dixie Valley had an average rate of 0.4 mm/yr over the last 15 m.y., and 1 mm/yr over the last 12,000 years.

Table 1. DESCRIPTION OF BASEMENT ROCK UNITS,
NORTHERN DIXIE VALLEY, NEVADA

Jdg - Upper Jurassic gabbroic and dioritic rocks consisting of hornblende gabbro, diorite, picrite, anorthosite, dolerite, keratophyre, and gabbroic pegmatite. R. C. Speed considers the complex to be a tabular mass, probably a lopolith, emplaced at shallow depth (probably less than 2,500 feet); thicknesses shown on this cross section are based on Page (1965). Commonly these rocks have been profoundly altered, e.g. albitized and bleached white or dolomitized, lacking original minerals and texture.

Trsl - Upper Triassic slate and phyllite. Slaty cleavage is approximately parallel to bedding except in axial parts of folds. Recrystallization is generally only incipient. Some of the slate sequence contains abundant fine-grained feldspathic quartzite interbeds from 1 to 35 inches thick. Generally, the quartzite beds are thin and widely spaced. Parts of the slate sequence are interrupted at intervals by limestone beds 1 to 60 inches thick. Many of the carbonate rocks are calcarenites, some containing limestone conglomerate and bioclastic material. The lower part of the section is actually not slate but, rather, silty shale that locally contains flinty streaks and nodules; many thin limestone beds occur in this unit. The stratigraphic thickness of this section cannot be measured because of complex deformation, but is estimated at 5,000 to 10,000 feet. The silty shale unit is about 500 feet thick. (Description from Page, 1965)

Trs - Upper Triassic siltstone and mudstone which may be more than 20,000 feet thick. Upper subunit is 30% to 50% intercalated limestone and dolomite, and middle subunit is more than 90% siltstone and mudstone with 10% sandstone, limestone, and conglomerate. The middle unit probably predominates along this cross section, and is probably correlative with the Trsl unit in the Stillwater Range. However, in the Clan Alpine Mountains it lacks the slaty cleavage which is pervasive in the Stillwater Range. It may be more than 20,000 feet thick in the Clan Alpines.

Data from Page, 1965, and Willden and Speed, 1974

JAMES B. KOENIG (415) 524-9242
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Detailed geophysical studies in Dixie Valley were conducted by graduate students at Stanford University during 1964 to 1966, and published as *Geophysical Study of Basin-Range Structure, Dixie Valley Region* in 1967. This work was under the direction of Professor George Thompson, and was sponsored by the Air Force Cambridge Research Laboratory. Studies included an aeromagnetic survey (Smith, 1967), a seismic refraction survey (Meister, 1967), photogeologic mapping of Quaternary faults and Lake Lahontan shorelines (Burke, 1967), and analysis of surface strain changes accompanying the 1954 earthquakes (Meister et al., 1967). Results of this work show depths to major geologic units and distribution of Quaternary faults, and are presented here in Plates 4, 5, 6, 7, and 11.

Aeromagnetic (U.S. Geological Survey, 1972) and Bouguer gravity (Erwin, 1973) anomalies of the Dixie Valley region are shown on Plates 8 and 9. Detailed gravity and ground-magnetic surveys of the leasehold and vicinity were carried out for Dow during November 1976, by Edcon Inc. The final report and fully reduced data were not available at this writing. However, preliminary gravity data show a rather uniform gradient of some 10 to 15 mgal/mile through leasehold, parallel to the range front. This suggests that normal faulting may be restricted to a single narrow zone, rather than being spread over several step faults.

Subsurface structural features interpreted from all geophysical data are plotted on Plate 10. Major conclusions concerning the structure of Dixie Valley are as follows:

(1) the valley is a deep, assymmetric graben with maximum subsidence along its west side;

(2) normal faulting on the west side of the graben has been concentrated in a narrow zone relative to that on its east side, where down-dropping is spread over a number of step faults;

(3) maximum depths to Tertiary volcanic and Mesozoic basement rocks are 3,000 feet and 7,000 feet respectively;

(4) in the leasehold and vicinity, Tertiary and Mesozoic bedrock surfaces deepen toward the east at rates between 2,000 and 4,000 feet per mile;

(5) a gabbroic lopolith (Jurassic) is present beneath northern Dixie Valley, and may have a thickness of 2,000 to 3,000 feet beneath the leasehold.

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Seismicity and Quaternary Faulting

Seismicity for the period 1970 to 1974 and Quaternary faults are plotted on Plate 12. Details concerning historic faulting and seismicity are given in Appendix 3. The data indicate that Dixie Valley is an area of very active crustal rifting, and that fault displacements from Miocene through historic time have been concentrated along the west side of the graben.

Recent seismicity in this area is largely confined to the zone of faulting that developed during the 1954 earthquakes, and decreases abruptly north of the northern termination of that zone. This suggests that much of the resent seismicity comprises continuing aftershocks of the 1954 earthquakes.

GEOTHERMAL FEATURES

Surface Phenomena

Dixie Hot Springs are located near the south edge of the leasehold, and have a reported temperature of 72°C and flow of about 200 ℓpm. The "Senator" Fumaroles, which discharge warm air and water vapor as well as some H_2S and sulfur, are located along the base of the Stillwater Range 12 miles northwest of the Bar A Ranch. Near the center of the leasehold, intense heat and hot water have been reported in workings of the Dixie Comstock Mine, at depths as little as 75 feet; this is said to have hindered operations there.

Clearly, geothermal fluids are leaking to the surface along faults that bound the east side of the Stillwater Range. As discussed below, these fluids are probably meteoric water heated by deep circulation within fault zones.

Temperature Gradient Survey

A temperature gradient survey of the leasehold and vicinity was conducted for Dow during the months of October and November 1976. Fourteen wells were drilled and logged, each to a depth of 300 feet. In addition, two pre-existing wells were logged. The original plan of operations called for the drilling of twenty wells, but six of these were deleted.

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Lithologic and temperature logs are included in Appendix 4 of this report. Temperature gradient values are plotted on Plate 13. As no wells penetrated through the alluvial cover, there are no important lithologic variations to report here. Temperature gradients shown on Plate 13 are taken from the most linear portions of the observed curves, generally at depths from 100 to 300 feet.

Temperature gradients observed along the base of the Stillwater Range vary from a low of 39°C/km (2 miles south of Dixie Hot Springs) to a high of 308°C/km in an old well near the Dixie Comstock mine. Gradients decrease rapidly away from this high, dropping below 100°C/km within 1-1/2 miles and below 50°C/km within 2-1/2 miles.

Lowest gradients occur near the mouths of Mississippi and Whiterock Canyons, which have relatively large drainage areas; a stream was flowing in the latter during the period of this survey. It is possible that shallow, lateral flow of cool ground water contributes to these low gradients. However, except in hole 13, gradients were all quite linear below depths of 75 to 150 feet. Hence, the data suggest that such disturbances must have been very small.

GEOTHERMAL POTENTIAL

Temperature gradient data, and the distribution of hot springs and fumaroles, indicate a periodic variation in heat flow along the front of the Stillwater Range, from Dixie Hot Springs on the south to the Senator Fumarole on the north. This apparent periodicity is most strongly in evidence as far north as Whiterock Canyon. Highs occur at Dixie Hot Springs, in the vicinity of the Dixie Comstock Mine, at the hot well 2-1/2 miles west of the Boyer Ranch, and at Senator Fumarole. These alternate with lows that are documented from south of Dixie Hot Springs to Whiterock Canyon. Overall, the pattern suggests a series of hydrothermal convection cells spread along the frontal fault or fault zone, as diagrammed in Plate 14.

The maximum depth of convection, and the temperatures at depths from 1 to 3 km (3,300 to 10,000 feet) are not easily determined from the shallow gradient data. Nevertheless, these are estimated in the following discussion.

Average temperature gradient for the 14 holes observed is 74°C/km; modal gradient is 70° ± 10°C/km. Therefore, "background" geothermal gradient in northern Dixie Valley may be nearly 70°C/km. This is about twice the average gradient observed throughout the western (Cordilleran region) United States.

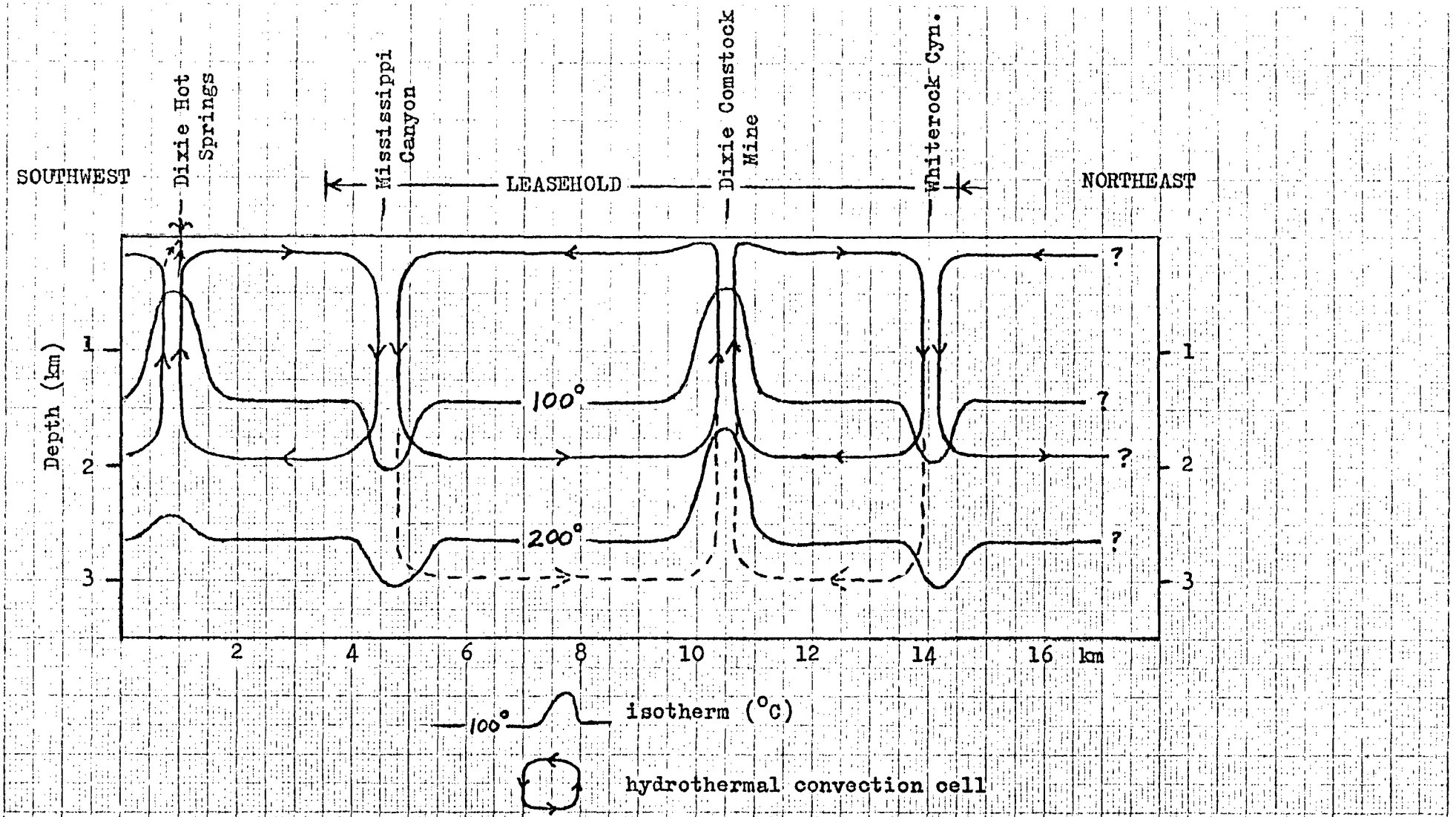

Plate 14. Schematic model of hydrothermal convection and temperature gradient, Quest leasehold and vicinity, Dixie Valley, Nevada. Section in plane of frontal fault.

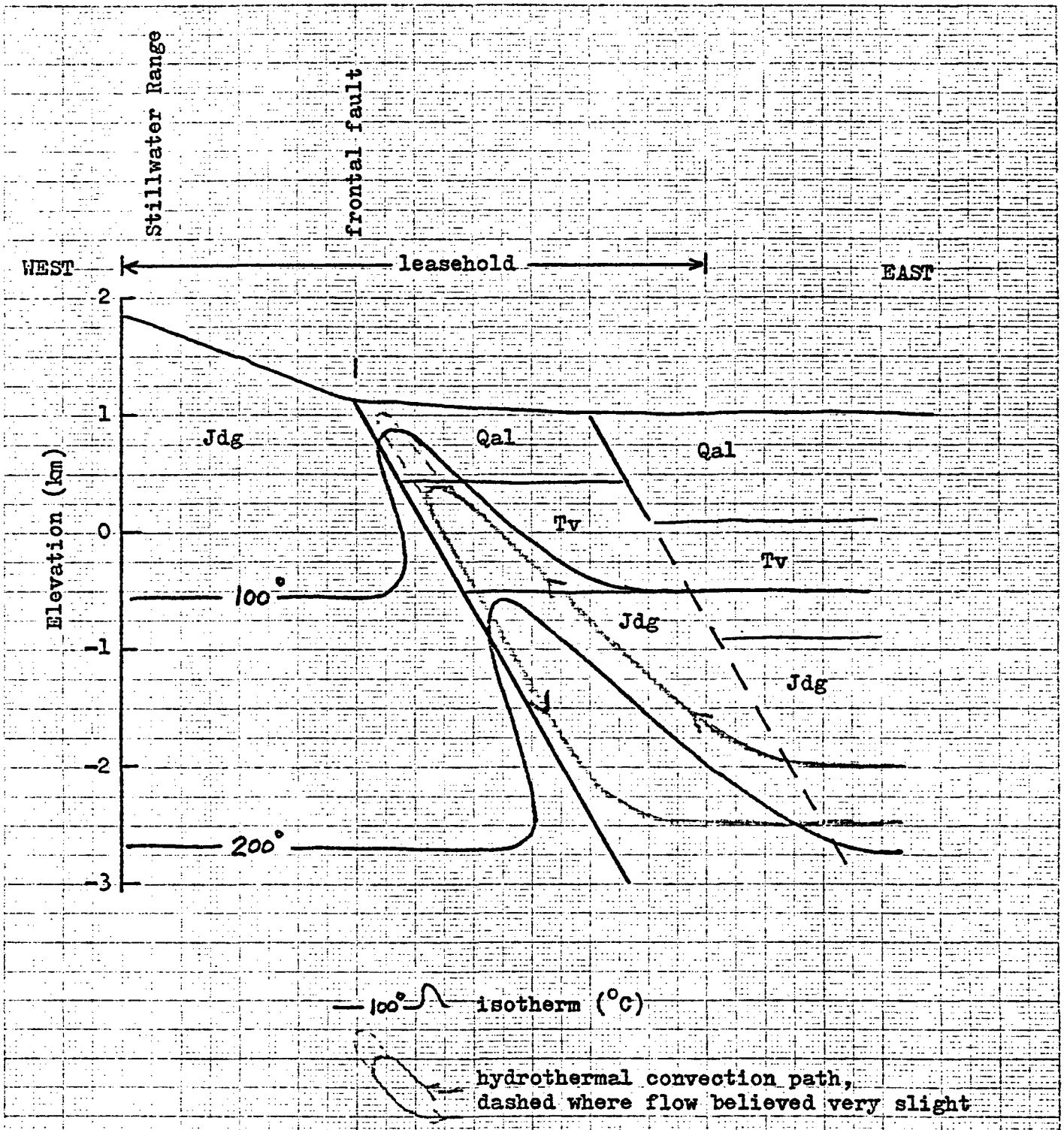

Plate 15. Schematic model of hydrothermal convection and temperature gradient, Quest leasehold and vicinity, Dixie Valley, Nevada. Section transverse to plane of frontal fault.

JAMES B. KOENIG (415) 524-9242
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Under these conditions, meteoric water circulating to a depth of 2 km (6,500 feet) would be heated to about 150°C, which is slightly above the reservoir temperature (143°C) calculated from SiO_2 and Na-K-Ca data for Dixie Hot Springs (Renner et al., 1975). However, it is noted that the SiO_2 geothermometer is considered accurate only for chemical equilibration at depths of 1 km or less (R. Fournier, U.S. Geological Survey, oral communication, 1974). Also, Dixie Hot Springs reaches temperatures as high as 80°C. This suggests that, in the convection "plume" rising beneath the springs, the 150° isotherm may be bowed upward to a depth of 1 km or less.

Within the leasehold, maximum gradients of between 220°C/km and 308°C/km occur near the Dixie Comstock Mine. If these gradients are valid to a depth of 1 km, the 200°C isotherm would be bent upward to a depth of about 1 km (3,300 feet) in the rising column of hot water. Furthermore, if circulation reaches to a depth of 3 km (10,000 feet), which does not appear remarkable for a historically active fault, then water heated to 220°C under assumed average-gradient conditions might be found at a depth of 2 km or even less. This model implies that a nearly isothermal condition might be observed in a well drilled into this or another rising plume of hot water (see Plate 14) at depths of 2 km and greater. Supporting this idea of thermal plumes is observation of a temperature of 125°C at a depth of 110 m (350 feet) in the "hot well" on the Mitchell claim (2-1/2 miles west of the Boyer Ranch).

The above discussion dealt with convection and its effects in longitudinal section along the frontal fault. However, the transverse section must also be considered, and a schematic model through the Dixie Comstock Mine is given in Plate 15. It shows that convecting water rises from the center of the basin, nearly parallel with the frontal fault and zone of associated fracturing. Then, having cooled somewhat, it descends back down the fault zone. Isotherms may be nearly parallel with paths of circulation.

Viewed in three dimensions, the hydrothermal model indicates that convection produces a series of "tongues" of rising hot water within the frontal fault zone on the east flank of the Stillwater Range. These tongues probably exist as extensions of a deeper hot-water reservoir.

Reservoir capacity within the fine-grained lacustrine sediments of Dixie Valley is likely to be poor. Underlying Cenozoic volcanic and Mesozoic basement rocks are probably intensely fractured as a result of the very active tectonism that has affected this region since Miocene time. Therefore, a reservoir is to be sought in brittle, fractured metamorphic and/or igneous rocks of Mesozoic age underlying the western part of the stepped-down Dixie Valley graben. These rocks are present at 5,000 feet in depth at a horizontal distance of 5,000 feet east of the Dixie Comstock Mine (see Plate 3). To the east, these rocks become progressively deeper.

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CONCLUSIONS

Based upon the foregoing analysis, it is believed that a sizeable geothermal reservoir exists beneath the unconsolidated sediments of northern Dixie Valley, and that convection within this reservoir may bring water with a temperature of 200°C or higher to within a depth of 2 km (6,500 feet) beneath the surface.

Convection probably is most pronounced within the frontal fault zone of the Stillwater Range, where fracturing is most intense. Also, it is not likely to occur within the footwall or range-block. Within the leasehold, isotherms are likely to have their greatest upward deflection near and immediately east of the Dixie Comstock Mine.

Based upon their age and relative mineralogical stability, the Mesozoic basement rocks are thought to have greatest reservoir potential: fractures in them are likely to remain open for a longer time than in the overlying Tertiary volcanic rocks. The close association of high-temperature geothermal manifestations and outcrops of Jurassic gabbroic intrusives suggests that this is true.

RECOMMENDATIONS

In order to test the model presented above, it is recommended that two 1,500-foot test wells be drilled, one next to the Dixie Comstock Mine, and another about 1 mile to the east. These will indicate whether the high temperature gradients observed to 300 feet actually persist to much greater depths. Also, they will indicate whether or not the postulated convection cell exists, and, if so, if it has substantial breadth. The recommended locations are shown on Plate 13.

If these tests support the model, then one deep test well should be drilled to a depth of about 8,000 feet. This will determine if the desired temperature and reservoir conditions exist within the leasehold. This probably should be drilled near the eastern 1,500-foot test, although results from the two 1,500-foot tests may indicate a slightly different location.

It is not recommended that further geophysical work be carried out at this time. However, it will be useful to make a careful review of the gravity and magnetic surveys performed by Edcon, Inc. before final selection of test-well sites. These data may indicate additional details of buried fault surfaces that could argue for modification of the proposed drill sites.

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REFERENCES CITED

BURKE, Dennis B., 1967, Aerial photograph survey of Dixie Valley, Nevada, in Geophysical study of Basin-Range structure, Dixie Valley region, Nevada: Air Force Cambridge Research Lab., Report No. 66-848, Part IV.

ERWIN, John, 1973, Bouguer gravity map of Nevada, Reno and Millet Sheets: Nev. Bur. Mines and Geol., Open File Maps, scale 1:250,000.

GeothermEx, Inc., 1975, Geothermal resources of a major lineament in northern Nevada: Consulting report for Dow Chemical Co., U.S.A.

MEISTER, Laurent J., 1967, Seismic refraction study of Dixie Valley, Nevada, in Geophysical study of Basin-Range structure, Dixie Valley region, Nevada: Air Force Cambridge Research Lab., Report No. 66-848, Part I.

MEISTER, Laurent J., et al., 1967, Surface strain changes and strain energy release in the Dixie Valley-Fairview Peak area, in Geophysical study of Basin-Range structure, Dixie Valley region, Nevada: Air Force Cambridge Research Lab., Report No. 66-848, Part V.

PAGE, B.M., 1965, Preliminary geologic map of a part of the Stillwater Range, Churchill County, Nevada: Nev. Bur. Mines Map 28, scale 1:125,000.

RENNER, J.L., et al., 1975, Hydrothermal convection systems, in Assessment of Geothermal Resources of the United States: U.S. Geol. Surv. Circular 726, pp. 5-57.

SMITH, Thomas E., 1967, Aeromagnetic measurements in Dixie Valley, Nevada, in Geophysical study of Basin-Range structure, Dixie Valley region, Nevada: Air Force Cambridge Research Lab., Report No. 66-848, Part III.

JAMES B. KOENIG (415) 524-9242
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THOMPSON, George A., and Dennis B. BURKE, 1974, Regional geophysics of the Basin and Range Province: Ann. Rev. Earth and Planetary Sci., Vol. 2, pp. 213-237.

U.S. Geological Survey, 1972, Aeromagnetic map of parts of the Lovelock, Reno, and Millett 1° by 2° quadrangles, Nevada: Open File Map, scale 1:250,000.

WILLDEN, Ronald, and Robert C. SPEED, 1974, Geology and Mineral Deposits of Churchill County, Nevada: Nev. Bur. Mines and Geol. Bull. 83.

APPENDIX 1

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APPENDIX 3

HISTORIC SEISMICITY AND FAULTING IN DIXIE VALLEY, NEVADA

Historically, the Dixie Valley area has exhibited high seismicity, including several large earthquakes accompanied by surface faulting. It is part of the very active 118° meridian seismic zone, which extends from Owens Valley to Pleasant Valley. This zone experienced major earthquakes and surface faulting in 1872 (Owens Valley), 1903 (Louderback Mountains), 1915 (Pleasant Valley), 1932 (Excelsior Mountain), 1934 (Cedar Mountain), and in 1954 (Rainbow Mountain, Fairview Valley, and Dixie Valley).

Probably in 1903, the Wonder earthquake produced 3 miles of normal faulting in the Louderback Mountains, along the north-trending Gold King fault (Slemmons et al., 1959). This same fault was reactivated during the Dixie Valley-Fairview Peak earthquakes of December 16, 1954. These two shocks had magnitudes of 6.8 and 7.1., and were accompanied by extensive faulting from Mt. Anna on the south to Dixie Meadows on the north, in a belt 60 miles long by 20 miles wide. Thirty miles of this faulting occurred along the east flank of the Stillwater Range, near the bedrock-alluvium contact. Displacements were mainly dip-slip, and ranged from as large as 12 feet near Fairview Peak to 2 feet in Dixie Meadows (Slemmons, 1957). In August 1954, the Rainbow Mountain earthquake (M = 6.5) had produced some 25 miles of faulting on the west side of the Stillwater Range, with maximum displacement of 2 feet. Including generally minor right-lateral slip components (but up to 12 feet at Fairview Peak), the surface faulting showed NW-SE oriented extension of the area and westward tilting of the Stillwater-Fairview Mountain block, as well as downdropping and westward tilting of Dixie Valley. Geodetic data (Whitten, 1957; Meister et al., 1967) confirm these displacements, and indicate a net lowering of the ground surface in both mountain and valley blocks. First-motion data for the Fairview Peak earthquake fit the fault data very well.

