Preliminary Three-Dimensional Mineralogic Model of Yucca Mountain, Nevada

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Abstract:

A Preliminary Three-Dimensional Mineralogic Model of Yucca Mountain, Nevada, has been prepared. This deliverable is now available, in preliminary form, for incorporation into the 3-D Integrated Site Model. This report describes the accompanying computer model, including a description of the data sources, the software used, the assumptions made, the mineral volumes derived, and the limitations of the model in its present form. This report also discusses the magnitude of expected increased model uncertainty if non-Q data are excluded. The model focuses on mineral volumes and distributions that are important to site performance. Minerals and mineral groups so described include smectite + illite, the sorptive zeolites, analcime, cristobalite + opal-CT, and tridymite. Distributions of glass are also included in the model. The model includes all available quantitative X-ray powder diffraction data from the surface down to the Paleozoic basement. Additional data will be incorporated as more analyses of core, particularly of Q core, become available. The model has been produced in a format that is amenable for use in process-level flow and transport models using the FEHM and TOUGH2 computer codes. The geologic and lithologic stratigraphy used in the model is consistent, to the extent possible, with the Reference Information Base Section 1.12(a), Stratigraphy: Geologic/Lithologic Stratigraphy, incorporating updates in the Integrated Site 3-D Framework Model. The use of Q and non-Q data in the model is clearly identified in this report. This report is a non-Q product.

INTRODUCTION

This report describes the progress made to date in generating a 3-D Mineralogic Model of Yucca Mountain. The data for this model were obtained from quantitative X-ray powder diffraction (XRD) analyses of core and cuttings from drill holes at Yucca Mountain. X-ray diffraction is the most direct and accurate analytical method for determining the presence of mineral species because the data obtained by this method are fundamentally linked to crystal structure. Other methods based on chemical or spectral properties are derivative and subject to much greater possibilities of misidentification. Significant effort has gone into the development of *quantitative* XRD for application to core and cuttings analysis at Yucca Mountain. This analytical capability has resulted in the development of a data base of mineral abundances in x, y, and z space at Yucca Mountain that is one of the most accurate mineral frameworks for such a large area anywhere in the world. However, uncertainties remain which result from limitations in sample spacing, sample density, inadequate data for particular stratigraphic subunits, the use of data obtained from drill cuttings, and in particular from the limited number of available drill holes. Nevertheless, the abundant data that are available provide a powerful tool for visualizing mineral abundances in three dimensions at Yucca Mountain *if both Q and non-Q data are used.*

The 3-D Mineralogic Model is being developed for incorporation into the 3-D Integrated Site Model [ISM]. For this purpose, the geologic/lithologic stratigraphy on which that model is based, from the Updated Integrated Site 3-D Framework Model, was used as the framework within which the Mineralogic Model was developed. The units used in this preliminary 3-D model are shown in Table 1. The stratigraphy as defined by Buesch *et al.* (1996) and the grid used by Zelinski and Clayton (1996) are included for comparison. In some instances geologic/lithologic stratigraphic boundaries correlate well with transitions between mineral types. However, in other instances mineralogic transitions occur within geologic/lithologic units, and/or the contacts between geologic/lithologic units do not correlate with any significant mineralogic changes. The manner of treating these mismatches will be the subject of subsequent work in this study.

The need for a complete and accurate 3-D mineralogic model of Yucca Mountain is driven by several concerns arising from site characterization. For example, despite the Project's long-standing concept of the role of stacked zeolite horizons as barriers to radionuclide migration between the potential repository horizon and the water table (*e.g.*, Vaniman *et al.*, 1984), there is a common misconception that there are "holes" at Yucca Mountain where no zeolitic barriers occur between the potential repository and the water table. This misconception is unsupported by available data. Furthermore, the view that significant zeolite holes exist demonstrates the critical need for a quantitative 3-D model of mineral distributions, widely accessible to Project participants, for accurate visualization of site properties. The utility of the 3-D Mineralogic Model is also evident in addressing at least four other aspects of site characterization and assessment:

1) Linkages between mineralogy and fluid flow

Mineralogy is often a very important parameter in defining the hydrologic behavior of rock masses. For example, vitric nonwelded tuffs and zeolitized tuffs can have very similar porosities but different hydraulic conductivities (Loeven, 1993). Smectite intervals, even in thin occurrences, can give aquitard characteristics to porous intervals that would otherwise be very transmissive when saturated. Other mineral associations with hydrologic properties could potentially be identified if mineralogic and hydrologic associations in x, y, z space are compared in the 3-D model.

2) Linkages between mineralogy and waste transport

Zeolitic horizons have long been and still remain an important factor in models of radionuclide transport at Yucca Mountain. A 3-D transport modeling capability has already been developed using a basic 3-D model of zeolite horizons that was not based on the Integrated Site Model (Robinson *et al.*, 1995). In this earlier study, zeolite horizons were defined based on assumed arbitrary cutoffs of zeolite percentage. The present Mineralogic Model incorporates zeolite and other mineral percentages as the basic distributed property, allowing mineral volumes to be defined as needed for specific performance studies. The present effort will provide a much more robust and more widely accessible model of zeolite distributions with ties to the Integrated Site Model. Moreover, the potentially large impact of minor minerals, particularly smectite, will be presented in a manner that can be considered in waste transport modeling.

3) Mineral distributions and thermal stability

Hydrous minerals and water-bearing glasses can be affected by repository-induced heating and can in turn serve to moderate heat accumulation within the rock mass. Other minerals, particularly silica polymorphs, may be structurally affected or may control the aqueous silica concentrations of fluids migrating under thermal loads, resulting in silica dissolution or precipitation and rock-property modification at distal locations along the thermal gradient. These effects must be considered in three dimensions to adequately address thermal impacts under a variety of repository loadings. The 3-D Mineralogic Model will also permit calculation of breakdown of glass to zeolites and smectite and reaction of zeolites to less hydrous assemblages. These reactions will be considered explicitly when the Conceptual Model of Mineral Evolution is coupled to the 3-D Mineralogic Model later this year.

4) Mineral distributions and health hazards

Distributions of crystalline silica polymorphs have had an important impact on determining the use of respirator protection by tunnel boring machine operators and others working during mining operations in the Exploratory Studies Facility. The Topopah Spring Tuff has highly variable ratios of the crystalline silica polymorphs and an accurate knowledge of the distributions of these minerals in three dimensions may help in planning for mitigation of dust inhalation hazards.

METHODOLOGY

Software Used to Conduct Modeling

To formulate the 3-D Mineralogic Model, the commercially available computer code, STRATAMODEL (or SGM), was used (Stratigraphic Geocellular Modeling Reference Guide, 1995). STRATAMODEL is a computer program generally used to create three dimensional geologic models that are based on stratigraphy and associated lithologic properties (attributes such as rock porosity, permeability, mineralogy, etc.). The program conducts weighted interpolations of stratigraphically controlled properties between vertical columns of data (*i.e.*, drill holes) to produce an areal or volumetric distribution of the rock property associated with each stratigraphic horizon. In addition, if a property has a known distribution within a stratigraphic unit, this distribution will be averaged vertically within stratigraphy as well as interpolated horizontally between drill holes. STRATAMODEL is a unique package in four ways: 1) it can model complex structural features (*e.g.*, folds, faults, and cross-cutting horizons); 2) it accurately fills model volumes with attributes based on deterministic extrapolation that can be controlled by the user; 3) it can accommodate up to 100 attributes; and 4) it provides state of the art 3-D visualization of the model (*e.g.*, cross sections, fence diagrams, full model volumes, and geobodies).

Assumptions Made in the Modeling:

Although we are using STRATAMODEL to statistically model the distribution of minerals both vertically within drill holes, and laterally across the stratigraphic units, some assumptions must be made and some manual control must be exerted. All modeling is limited by the quality and availability of existing data. A potential source of uncertainty is related to the use of mineralogic data obtained from drill cuttings instead of sidewall samples or drill core. Drill cuttings have a tendency to average mineralogic composition over a finite depth range. However, use of such data in the present Mineralogic Model should have little effect since mineralogy is averaged within stratigraphic units by STRATAMODEL.

An important assumption implicit in this model is that the existing stratigraphic contacts are all correct. Preliminary comparisons of the mineralogic data with particular geologic/lithologic stratigraphic units suggest some instances where slight modifications in the geologic/lithologic stratigraphy may be required. It would be premature to call for such modifications at present until they are discussed with responsible staff at the USGS. A second potential problem encountered is the absence of mineralogic data for many of the stratigraphic units (*e.g.*, several subunits of the Tiva Canyon Tuff). In such cases, an assumption was made that the few available mineralogic data are representative of the entire stratigraphic unit.

Another assumption is that the drill holes' spacings are sufficiently close around and within the repository block to accurately model mineral distributions within the block. Unfortunately, there is extremely limited mineralogic information to the west of the exploratory block (defined by drill holes USW H-3, H-5, and H-6; see Figure 1). Drill hole USW H-6 is located on the opposite side of a major structural feature, and very limited mineralogic data are available from this hole to constrain the model. Mineralogic data are also limited for drill hole USW H-3. The assumption was made that the mineralogic data available for drill holes USW H-3 and USW H-5 will adequately constrain the Mineralogic Model across the western part of the repository block.

The quality of any model is dependent on the number of data points vertically within each stratigraphic unit, and the number and locations of the drill holes that define the lateral distribution of the area to be modeled. The quality of the resulting model is also dependent on the number of stratigraphic units used in the model since each of the differing units has differing associated properties. For example, the various stratigraphic units at Yucca Mountain commonly have different associated physical/mechanical properties (*e.g.*, degree of welding, porosity, degree of saturation, etc.) which result from the formation of different alteration products whose distributions we intend to model. Problems can arise regarding the number of stratigraphic units to select. If we use too many individual stratigraphic units, there may be insufficient data points in each stratigraphic unit to define adequately the distribution of the property we wish to model.

Contents and Structure of the Input Data Files Used in the Computer Model:

Quantitative mineralogy as obtained by XRD methods was used as the mineralogic input into the 3-D Mineralogic Model. Data from a particular drill hole were included in the 3-D Mineralogic Model if a reasonable sample distribution existed for the drill hole or if the drill hole was located in an important location such as the edge of the modeling area. Consequently, data from drill holes such as USW J-12 and J-13 were not included in the model, whereas data from drill holes USW H-6 and USW WT-1 were included (because their locations help constrain extrapolations of data across the repository block). The drill holes and the mineralogic data sources used for the 3-D model are listed in Table 2.

Six classes of geologic materials have been incorporated in the preliminary 3-D Mineralogic Model. Only the most abundant of the potentially sorptive or reactive phases were included in the model since they are the important constituents to consider when modeling waste migration or thermal loading. Minerals such as quartz and feldspar were not included because they are ubiquitous at Yucca Mountain and are comparatively inert when considered in the mineral reactions of concern. Cristobalite/quartz/tridymite ratios will be considered in later versions of the model in order to address thermal loading concerns and concerns about the principal inhalation hazards when mining in the Topopah Spring Tuff. The minerals, mineral groups, or glasses presently used in the 3-D model are as follows:

1. Smectite + Illite
2. Zeolites (clinoptilolite, heulandite, mordenite, chabazite, erionite, stellerite)
3. Tridymite
4. Cristobalite + Opal-CT
5. Glass
6. Analcime

Appendix I lists the mineralogy (the 6 groups of minerals/glass), stratigraphy, and depths of analyzed samples for each of the 17 drill holes included in the 3-D Mineralogic Model. The stratigraphic units in bold type are from the Integrated Site 3-D Framework Model. The stratigraphic units in underlined-bold-italics are stratigraphic units that have been identified based on alteration mineralogy. Not all stratigraphic units and sub-units have been incorporated into this preliminary model although they are being considered for future refinements of the model.

Appendix I readily shows where samples have been analyzed with respect to the stratigraphy at Yucca Mountain. In general, the upper units of the Paintbrush Group (Tiva Canyon Tuff, Yucca Mountain Tuff, Pah Canyon Tuff) have been only lightly sampled across Yucca Mountain. Likewise, few drill holes extend to depths beyond the Tram Tuff. Several drill holes have been included in the 3-D model even though mineralogic data are limited. For example, drill holes USW H-3 and USW WT-1, which help constrain the model in the southern end of Yucca Mountain, do not have analyzed samples in all of the stratigraphic units they intersect.

The stratigraphic units used in the modeling are keyed to the geologic/lithologic stratigraphy used in the 3-D Integrated Site Model (Table 1, Figure 2). The thicknesses of the units portrayed in Figure 2 are meant only to illustrate relative thicknesses and are in no way intended to be exact. The thickness of an individual stratigraphic unit varies depending on its location at Yucca Mountain, and some stratigraphic units are absent in various drill holes. Stratigraphy from the updated Integrated Site 3-D Model was entered into STRATAMODEL as individual files for each stratigraphic unit. Each file listed the drill hole identifier, the Nevada plane coordinates of the drill hole (x-y location), and the elevation to the top to the stratigraphic unit (z position) in that drill hole. Drill holes in which the stratigraphic unit was not present were not included in the data file.

RESULTS and DISCUSSION

Computer Model of Mineral Distributions at Yucca Mountain

The current geologic model was constructed using STRATAMODEL, Version 4.0 (1995) from Landmark Graphics Corporation. The model is initiated by importing files of surfaces that contain x (easting), y (northing) and z (elevation in feet) coordinates. These input grids were obtained from Zelinski and Clayton (1996). STRATAMODEL then assigns a regular grid spacing to these irregular grids and generates continuous surfaces. A stratigraphic framework model was then constructed using knowledge of the structural relationships between the surfaces specific to this site. This model captures any pinchouts, onlaps, offlaps, or truncations that are known to exist. The model volume is then populated with attributes by importing formatted files of mineralogic data that occur at specific x, y, and depth locations within the model. STRATAMODEL uses a $1/r^2$ interpolation scheme to distribute the properties throughout the three-dimensional volume. That is, in a model cell for which there is no mineralogic information, STRATAMODEL assigns it a value by searching within a certain radius from that cell and giving weight to each data point found. The weight given is based on the distance (r) of the data point from the cell being filled. Data points farther from that cell are given less weight. STRATAMODEL is guided in this step by specifying a search radius based on knowledge of the area, such as drill-hole spacing.

The current 3-D model contains 90,000 cells covering a ground area of approximately 1.8×10^6 ft^2. Each cell of the model contains eleven values, including an abundance for six phases (zeolites, smectite + illite, cristobalite + opal-CT, tridymite, glass, and analcime), cell location, stratigraphic layer, elevation in feet, cell volume and cell thickness. Any cell within the volume can be queried to determine any of these values. Figure 3 shows an east-west cross section through Yucca Mountain showing the distribution and thicknesses of the stratigraphic units (listed in Table 1) used as the framework for the preliminary 3-D Mineralogic Model. The approximate elevation of the water table is superimposed for reference. Figure 4 shows elevations used in the following figures which depict volumes of mineral abundances.

Presently, the vertical distribution of mineralogic content in the model is more generalized than is indicated by drill core data. STRATAMODEL assigns one value to the center of each cell and in this case, each layer of the model is one cell thick. In cases where there are several data values per layer, only one value (the average) is reflected in the model. Future models will more finely subdivide stratigraphic horizons to allow visualization of the actual vertical distribution of mineralogic abundances.

Volume of Zeolites at Yucca Mountain

Figure 5 shows east-west cross sections extracted from the 3-D Mineralogic Model representing the volumes of zeolites (clinoptilolite + mordenite + erionite + stellerite + chabazite) at Yucca Mountain. Volumes of rock containing these sorptive zeolites vary across the exploration block. In the northern section, near drill hole USW G-2, the Calico Hills Formation contains the highest volume percentage of sorptive zeolites, although deeper strata contain significant volumes of sorptive zeolite in the Crater Flat Group. To the south, stacked strata with large volumes of sorptive zeolites occur in the Calico Hills Formation and in the nonwelded and bedded units interposed between tuffs of the Crater Flat Group. Although the zeolitic volume in the Calico Hills Formation decreases to the west and south, the zeolitic volumes in the Crater Flat Group persist beneath the non-zeolitized parts of the Calico Hills Formation.

Clinoptilolite and mordenite are the most abundant zeolites at Yucca Mountain. Major stratigraphically continuous intervals of clinoptilolite occur in all drill holes, from ~100-150 m above the water table to ~500 m below. Heulandite is fairly common at Yucca Mountain but is lumped with clinoptilolite in XRD analyses since the two minerals are isostructural. Mordenite often occurs along with clinoptilolite but is less abundant in drill holes farther to the south and is virtually absent in bulk-rock samples from drill hole USW GU-3/G-3. The zeolite analcime occurs as a prograde alteration product at greater depths, but the depths of analcime occurrence are so great that little interaction with waste is likely. The locations of zeolitic intervals are strongly controlled by tuff stratigraphy; zeolites formed from the glasses of nonwelded and bedded intervals between those portions of the tuffs that devitrified to form feldspars and silica minerals soon after emplacement. These zeolitic intervals and their effects on Np transport have been modeled recently by Robinson *et al.* (1995).

Until recently, chabazite was known only as a rare zeolite at Yucca Mountain. However, samples from the Calico Hills Formation in USW SD-7 contain significant amounts (up to 9%) of chabazite in this zeolitized interval, occurring principally in a clinoptilolite + chabazite zone of ~14 m thickness, above a clinoptilolite + mordenite zone (Chipera *et al.*, 1996). This new occurrence indicates that the sorptive zeolite assemblages may be more complex at the southern end of the exploration block than previously thought. Nevertheless, the principal sorptive zeolite mineral at Yucca Mountain remains clinoptilolite, followed in abundance by mordenite.

In addition to clinoptilolite, mordenite, analcime, and minor chabazite, restricted occurrences of a few other zeolites have been found at Yucca Mountain. Stellerite is common in fractures of the Topopah Spring Tuff and is particularly common in both fractures and matrix of the Topopah Spring Tuff in drill hole UE-25 UZ#16. Phillipsite is a rare zeolite at Yucca Mountain and has been found only in the zone of alteration above the water table at the top of the basal vitrophyre of the Topopah Spring Tuff (Carlos *et al.*, 1991; 1995a; 1995b). Until recently, erionite was also believed to occur only in fractures at the top of the Topopah Spring Tuff basal vitrophyre until it was found in significant quantities (up to 34%) in a 3-m thick sequence in the bulk rock underlying the Topopah Spring Tuff basal vitrophyre in drill core USW UZ-14 (Guthrie *et al.*, 1995). Laumontite occurs in very small amounts (<4%) in deep, altered tuffs of drill hole UE-25p#1 and perhaps in USW G-1 (Bish and Chipera, 1989). Phillipsite and laumontite are so rare that they are not important factors in developing zeolite volume estimates for this model.

Volume of Smectite + Illite at Yucca Mountain

Figure 6 illustrates east-west cross sections extracted from the 3-D Mineralogic Model representing the volumes of smectite + illite at Yucca Mountain. At the scale shown, smectite is seen to be ubiquitous but present in low abundance throughout Yucca Mountain. XRD analyses show that smectite occurs in virtually all analyzed samples, typically in amounts <2%. Volumes of smectite + illite rise at depth, particularly in the northern and central portions of the block where a fossil geothermal system occurs.

Above the water table there are two mappable zones of up to 75% smectite in the Paintbrush Tuff, one within the vitric nonwelded section above the Topopah Spring Tuff and one at the top of the basal vitrophyre of the Topopah Spring Tuff. These smectites typically have non-expandable illite contents of 10-20%. These thin units are difficult to resolve at the scale shown in Figure 3; future work will generate more detailed graphics. Well beneath the water table (depths >1000 m), the ancient (~10.7 Ma) geothermal system contains abundant smectite/illite but with a much higher illite content (~80-90%: Bish, 1989). Illitic clays have a higher layer charge than smectites, reducing their effective cation-exchange capacity. However, the illitic clays occur at such great depths that they are of little importance for transport modeling at Yucca Mountain. Future work will elucidate volumes of exceptional smectite abundance.

Silica Polymorph Distributions within the Repository Horizon: Volume of Tridymite and Cristobalite/Opal-CT at Yucca Mountain

The common silica polymorphs at Yucca Mountain include quartz, cristobalite, and tridymite. In addition, opal-CT is usually found in association with sorptive zeolites. Tridymite occurs primarily above the potential repository horizon, particularly in those parts of the Topopah Spring and Tiva Canyon Tuffs where vapor-phase crystallization is common. This distribution, as well as the common formation of tridymite in lithophysal cavities, is evidence of the vapor-phase growth of tridymite. Pseudomorphs of quartz after tridymite in deep fractures and cavities are evidence of the instability of tridymite under low-temperature aqueous conditions. Tridymite occurrences have been interpreted as a possible limit on past maximum rises in the water table at Yucca Mountain (Levy, 1991). Cristobalite is not restricted to vapor-phase formation; instead, it is found in virtually every sample above the water table and is found only rarely in a few fractures beneath the water table. The preservation of cristobalite in rocks above the water table is in accord with studies showing that an aqueous fluid is necessary for the rapid recrystallization of cristobalite to quartz (Ernst and Calvert, 1969). Opal-CT occurs both above and below the water table. Opal-CT and cristobalite are combined as one mineral group in the preliminary model because they are often almost indistinguishable in XRD analyses. Furthermore, these phases are the least stable of the silica minerals and generate comparable silica activities in aqueous solution.

