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Evolution of a Volcanic-Hosted Vapor-Dominated System: Petrologic and Geochemical Data from Corehole T-8, Karaha-Telaga Bodas, Indonesia

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ABSTRACT

Lithologic, petrographic, and fluid-inclusion investigations of corehole T-8 from the Karaha-Telaga Bodas geothermal system have been conducted to evaluate the field's thermal and chemical evolution and determine the origins and compositions of the hydrothermal fluids. Core was cut from 770.7 to 1327.1 m. The well encountered a maximum temperature of 288°C. From 770.7 to 860 m veins containing abundant calcite and quartz after chalcedony are common. At greater depths, the veins are dominated by epidote, actinolite, albite, and quartz, which in part was deposited as chalcedony. Biotite, talc, and clinopyroxene occur in the deepest samples. We suggest that the shallow veins were deposited by steam-heated condensate whereas the deeper veins represent the upwelling hydrothermal fluids. Fluid-inclusion measurements indicate that the deep fluids had temperatures ranging from 220-348°C, although most exceed 250°C, and salinities between 2 and 25 weight percent NaCl or NaCl + $CaCl_2$ equivalent. Salinities increased as the system evolved, reflecting interactions between magmatic and hydrothermal fluids and the formation of vapor-dominated conditions. The youngest stage of alteration is represented by inclusions with salinities of 31 weight percent NaCl equivalent and mineral coatings containing Na, K, Fe, Ti, and Cl. The inclusions and coatings formed as shallow, downward percolating steam condensate boiled off.

Introduction

The Karaha-Telaga Bodas geothermal field represents a new, potentially large resource in west central Java. The field was delineated by the Karaha-Telaga Bodas Company, LLC (KBC) in the 1990s. Their exploration efforts led to the discovery of a partially vapor-dominated geothermal system with a subsurface extent of at least 10 km and measured temperatures up to 350°C (Allis et al., 2000). The geologic setting of the field and the characteristics of the reservoir are described by Allis et al. (2000). Their analysis of the downhole pressure and temperature data indicates that the reservoir is horizontally zoned, consisting of an upper condensate layer, an underlying vapor-dominated region that thickens to the south, and a deeper single phase liquid.

Nine exploration and production wells and 19 temperature gradient coreholes were drilled to delineate the resource. Four coreholes with an aggregate length of over four km are being evaluated by the Energy & Geoscience Institute. This core is important because it provides an unparalleled opportunity to directly characterize lithologies, fracturing, and mineral parageneses throughout the system. In this paper, we present data on corehole T-8, which was continuously cored from 770.7-1327.1 m (Fig. 1). Approximately 65 samples were studied petrographically and analyzed by X-ray diffraction techniques. The well is located near the Telaga end of the field and encountered a maximum temperature of 288°C.

Hydrothermal Alteration Assemblages and Lithologies

The rocks in corehole T-8 consist mainly of andesitic lava flows and lahars. Coherent andesite flows dominate the top of the core to 850 m, and portions of the corehole from 1130 m to TD (Fig. 2). Thin ash-flow tuffs are present at several depths, and highly convoluted sediments occur at 980 m, but these lithologies represent only a minor component of the section. The lahars are poorly sorted and generally clast-supported. Glassy, porphyritic andesite containing altered phenocrysts of plagioclase, pyroxene, hornblende, and rarely olivine dominates the clast lithology. The fine-grained matrix between the clasts is commonly altered to chlorite, but in places, glass shards and pumice can be distinguished in the matrix and clasts. Although moderate to strong propylitic alteration characterizes the flow rocks and lahars, the original textures are well preserved throughout most of the well. In contrast, original textures in the ash-flow tuffs are generally obscured by intense sericite alteration.

The distribution of secondary alteration minerals in bulk samples of T-8 is illustrated in Figure 2. In general, similar mineral assemblages characterize the wall rocks and veins. Both the direct replacement of phenocrysts by secondary minerals and the infilling of vugs produced by dissolution of the phenocrysts are observed. These vugs and partially filled amygdules may contribute significantly to the overall porosity of the rocks.

Figure 2 shows that the secondary minerals are strongly zoned with depth. From the top of the core to 860 m, the common secondary minerals include calcite, quartz and minor pyrite, chlorite, magnetite, hematite, anhydrite, and titanite. Mixed-layer illite-smectite occurs at 807.3 m and at 859.7 m, wairakite is present. Below depths of 860 m silicate minerals dominate the hydrothermal assemblages. Calcite persists to a depth of about 930 m whereas anhydrite is found to 1044.9 m. Epidote first appears at ~778 m as an alteration product of primary plagioclase but is not observed in the veins until 829.5 m. Actinolite is encountered at 885 m and is an important vein mineral below 950 m. Biotite appears as aggregates of fine-grained, brownish-colored grains and in veinlets at ~1124 m. Minor clinopyroxene and talc are present below ~1230 m. In addition, secondary albite, minor potassium feldspar after albite or rarely as individual crystals, and pyrophyllite are found below 860 m. However, the presence of actinolite, biotite, talc, and clinopyroxene are important because they are indicative of temperatures >300°C (Henley and Ellis, 1985).

SEM backscattered electron images of core samples from several depths indicates that the minerals were coated with scales. Figure 3 shows scale coating late anhydrite from a depth of 1044.9 m. The scales exhibit desiccation cracks, and in Figure 3, the scale can be seen peeling off of the anhydrite. EDAX analyses of the scales indicate that they contain various proportions of Fe, Na, K, Ti, and Cl and X-ray analysis of the sample from 1018.5 m indicates that presence of halite. The scale in Figure 3 consists dominantly of Ti, Si, and Fe. Scale consisting of iron chloride occurs at 1169.3 m. The high solubility of iron chloride suggests that the rocks were not "washed" by the hydrothermal fluids after scale formation.

Mineral Paragenetic Relationships

The mineral parageneses of most veins are relatively simple. Petrographically, the veins can be grouped into three types on the basis of their assemblages. The veins are dominated by 1) illite and illite/smectite; 2) calcite; and 3) propylitic assemblages (epidote + actinolite ± albite). Interlayered illite/smectite or illite veins and extensive wallrock alteration to these minerals occurs sporadically throughout the well and at 1018.5, pyrophyllite is also present. At 807.8 m, the clay minerals are overprinted by anhydrite + quartz and at 1066.9 and 1132.3 m, propylitic assemblages clearly postdate the as rounded grains that are tentatively identified as fluorite, based on the crystal form produced when the inclusions are repeatedly heated and cooled. None of the other solid phases has yet been identified. However, their crystal habits indicate that neither halite nor sylvite (KCl), which are common in magmatic environments, are likely to be present (Roedder, 1984).

Homogenization temperatures and salinities obtained on individual inclusions are shown in Figure 5. The homogenization temperatures range from 198° to 348°C, but most exceed 250°C. The compositions of the inclusions, however, vary widely from 2 to 31 weight percent NaCl equivalent. Primary fluid inclusions trapped in quartz from 1169.6 m have salinities ranging from 3.1 to 7.0 weight percent NaCl equivalent. These salinities may most closely represent the compositions of the early deep reservoir fluids. In contrast, the primary inclusion fluids trapped in calcite from 913 m, and the majority of the secondary inclusions, have salinities that are higher than those of modern geothermal systems. The behavior of the fluid inclusions from 1266.6 m during heating and freezing indicates that the fluids are chemically complex brines containing divalent cations (e.g. Ca, Mg, and Fe) in addition to monovalent Na and K. The estimated salinities of these inclusions, based on phase relationships in the system H_2O – NaCl - $CaCl_2$ (Goldstein and Reynolds, 1994), range from 22.3-25 weight percent NaCl + $CaCl_2$ equivalent. It is likely that most of the high salinity inclusions from other depths also contain significant concentrations of divalent cations, although this cannot be demonstrated with certainty.

Only secondary inclusions were observed in the late-stage anhydrite. Liquid-rich inclusions trapped in anhydrite from 1044.9 m, which is coated with scale, are halite saturated. These inclusions have salinities calculated from halite dissolution temperatures (Brown, 1989) of 31 weight percent NaCl equivalent.

Synthesis of Petrologic Data

The vein minerals and fluid-inclusion data suggest that the early geothermal system at Karaha-Telaga Bodas consisted of a deep high temperature saline reservoir and an overlying thick blanket of steam condensate rich in dissolved CO_2. Boiling of the steam condensate resulted in the formation of the calcite veins and subsequent replacement of calcite by quartz and chalcedony. At greater depths, epidote, actinolite, albite, biotite, clinopyroxene, and quartz precipitated from neutral pH fluids with salinities of 6.5 to 7 weight percent NaCl equivalent. Significantly, no evidence that the system has cooled to temperatures below the present-day conditions has been observed in the rocks in corehole T-8.

As the system evolved, the salinities of the fluids increased. There are several possible mechanisms that could result in these higher salinities. The most likely include the boiling off and concentration of the existing fluids, downward percolation and boiling of shallow condensate, trapping of magmatic fluids, and interactions between magmatic gases and deep hydrothermal fluids. Extensive boiling off of the early hydrothermal fluids, with an average salinity of ~6 weight percent NaCl equivalent is unlikely because this should have resulted in a reservoir fluid that is more concentrated than the present fluid of ~1 weight percent NaCl. Downward percolation of waters should have resulted in the formation of late anhydrite and/or calcite because of their retrograde solubilities, but these minerals are not common in the deepest part of the corehole. The direct trapping of magmatic brines is also unlikely because halite- or sylvite-saturated fluids, which are common in rocks immediately adjacent to intrusions (e.g. Roedder, 1984), are absent. Alternatively, high salinity chemically complex brines may result from interactions between magmatic gases (especially HCl and SO_2) and the overlying hydrothermal waters or condensate. These gases can reach relatively shallow depths when vapor-dominated chimneys develop over the subvolcanic intrusions supplying heat to the system (Reyes, 1993; Allis et al., 2000). Dissolution of the gases into the overlying liquids will produce an acidic fluid enriched in SO_4^{-2} and Cl^-. As the rocks in contact with these fluids undergo advanced argillic alteration and intense acid leaching, the pH and cation contents of the fluids will increase (Hemley et al., 1969). Further neutralization and cooling can lead to illite stability and finally equilibrium with propylitic assemblages. Lateral or downward migration of these compositionally complex, pH-neutralized fluids could have been the source of the high-salinity fluids trapped in the quartz and calcite. Similar fluid salinities (7-21 weight percent NaCl equivalent) have been found in the acid altered rocks associated with the Summitville gold deposit and other fossil systems (Bruha and Noble, 1983). The abundance of vapor-rich inclusions and evidence of chalcedony deposition at high temperatures in corehole T-8 suggest that development of vapor-dominated conditions was triggered by volcanic eruptions and the accompanying depressurization and boiling of the reservoir fluids.

As the initial high pressures within the chimney declined, heating of downward percolating carbonate- and sulfate-rich steam condensates resulted in the deposition of anhydrite and calcite. These fluids boiled off, leaving halite-saturated fluid inclusions trapped in the anhydrite and chemically complex precipitates on the vein minerals.

Acknowledgements

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Figure Captions

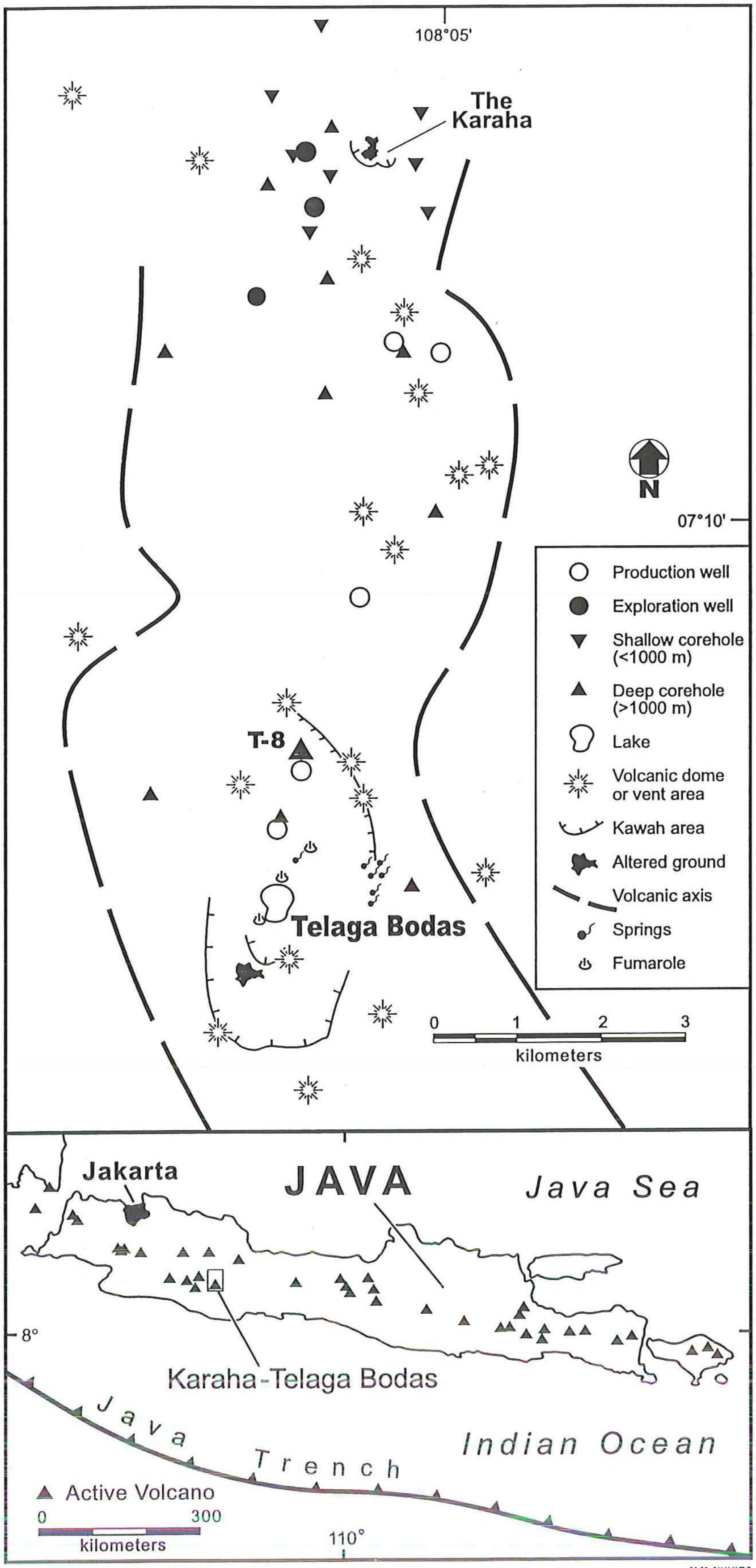
Fig. 1. Location map of the Karaha-Telaga Bodas geothermal system showing the distribution of wells and volcanic and thermal features. Triangles in the lower figure of Java denote volcanoes that have erupted since 10,000 BP.

Fig. 2. Lithologies and alteration minerals encountered in corehole T-8. Abbreviations: Act = actinolite; Alb = albite; Anhy = anhydrite; Ba = barite; Bio = biotite; Cal = calcite; Cpx = clinopyroxene Ep = epidote; I/S = interlayered illite/smectite; I = illite; KF = potassium feldspar; Py = pyrite; Pyro = pyrophyllite; Qtz = quartz; Tc = talc; Wair = wairakite. Mineral abundances are indicated by the width of the line.

Fig. 3. SEM electron bacscattered image of anhydrite coated with Ti-rich scale. The anhydrite encapsulates fine needles of actinolite. The coarser-grained crystal on the left is epidote. Note that the scale has peeled off the top of the crystal. The sample is from a depth of 1044.9 m.

