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A STUDY OF ROCK-WATER-NUCLEAR WASTE INTERACTIONS IN THE PASCO BASIN, WASHINGTON -- Part: Distribution and Composition of Secondary and Primary Mineral Phases in Basalts of the Pasco Basin, Washington

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A STUDY OF ROCK-WATER-NUCLEAR WASTE INTERACTIONS IN THE PASCO BASIN, WASHINGTON

PART I

DISTRIBUTION AND COMPOSITION OF SECONDARY AND PRIMARY MINERAL PHASES IN BASALTS OF THE PASCO BASIN, WASHINGTON

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INTRODUCTION

In Part I of this report the results of Task III are presented and discussed. The subject of Task III is the study and identification of secondary and primary mineral assemblages in basalts of the Pasco Basin of southeastern Washington. In particular, we have determined the relative amounts, crystallization sequence, and compositions of secondary minerals found lining vesicle and fracture surfaces. This information, together with data on the chemical composition of primary minerals and the extent to which they have undergone dissolution, has been used in theoretical simulations of mass transfer which is the subject of Part II (Task IV) of this report.

SAMPLING PROCEDURES

Samples were obtained from four drill cores (DC2, DC6, DH4, DH5). Figure 1 shows the locations of these cores. Most of the samples are representative of an interval of core possessing a similar style of alteration. Figure 2 shows the vertical distribution of samples in DC2, DC6, and DH5. Data from DH4 has not been displayed since it consists solely of electron microprobe (EMP) results from a few closely spaced samples.

In DC6 similar appearing vesicles from the same depth were sampled for both x-ray diffraction (XRD) and scanning electron microscopy (SEM) studies. This procedure had not been implemented in the earlier stages of the study (fiscal years 1977 and 1978). It was adopted in order to allow more exacting comparisons of XRD and SEM data. Electron microprobe samples were taken from locations near SEM and XRD sampling sites. Additional samples were taken from unaltered regions of core for EMP analysis of feldspars and clinopyroxenes.

XRD and SEM samples have been labeled with an alphanumeric designation indicating the core number, the depth of the sample, the type of analysis (X = XRD, S = SEM), and the type of sample (v = vesicle, f = fracture). For example, DC6 2407 X1 (v) is a vesicular sample from a depth of 2407 ft in DC6 used for XRD analysis. The 1 in X1 refers to the sample number.

SCANNING ELECTRON MICROSCOPY (SEM)

Procedures

Samples approximately 1 cm in diameter were epoxied onto aluminum studs and gold coated. The samples were examined with an AMR 1000A scanning electron microscope equipped with an energy dispersive spectrometer (EDS). An accelerating potential of 20 kV was employed. Some 147 samples from DC2, DC6, and DH5 were studied; 85% of these samples came from vesicles.

Identification of individual phases was often made by coupling crystal morphology observed with the SEM with the EDS compositional data. For example, the smectite nontronite can be readily distinguished from the zeolite clinoptilolite, since the smectite contains abundant iron (clinoptilolite contains no iron) and has a fine-grained habit. Both Mumpton and Ormsby's (1978) and Sheppard's (1976) excellent tabulations of zeolite crystal morphologies proved useful.

In certain cases XRD was used to associate a particular crystal habit with a mineral. For example, a fibrous mineral with no detectable iron was observed in several samples taken from depths in excess of 900 m. X-ray diffraction of this material showed it to be the zeolite mordenite.

The presence or absence of a pure silica phase can be readily determined with energy dispersive spectroscopy (EDS); however, determination of the exact polymorph (quartz, opal, cristobalite, or tridymite) is more difficult. Crystal morphology can be of some help, i.e., cristobalite often occurs in nature as octahedral crystals and quartz in hexagonal or trigonal forms (Klasik, 1975; Deer et al., 1963). However, our XRD studies have indicated more than one silica phase present in samples possessing a single crystal habit. The reason for this is not clear; it could be that one morphologically distinct silica phase has simply overgrown another or that one metastable phase is in the process of inverting to a more stable form without change in crystal habit.

Results

Crystal morphology. A variety of crystal morphologies for each of the mineral phases have been identified with the SEM. Figures 6 through 9 illustrate the various forms of clays. Silica also occurs in many forms as shown in Figures 10 through 12. Clinoptilolite occurs as intergrown, blocky or tabular crystals (Figure 13), and mordenite occurs as fibrous bundles (Figures 14 and 15). Although trivial in terms of mass, there are a number of last-formed minerals which remain unidentified. Examples of such minerals are illustrated in Figures 17 through 22.

Crystallization sequences. Examples of vesicles coated with successive generations of mineral phases are shown in Figures 3 and 4. The apparent intergrowth of different mineral phases in vesicles is also depicted in Figures 3 and 4. In many instances it is extremely difficult to determine with the SEM whether two phases grew together or sequentially. Sample DC6 3387 S2 (Figure 4) is an example of the intergrowth of clay and silica. Intergrowth occurred during only a portion of the time silica was being deposited. Sample DC6 3538 S4 (Figure 3) is a sample where intergrowth may have occurred or, alternatively, clinoptilolite could have formed first followed by the deposition of clay. In table 1 "-" refers to a situation where we cannot positively determine that two phases were sequentially deposited. Data from thin section petrography has helped to resolve this problem (see below).

Crystallization sequences deduced from SEM/EDS observations are shown in Table 1. We examined 123 vesicles in DC2, DC6, and DH5. In 18 of the vesicles the first two or three "layers" of precipitate appear intergrown. In the 105 remaining vesicles, the first layer consists of some form of clay 74 times, clinoptilolite 17 times, and some form of silica 14 times. Ninety-seven of the vesicles possess two or more layers. There are 66 second layers not intergrown with first or third layers. Of these layers, 23 are clay, 24 are clinoptilolite, and 14 are silica. There are 30 vesicles in which the third layer is not intergrown with either second or fourth layers. In these vesicles the third layer is composed of clay 11 times, clinoptilolite three times, and silica 12 times. There are 11 vesicles which possess a fourth layer not intergrown with either a third or fifth layer. Seven of the fourth layers consist of clay, one of clinoptilolite, one of silica, and two of a fibrous mineral identified as mordenite. Fourteen samples possess intergrown first and second layers; and in these samples, clay is present 8 times, clinoptilolite 12 times, and silica 6 times.

The data show that clay minerals dominate the first- and last-formed layers and are common constituents of the second and third layers. Clinoptilolite is the most common second-layer mineral and silica is the most common third-layer mineral.

<u>Mineralogical trends with depth</u>. Clinoptilolite, clay, and silica occur throughout the depth intervals examined in DC2, DC5, and DH5. A fibrous mineral identified as mordenite occurs in six of the depths studied below 940 m in DC6. Mordenite was also identified in two of the three deepest samples taken from DC2.

Relative abundances of secondary minerals. Table 2 shows estimated relative volumes of secondary minerals in vesicles of DC2, DC6, and DH5. Volume percents were determined independently "by eye" by three individuals. When the individual estimates did not agree within a few percent, the individuals went over the SEM photomicrograph together. Often the difference was found to be due to a misunderstanding as to the identity of the phase. The group then agreed on an estimate or averaged the individual results if agreement could not be obtained. In any case the data should be considered in a qualitative sense only. The data do not reveal any definite trends with depth. In addition, different vesicles from the same depth were found to contain significantly different relative amounts of secondary minerals. The data suggest that clay and clinoptilolite are about equally abundant. Silica is not nearly as abundant as either of these two phases.

Evidence of dissolution. Several vesicles possess secondary minerals which have undergone dissolution: DC2 3264 S3A (silica), DH5 2831 S2 (gypsum), DC6 2156 S1 (unknown), DC6 2908 S4 (clinoptilolite), DC6 3387 S1 (clinoptilolite), and DC6 3387 S6 (clinoptilolite). Several examples of mineral dissolution are illustrated in Figures 4 and 5. Also illustrated in Figure 4 are silica spheres (DC6 3089 S3) which possess circular depressions - some of which are filled with clay spheres. This texture is probably formed by intergrowth of silica and clay, but may also have formed by dissolution of the silica followed by precipitation of the clay.

Discussion of SEM/EDAX Results

Three types of minerals, clay (smectite or iron-rich illite), zeolite clinoptilolite), and silica (quartz, cristobalite, tridymite, or opal), dominate secondary mineral assemblages. These minerals appear not to have always formed in the same sequence although the most common sequence appears to be clay, clinoptilolite, silica and clay. Different vesicles at the same depth often record different portions of the common sequence. For example DC6 2908 S3 contains five layers of precipitate - two layers of clay followed in order by quartz, clinoptilolite and a potassium aluminum silicate. DC6 2908 S5 contains only the clay layers (Figs. 16 and 17; Table 1). Infrequently, different vesicles at the same depth record different sequences of events. For example in DH5 2620, two vesicles contain clay followed by clinoptilolite; the reverse sequence was noted in three other vesicles (Table 1).

The only observed depth zonation was the appearance of the zeolite mordenite at 902 m in DC2 and 940 m in DC6. These samples are from the upper part of the Umtanum unit of the Grande Ronde Basalt Formation. In DC6 the appearance of mordenite correlates roughly with the dissolution of clinoptilolite, suggesting that clinoptilolite may be unstable with respect to mordenite below depths of approximately 900 m.

In samples DC6 4204 S1 and S4 quartz in the form of hexagonal dipyramids was identified. This is the sole occurrence of this morphology and suggests that silica of deposition under conditions of elevated temperature was not common.

X-RAY DIFFRACTION (XRD) STUDIES

Procedures

Samples were scraped from vesicles and fractures, ground to very fine powders and mixed with a silicon standard. The powders were mixed with a water- or balsam-xylene mixture and applied to glass slides. Anaylsis was done with a Norelco diffractometer equipped with a Ni-filtered CuKα radiation source and a graphite monochromator. X-ray diffraction patterns were indexed using data compiled by the American Society for Testing Materials (ASTM), and diffraction patterns of natural zeolite and clay reference materials. Relative mineral abundances were estimated by approximating the integrated area of the most intense peak of each mineral by its half-width multiplied by its peak height. Internal intensity standards were not used.

Results

Generalized x-ray diffraction patterns for commonly occurring minerals are shown in Figure 23. The topmost pattern shows the broad cristobalite and tridymite reflections, indication of opal-CT. The next pattern indicates peaks which can be used to distinguish the two zeolites, clinoptilolite and mordenite. The two lower patterns in Figure 23 are of smectite and an illite-like clay (celadonite).

A total of 170 samples (127 vesicles, 37 fractures, 5 breccias, and 1 massively altered sample) from DC2, DC6, and DH5 were analyzed in this study. The results of the analyses are given in Table 3. Both vesicle and fracture samples samples are dominated by clinoptilolite, smectite, and silica. Clinoptilolite occurs in 80%, smectite in 75%, quartz in 40%, cristobalite in 35%, and tridymite in 15% of all samples. The percentage occurrence of these and other minerals in fracture and vesicles is itemized in Table 4. Note that the data of Ames (1976) have not been incorporated in this table.

Vesicles exhibit a more complex mineralogical assemblage than fractures. Other than clinoptilolite, smectite, and silica, the only minerals found in fractures are illite and pyrite. Vesicles, on the other hand, were found to contain minor amounts of a variety of secondary phases such as erionite, chabazite, analcime, vermiculite, phillipsite, gypsum, and calcite. Certain of these identifications were aided and suported by SEM/EDS studies.

The distribution of secondary minerals in vesicles and fractures with depth is shown in Figure 24. Data on DDH1, DDH3, DH4, and DH5 from Ames

(1976) have been included with data on DC2 and DC6 from this study. It should be noted that significant percentages of quartz, illite, and smectite from the upper 300 m of DDH1, DDH3, DH4, and DH5 are associated with detrital sediments and are not authigenic. The following observations pertain only to authigenic minerals.

Distribution of smectite. This category includes minerals that Ames (1976) identified as montmorillonites, nontronites and beidellites. Smectite occurs throughout all depths in all cores. However, it appears to be less common in samples from depths greater than 600 m. The decrease in abundance may be an artifact of preferential sampling or it may be a result of masking by more abundant secondary phases.

Distribution of celadonite. Celadonite has an extremely patchy occurrence. For instance, celadonite was found in a single sample from DC2 while several samples in DC6 were found to contain celadonite.

Distribution of silica. Quartz occurs throughout all cores. Opal was noted in four of the six cores studied and is most abundant at depths in excess of 450 m. Over the depth interval of 600 to 1000 m, opal occurs more frequently than quartz in DH4 and DH5. Cristobalite is the dominant silica mineral in the same depth interval in DC2 and DDH3.

Distribution of clinoptilolite. Clinoptilolite occurs only in samples from depths in excess of 370 m. Below this depth it occurs throughout all core intervals studied.

Distribution of mordenite. Mordenite occurs infrequently and only at depths in excess of 880 m.

Distribution of calcite. Calcite occurs over two depth intervals, 0 to 350 m and 975 m to core bottom.

Discussion of XRD Results

Mineral zonation with depth is apparent but is not a striking feature. Clinoptilolite first appears at about 370 m and mordenite at about 880 m, whereas calcite occurs in both the upper and lower thirds of the depths studied. Silica and smectite are ubiquitous and illite has an extremely patchy distribution. A change with depth in the type of silica phase is not apparent in the two cores extensively studied by this group.

ELECTRON MICROPROBE (EMP) STUDIES

Procedures

Polished thin sections were analyzed with an ARL-SEMQ electron microprobe. The elements potassium, sodium, calcium, magnesium, barium, iron, aluminum and silicon were monitored simultaneously using an electron beam voltage of 15 kV and a sample current of 0.012 μAmp. A defocused beam (10 to 30 μm) was used to minimize volatilization of the lighter elements. Various standards were used including quartz (47), clinopyroxene (55) anorthoclase (54), synthetic anorthite (32), biotite (3) orthoclase (59) and bytownite (65). The number in parentheses refers to the University of California/Berkeley mineral number. The Bence-Albee correction method was used for data reduction. For the zeolite analyses, water was determined by difference. For the clay analyses water was assumed to be present in the ratio one water to eleven oxygens, i.e., $MO_{10}(OH)_2$ where M refers to metal ions.

A volatilization study was performed in which each element of interest was monitored as a function of time for both clay and zeolite. Count integration time was 1.5 seconds. A beam voltage of 15 kV and a sample current of 0.012 μAmp were used. Only sodium in clinoptilolite appeared to volatilize (Figure 25); note that sodium loss appears significant only at times greater than ten seconds. To test the effect of volatilization on the accuracy of the analyses, a second study was performed in which several zeolite crystals were analyzed for 4, 10, and 20 second intervals. The results of this study (Figure 26) indicate that sodium often decreases between 4 and 10 second run times (7 out of 10 times) but not between 10 and 20 second run times (3 out of 10 times). Complete analyses made within the 4 second period commonly result in totals in excess of 90 weight percent exclusive of water. These totals are high as water has been shown to commonly make up 12 to 16 percent of the total weight (Boles, 1972). We have therefore elected to use the 10 and 20 second data recognizing that significant sodium loss may have occurred during there runs. The data thus obtained should be viewed as yielding good but not necessarily precise estimates of zeolite composition.

Results and Discussion

The results of the EMP analyses of zeolites, clays, plagioclase feldspars and clinopyroxenes are given in Tables 5 through 8. Photomicrographs showing the locations of the EMP analyses are shown in Figures 27 through 50. The different symbols for clay analyses usually represent different generations (layers) of clay. However, for zeolites a different symbol often indicates no more than a different region on a relatively large single crystal.

Traverses. Electron microprobe traverses, made across vesicles and fractures containing single or multiple generations of clay or zeolite, are illustrated in Figures 51 through 60. The following observations were made:

(1) Thick single generations of clay in both fractures and vesicles appear chemically homogeneous (Figure 51).

(2) Thick single generations of clinoptilolite in fractures and vesicles are somewhat heterogeneous (Figures 52-54). However, composition does not

appear to vary in any simple manner with distance from the vesicle or fracture wall.

(3) In single vesicles and fractures having multiple generations of clay or clinoptilolite, composition often changes significantly from generation to generation (Figures 55-60).

(4) Multiple generations of clay from nearby fractures appear to exhibit similar patterns of compositional variations from one generation to the next (Figure 55).

(5) Multiple generations of clay from nearby vesicles also appear to exhibit similar compositional variations from one generation to the next (Figure 56).

(6) There are considerable differences between the compositions of individual generations of clay from either vesicle or fracture samples (Figures 57-60). No overall systematic trend in composition as a function of distance (generation) from vesicle or fracture walls has been found to exist.

Statistical calculations. Simple statistical calculations were done to determine the compositional nature of individual generations of clay and zeolite. Zeolite analyses were rejected when they indicated more than 0.3 wt. % MgO or more than 0.25 wt. % Fe_2O_3 or whose totals (exclusive of water) were less than 80 wt. %. Clays having calculated stoichiometric waters <7.9 wt. % or >9.0 wt. % were also rejected.

Few of the samples examined possess more than a single generation of zeolite. In addition, mean compositions of first and second generation zeolites do not differ significantly. Therefore, compositional data for both generations were combined. Histograms of oxide compositions of zeolites from DC2 and DC6 are displayed in Figure 61. The mean, standard deviation, and sample population are also given for each oxide. The distributions of oxides other than BaO and

Fe_2O_3 are characteristically multimodal. In addition, the range in composition of a particular oxide is large.

It was pointed out in a preceding section that vesicles and fractures commonly possess more than a single generation of clay. Table 9, which shows the crystallization order of secondary minerals determined from thin section petrography, documents this fact in greater detail.

Little compositional data were obtained on second generation and later clays; therefore, the clay data have been displayed in two ways. Oxide compositions of first generation clays from vesicles and oxide compositions of first generation clays from fractures are displayed in Figures 62-63. Oxide compositions of all clays formed prior to the deposition of silica or zeolite are shown in Figure 64. Data for clays with $K^+/Na^+ > 3$ have been excluded, therefore the data represent mainly smectites and not illites.

Observations with respect to the composition of first generation clays include the following:

(1) Oxide compositional ranges are nearly the same in both fractures and vesicles.

(2) The Al_2O_3 distribution is very nearly identical in both fractures and vesicles.

(3) Most oxide distributions are neither Gaussian nor unimodal.

(4) Certain oxides (e.g., MgO and CaO) exhibit different kinds of distributions for fractures and vesicles.

The oxide distributions of all clays formed before the deposition of silica or zeolite (Figure 64) bear a close resemblance to the oxide distributions of first generation clays. This is somewhat expected since first generation clays comprise 35% of all fracture clays and 42% of all vesicle clays analyzed.

Histograms, means, standard deviations and population size of EMP analyses of plagioclase feldspars and clinopyroxenes are shown in Figures 65 through 66.

Nature of the zeolite phase. Although the principal zeolite phase has been referred to as clinoptilolite, neither the XRD nor the SEM studies are sufficient to distinguish clinoptilolite from its isomorphous counterpart heulandite. Mumpton (1960) proposed a molecular Si:Al ratio of 2.75 to 3.25 for heulandites and 4.25 to 5.25 for clinoptilolites. Mason and Sand (1960) also suggested that heulandites can be distinguished from clinoptilolites on the basis of the molar ratio of monovalent to divalent cations, i.e., (Na + K) > Ca in clinoptilolites. Based on these criteria the zeolites probed in this study should be called clinoptilolites since the mean Si:Al ratio is 4.68 and CaO never exceeds 50% (Figures 68-69).

The compositional distinction between clinoptilolite and heulandite is somewhat arbitrary. Boles (1972) has shown that "heulandite group" minerals possessing intermediate Si:Al ratios exist in nature. In addition, Shepard and Starkey (1964) have shown that both endmembers (defined in terms of Si:Al) can be fully exchanged (Na -> K -> Ca) at $100^{\circ}C$.

Compositional trends with depth. The oxide compositions of zeolites and clays as a function of depth in DC2 and DC6 are shown in Figures 69 and 70. Distinct trends appear to be more a function of the crystal probed than of depth. Exchange ion ratios in clinoptilolites of DC6 are displayed as a function of depth in the data of Figure 71. A definite increase in the Ca^{++}/Na^{+} ratio occurs below 1100 m. This increase is also reflected in the data of Figure 67.

The compositions of pyroxenes and feldspars analyzed in this study were not found to vary in any systematic manner with depth.

TRENDS IN BULK ROCK COMPOSITION

Iron and silicon oxide analyses of bulk rock samples from DC2 and DC6 are displayed as a function of depth in Figure 72. These data are from Ames (1976). Similar trends with depth exist in both cores. Certain abrupt changes in composition occur at formation interfaces. For instance, the Vantage Sandstone which separates the Wanapum Basalt Formation from the Grande Ronde Basalt Formation occurs at a depth of 656.8 m (2155 ft) in DC6 and at a depth of 624.8 m (2050 ft) in DC2. SiO_2, Al_2O_3 (not shown), and FeO show marked changes across this interface. It should be noted that the EMP studies were performed over intervals of DC2 and DC6 in which the variability of bulk rock composition is small. This unfortunately excludes testing the control of primary mineral composition on secondary mineral composition.

THIN SECTION PETROGRAPHY

Procedures

Fifty-five vesicles and 27 fractures from DC2, DC6, DH4, and DH5 were examined in thin section in order to determine crystallization sequences (Table 9). In addition, point counting of the relative amounts of secondary minerals lining eight fractures in DC6 was accomplished, and a reconnaissance study of all thin sections was made in order to determine if selective dissolution and replacement of primary mineral or groundmass had occurred.

Results

Clay was the first mineral to form in 96% of the fractures and in 94% of the vesicles. Zeolite was the first phase to form the rest of the time, and the second phase to form in fractures 81% of the time and in vesicles 97% of the time. In samples having a third phase, silica followed clinoptilolite 100% of the time in fractures and 67% of the time in vesicles. Clay was precipitated after zeolite in the remaining 33% of the vesicles. Point counting of secondary minerals in fractures of DC6 showed that clay dominates the assemblage (Table 10).

The thin-section reconnaissance study also indicated that alteration of primary minerals and groundmass occurred most frequently in the vicinity of vesicles and fractures. Alteration of groundmass to clay was a pervasive feature. The alteration of feldspar, clinopyroxene and magnetite has occurred on a much smaller scale. These observations are similar to those made by Hay and Jones (1972) in a study of the weathering of basaltic tephra on the island of Hawaii. It is extremely difficult to quantify the relative degree of alteration experienced by the primary minerals. The overall quantitative impression is that the iron-bearing phases, clinopyroxene and magnetite, have experienced a greater degree of alteration than the feldspars.

Discussion of Petrographic Data

The sequence of crystallization can be determined more exactly with thin section petrography than with SEM techniques. Although the SEM yields a two-dimensional representation of a three-dimensional volume, sampling often precluded observation of the innermost layers. On the other hand, a two-dimensional thin section can be aligned normal to the growth direction of secondary minerals so that the entire sequence of alteration can be observed. The SEM data (Table 1) indicate the overall sequence clay -> clinoptilolite -> silica/clay; however the petrographic data (Table 9) demonstrate conclusively that this is indeed the general trend. This is not to say that a certain amount of intergrowth of minerals has not occurred. The change in the relative amounts of secondary minerals over very short distances points out the difficulty in making accurate statements about their abundance. Pryoxenes and groundmass appear highly altered.

WET CHEMICAL ANALYSIS OF FRACTURE MATERIALS

Procedures

Material was scraped from four fractures in DC6. The samples, which are predominantly clay, were ground to fine powders and the powders split three ways. One split was analyzed by XRD. Cation exchange capacities (CEC) using calcium, ammonia, and potassium were measured on a second split using methods given in Jackson (1975). Amorphous iron and aluminum extractions were performed on a third split using ammonium oxalate at pH 4 (Schwertmann, 1964). Extracted and unextracted splits were subsequently analyzed using atomic adsorption spectrophotometry to determine total iron and aluminum. Ferrous iron was determined by H_2SO_4-HF dissolution of the samples followed by titration of Fe^{2+} with $K_2Cr_2O_7$ using diphenylamine sulfonic acid sodium salt as an indicator. The results of the analyses are given in Table 11.

Results

The cation exchange capacity (CEC) of DC6 3134 is in the expected range. The two samples containing clinoptilolite have slightly larger CECs; this may be due to the higher CEC of clinoptilolite (~ 2 meq x g^{-1}).

The change in Al_2O_3 upon processing is generally not significant. All samples were found to contain a significant amount of iron in the ferrous state. A significant amount of extractable iron was present in all samples.

Discussion of Wet Chemical Data

It appears that iron in the clays is in both ferrous and ferric forms. This must be taken into account in the calculation of clay structural formulas. The presence of easily extractable iron indicates that the clays are contaminated with iron oxyhydroxides; this too must be taken into account in clay mineral structural formulations. The ratio of oxidation states indicated by these data should be considered in a qualitative sense only when setting the

Fe^{2+}/Fe^{3+} ratio of Hanford clays. The samples are obviously contaminated with other iron-bearing phases and are not necessarily representative of vesicle- or other fracture-filling clays. This also implies that an iron-rich phase such as hematite or goethite should be included as a potential product mineral in equilibrium-step mass-transfer simulations. No evidence for the presence of significant amounts of aluminum oxyhydroxides was found. The presence of extractable silica was not tested due to small sample size. However, structural calculations of smectite showed that in certain samples the amount of silica exceeded the four tetrahedral positions. This suggests that a silica phase may be intergrown with the smectite.

SUMMARY AND CONCLUSIONS

This study has provided certain data which are extremely useful for the equilibrium-step mass-transfer simulations of Part II of this report. In the samples studied, the general secondary mineral crystallization sequence is: clay, (one or more generations), clinoptilolite, silica and/or clay. The initial clay phase is invariably smectite. Silica occurs in one or more of the following forms: opal, cristobalite, tridymite, or quartz. The co-occurrence of these forms may indicates formation under low-temperature (<100°C) diagenetic conditions (Murata and Larson, 1975). Only in a single instance was silica found in a definitive high-temperature form. Another iron phase, possibly hematite or goethite, occurs within the smectite. Co-precipitation of authigenic minerals has certainly occurred in at least some of the samples.

Certain vesicles and fractures record only a portion of the general sequence of precipitation. This is hypothesized to be due to changes in the degree of isolation of a particular void with time; i.e., some vesicles are initially isolated from the flowing hydrochemical system until dissolution processes create the necessary interconnections. Other vesicles, which are initially a part of the permeable network, become blocked with precipitate over time and hence become isolated from latter events which occur in the advective system.

Petrographic observations indicate that the groundmass, which was initially mostly glass, and the pyroxene mineral have experienced a greater degree of alteration than plagioclase.

Volume estimates of secondary minerals (Tables 2, 3, and 10) indicate that clay and clinoptilolite are approximately equal in abundance in vesicles. Silica is much less abundant. In fractures clay appears to be more abundant than clinoptilolite; both phases are more abundant than silica.

Electron microprobe results indicate that clinoptilolite and clay exhibit a wide range of composition. Thus, although the observed sequence of crystallization appears relatively straight forward, the compositions as well as amounts of secondary mineral solid solutions vary in an unpredictable manner over small vertical and horizontal distances. The observation that the geochemical system is characterized by a "fine-grained" spatial heterogeneity suggests that modeling or simulations of the chemical evolution of the natural system should be accomplished with the use of mean quantities which are representative of the spatial volume of interest.

From the data obtained in this study, it is impossible to unequivocally ascertain the thermal conditions under which the Pasco Basin basalts experienced alteration. Certainly hydrothermal conditions dominated at those times of basalt emplacement. But the effects of these transient conditions relative to the cumulative effects of long-term low-temperature processes are not adequately understood. One way to address this question is to call upon "Ockham's razor", i.e., given alternative hypotheses which adequately explain an observable phenomena, the simplest one is preferred. In this respect we note that similar secondary mineral assemblages have been noted in a variety of low-temperature diagenetic environments, e.g., Hay (1963), Sheppard and Gude (1968), Hoover (1968), Iijima (1971), Sheppard and Gude (1973), Walton (1975), and White, et al. (1980). We therefore adopt the hypothesis that the geochemical evolution of the Pasco Basin system is due mainly to diagenetic and not hydrothermal processes. We assume that hydrothermal events associated with the emplacement of volcanic flows have occurred at discrete times in the past but have only served to complicate and not dictate the scope of the chemical evolution of the natural system.

Zonation of mineral assemblages with depth does occur but is not a pronounced feature. Ames (1976) XRD data on DDH3, DH4, and DH5 indicate the appearance of clinoptilolite at approximately 400 m. XRD data from this and Ames (1976) study indicate the appearance of mordenite at depths in excess of 880 m in five of six cores studied. The appearance of mordenite correlates roughly with features which are interpreted to indicate that clinoptilolite has or is undergoing dissolution.

Mineral zonation with depth parallels the zonation of mineral precipitates found in single vesicles from the deepest portion of the studied sequence. This suggests that the chemical evolution of the system can be described as a function of time at a single point in space or as a function of space which is itself a measure (abeit nonlinear) of time. Both time and depth variables can in turn be transformed into extent of reaction space (ξ - space) with the appropriate kinetic data. This statement contains the implicit assumption that in the Pasco Basin the extent of reaction is not a strong function of temperature over the range 30 - 70^{o}C.

