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A CO₂-SILICA GEOTHERMOMETER FOR
LOW TEMPERATURE GEOTHERMAL RESOURCE ASSESSMENT,
WITH APPLICATION TO RESOURCES IN THE SAFFORD BASIN, ARIZONA

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INTRODUCTION

GEOHERMAL STUDIES

Geothermics is the study of the earth's heat energy, it's affect on subsurface temperature distribution, it's physical and chemical sources, and it's role in dynamic geologic processes. The term, geothermometry, is applied to the determination of equilibrium temperatures of natural chemical systems, including rock, mineral, and liquid phases. An assemblage of minerals or a chemical system whose phase composition is a function of temperature and pressure can be used as a geothermometer. Thus a geothermometer is useful to determine the formation temperature of rock or the last equilibrium temperature of a flowing aqueous solution such as ground water and hydrothermal fluids.

GEOHERMOMETERS

Several types of geothermometers exist to determine temperature using analyses aqueous solutions from near-surface (upper crust) environments. They include isotope geothermometers, which are based upon temperature dependent fractionation (Craig, 1953; Lloyd, 1968; Mizutani and Rafter, 1967; McKenzie and Truesdell, 1977; and Ellis and Mahon, 1977) and chemical geothermometers. Commonly used chemical geothermometers fall into one of two categories: (1) cation geothermometers (White, 1963; Ellis and Mahon, 1967; Fournier and Truesdell, 1973; Paces, 1975; Fournier, 1979; Fournier and Potter, 1979; and Benjamin and others, 1983), and (2) silica geothermometers (Bodvarsson, 1960; Fournier and Rowe, 1966; Mahon, 1966; Truesdell, 1976; Fournier, 1973; Fournier, 1977; Fournier, 1981; Fournier and Potter, 1982; and Arnorsson and others, 1983). The subject of this research is silica geothermometers.

SILICA GEOTHERMOMETERS

Silica geothermometers exist for several geothermometry models, which have different characteristics, limits, and uses. In an ideal sense, silica geothermometers are based upon temperature dependent water solubility of various polymorphs of silica. Common low pressure polymorphs include alpha-quartz, alpha-cristobalite, and tridymite (Fronzel, 1962; and Deer, Howie, and Zussman, 1966). Alpha-quartz (hexagonal) is a relatively pure, stable form of silica and it is one of the most ubiquitous minerals of the upper crust. Several varieties of alpha-quartz exist, which are identified by color and crystalline state. The latter varieties are of importance in geothermometry due to their solubility differences in water. Crystalline forms of alpha-quartz are quartz, while "non-crystalline" forms fall into a group called chalcedony. Chalcedony is actually cryptocrystalline quartz having a fibrous microscopic texture. Agate, chert, petrified wood and flint are all chalcedony. Chalcedony is more soluble than quartz.

Alpha-cristobalite (tetragonal) is a metastable, high-temperature polymorph of silica. It may be a common constituent in volcanic rocks. Opal, normally regarded as amorphous silica, is actually a hydrous sub-microcrystalline aggregate of cristobalite. Tridymite (orthorhombic) is another metastable, high-temperature polymorph of silica. In some siliceous volcanic rocks it may be the dominant silica polymorph. Both cristobalite and tridymite contain greater impurities than alpha-quartz and they have solubilities greater than quartz and chalcedony. Opal is the most soluble silica species.

Silica geothermometry was proposed by Bodvarsson (1960), who published a rough empirical relationship describing silica concentration versus temperature from Icelandic geothermal sources. Fournier and Rowe (1966), using experimental solubility studies of quartz at the vapor pressure of solution, which were published by Kennedy (1950) and Morey and others (1962), developed a quantitative silica geothermometer assuming quartz is the equilibrium silica phase. Mahon (1966) showed that silica concentrations in New Zealand geothermal wells ($>150^{\circ}\text{C}$) were controlled by quartz equilibrium.

While quartz is the most stable silica polymorph, other varieties of silica, such as metastable chalcedony, cristobalite and opal may also control silica concentrations in water.

Fournier (1981) reviewed evidence for non-quartz control of dissolved silica. This evidence includes (1) anomalously high silica concentrations in natural waters; (2) paragenetic sequences of silica minerals in drill core from geothermal areas; and (3) experimental silica solubility studies that determined of two different silica varieties contact a solution, the more soluble one controls silica concentration. Arnorsson (1975) demonstrated that chalcedony control silica concentrations in Icelandic geothermal systems in basaltic rocks below 110°C and to 180 °C in some cases. To summarize, control of silica concentration in natural waters rests largely upon the silica phase present and upon reaction kinetics (discussed in a later section), in addition to temperature.

In order to successfully apply silica geothermometers to geothermal exploration and reservoir engineering, several models have been developed for their use. These models describe circumstances commonly found in nature. Each model has its own set of requirements, which must hold true if results of geothermometry are to be accurate and reliable. These models are:

(1) The conductive model

If a solution cools conductively (heat loss to country rock) after it leaves a reservoir where it has equilibrated with some polymorphs of silica, it does not lose or gain dissolved silica; it is not mixed with cool near-surface water, or it has not lost steam, a conductive silica geothermometer applies. Conductive silica geothermometers exist for quartz, chalcedony, cristobalite, and opal (Fournier, 1973; Fournier and others, 1974; Fournier, 1977; and Arnorsson, 1983).

(2) The adiabatic model

If a geothermal water has lost steam, the residual silica in solution increases proportional to steam loss. Therefore, the proportion of adiabatic steam loss to conductive cooling is used to correct the silica geothermometer. Adiabatic geothermometers exist for quartz and chalcedony (Fournier and others, 1977; Fournier, 1977; and Arnorsson, 1983). These geothermometers apply to near-surface boiling systems where minimal or no conductive heat loss occurs and no loss of dissolved silica occurs.

(3) Mixing models

Several mixing models exist, which may include the effect of surface boiling (single stage steam loss at a specified enthalpy). The simplest mixing model is hot

water mixed with cold water where the gross compositions of each differ, no steam loss occurs, no silica precipitates before or after mixing and no conductive heat loss occurs. Mixing model geothermometry techniques may include the use of heat, silica and chloride-balance equations, which are solved simultaneously, enthalpy-silica diagrams, and enthalpy-chloride diagrams. The latter technique may calculate enthalpy with silica geothermometers or cation geothermometers and the combined effects of mixing, boiling and conductive heat loss may be observed provided several discharges from the same reservoir are used (Fournier and Truesdell, 1974; Truesdell and Fournier, 1977; Mahon, 1975; and Fournier 1979). Before mixing models are applied the occurrence of mixing must be established. Truesdell and Fournier (1976) Fournier (1979, 1981) reviewed factors that may indicate mixing: (1) chloride concentration variations too great to be explained by steam loss in boiling (which causes increased chloride concentration); (2) systematic variation of ratios of highly soluble and conservative constituents such as Cl/B, B/Li, and Cl/Li; (3) variations in oxygen and hydrogen isotopes; (4) Cool springs with high flow rates but high geothermometer values (either silica conductive or cation geothermometers); (5) systematic variations of spring compositions and measured temperatures. Successful application of mixing models may require knowledge of chemistry and temperature of the cold mixing waters.

We propose that another model, which we call a steady-state model, has use as a geothermometer on low-temperature waters (<150°C). At these temperatures silica-reaction kinetics are slow and may have similar or lower rates than aluminosilicate-water reactions. Our study addressed the affect of CO₂ concentration on silica geothermometry and devised a method to correct CO₂ affects in order to obtain an accurate silica geothermometer for use on waters less than 100°C.

Impetus to study and develop this geothermometry model was two-fold. First, systems with reservoir temperatures less than 150 °C frequently do not realistically fit models previously developed, which were outlined in the preceeding discussion. This makes geothermometers unreliable and ambiguous to interpret. One major reason is that the silica in these waters is not from quartz or other silica polymorph forms. The dissolved silica contributions are from non-equilibrium reactions whose rates may exceed polymorph equilibrium. Second, the problem is important because the greatest number of geothermal resources have reservoir temperatures less than 150 °C. Successful demonstration and use of a steady-state geothermometry model will

aid exploration and development of the low- to moderate-temperature resources.

PREVIOUS STUDIES

Feth and others (1964) and Garrels and McKenzie (1967) showed that the reactions of dissolved carbon dioxide with primary rock minerals such as feldspars explain the chemical compositions of springs in the Sierra Nevada of California and Nevada. Dissolved silica in these low-temperature waters may be due entirely to acid attack by dissolved carbon dioxide on aluminosilicate minerals, which also releases cations to solution. Busenberg and Clemency (1976) have experimentally determined in long-term tests at standard conditions and constant pCO_2 (1 atmosphere) that silica is initially released rapidly during feldspar-water reactions. However, after several days the silica release rate was very slow and nearly constant. Studies by Rimstidt and Barnes (1980) showed that equilibration rates of silica polymorphs are extremely slow at lower temperatures. Fieser (1978) has suggested that aqueous concentrations associated with acid (pCO_2) attack of aluminosilicate minerals are controlled by "hydrodynamic or chemical steady-state mechanisms or through chemical equilibrium with a reversible metastable (aluminum silicate solid)." The foregoing studies make it abundantly clear that silica geothermometry at low temperatures (less than 80 °C) is fraught with difficulty due to reactions which introduce dissolved silica to solution from non-polymorph sources.

This study investigates silica-water reactions in low-temperature geothermal water in areas near Safford, southeastern Arizona, and derives a pCO_2 correction for conductive silica geothermometers. Use and limitations of the technique are also discussed. Data collection, interpretation approach, and basic geochemistry, as it applies to this study, are outlined. In addition, the geology, thermal regime, geohydrology, and gross geochemistry of the Safford area are reviewed. Finally, geothermal potential, as indicated by this study and previous studies is discussed.

DATA COLLECTION AND INTERPRETATION

DATA SOURCES

Data collected for this study include ground water chemical analyses, drillers' logs of water wells, geohydrologic and geologic information. Published chemical analyses were compiled from Witcher, 1981; Swanberg and others, 1977; Muller and others, 1973; Dutt and McCreary, 1970; and Hem, 1950. Additional analyses from an area near Buena Vista were obtained from a University of Arizona Master's thesis on a sub-economic mineral deposit (Yarter, 1981). Knechtel (1938) published several analyses from the area in a U.S. Geological Survey Water Supply Paper. Knechtel's data were not included in our data base because they were relatively incomplete. Unpublished chemical analyses were obtained from files of the city of Safford's engineers' office and from files of the U. S. Geological Survey, Water Resources Division, Tucson. Because available published and unpublished chemical analyses usually had no aluminum, boron, or lithium analyses and because reliability of pH and alkalinity data were generally unknown, field collection of an additional 42 chemical analyses of ground water was performed.

Drillers' logs and geohydrologic information were obtained from Knechtel, 1938; Witcher, 1982; and from files of the Arizona Department of Water Resources, Phoenix and the U. S. Geological Survey, Water Resources Division, Tucson.

FIELD WATER SAMPLING

Samples were selectively taken from flowing artesian wells except for one pumped well at Buena Vista and one surface runoff sample. Temperature, pH, and total alkalinity were carefully measured in the field in order to obtain the most accurate

values. The pH and alkalinity are critical measurements to determine pCO₂ pressure.

The pH was measured with a Corning Model 610A Expand Portable Meter equipped with a Corning 476115, KCl-AgCl Combination Glass Electrode. Calibration was done by standardizing the electrode in pH7 buffer standard. The buffer standard was temperature equilibrated to the sample temperature. This temperature was set on the pH meter temperature compensator during the calibration. The electrode was rinsed in deionized water after calibration and placed in an unfiltered volume of sample. The pH readings were taken at intervals of time until the pH meter stabilized. The stabilized pH value was recorded. Temperatures were taken with a 0.1 C graduated mercury thermometer.

After measuring temperature and pH, an electrometric titration was performed on an unfiltered 50ml pipette volume of sample. A 0.02297N standardized solution of H₂SO₄ was used for titration. Acid was added in small increments (0.1 to 0.05ml) near the CO₃ and HCO₃ end points (approximately pH 8.3 to pH 4.5, respectively). End points were determined by noting the highest ratios of pH/ ml acid. The volume of acid required to reach these end points was used to calculate alkalinity.

Two samples were prepared in the field to preserve chemistry for laboratory analysis. Both samples were filtered through a 0.45 micron Nalgene filter, using an on-line vacuum filtration system. A hand pump was used to create the vacuum. The first sample consisted of approximately 500ml of pure filtered sample. The second sample consisted of approximately 500ml of filtered sample with 5ml of 1N HCl added to preserve cations and aluminum. Both samples were placed in clean, rinsed plastic bottles. Because very high silica concentrations (> 100 ppm) were not expected, sample dilution with deionized water was not performed to prevent silica polymerization.

CHEMICAL ANALYSES

Samples were shipped in wooden boxes lined with styrofoam by bus to B. C. Laboratories in Bakersfield, California. Blue ice packages kept the box interiors cool during shipment. Analyses were performed according to APHA-AWWA-WPCF-EPA standards (American Public Health Association, 1979; Environmental Protection Agency, 1979).

Milliequivalent charge balances of lab analyses were all less

than 2 percent. Ion charge balance after speciation calculations, using field pH and alkalinity, were within three percent, except for four samples. Charge balance differences between five and seven percent occurred in three samples; 16W83 was off by 15 percent. Samples 21W83 and 40W83 are from the same well but were collected on different days. Agreement between analyses is better than 96 percent. Thus, the combined effects of sampling error, lab error and changes in discharge chemistry with time are minimal in these two samples.

DRILLERS' LOGS OF WELL LITHOLOGY

Available drillers' logs were compiled to obtain subsurface stratigraphic and structural information. Drillers' logs are difficult to interpret and they may be ambiguous because drillers they usually do not follow geologic convention or vernacular. However, in areas where distinctive lithologic units occur, drillers' logs can be interpreted with a fair degree of confidence. In many cases they provide the only available subsurface information.

Table 1 shows the systematics of drillers'-log interpretation. This method of interpretation is not perfect; but it allows consistent evaluation of the logs. It has been used successfully in the San Simon and Willcox basins (Witcher, 1981; 1982). Units with distinctive color, texture and grain size are generally noted consistently by drillers. In this area, the blue-green clay and sand and gravel descriptions fall into this recognizable category. The blue or green clay is a real unit, which is found in outcrop. Harbour (1966) and White and Smith (1965) indicated that the unit is of lacustrine origin. Witcher (1981; 1982) showed that it occurs as a lens shaped marker bed in the Safford-San Simon basins and the Willcox basin. The blue or green clay thickens toward depositional basin centers; but the blue-green clay elevation tops usually vary only slightly. Perhaps the most difficult stratigraphy to distinguish in drillers' logs is the evaporite sequences within the basins of southeastern Arizona. Geophysical logs and resistivity data are used to supplement drillers' logs when they are available. These methods are sensitive to clay and evaporite sequences (and to ground water with high TDS that is associated with these units). Drillers'-log interpretations are only guides and are not absolutely reliable by themselves. However, their usefulness should not be underestimated; that is why we used them when other information was unavailable.

DATA PROCESSING

Standard laboratory chemical analyses were used to determine the gross chemistry of ground water. These analyses are reported in terms of total analytical concentration of sodium, potassium, calcium, silica and so forth. Concentrations of individual ions and ion pairs are not reported. For instance, reported calcium concentrations are actually the sum of several ionic calcium species and uncharged complexes (ion pairs) present in the ground water:

Equation 1

In detailed studies of equilibrium and reaction kinetics the thermodynamic state or saturation level of a sample water is required. In order to know the thermodynamic state of ground water, ionic speciation requires calculation. Because of electrostatic interaction of ions in a solution, the Gibbs free energy change may be different in a real solution than in an ideal solution. Hence, it is necessary to determine effective concentration (activity) of ions in solution. Species activity is related to species concentration by an activity coefficient:

Equation 2

$$a_i = \gamma_i m_i$$

a_i is activity concentration of species i

m_i is concentration of species i

γ_i is activity coefficient of species i

In dilute solutions activity is near unity. As concentration

increases the coefficient deviates more and more from unity.

Calculation of speciation is accomplished by setting up a geochemical model involving mass balance equations similar to Equation 1. Mass action equations are then derived to describe all of the components in the mass balance equations. Using a simplified example from Equation 1, the mass action equations are:

Equation 3

$$K_1 = a_{\text{CaCO}_3^0} / a_{\text{Ca}^{++}} a_{\text{CO}_3^{--}}$$

Equation 4

$$K_2 = a_{\text{CaSO}_4^0} / a_{\text{Ca}^{++}} a_{\text{SO}_4^{--}}$$

from these equations:

Equation 5

$$m_{\text{CaCO}_3^0} = K_1 a_{\text{CO}_3^{--}} m_{\text{Ca}^{++}} y_{\text{Ca}^{++}} / y_{\text{CaCO}_3^0}$$

Equation 6

$$m_{\text{CaSO}_4^0} = K_2 a_{\text{SO}_4^{--}} m_{\text{Ca}^{++}} y_{\text{Ca}^{++}} / y_{\text{CaSO}_4^0}$$

combining equations 5, 6, and 1:

Equation 7

$$m_{\text{Ca}^{++}} = m_{\text{Ca}^{++}}(\text{analyzed}) / 1 + y_{\text{Ca}^{++}} (K_1 a_{\text{CO}_3^{--}} /$$

A set of equations similar to Equation 7 is solved simultaneously by iterative methods until a mass-charge balance is obtained.

When activities have been calculated it is possible to determine aqueous saturation with solid mineral phases. Several geochemical models and computer programs have been developed to determine speciation, activities, and mineral saturation of ground waters. Our study has employed the WATSPEC program (Wigley, 1977), which is a shortened FORTRAN IV program based upon the longer and more detailed WATEQ (Truesdell and Jones, 1974) and WATEQF (Plummer and others, 1976) programs. WATSPEC was chosen because it uses only major constituents normally analyzed in ground water. It is well documented, and it uses little computer time. Because our data did not include pH data and our study did not require trace element speciation, this program was basically tailored to our research.

WATSPEC uses an extended Debye-Huckel equation to calculate activity coefficients (Stumm and Morgan, 1970). Thermodynamic data used in WATSPEC has the same values as those used in WATEQ. Temperature adjustment of equilibrium constants is done with the Van't Hoff relationship except where analytical expressions were employed.

A DEC PDP 11 computer was used to process data through the WATSPEC program. The WATSPEC program was modified to eliminate calculation of iron and sulfur speciation. Equilibrium constants smaller than $10E-37$ for certain sulfur and iron species in a data statement caused an overflow problem. Since iron and sulfur were not critical to our study, these calculations were overridden. In addition, our data base was incomplete with respect to iron and sulfur. The program was also modified to calculate saturation indices of silica phases, using the latest analytical expressions of the temperature dependence of their respective equilibrium constants. Silica saturation indices using original equilibrium constants are still calculated and presented in output along with the new values. WATSPEC was further modified to give additional output information in a different format than the published version.

Because WATSPEC accepts chemical data in millimoles per liter, a small FORTRAN IV program, MOLAL, was written to convert parts per million concentration into millimoles per liter and make a data base with a suitable format for WATSPEC to accept.

BACKGROUND

GENERAL THERMODYNAMIC BASIS OF CHEMICAL GEOTHERMOMETRY

Chemical geothermometry is based upon two important concepts describing a chemical reaction. These concepts, chemical equilibrium and reaction kinetics, are best described in terms of energy changes that occur during a chemical reaction. As a reaction proceeds, a point is eventually reached where no net change in energy takes place. At this point a chemical system is in chemical equilibrium. The rate at which a reaction approaches equilibrium is described by reaction kinetics. When a chemical system reaches an equilibrium condition, no net change in energy occurs unless new forces are introduced. Like physical systems in a non-equilibrium condition, chemical systems undergo a spontaneous change until the energy of the system has been minimized. This minimized-energy condition or equilibrium energy is called Gibbs free energy.

Gibbs free energy is a thermodynamic parameter that is used to relate the concentrations of chemical species involved in a reaction. The driving force in a non-equilibrium or initial state that causes a system to change to a final or equilibrium state is called the Gibbs free energy change (ΔG). This parameter commonly employs units of Kcal/mole and is expressed as:

Equation 8

$$\Delta G = \Delta G(\text{final}) - \Delta G(\text{initial})$$

In terms of a chemical reaction the Gibbs free energy change may also be written as:

Equation 9

$$\Delta G = \Sigma G(\text{products}) - \Sigma G(\text{reactants})$$

The Gibbs free energy of an individual species is dependent upon temperature, pressure, and concentration. These physical conditions define a state. At standard state conditions (25 C, 1 atmosphere and 1.0 molar pure concentration or unit activity) Gibbs free energy is designated as standard free energy of formation (Gf).

Because the concentrations of the species involved in reactions in natural systems are generally different from those specified for the standard state, it is necessary to relate standard free energy of formation to Gibbs free energy change. Chemical thermodynamics predicts the following relationship:

Equation 10

$$G_x = G_f + RT \ln a_x$$

R is universal gas constant or 1.987 cal/mol K

T is absolute temperature in degrees Kelvin (K)

a_x is activity concentration of chemical species x

This relationship can be extended to include all species in a reaction in order to determine the Gibbs free energy change in a reaction. First, a general chemical reaction may be written as:

Equation 11

a,b,c,d are stoichiometric coefficients

A,B,C,D, are of species involved in the reaction

Second, by combining equations 9 and 11 an expression for the Gibbs free energy change for this reaction is obtained:

Equation 12

$$\Delta G_r = c\Delta G(C) + d\Delta G(D) - a\Delta G(A) - b\Delta G(B)$$

In order to relate Gibbs free energy change of the reaction to standard free energy of formation, equations 10 and 12 are combined and terms rearranged to give:

Equation 13

$$\Delta G_r = \Delta G_f + RT \ln \frac{(a_C)^c (a_D)^d}{(a_A)^a (a_B)^b}$$

or stated another way:

$$\Delta G_r = \Delta G_f + RT \ln Q$$

$$Q \text{ is a reaction quotient } Q = \frac{(a_C)^c (a_D)^d}{(a_A)^a (a_B)^b}$$

Because a system at equilibrium shows no net energy change, a system at equilibrium at standard state is described as follows:

Equation 14

$$\Delta G_r = 0 = \Delta G_f + RT \ln Q$$

or

$$\Delta G_f = -RT \ln K$$

K is an equilibrium constant

At equilibrium the reaction quotient (Q) equals the equilibrium constant (K). Because geothermometry by definition assumes equilibrium at some specified state, the log ratio Q/K is an important factor to predict how far a reaction has proceeded toward equilibrium and assess the geothermometer reliability in a natural system. This ratio is often referred to as I, an indices of saturation:

Equation 15

$$\log I = \log Q/K$$

I is related to Gibbs free energy change by:

Equation 16

$$\Delta G_r = 2.303 RT \log I$$

In order to use chemical geothermometry, it is necessary to relate the thermodynamic equilibrium constant (K) to temperatures and pressures other than standard state. The influence of pressure at shallow depths is minimal and will not be discussed.

Another definition of Gibbs free energy change provides a useful starting point to discuss the effects of temperature on equilibrium. Gibbs free energy change for a given chemical reaction at constant temperature is dependent upon the enthalpy change (H), the entropy change (S), and temperature as follows:

Equation 17

$$\Delta G_r = \Delta H_r - T\Delta S_r$$

ΔH_r is commonly in units kcal/mole

ΔS_r is commonly in units cal/deg mole

T is absolute temperature degrees Kelvin

The magnitude and direction of a reaction is dependent upon temperature and the respective signs of enthalpy and entropy. Because enthalpy change (ΔH_r) is a quantity of heat liberated or absorbed in a chemical reaction, enthalpy change is useful to relate the equilibrium constant (K) to temperatures other than a standard state. This is done using the Van't Hoff relationship:

Equation 18

$$\ln K_t / \ln K_s = (-\Delta H_f / R) (T_t - T_s / T_s T_t)$$

The quantity of ΔH_f is the standard enthalpy change and it is assumed to remain constant over the temperature range T_t to T_s .

Discussion up to this point relates the equilibrium constant (K) to temperatures and concentrations other than standard state conditions. It should be pointed out that this discussion of

concentration is in terms of activity concentration. The relationship between activity concentration, speciation, and measured laboratory concentration is discussed in a later section.

Clearly there are several reactions that have a theoretical potential as geothermometers. However, more is required than temperature dependence of species concentration in a reaction. For a specified reaction to have use, species in the reaction can not be involved in other reactions at faster rates. Just as important, in order that geothermometers have any meaning beyond measured surface conditions, the reaction kinetics must be slow at low temperatures. This slow reaction rate preserves the chemical species concentration after the aqueous solution at equilibrium leaves a reservoir and cools, thus allowing calculation of a reservoir temperature.

Kinetics is described by a general reaction of the form:

Equation 19

k_f and k_r are rate constants

The forward reaction rate (R_f) is described by:

Equation 20

$$R_f = k_f[A][B]$$

Brackets denote activity concentration of species A and B.

This relationship is interpreted to show that as a reaction proceeds, the activity concentrations of A and B decrease; likewise R_f , which is initially large, decreases also. The reverse rate (R_r) is described by:

Equation 21

$$R_r = k_r[C][D]$$

As the reaction in Equation 19 proceeds the activities of C and D increase, and R_r increases. When $R_f = R_r$, equilibrium is reached. This condition is described by:

Equation 22

$$K_t = k_f/k_r = [C][D]/[A][B]$$

K_t is an equilibrium constant for the reaction at temperature t

In summary, the preceeding geochemical discussion provides a general basis for understanding chemical geothermometers. Two main conclusions from this discussion are relevent to chemical geothermometry in natural aqueous systems:

(1) A reaction must have sufficient standard enthalpy change to allow an easily observed temperature dependent variation of species concentration. (2) The reaction kinetics must be faster at higher temperatures and much slower at lower temperatures for a reaction to have use as a geothermometer.

However, the main factor required for successful geothermometry is that a particular reaction must reach temperature-dependent equilibrium in a natural system. For that to happen the chemical species required for the reaction must be present, and the specified reaction must occur, not another reaction that uses the same species.

THE GEOCHEMICAL SYSTEM WITHIN BASINS IN THE SOUTHWESTERN U. S.

In order for silica and cation geothermometry to predict valid subsurface temperatures, the reactions upon which they are based must occur. At higher temperatures (greater than 100 to 150°C) alteration and mineral assemblages found in active and fossil geothermal systems are compatible with the geothermometers. Reliability of geothermometers at lower temperatures (less than 150 to 100°C) is less certain. Part of the problem deals with slower reaction kinetics at lower temperatures, and part involves the occurrence of the specified reactions necessary for valid geothermometry results. In order to address this latter problem,

the geochemical systems found in basins in the southwestern U. S. must first be characterized.

The processes of sediment diagenesis provided general information on basin geochemistry. Diagenesis has been defined by Pettijohn and others (1973) as . . . "all those processes, chemical and physical, which affect the sediment after deposition and up to the lowest grade of metamorphism, the greenschist facies." The overall trend during diagenesis is towards equilibrium, however, equilibrium is usually not reached between all minerals and contained fluids. In an ideal sense, herein lies the main difference between diagenesis and metamorphism. Generally, diagenetic mineral and alteration assemblages only approach equilibrium; whereas metamorphic and hydrothermal assemblages are sometimes interpretable in terms of the assemblage equilibrium at a specified temperature and pressure (Pettijohn and others, 1973). Factors responsible to varying degrees for this difference in overall state of chemical equilibrium are reaction kinetics, time, and fluid-flow rate.

As with hydrothermal and metamorphic processes, diagenetic processes also dramatically change the chemical composition of rocks by chemical mass transport in aqueous solutions. These chemical processes involve both dissolution and precipitation of minerals and cements. Dissolution may be congruent or incongruent. Congruent dissolution removes all components in a solid species into solution. Incongruent dissolution selectively removes a few components to change the composition of a solid. Alteration of feldspars to clay minerals is an example of incongruent dissolution. Precipitation requires that the system is open to fluid flow in order to replenish supersaturated solutions. However, with time precipitation of cements and authigenic minerals decreases permeability by filling pore spaces.

Diagenesis of basin-fill sediments in the southwest United States and northern Mexico have been discussed in detail by Walker and others (1978) and Turner (1980). Walker and others (1978) showed that four post-depositional processes affect basin-fill sediments: (1) mechanical infiltration of detrital clay into the interstitial pore spaces; (2) dissolution of primary detrital framework silicate (tectosilicate) minerals; (3) replacement of primary detrital framework silicate minerals by clay; and (4) precipitation of a wide variety of stable and metastable authigenic cementing minerals. These authors noted that these processes are "not equally important everywhere, but almost everywhere one or more of these processes significantly altered the original texture and mineral composition of the sediments." Three stages of diagenesis through time were indentified by Walker and others (1978) (Fig. 1). Stage 1 is infiltration of detrital clay; stage 2 is significant alteration of pyroxene, amphibole and calcium plagioclase; stage 3 is

Figure 1 Stages of basin-fill diagenesis

After Walker and others (1978)

complete or nearly complete loss of pyroxene, amphibole and most calcium plagioclase, while potassium feldspar and quartz may show evidence of alteration.

Alteration of primary framework silicate minerals is greatest in minerals low in the Goldich stability series (Goldich, 1938; Loughnan, 1969; Walker and others, 1978; and Turner, 1980). These minerals include plagioclase, augite and hornblende. Dissolution and replacement by clay is the common alteration mechanism.

Walker and others (1978) found that replacement of silicate minerals by clay commonly exceeds 15 percent of the sediment volume and that in most instances this clay is nearly pure montmorillonite.

Most authigenic minerals in the basin-fill sediments are extremely fine grained and normally they are very difficult to recognize without the aid of a scanning electron microscope (Walker and others, 1978). Potassium feldspar is one of the most common authigenic minerals. Detrital grains of primary potassium feldspar and plagioclase serve as hosts for overgrowths of secondary potassium feldspar. In many locations potassium feldspar crystals are important components of interstitial matrix along with infiltrated clay and authigenic montmorillonite (Walker and others, 1978).

Clinoptilolite, a high-silica zeolite, forms a common cementing material where volcanoclastic detritus occurs. Authigenic potassium feldspar and quartz are commonly associated with this zeolite (Walker and others, 1978). Sheppard and Gude (1973) described the occurrence of zeolite minerals in the Big Sandy formation in western Arizona. Authigenic zeolites are most abundant in altered vitric tuffs and tuffaceous sediments, and may show laterally or vertically zoned zeolite assemblages. Commercial zeolite deposits exist in the Safford-San Simon basin northeast of Bowie, Arizona (Eyde, 1978).

Authigenic montmorillonite is frequently observed in interstitial cavities as small crystals in addition to being a common replacement of alteration minerals (Walker and others, 1978).

Walker and others (1978) found that silica is precipitated as quartz, exhibiting two crystal forms. They stated, "We have not observed the two crystal forms occurring together, and therefore we conclude that one is not the precursor of the other. We also conclude that the two forms reflect either different concentrations of SiO_2 in the groundwaters or other differences in the interstitial chemical conditions but we do not know the nature of the differences. Both quartz forms commonly are associated with authigenic potassium feldspar." They further noted that dissolution of detrital silicate minerals precedes

precipitation of authigenic quartz.

Authigenic calcite most commonly causes induration of basin-fill sediments. Calcite is usually coarse grained and it fills interstitial voids and voids formed by dissolution of detrital minerals. Hematite is an additional authigenic mineral common to basin-fill sediments. Chlorite was not discussed by Walker and others (1978); however, Turner (1980) pointed out that it is one of the common minerals in ancient red-bed deposits.

IDENTIFICATION OF FACTORS AFFECTING THE USE OF GEOTHERMOMETERS

Studies of diagenesis in basin-fill sediments reveal that silicate minerals and aqueous solutions interact extensively. Primary detrital minerals such as amphiboles, pyroxenes, biotite, and calcium plagioclase are altered or dissolved to the greatest extent. Authigenic minerals and cements include various clay minerals, various zeolites, potassium feldspar, quartz and calcite. Thus silica dissolved in water is lost to solution by precipitation of aluminosilicates and quartz. No mention was found of other solid silica phases such as chalcedony or cristobalite having been identified as authigenic precipitates in basin-fill sediments. (Chalcedony, cristobalite, and opal have been found as primary detrital minerals where detritus from volcanic terranes comprises the basin-fill sediments.)

Chemical reactions occur and mineral phases exist in basin sediments and their fluids which are compatible with cation and silica geothermometers. But, the primary detrital minerals are not an equilibrium assemblage as shown by their dissolution and extensive alteration. As they dissolve or alter their contributions of silica and cations to solution cause supersaturation of components that are necessary to precipitate authigenic (equilibrium) minerals such as quartz and potassium feldspar, zeolites, chlorite, clays, and calcite. If the kinetics of the dissolution reactions exceed the kinetics of precipitation reactions, silica geothermometry will predict high and unrealistic reservoir temperatures. In the case of the quartz geothermometer, the rate at which dissolved silica from alteration of primary detrital framework silicate minerals is added to solution may exceed the rates of quartz and authigenic aluminosilicate precipitation to give excess dissolved aqueous silica and erroneously high reservoir temperatures.

In order to maintain dissolution, authigenic mineral precipitation, and excess dissolved silica in ground water, a

constant supply of reactive fluid is required. Ground water containing significant quantities of dissolved carbon dioxide is highly reactive with aluminosilicate minerals. The atmosphere and decay of organic material provide the sources for a constant supply of CO₂ in areas of recharging groundwater.

SITE SELECTION FOR THIS STUDY

Two areas near Safford, Arizona were selected for this study. The principal area is south of Safford at Cactus Flat-Artesia. The other is at Buena Vista northeast of Safford.

Major factors for selecting these sites included a knowledge of subsurface temperatures and an understanding of local ground-water geochemistry and the geohydrologic flow system. At Cactus Flat-Artesia these factors have been well characterized. The geochemical, geohydrologic and thermal regimes at Buena Vista are less well known. Another major factor in selecting these sites was that they meet the criteria necessary to adequately study geothermometry. These criteria include:

- (1) distinct, and confined groundwater aquifers.
- (2) relatively unmixed discharges from the aquifers.
- (3) relatively wide and predictable subsurface temperature ranges.
- (4) long term well discharge so that temperature and chemistry best reflect aquifer conditions.
- (5) adequate knowledge of subsurface geology to detail geochemistry and geohydrology.

The Cactus Flat-Artesia area, characterized by numerous thermal and non-thermal flowing artesian wells, meets these criteria very well. While the Buena Vista area has flowing wells, its geologic and geohydrologic conditions are less well known. It was studied primarily to gain more information about the geothermal potential there. Results and conclusions obtained in studies in the Cactus Flat area, therefore, have been applied to assess geothermal resources at Buena Vista.

STUDY AREAS

INTRODUCTION

The two areas investigated during this study lie within the northwest-trending Safford-San Simon basin (Fig. 2). The Cactus Flat-Artesia area straddles U. S. Highway 666 between 8 to 24 km south of Safford. The Buena Vista area encompasses a 16km area northeast of the town of Safford along the Gila River. Both areas have thermal flowing wells with temperatures varying from 35 to 50°C. At present, these waters are utilized in three mineral baths and a catfish farm in the Cactus Flat-Artesia area.

PHYSIOGRAPHY AND CLIMATE

The Cactus Flat-Artesia area is at the base of the Pinaleno Mountains (Fig. 2). Stockton, Marijilda and Graveyard washes, which discharge surface water from deep canyons in the Pinaleno Mountains, have dissected the area into a succession of mesas, fans, and arroyos. Flow occurs during winter and early spring due to snow melt at high elevations. All drainage flows north and east toward the Gila Valley.

The impressive Pinaleno Mountains rise abruptly to form a range over 3,300m in elevation, where more than 76cm/yr of precipitation falls. The Cactus Flat area lies at 900 to 1,100m elevation and receives only 20 to 25cm of precipitation annually. Because of high mean annual temperature (17 °C) and thick stands of tamarisk trees, evapotranspiration is high in this area.

The Buena Vista area is in the Gila River flood plain at an elevation of 910 to 920m. West of Buena Vista, the flood plain widens and curves northwestward south of Safford to form a

flat-bottomed valley 5 to 8km across (Fig. 2). Eastward, the flood plain narrows into the northeast-trending Gila Box, a canyon formed by the Gila River between the Gila Mountains and the Peloncillo Mountains. Paired terraces 20 to 30m high bound the flood plain. Above the terraces 5 to 20km-wide piedmonts slope gently upward toward the Gila and Peloncillo Mountains except north of Buena Vista where at least two more older ancestral Gila River terraces are found. Mean annual temperature is 17°C and precipitation is less than 25cm/yr. The Gila River is a perennial stream at this location.

HISTORICAL GEOLOGY

The crust of this region is highly anisotropic and is dominated by a west-northwest structural grain, which is superimposed on a older northeast grain (Swan, 1982; Silver, 1978). This anisotropy originated during the Precambrian. During the Mesozoic, tectonism reactivated structures to create a highland that crosses the Safford region (Coney, 1978; Turner, 1962; Elston, 1958). Major erosion, resulting from uplift, removed Paleozoic and pre-Late Cretaceous rocks to expose Precambrian basement. Late Cretaceous shales and sandstones were deposited over the Precambrian terrane (Elston, 1958). Later, Paleocene (Laramide) volcanism and plutonism was active in the area. Laramide andesitic flows and silicic stocks crop out in the Gila Mountains and are associated with economic copper mineralization (Dunn, 1978). The Eocene was an interval of erosion and local sedimentation, probably accompanying major tectonism and a break in volcanism. During this time copper mineralization was unroofed in the Gila Mountains, and Late Cretaceous shales were partially removed. Late Oligocene and early Miocene volcanism buried the area in basaltic and andesitic flows and volcanoclastic sediment up to 1km thick (Strangway and others, 1976; Richter and others, 1981). Limited silicic volcanism occurred as rhyolitic-dacitic domes and associated pyroclastic deposits in the vents and on margins of large stratovolcanoes and along major structural lineaments. No major silicic cauldrons, such as those found in southwestern New Mexico and in the Chiricahua Mountains, Arizona, have been observed in the Safford area. However, silicic mid-Tertiary plutons were emplaced in the Pinaleno Mountains (Thorman, 1981). During Miocene, crustal extension began to form the proto Basin and Range. This normal faulting was characterized in places by listric style rotation of upper crustal fault blocks, overlying low angle decollements at depth. Local sedimentation accompanied this tectonism. Low angle faults are sometimes closely related spatially and

genetically to metamorphic complexes in Arizona (Davis and Coney, 1979). The Pinaleno Mountains have been described by Davis and Coney (1979) as a metamorphic core complex. During mid to late Miocene high angle normal faulting began to create the gross structure and topography of the contemporary Basin and Range Province (Scarborough and Peirce, 1978). By the time this last stage of tectonism was well underway, volcanism had ceased. The youngest volcanic rocks in the Safford area are 16 m.y. old alkali-rich basalts in the Whitlock Mountains (Richter and others, 1981). Pliocene to Quaternary basalts are found northwest of the area on the San Carlos Indian Reservation. Major late Miocene and Pliocene sedimentation occurred in the Safford basin. A large Pliocene lake existed in the basin and through-flowing drainage of the Gila system probably did not exist prior to latest Pliocene or earliest Pleistocene (Harbour, 1966).

STRUCTURE

Figures 3 and 4 provide one interpretation of the gross structural relationships of the Safford basin. Figure 4 is a structural cross section through the Cactus Flat-Artesia area and the Buena Vista area. Structural relationships are based upon published geology, deep well drill core, drillers' logs of water wells, Bouguer gravity, and electrical resistivity information.

The Safford basin is an asymmetrical graben complex bound by a major fault zone at the base of the Pinaleno Mountains on the southwest and south. The basin is probably underlain by a series of faulted stair-step blocks, which rise upward to form the Gila Mountains on the northeast and north. Bouguer gravity profile modeling by Oppenheimer and Sumner (1981) suggests that bedrock in the basin center is buried by a least 3,050m of clastic sediments. The existence of stratigraphic unit Tso shown in Figure 4 has been inferred by us from sonic logs and three cores from the Safford A-1 wildcat exploration hole (D-9-26-16ab) drilled by Phillips Petroleum in 1982. The core and log are on file at the Arizona Oil and Gas Commission in Phoenix. All three cores are at the bottom or in the lower 610m of the hole and consist of an indurated reddish brown granite conglomerate. No volcanic clasts or metamorphic clasts were observed in the cores; therefore, we believe this unit is an Eocene to early Oligocene conglomerate (or older) and it should properly be classified as a pre-Basin and Range sediment.

Pleistocene fault scarps occur at the base of the Pinaleno Mountains (Menges and others 1982). Another Pleistocene(?) scarp occurs southeast of Buena Vista (Figure 3) (Menges and

Figure 3 Map of major structures in the Safford Basin

Figure 4 Geologic cross section of the Safford Basin

others, 1982).

Bedrock (noncontinental clastic rocks) includes mostly schist, gneiss, granite, quartzitic mylonite, andesitic to basaltic volcanic rocks and minor rhyolitic to dacitic volcanic rocks. Mineralogy of these units includes common aluminosilicate minerals, hornblende, augite, biotite, chlorite and feldspars. Volcanic minerals probably comprise olivine, chalcedony, cristobalite, zeolites and calcite. Quartz is common to all units. Rocks associated with Laramide copper mineralization also contain kaolinite, sericite, epidote, chlorite, gypsum and anhydrite.

Sediments filling the contemporary Safford basin are over 1,220m thick and they indicate several distinct depositional environments. In general, but not always, the fine-grained and evaporite sediments are found toward the basin center and away from the margins. Basin-filling units are probably most important in this study because nearly all water sampled during this study has been confined to these formations. Water in the Buena Vista area is a possible exception; it may have flowed upward from underlying bedrock.

BASIN-FILLING SEDIMENTS

Harbour (1966) divided the basin-fill into two major units, upper and lower basin fill. These units are separated by a time-stratigraphic horizon that shows a change in sedimentation processes (fluvial-lacustrine-playa to fluvial-alluvial) and by a Pliocene to Quaternary faunal transition. Harbour (1966) also divided the basin-fill sediments into facies. Because drillers' logs were used in our subsurface interpretations, we have generalized Harbour's units into three major groups. Table 1 shows the correlation of our stratigraphic units with those of Harbour and gives the systematics of drillers'-logs interpretation within our stratigraphic divisions. We used the following stratigraphic subdivisions: (1) a sand-conglomerate facies, (2) a silt-clay facies, and (3) an evaporite facies. We have divided the silt-clay facies into two sub-units: (1) a blue or green clay unit, and (2) a brown-yellow silt and clay. All of the facies intertongue.

The silt-clay facies is lacustrine (blue-green clay) and fluvial over-bank (blue-green clay, in part, and the yellow-brown silt and clay unit). The evaporite facies consists of gypsiferous clay, gypsum, anhydrite, and halite and it was

TABLE 1 - Systematics of drillers' log interpretation

Unit	Drillers' Descriptive Term	Correlation with Harbour's basin-fill units
Sand/conglomerate facies	Sand, gravel, conglomerate, honeycomb formation, caliche, sandy loam, silt gravel, cement	Basal conglomerate facies, piedmont facies, orange silt and conglomerate facies
Silt/clay facies blue clay	Blue clay, blue shale, black clay, gray clay, green clay, sticky clay, white and blue clay	Green clay facies
Silt/clay facies brown clay	Brown clay, yellow clay, mudstone, red clay, tuff, sandy clay, siltstone, gravel clay, silt and clay, sandy clay, gravel silt	Green clay facies, delta facies, red facies
Evaporite facies	Gypsum, anhydrite, evaporites, salt halite, hardlayers, hardpan	Evaporite facies

deposited in a playa environment. In a few areas the top of the silt-clay facies consists of a zone of gypsiferous, limonitic and calcareous clay. These deposits may indicate desiccation of the Pliocene lake. Air-fall ash deposits are common in the upper silt-clay facies and they are commonly zeolitized, diatomaceous, or argillic and calcareous. Harbour (1966) suggested the most common basin-fill clay mineral is montmorillonite.

Upper basin-fill consists of mostly gruslike sand with gravel lenses, except north of Buena Vista, where fine grained tuffaceous sediments are interbedded in sandy and silty sediments adjacent to the Gila Mountains.

A thin generally less than 20m-thick cobble to boulder conglomerate caps the basin-fill deposits to form Pleistocene to Recent geomorphic surfaces. These sediments are pediment caps, ancestral Gila River terrace deposits, and alluvial fan deposits. Ancestral Gila River gravels are usually well rounded dark volcanic clasts with a few well rounded red granite clasts (Morenci Granite?).

Calcite is the most common cement in upper basin fill and in degradational deposits. Harbour (1966) stated that coarse upper basin-fill units frequently show "replacement" of hornblende and plagioclase by sparry calcite. Other minerals such as quartz and orthoclase may show "corrosion" by calcite. Harbour also described two unusual forms of interstitial calcite: spherulitic cementation, and sand-calcite crystals.

CACTUS FLAT-ARTESIA SUBSURFACE GEOLOGY

We have inferred subsurface geology has been inferred from drillers' logs. Figure 5 shows the locations of cross sections in Figures 6, 7, and 8. Cross section B-B' from Swift Trail to Cactus Flat shows the blue clay unit pinching out to the south and fine grained units becoming dominate at Cactus Flat. Cross section C-C' is from Swift Trail to Artesia. The blue clay pinches out to the west and silt-clay is dominant towards Artesia. Cross section D-D' is from west to east across the Cactus Flat area. Drillers' logs were used to infer structure also, which is somewhat speculative. However, the high total dissolved solids in wells in this area could result from contact with the gypsiferous sediments (evaporites) that we have interpreted to be faulted upward in a narrow horst block in this area (also see Figure 9). This structural interpretation is based upon blue clay elevation tops and the top of the evaporite

Figure 5 Location of geologic cross sections at Cactus Flat-Artesia

Figure 6 Geologic cross section B to B' from Swift Trail to Cactus Flat

Figure 7 Geologic cross section C to C' from Swift Trail to Artesia

Figure 8 Geologic cross section D to D' at Cactus Flat

sequence as interpreted from drillers' logs, using Table 2. Figure 9 shows the blue clay elevation tops and a structural interpretation. Probably the most noteworthy feature of these cross sections is the persistent layers or lenses of sand and gravel that produce water. These zones have been interpreted as tongues of the sand-gravel facies that predominate to the south and west in the subsurface nearest the Pinaleno Mountains.

BUENA VISTA SUBSURFACE GEOLOGY

Buena Vista overlies a structural bench bound by fault zones (see Fig 3). Clastic basin-fill sediments overlie the bench, which is composed mainly of Laramide volcanic and intrusive rocks. Silt-clay and sandy clay with gravel lenses overlie sand and gravel and clay lenses (Witcher, 1981). The fine grained section is probably equivalent to the silt-clay facies, while the coarse units represent the sand-conglomerate facies. At Buena Vista the base of the silt-clay facies is 105m below the surface. This unit thins and pinches out to the northeast near the Gila River. Recent flood plain gravels less than 30m thick overlie the silt-clay facies. Well D-6-27-35cbb penetrated pre-basin-fill formations at 210m depth. Mid-Tertiary volcanic rocks and associated interbedded clastic sediments occur between 210m and 275m. At 275m an epidotized andesite containing oxidized copper mineralization has been observed, which we believe represents the Laramide volcanic sequence. Well D-7-27-2cdb encountered "red granite" at 213m. This rock may be a Laramide iron-stained and altered silicic tuff or felsic intrusive rock. Deep core drilling at the Sol copper prospect 5km southeast of Buena Vista encountered Laramide rocks between 300 and 600m of basin-fill sediments (Yarter, 1981). In the adjacent Gila Mountains, the Laramide sequence is altered and highly fractured and sheared, especially near intrusive mineralized stocks (Robinson and Cook, 1966; Dunn, 1978). Northeast-striking dike swarms, faults and fractures are common.

GEOHYDROLOGY CACTUS FLAT-ARTESIA

Figure 10 is a water-table map constructed from shallow heat-flow hole data (less than 60m) (Witcher, 1982) and from water well

TABLE 2 - Formation tops of blue clay unit at Cactus Flat-Artesia

No.	Well Location	Elevation	Top Blue Clay (Depth)	Top Blue Clay (Elevation)
1	(D-8-26) 5bbc	3,100'	148'	2,952'
2	(D-8-26) 6ccb	3,200'	115'	3,085'
3	(D-8-26) 7acc	3,170'	48'	3,122'
4	(D-8-26) 7adc ₂	3,160'	81'	3,079'
5	(D-8-26) 7hbb	3,180'	80'	3,100'
6	(D-8-26) 7bcc ₂	3,190'	40'	3,115'
7	(D-8-26) 7bda	3,180'	269'	2,911'
8	(D-8-26) 7bdb ₂	3,200'	269'	2,931'
9	(D-8-26) 8bdc	3,160'	557'	2,603'
10	(D-8-26) 17abb	3,130'	190'	2,940'
11	(D-8-26) 17bbc	3,180'	565'	2,615'
12	(D-8-26) 21cdc	3,210'	101'	3,109'
13	(D-8-26) 28dbb	3,230'	81'	3,149'
14	(D-8-26) 30aca	3,342'	60'	3,282'
15	(D-8-26) 30baa	3,350'	80'	3,270'

data (less than 100m) (U. S. Geological Survey, WRD, Tucson). Shallow unconfined ground water flows generally toward the north and north-northeast as does surface drainage. The water table gradient is about 100 feet per mile. A small ground-water depression exists at Artesia, which may result from drawdown due to heavy pumping.