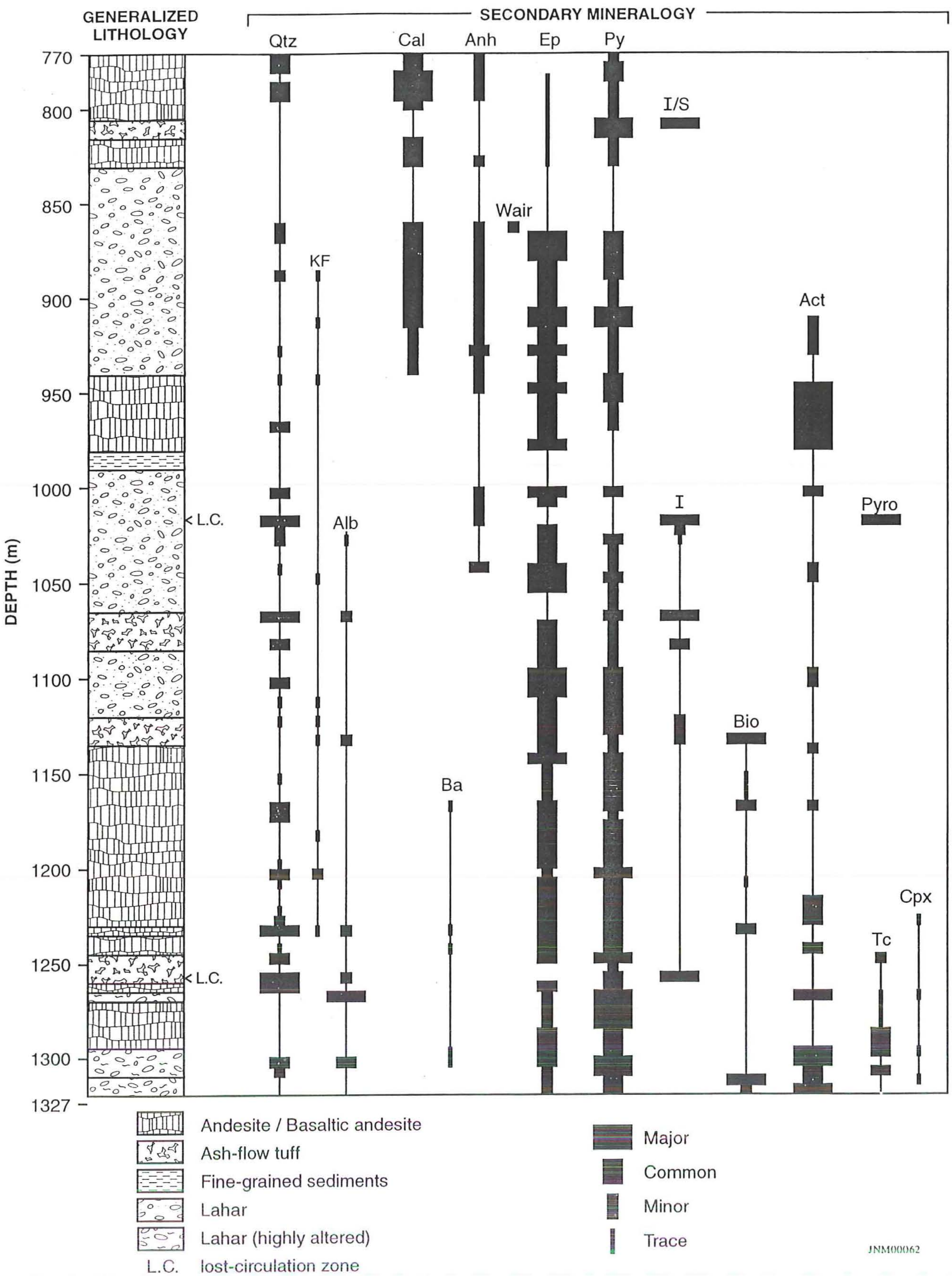
Fig. 4. Photomicrograph of a vein from 1139.5 m in corehole T-8. Abbreviations as in Fig. 2; chal = chalcedony. The botryoidal textures of the quartz indicate that it was deposited as chalcedony or amorphous silica. Some of the actinolite (labeled) near the lower center edge of the vein was deposited after the initial deposition of chalcedony. These textures suggest that deposition of chalcedony occurred at >300°C in response to rapid decompression.

Fig. 5. Homogenization temperatures and salinities of individual fluid inclusions from corehole T-8. Mineral abbreviations as in Figure 1. Other abbreviations: p = primary fluid inclusion; s = secondary fluid inclusion. All salinities calculated as weight percent NaCl equivalent except those in quartz with the highest salinities, which are calculated as weight percent NaCl + $CaCl_2$ equivalent.



JNM(XX)72

fig. 1 (Karaha)



GENERALIZED LITHOLOGY
SECONDARY MINERALOGY
Qtz
Cal
Anh
Ep
Py
I/S
Wair
KF
Act
I
Pyro
Alb
Bio
Ba
Cpx
Tc
770
800
850
900
950
1000
1050
1100
1150
1200
1250
1300
1327
DEPTH (m)
L.C.
L.C.
Andesite / Basaltic andesite
Ash-flow tuff
Fine-grained sediments
Lahar
Lahar (highly altered)
L.C. lost-circulation zone
Major
Common
Minor
Trace
JNM00062

fig. 2 (Karaha)

JNM00013

fig. 3 (Karaha)

fig. 4 (Karaha)

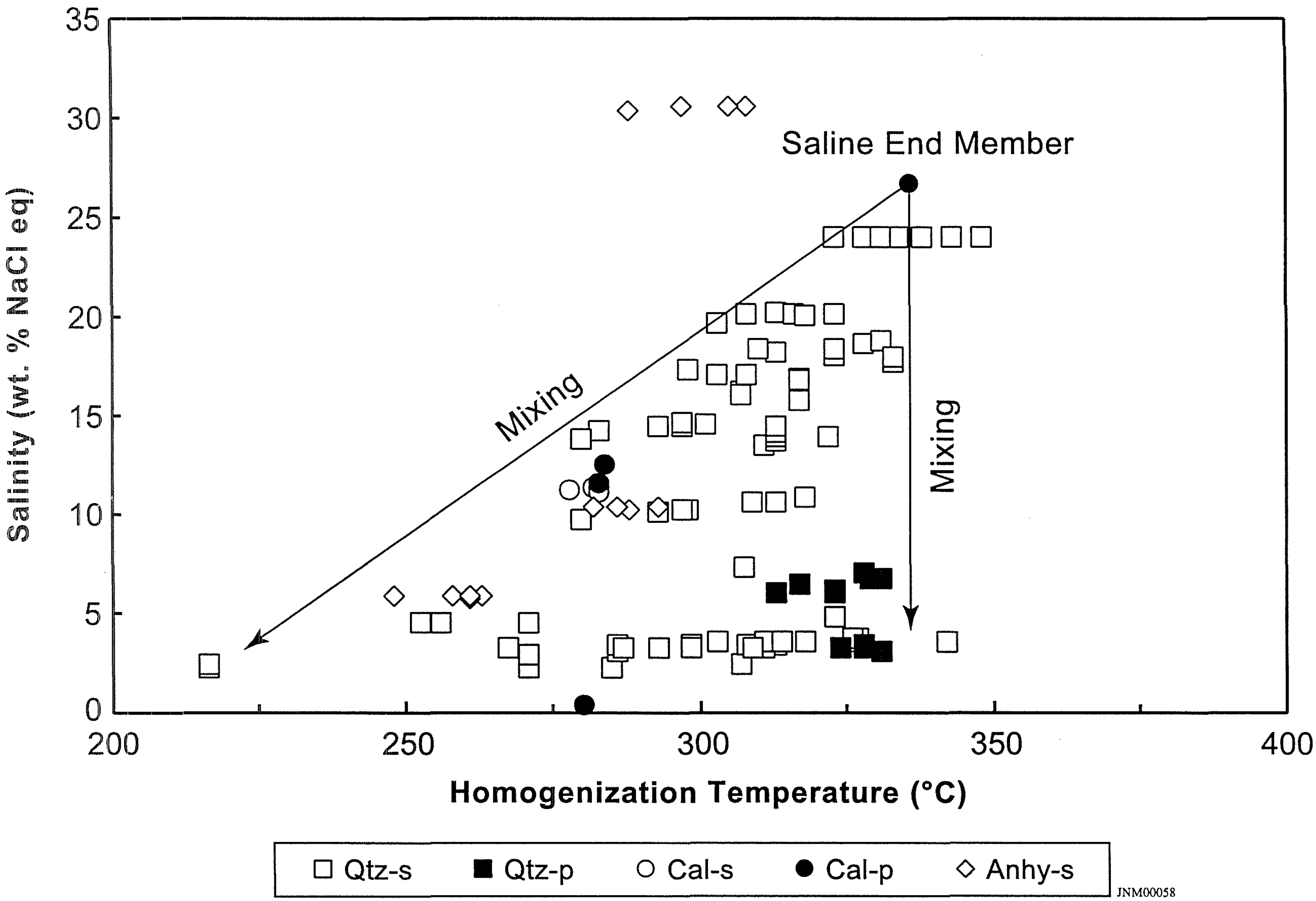

Saline End Member
Mixing
Mixing
Salinity (wt. % NaCl eq)
Homogenization Temperature (°C)
35
30
25
20
15
10
5
0
200
250
300
350
400
Qtz-s
Qtz-p
Cal-s
Cal-p
Anhy-s
JNM00058

fig. 5 (Karaha)

COLOR RELATED LITHOLOGY

- Volcaniclastic/Alluvium/Paleosol
- Debris Flow
- Lithic Tuff (Lahar/Block and Ash Flow/Tuff Breccia)
- Crystal Tuff
- Crystal Lithic Tuff
- Dacite
- Andesite
- Ash

SECONDARY MINERAL ABBREVIATIONS

C - Calcite

P/Py - Pyrite

Fe - Iron Oxides

Sm - Smectites (green clay)

Ch - Chlorite

Si/Q - Quartz

E - Epidote

K - Kalonite

LITHOLOGIC RELATED SYMBOLS

- Volcaniclastic/Alluvium/Paleosol
- Clay
- Lava
- Welded Tuff
- Crystal Tuff
- Crystal Lithic Tuff
- Lithic Crystal Tuff
- Lithic Tuff
- Ash Tuff

STRUCTURE

V - Vein

F - Fracture

Slk - Slickensides

KARAHA BODAS COMPANY L.L.C.

T-8 LITHOLOGY LEGEND

WELL: 3 SHEET NO.: 1

LITH		Fracture Vein	Secondary Minrls							RCVY	NOTES
	0								0		
NR	1								3		
NR	2								7		
NR	3								9		
NR	4								13		
NR	5								16		
NR	6								20		
NR	7								23		
NR	8								26		
NR	9								30		
NR	10								33		
NR	11								36		
NR	12								39		
NR	13								43		
NR	14								46		
NR	15								49		
NR	16								52		
NR	17								56		
NR	18								59		
NR	19								62		
NR	20								66		
NR	21								69		
NR	22								72		
NR	23								75		
NR	24								79		
NR	25								82		
NR	26								85		
NR	27								89		
NR	28								92		
NR	29								95		
NR	30								98		
NR	31								102		
NR	32								105		
NR	33								108		
NR	34								112		
NR	35								115		
NR	36								118		
NR	37								121		
NR	38								125		
NR	39								128		
NR	40								131		
NR	41								134		
NR	42								138		
NR	43			Py	K	Fe			141		@146'-156' Crystal Tuff/altered/bleached?
NR	44								144		White, v soft, fine grained, completely
^	45				10	a			148		altered w/ white clay, hem/lim.
^	46								151		
^	47								154		156'-166' A/A
^	48								157		
^	49								161		
^	50			C	10	a			164		

(AP)

WELL -8 SHEET NO.: 2

LITH	Fracture Vein	Secondary Mnrls: Py	K	Fe	An	Gr cly	Depth	RCVY	NOTES
51							167		
52							170	R	
53							174		@ 166'-186' A/A
54		c	10	m			177		
55							180	o	@ 186'-196' A/A
56							184		
57		c	10	r	r		187	t	
58							190		
59							194		@ 196'-206' crystal Tuff / boundary line /
60							197		soil horizon, creamy, yellowish gry, crystal
61							200	a	tuff frags. soft, w/ gry cly, hem./lim,
62							203		diss. Py.
63		m	r	10	t	20	207	r	
64							210		@ 206'-216' Volcanic Ash / Gry Cly
65							213		Gry, v soft, v fine grained
66		20		m		40	216	y	
67							220		@ 216'-226' A/A, drk gry, v soft, v fine
68							223		grained
69		30		m	r	40	226		@ 226'-236' crystal Tuff, drk gry, soft,
70							230		original text. was CT altered to gry cly,
71							233		fine grained, strong to complete alt'd w/
72		20		r	t	20	236		diss. Py, hem/lim, gry cly.
73							239		
74							243	D	@ 236'-246' A/A
75		a		m	m	50	246		
76							249		@ 246'-256' A/A
77							253	r	
78		m	10	m	r	30	256		@ 256'-266' crystal Tuff, creamy, white, yellow,
79							259	i	soft, fine grained, frags. from CT among
80							262		wh cly & ash mat.
81		m	40	m	t	20	266		
82							269	l	@ 266'-276' crystal Tuff, lt gry, v soft, sticky,
83							272		clayey, v fine grained.
84		m	10	m	t	40	276	l	
85							279		@ 276'-286' Volcanic Ash / Gry Cly, gry,
86							282	i	v soft, sticky, v fine grained, completely
87		m		r		60	285		alt'd w/ gry cly, diss Py.
88							289		
89							292	n	@ 286'-296' A/A
90		10	r	t		60	295		
91							298		@ 296'-306' A/A
92							302	g	
93		10	r	t		60	305		@ 306'-316' A/A
94							308		
95							312		
96		20		t		60	315		@ 316'-326'
97							318		
98							321		
99		10	r	t		60	325		
100							328		

(AP)

WELL: T-8 SHEET NO.: 3

LITH		Fracture Vein	Ca	Py	K	Fe	An	Cly		RCVY
^	101								331	
^	102			a	r	t		40	335	
^	103								338	P
^	104								341	
^	105			m	t	t		40	344	
^	106								348	O
^	107								351	
^	108			m	t	15		40	354	
^	109								358	T
^	110								361	
^	111			m		r	r	50	364	
^	112								367	R
^	113								371	
^	114			m		t	m	30	374	
^	115								377	T
^	116	14/6 '97							380	
^	117	09:45		r	r	r	m	40	384	
^	118								387	I
^	119								390	
^	120	10:16		c	t	t	m	40	394	
^	121								397	
^	122								400	
^	123	11:05		10		r		40	403	
v	124								407	
v	125								410	
v	126	11:55	t	15	r	30		15	413	O
v	127								417	
v	128								420	T
v	129								423	
v	130								426	
v	131								430	-.
v	132								433	
v	133	12:38	t	10		m	r	10	436	—
v	134	13:26	t	10		m	r	10	440	
v	135								443	—
v	136								447	
v	137	14:15	r	c		r	r	10	450	-.
v	138								453	
v	139								456	
v	140	15:20	r	15		r	r	10	459	
v	141								462	S
v	142								466	
v	143	16:38	r	15		r	t	c	469	
v	144								472	U
v	145								476	
^	146	17:55	r	10		20	t	c	479	
^	147								482	
^	148								485	
^	149	19:43	r	c	r	m	t	c	489	
^	150								492	

(Secondary Mnrls: Ca Py K Fe An Cly)

NOTES

@ 326-336' Crystal Tuff
Gry, soft, fine grained strongly altd w/ gry cly, diss. Py, wh cly.

@ 336'-346' A/A

@ 346'-356' A/A w/ increasing hem./lim contain.

@ 356'-366' A/A

@ 366'-376' Crystal Tuff lt gry, soft, fine grained, strong to completely altd. w/ gry cly, diss Py & Anhydrite

@ 376'-386' A/A

@ 386'-396' A/A

@ 396'-406' A/A

@ 406-416 Crystal Lithic Tuff, reddish brown, gry, med. hrd, andesite frags. among ash mat. strongly altd. w/ diss Py, An & Py

@ 416'-436' A/A w/ 10% LCM, lt gry, soft to med. hrd (only few chips), rare andesite frags. strongly altd w/ diss Ca, Py, Gry cly, hem & An.

