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Fran Ridge Horizontal Coring Summary Report Hole UE-25h#1, Yucca Mountain Area, Nye County, Nevada

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FRAN RIDGE HORIZONTAL CORING SUMMARY REPORT
HOLE UE-25h#1, YUCCA MOUNTAIN AREA, NYE COUNTY, NEVADA

by

A. E. Norris, F. M. Byers, Jr., and T. J. Merson

ABSTRACT

Hole UE-25h#1 was core drilled during December 1982 and January 1983 within several degrees of due west, 400 ft horizontally into the southeast slope of Fran Ridge at an altitude of 3409 ft. The purpose of the hole was to obtain data pertinent for radionuclide transport studies in the Topopah Spring Member of the Paintbrush Tuff. This unit had been selected previously as the host rock for the potential underground nuclear waste repository at Yucca Mountain, adjacent to the southwestern part of the Nevada Test Site.

The hole was core drilled first with air, then with air mist, and finally with air, soap, and water. Many problems were encountered, including sloughing of tuff into the uncased hole, vibration of the drill rods, high rates of bit wear, and lost circulation of drilling fluids. On the basis of experience gained in drilling this hole, ways to improve horizontal coring with air are suggested in this report.

All of the recovered core, except those pieces that were wrapped and waxed, was examined for lithophysal content, for fractures, and for fracture-fill mineralization. The results of this examination are given in this report. Core recovery greater than 80% at between 209 and 388 ft permitted a fracture frequency analysis. The results are similar to the fracture frequencies observed in densely welded nonlithophysal tuff from holes USW GU-3 and USW G-4. The fractures in core from UE-25h#1 were found to be smooth and nonmineralized or coated with calcite, silica, or manganese oxide. Open fractures with caliche (porous, nonsparry calcite) were not observed beyond 83.5 ft, which corresponds to an overburden depth of 30 ft.

I. INTRODUCTION

The Nevada Nuclear Waste Storage Investigations (NNWSI) are a U.S. Department of Energy project to determine whether a nuclear waste repository, if located in hydrologically unsaturated tuff beneath Yucca Mountain, Nevada, would meet the safety criteria for licensing that have been established by the

U.S. Nuclear Regulatory Commission. An important aspect for assessing the expected postclosure performance of such a repository is the retardation that radioactive species would undergo relative to the flow of water that might transport them through tuff. Certain retardation properties, such as sorption, precipitation, diffusion, and chemical speciation, can be measured in laboratory experiments. Computer-based models can extrapolate the data from laboratory measurements to field conditions. Modeling accuracy can be confirmed by measuring radionuclide retardation under field conditions. Laboratory measurements of retardation in the presence of tuff and computer-based modeling had progressed during 1980 to the point where a field test of migration was planned. The program plan for this field test (Erdal et al. 1981) identified the Miocene Tunnel Bed 5 tuff of G-Tunnel, at the Nevada Test Site, as the location for a fracture-flow experiment under vadose zone conditions. This field test was not performed for three reasons. First, the bedding planes in the tuff proved to be no more permeable to water flow than was the tuff matrix. Second, sorption measurements were much less reproducible with Tunnel Bed 5 tuff than with other tuffs. Finally, the modeling calculations indicated that water was unlikely to flow through a fracture in this tuff in the manner initially expected. A report by Norris et al. (1982) documents the laboratory and modeling results from the Tunnel Bed 5 tuff work.

The search for a suitable location in which to perform a radionuclide migration field test in tuff shifted in 1982 from G-Tunnel to Yucca Mountain. By this time the Topopah Spring Member of the Paintbrush Tuff had been chosen as the Yucca Mountain target horizon (DOE 1984). If Yucca Mountain was chosen by the President as one of the three potentially acceptable nuclear waste repository sites, site characterization activities would include construction of an Exploratory Shaft for in situ testing. In 1982 the Exploratory Shaft construction was not scheduled to commence until 1984, and it would take about two years longer to excavate completely the main underground facility in the Topopah Spring Member. Our thinking was that a facility in the Topopah Spring Member that was not part of the Exploratory Shaft would be useful during the interim to investigate fracture flow characteristics in this tuff and problems associated with conducting a field test. Consequently, an exposure of Topopah Spring Member was located on the southeast flank of Fran Ridge that might be suitable for construction of an adit in which this field test could be performed (Fig. 1). The lithostatic load would not be equal to that of the

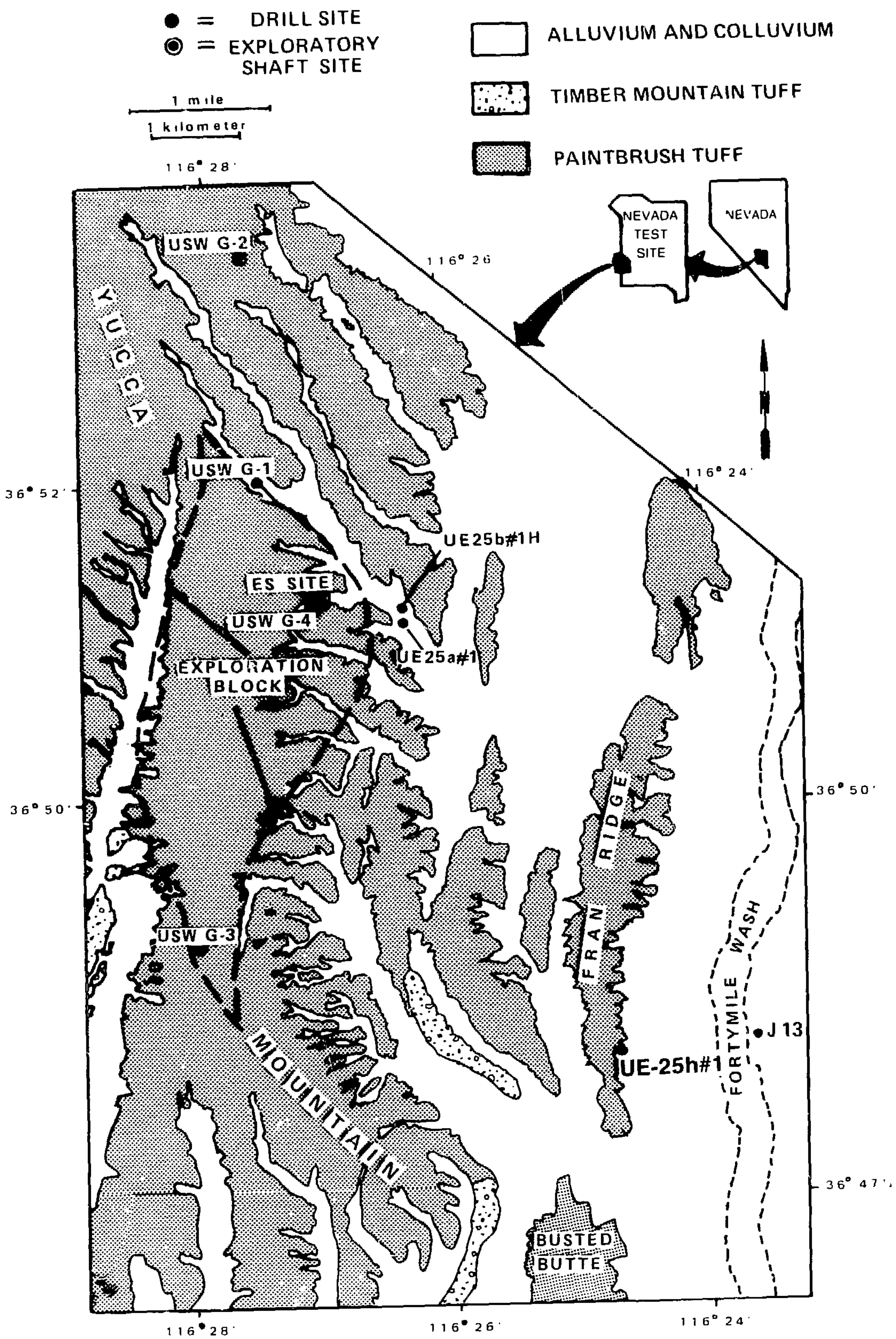

Fig. 1.
Map of Yucca Mountain area, showing location of horizontal drill hole UE-25h#1.

Exploratory Shaft underground facility, but this difference would not impede development of the field test procedures.

Two 4-in.-diameter holes were to be cored horizontally to a distance of 400 ft as the first part of the work to characterize the suitability of the Fran Ridge site for an adit. The horizontal distance was determined by the maximum horizontal penetration of the adit. A deeper adit would require mechanical ventilation, and this complication was not desirable. One of the two 4-in.-diameter holes was to be located about 10 ft above the other, and both holes were to be cored with air to avoid introducing water into the formation. After coring, isolated segments of the two holes would be tested to determine the extent to which water would flow between them. The cores would be examined to determine the fracture patterns in this tuff.

In actuality only one hole was drilled. The location of this hole, designated UE-25h#1, is shown in Fig. 1. The Nevada State Coordinates of the hole are N.748,353.08 ft, E.574,461.38 ft, and the elevation, 3,409.38 ft (L. Price, Holmes & Narver, Inc., written commun., June 2, 1986). The geologic mapping of Scott and Bonk (1984) indicates that the stratigraphic thickness of the Topopah Spring Member at the location of UE-25h#1 is approximately 1000 ft, which is comparable to the thickness penetrated in USW G-4. The subunit cored by UE-25h#1 corresponds to the middle nonlithophysal zone observed in USW G-4 core in the depth interval from 680 to 770 ft. This subunit was identified by observing an upper lithophysal zone above a contact some 30 ft upslope from the UE-25h#1 drill collar. The upper lithophysal zone is a distinct subunit characterized by spheroidal lithophysae averaging about 5 cm in diameter. The lower lithophysal zone, which underlies the subunit in which UE-25h#1 was drilled, is exposed southward up the component dip in a cutbank of the dry wash that truncates the south end of Fran Ridge. At the time of drilling, the Exploratory Shaft breakout zone was expected to be the lower nonlithophysal zone. The middle and lower nonlithophysal zones of the Topopah Spring Member are mineralogically and petrographically similar (Byers 1985). The physical properties of the subunit in which UE-25h#1 was drilled were expected to be nearly identical to those in the subunit that would contain the main underground facility of the Exploratory Shaft.

Funding from the NNWSI geochemistry program was provided to cover the estimated costs of the two core holes originally planned at Fran Ridge.

However, UE-25h#1 cost twice as much as estimated. The presumption that the start of Exploratory Shaft construction was imminent resulted in no further funding for an in situ geochemical test facility at Fran Ridge.

This report presents a history of the UE-25h#1 drilling operations and the results of a petrographic analysis of the core that was recovered. Section II is a summary of the drilling operations. Some readers may find a detailed drilling history useful because horizontal coring in highly fractured Topopah Spring Member tuff is not a routine operation. Therefore, a log of daily activities is included as Appendix A. We have listed in Section III our recommendations for future horizontal coring in this tuff so that others can profit from our experience. The core analysis results are given in Section IV. Appendix B contains the detailed log of the core examination. The data for the fracture frequency analysis in the interval from 209 to 388 ft are tabulated in Appendix C.

II. HOLE HISTORY

A summary of the UE-25h#1 drilling operations is presented in this section. Details are listed in Appendix A. The hole was drilled by employees of the Reynolds Electrical and Engineering Company (REECo). Fenix & Scisson, Incorporated (F&S) provided drilling specialists and geologists during the coring of this hole. Los Alamos National Laboratory personnel observed most of the drilling operations.

Site preparation commenced the first week of December 1982. Bruce M. Crowe, Los Alamos, specified the precise hole location. Drilling to core the first 20 ft started on December 10. A water-cooled 6.25-in. bit was used to permit emplacement of casing in cement. The casing served as a collar to help reduce drill-string vibrations during subsequent air-coring operations. Water circulation was lost at 17 ft, but cementing and casing solved the problem.

The next 165-ft interval of UE-25h#1 was cored with air, and 3.937-in. bits were used. The coring proceeded very slowly. Eight shifts were required to drill this interval, but three of these shifts were devoted to developing technology to overcome some of the problems that were encountered. The problems included high rates of bit wear, drill-string vibrations that caused slow drilling and malfunctioning of the core retrieval system, loss of air circulation, and sloughing of the tuff, which apparently caused the breakage of one drill bit. Four other bits were worn out in drilling this interval.

Core recovery was 73%, but 65% of the recovered core was broken. Work ceased for the Christmas holidays on December 17.

The drilling problems, the slow drilling rate, and the expense involved in coring the first 185 ft of UE-25h#1 clearly showed that it would be impossible to drill two air-cored holes at this site with the funds available. Therefore, the objective was changed to obtaining unbroken core to a depth of 400 ft in one hole as expeditiously as possible. When coring recommenced on January 3, 1983, the first lubricant used was an air and water mist. This lubricant proved ineffective in solving the drill-string vibration and bit wear problems. The lubricant was changed to air, soap, and water. The water supply rate was 10 gal. per minute. Lithium chloride was added to the water as a tracer. Drilling from 185 ft to 216 ft required seven shifts. Two bits were worn out. Core recovery was 52%, and all recovered core was broken. Work was suspended on January 5 while the drilling crews were employed at USW G-4.

Drilling commenced again at UE-25h#1 on January 18. Severe sloughing had occurred. Nine shifts were required to clean out the hole to 216 ft. The hole was drilled, rather than cored, to 220 ft. The next 17-ft interval was cored, but with lost circulation of the lubricating fluid. The drilling engineers decided that the best way to complete this hole was to line the portion already completed and reduce the size of the drill bits to 3.032 in. for the remainder of the coring.

Coring from 240 to 400 ft occurred during eight shifts. Four bits were used, of which three were worn out. Core recovery was much better than in the previous drilling, most likely because the 240 ft of lining seemed to dampen the drill-string vibrations.

The completed hole was logged with a Birdwell 3-arm caliper. Electronic noise from this tool compromised the logging record to the extent that fracture patterns of UE-25h#1 were attempted with a Westech television camera, which could not penetrate beyond an obstruction in the casing at 94 ft.

Hole UE-25h#1 was started horizontally on a due west heading. Surveys of heading and inclination taken during the course of drilling were used to construct the diagrams of the hole that are shown in Fig. 2.

A total of 68 drilling crew shifts were used to core this 400-ft hole. The volume of water and soap used to core from 185 ft, where air coring

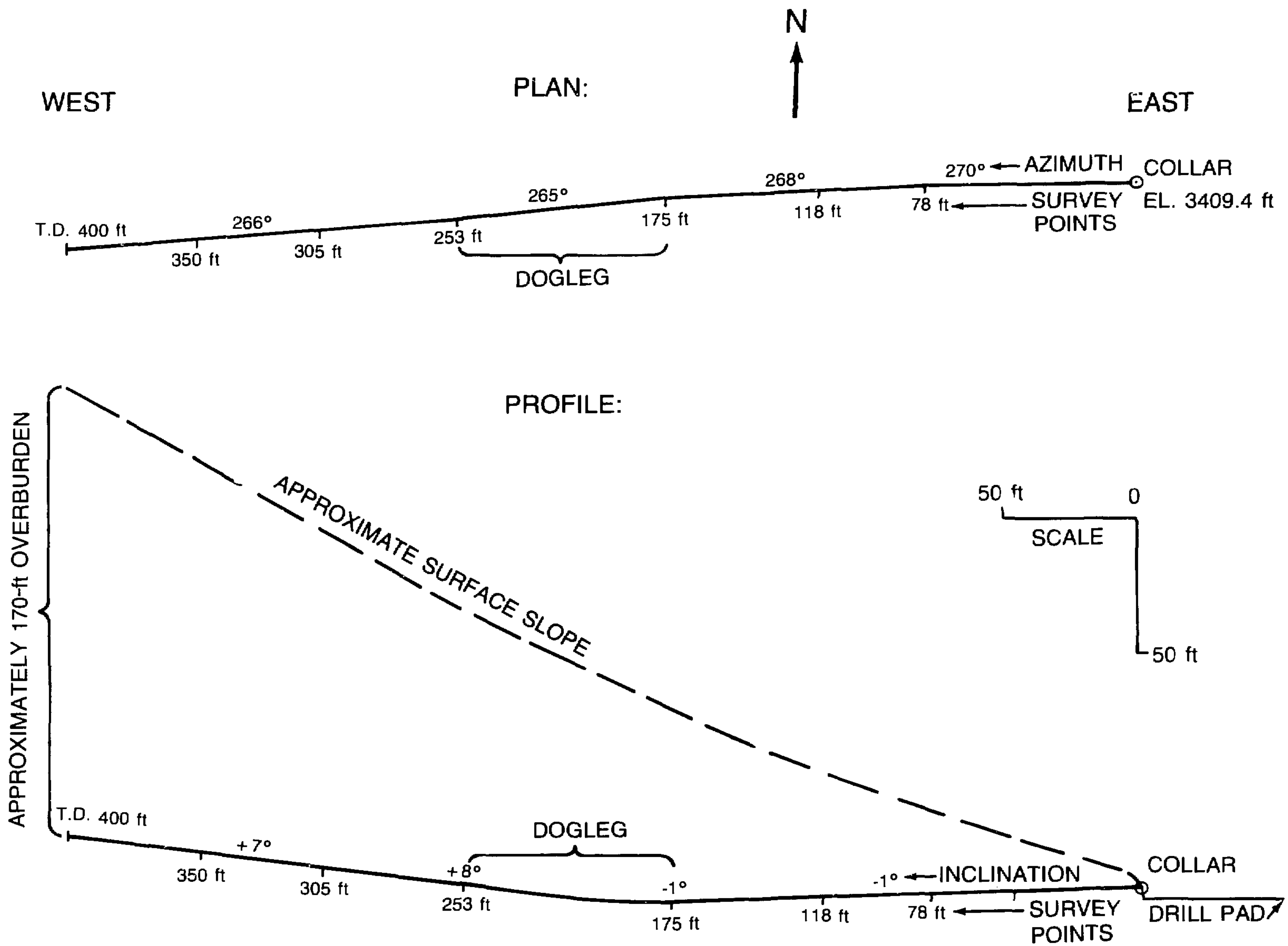

Fig. 2.
Plan and profile of horizontal drill hole UE-25h#1.

ceased, was 1,438 bbls (60,396 gal.). Poor returns resulted in most of this water remaining in the formation.

III. DRILLING TECHNOLOGY: OBSERVATIONS AND RECOMMENDATIONS

Our objective in drilling at Fran Ridge was to obtain data pertinent for radionuclide transport studies in the welded tuff of the Topopah Spring Member. Developing air-drilling technology was also part of the plan. The nonroutine nature of this horizontal coring prompts us to offer the following observations to help those who may require horizontal air coring in the Exploratory Shaft.

(1) In fractured rock, horizontal holes tend to be less stable than vertical holes because the gravity loading of rock fragments is normal to the hole axis in horizontal holes.

(2) Air drilling does not appear to cool the drill bits adequately.

(3) Vibration of the drill string, caused by inadequate drilling fluid lubrication, contributed to poor core recovery and aggravated sloughing of material into the hole.

(4) Drill tool design was not optimized for cooling with air, and probably several bits were damaged when they were withdrawn through the unstable hole. Perhaps a reaming cutter should be tried to aid tool withdrawal.

(5) During early drilling, vibration of the drill string compromised the integrity of the hole and may have compounded problems such as lack of drilling fluid returns, nontrue drilling directions, and standing water in the finished hole. Better drilling results might have been obtained, once a decision was made to use water as a lubricant, if a new hole had been started.

(6) The rock was harder than the drillers had expected. Perhaps more experience is needed to determine the proper combination of thrust, bit revolutions per minute, and air pressure and volume to minimize vibration and maximize bit life.

The following possibilities should be considered in future horizontal air-drilling demonstrations.

(1) Using a bit that provides large coolant passages and a chamfer or reaming cutter to protect the bit during tool removal.

(2) Recording accurate real-time data on bit thrust, revolutions per minute, air pressure and volume, and extent of vibration. These data will permit optimization of drilling parameters.

(3) Developing horizontal drilling in a prototypical lithostatic stress field with prototypical rock strength and fracture characteristics.

(4) Not allowing an uncased horizontal hole to remain without drill string or casing for longer than several hours.