Artesian wells occur in a 3-km-wide arc, which mimics the Pinaleno Mountain front. This arc is between 3 and 4km from the mountain front (Fig. 11). We believe the arcuate distribution of the artesian wells is a result of sand-conglomerate tongues in the silt-clay and evaporite facies, rather than fault-induced geohydrologic processes. The convergence of topography and hydraulic head in sand and gravel aquifers is of primary importance in allowing flow from these wells. Flow rates from the artesian wells increase systematically with depth (Fig. 12). This fact suggests that several distinct and confined aquifers exist and that hydraulic pressure also increases with depth.

Several flowing wells and pumped artesian wells discharge thermal water (>35 °C) at Buena Vista. Pumped flow rates exceed 1,000 gpm (U. S. Geological Survey, WRD, Tucson). This water is produced from sand-conglomerate facies that are confined below

Figure 9 Map showing elevation tops of the blue clay and inferred structure

Figure 10 Ground water elevation map at the Cactus Flat- Artesia area
(Water table elevation for wells less than 160 feet in depth)

Figure 11 Distribution of artesian wells in Cactus Flat-Artesia

Figure 12 Flow rate versus depth of artesian wells

the silt-clay facies, but temperatures suggest a deeper origin. Mining company wells northwest of the area, along the piedmont of the Gila Mountains, produce thermal water ($>35^{\circ}\text{C}$) that has chemistry and temperatures similar to Buena Vista wells (see Well D-6-26-35ccc in Table 6). A deep well in the basin near Safford, which was completed in the sand-conglomerate facies below the silt-clay and evaporite facies, produces brackish water with a much higher total dissolved solids than the Buena Vista waters.

THERMAL REGIME

Background heat flow for the Safford area is about 80mWm^{-2} , which is the approximate average value obtained from several deep ($>300\text{m}$) holes in the Gila Mountains (Reiter and Shearer, 1979). Surface discharge temperatures of artesian waters at Cactus Flat, excluding wells at Artesia, show a linear increase in temperature with the depth (4.5°C per 100m) (Witcher, 1979). Two artesian wells were temperature logged and showed less than 1°C temperature change from surface to bottom (Witcher, 1979). Heat flow studies (Witcher, 1982) indicate that basin-fill sediments in this area have thermal conductivities less than 1.88W/mK . Thus a 45°C/km temperature gradient is normal for a conductive heat flow of 80mWm^{-2} .

Unusually warm wells near Artesia have estimated gradients exceeding 100°C/km . A soil mercury survey and heat flow study have delineated a hidden convection system south of Artesia (Witcher, 1982). No wells penetrate this system. We have estimated that the heat flow over the top of this system exceeds 200mWm^{-2} .

Wells at Buena Vista are anomalously warm for their depths. Reiter and Shearer (1979) measured heat flow in a mineral exploration hole 5km east of Buena Vista. A value of 209mWm^{-2} was reported for the 300 to 500m depth interval; 50mWm^{-2} was reported for the 950 to $1,050\text{m}$ interval. A temperature log of this hole shows a temperature inversion below 500m , which accounts for the reported heat flow. Apparently this hole encountered a horizontal flow of thermal water (approximately 70°C) at about 600m depth. Interpretation of temperature information from this hole indicates the existence of a nearby low to moderate geothermal convection system and suggests that the thermal anomaly at Buena Vista is more extensive and hotter than is apparent from temperatures measured in thermal irrigation wells.

GEOCHEMICAL MODEL AT CACTUS FLAT-ARTESIA

Cold ($<30^{\circ}\text{C}$) ground water in the Cactus Flat area has generally sodium sulfate-bicarbonate chemistry with TDS less than 1,000 ppm. Thermal water ($>30^{\circ}\text{C}$) has sodium chloride-sulfate chemistry with TDS between 1,000 and 9,000 ppm. Witcher (1981) showed that the milliequivalent chloride-sulfate versus bicarbonate ratio has a logarithmic relation to the milliequivalent lithium concentration. This correlation suggests that thermal and nonthermal water chemistry evolves from contact with differing rocks through equilibria and (or) ion exchange processes. The silt-clay and evaporite facies provide a source for sulfate, chloride, and lithium.

Silica concentrations are frequently highest in nonthermal, sodium bicarbonate waters. Also, unusually warm waters near Artesia do not deviate from these observations and their gross chemistry trends are indistinct from other waters in the Cactus Flat-Artesia area. The following geochemical model applies in the Cactus Flat area. Meteoric water recharging aquifers near the Pinaleno Mountain front has high dissolved carbon dioxide content, which attacks aluminosilicate minerals to form sodium-bicarbonate water. As ground water flows deeper into and laterally through sand and gravel zones confined by silt-clay and

evaporite sequences, gypsum, halite, and carbonate minerals dissolve. Solution of evaporites and ion exchange with clay minerals occurs to transform the sodium bicarbonate water into sulfate-chloride water.

GEOCHEMISTRY

INTRODUCTION

The geochemical discussion presented in the following section focuses on mineral-water thermodynamic processes and how they relate to silica concentration and dissolved carbon dioxide. In a previous section the rates of chemical processes were discussed in terms of reaction kinetics from a thermodynamic standpoint. Hydrodynamic factors are equally important in overall kinetics of natural systems. Hydrodynamic factors involve the flow paths, contact time, and nature of the interface between minerals and solutions. In-depth discussion of these factors are found in Berner (1978, 1980), Freeze and Cherry (1979), Dominico (1977), and Paces (1976). In this report these factors are not discussed except where they grossly influence thermodynamic processes.

SILICA GEOCHEMISTRY

Dissolved silica solutions that become supersaturated with respect to opal are unique compared to most other inorganic solutions because silica tends to polymerize and stay in solution as colloidal particles and gels (Iler, 1979). However, at concentrations usually encountered in low temperature waters, silica occurs as a monomeric species rather than in a multimeric form. Studies by Alexander and others (1954) have shown that the colored complex, formed by silico-molybdate colorimetric measurements of aqueous silica, results from monomeric silicic acid ($\text{H}_4\text{SiO}_4^\circ$). Solid silica polymorphs dissolve in water to produce this species.

The solubility constant (K_{qtz}) for this reaction is:

Equation 23

$$K_{qtz} = a_{H_4SiO_4^0} / a_{H_2O}$$

A dilute solution of a_{H_2O} is about 1.

$$K_{qtz} = a_{H_4SiO_4^0}$$

Dissolved silicic acid dissociates at pH greater than 8 to form ionic species of dissolved silica (Stumm and Morgan, 1970; Seward, 1974). The following mass action equations describe these processes:

Equation 24

Equation 25

$$K_1 = a_{H_3SiO_4^-} a_{H^+} / a_{H_4SiO_4^0}$$

Equation 26

Equation 27

$$K_2 = a_{H_2SiO_4^{--}} + a_{H^+} / a_{H_3SiO_4^-}$$

Seward (1974) suggested that the $NaH_3SiO_4^0$ complex may be an important silica species in high pH ($pH > 8$) solutions where sodium exceeds 0.1 molar concentration. This species was not calculated in this study although some of the ground water we sampled fits Seward's criteria for its presence. Total measured silica concentrations in natural water are described by the following mass balance equation:

Equation 28

$$SiO_2(\text{measured}) = m_{H_4SiO_4^0} + m_{H_3SiO_4^-} + m_{H_2SiO_4^{--}}$$

Only the $H_4SiO_4^0$ species is used in silica geothermometry. Therefore, when reservoir pH exceeds 8.0 it may be necessary to make a pH correction to measured silica values in order to correct for dissociation. Speciation and activity calculations in the WATSPEC program automatically perform this correction. Truesdell and Jones (1974) presented an equation that is used to calculate silica speciation, but it may also be used as a pH correction for silica geothermometry. This equation was derived by combining equations 25, 27, and 28 and re-evaluating and rearranging the terms.

Equation 29

$$m_{H_4SiO_4^0} = SiO_2(\text{measured as molality}) / [1 + \gamma_{H_4SiO_4^0} (K_1 10^{\frac{pH}{2}} / \gamma_{H_3SiO_4^-} + K_1 K_2 10^{\frac{2pH}{2}} / \gamma_{H_2SiO_4^{--}})]$$

where:

γ_i = activity coefficient of species i
 m_i = molal concentration of species i

Analytical expressions that may be used to calculate K and K at any temperature are:

Equation 30

$$K_1 = -2549/T - 15.36 \times 10^{-6} T^2 \text{ (Arnorsson and others, 1982)}$$

Equation 31

$$K_2 = 5.37 - 3320/T - 20 \times 10^{-3} T \text{ (Arnorsson and others, 1982)}$$

where:

T = absolute temperature in degrees Kelvin

Constants K_1 and K_2 used in the WATSPEC program are determined using analytical expressions given by Truesdell and Jones (1974). Quartz solubilities have been measured experimentally over a wide range of temperatures and pressures in both pure water and in salt solutions. Fournier and Potter (1982) and Fournier (1983) have reviewed these experiments and provided additional experimental solubility information. Table 3 lists several analytical expressions from recent literature relating quartz solubilities to temperature.

Experimental solubilities of other polymorphic forms of silica are found in Kennedy (1950), Alexander and others (1954), Siever (1962), Krauskopf (1956), Fournier (1973), Fournier and Rowe (1977), Rimstidt and Barnes (1981), and Fournier and Marshall (1983). The empirical solubility of chalcedony based on geothermal wells in Iceland was given by Arnorsson and others (1983). Table 3 lists analytical expressions relating various silica polymorph phase solubilities to temperature.

The kinetics of silica-water reactions were reported in terms of interfacial area and water mass by Rimstidt and Barnes (1981). They reported that reverse rate (precipitation) constants of all silica phases are the same at a specified temperature. However,

TABLE 3 - Analytical expressions relating silica polymorph solubility to temperature

I. Quartz

(A) $\text{Log } K_{\text{qtz}} = 0.41 - 1309/T$ Fournier (1977)
 Arnorsson and others (1982)

(B) $\text{Log } K_{\text{qtz}} = 1.881 - 2.028 \times 10^{-3} (T) - 1560/T$
 Rimstidt and Barnes (1980)

(C) $\text{Log } K_{\text{qtz}} = A + B (\text{Log } V) + C (\text{Log } V)^2$
 Fournier and Potter (1982)

V = specific volume (inverse of density)

$A = 4.66206 + 0.0034063T + 2179.7/T -$
 $1.1292 \times 10^6/T^2 + 1.3543 \times 10^8/T^3$

$B = -0.0014180T - 806.97/T$

$C = 3.9465 \times 10^{-4}(T)$

$T = ^\circ\text{K}$

II. Chalcedony

(A) $\text{Log } K_{\text{chal}} = 0.11 - 1101/T$
 Arnorsson and others (1982)

III. Alpha-Cristobalite

(A) $\text{Log } K_{\text{crist}} = -0.0321 - 988.2/T$
 Rimstidt and Barnes (1980)

IV. Amorphous Silica (opal)

(A) $\text{Log } K_{\text{amorph}} = 0.3380 - 7.889 \times 10^{-4}(T) - 840.1/T$
 Rimstidt and Barnes (1980)

the forward rate (dissolution) constants vary depending upon the polymorphic phase present at a particular temperature. Reaction rates are faster at higher temperatures and slower at lower temperatures. One practical aspect of the Rimstidt and Barnes (1981) work is,

"Upon cooling a silica-saturated solution below the equilibrium temperature, the decreasing solubility causes increasing supersaturation, which tends to raise the precipitation rate, but the rate constants rapidly decrease, which tends to lower the precipitation rate. These competing effects cause a maximum rate of precipitation 25-50 °C below the saturation temperature. At temperatures below that of the maximum rate, silica is often quenched into solution by very slow reaction rates. Consequently, the quartz geothermometer will give the most accurate results if samples are taken from the hottest, highest flow rate, thermal springs which occur above highly fracture areas."

A parallel conclusion drawn by these authors is that due to fast reaction rates above 150 °C, quartz geothermometers work best on systems whose reservoir temperatures are below 200 °C. In systems near or above 200 °C, significant precipitation of quartz is highly probable, as the waters cool and flow through the 150 to 200 °C temperature zones on the margins of high temperature systems.

In conclusion, the congruent dissolution (and precipitation) reaction rates of silica polymorphs are very slow at low temperatures. Where very fine grained particles or crystals of the polymorphs exist, reaction rates are faster and solubilities are apparently higher.

SILICATE-WATER REACTIONS

So far discussion has shown that silica polymorphs in contact with water are sources of dissolved monomeric silicic acid. Another large group of water-mineral reactions also releases H_4SiO_4 to solution. Studies by Feth and others (1964) were among the first to dramatically detail these sources of H_4SiO_4 in low temperature water. Feth and others (1964) in studies of low temperature and thermal springs in the Sierra Nevada of

California and Nevada, demonstrated thermodynamically that reactions between silicate minerals in granitic rocks and water rich in dissolved carbon dioxide may account for the chemistry of and silica contained in Sierra Nevada springs. Follow-up studies by Garrels (1967) and Garrels and MacKenzie (1967), using a mass balance approach, showed that Sierra Nevada spring chemistry is controlled almost entirely by reactions of dissolved carbon dioxide-rich water with aluminosilicate minerals. Their studies indicate that virtually all silica dissolved in these waters was obtained from dissolution of aluminosilicate minerals. They further concluded that plagioclase reactions with carbon dioxide-rich water accounted for more than three quarters of the dissolved constituents found in spring waters that have had contact with silicic rocks in near surface environments.

A typical reaction of an aluminosilicate mineral with water is:

Equation 32

In this reaction Na^+ , HCO_3^- , and $\text{H}_4\text{SiO}_4^\circ$ are released into solution. A solid residue of kaolinite remains to conserve aluminum in a solid phase and retains a portion of silica originally contained in albite. Reactions of this kind are incongruent because not all components of albite go into solution. The equilibrium composition of water as a function of $p\text{CO}_2$ can be calculated because the charge balance, the stoichiometric relationship of Na and HCO_3^- to $\text{H}_4\text{SiO}_4^\circ$, is known and the equilibrium constant (K_{eq}) for the albite-kaolinite reaction can be estimated.

Equation 33

$$m\text{Na}^+ = m\text{HCO}_3^- \quad (\text{charge balance})$$

$$m\text{Na}^+ = m \frac{1}{2} \text{H}_4\text{SiO}_4^\circ \quad (\text{stoichiometric relationship})$$

$$\log K_{eq} \sim 4\log a\text{H}_4\text{SiO}_4^\circ - \log p\text{CO}_2$$

$$\log K_{eq} = -8.18$$

The equilibrium constant K_{eq} was estimated using standard free energy of formation values given in Drever (1983). Standard free energy values for kaolinite and albite are those of Robie and others (1978), which were tabulated by Drever (1982). Using Equation 33, the solubility of albite expressed as activity $\text{H}_4\text{SiO}_4^\circ$, is shown as a function of $p\text{CO}_2$ in Figure 13. Figure 13 shows that albite is more soluble with higher $p\text{CO}_2$. Stumm and Morgan (1970) showed that other common aluminosilicate minerals behave similarly. Instead of expressing solubilities as $\text{H}_4\text{SiO}_4^\circ$

Figure 13 Solubility of albite expressed as a function of Log $a_{H_4SiO_4}$ versus Log pCO_2 concentration

they used HCO_3^- in a manner identical to our example with albite.

Another way to study solubility of silicate minerals is with activity-activity diagrams, which define an equilibrium system. These diagrams are useful to model incongruent dissolution of aluminosilicate minerals. Figure 14 is a stability diagram for the system $\text{H}_2\text{O}-\text{NaO}-\text{Al}_2\text{O}_3-\text{SiO}_2$ at 25°C and 1 atmosphere pressure. This diagram will be used to show what happens to the composition of water as albite reacts with water and the solution reaches equilibrium or becomes stable with respect to various alteration phases. Successive small amounts of albite are hypothetically added and allowed to reach equilibrium. Helgeson (1969) discussed models of this type in detail. The first batch of albite will dissolve completely.

Equation 34

At point A the solution becomes saturated with gibbsite and the albite then alters to gibbsite.

Equation 35

Path A to B is followed as more albite alters to gibbsite and Na^+ , OH^- , and $\text{H}_4\text{SiO}_4^\circ$ enter solution. This reaction is also accompanied by a pH rise due to loss of H^+ to gibbsite. At B the solution is in equilibrium with kaolinite. However, the solution will not leave the gibbsite stability field as long as gibbsite remains in the system. Addition of more albite to the reaction causes the gibbsite to alter to kaolinite.

Equation 36

Note that no silica is released to solution. Any release of $\text{H}_4\text{SiO}_4^\circ$ is quickly consumed in the gibbsite to kaolinite conversion. Further addition of albite causes all gibbsite to be converted into kaolinite at C. Between C and D albite is converted into kaolinite and again $\text{H}_4\text{SiO}_4^\circ$ is released to solution.

Equation 37

Figure 14 Theoretical activity diagram for the system NaO-Al₂O₃-SiO₂-H₂O at 25°C and 1 atmosphere. Diagram shows predicted path or evolution of solution as albite reacts with water (after Drever, 1982).

Note that this reaction is the same as the one given in Equation 32, except CO_2 was added, OH^- was replaced by HCO_3^- , and stoichiometry was reduced by one half for all components. At D the solution is in equilibrium with Na-montmorillonite. In this case the solution evolves along D-E, as more albite is reacted, until all kaolinite in the system is converted to Na-montmorillonite. Along this path, Na^+ is released but $\text{H}_4\text{SiO}_4^\circ$ is taken from solution in the kaolinite to montmorillonite conversion. Garrels (1967) has shown that the kaolinite-montmorillonite boundary forms the compositional limit of most low temperature waters.

It is clear that not only does pCO_2 concentration effect $\text{H}_4\text{SiO}_4^\circ$ concentration of water in contact with silicate minerals, but the degree to which silicate-water reactions have taken place and the relationship of water chemistry to stability boundaries have important effects upon $\text{H}_4\text{SiO}_4^\circ$ concentrations.

Kinetics of incongruent dissolution of silicate minerals at low temperature has been studied by numerous investigators (Garrels and Howard, 1957; Wollast, 1967; Helgeson, 1971; Luce and others, 1972; Paces, 1973; Busenberg and Clemency, 1976; Holdren and Berner, 1979; Berner and Holdren, 1977; Petrovic and others, 1976; Correns, 1963; Bailey, 1976; and Wildman and others, 1968). Most of these experimenters have studied feldspar reactions.

Studies by Wollast (1967), Helgeson (1971), Paces (1973, 1978), and Busenberg and Clemency (1976) suggest that kinetics of feldspar dissolution are controlled by the formation of a surface alteration product layer. This layer apparently controls diffusion rates to the feldspar surface and (or) reversible silica and aluminum exchange with solution. The layer model explains cation and silica release to solution versus time in feldspar-dissolution experiments. Busenberg and Clemency (1976) showed four stages of alteration processes in their experiments, each with different reaction rates: (1) initial rapid release of cations and silica lasting about 1 minute; (2) a 1.5 to 100 hour release of significant amounts of cations and silica that does not correspond to any simple rate equation model; (3) release of silica and cations for up to 19 days, following a parabolic rate law; and (4) slow linear rate law release of silica and cations over a very long time span.

In other studies, Petrovic and others (1976), Berner and Holdren (1977, 1979), and Holdren and Berner (1977) argue that SEM does not conclusively show the existence of a surface layer. They also attribute the commonly observed parabolic rate law kinetics to very fine feldspar particles and crystal structure dislocations. Because surface energies of small particles and crystal dislocations are relatively high compared to ideal surfaces, greater solubility is predictable until surface energies are minimized. Drever (1982) stated:

"...although Berner and Holdren explained well the rate of dissolution of silicates, their mechanism does not directly explain the stoichiometry. In experiments of Busenberg and Clemency (1976), and in those of Luce and others (1972), cations appeared in solution at a more rapid rate than silica, implying that a silica-rich residue must exist somewhere."

Models presented by Paces (1978, 1973) may best explain the low silica release rate, compared to cations, and solid conservation of aluminum, during linear rate law release. Paces (1978, 1973) proposed that an amorphous metastable reversible aluminum silicate whose composition varies with pH controls silica concentration rather than a strictly irreversible and incongruent dissolution model, such as was previously discussed in this study using a stability diagram and albite reactions. Whether or not Paces' hypothesized metastable aluminumsilicate forms a diffusive surface layer, which controls early cation release, is apparently highly uncertain.

Other interesting results of feldspar reaction experiments are also pertinent to this study. Bailey (1976) showed that higher temperatures increase the linear rate kinetics of incongruent silicate dissolution. Results of Busenberg and Clemency (1976) indicate that the different feldspar phases have linear rate kinetics at a particular temperature and $p\text{CO}_2$, which are within an order of magnitude of one another. Finally, Paces (1973) and Wildman and others (1968) showed that incongruent solubility of silicate minerals is also a function of $p\text{CO}_2$ in natural systems.

Regardless of the exact nature of aluminum silicate dissolution, the following conclusions are evident from the literature:

- (1) Both temperature and $p\text{CO}_2$ have a significant effect on silicate mineral solubility.
- (2) pH of waters in terranes comprised of silicic rocks is buffered by dissolution of primary silicate minerals.
- (3) $\text{H}_4\text{SiO}_4^\circ$ in low temperature water in contact with silicic rocks is largely due to incongruent dissolution and possibly steady-state equilibrium with various stable and metastable alteration products such as magnesium silicates, zeolites, clay minerals, and aluminum silicates. The effect of silica polymorph control on $\text{H}_4\text{SiO}_4^\circ$ concentration may increase with higher temperature and (or) lower $p\text{CO}_2$.

CARBON DIOXIDE

The sources of dissolved carbon dioxide may be very important to our study. One source of carbon dioxide is the earth's atmosphere.

Equation 38

Henry's law states that the partial pressure (in bars) of a gas phase ($p\text{CO}_2$) in contact with a dilute water solution will be inversely related to the molality of the dissolved gas (H_2CO_3) in equilibrium with the solution by a proportionality constant ($K\text{CO}_2$).

Equation 39

$$K\text{CO}_2 = a\text{H}_2\text{CO}_3 / p\text{CO}_2$$

$\log K\text{CO}_2(25^\circ\text{C}) = -1.47$
 $\log K\text{CO}_2(40^\circ\text{C}) = -1.64$
 Drever (1982)

$K\text{CO}_2$ varies only with temperature. $p\text{CO}_2$ is used in our discussions in terms of a hypothetical gas phase, since no gas phase is actually present in subsurface aquifers, and it is related to $a\text{H}_2\text{CO}_3$ by Equation 39. Note that H_2CO_3 is carbonic acid. Average atmospheric $p\text{CO}_2$ is about $10^{-3.5}$ atmosphere partial pressure. Another source of carbon dioxide is decomposition of organic matter:

Equation 40

Very large amounts of CO_2 are produced in this manner in near-surface soil environments. The same processes can occur in the subsurface where similar reactions decompose organic material such as coal. In this study we have assumed that the subsurface chemical system is closed to the direct addition of atmospheric and organic $p\text{CO}_2$ except for recharge water, which passes from the atmosphere through a near-surface soil zone to an aquifer in the

subsurface. Calcite and dolomite precipitation are additional subsurface sources of $p\text{CO}_2$. This process is not a net gain in carbonate to the system.

Equation 41

Details of carbonate chemistry are discussed in Garrels and Christ (1965) along with common ion effects of gypsum dissolution on carbonate equilibria.

INTERPRETATION OF FIELD STUDIES

INTERPRETATION

Geochemical theories and laboratory experiments reported in the literature concerning the relations between aluminosilicate minerals and carbon dioxide rich waters were tested and applied to the chemistry of ground water collected from the Safford area.

Examination of mineral saturation indices calculated by the WATSPEC program reveals that calcite (CaCO_3), talc ($\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$), and quartz (SiO_2) are routinely saturated or supersaturated. Dolomite ($\text{CaMg}(\text{CO}_3)_2$), chalcedony (SiO_2), chlorite ($\text{Mg}_3\text{Al}_2\text{Si}_3\text{O}_{10}(\text{OH})_8$), and aragonite (CaCO_3) are sometimes supersaturated, but they are usually slightly undersaturated to saturated. Adularia (KAlSi_3O_8), albite ($\text{NaAlSi}_3\text{O}_8$), Ca-montmorillonite ($\text{Ca}_{0.167}\text{Al}_2.33\text{Si}_{3.67}\text{O}_{10}(\text{OH})_2$), and kaolinite ($\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$) are generally slightly saturated to undersaturated. Mineral equilibrium was indicated if the indices were within ± 5 percent of the mineral equilibrium constant, taken from Truesdell and Jones (1974). Minerals in equilibrium with Safford area ground water are consistent with the mineralogy of basin-fill sediments. Where aluminum concentration was below the unit of reliable quantitative analyses, indices for aluminosilicate minerals were not calculated by WATSPEC.

Since montmorillonite is a ubiquitous mineral in basin-fill sediments, ground-water chemistry was plotted on an activity-activity diagram showing the stability fields for Mg-montmorillonite, Ca-montmorillonite, and kaolinite (Fig.15). This diagram allows interpretation of various components of the ground-water chemistry with respect to mineral phases. Calcite and dolomite saturation surfaces at a particular $p\text{CO}_2$ were plotted as a function of $a\text{Ca}^{++}/a2\text{H}^+$ (Drever, 1982). The saturation surfaces of talc and sepiolite were plotted as a function of $a\text{Mg}^{++}/a2\text{H}^+$. Solubility constants for these magnesium silicates were calculated from thermodynamic data tabulated in Drever (1982).

Figure 15 Theoretical activity diagram for the system $\text{CaO-MgO-Al}_2\text{O}_3\text{-SiO}_2\text{-CO}_2\text{-H}_2\text{O}$ at 40°C , 1 atmosphere and at $\text{Log } A_{\text{H}_4\text{SiO}_4^0} = -3.54$ (diagram modified from Cole, 1983)

Most sampled ground water falls into the Mg-montmorillonite stability field. Four samples plot in the kaolinite field; the remaining samples plot in the Ca-montmorillonite field. Sample 22, which plots in the middle-left portion of the kaolinite field, is surface snow-melt flow from Marijilda Wash. This sample is representative of recharge water before it reacts with soil and near surface sediments and enters the ground-water system. As recharge water reacts with subsurface rocks it loses pCO_2 and increases in pH through loss of H^+ to silicate alteration minerals. Since talc and sepiolite are apparently saturated, they may control magnesium (and silica) concentration at pH greater than 8.5 and at lower pCO_2 ($-\log pCO_2 > 3.8$). At lower pH and higher pCO_2 concentrations, dolomite is the more stable mineral phase.

Comparison of the calcite saturation indices with total calcium concentration dramatically shows that calcite equilibrium controls total calcium concentration (Fig. 16). Nearly all samples plot within the bounds of calcite saturation. Figure 17 is a plot of dolomite saturation indices versus total magnesium concentration in parts per million. Generally, concentrations above 0.6 ppm are controlled by dolomite equilibrium. The small number of samples in apparent supersaturation with calcite are in equilibrium with dolomite. Samples that plot in the Ca-montmorillonite stability field and in the Mg-montmorillonite field above a line drawn between samples 12 and 7, are undersaturated with dolomite. Due to the low magnesium concentration in these waters, another magnesium mineral(s) is suspected to control magnesium concentration in the dolomite-undersaturated water.

Talc saturation indices were plotted against total magnesium concentration in Figure 18. Samples that were undersaturated with dolomite approach gross equilibrium with talc. Waters with magnesium concentration greater than 1.0 ppm are either in equilibrium or supersaturated with talc. Samples with magnesium concentration less than 0.6 ppm fall into two general groupings. One group approaches gross equilibrium; the other group is in a field approaching supersaturation. The latter group may actually have attained equilibrium with sepiolite. These relationships suggest that magnesium silicates control very low (< 0.6 ppm) magnesium concentrations. Magnesium silicate solubility control of dissolved magnesium and silica at high pH has been suggested by the field and laboratory studies of Klein (1974) in the San Luis basin, Colorado and by the laboratory experiments of Siffert (1962). For completeness, it should be noted that if a sepiolite equilibria phase exists, it is metastable because talc and dolomite are more stable.

Figure 19 is a plot of pCO_2 versus chalcedony saturation indices. It is generally believed by most workers that chalcedony controls silica concentration in waters below 100 C.

Figure 16 Calcite saturation indices versus total calcium concentration

Figure 17 Dolomite saturation indices versus total magnesium concentration

Figure 18 Talc saturation indices versus total magnesium concentration

Figure 19 Chalcedony saturation indices versus $-\text{Log } p \text{ CO}_2$ concentration

However, most waters sampled in this study plot outside the chalcedony saturation boundaries. Two trends are striking. Indices increase systematically above Log pCO₂ -3.5 and they decrease systematically below Log pCO₂ -3.5. Sample 39 does not plot in either field. This water is highly anomalous and its dissolved silica concentration is probably in equilibrium with chalcedony. This water has high TDS (7797 ppm), mostly sodium and chloride, and contains 10 ppm boron! The flow rate of this well is less than 0.5 gpm, about an order of magnitude lower than all other wells sampled for this study. Interestingly, the fluoride concentration in Sample 39 is the lowest analyzed in the area. Due to a low flow rate and rotten surface casing it appears that major changes in carbonate and silica chemistry have occurred due to mixing, precipitation, and shallow water-rock interactions after this water left the aquifer. The ground surface above and below this well was moist and had a salt crust.

Figure 20 is a plot of quartz saturation indices compared to pCO₂. It shows the same relationships as Figure 19. The upper surface limit of silica indices versus pCO₂ above Log pCO₂ -3.5 is better defined with the quartz indices than with the chalcedony indices. Nearly all waters plotting below Log pCO₂ -3.5 have very low magnesium concentration, are undersaturated with dolomite, and are saturated with talc. The trend in these later waters suggests precipitation of magnesium silicate after an initial dissolved-silica equilibrium with chalcedony or silica input from zeolite reactions. Water showing a systematic increase in saturation indices above Log pCO₂ -3.5 suggests a dissolved carbon dioxide reaction with aluminosilicate minerals. A steady-state equilibrium exists in these waters.

Assumptions made in these interpretations are: (1) no mixing has taken place; (2) chemistry is representative of aquifer conditions; (3) well discharge temperatures are very close to aquifer temperatures; and (4) no carbonate or pH change has occurred.

Figure 20 Quartz saturation indices versus -Log pCO₂ concentration

A CO2-CORRECTED QUARTZ GEOTHERMOMETER

Silica geothermometers are based upon experimental solubility of solid silica polymorphs at different temperatures. They were derived with plots of log silica concentration (log K) versus the inverse of absolute temperature (T). The equation is a variation of the familiar linear relationship describing a line:

Equation 42

$$1000/T = (m \log K) + b$$

where m and b are constants

We propose a correction to the silica geothermometer for ground water less than 100 C. This correction involves the use of a disequilibrium indices (I) that is determined from the relationship between quartz saturation indices and log pCO2 concentration. This factor I is subtracted from log K in the pCO2 corrected geothermometer.

Equation 43

$$1000/T = (m \log K - I) + b$$

We use an upper limit of quartz saturation indices versus log pCO2 greater than -3.50 of samples from Cactus Flat to describe I (see Figure 20). Samples which are undersaturated with dolomite and saturated with talc (open symbols) are not used to describe this limit because they may have lost dissolved silica due to precipitation of magnesium silicate minerals. Also, samples 17, 37, and 39 are not used. Samples 17 and 34 are from Buena Vista. Sample 39 is unrepresentative of aquifer conditions (see section on interpretation of field studies). The equation describing this upper limit is:

Equation 44

$$I = -0.78(-\log pCO_2) + 2.93786$$

This correction is limited to ground water with $\log pCO_2$ greater than -3.50. At lower pCO_2 concentrations traditional chalcedony and quartz geothermometers apply. The quartz geothermometer presented by Fournier (1977, 1981) is modified to obtain a pCO_2 corrected silica temperature as follows:

Equation 45

$$T^{\circ}C = (1309/5.19 - \log SiO_2 + I) - 273.15$$

where $\log SiO_2$ is in ppm silica concentration and I is determined from Equation 44

In order to successfully apply this technique, accurate field pH measurement is required. Laboratory alkalinity measurement will give accurate carbonate information if analyses are done within a few days (or a couple of weeks if the sample is kept cool). However, if calcite actively precipitates at a spring or well, field measurement of alkalinity should be performed. Scaling and travertine deposits will indicate calcite precipitation. Total alkalinity and pH are used to calculate pCO_2 concentration. These calculations are well documented in standard references (Garrels and Christ, 1967; Stumm and Morgan, 1970; and Drever, 1982).

APPLICATION OF THE NEW CO₂ CORRECTION TO THE QUARTZ GEOTHERMOMETERS AT CACTUS FLAT-ARTESIA AND BUENA VISTA

APPLICATION

A CO₂ correction to the quartz geothermometer was applied to waters having log pCO₂ greater than -3.50. This correction subtracts the non-silica polymorph dissolved fraction to allow realistic application of silica geothermometers to low temperature ground water. In other waters, with log pCO₂ less than -3.50, dissolved silica is in apparent equilibrium with chalcedony (Figure 19). Comparison of the CO₂ corrected geothermometer temperatures and the chalcedony temperatures with measured temperatures for the Cactus Flat-Artesia area shows that these geothermometers agree well with measured temperatures. This is expected because the Cactus Flat-Artesia samples are from confined aquifers.

We compared the results of a conventional resource assessment using Na-K-Ca and SiO₂ geothermometer temperatures calculated from published data with our CO₂-corrected silica geothermometer temperatures and chalcedony geothermometer temperatures calculated from water chemistry collected during this study. First, we reviewed the published water chemistry from Cactus-Artesia and Buena Vista and applied the conventional geothermometers to estimate reservoir temperatures (Table 4). Figures 21, 22, and 23 show that these geothermometers suggest a 80 to 100°C reservoir at Buena Vista and 80 to 90°C reservoir at Cactus Flat-Artesia. Second, we tabulated the silica geothermometer temperatures for water samples we collected (Table 5) and applied the CO₂ correction to those samples having log pCO₂ greater than -3.5. The correction was applicable to seven samples at Cactus Flat and five at Buena Vista.

These new values and the revised silica geothermometer maps (Figs. 24 and 25) suggest lower reservoir temperatures. A more realistic resource temperature at Buena Vista appears to be in the 50 to 70°C range, about 30 °C lower than predicted on the basis of an uncorrected silica geothermometer alone. A temperature-depth profile of a deep well 5km east of Buena Vista shows a temperature inversion at 500m (Reiter and Shearer, 1979). This profile indicates the existence of a 65 to 70°C convective geothermal system in the Buena Vista area. The CO₂-corrected

silica geothermometer temperatures for the area range between 52 and 68°C.

CONCLUSIONS

Dissolved silica concentrations in the low temperature waters are not restricted to silica polymorph solubility. Steady state processes occur that involve introduction of silica by reaction of water with aluminosilicate minerals and precipitation of magnesium silicates, clay and aluminum silicates. Zeolite-water reactions may contribute silica; however, thermodynamic data for zeolites are uncertain and their influence was not evaluated.

Non-silica polymorph contributions of dissolved silica may cause traditional silica geothermometers to give unrealistic and unreliable results. Application of a CO₂ correction to quartz geothermometers appears to give accurate reservoir temperatures of low temperature geothermal resources.

TABLE 4 - Measured and Geothermometer Temperatures,
Published Data, Cactus Flat-Artesia and Buena Vista

Location	Temp($^{\circ}$ C)	TChal($^{\circ}$ C)	TQtz($^{\circ}$ C)	TNa-K-Ca($^{\circ}$ C)
(D-8-25) 1ddd	36	31.4	63.4	81.0
12aaa	39	26.5	58.7	94.3
12aaa	39	45.0	76.6	75.7
12aaa	39	31.4	63.4	95.6
(D-8-26) 6cbb	31	25.2	57.4	61.7 *
7ab	45	31.4	63.4	83.6
7ac	37	50.5	81.7	67.8
7adc	32	20.5	53.0	85.5 *
7ba	34.5	45.0	76.6	87.4
7bb	33.5	45.6	78.0	68.0
7bbb	34	27.3	59.5	93.3
7da	41.5	45.0	76.6	86.7
7dd	42	38.6	70.4	84.8
7dda	39	28.3	60.5	87.5
7dda	39	35.1	67.0	74.5
7ddb	35	35.1	67.0	74.8
7ddb	38	36.9	68.7	73.3
8bdcc	39	18.3	50.8	92.2 *
8ca	39.4	35.1	67.0	92.5
9bc	29.4	48.1	79.4	51.9 *
9bc	38.9	31.4	63.4	60.4 *
19cdda	27	68.8	98.9	57.3
19cddb	27	56.2	87.1	61.0
19cddbc	29	53.5	84.6	66.9
19dccb	27	71.9	101.8	52.6
20cd	44	42.0	73.6	93.9
20dbcc	45	28.1	60.3	105.2
20dc	39.4	45.1	76.6	64.2
32dcc	28	45.1	76.6	82.4
33cccc	31	52.2	83.4	50.5
33ccd	34	42.0	73.6	69.4
(D-9-26) 5ab	33	45.1	76.6	66.9
5acb	33	46.6	78.0	64.3
(D-6-27) 35dddd	27	73.9	103.6	63.2 *
(D-7-27) 2aadc	36	45.1	76.6	66.2
2aca	37.5	87.2	116.0	78.6 *
2acb	38	82.1	111.3	67.9 *
2adbb	40	43.5	75.1	29.2
2add	41	85.5	114.5	73.3 *
2addcb	39	83.9	113.0	127.6 *
11bbb	43.5	87.2	116.0	75.8 *

* Mg correction applied

Figure 21 Maps showing Na-K-Ca (upper) and SiO_2 (lower) geothermometer temperatures calculated from published data for Buena Vista

Figure 22 Map showing Na-K-Ca geothermometer temperatures calculated from published data at Cactus Flat-Artesia

Figure 23 Map showing SiO₂ geothermometer temperatures calculated from published data at Cactus Flat-Artesia

Figure 24 Map showing CO₂-corrected quartz geothermometer temperatures, this study, Buena Vista

Figure 25 Map showing CO₂-corrected quartz geothermometer temperatures, this study, Cactus Flat-Artesia

TABLE 5 - Measured, SiO_2 , and pCO_2 -Corrected Geothermometer Temperatures, This Report, Cactus Flat-Artesia and Buena Vista

Location	Well No.	Temp($^{\circ}\text{C}$)	T _{Chal} ($^{\circ}\text{C}$)	T _{Qtz} ($^{\circ}\text{C}$)	T _{Qcorr} ($^{\circ}\text{C}$)
(D-8-26) 7ddba	1W83	38.6	33.3	65.3	30.8
7ddbc	2W83	34.6	33.3	65.3	
7bdab	3W83	34.3	33.3	65.3	
7bbcd	4W83	33.1	33.3	65.3	
7baac	5W83	41.4	25.2	57.4	
7adbc	6W83	29.2	15.4	48.0	
7acad	7W83	35.3	29.4	61.5	
7acad	8W83	37.8	27.3	59.5	
7adcd	9W83	33.7	31.4	63.4	
7bbbc	10W83	33.8	22.9	55.3	
12aaaa	11W83	36.0	22.9	55.3	
12aaaa	12W83	38.5	29.4	61.5	
6ccba	13W83	30.4	22.9	55.3	40.5
7adcc	15W83	31.6	12.7	45.3	54.7
(D-7-27) 2aaab	17W83	26.3	67.8	98.0	
2acda	18W83	39.4	83.0	112.1	57.8
11bbbb	19W83	48.4	85.5	114.5	71.3
11bbbb	20W83	49.2	85.5	114.5	61.7
(D-8-26) 7bdbb	21W83	39.9	35.1	67.1	5.2
(D-8-25) 27caaa	22W83	6.5	25.2	57.4	
(D-8-26) 20dbbd	23W83	35.1	31.4	63.4	
20dbcb	24W83	38.7	27.3	59.5	
20dbca	25W83	36.5	38.7	70.4	31.9
20acdb	26W83	33.7	35.1	67.1	
20acdb	27W83	38.0	42.0	73.6	
20adcc	29W83	26.5	27.3	59.5	
18abdd	30W83	37.2	42.0	73.6	
18abdc	31W83	38.9	35.1	67.1	
17abbb	32W83	39.0	33.3	65.3	
8dcaa	33W83	26.6	27.3	59.5	27.2
8dcad	34W83	25.1	38.7	70.4	36.7
7bdba	35W83	41.3	35.1	67.1	47.3
8bdcc	36W83	39.1	31.4	63.4	
(D-7-27) 2addc	37W83	40.4	93.5	121.7	65.6
(D-8-26) 18addb	38W83	41.4	35.1	67.1	43.9
7bdbb	40W83	39.9	36.9	68.8	39.5
(D-6-25) 23bbad	41W83	39.6	91.9	120.3	
36cbbb	42W83	46.1	85.5	114.5	52.6

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APPENDIX A

Drillers' Logs

Depth Interval (feet)		Depth Interval (feet)		Depth Interval (feet)	
<u>(D-6-25) 7acab</u>		med. soft sand	2119-2149	<u>(D-6-27) 35cbb</u>	
dirt rock, top soil	0-20	hard sand & shale	2149-2161	Logged 1958 by Davidson. Only core 560 to 1,000 ft. located.	
silt	20-35	U.S.G.S. analysis:		dense, well cemented	
silt w/rock	73-79	mudstone	235-850	cg w/lenses of ss &	
red clay	79-165	gypsum 70-90%	850-1650	tuff beds. Red	
		volcanic sand	1650-2160	granite is present.	
<u>(D-6-25) 34bbb</u>		<u>(D-6-26) 7cac</u>		Bedding is up to 30°	
sandy loam	1-28	gravel, sand,		from perpend. to	
gravel	28-33	pebbles, boulders	0-10	core. . . pre Plio-	
clay	33-98	unconsolidated	10-90	Pleistocene basin	
gravel	98-103	consolidated sand,		fill. May be equiv.	
clay	103-250	pebbles, boulders		to Bonita Creek cg. 560-589	
gravel	250-252	of Cretaceous &		May be equiv. to inter-	
clay	252-400	Tertiary origin	90-710	mediate series andes	
<u>(D-6-25) 36cbb</u>		Tertiary volcanics,		& basalts - early	
silty clay	40-179	red porphyry docite	710-730	Cenozoic. 689-893	
soft clay	179-209	Tuffaceous cg (frogs		epidotized andesite	
hard clay	209-235	of andes enclosed in		Cretaceous, prop.	
sticky clay	235-292	rh matrix)	730-1060	equiv. to Silverbell	
clay	292-440	Porphyry docite? light		cg of Tucson 893-TD	
sticky clay	440-507	yel-brn, soft	1060-1100	-----	
hard clay	507-522	Pink, soft,		cg	
sticky clay	522-570	non-porphyratic	1100-1110	560-566	
clay	570-715	<u>(D-6-26) 8abb</u>		white tuff	
clay w/streaks		gravel	0-450	566-568	
of shale	715-754	Tertiary volcanic		mudstone 30°	
soft sandy clay	754-770	(tuff agglomerate)	450-525	568-581	
hard clay	770-881	andesite porphyry	525-540	sandstone	
shale	881-897	dacite porphyry	540-618	581-588	
clay	897-911	rhyolite tuff	620-630	siltstone	
clay w/streaks		cg	630-690	588-601.7	
of sand	911-1012	andesite	690-745	red granite	
sandy shale	1012-1044	rhyolite Tuff cg	745-820	4" cobble	
shale w/streaks		rhyolite	820-840	601.8	
of gravel	1044-1106	cg - rhyolite tuff	840-925	cg grit	
hard cemented sand	1106-1111	andesite	925-960	601.8-616	
sandy shale	1111-1198	cg - rhyolite tuff	960-965	siltstone & mudstone	
sandy shale w/streaks		alt. tuff & andesite	965-1075	616-625	
of cemented sand	1198-1389	gray andesite	1075-1100	sandstone (red gr)	
cemented sand		<u>(D-6-26) 8ccd</u>		625-658	
w/streaks of gravel	1389-1510	gravel		cg	
hard clay & shale	1510-1561	0-580		658-689	
sand & gravel		<u>(D-6-26) 8bbb</u>		siltstone to ss	
w/streaks of clay	1561-1654	gravel		689-692	
coarse gravel		0-700		cg	
w/streaks of clay	1654-1761	Tertiary volcanic		692-754	
hard sandy shale		(dacite? prop.)		mudstone	
w/streaks of sand	1761-1812	perlitic tuff		754-756	
hard sandy shale	1812-1835	tuffaceous cg;		flow breccias or cg	
cemented sand	1835-1918	rh matrix		756-761	
soft break	1918-1922	<u>(D-6-27) 02abd</u>		andesite	
hard sandy shale	1922-1927	soil		761-893	
soft break	1927-1935	0-10		andesite & basalt	
hard sandy shale	1935-1938	malpais		893-1000	
soft break		(cavern at 400 ft.)		<u>(D-6-26) 35aaa</u>	
"lost some mud"	1938-1945	On outcrop of younger vols.		gravel	
hard sandy shale	1945-1961	<u>(D-6-27) 13cc</u>		0-119	
sandy shale	1961-1985	basalt		clay	
loose sand & gravel		0-200		119-896	
"lost some mud"	1985-1996	<u>(D-6-27) 30b</u>		gravel	
hard sand	1996-2001	top fill & boulders		896-1112	
fine sand w/streaks		0-90		gravel	
of shale	2001-2025	red & blue clay		1112-1167	
hard sand plus shale	2025-2037	black mud "in cavity"		bedrock	
fine sand w/streaks		0-200		1167	
of shale	2037-2042	<u>(D-6-27) 03 ccd</u>		<u>(D-6-27) 36ccc</u>	
hard sand & shale	2042-2048	conglomerate		0-15	
loose gravel		0-2015		gravel & caliche,	
"lost some mud"	2048-2052	"just reached basalt"		alternating in beds	
hard sand	2052-2060	"N40°W trending fault just NE		3' apart	
med. soft sand		of hole - down drop to SW"		15-250	
w/some shale	2060-2119			<u>(D-6-27) dbdz dbdc</u>	

	Depth Interval (feet)
<u>(D-6-28) 31dba</u>	
top soil	1-4
clay, gravel	4-36
boulders	36-45
clay & gravel	45-116
cg	116-280
sandy clay	280-294
rocks & clay	294-400

<u>(D-7-25) 07ccc</u>	
sandy loam	0-25
red blue clay	25-250
blue, gray clay	250-975
fine, sandy, honeycomb clay	975-980
clay	980-1100

<u>(D-7-25) 22ddd</u>	
silt, sand-calcareous	0-18
sand w/some siltstone	18-60
siltstone, grey to brown & calcareous	60-500
siltstone (described by driller as "sticky clay") grey to brown	500-730
silty clay, calcareous	730-800
siltstone, limey brown (driller reports it sticky)	800-981
siltstone - brown to grey calcareous.	
Some thin hard layers from 1270-1360 ft.	981-1465
Siltstone w. some hard layers. Mostly grey in color	1465-1705
Greyish siltstone	1705-1780
Siltstone w/minor qty. (gyp?) fragments	1780-1828
"Hard rock" probably gypsum bed in silts	1828-1935
Siltstone, brownish calcareous w/some interbedded gypsum.	
Temp. up to 100°F	1835-1988
Siltstone-brown cal- careous; light grey fragments	1988-2160
Siltstone - brown, light grey fragments.	
Temp. 2181 92°	
2220 98°	
2260 99°	2160-2282
Siltstone - brown w/lighter fragments.	
Calcareous	
Temp. 2320 96°	
2380 98°	
2420 100°	2282-2422
Hard layer - considerable gypsum in grey siltstone	
calcareous	2422-2483
Brown & grey siltstone, calcareous	2483-2515
Probably bedrock potash granite	2515-2535

<u>(D-7-25) 26 cbc₂</u>	
Sand, few gravels, some gypsum (blue- grey)	0-45
Sand, few gravels, no gypsum (blue-grey)	45-119
Fine to coarse sand	119-397
Sand, few gravel	397-668
Grey sand, rare gravel	668-1499

