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LOGGING OF POST-TEST AND CCH RECORD CORE SAMPLES
FOR THE SPENT FUEL TEST-CLIMAX

R. Thorpe
B. Qualheim

FEBRUARY 1985

Lawrence
Livermore
National
Laboratory

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Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

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ABSTRACT

Over 1300 ft of core obtained from 50 boreholes are described, with emphasis on the nature and orientations of geologic discontinuities in the Climax Stock. Although most of the core was not oriented with respect to global coordinates, approximate orientations of planar features, such as joints, veins, and shear fractures, were obtained by taking core measurements relative to a set of low-angle joints found throughout the rock mass. The method for determining the approximate core orientation is described in detail, and the associated uncertainty is discussed. A graphical fracture log for each hole is provided, along with the computer code used to generate it.

1. INTRODUCTION

1.1 Purpose and Scope

The Spent Fuel Test-Climax (SFT-C) has been conducted under the technical direction of the Lawrence Livermore National Laboratory as part of the U.S. Department of Energy's Nevada Nuclear Waste Storage Investigations. The location and general geology of the site are indicated by Figs. 1 and 2. One of the tasks of the SFT-C has been to characterize the fracture system in the Climax Stock for hydrologic and rock mechanics purposes. To accomplish this, underground fracture mapping [1,2] and core logging [3] were conducted. This has resulted in a large amount of data on geologic discontinuities in holes drilled prior to completion of the project. However, a significant amount of core drilling has been accomplished after removal of the spent-fuel canisters and thermal simulators. Hence, the purpose of this report is to present and summarize this most recent data base, which pertains to the holes shown in Fig. 3. Over 1300 ft. of core from 50 boreholes are included in the study. A summary of the sizes, depths and orientations of these holes is provided in Table 1.

All of the core samples were obtained post-test, except the CCH Series which serve as pretest "record" cores. All of the logging, except for ISS-11, was performed post-test by the same individual using the same method. Hole ISS-11 was the last borehole in the project, and logging of its core was done by a different geologist. However, throughout the effort, our goal was to provide objective observations, rather than subjective geologic interpretations. Detailed consideration of the nature and significance of specific geologic structures or features is beyond the scope of this report.

Fig. 1. Geology of the Climax Stock, Nevada Test Site (modified after ref. 3).

Fig. 2. Pile Driver and SFT-C Facility location
(after ref. 3).

Fig. 3. Locations of boreholes.

Table 1. Collar locations and average bearings and inclinations from collar to total depth for boreholes in this study.

Hole No.	Location	Average Bearing	Average Inclination*	Length (ft)
ISS-4	North drift pillar sta. 3+34.61 ft	S28° 57' 24.9"W	+1° 3' 34.9"	16.2
ISS-5	North drift pillar sta. 2+65.77 ft	S28° 56' 47.0"W	+1° 22' 28.8"	15.6
ISS-6	South drift pillar sta. 3 + 11.47 ft	N27° 51' 42.9"E	+1° 14' 38.0"	18.2
ISS-7	South drift pillar sta. 2+58.27 ft	N29° 55' 13.1"E	+0° 55' 47.7"	17.3
ISS-8	South drift abutment sta. 2+59.00 ft	S28° 38' 19"W	+2° 55' 29"	108.6
ISS-9	Tail drift hor., sta. 2+57.59 ft	N61° 51' 16"W	+3° 39' 12.0"	60.2
ISS-10	Tail drift inclined sta. 2+56.95 ft	N59° 54' 23"W	+46° 11' 41"	80.5
ISS-11	Tail drift inclined sta. 2+57.00 ft	N59° 42' 10.6"E	-43° 11' 41"	93.8
BMT1	North heater sta. 3+10.00 ft	N28° 36' 53.5"E	+01° 22' 59.7"	49.5
BMT2	South heater sta. 3+39.88 ft	S18° 36' W	+01°	50.2
NHH-4	North heater drift sta. 2+75.23 ft		vert.	78.1
NHH-10	North heater drift sta. 3+95.23 ft		vert.	16.1
NHH-10A	North heater drift sta. 3+92.73 ft		vert.	16.0
SHH-5	South heater drift sta. 2+95.23 ft		vert.	18.2
SHH-5A	South heater drift sta. 2+92.73 ft		vert.	18.4
SHH-6	South heater drift sta. 3+15.23 ft		vert.	18.8
CHH & CHHPT Series	Canister drift sta. 2+17 to 3+78		vert.	varies 16-18

*Upward positive, downward negative

1.2 Purpose and Description of Holes

CCH and CCHPT Series

The Canister Core Holes (CCH) were drilled vertically downward in the Canister drift to provide geologic records of the rock prior to emplacement hole drilling and any thermal and/or radiation exposure. Each CCH hole was aligned parallel and tangential to a respective canister emplacement hole, as shown in Fig. 4. Diameters of the CCH holes were NX size, producing core samples 2.125 in. diameter.

The Post-Test Canister Core Holes (CCHPT) were drilled after removal of the spent fuel and heater assemblies from the emplacement holes. These holes also were aligned vertically downward and tangential to both the canister and CCH holes (Fig. 4). This design allows direct observation of the effects that radiation and/or heat had on specific geologic features. All CCHPT cores were 5.51 in diameter.

NHH and SHH Series

Cores were drilled in the north and south heater drifts (NHH and SHH Series) to study thermal effects on the rock surrounding four of the electrical heaters. Two of the holes, NHH-4PT and SHH-6PT, were six inch diameter overcores of the original heater holes, as shown in Fig. 5a. In the vicinity of each of NHH-10 and SHH-5, two post-test cores were drilled (Fig. 5b). NHH-10PT and SHH-5PT were drilled tangential to the AX (1.875 in. diameter) portion of each heater hole, which included the lower eight feet in

Fig. 4. Layout of CCH and CCHPT Holes in relation to Canister Emplacement Holes.

Fig. 5. Layout of core samples in the vicinity of the NHH and SHH Holes.

each case. The diameter of both PT holes was six inches, with a core diameter of 5.51 inches. The upper eight feet of each heater hole was NX SIZE (3.0 in. diameter), so the PT holes overlapped the original diameter in the top interval. Holes NHH-10A and SHH-5A were also NX size, drilled on the drift centerline 2.5 ft from the heater holes (Fig. 5b). Each pair of A and PT cores thus were subjected to different temperatures, and a study of this effect is in progress.

ISS Series

Seven holes were drilled at various locations and orientations in the tail and heater drifts in conjunction with in situ stress measurements. As shown in Fig. 3, most were nearly horizontal; however, ISS-10 and ISS-11 in the Tail drift were inclined approximately 45 degrees upward and downward, respectively. The seven ISS holes presented here are in addition to four stress measurement holes drilled earlier in the project [4]. Measurements in the present phase were made by stress relief techniques involving an EX (1.5 in. diameter) pilot hole followed by a six inch diameter overcore. The ISS core logs contained in this report all pertain to the overcore.

BMT Series

One borehole was drilled horizontally from each of the Heater drifts (Fig. 3) for measurement of in situ deformability of the rock mass. Each of these borehole modulus test holes (BMT) were three inch diameter (NX) to permit use of the hardrock Goodman Borehole Jack.

2. CORE LOGGING

2.1 Procedure

Although the Climax Stock quartz monzonite shows very little lithologic variation within the rock matrix, geologic features such as shear fractures, joints, dikes, and alteration zones are present. In this report the core logging emphasizes fracture characteristics such as depth, orientation, mineralization, and alteration. The information was systematically recorded on a field logging form, as illustrated by Fig. 6. With regard to fracture characteristics, the field notes include: (1) a sketch of apparent dips of joint planes, each rotated so that the downhole dip is to the right; (2) depths of the planar features at the point where they intersect the core center line, (3) two angles denoting relative joint orientations, which are described further in Chapter 3; and (4) descriptive information about discontinuities, alteration thickness, type of mineralization, slickensiding, and whether the joints were healed or open. Geologic features in the core which did not pertain to specific fractures, such as lithologic variations were also noted.

The first task in the logging process was reconstruction of the core. This was done by piecing each section together in a core trough to form a continuous single line. For the 5.51 in diameter core this was done on a laboratory bench using two pieces of angle stock fixed to a table to prevent the core from rolling. Once the length of core was reconstructed, usually in nine foot sections, a tape measure was laid along the section for depth measurements. An orientation reference line was then scribed down the core on the basis of a pervasive "low-angle" joint set which has a consistent orientation in the rock mass. This process is described further in the following chapter.

HOLE: U15-01-CCH 12

LOGGERS

DATE:

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DESCRIPTION/REMARKS

[illegible]

Fig. 6. Typical field core log.

The geologic observations and measurements were made using a hand lens and protractor. Important items such as alteration color, mineralization, evidence of shearing, and any other distinctive features were noted. Usually, specific types of minerals, such as pyrite, sericite, and calcite, could be identified macroscopically with confidence. However, other features, such as the nature of the rock alteration, would require microscopic examination. In these cases, only the alteration color was noted.

2.2 Summary of Geologic Features

As noted above, the lithology of the quartz monzonite is remarkably consistent throughout the core logged in this study, and a detailed petrologic analysis of the unaltered rock is available [5]. The most distinctive discontinuities seen in the core are the "low-angle" joints reported by other investigators [1,2]. The following section briefly describes these and other significant features found in the different groups of cores. Most of these relate to specific discontinuities appearing in the fracture logs in Appendix A, while other geologic descriptions refer to the summary notes accompanying the logs.

CCH and CCHPT Series

The most distinctive features are highly altered zones of rock surrounding the low-angle joints. These are up to several inches thick and appear either green, pink or white in color. Specimens of each type of alteration have been cut from the CCH core for microscopic and electron microprobe analysis, and each location is denoted by an "S" on the core logs in Appendix A. Results of

the laboratory analysis [5] indicate that the alteration minerals include sericite, chlorite, and calcite. Quartz phenocrysts are typically found within the joint infillings. The most prominent examples of this type of alteration are found in CCH and CCHPT hole numbers 1, 5, 6, 9, 10, 14, 16 and 17.

Macroscopically, the most important difference observed between the CCH and CCHPT core is a marked darkening of the quartz phenocrysts in the CCHPT series caused by the ionizing radiation from the spent fuel rods. Further analysis is in progress to study this characteristic, as well as any other microscopic differences between the two core sets. Other microscopic features include (1) a series of high-angle, calcite-filled joints in CCH and CCHPT holes 8 and 10, some of which have slickensides in CCHPT-8; (2) a mafic-rich zone of rock over ten feet long in hole number 2; and (3) several highly fractured (rubble) zones in holes CCH5 and 8. Samples of these features were cut from the core for laboratory analysis and results are published [5].

Past studies of the joint system in the Climax Stock have included discussion of the frequency with which fractures are found in the rock mass [2-4]. Table 2 presents similar data for the CCH and CCHPT holes. By inspection, one sees that there are between one and three features per foot of core if both healed and open joints are included. However, if only the open fractures are counted, the frequency is down by as much as an order of magnitude. Table 2 also indicates the effect that core size can have on the open joint frequency. Recalling that the CCH core is 2.125 in diameter (NX) and the CCHPT core is 5.51 in, we note that the larger core contains one-half to two-thirds the number of open joints, even though each pair comes from essentially the same location. The significance attached to this observation is that large core

seems to be less susceptible to drilling disturbance or damage. Indeed, this is the reason that rock classification schemes based on core condition refer only to the standard NX core size.

Figs. 7 and 8 are joint spacing histograms for the CCH and CCHPT holes, respectively. The smallest spacing interval in each graph is under-represented because rubble zones in the core are not included. Had these been shown, the data for both open and healed joints (Figs. 7a and 8a) would be represented well by the negative exponential distribution function, as previously demonstrated for Climax Stock joint systems [3,6]. The general shapes of the histograms for all joints are very similar because the two sets of holes sample the same regions of the rock mass. However, if only the open joint spacings are plotted (Figs. 7b and 8b), the smaller data set for the large core yields a distribution unlike the negative exponential (Fig. 3b).

ISS Series

The nature of the geologic features in the ISS series holes is basically the same as described for the CCK and CCHPT series. Examples of the joints with distinctly altered wall rock are found in all of the cores. In addition, a mafic-rich zone occurs at 38.5 ft in ISS-9. The only observation of slickensides on an open joint surface is at 36.7 ft in the same hole.

For ISS-11, the true orientation over the last 40 ft interval of the hole was determined by visually noting the top surface of the mounting glue used in the stress measurement operation. The joint orientations listed for this hole in Appendix A reflect this true core orientation, rather than a relative reference to the low-angle joint set. This affords an opportunity to evaluate the accuracy of the approximate orientation technique, and results are presented later in the report.

Table 2. Joint Frequency Data for CCH and CCHPT Series Holes.

Hole	Total no. of joints	Total no. open joints	Hole length (ft)	Total joint freq. (jnts/ft)	Open joint freq. (jnts/ft)
CCH1	48	18	17.0	2.8	1.1
CCH1PT	47	4	17.4	2.7	0.2
CCH2	40	9	17.4	3.4	0.5
CCH2PT	43	7	18.2	2.4	0.4
CCH3	33	9	16.9	1.95	0.3
CCH3PT	35	4	18.0	1.94	0.2
CCH4	34	6	16.9	2.0	0.4
CCH4PT	38	2	18.2	2.1	0.1
CCH5	27	10	16.4	1.6	0.6
CCH5PT	31	6	16.4	1.9	0.4
CCH6	41	17	16.9	2.4	1.0
CCH6PT	34	8	18.4	1.8	0.4
CCH7	41	10	17.4	2.4	0.6
CCH7PT	42	7	17.9	2.3	0.4
CCH8	43	19	17.0	2.5	1.1
CCH8PT	29	11	16.6	1.8	0.7
CCH9	52	14	17.3	3.0	0.8
CCH9PT	52	7	18.2	2.9	0.4
CCH10	40	10	17.2	2.3	0.6
CCH10PT	40	5	18.1	2.2	0.3
CCH11	46	7	16.9	2.7	0.4
CCH11PT	47	3	18.4	2.6	0.2
CCH12	37	5	17.0	2.2	0.3
CCH12PT	48	3	18.4	2.6	0.2
CCH13	37	6	17.2	2.2	0.3
CCH13PT	37	2	13.8	2.7	0.1
CCH14	43	4	16.8	2.6	0.2
CCH14PT	48	4	17.8	2.7	0.2
CCH15	42	4	16.8	2.5	0.2
CCH15PT	49	4	18.0	2.7	0.2
CCH16	42	6	17.4	2.4	0.3
CCH16PT	39	1	17.4	2.2	0.1
CCH17	31	3	17.3	1.8	0.2
CCH17PT	35	2	18.2	1.9	0.1

Fig. 7. Joint spacing histograms for CCH cores:
(a) both open and healed joints and (b)
only open joints.

Fig. 8. Joint spacing histograms for CCHPT cores:
(a) both open and healed joints and (b)
only open joints.

Table 3 contains joint frequency data for the ISS holes. In Fig. 9 we have combined the data into spacing histograms for both open and healed joints (Fig. 9a) and only open joints (Fig. 9b). Interval frequencies in these graphs are generally higher than those appearing in the preceding figures for the CCHPT cores. This results from the ISS holes having several different orientations, hence less directional bias in intersecting the different joint sets.

Table 3. Joint Frequency Data for ISS Series Holes.

Hole	Total no. of joints	Total no. open joints	Hole length (ft)	Total joint freq. (jnts/ft)	Open joint freq. (jnts/ft)
ISS4	22	9	16.2	1.4	0.6
ISS5	18	6	15.6	1.2	0.4
ISS6	15	1	18.2	0.8	0.1
ISS7	15	5	17.3	0.9	0.3
ISS8	104	47	108.6	1.0	0.4
ISS9	65	33	60.2	1.1	0.6
ISS10	157	24	80.5	1.95	0.3
ISS11	213	18	93.8	2.3	0.2

BMT Series

These two holes are nearly horizontal, so the previous comments regarding the occurrence of low-angle joints and alteration zones are applicable. In BMT-1, examples of these features are found at depths of 9.3, 10.9, 24.7, and 38.5 ft. The interval from 6.2 to 11.5 ft contains clusters of the low-angle

Fig. 9. Joint spacing histograms for the ISS cores:
(a) both open and healed joints and (b) only open joints.

joints. BMT-2 displays highly altered zones at 12.65, 18.1, 24.0, 29.7, and 46.3 ft. In addition, a mafic zone occurs between 48.1 and 50.0 ft.

Table 4 gives the joint frequency data for the BMT holes, and Fig. 10 shows fracture spacing histograms for the combined data of the two holes. Because the populations are relatively small, the histograms are more sparse than the previous diagrams, and comparisons are unwarranted.

Table 4. Joint Frequency Data for BMT Series Holes.

Hole	Total no. of joints	Total no. open joints	Hole length (ft)	Total joint freq. (jnts/ft)	Open joint freq. (jnts/ft)
BMT1	82	19	49.5	1.7	0.4
BMT2	48	9	50.2	0.96	0.2

Fig. 10. Joint spacing histograms for the BMT cores:
(a) both open and healed joints and (b) only open joints.

NHH and SHH Series

The NHH and SHH series holes are vertical and features in the core are similar to those described for the CCH and CCHPT holes. Several prominent low-angle joints with highly altered zones in hole NHH-10A occur at depths of 0.5, 4.5, and 12.0 ft. In hole NHH-10, which is nearby, the alteration appears to be more pink, perhaps displaying greater albitization than other cores in the series. Also in NHH-10, there is evidence of slickensides on a high-angle fracture at 4.5 ft depth.