IV. CORE ANALYSIS RESULTS

Each piece of recovered core from the 400 ft of drilling, except for those pieces that were wrapped and waxed, was examined for fractures, for fracture-fill mineralization, and for lithophysal content. The number of fractures and their orientations were important in assessing the potential utility of this Topopah Spring Member exposure for field measurements of radionuclide transport by aqueous flow in fractures. Knowledge of the fracture-fill mineralization is necessary for calculating radionuclide sorption characteristics under aqueous flow conditions and for determining the depth of surface water effects. The lithophysal content of the core is nearly zero; only a few small lenticular lithophysae, 0.5 x 2.0 cm, were observed.

Figure 3 (in pocket) is a graphic log of structural features of the core. Because the core orientation was not recorded, all single fractures are arbitrarily shown dipping west in Fig. 3. With intersecting fractures, the one that makes the higher angle with the horizontal core axis is arbitrarily shown dipping west.

Two fracture frequency figures are shown in Fig. 3 for the horizontal depth interval between 209 and 388 ft. The fraction of core recovered in this interval was sufficiently high, slightly greater than 80%, to justify this analysis. The fractures per linear meter are shown as dots connected with dashed lines. The original data are tabulated in Appendix B. The mean number of fractures per linear meter is 22. The linear fracture frequency is converted to a hypothetical set of fractures normal to the core axis for a unit cubic meter sphere (Scott et al. 1983). This conversion is performed to permit a comparison of the UE-25h#1 data with similar U.S. Geological Survey (USGS) data already available from vertical holes on Yucca Mountain. Fractures per unit cubic meter, F_c, are calculated through application of the formula (Scott et al. 1983)

$$F_c = (\cos A)^{-1} \cdot F_m ,$$

where A is the measured acute angle between the vertical plane perpendicular to the core axis and the fracture set, and F_m is the observed linear fracture frequency of the fracture set. For a preselected footage interval, usually the core run of 10 ft, the products of the preceding formula are summed over the footage interval, multiplied by the diameter (4.07 ft) of the unit meter sphere, and divided by the footage interval. A computer program was written and executed to perform these operations (see Appendix C).

The calculated fractures per unit cubic meter for the UE-25h#1 data are plotted as histograms for the 209- to 388-ft interval in Fig. 3. The mean number of fractures per unit cubic meter is 59 for the Fran Ridge core. The USW GU-3 data in Scott and Castellanos (1984) give an average of 42 fractures per unit cubic meter for the moderately to densely welded tuff of the Topopah Spring Member. The Fran Ridge data for the same lithology of the Topopah Spring Member corroborate the USW GU-3 data concerning the highly fractured character of the Topopah Spring Member. Whether this formation is too highly fractured to permit the isolation of a single fracture for radionuclide transport studies (which was the reason for this coring) is a question that can be answered only by hydraulic conductivity measurements between two boreholes. The absence of a second borehole at UE-25h#1 precludes the possibility of such measurements.

The tuff and the mineralization that were observed in the core recovered from UE-25h#1 can be characterized by the following generalizations. The tuff resulted from a welded ash flow. It is devitrified, hard (Mohs scale H 7), and densely welded. The densities of four pieces from the final 25 ft of coring are 2.21, 2.23, 2.21, and 2.21 g/cm^3. The intergranular porosity of the tuff is near zero.

The minerals filling the fractures are calcium carbonate, manganese oxides, and silica minerals. The location of each fill material is indicated by a colored mark on the core map, Fig. 3. Breccia fill in fractures at 17 ft, 131 ft, and 155 ft indicates that the fractures may be part of a fault system. Calcium carbonate deposits fill fractures within certain intervals throughout the 400 ft of core. However, calcium carbonate in the form of caliche was not observed beyond 83 ft, which appears to be the limit for surface water effects. The ground surface has a slope of 20° at UE-25h#1 (Fig. 2). Therefore, the 83-ft horizontal distance is about 30 ft beneath the ground surface. A sample of calcium carbonate fill from a fracture at 285 ft was analyzed by x-ray diffraction techniques. The fill is 90 to 100% calcite and about 1% quartz (Ellen Semarge, Sandia National Laboratories, written commun., 1983). Materials filling other fractures are manganese oxides and silica minerals. The silica fill in a fracture at 266 ft was determined, using x-ray diffraction techniques, to contain 85 to 95% tridymite and 10 to 15% quartz (Ellen Semarge, Sandia National Laboratories, written commun., 1983).

The tuff contains light- and dark-brown lenticular pumice inclusions throughout the hole, ranging from less than 1 cm to 5 cm in diameter. Generally, the pumice is flattened; the flat plane of the inclusion is nearly parallel to the axis of the core. The only indication of lithophysae anywhere in the core occurs in a few pumice inclusions located between 266.5 and 272 ft. The lithophysal cavities can best be described as incipient, although they do contain minute vapor phase crystals. Nevertheless, the general character of the cored Topopah Spring Member is lithophysal free, like the Exploratory Shaft target unit (DOE 1984). However, the Topopah Spring Member at Fran Ridge is not the stratigraphic equivalent of the target unit: the lithophysal-free zone at Fran Ridge is interbedded between lithophysae-bearing strata, whereas the target unit, as penetrated in drill hole USW G-4, underlies all the lithophysal zones (Spengler and Chornack 1984). The essentially nonlithophysal, devitrified subunit tested at Fran Ridge most likely correlates with a similar subunit penetrated in USW G-4 from 680 to 770 ft between two lithophysal zones (Spengler and Chornack 1984). The lithologic character of this zone and that of the target unit, however, are essentially the same.

ACKNOWLEDGMENTS

R. B. Scott of the USGS provided helpful advice on measuring fractures in the core and on distinguishing natural fractures from drilling-induced fractures. He also identified the UE-25h#1 target horizon as the middle nonlithophysal zone of the Topopah Spring Member, based on his geologic mapping of Fran Ridge (Scott and Bonk 1984).

The work of the following Los Alamos National Laboratory personnel also is acknowledged. S. D. Francis provided technical advice. J. P. Hong and S. W. White wrote a computer program to calculate the fractures per cubic meter. B. E. Hahn typed the manuscript, and P. L. Aamodt contributed helpful criticism that improved the text.

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APPENDIX A

UE-25h#1 HOLE HISTORY--DAILY REPORT

(Compiled by J. C. McDaniel, drilling superintendent, Reynolds Electrical and Engineering Company, with minor additions from the Fenix and Scisson drill specialist's daily report).

12-09-82 Rigged up Acker drill, rigged up 900 compressor. No approval to drill yet.

12-10-82 16 hours rigging up.
3:30 PM - Received OK to start drilling.
Cored 6-1/4-in. hole from 0 to 16 ft - 100% recovery - 2 h, using clear water with Bean pump. 150 rpm, 2000# on bit. No pressure. Full returns.

12-11-82 Cored 6-1/4-in. hole from 16 to 20 ft - 1 h.
(Note) Lost circulation at 17 ft.
Ran 4-1/2-in. H.W. casing to 20 ft.
Cemented same with 17 cu. ft Cal Seal. Good cement returns.
Cored 3.937-in. hole from 0 to 20 ft - 8 ft recovery. Coring with air only, 900 compressor.
Cored from 20 to 30 ft, 10 ft - 1 h, 10 ft recovered.
100 rpm, 2000# on bit, 10 stabilized core barrel.
Lost crown off bit.

12-12-82 Coring 3.937-in. hole, air only, 900 cfm.
30 to 62 ft - 40 rpm, 2000# on bit, 150 psi, lots of vibration on rods - breaking ears off latch-in head.
At 68 ft, picked up 15-ft core barrel.
(Note) Bits #3 & #4 - lost part of crown.
Short runs, really fractured, poor recovery.

12-13-82 Coring 3.937-in. hole, air only, 900 cfm.
92 to 126 ft - 34 ft in 10 h.
30 to 40 rpm, 2000# on bit, 160 psi, lots of vibration.
Survey at 118 ft - 89°, 2° S.W. (See summary on hole deviation at end).

12-15-82 Coring 3.937-in. hole, air only, 900 cfm, days only.
126 to 144 ft - 18 ft with 15-ft core barrel.
Christensen on location - 2 men.

Lots of vibration of rods.
Christensen trying to make pump-in tool work and new air bits.

12-16-82 3.937-in. hole, air only, 900 cfm.
144 to 182 ft - 38 ft, lots of vibration, it is breaking the latch-head springs.
Two Christensen men on location working on pump-in tools and air bits.
(Note) 167 ft - lost air returns.
Pressure dropped from 225 psi to 50 psi, lots of sloughing problems from 45 to 182 ft. Cleaning hole in and out.
Survey at 175 ft - 89°, 2° S.W. (See summary at end).
(Note) from 20 to 167 ft, hole dusting well.

12-17-82 3.937-in. hole, air only, 900 cfm.
182 to 185 ft - 3 ft.
Cleaning out with 3-3/4-in. tri-cone bit, no returns, hole won't clean up.
10:00 AM - Tripped in with core barrel, cleaned fill from 162 to 182 ft.
11:30 AM - Cored from 182 to 185 ft, 3 ft - 1 h, 1/2 ft recovered.
Lots of torque and vibration.
Christensen men on location - 2 men.
2:00 PM - Secured operation for Christmas Holidays.
(Note) Acker drill ram, O-ring leaking, will have to be replaced before continuing coring or cleaning out.

01-03-83 3.937-in. hole, air and mist, lithium chloride.
Ted Norris, LANL, gave OK for air and mist, then, air and soap.
Total water pumped in = 46 bbls or 1932 gal. fluid.
8:00 AM - Started up, replaced packing in Acker drill, rigged up fluid tank and pump.
4:00 PM - Tripped in with 3-3/4-in. rock bit, reamed from 160 to 185 ft with air and mist, no returns, lots of vibration.
6 h - Kept trying to clean hole, no success.
Steve Francis, LANL, gave OK to go to air and soap.

01-04-83 3.937-in. hole, air and soap and lithium chloride, 900 cfm.
185 to 200 ft - 15 ft - 100 rpm, 1000# on bit, 50 psi, fluid 10 gpm.
Cleaning out with 3-3/4-in. rock bit.
6:00 AM - Tripped in hole with core barrel, fill at 170 ft, cleaned out with core barrel.
9:00 AM - Cored from 185 to 188 ft - 3 ft - 1 h - blocked.
Returned inner barrel, recovered one core - fractured.
Pump-in tool seemed to be working well. Cored from 185 to 200 ft, 15 ft.
(Note) Vibration is getting better, 100 rpm, 2000# on bit, 220 psi, Bean 35 - 5 gpm fluid, 80% recovery - fractured.

01-05-83 Coring 3.937-in. hole, air and soap and lithium chloride, 900 cfm.
200 to 216 ft - 16 ft - 105 rpm, 1000# on bit, 150 psi, 10 gpm soap.
(Note) 209 ft - tripped out, laid down 15-ft Christensen core barrel, picked up 10-ft Longyear core barrel.
209 ft - trip - fluid back in 80 ft.
216 ft - trip out - fluid back in 180 ft.
Longyear core barrel and pump-in equipment work better than Christensen - had 50 ft to clean out with Longyear barrel, small amount of vibration at 130 to 150 rpm.
(Note) 2:30 PM - Secured operation to go to USW G-4, will have meeting about 01-13-83 with LANL, F&S, DOE, and REECo about the completion of these holes.

Total days - 9-2/3 days.

01-18-83 Moved equipment from USW G-4 to UE-25h#1. 3.937-in. hole, 216 ft, air and soap and lithium chloride. Rigged up.
Tripped in hole with Christensen 3.937 Geoset bit, shell, 10-ft Longyear barrel. Fill at 73 ft, cleaning out to 193 ft with air and soap, no returns, 200 psi.
3:30 PM: Tube plugged, tools stuck. Retrieved inner barrel, pumped in 35 gal. water with #3 popper, air and soap, worked tools out from 193 to 184 ft, tight. Came free.
5:00 PM: Out of hole, left Geoset bit and shell and threads of

core barrel in hole. Fish at 184 ft. Working Acker head about 40,000# push and pull.

10:00 PM: Tripped in hole with tap on 3-1/2-in. x 2-3/8-in. IF drill pipe. Pushed fish to 192.65 ft, tripped out, no fish.

01-19-83 Tripped in hole with 1.9 tubing open ended. Cleaned fill from 155 to 185.62 ft. Good returns, no pressure. 1.9 stopped at 185.62 ft. Tripped in with tap on IF drill pipe, worked tap in from 185 to 197 ft. Tripped out, no fish.

10:00 AM: Tripped in with tap, 3-1/2-in. O.D. x 1-1/4-in. I.D., 191 ft fill, worked tap in to 193 ft, tapped plug, 700 psi, worked tap loose, tripped out, left tap in hole, 3-1/2-in. O.D. x 1-1/4-in. I.D. - 1 ft long.

12:30 PM: Tripped in with taper tap 3/4 to 2 in. to 163 ft fill, plugged tap. Tripped out, unplugged, tripped in, fill at 155 ft, cleaned out from 155 to 196 ft, 200 psi, no returns. Tripped in with taper tap on 2-3/8-in. IF drill pipe, pushed fish to 212.48 ft. Tripped out, no fish. Tripped back in with taper tap to 195.18 ft.

01-20-83 Cleaned from 195.18 to 197 ft, no returns, tools plugged, tripped out. Changed out 900 compressor for HHE 1200. Tripped back in with tap. Reamed from 151 to 160 ft, started getting returns with LCM 20# with water, won't drill anymore, plugged. Tripped in with 1.9 tubing open ended to 150 ft, pumped in LCM. Tripped out, tripped in with 3-3/4-in. rock bit, cleaned fill from 159 to 216.10 ft. Tripped out, cones gone off bit, partial returns.

01-21-83 3.937-in. hole, 216 ft, air and soap and lithium chloride. From 216 to 237 ft - 21 ft in 4 h. Lost 7 ft core, good rock.

1:00 AM: Tripped in hole with 1.9-in. tubing to 180 ft, mixed heavy soap. Pumped in from 160 to 180 ft, conditioned hole, good returns. 200 psi, 1 - 1200 compressor, Bean 35 pump.

5:00 AM: Tripped in hole with HQ core barrel, reamed from 150 to 199 ft, stopped.

9:00 AM: Tripped out. Drill tools out to 150 ft, partial returns, pumped in 17 gpm, 5-gpm returns, no air returns, 150 psi.

10:30 AM: Tripped in with 3-3/4-in. flat bottom mill to 196 ft, cleaned out to 220 ft, no returns, air or soap. Tripped back in with core barrel, washed from 140 to 220 ft using air, soap, and lithium chloride, partial returns, air - soap, 300 psi.

3:00 PM: Coring from 220 to 237 ft, little returns. (Note) Last 7 ft, good core.

4:00 PM: Talked to Ted Norris and Hammer about reducing hole size to 3.032 in., OK'ed by Ted Norris, LANL.

10:30 PM: Inner barrel stuck, tripped tools.

01-22-83 3.937-in. hole, 237 ft.

1:00 AM: Tripped in hole 3-1/2-in. HCQ rods, with reaming shoe to 184 ft, washed and reamed into 216 ft, stopped.

9:30 AM: Tripped out, tight hole, reamed out, very little returns, air/soap, casing shoe worn out.

11:30 AM: Made up casing shoe, 3-3/4 in., tripped in, fill at 196 to 218 ft, stopped. Tripped out. Shoe worn out. Very little returns, no air returns. Made up 3-3/4-in. flat bottom mill, tripped in with 2-3/8-in. IF drill pipe.

4:00 PM: Reamed and washed from 196 to 235.5 ft, stopped. Little returns.

9:00 PM: Tripped out, mill worn out. Tripped back in with 3-3/4-in. flat bottom mill to 217 ft.

01-23-83 3-3/4-in. hole to 240 ft. Reamed with flat bottom mill from 217 to 240 ft, made 3 ft of new hole, no returns, Bean 35, no air.

4:00 AM: Tripped out with 2-3/8-in. IF drill pipe, tripped in with 3-1/2-in. HCQ rod with reaming shoe.

5:00 AM: Reamed from 158 to 170 ft, soap only, no returns, 170 ft stopped.

6:00 AM: Tripped out, left reaming shoe (3-1/2-in. O.D. x 6 in. long) + 2.5-ft HCQ rod in hole. (Note): Total junk left in hole at this time - depth 160 to 190 ft: 3.937-in. core bit, 6-in.-long reaming shell, with threads of core barrel pulled off, taper tap -

2-1/4 to 3-1/4 in., 1-1/4-in. I.D., 1 ft long. Three cones off 3-3/4-in. bit. Recovered 2 cones, 3-1/2-in. casing shoe 6 in. long, 2/5-ft HCQ drill rod 3-1/16-in. I.D.

8:00 AM: Tripped in hole with 3-1/16-in. casing spear on 2-3/8 IF drill pipe, cleaned out fill from 151 to 171 ft, 1-1/2 h, no returns, air and soap, 100 psi. Tripped out, no fish, mandrel on spear was bent due to pushing in.

11:30 AM: Tripped back in with taper tap, 2-1/4 in. x 3-1/2 in. - 1-1/4-in. I.D., 1 ft long - new. Fill at 160 to 167 ft, tap plugged. Tripped out, unplugged tap, tripped in with same tap, washed from 153 to 167 ft, can't get past 167 ft. Tap completely worn out.

2:00 PM: Tripped in with 3-3/4-in. flat bottom mill on 2-3/8 IF drill pipe, reamed from 160.5 to 172.20 ft - 2 h, mill worn 1/2 in. - not too bad.

5:30 PM: Tripped in with 1.9-in. tubing open ended to 172 ft, tried to wash past 172 ft with air and soap, 200 psi, pumping in 17 gpm, returns 5 gpm, very little air, tripped out.

6:30 PM: Tripped in with 3-1/4-in. casing spear on 2-3/8-in. IF drill pipe to 172.70 ft, tripped out, no fish.

8:00 PM: Tripped in with 3.937 impregnated bit on HCQ rod, reamed from 161 to 181 ft, no returns, tripped out. 1-1/2 ft of rocks in rods, bit worn out.

01-24-83 3-3/4-in. hole, 240 ft. Tripped in with wash shoe on 3-1/2-in. HCQ rod, cleaned out fill from 136 to 161 ft, good returns, air and soap, 60 psi. Tools good and free, reamed to 191 ft, reamed and rereamed 170 to 191 ft, partial returns, 40 psi, air and soap.

9:30 AM: Tripped out, shoe worn out.

10:30 AM: Tripped in with 3-3/4-in. flat bottom mill on 2-3/8-in. IF drill pipe. Reamed from 150 to 240 ft - 5 h. Reamed and rereamed, partial returns, 100 psi, conditioned hole.

3:00 PM: Tripped out mill, not bad.

4:00 PM: Tripped in with casing shoe on 3-1/2-in. HCQ rod. Reamed from 150 to 194.30 ft - 4-1/2 h, stopped. Had 1 ft partial returns, rocks in HCQ rod.

10:30 PM: Built up flat bottom mill. 3-3/4 in. - 24 h total fluid used: 156 bbls. Total fluid pumped in hole: 479 bbls.

01-25-83 3-3/4-in. hole to 240 ft. Reamed with 3-3/4-in. flat bottom mill from 130 to 240 ft, reamed and rereamed. Water and lithium chloride only, 30 rpm, 0/100 psi, 35 gpm - no returns. Total fluid pumped in this 24 h - 355 bbls.

1:00 PM: Tripped out, mill not bad.

2:00 PM: Tripped in with HCQ rod, homemade shoe, reamed in from 190 to 240 ft, dry landed HCQ at 240 ft.

3:00 PM: Tripped in with 3-in. homemade mill shoe with 2-3/4-in. NCQ drill rod, cleaned out HCQ rod from 170 to 240 ft with water only.

10:30 PM: Tripped out to check mill - OK. Tripped back in - 1 h - milled on 3-1/2-in. casing shoe - 240 ft - 40 rpm, water only, 20 gpm, 20 psi.

01-26-83 3-1/2-in. HCQ set at 240 ft, 2 h milling on HCQ casing shoe, 50% returns. Tripped out mill - 1/16 in. under gauge.

