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Characterization of Climax Granite Ground Water

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CHARACTERIZATION OF CLIMAX GRANITE GROUND WATER

ABSTRACT

The Climax ground water fails to match the commonly held views regarding the nature of deep granitic ground waters. It is neither dilute nor in equilibrium with the granite. Ground-water samples were taken for chemical analysis from five sites in the fractured Climax granite at the Nevada Test Site. The waters are high in total dissolved solids (1200 to 2160 mg/L) and rich in sodium (56 to 250 mg/L), calcium (114 to 283 mg/L) and sulfate (325 to 1060 mg/L). Two of the samples contained relatively high amounts of uranium (1.8 and 18.5 mg/L), whereas the other three contained uranium below the level of detection (<0.1 mg/L). The pH is in the neutral range (7.3 to 8.2). The differences in composition between samples (as seen in the wide range of values for the major constituents and total dissolved solids) suggest the samples came from different, independent fracture systems. However, the apparent trend of increasing sodium with depth at the expense of calcium and magnesium suggests a common evolutionary chemical process, if not an interconnected system. The waters appear to be less oxidizing with depth (+410 mV at 420 m below the surface vs +86 mV at 565 m). However, with Eh measurements on only two samples, this correlation is questionable. Isotopic analyses show that the waters are of meteoric origin and that the source of the sulfate is probably the pyrite in the fracture-fill material. Analysis of the measured water characteristics using the chemical equilibrium computer program EQ3 indicates that the waters are not in equilibrium with the local mineral assemblage. The solutions appear to be supersaturated with respect to the minerals calcite, quartz, kaolinite, muscovite, K-feldspar, and many others.

INTRODUCTION

To evaluate the potential of granite as a host rock for a nuclear waste repository, information is needed on radionuclide migration through fractured

rock. In response to this need, Lawrence Livermore National Laboratory designed a radionuclide migration test to be conducted in the Climax granite at the Nevada Test Site (Isherwood et al., 1982). The experimental design for this test includes the complete characterization of the Climax ground water since the geochemistry of the ground water is one of the fundamental parameters controlling radionuclide migration.

This report is one of several that document work accomplished up to the time the radionuclide migration field test was cancelled due to a change in funding priorities in the National Waste Terminal Storage Program. Although consideration of granite as a repository host rock has been delayed in the United States, this report should be useful as an addition to the existing data base on granite and to the various international waste management projects now studying its suitability for a repository site.

GEOLOGIC SETTING

The Climax Stock is a composite, granitic, and intrusive body located at the northern end of the Nevada Test Site (Fig. 1). The composite stock is of Cretaceous age and intrudes Paleozoic sediments and metasediments. The majority of the exposed wall rocks are Ordovician limestones and dolomites of the Pogonip Group. The stock also intrudes the Eleana Formation, a series of argillites, limestones, and quartzites of Carboniferous age and the Cambrian Stirling quartzite (Houser and Poole, 1960). The stock and the rocks it intrudes are overlain by the Tertiary pyroclastic rocks of the Oak Spring Formation. The stock itself is intruded by numerous aplite and pegmatite dikes. Figure 2 shows the detailed outcrop pattern and adjacent rock types. Vertical cross sections through the Climax Stock are shown in Fig. 3 (east-west) and Fig. 4 (north-south).

The Climax Stock is composed of two main units (granodiorite and quartz monzonite), and contains numerous fractures and local faults. Tables 1 and 2 summarize the mineralogy and average chemical composition of the two units. The underground workings at the Spent Fuel Test level (shaft 1501) provide access to this granitic mass at a depth (420 m) comparable to that being considered for geologic disposal of nuclear waste. Figure 5 is a map of the Spent Fuel Test level. The accessible areas are entirely within the quartz

Figure 1. Principal rock types and test areas at the Nevada Test Site.

Figure 2. Geologic map of Climax Stock (modified from Barnes et al., 1963).

Figure 3. Vertical geologic section through Climax Stock, east-west.

Figure 4. Vertical geologic section through Climax Stock, north-south (modified from Houser and Poole, 1969).

Figure 5. Layout of the Spent Fuel Test facility and adjacent workings. Arrows mark location of sampling sites (CGW-1, NH-01, UG-02, C-30, and C-36).

monzonite unit. Initial exploration of the Climax Stock was conducted in the late 1950s to determine the suitability of the rock mass for nuclear tests and to estimate the water content of the rock. Two shafts were excavated in the Climax Stock for nuclear tests, the "Tiny Tot" and the "Pile Driver" Shafts (see Fig. 2). Extensive horizontal tunnel complexes are associated with the Pile Driver Shaft. At the 250-m depth level, there are drifts from the "Hard

Table 1. Climax Stock mineralogy.^a

Matrix minerals ^b	Granodiorite	Quartz monzonite
Quartz	28	28
Plagioclase	45	40
Orthoclase	16	25
Biotite	9	6
Fracture-fill minerals	Calcite, quartz, pyrite, iron oxides, chlorite, and minor amounts of certain trace minerals.	

^a Average model analyses for unaltered rock from Houser et al. (1961) and Connolly (1981).

^b Accessory minerals include muscovite, rutile, calcite, apatite, zircon, titanite, opaques and miscellaneous others.

Table 2. Average chemical composition of Climax Stock in weight percent (from Maldonado, 1977)

	Granodiorite	Quartz monzonite
SiO ₂	67.6	69.1
Al ₂ O ₃	15.8	15.8
Fe ₂ O ₃	1.8	1.5
FeO	1.6	1.3
MgO	0.8	0.6
CaO	3.7	3.2
Na ₂ O	3.1	3.0
K ₂ O	3.5	3.9
TiO ₂	0.4	0.4
P ₂ O ₅	0.2	0.2
MnO	0.1	<0.05
CO ₂	0.2	0.1
H ₂ O	<u>1.0</u>	<u>0.9</u>
Total	99.8	100.0

Hat" Event; and at the 420-m depth level, drifts from the Pile Driver Event (see Fig. 5).

Based on analysis of known geological and hydrological data, Murray (1981) concludes that the water table in the Climax Stock probably lies at 975 m MSL beneath the location of the Spent Fuel Test (i.e., approximately 145 m below the experimental area). The primary basis for this conclusion is the standing water level in borehole UG-02. Ground-water seeps from isolated fractures into the drifts are attributed to overflow from perched water locations.

Detailed fracture mapping in the Pile Driver Drift was done by Thorpe and Springer (1981). The predominant orientation of the fractures is N50W/90 (strike/dip). A somewhat smaller peak within this clustering is oriented N25W/85SW. These correspond roughly to the NW-striking fault and joint sets reported by Maldonado (1977), as well as to some of the shear zones and joints given by Wilder and Patrick (1980). Typical mineralization of fractures in the main access drift is mostly calcite, with some iron oxide and chlorite. The wall rock is sometimes altered to clay. Thickness of filling varies widely both on a given fracture and among fractures. However, it is typically 1 to 3 mm for single unsheared features.

Another prominent grouping of high-angle fractures is oriented N45E/87SE and corresponds to the NE-striking set of high-angle fractures reported by Maldonado (1977) and Wilder and Patrick (1980). These fractures also appear to be filled with mostly calcite and minor amounts of clay and iron oxide. A third set of discontinuities was observed in the access drift with a mean orientation of N35W/25NE. This subhorizontal set is apparently pervasive in the Climax Stock. Most of these features are planar and healed by quartz up to 10 mm thick. They typically contain pyrite in either continuous veinlets or discontinuous stringers. They tend to break or be open where the pyrite is continuous.

COLLECTION TECHNIQUES

Ground-water samples were taken from five sites in the Climax workings (Fig. 6). Because the sophistication of the collection technique depended on the physical environment at each site, some knowledge of these techniques is

Figure 6. Cross section of the Climax Stock, showing locations of water sampling sites.

necessary to evaluate the quality of the data. Appendix A contains a description of the analytical techniques.

CGW-1

The CGW-1 samples collected in the Pile Driver Drift were obtained using two different types of apparatus. The first, an acrylic plastic cone with an attached collection container, was installed against the rock face to isolate a seep coming from two interconnecting fractures (Isherwood *et al.*, 1980). We abandoned the first apparatus when we were unable to get an adequate seal between the cone and the rock. Believing this site offered the best opportunity for obtaining *in situ* samples undisturbed by contact with the outside environment, we designed and built a second apparatus that consisted of a packer assembly and sampling device inserted into a borehole drilled to intersect a saturated fracture (Harrar and Raber, 1982). This collection device worked well. Since the oxygen content of the water was less than the

limit of detection of the oxygen probe used in the device (i.e., <0.01 parts per million), we assumed that the dissolved oxygen in the ground-water sample is naturally <0.01 ppm and that the borehole collector adequately sealed the sample, preventing contamination from the atmosphere.

UG-02

This sample was collected from an exploratory borehole slant drilled 160 vertical meters beneath the Climax working level at 420 m. Long-term borehole monitoring showed that the water level stabilized at 565 m, leaving approximately 15 vertical meters of water in the hole. A pump (Bennett Model 180) was installed and the hole pumped dry a number of times followed by a period of recharge. The Bennett pump, which utilizes positive displacement by forcing gas to move a piston, thereby squeezing the water to the surface, maintains the geochemical integrity of the sample. Samples were collected and analyzed over several months. When comparable analyses were obtained, we assumed that the hole was clean of drilling contamination. Three samples were then collected approximately a month apart.

C-30 and C-36

These samples were collected from seeps in the upper part of the shaft at approximately 64 and 73 m from the surface. Each sample was collected by holding a plastic bottle under the seep while standing on the lift. Although we tried to get as close to the source of the seep as possible, we were physically constrained by the lift. The water was observed flowing over the highly weathered rock and may have come in contact with the wood and metal lining material of the shaft before collection.

NH-01

This sample was collected in the west end of the north heater drift. A number of intersecting fractures in the drift crown were identified as the source of several small seeps. Since the area is protected by wire mesh at approximately 30 cm from the surface of the rock, the samples were collected by balancing several small (50 mL) beakers on the wire mesh overnight. The

samples were then combined and treated as one sample (NH-01). (The sample was contaminated by rust from the wire mesh.) Because the total dissolved solids (mg/L) found in NH-01 are close to the total in CGW-1, we believe that evaporation had little effect on the sample.

ANALYTICAL RESULTS

CHEMICAL COMPOSITION

The Climax ground-water samples are high in total dissolved solids and rich in sodium, calcium, chloride, and sulfate (Table 3). The pH is in the neutral range (7.3 to 8.2). The water appears to be less oxidizing with depth (+410 mV at 420 m below the surface vs +86 mV at 565 m). However, with only two Eh measurements, a correlation between Eh and depth is questionable. The difference in values for the Eh of these samples (CGW-1 and UG-06) is reflected in the amount of sulfide found in these waters (<0.01 vs 3.0 ppm).

The most striking characteristic of the Climax waters is the variability in composition between samples. Some samples contain detectable uranium, others do not. Sulfate concentrations vary from 325 to 1060 mg/L. Samples from sites within 9 m of each other (e.g., C-30 and C-36) are very different. Sulfate, bicarbonate, and magnesium varied by approximately 100%. There were also major differences in chloride, sodium, and calcium--as though each sample came from an independent fracture system, with a separate history responsible for its composition. Yet, if we look at the calcium, magnesium, and sodium relationship (Fig. 7), we see an apparent trend with depth, suggesting at least a common evolutionary process if not an interconnected system. This trend shows that the relative amount of sodium increases at the expense of calcium and magnesium. However, evidence that this has occurred is limited. For example, although the saturation index for dolomite decreases with depth, dolomite was not identified as a component of the fracture fill material and the amount of bicarbonate is independent of depth. (For an explanation of saturation indexes, see the section on "Chemical Equilibrium Modeling".)

All the samples contain an uncommonly high amount of sulfate. The most likely source of the sulfate is pyrite oxidation. Pyrite occurs along fractures and it is disseminated in the granite to a limited extent. However,

Table 3. Chemical analyses of Climax ground-water samples (concentrations in mg/L except as noted).

Parameter	CGW-1 (10) ^a	NH-01 (1)	UG-02 (3)	C-30 (2)	C-36 (2)
Na	250	229	214	72	56
Ca	283	240	114	161	126
K	3.4	3.8	4.7	6.5	4.8
Mg	0.9	4.8	1.5	118	63
Sr	5.6	7.9	4.2	0.8	1.8
Cs	0.002	ND ^b	ND	ND	ND
Al	0.03	0.05	0.02	<0.05	<0.05
SiO ₂	15.8	22.5	23.9	29.3	33.8
U	1.8	18.5	<0.1	<0.1	<0.1
Fe	0.006	0.5 ^e	0.8 ^d	0.003	<0.004
Zn	0.005	0.03 ^e	0.03 ^d	0.008	0.004
Mn	0.05	0.008	0.05	0.002	0.03
Li	0.25	0.17	0.17	0.14	0.07
W	0.15	ND	ND	ND	ND
Mo	0.72	0.22	0.09	0.20	0.18
As	0.03	ND	ND	ND	ND
PO ₄	<0.5	0.5	<0.3	1.9	1.2
Ti	0.004	0.02	<0.002	0.003	<0.001
Cl	77	160	70	77	52
SO ₄	1060	850	480	750	325
S	<0.01	ND	3.0	ND	ND
HCO ₃	163	65	165	167	316
NO ₃	<0.02	ND	ND	ND	ND
F	0.9	ND	1.4	ND	ND
TDS ^c	1900	1770	1110	1910	1150
Conductivity (μS)	2160	2050	1340	1700	1200
Dissolved O ₂ (mg/L)	<0.01	ND	<0.15	ND	ND

Table 3. (Continued)

Parameter	CGW-1 (10) ^a	NH-01 (1)	UG-02 (3)	C-30 (2)	C-36 (2)
Eh (mV)	+410	ND	+86	ND	ND
pH	7.3	8.2	7.5	8.1	7.8
Sample depth (m)	420	420	565	64	73

^a Nos. in parentheses are No. of samples analyzed.

^b ND = Not determined.

^c TDS = Total dissolved solids (mg/L).

^d Sample contaminated with Fe and Zn from drill bit.

^e Sample contaminated by wire mesh covering collection site.

Figure 7. Diagram showing relative percentage of sodium, calcite, and magnesium (equivalents/L) for Climax ground-water samples.

if the sulfate is from the pyrite, we would expect the amount of sulfate in the ground water to be greatest in the upper, presumably more oxidized, region of the stock, yet this has not occurred. Because the flow path of ground water entering the Climax Stock is unknown, we cannot rule out the possibility that the sulfate originated in the nearby volcanic rock (cf. Figs. 2, 3, and 4). Sulfur isotope data (presented later) rules out the sedimentary carbonates as the source.

TRITIUM

Tritium levels of 100 to 195 pCi/mL were found in seeps sampled in the north heater drift (NH-01), the Pile Driver Drift (CGW-1) and in the UG-02 borehole. In the shaft, the tritium level increases with increasing depth from the surface (Table 4).

This supports our belief that the tritium has migrated from the Pile Driver nuclear test, probably at the time of the test. If so, the water is likely to be contaminated with ^{36}Cl and ^{14}C and would be difficult to age-date using those techniques.

Table 4. Tritium analyses.

Sample	^3H (pCi/mL)
CGW-1	157
NH-01	100
UG-02	195
<u>Shaft^a (m)</u>	
55.6	1
72.4	2
76.2	4
124.2	6
177.5	27
180.6	22
381.0	~400

^a T. Roy (1981).

URANIUM

The anomalously high levels of uranium found in CGW-1 and NH-01 (1.8 and 17.8 mg/L) using both the inductively coupled plasma (ICP) emission spectrophotometry and site-selection fluorescence spectroscopy techniques were confirmed by a complete isotopic analysis (Table 5). The only alpha-emitting uranium isotopes observed are the naturally occurring isotopes of mass numbers 238, 235, 234. Fission-produced uranium isotopes of mass numbers 236, 233, and 232 are not present. Note that the $^{235}\text{U}/^{238}\text{U}$ activity ratio is indistinguishable from the natural activity ratio of 0.04607. There is no evidence of nuclear device-produced ^{235}U .

The $^{234}\text{U}/^{238}\text{U}$ activity ratio is within the normal range for ground waters (Osmond, 1980). This "excess" ^{234}U is found in most surface and ground waters as a result of one or more so-called "hot-atom" or Cherdyntsev effects. Interestingly enough, this water has a $^{234}\text{U}/^{238}\text{U}$ activity ratio quite different from the estimated ratio in surface waters draining from the Climax Stock. This estimated ratio is based on the caliche in the gouge zone along the nearby Boundary Fault [a $^{234}\text{U}/^{238}\text{U}$ ratio of 1.3 (Knauss, 1981)]. The $^{234}\text{U}/^{238}\text{U}$ ratio of the caliche should be identical to that of the waters from which the caliche was derived. Whether the difference between the surface water and the Climax ground water reflects "aging" of surface

Table 5. Uranium isotopic analysis for Climax ground water.

	CGW-1	NH-01 ^a
^{238}U (ppm)	1.827 ± 0.029	18.5 ± 1
^{238}U (dpm/g)	1.363 ± 0.021	--
^{235}U (dpm/g)	0.06073 ± 0.00238	ND
^{234}U (dpm/g)	1.520 ± 0.023	--
$^{234}\text{U}/^{238}\text{U}$ (AR)	1.115 ± 0.012	1.05 ± 0.02
$^{235}\text{U}/^{238}\text{U}$ (AR)	0.04455 ± 0.00167	--

^a Analysis done by M. Michel at Lawrence Berkeley Laboratory, Berkeley, CA.

waters as they percolate down through the stock cannot be known without additional analyses.

The question still remains as to why some of the Climax ground water contains so much uranium, even if it is natural. Fractures in oxidized, weathered granite bodies frequently contain uraniferous phosphates (varieties of autunite and torbernite). To maintain the high concentration of uranium in the water, the fractures immediately adjacent to the drift ceiling must contain these or other minerals, otherwise the uranium would be diluted by "normal" water containing uranium in the ppb range. The water samples from UG-02 and the access shaft contain uranium below the limit of detection by ICP analysis (<100 ppb). They have either been diluted or the waters did not come into contact with the uranium deposits.

ISOTOPE ANALYSES

OXYGEN-18 AND DEUTERIUM

The isotope ratios, $^{18}\text{O}/^{16}\text{O}$ and $\text{D}/^1\text{H}$, were obtained only for the CGW-1 site. Samples collected by the two different water collectors described earlier gave almost identical values for both $\delta^{18}\text{O}$ and δD (Table 6).

Table 6. Isotope analyses.^a

Sample	$\delta^{13}\text{C}$	$\delta^2\text{D}$	$\delta^{18}\text{O}$	$\delta^{34}\text{S}^b$
<u>Water</u>				
CGW-1a ^c	-4.57	-92	-12.62	+0.98
CGW-1b	-3.54	-94	-12.71	+3.58
UG-02	--	--	--	+6.02
Pyrite from fracture surface	--	--	--	+5.28

^a Analyses by Global Geochemistry, Canoga Park, CA.

^b $\delta^{34}\text{S}$ from sulfate precipitated from sample with BaCl_2 .

^c CGW-1a,b samples were collected from two fractures in the same general location. Their relative orientation suggests they are interconnected.

These values lie on the meteoric water line (Fig. 8), indicating that the ground water is of meteoric origin and that little or no alteration of the isotopic composition has occurred as the result of chemical interactions with the granite. This is typical of shallower ground-water systems with normal temperatures (Freeze and Cherry, 1979).

The isotope ratios are expressed in delta units (δ) as per mille (parts per thousand or ‰) differences relative to an arbitrary standard known as standard mean ocean water (SMOW):

$$\delta\text{‰} = \left[(R - R_{\text{standard}}) / R_{\text{standard}} \right] \times 1000 ,$$

where R and R_{standard} are the isotope ratios, $D/{}^1H$ or ${}^{18}O/{}^{16}O$, of the sample and the standard, respectively. For a discussion of the isotope ratios, ${}^{34}S/{}^{32}S$ and ${}^{13}C/{}^{12}C$, and the standards used, see Fritz and Fontes (1980).

CARBON-13

The $\delta^{13}C$ values for two samples from the CGW-1 site are -4.57 and -3.5‰. These values represent an increased amount of ${}^{13}C$ relative to both atmospheric ($\delta^{13}C = -7\text{‰}$) or soil carbonate ($\delta^{13}C = -25\text{‰}$). It is not known whether the ${}^{13}C$ partially represents the ${}^{13}C$ content of an unidentified ground-water source outside the Climax (e.g., the Paleozoic carbonates) and/or whether the ${}^{13}C$ content is the result of fractionation of

Figure 8. A generalized $\delta^{18}O$ vs δD plot showing the meteoric water line and the location of the CGW-1 data.

the carbon isotopes during calcite precipitation along the fractures. If isotopic equilibrium is reached in the formation of inorganically precipitated carbonates, it can be shown that the carbonates will have an isotopic composition heavier than the dissolved carbonate from which they are derived (Bender, 1972). Considering we have only two $\delta^{13}\text{C}$ data points for the entire Climax Stock, we can only guess at the interpretation. Any future work should include isotope data for the calcite fracture fill material, the Paleozoic carbonates and other surrounding rocks, and the caliche in the surface oxidized zone.

SULFUR-34

Sulfate in both surface and ground waters may have $\delta^{34}\text{S}$ values characteristic of one or more of the following sources: sulfate in atmospheric dust, which has dissolved in precipitation, or solution of evaporite minerals and sulfate from the oxidation of sulfide minerals. Of these three sources, only the first and last are likely sources for the Climax samples. Sulfur from gypsum found in Paleozoic sediments has $\delta^{34}\text{S}$ values from +20 to +25‰ (P. Fritz, 1982). In contrast, the sulfate in samples from sites UG-02 and CGW-1 vary from +0.98 to +6.02. These values are comparable to the +5.28 value for the sulfur in the pyrite from the fracture fill material since isotope fractionation during oxidation-reduction reactions can easily result in a range of values for a ground-water system depending on the local environmental conditions. Note that even though the values for fractures 1 and 2 (believed to be connected) are different (+0.98 vs +3.58), they are well below the range of values considered normal for the Paleozoic sediments. If this study were to continue, we would want to have a sulfur isotope analysis for rain samples collected at the surface of the Climax facility to evaluate the contribution from this source.

CHEMICAL EQUILIBRIUM MODELING

Interpretation of the analytical results was aided by the use of EQ3, a chemical equilibrium computer code (Wolery, 1979). EQ3 computes the distribution of chemical species (ions, neutral species, ion-pairs, and complexes) in an aqueous solution from input analytical data. This calculation produces a model of the fluid that specifies the concentration and

thermodynamic activity of each chemical species occurring in the specific chemical system (e.g., the Climax ground water). The program then calculates the saturation state of the fluid with respect to all relevant mineral phases in the data base. Mineral phases can also be used as solubility controls to determine the mineral-species equilibrium concentration (e.g., hematite used to limit the concentration of Fe^{+3}).

The chemical compositions of the five samples were used as input data to EQ3. Appendix 2 contains the EQ3 output files for the five runs. Since there were no Eh or dissolved oxygen measurements for samples C-30, C-36, and NH-01, we assumed that the solutions were air-saturated (i.e., Eh = 0.8 V) at the time they were collected.

The results from the EQ3 analyses show that equilibrium does not exist between the Climax ground waters and a great many mineral phases (some of which are present in the rock and the fracture fill material). The solutions are supersaturated with respect to 38 to 60 of the pure mineral phases included in the EQ3 data base. Table 7 lists the saturation indexes (log Q/K)

Table 7. Selected mineral saturation indexes for Climax ground water.^a

Mineral	Log Q/K				
	C-30	C-36	NH-01	CGW-1	UG-02
Calcite	0.78	0.80	0.82	0.19	0.17
Dolomite	2.69	2.55	0.76	-0.86	-0.36
Quartz	0.67	0.74	0.55	0.42	0.63
K-feldspar	3.17	3.51	2.80	2.11	3.09
Kaolinite	4.02	5.14	3.92	5.00	5.52
Muscovite	6.80	8.10	6.57	7.23	8.92
Na-beidellite ^b	4.31	5.59	4.26	5.04	5.99
Sat. minerals ^c	58	60	55	38	49

^a The saturation index was calculated using the EQ3 model.

^b Na-beidellite is a form of montmorillonite with an average composition of $\text{Na}_{0.33}\text{Al}_{2.17}(\text{Al}_{3.17}\text{Al}_{0.83})\text{O}_{10}(\text{OH})_2$. It is similar to the one used to construct Fig. 8.

^c The total number of supersaturated minerals (i.e., log Q/K > 0) depends on the data base used in the EQ3 code.

for a few common minerals as an example of the variability in saturation between samples and the extent of saturation present. We realize that many of the minerals identified by EQ3 as supersaturated would not be expected to form in this environment because of kinetic constraints (e.g., dolomite). However, minerals such as quartz, calcite, and the feldspars are present in the Climax Stock and should be close to equilibrium with the water.

For the average analysis of CGW-1 (where we obtained the most complete set of data), we used solubility controls with EQ3 to identify adjusted ground-water compositions that would not be supersaturated with respect to certain minerals. In Table 8, Run 1 is for the original analysis that resulted in the identification of 38 supersaturated minerals. In run 2, gibbsite and hematite were used as solubility controls on aluminum and iron. That is, the concentrations of iron and aluminum were reduced automatically by EQ3 until $\log Q/K = 0$ for hematite and gibbsite. The aluminum and iron values measured for CGW-1 were suspect since (a) the soluble aluminum and iron reported in most ground waters often result from contamination by amorphous particulates not removed by filtering (Busenberg, 1978); and (b) the values obtained approached the detection limits of the analytical method. The solubility controls reduced the aluminum from 0.03 to 0.0004 mg/L and iron from 0.006 to $<10^{-4}$ mg/L. A number of iron- and aluminum-bearing minerals previously reported as supersaturated were eliminated. In this manner, the total number of supersaturated minerals was reduced to 10.

In Run 3, the solubility controls used were calcite for calcium, kaolinite for SiO_2 , strontianite for strontium, and hematite for iron. Potassium was reduced to 2.3 mg/L and bicarbonate to 143 mg/L (the lowest values reported for CGW-1). Aluminum was reduced to 0.0001 mg/L. These adjustments in the CGW-1 analyses resulted in the removal of all but quartz from the list of supersaturated minerals. In so doing, only the calcium and strontium required major adjustments. Because aluminosilicates, rather than quartz, are the most likely solubility controls on aqueous SiO_2 in ground waters (Freeze and Cherry, 1979), our identification of quartz as supersaturated is not inconsistent with an equilibrium ground-water composition.

The EQ3 analysis of the Climax waters is useful since it allows us to identify candidate secondary minerals and to predict a possible ground-water composition close to thermodynamic equilibrium. It also allows us to evaluate whether an analysis is realistic. For example, the measured concentrations of iron are no doubt several orders of magnitude too high to be in true

Table 8. Results from EQ3 runs using adjusted analyses.

Chemical parameters	Run		
	1 ^a	2 ^b	3 ^c
Na	250	250	250
K	3.4	3.4	2.3
Ca	283	283	208
Mg	0.9	0.9	0.9
Al	0.03	0.0004	0.0001
SiO ₂	15.8	15.8	14.8
Sr	5.6	5.6	0.38
Zn	0.005	0.005	0.005
Mn	0.49	0.49	0.49
Fe	0.006	<10 ⁻⁴	<10 ⁻⁴
U	1.7	1.7	1.7
Cl	77	77	77
SO ₄	1060	1060	1060
F	0.86	0.86	0.86
HCO ₃	163	163	143
pH	7.3	7.3	7.3
Eh (V)	+0.41	+0.41	+0.41
No. of supersat. minerals	38	10	1

^a Avg. values for original CGW-1 analyses in mg/L.

^b Gibbsite and hematite used as solubility controls on Al and Fe.

^c Solubility controls used, calcite (Ca), kaolinite (SiO₂), strontianite (Sr), and hematite (Fe). K was reduced to 2.3 mg/L (lowest value reported), Al to 0.0001, and HCO₃ to 143 (lowest value reported).

solution. The concentrations of iron and aluminum in the Climax waters probably lie somewhere between the reported values and the calculated equilibrium values.

STABILITY RELATIONS

One approach to understanding the compositions of the ground-water samples and their relationship to the mineral phases is through stability diagrams compiled from thermodynamic data. Figures 9a and 9b were compiled using the methods described by Feth et al. (1964). They involve the phases in the systems $\text{Na}_2\text{O}-\text{Al}_2\text{O}_3-\text{SiO}_2$ and $\text{K}_2\text{O}-\text{Al}_2\text{O}_3-\text{SiO}_2-\text{H}_2\text{O}$. The stability relationships are plotted as a function of $[\text{Na}^+/\text{H}^+]$, $[\text{K}^+/\text{H}^+]$ and $[\text{H}_4\text{SiO}_4]$. The values were calculated using the EQ3 chemical equilibrium code, and the results are typical of granitic ground waters. They indicate that the chemical characteristics of the Climax waters are such that kaolinite and montmorillonite are stable weathering products. On the other hand, potassium-mica and the two feldspars shown are unstable. In spite of the heterogeneous chemical composition of the five samples, the values do appear to cluster on the two diagrams. This suggests a commonality of source and history not evident in the analytical data.

