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November 16, 1987

TO:

FM: Daniel L. Carrier

RE:

EXECUTIVE SUMMARY

A high-temperature hydrothermal system probably exists in the eastern half of the Medicine Lake Basin. This is the most significant conclusion of a study on mineralogy, fluid inclusions, and select temperature data obtained from boreholes drilled in and around of the Glass Mountain Federal Unit. Alteration that occurs on the northwestern margin of the Basin is old and not in thermal equilibrium with observed temperatures. Weak argillic alteration of uncertain age is found about 1-2 miles outside the Basin to the west and southwest. A detailed mineralogical study of the deep exploratory wells GMF 17A-6 and GMF 68-8 is still in progress.

The best evidence for an active system is observed in GMF 28-32 located on the eastern flank of Mt. Hoffman. The pattern of alteration in the temperature borehole varies systematically from zeolite-smectite (2480') to argillic (2680') to propylitic (3460' to 4500'). In addition, fluid inclusion data indicate that vein mineralogy at 4022' in GMF 28-32 is probably in thermal equilibrium with formation temperatures of 482°F and a hydrothermal fluid with a salinity of $\leq$20,000 ppm. The geothermal system possibly exists at shallower depths in the vicinity of boreholes GMF 44-33 and GMF 87-13, and is evidenced by the shallower occurrence of argillic alteration. However, the total depths of the two boreholes are not great enough to confirm the presence of propylitic alteration in those areas.

Mineralogical data indicate a 410 to 455°F geothermal system has existed as shallow as 1500-2500' near the northwest margin of the Medicine Lake Basin. However, measured temperature and fluid inclusion data from boreholes GMF 56-3 (1786' TD) and GMF 45-36 (4000' TD) indicate the geothermal system has declined. It is uncertain whether a high-temperature resource still exists in the area at depths greater than the two boreholes. Evidence for the hydrothermal event is characterized in GMF

56-3 by the occurrance at 1426' of chlorite-smectite clays that typically have formation temperatures of 390° to 455°F. The hydrothermal event in GMF 45-36 is evidenced by propylitic mineral assemblages at 2500' to 3430' and 3720' to 4000' TD. The upper propylitic assemblage in GMF 45-36 is sandwiched between two zones of argillic alteration, and is probably a relic of hydrothermal outflow. Fluid inclusion data suggest the outflow occurred at a temperature of at least 410° to 445°F.

Anomalous argillic alteration is observed in ML 36-28 at 1820' and ML 62-21 at 2115'. ML 36-28 is located about 2 miles outside the Medicine Lake Basin in the Little Glass Mountain Structural Zone. ML 62-21 is located about one mile outside the southwestern margin of the Basin. It is not clear if the observed alteration in either area is caused by localized hydrothermal activity, or if the alteration is linked by upflow or outflow to activity that has existed on the Basin margin.

RECOMMENDATIONS

The results of this study lead to the following recommendations concering future leasing in the Glass Mountain KGRA and potentially beneficial studies:

1. Five sections of KGRA land in the Glass Mountain area have demonstrable geothermal potential and are recommended for leasing. First priority is given to leasing section 19, T43N, R4E. Second priority is given to leasing section 28, T44N, R3E, and section 22, T43N, R3E. The two additional sections recommended for leasing are section 5, T43N, R3E and section 29, T44N, R3E.

2. A detailed mineralogy and fluid inclusion study similar to this one should be completed for exploratory wells GMF 68-8 and GMF 17A-6. This study will contribute to the understanding of the Glass Mountain prospect, and will assist future exploration in the Glass Mountain Unit.

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HYDROTHERMAL ALTERATION

Introduction

Broadscale alteration zoning has been mapped in 24 temperature boreholes drilled in and around the Glass Mountain Federal Unit. Alteration data has also been collected for the two exploratory wells drilled in the Unit, GMF17A-6 and GMF68-8 (Figure 1). The data from the wells, however, are still being analyzed and will be reported in a later report. The purpose of characterizing and outlining the alteration mineralogy observed in the boreholes is to help focus exploration, development and leasing efforts on the potentially hottest and most permeable areas. Fluid inclusion temperatures have also been measured on select samples to quantify the formation temperatures of the mineralogy. Finally, the geochemical data will be integrated with actual measured temperature data from select boreholes to constrain the conceptual models.

Several factors affect the formation of hydrothermal minerals including temperature, pressure, primary lithology, permeability, fluid composition, and duration of the hydrothermal activity (Rose and Burt, 1979). The influence of primary lithology diminishes as formation temperatures are increased, and becomes insignificant when temperatures exceed 536°F (280°C) (Brown, 1978). The rock types drilled at Glass Mountain range the full spectrum from basalts to rhyolites, and measured borehole temperatures are in general significantly less than 536°F. It is, therefore, likely primary lithology has some influence on the distribution of alteration observed in Glass Mountain boreholes. This possibly results in minor irregularities in the distribution of low-temperature alteration that are caused by lithologic differences rather than temperature or permeability.

Borehole depths must be considered when interpreting the mineralogy data in this report. The total drilled depths of the boreholes varied from 918'-4500'. This variability could potentially result in the unequal evaluation of each borehole. Therefore, care has been exercised to insure that the absence of alteration zones in a shallow borehole is not the single criteria used to evaluate an area.

Methods and Data

Rock samples from 24 boreholes were sent to Dr. Jeff Hulen at the University of Utah Research Institute for bulk x-ray defraction analysis (Appendix 1). Thin sections were prepared and examined for 17 boreholes. Core and cutting samples were relogged in detail for five boreholes (ML 29-1, GMF 28-32, GMF 45-36, GMF 17-6 and GMF 44-33), and the scanning sets for several boreholes were examined as well.