3:00 PM: Tripped in with 3.032 core barrel and bit, milled through shoe at 240 ft.

3:30 PM: Coring from 240 to 272 ft - 32-ft short runs, blocking off every 4 or 5 ft, 200 rpm, 2/4000# on bit, 200 psi, 2 gpm - 1 compressor, 95% core recovery. Survey at 253 ft - 98° 5 ft S-W. Total fluid used this 24 h - 60 bbls.

01-27-83 3-1/2-in. HCQ set at 240 ft. Coring 3.032 hole from 272 to 333 ft - 61 ft - 85% core recovery, short runs, blocking off. 200 rpm, 2/4000# on bit, 200 psi, 20 gpm - 1 compressor, 25 to 50% fluid returns, very little air. Survey at 305 ft - 97° 40' S-W.

4:00 PM: (Note): 316 ft, hole getting very tight. No returns, tripped out, bit inner gauge worn, tripped in with new bit.

6:00 PM: Washed from 316 to 318 ft.

8:00 PM: Coring, very little returns. Total fluid used this 24 h - 108 bbls.

01-28-83 3-1/2-in. HCQ rod set at 240 ft. 3.032 hole from 333 to 388 ft - 55 ft, 90% core recovery. 150 rpm, 4000# on bit, 150 psi, 20 gpm - 1 compressor. little fluid returns.

1:30 AM: 333 ft, tried to pull inner barrel, broke ears on tube, tripped rods, inner barrel crushed, trying to rig up another inner barrel.

8:00 AM: Received inner barrel from area 12, made up new Longyear assembly, tripped in hole, no fill.

2:00 PM: Coring 333 to 388 ft. Total fluid used this 24 h - 121 bbls.

01-29-83 3-1/2-in. HCQ rod set at 240 ft, 3.032 hole, 388 to 400 ft - 2 h - 12 ft - 105 rpm, 2000# on bit, 100 psi, 20 gpm, 1 compressor.

2:00 AM: TD at 400 ft - no returns. Tripped out, tight hole, 355-ft hole very tight, working stuck pipe from 355 to 345 ft with Bean 35 pump only.

11:00 AM: Tripped inside NCQ rod with 1.9-in. tubing with taper tap, 1-1/2 in. x 2-1/4 in., to retrieve inner barrel, core inside, can't work tap in inner barrel. Rigged up 5 x 8 pump, working stuck pipe 3 ft free, working pipe hard.

6:00 PM: Rigged up air, mixed 20 gal. soap, pumped in working pipe.

9:00 PM: Pipe rotating, working pipe free, tripped out laying down tools. Total fluid used this 24 h - 154 bbls.

01-30-83 3-1/2-in. HCQ rods set at 240 ft, 3.032 hole at 400 ft. Moved out equipment to rig up Birdwell.

3:00 AM: Ran Birdwell caliper log, pushed in on 1/2-in. aluminum rods, stopped at 290 ft, logged from 290 out to 240 ft. Checked tools, reran same, stopped at 290 ft, tripped caliper.

5:00 AM: Tripped in with NCQ rod with 3-in. mill, cleaned out with mill from 198 to 380 ft with Bean pump, 35 gpm, water only, hole getting tight, rigged up 5 x 8 pump, pumping to 60 gpm, cleaning hole to 400 ft - no returns, conditioned hole.

12:30 PM: Reran caliper log, stopped at 293 ft. Rigged down Birdwell, ran Westech TV camera, 2-7/8-in. O.D., stopped at 94 ft, at 45 ft camera started in dirty water.

4:00 PM: Rigged down equipment and moved to UE-25b#1. Total fluid used in this 24 h - 161 bbls. Total fluid pumped in UE-25h#1 - 1438 bbls of water, soap, lithium chloride solution.

Total days - 22-2/3 operating days.

(Notes): Tools left in hole: 3-1/2-in. HCQ rods, 240 ft with reaming shoe, dogleg 175 to 253 ft - 68 ft.

Junk left in hole: 3.937 bit 5 in. long, reaming shell, 6-in. taper tap 2-1/4 in. x 3-1/4 in. x 1-1/4-in. I.D., 2 cones of 3-3/4-in. bit, reaming shell 6 in., 2-1/2-ft HCQ rod

	Azimuth	Inclination	Date of Survey
Survey at 78 ft	270°	-1°	12/12/83
118 ft	268°	-1°	12/13/82
175 ft	268°	-1°	12/16/82
253 ft	265°	+8°	1/26/83
305 ft	266°	+7°	1/27/83
350 ft	-*	+7°	1/28/83

*Unable to read direction.

APPENDIX A (cont)

DRILL BIT RECORD

#1 - New	Christensen 6-1/4 in. - 0 to 20 ft, 2-1/2 h - Good 20% recovery.	
#2 - New	Christensen 3.937 in. - 20 to 30 ft - 1 h - left crown in hole 100 rpm, 2000# on bit, air only, 50 psi. Surface set.	
#3 - Used	Huddy Impregnated 3.937 in. - 30 to 46 ft - 16 ft - 2 h. 1/3 of crown left in hole. 60 rpm, 75 psi, air only, 2000# on bit.	Worn out
#4 - New	Longyear Impregnated - 46 to 68 ft - 22 ft - 3 h, 60 rpm, 3000# on bit, 150 psi, air only, lots of vibration.	Worn out
#5 - New	Christensen Chrisdrill - carbide inserts 68 to 78 ft - 10 ft - 1 h - inserts missing, 1/3 of crown gone - pulled off.	
#6 - Used	Truco Impregnated - 78 to 111 ft - 33 ft - 6 h, 40 rpm, 2000# on bit, 150 psi, 900 cfm.	Worn out
#7 - New	Geoset, Christensen - 111 to 185 ft - 73 ft - 4 h, 40 rpm, 2000/4000# on bit, air only, no returns at 167 ft. Christensen on location.	Worn out
#8 - New	3-3/4-in. rock bit, clean out 185 ft - went to air and mist.	Fair
#9 - New	Christensen Impregnated - 185 to 209 ft 24 ft - 3 h, 100 rpm, 2000# on bit, 220 psi, air and soap.	Worn out
#10 - New	Wesdrill S.S. - 209 to 216 ft - 7 ft - 1-1/2 h, 130 rpm, 6000# on bit, 150 psi, 10 gpm.	Worn out

Total cost - New bits at $1,400.00 each - $11,200.00

(Note) Bits 11 through 14 were homemade REECo flat bottom mills and casing shoes, no cost.

#15 - New	Wesdrill from 240 to 253 ft - 13 ft - 3 h, 200 rpm, 4000#, 200 psi, 20 gpm, 1200 cfm, 25% fluid returns.	Worn out
#16 - New	Wesdrill 3.032, 253 to 316 ft - 63 ft - 14 h 200 rpm, 2/4000# on bit, 200 psi, 20 gpm, 1200 cfm, 25 to 50% fluid returns.	Inside gauge worn

APPENDIX A (cont)

#17 - New	J. K. Smith 3.032, 316 to 333 ft - 17 ft - 2 h	Worn from cleaning out
#18 - New	Longyear 3.032, 333 to 400 ft - 67 ft, 12 h, 150 rpm, 2000# on bit, 200 psi, 20 gpm, 1200 cfm.	Good

Total cost of bits and core barrels - $14,000.00.

APPENDIX B

DETAILED FRACTURE LOG OF HORIZONTAL DRILL HOLE UE-25h#1

The zone consists of generally grayish-red, dense, hard, moderately to densely welded tuff; rare light-gray rhyolite xenoliths, 1 cm in maximum dimension; rare-to-sparse flattened pumice, maximum 2 cm in length, with vapor phase crystals of cristobalite/tridymite (SiO_2) and alkali feldspar. Caliche (porous $CaCO_3$) and calcite (sparry $CaCO_3$) identified with dilute HCl. Silica minerals (quartz and tridymite) identified by E. Semarge, using x-ray diffraction. Thicknesses of mineral coatings on fractures less than 0.5 mm were not measured. Lithologic and fracture log by F. M. Byers, Jr.

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
Ash-flow tuff, densely welded, complex stockwork of fractures filled with caliche; in middle of interval, 5-cm caliche vein cuts core at 10°.	0.0-6.4 (0.0-1.95)	6.4 (1.95)
Ash-flow tuff, densely welded footages and angles of fractures: 7.0: 35° 1-cm veinlet caliche 7.2: 45° 1-mm veinlet caliche 7.4: 60° 1-mm veinlet caliche 7.8: 45° 1-mm veinlet caliche 7.9: 30° intersecting 45° above 8.1: 45° 1-mm veinlet caliche	6.4-8.4 (1.95-2.56)	2.0 (0.61)
Ash-flow tuff, densely welded, complex stockwork of broken core along caliche-filled fractures.	8.4-10.2 (2.56-3.11)	1.8 (0.55)
As above, two pieces of core separated and broken along 3-mm caliche-filled fracture.	10.2-11.0 (3.11-3.35)	0.8 (0.24)
As above, broken core with many caliche-coated fractures.	11.0-12.0 (3.35-3.66)	1.0 (0.31)
As above, core piece truncated at 12.8 ft by 1-mm caliche-coated fracture, 60°.	12.0-12.8 (3.66-3.90)	0.8 (0.24)
As above, broken core, caliche-coated surfaces.	12.8-13.6 (3.90-4.15)	0.8 (0.24)
Ash-flow tuff, pale brown, densely welded, minor vapor phase crystals in pumice; core in 0.3- to 0.8-ft pieces; core broken near 90°, mostly drilling induced.	13.6-17.4 (4.15-5.30)	3.6 (1.10)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
Fractures at footages: 16.8: 40° 2-cm-wide fault breccia 17.1: 40° fracture intersects fault breccia at end of core.		
Ash-flow tuff, as preceding interval, broken core, caliche-coated surfaces.	17.4-18.0 (5.30-5.48)	0.6 (0.18)
As preceding, less broken core, fractures at following footages: 18.0: 60° caliche coated 18.2: 30° " " 18.6: 30° clean, possibly drilling induced 19.0: 70° rough, purplish alteration 19.1: 45° microbreccia, 5 mm thick 19.2: 90° ± possibly drilling induced 19.5: 60° smooth 19.6: 60° smooth intersects above 20.0: core broke irregularly	18.0-20.0 (5.48-6.10)	2.0 (0.62)
As preceding, about 50% welded tuff breccia fragments in cement grout used to anchor casing.	20.0-20.6 (6.10-6.28)	0.6
Ash-flow tuff, core variably broken from small pieces, granule-size to one 0.9-in.-length core from 22.0 to 22.9 ft. Most core fragments caliche coated and bounded by irregular surfaces. Fractures at following footages: 24.5: 45° 24.7: 45° intersects above 24.8: 55° " " 25.3: 30° planar, no caliche	20.6-25.3 (6.28-7.71)	4.7 (1.43)
Ash-flow tuff, as preceding, variably broken core from small pebble-size pieces to 0.5-ft-maximum length. Three waxed intervals 32.0-32.4 ft, 32.55-33.05 ft, and 33.75-34.1 ft. Broken core surfaces irregular, possibly drilling induced. Occasional caliche-coated surface.	25.3-47.4 (7.71-14.45)	22.1 (6.74)
Ash-flow tuff, as preceding, variably broken with intermittent swarms of pebble-size fragments alternating with larger pieces of core up to 0.6 ft. Waxed intervals at 49.4-49.65, 50.2-50.5, 58.5-58.9, 60.0-60.25, and 69.9-70.45 ft. Thin (±1 mm) caliche coated. Surfaces at following footages: 51.0: 45° 59.0: 40°	47.4-83.5 (14.45-25.45)	36.1 (11.00)

APPENDIX B (cont)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
Planar at following footages: 77.1: 40° 77.6: 40°, almost perpendicular to preceding.		
Ash-flow tuff with common small pumice lenticles less than 1 cm length. Hardness 6-1/2 to 7, essentially zero intergranular or matrix porosity. Core is mostly broken along hackly irregular breaks, probably largely drilling induced. Fracture footage, angle with core axis, description: 83.5: 45° 4-mm-thick caliche veinlet 85.0: 0°± a few cm long, curved, with thin Mn oxide coating 86.3: 50° planar 87.4-87.9: 5-15° curved, smooth 89.6-90.7: 5° fracture in central part of several core pieces, Mn oxide coating overlain by 1-mm-thick sporadic coating of sparry calcite ($CaCO_3$) 91.3-91.8: 10-20° rough fracture with very thin (<0.1-mm) coating of sparry calcite 92.3-92.7: 30° rough fracture with thin calcite (from here to end of hole, calcite is sparry) 94.0-94.2: 3° rough 95.4-95.9: 0°± <0.1-mm coating of calcite 96.7-97.0: 30° " " " " " 98.7-99.0: 30° 0.1±-mm SiO_2 minerals 99.7: ? chip, smooth, planar, Mn oxide coated.	83.5-100.0 (24.45-30.48)	16.5 (6.03)
Ash-flow tuff, very hard, 6-1/2±; no visible intergranular porosity. Core mostly broken into chips with only several pieces 0.2-0.4 ft long. Fracture footages, angle, and description: 104.6-105.0: 0°± slightly curved, white gougy material 106.7-107.6: 20° gouge, calcareous 108.6: 45° planar, smooth 110.8: 45° planar, Mn oxides 111.2: 30° " " "	100.0-111.6 (30.48-34.02)	11.6 (3.54)
Ash-flow tuff, as above; less breakage than previous run with 4 core pieces 0.4 to 0.7 ft. Waxed core, 113.6-114.0. Fracture footages, angle, and description: 112.6-112.3: 0°± rough 113.2: 35° planar	111.6-114.6 (34.02-34.93)	3.0 (0.91)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
113.3: 40° planar; intersects 113.2 114.0: 70° planar; Mn oxide coating		
Ash-flow tuff, as preceding, largely broken core with a few slivers 0.3 ft long. Inferred fracture footages: 117.2-117.5: planar surface with 1-mm coating of calcite 119.0-119.6: a few chips with planar surface with Mn oxide coating <0.1 mm.	114.6-120.0 (34.93-36.58)	5.4 (1.65)
Ash-flow tuff, as preceding, hard, no visible intergranular porosity. Pieces of core 0.2 to 0.5 ft long alternate with broken core, 0.2- to 0.5-ft intervals. Intervals broken core from 126-137 ft contain subrounded pebble-size chips, probably drilling induced and recovery is about 50%. Elsewhere in this run, core recovery is 85% or better. No visible pumice, very fine grained, with sparse phenocrysts, lithic granules, and Mn oxide specks. Fractures at following footages: 120.3: 45° planar, <0.1-mm Mn oxide coating (120.3-120.7): waxed core 122±: 80° planar, Mn oxide coated (123.1-123.5): waxed core 131±: 45° rough, calcite-cemented microbreccia, 1 mm thick 136±: 10° rough, <0.5-mm calcite 136.5: 60° smooth, <0.1-mm Mn oxide 136.6: 10° rough, <0.5-mm calcite (intersects 136.5 at 30°) 137.5: ? smooth, <0.05-mm Mn oxide 143.5: 20° smooth, Mn oxide dendrites 144.0: 65° smooth, planar 144.7: 40° rough, planar 144.8: 45° " " 148.2-148.4: 0° planar, smooth, <0.5-mm calcite coating 150.7: 45° rough, planar 151.1: ? smooth, planar.	120.0-152± (36.58-46.3±)	32.0± (9.75±)
Ash-flow tuff, as preceding. Core broken, subangular to subrounded, except for 3 pieces, 0.2-0.3 ft. Densely welded with flattened pumice lenticles, 0.5-3.0 cm, making 10-25° foliation attitude with core axis; probably	152.0±-153.5 (46.33±-46.79)	1.5± (0.45±)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
represents east dip; fractures at following footages: 152±: 60° rough 152.5: 65° smooth, planar, Mn oxide coating.		
Ash-flow tuff, hard, dense, core broken, subangular. Maximum dip of foliation, 15°. Four core pieces 0.3-0.4 in. long. Fractures and angle with core axis at following footages: 153.5: 60°x20° intersecting, Mn oxide coated 154±: 75x15° " " " " 155±: 25° Mn oxide coated 155.5: 20° " " " 157±: 50° " " " 159?: 25° " " " intersects 60° calcite coated	153.5-159± (46.79-48.46±)	5.5± (1.67±)
Core broken and mostly missing, recovery less than 50%	159.0±-163.0 (48.46±-49.68)	4.0± (1.22±)
Ash-flow tuff, as preceding, except maximum dip (angle with core axis but probably indicating easterly dip) is 20°. Core broken with 4 pieces, 0.2 to 0.3 ft long. Fractures at following estimated footages: 163-164: At least 2 Mn-oxide-stained fractures 164.5: 55° calcite-coated fracture intersects 35° calcite-cemented 2-mm-thick fault microbreccia 164.5-173.0: broken core, less than 50% recovery. About 6 Mn-oxide-coated fractures of undeterminable orientation.	163.0-173.0 (49.68-52.73)	10.0 (3.05)
Ash-flow tuff, as preceding, core broken into pebble-size chips with two pieces 0.3-0.4 ft long. Fractures at following footages: 173.5: calcite, 0.5-mm coating irregular surface 174±: three planar fractures on broken surfaces 175±: 20° two planar fractures 175.5: 0°± Mn-oxide-coated fracture 176.0: 10° " " " " 176.5: 10° one planar fracture 176.6: calcite up to 2 mm thick on broken end of 0.4-ft core piece.	173.0-177.0 (52.73-53.95)	4.0 (1.22)

APPENDIX B (cont)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
Ash-flow tuff, as preceding, no visible pumice; broken core. At least 2 planar fractures of undeterminable orientation.	177.0-177.4 (53.95-54.07)	0.4 (0.12)
Ash-flow tuff, as preceding, but run labeled "Fill from undetermined depth"... Core rounded and beveled by drilling.	177.4-182.0 (54.07-55.47)	4.6 (1.40)
As preceding, recovered 0.2 ft (Changed from air to air mist and soap--see Appendix A)	182.0-185.0 (55.47-56.39)	3.0 (0.92)
Ash-flow tuff, densely welded, hard, pumice <1 cm length, 20°, assumed to dip easterly as in surface outcrop. Core almost entirely broken with rotated pieces grooved by drill bit at varying angles. Breakage appears drilling induced.	185.0-188.0 (56.39-57.30)	3.0 (0.91)
Ash-flow tuff, as preceding, about 30% recovery.	188.0-191.0 (57.30-58.22)	3.0 (0.92)
Ash-flow tuff, as preceding. Core broken with 3 pieces 0.3 to 0.4 ft long. Core recovery 66%. Fractures at footages and angle with core axis: 191.5: 45° pumice foliation is 5° 191.8: 45° pumice foliation, 0°± 192.2: 55° 0.5 mm calcite coating 192.4: 60° planar 193.2: 60° " 193.6: 55° Mn oxide stained 193.8: 60° " " "	191.0-194.0 (58.22-59.13)	3.0 (0.91)
Ash-flow tuff, broken, three 0.4-ft pieces, pumice <2 cm long, <5° from core axis, 87% core recovery. Fractures and angles with core axis: 194.5: 45° planar 194.8: 35° " 195.2: 45° " 195.5: 2 intersecting at 90° 196.0: 45° and 10° 196.5: 80° planar, Mn oxide coating 197.5: 10° " 197.7: 10° " 198.0: 10° " 198.8: 60° <0.5 mm calcite coating 199.2: 40° planar 199.5: 40° "	194.0-200.0 (59.13-60.96)	6.0 (1.83)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
Ash-flow tuff, as preceding. Rock completely broken from sand to cobble size. At least 3 fractures of indeterminable orientation. 20% core recovery, but see below.	200.0-204.0 (60.96-62.18)	4.0 (1.22)
As preceding, pumice foliation angle 20°. Recovered 3 ft of core, including 2 ft from preceding run. Core largely broken along fractures, resulting in angular pieces, pebble to cobble size. Fractures include following: No. planar 1 No. Mn oxide stained 9 No. thin calcite coating 3	204.0-205.0 (62.18-62.48)	1.0 (0.30)
As preceding, except for 0.3 ft at 208.7-209.0, 87% core recovery. Fractures include following: No. planar 7 No. Mn oxide stained 10 (mostly <40° from core axis) No. calcite coated 1	205.0-209.0 (62.48-63.70)	4.0 (1.22)
Ash-flow tuff, as preceding, 100% core recovery, mostly broken except at following footages (no down arrows) 209.0-209.3: 1/2 core cut longitudinally by 15° planar, ends cut by 75° Mn oxide coated and 60° planar. 209.4-209.7: bounded by 60° Mn oxide coated and 70° planar, fracture within core 35° planar. 209.7-209.9: bounded by 40° and 65° planar fractures. 209.9-210.6: broken core, following fractures: No. planar 4 No. Mn oxide coated 5 210.6-210.8: bounded one end, 50° planar 210.9-211.3: bounded by two 45° planar and one irregular 90° fracture down middle of core. 211.3-211.45: bounded by subparallel 45°. 211.45-211.6: bounded on one end by intersecting 60° planar and 45° Mn oxide coated; also 25° Mn oxide and 60° planar fractures. 211.6-211.8: 2 subparallel 40° planar on each end. 211.8-212.5: Following fractures: Mn oxide coated 2 Mn oxide coated: 40°, 45°, 45° Planar: 45° 45°	209.0-216.0 (63.70-65.83)	7.0 (2.13)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)