Although all five water samples are supersaturated with respect to both the stable and unstable weathering products mentioned above (see Table 7), we would expect to see a preference for kaolinite and montmorillonite formation as these waters tend towards equilibrium. At present, kaolinite has not been identified in the fracture fill material. However, we do find montmorillonite in the heavily altered shear zones. The information gained from these stability relationship diagrams adds to the growing evidence that the Climax ground waters are not in equilibrium with the surrounding rock.

SUMMARY

The characterization of the Climax ground water was done in preparation for the in situ radionuclide migration experiments planned for the Climax Stock at the Nevada Test Site. Since the geochemistry of the ground water is one of the fundamental parameters controlling radionuclide migration, it was

Figure 9. Stability relations of phases in the system:
a) Na₂O-Al₂O₃-SiO₂-H₂O as functions of $[\text{Na}^+]/[\text{H}^+]$ and $[\text{H}_4\text{SiO}_4]$;
b) K₂O-Al₂O₃-SiO₂-H₂O as functions of $[\text{K}^+]/[\text{H}^+]$ and $[\text{H}_4\text{SiO}_4]$
at 25°C and 1 atm total pressure.

important to determine both the water quality and whether the water was in equilibrium with the granite.

Samples were collected from five sites at various depths in the Climax Stock from 64 to 565 m below the surface. Four of the samples were collected from ground-water seeps out of isolated fractures. These seeps are attributed either to overflow from perched water locations or to water draining directly

from the surface into the access shaft. The sample collected at 565 m was from a borehole believed to intersect the local water table.

The Climax Stock is composed of two main units (granodiorite and quartz monzonite). The area sampled lies in the quartz monzonite region. However, the water flowing from fractures in the quartz monzonite could have "seen" the granodiorite as well. Since ground-water flow in the Climax Stock is dominated by fracture flow (the granite is essentially impermeable), the water also came in contact with the fracture fill materials, which are predominantly calcite, quartz, and pyrite.

Results from the chemical and isotopic analyses of the five samples show that:

1. Climax ground water is high in total dissolved solids and rich in sodium, calcium, chloride and sulfate.
2. pH is in the neutral range (7.3 to 8.2).
3. The water appears less oxidizing with depth. However, with only two Eh measurements, one at 420 m below the surface (+410 mV) and one at 565 m (+86 mV), a correlation of Eh with depth needs to be confirmed by sampling at other depths.
4. The composition of the Climax waters is highly variable. There are major differences between samples for chloride, sodium, calcium, sulfate, bicarbonate, and magnesium.
5. Anomalously high levels of natural uranium were found in two samples (1.8 and 18.5 mg/L), but in the remaining samples uranium was below the level of detection (<0.1 mg/L).
6. Tritium levels increase with increasing depth--the result of the Pile Driver nuclear event that occurred in the mid-1960s at the 420-m level.
7. Isotopic analyses for oxygen, hydrogen and sulfur show that the water is of meteoric origin and that the source of the sulfate is most likely the oxidation of pyrite in the fracture fill material.

Interpretation of the analytical results was aided by EQ3, a chemical equilibrium computer code (Wolery, 1979). The chemical compositions of the five water samples were used as input data to EQ3. The results for the five computer runs using this data show that

- Equilibrium does not exist between the Climax ground waters and a great many mineral phases, including quartz, calcite, K-feldspar, and

others present either in the Climax granite or the fracture fill materials.

- The waters are supersaturated with respect to 38 to 60 of the pure mineral phases included in the EQ3 data base.
- Using solubility controls to modify the existing water analysis, we predict a ground-water composition corresponding to equilibrium conditions. The equilibrium ground-water composition is one reduced in iron, aluminum, calcium, silica, and strontium. However, with the exception of calcium, these changes are minor.
- Using the EQ3 analyses, we predict that the precipitation of calcite is a continuing process in the Climax fractures and that kaolinite, and possibly montmorillonite, will form as secondary alteration products.

The differences in composition between samples as seen in the wide range of values for the major constituents and total dissolved solids suggests that the samples obtained at the various sites are from different fracture systems, each independent of the other. This conflicts with the apparent trend with depth of increasing sodium at the expense of calcium and magnesium (indicative of an interconnected system of fractures). However, this trend could also be explained as a result of a common evolutionary process in a non-connected system.

In the characterization studies of a nuclear waste repository site, a complete analysis of site geochemistry will be required. In view of the heterogeneity and unusual character of the Climax ground water, it is essential that the ground-water sampling of a candidate repository site be extensive so that the final set of data describing the site truly represents the geochemical environment.

REFERENCES

- Barnes, H., F. Houser, and F. Poole (1963), Geologic Map of the Oak Spring Quadrangle, Nye County, Nevada, USGS, Denver, CO, Quadrangle Map GQ-214.
- Bender, M. (1972), "Carbon Isotope Fractionation," in The Encyclopedia of Geochemistry and Environmental Sciences, R. Fairbrige, ed. (Van Nostrand Reinhold Co., New York) 133.
- Busenberg, E. (1978), "The Products of the Interaction of Feldspars with Aqueous Solutions At 25°C," Geochimica et Cosmochimica Acta 42, pp. 1679-1686.
- Connolly, J. (1981), Hydrothermal Alteration In the Climax Granite Stock at the Nevada Test Site, M.S. thesis, Arizona State University, Tucson.
- Feth, J., C. Roberson, and W. Polzer (1964), Sources of Mineral Constituents in Water from Granite Rocks Sierra Nevada, California and Nevada, USGS, Denver, CO, Water-Supply Paper 1535-J.
- Freeze, R., and J. Cherry (1979), Groundwater (Prentice-Hall, Inc., Englewood Cliffs, NJ).
- Fritz, P. and J. Ch. Fontes (1980), Handbook of Environmental Isotope Geochemistry (Elsevier Scientific Publishing Co., New York).
- Fritz, P. (March 1982), Univ. of Waterloo, Waterloo, Ontario, Canada, private communication.
- Harrar, J., and E. Raber (1982), "Borehole Collector for In Situ Chemical Analysis of Ground Water," Ground Water 20, 4, pp. 479-481.
- Houser, F., and F. Poole (1960), Age Relations of the Climax Composite Stock, NTS, USGS Prof. Paper, Denver, CO, 424B.

- Houser, F., R. Davies, and W. Emerick (1961), Geologic Reconnaissance of Granitic Intrusive Masses at Gold Meadows, Tem Piute and Trappman's Camp, Lincoln and Nye Counties, Nevada and Comparison with the Climax Stock of the Nevada Test Site, USGS, TEI-793.
- Isherwood, D., E. Raber, R. Stone, D. Lord, N. Rector, and R. Failor (1982), Engineering Test Plan for Field Radionuclide Migration Experiments in Climax Granite, Lawrence Livermore National Laboratory, Livermore, CA, UCRL-53286.
- Knauss, K. (1981), Dating Fault Associated Quaternary Material from the Nevada Test Site Using Uranium-Series Methods, Lawrence Livermore National Laboratory, Livermore, CA, UCRL-53231.
- Laxen, D., and I. Chandler (1982), "Comparison of Filtration Techniques for Size Distribution in Freshwaters," Analytical Chemistry 54, pp. 1350-1355.
- Maldonado, F. (1977), Summary of the Geology and Physical Properties of the Climax Stock, Nevada Test Site, USGS, Denver, CO, open-file report pp. 77-356.
- Murray, W. (1981), Geohydrology of the Climax Stock Granite and Surrounding Rock Formations, NTS, Lawrence Livermore National Laboratory, Livermore, CA, UCRL-53138.
- Osmond, J. (1980), "Uranium Disequilibrium in Hydrologic Studies," in Handbook of Isotope Geochemistry, P. Fritz and J. C. Fontes, Eds. (Elsevier Scientific Publishing, New York), pp. 259-282.
- Peck, E., A. Langhorst, and D. O'Brien (1979), Analysis of Natural Waters with an Automated Inductively-Coupled Plasma Spectrometer System (presented at the Federation of Analytical Chemistry and Spectroscopy Societies, 5th Annual Meeting, Boston, MA), Lawrence Livermore National Laboratory, Livermore, CA, UCID-81043.
- Roy, T. (1981), Lawrence Livermore National Laboratory, Livermore, CA, private communication, memorandum No. TCR-111-81 (December 8, 1981).

Thorpe, R., and J. Springer (1981), Fracture Mapping for Radionuclide Migration Studies in the Climax Granite, Lawrence Livermore National Laboratory, Livermore, CA, UCID-19081.

Wilder, D., and W. Patrick (1980), Geotechnical Status Report for Test Storage of Spent Reactor Fuel in Climax Granite, NTS, Lawrence Livermore National Laboratory, Livermore, CA, UCRL-85096.

Wolery, T. (1979), Calculation of Chemical Equilibrium Between Aqueous Solution and Minerals: The EQ3/6 Software Package, Lawrence Livermore National Laboratory, Livermore, CA, UCRL-52658.

BF/lb

APPENDIX A

ANALYTICAL TECHNIQUES

The following is an outline of the procedures used for the analysis of the water samples collected at the Climax Stock. As indicated, the unstable components were measured in the field.

1. pH and Eh--Electrodes used were an HNU Systems model ISE-45-03-00 combination pH electrode and a Beckman Instruments platinum-inlay redox electrode. The pH electrode was standardized with three buffers according to ASTM D1293-78, and stored with its cap on when not in use. The Eh electrode was cleaned with hot HCl and stored dry between measurements. These electrodes are placed in the electrode chamber for the subsequent measurements, the outlet of which was connected to a length of Tygon tubing (cf. Harrar and Raber, 1982). Water from the collector was run into the electrode chamber and out of the tubing to provide samples for the chemical analyses. Each time samples were taken, the pH and Eh readings were noted on an Orion model 701A pH meter. Eh was measured by connecting the platinum electrode to the pH input and the reference electrode lead from the combination pH electrode to the reference input. Eh values were corrected for the potential of the Ag-AgCl reference vs the standard hydrogen electrode.
2. Dissolved oxygen--Two methods were used for on-site measurements. The first was a titration using a Hach model OX-DT kit that consumes 300 mL/measurement; the second employed a modified Leeds and Northrup model 7931 dissolved-oxygen monitoring system. This method was used only for the CGW-1 sample from the borehole water collector described in Harrar and Raber (1982).
3. Alkalinity--The alkalinity was determined using a Hach digital titrator with a 1.589 N H_2SO_4 cartridge. A second HNU pH electrode with the Orion meter was used to titrate 100 mL of water to pH 4.8. Measurement took place on site.

4. Sulfide--Sulfide was measured on site using a Hach Model HS-6 kit.

The following analyses were performed at Livermore using two kinds of samples: one that was untreated and one that was acidified with HNO_3 . Both are contained in 500-mL polyethylene bottles previously leached with 0.5 M HNO_3 and soaked with deionized water. The acidified water sample was prepared by adding 15 mL of ACS Reagent Grade HNO_3 to 500 mL of water in the sample bottle. The bottle caps (Polyseal type) are wrapped with vinyl tape for transportation and storage. Samples of waters from UG-02, NG-01, C-20, and C-36 were poured through a 0.4- μm filter on site at the time of collection. In the case of CGW-1, an experiment was conducted in which an unfiltered sample and a sample filtered through a 0.2- μm filter were analyzed and the results compared. There was no significant difference, thus subsequent samples were not filtered. Nonetheless, considering the recent work of Laxen and Chandler (1982), filters with smaller pore sizes should be tested in the future prior to a decision not to filter.

1. Chloride and sulfate--Determined in the untreated samples using a Technicon Auto Analyzer, and Technicon methods 99-70W/B and 118-71W/B, respectively.
2. Fluoride--Determined in untreated samples by titration with $\text{La}(\text{NO}_3)_3$, using a fluoride, ion-selective electrode.
3. Conductivity--Measured for the untreated samples, using an Industrial Instruments model RC-16B2 bridge operated at 1000 Hz and a precision conductivity dip cell.
4. Elemental analyses--Twenty-four elements are determined in the acidified samples by inductively coupled plasma, emission spectrography. The values obtained are corrected for a reagent blank prepared with deionized water in the same manner as the samples. The ICP-ES facility at LLNL and its operation are described in Peck et al. (1979).

APPENDIX B
EQ3 OUTPUT FILES

The following computer printouts are from the EQ3 interpretation of samples C-30, C-36, CGW-1, NH-01, and UG-02.

<u>File no.</u>	<u>Input analysis</u>
1	C-30
2	C-36
3	CGW-1
4	NH-01
5	UG-02

UTITL
CLIMAX GROUND WATER
SHAFT WATER SET 30 AIR SATURATED
BASED ON JACK HARRAR'S MEMO OF 1/20/82
TEMPERATURE NOT REPORTED, 25 DEG C ASSUMED

TEMPC

.250000E+02

RHO

0.

0. TDS1

0. TDS2

F02/EH/PE

.800000E+00

0. COUPLE

02(AQ)

T0LBT

0.

0. T0LTL

0. T0LSAT

ITERMX

0

I0PT

-1

2

3

4

5

6

7

8

9

IPRNT

-1

2

3

4

5

6

7

0

0

IDBUG

-1

2

3

4

5

6

7

0

UEBAL

0

0

0

0

0

0

0

SUPPRESSED/ALTERED SPECIES (AQ, MIN, GAS, SOL)

0

0

0

0

NA+

.72300E+02

2

K+

.65000E+01

2

CA++

.16100E+03

2

MG++

.11800E+03

2

AL+++

.30000E-01

2

S102(AQ)

.29000E+02

2

SR++

.80000E+00

2

ZN++

.80000E-02

2

H+

.80500E+01

16

HC03-

CO3--

0.

30

CL-

.77000E+02

2

SO4--

.75000E+03

2

MN++

.20000E-02

2

FE++

.30000E-02

2

U02++

U++++

.10000E+00

2

O2(G)

0.

0

O2(AQ)

0.

4

H2(AQ)

0.

27

HC03-

.16700E+03

2

HPO4--

.19000E+01

2

ENDIT.

FILE DATA1 HAS BEEN SUCCESSFULLY READ

----- CONFLICTING INPUT OPTIONS FOR F02 -----

I0PT1 = -1 OVERRIDES UREDOX = 02(AQ)

```

EEEE  QQQ  33333
EEEE  QQ   33
EEEE  Q   3
EEEE  QQQ  3333
      Q

```

3230 VERSION

CLIMAX GROUND WATER
 SHAFT WATER SET 30 AIR SATURATED
 BASED ON JACK HARRAR'S MEMO OF 1/20/82
 TEMPERATURE NOT REPORTED, 25 DEG C ASSUMED

DATA FILE SET DEQPAK9
 SUPPORTING DATA FOR PROGRAMS EQ3 AND EQ6
 1 ATM.-STEAM SATURATION CURVE DATA
 LAST REVISED 20 NOVEMBER 1981

THE TOTAL PRESSURE IS 1.0134 BARS
 THE TEMPERATURE IS 25.00 DEGREES CELSIUS

29 ELEMENTS ARE IN THE DATA BASE
 40 ELEMENTS CAN BE LOADED INTO MEMORY
 17 ELEMENTS ARE IN THE PROBLEM SYSTEM

170 AQUEOUS SPECIES WERE LOADED INTO MEMORY
 300 AQUEOUS SPECIES CAN BE LOADED INTO MEMORY

140 AQUEOUS REACTIONS WERE LOADED INTO MEMORY
 259 AQUEOUS REACTIONS CAN BE LOADED INTO MEMORY

148 MINERALS WERE LOADED INTO MEMORY
 275 MINERALS CAN BE LOADED INTO MEMORY

12 SOLID SOLUTIONS ARE IN THE DATA BASE
 20 SOLID SOLUTIONS CAN BE LOADED INTO MEMORY

7 GASES WERE LOADED INTO MEMORY
 15 GASES CAN BE LOADED INTO MEMORY

LOPT1 = -1 (REDOX OPTION SWITCH)
 LOPT2 = 0 (AUTOMATIC BASIS SWITCHING SWITCH)
 LOPT3 = 0 (INTERFACING OUTPUT CONTROL SWITCH)
 LOPT4 = 0 (TURN-ON SOLID SOLUTIONS SWITCH)
 LOPT5 = 0 (NOT CURRENTLY USED)
 LOPT6 = 0 (NOT CURRENTLY USED)
 LOPT7 = 0 (TURN OFF LUREFF CALLS SWITCH)
 LOPT8 = 0 (CONV. TEST CRITERIA SWITCH)
 LOPT9 = 3 (MAXIMUM PTS. USED IN FIND ROUTINE)

```

IPRNT1 = -1 (LIST LOADING OF SPECIES)
IPRNT2 = 0 (LIST REACTIONS AND LOG K VALUES)
IPRNT3 = 0 (NOT CURRENTLY USED)
IPRNT4 = 0 (SPECIATION PRINT CONTROL)
IPRNT5 = 0 (NOT CURRENTLY USED)
IPRNT6 = 0 (NOT CURRENTLY USED)
IPRNT7 = 0 (MINERAL AFFINITY PRINT CONTROL)

```

```

IDBUG1 = 0 (PRINT INFO. MESSAGES SWITCH)
IDBUG2 = 0 (PRINT DATA1 READ INFO. SWITCH)
IDBUG3 = 0 (NOT CURRENTLY USED)
IDBUG4 = 0 (PRINT NEWTON-RAPHSON ITERATIONS SWITCH)
IDBUG5 = 0 (NOT CURRENTLY USED)
IDBUG6 = 0 (LIST STOICH. EQUIVALENCES SWITCH)
IDBUG7 = 0 (WRITE REACTIONS ON RFILE SWITCH)

```

THE DEFAULT REDOX STATE IS CONSTRAINED BY EH = .80000 VOLTS

```

SOLUTION DENSITY = 1.00000 G/ML
TOTAL DISSOLVED SALTS = 0.00 MG/KG SOLUTION
TOTAL DISSOLVED SALTS = 0.00 MG/L

```

```

TOLBT = .10000E-09 (CONVERGENCE TOLERANCE ON RESIDUAL FUNCTIONS)
TOLDL = .10000E-09 (CONVERGENCE TOLERANCE ON CORRECTION TERMS)
TOLSAT = .50000E+00 (PHASE SATURATION TOLERANCE, DOES NOT AFFECT
CONVERGENCE)

```

----- INPUT CONSTRAINTS -----

SPECIES	CSP	JFLAG	TYPE OF INPUT	UPHASE	BASIS SPECIES
NA+	.72300E+02	2	TOT CONC, MG/L		
K+	.65000E+01	2	TOT CONC, MG/L		
CA++	.16100E+03	2	TOT CONC, MG/L		
MG++	.11800E+03	2	TOT CONC, MG/L		
AL+++	.30000E-01	2	TOT CONC, MG/L		
SiO2(AQ)	.29000E+02	2	TOT CONC, MG/L		
SR++	.80000E+00	2	TOT CONC, MG/L		
ZN++	.80000E-02	2	TOT CONC, MG/L		
H+	.60500E+01	16	LOG ACTIVITY		
CO3--	0.	30	ELIMINATED SPECIES		HC03-
CL-	.77000E+02	2	TOT CONC, MG/L		
SO4--	.75000E+03	2	TOT CONC, MG/L		
MN++	.20000E-02	2	TOT CONC, MG/L		
FE++	.30000E-02	2	TOT CONC, MG/L		
U++++	.10000E+00	2	TOT CONC, MG/L		UO2++
O2(AQ)	0.	4	FREE CONC, MOLAL		
H2(AQ)	0.	27	DEPENDENT SPECIES		
HCO3-	.16700E+03	2	TOT CONC, MG/L		CO3--
HPO4--	.19000E+01	2	TOT CONC, MG/L		

----- INACTIVE AQUEOUS SPECIES -----

CH4(AQ)
 FECL+
 FE(SO4)2-
 MNCL4--
 MNCL4-

MN+++
 FECL2
 MNCL+
 MNCL2+
 KOH

KCL
 FECL3-
 MNCL2
 MNCL2+
 MGCL+

KCO3-
 FECL4--
 MNCL3-
 MNCL3

SWITCHING CO3--

FROM THE BASIS FOR HCO3-

1.000 HCO3-
 ==
 1.000 H+ LOG K = -10.3281
 + 1.000 CO3--
 1.000 CO3--
 + 1.000 H+ LOG K = 10.3281
 ==
 1.000 HCO3-

SWITCHING U++++

FROM THE BASIS FOR UO2++

1.000 UO2++
 + 2.000 H+ LOG K = -32.3246
 ==
 1.000 H2O
 + 1.000 U++++
 + .500 O2(G)
 1.000 U++++
 + 1.000 H2O
 + .500 O2(G) LOG K = 32.3246
 ==
 2.000 H+
 + 1.000 UO2++

35

SPECIES	CSP	JFLAG	TYPE OF INPUT	UPHASE
NA+	.31448E-02	0	TOT CONC, MOLAL	
K+	.16625E-03	0	TOT CONC, MOLAL	
CA++	.40170E-02	0	TOT CONC, MOLAL	
MG++	.48530E-02	0	TOT CONC, MOLAL	
AL+++	.11119E-05	0	TOT CONC, MOLAL	
SiO2(AQ)	.48266E-03	0	TOT CONC, MOLAL	
SR++	.91303E-05	0	TOT CONC, MOLAL	
ZN++	.12236E-06	0	TOT CONC, MOLAL	
H+	.60500E+01	16	LOG ACTIVITY	
HCO3-	.27369E-02	0	TOT CONC, MOLAL	
CL-	.21719E-02	0	TOT CONC, MOLAL	
SO4--	.78078E-02	0	TOT CONC, MOLAL	
MN++	.36405E-07	0	TOT CONC, MOLAL	
FE++	.53718E-07	0	TOT CONC, MOLAL	
UO2++	.42012E-06	0	TOT CONC, MOLAL	
HP04--	.19796E-04	0	TOT CONC, MOLAL	
O2(AQ)			NOT PRESENT IN THE MODEL	
H2(AQ)	0.	27	DEPENDENT SPECIES	
CH4(AQ)			NOT PRESENT IN THE MODEL	

U+++	0.	30	ELIMINATED SPECIES
HS-	0.	30	ELIMINATED SPECIES
MN+++	0.		NOT PRESENT IN THE MODEL
FE+++	0.	30	ELIMINATED SPECIES
U+++	0.	30	ELIMINATED SPECIES
UO2+	0.	30	ELIMINATED SPECIES
H2FO4-	0.	30	ELIMINATED SPECIES
CO3--	0.	30	ELIMINATED SPECIES
OH-	0.	30	ELIMINATED SPECIES

THE ION FOR ESTIMATING WATER ACTIVITY IS NA+

ITER = 0	DELMAX = 0.	DEL(XI) = 0.	BETA(XI) = .110E+02	DELFNC = 0.
ITER = 1	DELMAX = .132E+02	DEL(XI) = .100E+01	BETA(MN++) = .195E+01	DELFNC = 0.
ITER = 2	DELMAX = .243E+00	DEL(FE++) = -.243E+00	BETA(MN++) = .526E+00	DELFNC = .982E+00
ITER = 3	DELMAX = .151E+00	DEL(MN++) = -.151E+00	BETA(MN++) = .820E-01	DELFNC = .377E+00
ITER = 4	DELMAX = .335E-01	DEL(MN++) = -.335E-01	BETA(MN++) = .303E-02	DELFNC = .779E+00
ITER = 5	DELMAX = .132E-02	DEL(MN++) = -.132E-02	BETA(MN++) = .460E-05	DELFNC = .961E+00
ITER = 6	DELMAX = .200E-05	DEL(MN++) = -.200E-05	BETA(MN++) = .147E-10	DELFNC = .998E+00
ITER = 7	DELMAX = .675E-11	DEL(MN++) = -.675E-11	BETA(AL+++) = .299E-12	DELFNC = .100E+01

NEWTON-RAPHSON ITERATION CONVERGED IN 7 STEPS

----- SUMMARY OF THE AQUEOUS PHASE -----

----- ELEMENTAL COMPOSITION OF THE AQUEOUS PHASE -----

ELEMENT	MG/L	MG/KG	MOLES/KG
O	888763.8643	888763.8643	.5554982463E+02
NA	72.2993	72.2993	.3144845585E-02
K	6.5000	6.5000	.1662489130E-03
CA	161.0000	161.0000	.4016956068E-02
MG	118.0000	118.0000	.4854968114E-02
AL	.0300	.0300	.1111852346E-05
SI	13.5557	13.5557	.4826576127E-03
SR	.8000	.8000	.9130335540E-05
ZN	.0080	.0080	.1223615785E-06
H	111898.4441	111898.4441	.1110213752E+03
C	32.8734	32.8734	.2736942164E-02
CL	77.0000	77.0000	.2171889544E-02
S	250.3175	250.3175	.7807782798E-02
MN	.0020	.0020	.3640467436E-07
FE	.0030	.0030	.5371819435E-07
U	.1000	.1000	.4201168765E-06
P	.6132	.6132	.1979599704E-04

----- ELEMENTAL COMPOSITION AS STRICT BASIS SPECIES -----

SPECIES	MG/L	MG/KG	MOLES/KG
---------	------	-------	----------

H2O	1000730.0908	1000730.0908	.5554982463E+02
NA+	72.3000	72.3000	.3144845585E-02
K+	6.5000	6.5000	.1662489130E-03
CA++	161.0000	161.0000	.4016966068E-02
MG++	118.0000	118.0000	.4854968114E-02
AL+++	.0300	.0300	.1111852346E-05
SiO2(A)	29.0000	29.0000	.4826576127E-03
SR++	.8000	.8000	.9130335540E-05
ZN++	.0080	.0080	.1223615785E-06
H+	111909.5462	111909.5462	.1110213752E+03
CO3--	164.2412	164.2412	.2736942164E-02
CL-	77.0000	77.0000	.2171889544E-02
SO4--	750.0000	750.0000	.7807782798E-02
MN++	.0020	.0020	.3640467436E-07
FE++	.0030	.0030	.5371819435E-07
U++++	.1000	.1000	.4201168765E-06
HP04--	1.9000	1.9000	.1979599704E-04

----- EQUIVALENT COMPOSITION OF THE AQUEOUS PHASE -----

SPECIES	MOLES/KG H2O
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H2O	.5554982463E+02
NA+	.3144845585E-02
K+	.1662489130E-03
CA++	.4016966068E-02
MG++	.4854968114E-02
AL+++	.1111852346E-05
SiO2(AQ)	.4826576127E-03
SR++	.9130335540E-05
ZN++	.1223615785E-06
H+	.1110213752E+03
HCO3-	.2736942164E-02
CL-	.2171889544E-02
SO4--	.7807782798E-02
MN++	.3640467436E-07
FE++	.5371819435E-07
UO2++	.4201168765E-06
HP04--	.1979599704E-04

IONIC STRENGTH = .0286247959683
 EQUIV. STOICH. IONIC STRENGTH (NA+) = .0031448455850

PH = 8.05000
 ACTIVITY OF WATER = .99989
 LOG ACTIVITY OF WATER = -.00005
 TITRATION ALKALINITY = .27913E-02 EQ/KG H2O

----- ELECTRICAL IMBALANCE -----

THE CALCULATED IMBALANCE IS .45768E-03 EQUIV/KG H2O
 THIS IS 1.60 PER CENT OF THE IONIC STRENGTH

----- ACTIVITY RATIOS OF CATIONS -----

LOG (NA+ /H**1)	5.4714
LOG (K+ /H**1)	4.1890
LOG (CA++ /H**2)	13.3094
LOG (MG++ /H**2)	13.4250
LOG (AL+++ /H**3)	9.0573
LOG (SR++ /H**2)	10.7916
LOG (ZN++ /H**2)	8.7875
LOG (MN++ /H**2)	7.0800
LOG (FE++ /H**2)	-2.1191
LOG (U++++ /H**4)	-32.4285
LOG (U+++ /H**3)	-62.8022
LOG (FE+++ /H**3)	6.4434
LOG (UO2++ /H**2)	1.4915
LOG (UO2+ /H**1)	-17.3011