Aftershocks of the 1954 events have continued up until the present time, and have been the subject of several published papers. In the winter and spring of 1965, Westphal and Lange (1967) recorded more than 1,300 local shocks in the area between the Louderback Mountains and Mt. Anna; activity was notably concentrated in the area of Bell Flat. Total recording time was 129 days. Focal depths ranged from 5 to 15 km. In the summer of 1966, Stauder and Ryall (1967) recorded more than 1,000 micro-earthquakes during six weeks in the Fairview Peak-Mt. Anna area. Focal depths ranged from 5 to 20 km but were chiefly in the range 10 to 15 km.

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Focal mechanisms were predominantly dip-slip, representing continued down-dropping of the Bell Flat graben. Unpublished microearthquake data recorded by R. Greensfelder, working for the U.S. Geological Survey, indicated continuing intense activity in this area during 1966, 1967, and 1968.

None of the above-described studies revealed significant activity north of the Louderback Mountains, partly because in all cases the station networks had their perimeters south of that area, and probably also because activity was much less there.

Since mid-1964, the University of Nevada, Reno, has operated a seismograph network in northern Nevada, with permanent stations at Reno, Unionville (in the Sonoma Range north of Lovelock), near Battle Mountain, and at Tonopah; several stations have been added since then, chiefly in the area around Mina, south of Walker Lake. The 1970 to present epicenter data are considered to be more precise than that before 1970, and epicenter data for Dixie Valley for 1970-1974 have been obtained from UNR. They cover the area from 39° 20' to 40° 00' north latitude, from the west side of the Stillwater Range to the east side of the Clan Alpine Range. About 160 events with magnitudes from 1.5 to 4.2 were located in this area, and were recorded by an average of 6 stations, but occassionally as many as 11. Standard errors of computed versus observed arrival times averaged less than about 0.35 second; therefore, computed epicenter locations are probably precise to within about 4 km at the 95% confidence level. Focal depths are unavailable for these shocks, but may reasonably be assumed to be from 5 to 15 km, based on earlier results in the area.

The 1970 to 1974 activity was notably concentrated in central Dixie Valley between the Louderback Mountains on the south and latitude 39° 45' on the north. No events were located within the project area or along the Stillwater Range frontal fault north to latitude 40° N. The nearest event to the south is along the Stillwater fault just west of Dixie Meadows.

Overall, the distribution of epicenters suggests three possible patterns of faulting, two or all of which may be real:

(1) aftershock activity of the 1954 'quakes continues at depths of from 12 to 20 km along the east-dipping Stillwater frontal fault system;

(2) seismicity, perhaps aftershocks of the '54 'quakes, is taking place along subsurface north-trending faults which are seen in both bedrock and alluvium in the Louderback Mountains area and which may extend as far north as Dixie Hot Springs; Holocene alluvial scarps in the valley exhibit a weak northerly alinement along this trend;

(3) a weak northwesterly alinement in the cluster of epicenters near about 39° 45' N suggests movement along a conjugate fault set.

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REFERENCES CITED

MEISTER, Laurent J., Robert O. BURFORD, George A. THOMPSON, and Robert L. KOVACH, 1967, Surface strain changes and strain energy release in the Dixie Valley-Fairview Peak area, Nevada, in Geophysical Study of Basin-Range Structure, Dixie Valley Region, AFCRL-66-848.

SLEMMONS, David B., 1957, Geological effects of the Dixie Valley-Fairview Peak, Nevada, earthquakes of December 16, 1954: Bull. Seis. Soc. Am., v. 47, pp. 353-376.

SLEMMONS, David B., et al., 1959, Wonder, Nevada, earthquake of 1903: Bull. Seis. Soc. Am., v. 49, pp. 251-265.

STAUDER, William, and Alan S. RYALL, 1967, Spatial distribution and source mechanism of microearthquakes in central Nevada: Bull. Seis. Soc. Am., v. 57, pp. 1317-1346.

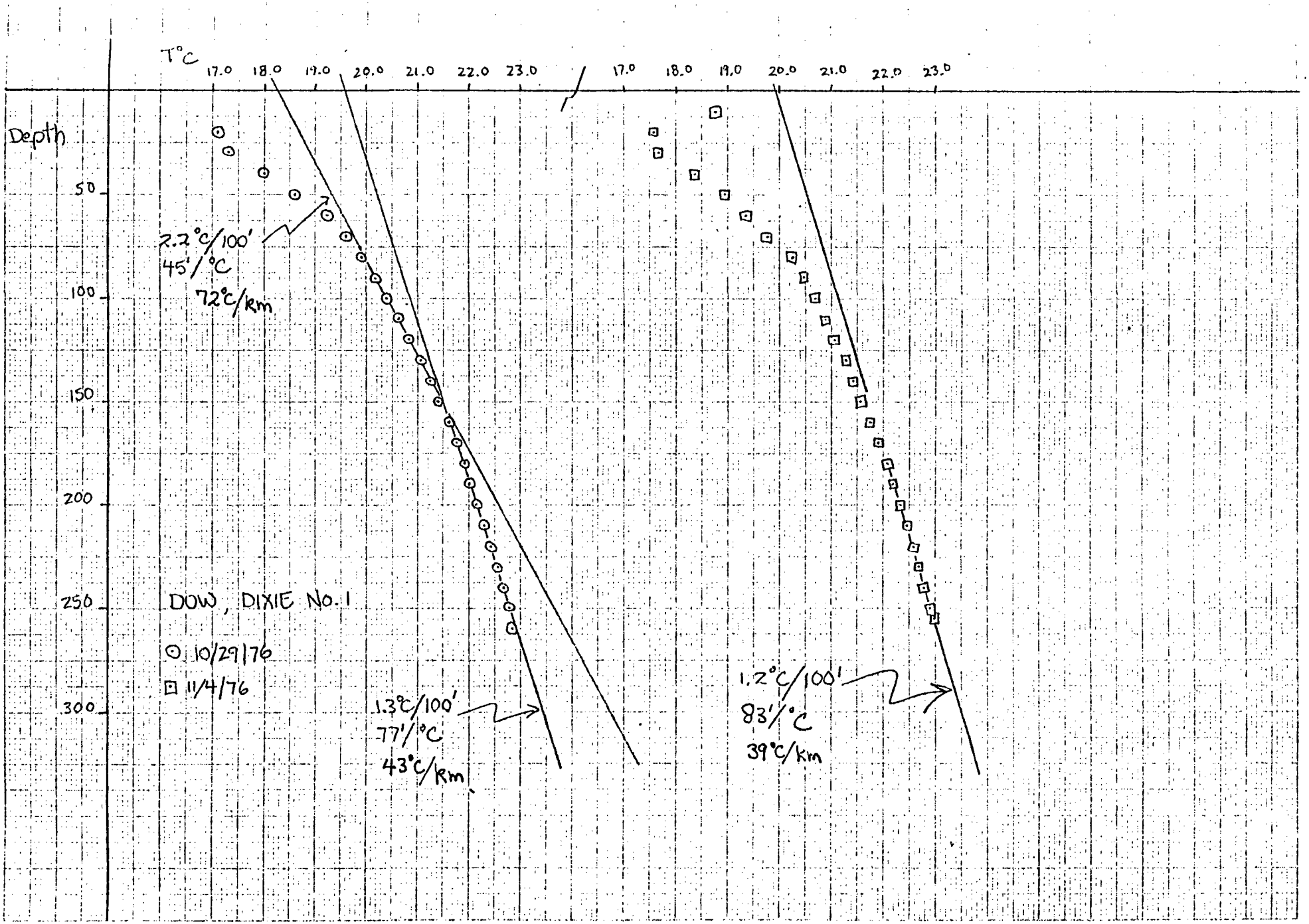
WESTPHAL, W.H., and A.L. LANGE, 1967, Local seismic monitoring -- Fairview Peak area, Nevada: Bull. Seis. Soc. Am., v. 57, pp. 1279-1298.

WHITTEN C.A., 1957, Geodetic measurements in the Dixie Valley area: Bull. Seis. Soc. Am., v. 47, pp. 321-326.

Appendix 4

Drilling, Temperature Logs, Lithologic Logs

DOW DIXIE NO. 1


T°C
17.0
18.0
19.0
20.0
21.0
22.0
23.0
Depth
50
100
150
200
250
300
2.2°C/100'
45'/°C
72°C/km
DOW, DIXIE No.1
10/29/76
11/4/76
1.3°C/100'
77'/°C
43°C/km
1.2°C/100'
83'/°C
39°C/km

DOW, DIXIE No. 1 TEMPERATURE LOG C. Klein

Loc:

Date: 11/4/76

Time: 0915 hrs

Depth	T°C, down
10	18.77
20	17.58
30	17.68
40	18.34
50	18.93
60	19.35
70	19.78
80	20.26
90	20.48
100	20.69
110	20.88
120	21.09
130	21.29
140	21.42
150	21.57
160	21.77
170	21.90
180	22.07
190	22.17
200	22.34
210	22.45
220	22.58
230	22.69
240	22.79
250	22.91
c.255	22.98 ← block

DOW DIXIE No. 1 TEMPERATURE LOG

M. Gardner, transcribed by C. Klein

Loc: East of intersection, SW¼ Sec. 18, T22N, R35E

Date: 10/29/76

Time:

Depth	T°C, down	
10	34.5	
20	17.1	
30	17.31	
40	18	
50	18.6	
60	19.21	
70	19.6	
80	19.92	
90	20.18	
100	20.37	
110	20.62	
120	20.84	
130	21.05	
140	21.24	
150	21.39	
160	21.61	
170	21.76	
180	21.91	
190	22.0	
200	22.14	
210	22.3	
220	22.44	
230	22.57	
240	22.69	
250	22.78	
260	22.84	block in pipe
300	——	TD

Gradient:

90–150': 20.4–18.2/100 = 2.2°C/100'

45'/°C

150–260': 20.85–19.59 = 1.3°C/100'

77'/°C

Hole No. 1
Operation Summary

M. Gardner,
transcribed by
C. Klein

Loc: East of intersection, Sec. 18, T22N, R35E (.4 mi N of USBM H103 (1958): BM x 3469 (in SW¼).

Drilling Log:

10/27/76	Driller: R. Cardell to c. 2100; L. Millard 2100 hrs to completio
1900	Arrive and set up.
2130	kelley down,
2200	breakdown main pump, repairs by crew.
2400	repairs fail, second attempt at maintenance - Successful, renew drilling
—	secure logger
10/28/76	
0745	reach 300' TD, circulate
0815	pull string
0930	place pipe, clean up.
1045	secure to load and transport gear to east side valley.

Geologic Setting: Distal, gently sloping region of alluvial fan, 1 mile from range front; at about 3500 ft. altitude, 2 miles from edge of basin low at 3380 ft. to east. Cold springs issue from base of NE strik scarp(s) in fan deposits passing ½ mile to east of site.

Geologic Summary: Entire section 0-300 ft is fan deposits. Alternating sandy-gravelly zones; coarsest returns in some samples are about 5 mm, in others pebbles to 1.5 cm, rarely to 3 cm, are present. Rocks include basalt, andesite and rhyolite porphyry, shale, silt.

GeothermEx, Inc.
Site Scientist MC G
Date 10/27-28/76

LITHOLOGIC LOG

Dow
Dixie No. 1

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATIO
0 - 10		pebbles to 15 mm of basalt, rhyolite + cmbd. porp., indur. salt, shale, etc. fragments of same	gang.
10 - 20		do; some to 20 mm on long axis	do
20 - 30		do; 10% fines	do, some sand less
30 - 40		do; 20% fines	do
40 - 55		do; 2 sizes 10-15 mm + 1-2 mm	gang + cd shifting deposition
55 - 70		do; very coarse pebbles + fragments to 30 mm	gang
70 - 85		do	do
85 - 100		do; 25% fine fraction	gang + sd shifting deposition
100 - 115		do, 30% f fraction	do

Dow
Dixie #1

LITHOLOGIC LOG

GeothermEx, Inc.
Site Scientist MC
Date 10/27-28/76

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
115' – 130'		do; 30% fine fraction	do
130 – 145'		do; 20% fine fraction	do
145' – 160		do; even 1.5–7 mm size, few grains to 12 mm	do; gravel deposition shifting into sequence
160 – 175'		do; more crse pebbled fragments	do.
175' – 190		do; even size distribution	med. grained sand
190 – 205'		do; 1-8 mm, mostly pebbles to 12 mm	do
205' – 220		do; 1-4 mm, some pebbles to 10 mm	do
220 – 235'		do; 1-5 mm, few pebbles to 15 mm	do
235' – 240		do; 1-5 mm, 2 mm predominates	do

DOW

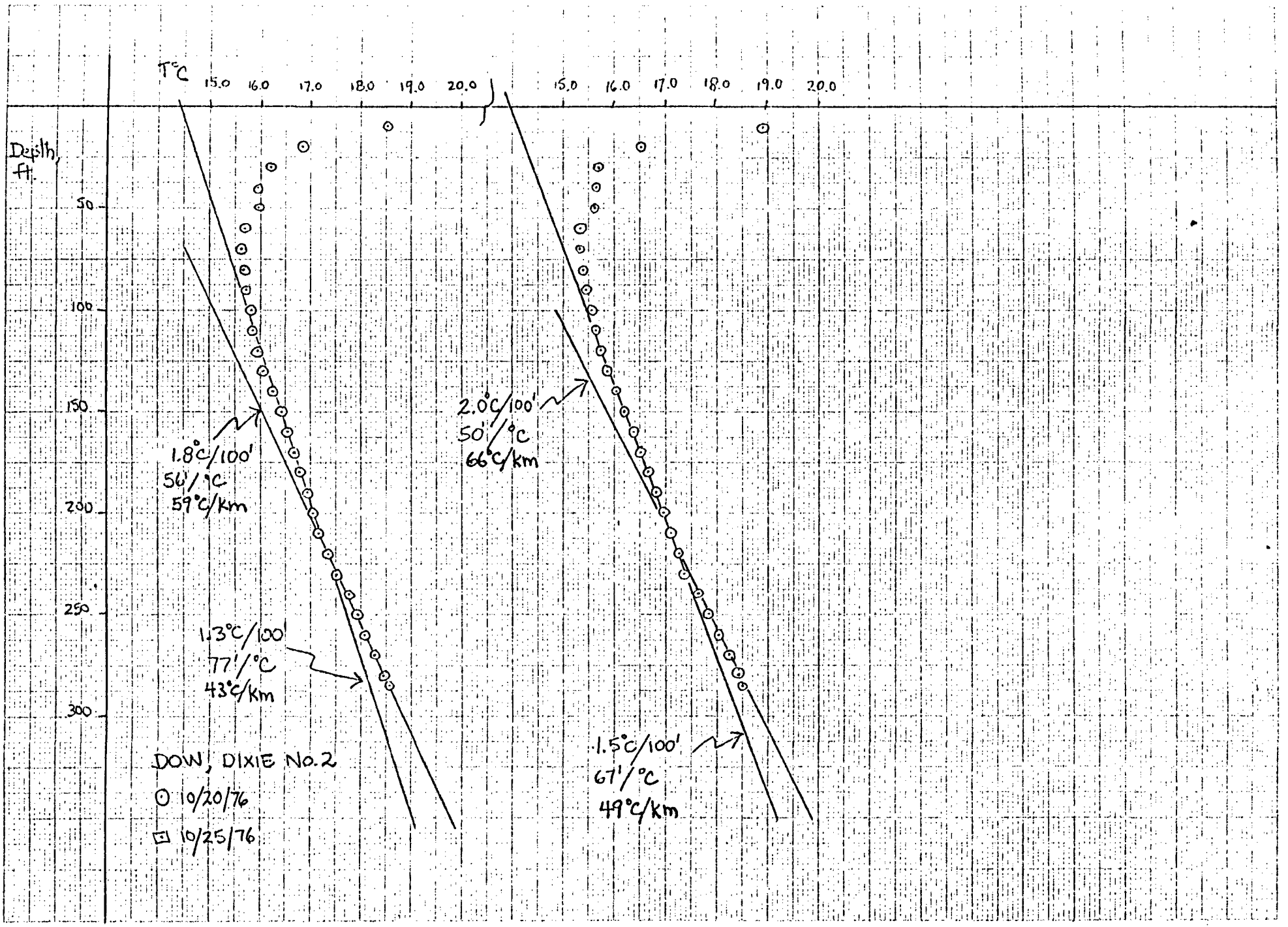
DIXIE #1

LITHOLOGIC LOG

GeothermEx, Inc.
Site Scientist
Date 6/27-28/76

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATIO
240 265		do; 1-3 mm size predominates	do
265 280		do; 2-12 mm, mostly larger sizes predominate	do; shift to growth deposition
280 295		do; ~~1-6~~ 1-6 mm	do
295 305		do; 2-7 mm	do

DOW DIXIE NO. 2


T°C
15.0
16.0
17.0
18.0
19.0
20.0
Depth, ft.
50
100
150
200
250
300
1.8°C/100'
56'/°C
59°C/km
1.3°C/100'
77'/°C
43°C/km
DOW, DIXIE No. 2
⊙ 10/20/76
⊡ 10/25/76
2.0°C/100'
50'/°C
66°C/km
1.5°C/100'
67'/°C
49°C/km

DOW, DIXIE No. 2 TEMPERATURE LOG C. Klein

Loc:

Date: 10/25/76

Time: 1430 hrs

Depth	T°C, down	
10	18.91	
20	16.54	
30	15.70	
40	15.56	
50	15.52	
60	15.34	
70	15.31	
80	15.39	
90	15.44	
100	15.56	
110	15.64	
120	15.75	
130	15.88	
140	16.05	
150	16.20	
160	16.38	
170	16.51	
180	16.66	
190	16.81	
200	16.94	
210	17.10	
220	17.27	
230	17.46	
240	17.63	
250	17.82	
260	18.02	
270	18.22	
280	18.40	
285	18.50	← bottom

Note: This survey carried out after 7 day rather than 9 day pre drilling interval. Opportunity afforded by break in drilling activities.

DOW, DIXIE No. 2 TEMPERATURE LOG C. Klein

Loc: Berm of trail, NE¼ Sec. 30, T23N, R35E.

Date: 10/20/76

Time:

Depth	T°C, down	
10	18.53	
20	16.83	
30	16.20	
40	15.95	
50	15.95	
60	15.70	
70	15.62	
80	15.66	
90	15.73	
100	15.82	
110	15.86	
120	15.96	
130	16.09	
140	16.26	
150	16.41	
160	16.53	
170	16.69	
180	16.78	
190	16.94	
200	17.06	
210	17.18	
220	17.35	
230	17.51	
240	17.74	
250	17.91	
260	18.08	
270	18.28	
280	18.44	
285	18.53	← bottom

Temp. gradient:

210-285': (16.95-15.13)°/100' = 1.82°/100'

55.6'/°C

Hole No. 2
Operation Summary by: C. Klein

Loc: Bend of trail, NE¼ Sec. 30 T23N R3SE

Drilling Log:

10/5/76
1015 Rig lvs. Reno. Driller: Randy Cardell, Asst: Kenny Howard
1515 Arr. site
1645 Spud in, drilling w/air
1700 Shut down

10/6/76
0700 water trip
0900 Drilling w/air, foam – poor return (crs cuttings, gravel)
0945 Set-up to drill w/mud
1330 Redrilling top 20 ft. – caving, slough
1330-1400 Lunch. Water trip
1600 Have reached max. 35 ft.; continued slough, zones of fluid loss – gravel w/ occas boulders. Cottonseed hulls added 1535. Water trip.
1745 Repeated caving – drill to c. 25, w/draw, hole open to c 14 ft. Fluid loss (v. thick mud, cottonseed) cont. By agreement w/ Gerald ____ (driller Foreman – left site c. 1530 hrs) this hole to be temp abandoned. Will return w/ casing, welder? Moving this site only sev. 100 ft seems unlikely to find better conditions, as still would be on alluv. fan.
1800 Rig lowered
1900 Shut down

10/14/76 morning – repairs to rig transmission, brakes at Site No. 6
early afternoon – re-inhabit site, drill spot relocated c. 100 ft. NW of abortive hole 10/5-10/6. Spud-in, drilling w/mud
1420 – Caving of boulders in hole necessitates repeated re-drilling of upper 20 ft.

Hole No 2 - cont

1600 At 40ft - slow drilling due to repeated caving.
1800 At 70 ft. Shutdown.

10/15/76

0730 Start-up
— c.80 ft - driller reports ground is mostly clay, gray color.
0910 At 100 ft, clay continues
1010 At 145 ft, clay continues, gravel bed between 135-140 ?
1130 At 175 ft, shutdown for water trip.
1145 Resume drilling
1300 At 205 ft. Trip out for new bit
c.1400 Shutdown

10/18/76

Late morning - arrive; trip down.
1320 - Reach TD 300 ft. - drill cellar to 305
1500 - 290 ft PVC casing down. Great resistance to last 40 ft of insertion, decide to stop at 290 rather than risk damage to pipe (wt. of Kelley + pulldown hydraulic used to force last 40 ft. down).

Geologic Setting: Head of alluvial fan at entrance to canyon, close to line of (buried) range bounding fault, 100 ft. N. of present day stream gulley on fan.