Figure 7 shows east-west cross sections extracted from the 3-D Mineralogic Model representing cristobalite + opal-CT volumes at Yucca Mountain. The very high percentages of these minerals in the Paintbrush Group represent cristobalite-rich devitrified tuffs. Volumes below the Paintbrush Tuff units represent opal-CT in tuffs containing high volumes of sorptive zeolites. In future work, the volumes of cristobalite and opal-CT will be examined in more detail using correlations with other minerals and petrologic constraints on cristobalite versus opal-CT occurrence.

Figure 8 illustrates east-west cross sections extracted from the 3-D Mineralogic Model representing the volumes of tridymite at Yucca Mountain. Volumes of exceptionally high tridymite content are restricted to the upper strata within the Tiva Canyon and Topopah Spring Tuffs. These volumes are mostly above the potential repository horizon.

Limitations and Deficiencies in the Modeling

In its present form, the 3-D Mineralogic Model is most limited by the need to test and modify the fits of quantitative mineralogic data to the geologic/lithologic stratigraphy. This will be done in concert with work in progress to address another limitation, the lack of sufficient Q data. As more data are added to the model, the volumes of principal mineral species will be reassessed. It is anticipated, however, that further limitations will be illustrated as the model is developed throughout this fiscal year. Some of these limitations will be addressed by analysis and addition of yet unanalyzed core data from existing drill holes. Gaps in the data may have to be filled by such analyses, both from QA core and from older core. In addition, some of the areal limitations in the Mineralogic Model will likely point to regions where new drill holes may be best sited.

Magnitude of Increased Model Uncertainty if non-Q Data Were Excluded.

Currently, data from all non-Q core together with those from available Q core are required to generate a 3-D Mineralogic Model of Yucca Mountain. To include only data from existing Q core would severely limit the model. Figure 1 shows and Table 2 lists the 17 drill holes used to generate the 3-D model. Of the 17 drill holes, only four drill holes (USW SD-7, USW SD-9, USW SD-12, and UE-25 UZ#16) are QA qualified. These four drill holes are all located in or near the eastern half of the repository block, allowing little control for statistical extrapolation to the west across the block. Furthermore, of the four analyzed QA drill holes, only partial data have been collected from the USW SD-7, -9, and -12 holes. To exclude non-Q drill holes would mean that the Project has no mineralogic information for any of the stratigraphic units below the Prow Pass Tuff and, until more data are collected from existing Q drill holes, all mineralogic data for the stratigraphic units above the lower vitrophyre of the Topopah Spring Tuff would have to be extrapolated from the available data from *only one drill hole* (UE-25 UZ#16). Once all of the available Q holes are analyzed, there will still be important areas to the west where no Q-hole data are available. Clearly, a defensible 3-D Mineralogic Model of Yucca Mountain *cannot* be constructed using only data from Q holes.

Although quantitative XRD analyses are currently being conducted for drill holes USW UZ#14 and USW NRG-7/7a, and data from USW NRG-6 will soon be incorporated into the model, additional portions of USW SD-7, 9, and 12, and the non-Q data will still be required to exert statistical control when extrapolating the model to the west and to the south where we have extremely limited mineralogic data, even when the non-Q drill cores are included.

Incorporation of the 3-D Mineralogic Model into the FEHM and TOUGH2 Codes

The 3-D Mineralogic Model is available in two formats located on an anonymous ftp site on computer node ees5-ftp.lanl.gov (IP address: 128.165.92.146), accessible to Project personnel. The model files can be obtained by logging in as "anonymous" then changing directory to /pub/karen/ymp. The two model files include the original STRATAMODEL data file (3DMIN.SFM) and an ASCII representation of the Mineralogic Model (3DMIN.ASC). These formats are compatible with the FEHM and TOUGH2 computer codes.

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QUALITY ASSURANCE

The Mineralogic Model was constructed using STRATAMODEL, Version 4.0. STRATAMODEL is a commercially available software package created by Landmark Graphics Corporation (Stratigraphic Geocellular Modeling Reference Guide, Landmark Graphics Corporation, Dec. 1995, 540 pp.).

DATA SOURCES

The 3-D Mineralogic Model is based on quantitative XRD data from 17 drill holes (Figure 1). It is important to note that only 4 of the 17 drill holes provide QA core; without the data from older core, the ability to construct a realistic 3-D mineralogic model is severely constrained. This limitation is discussed in more detail in this report. Several of the QA cores shown in Figure 1 are presently incompletely analyzed by XRD, but new data will be available by the end of FY97, partially completing the studies of USW SD-7, -9, and -12 and adding data from the QA cores USW UZ#14, NRG-6, and NRG-7/7A.

The accession numbers and data tracking numbers for Q and for non-Q data currently used in the 3-D model are listed below.

Q Data

Accession numbers:

NNA.490427.0099 [Chipera, S. J., Vaniman, D. T., Carlos, B. A., and Bish, D. L. (1995). Mineralogic variation in drill core UE-25 UZ-16, Yucca Mountain, Nevada. Los Alamos National Laboratory Report LA-12810-MS, 39 p.]

Data tracking numbers:

LA000000000086.002 [quantitative XRD portion of the report by Chipera, S. J., Vaniman, D. T., Carlos, B. A., and Bish, D. L. (1995) Mineralogic variation in drill core UE-25 UZ-16, Yucca Mountain, Nevada. Los Alamos National Laboratory Report LA-12810-MS, 39 p.]

LASC831321DQ96.001 [Chipera, S. J., Vaniman, D. T., and Bish, D. L. (1996) Zeolite abundances and the vitric-to-zeolitic transition in drill holes USW SD-7, 9, and 12, Yucca Mountain, Nevada. Los Alamos National Laboratory Report LA-EES-1-TIP-96-005, 20 p.]

LASC831321DQ96.002 [DTN for the Los Alamos Min-Pet Summary and Synthesis report]

Non-Q Data

Accession numbers:

NNA.870407.0330 [Bish, D. L., and Vaniman, D. T. (1985) Mineralogic summary of Yucca Mountain, Nevada: Los Alamos National Laboratory Report LA-10543-MS, 55 p.]

NNA.870519.0041 [Caporuscio, F., Vaniman, D., Bish, D., Broxton, D., Arney, B., Heiken, G., Byers, F., Gooley, R., and Semarge, E. (1982) Petrologic studies of drill cores USW G-2 and UE25b-1H, Yucca Mountain, Nevada. Los Alamos National Laboratory Report LA-9255-MS, 111 p.]

NNA.870519.0043 [Vaniman, D., Bish, D., Broxton, D., Byers, F., Heiken, G., Carlos, B., Semarge, E., Caporuscio, F., and Gooley, R. (1984) Variations in authigenic mineralogy and sorptive zeolite abundance at Yucca Mountain, Nevada, based on studies of drill cores USW GU-3 and G-3: Los Alamos National Laboratory Report LA-9707-MS, 71 p.]

NNA.880607.0036 [Chipera, S. J. and Bish D. L. (1988) Mineralogy of drill hole UE-25p#1 at Yucca Mountain, Nevada. Los Alamos National Laboratory Report LA-11292-MS, 24 p.]

NNA.891019.0029 [Bish, D. L., and Chipera, S. J. (1989) Revised mineralogic summary of Yucca Mountain, Nevada. Los Alamos National Laboratory Report LA-11497-MS, 68 p.]

Data tracking numbers:

LA000000000110.002 and LA000000000111.002 [Bish, D. L., and Chipera, S. J. (1989) Revised mineralogic summary of Yucca Mountain, Nevada. Los Alamos National Laboratory Report LA-11497-MS, 68 p.]

LA000000000116.002 [Vaniman, D., Bish, D., Broxton, D., Byers, F., Heiken, G., Carlos, B., Semarge, E., Caporuscio, F., and Gooley, R. (1984) Variations in authigenic mineralogy and sorptive zeolite abundance at Yucca Mountain, Nevada, based on studies of drill cores USW GU-3 and G-3: Los Alamos National Laboratory Report LA-9707-MS, 71 p.]

Table 1. Stratigraphic units used in the preliminary 3-D Mineralogic Model

Buesch *et al.* 1996	Integrated Site 3-D Framework Model	Zelinski & Clayton (1996)	Units Used in This Study
			31 (Topography)
Tiva Canyon Tuff (Tpc)	Tpc		
crystal-rich member (Tpcr)			
vitric zone (Tpcrv)	Tpcrv1		
nonlithophysal zone (Tpcrn)	Tpcrn		
subvitrophyre transition subzone (Tpcrn4)			
pumice-poor subzone (Tpcrn3)			
mixed pumice subzone (Tpcrn2)			
crystal transition subzone (Tpcrn1)			
lithophysal zone (Tpcr1)			
crystal-poor member (Tpcp)			
upper lithophysal zone (Tpcpul)	Tpcpul		
middle nonlithophysal zone (Tpcpmn)	Tpcpmn		
lower lithophysal zone (Tpcpll)	Tpcpll		
lower nonlithophysal zone (Tpcpln)	Tpcpln		
hackly subzone (Tpcplnh)	Tpcplnh		
columnar subzone (Tpcplnc)	Tpcplnc		
argillic pumice interval (Tpcplnc)			
vitric zone (Tpcpv)		44	30
densely welded subzone (Tpcpv3v)	Tpcpv3		
moderately welded subzone (Tpcpv2)	Tpcpv2		
non-to part welded subzone(Tpcpv1)	Tpcpv1	42	29
Pre-Tiva Canyon Tuff bedded tuff (Tpbt4)	Tpb4	41	28
Yucca Mountain Tuff (Tpy)	Tpy	40	27
Pre-Yucca Mountain Tuff bedded tuff (Tpbt3)	Tpbt3	39	26
Pah Canyon Tuff (Tpp)	Tpp	38	25
Pre-Pah Canyon Tuff bedded tuff (Tpbt2)	Tpbt2	37	24
Topopah Spring Tuff (Tpt)	Tpt	36	23
crystal-rich member (Tptr)			
vitric zone (Tptrv)			
nonwelded subzone (Tptrv3)	Tptrv3		
moderately welded subzone (Tptrv2)	Tptrv2		
densely welded subzone (Tptrv1)	Tptrv1	34	22
nonlithophysal zone (Tptrn)	Tptrn	33	21
dense subzone (Tptrn3)			
vapor-phase corroded subzone (Tptrn2)			
lithophysal zone (Tptrl)	Tptrl		

Table 1 (continued)

Buesch *et al.* 1996	**Integrated Site 3-D Framework Model**	**Zelinski & Clayton (1996)**	**Units Used in This Study**
crystal-poor member (Tptp)			
upper lithophysal zone (Tptpul)	Tptpul	32	20
mid nonlithophysal zone (Tptpmn)	Tptpmn	31	19
lower lithophysal zone (Tptpll)	Tptpll	30	18
lower nonlithophysal zone (Tptpln)	Tptpln	29	17
vitric zone (Tptpv)		28	16
densely welded subzone (Tptpv3)	Tptpv3		
moderately welded subzone (Tptpv2)	Tptpv2		
nonwelded subzone (Tptpv1)	Tptpv1	26	15
Pre-Topopah Spring Tuff bedded tuff	Tpbt1	25	14
Calico Hills Formation (Tac)	Tac	24	13
Unit 4 Pumiceous pyroclastic flow			
Unit 3 Lithic-rich pyroclastic flow			
Unit 2 Pumiceous pyroclastic flow			
Unit 1 Lithic-rich pyroclastic flow			
Bedded tuff (Tacbt)	Tabt1	23	12
Basal sandstone (Tacbs)			
Prow Pass Tuff (Tcp)	Tcp	22	11
Unit 4 Pyroxene rich			
Unit 3 Welded pyroclastic flow		21	10
Unit 2 Lithic-rich pyroclastic flow		18	9
Unit 1 Pumiceous pyroclastic flow			
Pre-Prow Pass bedded tuff (Tcpbt)	Tcbt3	17	8
Bullfrog Tuff (Tcb)	Tcb		
upper nonwelded		16	7
middle variably welded		15	6
lower nonwelded/altered		12	5
Bedded tuff	Tcbt2	11	4
Tram Tuff (Tct)	Tct	10	3
Bedded tuff	Tcbt1		
Older tuff and lavas below Tcbt1		9	2
Paleozoic Basement		1	1

Table 2. Drill holes and mineralogic data sources used in the 3-D Mineralogic Model

Drill Hole	Source for Mineralogic Data
UE-25a#1	Bish and Chipera (1986, 1989)
UE-25b#1	Bish and Chipera (1989)
UE-25p#1	Chipera and Bish (1988); Bish and Chipera (1989)
UE-25 UZ#16	Chipera *et al.*, (1995)
USW G-1	Bish and Chipera (1986,1989)
USW G-2	Bish and Chipera (1989)
USW G-3/GU-3	Bish and Chipera (1989)
USW G-4	Bish and Chipera (1989)
USW H-3	Levy (1984); Bish and Chipera (1989)
USW H-4	Levy (1984); Bish and Chipera (1989)
USW H-5	Levy (1984); Bish and Chipera (1989)
USW H-6	Bish and Chipera (1989)
USW SD-7	Chipera *et al.* (1996)
USW SD-9	Chipera *et al.* (1996)
USW SD-12	Chipera *et al.* (1996)
USW WT-1	Bish and Chipera (1989)
USW WT-2	Bish and Chipera (1989)

Figure Captions

Figure 1: Map of Yucca Mountain, Nevada, showing the locations of the 17 drill holes used to provide mineralogic data for the 3-D model.

Figure 2: Schematic stratigraphic column showing the approximate thicknesses of each unit listed in the Updated Integrated Site 3-D Framework Model.

Figure 3: East-west cross section through Yucca Mountain showing the distribution and thicknesses of the stratigraphic units (listed in Table 1) used as the framework for the preliminary 3-D Mineralogic Model. The approximate elevation of the water table is superimposed for reference.

Figure 4: East-west cross sections of Yucca Mountain representing elevations used in the following figures.

Figure 5: East-west cross sections extracted from the 3-D Mineralogic Model representing the volumes of zeolites (clinoptilolite + mordenite + erionite + stellerite + chabazite) at Yucca Mountain.

Figure 6: East-west cross sections extracted from the 3-D Mineralogic Model representing the volumes of smectite + illite at Yucca Mountain.

Figure 7: East-west cross sections extracted from the 3-D Mineralogic Model representing cristobalite + opal-CT volumes at Yucca Mountain.

Figure 8: East-west cross sections extracted from the 3-D Mineralogic Model representing the volumes of tridymite at Yucca Mountain.

Model Data Files

The 3-D Mineralogic Model is available in two formats which are located on an anonymous ftp site on computer node ees5-ftp.lanl.gov (IP address: 128.165.92.146), accessible to Project personnel. The model files can be obtained by logging in as "anonymous" then changing directory to /pub/karen/ymp. The two model files include the original STRATAMODEL data file (3DMIN.SFM) and an ASCII representation of the model (3DMIN.ASC). These formats are compatible with the FEHM and TOUGH2 computer codes.

Appendix

Appendix I: Drill Hole Mineralogy, Stratigraphy, and Sample Depths for the Drill Holes Included in the 3-D Mineralogic Model.

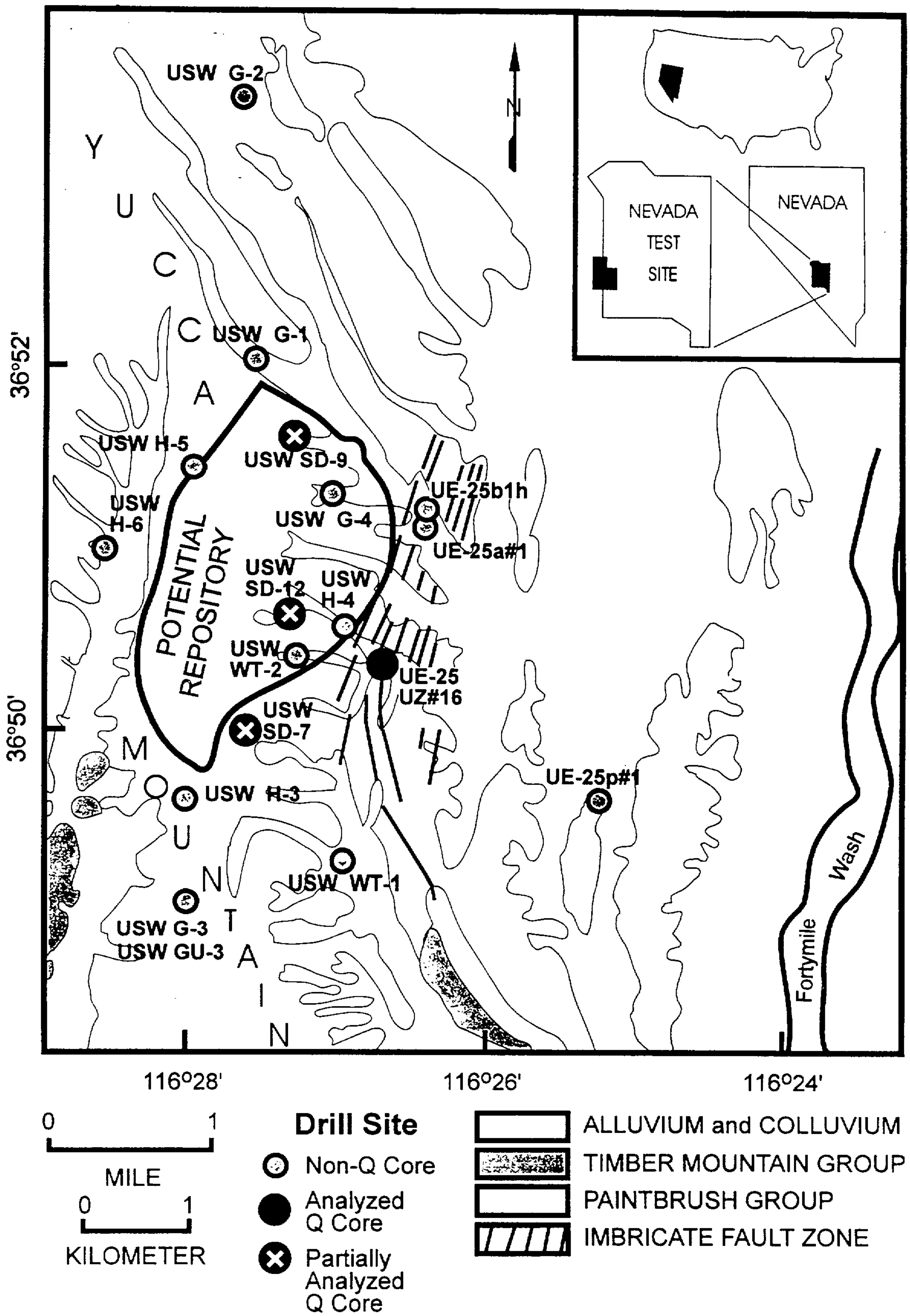


Figure 1: Map of Yucca Mountain showing the locations of the 17 drill holes used to provide mineralogic data into the 3-D model.