The NHH-4 core was difficult to reconstruct and log because of several rubble zones. In these zones, we find numerous open high-angle joints with calcite deposits and iron staining. The remaining holes in the series contain no distinctive features other than the typical low-angle joints, most of which are healed.

Table 5 summarizes the fracture frequency data from the NHH and SHH holes. Because the core samples are of different diameters and represent widely separated regions of the rock mass, we have not pooled the data into histograms as above.

Table 5. Joint Frequency Data for NHH and SHH Series Holes.

Hole	Total no. of joints	Total no. open joints	Hole length (ft)	Total joint freq. (jnts/ft)	Open joint freq. (jnts/ft)
NHH10	36	9	16.1	2.2	0.6
NHH10A	38	16	16.0	2.4	1.0
SHH5	39	5	18.2	2.1	0.3
SHH5A	50	14	18.4	2.7	0.8
SHH6	45	3	18.8	2.4	0.2
NHH4	27	8	18.1	1.5	0.4

3. ORIENTATION OF GEOLOGIC FEATURES

3.1 Relative Orientations in the Core

Our method of orienting the core samples follows a convention used previously in the SFT-C project for the UG-2 core [6]. The system relies on the fact that the low-angle (sub-horizontal) joints in the Climax Stock are so pervasive that at least one may be observed in nearly any core segment at least three feet in length. Underground mapping has shown the modal orientation of the set to strike N44W and dip 20NE, with a natural dispersion of about ten degrees in any direction about the modal pole [1,6]. In addition, these low-angle joints are easily recognized by their distinctive mineralization and wall rock alteration. Of course, this method gives only an approximate core orientation; and we discuss its reliability later in the chapter.

First, we will outline the procedure and convention used in making measurements on the core. After a particular core section was carefully reconstructed, joints in the low-angle set were identified. The lower-most points (i.e., in the direction of drilling) of several of these were marked, and a line was drawn down the length of the core using a straight edge. The relative orientation of each joint plane then was described by two angles, as illustrated in Fig. 11. The angle "alpha" was measured between the core axis and the joint plane. Note that alpha is the complement of the "apparent dip". "Beta" was measured with a 360 degree graduated band wrapped clockwise around the core from the reference line, looking in the direction of drilling. The depth of a joint plane was measured to the center of its intersection ellipse (i.e., at the core centerline).

Figure 11. Convention for measuring relative orientations of fractures.

3.2 Conversion to True Orientation

To convert the local alpha and beta angles into a true dip and dip azimuths, we must find the absolute orientation of the reference line on the core. It is convenient to do this by stereographic projection; the general procedure for this is detailed elsewhere [6,7]. However, since it is not a trivial task, we will describe the solution for one of the holes in this study, ISS-10, and refer to Fig. 12. This hole has an azimuth of 300 degrees (clockwise from true north), and is inclined upwards at 46 degrees. Using an equal-angle (Wulff) stereonet, we plot the plane perpendicular to the core axis (β -plane, Fig. 12) and the nodal plane of the low-angle joint set (L-plane). Solid lines and points represent lower hemisphere projections of planes and vectors, respectively; dashed lines and open points are in the upper hemisphere. Note that the direction of drilling for ISS-10 is in the upper hemisphere.

The intersection between a joint plane and core surface is an ellipse whose minor and major axes can be found on the stereonet. The minor axis passes through the intersection points between the β - and L-planes in Fig. 12. (For a vertical borehole, this would be the strike line.) The major axis of the joint ellipse passes through two points 90 degrees from these, measured along the L-plane. To find the reference line, we next plot the plane parallel to the core axis (A plane), which contains the points of the major axis. The major downhole axis is always within 90 degrees of the down-hole direction, measured in the A-plane. We find the reference line vector ($\beta = 0$) by selecting the intersection point of the β - and A-planes that is closer to the major downhole axis.

Figure 12. Determination of core reference line orientation based on modal pole of low-angle joint set.

With the reference line plotted on the β -plane, we can locate any other joint plane on the stereonet according to its alpha and beta angles. An example for alpha and beta equal to 60 and 110 degrees, respectively, is illustrated by Fig. 13. However, the process can be done more efficiently using a transformation of axes between local (core-based) and global (true north) coordinate systems. In the local system, our convention is that the X' -axis is directed toward the reference line, the Y' -axis toward $\beta = 270^\circ$, and the Z' -axis along the hole centerline, opposite the direction of drilling. The global axes are: X-axis to the east, Y-axis to toward true north, and Z-axis upward.

To convert from one Cartesian system to the other, we multiply coordinates (such as direction cosines of the pole to a joint plane) by a 3×3 transformation matrix. This matrix contains the direction cosines between the two sets of axes, and can be calculated directly from what are commonly termed "Eulerian angles." These angles define three successive rotations that bring one system coincident with the other, and the rotations must be carried out in the specific sequence shown in Fig. 14. First, we rotate the initial global XYZ system counterclockwise by an angle ϕ , and label the intermediate axes X_I, Y_I, Z_I as indicated in the figure. The angle ϕ is such it brings in the Y_I -axis coincident with the azimuth of drilling. Next, the X_I, Y_I, Z_I axes are rotated counterclockwise about the X_I axis by an angle θ to give another intermediate set of axes, X_I', Y_I', Z_I' . This rotation aligns the Z_I' axis opposite to the direction of drilling, and the X_I', Y_I' plane is the β plane described above. Finally, we rotate the X_I', Y_I', Z_I' system counterclockwise about the Z_I' axis by an angle ψ to coincide with the specified local (core-based) system, $X'Y'Z'$. In physical terms, ψ is the counterclockwise rotation of X_I' , looking in the direction of drilling, that aligns it with the core reference line found earlier in Fig. 12. Fig. 15 summarizes the transformation by defining the Eulerian angles for hole ISS-10.

Figure 13. Determination of true joint orientation from alpha and beta angle measurements.

Figure 14. Rotations defining Eulerian angles for transformation of axes.

Figure 15. Eulerian angles for borehole ISS-10.

Calculation of global coordinates involves the following:

$$\begin{bmatrix} x_G \\ y_G \\ z_G \end{bmatrix} = \begin{bmatrix} l_1 & l_2 & l_3 \\ m_1 & m_2 & m_3 \\ n_1 & n_2 & n_3 \end{bmatrix} \cdot \begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} \quad (1)$$

where

$$\begin{aligned} l_1 &= \cos\psi \cos\phi - \cos\theta \sin\phi \sin\psi \\ l_2 &= \sin\psi \cos\phi - \cos\theta \sin\phi \cos\psi \\ l_3 &= \sin\theta \sin\phi \\ m_1 &= \cos\psi \sin\phi + \cos\theta \cos\phi \sin\psi \\ m_2 &= -\sin\psi \sin\phi + \cos\theta \cos\phi \cos\psi \\ m_3 &= -\sin\theta \cos\phi \\ n_1 &= \sin\theta \sin\psi \\ n_2 &= \sin\theta \cos\psi \\ n_3 &= \cos\theta . \end{aligned} \quad (2)$$

A Fortran code is included in Appendix B for converting core alpha and beta measurements to true joint dips and dip azimuths. Given the azimuth of drilling and the inclination of the hole from horizontal, all that is needed is the angle ψ from Fig. 15. The code reads a specified input file, then plots a graphical log of elliptical joint traces on a core surface, along with the respective true joint orientations and descriptions. We have used the program to generate the fracture logs found in Appendix B. Other geologic notes have been added at the end of each log.

3.3 Accuracy of the Technique

As mentioned earlier, use of the low-angle joint set provides only an approximate means of orienting a core. The method assumes that (1) the mean orientation of joints in this set does not vary along the core, and (2) when any group of the joints are used to draw the reference line, their mean is the same as the mean of the entire population (i.e. stationarity is assumed). However, if the number of intersected joints is small, as is the case for nearly horizontal holes, the potential error in the reference line (ψ angle) could be significant.

We estimated the confidence limits in establishing a reference line orientation for each core by assuming a low angle joint (L-plane) could deviate from the N44W-20NE mode by 10 degrees in any direction [1,6]. As an example, we outline the analysis for hole ISS-10. Fig. 16 is a stereographic plot similar to Fig. 12, except that a 10 degree error circle is plotted around the modal L-plane pole to represent its uncertainty. (Note that on the equal angle projection, the center of the circle does not coincide with the modal pole.) The maximum and minimum values of angle ψ are found by drawing A-planes (i.e., containing the downhole vector) that are tangent to the error circle. Fig. 16 shows the corresponding limits of ψ to be about +14 and -9 degrees with respect to the modal value. Similar stereographic constructions for the rest of the holes produced the results in Table 6. The greatest uncertainty is associated with vertical holes, where the range is +28 and -31 degrees. This occurs because vertical boreholes are nearly perpendicular to the low-angle joint set, in which case slight variation in the orientation of a joint pole can produce a large change in its dip direction. The variation of "true" joint orientations based on this uncertainty in ψ could be determined

Figure 16. Range of uncertainty in reference line orientation (ψ -angle, Fig. 11), using ± 10 degree uncertainty in low-angle joints.

Table 6. Uncertainty in core reference line location (ψ) associated with the approximate method, using ± 10 degree variation in modal pole of low-angle joint set.

Hole No.	ψ_{mode} (deg)	ψ_{min} (deg)	ψ_{max} (deg)	Range (deg)
ISS-4	95	85	105	± 10
ISS-5	95	85	105	± 10
ISS-6	265	255	275	± 10
ISS-7	264	254	275	± 10
ISS-8	96	86	106	± 10
ISS-9	70	60	80	± 10
ISS-10	247	233	257	+10, -14
ISS-11	60	75	47	+15, -13
BMT-1	265	255	275	± 10
BMT-2	95	85	105	± 10
Vert. holes	44	13	72	+28, -31

for each joint in a core log by entering upper and lower bounds for ψ in the transformation code in Appendix B. Although this is beyond the scope of the present work, we recommend it in future studies involving this core orientation method.

It was noted earlier that the true orientation for the lower portion of the ISS-11 core was determined. To further check the accuracy, we compare the joint orientations obtained by both the approximate and direct methods in Fig. 17. The equal-area contour diagram in Fig. 17a represents poles to 126 joints over the first 54 ft of core whose orientations were found relative to the low-angle set. Fig. 17b plots the remaining 85 joints according to the true core orientation. In both diagrams, the low-angle joint set accounts for at least 90 percent of all joints logged. By simple inspection, one can see that the modal poles are within a few degrees of each other. This result gives certain confidence in the data for at least the non-vertical cores, judging from our estimated uncertainty ranges listed in Table 6. However, we remain somewhat skeptical of orientations in a vertical core, since the estimated uncertainty in that case is appreciable.

4. CONCLUSIONS

Important geologic features in the core samples have been identified for the benefit of ongoing and future investigations related to the various types of holes. A technique for determining the approximate orientation of planar features has been demonstrated; however, in the context of Climax Stock geology, substantial error is associated with the technique when applied to vertical holes. A computer code for generating graphical core logs on the LLNL Octopus system is provided. Potential users are encouraged to contact the authors for assistance in its implementation.

Fig. 17. Comparison of joint orientations obtained from (a) approximate and (b) true core orientation methods.

ACKNOWLEDGMENTS

This work was funded by the LLNL Waste Isolation Program, Spent Fuel Test-Climax. We thank L. Rampott and W. Patrick for their support. The contribution of H. Ganow, who logged Hole ISS-11, is gratefully acknowledged. We also thank J. Cooper for his assistance in developing the computer code, and L. Burrow for preparing the manuscript.

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APPENDIX A - Core Fracture Logs

Abbreviations in core logs

Alt	=	Alteration
Ang	=	Angle
Brks	=	Breaks
CC	=	Calcareous
Dk	=	Dark or discolored
Fest	=	Iron stain
Grn	=	Green Alteration
H or Hld	=	Healed or closed joint
Hi	=	High
Jnt	=	Joint
Lt	=	Light colored
Maf	=	Mafic minerals
MB	=	Mechanical Break
O	=	Open Joint
Ori	=	Joint from which reference line was derived
Pnk	=	Pink Alteration
Numeral	=	Indicates thickness of alteration in millimeters
Part	=	Partially
Pyr	=	Pyrite
Poss	=	Possible
Qtz	=	Quartz
Rub	=	Rubble zone (indicates depth interval)
Rot	=	Rotational
Ser	=	Sericite
Slk	=	Slickensides indicated
Sl	=	Slightly
TD	=	Total Depth
Vert	=	Vertical
Wht	=	White Alteration
Zeo	=	Zeolite
Zn	=	Zone
Kap	=	Potassium feldspar
S	=	Sample location, CCH Series

CCH1

0.00 to 10.

depth dip dip az. description

CCH1

10.00 to 20.00

depth dip dip az. description

CCH1 Notes:

48 joints, 18 open. Most altered zones and over 1/2 joints occur in upper 9 ft. 10 joint samples selected for lab study.

CCH1pt

0.00 to 10.00

depth dip dip az. description

0.90	25.0	321.0	O,qlz,pyr,whl,10
1.20	22.0	106.0	H,grn,pyr,8
1.60	25.0	46.0	H,qlz,pyr,whl,20
1.90	20.0	76.0	H,whl,pyr,15
2.30	70.0	116.0	H,pyr,whl,3
2.70	20.0	46.0	H,whl,pyr,8,Ori
2.90	27.0	336.0	H,pyr,whl,5
3.50	40.0	356.0	H,pyr,whl,20
3.70	30.0	336.0	H,pyr,whl,3
3.80	24.0	86.0	H,whl,pyr,3
4.20	10.0	121.0	H,qlz,pyr,2
4.40	20.0	336.0	H,qlz,whl,7
4.70	45.0	16.0	H,qlz,whl,3
4.90	15.0	341.0	H,qlz,whl,2
5.00	15.0	8.0	H,qlz,whl,2
5.10	24.0	76.0	H,whl,pyr,7
5.60	25.0	356.0	H,whl,pyr,10
5.70	30.0	106.0	H,whl,pyr,8
5.80	22.0	96.0	H,qlz,whl,3
6.10	20.0	336.0	H,whl,8
6.20	17.0	336.0	H,qlz,pyr,maf zn,8
6.40	35.0	6.0	H,qlz,whl,3
6.50	25.0	6.0	H,qlz,whl,7
6.70	36.0	6.0	H,qlz,whl,grn,10
7.00	20.0	6.0	H,whl,pyr,6
7.30	25.0	76.0	H,grn,pyr,4
7.50	20.0	76.0	H,qlz,grn,10
7.80	45.0	1.0	H,whl,8
8.30	47.0	6.0	H,qlz,whl,7
8.40	15.0	36.0	H,qlz,whl,3
9.00	75.0	106.0	H,whl,3
9.40	20.0	46.0	H,whl,pyr,15
9.50	42.0	356.0	H,qlz,whl,3

CCH1pt

10.00 to 20.0

depth dip dip az. description

10.20	70.0	166.0	H,cc
11.00	70.0	166.0	O,cc,whl,
11.70	35.0	291.0	H,qlz,whl,5
12.30	25.0	26.0	H,grn,pyr,12
13.30	15.0	26.0	O,
13.90	22.0	46.0	H,grn,pyr,12,Ori
14.30	20.0	46.0	H,grn,pyr,10
14.70	35.0	316.0	H,qlz,whl,7
15.10	20.0	46.0	H,whl,
16.20	20.0	356.0	H,pyr,grn,
16.40	20.0	46.0	O,cc,
17.00	40.0	326.0	H,qlz,10
17.20	40.0	326.0	H,grn,whl,10
17.80	25.0	15.0	H,pyr,
18.20	0.0	0.0	WB 10

CCH1PT Notes:

47 joints, 4 open. Dark quartz phenocrysts from 2.8 to 17.0 ft.
 mafic rich xenolith 5.3-6.3 ft. Over 1/2 joints in upper 9 ft.
 Higher apparent dips in lower 1/2 of hole.

CCH2

0.00 to 10.

depth dip dip az. description

CCH2

10.00 to 20.00

depth dip dip az. description

CCH2 Notes:

48 joints, 9 open. Mafic rich zone 4.0-15.2 ft.

CCH2PT

0.00 to 10.0

depth dip dip az. description

CCH2PT

10.00 to 20.00

depth dip dip az. description

CCH2PT Notes:

43 joints, 7 open. Clusters of joints at 2.0 ft and 6.2-7.4 ft; most have 20° apparent dips. Near vertical joint 10.2-17.9 ft. Mafic rich zone 3.0-16.0 ft.

CCH3

0.00 to 10.00

depth dip dip az. description

CCH3

10.00 to 20.0

depth dip dip az. description

CCH3 Notes:
33 joints, 9 open.