@ 436'-440' A/A no LCM.

@ 440'-450' A/A w/ Py vng inside andesite frags.

@ 450'-460' A/A

@ 460'-470' A/A w/ lithic frags increased

@ 470'-480' unit boundary w/ limonitic dominant.

@ 480'-490' Crystal Tuff,
Lt gry, soft, subhedral to euhedral plag, An crystal, fine grained. Strong to completely altd. w/ diss Py & Ca, hem, gry cly.

(AP)

WELL: T-9 SHEET NO.: 4

	LITH		Fracture Vein	Ca	Py	K	Fe	An	Gr Cly		RCVY	NOTES
	^	151								495		@490'-500' A/A
	^	152	22:45	r	10	r		r	c	499	R	@500' MRT 120°F, dev. 1/2°
1 →	^	153								502		
	^	154								505		@500'-510' A/A w/ calcite vng.
	^	155	23:15	c	15	r		r	c	508	O	
	^	156	15/6 97							512		@510'-520' A/A
	^	157								515		
	^	158	00:28	c	10	r		r	m	518		@520'-530' A/A
	^	159								522	T	
	^	160								525		@530'-540' Crystal Lithic Tuff
	^	161	02:48	c	10	r		r	m	528		Lt gry to gry, soft to med. hrd, drk
	v	162								531		gry to black andesite clast frags among
	v	163								535	A	the crystal & ash matrix. Strongly
	v	164	04:10	m	10	r	r	r	m	538		altd w/ diss Py & Ca also vng, gry cly,
	v	165								541		An, hem.
	v	166								544	R	@540'-550' A/A w/ more and. frags &
	v	167	06:05	c	15	t	r	t	t	548		diss & Py vng inside it + Calc vng.
	v	168								551		
	v	169								554		@550'-560' A/A
	v	170	07:27	c	15	r	t	r	t	558	Y	
	v	171								561		@560'-570' A/A
	v	172								564		
	v	173	09:55	c	25	t		t		567		@570'-580 Crystal Lithic Tuff, less
	v	174								571		lithic frags among ash & fine grained
	v	175								574		mat. Strongly altd w/ gry cly, diss
	v	176	10:37	m	20	t		t	10	577		Py & Ca, Py & Ca vng.
	^	177								581	D	
	^	178								584		
	^	179								587	R	@580'-590' Crystal Tuff, lt gry, soft,
	^	180	12:10	m	15	a	t	r	30	590		fine grained, dominantly ash mat. w/ v
	^	181								594		rare lithic frags. Strong to completely
	^	182								597	I	altd w/ diss Py, diss Ca & vng, wh cly,
	^	183	13:15	m	15	a		r	40	600		
	^	184								604	L	@590'-600' A/A
	^	185								607		
	^	186	14:10	m	20	c		r	30	610		@600'-610' A/A
	^	187								613	L	
	^	188								617		@610'-620' Andesitic Crystal Tuff, gry to
	^	189	15:23	m	20	t		t	10	620	I	drk gry, hrd, subhedral crystal,
	^	190								623		fine grained, slightly altd w/ diss Py
	^	191								626		& Ca, gry cly.
	^	192	17:20	r	25	t		t		630	N	
	^	193								633		@620'-630' A/A
	^	194								636		
	^	195	19:00	r	20	m	t	t	10	640	G	@630'-640' A/A lt gry, v soft to soft,
	^	196								643		fine grained crystal & ash mat. Strong
	^	197								646		to completely altd w/ diss Py & Ca, gry cly
	^	198	20:08	r	20	m	t	t	10	649		
	^	199								653		@640'-650' A/A
	^	200								656		

Secondary Mnrls

(AP)

WELL: T-8 SHEET NO.: 5

LITH		Fracture Vein	Ca	Py	K	Fe	An	Cty cly		RCVY	NOTES
^	201	22:15	r	15	m	t		10	659		@650-660' A/A
^	202								663		
^	203	16/6/97							666	R	@660'-670' A/A
^	204	03:58	r	20	r			10	669		
^	205								672		@670'-680' A/A
^	206								676	O	
^	207	04:35	r	20	r			10	679		@680'-690' A/A
^	208								682		
^	209								686	T	@690'-700' A/A
^	210	05:12	r	15	t		t	c	689		
^	211								692		@700-710' crystal Tuff, lt gry, soft to
^	212								695		med. hrd w/ few chips more fress &
^	213	05:35	r	15	t		t	c	699	A	harder than the other.
^	214								702		
^	215								705		@710'-720' A/A going back to soft
^	216	05:55	r	10	t		t	c	708	R	w/ v rare fresh chips.
^	217								712		
^	218								715		@720'-730' A/A
^	219	06:10	r	10	t		t	c	718	Y	
^	220								722		@730'-740' Andesitic crystal Tuff
^	221								725		Gry, med. hrd, more fresh, glassy ground-
^	222	06:20	r	10	t		t	c	728		mass, slightly altd w/ diss. Ca & Py, An, gry
^	223								731		cly & grn cly.
^	224				sm				734		
^	225	07:00	r	10	r		r	r	738		@740'-750' A/A
^	226								741		
^	227								745		@750'-760' crystal Tuff, lt gry grades
^	228	07:15	t	15	m		r	r	748	D	to soft.
2 → ^	229								751		@750' MRT 130° F (30 min.) dev. 1/4°
^	230								754	U	
^	231	07:40	t	10	r		t	r	758		@760'-770' crystal Tuff, variated color,
^	232								761		reddish brown, lt gry to drk gry, soft
^	233								764	-	to med. hrd ash matrix devit. to glassy
^	234	08:28	t	10	t	m	t	r	768		material. Med. altd w/ diss. Py, hemati
^	235								771	—	tic + grn cly.
^	236								774		
^	237	09:03	t	10	c	r	t		777		@770'-780' A/A grades to gry & became
^	238								781	—	hrd.
•	239								784		
•	240								787	-	@780'-790' unit boundary/paleosoil
•	241	10:30	r	c		10	r		790		dominantly CT composition, reddish brown,
•	242								794		gry, white.
•	243								797	S	
•	244	10:56	t	m		60	r		800		@790'-800' A/A hematitic, reddish
•	245								804	T	brown, soft to med. hrd w/ original
•	246								807		texture was CT.
•	247	11:27	t	m	m	50	r		810		
•	248								813		@800'-810' A/A
•	249								817		
•	250	13:16	t	m	m	40	m		820		@810'-820' A/A grades to brown

(AP)

WELL: T-8 SHEET NO.: 6

LITH		Fracture Vein	Ca	Py	Sm	Fe	An	Cly		RCVY
+	251								823	
+	252								827	
+	253	14:29	t	c	m	r	r		830	R
+	254								833	
+	255								836	
+	256	15:22	t	a	m	m	t		840	O
+	257								843	
+	258								846	
+	259	16:10	r	c	r	10	t		850	T
+	260								853	
+	261								856	
+	262	16:35	r	c	r	15	t		859	
+	263								863	A
+	264								866	
+	265	16:43	r	m	r	20	t		869	
+	266								872	R
+	267								876	
+	268	17:30	r	m	t	t	t		879	
+	269								882	
^	270								886	Y
^	271	18:30	r	10		50			889	
^	272								892	
^	273								895	
^	274	18:45	r	10		40			899	
^	275								902	
^	276								905	D
^	277	19:05	r	15		c		20	909	
—	278								912	R
—	279								915	
—	280	19:20	r	a	t	t	t	20	918	
—	281								922	I
—	282								925	
—	283	19:30	r	a		t	t	25	928	
v	284								932	L
v	285								935	
v	286	19:50	r	a	m	c	t	10	938	L
v	287								941	
v	288								945	
v	289	20:05	r	a	r	r	t	10	948	I
v	290								951	
v	291								954	
v	292	20:12	r	c	m	m	t	10	958	N
v	293								961	
v	294								964	G
v	295	21:50	r	c	t	r	t	10	968	
v	296								971	
v	297								974	
v	298	22:10	r	c	t	r	t	10	977	
v	299								981	
v	300								984	

NOTES

@820-830' Andesite, gry, med. hrd to hrd, sub heudral plag x'tal w/ Sm vng, fine grained, massive, porphyritic, glassy groundmass. Slightly to mod. altd w/ diss Py, An, grn cly.

@ 830-840' A/A

@ 840-850' Andesite/weathered, brownish gry, soft to med. hrd, porph., sub heudral plag phen. Mod. altd w/ diss ca & Py, hem & grn cly.

@ 850'-860' A/A

@ 860'-870' A/A

@ 870'-880' Andesite, gry, hrd, massive, porph. glassy groundmass. Slightly altd w/ diss. Py, Ca vng.

@ 880'-890' unit boundary/paleosoil, multi colored, creamy dominantly yellow, soft mixed section from gry porph. and. w/ limonitic CT, strong to completely altd. w/ lim. diss Py, ca vng.

@ 890'-900' A/A dominantly hematitic CT, brownish, yellow, lt gry, strongly alt w/ hem, diss. Py, Ca vng.

@ 900'-910' crystal Tuff, lt gry, v soft to soft, fine grain x'tal among ash mat. strong to completely altd w/ gry cly, hem, diss Py & ca vng

@ 910'-920' Crystal Tuff/Volcanic Ash

@ 920'-930' A/A

@ 930'-940' unit boundary, crystal Lithic Tuff, lt gry to gry, soft w/ few and. frags. matrix is CT & ash mat. Strongly altd w/ gry cly, diss Py & ca vng, grn cly, hem/lim.

@ 940'-950' crystal Lithic Tuff less hem/lim, rare lithic frags.

@ 950'-960' A/A

@ 960'-970' A/A

@ 970'-980' A/A

(AP)

WELL: 3 SHEET NO.: 7

LITH		Fracture Vein	Secondary Mnrls Ca	P	Sm	I	An	CLAY		RCVY	NOTES
	301								987		
	302								991		
	303								994		
	304								997		
	305								1000		
	306								1004		
	307								1007		
	308								1010		
	309								1014		
	310								1017		7-INCH CASING AT 1016 FT.
	311								1020		1020 - 28 FT. CLAY - LT. GREY, SOFT
	312	6/20/97							1023		STICKY, R. QZT CRYSTALS, DISS. PYRITE,
	313	01:05	R	T				90	1027		ALTERED ASH(?)
	314								1030		
	315								1033		
	316								1036		1028-38 FT. A/A
	317	01:20	R	T				95	1040		
	318								1043		
	319								1046		
	320	01:35	R	T				95	1050		1038-48 FT CLAY - LT. GREY, SOFT,
	321								1053		STICKY, DISS. PYRITE, ALTERED
	322								1056		ASH (?)
	323	02:01	R	T				95	1059		1048-58 FT. A/A
	324								1063		
	325								1066		
	326	02:15	R	T	V/R			90	1069		1058-68 FT. CLAY - LT. GREY, SOFT
	327								1073		STICKY, DISS. PYRITE, R. SMECTITE
	328								1076		
	329	02:35	R	T				80	1079		1068-78 FT. A/A
	330								1082		
	331								1086		
	332	02:45	R	T				60	1089		1078-88 FT. A/A EXCEPT 40%
	333								1092		ROUNDED, MUTLI-LITHIC FRAGMENT
	334								1096		WATER-LAID ASH INTERBEDDED W/ SAND
	335	03:10	R	M		M		10	1099		1088-98 SAND, LT. GREY, SUB-ANG TO
	336								1102		SUB-ROUND, 0.2" DIAMETER, POOR SORTED
	337								1105		MOSTLY ALT. CLT FRAGMENTS, FRAGMENT
	338	03:20	R	M		M		5	1109		CONTAIN M. PY, R. CAL, & M. ILLITE
	339								1112		1098-1108 FT. A/A APPROXIMATELY
	340								1115		5% LT. GREY CLAY
	341	03:42	R	R		R	R	5	1118		1108-18 FT. A/A
	342								1122		
	343								1125		
	344	03:50	R	R		R	R	5	1128		1118-28 FT. A/A
	345								1132		
	346								1135		
	347	04:10	R	R			R	5	1138		1128-38 FT A/A
	348								1141		
	349								1145		
	350	04:28	R	M				25	1148		1138-48 FT. INCREASING LT GREY CLAY

WELL: SHEET NO.: 8

No.	Fracture Vein	CA	P	I	AN	S	CLAY	Depth	NOTES
351								1151	
352								1155	
353	04:50	R	T				80	1158	1048-58 FT. CLAY, GREY, SOFT, STICKY
354								1161	w/ 20% SAND, WATER-LAID ASH(?)
355								1164	DISS PYRITE
356	05:08	R	T				80	1168	1058-68' A/A
357								1171	
358								1174	
359	05:28	R	R				90	1178	1068-78' A/A SAND DECREASING
360								1181	
361								1184	
362	05:40	R	R				90	1187	1078-88' A/A
363								1191	
364								1194	
365	06:05	R	R				80	1197	1088-98 FT. A/A SAND INCREASING
366								1200	
367								1204	
368	06:15	R	T				60	1207	1098-2008 FT. 60% GREY CLAY
369								1210	40% SAND
370								1214	
371								1217	
372	06:55	M	T				20	1220	2008-18 FT. GRAVEL, WHITE TO DK GREY
373								1223	POORLY SORT, SUB-ROUND, 0.5" LITHIC
374								1227	FRAGMENTS OF ANDESITE & X TUFF
375	07:17	C	T				50	1230	20% GREY CLAY
376								1233	1218-28 FT INCREASING GREY CLAY
377	08:13							1237	1228-38 ALTER CRYSTAL TUFF, LT-DR
378		T	M		T		30	1240	GREY, FIRM-HARD, QZT. PORPH, R.
379								1243	PY+CA+AN VEIN, T. DISS. PYRITE
380								1246	
381	08:30	T	T		T		20	1250	1238-48 FT A/A CLAY DECREASING
382								1253	MRT 145°F @ 1248 FT, 3/4° DEV.
383								1256	
384	09:05	T	M		T		10	1260	1248-58 FT A/A CONTINUED
385								1263	DECRASE CLAY, MAY BE CARRY-OVER
386								1266	
387	09:20	T	T				10	1269	1258-68 FT. A/A VEINS
388								1273	DECREASING W/ DEPTH
389								1276	
390	10:10	T	M				50	1279	1268-78 FT. A/A CLAY INCREASE
391								1282	
392								1286	
393	10:30		T				90	1289	1278-88 FT CLAY - LT GREY, SOFT,
394								1292	STICKY, CRY. TUFF FRAGMENTS,
395								1296	DISS. PYRITE & ANHYDRITE(?),
396	10:45		T		R		90	1299	ALTER ASH(?)
397								1302	1288-98 FT. A/A
398								1305	
399	11:32	R	M	R	R	R	20	1309	1298-1308, ALTER ANDESITE, DR. GREY
400								1312	FIRM. APHANTIC, PY. VEINS, R. GREEN