212.5-212.6: Following fractures:
  Planar 2
  Mn oxide coated 2
212.6-213.7 ft: 3 pieces core
212.6: 80° Mn oxide coated
212.9: 40° rough surface
  15° Mn oxide coated
212.9-213.5: calcite coated, curved low-angle fracture. Pumice foliation, 5°
213.5-213.7: 40°, 50°, and 75° planar fractures
213.7-216.0: broken core, subangular fractures
  Mn oxide coated 13
  Calcite coated 1		

Drilled with rock bit, no core	216.0-220.0 (65.83-67.06)	4.0 (1.23)
Drilled 1.0 ft; recovered 6 ft; 5 ft, sprayed with blue paint, are "E-core," pebble-size, subangular, no fractures recognizable, may be coarse cuttings from rock bitting. 220.0-221.0 valid core, pebble to cobble size, angular to subangular. Ash-flow tuff, as preceding. Three poorly defined fractures, 25°, 40°, and indeterminate.	220.0-221.0 (67.06-67.36)	1.0 (0.30)

Ash-flow tuff, as preceding, granule to cobble size, angular.
Fracture surfaces noted:
  No. planar, incl. one 50° 18
  No. Mn oxide coated, incl. 35°, 20°, 5°, 0° 23
  No. SiO_2 mineral coated 65° 1
	221.0-224.5 (67.36-68.43)	3.5 (1.07)

Ash-flow tuff, as preceding, foliation angle 15°. Fractures at following footages:
  224.5: 45° planar
  224.7: 35° Mn oxide stained
  224.9: 0° hairline, irregular
	224.5-225.2 (68.43-68.64)	0.7 (0.21)

Ash-flow tuff, as preceding, pebble to cobble size, except for 1 piece,
  225.2-225.5:
    35° planar
    40° Mn oxide coated
	225.2-226.6 (68.64-69.07)	1.4 (0.43)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
50° planar 0° longitudinal planar 225.5-226.4, broken core following fractures No. planar 5 No. Mn oxide stained 10 No. SiO_2 mineral coated 1 226.4-226.6: 1 piece bounded by two parallel planar 55° fractures.		
Ash-flow tuff, as preceding, broken core following fractures No. planar 4 No. Mn oxide coated, incl. 60°, 60°, 60°, 40° 14 No. SiO_2 mineral coated 1	226.6-228.0 (69.07-69.49)	1.4 (0.42)
Ash-flow tuff, as preceding, broken core following fractures No. planar, 0°, 45°, 15°, 60°, 0° 11 No. Mn oxide coated, incl. 5°, 45°, 35°, 35°, 30°, 45°, 5° 27 No. calcite coated 1 No. SiO_2 mineral coated 20°, 0°, 30°, 40° 4	228.0-232.0 (69.49-70.71)	4.0 (1.22)
Ash-flow tuff, as preceding, 80% recovery; detail of footages: 232.0-232.3: broken core, following fractures: No. Mn oxide coated 2 No. planar 1 232.3-232.7: 1 piece, following fractures: 40° planar 5° planar 70° Mn oxide stained 232.7-233.0: core not recovered(?) 233.0-233.9: 1 piece, following fractures: 233.0: 50° 1-mm calcite coating 233.4: 30° irregular hairline 233.9: 55° Mn oxide coated 233.9-234.8: broken core, following fractures: 234.0: 55° Mn oxide and calcite 234.1: 0° calcite coating 234.2: 65° Mn oxide and calcite 234.5: 75° and 40° planar 234.5-234.8: Mn oxide stained, 3	232.0-237.0 (70.71-72.24)	5.0 (1.53)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
234.8-235.2: 1 piece: 234.8: 70° Mn oxide coated 235.2: 40° " " " 235.2-235.4: Assumed core loss (core below does not match with preceding) 235.4-237.0: broken core, following fractures: 235.4: 90° planar 235.6-235.7: 2 parallel 65° Mn oxide coated		
Drilled with rock bit. Reduced diameter from HCQ to NX	237.0-240.0 (72.24-73.15)	3.0 (0.91)
Ash-flow tuff, as preceding, mostly broken, except for four 0.3-0.4-ft pieces. 90% recovery. 240.1: 40°, 40° planar 240.3: 2 planar 45° intersecting 240.6: 60° planar 240.6-241.0: broken core No. planar 4 241.0-241.3: 1 piece: 0° planar 45° and 55° planar 40° Mn oxide stained 241.3-242.0: broken core 0° and 20° planar 45° and 10° Mn oxide stained 242.0-242.4: 1 piece: 70° and 20° hairline cracks 45° and 40° planar 242.4-243.2: broken core No. planar 2 No. Mn oxide coated 6 No. SiO_2 mineral coated 2 243.2-243.5: 1 piece; small 1-cm-long pumice foliation, 0-5° with core axis 243.2: 45° planar 243.5: 70° calcite coated 243.5-243.9: broken core 10° and 55° planar 45° Mn oxide coated 243.9-244.3: 40° rough planar 244.3-244.7: broken core 35°, 60°, 0°, 0° 4 244.7-245.0: no core	240.0-245.0 (73.15-74.68)	5.0 (1.53)

APPENDIX B (cont)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
Ash-flow tuff, moderately welded; pumice compaction, 2:1. Fractures at following footages:	245.0-249.0 (74.68-75.90)	4.0 (1.22)
245.0: 45° planar		
245.25-245.55: waxed core		
245.55-245.8: 45°, 35°, 30° hairline fractures		
246.0: 45° planar		
246.2: 45° hairline		
246.3: 45° rough silica mineral coated		
246.3-246.5: 70° 45° planar; 0° Mn oxides		
246.5-247.2: 1 core piece split in middle, 5°:		
246.5: 70° planar		
247.2: 75° "		
247.2-249.0: continuous core:		
248.0: 30° planar		
248.1: 60° "		
248.2: 45° "		
248.4: 45° "		
249.0: 55° and 55° intersecting planars.		
Ash-flow tuff, light brownish gray, pumice indistinct, not flattened (compacted). Color change from overlying light brown gradational from 240.0 to 249.0: Core recovery, 92%. Details at following footages:	249.0-253.0 (75.90-77.11)	4.0 (1.21)
249.0-249.2: broken core		
249.2: 60° rough		
250.1: 40° rough		
250.1-250.7: broken core, angular		
90°, 45°, 70° Mn oxide coated		
90° SiO_2 mineral coated		
250.7: 40° Mn oxide coated		
250.8: 5° planar		
251.2: 45° Mn oxide coated		
251.2-252.4: 5° Mn oxide coated		
251.4: 15° planar		
251.6: 40°, 30°, irregular, hairline		
252.1: 75° Mn oxide coated		
252.4: 50° planar, 45° Mn oxide coated		
252.6: 35° Mn oxide coated		
252.7: 45° " " "		
252.7-253.0: broken core, angular		
No. planar 1		
No. Mn oxide coated 3		
No. calcite coated 1		

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
Ash-flow tuff, as preceding, small indistinct pumice foliation makes angle near 0°. Details at following footages: 253.5: hairline crack, irregular 253.6: 45° planar 253.7: 60° " 253.9: irregular crack 254.0: 40° Mn oxide coated 254.0-255.0: broken core angular 40° planar 5°, 45°, 10° Mn oxide coated 45°, 65° SiO_2 mineral coated 5° calcite coated.	253.0-255.0 (77.11-77.72)	2.0 (0.61)
Ash-flow tuff, core more broken than preceding run; one 0.5 piece, others <0.2 ft, angular, 90% recovery. 255.3: 45° planar, rough 255.5: 40° " " 255.7: 35° calcite coated, 45° planar 255.8: 45° Mn oxide coated 256.0: 35° " " " 256.5: 10°± irregular, rough 256.8: 80° planar 256.9-257.2: 10°± curved, Mn oxide 257.3 15° Mn oxide coated 257.5 45° " " " 257.7 75°± Mn oxide coated 257.7-257.9: 15° planar, 40° Mn oxide, 70° hairline 257.9-259.0 broken core 15°, 60° planar 45°, 45°, 55°, 45° Mn oxide coated 20° calcite coated	255.0-259.0 (77.72-78.94)	4.0 (1.22)
Ash-flow tuff, as preceding, pumice foliation near 0°. Details at following footages: 259.5: 55° planar 259.5-259.8: 20°± irregular 259.8: 60°± curved 259.8-260.4: 20° hairline 260.6: 50° Mn oxide coated 260.7: 45° planar 261.1: 50° " 261.1-261.7: broken, angular 261.7-261.9: 80° calcite coated, 0° planar 261.9-262.1: 0°, 70° planar 262.2: 10° planar	259.0-263.5 (78.94-80.31)	4.5 (1.37)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
262.3: 65° planar 262.4: 85° SiO_2 mineral, 60° planar, 45° Mn oxide 262.5: 55° planar 262.5-262.7: broken core, angular 262.7: 70° SiO_2 mineral coating 262.9: 40° Mn oxide coating 263.2: 30° irregular, hairline 263.4-263.5: broken, angular		
Ash-flow tuff, as preceding, 0.7 ft of E-core, blue painted. Fractures and angles at following footages: 263.5: 35° Mn oxide, 45° SiO_2 minerals 263.5-264.0: 10° irregular 264.0-264.3: 10° planar 264.3: Mn oxide coated 264.3-264.5: broken, angular, pebble size 264.5: 10°± curved, Mn oxide coated 264.5-264.9: 20° rough, hairline crack 265.1: 60° and 45° intersecting, Mn oxide 265.2: 15° SiO_2 minerals and 0° hackly 265.4-265.8: broken core, angular No. Mn oxide coated 7 266.3: 35° SiO_2 mineral coated, 60° Mn oxide coated 266.5: Mn oxide coated	263.5-266.5 (80.31-81.23)	3.0 (0.92)
Ash-flow tuff, light yellowish brown, subtle gradational color change from overlying subunit (hole penetrates successively older subunits inward, assuming no major fault crossing, inasmuch as general dip is east toward collar of hole). Several larger flattened pumices, as much as 5 cm long, a few with small lithophysal cavities with vapor phase crystals. Pumice flattening ratio, 3:1 to 5:1, moderately welded. Pumice flattening within a few degrees of 0°. Fractures at following footages: 266.5-266.8: 30° Mn oxide coated 266.8: 60°± curved, Mn oxide coated 267.4: 30°± " , 25°± irregular 267.6: 35°, 40° Mn oxide coated 268.1: 45° and 40° intersecting, Mn oxide; 20° Mn oxide coating 268.3: 60° Mn oxide 268.5: 0°, 65° Mn oxide, 45° planar 268.6: 30° SiO_2 minerals, 55°and 45° Mn oxide	266.5-272.0 (81.23-82.91)	5.5 (1.68)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
268.8: 40°± curved, Mn oxide 268.9: 45°, 50° Mn oxide 268.9-269.3: irregular hairline cracks 269.5: hairline crack 269.6: 30° rough surface 269.8: 60° rough, 0° planar 269.9: 50° planar 270.1: 30° planar 270.2: 40° Mn oxide coating 270.4: 45° planar 270.7: 45° hairline crack 270.8: 30°± curved 271.0: 40° irregular 271.1: 60° planar 271.2: 45° Mn oxide coated 271.5: 25° rough surface, planar 271.5-272.0: broken, angular pieces		
Ash-flow tuff, as preceding, mostly broken core, 70% recovery. Fractures: 50°, 30°, 40°, 35°, 45°, 15°, 80° planar, 0°, 70°, 45° Mn oxide coated, 90° SiO_2 mineral coating	272.0-275.0 (82.91-83.82)	3.0 (0.91)
Ash-flow tuff, as preceding, but not broken. Pumice 2-5 cm with flattening ratio 2:1 to 4:1, and near 0°. Radio indicates moderate welding or compaction. Small (0.5-cm) scattered white spherulites. Fractures at 275.0: 70° rough, SiO_2 mineral coating 275.2: 70°, 30° Mn oxide coating 275.2-275.4: 0°± curved, Mn oxide coating 275.4: 40° Mn oxide coating 275.4-275.8: 0° planar 275.8: 50° planar 275.8-276.1: 5° Mn oxide 276.1: 45°, 35° intersecting planar 276.1-276.8: solid piece, faint hairline cracks 276.8: 45° rough, planar 277.1: 45°± curved, Mn oxide 277.3-277.6: 25°, 3 parallel fractures 277.6: 40°, 55° Mn oxide coated 277.9: irregular hairline cracks 277.9-278.3: 10° rough 278.1: 40° rough 278.5: 35° " 279.0: 40° "	275.0-282.0 (83.82-85.95)	7.0 (2.13)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
279.0-280.0: solid piece, faint hairline cracks		
280.7: 45° rough		
280.9: 45° "		
281.0: 55°, 60° intersecting, rough		
281.2: 60°, 15°± planar and curved		
281.2-282.0: broken core, fracture surfaces:		
35°, 50°, 60°, 55° planar		
50°, 40°, 60°, 55°, 55° Mn oxide		
5°, 0° hairline cracks		
Ash-flow tuff, as preceding but somewhat more broken. Fractures:	282.0-286.0 (85.95-87.17)	4.0 (1.22)
282.0: 15°, 25° Mn oxide coating		
282.2: 80° SiO_2 mineral coating		
282.3: 35° Mn oxide; 30° intersecting planar		
282.5: 70°± curved, Mn oxide		
282.7: 40° Mn oxide coated		
282.8: 40°, 35°, 55° Mn oxide		
282.8-283.0: 35° planar		
283.0: 65°± curved, Mn oxide coated		
283.2: 40°, 80° closed cracks		
283.4-283.7: 0°→25° curved, Mn oxide		
283.6: 55° Mn oxide coated		
283.8: 90°± curved, Mn oxide coated		
283.8-284.0: 0°→10° curved, Mn oxide		
284.0: 75° rough surface		
284.1: 45° and 20° calcite coated		
284.1-284.4: 20°, 0° Mn oxide coated		
284.4: 30° Mn oxide coated		
284.7: 0°, 10°, 80°, 75° calcite coated		
284.8-285.2: 20° calcite and SiO_2 minerals		
285.0: 90°± Mn oxide coated		
285.2: 45° planar		
285.4: 50° calcite coated		
285.4-285.9: 2 core pieces, hairline cracks		
285.65-285.9: 15° Mn oxide coated		
285.9: 60° planar		
286.0: 65° "		
Ash-flow tuff, as preceding. Fractures:	286.0-290.0 (87.17-88.39)	4.0 (1.22)
286.0-286.7: 1 piece, hairline cracks		
286.7: 45°± curved, Mn oxide coating		
286.9: 50° rough surface		
286.9-287.0: broken core		
287.0: 60° and 65° intersecting planar		
287.3: 70° planar		
287.3-287.7: 15° Mn oxide coating		

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
287.8: 80° Mn oxide coating 287.8-288.6: broken core; fractures: 50°, 85° planar 10°, 55°, 85°, 0° Mn oxide coating 0°, 65°, 45° calcite coated 288.6: 70° SiO_2 mineral 288.6-288.9: 0° Mn oxide coated 288.9: 90° Mn oxide coated 288.9-290.0: broken core, granules to cobble size, intricately fractured		
Ash-flow tuff, as preceding. Fractures: 290.0-290.2: broken core, subangular 290.2: 60° SiO_2 mineral, 30° rough 290.4: 30° Mn oxide coated 290.7: 20°± curved, Mn oxide; 40° planar 290.8: 40° Mn oxide coated 290.8-291.8: broken core, angular 60°, 45°, 70°, 45° planar 5°, 50°, 60°, 60° Mn oxide 291.8: 40° Mn oxide coating 291.8-292.0: 5° rough surface 292.0: 65° Mn oxide coated 292.3: 45° planar 292.3-292.5: broken core, subangular 292.5: 45° 1.5 mm calcite coated 292.6-292.9: 60° 0.5-mm SiO_2 mineral	290.0-293.0 (88.39-89.30)	3.0 (0.91)
Ash-flow tuff, color midway between pale yellowish brown and light brown (5YR5/6) with moderate brown (5YR4/4) flattened (3:1 to 4:1) pumice (2-5 cm) with spherulites in center, otherwise rock is similar to preceding. Core recovery 55%. Fractures at footages: 293.0-293.4: broken core, angular, pebble size 293.5±: 40° Mn oxide coated 294±: 80° Mn oxide coated and 55° calcite coated 294.5±: 45°, 5°, 30° Mn oxide coated 295±: 45°, 30° Mn oxide coated	293.0-295.0 (89.30-89.92)	2.0 (0.62)
Ash-flow tuff, as preceding, fractures: 295.0-295.1: broken, angular 295.1: 60° Mn oxide coated 295.3: 70° 1 mm calcite coated 295.4: 65° Mn oxide coated 295.4-296.1: broken core, angular, cobble size	295.0-299.0 (89.92-91.14)	4.0 (1.22)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
70° planar 50°, 40°, 30°, 5°, 5°, 45° Mn oxide coated 296.3: 45° Mn oxide coated 296.5: 55° " " " 296.6: 20° " " " 296.8: 45° " " " rough surface 296.9: 40° planar, rough surface 297.0: 50° " " " 297.0-297.1: broken core, angular 297.1: 55° Mn oxide coated 297.3: 40° " " " 297.8: 20° " " " 297.8-298.4: broken, angular, granule to pebble size 298.4: 40° planar 298.7: 50° SiO_2 mineral coated 298.9: 75° " " " 298.9-299.0: broken core		
Ash-flow tuff, light yellowish brown with moderate brown 2-5-cm pumice flattened 3:1 to 4:1 (moderately welded) and small, similarly flattened light-gray pumice, 3 to 8 mm, angle with core axis, 0-5°. Core broken in cobble-size pieces. Fracture summary: 70°, 35° 70°, 40°, 55°, 15°, 40°, 30° planar; 80°, 0°, 15°, 35°, 80°, 80° Mn oxide coated; 30° SiO_2 mineral coated.	299.0-302.0 (91.14-92.05)	3.0 (0.91)
Ash-flow tuff, as preceding, granule to cobble size; fracture summary 5°, 50°, 45° planar; 40°, 60°, 75° Mn oxide coated; 45°, 80°, 70°, 40°, 50° SiO_2 mineral coated.	302.0-305.0 (92.05-92.96)	3.0 (0.91)
Ash-flow tuff, as preceding, fractures masked by core breakage; 50% core recovery.	305.0-307.0 (92.96-93.57)	2.0 (0.61)
Ash-flow tuff, as preceding, pumice foliation, 10°. Core intermittently fragmented and intact with one piece (waxed) 0.6 ft. Fracture footages and angles below: 307.0-308.3: broken, angular, pebble-size 85°, 80°, 85°, 90° planar surface 85° Mn oxide coated 308.3-308.7: 15° Mn oxide coated 308.7: 55° planar surface 308.7-309.3: waxed core 309.3: 45° planar surface	307.0-312.0 (93.57-95.10)	5.0 (1.53)