Geologic Summary: (0-75'): fanglomerate deposit, angular to occas subrounded, sand, pebbles to 3cm, brown silt and clay; purple, red, tan, brown, green volcanics, mostly tuff, minor gabbro. (75-300'): sandy clay, mostly light gray, but purplish brown in 110-120' and 130-140'

GeoTherm Ex, Inc.
Site Geologist C. Klein
Date 10/14/76

LITHOLOGIC LOG

DOW
DIXIE No. 2

	INTERVAL	SCHEMATIC OF SECTION	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATIC
10/14	10-20'		Fan deposits: angular sand, pebbles to 3cm, brown silt + clay (not recovered), some clasts subrounded. Purple, red, tan, brown, green volcanics, mostly tuff; minor gabbro. Tuff is silicious-intermed, vitric, vitric crystal.	Drilling mud brown
	20-30'		same	
	30-40'		same	
	40-50'		same	
	50-60'		same	
	60-70'		same	
10/15	70-80'	c.75' →	Angular pebbles, sand as above, plus abundant clots clay, dark gray, light + dark gray brown, brown.	
	80-90		similar, but fewer pebble-sized clasts recovered	c.90-ft-drilling mud notably gray.
	90-100'		same	

LITHOLOGIC LOG

Continental Ex, Inc.
Site Geologist C. Klein
Date 10/15/76

DOW
DIXIE No. 2

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
100-110'		Med grained angular sand, clots of lt. gray and purplish brown clay, sandy clay. Sudden absence of crs. sand + pebbles (compare 90-100) probably due to change in sampling technique, see Comments.	Change in sampling technique: to 100' sampled cuttings by scooping from portable sump w/ shovel at 10' intervals, technique used also at holes 3, 6 & 8. Feel that technique tends to mix recent cuttings/returns w/ material from higher up. Here & below sieve suspended at hole outlet to catch cuttings directly as come up. Sieve in place for only 2-3' of drilling prior to completion of interval recorded so, e.g. sample 100-110 comprises cuttings returned to surface while drilling c. 107-110.
110-120'		same, purplish brown clay dominates, sandy	
120-130'		same, gray clay dominates, sandy	
130-140'		same, purplish brown clay dominates, sandy	
140-150'		same, gray clay dominates, sandy	
150-160'		same	
160-170'		same	
170-190'		same	
190-200'		same	

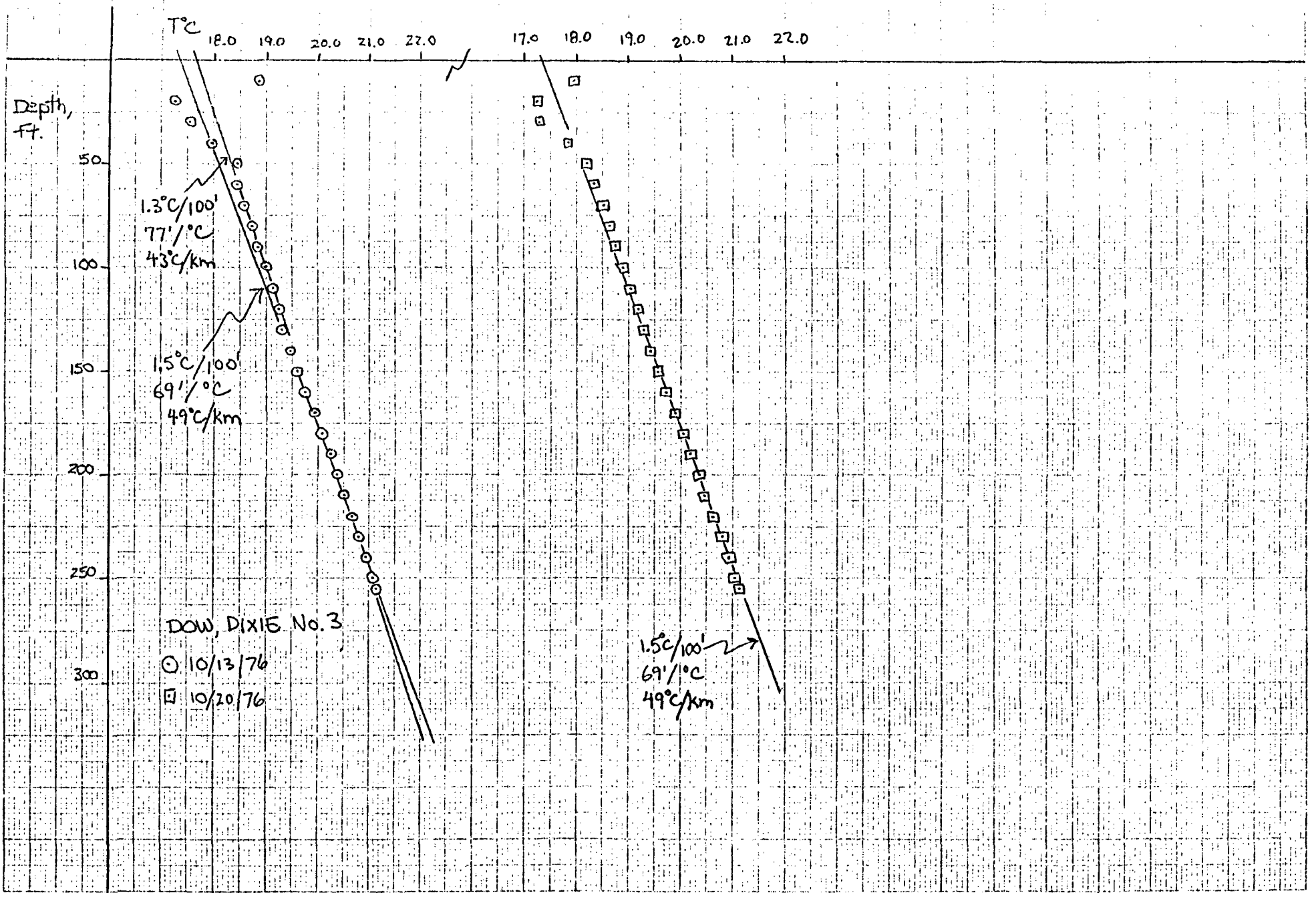
DOW
DIXIE No. 2

LITHOLOGIC LOG

[illegible]mEx, Inc.
Site Scientist C. Klein
Date 10/18/76

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATIC
200-210	same		
210-220	same		
220-230	same		
230-240	same		Note: driller collected samples 200-210 to 280-290, washed off most clay from sand. C.K. collected 280-300.
240-250	same		
250-260	same		
260-270	same		
270-280	same		
280-290	same		
290-300	same		
	300' TD		

DOW DIXIE NO. 3


T°C
18.0
19.0
20.0
21.0
22.0
17.0
18.0
19.0
20.0
21.0
22.0
Depth, ft.
50
100
150
200
250
300
1.3°C/100'
77'/°C
43°C/km
1.5°C/100'
69'/°C
49°C/km
DOW, DIXIE No. 3
⊙ 10/13/76
⊡ 10/20/76
1.5°C/100'
69'/°C
49°C/km

TEMPERATURE LOG C. Klein

DOW DIXIE No. 3

Date : 10/20/76

Time : 0815 Air temp : 9.3°c

Depth	T°C. down
0	11.1°c
10	17.95
20	17.25
30	17.30
40	17.84
50	18.20
60	18.34
70	18.53
80	18.63
90	18.76
100	18.90
110	19.05
120	19.20
130	19.30
140	19.42
150	19.56
160	19.72
170	19.89
180	20.05
190	20.18
200	20.35
210	20.47
220	20.62
230	20.80
240	20.92
250	21.05
255	21.13

Finish : 0915 hrs.

DON DIXIE No.3 TEMPERATURE LOG C.Klein

10/13/76

Date: 10/13/76

Time: 0930 hrs. Air temp: 12.8°C *

*Note: max reg. Hg therm - 14.5°C
dial therm - 12°C.

** in water; dial therm - 16.5°C.

Depth	T°C down	T°C up
0 ft.**	16.90	
10	18.85	
20	17.25	
30	17.55	
40	17.97	
50	18.43	
60	18.45	
70	18.60	
80	18.73	
90	18.86	
100	18.99	19.00
110	19.11	
120	19.24	
130	19.37	
140	19.47	
150	19.60	
160	19.76	
170	19.93	
180	20.07	
190	20.23	
200	20.37	20.38
210	20.51	
220	20.65	
230	20.79	
240	20.93	
250	21.08	
255	21.13	← hole blocked below 257-257.5 ft

Finish = 1145 hrs

Gradient from plot of data

50-120' : 0' intercept = 17.7°C

300' " = 21.7°C

1.3°C/100' ≡ 77'/°C

130-250' : 0' intercept = 17.34°C

300' " = 21.82°C

(21.82-17.34)/300' = 4.48°/300' = 1.5°C/1

= 69'/°C

Hole No. 3
Operation Summary

by: C. Klein

Loc: Near intersection, SE¼ sec. 34, T23N, R3SE

Drilling Log:

10/7/76
- 0700 Commence move to site
- 0900 Spud in — drilling in gravelly alluvium
- 0950 At c. 18 ft. Fluid loss low, some slough
- 1100 Repeated re-drilling of zone c. 15–20 ft. Joe — driller N end of valley, stops by.
- 1330 Drilling at 40 ft., gravel
- 1400 At 60 ft. — gravel, clay since c. 40 ft.
- — c. 60 ft. gravel, no clay, slight fluid loss
- 1530 At 80 ft, gravel, sand
- 1630 At 120 ft, gravel, sand
- 1645 At 135 ft. Stops to fix cable.

10/8/76
- 0730 Back into hole — clear to bottom
- 0845 At 165 ft. — mud temp 17.5°C
- 1020 205 ft. — harder rock? Mud is v. thick — cuttings not settling quickly.
- 1130 Shutdown — mud too thick, no settling of cuttings. Water trip, mud dumped, new batch.
- 1410 Drilling resumes at 220' — quick penetration
- 1500 c. 260 ft — rate of penetration slows — driller feels bit worn
- 1515 Begin trip out
- 1345 Shutdown

10/11/76
- mid-morning Hole completed to TD 300 ft, driller reports no change in conditions
- late-morning PVC 1¼" pipe set to TD, top 10 feet of annulus cemented. Rig removed to site #8.

Geologic setting: on lower portion of alluvial fan, c. 200 m from flat valley floor. Ground surface is mostly silt and clay; lesser sand, occas. pebbles, cobbles.

Geologic summary: Entire section 0-300' is fan deposit of angular-subrounded sand, small pebbles in brown silt and clay matrix. Relative abundance of the various size fractions varies somewhat from level to level, but signs of sharp breaks or changes in sorting are generally absent. Brown silt-clay is most abundant in 40-60' level (clots of clay form c. 60% of recovery), where zones of clay-silt nearly devoid of sand may be present.

GeothermEx, Inc.
Geologist C. Klein
Date 10/7/76

LITHOLOGIC LOG

DOW
DIXIE V. No. 3

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
0			
0-20'		Soil; sand, gravel. Angular, subrounded. Red, brn, purple, green, tan-colored tuff. Some greenish gabbro (altd). Rare slate (?, aph, dk grny, cleavage not apparent). Occas frag qtz, (c?, ep rare).	Vitric tuff. Vitric-xal tuff. Some banded & welded. Tuff or porph volcanics. Fspars, qtz, occas bio.
20-30'		no sample	
30-40'		as above, all (?) returns sand-sized, angular-subrounded.	
	40'		
40-60'		sand, gravel as above; plus abundant brown silt and clay, in thumb-sized clots, generally free of sand. Sand, gravel c. 40%?, clay c. 60%?	
	60'		
60-70'		gravel, crs sand as above; brn clay rare	Drop in return of drilling fluid, c. 60 ft. Extra mud, cottonseed added.
70-80'		some	
80-100'		gravel, sand - 90 to 95% brown or pinkish brn sandy clay-silt - 5-10%*	*percentages in sample. Amts of clay-silt in ground prob. much higher, mixed w/ drilling mud.
100-110'		some	
110'-120'		same	

LITHOLOGIC LOG

DOW
DIXIE V. No.3, cont.

Sample Specialist C. Klein
Date 10/7/76

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
120'			
120-130'		as above. Clots of brown sandy clay + silt 10-15% of sample	
130-140'		same. Percent gravel recovered may be decreasing relative to sand, silt.	
140-150'		same. Clots of sandy brown silt-clay 15-20% of recovery.	
150-160'		same.	
160-170		same	
170-180'		same. Gravel fraction* c.20% of total. Clots of silt-clay-sand 30+%	*(>.5cm)
180-190'		same	
190-200'		same	
200-210'			205' - driller suspects harder rock. Note: From c.60 ft-220' mud thickens to state where cuttings no longer settle - samples prob. do not show lith. variation 220' - new mud. if any.

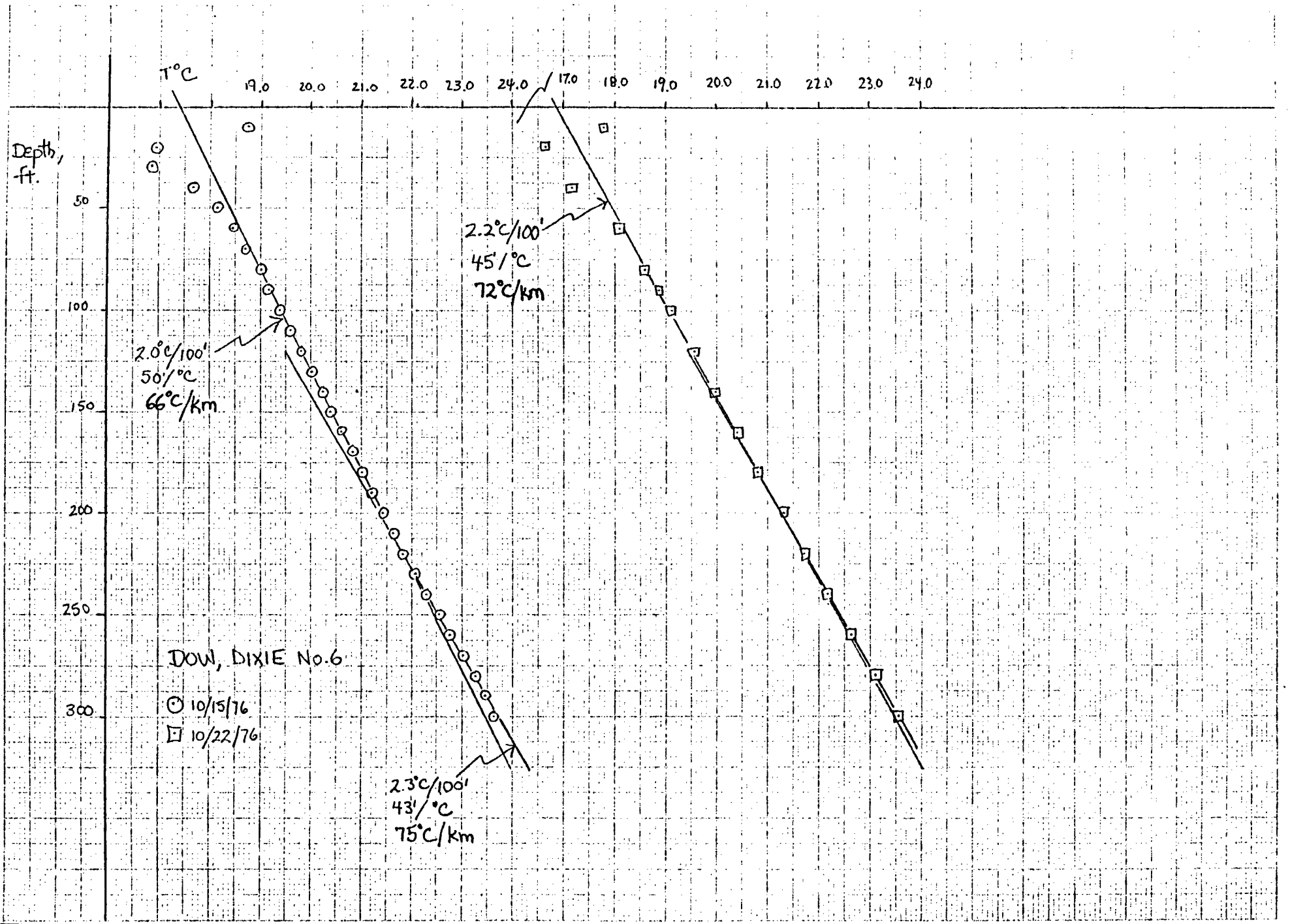
LITHOLOGIC LOG

DOW
DIXIE No. 3

Site Scientist C. Klein
Date 10/3/76

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
210-220		same	
225-230		same	
230-240		same	
240-250		same	
250-260		same	c. 260 ft - penetration slows ~~worn bit?~~ no suspect boulder.
260-270		percent recovery silt-clay decreases, 98% is sand-gravel, most angular, to occas. rounded. Max dim 2cm.	
270-280		same	
280-290		same	
290-300		same	
	300' TD		

DOW DIXIE NO. 6


T°C
19.0
20.0
21.0
22.0
23.0
24.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
Depth, -ft.
50
100
150
200
250
300
2.0°C/100'
50'/°C
66°C/km
2.2°C/100'
45'/°C
72°C/km
2.3°C/100'
43'/°C
75°C/km
DOW, DIXIE No.6
10/15/76
10/22/76

DOW, DIXIE NO.6 TEMPERATURE LOG C. Klein

Loc.

Date: 10/22/76

Time. 1130 hrs

Depth	T°C, down
10 ft	17.79
20	16.66
40	17.17
60	18.10
80	18.59
90	18.86
100	19.11
120	19.56
140	19.99
150	20.20
160	20.40
180	20.80
200	21.32
220	21.71
240	22.18
260	22.63
280	23.10
300	23.54

TEMPERATURE LOG

by. C. Klein

Dow, DIXIE No. 6

Loc: bend in road, SE ¼, Sec. 27, T23N, R35E

Date: 10/15/76

Time: 1320 Air temp: 24.1 °C

Depth	T°down
0	20.50
10	18.76
20	16.93
30	16.87
40	17.68
50	18.16
60	18.45
70	18.70
80	19.00
90	19.15
100	19.37
110	19.59
120	19.79
130	20.02
140	20.23
150	20.39
160	20.59
170	20.81
130	21.00
190	21.21
200	21.42
210	21.60
220	21.82
230	22.06
240	22.29
250	22.55
260	22.75
270	23.02
280	23.26
290	23.47
300	23.61

Finish: 1510 hrs.

Gradient from plot of data:

$$220\text{-}300' = \frac{22.4 - 20.1}{250 - 150} = \frac{2.3°C}{100'}$$

$$70\text{-}220' = \frac{21.4 - 19.4}{200' - 100'} = \frac{2.0°C}{100'}$$

Hole No. 6
Operation Summary — by. C. Klein

Loc: bend in road, SE¼, Sec. 27, T23N, R35E.

Drilling Log:

10/13/76 0900 move onto site. Hole placed 75 ft SE of flag, for greater convenience in use of portable sump.
1200 At 100 ft., all gravel., no pbms.
1220 at 130 ft., shutdown, wait for water truck.
c. 1300 resumes drilling.
1350 at 190 ft., smooth drilling, rapid + even. Mud temp 22°C.
1400 stop to dump mud, mix new load, 205 ft
1420 drilling at 205 ft.
1515 at 265 ft. — mud has thickened w/ brn clay from hole, drain part of tank + refill.
1615 reach TD, 300 ft.
1820 — PVC pipe in place. Shutdown.

Geological Setting: About 800 ft from range front on gently sloping fanglomerate. Surface mostly angular pebbles, sand, silt. Occasional boulders, but relative scarcity of material larger than cobble-sized is probably due to lack of major surface drainage on range front here — no large canyon to produce flash floods which would move boulders as far as site. Fanglomerate c 700 ft upslope + N + S of site has Recent (but probably pre-1954) fault escarpment (?). Range is altered volcanics, dipping strata.

Geological Summary: To c 205 ft. drill encountered a homogeneous-appearing section of 'fanglomerate'; pebbles, sand, brown silt + clay, mostly angular, of volcanics, with rare fragments of gabbro. The abundance of coarser, pebble-sized clasts may decrease slightly moving downwards. Below c. 205 ft. clasts coarser than sand (max. about 4 mm) are rare, and the abundance of brown clay + silt increases. Most of 205-300 ft is probably sandy brown silt and clay. Whether the sand is mixed with the finer

GeothermEx, Inc.
Site Scientist C. Klein
Date 10/13/76

DOW
DIXIE No.6

LITHOLOGIC LOG

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATIO
0-10'		Alluvial gravel: sand + pebbles, angular to subrounded, occas. clots brown sandy clay + silt, rare clots tan clay. Mostly volc. rk, tuff, flow material, pink, gray, purple, red, green; occas frag gabbro	
10-20'		same	
20-30'		same	
30-40		same	
40-50		same	
50-60		same	
60-70		same	
70-80		same	

DOW

LITHOLOGIC LOG

DIXIE V. No. 6

Geochem Ex, Inc.
Geologist C. Klein
Date 10/13/76

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
80-90'		same	
90-110'		same	
110-120'		Same	
120-130		same - note that most clasts are .5cm or smaller - angular pebbles ≥.5cm are <15% of total.	
130-140		Same	
140-150		same	
150-160		same	
160-170		same	
170-180		same	

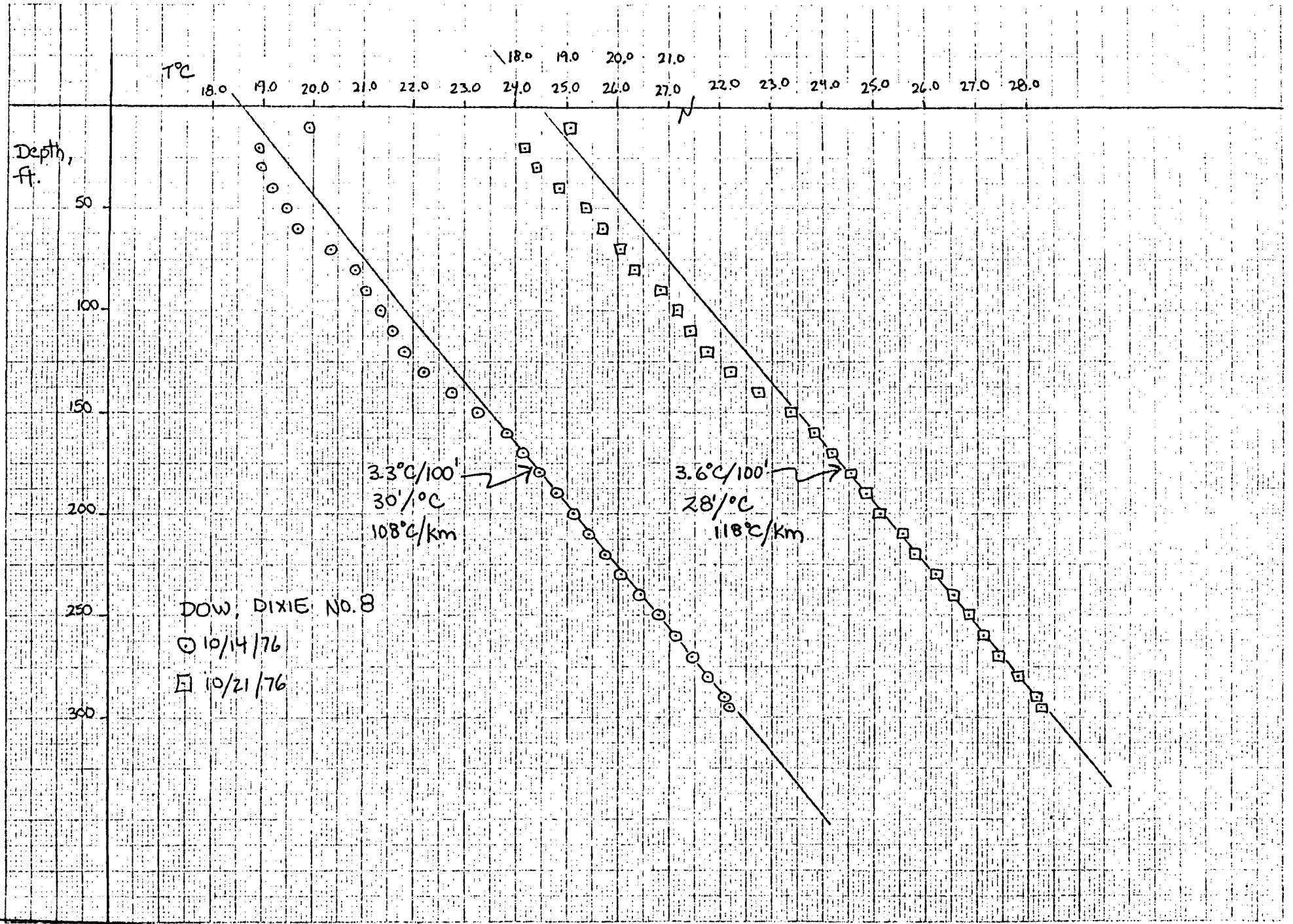
GeoChem Ex, Inc.
Site Geologist C. Klein
Date 10/13/76

LITHOLOGIC LOG

DOW
DIXIE V. No 6

INTERVAL	SCHEMATIC OF SAMPLE RETURNS	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
180-190		same	
190-205		same - clots brn sandy clay-silt abundant	
205-220		same - 80% of recovery* is ≤ 4mm; clots of brn sandy clay-silt not abundant	205 - new mud mixed *Below 205' returns crsr than seive (c. 1mm) not abundant, to ± scarce; simultaneous thickening of mud implies drilling dominantly brown clay-si + sandy clay silt. (Sand lenses?) However, presence of pebble-cobble zones, gravel to fine cuttings, cannot be discounted.
220-235		same	
235-250		same - clots of brn clay-silt scarce	
250-265		same	
265-280		same - almost all recovery is 1-3 mm angular sand, but amount recovered small - mud thickening + drill behavior implies abundant clay, as generally since ~205.	
280-290		same	
290-300		same	
	300		
	TD		

DOW DIXIE NO. 8



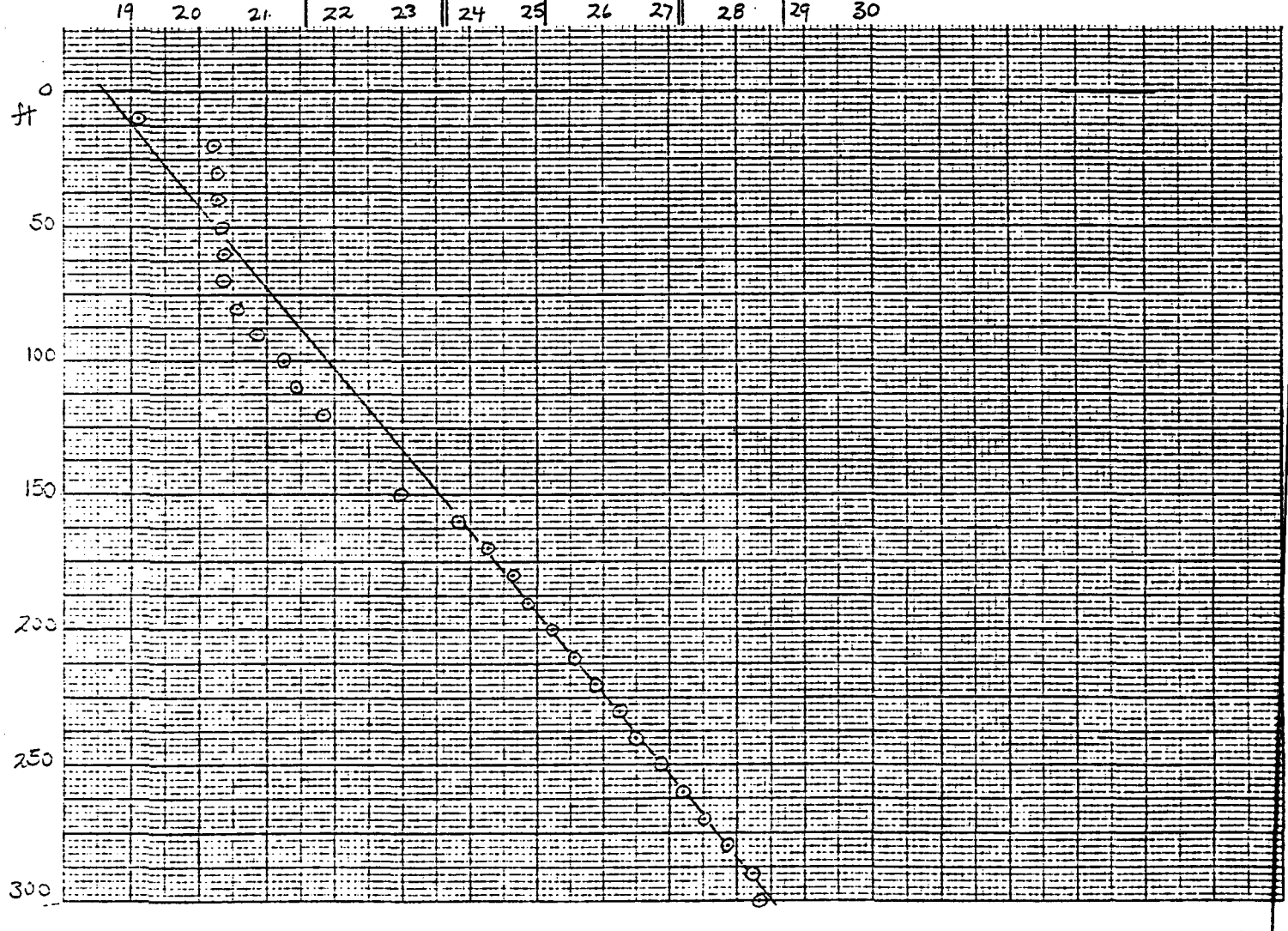
TEMPERATURE LOG

GeothermEx

Project:
Hole No.: DOW-DIXIE V. No. 8
Loc.:

Date: 12/2/76
Time: 1430
by: CWK

Depth	T°C.(down)	Depth	T°C.	Depth	T°C.	Comments:
10	19.12	210	25.59			Slope 3.3°C/100 ft.
20	20.21	220	25.90			
30	20.27	230	26.25			
40	20.27	240	26.50			
50	20.32	250	26.87			
60	20.35	260	27.20			
70	20.37	270	27.52			
80	20.56	280	27.87			
90	20.86	290	28.23			
100	21.26	S 295	28.34			
110	21.43					
120	21.85					
150	22.97					
160	23.82					
170	24.27					
180	24.63					
190	24.89					
200	25.22					



DOW, DIXIE No. 8 TEMPERATURE LOG C. Klein

Loc:

Date : 10/21/76

Time: 1000

Depth	T°C, down
0	13.7°C
10	19.07
20	18.18
30	18.40
40	18.87
50	19.38
60	19.70
70	20.06
80	20.34
90	20.82
100	21.16
110	21.40
120	21.76
130	22.20
140	22.76
150	23.38
160	23.82
170	24.17
180	24.53
190	24.85
200	25.12
210	25.51
220	25.79
230	26.20
240	26.52
250	26.87
260	27.12
270	27.42
280	27.80
290	28.16
295	28.26

Water found at top of pipe.