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TABLE 1

CRYSTALLIZATION SEQUENCES OBSERVED IN SEM SAMPLES

Sample	Depth (m)	Crystallization Sequence
DC2 2206 S1 (v)	673.4	Cl -> C -> Si
S2A (v)		Cl -> C
S2B (v)		Cl -> C -> Si
S3 (v)		C -> Si -> U(K)
S4 (v)		Cl -> Si -> Cl
DC2 2240 S1 (f)	682.8	Cl
S2 (f)		Cl
DC2 2282 S1 (f)	695.6	Si -> Cl
DC2 2314 S1 (f)	705.3	Cl
DC2 2319 S1 (v)	706.8	Cl
S2 (v)		Cl
S3 (v)		Cl
S4A (v)		Cl
S4B (v)		Cl
S5A (v)		Cl -> C - Cl
S5B (v)		Cl
S5C (v)		C -> Cl
DC2 2347 S1 (v)	715.4	Cl -> Si
DC2 2354 S1 (v)	717.5	Cl -> Si -> C - Py
DC2 2359 S1A (v)	719.0	C -> Cl
S1B (v)		Cl
S2A (v)		C -> Cl
S2B (v)		Cl -> C -> Cl
DC2 2366 S1A (v)	721.2	Cl -> C -> Si - Ap(?)
S1B (v)		Cl -> C(?) -> Si -> Cl
DC2 2402 S1 (f)	732.1	Cl -> Si -> Cl
DC2 2448 S1 (v)	746.2	Cl -> M(?)
S2 (v)		Si - Cl -> Si -> Cl
DC2 2507 S1 (f)	764.1	Si
DC2 2561 S1 (f)	780.6	Cl -> Si - Cl

TABLE 1 (Cont'd)

CRYSTALLIZATION SEQUENCES OBSERVED IN SEM SAMPLES

Sample	Depth (m)	Crystallization Sequence
DC2 2632 S1 (v)	802.2	Cl
S2 (b)		Cl
S3A (v)		Cl -> C -> Cl
S3B (v)		Cl -> F(?) -> C -> Cl -> Si
S3C (v)		Cl
S3D (v)		Cl -> C -> Cl - CR(?)
S3E (v)		Cl -> C - CR(?)
DC2 2666 S1A (v)	812.6	Si
S1B (v)		C -> Si
S1C (v)		Cl
S1D (v)		C -> Si -> Cl
S2 (f)		Cl - Si - C(?)
DC2 2749 S1A (v)	837.9	Cl - C -> Cl
S1B (v)		Cl - C -> Cl
S1C (b)		Cl
DC2 2803 S1 (v)	854.4	Cl -> C -> Si - Cl
S2A (v)		Cl
S2B (v)		C -> Si -> Cl
DC2 2831 S1 (v)	862.9	Cl
DC2 2868 S1 (b)	874.2	Cl
DC2 2883 S1 (f)	878.7	Si -> Cl
S2 (f)		C(?)
DC2 2926 S1 (f)	891.8	Py - Cl
DC2 2955 S1 (f)	900.7	Si - Py -> Cl -> Si
DC2 2960 S1A (v)	902.2	Si - C -> M(?) -> Cl
S1B (f)		Cl
DC2 3181 S1 (v)	969.6	Cl -> Cl(Fe)
DC2 3264 S1 (v)	994.9	C -> Si - M(?) -> Cl
S2 (v)		Cl -> Si - Cl -> Si
S3 (v)		Si
S4 (v)		Si -> M(?)

TABLE 1 (Cont'd)

CRYSTALLIZATION SEQUENCES OBSERVED IN SEM SAMPLES

Sample	Depth (m)	Crystallization Sequence
DC6 1978 S1 (v)	602.9	S -> Q/Op -> Cc(?)
DC6 2156 S1 (v)	657.1	S -> Ph(?) -> C
DC6 2190 S1 (v)	667.5	S/I -> S/I -> S/I
S2 (v)		I
S3 (v)		S/I -> Si
DC6 2427 S1 (v)	739.7	S(Ti) -> S(K) -> S(Mg) -> C
S2 (a)		Op -> C - Cl -> Si - Cl
DC6 2464 S3 (v)	751.0	I -> Q -> I
S3A (v)		I -> C -> Q -> Cl
S4 (v)		I -> C -> I
DC6 2695 S1 (v)	821.4	I -> C -> Si - Cl -> Op
S2 (v)		S -> CR/Q -> C - Cc(?)
S4 (v)		I -> C -> Q
DC6 2908 S1 (v)	886.4	C
S2 (v)		Cl -> C
S3 (v)		S/I -> S/I -> Q -> C -> U(K)
S4 (v)		Cl -> Cl -> C - Q - Cl
S5 (v)		Cl -> Cl(Fe)
DC6 2949 S1 (v)	898.9	Cl -> Cl
S3 (v)		Cl
DC6 2989 S1 (v)	911.0	S
S3 (v)		S -> S -> S
S6 (v)		S -> U(TiSiFe)
DC6 3038 S1 (v)	926.0	CR/Q - C - S -> CR/Q
S2 (v)		C -> S
DC6 3089 S2 (v)	941.5	Si -> Cl
S3 (v)		S -> Op/Q - C -> S -> M(?)
S4 (v)		M - Op
DC6 3267 S1 (v)	995.8	S/I -> C -> S/I -> M(?)
DC6 3337 S1 (v)	1017.1	S -> C -> Q -> S
S5 (v)		C

TABLE 1 (Cont'd)

CRYSTALLIZATION SEQUENCES OBSERVED IN SEM SAMPLES

Sample			Depth (m)	Crystallization Sequence
DC6 3367	S1	(v)	1026.3	C -> Si -> Cl
	S4	(v)		M -> Cl
DC6 3387	S1	(v)	1032.4	S -> C -> Q/CR
	S2	(v)		C -> Q/CR/T - S -> M(?)
	S3	(v)		S/I -> C -> CR/Op/Q -> M -> Cl
	S4	(v)		Cl -> Si - C - Cl
	S5	(v)		S - C -> I(?)
	S6	(v)		Cl -> C - Cl -> Si
DC6 3421	S3	(v)	1042.7	C -> Cl -> Op, Ap(?), Cl
DC6 3538	S1	(v)	1078.4	S -> Q/CR/Op
	S2	(v)		C - S
	S3	(v)		C - S -> M
	S4	(v)		C - Si - Cl
DC6 3609	S3	(v)	1100.0	Cl -> C -> Cl -> Q -> M -> Cl(Mg)
DC6 3688	S1	(v-f)	1124.1	S, Q/CR, C, M(?), U(CaKNa)
DC6 4204	S1	(b)	1281.4	Q/CR -> S, U(CaMg), U(Mg)
	S4	(v)		Cl -> Q(?)
DH5 2616	S1	(v)	797.4	Cl
DH5 2620	S1	(b)	798.6	Cl
	S2	(v)		Cl
	S3A	(v)		C -> Cl
	S3B	(v)		Cl -> C
	S3D	(v)		C -> Cl -> Si
	S3E	(v)		Cl -> C -> Si -> Cl
	S4A	(v)		C - Si -> Cl
	S4B	(v)		C - Si -> Cl -> Cl
	S5A	(v)		C - Cl
	S5B	(v)		Py - Cl
DH5 2633	S1	(v)	802.5	C - Si
	S2	(v)		Cl -> Cl - Si
	S3	(v)		Si -> C

TABLE 1 (Cont'd)

CRYSTALLIZATION SEQUENCES OBSERVED IN SEM SAMPLES

Sample	Depth (m)	Crystallization Sequence
DH5 2643 S1 (v)	805.6	C - Si -> Cl
S2A (v)		Si -> Cl
S2B (v)		Si -> Cl - C
S2C (v)		Si -> Cl
S2D (v)		Si -> C
DH5 2668 S1A (v)	813.2	Cl
S1B (v)		Si
DH5 2691 S1 (f)	820.2	Cl -> U(fi)
DH5 2717 S1 (f)	828.1	Cl
DH5 2727 S1 (f)	831.2	Cl
S2 (f)		Si - Cl
DH5 2745 S1 (v)	836.7	Cl -> C -> Si - Cl
DH5 2811 S1 (f)	856.8	Cl
DH5 2831 S1A (v)	862.9	Si
S1B (v)		Si -> C
S1C (v)		Si
S2 (v)		Py - G(?) - Si
S3A (v)		Cl - C(?)
S3B (v)		Cl
S3C (v)		Cl -> Cl
S4A (v)		C -> Cl -> Si
S4B (v)		Cl - Cl - Si -> Py - G(?)
S5A (v)		C -> Si -> Py - G(?)
S5B (v)		Cl -> C -> Si - Cl
S6 (f)		Cl

TABLE 1 (Cont'd)

CRYSTALLIZATION SEQUENCES OBSERVED IN SEM SAMPLES

Legend

Sample Type:

a = totally altered basalt
b = breccia
f = fracture
v = vesicle
v-f = large void in thick fracture; only one of this type

Mineralogy:

Ap = apatite
C = clinoptilolite
Cc = calcite
Cl = clay, distinctive or especially abundant cations listed in parentheses
CR = low-cristobalite
F = feldspar
G = gypsum
I = illite-like mineral, probably celadonite (identification based on chemical composition and occurrence)
M = mordenite
Op = opal
Ph = phillipsite
Py = pyrite
Q = quartz
S = smectite, distinctive or especially abundant cations listed in parentheses
Si = silica, unspecified type
T = tridymite
U = unidentified mineral; major cations listed in parentheses

Symbols:

-> = Separates phases which are consecutively layered
~ = Separates phases which are intergrown
, = Separates phases whose crystallization order cannot be positively determined
/ = Separates phases identified with XRD but which cannot be correlated with different morphologies
? = Tentative identification based on chemical and morphological characteristics or by comparison with samples at same depth in core
fi = fibrous mineral

TABLE 2

VOLUME ESTIMATES OF SECONDARY MINERALS IN VESICLES OF DC2, DC6, and DH5

Sample	Depth (m)	Mineralogy	Volume Percent
DC2 2206 S2A	673.4	Cl	10
		C	90
DC2 2206 S2B		Cl	55
		C	35
		Si	10
DC2 2632 S3D	802.2	Cl	36
		C	58
		Si	4
		Cl	2
DC2 2666 S1D	812.6	C	50
		Si	40
		Cl	10
DC2 2803 S2A	854.4	C	90
		Cl	10
DC2 2960 S1A	902.2	C	50
		Si	15
		Fi (CaNaK)	15
		Cl	20
DC2 3181 S1	969.6	Cl	10
		Cl (Fe)	90
DC6 1978 S1	602.9	S	57
		Q/T	43
		$CaCO_3$	<1
DC6 2156 S1	657.1	S	4
		Ph(?)	14
		C	82
DC6 2190 S1	667.5	S/I	90
		S/I	8
		S/I	2
DC6 2427 S1	739.7	S(TiNa)	33
		S(K)	22
		S(Mg)	18
		C	27
DC6 2464 S3	751.0	I	57
		Q	40
		I	3

TABLE 2 (Cont.)

VOLUME ESTIMATES OF SECONDARY MINERALS IN VESICLES OF DC2, DC6, and DH5

Sample	Depth (m)	Mineralogy	Volume Percent
DC6 2908 S3	886.4	S/I	20
		S/I	30
		Q	5
		C	45
		K	<1
DC6 3089 S2	941.5	Si	97
		Cl	3
DC6 3367 S1	1026.3	C	55
		Si	42
		Cl(pris)	3
DC6 3387 S5	1032.4	C	60
		S	35
		I(pris)	5
DC6 3421 S3	1042.7	C	30
		Cl	45
		T	15
		CaP	10
DC6 3538 S4	1078.4	C	45
		Si	30
		Cl	25
DH5 2620 S3B	798.6	Cl	10
		C	90
DH5 2620 S4B		C	47
		Si	13
		Cl	31
		Cl	9
DH5 2620 S5A		Cl	65
		C	35
DH5 2643 S2A	805.6	Si	80
		C	20
DH5 2643 S2B		Si	65
		C	20
		Cl	15
DH5 2643 S2C		Si	90
		Cl	10
DH5 2831 S5A	862.9	C	80
		Si	15
		CaS	5

TABLE 2 (Cont.)

VOLUME ESTIMATES OF SECONDARY MINERALS IN VESICLES OF DC2, DC6, and DH5

Legend

Cl	= clay
S	= smectite
S/I	= smectite and/or illite
I	= illite
C	= clinoptilolite
Si	= silica
Q/T	= quartz and/or tridymite
T	= tridymite
Q	= quartz
Fi	= fibrous
CaS	= calcium sulfate (gypsum)
$CaCO_3$	= calcium carbonate
CaP	= calcium phosphate (probably apatite)
K	= potassium aluminum silicate
Ph	= phillipsite
pris	= prismatic
?	= probable identity of the mineral

Note: Elements in parentheses after mineral name indicate distinctive or especially abundant components.

TABLE 3

AUTHIGENIC MINERALS FOUND IN XRD SAMPLES

Sample	Depth (m)	S	I	C	M	Q	CR	Op	Other
DC2 2206 x1 (v)	673.4	a		d					
x2 (v)		m						a	
x3 (v)		m		d			m		
x4 (v)				d			a		
DC2 2240 x1' (f)	682.8	d							
x1" (f)		d							
x2' (f)		a				t		a	
x2" (f)		d				m		a	
DC2 2282 x1 (f)	695.6			t		t		d	
DC2 2314 x1 (f)	705.3	d							
DC2 2319 x1 (v)	706.8	m		a			m		
x2 (v)		m		d					
x3 (v)				d		t			
x4 (v)		t		d					
x5 (v)				d					W
x6 (v)		d		m					
DC2 2347 x1 (v)	715.4			t		d		m	
DC2 2354 x2 (v)	717.5	t		d			t		
x3' (v)		a		d					
x3" (v)		m		d			m		
x4 (v)		m		d					
x5 (v)		t		d		m			
DC2 2359 x1 (v)	719.0	m		m			d		
x2 (v)		m		d			a		
x3 (v)				d		a			
x4 (v)		a		a			d		
DC2 2366 x1 (v)	721.2			d				a	A,E
x2 (v)				d					E
DC2 2402 x1 (f)	732.1	d							
x2 (f)				t		d		a	
x3 (f)		m		d					
DC2 2448 x1 (v)	746.2			t				d	
x2 (v)		t		d				a	

TABLE 3 (Cont'd)

AUTHIGENIC MINERALS FOUND IN XRD SAMPLES

Sample			Depth (m)	S	I	C	M	Q	CR	Op	Other
DC2 2507	x1	(f)	764.1	a		t		m		d	
DC2 2561	x1	(f)	780.6	m		t		t		d	
DC2 2632	x1	(v)	802.2			d			t		
	x2	(v)		m		d					
	x3	(v)		t		m		t	a		
DC2 2666	x1	(v)	812.6			a		m		d	
	x2	(v)		d							
	x3	(f)						d	m		
DC2 2749	x1	(b)	837.9	d				m			
	x3	(v)		t		d		m			
DC2 2803	x1	(v)	854.4	m		a		d	t		
	x2	(v)		a		t		d	t		
	x3	(v)						t	d		
	x4'	(v)		m		m		m	d		
	x4"	(v)		a		t		d	t		
	x5	(v)		d		m		a	t		
	x6	(v)		t		t		d			
DC2 2868	x1	(b)	874.2	d		m					
DC2 2883	x1	(f)	878.7			t				d	
	x2	(v)				t				d	
	x3	(v)		t		t			m		
DC2 2926	x1	(f)	891.8	a		m				d	
DC2 2955	x1	(v)	900.7			t				d	
	x2	(v)				m				d	Py
DC2 2960	x1	(v)	902.2	t		d			m		
	x2	(v)				d			m		
	x3	(v)				d				a	
DC2 3181	x1	(v)	969.6	d							Cc
	x1'	(v)		d					t		
DC2 3264	x1	(v)	994.9	m	d	m					
	x2	(v)						d			
	x3	(v)		d		m	a				
	x3'	(v)		m		m	d				
	x3"	(v)		m		a	m	m	d		

TABLE 3 (Cont'd)

AUTHIGENIC MINERALS FOUND IN XRD SAMPLES

Sample	Depth (m)	S	I	C	M	Q	CR	Op	Other
DC6 1978 x1' (v)	602.9	m				d		t	
DC6 2011 x1 (v)	613.1	d							
DC6 2156 x1 (v)	657.1	t		d					Ph
DC6 2190 x1 (v)	667.5	d	a						
X2 (v)			d						
x3 (v)		a	m						
DC6 2279 x3 (v)	694.8		d						
DC6 2403 x1 (f)	732.6	d	a	m					
DC6 2427 x1 (v)	739.7	m		m					
x2 (a)				a				d	
DC6 2464 x3 (v)	751.0		t	a		d			
x4 (v)			d	a					
DC6 2695 x1 (v)	821.4		d	m					
x1' (v)				d					
x1" (v)				m				d	
x2 (v)		m		a		m	a		
x4 (v)			m	d		m			
DC6 2908 x1 (v)	886.4			a		d			
x1' (v)		a	d						
x2 (v)				d					
x3 (v)		a	t	d					
x4 (v)				t		d			
x5 (v)				t		d			
x6 (v)						d			
DC6 2949 x1 (f)	898.9	d		t		m			
DC6 2989 x1 (v)	911.0	d							
x2 (f)		d		m					
x3 (v)		a							
x5 (v)									Ch
x6 (v)		d		m		t			
DC6 3006 x1 (f)	916.5	d				t			Py
DC6 3038 x1 (v)	926.0	m		d		t	m		
x2 (v)		d		a		m			
x3 (v)		t		d					

TABLE 3 (Cont'd)

AUTHIGENIC MINERALS FOUND IN XRD SAMPLES

Sample	Depth (m)	S	I	C	M	Q	CR	Op	Other
DC6 3074 x1 (f)	937.2	d		a					
DC6 3078 x1 (f)	938.4	d		m					
DC6 3089 x1 (f)	941.5	d		m					
x3 (v)		t		d		t		m	
x3' (v)		t		d				m	
x4 (v)		t	t		d				
x4' (v)					t			d	
DC6 3134 x1 (f)	955.5	d							
DC6 3174 x1 (f)	967.7	d	m	m				t	
DC6 3267 x1 (v)	995.8	t	t	d					
x1' (v)		t	t	d					
x1" (v)		m	m	d					
DC6 3274 x1 (f)	998.2	d	m	m			m		
DC6 3324 x1 (f)	1013.4	d		a					
x2 (f)		d							
DC6 3337 x1 (v)	1017.1	a		m		d			
x2 (v)		t				d			
x4 (v)		d		m		a			
DC6 3367 x4 (v)	1026.3				d	a			
DC6 3387 x1 (v)	1032.4			t	t	d	m		
x1' (v)		d				a	m		
x2 (v)		t		t		d	m		T
x3 (v)		t			d	m	m		
x3' (v)		t	t	d		t	m	m	
x5 (v)			m	d		m			T
x5' (v)		a	t	d					
DC6 3421 x3 (v)	1042.7			d				t	
DC6 3488 x1 (v)	1063.4	d							
DC6 3538 x1 (v)	1078.4	m		m		d	a		
x1' (v)		t		m		d		t	
x1" (v)		t	t	t		d	t	t	
x2 (v)		d		t	m	m			
x3 (v)		a		t	d	a			

TABLE 3 (Cont'd)

AUTHIGENIC MINERALS FOUND IN XRD SAMPLES

Sample		Depth (m)	S	I	C	M	Q	CR	Op	Other
DC6 3572 x1	(f)	1089.0	a		m		d	t		
DC6 3581 x1	(f)	1091.8	m		d		t			
x2	(f)		t		d		a	m		
x3	(f)		m		d					
x4	(f)		d		a					
DC6 3608 x1	(f)	1100.0	d		m					
x2	(f)		m		d		t			
x3	(v)				m	t	d		t	
DC6 3620 x1	(f)	1103.7	d		m					
DC6 3688 x1	(v-f)	1124.1	d		a		a	t		
DC6 4204 x1	(b)	1281.4	m		t		d	t		
DH5 2616 x1	(v)	797.4			a					Py
x2	(v)				d		t			
x3	(v)				d					
DH5 2620 x1	(b)	798.6			a					
x2	(v)		m	d	t					
x3	(v)				d					
x4	(f)		d							Py
x5	(b)				d			t		
x6'	(				d			t		
x6"	(v)				d					
x8	(v)		d		a					Py
DH5 2633 x1	(v)	802.5			m		m		d	
x2	(v)				a				a	
DH5 2643 x1	(v)	805.6			d					
x2	(v)				a		a		d	
DH5 2668 x1	(v)	813.2			a				d	
x2	(v)				t				d	
DH5 2727 x1	(f)	831.2			d			m		
DH5 2831 x2	(v)	862.9			d		m			
x3'	(v)				m		m		a	
x3"	(v)				m		m		d	
x4'	(v)									G
x4"	(v)		t		d				m	
x4"	(v)						t			G
x6	(f)				d		m		a	

TABLE 3 (Cont'd)

AUTHIGENIC MINERALS FOUND IN XRD SAMPLES

Legend

Sample type:

a = totally altered region of core
b = breccia
f = fracture
v = vesicle
v-f = large void in vesicle
* = sample from thin section chip

Mineral Abundances:

d = dominant
a = abundant >20%
m = minor 6-20%
t = trace 1-5%

Mineralogy:

A = analcime
C = clinoptilolite
Cc = calcite
Ch = chabazite
CR = low-cristobalite
E = erionite
G = gypsum
I = illite-like clay, probably celadonite
M = mordenite
Op = opal
Ph = phillipsite
Py = pyrite
Q = low-quartz
S = smectite
T = tridymite
W = wairakite (Ca-analcime)

TABLE 4

PERCENT OF FRACTURE AND VESICLE SAMPLES CONTAINING A SPECIFIC SECONDARY MINERAL FOUND BY X-RAY DIFFRACTION.

Secondary Mineral	Fracture Samples DC2	DC6	DH5	Σ^*	Vesicular Samples DC2	DC6	DH5	Σ^*
CLINOPTILOLITE	50	86	80	71	88	68	90	82
MORDENITE	0	0	0	0	6	14	0	9
SMECTITE	75	95	20	63	67	64	15	57
CELADONITE+	0	14	0	7	2	32	5	16
QUARTZ	44	32	20	32	31	52	35	41
CRISTOBALITE	12	18	40	23	39	18	5	21
OPAL	50	9	20	26	20	18	40	26
TRIDYMITE	6	0	0	2	0	5	0	2

Σ^* indicates average taken over all cores.

+ Celadonite identification is based on XRD and EDS analyses and mode of occurrence.

TABLE 5

CHEMICAL COMPOSITION OF ZEOLITES

Sample		m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	Total
DC2	2282	696	A	1-4	(f)	70.95±1.10	12.13± .45	.09± .03	0.0	.62± .09	.38± .09	2.52± .14	4.34± .34	91.04
DC2	2314	705	A	16-28	(f)	69.65±1.29	10.74± .44	.47± .05	.02± .01	.61± .07	NA	2.32± .20	2.71± .24	81.52
DC2	2319	707	C	38-41	(v)	63.18±2.61	12.41± .14	.87± .94	.07± .07	.99± .07	.43± .11	2.67± .24	2.79± .24	83.40
			C	42-43	(v)	64.40±1.18	12.52± .51	.48± .62	.03± .03	.96± .04	.48± .13	2.96± .23	3.0 ± .13	84.83
			C	45-47	(v)	57.42± .85	10.50± .31	5.57±3.34	.42± .28	1.08± .14	.35± .13	2.23± .06	2.28± .35	79.84
			C	49-51, 53,55	(v)	67.10± .47	13.26± .26	.10± .05	0.0	.95± .08	.44± .06	3.63± .39	3.54± .34	89.02
			D	19,21-23	(v)	67.86±5.17	9.82±1.65	2.26±2.89	0.0	.77± .16	.28± .04	2.26± .39	2.36± .27	85.65
DC2	2359	719	A	14-18, 20-24	(v)	68.73±2.43	12.09± .46	.47± .26	.07± .06	1.02± .13	.24± .05	3.34± .43	2.72± .19	88.68
			B	22,24	(v)	70.75± .70	13.52± .12	.07± .04	0.0	.95± .03	.36± .13	4.21± .16	3.71± .15	93.56
			B	23,25	(v)	67.06±3.20	13.72± .39	.54± .21	0.0	1.59± .32	.40± .08	3.61± .06	3.07± .18	90.10
			B	26,32	(v)	67.25±1.47	12.77± .35	.05± .01	0.0	1.02± .06	.62± .08	2.77± .00	3.10± .08	87.57
			B	27-31, 33-35	(v)	68.42±1.29	13.07± .17	.06± .02	0.0	1.05± .07	.48± .07	2.43± .20	3.00± .15	88.51
			C	14-23	(v)	70.80± .91	13.40± .37	.11± .05	0.0	1.01± .09	.45± .10	2.82± .25	3.57± .16	92.16
DC2	2366	721	A	4-5, 45-49	(v)	67.17± .95	11.77± .33	0.0	0.0	.73± .06	.36± .07	2.58± .26	3.70± .17	86.31
			A	6-8	(v)	67.86±1.21	12.08± .60	0.0	0.0	.84± .04	.41± .04	1.98± .28	3.13± .23	86.29
			A	9-12, 19-21	(v)	67.97±1.62	12.43± .33	0.0	0.0	.99± .22	.51± .08	2.80± .24	3.52± .27	88.22
			A	13-15, 37-40	(v)	66.41±1.48	12.87± .25	0.0	0.0	1.61± .15	.70± .06	2.70± .23	2.65± .19	86.94
			A	16-17	(v)	64.34± .71	12.45± .02	.31± .27	.03± .02	1.67± .04	.07± .04	2.51± .32	2.08± .06	85.10
			A	22-35, 41-44	(v)	62.83±1.89	15.97± .42	.14± .10	0.0	.13± .04	1.39± .14	4.66± .22	5.01± .31	90.14

TABLE 5 (Cont.)

CHEMICAL COMPOSITION OF ZEOLITES

Sample		m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	Total
DC2	2666	813	C	14-15	(v)	66.86± .43	11.54± .01	0.0	.01± .00	.61+ .13	.28+ .03	2.68+ .23	3.49± .11	85.50
			C	16-21	(v)	68.42±2.19	11.82± .32	0.0	0.0	.66± .14	.35± .12	2.42± .30	3.43± .17	87.11
			C	22-24	(v)	68.76±1.12	12.57± .30	.01± .01	0.0	.78± .05	.53± .03	2.29± .05	3.24± .18	88.19
			C	25-26	(v)	69.99± .76	11.92± .10	.05± .07	0.0	.75± .10	.33± .03	2.35± .27	3.27± .16	88.65
			C	28-33	(v)	69.26± .61	12.01± .33	0.0	0.0	.83± .09	.39± .07	2.32± .22	3.14± .21	88.00
DC2	2803	854	D	31,33-34	(v)	68.70±2.32	12.70± .27	.23± .07	0.0	1.22± .12	.39± .04	4.80± .44	1.85± .04	89.92
			D	60,63,65	(v)	69.08± .19	12.44± .09	.25± .04	0.0	1.25± .06	.31± .11	3.69± .63	2.21± .04	89.08
DC2	2883	879	A	15-20,24	(f)	76.10±1.68	12.41± .67	.13± .05	0.0	.87± .10	.34± .02	3.40± .50	3.20± .35	96.45
DC2	2926	892	B	15	(f)	73.00	5.20	.09	.02	.79	[illegible]	2.37	3.41	89.71
			B	16-18	(f)	63.75± .21	10.72±1.00	2.19±1.65	.22± .18	.82± .10	.35± .07	2.74± [illegible]	3.78± .53	84.56
			B	25-27	(f)	66.43± .32	12.29± .04	.20± .26	0.0	.97± .03	.33± .04	3.13± .26	4.29± .32	87.68
DC2	3264	995	B	1-2,5-7	(v)	69.13±1.69	13.22± .28	.06± .02	0.0	2.01± .24	.44± .06	2.94± .77	1.93± .22	89.74
			B	8	(v)	70.75	13.03	.14	.04	1.94	.28	3.40	1.98	91.56
			B	14-15	(v)	69.05± .73	12.19± .03	.10± .04	0.0	1.91±0.0	.41± .07	3.33± .54	1.96± .23	88.96
			D	19-26	(v)	73.94± .92	11.74± .27	.11± .03	0.0	2.65± .07	.04± .03	2.82± .22	.42± .03	91.68
			E	1-2	(v)	68.96± .29	13.74± .17	0.0	0.0	1.91± .00	.34± .48	4.18± .32	2.05± .05	91.22
			E	4	(v)	63.31	11.87	.08	0.0	1.81	.59	3.27	1.90	82.85
			E	7-8,16	(v)	70.22± .60	13.57± .39	.07± .02	0.0	1.97± .31	.36± .01	4.04± .29	2.17± .03	92.40
			E	10	(v)	68.90	12.53	.08	0.0	1.59	.42	3.69	2.14	89.35
			E	11	(v)	69.49	12.62	.05	0.0	1.58	.56	3.02	1.91	89.23
			E	12	(v)	67.91	13.02	.19	0.0	1.86	.45	3.44	2.01	88.88
			E	13	(v)	65.56	12.26	.15	.03	1.71	.57	3.08	1.81	85.18
			E	18	(v)	67.17	12.80	.19	.02	1.43	.27	3.44	1.91	87.23

TABLE 5 (Cont.)