SMECTITE VEINS

WELL: J. SHEET NO.: 9

LITH	Fracture Vein	Fe Ox	CA	P	I	AN	Sm	CLAY		RCVY	NOTES
401									1315		
402	11:55	R	R	T	R		R	10	1319		1308-18 FT. A/A R. PYRITE + ANHYDITE +
403									1322		CA VEINS W/ FEO_x
404									1325		
405	12:35	R	R	T	R			10	1328		1318-28 FT. A/A
406									1332		
407									1335		
408	13:10		R	M	R	R		20	1338		1328-38 FT. A/A V.R. QUARTZ VEINS
409									1342		WAXY WHITE VEIN MINERAL, INCREASE
410									1345		IN PYRITE
411	13:35		R	T	R	R		30	1348		1338-48 FT. A/A GREY CLAY
412									1351		INCREASING W/ DEPTH
413									1355		
414	14:10		R	M	T	R		20	1358		1348-58 FT. ALTER ANDSITE, DK.
415									1361		GREY, FIRM, APHANTIC, DISS. PYRITE
416									1364		INCREASING
417	14:35		R	M	T	R		30	1368		1358-68 FT. A/A
418									1371		
419									1374		
420	15:15	R		T	M		R	30	1378		1368-78' A/A LESS ALTER, T. GREEN
421									1381		PYROXENE, R. SMECTITE, R. FEO_x STAIN
422									1384		
423	15:40		R	M	M	T		50	1387		1378-88' A/A WITH 50% CLAY,
424									1391		ALTER ASH (?), T. PY + ILLITE + CA VEINS
425									1394		
426	16:00		R	C	M	T		50	1397		1388-98 FT. ALTER ASH-FLOW CRYSTAL
427									1401		TUFF, LT GREY, FIRM, UNWELDED, ORGINAL
428									1404		CRY + MATRIX ALTER TO ILLITE +
429									1407		SMECTITE, COM. DISS PY, M. PY + I + AN + CA
430	16:20		R	M	M	T		50	1410		VEINS
431									1414		1398-1408 FT. A/A
432	16:38		R	M	T		R	50	1417		1408-18 FT. A/A R. PY VEINS
433									1420		
434									1424		
435									1427		1418-28 FT. LESS ALTERED, MOD.
436	16:45		R	T	R			30	1430		WELDED, LESS DISS. PYRITE
437									1433		
438	17:00		T	T	T			20	1437		1428-38 FT. A/A
439									1440		
440									1443		
441									1446		
442	17:20		T	T	R			40	1450		1438-48 FT. A/A BECOMING
443									1453		SANDY, BOTTOM CONTACT (?)
444									1456		
445	17:30		T	T	T			50	1460		1448-58 FT. SAND & SOFT, GREY,
446									1463		STICKY CLAY, SAND IS POORLY SORT
447									1466		SUB-ROUND, MULTI-LITHIC FRAGMENTS
448	17:55		R	T	R			80	1469		MOSTLY GREY XT, WATER-LAID ASH(?)
449									1473		1458-68 FT. A/A INCREASED
450									1476		CLAY

WELL: T? SHEET NO.: 10

LITH	Sample	Fracture Vein	Ca	P	I	An	S	CLAY	Depth	RCVY	NOTES
	451	18:03	R	R	R	T		50	1479		1468-78 FT. ALTER CRYSTAL ASH-FLOW
	452								1483		TUFF, GREY, SOFT, UNWELDED, MAY BE
	453								1486		SAND & WATER-LAID ASH, R. DISS. PYRITE
	454	18:15	R	R	R	R		70	1489		1478-88 FT. A/A
	455								1492		
	456								1496		1488-98 FT. CLAY & 10% SAND, CLAY
	457	18:35	R	R	R	R		90	1499		IS SOFT, STICKY, LT. GREY
	458								1502		MRT 170°F @ 1508 FT, 3/4° DEV
	459								1506		1498-1508' A/A INCREASE SAND
	460	18:35(?)	R	R	R	R		80	1509		
	461	MISS MARK							1512		
	462								1515		1508-18 FT. 50% SAND 50% LT. GREY
	463	18:45	R	R	T			50	1519		SOFT, STICKY CLAY, SAND IS SUB-ROUND
	464								1522		POOR SORT, MOSTLY DK. GREY CRYSTAL
	465								1525		TUFF FRAGMENT, WATER-LAID ASH(?)
	466	18:55	R	R	T			75	1528		W/ INTERBEDDED SAND
	467								1532		1518-28 FT A/A 75% CLAY W/
	468								1535		DISS PYRITE & 25% SAND
	469	19:20	R	R	R			20	1538		1528-38 FT. A/A 20% CLAY 80%
	470								1542		SAND, ALSO ANDESITE FRAGMENTS
	471								1545		THIN FLOW (?)
	472	20:05	R	R	R			10	1548		1538-48 FT. SAND W/ POSSIBLE THIN
	473								1551		ANDESITE FLOW
	474								1555		1548-58 FT. SAND W/ GREY GREY
	475	20:20	R	R	R			30	1558		CLAY, WATER-LAID ASH(?), R. DISS.
	476								1561		PYRITE
	477								1565		
	478	20:40	R	R	R			30	1568		1558-68 FT. A/A
	479								1571		
	480								1574		
	481	21:00	R	R	R			30	1578		1568-78 FT. SAND & GREY CLAY,
	482								1581		SAND IS SUB-ROUND, POOR SORT,
	483								1584		MULTI-LITH FRAGMENTS, R. DISS.
	484	21:15	R	R	R			70	1588		PYRITE, WATER-LAIN ASH
	485								1591		1578-88 FT. INCREASE CLAY
	486								1594		
	487	21:20	R	R	R			80	1597		1588-98 FT. A/A MOSTLY CLAY
	488								1601		
	489								1604		
	490	21:40	R	R	R			80	1607		1598-1608 FT. A/A
	491								1610		
	492								1614		
	493	22:07	R	T	P			50	1617		1608-18 FT. A/A MORE SAND
	494								1620		<0.1" DIAMETER, UNCEMENTED
	495								1624		
	496	22:20	R	R	R			20	1627		1618-28 FT. A/A
	497								1630		
	498								1633		
	499	22:35	R	T	R			60	1637		1628-38 FT. A/A. MORE CLAY
	500								1640		ALTER ASH(?)

WELL: T- SHEET NO.: 11

LITH		Fracture Vein	Fe Ox	Secondary Mnrls Ca	P	I	AuCh	CLAY		RCVY	NOTES
	501								1643		1638-48 FT. SAND & GREY CLAY, SAND IS
	502								1647		SUB-ROUND, POOR SORTED, LT. GREY CRY TUFF,
	503	22:50		R	R	T		60	1650		DR GREY CRY TUFF & GREY ANDESITE
	504								1653		FRAGMENT, WATER-LAID ASH (?)
	505								1656		DISS. PYRITE
	506	23:00		R	T	T		40	1660		1648-58 FT. A/A LESS CLAY
	507								1663		
	508								1666		
	509	23:10		R	T	R		40	1670		1658-68 FT. A/A SAND IS
	510								1673		COARSE GRAINED
	511								1676		
	512	23:20		T	R	R		10	1679		1668-78 FT. SAND W/ 10% CLAY
	513								1683		DISS. PYRITE, NOTE ROP
	514								1686		
	515	23:26		R	T	R		50	1689		1678-88 FT. 50% COARSE SAND/50%
	516								1692		GREY CLAY, DISS PYRITE, ALT. WATER
	517								1696		-LAID ASH (?)
	518	23:40		R	T	R		10	1699		1688-98 FT. COARSE SAND W/10%
	519								1702		CLAY, DISS. PYRITE, VOLCANIC
	520	6/21/97							1706		SEDIMENT FILLING CALDERA (?)
	521	00:03		R	R	T		80	1709		MRT 185°F @ 1708 FT., 3/4° DEV.
	522								1712		1698-1708 FT. A/A MORE CLAY
	523								1715		
	524	00:20		R	T	T		40	1719		1708-18 FT. 60% COARSE SAND/
	525								1722		40% SOFT, STICKY CLAY, DISS.
	526								1725		PYRITE, ALTER WATER-LAID ASH
	527	00:40		R	R	T		60	1729		1718-28 FT. A/A UNCEMENTED
	528								1732		
	529								1735		
	530	00:50	VR	T	R	T		40	1738		1728-38 FT. A/A NOTE ROP
	531								1742		SECTION APPEARS TO BE VOLCANIC
	532								1745		SEDIMENT & ASH FILLING CALDERA(?)
	533	01:05	VR	T	R	R		30	1748		ALTERED W DISS PYRITE.
	534								1752		1738-48 FT. A/A VERY RARE
	535								1755		HEMATITE STAIN, POSSIBLE CINNABAR
	536	02:25	R	R	R	R		10	1758		1748-58 FT. COARSE SAND, POOR
	537								1761		SORT, SUB-ROUND, R. HEMATITE,
	538								1765		POSS. CINNABAR
	539	02:35			R	R		10	1768		1758-68 FT. A/A R. DISS PYRITE
	540								1771		
	541								1774		
	542	03:00			R	R		10	1778		1768-78 FT. A/A UNCEMENTED
	543								1781		
	544								1784		
	545	03:20		R	R	R		10	1788		1778-88 FT. A/A
	546								1791		
	547								1794		
	548	03:45	R	R	T	R		50	1797		1788-98 FT. 50% COARSE SAND/50%
	549								1801		GREY CLAY, ALT ASH (?)
	550								1804		T. DISS. PYRITE

WELL: T-E SHEET NO.: 12

LITH		Fracture Vein	Fe Ox	CA	P	I	An	Ch	CLAY		RCVY		NOTES
	551	04:10	—	R	R	R			50	1807		—	1798-1808 FT. COARSE SAND & GREY
	552		—							1811		—	CLAY, R. DISS PYRITE & CALCITE,
	553		—							1814		—	ALT. WATER-LAID ASH(?)
	554	04:35	R	R	R	R			10	1817		—	1808-18 FT. SAND W/ 10% GREY
	555		—							1820		—	CLAY, SUB-ROUND, POOR SORT, R. HEMA.
	556		—							1824		—	
	557		—							1827		—	
	558	05:20	R	T	R	R			5	1830		—	1818-28 FT. COARE SAND W/ LAYER
	559		—							1834		—	OF GREEN CALCITE CEMENTED SAND,
	560	05:30	R	T	R	R			20	1837		—	POOR SORT, SUB-ANG, SOFT-V. HARD
	561		—							1840		—	CRY. TUFF & PORPH. CRY TUFF
	562		—							1843		—	1828-38 FT. SAND W/ 20% GREY
	563	05:45	—							1847		—	CLAY, DISS PYRITE, R. HEMATITE
	564		—							1850		—	STAIN, HIGH ROP
	565		—							1853		—	1838-48 FT. A/A
	566		—							1856		—	1848-58 FT. MISSING
	567		—							1860		—	
	568		—							1863		—	
	569	05:55	—	R	VR	R			5	1866		—	1858-68 FT. CRY. TUFF, LT TO DK GREY,
	570		—							1870		—	SOFT-FIRM, QTZ-PLAG PORPH, FINE
	571		—							1873		—	DK. GLASSY MATRIX, WELDED, R.
	572		—							1876		—	CAL + PY VEINS
	573	06:10	R	R	VR	R			15	1879		—	1868-78 FT. A/A MAY BE SINGLE
	574		—							1883		—	LITH: SAND
	575		—							1886		—	
	576	06:20	C	R	R					1889		—	1878-88' A/A W/C. HEMATITE STAIN
	577		—							1893		—	MATRIX, R. EUHED. PYRITE, CINNABAR(?)
	578		—							1896		—	
	579	06:30	C	R	R				50	1899		—	1888-98 FT. GREY, SOFT, CLAY & SAND
	580		—							1902		—	THAT IS POOR SORT, SUB-ROUND, MOSTLY
	581		—							1906		—	HEMATITE STAIN CRY. TUFF
	582	06:35	C	R	R				50	1909		—	1898-1908 FT. A/A HIGH ROP
	583		—							1912		—	
	584		—							1916		—	
	585	06:45	A	T	R				50	1919		—	1908-18 FT. A. HEMATITE &
	586		—							1922		—	BRICK RED, HARD, ANG. CRY. TUFF
	587		—							1925		—	ALTERED
	588	07:05	A	T	R				10	1929		—	1918-28 FT. ALTER. CRY TUFF,
	589		—							1932		—	HEMATITE TO BRICK RED, HARD,
	590		—							1935		—	MAY BE SAND, R. DISS PYRITE
	591	07:15	A	R	R				5	1938		—	1928-38 FT. A/A
	592		—							1942		—	
	593		—							1945		—	
	594	07:30	A	R	R				5	1948		—	1938-48 FT. A/A
	595	TRIP	—							1952		—	
	596		—							1955		—	
	597	16:10	C	R	R				5	1958		—	1948-58 FT. BAD SAMPLE AFTER
	598		—							1961		—	TRIP, SAMPLED TO SOON, MIXTURE
	599		—							1965		—	OF ABOVE LITHOLOGIES
	600	16:21	C	R	T	T			20	1968		—	1958-68 FT. ALTER. CRY TUFF

HEMATITE STAIN TO BRICK RED COLOR

WELL: 3 SHEET NO.: 13

LITH	Sample	Fracture Vein	FE Ox	CA	P	I	AN	S	CLAY	Depth	RCVY
	601		—							1971	—
	602		—							1975	—
	603	16:35	A	R	VR	C		T	5	1978	—
	604		—							1981	—
	605		—							1984	—
	606	16:40	A	R	R	C		T		1988	—
	607		—							1991	—
	608		—							1994	—
	609	16:58	A	R	R	C		T		1998	—
	610		—							2001	—
	611		—							2004	—
	612	17:03	M	R	T	T				2007	—
	613		—							2010	—
	614		—							2013	—
	615		—							2017	—
	616	17:22	M	R	T	T				2020	—
	617		—							2024	—
	618	17:28	T	R	T	T				2027	—
	619		—							2030	—
	620		—							2034	—
	621	17:52	T	R	T	T				2037	—
	622		—							2040	—
	623		—							2043	—
	624	18:00	R	R	T	T				2047	—
	625		—							2050	—
	626		—							2053	—
	627		—							2057	—
	628	18:13	M	R	R	T				2060	—
	629		—							2063	—
	630		—							2066	—
	631	18:18	R		R	A				2070	—
	632									2073	—
	633	18:32	—		R	A			50	2076	—
	634		—							2080	—
	635		—							2083	—
	636		—							2086	—
	637	18:40	—		R	A			10	2089	—
	638		—							2093	—
	639		—							2096	—
	640	18:52	—		R	A			80	2099	—
	641		—							2102	—
	642		—							2106	—
	643	19:01	—		VR	A			80	2109	—
	644		—							2112	—
	645		—							2116	—
	646	19:16	—	VR	M	C		M	70	2119	—
	647		—							2122	—
	648		—							2125	—
	649	19:29	—	VR	M	C		M	5	2129	—
	650		—							2132	—

NOTES

1968-78 ALTER CRY TUFF, BRICK RED, SOFT-FIRM, PLAG ALTER TO ILLITE, PYROXENE TO SMECTITE, V. SMALL CUTTINGS, SAND(?)