CCH3PT

0.00 to 10.0

depth dip dip az. description

1.30	30.0	331.0	H,qtz,6
1.70	17.0	326.0	H,qtz,whl,7
1.90	20.0	46.0	H,whl,pyr,15,Orie
2.10	20.0	46.0	H,grn
2.20	20.0	46.0	H,grn
2.20	70.0	226.0	O,whl
2.50	30.0	346.0	H,whl
3.00	40.0	326.0	H,qtz,10
3.90	20.0	46.0	H,grn,pyr,4
4.00	20.0	46.0	H,whl,pyr
4.30	17.0	16.0	H,pyr,2
4.90	40.0	346.0	H,qtz,7
5.00	20.0	46.0	H,grn,pyr,13
5.10	70.0	256.0	O
6.80	32.0	356.0	H,whl,3
7.30	20.0	46.0	H,whl,5
8.20	20.0	76.0	H,whl,pyr,8
8.30	20.0	46.0	H,grn,pyr,16
9.00	20.0	46.0	O,grn,ser,hi oil
9.60	20.0	46.0	H,grn,20
9.80	30.0	326.0	H,qtz,whl,3

CCH3PT

10.00 to 20.00

depth dip dip az. description

10.50	45.0	306.0	H,whl
10.80	24.0	56.0	H,whl,qtz,12
11.80	20.0	336.0	H,whl,pyr,12
12.20	32.0	336.0	H,qtz,12
12.80	45.0	356.0	H,qtz,3
13.50	10.0	46.0	O,pyr
14.30	20.0	46.0	H,grn,15
15.20	20.0	46.0	H,grn,pyr,8
15.35	20.0	46.0	H,grn,pyr,10
15.70	20.0	46.0	H,qtz,grn,whl,20
16.40	20.0	46.0	H,grn,qtz,whl,14
16.90	10.0	326.0	H,whl,pyr
17.10	20.0	46.0	H,whl
17.80	32.0	356.0	H,whl,pyr,10
18.00	0.0	0.0	10

CCH3PT Notes:

35 joints, 4 open. Dark quartz phenocrysts 2.0-16.5 ft. Highly altered zone at 9.0 ft.

CCH4

0.00 to 10.00

depth dip dip az. description

depth	dip	dip az.	description
0.60	30.0	46.0	O.pyr, grn,
1.10	35.0	46.0	H.wht, pyr. 18
1.50	30.0	336.0	O.pyr,
1.90	15.0	46.0	O.wht,
2.20	20.0	336.0	H.pyr, qtz, 2
2.30	30.0	346.0	O,
2.40	20.0	46.0	H.wht,
2.60	20.0	46.0	H.pyr, grn, 10, Ori.
3.60	50.0	96.0	H.pyr, 1
3.90	10.0	46.0	H.pyr, wht,
4.60	40.0	336.0	H, qtz, 10
4.90	20.0	46.0	H, qtz, wht, 6
5.70	40.0	336.0	H.pyr, qtz,
6.30	20.0	46.0	H.wht,
8.00	25.0	316.0	H.pyr, 1
8.70	20.0	46.0	O.pyr,
9.20	20.0	46.0	H.wht, 4, Ori.
9.70	20.0	46.0	H,
9.80	40.0	341.0	H, qtz, pyr,

CCH4

10.00 to 20.0

depth dip dip az. description

depth	dip	dip az.	description
11.10	20.0	61.0	H.wht,
11.30	45.0	331.0	H.pyr, 1
11.90	20.0	96.0	O,
12.20	20.0	46.0	H.wht, 3
12.90	20.0	1.0	H.pyr, 1
13.20	40.0	336.0	H, qtz, pyr, 4
13.50	12.0	66.0	H.pyr, wht, 1
13.60	15.0	346.0	H.pyr, 1
13.80	20.0	346.0	H, qtz, wht, 5
14.40	23.0	336.0	H.pyr, 1
14.50	25.0	316.0	H.pyr, 1
15.40	20.0	356.0	H.pyr, grn, 13
15.50	20.0	356.0	H.pyr, grn, 10
15.60	20.0	46.0	H.pyr, grn, 10
15.90	20.0	71.0	H.wht, 3
16.90	0.0	0.0	TD

CCH4 Notes:
34 joints, 5 open.

0.00 to 10.00

depth	dip	dip oz.	description
10	10	10	10
20	20	20	20
30	30	30	30
40	40	40	40
50	50	50	50
60	60	60	60
70	70	70	70
80	80	80	80
90	90	90	90
100	100	100	100
110	110	110	110
120	120	120	120
130	130	130	130
140	140	140	140
150	150	150	150
160	160	160	160
170	170	170	170
180	180	180	180
190	190	190	190
200	200	200	200
210	210	210	210
220	220	220	220
230	230	230	230
240	240	240	240
250	250	250	250
260	260	260	260
270	270	270	270
280	280	280	280
290	290	290	290
300	300	300	300
310	310	310	310
320	320	320	320
330	330	330	330
340	340	340	340
350	350	350	350
360	360	360	360
370	370	370	370
380	380	380	380
390	390	390	390
400	400	400	400
410	410	410	410
420	420	420	420
430	430	430	430
440	440	440	440
450	450	450	450
460	460	460	460
470	470	470	470
480	480	480	480
490	490	490	490
500	500	500	500
510	510	510	510
520	520	520	520
530	530	530	530
540	540	540	540
550	550	550	550
560	560	560	560
570	570	570	570
580	580	580	580
590	590	590	590
600	600	600	600
610	610	610	610
620	620	620	620
630	630	630	630
640	640	640	640
650	650	650	650
660	660	660	660
670	670	670	670
680	680	680	680
690	690	690	690
700	700	700	700
710	710	710	710
720	720	720	720
730	730	730	730
740	740	740	740
750	750	750	750
760	760	760	760
770	770	770	770
780	780	780	780
790	790	790	790
800	800	800	800
810	810	810	810
820	820	820	820
830	830	830	830
840	840	840	840
850	850	850	850
860	860	860	860
870	870	870	870
880	880	880	880
890	890	890	890
900	900	900	900
910	910	910	910
920	920	920	920
930	930	930	930
940	940	940	940
950	950	950	950

CCH4PT

10.00 to 20.0

depth	dip	dip az.	description
10	10	10	10
20	20	20	20
30	30	30	30
40	40	40	40
50	50	50	50
60	60	60	60
70	70	70	70
80	80	80	80
90	90	90	90
100	100	100	100
110	110	110	110
120	120	120	120
130	130	130	130
140	140	140	140
150	150	150	150
160	160	160	160
170	170	170	170
180	180	180	180
190	190	190	190
200	200	200	200
210	210	210	210
220	220	220	220
230	230	230	230
240	240	240	240
250	250	250	250
260	260	260	260
270	270	270	270
280	280	280	280
290	290	290	290
300	300	300	300
310	310	310	310
320	320	320	320
330	330	330	330
340	340	340	340
350	350	350	350
360	360	360	360
370	370	370	370
380	380	380	380
390	390	390	390
400	400	400	400
410	410	410	410
420	420	420	420
430	430	430	430
440	440	440	440
450	450	450	450
460	460	460	460
470	470	470	470
480	480	480	480
490	490	490	490
500	500	500	500
510	510	510	510
520	520	520	520
530	530	530	530
540	540	540	540
550	550	550	550
560	560	560	560
570	570	570	570
580	580	580	580
590	590	590	590
600	600	600	600
610	610	610	610
620	620	620	620
630	630	630	630
640	640	640	640
650	650	650	650
660	660	660	660
670	670	670	670
680	680	680	680
690	690	690	690
700	700	700	700
710	710	710	710
720	720	720	720
730	730	730	730
740	740	740	740
750	750	750	750
760	760	760	760
770	770	770	770
780	780	780	780
790	790	790	790
800	800	800	800
810	810	810	810
820	820	820	820
830	830	830	830
840	840	840	840
850	850	850	850
860	860	860	860
870	870	870	870
880	880	880	880
890	890	890	890
900	900	900	900
910	910	910	910
920	920	920	920
930	930	930	930
940	940	940	940
950	950	950	950

CCH4PT Notes:

38 joints, 2 open. Cluster of 9 joints 14.0-15.3 ft. Dark quartz throughout.

CCH5

0.00 to 10.00

depth dip dip az. description

0				
	0.20	0.0	0.0	Rub(0.9-1.6)
	1.60	45.0	325.0	O,
	1.90	25.0	135.0	H,pyr,1
	2.10	65.0	101.0	O,
	2.50	65.0	286.0	O,cc,
	2.90	30.0	325.0	H,whl,4
	3.00	15.0	46.0	H,qtz,2
	3.40	10.0	76.0	O,ser,pyr,
	3.80	70.0	131.0	O,
	4.10	20.0	46.0	H,whl,
	4.30	70.0	131.0	O,
	4.40	20.0	46.0	H,whl,3
	5.10	40.0	316.0	H,qtz,5
	5.40	40.0	325.0	H,pyr,2
	6.40	20.0	66.0	H,grn,pyr,
	6.50	20.0	66.0	H,grn,pyr,
	6.60	20.0	46.0	H,grn,whl,10,Ori
	6.90	40.0	336.0	H,qtz,whl,3
	7.80	35.0	266.0	O,
	8.00	62.0	271.0	O,cc,zeo,
	8.70	30.0	46.0	H,pyr,
	9.50	30.0	336.0	H,pyr,whl,4
10				

CCH5

10.00 to 20.0

depth dip dip az. description

10	10.20	20.0	46.0	O,ser,grn,sl cc,60,hi alt,
	10.90	20.0	46.0	H,grn,Ori
	11.30	20.0	46.0	O,ser,cc,40,
	12.40	30.0	46.0	H,grn,pyr,
	14.60	20.0	46.0	H,whl,
	15.90	10.0	46.0	H,qtz,
	16.40	0.0	0.0	WB TO
20				

CCH5 Notes:

27 joints. 10 open. Coring problems 12.7-16.4 ft. caused series of rotational breaks. 3 highly altered zones at 6.5, 10.3, and 11.3 ft. Alteration minerals consist of sericite, chlorite, and calcite. Joint at 8.0 ft appears to have calcite and zeolite as a secondary alteration product.

CCH5PT

0.00 to 10.00

depth dip dip az. description

0				
	1.40	0.0	0.0	Rub(1.4-2.5)
	2.50	65.0	266.0	O,hi cc,pyr.
	3.20	25.0	285.0	H,qtz,pyr,whl,5
	3.20	15.0	46.0	H,qtz,grn.
	3.40	20.0	331.0	H,qtz,whl,10
	3.60	20.0	46.0	H,whl,grn,30
	4.40	60.0	96.0	O,cc.
	4.50	30.0	316.0	H,qtz,2
	4.50	20.0	46.0	H,whl,5
	4.70	20.0	46.0	H,whl,pyr,10
	5.30	55.0	296.0	H,qtz.
	5.70	40.0	326.0	H,qtz,whl,8
	6.80	30.0	46.0	H,qtz,grn,15
	7.00	20.0	46.0	H,qtz,grn,pyr,23,Oris
	7.40	30.0	336.0	H,
	8.00	65.0	276.0	O,cc
	8.50	25.0	346.0	H,pyr,3
	9.00	26.0	281.0	H,pyr,qtz,2
10	9.90	30.0	346.0	H,whl,4

CCH5PT

10.00 to 20.00

depth dip dip az. description

10	9.90	30.0	346.0	H,whl,4
	10.40	10.0	16.0	H,whl,8
	10.60	20.0	46.0	H,grn,20
	11.10	20.0	46.0	O,ser,cc,hi alt,40
	11.30	20.0	326.0	H,qtz,grn,20
	11.40	20.0	326.0	H,whl,qtz,10
	12.50	30.0	316.0	H,pyr,whl,3
	12.70	20.0	46.0	H,whl,qtz,pyr,15
	12.70	55.0	146.0	O,cc.
	12.80	35.0	316.0	O,sl cc,pyr.
	13.50	40.0	336.0	H,whl,qtz,4
	13.60	40.0	336.0	H,whl,pyr,6
	15.00	30.0	46.0	H,whl,pyr,7
	15.50	50.0	326.0	H,qtz,whl,5
	16.40	0.0	0.0	MB TD

CCH5PT Notes:

31 joints, 6 open. Highly altered zones at 7-0, 11.1 to 11.4 ft.
Dark quartz 3.0-14.0 ft.

CCH6

0.00 to 10.00

depth dip dip az. description

CCH6

10.00 to 20.0

depth dip dip az. description

CCH6 Notes:

41 joints, 10 open. Highly altered zones at 4.7, 5.9, 13.1 and 14.0 ft.

CCH6PT

0.00 to 10.0

depth dip dip az. description

CCH6PT

10.00 to 20.00

depth dip dip az. description

CCH6PT Notes:

36 joints, 8 open. High-angle joints, open and calcite-filled at 5.4 and from 11.8 to 18.4 ft. Highly altered zones at 5.2, 6.6 and 13.7 ft.

CCH7

0.00 to 10.00

depth dip dip az. description

0				
	0.90	20.0	176.0	0,
	1.00	25.0	46.0	0,
	1.20	40.0	326.0	0,pyr,
	1.50	20.0	46.0	0,whl,Ori.
	2.20	20.0	166.0	0,
	2.90	20.0	46.0	H,whl,
	3.60	10.0	316.0	0,pyr,whl,
	3.90	30.0	46.0	H,pyr,1
	3.95	25.0	6.0	H,pyr,ul,
	4.50	20.0	46.0	H,whl,pyr,5
	5.80	10.0	336.0	H,pyr,1
	6.00	50.0	161.0	0,
	6.20	50.0	306.0	0,whl,
	6.90	20.0	46.0	0,whl
	8.10	20.0	46.0	0,
	8.15	15.0	326.0	H,pyr,1
	8.20	15.0	326.0	H,pyr,1
	8.75	15.0	11.0	H,grn,pyr,whl,
	8.80	15.0	11.0	H,grn,pyr,whl,
	9.10	10.0	46.0	H,grn,pyr,
	9.20	30.0	46.0	H,pyr,qtz,2,
	9.50	25.0	326.0	H,pyr,1
	9.60	25.0	6.0	H,pyr,grn,10,
	9.90	20.0	6.0	H,pyr,grn,10
10				

CCH7

10.00 to 20.0

depth dip dip az. description

10				
	10.30	30.0	46.0	H,pyr,whl,3
	10.90	15.0	6.0	H,whl,7,
	11.90	25.0	306.0	H,qtz,whl,5
	12.30	20.0	46.0	H,whl,pyr,
	12.70	20.0	266.0	H,pyr,1
	12.90	20.0	276.0	H,grn,16
	13.10	23.0	276.0	H,pyr,grn,
	13.80	45.0	276.0	H,qtz,7,
	14.00	45.0	276.0	H,qtz,1
	14.30	20.0	46.0	H,whl,
	14.40	40.0	306.0	H,qtz,5,
	14.80	20.0	46.0	H,whl,
	15.00	40.0	26.0	H,qtz,whl,3
	15.40	10.0	306.0	H,pyr,whl,1
	15.70	40.0	301.0	H,pyr,1
	16.30	40.0	301.0	H,pyr,1
	17.30	30.0	306.0	H,qtz,whl,5,
	17.40	0.0	0.0	MB TO
20				

CCH7 Notes:

41 joints, 7 open. Dark quartz 2.4-16.0 ft.

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CCH7PT

0.00 to 10.00

depth dip dip az. description

0				
	1.00	23.0	306.0	O.
	1.30	63.0	286.0	H.pyr, 1
	1.70	40.0	336.0	O.pyr, 3.
	1.70	40.0	206.0	O.
	2.20	20.0	46.0	H.wht.pyr, 15, Ori.
	2.50	20.0	316.0	O. sl cc. fest.
	3.40	20.0	46.0	H.wht, 5
	3.80	23.0	321.0	H.qlz, wht, 8
	3.90	12.0	316.0	H.wht, qlz, 3
	4.60	23.0	16.0	H.wht, pyr, 3
	5.10	20.0	46.0	H.wht, 5
	5.70	60.0	181.0	O.
	6.30	20.0	356.0	H.pyr, 1
	6.60	25.0	6.0	H.wht, pyr, 8.
	6.70	40.0	316.0	H.qlz, 5
	7.30	20.0	46.0	O.wht, cc, fest, 35
	7.50	20.0	46.0	H.wht, 5
	8.60	20.0	46.0	H.qlz, grn, pyr, 20
	9.10	20.0	46.0	H.wht, 5
	9.40	20.0	46.0	H.qlz, grn, 25
	9.50	20.0	46.0	H.grn, pyr, 12
	9.60	15.0	316.0	H.pyr, 2
10				

CCH7PT

10.00 to 20.0

depth dip dip az. description

10	9.90	40.0	71.0	H.qlz, pyr, 2
	10.30	20.0	46.0	H.qlz, pyr, grn, 20
	11.00	20.0	46.0	H.pyr, wht, 3
	11.40	20.0	46.0	H.wht, 7
	12.40	35.0	336.0	H.qlz, wht, 5
	13.00	25.0	316.0	H.qlz, wht, 7
	13.20	20.0	46.0	H.wht, 1
	13.40	20.0	46.0	O.grn, pyr, ser, 13
	13.50	20.0	301.0	H.qlz, grn, 10
	14.20	40.0	336.0	H.pyr, wht, 8
	14.50	40.0	336.0	H.qlz, wht, pyr, 8
	14.50	37.0	336.0	H.qlz, wht, pyr, 20
	14.50	20.0	76.0	H.qlz, pyr, wht, grn, 23
	14.90	37.0	341.0	H.qlz, wht, 5
	15.30	20.0	46.0	H.wht, 6
	15.30	35.0	346.0	H.qlz, 3
	15.70	37.0	321.0	H.
	16.20	40.0	96.0	H.qlz, pyr, wht, 4
	16.90	40.0	356.0	H.pyr, wht, 4
	17.90	40.0	356.0	H.qlz, wht, 5
	17.90	0.0	0.0	TD
20				

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CCH8

0.00 to 10.00

depth dip dip az. description

0				
	1.50	25.0	276.0	H,qtz,whl,grn,6
	1.90	30.0	155.0	O,
	2.15	20.0	46.0	H,whl,10,Ori
	2.30	20.0	46.0	H,whl,8
	2.40	40.0	106.0	O,
	3.10	70.0	86.0	O,pyr,
	3.10	40.0	326.0	O,pyr,
	3.90	60.0	66.0	O,sl cc,
	4.50	60.0	66.0	O,cc
	4.80	30.0	46.0	O,cc
5	5.10	20.0	256.0	O,
	5.15	20.0	256.0	O,
	5.30	35.0	16.0	H,qtz,whl,4
	5.60	10.0	166.0	O,
	5.90	15.0	216.0	O,whl,
	6.00	70.0	126.0	O,whl,
	6.80	75.0	96.0	O,
	7.20	40.0	16.0	H,qtz,13
	8.50	70.0	286.0	O,cc,
	9.00	40.0	6.0	H,qtz,whl,pyr,2
	9.20	60.0	286.0	O,
	9.40	30.0	16.0	H,qtz,
10				

CCH8

10.00 to 20.0

depth dip dip az. description

10	10.20	15.0	46.0	H,qtz,grn,12
	10.50	20.0	46.0	H,whl,grn,pyr,10,Ori
	10.60	20.0	46.0	H,whl,grn,pyr,10
	10.80	15.0	96.0	O,pyr,
	11.10	20.0	46.0	H,whl,grn,7
	11.20	30.0	336.0	H,pyr,1
	11.80	30.0	346.0	H,qtz,whl,4
	11.90	60.0	276.0	O,cc
	12.20	10.0	276.0	H,whl,
	12.50	30.0	66.0	H,pyr,whl,
	12.70	15.0	76.0	H,pyr,whl,
	12.80	20.0	46.0	H,whl,4
	13.30	30.0	336.0	H,qtz,4
	13.40	20.0	46.0	H,whl,grn,3
	13.60	20.0	46.0	O,pyr,
	14.30	20.0	46.0	H,qtz,whl,4
	14.40	40.0	66.0	H,pyr,2
15	15.30	65.0	276.0	O,cc,
	15.50	30.0	316.0	H,qtz,whl,
	15.70	20.0	46.0	H,pyr,whl,5
	16.70	20.0	11.0	H,pyr,3
20	17.00	0.0	0.0	MB 10

CCH8 Notes:

43 joints, 19 open. 4 high-angle joints, all calcite filled at 3.9, 8.5, 11.9, and 15.3 ft.