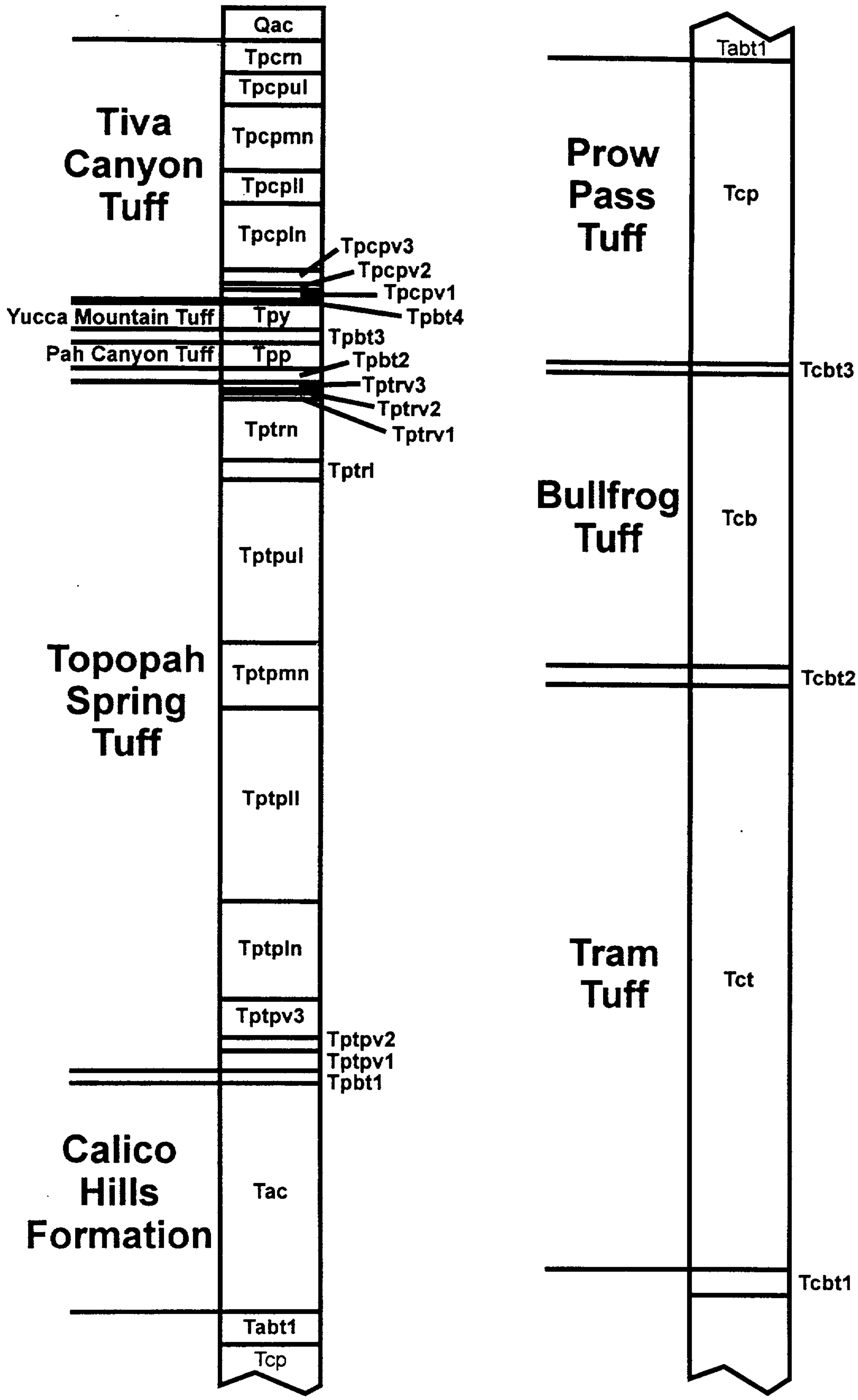
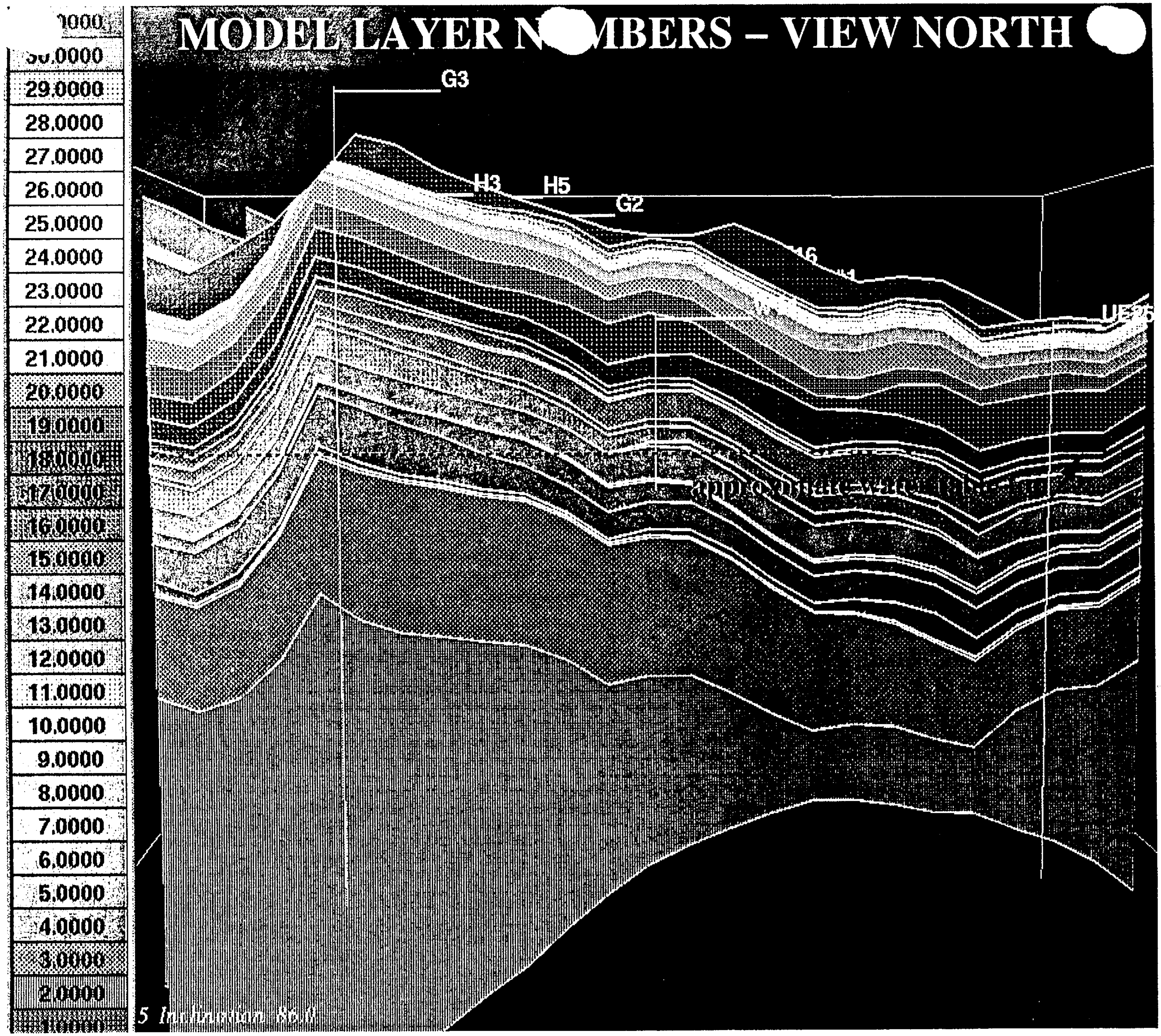
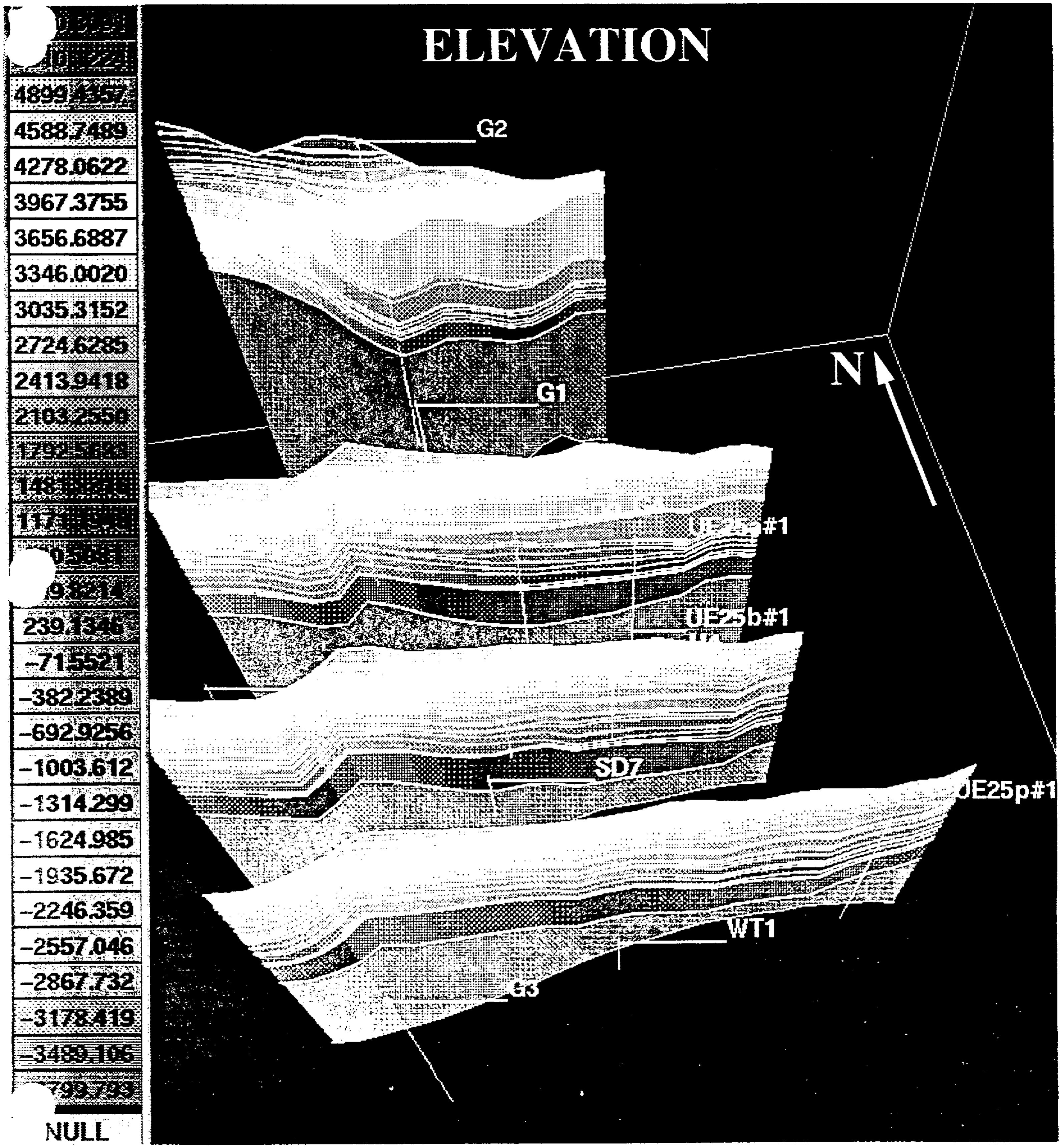
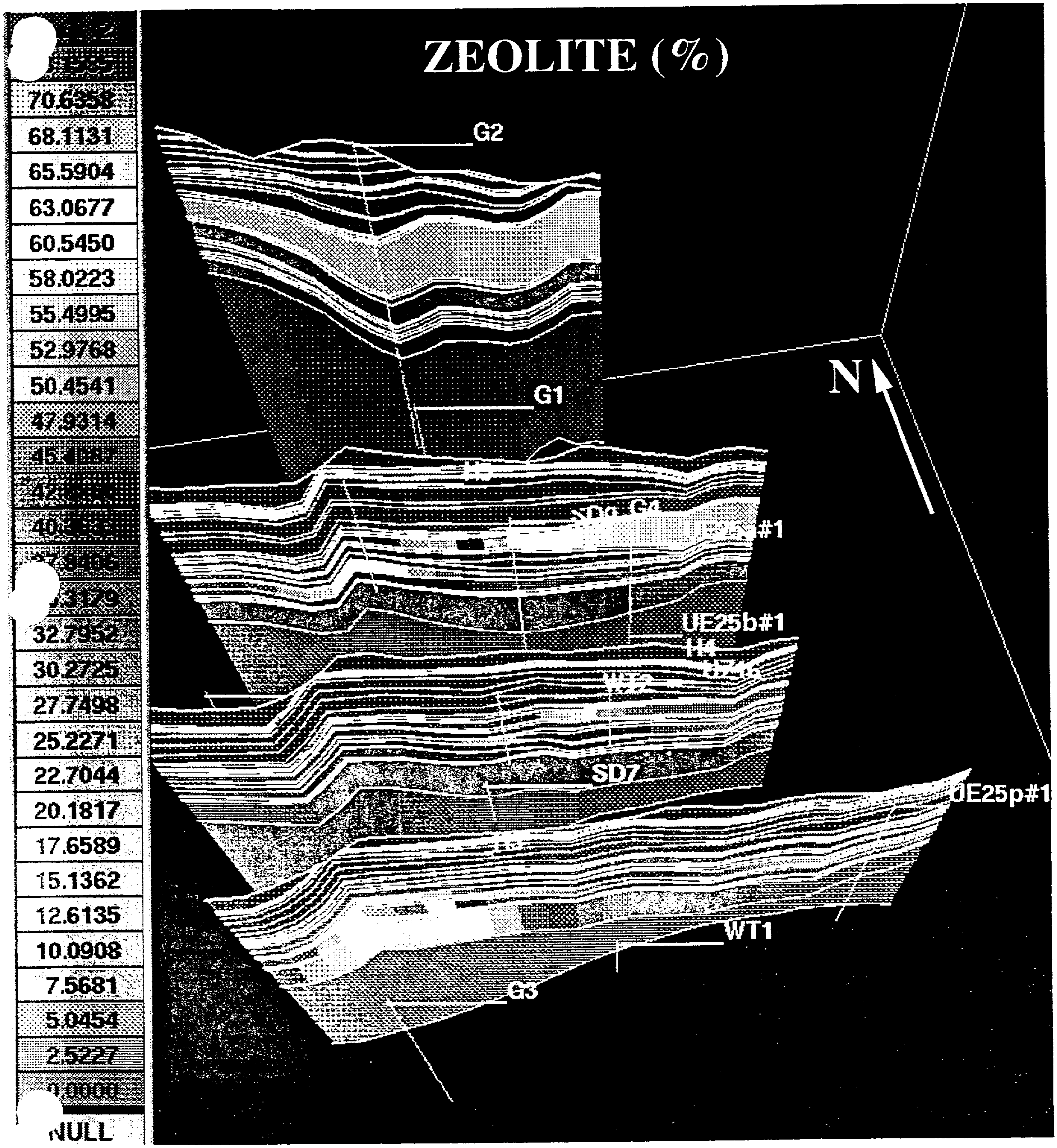


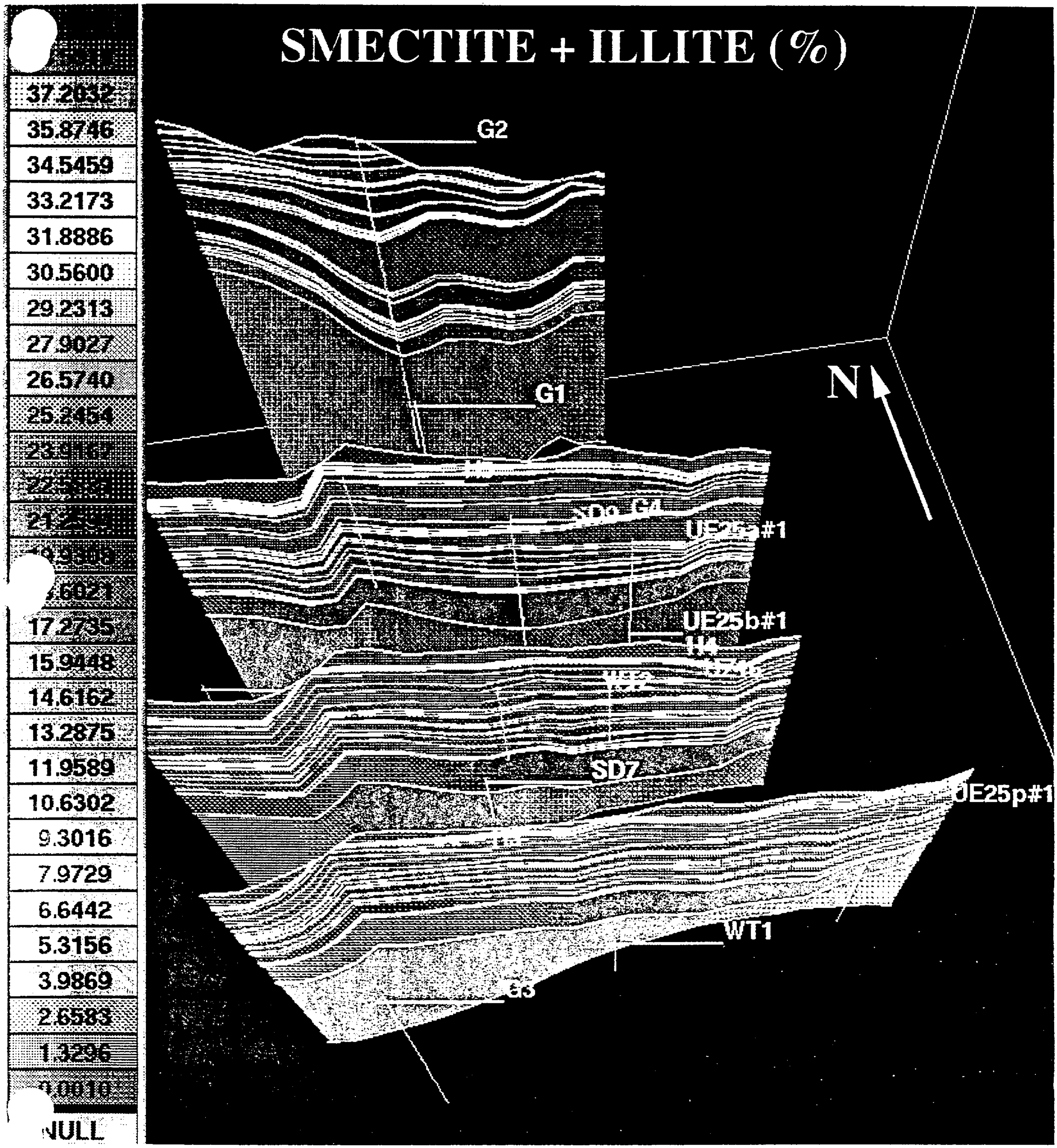
Figure 2: Schematic stratigraphic column showing the approximate thicknesses of the units listed in the Updated Integrated Site 3-D Framework Model.