<u>(D-7-25) 27 dad₃</u>	
?	0-130
Grey vol. sand, gravel, few pebbles	130-230
Sticky brown clay, vol. sand & gravel; few granite fragments	230-310
Very fine to coarse sand w/gypsum fragments	310-446
Gypsum	446-1206
Very fine to coarse volcanic sand	1206-1396

<u>(D-7-25) 27 dcc</u>	
Sand or sandy gravels interbedded w/silt or V.F. sand	0-10
Sand w/interbedded silt. Enters tuff bed near 20 ft.	10-20
Tuff	20-30
Silts & silty tuffs w/interbedded or dis- seminated sands	30-40
Bedded sands	40-50
Silts & silty tuffs	50-60
Sand w/disseminated clay or clay seams	60-70
Silts & micaceous tuffs w/stringers of sand & pebbles	70-80
Clayed sands & silts	80-90
Clayey silt	90-110
Fine silty sand	110-120
Silty & clayey sand	120-140
Sandy mudstone or clayey sand	140-150
Clayey sand or silt	150-170
Silty sand w/some clay	170-180
Clayey siltstone	180-185
Silty sand	185-190
V.F. sand w/disse- minated silt or silt layers	190-200
Clayey silt	200-210
Silty clay	210-230
Interbedded silty sands & clays	230-240
Clayey siltstone	240-320
Calcareous siltstone	320-330

<u>(D-7-26) 4 cad</u>	
Boulders & sand	1-70
Blue clay	70-250
<u>(D-7-26) 07 cbd</u>	
Clay & gravel	0-57
Water	57-60
Clay & gravel	57-90
"Full amt. of water"	80
"Dry clay"	90-303

<u>(D-7-26) 17 baa</u>	
Soil	0-8
Gravel & boulders	8-90
Blue & yellow clay; streaks of gypsum & strata of hard rock (800 to 895 ft.)	90-895
Blue clay	90-190
Yellow clay	190-260

Blue clay	260-300
Yellow stratified clay	300-700
Yellow clay w/ streaks of clay	700-800
Yellow clay w/ strata of hard rock	800-895

<u>(D-7-26) 19aa</u>	
Yellow brown sand	0-60
Gravel predom w/ some sand	60-80
Brown sand, some gypsum; much silt- stone, some gravel	80-260
Pinkish brown sand; little gravel, much siltstone	260-400

<u>(D-7-26) 26aba</u>	
Grey & brown clay & silt	0-1910
Siltstone & mdstn.	1910-2262

<u>(D-7-26) 31cda</u>	
Top soil	0-1
Sand & rock	1-7
Fractured rock	7-23
Tan clay	23-52
Clay w/mixed grvl.	52-70
Gravel & water	70-82
Clay	82-98
Gravel & water	98-105
Hard red clay	105-115
Wash gravel & water	115-120
Clay	120-153
Gravel & water	153-170
Clay	170-180
Blue clay	180-190

Perforations	130-180
Gravel	110-190
Grouted	20-110

<u>(D-7-27) 1bbg</u>	
Gravel	0-15
Gravel & caliche in alternating 3' layers	15-250

<u>(D-7-27) 02aaa₂</u>	
Pediment cap	0-18
Green clay	18-212
Basal cg	212-400

Artesian-water rose to
18' depth

<u>(D-7-27) 02aab₂</u>	
Brown sand & dirt	0-16
Boulders	16-24
Yellow clay	24-125
Gravel	125-180
Clay	180-190
Gravel, cg	190-330
Yellow clay	330-350
Cg	350-500

(D-7-27) 02aca2

Top soil	0-10
Boulders	10-25

(D-7-27) 2cbb

Top soil	0-8
Sand, dry & gravel	8-16
Gravel, water	16-46
Rock & clay	46-66
Boulders	66-70
Clay	70-117
Sand	117-124
Clay	124-131
Sand	131-138
Clay	138-144
Gravel	144-149
Clay	149-158
Sand	158-167
Clay	167-175
Sand	175-179
Clay	179-186
Gravel	186-191
Clay	191-238
Gravel	238-247
Clay	247-278
Gravel	278-287
Clay	287-291
Clay - sandy	291-297
Sand	297-304
Clay	304-323
Gravel	323-331
Clay	331-338
Gravel	338-341
Clay	341-349
Gravel	349-360
Clay	360-374
Gravel & clay	374-387
Gravel	387-435

(D-7-27) 02acd

Top soil	0-8
Gravel	8-15
Green clay	15-262
Basal cg	262-400

(D-7-27) 2cdb

Surface soil	0-16
Boulders	16-48
Yellow clay	48-130
Gravel	130-142
Yellow clay	142-158
Gravel	158-172
Yellow gravel	172-197
Gravel	197-215
Yellow clay	215-222
Gravel	222-237
Clay	237-248
Gravel	248-255
Clay	255-260
Cg	260-301
Yellow clay	301-307
Water/gravel	307-415
Yellow clay	415-418
Water/gravel	418-502
Yellow gravel	502-508
Water/gravel	508-535
Yellow clay	535-538
Sand & boulders	538-560
Yellow clay	560-566
Water/gravel & sand	566-700
Bedrock - red granite	700-702

Depth Interval
(feet)

(D-7-27) 2dbb

Water - loam	0-14
Gravel/rock	14-35
Rock & clay	35-45
Clay	45-55
Clay & gravel	55-75
Water/gravel	75-76
(water came up to within 6' of top)	
Clay	76-130
Gravel	105-112
Clay	112-142
Gravel	142-148
Clay	148-155
Gravel	155-160
Clay	160-166
Gravel	166-169
Clay	169-180
Gravel	180-187
Clay	187-193
Gravel	193-198
Clay	198-210
Gravel	210-232
Clay	232-238
Gravel	238-257
Clay	257-268
Gravel	268-276
Clay	276-282
Gravel	282-287
Clay	287-291
Gravel	291-297
Clay	297-308
Gravel	308-315
Clay	315-322
Gravel	322-327
Clay	327-334
Gravel	334-342
Clay	342-348
Gravel (flowing water)	348-356
Clay	356-364
Gravel	364-373
Clay	373-381
Gravel	381-433

(D-7-27) 2dbc

Native top soil	0-15
Sand & gravel & water-bearing sand	15-75
Rock & gravel	75-125
Rock & gravel	125-250

(D-7-27) 11bbb

Boulders	0-18
Clay	18-42
Sand & water	42-46
Alternate beds of sand & clay	46-110
Gravel	110-112
Alt. sand & clay	112-129
Sandy clay	129-145
Alt. sand & clay	145-302
Sandy clay	302-339
Clay	339-344
Water/gravel	344-356
Clay	356-361
Sand & gravel	361-398
Alt. sand & clay	398-420
Coarse sand	420-435

Depth Interval
(feet)

(D-8-26) 01aab

Sandstone	0-2
Red clay	2-10
Sand & SS hard	10-53
Sand & water	53-60
Clay	60-68
Sand & water	68-72
Red clay	72-80
Sand & water	80-93
Sand & sm gravel	93-105
River rock & water	105-115
Sand & water	115-135
Blue clay	135-145

Perforations	105-145
Gravel	100-145
Grouted	1-100

(D-8-26) 5bbc

Top soil	0-26
Brown clay & SS	26-29
Clay & sand	29-37
Brown clay	37-87
Clay & sand	87-91
Brown clay	91-103
Gravel	103-119
Brown clay	119-130
Gravel	130-145
Brown clay	145-148
Blue clay	148-204

(D-8-26) 5ccd

Fill	0-30
Brown clay	30-47
Water/sand	47-48
Red clay	48-65
Brown clay	65-70
Dark brown clay	70-82
Light brown clay	82-88
Red clay	88-95
Water/gravel	95-106

(D-8-26) 6abc

Sandy loam	0-36
Sand	36-39
Sandy clay alt. w/ water/gravel in about 5' beds	39-206
Clay	206-210
Sand	210-214
Sandy clay	214-220
Clay	220-224
Sandy clay	224-234
Hard sand	234-235
Water sand & gravel	235-237

(D-8-26) 6cbc

Flowing 10 gpm	3-60
Flowing	7-60
Flowing - very small amount	11-60
Water @ 95'; 256'; 403'; 455'; 500'; 525'; 624' & 642'	
Sandy silt	0-10
Silty sand w/interbedded thin siltstone	10-19
Interbedded siltstone & sands	19-29

Depth Interval (feet)	Depth Interval (feet)	Depth Interval (feet)
<u>(D-8-26) 6cbc - continued</u>	<u>(D-8-26) 7adc</u>	<u>(D-8-26) 7bdb₂</u>
Siltstone w/interb. silty sands 29-42	Siltstone-clay streaks 0-82	SS Clay 0-130
Siltstone w/interb. silty sands 42-52	Clay 82-217	Water 130-132
Interbed siltstone w/ sand. Siltstone predominate 52-85	Water at all depth measurements 217-314	Clay SS 132-265
Interbed sand & siltstn. 85-96	Vary between 6" to 4' 314-337	Water 265-269
Limey sand 96-107	Water in honeycomb formation 485-530	Blue clay 269-356
Limey silty sand 107-117	U.S.G.S. well depth 545'	Water 356-357
Limey sandy silt 117-128		Clay 357-642
Limey siltstone 128-139	<u>(D-8-26) 7adc₂</u>	Clay Hard Pans 642-760
Limey siltstone, somewhat sandy 139-172	Sandstone, clay 0-80	Water 760-764
Limey siltstone w/ interbed gypsum 172-218	Water 80-82	Clay Hard Pans 764-1010
Limey siltstone, some dissem. sand 218-229	Blue s.s. clay 82-187	Water Hard Pans 1010-1032
Interbed siltstone & sand, Limey 229-239	Water 187-190	Hard Pans Clay 1032-1150
Interbed sands & limey siltstone 239-250	Hardpan, clay 190-314	Water 1150-1160
Limey fine sand occas. grading to silt 250-261	Water 314-316	Clay 1160-1265
Limey silt & fine sand 261-271	Clay 316-385	Water 1265-1310
Limey siltstone (gypsiferous?) 271-282	Hardpan 385-389	Clay Hard Pans 1310-1500
Limey siltstone 282-349	Water 389-394	Water 1500-1518
Sand w/interbed siltstone 349-383	Brown clay, hardpan 394-647	
Sand 383-414	Water 647-660	<u>(D-8-26) 7ccc</u>
Siltstone w/interbed sands 414-447	Brown clay 660-668	Rocks, gravel, blue & red clay 478-508
Siltstone 447-458		
Sand w/interbed siltstone 458-469	<u>(D-8-26) 7bbb</u>	
Sand 469-491	Clay 0-20	
Siltstone w/interbed sands 491-523	Clay & sand 20-60	
Sand w/interbed siltstone 523-545	Clay, sand & gravel 60-80	
Siltstone w/interbed sand 545-589	Blue clay 80-270	
Interbed sand & silt 589-651	Clay, sand 270-310	
	<u>(D-8-26) 7bcc</u>	
	Sandstone, clay 135	
	Water at all depths 228-271	
	Measurements vary from 8" to 12' 290-430	
	<u>(D-8-26) 7bcc₂</u>	
	Fill 0-16	
	Sand & water 16-40	
	Blue clay 40-47	
	Red clay 47-81	
	Sand water seep 81-92	
	Blue clay 92-109	
	Sand water seep 109-110	
	Blue clay 110-127	
	Sand water 127-128½	
	Blue clay 128½-132	
	<u>(D-8-26) 7bda</u>	
	SS & clay 0-130	
	Water 130-132	
	Clay, SS streaks 132-265	
	Water 265-269	
	Blue clay 269-356	
	Water 356-357	
	Clay 357-642	
	Clay, hard pans 642-760	
	Water 760-764	
	Clay, hard pans 764-1010	
	Water btwn hard pans 1010-1032	
	Hard pans, clay 1032-1150	
	Water 1150-1160	
	Clay 1160-1265	
	Water Honeycomb fm 1265-1310	
		<u>(D-8-26) 8adc₁</u>
		Samples to Bur. of Mines
		<u>(D-8-26) 8adc₂</u>
		Samples to Bur. of Mines
		<u>(D-8-26) 8bdc</u>
		Sand & sml gravel 19-166
		Some fine sand, silt, clay (mud) 166-392
		Silt gravel 392-557
		Silt & clay (mud) grey-green 557-1098
		Mostly silt & clay 1098-1399
<u>(D-8-26) 6ccb</u>		
Sandstone & clay 0-115		
Blue white clay & silt- stone, red clay & siltstone 115-256		
started flowing 624-655		
<u>(D-8-26) 7acc</u>		
Top sandy soil 0-20		
Sand-water (sealed off) 20-28		
Brown clay 28-42		
Blue sand - blue clay 42-48		
Blue clay - all water sealed off to this depth 48-85		
Blue clay 85-145		
Blue sand - gravel water 145-148		
Blue clay 148-160		
Blue sand 160-162		
Blue clay 162-197		
Blue sand 197-198		
Brown clay 198-200		

Depth Interval (feet)	Depth Interval (feet)	Depth Interval (feet)
<u>(D-8-26) 8cdd</u>	<u>(D-8-26) 21cdc</u>	
Sandstone, clay, rocks 0-301	Fill or overburden 0-51	Sandy clay 141-182
Water 301-303	Red clay 51-97	Sand & water 182-184
SS (clay streaks) 303-365	Dry sand 97-101	Sandy clay 184-236
Water (honeycomb) 365-415	Grey clay 101-137	Sand & water 236-238
Clay 415-418	Red clay 137-154	Sandy clay 238-284
	Grey-green clay 154-173	Water & sand 284-288
	Water sand	
<u>(D-8-26) 16bca</u>	(very little water) 173'	<u>(D-8-26) 29dbd</u>
Surface soil 0-60	Red clay 173-189	Soil & clay 0-8
Sandstone 60-70	Water gravel 189-192	Sand & clay 8-17
Clay 70-250	Red brown clay 192-209	Gravel & clay 17-31
Clay & sandstone 250-300	Water gravel 209-213	Brown clay 31-60
Sand & sandstone 300-340	Brown clay 213-241	Blue clay 60-71
Water 340'	Water gravel 241-244	Brown clay 71-92
Clay & sandstone 340-460	Red clay 244-250	Blue clay 92-99
		Brown clay 99-107
<u>(D-8-26) 16ccd</u>	<u>(D-8-26) 28bdd</u>	Brown & blue clay
Sand, rock & clay 75-85	Soil & rocks to 50'	mixed layers 107-275
Clay & sandstone 110-112	Clay to 365'. Water in	Sandstone 275-275
Honeycomb 280-295	honeycomb formation 365-390	Sand & brown clay 276-302
Honeycomb flowing 400-410		Sandstone
Sand & clay 525-535	<u>(D-8-26) 28dbb</u>	water level 213' 302-303
Clay 549-551	Decomposed granite fill 0-4	Sand & clay 303-314
Clay 551-564	Fill & boulders 4-12	Sandstone
	Granite boulder & clay 12-18	water level 128' 314-315
<u>(D-8-26) 17abb</u>	Sandstone 18-22	Sand & clay 315-331
Red SS 0-33	Yellow clay 22-27	
"Water stood @ 9' at 33'"	Brown squeezing clay 27-35	water level 75' 331-332
Red SS 33-190	Red clay 35-51	Sand & clay 332-338
Blue shale 190-790	Grey sandstone	Gravel
"Water at 262'; 323'; 390'; 410';	some water 5 gpm 51-64	water level 38' 338-341
520'; 574'; 631'; 675'; 734'; 747';"	Benonite clay 64-72	Sand & clay 341-369
Some water 756-788	Red clay 72-76	Gravel
Water good 790'	River salt 76-81	water level 18' 369-370
Honeycomb, lots water 790-842	Blue clay 81-84	Sand & clay 370-386
Layer sand 675'; 734'; 747'	Green benonite clay 84-95	Sand & gravel
Choc. sandy clay 842-1412	Brown clay 95-99	water level 9' 386-389
Blue shale 1412-1449	Red clay 99-101	Sand & clay 389-395
"Water @ 1449' honeycomb (salt wtr.)"	Brown clay 101-113	Sand & gravel
"Water at 1064'; 1140'; 1164'; 1216';	Joint clay 113-118	water level 5' 395-397
1260'; & 1337'"	Brown clay 118-124	Brown clay 397-407
	Grey sandstone 124-131	Red clay & gravel 407-600
<u>(D-8-26) 17bbc</u>	Brown clay 131-145	
Sand & clay 0-25	Benonite clay green 145-152	<u>(D-8-26) 30 aca</u>
Gravel - 1st water -27	Brown sandy clay 152-157	Sand & rock 0-23
Clay 27-260	Brown benonite clay 157-161	Sandy clay 23-56
Alt. sand & clay 260-460	Sandstone 161-165	Brown clay 56-60
Clay, sand & gravel 460-475	Brown clay 165-169	Blue sandy clay 60-104
Sand & gravel 475-490	Sticky olive green clay	Green sandy clay 104-120
Hard sand & gravel 490-520	w/small gravel & rock 169-187	Brown sandy clay 120-140
CG, hard 520-565	Grey sticky clay 187-201	Brown clay 140-151
Grey clay 565-575	Benonite clay green 201-205	Brown sandy clay 151-162
Sand & gravel 575-580	Grey sticky clay 205-260	Brown clay 162-164
Clay 580-610	Green benonite 260-268	Sand & water 164-166
	Grey sticky clay 268-315	Blue clay 166-173
<u>(D-8-26) 18add</u>	Grey clay w/very	Sandstone 173-220
Sandstone & clay 1250-1525	fine sand 315-335	Coarse sand & water 220-223
	Grey sticky clay 335-350	Brown clay 223-225
<u>(D-8-26) 19dcc₂</u>	Grey clay w/very	Brown sandy clay 225-230
Boulders 0-16	fine sand 350-361	Fine sand & water 230-243
Brown sandy shale 16-90	Grey clay 361-430	Brown clay 243-248
Brown sandy clay 90-122	Blue SS 430-435	
Brown sandy shale 122-130	Blue sand, very fine 435-441	<u>(D-8-26) 30baa</u>
Sand, trace of water 130-134	Water	Big boulders 0-11
Brown sandy clay 134-203	Water raised to 100' of	Sandy clay (few bldrs) 11-20
Brown sand, source	surface.	Boulders 20-22
of water 203-210	<u>(D-8-26) 29bbd</u>	Sand & clay 22-30
Brown clay 210-233	Sandy soil 0-95	Gravel 30-32
Sand & gravel 233-238	Sand & water 95-96	Big boulders 32-34
Brown shale & sand 238-250	Sandy clay 96-140	Sand, grvl & clay 34-45
	Sand & water 140-141	Sandy clay 45-60
		Clay w/sand & grvl 60-77
		Sand, grvl & clay 77-80

Depth Interval
(feet)

(D-8-26) 30baa - continued

Sandy clay & blue clay	80-85
Brown or grey clay & blue clay	85-95
Blue clay & sandy clay	95-111
Sandy clay & small streaks of sand	111-126
Brown sandy clay	126-162
Sand, brown clay w/ sand & gravel	162-164
Sand, gravel & clay	164-168
Sandy clay	168-170
Sand, gravel & clay streaks	170-172
Sand & clay broken	172-186
Sand & clay broken; some gravel	186-211
Sand, gravel & clay	211-228
Sandy clay & sand streaks	228-238
Sandy clay	238-246
Sandy clay streaks	246-248
Sandy clay	248-256
Big gravel, sand & clay streaks	256-259
Sandy clay	259-263
Sandy clay w/sand & small gravel	263-278
Sand & gravel	278-280
Small streaks sand & gravel	280-293
Sand gravel w/few sm. clay streaks	293-300
Sandy clay w/sand streaks	300-306
Sand streaks w/clay & few gravel streaks	306-321
Sand & clay broken	321-339
Clay	339-340
Sand & gravel	340-357
Sand & clay	357-362
Sand & gravel	362-387
Sandy clay & sand	387-397

(D-8-26) 30bdb

Granite boulders	0-30
Sand w/water	425-450
Most of water supply	650-670
"From start to finish very little to no clay. Granite sandstone the entire way."	

(D-8-26) 30bdd

Granite fill & "boulders"	0-20
Granite fill	20-172
Sandstone - water	172-202
Red sandstone - water	202-245
Granite fill	245-300

(D-8-26) 30ddd

Sandy soil	0-95
Sand & water	95-96
Sandy clay	96-140
Sand & water	140-141
Sandy clay	141-182
Water & sand	182-184
Sandy clay	184-236
Sand & water	236-238
Sandy clay	238-284
Water & sand	284-288

Depth Interval
(feet)

(D-8-26) 31abd

Top soil	0-35
Sand & clay strips	35-90
Small amt. water	90'
Sand & clay strips	90-140
Red clay	140-250
Sand w/water	250-257
Clay	257-290
Sand w/water	290-293
Clay	293-404
Sand w/water	404-450

(D-8-26) 31ddc

Sand	0-17
Sandstone	17-26
Sandy clay	26-29
Sandstone	29-36
Sandy clay	36-66
Water sand	66-68
Sandy clay	68-84
Red clay	84-108
Water gravel	108-110
Clay	110-115
Sandy clay	115-123
Sand & clay alternating beds in 1'sand;8'clay	123-161
Sandy clay	161-175
Clay	175-209
Water sand	209-211
Clay	211-241
Hard sandy clay	241-250

(D-9-26) 5acd

Fill	0-25
Brown clay	25-90
Seep	90
Brown clay	90-185
Water gravel	185-186
Red clay	186-232
Water gravel	232-234
Brown clay	234-250

(D-9-26) 6bda

Sand & clay	0-50
Sand & gravel (1st water)	50-51
Sand, clay	51-108
Gravel, water	108-110
Sand, gravel clay	110-120
Sand, gravel, rock (caving)	120-127
Conglomerate	127-140
Sand	140-143
Conglomerate	143-166
Sandy clay	166-175
Sand, gravel	175-180
Sandy clay	180-200

(D-9-27) 36bc

Hardpan	0-32
Gravel	32-38
Yellow clay	38-90
Sand & gravel	90-124
Yellow clay	124-132
Gravel	132-144
Blue clay	144-240
Blue clay & sand	240-254
Gravel & sand	254-260
Blue clay	260-284
Sand	284-288
Yellow clay	288-322

Depth Interval
(feet)

Blue clay	326-396
Sandstone	396-400
Blue clay	400-592
Gypsum & clay	592-735
Gypsum	735-765

(D-9-27) 36cdb

Greyish brown sand; some gravel, mud-stone	280-450
Greenish gray sand; some gravel, some calcite, ankyd & gypsum	460-950
Grey sand; some gravel; some halite, ankyd & calcite	960-1630
White sand; some gravel, ankyd & calcite	1640-1790
Grey sand; some gravel, ankyd, calcite	1800-3390
Brown sand; some gravel, ankydrite, calcite	3400-3480

APPENDIX B

Water Chemistry

CHEMISTRY REPORTED IN PARTS PER MILLION (PPM) EXCEPT FOR ALKALINITY. ALKALINITY IN MILLEQUIVALENTS.

SAMPLE	NA	K	CA	MG	CL	SO4	HCO3	CO3	SIO2	B	LI	AL	F	ALKALINITY
001W83	475.00	3.60	26.80	0.15	490.00	346.00	35.56	4.65	21.00	0.80	1.30	0.01	15.00	0.66
002W83	477.00	3.10	25.00	0.16	405.00	370.00	32.76	6.55	21.00	0.75	1.40	0.00	14.40	0.65
003W83	427.00	3.50	6.00	0.21	407.00	270.00	78.13	11.20	21.00	0.80	1.00	0.01	14.40	1.47
004W83	325.00	2.50	8.50	0.13	285.00	205.00	53.08	6.55	21.00	0.56	0.75	0.01	15.20	0.98
005W83	1000.00	9.50	62.00	3.20	1140.00	625.00	38.19	4.65	17.00	1.40	2.20	0.01	9.30	0.70
006W83	660.00	5.90	5.40	1.60	640.00	360.00	189.72	10.68	13.00	1.60	0.80	0.01	9.50	3.20
007W83	780.00	5.50	15.00	1.50	740.00	570.00	115.44	12.23	19.00	1.70	1.50	0.01	11.60	2.10
008W83	600.00	5.20	27.80	1.00	609.00	430.00	44.32	4.65	18.00	1.00	1.50	0.02	14.40	0.80
009W83	443.00	3.40	5.00	0.18	400.00	310.00	20.32	9.30	20.00	0.80	1.00	0.10	14.60	0.49
010W83	435.00	3.90	15.00	0.31	430.00	310.00	40.12	4.65	16.00	0.80	1.30	0.01	14.20	0.74
011W83	605.00	5.10	28.00	0.55	640.00	410.00	39.07	3.79	16.00	0.95	1.50	0.01	13.00	0.70
012W83	850.00	7.40	65.00	0.96	980.00	540.00	28.91	4.31	19.00	1.10	2.00	0.01	10.00	0.55
013W83	620.00	3.90	2.60	0.55	520.00	380.00	263.65	17.23	16.00	2.30	0.70	0.00	11.60	4.61
014W83	490.00	5.70	17.00	0.59	505.00	275.00	99.85	2.58	23.00	0.60	1.20	0.02	15.20	1.68
015W83	500.00	4.00	3.10	0.48	455.00	300.00	142.60	15.16	12.00	1.20	0.90	0.01	11.00	2.59
016W83	305.00	3.30	3.40	0.28	225.00	100.00	86.54	12.23	45.00	0.20	0.25	0.00	7.00	1.62
017W83	290.00	4.20	5.00	0.72	224.00	95.00	258.92	9.30	46.00	0.25	0.25	0.00	7.40	4.40
018W83	375.00	4.90	3.90	0.28	225.00	240.00	254.02	10.16	62.00	0.50	0.32	0.00	10.80	4.33
019W83	365.00	5.00	2.90	0.10	204.00	275.00	234.75	14.82	65.00	0.50	0.33	0.00	11.40	4.09
020W83	365.00	5.40	3.20	0.10	217.00	270.00	241.58	9.30	65.00	0.45	0.35	0.00	11.80	4.11
021W83	822.00	8.80	67.00	0.52	956.00	525.00	22.07	2.76	22.00	0.95	1.70	0.02	9.20	0.41
022W83	8.30	1.90	10.00	2.40	1.80	21.00	30.13	0.00	17.00	0.02	0.01	0.04	1.90	0.49
023W83	340.00	2.10	6.90	0.05	268.00	235.00	44.50	3.79	20.00	0.56	0.90	0.00	16.20	0.79
024W83	410.00	2.90	19.80	0.19	443.00	250.00	79.01	5.51	18.00	0.45	0.90	0.00	11.60	1.39
025W83	370.00	6.40	19.00	0.26	368.00	270.00	40.99	3.62	24.00	0.55	1.00	0.01	11.40	0.73
026W83	425.00	5.30	28.00	0.23	474.00	290.00	26.98	3.79	22.00	0.50	1.20	0.01	8.80	0.51
027W83	445.00	5.00	22.00	0.20	425.00	350.00	39.07	5.51	26.00	0.75	1.30	0.01	13.40	0.73
028W83	260.00	5.00	6.60	1.50	182.00	100.00	172.03	5.51	17.00	0.65	0.27	0.02	8.50	2.91
029W83	255.00	5.20	6.80	1.20	177.00	167.00	158.02	1.00	18.00	0.44	0.26	0.00	8.80	2.59
030W83	275.00	3.30	3.80	0.12	225.00	140.00	119.47	7.41	26.00	0.50	0.50	0.02	19.60	2.08
031W83	303.00	3.90	4.10	0.14	262.00	130.00	133.00	13.78	22.00	0.60	0.60	0.02	19.20	2.42
032W83	965.00	10.20	54.00	6.40	1016.00	775.00	52.73	3.79	21.00	1.60	0.31	0.01	12.80	0.93
033W83	341.00	7.00	6.80	3.20	227.00	223.00	246.66	9.30	18.00	1.10	0.43	0.00	4.90	4.20
034W83	200.00	5.70	13.00	4.90	128.00	160.00	157.66	4.65	24.00	0.50	0.23	0.00	6.60	2.66
035W83	765.00	8.20	35.00	0.46	864.00	425.00	38.37	2.76	22.00	1.00	1.50	0.01	10.20	0.68
036W83	1015.00	10.70	32.00	4.20	1076.00	675.00	121.40	8.44	20.00	2.00	1.60	0.01	11.20	2.13
037W83	327.00	7.10	3.80	0.64	196.00	165.00	265.93	17.57	75.00	0.50	0.00	0.00	12.40	4.65
038W83	591.00	7.20	18.00	0.40	648.00	280.00	77.08	3.79	22.00	0.90	1.10	0.02	13.20	1.33
039W83	2650.00	20.00	90.00	29.50	3080.00	1650.00	248.23	0.00	17.00	10.00	2.60	0.00	1.70	4.07
040W83	780.00	4.90	64.00	0.53	938.00	500.00	22.77	3.79	23.00	0.95	1.70	0.01	9.40	0.44
041W83	1060.00	18.80	33.00	4.50	1218.00	550.00	185.87	1.89	73.00	1.30	1.30	0.00	7.30	3.08
042W83	2600.00	19.20	119.00	7.20	3611.00	750.00	77.61	1.00	65.00	1.60	1.70	0.00	6.20	1.27

CHEMISTRY REPORTED IN PARTS PER MILLION (PPM) EXCEPT FOR ALKALINITY. ALKALINITY IN MILLEQUIVALENTS.

SAMPLE	NA	K	CA	MG	CL	SO4	HCO3	CO3	SIO2	B	LI	AL	F	ALKALINITY
CF1	605.00	3.10	19.00	0.50	655.00	392.00	42.00	0.00	20.00	0.60	1.70	0.00	11.00	0.69
CF2	881.00	7.70	50.00	0.90	941.00	535.00	32.00	0.00	17.60	0.00	0.00	0.00	0.00	0.52
CF3	783.00	5.50	65.00	1.10	1024.00	497.00	31.00	3.60	28.00	1.18	2.40	0.00	0.00	0.56
CF4	810.00	5.30	26.00	0.80	965.00	542.00	31.00	0.00	20.00	0.30	2.10	0.00	7.80	0.50
CF5	644.00	2.70	1.00	0.50	538.00	330.00	223.00	0.00	17.00	2.50	0.80	0.00	8.60	3.70
CF6	1054.00	6.60	69.00	2.60	447.00	605.00	48.00	0.00	20.00	1.30	0.00	0.00	9.00	0.79
CF7	384.00	2.30	18.00	0.20	418.00	294.00	40.00	13.00	31.70	0.80	0.00	0.00	11.70	0.89
CF8	474.00	2.60	2.00	0.50	483.00	309.00	129.00	0.00	15.00	0.60	1.00	0.00	8.30	2.10
CF9	379.00	2.30	7.20	0.20	399.00	247.00	65.00	17.00	28.00	0.94	0.00	0.00	14.00	1.30
CF10	306.00	1.60	9.20	0.10	294.00	195.00	49.00	11.00	29.00	0.60	0.00	0.00	14.60	0.98
CF11	444.00	3.00	9.00	0.40	457.00	313.00	42.00	0.00	18.00	0.70	1.30	0.00	10.20	0.69
CF12	678.00	3.90	22.00	0.50	818.00	369.00	40.00	2.40	28.00	1.04	0.00	0.00	9.60	0.70
CF13	524.00	3.90	21.00	0.40	204.00	282.00	83.00	0.00	24.00	0.90	0.00	0.00	13.60	1.36
CF14	470.00	3.50	15.00	0.20	503.00	335.00	33.00	0.00	18.50	0.00	0.00	0.00	0.00	0.54
CF15	449.00	2.40	15.00	0.20	505.00	300.00	38.00	0.00	22.00	0.10	1.30	0.00	12.50	0.62
CF16	448.00	2.20	13.00	0.20	424.00	325.00	40.00	0.00	22.00	0.10	1.50	0.00	12.00	0.65
CF17	539.00	2.80	22.00	0.20	580.00	377.00	38.00	0.00	23.00	0.30	1.60	0.00	11.50	0.62
CF18	1152.00	10.60	31.00	4.30	1066.00	607.00	90.00	0.00	14.10	0.00	0.00	0.00	0.00	1.50
CF19	1025.00	6.20	42.10	5.70	1125.00	585.00	117.00	0.00	22.00	1.78	2.32	0.00	9.45	1.90
CF20	3283.00	14.10	67.90	20.70	4097.00	1688.00	165.00	0.00	30.00	8.40	5.16	0.00	1.20	2.70
CF21	443.00	6.20	37.70	11.40	365.00	410.00	172.00	0.00	20.00	2.06	0.93	0.00	5.40	2.80
CF22	23.00	7.20	7.00	4.10	19.00	6.00	116.00	0.00	47.00	0.20	0.10	0.00	1.20	1.90
CF23	48.00	3.10	14.00	2.70	108.00	58.00	104.00	0.00	36.00	0.50	0.30	0.00	1.00	1.70
CF24	60.00	2.80	10.00	2.00	201.00	95.00	96.00	0.00	34.00	0.00	0.50	0.00	1.00	1.60
CF25	50.00	0.00	30.00	7.00	30.00	22.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00
CF26	21.00	2.10	8.00	3.90	16.00	5.00	132.00	0.00	50.00	0.40	0.10	0.00	1.10	2.20
CF27	498.00	4.30	16.00	0.70	197.00	267.00	99.00	0.00	26.00	0.55	1.38	0.00	14.20	1.60
CF28	579.00	5.80	17.00	0.60	510.00	290.00	79.00	0.00	18.40	0.00	0.00	0.00	11.07	1.30
CF29	304.00	1.20	7.20	0.10	260.00	203.00	86.00	9.00	28.00	0.84	0.00	0.00	14.50	1.60
CF30	328.00	0.00	4.00	1.00	196.00	240.00	212.00	0.00	0.00	0.00	0.00	0.00	10.00	3.50
CF31	168.00	0.00	48.00	2.50	144.00	203.00	156.00	0.00	0.00	0.00	0.00	0.00	6.20	2.60
CF32	127.00	0.00	23.00	6.00	132.00	100.00	144.00	0.00	0.00	0.00	0.00	0.00	4.80	2.40
CF33	0.00	0.00	9.50	3.90	101.00	88.00	164.00	0.00	0.00	0.00	0.00	0.00	10.00	2.70
CF34	161.00	1.60	3.40	0.60	111.00	265.00	113.00	0.00	28.00	5.10	0.30	0.00	9.80	1.90
CF35	171.00	4.30	75.00	2.80	82.00	345.00	110.00	0.00	33.00	4.80	0.30	0.00	5.20	1.80
CF36	61.00	3.60	13.00	1.80	156.00	120.00	118.00	0.00	26.00	0.70	0.30	0.00	0.50	1.90
CF37	162.00	1.20	4.60	0.10	109.00	106.00	137.00	10.00	28.00	0.28	0.00	0.00	10.40	2.40
CF38	249.00	2.30	17.20	1.00	151.00	172.00	218.00	0.00	29.00	0.30	0.00	0.00	14.60	3.60

CHEMISTRY REPORTED IN PARTS PER MILLION (PPM) EXCEPT FOR ALKALINITY. ALKALINITY IN MILLIEQUIVALENTS.

SAMPLE	NA	K	CA	MG	CL	SO4	HCO3	CO3	SIO2	B	LI	AL	F	ALKALINITY
BV1	327.00	0.00	118.00	37.20	410.00	200.00	415.00	0.00	0.00	0.00	0.00	0.00	2.45	6.80
BV2	237.00	0.00	3.60	0.50	228.00	120.00	200.00	12.00	0.00	0.00	0.00	0.00	7.00	3.50
BV3	284.00	2.90	1.00	0.40	232.00	120.00	202.00	0.00	52.00	0.30	0.30	0.00	6.90	3.30
BV4	320.00	0.00	5.60	0.50	246.00	105.00	254.00	0.00	0.00	0.00	0.00	0.00	3.00	4.20
BV5	290.00	0.00	4.40	1.00	244.00	110.00	210.00	0.00	0.00	0.00	0.00	0.00	4.70	3.40
BV6	193.00	0.00	100.00	21.00	372.00	80.00	210.00	0.00	0.00	0.00	0.00	0.00	1.30	3.40
BV7	167.00	0.00	70.00	18.00	252.00	70.00	237.00	0.00	0.00	0.00	0.00	0.00	1.30	3.90
BV8	359.00	0.00	6.20	1.30	250.00	250.00	256.00	9.60	0.00	0.00	0.00	0.00	7.30	4.40
BV9	260.00	0.00	4.00	0.40	232.00	80.00	234.00	9.60	0.00	0.00	0.00	0.00	2.90	4.00
BV10	285.00	0.00	1.40	1.50	195.00	120.00	244.00	12.00	0.00	0.00	0.00	0.00	4.90	4.20
BV11	264.00	0.00	4.00	0.20	216.00	75.00	200.00	14.40	0.00	0.00	0.00	0.00	2.90	3.50
BV12	283.00	0.00	5.20	0.50	200.00	90.00	2.20	14.40	0.00	0.00	0.00	0.00	4.30	0.28
BV13	241.00	0.00	6.20	0.70	194.00	120.00	239.00	8.40	0.00	0.00	0.00	0.00	7.00	4.00
BV14	52.00	4.50	19.60	2.60	189.00	24.00	122.00	0.00	28.00	0.00	0.20	0.00	4.80	2.00
BV15	358.00	3.90	6.20	1.00	168.00	227.00	250.00	8.40	67.00	0.46	0.00	0.00	10.20	4.20
BV16	256.00	0.00	80.00	16.40	342.00	130.00	264.00	0.00	0.00	0.00	0.00	0.00	2.10	4.30
BV17	360.00	3.50	1.00	0.40	249.00	265.00	195.00	0.00	61.00	0.00	0.40	0.00	8.60	3.20
BV18	61.00	0.80	12.40	0.40	210.00	111.00	134.00	0.00	27.00	0.00	0.00	0.00	7.00	2.20
BV19	360.00	4.30	4.30	0.90	240.00	250.00	255.00	0.00	65.00	0.50	0.00	0.00	14.00	4.20
BV20	321.00	3.80	0.60	0.20	195.00	180.00	186.00	0.00	63.00	0.00	0.40	0.00	13.00	3.00
BV21	369.00	0.00	9.50	6.60	230.00	275.00	259.00	0.00	0.00	0.00	0.00	0.00	11.00	4.20
BV22	217.00	0.00	101.00	22.90	246.00	120.00	337.00	0.00	0.00	0.00	0.00	0.00	1.80	5.50
BV23	209.00	0.00	103.00	22.40	248.00	110.00	303.00	0.00	0.00	0.00	0.00	0.00	1.60	5.00
BV24	348.00	4.70	7.00	2.00	256.00	270.00	239.00	0.00	65.00	0.46	0.20	0.00	9.00	3.90
BV25	205.00	0.00	109.00	28.50	344.00	190.00	366.00	0.00	0.00	0.00	0.00	0.00	2.10	6.00
BV26	280.00	0.00	124.00	29.20	370.00	200.00	366.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00
BV27	235.00	0.00	114.00	27.40	332.00	160.00	356.00	0.00	0.00	0.00	0.00	0.00	0.00	5.80
BV28	163.00	0.00	69.00	15.00	218.00	70.00	244.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00
BV29	365.00	0.00	16.80	3.70	256.00	230.00	215.00	7.20	0.00	0.00	0.00	0.00	0.00	3.60
BV30	331.00	4.30	7.40	1.30	203.00	296.00	233.00	13.20	67.00	0.43	0.36	0.00	0.00	4.00
BV31	365.00	0.00	4.40	0.97	220.00	150.00	223.00	0.00	0.00	0.00	0.00	0.00	0.00	3.70
BV32	60.00	1.00	4.50	0.10	201.00	190.00	124.00	0.00	31.00	0.00	0.10	0.00	4.10	2.00
BV33	333.00	3.90	1.00	0.10	212.00	272.00	205.00	0.00	62.00	0.00	0.40	0.00	16.20	3.40
BV34	215.00	0.00	92.00	23.00	350.00	240.00	427.00	0.00	0.00	0.00	0.00	0.00	2.80	7.00
BV35	192.00	0.00	129.00	29.00	236.00	170.00	386.00	0.00	0.00	0.00	0.00	0.00	1.80	6.30
BV36	283.00	0.00	120.00	25.30	246.00	170.00	395.00	0.00	0.00	0.00	0.00	0.00	2.00	6.50
BV37	315.00	0.00	68.80	16.50	320.00	250.00	390.00	0.00	0.00	0.00	0.00	0.00	3.40	6.40
BV38	2900.00	12.00	120.00	8.70	4100.00	0.00	78.00	0.00	53.00	1.50	0.00	0.00	6.80	1.30
BV39	410.00	3.00	6.80	0.34	300.00	110.00	251.00	0.00	55.00	0.00	0.00	0.00	11.00	4.10

APPENDIX C

Geochemistry of Water Samples

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.6687E-03 MGTOT 0.6200E-05 NATOT 0.2066E-01 KTOT 0.9210E-04 CLTOT 0.1382E-01 ALK 0.6600E-03
 SO4TOT 0.3602E-02 ALTOT 0.3715E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.1873E-03
 NU3TOT 0.0000E+00 SID2TOT 0.3494E-03 BTOT 0.7400E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.46 PF = 99.99 TEMP = 38.60DEG C DENSITY = 1.000GM/CC
 -LOG(PCO2) = 3.88 -LOG(PO2) = 99.99 -LOG(PCMH4) = 99.99
 IONIC STRENGTH = 0.02538 TOTAL DISS SOLIDS = 1.41GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.5880E-03
 ION BALANCE ERROR = 1.41PERCENT CATION EXCESS = 0.6070E-03(CHARGE*MULES) H2O ACTIVITY = 0.9993

INDIVIDUAL SPECIES MOLALITIES

OH-	0.9095E-05	CO3--	0.1472E-04	HCO3-	0.5519E-03	SO4--	0.3277E-02	CL-	0.1384E-01	CA++	0.5420E-03
CAOH+	0.7314E-07	CACO3	0.4951E-05	CAHCO3	0.2576E-05	CASO4	0.1200E-03	MG++	0.5184E-05	MGOH++	0.4953E-08
MGCO3	0.2738E-07	MGHCO3	0.2055E-07	MGSU4	0.9723E-06	NA+	0.2047E-01	NAO3-	0.5895E-05	NAHCO3	0.4662E-05
NASO4-	0.2064E-03	NACLO	0.5137E-05	K+	0.9080E-04	KSO4-	0.1409E-05	KCLO	0.2353E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.1861E-03	LIOH	0.2798E-08	LISO4-	0.1455E-05
H4SIO4	0.3253E-03	H3SIO4	0.2459E-04	H2SIO4	0.9732E-07	AL+++	0.6581E-19	ALOH++	0.3304E-15	ALOH2+	0.2433E-11
ALOH4-	0.3720E-06	ALSO4+	0.7954E-19	ALSO42	0.1191E-19	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2	0.0000E+00	FEOH-	0.0000E+00	FESO4	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.3949E-08	H2SO4	0.4444E-20	H5O4-	0.1030E-08
HCL	0.1271E-15	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3	0.5896E-04
H2BO3-	0.1514E-04	H2CO3*	0.3260E-05	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.11	CO3--	5.09	HCO3-	3.32	SO4--	2.75	CL-	1.93	CA++	3.53	CAOH+	7.20
CACO3	5.30	CAHCO3	5.65	CASO4	3.92	MG++	5.54	MGOH+	8.37	MGCO3	7.56	MGHCO3	7.76
MGSO4	6.01	NA+	1.76	NAO3-	5.29	NAHCO3	5.33	NASO4-	3.75	NACLO	5.29	K+	4.11
KSO4-	5.92	KCLO	7.63	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	3.79
LIOH	8.55	LISO4-	5.90	H4SIO4	3.49	H3SIO4	4.68	H2SIO4	7.27	AL+++	19.69	ALOH++	15.74
ALOH2+	11.68	ALOH4-	6.50	ALSO4+	19.17	ALSO42	19.99	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2	-99.99	FEOH-	-99.99	FESO4	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.46	H2SO4	20.35	H5O4-	9.05	HCL	15.89	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3	4.23	H2BO3-	4.90	H2CO3	5.48	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-1.48	ALBITE	-1.53	ANHYDRIT	-1.61	ANORTHIT	-4.72	ARAGONIT	-0.31	BARITE	-99.99	BOEHMITE	-2.00
BRUCITE	-4.38	CALCITE	-0.04	CA-MONT	-2.31	CELESTIT	-99.99	CHALCEDON	-0.11	CHLORITE	-3.17	DULOMITE	-1.96
GIBBSITE	-2.72	GEOHITE	-99.99	GLIEGITE	-99.99	GYPSUM	-1.65	HALITE	-5.30	HALLUYST	-5.49	HEMATITE	-99.99
HUNTITE	-9.17	HYDROMAG	-9.02	ILLITE	-2.58	KAILINIT	-1.54	K-MICA	-4.05	MACKINAW	-99.99	MAGNESIT	-2.19
MAGNETIT	-99.99	MIRABILIT	-5.76	NESQUEHU	-5.27	PHLOGOPT	-4.82	PYRITE	-99.99	PYROPHYL	-1.42	QUARTZ	0.32
SIDERITE	-99.99	STRONTIT	-99.99	TALC	-0.37	THENARDT	-6.06	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4 3.49 QUARTZ 0.30 CHALCEDONY -0.06 A-CRISTOBALITE -0.32 AMORPHOUS -1.37

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.6237E-03 MGTOT 0.5600E-05 NATOT 0.1901E-01 KTOT 0.7930E-04 CLTOT 0.1143E-01 ALK 0.6500E-03
 SD4TOT 0.3852E-02 ALTOT 0.0000E+00 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.2018E-03
 NO3TOT 0.0000E+00 SIO2TOT 0.1494E-03 BTOT 0.6938E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.61 PE = 99.99 TEMP = 34.60DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 4.07 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.02377 TOTAL DISS SOLIDS = 1.30GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.5675E-03

ION BALANCE ERROR = 1.96PERCENT CATION EXCESS = 0.7738E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9994

INDIVIDUAL SPECIES MOLALITIES

OH-	0.9656E-05	CO3--	0.1853E-04	HCO3-	0.5295E-03	SO4--	0.3529E-02	CL-	0.1144E-01	CA++	0.4975E-03
CAOH+	0.7094E-07	CAC030	0.5262E-05	CANCO3	0.2046E-05	CAS040	0.1197E-03	MG++	0.5436E-05	MGOH++	0.5364E-08
MGC030	0.3531E-07	MGMCO3	0.2044E-07	MGS040	0.1112E-05	NA+	0.1882E-01	NAC03-	0.5768E-05	NAHCO3	0.4154E-05
NAS04-	0.2038E-03	NACLO	0.3946E-05	K+	0.7814E-04	KSO4-	0.1250E-05	KCLO	0.1693E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.2003E-03	LIOH0	0.2920E-08	LIS04-	0.1721E-05
H4SIO4	0.3213E-03	H3SIO4	0.2859E-04	H2SIO4	0.1054E-06	AL+++	0.0000E+00	ALOH++	0.0000E+00	ALOH2+	0.0000E+00
ALOH4-	0.0000E+00	ALSO4+	0.0000E+00	ALSO42	0.0000E+00	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FE0H30	0.0000E+00	FE0H4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL30	0.0000E+00	FES04+	0.0000E+00
FE++	0.0000E+00	FE0H+	0.0000E+00	FE0H20	0.0000E+00	FE0OH-	0.0000E+00	FES040	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4S04	0.0000E+00	NO3-	0.0000E+00	H+	0.2785E-08	H2S040	0.1985E-20	HS04-	0.7102E-09
HCL0	0.5062E-16	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO30	0.5201E-04
H2BO3-	0.1746E-04	H2CO3*	0.2292E-05	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.08	CO3--	4.98	HCO3-	3.34	SO4--	2.71	CL-	2.01	CA++	3.55	CAOH+	7.21
CAC030	5.28	CAHCO3	5.75	CAS040	3.92	MG++	5.51	MGOH+	8.33	MGC030	7.45	MGMCO3	7.76
MGS040	5.95	NA+	1.79	NAC03-	5.30	NAHCO3	5.38	NAS04-	3.75	NACLO	5.40	K+	4.17
KSO4-	5.97	KCLO	7.77	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	3.76
LIOH0	8.53	LIS04-	5.83	H4SIO4	3.49	H3SIO4	4.61	H2SIO4	7.23	AL+++	-99.99	ALOH++	-99.99
ALOH2+	-99.99	ALOH4-	-99.99	ALSO4+	-99.99	ALSO42	-99.99	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FE0H3	-99.99	FE0H4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL30	-99.99	FES04+	-99.99	FE++	-99.99
FE0H+	-99.99	FE0H20	-99.99	FE0OH-	-99.99	FES040	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4S04	-99.99
NO3-	-99.99	H+	8.61	H2S040	20.70	HS04-	9.21	HCL0	16.29	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO30	4.28	H2BO3-	4.84	H2CO3	5.64	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-99.99	ALBITE	-99.99	ANHYDRIT	-1.63	ANORTHIT	-99.99	ARAGONIT	-0.26	BARITE	-99.99	BOEHMITE	-99.99
BRUCITE	-4.29	CALCITE	0.01	CA-MONT	-99.99	CELESTIT	-99.99	CHALCEDON	-0.07	CHLORITE	-99.99	DOLOMITE	-1.82
GIBBSITE	-99.99	GEOTHITE	-99.99	GRIEGITE	-99.99	GYPNUM	-1.65	HALITE	-5.40	HALLUYST	-99.99	HEMATITE	-99.99
HUNTITE	-8.72	HYDROMAG	-8.75	ILLITE	-99.99	KAOLINIT	-99.99	K-MICA	-99.99	MACKINAW	-99.99	MAGNESIT	-2.11
MAGNETIT	-99.99	MIRABILIT	-5.61	MESQUEHO	-5.18	PHLOGOPT	-99.99	PYRITE	-99.99	PYRUPHYL	-99.99	QUARTZ	0.37
SIDERITE	-99.99	STROMTINT	-99.99	TALC	0.27	THENARDT	-6.10	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO40 3.49 QUARTZ 0.35 CHALCEDONY -0.02 A-CRISTOBALITE -0.28 AMORPHOUS -1.34