Finish : 1100 hrs.

TEMPERATURE LOG

C. Klein
10/14/76

DOW, DIXIE V. No. 8

Well Loc. 8

Date: 10/14/76

Time: 1630 hrs Air temp: 24.9°C

Depth	T°C down	T°C up
10 ft.	19.92	
20	18.92	
30	18.96	
40	19.20	
50	19.48	
60	19.69	
70	20.37	
80	20.84	
90	21.09	
100	21.35	
110	21.58	
120	21.82	
130	22.22	
140	22.79	
150	23.26	
160	23.83	
170	24.13	
180	24.45	
190	24.79	
200	25.11	25.16
210	25.42	
220	25.75	
230	26.07	
240	26.43	
250	26.79	
260	27.12	
270	27.45	
280	27.74	
290	28.08	
c.295	28.18	Bottom

Water in pipe is at c7 ft – on 10/12 was at 0 ft, ∴ pipe is leaking water.

Gradient from plot of data:

160-290': 3.3°C/100'

30'/°C

Finish: 1750 hrs.

Hole re-filled w/ water to top.

Hole No. 8
Operation Summary

by: C. Klein

Loc: road intersec., SW¼ Sec. 23, T23N R35E

Drilling log:

10/11/76 early afternoon – move onto site.
1645 drill to 100ft w/out difficulty, shut down for day.
Driller using trench adj to rig for mud sump.

10/12/76 0730 Arrive at site, set-up portable sump. Norm Parsons, drilling Foreman, at site. Pump clogs.
1115 Begin drilling at 100ft.
1145-1215 Visit by R. Bennet, BLM
1215 c. 145 ft. – circ. loss.
1230 – mud temp 19.5°C
1245 – c. 155-160 – gaining water
1320 – c. 190 – gaining water; mud temp 20.5°C. } total water gain only slight – does not req dumping mud, or thickening.
1350 – 205' – penetration slows.
c210-220 – rapid penetration } bouldery zones?
220 – slow " , much vibration
c. 245 – sl. loss of fluid
1530 at 250' shutdown to dump mud, mix new batch.
1615 resume drilling
1640 at 265' mud temp 22.5°C.
c. 270 – rate of penetration fastest since above 205', gaining sm. amt water?
1715 – Reach TD, 300ft.
1815 – PVC pipe down. Shutdown.

Geologic setting: Near base of fan at transition to basin deposits, ½ mile from mountain scarp. Hole is at south end of c. 40ft.-wide graben in fan, occupied by road; trends north-south. The graben escarpments are c. 10 ft. high maximum.

Geologic summary: Interlayered gravelly to sandy alluvial fan and clayey basin deposits. 0-40' w angular to subrounded coarse sand and pebbles

to 2 cm diameter, brown silt and clay, all chaotically intermixed. Clasts are mostly volcanic flow and pyroclastic rocks, red, brown, gray, purple, tan, plus occasional gabbro and tan limestone. From 40'–70' these materials are jointed by lenses or interbeds of medium gray clay, clay-silt, and sandy clay-silt. 70–100' is dominantly or all fan deposit as above. Pale tan clay is interlayered with the fan debris in 100'–120', but apparently absent in 120–130'. From 130–180' occur the fan deposits plus zones of dark gray and greenish gray clay and clay-silt; the coarsest clasts recovered from the fan deposits are 1 cm across. Clay appears to be $\frac{1}{4}$ to $\frac{1}{2}$ or more of this sequence. In 180–190 the dark clay is replaced by light gray clay. From 190–300' clay zones are absent; recovery is all coarse sand and fine pebbles (to $\frac{1}{2}$ cm) in a matrix of brown, sandy silt and clay. The abundance of pebbles decreases downwards.

LITHOLOGIC LOG

[illegible] C. Klein
Date 10/12/76

DOW
DIXIE V No. 8

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
0			
0-10'		0-40': angular-subrounded crs sand to gravel, w/ pebbles to 2cm dia., plus to ~15% clots sandy brown clay-silt. Most clasts volcanic, flow, lesser (?) tuff, brown, gray, red, purple, greenish, plus occas gabbro, tan limestone.	Percent sandy brown clay-silt in ground prob. > amt. recovered.
10-20'			
20-30'			
30-40'			
40-50'		sand-gravel as above; clots sandy brown clay-silt; clots <u>med. gray</u> clay, clay-silt, clay-silt w/sand. Brown clay-silt c.5%, gray 10-15% of recovered sample.	Gray clay may rep. lenses w/in deposits of gravel sand w/ brown clay-silt matrix.
50-60'		same, lesser recovery of silts + clays	
60-70'		Gray clay-silt, sandy clay-silt v abundant, sand-pebbles also rec., tend to be more subrounded than angular.	
70-80'		As above 40-50', w/ occas. clots gray silt-sand (slough?)	
80-90'		same, note occas clots partly gray, partly brown silt-clay.	

GeothermEX, Inc.

Geologist C. Klein

Date 10/12/76

LITHOLOGIC LOG

DOW

DIXIE V. No. 8

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
90–100'		same, no gray clay-silt	
100–110'		crs. sand-fine pebbles, lith. as above, angular–subrounded; c. 40% clots brown sandy silt-clay (as above) +/or pale tan clay	Tan = lenses w/in gravel ?
110–120'		same	
120–130'		no tan clay, otherwise same	
130–140'		c. ½ sand-gravel (max. 1 cm dia) as above, c. ¼ clots brown sandy silt-clay + ¼ clots dk gray + greenish gray silt-clay + clay.	c. 145 – partial circ. loss. Fine sparkles vs. in some dk gry-grn gry under dx. su
140–160'		same	Lack of sand in dk gray + grn-gry clay + clay silt ⇒ lenses (?) interlayered w/ gravel
160–170'		same	155–160 – gaining water ?
170–180		same, but recovery of clays + silts sl. lower (30–40%)	
180–190		most dk gry + grn-gry replaced by lt. gray clay	c. 190 – water ?

GeothermEx, Inc.
Geologist C. Klein
Date 10/12/76

DOW
DIXIE No. 8

LITHOLOGIC LOG

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
190-200'		recovery mostly crs sand, fine pebbles (≤½cm), small amt brn sandy clay-silt. Occas clot dk gray clay (slough?)	
200-210'		same	
210-220'		same	
220-230'		same; brn, gry clays recov. in trace amts only (2-3%)	
230-240'		brn sandy silt-clay 35-40% of recovered sample	
240-250'		same	
250'-260'		brn sandy silt-clay clots 15-20% of sample, most crs. matl recovered is crs. angular sand (≤.5mm)	From 240-250 to 260-270 returns become gen. finer, fewer sm. pebbles; crs-med. sand dominant.
260-270'		same, pebbles uncommon.	
270-280'		same	

GeothermEX, Inc.

Geologist C. Klein

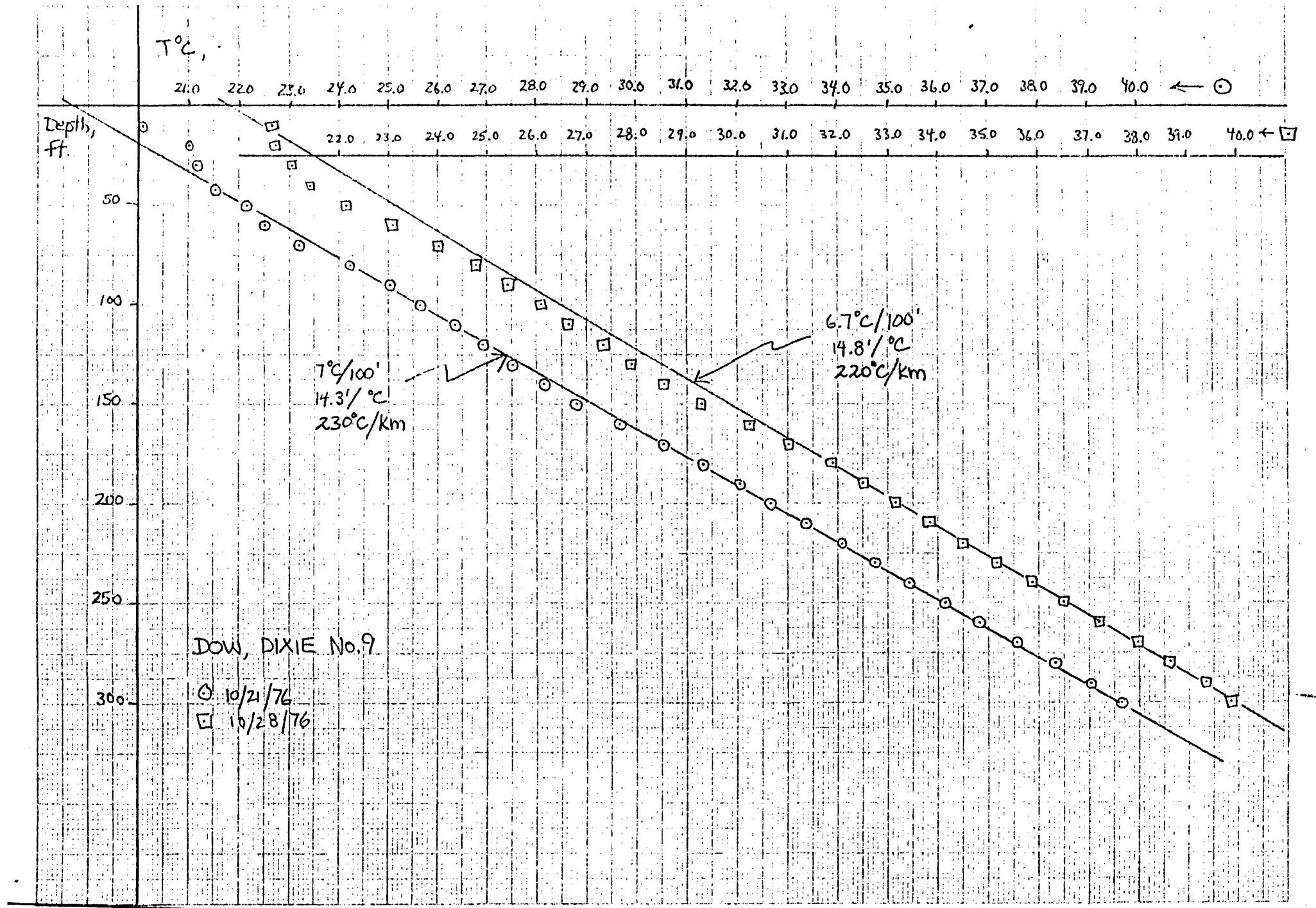
Date 10/12/76

DOW
DIXIE No. 8

LITHOLOGIC LOG

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
280-290		Same	
290-300		30-35% is brn sandy silt-clay, otherwise Same	
	300' TD		

DOW DIXIE NO. 9


T°C,
21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0 31.0 32.0 33.0 34.0 35.0 36.0 37.0 38.0 39.0 40.0
Depth, ft.
50
100
150
200
250
300
7°C/100'
14.3'/°C
230°C/km
6.7°C/100'
14.8'/°C
220°C/km
DOW, DIXIE No.9
10/21/76
10/28/76

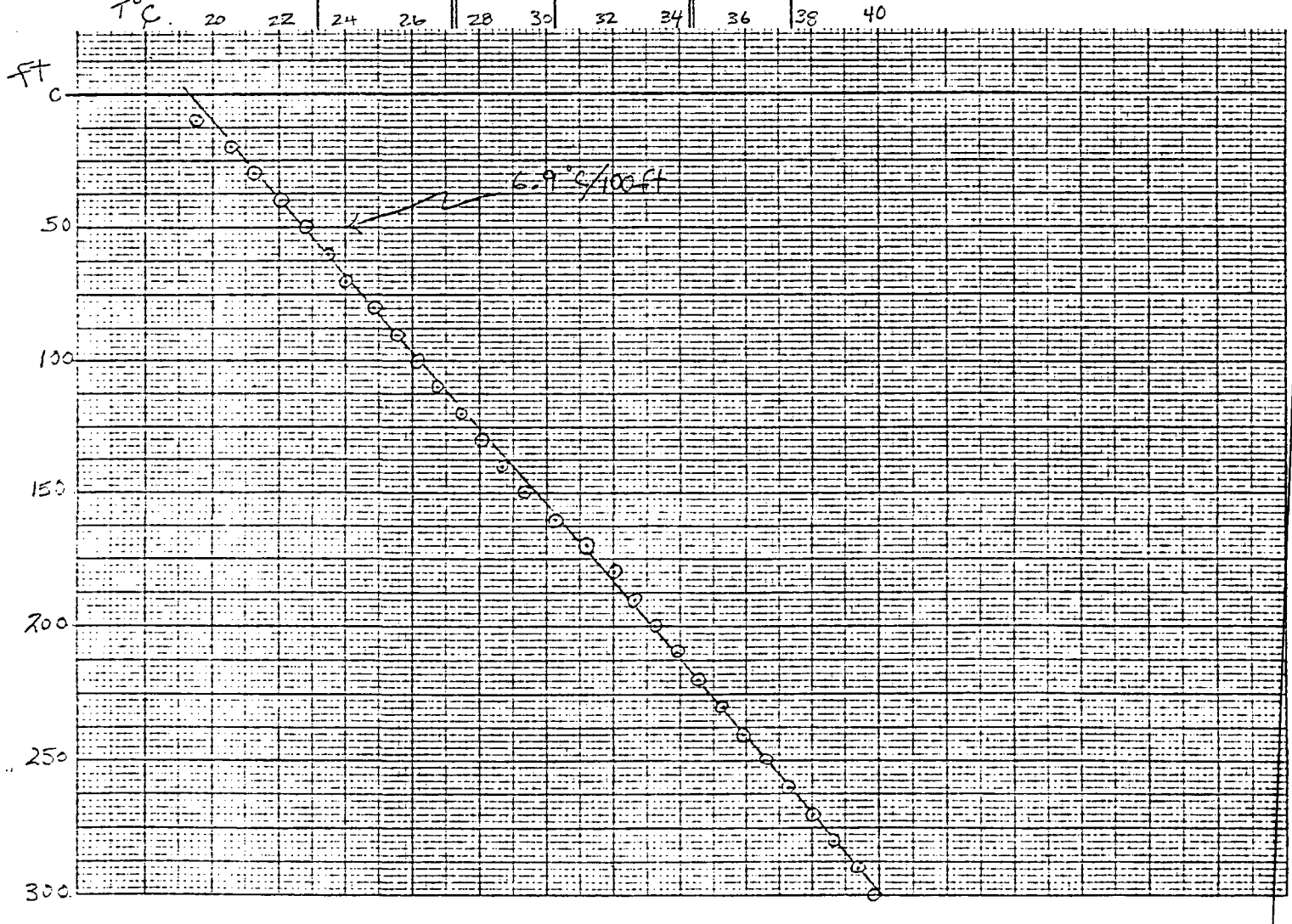
TEMPERATURE LOG

GeothermEx

Project:
Hole No.: DOW-DIXIE No.9
Loc.:

Date: 12/2/76
Time: 1000 hrs
by: CLUK

Depth	T°C.(down)	Depth	T°C.	Depth	T°C.	Comments:
10	19.53	230	35.32			Slope = 6.9°C/100'
20	20.58	240	35.98			
30	21.27	250	36.62			
40	22.12	260	37.30			
50	22.88	270	38.07			
60	23.49	280	38.72			
70	24.03	290	39.40			
80	24.88	300	39.89			
90	25.52					
100	26.16					
110	26.77					
120	27.45					
130	28.06					
140	28.67					
150	29.35					
160	30.26					
170	31.20					
180	32.02					
190	32.63					
200	33.25					
210	33.97					
220	34.58					



10 Millimeters to the Centimeter

DOW, DIXIE No. 9 TEMPERATURE LOG

M. Gardner, transcribed by C. Klein

LOC:

Date: 10/28/76

Time: 1740 hrs.

Depth	T°C, down
10	20.65
20	20.72
30	21.04
40	21.43
50	22.14
60	23.1
70	24.02
80	24.79
90	25.44
100	26.1
110	26.66
120	27.35
130	27.92
140	28.55
150	29.3
160	30.24
170	31.02
180	31.91
190	32.5
200	33.16
210	33.84
220	34.5
230	35.18
240	35.89
250	36.50
260	37.2
270	37.98
280	38.62
290	39.35
300	39.85 TD

Gradient: 26.5 − 19.8 /100' = 6.7°C/100°C

TEMPERATURE LOG

C. Klein

Dow, DIXIE No. 9

Loc:

Date: 10/21/76

Time: 1730

Depth	T°C, down
0	14.95
10	20.50
20	21.01
30	21.17
40	21.54
50	22.18
60	22.51
70	23.22
80	24.22
90	25.03
100	25.66
110	26.36
120	26.94
130	27.51
140	28.15
150	28.81
160	29.69
170	30.53
180	31.32
190	32.05
200	32.68
210	33.37
220	34.08
230	34.77
240	35.44
250	36.15
260	36.85
270	37.58
280	38.31
290	39.02
300	39.66

Finish 1830

Gradient: $\frac{39.66 - 25.66}{300' - 100'} = 7°C/100' \equiv 14.3'/°C$

Hole No. 9

Operation Summary

by. C. Klein

Loc: Intersection near center, Sec. 14, T23N, R35E

Drilling log:

10/18/76	1630	move onto site from Hole No. 2, begin set-up.
	1730	Shutdown
10/19/76	0800	Arrive, water trip, complete set-up.
	0915	Spud-in:
	1000	c. 40-45 ft. fluid loss to formation
		50 ft-enter clay.
	1130	At 155-ft., smooth drilling.
	1310	Reach TD 300 ft.
	1400	1¼" PVC pipe in place

Geologic Setting: Near base of fan about ¼ mile from mountain front. Narrow width of fan relates to lack of major gulley in mountains at this location. Dixie Comstock mine is immediately NW of site, ¼ mile away, at base of range. Ten to fifteen-foot high east-facing fault scarp cuts alluvium c. 500 ft (not paced) to west.

Geologic Summary: Alternating distal alluvial fan and basin clay deposits.

0-45 ft: fan deposit angular sand and pebbles, silt and clay, pebbles to 2.5 cm diameter, mafic volcanics, gabbro; 40-60 ft.: medium grayish green clay, with medium to coarse sand in c. 50-60 ft.; 60-70 ft.: light brown clay-silt with minor sand; 70-150 ft.: fan deposit of coarse to fine angular sand, light brown clay-silt, possible thin interbeds of medium gray clay; 150-180 ft: medium gray clay, lesser fan debris as in 70-150 ft.; 180-300 ft.: fan deposits as in 70-150 ft.

DOW
DIXIE No. 9

LITHOLOGIC LOG

[illegible]Ex, Inc.
Site Scientist C. Klein
Date 10/19/76

INTERVAL	SCHEMATIC OF SUBSURFACE	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
0-10'		Fan deposit; angular sand and pebbles, med. brown silt and clay; red, green, gray, brown volcanics, fspars, gabbro. Pebbles to 2.5 cm dia. Volcanics are mafic, gabbro often altered.	Detritus from Jurassic volcanic complex and underlying gabbro
10-20'		same	
20-30'		same	
30-40'		Coarse sand, fine pebbles (max. 7 mm dia.), medium to pale lt. brown sandy clay-silt in clots	
	40		
40-50'		Medium grayish green clay.	
50-60'		Med. grayish green clay, light greenish gray clay, med. to coarse subangular-subrounded sand, mostly of an aphanitic dark greenish gray rock which occas. shows traces of mineralization	Gold? in dark greenstone formed from gabbro or basalt. Also traces of a red phase (cinnabar?, hematite?)
60-70'		Lt brown clay-silt; sandy, w/ grains as immed. above but less abundant. Occas. clots gray clay (slough?)	
70-80'		Coarse to fine, angular sand gabbro, mafic volcanics, lt. brown clay-silt.	Drilling mud thickens, returns of sand relatively small. Pebbles, cobbles could be present, ground to finer cuttings.
80-90'		same	

DOW
DIXIE No. 9

LITHOLOGIC LOG

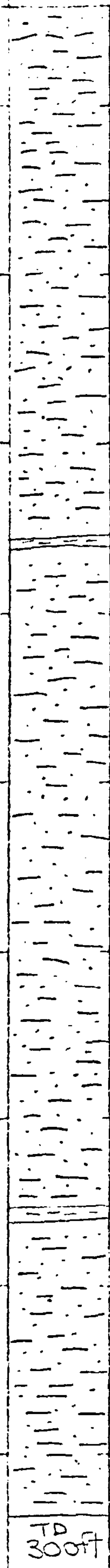
[illegible], Inc.
Site Geologist C. Klein
Date 10/19/76

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
90-110'		same; occas. clots med. gray clay	Med. gray clay prob. represents interbeds or lenses w/in sandy silt-clay distal fan deposits in alternating fan-basin environment.
110-120'		same, gray clay rare	
120-130'		same	
140-150'		Same	
150-170'		Med. gray clay; lesser crs. to fine sand, brown sandy silt-clay.	
		Clay-rich zone 150-180'.	
170-180'		same, gray clay sometimes greenish	
180-190'		similar, less gray clay.	
190-200'		same	
200-210'		Crs. sand, brown sandy silt-clay; rare clots gray clay.	Sand grains to 7 mm.