----- DISTRIBUTION OF AQUEOUS SPECIES -----

SPECIES	MOLAL CONC	LOG CONC	LOG G	ACTIVITY	LOG ACT
NA+	.3096E-02	-2.5092	-.0693	.2639E-02	-2.5786
K+	.1628E-03	-3.7883	-.0727	.1377E-03	-3.8610
CA++	.2929E-02	-2.5333	-.2573	.1619E-02	-2.7906
MG++	.3651E-02	-2.4376	-.2374	.2114E-02	-2.6750
AL+++	.2649E-14	-14.5770	-.5158	.8077E-15	-15.0927
SIO2(AQ)	.4662E-03	-3.3315	0.0000	.4662E-03	-3.3315
SR++	.9122E-05	-5.0399	-.2685	.4915E-05	-5.3084
ZN++	.8806E-07	-7.0552	-.2573	.4869E-07	-7.3125
H+	.1015E-07	-7.9937	-.0563	.8913E-08	-8.0500
HCO3-	.2486E-02	-2.6045	-.0677	.2127E-02	-2.6722
CL-	.2171E-02	-2.6633	-.0727	.1837E-02	-2.7360
SO4--	.5663E-02	-2.2469	-.2808	.2967E-02	-2.5277
MN++	.1727E-08	-8.7627	-.2573	.9550E-09	-9.0200
FE++	.1092E-17	-17.9618	-.2573	.6038E-18	-18.2191
UO2++	.4571E-14	-14.3400	-.2685	.2463E-14	-14.6085
HP04--	.6751E-05	-5.1706	-.2808	.3537E-05	-5.4514
H2(AQ)	.5469E-46	-46.2621	-.0032	.5509E-46	-46.2589
U+++	.3661E-86	-86.4364	-.5158	.1116E-86	-86.9522
HS-	.3640-149	-149.4388	-.0710	.3092-149	-149.5098
FE+++	.6445E-17	-17.1908	-.5158	.1965E-17	-17.7066
U++++	.1682E-63	-63.7741	-.8545	.2352E-64	-64.6285
UO2+	.5227E-25	-25.2818	-.0693	.4456E-25	-25.3511
H2PO4-	.5931E-06	-6.2269	-.0693	.5056E-06	-6.2962
CO3--	.2110E-04	-4.6758	-.2745	.1121E-04	-4.9503
OH-	.1360E-05	-5.8665	-.0710	.1155E-05	-5.9374
AL(OH)++	.3087E-11	-11.5104	-.2573	.1707E-11	-11.7677
AL(OH)4-	.1112E-05	-5.9540	-.0693	.9478E-06	-6.0233
KS04-	.3425E-05	-5.4653	-.0710	.2909E-05	-5.5363
NaCl	.5928E-06	-6.2271	0.0000	.5928E-06	-6.2271
NAC03-	.3157E-06	-6.5008	-.0677	.2701E-06	-6.5685
NAS04-	.4806E-04	-4.3182	-.0684	.4106E-04	-4.3866
CAC03	.2866E-04	-4.5427	0.0000	.2866E-04	-4.5427
CAHC03+	.7127E-04	-4.1471	-.0657	.6127E-04	-4.2128
CAS04	.9841E-03	-3.0070	0.0000	.9841E-03	-3.0070
MGC03	.2269E-04	-4.6441	0.0000	.2269E-04	-4.6441
MGHC03+	.6433E-04	-4.1916	-.0693	.5484E-04	-4.2609
MGS04	.1109E-02	-2.9551	0.0000	.1109E-02	-2.9551
FES04	.3169E-18	-18.4991	0.0000	.3169E-18	-18.4991
FECL++	.1641E-18	-18.7848	-.2808	.8597E-19	-19.0656
FECL2+	.3459E-22	-22.4611	-.0693	.2949E-22	-22.5304

FECL3	.1643E-24	-24.7844	0.0000	.1643E-24	-24.7844
FECL4-	.4390E-29	-29.3576	-0.0693	.3742E-29	-29.4269
FES04+	.5637E-16	-16.2489	-0.0693	.4806E-16	-16.3183
MNS04	.5013E-09	-9.2999	0.0000	.5013E-09	-9.2999
ZNCL+	.2897E-09	-9.5381	-0.0693	.2469E-09	-9.6074
ZNCL2	.6942E-12	-12.1585	0.0000	.6942E-12	-12.1585
ZNCL3-	.1219E-14	-14.9141	-0.0693	.1039E-14	-14.9835
ZNCL4--	.1679E-17	-17.7749	-2808	.8798E-18	-18.0556
ZNS04	.3365E-07	-7.4730	0.0000	.3365E-07	-7.4730
H3SI04-	.1649E-04	-4.7827	-0.0693	.1406E-04	-4.8520
ALS04+	.2940E-14	-14.5317	-0.0693	.2506E-14	-14.6010
HS04-	.3138E-08	-8.5033	-0.0693	.2675E-08	-8.5727
S--	.4383E-158	-158.9582	-2685	.2362E-158	-158.6268
H2S(AQ)	.2635E-150	-150.5792	0.0000	.2635E-150	-150.5792
H2CO3	.4188E-04	-4.3780	0.0032	.4219E-04	-4.3748
HCL	.1203E-16	-16.9199	0.0000	.1203E-16	-16.9199
MG(OH)+	.4677E-06	-6.3300	-0.0693	.3987E-06	-6.3993
FE(OH)+	.4108E-18	-18.3864	-0.0693	.3502E-18	-18.4557
CA(OH)+	.5504E-07	-7.2593	-0.0693	.4692E-07	-7.3286
FE(OH)++	.2738E-11	-11.5625	-2808	.1434E-11	-11.8433
FE(OH)2+	.2079E-08	-8.6821	-0.0693	.1772E-08	-8.7515
FE(OH)3-	.1143E-25	-25.9421	-0.0693	.9740E-26	-26.0115
FE(OH)4-	.5164E-07	-7.2870	-0.0693	.4402E-07	-7.3564
NAOH	.6081E-09	-9.2160	0.0000	.6081E-09	-9.2160
(FE0H++)2	.9408E-21	-21.0265	-1.1267	.7028E-22	-22.1532
MN(OH)+	.3266E-11	-11.4860	-0.0693	.2784E-11	-11.5553
MNCO3	.3416E-07	-7.4665	0.0000	.3416E-07	-7.4665
UCL+++	.3200E-65	-65.4948	-5356	.9322E-66	-66.0305
U(OH)+++	.2042E-56	-56.6900	-5356	.5947E-57	-57.2257
U(OH)2++	.3111E-50	-50.5071	-2685	.1676E-50	-50.7756
U(OH)3+	.5217E-45	-45.2826	-0.0693	.4448E-45	-45.3519
U(OH)4	.1111E-40	-40.9542	0.0000	.1111E-40	-40.9542
U(OH)5-	.3630E-37	-37.4402	-0.0693	.3094E-37	-37.5095
U6(OH)15(9+)	0.	-279.8741	-4.3305	0.	-284.2046
US04++	.3741E-61	-61.4270	-2685	.2016E-61	-61.6955
U(S04)2	.1161E-59	-59.9353	0.0000	.1161E-59	-59.9353
U(HP04)++	.1620E-57	-57.7905	-2685	.8729E-58	-58.0590
U(HP04)2	.3400E-53	-53.4686	0.0000	.3400E-53	-53.4686
U(HP04)3--	.1024E-49	-49.9899	-2808	.5362E-50	-50.2707
U(HP04)4----	.2933E-46	-46.5327	-1.1267	.2191E-47	-47.6593
U02(OH)+	.5404E-12	-12.2673	-0.0693	.4607E-12	-12.3366
U02(OH)2	.3100E-10	-10.5086	0.0000	.3100E-10	-10.5086
(U02)2(OH)2++	.3322E-18	-18.4787	-2573	.1837E-18	-18.7360
(U02)3(OH)5+	.7373E-19	-19.1324	-0.0693	.6330E-19	-19.1986
(U02)3(OH)7-	.3921E-18	-18.4066	-0.0693	.3343E-18	-18.4759
U02CL+	.9108E-17	-17.7406	-0.0693	.7765E-17	-17.1099
U02CO2	.3477E-09	-9.4588	0.0000	.3477E-09	-9.4588
U02(C03)2--	.5911E-07	-7.2284	-2808	.3096E-07	-7.5092
(U02(C03)3----	.1167E-06	-6.9328	-1.1267	.8720E-08	-8.0595
U02S04	.3835E-14	-14.4162	0.0000	.3835E-14	-14.4162
U02(S04)2--	.6559E-15	-15.1832	-2808	.3436E-15	-15.4640
U02(HP04)	.2341E-11	-11.6307	0.0000	.2341E-11	-11.6307
U02(HP04)2--	.2439E-06	-6.6128	-2808	.1278E-06	-6.8936
U02(H2P04)+	.1555E-17	-17.8082	-0.0693	.1326E-17	-17.8776
U02(H2P04)2	.1850E-21	-21.7329	0.0000	.1850E-21	-21.7329
U02(H2P04)3-	.5598E-26	-26.2520	-0.0693	.4772E-26	-26.3213
U02S10(OH)3+	.5957E-12	-12.2250	-0.0693	.5078E-12	-12.2943
P04----	.8115E-09	-9.0907	-6332	.1888E-09	-9.7240
H3P04	.6376E-12	-12.1954	0.0000	.6376E-12	-12.1954
MGP04-	.1368E-05	-5.8639	-0.0693	.1166E-05	-5.9332

CAP04-	.1056E-05	-5.9761	-.0693	.9006E-06	-6.0454
SRP04-	.3533E-09	-9.4519	-.0693	.3012E-09	-9.5212
FEPO4-	.3455E-20	-20.4615	-.0693	.2946E-20	-20.5308
MNP04-	.3296E-12	-12.4820	-.0693	.2810E-12	-12.5513
ZNP04-	.2486E-10	-10.6045	-.0693	.2119E-10	-10.6738
NAHP04-	.1555E-06	-6.8082	-.0693	.1326E-06	-6.8775
KHP04-	.6343E-08	-8.1977	-.0693	.5408E-08	-8.2670
MGHP04	.6076E-05	-5.2163	0.0000	.6076E-05	-5.2163
CAHP04	.3251E-05	-5.4880	0.0000	.3251E-05	-5.4880
SRHP04	.7930E-08	-8.1007	0.0000	.7930E-08	-8.1007
FEHP04	.8483E-20	-20.0715	0.0000	.8483E-20	-20.0715
MNHP04	.1284E-10	-10.8916	0.0000	.1284E-10	-10.8916
ZNHP04	.3355E-09	-9.4743	0.0000	.3355E-09	-9.4743
FEHP04+	.1513E-12	-12.8203	-.0693	.1289E-12	-12.8896
ALHP04+	.2109E-12	-12.6758	-.0693	.1798E-12	-12.7452
MGH2PO4+	.4132E-07	-7.3839	-.0693	.3522E-07	-7.4532
SRH2PO4+	.1714E-10	-10.7660	-.0693	.1461E-10	-10.8353
FEH2PO4+	.1793E-21	-21.7464	-.0693	.1528E-21	-21.8157
MNH2PO4+	.1790E-13	-13.7472	-.0693	.1526E-13	-13.8165
ZNH2PO4+	.1447E-11	-11.8396	-.0693	.1233E-11	-11.9089
FEH2PO4+	.5075E-19	-19.2946	-.2685	.2735E-19	-19.5631
ALH2PO4+	.1512E-17	-17.8205	-.2685	.8146E-18	-18.0891
P2O7----	.1633E-13	-13.7713	-1.1267	.1265E-14	-14.8979
HP2O7---	.1243E-12	-12.9055	-.6332	.2893E-13	-13.5387
H2PO7---	.2495E-14	-14.6029	-.2808	.1307E-14	-14.8837
H3PO7-	.2177E-20	-20.6622	-.0693	.1856E-20	-20.7315
H4PO7	.9959E-28	-28.0018	0.0000	.9959E-28	-28.0018

----- SUMMARY OF AQUEOUS REDOX REACTIONS -----

COUPLE	EH, VOLTS	PE-	LOG F02	AH, KCAL
DEFAULT	.800	.1352E+02	3.191	18.450
H2(AQ)/H2O	.800	.1352E+02	3.191	18.450
U+++ /UO2++	.800	.1352E+02	3.191	18.450
HS- /SO4--	.800	.1352E+02	3.191	18.450
FE+++ /FE++	.800	.1352E+02	3.191	18.450
U+++ /UO2++	.800	.1352E+02	3.191	18.450
UO2+ /UO2++	.800	.1352E+02	3.191	18.450

----- SUMMARY OF AQUEOUS NON-EQUILIBRIUM NON-REDOX REACTIONS -----

COUPLE AFFINITY, KCAL

NONE

----- SUMMARY OF STOICHIOMETRIC MINERAL SATURATION STATES -----

(MINERALS WITH AFFINITIES .LT. -10 KCAL ARE NOT LISTED)

MINERAL	LOG Q/K	AFF, KCAL	STATE
ANGITZORITE	47.1571879	64.3358573	SUP. SATURATED
PHENGITE	5.3884672	7.3514064	SUPERSATURATED
MAGNETITE	6.9405567	9.4603993	SUPERSATURATED
CORUNDUM	-3.2694167	-4.4604171	
HEMATITE	17.2087199	23.4776032	SUPERSATURATED

DEHYDRATED ANALC	-4.1223097	-5.6240064	
BRUCITE	-3.0138819	-4.1117948	
GIBBSITE	1.0968193	1.4963744	SUPERSATURATED
HALITE	-6.9235066	-9.4456382	
REYKJANES SMECTI	7.9856479	10.8947019	SUPERSATURATED
CALCITE	.7839500	1.0695314	SUPERSATURATED
MAGNESITE	.2823992	.3852731	APPROX. SATURATED
RHODOCHROSITE	-3.4332895	-4.6839863	
DOLOMITE	2.6950492	3.6768159	SUPERSATURATED
HYDROMAGNESITE	-7.2618782	-9.9072735	
ANHYDRITE	-1.0529491	-1.4365229	
GYP SUM	-.4684456	-.6390934	
QUARTZ	.6678382	.9111219	SUPERSATURATED
MAXIMUM MICROCLI	3.1686108	4.3228891	SUPERSATURATED
LOW ALBITE	1.4369286	1.9603805	SUPERSATURATED
ANORTHITE	-2.3018231	-3.1403434	
SEPIOLITE	2.7070570	3.6931980	SUPERSATURATED
14A-AMESITE	6.0026154	8.1892798	SUPERSATURATED
NEPHELINE	-2.9363479	-4.0060162	
ANALCITE	.5856421	.7989829	SUPERSATURATED
KAOLINITE	4.0221633	5.4873782	SUPERSATURATED
CHERTSOTILE	2.0630789	2.8146282	SUPERSATURATED
PHYCOPHYLLITE	3.7285880	5.0868578	SUPERSATURATED
TALC	5.3862037	7.3483184	SUPERSATURATED
NA-FEIDELLITE	4.3050130	5.8732659	SUPERSATURATED
MUSCOVITE	6.8016459	9.2793854	SUPERSATURATED
ILLITE	5.2374207	7.1453359	SUPERSATURATED
ARTINITE	-3.7928275	-5.1744987	
TREMOLITE	5.4202235	7.3947312	SUPERSATURATED
ENSTATITE	-1.3752954	-1.8762953	
DIOPSIDE	-.8981401	-1.2253193	
WOLLASTONITE	-3.6459446	-4.9741086	
ZOISITE	-.1639002	-.2236066	APPROX. SATURATED
KYANITE	-1.5123784	-2.0633156	
FORSTERITE	-4.6279291	-6.3138156	
PREHNITE	1.4611840	1.9934719	SUPERSATURATED
HUNTITE	-.1018524	-.1389558	APPROX. SATURATED
AMORPHOUS SILICA	-.6178618	-.8429397	
PHLOGOPITE	5.3036615	7.2357074	SUPERSATURATED
K-FELDSPAR	3.1685108	4.3228891	SUPERSATURATED
HIGH SANIDINE	1.9694108	2.6868382	SUPERSATURATED
HIGH ALBITE	.1182286	.1612975	APPROX. SATURATED
HYDROUS CORDIERI	-4.9274578	-6.7224581	
STROMTIANITE	1.1688488	1.5946432	SUPERSATURATED
K-BEIDELLITE	4.2118151	5.7461174	SUPERSATURATED
CA-BEIDELLITE	4.7545810	6.4866049	SUPERSATURATED
MG-BEIDELLITE	4.7920631	6.5377412	SUPERSATURATED
H-BEIDELLITE	3.5189357	4.8008322	SUPERSATURATED
CELESTITE	-1.4047502	-1.9164801	
ARAGONITE	.6189500	.8444243	SUPERSATURATED
NA-SAPONITE	5.9625286	8.1345901	SUPERSATURATED
K-SAPONITE	5.8693308	8.0074416	SUPERSATURATED
CLINOZOISITE	-.1192002	-.1626231	APPROX. SATURATED
PAPAGONITE	4.1734636	5.6937950	SUPERSATURATED
SPINEL	-6.8533504	-9.3499250	
DIASPORE	.3054675	.4167449	APPROX. SATURATED
CA-SAPONITE	6.4121966	8.7480655	SUPERSATURATED
BOEHMITE	-.5389325	-.7352576	
CHALEDONY	.3966382	.5411277	SUPERSATURATED
MG-SAPONITE	6.4496788	8.7992018	SUPERSATURATED

ALUNITE	-6.5563977	-8.9447968	
7A-CLINOCCHLORE	3.3059366	4.5102407	SUPERSATURATED
ANDALUSITE	-1.7872784	-2.4383577	
H-SAPONITE	5.1870513	7.0766178	SUPERSATURATED
14A-CLINOCCHLORE	6.6792366	9.1123842	SUPERSATURATED
SMITHSONITE	-2.3702359	-3.2336779	
ANTHOPHYLLITE	-1.4653780	-1.6349084	
MONTICELLITE	-6.3487783	-8.6615448	
NA-NONTRONITE	21.3028495	29.0631641	SUPERSATURATED
K-NONTRONITE	21.2096517	28.9360156	SUPERSATURATED
GROSSULAR	-4.0860506	-5.5745387	
ALBITE	1.4369286	1.9603805	SUPERSATURATED
ORDERED EPIDOTE	10.1202681	13.8069328	SUPERSATURATED
ANDRADITE	14.3257859	19.5444589	SUPERSATURATED
CA-NONTRONITE	21.7524175	29.6765031	SUPERSATURATED
MG-NONTRONITE	21.7898997	29.7276394	SUPERSATURATED
H-NONTRONITE	20.5182723	27.9927768	SUPERSATURATED
CRISTOBALITE	1.173382	1.1600828	APPROX. SATURATED
DISORDERED DOLOM	1.1505492	1.5696773	SUPERSATURATED
ORDERED DOLOMITE	2.6950492	3.6768159	SUPERSATURATED
NEOQUEONITE	-2.4165456	-3.2968576	
EPIDOTE	10.1202681	13.8069328	SUPERSATURATED
PD-OXYANNITE	29.5480148	40.3119216	SUPERSATURATED
WAIRAKITE	-1.4608431	-1.6287215	
LAUMONTITE	3.9506604	5.3898278	SUPERSATURATED
MARGARITE	1.7045120	1.9611553	SUPERSATURATED
SILLIMANITE	-2.1463784	-2.9282725	
KALSILITE	-1.3423656	-1.8313697	
JADEITE	-1.8560097	-1.1678414	
GAMMA-UC3	-6.2415769	-8.5152915	
BETA-UC2(OH)2	-4.0434251	-5.5163854	
SCHOEPIITE	-3.9473734	-5.3853434	
RUTHERFORDINE	-5.0988440	-6.9562778	
HYDROXYAPATITE	13.4157093	18.3028547	SUPERSATURATED
STRENGITE	-1.9707873	-2.6887161	
MNHP04(C)	-1.5261972	-2.0821683	
ZN3(P04)2.4H2O	-6.0867007	-8.3039961	
BERLINITE	34.9968409	47.7456750	SUPERSATURATED
WHITLOCKITE	6.7256499	9.1757052	SUPERSATURATED
CAHP04.2H2O	-1.6848542	-2.2986218	
SRHP04(C)	-3.7598589	-5.1295202	

7 APPROX. SATURATED PURE MINERALS
0 APPROX. SATURATED END-MEMBERS OF SPECIFIED SOLID SOLUTIONS
0 SATURATED END-MEMBERS OF HYPOTHETICAL SOLID SOLUTIONS

58 SUPERSATURATED PURE MINERALS
0 SUPERSATD. END-MEMBERS OF SPECIFIED SOLID SOLUTIONS
0 SUPERSATD. HYPOTHETICAL SOLID SOLUTION PHASES

----- SUMMARY OF GASES -----

GAS	FUGACITY	LOG FUGACITY
CO2(G)	.129519E-02	-2.88767

O2(G)	.155200E+04	3.19089
S2(G)	0.	-238.50156
CH4(G)	.264333-152	-152.57785
H2(G)	.713026E-43	-43.14689
H2S(G)	.267301-149	-149.57300
STEAM	.313077E-01	-1.50435

----- END OF OUTPUT -----
 ----- END OF INPUT FILE -----

UTITL
CLIMAX GROUND WATER
SHAFT WATER SET 36 AIR SATURATED
BASED ON JACK HARRAR'S MEMO OF 1/20/82
TEMPERATURE NOT REPORTED, 25 DEG C ASSUMED

TEMPC

.250000E+02

RHO

0.

TDS1

TDS2

F02/EH/PE

.800000E+00

COUPLE

O2(AQ)

TOLDL

TOLSAT

TOLBT

0.

0.

0.

ITERMX

0

I0PT

-1

2

3

4

5

6

7

8

9

IPRNT

-1

2

3

4

5

6

7

0

C

IDBUG

-1

2

3

4

5

6

7

UEBAL

0

2

0

4

0

0

0

SUPPRESSED/ALTERED SPECIES (AQ, MIN, GAS, SOL)

0

0

0

0

NA+

.55900E+02

2

K+

.48000E+01

2

CA++

.12600E+03

2

MG++

.62500E+02

2

AL+++

.50000E-01

2

SI02(AQ)

.34000E+02

2

SR++

.18000E+01

2

ZN++

.40000E-02

2

H+

.78000E+01

1

HC03-

CO3--

0.

3

CL-

.52000E+02

2

SO4--

.32500E+03

2

MN++

.32000E-01

2

FE++

.40000E-02

2

U02++

U++++

.10000E-02

2

O2(G)

0.

0

O2(AQ)

0.

4

H2(AQ)

0.

2

HC03-

.31600E+03

2

HP04--

.12000E+01

2

ENDIT.

FILE DATA1 HAS BEEN SUCCESSFULLY READ

----- CONFLICTING INPUT OPTIONS FOR F02 -----

I0PT1 = -1 OVERRIDES UREDOX = O2(AQ)

```

EEEE  QQQ  33333
E      QQ   3
EEEE  QQ   33
E      Q   3
EEEE  QQQ  3333
      Q

```

3230 VERSION

CLIMAX GROUND WATER
 SHAFT WATER SET 36 AIR SATURATED
 BASED ON JACK HARRAR'S MEMO OF 1/20/82
 TEMPERATURE NOT REPORTED, 25 DEG C ASSUMED

DATA FILE SET DEQPAK9
 SUPPORTING DATA FOR PROGRAMS EQ3 AND EQ6
 1 ATM.-STEAM SATURATION CURVE DATA
 LAST REVISED 20 NOVEMBER 1981

THE TOTAL PRESSURE IS 1.0134 BARS
 THE TEMPERATURE IS 25.00 DEGREES CELSIUS

29 ELEMENTS ARE IN THE DATA BASE
 40 ELEMENTS CAN BE LOADED INTO MEMORY
 17 ELEMENTS ARE IN THE PROBLEM SYSTEM

170 AQUEOUS SPECIES WERE LOADED INTO MEMORY
 300 AQUEOUS SPECIES CAN BE LOADED INTO MEMORY

140 AQUEOUS REACTIONS WERE LOADED INTO MEMORY
 259 AQUEOUS REACTIONS CAN BE LOADED INTO MEMORY

148 MINERALS WERE LOADED INTO MEMORY
 275 MINERALS CAN BE LOADED INTO MEMORY

12 SOLID SOLUTIONS ARE IN THE DATA BASE
 20 SOLID SOLUTIONS CAN BE LOADED INTO MEMORY

7 GASES WERE LOADED INTO MEMORY
 15 GASES CAN BE LOADED INTO MEMORY

IOPT1 = -1 (REDOX OPTION SWITCH)
 IOPT2 = 0 (AUTOMATIC BASIS SWITCHING SWITCH)
 IOPT3 = 0 (INTERFACING OUTPUT CONTROL SWITCH)
 IOPT4 = 0 (TURN-ON SOLID SOLUTIONS SWITCH)
 IOPT5 = 0 (NOT CURRENTLY USED)
 IOPT6 = 0 (NOT CURRENTLY USED)
 IOPT7 = 0 (TURN OFF LUREFF CALLS SWITCH)
 IOPT8 = 0 (CCNV. TEST CRITERIA SWITCH)
 IOPT9 = 3 (MAXIMUM PTS. USED IN FIND ROUTINE)

```

IPRNT1 = -1 (LIST LOADING OF SPECIES)
IPRNT2 = 0 (LIST REACTIONS AND LOG K VALUES)
IPRNT3 = 0 (NOT CURRENTLY USED)
IPRNT4 = 0 (SPECIATION PRINT CONTROL)
IPRNT5 = 0 (NOT CURRENTLY USED)
IPRNT6 = 0 (NOT CURRENTLY USED)
IPRNT7 = 0 (MINERAL AFFINITY PRINT CONTROL)

```

```

IDBUG1 = 0 (PRINT INFO. MESSAGES SWITCH)
IDBUG2 = 0 (PRINT DATA1 READ INFO. SWITCH)
IDBUG3 = 0 (NOT CURRENTLY USED)
IDBUG4 = 0 (PRINT NEWTON-RAPHSON ITERATIONS SWITCH)
IDBUG5 = 0 (NOT CURRENTLY USED)
IDBUG6 = 0 (LIST STOICH. EQUIVALENCES SWITCH)
IDBUG7 = 0 (WRITE REACTIONS ON RFILE SWITCH)

```

THE DEFAULT REDOX STATE IS CONSTRAINED BY EH = .80000 VOLTS

```

SOLUTION DENSITY = 1.00000 G/ML
TOTAL DISSOLVED SALTS = 0.00 MG/KG SOLUTION
TOTAL DISSOLVED SALTS = 0.00 MG/L

```

```

TOLBT = .10000E-09 (CONVERGENCE TOLERANCE ON RESIDUAL FUNCTIONS)
TOLDL = .10000E-09 (CONVERGENCE TOLERANCE ON CORRECTION TERMS)
TOLSAT = .50000E+00 (PHASE SATURATION TOLERANCE, DOES NOT AFFECT
CONVERGENCE)

```

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----- INPUT CONSTRAINTS -----

SPECIES	CSP	JFLAG	TYPE OF INPUT	UPHASE	BASIS SPECIES
NA+	.55900E+02	2	TOT CONC, MG/L		
K+	.48000E+01	2	TOT CONC, MG/L		
CA++	.12600E+03	2	TOT CONC, MG/L		
MG++	.62500E+02	2	TOT CONC, MG/L		
AL+++	.50000E-01	2	TOT CONC, MG/L		
SiO2(AQ)	.34000E+02	2	TOT CONC, MG/L		
SR++	.18000E+01	2	TOT CONC, MG/L		
ZN++	.40000E-02	2	TOT CONC, MG/L		
H+	.78000E+01	16	LOG ACTIVITY		
CO3--	0.	30	ELIMINATED SPECIES		HC03-
CL-	.52000E+02	2	TOT CONC, MG/L		
SO4--	.32500E+03	2	TOT CONC, MG/L		
MN++	.32000E-01	2	TOT CONC, MG/L		
FE++	.40000E-02	2	TOT CONC, MG/L		
U++++	.10000E-02	2	TOT CONC, MG/L		UC02++
O2(AQ)	0.	4	FREE CONC, MOLAL		
H2(AQ)	0.	27	DEPENDENT SPECIES		
HC03-	.31600E+03	2	TOT CONC, MG/L		CO3--
HPO4--	.12000E+01	2	TOT CONC, MG/L		

----- INACTIVE AQUEOUS SPECIES -----

CH4(AQ)
 FECL+
 FE(SO4)2-
 MNCL4--
 MNCL4-

MN+++
 FECL2
 MNCL+
 MNCL2+
 KOH

KCL
 FECL3-
 MNCL2
 MNCL2+
 MGCL+

KCO3-
 FECL4--
 MNCL3-
 MNCL3

SWITCHING CO3--

FROM THE BASIS FOR HCO3-

1.000 HCO3-
 ==
 1.000 H+ LOG K = -10.3281
 + 1.000 CO3--
 1.000 CO3--
 + 1.000 H+ LOG K = 10.3281
 ==
 1.000 HCO3-

SWITCHING U++++

FROM THE BASIS FOR UO2++

1.000 UO2++
 + 2.000 H+ LOG K = -32.3246
 ==
 1.000 H2O
 + 1.000 U++++
 + .500 O2(G)
 1.000 U++++
 + 1.000 H2O
 + .500 O2(G) LOG K = 32.3246
 ==
 2.000 H+
 + 1.000 UO2++

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SPECIES	CSP	JFLAG	TYPE OF INPUT	UPHASE
NA+	.24315E-02	0	TOT CONC, MOLAL	
K+	.12277E-03	0	TOT CONC, MOLAL	
CA++	.31437E-02	0	TOT CONC, MOLAL	
MG++	.25715E-02	0	TOT CONC, MOLAL	
AL+++	.18531E-05	0	TOT CONC, MOLAL	
SI(O2(AQ))	.56587E-03	0	TOT CONC, MOLAL	
SR++	.20543E-04	0	TOT CONC, MOLAL	
ZN++	.61181E-07	0	TOT CONC, MOLAL	
H+	-.78000E+01	16	LOG ACTIVITY	
HCO3-	.51789E-02	0	TOT CONC, MOLAL	
CL-	.14667E-02	0	TOT CONC, MOLAL	
SO4--	.33834E-02	0	TOT CONC, MOLAL	
MN++	.58247E-06	0	TOT CONC, MOLAL	
FE++	.71624E-07	0	TOT CONC, MOLAL	
UO2++	.42012E-08	0	TOT CONC, MOLAL	
HPO4--	.12503E-04	0	TOT CONC, MOLAL	
O2(AQ)			NOT PRESENT IN THE MODEL	
H2(AQ)	0.	27	DEPENDENT SPECIES	
CH4(AQ)			NOT PRESENT IN THE MODEL	