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.1497E-03 MGTOT 0.8600E-05 NATOT 0.1857E-01 KTOT 0.8950E-04 CLTOT 0.1148E-01 ALK 0.1470E-02
 SO4TOT 0.2811E-02 ALTOT 0.3715E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.1441E-03
 NO3TOT 0.0000E+00 SIOTOT 0.3494E-03 BTOT 0.7400E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.99 PE = 99.99 TEMP = 34.30DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 4.13 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.02147 TOTAL DISS SOLIDS = 1.23GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.1231E-02

ION BALANCE ERROR = 1.49PERCENT CATION EXCESS = 0.5536E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9994

INDIVIDUAL SPECIES MOLALITIES

OH-	0.2252E-04	CO3--	0.8994E-04	HCO3-	0.1095E-02	SO4--	0.2636E-02	CL-	0.1149E-01	CA++	0.1199E-03
CAOH+	0.4077E-07	CAC030	0.6392E-05	CAHCO3	0.1035E-05	CAS040	0.2253E-04	MG++	0.7158E-05	MGOH++	0.1681E-07
MGC030	0.2351E-06	MGHCO3	0.5676E-07	MGS040	0.1143E-05	NA+	0.1840E-01	NAC03-	0.2764E-04	NAHCO3	0.8511E-05
NAS04-	0.1523E-03	NACLO	0.3930E-05	K+	0.8851E-04	KSO4-	0.1079E-05	KCLO	0.1954E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SR0H+	0.0000E+00	LI+	0.1433E-03	LIOH0	0.4898E-08	LISO4-	0.9416E-06
H4SIO4	0.2893E-03	H3SIO4	0.6050E-04	H2SIO4	0.5101E-06	AL+++	0.1267E-20	ALOH++	0.1574E-16	ALOH2+	0.3138E-12
ALOH4-	0.3720E-06	ALSO4+	0.1302E-20	ALSO42	0.1611E-21	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH30	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL30	0.0000E+00	FES04+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH20	0.0000E+00	FEOH-	0.0000E+00	FES040	0.0000E+00	NH4+	0.0000E+00
NH3A0	0.0000E+00	NH4S04	0.0000E+00	NO3-	0.0000E+00	H+	0.1156E-08	H2S040	0.2599E-21	HS04-	0.2232E-09
HCL0	0.2073E-16	H2SA0	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO30	0.4131E-04
H2BO3-	0.3278E-04	H2CO3*	0.1985E-05	O2A0	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	4.71	CO3--	4.29	HCO3-	3.02	SO4--	2.82	CL-	2.00	CA++	4.16	CAOH+	7.45
CACU30	5.19	CAHCO3	6.04	CAS040	4.65	MG++	5.38	MGOH+	7.83	MGC030	6.63	MGHCO3	7.31
MGS040	5.94	NA+	1.80	NAC03-	4.62	NAHCO3	5.07	NAS04-	3.88	NACLO	5.40	K+	4.12
KSO4-	6.03	KCLO	7.71	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SKOH+	-99.99	LI+	3.90
LIOH0	8.31	LISO4-	6.09	H4SIO4	3.54	H3SIO4	4.28	H2SIO4	6.53	AL+++	21.37	ALOH++	17.04
ALOH2+	12.56	ALOH4-	6.49	ALSO4+	20.95	ALSO42	21.86	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL30	-99.99	FES04+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH20	-99.99	FEOH-	-99.99	FES040	-99.99	NH4+	-99.99	NH3A0	-99.99	NH4S04	-99.99
NO3-	-99.99	H+	8.99	H2S040	21.58	HS04-	9.71	HCL0	16.68	H2SA0	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO30	4.38	H2BO3-	4.56	H2CO3	5.70	O2A0	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-1.33	ALBITE	-1.47	ANHYDRIT	-2.36	ANORTHIT	-5.28	ARAGONIT	-0.17	BARITE	-99.99	BOEHMITE	-2.36
BRUCITE	-3.41	CALCITE	0.09	CA-MONT	-3.08	CELESTIT	-99.99	CHALCEDON	-0.12	CHLORITE	1.20	DOLomite	-0.91
GIBBSITE	-3.06	GEOTHITE	-99.99	GRIEGITE	-99.99	GYPSUM	-2.37	HALITE	-5.40	HALLUYST	-6.21	HEMATITE	-99.99
HUNTITE	-6.37	HYDROMAG	-5.43	ILLITE	-2.81	KAULINIT	-2.21	K-MICA	-4.59	HACKINAW	-99.99	MAGNESIT	-1.29
MAGNETIT	-99.99	MIRABILT	-5.73	NE-SQUEHU	-4.36	PHLOGOPT	-2.10	PYRITE	-99.99	PYROPHYL	-2.68	QUARTZ	0.33
SIDERITE	-99.99	STRONTNT	-99.99	TALC	2.73	THERNARDT	-6.23	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4 3.54 QUARTZ 0.31 CHALCEDONY -0.07 A-CRISTOBALITE -0.32 AMORPHOUS -1.38

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.2121E-03 MGTOT 0.5300E-05 NATOT 0.1414E-01 KTOT 0.6390E-04 CLTOT 0.8040E-02 ALK 0.9800E-03
 SD4TOT 0.2134E-02 ALTOT 0.3715E-04 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.1081E-03
 NO3TOT 0.0000E+00 SIO2TOT 0.3494E-03 BTOT 0.5180E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.75 PE = 99.99 TEMP = 33.30DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 4.02 -LOG(PD2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.01608 TOTAL DISS SOLIDS = 0.91GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.8697E-03

ION BALANCE ERROR = 5.27PERCENT CATION EXCESS = 0.1459E-02(CHARGE*MOLES) H2O ACTIVITY = 0.9996

INDIVIDUAL SPECIES MOLALITIES

OH-	0.1186E-04	CO3--	0.3604E-04	HCO3-	0.8120E-03	SO4--	0.2011E-02	CL-	0.8045E-02	CA++	0.1781E-03
CAOH+	0.3381E-07	CAC030	0.4189E-05	CAHCO3	0.1176E-05	CASO40	0.2877E-04	MG++	0.4576E-05	MGOH++	0.5950E-08
MGCO30	0.6702E-07	MGHCO3	0.2829E-07	MGSU40	0.6273E-06	NA+	0.1404E-01	NACU3-	0.8578E-05	NAHCO3	0.4974E-05
NASO4-	0.9405E-04	NACLO	0.2174E-05	K+	0.6333E-04	KSO4-	0.6190E-06	KCLO	0.1015E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SKOH+	0.0000E+00	LI+	0.1076E-03	LIOH0	0.1952E-08	LISO4-	0.5746E-06
H4S104	0.3142E-03	H3S104	0.3547E-04	H2S104	0.1482E-06	AL+++	0.1332E-19	ALOH++	0.9197E-16	ALOH2+	0.1040E-11
ALOH4-	0.3718E-06	ALSO4+	0.1206E-19	ALS042	0.1209E-20	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FE0H30	0.0000E+00	FE0H4-	0.0000E+00	FECL+	0.0000E+00	FECL2+	0.0000E+00	FECL30	0.0000E+00	FES04+	0.0000E+00
FE++	0.0000E+00	FE0H+	0.0000E+00	FE0H20	0.0000E+00	FE0H-	0.0000E+00	FESU40	0.0000E+00	NH4+	0.0000E+00
NH3A0	0.0000E+00	NH4S04	0.0000E+00	NO3-	0.0000E+00	H+	0.1985E-08	H2SO40	0.6061E-21	HSO4-	0.3016E-09
HCL0	0.2327E-16	H2SA0	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO30	0.3607E-04
H2BO3-	0.1578E-04	H2CO3*	0.2620E-05	O2A0	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	4.98	CO3--	4.66	HCO3-	3.14	SO4--	2.91	CL-	2.15	CA++	3.96	CAOH+	7.52
CAC030	5.38	CAHCO3	5.98	CASO40	4.54	MG++	5.55	MGOH+	8.28	MGCO30	7.17	MGHCO3	7.60
MGS040	6.20	NA+	1.91	NAC03-	5.12	NAHCO3	5.30	NASO4-	4.08	NACLO	5.66	K+	4.26
KSO4-	6.26	KCLO	7.99	RA++	-99.99	BAOH+	-99.99	SR++	-99.99	SKOH+	-99.99	LI+	4.02
LIOH0	8.71	LISO4-	6.29	H4S104	3.50	H3S104	4.51	H2S104	7.04	AL+++	20.30	ALOH++	16.25
ALOH2+	12.04	ALOH4-	6.48	ALSO4+	19.97	ALS042	20.97	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FE0H3	-99.99	FE0H4-	-99.99	FECL+	-99.99	FECL2+	-99.99	FECL30	-99.99	FES04+	-99.99	FE++	-99.99
FE0H+	-99.99	FE0H20	-99.99	FE0H-	-99.99	FES040	-99.99	NH4+	-99.99	NH3A0	-99.99	NH4S04	-99.99
NO3-	-99.99	H+	8.75	H2SO40	21.22	HSO4-	9.58	HCL0	16.63	H2SA0	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO30	4.44	H2BO3-	4.87	H2CO3	5.58	O2A0	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-1.28	ALBITE	-1.41	ANHYDRIT	-2.26	ANORTHIT	-4.95	ARAGONIT	-0.35	BARITE	-99.99	BOEHMITE	-2.08
BRUCITE	-4.12	CALCITE	-0.09	CA-MONT	-2.29	CELESTIT	-99.99	CHALCEDON	-0.07	CHLORITE	-1.56	DOLOMITE	-1.64
GIBBSITE	-2.77	GEOTHITE	-99.99	GRIEGITE	-99.99	GYP SUM	-2.26	HALITE	-5.66	HALLUYST	-5.54	HEMATITE	-99.99
HUNTITE	-8.22	HYDROMAG	-7.81	ILLITE	-2.38	KAOLINIT	-1.54	K-MICA	-3.97	MACKINAH	-99.99	MAGNESIT	-1.84
MAGNETIT	-99.99	MIRABILIT	-6.00	NESQUEHO	-4.91	PHLOGOPT	-4.26	PYRITE	-99.99	PYKOPHYL	-2.04	QUARTZ	0.38
SIDERITE	-99.99	STROMTNT	-99.99	TALC	0.44	THENARDT	-6.54	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4S1040 3.50 QUARTZ 0.36 CHALCEDONY -0.02 A-CRISTOBALITE -0.28 AMORPHOUS -1.34

SAMPLE NUMBER 5
 TITLE 83 LOCATION D-08-26-078AAC

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.1547E-02 MGTOT 0.1316E-03 NATOT 0.4350E-01 KTOT 0.2429E-03 CLTOT 0.3216E-01 ALK 0.7000E-03
 SO4TOT 0.6506E-02 ALTOT 0.3715E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 SATOT 0.0000E+00 LITOT 0.3170E-03
 NO3TOT 0.0000E+00 SIO2TOT 0.2829E-03 BTOT 0.1295E-03 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.16 PE = 99.99 TEMP = 41.40DEG C DENSITY = 1.000GM/CC
 -LOG(PCO2) = 3.54 -LOG(PO2) = 99.99 -LOG(PC4) = 99.99
 IONIC STRENGTH = 0.05232 TOTAL DISS SOLIDS = 2.90GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.6491E-03
 ION BALANCE ERROR = 1.71PERCENT CATION EXCESS = 0.1551E-02(CHARGE*MOLES) H2O ACTIVITY = 0.9986

INDIVIDUAL SPECIES MOLALITIES

OH-	0.5841E-05	CO3--	0.9654E-05	HCO3-	0.6036E-03	SO4--	0.5563E-02	CL-	0.3223E-01	CA++	0.1222E-02
CAOH+	0.8838E-07	CACO3O	0.5481E-05	CAHCO3	0.5732E-05	CASO4O	0.3176E-03	MG++	0.1074E-03	MGOH++	0.5640E-07
MGCO3O	0.2683E-06	MGHCO3	0.4024E-06	MGSO4O	0.2383E-04	NA+	0.4298E-01	NACO3-	0.7618E-05	NAHCO3	0.9658E-05
NASO4-	0.6114E-03	NACLO	0.2246E-04	K+	0.2382E-03	KSO4-	0.5328E-05	KCLO	0.1277E-06	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.3145E-03	LIOH+	0.2922E-08	LISO4-	0.3438E-05
H4SIO4	0.2714E-03	H3SIO4	0.1230E-04	H2SIO4	0.3652E-07	AL+++	0.7213E-18	ALOH++	0.2001E-14	ALOH2+	0.7538E-11
ALOH4-	0.3726E-06	ALSO4+	0.9671E-18	ALSO42	0.2039E-18	FE+++	0.0000E+00	FEUH++	0.0000E+00	FEUH2+	0.0000E+00
FEOH3O	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3O	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2O	0.0000E+00	FEOHH-	0.0000E+00	FESO4O	0.0000E+00	NH4+	0.0000E+00
NH3AO	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.8157E-08	H2SO4O	0.2825E-19	H5O4-	0.3267E-08
HCLO	0.7256E-15	H2SAO	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3O	0.1131E-03
H2BO3-	0.1674E-04	H2CO3+	0.6661E-05	O2AO	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.33	CO3--	5.36	HCO3-	3.30	SO4--	2.61	CL-	1.59	CA++	3.25	CAOH+	7.14
CACO3O	5.26	CAHCO3	5.32	CASO4O	3.49	MG++	4.30	MGOH+	7.33	MGCO3O	6.57	MGHCO3	6.49
MGSO4O	4.62	NA+	1.46	NACO3-	5.20	NAHCO3	5.01	NASO4-	3.30	NACLO	4.64	K+	3.72
KSO4-	5.36	KCLO	6.89	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	3.59
LIOH+	8.53	LISO4-	5.55	H4SIO4	3.56	H3SIO4	5.00	H2SIO4	7.78	AL+++	18.79	ALOH++	15.04
ALOH2+	11.21	ALOH4-	6.52	ALSO4+	18.10	ALSO42	18.78	FE+++	-99.99	FEOH++	-99.99	FEUH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3O	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2O	-99.99	FEOHH-	-99.99	FESO4O	-99.99	NH4+	-99.99	NH3AO	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.16	H2SO4O	19.54	H5O4-	8.58	HCLO	15.13	H2SAO	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3O	3.94	H2BO3-	4.90	H2CO3	5.17	O2AO	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-1.52	ALBITE	-1.64	ANHYDRIT	-1.17	ANORTHIT	-4.75	ARAGONIT	-0.28	BARITE	-99.99	BOEHMITE	-1.82
BRUCITE	-3.58	CALCITE	-0.00	CA-MONT	-2.35	CELESTIT	-99.99	CHALCEDON	-0.21	CHLORITE	0.68	DOLomite	-0.93
GIBBSITE	-2.55	GEOHITE	-99.99	GRIEGITE	-99.99	GYPSUM	-1.22	HALITE	-4.66	HALLUOYST	-5.36	HEMATITE	-99.99
HUNTITE	-6.08	HYDROMAG	-5.13	ILLITE	-2.33	KAOLINIT	-1.44	K-MICA	-3.77	MACKINAW	-99.99	MAGNESIT	-1.18
MAGNETIT	-99.99	MIRABILT	-5.14	NESQUEHO	-4.27	PHLOGOPT	-2.25	PYRITE	-99.99	PYRUPHYL	-1.16	QUARTZ	0.21
SIDERITE	-99.99	STRONTNT	-99.99	TALC	1.46	THENARDT	-5.32	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4O 3.56 QUARTZ 0.19 CHALCEDONY -0.17 A-CRISTOBALITE -0.42 AMORPHOUS -1.48

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT	0.1347E-03	MGTOT	0.6580E-04	NATOT	0.2871E-01	KTOT	0.1509E-03	CLTOT	0.1805E-01	ALK	0.3200E-02
SO4TOT	0.3748E-02	ALTOT	0.3715E-06	FETOT	0.0000E+00	SRTOT	0.0000E+00	BATOT	0.0000E+00	LITOT	0.1153E-03
NU3TOT	0.0000E+00	SIO2TOT	0.2163E-03	BTOT	0.1480E-03	BRTOT	0.0000E+00	H2STOT	0.0000E+00	NH4TOT	0.0000E+00

PH = 8.63 PE = 99.99 TEMP = 29.20DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.41 -LOG(PU2) = 99.99 -LOG(PCO4) = 99.99

IONIC STRENGTH = 0.03240 TOTAL DISS SOLIDS = 1.88GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.3018E-02

ION BALANCE ERRUR = 1.10PERCENT CATION EXCESS = 0.6299E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9991

INDIVIDUAL SPECIES MOLALITIES

OH-	0.6984E-05	CO3--	0.9952E-04	HCO3-	0.2832E-02	SO4--	0.3450E-02	CL-	0.1808E-01	CA++	0.1074E-03
CAOH+	0.9975E-08	CACO3D	0.4595E-05	CAHCO3	0.1873E-05	CASO4O	0.2105E-04	MG++	0.5424E-04	MGOH++	0.3396E-07
MGC03O	0.1527E-05	MGHCO3	0.9900E-06	MGSO4O	0.9134E-05	NA*	0.2842E-01	NAC03-	0.3371E-04	NAHCO3	0.3236E-04
NASO4-	0.2714E-03	NACLO	0.9059E-05	K+	0.1492E-03	KSO4-	0.1981E-05	KCLO	0.4902E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.1146E-03	LIOH0	0.1010E-08	LISO4-	0.8985E-06
H4SIO4	0.2018E-03	H3SIO4	0.1493E-04	H2SIO4	0.3387E-07	AL+++	0.1341E-18	ALOH++	0.4474E-15	ALOH2+	0.2659E-11
ALOH4-	0.3722E-06	ALSO4+	0.1356E-18	ALSO42	0.1956E-19	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3O	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3O	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEDH+	0.0000E+00	FEDH2O	0.0000E+00	FEDOH-	0.0000E+00	FESO4O	0.0000E+00	NH4+	0.0000E+00
NH3AO	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.2694E-08	H2SO4O	0.1230E-20	HSO4-	0.5398E-09
HCL0	0.4340E-16	H2SAO	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3O	0.1115E-03
H2BO3-	0.3675E-04	H2CO3*	0.1199E-04	O2AO	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.23	CO3--	4.28	HCO3-	2.62	SO4--	2.75	CL-	1.82	CA++	4.25	CAOH+	8.07
CACO3O	5.33	CAHCO3	5.80	CASO4O	4.67	MG++	4.54	MGOH+	7.54	MGC03O	5.81	MGHCO3	6.08
MGSO4O	5.04	NA*	1.62	NAC03-	4.54	NAHCO3	4.49	NASO4-	3.64	NACLO	5.04	K+	3.90
KSO4-	5.77	KCLO	7.31	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	4.01
LIOH0	8.99	LISO4-	6.12	H4SIO4	3.69	H3SIO4	4.90	H2SIO4	7.75	AL+++	19.42	ALOH++	15.63
ALOH2+	11.65	ALOH4-	6.50	ALSO4+	18.94	ALSO42	19.78	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3O	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEDH2O	-99.99	FEDOH-	-99.99	FESO4O	-99.99	NH4+	-99.99	NH3AO	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.63	H2SO4O	20.91	HSO4-	9.34	HCL0	16.36	H2SAO	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3O	3.95	H2BO3-	4.53	H2CO3	4.92	O2AO	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-1.22	ALBITE	-1.46	ANHYDRIT	-2.41	ANORTHIT	-5.48	ARAGONIT	-0.29	BARITE	-99.99	BOEHMITE	-1.82
BRUCITE	-3.60	CALCITE	-0.03	CA-MUNT	-2.27	CELESTIT	-99.99	CHALCEDN	-0.22	CHLORITE	1.43	DOLOMITE	-0.25
GIBBSITE	-2.49	GEOTHITE	-99.99	GRIEGITE	-99.99	GYPSUM	-2.39	HALITE	-5.03	HALLOYST	-5.28	HEMATITE	-99.99
HUNTITE	-4.22	HYDTOMAG	-3.39	ILLITE	-1.95	KADLINIT	-1.24	K-MICA	-3.34	MACKINAW	-99.99	MAGNESIT	-0.52
MAGNETIT	-99.99	MIRABILT	-5.07	NI-SQUEHO	-3.56	PHLOGOPT	-2.96	PYRITE	-99.99	PYKOPHYL	-2.60	QUARTZ	0.25
SIDERITE	-99.99	STROMTNT	-99.99	TALC	2.06	THENARDT	-5.80	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4O	3.69	QUARTZ	0.23	CHALCEDONY	-0.16	A-CRISTOBALITE	-0.42	AMORPHOUS	-1.49
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TITLE 83

LOCATION D-08-26-07ACAD

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.3742E-03 HGTOT 0.6170E-04 NATOT 0.3393E-01 KTOT 0.1406E-03 CLTOT 0.2088E-01 ALK 0.2100E-02
 SO4TOT 0.5934E-02 ALTOT 0.3715E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.2162E-03
 NO3TOT 0.0000E+00 SIO2TOT 0.3162E-03 BTOT 0.1573E-03 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.75 PE = 99.99 TEMP = 35.30DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.72 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.04009 TOTAL DISS SOLIDS = 2.26GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.1856E-02

ION BALANCE ERROR = 0.46PERCENT CATION EXCESS = 0.3176E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9989

INDIVIDUAL SPECIES MOLALITIES

OH-	0.1454E-04	CO3--	0.9016E-04	HCO3-	0.1677E-02	SO4--	0.5368E-02	CL-	0.2091E-01	CA++	0.2810E-03
CAOH+	0.5299E-07	CAC030	0.1140E-04	CAHCO3	0.3290E-05	CAS040	0.7932E-04	MG++	0.4837E-04	MGOH++	0.6375E-07
MGC030	0.1202E-05	MGHCO3	0.5161E-06	MGSU40	0.1169E-04	NA+	0.3344E-01	NACU3-	0.4530E-04	NAHCO3	0.2182E-04
NAS04-	0.4830E-03	NACLO	0.1190E-04	K+	0.1379E-03	KSO4-	0.2950E-05	KCLO	0.5048E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SRDH+	0.0000E+00	LI+	0.2142E-03	LIOH0	0.4455E-08	LISO4-	0.2454E-05
H4SIO4	0.2800E-03	H3SIO4	0.3694E-04	H2SIO4	0.2215E-06	AL++	0.1136E-19	ALOH++	0.7940E-16	ALOH2+	0.8634E-12
ALOH4-	0.3723E-06	ALS04+	0.1658E-19	ALS042	0.3582E-20	FE+++	0.0000E+00	FEUH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH30	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL30	0.0000E+00	FES04+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH20	0.0000E+00	FEUOH-	0.0000E+00	FES040	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4S04	0.0000E+00	NO3-	0.0000E+00	H+	0.2067E-08	H2S040	0.1432E-20	HS04-	0.7227E-09
HCL0	0.6894E-16	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO30	0.1053E-03
H2BO3-	0.5239E-04	H2CO3*	0.5026E-05	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	4.92	CO3--	4.35	HCO3-	2.85	SO4--	2.58	CL-	1.76	CA++	3.86	CAOH+	7.35
CAC030	4.94	CAHCO3	5.56	CAS040	4.10	MG++	4.61	MGOH+	7.27	MGC030	5.92	MGHCO3	6.37
MGS040	4.93	NA+	1.55	NACU3-	4.42	NAHCO3	4.66	NAS04-	3.39	NACLO	4.92	K+	3.94
KSO4-	5.61	KCLO	7.29	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SRDH+	-99.99	LI+	3.74
LIOH0	8.35	LISO4-	5.69	H4SIO4	3.55	H3SIO4	4.51	H2SIO4	6.96	AL++	20.53	ALOH++	16.41
ALOH2+	12.14	ALOH4-	6.51	ALS04+	19.86	ALS042	20.53	FE+++	-99.99	FEUH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL30	-99.99	FES04+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH20	-99.99	FEUOH-	-99.99	FES040	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4S04	-99.99
NO3-	-99.99	H+	8.75	H2S040	20.84	HS04-	9.22	HCL0	16.16	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO30	3.97	H2BO3-	4.38	H2CO3	5.29	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-1.28	ALBITE	-1.34	ANHYDRIT	-1.80	ANORTHIT	-5.07	ARAGONIT	0.08	BARITE	-99.99	BOEHMITE	-2.18
BRUCITE	-3.07	CALCITE	0.34	CA-MONT	-2.77	CELESTIT	-99.99	CHALCEDN	-0.14	CHLORITE	3.17	DOLOMITE	0.05
GIBBSITE	-2.88	GEOTHITE	-99.99	GRIEGITE	-99.99	GYPSUM	-1.82	HALITE	-4.92	HALLUYST	-5.89	HEMATITE	-99.99
HUNTITE	-3.96	HYDTOMAG	-2.91	ILLITE	-2.44	KAULINIT	-1.91	K-MICA	-4.18	MACKINAW	-99.99	MAGNESIT	-0.57
MAGNETIT	-99.99	MIRABILIT	-5.05	MFSQUEHU	-3.64	PHLOGOPT	-0.93	PYRITE	-99.99	PYROPHYL	-2.28	QUARTZ	0.30
SIDERITE	-99.99	STRUNTNT	-99.99	TALC	3.63	THENARDT	-5.50	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO40 3.55 QUARTZ 0.28 CHALCEDONY -0.09 A-CRISTOBALITE -0.35 AMORPHOUS -1.41

SAMPLE NUMBER 8
 TITLE 033 LOCATION D-08-26-07ACAD

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)
 CATOT 0.6936E-03 MGTOT 0.4110E-04 NATOT 0.2610E-01 KTOT 0.1330E-03 CLTOT 0.1718E-01 ALK 0.8000E-03
 SO4TOT 0.4476E-02 ALTOT 0.7430E-06 FEOTOT 0.0000E+00 SKTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.2162E-03
 NO3TOT 0.0000E+00 SIU2TOT 0.2495E-03 BTOT 0.9250E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.47 PE = 99.99 TEMP = 37.80DEG C DENSITY = 1.000GM/CC
 -LOG(PCO2) = 3.81 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99
 IONIC STRENGTH = 0.03148 TOTAL DISS SOLIDS = 1.74GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.7191E-03
 ION BALANCE ERROR = 1.84PERCENT CATION EXCESS = 0.9901E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9992

INDIVIDUAL SPECIES MOLALITIES

OH-	0.8937E-05	CO3--	0.1883E-04	HCO3-	0.6717E-03	SO4--	0.4036E-02	CL-	0.1720E-01	CA++	0.5515E-03
CAOH+	0.6900E-07	CACO3D	0.5672E-05	CAHCO3	0.2958E-05	CASO4O	0.1346E-03	MG++	0.3377E-04	MGOH++	0.2985E-07
MGCO3O	0.2041E-06	MGHCO3	0.1547E-06	MGSO4O	0.7010E-05	NA+	0.2582E-01	NACU3-	0.8707E-05	MAHCO3	0.6964E-05
NASO4-	0.3025E-03	NaClO	0.7821E-05	K+	0.1309E-03	KSO4-	0.2336E-05	KClO	0.4087E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.2146E-03	LIOH0	0.3020E-08	LISO4-	0.1962E-05
H4SIO4	0.2789E-03	H3SIO4	0.2116E-04	H2SIO4	0.8217E-07	AL+++	0.1550E-18	ALOH++	0.7217E-15	ALOH2+	0.4994E-11
ALOH4-	0.7443E-06	ALSO4+	0.2018E-18	ALSU42	0.3518E-19	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3O	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3O	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2O	0.0000E+00	FEOH-	0.0000E+00	FESO4O	0.0000E+00	NH4+	0.0000E+00
NH3AO	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.3896E-08	H2SD4O	0.4749E-20	HSO4-	0.1164E-08
HClO	0.1406E-15	H2SAO	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3O	0.7324E-04
H2BO3-	0.1942E-04	H2CO3*	0.3840E-05	O2AO	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.13	CO3--	5.01	HCO3-	3.24	SO4--	2.68	CL-	1.84	CA++	3.54	CAOH+	7.23
CACO3O	5.24	CAHCO3	5.60	CASO4O	3.87	MG++	4.75	MGOH+	7.59	MGCO3O	6.69	MGHCO3	6.89
MGSO4O	5.15	NA+	1.66	NACU3-	5.13	NASO4-	5.15	NACLO	3.59	NaClO	5.10	K+	3.96
KSO4-	5.70	KClO	7.39	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	3.74
LIOH0	8.52	LISO4-	5.78	H4SIO4	3.55	H3SIO4	4.75	H2SIO4	7.37	AL+++	19.36	ALOH++	15.42
ALOH2+	11.37	ALOH4-	6.20	ALSO4+	18.77	ALSU42	19.53	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3O	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2O	-99.99	FEOH-	-99.99	FESO4O	-99.99	NH4+	-99.99	NH3AO	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.47	H2SD4O	20.32	HSO4-	9.01	HClO	15.85	H2SAO	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3O	4.13	H2BO3-	4.80	H2CO3	5.41	O2AO	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-1.17	ALBITE	-1.30	ANHYDRIT	-1.56	ANORTHIT	-4.24	ARAGONIT	-0.24	BARITE	-99.99	BOEHMITE	-1.68
BRUCITE	-3.61	CALCITE	0.03	CA-MONT	-1.78	CELESTIT	-99.99	CHALCEDN	-0.17	CHLORITE	1.17	DOLOMITE	-1.03
GIBBSITE	-2.40	GEOTHITE	-99.99	GRIEGITE	-99.99	GYPSUM	-1.60	HALITE	-5.11	HALLUYST	-4.97	HEMATITE	-99.99
HUNTITE	-6.52	HYDTOMAG	-5.66	ILLITE	-1.76	KAOLINIT	-1.02	K-MICA	-3.11	MACKINAW	-99.99	MAGNESIT	-1.33
MAGNETIT	-99.99	MIRABILT	-5.47	MESQUEHO	-4.40	PHLOGOPT	-2.27	PYRITE	-99.99	PYKOPHYL	-1.11	QUARTZ	0.27
SIDERITE	-99.99	STROMTNT	-99.99	TALC	1.74	THENARDT	-5.81	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4O	3.55	QUARTZ	0.25	CHALCEDONY	-0.12	A-CRISTOBALITE	-0.37	AMORPHOUS	-1.43
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INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.1247E-03 MGTOT 0.7400E-05 NATOT 0.1927E-01 KTOT 0.8690E-04 CLTOT 0.1128E-01 ALK 0.4900E-03
 SO4TOT 0.3227E-02 ALTOT 0.3715E-05 FETOT 0.0000E+00 SKTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.1441E-03
 NO3TOT 0.0000E+00 SIO2TOT 0.3328E-03 BTOT 0.7400E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.92 PE = 99.99 TEMP = 33.70DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 4.61 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.02193 TOTAL DISS SOLIDS = 1.21GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.3484E-03

ION BALANCE ERROR = 4.13PERCENT CATION EXCESS = 0.1551E-02(CHARGE*MOLES) H2O ACTIVITY = 0.9994

INDIVIDUAL SPECIES MOLALITIES

OH-	0.1839E-04	CO3--	0.2187E-04	HCO3-	0.3150E-03	SO4--	0.3026E-02	CL-	0.1129E-01	CA++	0.1016E-03
CAOH+	0.2800E-07	CACO3D	0.1285E-05	CAHCO3	0.2466E-06	CASO4O	0.2164E-04	MG++	0.6210E-05	MGOH++	0.1177E-07
MGC030	0.4875E-07	MGHCO3	0.1405E-07	MGS04O	0.1125E-05	NA+	0.1910E-01	NAC03-	0.6751E-05	NAHCO3	0.2534E-05
NAS04-	0.1800E-03	NACLO	0.3999E-05	K+	0.8580E-04	KSO4-	0.1183E-05	KCLO	0.1857E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SR0H+	0.0000E+00	LI+	0.1432E-03	LIOH0	0.3926E-08	LISO4-	0.1075E-05
H4SIO4	0.2840E-03	H3SIO4	0.4924E-04	H2SIO4	0.3329E-06	AL+++	0.2796E-19	ALOH++	0.2807E-15	ALOH2+	0.4579E-11
ALOH4-	0.3720E-05	ALSO4+	0.3241E-19	ALSO42	0.4573E-20	FE+++	0.0000E+00	FE0H++	0.0000E+00	FE0H2+	0.0000E+00
FE0H3O	0.0000E+00	FE0H4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3O	0.0000E+00	FES04+	0.0000E+00
FE++	0.0000E+00	FE0H+	0.0000E+00	FE0H2O	0.0000E+00	FE0H-	0.0000E+00	FES04O	0.0000E+00	NH4+	0.0000E+00
NH3AO	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.1359E-08	H2SO4O	0.3971E-21	HSO4-	0.2949E-09
HCL0	0.2252E-16	H2SAO	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3O	0.4438E-04
H2BO3-	0.2971E-04	H2CO3*	0.6728E-06	O2AO	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	4.80	CO3--	4.90	HCO3-	3.56	SO4--	2.77	CL-	2.01	CA++	4.24	CAOH+	7.61
CACO3O	5.89	CAHCO3	6.67	CASO4O	4.66	MG++	5.44	MGOH+	7.99	MGC030	7.31	MGHCO3	7.92
MGS04O	5.95	NA+	1.78	NAC03-	5.23	NAHCO3	5.59	NAS04-	3.81	NACLO	5.40	K+	4.13
KSO4-	5.99	KCLO	7.73	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SR0H+	-99.99	LI+	3.90
LIOH0	8.40	LISO4-	6.03	H4SIO4	3.54	H3SIO4	4.37	H2SIO4	6.72	AL+++	20.03	ALOH++	15.79
ALOH2+	11.40	ALOH4-	5.49	ALSO4+	19.55	ALSO42	20.40	FE+++	-99.99	FE0H++	-99.99	FE0H2+	-99.99
FE0H3	-99.99	FE0H4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3O	-99.99	FES04+	-99.99	FE++	-99.99
FE0H+	-99.99	FE0H2O	-99.99	FE0H-	-99.99	FES04O	-99.99	NH4+	-99.99	NH3AO	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.92	H2SO4O	21.40	HSO4-	9.59	HCL0	16.65	H2SAO	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3O	4.35	H2BO3-	4.60	H2CO3	6.17	O2AO	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-0.33	ALBITE	-0.44	ANHYDRIT	-2.38	ANORTHIT	-3.34	ARAGONIT	-0.86	BARITE	-99.99	BOEHMITE	-1.27
BRUCITE	-3.65	CALCITE	-0.60	CA-MONT	-0.58	CELESTIT	-99.99	CHALCEDN	-0.12	CHLORITE	2.23	DOLomite	-2.29
GIBBSITE	-1.97	GFOTHITE	-99.99	GRJEGITE	-99.99	GYPSUM	-2.39	HALITE	-5.39	HALLOYST	-4.02	HEMATITE	-99.99
MUMTITE	-9.14	HYDOMAG	-7.74	ILLITE	-0.41	KAOLINIT	-0.02	K-MICA	-1.40	MACKINAW	-99.99	MAGNESIT	-1.98
MAGNETIT	-99.99	MIRABILT	-5.61	NE-SQUEHO	-5.04	PHLOGOPT	-1.86	PYRITE	-99.99	PYKOPHYL	-0.57	QUARTZ	0.33
SIDERITE	-99.99	STROMTNT	-99.99	TALC	2.04	THENARDT	-6.14	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4O 3.54 QUARTZ 0.31 CHALCEDONY -0.07 A-CRISTOBALITE -0.32 AMORPHOUS -1.39

TITLE 0 LOCATION D-08-26-07888C

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.3742E-03 MGTOT 0.1280E-04 NATOT 0.1892E-01 KTOT 0.9970E-04 CLTOT 0.1213E-01 ALK 0.7400E-03
 SO4TOT 0.3227E-02 ALTOT 0.3715E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.1873E-03
 NO3TOT 0.0000E+00 SIO2TOT 0.2662E-03 BTOT 0.7400E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.50 PE = 99.99 TEMP = 33.80DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.88 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.02267 TOTAL DISS SOLIDS = 1.26GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.6791E-03

ION BALANCE ERROR = 1.71PERCENT CATION EXCESS = 0.6609E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9994

INDIVIDUAL SPECIES MOLALITIES

OH-	0.7007E-05	CO3--	0.1708E-04	HCO3-	0.6436E-03	SO4--	0.2990E-02	CL-	0.1214E-01	CA++	0.3066E-03
CAOH+	0.3193E-07	CAC030	0.2982E-05	CAHCO3	0.1509E-05	CAS040	0.6352E-04	MG++	0.1079E-04	MGOH++	0.7736E-08
MGC030	0.6521E-07	MGHCO3	0.4954E-07	MGS040	0.1902E-05	NA+	0.1876E-01	NAC03-	0.5140E-05	NAHCO3	0.5065E-05
NAS04-	0.1733E-03	NACLO	0.4204E-05	K+	0.9847E-04	KSO4-	0.1331E-05	KCLO	0.2281E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.1862E-03	LIDHO	0.1937E-08	LISO4-	0.1371E-05
H4SIO4	0.2500E-03	H3SIO4	0.1652E-04	H2SIO4	0.4269E-07	AL+++	0.1353E-18	ALOH++	0.5136E-15	ALOH2+	0.3168E-11
ALOH4-	0.3720E-06	ALSO4+	0.1521E-18	ALSO42	0.2104E-19	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH30	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL30	0.0000E+00	FES04+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH20	0.0000E+00	FEOH-	0.0000E+00	FES040	0.0000E+00	NH4+	0.0000E+00
NH3AO	0.0000E+00	NH4S04	0.0000E+00	NO3-	0.0000E+00	H+	0.3580E-08	H2S040	0.2693E-20	HS04-	0.7621E-09
HCL0	0.6354E-16	H2SA0	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO30	0.5902E-04
H2BO3-	0.1507E-04	H2CO3*	0.3608E-05	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.22	CO3--	5.01	HCO3-	3.25	SO4--	2.78	CL-	1.98	CA++	3.76	CAOH+	7.56
CAC030	5.52	CAHCO3	5.88	CAS040	4.19	MG++	5.21	MGOH+	8.17	MGC030	7.18	MGHCO3	7.37
MGS040	5.72	NA+	1.79	NAC03-	5.35	NAHCO3	5.29	NAS04-	3.82	NACLO	5.37	K+	4.07
KSO4-	5.94	KCLO	7.64	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	3.79
LIDHO	8.71	LISO4-	5.93	H4SIO4	3.60	H3SIO4	4.85	H2SIO4	7.62	AL+++	19.35	ALOH++	15.54
ALOH2+	11.56	ALOH4-	6.49	ALSO4+	18.88	ALSO42	19.74	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL30	-99.99	FES04+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH20	-99.99	FEOH-	-99.99	FES040	-99.99	NH4+	-99.99	NH3AO	-99.99	NH4S04	-99.99
NO3-	-99.99	H+	8.50	H2S040	20.57	HS04-	9.18	HCL0	16.19	H2SA0	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO30	4.23	H2BO3-	4.90	H2CO3	5.44	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-1.43	ALBITE	-1.62	ANHYDRIT	-1.91	AMORTHIT	-4.98	ARAGONIT	-0.50	BARITE	-99.99	BOEHMITE	-1.85
BRUCITE	-4.26	CALCITE	-0.23	CA-MUNT	-2.19	CELESTIT	-99.99	CHALCEDN	-0.17	CHLORITE	-2.12	DOLOMITE	-1.80
GIBBSITE	-2.55	GEUTHITE	-99.99	GRLEGITE	-99.99	GYPSUM	-1.92	HALITE	-5.37	HALLUYST	-5.29	HEMATITE	-99.99
HUNTITE	-8.39	HYDTOMAG	-7.96	ILLITE	-2.30	KAOLINIT	-1.30	K-MICA	-3.67	MACKINAW	-99.99	MAGNESIT	-1.85
MAGNETIT	-99.99	MIKABIT	-5.64	NE SQUEHO	-4.92	PHLOGOPT	-4.78	PYRITE	-99.99	PYKOPHYL	-1.95	QUARTZ	0.28
SIDERITE	-99.99	STRUNTNT	-99.99	TALC	0.01	THENARDT	-6.16	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO40 3.60 QUARTZ 0.25 CHALCEDONY -0.12 A-CRISTOBALITE -0.38 AMORPHOUS -1.44

TITLE 83

LOCATION D-08-26-12AAAA

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.6986E-03 MGTOT 0.2260E-04 NATOT 0.2632E-01 KTOT 0.1304E-03 CLTOT 0.1905E-01 ALK 0.7000E-03
 SO4TOT 0.4268E-02 ALTOT 0.3715E-06 FE1OT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.2162E-03
 NO3TOT 0.0000E+00 SIOTOT 0.2662E-03 BTOT 0.8788E-04 BRTOT 0.0000E+00 H2S1OT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.33 PE = 99.99 TEMP = 36.00DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.72 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.03160 TOTAL DISS SOLIDS = 1.75GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.6511E-03

ION BALANCE ERROR = 1.51PERCENT CATION EXCESS = 0.8185E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9991

INDIVIDUAL SPECIES MOLALITIES

OH-	0.5708E-05	CO3--	0.1217E-04	HCO3-	0.6160E-03	SO4--	0.3850E-02	CL-	0.1808E-01	CA++	0.5638E-03
CAOH+	0.4460E-07	CACD30	0.3555E-05	CAHCO3	0.2628E-05	CASO40	0.1298E-03	MG++	0.1879E-04	MGOH++	0.1040E-07
MGCO30	0.7158E-07	MGHCO3	0.7803E-07	MGSO40	0.3686E-05	NA+	0.2606E-01	NACD3-	0.5228E-05	MAHCO3	0.6449E-05
NASO4-	0.2886E-03	NACLO	0.8299E-05	K+	0.1285E-03	KSO4-	0.2128E-05	KCLO	0.4219E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SRDH+	0.0000E+00	LI+	0.2147E-03	LIOH0	0.1845E-08	LISD4-	0.1875E-05
H4SIO4	0.2538E-03	H3SIO4	0.1289E-04	H2SIO4	0.3024E-07	AL+++	0.4253E-18	ALOH++	0.1243E-14	ALOH2+	0.5604E-11
ALOH4-	0.3721E-06	ALSD4+	0.5185E-18	ALSD42	0.8573E-19	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH30	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL30	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH20	0.0000E+00	FEDOH-	0.0000E+00	FESO40	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.5377E-08	H2SO40	0.7864E-20	HSO4-	0.1457E-08
HCL0	0.1712E-15	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO30	0.7422E-04
H2BO3-	0.1382E-04	H2CD3+	0.4915E-05	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.32	CO3--	5.20	HCO3-	3.28	SO4--	2.70	CL-	1.82	CA++	3.53	CAOH+	7.42
CACD30	5.45	CAHCO3	5.65	CASO40	3.88	MG++	5.00	MGOH+	8.05	MGCO30	7.14	MGHCO3	7.18
MGSO40	5.43	NA+	1.66	NACD3-	5.35	MAHCO3	5.19	NASO4-	3.61	NACLO	5.08	K+	3.97
KSO4-	5.74	KCLO	7.37	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SRDH+	-99.99	LI+	3.74
LIOH0	8.73	LISD4-	5.80	H4SIO4	3.59	H3SIO4	4.96	H2SIO4	7.80	AL+++	18.92	ALOH++	15.19
ALOH2+	11.32	ALOH4-	6.50	ALSD4+	18.36	ALSD42	19.14	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL30	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH20	-99.99	FEDOH-	-99.99	FESO40	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.33	H2SO40	20.10	HSO4-	8.91	HCL0	15.76	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO30	4.13	H2BO3-	4.95	H2CD3	5.31	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-1.48	ALBITE	-1.61	ANHYDRIT	-1.59	ANORTHIT	-4.84	ARAGONIT	-0.43	BARITE	-99.99	BOEHMITE	-1.78
BRUCITE	-4.25	CALCITE	-0.17	CA-MONT	-2.11	CELESTIT	-99.99	CHALCEDN	-0.19	CHLORITE	-2.16	DOLOMITE	-1.68
GIBBSITE	-2.48	GEOTHITE	-99.99	GRIEGITE	-99.99	GYP SUM	-1.61	HALITE	-5.08	HALLOYST	-5.19	HEMATITE	-99.99
HUNTITE	-8.13	HYDTOMAG	-7.74	ILLITE	-2.27	KAOLINIT	-1.22	K-MICA	-3.59	HACKINAM	-99.99	MAGNESIT	-1.79
MAGNETIT	-99.99	MIRABILT	-5.40	NESQUEHO	-4.87	PHLOGOPT	-4.63	PYRITE	-99.99	PYRUPHYL	-1.60	QUARTZ	0.25
SIDERITE	-99.99	STROMTNT	-99.99	TALC	-0.17	THENARDT	-5.82	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO40	3.59	QUARTZ	0.23	CHALCEDONY	-0.14	A-CRISTOBALITE	-0.40	AMORPHOUS	-1.46
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TITLE 0 LOCATION D-OR-25-12AAAA

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.1622E-02 MGTOT 0.3950E-04 NATOT 0.3698E-01 KTOT 0.1892E-03 CLTOT 0.2765E-01 ALK 0.5500E-03
 SO4TOT 0.5621E-02 ALTOT 0.3715E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.2882E-03
 NO3TOT 0.0000E+00 SIO2TOT 0.3162E-03 BTOT 0.1018E-03 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.15 PE = 99.99 TEMP = 38.50DEG C DENSITY = 1.000GM/CC
 -LOG(PCO2) = 3.65 -LOG(PO2) = 99.99 -LOG(PCO4) = 99.99
 IONIC STRENGTH = 0.04523 TOTAL DISS SOLIDS = 2.50GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.5113E-03
 ION BALANCE ERROR = 1.72PERCENT CATION EXCESS = 0.1341E-02(CHARGE*MOLES) H2O ACTIVITY = 0.9988

INDIVIDUAL SPECIES MOLALITIES

OH-	0.4618E-05	CO3--	0.6966E-05	HCO3-	0.4789E-03	SO4--	0.4840E-02	CL-	0.2770E-01	CA++	0.1302E-02
CAOH+	0.7655E-07	CACO3O	0.4185E-05	CAHCO3	0.4629E-05	CASO4O	0.3153E-03	MG++	0.3267E-04	MGOH++	0.1369E-07
MGCO3O	0.6136E-07	MGHCO3	0.9866E-07	MGSO4O	0.6759E-05	NA+	0.3657E-01	NAO3-	0.4283E-05	NAHCO3	0.6680E-05
NASO4-	0.4668E-03	NACLO	0.1687E-04	K+	0.1860E-03	KSO4-	0.3630E-05	KCLO	0.8813E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.2861E-03	LIOH0	0.2006E-08	LISO4-	0.2847E-05
H4SIO4	0.3052E-03	H3SIO4	0.1178E-04	H2SIO4	0.2508E-07	AL+++	0.1435E-17	ALOH++	0.3181E-14	ALOH2+	0.1023E-10
ALOH4-	0.3724E-06	ALSO4+	0.1798E-17	ALSO42	0.3414E-18	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3O	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3O	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2O	0.0000E+00	FEODH-	0.0000E+00	FESO4O	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.8282E-08	H2SO4O	0.2327E-19	HSO4-	0.2767E-08
HCL0	0.4908E-15	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3O	0.8995E-04
H2BO3-	0.1210E-04	H2CO3*	0.5547E-05	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.42	CO3--	5.48	HCO3-	3.40	SO4--	2.65	CL-	1.65	CA++	3.21	CAOH+	7.19
CACO3O	5.37	CAHCO3	5.41	CASO4O	3.50	MG++	4.80	MGOH+	7.94	MGCO3O	7.21	MGHCO3	7.09
MGSO4O	5.17	NA+	1.52	NAHCO3-	5.45	NAHCO3	5.17	NASO4-	3.41	NACLO	4.77	K+	3.82
KSO4-	5.52	KCLO	7.05	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SKOH+	-99.99	LI+	3.62
LIOH0	8.69	LISO4-	5.63	H4SIO4	3.51	H3SIO4	5.02	H2SIO4	7.92	AL+++	18.46	ALOH++	14.82
ALOH2+	11.07	ALOH4-	6.51	ALSO4+	17.83	ALSO42	18.55	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3O	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2O	-99.99	FEODH-	-99.99	FESO4O	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.15	H2SO4O	19.63	HSO4-	8.64	HCL0	15.30	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3O	4.04	H2BO3-	5.03	H2CO3	5.25	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-1.27	ALBITE	-1.38	ANHYDRIT	-1.19	ANORTHIT	-4.48	ARAGONIT	-0.38	BARITE	-99.99	BOEHMITE	-1.70
BRUCITE	-4.26	CALCITE	-0.11	CA-MONT	-1.75	CELESTIT	-99.99	CHALCEDN	-0.13	CHLORITE	-2.07	DOLomite	-1.68
GIBBSITE	-2.42	GEOTHITE	-99.99	GRIEGITE	-99.99	GYPSUM	-1.23	HALITE	-4.78	HALLUYST	-4.94	HEMATITE	-99.99
HUNTITE	-8.19	HYDROMAG	-7.85	ILLITE	-1.96	KAULINIT	-1.00	K-MICA	-3.25	MACKINAW	-99.99	MAGNESIT	-1.84
MAGNETIT	-99.99	MIRABILIT	-5.18	NESQUEHO	-4.92	PHLOGOPT	-4.27	PYRITE	-99.99	PYROPHYL	-0.93	QUARTZ	0.30
SIDERITE	-99.99	STROMTNT	-99.99	TALC	-0.12	THEMARDT	-5.49	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4O 3.51 QUARTZ 0.28 CHALCEDONY -0.09 A-CRISTOBALITE -0.34 AMORPHOUS -1.40