CHEMICAL COMPOSITION OF ZEOLITES

Sample	m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	Total
DC2 2366	721	C	3	(v)	66.87	12.22	0.0	0.0	.83	.40	2.00	3.22	85.53
		C	4	(v)	67.03	11.93	.01	0.0	.83	.36	1.61	2.66	84.43
		C	5	(v)	67.11	12.36	.02	0.0	.69	.26	1.53	2.61	84.58
		C	7	(v)	64.78	11.52	0.0	0.0	.89	.44	1.93	2.99	82.55
		C	8	(v)	65.11	12.01	0.0	0.0	.84	.35	1.52	2.61	82.44
		C	9-10	(v)	65.41± .50	12.02± .14	0.0	0.0	.98± .12	.23± .07	1.36± .21	2.32± .17	82.32
		C	12-14	(v)	66.51±1.67	12.27± .04	.01	0.0	.83± .10	.41± .03	2.43± .15	3.50± .31	85.97
		C	16-18	(v)	68.75±1.40	12.68± .22	0.0	0.0	.85± .09	.44± .04	2.73± .22	3.5[illegible]± .16	88.96
		C	19-26	(v)	65.71± .[illegible]2	13.04± .44	.12± .08	.05± .02	1.45± .06	.63± .06	2.80± .10	3.39± .13	87.23
		C	27-28	(v)	68.57±1.41	12.77± .52	0.0	0.0	.84± .07	.47± .01	2.31± .15	3.70± .09	88.68
DC2 2402	732	D	23-24, 28-35	(v)	74.36±8.72	9.66±2.60	.30± .45	0.0	.50± .04	.13± .08	1.90± .43	3.54± .90	90.40
DC2 2448	746	A	10,12,15	(f)	72.04	11.51	.87	.02	.33	.30	3.24	3.07	91.38
DC2 2561	781	A	7-8	(f)	70.97± .80	12.09± .38	.24± .03	.03± .01	.41± .02	.42± .01	4.05± .41	4.05± .17	92.78
		A	11-14	(f)	69.55± .42	12.69± .69	.15± .05	0.0	.43± .07	.43± .09	3.65± .43	4.67± .12	91.64
		B	7-10	(m)	61.76±1.75	15.90± .27	.68± .44	.12± .06	.07± .05	1.43± .11	4.82± .69	4.03± .36	88.80
		B	32-34	(f)	72.18±2.30	12.81± .34	.18± .09	.03± .03	.57± .06	.47± .11	3.70± .34	4.12± .28	94.06
DC2 2632	802	D	1-3,5-6, 8-13,18-23	(v)	69.89±1.04	12.10± .38	.11± .10	.04± .03	1.00± .09	NA	2.52± .17	3.88± .22	89.57
		E	14-18, 20-25	(v)	69.59±1.24	12.01± .43	.08± .09	0.0	.96± .07	NA	2.62± .21	4.07± .23	89.35
		G	7-17	(v)	69.58±1.83	11.98± .54	.12± .12	.04± .04	.95± .08	NA	2.38± .21	4.09± .22	89.90
DC2 2666	813	B	1,3, 25-26	(v)	69.92±1.53	12.51± .45	.18± .15	0.0	.77± .10	.35± .12	2.82± .35	3.19± .06	89.75
		B	2,5-10	(v)	70.77±1.20	11.91± .34	.12± .10	0.0	.67± .12	.35± .08	2.76± .18	3.50± .30	90.09
		B	21-24	(v)	67.44±1.06	11.64± .45	0.0	0.0	.70± .07	.33± .09	2.44± .16	3.09± .11	85.67

TABLE 5 (Cont.)

CHEMICAL COMPOSITION OF ZEOLITES

Sample		m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	Total
DC2	3264	995	B	19	(v)	66.09	12.52	.07	0.0	1.72	.35	2.62	1.54	84.91
			E	21	(v)	69.01	11.70	.11	0.0	1.54	.22	3.94	1.98	88.50
			E	22	(v)	68.89	12.67	.02	0.0	1.55	.62	3.75	2.10	89.59
			G	11-12	(v)	67.26± .13	12.96± .26	.42± .13	.10± .05	2.66± .14	.34± .02	2.60± .45	1.68± .04	88.03
			G	19-23	(v)	69.19±1.69	12.35± .33	.15± .06	0.0	1.70± .17	.34± .05	3.13± .20	2.03± .19	88.91
			G	24	(v)	73.22	12.70	.13	0.0	1.33	.21	3.89	2.41	93.89
			G	25-28	(v)	67.16±1.45	12.32± .20	0.0	0.0	1.47± .02	.24± .12	2.48± .59	2.11± .22	85.83
			I	13-18	(v)	65.89±1.31	11.40± .36	.05± .03	0.0	1.50± .14	.28± .06	3.02± .08	2.24± .17	84.38
DH4	2438	743	A	1-5	(v)	66.54± .91	12.31± .12	.02± .01	.01± .00	1.16± .06	NA	3.49± .02	2.62± .22	86.15
			A	6-10	(v)	67.15±1.61	12.10± .44	.05± .06	0.0	.94± .04	NA	3.70± .35	2.40± .25	86.34
			A	11-13	(v)	68.00±1.45	12.29± .26	.17± .03	0.0	1.05± .09	NA	3.98± .16	2.21± .08	87.70
DH4	2466A	752	B	12-24, 26-27	(v)	65.88± .94	12.20± .55	.16± .07	.02± .02	1.10± .24	.49± .10	3.41± .59	2.40± .30	85.66
			C	1-6,8-10 12-13	(v)	67.69±1.73	12.47± .38	.13± .05	0.0	1.07± .12	.35± .07	3.87± .60	2.25± .26	87.83
DH4	2466B	752	C	1-8	(v)	67.15±1.05	11.62± .36	.02± .01	0.0	1.14± .19	NA	3.77± .19	1.52± .14	85.22
			C	10,12-15	(v)	66.32±1.84	11.69± .58	.11± .04	0.0	1.13± .24	NA	3.88± .38	1.53± .17	84.66
DH5	2633	803	A	29-30, 32-37	(v)	70.04±2.45	12.35±1.35	.16± .08	.08± .14	1.71± .35	.11± .03	1.60± .29	2.70± .33	88.72
DH5	2668	813	A	12,16 18,19	(m)	67.37±1.14	13.31± .08	.11± .09	.22± .05	1.70± .06	.19± .05	1.76± .12	4.55± .08	89.21
			B	1-6,9-10	(m)	67.24±1.63	13.06± .52	.67± .74	.09± .04	1.55± .20	.20± .06	2.01± .19	4.25± .17	89.07
DC6	2156	657	D	1*-7*	(v)	45.79± .54	11.48±1.27	5.69± .16	2.12± .04	1.08± .25	1.80± .11	2.70± .26	2.75± .28	73.41
			D	2*-5*	(v)	57.92±1.77	16.71± .49	.14± .09	0.0	.16± .01	3.81± .37	5.29± .37	3.81± .43	87.84

TABLE 5 (Cont.)

CHEMICAL COMPOSITION OF ZEOLITES

Sample	m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	Total
DC6 2156	657	D	8*-11*	(v)	51.91±1.00	13.02±2.60	.73± .49	.05± .08	.28± .15	2.70± .38	3.67± .63	4.09± .48	76.45
		D	15*,16*, 20*-22*	(v)	63.72± .85	13.82± .61	.35± .73	.16± .29	1.80± .20	1.30± .26	2.34± .25	3.51± .35	87.00
		D	19*	(v)	59.00	16.81	.06	.0	.46	2.99	4.56	4.53	88.41
		E	2*-3*	(v)	55.68±2.88	14.74±1.06	.14± .01	.01± .01	.11± .05	2.91± .02	4.42± .41	4.20± .09	82.21
		E	4*-7*	(v)	54.27±2.50	14.79± .81	.14± .16	.02± .02	.14± .05	3.14± .50	4.14± .25	4.71± .20	81.35
		E	8*-9*	(v)	54.03±5.25	12.86± .95	.19± .00	.03± .01	.80± .20	1.62± .02	3.47± .29	3.99± .47	76.99
		E	10*-11*	(v)	59.14±1.27	16.39± .27	.02± .03	0.0	.13+ .01	3.41+ .06	4.21+ .42	4.93+ .37	88.23
		E	13*-18*	(v)	63.33±1.63	12.69± .48	.46±1.05	.02± .02	1.76± .20	1.05± .10	2.56± .66	4.28± .62	86.15
DC6 2279	695	A	2*,4*-7* 9*-10*, 12*-15*	(v)	58.71±1.89	11.07± .36	.10± .17	0.0	1.14± .20	.48± .10	2.33± .19	3.07± .24	76.90
DC6 2282	696	C	2*-4*, 6*-11*	(v)	69.59±2.78	11.81± .63	.53± .78	.08± .14	1.14± .14	.50± .10	2.67± .37	3.55± .32	89.87
		H	1*-10*, 12*-15*	(v)	70.97±1.16	12.45± .39	.18± .12	0.0	1.19± .12	.56± .12	3.25± .41	3.11± .35	91.71
DC6 2483X	732	A	2*-7*,9*	(f)	67.80±1.86	11.63± .75	.95± .67	.06± .09	.95± .67	.53± .20	3.11± .32	2.99± .26	88.02
		D	1*	(v)	66.74	12.22	.27	0.0	.91	.61	2.85	4.14	87.74
		D	2*-3*	(v)	69.30± .19	11.91± .24	.30± .42	0.0	.82± .08	.47± .09	2.88± .01	3.53± .19	89.21
		D	4*-5*	(v)	67.67± .58	12.06± .57	.07± .05	0.0	1.15± .08	.58± .23	3.10± .15	0.58± .23	85.21
		D	6*	(v)	67.39	13.07	.04	0.0	1.18	.55	2.82	3.35	88.40
		D	8*-9*	(v)	63.08±2.14	12.16± .29	.11± .06	0.0	.98± .21	.60± .21	2.88± .14	3.42± .11	83.23
		D	10*-11*	(v)	64.79±1.41	12.13± .96	.04± .05	0.0	1.01± .16	.65± .21	2.56± .08	3.30± .13	84.48
		D	12*-14*	(v)	66.67± .76	11.98± .51	.15± .04	0.0	.85± 18	.56± .18	2.85± .16	3.79± .33	86.85
		D	15*	(v)	62.74	11.11	0.0	0.0	1.17	.61	3.21	3.08	81.92

TABLE 5 (Cont.)

CHEMICAL COMPOSITION OF ZEOLITES

Sample	m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	Total
DC6 2483X	732	D	16*	(v)	66.15	12.17	.06	0.0	.98	.58	2.96	3.41	86.31
		D	17*	(v)	67.08	11.57	.02	0.0	1.34	.72	3.22	3.04	86.99
		D	18*	(v)	63.01	11.89	.05	0.0	.96	.62	2.94	3.64	83.11
		D	19*-20*	(v)	67.23± .21	12.76± .63	.11± .02	0.0	.98± .03	.76± .22	3.15± .05	3.61± .14	88.60
DC6 2695	821	A	1*-11*	(v)	67.33±3.09	12.31± .69	.14± .23	0.0	1.13± .12	.53± .19	3.05± .19	3.44± .25	87.93
		C	4*,6*-7* 9*-13*	(v)	67.70±2.18	12.38± .69	.11± .08	.02± .03	1.05± .13	.52± .10	3.33± .28	3.31± .09	88.42
DC6 2977A	907	E	17*-24*	(v)	66.45±1.87	11.34± .24	.05± .04	0.0	.42± .07	.48± .11	2.92± .19	3.89± .21	85.55
DC6 3134	955	B	30-34,36	(f)	66.85±1.39	12.27± .59	.18± .07	.02± .01	.60± .08	NA	2.99± .23	3.85± .17	86.76
		D	19,22	(f)	64.51±2.04	13.24±1.44	2.67± .40	.07± .00	2.21± .49	NA	3.94± .57	3.32± .17	89.96
DC6 3220	981	B	2-4	(f)	73.89±4.89	9.42±1.05	.24± .10	0.0	.52± .26	.20± .02	2.50± .23	2.94± .29	89.71
		C	1-4,8-11 13-14	(f)	66.39±1.82	11.24± .87	.85± .72	0.0	1.34± .99	.28± .08	3.03± .21	3.72± .21	86.85
DC6 3421	1043	A	10,11,13	(v)	63.59± .49	13.04± .40	3.24±1.85	.24± .23	1.30± .51	.30± .07	3.78± .59	4.19± .70	89.68
		A	16-17	(v)	65.17±1.46	13.42± .81	3.40±1.62	.26± .23	1.50± .25	.37± .16	4.27± .25	3.46±1.03	91.85
		A	20-24	(v)	69.06±1.84	12.52± .87	.10± .10	.02± .02	.76± .10	.48± .13	4.42± .40	3.26± .10	90.62
		A	25-26	(v)	69.79±1.78	11.91± .85	.06± .08	.03± .04	.68± .01	.37± .05	4.10± .57	3.09± .48	90.03
		A	27-30	(v)	67.83±2.43	11.99± .13	.07± .08	.02± .02	.69± .19	.31± .23	4.20± .46	3.31± .14	88.42
		B	4-7	(v)	63.87±1.26	11.57± .75	.45± .21	.04± .03	.94± .32	.23± .15	3.48± .41	3.21± .20	83.79
		B	8-10	(v)	69.29±1.29	11.69± .11	.05± .07	0.0	.50± .09	.36± .12	3.45± .66	3.72± .49	89.06
		B	12	(v)	69.09	12.84	.02	0.0	.97	.60	4.19	2.99	90.70
		B	13-18	(v)	67.85±2.82	12.01± .84	.11± .06	.02± .01	.71± .14	.50± .10	3.90± .28	3.36± .10	88.46
		B	22-23	(v)	61.71±2.81	14.05±1.29	4.79±4.82	.2± .26	3.19± .64	.44± .05	4.96± .89	3.54± .59	92.92

TABLE 5 (Cont.)

CHEMICAL COMPOSITION OF ZEOLITES

Sample		m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	Total
DC6	3421	1043	B	24-26	(v)	65.98±2.88	15.34± .49	1.59± .87	.12± .07	1.47± .14	0.39± .04	4.58± .58	5.40±1.95	94.87
DC6	3581	1091	A	4-6	(f)	68.06± .30	12.21± .27	.06± .04	.01± .02	1.75± .08	NA	2.90± .03	1.61± .04	86.60
			A	7-9	(f)	65.65±1.26	11.54± .31	.03± .05	.01± .01	1.67± .04	NA	2.53± .10	1.64± .05	83.07
			A	10-12	(f)	66.98±1.91	12.31± .30	.09± .09	.02± .03	1.80± .12	NA	2.67± .21	1.69± .10	85.56
			A	15,18,19	(f)	67.01±3.37	12.25± .35	.02± .01	.01± .01	1.00± .10	NA	3.50± .30	1.97± .27	87.46
			A	16-17	(f)	67.91±2.34	13.08± .06	.40± .01	.03± .01	2.03± .03	NA	3.54± .03	1.98± .06	88.97
			A	22-25	(f)	65.38±1.62	12.68± .44	.10± .04	.01± .01	1.77± .17	NA	3.06± .52	1.73± .18	84.73
			B	25-27, 29-33,35	(f)	66.42±2.01	12.91± .80	.12± .07	.02± .02	2.06± .49	NA	3.44± .16	1.65± .25	86.62
DC6	3636	1108	A	1-6,9	(m)	69.85±1.43	12.31± .60	.10± .09	.01± .01	2.24± .33	.28± .15	4.13± .48	.67± .15	89.59
			B	9-12	(v)	70.61±1.66	12.42± .45	0.0	0.0	1.83± .23	.25± .17	4.13± .29	1.69± .17	90.93
			B	13-16	(v)	71.18±1.35	13.16± .32	.10± .08	.01± .01	2.25± .29	.40± .25	4.30± .14	1.84± .15	93.24
			C	16-19,21 22,24,26-27	(m)	70.32±1.21	12.66± .83	.32± .20	.03± .03	2.02± .20	.34± .08	3.99± .22	1.98± .08	91.66
DC6	3684	1123	B	17-20	(f)	66.25±2.90	12.17± .79	.17± .13	.01± .02	2.34± .19	.30± .08	3.35± .27	.54± .17	85.13
			B	21-25	(f)	68.70±5.13	10.50±1.65	.16± .15	0.0	2.14± .33	.28± .09	2.64± .47	.44± .09	84.86
DC6	3861	1177	B	22,24-25,27	(f)	70.13±2.59	11.00± .44	1.16±1.01	.07± .05	0.22± .07	.26± .08	3.28± .31	3.74± .34	89.86
			C	8-10, 12-15	(m)	67.15±1.80	10.28±1.26	.11± .02	.01± .01	0.21± .13	.16± .15	3.52± .35	3.68± .96	85.12
			C	11	(m)	73.62	9.64	0.0	0.0	0.63	0.07	4.01	1.31	89.28

TABLE 5 (Cont.)

CHEMICAL COMPOSITION OF ZEOLITES

Sample	m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	Total
DC6 4220	1286	A	11-20	(v)	65.79±1.56	12.28± .40	.16± .06	.08± .03	2.02± .11	NA	3.58± .34	1.34± .07	85.25
		B	22-25	(f)	66.43±1.43	12.39± .24	.29± .27	.10± .02	1.98± .08	NA	3.14± .15	1.30± .10	85.63

Legend

*Total iron calculated as Fe_2O_3
Number = sample number of electron microprobe analysis
± = standard deviation
A, B, X = additional section at specified depth
(v) = vesicle
(f) = fracture
(m) = matrix

TABLE 6

CHEMICAL COMPOSITION OF CLAYS

Sample	m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	H_2O
DC2 2240	683	B	1-3,5-6	(f)	47.94±1.69	5.61± .79	27.06±2.58	7.45± .67	2.11± .43	0.0	1.18± .82	.40± .07	8.24
		B	9-11, 13-14	(f)	47.98±1.33	5.34± .47	22.17± .39	13.04± .51	1.15± .17	0.0	1.39± .03	.58± .58	8.34
		B	12,15	(f)	54.53± .09	5.88± .13	26.13± .36	1.42± .11	1.24± .00	0.0	1.76± .09	.63± .10	8.43
		B	16-20	(f)	51.51±1.92	3.30± .21	23.95± .31	9.97± .21	1.22± .08	0.0	1.26± .16	.41± .07	8.37
		B	23-25	(f)	57.93±2.19	2.52± .27	22.85±1.19	5.11±1.69	1.18± .06	0.0	1.53± .18	.29± .06	8.55
		B	27-29	(f)	52.24± .81	3.23± .19	24.19± .13	9.16± .57	1.25± .06	0.0	1.23± .05	.41± .05	8.39
		B	30-34	(f)	52.50±1.61	3.04± .13	26.85± .56	6.18± .27	1.35± .03	0.0	1.45± .09	.26± .04	8.35
		B	37	(f)	52.14	3.22	24.59	8.57	1.24	0.0	1.37	.43	8.36
DC2 2314	705	A	6,8-15	(f)	47.93±1.43	6.20± .51	28.22±1.33	6.36±1.89	1.71± .18	.12± .04	.73± .18	.89± .19	7.80
DC2 2319	707	C	1,4-7	(m)	50.78±4.48	12.81±1.91	13.67±3.01	3.27± .80	5.29± .82	.03± .02	3.33± .55	2.38±1.10	8.44
		C	2-3	(m)	47.77±8.96	7.50±1.88	6.52± .67	23.81±2.83	2.98± .07	.02± .01	1.49± .05	1.35± .27	8.56
		C	14-16	(v)	48.76±5.95	6.69±1.29	23.31±2.21	8.85±1.96	2.39± .17	0.0	1.10± .56	.57± .32	8.33
		C	20-35	(v)	44.02± .48	6.35± .36	28.57± .48	9.22± .37	1.71± .21	0.0	1.53± .10	.50± .04	8.12
		D	1-5	(v)	46.75±1.28	6.72± .49	28.17±1.11	6.23± .29	1.73± .17	0.0	1.05± .23	1.15± .13	8.18
		D	7-10	(v)	48.01±1.34	1.68± .14	25.52±2.88	8.57±1.57	1.68± .14	0.0	.82± .16	1.07± .24	7.85
		D	16-17, 24-27	(v)	51.39±4.80	7.03±1.20	23.28±5.30	4.21±1.03	1.79± .19	.08± .06	1.83± .24	1.59± .03	8.37
DC2 2359	719	A	1-11	(v)	45.44±1.50	6.48± .38	30.40±2.99	5.82± .69	2.14± .20	0.0	.59± .23	1.01± .33	8.11
		A	27-31,34	(v)	49.62±2.50	3.66±3.66	31.93±1.50	3.61± .17	1.55± .06	0.0	.88± .13	.55± .05	8.18
		B	2-19	(v)	45.16±1.07	5.86± .37	26.53±1.07	10.44± .36	1.56± .30	0.0	1.62± .15	.66± .08	8.16
		C	1-13	(v)	45.70±1.05	5.77± .20	25.[illegible]7±1.10	10.62± .42	1.41± .25	0.0	1.65± .13	.79± .07	8.19

TABLE 6 (Cont.)

CHEMICAL COMPOSITION OF CLAYS

Sample		m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	H_2O
DC2	2359	719	C	27	(v)	50.76	13.07	12.26	3.66	8.03	.02	2.75	.96	8.49
			C	30,32	(m)	59.31±3.08	10.04±6.16	17.91±6.00	6.46±2.01	4.07±1.39	0.0	2.22± .92	.66± .22	8.45
			C	31	(m)	50.27	5.44	23.19	7.34	3.44	0.0	1.13	.97	8.32
DC2	2402	732	D	1-6,9-13	(v)	48.71±4.01	7.14±1.17	27.34±1.35	4.38±1.16	1.55± .44	0.0	.96± .36	1.69± .64	8.23
DC2	2448	746	A	1-6,21-24	(f)	48.74±1.48	5.44± .47	25.90±1.33	7.66±3.37	2.03±2.41	0.0	1.12± .74	.87± .26	8.25
			F	2-3	(f)	48.29± .68	5.40± .03	23.28± .04	12.31± .24	.79± .01	.04± .06	.81± .03	.78± .07	8.34
			F	4-8	(f)	47.82±2.13	5.57± .29	25.76±1.56	9.45±2.50	1.24± .60	0.0	.95± .15	.95± .34	8.25
DC2	2507	764	A	7-10,12, 14,18	(f)	50.06±2.22	5.32±1.09	23.91±2.12	8.21±1.55	2.28±1.92	NA	1.[illegible]± .92	.48± .20	8.33
DC2	2561	781	A	1-6	(m)	48.40±1.45	5.88± .44	25.36±1.07	8.48± .38	1.96±1.24	0.0	.87± .10	.76± .19	8.28
			A	9-10	(f)	54.59±1.08	2.60± .61	14.35±1.09	16.26±2.50	.30± .03	0.0	1.39± .61	1.76± .06	8.58
			B	1-2,5-6	(m)	53.19±1.10	6.80±1.55	16.54±3.89	10.70±2.39	.92± .89	.30± .14	1.68± .34	1.34± .39	8.54
			B	3-4	(m)	49.08± .99	5.21± .66	24.72± .86	8.83± .86	1.84± .04	0.0	1.01± .02	.83± .20	8.43
			B	11-12	(f)	50.38± .16	4.01±1.07	20.32± .98	13.55±1.69	1.17± .58	.04± .01	1.13± .06	1.02± .29	8.40
			B	14-19	(f)	47.29± .68	5.65± .74	25.70±1.43	8.02± .38	1.61± .11	0.0	.86± .32	1.03± .21	8.11
			B	20-22	(f)	52.72±1.16	2.35± .14	18.02± .51	15.58± .45	.86± .10	0.0	1.02± .12	.93± .09	8.47
			B	23-28	(f)	50.89±2.21	3.09± .16	18.86±1.24	14.04±1.47	1.00± .10	0.0	1.39± .10	.71± .03	8.30
			B	29-31	(f)	50.12± .42	3.48± .17	21.28± .23	13.77± .24	.92± .04	0.0	1.19± .06	.80± .03	8.37
DC2	2632	802	D	4,7	(v)	48.34±1.61	5.31±2.21	29.59± .70	5.13±2.00	1.28± .23	NA	1.35± .63	1.24± .65	7.76
			E	1-7, 10-11,13	(v)	49.84±2.36	3.91± .17	31.12± .65	3.80± .13	1.28± .20	NA	1.25± .10	.81± .13	7.73
			G	1-6	(v)	50.11± .89	4.06± .27	30.64± .77	3.96± .07	1.32± .09	NA	1.21± .13	.68± .35	7.76

TABLE 6 (Cont.)

CHEMICAL COMPOSITION OF CLAYS

Sample	m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	H_2O
DC2 2666	813	C	5	(m)	56.67	13.76	7.30	.57	3.75	.30	5.84	3.16	8.64
DC2 2803	854	D	4-7,8 10,13	(v)	46.51±2.11	6.09± .33	23.74± .92	12.14± .39	1.50± .14	.01± .02	1.41± .51	.32± .04	8.28
		D	14-18	(v)	54.19±4.71	7.91± .63	17.34±1.36	6.08± .41	1.00± .06	0.0	.34± .09	4.68± .77	8.47
		D	21-22	(v)	46.78± .23	5.96± .24	23.02± .60	12.56± .20	1.65± .11	0.0	1.45± .04	.30± .05	8.30
		D	23,25	(v)	45.87±1.74	6.54± .08	24.49±3.00	11.37±1.39	1.52± .02	0.0	1.56± .47	.42± .59	8.25
		D	24,26-27	(v)	54.18±2.02	7.84± .18	16.98± .70	5.80± .07	1.16± .16	0.0	.53± .04	5.06± .39	8.46
		D	28-31	(v)	44.97±1.87	6.33± .52	26.56±1.56	10.30± .66	1.89± .29	0.0	1.12± .28	.66± .20	8.18
		D	35-36,38	(v)	53.63±5.58	5.48± .66	27.59±1.94	9.56± .92	1.42± .17	0.0	1.35± .16	.94± .03	8.25
		D	39-40	(m)	49.18±1.91	6.49±1.14	24.22±3.27	8.36±1.56	1.85± .32	0.0	1.41± .39	1.70±1.11	8.25
		D	48-50	(v)	47.53±1.33	5.97± .20	22.28±1.88	12.41± .26	1.36± .02	0.0	1.73± .02	.35± .02	8.32
		D	51-53	(v)	53.95±2.32	8.02± .57	16.71± .80	4.05± .29	1.05± .19	0.0	.42± .07	5.68± .43	8.16
		D	54,56-57	(v)	44.54±1.68	6.39± .65	26.76±1.54	10.41± .48	1.52± .24	0.0	1.54± .30	.67± .25	8.16
		D	66-67	(v)	65.59±2.55	3.35± .68	15.06±4.92	4.85±1.78	.87± .32	.07± .03	.90± .42	.41± .17	8.91
DC2 2803	879	A	25-29, 32-36	(f)	54.43±2.95	11.58±1.80	12.76±2.66	1.00± .23	5.53± .70	.17± .05	4.38± .67	1.65± .20	8.53
DC2 2926	892	F	1-5	(m)	44.77±3.44	2.82± .43	20.39±1.39	11.61± .76	11.91±1.47	.03± .14	.75± .14	.46± .32	8.11
		B	6-8	(m)	49.14± .99	3.12±1.79	15.99± .61	10.90±4.40	12.12±2.81	.07± .04	.76± .36	.59± .65	8.29
DC2 3264	995	B	20-27	(v)	54.54±2.94	6.11± .43	18.36± .90	3.[illegible]± .87	.92± .31	0.0	.68± .17	5.50± .90	8.40
		D	2-6	(v)	53.59±4.11	7.31± .39	19.70± .28	4.55±1.06	1.23± .26	0.0	.68± .16	4.44±1.66	8.40
		D	7-10	(v)	51.54±2.75	6.72±1.09	22.32± .96	4.95±1.64	1.80± .14	0.0	.94± .19	3.40±1.53	8.32
		D	12-18	(v)	54.88± .11	7.43± .25	18.71± .42	2.79± .36	.75± .14	0.0	.45± .06	6.60± .52	8.36

TABLE 6 (Cont.)