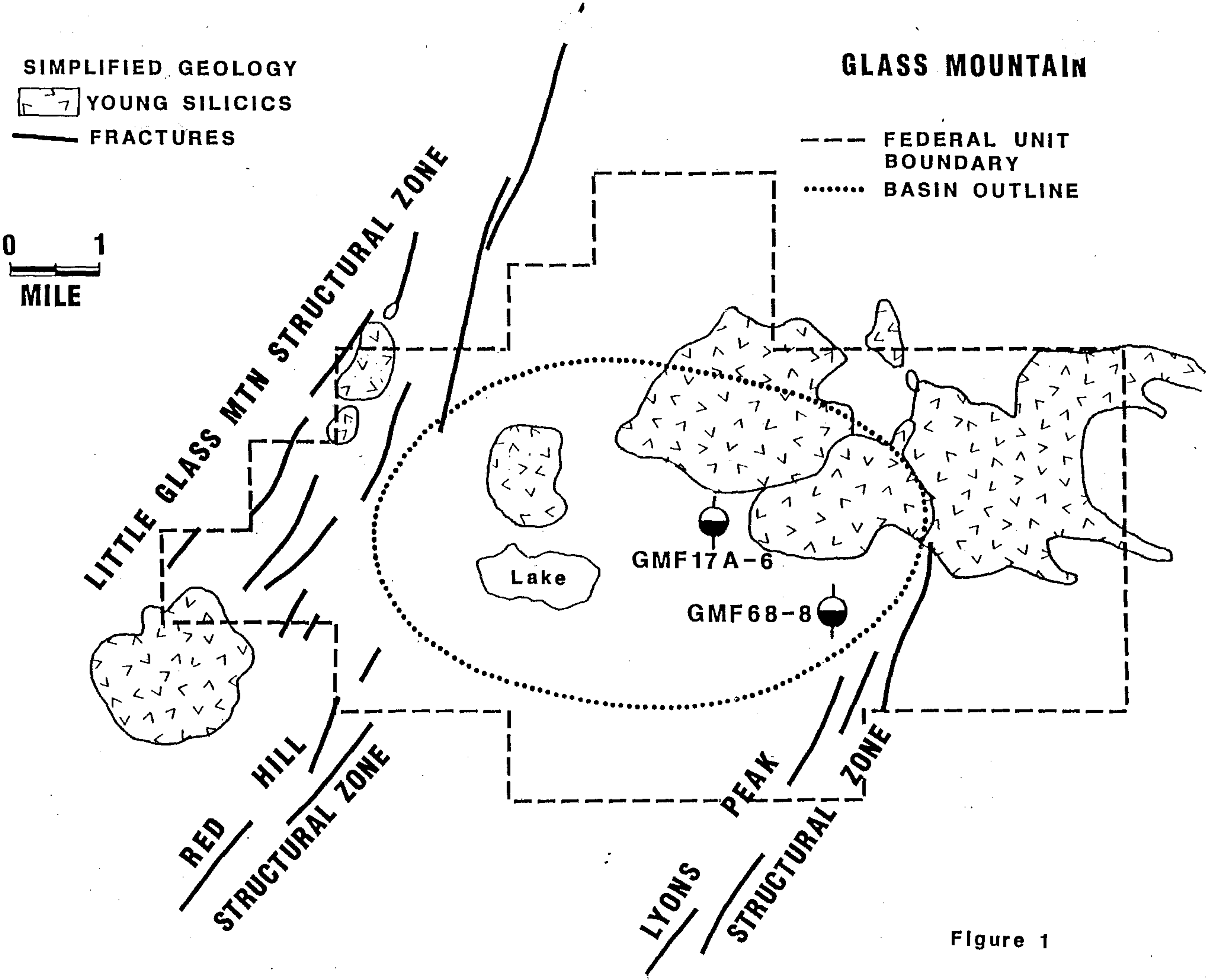
SIMPLIFIED GEOLOGY
YOUNG SILICICS
FRACTURES
0
1
MILE
GLASS MOUNTAIN
FEDERAL UNIT BOUNDARY
BASIN OUTLINE
LITTLE GLASS MTN STRUCTURAL ZONE
Lake
GMF17A-6
GMF68-8
RED HILL STRUCTURAL ZONE
LYONS PEAK STRUCTURAL ZONE
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Figure 1

Twelve samples from five temperature boreholes were sent to Dr. T. James Reynolds of Fluid Inc. for fluid inclusion analysis. The five boreholes sampled were ML 36-28, ML 65-26, GMF 28-32, GMF 45-36 and GMF 56-3. GMF 28-32, GMF 45-36 and GMF 56-3 contained a total of five samples with usable fluid inclusions.

Borehole Stratigraphy

Drilled stratigraphy generally mirrors the surface geology mapped by Hausback (1984), although more lithologic detail is contained in the borehole data. Individual units of volcanic rock are difficult to correlate in Glass Mountain boreholes. Therefore, the rocks are classified into the following broad groups that are listed here in order of increasing age: bimodal rhyolites and basalts, shield-building mafics, flow-banded rhyolites and pyroclastics, and older mafics. In addition, the rock groups are sometimes discontinuous and the contacts between rock groups are not always sharp. For example, the transition the from flow-banded rhyolite to the overlying and underlying mafic rocks is marked by a variable zone of interlayered mafic flows and pumaceous lithic tuffs. Similarly, a possible silicic horizon occurs only in boreholes drilled in and around the Medicine Lake Basin. This silicic horizon is found at depths of 300' to 1000'; and possibly correlates with the 0.10 ± .01 m.y. old dacitic rocks mapped on the eastern flank of Glass Mountain (Mertzman, 1983). Geologic cross-sections that show some of these relationships will be presented in a later section. Additional stratigraphic analyses and correlation of rock types are needed before the rock groups can be further subdivided.

Alteration Zoning and Mineralogy

Hydrothermal alteration, as measured in Glass Mountain temperature boreholes, is classified into three distinctive types or zones: zeolite-smectite, argillic, and propylitic. This classification is a modification of those presented by Rose and Burt (1979) and Kristmannsdottier (1982). The classification is based on observed mineralogy and does not directly utilize temperature or lithologic data. The zeolite-smectite alteration zone is defined by the presence of either low-temperature zeolites, such as mordenite, stilbite and clinoptilolite, or of smectite as 3-15% (minor concentrations) of the XRD samples. The argillic alteration zone is characterized by the presence of hydrothermal quartz and 15-50% hydrothermal clay (major concentrations) in XRD samples. The clays used to characterize the zone include smectite, illite, chlorite, kaoline and the mixed layered clays illite-smectite and chlorite-smectite. Rocks are considered to be in the propylitic alteration zone when two of the following three secondary mineral groups are present: sodic plagioclase, chlorite and epidote or calcite (replacing feldspar). The distribution of alteration zones in each borehole is summarized in Appendix 2.

The occurrence of zeolite-smectite alteration is shallowest in boreholes located near or inside the Medicine Lake Basin. The distribution of the alteration is shown in Figure 2. Since the size of the intervals sampled for XRD analysis range from 200' to 700', the contours shown in the figure actually only outline broad trends in the data. The zeolite-smectite zone occurs at the shallowest depths in three boreholes located near the margins of the Basin, GMF 56-3, GMF 87-13 and GMF 44-33. A second trend towards shallow zeolite-smectite alteration is measured in boreholes located along the Little Glass Mountain Structural Zone. The alteration zone in this area occurs at depths of 800'-1500' in boreholes ML 57-11, ML 75-6, ML 36-28 and ML 14-23. Only four boreholes in Figure 2, ML 27-27 (southeast), ML 65-26 (south), ML1-81 (southwest), and ML2-81 (west), do not contain zeolite-smectite alteration. The only alteration in MLF 51-2, located in the very southwestern part of the area, is zeolite-smectite alteration and it occurs in the 900' to 1150' interval. The borehole is unaltered from 1150' to 1836' T.D.