APPENDIX B (cont)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
309.4: 45° planar surface 309.6: 40° rough surface 309.6-310.0: irregular hairline cracks 310.0: 35° Mn oxide coated 310.0-310.1: broken core 310.1: 80° planar 310.4: 30°, 40°, 60° Mn oxide coated 310.6: 35° planar 310.7: 45° SiO_2 mineral coated 311.0: 75° planar 311.3: 45°, 40° Mn oxide coated 311.3-312.0: broken, angular, pebble-cobble size 85°, 65° planar surface 35°, 10°, 70°, 15° Mn oxide coated		
Ash-flow tuff, light yellowish brown, less broken, with 4 pieces >0.4 ft; 75% core recovery. Fractures and angles at footages: 312.0-312.3: broken, angular 35° Mn oxide coated 35° calcite coated 60° planar surface 312.3-312.8: 1 piece, pumice foliation <5° 312.3: 50°x20° intersecting, calcite coated 312.4: irregular hairline crack 312.8: 40° planar 312.8-313.4: 1 piece with irregular hairline crack at 313.1. 313.4: 60° planar, rough surface 313.4-313.6: broken core, angular 45° planar 30°, 45° Mn oxide coated 313.6-314.2: waxed core 314.2: 40° Mn oxide coated 314.3: 55° and 40° intersecting planar fractures 314.7: 80° rough hackly, rare Mn oxide 314.8: 65° Mn oxide coated 315±: 55° calcite coated 315.2: 50° Mn oxide coated 315.2-316.0: lost core	312.0-316.0 (95.10-96.32)	4.0 (1.22)
Ash-flow tuff, as preceding, 40% recovery. Fractures: 75° planar; 35° rough surface (probably others in lost core)	316.0-316.5 (96.32-96.47)	0.5 (0.15)

APPENDIX B (cont)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
Ash-flow tuff, as preceding. Fractures at 316.5: 70° planar 316.6: 50° " 316.9: 60°, 35° intersecting, Mn oxide coating on both 317.1: 80° Mn oxide coated 317.3: 65° planar 317.6: 90°, 75° intersecting planar 318.0: 60° planar	316.5-318.0 (96.47-96.93)	1.5 (0.46)
Ash-flow tuff, as preceding but more broken, 86% recovery. Fracture footages and angles: 318.3: 55° planar 318.4: 40° Mn oxide coated 318.6: 30° " " " 318.7: 45° " " " 318.8: 90° and 75° Mn oxide coated 318.9: 80° planar 319.0: 70°-90° curved irregularly, hackly 319.2: 50°-80° " " " 319.2-319.9: broken core, angular, pebble-size 90° 45°, 35° planar 60°, 75° Mn oxide coated 319.9: 50° planar 319.9-320.0: 0° planar terminated at 320.0 320.0: 60-65° irregular fracture 320.1: 50° calcite coated 320.2-320.3: 70° and 20-45° 1.5-mm calcite-fill fracture makes sharp bend 320.3: 45° planar truncates calcite fracture 320.5: 40° and 45° intersecting planars 320.6: 60° Mn oxide coated 320.7: 75° " " " 320.7-321.0: 20° to 45° curved hackly 321.0: 60-90° curved rough surface 321.1: 75° rough 321.1-321.2: broken core 321.2: 65° Mn oxide coated 30° rough 321.7: 50° Mn oxide coated 321.9: 70° 1-mm calcite coating 322.3: 70° rough intersects 20° Mn oxide 322.3-323.0: assigned to lost core.	318.0-323.0 (96.93-98.45)	5.0 (1.52)
Ash-flow tuff, as preceding, three pebble-size pieces, subrounded as if they had been in ball mill. 4% core recovery.	323.0-333.0 (98.45-101.50)	10.0 (3.05)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
Ash-flow tuff, as preceding, except full recovery and much less breakage. Large (1-5-cm) and small (<1-cm) pumice lenticles, 0 to 10°. Fractures and angles at footages:	333.0-343.0 (101.50-104.55)	10.0 (3.05)

333.0-333.3: broken, subangular, pebble to cobble size.
333.3: 90° Mn oxide coated
45° 1/2-mm calcite filled
333.3-333.5: 10° calcite coated
333.7: 70°x70° intersecting fractures; Mn oxide coated
334.0: 55° Mn oxide coated
334.4: 75° planar
334.6: 80° SiO_2 mineral coated
334.6-335.1: broken, angular, pebble size
40° planar
50°, 85° Mn oxide coated
15°, 40°, 0° SiO_2 mineral coated
335.1-335.8: 1 core piece, beveled
335.1: 70° Mn oxide cut by 40° SiO_2 mineral coated, in turn cut by 5° SiO_2 mineral coated
335.8: other end, 85° Mn oxide coated
335.8-335.83: "poker chip" beveled by fractures
335.83: 90° Mn oxide coated
335.83: 1 core piece, beveled
336.4: 90° Mn oxide coated
336.6: 50° rough planar
336.6-337.0: 1 core piece, ends beveled
337.0: 75° Mn oxide coated
337.0-337.1: 45° hairline crack broke open to hackly fracture as core was pulled out of tray.
337.3: 45°, 80° hackly fracture
337.8: 70° Mn oxide coated
338.3: 70°, 30° hackly
338.4: 55° hackly
338.6: 40° hackly, SiO_2 mineral coated
90° hackly
338.6-338.8: 5° Mn oxide coated
338.8: 65° Mn oxide coated
339.3: core broken by hammer to fit in tray
339.3-339.9: waxed core
339.9: 90°± curved
340.0: 80° Mn oxide
340.2: irregular hairline crack
340.3: 45°, 70° rough
340.3-340.5: 10° 0.5-mm calcite filled
340.5: 45° Mn oxide, 80° rough

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
340.8: 80° rough 341.2: 70° planar 341.4: 75° Mn oxide coated 341.6: 75° Mn oxide coated 341.6: 75° planar 341.6-342.2: 1 piece, no fractures inside 342.2: 75° Mn oxide, 45° rough 342.2-342.4: 10°± curved 342.5: 45° rough 342.5-342.7: 30° planar 342.7: 55° rough 342.7-343.0: broken core, angular, pebble size		
Ash-flow tuff, as preceding, but more broken; core recovery 60%. Footages and angle of fractures: 343.0-343.2: broken 90°, 80° planar 80°, 70°, 40° Mn oxide coated 343.2: 45° planar 343.5: 85°, 45°, 45° rough 343.7: 90° Mn oxide coated 344.0: 50° " " " 344.0-344.8: broken, angular, pebble to cobble size: 45°, 60°, 40°, 5°, 45°, 30°, 35° rough 35°, 50° Mn oxide coated 344.8: 80° SiO_2 mineral coated 345.0: 60°± curved 345.0-345.2: 0°-20° curved, rough 345.2: 65° rough 345.2-345.4: broken, angular, pebble size 345.4: 70° rough 345.5: 45° planar, intersects 60°± curved 345.6: 35° planar 345.9: 75° rough 345.9-346.5: broken core, pebble to cobble size, angular to subangular, irregular fractures, possibly drilling induced 346.5-346.7: 30° rough, bevels end of core piece 347.0: broken like 345.9-346.5 347.7-350: assigned to lost core	343.0-350.0 (104.55-106.68)	7.0 (2.13)
Ash-flow tuff, as preceding, but mostly broken core, granule to cobble size. Core recovery 87%. Fractures and angles: 40°, 20°, 80°, 55°, 70°, 75°, 50°, 0°, 40°, 40° rough surface	350.0-353.0 (106.68-107.59)	3.0 (0.91)

APPENDIX B (cont)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
50°, 10°, 20°, 0°, 30° Mn oxide coated 45°, 80°, 55° planar		
Ash-flow tuff, as preceding, 75% core recovery; fractures: 45°, 30°, 90°, 70°, 30°, 40°, 75°, 55°, 65°, 70° rough surface 35° SiO_2 mineral coated	353.0-355.0 (107.59-108.20)	2.0 (0.61)
Ash-flow tuff, as preceding, except for 2 beveled 0.35-ft pieces. Core recovery, 91%; fractures: 355-356.7: broken angular, pebble size 0°, 55° planar 45°, 0°, 90°, 20°, 45°, 40°, 75°, 45° rough 356.7: 10° Mn oxide coated 356.7-357.05: 1 core piece beveled 357.05: 85° rough 357.05-357.4: 1 core piece beveled 357.4: 40° rough bevel of above 357.4-359.5: broken, angular, pebble to cobble size 40°, 40°, 40° (2 parallel) 30°, 40° planar 45°, 40°, 5°, 75°, 35°, 0°, 60° rough 20°, 25° SiO_2 mineral coated 30°, 0° Mn oxide coated 359.5: 80°± curved, 50° planar 359.6: 50°± curved 359.6-359.8: broken core 359.8: 90°± irregular, 20° rough surface 360.0: 70° curved 360.0-360.1: broken core 360.1: 55° SiO_2 mineral coated 360.3: 80°± curved 360.6: 50° Mn oxide coated 360.7: 90°± curved 360.8: 45° planar 360.7-360.9: 5° SiO_2 mineral coated 360.9: 50° rough 360.9-362.3: broken core, angular, pebble size 45°, 65° planar 45°, 70°, 65°, 45° rough surface 50°, 5° Mn oxide coating 5° SiO_2 mineral coated, same fracture as 360.7-360.9 (The two 5° fractures run the length of this core interval and may have caused the breakage) 362.3: 85° rough	355.0-363.0 (108.20-110.64)	8.0 (2.44)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
362.5: 50° rough 362.5-363.0: assumed core loss		
Ash-flow tuff, grayish orange pink (5YR 5/2), slight change in color from preceding. Pumice lenticles, rare, indistinct. Core less broken than 353.0-363.0 run, 100% recovery. Fractures and angles at following footages: 363.0-363.3: broken core 35° planar 30°, 75° rough surface 30° SiO_2 mineral coated 363.3: 35° planar 363.6: 50° rough 363.8: 45° " 364.0: 50°, 20° rough 364.2: 35° rough 364.3: 80° " 364.3-365.1: 1 piece, no fractures 365.1: 55°± and 85°± intersecting curving fractures 365.2: 45° Mn oxide coated 365.25: 35° 0.5-mm SiO_2 mineral veinlet 365.5: 40° planar 365.7: 45° rough surface 365.9: 40° planar 365.9-366.6: broken core, several fractures; 5° SiO_2 mineralized fracture only one measurable 366.6: 35° planar, 40°± curved 366.9: 60° rough 367.3: 40°, 40° two parallel planar, 1 cm apart 367.5: 30° planar 367.8: 70° Mn oxide coated 367.8-368.0: broken core, 20° rough	363.0-368.0 (110.64-112.17)	5.0 (1.53)
Ash-flow tuff, color changes back to light yellowish brown, still hard, dense, as preceding; pumice lenticles small (<1 cm), indistinct, except for sparse larger (1-5-cm) pumice with vapor phase crystals and spherulites. Fractures and angles at following footages: 368.0-368.1: broken core 368.1: 65°, 35° Mn oxide coated 368.3: 35° rough 368.4: 10° Mn oxide coated 368.4-368.5: broken core 368.5: 60° rough surface 368.6: 75° " "	368.0-378.0 (112.17-115.21)	10.0 (3.04)

APPENDIX B (cont)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
368.8: 35° Mn oxide coated		
5° SiO_2 mineral coated		
368.8-369.0: 0° Mn oxide coated		
369.0-370.2: broken core, angular, pebble size		
75° planar		
80°, 90°, 65°, 85° rough surface		
20°, 90°, 35°, 45° Mn oxide coated		
370.2: 70° rough surface		
370.5: 65° " "		
370.55: 70° Mn oxide		
370.7: 70° SiO_2 mineral coating		
370.7-371.1: 1 piece with irregular hairline crack		
371.1: 60° rough surface		
371.1-371.3: 30° rough		
371.3: 50° planar		
371.5: 65°, 35° rough		
371.5-371.7: 5° Mn oxide coated		
371.7-372.4: broken zone, subangular, pebble size; 5° Mn-oxide-coated fracture continues through zone, intersected by a few low-angle fractures.		
372.4: 45° rough surface		
372.6: 90°± curved surface		
372.9: 90°± " "		
373.0: 70° rough "		
373.2: 90°± curved "		
373.3: 85° rough "		
373.4: 60° " "		
373.5: 90°± " "		
373.8: 90°± curved "		
373.8-374.1: broken core; fractures:		
0°, 90°, 40°, 90° rough surface		
374.1: 70°, 40° rough		
374.4: 90°± curved surface		
374.4-374.9: 1 core piece--no fractures		
374.9: 50°x50°, intersecting, rough		
375.1: 90°± curved		
375.1-375.3: 10°, 50°, 70°, 90° rough		
375.3: 60° rough		
375.3-375.7: 1 core piece--no fractures		
375.7: 80°± curved		
375.8: 45°, 55° rough surface		
376.1: 25°, 70° " "		
376.3: 30° SiO_2 mineral coated		
376.6: 35°, 0°-20° irregular		
376.7: 45° calcite coated		
377.0: 55° SiO_2 mineral coated, rough		

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
377.0-377.3: 0° rough surface 377.3: 75° rough surface 377.5: 80° planar, intersected by 80°, opposite direction 377.5-377.7: 10° rough surface 377.7: 85° rough 377.7-378.0: broken core, small pebble size.		
Ash-flow tuff, color midway between grayish orange pink (5YR7/2) and pale yellowish brown (10YR6/2), similar to light yellowish brown core toward collar, dense, hard, several pieces of core 0.4 to 1.6 ft in length. Small (<1-cm) light gray pumice indistinct and sparse larger (1-5-cm) flattened (3:1 ratio) pumice subparallel to core axis. Detailed footages and angles of fractures follow: 378.0: 65° Mn oxide coated 378.3: 80° rough planar surface 378.55: 45° " 378.55-378.9: 5° 1-mm calcite coating 378.9: 50° 1/2-1-mm calcite coating intersects 5° 1-mm calcite 379.3: 80° rough 379.3-379.7: waxed core 379.7-380.05: " " 380.05: 80°± curved, rough 380.2: 45° SiO_2 mineral coated 380.2-380.4: 30°± curved, rough 380.7: rounded end of 0.5-ft core from 380.2-380.7 65° planar at end of following core piece 380.9: 60°, truncated by 50° rough 381.1: 65° rough surface 381.3: 90° " " 381.5: 90° " " 381.7: 55° " " 381.7-383.3: 1 core piece 382.3-382.8: 70° SiO_2 mineral filling crinkly fracture 383.3: 80° rough surface 383.8: 75° rough, cuts 40°± curved 384.05: 80° rough 384.2: 50° " truncates 55° rough 384.3: 70° SiO_2 mineral coating 384.5: 35° rough, truncates 70° rough	378.0-388.0 (115.21-118.26)	10.0 (3.05)

Description of Footage Interval (angles are measured from core axis)	Horizontal Footage (m)	Thickness of Interval in ft (m)
384.5-385.3: 1 core piece with both ends beveled; no internal fractures. Pumice lenticles make 5-10° with core axis--no fractures 385.3: 30°± rough, truncates 20° rough 385.6: 35°± curved, rough 385.6-385.9: broken core, mostly angular chips from intersection of fractures logged at 385.6 and 385.9 385.9: 35° Mn oxide coated truncates 60° rough planar fracture. 386.1: 75° Mn oxide coated 20°-65° curved, Mn oxide coated 386.3: 70° Mn oxide coated 386.3-386.8: unfractured core piece 386.8: 35° rough, truncates 70° rough 387.1: 70° rough, wavy, may be drilling induced 387.1-387.4: waxed core 387.4: 90° rough 387.45 85° Mn oxide coated 387.9: 45° rough, intersects 388.0: 60° "		
Ash-flow tuff, color masked by rust from core barrel. Because of difficulty in removing core from barrel, part of core was not removed for 24 h. Core recovery 50% and consists of 17 pieces ranging from 0.2 to 0.4 ft. Core pieces are subangular to subrounded on ends, probably an artifact of being stuck in barrel. A few rough and planar surfaces are burnished with hardness greater than steel. Many fractures may have been in lost core. Following fractures and angles measured: 20°, 45°, 85°, 75°, 45°, 65°, 80° rough surface 50°, 30° Mn oxide coated 75°, 70°, 65° planar 50° SiO_2 mineral coated Four samples submitted for density measurement are 2.21, 2.23, 2.21, and 2.21 g/cm^3 (see text).	388.0-400.0(TD) (118.26-121.92)	12.0 (3.66)

APPENDIX C

DRILL CORE FRACTURE DATA

[In the following calculations the "dip" is the dihedral angle between the plane of the fracture and a plane perpendicular to the core axis, analogous to the relation in a vertical hole in which this measurement represents the true dip. The dip parameter used in Appendix C is for calculational purposes and is the complement of the "dips" for corresponding footages in Appendix B, in which only the high-angle dips (>70°) approximate the true dip and a northerly strike (because the hole was drilled westerly).]

TABLE C-1. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 209.0 to 216.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
75.0	3.9	1.0	3.9	3.9	209.0-209.3	
15.0	1.0	1.0	1.0	4.9	209.0-209.3	
30.0	1.2	1.0	1.2	6.1	209.0-209.3	
30.0	1.2	1.0	1.2	7.2	209.4-209.7	
20.0	1.1	1.0	1.1	8.3	209.4-209.7	
55.0	1.7	1.0	1.7	10.0	209.4-209.7	
50.0	1.6	1.0	1.6	11.6	209.7-209.9	
25.0	1.1	1.0	1.1	12.7	209.7-209.9	
45.0	1.4	4.5	6.4	19.0	209.9-210.6	broken core
40.0	1.3	1.0	1.3	20.3	210.8	
0.0	1.0	0.0	0.0	20.3	210.8-210.9	broken core
45.0	1.4	1.0	1.4	21.8	210.9-211.3	
85.0	11.5	1.0	11.5	33.2	210.9-211.3	
45.0	1.4	2.0	2.8	36.1	211.3-211.45	
30.0	1.2	2.0	2.3	38.4	211.45-211.6	
45.0	1.4	1.0	1.4	39.8	211.45-211.6	
65.0	2.4	1.0	2.4	42.2	211.45-211.6	
50.0	1.6	2.0	3.1	45.3	211.6-211.8	
35.0	1.2	1.0	1.2	46.5	211.6-211.8	
80.0	5.8	1.0	5.8	52.2	211.6-211.8	
45.0	1.4	2.0	2.8	55.1	211.8-212.5	
50.0	1.6	1.0	1.6	56.6	211.8-212.5	
0.0	1.0	0.0	0.0	56.6	212.5-212.6	broken core
10.0	1.0	1.0	1.0	57.6	212.6	
50.0	1.6	1.0	1.6	59.2	212.9	
75.0	3.9	1.0	3.9	63.1	212.9	
80.0	5.8	1.0	5.8	68.8	212.9-213.5	
45.0	1.4	2.0	2.8	71.6		irregular cracks
50.0	1.6	1.0	1.6	73.2	213.5-213.7	
40.0	1.3	1.0	1.3	74.5	213.5-213.7	
15.0	1.0	1.0	1.0	75.5	213.5-213.7	
45.0	1.4	7.0	9.9	85.4	213.7-216.0	broken core

Footage interval 7.0.
Fractures per cubic meter 50.
Fractures per linear meter 21.

TABLE C-2. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 221.0 to 224.5 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
40.0	1.3	1.0	1.3	1.3	221.0-224.5	broken core
55.0	1.7	1.0	1.7	3.0	221.0-224.5	broken core
70.0	2.9	1.0	2.9	6.0	221.0-224.5	broken core
85.0	11.5	1.0	11.5	17.4	221.0-224.5	broken core
25.0	1.1	1.0	1.1	18.5	221.0-224.5	broken core
45.0	1.4	18.0	25.5	44.0	221.0-224.5	broken core

Footage interval 3.5.
Fractures per cubic meter 51.
Fractures per linear meter 22.