CHEMICAL COMPOSITION OF CLAYS

Sample		m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	H_2O
DC2	3264	995	E	23-25, 32-33	(v)	55.17±2.53	7.33± .32	18.09± .95	3.55± .18	.88± .06	0.0	.56± .07	5.99± .36	8.41
			G	1-10	(v)	54.55±2.14	7.77± .44	18.36±1.49	3.83± .29	1.12± .20	.07± .06	.71± .24	5.18± .67	8.43
			G	13,15	(v)	55.61±2.78	7.98± .95	19.06± .14	4.30± .06	1.08± .24	.07± .09	.84± .27	2.53±3.58	8.55
			G	16-18	(m)	51.41±2.63	7.09± .82	21.0[illegible]±1.18	6.90± .39	1.83± .34	.07± .04	1.24± .26	2.08± .35	8.39
			I	2-5,2*-5*	(m)	52.93±3.78	6.64± .99	20.30± .87	6.22± .97	1.50±1.50	.03± .05	1.44± .49	2.53± .99	8.42
			I	9*-12*,9	(v)	54.99± 54	6.85± .30	18.59± .42	3.96± .21	0.82± .12	0.0	.68± .07	5.71± .32	8.40
DH4	2438	743	A	14,17-20	(v)	57.01±2.73	8.39± .55	16.39±1.26	3.27± .25	0.63± .20	NA	1.27± .47	4.49± .61	8.56
DH4	2466A	752	B	1,3,7-8	(v)	54.44±4.60	7.78±2.10	19.66±4.48	4.88±1.42	0.92± .25	0.0	2.20±1.81	1.61± .13	8.52
			B	2,4,9	(v)	55.21±4.49	8.96± .58	16.79±1.76	3.44± .08	0.59± .04	0.0	2.94±3.41	3.58±1.09	8.51
DH4	2466B	752	C	16-17	(v)	55.92±1.71	6.66± .12	15.17± .27	4.02± .60	2.35± .23	NA	0.46± .04	7.03±1.15	8.40
			C	18-21	(v)	58.50±2.77	6.82± .36	14.03±1.77	4.10± .15	0.28± .04	NA	0.51± .04	7.22± .58	8.53
			C	22-25	(v)	58.78±2.85	7.55± .28	13.73±1.29	4.17± .15	0.41± .03	NA	0.81± .06	5.97± .85	8.59
DH5	2633	803	A	5,16	(m)	45.57±1.87	10.27±4.94	16.57±1.52	3.99± .63	8.50±4.36	0.0	4.95±1.54	1.99± .32	8.13
			A	11,13, 27-28	(v)	40.39±2.81	6.72±1.31	21.61±2.06	4.74±2.48	16.09±5.57	0.0	2.22±1.18	0.40± .38	7.84
			A	12,25-26	(v)	46.10±3.31	2.36±2.37	17.39±1.50	9.63±2.48	11.50±3.20	0.0	4.75± .44	0.23± .33	8.04
			A	23-24	(v)	52.94±1.88	9.38± .18	21.93± .07	4.81± .39	1.97± .07	0.0	.10± .10	.32± .26	8.55
DH5	2668	813	B	7	(m)	52.82	19.14	4.82	.16	6.15	0.0	5.01	3.24	8.65
DC6	2011	613	D	9-14	(v)	52.09±1.69	3.02±1.65	24.77± .67	5.35± .74	0.25± .13	0.0	.78± .10	5.55± .52	8.18
			D	15	(v)	53.42	1.94	24.66	5.98	0.12	0.0	.72	4.94	8.23
			D	16	(v)	53.76	1.46	23.67	6.13	0.24	.05	.75	5.72	8.21

TABLE 6 (Cont.)

CHEMICAL COMPOSITION OF CLAYS

Sample	m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	H_2O
DC6 2011	613	D	17-18	(v)	51.81± .05	2.49± .31	24.25± .08	7.25± .16	.32± .05	.07± .00	.84± .10	4.77± .27	8.20
		D	9-18	(v)	52.35±1.59	2.65±1.35	24.55± .61	5.87± .95	.24± .11	0.0	.78± .09	5.36± .55	8.19
		D	20-23	(m)	49.24±2.82	12.90±2.86	13.68±4.54	4.49± .63	5.76±2.93	.16± .05	3.82±1.24	1.54± .34	8.41
		E	1,4	(m)	46.55± .09	10.06± .50	19.35± .41	5.11± .55	6.63±2.43	.10± .08	2.73± .33	1.21± .45	8.23
		E	9-10	(m)	47.85± .25	11.84±2.22	17.95±4.85	2.81± .96	5.87±2.80	.13± .08	3.26± .95	2.02± .50	8.28
		E	12	(m)	43.76	10.38	19.49	5.35	10.80	.04	.49	1.58	8.12
		E	17-20, 29-32	(v)	53.97±1.20	1.15± .10	25.61± .70	6.06± .23	.12± .04	0.0	.62± .05	4.22± .71	8.25
		E	34-40	(v)	45.52±1.14	4.06± .37	31.61±1.65	6.01± .16	.42± .04	0.0	1.42± .43	2.98± .40	7.99
		E	41-44	(v)	47.98± .70	3.78± .13	30.63± .29	2.72± .02	0.11± .01	0.0	.38± .02	6.45± .11	7.95
		F	21	(m)	47.89	6.12	25.68	4.00	.43	.14	3.49	4.18	8.07
		F	22	(m)	49.05	6.88	25.86	3.80	.47	.13	1.43	4.22	8.16
		F	23	(m)	50.05	6.21	25.94	4.02	.44	.07	.96	4.12	8.20
		F	24	(m)	47.19	5.81	28.62	4.02	1.55	.16	.75	3.85	8.06
		F	21-24	(m)	48.56±3.18	6.26± .61	26.48± .48	3.96± .18	.71± .50	.13± .03	1.67±1.29	4.10± .32	8.12
		F	26-30	(v)	53.25±1.01	1.00± .65	25.43± .38	5.34± .27	.13± .04	.03± .03	.57± .13	5.24± .35	8.20
		F	31-32, 36-38	(v)	53.08±1.47	1.97± .44	25.07± .59	6.02± .67	.15± .05	0.0	.63± .16	4.86± .62	8.22
		F	33-35	(v)	51.40± .44	2.94± .32	25.38± .53	7.06± .42	.19± .06	0.0	.93± .09	3.89± .18	8.22
		F	39-40	(v)	47.89±1.23	5.51± .38	26.14± .23	4.49± .06	.32± .01	.12± .01	2.69± .03	4.78± .00	8.05
		F	26-40	(v)	52.13±2.34	2.57±1.33	25.40± .51	5.80± .92	.17± .07	0.0	.95± .72	4.79± .64	8.19
DC6 2053	626	C	5-8	(m)	53.24±3.28	12.97±2.53	12.75±4.87	3.17±1.03	2.45± .42	0.0	3.71± .71	3.16± .64	8.55

TABLE 6 (Cont.)

CHEMICAL COMPOSITION OF CLAYS

Sample		m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	H_2O
DC6	2053	626	C	9,11-12	(v)	52.13±1.71	5.95±1.85	20.89±3.01	4.17± .60	2.34± .97	0.0	2.45±1.79	3.80±1.46	8.28
			C	10,16	(v)	45.93±3.00	6.87± .28	23.25±2.68	11.50±1.24	2.71± .28	0.0	.83± .10	.66± .48	8.26
			C	13-15	(v)	49.78± .14	7.05± .56	17.29±2.10	14.04± .71	2.15± .39	0.0	.77± .06	.42± .36	8.49
			C	17-20	(v)	52.16±1.80	7.08± .42	17.30±2.08	7.46±1.28	1.29± .50	0.0	.34± .11	6.03±1.49	8.34
			C	21	(v)	55.39	7.09	14.89	5.41	.52	0.0	.16±	8.14	8.40
			C	25-26	(v)	56.78±1.26	7.83± .44	11.99± .81	7.15± .01	.89± .07	0.0	.36± .01	6.45± .49	8.56
			C	27-30	(v)	51.16±1.27	7.21± .30	17.21± .74	10.32±1.07	1.80± .32	0.0	.54± .04	3.34±1.03	8.42
			E	5-8	(m)	55.06±1.76	8.34± .01	14.36± .70	5.26± .00	2.09± .10	0.0	.96± .10	5.45± .52	8.48
			E	12	(m)	51.76	7.08	17.93	8.65	1.63	0.0	1.03	3.51	8.40
			E	16	(m)	57.61	17.48	3.90	1.37	2.39	.13	6.21	2.06	8.86
			E	17-18	(m)	55.83± .07	9.54±2.44	14.37±1.53	4.37± .74	.66± .20	0.0	.74± .08	6.68±1.83	8.51
			E	20,22	(m)	56.89±1.35	12.48± .89	11.73± .67	3.75± .37	.95± .14	0.0	.53± .05	4.97± .31	8.69
			E	23-26	(v)	49.96±2.67	7.27± .23	18.56±2.44	10.59± .58	2.58± .19	0.0	.96± .04	1.67± .45	8.41
			E	27-30	(v)	53.44±2.24	7.25± .25	16.57± .62	6.16± .34	.79± .13	0.0	.25± .07	7.17± .72	8.35
			E	31-33	(v)	47.60± .26	6.55± .19	22.22± .28	10.20± .22	2.33± .08	0.0	.54± .02	2.30± .17	8.26
			E	34-37	(v)	44.84±2.27	6.37± .52	25.11±1.30	12.31± .42	2.07± .59	0.0	.87± .39	.21± .05	8.22
DC6	2156	657	E	7-8	(m)	53.37±1.79	17.51±1.76	6.70± .23	2.88± .64	4.88±1.25	0.0	3.93± .18	2.02± .21	8.71
DC6	2279	695	A	2,4-5	(v)	59.70±3.81	5.56±1.18	12.75±1.53	5.49± .60	.41± .19	0.0	.67± .43	6.85± .27	8.57
			B	7,9-13	(m)	53.18±4.78	8.86±4.07	16.42±1.84	3.11±1.34	2.70±2.14	0.0	2.11±1.25	5.26±2.10	8.37
			B	14-19	(v)	57.87±4.09	4.06± .30	15.59±2.94	5.06± .25	.30± .04	0.0	.56± .17	8.15± .94	8.40
			C	8-10	(m)	54.66±1.42	14.42± .79	10.82± .97	.83± .15	4.57± .49	0.0	3.78± .17	2.30± .54	8.63

TABLE 6 (Cont.)

CHEMICAL COMPOSITION OF CLAYS

Sample		m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	H_2O
DC6	2279	695	C	11,13	(m)	53.66± .74	5.26±2.00	17.12± .91	4.99± .21	2.60±1.17	0.0	.90± .37	7.20± .26	8.27
			C	14-16	(v)	56.51±2.06	3.66± .39	16.89±1.28	4.93± .28	.23± .01	0.0	.41± .03	9.07± .65	8.30
			C	17-18	(v)	56.64±3.30	3.69± .07	16.26±1.24	5.09± .05	.33± .16	0.0	.35± .00	9.33± .36	8.31
			C	19-20	(v)	55.19± .11	3.95± .09	17.92± .07	4.82± .06	.26± .04	0.0	.31± .02	9.30± .12	8.25
DC6	2282	696	C	9-11	(m)	50.03± .64	10.32±1.27	18.05± .84	1.85± .42	5.00± .18	0.0	2.85±1.10	3.62± .73	8.28
			C	12-13	(v)	50.86±1.24	5.48± .31	26.57± .62	3.62± .09	1.99± .01	0.0	.85± .14	2.28± .14	8.25
			C	15-18	(m)	50.31±2.90	11.39±1.21	16.51±3.14	1.72± .55	5.18± .40	.11± .08	3.80± .34	2.64± .89	8.34
			C	19-23	(v)	40.58± .80	5.40± .30	28.42±2.88	4.98± .48	2.05± .31	0.0	1.02± .06	1.37± .12	8.19
			G	7	(m)	48.80	4.53	16.17	8.62	10.82	0.0	.29	2.59	8.19
			G	9-11	(m)	40.32±3.07	4.59±1.48	21.12±3.39	7.04±2.58	8.22±4.04	0.0	.56± .14	1.99± .97	8.16
			G	18-19	(m)	51.48±3.34	6.02± .11	24.45± .90	3.79± .05	1.42± .07	0.0	.69± .09	3.89± .39	8.26
			H	26-30	(v)	47.58±3.32	6.21± .95	27.96±2.15	4.12± .35	2.94± .80	0.0	.96± .10	[illegible].09± .46	8.14
			H	31-34, 41-43	(v)	51.31±2.27	5.54± .26	23.78± .87	5.62±1.83	1.56± .22	0.0	.89± .13	3.02± .69	8.29
DC6	2330	710	A	14	(v)	52.05	9.23	17.15	3.02	5.54	0.0	2.10	2.53	8.39
			A	15-16	(v)	50.21±1.35	7.08± .27	21.72± .66	7.53±2.61	2.73± .78	63± .33	1.19± .07	.56± .14	8.36
			A	36-45	(v)	50.06±2.19	6.81± .77	22.24±3.24	8.66±1.76	2.18± .61	0.0	1.13± .23	.52± .09	8.39
DC6	2403X	732	A	7	(m)	51.06	5.74	22.81	7.12	1.52	0.0	1.09	2.33	8.33
			A	9-13,19	(f)	52.75±2.34	5.96± .65	20.76±1.23	5.99± .47	1.40± .16	0.0	1.27± .21	3.50± .70	8.36
			A	20-21	(f)	55.32±1.58	5.72± .17	16.86±1.51	6.38± .17	1.80± .66	0.0	1.39± .02	4.08± .09	8.46
			B	16-19	(v)	45.49±2.19	6.06± .37	25.37±1.95	10.11±1.08	2.57± .13	.04± .04	1.17± .21	2.04± .12	8.15

TABLE 6 (Cont.)

CHEMICAL COMPOSITION OF CLAYS

Sample	m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	H_2O
DC6 2403X	732	B	20,26	(m)	51.09±5.96	14.70±1.26	11.55±1.52	2.57± .83	4.82±2.04	0.0	44.74±1.17	2.02± .59	8.51
		B	21-22	(m)	50.83± .86	7.80±1.62	22.36±2.37	4.33± .57	2.16± .18	0.0	.99± .18	3.21± .35	8.31
		B	28	(m)	50.31	5.76	19.60	6.43	6.67	0.0	1.25	1.69	8.28
		D	1-7	(v)	58.56±1.67	5.65± .39	21.38± .32	4.30± .58	1.08± .19	.03± .03	.79± .12	4.90± .58	8.32
DC6 2464	751	D	9-10,12 14,16	(m)	50.57±1.36	26.60± .98	.51± .05	.05± .02	7.98± .94	0.0	5.14± .56	.29± .06	8.86
		D	13	(m)	51.35	1.88	12.41	14.73	10.61	0.0	.25	.38	8.39
		D	17-18	(m)	56.85±4.08	6.58±1.00	15.10± .62	4.97±1.19	1.05± .45	0.0	.98± .51	5.97± .40	8.49
		D	19,21	(m)	46.73±1.83	2.30± .19	17.79±1.19	11.52± .46	12.28±2.67	0.0	.46± .06	.82± .86	8.12
		D	29-30	(m)	55.54±7.32	7.67±1.82	14.36± .64	6.20± .83	.74± .39	0.0	.68± .02	6.35±2.54	8.48
		E	3-7	(m)	52.85±5.24	5.82± .80	18.40±3.98	5.09± .48	5.37±2.96	0.0	.59± .08	4.39±1.23	8.28
		E	17-19	(m)	54.63±2.41	4.94± .69	18.44±3.45	4.85± .72	1.92±2.03	0.0	.34± .01	6.54± .73	8.32
		E	22-25,28	(v)	57.61±3.26	3.07± .42	15.63±1.93	4.75± .21	.46± .01	0.0	.26± .05	7.88± .39	8.43
		E	29-31	(v)	57.56±2.27	6.79± .94	13.39± .76	5.05± .19	.39± .07	0.0	.24± .07	8.69± .21	8.48
		E	32-35	(v)	55.64±1.19	5.03± .93	16.43± .51	4.96± .42	.30± .01	0.0	.12± .02	9.20± .14	8.31
		F	36-41	(v)	55.48±2.53	.27± .10	20.37±1.72	5.98± .71	.02± .01	0.0	0.0	9.74± .72	8.15
		F	42-44	(v)	55.19± .32	3.78±1.29	17.78±1.89	5.02± .15	.18± .12	0.0	.04± .01	9.77± .32	8.24
DC6 2533	772	B	1,10	(f)	53.64± .30	3.58± .33	11.83±1.03	18.55± .36	1.14± .03	0.0	1.84± .06	.79± .16	8.62
		B	2	(f)	50.53	4.02	17.12	17.40	.95	.02	1.12	.35	8.49
		B	3,8,9	(f)	47.70±2.24	4.33± .18	20.85± .57	15.72±1.09	.90± .10	0.0	1.62± .14	.54± .07	8.33
		B	4-7	(f)	51.24±3.50	3.09±1.19	22.59± .19	10.00±3.06	1.58± .30	0.0	1.25± .40	1.94±1.25	8.31

TABLE 6 (Cont.)

CHEMICAL COMPOSITION OF CLAYS

Sample	m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	H_2O
DC6 2533X	772	C	1-5	(m)	47.78±1.81	6.31± .24	22.16± .38	12.07± .35	1.28± .08	0.0	1.60± .15	.47± .05	8.34
		C	16-20	(m)	48.36±1.64	6.77±1.34	21.15±2.47	11.42±1.96	1.42± .43	0.0	1.76± .47	.76± .56	8.36
		D	1-2	(f)	51.11±2.45	3.21± .14	23.82± .56	9.94± .67	1.68± .12	0.0	1.05± .00	.85± .40	8.34
		D	4-7	(f)	53.38±1.61	2.58± .38	23.89± .74	7.28± .66	1.42± .34	0.0	.83± .16	2.28± .40	8.34
		D	8,9,12	(f)	46.97± .34	4.42± .26	23.55±1.70	12.91± .74	1.91± .49	0.0	1.63± .11	.35± .03	8.25
		D	13-16	(f)	48.76±2.56	3.97± .01	20.91±2.24	15.02± .98	1.05± .15	0.0	1.53± .46	.39± .07	8.36
		D	17-20	(f)	52.03±1.84	2.92± .22	17.38± .38	16.55± .17	1.27± .21	0.0	1.01± .13	.33± .02	8.51
		D	24-28	(f)	49.68±1.81	3.64±1.31	19.66±3.45	15.03±1.76	1.43± .23	0.0	1.70± .32	.43± .05	8.39
DC6 2695	821	A	3-6	(m)	57.77±3.11	12.58±1.11	8.31±1.00	.32± .40	5.01± .88	.05± .03	3.17± .73	4.14±2.17	8.65
		A	10-12	(m)	57.16±2.76	11.26±1.37	11.50±1.23	.70± .63	4.73±1.10	.09± .01	3.38± .83	2.55±1.10	8.63
		A	18,22, 24-25	(v)	55.68± .71	6.04± .20	16.06± .64	5.83± .34	.54± .08	0.0	.45± .05	6.98± .22	8.41
		A	33-34,37	(v)	58.41±2.29	12.68±4.09	7.91±3.86	1.69±1.42	5.62±1.03	.37± .42	2.40± .72	2.17±1.59	8.75
		B	7-9	(m)	56.37±1.93	6.60± .49	15.50± .60	5.87± .09	.63± .07	0.0	.72± .09	5.81± .32	8.49
		B	17	(m)	56.61	6.22	16.42	6.13	1.07	0.0	.58	4.44	8.53
		B	18	(m)	48.51	6.57	16.24	8.74	9.44	.04	1.42	.75	8.28
		C	3-6	(v)	56.70±10.28	5.91±2.24	16.97±1.98	6.93±3.97	2.94±2.74	.04± .05	.84± .50	1.06± .66	8.61
		C	18-20	(v)	56.90±1.01	6.58± .27	14.85±2.76	5.20±1.01	.52± .17	0.0	.29± .03	7.20± .40	8.47
		C	21-23	(v)	56.84±2.20	6.74± .14	13.99±1.81	6.41± .48	.50± .11	0.0	.36± .09	6.65± .36	8.51
		C	24-26	(v)	49.85+3.27	5.28± .10	10.50± .80	13.87±1.33	.73± .08	0.0	1.49± .53	1.88± .63	8.40
		C	36-40	(m)	54.65±4.01	13.26±3.50	10.27±4.33	1.31±1.95	3.85± .23	.07± .05	2.72± .83	5.33±2.71	8.53

TABLE 6 (Cont.)

CHEMICAL COMPOSITION OF CLAYS

Sample	m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	H_2O
DC6 2977A	907	B	7-8	(f)	43.89±2.88	4.67± .51	33.77± .80	5.83± .63	1.28± .06	.01± .01	1.75± .36	.81± .13	7.98
		B	9,22	(f)	48.02± .85	5.38±1.18	27.81±1.58	6.04± .03	1.34± .58	.01± .01	1.84± .28	1.38± .43	8.18
		B	10-11	(f)	53.98± .12	5.16± .09	22.03± .02	4.68± .23	.35± .04	.02± .03	.89± .11	4.55± .16	8.34
		B	12-14	(f)	52.13±1.91	4.69± .11	23.71± .38	6.19± .26	.77± .04	0.0	1.55± .29	2.65± .30	8.32
		B	16,18	(f)	51.51± .83	4.63± .10	25.20±4.47	5.48± .45	.63± .24	.01± .01	1.21± .36	3.07± .65	8.26
		E	7-9	(m)	46.39±1.89	5.67± .73	24.15±2.09	8.15±1.01	4.65±1.14	.03± .03	1.56± .32	1.25± .20	8.15
		E	11-13	(v)	47.30±2.67	6.39± .95	25.87±1.89	7.71±1.04	2.17± .70	0.0	1.26± 10	1.08± .28	8.22
		E	15-16	(v)	53.41±1.86	6.25± .35	21.22±1.34	5.63±1.47	2.41± .27	.10± .02	1.84± .21	.70± .10	8.45
DC6 2977B	907	B	1[illegible]-25*	(f)	50.42±2.18	6.76± .49	23.79±1.34	4.27± .16	.76± .14	.05± .05	1.24± .21	4.47±1.08	8.23
		C	11-12	(m)	44.84± .37	5.79±1.46	26.83±2.11	6.91± .40	4.72±1.75	.04± .05	1.79± .74	1.02± .26	8.06
		C	14	(m)	50.74	18.04	8.88	2.27	5.56	.12	3.86	1.93	8.60
		C	15,20,21	(m)	66.86±3.20	14.06± .30	.55± .17	.06± .04	1.11± .50	.85± .08	3.99± .31	3.43±1.75	9.10
DC6 2999	914	A	18-19	(m)	48.77±2.27	5.06± .68	26.21± .43	7.11±1.11	2.52±2.14	.03± .04	.96± .12	1.12± .21	8.23
		A	27-28, 30-33	(f)	50.12±1.39	5.01± .13	26.54± .98	5.16± .40	.73± .04	.02± .03	2.92± .59	1.27± .20	8.24
		B	20-24	(f)	45.56±1.49	6.03± .37	20.80±1.25	6.60± .55	1.11± .33	.03± .03	3.03± .75	.71± .18	8.11
		B	26-30	(f)	48.02±1.78	4.69± .48	26.43±1.36	7.49±1.05	.93± .14	.02± .03	3.87± .93	.36± .18	8.19
		B	31-35	(f)	45.90±1.03	5.65± .17	26.64± .46	10.30± .28	.59± .11	.02± .04	1.66± 20	1.05± .10	8.18
		B	36	(f)	45.73	5.63	25.11	11.07	.41	.09	2.64	1.15	8.18
		B	37-39	(f)	55.39±2.48	3.95± .28	25.18± .79	3.32± .14	.68± .08	0.0	2.84± .84	.21± .05	8.44
		D	3-9	(m)	51.98±2.88	5.62± .40	23.33±1.06	7.08± .57	1.58±1.00	.03± .03	1.46± .40	.49± .07	8.41
		D	13	(m)	47.52	1.61	16.42	14.79	10.98	.06	.35	.06	8.21

TABLE 6 (Cont.)

CHEMICAL COMPOSITION OF CLAY

Sample	m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	H_2O
DC6 3134	955	A	1-7	(f)	48.33±2.39	7.27± .32	28.62± .75	2.80± .18	1.09± .14	NA	2.19± .79	1.52± .15	8.19
		A	8	(f)	48.84	6.27	29.66	3.00	.79	NA	.92	2.35	8.17
		A	10,12	[illegible]	54.76±1.84	7.09±1.00	23.59±2.01	2.27± .30	.96± .12	NA	1.44± .28	1.42± .33	8.47
		A	13-17,19	(f)	58.11±4.91	17.97±1.58	18.41±5.60	1.72± .57	.97± .57	NA	2.19± .10	2.01± .54	8.62
		B	11-13, 15-16	(m)	53.80±2.17	12.75±1.11	11.24±2.09	1.09± .51	6.40± .53	NA	4.01± .38	2.18± .10	8.54
		B	17-19, 21-22	(f)	49.18±1.83	7.00± .21	27.62±1.44	3.08± .30	1.04± .09	NA	2.27± .45	1.59± .18	8.22
		B	23-29	(f)	52.84±2.19	6.78± .63	24.81±1.88	2.37± .45	1.02± .21	NA	2.43± .82	1.39± .36	8.37
		D	14-18	(m)	54.62±2.19	12.10±1.57	11.43±3.13	1.12± .89	5.80±1.27	NA	3.34± .87	3.05± .45	8.54
		D	20-21,25	(m)	54.34±2.92	12.74±4.54	12.88±3.91	.72± .32	5.28±1.92	NA	3.58± .94	1.88± .34	8.57
DC6 3220	981	A	1-2,4-7	(f)	46.32± .73	8.52± .40	31.57±1.10	1.77± .11	.68± .09	.02± .02	2.08± .20	.89± .25	8.14
		A	8-12	(f)	52.66±1.25	6.30± .93	27.42±2.79	1.88± .32	.76± .16	.03± .06	1.64± .29	.95± .31	8.35
		A	13-14	(m)	39.74±1.30	6.44±3.19	37.88±3.37	1.90± .80	3.22±1.58	.02± .02	2.26± .75	.76± .46	7.77
		A	15	(m)	52.56	11.45	18.10	1.00	2.62	.21	4.64	.96	8.46
		A	16-17	(m)	59.93±2.77	14.30± .52	6.65±1.36	.35± .13	2.13±2.10	.15± .06	3.64± .38	4.05± .07	8.81
		C	7-18	(f)	48.46±1.18	6.91± .46	29.96±1.84	2.47± .28	.96± .10	.06± .03	2.18± .72	.82± .13	8.19
		C	11-15	(f)	56.47±2.86	5.81±1.32	22.[illegible]1±2.38	1.17± .33	2.71±2.01	.08± .08	2.24± .26	1.02± .32	8.48
DC6 3489	1063	B	15	(m)	49.67	5.68	26.38	1.87	3.87	0.0	2.51	1.87	8.16
		B	21-24, 28-30	(f)	47.60±2.0[illegible]	4.86±1.13	29.13±4.47	4.78±1.93	1.30± .18	NA	3.60± .46	.61± .59	8.13
DC6 3581	1091	A	27,28,31	(f)	53.78±6.18	13.17± .94	9.91± .86	1.13± .41	7.60± .98	NA	3.97± .36	1.89± .45	8.55
		A	26	(m)	55.13	17.88	4.19	.43	6.85	NA	5.09	1.68	8.75

TABLE 6 (Cont.)

CHEMICAL COMPOSITION OF CLAYS

Sample	m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	H_2O
DC6 3581	1091	B	9,12	(m)	54.29±4.66	5.22± .52	20.24± .61	5.00± .34	.79± .25	NA	0.66± .01	5.45± .71	8.34
		B	13-15, 17-20	(f)	63.14±3.91	5.54±2.72	12.90±3.31	3.46± .97	.68± .40	NA	0.87± .64	4.67± .82	8.74
DC6 3636	1108	A	12-13,15	(m)	51.80±1.95	6.35± .25	22.43±3.26	4.83±1.39	3.39± .97	0.0	1.09± .36	.95± .61	8.36
		A	14	(m)	45.95	7.30	25.42	8.14	1.47	0.0	1.79	1.75	8.19
		A	17	(m)	46.02	7.06	26.71	7.53	1.62	0.0	1.75	1.13	8.18
		B	1	(v)	55.04	9.22	17.29	4.04	1.31	.04	1.39	3.14	8.54
		B	2-6	(v)	55.10±2.91	9.12± .61	17.56±2.04	3.80± .29	1.57± .56	NA	1.37± .20	2.94± .71	8.54
		C	8-9,11 13-15	(m)	51.97±2.57	6.34±1.23	25.08±2.26	2.62± .46	3.15± .96	0.0	1.96± .47	.54± .44	8.34
DC6 3684	1123	C	31-35	(f)	49.06±2.89	6.26± .41	26.32±1.67	5.16±1.11	2.50± .31	.06± .06	2.33± .41	.05± .06	8.26
DC6 3761	1146	B	7-10	(v)	49.17±2.03	14.41±1.92	11.78±1.63	3.80±.72	7.22±1.25	.06± .08	3.53± .24	1.58± .53	8.45
DC6 3761X	1146	A	23-28	(v)	47.17±1.13	8.68± .23	20.63±2.20	10.11±1.45	1.72± .44	0.0	1.69± .28	1.68± .90	8.32
		A	29,31	(v)	50.60± .39	7.78± .24	18.38±2.26	8.62±1.27	1.59± .06	0.0	1.37± .03	3.30± .47	8.38
		A	30	(v)	49.19	9.10	14.26	6.21	8.13	0.0	1.95	2.85	8.30
		A	32-33	(v)	51.94± .84	9.11± .13	16.05± .27	6.28± .49	2.11± .95	.02± .02	.97± .20	5.13± .02	8.39
		A	34-38	(v)	42.17±2.28	9.13± .86	26.60±3.11	9.81±1.16	1.30± .40	.03± .07	2.79± .47	.04± .08	8.14
		B	12-16	(m)	50.59±2.40	13.16±1.57	12.43±3.32	3.07±1.09	6.01±1.14	.08± .08	3.35± .69	2.91± .99	8.43
		B	18-20,23*	(v)	43.08±1.83	8.32± .81	25.04±2.11	11.50± .95	2.15± .19	0.0	1.72± .10	0.0	8.19
		B	27-28	(v)	41.80±1.63	8.76± .66	27.19±2.79	10.00± .53	1.46± .05	.01± .01	2.66± .21	0.0	8.11
		B	29	(v)	43.07	8.81	26.20	10.02	1.40	.03	2.21	.01	8.17
		B	30	(v)	42.93	8.75	26.59	9.92	2.00	0.0	1.63	0.0	8.17

TABLE 6 (Cont.)