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)
 CATOT 0.6490E-04 MGTOT 0.2260E-04 NATOT 0.2697E-01 KTOT 0.9970E-04 CLTOT 0.1467E-01 ALK 0.4610E-02
 SO4TOT 0.3956E-02 ALTOT 0.0000E+00 FETOT 0.0000E+00 SRTOT 0.0000E+00 JATOT 0.0000E+00 LITOT 0.1009E-03
 NO3TOT 0.0000E+00 SIO2TOT 0.2662E-03 BTOT 0.2128E-03 RTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.83 PE = 99.99 TEMP = 30.40DEG C DENSITY = 1.000GM/CC
 -LOG(PCO2) = 3.46 -LOG(PD2) = 99.99 -LOG(PCM4) = 99.99
 IONIC STRENGTH = 0.03083 TOTAL DISS SOLIDS = 1.83GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.4215E-02
 ION BALANCE ERROR = 0.29PERCENT CATION EXCESS = 0.1551E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9991

INDIVIDUAL SPECIES MOLALITIES

OH-	0.1205E-04	CO3--	0.2181E-03	HCO3-	0.3863E-02	SO4--	0.3671E-02	CL-	0.1469E-01	CA++	0.4855E-04
CAOH+	0.7925E-08	CACO3	0.4798E-05	CAHCO3	0.1211E-05	CASO4	0.1045E-04	MG++	0.1775E-04	MGOH++	0.1966E-07
MGCO3	0.1140E-05	MGHCO3	0.4498E-06	MGSO4	0.3278E-05	NA+	0.2662E-01	NACU3-	0.7418E-04	NAHCO3	0.4160E-04
NASO4-	0.2757E-03	NACLO	0.6939E-05	K+	0.9842E-04	KSO4-	0.1436E-05	KCLO	0.2646E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.1002E-03	LIOH	0.1583E-08	LISO4-	0.8455E-06
H4SIO4	0.2373E-03	H3SIO4	0.2936E-04	H2SIO4	0.1196E-06	AL+++	0.0000E+00	ALOH++	0.0000E+00	ALOH2+	0.0000E+00
ALOH4-	0.0000E+00	ALSO4+	0.0000E+00	ALSO42	0.0000E+00	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3	0.0000E+00	FEOH4-	0.0000E+00	FECL+	0.0000E+00	FECL2+	0.0000E+00	FECL3	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2	0.0000E+00	FEUOH-	0.0000E+00	FESO4	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.1696E-08	H2SO4	0.5628E-21	HSO4-	0.3780E-09
HCL	0.2524E-16	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3	0.1393E-03
H2BO3-	0.7392E-04	H2CO3*	0.1023E-04	U2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	4.99	CO3--	3.94	HCO3-	2.48	SO4--	2.72	CL-	1.91	CA++	4.59	CAOH+	8.17
CACO3	5.32	CAHCO3	5.98	CASO4	4.98	MG++	5.02	MGOH+	7.77	MGCO3	5.94	MGHCO3	6.42
MGSO4	5.48	NA+	1.65	NACU3-	4.20	NAHCO3	4.38	NASO4-	3.63	NACLO	5.16	K+	4.08
KSO4-	5.91	KCLO	7.57	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SKOH+	-99.99	LI+	4.07
LIOH	8.80	LISO4-	6.14	H4SIO4	3.62	H3SIO4	4.61	H2SIO4	7.20	AL+++	-99.99	ALOH++	-99.99
ALOH2+	-99.99	ALOH4-	-99.99	ALSO4+	-99.99	ALSO42	-99.99	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL+	-99.99	FECL2+	-99.99	FECL3	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2	-99.99	FEUOH-	-99.99	FESO4	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.83	H2SO4	21.25	HSO4-	9.49	HCL	16.59	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3	3.85	H2BO3-	4.22	H2CU3	4.99	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-99.99	ALBITE	-99.99	ANHYDRIT	-2.71	ANDRTHIT	-99.99	ARAGONIT	-0.27	BARITE	-99.99	BOEHMITE	-99.99
BRUCITE	-3.61	CALCITE	-0.01	CA-MONT	-99.99	CELESTIT	-99.99	CHALCEDON	-0.16	CHLORITE	-99.99	DOLomite	-0.35
GIBBSITE	-99.99	GEUTHITE	-99.99	GRIEGITE	-99.99	GYPSUM	-2.70	HALITE	-5.15	HALLOYST	-99.99	HEMATITE	-99.99
HUNTITE	-4.55	HYDROMAG	-3.72	ILLITE	-99.99	KAULINIT	-99.99	K-MICA	-99.99	MACKINAM	-99.99	MAGNESIT	-0.64
MAGNETIT	-99.99	MIRABILT	-5.15	NESQUEHU	-3.69	PHLOGOPT	-99.99	PYRITE	-99.99	PYROPHYL	-99.99	QUARTZ	0.30
SIDERITE	-99.99	STROMTNT	-99.99	TALC	2.20	THENARDT	-5.82	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4 3.62 QUARTZ 0.28 CHALCEDONY -0.10 A-CRISTOBALITE -0.37 AMORPHOUS -1.43

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.4241E-03 MGTOT 0.2430E-04 NATOT 0.2132E-01 KTOT 0.1457E-03 CLTOT 0.1425E-01 ALK 0.1680E-02
 SO4TOT 0.2863E-02 ALTOT 0.7430E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.1729E-03
 NO3TOT 0.0000E+00 SIOTOT 0.3827E-03 BTOT 0.5550E-04 BRTOT 0.0000E+00 H2SOTOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.40 PE = 99.99 TEMP = 44.50DEG C DENSITY = 1.000GM/CC
 -LOG(PCO2) = 3.35 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99
 IONIC STRENGTH = 0.02477 TOTAL DISS SOLIDS = 1.42GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.1569E-02
 ION BALANCE ERROR = 2.03PERCENT CATION EXCESS = 0.8825E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9993

INDIVIDUAL SPECIES MOLALITIES

OH-	0.1182E-04	CO3--	0.3695E-04	HCO3-	0.1474E-02	SO4--	0.2621E-02	CL-	0.1426E-01	CA++	0.3458E-03
CAOH+	0.6278E-07	CAC030	0.9650E-05	CAHCO3	0.5253E-05	CAS040	0.6393E-04	MG++	0.2058E-04	MGMH++	0.2737E-07
MGC030	0.2981E-06	MGMCO3	0.2240E-06	MGS040	0.3200E-05	NA+	0.2113E-01	NAC03-	0.1993E-04	NAHCO3	0.1285E-04
MAS04-	0.1760E-03	NACLO	0.5463E-05	K+	0.1439E-03	KSO4-	0.1957E-05	KCLO	0.3842E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SRDH+	0.0000E+00	LI+	0.1721E-03	LIOH0	0.3885E-08	LISO4-	0.1075E-05
H4SIO4	0.3535E-03	H3SIO4	0.2974E-04	H2SIO4	0.1786E-06	AL+++	0.6122E-19	ALUH++	0.4231E-15	ALOH2+	0.3812E-11
ALOH4-	0.7441E-06	ALSO4+	0.6314E-19	ALSO42	0.7736E-20	FE+++	0.0000E+00	FEDH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH30	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL30	0.0000E+00	FES04+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH20	0.0000E+00	FEOH-	0.0000E+00	FES040	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4S04	0.0000E+00	NO3-	0.0000E+00	H+	0.4536E-08	H2S040	0.6318E-20	HS04-	0.1123E-08
HCL0	0.2630E-15	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO30	0.4456E-04
H2BO3-	0.1102E-04	H2CO3*	0.9785E-05	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.00	CO3--	4.69	HCO3-	2.90	SO4--	2.85	CL-	1.92	CA++	3.72	CAOH+	7.27
CAC030	5.01	CAHCO3	5.34	CAS040	4.19	MG++	4.94	MGMH+	7.62	MGC030	6.52	MGMCO3	6.71
MGS040	5.49	NA+	1.74	NAC03-	4.77	NAHCO3	4.89	NAS04-	3.82	NACLO	5.26	K+	3.91
KSO4-	5.77	KCLO	7.41	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	3.83
LIOH0	8.41	LISO4-	6.03	H4SIO4	3.45	H3SIO4	4.60	H2SIO4	7.01	AL+++	19.72	ALUH++	15.63
ALOH2+	11.48	ALOH4-	6.20	ALSO4+	19.27	ALSO42	20.18	FE+++	-99.99	FEDH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL30	-99.99	FES04+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH20	-99.99	FEOH-	-99.99	FES040	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4S04	-99.99
NO3-	-99.99	H+	8.40	H2S040	20.20	HS04-	9.02	HCL0	15.58	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO30	4.35	H2BO3-	5.04	H2CO3	5.01	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-1.27	ALBITE	-1.45	ANHYDRIT	-1.85	ANORTHIT	-4.47	ARAGONIT	-0.07	BARITE	-99.99	BOEHMITE	-1.84
BRUCITE	-3.56	CALCITE	0.23	CA-MONT	-2.15	CELESTIT	-99.99	CHALCEDN	-0.13	CHLORITE	0.72	DOLomite	-0.65
GIBBSITE	-2.60	GEUTHITE	-99.99	GRIEGITE	-99.99	GYPSUM	-1.92	HALITE	-5.28	HALLUYST	-5.28	HEMATITE	-99.99
HUNTITE	-5.64	HYDTOMAG	-4.87	ILLITE	-2.13	KAULINIT	-1.39	K-MICA	-3.61	MACKINAW	-99.99	MAGNESIT	-1.12
MAGNETIT	-99.99	MIRABILT	-6.08	MESQUEHO	-4.22	PHLOGOPT	-1.73	PYRITE	-99.99	PYRUPHYL	-0.55	QUARTZ	0.28
SIDERITE	-99.99	STROMTNT	-99.99	TALC	1.66	THENARDT	-6.13	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO40 3.45 QUARTZ 0.26 CHALCEDONY -0.09 A-CRISTOBALITE -0.34 AMORPHOUS -1.39

TITLE 033

LOCATION D-08-26-07ADCC

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.7730E-04 MGTOT 0.1970E-04 NATOT 0.2175E-01 KTOT 0.1023E-03 CLTOT 0.1284E-01 ALK 0.2590E-02
 SO4TOT 0.3123E-02 ALTOT 0.3715E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.1297E-03
 NO3TOT 0.0000E+00 SIU2TOT 0.1997E-03 BTOT 0.1110E-03 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.81 PE = 99.99 TEMP = 31.60DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.68 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.02478 TOTAL DISS SOLIDS = 1.43GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.2371E-02

ION BALANCE EKROR = 1.17PERCENT CATION EXCESS = 0.5063E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9993

INDIVIDUAL SPECIES MOLALITIES

OH-	0.1237E-04	CO3--	0.1160E-03	HCO3-	0.2188E-02	SO4--	0.2922E-02	CL-	0.1285E-01	CA++	0.6107E-04
CAOH+	0.1087E-07	CACO3	0.3669E-05	CAHCU3	0.9409E-06	CASO4	0.1172E-04	MG++	0.1619E-04	MGDM++	0.1963E-07
MGCU3	0.6212E-06	MGMCO3	0.2450E-06	MGSO4	0.2653E-05	NA+	0.2153E-01	NAC03-	0.3559E-04	NAHCO3	0.1958E-04
NASO4-	0.1885E-03	NaClO	0.5054E-05	K+	0.1012E-03	KSO4-	0.1266E-05	KCL0	0.2452E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.1290E-03	LIOH0	0.2220E-08	LISO4-	0.9115E-06
H4SIO4	0.1781E-03	H3SIO4	0.2192E-04	H2SIO4	0.9374E-07	AL+++	0.1315E-19	ALOH++	0.8462E-16	ALOH2+	0.9248E-12
ALOH4-	0.3720E-06	ALSO4+	0.1347E-19	ALSO42	0.1772E-20	FE+++	0.0000E+00	FEDH++	0.0000E+00	FEDH2+	0.0000E+00
FEDH3	0.0000E+00	FEDH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL30	0.0000E+00	FES04+	0.0000E+00
FE++	0.0000E+00	FEDH+	0.0000E+00	FEDH20	0.0000E+00	FEDOH-	0.0000E+00	FES040	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.1759E-08	H2SO40	0.5533E-21	HSO4-	0.3389E-09
HCL0	0.2653E-16	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3	0.7380E-04
H2BO3-	0.3736E-04	H2CO3*	0.6084E-05	U2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	4.98	CO3--	4.19	HCO3-	2.72	SO4--	2.79	CL-	1.96	CA++	4.47	CAOH+	8.03
CACO3	5.43	CAHCO3	6.09	CASO4	4.93	MG++	5.04	MGDM+	7.77	MGCO3	6.20	MGMCO3	6.68
MGSO4	5.57	NA+	1.73	NAC03-	4.51	NAHCO3	4.71	NASO4-	3.79	NaClO	5.29	K+	4.06
KSO4-	5.96	KCL0	7.61	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	3.95
LIOH0	8.65	LISO4-	6.10	H4SIO4	3.75	H3SIO4	4.73	H2SIO4	7.28	AL+++	20.38	ALOH++	16.33
ALOH2+	12.10	ALOH4-	6.50	ALSO4+	19.94	ALSO42	20.82	FE+++	-99.99	FEDH++	-99.99	FEDH2+	-99.99
FEDH3	-99.99	FEDH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL30	-99.99	FES04+	-99.99	FE++	-99.99
FEDH+	-99.99	FEDH20	-99.99	FEDOH-	-99.99	FES040	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.81	H2SO40	21.25	HSO4-	9.54	HCL0	16.57	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3	4.13	H2BO3-	4.51	H2CO3	5.21	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-1.72	ALBITE	-1.88	ANHYDRIT	-2.65	ANORTHIT	-5.90	ARAGONIT	-0.40	BARITE	-99.99	BOEHMITE	-2.09
BRUCITE	-3.60	CALCITE	-0.14	CA-MONT	-3.19	CELESTIT	-99.99	CHALCEDON	-0.30	CHLORITE	0.51	DOLomite	-0.73
GIBBSITE	-2.77	GEUTHITE	-99.99	GRIEGITE	-99.99	GYPsum	-2.65	HALITE	-5.29	HALLUYST	-5.99	HEMATITE	-99.99
HUNTITE	-5.42	HYDROMAG	-4.45	ILLITE	-2.88	KAULINIT	-1.97	K-MICA	-4.39	MACKINAW	-99.99	MAGNESIT	-0.89
MAGNETIT	-99.99	MIRABILT	-5.45	NFSQUEHO	-3.95	PHLOGOPT	-3.24	PYRITE	-99.99	PYRUPHYL	-3.16	QUARTZ	0.16
SIDERITE	-99.99	STROMTNT	-99.99	TALC	1.62	THENARDT	-6.07	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4 3.75 QUARTZ 0.14 CHALCEDONY -0.24 A-CRISTOBALITE -0.50 AMORPHOUS -1.57

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.8480E-04 MGTOT 0.1150E-04 NATOT 0.1327E-01 KTOT 0.8440E-04 CLTOT 0.6347E-02 ALK 0.1620E-02
 SU4TOT 0.1041E-02 ALTOT 0.0000E+00 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.3603E-04
 MO3TOT 0.0000E+00 SIO2TOT 0.7488E-03 BTOT 0.1850E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.58 PF = 99.99 TEMP = 23.80DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.65 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.01286 TOTAL DISS SOLIDS = 0.78GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.1545E-02

ION BALANCE ERROR = 15.04PERCENT CATION EXCESS = 0.3534E-02(CHARGE*MOLES) H2O ACTIVITY = 0.9996

INDIVIDUAL SPECIES MOLALITIES

OH-	0.3920E-05	CO3--	0.3590E-04	HCO3-	0.1484E-02	SO4--	0.9910E-03	CL-	0.6350E-02	CA++	0.7634E-04
CAOH+	0.4746E-08	CACO3O	0.1560E-05	CAHCO3	0.7252E-06	CASO4O	0.6233E-05	MG++	0.1051E-04	MGOH++	0.4250E-08
MGCO3O	0.1465E-06	MGHCO3	0.1171E-06	MGSO4O	0.7353E-06	NA+	0.1322E-01	NACO3-	0.5304E-05	NAHCO3	0.8793E-05
NASO4-	0.4343E-04	NACLO	0.1662E-05	K+	0.8409E-04	KSO4-	0.3636E-06	KCLO	0.1095E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.3596E-04	LIOH0	0.1719E-09	LISO4-	0.9961E-07
H4SIO4	0.7155E-03	H3SIO4	0.3393E-04	H2SIO4	0.3179E-07	AL+++	0.0000E+00	ALOH++	0.0000E+00	ALOH2+	0.0000E+00
ALOH4-	0.0000E+00	ALSO4+	0.0000E+00	ALSO42	0.0000E+00	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3O	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3O	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2O	0.0000E+00	FEOH-	0.0000E+00	FESO4O	0.0000E+00	NH4+	0.0000E+00
NH3AO	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.2905E-08	H2SO4O	0.4075E-21	HSO4-	0.1750E-09
HCL0	0.1036E-16	H2SAO	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3O	0.1488E-04
H2BO3-	0.3639E-05	H2CO3*	0.7944E-05	O2AO	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.46	CO3--	4.64	HCO3-	2.88	SO4--	3.20	CL-	2.25	CA++	4.31	CAOH+	8.37
CACO3O	5.81	CAHCO3	6.19	CASO4O	5.20	MG++	5.17	MGOH+	8.42	MGCO3O	6.83	MGHCO3	6.98
MGSO4O	6.13	NA+	1.93	NACO3-	5.32	NAHCO3	5.05	NASO4-	4.41	NACLO	5.78	K+	4.13
KSO4-	6.49	KCLO	7.96	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	4.49
LIOH0	9.76	LISO4-	7.05	H4SIO4	3.14	H3SIO4	4.52	H2SIO4	7.69	AL+++	-99.99	ALOH++	-99.99
ALOH2+	-99.99	ALOH4-	-99.99	ALSO4+	-99.99	ALSO42	-99.99	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3O	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2O	-99.99	FEOH-	-99.99	FESO4O	-99.99	NH4+	-99.99	NH3AO	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.58	H2SO4O	21.39	HSO4-	9.81	HCL0	16.98	H2SAO	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3O	4.83	H2BO3-	5.50	H2CO3	5.10	O2AO	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-99.99	ALBITE	-99.99	ANHYDRIT	-2.97	ANORTHIT	-99.99	ARAGONIT	-0.74	BARITE	-99.99	BOEHMITE	-99.99
BRUCITE	-4.67	CALCITE	-0.48	CA-MONT	-99.99	CELESTIT	-99.99	CHALCEDN	0.39	CHLORITE	-99.99	DOLOMITE	-1.76
GIBBSITE	-99.99	GEOTHITE	-99.99	GRIEGITE	-99.99	GYP SUM	-2.91	HALITE	-5.76	HALLUYST	-99.99	HEMATITE	-99.99
MUNTITE	-7.93	HYDROMAG	-7.75	ILLITE	-99.99	KAOLINIT	-99.99	K-MICA	-99.99	MACKINAW	-99.99	MAGNESIT	-1.58
MAGNETIT	-99.99	MIRABILT	-5.89	NESQUEHO	-4.61	PHLOGOPT	-99.99	PYRITE	-99.99	PYRUPHYL	-99.99	QUARTZ	0.88
SIDERITE	-99.99	STROMTNT	-99.99	TALC	1.60	THENARDT	-6.88	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4O 3.14 QUARTZ 0.85 CHALCEDONY 0.45 A-CRISTOBALITE 0.18 AMORPHOUS -0.89

TITLE 83

LOCATION D-07-27-02AAAB

INPUT DATA (MOLES PER LITER OF SOLUTION = EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.1247E-03 MGTOT 0.2960E-04 NATOT 0.1261E-01 KTOT 0.1074E-03 CLTOT 0.6319E-02 ALK 0.4400E-02
 SU4TOT 0.9889E-03 ALTOT 0.0000E+00 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.3603E-04
 NU3TOT 0.0000E+00 SIO2TOT 0.7654E-03 BTOT 0.2313E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.52 PE = 99.99 TEMP = 26.20DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.13 -LOG(PO2) = 99.99 -LOG(PCO4) = 99.99

IONIC STRENGTH = 0.01394 TOTAL DISS SOLIDS = 0.93GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.4273E-02

ION BALANCE ERROR = 1.45PERCENT CATION EXCESS = 0.3706E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9996

INDIVIDUAL SPECIES MOLALITIES

OH-	0.4113E-05	CO3--	0.9207E-04	HCO3-	0.4108E-02	SO4--	0.9403E-03	CL-	0.6323E-02	CA++	0.1078E-03
CAOH+	0.7020E-08	CACO3	0.5764E-05	CAHCO3	0.2999E-05	CASO4	0.8232E-05	MG++	0.2616E-04	MGOH++	0.1123E-07
MGCO3	0.9387E-06	MGHCO3	0.8061E-06	MGSU4	0.1708E-05	NA+	0.1255E-01	NACD3-	0.1433E-04	NAHCO3	0.2290E-04
NASO4-	0.3901E-04	NACLO	0.1556E-05	K+	0.1070E-03	KSO4-	0.4497E-06	KCLO	0.1375E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.3597E-04	LIOH	0.1909E-09	LISO4-	0.9293E-07
H4SIO4	0.7318E-03	H3SIO4	0.3429E-04	H2SIO4	0.3758E-07	AL+++	0.0000E+00	ALOH++	0.0000E+00	ALOH2+	0.0000E+00
ALOH4-	0.0000E+00	ALSO4+	0.0000E+00	ALSO42	0.0000E+00	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2O	0.0000E+00	FEOH-	0.0000E+00	FESO4	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.3347E-08	H2SO4	0.5736E-21	HSO4-	0.2011E-09
HCL	0.1518E-16	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3	0.1891E-04
H2BO3-	0.4238E-05	H2CO3*	0.2438E-04	U2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.44	CO3--	4.24	HCO3-	2.44	SO4--	3.23	CL-	2.25	CA++	4.17	CAOH+	8.20
CACO3	5.24	CAHCO3	5.57	CASO4	5.08	MG++	4.78	MGOH+	8.00	MGCO3	6.03	MGHCO3	6.15
MGSO4	5.77	NA+	1.95	NACD3-	4.89	NAHCO3	4.64	NASO4-	4.46	NACLO	5.81	K+	4.02
KSO4-	6.40	KCLO	7.86	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	4.49
LIOH	9.72	LISO4-	7.08	H4SIO4	3.13	H3SIO4	4.52	H2SIO4	7.62	AL+++	-99.99	ALOH++	-99.99
ALOH2+	-99.99	ALOH4-	-99.99	ALSO4+	-99.99	ALSO42	-99.99	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2O	-99.99	FEOH-	-99.99	FESO4	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.52	H2SO4	21.24	HSO4-	9.75	HCL	16.82	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3	4.72	H2BO3-	5.43	H2CO3	4.61	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-99.99	ALBITE	-99.99	ANHYDRIT	-2.84	ANORTHIT	-99.99	ARAGONIT	-0.18	BARITE	-99.99	BOEHMITE	-99.99
BRUCITE	-4.25	CALCITE	0.08	CA-MONT	-99.99	CELESTIT	-99.99	CHALCEDN	0.38	CHLORITE	-99.99	DOLomite	-0.37
GIBBSITE	-99.99	GEOTHITE	-99.99	GR IEGITE	-99.99	GYPSUM	-2.79	HALITE	-5.79	HALLUYST	-99.99	HEMATITE	-99.99
HUNTITE	-4.86	HYDTOMAG	-4.80	ILLITE	-99.99	KAULINIT	-99.99	K-MICA	-99.99	MACKINAW	-99.99	MAGNESIT	-0.76
MAGNETIT	-99.99	MIRABILT	-6.08	NESQUEHO	-3.79	PHLOGOPT	-99.99	PYRITE	-99.99	PYROPHYL	-99.99	QUARTZ	0.85
SIDERITE	-99.99	STRONTNT	-99.99	TALC	2.65	THENARDT	-6.95	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4 3.13 QUARTZ 0.83 CHALCEDONY 0.43 A-CRISTOBALITE 0.17 AMORPHOUS -0.90

SAMPLE NUMBER 18
 TITLE 3 LOCATION D-07-27-02ACDA

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.9730E-04 MGTOT 0.1150E-04 NATOT 0.1631E-01 KTOT 0.1253E-03 CLTOT 0.6347E-02 ALK 0.4330E-02
 S04TOT 0.2498E-02 ALTOT 0.0000E+00 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.4612E-04
 NO3TOT 0.0000E+00 S102TOT 0.1032E-02 BTOT 0.4625E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.47 PE = 99.99 TEMP = 39.40DEG C DENSITY = 1.000GM/CC
 -LOG(PCO2) = 3.02 -LOG(PD2) = 99.99 -LOG(PCH4) = 99.99
 IONIC STRENGTH = 0.01851 TOTAL DISS SOLIDS = 1.18GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.4118E-02
 ION BALANCE ERROR = 3.22PERCENT CATION EXCESS = 0.1029E-02(CHARGE*MOLES) H2O ACTIVITY = 0.9995

INDIVIDUAL SPECIES MOLALITIES

OH-	0.9640E-05	CO3--	0.1027E-03	HCO3-	0.3920E-02	S04--	0.2358E-02	CL-	0.6353E-02	CA++	0.7509E-04
CAOH+	0.1160E-07	CACO3	0.5647E-05	CAHCO3	0.2785E-05	CASO4	0.1388E-04	MG++	0.9360E-05	MGOH++	0.1026E-07
MGC030	0.4004E-06	MGHCO3	0.2826E-06	MGS04	0.1460E-05	NA+	0.1614E-01	NAC03-	0.3609E-04	NAHCO3	0.2710E-04
NAS04-	0.1266E-03	NACLO	0.1935E-05	K+	0.1239E-03	KS04-	0.1510E-05	KCLO	0.1537E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.4590E-04	LIOH0	0.7752E-09	LIS04-	0.2772E-06
H4S104	0.9581E-03	H3S104	0.7510E-04	H2S104	0.3128E-06	AL+++	0.0000E+00	ALOH++	0.0000E+00	ALOH2+	0.0000E+00
ALOH4-	0.0000E+00	ALS04+	0.0000E+00	ALS042	0.0000E+00	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH30	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL30	0.0000E+00	FES04+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH20	0.0000E+00	FEOH-	0.0000E+00	FES040	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4S04	0.0000E+00	NO3-	0.0000E+00	H+	0.3808E-08	H2S040	0.3426E-20	HS04-	0.7819E-09
HCL0	0.6294E-16	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO30	0.3679E-04
H2BO3-	0.9518E-05	H2CO3*	0.2297E-04	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.08	CO3--	4.22	HCO3-	2.46	S04--	2.86	CL-	2.26	CA++	4.35	CAOH+	7.99
CACO3	5.25	CAHCO3	5.61	CASO4	4.86	MG++	5.25	MGOH+	8.04	MGC030	6.40	MGHCO3	6.61
MGS040	5.83	NA+	1.85	NAC03-	4.50	NAHCO3	4.57	NAS04-	3.96	NACLO	5.71	K+	3.97
KS04-	5.88	KCLO	7.81	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	4.39
LIOH0	9.11	LIS04-	6.62	H4S104	3.02	H3S104	4.18	H2S104	6.73	AL+++	-99.99	ALOH++	-99.99
ALOH2+	-99.99	ALOH4-	-99.99	ALS04+	-99.99	ALS042	-99.99	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL30	-99.99	FES04+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH20	-99.99	FEOH-	-99.99	FES040	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4S04	-99.99
NO3-	-99.99	H+	8.47	H2S040	20.46	HS04-	9.17	HCL0	16.20	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO30	4.43	H2BO3-	5.09	H2CO3	4.64	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-99.99	ALBITE	-99.99	ANHYDRIT	-2.54	AMURTHIT	-99.99	ARAGONIT	-0.26	BARITE	-99.99	BOEHMITE	-99.99
BRUCITE	-4.03	CALCITE	0.02	CA-MONT	-99.99	CELESTIT	-99.99	CHALCEDN	0.35	CHLORITE	-99.99	DOLOMITE	-0.74
GIBBSITE	-99.99	GEUTHITE	-99.99	GRIEGITE	-99.99	GYPSUM	-2.58	HALITE	-5.72	HALLUYST	-99.99	HEMATITE	-99.99
HUNTITE	-5.61	HYDTOMAG	-5.14	ILLITE	-99.99	KAOLINIT	-99.99	K-MICA	-99.99	MACKINAW	-99.99	MAGNESIT	-1.02
MAGNETIT	-99.99	MIRABILT	-6.09	NESQUEHO	-4.11	PHLOGOPT	-99.99	PYRITE	-99.99	PYROPHYL	-99.99	QUARTZ	0.78
SIDERITE	-99.99	STROMTNT	-99.99	TALC	2.48	THENARDT	-6.37	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4S1040 3.02 QUARTZ 0.76 CHALCEDONY 0.40 A-CRISTOBALITE 0.15 AMORPHOUS -0.91

TITLE W83

LOCATION D-07-27-11888

INPUT DATA (MOLES PER LITER OF SOLUTION = EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.7240E-04 MGTOT 0.4100E-05 NATOT 0.1588E-01 KTOT 0.1278E-03 CLTOT 0.5755E-02 ALK 0.4090E-02
 SU4TOT 0.2863E-02 ALTOT 0.0000E+00 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.4756E-04
 NO3TOT 0.0000E+00 SIO2TOT 0.1082E-02 BTOT 0.4625E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.63 PE = 99.99 TEMP = 48.40DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.18 -LOG(PO2) = 99.99 -LOG(PCO4) = 99.99

IONIC STRENGTH = 0.01853 TOTAL DISS SOLIDS = 1.17GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.3687E-02

ION BALANCE ERROR = 2.04PERCENT CATION EXCESS = 0.6364E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9995

INDIVIDUAL SPECIES MOLALITIES

OH-	0.2549E-04	CO3--	0.1451E-03	HCO3-	0.3422E-02	SO4--	0.2705E-02	CL-	0.5760E-02	CA++	0.5147E-04
CAOH+	0.2197E-07	CAC030	0.7354E-05	CAHCO3	0.2174E-05	CAS040	0.1146E-04	MG++	0.3194E-05	MGMH++	0.1020E-07
MGCO30	0.2174E-06	MGHCO3	0.8970E-07	MGS040	0.5938E-06	NA+	0.1565E-01	NACU3-	0.7314E-04	MAHCO3	0.2283E-04
NAS04-	0.1465E-03	NACLO	0.1693E-05	K+	0.1259E-03	KSO4-	0.2003E-05	KCLO	0.1409E-07	BA++	0.0000E+00
BADH+	0.0000E+00	SR++	0.0000E+00	SROM+	0.0000E+00	LI+	0.4729E-04	LIOH0	0.2613E-08	LISO4-	0.3246E-06
H4SIO4	0.9311E-03	H3SIO4	0.1521E-03	H2SIO4	0.2089E-05	AL+++	0.0000E+00	ALOH++	0.0000E+00	ALOH2+	0.0000E+00
ALOH4-	0.0000E+00	ALSO4+	0.0000E+00	ALSO42	0.0000E+00	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH30	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL30	0.0000E+00	FES04+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH20	0.0000E+00	FEUOH-	0.0000E+00	FES040	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4S04	0.0000E+00	NO3-	0.0000E+00	H+	0.2640E-08	H2S040	0.2924E-20	HS04-	0.8034E-09
HCL0	0.9118E-16	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3B030	0.3223E-04
H2B03-	0.1407E-04	H2CO3*	0.1353E-04	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	4.66	CO3--	4.07	HCO3-	2.52	SO4--	2.81	CL-	2.30	CA++	4.52	CAOH+	7.72
CAC030	5.13	CAHCO3	5.72	CAS040	4.94	MG++	5.72	MGMH+	8.05	MGHCO3	6.66	MGHCO3	7.11
MGS040	6.22	NA+	1.87	NAC03-	4.19	NAHCO3	4.64	NAS04-	3.89	NACLO	5.77	K+	3.96
KSO4-	5.76	KCLO	7.85	BA++	-99.99	BADH+	-99.99	SR++	-99.99	SROM+	-99.99	LI+	4.38
LIOH0	8.58	LISO4-	6.55	H4SIO4	3.03	H3SIO4	3.88	H2SIO4	5.91	AL+++	-99.99	ALOH++	-99.99
ALOH2+	-99.99	ALOH4-	-99.99	ALSO4+	-99.99	ALSO42	-99.99	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL30	-99.99	FES04+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH20	-99.99	FEUOH-	-99.99	FES040	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4S04	-99.99
NO3-	-99.99	H+	8.63	H2S040	20.53	HS04-	9.16	HCL0	16.04	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3B030	4.49	H2B03-	4.92	H2CO3	4.87	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-99.99	ALBITE	-99.99	ANHYDRIT	-2.58	ANORTHIT	-99.99	ARAGONIT	-0.22	BARITE	-99.99	BOEHMITE	-99.99
BRUCITE	-3.67	CALCITE	0.09	CA-MONT	-99.99	CELESTIT	-99.99	CHALCEDN	0.25	CHLORITE	-99.99	DOLomite	-0.93
GIBBSITE	-99.99	GEOTHITE	-99.99	GRIEGITE	-99.99	GYPSUM	-2.66	HALITE	-5.80	HALLUYST	-99.99	HEMATITE	-99.99
HUNTITE	-6.10	HYDROMAG	-5.25	ILLITE	-99.99	KAOLINIT	-99.99	K-MICA	-99.99	MACKINAW	-99.99	MAGNESIT	-1.23
MAGNETIT	-99.99	MIRABILT	-6.44	NE SQUEHU	-4.34	PHLOGOPT	-99.99	PYRITE	-99.99	PYRUPHYL	-99.99	QUARTZ	0.64
SIDERITE	-99.99	STROMTNT	-99.99	TALC	2.66	THENARDT	-6.33	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO40 3.03 QUARTZ 0.63 CHALCEDONY 0.28 A-CRISTOBALITE 0.04 AMORPHOUS -1.01

TITLE 000003

LOCATION 0-07-27-118888

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.7980E-04 MGTOT 0.4100E-05 NATOT 0.1588E-01 KTOT 0.1381E-03 CLTOT 0.6122E-02 ALK 0.4110E-02
 SO4TOT 0.2811E-02 ALTOT 0.0000E+00 FE1TOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.5044E-04
 NO3TOT 0.0000E+00 SIO2TOT 0.1082E-02 BTOT 0.4163E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.53 PE = 99.99 TEMP = 49.20DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.05 -LOG(PO2) = 99.99 -LOG(PCO4) = 99.99

IONIC STRENGTH = 0.01862 TOTAL DISS SOLIDS = 1.18GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.3779E-02

ION BALANCE ERROR = 1.21PERCENT CATION EXCESS = 0.3813E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9995

INDIVIDUAL SPECIES MOLALITIES

OH- 0.2134E-04 CO3-- 0.1205E-03 HCO3- 0.3545E-02 SO4-- 0.2654E-02 CL- 0.6127E-02 CA++ 0.5765E-04
 CAOH+ 0.2065E-07 CACO3O 0.7022E-05 CAHCO3 0.2580E-05 CASO4O 0.1262E-04 MG++ 0.3228E-05 MGOH++ 0.8692E-08
 MGC03O 0.1840E-06 MGHC03 0.9439E-07 MGS04O 0.5895E-06 NA+ 0.1566E-01 NACO3- 0.6279E-04 NAHCO3 0.2364E-04
 NASO4- 0.1442E-03 NACLO 0.1800E-05 K+ 0.1361E-03 KSO4- 0.2145E-05 KCLO 0.1618E-07 BA++ 0.0000E+00
 BAOH+ 0.0000E+00 SR++ 0.0000E+00 SROH+ 0.0000E+00 LI+ 0.5016E-04 LIOH0 0.2362E-08 LISO4- 0.3371E-06
 H4SIO4 0.9554E-03 H3SIO4 0.1279E-03 H2SIO4 0.1495E-05 AL+++ 0.0000E+00 ALOH++ 0.0000E+00 ALOH2+ 0.0000E+00
 ALOH4- 0.0000E+00 ALSO4+ 0.0000E+00 ALSO42 0.0000E+00 FE+++ 0.0000E+00 FEDH++ 0.0000E+00 FEDH2+ 0.0000E+00
 FEDH3O 0.0000E+00 FEDH4- 0.0000E+00 FECL++ 0.0000E+00 FECL2+ 0.0000E+00 FECL3O 0.0000E+00 FESO4+ 0.0000E+00
 FE++ 0.0000E+00 FEDH+ 0.0000E+00 FEDH2O 0.0000E+00 FEUOH- 0.0000E+00 FESO4O 0.0000E+00 NH4+ 0.0000E+00
 NH3AO 0.0000E+00 NH4SO4 0.0000E+00 NO3- 0.0000E+00 H+ 0.3325E-08 H2SU4O 0.4718E-20 HSO4- 0.1015E-08
 HCL0 0.1312E-15 H2SAO 0.0000E+00 HS- 0.0000E+00 S-- 0.0000E+00 BR- 0.0000E+00 H3BO3O 0.3083E-04
 H2BO3- 0.1085E-04 H2CO3+ 0.1763E-04 O2AO 0.0000E+00

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH 4.73 CO3-- 4.15 HCO3- 2.51 SO4-- 2.81 CL- 2.28 CA++ 4.47 CAOH+ 7.74
 CACO3O 5.15 CAHCO3 5.65 CASO4O 4.90 MG++ 5.72 MGOH+ 8.12 MGC03O 6.73 MGHC03 7.09
 MGS04O 6.23 NA+ 1.87 NACO3- 4.26 NASO4- 3.90 NACLO 5.74 K+ 3.93
 KSO4- 5.73 KCLO 7.79 BA++ -99.99 BAOH+ -99.99 SR++ -99.99 SROH+ -99.99 LI+ 4.36
 LIOH0 8.62 LISO4- 6.53 H4SIO4 3.02 H3SIO4 3.95 H2SIO4 6.06 AL+++ -99.99 ALOH++ -99.99
 ALOH2+ -99.99 ALOH4- -99.99 ALSO4+ -99.99 ALSO42 -99.99 FE+++ -99.99 FEDH++ -99.99 FEDH2+ -99.99
 FEDH3 -99.99 FEDH4- -99.99 FECL++ -99.99 FECL2+ -99.99 FECL3O -99.99 FESO4+ -99.99 FE++ -99.99
 FEDH+ -99.99 FEDH2O -99.99 FEDOH- -99.99 FESO4O -99.99 NH4+ -99.99 NH3AO -99.99 NH4SO4 -99.99
 NO3- -99.99 H+ 8.53 H2SO4O 20.32 HSO4- 9.05 HCL0 15.88 H2SAO -99.99 HS- -99.99
 S-- -99.99 BR-- -99.99 H3BO3O 4.51 H2BO3- 5.04 H2CU3 4.75 O2AO -99.99

MINERAL SATURATION INDICES

ADULARIA -99.99 ALBITE -99.99 ANHYDRIT -2.53 AMORTHIT -99.99 ARAGONIT -0.25 BARITE -99.99 BOEHMITE -99.99
 BRUCITE -3.83 CALCITE 0.06 CA-MONT -99.99 CELESTIT -99.99 CHALCEDON 0.25 CHLORITE -99.99 DOLOMITE -1.03
 GIBBSITE -99.99 GEOTHITE -99.99 GRIEGITE -99.99 GYPSUM -2.61 HALITE -5.77 HALUYST -99.99 HEMATITE -99.99
 HUNTITE -6.32 HYDTOMAG -5.59 ILLITE -99.99 KAOLINIT -99.99 K-MICA -99.99 MACKINAW -99.99 MAGNESIT -1.29
 MAGNETIT -99.99 MIRABILT -6.48 MESQUEHO -4.41 PHLOGOPT -99.99 PYRITE -99.99 PYROPHYL -99.99 QUARTZ 0.65
 SIDERITE -99.99 STROMTNT -99.99 TALC 2.17 THENARDT -6.34 WITHERIT -99.99

SILICA SATURATION INDICES

-LOG H4SIO4O 3.02 QUARTZ 0.63 CHALCEDONY 0.29 A-CRISTOBALITE 0.05 AMORPHOUS -1.00

TITLE 03

LOCATION D-08-26-078083

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.1672E-02 MGTOT 0.2140E-04 NATOT 0.3576E-01 KTOT 0.2250E-03 CLTOT 0.2697E-01 ALK 0.4100E-03
 SO4TOT 0.5465E-02 ALTOT 0.7430E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.2450E-03
 NO3TOT 0.0000E+00 SIO2TOT 0.3661E-03 BTOT 0.8788E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.33 PE = 99.99 TEMP = 39.90DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.99 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.04398 TOTAL DISS SOLIDS = 2.43GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.3494E-03

ION BALANCE ERROR = 1.73PERCENT CATION EXCESS = 0.1309E-02(CHARGE*MOLES) H2O ACTIVITY = 0.9988

INDIVIDUAL SPECIES MOLALITIES

OH-	0.7684E-05	CO3--	0.7209E-05	HCO3-	0.3226E-03	SO4--	0.4700E-02	CL-	0.2702E-01	CA++	0.1344E-02
CAOH+	0.1334E-06	CACD30	0.4733E-05	CAHCO3	0.3379E-05	CASD40	0.3233E-03	MG++	0.1773E-04	MGOH++	0.1264E-07
MGCU30	0.3560E-07	MGHCO3	0.3663E-07	MGS040	0.3636E-05	NA+	0.3537E-01	NACD3-	0.4598E-05	NAHCO3	0.4366E-05
NAS04-	0.4446E-03	NACLO	0.1597E-04	K+	0.2211E-03	KSD4-	0.4313E-05	KCLO	0.1026E-06	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.2432E-03	LIOH0	0.2948E-08	LIS04-	0.2364E-05
H4SIO4	0.3456E-03	H3SIO4	0.2139E-04	H2SIO4	0.7866E-07	AL+++	0.3949E-18	ALOH++	0.1485E-14	ALOH2+	0.7875E-11
ALOH4-	0.7448E-06	ALSD4+	0.4949E-18	ALSD42	0.9235E-19	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH30	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL30	0.0000E+00	FES04+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH20	0.0000E+00	FEOH-	0.0000E+00	FES040	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4SD4	0.0000E+00	NO3-	0.0000E+00	H+	0.5467E-08	H2SD40	0.1067E-19	HS04-	0.1857E-08
HCL0	0.3626E-15	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO30	0.7293E-04
H2BO3-	0.1516E-04	H2CO3*	0.2456E-05	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.20	CO3--	5.46	HCO3-	3.57	SO4--	2.66	CL-	1.66	CA++	3.19	CAOH+	6.95
CACD30	5.32	CAHCO3	5.55	CASD40	3.49	MG++	5.06	MGOH+	7.97	MGCD30	7.44	MGHCO3	7.52
MGS040	5.43	NA+	1.53	NACD3-	5.42	NAHCO3	5.36	NAS04-	3.43	NACLO	4.79	K+	3.74
KSD4-	5.45	KCLO	6.98	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	3.69
LIOH0	8.53	LIS04-	5.71	H4SIO4	3.46	H3SIO4	4.76	H2SIO4	7.42	AL+++	19.01	ALOH++	15.15
ALOH2+	11.18	ALOH4-	6.21	ALSD4+	18.39	ALSD42	19.12	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL30	-99.99	FES04+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH20	-99.99	FEOH-	-99.99	FES040	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4SD4	-99.99
NO3-	-99.99	H+	8.33	H2SD40	19.97	HS04-	8.82	HCL0	15.44	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO30	4.13	H2BO3-	4.93	H2CO3	5.61	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-0.83	ALBITE	-1.02	ANHYDRIT	-1.17	ANORTHIT	-3.81	ARAGONIT	-0.33	BARITE	-99.99	BOEHMITE	-1.63
BRUCITE	-4.09	CALCITE	-0.06	CA-MONT	-1.39	CELESTIT	-99.99	CHALCEDN	-0.09	CHLORITE	-1.02	DOLOMITE	-1.87
GIBBSITE	-2.36	GEOTHITE	-99.99	GRIEGITE	-99.99	GYP SUM	-1.22	HALITE	-4.80	HALLUYST	-4.73	HEMATITE	-99.99
HUNTITE	-8.81	HYDTOMAG	-8.33	ILLITE	-1.49	KAOLINIT	-0.80	K-MICA	-2.68	MACKINAW	-99.99	MAGNESIT	-2.07
MAGNETIT	-99.99	MIRABILT	-5.28	NESQUEHU	-5.15	PHLOGOPT	-3.19	PYRITE	-99.99	PYRUPHYL	-0.48	QUARTZ	0.33
SIDERITE	-99.99	STROMTNT	-99.99	TALC	0.49	THEFAROT	-5.53	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO40 3.46 QUARTZ 0.31 CHALCEDONY -0.05 A-CRISTOBALITE -0.30 AMORPHOUS -1.36

TITLE 83

LOCATION D-08-25-27CAAA

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.2495E-03 MGTOT 0.9870E-04 NATOT 0.3611E-03 KTOT 0.4860E-04 CLTOT 0.5080E-04 ALK 0.4900E-03
 SO4TOT 0.2186E-03 ALTOT 0.1486E-05 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.1441E-05
 NO3TOT 0.0000E+00 SID2TOT 0.2829E-03 BTOT 0.1850E-05 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 7.18 PE = 99.99 TEMP = 6.50DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 2.80 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.00157 TOTAL DISS SOLIDS = 0.09GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.5804E-03