Argillic alteration occurs in eight area boreholes including all five boreholes drilled in the Medicine Lake Basin (Figure 3). The alteration zone is shallowest in boreholes GMF 56-3, GMF 87-13 and GMF 44-33, and only two boreholes penetrate the zone, GMF 28-32 and GMF 45-36. The greatest thickness of argillic alteration is found in GMF 17-6, where at least 1000' of argillic alteration is observed before the borehole reaches total depth. Boreholes ML 62-21 and ML 36-28, located on the outside margin of the basin, are only weakly altered. The absence of argillic alteration in GMF 84-17, and ML 75-6 is possibly due to the shallow depths of the boreholes relative to the local trends in the argillic zone. Both boreholes are located in areas of shallow zeolite-smectite alteration and contain zeolite-smectite alteration to total depth.

GMF 28-32 and GMF 45-36 are the only two boreholes to contain propylitic alteration. The alteration zone occurs at a depth of 3460' in GMF 28-32 and 2500' in GMF 45-36. The boreholes are located within the Basin at its northern margin.

General Stratigraphy and Alteration Patterns in Cross-Section

The pattern and intensity of alteration in the Glass Mountain KGRA appears to be generally independent of rock type. This is demonstrated in the two cross-sections shown in Figures 4 and 5 that integrate the alteration zoning and general geology observed in several of the deepest boreholes. Cross-section A-A' trends roughly north-south and extends through the eastern half of the Basin (Figure 3). Cross-section B-B' trends