CCH8PT

0.00 to 10.0

depth dip dip az. description

0				
	1.25	0.0	0.0	Rub(1.25-2.1)
	2.20	20.0	46.0	H.grn,qtz,20,Ori
	2.70	20.0	46.0	H,whl,7
	2.80	20.0	46.0	O,pyr.
	2.90	20.0	46.0	H,whl,
	3.00	20.0	46.0	H,whl,5
	3.20	10.0	276.0	O,pyr.
	3.70	50.0	276.0	O,qtz,grn,whl,pyr,hi att,3
	4.30	60.0	236.0	O,cc
	4.50	0.0	0.0	Rub(4.5-7.0),hi ang jnts,s
5				
	7.00	20.0	46.0	O,pyr,cc,whl,
	7.70	35.0	346.0	H,qtz,whl,6
	7.90	40.0	326.0	H,qtz,15
	8.40	70.0	346.0	O,cc
	8.80	45.0	286.0	H,qtz,whl,8
	9.20	20.0	256.0	H,whl,4
	9.30	40.0	326.0	H,qtz,whl,
10	9.70	80.0	126.0	O,cc

CCH8PT

10.00 to 20.00

depth dip dip az. description

10				
	10.50	0.0	0.0	Rub(10.5-11.0)
	11.20	20.0	46.0	H,grn,qtz,30,Ori
	11.50	20.0	46.0	H,whl,grn,20
	11.90	20.0	46.0	O,grn,pyr,
	11.90	75.0	296.0	O,hi cc,whl,
	12.50	20.0	46.0	H,whl,5
	12.60	35.0	336.0	H,qtz,2
	12.90	40.0	336.0	H,qtz,whl,7
	13.20	40.0	336.0	H,qtz,8
	13.70	20.0	46.0	H,qtz,whl,8
	13.80	20.0	46.0	H,whl,20
15				
	15.30	70.0	286.0	O,hi cc,
	15.80	70.0	96.0	O,cc,
	16.00	40.0	336.0	H,qtz,5,
	16.30	0.0	0.0	WB 10
20				

CCH8PT Notes:

29 joints, 11 open. Numerous high-angle, open joints, calcite filled. Some areas reduced to rubble. Rubble zone at 4.5-7.0 ft has numerous high-angle joints with slickensides. Dark quartz 2.0-14.0 ft.

CCH9

0.00 to 10.0

depth dip dip az. description

CCH9

10.00 to 20.00

depth dip dip az. description

CCH9 Notes:

52 joints, 16 open. Highly altered zone at 2.3 ft.

0.00 to 10.00

depth	dip	dip az.	description
10	10	10	10
20	20	20	20
30	30	30	30
40	40	40	40
50	50	50	50
60	60	60	60
70	70	70	70
80	80	80	80
90	90	90	90
100	100	100	100
110	110	110	110
120	120	120	120
130	130	130	130
140	140	140	140
150	150	150	150
160	160	160	160
170	170	170	170
180	180	180	180
190	190	190	190
200	200	200	200
210	210	210	210
220	220	220	220
230	230	230	230
240	240	240	240
250	250	250	250
260	260	260	260
270	270	270	270
280	280	280	280
290	290	290	290
300	300	300	300
310	310	310	310
320	320	320	320
330	330	330	330
340	340	340	340
350	350	350	350
360	360	360	360
370	370	370	370
380	380	380	380
390	390	390	390
400	400	400	400
410	410	410	410
420	420	420	420
430	430	430	430
440	440	440	440
450	450	450	450
460	460	460	460
470	470	470	470
480	480	480	480
490	490	490	490
500	500	500	500
510	510	510	510
520	520	520	520
530	530	530	530
540	540	540	540
550	550	550	550
560	560	560	560
570	570	570	570
580	580	580	580
590	590	590	590
600	600	600	600
610	610	610	610
620	620	620	620
630	630	630	630
640	640	640	640
650	650	650	650
660	660	660	660
670	670	670	670
680	680	680	680
690	690	690	690
700	700	700	700
710	710	710	710
720	720	720	720
730	730	730	730
740	740	740	740
750	750	750	750
760	760	760	760
770	770	770	770
780	780	780	780
790	790	790	790
800	800	800	800
810	810	810	810
820	820	820	820
830	830	830	830
840	840	840	840
850	850	850	850
860	860	860	860
870	870	870	870
880	880	880	880
890	890	890	890
900	900	900	900
910	910	910	910
920	920	920	920
930	930	930	930
940	940	940	940
950	950	950	950

1.30	40.0	336.0	H,qtz,pyr,whl,10
2.50	30.0	236.0	O.
2.60	65.0	76.0	O,whl.
2.10	30.0	46.0	H,qtz,whl,3
2.20	30.0	336.0	H,qtz,10
2.40	20.0	46.0	O,grn,ser,pyr,20
2.60	20.0	46.0	H,whl,8
2.80	15.0	46.0	H,grn,pyr,10
3.30	18.0	316.0	H,pyr,whl,2
3.30	20.0	46.0	H,whl,3
3.40	20.0	46.0	H,whl,3
3.70	20.0	46.0	H,qtz,grn,whl,12,Orie
4.20	40.0	336.0	H,qtz,whl,pyr,8.
4.30	20.0	46.0	H,whl,4
4.40	45.0	306.0	H,qtz,whl,2
4.60	20.0	46.0	H,whl,3
4.80	20.0	46.0	H,whl,pyr,5
5.30	50.0	196.0	O.
5.40	55.0	316.0	H,pyr.
5.80	20.0	296.0	H,whl,pyr,3
5.90	30.0	186.0	O,cc
6.10	30.0	186.0	O,cc,slk
6.30	20.0	286.0	H,whl,2
6.90	47.0	321.0	H,qtz,whl,7
7.60	65.0	246.0	H,qtz,grn,hi att,35
7.80	23.0	66.0	O,sl cc,
8.90	20.0	46.0	H,whl,grn.
9.00	65.0	306.0	H,qtz,pyr,1
9.30	10.0	46.0	H,whl,8
9.40	20.0	46.0	H,whl,4
9.50	10.0	326.0	H,pyr,grn,15
9.90	55.0	326.0	H,qtz,8

CCH9 p t

10.00 to 20.0

depth	dip	dip az.	description
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10.70	23.0	46.0	H, wht, 10
11.80	15.0	326.0	H, pyr, wht.
12.30	20.0	46.0	H, qtz, grn, 25
13.00	20.0	346.0	H, pyr, wht, 5
13.10	20.0	46.0	H, pyr, grn, 13
13.30	48.0	325.0	H, grn, qtz, pyr, 10
13.40	20.0	46.0	H, grn, pyr, 5
13.50	20.0	46.0	H, grn, pyr, 5
14.20	20.0	46.0	H, grn, pyr, 15
14.30	32.0	336.0	H, qtz, wht, 3
15.00	20.0	46.0	H, grn, wht, pyr, 16
15.30	20.0	336.0	H, qtz, grn, pyr, 10
15.50	20.0	46.0	H, grn, 10
16.00	20.0	306.0	H, wht.
16.40	20.0	46.0	H, grn, pyr, 15
16.60	10.0	318.0	H, qtz, wht, 10
17.40	32.0	306.0	H, pyr, 2
17.70	25.0	95.0	H, grn, wht, pyr, 12
17.80	25.0	96.0	H, grn, wht, pyr, 12
18.00	20.0	16.0	H, grn, wht, 30
18.20	0.0	0.0	MS 10.

GCH9PT Notes:

32 joints, 7 open. Highly altered zones at 2.1-2.8, 3.7, 7.6, 12.3, and 16.4 ft. Slickensides on joint at 6.1 ft. Dark quartz 2.3-16.3 ft.

CCH10

0.00 to 10.00

depth dip dip az. description

0				
	1.00	40.0	306.0	H,qtz,7
	1.10	30.0	246.0	O,
	1.30	30.0	246.0	O,
	1.40	30.0	246.0	O,
	1.50	45.0	256.0	O,
	1.60	15.0	346.0	H,
	2.50	30.0	46.0	H,pyr,grn,7
	2.70	18.0	86.0	H,whl,grn,10
	3.20	40.0	336.0	H,qtz,9
	3.30	20.0	46.0	H,whl,grn,10
	3.70	42.0	256.0	O,
	4.00	20.0	46.0	H,pyr,grn,
	4.50	40.0	66.0	H,qtz,whl,8
	4.80	10.0	46.0	H,whl,3
	5.20	20.0	46.0	H,pyr,grn,3
	5.50	30.0	351.0	H,whl,qtz,10
	5.90	20.0	46.0	H,whl,3,Orie
	6.80	20.0	46.0	H,grn,pyr,
	6.90	20.0	46.0	H,grn,pyr,
	8.30	70.0	141.0	O,cc
	8.80	33.0	336.0	H,qtz,5
	9.10	60.0	45.0	O,whl,maf,
	9.50	22.0	326.0	H,pyr,1
10				

CCH10

10.00 to 20.0

depth dip dip az. description

10				
	10.20	15.0	76.0	H,whl,3
	10.60	65.0	76.0	O,
	11.30	30.0	46.0	H,qtz,pyr,1
	11.60	37.0	321.0	H,qtz,whl,2
	11.70	30.0	346.0	H,qtz,1
	12.10	40.0	326.0	H,qtz,2
	12.70	10.0	46.0	H,whl,pyr,2
	13.00	20.0	46.0	H,grn,pyr,10
	13.30	20.0	46.0	O,pyr,cc
	13.70	38.0	341.0	H,qtz,whl,
	14.30	20.0	46.0	H,pyr,grn,18
	14.90	20.0	46.0	H,grn,10
	15.00	20.0	46.0	H,grn,10
	15.50	50.0	296.0	O,cc,60,hi alt,
	16.00	20.0	46.0	H,whl,1
	16.30	40.0	341.0	H,qtz,3
	16.40	20.0	46.0	H,grn,whl,6
	17.20	0.0	0.0	TD
20				

CCH10 Notes:

42 joints, 10 open. 4 high-angle joints, calcite filled; one at 9.1 shows a mafic rim. Highly altered zones at 10.3, 15.0, and 15.5 ft. Zone at 15.5 ft has joint with clay and calcite infilling.

CCH10PT

0.00 to 10.00

depth dip dip az. description

0				
1.70	35.0	316.0	H,qtz,12	
2.20	32.0	321.0	H,whl,5	
2.70	30.0	331.0	H,whl,pyr,20	
2.70	52.0	266.0	O,pyr,	
3.20	52.0	266.0	O,pyr,	
3.20	25.0	46.0	H,grn,whl,pyr,25	
3.80	20.0	46.0	H,whl,grn,10	
3.80	40.0	326.0	H,qtz,pyr,11	
4.70	25.0	46.0	H,grn,12	
4.80	20.0	46.0	H,grn,pyr,8	
5.30	50.0	66.0	H,qtz,whl,5	
5.70	20.0	46.0	H,grn,12	
6.20	30.0	356.0	H,whl,pyr,17	
6.40	20.0	46.0	C,grn,whl,pyr,sl cc,Ori	
7.30	20.0	46.0	H,grn,whl,pyr,25	
8.10	20.0	46.0	H,whl,3	
8.40	40.0	266.0	H,qtz,pyr,2	
9.30	38.0	326.0	H,qtz,whl,8	
9.90	60.0	46.0	O,cc	
10.10	50.0	236.0	H,qtz,whl,2	
10				

CCH10PT

10.00 to 20.0

depth dip dip az. description

10.70	20.0	46.0	H,grn,whl,20	
10.90	50.0	46.0	H,qtz,whl,3	
11.30	50.0	331.0	H,qtz,whl,7	
11.40	50.0	331.0	H,qtz,8	
11.90	20.0	46.0	H,pyr,whl,5	
12.00	62.0	66.0	H,qtz,2	
12.10	45.0	316.0	H,qtz,whl,2	
12.20	45.0	316.0	H,qtz,1	
12.40	62.0	66.0	O,cc	
12.70	45.0	316.0	H,pyr,whl,3	
13.50	20.0	46.0	H,grn,pyr,20	
13.80	20.0	46.0	H,grn,qtz,14	
14.30	38.0	326.0	H,pyr,qtz,3	
14.80	20.0	46.0	H,grn,10	
15.50	20.0	46.0	H,grn,whl,22	
15.60	20.0	46.0	H,grn,10	
15.80	50.0	326.0	H,cc	
15.90	50.0	326.0	H,whl,cc	
16.10	40.0	336.0	H,qtz,	
16.20	40.0	336.0	H,qtz,	
18.10	0.0	0.0	MB TD	
20				

CCH10PT Notes:

40 joints, 5 open. Same alteration zones as CCH10. High-angle joint at 10.9 ft has quartz in filling with white granular specks. Dark quartz 2.2-16.4 ft.

10.00 to 20.00

depth	dip	dip az.	description
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CCH11 Notes:
46 joints, 7 open.

-58-

CCH11pt

0.00 to 10.0

depth dip dip az. description

CCH11pt

10.00 to 20.00

depth dip dip az. description

CCH11PT Notes:

47 joints, 3 open. Dark quartz 2.2-16.2 ft.

CCH12

0.00 to 10.00

depth dip dip az. description

0				
	0.80	18.0	276.0	0.
	0.80	30.0	76.0	H,qtz,whl,
	1.00	20.0	16.0	0,pyr,
	1.10	20.0	46.0	H,whl,
	1.40	25.0	71.0	H,grn,whl,8
	1.60	20.0	66.0	0,grn,
	2.40	20.0	46.0	H,pyr,grn,5
	2.70	20.0	46.0	H,grn,15
	3.20	12.0	356.0	H,pyr,1
	3.80	20.0	46.0	H,whl,qtz,4
	3.90	20.0	46.0	H,grn
	4.50	40.0	326.0	H,pyr,2
	5.20	20.0	46.0	H,grn,15
	5.50	20.0	46.0	H,whl,4,0rie
	6.70	20.0	46.0	H,whl,7
	7.00	30.0	336.0	H,pyr,1
	7.40	20.0	46.0	H,whl,4
	7.90	10.0	226.0	0.
	8.10	20.0	66.0	0.
	8.50	20.0	46.0	H,pyr,1
	8.90	20.0	46.0	H,grn,pyr,10
	9.20	30.0	336.0	H,pyr,qtz,2
	9.50	30.0	336.0	H,pyr,1
	9.80	25.0	6.0	H,grn,pyr,8
10				

CCH12

10.00 to 20.0

depth dip dip az. description

10				
	11.90	20.0	286.0	H,qtz,pyr,2
	12.10	20.0	316.0	H,whl,7
	12.90	15.0	46.0	H,whl,
	13.40	10.0	331.0	H,qtz,pyr,2
	13.70	25.0	316.0	H,pyr,1
	13.90	30.0	336.0	H,qtz,whl,2
	14.20	20.0	46.0	H,grn,8
	14.60	20.0	46.0	H,whl,2
	15.10	20.0	46.0	H,whl,pyr,7
	15.20	60.0	296.0	H,qtz,3
	15.30	35.0	326.0	H,qtz,2
	15.70	30.0	306.0	H,pyr,4
	16.60	45.0	36.0	H,pyr,1
	17.00	0.0	0.0	TD
20				

CCH12 Notes:
37 joints, 5 open.