U++	0.	30	ELIMINATED SPECIES
HS-	0.	30	ELIMINATED SPECIES
MN+++			NOT PRESENT IN THE MODEL
FC++	0.	30	ELIMINATED SPECIES
U+++	0.	30	ELIMINATED SPECIES
UO2+	0.	30	ELIMINATED SPECIES
H2PO4-	0.	30	ELIMINATED SPECIES
CO3--	0.	30	ELIMINATED SPECIES
OH-	0.	30	ELIMINATED SPECIES

THE ION FOR ESTIMATING WATER ACTIVITY IS NA+

ITER = 0	DELMAX = 0.	DEL() = 0.	BETA(XI) = .850E+01	DELFNC = 0.
ITER = 1	DELMAX = .442E+01	DEL(XI) = .552E+00	BETA(XI) = .172E+01	DELFNC = 0.
ITER = 2	DELMAX = .586E+00	DEL(XI) = .586E+00	BETA(XI) = -.383E+00	DELFNC = .867E+00
ITER = 3	DELMAX = .186E+00	DEL(XI) = -.186E+00	BETA(XI) = -.120E+00	DELFNC = .682E+00
ITER = 4	DELMAX = .549E-01	DEL(XI) = -.549E-01	BETA(XI) = -.864E-02	DELFNC = .705E+00
ITER = 5	DELMAX = .411E-02	DEL(XI) = -.411E-02	BETA(AL+++) = -.370E-03	DELFNC = .925E+00
ITER = 6	DELMAX = .815E-04	DEL(MN++) = -.815E-04	BETA(AL+++) = -.272E-05	DELFNC = .980E+00
ITER = 7	DELMAX = .628E-06	DEL(MN++) = -.628E-06	BETA(AL+++) = -.820E-08	DELFNC = .992E+00
ITER = 8	DELMAX = .184E-08	DEL(MN++) = -.184E-08	BETA(AL+++) = -.236E-10	DELFNC = .997E+00
ITER = 9	DELMAX = .532E-11	DEL(MN++) = -.532E-11	BETA(UO2+) = -.158E-12	DELFNC = .997E+00

NEWTON-RAPHSON ITERATION CONVERGED IN 9 STEPS

----- SUMMARY OF THE AQUEOUS PHASE -----

----- ELEMENTAL COMPOSITION OF THE AQUEOUS PHASE -----

ELEMENT	MG/L	MG/KG	MOLES/KG
O	888599.9545	883599.9545	.5553957989E+02
NA	55.8994	55.8994	.2431491953E-02
K	4.8000	4.8000	.1227684281E-03
CA	126.0000	126.0000	.3143712575E-02
MG	62.5000	62.5000	.2571487348E-02
AL	.0500	.0500	.1853087243E-05
SI	15.8929	15.8929	.5658744424E-03
SR	1.8000	1.8000	.2054325496E-04
ZN	.0040	.0040	.6118078923E-07
H	111900.9959	111900.9959	.1110239071E+03
C	62.2036	62.2036	.5178884573E-02
CL	52.0000	52.0000	.1466730601E-02
S	108.4709	108.4709	.3383372546E-02
MN	.0320	.0320	.5824747898E-06
FE	.0040	.0040	.7162425914E-07
U	.0010	.0010	.4201168765E-08
P	.3873	.3873	.1250273497E-04

--- ELEMENTAL COMPOSITION AS STRICT BASIS SPECIES -----

SPECIES	MG/L	MG/KG	MOLES/KG
H2O	1000545.5318	1000545.5318	.5553957989E+02
NA+	55.9000	55.9000	.2431491953E-02
K+	4.8000	4.8000	.1227684281E-03
CA++	126.0000	126.0000	.3143712575E-02
MG++	62.5000	62.5000	.2571487348E-02
AL+++	.0500	.0500	.1853087243E-05
SiO2(A	34.0000	34.0000	.5658744424E-03
SR++	1.8000	1.8000	.2054325496E-04
ZN++	.0040	.0040	.6118078923E-07
H+	111912.0983	111912.0983	.1110239071E+03
CO3--	310.7797	310.7797	.5178884573E-02
CL-	52.0000	52.0000	.1466730601E-02
SO4--	325.0000	325.0000	.3383372546E-02
MN++	.0320	.0320	.5824747898E-06
FE++	.0040	.0040	.7162425914E-07
U++++	.0010	.0010	.4201168765E-08
HPO4--	1.2000	1.2000	.1250273497E-04

----- EQUIVALENT COMPOSITION OF THE AQUEOUS PHASE -----

SPECIES	MOLES/KG H2O
H2O	.5553957989E+02
NA+	.2431491953E-02
K+	.1227684281E-03
CA++	.3143712575E-02
MG++	.2571487348E-02
AL+++	.1853087243E-05
SiO2(AQ)	.5658744424E-03
SR++	.2054325496E-04
ZN++	.6118078923E-07
H+	.1110239071E+03
HCO3-	.5178884573E-02
CL-	.1466730601E-02
SO4--	.3383372546E-02
MN++	.5824747898E-06
FE++	.7162425914E-07
UO2++	.4201168765E-08
HPO4--	.1250273497E-04

IONIC STRENGTH = .0190039611102
 EQUIV. STOICH. IONIC STRENGTH (NA+) = .0024314919530

PH = 7.80000
 ACTIVITY OF WATER = .99991
 LOG ACTIVITY OF WATER = -.00004
 TITRATION ALKALINITY = .51187E-02 EQ/KG H2O

----- ELECTRICAL IMBALANCE -----

THE CALCULATED IMBALANCE IS .65518E-03 EQUIV/KG H2O
 THIS IS 3.45 PER CENT OF THE IONIC STRENGTH

----- ACTIVITY RATIOS OF CATIONS -----

LOG (NA+ /H+*1)	5.1237
LOG (K+ /H+*1)	3.8235
LOG (CA++ /H+*2)	12.7817
LOG (MG++ /H+*2)	12.7225
LOG (AL+++ /H+*3)	9.5397
LOG (SR++ /H+*2)	10.6841
LOG (ZN++ /H+*2)	8.0824
LOG (MN++ /H+*2)	7.7487
LOG (FE++ /H+*2)	-1.5186
LOG (U+++ /H+*4)	-34.3083
LOG (U+++ /H+*3)	-64.4319
LOG (FE+++ /H+*3)	6.7940
LOG (UO2++ /H+*2)	- .8883
LOG (UO2+ /H+*1)	-19.4308

----- DISTRIBUTION OF AQUEOUS SPECIES -----

SPECIES	MOLAL CONC	LOG CONC	LOG G	ACTIVITY	LOG ACT
NA+	.2412E-02	-2.6176	-.0587	.2107E-02	-2.6763
K+	.1215E-03	-3.9155	-.0610	.1056E-03	-3.9765
CA++	.2522E-02	-2.5983	-.2200	.1520E-02	-2.8183
MG++	.2128E-02	-2.6721	-.2054	.1326E-02	-2.8775
AL+++	.3871E-13	-13.4121	-.4481	.1380E-13	-13.8603
SiO2(AQ)	.5551E-03	-3.2556	0.0000	.5551E-03	-3.2556
SR++	.2053E-04	-4.6877	-.2282	.1214E-04	-4.9159
ZN++	.5040E-07	-7.2975	-.2200	.3037E-07	-7.5176
H+	.1775E-07	-7.7509	-.0491	.1585E-07	-7.8000
HCO3-	.4760E-02	-2.3224	-.0575	.4169E-02	-2.3799
CL-	.1466E-02	-2.8337	-.0610	.1274E-02	-2.8948
SO4--	.2555E-02	-2.5926	-.2370	.1481E-02	-2.8295
MN++	.2337E-07	-7.6313	-.2200	.1408E-07	-7.8513
FE++	.1263E-16	-16.8985	-.2200	.7611E-17	-17.1186
UO2++	.5494E-16	-16.2601	-.2282	.3249E-16	-16.4883
HP04--	.5018E-05	-5.2995	-.2370	.2908E-05	-5.5364
H2(AQ)	.1734E-45	-45.7610	.0021	.1742E-45	-45.7589
U+++	.4132E-87	-87.3838	-.4481	.1473E-87	-87.8319
HS-	.3149-147	-147.5018	-.0598	.2744-147	-147.5617
FE+++	.6952E-16	-16.1579	-.4481	.2477E-16	-16.6060
U++++	.1741E-64	-64.7592	-.7491	.3102E-65	-65.5083
UO2+	.6727E-27	-27.1722	-.0587	.5877E-27	-27.2308
H2PO4-	.8461E-06	-6.0726	-.0587	.7392E-06	-6.1312
CO3--	.2111E-04	-4.6755	-.2325	.1236E-04	-4.9080
OH-	.7454E-06	-6.1276	-.0598	.6495E-06	-6.1874
AL(OH)++	.2721E-10	-10.5652	-.2200	.1640E-10	-10.7853
AL(OH)4-	.1853E-05	-5.7321	-.0587	.1619E-05	-5.7908
KSO4-	.1277E-05	-5.8938	-.0598	.1113E-05	-5.9536
NaCl	.3284E-06	-6.4836	0.0000	.3284E-06	-6.4836
NaCO3-	.2714E-06	-6.5664	-.0575	.2377E-06	-6.6240
NaSO4-	.1870E-04	-4.7281	-.0580	.1636E-04	-4.7861
CACO3	.2964E-04	-4.5281	0.0000	.2964E-04	-4.5281
CAHCO3+	.1282E-03	-3.8921	-.0560	.1127E-03	-3.9481
CASO4	.4609E-03	-3.3364	0.0000	.4609E-03	-3.3364
MGCO3	.1569E-04	-4.8043	0.0000	.1569E-04	-4.8043
MGHCO3+	.7719E-04	-4.1125	-.0587	.6744E-04	-4.1711
MGSO4	.3472E-03	-3.4594	0.0000	.3472E-03	-3.4594
FES04	.1994E-17	-17.7003	0.0000	.1994E-17	-17.7003

FECL++	.1297E-17	-17.8869	-2370	.7518E-18	-18.1239
FECL2+	.2047E-21	-21.6888	-0587	.1789E-21	-21.7475
FECL3	.6913E-24	-24.1603	0.0000	.6913E-24	-24.1603
FECL4-	.1250E-28	-28.9029	-0587	.1092E-28	-28.9616
FES04+	.3461E-15	-15.4609	-0587	.3023E-15	-15.5195
MNS04	.3689E-08	-8.4331	0.0000	.3689E-08	-8.4331
ZNCL+	.1223E-09	-9.9126	-0587	.1068E-09	-9.9713
ZNCL2	.2083E-12	-12.6812	0.0000	.2083E-12	-12.6812
ZNCL3--	.2476E-15	-15.6063	-0587	.2163E-15	-15.6650
ZNCL4--	.2193E-18	-18.6590	-2370	.1271E-18	-18.8960
ZNS04	.1047E-07	-7.9799	0.0000	.1047E-07	-7.9799
H3S104-	.1078E-04	-4.9675	-0587	.9416E-05	-5.0261
ALSO4+	.2445E-13	-13.6117	-0587	.2136E-13	-13.6703
HSO4-	.2718E-08	-8.5658	-0587	.2374E-08	-8.6245
S--	.1993-156	-156.7004	-2282	.1179-156	-156.9286
H2S(AQ)	.4159-148	-148.3811	0.0000	.4159-148	-148.3811
H2CO3	.1463E-03	-3.8346	.0021	.1471E-03	-3.8325
HCL	.1484E-16	-16.8287	0.0000	.1484E-16	-16.8287
MG(OH)+	.1610E-06	-6.7931	-0587	.1407E-06	-6.8518
FE(OH)+	.2841E-17	-17.5465	-0587	.2482E-17	-17.6051
CA(OH)+	.2834E-07	-7.5476	-0587	.2476E-07	-7.6062
FE(OH)++	.1755E-10	-10.7558	-2370	.1017E-10	-10.9928
FE(OH)2+	.8087E-08	-8.0922	-0587	.7065E-08	-8.1509
FE(OH)3-	.2499E-25	-25.6022	-0587	.2183E-25	-25.6609
FE(OH)4-	.6352E-07	-7.1971	-0587	.5549E-07	-7.2558
NAOH	.2731E-09	-9.5637	0.0000	.2731E-09	-9.5637
(FECH++)2	.3149E-19	-19.5018	-9502	.3532E-20	-20.4520
MN(OH)+	.2642E-10	-10.5780	-0587	.2309E-10	-10.6367
MNCO3	.5552E-06	-6.2555	0.0000	.5552E-06	-6.2555
UCL+++	.2477E-66	-66.6060	-4630	.8530E-67	-67.0691
U(OH)+++	.1281E-57	-57.8924	-4630	.4411E-58	-58.3554
U(OH)2++	.1183E-51	-51.9272	-2282	.6993E-52	-52.1554
U(OH)3+	.1194E-46	-46.9229	-0587	.1043E-46	-46.9816
U(OH)4	.1466E-42	-42.8339	0.0000	.1466E-42	-42.8339
U(OH)5-	.2627E-39	-39.5805	-0587	.2295E-39	-39.6392
U6(OH)15(9+)	0.	-289.4377	-3.7953	0.	-293.2330
US04++	.2244E-62	-62.6489	-2282	.1327E-62	-62.8771
U(S04)2	.3814E-61	-61.4186	0.0000	.3814E-61	-61.4186
U(HPO4)++	.1601E-58	-58.7956	-2282	.9466E-59	-59.0238
U(HPO4)2	.3032E-54	-54.5183	0.0000	.3032E-54	-54.5183
U(HPO4)3--	.6784E-51	-51.1685	-2370	.3931E-51	-51.4055
U(HPO4)4----	.1178E-47	-47.9289	-9502	.1321E-48	-48.8791
UO2(OH)+	.3912E-14	-14.4076	-0587	.3417E-14	-14.4663
UO2(OH)2	.1293E-12	-12.8883	0.0000	.1293E-12	-12.8883
(UO2)2(OH)2++	.1677E-22	-22.7754	-2200	.1011E-22	-22.9954
(UO2)3(OH)5+	.9304E-26	-26.0313	-0565	.8170E-26	-26.0878
(UO2)3(OH)7-	.1562E-25	-25.8064	-0587	.1364E-25	-25.8651
UO2CL+	.8132E-19	-19.0898	-0587	.7105E-19	-19.1484
UO2CO3	.5055E-11	-11.2963	0.0000	.5055E-11	-11.2963
UO2(CO3)2--	.8563E-09	-9.0674	-2370	.4962E-09	-9.3044
UO2(CO3)3----	.1373E-08	-8.8622	-9502	.1540E-09	-9.8124
UO2S04	.2525E-16	-16.5978	0.0000	.2525E-16	-16.5978
UO2(S04)2--	.1948E-17	-17.7103	-2370	.1129E-17	-17.9473
UO2(HPO4)	.2539E-13	-13.5354	0.0000	.2539E-13	-13.5954
UO2(HPO4)2--	.1966E-08	-8.7064	-2370	.1139E-08	-8.9433
UO2(H2PO4)+	.2927E-19	-19.5336	-0587	.2557E-19	-19.5923
UO2(H2PO4)2	.5217E-23	-23.2825	0.0000	.5217E-23	-23.2826
UO2(H2PO4)3-	.2252E-27	-27.6474	-0587	.1968E-27	-27.7060
UO2S10(OH)3+	.5134E-14	-14.2895	-0587	.4486E-14	-14.3482
P04----	.2987E-09	-9.5248	-5341	.8731E-10	-10.0590

H3PO4	.1658E-11	-11.7804	0.0000	.1658E-11	-11.7804
MGP04-	.3872E-06	-6.4120	-.0587	.3383E-06	-6.4707
CAP04-	.4472E-06	-6.3495	-.0587	.3907E-06	-6.4081
SRP04-	.3936E-09	-9.4050	-.0587	.3439E-09	-9.4636
FEP04-	.1965E-19	-19.7066	-.0587	.1717E-19	-19.7653
MNP04-	.2193E-11	-11.6590	-.0587	.1916E-11	-11.7176
ZNP04-	.6994E-11	-11.1552	-.0587	.6111E-11	-11.2139
NAHP04-	.9963E-07	-7.0016	-.0587	.8704E-07	-7.0603
KHP04-	.3901E-08	-8.4089	-.0587	.3408E-08	-8.4675
MGHP04	.3135E-05	-5.5038	0.0000	.3135E-05	-5.5038
CAHP04	.2508E-05	-5.6007	0.0000	.2508E-05	-5.6007
SRHP04	.1610E-07	-7.7932	0.0000	.1610E-07	-7.7932
FEHP04	.8792E-19	-19.0559	0.0000	.8792E-19	-19.0559
MNHP04	.1556E-09	-9.8079	0.0000	.1556E-09	-9.8079
ZNHP04	.1720E-09	-9.7644	0.0000	.1720E-09	-9.7644
ALHP04+	.1530E-11	-11.8154	-.0587	.1336E-11	-11.8740
ALHP04+	.2890E-11	-11.5390	-.0587	.2525E-11	-11.5977
MGH2PO4+	.3698E-07	-7.4320	-.0587	.3231E-07	-7.4906
SRH2PO4+	.6038E-10	-10.2191	-.0587	.5275E-10	-10.2777
FEH2PO4+	.3225E-20	-20.4915	-.0587	.2817E-20	-20.5502
MNH2PO4+	.3766E-12	-12.4242	-.0587	.3290E-12	-12.4828
ZNH2PO4+	.1287E-11	-11.8903	-.0587	.1125E-11	-11.9490
FEH2PO4++	.8524E-18	-18.0693	-.2282	.5040E-18	-18.2975
ALH2PO4++	.3440E-16	-16.4634	-.2282	.2034E-16	-16.6916
P2O7----	.7625E-14	-14.1177	-.9502	.8552E-15	-15.0679
HP2O7----	.1190E-12	-12.9246	-.5341	.3478E-13	-13.4587
H2P2O7--	.4822E-14	-14.3167	-.2370	.2794E-14	-14.5537
H3P2O7-	.8075E-20	-20.0929	-.0587	.7055E-20	-20.1515
H4P2O7	.6733E-27	-27.1718	0.0000	.6733E-27	-27.1718

----- SUMMARY OF AQUEOUS REDOX REACTIONS -----

COUPLE	EH, VOLTS	PE-	LOG F02	AH, KCAL
DEFAULT	.800	.1352E+02	2.191	18.450
H2(AQ)/H2O	.800	.1352E+02	2.191	18.450
U+++ /UO2++	.800	.1352E+02	2.191	18.450
HS- /SO4--	.800	.1352E+02	2.191	18.450
FE+++ /FE++	.800	.1352E+02	2.191	18.450
U++++ /UO2++	.800	.1352E+02	2.191	18.450
UO2+ /UO2++	.800	.1352E+02	2.191	18.450

----- SUMMARY OF AQUEOUS NON-EQUILIBRIUM NON-REDOX REACTIONS -----

COUPLE	AFFINITY, KCAL
NONE	

----- SUMMARY OF STOICHIOMETRIC MINERAL SATURATION STATES -----

(MINERALS WITH AFFINITIES .LT. -10 KCAL ARE NOT LISTED)

MINERAL	LOG Q/K	AFF, KCAL	STATE
ANTIGORITE	16.0174615	21.8523870	SUPERSATURATED
PHENGITE	5.1062935	6.9664410	SUPERSATURATED
MAGNETITE	8.2422806	11.2448222	SUPERSATURATED

CORUNDUM	-2.3044667	-3.1439500	
HEMATITE	17.9098722	24.4341758	SUPERSATURATED
DEHYDRATED ANALC	-3.8358775	-5.2332312	
BRUCITE	-3.7163357	-5.0701420	
GIBBSITE	1.5793106	2.1546302	SUPERSATURATED
HALITE	-7.1800350	-9.7956161	
REYKJANES SMECTI	7.7090319	10.5173188	SUPERSATURATED
CALCITE	.7985642	1.0894694	SUPERSATURATED
MAGNESITE	.1221956	.1667097	APPROX. SATURATED
RHODOCHROSITE	-2.2223358	-3.0319000	
DOLOMITE	2.5494599	3.4781906	SUPERSATURATED
ANHYDRITE	-1.3824141	-1.8860073	
GYPSUM	-1.7978889	-1.0885481	
QUARTZ	.7436687	1.0145763	SUPERSATURATED
MAXIMUM MICROCLI	3.5130604	4.7928166	SUPERSATURATED
LOW ALBITE	1.7991913	2.4546102	SUPERSATURATED
ANORTHITE	-1.7128588	-2.3368281	
SEPIOLITE	.3522577	.4805800	APPROX. SATURATED
14A-AMESITE	5.2743615	7.1957337	SUPERSATURATED
NEPHELINE	-2.7257462	-3.7186955	
ANALCIME	.8720851	1.1897729	SUPERSATURATED
KAOCLINITE	5.1387960	7.0107838	SUPERSATURATED
CHRYSOTILE	.1073679	.1464805	APPROX. SATURATED
PYROPHYLLITE	4.9968709	6.8171574	SUPERSATURATED
TALC	3.5821428	4.8870647	SUPERSATURATED
NA-BEIDELLITE	5.5927463	7.6301014	SUPERSATURATED
MUSCOVITE	8.1110563	11.0657947	SUPERSATURATED
ILLITE	6.2176044	8.4825862	SUPERSATURATED
ARTINITE	-4.6554522	-6.3513649	
TREMOLITE	1.4592620	1.9908496	SUPERSATURATED
ENSTATITE	-2.0019295	-2.7312030	
DIOPSIDE	-1.9765904	-2.6966332	
WOLLASTONITE	-4.0977609	-5.5905149	
ZOISITE	.4557282	.6217433	SUPERSATURATED
KYANITE	-.4715980	-.6433942	
FORSTERITE	-5.9570278	-8.1270853	
PREHNITE	1.5983429	2.1805957	SUPERSATURATED
HUNTITE	-.5678489	-.7747079	
AMORPHOUS SILICA	-.5420313	-.7394853	
PHLOGOPITE	3.5407282	4.8305633	SUPERSATURATED
ANHYDROUS CORDIE	-6.5042862	-8.8737019	
K-FELDSPAR	3.5130604	4.7928166	SUPERSATURATED
HIGH SANIDINE	2.3138604	3.1567657	SUPERSATURATED
HIGH ALBITE	.4804913	.6555272	SUPERSATURATED
HYDROUS CORDIERI	-4.0233236	-5.4889611	
STRONTIANITE	1.6036853	2.1878842	SUPERSATURATED
K-BEIDELLITE	5.4936701	7.4949332	SUPERSATURATED
CA-BEIDELLITE	6.0699948	8.2812046	SUPERSATURATED
MG-BEIDELLITE	6.0786320	8.2929882	SUPERSATURATED
H-BEIDELLITE	4.9214130	6.7142114	SUPERSATURATED
CELESTITE	-1.3139931	-1.7926615	
ARAGONITE	.6335642	.8643624	SUPERSATURATED
NA-SAPONITE	4.1779182	5.6998723	SUPERSATURATED
K-SAPONITE	4.0788420	5.5647041	SUPERSATURATED
CLINOZOISITE	.5004282	.6827269	SUPERSATURATED
PARAGONITE	5.5006872	7.5045065	SUPERSATURATED
SPINEL	-6.5908650	-8.9918201	
DIASPORE	.7879480	1.0749858	SUPERSATURATED
CA-SAPONITE	4.6552667	6.3511119	SUPERSATURATED
BOEHMITE	-.0564520	-.0770167	APPROX. SATURATED

CHALCEDONY	.4724687	.6445822	SUPERSATURATED
MG-SAPONITE	4.6639039	6.3628954	SUPERSATURATED
ALUNITE	-5.0780937	-6.9279685	
7A-CLINOCHLORE	.9860986	1.3453199	SUPERSATURATED
ANDALUSITE	-.7464930	-1.0184362	
H-SAPONITE	3.5171849	4.7984436	SUPERSATURATED
14A-CLINOCHLORE	4.3593986	5.9474634	SUPERSATURATED
SMITHSONITE	-2.5330231	-3.4557662	
ANTHOPHYLLITE	-4.7759753	-6.5157928	
NA-NONTRONITE	22.3267858	30.4601052	SUPERSATURATED
K-NONTRONITE	22.2277096	30.3249370	SUPERSATURATED
GROSSULAR	-4.4765494	-6.1072904	
ALBITE	1.7991913	2.4546102	SUPERSATURATED
ORDERED EPIDOTE	10.6079980	14.4723355	SUPERSATURATED
ANDRADITE	13.6714901	18.6518127	SUPERSATURATED
CA-NONTRONITE	22.8040343	31.1112083	SUPERSATURATED
MG-NONTRONITE	22.8126715	31.1229919	SUPERSATURATED
H-NONTRONITE	21.6569525	29.5462615	SUPERSATURATED
CRISTOBALITE	.1931687	.2635373	APPROX. SATURATED
DISORDERED DOLOM	1.0049599	1.3710519	SUPERSATURATED
ORDERED DOLOMITE	2.5494599	3.4781906	SUPERSATURATED
NESQUEHONITE	-2.5767166	-3.5153765	
EPIDOTE	10.6079980	14.4723355	SUPERSATURATED
PD-OXYANNITE	30.9441883	42.2167005	SUPERSATURATED
WAIRAKITE	.2798039	.3817323	APPROX. SATURATED
LAUMONTITE	4.6913291	6.4003112	SUPERSATURATED
MARGARITE	2.2584371	3.0811525	SUPERSATURATED
SILLIMANITE	-1.1055979	-1.5083510	
KALSILITE	-1.1495771	-1.5683511	
JADEITE	-.5695775	-.7770662	
BETA-UO2(OH)2	-6.4231434	-8.7630000	
SCHOEPITE	-6.3270808	-8.6319432	
RUTHERFORDINE	-6.9363121	-9.4631085	
HYDROXYAPATITE	12.0224270	16.4020202	SUPERSATURATED
STRENGITE	-1.2052071	-1.6442463	
MNHPO4(C)	-.4425170	-.6037195	
BERLINITE	35.8942979	48.9700623	SUPERSATURATED
WHITLOCKITE	5.9726737	8.1484308	SUPERSATURATED
CAHPO4.2H2O	-1.7974918	-2.4522916	
SRHPO4(C)	-3.4522960	-4.7099166	

6 APPROX. SATURATED PURE MINERALS
0 APPROX. SATURATED END-MEMBERS OF SPECIFIED SOLID SOLUTIONS
0 SATURATED END-MEMBERS OF HYPOTHETICAL SOLID SOLUTIONS

60 SUPERSATURATED PURE MINERALS
0 SUPERSATD. END-MEMBERS OF SPECIFIED SOLID SOLUTIONS
0 SUPERSATD. HYPOTHETICAL SOLID SOLUTION PHASES

----- SUMMARY OF GASES -----

GAS	FUGACITY	LOG FUGACITY
CO2(G)	.451434E-02	-2.34541
O2(G)	.155208E+03	2.19091

S2(G)	0.	-235.10526
CH4(G)	.921278-150	-150.03561
H2(G)	.225479E-42	-42.64689
H2S(G)	.421842-147	-147.37485
STEAM	.313085E-01	-1.50434

----- END OF OUTPUT -----
 ----- END OF INPUT FILE -----

UTITL
CLIMAX GROUND WATER
AVERAGES OF BOREHOLE AND COLES COLLECTOR
BASED ON JACK HARRAR'S MEMO OF 1/20/82
TEMPERATURE NOT REPORTED, 25 DEG C ASSUMED

TEMPC

.250000E+02

RHO

0.

TDS1

0.

TDS2

0.

F02/EH/PE

.410000E+00

COUPLE

O2(AQ)

TOLBT

0.

TOLDL

0.

TOLSAT

0.

ITERMX

0

LOPT

-1

2

3

4

5

6

7

8

9

1PRNT

-1

2

3

4

5

6

7

8

9

IDBUG

1

2

3

4

5

6

7

8

9

UEBAL

1

0

0

1

0

0

0

0

0

SUPPRESSED/ALTERED SPECIES (AQ,MIN,GAS,SOL)

0

0

0

0

NA+

.25000E+03

2

K+

.34000E+01

22

CA++

.28300E+03

22

MG++

.88000E+00

22

AL+++

.30000E-01

22

SiO2(AQ)

.15800E+02

22

SR++

.56000E+01

22

ZN++

.50000E-02

22

H+

.73000E+01

16

HCO3-

CO3--

0.

30

CL-

.77000E+02

2

SO4--

.10600E+04

22

F-

.86000E+00

22

MN++

.49000E+00

22

FE++

.60000E-02

22

UO2++

U++++

.16500E+01

22

O2(G)

0.