MODEL LAYER N MBERS – VIEW NORTH
29.0000
28.0000
27.0000
26.0000
25.0000
24.0000
23.0000
22.0000
21.0000
20.0000
19.0000
18.0000
17.0000
16.0000
15.0000
14.0000
13.0000
12.0000
11.0000
10.0000
9.0000
8.0000
7.0000
6.0000
5.0000
4.0000
3.0000
2.0000
G3
H3
H5
G2

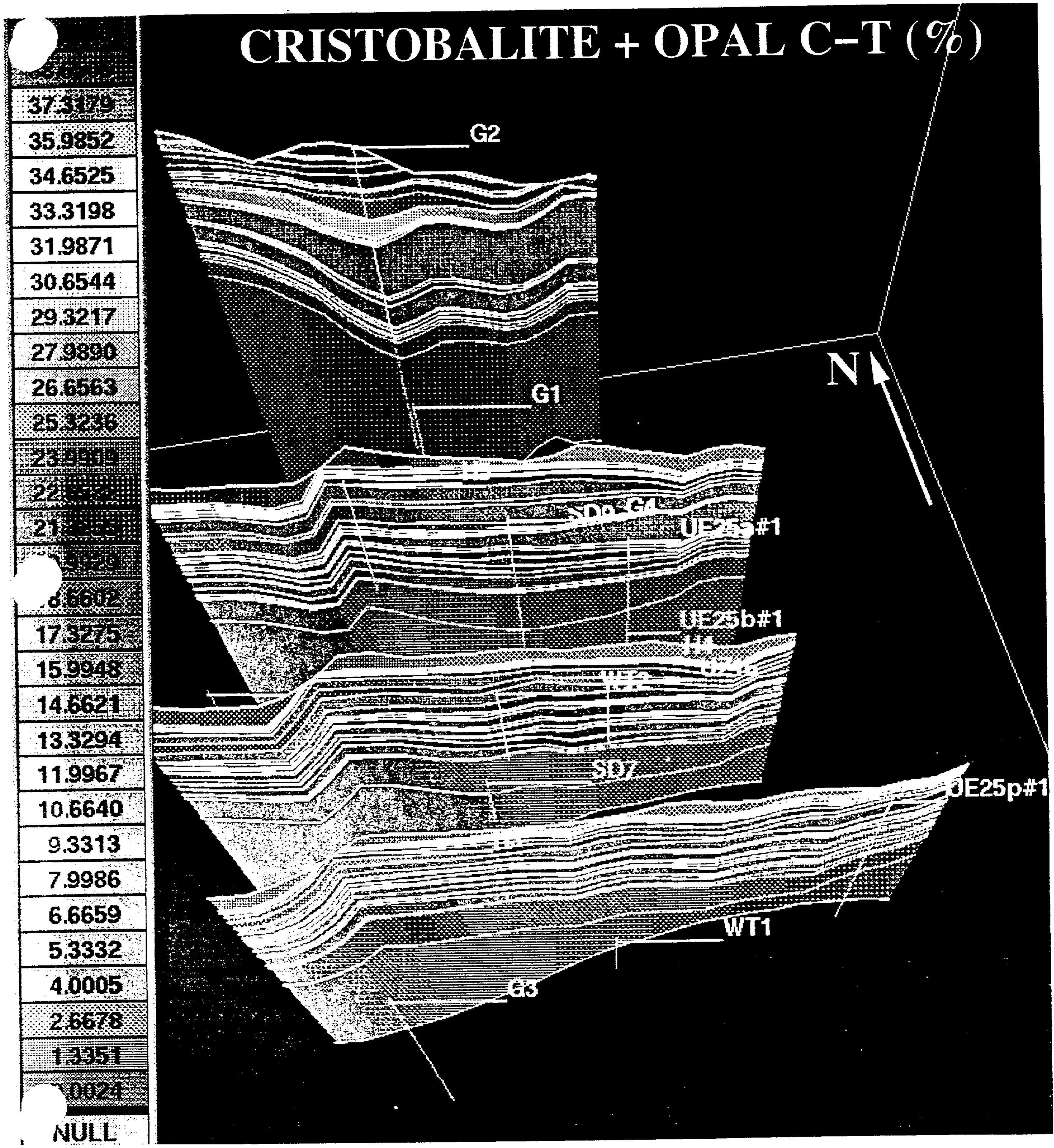

ELEVATION
4899.4357
4588.7489
4278.0622
3967.3755
3656.6887
3346.0020
3035.3152
2724.6285
2413.9418
2103.2550
239.1346
-71.5521
-382.2389
-692.9256
-1003.612
-1314.299
-1624.985
-1935.672
-2246.359
-2557.046
-2867.732
-3178.419
-3489.106
NULL
G2
G1
N
UE25b#1
SD7
UE25p#1
WT1
G3


ZEOLITE (%)
70.6358
68.1131
65.5904
63.0677
60.5450
58.0223
55.4995
52.9768
50.4541
32.7952
30.2725
27.7498
25.2271
22.7044
20.1817
17.6589
15.1362
12.6135
10.0908
7.5681
5.0454
2.5227
NULL
G2
G1
N
UE25b#1
SD7
UE25p#1
WT1
G3

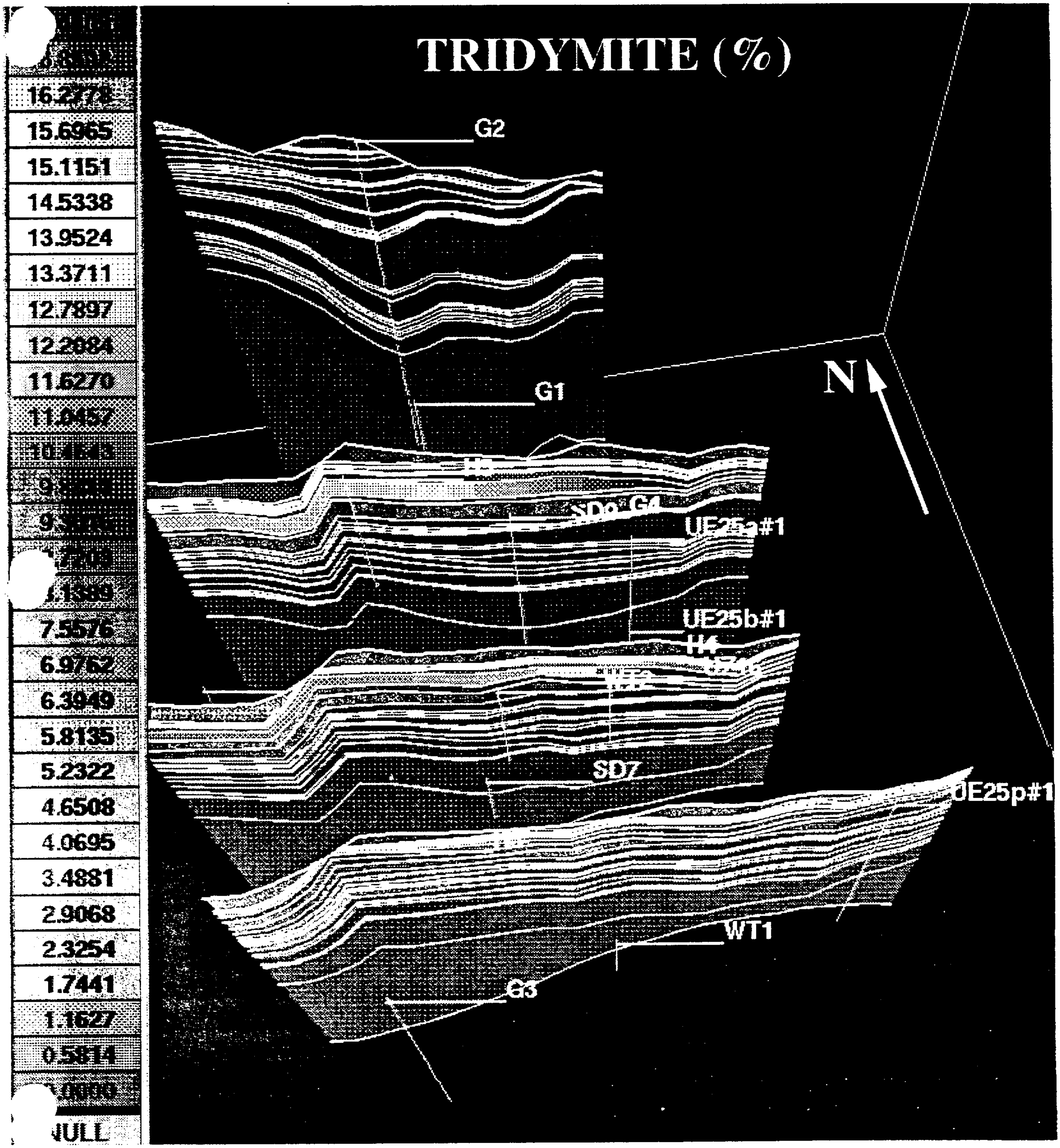
5



SMECTITE + ILLITE (%)
37.2032
35.8746
34.5459
33.2173
31.8886
30.5600
29.2313
27.9027
26.5740
25.2454
17.2735
15.9448
14.6162
13.2875
11.9589
10.6302
9.3016
7.9729
6.6442
5.3156
3.9869
2.6583
1.3296
NULL
G2
G1
N
UE25b#1
SD7
UE25p#1
WT1



CRISTOBALITE + OPAL C-T (%)
37.3179
35.9852
34.6525
33.3198
31.9871
30.6544
29.3217
27.9890
26.6563
25.3236
17.3275
15.9948
14.6621
13.3294
11.9967
10.6640
9.3313
7.9986
6.6659
5.3332
4.0005
2.6678
1.3351
NULL
G2
G1
N
UE25a#1
UE25b#1
SD7
UE25p#1
WT1
G3



TRIDYMITE (%)
15.6965
15.1151
14.5338
13.9524
13.3711
12.7897
11.6270
7.5576
6.9762
6.3949
5.8135
5.2322
4.6508
4.0695
3.4881
2.9068
2.3254
1.7441
1.1627
0.5814
NULL
G2
G1
N
G4
UE25a#1
UE25b#1
SD7
UE25p#1
WT1
G3

Appendix I

Drill Hole Mineralogy, Stratigraphy, and Sample Depths for the Drill Holes Included in the 3-D Mineralogic Model

0 = not present

0.01 = present at trace abundances of <0.5 wt %.

UE-25a#1

N-S	E-W	Elevation
764900	566350	3932.8 ft

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Qac	**0-30.0**							
Tpcpll	**30.0-72.0**							
Tpcplnc	**72.0-199.0**							
84	25.6	84	3	0	0	25	0	0
157	47.9	157	1	0	0	24	0	0
187	57.0	187	0	0	0	24	0	0
Tpcpv1	**199.9-217.0**							
Tpbt3	**217.0-218.2**							
Tpp	**218.2-239.5**							
226	68.9	226	42	0	0	0.01	36	0
Tpbt2	**239.5-270.0**							
251	76.5	251	24	0	0	0.01	59	0
Tptrv2	**270.0-275.6**							
Tptrn	**275.6-408.0**							
277	84.4	277	0	0	0	0.01	80	0
335	102.1	335	0.01	0	8	5	0	0
Tptpul	**408.0-631.0**							
450	137.2	450	5	0	7	17	0	0
469	143.0	469	0	0	8	20	0	0
Tptpmn	**631.0-740.0**							
677	206.4	677	1	0	0	12	0	0
733	223.4	733	3	0	2	13	0	0
Tptpll	**740.0-1129.0**							
744	226.8	744	2	0.01	0.01	16	0	0
836	254.8	836	1	0.01	0	0.01	0	0
848	258.5	848	2	0	0	3	0	0
879	267.9	879	0.01	0	0	8	0	0
894	272.5	894	2	0	4	10	0	0
937	285.6	937	0	0	5	10	0	0
1012	308.5	1012	0.01	0	5	7	0	0
1061	323.4	1061	0	3	2	1	0	0
1112	338.9	1112	1	0	0	7	0	0
Tptpln	**1129.0-1262.0**							
1153	351.4	1153	1	0	0	9	0	0
1195	364.2	1195	.1	0	0	8	0	0
Tptpv3	**1262.0-1317.2**							
Tptpv3a	***1262.0-1265.0***							
1264	385.3	1264	1	5	0	8	0	0
Tptpv3v	***1265.0-1317.2***							
1279	389.8	1279	6	0	0	2	85	0
Tptpv1	**1317.2-1360.0**							
1324	403.6	1324	0	86	0	6	0	0
1358	413.9	1358	0	79	0	17	0	0
Tpbt1	**1360.0-1368.6**							

UE-25a#1 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tac	**1368.6-1789.3**							
1382	421.2	1382	0	73	0	21	0	0
1424	434.0	1424	0	79	0	17	0	0
1478	450.5	1478	2	63	0	23	0	0
1528	465.7	1528	1	56	0	21	0	0
1566	477.3	1566	7	38.01	0	29	0	0
1630	496.8	1630	2	76	0	14	0	0
1680	512.1	1680	0	77	0	17	0	0
1718	523.6	1718	1	60	0	20	0	0
Tacbt	**1789.3-1832.2**							
1824	556.0	1824	6	18	0	0	0	0
Tcp	**1832.2-2331.4**							
1852	564.5	1852	0	0	0	0	0	0
1904	580.3	1904	7	0	0	0	0	0
1953	595.3	1953	2	0	0	0	0	0
2002	610.2	2002	0.01	0	0	0	0	0
2051	625.1	2051	5	0	0	0	0	0
Tcplnw	***2083.0-2331.4***							
2113	644.0	2113	3	11	0	0	69	0
2220	676.7	2220	1	68	0	15	0	0
2304	702.3	2304	4	52	0	0	0	0
Tcbt3	**2331.4-2333.5**							
Tcb	**2333.5-bottom**							
2361	719.6	2361	3	0	0	0	0	0
2408	734.0	2408	2	0	0	0	0	0
2449	746.5	2449	2	0	0	0	0	0
2492	759.6	2492	4	0	0	0	0	0

UE-25b#1

N-S	E-W	Elevation
765247	566350	3938.2 ft

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tcbt3	**2355.6-2361.3**							
Tcb	**2361.3-2852.8**							
Tcbunw	***2361.3-2382.0***							
Tcbuw	***2382.0-2784.0***							
2402	732.1	2402	15	0	0	0	0	0
2450	746.8	2450	10	0	0	0	0	0
2525	769.6	2525	10	0	0	0	0	0
2596	791.3	2596	10	0	0	0	0	0
2651	808.0	2651	10	0	0	0	0	0
2737	834.2	2737	3	0	0	0	0	0
Tcblnw	***2784.0-2852.8***							
2832	863.2	2832	15	21	0	0	0	0
2847	867.7	2847	7	19	0	0	0	0
Tcbt2	**2852.8-2882.7**							
2855	870.2	2855	18	21	0	0	0	0
2867	873.9	2867	18	3	0	0	0	0
2879	877.5	2879	23	20	0	0	0	0
Tct	**2882.7-3901.1**							
Tctunw	***2882.7-2932.0***							
2919	889.7	2919	0	30	0	0	0	0
Tctuw	***2932.0-3368.0***							
2946	897.9	2946	6	0	0	0	0	0
2953	900.1	2953	6	0	0	0	0	0
2988	910.7	2988	10	0.01	0	0	0	0
3050	929.6	3050	10	3	0	0	0	0
3092	942.4	3092	6	0.01	0	0	0	0
3095	943.4	3095	3	0	0	0	0	0
3098	944.3	3098	10	0	0	0	0	0
3128	953.4	3128	10	0	0	0	0	0
3163	964.1	3163	3	0	0	0	0	0
3185	970.8	3185	18	0	0	0	0	0
3196	974.1	3196	6	0	0	0	0	0
3222	982.1	3222	3	0	0	0	0	0
3225	983.0	3225	10	0	0	0	0	0
3257	992.7	3257	40	0	0	0	0	0
3267	995.8	3267	23	0	0	0	0	0
3298	1005.2	3298	10	0	0	0	0	0.01
3326	1013.8	3326	10	0	0	0	0	3
3362	1024.7	3362	18	0	0	0	0	3

UE-25b#1 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tctlnw	***3368.0-3901.1***							
3374	1028.4	3374	10	0	0	0	0	20
3393	1034.2	3393	10	0	0	0	0	20
3401	1036.6	3401	3	0	0	0	0	20
3459	1054.3	3459	10	0	0	0	0	20
3469	1057.4	3469	10	0	0	0	0	20
3506	1068.6	3506	18	0	0	0	0	20
3530	1075.9	3530	15	0	0	0	0	23
3548	1081.4	3548	10	0	0	0	0	3
3571	1088.4	3571	7	0	0	0	0	3
3572	1088.7	3572	6	0	0	0	0	1
3602	1097.9	3602	10	0	0	0	0	20
3660	1115.6	3660	10	0	0	0	0	23
3708	1130.2	3708	10	0	0	0	0	23
3767	1148.2	3767	10	0	0	0	0	23
3792	1155.8	3792	15	0	0	0	0	10
3835	1168.9	3835	15	0	0	0	0	23
3880	1182.6	3880	15	0	0	0	0	15
3901	1189.0	3901	40	0	0	0	0	0.01
Tcbt1	**3901.1-3960.5**							
3902	1189.3	3902	40	6	0	0	0	0
3904	1189.9	3904	30	0	0	0	0	23
3910	1191.8	3910	10	0	0	0	0	6
3926	1196.6	3926	15	0	0	0	0	0
3956	1205.8	3956	23	0	0	0	0	3
Tr	**3960.5-bottom**							
3963	1207.9	3963	30	0	0	0	0	18
3988	1215.5	3988	18	0	0	0	0	0

UE-25p#1

N-S	E-W	Elevation
756171	571485	3655.0 ft

Sample	Strat Interval (ft) Sample Depth	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Qac	**0-128.0**							
Tmr	**128.0-170.0**							
Tpbt6	**170.0-180.0**							
Tpcrn	**180.0-250.0**							
200-210	61.8-64.0	205	0	0	14	6	0	0
Tpcpul	**250.0-267.0**							
260-270	79.2-82.3	265	2	0	0.01	24	0	0
Tptrn	**267.0-403.0**							
280-290	85.3-88.4	285	2	0	0.01	25	0	0
Tptpul	**403.0-495.0**							
410-420	125.0-128.0	415	3	0	4	24	0	0
Tptpmn	**495.0-646.0**							
570-580	173.7-176.8	575	2	0	0.01	3	0	0
Tptpll	**646.0-952.0**							
810-820	246.9-249.9	815	2	0	0	5	0	0
900-910	274.3-277.4	905	1	0	0	1	0	0
Tptpln	**952.0-1095.0**							
1040-1050	317.0-320.0	1045	0	0	0	5	0	0
Tptpv3	**1095.0-1153.0**							
Tptpv1	**1153.0-1250.0**							
1240-1250	378.0-381.0	1245	1	54	0	20	0	0
Tac	**1250.0-1385.0**							
1260-1270	384.0-387.1	1265	1	62	0	23	0	0
1290SW	393.2	1290	2	37	0	22	0	0
1340-1350	408.4-411.5	1345	0.01	56	0	20	0	0
Tacbt	**1385.0-1430.0**							
1400SW	426.7	1400	10	34	0	0	9	0
1420SW	432.8	1420	12	0	0	0	22	0
Tcp	**1430.0-1792.0**							
Tcpunw	***1430.0-1530.0***							
1470SW	448.1	1470	5	34	0	0	0	0
Tcpuw	***1530.0-1670.0***							
1590-1598	484.6-487.1	1595	0	3	0	0	0	0
1640-1650	499.9-502.9	1645	5	0	0	0	0	0
Tcplnw	***1670.0-1792.0***							
1690-1700	515.1-518.2	1695	7	40	0	17	0	0
1730-1740	527.3-530.4	1735	3	60	0	14	0	0
Tcbt3	**1792.0-1830.0**							
1790-1800	545.6-548.6	1795	1	68	0	0	0	0

UE-25p#1 continued

Sample	Strat Interval (ft) Sample Depth	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tcb	**1830.0-2240.0**							
Tcbuw	***1830.0-2185.0***							
1830-1840	557.8-560.8	1835	0.01	0	0	0	0	0
1870-1880	570.0-573.0	1875	3	9	0	0	0	0
1920-1930	585.2-588.3	1925	5	0	0	0	0	0
1970-1980	600.5-603.5	1975	0.01	0	0	0	0	0
1990-2000	606.6-609.6	1995	1	0	0	0	0	0
2030-2040	618.7-621.8	2035	2	0	0	0	7	0
2070-2080	630.9-634.0	2075	0.01	0	0	0	0	0
2120-2130	646.2-649.2	2125	0.01	0	0	0	0	0
2150-2160	655.3-658.4	2155	3	0.01	0	0	0	0
Tcblnw	***2185.0-2240.0***							
2210-2220	673.6-676.7	2215	3	28	0	0	0	14
Tcbt2	**2240.0-2265.0**							
2240-2250	682.8-685.8	2245	7	3	0	0	0	8
Tct	**2265.0-2863.0**							
Tctunw	***2265.0-2310.0***							
2280-2290	694.9-698.0	2285	6	31	0	0	0	4
Tctuw	***2310.0-2725.0***							
2330-2340	710.2-713.2	2335	11	2	0	0	0	4
2370-2380	722.4-725.4	2375	7	0	0	0	0	0
2410-2420	734.6-737.6	2415	0.01	0	0	0	0	0
2460-2470	749.8-752.9	2465	2	0	0	0	0	0
2510-2520	765.0-768.1	2515	0	0	0	0	0	0
2570-2580	783.3-786.4	2575	2	0	0	0	0	0
2630-2640	801.6-804.7	2635	7	0	0	0	0	0
2650-2660	807.7-810.8	2655	15	0	0	0	0	0
2690-2700	819.9-823.0	2695	4	0	0	0	0	0
Tctlnw	***2725.0-2863.0***							
2750-2760	838.2-841.2	2755	13	13	0	0	0	0
2790-2800	850.4-853.4	2795	21	4	0	0	0	0
2840-2850	865.6-868.7	2845	25	0	0	0	0	0.01
Tr	**2863.0-3488.0**							
2890-2900	880.9-883.9	2895	15	0	0	0	0	0
2940-2950	896.1-899.2	2945	4	0	0	0	0	2
2980-2990	908.3-911.4	2985	6	0	0	0	0	6
3030-3040	923.5-926.6	3035	11	1	0	0	0	0.01
3080-3090	938.8-941.8	3085	15	0	0	0	0	0
3130-3140	954.0-957.1	3135	6	2	0	0	0	5
3160-3170	963.2-966.2	3165	13	3	0	0	0	11
3230-3240	984.5-987.6	3235	5	0.01	0	0	0	19
3270-3280	996.7-999.7	3275	5	2	0	0	0	13
3320-3330	1011.9-1015.0	3225	25	4	0	0	0	0