100-

CCH12pt

0.00 to 10.00

depth dip dip az. description

0				
	1.30	25.0	56.0	H,qtz,grn,ser,15
	1.30	20.0	336.0	H,qtz,grn,
	1.80	20.0	46.0	H,grn,pyr,8
	1.90	20.0	46.0	H,grn,pyr,20
	2.30	20.0	46.0	H,grn,pyr,30
	2.50	30.0	46.0	H,whl,pyr,12
	2.70	40.0	316.0	H,qtz,pyr,5
	3.00	20.0	46.0	H,whl,grn,12
	3.20	20.0	46.0	H,grn,22
	3.60	15.0	316.0	H,pyr,whl,
	4.10	30.0	316.0	H,qtz,whl,5
	4.50	20.0	46.0	O,grn,ser,cc
	4.60	20.0	46.0	H,grn,15
	4.90	30.0	301.0	H,qtz,whl,3
	5.20	30.0	336.0	H,qtz,whl,4
	5.70	18.0	301.0	H,qtz,2
	5.80	20.0	46.0	H,grn,15
	6.20	20.0	46.0	H,whl,grn,20,Orie
	7.30	20.0	46.0	H,whl,15
	7.50	30.0	266.0	H,pyr,qtz,5
	7.60	16.0	1.0	H,whl,6
	7.70	50.0	336.0	H,qtz,1
	8.00	20.0	46.0	H,whl,pyr,4
	8.10	20.0	46.0	H,whl,pyr,4
	8.50	30.0	46.0	H,grn,15
	9.10	70.0	66.0	O,cc,16
	9.30	25.0	46.0	H,qtz,grn,20
	9.50	20.0	46.0	H,grn,
	9.80	40.0	336.0	H,qtz,pyr,12
10				

CCH12pt

10.00 to 20.0

depth dip dip az. description

10				
	10.30	20.0	46.0	O,pyr,sl cc,grn,
	10.80	65.0	286.0	H,qtz,whl,5
	11.20	30.0	336.0	H,qtz,2
	12.10	16.0	346.0	H,whl,7
	12.50	16.0	336.0	H,qtz,whl,13
	13.50	20.0	46.0	H,whl,12
	13.80	10.0	316.0	H,whl,qtz,7
	14.60	30.0	336.0	H,qtz,3
	14.70	30.0	326.0	H,grn,pyr,5
	15.00	20.0	306.0	H,qtz,2
	15.10	20.0	46.0	H,whl,7
	15.30	60.0	286.0	H,qtz,1
	15.70	20.0	46.0	H,qtz,whl,5
	16.10	20.0	326.0	H,whl,5
	16.20	38.0	326.0	H,qtz,whl,2
	16.50	20.0	326.0	H,pyr,1
	17.40	40.0	66.0	H,pyr,1
	18.00	20.0	46.0	H,qtz,whl,5
	18.10	20.0	46.0	H,whl,grn,25
	18.40	0.0	0.0	MB TD
20				

CCH12PT Metas:

48 joints, 3 open. Dark quartz 2.2-16.2 ft.

CCH13

0.00 to 10.0

depth dip dip az. description

0.70	20.0	46.0	O.
0.80	30.0	6.0	H.qtz,wht,5
1.40	20.0	86.0	H.pyr,1
1.45	20.0	86.0	H.pyr,1
2.00	30.0	6.0	H.qtz,3
2.30	20.0	46.0	H,whl,qtz,3,Oris
2.85	20.0	46.0	H.pyr,1
2.90	20.0	46.0	H,whl,3
3.30	30.0	76.0	H.qtz,7
3.90	20.0	76.0	H,grn,10
4.10	45.0	106.0	H,qtz,pyr,8
5.00	15.0	346.0	H,qtz,pyr,1
5.50	25.0	86.0	H.pyr,whl,6
6.50	20.0	76.0	H,qtz,whl,2
7.70	40.0	359.0	H,qtz,3
8.40	40.0	356.0	H.pyr,qtz,1
8.70	20.0	46.0	O,whl,25
8.90	20.0	66.0	H,whl,grn,
9.00	20.0	66.0	H,whl,grn,
9.40	28.0	6.0	H.pyr,1
9.90	20.0	46.0	H,whl,1

CCH13

10.00 to 20.00

depth dip dip az. description

10.70	12.0	336.0	O,whl,pyr,
11.10	6.0	356.0	H.pyr,whl,1
11.60	40.0	6.0	H,whl,qtz,10
11.90	70.0	96.0	H.pyr,2
12.70	20.0	236.0	O,
12.80	12.0	351.0	H,whl,5
13.40	50.0	356.0	H,qtz,pyr,4
13.60	50.0	356.0	H,qtz,2
13.80	24.0	6.0	H,whl,5
14.30	20.0	46.0	H,whl,12
14.80	15.0	66.0	O,whl,pyr,
15.40	18.0	76.0	H,whl,10
15.50	27.0	66.0	H,whl,4
15.70	23.0	341.0	H.pyr,1
16.10	15.0	81.0	O,pyr,whl,
16.60	22.0	346.0	H.pyr,1
17.20	0.0	0.0	MB TO

CCH13 Notes:
37 joints, 6 open.

CCH13PT

0.00 to 10.00

depth dip dip az. description

0				
	1.20	50.0	301.0	H,qtz,1
	1.40	36.0	316.0	H,qtz,pyr,whl,cc,20
	1.80	20.0	286.0	H,pyr,1
	1.80	14.0	286.0	H,pyr,whl,2
	2.10	40.0	331.0	H,qtz,whl,7
	2.60	37.0	316.0	H,qtz,pyr,8
	2.60	20.0	46.0	H,grn,pyr,15
	2.70	20.0	46.0	H,grn,pyr,13
	2.90	20.0	46.0	H,qtz,whl,18,Ori
	3.20	20.0	46.0	H,grn,pyr,7
	3.45	20.0	46.0	H,whl,pyr,6
	3.50	20.0	46.0	H,whl,pyr,7
	3.60	20.0	46.0	H,whl,pyr,8
	3.90	26.0	46.0	H,qtz,grn,whl,25
	4.40	25.0	46.0	O,grn,pyr
	4.60	25.0	46.0	H,grn,pyr,8
	4.70	30.0	46.0	H,qtz,11
	5.50	40.0	351.0	H,whl,12
	6.00	30.0	11.0	H,whl,pyr,
	7.10	20.0	46.0	H,grn,qtz,pyr,16
	7.30	43.0	356.0	H,grn,pyr,
	7.40	40.0	356.0	H,grn,pyr,
	8.20	20.0	46.0	H,whl,pyr,13
	8.30	30.0	316.0	H,qtz,4
	9.20	20.0	46.0	O,whl,pyr,cc,20,
	9.40	20.0	46.0	H,grn,pyr,15
	9.60	20.0	46.0	H,whl,pyr,12
	9.70	15.0	306.0	H,qtz,whl,10
	9.90	25.0	306.0	H,pyr,2
	10.00	15.0	1.0	H,pyr,10

CCH13PT

10.00 to 20.0

depth dip dip az. description

10				
	10.40	20.0	46.0	H,whl,3
	10.50	20.0	46.0	H,pyr,whl,3
	10.70	35.0	346.0	H,pyr,whl,25
	11.20	15.0	316.0	H,whl,pyr,5
	11.50	12.0	316.0	H,pyr,whl,12
	12.30	35.0	336.0	H,whl,cc,20
	12.80	70.0	106.0	H,qtz,whl,5
	13.80	0.0	0.0	MB TD

CCH13PT Notes:
37 jolite, 2 open.

100

10.00 to 20.00

depth	dip	dip az.	description
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43 joints, 4 open. Highly altered zones at 8.0, 10.3, and 13.7 ft.

CCH14PT

0.00 to 10.0

depth dip dip az. description

0				
	1.20	50.0	46.0	H,pyr,1
	1.40	45.0	46.0	H,pyr,1
	1.40	20.0	46.0	H,qtz,whl,grn,25
	1.40	50.0	316.0	O,pyr,cc
	1.80	20.0	46.0	H,grn,pyr,15
	2.20	12.5	266.0	H,qtz,8
	2.40	40.0	336.0	H,pyr,whl,3
	3.60	40.0	316.0	H,pyr,grn,3
	3.70	20.0	28.0	H,grn,pyr,15
	3.70	45.0	316.0	H,qtz,4
	3.90	33.0	16.0	H,grn,whl,10
	4.70	20.0	46.0	H,qtz,grn,18
	4.80	40.0	316.0	H,qtz,2
	5.10	40.0	316.0	H,qtz,whl,4
	5.30	20.0	46.0	H,whl,grn,10
	5.60	20.0	46.0	H,whl,4
	5.70	75.0	88.0	H,whl,4
	5.90	25.0	16.0	H,qtz,whl,20
	6.30	40.0	326.0	H,qtz,7
	6.70	35.0	46.0	H,qtz,grn,15
	7.60	25.0	46.0	O,pyr,grn,cc,20
	7.90	25.0	46.0	O,pyr,grn,cc,
	8.80	15.0	46.0	H,qtz,whl,15
	8.90	23.0	46.0	H,whl,5
	9.00	20.0	336.0	H,pyr,2
	9.20	20.0	336.0	H,pyr,whl,2
	9.70	40.0	331.0	H,qtz,whl,2
	9.80	50.0	356.0	H,pyr,qtz,2
10				

CCH14PT

10.00 to 20.00

depth dip dip az. description

10				
	10.20	20.0	46.0	H,whl,8
	10.50	20.0	46.0	H,qtz,whl,15
	11.20	26.0	46.0	H,whl,14
	12.40	45.0	331.0	H,pyr,1
	12.40	30.0	331.0	H,pyr,whl,2
	12.50	30.0	331.0	H,pyr,whl,2
	13.10	16.0	346.0	H,whl,3
	13.50	45.0	336.0	H,qtz,3
	13.80	20.0	336.0	H,whl,2
	14.30	20.0	316.0	H,qtz,whl,12
	14.60	20.0	356.0	H,whl,qtz,3
	15.60	20.0	46.0	H,grn,pyr,18
	15.80	46.0	326.0	H,pyr,2
	16.00	10.0	326.0	H,pyr,whl,2
	16.60	20.0	46.0	H,whl,4
	16.60	12.0	346.0	H,pyr,qtz,3
	16.90	20.0	46.0	H,grn,pyr,18
	16.90	35.0	326.0	H,qtz,whl,5
	17.30	40.0	336.0	H,qtz,2
	17.60	20.0	45.0	O,whl,hi alt,TD
20				

CCH14PT Notes:

48 joints, 4 open. Same alteration zones at CCH14. Dark quartz 2.2-15.7 ft.

CCH15

0.00 to 10.00

depth dip dip az. description

0.70	40.0	336.0	O,pyr.
1.10	68.0	296.0	O,
1.20	40.0	346.0	H,qtz,3
1.60	40.0	6.0	H,pyr,qtz,1
1.70	25.0	316.0	H,pyr,1
1.90	25.0	296.0	H,pyr,1
2.30	20.0	306.0	H,qtz,pyr,3
2.40	20.0	81.0	O,ser,cc,pyr,hi alt,
2.80	20.0	46.0	H,grn,12
3.10	20.0	46.0	H,whl,3
3.90	50.0	126.0	O,cc,
4.30	20.0	326.0	H,whl,4
4.60	20.0	336.0	H,whl,3
5.10	35.0	346.0	H,qtz,3
5.20	20.0	46.0	H,whl,qtz,7,Ori
5.60	20.0	46.0	H,grn,8
5.80	20.0	46.0	H,grn,whl,8
5.90	10.0	346.0	H,pyr,
6.60	20.0	46.0	H,whl,qtz,20
7.50	20.0	316.0	H,qtz,whl,4
8.10	40.0	336.0	H,qtz,2
8.50	22.0	46.0	H,whl,5
8.60	22.0	46.0	H,whl,5
9.00	20.0	336.0	H,pyr,1
9.10	30.0	336.0	H,qtz,5
9.20	20.0	46.0	H,
9.30	20.0	46.0	H,grn,pyr,5
9.50	20.0	46.0	H,grn,pyr,5

CCH15

10.00 to 20.0

depth dip dip az. description

10.10	30.0	346.0	H,qtz,whl,3
10.10	30.0	336.0	H,qtz,whl,3
11.40	40.0	316.0	H,pyr,1
11.90	40.0	316.0	H,pyr,qtz,7
12.10	25.0	316.0	H,pyr,1
12.30	20.0	6.0	H,pyr,qtz,2
12.90	40.0	306.0	H,qtz,3
13.30	20.0	326.0	H,pyr,1
13.40	50.0	326.0	H,qtz,7
13.60	40.0	316.0	H,qtz,7
14.30	15.0	46.0	H,pyr,1
15.30	30.0	326.0	H,qtz,3
15.60	30.0	326.0	H,qtz,1
16.20	20.0	46.0	H,whl,2,Ori
16.80	0.0	0.0	MB TD

CCH15 Notes:
42 joints, 4 open-

CCH15pt

0.00 to 10.0

depth dip dip az. description

0				
1.10	40.0	156.0	O, wht, 1	
1.20	77.0	286.0	O, wht, 1	
1.30	35.0	326.0	H, qtz, 2	
2.50	35.0	336.0	H, pyr, 2	
2.70	24.0	321.0	H, qtz, pyr, 3	
3.00	20.0	46.0	O, ser, grn, 50, hi alt.	
3.40	20.0	46.0	H, grn, pyr, 20	
3.70	55.0	61.0	H, pyr, 2	
3.80	55.0	61.0	H, pyr, wht, 4	
4.40	56.0	216.0	O, cc,	
4.80	26.0	326.0	H, wht, pyr, 7	
5.00	75.0	46.0	H, pyr, 1	
5.00	26.0	316.0	H, pyr, 1	
5.10	35.0	46.0	H, wht, pyr, 12	
5.60	20.0	46.0	H, pyr, wht, 4	
5.90	20.0	46.0	H, wht, grn, 27, Ori	
6.10	40.0	331.0	H, qtz, pyr, 3	
6.30	20.0	46.0	H, wht, grn, 25	
6.50	20.0	46.0	H, grn, pyr, 12	
7.30	20.0	46.0	H, qtz, wht, grn, 35	
7.50	20.0	46.0	H, grn, qtz, pyr, 22	
7.50	20.0	316.0	H, grn, pyr, 5	
7.90	30.0	306.0	H, qtz, wht, 13	
8.60	30.0	306.0	H, qtz, pyr, 3	
9.40	20.0	46.0	H, grn, pyr, 7	
9.60	18.0	321.0	H, wht, pyr, 6	
9.90	43.0	326.0	H, qtz, pyr, 8	
10				

CCH15pt

10.00 to 20.00

depth dip dip az. description

10.10	30.0	46.0	H, qtz, wht, 16	
10.30	26.0	356.0	H, grn, wht, pyr, 12	
10.90	15.0	326.0	H, pyr, wht, 8	
11.00	40.0	326.0	H, qtz, wht, 4	
11.70	5.0	36.0	H, wht, pyr, 15	
11.90	5.0	36.0	H, wht, pyr, 12	
12.50	20.0	46.0	H, wht, 3	
12.70	40.0	306.0	H, pyr, wht, 1	
13.10	50.0	336.0	H, pyr, 1	
13.20	22.0	356.0	H, qtz, wht, 6	
13.30	20.0	46.0	H, wht, 7	
13.70	43.0	326.0	H, qtz, wht, 3	
14.10	43.0	326.0	H, pyr, wht, 40	
14.30	40.0	326.0	H, pyr, 1	
14.50	40.0	326.0	H, qtz, 6	
14.60	20.0	286.0	H, pyr, 1	
15.10	20.0	46.0	H, wht, pyr, 4	
15.40	43.0	301.0	H, pyr, wht, 1	
16.10	40.0	321.0	H, qtz, pyr, 2	
16.60	45.0	321.0	H, wht, pyr, 5	
16.90	20.0	46.0	H, grn, wht, 12, Ori	
17.00	20.0	46.0	H, grn, wht, 12,	
18.00	0.0	0.0	MB TO	
20				

CCH15PT Notes:
49 joints, 4 open

CCH16

0.00 to 10.00

depth dip dip az. description

0				
	1.10	13.0	91.0	O,whl,pyr,
	1.30	40.0	336.0	O,
	1.50	20.0	346.0	H,pyr,1
	1.80	20.0	336.0	H,pyr,whl,5
	2.50	30.0	6.0	H,qtz,whl,3
	2.80	35.0	356.0	H,pyr,1
	3.00	10.0	46.0	O,ser,pyr,
	3.20	20.0	46.0	H,grn,whl,pyr,12
	3.30	20.0	46.0	H,grn,10
	3.70	30.0	26.0	H,pyr,1
	3.80	20.0	46.0	H,whl,18,Ori
	4.00	30.0	46.0	H,qtz,2
	4.20	20.0	46.0	H,grn,12
	4.40	30.0	356.0	H,qtz,whl,4
	5.00	40.0	6.0	H,pyr,1
	5.20	15.0	46.0	H,pyr,1
	5.70	20.0	356.0	H,whl,pyr,1
	5.80	20.0	336.0	H,pyr,1
	6.60	12.0	86.0	O,grn,15
	6.70	10.0	46.0	H,pyr,1
	7.00	40.0	6.0	H,qtz,2
	7.40	10.0	46.0	O,pyr
	8.10	15.0	46.0	H,qtz,whl,6
	8.30	10.0	336.0	O,pyr,
	8.90	40.0	6.0	H,qtz,pyr,3
	9.10	20.0	356.0	H,pyr,1
	9.40	10.0	6.0	H,qtz,whl,8
	9.50	20.0	6.0	H,whl,grn,15
	9.70	60.0	326.0	H,pyr,1
10				

CCH16

10.00 to 20.0

depth dip dip az. description

10	10.20	35.0	6.0	H,qtz,9
	11.00	40.0	306.0	H,qtz,pyr,4
	11.20	40.0	6.0	H,whl,1
	11.30	50.0	126.0	H,qtz,whl,1
	11.80	20.0	76.0	H,qtz,pyr,13
	12.10	20.0	76.0	H,pyr,1
	13.10	35.0	106.0	H,qtz,whl,2
	13.40	30.0	326.0	H,pyr,1
	14.20	30.0	91.0	H,whl,15
	14.80	40.0	346.0	H,pyr,qtz,3
	16.10	30.0	326.0	H,pyr,1
	16.30	20.0	346.0	H,pyr,1
	16.90	20.0	356.0	H,qtz,pyr,1
	17.40	0.0	0.0	MB TO
15				
20				

CCH16 Notes:
42 joints, 6 open.