CHEMICAL COMPOSITION OF CLAYS

Sample	m	Analysis	Number		SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	H_2O
DC6 3861	1177	B	9	(m)	63.34	10.12	8.28	.22	2.07	.12	3.14	3.88	8.83
		B	10-11, 13-14	(m)	51.08±3.32	6.57± .93	26.11±3.60	1.70± .66	1.88±1.58	.03± .05	2.88± .38	1.48± .22	8.26
		B	12	(m)	57.82	8.44	13.72	.66	3.95	.07	2.16	4.65	8.52
		B	16-17,19	(f)	46.30±1.74	7.22± .35	31.71± .62	2.40± .25	.52± .06	.06± .06	2.16± .73	1.56± .62	8.09
DC6 4220	1286	A	21-25	(v)	51.08±1.56	3.73± .20	31.93± .64	1.79± .07	.98± .10	NA	2.19± .58	.09± .02	8.21
		A	26-31	(v)	51.88±1.52	3.74± .08	32.07± .81	1.74± .13	1.10± .06	NA	1.10± .42	.11± .03	8.26
		A	32-34	(v)	52.11±7.62	4.86±1.39	29.93±5.88	1.80± .30	1.27± .26	NA	1.40± .18	.34± .33	8.30
		B	16,18,21	(m)	61.09±1.46	8.03±1.23	14.06±3.63	1.80±1.09	3.15±1.51	NA	2.10±1.33	.99± .10	8.78
		B	19,20	(f)	54.54± .10	4.31± .10	28.21± .99	1.83± .07	3.36± .26	NA	1.13± .20	.23± .01	8.39

Legend

* Total iron calculated as Fe_2O_3
** Stoichiometric H_2O
Number = sample number of electron microprobe analysis
± = standard deviation
A, B, X = additional section at specified depth
(v) = vesicle
(f) = fracture
(m) = matrix

TABLE 7

CHEMICAL COMPOSITION OF PLAGIOCLASE

Sample	m	Analysis	Number	SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	Total
DC2 2507	764	A	22	57.32	26.50	1.19	.14	9.34	NA	5.54	.51	100.54
		A	23-25	58.05± .79	26.44± .66	1.65± .50	.31± .22	9.62± .33	NA	5.22± .12	.48± .06	101.77
		A	28-29	60.61± .99	24.04±1.24	1.16± .66	.15± .16	1.21± .07	NA	6.76± .27	.79± .06	99.72
DC2 2926	892	B	9-11	54.79±1.35	27.28± .75	.81± .05	.12± .01	10.45±1.05	.04± .03	5.46± .55	.54± .14	99.49
DH4 2466A	752	C	1,3	56.32±2.88	[illegible]6.32±3.37	1.36± .40	.19± .08	8.85±2.68	.07± .02	6.05± .98	.94± .49	100.08
DH5 2633	803	A	1-3,5, 7,10	55.12±1.44	26.1[illegible]± .49	1.15± .14	.11± .07	9.18± .47	.02± .02	6.00± .23	.43± .07	98.19
DH5 2668	813	A	15	51.82	23.10	4.85	2.81	10.77	.00	4.34	.35	98.03
		B	11-14	55.08± .88	27.53± .32	1.05± .11	.18± .06	10.37± .06	.05± .05	5.73± .15	.44± .05	100.43
DC6 2011	613	D	2-8	54.77±1.10	28.48± .46	.96± .18	.16± .03	10.61± .42	.00	5.28± .23	.40± .07	100.63
		E	2,5-8, 45-49	56.65±1.01	25.18± .80	1.51± .27	.18± .05	9.03± .82	.05± .05	5.84± .[illegible]2	.54± .08	98.98
		E	11	53.67	19.44	6.55	2.58	11.63	.04	4.83	.43	99.17
		F	1-20	55.04±1.39	25.85± .82	1.81±1.43	.25± .21	9.96± .82	.04± .04	5.37± .35	.46± .19	98.79
DC6 2053	626	E	2-4	55.17±1.63	25.90±1.64	1.48±1.07	0.31± .33	9.75± .47	0.0	5.28± .79	.61± .49	98.53
		E	11	56.66	25.90	.84	.09	.90	.08	6.34	.57	99.38
DC6 2156	657	B	10	52.11	27.90	1.65	.44	11.81	.01	4.27	.55	98.11
DC6 2279	695	B	1-5	53.32± .69	28.65± .74	.78± .13	.19± .01	11.54± .40	0.0	4.57+ .22	.52+ .25	99.75
		C	1-5,7	52.75±1.00	29.66±1.27	1.10± .32	.27± .09	11.84± .70	.02± .01	4.45± .21	.59± .34	100.66
DC6 2282	696	C	1-6,8	55.36±2.88	26.88±2.36	1.23± .46	.32± .31	9.98±2.38	0.0	5.60± .98	.55± .39	99.92
		G	1-2,4,6	51.82±1.70	28.64± .60	.99± .33	.17± .06	11.44± .42	.07± .07	5.03± .09	.40± .12	98.53
		G	21-25	53.08±1.02	29.04± .12	.80± .12	.15± .04	11.64± .08	0.0	4.91± .03	.30± .03	99.93

TABLE 7 (Cont.)

CHEMICAL COMPOSITION OF PLAGIOCLASE

Sample		m	Analysis	Number	SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	Total
DC6	2403K	732	B	25,27-30	53.48±1.37	28.75±2.19	1.64±1.04	.33± .14	10.59±1.58	0.0	5.45± .55	.48± .16	100.71
			D	8-15	54.33±1.11	28.16±2.06	1.54±1.55	0.0	10.93± .89	0.0	4.99± .37	.43± .13	100.80
DC6	2464	751	D	19	55.30	28.41	.85	.14	10.63	.07	4.78	.41	100.59
			D	20	59.03	25.41	.80	.03	7.16	.04	6.37	.79	99.64
			D	31-35	53.25± .67	28.77± .54	1.11± .51	.09± .08	11.18± .36	.03± .02	4.62± .15	.40± .11	99.45
			E	1-2,8-15	53.61± .83	27.83± .67	.98± .26	.09± .03	11.11± .57	.05± .02	4.78± .30	.36± .03	98.81
			E	1-2	54.42± .70	27.08± .01	1.03± .03	.06± .04	10.37± .11	.08± .02	5.15± .16	.46± .07	98.63
			E	8-10	53.13± .72	27.93± .97	1.06± .51	.10± .03	11.51± .46	.05± .03	4.56± .19	.34± .09	98.68
			E	13-15	53.76±1.08	28.12± .59	.87± .08	.08± .02	11.04± .62	.04± .01	4.81± .37	.35± .02	99.07
			E	20	53.06	28.02	.89	.12	11.48	.07	4.62	.23	98.54
			E	26	53.54	27.97	1.04	.09	11.26	.04	4.75	.33	99.02
DC5	2533	772	C	6-10	55.10±2.92	28.15±1.48	.91± .06	.15± .06	11.26±1.78	0.0	5.35±1.02	.30± .14	101.22
DC6	2695	821	B	1-5	53.91± .54	27.97± .57	.57± .03	.17± .01	11.96± .77	.04± .04	4.72± .28	.26± .04	9[illegible].60
			B	10-16	53.09±1.07	27.70± .63	.88± .50	.23± .14	11.95± .51	0.0	4.63± .12	.33± .15	98.81
			B	20-21	57.55±1.39	26.25±1.46	.91± .17	.12± .08	9.35±1.03	0.0	5.93± .76	.46± .10	100.57
			C	28,34,35	52.16±1.29	28.18±1.75	.77± .12	.13± .02	11.37±1.30	0.0	4.41± .63	.26± .07	97.28
DC6	2977A	907	B	1-6	53.41± .99	26.19± .71	1.38± .21	22± .07	10.30± .57	.06± .04	4.94± .35	.27± .07	96.77
			D	19	55.12	27.45	.96	.19	11.81	.02	4.91	.23	100.69
			D	20-22	52.92± .64	27.34± .29	.76± .13	.13± .03	10.49± .74	.05± .07	5.12± .44	.23± .01	97.04
			E	1-2,5	53.32±1.40	27.99± .60	.94± .17	.18± .05	11.95± .19	.01± .02	4.42± .13	.12± .05	98.93
DC6	2977B	907	B	1-4	54.01±1.13	28.79± .50	.80± .08	.23± .05	12.00± .08	.[illegible]± .04	4.58± .19	.19± .05	100.69

TABLE 7 (Cont.)

CHEMICAL COMPOSITION OF PLAGIOCLASE

Sample	m	Analysis	Number	SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	Total
DC6 2977B	907	B	13-14,16	53.67±1.24	21.89± .69	6.46+ .53	1.29+ .30	7.78+ .19	0.0	4.09+ .17	1.67+ .35	96.85
		C	2-4	53.56±1.37	28.89± .77	.82± .19	.19± .02	12.23±1.09	.06± .06	4.60± .31	.28± .22	100.63
		C	9-10	54.97± .40	28.27±1.21	1.04± .05	.18± .08	10.75±1.94	.02± .02	5.27± .98	.49± .01	100.99
		C	17	53.06	24.83	4.10	1.90	11.04	.09	3.98	.76	99.76
DC6 2999	914	B	1-2	53.45± .90	27.72± .02	.88± .19	.13± .01	10.66± .28	.02± .02	5.44± .28	.36± .01	98.66
		B	3-4	54.20± .57	29.06± .47	.92± .32	.15± .06	11.62± .22	.04± .01	5.07± .23	.28± .01	101.32
		B	11,13-14	54.53± .23	28.81± .34	1.20± .38	.16± .02	11.46± .25	.03± .03	5.24± .31	.30± .02	101.69
		B	16-17	54.70± .22	27.74± .29	1.55± .11	.21± .02	10.98± .08	.06± .02	5.26± .21	.58± .23	101.05
		D	16,18-19	58.93± .93	26.02±1.43	.86± .31	.12± .04	8.73± .42	.05± .04	6.04± .47	.75± .30	101.51
DC6 3134	955	B	1-2,5-8	54.20± .82	26.76±1.32	2.11±1.07	.34± .22	10.49± .64	NA	5.21± .25	.31± .15	99.62
		B	10,14	58.52± .26	23.04±2.55	3.10±2.83	.24± .21	7.80± .55	NA	6.74± .66	.80± .01	100.24
		D	1,3-4	57.21±1.05	26.61± .95	1.40± .34	.21± .15	10.35± .62	NA	5.44± .55	.46± .10	101.68
DC6 3220	981	A	18,20-21	55.13±1.42	26.94±1.44	1.51± .14	.22± .13	10.21± .62	.04± .04	5.43± .20	.28± .10	99.76
DC6 3421	1042	A	8	58.21	23.28	1.14	.07	7.25	.22	6.86	.98	98.01
		A	14	56.55	25.97	1.74	.21	9.15	.05	5.02	.58	99.27
		B	19,30-33	56.26±1.28	26.03±1.06	1.37±.72	.32± .42	10.36± .36	.03± .03	5.30± .18	.42± .09	100.09
DC6 3581	1091	B	1-3,5-6	55.50	27.79	1.11	.21	10.23	NA	5.53	.43	101.80
DC6 3636	1108	A	1-3	55.91±1.35	26.90± .19	.74± .04	.16± .04	10.98± .29	0.0	5.11± .08	.47± .03	100.27
		A	6-9	55.48± .84	27.10± .63	.82± .11	.20± .02	10.78± .35	0.0	5.25± .15	.54± .07	100.17
		C	1-5	56.12±1.52	27.68± .51	.74± .07	.15± .02	10.98± .27	.04± .05	5.29± .20	.34± .06	101.34

TABLE 7 (Cont.)

CHEMICAL COMPOSITION OF PLAGIOCLASE

Sample	m	Analysis	Number	SiO_2	Al_2O_3	Fe_2O_3*	MgO	CaO	BaO	Na_2O	K_2O	Total
DC6 3684	1123	B	1-5	56.27±1.48	27.31± .86	1.07± .25	.17± .14	9.61± .93	.10± .04	6.04± .63	.26± .11	100.83
		C	27-30	55.67± .15	26.63± .48	1.19+ .25	.14+ .09	9.86+ .95	.02+ .02	5.92+ .26	.33+ .04	99.76
DC6 3761	1146	A	14-18	56.15± .86	27.31± .74	.90± .04	.19± .05	10.98± .32	.19± .17	5.15± .17	.44+ .21	101.31
3761X	1146	B	2,5-7	55.88±1.07	27.02± .76	.82± .04	.14± .02	10.60± .28	.05± .04	5.87± .15	.36± .05	100.74
DC6 3861	1177	B	1-2,4	56.11± .54	26.51± .56	1.16± .12	.11± .03	10.15± .19	.09± .08	5.39± .19	.44± .08	99.96
		B	5-6,8	57.61±1.43	25.27± .68	1.25± .40	.15± .07	10.05±1.00	.04± .05	5.82± .47	.47± .09	100.66
		C	1,3-7	57.26± .74	25.25±1.04	1.43± .43	.16± .12	8.77± .67	.14± .11	5.88± .37	.92± .42	99.73
DC6 4220	1286	A	1-2,4-5,8-10	54.76± .52	28.05± .58	.85± .11	.10± .03	10.58± .52	NA	5.44± .22	.47± .10	100.25
		B	5-9	54.74±1.07	27.76± .42	1.06± .48	.11± .03	10.59± .41	NA	5.36± .15	.39± .08	100.01

<u>Legend</u>

* Total iron calculated as Fe_2O_3
Number = sample number of electron microprobe analysis
± = standard deviation
A, B, X = additional section at specified depth
(v) = vesicle
(f) = fracture
(m) = matrix

TABLE 8

CHEMICAL COMPOSITION OF CLINOPYROXENES

Sample	m	Analysis	Number	SiO_2	Al_2O_3	FeO*	MgO	CaO	BaO	Na_2O	K_2O	Total
DC6 2464	751	E	11-12,16	50.00± .48	5.28±1.82	14.32±1.08	14.82±1.83	15.28±1.82	0.0	.21± .01	.04± .02	99.95
DC6 2533	772	C	13,15	52.04± .28	.76± .26	22.15± .02	18.63± .50	5.67± .22	0.0	.11± .03	.00	99.36
		C	14	51.68	1.50	17.70	15.83	12.65	0.0	.24	0.0	99.68
DC6 2977B	907	C	6-8	51.79±1.55	1.79± .35	13.55±2.18	16.34±1.44	15.45±3.31	.01± .01	.23± .05	0.0	99.16
DC6 2999	914	A	13,15	52.03±1.71	1.69± .40	12.34± .62	17.47±1.07	16.58±1.54	.00	.22± .02	0.0	100.33
		A	14,16	51.71± .23	1.23± .09	20.79±1.12	18.27±1.91	8.87± .83	.03± .04	.16± .01	.01± .01	101.07
		A	17	50.79	2.85	16.84	13.53	15.17	.04	.63	.09	99.94
		B	5-9	51.10±1.44	1.29± .19	19.67± .89	16.96±2.84	10.23±2.68	.02± .02	.19± .05	.01± .01	99.47
		B	15	51.82	1.58	15.67	17.01	13.61	.03	.21	0.0	99.93
		D	14-15	52.83± .46	.91± .05	19.42±1.29	19.44±1.35	7.35± .11	.02± .00	.12± .00	.02± .01	100.11
		D	28-24	51.72± .77	1.59± .27	11.94±1.16	17.20± .73	16.66±1.79	.00	.22± .03	.01± .01	99.34
DC6 3[illegible]34	955	D	6-7,10-12	52.60± .86	1.61± .28	19.29±2.58	14.46±2.02	12.93±4.00	NA	.20± .08	.01± .01	101.10
DC6 3421	1043	A	3-4	52.16± .78	1.40± .06	17.11±2.54	14.23± .66	14.30±1.57	.03± .00	.20± .08	0.0	99.43
DC6 3489	1063	B	18	49.36	1.64	19.51	11.77	15.88	NA	.67	0.0	98.83
DC6 3636	1108	C	6-7	52.71± .19	.94± .05	18.55± .11	21.64± .15	4.42± .04	.02± .03	.02± .01	.01± .01	98.31
DC6 3684	1123	C	36-40	50.20± .62	2.04± .93	15.31±1.29	15.07±1.44	15.12±1.20	.03± .06	.37± .13	0.0	98.14
DC6 3761	1146	B	1,3-5	51.32± .96	2.63± .51	12.06±1.43	16.77± .69	16.25±2.28	.02± .02	.25± .05	0.0	99.50
DC6 3761X		A	3,6	51.31±1.43	3.25± .64	11.87± .82	14.96± .27	17.20± .18	.06± .08	.32± .01	0.0	98.97

Legend

*Total iron calculated as FeO
Number = sample numbers of electron microprobe analysis
± = standard deviation

TABLE 9

CRYSTALLIZATION ORDER IN DC2, DC6, DH4, AND DH5
DETERMINED FROM THIN SECTION PETROGRAPHY

Sample		Depth (m)	Crystallization Sequence
DC2 2240B	(f)	682.8	$C_1 - C_7$
DC2 2282B	(f)	695.6	$Z_1Z_2S_1 - S_9$
DC2 2314A	(f)	705.3	C_1Z_1
DC2 2448A	(f)	746.2	C_1Z_1
F	(f)		C_1S_1
DC2 2507A	(f)	764.1	C_1S_1
DC2 2561A	(f)	780.6	$C_1Z_1S_1S_2$
B	(f)		$C_1 - C_3Z_1S_1$
DC2 2883A	(f)	878.7	$C_1Z_1S_1$
DC2 2926B	(f)	891.8	Z_1C_1
DC2 2319C	(v)	706.8	$C_1C_2Z_1$
D	(v)		$C_1 - C_3Z_1$
DC2 2359A	(v)	719.0	$C_1Z_1C_2$
B	(v)		C_1Z_1
C	(v)		$C_1Z_1C_2$
DC2 2366A	(v)	721.2	$C_1Z_1Z_2$
C	(v)		C_1Z_1
DC2 2402D	(v)	732.1	$C_1Z_1C_2/S_1$
DC2 2632D	(v)	802.2	$C_1Z_1C_2$
E	(v)		$C_1Z_1C_2$
G	(v)		$C_1Z_1C_2$
DC2 2666B	(v)	812.6	$C_1Z_1S_1 - S_3$
C	(v)		$C_1Z_1S_1 - S_3$
DC2 2803D	(v)	854.4	$C_1 - C_3Z_1C_4$
DC2 3264B	(v)	994.9	$C_1 - C_3Z_1Z_2S_1$
D	(v)		$C_1 - C_3Z_1Z_2S_1$
E	(v)		$C_1 - C_3Z_1Z_2S_1$
G	(v)		$C_1 - C_3Z_1Z_2S_1$
I	(v)		$C_1 - C_3Z_1Z_2S_1$

TABLE 9 (Cont.)

CRYSTALLIZATION ORDER IN DC2, DC6, DH4, AND DH5
DETERMINED FROM THIN SECTION PETROGRAPHY

Sample		Depth (m)	Crystallization Sequence
DC6 2403XA*	(f)	732.4	C_1Z_1
XD	(f)		C_1
DC6 2533B	(f)	772.1	$C_1 - C_3$
D	(f)		$C_1 - C_4S_1S_2$
DC6 2977AB	(f)	907.4	C_1C_2
BB	(f)		C_1
DC6 2999A	(f)	914.1	C_1
B	(f)		C_1C_4
DC6 3134A	(f)	955.2	$C_1 - C_3Z_1$
B			$C_1C_2Z_1$
DC6 3220A	(f)	981.5	C_1C_2
C	(f)		$C_1C_2Z_1$
DC6 3489B	(f)	1063.0	C_1
DC6 3581A	(f)	1091.0	C_1Z_1
B	(f)		C_1Z_1
DC6 3684B	(f)	1123.0	C_1Z_1
C	(f)		C_1
DC6 3861B	(f)	1177.0	C_1Z_1
DC6 2011D	(v)	613.0	C_1C_2
E	(v)		C_1C_2
F	(v)		C_1C_2
DC6 2053C	(v)	625.8	$C_1 - C_4$
E	(v)		$C_1 - C_4$
DC6 2156D	(v)	657.1	$C_1 - C_3Z_1$
E	(v)		$C_2C_3Z_1/Z_2$
DC6 2279A	(v)	694.6	C_1Z_1/C_1
A*	(v)		C_1Z_1/C_1
B	(v)		C_1
C	(v)		C_1
DC6 2282C	(v)	695.6	$C_1C_2Z_1S_1$
C*	(v)		$C_1C_2Z_1S_1$
H*	(v)		$C_1C_2Z_1S_1S_2$

TABLE 9 (Cont.)

CRYSTALLIZATION ORDER IN DC2, DC6, DH4, AND DH5
DETERMINED FROM THIN SECTION PETROGRAPHY

Sample		Depth (m)	Crystallization Sequence
DC6 2330A	(v)	710.2	C_1
B	(v)		C_1
DC6 2403XB	(v)	732.4	$C_1Z_1S_1$
XD*	(v)		$C_1Z_1S_1$
DC6 2464E	(v)	751.0	$C_1 - C_3$
F	(v)		$C_1 - C_3$
DC6 2695A*	(v)	821.4	$C_1 - C_3Z_1C_4$
C*	(v)		$C_1 - C_3Z_1C_4$
DC6 2977AE	(v)	907.4	$C_1 - C_3Z_1$
DC6 3421A	(v)	1043.0	Z_1Z_2
B	(v)	1043.0	Z_1Z_2
DC6 3636B	(v)	1108.0	$C_1Z_1S_1C_2$
DC6 3761B	(v)	1146.0	C_1C_2
XA	(v)		C_1C_3
XB	(v)		$C_1 - C_3S_1$
DC6 4220A	(v)	1286	Z_1C_1
DH4 2438A	(v)	743.1	C_1Z_1
DH4 2466AB	(v)	751.6	C_1Z_1
AC	(v)		$C_1Z_1C_2S_1$
BC	(v)		$C_1 - C_3Z_1$
DH5 2633A	(v)	802.5	C_1/S_1

Legend

C_n = nth generation clay
Z_n = nth generation zeolite
S_n = nth generation silica phase
(f) = fracture
(v) = vesicle
/ = phases are intergrown

TABLE 10

ESTIMATES OF RELATIVE AMOUNTS OF SECONDARY
MINERALS IN FRACTURES OF DC6 FROM POINT COUNTING

Sample	Green Clay	Non-Green Clay	Clinoptilolite	Silica
DC6 2977 AB	39	61		
DC6 3220 C	1	68	31	
DC6 2403 XD	50	50		
DC6 3489 B		100		
DC6 2533		68		32
DC6 3134 B		59	41	
DC6 3581	11	27	57	5
DC6 3684 B		45	55	
DC6 3684 C		100		

TABLE 11

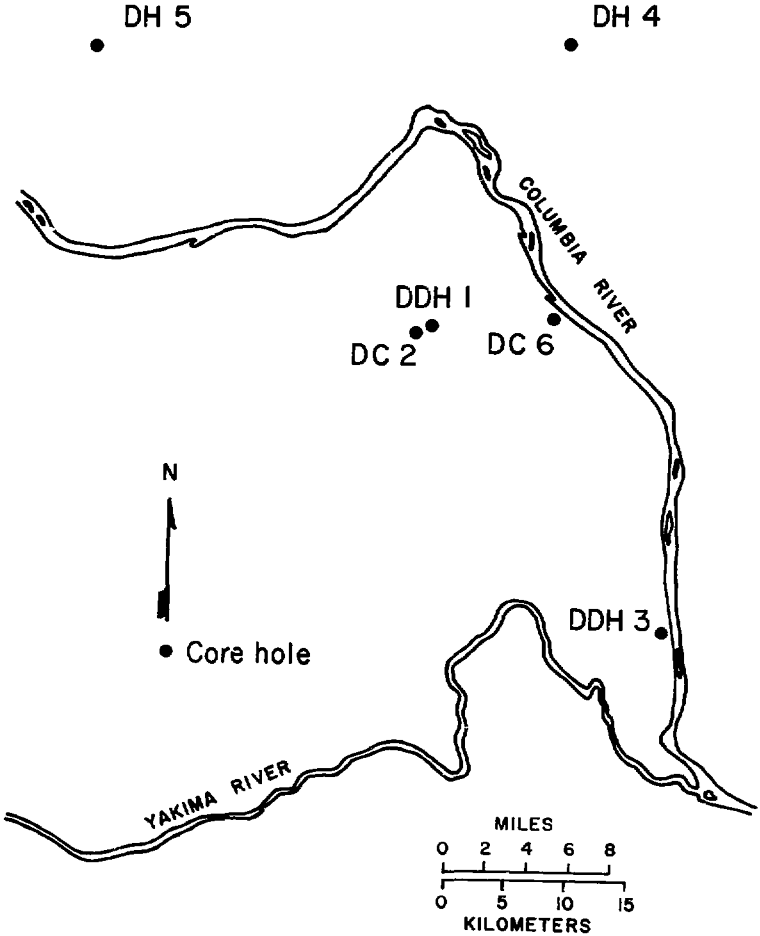
WET CHEMICAL ANALYSES OF FeO, Fe_2O_3, Al_2O_3 AND CATION EXCHANGE CAPACITIES FOR SELECTED CLAYS FROM DC6

		OXIDE WEIGHT %		CEC (meq x g^{-1})			
	Fe_2O_3	FeO	Al_2O_3	Ca	NH_3	K	XRD
DC6 2279 (U)	14.06	4.89	7.06				
(P)	11.31	5.91	7.04	—	—	--	I,F
DC6 3134 (U)	12.30	3.95	8.78				
(P)	11.06	4.10	8.57	78	93	109	S
DC6 3324 (U)	18.51	4.46	6.69				
(P)	17.71	3.44	6.76	95	130	135	S,C,F
DC6 3608 (U)	20.67	3.68	7.72				
(P)	21.64	2.80	7.38	93	103	113	C,S,Q,F

Legend

U = unprocessed
P = processed
S = smectite
C = clinoptilolite
I = illite
F = feldspar
Q = quartz