TABLE C-3. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 224.5 to 232.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
45.0	1.4	1.0	1.4	1.4	224.5	
55.0	1.7	1.0	1.7	3.2	224.7	
85.0	11.5	1.0	11.5	14.6	224.9	
55.0	1.7	1.0	1.7	16.4	225.2-225.5	
50.0	1.6	1.0	1.6	17.9	225.2-225.5	
40.0	1.3	1.0	1.3	19.2	225.2-225.5	
85.0	11.5	1.0	11.5	30.7	225.2-225.5	
45.0	1.4	8.0	11.3	42.0	225.5-226.4	broken core
35.0	1.2	2.0	2.4	44.5	226.4-226.6	
45.0	1.4	7.5	10.6	55.1	226.6-228.0	broken core
30.0	1.2	1.5	1.7	56.8	226.6-228.0	broken core
50.0	1.6	1.0	1.6	58.4	226.6-228.0	broken core
45.0	1.4	14.5	20.5	78.9	228.0-232.0	broken core
85.0	11.5	2.5	28.7	107.5	228.0-232.0	broken core
45.0	1.4	3.0	4.2	111.8	228.0-232.0	broken core
75.0	3.9	1.0	3.9	115.7	228.0-232.0	broken core
30.0	1.2	2.0	2.3	118.0	228.0-232.0	broken core
55.0	1.7	1.0	1.7	119.7	228.0-232.0	broken core
70.0	2.9	1.0	2.9	122.6	228.0-232.0	broken core
60.0	2.0	1.0	2.0	124.6	228.0-232.0	broken core
50.0	1.6	1.0	1.6	126.2	228.0-232.0	broken core

Footage interval 7.5.
Fractures per cubic meter 68.
Fractures per linear meter 24.

APPENDIX C (cont)

TABLE C-4. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 232.0 to 237.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
45.0	1.4	1.5	2.1	2.1	232.0-232.3	broken core
50.0	1.6	1.0	1.6	3.7	232.3	
85.0	11.5	1.0	11.5	15.2	232.3-232.7	
20.0	1.1	1.0	1.1	16.2	232.7	
0.0	1.0	0.0	0.0	16.2	232.7-233.0	lost core
40.0	1.3	1.0	1.3	17.5	233.0	
60.0	2.0	1.0	2.0	19.5	233.4	
35.0	1.2	1.0	1.2	20.7	233.9	
25.0	1.1	1.0	1.1	21.8	234.0	
85.0	11.5	1.0	11.5	33.3	234.1	
25.0	1.1	1.0	1.1	34.4	234.2	
15.0	1.0	1.0	1.0	35.5	234.5	
50.0	1.6	1.0	1.6	37.0	234.5	
45.0	1.4	1.5	2.1	39.1	234.5-234.8	broken core
20.0	1.1	1.0	1.1	40.2	234.8	
50.0	1.6	1.0	1.6	41.8	235.2	
0.0	1.0	0.0	0.0	41.8	235.2-235.4	lost core
50.0	1.6	1.0	1.6	43.3	235.4	
25.0	1.1	1.0	1.1	44.4	235.6	
25.0	1.1	1.0	1.1	45.5	235.7	
45.0	1.4	5.0	7.1	52.6	235.7-236.5	broken core
0.0	1.0	0.0	0.0	52.6	236.5-237.0	lost core

Footage interval 5.0.
Fractures per cubic meter 43.
Fractures per linear meter 16.

APPENDIX C (cont)

TABLE C-5. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 240.0 to 245.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
50.0	1.6	2.0	3.1	3.1	240.0-240.1	
45.0	1.4	2.0	2.8	5.9	240.3	
60.0	2.0	1.0	2.0	7.9	240.6	
45.0	1.4	2.0	2.8	10.8	240.6-241.0	
85.0	11.5	1.0	11.5	22.2	241.0-241.3	
45.0	1.4	1.0	1.4	23.7	241.0-241.3	
55.0	1.7	1.0	1.7	25.4	241.0-241.3	
50.0	1.6	1.0	1.6	27.0	241.0-241.3	
85.0	11.5	1.0	11.5	38.4	241.3-242.0	
70.0	2.9	1.0	2.9	41.4	241.3-242.0	
45.0	1.4	1.0	1.4	42.8	241.3-242.0	
80.0	5.8	1.0	5.8	48.5	241.3-242.0	
20.0	1.1	1.0	1.1	49.6	242.0-242.4	
70.0	2.9	1.0	2.9	52.5	242.0-242.4	
45.0	1.4	1.0	1.4	53.9	242.0-242.4	
50.0	1.6	1.0	1.6	55.5	242.0-242.4	
45.0	1.4	4.0	5.7	61.1	242.4-243.2	
20.0	1.1	1.0	1.1	62.2	242.4-243.2	
50.0	1.6	1.0	1.6	63.8	242.4-243.2	
45.0	1.4	1.0	1.4	65.2	243.2-243.5	
20.0	1.1	1.0	1.1	66.2	243.2-243.5	
85.0	11.5	1.0	11.5	77.7	243.2-243.5	
80.0	5.8	1.0	5.8	83.5	243.5-243.9	
35.0	1.2	1.0	1.2	84.7	243.5-243.9	
45.0	1.4	1.0	1.4	86.1	243.5-243.9	
50.0	1.6	1.0	1.6	87.7	243.9-244.3	
55.0	1.7	1.0	1.7	89.4	244.3-244.7	broken core
30.0	1.2	1.0	1.2	90.6	244.3-244.7	broken core
85.0	11.5	2.0	22.9	113.5	244.3-244.7	broken core
0.0	1.0	0.0	0.0	113.5	244.7-245.0	lost core

Footage interval 5.0.
Fractures per cubic meter 92.
Fractures per linear meter 24.

TABLE C-6. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 245.0 to 249.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
45.0	1.4	1.0	1.4	1.4	245.0	
0.0	1.0	0.0	0.0	1.4	245.25-245.55	waxed core
45.0	1.4	1.0	1.4	2.8	245.55-245.8	
55.0	1.7	1.0	1.7	4.6	245.55-245.8	
60.0	2.0	1.0	2.0	6.6	245.55-245.8	
45.0	1.4	3.0	4.2	10.8	246.0-246.3	
20.0	1.1	1.0	1.1	11.9	246.3-246.5	
45.0	1.4	1.0	1.4	13.3	246.3-246.5	
85.0	11.5	1.0	11.5	24.8	246.3-246.5	
85.0	11.5	1.0	11.5	36.2	246.5-247.2	
20.0	1.1	1.0	1.1	37.3	246.5-247.2	
15.0	1.0	1.0	1.0	38.3	246.5-247.2	
60.0	2.0	1.0	2.0	40.3	247.2-249.0	
30.0	1.2	1.0	1.2	41.5	247.2-249.0	
45.0	1.4	2.0	2.8	44.3	247.2-249.0	
35.0	1.2	2.0	2.4	46.8	247.2-249.0	

Footage interval 4.0.
Fractures per cubic meter 48.
Fractures per linear meter 16.

TABLE C-7. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 249.0 to 253.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
0.0	1.0	0.0	0.0	0.0	249.0-249.2	broken core
30.0	1.2	1.0	1.2	1.2	249.2	
50.0	1.6	1.0	1.6	2.7	250.1	
0.0	1.0	2.0	2.0	4.7	250.1-250.7	
45.0	1.4	1.0	1.4	6.1	250.1-250.7	
20.0	1.1	1.0	1.1	7.2	250.1-250.7	
50.0	1.6	1.0	1.6	8.7	250.7	
85.0	11.5	1.0	11.5	20.2	250.8	
45.0	1.4	1.0	1.4	21.6	251.2	
85.0	11.5	1.0	11.5	33.1	251.2-252.4	
75.0	3.9	1.0	3.9	37.0	251.4	
50.0	1.6	1.0	1.6	38.5	251.6	
60.0	2.0	1.0	2.0	40.5	251.6	
15.0	1.0	1.0	1.0	41.6	252.1	
40.0	1.3	1.0	1.3	42.9	252.4	
55.0	1.7	1.0	1.7	44.6	252.6	
45.0	1.4	1.0	1.4	46.0	252.7	
45.0	1.4	2.5	3.5	49.6	252.7-253.0	broken core

Footage interval 4.0.
Fractures per cubic meter 50.
Fractures per linear meter 16.

APPENDIX C (cont)

TABLE C-8. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 253.0 to 259.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
45.0	1.4	2.0	2.8	2.8	253.0-253.5	
45.0	1.4	1.0	1.4	4.2	253.6	
30.0	1.2	1.0	1.2	5.4	253.7	
45.0	1.4	1.0	1.4	6.8	253.9	
50.0	1.6	1.0	1.6	8.4	254.0	
45.0	1.4	2.0	2.8	11.2	254.0-255.0	broken core
85.0	11.5	2.0	22.9	34.1	254.0-255.0	broken core
50.0	1.6	1.0	1.6	35.7	254.0-255.0	broken core
80.0	5.8	1.0	5.8	41.5	254.0-255.0	broken core
25.0	1.1	1.0	1.1	42.6	254.0-255.0	broken core
45.0	1.4	1.0	1.4	44.0	255.3	
50.0	1.6	1.0	1.6	45.5	255.5	
55.0	1.7	1.0	1.7	47.3	255.7	
45.0	1.4	1.0	1.4	48.7	255.8	
55.0	1.7	1.0	1.7	50.4	256.0	
80.0	5.8	1.0	5.8	56.2	256.5	
10.0	1.0	1.0	1.0	57.2	256.8	
80.0	5.8	1.0	5.8	63.0	256.9-257.2	
75.0	3.9	1.0	3.9	66.8	257.3	
45.0	1.4	1.0	1.4	68.2	257.5	
15.0	1.0	1.0	1.0	69.3	257.7	
75.0	3.9	1.0	3.9	73.1	257.7-257.9	
50.0	1.6	1.0	1.6	74.7	257.7-257.9	
20.0	1.1	1.0	1.1	75.8	257.7-257.9	
45.0	1.4	2.0	2.8	78.6	257.9-259.0	broken core
85.0	11.5	2.0	22.9	101.5	257.9-259.0	broken core
50.0	1.6	1.0	1.6	103.1	257.9-259.0	broken core
80.0	5.8	1.0	5.8	108.9	257.9-259.0	broken core
25.0	1.1	1.0	1.1	110.0	257.9-259.0	broken core

Footage interval 6.0.
Fractures per cubic meter 75.
Fractures per linear meter 19.

TABLE C-9. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 259.0 to 263.5 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
35.0	1.2	1.0	1.2	1.2	259.0-259.5	
70.0	2.9	1.0	2.9	4.1	259.5-259.8	
30.0	1.2	1.0	1.2	5.3	259.8	
70.0	2.9	1.0	2.9	8.2	259.8-260.4	
40.0	1.3	1.0	1.3	9.5	260.6	
45.0	1.4	1.0	1.4	10.9	260.7	
40.0	1.3	1.0	1.3	12.2	261.1	
45.0	1.4	2.0	2.8	15.1	261.1-261.7	
10.0	1.0	1.0	1.0	16.1	261.7-261.9	
85.0	11.5	1.0	11.5	27.6	261.7-261.9	
85.0	11.5	1.0	11.5	39.0	261.9-262.1	
20.0	1.1	1.0	1.1	40.1	261.9-262.1	
80.0	5.8	1.0	5.8	45.9	262.2	
25.0	1.1	1.0	1.1	47.0	262.3	
5.0	1.0	1.0	1.0	48.0	262.4	
30.0	1.2	1.0	1.2	49.1	262.4	
45.0	1.4	1.0	1.4	50.5	262.4	
35.0	1.2	1.0	1.2	51.8	262.5	
45.0	1.4	2.0	2.8	54.6	262.5-262.7	broken core
20.0	1.1	1.0	1.1	55.7	262.7	
50.0	1.6	1.0	1.6	57.2	262.9	
60.0	2.0	1.0	2.0	59.2	263.2	
45.0	1.4	2.0	2.8	62.0	263.4-263.5	

Footage interval 4.5.
Fractures per cubic meter 56.
Fractures per linear meter 19.

APPENDIX C (cont)

TABLE C-10. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 263.5 to 266.5 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
55.0	1.7	1.0	1.7	1.7	263.5	
45.0	1.4	1.0	1.4	3.2	263.5	
80.0	5.8	1.0	5.8	8.9	263.5-264.0	
80.0	5.8	1.0	5.8	14.7	264.0-264.3	
40.0	1.3	1.0	1.3	16.0	264.3	
45.0	1.4	2.0	2.8	18.8	264.3-264.5	broken core
80.0	5.8	1.0	5.8	24.6	264.5	
70.0	2.9	1.0	2.9	27.5	264.5-264.9	
30.0	1.2	1.0	1.2	28.6	265.1	
45.0	1.4	1.0	1.4	30.1	265.1	
15.0	1.0	1.0	1.0	31.1	265.2	
85.0	11.5	1.0	11.5	42.6	265.2	
45.0	1.4	3.5	4.9	47.5	265.4-265.8	broken core
55.0	1.7	1.0	1.7	49.3	266.3-265.8	
30.0	1.2	1.0	1.2	50.4	266.3-265.8	
15.0	1.0	1.0	1.0	51.5	266.5	

Footage interval 3.0.
Fractures per cubic meter 70.
Fractures per linear meter 21.

TABLE C-11. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 – 266.5 to 272.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage
60.0	2.0	1.0	2.0	2.0	266.5-266.8
30.0	1.2	1.0	1.2	3.2	266.8
50.0	1.6	1.0	1.6	4.7	267.4
65.0	2.4	1.0	2.4	7.1	267.4
55.0	1.7	1.0	1.7	8.8	267.6
50.0	1.6	1.0	1.6	10.4	267.6
50.0	1.6	1.0	1.6	11.9	267.8
45.0	1.4	1.0	1.4	13.3	268.1
50.0	1.6	1.0	1.6	14.9	268.1
70.0	2.9	1.0	2.9	17.8	268.1
30.0	1.2	1.0	1.2	19.0	268.3
85.0	11.5	1.0	11.5	30.5	268.5
25.0	1.1	1.0	1.1	31.6	268.5
45.0	1.4	1.0	1.4	33.0	268.5
60.0	2.0	1.0	2.0	35.0	268.6
35.0	1.2	1.0	1.2	36.2	268.6
45.0	1.4	1.0	1.4	37.6	268.6
50.0	1.6	1.0	1.6	39.2	268.8
45.0	1.4	1.0	1.4	40.6	268.9
40.0	1.3	1.0	1.3	41.9	268.9
45.0	1.4	2.0	2.8	44.7	268.9-269.3
30.0	1.2	1.0	1.2	45.9	269.3
45.0	1.4	1.0	1.4	47.3	269.5
60.0	2.0	1.0	2.0	49.3	269.6
30.0	1.2	1.0	1.2	50.4	269.8
85.0	11.5	1.0	11.5	61.9	269.8
40.0	1.3	1.0	1.3	63.2	269.9
60.0	2.0	1.0	2.0	65.2	270.1
50.0	1.6	1.0	1.6	66.8	270.2
45.0	1.4	1.0	1.4	68.2	270.4
45.0	1.4	1.0	1.4	69.6	270.7
60.0	2.0	1.0	2.0	71.6	270.8
50.0	1.6	1.0	1.6	73.2	271.0
30.0	1.2	1.0	1.2	74.3	271.1
45.0	1.4	1.0	1.4	75.7	271.2
65.0	2.4	1.0	2.4	78.1	271.5
45.0	1.4	2.0	2.8	80.9	271.5-272.0

Footage interval 5.5.
Fractures per cubic meter 60.
Fractures per linear meter 23.

TABLE C-12. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 272.0 to 275.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
40.0	1.3	1.0	1.3	1.3	272.0-275.0	broken core
45.0	1.4	3.0	4.2	5.5		
60.0	2.0	1.0	2.0	7.5		
50.0	1.6	1.0	1.6	9.1		
55.0	1.7	1.0	1.7	10.8		
75.0	3.9	1.0	3.9	14.7		
10.0	1.0	1.0	1.0	15.7		
85.0	11.5	1.0	11.5	27.2		
20.0	1.1	1.0	1.1	28.3		
0.0	1.0	1.0	1.0	29.3		

Footage interval 3.0.
Fractures per cubic meter 40.
Fractures per linear meter 13.

TABLE C-13. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 – 275.0 to 282.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
20.0	1.1	1.0	1.1	1.1	275.0	
20.0	1.1	1.0	1.1	2.1	275.2	
60.0	2.0	1.0	2.0	4.1	275.2	
85.0	11.5	1.0	11.5	15.6	275.2-275.4	
50.0	1.6	1.0	1.6	17.2	275.4	
85.0	11.5	1.0	11.5	28.6	275.4-275.8	
40.0	1.3	1.0	1.3	29.9	275.8	
85.0	11.5	1.0	11.5	41.4	275.8-276.1	
45.0	1.4	1.0	1.4	42.8	276.1	
55.0	1.7	1.0	1.7	44.6	276.1	
45.0	1.4	1.0	1.4	46.0	276.1-276.8	
45.0	1.4	1.0	1.4	47.4	276.8	
45.0	1.4	1.0	1.4	48.8	277.1	
65.0	2.4	3.0	7.1	55.9	277.3-277.6	
50.0	1.6	1.0	1.6	57.5	277.6	
35.0	1.2	1.0	1.2	58.7	277.6	
45.0	1.4	1.0	1.4	60.1	277.9	
80.0	5.8	1.0	5.8	65.9	277.9-278.3	
50.0	1.6	1.0	1.6	67.4	278.3	
50.0	1.6	1.0	1.6	69.0	278.5	
50.0	1.6	1.0	1.6	70.5	279.0	
45.0	1.4	2.0	2.8	73.4	279.0-280.0	
20.0	1.1	1.0	1.1	74.4	280.0	
45.0	1.4	1.0	1.4	75.8	280.0-280.7	
45.0	1.4	1.0	1.4	77.2	280.7	
45.0	1.4	1.0	1.4	78.7	280.9	
35.0	1.2	1.0	1.2	79.9	281.0	
30.0	1.2	1.0	1.2	81.0	281.0	
30.0	1.2	1.0	1.2	82.2	281.2	
75.0	3.9	1.0	3.9	86.1	281.2	
55.0	1.7	1.0	1.7	87.8	281.2-282.0	broken core
40.0	1.3	2.0	2.6	90.4		
30.0	1.2	2.0	2.3	92.7		
35.0	1.2	3.0	3.7	96.4		
50.0	1.6	1.0	1.6	97.9		
85.0	11.5	2.0	22.9	120.9		

Footage interval 7.0.
Fractures per cubic meter 70.
Fractures per linear meter 21.

TABLE C-14. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 282.0 to 286.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage
75.0	3.9	1.0	3.9	3.9	282.0
65.0	2.4	1.0	2.4	6.2	282.0
10.0	1.0	1.0	1.0	7.2	282.2
55.0	1.7	1.0	1.7	9.0	282.3
60.0	2.0	1.0	2.0	11.0	282.3
20.0	1.1	1.0	1.1	12.1	282.5
50.0	1.6	1.0	1.6	13.6	282.7
50.0	1.6	1.0	1.6	15.2	282.8
55.0	1.7	1.0	1.7	16.9	282.8
35.0	1.2	1.0	1.2	18.1	282.8
65.0	2.4	1.0	2.4	20.5	282.8-283.0
25.0	1.1	1.0	1.1	21.6	283.0
50.0	1.6	1.0	1.6	23.2	283.2
10.0	1.0	1.0	1.0	24.2	283.2
80.0	5.8	1.0	5.8	29.9	283.4-283.7
25.0	1.1	1.0	1.1	31.0	283.6
0.0	1.0	1.0	1.0	32.0	283.8
85.0	11.5	1.0	11.5	43.5	283.8-284.0
15.0	1.0	1.0	1.0	44.5	284.0
45.0	1.4	1.0	1.4	46.0	284.1
70.0	2.9	1.0	2.9	48.9	284.1
70.0	2.9	1.0	2.9	51.8	284.1-284.4
85.0	11.5	1.0	11.5	63.3	284.1-284.4
60.0	2.0	1.0	2.0	65.3	284.4
85.0	11.5	2.0	22.9	88.2	284.7
10.0	1.0	1.0	1.0	89.2	284.7
15.0	1.0	1.0	1.0	90.3	284.7
70.0	2.9	1.0	2.9	93.2	284.8-285.2
0.0	1.0	1.0	1.0	94.2	284.8-285.2
45.0	1.4	1.0	1.4	95.6	285.2
40.0	1.3	1.0	1.3	96.9	285.4
45.0	1.4	2.0	2.8	99.7	285.4-285.9
75.0	3.9	1.0	3.9	103.6	285.4-285.9
30.0	1.2	1.0	1.2	104.8	285.9
25.0	1.1	1.0	1.1	105.9	286.0

Footage interval 4.0.
Fractures per cubic meter 108.
Fractures per linear meter 30.