1978-88 FT. A/A HIGH ROP DISS PYRITE INCREASING

1988-98 FT. A/A BECOMING GREY COLORED

1998-2008 FT. ALTED ASH FLOW TUFF, RED-GREY, V. SOFT, UNWELD, ASH RICH, FLOATS IN WATER, PLAG TO ILLITE, T. DISS PYRITE, HEMATITE STAINED

2008-18 FT. A/A

2018-28 FT. A/A MOSTLY GREY

2028-38 FT. ALTER CRY. TUFF, GREY, FIRM, MOD. WELDED, DISS PYRITE & CALCITE, ASH RICH

2038-48 FT. A/A PLAG ALTER TO ILLITE

2048-58 FT. A/A INCREASING HEMATITE STAIN

2058-68 FT. ALTER ASH, WHITE-LT GREY, V. SOFT, ALTER TO ILLITE, RELIC PLAG(?) TEXTURE, R. DISS PYRITE

2068-78 FT. A/A WHITE DECREASING W/DEPTH, INCREASING GREY CLAY

2078-88 FT. ASH, LT. GREY, SOFT, ALTER TO ILLITE, DISS PYRITE

2088-98 FT. A/A, R. PYRITE VEINS WHITE WAXY SOFT MINERAL

MRT 204°F @ 2100 FT

2098-2108 FT GREY CLAY, ALTER ASH (?), SOFT, STICKY

2108-18 FT. ALTER CRY TUFF, DK GREY, FIRM, MOD. WELDED, PLAG TO ILLITE, M. DISS PYRITE, MAFIC TO SMECTITE, R. GREEN SMECTITE VE

2118-2128 A/A

WELL: T-8 SHEET NO.: 14

LITH	Fracture Vein	Fe Ox	Ca	P	I	Au	S	CLAY	Depth	RCVY	NOTES
651		—							2135	—	
652	20:45	—	R	M	C		M	T	2139	—	2128-38 FT. A/A
653		—							2142	—	
654		—							2145	—	
655	20:55	R	R	T	C		M	T	2148	—	2138-48 FT. A/A LESS DISS
656		—							2152	—	PYRITE, R. HEMATITE STAIN
657		—							2155	—	
658	21:19	R	R	T	C		M	T	2158	—	2148-58 FT. A/A
659		—							2162	—	
660		—							2165	—	
661	21:28	R	R	T	C		T	T	2168	—	2158-68 FT. A/A T. SMECTITE
662		—							2171	—	
663		—							2175	—	
664	21:46	R	VR	M	C		T	T	2178	—	2168-78 FT. A/A DISS. PYRITE
665		—							2181	—	INCREASING
666		—							2184	—	
667	21:55	T	VR	R	C		M	20	2188	—	2178-88 FT. A/A R. DISS PYRITE
668		—							2191	—	20% GREY CLAY, DIV. GRASSY
669		—							2194	—	TUFF (?)
670	22:15	R	R	T	C		M		2198	—	2188-98 FT. ALTER CRY. TUFF, WHITE
671		—							2201	—	-DK. GREY, SOFT-FIRM, V. SMALL CUTTINGS
672		—							2204	—	PLAG TO ILLITE, MAFIC TO SMECTITE
673		—							2207	—	R. PYRITE VEINS, M. DISS. PYRITE
674	22:25	R	R	T	C		M		2211	—	2198-2208 FT. A/A UNWELDED
675		—							2214	—	
676	22:45	R	R	M	C		M		2217	—	2208-18 FT. A/A
677		—							2221	—	
678		—							2224	—	2218-28 FT. ALTER. CRYSTAL TUFF,
679	23:18	R	R	T	C		T		2227	—	DK. GREY, FIRM-HD. PORPH. TEXTURE,
680		—							2230	—	PLAG ALTER ILLITE, MAFIC ALTER
681		—							2234	—	SMECTITE, GREY GLASSY MATRIX W/
682	23:33	VR		R	T		T		2237	—	ILLITE, T. DISS. PYRITE, R. EUHED
683		—							2240	—	PYRITE, WELDED, V. SMALL CUTTINGS
684		—							2244	—	2228-38 FT. A/A W/ SOFT YELLOW
685	22:30	—							2247	—	MINERAL
686	MISS	—	R	R	T		T		2250	—	2238-48 FT. A/A
687	MARKED	—							2253	—	
688		—							2257	—	
689	23:45	—	R	R	T		T		2260	—	2248-58 FT. A/A
690		—							2263	—	
691		—							2266	—	
692	23:55	VR	R	R	C		C		2270	—	2258-68 FT. A/A MORE MATRIX
693	6/22/97	—							2273	—	ALTERATION
694		—							2276	—	
695	00:12	VR	R	R	C		C		2280	—	2268-78 FT. A/A DISS. PYRITE
696		—							2283	—	DECREASING
697		—							2286	—	
698	00:25	—	R	R	C		C		2289	—	2278-88 FT. A/A
699		—							2293	—	
700		—							2296	—	

LITH	Fracture Vein	FE Ox	Ca	P	I	AN	S	CLAY	Depth	RCVY	NOTES
701	00:50	-	T	R	C		C		2299	-	2288-98 FT A/A
702		-							2303	-	
703		-							2306	-	
704	01:00	-	T	T	C		C		2309	-	2298-2308 FT. A/A
705		-							2312	-	
706		-							2316	-	2308-18 FT. ALTER PORPH ANDESITE,
707	01:25	R	R	R	C		C		2319	-	GREEN-GRAY, FIRM-MOD. HARD, RELIC
708		-							2322	-	PLAG & PYROXENE TEXTURE ALTER TO
709		-							2326	-	ILLITE & SMECTITE, LARGE CUTTING
710	01:35	R	T	R	A		C	T	2329	-	2318-28 FT. A/A R. HEMATITE
711		-							2332	-	STAIN, DISS. PYRITE
712		-							2335	-	
713	02:03	R	T	R	A		C	T	2339	-	2328-38 FT. A/A
714		-							2342	-	
715		-							2345	-	
716	02:15	R	T	R	A		C		2348	-	2338-48 FT. A/A
717		-							2352	-	
718		-							2355	-	2348-58 FT. ALTER. CRYSTAL TUFF, WHITE
719	02:38	R	T	T	A		C		2358	-	-GREY, FIRM-MOD HARD, PLAG. PORPH,
720		-							2362	-	ILLITE & SMECTITE ALTER; T. PYRITE
721		-							2365	-	VEINS, T. DISS PYRITE, R. QZT VEINS,
722	02:50	R	T	T	A		C	10	2368	-	SILICIFIED ALONG VEINS
723		-							2371	-	2358-68 FT. A/A 10% SOFT,
724		-							2375	-	STICKY GREY CLAY
725	03:17	R	T	M	A		A		2378	-	2368-78 FT. A/A COMMON PYRITE
726		-							2381	-	VEINS, NO CLAY, SAMPLING PROBLEM(?)
727		-							2385	-	
728	03:35	R	R	R	A		A	25	2388	-	2378-88 FT. ALTER. CRYSTAL TUFF,
729		-							2391	-	GREENISH, FIRM, COMPLETEY ALTER TO
730		-							2394	-	ILLITE & SMECTITE, RELIC POPH. TEXTURE,
731	04:05	R	R	T	A		A		2398	-	R. PYRITE VEINS, R. CINNABAR (?)
732		-							2401	-	2388-98 FT. A/A LACK OF CLAY
733		-							2404	-	MAY BE SAMPLING PROBLEM
734	04:13	R	R	R	A		A		2408	-	2398-2408 FT. A/A
735		-							2411	-	
736		-							2414	-	
737	04:37	-	VR	C	M		M	80	2417	-	2408-18 FT. GREY CLAY & SAND, SAND
738		-							2421	-	IS SUB-ROUND-ROUND, POOR SORT, MULTI-
739		-							2424	-	LITH FRAGMENT, 0.3" DIAMETER,
740	04:47	-	VR	C	M		M	40	2427	-	C. DISS PYRITE
741		-							2430	-	2418-28 FT. MORE SAND, WATER-
742		-							2434	-	LAID ASH (?)
743	05:15	-		T	M		M	30	2437	-	2428-38 FT. A/A
744		-							2440	-	
745		-							2444	-	
746		-							2447	-	2438-48 FT. ALTER ANDESITE, GREEN
747	05:25	-		R	A		M	C	2450	-	GREY, MOD. HARD, V. LARGE SUB-ANG
748		-							2453	-	CUTTINGS (0.5"). RELIC PLAG & PYROXENE
749	05:50	-							2457	-	(?) PORPH. TEXTURE, DISS PYRITE,
750		-		M	A		M		2460		BRECCIA FLOW TOP(?)

WELL: T-8 SHEET NO.: 16

LITH	Depth (m)	Fracture Vein	Fe Ox	Ca	P	I	An	S	Clay	Depth (ft)	RCVY
+	751									2463	
+	752									2467	
+	753	06:05	R		C	A		M		2470	
—	754									2473	
—	755									2476	
—	756	06:31	R	T	M	T		T		2480	
—	757									2483	
—	758	06:44			A	C				2486	
—	759									2490	
—	760									2493	
—	761									2496	
—	762	07:05			M	C		T		2499	
—	763									2503	
—	764									2506	
—	765	07:30			M	C		M		2509	
—	766									2512	
+ (Casing 7 1/2" @ 2518')	767					Fe			Sm	2516	
+	768	07:55	R	R	R				Qtz	2519	
+	769			r	r	r	m			2522	
+	770			r	r	r	m			2526	
+	771			r	r	r	m	C		2529	
+	772	brecciated		r	r	t	m	C		2532	81
+	773	Ca 80		r	r	t	m	C		2535	
+	774	vug		r	r	t	m	c		2539	
+	775	vug → An, Ca; 3cm; Qtz 1cm		r	r	t	c	c	t	2542	
+	776			r	r	t	c	c		2545	09:45
+	777	Ca 50°		r	m	t	c	C		2549	
+	778	Ca 85°; Py 80°		r	m		c	c	t	2552	
+	779	V Ca 30°		r	m		c	c		2555	100
+	780	An, Ca		r	m	t	a	c		2558	
+	781	Fe, Qtz		r	r	r	a	c		2562	
+	782	contact Fe 50° formation		r	r		m	c		2565	
o	783			t	t	t		10		2568	12:27
o	784			t	t	t		10		2572	
o	785			t	t	t		10		2575	100
o	786			t	t	t		10		2578	
o	787			t	t	t		10		2581	
o	788			t	t	t		10		2585	
o	789			t	t	t		10		2588	14:55
o	790			t	t	t		10		2591	
o	791			t	t	t		10		2594	100
o	792			t	t	t		10		2598	
o	793			t	t	Sm		10		2601	
o	794			t	t	t		10		2604	
o	795	Vug Qtz		t	t	C	m	10	t	2608	17:02
o	796	Ca, An		t	t	C	m	10		2611	
o	797			t	t	t	m	10		2614	100
o	798			t	t	C		10		2617	
o	799			t	t	C		10		2621	
o	800			t	t	C		10		2624	18:40

NOTES

2448-58 FT, ALTER ANDESITE SAND (?)
V. SMALL CUTTINGS, MOD. HARD, DK GREY,
2458-68 FT, A/A C. DISS PYRITE, R.
CINNABAR (?), ILLITE & SMECTITE ALTER.

2468-78 FT, ALTER. CRYSTAL ASH-FLOW
TUFF - CRYSTAL TUFF, WHITE-GREY, SOFT-
MOD. HD, RELIC PORPH TEXTURE, V. LARGE TO
V. SMALL CUTTINGS, MAY BE SAND (?)
2478-88 FT, ALTER. ASH-FLOW TUFF,
GREY, SOFT, UNWELD, PLAG. ALTER ILLITE,
A. DISS PYRITE
2488-98 FT, A/A FIRM-MOD HD

2498-2508 FT, A/A

2508-18 FT, A/A GRADES INTO
ANDESITE, DK. GREY, HD, GLASSY MATRIX
FRESH PYROXENE, R. CINNABAR (?), V. THIN
CALCITE STOCKWORK, R. PYRITE IN
CALCITE VEINS, BRECCIA X TUFF
REPLACED BY SILICA + PYRITE
(SM)

@ 767.7 - 782.0m Altered Andesite / brecciated
Grysh gry, hrd, porph. brecc. start from 770.5m
till 776.5m, common stockwork vug / "jigsaw fit"
texture filled supporting brecc, less then 1mm
plag phen, mafic min altd to ch, plag altd to
sericite (?), Vug consist of brown FeO (?) & soft
brown fibrous calc, ammin, @ 771.0m common
fine grain Py & An which form massive 0.3 in xtal.
@ 2565' MRT > 400°F
@ 772.0m euhedral calc xtal leave trace
open space.
@ 777.6 grn silicified & calcified fault
gauge containing abundant Py & trace
euhedral Py.
@ 2585' MRT 420°F
@ 779.7 containt calc, bluish opal, trace black
sulphide, hematite (?) oxidizing FeO to
red @ 780.4 A/A w/ black massive sulphide
hematite (?), @ 780.6m open vug w/ euhedral
An (1 in wide) numerous .05 in w/ abundant Py
@ 2605 MRT 425°F
@ 782.0-794.2m Lithic Tuff / Debris Flow
Grysh gry, soft to med. hrd, poorly sorted, un-
graded, matrix s/pp w/ fine to coarse sand
sized, 1 to 10 cm frags sized. Frags from
drk gry, porph. and, lithic crystal tuff
w/ mafic min altd to ch.
(LAP)

WELL: T-8 SHEET NO.: 17

LITH	Depth (m)	Fracture Vein	Ca	Py	Fe	An	Ch	Sm	Depth (ft)	RCVY
o	801	v An, Ca	t	r			c	10	2627	
o	802	An	t	r		m	c	10	2631	
o	803	vng Ca	t	r			c	10	2634	
o	804		t	r			c	10	2637	100
o	805	An, Ca	t	r		m	c	10	2640	
o	806		t	t			c	10	2644	
o	807		t	t			c	10	2647	20:15
o	808		t	t			10	10	2650	
o	809		t				10	10	2654	
o	810		t				10	10	2657	100
o	811	v Ca, An	t			r	10	10	2660	
o	812		r			r	10	10	2663	
o	813	68	r	t		r	10	10	2667	21:30
o	814	Ca An	r	r		m	m	t	2690	
+	815	Vug	r	r		m	m	t	2673	
+	816		r	r		m	m	t	2676	
+	817	Ca An Vug &	t			m	m	c	2680	100
+	818	vng	t	t		r	m	c	2683	
o	819		t	t		t	10	10	2686	22:45
o	820		t	t	r	t	10	10	2690	
o	821		t	t	r	t	10	20	2693	
o	822		t	t	r		10	20	2696	
o	823		t	t			10	20	2699	100
o	824		t	t			10	20	2703	
o	825		t	r			a	15	2706	23:50
o	826	Ca, An	t	r			a	15	2709	
o	827		t	m		Ep	a	15	2713	
o	828		t	m			a	15	2716	
o	829		t	m		t	c	15	2719	100
o	830		r	m		t	c	15	2722	
o	831	Slk	r	m			m	c	2726	00:56
o	832	50/48	t	m			m	m	2729	
o	833		t	m			m	m	2732	
o	834		t	m			m	c	2736	
o	835		t	r			m	c	2739	100
o	836		t	r			m	c	2742	
o	837	Vug	r	r		m	m	c	2745	
o	838	Ep f Ca 70	t	r			c	10	2749	02:00
o	839		t	r			c	10	2752	
o	840	f Ca 70	t	r			c	10	2755	
o	841		r	r			c	10	2758	100
o	842		t	t			c	15	2762	
o	843	Slk	t	t		t	c	15	2765	
o	844	80/30	t	t		t	c	15	2768	02:53
o	845		t	t		t	c	15	2772	
o	846		t	t		t	c	15	2775	
o	847		t	t		t	c	15	2778	100
o	848		t	t		t	c	15	2781	
o	849		t	t		t	c	15	2785	03:46
o	850		t	t		t	c	15	2788	

29/6 '97

NOTES

@ 794.2 - 814.5 m Lithic Tuff / lahar
Grnsh gry, med. hrd, poorly sorted, matrix supp. blackish & soft from 807.0 - 808.0 m subangular, ungradded, fine to med. sand matrix sized, coarse sand to 10 cm pebble frags sized, polymict, w/ matrix composition from ash & x'tal. Few stockwork veining.

@ 805.5 m → Anhydrite & Calcite

Strongly altd w/ chtized, grn cly & diss Py & Calc.

@ 814.5 m - 818.0 m Andesite
Drk gry, hrd to v hrd, aphanitic, massive glass groundmass, vein filled by Calc & An. Fresh to slightly altd w/ chtized, grn cly, diss Py & Calc, An.

@ 2700' MRT 480°F

@ 818.0 - 859.5 m Lithic Tuff / lahar
Drk grnsh gry, hrd, poorly sorted, polymict w/ lithic x'tal tuff, few and frags (?), subangular, ungradded, med. sand matrix sized, coarse sand to pebble frags sized.
Strongly altd w/ diss Calc & Py
Ep inside vug as replaced min, chtized + grn cly.