CCH16PT

0.00 to 10.00

depth dip dip az. description

0				
	1.60	20.0	46.0	H,whl,grn,2
	1.90	15.0	1.0	H,whl,pyr,3
	2.20	20.0	316.0	H,pyr,whl,3
	2.30	20.0	46.0	H,whl,6
	3.10	20.0	26.0	H,whl,pyr,6
	3.30	42.0	346.0	H,pyr,2
	3.50	20.0	46.0	H,grn,whl,25
	3.70	20.0	46.0	H,grn,35
	4.20	42.0	341.0	H,pyr,cc,8
	4.30	20.0	46.0	H,whl,qtz,20,Orl
	4.50	20.0	76.0	O,pyr,cc,grn,
	4.60	40.0	336.0	H,qtz,pyr,4,
	5.00	48.0	356.0	H,pyr,1
	5.40	15.0	46.0	H,pyr,1
	6.00	22.0	316.0	H,pyr,2
	6.10	20.0	336.0	H,whl,pyr,1
	6.70	43.0	336.0	H,qtz,pyr,whl,5
	7.10	20.0	71.0	H,qtz,grn,17
	7.50	50.0	336.0	H,qtz,pyr,2
	7.80	17.0	71.0	H,grn,pyr,7
	8.60	20.0	56.0	H,qtz,whl,grn,20
	8.70	30.0	336.0	H,qtz,8
	9.40	40.0	316.0	H,qtz,whl,20
	9.60	20.0	356.0	H,pyr,1
	9.80	15.0	16.0	H,qtz,whl,grn,pyr,5
	9.80	20.0	326.0	H,whl,grn,25
10				

CCH16PT

10.00 to 20.0

depth dip dip az. description

10	10.10	60.0	286.0	H,qtz,pyr,2
	10.70	40.0	336.0	H,qtz,whl,12
	11.10	50.0	276.0	H,qtz,whl,7
	11.40	20.0	46.0	H,grn,pyr,
	11.60	20.0	46.0	H,grn,whl,pyr,18
	11.80	65.0	286.0	H,pyr,1
	12.50	30.0	36.0	H,qtz,grn,whl,10
	12.60	20.0	46.0	H,qtz,whl,4
	13.70	45.0	71.0	H,whl,qtz,5
	13.90	40.0	46.0	H,whl,qtz,3
	14.60	20.0	46.0	H,whl,11
	15.30	40.0	326.0	H,whl,pyr,cc,40
	17.00	20.0	316.0	H,whl,pyr,4
	17.40	0.0	0.0	MB TO
20				

CCH16PT Notes:

39 joints, 1 open- Highly altered zones at 4.3, 8.6, and 15.3 ft.

CCH17

0.00 to 10.0

CCH17

10.00 to 20.00

depth	dip	dip oz.	description
10	10	10	10
20	20	20	20
30	30	30	30
40	40	40	40
50	50	50	50
60	60	60	60
70	70	70	70
80	80	80	80
90	90	90	90
100	100	100	100
110	110	110	110
120	120	120	120
130	130	130	130
140	140	140	140
150	150	150	150
160	160	160	160
170	170	170	170
180	180	180	180
190	190	190	190
200	200	200	200
210	210	210	210
220	220	220	220
230	230	230	230
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410	410	410	410
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910	910	910	910
920	920	920	920
930	930	930	930
940	940	940	940
950	950	950	950

depth	dip	dip oz.	description
10	10	10	10
20	20	20	20
30	30	30	30
40	40	40	40
50	50	50	50
60	60	60	60
70	70	70	70
80	80	80	80
90	90	90	90
100	100	100	100
110	110	110	110
120	120	120	120
130	130	130	130
140	140	140	140
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860	860	860	860
870	870	870	870
880	880	880	880
890	890	890	890
900	900	900	900
910	910	910	910
920	920	920	920
930	930	930	930
940	940	940	940
950	950	950	950

CCH17 Notes:

31 joints, 3 open. Highly altered zones at 8.2-8.5, 14.0, and 17.0 ft.

CCH17PT

0.00 to 10.0

depth dip dip az. description

CCH17PT

10.00 to 20.00

depth dip dip az. description

CCH17PT Notes:

35 joints, 2 open. Highly altered zones at 8.4, 9.4, 14.2 and 17.4 ft.

NHH4PT

0.00 to 10.00

depth dip dip az. description

NHH4PT

10.00 to 20.0

depth dip dip az. description

NHH4PT Notes:

29 joints, 5 open. All open joints calcite filled and high-angle. 5 rubble zones at 10.5-11.1, 12.1-15.7 and 16.3-16.7 ft, consisting of high-angle joints with calcite infilling and iron staining. No slickensides.

NHH10PT

0.00 to 10.00

	depth	dip	dip az.	description
0	0.03	0.0	0.0	Rub(0.03.3)
	3.30	20.0	46.0	H,pnk,pyr,12
	3.70	20.0	46.0	H,pnk,pyr,20,Ori
	4.50	82.0	226.0	O,cc,slk,whl,
	5.00	82.0	226.0	O,cc,feat,depth approx,
5	5.00	0.0	0.0	Rub(5.0-6.5)
	6.50	20.0	46.0	H,pnk,12
	6.60	50.0	106.0	O,cc
	7.30	37.0	316.0	H,pyr,2
	7.60	35.0	336.0	H,pyr,2
	7.80	60.0	246.0	H,pyr,
	7.90	30.0	46.0	H,qtz,pyr,pnk,13
	8.00	48.0	246.0	O,cc,
	8.40	20.0	46.0	H,whl,pnk,17
	8.80	30.0	46.0	O,pyr,whl,
	9.20	20.0	46.0	H,whl,pyr,Ori
10	9.70	64.0	126.0	O,cc

NHH10PT

10.00 to 20.00

	depth	dip	dip az.	description
10	10.50	20.0	46.0	H,qtz,pyr,whl,pnk,22,Ori
	10.60	20.0	306.0	H,whl,5
	10.70	20.0	16.0	H,qtz,whl,10
	10.80	30.0	46.0	H,pyr,whl,5
	11.30	20.0	46.0	H,pyr,whl,20
	11.40	35.0	326.0	H,qtz,pyr,
	11.50	20.0	306.0	H,pyr,2
	11.90	75.0	126.0	O,
	12.20	20.0	21.0	H,grn,whl,pyr,27
	12.60	40.0	306.0	O,cc,whl,
	13.40	23.0	306.0	H,pyr,3
	13.60	20.0	46.0	H,whl,pyr,2
	14.10	20.0	306.0	H,whl,pyr,3
	14.30	30.0	306.0	H,qtz,pyr,whl,6
	14.80	20.0	46.0	H,whl,pyr,6
	15.00	37.0	306.0	H,qtz,pyr,whl,17
	15.20	20.0	46.0	H,whl,pyr,10
	15.30	43.0	316.0	H,qtz,pyr,8
	15.50	45.0	356.0	H,whl,pyr,3
	16.00	20.0	46.0	H,whl,pyr,3
	16.10	20.0	46.0	O,grn,pyr,cc,TD

NHH10PT Notes:

36 joints, 9 open. Very pink core, perhaps more albite. Chlorite alteration also appears greener. Slickensides on high-angle joint at 4.5 ft.

NHH10A

0.00 to 10.00

depth dip dip az. description

0.70	20.0	46.0	H.grn.pyr,200
0.80	20.0	46.0	O.cc.grn.pyr,200
0.90	20.0	46.0	H.pyr.grn.pnk,200
1.00	40.0	46.0	H.grn.pyr,4
1.30	25.0	336.0	H.pnk.qtz.cc,300,*Ori
1.50	25.0	336.0	H.pyr,2
1.80	20.0	46.0	H.pyr.whl,3
2.40	40.0	316.0	H.whl.grn,3
3.50	30.0	96.0	O.cc.whl,3
4.30	60.0	96.0	O.cc.whl.grn.Ori?
4.50	60.0	96.0	O.cc.whl.qtz,8
5.00	20.0	46.0	H.pnk.pyr,150
5.30	20.0	6.0	O.cc.whl.qtz,8
5.50	40.0	336.0	H.whl.qtz,5
5.60	40.0	336.0	H.whl.qtz,3
5.90	45.0	286.0	H.whl.pyr,3
6.60	40.0	336.0	H.pyr.qtz.grn
6.80	20.0	46.0	O.pnk.grn,200,*Ori
7.0	80.0	246.0	H.whl.pyr,2
7.80	0.0	0.0	Rub.(7.8-10.0)

NHH10A

10.00 to 20.0

depth dip dip az. description

10.00	35.0	346.0	O.cc.pyr
10.50	50.0	46.0	O.cc.whl,5
10.80	20.0	46.0	O.cc.pnk
10.90	30.0	346.0	H.whl,1
11.30	30.0	346.0	H.pnk.pyr,4
11.60	20.0	46.0	H.pnk.qtz.pyr,160
12.00	20.0	46.0	O.pnk.cc.grn,250
12.20	80.0	226.0	O.cc
12.40	40.0	316.0	H.qtz.pnk,8
12.60	10.0	316.0	H.whl.qtz,3
13.10	80.0	196.0	H.pyr.qtz,2
13.20	20.0	46.0	O.pyr.whl,3
14.20	20.0	96.0	H.whl,2
14.40	20.0	96.0	O.pyr.whl,3
14.80	40.0	176.0	O.whl,2
14.90	65.0	326.0	O.cc.whl,5
15.20	40.0	356.0	O.whl.pyr.pnk,100
15.30	20.0	46.0	H.whl.pyr.qtz.grn,4,*Ori
15.70	30.0	356.0	H.pyr.whl,3
16.00	0.0	0.0	MB TO

NHH10A Notes:

38 joints, 16 open. Highly altered zones at 0.8, 7.0, and 11.6-12.0 ft. Zone of broken core 7.8-10.0 ft.

SHH5PT

0.00 to 10.0

depth dip dip az. description

SHH5PT

10.00 to 20.00

depth dip dip az. description

SHH5PT Notes:

39 joints, 5 open. Highly altered zones at 3.8-4.3, 11.0, 15.3, and 15.8.

SHH5A

0.00 to 10.00

depth dip dip az. description

0.00	0.0	0.0	Coiler Pipe (0.0-1.5)
1.75	20.0	206.0	H, pyr, 2
1.75	42.0	46.0	H, wht, pyr, 3
1.85	20.0	246.0	O, pyr
1.95	43.0	326.0	H, qtz, wht, 12
2.10	35.0	58.0	H, wht, qtz, pyr, 8
2.40	42.0	186.0	O,
2.65	15.0	306.0	O, pyr, 1
3.00	50.0	78.0	H, pyr, wht, 2
3.10	20.0	326.0	O, pyr, wht, 5
3.30	20.0	306.0	H, wht, pnk, pyr, 18
3.40	20.0	46.0	O, cc, wht, pyr, 5
3.50	20.0	46.0	H, wht, 4
3.80	40.0	46.0	H, wht, pyr, 13
3.95	35.0	46.0	H, grn, pyr, 2
4.20	30.0	336.0	H, pyr, wht, 5
4.30	20.0	46.0	H, wht, 4
4.40	40.0	316.0	H, wht, 3
4.60	20.0	46.0	H, wht, pyr, 10
5.00	20.0	46.0	H, wht, 5
5.30	20.0	46.0	H, wht, pyr, 6
5.50	20.0	266.0	H, pyr, wht, 4
5.75	45.0	306.0	H, qtz, pyr, wht,
6.80	20.0	46.0	H, grn, qtz, pyr, cc, 15, Ori
7.20	20.0	46.0	O, wht, grn, sl cc, pyr, 10
7.80	40.0	296.0	H, qtz, pyr, wht, 8
8.50	15.0	306.0	O, pyr,
8.90	40.0	306.0	H, qtz, wht, 10
9.10	25.0	306.0	H, wht, pyr, 12
9.60	30.0	296.0	H, pyr, wht, 2
9.80	20.0	46.0	O, wht, qtz, grn, 13

SHH5A

10.00 to 20.0

depth dip dip az. description

10.10	30.0	316.0	H, qtz, wht, 5
10.40	20.0	46.0	H, wht, 8
10.60	20.0	46.0	H, wht, pyr, 5
10.90	20.0	46.0	H, grn, ser, cc, wht, 20
11.40	20.0	16.0	O,
11.80	20.0	296.0	O, wht, pyr, 4
12.15	0.0	0.0	Rub (12.15-12.55)
12.60	25.0	206.0	H, pyr, wht, 3
12.70	30.0	166.0	H, qtz, wht, pyr, 4
13.10	50.0	116.0	H, qtz, pyr, 3
13.20	50.0	116.0	H, qtz, pyr, 2
13.70	40.0	296.0	H, wht, pyr, 4
13.90	30.0	356.0	H, wht, 3
14.10	25.0	36.0	H, pyr, wht, 3
14.60	40.0	346.0	d, wht, 4
14.80	80.0	46.0	O, hi cc, wht, pnk, 3
14.90	20.0	46.0	O, grn, wht, pyr, 16, Ori
15.80	40.0	206.0	O,
16.00	40.0	206.0	O,
16.55	0.0	0.0	Rub (16.55-17.2)?
17.40	20.0	46.0	H, wht, grn, pyr, 8, Ori
17.50	20.0	46.0	H, wht, qtz, pyr, 20
18.40	0.0	0.0	Rub (17.9-18.4 TO)

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SHH5A Notes:

50 joints, 14 open. Near vertical joint 12.15-18.4 ft, with some zones of broken core.

0.00 to 10.0

depth	dip	dip az.	description
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SHH6 P I

10.00 to 20.00

depth	dip	dip oz.	description
10	10	10	10
20	20	20	20
30	30	30	30
40	40	40	40
50	50	50	50
60	60	60	60
70	70	70	70
80	80	80	80
90	90	90	90
100	100	100	100
110	110	110	110
120	120	120	120
130	130	130	130
140	140	140	140
150	150	150	150
160	160	160	160
170	170	170	170
180	180	180	180
190	190	190	190
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890	890	890	890
900	900	900	900
910	910	910	910
920	920	920	920
930	930	930	930
940	940	940	940
950	950	950	950

SHH6PT Notes:
43 joints, 3 open.

BMT1

0.00 to 10.00

depth dip dip az. description

BMT1

10.00 to 20.00

depth dip dip az. description

BMT1

20.00 to 30.00

depth	dip	dip az.	description
20.20	86.2	271.4	H, wht, 5
21.40	85.8	273.4	H, grn, pyr, 12
21.60	58.0	89.7	H, qtz, wht, pyr, 7
22.80	76.9	273.6	H, wht, grn, pyr, 20
23.10	76.9	273.6	H, qtz, 1
23.20	56.8	95.5	H, qtz, 1
23.60	77.8	267.5	H, grn, pyr, 17
24.70	29.0	37.6	H, grn, wht, pyr, 14, Ori
24.80	29.0	37.6	H, grn, pyr, 16
25.50	12.6	51.5	H, wht, pyr, qtz, 5
26.40	12.6	51.5	H, pyr, wht, 4
27.40	14.5	48.3	H, wht, qtz, pyr, 3
27.50	19.3	43.0	H, pyr, wht, 5
27.70	84.4	37.7	0
28.20	81.4	57.9	0, pyr
28.30	81.4	57.9	H, pyr, 1
28.90	84.9	113.7	H, pyr
29.50	29.0	37.6	H, qtz, pyr, grn, 12
29.70	85.7	68.6	0,

BMT1

30.00 to 40.00

depth	dip	dip az.	description
30.50	19.3	43.0	H, qtz, wht, pyr, grn, 15
31.50	29.6	334.2	H, wht, pyr, 8
32.90	76.6	56.4	0
34.20	5.4	80.2	0, pyr, grn, 3
34.70	43.8	74.4	H, wht, grn, 7
35.40	30.7	337.6	H, wht, pyr,
35.70	77.7	77.8	0, pyr, wht
35.90	80.4	46.9	0, sl cc
36.90	24.1	39.8	H, wht, pyr, 5
37.70	37.2	351.3	H, wht, pyr, 3
38.30	29.0	37.6	H, pnk, pyr, 10
38.50	29.0	37.6	H, pnk, pyr, 20
39.20	78.7	29.5	H, wht, 2
39.80	29.0	37.6	H, wht, pnk, 10

BMT1

40.00 to 50.

depth dip dip az. description

BMT1 Notes:
 82 joints, 19 open. Highly altered zones at 9.3, 10.9, 26.7, and 38.5
 ft. Clusters of high-angle joints 6.2-11.5 ft, some appear to be
 highly altered.