ION BALANCE ERROR = 6.55PERCENT CATION EXCESS = 0.1340E-03(CHARGE*MOLES) H2O ACTIVITY = 1.0000

INDIVIDUAL SPECIES MOLALITIES

OH-	0.3578E-07	CO3--	0.2425E-06	HCO3-	0.4824E-03	SO4--	0.2099E-03	CL-	0.5080E-04	CA++	0.2426E-03
CAOH+	0.1611E-09	CACO3O	0.4460E-07	CAHCO3	0.5812E-06	CASO4O	0.6254E-05	MG++	0.9612E-04	MGOH++	0.3814E-09
MGCO3O	0.1196E-07	MGHCO3	0.4151E-06	MGSO4O	0.2161E-05	NA+	0.3607E-03	MACO3-	0.5064E-09	MAHCO3	0.8988E-07
NASO4-	0.2965E-06	NACLO	0.4205E-09	K+	0.4856E-04	KSO4-	0.4281E-07	KCLO	0.5884E-10	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.1440E-05	LIOH+	0.4371E-13	LISO4-	0.1114E-08
H4SIO4	0.2827E-03	H3SIO4	0.1853E-06	H2SIO4	0.5567E-12	AL+++	0.5707E-10	ALOH++	0.1283E-08	ALOH2+	0.8349E-07
ALOH4-	0.1401E-05	ALSO4+	0.9004E-11	ALSO42	0.1161E-12	FE++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3O	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3O	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2O	0.0000E+00	FEOH-	0.0000E+00	FESO4O	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.6879E-07	H2SO4O	0.2531E-19	HSO4-	0.7213E-09
HCLO	0.3189E-18	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3O	0.1838E-05
H2BO3-	0.1174E-07	H2CO3*	0.9659E-04	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	7.47	CO3--	6.69	HCO3-	3.33	SO4--	3.75	CL-	4.31	CA++	3.69	CAOH+	9.81
CACO3O	7.35	CAHCO3	6.25	CASO4O	5.20	MG++	4.09	MGOH+	9.44	MGCO3O	7.92	MGHCO3	6.40
MGSO4O	5.67	NA+	3.46	NACO3-	9.31	NAHCO3	7.05	NASO4-	6.55	NACLO	9.38	K+	4.33
KSO4-	7.39	KCLO	10.23	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	5.86
LIOH+	13.36	LISO4-	8.97	H4SIO4	3.55	H3SIO4	6.75	H2SIO4	12.33	AL+++	10.40	ALOH++	8.97
ALOH2+	7.10	ALOH4-	5.87	ALSO4+	11.06	ALSO42	12.95	FE++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3O	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2O	-99.99	FEOH-	-99.99	FESO4O	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	7.18	H2SO4O	19.60	HSO4-	9.16	HCLO	18.50	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3O	5.74	H2BO3-	7.95	H2CO3	4.01	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	1.21	ALBITE	-0.72	ANHYDRIT	-3.07	ANORTHIT	-2.35	ARAGONIT	-2.31	BARITE	-99.99	BOEHMITE	1.19
BRUCITE	-7.57	CALCITE	-1.98	CA-MONT	6.14	CELESTIT	-99.99	CHALCEDON	0.20	CHLORITE	-9.29	DOLOMITE	-4.54
GIBBSITE	0.67	GEOTHITE	-99.99	GRIEGITE	-99.99	GYP SUM	-2.81	HALITE	-9.31	HALLUYST	1.79	HEMATITE	-99.99
HUNTITE	-13.45	HYDTOMAG	-14.77	ILLITE	4.80	KAOLINIT	6.09	K-MICA	5.43	MACKINAW	-99.99	MAGNESIT	-2.84
MAGNETIT	-99.99	MIRABILT	-8.64	MESQUEHO	-5.79	PHLOGOPT	-14.38	PYRITE	-99.99	PYRUPHYL	2.13	QUARTZ	0.76
SIDERITE	-99.99	STROMTNT	-99.99	TALC	-6.78	THENARDT	-10.52	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4O 3.55 QUARTZ 0.72 CHALCEDONY 0.28 A-CRISTOBALITE -0.01 AMORPHOUS -1.10

TITLE 33

LOCATION D-08-26-200880

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.1722E-03 MGTOT 0.2100E-05 NATOT 0.1479E-01 KTOT 0.5370E-04 CLTOT 0.7560E-02 ALK 0.7900E-03
 SO4TOT 0.2446E-02 ALTOT 0.0000E+00 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.1297E-03
 NO3TOT 0.0000E+00 SIU2TOT 0.3328E-03 BTOT 0.5180E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.44 PE = 99.99 TEMP = 35.10DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.76 -LOG(PO2) = 99.99 -LOG(PCO4) = 99.99

IONIC STRENGTH = 0.01658 TOTAL DISS SOLIDS = 0.92GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.7385E-03

ION BALANCE ERROR = 7.37PERCENT CATION EXCESS = 0.2081E-02(CHARGE*MOLES) H2O ACTIVITY = 0.9996

INDIVIDUAL SPECIES MOLALITIES

OH-	0.6616E-05	CO3--	0.1591E-04	HCO3-	0.7068E-03	SO4--	0.2307E-02	CL-	0.7565E-02	CA++	0.1434E-03
CAOH+	0.1523E-07	CACD3O	0.1544E-05	CAHCU3	0.8640E-06	CASD4O	0.2653E-04	MG++	0.1798E-05	MGOH++	0.1321E-08
MGCU3O	0.1176E-07	MGMCO3	0.9723E-08	MGSO4O	0.2816E-06	NA+	0.1468E-01	NACD3-	0.4277E-05	NAHCO3	0.4508E-05
NASO4-	0.1131E-03	NACLO	0.2128E-05	K+	0.5313E-04	KSO4-	0.6085E-06	KCLO	0.7971E-08	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.1290E-03	LIOH0	0.1362E-08	LISO4-	0.7840E-06
H4SIO4	0.3142E-03	H3SIO4	0.1889E-04	H2SIO4	0.4690E-07	AL+++	0.0000E+00	ALOH++	0.0000E+00	ALOH2+	0.0000E+00
ALOH4-	0.0000E+00	ALSO4+	0.0000E+00	ALSO42	0.0000E+00	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3O	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3O	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2O	0.0000E+00	FEOH-	0.0000E+00	FESO4O	0.0000E+00	NH4+	0.0000E+00
NH3AO	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.4059E-08	H2SO4O	0.3164E-20	HSO4-	0.7393E-09
HCL0	0.5329E-16	H2SAO	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3O	0.4244E-04
H2BO3-	0.9412E-05	H2CO3*	0.4584E-05	O2AO	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.24	CO3--	5.02	HCO3-	3.21	SO4--	2.86	CL-	2.18	CA++	4.06	CAOH+	7.87
CACD3O	5.81	CAHCO3	6.12	CASD4O	4.57	MG++	5.96	MGOH+	8.93	MGCD3O	7.93	MGMCO3	8.07
MGSO4O	6.55	NA+	1.89	NACD3-	5.42	NAHCO3	5.34	NASO4-	4.00	NACLO	5.67	K+	4.33
KSO4-	6.27	KCLO	8.10	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	3.94
LIOH0	8.86	LISO4-	6.16	H4SIO4	3.50	H3SIO4	4.78	H2SIO4	7.55	AL+++	-99.99	ALOH++	-99.99
ALOH2+	-99.99	ALOH4-	-99.99	ALSO4+	-99.99	ALSO42	-99.99	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3O	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2O	-99.99	FEOH-	-99.99	FESO4O	-99.99	NH4+	-99.99	NH3AO	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.44	H2SO4O	20.50	HSO4-	9.19	HCL0	16.27	H2SAO	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3O	4.37	H2BO3-	5.09	H2CU3	5.34	O2AO	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-99.99	ALBITE	-99.99	ANHYDRIT	-2.28	ANORTHIT	-99.99	ARAGONIT	-0.79	BARITE	-99.99	BOEHMITE	-99.99
BRUCITE	-5.04	CALCITE	-0.53	CA-MONT	-99.99	CELESTIT	-99.99	CHALCEDON	-0.09	CHLORITE	-99.99	DOLOMITE	-2.83
GIBBSITE	-99.99	GEOTHITE	-99.99	GRIEGITE	-99.99	GYPSUM	-2.30	HALITE	-5.67	HALLOYST	-99.99	HEMATITE	-99.99
HUNTITE	-10.87	HYDTOMAG	-10.93	ILLITE	-99.99	KAOLINIT	-99.99	K-MICA	-99.99	MACKINAW	-99.99	MAGNESIT	-2.59
MAGNETIT	-99.99	MIRABILT	-5.98	NE-SQUEHU	-5.66	PHLOGOPT	-99.99	PYRITE	-99.99	PYROPHYL	-99.99	QUARTZ	0.35
SIDERITE	-99.99	STROMTNT	-99.99	TALC	-2.10	THENARDT	-6.44	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4O	3.50	QUARTZ	0.34	CHALCEDONY	-0.04	A-CRISTOBALITE	-0.30	AMORPHOUS	-1.36
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TITLE 0013

LOCATION 0-08-26-2008C8

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.4940E-03 MGTOT 0.7800E-05 NATOT 0.1783E-01 KTOT 0.7420E-04 CLTOT 0.1250E-01 ALK 0.1390E-02
 SO4TOT 0.2602E-02 ALTOT 0.0000E+00 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.1297E-03
 NO3TOT 0.0000E+00 SIO2TOT 0.2995E-03 BTOT 0.4163E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.53 PE = 99.99 TEMP = 38.70DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.60 -LOG(PO2) = 99.99 -LOG(PCO4) = 99.99

IONIC STRENGTH = 0.02161 TOTAL DISS SOLIDS = 1.23GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.1292E-02

ION BALANCE ERROR = -0.13PERCENT CATION EXCESS = -0.4956E-04(CHARGE*MOLES) H2O ACTIVITY = 0.9994

INDIVIDUAL SPECIES MOLALITIES

OH-	0.1065E-04	CO3--	0.3702E-04	HCO3-	0.1212E-02	SO4--	0.2396E-02	CL-	0.1251E-01	CA++	0.4086E-03
CAOH+	0.6709E-07	CAC030	0.1013E-04	CAHCO3	0.4437E-05	CAS040	0.7138E-04	MG++	0.6663E-05	MGOH++	0.7740E-08
MGC030	0.9523E-07	MGHCO3	0.6003E-07	MGS040	0.9841E-06	NA+	0.1769E-01	NAC03-	0.1336E-04	NAHCO3	0.9027E-05
NAS04-	0.1357E-03	NACLO	0.4099E-05	K+	0.7341E-04	KSO4-	0.8676E-06	KCLO	0.1758E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.1291E-03	LIOH0	0.2324E-08	LISO4-	0.7662E-06
H4SIO4	0.2756E-03	H3SIO4	0.2430E-04	H2SIO4	0.1112E-06	AL+++	0.0000E+00	ALOH++	0.0000E+00	ALOH2+	0.0000E+00
ALOH4-	0.0000E+00	ALSO4+	0.0000E+00	ALSO42	0.0000E+00	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOM30	0.0000E+00	FEOM4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL30	0.0000E+00	FES04+	0.0000E+00
FE++	0.0000E+00	FEOM+	0.0000E+00	FEOM20	0.0000E+00	FEOMH-	0.0000E+00	FES040	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.3338E-08	H2SO40	0.2460E-20	HSO4-	0.6612E-09
HCL0	0.9990E-16	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO30	0.3212E-04
H2BO3-	0.9559E-05	H2CO3*	0.6153E-05	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.04	CO3--	4.68	HCO3-	2.98	SO4--	2.87	CL-	1.97	CA++	3.63	CAOH+	7.23
CAC030	4.99	CAHCO3	5.41	CAS040	4.14	MG++	5.41	MGOH+	8.17	MGC030	7.02	MGHCO3	7.29
MGS040	6.00	NA+	1.81	NAC03-	4.94	NAHCO3	5.04	NAS04-	3.93	NACLO	5.39	K+	4.20
KSO4-	6.12	KCLO	7.75	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	3.95
LIOH0	8.63	LISO4-	6.18	H4SIO4	3.56	H3SIO4	4.68	H2SIO4	7.20	AL+++	-99.99	ALOH++	-99.99
ALOH2+	-99.99	ALOH4-	-99.99	ALSO4+	-99.99	ALSO42	-99.99	FE+++	-99.99	FEOM++	-99.99	FEOM2+	-99.99
FEOM3	-99.99	FEOM4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL30	-99.99	FES04+	-99.99	FE++	-99.99
FEOM+	-99.99	FEOM20	-99.99	FEOMH-	-99.99	FES040	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.53	H2SO40	20.61	HSO4-	9.24	HCL0	16.00	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO30	4.49	H2BO3-	5.10	H2CO3	5.21	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-99.99	ALBITE	-99.99	ANHYDRIT	-1.83	ANORTHIT	-99.99	ARAGONIT	0.00	BARITE	-99.99	BOEHMITE	-99.99
BRUCITE	-4.11	CALCITE	0.27	CA-MONT	-99.99	CELESTIT	-99.99	CHALCEDN	-0.18	CHLORITE	-99.99	DOLOMITE	-1.11
GIBBSITE	-99.99	GEOTHITE	-99.99	GIEGITE	-99.99	GYPNUM	-1.87	HALITE	-5.39	HALLUYST	-99.99	HEMATITE	-99.99
HUNTITE	-7.24	HYDROMAG	-7.12	ILLITE	-99.99	KAOLINIT	-99.99	K-MICA	-99.99	MACKINAW	-99.99	MAGNESIT	-1.65
MAGNETIT	-99.99	MIRABILT	-6.00	NESQUEHO	-4.73	PHLOGOPT	-99.99	PYRITE	-99.99	PYRUPHYL	-99.99	QUARTZ	0.25
SIDERITE	-99.99	STROMTNT	-99.99	TALC	0.14	THENARDT	-6.30	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO40 3.56 QUARTZ 0.23 CHALCEDONY -0.14 A-CRISTOBALITE -0.39 AMORPHOUS -1.45

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.4740E-03 MGTOT 0.1070E-04 NATOT 0.1609E-01 KTOT 0.1636E-03 CLTOT 0.1036E-01 ALK 0.7300E-03
 SO4TOT 0.2811E-02 ALTOT 0.3715E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.1441E-03
 NO3TOT 0.0000E+00 SIO2TOT 0.3994E-03 BTOT 0.5088E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.39 PE = 99.99 TEMP = 36.50 DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.75 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.01977 TOTAL DISS SOLIDS = 1.10GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.6755E-03

ION BALANCE ERROR = 1.91PERCENT CATION EXCESS = 0.6412E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9995

INDIVIDUAL SPECIES MOLALITIES

OH-	0.6578E-05	CO3--	0.1356E-04	HCO3-	0.6432E-03	SO4--	0.2599E-02	CL-	0.1039E-01	CA++	0.3924E-03
CAOH+	0.4017E-07	CAC03D	0.3478E-05	CAHCO3	0.2161E-05	CAS04D	0.7642E-04	MG++	0.9111E-05	MGMH++	0.6513E-08
MGC030	0.4814E-07	MGMCO3	0.4372E-07	MGS04D	0.1503E-05	NA+	0.1597E-01	NAC03-	0.4075E-05	NAHCO3	0.4372E-05
NAS04-	0.1342E-03	NACLO	0.3110E-05	K+	0.1617E-03	KS04-	0.2048E-05	KCLO	0.3258E-07	BA++	0.0000E+00
BADH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.1433E-03	LI0H0	0.1526E-08	LIS04-	0.9432E-06
H4S104	0.3780E-03	H3S104	0.2181E-04	H2S104	0.5719E-07	AL+++	0.1863E-18	ALOH++	0.7028E-15	ALOH2+	0.4064E-11
ALOH4-	0.3719E-06	ALSO4+	0.2016E-18	ALSO42	0.2522E-19	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH30	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL30	0.0000E+00	FES04+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2D	0.0000E+00	FEOH-	0.0000E+00	FES04D	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4S04	0.0000E+00	NO3-	0.0000E+00	H+	0.4588E-08	H2S04D	0.4639E-20	HS04-	0.9445E-09
HCL0	0.9313E-16	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3B030	0.4225E-04
H2B03-	0.8690E-05	H2CO3*	0.4590E-05	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.24	CO3--	5.10	HCO3-	3.25	SO4--	2.82	CL-	2.05	CA++	3.64	CAOH+	7.45
CAC03D	5.46	CAHCO3	5.72	CAS04D	4.11	MG++	5.27	MGMH+	8.24	MGC030	7.32	MGMCO3	7.42
MGS04D	5.82	NA+	1.86	NAC03-	5.45	NAHCO3	5.36	NAS04-	3.93	NACLO	5.51	K+	3.85
KS04-	5.75	KCLO	7.49	BA++	-99.99	BADH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	3.90
LI0H0	8.81	LIS04-	6.08	H4S104	3.42	H3S104	4.72	H2S104	7.48	AL+++	19.19	ALOH++	15.39
ALOH2+	11.45	ALOH4-	6.49	ALSO4+	18.76	ALSO42	19.66	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL30	-99.99	FES04+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2D	-99.99	FEOH-	-99.99	FES04D	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4S04	-99.99
NO3-	-99.99	H+	8.39	H2S04D	20.33	HS04-	9.09	HCL0	16.03	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3B030	4.37	H2B03-	5.13	H2CO3	5.34	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-0.87	ALBITE	-1.31	ANHYDRIT	-1.81	ANORTHIT	-4.61	ARAGONIT	-0.45	BARITE	-99.99	BOEHMITE	-1.84
BRUCITE	-4.37	CALCITE	-0.18	CA-MONT	-1.66	CELESTIT	-99.99	CHALCEDN	-0.02	CHLORITE	-2.43	DOLomite	-1.87
GIBBSITE	-2.55	GEOTHITE	-99.99	GRIEGITE	-99.99	GYPSUM	-1.84	HALITE	-5.51	HALLOYST	-5.00	HEMATITE	-99.99
HUNTITE	-8.65	HYDTOMAG	-8.36	ILLITE	-1.77	KAULINIT	-1.03	K-MICA	-3.12	MACKINAW	-99.99	MAGNESIT	-1.96
MAGNETIT	-99.99	MIRABILT	-5.94	NE-SQUEHO	-5.04	PHUGOPT	-4.35	PYRITE	-99.99	PYROPHYL	-1.01	QUARTZ	0.42
SIDERITE	-99.99	STRONTNT	-99.99	TALC	0.10	THENARDT	-6.34	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4S104D 3.42 QUARTZ 0.40 CHALCEDONY 0.03 A-CRISTOBALITE -0.23 AMORPHOUS -1.29

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.6986E-03 MGOT 0.9500E-05 MATOT 0.1849E-01 KTOT 0.1355E-03 CLTOT 0.1337E-01 ALK 0.5100E-03
 S04TOT 0.3019E-02 ALTOT 0.3715E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.1729E-03
 NU3TOT 0.0000E+00 S102TOT 0.3661E-03 8TOT 0.4625E-04 BRITOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.56 PE = 99.99 TEMP = 33.70DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 4.13 -LOG(PH2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.02304 TOTAL DISS SOLIDS = 1.28GM/LITER SOLM TOTAL INORG CARBON MOLALITY = 0.4458E-03

ION BALANCE ERROR = 0.75PERCENT CATION EXCESS = 0.2943E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9994

INDIVIDUAL SPECIES MOLALITIES

OH- 0.8054E-05 CO3-- 0.1277E-04 HCO3- 0.4179E-03 S04-- 0.2753E-02 CL- 0.1338E-01 CA++ 0.5830E-03
 CADH+ 0.6952E-07 CACO3 0.4207E-05 CAHCO3 0.1056E-05 CASO4 0.1104E-03 MG++ 0.8134E-05 MGDH++ 0.6678E-08
 MGC030 0.3649E-07 MGHCO3 0.2417E-07 MGS04 0.1311E-05 NA+ 0.1834E-01 NAC03- 0.3744E-05 NAHCO3 0.3210E-05
 NASO4- 0.1555E-03 NACLO K+ 0.1340E-03 KSO4- 0.1661E-05 KCLO 0.3413E-07 BA++ 0.0000E+00
 BADH+ 0.0000E+00 SR++ 0.0000E+00 SROH+ 0.0000E+00 LI+ 0.1720E-03 LIOM 0.2052E-08 LIS04- 0.1162E-05
 H4S104 0.3407E-03 H3S104 0.2587E-04 H2S104 0.7697E-07 AL++ 0.7829E-19 ALOH++ 0.3403E-15 ALOH2+ 0.2403E-11
 ALOH4- 0.3720E-06 ALS04+ 0.8030E-19 ALS042 0.1019E-19 FE++ 0.0000E+00 FEDH++ 0.0000E+00 FEDH2+ 0.0000E+00
 FEDH30 0.0000E+00 FEDH4- 0.0000E+00 FECL++ 0.0000E+00 FECL2+ 0.0000E+00 FECL30 0.0000E+00 FES04+ 0.0000E+00
 FE++ 0.0000E+00 FEDH+ 0.0000E+00 FEDH20 0.0000E+00 FEQDH- 0.0000E+00 FES04 0.0000E+00 NH4+ 0.0000E+00
 NH3AQ 0.0000E+00 NH4S04 0.0000E+00 NO3- 0.0000E+00 H+ 0.3120E-08 H2S04 0.1874E-20 H304- 0.0000E+00
 HCL0 0.6094E-16 H2SAQ 0.0000E+00 HS- 0.0000E+00 BR- 0.0000E+00 H2S04 0.0000E+00 H3030 0.3580E-04
 H2B03- 0.1051E-04 H2CO3+ 0.2039E-05 O2AQ 0.0000E+00 S-- 0.0000E+00

INDIVIDUAL SPECIES ACTIVITIES-LOG ACTIVITY)

OH 5.16 CO3-- 5.14 HCO3- 3.44 S04-- 2.81 CL- 1.94 CA++ 3.48 CADH+ 7.22
 CACO3 5.37 CAC03 5.79 CASO4 3.95 MGH++ 5.33 MGDH+ 8.23 MGC030 7.44 MGHCO3 7.68
 MGS04 5.88 NA+ 1.80 NAC03- 5.49 NAHCO3 5.49 MAS04- 3.87 NACLO 5.34 K+ 3.94
 KSO4- 5.84 KCL0 7.46 BA++ 99.99 BADH+ 99.99 SROH+ 99.99 LI+ 3.83
 LIOM 8.64 LIS04- 6.00 H4S104 3.47 H3S104 4.65 H2S104 7.36 AL+++ 19.59 ALOH++ 15.72
 ALOH2+ 11.68 ALOH4- 6.49 ALS04+ 19.16 ALS042 20.06 FE+++ 99.99 FEDH++ 99.99 FEDH2+ 99.99
 FEH03 99.99 FEOM4- 99.99 FECL++ 99.99 FECL2+ 99.99 FECL30 99.99 FES04+ 99.99 FE++ 99.99
 FEDH+ 99.99 FEDH20 99.99 FEDH+ 99.99 FES04 99.99 NH3AQ 99.99 NH4S04 99.99
 NO3- 99.99 H+ 8.56 H2S04 20.72 HSD4- 9.28 HCL0 16.21 H2SAQ 99.99 HS- 99.99
 S-- 99.99 BR-- 99.99 H3B030 4.44 H2B03- 5.06 H2CO3 5.69 O2AQ 99.99

MINERAL SATURATION INDICES

ADULARIA -0.90 ALBITE -1.23 ANHYDRIT -1.67 ANORTHIT -4.43 ARAGONIT -0.35 BARITE -99.99 BOEHMITE -1.91
 BRUCITE -4.26 CALCITE -0.09 CA-MONT -1.77 CELESTIT -99.99 CHALCEDON -0.04 CHLORITE -1.86 DOLomite -1.90
 GIBBSITE -2.61 GEOTHITE -99.99 GRIEGITE -99.99 GYPSUM -1.68 HALITE -5.34 HALLJYST -5.14 HEMATITE -99.99
 HUNITE -9.00 HYDROMAG -8.72 ILLITE -1.86 KAOLINIT -1.15 K-MICA -3.25 MACKINAM -99.99 MAGNESIT -2.11
 MAGNETIT -99.99 MIKABILT -5.70 MESQUEHO -5.17 PHLOGOPT -4.26 PYRITE -99.99 PYRUPHYL -1.54 QUARTZ 0.41
 SIDERITE -99.99 STROMTNT -99.99 TALC 0.53 THENARDI -6.22 WITHERIT -99.99

SILICA SATURATION INDICES

-LOG H4S104 3.47 QUARTZ 0.39 CHALCEDONY 0.01 A-CRISTOBALITE -0.24 AMORPHOUS -1.31

TITLE 13

LOCATION D-08-26-20ACDB

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.5489E-03 MGTOT 0.8200E-05 NATOT 0.1936E-01 KTOT 0.1278E-03 CLTOT 0.1199E-01 ALK 0.7300E-03
 S04TOT 0.3644E-02 ALTOT 0.3715E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.1873E-03
 ND3TOT 0.0000E+00 SIO2TOT 0.4326E-03 BTOT 0.6938E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.82 PE = 99.99 TEMP = 38.00DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 4.27 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.02379 TOTAL DISS SOLIDS = 1.32GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.5713E-03

ION BALANCE ERROR = 1.96PERCENT CATION EXCESS = 0.7827E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9994

INDIVIDUAL SPECIES MOLALITIES

OH-	0.1990E-04	CO3--	0.3074E-04	HCO3-	0.5133E-03	S04--	0.3342E-02	CL-	0.1200E-01	CA++	0.4376E-03
CAOH+	0.1308E-06	CAC030	0.8449E-05	CAHCO3	0.1928E-05	CAS040	0.1016E-03	MG++	0.6765E-05	MGOH++	0.1426E-07
MGC030	0.7624E-07	MGHCO3	0.2519E-07	MGS040	0.1330E-05	NA+	0.1916E-01	NAC03-	0.1139E-04	NAHCO3	0.4093E-05
NAS04-	0.1997E-03	NACLO	0.4208E-05	K+	0.1259E-03	KS04-	0.2007E-05	KCLO	0.2857E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.1860E-03	LIOH0	0.6080E-08	LIS04-	0.1508E-05
H4SIO4	0.3709E-03	H3SIO4	0.6228E-04	H2SIO4	0.5265E-06	AL+++	0.2679E-20	ALOH++	0.2971E-16	ALOH2+	0.4895E-12
ALOH4-	0.3720E-06	ALSO4+	0.3408E-20	ALSO42	0.5280E-21	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH30	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL30	0.0000E+00	FES04+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH20	0.0000E+00	FEOH-	0.0000E+00	FES040	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4S04	0.0000E+00	NO3-	0.0000E+00	H+	0.1719E-08	H2S040	0.8512E-21	HS04-	0.4561E-09
HCL0	0.4564E-16	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO30	0.4401E-04
H2BO3-	0.2546E-04	H2CO3*	0.1333E-05	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	4.77	CO3--	4.77	HCO3-	3.35	S04--	2.73	CL-	1.99	CA++	3.61	CAOH+	6.95
CAC030	5.07	CAHCO3	5.78	CAS040	3.99	MG++	5.42	MGOH+	7.91	MGC030	7.12	MGHCO3	7.67
MGS040	5.87	NA+	1.78	NAC03-	5.01	NAHCO3	5.39	NAS04-	3.76	NACLO	5.37	K+	3.97
KS04-	5.76	KCLO	7.54	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	3.79
LIOH0	8.21	LIS04-	5.89	H4SIO4	3.43	H3SIO4	4.27	H2SIO4	6.53	AL+++	21.07	ALOH++	16.78
ALOH2+	12.37	ALOH4-	6.50	ALSO4+	20.53	ALSO42	21.34	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL30	-99.99	FES04+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH20	-99.99	FEOH-	-99.99	FES040	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4S04	-99.99
NO3-	-99.99	H+	8.82	H2S040	21.07	HS04-	9.41	HCL0	16.34	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO30	4.35	H2BO3-	4.67	H2CO3	5.87	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-1.12	ALBITE	-1.35	ANHYDRIT	-1.68	AMORTHIT	-4.66	ARAGONIT	-0.07	BARITE	-99.99	BOEHMITE	-2.33
BRUCITE	-3.57	CALCITE	0.20	CA-MONT	-2.75	CELESTIT	-99.99	CHALCEDN	-0.05	CHLORITE	0.42	DOLomite	-1.28
GIBBSITE	-3.05	GEOTHITE	-99.99	GRIEGITE	-99.99	GYPSUM	-1.72	HALITE	-5.38	HALLUYST	-6.03	HEMATITE	-99.99
HUNTITE	-7.62	HYDROMAG	-6.90	ILLITE	-2.62	KAULINIT	-2.08	K-MICA	-4.36	MACKINAW	-99.99	MAGNESIT	-1.75
MAGNETIT	-99.99	MIRABILT	-5.77	NESQUEHO	-4.93	PHUGOPT	-2.08	PYRITE	-99.99	PYRUPHYL	-1.91	QUARTZ	0.39
SIDERITE	-99.99	STROMTNT	-99.99	TALC	2.33	THENARDT	-6.10	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO40 3.43 QUARTZ 0.37 CHALCEDONY 0.00 A-CRISTOBALITE -0.25 AMORPHOUS -1.31

TITLE 83

LOCATION D-08-26-20AD88

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.1647E-03 MGTOT 0.6170E-04 NATOT 0.1131E-01 KTOT 0.1278E-03 CLTOT 0.5134E-02 ALK 0.2910E-02
 SO4TOT 0.1041E-02 ALTOT 0.7430E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.3891E-04
 NO3TOT 0.0000E+00 SIO2TOT 0.2829E-03 BTOT 0.6012E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.45 PE = 99.99 TEMP = 24.80DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.24 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.01217 TOTAL DISS SOLIDS = 0.75GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.2844E-02

ION BALANCE ERROR = 8.27PERCENT CATION EXCESS = 0.1807E-02(CHARGE*MOLES) H2O ACTIVITY = 0.9996

INDIVIDUAL SPECIES MOLALITIES

OH-	0.3127E-05	CO3--	0.4990E-04	HCO3-	0.2745E-02	SO4--	0.9875E-03	CL-	0.5137E-02	CA++	0.1457E-03
CAOH+	0.7343E-08	CACO3	0.4309E-05	CAHCO3	0.2663E-05	CASO4	0.1218E-04	MG++	0.5548E-04	MGOH++	0.1829E-07
MGCO3	0.1113E-05	MGMCO3	0.1161E-05	MGSU4	0.3972E-05	NA+	0.1126E-01	MACO3-	0.6669E-05	NAHCO3	0.1392E-04
NASO4-	0.3745E-04	MACLO	0.1151E-05	K+	0.1273E-03	KSO4-	0.5638E-06	KCLO	0.1349E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.3883E-04	LIOH	0.1530E-09	LISO4-	0.1082E-06
H4SIO4	0.2730E-03	H3SIO4	0.1007E-04	H2SIO4	0.7825E-08	AL+++	0.3025E-17	ALOH++	0.5366E-14	ALOH2+	0.1870E-10
ALOH4-	0.7435E-06	ALSO4+	0.1413E-17	ALSO42	0.7137E-19	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2	0.0000E+00	FEOH-	0.0000E+00	FESO4	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.3912E-08	H2SO4	0.7899E-21	HSO4-	0.2435E-09
HCL	0.1261E-16	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3	0.5081E-04
H2BO3-	0.9353E-05	H2CO3*	0.1961E-04	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.55	CO3--	4.49	HCO3-	2.61	SO4--	3.20	CL-	2.34	CA++	4.02	CAOH+	8.18
CACO3	5.36	CAHCO3	5.62	CASO4	4.91	MG++	4.44	MGOH+	7.78	MGCO3	5.95	MGMCO3	5.98
MGSO4	5.40	NA+	2.00	NACU3-	5.22	NAHCO3	4.86	NASO4-	4.47	MACLO	5.94	K+	3.94
KSO4-	6.30	KCLO	7.87	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	4.46
LIOH	9.81	LISO4-	7.01	H4SIO4	3.56	H3SIO4	5.05	H2SIO4	8.29	AL+++	17.90	ALOH++	14.46
ALOH2+	10.78	ALOH4-	6.18	ALSO4+	17.90	ALSO42	19.19	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3	-99.99	FESU4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2	-99.99	FEOH-	-99.99	FESO4	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.45	H2SU4	21.10	HSO4-	9.66	HCL	16.90	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3	4.29	H2BO3-	5.09	H2CO3	4.71	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-0.22	ALBITE	-0.85	ANHYDRIT	-2.68	ANORTHIT	-4.16	ARAGONIT	-0.30	BARITE	-99.99	BOEHMITE	-1.15
BRUCITE	-4.14	CALCITE	-0.04	CA-MONT	-0.02	CELESTIT	-99.99	CHALCEDN	-0.04	CHLORITE	0.95	DOLomite	-0.43
GIBBSITE	-1.79	GEOTHITE	-99.99	GYPSE	-99.99	HALITE	-2.62	HALLOYST	-3.54	HEMATITE	-99.99		
HUNTITE	-4.81	HYDROMAG	-4.54	ILLITE	0.05	KAOLINIT	0.56	K-MICA	-0.94	MACKINAW	-99.99	MAGNESIT	-0.69
MAGNETIT	-99.99	MIRABILIT	-6.07	MESQUEHO	-3.72	PHLOGOPT	-3.93	PYRITE	-99.99	PYROPHYL	-1.07	QUARTZ	0.45
SIDERITE	-99.99	STRUMTNT	-99.99	TALC	1.41	THEMARDT	-7.01	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4 3.56 QUARTZ 0.42 CHALCEDONY 0.02 A-CRISTOBALITE -0.25 AMORPHOUS -1.32

TITLE 0013

LOCATION D-08-26-20ADCC

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.1697E-03 MGTOT 0.4940E-04 NATOT 0.1109E-01 KTOT 0.1330E-03 CLTOT 0.4993E-02 ALK 0.2590E-02
 SU4TOT 0.1738E-02 ALTOT 0.0000E+00 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.3747E-04
 NO3TOT 0.0000E+00 SIOTOT 0.2995E-03 BTOT 0.4070E-04 BRITOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.43 PE = 99.99 TEMP = 26.50DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.26 -LOG(PD2) = 99.99 -LOG(PCO4) = 99.99

IONIC STRENGTH = 0.01313 TOTAL DISS SOLIDS = 0.79GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.2534E-02

ION BALANCE ERROR = 2.85PERCENT CATION EXCESS = 0.6415E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9996

INDIVIDUAL SPECIES MOLALITIES

OH-	0.3402E-05	CO3--	0.4444E-04	HCO3-	0.2445E-02	SO4--	0.1653E-02	CL-	0.4996E-02	CA++	0.1438E-03
CAOH+	0.7865E-08	CACO3	0.3821E-05	CAHCO3	0.2429E-05	CASO4	0.1979E-04	MG++	0.4283E-04	MGOH++	0.1546E-07
MGCO3	0.7616E-06	MGHCO3	0.7951E-06	MGSO4	0.5037E-05	NA+	0.1102E-01	NACO3-	0.6234E-05	NAHCO3	0.1204E-04
NASO4-	0.6103E-04	NACLO	0.1087E-05	K+	0.1321E-03	KSO4-	0.9922E-06	KCLO	0.1349E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.3733E-04	LIOH	0.1665E-09	LISO4-	0.1714E-06
H4SIO4	0.2886E-03	H3SIO4	0.1112E-04	H2SIO4	0.1017E-07	AL+++	0.0000E+00	ALOH++	0.0000E+00	ALOH2+	0.0000E+00
ALOH4-	0.0000E+00	ALSO4+	0.0000E+00	ALSO42	0.0000E+00	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2	0.0000E+00	FEOH-	0.0000E+00	FESO4	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.4109E-08	H2SO4	0.1570E-20	HSO4-	0.4423E-09
HCL	0.1528E-16	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3	0.3445E-04
H2BO3-	0.6282E-05	H2CO3*	0.1784E-04	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.52	CO3--	4.55	HCO3-	2.66	SO4--	2.98	CL-	2.35	CA++	4.04	CAOH+	8.15
CACO3	5.42	CAHCO3	5.66	CASO4	4.70	MG++	4.56	MGOH+	7.86	MGCO3	6.12	MGHCO3	6.15
MGSO4	5.30	NA+	2.01	NACO3-	5.25	NAHCO3	4.92	NASO4-	4.26	NACLO	5.96	K+	3.93
KSO4-	6.05	KCLO	7.87	RA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	4.48
LIOH	9.78	LISO4-	6.82	H4SIO4	3.54	H3SIO4	5.00	H2SIO4	8.19	AL+++	-99.99	ALOH++	-99.99
ALOH2+	-99.99	ALOH4-	-99.99	ALSO4+	-99.99	ALSO42	-99.99	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2	-99.99	FEOH-	-99.99	FESO4	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.43	H2SO4	20.80	HSO4-	9.40	HCL	16.81	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3	4.46	H2BO3-	5.26	H2CO3	4.75	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-99.99	ALBITE	-99.99	ANHYDRIT	-2.45	ANORTHIT	-99.99	ARAGONIT	-0.36	BARITE	-99.99	BOEHMITE	-99.99
BRUCITE	-4.19	CALCITE	-0.10	CA-MONT	-99.99	CELESTIT	-99.99	CHALCEDON	-0.03	CHLORITE	-99.99	DOLOMITE	-0.64
GIBBSITE	-99.99	GEOTHITE	-99.99	GRIEGITE	-99.99	GYPSON	-2.41	HALITE	-5.95	HALLOYST	-99.99	HEMATITE	-99.99
HUNTITE	-5.30	HYDROMAG	-5.00	ILLITE	-99.99	KAOLINIT	-99.99	K-MICA	-99.99	MACKINAW	-99.99	MAGNESIT	-0.84
MAGNETIT	-99.99	MIRABILIT	-5.95	NESQUEHO	-3.88	PHLOGOPT	-99.99	PYRITE	-99.99	PYROPHYL	-99.99	QUARTZ	0.44
SIDERITE	-99.99	STROMTNT	-99.99	TALC	1.18	THENARDT	-6.81	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4 3.54 QUARTZ 0.42 CHALCEDONY 0.03 A-CRISTOBALITE -0.24 AMORPHOUS -1.31

TITLE 0

LOCATION 0-08-26-18A800

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.9480E-04 MGTOT 0.4900E-05 NATOT 0.1196E-01 KTOT 0.8440E-04 CLTOT 0.6347E-02 ALK 0.2080E-02
 S04TOT 0.1457E-02 ALTOT 0.7430E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.7205E-04
 NO3TOT 0.0000E+00 SIO2TOT 0.4326E-03 BTOT 0.4625E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.92 PE = 99.99 TEMP = 37.20DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.85 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.01329 TOTAL DISS SOLIDS = 0.80GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.1820E-02

ION BALANCE ERROR = 4.18PERCENT CATION EXCESS = 0.9794E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9996

INDIVIDUAL SPECIES MOLALITIES

OH-	0.2288E-04	CO3--	0.1128E-03	HCO3-	0.1658E-02	SO4--	0.1389E-02	CL-	0.6351E-02	CA++	0.7726E-04
CAOH+	0.3004E-07	CACO3D	0.6834E-05	CAHCO3	0.1215E-05	CASO4O	0.9532E-05	MG++	0.4184E-05	MGOH++	0.1137E-07
MGCO3O	0.2176E-06	MGMCO3	0.5605E-07	MGSO4O	0.4353E-06	NA+	0.1188E-01	NAC03-	0.2823E-04	NAHCO3	0.8748E-05
NASO4-	0.5824E-04	NACLO	0.1479E-05	K+	0.8383E-04	KSO4-	0.6254E-06	KCLO	0.1082E-07	BA++	0.0000E+00
RAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.7183E-04	LIOH0	0.2829E-08	LISO4-	0.2742E-06
H4SIO4	0.3617E-03	H3SIO4	0.7121E-04	H2SIO4	0.6406E-06	AL+++	0.2129E-20	ALOH++	0.3064E-16	ALOH2+	0.6648E-12
ALOH4-	0.7436E-06	ALSO4+	0.1523E-20	ALSO42	0.1110E-21	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3O	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3O	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2O	0.0000E+00	FEOH-	0.0000E+00	FESO4O	0.0000E+00	NH4+	0.0000E+00
NH3AO	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.1333E-08	H2SO4O	0.2438E-21	H5O4-	0.1617E-09
HCL0	0.1843E-16	H2SAO	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3O	0.2749E-04
H2BO3-	0.1879E-04	H2CO3*	0.3553E-05	O2AO	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	4.69	CO3--	4.15	HCO3-	2.83	SO4--	3.06	CL-	2.25	CA++	4.31	CAOH+	7.57
CACO3O	5.16	CAHCO3	5.96	CASO4O	5.02	MG++	5.57	MGOH+	7.99	MGCO3O	6.66	MGMCO3	7.30
MGSO4O	5.36	NA+	1.98	NAC03-	4.60	NAHCO3	5.06	NASO4-	4.28	NACLO	5.83	K+	4.13
KSO4-	6.25	KCLO	7.96	RA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	4.19
LIOH0	8.55	LISO4-	6.61	H4SIO4	3.44	H3SIO4	4.20	H2SIO4	6.39	AL+++	21.07	ALOH++	16.71
ALOH2+	12.23	ALOH4-	6.18	ALSO4+	20.87	ALSO42	22.01	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3O	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2O	-99.99	FEOH-	-99.99	FESO4O	-99.99	NH4+	-99.99	NH3AO	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.92	H2SO4O	21.61	H5O4-	9.84	HCL0	16.73	H2SAO	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3O	4.56	H2BO3-	4.79	H2CO3	5.45	O2AO	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-0.95	ALBITE	-1.22	ANHYDRIT	-2.72	ANORTHIT	-4.73	ARAGONIT	-0.16	SARITE	-99.99	BOEHMITE	-2.09
BRUCITE	-3.58	CALCITE	0.11	CA-MONT	-2.28	CELESTIT	-99.99	CHALCEDON	-0.05	CHLORITE	0.93	DOLOMITE	-0.92
GIBBSITE	-2.80	GEOTHITE	-99.99	GIEGITE	-99.99	GYPSUM	-2.75	HALITE	-5.84	HALLOYST	-5.55	HEMATITE	-99.99
HUNTITE	-6.37	HYDTOMAG	-5.57	ILLITE	-2.09	KAOLINIT	-1.59	K-MICA	-3.69	MACKINAW	-99.99	MAGNESIT	-1.30
MAGNETIT	-99.99	MIRABILIT	-6.45	NESQUEHO	-4.38	PHLOGOPT	-1.98	PYRITE	-99.99	PYROPHYL	-1.53	QUARTZ	0.39
SIDERITE	-99.99	STRONTNT	-99.99	TALC	2.35	THENARDT	-6.82	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4O 3.44 QUARTZ 0.37 CHALCEDONY -0.00 A-CRISTOBALITE -0.26 AMORPHOUS -1.32

SAMPLE NUMBER 31
 TITLE 83 LOCATION D-08-26-18ABDC

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)
 CATOT 0.1023E-03 MGTOT 0.5800E-05 NATOT 0.1318E-01 KTOT 0.9970E-04 CLTOT 0.7391E-02 ALK 0.2420E-02
 SO4TOT 0.1353E-02 ALTOT 0.7430E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.8647E-04
 NO3TOT 0.0000E+00 SIO2TOT 0.3661E-03 ETOT 0.5550E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.71 PE = 99.99 TEMP = 39.90DEG C DENSITY = 1.000GM/CC
 -LOG(PCO2) = 3.54 -LOG(PD2) = 99.99 -LOG(PCH4) = 99.99
 IONIC STRENGTH = 0.01439 TOTAL DISS SOLIDS = 0.87GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.2227E-02
 ION BALANCE ERROR = 4.13PERCENT CATION EXCESS = 0.1068E-02(CHARGE*MOLES) H2O ACTIVITY = 0.9996

INDIVIDUAL SPECIES MOLALITIES

NH-	0.1595E-04	CO3--	0.9057E-04	HCO3-	0.2082E-02	SO4--	0.1285E-02	CL-	0.7396E-02	CA++	0.8498E-04
CAOH+	0.2287E-07	CACO3O	0.6157E-05	CAHCO3	0.1737E-05	CASO4O	0.9489E-05	MG++	0.5030E-05	MGOH++	0.9557E-08
MGCO3O	0.2096E-06	MGHCO3	0.8433E-07	MGSO4O	0.4729E-06	NA+	0.1309E-01	NACO3-	0.2659E-04	NAHCO3	0.1200E-04
NASO4-	0.5890E-04	NACLO	0.1882E-05	K+	0.9908E-04	KSO4-	0.6898E-06	KCLO	0.1475E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.8624E-04	LIOH+	0.2448E-08	LISO4-	0.2992E-06
H4SIO4	0.3239E-03	H3SIO4	0.4253E-04	H2SIO4	0.2824E-04	AL+++	0.1025E-19	ALOH++	0.1027E-15	ALOH2+	0.1500E-11
ALOH4-	0.7436E-06	ALSO4+	0.6620E-20	ALSO42	0.4414E-21	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3O	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3O	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2O	0.0000E+00	FEOH-	0.0000E+00	FESO4O	0.0000E+00	NH4+	0.0000E+00
NH3AO	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.2169E-08	H2SO4O	0.6363E-21	HSD4-	0.2515E-09
HCLO	0.4082E-16	H2SAO	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3O	0.3866E-04
H2BO3-	0.1689E-04	H2CO3+	0.7137E-05	O2AO	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

NH	4.85	CO3--	4.25	HCO3-	2.73	SO4--	3.10	CL-	2.19	CA++	4.28	CAOH+	7.69
CACO3O	5.21	CAHCO3	5.81	CASO4O	5.02	MG++	5.50	MGOH+	8.07	MGCO3O	6.68	MGHCO3	7.13
MGSO4O	6.32	NA+	1.94	NACO3-	4.63	NAHCO3	4.92	NASO4-	4.28	NACLO	5.72	K+	4.06
KSO4-	6.21	KCLO	7.83	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	4.11
LIOH+	8.61	LISO4-	6.58	H4SIO4	3.49	H3SIO4	4.43	H2SIO4	6.76	AL+++	20.41	ALOH++	16.20
ALOH2+	11.88	ALOH4-	6.18	ALSO4+	20.23	ALSO42	21.41	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3O	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2O	-99.99	FEOH-	-99.99	FESO4O	-99.99	NH4+	-99.99	NH3AO	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.71	H2SO4O	21.19	HSD4-	9.65	HCLO	16.39	H2SAO	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3O	4.41	H2BO3-	4.84	H2CO3	5.15	O2AO	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-1.14	ALBITE	-1.43	ANHYDRIT	-2.71	ANORTHIT	-4.86	ARAGONIT	-0.22	BARITE	-99.99	BOEHMITE	-1.94
BRUCITE	-3.82	CALCITE	0.06	CA-MONT	-2.26	CELESTIT	-99.99	CHALCEDN	-0.12	CHLORITE	-0.33	DOLOMITE	-0.99
GIBBSITE	-2.67	GEOTHITE	-99.99	GRIEGITE	-99.99	GYPSUM	-2.75	HALITE	-5.73	HALLUYST	-5.40	HEMATITE	-99.99
HUNTITE	-6.43	HYDOMAG	-5.81	ILLITE	-2.16	KAOLINIT	-1.45	K-MICA	-3.61	MACKINAW	-99.99	MAGNESIT	-1.31
MAGNETIT	-99.99	MIRABILIT	-6.48	NE SQUEHO	-4.39	PHLOGOPT	-2.79	PYRITE	-99.99	PYRROPHYL	-1.30	QUARTZ	0.31
SIDERITE	-99.99	STRONTNT	-99.99	TALC	1.25	THENARDT	-6.78	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4O	3.49	QUARTZ	0.30	CHALCEDONY	-0.07	A-CRISTOBALITE	-0.32	AMORPHOUS	-1.38
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TITLE 13

LOCATION D-08-26-17A888

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.1347E-02 MGTOT 0.2632E-03 NATOT 0.4198E-01 KTOT 0.2608E-03 CLTOT 0.2866E-01 ALK 0.9300E-03
 SO4TOT 0.8068E-02 ALTOT 0.3715E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.4467E-04
 NO3TOT 0.0000E+00 SIO2TOT 0.3494E-03 BTOT 0.1480E-03 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.51 PE = 99.99 TEMP = 39.00DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.82 -LOG(PO2) = 99.99 -LOG(PCO4) = 99.99

IONIC STRENGTH = 0.05238 TOTAL DISS SOLIDS = 2.91GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.8037E-03

ION BALANCE ERROR = -0.25PERCENT CATION EXCESS = -0.2224E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9986

INDIVIDUAL SPECIES MOLALITIES

OH-	0.1101E-04	CO3--	0.2516E-04	HCO3-	0.7282E-03	SO4--	0.6973E-02	CL-	0.2873E-01	CA++	0.1010E-02
CAOH+	0.1360E-06	CACD3O	0.1094E-04	CAMCO3	0.5310E-05	CASO4O	0.3249E-03	MG++	0.2051E-03	MGOH++	0.1978E-06
MGCD3O	0.1293E-05	MGHCO3	0.9119E-06	MGSO4O	0.5648E-04	NA+	0.4132E-01	NACD3-	0.1709E-04	NAHCO3	0.1122E-04
NASO4-	0.7291E-03	NACLO	0.1929E-04	K+	0.2546E-03	KSO4-	0.6885E-05	KCLO	0.1219E-06	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.4419E-04	LIOH+	0.7288E-09	LISO4-	0.6075E-06
H4SIO4	0.3211E-03	H3SIO4	0.2928E-04	H2SIO4	0.1529E-06	AL+++	0.5023E-19	ALOH++	0.2570E-15	ALOH2+	0.1879E-11
ALOH4-	0.3726E-06	ALSO4+	0.8269E-19	ALSO42	0.2171E-19	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3O	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3O	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2O	0.0000E+00	FEODH-	0.0000E+00	FESO4O	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.3641E-08	H2SO4O	0.6237E-20	HSO4-	0.1705E-08
HCLO	0.2277E-15	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3O	0.1127E-03
H2BO3-	0.3573E-04	H2CO3*	0.3631E-05	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.05	CO3--	4.94	HCO3-	3.22	SO4--	2.51	CL-	1.64	CA++	3.33	CAOH+	6.95
CACD3O	4.96	CAMCO3	5.36	CASO4O	3.48	MG++	4.02	MGOH+	6.78	MGCD3O	5.88	MGHCO3	6.13
MGSO4O	4.24	NA+	1.47	NACD3-	4.85	NAHCO3	4.94	NASO4-	3.22	NACLO	4.71	K+	3.69
KSO4-	5.25	KCLO	6.91	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	4.44
LIOH+	9.13	LISO4-	6.30	H4SIO4	3.49	H3SIO4	4.63	H2SIO4	7.16	AL+++	19.94	ALOH++	15.93
ALOH2+	11.81	ALOH4-	6.52	ALSO4+	19.17	ALSO42	19.75	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3O	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2O	-99.99	FEODH-	-99.99	FESO4O	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.51	H2SO4O	20.20	HSO4-	8.86	HCLO	15.64	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3O	3.94	H2BO3-	4.57	H2CO3	5.43	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-1.10	ALBITE	-1.29	ANHYDRIT	-1.17	ANORTHIT	-4.58	ARAGONIT	0.04	BARITE	-99.99	BOEHMITE	-2.08
BRUCITE	-2.74	CALCITE	0.31	CA-MONT	-2.47	CELESTIT	-99.99	CHALCEON	-0.11	CHLORITE	4.82	DOLomite	0.06
GIBBSITE	-2.80	GEOTHITE	-99.99	GRIEGITE	-99.99	GYP SUM	-1.21	HALITE	-4.72	HALLUYST	-5.67	HEMATITE	-99.99
HUNTITE	-3.79	HYDROMAG	-2.34	ILLITE	-2.10	KAOLINIT	-1.72	K-MICA	-3.85	MACKINAW	-99.99	MAGNESIT	-0.51
MAGNETIT	-99.99	MIRABILT	-4.96	MESQUEHO	-3.60	PHLOGOPT	0.50	PYRITE	-99.99	PYROPHYL	-1.57	QUARTZ	0.32
SIDERITE	-99.99	STROMTNT	-99.99	TALC	4.51	THEMART	-5.25	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4O 3.49 QUARTZ 0.30 CHALCEDONY -0.07 A-CRISTOBALITE -0.32 AMORPHOUS -1.38