0

O2(AQ)

.20000E-01

4

H2(AQ)

0.

27

HCO3-

.16300E+03

2

ENDIT.

FILE DATA1 HAS BEEN SUCCESSFULLY READ

----- CONFLICTING INPUT OPTIONS FOR F02 -----

LOPT1 = -1 OVERRIDES UREDOX = O2(AQ)

```

EEEE  QQQ  3333
E     Q  Q  3
EEEE  Q  Q  33
E     Q  Q  3
EEEE  QQQ  3333
      Q

```

3230 VERSION

CLIMAX GROUND WATER
 AVERAGES OF BOREHOLE AND COLES COLLECTOR
 BASED ON JACK HARRAR'S MEMO OF 1/20/82
 TEMPERATURE NOT REPORTED, 25 DEG C ASSUMED

DATA FILE SET DEQPAK9
 SUPPORTING DATA FOR PROGRAMS EQ3 AND EQ6
 1 ATM.-STEAM SATURATION CURVE DATA
 LAST REVISED 20 NOVEMBER 1981

THE TOTAL PRESSURE IS 1.0134 BARS
 THE TEMPERATURE IS 25.00 DEGREES CELSIUS

29 ELEMENTS ARE IN THE DATA BASE
 40 ELEMENTS CAN BE LOADED INTO MEMORY
 17 ELEMENTS ARE IN THE PROBLEM SYSTEM

161 AQUEOUS SPECIES WERE LOADED INTO MEMORY
 300 AQUEOUS SPECIES CAN BE LOADED INTO MEMORY
 131 AQUEOUS REACTIONS WERE LOADED INTO MEMORY
 259 AQUEOUS REACTIONS CAN BE LOADED INTO MEMORY

144 MINERALS WERE LOADED INTO MEMORY
 275 MINERALS CAN BE LOADED INTO MEMORY
 12 SOLID SOLUTIONS ARE IN THE DATA BASE
 20 SOLID SOLUTIONS CAN BE LOADED INTO MEMORY
 7 GASES WERE LOADED INTO MEMORY
 15 GASES CAN BE LOADED INTO MEMORY

IOPT1 = -1 (REDOX OPTION SWITCH)
 IOPT2 = 0 (AUTOMATIC BASIS SWITCHING SWITCH)
 IOPT3 = 0 (INTERFACING OUTPUT CONTROL SWITCH)
 IOPT4 = 0 (TURN-ON SOLID SOLUTIONS SWITCH)
 IOPT5 = 0 (NOT CURRENTLY USED)
 IOPT6 = 0 (NOT CURRENTLY USED)
 IOPT7 = 0 (TURN OFF LUREFF CALLS SWITCH)
 IOPT8 = 0 (CONV. TEST CRITERIA SWITCH)
 IOPT9 = 3 (MAXIMUM PTS. USED IN FIND ROUTINE)

```

IPRNT1 = -1 (LIST LOADING OF SPECIES)
IPRNT2 = 0 (LIST REACTIONS AND LOG K VALUES)
IPRNT3 = 0 (NOT CURRENTLY USED)
IPRNT4 = 0 (SPECIATION PRINT CONTROL)
IPRNT5 = 0 (NOT CURRENTLY USED)
IPRNT6 = 0 (NOT CURRENTLY USED)
IPRNT7 = 0 (MINERAL AFFINITY PRINT CONTROL)

IDBUG1 = 1 (PRINT INFO. MESSAGES SWITCH)
IDBUG2 = 0 (PRINT DATA1 READ INFO. SWITCH)
IDBUG3 = 0 (NOT CURRENTLY USED)
IDBUG4 = 1 (PRINT NEWTON-RAPHSON ITERATIONS SWITCH)
IDBUG5 = 0 (NOT CURRENTLY USED)
IDBUG6 = 0 (LIST STOICH. EQUIVALENCES SWITCH)
IDBUG7 = 0 (WRITE REACTIONS ON RFILE SWITCH)

```

THE DEFAULT REDOX STATE IS CONSTRAINED BY EH = .41000 VOLTS

```

SOLUTION DENSITY = 1.00000 G/ML
TOTAL DISSOLVED SALTS = 0.00 MG/KG SOLUTION
TOTAL DISSOLVED SALTS = 0.00 MG/L

```

```

TOLBT = .10000E-09 (CONVERGENCE TOLERANCE ON RESIDUAL FUNCTIONS)
TOLDL = .10000E-09 (CONVERGENCE TOLERANCE ON CORRECTION TERMS)
TOLSAT = .50000E+00 (PHASE SATURATION TOLERANCE, DOES NOT AFFECT
                     CONVERGENCE)

```

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----- INPUT CONSTRAINTS -----

SPECIES	CSP	JFLAG	TYPE OF INPUT	UPHASE	BASIS SPECIES
NA+	.25000E+03	2	TOT CONC, MG/L		
K+	.34000E+01	2	TOT CONC, MG/L		
CA++	.28300E+03	2	TOT CONC, MG/L		
MG++	.68000E+00	2	TOT CONC, MG/L		
AL+++	.30000E-01	2	TOT CONC, MG/L		
SiO2(AQ)	.15800E+02	2	TOT CONC, MG/L		
SR++	.56000E+01	2	TOT CONC, MG/L		
ZN++	.50000E-02	2	TOT CONC, MG/L		
H+	.73000E+01	16	LOG ACTIVITY		
CO3--	0.	30	ELIMINATED SPECIES		HC03-
CL-	.77000E+02	2	TOT CONC, MG/L		
SO4--	.10600E+04	2	TOT CONC, MG/L		
F-	.86000E+00	2	TOT CONC, MG/L		
MN++	.49000E+00	2	TOT CONC, MG/L		
FE++	.60000E-02	2	TOT CONC, MG/L		
U++++	.16500E+01	2	TOT CONC, MG/L		UO2++
O2(AQ)	.20000E-01	4	FREE CONC, MOLAL		
H2(AQ)	0.	27	DEPENDENT SPECIES		
HC03-	.16300E+03	2	TOT CONC, MG/L		CO3--

----- INACTIVE AQUEOUS SPECIES -----

CH4(AQ)
 FECL+
 FE(SO4)2-
 MNCL4--
 MNCL4-

MN+++
 FECL2
 MNCL+
 MNCL++
 KOH

KCL
 FECL3-
 MNCL2
 MNCL2+
 MGCL+

KCO3-
 FECL4--
 MNCL3-
 MNCL3

SWITCHING CO3--

FROM THE BASIS FOR HCO3-

1.000 HCO3-
 ==
 LOG K = -10.3281
 + 1.000 H+
 1.000 CO3--
 1.000 CO3--
 + 1.000 H+
 ==
 LOG K = 10.3281
 1.000 HCO3-

SWITCHING U++++

FROM THE BASIS FOR UO2++

1.000 UO2++
 + 2.000 H+
 ==
 LOG K = -32.3245
 1.000 H2O
 + 1.000 U++++
 + .500 O2(G)
 1.000 U++++
 + 1.000 H2O
 + .500 O2(G)
 ==
 LOG K = 32.3246
 2.000 H+
 + 1.000 UO2++

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SPECIES	CSP	JFLAG	TYPE OF INPUT	UPHASE
NA+	.10874E-01	0	TOT CONC, MOLAL	
K+	.86961E-04	0	TOT CONC, MOLAL	
CA++	.70609E-02	0	TOT CONC, MOLAL	
MG++	.36207E-04	0	TOT CONC, MOLAL	
AL+++	.11119E-05	0	TOT CONC, MOLAL	
SIO2(AQ)	.26297E-03	0	TOT CONC, MOLAL	
SR++	.63912E-04	0	TOT CONC, MOLAL	
ZN++	.76476E-07	0	TOT CONC, MOLAL	
H+	-.73000E+01	16	LOG ACTIVITY	
HCO3-	.26714E-02	0	TOT CONC, MOLAL	
CL-	.21719E-02	0	TOT CONC, MOLAL	
SO4--	.11035E-01	0	TOT CONC, MOLAL	
F-	.45268E-04	0	TOT CONC, MOLAL	
MN++	.89191E-05	0	TOT CONC, MOLAL	
FE++	.10744E-06	0	TOT CONC, MOLAL	
UO2++	.69319E-05	0	TOT CONC, MOLAL	
O2(AQ)	.20000E-01	4	FREE CONC, MOLAL	
H2(AQ)	0.	27	DEPENDENT SPECIES	
CH4(AQ)			NOT PRESENT IN THE MODEL	

U+++	0.	30	ELIMINATED SPECIES
HS-	0.	30	ELIMINATED SPECIES
MN+++			NOT PRESENT IN THE MODEL
FE+++	0.	30	ELIMINATED SPECIES
U++++	0.	30	ELIMINATED SPECIES
UO2+	0.	30	ELIMINATED SPECIES
CO3--	0.	30	ELIMINATED SPECIES
OH-	0.	30	ELIMINATED SPECIES

THE ION FOR ESTIMATING WATER ACTIVITY IS NA+

----- ITERATION MATRIX STRUCTURE -----

1	1	H2O	DEFINING EQUATION
2	2	NA+	TOT CONC, MOLAL
3	3	K+	TOT CONC, MOLAL
4	4	CA++	TOT CONC, MOLAL
5	5	MG++	TOT CONC, MOLAL
6	6	AL+++	TOT CONC, MOLAL
7	7	SiO2(AQ)	TOT CONC, MOLAL
8	8	SR++	TOT CONC, MOLAL
9	9	ZN++	TOT CONC, MOLAL
10	13	H+	LOG ACTIVITY
11	14	HCO3-	TOT CONC, MOLAL
12	16	CL-	TOT CONC, MOLAL
13	17	SO4--	TOT CONC, MOLAL
14	18	F-	TOT CONC, MOLAL
15	21	MN++	TOT CONC, MOLAL
16	22	FE++	TOT CONC, MOLAL
17	25	UO2++	TOT CONC, MOLAL
18	30	O2(G)	EH
19	31	O2(AQ)	FREE CONC, MOLAL
20	0	EQ STO IONIC STR	DEFINING EQUATION
21	0	IONIC STRENGTH	DEFINING EQUATION

----- STRUCTURE FOR SIMULTANEOUS EVALUATION OF STARTING ESTIMATES -----

1	31	O2(G)	EH
---	----	-------	----

----- MATRIX -----

1.00

----- RIGHT-HAND-SIDE VECTOR -----

1	30	-.261801E+02
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----- ZLG1 VALUES -----

1 30 -26.1801

----- POSSIBLE BASIS SWITCHES -----

AL+++ COULD BE SWITCHED WITH AL(OH)4-
 UO2++ COULD BE SWITCHED WITH (UO2)3(OH)5+

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      DECREASING ZLG1( 6) FROM -5.9540 ... BETA( 6) WAS .56783E+06
      DECREASING ZLG1( 11) FROM -2.5733 ... BETA( 11) WAS .35451E+04
      DECREASING ZLG1( 14) FROM -4.3442 ... BETA( 14) WAS .26371E+03
      DECREASING ZLG1( 15) FROM -5.0497 ... BETA( 15) WAS .56477E+01
      DECREASING ZLG1( 16) FROM -6.9688 ... BETA( 16) WAS .32432E+02
      DECREASING ZLG1( 17) FROM -5.1591 ... BETA( 17) WAS .40236E+11
OPTIMIZING STARTING ESTIMATES ( 1)
      DECREASING ZLG1( 6) FROM -7.9540 ... BETA( 6) WAS .56303E+04
      INCREASING ZLG1( 11) FROM -4.5733 ... BETA( 11) WAS -.98638E+00
      INCREASING ZLG1( 14) FROM -5.3442 ... BETA( 14) WAS -.87098E+00
      INCREASING ZLG1( 15) FROM -6.0497 ... BETA( 15) WAS -.81036E+00
      DECREASING ZLG1( 17) FROM -7.8103 ... BETA( 17) WAS .44812E+03
OPTIMIZING STARTING ESTIMATES ( 2)
      DECREASING ZLG1( 6) FROM -9.9540 ... BETA( 6) WAS .55351E+02
      INCREASING ZLG1( 11) FROM -4.0733 ... BETA( 11) WAS -.96121E+00
      INCREASING ZLG1( 14) FROM -4.8442 ... BETA( 14) WAS -.66141E+00
      INCREASING ZLG1( 15) FROM -5.5497 ... BETA( 15) WAS -.36744E+00
      INCREASING ZLG1( 17) FROM -8.8103 ... BETA( 17) WAS -.23525E+00
OPTIMIZING STARTING ESTIMATES ( 3)
      INCREASING ZLG1( 11) FROM -3.5733 ... BETA( 11) WAS -.85635E+00
      DECREASING ZLG1( 17) FROM -8.3103 ... BETA( 17) WAS .18417E+02
OPTIMIZING STARTING ESTIMATES ( 4)
      INCREASING ZLG1( 11) FROM -3.0733 ... BETA( 11) WAS -.59629E+00
OPTIMIZING STARTING ESTIMATES ( 5)
      DECREASING ZLG1( 15) FROM -5.0497 ... BETA( 15) WAS .56477E+01
      DECREASING ZLG1( 17) FROM -9.3103 ... BETA( 17) WAS .44184E+02
OPTIMIZING STARTING ESTIMATES ( 6)
      INCREASING ZLG1( 15) FROM -6.0497 ... BETA( 15) WAS -.33523E+00
OPTIMIZING STARTING ESTIMATES ( 7)

```

ITER = 0	DELMAX = 0.	DEL(XI) = 0.	BETA(AL+++) = .468E+01	DELFNC = 0.
ITER = 1	DELMAX = .136E+01	DEL(XI) = .340E+00	BETA(AL+++) = .367E+01	DELFNC = 0.
ITER = 2	DELMAX = .252E+00	DEL(AL+++) = -.630E-01	BETA(AL+++) = .285E+01	DELFNC = .815E+00
ITER = 3	DELMAX = .267E+00	DEL(AL+++) = -.668E-01	BETA(AL+++) = .219E+01	DELFNC = -.608E-01
ITER = 4	DELMAX = .261E+00	DEL(AL+++) = -.653E-01	BETA(AL+++) = .170E+01	DELFNC = .230E-01
ITER = 5	DELMAX = .246E+00	DEL(AL+++) = -.246E+00	BETA(AL+++) = .452E+00	DELFNC = .575E-01
ITER = 6	DELMAX = .135E+00	DEL(AL+++) = -.135E+00	BETA(AL+++) = .625E-01	DELFNC = .452E+00
ITER = 7	DELMAX = .260E-01	DEL(AL+++) = -.260E-01	BETA(AL+++) = .179E-02	DELFNC = .807E+00
ITER = 8	DELMAX = .781E-03	DEL(AL+++) = -.781E-03	BETA(AL+++) = .146E-05	DELFNC = .970E+00
ITER = 9	DELMAX = .685E-06	DEL(AL+++) = -.685E-06	BETA(AL+++) = -.954E-09	DELFNC = .999E+00
ITER = 10	DELMAX = .252E-09	DEL(UO2+) = -.252E-09	BETA(AL+++) = -.730E-11	DELFNC = .100E+01
ITER = 11	DELMAX = .180E-11	DEL(UO2+) = -.180E-11	BETA(O2(G)) = -.229E-12	DELFNC = .993E+00

NEWTON-RAPHSON ITERATION CONVERGED IN 11 STEPS

----- SUMMARY OF THE AQUEOUS PHASE -----

----- ELEMENTAL COMPOSITION OF THE AQUEOUS PHASE -----

ELEMENT	MG/L	MG/KG	MOLES/KG
O	889598.6398	889598.6398	.5560200007E+02
NA	249.9975	249.9975	.1087429317E-01
K	3.4000	3.4000	.8696096987E-04
CA	283.0000	283.0000	.7060878244E-02
MG	.8800	.8800	.3620654186E-04
AL	.0300	.0300	.1111852346E-05
SI	7.3855	7.3855	.2629651821E-03
SR	5.6000	5.6000	.6391234878E-04
ZN	.0050	.0050	.7647598654E-07
H	111898.5304	111898.5304	.1110214609E+03
C	32.0860	32.0860	.2671386663E-02
CL	77.0000	77.0000	.2171889544E-02
S	353.7821	353.7821	.1103499969E-01
F	.8600	.8600	.4526792294E-04
MN	.4900	.4900	.8919145218E-05
FE	.0060	.0060	.1074363887E-06
U	1.6500	1.6500	.6931928462E-05

----- ELEMENTAL COMPOSITION AS STRICT BASIS SPECIES -----

SPECIES	MG/L	MG/KG	MOLES/KG
H2O	1001670.0312	1001670.0312	.5560200007E+02
NA+	250.0000	250.0000	.1087429317E-01
K+	3.4000	3.4000	.8696096987E-04
CA++	283.0000	283.0000	.7060878244E-02
MG++	.8800	.8800	.3620654186E-04
AL+++	.0300	.0300	.1111852346E-05
SiO2(A	15.8000	15.8000	.2629651821E-03
SR++	5.6000	5.6000	.6391234878E-04
ZN++	.0050	.0050	.7647598654E-07
H+	111909.6326	111909.6326	.1110214609E+03
CO3--	160.3072	160.3072	.2671386663E-02
CL-	77.0000	77.0000	.2171889544E-02
SO4--	1060.0000	1060.0000	.1103499969E-01
F-	.8600	.8600	.4526792294E-04
MN++	.4900	.4900	.8919145218E-05
FE++	.0060	.0060	.1074363887E-06
U++++	1.6500	1.6500	.6931928462E-05

----- EQUIVALENT COMPOSITION OF THE AQUEOUS PHASE -----

SPECIES	MOLES/KG H2O
H2O	.5560200007E+02
NA+	.1087429317E-01
K+	.8696096987E-04
CA++	.7060878244E-02
MG++	.3620654186E-04
AL+++	.1111852346E-05
SiO2(AQ)	.2629651821E-03

SR++ .6391234878E-04
 ZN++ .7647598654E-07
 H+ .1110214609E+03
 HCO3- .2671386663E-02
 CL- .2171889544E-02
 SO4-- .1103499969E-01
 F- .4526792294E-04
 MN++ .8919145218E-05
 FE++ .1074363887E-06
 UO2++ .6931928462E-05
 O2(AQ) .2000000000E-01

IONIC STRENGTH = .0346814491007
 EQUIV. STOICH. IONIC STRENGTH (NA+) = .0108742931709

PH = 7.30000
 ACTIVITY OF WATER = .99962
 LOG ACTIVITY OF WATER = -.00016
 TITRATION ALKALINITY = .24880E-02 EQ/KG H2O

----- ELECTRICAL IMBALANCE -----

THE CALCULATED IMBALANCE IS -.14625E-02 EQUIV/KG H2O
 THIS IS 4.22 PER CENT OF THE IONIC STRENGTH

----- ACTIVITY RATIOS OF CATIONS -----

LOG (NA+ /H**1) 5.2519
 LOG (K+ /H**1) 3.1477
 LOG (CA++ /H**2) 12.0006
 LOG (MG++ /H**2) 9.7472
 LOG (AL+++ /H**3) 9.7992
 LOG (SR++ /H**2) 10.1164
 LOG (ZN++ /H**2) 7.0227
 LOG (MN++ /H**2) 8.6206
 LOG (FE++ /H**2) 5.9049
 LOG (U++++ /H**4) -15.7755
 LOG (U+++ /H**3) -38.8065
 LOG (FE+++ /H**3) 7.1248
 LOG (UO2++ /H**2) 3.4589
 LOG (UO2+ /H**1) -7.9910

----- DISTRIBUTION OF AQUEOUS SPECIES -----

SPECIES	MOLAL CONC	LOG CONC	LOG G	ACTIVITY	LOG ACT
NA+	.1063E-01	-1.9733	-.0748	.8953E-02	-2.0481
K+	.8441E-04	-4.0736	-.0787	.7042E-04	-4.1523
CA++	.4750E-02	-2.3233	-.2761	.2515E-02	-2.5994
MG++	.2515E-04	-4.5995	-.2533	.1403E-04	-4.8528
AL+++	.2807E-11	-11.5517	-.5491	.7928E-12	-12.1008
SiO2(AQ)	.2613E-03	-3.5829	0.0000	.2613E-03	-3.5829
SR++	.6390E-04	-4.1945	-.2891	.3284E-04	-4.4836
ZN++	.4998E-07	-7.3012	-.2761	.2647E-07	-7.5773
H+	.5751E-07	-7.2403	-.0597	.5012E-07	-7.3000
HCO3-	.2318E-02	-2.6348	-.0729	.1960E-02	-2.7078
CL-	.2170E-02	-2.6636	-.0787	.1810E-02	-2.7423

SO4--	894	4E-02	2	0663	3034	4393E-02	-2	3697
F-	437	4E-04	-4	3592	367	366E-04	-4	4359
Fe++	190	0E-05	-5	7032	61	1049E-05	-5	9794
Fe++	381	1E-08	-8	4190	77	2018E-08	-8	6951
UO2+	1406	-10	-10	6520	69	2078E-11	-11	1411
O2(AQ)	4000	0E-01	-1	6990	39	2670E-31	-31	6951
H2(AQ)	2646	0E-60	-60	1574	39	1966E-60	-60	7065
HS-	1648	0E-89	-89	7831	17	1381E-89	-89	8598
Fe++	1534	2E-14	-14	2261	91	1678E-14	-14	7732
U++	851	6E-44	-44	0698	78	1058E-44	-44	9755
U++	607	9E-15	-15	2162	48	5117E-15	-15	2910
O3-	225	0E-06	-6	6108	7	1837E-06	-6	7359
Al(OH)3	557	0E-09	-9	2499	67	2037E-09	-9	6876
Al(OH)4-	552	0E-05	-5	9571	1	2937E-05	-5	5260
KSO4-	1982	0E-05	-5	5929	87	2140E-05	-5	0318
NACL	1768	0E-06	-6	7029	9	2004E-06	-6	6966
NAClO3-	2735	0E-03	-3	6244	27	2004E-03	-3	7029
NASO4-	2734	0E-05	-5	3244	0	2004E-05	-5	6981
CAClO3	1031	0E-03	-3	9866	0	8168E-04	-4	1370
CASO4	2199	0E-02	-2	774	0	2199E-02	-2	0671
MgHCO3+	2966	0E-06	-6	3995	0	3355E-06	-6	6074
MgHCO3	1060	0E-04	-4	9749	0	1060E-04	-4	9749
FeSO4	1524	0E-08	-8	8170	0	1524E-08	-8	8170
FeCl2+	1205	1E-19	-19	8325	38	2355E-19	-19	6116
FeCl3	1243	0E-21	-21	8720	0	2355E-21	-21	8720
FeCl4-	3814	1E-13	-13	4460	8	3044E-13	-13	5208
FESO4-	7520	0E-06	-6	1013	0	5920E-06	-6	2288
MNSO4	1571	0E-09	-9	8037	0	3233E-09	-9	8765
NNCL2	6631	0E-12	-12	4359	0	3693E-12	-12	4359
NNCL3	6631	0E-15	-15	1924	0	4512E-15	-15	2672
NNCL4-	9072	0E-18	-18	0423	0	2322E-18	-18	3457
NH5SO4	2664	0E-05	-5	7797	0	4512E-05	-5	5797
AL3O4+	2005	1E-17	-17	3792	0	3401E-17	-17	8536
HSO4-	2071	0E-07	-7	5895	0	3401E-07	-7	4510
S-	6619	0E-99	-99	4377	1	6619E-99	-99	6646
H2CO3	6665	0E-16	-16	1792	0	6665E-16	-16	7259
HCL	6665	0E-09	-9	2625	0	4071E-09	-9	6818
Mg(OH)+	6665	0E-09	-9	6070	0	2091E-09	-9	6818
Fe(OH)+	221	9E-07	-7	8127	0	1296E-07	-7	8875
Ca(OH)++	4378	0E-09	-9	3587	0	2177E-09	-9	6621
Fe(OH)2+	5681	0E-07	-7	2455	0	4839E-07	-7	3203
Fe(OH)3-	2146	0E-18	-18	6507	0	1829E-18	-18	7377
Fe(OH)4-	4608	0E-09	-9	3507	0	3755E-09	-9	7354
NaOH	3688	0E-16	-16	4326	1	1839E-17	-17	4356
(FeOH++)2	6665	0E-05	-5	1901	0	1839E-05	-5	2649
MN(OH)+	6665	0E-05	-5	2114	0	6143E-05	-5	2114
MNCO3	6665	0E-45	-45	8121	0	4133E-46	-46	3638
UFe++	1541	0E-40	-40	2198	0	1616E-39	-39	7919
UFe++	787	7E-39	-39	1036	0	4048E-39	-39	3927
UFe3+	803	0E-39	-39	0921	0	6810E-39	-39	1166

UF4	.8175E-39	-39.0875	0.0000	.8175E-39	-39.0875
UF5-	.1364E-41	-41.8653	-.0748	.1148E-41	-41.9401
UF6--	.2456E-43	-43.6098	-.3034	.1221E-43	-43.9131
U(OH)+++	.1774E-37	-37.7511	-.5717	.4756E-38	-38.3228
U(OH)2++	.4637E-32	-32.3338	-.2891	.2383E-32	-32.6228
U(OH)3+	.1335E-27	-27.6744	-.0748	.1124E-27	-27.9492
U(OH)4	.4993E-24	-24.3017	0.0000	.4993E-24	-24.3017
U(OH)5-	.2936E-21	-21.5323	-.0748	.2472E-21	-21.6070
U6(OH)15(9+)	.1129-172	-172.9472	-4.5911	.2896-177	-177.5382
USO4++	.2539E-41	-41.5954	-.2891	.1305E-41	-41.8845
U(SO4)2	.1081E-39	-39.9661	0.0000	.1081E-39	-39.9661
UO2(OH)+	.2854E-09	-9.5445	-.0748	.2403E-09	-9.6193
UO2(OH)2	.2874E-08	-8.5414	0.0000	.2874E-08	-8.5414
(UO2)2(OH)2++	.9435E-13	-13.0253	-.2761	.4996E-13	-13.3013
(UO2)3(OH)5+	.3344E-12	-12.4757	-.0712	.2838E-12	-12.5470
(UO2)3(OH)7-	.5627E-13	-13.2497	-.0748	.4737E-13	-13.3245
UO2CL+	.2667E-13	-13.5740	-.0748	.2245E-13	-13.6488
UO2F+	.3976E-10	-10.4006	-.0748	.3347E-10	-10.4754
UO2F2	.8796E-11	-11.0557	0.0000	.8796E-11	-11.0557
UO2F3-	.9391E-13	-13.0273	-.0748	.7905E-13	-13.1021
UO2F4--	.9599E-16	-16.0178	-.3034	.4774E-16	-16.3211
UO2CO3	.1671E-06	-6.7770	0.0000	.1671E-06	-6.7770
UO2(CO3)2--	.4904E-05	-5.3095	-.3034	.2439E-05	-5.6128
UO2(CO3)3----	.1858E-05	-5.7310	-1.2177	.1125E-06	-6.9487
UO2SO4	.1619E-10	-10.7908	0.0000	.1619E-10	-10.7908
UO2(SO4)2--	.4197E-11	-11.3771	-.3034	.2087E-11	-11.6804
UO2S1O(OH)3+	.1763E-09	-9.7537	-.0748	.1484E-09	-9.8285
HF	.2709E-08	-8.5673	0.0000	.2709E-08	-8.5673
HF2-	.3726E-12	-12.4288	-.0748	.3136E-12	-12.5036
H2F2	.1973E-16	-16.7048	0.0000	.1973E-16	-16.7048
NAF	.4384E-07	-7.3581	0.0000	.4384E-07	-7.3581
MGF+	.3842E-07	-7.4155	-.0748	.3234E-07	-7.4902
CAF+	.1420E-05	-5.8477	-.0748	.1196E-05	-5.9225
SrF+	.9840E-08	-8.0070	-.0748	.8284E-08	-8.0818
FEF+	.2460E-11	-11.6091	-.0748	.2071E-11	-11.6839
MNF+	.9950E-09	-9.0022	-.0748	.8376E-09	-9.0770
ZNF+	.1855E-10	-10.7316	-.0748	.1562E-10	-10.8064
ALF++	.5497E-09	-9.2598	-.2891	.2825E-09	-9.5489
ALF2+	.4901E-08	-8.3097	-.0748	.4126E-08	-8.3844
ALF3	.1905E-08	-8.7202	0.0000	.1905E-08	-8.7202
ALF4-	.2084E-10	-10.6811	-.0748	.1754E-10	-10.7559
ALF5--	.9614E-13	-13.0171	-.3034	.4781E-13	-13.3205
ALF6---	.4631E-17	-17.3343	-.6843	.9579E-18	-18.0187
FEF+	.1192E-12	-12.9237	-.2891	.6126E-13	-13.2128
FEF2+	.1533E-12	-12.8146	-.0748	.1290E-12	-12.8894
FEF3	.5445E-14	-14.2640	0.0000	.5445E-14	-14.2640
SIF6--	.1208E-28	-28.9181	-.3034	.6005E-29	-29.2215

----- SUMMARY OF AQUEOUS REDOX REACTIONS -----

COUPLE	EH, VOLTS	PE-	LOG F02	AH, KCAL
DEFAULT	.410	.6931E+01	-26.180	9.456
O2(AQ)/H2O	.815	.1378E+02	-1.204	18.795
H2(AQ)/H2O	.410	.6931E+01	-26.180	9.456
U+++ /UO2++	.410	.6931E+01	-26.180	9.456
HS- /SO4--	.410	.6931E+01	-26.180	9.456
FE+++ /FE++	.410	.6931E+01	-26.180	9.456
U++++ /UO2++	.410	.6931E+01	-26.180	9.456

U02+ /U02++ .410 .6931E+01 -26.180 9.456

----- SUMMARY OF AQUEOUS NON-EQUILIBRIUM NON-REDOX REACTIONS -----

COUPLE AFFINITY, KCAL

NONE

----- SUMMARY OF STOICHIOMETRIC MINERAL SATURATION STATES -----

(MINERALS WITH AFFINITIES .LT. -10 KCAL ARE NOT LISTED)

MINERAL	LOG Q/K	AFF, KCAL	STATE
14A-DAPHNITE	-3.4527996	-4.7106036	
PHENGITE	.4051485	.5527382	SUPERSATURATED
MAGNETITE	16.3269153	22.2745702	SUPERSATURATED
CORUNDUM	-1.7859751	-2.4365796	
HEMATITE	18.5711331	25.3363235	SUPERSATURATED
DEHYDRATED ANALC	-4.1029382	-5.5975782	
BRUCITE	-6.6919182	-9.1296855	
GIBBSITE	1.8383655	2.5080550	SUPERSATURATED
HALITE	-6.3993180	-8.7304954	
REYKJANES SMECTI	5.2015483	7.0963957	SUPERSATURATED
CALCITE	.1896074	.2586786	APPROX. SATURATED
MAGNESITE	-2.6809526	-3.6575842	
SIDERITE	-1.6986169	-2.3173980	
RHODOCHROSITE	-1.1782556	-1.6074767	
DOLOMITE	-.8626452	-1.1768942	
ANHYDRITE	-.7036860	-.9600284	
GYPSUM	-.1194152	-.1629164	APPROX. SATURATED
QUARTZ	.4164411	.5681444	SUPERSATURATED
MAXIMUM MICROCLI	2.1147257	2.8850891	SUPERSATURATED
LOW ALBITE	1.2049029	1.6438312	SUPERSATURATED
ANORTHITE	-2.6300865	-3.5881883	
14A-AMESITE	-6.2454409	-8.5205631	
NEPHELINE	-2.6655793	-3.6366106	
ANALCIME	.6048972	.8252524	SUPERSATURATED
KAOHLINITE	5.0025778	6.8249433	SUPERSATURATED
PYROPHYLLITE	4.2063245	5.7386266	SUPERSATURATED
TALC	-6.6532611	-9.0769462	
NA-BEIDELLITE	5.0380253	6.8733037	SUPERSATURATED
MUSCOVITE	7.2310859	9.8652641	SUPERSATURATED
ILLITE	4.5190433	6.1652643	SUPERSATURATED
ANNITE	-3.2702925	-4.4616119	
ENSTATITE	-5.3046125	-7.2370048	
DIOPSIDE	-6.3877650	-8.7147337	
WOLLASTONITE	-5.2062524	-7.1028136	
ZOISITE	-1.3108088	-1.7883172	
KYANITE	-.2803341	-.3824557	APPROX. SATURATED
FAYALITE	-6.4550946	-8.8065906	
PREHNITE	-.4275035	-.5832368	
AMORPHOUS SILICA	-.8692589	-1.1859172	
PHLOGOPITE	-6.7840997	-9.2554473	
K-FELDSPAR	2.1147257	2.8850891	SUPERSATURATED
HIGH SANIDINE	-.9155257	1.2490382	SUPERSATURATED
HIGH ALBITE	-.1137971	-.1552518	APPROX. SATURATED
STRONTIANITE	1.2081703	1.6482889	SUPERSATURATED

K-BEIDELLITE	4.6736138	6.3761425	SUPERSATURATED
CA-BEIDELLITE	5.3440761	7.2908444	SUPERSATURATED
MG-BEIDELLITE	4.9906717	6.8087000	SUPERSATURATED
H-BEIDELLITE	4.3243819	5.8946906	SUPERSATURATED
CELESTITE	-4.218232	-5.5754871	
FERROUS OXIDE	-5.4123179	-7.3839456	
APAGONITE	-0.246074	-0.0335716	APPROX. SATURATED
NA-SAPONITE	-5.8216603	-7.9424055	
K-SAPONITE	-6.1860718	-8.4395667	
CLINOZOISITE	-1.2661088	-1.7273336	
PARAGONITE	5.4247631	7.4009245	SUPERSATURATED
DIASPORE	1.0471301	1.4285842	SUPERSATURATED
CA-SAPONITE	-5.5155095	-7.5247284	
BOEHMITE	-2.027301	-2.2765817	APPROX. SATURATED
CHALCEDONY	-1.452411	-1.1981502	APPROX. SATURATED
MG-SAPONITE	-5.8689139	-8.0068728	
ALUNITE	-2.0568514	-2.6058593	
ANDALUSITE	-1.5552341	-1.7574977	
H-SAPONITE	-6.5247037	-8.9015572	
SMITHSONITE	-3.4205560	-4.6666141	
NA-NONTRONITE	21.9148335	29.8980848	SUPERSATURATED
K-NONTRONITE	21.5504220	29.4009236	SUPERSATURATED
GROSSULAR	-7.2835325	-9.9368161	
ALBITE	1.2049029	1.6438312	SUPERSATURATED
ORDERED EPIDOTE	8.9128453	12.1596637	SUPERSATURATED
ANDRADITE	11.0072758	15.0170643	SUPERSATURATED
HEDENBERGITE	-6.5151292	-8.8884949	
CA-NONTRONITE	22.2208844	30.3156255	SUPERSATURATED
MG-NONTRONITE	21.8674800	29.8334811	SUPERSATURATED
H-NONTRONITE	21.2028902	28.9265181	SUPERSATURATED
CRISTOBALITE	-1.1340589	-1.1828946	APPROX. SATURATED
DISORDERED DOLOM	-2.4071452	-3.2840328	
ORDERED DOLOMITE	-1.8626452	-1.1768942	
FERROSILITE	-3.2241768	-4.3986969	
NESQUEHONITE	-5.3802464	-7.3401910	
EPIDOTE	8.9128453	12.1596636	SUPERSATURATED
PD-OXYANNITE	30.5378076	41.6622814	SUPERSATURATED
WAIRAKITE	-1.2921336	-1.7628388	
LAUMONTITE	3.1191372	4.2553930	SUPERSATURATED
MARGARITE	1.8595738	2.5369891	SUPERSATURATED
FLUORITE	-1.5122371	-1.6988375	
SILLIMANITE	-1.9143341	-1.2474125	
KALSILITE	-1.8934565	-2.5832148	
JADEITE	-1.8366382	-1.1414132	
GREENALITE	-5.4754006	-7.4700085	
MINNESOTAITE	-3.9524539	-5.3922747	
7A-CHAMOSITE	-1.2070990	-1.6468274	
GAMMA-UG3	-4.2742737	-5.8313286	
BETA-UG2(OH)2	-2.0762383	-2.8325813	
SCHÖEPITE	-1.9803028	-2.7016980	
GUMMITE	-6.9569737	-9.4912968	
URANOPHANE	-5.7370233	-7.8269364	
UG2SO4.3H2O	-6.0054599	-8.1931606	
RUTHERFORDINE	-2.4169727	-3.2974403	
MGF2(C)	-5.5458972	-7.5661859	
SRF2(C)	-4.8167743	-6.5714542	

8 APPROX. SATURATED PURE MINERALS
 0 APPROX. SATURATED END-MEMBERS OF SPECIFIED SOLID SOLUTIONS
 0 SATURATED END-MEMBERS OF HYPOTHETICAL SOLID SOLUTIONS

35 SUPERSATURATED PURE MINERALS
 0 SUPERSATD. END-MEMBERS OF SPECIFIED SOLID SOLUTIONS
 0 SUPERSATD. HYPOTHETICAL SOLID SOLUTION PHASES

----- SUMMARY OF GASES -----

GAS	FUGACITY	LOG FUGACITY
CO2(G)	.671276E-02	-2.17310
O2(G)	.660599E-26	-26.18006
S2(G)	.846549-147	-147.07235
CH4(G)	.755782E-93	-93.12160
H2(G)	.345515E-28	-28.46153
H2S(G)	.671379E-89	-89.17303
STEAM	.312994E-01	-1.50446

----- END OF OUTPUT -----
 ----- END OF INPUT FILE -----

UTITL
CLIMAX GROUND WATER
NORTH HEATER DRIFT WATER
BASED ON JACK HARRAR'S MEMO OF 1/20/82
TEMPERATURE NOT REPORTED, 25 DEG C ASSUMED

TEMPC

.250000E+02

RHO

0.

TDS1

TDS2

F02/EH/PE

.800000E+00

0.

COUPLE

0.

TOLBT

0.

0.

02(AQ)

0.

TOLSAT

ITERMX

0.

0.

0.

I OPT

0

1

2

3

4

5

6

7

8

9

IPRNT

1

2

3

4

5

6

7

8

9

IDBUG

1

2

3

4

5

6

7

8

9

UEBAL

1

0

0

1

0

0

0

0

0

SUPPRESSED/ALTERED SPECIES (AQ, MIN, GAS, SOL)

0

0

0

0

NA+

.22900E+03

2

K+

.38000E+01

2

CA++

.24000E+03

2

MG++

.48000E+01

2

AL+++

.50000E+00

2

SI02(AQ)

.22500E+02

2

SR++

.79000E+01

2

ZN++

.30000E-01

2

H+

.82000E+01

16

HC03-

CO3--

0.

30

CL-

.16000E+03

2

SO4--

.85000E+03

2

MN++

.80000E-02

2

FE++

.50000E+00

2

U02++

U++++

.18500E+02

2

O2(G)

0.

0

O2(AQ)

0.

4

H2(AQ)

0.

27

HC03-

.65000E+02

2

HP04--

.50000E+00

2

ENDIT.

FILE DATA1 HAS BEEN SUCCESSFULLY READ

----- CONFLICTING INPUT OPTIONS FOR F02 -----

I OPT1 = -1 OVERRIDES UREDOX = 02(AQ)