BMT2

0.00 to 10.00

depth dip dip az. description

BMT2

10.00 to 20.00

depth dip dip az. description

BMT2

20.00 to 30.0

depth dip dip az. description

20	20.10	78.7	252.7	O, wht,
	20.40	78.7	252.7	O,
	20.80	48.8	326.6	H, pyr, wht, 2
	23.40	88.4	58.5	O, cc wht,
	23.60	31.4	36.9	H, wht, cc, hi alt,
	24.30	41.2	82.5	H, grn, pyr, 8
	24.50	32.3	340.5	H, qtz, wht, 4
	26.90	17.7	44.6	H, wht, 4
	29.70	89.0	208.6	H, wht, pyr, hi alt, 150
30				

BMT2

30.00 to 40.0

depth dip dip az. description

30	30.90	31.4	36.9	H, qtz, pyr, 3
	31.60	35.5	347.4	H, qtz, wht, 8
	32.40	7.8	68.3	H, pyr, wht, 4
	33.50	12.1	52.8	H, pyr, wht, 2
	35.20	45.5	72.7	H, wht, pyr, 8
	36.50	41.2	82.5	H, wht, pyr, 10
	38.50	46.2	33.5	H, wht, 1
	38.80	34.1	5.1	H, qtz, 4
	39.50	31.1	79.7	H, pyr, 1
40				

BMT2

40.00 to 50.00

depth dip dip az. description

40					
	40.90	35.5	347.4	H,qtz,4	
	42.20	39.1	353.1	H,whl,qtz,12,hi oit,	
	43.20	45.5	344.5	H,qtz,pyr,3	
	44.30	36.4	358.7	H,qtz,5	
45					
	45.80	21.6	41.5	H,qtz,whl,2	
	46.30	43.2	11.8	C,grn,whl,ser,pyr,hi oit,7	
	46.60	39.1	64.1	H,whl,grn,pyr,25	
	48.40	19.6	42.9	H,grn,6	
	49.00	81.7	158.9	O,qtz,2	
50	49.70	59.2	88.4	H,whl,7	

BMT2

50.00 to 60.00

depth dip dip az. description

50					
	50.00	31.4	36.9	H,qtz,pyr,20	
	50.20	89.0	208.6	MD TO	

BMT2 Notes:

48 joints, 9 open. Highly altered zones at 12.7, 18.1, 23.6, 29.7 and 46.3 ft. Mafic zone at 48.1-50.0 ft.

100

55

60

ISS4

0.00 to 10.00

depth dip dip az. description

ISS4

10.00 to 20.0

depth dip dip az. description

ISS4 Notes:

22 joints, 11 open.

ISS5

0.00 to 10.0

depth dip dip az. description

ISS5

10.00 to 20.00

depth dip dip az. description

ISS5 Notes:

18 joints, 6 open. Most joints at 5.6-11.3 ft. All of these are high-angle, and have sericite, ca²⁺ to, and white/green alteration.

ISS6

0.00 to 10.00

depth dip dip az. description

ISS6

10.00 to 20.0

depth dip dip az. description

ISS6 Notes:
 16 joints, few open. Alteration zones up to 8 cm wide. Open joints contain calcite. Highly altered zone, 14.6-15.4 ft, consists of green alteration and pyrite.

ISS7

0.00 to 10.0

depth dip dip az. description

ISS7

10.00 to 20.00

depth dip dip az. description

ISS8

0.00 to 10.00

depth dip dip az. description

ISS8

10.00 to 20.00

depth dip dip az. description

ISS8

20.00 to 30.0

depth dip dip az. description

ISS8

30.00 to 40.0

depth dip dip az. description

ISS8

40.00 to 50.0

depth dip dip az. description

ISS8

50.00 to 60.0

depth dip dip az. description

ISS8

60.00 to 70.0

depth dip dip az. description

60.50	45.7	315.7	H,grn,whl,pyr,12
61.40	83.9	247.6	O,cc,whl,
62.00	89.5	238.6	H,whl,2
65.30	77.2	327.2	O,cc,whl,
66.10	31.0	339.5	H,qlz,whl,pyr,3
66.80	23.7	42.8	H,grn,pyr,15
68.40	89.9	29.0	O,cc,grn,
69.00	52.6	324.0	H,qlz,pyr,grn,whl,7
69.70	23.7	42.8	H,grn,qlz,pyr,35,Ori=
69.90	77.4	21.6	O,cc,

ISS8

70.00 to 80.0

depth dip dip az. description

70.90	23.7	42.8	H,grn,qlz,pyr,cc,30
71.20	85.4	225.6	O,ser,cc
72.30	79.7	258.5	O,whl,sl cc,
72.70	85.0	78.1	O,
72.80	67.6	259.6	O,hi cc,
73.10	21.7	44.2	H,grn,pyr,14
73.40	84.9	313.0	O,
73.60	63.2	260.5	O,cc,whl,
73.60	21.7	44.2	H,grn,whl,pyr,30,Ori=
76.90	72.1	257.4	O,
77.10	72.1	257.4	O,
77.40	23.7	42.8	H,grn,pyr,cc,30
78.10	23.7	42.8	H,grn,pyr,40
80.10	86.9	236.7	O,whl,

ISS8

80.00 to 90.0

depth dip dip az. description

ISS8

90.00 to 100.0

depth dip dip az. description

ISS8

100.00 to 110.00

depth dip dip az. description

ISS8 Notes:

104 joints, mostly high-angle. Healed joints usually have pyrite, sericite, and white/green alteration. Cluster of high-angle joints at 57-60 ft, most are open with calcite infilling. Highly altered zone at 35-36.7 ft.

ISS9

0.00 to 10.00

depth dip dip az. description

ISS9

10.00 to 20.00

depth dip dip az. description

ISS9

20.00 to 30.00

depth dip dip az. description

20

20.50 36.4 326.3 H,qtz,wht,14
 21.00 63.7 60.7 0.
 21.10 64.8 63.9 0,grn,
 21.30 67.2 62.9 0,grn,
 21.90 41.9 39.8 H,pyr,grn,20,Ori*(0.0-46.0)
 22.00 21.8 51.4 H,pyr,grn,20

24.20 51.3 5.3 H,pnk,wht,grn,hi alt.
 24.70 62.5 331.9 H,qtz,wht,5
 25.20 63.3 338.6 H,qtz,pyr,wht,
 25.80 20.8 43.6 H,grn,wht,pyr,12,Vert Jnt
 26.20 50.0 336.2 H,pyr,wht,7
 26.80 68.5 300.8 0,fest,wht

27.70 36.6 291.7 H,pyr,wht,4
 28.00 64.0 69.1 H,wht,maf

29.30 45.8 102.1 H,qtz,grn,20

30

ISS9

30.00 to 40.00

depth dip dip az. description

30

30.30 34.6 85.1 H,grn,pyr,2
 30.60 81.8 296.0 0,grn,cc,
 31.40 83.2 59.0 0,grn,cc
 31.80 71.6 90.6 0.
 32.00 84.9 278.1 0,sl cc,
 32.70 66.4 296.3 0,slk,cc,grn,8
 33.10 53.1 170.1 H,grn,wht,pyr,2

34.10 46.1 348.8 H,wht,1
 34.20 64.1 348.4 H,wht,pyr,1
 34.40 47.8 151.7 H,qtz,pyr,wht,8
 34.60 60.7 164.2 0,wht,cc,
 34.90 57.6 171.4 H,qtz,pyr,7

35.50 74.2 177.7 H,wht,pyr,2

36.30 61.2 174.5 H,wht,pyr,4
 36.60 61.2 174.5 H,wht,pyr,2

38.10 74.2 168.0 H,wht,pyr,6

40

ISS9

40.00 to 50.00

depth dip dip az. description

ISS9

50.00 to 60.00

depth dip dip az. description

ISS9 Notes:
 87 joints, most are high-angle. Highly altered zones at 48.0-48.7 and 53.0-53.7 ft. Clusters of open joints at 3, 6, 21, and 30 ft. Matrix somewhat less matrix-rich zone at 38.5 ft. Joints with slickensides at 37.7 ft.

ISS10

0.00 to 10.00

depth dip dip az. description

ISS10

10.00 to 20.0

depth dip dip az. description

30.00 to 40.00

depth	dip	dip az.	description
10	10	10	10
20	20	20	20
30	30	30	30
40	40	40	40
50	50	50	50
60	60	60	60
70	70	70	70
80	80	80	80
90	90	90	90
100	100	100	100
110	110	110	110
120	120	120	120
130	130	130	130
140	140	140	140
150	150	150	150
160	160	160	160
170	170	170	170
180	180	180	180
190	190	190	190
200	200	200	200
210	210	210	210
220	220	220	220
230	230	230	230
240	240	240	240
250	250	250	250
260	260	260	260
270	270	270	270
280	280	280	280
290	290	290	290
300	300	300	300
310	310	310	310
320	320	320	320
330	330	330	330
340	340	340	340
350	350	350	350
360	360	360	360
370	370	370	370
380	380	380	380
390	390	390	390
400	400	400	400
410	410	410	410
420	420	420	420
430	430	430	430
440	440	440	440
450	450	450	450
460	460	460	460
470	470	470	470
480	480	480	480
490	490	490	490
500	500	500	500
510	510	510	510
520	520	520	520
530	530	530	530
540	540	540	540
550	550	550	550
560	560	560	560
570	570	570	570
580	580	580	580
590	590	590	590
600	600	600	600
610	610	610	610
620	620	620	620
630	630	630	630
640	640	640	640
650	650	650	650
660	660	660	660
670	670	670	670
680	680	680	680
690	690	690	690
700	700	700	700
710	710	710	710
720	720	720	720
730	730	730	730
740	740	740	740
750	750	750	750
760	760	760	760
770	770	770	770
780	780	780	780
790	790	790	790
800	800	800	800
810	810	810	810
820	820	820	820
830	830	830	830
840	840	840	840
850	850	850	850
860	860	860	860
870	870	870	870
880	880	880	880
890	890	890	890
900	900	900	900
910	910	910	910
920	920	920	920
930	930	930	930
940	940	940	940
950	950	950	950

ISS10

40.00 to 50.00

depth dip dip az. description

40.20	1.2	155.4	H,pyr,2
40.30	28.9	355.7	H,grn,pyr,16
41.00	43.0	7.6	H,whl,grn,5
41.20	37.7	329.3	H,whl,pyr,20
41.80	44.5	208.5	H,drk,
42.30	29.5	323.5	H,pyr,grn,2
42.40	24.3	347.7	H,pyr,grn,2
42.60	38.3	38.7	H,pyr,whl,7
43.00	41.8	23.6	0,ser,cc,pyr,
44.00	40.8	329.5	H,whl,6
44.50	83.9	352.1	H,pyr,1
46.70	45.8	328.4	H,whl,grn,40
47.80	44.7	321.5	H,qtz,whl,15
48.00	31.7	314.2	H,whl,4
49.30	45.8	328.4	H,whl,1
49.40	45.8	328.4	H,whl,pyr
48.90	42.4	24.9	H,
50.00	42.6	174.9	H,drk,
50.10	47.2	12.4	H,grn,12

ISS10

50.00 to 60.00

depth dip dip az. description

50.00	42.6	174.9	H,drk,
50.10	47.2	12.4	H,grn,12
50.70	55.7	5.6	0,ser,cc
50.80	45.8	328.4	H,pyr,1
51.00	76.5	254.4	0,ser,cc
51.20	37.4	2.5	H,grn,20
51.70	23.4	341.8	H,pyr,qtz,2
51.90	44.1	343.7	H,qtz,whl,3
52.10	44.5	343.5	H,qtz,5
52.80	39.9	18.3	H,grn,whl,8
52.90	39.9	18.3	H,grn,20
53.30	39.6	246.8	0,
53.60	38.9	28.2	H,whl,grn,35
53.90	34.5	337.2	H,whl,2
54.50	53.2	315.9	0,
55.50	48.0	4.0	H,whl,cc,10
56.10	56.6	320.3	H,qtz,whl,pyr,5
56.70	52.7	324.3	H,
56.70	36.3	320.1	H,whl,qtz,8
57.00	42.3	8.0	H,pyr,grn,20
58.00	41.0	8.9	H,grn,8
58.10	39.7	9.7	H,whl,3
58.30	37.8	11.0	H,whl,6
58.40	36.5	11.9	H,grn,10
58.70	39.4	297.2	H,pyr,grn,2
58.90	73.7	353.1	H,whl,pyr,7
59.00	43.2	15.5	H,grn,whl,pyr,20
59.20	50.8	313.4	H,qtz,whl,3
59.30	53.8	17.7	H,whl,4
59.80	59.2	348.2	H,grn,pyr,14
59.90	58.2	313.8	0,grn,whl,cc,
60.10	42.4	349.0	H,grn,pyr,8

ISS10

60.00 to 70.00

depth dip dip az. description

60.10	42.4	349.0	H.grn.pyr,8
60.20	61.7	353.3	H.pyr,whl,4
61.30	47.7	1.2	H.grn.pyr,14
61.80	51.3	309.2	H.qtz.pyr,3
62.60	48.9	318.1	H.qtz,whl,7
63.20	44.4	318.7	H,whl.pyr,4
63.70	37.9	324.4	H,whl.pyr,2
64.00	41.0	8.9	H.grn.pyr,15
64.20	37.1	320.6	H,
64.90	49.2	341.1	H.grn.pyr,15
65.00	55.4	355.6	H.grn.pyr,
65.60	44.0	321.7	O,whl.pyr,
66.00	50.6	321.5	H,qtz,whl.pyr,9
66.80	42.5	329.3	H,whl.pyr,5
68.40	47.3	360.0	H,whl.pyr,8
68.80	52.6	15.7	H,whl,8
68.80	40.8	323.4	H.pyr,whl,2
69.40	44.7	321.5	H.grn.pyr,16
69.70	26.6	244.5	O,
69.80	26.6	244.5	O,
70.10	58.2	0.5	H,whl.pyr,7

ISS10

70.00 to 80.00

depth dip dip az. description

70.10	58.2	0.5	H,whl.pyr,7
70.40	46.8	325.1	H.pyr,whl,3
70.60	48.5	331.4	H.pyr,whl,5
70.90	52.1	5.5	H,whl,9
71.30	42.4	24.9	H,whl.pyr,20
72.20	46.6	12.9	H,whl.pyr,10
72.50	45.8	21.7	H,whl,qtz.pyr,30
72.60	54.1	1.0	H,whl.grn.pyr,qtz,
72.80	46.0	321.1	H,qtz.pyr,3
72.80	50.5	2.2	H.grn.pyr,30
73.30	35.5	321.3	H.pyr,grn,8
74.60	53.9	345.2	H,whl.pyr,11
74.80	61.0	310.7	H,whl.pyr,7
75.60	76.0	147.8	H,whl,drk,
76.40	52.8	316.3	H,qtz.pyr,2
76.80	47.1	326.4	H,qtz.pyr,3
78.00	33.1	4.5	H,whl,grn.pyr,30
79.50	38.0	353.9	H.grn.pyr,12
79.60	55.6	20.6	H,whl,6
80.00	55.6	20.6	H,whl,grn.pyr,30

15510

80.00 to 90.00

depth dip dip az. description

80

80.00 55.6 20.6 H, wht. grn. pyr, 30

80.60 41.3 355.7 H, grn. pyr, 20

80.80 39.1 337.4 H, wht. grn, 20

15510 Notes:

156 joints. Numerous highly altered zones over 2 cm wide. All high-angle joints contained calcite, but no slickensides were observed.