UE-25p#1 continued

Sample	Strat Interval (ft) Sample Depth	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
3370-3380	1027.2-1030.2	3375	22	2	0	0	0	0
3410-3420	1039.4-1042.4	3415	7	3	0	0	0	6
3453C	1052.5	3453	6	2	0	0	0	13
3480-3490	1060.7-1063.8	3485	7	7	0	0	0	4
Trbt	**3488.0-3502.0**							
Tta	**3502.0-3610.0**							
3510-3520	1069.8-1072.9	3515	11	0	0	0	0	0
3550-3560	1082.0-1085.1	3555	4	0	0	0	0	0
3560-3570	1085.1-1088.1	3565	7	0	0	0	0	0
3590-3600	1094.2-1097.3	3595	9	0	0	0	0	0
Ttc	**3610.0-3844.0**							
3630-3640	1106.4-1109.5	3635	19	0	0	0	0	0
3650-3660	1112.5-1115.6	3655	19	0	0	0	0	0
3660-3670	1115.6-1118.6	3665	16	0	0	0	0	0
3690-3700	1124.7-1127.8	3695	15	0	0	0	0	3
3720-3730	1133.9-1136.9	3725	20	0	0	0	0	2
3750-3760	1143.0-1146.0	3755	15	0.01	0	0	0	0
3790-3800	1155.2-1158.2	3795	14	0	0	0	0	0
3820-3830	1164.3-1167.4	3825	9	0.01	0	0	0	0
Tca	**3844.0-4080.0**							
3860-3870	1176.5-1179.6	3865	10	0	0	0	0	0
3913C	1192.7	3913	37	0	0	0	0	0
3916C	1193.6	3916	45	0	0	0	0	0
3928C	1197.3	3928	40	0	0	0	0	0
3940-3950	1200.9-1204.0	3945	9	0	0	0	0	0.01
3980-3990	1213.1-1216.2	3985	13	2	0	0	0	2
4040-4050	1231.4-1234.4	4045	16	2	0	0	0	0.01
4070-4080	1240.5-1243.6	4075	29	1	0	0	0	0.01
Slm	**4080.0-5470.0**							
4080-4090	1243.6-1249.1	4085	2	0	0	0	0	0
4170-4180	1271.0-1274.1	4175	9	0	0	0	0	0
4313-4318	1314.6-1316.1	4316	1	0	0	0	0	0
Srm	**5470.0-bottom**							

UE-25 UZ#16

N-S	E-W	Elevation
760535	564858	4000.6 ft

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Qac	**0-39.7**							
39.2/39.3	12.0	39.3	0.01	0	20	15	0	0
Tpcpll	**39.7-75.0**							
54.8/55.0	16.8	54.9	2	0	4	28	0	0
64.7/64.9	19.8	64.8	3	0	7	25	0	0
Tpcpln	**75.0-93.5**							
78.6/78.9	24.1	78.8	3	0	3	30	0	0
88.7/88.8	27.1	88.8	2	0	3	31	0	0
Tpclnc	**93.5-140.8**							
102.1/102.2	31.2	102.2	3	0	3	32	0	0
112.5/112.7	34.4	112.6	3	0	2	32	0	0
126.0/126.2	38.5	126.1	1	1	0.01	33	0	0
140.2/140.3	42.8	140.3	1	0	0.01	32	0	0
Tpcpv1	**140.8-160.7**							
154.2/154.5	47.1	154.4	8	0	0	12	63	0
156.1/156.2	47.6	156.2	14	0	0	0.01	82	0
Tpbt4	**160.7-165.9**							
165.1/165.3	50.4	165.2	6	0	0	2	71	0
Tpy	**165.9-175.0**							
167.4/167.5	51.1	167.5	12	0	0	0	85	0
171.3/171.5	52.3	171.4	9	0	0	0	91	0
174.9/175.1	53.4	175.0	11	0	0	2	78	0
Tpbt3	**175.0-188.8**							
179.3/179.4	54.7	179.4	6	0	0	2	65	0
183.9/184.1	56.1	184.0	18	0	0	1	59	0
188.5/188.7	57.5	188.6	7	0	0	1	70	0
Tpbt2	**188.8-209.7**							
190.4/190.5	58.1	190.5	16	0	0	1	58	0
201.8/202.2	61.6	202.0	9	0	0	0.01	64	0
Tptrv2	**209.7-230.3**							
211.4/211.6	64.5	211.5	8	0	0	0.01	71	0
217.1/218.0	66.5	217.6	18	0	0	0.01	57	0
223.7/224.2	68.3	224.0	9	18	0	15	0	0
224.1/224.7	68.5	224.4	6	18	0	24	0	0
227.0/227.2	69.3	227.1	5	17	0	34	0	0
230.1/230.3	70.2	230.2	1	0	0	1	73	0
Tptrv1	**230.3-238.9**							
234.1/234.2	71.4	234.2	0.01	0	0	2	58	0
Tptrn	**238.9-357.8**							
249.8/250.0	76.2	249.9	1	0	3	13	0	0
269.2/269.8	82.2	269.5	1	0	7	11	0	0
290.8/291.2	88.8	291.0	1	0	12	8	0	0
309.1/309.5	94.3	309.3	0.01	0	13	8	0	0
331.7/332.2	100.3	332.0	1	0	22	5	0	0
348.7/349.7	106.6	349.2	5	0	22	8	0	0

UE-25 UZ#16 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tptrl	**357.8-371.0**							
370.2/370.7	113.0	370.5	7	0	22	8	0	0
Tptpul	**371.0-549.0**							
391.6/392.0	119.5	391.8	6	0	11	21	0	0
412.7/413.0	125.9	412.9	4	0	16	19	0	0
435.1/435.5	132.7	435.3	4	0	7	28	0	0
458.6/458.9	139.9	458.8	4	0	10	17	0	0
484.4/485.7	148.0	484.6	4	0	4	29	0	0
509.6/510.0	155.5	509.8	4	0	3	28	0	0
533.3/533.6	162.6	533.5	4	0	1	25	0	0
Tptpmn	**549.0-690.0**							
552.9/553.3	168.7	553.1	3	0	0.01	16	0	0
577.3/577.6	176.1	577.5	3	0	1	13	0	0
602.8/603.4	183.9	603.1	3	0	3	27	0	0
627.9/628.2	191.5	628.1	3	0.01	1	26	0	0
648.8/649.3	197.9	649.1	4	1	4	27	0	0
674.2/674.7	205.7	674.5	5	0	1	13	0	0
Tptpll	**690.0-915.0**							
701.5/701.9	213.9	701.7	3	0	1	5	0	0
726.1/726.4	221.4	726.3	1	2	7	10	0	0
751.4/751.7	229.1	751.6	3	0	1	10	0	0
773.0/773.4	235.7	773.2	1	3	3	19	0	0
797.0/797.2	243.0	797.1	1	1	1	23	0	0
820.6/820.9	250.2	820.8	3	1	1	11	0	0
843.0/843.5	257.1	843.3	3	0.01	6	16	0	0
862.4/862.7	263.0	862.6	2	5	5	22	0	0
876.8/877.1	267.3	877.0	3	11	4	21	0	0
896.2/896.6	273.3	896.4	4	0	6	24	0	0
910.2/910.4	277.5	910.3	6	2	3	18	0	0
Tptpln	**915.0-1111.2**							
925.4/925.7	282.2	925.6	4	5	4	26	0	0
940.0/940.4	286.6	940.2	4	1	0.01	13	0	0
954.3/954.7	291.0	954.5	3	2	3	20	0	0
970.9/971.4	296.1	971.2	5	2	2	21	0	0
984.2/984.8	300.2	984.5	4	4	2	21	0	0
1001.0/1001.6	305.3	1001.3	5	4	1	16	0	0
1014.9/1015.0	309.4	1015.0	6	0	5	21	0	0
1029.2/1029.5	313.8	1029.4	5	14	3	21	0	0
1030.4/1030.6	314.1	1030.5	4	8	2	18	0	0
1047.0/1047.3	319.2	1047.2	4	2	2	13	0	0
1059.6/1059.8	323.0	1059.7	5	0	3	23	0	0
1074.8/1075.1	327.7	1075.0	4	1	2	17	0	0
1090.4/1090.6	332.4	1090.5	4	2	1	15	0	0
1104.1/1104.4	336.6	1104.3	2	0	0	8	0	0
Tptpv3	**1111.2-1165.2**							
Tptpv3a	**1111.2-1113.1**							
1113.0/1113.2a	339.3	1113.0	73	4	0	10	0	0

UE-25 UZ#16 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tptpv3v	**1113.1-1165.2**							
1113.0/1113.2b	339.3	1113.2	5	0	0	7	73	0
1135.3/1135.6	346.1	1135.5	3	0	0	9	80	0
1149.2/1149.5	350.4	1149.4	0	0	0	10	82	0
1157.4/1157.6	352.8	1157.5	1	0	0	12	75	0
Tptpv1	**1165.2-1191.2**							
1166.5/1167.0	355.7	1166.8	2	10	0	20	49	0
1179.8/1180.5	359.8	1180.2	1	80	0	13	0	0
1190.2/1191.2	363.1	1190.7	6	85	0	6	0	0
Tpbt1	**1191.2-1201.3**							
Tac	**1201.3-1455.4**							
1202.8/1203.1	366.7	1203.0	1	78	0	14	0	0
1215.7/1216.0	370.6	1215.9	1	83	0	12	0	0
1235.5/1235.7	376.6	1135.6	1	76	0	18	0	0
1256.6/1256.9	383.1	1256.8	8	72	0	10	0	0
1261.0/1261.2a	384.4	1261.1	1	66	0	22	0	0
1275.7/1276.0	388.9	1275.9	3	62	0	18	0	0
1300.2/1300.3	396.3	1300.3	9	63	0	20	0	0
1305.0/1305.3	397.9	1305.2	2	69	0	19	0	0
1312.0/1312.4	400.0	1312.2	3	66	0	18	0	0
1335.4/1336.2	407.3	1335.8	1	49	0	26	0	0
1342.7/1343.0	409.4	1342.9	3	71	0	19	0	0
1362.3/1362.7	415.4	1362.5	3	65	0	17	0	0
1379.3/1379.5	420.5	1379.4	3	69	0	21	0	0
1417.5/1418.0	432.2	1417.8	2	66	0	19	0	0
1441.3/1441.8	439.5	1441.6	2	77	0	17	0	0
Tabt1	**1455.4-1485.0**							
1460.2/1460.7	445.2	1460.5	5	46	0	27	0	0
1476.7/1477.0	450.2	1476.9	5	40	0	20	0	0
Tcp	**1485.0-bottom**							
Tcpunw	**1485.0-1510.0**							
1498.4/1498.9	456.9	1498.7	0	8	0	20	0	0
Tcpuw	**1510.0-1659.0**							
1521.7/1522.2	464.0	1522.0	3	0	0	0	0	0
1539.3/1539.7	469.3	1539.5	4	0	0	0	0	0
1561.2/1561.7	476.0	1561.5	4	0	0	0	0	0
1579.1/1579.9	481.6	1579.5	3	0	0	0	0	0
1600.2/1600.4	487.8	1600.3	4	0	0	0	0	0
1618.7/1619.2	493.5	1619.0	3	0	0	14	0	0
1638.7/1639.2	499.6	1639.0	7	0	0	15	0	0
1655.5/1656.0	504.8	1655.8	6	0	0	27	0	0
Tcplnw	**1659.0-bottom**							
1683.5/1684.0	513.3	1683.8	3	42	0	28	0	0

USW G-1

	N-S	E-W	Elevation
	770477	561000	4348.6 ft

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Qac	**0-60.0**							
Tpy	**60.0-100.0**							
Tpbt3	**100.0-135.0**							
Tpp	**135.0-235.0**							
Tptrv3	**235.0-270.0**							
Tptrv1	**270.0-292.5**							
292	89.0	292	0	0	4	15	0	0
Tptrn	**292.5-438.0**							
352	107.3	352	0	3	9	8	0	0
399	121.6	399	0	0	12	5	0	0
Tptpul	**438.0-713.4**							
450	137.2	450	3	0	24	6	0	0
553	168.6	553	2	0	7	27	0	0
619	188.7	619	2	0	20	11	0	0
673	205.1	673	1	0	6	24	0	0
Tptpmn	**713.4-814.8**							
722	220.1	722	2	0	0.01	22	0	0
757	230.7	757	1	0	6	27	0	0
Tptpll	**814.8-1199.2**							
819	249.6	819	2	0	4	26	0	0
874	266.4	874	2	0	7	5	0	0
995	303.3	995	3	0	5	23	0	0
1063	324.0	1063	2	0	7	16	0	0
1104	336.5	1104	2	0	4	20	0	0
1123	342.3	1123	2	0	6	18	0	0
1179	359.4	1179	3	0	3	19	0	0
1191	363.0	1191	4	0	6	16	0	0
Tptpln	**1199.2-1286.0**							
1240	378.0	1240	2	0	2	17	0	0
1274	388.3	1274	2	0.01	2	18	0	0
1281	390.4	1281	2	0	2	14	0	0
Tptbv3	**1286.0-1342.4**							
Tptpv3a	*1286.0-1288.0*							
1286	392.0	1286	33	10	0	16	0	0
Tptpv3v	*1288.0-1342.4*							
1319	402.0	1319	0	0	0	3	92	0
1341	408.7	1341	0	2	0	4	87	0
Tptpv2	**1342.4-1360.5**							
1357	413.6	1357	1	0	0	3	88	0
Tptpv1	**1360.5-1403.9**							
1392	424.3	1392	0.01	6	0	2	88	0
1400	426.7	1400	0.01	83	0	12	0	0
Tpbt1	**1403.9-1425.5**							

USW G-1 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tac	**1425.5-1736.4**							
1492	454.8	1492	0.01	74	0	19	0	0
1539	469.1	1539	1	46.01	0	19	0	0
1561	475.8	1561	0.01	79	0	11	0	0
1639	499.6	1639	0.01	72	0	12	0	0
1693	516.0	1693	0	66	0	15	0	0
Tacbt	**1736.4-1799.0**							
1748	532.8	1748	0	66	0	26	0	0
1774	540.7	1774	0.01	60	0	4	0	0
1784	543.8	1784	4	38	0.01	7	0	0
Tcp	**1799.0-2154.9**							
Tcpunw	***1799.0-1880.0***							
1799	548.3	1799	3	51	0	35	0	0
1819	554.4	1819	1	54	0	20	0	0
Tcpuw	***1880.0-1990.0***							
1942	591.9	1942	2	0	0	5	0	0
Tcplnw	***1990.0-2154.9***							
2136	651.1	2136	0	51	0	23	0	0
Tcbt3	**2154.9-2173.0**							
2173	662.3	2173	0	42	0	8	0	0
Tcb	**2173.0-2601.6**							
Tcbunw	***2173.0-2370.0***							
2190	667.5	2190	4	51	0	23	0	0
2198	670.0	2198	1	50	0	20	0	0
2256	687.6	2256	0	44.01	0	22	0	0
2279	694.6	2279	0.01	67	0	8	0	0
2290	698.0	2290	2	74	0	2	0	0
2316	705.9	2316	0	53	0	0	0	0
Tcbuw	***2370.0-2554.0***							
2401	731.8	2401	3	0	0	0.01	0	0
2456	748.6	2456	1	0	0	0	0	0
2486	757.7	2486	1	0	0	0	0	0
2499	761.7	2499	0.01	0	0	0.01	0	0
2506	763.8	2506	0.01	0	0	0.01	0	0
2544	775.4	2544	0.01	0	0	0.01	0	0
Tcblnw	***2554.0-2601.6***							
2564	781.5	2564	0.01	67	0	10	0	0
2600	792.5	2600	0	87	0	2	0	0
Tcbt2	**2601.6-2639.4**							
2606	794.3	2606	0.01	68	0	1	0	0
2607	794.6	2607	0	47	0	1	0	0
2622	799.2	2622	0.01	44	0	1	0	0

USW G-1 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tct	**2639.4-3522.0**							
Tctunw	***2639.4-2785.0***							
2641	805.0	2641	2	36	0	7	0	0
2663	811.7	2663	0.01	55	0	4	0	0
2734	833.3	2734	0.01	35	0	8	0	0
2765	842.8	2765	4	15.01	0	8	0	0
Tctuw	***2785.0-2998.0***							
2804	854.7	2804	1	0	0	1	0	0
2805	855.0	2805	3	0	0	1	0	0
2820	859.5	2820	1	0	0	0.01	0	0
2838	865.0	2838	2	0	0	0	0	0
2868	874.2	2868	1	0	0	0.01	0	0
2884	879.0	2884	2	0	0	0	0	0
2915	888.5	2915	2	0	0	0	0	0
2932	893.7	2932	1	0	0	0	0	0
2937	895.2	2937	2	0	0	0	0	0
2948	898.6	2948	2	2	0	0	0	0
2966	904.0	2966	1	0	0	0	0	0
2981	908.6	2981	3	0	0	0	0	0
Tctlnw	***2998.0-3522.0***							
3018	919.9	3018	18	7	0	0	0	4
3079	938.5	3079	11	13	0	0	0	5
3167	965.3	3167	10	19	0	0	0	5
3288	1002.2	3288	17	40	0	0	0	1
3401	1036.6	3401	4	10	0	0	0	2
Tcbt1	**3522.0-3558.2**							
3523	1073.8	3523	7	13	0	0	0	1
Tll	**3558.2-3920.0**							
3621	1103.7	3621	24	0	0	6	0	0
3810	1161.3	3810	65	0	0	0	0	0
Tllbt	**3920.0-3945.8**							
3940	1200.9	3940	48	2	0	0	0	2
Tr	**3945.8-4920.7**							
4246	1294.2	4246	17	0	0	0	0	6
4400	1341.1	4400	7	0	0	0	0	13
4503	1372.5	4503	4	0	0	0	0	19
4555	1388.4	4555	21	0	0	0	0	2
4612	1405.7	4612	13	0	0	0	0	7
4626	1410.0	4626	4	0	0	0	0	0
4652	1417.9	4652	7	0	0	0	0	11
4700	1432.6	4700	6	0	0	0	0	7
4750	1447.8	4750	8	0	0	0	0	10
4805	1464.6	4805	8	0	0	0	0	9
4848	1477.7	4848	6	0	0	0	0	11
4876	1486.2	4876	4	0	0	0	0	4
4912	1497.2	4912	7	0	0	0	0	8

USW G-1 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Trbt	**4920.7-4940.2**							
Tta	**4920.2-5320.0**							
4941	1506.0	4941	27	0	0	0	0	7
4958	1511.2	4958	8	0	0	0	0	17
4998	1523.4	4998	30	0	0	0	0	3
5026	1531.9	5026	5	0	0	0	0	2
5049	1538.9	5049	52	0	0	0	0	0
5093	1552.3	5093	5	3	0	0	0	2
5126	1562.4	5126	2	0	0	0	0	15
5167	1574.9	5167	2	0	0	0	0	14
5212	1588.6	5212	1	0	0	0	0	16
5253	1601.1	5253	1	0	0	0	0	27
5296	1614.2	5296	2	0	0	0	0	19
5310	1618.5	5310	29	0	0	0	0	0
5311	1618.8	5311	6	1	0	0	0	0
Ttb	**5320.0-5434.0**							
5329	1624.3	5329	11	0	0	0	0	12
5338	1627.0	5338	41	1	0	0	0	0
5348	1630.1	5348	9	0.01	0	0	0	0
5378	1639.2	5378	46	15	0	0	0	0
5412	1649.6	5412	5	0	0	0	0	12
5433	1656.0	5433	35	20	0	0	0	0
Ttc	**5434.0-bottom**							
5458	1663.6	5458	26	25	0	0	0	0
5477	1669.4	5477	5	0	0	0	0	12
5498	1675.8	5498	5	0	0	0	0	17
5534	1686.8	5534	38	20	0	0	0	4
5560	1694.7	5560	5	39	0	0	0	0
5596	1705.7	5596	2	1	0	0	0	7
5637	1718.2	5637	3	0	0	0	0	16
5679	1731.0	5679	20	0	0	0	0	13
5699	1737.1	5699	5	0	0	0	0	9
5746	1751.4	5746	12	0	0	0	0	10
5803	1768.8	5803	10	0	0	0	0	0
5847	1782.2	5847	13	0	0	0	0	0
5898	1797.7	5898	7	0	0	0	0	12
5947	1812.6	5947	12	2	0	0	0	15
5980	1822.7	5980	14	4	0	0	0	0