```

EEEE  QQQ  33333
E      Q  Q  3
EEEE  Q  Q  33
E      Q  Q  3
EEEE  QQQ  3333
      Q

```

3230 VERSION

CLIMAX GROUND WATER
 NORTH HEATER DRIFT WATER
 BASED ON JACK HARRAR'S MEMO OF 1/20/82
 TEMPERATURE NOT REPORTED, 25 DEG C ASSUMED

DATA FILE SET DEOPAK9
 SUPPORTING DATA FOR PROGRAMS EQ3 AND EQ6
 1 ATM.-STEAM SATURATION CURVE DATA
 LAST REVISED 20 NOVEMBER 1981

THE TOTAL PRESSURE IS 1.0134 BARS
 THE TEMPERATURE IS 25.00 DEGREES CELSIUS

29 ELEMENTS ARE IN THE DATA BASE
 40 ELEMENTS CAN BE LOADED INTO MEMORY
 17 ELEMENTS ARE IN THE PROBLEM SYSTEM

170 AQUEOUS SPECIES WERE LOADED INTO MEMORY
 300 AQUEOUS SPECIES CAN BE LOADED INTO MEMORY

140 AQUEOUS REACTIONS WERE LOADED INTO MEMORY
 259 AQUEOUS REACTIONS CAN BE LOADED INTO MEMORY

148 MINERALS WERE LOADED INTO MEMORY
 275 MINERALS CAN BE LOADED INTO MEMORY

12 SOLID SOLUTIONS ARE IN THE DATA BASE
 20 SOLID SOLUTIONS CAN BE LOADED INTO MEMORY

7 GASES WERE LOADED INTO MEMORY
 15 GASES CAN BE LOADED INTO MEMORY

IOPT1 = -1 (REDOX OPTION SWITCH)
 IOPT2 = 0 (AUTOMATIC BASIS SWITCHING SWITCH)
 IOPT3 = 0 (INTERFACING OUTPUT CONTROL SWITCH)
 IOPT4 = 0 (TURN-ON SOLID SOLUTIONS SWITCH)
 IOPT5 = 0 (NOT CURRENTLY USED)
 IOPT6 = 0 (NOT CURRENTLY USED)
 IOPT7 = 0 (TURN OFF LUREFF CALLS SWITCH)
 IOPT8 = 0 (CONV. TEST CRITERIA SWITCH)
 IOPT9 = 3 (MAXIMUM PTS. USED IN FIND ROUTINE)

```

IPRNT1 = -1 (LIST LOADING OF SPECIES)
IPRNT2 = 0 (LIST REACTIONS AND LOG K VALUES)
IPRNT3 = 0 (NOT CURRENTLY USED)
IPRNT4 = 0 (SPECIATION PRINT CONTROL)
IPRNT5 = 0 (NOT CURRENTLY USED)
IPRNT6 = 0 (NOT CURRENTLY USED)
IPRNT7 = 0 (MINERAL AFFINITY PRINT CONTROL)

```

```

IDBUG1 = 1 (PRINT INFO. MESSAGES SWITCH)
IDBUG2 = 0 (PRINT DATA1 READ INFO. SWITCH)
IDBUG3 = 0 (NOT CURRENTLY USED)
IDBUG4 = 1 (PRINT NEWTON-RAPHSON ITERATIONS SWITCH)
IDBUG5 = 0 (NOT CURRENTLY USED)
IDBUG6 = 0 (LIST STOICH. EQUIVALENCES SWITCH)
IDBUG7 = 0 (WRITE REACTIONS ON RFILE SWITCH)

```

THE DEFAULT REDOX STATE IS CONSTRAINED BY EH = .80000 VOLTS

```

SOLUTION DENSITY = 1.00000 G/ML
TOTAL DISSOLVED SALTS = 0.00 MG/KG SOLUTION
TOTAL DISSOLVED SALTS = 0.00 MG/L

```

```

TOLBT = .10000E-09 (CONVERGENCE TOLERANCE ON RESIDUAL FUNCTIONS)
TOLDL = .10000E-09 (CONVERGENCE TOLERANCE ON CORRECTION TERMS)
TOLSAT = .50000E+00 (PHASE SATURATION TOLERANCE, DOES NOT AFFECT
CONVERGENCE)

```

----- INPUT CONSTRAINTS -----

SPECIES	CSP	JFLAG	TYPE OF INPUT	UPHASE	BASIS SPECIES
NA+	.22900E+03	2	TOT CONC, MG/L		
K+	.38000E+01	2	TOT CONC, MG/L		
CA++	.24000E+03	2	TOT CONC, MG/L		
MG++	.48000E+01	2	TOT CONC, MG/L		
AL+++	.50000E+00	2	TOT CONC, MG/L		
SiO2(AQ)	.22500E+02	2	TOT CONC, MG/L		
SR++	.79000E+01	2	TOT CONC, MG/L		
ZN++	.30000E+01	2	TOT CONC, MG/L		
H+	.62000E+01	16	LOG ACTIVITY		
CO3--	0.	30	ELIMINATED SPECIES		HC03-
CL-	.16000E+03	2	TOT CONC, MG/L		
SO4--	.65000E+03	2	TOT CONC, MG/L		
MN++	.60000E+02	2	TOT CONC, MG/L		
FE++	.50000E+00	2	TOT CONC, MG/L		
U++++	.18500E+02	2	TOT CONC, MG/L		U02++
O2(AQ)	0.	4	FREE CONC, MOLAL		
H2(AQ)	0.	27	DEPENDENT SPECIES		
HC03-	.65000E+02	2	TOT CONC, MG/L		CO3--
HP04--	.50000E+00	2	TOT CONC, MG/L		

----- INACTIVE AQUEOUS SPECIES -----

CH4(AQ)	MN+++	KCL	KC03-
FECL+	FECL2	FECL3-	FECL4--
FF(S04)2-	MNCL+	MNCL2	MNCL3-
MNCL4--	MNCL++	MNCL2+	MNCL3
MNCL4-	KOH	MGCL+	

SWITCHING C03-- FROM THE BASIS FOR HC03-

-	1.000	HC03-	
	=		
	1.000	H+	LOG K = -10.3281
+	1.000	C03--	
	1.000	C03--	
+	1.000	H+	LOG K = 10.3281
	=		
	1.000	HC03-	

SWITCHING U++++ FROM THE BASIS FOR U02++

	1.000	U02++	
+	2.000	H+	LOG K = -32.3246
	=		
	1.000	H2O	
+	1.000	U++++	
+	.500	O2(G)	
	1.000	U++++	
+	1.000	H2O	
+	.500	O2(G)	LOG K = 32.3246
	=		
	2.000	H+	
+	1.000	U02++	

72

SPECIES	CSP	JFLAG	TYPE OF INPUT	UPHASE
NA+	.99609E-02	0	TOT CONC, MOLAL	
K+	.97192E-04	0	TOT CONC, MOLAL	
CA++	.59880E-02	0	TOT CONC, MOLAL	
MG++	.19749E-03	0	TOT CONC, MOLAL	
AL+++	.18531E-04	0	TOT CONC, MOLAL	
SiO2(AQ)	.37448E-03	0	TOT CONC, MOLAL	
SR++	.90162E-04	0	TOT CONC, MOLAL	
ZN++	.45886E-06	0	TOT CONC, MOLAL	
H+	-.62000E+01	16	LOG ACTIVITY	
HC03-	.10653E-02	0	TOT CONC, MOLAL	
CL-	.45130E-02	0	TOT CONC, MOLAL	
S04--	.88488E-02	0	TOT CONC, MOLAL	
MN++	.14562E-06	0	TOT CONC, MOLAL	
FE++	.69530E-05	0	TOT CONC, MOLAL	
U02++	.77722E-04	0	TOT CONC, MOLAL	
HP04--	.52095E-05	0	TOT CONC, MOLAL	
O2(AQ)			NOT PRESENT IN THE MODEL	
H2(AQ)	0.	27	DEPENDENT SPECIES	
CH4(AQ)			NOT PRESENT IN THE MODEL	

U+++	0.	30	ELIMINATED SPECIES
HS-	0.	30	ELIMINATED SPECIES
MN+++			NOT PRESENT IN THE MODEL
FE+++	0.	30	ELIMINATED SPECIES
U++++	0.	30	ELIMINATED SPECIES
UO2+	0.	30	ELIMINATED SPECIES
H2PO4-	0.	30	ELIMINATED SPECIES
CO3--	0.	30	ELIMINATED SPECIES
OH-	0.	30	ELIMINATED SPECIES

THE ION FOR ESTIMATING WATER ACTIVITY IS NA+

----- ITERATION MATRIX STRUCTURE -----

1	1	H2O	DEFINING EQUATION
2	2	NA+	TOT CONC, MOLAL
3	3	K+	TOT CONC, MOLAL
4	4	CA++	TOT CONC, MOLAL
5	5	MG++	TOT CONC, MOLAL
6	6	AL+++	TOT CONC, MOLAL
7	7	SI02(AQ)	TOT CONC, MOLAL
8	8	SR++	TOT CONC, MOLAL
9	9	ZN++	TOT CONC, MOLAL
10	10	H+	LOG ACTIVITY
11	11	HCO3-	TOT CONC, MOLAL
12	12	CL-	TOT CONC, MOLAL
13	13	SO4--	TOT CONC, MOLAL
14	14	MN++	TOT CONC, MOLAL
15	15	FE++	TOT CONC, MOLAL
16	16	UO2++	TOT CONC, MOLAL
17	17	HPO4--	TOT CONC, MOLAL
18	18	O2(G)	EH
19	19	EQ STO IONIC STR	DEFINING EQUATION
20	20	IONIC STRENGTH	DEFINING EQUATION

----- STRUCTURE FOR SIMULTANEOUS EVALUATION OF STARTING ESTIMATES -----

1	30	O2(G)	EH
---	----	-------	----

----- MATRIX -----

1.00

----- RIGHT-HAND-SIDE VECTOR -----

1	30	.379069E+01
---	----	-------------

----- ZLG1 VALUES -----

----- POSSIBLE BASIS SWITCHES -----

AL+++ COULD BE SWITCHED WITH AL(OH)4-
 HC03- COULD BE SWITCHED WITH U02(C03)2--
 FE++ COULD BE SWITCHED WITH FE(OH)4-
 U02++ COULD BE SWITCHED WITH (U02)3(OH)7-
 HPO4-- COULD BE SWITCHED WITH U02(HPO4)2--

DECREASING	ZLG1(6)	FROM	-4.7321	...	BETA(6)	WAS	.22949E+10
DECREASING	ZLG1(7)	FROM	-3.4266	...	BETA(7)	WAS	.36047E+02
DECREASING	ZLG1(11)	FROM	-2.9725	...	BETA(11)	WAS	.14726E+07
DECREASING	ZLG1(14)	FROM	-6.8368	...	BETA(14)	WAS	.16195E+02
DECREASING	ZLG1(15)	FROM	-5.0480	...	BETA(15)	WAS	.23836E+12
DECREASING	ZLG1(16)	FROM	-4.1095	...	BETA(16)	WAS	.16527E+19
DECREASING	ZLG1(17)	FROM	-5.2832	...	BETA(17)	WAS	.14882E+10

----- POSSIBLE BASIS SWITCHES -----

AL+++ COULD BE SWITCHED WITH AL(OH)4-
 FE++ COULD BE SWITCHED WITH FE(OH)4-

OPTIMIZING STARTING ESTIMATES (1)

DECREASING	ZLG1(6)	FROM	-6.7321	...	BETA(6)	WAS	.22949E+08
INCREASING	ZLG1(7)	FROM	-4.4266	...	BETA(7)	WAS	-.89518E+00
INCREASING	ZLG1(11)	FROM	-4.9725	...	BETA(11)	WAS	-.98522E+00
INCREASING	ZLG1(14)	FROM	-7.8368	...	BETA(14)	WAS	-.81408E+00
DECREASING	ZLG1(15)	FROM	-7.0480	...	BETA(15)	WAS	.22202E+10
DECREASING	ZLG1(16)	FROM	-8.6640	...	BETA(16)	WAS	.35854E+05
DECREASING	ZLG1(17)	FROM	-7.2832	...	BETA(17)	WAS	.30057E+02

----- POSSIBLE BASIS SWITCHES -----

AL+++ COULD BE SWITCHED WITH AL(OH)4-
 FE++ COULD BE SWITCHED WITH FE(OH)4-

OPTIMIZING STARTING ESTIMATES (2)

DECREASING	ZLG1(6)	FROM	-8.7321	...	BETA(6)	WAS	.22949E+06
INCREASING	ZLG1(7)	FROM	-3.9266	...	BETA(7)	WAS	-.66885E+00
INCREASING	ZLG1(11)	FROM	-4.4725	...	BETA(11)	WAS	-.96364E+00
INCREASING	ZLG1(14)	FROM	-7.3368	...	BETA(14)	WAS	-.30624E+00
DECREASING	ZLG1(15)	FROM	-9.3846	...	BETA(15)	WAS	.10221E+08
INCREASING	ZLG1(16)	FROM	-10.6640	...	BETA(16)	WAS	-.95736E+00
INCREASING	ZLG1(17)	FROM	-8.2832	...	BETA(17)	WAS	-.98372E+00

----- POSSIBLE BASIS SWITCHES -----

FE++ COULD BE SWITCHED WITH FE(OH)4-

OPTIMIZING STARTING ESTIMATES (3)

DECREASING	ZLG1(6)	FROM	-10.7321	...	BETA(6)	WAS	.22939E+04
INCREASING	ZLG1(11)	FROM	-3.9725	...	BETA(11)	WAS	-.87799E+00
DECREASING	ZLG1(15)	FROM	-11.1370	...	BETA(15)	WAS	.18076E+06

```

      INCREASING ZLG1( 17) FROM      -7.7832 ... BETA( 17) WAS      -.97519E+00
OPTIMIZING STARTING ESTIMATES ( 4)
      DECREASING ZLG1( 6) FROM      -12.7321 ... BETA( 6) WAS      .21949E+02
      INCREASING ZLG1( 11) FROM      -3.4725 ... BETA( 11) WAS      -.55059E+00
      DECREASING ZLG1( 14) FROM      -6.8368 ... BETA( 14) WAS      .56001E+01
      DECREASING ZLG1( 15) FROM      -12.4513 ... BETA( 15) WAS      .87656E+04
      INCREASING ZLG1( 17) FROM      -7.2832 ... BETA( 17) WAS      -.83391E+00
OPTIMIZING STARTING ESTIMATES ( 5)
      DECREASING ZLG1( 15) FROM      -14.4513 ... BETA( 15) WAS      .86666E+02
      DECREASING ZLG1( 16) FROM      -10.1640 ... BETA( 16) WAS      .76912E+01
OPTIMIZING STARTING ESTIMATES ( 6)
      DECREASING ZLG1( 15) FROM      -15.4513 ... BETA( 15) WAS      .77666E+01
      INCREASING ZLG1( 16) FROM      -11.1640 ... BETA( 16) WAS      -.24313E+00
      INCREASING ZLG1( 17) FROM      -6.7832 ... BETA( 17) WAS      -.75911E+00
OPTIMIZING STARTING ESTIMATES ( 7)
      INCREASING ZLG1( 15) FROM      -16.4513 ... BETA( 15) WAS      -.12334E+00
OPTIMIZING STARTING ESTIMATES ( 8)
ITER = 0 DELMAX = 0 DEL( ) = 0 BETA(HP04--) = .350E+01 DELFNC = 0
ITER = 1 DELMAX = .122E+01 DEL(X1) = .306E+00 BETA(HP04--) = .257E+01 DELFNC = 0
ITER = 2 DELMAX = .269E+00 DEL(X1) = .674E-01 BETA(HP04--) = .197E+01 DELFNC = .780E+00
ITER = 3 DELMAX = .195E+00 DEL(FE++) = -.195E+00 BETA(HP04--) = .523E+00 DELFNC = .276E+00
ITER = 4 DELMAX = .852E-01 DEL(FE++) = -.852E-01 BETA(HP04--) = .829E-01 DELFNC = .563E+00
ITER = 5 DELMAX = .147E-01 DEL(HP04--) = -.147E-01 BETA(HP04--) = .332E-02 DELFNC = .827E+00
ITER = 6 DELMAX = .720E-03 DEL(HP04--) = -.720E-03 BETA(HP04--) = .608E-05 DELFNC = .951E+00
ITER = 7 DELMAX = .129E-05 DEL(HP04--) = -.129E-05 BETA(AL+++ ) = -.424E-08 DELFNC = .998E+00
ITER = 8 DELMAX = .111E-08 DEL(U02++) = -.111E-08 BETA(AL+++ ) = -.161E-10 DELFNC = .999E+00
ITER = 9 DELMAX = .405E-11 DEL(U02++) = -.405E-11 BETA(AL+++ ) = .644E-12 DELFNC = .996E+00

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NEWTON-RAPHSON ITERATION CONVERGED IN 9 STEPS

----- SUMMARY OF THE AQUEOUS PHASE -----

----- ELEMENTAL COMPOSITION OF THE AQUEOUS PHASE -----

ELEMENT	MG/L	MG/KG	MOLES/KG
O	888750.0771	888750.0771	.5554896290E+02
NA	228.9977	228.9977	.9960852545E-02
K	3.8000	3.8000	.9719167221E-04
CA	240.0000	240.0000	.5988023952E-02
MG	4.8000	4.8000	.1974902283E-03
AL	.5000	.5000	.1853087243E-04
SI	10.5173	10.5173	.3744757340E-03
SR	7.9000	7.9000	.9016206346E-04
ZN	.0300	.0300	.4588559192E-06
H	111896.6820	111896.6820	.1110196270E+03
C	12.7950	12.7950	.1065276890E-02
CL	160.0000	160.0000	.4513017234E-02
S	283.6932	283.6932	.8848820504E-02
MN	.0080	.0080	.1456186974E-06
FE	.5000	.5000	.8953032392E-05
U	18.5000	18.5000	.7772162216E-04
P	.1614	.1614	.5209472906E-05

----- ELEMENTAL COMPOSITION AS STRICT BASIS SPECIES -----

SPECIES	MG/L	MG/KG	MOLES/KG
H2O	1000714.5667	1000714.5667	.5554896290E+02
NA+	229.0000	229.0000	.9960852545E-02
K+	3.8000	3.8000	.9719167221E-04
CA++	240.0000	240.0000	.5988023952E-02
MG++	4.8000	4.8000	.1974902283E-03
AL+++	.5000	.5000	.1853087243E-04
SiO2(A	22.5000	22.5000	.3744757340E-03
SR++	7.9000	7.9000	.9016206346E-04
ZN++	.0300	.0300	.4588559192E-06
H+	111907.7840	111907.7840	.1110196270E+03
CO3--	63.9262	63.9262	.1065276890E-02
CL-	160.0000	160.0000	.4513017234E-02
SO4--	650.0000	850.0000	.8848820504E-02
MN++	.0080	.0080	.1456186974E-06
FE++	.5000	.5000	.8953032392E-05
U++++	18.5000	18.5000	.7772162216E-04
HP04--	.5000	.5000	.5209472906E-05