85

90

ISS11

0.00 to 10.00

depth dip dip az. description

0
5
10

2.20	25.5	47.8	o
2.40	5.0	112.7	h
2.60	52.0	119.2	h
2.80	20.2	72.7	h
2.85	19.1	77.4	h
2.91	4.2	64.9	h
2.93	32.7	11.4	h
2.95	31.3	273.4	h
3.10	25.3	89.2	h
3.76	32.7	43.2	o
3.92	25.3	234.3	h
4.25	40.9	133.4	h, part open
4.27	36.1	138.7	h
4.33	24.1	24.1	h, wt, 5
4.38	37.6	151.7	o
4.72	22.3	15.6	h, grn, ch, pnk, ksp, 15
4.73	22.3	196.0	h, grn, ch, pnk, ksp, 20
4.96	18.2	42.4	h, pyr
5.09	22.7	38.9	h, pyr
5.21	20.4	31.5	h
5.49	73.5	131.3	h
5.57	21.1	40.7	h, 12
5.93	20.1	34.3	h, 10
6.28	55.9	63.5	h
6.34	23.2	41.8	h
6.80	16.9	20.6	h
7.15	48.1	78.4	h
7.42	26.8	36.8	h
7.47	87.6	145.3	h
7.59	20.8	22.8	h
7.50	67.2	138.9	h
8.02	28.6	31.4	h, pnk, 15
8.18	30.7	26.7	h, pnk, 12
8.29	25.3	5.7	h
8.61	26.5	38.9	h
8.72	14.5	155.3	h
9.02	16.4	59.6	h
9.03	22.2	62.6	h
9.17	26.4	94.1	h
9.31	6.9	92.7	h, ser, pyr, qlz, cl

ISS11

10.00 to 20.00

depth dip dip az. description

10
15
20

9.93	23.5	14.6	h, ser, pyr, qlz, cl, 20
10.02	20.7	49.1	h
10.51	23.3	4.8	h
10.89	20.8	46.3	h
11.18	60.4	71.3	h
11.43	74.6	195.5	o
11.50	27.9	7.8	o, ser, qlz, cc
11.94	77.1	65.6	h
12.08	27.3	3.7	h
12.11	59.1	54.6	h
13.64	29.2	10.1	h
13.70	37.3	4.0	h
13.96	21.1	26.2	h
14.53	22.1	8.8	h, wht, 25
14.72	22.8	13.4	h, wht, 25
15.12	15.5	18.3	h, 12
16.41	38.1	50.2	h, 4
16.54	25.7	45.6	h, 3
16.67	17.8	35.7	h, wht, 5
18.09	29.9	13.9	h, wht, grn, ksp, 13
19.78	30.2	49.8	h, wht, grn, ksp, 28

ISS11

20.00 to 30.00

depth dip dip az. description

20	20.39	34.1	64.3	h
	21.22	29.3	238.0	h, 11
	21.88	25.2	71.3	h, wht, 5
	22.34	24.1	39.8	h, wht
	22.42	31.3	38.1	h, wht, 4
	24.48	26.9	41.5	h, wht, grn, 15
	24.82	60.6	172.9	h, wht, 5
	24.91	64.1	188.2	h, wht, 5
	24.97	69.3	189.2	h, wht, 5
	25.47	26.2	26.5	h, wht, 5
	25.62	31.0	39.9	h, wht, 5
	25.87	31.3	52.2	h, wht, qtz, 15
	26.56	23.3	34.0	h, wht
	27.55	22.7	49.4	h, wht, 6
	27.85	47.8	179.2	h, wht, 7
	28.55	28.2	37.9	h, wht, 7
	28.64	87.2	288.0	h
	29.35	83.1	155.6	o
	29.52	26.9	41.5	h, pnk
30	29.96	19.5	42.9	h, slt pnk

ISS11

30.00 to 40.00

depth dip dip az. description

30	29.98	27.4	15.2	h, slt pnk
	30.05	89.0	180.7	h, slt pnk
	30.21	32.1	58.3	h, pnk
	31.35	19.4	129.3	o
	31.38	17.0	136.7	o
	32.50	24.6	7.5	h, slt pnk
	32.55	22.7	10.1	h, slt pnk
	33.98	31.1	77.5	h, slt pnk
	34.83	19.9	37.1	h, wht, 4
	34.97	21.0	355.0	h, wht, 2
	35.27	19.7	60.9	h, wht, 4
	35.45	27.2	30.1	h, wht, 4
	35.72	77.7	156.4	o
	36.29	26.4	45.9	h, wht, 6
	36.30	22.5	337.4	h
	36.98	79.2	159.4	o
	37.35	40.0	58.0	o, qtz, pyr, cc, 15
	38.68	57.7	67.7	h
	39.19	22.2	62.6	h
	39.21	27.8	335.8	h, pyr
40	39.81	22.8	46.9	h

ISS11

40.00 to 50.00

depth dip dip az. description

ISS11

50.00 to 60.00

depth dip dip az. description

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ISS11

60.00 to 70.00

depth dip dip az. description

60	59.82	12.6	6.9	h
	59.87	18.4	355.4	h
	61.20	20.8	9.7	h,whl,11
	61.39	22.5	27.8	h,whl,3
	61.50	68.3	306.9	h,whl,qtz
	63.42	20.2	0.7	h,whl,15
	64.24	37.5	37.3	o,qtz,pyr,cc
	64.72	81.5	93.7	o,qtz,pyr,cc
	65.10	27.5	18.0	h,whl,3
	65.87	16.9	55.8	h
	65.97	36.1	49.0	h,whl,12
	66.11	19.1	353.3	h,whl,3
	66.67	20.1	49.0	h,whl,3
	67.31	85.9	141.4	o,qtz,cc
	68.05	14.7	49.3	h,whl,6
70	69.92	16.2	38.2	h,whl,17

ISS11

70.00 to 80.00

depth dip dip az. description

70	70.38	22.7	38.9	h,whl,ksp,4
	70.76	16.9	38.5	h,whl,4
	71.42	84.4	133.0	o,qtz,pyr,cc
	71.61	20.7	51.9	h,pyr,13
	72.09	25.1	38.0	h,whl,8
	73.21	26.5	38.9	h,whl,4
	73.27	22.0	21.3	h,whl,4
	73.88	40.6	46.7	h,whl,pyr
	74.49	66.6	85.2	h,qtz,pyr
	76.12	27.8	35.3	h,whl,4
	76.20	20.4	343.8	h,whl,6
	76.22	33.5	29.7	o,qtz,pyr,cc,ser
	76.25	23.0	334.2	h,whl,8
	76.07	26.5	38.9	h,whl,6
	76.75	48.4	28.3	h,whl,6
	76.82	27.2	52.9	h,whl,6
	76.98	23.3	42.2	h,whl,6
	77.34	26.0	23.7	h,whl,6
	77.42	20.0	28.1	h,3
	77.96	18.1	48.9	h,1
	78.03	21.5	29.6	h,4
	78.17	25.7	20.8	h,13
	78.41	24.6	7.5	h,6
	78.48	16.3	2.8	h,6
	78.57	26.1	39.8	h,5

ISS11

80.00 to 90.00

depth dip dip az. description

ISS11

90.00 to 100.00

depth dip dip az. description

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APPENDIX B - Computer Graphics Code Listing

c This code was developed by R. Thorpe for graphical presentation of
c core fracture logs. Potential users are encouraged to contact me
c at 213-395 for assistance in its implementation or modification.
c It was compiled on the LNL Octopus system (Cray) with the
c following trix-run statement

```

$trixc lncorep.f, n=corep.c, lib=quikdraw, p
c
c   program corep.c
c
c   dimension x(100),y(100),dc(2,3)
c   dimension name(12),junk(12),iram(6)
c
c   call link("units$etty,un$5="(1,taxt)"/")
c   call dropfile(0)
c
c   read control data from log
c
c   dtr=3.1415926/180.
c   read(5,2000)(name(i),i=1,12)
c   read(5,2010)rh,td
c   read(5,2015)haz,hdp,araf
c   dmax=-1.
c
c   enter plot parameters & set screen
c
c   100 call plotset(dwin,dint,dmax,td,rotxy,rh,name)
c
c   rewind 5
c   do 200 j=1,3
c   200 read(5,2000)(junk(i),i=1,12)
c
c   hp=.5.
c   htx=.52*dint
c   do 700 ijl=1,2000
c   read(5,2020)a,b,d,(iram(i),i=1,5)
c   a=float(a)
c   b=float(b)
c
c
c   if(lostatus(5,istat)1800,600,600)
c   500 write(59,3000)
c   call exit
c   600 if(a.eq.0.)then
c   write(55,2030)ijt
c   go to 300
c   endif
c   if(a.lt.0.)go to 800
c   dymh*cos(a*dtr)/sin(a*dtr)
c   dup=d-dy
c   dlp=d-dy
c   if((dup.gt.dmax).or.(dlp.lt.dmin))go to 700
c   if((dup.lt.dmin).or.(dlp.gt.dmax)) call gsvtcl("onb")
c   call twardpla,b,dip,dipaz,haz,hdp,araf)
c   call jctrdpla,x,y,rh)
c   call transla,b,d,x,y,rotxy,nxy)
c   call jtplo(x,y,d,hp,nxy,dip,dipaz,iram,htx,rh,dwin,dmax)
c   700 continue
c
c   800 call endpic
c
c
c   write(59,2040)
c   read(59,2000)lend
c   if(lend.ne."end")go to 100
c   999 call exit
c
c   2000 format(12a6)
c   2010 format(3f10.5)
c   2020 format(8a,2i5,f6.5a6)
c   2030 format(/," joint no.",i5," is partial core")
c   2040 format(/," type end to stop plot")
c   3000 format(" end of file reached")
c
c   end

```

```

C =====
C
C      subroutine plotset(dmin,dint,dmax,ld,rotxy,rh,name)
C
C      dimension name(12)
C
C      write(59,2400)
C      read(59,2400) dmin
C      write(59,2500)
C      read(59,2500) dint
C      write(59,2600)
C      read(59,2600) rotxy
C
C      if(dmax.ge.0.) go to 10
C      call tmd(0)
C      call fwrite
C      write(59,2200)
C      read(59,2200) irj
C      if(irj.eq."y") then
C      call rjet(0)
C      call setvs("rt=10")
C      go to 10
C      endif
C      write(59,2300)
C      read(59,2300) ityp
C      if(ityp.eq."y") then
C      call ttypest(0)
C      call setvs("lv=0, kp=1, rt=10")
C      endif
C
C      10 dmax=dmin+dint
C      hmin=-dmax
C      hmax=-dmin
C      call image(0.5, 11.0)
C      call cutmrk
C      call margin(1.75, .5, .5, 0.)
C      call form(0,1)
C      call region(1)
C      call window("linlin0", 0., 10., 0., 3.)
C      call settk("no=70, xj=left, yj=bottom, ft=20")
C      call locate(1,0,2,0)
C      write(100,3000) lname(1),l=1,4,dmin,dmax
C      call locate(2,45,1,0)
C      call settk("no=85, xj=left, yj=bottom, ft=20")
C      write(100,3000)
C
C      call region(2)
C      call window("linlin0", -2.5, 2.5, hmin, hmax)
C      call setin("sz=0.10")
C      call settk("xj=right, yj=center, ft=20")
C      call line(0., hmax, 0., hmin)
C
C      do 50 i=0,1000
C      dh=float(i)
C      h=hmax-dh
C      if(h.lt.dmin) go to 50
C      do 40 j=0,1000,5
C      dj=float(j)
C      if(dj.eq.dh) then
C      call line(0., h, -1., h)
C      (h=ftx-h)
C      call locate(-1,1, h)
C      write(100,4000) lha
C      go to 50
C      endif
C      40 continue
C      call line(0., h, -.5, h)
C      50 continue
C
C      60 call region(3)
C      xmin=-.5
C      xmax=.5
C      call window("linlin0", xmin, xmax, hmin, hmax)
C      call setin("sz=0.20")
C      xl=-rh
C      hb=hmin
C      if(dmax.gt.ld) hb=-td
C      call line(1, hmax, xl, hb)
C      call line(rh, hmax, rh, hb)
C      xr=cos(rotxy)*3.1415926/(100.)*rh
C      call setin("sz=0.1, st=10")
C      call line(xr, hmax, xr, hb)
C
C      call show
C
C      return
C
C      2010 format(a1)
C      2020 format(710,0)
C      2030 format(" do you want rjet output? ")
C      2040 format(" do you want rjet hardcopy? ")
C      2050 format(" minimum depth to be plotted: ")
C      2060 format(" core length to be plotted: ")
C      2070 format(" plot rotation (0. to 100., multiple of 10): ")
C      2080 format(40,0x,f5,2," to ",f5,2)
C      2090 format("depth dip dip az. description")
C      4000 format(i4)
C      end

```

```

C *****
C
C      subroutine truedip(a,b,dip,dipaz,az,af,ac)
C
C      dimension dc(3,3)
C
C      a1 = inclination of hole from horizontal: +down, -up
C      az = azimuth of hole, clockwise from true north
C      ac = angle of reference line measured anticlockwise from
C           0 o'clock position, looking in the direction of drilling
C      aa,ba,& ca are eulerian angles phi, theta, & psi
C      required to rotate global axes into core system.
C
C      dtr=3.1415926/180.
C      aa=(360.-az)*dtr
C      ba=(90.-a1)*dtr
C      ca=ac*dtr
C      call matdc(aa,ba,ca,dc)
C
C      calculate local (core) direction cosines of downward normal
C
C      aa=a*dtr
C      bb=(-b-180.)*dtr
C      xnp=cos(aa)*cos(bb)
C      ynp=cos(aa)*sin(bb)
C      znp=-sin(aa)
C
C      transform direction cosines to global (true north) system
C
C      xng=dc(1,1)*xnp + dc(1,2)*ynp + dc(1,3)*znp
C      yng=dc(2,1)*xnp + dc(2,2)*ynp + dc(2,3)*znp
C      zng=dc(3,1)*xnp + dc(3,2)*ynp + dc(3,3)*znp
C      if(zng.ge.0.)then
C        convert to downward normal
C        xng=-xng
C        yng=-yng
C        zng=-zng
C      endif
C
C      dip=acos(-zng)/dtr
C      if(zng.eq.-1.)then
C        joint is horizontal
C        dipaz=0.
C        return
C      endif
C
C      xdaz=-xng
C      ydaz=-yng
C
C      if(xdaz.eq.0.)then
C        if(ydaz.gt.0.)then
C          dipaz=90.
C        else
C          dipaz=270.
C        endif
C        return
C      endif
C      theta=atan(ydaz/xdaz)/dtr
C      if(xdaz.lt.0.) theta=theta+180.
C      dipaz=90.-theta
C      if(dipaz.lt.0.) dipaz=dipaz+360.
C      return
C
C      end
C *****
C
C      subroutine jtrcds(a,x,y,rh)
C
C      dimension x(100),y(100)
C
C      dtr=3.1415926/180.
C      sina=sin(a*dtr)
C
C      do 200 lpr=1,100
C        tpr=float(lpr-1)
C        theta=tpr*dtr*2.
C        cost=cos(theta)
C        sint=sin(theta)
C        x(lpr)=rh*cost/sina
C        y(lpr)=rh*sint
C      200 continue
C
C      return
C      end

```



```

C *****
C
C      subroutine matdc(aa,ba,ca,dc)
C
C      dimension dc(3,3)
C
C      calculate transformation matrix
C
C      a1=sin(aa)
C      a2=sin(ba)
C      a3=sin(ca)
C      c1=cos(aa)
C      c2=cos(ba)
C      c3=cos(ca)
C
C      dc(1,1)= c3*c1-c2*a1*a3
C      dc(1,2)=-a3*c1-c2*a1*c3
C      dc(1,3)= a2*a1
C      dc(2,1)= c3*a1+c2*c1*a3
C      dc(2,2)=-a3*a1+c2*c1*c3
C      dc(2,3)=-a2*c1
C      dc(3,1)= a3*a2
C      dc(3,2)= c3*a2
C      dc(3,3)= c2
C
C      return
C      end
C
C *****
C
C      subroutine trans(alpha,beta,d,x,y,rotxy,nxy)
C
C      dimension x(100),y(100),dc(3,3),xx(100),yy(100)
C
C      this subroutine transforms coordinates from the local core system
C      to the screen system. core axes are: x opposite direction of
C      drilling, x is towards the reference line (beta=0), and y is towards
C      beta=270. origin at beginning of hole, on the core centerline.
C      screen axes are: x to the right, z upwards, and y into the screen,
C      x,y values .10, .8 are plotted on screen.
C
C      dtr=3.1415926/180.
C      aa=(90.-rotxy+beta)*dtr
C      ba=(90.-alpha)*dtr
C      ca=-90.*dtr
C      call matdc(aa,ba,ca,dc)
C
C      if=1
C      do 200 i=1,100
C      xg=dc(1,1)*x(i) + dc(1,2)*y(i)
C      yg=dc(2,1)*x(i) + dc(2,2)*y(i)
C      zg=dc(3,1)*x(i) + dc(3,2)*y(i) - d
C      if(yg.le.8.)then
C      xx(i)=xg
C      yy(i)=zg
C      if(i)=1
C      endif
C      200 continue
C      nxy=i-1
C
C      call aminmax(xx,1,nxy,1,xmin,xxmax,imin,imax)
C      jj=1
C      do 600 ipt=imin,nxy
C      x(jj)=xx(ipt)
C      y(jj)=yy(ipt)
C      jj=jj+1
C      600 continue
C      if(imin.eq.1)return
C      do 700 ipt=1,imin-1
C      x(jj)=xx(ipt)
C      y(jj)=yy(ipt)
C      jj=jj+1
C      700 continue
C
C      return
C      end
C
C *****
C
C      subroutine jplot(x,y,d,hp,nxy,dip,dipaz,from,htx,rh,dmin,dmax)
C
C      dimension x(100), y(100), from(7)
C
C      call setln('xt=1, sz=0,10')
C      call curvof(x,y,nxy)
C      call gsvtcl('off')
C      call settx('no=100, xj=left, yj=center, r=20')
C
C      dvrmin=dmin-htx
C      dvrmax=dmax+htx
C      if((d.lt.dvrmin).or.(d.gt.dvrmax))return
C      hwrta=d
C      hhehp=hwrta
C      if(hh.lt.htx) hwrta=hp-htx
C      nwrta=65
C      call locate(nwrta, hwrta)
C      write(100,1000)d,dip,dipaz,(from(i),i=1,7)
C      hp=hwrta
C
C      return
C      1000 format(f7.2,f6.1,f7.1,1x,7a6)

```