F I G U R E S



XBL 796-7541

Figure 1

SAMPLE LOCATIONS

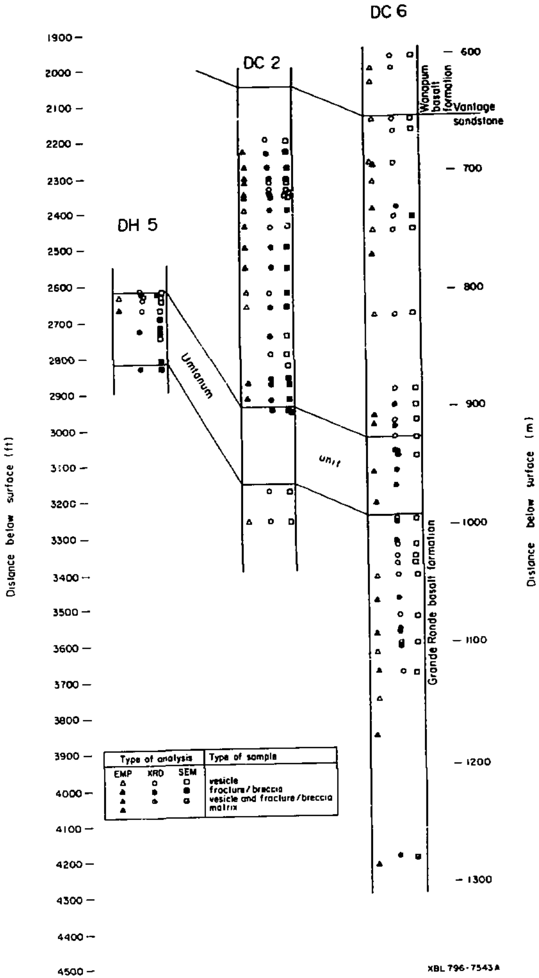


Figure 2

DC6 2695 S2 20Y

DC6 2695 S2 600X

DC6 3538 S4 200X

DC6 2989 S3 200X

XBB 795-7476

Figure 3

DC6 3387 S2 20X

DC6 3387 S2 125X

DH5 2831 S2 20X

DC6 3089 S3 500X

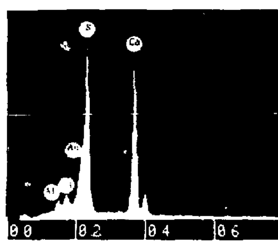
XBB 795-7475

Figure 4

DC2 3264 S3A 200X

DC6 3387 S1 2000X

DH5 2831 S4B 2000X

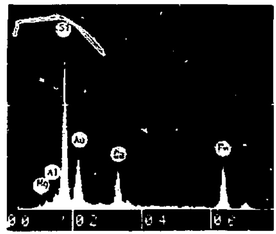


DH5 2831 S5

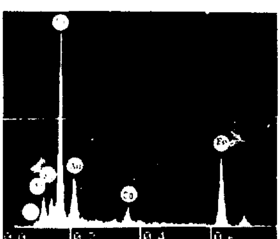
XBB 795-7477

Figure 5

DC6 2464 S4 500X



DC6 2464 S4



DC6 3038 S2

DC6 2989 S1 200X

XBB 795-7458

Figure 6

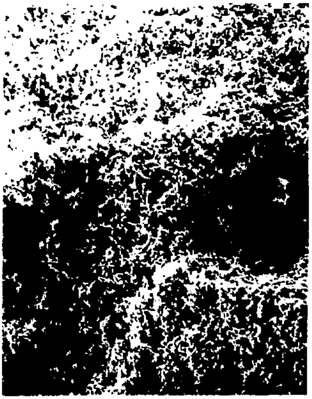
DC6 3387 S5 200X

DC6 3387 S5 5000X

DC6 2190 S1 1000X

XBB 795-7459

Figure 7



DC2 2803 S1B 200X

DC2 2803 S1B 5000X

DC2 2319 S2 500X

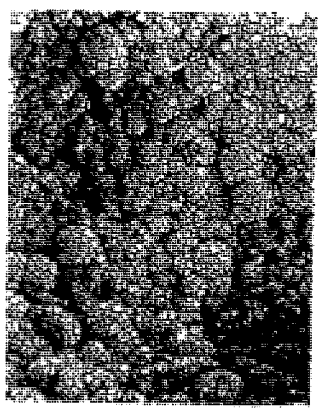
DH5 2620 S5C 200X

XBB 795-7457

Figure 8

DC6 4204 S4 500X

DC6 4204 S4 2200X



DH5 2643 S2A 100X

XBB 795-7461

Figure 9

DC2 2632 S3E 500X

DC2 2632 S3E 2000X

DC6 2464 S3 100X

DC6 2908 S4 5000X

XBB 795-7462

Figure 10

DC6 3387 S1 20X

DC6 3387 S1 500X

DC6 3538 S1 20X

DC6 3538 S1 500X

XBB 795-7464

Figure 11

DC6 2190 S3 500X

DH5 2668 S1B 100X

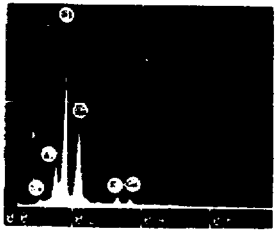
DC6 3367 S1 30X

DC6 3367 S1 5000X

XBB 795-7460

Figure 1

DC6 2427 S1 20X



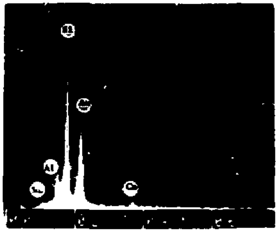
DC6 2908 S3

DC6 2695 S2 200X

XBB 795-7465

Figure 13

DC6 3609 S3 20X



DC6 3609 S3

DC6 3609 S3 5500X

XBB 795-7463

Figure 14

DC6 3267 S1 100X

DC6 3267 S1

DC6 3267 S1 2000X

XBB 795-7470

Figure 15

DC6 2908 S3 20X

DC6 2908 S3 200X

DC6 2908 S3 500X

DC6 2908 S3 4500X

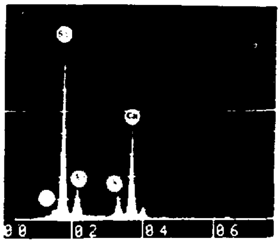
XBC 795-7471

Figure 16

DC6 2908 S5 100X

DC6 2908 S5 500X

DC6 3688 S1 100X

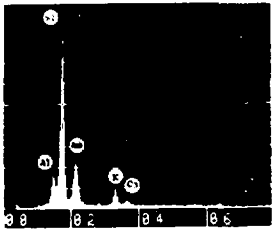


DC6 3688 S1

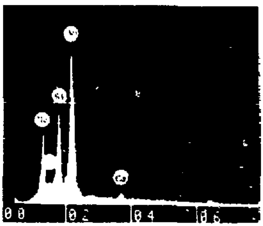
XBB 795-7469

Figure 17

DH5 2691 S1 1000X



DH5 2691 S1



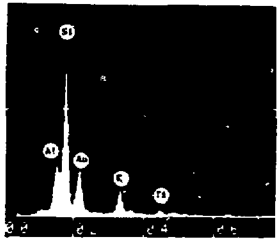
DC6 3609 S3

DC6 3609 S3 5000X

XBB 795-7473

Figure 18

DC6 2156 S1 20X



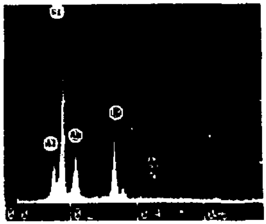
DC6 2156 S1

DC6 2156 S1 500X

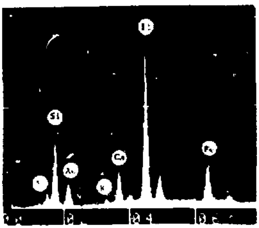
XBB 795-7472

Figure 19

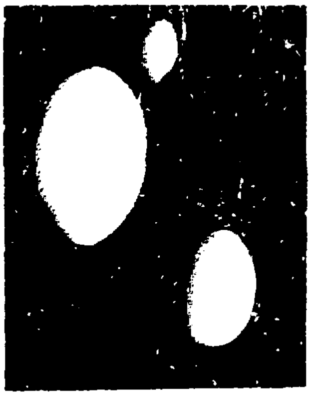
DC6 2908 S3 5000X



DC6 2908 S3



DC6 2989 S6

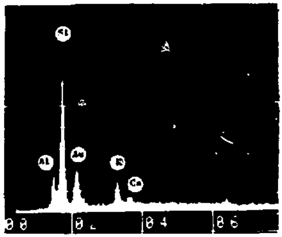


DC6 2989 S6 5000X

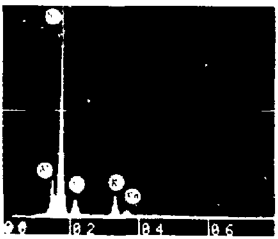
XBB 795-7474

Figure 20

DC2 2206 S3 5000X



DC2 2206 S3



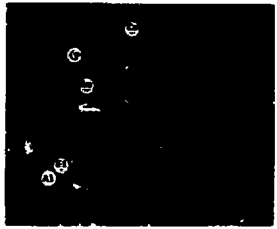
DC2 2359 S2B

DC2 2359 S2B 1000X

XBB 795-7467

Figure 2i

DC6 3421 S3 20X

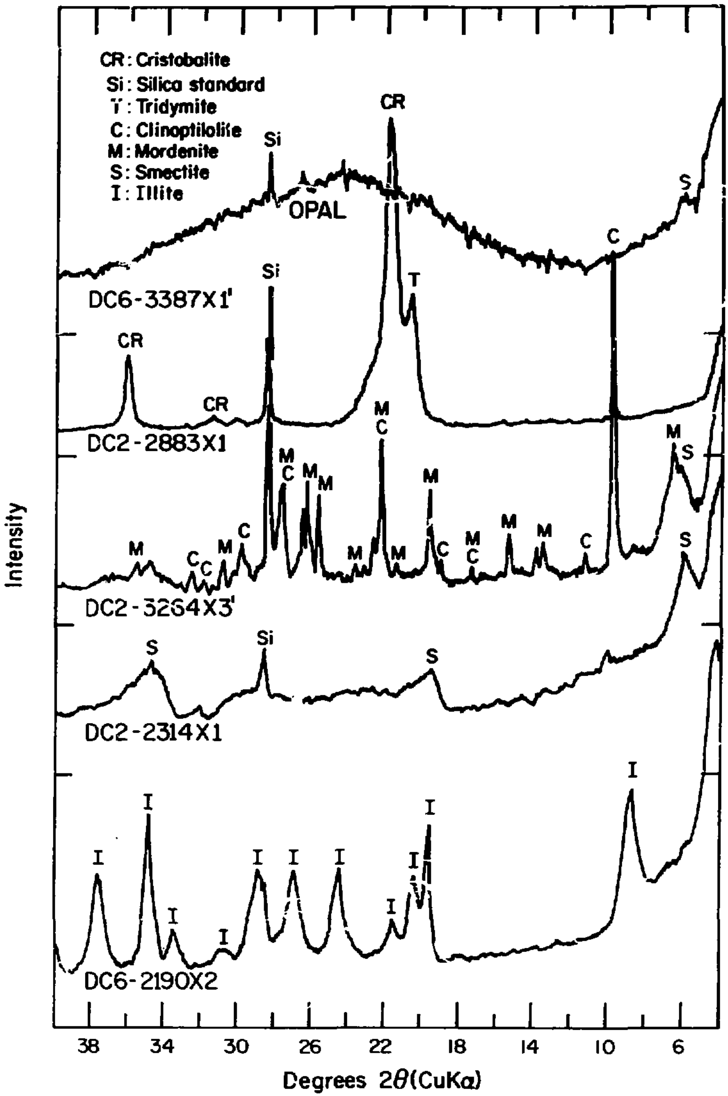


DC6 3421 S3

DC6 3421 S3 1000X

XBB 795-7468

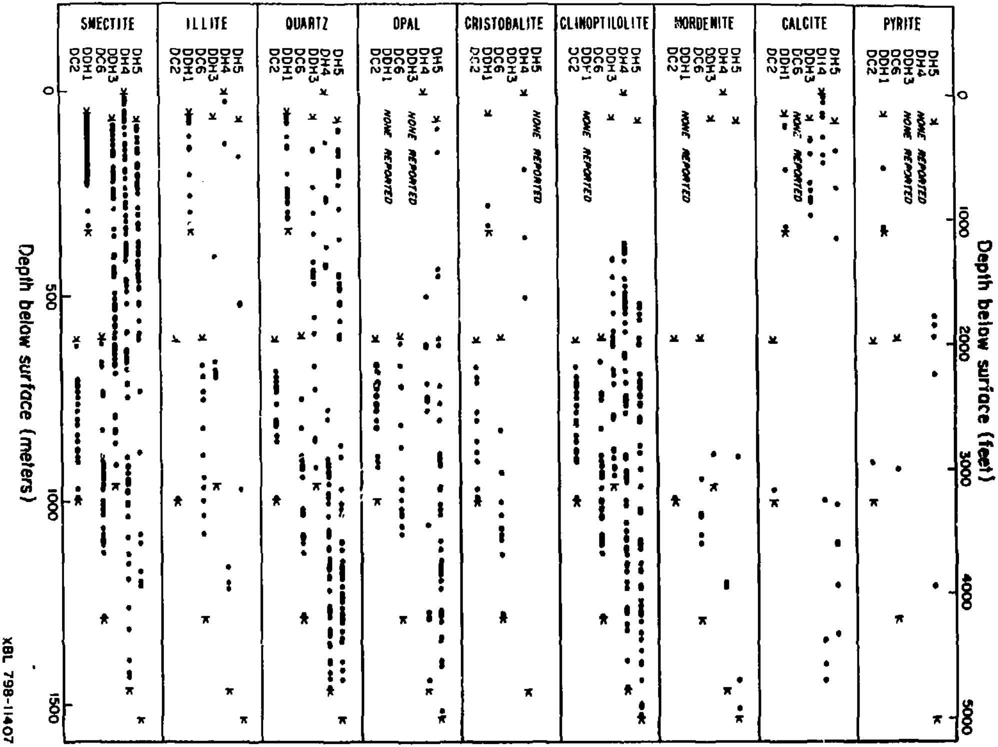
Figure 22



XBL 796-7542

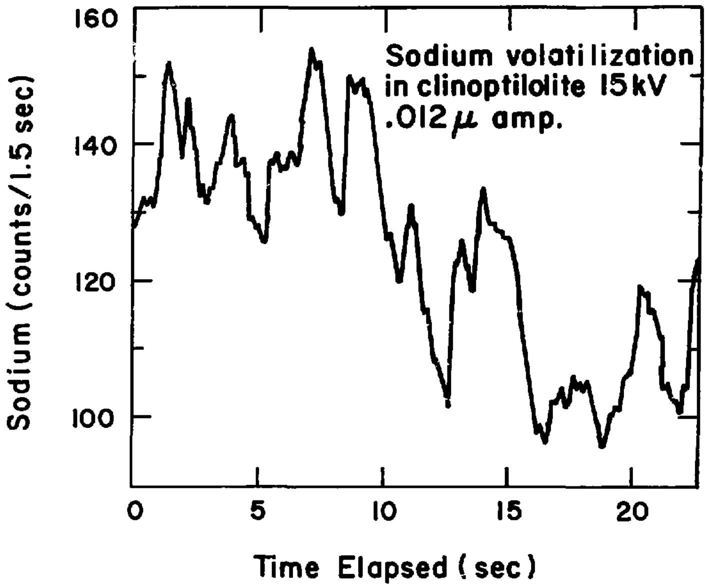
Figure 23

Depth of secondary mineral occurrence from XRD data



XBL 798-11407

Figure 24



XBL796-1808

Figure 25

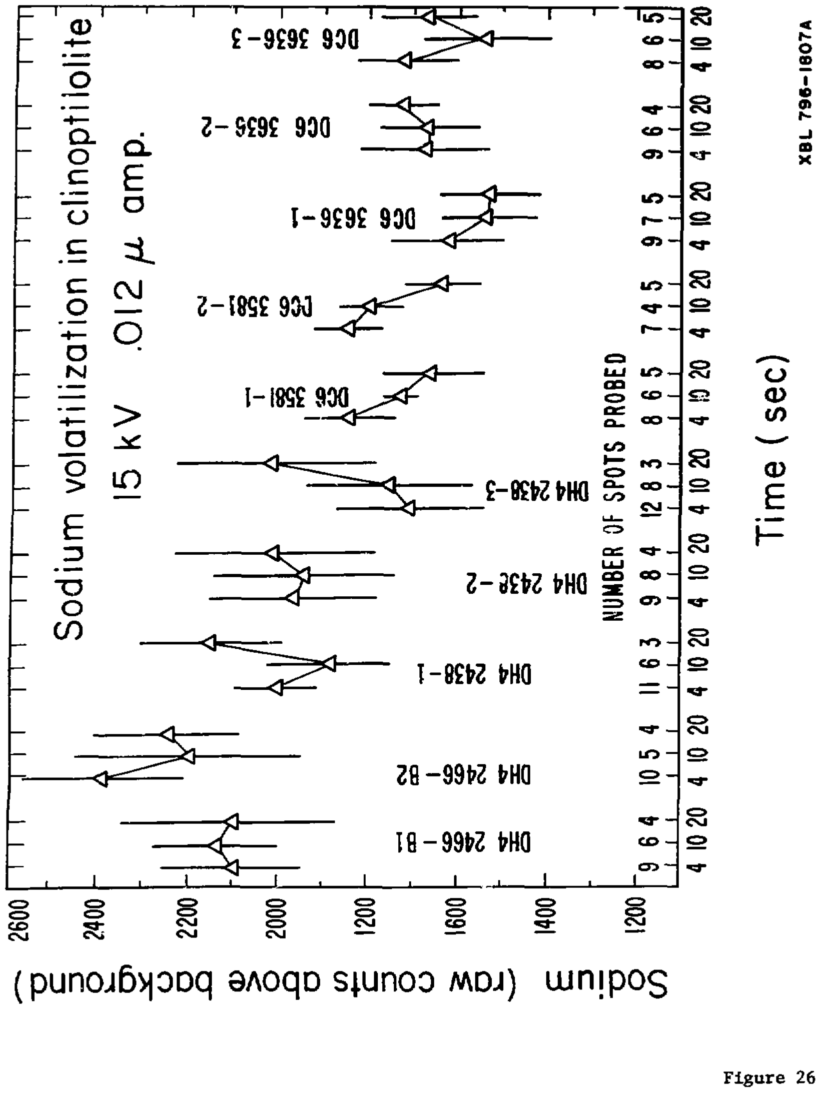
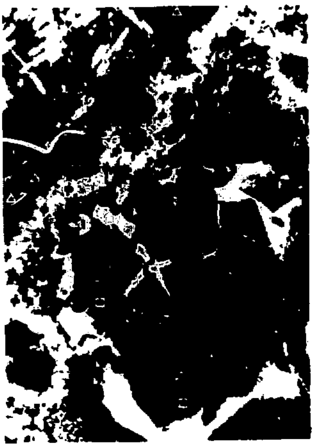

Sodium volatilization in clinoptilolite
15 kV .012 μ amp.
Sodium (raw counts above background)
Time (sec)
NUMBER OF SPOTS PROBED
DH4 2466-B1
DH4 2466-B2
DH4 2438-1
DH4 2438-2
DH4 2438-3
DC6 3581-1
DC6 3581-2
DC6 3636-1
DC6 3636-2
DC6 3636-3
XBL 796-1807A