APPENDIX C (cont)

TABLE C-15. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 286.0 to 293.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
45.0	1.4	2.0	2.8	2.8	286.0-286.7	
45.0	1.4	1.0	1.4	4.2	286.7	
40.0	1.3	1.0	1.3	5.5	286.9	
45.0	1.4	1.0	1.4	7.0	286.9-287.0	broken core
30.0	1.2	1.0	1.2	8.1	287.0	intersecting frac
25.0	1.1	1.0	1.1	9.2		
10.0	1.0	1.0	1.0	10.2	287.8	
45.0	1.4	3.0	4.2	14.5	287.8-288.6	broken core
40.0	1.3	1.0	1.3	15.8		
5.0	1.0	2.0	2.0	17.8		
80.0	5.8	1.0	5.8	23.6		
35.0	1.2	1.0	1.2	24.8		
85.0	11.5	2.0	22.9	47.7		
25.0	1.1	1.0	1.1	48.8		
20.0	1.1	1.0	1.1	49.9	288.6	
85.0	11.5	1.0	11.5	61.4	288.6-288.9	
0.0	1.0	1.0	1.0	62.4	288.9	
45.0	1.4	3.0	4.2	66.6	288.9-290.2	broken core
30.0	1.2	1.0	1.2	67.8	290.2	
60.0	2.0	1.0	2.0	69.8	290.4	
70.0	2.9	1.0	2.9	72.7	290.7	
50.0	1.6	1.0	1.6	74.2	290.7	
50.0	1.6	1.0	1.6	75.8	290.8	
45.0	1.4	1.0	1.4	77.2	290.8-291.8	broken core
20.0	1.1	2.0	2.1	79.3		
30.0	1.2	2.0	2.3	81.6		
85.0	11.5	1.0	11.5	93.1		
40.0	1.3	1.0	1.3	94.4		
50.0	1.6	1.0	1.6	96.0	291.8	
85.0	11.5	1.0	11.5	107.5	291.8-292.0	
25.0	1.1	1.0	1.1	108.6	292.0	
45.0	1.4	1.0	1.4	110.0	292.3	
45.0	1.4	2.0	2.8	112.8	292.3-292.5	broken core
45.0	1.4	1.0	1.4	114.2	292.3-292.5	broken core
60.0	2.0	1.0	2.0	116.2	292.6-293.0	

Footage interval 7.0.
Fractures per cubic meter 68.
Fractures per linear meter 21.

APPENDIX C (cont)

TABLE C-16. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 293.0 to 299.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
45.0	1.4	4.0	5.7	5.7	293.0-293.4	
50.0	1.6	1.0	1.6	7.2	293.5	
10.0	1.0	1.0	1.0	8.2	294.0	
35.0	1.2	1.0	1.2	9.4	294.0	
45.0	1.4	2.0	2.8	12.3	294.5-295.0	
60.0	2.0	2.0	4.0	16.3	294.5-295.0	
85.0	11.5	1.0	11.5	27.8		
45.0	1.4	1.0	1.4	29.2	295.0-295.1	broken core
30.0	1.2	1.0	1.2	30.3	295.1	
20.0	1.1	1.0	1.1	31.4	295.3	
25.0	1.1	1.0	1.1	32.5	295.4	
85.0	11.5	1.0	11.5	44.0	295.4-296.1	broken core
20.0	1.1	1.0	1.1	45.0		
50.0	1.6	1.0	1.6	46.6		
60.0	2.0	1.0	2.0	48.6		
45.0	1.4	1.0	1.4	50.0		
40.0	1.3	1.0	1.3	51.3		
45.0	1.4	2.0	2.8	54.1	296.3	
35.0	1.2	1.0	1.2	55.3	296.5	
70.0	2.9	1.0	2.9	58.3	296.6	
45.0	1.4	1.0	1.4	59.7	296.8	
50.0	1.6	1.0	1.6	61.2	296.9	
40.0	1.3	1.0	1.3	62.5	297.0	
45.0	1.4	1.0	1.4	64.0	297.0-297.1	broken core
35.0	1.2	1.0	1.2	65.2	297.1	
50.0	1.6	1.0	1.6	66.7	297.3	
70.0	2.9	1.0	2.9	69.7	297.8	
45.0	1.4	6.0	8.5	78.1	297.8-298.4	broken core
50.0	1.6	1.0	1.6	79.7	298.4	
40.0	1.3	1.0	1.3	81.0	298.7	
15.0	1.0	1.0	1.0	82.0	298.9	
45.0	1.4	1.0	1.4	83.5	298.9-299.0	broken core

Footage interval 6.0.
Fractures per cubic meter 57.
Fractures per linear meter 24.

APPENDIX C (cont)

TABLE C-17. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 299.0 to 305.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
20.0	1.1	1.0	1.1	1.1	299.0-302.0	broken core
55.0	1.7	1.0	1.7	2.8		
50.0	1.6	1.0	1.6	4.4		
35.0	1.2	1.0	1.2	5.6		
75.0	3.9	1.0	3.9	9.4		
60.0	2.0	1.0	2.0	11.4		
10.0	1.0	1.5	1.5	13.0		
85.0	11.5	1.0	11.5	24.4		
75.0	3.9	1.0	3.9	28.3		
55.0	1.7	1.0	1.7	30.1		
60.0	2.0	1.0	2.0	32.1		broken core
45.0	1.4	10.0	14.1	46.2		hairline cracks
85.0	11.5	1.0	11.5	57.7	302.0-305.0	broken core
40.0	1.3	1.0	1.3	59.0		
45.0	1.4	1.0	1.4	60.4		
50.0	1.6	1.0	1.6	61.9		
30.0	1.2	1.0	1.2	63.1		
15.0	1.0	1.0	1.0	64.1		
45.0	1.4	1.0	1.4	65.5		
10.0	1.0	1.0	1.0	66.6		
20.0	1.1	1.0	1.1	67.6		
50.0	1.6	1.0	1.6	69.2		
40.0	1.3	1.0	1.3	70.5		

Footage interval 6.0.
Fractures per cubic meter 48.
Fractures per linear meter 18.

TABLE C-18. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 307.0 to 312.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
5.0	1.0	3.0	3.0	3.0	307.0-308.3	broken core
10.0	1.0	1.0	1.0	4.0		
0.0	1.0	1.0	1.0	5.0		
30.0	1.2	1.0	1.2	6.2	308.3	
75.0	3.9	1.0	3.9	10.0	308.3-308.7	
35.0	1.2	1.0	1.2	11.3	308.7	
0.0	1.0	0.0	0.0	11.3	308.7-309.3	waxed core
45.0	1.4	1.0	1.4	12.7	309.3	
45.0	1.4	1.0	1.4	14.1	309.4	
50.0	1.6	1.0	1.6	15.7	309.6	
45.0	1.4	4.0	5.7	21.3	309.6-310.0	
55.0	1.7	1.0	1.7	23.1	310.0	
45.0	1.4	1.0	1.4	24.5	310.0-310.1	broken core
10.0	1.0	1.0	1.0	25.5	310.1	
60.0	2.0	1.0	2.0	27.5	310.4	
50.0	1.6	1.0	1.6	29.0	310.4	
30.0	1.2	1.0	1.2	30.2	310.4	
55.0	1.7	1.0	1.7	31.9	310.6	
45.0	1.4	1.0	1.4	33.3	310.7	
15.0	1.0	1.0	1.0	34.4	311.0	
45.0	1.4	1.0	1.4	35.8	311.3	
50.0	1.6	1.0	1.6	37.4	311.3	
5.0	1.0	1.0	1.0	38.4	311.3-312.0	broken core
25.0	1.1	1.0	1.1	39.5		
55.0	1.7	1.0	1.7	41.2		
80.0	5.8	1.0	5.8	47.0		
20.0	1.1	1.0	1.1	48.0		
75.0	3.9	1.0	3.9	51.9		

Footage interval 5.0.
Fractures per cubic meter 42.
Fractures per linear meter 21.

APPENDIX C (cont)

TABLE C-19. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 312.0 to 318.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
55.0	1.7	2.0	3.5	3.5	312.0-312.3	broken core
30.0	1.2	1.0	1.2	4.6		
40.0	1.3	2.0	2.6	7.3	312.3	
45.0	1.4	1.0	1.4	8.7	312.4	
50.0	1.6	1.0	1.6	10.2	312.8	
45.0	1.4	1.0	1.4	11.6	313.1	
30.0	1.2	1.0	1.2	12.8	313.4	
45.0	1.4	4.0	5.7	18.4	313.4-313.6	broken core
60.0	2.0	1.0	2.0	20.4		
0.0	1.0	0.0	0.0	20.4	313.6-314.2	waxed core
50.0	1.6	1.0	1.6	22.0	314.2	
50.0	1.6	1.0	1.6	23.6	314.3	
35.0	1.2	1.0	1.2	24.8	314.3	
10.0	1.0	1.0	1.0	25.8	314.7	
25.0	1.1	1.0	1.1	26.9	314.8	
35.0	1.2	1.0	1.2	28.1	315.0	
40.0	1.3	1.0	1.3	29.4	315.2	
45.0	1.4	8.0	11.3	40.7	315.2-316.0	lost core
15.0	1.0	1.0	1.0	41.8	316.0-316.5	40% recovery
55.0	1.7	1.0	1.7	43.5		
45.0	1.4	4.0	5.7	49.2		
20.0	1.1	1.0	1.1	50.2	316.5	
40.0	1.3	1.0	1.3	51.5	316.6	
30.0	1.2	1.0	1.2	52.7	316.9	
55.0	1.7	1.0	1.7	54.4	316.9	
10.0	1.0	1.0	1.0	55.5	317.1	
25.0	1.1	1.0	1.1	56.6	317.3	
0.0	1.0	1.0	1.0	57.6	317.6	
15.0	1.0	1.0	1.0	58.6	317.6	
30.0	1.2	1.0	1.2	59.8	318.0	

Footage interval 6.0.
Fractures per cubic meter 41.
Fractures per linear meter 24.

APPENDIX C (cont)

TABLE C-20. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 318.0 to 323.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
35.0	1.2	1.0	1.2	1.2	318.0-318.3	
50.0	1.6	1.0	1.6	2.8	318.4	
60.0	2.0	1.0	2.0	4.8	318.6	
45.0	1.4	1.0	1.4	6.2	318.7	
0.0	1.0	1.0	1.0	7.2	318.8	
15.0	1.0	1.0	1.0	8.2	318.8	
10.0	1.0	1.0	1.0	9.2	318.9	
10.0	1.0	1.0	1.0	10.3	319.0	
25.0	1.1	1.0	1.1	11.4	319.2	
0.0	1.0	1.0	1.0	12.4	319.2-319.9	broken core
45.0	1.4	1.0	1.4	13.8		
35.0	1.2	1.0	1.2	15.0		
30.0	1.2	1.0	1.2	16.1		
15.0	1.0	1.0	1.0	17.2		
40.0	1.3	1.0	1.3	18.5	319.9	
85.0	11.5	1.0	11.5	30.0	319.9-320.0	
30.0	1.2	1.0	1.2	31.1	320.0	
40.0	1.3	1.0	1.3	32.4	320.1	
20.0	1.1	1.0	1.1	33.5	320.2-320.3	
45.0	1.4	2.0	2.8	36.3		
70.0	2.9	1.0	2.9	39.2		
45.0	1.4	1.0	1.4	40.7	320.5	
50.0	1.6	1.0	1.6	42.2		
30.0	1.2	1.0	1.2	43.4	320.6	
15.0	1.0	1.0	1.0	44.4	320.7	
45.0	1.4	1.0	1.4	45.8	320.7-321.0	
70.0	2.9	1.0	2.9	48.7		
15.0	1.0	1.0	1.0	49.8	321.0	
15.0	1.0	1.0	1.0	50.8	321.1	
45.0	1.4	1.0	1.4	52.2	321.1-321.2	broken core
25.0	1.1	1.0	1.1	53.3	321.2	
60.0	2.0	1.0	2.0	55.3		
40.0	1.3	1.0	1.3	56.6	321.7	
20.0	1.1	1.0	1.1	57.7	321.9	
20.0	1.1	1.0	1.1	58.8	322.3	
70.0	2.9	1.0	2.9	61.7	322.3	
45.0	1.4	7.0	9.9	71.6	322.3-323.0	lost core

Footage interval 5.0.
Fractures per cubic meter 58.
Fractures per linear meter 29.

APPENDIX C (cont)

TABLE C-21. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 333.0 to 337.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
45.0	1.4	3.0	4.2	4.2	333.0-333.3	broken core
0.0	1.0	1.0	1.0	5.2	333.3	
45.0	1.4	1.0	1.4	6.7	333.3	
80.0	5.8	1.0	5.8	12.4	333.3-333.5	
20.0	1.1	2.0	2.1	14.5	333.7	
35.0	1.2	1.0	1.2	15.8	334.0	
15.0	1.0	1.0	1.0	16.8	334.4	
10.0	1.0	1.0	1.0	17.8	334.6	
50.0	1.6	2.0	3.1	20.9	334.6-335.1	broken core
40.0	1.3	1.0	1.3	22.2		
5.0	1.0	1.0	1.0	23.2		
75.0	3.9	1.0	3.9	27.1		
85.0	11.5	1.0	11.5	38.6		
20.0	1.1	1.0	1.1	39.6	335.1	
5.0	1.0	1.0	1.0	40.6	335.8	
0.0	1.0	1.0	1.0	41.6		
0.0	1.0	1.0	1.0	42.6	336.4	
40.0	1.3	1.0	1.3	43.9	336.6	
15.0	1.0	1.0	1.0	45.0	337.0	

Footage interval 4.0.
Fractures per cubic meter 46.
Fractures per linear meter 19.

TABLE C-22. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 337.0 to 343.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
45.0	1.4	1.0	1.4	1.4	337.0-337.1	
45.0	1.4	1.0	1.4	2.8	337.3	
10.0	1.0	1.0	1.0	3.8		
20.0	1.1	1.0	1.1	4.9	337.8	
20.0	1.1	1.0	1.1	6.0	338.3	
60.0	2.0	1.0	2.0	8.0	338.3	
35.0	1.2	1.0	1.2	9.2	338.4	
50.0	1.6	1.0	1.6	10.7	338.6	
0.0	1.0	1.0	1.0	11.7	338.6	
85.0	11.5	1.0	11.5	23.2	338.6-338.8	
25.0	1.1	1.0	1.1	24.3	338.8	
0.0	1.0	0.0	0.0	24.3	339.3-339.9	broken core
0.0	1.0	1.0	1.0	25.3	339.9	
10.0	1.0	1.0	1.0	26.3	340.0	
45.0	1.4	1.0	1.4	27.8	340.2	
45.0	1.4	1.0	1.4	29.2	340.3	
20.0	1.1	1.0	1.1	30.2	340.3	
80.0	5.8	1.0	5.8	36.0	340.3-340.5	
45.0	1.4	1.0	1.4	37.4	340.5	
10.0	1.0	1.0	1.0	38.4	340.5	
10.0	1.0	1.0	1.0	39.4	340.8	
20.0	1.1	1.0	1.1	40.5	341.2	
15.0	1.0	1.0	1.0	41.5	341.4	
15.0	1.0	1.0	1.0	42.6	341.6	
15.0	1.0	1.0	1.0	43.6	342.2	
45.0	1.4	1.0	1.4	45.0	342.2	
80.0	5.8	1.0	5.8	50.8	342.2-342.4	
45.0	1.4	1.0	1.4	52.2	342.5	
60.0	2.0	1.0	2.0	54.2	342.5-342.7	
35.0	1.2	1.0	1.2	55.4	342.7	
45.0	1.4	3.0	4.2	59.7	342.7-343.0	

Footage interval 6.0.
Fractures per cubic meter 40.
Fractures per linear meter 17.

TABLE C-23. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 343.0 to 350.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
10.0	1.0	2.0	2.0	2.0	343.0-343.2	hairline cracks
0.0	1.0	1.0	1.0	3.0		
20.0	1.1	1.0	1.1	4.1		
50.0	1.6	1.0	1.6	5.7		
45.0	1.4	1.0	1.4	7.1	343.2	
45.0	1.4	2.0	2.8	9.9	343.5	
5.0	1.0	1.0	1.0	10.9		
0.0	1.0	1.0	1.0	11.9	343.7	
40.0	1.3	1.0	1.3	13.2	344.0	
45.0	1.4	1.0	1.4	14.6	344.0-344.8	broken core
55.0	1.7	2.0	3.5	18.1		
30.0	1.2	1.0	1.2	19.3		
50.0	1.6	1.0	1.6	20.8		
85.0	11.5	1.0	11.5	32.3		
60.0	2.0	1.0	2.0	34.3		
40.0	1.3	1.0	1.3	35.6		
10.0	1.0	1.0	1.0	36.6	344.8	
30.0	1.2	1.0	1.2	37.8	345.0	
80.0	5.8	1.0	5.8	43.5	345.0-345.2	
25.0	1.1	1.0	1.1	44.6	345.2	
45.0	1.4	2.0	2.8	47.5	345.2-345.4	broken core
20.0	1.1	1.0	1.1	48.5	345.4	
45.0	1.4	1.0	1.4	49.9	345.5	
30.0	1.2	1.0	1.2	51.1	345.5	
55.0	1.7	1.0	1.7	52.8	345.6	
15.0	1.0	1.0	1.0	53.9	345.9	
45.0	1.4	6.0	8.5	62.4	345.9-346.5	broken core
60.0	2.0	1.0	2.0	64.4	346.5-346.7	
35.0	1.2	1.0	1.2	65.6	347.0	
45.0	1.4	7.0	9.9	75.5	347.0-347.7	broken core
45.0	1.4	22.0	31.1	106.6	347.7-350.0	lost core

Footage interval 7.0.
Fractures per cubic meter 62.
Fractures per linear meter 31.

TABLE C-24. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 350.0 to 355.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
50.0	1.6	1.5	2.3	2.3	350.0-353.0	broken core
70.0	2.9	2.0	5.8	8.2		
10.0	1.0	2.0	2.0	10.2		
35.0	1.2	2.0	2.4	12.7		
20.0	1.1	1.0	1.1	13.7		
15.0	1.0	1.0	1.0	14.8		
40.0	1.3	2.0	2.6	17.4		
85.0	11.5	2.0	22.9	40.3		
80.0	5.8	1.0	5.8	46.1		
60.0	2.0	1.0	2.0	48.1		
45.0	1.4	1.0	1.4	49.5		
20.0	1.1	1.0	1.1	50.5	353.0-355.0	broken core
60.0	2.0	1.0	2.0	52.5		
45.0	1.4	1.0	1.4	54.0		
0.0	1.0	1.0	1.0	55.0		
50.0	1.6	1.0	1.6	56.5		
15.0	1.0	1.0	1.0	57.6		
35.0	1.2	1.0	1.2	58.8		
25.0	1.1	1.0	1.1	59.9		
55.0	1.7	1.0	1.7	61.6		

Footage interval 5.0.
Fractures per cubic meter 50.
Fractures per linear meter 17.