USW G-2

N-S	E-W	Elevation
778803	560513	5098.0 ft

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Qac	**0-45.0**							
10	3.0	10	0	0	15	40	0	0
Tpcrn	**45.0-105.0**							
100	30.5	100	0	0	18	40	0	0
Tpcpul	**105.0-140.0**							
Tpcpmn	**140.0-200.0**							
Tpcpln	**200.0-215.0**							
200	61.0	200	0	0	10	40	0	0
Tpcpv2	**215.0-220.0**							
Tptcpv1	**220.0-225.0**							
Tpbt4	**225.0-245.0**							
230	70.1	230	0	0	10	40	0	0
Tpy	**245.0-341.0**							
270	82.3	270	6	0	0	40	0	0
304	92.7	304	0	0	15	40	0	0
331	100.9	331	40	0	0	40	0	0
338	103.0	338	50	0	0	0	40	0
Tpbt3	**341.0-498.0**							
358	109.1	358	23	0	0	7	30	0
395	120.4	395	10	0	0	15	40	0
Tpp	**498.0-730.7**							
501	152.7	501	12	0	0	7	50	0
547	166.7	547	10	0	0	10	50	0
548	167.0	548	0	7	0	30	0	0
561	171.0	561	15	15	0	30	0	0
627	191.1	627	10	15	0	30	0	0
675	205.7	675	40	23	0	7	0	0
723	220.4	723	10	0	0	3	23	0
Tpbt2	**730.7-754.9**							
743	226.5	743	35	3	0	10	20	0
Tptrv3	**754.9-761.8**							
Tptrv2	**761.8-767.0**							
762	232.3	762	3	75	15	10	0	0
Tptrv1	**767.0-770.9**							
770	234.7	770	1	0	0	23	0	0
Tptrn	**770.9-906.4**							
822	250.5	822	7	0	15	30	0	0
855	260.6	855	3	0	10	30	0	0
898	273.7	898	1	3	7	30	0	0

USW G-2 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tptpul	**906.4-1249.4**							
921	280.7	921	15	0	0	23	0	0
951	289.9	951	1	0	0	30	0	0
984	299.9	984	6	0	0	15	0	0
1032	314.6	1032	6	0	0	30	0	0
1072	326.7	1072	6	0	0	10	0	0
1133	345.3	1133	10	0	0	30	0	0
1178	359.1	1178	3	0	0	30	0	0
1234	376.1	1234	6	0	0	30	0	0
Tptpmn	**1249.4-1271.5**							
Tptpll	**1271.5-1604.0**							
1281	390.4	1281	10	0	0	23	0	0
1331	405.7	1331	10	0	0	30	0	0
1382	421.2	1382	10	0	0	23	0	0
1420	432.8	1420	10	0	0	30	0	0
1461	445.3	1461	10	0	0	40	0	0
1536	468.2	1536	15	3	0	40	0	0
1585	483.1	1585	10	3	0	30	0	0
Tptpln	**1604.0-1634.0**							
Tptpv3	**1634.0-1669.0**							
Tptpv3a	***1634.0-1637.0***							
1634	498.0	1634	40	40	0	23	0	0
Tptpv3v	***1637.0-1669.0***							
1664	507.2	1664	1	1	0	7	60	0
Tptpv2	**1669.0-1681.0**							
Tptpv1	**1681.0-1701.0**							
1691	515.4	1691	10	57	0	20	0	0
Tpbt1	**1701.0-1757.0**							
1745	531.9	1745	15	47	0	23	0	0
1752	534.0	1752	10	67	0	10	0	0
Tac	**1757.0-2576.5**							
1798	548.0	1798	1	73	0	15	0	0
1848	563.3	1848	0	73	0	23	0	0
1899	578.8	1899	1	73	0	15	0	0
1952	595.0	1952	0	57	0	15	0	0
2001	609.9	2001	0	57	0	15	0	0
2078	633.4	2078	3	60	0	15	0	0
2158	657.8	2158	3	53	0	23	0	0.01
2248	685.2	2248	3	60	0	23	0	0
2353	717.2	2353	1	40	0	23	0	0
2430	740.7	2430	3	40	0	5	0	0
2528	770.5	2528	3	26	0	3	0	0
Tacbt	**2576.5-2704.0**							
2667	812.9	2667	3	30	0	3	0	0

USW G-2 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tcp	**2704.0-3246.5**							
Tcpunw	***2704.0-2714.0***							
Tcpuw	***2714.0-3033.0***							
2744	836.4	2744	3	0	0	7	0	0
2820	859.5	2820	1	0	0	6	0	0
2869	874.5	2869	1	0	0	3	0	0
2887	880.0	2887	3	0	0	3	0	0
2950	899.2	2950	6	0	0	6	0	0
2970	905.3	2970	10	0	0	5	0	0
Tcplnw	***3033.0-3246.5***							
3037	925.7	3037	40	3	0	3	0	0
3067	934.8	3067	0	37	0	30	0	0
3192	972.9	3192	7	40	0	3	0	0.01
3228	983.9	3228	6	1	0	0	0	30
Tcbt3	**3246.5-3281.9**							
3250	990.6	3250	23	20	0	3	0	30
Tcb	**3281.9-3503.4**							
Tcbunw	***3281.9-3302.5***							
Tcbuw	***3302.5-3447.0***							
3308	1008.3	3308	3	0	0	5	0	0
3330	1015.0	3330	0	0	0	5	0	0
3349	1020.8	3349	1	0	0	5	0	0
3366	1026.0	3366	1	0	0	5	0	0
3416	1041.2	3416	1	0	0	0	0	0
Tcblnw	***3447.0-3503.4***							
3453	1052.8	3453	28	23	0	0	0	0.01
3492	1064.4	3492	18	23	0	0	0	7
Tcbt2	**3503.4-3574.0**							
3512	1070.5	3512	15	6	0	0	0	15
3541	1079.3	3541	10	0	0	0	0	30
Tct	**3574.0-3914.0**							
Tctunw	***3574.0-3600.0***							
3578	1090.6	3578	23	23	0	0	0	0
Tctuw	***3600.0-3914.0***							
3627	1105.5	3627	15	0	0	0	0	3
3671	1118.9	3671	10	0	0	0	0	7
3720	1133.9	3720	10	0	0	0	0	0.01
3724	1135.1	3724	25	0	0	0	0	0
3750	1143.0	3750	25	0	0	0	0	0
3772	1149.7	3772	23	0	0	0	0	0
3795	1156.7	3795	32	0	0	0	0	1
3833	1168.3	3833	30	0	0	0	0	0
3875	1181.1	3875	25	0	0	0	0	3
3908	1191.2	3908	18	0	0	0	0	0

USW G-2 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tcbt1	**3914.0-4078.9**							
3933	1198.8	3933	15	0	0	0	0	30
3968	1209.4	3968	18	0	0	0	0	0.01
4005	1220.7	4005	15	0	0	0	0	3
Tll	**4078.9-4150.0**							
4090	1246.6	4090	23	0	0	0	0	6
Tllbt	**4150.0-4195.2**							
4167	1270.1	4167	15	0	0	0	0	1
Tr	**4195.2-4803.2**							
4199	1279.9	4199	15	0	0	0	0	0.01
4209	1282.9	4209	10	0	0	0	0	6
4267	1300.6	4267	15	0	0	0	0	3
4329	1319.5	4329	10	0	0	0	0	3
4467	1361.5	4467	10	0	0	0	0	3
4570	1392.9	4570	10	0	0	0	0	3
4788	1459.4	4788	15	0	0	0	0	0.01
Trbt	**4803.2-4874.0**							
4805	1464.6	4805	20	0	0	0	0	0.01
4816	1467.9	4816	23	0	0	0	0	0.01
4838	1474.6	4838	23	0	0	0	0	3
4873	1485.3	4873	30	0	0	0	0	1
Tll2	**4874.0-5637.3**							
4885	1488.9	4885	30	0	0	0	0	0
4893	1491.4	4893	23	0	0	0	0	1
4924	1500.8	4924	18	0	0	0	0	3
4949	1508.5	4949	40	0	0	0	0	0
5017	1529.2	5017	20	0	0	0	0	0
5029	1532.8	5029	20	0	0	0	0	0
5144	1567.9	5144	6	0	0	0	0	0
5171	1576.1	5171	18	0	0	0	0	0
5206	1586.8	5206	15	0	0	0	0	0.01
5213	1588.9	5213	10	0	0	0	0	0
5305	1617.0	5305	10	0	0	0	0	0
5369	1636.5	5369	10	0	0	0	0	0
5379	1639.5	5379	6	0	0	0	0	0
5434	1656.3	5434	6	0	0	0	0	1
5493	1674.3	5493	3	0	0	0	0	0
5505	1677.9	5505	10	0	0	0	0	0
5538	1688.0	5538	25	0	0	0	0	0
5596	1705.7	5596	15	0	0	0	0	0
Tll2bt	**5637.3-5670.6**							
5638	1718.5	5638	18	0	0	0	0	0.01
5657	1724.3	5657	30	0	0	0	0	0

USW G-2 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tll3	**5670.6-5885.4**							
5696	1736.1	5696	15	0	0	0	0	1
5762	1756.3	5762	10	0	0	0	0	0
5820	1773.9	5820	0	0	0	0	0	0
5885	1793.7	5885	18	0	0	0	0	0
Tll3bt	**5885.4-5942.5**							
5895	1796.8	5895	18	0	0	0	0	0
5918	1803.8	5918	10	0	0	0	0	0
5926	1806.2	5926	15	0	0	0	0	0.01
5931	1807.8	5931	23	0	0	0	0	0
Tt	**5942.5-bottom**							
5951	1813.9	5951	23	0	0	0	0	1
5971	1820.0	5971	18	0	0	0	0	3
5992	1826.4	5992	18	0	0	0	0	3

USW G3/GU-3

N-S	E-W	Elevation
752650	558497	4856.9 ft

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tpcrn	**0-31.3**							
31.0	9.5	31.0	3	0	0	10	0	0
Tpcpul	**31.3-64.0**							
45.0	13.7	45.0	0	0	6	17	0	0
Tpcpmn	**64.0-212.3**							
79.0	24.1	79.0	0	0	25	6	0	0
103.1	31.4	103.1	0	0	7	20	0	0
196.3	59.8	196.3	0	0	0	25	0	0
Tpcpll	**212.3-281.0**							
245.7	74.9	245.7	2	0	3	25	0	0
Tpcpln	**281.0-343.5**							
303.6	92.5	303.6	0.01	0	0	25	0	0
316.8	96.6	316.8	0	0	0	22	0	0
341.5	104.1	341.5	3	0	0	30	0	0
Tpcpv3	**343.5-348.1**							
Tpcpv2	**348.1-354.3**							
Tpcpv1	**354.3-373.7**							
356.5	108.7	356.5	7	0	0	15	40	0
Tpbt2	**373.7-423.8**							
376.1	114.6	376.1	4	0	0	5	40	0
410.0	125.0	410.0	20	0	0	25	0	0
414.3	126.3	414.3	3	0	0	20	0	0
417.5	127.3	417.5	12	0	0	17	0	0
Tptrv2	**423.8-427.8**							
424.4	129.4	424.4	0	0	6	17	0	0
Tptrv1	**427.8-429.8**							
429.0	130.8	429.0	0	0	4	20	0	0
Tptrn	**429.8-550.8**							
430.5	131.2	430.5	0	0	4	12	0	0
465.5	141.9	465.5	0	0	10	9	0	0
482.0	146.9	482.0	0	0	20	7	0	0
520.3	158.6	520.3	0	0	20	5	0	0
525.3	160.1	525.3	1	0	20	6	0	0
Tptpul	**550.8-728.3**							
579.0	176.5	579.0	1	0	12	22	0	0
633.4	193.1	633.4	1	0	7	22	0	0
674.7	205.7	674.7	1	0	5	22	0	0
702.5	214.1	702.5	1	0	0	17	0	0
Tptpmn	**728.3-903.9**							
769.1	234.4	769.1	1	0	6	22	0	0
849.4	258.9	849.4	1	0	0	17	0	0

USW G3/GU-3 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tptpll	**903.9-1044.0**							
910.5	277.5	910.5	1	0	0	27	0	0
924.3	281.7	924.3	1	0	10	12	0	0
951.1	289.9	951.1	1	0	5	17	0	0
954.8	291.0	954.8	1	0	0	12	0	0
1027.0	313.0	1027.0	0	0	0	17	0	0
Tptpln	**1044.0-1187.2**							
1061.0	323.4	1061.0	0	0	0	7	0	0
1130.3	344.5	1130.3	0	0	0	10	0	0
1175.0	358.1	1175.0	1	0	0	3	0	0
Tptpv3	**1187.2-1268.8**							
Tptpv3a	***1187.2-1196.0***							
1195.7	364.5	1195.7	5	0	0	27	30	0
Tptpv3v	***1196.0-1268.8***							
1227.0	374.0	1227.0	2	0	0	17	40	0
Tptpv2	**1268.8-1299.2**							
Tptpv1	**1299.2-1406.4**							
1302.4	397.0	1302.4	2	0	0	12	45	0
1322.0	403.0	1322.0	0	0	0	7	65	0
1344.8	409.9	1344.8	0	0	0	7	55	0
1369.6	417.5	1369.6	0	0	0	6	65	0
1394.5	425.0	1394.5	0	0	0	6	65	0
1394.6	425.1	1394.6	0	0	0	6	65	0
Tpbt1	**1406.4-1412.9**							
Tac	**1412.9-1506.8**							
1415.5	431.4	1415.5	0	0	0	6	55	0
1439.2	438.7	1439.2	0.01	0	0	6	55	0
1439.5	438.8	1439.5	1	0	0	6	55	0
1468.5	447.6	1468.5	0	0	0	6	55	0
1493.7	455.3	1493.7	1	2	0	6	65	0
1498.3	456.7	1498.3	0	3	0	6	65	0
Tacbt	**1506.8-1553.9**							
1510.7	460.5	1510.7	3	0	0	6	65	0
1537.5	468.6	1537.5	3	2	0	4	20	0
Tcp	**1553.9-1992.3**			0				
Tcpunw	***1553.9-1570.0***							
Tcpuw	***1570.0-1790.0***							
1571.6	479.0	1571.6	2	0	0	5	45	0
1598.5	487.2	1598.5	4	0	0	2	45	0
1603.0	488.6	1603.0	0	0	0	30	0	0
1624.2	495.1	1624.2	0	0	7	2	0	0
1653.2	504.0	1653.2	1	0	15	3	0	0
1709.0	521.0	1709.0	1	0	0	12	0	0
1744.0	531.6	1744.0	0	0	0	25	0	0

USW G3/GU-3 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tcplnw	***1790.0-1992.3***							
1827.2	557.0	1827.2	2	30	0	7	38	0
1874.0	571.2	1874.0	0	50	0	5	0	0
1935.8	590.0	1935.8	3	60	0	4	0	0
1986.0	605.3	1986.0	0	70	0	6	0	0
Tcbt3	**1992.3-1998.7**							
1993.1	607.5	1993.1	0	60	0	10	0	0
Tcb	**1998.7-2617.2**							
Tcbunw	***1998.7-2040.0***							
2013.2	613.6	2013.2	2	50	0	4	0	0
Tcbuw	***2040.0-2515.3***							
2070.2	631.0	2070.2	2	0	7	3	0	0
2138.2	651.7	2138.2	2	0	0	12	0	0
2177.3	663.6	2177.3	2	0	0	10	0	0
2189.3	667.3	2189.3	2	0	0	15	0	0
2198.0	670.0	2198.0	2	0	0	17	0	0
2360.0	719.3	2360.0	0	0	0	12	0	0
2369.4	722.2	2369.4	2	0	0	12	0	0
2467.4	752.1	2467.4	0	0	0	10	0	0
Tcblnw	***2515.3-2617.2***							
2548.4	776.8	2548.4	30	12	0	0	0	0
2577.4	785.6	2577.4	3	50	0	5	0	0
2615.3	797.1	2615.3	2	40	0	7	0	0
Tcbt2	**2617.2-2637.1**							
2623.4	799.6	2623.4	3	30	0	2	0	0
Tct	**2637.1-3849.0**							
Tctunw	***2637.1-2710.0***							
2656.6	809.7	2656.6	4	30	0	8	0	0
2695.7	821.7	2695.7	1	40	0	10	0	0
Tctuw	***2710.0-3138.0***							
2727.4	831.3	2727.4	1	0	0	15	0	0
2914.5	888.3	2914.5	0	0	0	7	0	0
2971.0	905.6	2971.0	1	0	0	12	0	0
3004.5	915.8	3004.5	0	0	0	4	0	0
3045.3	928.2	3045.3	1	0	0	7	0	0
3113.1	948.9	3113.1	1	0	0	17	0	0
Tctlnw	***3138.0-3849.0***							
3164.1	964.4	3164.1	2	10	0	15	0	0
3207.4	977.6	3207.4	2	10	0	17	0	0
3226.0	983.3	3226.0	5	6	0	15	0	0
3239.0	987.3	3239.0	0	0	0	15	0	0
3311.0	1009.2	3311.0	3	15	0	10	0	0
3475.3	1059.3	3475.3	3	20	0	10	0	0
3589.4	1094.1	3589.4	7	35	0	7	0	0
3672.0	1119.2	3672.0	6	22	0	8	0	0
3759.1	1145.8	3759.1	9	15	0	0	0	0

USW G3/GU-3 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tcbt1	**3849.0-3876.3**							
3854.8	1174.9	3854.8	7	35	0	0	0	0
3859.3	1176.3	3859.3	3	25	0	0	0	0
Tr	**3876.3-4873.2**							
3936.3	1199.8	3936.3	1	10	0	1	0	5
4008.3	1221.7	4008.3	3	0	0	0	0	15
4117.0	1254.9	4117.0	4	0	0	0	0	9
4240.6	1292.5	4240.6	12	0	0	0	0	0
4263.8	1299.6	4263.8	4	0	0	0	0	25
4416.0	1346.0	4416.0	4	0	0	0	0	7
4423.0	1348.1	4423.0	9	12	0	0	0	7
4503.7	1372.7	4503.7	20	4	0	0	0	4
4568.4	1392.5	4568.4	17	2	0	0	0	12
4600.3	1402.2	4600.3	6	2	0	0	0	0
4708.5	1435.2	4708.5	9	0	0	0	0	17
4756.5	1449.8	4756.5	6	0	0	0	0	12
4786.4	1458.9	4786.4	7	0	0	0	0	17
4803.2	1464.0	4803.2	1	0	0	0	0	17
4869.4	1484.2	4869.4	3	0	0	0	0	37
Tll3bt	**4873.2-4883.0**							
Tt	**4883.0-bottom**							
4906.5	1495.5	4906.5	2	0	0	0	0	35
5014.0	1528.3	5014.0	4	0	0	0	0	15

USW G-4

	N-S	E-W	Elevation
	765764	563036	4166.9 ft

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Qac	**0-30.0**							
Tpcpul	**30.0-60.5**							
47	14.3	47	2	0	0	28	0	0
Tpcpmn	**60.5-96.7**							
72	21.9	72	1	0	0	28	0	0
Tpcpln	**96.7-118.0**							
107	32.6	107	0	0	0	32	0	0
Tpcpv1	**118.0-138.0**							
123	37.5	123	25	0	0	15	20	0
Tpbt4	**138.0-148.0**							
148	45.1	148	35	0	0	15	50	0
Tpy	**148.0-148.8**							
Tpbt3	**148.8-168.2**							
Tpp	**168.2-188.0**							
170	51.8	170	28	0	0	5	20	0
Tpbt2	**188.0-228.0**							
220	67.1	220	10	0	0	5	20	0
Tptrv3	**228.0-233.4**							
231	70.4	231	8	0	0	3	20	0
Tptrv2	**233.4-239.0**							
236	71.9	236	0	0	0	10	60	0
Tptrv1	**239.0-242.8**							
Tptrn	**242.8-400.4**							
268	81.7	268	0	0	20	6	0	0
280	85.3	280	0	0	10	5	0	0
332	101.2	332	0	0	7	15	0	0
383	116.7	383	3	0	15	11	0	0
Tptrl	**400.4-420.0**							
410	125.0	410	3	0	17	12	0	0
416	126.8	416	3	0	9	14	0	0
Tptpul	**420.0-680.0**							
447	136.2	447	2	0	6	20	0	0
514	156.7	514	2	0	6	22	0	0
556	169.5	556	2	0	19	9	0	0
625	190.5	625	2	0	11	6	0	0
676	206.0	676	3	0	4	23	0	0
Tptpmn	**680.0-770.0**							
694	211.5	694	3	0	17	13	0	0
746	227.4	746	1	0	0	28	0	0
Tptpll	**770.0-1127.9**							
817	249.0	817	2	0	0	7	0	0
934	284.7	934	1	0	8	11	0	0
1026	312.7	1026	1	0	5	20	0	0
1089	331.9	1089	1	0	16	10	0	0
1117	340.5	1117	1	0	0	14	0	0