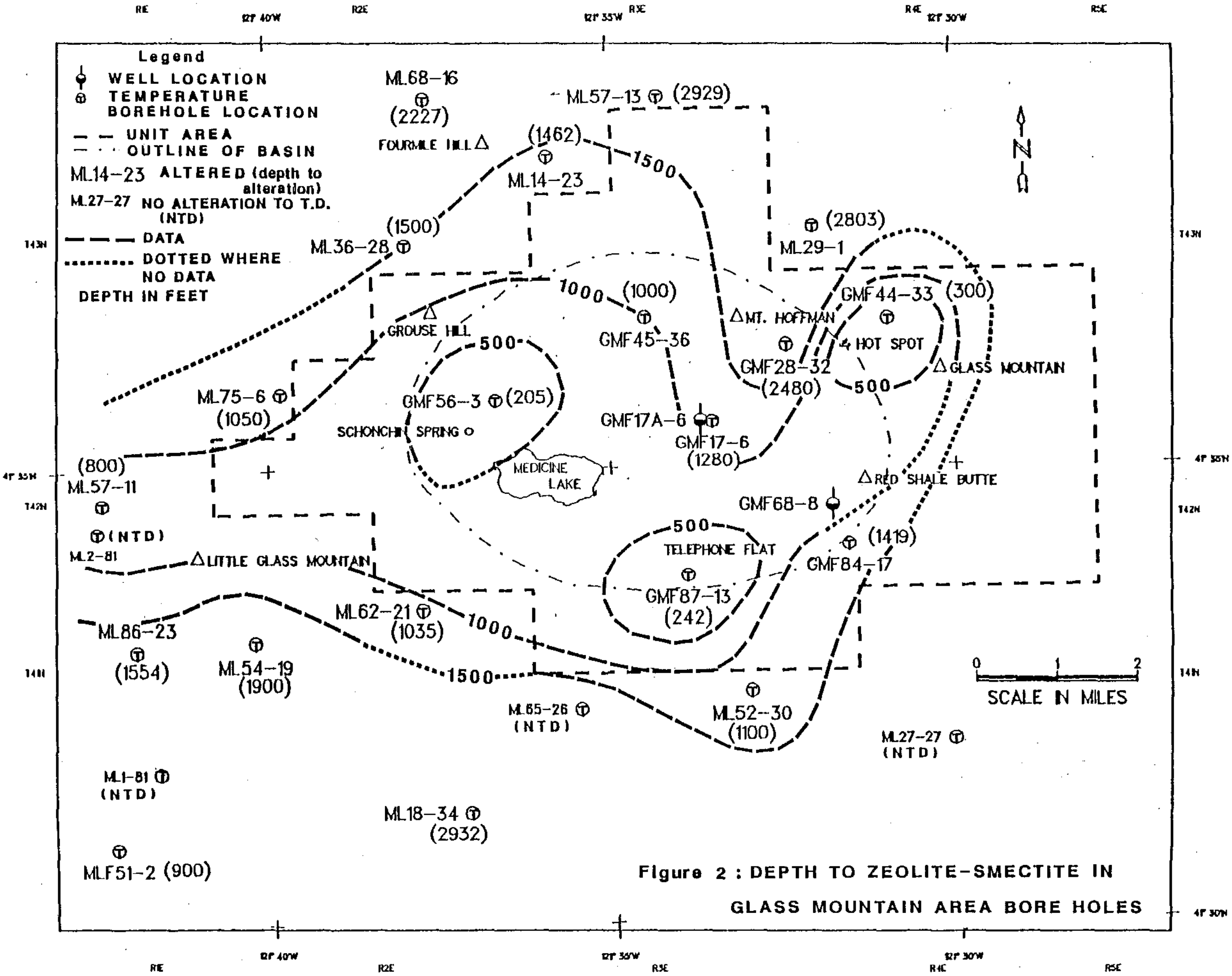

Figure 2 : DEPTH TO ZEOLITE-SMECTITE IN GLASS MOUNTAIN AREA BORE HOLES

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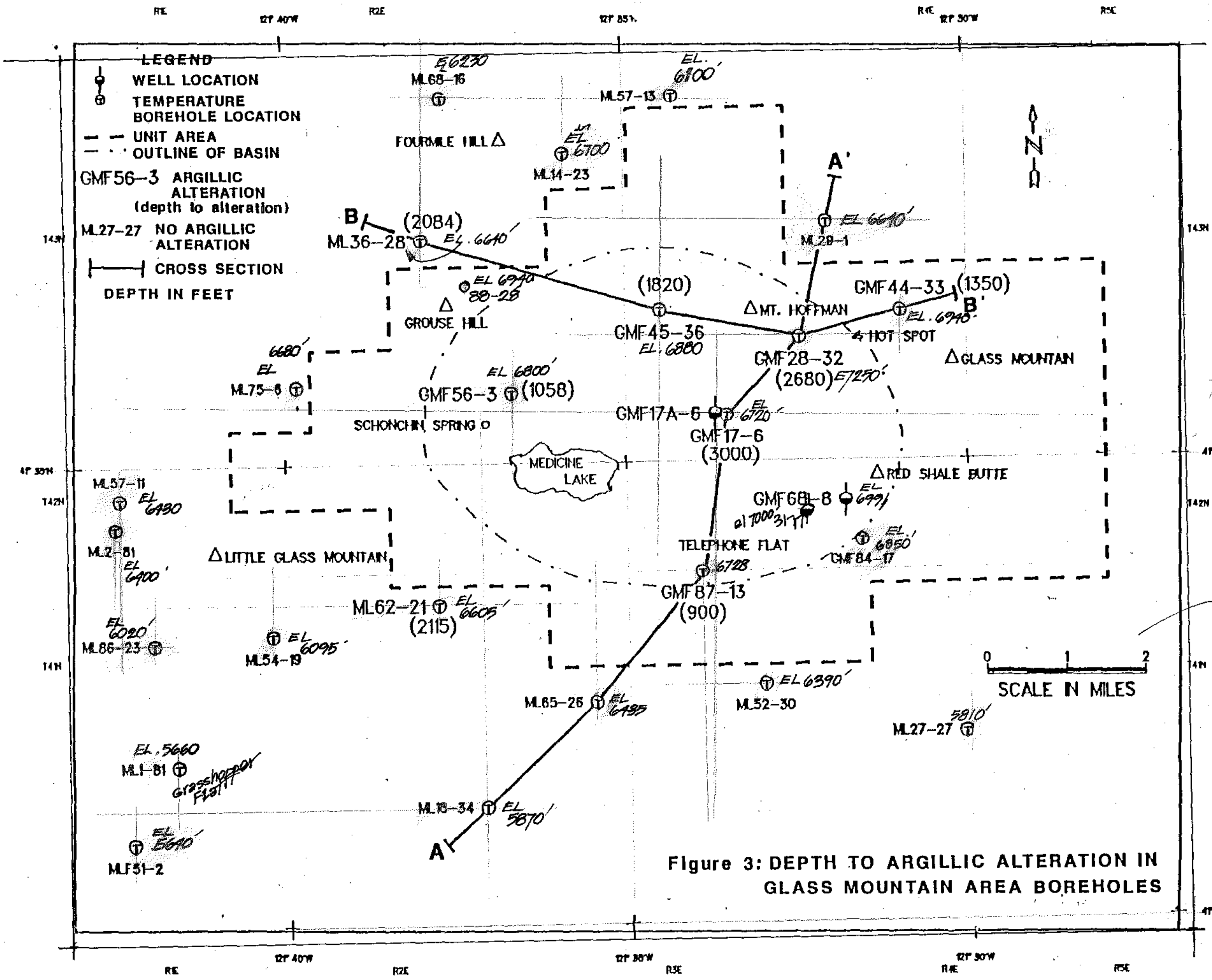

Figure 3: DEPTH TO ARGILLIC ALTERATION IN GLASS MOUNTAIN AREA BOREHOLES

1mi = 30.85
50

16.78 ft
16.78-8'
71

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roughly east-west and includes boreholes located on the northern margin of the Basin. The alteration zones observed in the cross-sections are well developed, and transitions between zones are systematic and not marked by abrupt hiatuses.

Cross-section A-A' (Figure 4) clearly illustrates the trend of shallowing alteration with increased proximity to the Medicine Lake Basin. Argillic alteration is observed only in boreholes located in the basin, and is shallowest at the margins in GMF 28-32 and GMF 87-13. Propylitic alteration is observed only in one of the deepest boreholes, GMF 28-32.

Cross-section B-B' (Figure 5) is not as clear as A-A' in demonstrating a trend towards shallowing alteration with increased proximity to the Medicine Lake Basin. The shallowest argillic alteration is actually found just outside the basin in GMF 44-33, which is located near the Hot Spot. Argillic alteration is found in boreholes GMF 28-32, GMF 45-36, and ML 36-28 at depths that vary by only about 500'. Propylitic alteration is observed in boreholes GMF 45-36 and GMF 28-32. Borehole GMF 45-36 shows the pattern of reverse mineralization that is suggestive of lateral flow. The direction of lateral flow is unknown and is arbitrarily drawn.

Fluid Inclusions

Fluid inclusion data are presented in Table 1 for samples from the three boreholes that contained minerals with measureable inclusions, GMF 45-36, GMF 28-32, and GMF 56-3. The characteristics of fluid inclusions and the several techniques and problems specific to fluid inclusions are detailed in Roedder (1972) and Bodnar and others (1985), and are only briefly discussed below. All the inclusions surveyed are of primary origin and formed during the growth of the secondary host crystals. The minerals surveyed include quartz, calcite, calcium zeolites (wairakite and laumontite), vein prehnite(?) and wallrock prehnite(?). The salinities observed varied from <1-2 wt% NaCl equivalent in the vein minerals. A salinity of <3.5 wt% NaCl equivalent was measured for the samples of wallrock prehnite found in GMF 45-36. A salinity of 1 wt% NaCl equivalent is approximately the same as a TDS of 10,000 ppm. The principal assumption made is that the salinity of an inclusion is due solely to dissolved sodium, potassium and calcium chlorides. However, if CO_2 is trapped in an inclusion, then measured salinities will be too high (Bodnar and others, 1985).

Fluid inclusion geothermometry is useful in determining the temperatures at which secondary mineral formed (also called homogenization temperatures). These temperatures are best thought of as the minimum formation temperatures for the minerals. Because hydrothermal systems are dynamic, it is not

Table 1. Fluid inclusion data obtained on samples from three temperature boreholes drilled in the Glass Mountain area. Analysis were made by T. James Reynolds of Fluid Inc.