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)
 CATOT 0.1697E-03 MGTOT 0.1316E-03 NATOT 0.1483E-01 KTOT 0.1790E-03 CLTOT 0.6404E-02 ALK 0.4200E-02
 SO4TOT 0.2321E-02 ALTOT 0.0000E+00 FETOT 0.0000E+00 SKTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.6197E-04
 NO3TOT 0.0000E+00 SIO2TOT 0.2995E-03 BTOT 0.1018E-03 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.54 PE = 99.99 TEMP = 26.60DEG C DENSITY = 1.000GM/CC
 -LOG(PCO2) = 3.18 -LOG(PO2) = 99.99 -LOG(PCO4) = 99.99
 IONIC STRENGTH = 0.01776 TOTAL DISS SOLIDS = 1.08GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.4064E-02
 ION BALANCE ERROR = 1.42PERCENT CATION EXCESS = 0.4310E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9995

INDIVIDUAL SPECIES MOLALITIES

OH-	0.4499E-05	CO3--	0.9535E-04	HCO3-	0.3889E-02	SO4--	0.2183E-02	CL-	0.6409E-02	CA++	0.1373E-03
CAOH+	0.9325E-08	CACO3O	0.6965E-05	CAHCO3	0.3486E-05	CASO4O	0.2213E-04	MG++	0.1097E-03	MGOH++	0.4931E-07
MGCO3O	0.3731E-05	MGHCO3	0.3068E-05	MGSO4O	0.1515E-04	NA+	0.1470E-01	NAO3-	0.1689E-04	NAHCO3	0.2476E-04
NASO4-	0.1012E-03	NACLO	0.1799E-05	K+	0.1775E-03	KSO4-	0.1657E-05	KCLO	0.2247E-07	BA++	0.0000E+00
HAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.6168E-04	LIOH+	0.3527E-09	LISO4-	0.3524E-06
H4SIO4	0.2853E-03	H3SIO4	0.1449E-04	H2SIO4	0.1803E-07	AL+++	0.0000E+00	ALOH++	0.0000E+00	ALOH2+	0.0000E+00
ALOH4-	0.0000E+00	ALSO4+	0.0000E+00	ALSO42	0.0000E+00	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3O	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3O	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2O	0.0000E+00	FEODH-	0.0000E+00	FESO4O	0.0000E+00	NH4+	0.0000E+00
NH3AO	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.3227E-08	H2SO4O	0.1181E-20	HSD4-	0.4346E-09
HCLO	0.1510E-16	H2SAO	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3O	0.8213E-04
H2BO3-	0.1978E-04	H2CO3*	0.2165E-04	O2AO	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.41	CO3--	4.24	HCO3-	2.47	SO4--	2.89	CL-	2.25	CA++	4.08	CAOH+	8.08
CACO3O	5.16	CAHCO3	5.51	CASO4O	4.65	MG++	4.18	MGOH+	7.36	MGCO3O	5.43	MGHCO3	5.57
MGSO4O	4.82	NA+	1.89	NAHCO3	4.83	NAO3-	4.60	NACLO	5.74	K+	3.81		
KSO4-	5.84	KCLO	7.65	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	4.26
LIOH+	9.45	LISO4-	6.51	H4SIO4	3.54	H3SIO4	4.90	H2SIO4	7.96	AL+++	-99.99	ALOH++	-99.99
ALOH2+	-99.99	ALOH4-	-99.99	ALSO4+	-99.99	ALSO42	-99.99	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3O	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2O	-99.99	FEODH-	-99.99	FESO4O	-99.99	NH4+	-99.99	NH3AO	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.54	H2SO4O	20.93	HSD4-	9.42	HCLO	16.82	H2SAO	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3O	4.08	H2BO3-	4.77	H2CO3	4.66	O2AO	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-99.99	ALBITE	-99.99	ANHYDRIT	-2.41	ANORTHIT	-99.99	ARAGONIT	-0.10	BARITE	-99.99	BOEHMITE	-99.99
RRUCITE	-3.58	CALCITE	0.16	CA-MONT	-99.99	CELESTIT	-99.99	CHALCEDON	-0.04	CHLORITE	-99.99	DOLomite	0.31
GIBBSITE	-99.99	GEOTHITE	-99.99	GYPSE	-2.36	HALITE	-5.73	HALLOYST	-99.99	HEMATITE	-99.99		
HUNTITE	-2.96	HYDROMAG	-2.32	ILLITE	-99.99	KAOLINIT	-99.99	K-MICA	-99.99	MACKINAW	-99.99	MAGNESIT	-0.15
MAGNETIT	-99.99	MIRABILIT	-5.63	NE-SQUEHD	-3.19	PHLOGOPT	-99.99	PYRITE	-99.99	PYROPHYL	-99.99	QUARTZ	0.44
SIDERITE	-99.99	STROMTNT	-99.99	TALC	2.98	THENARDT	-6.48	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4O 3.54 QUARTZ 0.41 CHALCEDONY 0.02 A-CRISTOBALITE -0.25 AMORPHOUS -1.31

TITLE 0000000000

LOCATION D-08-26-08DCA0

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.3243E-03 MGTOT 0.2015E-03 NATOT 0.8700E-02 KTOT 0.1457E-03 CLTOT 0.3611E-02 ALK 0.2660E-02
 SD4TOT 0.1666E-02 ALTOT 0.0000E+00 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.3315E-04
 NO3TOT 0.0000E+00 SIO2TOT 0.3994E-03 RTOT 0.4625E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.36 PE = 99.99 TEMP = 25.10DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.19 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.01162 TOTAL DISS SOLIDS = 0.70GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.2613E-02

ION BALANCE ERROR = 1.72PERCENT CATION EXCESS = 0.3286E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9997

INDIVIDUAL SPECIES MOLALITIES

OH-	0.2594E-05	CO3--	0.3729E-04	HCO3-	0.2523E-02	SO4--	0.1562E-02	CL-	0.3613E-02	CA++	0.2763E-03
CAOH+	0.1168E-07	CACO3	0.6250E-05	CAHCO3	0.4724E-05	CASO4	0.3725E-04	MG++	0.1753E-03	MGOH++	0.4850E-07
MGCO3	0.2681E-05	MGHCO3	0.3403E-05	MGSO4	0.2022E-04	NA+	0.8646E-02	NAC03-	0.3916E-05	NAHCO3	0.9866E-05
NASO4-	0.4596E-04	NACLO	0.6244E-06	K+	0.1448E-03	KSO4-	0.1028E-05	KCLO	0.1084E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SRDH+	0.0000E+00	LI+	0.3303E-04	LIOH0	0.1093E-09	LISO4-	0.1468E-06
H4SIO4	0.3879E-03	H3SIO4	0.1178E-04	H2SIO4	0.7663E-08	AL++	0.0000E+00	ALOH++	0.0000E+00	ALOH2+	0.0000E+00
ALOH4-	0.0000E+00	ALSO4+	0.0000E+00	ALSO42	0.0000E+00	FE++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2	0.0000E+00	FEOH-	0.0000E+00	FESO4	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.4805E-08	H2SO4	0.1940E-20	HSO4-	0.4809E-09
HCL0	0.1129E-16	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3	0.4025E-04
H2BO3-	0.6037E-05	H2CO3*	0.2214E-04	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.63	CO3--	4.61	HCO3-	2.64	SO4--	2.99	CL-	2.49	CA++	3.74	CAOH+	7.98
CACO3	5.20	CAHCO3	5.37	CASO4	4.43	MG++	3.94	MGOH+	7.36	MGCO3	5.57	MGHCO3	5.52
MGSO4	4.69	NA+	2.11	NAC03-	5.45	NAHCO3	5.00	NASO4-	4.38	NACLO	6.20	K+	3.89
KSO4-	6.03	KCLO	7.94	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	4.53
LIOH0	9.96	LISO4-	6.88	H4SIO4	3.41	H3SIO4	4.98	H2SIO4	8.30	AL++	-99.99	ALOH++	-99.99
ALOH2+	-99.99	ALOH4-	-99.99	ALSO4+	-99.99	ALSO42	-99.99	FE++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2	-99.99	FEOH-	-99.99	FESO4	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.36	H2SO4	20.71	HSO4-	9.37	HCL0	16.95	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3	4.39	H2BO3-	5.27	H2CO3	4.65	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-99.99	ALBITE	-99.99	ANHYDRIT	-2.19	ANORTHIT	-99.99	ARAGONIT	-0.14	BARITE	-99.99	BOEHMITE	-99.99
BRUCITE	-3.80	CALCITE	0.12	CA-MONT	-99.99	CELESTIT	-99.99	CHALCEDON	0.11	CHLORITE	-99.99	DOLomite	0.11
GIBBSITE	-99.99	GEOTHITE	-99.99	GIEGITE	-99.99	GYPSUM	-2.13	HALITE	-6.18	HALLOYST	-99.99	HEMATITE	-99.99
HUNTITE	-3.49	HYDROMAG	-3.03	ILLITE	-99.99	KAOLINIT	-99.99	K-MICA	-99.99	MACKINAW	-99.99	MAGNESIT	-0.31
MAGNETIT	-99.99	MIRABILT	-6.11	NESQUEHO	-3.34	PHLOGOPT	-99.99	PYRITE	-99.99	PYRUPHYL	-99.99	QUARTZ	0.59
SIDERITE	-99.99	STRONTNT	-99.99	TALC	3.02	THENARDT	-7.04	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4	3.41	QUARTZ	0.57	CHALCEDONY	0.17	A-CRISTOBALITE	-0.10	AMORPHOUS	-1.17
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TITLE 0

LOCATION D-OR-26-07080A

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.8733E-03 MGTOT 0.1890E-04 NATOT 0.3328E-01 KTOT 0.2097E-03 CLTOT 0.2437E-01 ALK 0.6800E-03
 SO4TOT 0.4424E-02 ALTOT 0.3715E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.2162E-03
 NO3TOT 0.0000E+00 SIO2TOT 0.3661E-03 BTOT 0.9250E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.45 PE = 99.99 TEMP = 41.30DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.87 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.03870 TOTAL DISS SOLIDS = 2.16GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.5900E-03

ION BALANCE ERROR = 2.34PERCENT CATION EXCESS = 0.1591E-02(CHARGE*MOLES) H2O ACTIVITY = 0.9989

INDIVIDUAL SPECIES MOLALITIES

OH-	0.1104E-04	CO3--	0.1594E-04	HCO3-	0.5440E-03	SO4--	0.3912E-02	CL-	0.2441E-01	CA++	0.7117E-03
CAOH+	0.1059E-06	CACO3O	0.6189E-05	CAHCO3	0.3252E-05	CASO4O	0.1539E-03	MG++	0.1587E-04	MGMH++	0.1706E-07
MGCO3O	0.7663E-07	MGHCO3	0.5749E-07	MGSO4O	0.2916E-05	NA+	0.3296E-01	NAC03-	0.1043E-04	NAHCO3	0.6981E-05
NASO4-	0.3596E-03	NACLO	0.1370E-04	K+	0.2065E-03	KSO4-	0.3551E-05	KCLO	0.8837E-07	BA++	0.0000E+00
RAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.2149E-03	LIOH0	0.3945E-08	LISO4-	0.1797E-05
H4SIO4	0.3380E-03	H3SIO4	0.2894E-04	H2SIO4	0.1567E-06	AL+++	0.4568E-19	ALOH++	0.2577E-15	ALOH2+	0.2002E-11
ALOH4-	0.3723E-06	ALSO4+	0.5228E-19	ALSO42	0.8444E-20	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3O	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3O	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2O	0.0000E+00	FEOH-	0.0000E+00	FESO4O	0.0000E+00	NH4+	0.0000E+00
NH3AO	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.4123E-08	H2SO4O	0.5685E-20	HSO4-	0.1252E-08
HCL0	0.2870E-15	H2SAO	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3O	0.7264E-04
H2BO3-	0.2006E-04	H2CO3*	0.3153E-05	O2AO	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.04	CO3--	5.10	HCO3-	3.34	SO4--	2.72	CL-	1.70	CA++	3.45	CAOH+	7.05
CACO3O	5.20	CAHCO3	5.56	CASO4O	3.81	MG++	5.10	MGMH+	7.84	MGCO3O	7.11	MGHCO3	7.32
MGSO4O	5.53	NA+	1.56	NAC03-	5.06	NAHCO3	5.15	NASO4-	3.52	NACLO	4.86	K+	3.77
KSO4-	5.53	KCLO	7.05	RA++	-99.99	RAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	3.74
LIOH0	8.40	LISO4-	5.82	H4SIO4	3.47	H3SIO4	4.62	H2SIO4	7.11	AL+++	19.93	ALOH++	15.90
ALOH2+	11.79	ALOH4-	6.51	ALSO4+	19.36	ALSO42	20.15	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3O	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2O	-99.99	FEOH-	-99.99	FESO4O	-99.99	NH4+	-99.99	NH3AO	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.45	H2SO4O	20.24	HSO4-	8.98	HCL0	15.54	H2SAO	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3O	4.13	H2BO3-	4.80	H2CO3	5.50	O2AO	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-1.28	ALBITE	-1.45	ANHYDRIT	-1.48	ANORTHIT	-4.74	ARAGONIT	-0.23	BARITE	-99.99	BOEHMITE	-2.09
BRUCITE	-3.90	CALCITE	0.05	CA-MONT	-2.59	CELESTIT	-99.99	CHALCEDON	-0.12	CHLORITE	-0.70	DOLomite	-1.42
GIBBSITE	-2.83	GEOTHITE	-99.99	GRIEGITE	-99.99	GYPNUM	-1.54	HALITE	-4.87	HALLOYST	-5.73	HEMATITE	-99.99
HUNTITE	-7.67	HYDTOMAG	-6.99	ILLITE	-2.54	KAULINIT	-1.81	K-MICA	-4.08	MACKINAW	-99.99	MAGNESIT	-1.73
MAGNETIT	-99.99	MIRABILT	-5.46	NFSQUEHU	-4.82	PHLOGOPT	-2.68	PYRITE	-99.99	PYRUPHYL	-1.35	QUARTZ	0.30
SIDERITE	-99.99	STRONTNT	-99.99	TALC	1.18	THENARDT	-5.64	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4O 3.47 QUARTZ 0.29 CHALCEDONY -0.08 A-CRISTOBALITE -0.32 AMORPHOUS -1.38

TITLE 000003

LOCATION D-08-26-08BDC

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.7994E-03 MGTOT 0.1727E-03 NATOT 0.4415E-01 KTOT 0.2736E-03 CLTOT 0.3035E-01 ALK 0.2130E-02
 SO4TOT 0.7027E-02 ALTOT 0.3715E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.2306E-03
 NO3TOT 0.0000E+00 SID2TOT 0.3328E-03 BTOT 0.1850E-03 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.52 PE = 99.99 TEMP = 39.10DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.45 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.05243 TOTAL DISS SOLIDS = 2.97GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.1931E-02

ION BALANCE ERROR = 0.07PERCENT CATION EXCESS = 0.6280E-04(CHARGE*MOLES) H2O ACTIVITY = 0.9986

INDIVIDUAL SPECIES MOLALITIES

OH- 0.1143E-04 CO3-- 0.6239E-04 HCO3- 0.1759E-02 SO4-- 0.6155E-02 CL- 0.3042E-01 CA++ 0.6048E-03
 CAOH+ 0.8459E-07 CACO3O 0.1634E-04 CAMCO3 0.7726E-05 CASO4O 0.1718E-03 MG++ 0.1363E-03 MGOH++ 0.1366E-06
 MGCO3O 0.2136E-05 MGHC03 0.1466E-05 MGSO4O 0.3315E-04 NA+ 0.4351E-01 MACO3- 0.4500E-04 MAHC03 0.2854E-04
 NASO4- 0.6781E-03 NACLO 0.2150E-04 K+ 0.2679E-03 KSO4- 0.6413E-05 KCLO 0.1358E-06 BA++ 0.0000E+00
 RAOH+ 0.0000E+00 SR++ 0.0000E+00 SROH+ 0.0000E+00 LI+ 0.2285E-03 LIOH0 0.3929E-08 LISO4- 0.2771E-05
 H4SIO4 0.3051E-03 H3SIO4 0.2871E-04 H2SIO4 0.1565E-06 AL++ 0.4382E-19 ALOH++ 0.2330E-15 ALOH2+ 0.1763E-11
 ALOH4- 0.3726E-06 ALSO4+ 0.6374E-19 ALSO42 0.1477E-19 FE++ 0.0000E+00 FEOH++ 0.0000E+00 FEOH2+ 0.0000E+00
 FEOH3O 0.0000E+00 FEOH4- 0.0000E+00 FECL++ 0.0000E+00 FECL2+ 0.0000E+00 FECL3O 0.0000E+00 FESO4+ 0.0000E+00
 FE++ 0.0000E+00 FEOH+ 0.0000E+00 FEOH2O 0.0000E+00 FEOH- 0.0000E+00 FESO4O 0.0000E+00 NH4+ 0.0000E+00
 NH3AQ 0.0000E+00 NH4SO4 0.0000E+00 NO3- 0.0000E+00 H+ 0.3559E-08 H2SO4O 0.5309E-20 HSO4- 0.1479E-08
 HCL0 0.2402E-15 H2SAQ 0.0000E+00 HS- 0.0000E+00 S-- 0.0000E+00 BR- 0.0000E+00 H3BO3O 0.1400E-03
 H2BO3- 0.4557E-04 H2CO3+ 0.8564E-05 O2AQ 0.0000E+00

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH 5.04 CO3-- 4.55 HCO3- 2.84 SO4-- 2.56 CL- 1.61 CA++ 3.56 CAOH+ 7.16
 CACO3O 4.78 CAMCO3 5.19 CASO4O 3.76 MG++ 4.19 MGOH+ 6.94 MGCO3O 5.67 MGHC03 5.93
 MGSO4O 4.47 NA+ 1.45 MACO3- 4.54 NASO4- 3.25 NACLO 4.66 K+ 3.67
 KSO4- 5.28 KCLO 6.86 RA++ -99.99 RAOH+ -99.99 SR++ -99.99 SROH+ -99.99 LI+ 3.72
 LIOH0 8.40 LISO4- 5.64 H4SIO4 3.51 H3SIO4 4.63 H2SIO4 7.15 AL++ 20.00 ALOH++ 15.97
 ALOH2+ 11.84 ALOH4- 6.52 ALSO4+ 19.29 ALSO42 19.92 FE++ -99.99 FEOH++ -99.99 FEOH2+ -99.99
 FEOH3 -99.99 FEOH4- -99.99 FECL++ -99.99 FECL2+ -99.99 FECL3O -99.99 FESO4+ -99.99 FE++ -99.99
 FEOH+ -99.99 FEOH2O -99.99 FEOH- -99.99 FESO4O -99.99 NH3AQ -99.99 NH4SO4 -99.99
 NO3- -99.99 H+ 8.52 H2SO4O 20.27 HSO4- 8.92 HCL0 15.61 H2SAQ -99.99 HS- -99.99
 S-- -99.99 BR-- -99.99 H3BO3O 3.85 H2BO3- 4.46 H2CO3 5.06 O2AQ -99.99

MINERAL SATURATION INDICES

ADULARIA -1.16 ALBITE -1.35 ANHYDRIT -1.45 ANURTHIT -4.86 ARAGONIT 0.21 BARITE -99.99 BOEHMITE -2.09
 BRUCITE -2.99 CALCITE 0.48 CA-MONT -2.64 CELESTIT -99.99 CHALCEDON -0.14 CHLORITE 3.97 DOLOMITE 0.45
 GIBBSITE -2.82 GEOTHITE -99.99 GRIEGITE -99.99 GYPSUM -1.49 HALITE -4.67 HALLOYST -5.75 HEMATITE -99.99
 HUNTITE -2.96 HYDROMAG -1.82 ILLITE -2.24 KAOLINIT -1.81 K-MICA -3.94 MACKINAW -99.99 MAGNESIT -0.29
 MAGNETIT -99.99 MIRABILT -4.98 NESQUEHO -3.38 PHLOGOPT 0.02 PYRITE -99.99 PYRUPHYL -1.68 QUARTZ 0.29
 SIDERITE -99.99 STRONTNT -99.99 TALC 3.96 THENARDT -5.26 WITHERIT -99.99

SILICA SATURATION INDICES

-LOG H4SIO4O 3.51 QUARTZ 0.27 CHALCEDONY -0.09 A-CRISTOBALITE -0.35 AMORPHOUS -1.40

TITLE 000003

LOCATION D-07-07-02ADDC

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.9480E-04 MGTOT 0.2630E-04 NATOT 0.1422E-01 KTOT 0.1815E-03 CLTOT 0.5529E-02 ALK 0.4650E-02
 SO4TOT 0.1718E-02 ALTOT 0.0000E+00 FETOT 0.0000E+00 SPTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.0000E+00
 NO3TOT 0.0000E+00 SIO2TOT 0.1248E-02 BTOT 0.4625E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.51 PE = 99.99 TEMP = 40.40DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.03 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.01579 TOTAL DISS SOLIDS = 1.06GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.4387E-02

ION BALANCE ERROR = 3.71PERCENT CATION EXCESS = 0.1035E-02(CHARGE*MOLES) H2O ACTIVITY = 0.9995

INDIVIDUAL SPECIES MOLALITIES

OH- 0.1122E-04 CO3-- 0.1185E-03 HCO3- 0.4169E-02 SO4-- 0.1626E-02 CL- 0.5534E-02 CA++ 0.7443E-04
 CAOH+ 0.1392E-07 CACO3D 0.7117E-05 CAHCO3 0.3126E-05 CASO4O 0.1021E-04 MG++ 0.2188E-04 MGOH++ 0.2916E-07
 MGC03O 0.1168E-05 MGHC03 0.7291E-06 MGS04O 0.2526E-05 NA+ 0.1409E-01 NAC03- 0.3932E-04 NAHCO3 0.2560E-04
 NASO4- 0.7726E-04 NACLO 0.1499E-05 K+ 0.1801E-03 KSO4- 0.1591E-05 KCLO 0.1982E-07 BA++ 0.0000E+00
 BAOH+ 0.0000E+00 SR++ 0.0000E+00 SROH+ 0.0000E+00 LI+ 0.0000E+00 LIOH0 0.0000E+00 LIS04- 0.0000E+00
 H4SIO4 0.1147E-02 H3SIO4 0.1019E-03 H2SIO4 0.5006E-06 AL+++ 0.0000E+00 ALOH++ 0.0000E+00 ALOH2+ 0.0000E+00
 ALOH4- 0.0000E+00 ALS04+ 0.0000E+00 ALS042 0.0000E+00 FE+++ 0.0000E+00 FEOM++ 0.0000E+00 FEOM2+ 0.0000E+00
 FEOM3O 0.0000E+00 FEOM4- 0.0000E+00 FECL++ 0.0000E+00 FECL2+ 0.0000E+00 FECL3O 0.0000E+00 FES04+ 0.0000E+00
 FE++ 0.0000E+00 FEOM+ 0.0000E+00 FEOMH2O 0.0000E+00 FEOMH- 0.0000E+00 FES04O 0.0000E+00 NH4+ 0.0000E+00
 NH3AQ 0.0000E+00 NH4S04 0.0000E+00 NO3- 0.0000E+00 H+ 0.3452E-08 H2S04O 0.2140E-20 HSO4- 0.5190E-09
 HCL0 0.5556E-16 H2SAQ 0.0000E+00 HS- 0.0000E+00 S-- 0.0000E+00 BR- 0.0000E+00 H3BO3O 0.3603E-04
 H2BO3- 0.1027E-04 H2CO3+ 0.2237E-04 O2AQ 0.0000E+00

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH 5.01 CO3-- 4.14 HCO3- 2.43 SO4-- 3.01 CL- 2.31 CA++ 4.34 CAOH+ 7.91
 CACO3O 5.15 CAHCO3 5.56 CASO4O 4.99 MG++ 4.87 MGOH+ 7.59 MGC03O 5.93 MGHC03 6.19
 MGS04O 5.60 NA+ 1.91 NAC03- 4.46 NAHCO3 4.59 NASO4- 4.15 NACLO 5.82 K+ 3.80
 KSO4- 5.85 KCLO 7.70 BA++ -99.99 BAOH+ -99.99 SR++ -99.99 SROH+ -99.99 LI+ -99.99
 LIOH0 -99.99 LIS04- -99.99 H4SIO4 2.94 H3SIO4 4.05 H2SIO4 6.52 AL+++ -99.99 ALOH++ -99.99
 ALOH2+ -99.99 ALOH4- -99.99 ALS04+ -99.99 ALS042 -99.99 FE+++ -99.99 FEOM++ -99.99 FEOM2+ -99.99
 FEOM3 -99.99 FEOM4- -99.99 FECL++ -99.99 FECL2+ -99.99 FECL3O -99.99 FES04+ -99.99 FE++ -99.99
 FEOM+ -99.99 FEOMH2O -99.99 FEOMH- -99.99 FES04O -99.99 NH4+ -99.99 NH3AQ -99.99 NH4S04 -99.99
 NO3- -99.99 H+ 8.51 H2S04O 20.67 HSO4- 9.34 HCL0 16.25 H2SAQ -99.99 HS- -99.99
 S-- -99.99 BR-- -99.99 H3BO3O 4.44 H2BO3- 5.05 H2CO3 4.65 O2AQ -99.99

MINERAL SATURATION INDICES

ADULARIA -99.99 ALBITE -99.99 ANHYDRIT -2.67 ANORTHIT -99.99 ARAGONIT -0.16 BARITE -99.99 BOEHMITE -99.99
 BRUCITE -3.51 CALCITE 0.11 CA-MONT -99.99 CELESTIT -99.99 CHALCEDON 0.42 CHLORITE -99.99 DOLOMITE -0.18
 GIBBSITE -99.99 GEOTHITE -99.99 GRIEGITE -99.99 GYPSUM -2.72 HALITE -5.84 HALLOYST -99.99 HEMATITE -99.99
 HUNTITE -4.09 HYDTOMAG -3.19 ILLITE -99.99 KAOLINIT -99.99 K-MICA -99.99 MACKINAW -99.99 MAGNESIT -0.55
 MAGNETIT -99.99 MIRABILT -6.39 NESQUEHO -3.64 PHLOGOPT -99.99 PYRITE -99.99 PYROPHYL -99.99 QUARTZ 0.84
 SIDERITE -99.99 STRONTNT -99.99 TALC 4.25 THENARDT -6.62 WITHERIT -99.99

SILICA SATURATION INDICES

-LOG H4SIO4O 2.94 QUARTZ 0.83 CHALCEDONY 0.46 A-CRISTOBALITE 0.21 AMORPHOUS -0.84

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.4491E-03 MGTOT 0.1650E-04 NATOT 0.2571E-01 KTOT 0.1841E-03 CLTOT 0.1828E-01 ALK 0.1330E-02
 SO4TOT 0.2915E-02 ALTOT 0.7430E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.1585E-03
 NO3TOT 0.0000E+00 SIU2TOT 0.3661E-03 BTOT 0.8325E-04 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.28 PE = 99.99 TEMP = 41.40DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 3.35 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.02893 TOTAL DISS SOLIDS = 1.65GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.1260E-02

ION BALANCE ERROR = 2.99PERCENT CATION EXCESS = 0.1547E-02(CHARGE*MOLES) H2O ACTIVITY = 0.9992

INDIVIDUAL SPECIES MOLALITIES

OH-	0.7352E-05	CO3--	0.2239E-04	HCO3-	0.1192E-02	SO4--	0.2647E-02	CL-	0.1830E-01	CA++	0.3763E-03
CAOH+	0.4028E-07	CACO3O	0.5346E-05	CAHCO3	0.4067E-05	CASO4O	0.6408E-04	MG++	0.1423E-04	MGOH++	0.1098E-07
MGCO3O	0.1116E-06	MGHCO3	0.1207E-06	MGSO4O	0.2050E-05	NA+	0.2551E-01	NAC03-	0.1227E-04	NAHCO3	0.1233E-04
NASO4-	0.2036E-03	NACLO	0.8303E-05	K+	0.1820E-03	KSO4-	0.2297E-05	KCLO	0.6112E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.1578E-03	LIOH0	0.2017E-08	LISO4-	0.9623E-06
H4SIO4	0.3470E-03	H3SIO4	0.1971E-04	H2SIO4	0.6913E-07	AL+++	0.3858E-18	ALOH++	0.1556E-14	ALOH2+	0.8686E-11
ALOH4-	0.7442E-06	ALSO4+	0.3573E-18	ALSO42	0.4218E-19	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3O	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3O	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2O	0.0000E+00	FEOH-	0.0000E+00	FESO4O	0.0000E+00	NH4+	0.0000E+00
NH3AO	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.6017E-08	H2SO4O	0.9152E-20	HSO4-	0.1330E-08
HCL0	0.3291E-15	H2SAO	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3O	0.7063E-04
H2BO3-	0.1276E-04	H2CO3*	0.1043E-04	O2AO	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.21	CO3--	4.92	HCO3-	2.99	SO4--	2.86	CL-	1.81	CA++	3.70	CAOH+	7.46
CACO3O	5.27	CAHCO3	5.46	CASO4O	4.19	MG++	5.11	MGOH+	8.03	MGCO3O	6.95	MGHCO3	6.99
MGSO4O	5.69	NA+	1.66	NAC03-	4.98	NAHCO3	4.91	NASO4-	3.76	NACLO	5.08	K+	3.81
KSO4-	5.71	KCLO	7.21	RA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	3.87
LIOH0	8.69	LISO4-	6.09	H4SIO4	3.46	H3SIO4	4.78	H2SIO4	7.43	AL+++	18.95	ALOH++	15.08
ALOH2+	11.13	ALOH4-	6.20	ALSO4+	18.52	ALSO42	19.45	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3O	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2O	-99.99	FEOH-	-99.99	FESO4O	-99.99	NH4+	-99.99	NH3AO	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.28	H2SO4O	20.04	HSO4-	8.95	HCL0	15.48	H2SAO	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3O	4.15	H2BO3-	4.98	H2CO3	4.98	O2AO	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-0.99	ALRITE	-1.22	ANHYDRIT	-1.86	ANORTHIT	-4.35	ARAGONIT	-0.30	BARITE	-99.99	BOEHMITE	-1.62
BRUCITE	-4.15	CALCITE	-0.02	CA-MONT	-1.55	CELESTIT	-99.99	CHALCEDN	-0.11	CHLORITE	-1.49	DOLOMITE	-1.33
GIBBSITE	-2.36	GFOHTITE	-99.99	GRIEGITE	-99.99	GYP SUM	-1.92	HALITE	-5.09	HALLOYST	-4.76	HEMATITE	-99.99
HUNTITE	-7.24	HYDTOMAG	-6.85	ILLITE	-1.64	KAOLINIT	-0.84	K-MICA	-2.84	MACKINAW	-99.99	MAGNESIT	-1.56
MAGNETIT	-99.99	MIRABILT	-5.80	NESQUEHU	-4.65	PHLOGOPT	-3.44	PYRITE	-99.99	PYROPHYL	-0.35	QUARTZ	0.31
SIDERITE	-99.99	STROMTNT	-99.99	TALC	0.15	THENAROT	-5.99	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4O 3.46 QUARTZ 0.29 CHALCEDONY -0.07 A-CRISTOBALITE -0.32 AMORPHOUS -1.37

TITLE 33

LOCATION D-0P-26-08ACCD

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.2245E-02 MGTOT 0.1213E-02 NATOT 0.1153E+00 KTOT 0.5114E-03 CLTOT 0.8689E-01 ALK 0.4070E-02
 SU4TOT 0.1718E-01 ALTOT 0.0000E+00 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.3747E-03
 NO3TOT 0.0000E+00 SI02TOT 0.2829E-03 BTOT 0.9250E-03 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 7.99 PE = 99.99 TEMP = 31.10DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 2.69 -LOG(PO2) = 99.99 -LOG(PCO4) = 99.99

IONIC STRENGTH = 0.13664 TOTAL DISS SOLIDS = 7.80GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.3967E-02

ION BALANCE ERROR = -0.93PERCENT CATION EXCESS = -0.2249E-02(CHARGE*MOLES) H2O ACTIVITY = 0.9961

INDIVIDUAL SPECIES MOLALITIES

OH-	0.2090E-05	CO3--	0.4129E-04	HCO3-	0.3635E-02	SO4--	0.1368E-01	CL-	0.8743E-01	CA++	0.1667E-02
CAOH+	0.3053E-07	CAC030	0.1354E-04	CAMCO3	0.2648E-04	CAS040	0.5558E-03	MG++	0.9279E-03	MGOH++	0.1190E-06
MGC030	0.5022E-05	MGMCO3	0.1565E-04	MGS040	0.2742E-03	NA+	0.1131E+00	NAC03-	0.4031E-04	NAHCO3	0.1311E-03
NAS04-	0.2776E-02	NACLO	0.1349E-03	K+	0.4979E-03	KSO4-	0.1696E-04	KCLO	0.5984E-06	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.3702E-03	LIOH0	0.7981E-09	LISO4-	0.7474E-05
H4SIO4	0.2791E-03	H3SIO4	0.5997E-05	H2SIO4	0.5137E-08	AL+++	0.0000E+00	ALOH++	0.0000E+00	ALOH2+	0.0000E+00
ALOH4-	0.0000E+00	ALSO4+	0.0000E+00	ALSO42	0.0000E+00	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH30	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL30	0.0000E+00	FES04+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH20	0.0000E+00	FEOH-	0.0000E+00	FES040	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.1262E-07	H2SO40	0.6458E-19	H5O4-	0.7100E-08
HCL0	0.9555E-15	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO30	0.8473E-03
H2BO3-	0.8495E-04	H2CO3*	0.5803E-04	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.81	CO3--	4.84	HCO3-	2.55	SO4--	2.34	CL-	1.19	CA++	3.23	CAOH+	7.63
CAC030	4.85	CAMCO3	4.69	CAS040	3.24	MG++	3.46	MGOH+	7.03	MGC030	5.29	MGMCO3	4.93
MGS040	3.55	NA+	1.06	NAC03-	4.51	NAHCO3	3.87	NAS04-	2.67	NACLO	3.86	K+	3.43
KSO4-	4.89	KCLO	6.21	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	3.54
LIOH0	9.08	LISO4-	5.24	H4SIO4	3.54	H3SIO4	5.35	H2SIO4	8.75	AL+++	-99.99	ALOH++	-99.99
ALOH2+	-99.99	ALOH4-	-99.99	ALSO4+	-99.99	ALSO42	-99.99	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL30	-99.99	FES04+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH20	-99.99	FEOH-	-99.99	FES040	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	7.99	H2SO40	19.18	H5O4-	8.27	HCL0	15.01	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO30	3.06	H2BO3-	4.26	H2CO3	4.22	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-99.99	ALBITE	-99.99	ANHYDRIT	-0.97	ANORTHIT	-99.99	ARAGONIT	0.19	BAKITE	-99.99	BOEHMITE	-99.99
BRUCITE	-3.59	CALCITE	0.44	CA-MONT	-99.99	CELESTIT	-99.99	CHALCEDON	-0.08	CHLORITE	-99.99	DOLomite	0.76
GIBBSITE	-99.99	GEOTHITE	-99.99	GRIEGITE	-99.99	GYPsum	-0.97	HALITE	-3.85	HALLUYST	-99.99	HEMATITE	-99.99
HUNTITE	-2.10	HYDTOMAG	-1.82	ILLITE	-99.99	KAOLINIT	-99.99	K-MICA	-99.99	MACKINAW	-99.99	MAGNESIT	0.02
MAGNETIT	-99.99	MIRABILT	-3.45	MESQUEHU	-3.03	PHLOGOPT	-99.99	PYRITE	-99.99	PYROPHYL	-99.99	QUARTZ	0.38
SIDERITE	-99.99	STRONTMT	-99.99	TALC	2.22	THENARDT	-4.28	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO40 3.54 QUARTZ 0.35 CHALCEDONY -0.03 A-CRISTOBALITE -0.29 AMORPHOUS -1.36

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.1597E-02 MGTOT 0.2180E-04 NATOT 0.3393E-01 KYOT 0.1253E-03 CLTOT 0.2646E-01 ALK 0.4400E-03
 SU4TOT 0.5204E-02 ALTOT 0.3715E-06 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.2450E-03
 NO3TOT 0.0000E+00 SIOTOT 0.3827E-03 RTOT 0.8788E-04 RRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 8.39 PF = 99.99 TEMP = 39.90DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 4.02 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.04226 TOTAL DISS SOLIDS = 2.34GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.3708E-03

ION BALANCE ERROR = 0.31PERCENT CATION EXCESS = 0.2281E-03(CHARGE*MOLES) H2O ACTIVITY = 0.9988

INDIVIDUAL SPECIES MOLALITIES

OH-	0.8794E-05	CO3--	0.8680E-05	HCO3-	0.3410E-03	SO4--	0.4497E-02	CL-	0.2651E-01	CA++	0.1288E-02
CAOH+	0.1480E-06	CACO3	0.5580E-05	CAHCO3	0.3460E-05	CASO4	0.3031E-03	MG++	0.1812E-04	MGOH++	0.1494E-07
MGCO3	0.4473E-07	MGHCO3	0.3994E-07	MGSO4	0.3633E-05	NA+	0.3358E-01	NACO3-	0.5312E-05	NAHCO3	0.4406E-05
NASO4-	0.4084E-03	NACLO	0.1497E-04	K+	0.1232E-03	KSO4-	0.2327E-05	KCLO	0.5648E-07	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.2433E-03	LIOH	0.3396E-08	LISO4-	0.2288E-05
H4SIO4	0.3582E-03	H3SIO4	0.2537E-04	H2SIO4	0.1063E-06	AL+++	0.1120E-18	ALOH++	0.4866E-15	ALOH2+	0.2987E-11
ALOH4-	0.3724E-06	ALSO4+	0.1378E-18	ALSO42	0.2487E-19	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2	0.0000E+00	FEOH-	0.0000E+00	FESO4	0.0000E+00	NH4+	0.0000E+00
NH3AO	0.0000E+00	NH4SO4	0.0000E+00	NU3-	0.0000E+00	H+	0.4752E-08	H2SO4	0.7836E-20	HSD4-	0.1560E-08
HCL	0.3109E-15	H2SAO	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3	0.7119E-04
H2BO3-	0.1670E-04	H2CO3*	0.2268E-05	O2AO	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.14	CO3--	5.38	HCO3-	3.55	SO4--	2.67	CL-	1.66	CA++	3.20	CAOH+	6.91
CACO3	5.25	CAHCO3	5.54	CASO4	3.51	MG++	5.05	MGOH+	7.90	MGCO3	7.35	MGHCO3	7.48
MGSO4	5.44	NA+	1.56	NACO3-	5.35	NAHCO3	5.35	NASO4-	3.47	NACLO	4.82	K+	4.00
KSO4-	5.71	KCLO	7.24	RA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	3.69
LIOH	8.46	LISO4-	5.72	H4SIO4	3.44	H3SIO4	4.68	H2SIO4	7.29	AL+++	19.55	ALOH++	15.63
ALOH2+	11.60	ALOH4-	6.51	ALSO4+	18.94	ALSO42	19.69	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2	-99.99	FEOH-	-99.99	FESO4	-99.99	NH4+	-99.99	NH3AO	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	8.39	H2SO4	20.10	HSD4-	8.89	HCL	15.50	H2SAO	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3	4.14	H2BO3-	4.88	H2CO3	5.64	O2AO	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-1.33	ALBITE	-1.29	ANHYDRIT	-1.20	AMORTHIT	-4.39	ARAGONIT	-0.26	BARITE	-99.99	BOEHMITE	-1.99
BRUCITE	-3.95	CALCITE	0.01	CA-MONT	-2.16	CELESTIT	-99.99	CHALCEDN	-0.08	CHLORITE	-1.02	DOLomite	-1.70
GIBBSITE	-2.72	GEOTHITE	-99.99	GRIEGITE	-99.99	GYPSUM	-1.24	HALITE	-4.83	HALLOYST	-5.42	HEMATITE	-99.99
HUNTITE	-8.45	HYDOMAG	-7.90	ILLITE	-2.34	KAOLINIT	-1.49	K-MICA	-3.91	MACKINAW	-99.99	MAGNESIT	-1.97
MAGNETIT	-99.99	MIRABILT	-5.34	MFSOUFHO	-5.06	PHLOGOPT	-3.30	PYRITE	-99.99	PYROPHYL	-1.13	QUARTZ	0.35
SIDERITE	-99.99	STRONTNT	-99.99	TALC	0.95	THENARDT	-5.58	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4 3.44 QUARTZ 0.33 CHALCEDONY -0.03 A-CRISTOBALITE -0.28 AMORPHOUS -1.34

SAMPLE NUMBER 41
 TITLE 183 LOCATION D-06-25-23BRAD

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)
 CATOT 0.8234E-03 MGTOT 0.1851E-03 NATOT 0.4611E-01 KTOT 0.4807E-03 CLTOT 0.3436E-01 ALK 0.3080E-02
 SO4TOT 0.5726E-02 ALTOT 0.0000E+00 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.1873E-03
 NO3TOT 0.0000E+00 SIO2TOT 0.1215E-02 BTOT 0.1202E-03 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 7.94 PE = 99.99 TEMP = 39.60DEG C DENSITY = 1.000GM/CC
 -LOG(PCO2) = 2.66 -LOG(PO2) = 99.99 -LOG(PCO4) = 99.99
 IONIC STRENGTH = 0.05375 TOTAL DISS SOLIDS = 3.15GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.3043E-02
 ION BALANCE ERROR = -0.10PERCENT CATION EXCESS = -0.9610E-04(CHARGE+MOLES) H2O ACTIVITY = 0.9984

INDIVIDUAL SPECIES MOLALITIES

OH-	0.3117E-05	CO3--	0.2710E-04	HCO3-	0.2868E-02	SO4--	0.4982E-02	CL-	0.3444E-01	CA++	0.6556E-03
CAOH+	0.2489E-07	CACO3O	0.7698E-05	CAHCO3	0.1376E-04	CASO4O	0.1489E-03	MG++	0.1523E-03	MGOH++	0.4159E-07
MGCO3O	0.1029E-05	MGHCO3	0.2663E-05	MGSU4O	0.2962E-04	NA+	0.4559E-01	NAC03-	0.2079E-04	NAHCO3	0.4856E-04
NASO4-	0.5720E-03	NAALO	0.2539E-04	K+	0.4728E-03	KSO4-	0.9156E-05	KALO	0.2700E-06	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.1861E-03	LIOH0	0.8799E-09	LISO4-	0.1812E-05
H4SIO4	0.1189E-02	H3SIO4	0.3013E-04	H2SIO4	0.4558E-07	AL+++	0.0000E+00	ALOH++	0.0000E+00	ALOH2+	0.0000E+00
ALOH4-	0.0000E+00	ALSO4+	0.0000E+00	ALSO42	0.0000E+00	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3O	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3O	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2O	0.0000E+00	FEUOH-	0.0000E+00	FESO4O	0.0000E+00	NH4+	0.0000E+00
NH3AO	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.1355E-07	H2SO4O	0.6320E-19	HSO4-	0.4589E-08
HALO	0.1082E-14	H2SAO	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3O	0.1110E-03
H2BO3-	0.9622E-05	H2CO3*	0.5285E-04	O2AO	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.60	CO3--	4.91	HCO3-	2.63	SO4--	2.66	CL-	1.56	CA++	3.53	CAOH+	7.69
CACO3O	5.11	CAHCO3	4.94	CASO4O	3.82	MG++	4.15	MGOH+	7.46	MGCO3O	5.98	MGHCO3	5.67
MGSU4O	4.52	NA+	1.43	NAC03-	4.77	NAHCO3	4.31	NASO4-	3.33	NAALO	4.59	K+	3.42
KSO4-	5.12	KALO	6.56	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	3.81
LIOH0	9.05	LISO4-	5.83	H4SIO4	2.92	H3SIO4	4.61	H2SIO4	7.68	AL+++	-99.99	ALOH++	-99.99
ALOH2+	-99.99	ALOH4-	-99.99	ALSO4+	-99.99	ALSO42	-99.99	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3O	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2O	-99.99	FEUOH-	-99.99	FESO4O	-99.99	NH4+	-99.99	NH3AO	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	7.94	H2SO4O	19.19	HSO4-	8.43	HALO	14.96	H2SAO	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3O	3.95	H2BO3-	5.14	H2CO3	4.27	O2AO	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-99.99	ALBITE	-99.99	ANHYDRIT	-1.51	ANORTHIT	-99.99	ARAGONIT	-0.12	BARITE	-99.99	BOEHMITE	-99.99
BRUCITE	-3.97	CALCITE	0.15	CA-MONT	-99.99	CELESTIT	-99.99	CHALCEDON	0.45	CHLURITE	-99.99	DOLOMITE	-0.19
GIBBSITE	-99.99	GEOTHITE	-99.99	GRIEGITE	-99.99	GYPSUM	-1.55	HALITE	-4.60	HALLUYST	-99.99	HEMATITE	-99.99
HUNTITE	-4.22	HYDOMAG	-3.84	ILLITE	-99.99	KAOLINIT	-99.99	K-MICA	-99.99	MACKINAW	-99.99	MAGNESIT	-0.61
MAGNETIT	-99.99	MIRABILT	-5.06	NI-SQUEHU	-3.69	PHLOGOPT	-99.99	PYRITE	-99.99	PYROPHYL	-99.99	QUARTZ	0.87
SIDERITE	-99.99	STRONTNT	-99.99	TALC	3.02	THENARDT	-5.32	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4O 2.92 QUARTZ 0.86 CHALCEDONY 0.49 A-CRISTOBALITE 0.24 AMORPHOUS -0.82

TITLE 483

LOCATION D-06-25-36C888

INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIVALENTS PER LITER FOR ALKALINITY)

CATOT 0.2969E-02 MGTOT 0.2961E-03 NATOT 0.1131E+00 KTOT 0.4909E-03 CLTOT 0.1019E+00 ALK 0.1270E-02
 SO4TOT 0.7807E-02 ALTOT 0.0000E+00 FETOT 0.0000E+00 SRTOT 0.0000E+00 BATOT 0.0000E+00 LITOT 0.2450E-03
 NO3TOT 0.0000E+00 SIOTOT 0.1082E-02 BTOT 0.1480E-03 BRTOT 0.0000E+00 H2STOT 0.0000E+00 NH4TOT 0.0000E+00

PH = 7.81 PE = 99.99 TEMP = 46.10DEG C DENSITY = 1.000GM/CC

-LOG(PCO2) = 2.92 -LOG(PO2) = 99.99 -LOG(PCH4) = 99.99

IONIC STRENGTH = 0.12681 TOTAL DISS SOLIDS = 7.25GM/LITER SOLN TOTAL INORG CARBON MOLALITY = 0.1221E-02

ION BALANCE ERROR = 0.69PERCENT CATION EXCESS = 0.1627E-02(CHARGE*MOLES) H2O ACTIVITY = 0.9961

INDIVIDUAL SPECIES MOLALITIES

OH-	0.3896E-05	CO3--	0.1020E-04	HCO3-	0.1098E-02	SO4--	0.6069E-02	CL-	0.1025E+00	CA++	0.2544E-02
CAOH+	0.9464E-07	CACO3	0.8144E-05	CAHCO3	0.1917E-04	CASO4	0.4192E-03	MG++	0.2592E-03	MGOH++	0.7342E-07
MGCO3	0.4315E-06	MGHCO3	0.1464E-05	MGSU4	0.3714E-04	NA+	0.1124E+00	NACO3-	0.1967E-04	NAHCO3	0.3928E-04
NASO4-	0.1328E-02	NACLO	0.1569E-03	K+	0.4845E-03	KSO4-	0.9278E-05	KCLO	0.6829E-06	BA++	0.0000E+00
BAOH+	0.0000E+00	SR++	0.0000E+00	SROH+	0.0000E+00	LI+	0.2446E-03	LIOH	0.1432E-08	LISO4-	0.2184E-05
H4SIO4	0.1061E-02	H3SIO4	0.2871E-04	H2SIO4	0.7091E-07	AL+++	0.0000E+00	ALOH++	0.0000E+00	ALOH2+	0.0000E+00
ALOH4-	0.0000E+00	ALSO4+	0.0000E+00	ALSO42	0.0000E+00	FE+++	0.0000E+00	FEOH++	0.0000E+00	FEOH2+	0.0000E+00
FEOH3	0.0000E+00	FEOH4-	0.0000E+00	FECL++	0.0000E+00	FECL2+	0.0000E+00	FECL3	0.0000E+00	FESO4+	0.0000E+00
FE++	0.0000E+00	FEOH+	0.0000E+00	FEOH2	0.0000E+00	FEOH-	0.0000E+00	FESO4	0.0000E+00	NH4+	0.0000E+00
NH3AQ	0.0000E+00	NH4SO4	0.0000E+00	NO3-	0.0000E+00	H+	0.1913E-07	H2SO4	0.1427E-18	HSO4-	0.7352E-08
HCL	0.7219E-14	H2SAQ	0.0000E+00	HS-	0.0000E+00	S--	0.0000E+00	BR-	0.0000E+00	H3BO3	0.1374E-03
H2BO3-	0.1172E-04	H2CO3*	0.2459E-04	O2AQ	0.0000E+00						

INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY)

OH	5.54	CO3--	5.45	HCO3-	3.07	SO4--	2.70	CL-	1.12	CA++	3.05	CAOH+	7.13
CACO3	5.08	CAHCO3	4.83	CASO4	3.36	MG++	4.02	MGOH+	7.24	MGCO3	6.35	MGHCO3	5.96
MGSO4	4.42	NA+	1.07	NACO3-	4.82	NAHCO3	4.39	NASO4-	2.99	NACLO	3.79	K+	3.45
KSO4-	5.15	KCLO	6.15	BA++	-99.99	BAOH+	-99.99	SR++	-99.99	SROH+	-99.99	LI+	3.72
LIOH	8.83	LISO4-	5.78	H4SIO4	2.96	H3SIO4	4.67	H2SIO4	7.61	AL+++	-99.99	ALOH++	-99.99
ALOH2+	-99.99	ALOH4-	-99.99	ALSO4+	-99.99	ALSO42	-99.99	FE+++	-99.99	FEOH++	-99.99	FEOH2+	-99.99
FEOH3	-99.99	FEOH4-	-99.99	FECL++	-99.99	FECL2+	-99.99	FECL3	-99.99	FESO4+	-99.99	FE++	-99.99
FEOH+	-99.99	FEOH2	-99.99	FEOH-	-99.99	FESO4	-99.99	NH4+	-99.99	NH3AQ	-99.99	NH4SO4	-99.99
NO3-	-99.99	H+	7.81	H2SO4	18.83	HSO4-	8.26	HCL	14.13	H2SAQ	-99.99	HS-	-99.99
S--	-99.99	BR--	-99.99	H3BO3	3.85	H2BO3-	5.12	H2CO3	4.60	O2AQ	-99.99		

MINERAL SATURATION INDICES

ADULARIA	-99.99	ALBITE	-99.99	ANHYDRIT	-1.02	ANORTHIT	-99.99	ARAGONIT	-0.14	BARITE	-99.99	BOEHMITE	-99.99
BRUCITE	-3.74	CALCITE	0.15	CA-MONT	-99.99	CELESTIT	-99.99	CHALCEDN	0.34	CHLORITE	-99.99	DOLomite	-0.55
GIBBSITE	-99.99	GROTHITE	-99.99	GRIEGITE	-99.99	GYPSUM	-1.09	HALITE	-3.82	HALLUYST	-99.99	HEMATITE	-99.99
HUNTITE	-5.16	HYDROMAG	-4.47	ILLITE	-99.99	KAOLINIT	-99.99	K-MICA	-99.99	MACKINAM	-99.99	MAGNESIT	-0.93
MAGNETIT	-99.99	MIRABILT	-4.66	MESQUEHO	-4.05	PHLOGOPT	-99.99	PYRITE	-99.99	PYROPHYL	-99.99	QUARTZ	0.75
SIDERITE	-99.99	STROMTNT	-99.99	TALC	2.96	THENARDT	-4.63	WITHERIT	-99.99				

SILICA SATURATION INDICES

-LOG H4SIO4 2.96 QUARTZ 0.73 CHALCEDONY 0.38 A-CRISTOBALITE 0.13 AMORPHOUS -0.92

APPENDIX D

WATSPEC Program

WATSPEC

REFERENCE : WIGLEY, T.M.L., 1977, WATSPEC-A COMPUTER PROGRAM FOR DETERMINING THE EQUILIBRIUM SPECIATION OF AQUEOUS SOLUTIONS: BRITISH GEOMORPHOLOGICAL GROUP TECHNICAL BULLETIN 20, GEO ABSTRACTS LTD, UNIVERSITY OF EAST ANGLIA, NORWICH NR4 7TJ, ENGLAND, 40P.