GeothermEx, Inc.
Site Scientist C.Klei
Date 10/19/76

DOW
DIXIE No.9

LITHOLOGIC LOG



INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATI
210-220'		same, coarsest sand c.4 mm.	
220-230'		same, coarsest sand c.3 mm	
230-240'		same	
240-250'		same	
250-260'		same	
260-270'		same	
270-280'		same	
280-290'		same	
290-300'		same	

DON DIXIE NO. 10

C Klein

Hole No. 10
Operation Summary

Loc. End of fence row, SE ¼, Sec. 12, T23N, R3SE

Drilling log:

10/19/76

1440 Arrive, set-up

1540 Spud-in, using drag bit. Penetration rate c. 20 ft/10 sec. through clays.

– 70 ft. encounter weak artesian water flow, c. 5-10 gpm

1610 At 82 ft. order halt to drilling. Artesian flow rate appears to be decreasing.

1630 Shutdown. Flow continues at c. ½ gpm

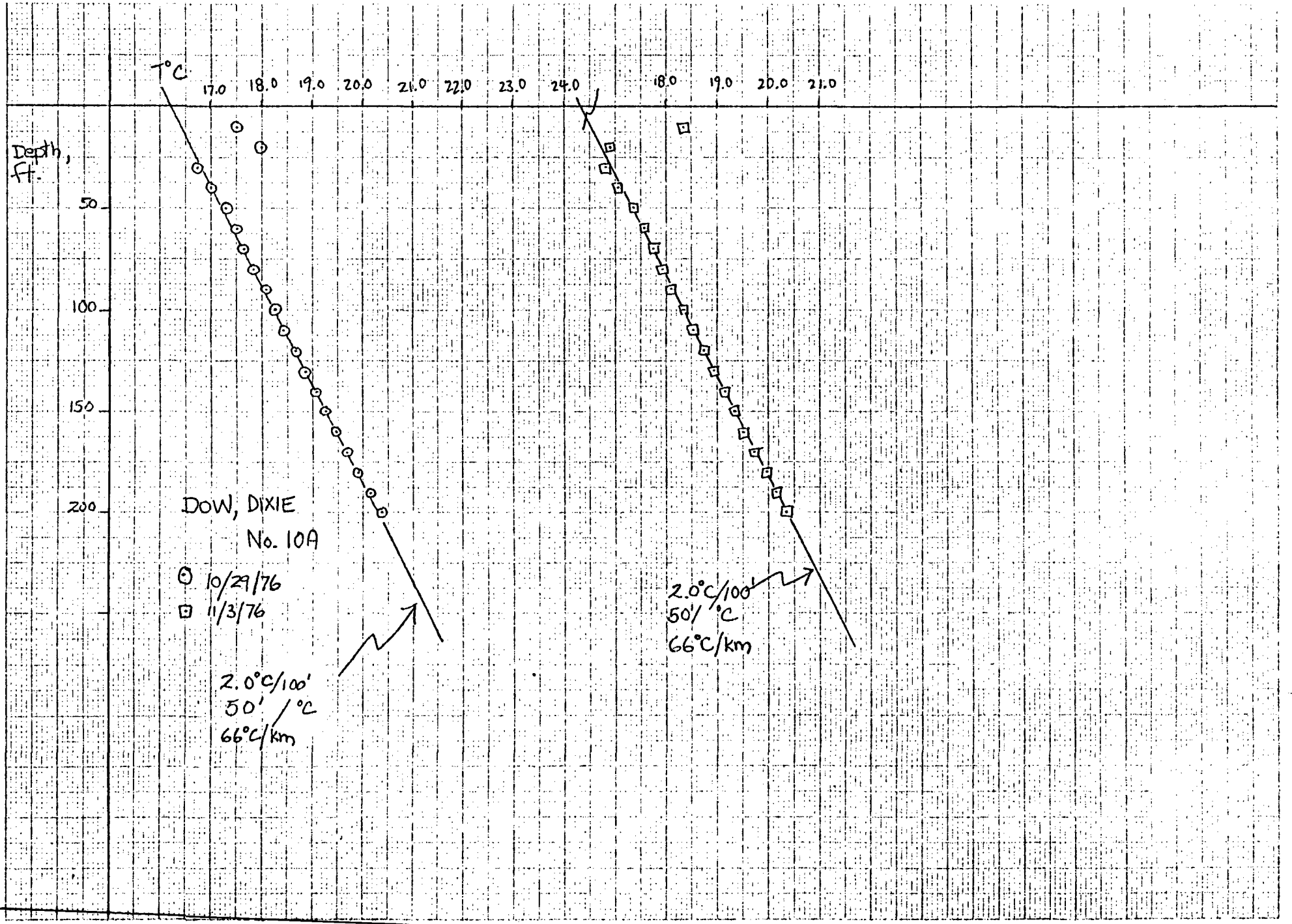
10/20/76

0800 Flow has ceased. Rig moved to site No. 11. This site to be abandoned.

10/27/76

0900 Mud level in hole is c. 4 ft. below surface.
Hole plugged with cement c. 10 ft to surface (2 sacks cement).

DOW DIXIE NO. 10-A


T°C
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
18.0
19.0
20.0
21.0
Depth, ft.
50
100
150
200
DOW, DIXIE
No. 10A
10/29/76
11/3/76
2.0°C/100'
50'/°C
66°C/km
2.0°C/100'
50'/°C
66°C/km

DOW, DIXIE No. 10A TEMPERATURE LOG C. Klein

Loc. Lamberti (Bar A-3) ranch

Date: 11/3/76

Time: 1615 hrs

Depth	T°C, down
10	18.36
20	16.90
30	16.82
40	17.06
50	17.37
60	17.57
70	17.75
80	17.93
90	18.10
100	18.35
110	18.54
120	18.75
130	18.95
140	19.15
150	19.33
160	19.51
170	19.72
180	19.97
190	20.14
200	20.35

DOW, DIXIE No. 10A

TEMPERATURE LOG

M. Gardner, transcribed by C. Klein

LOC: Lamberti (Bar A-3) Ranch

Date: 10/29/76

Time:

Depth	T°C, down	
10	17.52	
20	18.0	
30	16.75	
40	17.0	
50	17.3	
60	17.52	
70	17.64	
80	17.84	
90	18.09	
100	18.25	
110	18.44	
120	18.65	
130	18.85	
140	19.06	(last digit ?)
150	19.26	
160	19.47	
170	19.69	
180	19.91	
190	20.14	
200	20.39	TD

Hole No. 10A
Operation Summary

C. Klein

Loc. Lamberti (Bar A-3) Ranch, SE¼ SW¼ Sec. 1, T23N, R35E. See map below

Driller: L. Millard

Drilling Log:

10/26/76

1900 move onto site, set-up

c. 2030 Spud-in

2200 At. 40 ft.

2230 At. 85 ft

10/27/76

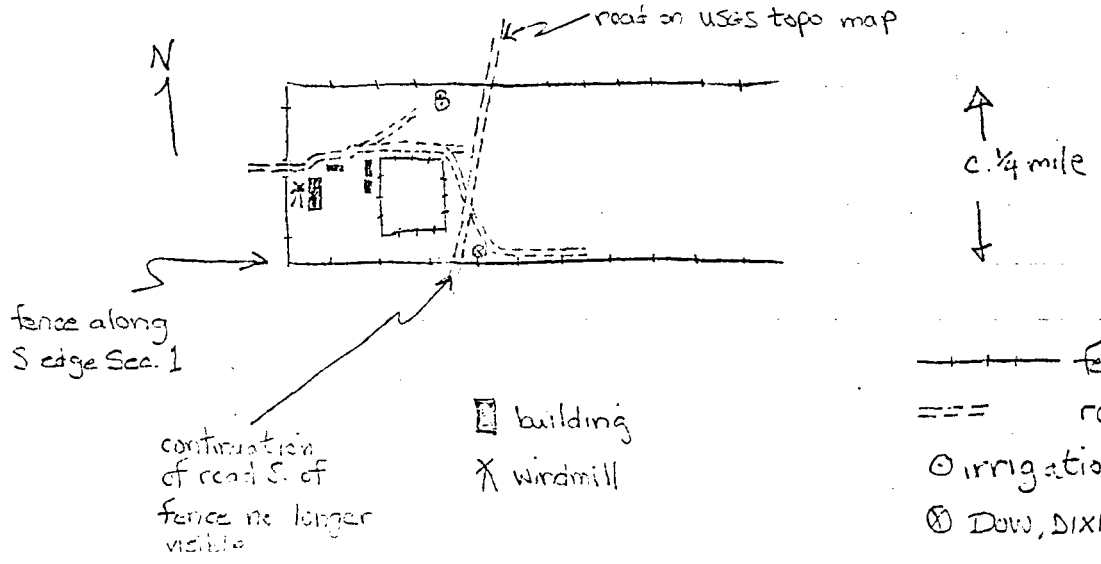
c. 0500 Hole complete to 200 ft. PVC pipe in place. End of shift

0745 Driller R. Cardell on shift. PVC pipe cemented, remove to site 10 to cement abandoned hole, then to site 14.

Geologic Setting: Distal portion of alluvial fan, about 1¼ mile from mountain front, ¾ mile from salt flat of basin, 40-50 ft in altitude above the flat.

Geologic Summary: Section penetrated is mostly alluvial gravel, with interbeds of clay which form most of the zone from 20-40 ft, much of 40-70 ft, and lesser amounts of 0-20 and 70-200 ft.

Map showing location:



DOW

DIXIE No. 10A

LITHOLOGIC LOG

GeoTrimEx, Inc.

Site Scientist C. Klein

Date 10/27/76

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
0-10'		Alluvial gravel (fan deposit): subangular to rounded sand, pebbles to 2 cm, brown silt and clay matrix. Gabbro, silicic and mafic volcanics.	
10-20'		same	
20-30'		sandy brown silt-clay, minor gravel as above	
30-40'		same	
40-55'		Gray clay, subangular-rounded sand, small pebbles (to 1cm), minor brown sandy silt-clay	Brown sandy silt-clay is probably matrix of gravelly-sandy interbeds
55-70'		Gray clay, subangular-rounded medium grained sand, brown sandy silt-clay.	
70-85'		Alluvial gravel plus clots of sandy brown silt-clay, as in 0-20'. Pebbles to 2 cm	
85-100'		same	
100-115'		same	

GeothermEx, Inc.
Site Scientist C. Klein
Date 10/27/76

DOW
DIXIE No. 10A

LITHOLOGIC LOG

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
115-130'		Same	
130-145'		Same	
145-160'		Same	
160-175'		Same	
175-190'		Same	
190-200'		Same	
	TD-200		

DOW DIXIE NO. 11

DOW, DIXIE No. 11 TEMPERATURE LOG C. Klein

Loc. Intersection, NE ¼, Sec. 11, T23N, R35E.

Date: 10/23/76

Time: 0910

Depth	T°C, down
10	17.13
20	16.64
30	16.85
40	17.22
50	17.50
60	17.79
70	17.92
80	18.08
90	18.34
100	18.58
110	18.82
120	19.02
130	19.23
140	19.47
150	19.70
160	—
170	20.16
180	20.40
190	20.62
200	20.83
210	21.09
220	21.35
230	21.60
240	21.81
250	22.06
260	22.33
270	22.64
280	22.88
290	23.11
300	23.32

Gradient: $\frac{23.2-16.3}{300'} = \frac{2.3°C}{100'} \equiv 43'/°C$

Finish: 1025

Hole No. 11 — by: C. Klein

Operation Summary

Loc: Intersection, NE¼ Sec. 11, T23N, R35E

Drilling Log:

10/20/76

0900 Arrive, set-up

c. 1030 Spud-in

1200 At 90 ft, smooth drilling,

1250 At 130 ft, " "

1410 At 205 ft, " "

1450 At 225 ft, pause for pump cleanout. smic c. 220-225

1500 Resume drilling. Penetration rate v. slow, drilling like hard rock. Mud very thick & cuttings not settling. Driller believes is in series of boulders, probably large

1630 At 235 ft, penetration rate increases somewhat, still bouldery.

1645 At 240 ft., pause to dump, re-mix mud.

1710 Resumes drilling

1730 Shutdown at 250 ft.

10/21/76

c. 0800 Start-up at 250 ft., in cobble. zone? Moderate penetration rate

0930 Reach TD 300 ft

c. 1100 PVC pipe in place, move to site #13.

Geologic Setting: About two-thirds of way down fan deposits from mountain range front to basin. One mile NNE from Dixie Comstock mine.

Geologic summary: Entire section is fan deposit of angular clasts gabbro and mafic volcanics, plus brown silt and clay. In 0-80 ft. pebbles to 3 cm were recovered. From 80 to 220 ft. the coarsest returns were about 1 cm across, and most material larger than silt was sand-sized; pebbles and cobbles may be present, but ground to finer cuttings. Very slow and rough penetration from c. 215-235 probably represented a bouldery zone. Below about 235 penetration was quicker, but still

GeothermEx, Inc.
Site Scientist C. Kle
Date 10/20/76

DOW
DIXIE No. 11

LITHOLOGIC LOG

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATI
0-80'		Fan deposit: angular-subangular. sand, pebbles to 3cm, brown silt and clay. Gabbro, mafic volcanics	Most of samples taken proba represents 0 to c. 40 ft.
80-90'		similar, but largest 'clasts' are coarse sand (3mm); relative amounts of silt and clay much greater than in 0-80; sand is probably < ½ of section.	
90-100'		largest returns are fine pebbles (≤1 cm)	Lg. pebbles, cobbles + boulders may be present in (parts of?) 80-220, but ground to sand sized cuttings. Moderate penetrat rate suggests boulders probably not typical of section.
100-110'		same	
110-120'		same	
120-130'		same	
130-140'		same	
140-150'		same	
150-160'		same	

GeothermEx, Inc.
Site: Somerset C. Klein
Date 10/20/76

DOW
DIXIE No. 11

LITHOLOGIC LOG

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
160-170'		same; clay-silt increasing relative to coarser clasts (general trend with depth, not this sample alone)	Driller's mud thickens
170-180'		same	
180-190'		same	
190-200'		same	
200-210'		Same	
210-220'		Same	
		gradational, at c. 215-220.	
220-230		Bouldery zone? V. hard.	V. slow, irregular penetration, much vibration
230-240'		Boulder-cobble zone? Softer.	All returns are of sand and smaller sizes, but drill behaves as if in cobbles & ? boulders. Clasts larger than sand are apparently being ground to cuttings, rather than washed out whole, as in upper 80' of hole.
240-250'		same	

GeothermEx, Inc.
Site Scientist C. Klein
Date 10/20/76

DOW
DIXIE No. 11

LITHOLOGIC LOG

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
160-170'		same; clay-silt increasing relative to coarser clasts (general trend with depth, not this sample alone)	Driller's mud thickens
170-180'		same	
180-190'		same	
190-200'		same	
200-210'		same	
210-220'		same	
		gradational, at c. 215-220.	
220-230		Bouldery zone? V. hard.	V. slow, irregular penetration, much vibration
230-240'		Boulder-cobble zone? Softer.	All returns are of sand and smaller sizes, but drill behaves as if in cobbles + (?) boulders. Clasts larger than sand are apparently being ground to cuttings rather than washed out whole, as in upper 80' of hole.
240-250'		same	

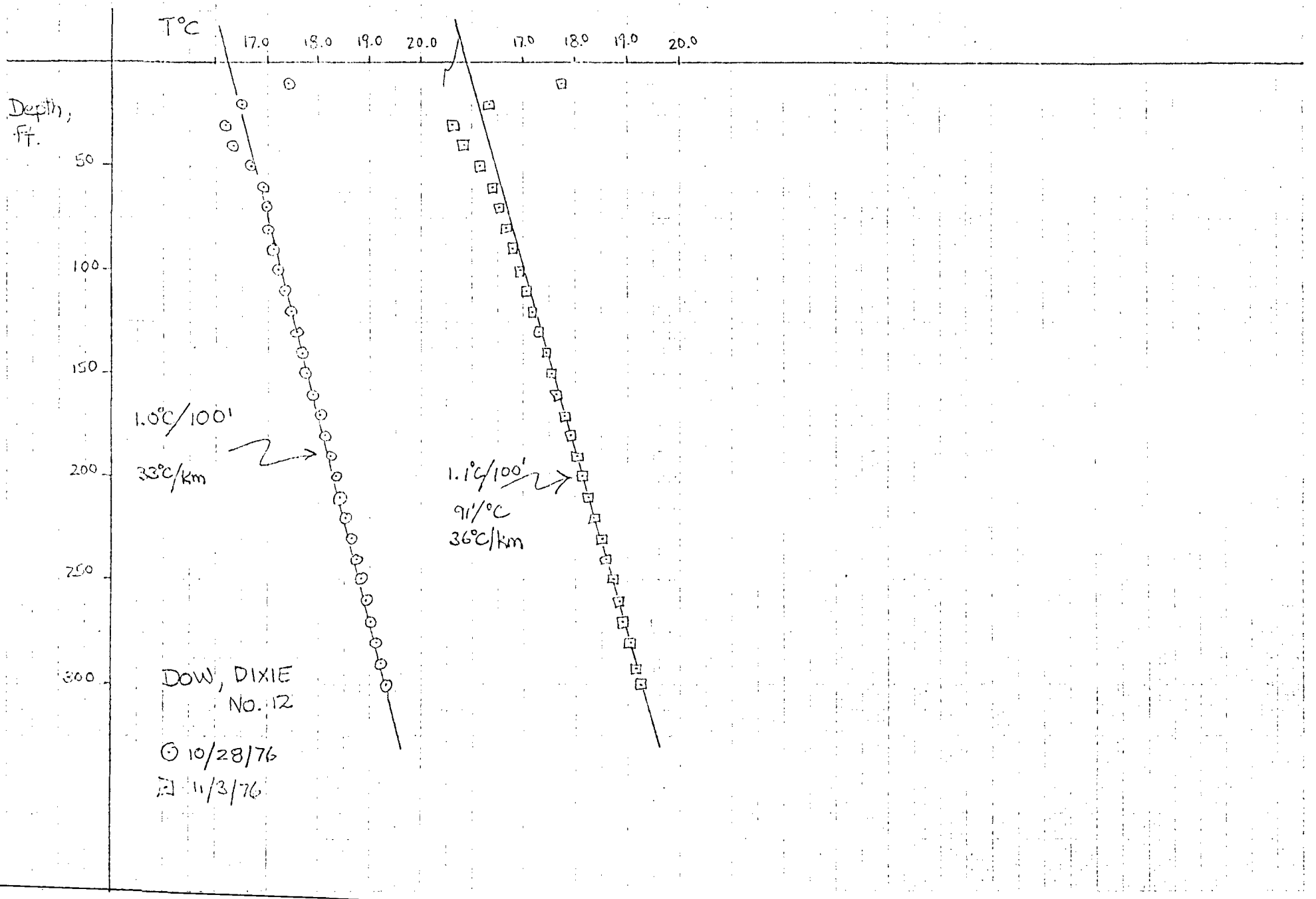
GeothermEx, Inc.
Site Geologist C. Klein
Date 10/21/76

DOW
DIXIE No. 11

LITHOLOGIC LOG

INTERVAL	SCHEMATIC OF STRATIGRAPHIC UNITS	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATIC
250-260'		Cobbly (?) fan deposit, cont.	
260-270		same	
270-280'			
280-290'			
290-300'			
	TD-300'		

DOW DIXIE NO. 12


T°C
17.0
18.0
19.0
20.0
17.0
18.0
19.0
20.0
Depth, ft.
50
100
150
200
250
300
1.0°C/100'
33°C/km
1.1°C/100'
91'/°C
36°C/km
DOW, DIXIE
No. 12
⊙ 10/28/76
□ 11/3/76

C. Klein

DOW, DIXIE NE. 12

TEMPERATURE LOG

Loc: Bend in trail, SW¼, Sec. 2, T23N, R35E

Date: 11/3/76

Time: 1450 hrs.

Depth	T°C, down
10	17.75
20	16.34
30	15.65
40	15.87
50	16.17
60	16.40
70	16.54
80	16.67
90	16.80
100	16.93
110	17.07
120	17.19
130	17.32
140	17.43
150	17.55
160	17.63
170	17.80
180	17.91
190	18.03
200	18.15
210	18.27
220	18.37
230	18.52
240	18.60
250	18.72
260	18.84
270	18.92
280	19.06
290	19.18
300	19.25

DOW, DIXIE No. 12 TEMPERATURE LOG

M. Gardner, transcribed by C. Klein

LOC: Bend in trail, SW¼, Sec. 2, T23N, R35E

Date: 10/28/76

Time:

Depth	T°C, down	
10	17.4	
20	16.50	
30	16.2	
40	16.34	
50	16.66	
60	16.91	
70	16.96	
80	17.02	
90	17.12	
100	17.2	
110	17.32	
120	17.47	
130	17.56	
140	17.69	
150	17.76	
160	17.88	
170	18.03	
180	18.11	
190	18.22	
200	18.34	
210	18.42	
220	18.52	
230	18.64	
240	18.74	
250	18.82	
260	18.92	
270	19.02	
280	19.11	
290	19.22	
300	19.32	TD

10/25/76 (cont.)

1115 At 20 ft. Kelley cable, caught by long bolt in bushing, breaks. Trip out. Rods bind. Hole crooked. Boulder at 3ft drags on collar. Hole will have to be relocated.

1215 Shutdown. R. Cardell to phone for cable. L. Millard remains to work on rig repair.

1643. New cable arrives. Installation begins c. 2100 hrs, complete.

10/26/76 (both crews)

0730 Drillers arrive, portable sump removed from hole, boulders removed from upper few feet of hole. Sump replaced.

0935 Drilling at 70 ft. R. Cardell

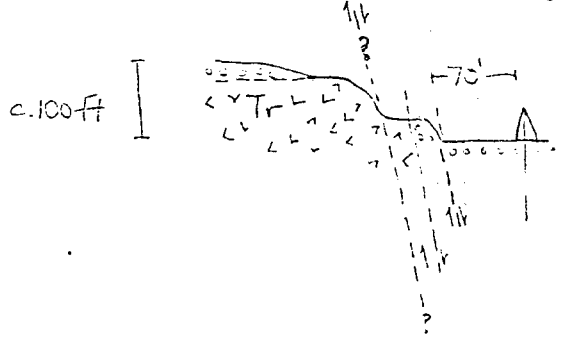
1230 At 190 ft. Pause to thin mud.

1240 Drilling

1715 Reach TD, 300 ft. Drill cellar.

1830 300 ft. PVC pipe in place. Remove to site 10A.

Geologic Setting: Seventy feet from base of fault scarp in fan deposits which overlie Tertiary reddish brown rhyolite. (See sketch x-section (schematic & simplified)



Geologic Summary: Angular gravelly fan debris - with a matrix of brown silt and clay to c. 145 ft and red brown silt and clay c 145-190 ft. From c. 190-300 ft. recovery consisted of angular sand plus occasional clots of gray to pinkish gray sandy silt-clay; penetration of this zone was slow, suggesting slight to moderate consolidation or lithification. Recovery of cuttings coarser than sand

Hole No. 12 — by: C. Klein

Operation Summary

Loc: Bend in trail, SW¼, Sec. 2, T23N, R35E

Driller: R. Cardell, L. Millard

Drilling Log:

10/22/76

1245 Arrive, set-up
1355 Start drilling
1400 Engine breakdown at 5 ft.
1430 Driller L. Millard comes on shift, R. Cardell off.
1645 Engine repaired. Start drilling
1700 At 15 ft., stop for water trip.
1800 Resume drilling
1945 At 20 ft, repeated caving, redrilling. Shutdown

10/23/76

0715 Arrive, motor repairs. Driller L. Millard
1130 Start drilling through slough at 15 ft.
1410 Repeated caving has hindered drilling. Finally succeeds in placing 20 ft. collar below Kelley rod.
1505 Caving at 35-40 ft. Shutdown for water trip.
1545 Resume activities. Unsuccessful.
1615 Begin abandonment of site. Move 50 ft. to north. Set-up.
1810 Spud-in.
1900 Drilling loose boulder at 3 ft. Shutdown.