Borehole	Sample Depth	No. Inclusions Measured	Mineral*	Homogenization Temperature	Weight-% NaCl Equivalent
GMF 28-32	4022'	12	Calcite	464-500°F	<1.5
		8	Quartz	464-477°F	
GMF 45-36	2757'	17	Calcite	410-446°F	<1.5
		8	Quartz	437-446°F	<2
	3448'	10	Wallrock Prehnite	347-365°F	<1
		8	Quartz	338-356°F	<1
		10	Calcite	320-347°F	<1
	3905'	18	Wallrock Prehnite	347-365°F	<3.5
		11	Quartz	356-374°F	<1
		7	Prehnite	338-356°F	
		17	Calcium Zeolite	374-428°F	<1
GMF 56-3	1723.5'	4	Calcium Zeolite I	286-300°F	<3
		3	Calcium Zeolite II	212-241°F	<3
		5	Quartz	235-261°F	<1.5

*All minerals are vein minerals unless otherwise stated.

appropriate for fluid inclusion temperature data to stand alone. Therefore, the geothermometry data are discussed below in conjunction with the petrological data. Finally, measured temperature data are integrated into the discussion to quantify the significance of the data.

Case Study of Mineralogy, Fluid Inclusion and Measured Temperature Data for Three Boreholes

GMF 28-32

Fluid inclusion temperatures, mineralogy and measured temperatures correlate well for GMF 28-32, and indicate the likely occurrence of an active hydrothermal system in the vicinity of the borehole. The sequence of alteration in GMF 28-32 is straight forward and begins with the occurrence of zeolite-smectite alteration near a depth of 2480'. Argillic alteration begins in the borehole at 2680' and is followed by weak propylitic alteration at 3460'. The essential secondary minerals present at this depth are calcite, which is replacing plagioclase, and chlorite. The grade of alteration becomes stronger with depth and is distinguished by the first occurrence of epidote at 4330'. Non-essential secondary minerals found in the borehole samples include prehnite, pyrite, wairakite and hematite.

Homogenization temperatures measured on a sample from 4022' in GFM 28-32 are 464-476°F for secondary quartz and 464-500°F for secondary calcite (Figure 6). These are the highest homogenization temperatures observed in samples from any of the boreholes and are reasonable temperatures for propylitic alteration. The fluid inclusion data also agree well with the measured borehole temperature of 482°F at this same depth. It is therefore possible that these inclusions were formed during the present thermal event. If that is the case, the salinities of ≤ 2 wt% NaCl equivalent (approximately 20,000 ppm) measured in the inclusions are possibly indicative of the local salinities expected for the active hydrothermal system.

GMF 45-36

The integration of the fluid inclusion, mineralogical, and temperature data sets indicate the observed alteration in GMF 45-36 is old, and that more than one hydrothermal event has probably occurred in the area. The pattern of alteration in GMF 45-36 (Figure 7) suggests that high-temperature hydrothermal outflow has probably occurred in the area. Secondary mineralogy in the borehole is initially straight forward with the occurrence of the zeolite-smectite zone at 1000' and the argillic zone at 1820'. The distribution of secondary mineralogy becomes more complicated with depth, as evidenced by the occurrence of two layers of propylitic

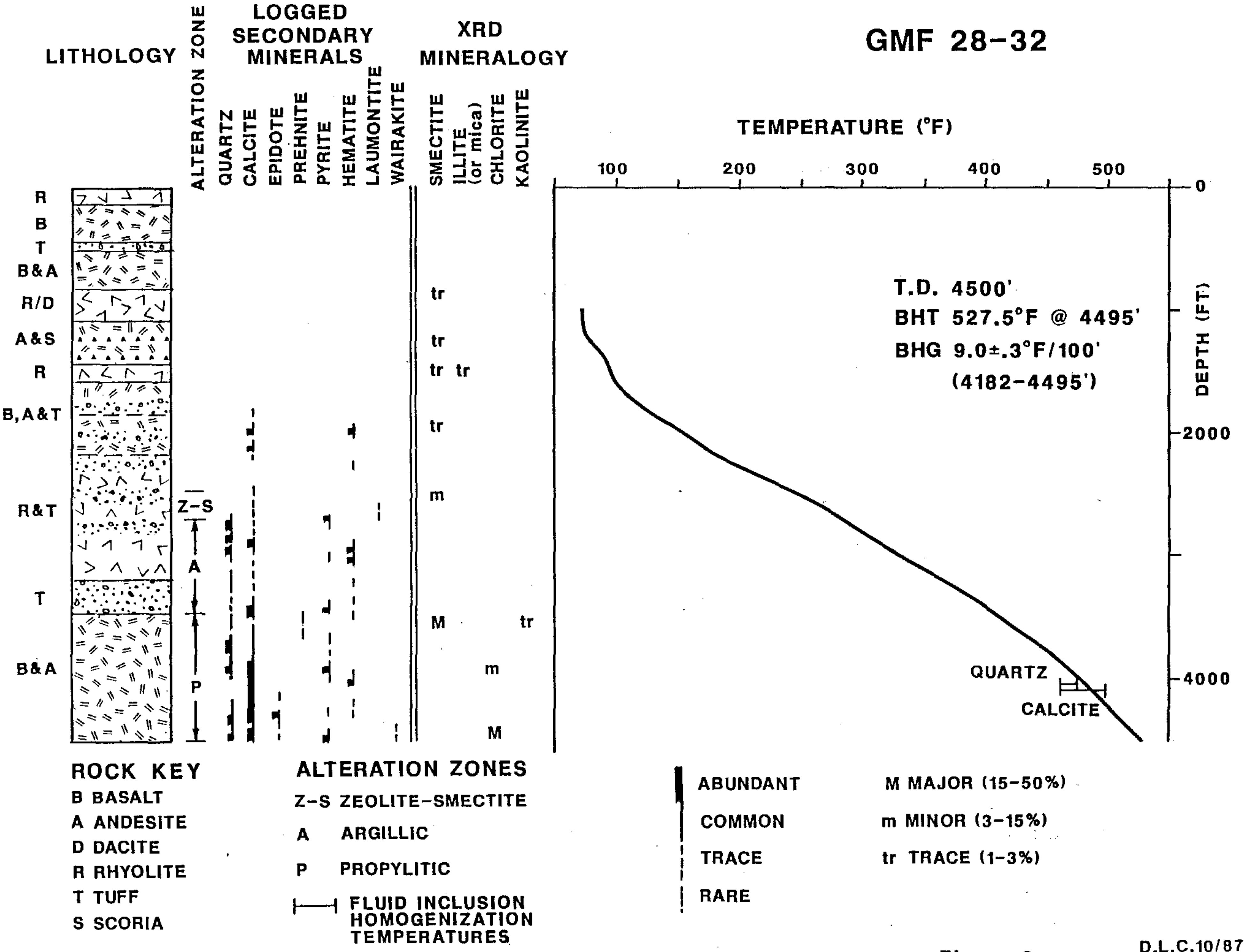
GMF 28-32
LITHOLOGY
ALTERATION ZONE
LOGGED SECONDARY MINERALS
QUARTZ
CALCITE
EPIDOTE
PREHNITE
PYRITE
HEMATITE
LAUMONTITE
WAIRAKITE
XRD MINERALOGY
SMECTITE
ILLITE (or mica)
CHLORITE
KAOLINITE
TEMPERATURE (°F)
100
200
300
400
500
DEPTH (FT)
0
2000
4000
R
B
T
B&A
R/D
A&S
R
B,A&T
R&T
T
B&A
Z-S
A
P
tr
tr
tr tr
tr
m
M
tr
m
M
T.D. 4500'
BHT 527.5°F @ 4495'
BHG 9.0±.3°F/100'
(4182-4495')
QUARTZ
CALCITE
ROCK KEY
B BASALT
A ANDESITE
D DACITE
R RHYOLITE
T TUFF
S SCORIA
ALTERATION ZONES
Z-S ZEOLITE-SMECTITE
A ARGILLIC
P PROPYLITIC
FLUID INCLUSION HOMOGENIZATION TEMPERATURES
ABUNDANT
COMMON
TRACE
RARE
M MAJOR (15-50%)
m MINOR (3-15%)
tr TRACE (1-3%)
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Figure 6