USW G-4 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tptpln	**1127.9-1314.0**							
1163	354.5	1163	0	0	0	15	0	0
1190	362.7	1190	1	0	0	13	0	0
1244	379.2	1244	1	0	0	15	0	0
1282	390.8	1282	1	0	0	18	0	0
1283-1293E	391.1-394.1	1288	1	0	0	23	0	0
1299	395.9	1299	2	5	0	23	0	0
1301	396.5	1301	1	5	0	20	0	0
1310	399.3	1310	1	3	0	24	0	0
Tptpv3	**1314.0-1345.4**							
Tptpv3a	***1314.0-1317.0***							
1314	400.5	1314	45	28	0	14	0	0
Tptpv3v	***1317.0-1345.4***							
1330	405.4	1330	0	0	0	0	70	0
1341	408.7	1341	0	0	0	0	60	0
Tptpv2	**1345.4-1353.6**							
Tptpv1	**1353.6-1406.8**							
1372	418.2	1372	6	1	0	12	40	0
1381	420.9	1381	7	56	0	4	0	0
1392	424.3	1392	2	70	0	4	0	0
Tpbt1	**1406.8-1409.4**							
Tac	**1409.4-1705.4**							
1419	432.5	1419	0	30	0	8	0	0
1432	436.5	1432	3	75	0	7	0	0
1438	438.3	1438	3	75	0	4	0	0
1470	448.1	1470	3	77	0	14	0	0
1544	470.6	1544	3	70	0	12	0	0
1602	488.3	1602	0	52	0	8	0	0
1685	513.6	1685	1	65	0	7	0	0
Tacbt	**1705.4-1762.7**							
1707	520.3	1707	1	44	0	14	0	0
1734	528.5	1734	0	40	0	15	0	0
Tcp	**1762.7-2237.5**							
Tcpunw	***1762.7-1791.0***							
1763	537.4	1763	7	50	0	32	0	0
1779	542.2	1779	2	45	0	10	0	0
1788	545.0	1788	3	28	0	5	0	0
Tcpuw	***1791.0-1955.0***							
1794	546.8	1794	0	0	0	29	0	0
1841	561.1	1841	2	0	0	3	0	0
1871	570.3	1871	1	0	0	5	0	0
1938	590.7	1938	1	0	0	29	0	0
1952	595.0	1952	1	0	0	18	0	0

USW G-4 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tcplnw	***1955.0-2237.5***							
1958	596.8	1958	8	40	0	4	0	0
1968	599.8	1968	3	35	0	10	0	0
1989	606.2	1989	0	44	0	15	0	0
2039	621.5	2039	0	45	0	8	0	0
2069	630.6	2069	0	55	0	4	0	0
2090	637.0	2090	0	45	0	10	0	0
2100	640.1	2100	2	60	0	0	0	0
2131	649.5	2131	0	50	0	0	0	0
2202	671.2	2202	0	50	0	7	0	0
2226	678.5	2226	1	50	0	2	0	0
Tcbt3	**2237.5-2244.2**							
2238	682.1	2238	1	75	0	0	0	0
Tcb	**2244.2-2733.3**							
Tcbunw	***2244.2-2253.0***							
2248	685.2	2248	0.01	47	0	0	0	0
Tcbuw	***2253.0-2640.0***							
2263	689.8	2263	0	0	0	1	0	0
2285	696.5	2285	1	0	0	2	0	0
2343	714.1	2343	1	0	0	0	0	0
2355	717.8	2355	0	0	0	0	0	0
2381	725.7	2381	1	0	0	0	0	0
2423	738.5	2423	1	0	0	0	0	0
2516	766.9	2516	0	0	0	0	0	0
2533	772.1	2533	1	0	0	0	0	0
2551	777.5	2551	0	0	0	0	0	0
2566	782.1	2566	0	0	0	0	0	0
2598	791.9	2598	1	0	0	0	0	0
Tcblnw	***2640.0-2733.3***							
2681	817.2	2681	22	0	0	0	0	0
2716	827.8	2716	0	80	0	0	0	0
2731	832.4	2731	0	73	0	0	0	0
Tcbt2	**2733.3-2755.6**							
2754	839.4	2754	12	26	0	0	0	0
Tct	**2755.6-bottom**							
Tctunw	***2755.6-2830.0***							
2758	840.6	2758	0	18	0	0	0	0
2762	841.9	2762	1	18	0	0	0	0
2792	851.0	2792	0	73	0	0	0	0
2823	860.5	2823	2	24	0	0	0	0
Tctuw	***2830.0-bottom***							
2838	865.0	2838	0	0	0	0	0	0
2840	865.6	2840	0	0	0	0	0	0
2875	876.3	2875	0	0	0	0	0	0
2931	893.3	2931	0.01	0	0	0	0	0
2947	898.2	2947	0	0	0	0	0	0
3000	914.4	3000	0	0	0	0	0	0

USW H-3

N-S	E-W	Elevation
756546	558446	4866.1 ft

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tpcpll	**0-379.9**							
Tpcpv1	**379.9-392.1**							
Tpbt4	**392.1-403.9**							
Tptrv3	**403.9-441.9**							
Tptrv1	**441.9-451.9**							
Tptrn	**451.9-526.9**							
470-480	143.3-146.3	475	0	0	13	8	0	0
520-530	158.5-161.5	525	0	0	0.01	24	0	0
Tptpul	**526.9-680.1**							
540-550	164.6-167.6	545	0	0	21	5	0	0
610-620	185.9-189.0	615	0	0	0.01	29	0	0
Tptpmn	**680.1-848.1**							
740-750	225.6-228.6	745	1	0	0	26	0	0
800-810	243.8-246.9	805	2	0	0.01	27	0	0
Tptpll	**848.1-1049.9**							
870-880	265.2-268.2	875	1	0	0	3	0	0
930-940	283.5-286.5	935	1	0	0	16	0	0
990-1000	301.8-304.8	995	1	0	4	23	0	0
1030-1040	313.9-317.0	1035	1	0	0.01	24	0	0
Tptpln	**1049.9-1194.0**							
1100-1110	335.3-338.3	1105	1	0	0.01	23	0	0
1160-1170	353.6-356.6	1165	1	0	0	29	0	0
Tptpv3	**1194.0-1252.0**							
Tptpv2	**1252.0-1379.9**							
1270-1280	387.1-390.1	1275	0	0	0	7	70	0
1320-1330	402.3-405.4	1325	0	0	0	5	70	0
Tptpv1	**1379.9-1392.1**							
Tac	**1392.1-1437.1**							
Tacbt	**1437.1-1486.9**							
Tcp	**1486.9-1900.0**							
Tcpunw	***1486.9-1510.0***							
Tcpuw	***1510.0-1750.0***							
1550(SW)	472.4	1550	0.01	2	7	7	0	0
1655(SW)	504.5	1655	0.01	2	7	7	0	0
1700(SW)	518.2	1700	0.01	2	0	15	15	0
Tcplnw	***1750.0-1900.0***							
1800(SW)	548.6	1800	2	60	0	0	0	0
Tcbt3	**1900.0-1907.2**							
1900(SW)	579.1	1900	7	75	2	2	0	0

USW H-3 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tcb	**1907.2-2449.3**							
Tcbunw	***1907.2-1925.0***							
Tcbuw	***1925.0-2368.0***							
Tcblnw	***2368.0-2449.3***							
2400(SW)	731.5	2400	0	75	0	2	0	0
2440(SW)	743.7	2440	0	65	0	2	0	0
Tcbt2	**2449.3-2477.2**							
Tct	**2477.2-3595.1**							
Tctunw	***2477.2-2500.0***							
2490(SW)	759.0	2490	2	70	0	0	0	0
Tcbt1	**3595.1-3637.3**							
Tr	**3637.3-bottom**							

USW H-4

N-S	E-W	Elevation
761643	563904	4097.0 ft

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tpcpll	**0-89.9**							
Tpcpln	**89.9-173.9**							
Tpcpv1	**173.9-202.0**							
Tpbt4	**202.0-214.0**							
Tptrv3	**214.0-224.0**							
Tptrv1	**224.0-252.0**							
Tptrn	**252.0-376.0**							
310-320	94.5-97.5	315	0	0	11	10	0	0
Tptpul	**376.0-585.0**							
390-400	118.9-121.9	395	2	0	14	13	0	0
440-450	134.1-137.2	445	2	0	19	13	0	0
490-500	149.4-152.4	495	2	0	11	18	0	0
Tptpmn	**585.0-708.0**							
640-650	195.1-198.1	645	2	0	0	26	0	0
Tptpll	**708.0-1002.9**							
830-840	253.0-256.0	835	3	0	12	14	0	0
910-920	277.4-280.4	915	1	0	0	20	0	0
940-950	286.5-289.6	945	1	0	0	21	0	0
Tptpln	**1002.9-1185.0**							
1040-1050	317.0-320.0	1045	1	0	0	23	0	0
1150-1160	350.5-353.6	1155	2	0	0	18	0	0
Tptpv3	**1185.0-1216.8**							
Tptpv3a	***1185.0-1187.0***							
Tptpv3v	***1187.0-1216.8***							
1190-1200	362.7-365.8	1195	0	5	0	15	70	0
Tptpv2	**1216.8-1230.0**							
Tptpv1	**1230.0-1312.0**							
1230-1240	374.9-378.0	1235	20	0	0	20	30	0
1312(SW)	399.9	1312	2	5	0	7	50	0
Tac	**1312.0-1575.0**							
1320-1330	402.3-405.4	1325	0	0	0	9	0	0
1350-1360	411.5-414.5	1355	0	78	0	9	0	0
1410-1420	429.8-432.8	1415	0	57	0	9	0	0
1420(SW)	432.8	1420	2	70	0	2	0	0
1455(SW)	443.5	1455	0	70	0	2	0	0
1540-1550	469.4-472.4	1545	3	45	0	10	0	0
1550(SW)	472.4	1550	2	75	0	2	0	0
Tacbt	**1575.0-1627.0**							
1600-1610	487.7-490.7	1605	0	31	0	9	0	0

USW H-4 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tcp	**1627.0-2263.0**							
Tcpunw	***1627.0-1653.0***							
1640-1650	499.9-502.9	1645	0	10	0	24	0	0
Tcpuw	***1653.0-1850.0***							
1656(SW)	504.8	1656	0	0	0	35	0	0
1710-1720	521.2-524.3	1715	1	0	0	3	0	0
1790-1800	545.6-548.6	1795	3	0	0	17	0	0
Tcplnw	***1850.0-2263.0***							
1900-1910	579.1-582.2	1905	0	22	0	16	0	0
1980-1990	603.5-606.6	1985	0	34	0	6	0	0
Tcbt3	**2263.0-2275.0**							
Tcb	**2275.0-2644.0**							
Tcbt2	**2644.0-2664.0**							
Tct	**2664.0-3788.0**							
Tcbt1	**3788.0-3819.0**							
Tr	**3819.0-bottom**							

USW H-5

N-S	E-W	Elevation
766624	558897	4851.0 ft

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT	Glass wt%	Analcime wt%
Tpcpll	**0-210.0**							
40/50	12.2/15.2	45	0	0	31	0	0	0
50 (DC)	15.2	50	0	0	17	2	0	0
110/120	33.5/36.6	115	0.01	0	17	13	0	0
160/170	48.8/51.8	165	0.01	0	13	20	0	0
190 (DC)	57.9	190	0	0	2	23	0	0
Tpcpln	**210.0-409.8**							
230/240	70.1/73.2	235	0.01	0	10	22	0	0
320/330	97.5/100.6	325	1	0	3	22	0	0
380/390	115.8/118.9	385	0	0	2	29	0	0
Tpcpv1	**409.8-484.9**							
420 (DC)	128	420	15	0	0	12	40	0
450 (DC)	137.2	450	0	0	0	0	96	0
460/470	140.2/143.3	465	14	0	0	2	69	0
Tpbt4	**484.9-490.2**							
Tpp	**490.2-535.1**							
Tpbt2	**535.1-542.0**							
Tptrv3	**542.0-567.9**							
Tptrv1	**567.9-569.9**							
Tptrn	**569.9-684.0**							
620/630	189.0/192.0	625	1	0	4	9	0	0
Tptpul	**684.0-1000.0**							
700 (DC)	213.4	700	0.01	0	20	15	0	0
720/730	219.5/222.5	725	3	0	23	9	0	0
750/760	228.6/231.6	755	5	0	17	17	0	0
800/810	243.8/246.9	805	3	0	0.01	24	0	0
830/840	253.0/256.0	835	0	0	0.01	24	0	0
860/870	262.1/265.2	865	4	0	8	23	0	0
920/930	280.4/283.5	925	2	0	0.01	24	0	0
970/980	295.7/298.7	975	2	0	0.01	26	0	0
990/1000	301.8/304.8	995	3	0	3	28	0	0
Tptpmn	**1000.0-1099.0**							
1050 (DC)	320.0	1050	0.01	0	0	40	0	0
1090/1100	332.2/335.3	1095	4	0	4	26	0	0
Tptpll	**1099.0-1399.9**							
1150/1160	350.5/353.6	1155	2	0	0	10	0	0
1200/1210	365.8/368.8	1205	3	0	3	11	0	0
1230/1240	374.9/378.0	1235	2	0	0	23	0	0
1290/1300	393.2/396.2	1295	2	0	0	18	0	0
1350/1360	411.5/414.5	1355	2	0	3	16	0	0
1380/1390	420.6/423.7	1385	2	0	0	20	0	0
Tptpln	**1399.9-1582.1**							
1450/1460	442.0/445.0	1455	0.01	0	0	8	0	0
1490/1500	454.2/457.2	1495	2	0	0	21	0	0
1530/1540	466.3/469.4	1535	1	0	0	14	0	0

USW H-5 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT	Glass wt%	Analcime wt%
Tptpv3	**1582.1-1654.9**							
Tptpv3a	***1582.1-1600.0***							
1590/1600	484.6/487.7	1595	35	10	0	17	0	0
Tptpv3v	***1600.0-1654.9***							
1610 (DC)	490.7	1610	0	0	0	2	90	0
1630/1640	496.8/499.9	1635	0.01	0	0	2	88	0
1650/1660	502.9/506.0	1655	0	0	0	5	89	0
Tptpv2	**1654.9-1699.2**							
1666 (DC)	507.8	1666	50	10	0	12	0	0
Tpbt1	**1699.2-1710.1**							
Tac	**1710.1-1880.0**							
1710/1720	521.2/524.3	1715	3	0	0	5	70	0
1750 (DC)	533.4	1750	0	0.01	0	5	85	0
1762 (SW)	537.1	1762	0	0	0	1	95	0
1760/1770	536.4/539.5	1765	0	6	0	4	81	0
1800 (SW)	548.6	1800	0	0	0	2	85	0
1820/1830	554.7/557.8	1825	0.01	4	0	2	80	0
1852 (SW)	564.5	1852	0	0	0	0	90	0
1875 (SW)	571.5	1875	0	0.01	0	0.01	92	0
Tacbt	**1880.0-1945.0**							
1890/1900	576.1/579.1	1895	1	11	0	3	75	0
1900/1910	579.1/582.2	1905	0.01	10	0	1	78	0
1910/1920	582.2/585.2	1915	0.01	18	0	5	65	0
1917 (SW)	584.3	1917	0	25	0	10	0	0
1920/1930	585.2/588.3	1925	3	52	0	7	6	0
1930 (DC)	588.3	1930	2	50	0	0	0	0
Tcp	**1945.0-2240.3**							
Tcpunw	***1945.0-1965.0***							
1950/1960	594.4/597.4	1955	3	51	0	5	31	0
Tcpuw	***1965.0-2175.0***							
1966 (SW)	599.2	1966	5	0	0	0	75	0
1990/2000	606.6/609.6	1995	1	10	0	9	59	0
2070/2080	630.9/634.0	2075	1	0	0	3	0	0
2140/2150	652.3/655.3	2145	1	0	0	7	0	0
Tcplnw	***2175.0-2240.3***							
2200 (DC)	670.6	2200	0.01	60	0	2	0	0
2230/2240	679.7/682.8	2235	2	72	0	16	0	0
Tcbt3	**2240.3-2263.2**							
Tcb	**2263.2-2713.1**							
Tcbunw	***2263.2-2280.0***							
2260/2270	688.8/691.9	2265	6	63	0	20	0	0
Tcbt2	**2713.1-2742.3**							
Tct	**2742.3-3412.2**							
Tcbt1	**3412.2-3422.1**							
Tll	**3422.1-bottom**							

USW H-6

N-S	E-W	Elevation
763260	554166	4270.9 ft

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Qac	**0-29.9**							
Tpcpln	**29.9-190.0**							
Tpcpv3	**190.0-200.1**							
Tpcpv1	**200.1-260.2**							
Tpbt4	**260.2-270.0**							
Tpp	**270.0-290.0**							
Tpbt2	**290.0-300.2**							
Tptrv3	**300.2-332.0**							
Tptrn	**332.0-420.0**							
Tptpul	**420.0-649.9**							
Tptpmn	**649.9-880.0**							
Tptpll	**880.0-1180.1**							
1092.4	333.0	1092.4	0.01	0	0	9	0	0
1128.8	344.1	1128.8	0.01	0	0	12	0	0
1149.2	350.3	1149.2	0.01	0	0	15	0	0
1166.3	355.5	1166.3	3	0	0	13	0	0
Tptpln	**1180.1-1216.9**							
Tptpv3	**1216.9-1310.0**							
Tptpv1	**1310.0-1346.2**							
Tpbt1	**1346.2-1376.4**							
1368.4	417.1	1368.4	3	0	0	3	60	0
1376.2	419.5	1376.2	0.01	0	0	4	60	0
Tac	**1376.4-1458.1**							
1380.8	420.9	1380.8	10	0	0	5	60	0
1426.6	434.8	1426.6	0	6	0	5	60	0
Tabt1	**1458.1-1504.0**							
Tcp	**1504.0-1765.2**							
Tcpunw	***1504.0-1530.0***							
1511.7	460.8	1511.7	10	35	0	5	10	0
Tcpuw	***1530.0-1720.0***							
1671.4	509.4	1671.4	0.01	0	0	23	0	0
1679.2	511.8	1679.2	0	0	0	25	0	0
Tcplnw	***1720.0-1765.2***							
Tcbt3	**1765.2-1795.0**							
Tcb	**1795.0-2225.2**							
Tcbunw	***1795.0-1825.0***							
Tcbuw	***1825.0-2180.0***							
1829.5	557.6	1829.5	0	0	0	6	0	0
2051.0	625.1	2051.0	0.01	0	0	8	0	0
Tcblnw	***2180.0-2225.2***							
Tcbt2	**2225.2-2255.0**							

USW H-6 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tct	**2255.0-2869.2**							
Tctunw	***2255.0-2290.0***							
Tctuw	***2290.0-2810.0***							
2354.6	717.7	2354.6	0	0	0	13	0	0
Tctlnw	***2810.0-2869.2***							
2865.0	873.3	2865.0	0.01	18	0	0	0	0
Tcbt1	**2869.2-2878.1**							
Tll	**2878.1-3694.1**							
3003.2	915.4	3003.2	0	26	0	5	0	0
3188.4	971.8	3188.4	3	0	0	19	0	0
3605.2	1098.9	3605.2	0.01	3	0	7	15	0
Tllbt	**3694.1-3708.2**							
Tr	**3708.2-bottom**							
3806.0	1160.1	3806.0	3	9	0	2	0	12

USW SD-7

N-S	E-W	Elevation
758950	561240	4470.0 ft

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Qac	**0-50.2**							
Tpcpmn	**50.2-140.0**							
Tpcpll	**140.0-195.2**							
Tpcpln	**195.2-295.0**							
Tpcpv3	**295.0-326.0**							
Tpbt4	**326.0-366.0**							
Tptrv3	**366.0-387.0**							
Tptrv1	**387.0-393.0**							
Tptrn	**393.0-490.0**							
Tptpul	**490.0-640.0**							
Tptpmn	**640.0-829.0**							
Tptpll	**829.0-1020.0**							
Tptpln	**1020.0-1182.1**							
1133.3/1133.4	345.5	1133.4	5	0	1	20	0	0
1156.7/1156.9	352.6	1156.8	7	0	0	16	0	0
1161.5/1161.6	354.1	1161.6	4	0	1	10	0	0
1165.0/1165.1	355.1	1165.1	6	0	0	18	0	0
1169.9/1170.0	356.6	1170.0	6	0	0	11	0	0
1175.1/1175.4	358.3	1175.3	6	0	0	16	0	0
1179.5/1179.7	359.6	1179.6	5	1	0	18	0	0
1181.6/1182.0	360.3	1181.8	7	1	2	17	0	0
Tptpv3	**1182.1-1274.6**							
Tptpv3a	***1182.1-1192.0***							
1187.0/1187.1	361.8	1187.1	59	5	0	22	0	0
1191.1/1191.3	363.1	1191.2	19	43	0	25	0	0
Tptpv3v	***1192.0-1274.6***							
1193.4/1193.5	363.8	1193.5	6	0	0	21	57	0
1201.7/1201.9	366.3	1201.8	1	0	0	17	67	0
1213.5/1213.7	369.9	1213.6	1	0	0	17	69	0
1230.7/1230.9	375.2	1230.8	1	0	0	12	76	0
1245.5/1246.0	379.8	1245.8	0.01	0	0	10	80	0
1260.2/1260.3	384.1	1260.3	0.01	0	0	9	83	0
Tptpv2	**1274.6-1357.0**							
1278.6/1278.9	389.8	1278.8	1	0	0	18	67	0
1298.8/1299.0	395.9	1298.9	2	0	0	14	71	0
1321.5/1321.6	402.8	1321.6	0.01	0	0	4	87	0
1338.5/1338.7	408	1338.6	0.01	0	0	2	94	0
1350.5/1350.7	411.7	1350.6	0.01	1	0	16	52	0
Tpbt1	**1357.0-1381.0**							