10/24/76

c. 0715 Arrive. Resume drilling. Driller L. Millard
0930 Bolts holding kelley bushing to pulldown broken & stripped. Shutdown. Driller leaves valley in search of replacements

10/25/76

0900 Driller R. Cardell arrives. Begin drilling. Wedges past boulder at 3 ft.
0915 At 20 ft.
1030 L. Millard arrives

DOW
DIXIE V. No. 12

LITHOLOGIC LOG

GeoChem Ex, Inc.
Site Geologist C. Klein
Date 10/22/76

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATIO
0-20'		Fan deboris: angular sand and pebbles gabbro, mafic volcanics? Pebbles to 2 cm	Clastic deboris from Jurassic complex. Note Tertiary volcanics absent. Drilling indicates occas. cobbles, boulders.
20-30'		same lithologies. Coarsest returns are fine pebbles. (7mm)	
30-40'		Coarsest returns are coarse sand, occas. fragments silicic volcanics. clots brown sandy silt-clay.	Probable sandy-pebbly fanglomerate. Size of coarsest clasts not known, may be only sand, but sorting would seem unlikely.
40-50'		same	
50-60'		Some.	
60-70'		Same	
70-85'		same	
85-100'		same	
100-115'		same	

GeoChemEx, Inc.
Site Scientist C. Klein
Date 10/26/76

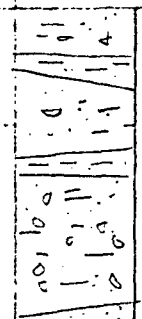
LITHOLOGIC LOG

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATIO
115-130		same	
130-145'		same	c 145 mud changes brown to red.
145-160'		sharp? ← Sand, fine-coarse, most medium, lithologies as above, plus clots full brownish red sandy silt clay.	Probable poorly consolidated sand-silt-clay deposits. Cannot discount presence of larger clasts, and since sorting of clasts to purley sand + finer may be unlikely in this environment, presence of pebbles seems reasonable speculation.
160-175		same	
175-190'		same	190'- mud changed. Does not thicken notably during subsequent drilling.
190-205'		← gradational? same, but recovered clots red sandy silt-clay fewer. Most of sample is sand. Note also occasional clots pinkish gray sandy silt-clay.	c 190: suspect gradation to fairly consolidated sandstone or fine conglomerate, with minor gray silt-clay interbeds.
205-220'		sand, occasional clots pinkish gray sandy silt-clay.	215: rate penetration rate has slowed considerably (exactly when, on gradational, not certain)
220-235'		same	220-235/30 min
235-250'		same. Clots silt-clay rare	235-250/35 min

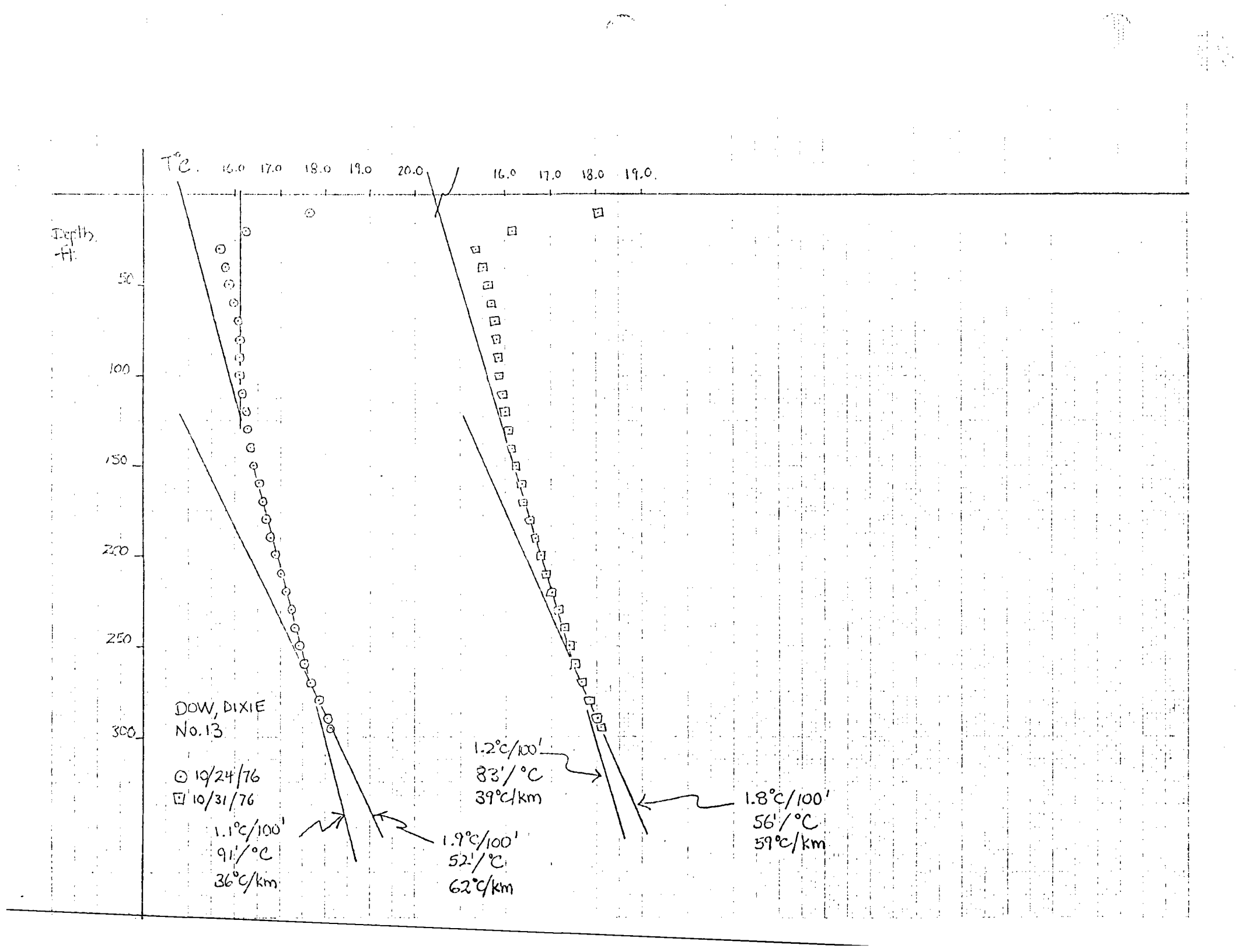
GeoTrinEx, Inc.
Site Scientist C. Klein
Date 10/26/76

DOW
DIXIE No. 12

LITHOLOGIC LOG

INTERVAL	SCHEMATIC OF SEDIMENTOLOGY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATIO
250-265'		Clots gray clay-silt, sandy, common. Occas. angular, small pebbles.	
265-280		No pebbles. Otherwise same.	
280-295		same, occas. pebbles, v. angular.	
295-300			
	TD 300 ft		

DON DIXIE NO. 13


T°C.
16.0
17.0
18.0
19.0
20.0
16.0
17.0
18.0
19.0
Depth -ft.
50
100
150
200
250
300
DOW, DIXIE
No. 13
⊙ 10/24/76
⊡ 10/31/76
1.1°C/100'
91'/°C
36°C/km
1.9°C/100'
52'/°C
62°C/km
1.2°C/100'
83'/°C
39°C/km
1.8°C/100'
56'/°C
59°C/km

DOW, DIXIE No. 13 TEMPERATURE LOG C. Klein

Loc: Near bench mark, NW¼, Sec. 1, T23N, R3E

Date 10/24/76

Time: 1015

Depth	T°C, down	
10	17.62	
20	16.23	
30	15.67	
40	15.80	
50	15.88	
60	15.97	
70	16.07	
80	16.10	
90	16.10	
100	16.10	
110	16.16	
120	16.23	
130	16.28	
140	16.34	
150	16.40	
160	16.51	
170	16.60	
180	16.68	
190	16.79	
200	16.87	
210	17.00	
220	17.11	
230	17.23	
240	17.32	
250	17.40	
260	17.52	
270	17.67	
280	17.85	
290	18.04	
c. 295	18.10	← bottom

Gradient from c. 140 - 260:

1.1°C/100' ≡ 91'/°C

270-290':

1.9°C/100' ≡ 52'/°C

C. Klein

DOW, DIXIE No. 13 — TEMPERATURE LOG

Loc:

Date: 10/31/76

Time: 1430 hrs.

Depth	T°C, down	
10	18.06	
20	16.16	
30	15.37	
40	15.51	
50	15.43	
60	15.71	
70	15.78	
80	15.82	
90	15.86	
100	15.88	
110	15.96	
120	16.00	
130	16.10	
140	16.15	
150	16.23	
160	16.35	
170	16.40	
180	16.53	
190	16.67	
200	16.78	
210	16.89	
220	17.02	
230	17.16	
240	17.30	
250	17.40	
260	17.52	
270	17.66	
280	17.85	
290	18.01	
295	18.10	block in pipe
300	—	TD

Finish 1545 hrs.

Hole No. 13

Operation Summary

by: C. Klein

Loc: Near bench mark, NW¼, Sec. 1, T23N, R35E.

Drilling Log:

10/21/76

1200 Move onto site

1300 Spud-in

1345 At 40 ft, engine dies

1430 Engine restarted

1500 At 85 ft, rapid penetration (15 ft/5 min.)

1604 At 175 ft.

1614 At 190 ft. (15 ft/10 min.)

1730 At 250 ft, shutdown

10/22/76

0820 Start-up

0940 Reach TD 300 ft, plus 5 ft cellar total 305 ft.

c1130 P/C pipe in place. remove to site no. 12

Geologic Setting: Alluvial fan, 1 mile from source area on mountain range front, 120' above basin floor. Closest portion of range front (last source of alluvium) is ⅓ mile to NW.

Geologic Summary: Entire 300 ft. is fan deposit of brown clay and silt, with sand, pebbles and probable cobbles of gabbro and siliceous to mafic volcanics. Amounts of clasts coarser than sand below 20 ft are uncertain, as all returns 20–300 ft are sand-sized and smaller; zones of rough and relatively slow drilling are inferred to be cobbly.

DOW

DIXIE No. 13

LITHOLOGIC LOG

GeoTherm Ex, Inc.

Site Geologist C. Klein

Date 10/21/76

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATIO
0-20'		Fan deposit: angular, occas subangular sand, pebbles to 2.5 cm (largest returns), brown silt and clay. Gabbro, volcanics, siliceous to mafic	
20-30'		similar, but largest returns coarse sand.	Smooth, rapid drilling, all clasts probably cobbles and smaller.
30-40'		same	
40-50'		largest returns medium sand-sized (2 mm), most ≤1 mm	
50-60'		same	
60-70'		same	70-85'/5 min — typical of section drilling rate
70-80'		same	
80-90'		same	
90-100'		same	

DOW
DIXIE No. 13

LITHOLOGIC LOG

Site Geologist C. Kerr
Date 10/21/76

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATIC
100-110'	Same		
110-120'	Same		Drilling somewhat rough, slight slower: infer cobbles, small boulders (?)
120-130'	Same		
130-140	Same		
140-150	Same		
150-160	Same		
160-170'	Same		
170-175'	Same		175-190'/10 min.
190-200'	Same		190-205'/16 min. Slower rate. Infer coarser clasts in fan deposit.

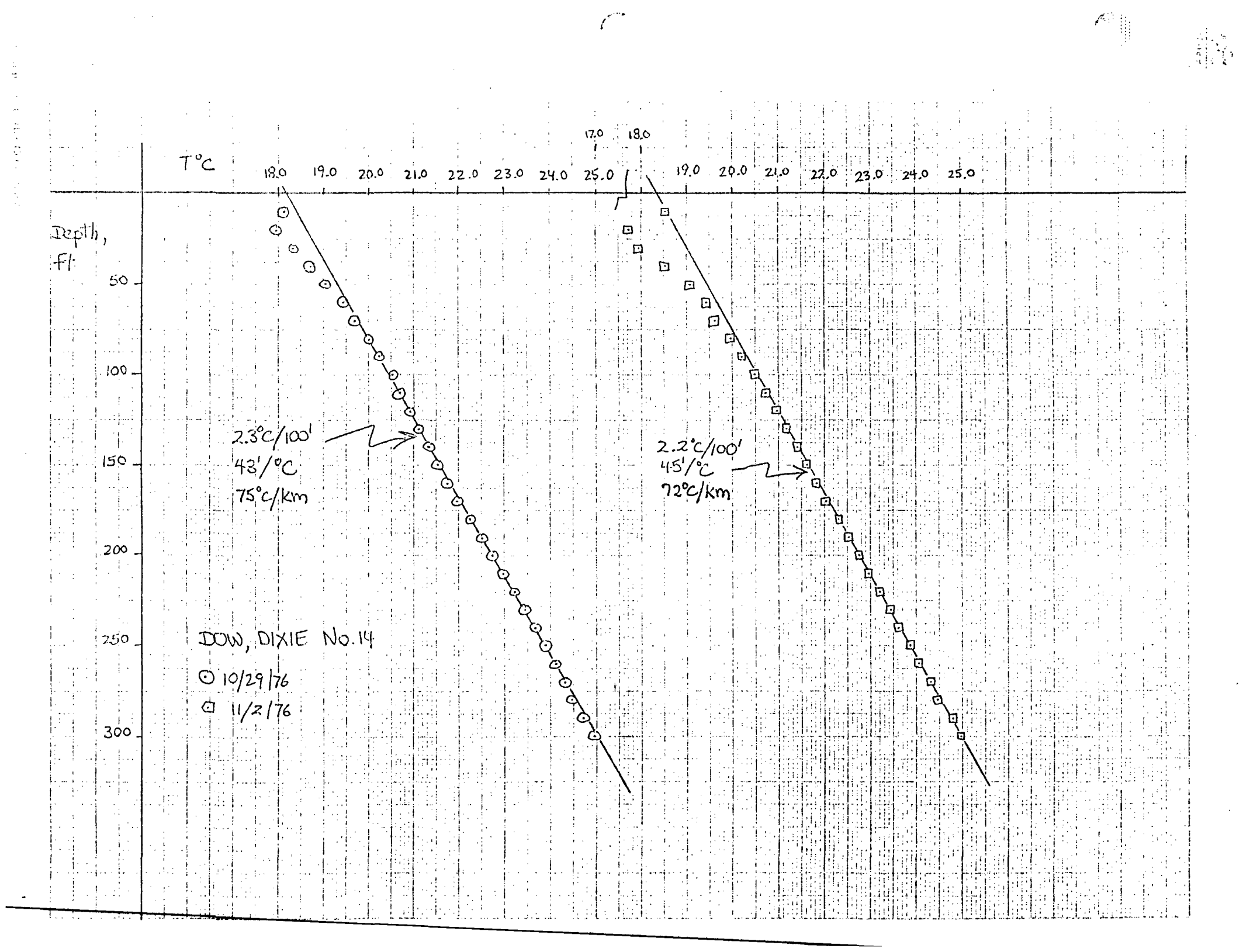
DOW
DIXIE No.13

LITHOLOGIC LOG

GeothermEx, Inc.
Site Geologist C. Klein
Date 10/21/76

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
200-220'	Same		Gravelly-sandy fan deposit
220-235'	Same		
235-250'	Same		
250-265'	Same		
265-280'	Same		
280-295'	Same		
295-300'	Same		
	TD-300'		

DOW DIXIE NO. 14


T°C
17.0
18.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
Depth, ft
50
100
150
200
250
300
2.3°C/100'
43'/°C
75°c/km
2.2°C/100'
45'/°C
72°C/km
DOW, DIXIE No.14
10/29/76
11/2/76

DOUG DIXIE No. 14 TEMPERATURE LOG C Klein

Loc:

Date: 11/2/76

Time: 1400

Depth	T°C, down
10	18.52
20	17.73
30	17.96
40	18.53
50	19.07
60	19.44
70	19.62
80	19.97
90	20.22
100	20.49
110	20.72
120	20.98
130	21.18
140	21.42
150	21.62
160	21.83
170	22.04
180	22.32
190	22.52
200	22.77
210	22.98
220	23.21
230	23.46
240	23.61
250	23.89
260	24.07
270	24.32
280	24.48
290	24.80
300	24.98 TD

Finish : 1500 hrs.

DOW DIXIE No.14 TEMPERATURE LOG

M. Gardner, transcribed by C. Klein

LOC: Approx. 1000' SW bench mark (3454), T24N, R36E

Date: 10/29/76

Time:

Depth	T°C. down
10	18.12
20	17.95
30	18.31
40	18.71
50	19.05
60	19.45
70	19.70
80	20.02
90	20.24
100	20.51
110	20.70
120	20.91
130	21.12
140	21.34
150	21.55
160	21.76
170	21.98
180	22.25
190	22.51
200	22.76
210	22.99
220	23.22
230	23.46
240	23.68
250	23.90
260	24.12
270	24.31
280	24.46
290	24.71
300	24.95 TD

Hole No. 14
Operation Summary

C. Klein to 1240 hrs
M. Gardner, transcribed by C. Klein 1240 hrs. to completion.

Loc: Approx. 1000' SW bench mark (3454), T24N, R36E.

Drilling log:

10/27/76 Driller: R. Cardell

1045 Arrive, set-up
1130 Drilling
1240 At 115 ft.
1535 At 235 ft.
1605 At 265 ft.
1705 At 300 ft., circulate cold water to wash hole and string.
1715 pull string, emplace PVC pipe, remove to site no. 1.

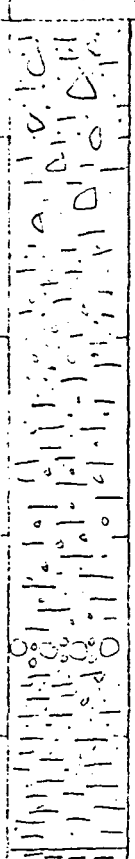
Geologic Setting: Distal region of fan deposits, 1½ mile from range front, about 50 ft. altitude above basin level opposite.

Geologic summary: Fan deposits with interbedded basin clays in zone 40-55 ft. Fan sediments are gravelly 0-10 ft. Below 10 ft. returns are mostly in sand and smaller sizes, with occasional pebbles (1 cm) to 130 ft. Periodic bouncing and vibration of string throughout section implies possible cobbly-bouldery (?) zones. Volcanic, slatey sediment lithologies. Driller reports water at 80-85 ft.

DOW
DIXIE No. 14

LITHOLOGIC LOG

GEOMETRICS, INC.
Site Scientist C. Klein
Date 10/27/76

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
0-10'		Fan deposits: angular pebbles, sand, brown silt and clay. Coarse material abundant. Multicolored volcanics.	
10-20'		Coarse and medium angular sand, brown silt & clay.	Compared to 0-10' amounts of debris recovered small, most of deposit inferred to be clay-silt-fine sand.
20-30'		Coarse angular sand, brown silt and clay. Abundant coarse cuttings black slate (?) in addition to volcanics.	30': much vibration. Gravel, Cobbles ? c 35 ft: rapid penetration. Cla
c 30-35			Black slate noted here continues below
30-40'		Sandy brown silt-clay, occasional pebbles	
40-55		Sandy brown silt-clay. Lt, faintly olive gray clay-silt with very fine sand.	Alternating fan-basin environment
55-70		Angular-subrounded sand, fine pebbles (to 1 cm), sandy brown silt-clay.	
70-85'		Same	70-85 periodic vibration v. strong. Rapid penetration. 85-100 : ibid
85-100'		same	Driller reports water at 80-85 ft. 100-115 : ibid
100-115'		same	

DOW
DIXIE No. 14

LITHOLOGIC LOG

Site Scientist C. Hart
Date 10/27/76

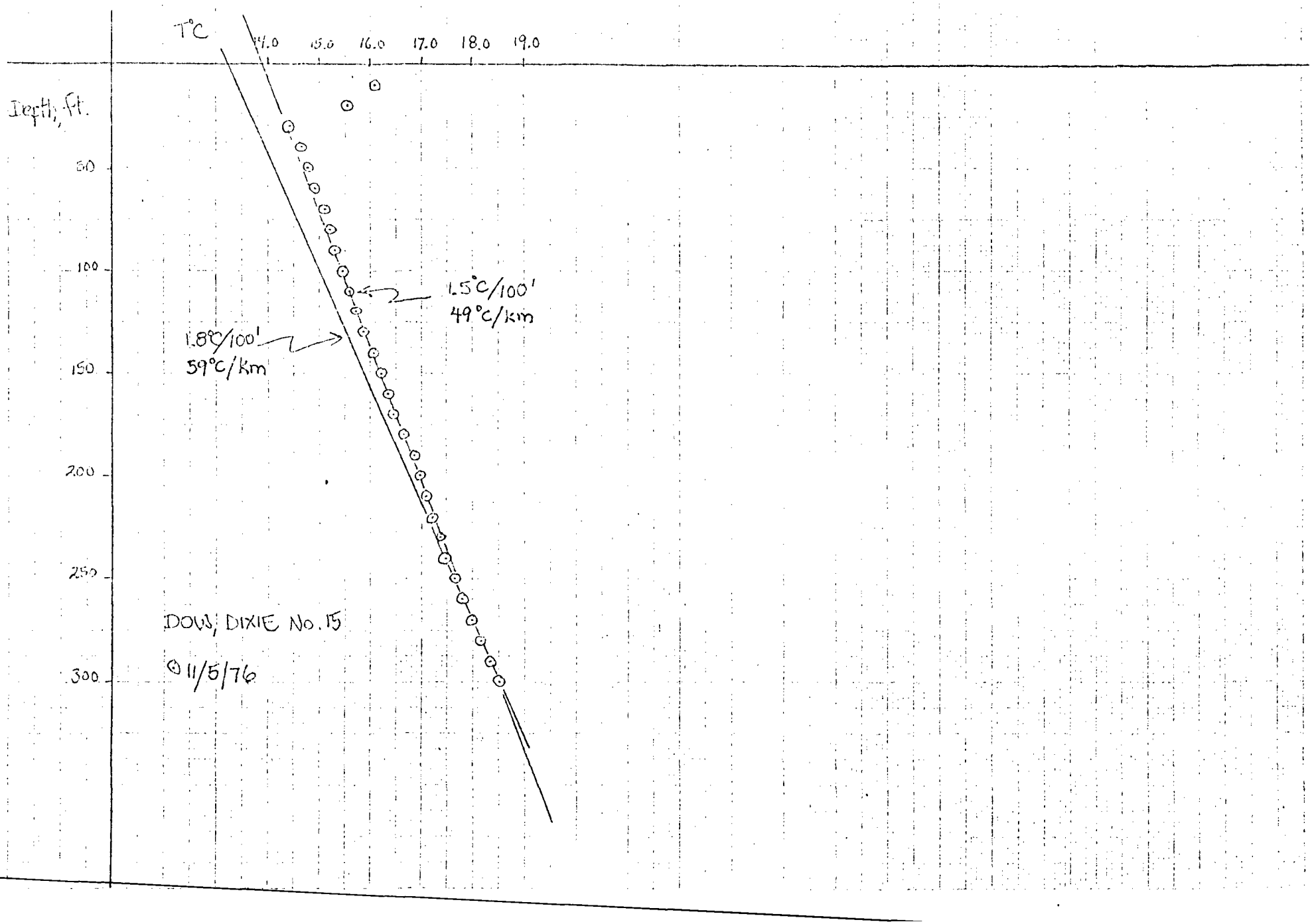
INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
			c.110 drilling rate slows.
115-130'		fewer pebbles	c.115 - Less frequent + intense vibration, rate continues somewhat slower than in 0-to c.110.
130-145'		pebbles rare	130-145: periodic strong vibrati
145-160		Chips of black siliceous silt, sed. scoria, small pebbles ashy silt,	
160-175		" ; white/pale gray clay grags	
175-190		" ; 3mm grains, fragments of fspr + few grns of qz.	
190-205		" ; buff sdy-silt gags.	vibration
205 220		"	
220 235		"	vibration, bit smoothing every approx 8', as if drilling selects most slow parts.
235 256		"	

LITHOLOGIC LOG

Geothermex, Inc.
Site Scientist [illegible]
Date 10/27/76

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
230-265		fine(1.5 mm) chips basalt, qtz, silica, shiny grains of yellow-brass col	
265-280		"	
280-295		"	R.t Bouncing
295-300		"	final mud T: ~80°F

DON DIXIE NO. 15


T°C
14.0
15.0
16.0
17.0
18.0
19.0
Depth, ft.
50
100
150
200
250
300
1.5°C/100'
49°C/km
1.8°C/100'
59°C/km
DOW, DIXIE No. 15
11/5/76

C. Klein

DOW, DIXIE No. 15 TEMPERATURE LOG

Loc.