alteration at 2500' to 3430' and 3720' to 4000' T.D. It is likely that the propylitic alteration in the 2500' to 3430' interval is the result of hydrothermal outflow. The two propylitic alteration zones are separated by a thin zone of argillic alteration. The essential secondary minerals in the upper layer of propylitic alteration are chlorite, albite, and from 3220' to 3430', calcite. The essential secondary minerals in the lower layer are chlorite, calcite and epidote. Nonessential secondary minerals that are present in either of the propylitic layers include prehnite, pyrite, hematite, laumontite and possible K-feldspar and wairakite.

The relationship between the fluid inclusion mineralogical and temperature data as shown in Figure 7 is not straight forward. Homogenization temperatures of secondary minerals in the upper propylitic layer at 2757' are 410-445°F and in the sandwiched argillic zone at 3448' are 320-365°F. These homogenization temperatures are probably consistent with the observed pattern of propylitic to argillic alteration. However, temperatures measured on fluid inclusions obtained from 3905' are complex and probably not indicative of the bottom hole propylitic assemblage. Vein quartz, vein prehnite and wallrock prehnite are all in equilibrium with a hydrothermal event of 338-374°F and not the 392°F+ event needed to form the epidote in the host rocks (Bird and others, 1984). Sampled veins are also filled by a calcium zeolite (probably wairakite) with a higher homogenization temperature of 374-428°F. These data suggest that two hydrothermal events are probably recorded in the mineralogy of GMF 45-36 at 3905'. The first event probably caused the propylitic alteration of the host rocks. Later, as this hydrothermal system declined, secondary quartz and prehnite were formed in the fracture at 338-374°F. A second thermal event followed that resulted in the filling of the still open fractures by calcium zeolites at 374-428°F. The probable source of the thermal events is either a single growing system, in which temperature slowly increased over time, or two distinct hydrothermal systems.

Measured temperatures in GMF 45-36 are not in equilibrium with borehole mineralogy or fluid inclusion data. It is uncertain whether the temperatures are a residual of a previous thermal event or are related to more recent activity. For example, measured temperatures of 297°F at 2757' clearly demonstrate that the propylitic alteration at the same depth is old. Borehole temperatures at 3448' and 3904' are deceptively similar to those observed in the fluid inclusions for secondary quartz and prehnite. However, the late-stage, vein filling minerals of calcite and calcium zeolite at 3448' and 3904' have formation temperatures that are markedly different. In addition, rock temperatures are presently higher at 3448' than when the late-stage calcite was formed, and lower at 3905' than when the late-stage calcium zeolite was formed.

GMF 56-3

Fluid inclusion and measured temperature data indicate the observed secondary mineralogy in GMF 56-3 is out of thermal equilibrium, and that the causative hydrothermal system has declined. Alteration in GMF 56-3 begins with zeolite-smectite alteration at a depth ≤205' and extends to 1031'. The argillic zone begins at 1031' and is the best developed sequence of argillic alteration (Figure 8) in any of the area boreholes. Secondary mineralization in the alteration zone consists of the characteristic minerals quartz, smectite and intermittent kaolinite. As the depth of the borehole increases, the mineralogy evolves toward the higher temperature minerals of chlorite-smectite, and wairakite (1426'-1459' and 1727'-1760'). This assemblage is indicative of the higher temperature end of the argillic alteration zone (Brown, 1978; Bird and others, 1984), and is approaching propylitic alteration. Chlorite-smectite clays are mapped in Iceland by Kristmannsdottier (1982) as a separate alteration zone that occurs in mafic igneous rocks at temperatures of 390° to 455°F (200° to 230°C).

The fluid inclusion data from secondary minerals in GMF 56-3 record the decline of the hydrothermal system in two generations of inclusions. These fluid inclusions are observed in quartz and calcium zeolites that are contained in a sample collected at 1723.5'. Homogenization temperatures in these inclusions systematically vary from 285-300°F and 212-260°F, and are probably the remnants of a slowly cooling system. The latest vein-filling mineral is calcite, which is barren of inclusions and probably deposited at temperatures less than 212°F. A measured BHT of 134.5°F at 1788' indicates that heat flow has declined even further in the area.

CONCEPTUAL MODEL

Integrated mineralogy, fluid inclusion and temperature data are used to construct a conceptual model of the geothermal system in the Glass Mountain area. The completeness and accuracy of the model is limited by the variability in temperature borehole total depth. This variability makes borehole to borehole correlations difficult and incomplete, and probably impacts the observed distribution of argillic and propylitic alteration. However, this limitation not withstanding, it is believed that the general trends presented below are probably correct.