USW SD-7 continued

Sample	Strat Interval (ft) / Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tac	**1381.0-1567.2**							
1391.0/1391.2	424	1391.1	1	0	0	2	85	0
1421.1/1421.3	433.2	1421.2	0.01	0	0	2	91	0
1444.6/1444.8	440.4	1444.7	0.01	0	0	2	90	0
1467.4/1467.5	444.2	1467.5	0.01	1.01	0	3	86	0
1471.5/1471.8	448.6	1471.7	0.01	1.01	0	2	85	0
1493.2/1493.3	455.2	1493.3	0.01	50	0	26	0	0
1493.3/1493.6	455.2	1493.5	11	17	0	5	53	0
1513.9/1514.2	461.5	1514.1	2	7	0	5	74	0
1517.3/1517.6	462.6	1517.5	5	3	0	5	63	0
1519.1/1519.3	463.1	1519.2	0.01	69	0	19	0	0
1538.5/1538.6	469	1538.6	3	19	0	10	56	0
1560.1/1560.5	475.6	1560.3	5	27	0	9	49	0
1567.1	477.7	1567.1	1	49	0	33	0	0
Tacbt	**1567.2-1617.2**							
1567.2/1567.3	477.7	1567.3	5	68	0	17	0	0
1581.2	482	1581.2	5	54	0	8	14	0
1581.3/1581.5	482	1581.4	1	53	0	37	0	0
1597.1/1597.4	486.9	1597.3	3	46	0	25	0	0
1601.5/1601.8	488.2	1601.7	3	50	0	15	0	0
Tcp	**1617.2-2167.7**							
Tcpunw	***1617.2-1642.0***							
1618.1/1618.2	493.2	1618.2	7	55	0	12	0	0
1622.6/1622.9	494.7	1622.8	8	54	0	25	0	0
1636.5/1636.8	498.9	1636.7	7	46	0	35	0	0
Tcpuw	***1642.0-1855.0***							
1647.7/1647.9	502.3	1647.8	1	0	4	35	0	0
1666.6/1666.8	508	1666.7	2	0	1	7	0	0
1688.2/1688.4	514.6	1688.3	2	0	3	2	0	0
1718.7/1718.9	523.9	1718.8	2	0	5	2	0	0
1741.0/1741.3	530.7	1741.2	1	0	6	3	0	0
1765.9/1766.3	538.4	1766.1	1	0	2	7	0	0
1787.1/1787.2	544.7	1787.2	1	0	0	15	0	0
1796.7/1797.0	547.7	1796.9	2	0	0	16	0	0
1824.6/1824.9	556.2	1824.8	2	0	0	26	0	0
1843.4/1843.7	562	1843.6	3	0	0	30	0	0
Tcplnw	***1855.0-2167.7***							
1867.5/1868.1	569.4	1867.8	2	35	0	21	0	0
1893.8/1894.1	577.3	1894.0	5	29	0	36	0	0
1913.4/1913.9	583.7	1913.7	4	45	0	28	0	0
1938.5/1938.7	590.9	1938.6	1	59	0	20	0	0
1962.8/1963.1	598.4	1963.0	2	65	0	14	0	0
1988.6/1989.0	606.2	1988.8	3	66	0	18	0	0
2010.2/2010.5	612.8	2010.4	1	82	0	12	0	0
2021.3/2021.6	616.2	2021.5	2	68	0	19	0	0

USW SD-7 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
2035.1/2035.3	620.4	2035.2	2	66	0	16	0	0
2043.8/2044.0	623	2043.9	2	68	0	14	0	0
2062.6/2062.8	628.7	2062.7	1	66	0	17	0	0
2082.8/2083.1	634.9	2083.0	1	68	0	15	0	0
2094.2/2094.6	638.4	2094.4	1	69	0	13	0	0
2109.6/2109.9	643.1	2109.8	1	71	0	13	0	0
2133.7/2133.9	650.4	2133.8	1	76	0	11	0	0
2159.6/2159.8	658.3	2159.7	2	67	0	12	0	0
Tcbt3	**2167.7-2182.0**							
2179.2/2179.4	664.3	2179.3	4	34	0	2	0	0
2180.0/2180.2	664.5	2180.1	0.01	0	0	5	0	0
Tcb	**2182.0-2579.5**							
Tcbunw	***2182.0-2183.9***							
Tcbuw	***2183.9-2484.1***							
2201.7/2201.9	671.1	2201.8	1	0	0	19	0	0
2225.3/2225.4	678.3	2225.4	2	0	0	19	0	0
Tcblnw	***2484.1-2579.5***							
Tcbt2	**2579.5-2601.2**							
Tct	**2601.2-bottom**							

USW SD-9

N-S	E-W	Elevation
768058	561591	4272.5 ft

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Qac	**0-30.0**							
Tpcpln	**30.0-57.2**							
Tpcpv2	**57.2-61.0**							
Tpcpv1	**61.0-92.4**							
Tpbt4	**92.4-95.9**							
Tpy	**95.9-141.0**							
Tpbt3	**141.0-156.5**							
Tpp	**156.5-226.6**							
Tpbt2	**226.6-255.6**							
Tptrv3	**255.6-266.7**							
Tptrv2	**266.7-268.5**							
Tptrv1	**268.5-272.2**							
Tptrn	**272.2-439.2**							
Tptrl	**439.2-484.2**							
Tptpul	**484.2-736.8**							
Tptpmn	**736.8-845.8**							
Tptpll	**845.8-1185.8**							
Tptpln	**1185.8-1365.0**							
Tptpv3	**1365.0-1418.4**							
Tptpv3a	***1365.0-1368.0***							
1364.8/1365.2	416.1	1365.0	9	3	0	21	54	0
Tptpv3v	***1368.0-1418.4***							
1381.0/1381.3	421	1381.2	0	0.01	0	6	88	0
1397.1/1397.2	425.9	1397.2	0	0	0	0	96	0
1415.4/1415.5	431.4	1415.5	0.01	0	0	5	90	0
Tptpv2	**1418.4-1425.7**							
1421.5/1421.6	433.3	1421.6	0.01	0	0	3	92	0
1425.5/1426.0	434.6	1425.8	5	0	0	6	85	0
Tptpv1	**1425.7-1464.1**							
1428.2/1428.4	435.4	1428.3	8	0	0	9	78	0
1431.7/1431.9	436.4	1431.8	10	3	0	7	73	0
1434.4/1434.5	437.2	1434.5	1	63	0	18	0	0
1440.1/1440.2	439	1440.2	3	28	0	8	54	0
1447.8/1448.0	441.4	1447.9	3	4	0	8	71	0
1457.2/1457.6	444.3	1457.4	1	67	0	11	10	0
1460.5/1460.8	445.3	1460.7	1	75	0	19	0	0
Tpbt1	**1464.1-1479.9**							
1465.9/1466.1	446.9	1466.0	2	80	0	9	0	0

USW SD-9 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tac	**1479.9-1764.4**							
1486.3/1486.6	453.1	1486.5	0.01	74	0	20	0	0
1508.5/1508.8	459.9	1508.7	0.01	71	0	16	0	0
1527.1/1527.4	465.6	1527.3	8	71	0	19	0	0
1547.1/1547.4	471.6	1547.3	0.01	73	0	18	0	0
1566.9/1567.3	477.7	1567.1	0.01	76	0	14	0	0
1585.4/1585.6	483.3	1585.5	1	59	0	16	0	0
1605.0/1605.2	489.3	1605.1	1	78	0	10	0	0
1626.2/1626.3	495.7	1626.3	1	80	0	15	0	0
1647.9/1648.2	502.4	1648.1	0.01	86	0	9	0	0
1669.7/1669.9	509	1669.8	0.01	82	0	13	0	0
1689.8/1690.3	515.2	1690.1	0.01	82	0	12	0	0
1711.7/1711.9	521.8	1711.8	0.01	83	0	13	0	0
1729.6/1729.9	527.3	1729.8	0.01	71	0	19	0	0
1752.6/1753.0	534.3	1752.8	0.01	63	0	16	0	0
Tacbt	**1764.4-1820.7**							
1770.7/1770.9	539.8	1770.8	1	60	0	16	0	0
1777.8/1778.0	541.9	1777.9	0.01	41	0	35	0	0
1797.8/1798.1	548.1	1798.0	0.01	56	0	5	0	0
Tcp	**1820.7-bottom**							
Tcpunw	***1820.7-1875.0***							
1821.1/1821.6	555.2	1821.4	8	47	0	33	0	0
1840.4/1840.6	561	1840.5	2	57	0	26	0	0
1864.6/1864.7	568.4	1864.7	0	42.01	0	40	0	0
1866.2/1866.5	568.9	1866.4	6	58	0	21	0	0
Tcpuw	***1875.0-bottom***							
1885.6/1886.0	574.9	1885.8	2	0	0	3	0	0
1908.5/1908.8	581.8	1908.7	1	0	0	3	0	0

USW SD-12

N-S	E-W	Elevation
761957	561606	4343.0 ft

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Qac	**0-5.3**							
Tpcpmn	**5.3-93.4**							
Tpcpll	**93.4-129.5**							
Tpcplnh	**129.5-176.0**							
Tpcplnc	**176.0-239.1**							
Tpcpv2	**239.1-256.0**							
Tpcpv1	**256.0-263.7**							
Tpbt4	**263.7-268.3**							
Tpbt3	**268.3-278.3**							
Tpp	**278.3-291.2**							
Tpbt2	**291.2-314.1**							
Tptrv3	**314.1-320.8**							
Tptrv2	**320.8-324.6**							
Tptrv1	**324.6-330.7**							
Tptrn	**330.7-436.4**							
Tptrl	**436.4-476.5**							
Tptpul	**476.5-663.7**							
Tptpmn	**663.7-786.9**							
Tptpll	**786.9-1041.0**							
Tptpln	**1041.0-1278.1**							
Tptpv3	**1278.1-1308.0**							
Tptpv2	**1308.0-1337.5**							
1309.3/1309.6	399.2	1309.5	0.01	0	0	20	65	0
1320.6/1321.0	402.6	1320.8	0.01	0	0	18	68	0
1333.2/1333.4	406.4	1333.3	2	0	0	8	80	0
Tptpv1	**1337.5-1408.0**							
1342.1/1342.2	409.1	1342.2	0.01	0	0	4	91	0
1351.9/1352.2	412.2	1352.1	0.01	0	0	6	88	0
1361.9/1362.0	415.1	1362.0	0	0	0	3	92	0
1371.4/1371.5	418	1371.5	0.01	0	0	2	93	0
1381.1/1381.3	421	1381.2	1	2	0	4	87	0
1388.0/1388.1	423.1	1388.1	0.01	2	0	5	82	0
1399.2/1399.3	426.5	1399.3	1	3	0	5	84	0
Tpbt1	**1408.0-1411.5**							
Tac	**1411.5-1599.4**							
1439.9/1440.1	438.9	1440.0	0	1	0	2	89	0
1458.7/1458.9	444.7	1458.8	0.01	4	0	2	87	0
1480.2/1480.5	451.3	1480.4	0.01	4	0	4	79	0
1500.8/1501.0	457.5	1500.9	1	5	0	4	79	0
1519.8/1520.1	463.3	1520.0	2	5	0	12	58	0
1540.9/1541.3	469.8	1541.1	2	10	0	9	64	0
1561.1/1561.3	475.9	1561.2	3	3	0	5	78	0
1581.3/1581.6	482.1	1581.5	2	9	0	5	73	0

USW SD-12 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tacbt	**1599.4-1648.4**							
1600.0/1600.2	487.7	1600.1	4	12	0	5	62	0
1600.3	487.8	1600.3	7	55	0	30	0	0
1601.5/1601.8	488.2	1601.7	5	68	0	15	0	0
1609.9/1610.4	490.8	1610.2	3	34	0	7	34	0
1620.4/1620.6	494	1620.5	4	59	0	18	0	0
1641.4/1641.7	500.4	1641.6	9	14	0	25	0	0
Tcp	**1648.4-2136.4**							
Tcpunw	***1648.4-1668.0***							
1656.3/1656.8	505	1656.6	7	58	0	23	0	0
Tcpuw	***1668.0-1867.0***							
1680.7/1680.9	512.3	1680.8	2	0	0	7	0	0
1700.3/1700.6	518.3	1700.5	3	0	2	4	0	0
1720.1/1720.4	524.4	1720.3	2	0	3	2	0	0
1739.8/1740.2	530.4	1740.0	2	0	3	2	0	0
1760.0/1760.4	536.6	1760.2	3	0	3	2	0	0
1780.2/1780.4	542.7	1780.3	2	0	0	10	0	0
1799.4/1800.0	548.6	1799.7	2	0	3	4	0	0
1821.2/1821.6	555.2	1821.4	0.01	0	0	18	0	0
1840.6/1840.8	561.1	1840.7	5	0	0	27	0	0
1860.0/1860.3	567	1860.2	2	0	0	31	0	0
Tcplnw	***1867.0-2136.4***							
1874.4/1874.5	571.3	1874.5	6	15	0	45	0	0
1891.6/1891.9	576.7	1891.8	5	60	0	11	0	0
1911.8/1911.9	582.7	1911.9	5	52	0	21	0	0
1929.7/1929.9	588.2	1929.8	3	57	0	21	0	0
1950.0/1950.7	594.6	1950.4	3	61	0	16	0	0
Tcbt3	**2136.4-2147.3**							
Tcbt3	**2147.3-bottom**							

USW WT-1

N-S	E-W	Elevation
753941	563739	3942.1 ft

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Qac	**0-30.0**							
Tpcrn	**30.0-56.0**							
Tpcpul	**56.0-124.0**							
Tpcpmn	**124.0-254.0**							
Tpcpll	**254.0-264.0**							
Tpcpln	**264.0-291.0**							
Tpcpv3	**291.0-372.0**							
Tpcpv1	**372.0-434.0**							
Tpbt2	**434.0-473.0**							
440-450	134.1-137.2	445	5	0	8	4	70	0
Tptrv3	**473.0-489.0**							
Tptrv1	**489.0-491.0**							
Tptrn	**491.0-582.0**							
500-510	152.4-155.4	505	0	0	11	12	0	0
550-560	167.6-170.7	555	0	0	19	10	0	0
Tptpul	**582.0-699.0**							
640-650	195.1-198.1	645	1	0	11	16	0	0
690-700	210.3-213.4	695	1	0	0	19	0	0
Tptpmn	**699.0-888.0**							
780-790	237.7-240.8	785	1	0	3	9	0	0
840-850	256.0-259.1	845	1	0	6	16	0	0
Tptpll	**888.0-1170.0**							
930-940	283.5-286.5	935	3	0	5	7	0	0
1000-1010	304.8-307.8	1005	1	0	0	16	0	0
1090-1100	332.2-335.3	1095	1	0	0	15	0	0
1160-1170	353.6-356.6	1165	1	1	11	18	0	0
Tptpln	**1170.0-1309.0**							
1220-1230	371.9-374.9	1225	0	0	5	8	0	0
1300-1310	396.2-399.3	1305	1	2	0	4	0	0
Tptpv3	**1309.0-1342.0**							
Tptpv3a	***1309.0-1330.0***							
1320-1330	402.3-405.4	1325	2	14	0	13	0	0
Tptpv3v	***1330.0-1342.0***							
Tptpv1	**1342.0-1374.0**							
1340-1350	408.4-411.5	1345	1	29	0	9	0	0
Tpbt1	**1374.0-1384.0**							
Tac	**1384.0-1564.0**							
1380-1390	420.6-423.7	1385	0	52	0	7	0	0
1410-1420	429.8-432.8	1415	0	48	0	8	0	0
1470-1480	448.1-451.1	1475	0	43	0	7	0	0
1510-1520	460.2-463.3	1515	0	53	0	5	0	0
1550-1560	472.4-475.5	1555	0	52	0	7	0	0
Tcb	**1564.0-bottom**							
Tcbunw	***1564.0-1580.0***							
1570-1580	478.5-481.6	1575	0	8	0	9	0	0

USW WT-2

N-S	E-W	Elevation
760661	561924	4269.9 ft

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Qac	**0-60.0**							
Tpcrn	**60.0-72.0**							
Tpcpul	**72.0-91.0**							
Tpcpmn	**91.0-107.0**							
Tpcpll	**107.0-114.0**							
Tpcpln	**114.0-179.0**							
Tpcpv3	**179.0-200.0**							
Tpcpv1	**200.0-260.0**							
250-260	76.2-79.2	255	4	0	0	11	50	0
Tpbt2	**260.0-270.0**							
260-270	79.2-82.3	265	7	0	0	7	30	0
Tptrv3	**270.0-281.0**							
Tptrv2	**281.0-283.0**							
Tptrv1	**283.0-290.0**							
Tptrn	**290.0-396.0**							
290-300	88.4-91.4	295	1	0	10	9	0	0
370-380	112.8-115.8	375	0.01	0	19	5	0	0
Tptpul	**396.0-595.0**							
420-450	128.0-131.0	425	1	0	12	11	0	0
510-520	155.4-158.5	515	1	0	13	21	0	0
570-580	173.7-176.8	575	3	0	13	21	0	0
Tptpmn	**595.0-717.0**							
650-660	198.1-201.1	655	2	0	10	22	0	0
Tptpll	**717.0-1015.0**							
720-730	219.5-222.5	725	1	0	10	19	0	0
780-790	237.7-240.8	785	1	0	6	10	0	0
850-860	259.1-262.1	855	1	0	13	16	0	0
930-940	283.5-286.5	935	1	0	13	17	0	0
990-1000	301.8-304.8	995	2	0	0	21	0	0
Tptpln	**1015.0-1179.0**							
1060-1070	323.1-326.1	1065	3	0	0	19	0	0
1130-1140	344.4-347.5	1135	0.01	0	0	15	0	0
Tptpv3	**1179.0-1222.0**							
Tptpv3a	***1179.0-1185.0***							
Tptpv3v	***1185.0-1222.0***							
1190-1200	362.7-365.8	1195	2	1	0	9	30	0
1200-1210	365.8-368.8	1205	1	1	0	15	50	0
Tptpv1	**1222.0-1293.0**							
1250-1260	381.0-384.0	1255	2	0	0	12	40	0
Tpbt1	**1293.0-1303.0**							

USW WT-2 continued

Sample	Strat Interval (ft) Sample Depth (m)	Depth (ft)	Smectite wt%	Zeolite wt%	Tridymite wt%	Crist/Opal-CT wt%	Glass wt%	Analcime wt%
Tac	**1303.0-1520.0**							
1300-1310	396.2-399.3	1305	0.01	1	0	12	40	0
1360-1370	414.5-417.6	1365	0.01	0.01	0	8	40	0
1420-1430	432.8-435.9	1425	0.01	4	0	4	30	0
1450-1460	442.0-445.0	1455	1	0.01	0	8	30	0
1470-1480	448.1-451.1	1475	0.01	5	0	8	30	0
Tacbt	**1520.0-1594.0**							
1520-1530	463.3-466.3	1525	3	24	0	12	0	0
1570-1580	478.5-481.6	1575	0	19	0	7	0	0
Tcp	**1594.0-2040.0**							
Tcpunw	***1594.0-1630.0***							
Tcpuw	***1630.0-1790.0***							
1640-1650	499.9-502.9	1645	1	2	0	7	0	0
1710-1720	521.2-524.3	1715	1	0.01	0	7	0	0
1750-1760	533.4-536.4	1755	1	1	0	17	0	0
Tcplnw	***1790.0-2040.0***							
1820-1830	554.7-557.8	1825	4	19	0	14	0	0
1910-1920	582.2-585.2	1915	0	42	0	6	0	0
2000-2010	609.6-612.6	2005	0	40	0	3	0	0
Unit	**Inconsistency**							
2050.25 core	624.9	2050.25	1	0	0	9	0	0
2053.7 core	626.0	2053.7	1	0	0	10	0	0
2059.3 core	627.7	2059.3	0.01	0	0	9	0	0