(LSM, AP)

WELL: T-8 SHEET NO.: 18

LITH	Depth (m)	Fracture Vein	Ca	Py	Q	Ep	Ch	Sm	Depth (ft)	RCVY
o	851		t	t		t	c	15	2791	
o	852		t	t		t	c	15	2795	
o	853	f ca 50°	t	t		t	c	15	2798	100
o	854		r	t		t	c	15	2801	
o	855		r	t		t	c	15	2804	
o	856		t	t		t	c	15	2808	04:33
o	857	slk 60/80°	t	t		t	c	15	2811	
o	858		t	t		t	c	15	2814	
o	859	f ca 70°	m	c		t	c	15	2818	100
+	860		m	c		t	c	15	2821	
+	861		m	m		t	c	a	2824	
+	862	f Py 40°	m	m		t	c	a	2827	05:40
o	863		r	m		t	c	10	2831	
o	864		r	r		t	c	10	2834	
o	865	vug	r	r		m	c	10	2837	
o	866	Ep Ca	r	r		c	m	10	2840	100
o	867		t	t		m	m	10	2844	
o	868		t	t		r	m	10	2847	06:32
o	869		t	t		r	m	10	2850	
o	870		t	t		t	m	10	2854	
o	871		t	t		t	m	10	2857	100
o	872		t	t		t	m	10	2860	
o	873		t	t		t	c	10	2863	
o	874		t	t		t	c	10	2867	07:30
o	875		t	t		t	c	10	2870	
o	876		t	t		t	c	10	2873	
o	877		t	r		t	c	10	2877	100
o	878		t	r		t	c	10	2880	
o	879		t	r		t	c	10	2883	
o	880		t	r		t	c	10	2886	08:41
o	881		t	r		t	c	10	2890	
o	882		t	r		t	c	10	2893	
o	883	Vug	t	r		t	c	10	2896	
o	884	Ep, Ca Qtz, An	t	r	t	t	c	10	2900	100
o	885		r	r	r	r	c	10	2903	
o	886		t	r		t	c	10	2906	10:43
o	887		t	t		r	c	15	2909	
o	888		t	t		r	c	15	2913	
o	889		t	t		r	c	15	2916	
o	890		t	t		r	c	15	2919	100
o	891		t	t		r	c	15	2922	
o	892	slk	t	t		r	c	15	2926	11:55
o	893	Ca 80/70°	m	t		r	c	15	2929	
o	894		r	t		r	c	10	2932	
o	895		t	t		r	c	10	2936	
o	896		t	t		r	c	10	2939	100
o	897		t	t		r	c	10	2942	
o	898	vug Ep	t	r		r	c	10	2945	
o	899	Py V	t	r	t	c	c	20	2949	13:50
o	900		t	r			c	20	2952	

NOTES

@853.0m start Epidote inside the matrix.

@2800' MRT 493°F

@859.5-862.0m Andesite/boulder Drk gry, hrd, porph., glassy groundmass. Slight to moderately altd w/ diss calc, Py, Ep, chtized + grn cly.

@862.0-884.0m Lithic Tuff/lahar Drk/blackish grnsh gry, hrd, poorly sorted, matrix supp, polymict, sub angular & few sub rounded frags like @867.4 m, fine grained matrix sized, coarse sand to pebble frags sized. Mod to strongly altd w/ diss. calc, Py, Ep, chtized + grn cly.

@2865' MRT 492°F

@2885' MRT 505°F

@2905' MRT 505°F

@884.0-897.8m Lithic Tuff/lahar Drk grnsh gry, med. hrd, poorly sorted, matrix supp, sub rounded frags, fine to med matrix sized, coarse sand to pebble frags sized. Strongly altd w/ diss Ca, Py, Ep, few Py vug, chtized + grn cly.

@898.5m → Epidote inside the vug.

(SM, AP)

WELL: T-8 SHEET NO.: 19

LITH	Depth (m)	Fracture / Vein	Ca	Py	An	Ep	Ch	Sm	Depth (ft)	RCVY
o	901		t	m	r	m	10	25	2955	
o	902		t	m	r	m	10	25	2959	100
o	903		t	m	r	m	10	25	2962	
o	904		t	m	r	m	10	25	2965	
o	905	An, Ca vug	t	t	r	r	m	C	2968	15:08
o	906		t	t	r	m	m	C	2972	
o	907		t	t	r	m	m	C	2975	100
o	908	70° Ep, An	t	t	r	m	m	C	2978	
o	909		t	t	C	m	m	C	2982	16:22
o	910		t	t	r	m	m	C	2985	
o	911	dissolution of vug fill min	t	t	r	r	m	C	2988	
o	912		t	t	r	r	m	C	2991	100
o	913			t	t	r	r	C	2995	
o	914			t	t	r	r	C	2998	
o	915			t	t	r	r	C	3001	
o	916			t	t	r	r	C	3004	17:30
o	917			t		r	r	C	3008	
o	918	rubble by drilling		t		r	r	C	3011	
o	919			t		r	r	C	3014	75
o	920			t		r	r	C	3018	
o	921			t		r	r	Sm	3021	
o	922			t		m	m	m	3024	20:09
o	923			t		m	m	m	3027	
o	924			t		m	C	C	3031	
o	925			t		C	C	C	3034	100
o	926			t	r	C	C	20	3037	
o	927	Vug Py		t	r	C	C	20	3041	
o	928	Ep, An	t	t	r	C	C	30	3044	21:36
o	929		t	t	r	C	C	30	3047	
o	930	Vug Py, An	t	t	r	C	C	20	3050	
o	931	Ep	t	t	r	C	C	30	3054	
o	932		t	t		C	C	30	3057	100
o	933		t	t		C	C	30	3060	
o	934		t	t		C	C	30	3064	
o	935		t	t		C	C	30	3067	22:34
o	936	f Py 68	t	r		C	10	30	3070	
o	937		t	r		C	10	30	3073	
o	938	f Py 50°	t	r		C	10	30	3077	100
o	939	slk	t	r		C	10	30	3080	
o	940	68/48	t	m		C	10	20	3083	
o	941	rubble slk 70/68	t	m		C	10	10	3086	
o	942		t	r		m	10	10	3090	00:25
o	943	fill 7f/m 68	t	r		m	10	C	3093	
	944	70°	t	t		m	15	C	3096	100
	945			t		m	15	m	3100	
	946			t		m	15	m	3103	
	947	Vug An		t	r	C	15	m	3106	01:19
	948	f Qtz		t	Q	C	15	m	3109	
	949	60°		t	t	m	15	m	3113	100
	950			t		m	15	m	3116	

x-ray (907)

3/6/97 (941)

NOTES

@897.8 – 903.4m Lithic Tuff / lahar
Grnsh gry, med hrd to hrd, poorly sorted matrix supp, sub angular, coarse sand
@2965' MRT 497°F
to gravel frags sized strongly altd w/ diss. Calc, Py, Ep, chltized + Grn Cly.

@908.5 m Open fracture.
→ Anhydrite
2cm

903.4 – 944.0m Lithic Tuff / lahar
Lt grnsh gry, soft to med. hrd, poorly sorted, polymict w/ few drk gry, porph and frags, clast frags from lithic crystal tuff, matrix supp, ungradded, sub rounded to sub angular, fine grained matrix from ash, x'tal & fine sand, coarse sand to pebble frags sized. Strongly altd w/ An, Ep, chltized + grn cly.

@944.0 – 959.2m Crystal Tuff
Grnsh gry, hrd, compt out, fine grained ash tuff & sub hedral mafic min. med to good sorted, matrix devit to grn cly.
Mod to strongly altd w/ diss Py, Ep, few tiny ophedral Qtz, An vug, Ch, grn cly.

@3100' MRT 520°F

(LSM, AP)

WELL: T-8 SHEET NO.: 20

LITH (m)	Fracture / Vein	Ca	Py	Q	Ep	Ch	Sm	Depth (ft)	RCVY
951	Vug, Ep 68°		t		m	10	m	3119	
952	Ep 70°		t		m	10	m	3122	
953			t		m	10	m	3126	62:14
954			t		m	10	m	3129	
955	Ep 70		t		m	15	m	3132	
956			t		m	15	m	3136	100
957			t		m	15	m	3139	
958			t		m	15	m	3142	
959			t		m	15	m	3145	
960		t	t		m	15	m	3149	03:15
961		t	t		m	15	m	3152	
962		t	t		c	15	m	3155	
963	Vug Ep Ch	t	t		c	15	c	3158	100
964		t	t		c	15	c	3161	
965		t	t		10	15	c	3165	
966		t	t		10	15	m	3168	04:10
967		t	t		10	15	m	3172	
968		t	t	An	10	15	m	3175	
969		t	m	t	10	15	m	3178	100
970	Vug An	t	m	r	15	20	c	3182	
971		t	m	r	15	20	c	3185	
972		t	r	r	15	20	c	3188	05:00
973	An, Ch, Py 60°	t	r		15	20	c	3191	
974		t	r	r	15	20	c	3195	
975		t	r	m	15	20	c	3198	100
976	ash filling vug	t	t		10	20	c	3201	
977	Domit[?]	t	t		10	20	c	3204	
978		t	t		10	20	c	3208	06:00
979	10 min lost circ	t	t		10	20	c	3211	
980		t	t		10	20	c	3214	
981		t	r		10	10	c	3218	100
982	vug Ch, An Ep	t	r		10	10	c	3221	
983	Ep 60°	t	r		a	10	c	3224	
984		t	r		a	10	c	3227	07:02
985		t	r		r	10	c	3230	
986		t	r		r	m	r	3234	
987		t	r	r	r	m	r	3237	100
988	vug Ch, Ep	t	r	m	m	m	r	3241	
989		t	r	r	m	m	r	3244	
990		t	r	r	m	m	r	3247	08:22
991		t	r		m	m	m	3250	
992		t	r		m	m	m	3254	
993		t	r		m	c	c	3257	100
994		t	r		m	c	c	3260	
995		t	t		m	c	c	3264	
996		t	t		m	c	10	3267	09:40
997		t	t		m	c	10	3270	
998	vug Ch, Ep	t	r		m	c	10	3273	100
999		t	r		m	c	10	3277	
1000		t	r		m	c	10	3280	

NOTES

@ 3145' MRT 520°F

@ 959.2 - 984.5 m Crystal Lithic Tuff. Lt grnsh gry, soft to med hrd, med sorted, matrix supp, subangular xtal, fine grained, rare lithic frags coarse sand frags sized. Mod to strongly alted w/ diss Py, Ep, Ch + Sm.

@ 3200' MRT 525°F

@ 984.5 - 989.2 m Volcanic Ash. Drk gry, med hrd, pseudo bedding plane, ash stringer, ash devit to glass. Mod. alted w/ diss Ca, Py, Ep, Ch + grn Cly

@ 3245' MRT 525°F

@ 989.2 - 1001.5 m Lithic Tuff / Debris Flow. Grnsh gry, med hrd, poorly sorted, matrix supp, sub angular to sub rounded fine grained matrix, coarse sand to gravel frags sized. Mod to strongly alted w/ diss Py, Ep, Ch + Sm

(LSM, AP)

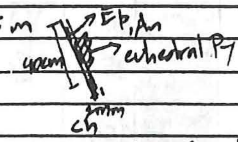
WELL: T-8 SHEET NO.: 21

LITH	Depth (m)	Fracture Vein	Ca	Py	An	Ep	Ch	Sm	Depth (ft)	RCVY
o	1001	Py 60	t	m	C	15	a	15	3283	
o	1002	Py 70	t	m	C	15	a	15	3287	11:02
o	1003	Py 70	t	m	m	C	a	15	3290	
o	1004		t	m	r	C	a	15	3293	
o	1005	ch, Ep vug	t	r		C	a	15	3296	100
o	1006		t	r		C	a	15	3300	
o	1007		t	t		C	a	15	3303	
o	1008		t	t		m	10	20	3306	12:21
o	1009		t	t		m	10	30	3310	
o	1010		t	t		m	10	30	3313	
o	1011		t	t		m	20	30	3316	100
o	1012		t	t		m	20	30	3319	
o	1013		t	t		m	20	30	3323	
o	1014	Qtz	t	t	Qtz	r	20	30	3326	13:50
o	1015	80°		t	r	r	C	a	3329	
o	1016			t		r	C	a	3332	
o	1017					r	C	a	3336	100
o	1018	rubble				r	C	a	3339	
o	1019			m		m	C	15	3342	15:20
o	1020			r		m	C	15	3346	
o	1021			r		m	C	15	3349	
o	1022	Ep		r		m	C	15	3352	100
o	1023	80°		r		m	C	15	3355	
o	1024			t		C	C	20	3359	
o	1025			t		C	C	20	3362	
o	1026			t		a	C	20	3365	17:36
o	1027			t		a	C	20	3369	
o	1028			t		a	C	20	3372	
o	1029			r		C	C	20	3375	100
o	1030			r		C	C	20	3378	
o	1031			r		C	C	20	3382	
o	1032			r		m	C	20	3385	19:03
o	1033			r		m	C	20	3388	
o	1034			r		m	C	20	3392	
o	1035			r		m	C	20	3395	100
o	1036			r		m	C	20	3398	
o	1037			m		m	C	20	3401	
o	1038			r		C	C	30	3405	20:34
o	1039			r		C	a	30	3408	
o	1040	Ep, Py		r		C	a	30	3411	
o	1041	80°		r		C	10	30	3414	100
o	1042			r		C	10	30	3418	
o	1043	Ash stringer		r		C	10	30	3421	
o	1044	Py 65°, Py 80°		m		C	10	30	3424	
o	1045			m		C	10	30	3428	21:55
	1046			m		C	10	30	3431	
	1047	Ash stringer		m		a	15	30	3434	
	1048	Py, Ep		m		a	15	20	3437	100
	1049	Chrisotile(?)		m		a	15	20	3441	
	1050	80°		m		a	15	20	3444	
										23:10

No sample → 1019

NOTES

@ 1001.5 m



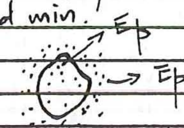
@ 1001.5 – 1013.2 m Lithic Tuff / Debris Flow
Lt grnsh gry, soft to med hrd, poorly sorted, matrix supp, sub angular, fine grained matrix, coarse sand to gravel frags sized. Mod to strongly altd w/ diss Py, Ep, chl + grn cly.

@ 3325' lost circulation, fluid level @ 700'

@ 1013.2 – 1019.8 m Lithic Tuff / Debris Flow
Lt gry, soft to med hrd & grades to soft from 1015.8 – 1019.0 m.

@ 3341' MRT 440°F, fluid level 430'

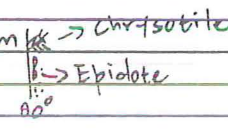
@ 1019.9 – 1046.7 m Lithic Tuff / Debris Flow
Lt grnsh gry, soft, poorly sorted, matrix supp, ungraded, polymict w/ x'tal tuff, sub rounded, med sand to 4 cm frags sized. Epidote grew inside & around the frags. as replaced min.



Strong to completely altd w/ diss Py, Ep @ matrix & fracs, chltized + grn cly.

@ 1046.7 – 1049.8 m Volcanic Ash
Gry, soft to med hrd, ash fine grained, derit to grn cly

@ 1044.6 m



(LSM, AP)

WELL: T-8   SHEET NO.: 22

LITH		Fracture Vein	Secondary Mnrls: Ca	Py	wh cly	Ep	ch	Sm		RCVY
o	1051			c		c	15	15	3447	
o	1052			c		c	15	10	3451	
o	1053			c		c	15	10	3454	100
o	1054			c		c	15	10	3457	
o	1055			c		c	15	10	3460	
o	1056		t	c		a	15	10	3464	
o	1057 (1/7'97)		t	c		10	15	10	3467	00:50
o	1058		t	c		15	15	10	3470	
o	1059		t	a	t	a	15	10	3474	
o	1060		t	c	t	c	15	10	3477	100
o	1061		t	m	t	10	15	10	3480	
o	1062		t	m	t	10	15	10	3483	
o	1063		t	m	t	10	15	10	3487	01:09
o	1064		t	m	t	a	15	10	3490	
o	1065		t	m	t	c	15	10	3493	
o	1066	t Py 70°	t	m	t	c	15	10	3496	100
o	1067 →		t	m	r	c	10	a	3500	
o	1068	t wh cly Ep 70°; vug Py	t	m	m	c	10	a	3503	
o	1069		t	c	c	c	10	c	3506	03:19
o	1070	t Py 70°; t Py 70°	t	c	m	m	10	c	3510	
o	1071		t	c	m	m	10	m	3513	
o	1072	t Py 40°	t	c	r	m	10	m	3516	100
o	1073		t	a	r	c	10	m	3519	
o	1074	t Py 70°	t	a	r	c	10	m	3523	
o	1075		t	10	r	c	10	c	3526	04:40
o	1076	t Py 80°	t	10	c	c	10	c	3529	
o	1077		t	10	r	c	10	a	3533	
o	1078	t Py 70°; t Py 60°	t	10	c	m	10	a	3536	100
o	1079		t	15	c	m	10	a	3539	
o	1080	rubble wh cly	t	15	15	c	m	c	3542	
o	1081 (x-ray check for sep)	t Py 70°	t	15	15	c	m	c	3546	06:00
o	1082			10	m	m	m	a	3549	
o	1083			a	t	m	10	a	3552	
o	1084			c	t	m	10	10	3556	100
o	1085			c	t	m	10	10	3559	
o	1086			m		c	10	10	3562	
o	1087			m		c	10	20	3565	
o	1088			c		c	10	20	3569	07:30
o	1089			c		c	10	20	3572	
o	1090			m		c	15	20	3575	100
o	1091			m		c	15	20	3578	
o	1092			m		c	15	20	3582	
o	1093			m		c	15	20	3585	
o	1094			m		c	15	20	3588	09:15 100
o	1095 →	t Py 70°		r		m	a	15	3592	10:30
o	1096			r		r	a	15	3595	
o	1097			r		r	a	15	3598	100
o	1098			r		r	a	15	3601	
o	1099			r		r	a	15	3605	
o	1100			r		r	a	15	3608	20:21

NOTES

@ 1049.8 – 1075.9 m Lithic Tuff / lahar
yellowish, grnsh gry, soft to med. hrd, poorly sorted, matrix supp, subrounded to subangular, med – coarse sand matrix sized, coarse sand – gravel ≈ 2.5 cm frags sized. Mod to strongly altd w/ diss Py, Ep, chtized + grn cly.