Four areas in the Glass Mountain Unit area are found to contain anomalous hydrothermal alteration. The location of these four areas and the distribution of KGRA land in the Glass Mountain Unit are shown in Figure 9. The resolution of each area is hindered by the generally <3000' depths and the often 2-3 mile separation of the boreholes. Therefore, it is uncertain

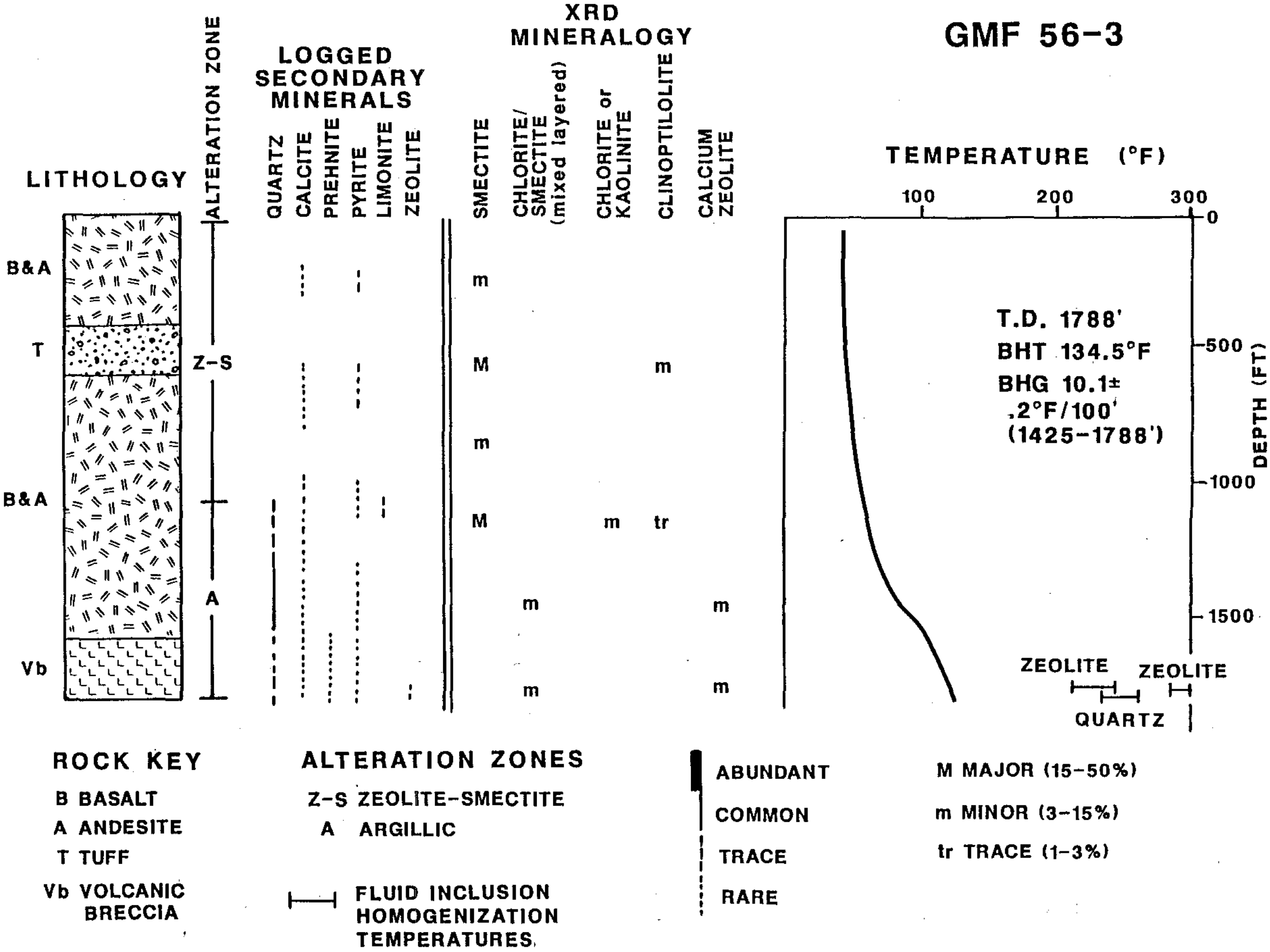

Figure 8

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whether the alteration observed in each area is the result of a distinct hydrothermal event, or if any or all the areas outlined result from the same geothermal event. Nevertheless, the data do establish the occurrence of widespread hydrothermal activity in the area. The salient features of each area are discussed below.

Area 1

A high-temperature geothermal system probably exists along the eastern margin of the Medicine Lake Basin. The most direct evidence for a system is contained in GMF 28-32 drilled along the eastern flanks of Mt. Hoffman. Fluid inclusion data suggests that observed temperatures and mineralogy are probably in thermal equilibrium, and that hydrothermal fluids associated with the alteration probably have a salinity of ≤20,000 ppm. Argillic alteration is also found at 900' in GMF 87-13, located near Telephone Flats, and at 1350' in GMF 44-33, located near the Hot Spot. The argillic alteration in the two boreholes occurs at depths that are shallower than the same alteration in GMF 28-32 (2680'). Because GMF 87-13 and GMF 44-33 are shallow, no propylitic alteration is observed in the boreholes. Nevertheless, the available data suggest that the hydrothermal system is found at shallower depths at GMF 87-13 and GMF 44-33 than at GMF 28-32.

Area 2

High-temperature hydrothermal activity has occurred along the west and northwestern margin of Medicine Lake Basin in the vicinity of GMF 56-3 (1788' TD) and GMF 45-36 (4000' TD). Measured temperatures in these boreholes, however, are less than the temperatures required to be in equilibrium with the observed mineralogy. Therefore, hydrothermal activity has declined in this area, and it is uncertain whether it still exists at depths greater than the total depths of the boreholes.

Area 3

Moderate-temperature hydrothermal activity has and is possible still occurring in the vicinity of the Little Glass Mountain Structural Zone. The highest grade of alteration is observed at 2084' in GMF 36-28, and consists of weak argillic alteration. It is uncertain whether the alteration is the result of a distinct hydrothermal event associated with volcanic activity in the Little Glass Mountain Structural Zone, or if it is related to high-temperature hydrothermal activity in Area 2.

Area 4

Moderate-temperature hydrothermal activity has and is possibly still occurring in the Red Hill Structural Zone located about