----- EQUIVALENT COMPOSITION OF THE AQUEOUS PHASE -----

SPECIES	MOLES/KG H2O
H2O	.5554896290E+02
NA+	.9960852545E-02
K+	.9719167221E-04
CA++	.5988023952E-02
MG++	.1974902283E-03
AL+++	.1853087243E-04
SiO2(AQ)	.3744757340E-03
SR++	.9016206346E-04
ZN++	.4588559192E-06
H+	.1110196270E+03
HCO3-	.1065276890E-02
CL-	.4513017234E-02
SO4--	.8348820504E-02
MN++	.1456186974E-06
FE++	.8953032392E-05
UO2++	.7772162216E-04
HP04--	.5209472906E-05

IONIC STRENGTH = .0309528773376
EQUIV. STOICH. IONIC STRENGTH (NA+) = .0099608525446

PH = 8.20000
ACTIVITY OF WATER = .99965
LOG ACTIVITY OF WATER = -.00015
TITRATION ALKALINITY = .14017E-02 EQ/KG H2O

----- ELECTRICAL IMBALANCE -----

THE CALCULATED IMBALANCE IS -.77451E-03 EQUIV/KG H2O
THIS IS 2.50 PER CENT OF THE IONIC STRENGTH

----- ACTIVITY RATIOS OF CATIONS -----

LOG (NA+)	6.1186
LOG (K+)	4.1017
LOG (CA++)	13.7638
LOG (MG++)	12.3158
LOG (AL+++)	10.1273
LOG (SR++)	12.0782
LOG (ZN++)	9.5334
LOG (MN++)	8.2893
LOG (FE++)	-1.3906
LOG (U++++)	-28.9474
LOG (U++++)	-59.4710
LOG (FE+++)	8.5220
LOG (UO2++)	5.2724
LOG (UO2+)	-13.6701

----- DISTRIBUTION OF AQUEOUS SPECIES -----

SPECIES	MOLAL CONC	LOG CONC	LOG G	ACTIVITY	LOG ACT
NA+	.975E-02	-2.0099	.0715	.929E-02	-2.0814
K+	.948E-04	-4.0232	.0751	.797E-04	-4.0983
CA++	.425E-02	-2.3713	.2648	.231E-02	-2.6382
MG++	.144E-03	-3.8403	.2648	.823E-04	-4.0842
AL+++	.113E-13	-13.9434	.5292	.356E-14	-14.4727
STO2(AQ)	.356E-03	-3.4479	0.0000	.356E-03	-3.4479
SR++	.901E-04	-4.0450	.2768	.476E-04	-4.3218
ZN++	.314E-06	-6.5018	.0577	.171E-06	-6.7666
NI+	.720E-08	-8.1423	.0699	.631E-08	-8.2000
CO3-	.800E-03	-3.0933	.0751	.686E-03	-3.1632
CL-	.450E-02	-2.3459	.2898	.379E-02	-2.4210
SO4--	.693E-02	-2.1593	.2898	.725E-02	-2.1491
MN++	.142E-07	-7.8458	.2648	.725E-06	-6.1107
FE++	.472E-16	-16.3257	.2648	.256E-16	-16.5906
UO2++	.1410E-10	-10.8508	.2768	.745E-11	-11.1276
HPO4--	.372E-06	-6.4290	.2898	.191E-06	-6.7188
H2(AQ)	.273E-46	-46.5624	.0035	.276E-46	-46.5589
U++	.287E-83	-83.5418	.5292	.849E-84	-84.0710
HS-	.196E-150	-150.7075	.0733	.165E-150	-150.7808
FE+++	.282E-61	-60.8721	.5292	.835E-61	-61.7474
UO2+	.125E-21	-21.7986	.0715	.134E-21	-21.9701
H2PO4-	.280E-07	-7.6421	.0715	.193E-07	-7.7136
CO3-	.565E-05	-5.0061	.2831	.511E-05	-5.2913
OH-	.193E-10	-10.7143	.0733	.107E-10	-10.7876
AL(OH)4-	.185E-10	-10.7329	.2648	.107E-10	-10.9978
KSO4-	.238E-05	-5.6217	.0715	.157E-05	-5.6950
NACL	.384E-06	-6.4150	.0733	.384E-06	-6.4150
NACD3-	.454E-05	-5.3425	0.0000	.387E-05	-5.4123
NASO4-	.181E-03	-3.7404	.0698	.154E-03	-3.8109
CACO3	.186E-04	-4.7292	.0705	.186E-04	-4.7292
CAHCO3+	.329E-04	-4.4816	.0676	.282E-04	-4.5492
CA5O4	.158E-02	-2.7739	0.0000	.168E-02	-2.7739
MGO3	.403E-06	-6.3942	0.0000	.403E-06	-6.3942
MgHCO3+	.813E-06	-6.0895	.0715	.690E-06	-6.1610

MGS04	.5180E-04	-4.2857	0.0000	.5180E-04	-4.2857
FES04	.1615E-16	-16.7919	0.0000	.1615E-16	-16.7919
FECL+ +	.1471E-16	-16.8323	-.2898	.7549E-17	-17.1221
FECL2+	.6304E-20	-20.2004	-.0715	.5347E-20	-20.2719
FECL3	.6152E-22	-22.2110	0.0000	.6152E-22	-22.2110
FECL4-	.3412E-26	-26.4670	-.0715	.2894E-26	-26.5385
FES04+	.2887E-14	-14.5396	-.0715	.2448E-14	-14.6111
MNS04	.4875E-08	-8.3120	0.0000	.4875E-08	-8.3120
ZNCL+	.2113E-08	-8.6751	-.0715	.1792E-08	-8.7466
ZNCL2	.1041E-10	-10.9827	0.0000	.1041E-10	-10.9827
ZNCL3-	.3792E-13	-13.4212	-.0715	.3216E-13	-13.4927
ZNCL4--	.1096E-15	-15.9601	-.2898	.5625E-16	-16.2499
ZNS04	.1417E-06	-6.8485	0.0000	.1417E-06	-6.8485
H3S104-	.1790E-04	-4.7471	-.0715	.1519E-04	-4.8186
ALS04+	.1476E-13	-13.8308	-.0715	.1252E-13	-13.9023
HS04-	.2676E-08	-8.5726	-.0715	.2270E-08	-8.6441
S--	.3381E-159	-159.4710	-.2768	.1788E-159	-159.7477
H2S(AQ)	.9996E-152	-152.0002	0.0000	.9996E-152	-152.0002
H2CO3	.9567E-05	-5.0192	.0035	.9644E-05	-5.0157
HCL	.1758E-16	-16.7549	0.0000	.1758E-16	-16.7549
MG(OH)+	.2588E-07	-7.5871	-.0715	.2195E-07	-7.6586
FE(OH)+	.2479E-16	-16.6057	-.0715	.2103E-16	-16.6773
CA(OH)+	.1115E-06	-6.9527	-.0715	.9457E-07	-7.0242
FE(OH)++	.1679E-09	-9.7751	-.2898	.8612E-10	-10.0649
FE(OH)2+	.1772E-06	-6.7516	-.0715	.1503E-06	-6.8231
FE(OH)3-	.1375E-23	-23.8617	-.0715	.1156E-23	-23.9332
FE(OH)4-	.8776E-05	-5.0567	-.0715	.7444E-05	-5.1282
NAOH	.2698E-08	-8.5690	0.0000	.2698E-08	-8.5690
(FE(OH)++)2	.3688E-17	-17.4332	-1.1631	.2534E-18	-18.5963
MN(OH)+	.3762E-10	-10.4246	-.0715	.3191E-10	-10.4961
MNC03	.1264E-06	-6.8981	0.0000	.1264E-06	-6.8981
UCL+++	.5198E-62	-62.2842	-.5502	.1464E-62	-62.8343
U(OH)+++	.2268E-53	-53.6444	-.5502	.6388E-54	-54.1946
U(OH)2++	.4810E-47	-47.3179	-.2768	.2543E-47	-47.5947
U(OH)3+	.1123E-41	-41.9495	-.0715	.9528E-42	-42.0210
U(OH)4	.3362E-37	-37.4735	0.0000	.3362E-37	-37.4735
U(OH)5-	.1558E-33	-33.8073	-.0715	.1322E-33	-33.8788
U6(OH)15(9+)	0.	-260.2331	-4.4360	0.	-264.6691
US04++	.3475E-58	-58.4590	-.2768	.1838E-58	-58.7358
U(S04)2	.1268E-56	-56.8969	0.0000	.1268E-56	-56.8969
U(HPO4)++	.6784E-56	-56.1685	-.2768	.3587E-56	-56.4453
U(HPO4)2	.7547E-53	-53.1222	0.0000	.7547E-53	-53.1222
U(HPO4)3--	.1253E-50	-50.9020	-.2898	.6430E-51	-51.1918
U(HPO4)4----	.2067E-48	-48.6847	-1.1631	.1420E-49	-49.8478
U02(OH)+	.2322E-08	-8.6342	-.0715	.1969E-08	-8.7057
U02(OH)2	.1871E-06	-6.7279	0.0000	.1871E-06	-6.7279
(U02)2(OH)2++	.6175E-11	-11.2094	-.2648	.3356E-11	-11.4742
(U02)3(OH)5+	.1153E-07	-7.9380	-.0682	.9858E-08	-8.0062
(U02)3(OH)7-	.1224E-06	-6.9122	-.0715	.1038E-06	-6.9837
U02CL+	.5722E-13	-13.2424	-.0715	.4853E-13	-13.3139
U02C03	.4799E-06	-6.3188	0.0000	.4799E-06	-6.3188
U02(C03)2--	.3800E-04	-4.4203	-.2898	.1949E-04	-4.7101
U02(C03)3----	.3645E-04	-4.4383	-1.1631	.2504E-05	-5.6014
U02S04	.1391E-10	-10.8567	0.0000	.1391E-10	-10.8567
U02(S04)2--	.2911E-11	-11.5360	-.2898	.1494E-11	-11.8258
U02(HPO4)	.3827E-09	-9.4171	0.0000	.3827E-09	-9.4171
U02(HPO4)2--	.2200E-05	-5.6576	-.2898	.1129E-05	-5.9475
U02(H2PO4)+	.1809E-15	-15.7425	-.0715	.1535E-15	-15.8140
U02(H2PO4)2	.8189E-21	-21.0868	0.0000	.8189E-21	-21.0868
U02(H2PO4)3-	.9526E-27	-27.0211	-.0715	.8080E-27	-27.0926

UO2SiO4(OH)3+	.1957E-08	-8.7084	-.0715	.1660E-08	-8.7799
PO4---	.6491E-10	-10.1877	-.6537	.1441E-10	-10.8414
H3PO4	.1726E-13	-13.7629	0.0000	.1726E-13	-13.7629
MGP04-	.4090E-08	-8.3883	-.0715	.3469E-08	-8.4598
CAP04-	.1156E-06	-6.9369	-.0715	.9808E-07	-7.0084
SRP04-	.2628E-09	-9.5804	-.0715	.2229E-09	-9.6519
FEP04-	.1127E-19	-19.9482	-.0715	.9556E-20	-20.0197
MNP04-	.2052E-12	-12.6879	-.0715	.1740E-12	-12.7594
ZNPO4-	.6701E-11	-11.1739	-.0715	.5683E-11	-11.2454
NAHP04-	.2653E-07	-7.5763	-.0715	.2250E-07	-7.6478
KHP04-	.1994E-09	-9.7002	-.0715	.1692E-09	-9.7777
MGHP04	.1280E-07	-7.8929	0.0000	.1280E-07	-7.8929
CAHP04	.2506E-06	-6.6010	0.0000	.2506E-06	-6.6010
SRHP04	.4154E-08	-8.3815	0.0000	.4154E-08	-8.3815
FEHP04	.1948E-19	-19.7103	0.0000	.1948E-19	-19.7103
MNHP04	.5627E-11	-11.2497	0.0000	.5627E-11	-11.2497
ZNHP04	.6370E-10	-10.1959	0.0000	.6370E-10	-10.1959
FEHP04+	.3492E-12	-12.4570	-.0715	.2962E-12	-12.5285
ALHP04+	.4775E-13	-13.3210	-.0715	.4050E-13	-13.3925
MGH2PO4+	.6191E-10	-10.2083	-.0715	.5251E-10	-10.2798
SRH2PO4+	.6389E-11	-11.1946	-.0715	.5419E-11	-11.2661
FEH2PO4+	.2930E-21	-21.5331	-.0715	.2485E-21	-21.6046
MNH2PO4+	.5583E-14	-14.2531	-.0715	.4736E-14	-14.3246
ZNH2PO4+	.1954E-12	-12.7090	-.0715	.1658E-12	-12.7805
FEH2PO4++	.8410E-19	-19.0752	-.2768	.4447E-19	-19.3520
ALH2PO4++	.2457E-18	-18.6096	-.2768	.1299E-18	-18.8864
P2O7----	.5376E-16	-16.2696	-1.1631	.3693E-17	-17.4327
HP2O7--	.2693E-15	-15.5698	-.6537	.5978E-16	-16.2234
H2P2O7--	.3727E-17	-17.4286	-.2898	.1912E-17	-17.7184
H3P2O7-	.2266E-23	-23.6447	-.0715	.1922E-23	-23.7162
H4P2O7	.7302E-31	-31.1365	0.0000	.7302E-31	-31.1365

----- SUMMARY OF AQUEOUS REDOX REACTIONS -----

COUPLE	EH, VOLTS	PE-	LOG F02	AH, KCAL
DEFAULT	.800	.1352E+02	3.791	18.450
H2(AQ)/H2O	.800	.1352E+02	3.791	18.450
U+++ /UO2++	.800	.1352E+02	3.791	18.450
HS- /SO4--	.800	.1352E+02	3.791	18.450
FE+++ /FE++	.800	.1352E+02	3.791	18.450
U+++ /UO2++	.800	.1352E+02	3.791	18.450
UO2+ /UO2++	.800	.1352E+02	3.791	18.450

----- SUMMARY OF AQUEOUS NON-EQUILIBRIUM NON-REDOX REACTIONS -----

COUPLE	AFFINITY, KCAL
NONE	

----- SUMMARY OF STOICHIOMETRIC MINERAL SATURATION STATES -----

(MINERALS WITH AFFINITIES .LT. -10 KCAL ARE NOT LISTED)

MINERAL	LOG Q/K	AFF, KCAL	STATE
PHENGITE	4.7960917	6.5432374	SUPERSATURATED

MAGNETITE	13.0257946	17.7708998	SUPERSATURATED
CORUNDUM	-1.1295791	-1.5410682	
HEMATITE	21.3655109	29.1486520	SUPERSATURATED
DEHYDRATED ANALC	-2.6380728	-3.5990838	
BRUCITE	-4.1232592	-5.6253018	
GIBBSITE	2.1665840	2.9558387	SUPERSATURATED
HALITE	-6.1113894	-8.3376786	
REYKJANES SMECTI	9.2599476	12.6332102	SUPERSATURATED
CALCITE	.5974631	.8151101	SUPERSATURATED
MAGNESITE	-1.4677236	-2.0023937	
RHODOCHROSITE	-2.8649280	-3.9085792	
DOLOMITE	.7584395	1.0347278	SUPERSATURATED
ANHYDRITE	-.8198834	-1.1185549	
GYP SUM	-.2355853	-.3214056	APPROX. SATURATED
QUARTZ	.5514461	.7523297	SUPERSATURATED
MAXIMUM MICROCLI	3.8020048	5.1870193	SUPERSATURATED
LOW ALBITE	2.8047733	3.8265109	SUPERSATURATED
ANORTHITE	.0595915	.0812998	APPROX. SATURATED
SEPIOLITE	-2.4291131	-3.3140033	
14A-AMESITE	5.6119972	7.6563652	SUPERSATURATED
NEPHELINE	-1.3357188	-1.8223015	
ANALCIME	2.0697763	2.8237653	SUPERSATURATED
KAOLINITE	5.9290111	8.0888626	SUPERSATURATED
CHRYSSOTILE	-1.4977344	-2.0433370	
PYROPHYLLITE	5.4027542	7.3708980	SUPERSATURATED
TALC	1.5927086	2.1729089	SUPERSATURATED
NA-BEIDELLITE	6.5842056	8.9827347	SUPERSATURATED
MUSCOVITE	9.5747748	13.0627243	SUPERSATURATED
ILLITE	6.9610309	9.4968321	SUPERSATURATED
ARTINITE	-6.6526356	-9.0760928	
TREMOLITE	-.1486665	-.2028235	APPROX. SATURATED
ENSTATITE	-2.6009622	-3.5484544	
DIOPSIDE	-1.7858376	-2.4363919	
WOLLASTONITE	-3.3079754	-4.5130222	
ZOISITE	3.6053511	4.9187274	SUPERSATURATED
KYANITE	.5110669	.6972411	SUPERSATURATED
FORSTERITE	-6.9628704	-9.4993416	
PREHNITE	4.1604651	5.6760614	SUPERSATURATED
HUNTITE	-5.5387077	-7.5563774	
AMORPHOUS SILICA	-.7342539	-1.0017318	
PHLOGOPITE	2.6091292	3.5595966	SUPERSATURATED
ANHYDROUS CORDIE	-5.9292444	-8.0891809	
K-FELDSPAR	3.8020048	5.1870193	SUPERSATURATED
HIGH SANIDINE	2.6028049	3.5509683	SUPERSATURATED
HIGH ALBITE	1.4860733	2.0274279	SUPERSATURATED
HYDROUS CORDIERI	-3.4483953	-4.7045950	
STRONTIANITE	1.8145605	2.4755782	SUPERSATURATED
K-BEIDELLITE	6.2486390	8.5249262	SUPERSATURATED
CA-BEIDELLITE	6.8951994	9.4070190	SUPERSATURATED
MG-BEIDELLITE	6.6746816	9.1061698	SUPERSATURATED
H-BEIDELLITE	5.5845675	7.6189432	SUPERSATURATED
CELESTITE	-.3394860	-.4631558	APPROX. SATURATED
ARAGONITE	.4324631	.5900031	SUPERSATURATED
NA-SAPONITE	2.7740600	3.7846093	SUPERSATURATED
K-SAPONITE	2.4384935	3.3268007	SUPERSATURATED
CLINOZOISITE	3.6500510	4.9797109	SUPERSATURATED
PARAGONITE	7.6810432	10.4791342	SUPERSATURATED
SPINEL	-5.8227874	-7.9439431	
DIASPORE	1.3753350	1.8763492	SUPERSATURATED
CA-SAPONITE	3.0851538	4.2090300	SUPERSATURATED

BOEHMITE	.5309350	.7243468	SUPERSATURATED
CHALCEDONY	.2802461	.3823356	APPROX. SATURATED
MG-SAPONITE	2.8646360	3.9081808	SUPERSATURATED
ALUNITE	-3.8768891	-5.2891828	SUPERSATURATED
7A-CLINOCHLORE	-.4501858	-.6141819	
ANDALUSITE	.2361669	.3221991	APPROX. SATURATED
H-SAPONITE	1.7850220	2.4352792	SUPERSATURATED
14A-CLINOCHLORE	2.9231142	3.9879616	SUPERSATURATED
SMITHSONITE	-2.1653069	-2.9540963	
MONTICELLITE	-7.1200836	-9.7138253	
NA-NONTRONITE	25.5989956	34.9243329	SUPERSATURATED
K-NONTRONITE	25.2634290	34.4665243	SUPERSATURATED
GROSSULAR	-.9323054	-1.2719305	
ALBITE	2.8047733	3.8265109	SUPERSATURATED
ORDERED EPIDOTE	14.8979961	20.3251167	SUPERSATURATED
ANDRADITE	19.4964846	26.5987670	SUPERSATURATED
CA-NONTRONITE	25.9099894	35.3486172	SUPERSATURATED
MG-NONTRONITE	25.6894716	35.0477680	SUPERSATURATED
H-NONTRONITE	24.6008575	33.5625878	SUPERSATURATED
CRISTOBALITE	-.0009461	.0012907	APPROX. SATURATED
DISORDERED DOLOM	-.7860605	-1.0724108	
ORDERED DOLOMITE	-.7584395	-1.0347278	SUPERSATURATED
NESQUEHONITE	-4.1669765	-5.6849446	
EPIDOTE	14.8979961	20.3251167	SUPERSATURATED
PD-OXYANNITE	36.4166467	49.6826950	SUPERSATURATED
WAIKAKITE	1.6675817	2.2750572	SUPERSATURATED
LAUMONTITE	6.0788799	8.2933263	SUPERSATURATED
MARGARITE	5.2056614	7.1020073	SUPERSATURATED
SILLIMANITE	-.1229331	-.1677158	APPROX. SATURATED
KALSILITE	-.4761873	-.6496553	
JADEITE	6.282272	8.570812	SUPERSATURATED
CA-AL PYROXENE	-5.8904546	-8.0362604	
GAMMA-UO3	-2.4607100	-3.3571104	
BETA-UO2(OH)2	-.2626610	-.3583445	APPROX. SATURATED
SCHÖEPITE	-.1667119	-.2274426	APPROX. SATURATED
GUMMITE	-5.1434100	-7.0170786	
URANOPHANE	-.0766003	-.1045047	APPROX. SATURATED
UO2SO4.3H2O	-6.0713248	-8.2830190	
RUTHERFORDINE	-1.9588254	-2.6723967	
HYDROXYAFATITE	10.9856541	14.9875662	SUPERSATURATED
STRENGITE	-1.4598674	-1.9916757	
MNHPO4(C)	-1.8843091	-2.5707352	
ZN3(PO4)2.4H2O	-6.6843203	-9.1193198	
BERLINITE	34.4994894	47.0671456	SUPERSATURATED
WHITLOCKITE	4.9541935	6.7569333	SUPERSATURATED
CAHPO4.2H2O	-2.7980198	-3.8172973	
SRHPO4(C)	-2.0406205	-5.5125591	

11 APPROX. SATURATED PURE MINERALS

0 APPROX. SATURATED END-MEMBERS OF SPECIFIED SOLID SOLUTIONS

0 SATURATED END-MEMBERS OF HYPOTHETICAL SOLID SOLUTIONS

59 SUPERSATURATED PURE MINERALS

0 SUPERSATD. END-MEMBERS OF SPECIFIED SOLID SOLUTIONS

0 SUPERSATD. HYPOTHETICAL SOLID SOLUTION PHASES

----- SUMMARY OF GASES -----

GAS	FUGACITY	LOG FUGACITY
CO ₂ (G)	.296131E-03	-3.52852
O ₂ (G)	.617571E+04	3.79069
S ₂ (G)	0.	-240.74353
Cl ₂ (G)	.381512-154	-154.41849
H ₂ (G)	.357360E-43	-43.44689
H ₂ O(G)	.101394-150	-150.99399
STEAM	.313003E-01	-1.50445

----- END OF OUTPUT -----

----- END OF INPUT FILE -----

UTITL
CLIMAX GROUND WATER
WELL WATER UG-02
BASED ON JACK HARRAR'S MEMO OF 1/20/82
TEMPERATURE NOT REPORTED, 25 DEG C ASSUMED

TEMPC

.250000E+02

RHO

0.

TDS1

0. TDS2

F02/EH/PE

.100000E+00

0.

COUPLE

0.

TOLBT

0.

0.

O2(AQ)

0.

TOLSAT

ITERMX

0

0.

0.

IOPT

-1

2

3

4

5

6

7

8

9

IPRNT

-1

2

3

4

5

6

7

0

0

IDBUG

-1

2

3

4

5

6

7

0

UEBAL

0

0

0

0

0

0

0

0

SUPPRESSED/ALTERED SPECIES (AQ, MIN, GAS, SOL)

0

0

0

0

NA+

.22000E+03

2

K+

.39000E+01

2

CA++

.11100E+03

2

MG++

.15000E+01

2

AL+++

.50000E-01

2

SI O2(AQ)

.26300E+02

2

SR++

.37000E+01

2

ZN++

.60000E+00

2

H+

.75000E+01

16

HC03-

CO3--

0.

30

CL-

.67000E+02

2

SO4--

.50000E+03

2

MN++

.40000E-01

2

FE++

.96000E+00

2

U02++

U++++

.10000E+00

2

O2(G)

0.

0

O2(AQ)

0.

4

H2(AQ)

0.

27

HCO3-

.16500E+03

2

HP04--

.30000E+00

2

ENDIT.

FILE DATA1 HAS BEEN SUCCESSFULLY READ

----- CONFLICTING INPUT OPTIONS FOR F02 -----

IOPT1 = -1 OVERRIDES URED0X = O2(AQ)

```

EEEE  QQQ  33333
EEEE  QQ   Q   3
EEEE  QQ   Q   33
EEEE  QQ   Q   3
EEEE  QQQ  3333
      Q

```

3230 VERSION

CLIMAX GROUND WATER
 WELL WATER UG-02
 BASED ON JACK HARRAR'S MEMO OF 1/20/82
 TEMPERATURE NOT REPORTED, 25 DEG C ASSUMED

DATA FILE SET DEQPAK9
 SUPPORTING DATA FOR PROGRAMS EQ3 AND EQ6
 1 ATM.-STEAM SATURATION CURVE DATA
 LAST REVISED 20 NOVEMBER 1981

THE TOTAL PRESSURE IS 1.0134 BARS
 THE TEMPERATURE IS 25.00 DEGREES CELSIUS

29 ELEMENTS ARE IN THE DATA BASE
 40 ELEMENTS CAN BE LOADED INTO MEMORY
 17 ELEMENTS ARE IN THE PROBLEM SYSTEM

170 AQUEOUS SPECIES WERE LOADED INTO MEMORY
 300 AQUEOUS SPECIES CAN BE LOADED INTO MEMORY

140 AQUEOUS REACTIONS WERE LOADED INTO MEMORY
 259 AQUEOUS REACTIONS CAN BE LOADED INTO MEMORY

148 MINERALS WERE LOADED INTO MEMORY
 275 MINERALS CAN BE LOADED INTO MEMORY

12 SOLID SOLUTIONS ARE IN THE DATA BASE
 20 SOLID SOLUTIONS CAN BE LOADED INTO MEMORY

7 GASES WERE LOADED INTO MEMORY
 15 GASES CAN BE LOADED INTO MEMORY

IOPT1 = -1 (REDOX OPTION SWITCH)
 IOPT2 = 0 (AUTOMATIC BASIS SWITCHING SWITCH)
 IOPT3 = 0 (INTERFACING OUTPUT CONTROL SWITCH)
 IOPT4 = 0 (TURN-ON SOLID SOLUTIONS SWITCH)
 IOPT5 = 0 (NOT CURRENTLY USED)
 IOPT6 = 0 (NOT CURRENTLY USED)
 IOPT7 = 0 (TURN OFF LUREFF CALLS SWITCH)
 IOPT8 = 0 (CONV. TEST CRITERIA SWITCH)
 IOPT9 = 3 (MAXIMUM PTS. USED IN FIND ROUTINE)

```

IPRNT1 = -1 (LIST LOADING OF SPECIES)
IPRNT2 = 0 (LIST REACTIONS AND LOG K VALUES)
IPRNT3 = 0 (NOT CURRENTLY USED)
IPRNT4 = 0 (SPECIATION PRINT CONTROL)
IPRNT5 = 0 (NOT CURRENTLY USED)
IPRNT6 = 0 (NOT CURRENTLY USED)
IPRNT7 = 0 (MINERAL AFFINITY PRINT CONTROL)

```

```

IDBUG1 = 0 (PRINT INFO. MESSAGES SWITCH)
IDBUG2 = 0 (PRINT DATA READ INFO. SWITCH)
IDBUG3 = 0 (NOT CURRENTLY USED)
IDBUG4 = 0 (PRINT NEWTON-RAPHSON ITERATIONS SWITCH)
IDBUG5 = 0 (NOT CURRENTLY USED)
IDBUG6 = 0 (LIST STOICH. EQUIVALENCES SWITCH)
IDBUG7 = 0 (WRITE REACTIONS ON RFILE SWITCH)

```

THE DEFAULT REDOX STATE IS CONSTRAINED BY EH = .10000 VOLTS

```

SOLUTION DENSITY = 1.00000 G/ML
TOTAL DISSOLVED SALTS = 0.00 MG/KG SOLUTION
TOTAL DISSOLVED SALTS = 0.00 MG/L

```

```

TOLBT = .10000E-09 (CONVERGENCE TOLERANCE ON RESIDUAL FUNCTIONS)
TOLDL = .10000E-09 (CONVERGENCE TOLERANCE ON CORRECTION TERMS)
TOLSAT = .50000E+00 (PHASE SATURATION TOLERANCE, DOES NOT AFFECT
CONVERGENCE)