WATSPEC IS AN AQUEOUS MODEL FOR DETERMINING EQUILIBRIUM CHEMICAL SPECIATION IN NATURAL WATERS. IT ACCEPTS UP TO 18 TOTAL SPECIES CONCENTRATIONS AS INPUT. EH INPUT CAN BE INCLUDED IN ANY OF 5 DIFFERENT WAYS, OR MAY BE OMITTED. WATSPEC ACCOUNTS FOR UP TO 70 AQUEOUS-PHASE SPECIES AND COMPUTES SATURATION INDICES FOR 40 MINERALS

INPUT DETAILS : EACH SAMPLE REQUIRES 2, 3, 4 OR 5 CARDS.

CARD 1 (211, F10.0)

FLAG1= 1 IF SAMPLE INCLUDES REDUCTION-OXIDATION DATA (CARD 3)

FLAG2= NUMBER OF MINOR SPECIES CARDS (CARDS 4 AND/OR 5)

16 MINOR SPECIES PER CARD SO FLAG2= 0, 1 OR 2

DENS= DENSITY (GM/CC OR KG/LITER) : IF DENS IS MISSING OR INPUT AS LESS THAN 1.0, WATSPEC PUTS DENS = 1.0

CARD 2 (9F6.0) : TEMP (DEG C), PH AND MAJOR SPECIES.

Z(1), I=1, 7 = MAJOR SPECIES TOTAL CONCENTRATIONS IN MILLIMOLES PER

LITER OF SOLUTION (MILLIEQUIVALENTS FOR TITRATION

ALKALINITY) : SPECIES ORDER, 1 = CALCIUM,

2 = MAGNESIUM, 3 = SODIUM, 4 = POTASSIUM, 5 = CHLORIDE

6 = TITRATION ALKALINITY, 7 = SULPHATE

CARD 3 (11, 2F10.0) : OXID-REDN DATA (OMIT IF FLAG1 NOT EQUAL TO 1).

THERE ARE 5 INPUT OPTIONS INDICATED BY FLAG3. ZZZ IS THE

APPROPRIATE DATA VALUE. EZ IS LEFT BLANK UNLESS FLAG3 = 3. EH VALUES IN VOLTS.

FLAG3 VALUE

ZZZ

1 MEASURED EH, TEMPERATURE CORRECTED

2 MEASURED EH, NOT TEMPERATURE CORRECTED

3 MEASURED EH, NOT TEMPERATURE CORRECTED. EZ MUST BE SPECIFIED WITH THIS OPTION. EZ = EH OF STANDARD

ZOBELLS SOLUTION

4 OXYGEN CONCENTRATION AS -LOG(MOLES OF O2 PER LITER OF SOLUTION)

5 TOTAL SULPHIDE AS -LOG(MOLES OF H2S PER LITER OF SOLUTION)

CARDS 4 AND 5 (6(12, G10.4) : MINOR SPECIES. OMIT IF NO MINOR SPECIES

DATA. DATA INPUT IS IN PAIRS WITH SPECIES NUMBER FOLLOWED BY TOTAL CONCENTRATION IN MILLIMOLES PER LITER OF SOLN : SPECIES NUMBERS

8 (ALUMINIUM), 9 (IRON), 10 (STRONTIUM), 11 (BARIUM), 12 (LITHIUM),

13 (NITRATE), 14 (SILICATE AS SiO2), 15 (BORATE AS B), 16 (BROMIDE)

17 (SULFIDE AS H2S), 18 (AMMONIA AS NH4+).

IF SULFIDE IS ENTERED ON CARD 4 OR 5 THIS VALUE WILL BE USED FOR

CALCULATION OF SPECIATION EVEN IF MEASURED EH DATA IS GIVEN ON

CARD 3. TO FIND SPECIATION WITH SULPHIDE DETERMINED BY MEASURED

EH DATA OMIT SULPHIDE FROM CARD 4.

END OF DATA: A CARD WITH 99 IN COLUMNS 1 AND 2 SHOULD ALWAYS BE

INCLUDED AFTER THE LAST DATA CARD TO DENOTE END OF DATA

DIMENSION R(72), B(72), IPAIR(21), IR1(21), IR2(21), GFW(18), NX(11)

1, CHH(72), XLOC(4)

INTEGER CHG, CHH, FLAG1, FLAG2, FLAG3

REAL K, KMIN

REAL*8 ATITLE

COMMON/75/ F(72), X(72), Z(72), AA, BB, CHG(72), CTOT, DENS, FLAG3, GMH2O,

1PPCH4, EZ, PE, PH, T, TEMP, TDS, U, ZZZ, K(77), KMIN(40), PK(77), PKMIN(40)

DATA IPAIR/19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 35, 58, 59,

160, 61, 68/, IR1/4*1, 4*2, 4*3, 4*4, 71, 71, 10, 11, 12, 12, 71/, IR2/72, 34, 6, 7,

32, 1, -1, 0, 0, -1, 0, 1, 1, 0, 1, 0, 1, 0, 0, -1, 0, -1, 0, -1, 0, -2, -1, 0, -1, -2,

43, 2, 1, 1, -1, -1, 3, 2, 0, 2, 1, -1, 1, 2, 1, 1, 0, -1, 0, 1, 1, 0, -1, -1, -2, 0, -1, 5*0,

51, -1/, GFW/40.08, 24.312, 22.99, 39.102, 35.453, 61.017, 96.062, 26.981,

655.847, 87.62, 137.34, 6.939, 62.005, 60.085, 10.811, 79.909, 34.08,

718.034/, R/5., 5.5, 4., 2*3.5, 5.4, 5., 4.5, 0., 5., 5., 6., 3., 0., 2.5, 4., 0.,

80., 6., 0., 6., 0., 6.5, 0., 4., 0., 0., 5.4, 0., 5.4, 0., 5.4, 0., 5.4, 4.5, 0., 4.,

95.4, 9., 2*5.4, 2*4.5, 0., 9., 5., 0., 5., 2*5.4, 5., 6., 5., 5., 0., 5., 0., 5.,

*5., 0., 5., 3.5, 5., 0., 5., 5*0., 9., 3.5/, 8/, .165., 2., 075, 2*.015, 0., -.04,

165*0./, ELIMIT/1.E-06/, NDATA/0/, TKEEP/1000./

A 2
A 3
A 4
A X4
A 5
A 6
A 7
A 8
A 10
A 11
A 12
A 13
A 14
A 15
A 16
A 17
A 18

C** OPEN FILES

C

```

      TYPE 901
901    FORMAT(' INPUT FILE? ',3)
      CALL ASSIGN(5,0,-1)
      TYPE 902
902    FORMAT(' OUTPUT FILE? ',3)
      CALL ASSIGN(6,0,-1)

```

C

C** DONE OPENING FILES

C

C

```

10    DO 20 I=1,72                                A 19
      CHG(I)=CHH(I)                                A 20
      Z(I)=0                                        A 21
      X(I)=0                                        A 22
      A(I)=0                                        A 23
20    F(I)=1                                        A 24
      NDATA=NDATA+1                                A 25
      READ(5,220,END=23)FLAG1,FLAG2,DENS,ATITLE,XLOC A 26
      IF((FLAG1.EQ.9).AND.(FLAG2.EQ.9))GO TO 130    A 27
      READ(5,230) TEMP,PH,(Z(I),I=1,7)             A 28
      IF(FLAG1.EQ.1)READ(5,240)FLAG3,ZZZ,EZ         A 29
      IF(FLAG2.GE.1)READ(5,250)((NX(I),Z(NX(I))),I=1,6) A 30
      IF(FLAG2.GE.2)READ(5,250)((NX(I),Z(NX(I))),I=1,6) A 31
      WRITE(6,170) NDATA                             A 32
      WRITE(6,211) ATITLE,XLOC                       AX32
      IF((DENS.GT.0).AND.(DENS.LT.1.))WRITE(6,210)DENS A 33
      IF((DENS.GE.0.).AND.(DENS.LT.1.))DENS=1.0      A 34
      T=TEMP+273.15                                  A 35
      IF(ABS(TEMP-TKEEP).GT.0.1)CALL FOUCON         A 36
      TKEEP=TEMP                                     A 37
      PPCH=99.99                                     A 38
      PE=99.99                                       A 39
      CTOT=1000                                     A 40
      TDS=0                                          A 41
      GMSOLN=1000.*DENS                             A 42
      DO 30 I=1,18                                  A 43
30    TDS=TDS+Z(I)*GFH(I)/1000.                    A 44
      GMSOLN=GMSOLN-TDS                             A 45
      DO 40 I=1,18                                  A 46
      Z(I)=Z(I)/GMSOLN                              A 47
40    X(I)=Z(I)                                      A 48
      IF((Z(17).GT.0.).AND.(FLAG1.NE.1))GO TO 120  A 49
      A(71)=10.**(-PH)                               A 50
      X(71)=A(71)                                    A 51
      X(72)=K(73)/A(71)                             A 52
      A(73)=1.                                       A 53
C      FIRST ESTIMATE OF HCO3- ACTIVITY.
      X(6)=(Z(6)+X(71)-X(72))/(1.+Z(1)*K(21)+Z(2)*K(25)+Z(3)*K(29)+
12.*(1.+7(1)*K(20)+Z(2)*K(24)+Z(3)*K(28))/(K(6)*A(71))) A 54
      IF(X(6).LT.0.)GO TO 120                       A 55
      ITEMP=0                                         A 56
50    IF(ITEMP.GE.50)GO TO 120                      A 57
C      CALC OF IONIC STRENGTH AND ACTIVITY COEFFICIENTS
      DO 60 I=1,72                                  A 58
60    U=U+.5*X(I)*CHG(I)*CHG(I)                    A 60
      XTOT=0                                          A 61
      DO 70 I=1,72                                  A 62
      C=SQRT(U)*CHG(I)*CHG(I)*A                    A 63
      IF(CHG(I).EQ.0)F(I)=10.**(-10.1*U)            A 64
      IF(CHG(I).NE.0)F(I)=10.**(-C/(1.+88*SQRT(U)*2(I))+U*2(I)) A 65
      IF(1.NE.71) A(I)=F(I)*X(I)                    A 66
70    XTOT=XTOT+X(I)                                 A 67
      C=TEMP*TEMP                                    A 68
      F(68)=10.**(-U*(33.5-.109*TEMP+.0014*C-U*(1.5+.015*TEMP-.0004*C)) A 69
      1/T)                                           A 70
C      ACTIVITIES OF H2O, OH-,AND CO3--.
      A(73)=1.-.017*XTOT                            A 71
      A(72)=K(73)*A(73)/A(71)                       A 72
      X(72)=A(72)/F(72)                             A 73
      A(34)=A(6)/(K(6)*A(71))                       A 74
C      TEST FOR CONVERGENCE.
      TEST=CTOT                                       A 75
      CTOT=X(6)+X(20)+X(21)+X(24)+X(25)+X(28)+X(29)+X(34)+X(68) A 76

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IF((ABS(TEST-CTOT)/CTOT).LT.ELIMIT)GO TO 110
ITER=ITER+1
C    CALCULATION OF PE, O2, CH4 AND SULPHIDE SPECIES.
IF(FLAG1.EQ.1)CALL PECALC
C    SILICATE SPECIES.
A(14)=Z(14)/(1./F(14)+(K(37)/F(37)+K(38)/F(38))/A(71))
A(37)=K(37)*A(14)/A(71)
A(38)=K(38)*A(14)/(A(71)*A(71))
C    BORATE SPECIES.
A(15)=Z(15)/(1./F(15)+K(44)/(F(44)*A(71)))
A(44)=K(44)*A(15)/A(71)
C    ALUMINIUM SPECIES.
A(39)=Z(18)/(1./F(39)+A(72)*A(72)*(A(72)*A(72)+K(8)/F(8)+K(40)/
1(F(40)*A(72))+K(41)/F(41))+A(7)*(K(42)/F(42)+K(43)*A(7)/F(43)))
C=A(39)*A(72)
A(8)=K(8)*C*A(72)**3
A(40)=K(40)*C
A(41)=K(41)*C*A(72)
A(42)=K(42)*A(39)*A(7)
A(43)=K(43)*A(39)*A(7)*A(7)
IF((FLAG1.NE.1).AND.(Z(9).GT.0.)) PE=10.
IF((FLAG1.NE.1).AND.(Z(9).EQ.0.)) GO TO 80
C    IRON SPECIES.
E=10.**(-PE)
A(74)=E
C=A(71)/A(73)
G=C*C
A(52)=E*Z(9)/(E/F(52)+K(9)/(F(9)*C*G)+K(45)/F(45)+K(46)*A(5)/F(46)
1+K(47)*A(5)**3/F(47)+K(48)/(F(48)*C)+K(49)/(F(49)*G)+K(50)/(F(50)*
2G*G)+K(51)*A(7)/F(51)+K(53)*A(5)*A(5)/F(53)+K(54)*E/(F(54)*C)
3+K(55)*E/(F(55)*G)+K(56)*E/(F(56)*G*A(71))+K(57)*E*A(7)/F(57))
Y=A(52)/E
A(9)=K(9)*Y/(C*G)
A(45)=K(45)*Y
A(46)=K(46)*Y*A(5)
A(47)=K(47)*Y*(A(5)**3)
A(48)=K(48)*Y/C
A(49)=K(49)*Y/G
A(50)=K(50)*Y/(G*G)
A(51)=K(51)*Y*A(7)
A(53)=K(53)*Y*A(5)*A(5)
A(54)=K(54)*A(52)/C
A(55)=K(55)*A(52)/G
A(56)=K(56)*A(52)/(G*A(71))
A(57)=K(57)*A(52)*A(7)
80    FOR THESE SPECIES.
C    IF(Z(18).GT.0.) A(18)=Z(18)/(1./F(18)+K(64)/(F(64)*A(71))+K(65)
1/(F(65)*A(7)))
IF(FLAG1.EQ.1)C=10.**((PK(76)+10.*PH+R.*PE+3.*ALOG10(A(73)))
IF((Z(13).GT.0.).AND.(FLAG1.EQ.1))X18=A(13)/(C*F(18))
IF((Z(18).GT.0.).AND.(FLAG1.EQ.1))X13=A(18)*C/F(13)
IF(A(18).GT.0.)A(64)=K(64)*A(18)/A(71)
IF(A(18).GT.0.)A(65)=K(65)*A(18)/A(7)
C    ALL OTHER ION PAIRS
DO 90 I=1,21
90    A(IPAIR(I))=K(IPAIR(I))*A(IR1(I))*A(IR2(I))
A(36)=K(36)*A(71)*A(71)*A(7)
DO 100 I=1,65
100    X(I+7)=A(I+7)/F(I+7)
C    KEY SPECIES
IF(X(1).GT.0.)X(1)=Z(1)/(1.+(X(19)+X(20)+X(21)+X(22))/X(1))
IF(X(2).GT.0.)X(2)=Z(2)/(1.+(X(23)+X(24)+X(25)+X(26))/X(2))
IF(X(3).GT.0.)X(3)=Z(3)/(1.+(X(27)+X(28)+X(29)+X(30))/X(3))
IF(X(4).GT.0.)X(4)=Z(4)/(1.+(X(31)+X(32))/X(4))
IF(X(5).GT.0.)X(5)=Z(5)/(1.+(X(27)+X(31)+X(33)+X(46))+3.*X(47)+2.*
1X(53))/X(5))
IF(X(7).GT.0.)X(7)=Z(7)/(1.+(X(22)+X(26)+X(30)+X(32)+X(35)+X(36)
1+X(42)+2.*X(43)+X(51)+X(57)+X(61)+X(65))/X(7))
IF(X(10).GT.0.)X(10)=Z(10)/(1.+X(58)/X(10))
IF(X(11).GT.0.)X(11)=Z(11)/(1.+X(59)/X(11))
IF(X(12).GT.0.)X(12)=Z(12)/(1.+(X(60)+X(61))/X(12))
C=X(37)+2.*X(38)+X(44)+X(8)+X(62)+2.*X(63)+X(72)+X(60)-X(71)
C=X(37)+2.*X(38)+X(44)+X(40)+2.*X(41)+4.*X(8)+X(62)+2.*X(63)+X(64)
1+X(72)+X(19)+X(23)+X(58)+X(59)+X(60)-X(71)-X(33)-X(35)-2.*X(36)
X(6)=Z(6)-C/(1.+(X(21)+X(25)+X(29)+2.*(X(20)+X(24)+X(28)+X(34)))
1/X(6))

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GO TO 50
110 IF((FLAG1.EQ.1).AND.(Z(18).GT.0.)) WRITE(6,140) X13
IF((FLAG1.EQ.1).AND.(Z(13).GT.0.)) WRITE(6,150) X18
IF((FLAG1.NE.1).AND.(Z(9).GT.0.)) WRITE(6,160)
CALL PRINT
GO TO 10
120 IF(ITER.GT.50) WRITE(6,180)
IF(X(6).LT.0.) WRITE (6,190)
IF((Z17.GT.0.).AND.(FLAG1.NE.1)) WRITE (6,200)
IF(ITER.GT.50) CALL PRINT
GO TO 10
130 CONTINUE
140 FORMAT(/,,' NH3 AND PE DATA GIVEN : NH3, PH AND PE IMPLY NO3- MOL
IALITY =',E11.4)
150 FORMAT(/,,' NO3 AND PE DATA GIVEN : NO3, PH AND PE IMPLY NH4+ MOL
IALITY =',E11.4)
160 FORMAT(/,,' PE TOTAL > ZERO BUT NO EM DATA CARD : PE ARBITRARILY
ASSUMED EQUAL TO 10.0')
170 FORMAT(1H1,' SAMPLE NUMBER',I4)
211 FORMAT(1,2X,'TITLE',2X,A6,10X,'LOCATION',2X,3A4,A2)
180 FORMAT(/,,' NOT CONVERGED AFTER 50 ITERATIONS. RESULTS AT THIS S
PAGE ARE ')
190 FORMAT(1X,' SAMPLE REJECTED : HCO3 < 0, POSSIBLE PH OR ALKALINIT
LY ERROR')
200 FORMAT(1X,' POSSIBLE DATA INPUT ERROR : TOTAL SULPHIDE SPECIFIED
1 BUT NO EM DATA CARD')
210 FORMAT(1X,' WARNING, DENSITY SPECIFIED AS',F6.3,' : VALUE CHAN
LGED TO 1.0')
220 FORMAT(2I1,F10.0,A6,3A4,A2)
230 FORMAT(9F8.4)
240 FORMAT(1I,2F10.0)
250 FORMAT(6(I2,G10.4))
C220 FORMAT(2I,F)
C230 FORMAT(9F)
C250 FORMAT(6(I,G))
23 STOP
END
SUBROUTINE EQUCON
C THIS SUBROUTINE CALCULATES ALL EQUILIRRIUM CONSTANTS AND
C DEBYE-HUCKEL CONSTANTS
DIMENSION I1(39),I2(15),PK25(78),DELH(78),A1(15),A2(15),A3(15)
INTEGER CHG,FLAG1,FLAG2,FLAG3
REAL K,KMIN
COMMONA(75),F(72),X(72),Z(72),AA,88,CHG(72),CTOT,DENS,FLAG3,GMH20,
1PPCH4,EZ,PE,PH,T,TEMP,TDS,U,ZZZ,K(77),KMIN(40),PK(77),PKMIN(40)
DATA I1/8,9,19,22,26,27,28,29,30,31,33,36,40,41,42,43,45,46,47,48,
149,50,51,53,54,55,56,57,59,59,60,61,63,65,66,73,74,75,76/,I2/6,20,
221,23,24,25,32,35,37,38,44,62,64,68,77/
DATA PK25/-33.938, 26.571, -1.4 , -2.309, -2.238, 1.602, -1.268,
1 .25 , -0.72 , 1.585, 6.1 , 1. , -8.998,-18.235, -3.2 ,
2 -5.1 , 13.013, 11.6 , 11.925, 15.473, 20.173, 34.894, 8.886,
3 10.919, 9.319, 20.57 , 29.458, -2.2 , -0.82 , -0.64 , -0.2 ,
4 -0.64 , 12.918, -1.11 , 21.495, 13.998,-40.644,-30.741,-119.077
5 , 8.215, 4.548, 8.24 , -1.582, 11.41 , 5.974, 9.756, 13.32 ,
6 10.55 , .179, 11.41 , 32.77 , 3.523, 4.005, 17.02 , 4.759,
7 5.211, 1.113, 4.631, 30.51 , 41.2 , 33.41 , -24.15 , 18. ,
8 63.53 , 20.57 , 49.09 , 19.33 , 62.29 , 36.91 , 32.82 , 90.61 ,
9 42.43 , 37.82 , -32.67 , 18.48 , 17.97 , 40.31 , 45. /
DATA DELH/ -9.32 , .0 , 1.19 , 1.5 , 1.27 , .0 , 8.911,
1 .0 , 1.1 , .0 , 18.63 , 10. , 1.99 , .0 , 2.29 ,
2 3.07 , 9.7 , 18.152, .0 , 20.115, .0 , .0 , 15.92 ,
3 .0 , 13.218, 28.565, 32.995, .56 , 1.15 , 1.75 , 4.832,
4 .0 , 12.1 , .0 , 33.457, 13.345,-65.44 , -57.435,-187.055
5 , -2.959, -3.769, -6.169, .918, 2.361, -1.054, 6.141, 6.95 ,
6 -5.328, -0.572, .85 , 14.47 , 4.615, 6.22 , -8.29 , .261,
7 -4.551, 18.987, .0 , -25.76 , 25.555, 11.905,-49.65 , 25.896,
8 .0 , 30.82 , 67.86 , 17.53 , 45.065, 49.15 , 44.68 , 54.76 ,
9 .0 , -25.52 , -68.86 , 11.3 , .0 , 54.684, 58.373/
DATAAL/-6.498,-27.393,-2.95,.684,.991,2.319,3.106,-5.3505,6.368,39
1.478,28.6059,11.17,.6322,-14.8435,-14.0184/,A2/.02379,.05617,.0133
2,.0051295,.00667,-.011056,0.,.0183412,-.016346,-.065927,.012078,-
302386,-.001225,.032786,.015264/,A3/2902.39,4114.,0.,0.,0.,-673.
46,557.25,-3405.9,-12355.1,1573.21,-3279.-2835.76,3404.71,2385.73/
DO 10 I=1,39
PK(I1(I))=PK25(I)+DELH(I)*(25.-TEMP)/(T*.13642378)

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10 IF((I1(I).NE.76).AND.(-PK(I1(I)).GT.35.0)) PK(I1(I))=-35.0      B X39
   IF(I1(I).NE.75) K(I1(I))=10.**(-PK(I1(I)))                      B 39
   DO 20 I=1,15                                                    B 38
   PK(I2(I))=-A1(I)-A2(I)*T-A3(I)/T                                B 39
   IF(I.EQ.6)PK(I2(I))=PK(I2(I))-2.29812E-05*T*T                  B 40
   IF(I.EQ.11)PK(I2(I))=PK(I2(I))+13.2258*ALOG10(T)+PK(73)        B 41
20 K(I2(I))=10.**(-PK(I2(I)))                                       B 42
   DO 30 I=1,39                                                    B 43
30 PKMIN(I+1)=PK25(I+39)+DELH(I+39)*(25.-TEMP)/(T*1.3642378)     B 44
   PKMIN(1)=-13.543+.0401*T+3000./T                                B 45
   PKMIN(17)=4.6535-TEMP*(.004545-.000101*TEMP)                   B 46
   AA=.49863+TEMP*7.48E-4+TEMP*TEMP*3.85E-6                      B 47
   BB=.32415+TEMP*1.65E-4+TEMP*TEMP*2.0E-7                       B 48
   RETURN                                                            B 49
   END                                                                B 50
   SUBROUTINE PECALC                                                C 1
C   THIS SUBROUTINE CALCULATES PE, O2, CH4 AND SULPHIDE SPECIES.
   INTEGER CHG,FLAG1,FLAG2,FLAG3
   REAL K,KMIN
   COMMONA(75),F(72),X(72),Z(72),AA,BB,CHG(72),CTOT,DENS,FLAG3,GMH20,
1PPCH4,EZ,PE,PH,T,TEMP,TDS,U,ZZZ,K(77),KMIN(40),PK(77),PKMIN(40)
   C=ALOG10(A(71))
   IF(FLAG3.EQ.1)EH=ZZZ
   IF(FLAG3.EQ.2)EH=ZZZ+.244+.00084*(25.-TEMP)
   IF(FLAG3.LT.4) PE=EH/(1.38422E-04*T)
   IF(FLAG3.NE.5) GO TO 10
   Z17=10.**(-ZZZ)/(GMH20/1000.)
   A(17)=Z17/(1./F(17)+K(62)*(1./F(62)+K(63)/(F(63)*A(71)))/A(71))
   PE=(-ALOG10(A(17))-4.*C+ALOG10(A(71))-10.*PH-PK(74))
10 IF(FLAG3.EQ.4) A(66)=10.**(-ZZZ)*F(66)/(GMH20/1000.)
   IF(FLAG3.EQ.4)PE=PK(66)-.5*C+PH+.25*ALOG10(A(66))
   IF(A(71).GT.0.)G=-PK(74)+ALOG10(A(71))-10.*PH-8.*PE-4.*C
   IF(A(71).GT.0.)AND.(G.GT.-35.)A(17)=10.**G
   IF(Z(17).GT.0.)A(17)=Z(17)/(1./F(17)+K(62)*(1./F(62)+K(63)/(F(63)*
1A(71)))/A(71))
   A(62)=K(62)*A(17)/A(71)
   A(63)=K(63)*A(62)/A(71)
   G=4.*(PE-PK(66))+.5*C+PH
   IF(FLAG3.NE.4).AND.(G.GT.-35.)A(66)=10.**G
   PPCH4=.9.*PE+.3.*C+PK(75)+.9.*PH-ALOG10(A(6))
   RETURN
   END
   SUBROUTINE PRINT
C   THIS SUBROUTINE CALCULATES SATURATION INDICES AND OTHER OUTPUTS.
   DIMENSION IS1(38),IS2(38),IS3(38),IS4(38),N1(38),N2(38),N3(38),
1N4(38),SI(40),IO1(69),IO2(40)
   INTEGER CHG,FLAG1,FLAG2,FLAG3
   REAL K,KMIN
   COMMONA(75),F(72),X(72),Z(72),AA,BB,CHG(72),CTOT,DENS,FLAG3,GMH20,
1PPCH4,EZ,PE,PH,T,TEMP,TDS,U,ZZZ,K(77),KMIN(40),PK(77),PKMIN(40)
   DATA IS1/3*1,2,3,2*10,2*11,52,7,2,39,2*14,2*1,2,7,52,1,45,39,52,3,
13*4,1,2,4*8,2,3*74/,N1/23*1,2,5*1,3,4*2,4,3*-2/,IS2/2*34,7,34,5,
234,7,7,2*34,3,2*72,2*73,2,7,34,3,62,2,2*72,71,5*8,72,2*71,72,71,72
3,3*71/,N2/10*1,2*2,3,2*-2,3*1,2,1,3*3,-6,3*1,3,2,6,2*2,8,2*2,-8,-2
4,-4/,IS3/15*75,34,3*73,71,34,15*73,2*62/,N3/15*0,2*2,3,10,-1,4,
52*-1,3,-8,-10,-8,-12,-8,-10,2*-7,-10,-12,3,4,2,4/,IS4/23*75,74,
610*14,34,3*52/,N4/23*0,-2,4*3,2,4,2*2,3,4,3,3,1,3/
   DATA IO1/72,34,6,7,5,1,19,20,21,22,2,23,24,25,26,3,28,29,30,27,4,3
12,31,11,59,10,58,12,60,61,14,37,38,39,40,41,8,42,43,45,48,49,9,50,
246,53,47,51,52,54,55,56,57,18,64,65,13,71,36,35,33,17,62,63,16,15,
344,68,66/, IO2/27,25,3,29,2,8,23,12,1,40,7,14,33,16,13,22,38,17,5,
432,24,21,35,39,31,28,20,4,36,19,18,26,37,34,15,10,6,30,11,9/
   A(75)=1.
   PPQ2=99.99
   SUMCAT=0.
   SUMAN=0
   DO 10 I=1,40
10 SI(I)=-99.99
   DO 20 I=1,38
20 IF((A(SI(1)).GT.0.)AND.(A(SI(2)).GT.0.)AND.(A(SI(3)).GT.0.)
1AND.(A(SI(4)).GT.0.))SI(I)=N1(I)*ALOG10(A(SI(1)))+N2(I)*ALOG10(A
2(SI(2)))+N3(I)*ALOG10(A(SI(3)))+N4(I)*ALOG10(A(SI(4)))+PKMIN(I)
   IF(SI(26).GT.-99.99)SI(26)=SI(26)+3.*ALOG10(A(2))+6.*ALOG10(A(72))
   IF(SI(28).GT.-99.99)SI(28)=SI(28)+2.*ALOG10(A(71))
   IF(SI(33).GT.-99.99)SI(33)=SI(33)+5.*ALOG10(A(2))

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      IF((A(2).GT.0.).AND.(A(4).GT.0.).AND.(A(8).GT.0.).AND.(A(14).GT.0. D 33
1))SI(39)=.25*ALOG10(A(2))+.6*ALOG10(A(4))+2.3*ALOG10(A(8))+3.5* D 34
2ALOG10(A(14))+1.2*ALOG10(A(71))-11.2*ALOG10(A(73))+PKMIN(39) D 35
      IF((A(11).GT.0.).AND.(A(8).GT.0.).AND.(A(14).GT.0.))SI(40)=.17*ALOG U 36
110(A(11))+2.33*ALOG10(A(8))+3.67*ALOG10(A(14))+2.*ALOG10(A(71))- D 37
212.*ALOG10(A(73))+PKMIN(40) D 38
      DO 30 I=1,72 D 39
      IF(CHG(I).GT.0)SUMCAT=SUMCAT+CHG(I)*X(I) D 40
      IF(CHG(I).LT.0)SUMAN=SUMAN-CHG(I)*X(I) D 41
      DO 40 I=1,18 D 42
40 Z(I)=Z(I)*GMH2O/1000. D 43
      WRITE(6,50) (Z(I),I=1,18) D 44
      PKH2O=2.850-2.8*(25.-TEMP)/(1.3642378) D 45
      IF(A(66).GT.0) PPO2=-ALOG10(A(66))-PKO2 D 46
      CATXS=SUMCAT-SUMAN D 48
      ERROR=100.*CATXS/(SUMCAT+SUMAN) D 49
      ACRST=(-0.0321-988.2)/T
      AAMOR=(0.3387-T*(-7.849/10000)-(840.1/T))
      ACHAL=0.11-1101/T
      AQTZ=0.41-1309/T
      DO 22 I=1,69
      IF(A(I01(I)).EQ.0.)A(I01(I))=-99.99
22 IF(A(I01(I)).NE.-99.99)A(I01(I))=-ALOG10(A(I01(I)))
      BCRST=-A(I01(31))-ACRST
      BAMOR=-A(I01(31))-AAMOR
      BCHAL=-A(I01(31))-ACHAL
      BQTZ=-A(I01(31))-AQTZ
      IF(A(I01(31)).EQ.-99.99)BCRST=-99.99
      IF(A(I01(31)).EQ.-99.99)BAMOR=-99.99
      IF(A(I01(31)).EQ.-99.99)BCHAL=-99.99
      IF(A(I01(31)).EQ.-99.99)BQTZ=-99.99
      WRITE(6,60) PH,PE,TEMP,DFNS,PPCO2,PPU2,PPCH4,U,TDS,CTOT,ERROR,
1CATXS,A(73) D 51
      WRITE(6,70)(X(I01(I)),I=1,69) D 52
      WRITE(6,92)(A(I01(I)),I=1,69) DX53
      WRITE(6,80)(SI(I02(I)),I=1,40) D 53
      WRITE(6,95)A(I01(31)),BQTZ,BCHAL,BCRST,BAMOR
50 FORMAT(/,' INPUT DATA (MOLES PER LITER OF SOLUTION : EQUIV
1ALENTS PER LITER FOR ALKALINITY)',/, D 55
2' CATOT',E12.4,' MGTOT',E13.4,' NATOT',E11.4,' KTOT',E12.4, D 56
3' CLTOT',E12.4,' ALK',E14.4,/, ' SD4TOT',E11.4,' ALTOT',E13.4, D 57
4' FETOT',E11.4,' SRTOT',E11.4,' BATOT',E12.4,' LITOT',E12.4,/, D 58
5' NO3TOT',E11.4,' SIO2TOT',E11.4,' BTOT',E12.4,' BRTOT', D 59
6E11.4,' H2STOT',E11.4,' NH4TOT',E11.4) D 60
60 FORMAT(/,' PH=',F6.2,' PE=',F6.2,' TEMP=',F6.2,'DEG C D 61
1ENSITY=',F6.3,'GM/CC',/, '-LOG(PCO2) =',F5.2,' -LOG(PO2) =', D 62
2F6.2,' -LOG(PCH4) =',F6.2,/, ' IONIC STRENGTH =',F8.5,' TOTA D 63
3L DISS SOLIDS =',F6.2,'GM/LITER SOLN TOTAL INORG CARBON MOLALITY D 64
4 =',E11.4,/, ' ION BALANCE ERROR =',F6.2,'PERCENT CATION EXCESS D 65
5 =',E11.4,'(CHARGE*MOLES) H2O ACTIVITY =',F7.4) D 66
70 FORMAT(/,' INDIVIDUAL SPECIES MOLALITIES ',//,2X,'DM- D 67
1 ',E11.4,' CO3--',E11.4,' HCO3- ',E11.4,' SO4-- ',E11.4,' C D 68
2L- ',E11.4,' CA++ ',E11.4,/, ' CAOH+ ',E11.4,' CACO3O',E11.4, D 69
3' CAMCO3',E11.4,' CASO4O',E11.4,' MG++ ',E11.4,' MGOH++', D 70
4 ',E11.4,/, ' MGC03O',E11.4,' MGHC03',E11.4,' MGS04O',E11.4, D 71
5' NA+ ',E11.4,' NAC03-',E11.4,' NAHCO3',E11.4,/, ' NASO4-', D 72
6E11.4,' NACLO ',E11.4,' K+ ',E11.4,' KSO4-',E11.4, D 73
7' KCLO ',E11.4,' BA++ ',E11.4,/, ' BAOH+ ',E11.4,' SR++ ', D 74
8E11.4,' SROM+ ',E11.4,' LI+ ',E11.4,' LIOHO ',E11.4, D 75
9' LIS04-',E11.4,/, ' H4SIO4',E11.4,' H3SIO4',E11.4,' H2SIO4', D 76
',E11.4,' AL++ ',E11.4,' ALOH++',E11.4,' ALOH2+',E11.4,/, ' AL D 77
1OH4-',E11.4,' ALS04+',E11.4,' ALS042',E11.4,' FE++ ',E11.4, D 78
2' FE0H++',E11.4,' FE0H2+',E11.4,/, ' FE0H3O',E11.4,' FE0H4-', D 79
3E11.4,' FECL++',E11.4,' FECL2+',E11.4,' FECL3O',E11.4, D 80
4FES04+',E11.4,/, ' FE++ ',E11.4,' FE0H+',E11.4,' FE0H2O',E11. D 81
54,' FE0OH-',E11.4,' FES04O',E11.4,' NH4+ ',E11.4,/, ' NH3AQ ', D 82
6E11.4,' NH4S04',E11.4,' NO3- ',E11.4,' H+ ',E11.4, D 83
7 H2S04O',E11.4,' HSO4- ',E11.4,/, ' HCLO ',E11.4,' H2SAQ ',E11. D 84
84,' HS- ',E11.4,' S-- ',E11.4,' BR- ',E11.4,' H3BO3O D 85
9',E11.4,/, ' H2BO3-',E11.4,' H2CO3+',E11.4,' O2AQ ',E11.4) D 86
92 FORMAT(/,' INDIVIDUAL SPECIES ACTIVITIES(-LOG ACTIVITY) '
1,/, ' OH ',F6.2,' CO3-- ',F6.2,' HCO3- ',F6.2,' SO4--
2 ',F6.2,' CL- ',F6.2,' CA++ ',F6.2,' CAOH+ ',F6.2,
3/, ' CACO3O ',F6.2,' CAMCO3 ',F6.2,' CASO4O ',F6.2,' MG++

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4 ,F6.2, MGTH+ ,F6.2, MGCO30 ,F6.2, MGHC03 ,F6.2,/,
5 ,F6.2, MGSO40 ,F6.2, NA+ ,F6.2, NAC03- ,F6.2, NAHC03 ,
6 ,F6.2, NAS04- ,F6.2, NACLO ,F6.2, K+ ,F6.2,/,
7 ,F6.2, KSO4- ,F6.2, KCL0 ,F6.2, HA++ ,F6.2, BAOM+ ,
8 ,F6.2, SR++ ,F6.2, SRDH+ ,F6.2, LI+ ,F6.2,/,
9 ,F6.2, H2SI04 ,F6.2, AL+++ ,F6.2, ALDH++ ,F6.2,/,
10 ,F6.2, ALDH2+ ,F6.2, ALDH4- ,F6.2, ALS04+ ,F6.2, ALS042 ,
11 ,F6.2, FE+++ ,F6.2, FE0H++ ,F6.2, FE0H2+ ,F6.2,/,
12 ,F6.2, FE0H3 ,F6.2, FE0H4- ,F6.2, FECL++ ,F6.2, FECL2+ ,
13 ,F6.2, FECL30 ,F6.2, FES04+ ,F6.2, FE++ ,F6.2,/,
14 ,F6.2, FE0H+ ,F6.2, FE0H20 ,F6.2, FE0DH- ,F6.2, FES040 ,
15 ,F6.2, NH4+ ,F6.2, NH3AO ,F6.2, NH4SO4 ,F6.2,/,
16 ,F6.2, NO3- ,F6.2, H+ ,F6.2, H2SO40 ,F6.2, HSO4- ,
17 ,F6.2, HCL0 ,F6.2, H2SAO ,F6.2, HS- ,F6.2,/,
18 ,F6.2, S-- ,F6.2, BR-- ,F6.2, H3BO30 ,F6.2, H2BO3- ,
19 ,F6.2, H2CO3 ,F6.2, O2AO ,F6.2,/,
80 FORMAT(//, MINERAL SATURATION INDICES ,//, ADULARIA D 87
1 ,F7.2, ALBITE ,F7.2, ANHYDRIT ,F7.2, ANORTHIT ,F7.2, ARA D 88
2 GONIT ,F7.2, BARITE ,F7.2, BOEHMITE ,F7.2,/, BRUCITE ,F7. D 89
32, CALCITE ,F7.2, CA-MONT ,F7.2, CELESTIT ,F7.2, CHALCED D 90
4N ,F7.2, CHLORITE ,F7.2, DOLOMITE ,F7.2,/, GIBBSITE ,F7.2, D 91
5 GEOTHITE ,F7.2, GRIEGITE ,F7.2, GYPSUM ,F7.2, HALITE ,F D 92
67.2, HALLOYST ,F7.2, HEMATITE ,F7.2,/, HUNTITE ,F7.2, HYD D 93
7TOMAG ,F7.2, ILLITE ,F7.2, KAOLINIT ,F7.2, K-MICA ,F7.2, D 94
8, MACKINAW ,F7.2, MAGNESIT ,F7.2,/, MAGNETIT ,F7.2, MIRABIL D 95
9T ,F7.2, NESQUEHO ,F7.2, PHLOGOPT ,F7.2, PYRITE ,F7.2, P D 96
9YROPHYL ,F7.2, QUARTZ ,F7.2,/, SIDERITE ,F7.2, STRONTNT ,F D 97
17.2, TALC ,F7.2, THENARDT ,F7.2, WITHERIT ,F7.2) D 98
95 FORMAT(//, SILICA SATURATION INDICES ,//,
1 ,F7.2, -LOG H4SIO40 ,F6.2, QUARTZ ,F7.2, CHALCEDONY ,F7.2,
2 ,F7.2, A-CRISTOBALITE ,F7.2, AMORPHOUS ,F7.2)
RETURN D 99
END D100

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INTEGER FLAG1, FLAG2, FLAG3, FLAG4, FLAG5
DIMENSION AN(18), XM(18), XLOC(4), AD(7), BN(18), YM(18), YLOC(4), BD(7)
REAL*8 ATITLE, SOURCE, XTITLE
DATA FLAG4, FLAG5, FLAG1, FLAG3/4*0/, FLAG2/2/

C
    TYPE 901
901    FORMAT(' INPUT FILE? ',S)
        CALL ASSIGN(1,0,-1)
        TYPE 902
902    FORMAT(' OUTPUT FILE? ',S)
        CALL ASSIGN(2,0,-1)
C        CALL ASSIGN(1,'CHEM',0,'OLD')
C        CALL ASSIGN(2,'KB:',0,'NEW','NC')
1    READ(1,500,END=23) ATITLE, XLOC,TEMP, PH,ID,SOURCE
    READ(1,525)AD
    READ(1,550) AN
500    FORMAT(A6,3A4,A2,F6.2,F6.2,A1,4A4)
525    FORMAT(7F10.0)
550    FORMAT(9F8.2)
    IF(TEMP.EQ.-9.9)GO TO 2
    GO TO 4
2    TEMP=24.99
4    IF(PH.EQ.-9.9)GO TO 3
    GO TO 5
3    PH=6.99
5    CONTINUE
    DO 55 I=1,18
    IF(AN(I).EQ.-9.99) AN(I) = 0.0
55    CONTINUE
    DO 175 I=1,18
    XM(I)=0
175    CONTINUE
    AN(17)=0.0
    XM(1)=AN(1)*0.04350
    XM(2)=AN(2)*0.02557
    XM(3)=AN(3)*0.02495
    XM(4)=AN(4)*0.04113
    XM(5)=AN(5)*0.02821
    XM(6)=AN(6)*0.01041
    XM(7)=AN(7)*0.01639
    XM(8)=AN(8)*0.01666
    XM(9)=AN(9)*0.01664
    XM(10)=AN(10)*0.09250
    XM(11)=AN(11)*0.14411
    XM(12)=AN(12)*0.03715
    XM(13)=AN(13)*0.01791
    XM(14)=AN(14)*0.01141
    XM(15)=AN(15)*0.00728
    XM(16)=AN(16)*0.01251
    XM(17)=AN(17)*0.01613
    XM(18)=AN(18)
    WRITE(2,700) FLAG1,FLAG2,DENS,ATITLE,XLOC
    WRITE(2,800) TEMP,PH,XM(3),XM(4),XM(1),XM(2),XM(5),XM(18),XM(6)
C    WRITE(2,900) FLAG3,ZZZ,FZ
    WRITE(2,600) XM(12),XM(13),XM(14),XM(15),XM(11),XM(17),XM(9),XM(10)
    1),XM(16),XM(17),XM(17),XM(17)
    GO TO 1
700    FORMAT(2I1,F10.00,A6,3A4,A2)
800    FORMAT(9F8.4)
C900    FORMAT(1I1,2F10.0)
600    FORMAT('09',F10.4,'09',F10.4,'10',F10.4,'11',F10.4,'12',F10.4,
1'13',F10.4,'14',F10.4,'15',F10.4,'16',F10.4,'17',F10.4,'18',
2F10.4,'13',F10.4)
23    STOP

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