CONCEPTUAL MODEL FOR GEOTHERMAL ACTIVITY IN THE GLASS MOUNTAIN UNIT AREA

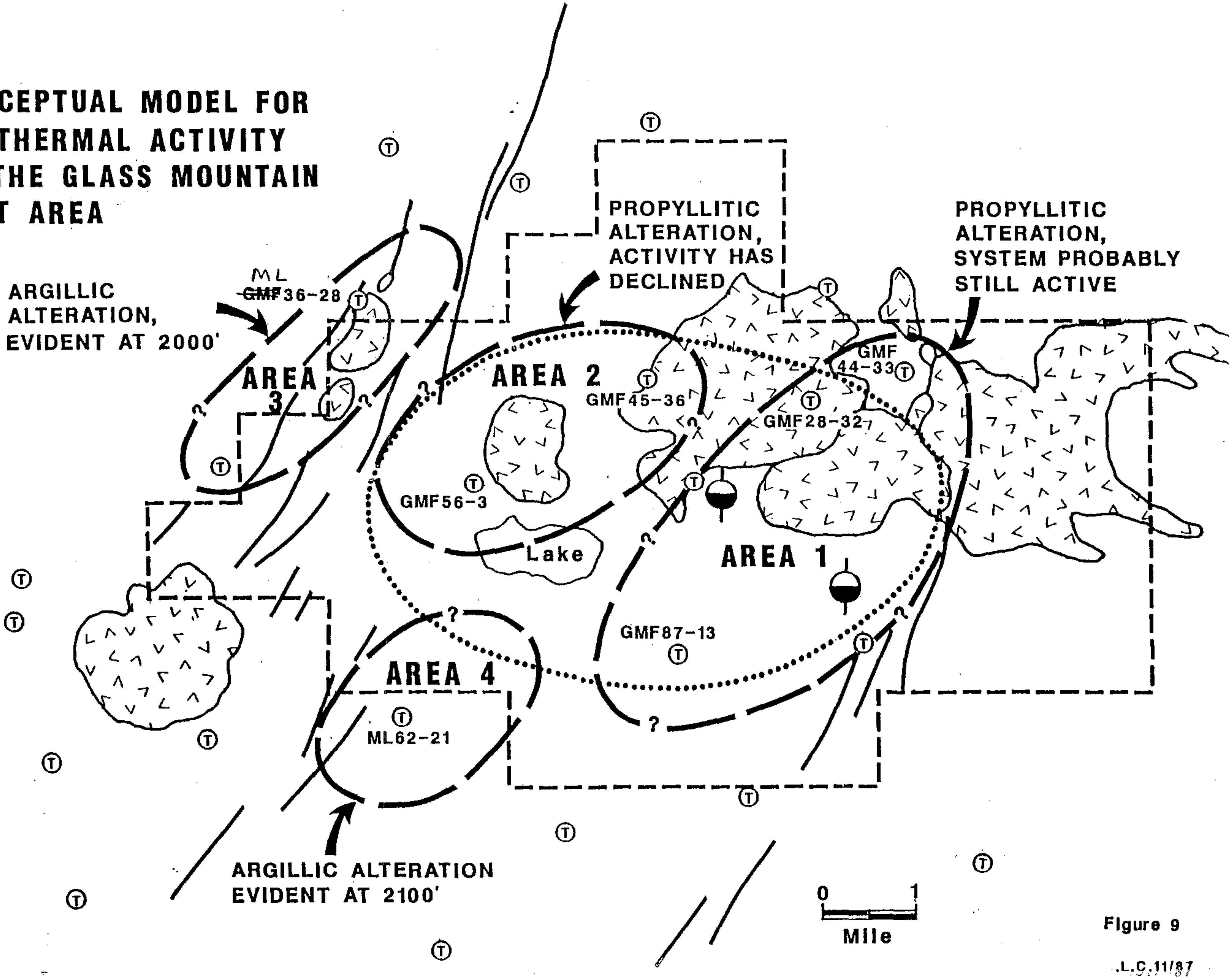

Figure 9

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one mile southwest of the Medicine Lake Basin. The activity is characterized by weak argillic alteration observed at 2115' in ML 62-21. It is uncertain whether the alteration is the result of a local hydrothermal event, or possibly related to high-temperature activity in Area 1 or Area 2.

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Appendix 2

The distribution of alteration zones observed in temperature boreholes drilled in the Glass Mountain Area.

Well Name	Total Sampled Depth (T.D.)	Alteration Zones	Interval
GMF 56-3	1760'	Zeolite-Smectite	<205'-1058'
		Argillic	1058'-T.D.
GMF 45-36	4000'	Unaltered	0 -1000'
		Zeolite-Smectite	1000'-1820'
		Argillic	1820'-2500' 3430'-3720'
		Prophylitic	2500'-3430' 3720'-T.D.
GMF 28-32	4500'	Unaltered	0 -2480'
		Zeolite-Smectite	2480'-2680'
		Argillic	2680'-3460'
		Propylitic	3460'-T.D.
GMF 44-33	2263'	Unaltered	0 -300'
		Zeolite-Smectite	300'-1350'
		Argillic	1350'-T.D.
GMF 17-6	4009'	Unaltered	0 -1280'
		Zeolite-Smectite	1280'-2680'
		Argillic	2680'-T.D.
GMF 84-17	1636'	Unaltered	0 -1419'
		Zeolite-Smectite	1419'-T.D.
GMF 87-13	916'	Unaltered	0 -242'
		Zeolite-Smectite	242'-900'
		Argillic	900'-T.D.
ML 68-16	2939'	Unaltered	0 -2227'
		Zeolite-Smectite	2227'-T.D.
ML 57-13	2929'	Unaltered	0 -2928'
		Zeolite-Smectite	2929'-T.D.
ML 14-23	3003'	Unaltered	0 -1462'
		Zeolite-Smectite	1462'-T.D.
ML 29-1	3088'	Unaltered	0 -2803'
		Zeolite-Smectite	2803'-T.D.

Appendix 2 (Cont.)

Well Name	Total Sampled Depth (T.D.)	Alteration Zones	Interval
ML 36-28	2246'	Unaltered	0 -1500'
		Zeolite-Smectite	1500'-2084'
		Argillic	2084'-T.D.
ML 75-6	1998'	Unaltered	0 -1050'
		Zeolite-Smectite	1050'-T.D.
ML 57-11	3002'	Unaltered	0 -800'
		Zeolite-Smectite	800'-T.D.
ML 2-81	740'	Unaltered	0 -T.D.
ML 86-23	3503'	Unaltered	0 -1554'
		Zeolite-Smectite	1554'-3503'
ML 54-19	2201'	Unaltered	0 -1900'
		Zeolite-Smectite	1900'-T.D.
ML 62-21	2142'	Unaltered	0 -1035'
		Zeolite-Smectite	1035'-2115'
		Argillic	2115'-T.D.
ML 65-26	2180'	Unaltered	0 -T.D.
ML 52-30	1972'	Unaltered	0 -1100'
		Zeolite-Smectite	1100'-T.D.
ML 27-27	3000'	Unaltered	0 -T.D.
ML 1-81	640'	Unaltered	0 -640'
ML 18-34	3500'	Unaltered	0 -2932'
		Zeolite-Smectite	2932'-T.D.
MLF 51-2	1836'	Unaltered	0 -900' 1150'-T.D.
		Zeolite-Smectite	900'-1150'