Figure 26

DC2 2319 C 150X

DC2 2319 D 150X



DC2 2359 A 150X

DC2 2359 B 225X

XBB 795-7506

Figure 27

DC2 2359 C 225X

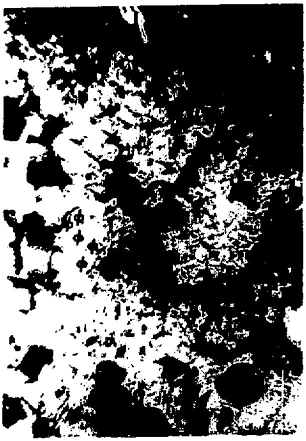
DC2 2366 A 100X

DC2 2366 C 100X

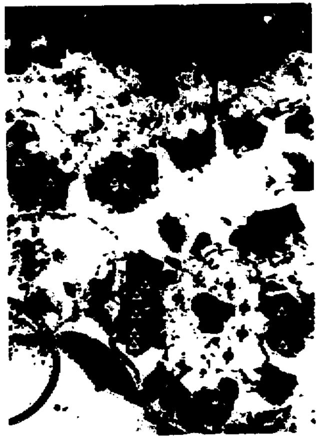
DC2 2402 D 250X

XBB 795-7507

Figure 28



DC2 2632 D 150X



DC2 2632 E 125X

DC2 2632 G 150X

DC2 2666 B 125X

XBB 795-7505

Figure 29

DC2 2666 C 150X

DC2 2803 D 150X

DC2 3264 B 100X

DC2 3264 D 50X

XBB 795-7515

Figure 30

DC2 3264 E 125X

DC2 3264 G 100X

DC2 3264 I 150X

DC6 2011 D 150X

XBB 796-7516

Figure 31

DC6 2011 E 150X

DC6 2011 F 175X

DC6 2053 C 150X

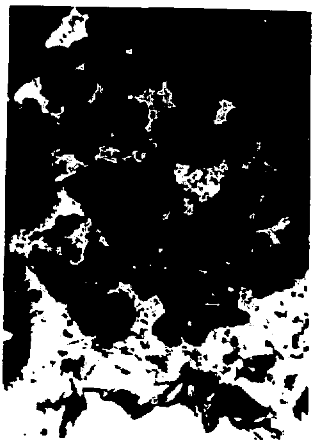
DC6 2053 E 200X

XBB 796-7514

Figure 32

DC6 2156 D* 150X

DC6 2156 E 150X

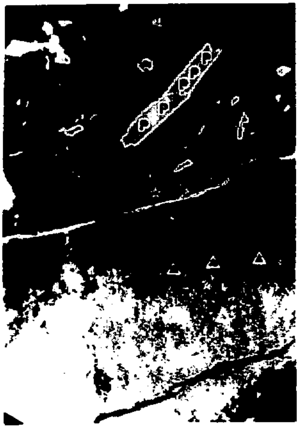


DC6 2279 A 150X

DC6 2279 A* 150X

XBB 796-7512

Figure 33



DC6 2279 B 150X

DC6 2279 C 150X

DC6 2282 C* 125X

DC6 2282 C** 175X

XBB 796-7513

Figure 34

DC6 2282 H* 150X

DC6 2330 A 100X

DC6 2330 B 100X

DC6 2403 XB 150X

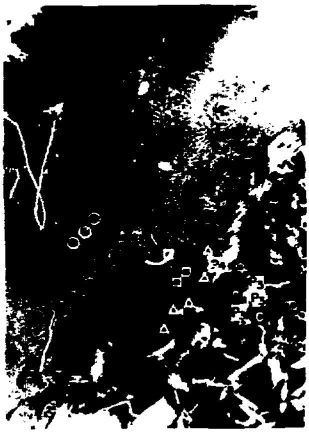
XBB 796-7511

Figure 35

DC6 2403 XD 50X

DC6 2403 XD* 200X

DC6 2464 D 150X



DC6 2464 E 150X

XBB 796-7509

Figure 36

DC6 2464 F 225X

DC6 2695 A* 150X

DC6 2695 C* 225X

DC6 2977 AE 150X

XBB 796-7510

Figure 37

DC6 3421 A 175X

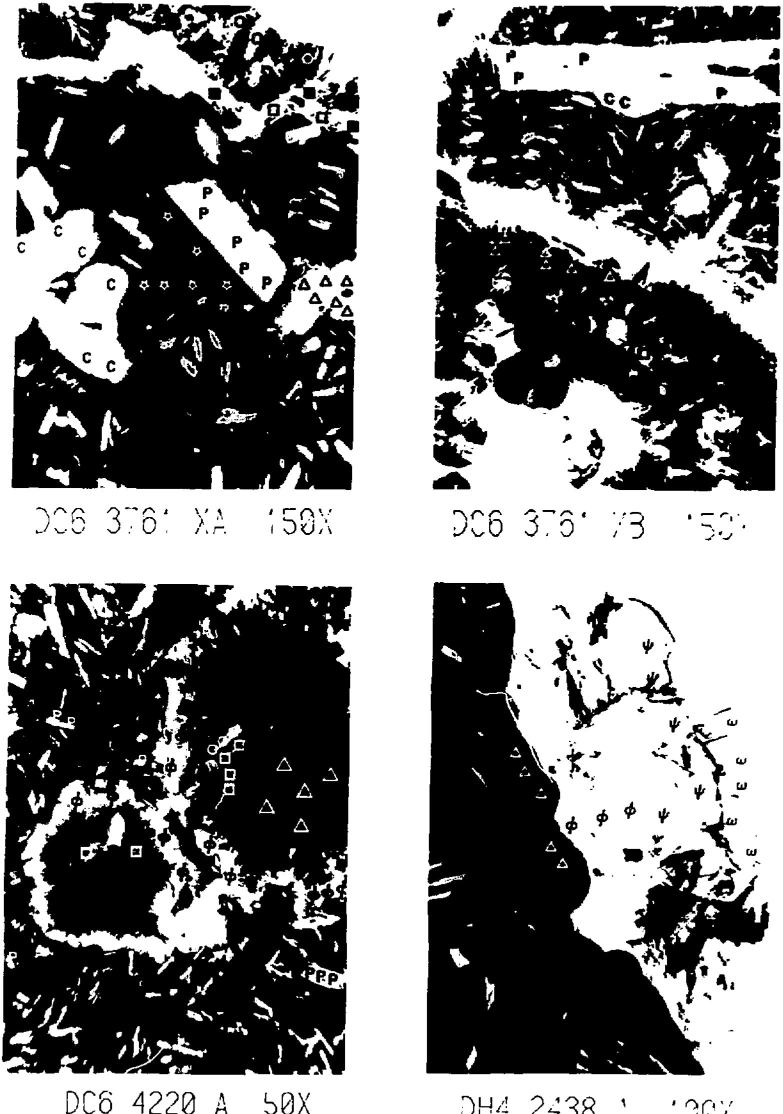
DC6 3421 B 175X

DC6 3636 B 150X

DC6 3761 B 50X

XBB 796-7508

Figure 38



XBB 796-7521

Figure 39

DH4 2466 AB 150X

DH4 2466 AC 150X

DH4 2466 BC 125X

DH5 2633 A 175X

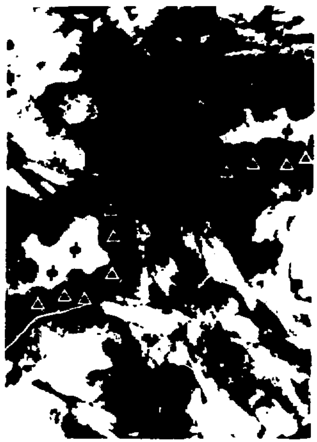
XBB 796-7522

Figure 40

DC2 2240 B 150X

DC2 2282 B 150X

DC2 2314 A 125X



DC2 2448 A* 150X

XBB 796-7520

Figure 41

DC2 2448 F 150X

DC2 2507 A* 100X

DC2 2561 A 175X

DC2 2561 B 150X

XBB 796-7503

Figure 42

DC2 2883 A 125X

DC2 2926 B 150X

DC6 2403 XA 150X

DC6 2533 B* 150X

XBB 796-7504

Figure 43

DC6 2533 D 150X

DC6 2977 AB 150X

DC6 2977 BB 150X

DC6 2999 A 200X

XBB 796-7502

Figure 44

DC6 2999 B 150X

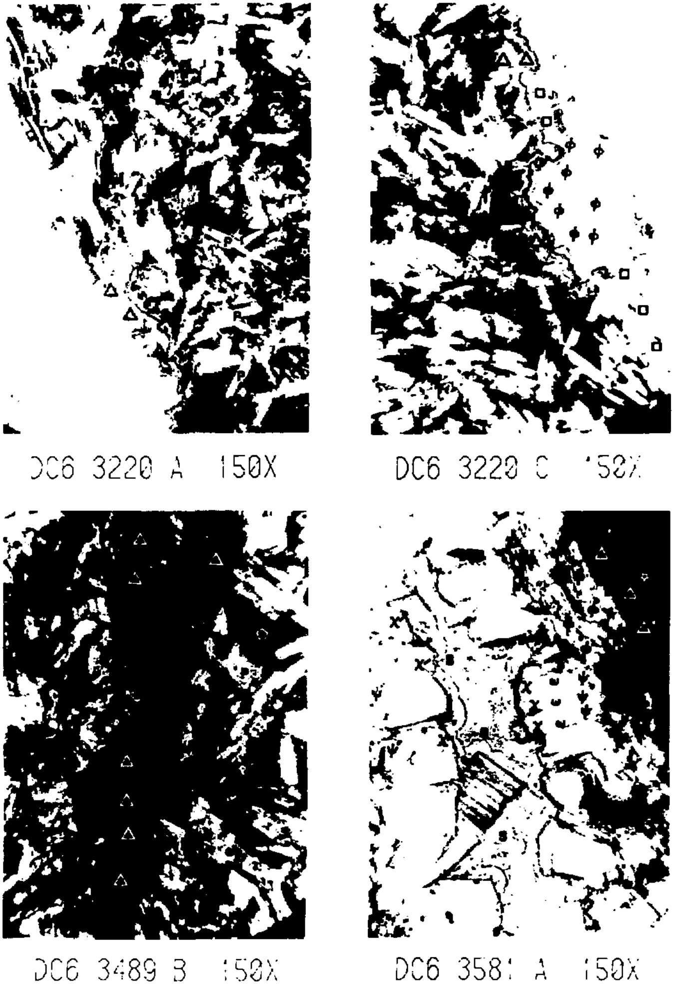
DC6 3134 A 225X

DC6 3134 B 175X

DC6 3134 D 225X

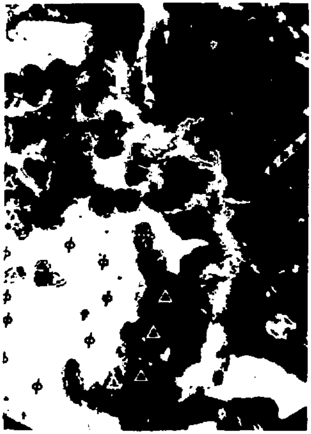
XBB 796-7518

Figure 45



XBB 796-7519

Figure 46



DC6 3581 B 150X

DC6 3684 B 150X

DC6 3684 C 150X

DC6 3861 B 150X

XBB 796-7517

Figure 47

DC6 4220 B 150X

DC6 2282 G* 150X

DC6 2533 C 150X

DC6 2695 B 175X

XBB 796-7500

Figure 48

DC6 2977 AD 150X

DC6 2977 BC 150X

DC6 2999 D 150X

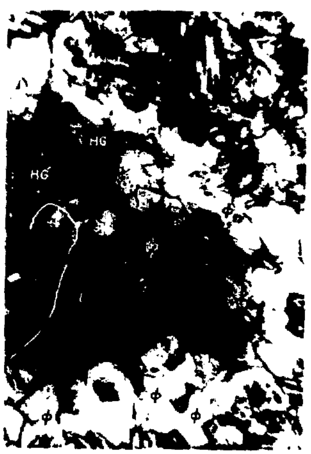
DC6 3636 A 175X

XBB 796-7501

Figure 49

DC6 3636 C 150X

DC6 3861 C 150X