Date: 11/5/76

Time: 1115 hrs

Depth	T°C, down
10	16.08
20	15.56
30	14.41
40	14.67
50	14.76
60	14.92
70	15.12
80	15.20
90	15.30
100	15.47
110	15.59
120	15.71
130	15.86
140	16.07
150	16.21
160	16.34
170	16.46
180	16.66
190	16.87
200	16.96
210	17.10
220	17.22
230	17.39
240	17.49
250	17.57
260	17.80
270	17.78
280	18.16
290	18.33
300	18.51

Hole No. 15 C. Klein

Operation Summary

Loc.

Drilling Log:

11/1/76 Driller: R. Cardell

am - move rig onto site, set-up

11/2/76 Driller: L. Millard

1100 Arrive, fix pump, water trip

1230 Spud-in

1345 ft. 220 ft., shutdown, water trip. Hole using much water.

11/3/76

0800 - Flat-tire on water truck while returning with load

1010 - drilling at 220 ft.

1100 - reach TD, 300' ft, plus 5 ft. cellar.

1300 - 300 ft PVC pipe in place. Begin mobilization to Reno.

Other: 11/2/76 - Bayles crew headed by field forman Gerald - cleans sites W side of valley.

Geologic Setting: Bajada at c. 3480 ft., region of very gentle slope 4½ miles from San Filipine range front, c. 7 miles from Humbolt salt marsh (elevation circa 3330 ft.

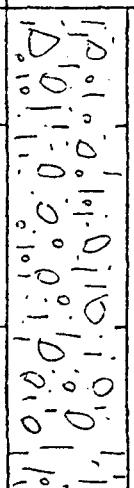
Geologic Summary: Entire section is alluvium, Sandy-pebbly 'fanglomerate' 0-20 ft. Much sandy brown silt-clay at 20 ft, with coarse sand and small pebbles, amount of clay decreasing downwards and present only as matrix to sand and pebbles below about 70 ft. Medium to coarse sand predominates below about 55 ft., pebbles (some > than 5cm) recovered only rarely below 220

DOW

LITHOLOGIC LOG

GeoThermEX, Inc.
Site Scientist C. Klein
Date 11/2/76

DIXIE No. 15

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
0-10'		Fan deposits: angular to subrounded, most subang-subrounded sand, pebbles to 1.5cm, in matrix of brown silt-clay, plus balls of sandy brown silt-clay. Quartzite, red scoria, lt. green, gray, tan silicic volcanics, uncommon free quartz, uncommon gabbro.	
10-20'		same	
20-30'		same; brown clay-silt balls more abundant; dominate sample. ← clay-rich zone	
30-40		same, sl. lesser brown silt-clay.	
40-55		same; clasts coarser than 1 cm uncommon. ← moderately clayey zone	
55-70'		same	
70-85		same; less recovery brown silt-clay.	
85-100'		same	
100-115'		same	

DOW
DIXIE No.15

LITHOLOGIC LOG

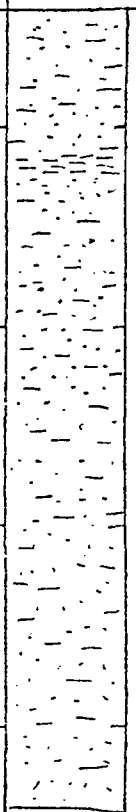
GeothermEx, Inc.
Site Scientist C. Klein
Date 11/2/76

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
115-130'		same, clasts coarser than 8 mm rare.	
130-145		same	
145-160		same	
160-175		same	
175-190		same	
190-205		same	
205-220		same	
		←*	At 220 - new mud mixed
220-235		sand, most medium (1-2mm), rarely >3mm. Matrix of brown silt-clay (little recovered). Fragments mostly angular - quartzite, silicic volcanics, some red, dk. gray, grn, brown volcanics, occas qtz, some shale-slate (lt. and dark). 80% of clasts are light colored. Uncommon gabbro.	Loose, unconsolidated, V. rapid drilling
235-250'		some, plus uncommon pebbles to 1.5 cm	* Apparent sharp change from fine gravel to sand at 220' probably not real. All gravel in sump dumped at 220'

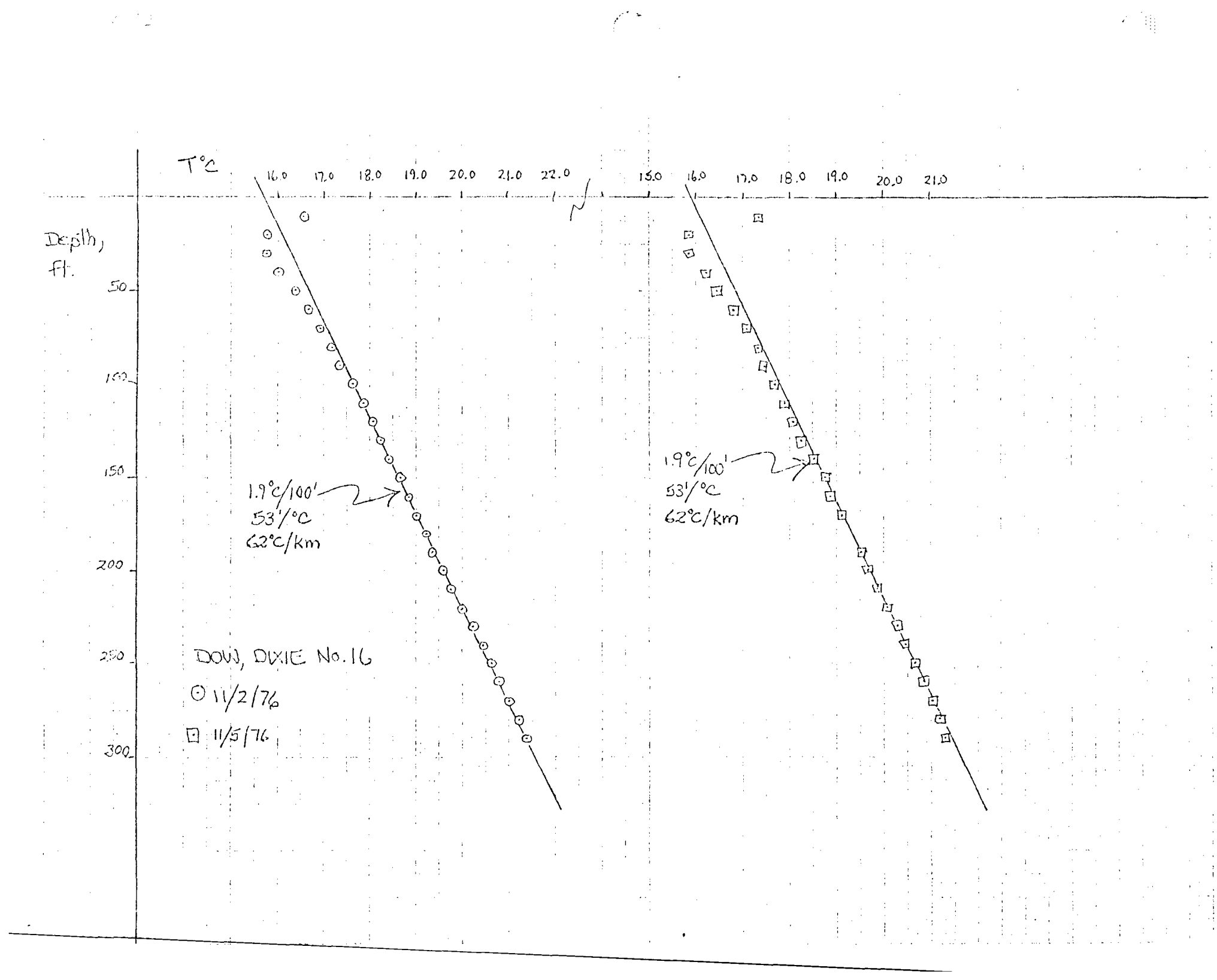
GeothermEx, Inc.
Site Scientist C. Klein
Date 11/3/76

DOW
DIXIE No. 15

LITHOLOGIC LOG

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
250-265'		same; no pebbles, uncommon balls of fine sandy brown silt-clay	
265-280'		same; no clay balls	
280-295		same	
295-300'		same	No sample retained
	300' TD		

DON DIXIE NO. 16


T°C
16.0
17.0
18.0
19.0
20.0
21.0
22.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
Depth, ft.
50
100
150
200
250
300
1.9°C/100'
53'/°C
62°C/km
1.9°C/100'
53'/°C
62°C/km
DOW, DIXIE No. 16
⊙ 11/2/76
⊡ 11/5/76

C. Klein

DOW, DIXIE No. 6

TEMPERATURE LOG

Loc:

Date: 11/5/76

Time: 1220

Depth	T°C, down	
10	17.37	
20	15.85	
30	15.84	
40	16.22	
50	16.43	
60	16.80	
70	17.07	
80	17.31	
90	17.46	
100	17.70	
110	17.90	
120	18.09	
130	18.26	
140	18.54	
150	18.75	
160	18.98	
170	19.10	← 180 skipped
190	19.51	
200	19.68	
210	19.89	
220	20.09	
230	20.30	
240	20.43	
250	20.67	
260	20.84	
270	21.02	
280	21.20	
290	21.30	← bottom

C. Klein

DOW, DIXIE No. 16 TEMPERATURE LOG

Loc.:

Date: 11/2/76

Time: 1700

Depth	T°C, down
10	16.46
20	15.76
30	15.76
40	16.01
50	16.38
60	16.66
70	16.91
80	17.13
90	17.37
100	17.61
110	17.83
120	18.07
130	18.23
140	18.41
150	18.65
160	18.83
170	19.00
180	19.21
190	19.38
200	19.60
210	19.76
220	20.00
230	20.22
240	20.45
250	20.62
260	20.80
270	21.00
280	21.22
290	21.39 ← bottom

Hole No. 16
Operation Summary

10/30-10/31: M. Gardner, transcrib
by C. Klein
11/1: C. Klein

Loc: Bend in road, NW¼ Sec. 31, T23N, R37E, E side of Dixie Valley (3.9 mi N of Dyer Junction)

Drilling Log:

10/30/76 Driller: L. Millard

1030 Arrival, set-up, spud-in

1335 100' depth, drilling steady and smooth; stop for minor maintenance to kelley chuck and swivel.

1355 drilling below 100'; some bouncing

1505 drilling below 190', water coming into hole

1750 T.D. 300 ft.

1800 Circulate and withdraw rods

1815 Rods binding. Hole sloughing at around 240-270'

1840 Withdraw above binding zone; plan to return in a.m. and flush and ream hole to T.D.

10/31/76 Driller L. Millard

0815 Arrive, set-up, water haul.

Mud pump inoperative, parts needed. Shut down, to Reno.

11/1/76 Driller R. Cardell

am Hole blocked at c. 260-280 ft. Ream to 300 ft. Emplace plastic casing. Remove to site 15.

Geologic Setting: Distal region of fan deposits, 4 miles from range front, about 140 ft. altitude above basin bottom 3 miles to west. Note E side of Dixie Valley is rotated fault block, not fault escarpment.

Geologic Summary: Entire section is fan deposits; pebbles, chips of gray silt, black shale, buff and orange sand, black basalt/gabbro, quartz, free calcite. Most grains are about 1-9 mm diameter; section is particularly sandy below about 175 ft. Flattish pebbles like from channel fill 205-220 ft. Driller reports water table at 85 ft. Hole noted contributing water but not artesian at about 220 ft..

DOW
DIXIE 16

LITHOLOGIC LOG

Site Scientist MCG
Date 30 OCT 16

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
0 10		Fang; pebbles, chips of gray s:lt to dk shale buff + orange sand, black vf slt/gabbro, qz, grn calcite; grains 1-9 mm majority; some to 30 mm	Conglomerate
10 20		do	do
20 30		do	do
30 40		do	do
40 50		do; some large grains	do
50 70		do	do
70 80		do	do WATER TABLE
80 100		do	do
100 115		do	do

DOW
DIXIE 16

LITHOLOGIC LOG

Geothermex, Inc.
Site Scientist MCA
Date 30 Oct 16

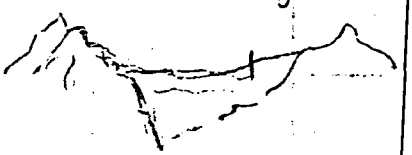
INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
115 130		do	do
130 145		do; 1–6 mm predominates	do; some w/ abundant Q sand, cemented by calcite(?)
145 160		do; few grains Q breccia	do
160 175		do; mud balling, around sand grains	do
175 190		do; increasing sand	do
190 205		do;	do
205 220		do; sand plus flattened pebbles, like prev channel fill.	do LITTLE CONTRIBUTION TO WATER BUT NOT ARTESIAN
220 235		do	
235 250		do	

DOW
DIXIE 16

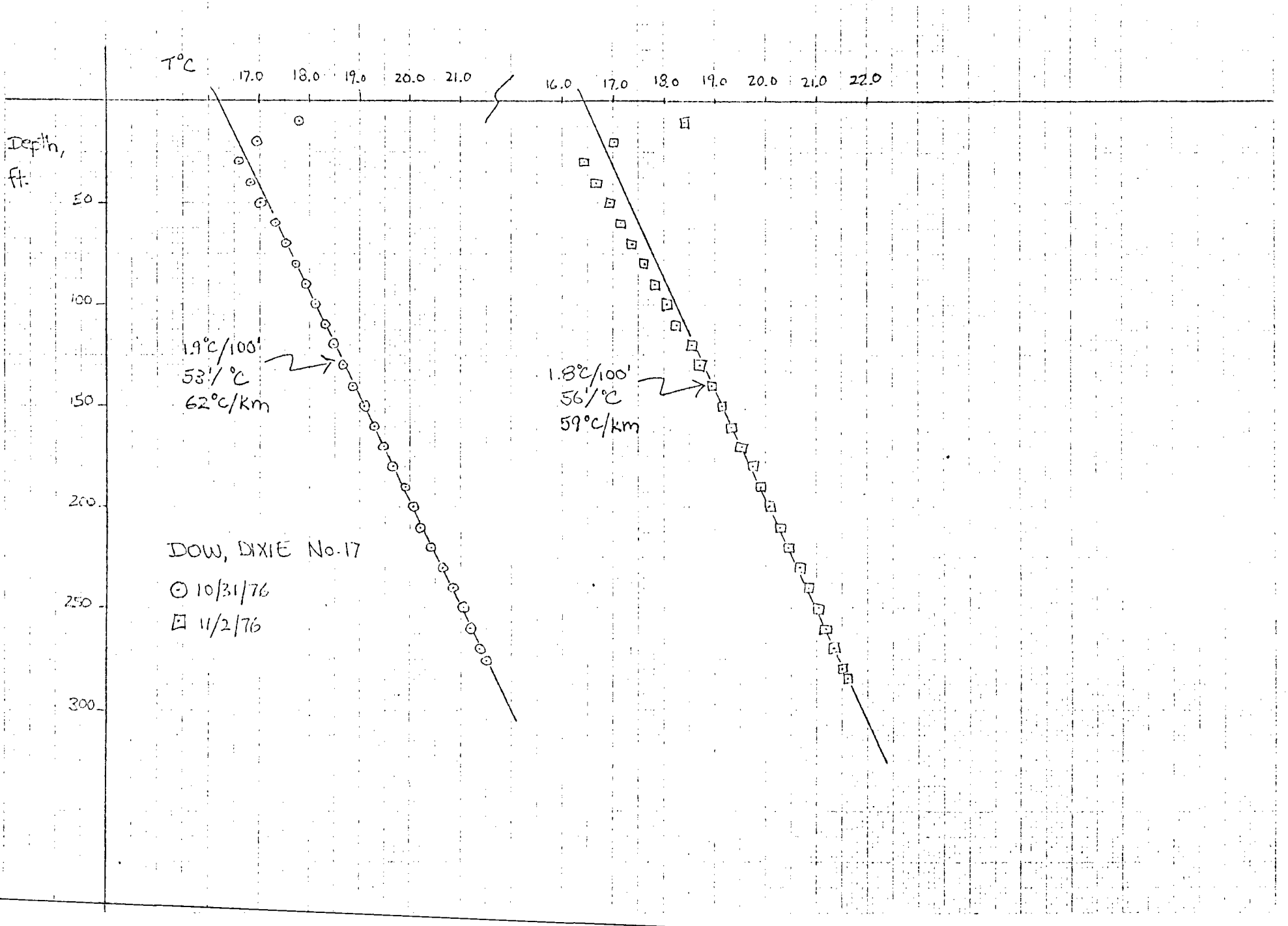
LITHOLOGIC LOG

Geothermex, Inc.
Site Scientist [illegible]
Date 30 Oct 76

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
260 265		do	do
265 280		predominantly fine grained material; blk sh, so, bslt/gn gabbro(?)	Coarse sdy gravel at base of most recent cnse gravel
280 295			
295 300		#	



DOW DIXIE NO. 17


T°C
17.0
18.0
19.0
20.0
21.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
Depth, ft.
50
100
150
200
250
300
1.9°C/100'
53'/°C
62°C/km
1.8°C/100'
56'/°C
59°C/km
DOW, DIXIE No.17
⊙ 10/31/76
⊡ 11/2/76

C. Klein

DOW. DIXIE No. 17

TEMPERATURE LOG

Loc:

Date: 11/2/76

Time: 1020

Depth	T°C, down
10	18.4
20	17.02
30	16.43
40	16.67
50	16.93
60	17.17
70	17.39
80	17.62
90	17.83
100	18.06
110	18.27
120	18.54
130	18.72
140	18.95
150	19.13
160	19.32
170	19.52
180	19.75
190	19.92
200	20.09
210	20.29
220	20.44
230	20.68
240	20.83
250	21.03
260	21.20
270	21.36
280	21.50
c. 286	21.61 ← block
	TD
300	

Dow, DIXIE No. 17 — TEMPERATURE LOG

M. Gardner, transcribed by C. Klein

Loc:

Date: 10/31/76

Time: morning

Depth	T°C, down	
10	17.8	
20	16.95	
30	16.59	
40	16.81	
50	17.00	
60	17.31	
70	17.52	
80	17.71	
90	17.90	
100	18.10	
110	18.31	
120	18.49	
130	18.66	
140	18.86	
150	19.09	
160	19.29	
170	19.49	
180	19.68	
190	19.91	180-190 : tight spot - surged
200	20.07	
210	20.21	
220	20.42	
230	20.64	
240	20.85	
250	21.04	
260	21.18	
270	21.37	
276	21.48	block in pipe
300	—	TD

Hole No. 17
Operation Summary

M. Gardner, transcribed by C. Klein

Loc: Bend in road, NW¼, Sec. 12, T23N, R36N (1.7 mi N of Dyer Canyon/Dyer Flat Well/Pernice Canyon Junction). East side Dixie Valley.

Drilling Log:

10/28/76	Driller: R. Cardell set-up; L. Millard 1900 hrs to 0500 hrs.
1430	Arrive and set-up, water trip, to Fallon for gas
1900	Night crew on. Spud-in. Vibration; chopping coarse, hard boulders
2000	55' depth, drilling.
2300	70' depth, drilling, smooth, finer grain (gravel) size
10/29/76	Driller: L. Millard to 0500 hrs; R. Cardell 0845 hrs to completion.
0500	170' depth; night crew off
0845	Day crew on; start drilling at 170'.
0940	190'; swivel head repairs.
1035	drilling intermittantly, performing maintenance, greasing concurrently.
1135	drilling steady at 255'
1235	drilling steady at 300'; TD, circulate.
1245	coming out of hole; some tight places, may have cave material on bottom(?).
—	plastic pipe in place, move to site no. 16. Water truck mired in ground at pond; driller had been instructed to get water at well at different location. Water truck extracted by L. Millard crew with help from H. Turley, local rancher, morning 10/30.

Geologic Setting: Central region of alluvial fan at 3600 ft. altitude, about 3½ miles from basin level 3380 ft to northwest, 4 miles from principal break in slope at range front at about 4800 ft. altitude, to southeast. Note range front E side Dixie Valley is rotated block, not fault escarpment.

- cont -

Hole No. 17- cont.

Geologic Summary: Entire section is fan deposits of sand, pebbles, chips to 45 mm of felsite, sandstone, slate/shale, basalt, fine-grained gabbro porphyry, quartzite. Fines predominate below 70 ft.; 1 to 6 mm, 2 to 4 mm and sands generally predominant. Returns probably represent fine gravel with lenses and interchannel fill of coarser debris.

Dow

Dixie #17

LITHOLOGIC LOG

Geothermex, Inc.
Site Scientist [illegible]
Date 10/28-29/76

INTERVAL		SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
0	10		pebbles, chips to pebbles to 30mm; bio-pyr felsite, ss, slate/sh., bslt/fine grained gabbro porphyry (silicified?), qtzT.	
10	20		do	
20	30		do	
30	40		do; gravel to 45 mm	
40	55		do	
55	70		do, silica 25%	
70	85		do; fines fraction increasing to 50%; fine grained gabbro fragments Pebble fragments	
85	100		do	
100	115		do; coarse gravel 5%	gravel bed

Dowi
Dixie # 17

GeoThermEx, Inc.
Site Scientist MCG
Date 10/21/6

LITHOLOGIC LOG

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
115 130		1-6 mm fragments; 2-4 mm plagioclase; pale green-buff silt, orange ss, etc., black fn. gabbro.	
130 145		do; 20% gravel to 30 mm	gravel lense
145 160		do; <10% larger gravel 50-80	
160 175		do	
175 190		do	
190 205		1-8 mm chips } red, buff, ..t ss, silt, blk sh, qtz, bslt	fine gravel, or coarse sand lenses, interbedded silt.
205 220		do	do
220 235		do	do
235 250		do	do

Dow

Dixie #1

LITHOLOGIC LOG

Site Scientist MGG

Date 10/29/96

INTERVAL	SCHEMATIC OF STRATIGRAPHY	LITHOLOGIC DESCRIPTION	COMMENTS, INTERPRETATION
150 – 165		do	do
165 – 220		do	do
250 – 295		do	do
295 – 310 T.D.		do	do

TEMPERATURE SURVEYS
OF
PRE-EXISTING WELLS

TEMPERATURE LOG

C. Klein

Artesian Well, flowing c. 10 gpm from 6" (?) dia hole in ground. About 83 ft of gray plastic pipe, 1" dia, capped at one end, lies on ground adjacent. Appears that this hole was drilled for temp. gradient measurements

Loc: NW¼ SW¼ Sec. 23, T23N, R35E, c. 1200 ft. NE of Dow, DIXIE No. 8.

Date: 10/15/76

Time: 0800 Air temp: 11.0°C

Depth	T°C. down
0	21.06
9 ft	21.26 — bottom.?