```

85

----- INPUT CONSTRAINTS -----

SPECIES	CSP	JFLAG	TYPE OF INPUT	UPHASE	BASIS SPECIES
NA+	.22000E+03	2	TOT CONC, MG/L		
K+	.39000E+01	2	TOT CONC, MG/L		
CA++	.11100E+03	2	TOT CONC, MG/L		
MG++	.15000E+01	2	TOT CONC, MG/L		
AL+++	.50000E-01	2	TOT CONC, MG/L		
SiO2(AQ)	.26300E+02	2	TOT CONC, MG/L		
SR++	.37000E+01	2	TOT CONC, MG/L		
ZN++	.60000E+00	2	TOT CONC, MG/L		
H+	.75000E+01	16	LOG ACTIVITY		
CO3--	0.	30	ELIMINATED SPECIES		HC03-
CL-	.67000E+02	2	TOT CONC, MG/L		
SO4--	.50000E+03	2	TOT CONC, MG/L		
MN++	.40000E-01	2	TOT CONC, MG/L		
FE++	.96000E+00	2	TOT CONC, MG/L		
U++++	.10000E+00	2	TOT CONC, MG/L		U02++
O2(AQ)	0.	4	FREE CONC, MOLAL		
H2(AQ)	0.	27	DEPENDENT SPECIES		
HC03-	.16500E+03	2	TOT CONC, MG/L		CO3--
H2C03--	.30000E+00	2	TOT CONC, MG/L		

----- INACTIVE AQUEOUS SPECIES -----

CH4(AQ)	MN+++	KCL	KC03-
FECL+	FECL2	FECL3-	FECL4--
FE(S04)2-	MNCL+	MNCL2	MNCL3-
MNCL4--	MNCL++	MNCL2+	MNCL3
MNCL4-	KOH	MGCL+	

SWITCHING C03-- FROM THE BASIS FOR HC03-

1.000	HC03-	
=		LOG K = -10.3281
1.000	H+	
+ 1.000	C03--	
1.000	C03--	
+ 1.000	H+	
=		LOG K = 10.3281
1.000	HC03-	

SWITCHING U+++ FROM THE BASIS FOR U02++

1.000	U02++	
+ 2.000	H+	
=		LOG K = -32.3246
1.000	H2O	
+ 1.000	U+++	
+ .500	O2(G)	
1.000	U+++	
+ 1.000	H2O	
+ .500	O2(G)	
=		LOG K = 32.3246
2.000	H+	
+ 1.000	U02++	

98

SPECIES	CSP	JFLAG	TYPE OF INPUT	UPHASE
NA+	.95694E-02	0	TOT CONC, MOLAL	
K+	.99749E-04	0	TOT CONC, MOLAL	
CA++	.27695E-02	0	TOT CONC, MOLAL	
MG++	.61716E-04	0	TOT CONC, MOLAL	
AL+++	.18531E-05	0	TOT CONC, MOLAL	
SI02(AQ)	.43772E-03	0	TOT CONC, MOLAL	
SR++	.42228E-04	0	TOT CONC, MOLAL	
ZN++	.91771E-05	0	TOT CONC, MOLAL	
H+	-.75000E+01	16	LOG ACTIVITY	
HC03-	.27042E-02	0	TOT CONC, MOLAL	
CL-	.18898E-02	0	TOT CONC, MOLAL	
S04--	.52052E-02	0	TOT CONC, MOLAL	
MN++	.72809E-06	0	TOT CONC, MOLAL	
FE++	.17190E-04	0	TOT CONC, MOLAL	
U02++	.42012E-06	0	TOT CONC, MOLAL	
HP04--	.31257E-05	0	TOT CONC, MOLAL	
O2(AQ)			NOT PRESENT IN THE MODEL	
H2(AQ)	0	27	DEPENDENT SPECIES	
CH4(AQ)			NOT PRESENT IN THE MODEL	

U+++	0.	30	ELIMINATED SPECIES
HS-	0.	30	ELIMINATED SPECIES
MN+++			NOT PRESENT IN THE MODEL
FE+++	0.	30	ELIMINATED SPECIES
U++++	0.	30	ELIMINATED SPECIES
UO2+	0.	30	ELIMINATED SPECIES
H2PO4-	0.	30	ELIMINATED SPECIES
CO3--	0.	30	ELIMINATED SPECIES
OH-	0.	30	ELIMINATED SPECIES

THE ION FOR ESTIMATING WATER ACTIVITY IS NA+

ITER = 0	DELMAX = 0.	DEL() = 0.	BETA(AL+++) = .268E+01	DELFNC = 0
ITER = 1	DELMAX = .526E+00	DEL(X1) = .131E+00	BETA(AL+++) = .206E+01	DELFNC = 0.
ITER = 2	DELMAX = .258E+00	DEL(X1) = .644E-01	BETA(AL+++) = .159E+01	DELFNC = .510E+00
ITER = 3	DELMAX = .219E+00	DEL(AL+++) = -.219E+00	BETA(AL+++) = .402E+00	DELFNC = .152E+00
ITER = 4	DELMAX = .131E+00	DEL(AL+++) = -.131E+00	BETA(UO2++) = .516E-01	DELFNC = .399E+00
ITER = 5	DELMAX = .218E-01	DEL(AL+++) = -.218E-01	BETA(UO2++) = .150E-02	DELFNC = .834E+00
ITER = 6	DELMAX = .517E-03	DEL(AL+++) = -.517E-03	BETA(UO2++) = .121E-05	DELFNC = .976E+00
ITER = 7	DELMAX = .467E-06	DEL(UO2++) = -.467E-06	BETA(AL+++) = -.132E-09	DELFNC = .999E+00
ITER = 8	DELMAX = .224E-10	DEL(UO2++) = -.224E-10	BETA(AL+++) = -.750E-12	DELFNC = .100E+01

NEWTON-RAPHSON ITERATION CONVERGED IN 8 STEPS

----- SUMMARY OF THE AQUEOUS PHASE -----

----- ELEMENTAL COMPOSITION OF THE AQUEOUS PHASE -----

ELEMENT	MG/L	MG/KG	MOLES/KG
O	888592.8769	888592.8769	.5553913752E+02
NA	219.9978	219.9978	.9569377990E-02
K	3.9000	3.9000	.9974934779E-04
CA	111.0000	111.0000	.2769461078E-02
MG	1.5000	1.5000	.6171569636E-04
AL	.0500	.0500	.1853087243E-05
SI	12.2936	12.2936	.4377205246E-03
SR	3.7000	3.7000	.4222780187E-04
ZN	.6000	.6000	.9177118385E-05
H	111698.5335	111698.5335	.1110214639E+03
C	32.4797	32.4797	.2704164413E-02
CL	67.0000	67.0000	.1889825967E-02
S	166.8783	166.8783	.5205188532E-02
MN	.0400	.0400	.7280934872E-06
FE	.9600	.9600	.1718982219E-04
U	.1000	.1000	.4201168765E-06
P	.0968	.0968	.3125683743E-05

----- ELEMENTAL COMPOSITION AS STRICT BASIS SPECIES -----

SPECIES	MG/L	MG/KG	MOLES/KG
H2O	1000537.5625	1000537.5625	.5553913752E+02
NA+	220.0000	220.0000	.9569377990E-02
K+	3.9000	3.9000	.9974934779E-04
CA++	111.0000	111.0000	.2769461078E-02
MG++	1.5000	1.5000	.6171569636E-04
AL+++	.0500	.0500	.1853087243E-05
SiO2(A)	26.3000	26.3000	.4377205246E-03
SR++	3.7000	3.7000	.4222780187E-04
ZN++	.6000	.6000	.9177118385E-05
H+	111909.6356	111909.6356	.1110214639E+03
HCO3--	162.2742	162.2742	.2704164413E-02
CL-	67.0000	67.0000	.1889825967E-02
SO4--	500.0000	500.0000	.5205188532E-02
MN++	.0400	.0400	.7280934872E-06
FE++	.9600	.9600	.1718982219E-04
UO2++	.1000	.1000	.4201168765E-06
HFO4--	.3000	.3000	.3125683743E-05

----- EQUIVALENT COMPOSITION OF THE AQUEOUS PHASE -----

SPECIES	MOLES/KG H2O
H2O	.5553913752E+02
NA+	.9569377990E-02
K+	.9974934779E-04
CA++	.2769461078E-02
MG++	.6171569636E-04
AL+++	.1853087243E-05
SiO2(AQ)	.4377205246E-03
SR++	.4222780187E-04
ZN++	.9177118385E-05
H+	.1110214639E+03
HCO3-	.2704164413E-02
CL-	.1889825967E-02
SO4--	.5205188532E-02
MN++	.7280934872E-06
FE++	.1718982219E-04
UO2++	.4201168765E-06
HFO4--	.3125683743E-05

IONIC STRENGTH = .0202731337467
 EQUIV. STOICH. IONIC STRENGTH (NA+) = .0095693779904

PH = 7.50000
 ACTIVITY OF WATER = .99967
 LOG ACTIVITY OF WATER = -.00015
 TITRATION ALKALINITY = .25784E-02 EQ/KG H2O

----- ELECTRICAL IMBALANCE -----

THE CALCULATED IMBALANCE IS .59153E-03 EQUIV/KG H2O
 THIS IS 2.92 PER CENT OF THE IONIC STRENGTH

----- ACTIVITY RATIOS OF CATIONS -----

LOG (NA+ /H+*1)	5.4148
LOG (K+ /H+*1)	3.4284
LOG (CA++ /H+*2)	12.0906
LOG (MG++ /H+*2)	10.4675
LOG (AL+++ /H+*3)	9.8385
LOG (SR++ /H+*2)	10.3913
LOG (ZN++ /H+*2)	9.6055
LOG (MN++ /H+*2)	7.7685
LOG (FE++ /H+*2)	9.8697
LOG (U+++ /H+*4)	-7.3832
LOG (U+++ /H+*3)	-25.3739
LOG (FE+++ /H+*3)	6.0492
LOG (UO2++ /H+*2)	1.7705
LOG (UO2+ /H+*1)	-4.6390

----- DISTRIBUTION OF AQUEOUS SPECIES -----

SPECIES	MOLAL CONC	LOG CONC	LOG G	ACTIVITY	LOG ACT
NA+	.9443E-02	-2.0249	-.0602	.8219E-02	-2.0852
K+	.9799E-04	-4.0088	-.0628	.8481E-04	-4.0716
CA++	.2071E-02	-2.6838	-.2257	.1232E-02	-2.9094
MG++	.4761E-04	-4.3223	-.2102	.2934E-04	-4.5325
AL+++	.6266E-12	-12.2030	-.4585	.2180E-12	-12.6615
SI02(AQ)	.4335E-03	-3.3630	0.0000	.4335E-03	-3.3630
SR++	.4222E-04	-4.3745	-.2342	.2462E-04	-4.6087
ZN++	.6779E-05	-5.1688	-.2257	.4032E-05	-5.3945
H+	.3550E-07	-7.4498	-.0502	.3162E-07	-7.5000
HCO3-	.2484E-02	-2.6048	-.0591	.2168E-02	-2.6639
CL-	.1888E-02	-2.7240	-.0628	.1634E-02	-2.7867
SO4--	.4423E-02	-2.3543	-.2435	.2525E-02	-2.5978
MN++	.9866E-07	-7.0058	-.2257	.5868E-07	-7.2315
FE++	.1245E-04	-4.9047	-.2257	.7408E-05	-5.1303
UO2++	.1011E-12	-12.9952	-.2342	.5896E-13	-13.2295
HPO4--	.1374E-05	-5.8619	-.2435	.7845E-06	-6.1054
H2(AQ)	.3198E-21	-21.4951	.0023	.3215E-21	-21.4929
U+++	.3842E-47	-47.4154	-.4585	.1337E-47	-47.8739
HS-	.1248E-49	-49.9039	-.0615	.1083E-49	-49.9654
FE+++	.1018E-15	-15.9923	-.4585	.3542E-16	-16.4508
U+++	.2410E-36	-36.6180	-.7653	.4138E-37	-37.3832
UO2+	.8342E-12	-12.0788	-.0602	.7261E-12	-12.1390
H2FO4-	.4571E-06	-6.3400	-.0602	.3979E-06	-6.4002
CO3--	.5582E-05	-5.2532	-.2388	.3221E-05	-5.4920
OH-	.3749E-06	-6.4261	-.0615	.3254E-06	-6.4875
AL(OH)++	.2183E-09	-9.6609	-.2257	.1298E-09	-9.8866
AL(OH)+	.1853E-05	-5.7322	-.0602	.1613E-05	-5.7924
KSO4-	.1756E-05	-5.7555	-.0615	.1524E-05	-5.8169
NaCl	.1643E-05	-5.7845	0.0000	.1643E-05	-5.7845
NaCO3-	.2769E-06	-6.5578	-.0591	.2416E-06	-6.6168
NaSO4-	.1248E-03	-3.9038	-.0595	.1088E-03	-3.9633
CaCO3	.6264E-05	-5.2031	0.0000	.6264E-05	-5.2031
CaHCO3+	.5423E-04	-4.2657	-.0575	.4751E-04	-4.3232
CaSO4	.6371E-03	-3.1958	0.0000	.6371E-03	-3.1958
MgCO3	.9051E-07	-7.0433	0.0000	.9051E-07	-7.0433
MgHCO3+	.8915E-06	-6.0499	-.0602	.7760E-06	-6.1101
MgSO4	.1310E-04	-4.8827	0.0000	.1310E-04	-4.8827
FeSO4	.3308E-05	-5.4804	0.0000	.3308E-05	-5.4804
FeCL++	.2415E-17	-17.6171	-.2435	.1378E-17	-17.8606

FFC2+	4832E-23	1	23	1	369	1	23	1	369
FLC1-	2085E-28	1	28	1	369	1	28	1	369
FLC1-	4866E-15	1	15	1	369	1	15	1	369
FLC1-	2621E-07	1	7	1	369	1	7	1	369
ANCL2	2080E-13	1	13	1	369	1	13	1	369
ANCL2	6559E-13	1	13	1	369	1	13	1	369
ANCL3--	2971E-05	1	5	1	369	1	5	1	369
ANCL4--	4232E-12	1	12	1	369	1	12	1	369
HS104-	6614E-08	1	8	1	369	1	8	1	369
ALSO4-	9999E-09	1	9	1	369	1	9	1	369
HSO4-	3275E-03	1	3	1	369	1	3	1	369
S--	1518E-03	1	3	1	369	1	3	1	369
H2S(AO)	3796E-16	1	16	1	369	1	16	1	369
H2O3	1792E-08	1	8	1	369	1	8	1	369
HCL	1391E-07	1	7	1	369	1	7	1	369
MGL(OH)+	1356E-10	1	10	1	369	1	10	1	369
FE(OH)+	2913E-14	1	14	1	369	1	14	1	369
CA(OH)+	3071E-08	1	8	1	369	1	8	1	369
FE(OH)+	5337E-08	1	8	1	369	1	8	1	369
FE(OH)2+	1717E-19	1	19	1	369	1	19	1	369
FE(OH)3-	5337E-08	1	8	1	369	1	8	1	369
FE(OH)4-	1537E-10	1	10	1	369	1	10	1	369
NACH	6030E-06	1	6	1	369	1	6	1	369
(FECH++)2	4346E-38	1	38	1	369	1	38	1	369
MN(OH)+	8782E-30	1	30	1	369	1	30	1	369
MNC3	4015E-24	1	24	1	369	1	24	1	369
UCL++	2011E-19	1	19	1	369	1	19	1	369
U(OH)++	1232E-12	1	12	1	369	1	12	1	369
U(OH)++	1111E-12	1	12	1	369	1	12	1	369
U(OH)3+	7820-125	1	125	1	369	1	125	1	369
U(OH)4	5175E-34	1	34	1	369	1	34	1	369
U(OH)5-(9+)	1479E-31	1	31	1	369	1	31	1	369
USO4++	5841E-31	1	31	1	369	1	31	1	369
U(SO4)2	2942E-27	1	27	1	369	1	27	1	369
U(H2O4)++	1803E-24	1	24	1	369	1	24	1	369
U(H2O4)2	8839E-22	1	22	1	369	1	22	1	369
U(H2O4)3--	3570E-11	1	11	1	369	1	11	1	369
U(H2O4)4--	1405E-10	1	10	1	369	1	10	1	369
UO2(OH)2++	7427E-18	1	18	1	369	1	18	1	369
UO2(OH)2++	1900E-15	1	15	1	369	1	15	1	369
UO2(OH)5+	1072E-08	1	8	1	369	1	8	1	369
UO2(OH)7-	4688E-07	1	7	1	369	1	7	1	369
UO2Cl+	7811E-13	1	13	1	369	1	13	1	369
UO2CO3	1243E-10	1	10	1	369	1	10	1	369
UO2CO32--	2636E-06	1	6	1	369	1	6	1	369
UO2CO33--	2743E-25	1	25	1	369	1	25	1	369
UO2(SO4)2--	4178E-11	1	11	1	369	1	11	1	369
UO2(SO4)2--	1243E-10	1	10	1	369	1	10	1	369
UO2(H2PO4)2--	2636E-06	1	6	1	369	1	6	1	369
UO2(H2PO4)2--	2743E-25	1	25	1	369	1	25	1	369
UO2(H2PO4)3+	4178E-11	1	11	1	369	1	11	1	369
UO2S16(OH)3+	4178E-11	1	11	1	369	1	11	1	369
PO4--	4178E-11	1	11	1	369	1	11	1	369
H3PO4	4178E-11	1	11	1	369	1	11	1	369

MGP04-	.1163E-08	-8.9345	-.0602	.1012E-08	-8.9948
CAP04-	.4921E-07	-7.3080	-.0602	.4283E-07	-7.3682
SFP04-	.1083E-09	-9.9652	-.0602	.9430E-10	-10.0255
FEPO4-	.2595E-08	-8.5858	-.0602	.2259E-08	-8.6461
MNP04-	.1240E-11	-11.9066	-.0602	.1079E-11	-11.9668
ZNPO4-	.1260E-09	-9.8996	-.0602	.1097E-09	-9.9598
NAHP04-	.1052E-06	-6.9779	-.0602	.9159E-07	-7.0382
KHP04-	.8485E-09	-9.0713	-.0602	.7386E-09	-9.1316
MGHP04	.1871E-07	-7.7279	0.0000	.1871E-07	-7.7279
CAHP04	.5485E-06	-6.2608	0.0000	.5485E-06	-6.2608
SRHP04	.8810E-08	-8.0550	0.0000	.8810E-08	-8.0550
FEHP04	.2309E-07	-7.6367	0.0000	.2309E-07	-7.6367
MNHP04	.1749E-09	-9.7571	0.0000	.1749E-09	-9.7571
ZNHP04	.6161E-08	-8.2103	0.0000	.6161E-08	-8.2103
FEHP04+	.5921E-12	-12.2276	-.0602	.5154E-12	-12.2878
ALHP04+	.1237E-10	-10.9077	-.0602	.1077E-10	-10.9679
MGH2PO4+	.4421E-09	-9.3545	-.0602	.3848E-09	-9.4147
SRH2PO4+	.6617E-10	-10.1794	-.0602	.5760E-10	-10.2396
FEH2PO4+	.1696E-08	-8.7707	-.0602	.1476E-08	-8.8310
MNH2PO4+	.8477E-12	-12.0718	-.0602	.7379E-12	-12.1320
ZNH2PO4+	.9233E-10	-10.0347	-.0602	.8037E-10	-10.0949
FEH2PO4++	.6651E-18	-18.1771	-.2342	.3879E-18	-18.4113
ALH2PO4++	.2968E-15	-15.5276	-.2342	.1731E-15	-15.7618
P2O7----	.5897E-15	-15.2294	-.9765	.6226E-16	-16.2058
HP2O7---	.1788E-13	-13.7477	-.5489	.5051E-14	-14.2966
H2P2O7--	.1419E-14	-14.8481	-.2435	.8098E-15	-15.0916
H3P2O7-	.4686E-20	-20.3292	-.0602	.4079E-20	-20.3894
H4P2O7	.7768E-27	-27.1097	0.0000	.7768E-27	-27.1097

----- SUMMARY OF AQUEOUS REDOX REACTIONS -----

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COUPLE	EH, VOLTS	PE-	LOG F02	AH, KCAL
DEFAULT	.100	.1690E+01	-46.341	2.306
H2(AQ):H2O	.100	.1690E+01	-46.341	2.306
U+ + + / UO2++	.100	.1690E+01	-46.341	2.306
HS- / SO4--	.100	.1690E+01	-46.341	2.306
FE++ / FE++	.100	.1690E+01	-46.341	2.306
U+ + + / UO2++	.100	.1690E+01	-46.341	2.306
UO2+ / UO2++	.100	.1690E+01	-46.341	2.306

----- SUMMARY OF AQUEOUS NON-EQUILIBRIUM NON-REDOX REACTIONS -----

COUPLE AFFINITY, KCAL
NONE

----- SUMMARY OF STOICHIOMETRIC MINERAL SATURATION STATES -----

(MINERALS WITH AFFINITIES .LT. -10 KCAL ARE NOT LISTED)

MINERAL	LOG Q/K	AFF, KCAL	STATE
14A-DAPHNITE	17.1092925	23.3419558	SUPERSATURATED
PHENGITE	2.3249579	3.1719058	SUPERSATURATED
MAGNETITE	18.1405054	24.7488244	SUPERSATURATED
CORUNDUM	-1.7072088	-2.3291199	

HEMATITE	16.4199758	22.4015313	SUPERSATURATED
DEHYDRATED ANALC	-3.4609816	-4.7217663	
DIOPHASE	-5.9716153	-8.1469875	
OTTOPEITE	1.8777780	2.5618248	SUPERSATURATED
HARITE	-6.4808751	-8.8417625	
REYNOLDS SMECTI	7.9163294	10.8001317	SUPERSATURATED
CALCITE	1.234835	1.1684667	APPROX. SATURATED
MAGNESITE	-2.1168315	-2.8879620	
SIDERITE	-2.1099687	2.8785993	SUPERSATURATED
RHODOCHROSITE	-2.1864979	-2.9830069	
DOLomite	-1.3646480	-1.4974839	APPROX. SATURATED
ANHYDRITE	-1.2418098	-1.6941828	
GYPSUM	-1.6574999	-1.8970175	
QUARTZ	1.6362780	1.8680646	SUPERSATURATED
MAXIMUM MICROCL	3.0943957	4.2216335	SUPERSATURATED
LOW ALBITE	2.0666963	2.8195634	SUPERSATURATED
ANORTHITE	-2.0216086	-2.7580509	
14A-AMESITE	-2.7670248	-3.7750111	
NEPHELINE	-2.2434596	-3.0607189	
ANALCITE	1.2468733	1.7010909	SUPERSATURATED
FAULINITE	5.5210560	7.5322967	SUPERSATURATED
CHRYSOTILE	-6.8731463	9.3769323	
EPIDYLLITE	-5.1644579	7.0457939	SUPERSATURATED
TALC	-3.6130453	-4.4292245	
PARALDITE	5.9902658	8.1725679	SUPERSATURATED
PRE-CLITE	8.1490418	11.3992998	SUPERSATURATED
ILLITE	5.1224008	7.3140036	SUPERSATURATED
ANDITE	9.6000392	13.1021036	SUPERSATURATED
PHILLITE	-4.3611027	-5.9544132	
HEULANDITE	-0.1377705	-2.0693847	
WOLLASTONITE	-4.3902776	-6.0000561	
ZONITE	-1.0030634	-1.4816791	APPROX. SATURATED
KYANITE	1.0181691	1.0249243	APPROX. SATURATED
FAIRFAXITE	1.0012371	2.3114227	SUPERSATURATED
IRIDITE	1.4908685	1.6696847	SUPERSATURATED
AMPHIBOLUS SILICA	-1.6494220	-1.8859969	
ULFVINGITE	-3.1510918	-4.2989881	SUPERSATURATED
PHOSPHATE	-3.6435614	-4.9708572	
PHOSPHATE	3.0943957	4.2216385	SUPERSATURATED
HILFMANINE	1.8951957	2.5855873	SUPERSATURATED
HILFMANINE	1.7479963	1.0204804	SUPERSATURATED
CLINTIANITE	1.3268646	1.8102219	SUPERSATURATED
HEULANDITE	5.6648536	7.7284764	SUPERSATURATED
CA-BELOLLITE	6.2575160	8.5370370	SUPERSATURATED
NG-BELOLLITE	6.0081021	8.1967652	SUPERSATURATED
H-BELOLLITE	5.2229688	7.1256195	SUPERSATURATED
CELESTITE	-1.7751286	-1.0574965	
FERROUS OXIDE	-1.4475705	-1.9748991	
ARAGONITE	-1.0415165	-1.0566404	APPROX. SATURATED
NA-SAPONITE	-2.7872374	-3.8025869	
K-SAPONITE	-3.1127496	-4.2466795	
CLINOZOISITE	-1.3083634	-1.4206956	APPROX. SATURATED
PARAGONITE	6.3653424	8.6841430	SUPERSATURATED
DIASPORE	1.0865230	1.4823274	SUPERSATURATED
CA-SAPONITE	-2.5199871	-3.4379814	
BOEHMITE	1.2421230	1.3303249	APPROX. SATURATED
CHALCEDONY	1.3650780	1.4980705	APPROX. SATURATED
MG-SAPONITE	-2.7694011	-3.7782532	
ALUNITE	-2.9139903	-3.9755141	
ANDALUSITE	-1.2566309	-1.3501177	APPROX. SATURATED

H-SAPONITE	-3	5440344	-4	8350740	
14A-CLINOCHLORE	-6	6418087	-9	0613218	
SMITHSONITE	-	9939076	-1	3559735	
NA-NONTRONITE	20	6372504	28	1550970	SUPERSATURATED
K-NONTRONITE	20	3117382	27	7110055	SUPERSATURATED
GROSSULAR	-6	2751421	-8	5610841	
ALBITE	2	0666963	2	8195634	SUPERSATURATED
ORDERED EPIDOTE	8	7556290	11	9451757	SUPERSATURATED
ANDRADITE	9	7857425	13	3505444	SUPERSATURATED
HEDENBERGITE	-2	0206703	-2	7567707	
CA-NONTRONITE	20	9044007	28	5195661	SUPERSATURATED
MG-NONTRONITE	20	6549867	28	1782943	SUPERSATURATED
H-NONTRONITE	19	8713534	27	1101950	SUPERSATURATED
CRISTOBALITE	-	0857780	-	1170256	APPROX SATURATED
DISORDERED DOLOM	-1	9091480	-2	6046225	
ORDERED DOLOMITE	-	3646480	-	4974839	APPROX SATURATED
FERROSILITE	-	9604075	1	3102098	SUPERSATURATED
NESQUEHONITE	-4	8160667	-6	5704890	
EPIDOTE	8	7556289	11	9451757	SUPERSATURATED
PD-OXYANITE	28	2907319	38	5066291	SUPERSATURATED
WATRAKITE	-	2439429	-	3088077	APPROX SATURATED
LAUMONTITE	4	1673663	5	6854774	SUPERSATURATED
MARGARITE	2	5468375	3	4746129	SUPERSATURATED
SILLIMANITE	-	6157309	-	8400325	
KALSILITE	-1	3534602	-1	8465059	
JADEITE	-	1946816	-	2656013	APPROX SATURATED
GREENALITE	6	8585544	9	3570248	SUPERSATURATED
MINNESOTAITE	8	8211554	12	0345724	SUPERSATURATED
7A-CHAPOSITE	7	0210361	9	5286939	SUPERSATURATED
URANINITE	-2	7720358	-3	7832119	
GAMMA-UO3	-5	9026191	-8	1247124	
ALPHA-U3O8	-6	5987739	-9	0626101	
BETA-UO2(OH)2	-3	7645642	-5	1059395	
SCHOEPIITE	-3	6686092	-5	0050296	
COFFINITE	-3	1161578	-4	2513282	
RUTHERFORDINE	-4	2614799	-5	5138743	
HYDROXYAFATITE	8	6597274	11	8143386	SUPERSATURATED
STRENGITE	-1	9192094	-2	6183492	
VIVIANITE	-1	2724863	-1	7360344	
MNHPO4(O)	-	3917168	-	5344134	
ZN3(PO4)2.4H2O	-2	7410350	-3	7395537	
BERLINITE	36	2240884	49	4199907	SUPERSATURATED
WHITLOCKITE	3	9613185	5	4043685	SUPERSATURATED
CAHPO4.2H2O	-2	4578256	-3	3531753	
SRHPO4(O)	-3	7141543	-5	0671660	

13 APPROX. SATURATED PURE MINERALS

- 0 APPROX. SATURATED END-MEMBERS OF SPECIFIED SOLID SOLUTIONS
- 0 SATURATED END-MEMBERS OF HYPOTHETICAL SOLID SOLUTIONS

49 SUPERSATURATED PURE MINERALS

- 0 SUPERSATD. END-MEMBERS OF SPECIFIED SOLID SOLUTIONS
- 0 SUPERSATD. HYPOTHETICAL SOLID SOLUTION PHASES

----- SUMMARY OF GASES -----

GAS	FUGACITY	LOG FUGACITY
CO2(G)	.468532E-02	-2.32926
O2(G)	.455652E-46	-46.34137
S2(G)	.142969E-87	-87.84476
CH4(G)	.110887E-52	-52.95512
H2(G)	.416043E-18	-18.38086
H2S(G)	.332226E-49	-49.47857
STEAM	.313008E-01	-1.50445

----- END OF OUTPUT -----
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