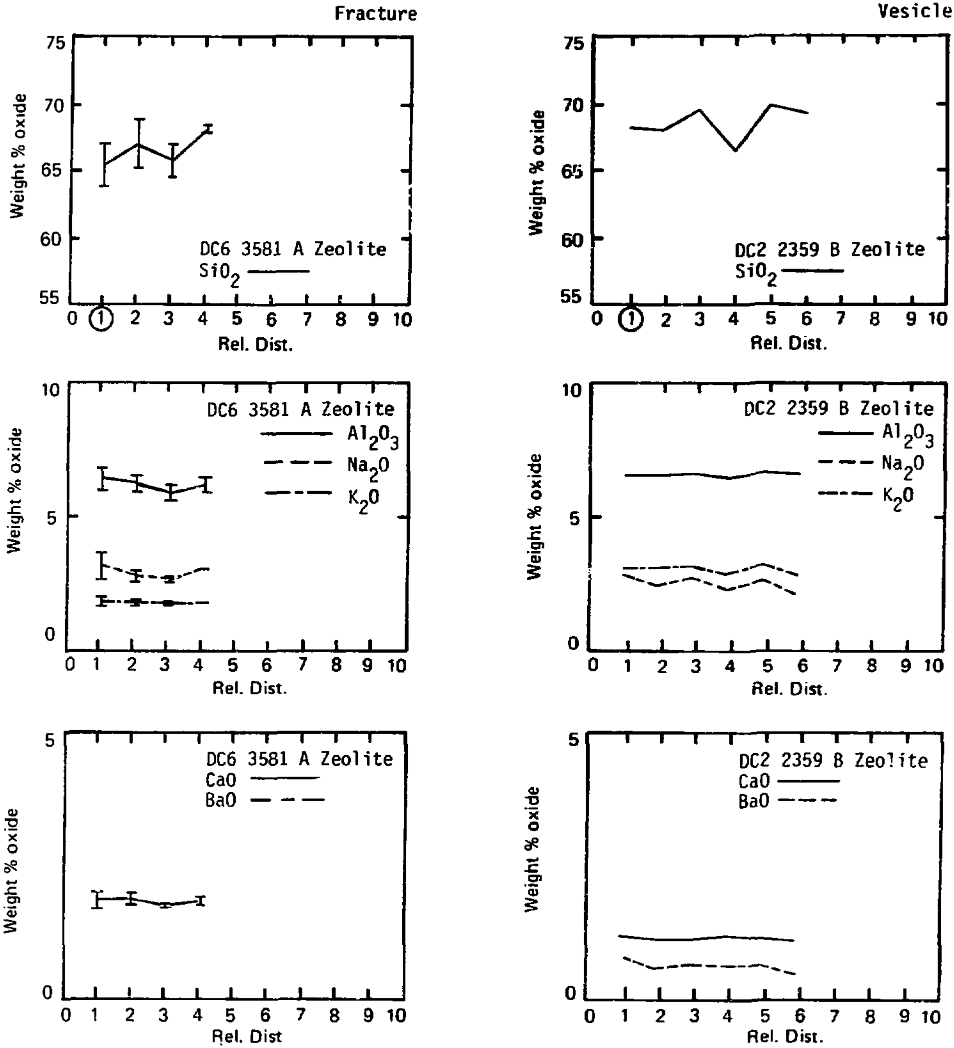


DH5 2668 A 100X

DH5 2668 B 150X

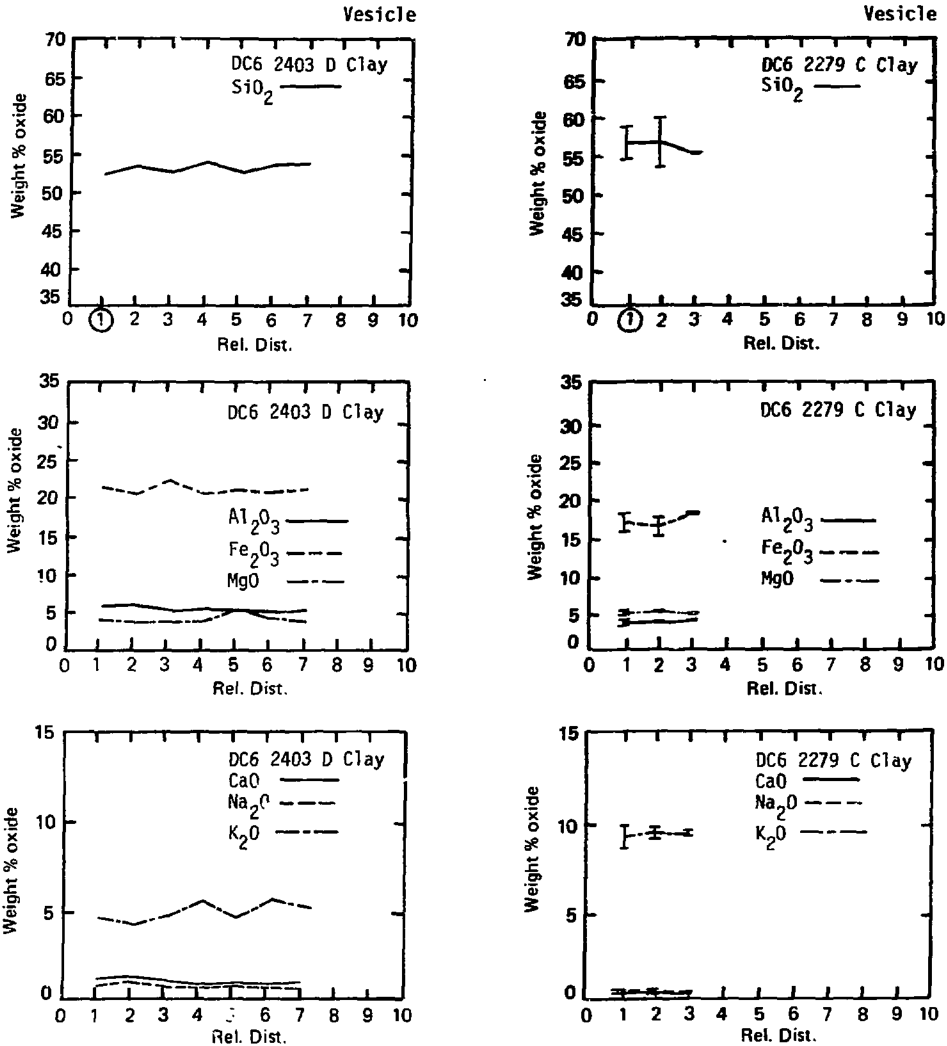
XBB 796-7499

Figure 50



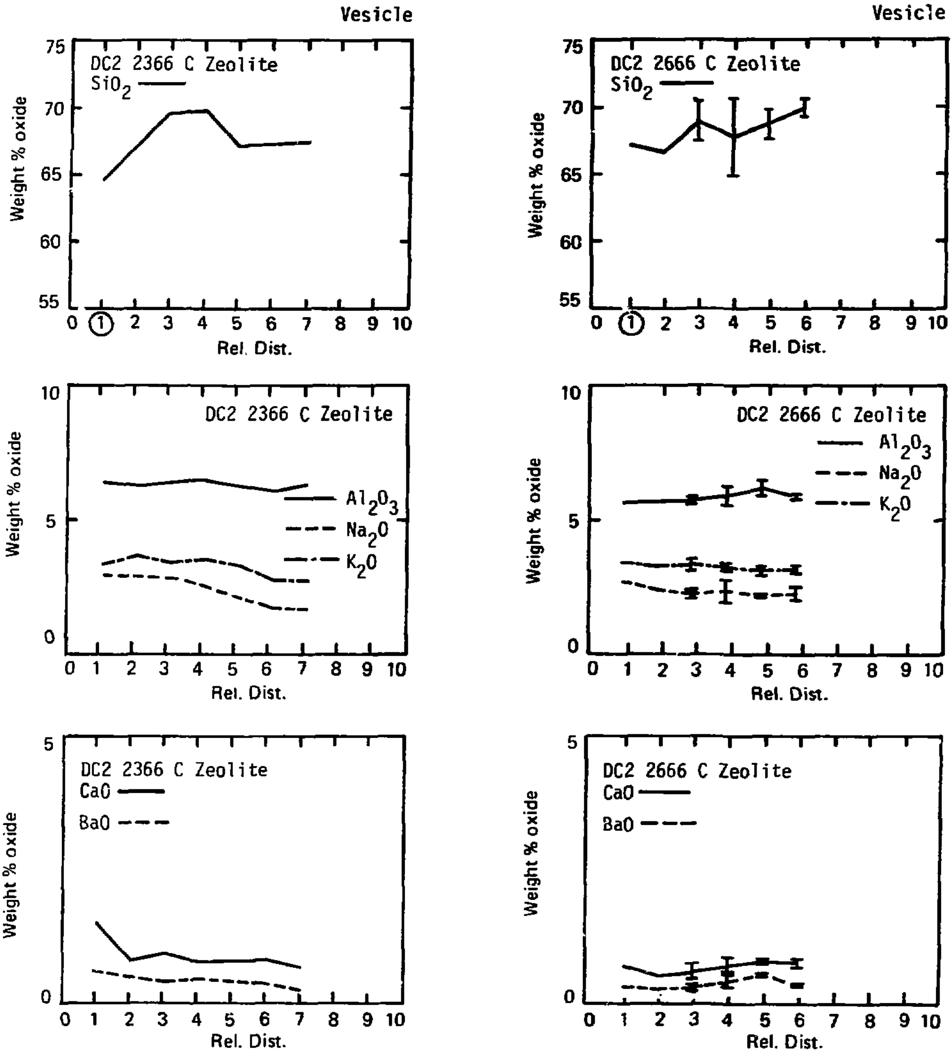
XBL 799 - 2986

Figure 52



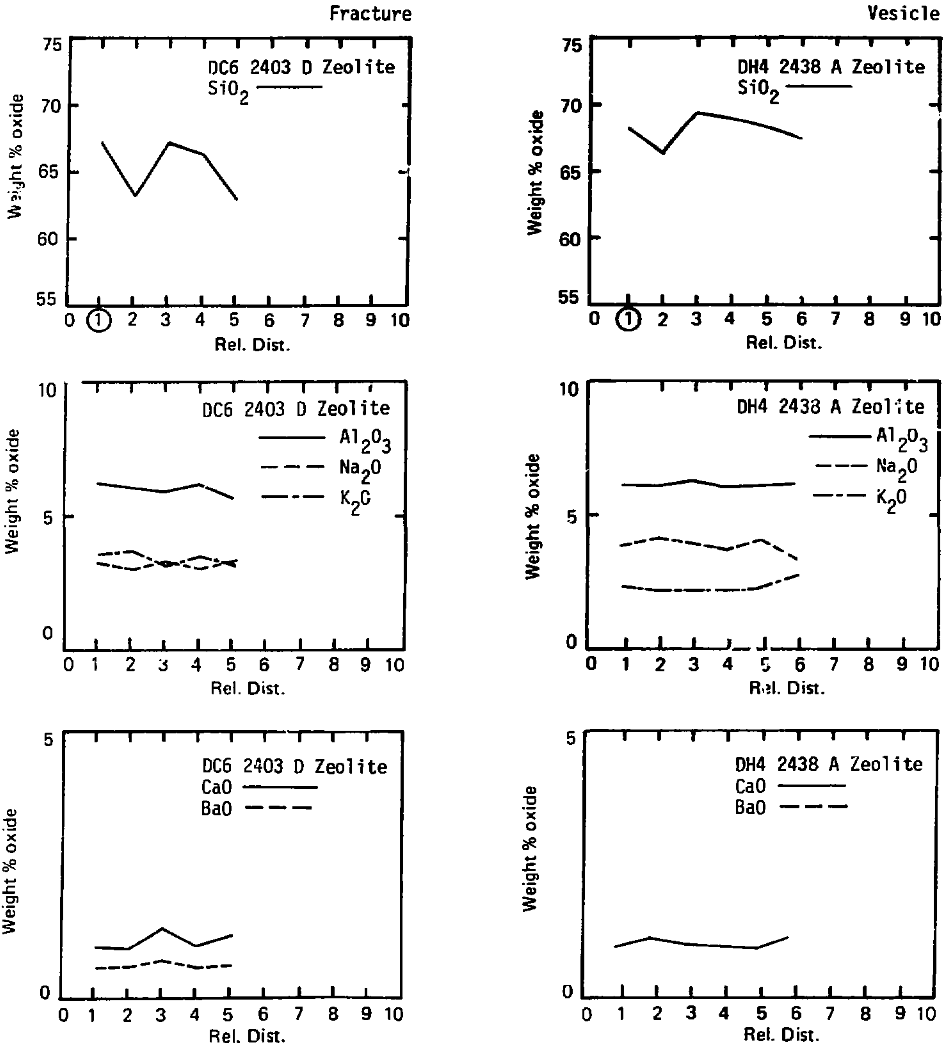
XBL 799 - 2989

Figure 51



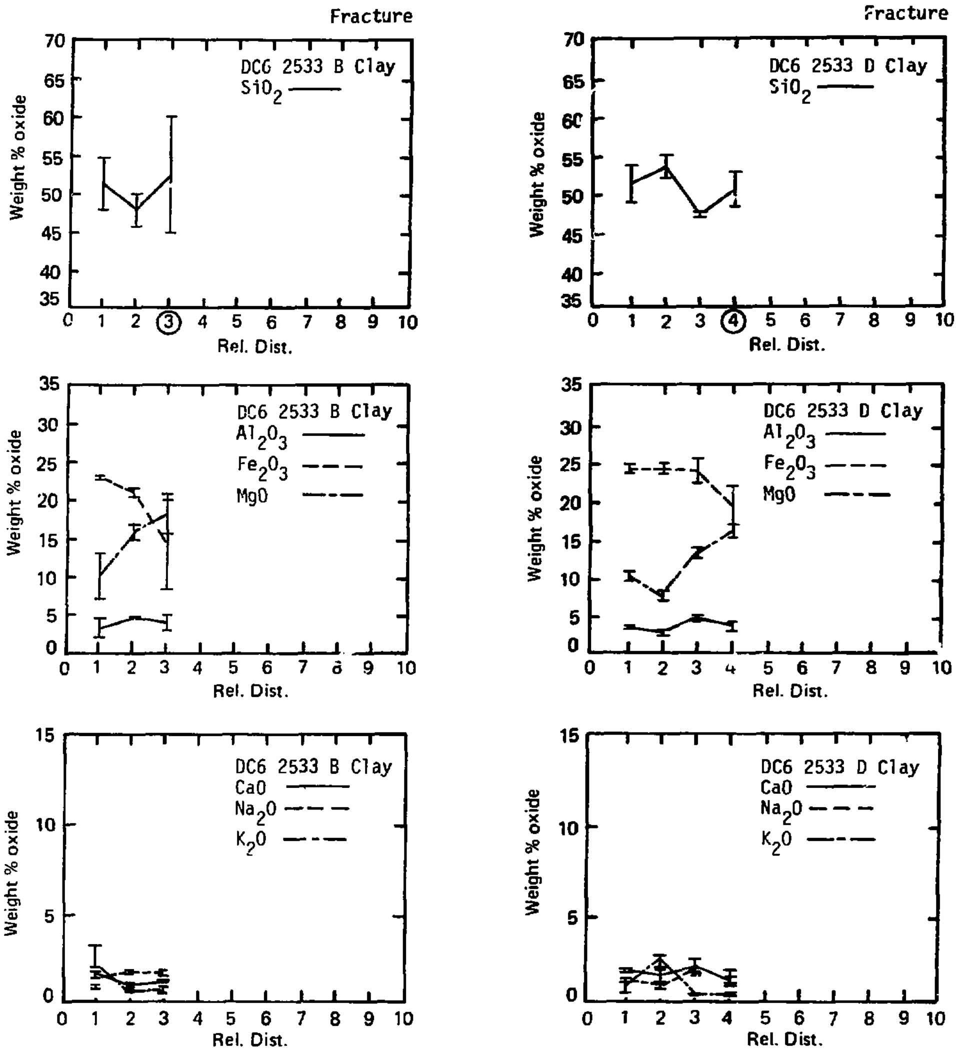
XBL 799 - 2982

Figure 53



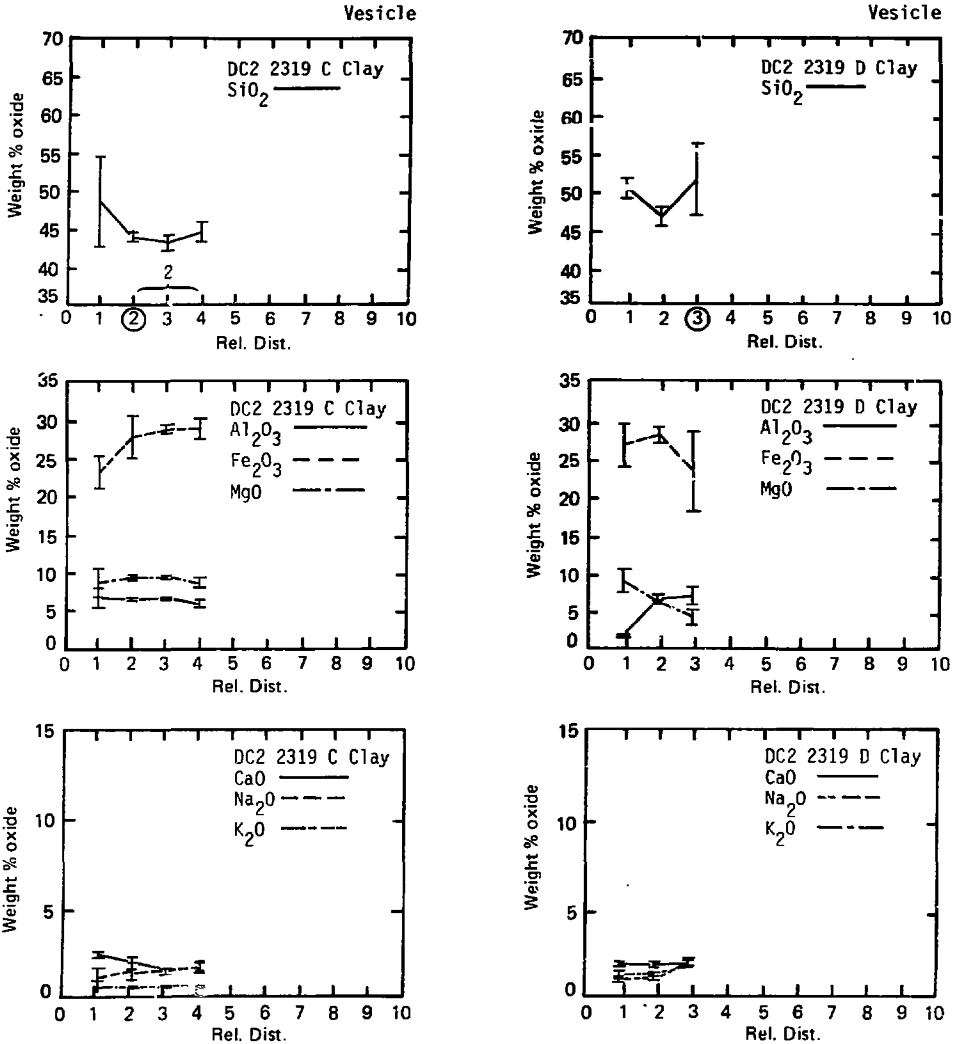
XBL 799 - 2983

Figure 54



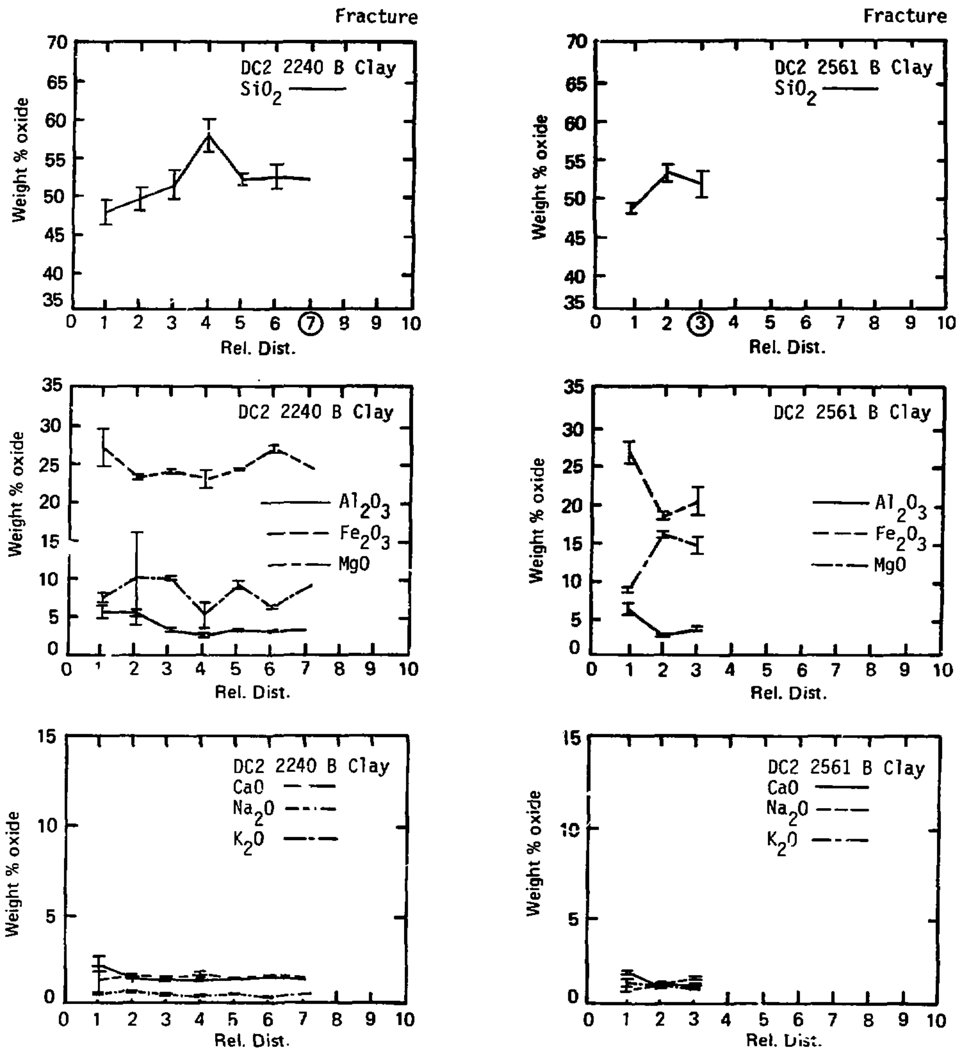
XBL 799 - 2990

Figure 55



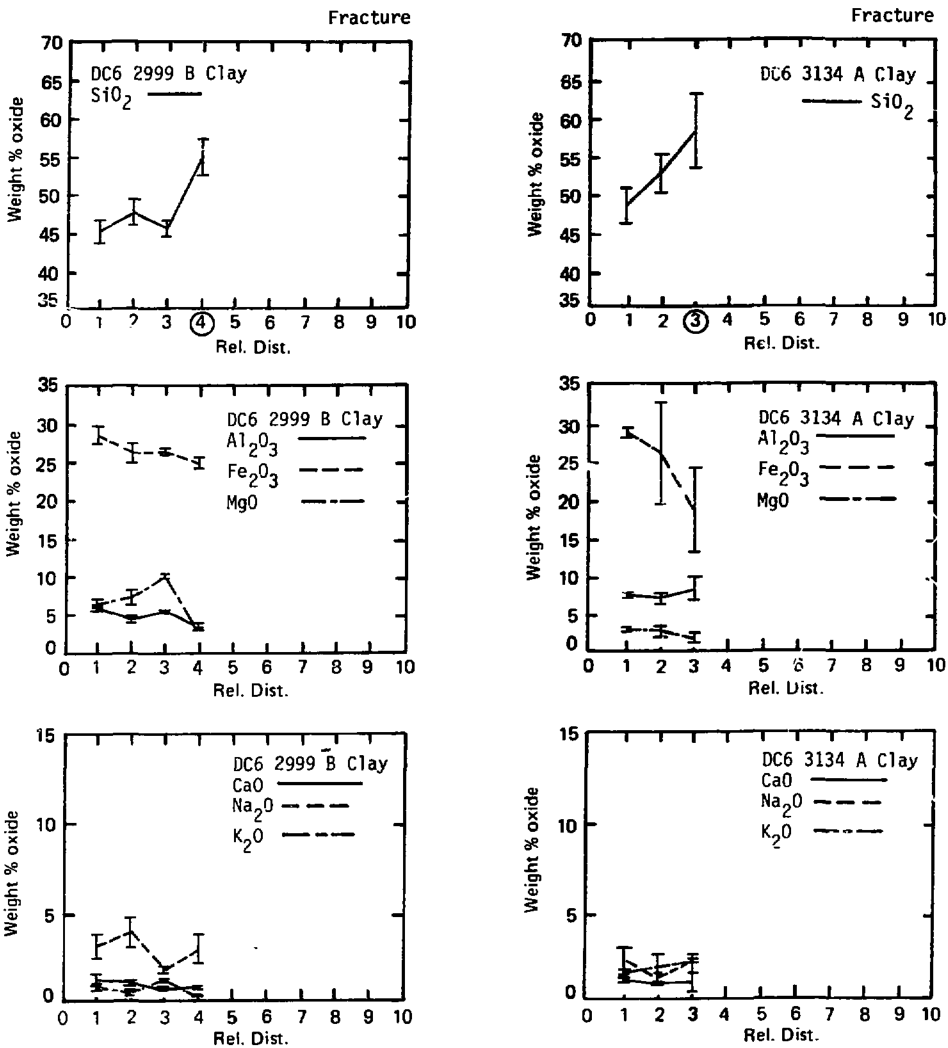
XBL 799 - 2987

Figure 56



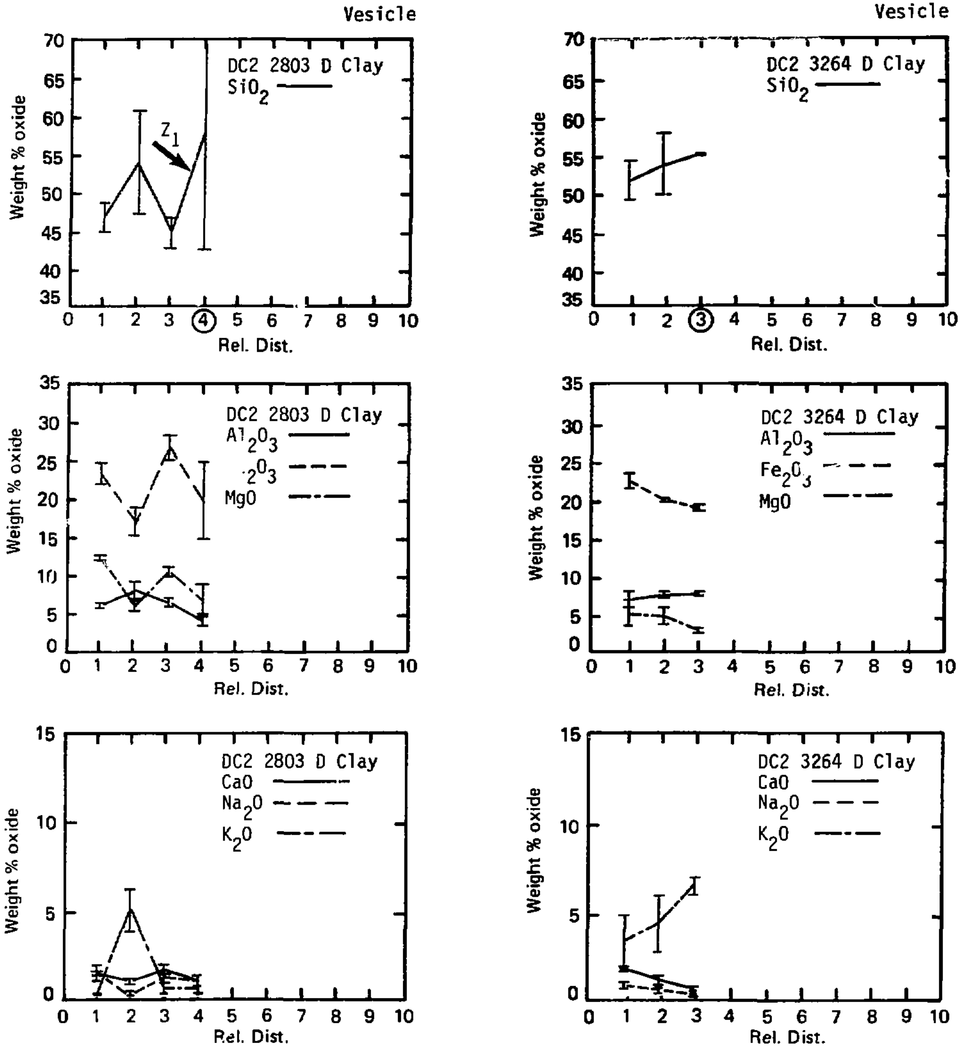
XBL 799 - 2991

Figure 57



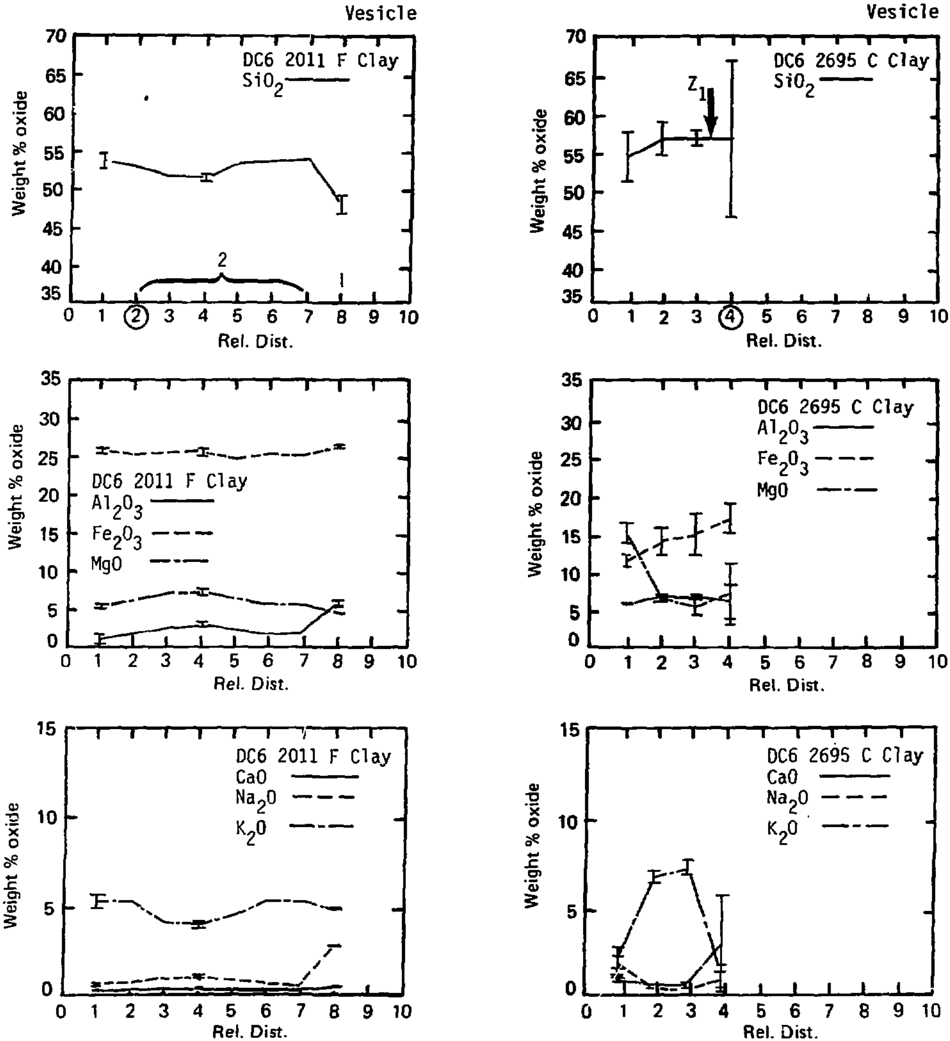
XBL 799 - 2984

Figure 58



XBL 799 - 2988

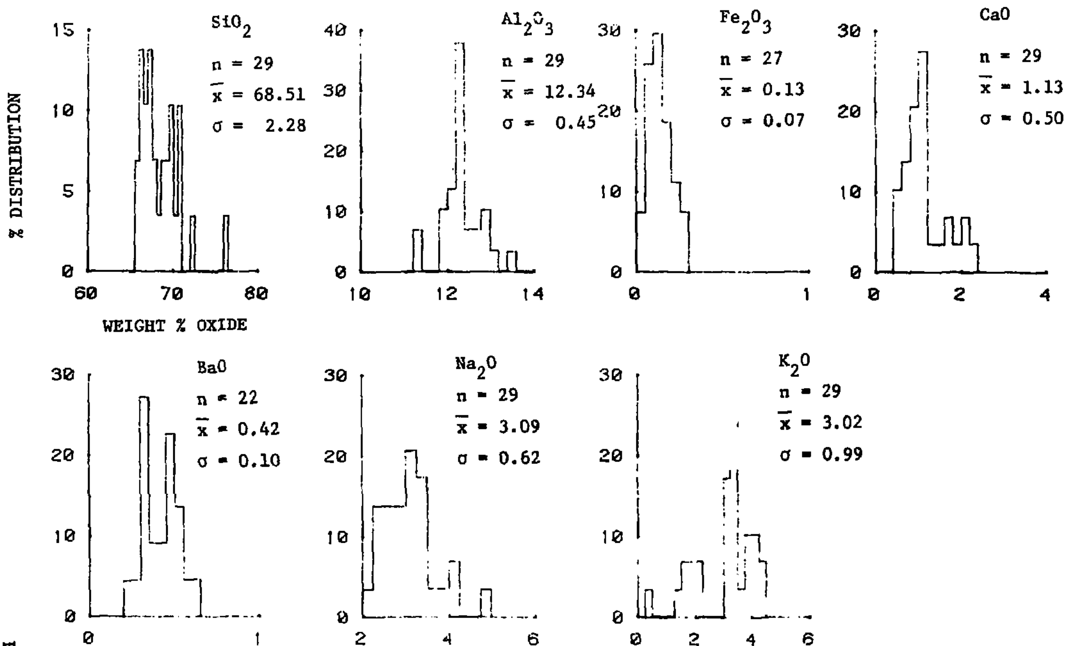
Figure 59



XBL 799 - 2985

Figure 60

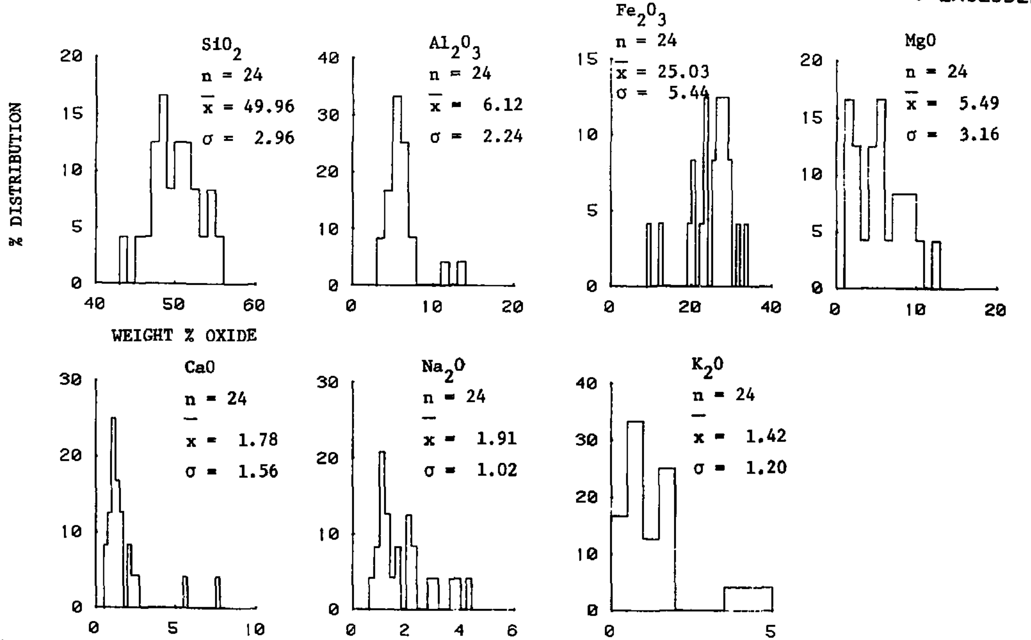
COMPOSITIONS OF FIRST AND SECOND GENERATION NONSPHERICAL ZEOLITES



XBL 798-10961

Figure 61

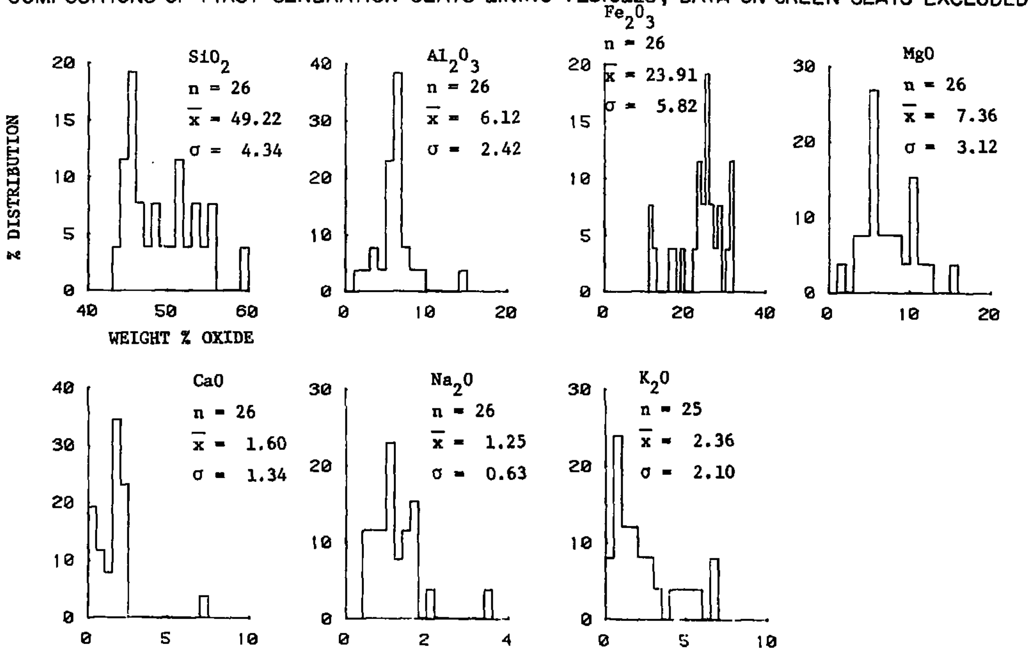
COMPOSITIONS OF FIRST GENERATION CLAYS LINING FRACTURES; DATA ON GREEN CLAYS EXCLUDED



XBL 798-10964

Figure 62

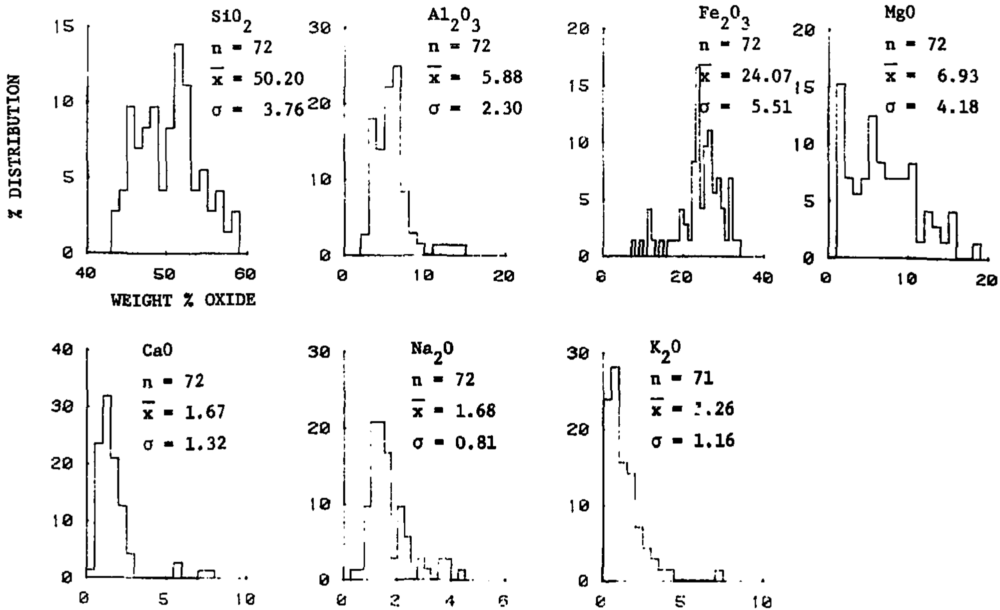
COMPOSITIONS OF FIRST GENERATION CLAYS LINING VESICLES; DATA ON GREEN CLAYS EXCLUDED



XBL 798-10965

Figure 63

COMPOSITION OF ALL CLAYS FORMED PRIOR TO DEPOSITION OF ZEOLITE OR SILICA;
DATA FOR FRACTURES AND VESICLES HAVE BEEN COMBINED
DATA ON CLAYS WITH K^+:Na^+ RATIOS ≥3 EXCLUDED



XBL 798-10966

Figure 64

PLAGIOCLASE COMPOSITIONS

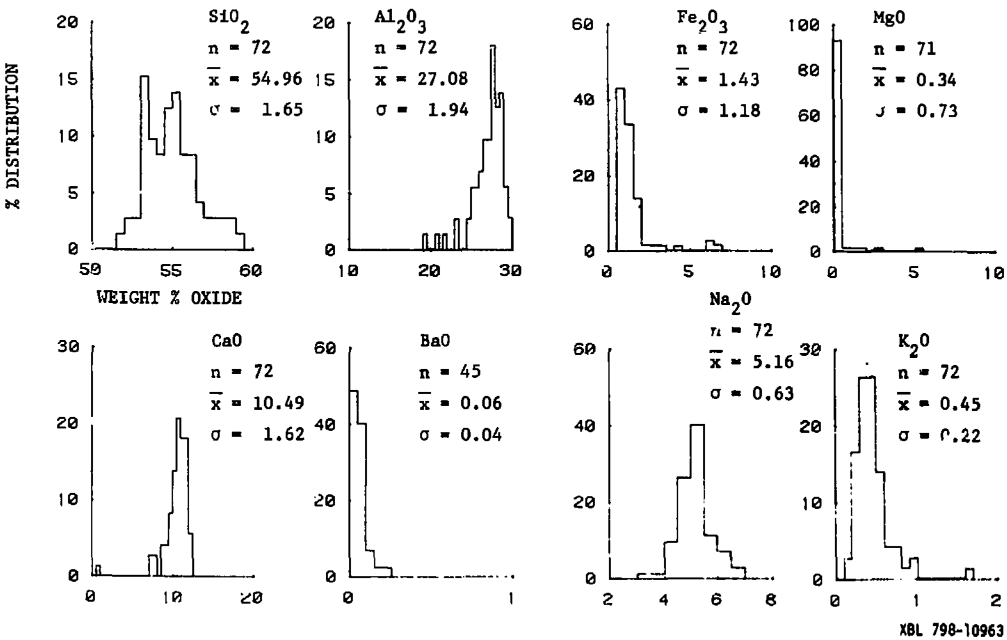


Figure 65

CLINOPYROXENE COMPOSITIONS

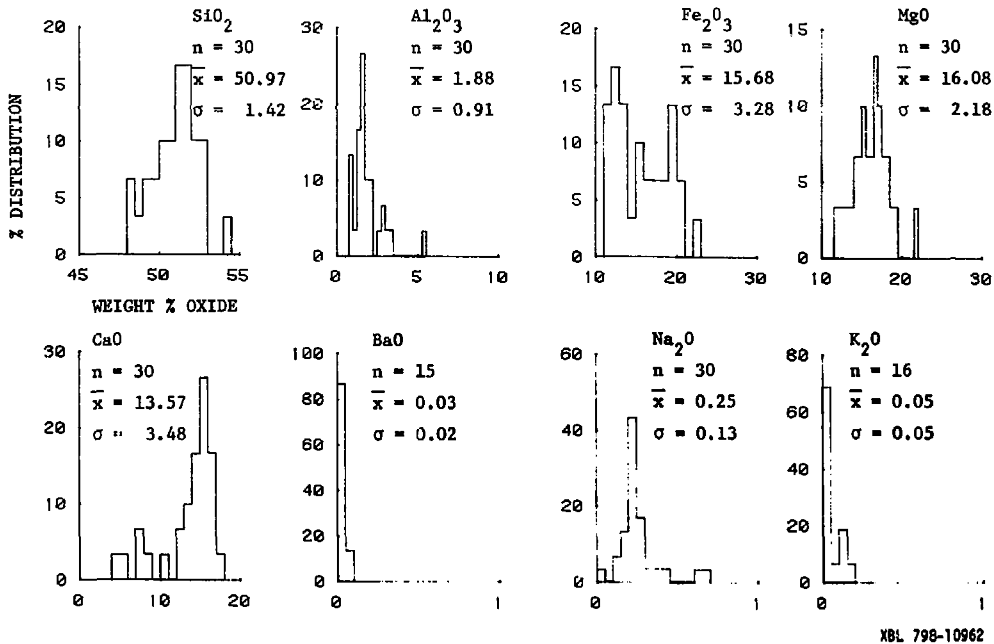
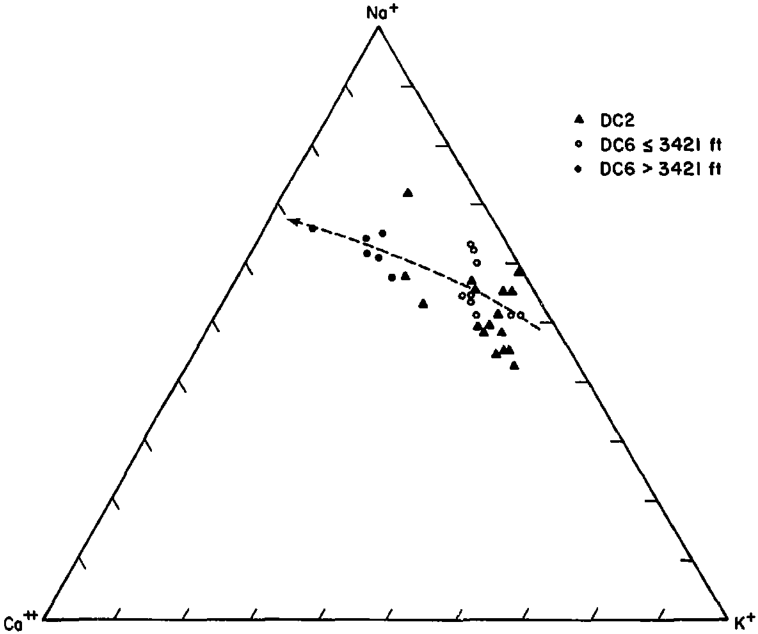


Figure 66

RELATIVE MOLAR PERCENTAGES OF EXCHANGE IONS IN DC2 and DC6



XBL 798-11423

Figure 67

ZEOLITE Si:Al MOLE RATIOS

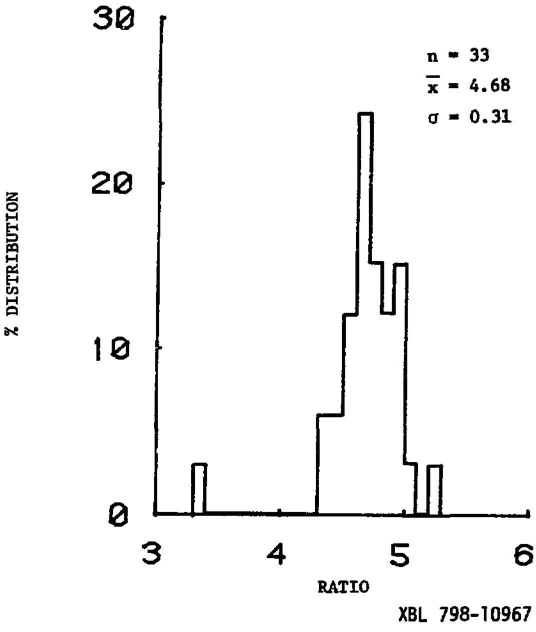


Figure 68

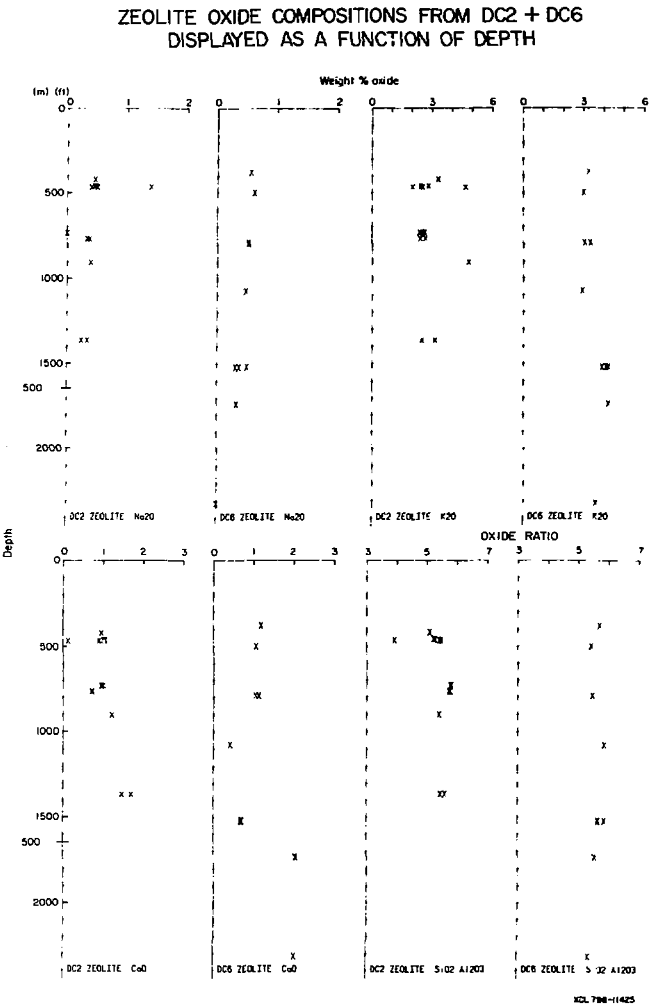

ZEOLITE OXIDE COMPOSITIONS FROM DC2 + DC6
DISPLAYED AS A FUNCTION OF DEPTH
Weight % oxide
(m) (ft)
Depth
OXIDE RATIO
DC2 ZEOLITE Na2O
DC6 ZEOLITE Na2O
DC2 ZEOLITE K2O
DC6 ZEOLITE K2O
DC2 ZEOLITE CaO
DC6 ZEOLITE CaO
DC2 ZEOLITE SiO2 Al2O3
DC6 ZEOLITE SiO2 Al2O3
XCL 798-11425

Figure 69

CLAY OXIDE COMPOSITIONS FROM DC2+DC6 DISPLAYED AS A FUNCTION OF DEPTH

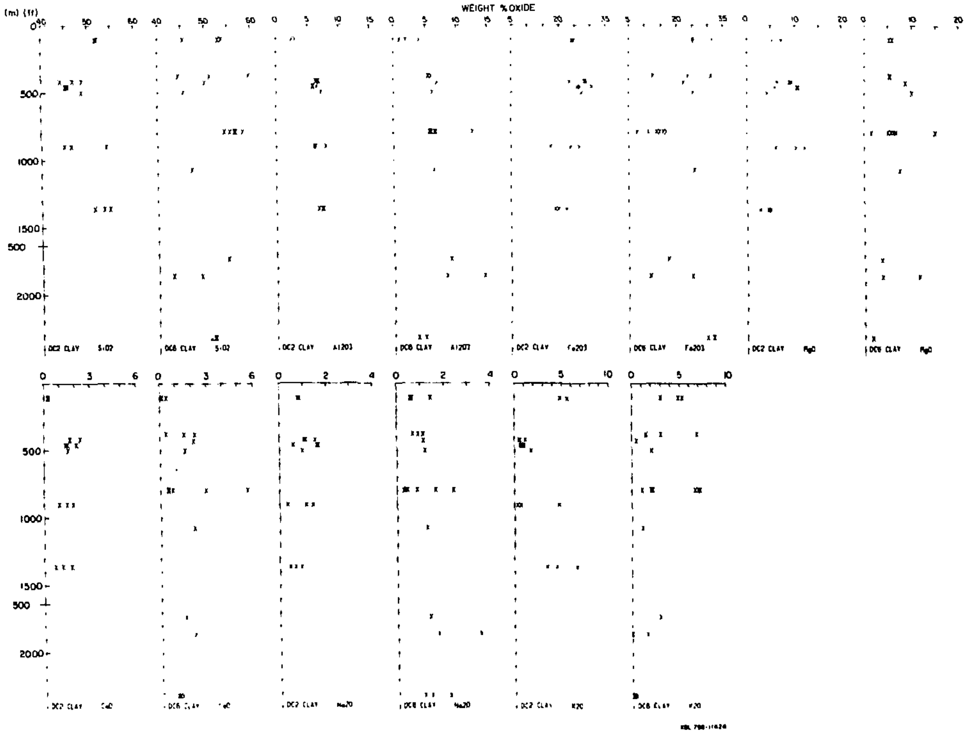
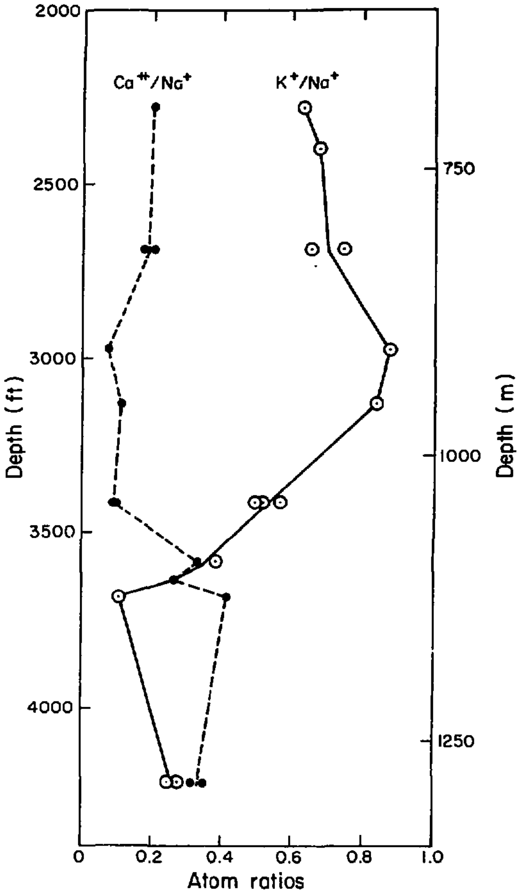


Figure 70

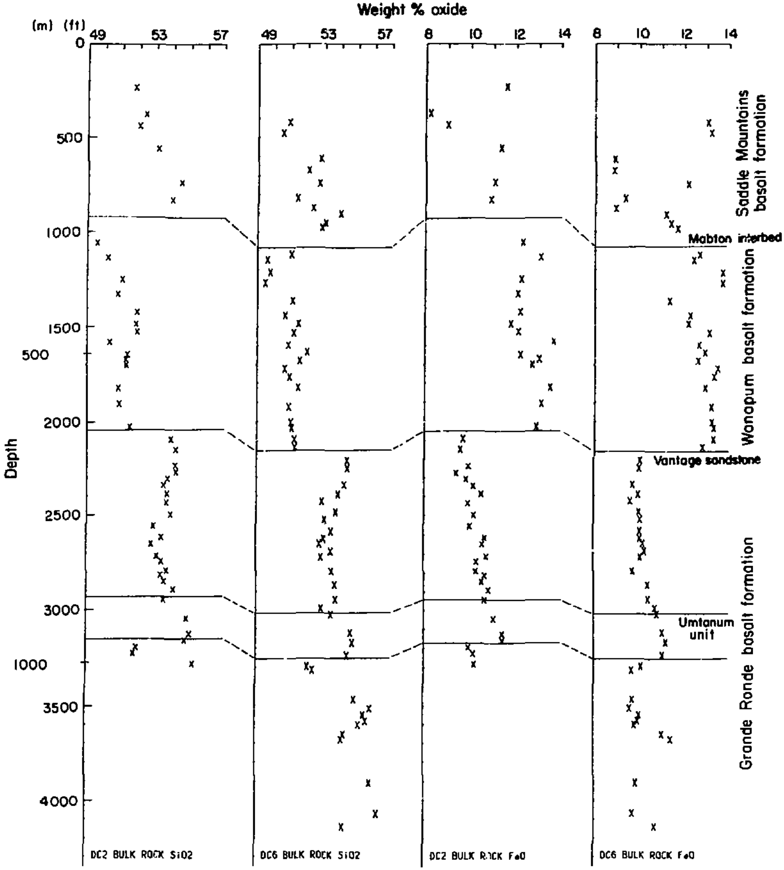
EXCHANGE ION RATIOS IN ZEOLITES OF DC6



XBL 798-11409

Figure 71

BULK ROCK OXIDE COMPOSITIONS FROM DC2 + DC6
DISPLAYED AS A FUNCTION OF DEPTH



XBL 798-11408

Figure 72