TABLE C-25. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 355.0 to 363.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
85.0	11.5	2.0	22.9	22.9	355.0-356.7	broken core
35.0	1.2	1.0	1.2	24.2		
45.0	1.4	3.0	4.2	28.4		
0.0	1.0	1.0	1.0	29.4		
70.0	2.9	1.0	2.9	32.3		
50.0	1.6	1.0	1.6	33.9		
15.0	1.0	1.0	1.0	34.9		
80.0	5.8	1.0	5.8	40.7		
60.0	2.0	1.0	2.0	42.7	356.7-357.1	
5.0	1.0	1.0	1.0	43.7	357.1	
85.0	11.5	1.0	11.5	55.2	357.1-357.4	
50.0	1.6	1.0	1.6	56.7	357.4	
50.0	1.6	3.0	4.7	61.4	357.4-359.5	broken core
60.0	2.0	2.0	4.0	65.4		
45.0	1.4	1.0	1.4	66.8		
85.0	11.5	2.0	22.9	89.7		
15.0	1.0	1.0	1.0	90.8		
55.0	1.7	1.0	1.7	92.5		
30.0	1.2	1.0	1.2	93.7		
70.0	2.9	1.0	2.9	96.6		
65.0	2.4	1.0	2.4	99.0		
10.0	1.0	1.0	1.0	100.0	359.5	
40.0	1.3	1.0	1.3	101.3	359.5	
40.0	1.3	1.0	1.3	102.6	359.6	
45.0	1.4	2.0	2.8	105.4	359.6-359.8	broken core
0.0	1.0	1.0	1.0	106.4	359.8	
70.0	2.9	1.0	2.9	109.3	359.8	
20.0	1.1	1.0	1.1	110.4	360.0	
35.0	1.2	1.0	1.2	111.6	360.0-360.1	broken core
0.0	1.0	1.0	1.0	112.6		
85.0	11.5	1.0	11.5	124.1	360.1-360.3	
10.0	1.0	1.0	1.0	125.1	360.3	
40.0	1.3	1.0	1.3	126.4	360.6	
0.0	1.0	1.0	1.0	127.4	360.7	
45.0	1.4	1.0	1.4	128.8	360.8	
85.0	11.5	1.0	11.5	140.3	360.7-360.9	
40.0	1.3	1.0	1.3	141.6	360.9	
45.0	1.4	2.5	3.5	145.2	360.9-362.3	broken core
25.0	1.1	2.0	2.2	147.4		
20.0	1.1	1.0	1.1	148.4		
40.0	1.3	1.0	1.3	149.7		
85.0	11.5	2.0	22.9	172.7		
5.0	1.0	1.0	1.0	173.7	362.3	
40.0	1.3	1.0	1.3	175.0	362.5	
45.0	1.4	4.0	5.7	180.6	362.5-363.0	lost core

Footage interval 8.0.
Fractures per cubic meter 92.
Fractures per linear meter 24.

APPENDIX C (cont)

TABLE C-26. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 363.0 to 368.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
60.0	2.0	2.0	4.0	4.0	363.0-363.3	broken core
55.0	1.7	1.0	1.7	5.7		
15.0	1.0	1.0	1.0	6.8		
55.0	1.7	1.0	1.7	8.5	363.3	
40.0	1.3	1.0	1.3	9.8	363.6	
45.0	1.4	1.0	1.4	11.2	363.8	
40.0	1.3	1.0	1.3	12.5	364.0	
70.0	2.9	1.0	2.9	15.5	364.0	
55.0	1.7	1.0	1.7	17.2	364.2	
10.0	1.0	1.0	1.0	18.2	364.3	
35.0	1.2	1.0	1.2	19.5	365.1	
5.0	1.0	1.0	1.0	20.5	365.1	
45.0	1.4	1.0	1.4	21.9	365.2-365.3	
55.0	1.7	1.0	1.7	23.6		
0.0	1.0	1.0	1.0	24.6		
40.0	1.3	1.0	1.3	25.9		
50.0	1.6	1.0	1.6	27.5	365.5	
45.0	1.4	1.0	1.4	28.9	365.7	
50.0	1.6	1.0	1.6	30.4	365.9	
45.0	1.4	6.0	8.5	38.9	365.9-366.6	broken core
81.0	6.4	1.0	6.4	45.3		
55.0	1.7	2.0	3.5	48.8	366.6	
30.0	1.2	1.0	1.2	50.0	366.9	
50.0	1.6	2.0	3.1	53.1	367.3	
60.0	2.0	1.0	2.0	55.1	367.5	
20.0	1.1	1.0	1.1	56.1	367.8	
70.0	2.9	1.0	2.9	59.1	367.8-368.0	broken core
10.0	1.0	1.0	1.0	60.1		

Footage interval 5.0.
Fractures per cubic meter 49.
Fractures per linear meter 24.

APPENDIX C (cont)

TABLE C-27. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 368.0 to 372.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
45.0	1.4	1.0	1.4	1.4	368.0-368.1	broken core
25.0	1.1	1.0	1.1	2.5	368.1	
55.0	1.7	1.0	1.7	4.3	368.1	
55.0	1.7	1.0	1.7	6.0	368.3	
80.0	5.8	1.0	5.8	11.8	368.4	
45.0	1.4	1.0	1.4	13.2	368.4-368.5	broken core
30.0	1.2	1.0	1.2	14.3	368.5	
15.0	1.0	1.0	1.0	15.4	368.6	
55.0	1.7	1.0	1.7	17.1	368.8	
5.0	1.0	1.0	1.0	18.1	368.8	
85.0	11.5	1.0	11.5	29.6	368.8-369.0	
15.0	1.0	1.0	1.0	30.6	369.0-370.2	broken core
10.0	1.0	1.0	1.0	31.6		
0.0	1.0	2.0	2.0	33.6		
25.0	1.1	1.0	1.1	34.7		
5.0	1.0	1.0	1.0	35.7		
70.0	2.9	1.0	2.9	38.7		
55.0	1.7	1.0	1.7	40.4		
45.0	1.4	1.0	1.4	41.8		
20.0	1.1	1.0	1.1	42.9	370.2-370.5	
85.0	11.5	1.0	11.5	54.4		
25.0	1.1	1.0	1.1	55.5		
20.0	1.1	1.0	1.1	56.5	370.6	
20.0	1.1	1.0	1.1	57.6	370.7	
50.0	1.6	1.0	1.6	59.2	370.7-371.1	
30.0	1.2	1.0	1.2	60.3	371.1	
60.0	2.0	1.0	2.0	62.3	371.1-371.3	
40.0	1.3	1.0	1.3	63.6	371.3	
25.0	1.1	1.0	1.1	64.7	371.5	
55.0	1.7	1.0	1.7	66.5	371.5	
85.0	11.5	1.0	11.5	77.9	371.5-371.7	
10.0	1.0	3.0	3.0	81.0	371.7-372.0	broken core

Footage interval 4.0.
Fractures per cubic meter 82.
Fractures per linear meter 29.

TABLE C-28. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 372.0 to 378.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
10.0	1.0	4.0	4.1	4.1	372.0-372.4	
45.0	1.4	1.0	1.4	5.5	372.4	
0.0	1.0	1.0	1.0	6.5	372.6	
0.0	1.0	1.0	1.0	7.5	372.9	
20.0	1.1	1.0	1.1	8.5	373.0	
0.0	1.0	1.0	1.0	9.5	373.2	
5.0	1.0	1.0	1.0	10.5	373.3	
30.0	1.2	1.0	1.2	11.7	373.4	
0.0	1.0	1.0	1.0	12.7	373.5	
0.0	1.0	1.0	1.0	13.7	373.8	
85.0	11.5	1.0	11.5	25.2	373.8-374.1	broken core
0.0	1.0	1.0	1.0	26.2		
50.0	1.6	1.0	1.6	27.7		
20.0	1.1	1.0	1.1	28.8	374.1	
50.0	1.6	1.0	1.6	30.3	374.1	
0.0	1.0	1.0	1.0	31.3	374.4	
40.0	1.3	2.0	2.6	34.0	374.9	
0.0	1.0	1.0	1.0	35.0	375.1	
80.0	5.8	1.0	5.8	40.7	375.1-375.3	
40.0	1.3	1.0	1.3	42.0		
20.0	1.1	1.0	1.1	43.1		
0.0	1.0	1.0	1.0	44.1		
30.0	1.2	1.0	1.2	45.2	375.3	
10.0	1.0	1.0	1.0	46.3	375.7	
45.0	1.4	1.0	1.4	47.7	375.8	
35.0	1.2	1.0	1.2	48.9	375.8	
65.0	2.4	1.0	2.4	51.3	376.1	
20.0	1.1	1.0	1.1	52.3	376.1	
45.0	1.4	1.0	1.4	53.7	376.1-376.2	broken core
60.0	2.0	1.0	2.0	55.7	376.3	
55.0	1.7	1.0	1.7	57.5	376.6	
10.0	1.0	1.0	1.0	58.5	376.6	
45.0	1.4	1.0	1.4	59.9	376.7	
35.0	1.2	1.0	1.2	61.1	377.0	
85.0	11.5	1.0	11.5	72.6	377.0-377.3	
15.0	1.0	1.0	1.0	73.6	377.3	
10.0	1.0	2.0	2.0	75.7	377.5	
80.0	5.8	1.0	5.8	81.4	377.5-377.7	
5.0	1.0	1.0	1.0	82.4	377.7	
5.0	1.0	1.0	1.0	83.4	377.7-378.0	broken core
45.0	1.4	2.0	2.8	86.3		

Footage interval 6.0.
Fractures per cubic meter 59.
Fractures per linear meter 26.

TABLE C-29. Calculation of Fracture Frequency per Cubic Meter
UE-25h#1 — 378.0 to 388.0 ft

Dip	1/cos	# Fract	Product	Sum	Footage	
25.0	1.1	1.0	1.1	1.1	378.0	
10.0	1.0	1.0	1.0	2.1	378.3	
45.0	1.4	1.0	1.4	3.5	378.5	
85.0	11.5	1.0	11.5	15.0	378.5-378.9	
40.0	1.3	1.0	1.3	16.3	378.9	
10.0	1.0	1.0	1.0	17.3	379.3	
0.0	1.0	0.0	0.0	17.3	379.3-380.0	waxed core
10.0	1.0	1.0	1.0	18.3	380.0	
45.0	1.4	1.0	1.4	19.8	380.2	
60.0	2.0	1.0	2.0	21.8	380.2-380.4	
25.0	1.1	1.0	1.1	22.9	380.7	
30.0	1.2	1.0	1.2	24.0	380.9	
40.0	1.3	1.0	1.3	25.3	380.9	
25.0	1.1	1.0	1.1	26.4	381.1	
0.0	1.0	1.0	1.0	27.4	381.3	
0.0	1.0	1.0	1.0	28.4	381.5	
35.0	1.2	1.0	1.2	29.6	381.7	
70.0	2.9	1.0	2.9	32.6	382.3-382.8	
10.0	1.0	1.0	1.0	33.6	383.3	
15.0	1.0	1.0	1.0	34.6	383.8	
50.0	1.6	1.0	1.6	36.2	383.8	
10.0	1.0	1.0	1.0	37.2	384.0	
40.0	1.3	1.0	1.3	38.5	384.2	
35.0	1.2	1.0	1.2	39.7	384.2	
20.0	1.1	1.0	1.1	40.8	384.3	
55.0	1.7	1.0	1.7	42.5	384.5	
20.0	1.1	1.0	1.1	43.6	384.5	
55.0	1.7	1.0	1.7	45.3	384.5	
20.0	1.1	1.0	1.1	46.4	384.5	
55.0	1.7	1.0	1.7	48.1	385.3	
20.0	1.1	1.0	1.1	49.2	385.3	
55.0	1.7	1.0	1.7	50.9	385.6	
45.0	1.4	3.0	4.2	55.2	385.6-385.9	
55.0	1.7	1.0	1.7	56.9	385.9	
30.0	1.2	1.0	1.2	58.1	385.9	
15.0	1.0	1.0	1.0	59.1	386.1	
50.0	1.6	1.0	1.6	60.7	386.1	
20.0	1.1	1.0	1.1	61.7	386.3	
55.0	1.7	1.0	1.7	63.5	386.8	
20.0	1.1	1.0	1.1	64.6	386.8	
20.0	1.1	1.0	1.1	65.6	387.1	
0.0	1.0	0.0	0.0	65.6	387.1-387.4	waxed core
0.0	1.0	1.0	1.0	66.6	387.4	
5.0	1.0	1.0	1.0	67.6	387.5	
45.0	1.4	1.0	1.4	69.0	387.9	
30.0	1.2	1.0	1.2	70.2	388.0	

Footage interval 10.0.
Fractures per cubic meter 29.
Fractures per linear meter 15.

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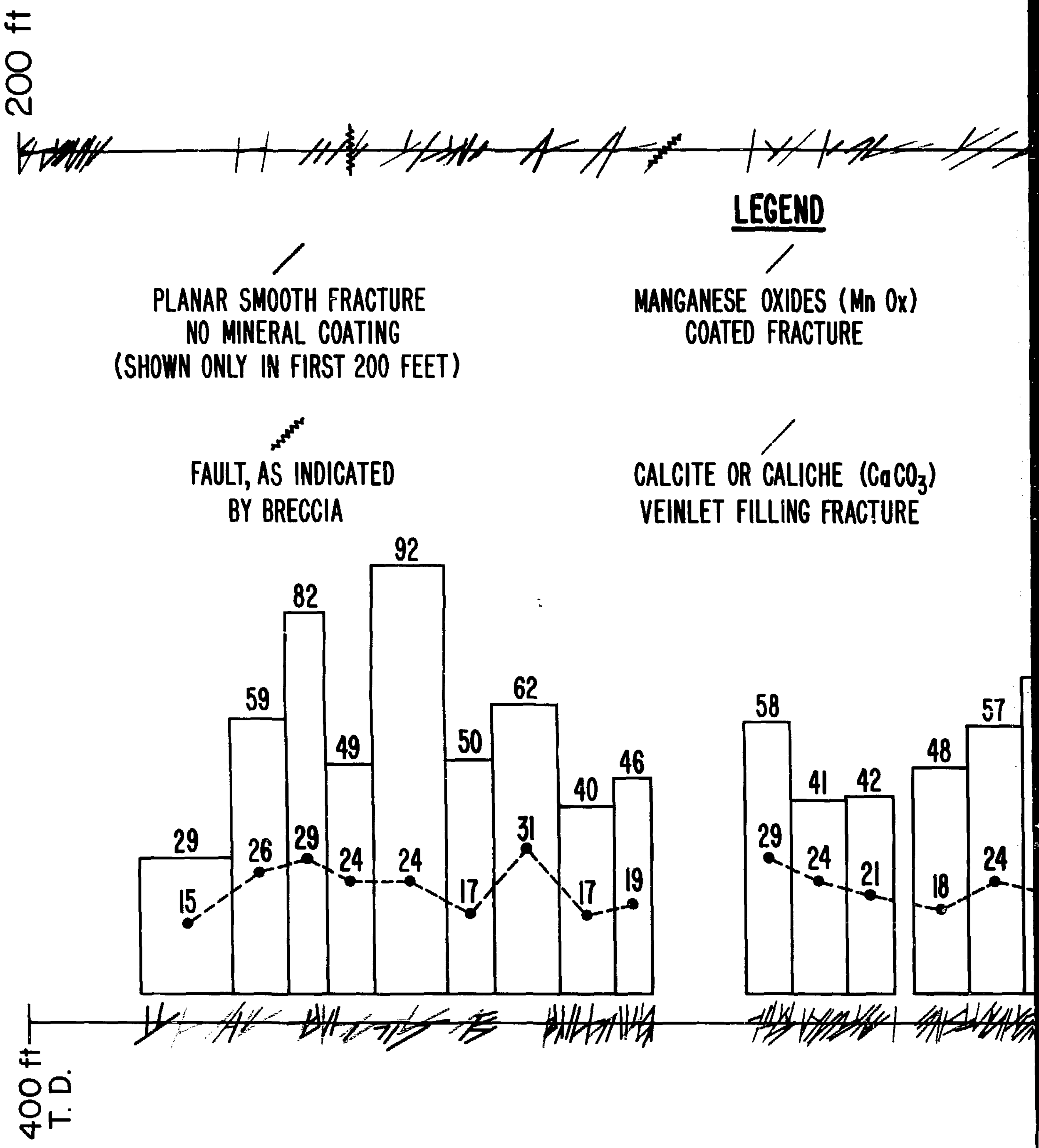

Fig
East-West vertical projection of Drill Hole UE-
deviation). In absence of oriented core, angle of
west, except for second fracture that intersects
angle west may actually dip east. For explanati
Footages with no graphs had significant core loss
(see Appendix C). Moreover, not all nonmineralized
(see Appendix C), but nearly all mineralized fractu

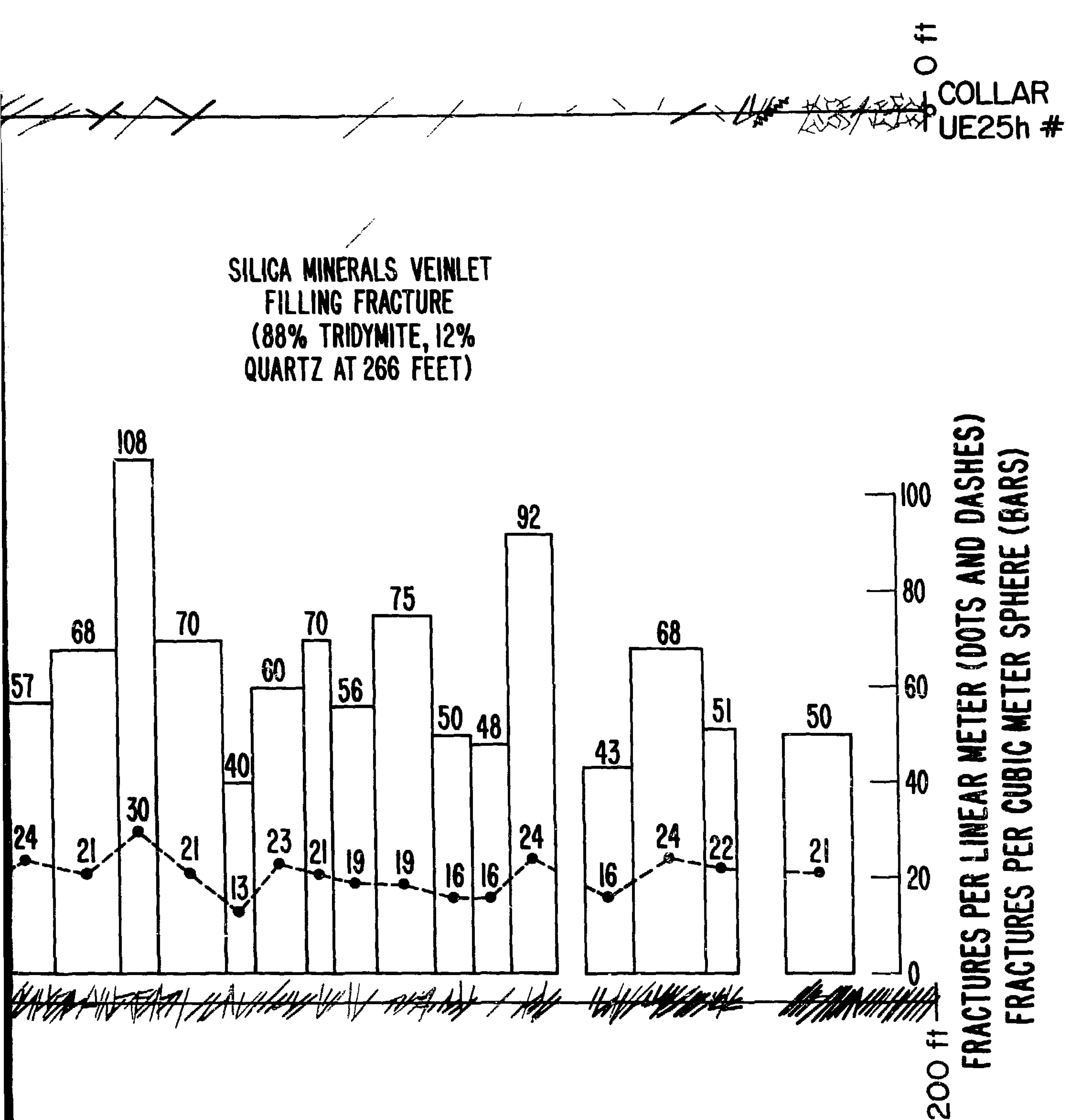

Fig. 3.
e UE-25h#1, assumed horizontal (see Fig. 2 for hole
e of fracture with core axis is generally assumed to dip
ects first. Some fractures shown as dipping at a low
anation of fractures per cubic meter sphere see text.
loss and therefore not all fractures were represented
lized fractures observed can be shown at scale of Fig. 3
ractures observed are shown.