@ 3500' MRT 330°F, fluid level 800'

@ 1067.0 m — euhedral Pyrite, 70°

@ 1075.9 – 1081.0 m Lithic Tuff / lahar
Lt grnsh gry, v soft to soft w/ wh cly, poorly sorted, matrix supp, ungradded, subangular, coarse sand to ≈ 5 cm frags sized. Strongly altd

@ 1081.0 – 1094.5 m Lithic Tuff / lahar
yellowish, grnsh gry, soft, poorly sorted, matrix supp, ungradded, subrounded, coarse sand to ≈ 6 cm frags sized, Ch & Ep inside the frags as the replaced min.
wh cly as cly gauge @ the rubble zone 1079.5 – 1081.0 m.
Strongly altd w/ diss Py, fracs, Ep, chtized + grn cly.

@ 3590' 7 hrs static temp. was 515°F

(SM, AP)

WELL: T-8 SHEET NO.: 23

Margin	LITH	Depth (m)	Fracture Vein	Ca	Py	Qtz	Ep	Chl	Sm	Depth (ft)	RCVY
	o	1101	+ Py 70°		m		r	a	10	3611	
Fluid Inc	o	1102	+ Ep Qtz 80°		r	r	c	a	10	3614	
	o	1103	+ Ep 50°		r		c	a	10	3618	100
	o	1104			r		c	a	10	3621	
	o	1105			m		a	a	10	3624	
	o	1106			m		a	a	10	3628	21:45
	o	1107	+ ch, Py, Ep 75°		m		a	a	10	3631	
	o	1108			c		a	a	10	3634	100
	o	1109			m		a	10	10	3637	
	o	1110			r		a	10	15	3640	
	o	1111			r		a	10	15	3644	
	o	1112	+ Ep, Py		r		c	10	15	3647	23:05
	o	1113	60°		m		c	10	15	3651	
	o	1114	Py		m		m	10	15	3654	
	o	1115			m		m	10	20	3657	100
	o	1116			m		m	10	20	3660	
2/7/97	o	1117			m		m	10	20	3663	
	o	1118			m		m	10	20	3667	00:25
	o	1119			m		m	10	20	3670	
	o	1120			m		c	10	20	3673	
	o	1121			m		c	20	20	3677	100
	o	1122			m		c	20	20	3680	
	o	1123	+ Py 50°		m		10	20	20	3683	
	o	1124			c		10	20	20	3687	01:45
	+	1125			m		15	20	20	3690	
	+	1126			m		15	20	20	3693	
	+	1127	vug Py	wh cly	c		15	20	20	3696	100
→	+	1128	brecciated		m		15	20	20	3700	
	+	1129			m		15	20	20	3703	
	+	1130		t	m		10	20	15	3706	03:00
	+	1131	blk wh cly gauge 60/30°	t	m		10	20	15	3709	
	+	1132		t	m		a	15	15	3712	
	+	1133			m		a	15	15	3716	100
	o	1134			m		a	15	10	3719	
	o	1135	+ Py 60°		m		a	15	10	3723	
	o	1136			m		a	15	10	3726	04:25
	o	1137	brecc.		m		a	15	10	3729	
	o	1138	+ Py 50°		m		a	15	10	3732	
	+	1139	+ Py 70°		m		a	20	10	3735	100
	+	1140			m		a	20	10	3739	
	+	1141		t	m		10	20	10	3742	
	+	1142		t	m		10	20	10	3746	05:18
	+	1143			m		c	20	10	3749	
	+	1144			r		r	10	a	3752	
	+	1145			r		r	a	a	3756	100
	+	1146			r		r	c	c	3759	
	+	1147			r		r	c	c	3762	
	+	1148			t		r	m	m	3765	07:10
	+	1149			t		r	r	r	3769	
	+	1150			r		r	r	r	3772	

NOTES

@1094.5-1124.4m Lithic Tuff / lahar
Yellowish, grnsh gry, soft to med hrd, poorly sorted, matrix supp, ungradded sub rounded to rounded, polymict from x'tal tuff & x'tal lithic tuff, ash to fine sand matrix sized, med sand to big gravel ≈ 5 cm frags sized, ash & matrix devit. to grn cly. Mod to strongly altd w/ diss Py & euhedral Py vng, Ep as replaced min, chtized & grn cly.

@1124.4-1132.5m Andesite
Grnsh gry, med hrd to hrd, porph, 1-2mm plag phen, groundmass devit to grn cly, brecciated @ 1129.0m broken to smaller pieces which form "jigsaw fit" texture, strongly altd w/ Py, Ep, chtized + grn cly.

@3700' MRT 362°F

@1132.5-1138.2m Lithic Tuff / lahar
Grnsh gry, soft to med hrd, poorly sorted, sub angular fine to med sand matrix sized, coarse sand to gravel frags sized. Strongly altd w/ diss Py, Ep, chtized + grn cly.

@3745' fluid level 700', start to harder formation.

@1138.2-1160.0m Andesite
unit boundary w/ 40 cm black paleosoil horizon, grnsh gry/grades to drk gry from 1147.6m, hrd, massive, porph, 2 mm subhedral plag phen, groundmass devit. to glassy & grn cly
(SM, AP)

WELL: T-8 SHEET NO. 24

Margin	LITH	Depth (m)	Fracture Vein	Ca	Py	Qtz	Ep	Ch	Sm	Depth (ft)	RCVY
Flinc	+	1151	Ch 70°		r		m	m	r	3775	
	+	1152			r		r	m	r	3778	
	+	1153	Stockwork vng, Qtz		m	r	r	m	r	3781	100
	+	1154	Py 70°		a		r	c	r	3785	
	+	1155	Py		a		r	c	r	3788	08:50
	+	1156	70° Py, Qtz		c		r	c	r	3791	
~~Flinc~~ no sample	+	1157	Gry cly 70°		c	r	r	c	r	3795	100
	+	1158	gauge		c		r	c	r	3798	
→	+	1159			c		r	c	r	3801	
	+	1160			m		r	c	r	3805	
	+	1161			m		m	c	r	3808	10:50
	+	1162	An 70°		m		m	c	r	3811	
	+	1163			m		m	c	r	3815	100
	+	1164			m		m	c	r	3818	
	+	1165			m		m	c	r	3821	
	+	1166	Py 40°		t		t	r		3824	
→	+	1167	Py 50°, Py		t		t	r		3828	17:35
	+	1168	Geysenite 60°		t	t	t	r		3831	
Flinc	[patterned]	1169	70°		r		t	r		3834	100
	[patterned]	1170	Py, Ep		m		r	r		3838	
	[patterned]	1171	70°, vng Py Ep		m		r	m		3841	
3/7/'97	[patterned]	1172	Py		m		m	m		3844	
	+	1173	70° Py, Ep		c		m	c		3847	00:26
	+	1174	90°		c		m	c		3851	
	+	1175	Py, Chalcopyrite 60°		c		m	a		3854	
	[patterned]	1176			m		m	a	t	3857	100
	[patterned]	1177			m		m	a	t	3860	
	[patterned]	1178			m		m	a	r	3863	
	[patterned]	1179			r		c	20	r	3867	02:12
	[patterned]	1180			r		c	20	m	3870	
	[patterned]	1181	vng Py		m		c	20	m	3874	
	[patterned]	1182	An, Qtz 40°		r		c	20	m	3877	100
	[patterned]	1183			r	t	c	20	m	3880	
	[patterned]	1184			r		c	20	m	3883	
	[patterned]	1185			r		c	20	m	3887	03:30
	[patterned]	1186			r		c	20	m	3890	
	[patterned]	1187			r		c	20	c	3893	
	[patterned]	1188			r		c	20	c	3897	100
→	[patterned]	1189	An vng		r		c	20	c	3900	
	[patterned]	1190			m		c	20	c	3903	
	[patterned]	1191			m		a	20	c	3906	04:45
	[patterned]	1192	An Qtz		m	r	a	20	c	3910	
	[patterned]	1193			m		a	20	c	3913	
	[patterned]	1194			m		a	15	c	3916	100
	[patterned]	1195	Py		m		a	15	c	3920	
	[patterned]	1196			m		a	15	c	3923	
	[patterned]	1197	70°		m		c	15	c	3926	06:06
	[patterned]	1198	Stockwork vng		m		c	15	c	3929	
	[patterned]	1199			m		c	15	c	3933	
	[patterned]	1200			m		c	15	c	3936	

NOTES

stockwork vng @ 1152.5 m.
Slightly to moderately altd w/ diss Py & inside fracs, Ep, chtized + grn Cly

@ 3800' MRT 456°F

@1160.0-1169.0 Andesite
Drk gry, hrd, porph, fresh section from 1166.1 - 1169.0m. Slightly altd w/diss Py, & fracs, diss Ep, Ch.

@ 3825' 8½ hrs static temp. was 519°F

@ 1168.0m Py, Qtz, An, 60° @ 1169.5 An, fibrous 70° Chrysotile

@ 1169.0-1172.6m Crystal Tuff / brecciated
Drk grnsh gry, med hrd, brecciated related to hydrothermal brecciation w/ fracs contained, fine grained, mafic min. replaced by chlorite. Ep occurs on fracs surfaces & inside vng

@1172.6-1175.0m Andesite
Grnsh gry, med hrd to hrd, porph, subhedral Pyroxene & plag as phen. Strongly altd w/ diss Py & Py frac. Plag's replaced by Ep. Pyr replaced by Ch.

@ 3900' MRT 437°F, fluid level 700'

(SH, AP)

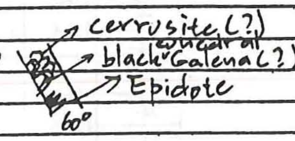
WELL: T-8 SHEET NO. 25

LITH (m)	Fracture Vein	An	Py	Q	Ep	Ch	Sm	(ft)	RCVY
1201	Stk 10/78		c		c	15	a	3939	
1202	+ vug An		c		c	15	a	3943	100
1203	An, Qtz 80°		c	r	c	15	a	3946	07:40
1204			c		c	15	15	3949	
1205	vug		c		c	15	15	3952	100
1206	@ Ep, Py, Chalcopyrite		c		c	20	20	3956	
1207			c		m	20	10	3959	
1208			c		m	20	10	3962	
1209			m		m	20	10	3966	09:21
1210	stockwork vng		m		m	20	10	3969	
1211			m		m	20	20	3972	
1212	vug		m		m	20	20	3975	100
1213	+ Py, Qtz		m	t	m	20	20	3979	
1214	60°		m		m	20	20	3982	
1215			m		m	20	10	3985	
1216	+		r		t	10	c	3988	11:00
1217	Qtz		r	r	t	a	m	3992	
1218	+ 80° Qtz 60° + Qtz		t	t		a	t	3995	100
1219	80°		t	t		a	t	3998	
1220			t			a	t	4002	
1221			t			a	t	4005	
1222			r		t	15	r	4008	12:50
1223			r		m	15	c	4011	
1224	+ ch		r		m	15	c	4015	100
1225	30°		r		m	15	c	4018	
1226			r		m	15	c	4021	
1227	ch, Py		r		m	15	c	4025	
1228	black euhedral		r		c	20	c	4028	14:19
1229	min		r		c	20	c	4031	
1230	Py vug		r		c	20	c	4034	100
1231	Stk vug Py, Ep		r		c	20	c	4038	
1232	20/30°		r		c	20	c	4041	
1233	vug Py, Ep, Qtz		r		c	20	c	4044	
1234	vug		r		m	30	c	4048	15:48
1235	An, Qtz	m	r	t	r	30	c	4051	
1236			m		t	30	c	4054	100
1237	stockwork vng		m		t	30	m	4057	
1238			m		t	30	m	4061	
1239			m		t	30	m	4064	
1240			m		t	30	m	4067	17:30
1241			r		r	35	c	4070	
1242			r		r	35	a	4074	100
1243			t		r	35	a	4077	
1244	+ Py, Galena (?)		t		r	35	a	4080	
1245	50°		t		r	35	a	4084	
1246	+ Py		t		r	20	10	4087	18:57
1247			t		r	20	10	4090	
1248	70°		t		r	30	10	4093	100
1249			t		r	30	10	4097	
1250			t		r	30	10	4100	

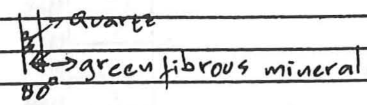
NOTES

@ 1175.0-1214.5m Andesitic Crystal Tuff yellowish, grnsh gry, soft to med hrd brecciated @ 1184.5-1187.3m, 1192.0-1192.9m broken to ≈ 2.5cm clasts pieces.
Strongly altd w/ diss Py & vng, Ep, chtized + grn cly.

@ 1214.0m



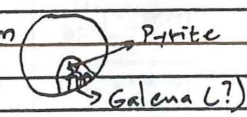
@ 1217.0m



@ 4000' MRT 470°F, fluid level 450'

@ 1214.5-1221.4m Andesitic crystal Tuff / welded.
Drk gry, hrd to v hrd, solid, good sorted w/ ≈ 2mm x'tal of mafic min. ash matrix devit. to glass. Slightly altd w/ Qtz inside fracs, chtized.

@ 1229.6m



@ 1221.4-1225.4m Andesitic Crystal Tuff
Grnsh gry, med hrd, med sorted, matrix supp, fine grained, ≈ 2mm sub hedral x'tal of plag, some of them replaced by Ep, ash matrix devit to grn cly.

@ 1225.4-1233.2m Andesitic Crystal Tuff / brecciated
Grnsh gry, med hrd to hrd, med sorted, ≈ 2.5mm sub hedral plag x'tal, some of them replaced by Ep, ash matrix devit to grn cly, rock broken to small frags, space filled by grn cly & Py vng.
Strongly altd w/ Py, Ep, chtized + grn cly.