Probe withdrawn - plastic pipe lowered into hole - block at 9 ft penetrated by ramming. Second block at c. 77 ft passed by ramming. Pipe goes in full length w/out bottom (83 ft). Withdrawn, as have no way to secure pipe, prevent sinking if filled w/ water. Will return + attempt log through open hole

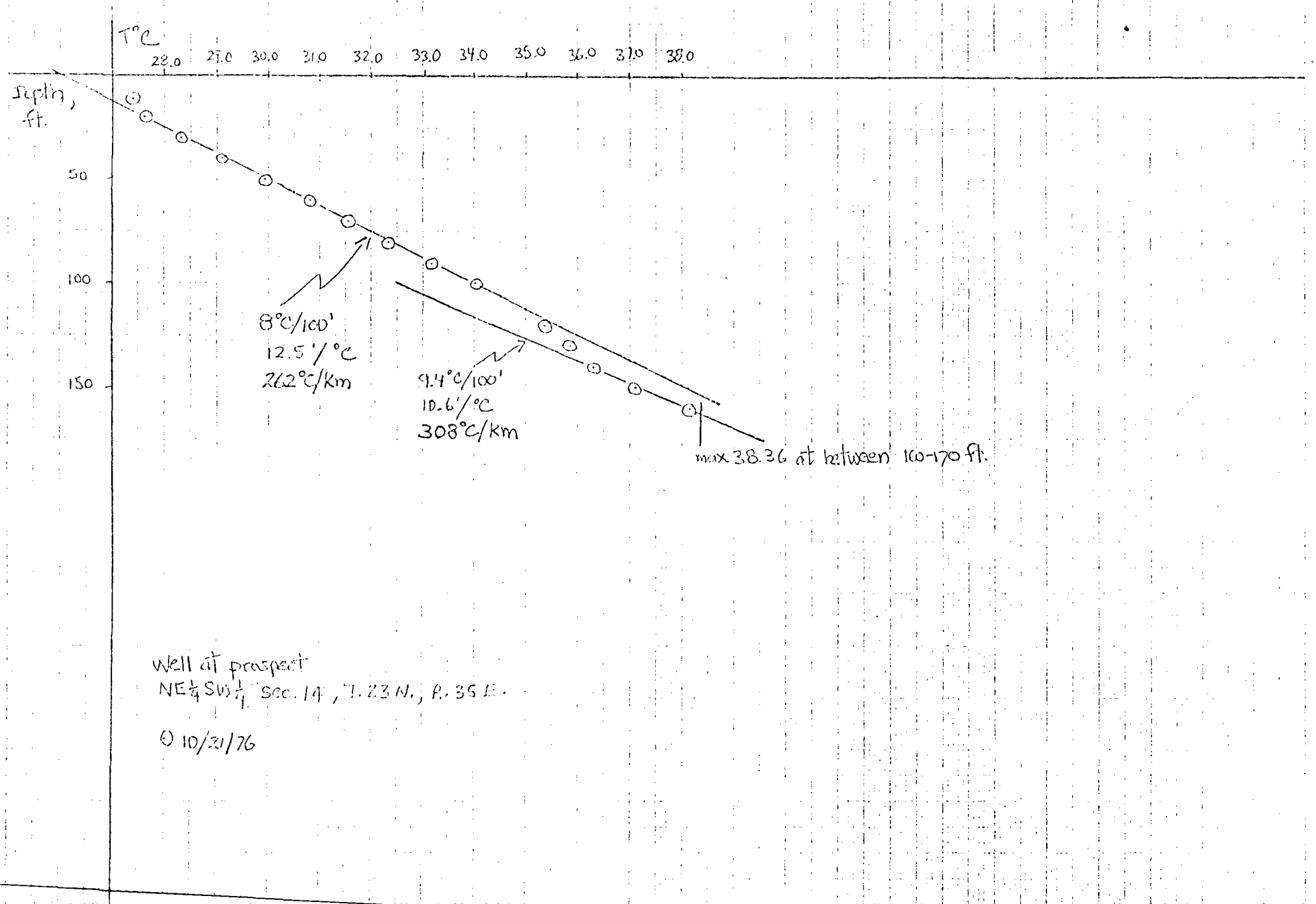
Finish: 0850 hrs.

Date: 10/13/76

Time: 0845

Depth	T°C down
0	20.78
10	21.13

Unable to lower probe beyond 11 ft.



Well at prospect
NE¼ SW¼ Sec. 14, T. 23 N., R. 35 E.

10/31/76

TEMPERATURE LOG

C. Klein

Well at prospect.

Loc. 15 ft. N of abandoned shaft, center NE¼ SW¼ Sec. 14, T22N, R35E. 8" casing (iron).

This site is 1000 ft. west of Dow, DIXIE No. 9.

Date: 10/21/76

Time: 1115 hrs.

Depth	T°C, down	T°C, up
12 ft	27.40	water level
20	27.60	
30	28.31	← feel bottom at ~~< 23 ft >~~ no, temp. increasing
40	29.11	
50	29.92	
60	30.81	
70	31.57	
80	32.35	
90	33.17	
100	34.03	
120 ~~140~~	35.38	— 35.46
130 ~~120~~	35.86	
140 ~~130~~	36.30	— 36.34
150 ~~160~~	37.10	
160 ~~150~~	38.15	← Bottom between 160–170 ft. (inferred from top of isotherm)
170	38.36	
180	38.36	
190	38.36	

Finish: 1215 hrs

Gradient: $\frac{34.6-26.0}{100'} = 8°C/100' \equiv 12.5'/°C$ in 20'–100'

$\frac{37.2-32.5}{50'} = 9.4°C/100' \equiv 10.6'/°C$

Note: Well is 20 ft east of a 10–15 ft. high fault scarp (east-facing) in alluvial fan.

Well at Prospect

Loc: ~~c~~ 1000 ft E of DOW, DIXIE No. 9

Water at 9 ft

10 ft – 16.8

~~c~~ 15 ft bottom

C. Klein

TEMPERATURE LOG

Abandoned irrigation well

Loc: NW corner SW¼, Sec. 12, T23N, R35E, 1 mi S. of Bar A-3 ranch (Lamberti ranch, abandoned)

Date: 10/22/76

Time: 0845 hrs

Depth	T°C, down	
4 ft	18.80°C	Water level
20 ft	19.15	
30	19.21	
40	19.26	← presume bottom at c. 40-50 ft
50	19.26	

12" iron casing

Abandoned irrigation well, (outside) SW corner Bar A-3 ranch

Loc: NW corner, Sec. 12, T23N, R35E

Date: 10/22/76

Time: 0915 hrs

Depth	T°C, down	
40 ft	17.80	water level.
50	17.82	
60	17.86	
70	17.88	← infer approx bottom.
80	17.88	
90	17.88	

16" iron casing

TEMPERATURE LOG

C. Klein

Lamberti Ranch (old Bar A-3) #1 Well, 1968

Loc: center, SW¼ Sec. 1, T23N, R35E; along fence next to old road, 1000 ft ENE of ranch house

Date: 10/20/76

Time: 1050

Depth	T°C, down
35 ft	water level
40 ft	20.17
50	20.20
60	20.22
70	20.22
80	20.19
90	20.15
100	20.09
110	20.00
120	19.92
130	19.90 ← Bottom? *
140	19.90
150	19.90
160	19.90
170	19.90
180	19.90
190	"
210	"
230	"
250	"
290	19.90
340	19.90
370	"
400	"
450	"
500	"

Well has 12" casing, 4x4 ft concrete slab at surface. 10 ft to S is similar well-head, with pump.

limit of calibration on cable, lowered an additional c. 100 ft w/out feeling bottom

* ~~the~~ cable retrieved + counted knots at 250 + 100 ft. Thus failed to feel bottom, which probably lies at c 130 ft. (top of isotherm)

TEMPERATURE LOG

C Klein

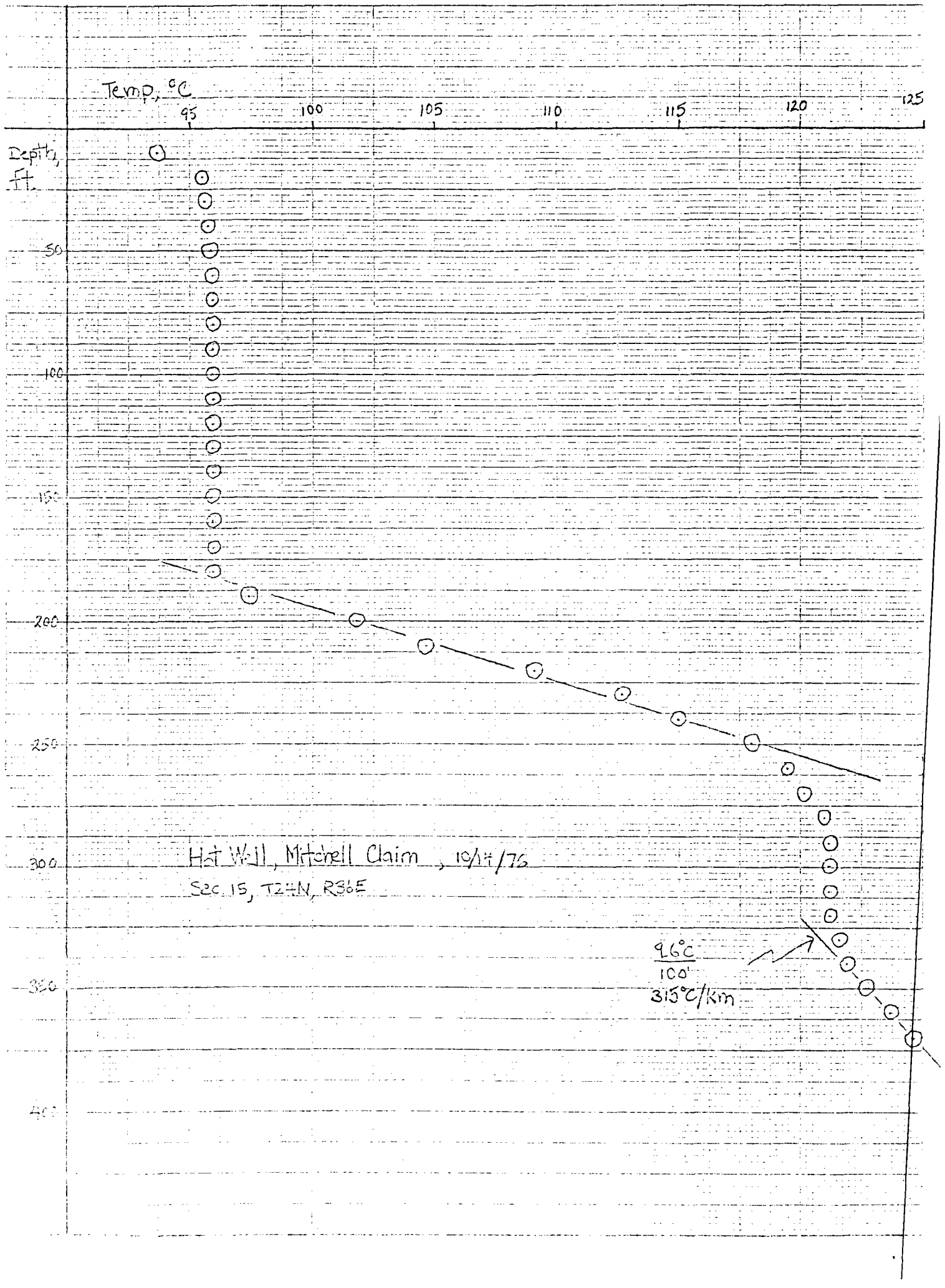
Lambert Ranch (formerly Bar A-3), windmill well

Loc:

Date: 10/21/76

Time: 1720 hrs

Depth	T°C, down
55 ft	water level
70 ft.	17.40°C } infer bottom, not felt, lies at 55-70 ft.
80 ft.	17.42
90.	17.42


Temp, °C
95
100
105
110
115
120
125
Depth, ft.
50
100
150
200
250
300
350
400
Hot Well, Mitchell Claim, 10/14/76
Sec. 15, T24N, R36E
96°C
100'
315°C/Km

Hot well, at Kenneth Mitchell Claim

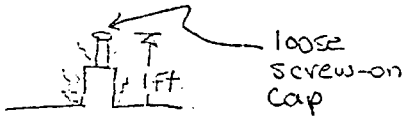
TEMPERATURE LOG

C. Klein
10/14/76

Well Loc: Sec 15 (unsurveyed), T24N, R36E, 25' W of cabin, level site,

Date: 10/14/76

Time: 0930 hrs Air temp: 23.1 °C



Depth	T°C down	T°C up
0 *	86.4 **	
10	93.7 **	
20	95.5 **	
30	95.60	
40	95.75	
50	95.80	
60	95.84	
70	95.84	
80	95.86	
90	95.86	
100	95.86	
110	95.86	
120	"	
130	"	
140	"	
150	"	
160	"	
170	"	
180	"	
190	97.4 **	
200	101.8 **	
210	104.7 **	
220	109.1 **	
230	112.7 **	
240	115.0 **	
250	118.0 **	
260	119.5 **	
270	120.2 **	
280	121.0 **	
290	121.2 **	
300	121.18	
310	121.18	
320	121.22	
330	121.56	
340	121.85	
350	122.70	
360	123.68	
370	124.53	
380	>125 ← max. range of thermometer	

Note: logged inside 1¼" ID iron pipe which sits w/in 3" ID iron casing. Hot gases arise from both 1¼" pipe & pipe-casing interspace (annulus), gases from 4 outlets

* 1 ft inside 1¼" pipe — dry, vapor temp rec.

** estimated to nearest .1°C prior to total equilibration (after 5–10 min). At 240' + below plot of readings at 1 min. int used to est. equil. Temp by asymptote. Above 240 "guesstimation" used.

greatest gas discharge is from ground at casing surface. Varies from barely visible to producing an audible "hiss"

Hole clear to 400' — not tested below. Probe dry on retrieval. Felt no clear indication of water anywhere in hole. Cabin at site contains pieces of NX drill core, all gabbro. Sample taken from a box labeled "Mt. Grant", 533–543 ft

Finish, 1345 hrs.

Note: this is Corral Canyon District of Whitaker et al Speech, 1974, p. 64–66.

C. Kittle reports that Mitchell no longer owns claim. Mitchell is pers. friend, lives in Sacto. Co.

TEMPERATURE LOG C Klein

Fumarole

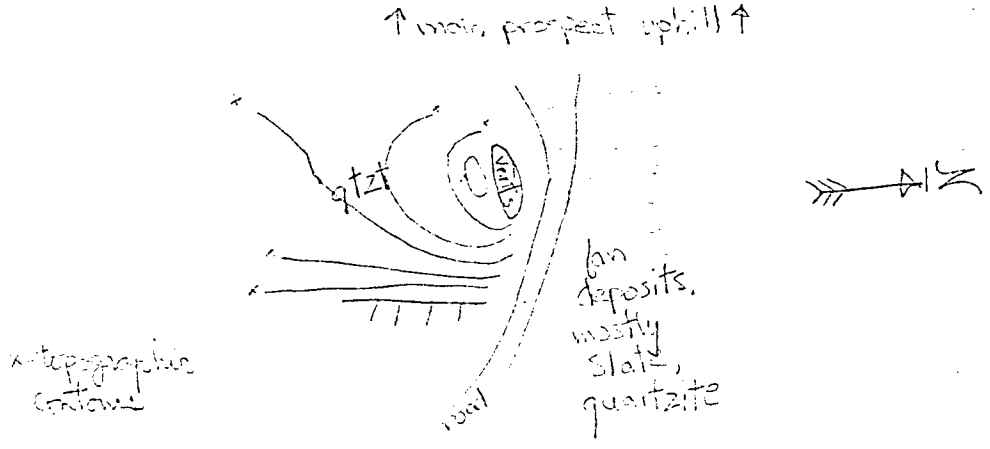
Loc. E edge of prospect, near intersection Sec. 31 and 32, T25N, R37E.

Date: 10/18/76

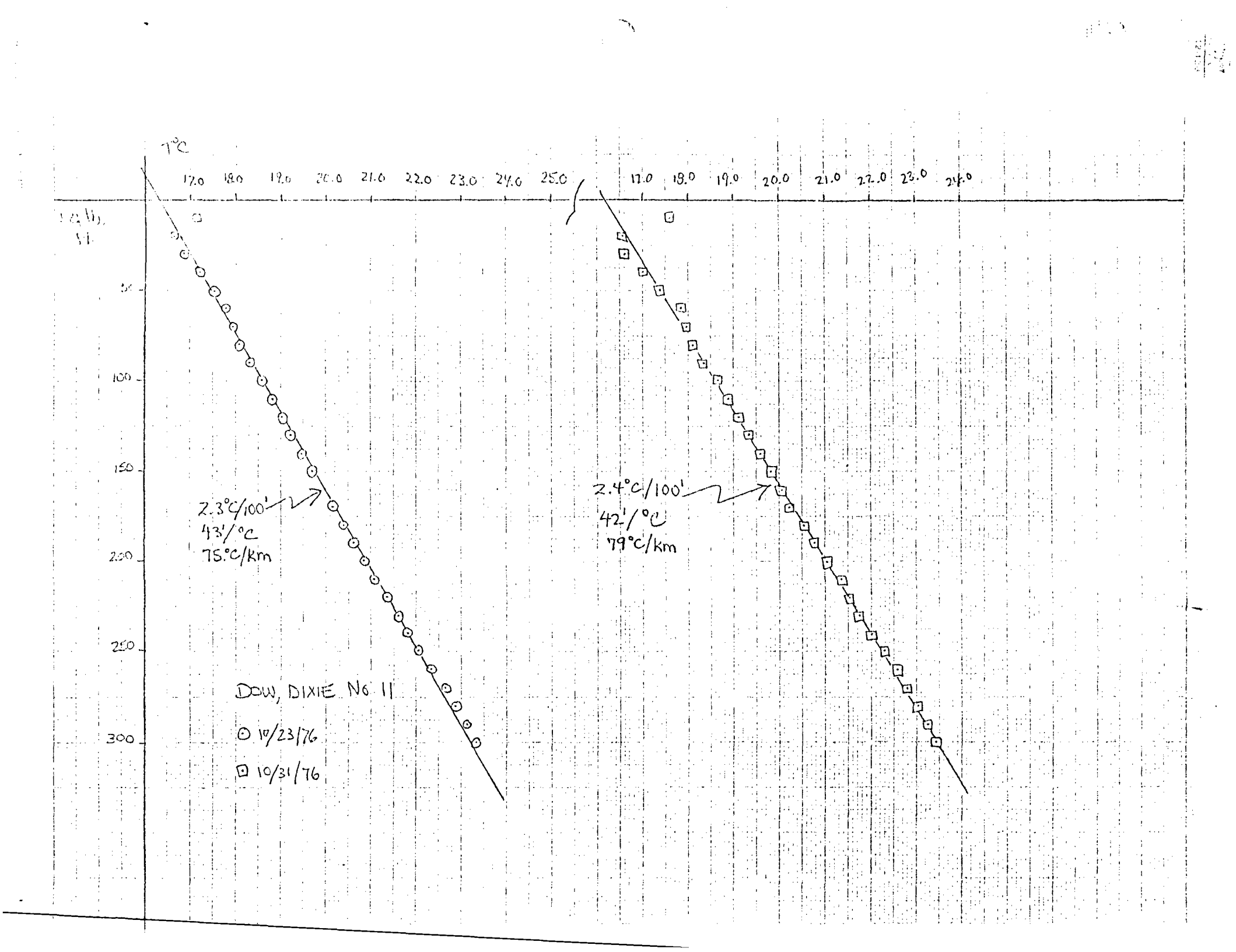
Time: 1115 hrs.

Temp. 95.7°C (major vent)

Geologic Setting: One large and several small vents in a bulldozer cut facing N at entrance of workings. Gases issue from between blocks of white "quartzite". This is Jurassic quartz arenite unit of Wilden + Speed (1974, p. 14, Pl. 1). Rock is very hard, appears structureless though weathers to a rough, veined-looking surface which resembles a limestone (no reaction with HCl). May have been hornfelsed by nearby Jurassic gabbro (granger?) or silicified by hydrothermal activity. Dark gray 'quartzite' is also exposed nearby. Ground around fumarole is mantled with mine dump and angular fanglomerate debris, but possible bedrock exposures of the 'quartzite' appear on low hill south of the bulldozer cut. Steep E side of this hill could be an old fault scarp.



Zones between the quartzite blocks at the fumarole are powdery, punky, friable. The gases are a sulfurous smell, and deposits colorless, white, yellow (sulfur?) and various green minerals around the vents. Main prospect uphill is in the 'quartzite' which is mostly white, locally stained cinnabar red, and locally extensively punky and friable in zones with bright yellow sulfur deposits. Occasional carbonate veins, punky surface deposits are found. Punky, punky friable zones in the


T°C
17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0
17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0
100
150
200
250
300
2.3°C/100'
43'/°C
75.°C/km
2.4°C/100'
42'/°C
79°C/km
DOW, DIXIE No 11
10/23/76
10/31/76

TEMPERATURE LOG

GeothermEx

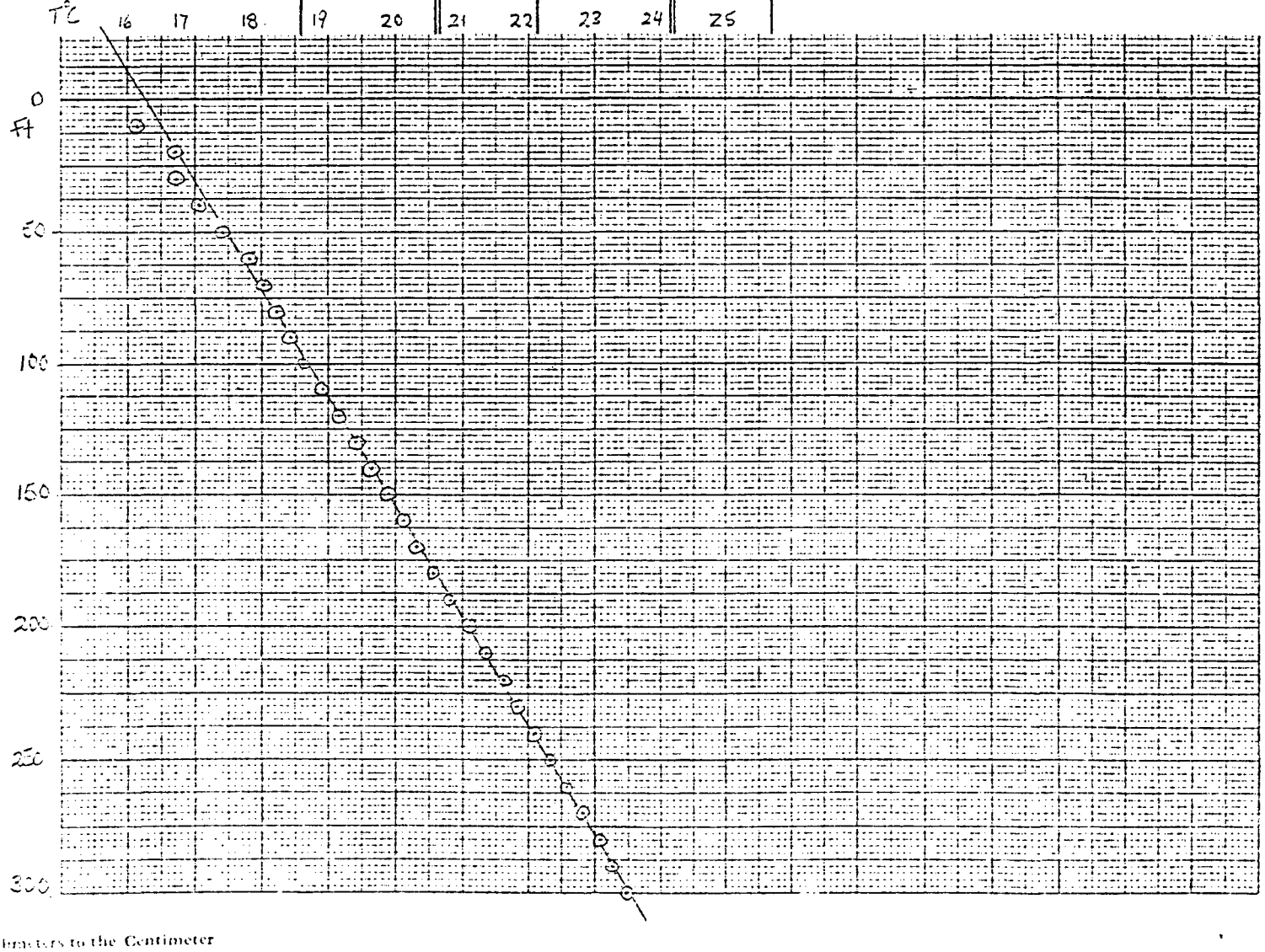
Project:
Hole No.: DOW-DIXIE No. 11
Loc.:

Date: 12/2/76
Time: 1200 hrs
by: CWK

Depth	T°C.(down)	Depth	T°C.	Depth	T°C.
ft- 10	16.16	160	20.11		
20	16.73	170	20.33		
30	16.73	180	20.59		
40	17.09	190	20.34		
50	17.41	200	21.10		
60	17.83	210	21.36		
70	18.04	220	21.62		
80	18.22	230	21.83		
90	18.45	240	22.10		
100	18.63	250	22.33		
110	18.94	260	22.58		
120	19.18	270	22.82		
130	19.40	280	23.08		
140	19.65	290	23.27		
150	19.90	300	23.48		

Comments:

Slope 2.6°C/100'



DOW, DIXIE No. 11 TEMPERATURE LOG C. Klein

Loc: Intersection, NE¼, Sec. 11, T23N, R35E
Date: 10/31/76
Time: 1600 hrs

Depth	T°C, down	
10	17.61	
20	16.57	
30	16.61	
40	17.02	
50	17.39	
60	17.85	
70	17.96	
80	18.12	
90	18.36	
100	18.66	
110	18.96	
120	19.13	
130	19.35	
140	19.60	
150	19.82	
160	20.06	
170	20.22	
180	20.52	
190	20.78	
200	21.04	
210	21.34	
220	21.51	
230	21.74	
240	22.02	
250	22.28	
260	22.58	
270	22.80	
280	23.02	
290	23.25	
300	23.41	TD

Finish: 1645 hrs