(SM, AP)

WELL: T-8 SHEET NO.: 26

Date	Depth (m)	Fracture / Vein	An	Py	Q	Ep	Ch	Sm	Depth (ft)	RCVY
	1251	Stockwork vng		m		r	20	c	4103	
	1252			c		r	20	c	4107	20:50
	1253	Py		c		t	10	m	4110	
	1254	Py		c		t	a	m	4113	
	1255	+ An, Qtz 50°	r	c		t	c	m	4116	100
	1256			c		t	c	m	4120	
	1257		wh CH	c		t	r	r	4123	
	1258	rubble w/ wh cly	c	c		r	r	r	4126	22:23
	1259		c	c		r	r	r	4130	
	1260		c	c		m	m	r	4133	
	1261	+ Py, Gypsum 40°	m	c		m	c	c	4136	100
	1262	Py, Gyp vng	r	c		m	c	c	4139	
	1263	last open frac		c		m	c	c	4143	
	1264			c		r	c	a	4146	23:22
	1265	Py		m		r	c	a	4149	
	1266			m		r	c	a	4152	
	1267	+ Ch, Ep 60°		m		r	c	a	4156	100
	1268			m		t	c	a	4159	
	1269			m			c	a	4162	
4/1/97	1270			m			c	a	4166	00:46
	1271			m			c	a	4169	
	1272			m		t	c	a	4172	
	1273			r		t	10	a	4175	100
	1274			r		t	10	a	4179	
	1275			r		t	10	a	4182	
	1276			t		t	10	a	4185	
	1277			t		t	10	a	4189	02:25
	1278			t		t	10	a	4192	
	1279			t		t	10	a	4195	100
	1280			t		t	10	a	4198	
→	1281			t		t	10	a	4202	
	1282			t		t	10	a	4205	
	1283			t		t	10	a	4208	03:55
	1284	Stockwork vng		r			15	a	4212	
	1285			r			15	a	4215	100
	1286	+ Pyrophyllite 50°		r			15	a	4218	
	1287			r		t	15	a	4221	
	1288			r		t	15	a	4225	
	1289			r		t	15	a	4228	05:25
	1290			r		t	15	a	4231	
	1291	Py v		r		t	20	a	4234	100
	1292	+ Py 50°		r		t	20	c	4238	
	1293			r		t	20	c	4241	
	1294			r		t	20	c	4244	
	1295			t		t	10	a	4248	07:00
	1296	Qtz vug		t		t	10	a	4251	
	1297			t	t	t	10	a	4254	100
	1298			t		t	10	20	4257	
	1299			t		t	10	20	4261	
	1300			t		t	10	20	4264	08:53

NOTES

@1233.2–1239.5m Andesitic Crystal Tuff
Grnsh gry, med hrd to hrd, unwelded, good sorted, ≈ 2mm plag x'tal & mafic min, ash matrix devit. to grn cly. Strongly altd w/ Py, chtized + grn cly

@1260.6m → soft, euhedral Gypsum (?) 40°

@1239.5–1248.0m Lithic Tuff/debris flow
Grnsh gry, med hrd, poorly sorted, matrix supp, monomict from x'tal tuff, v rare x'tal lithic tuff, sub angular, ash to fine sand matrix sized, coarse sand to ≈ 4cm gravel sized. Mod to strongly altd w/ Ep, chtized + grn cly.

@1248.0–1257.4m Andesitic Crystal Tuff
Drk grnsh gry, hrd, comptent & silicified from 1249.0 – 1254.8 m, fine grained, ash devit. to grn cly. Mod altd w/ diss Py, Ep, ch + grn cly.

@1257.4–1269.8m Lithic Tuff/debris flow
white & v soft from 1257.4–1260.0m (rubble zone + wh cly), yellowish grnsh gry, soft, poorly sorted, matrix supp, monomict from x'tal tuff, sub rounded, coarse sand to ≈ 5cm frags sized. Strongly altd w/ diss & Py frac, Ep, Ch, Sm.

@4200' MRT 534°F, fluid level 1000'

@1269.8–1279.7m Andesitic Crystal Tuff
Drk grnsh gry, hrd, fine grained, ash matrix devit to glass & grn cly.

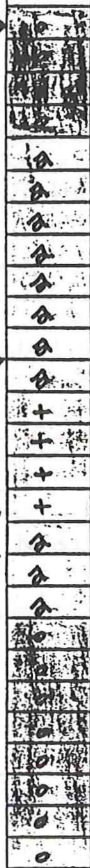
@1279.7–1282.6m Lithic Tuff/debris flow
Grnsh gry, med hrd, good sorted, frags supp, sub rounded to rounded, monomict w/ x'tal tuff, ungradded, coarse sand to 25cm frags sized, matrix & few frags devit to grn cly. Strongly altd w/ Py, Ep, Ch, Sm

@1282.6–1294.2m Andesitic Crystal Tuff
Drk gry grades to gry, hrd, sub heudral pyroxene (?), ash matrix devit. to grn cly. Strongly altd w/ Py, Ep, ch, sm

@1294.2–1304.6m Lithic Tuff/debris flow
Grnsh gry, soft to med hrd, good sorted.

(SM, AP)

WELL: T-8 SHEET NO. 27

LITH	Depth (m)	Fracture Vein	Py	Qtz	Ep	Ch	Sm	Depth (ft)	RCVY
	1301	Qtz, Py, 70°, Galena, stockwork vng	r		t	15	20	4263	100 / 03:20
	1302		r	t	t	15	20	4271	
	1303		r		t	15	20	4274	100
	1304		r		t	10	10	4277	
	1305	Qtz 70°	r	r	t	a	10	4280	
	1306	Py 60°	r		t	a	a	4284	
	1307		r		r	a	m	4287	03:58
	1308	Py	r		r	a	m	4290	
	1309	70°	r		t	a	m	4294	
	1310		r			10	m	4297	100
	1311		r			10	r	4300	
	1312		r			a	r	4303	
	1313	>20 f/m	r			c	r	4307	05:50
	1314		t			m		4310	
	1315		t			m		4313	
	1316		t			m		4316	100
	1317	vug	r			m	m	4320	
	1318		r			c	c	4323	
	1319	Lawsonite (?)	r		t	a	c	4326	07:25
	1320	vug	t		t	a	c	4330	
	1321	Lawsonite(?)	t		t	a	c	4333	100
	1322		t		t	a	c	4336	
	1323		t		t	15	20	4339	
	1324		r		t	15	20	4343	
	1325		r		t	15	20	4346	08:58
	1326		r		t	15	20	4349	100
	1327		r		t	15	20	4353	TD / 10:24
	1328							4356	
	1329							4359	
	1330							4362	
	1331							4366	
	1332							4369	
	1333							4372	
	1334							4376	
	1335							4379	
	1336							4382	
	1337							4385	
	1338							4389	
	1339							4392	
	1340							4395	
	1341							4398	
	1342							4402	
	1343							4405	
	1344							4408	
	1345							4412	
	1346							4415	
	1347							4418	
	1348							4421	
	1349							4425	
	1350							4428	

NOTES

@ 4265' MRT 404°F, fluid level 1000'
frags supp, polymict w/ xtal tuff, and, sub rounded to rounded, fine to med sand matrix sized, coarse sand to 1.5 cm frags sized. Strongly altd w/ diss Py, Ep, chtized + grn cly.

@ 1305.8m → Bornite, → Epidote, → Lawsonite (?), → fibrous hairy mineral, 60°

@ 4300' MRT 470°F, fluid level 850'

@ 1304.6–1313.4m Andesitic Lithic Crystal Tuff
Drk grnsh gry, hrd, solid, med to good sorted, matrix supp, sub angular, fine to med sand matrix sized altered to grn cly, med sand to coarse ≈ 5 mm sand frags sized. Mod to strongly altd w/ diss Py, Ep, Ch + Sm.

@ 1313.4–1316.2m Andesite
Black, drk gry, v hrd, solid & massive, aphanitic ≈ 2mm pyroxene phen, groundmass devit to glass. Slightly altd w/ diss Py + ch.

@ 1316.2–1318.9m Andesitic Lithic Crystal Tuff
Drk grnsh gry, hrd, solid, med to good sorted, mat supp, sub angular, med sand to coarse ≈ 5mm sand frags sized, matrix devit to grn cly. Mod to strongly altd w/ Py, ch + Sm.

@ 1318.9–1327.1m Lithic Tuff / debris flow
Drk grnsh gry, hrd, med sorted, frags supp grades to matrix supp, sub rounded to rounded, med to coarse sand matrix sized, coarse sand to ≈ 3 cm gravel frags sized, matrix devit to grn cly, few lithic frags became chtized. Strongly altd w/ diss Py & Ep, chtized + grn cly.

TD @ 4353'

Note: 1st lost circ @ 3325'
2nd —"— @ 4125'
2 3/8" perforated tubing @ 4321'–3105'
2 7/8" blank tubing @ 3105'–surface
⇨ 7" casing @ 1016'
4 1/2" casing @ 2516'

(SH, AP)

Caithness
Karaha T-8
core samples (ft)

Mineralogy, Approx. Wt.% [X] (or) Relative Abundance [ ]

Sample No.	Quartz	Plagioclase	K-feldspar	Calcite	Anhydrite	Gypsum	Wairakite	Epidote	Magnetite	Leucoxene	Pyrite	Amphibole	Talc	Chlorite	Chlorite-smectite	Illite	Illite-smectite	Amorphous/ Below detection		% smectite in mixed-layer il/sm	% smectite in mixed-layer chl/sm	
770.7 bulk	16	46	3	5	1	1			2	5	5			16				-				
clay														100	tr							
771.0 bulk	15	40	6	8	1				3	10	3			12				2				tr hem
clay														100	tr							
772.6 bulk	15	42	3	6	1	tr			4	10	2			9	4			4				
clay														78	22						10	
775.0 bulk	27	22		13	1				2	10	9			8				8				
clay														100								
777.1 bulk	11	46	5	7	1				3	14				13				-				specular hem in vein
clay														100								
778.0 bulk	13	38	3	4	2	tr			4	20	6			10				-				tr hem
clay														100								
780.8 bulk	32	9	3	33	tr			tr		5	3			10	3			2				mostly vein
clay														32	68						10	
794.7 bulk	25	26	3	19	1			tr	2	10	2			12				-				
clay														100								
802.2 bulk	13	49	5	5				tr	4	10	1			13				-				
clay														100								
807.3 bulk	6	9	11							10	16						48	-				
clay																	100			10		
817.8 bulk	15	36	5	11				tr	4	5	2			12				10				
clay														100								
829.5 bulk	7	55	6	4	2	tr		tr	5	7	3			8	3			-				
clay														58	42							

MM = Predominant M = Major m = Minor Tr = Trace ? = Tentative Identification

EGI

SUMMARY OF X-RAY DIFFRACTION ANALYSIS

Energy & Geoscience Institute at the University of Utah

S. Lutz
03-2000

Caithness Karaha T-8 core samples (ft) Sample No.	Quartz	Plagioclase	K-feldspar	Calcite	Anhydrite	Gypsum	Wairakite	Epidote	Magnetite	Leucoxene	Pyrite	Amphibole	Talc	Chlorite	Chlorite-smectite	Illite	Illite-smectite	Amorphous/ Below detection	% smectite in mixed-layer il/sm	% smectite in mixed-layer chl/sm	
859.7 bulk	13	36	4	13	3		1?	tr	3	7	10			8	2			-			
clay														56	44					10	
866.7 bulk	1	35	7	6	3		tr?	20	4	5	8			11				-			
clay														100							
885.3 bulk	14	33	3	6	3			6	4	10	8	tr		13				-			
clay														100							
904.0 bulk	6	45	11	9	2			4	4	6	3	tr		10				-			
clay														100							
907.2 bulk	1	33		7	3			23	3	10	13	tr		7				-			
clay														100							
913.8 bulk	15	15	3	15	2			20	3	6	13	1		7				-			
clay														100							
928.5 bulk	8	38	5	2	18			12	3		3	4		7				-			
clay														100							
930.8 bulk	1	11	3	tr	3			50	3	10	3	2		14				-			mostly vein
clay														100							
940.2 bulk	17	37	7	1	1			7	3	6	7			14				-			
clay														100							
948.3 bulk	6	33	2		2			18	3		12	18		6				-			mostly vein
clay														100		tr?					
968.1 bulk	17	30	4					7	2	8	6	13		13				-			
clay														100							
978.7 bulk								75				23		2				-			vein
clay														100							

Mineralogy, Approx. Wt.% [X] (or) Relative Abundance [ ]

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Caithness
Karaha T-8
core samples (ft)

Mineralogy, Approx. Wt.% [X] (or) Relative Abundance [ ]

Sample No.		Quartz	Plagioclase	K-feldspar	Calcite	Anhydrite	Halite	Wairakite	Epidote	Magnetite	Leucoxene	Pyrite	Amphibole	Pyrophyllite	Chlorite	Chlorite-smectite	Illite	Illite-smectite	Amorphous/ Below detection	% smectite in mixed-layer il/sm	% smectite in mixed-layer chl/sm		
1001.2 bulk		21	19	2		4			25		3	10	7		9				-				no t.s.
clay															100								
1018.5 bulk		25	4			2	2?				10			15			42		-				
clay														M			100						
1029.7 bulk		13	43	4					8	3	10	13			5		1		-				
clay															84		16						
1042.0 bulk		8	35	4					17	4	15	7	3		7				-				
clay															100								
1044.9 bulk		13	42	2		6			9	2	12	4	1		9				-				
clay															100								
1047.1 bulk		10	28	4					23	3	15	13	4		8				-				leu in t.s. = ep in xrd?
clay															100								
1052.3 bulk		12	31	10?					15	3	11	3	1		14				-				can't see kf in t.s.
clay															100								
1066.9 bulk		26	*11	6					1		2	12					42		-				tr apatite, *part albite
clay																	100						
1072.4 bulk		11	55	2					6	3	6	7			10				-				
clay															100								
1075.2 bulk		12	38	6					5	3	20	5			11				-				
clay															100								
1080.5 bulk		20	40	4					6	4	4	5			8		9		-				
clay															67		33						
1094.5 bulk		7	45	4					14	2	9	6	5		8				-				
clay															100								

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Caithness Karaha T-8 core samples (ft) Sample No.	Quartz	Plagioclase	K-feldspar	Calcite	Anhydrite	Barite	Wairakite	Epidote	Magnetite	Leucoxene	Pyrite	Amphibole	Talc	Chlorite	Chlorite-smectite	Illite+/-Mica	Illite-smectite	Amorphous/ Below detection	% smectite in mixed-layer il/sm	% smectite in mixed-layer chl/sm	
1217.6 bulk	7	47	5					5	5	10	5	5		10				-			
clay														100							
1226.6 bulk	12	44	6					3	5	5	8	7		10				-			
clay														100							
1230.4 bulk	5	49	7			tr		10	4	3	11			9		*2		-			
clay														83		*17					*hydrothermal biotite
1234.4 bulk	17	40						8	4	10	10			5		*6		-			
clay														51		*49					
1240.1 bulk	7	24	4			tr		10	2		13	14		8				^18			^amorphous Fe oxides-hydroxides in vein
clay												M		100							
1246.4 bulk	15	28	6					13	4	10	15		3	6				-			
clay													M	100							
1257.7 bulk	25	27	5?							4	2			2		`35		-			`sericite (not biotite)
clay														4		`96					
1259.2 bulk	38	19							2	3	9			8		`18		^3			pyroxene? (tr)
clay														41		`59					
1262.8 bulk	19	34	6?		tr			14	4	4	8			11				-			anhydrite, pyroxene
clay														100							
1266.6 bulk	1	41			tr			3		8	24	20		3				-			anhydrite
clay												M	tr	100							
1287.0 bulk	7	43	5			trace		5	4	5	12		9	10				-			
clay													M	100							
1297.1 bulk	4	34	5					8	4	10	10	17	3	5				-			pyroxene
clay												M	m	100							

Mineralogy, Approx. Wt.% [X] (or) Relative Abundance [ ]

silicic dike? (1257.7–1259.2)

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Caithness Karaha T-8 core samples (ft)

Sample No.	Quartz	Plagioclase	K-feldspar	Calcite	Anhydrite	Barite	Wairakite	Epidote	Magnetite	Leucoxene	Pyrite	Amphibole	Talc	Chlorite	Chlorite-smectite	Illite+/-Mica	Illite-smectite	Amorphous/ Below detection	% smectite in mixed-layer il/sm	% smectite in mixed-layer chl/sm	
1301.9 bulk	15	24				tr		5	2	2	12	40						-			pyroxene
clay												MM		tr							
1306.0 bulk	10	31						10		4	24	4	11	6				-			pyroxene
clay												m	MM	m							
1311.8 bulk	4	43						5		4	7	13				*24		-			pyroxene
clay												m		tr		*100					*hydrothermal biotite
1320.0 bulk	15	35						5			9	33		2		*1		-			pyroxene
clay												MM	m	79		*21					

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SUMMARY OF X-RAY DIFFRACTION ANALYSIS

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