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OAK RIDGE
Y-12
PLANT

MARTIN MARIETTA

CHEMICAL CHARACTERISTICS OF WATERS IN KARST FORMATIONS AT THE OAK RIDGE Y-12 PLANT

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Environmental Sciences Division
Oak Ridge National Laboratory

November 1994

Prepared for the
Environmental Management Department
Health, Safety, Environment, and
Accountability Organization
Oak Ridge Y-12 Plant
Oak Ridge, Tennessee 38731

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MARTIN MARIETTA ENERGY SYSTEMS, INC.
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Abbreviations

BCV	Bear Creek Valley
Ccr	Copper Ridge Dolomite
Cmn	Maynardville Limestone
Cn	Nolichucky Shale
CV	Coefficient of Variation of Hardness
delCAL	Minimum minus maximum calculated values of calcite saturation indices in individual wells
delDOL	Minimum minus maximum calculated values of dolomite saturation indices in individual wells
Fm	Formation
ORR	Oak Ridge Reservation
P_{CO2}	Partial pressure of carbon dioxide
SI	Saturation index
SIcal	Calcite saturation index
SIdol	Dolomite saturation index

EXECUTIVE SUMMARY

Profound effects on contaminant transport rates may result when waste disposal facilities are located on or adjacent to karst aquifers. Several waste disposal sites are located adjacent to or on a karst aquifer composed of the Cambrian Maynardville Limestone (Cmn) and the Cambrian Copper Ridge Dolomite (Ccr) at the U.S. Department of Energy Oak Ridge Y-12 Plant in Oak Ridge, TN. The chemical characteristics of waters intersected by wells in karst aquifers can provide insight into the behavior of the aquifer system. Highly variable chemical characteristics (i.e., hardness) can indicate that the portion of the aquifer tapped by a particular well is subject to a significant quick-flow component where recharge to the system is rapid and water levels and water quality change rapidly in response to precipitation events.

Water zones in wells at the Y-12 Plant that exhibit quick-flow behavior (i.e., high hydraulic conductivity) are identified based on their geochemical characteristics and variability in geochemical parameters, and observations made during drilling of the wells. The chemical data used in this study consist of between one and 20 chemical analyses for each of 102 wells and multiport monitoring zones. Of these 102 water zones, 10 were consistently undersaturated with respect to calcite suggesting active dissolution. Numerous other waters were undersaturated with respect to calcite on at least one sampling occasion. Repeat sampling of water zones shows that both supersaturation and undersaturation with respect to dolomite occurs in 46 water zones. This pattern indicates that relatively old waters diffusing from the rock matrix into conduits during baseflow experience periodic flushing by rapidly recharging waters. Twelve of the zones had partial pressure of CO_2 near atmospheric values suggesting limited interaction between recharge waters and the gases and solids in the vadose zone and aquifer, and hence, relatively short residence times. Forty-five percent (33 water zones) of the Cmn zones have magnesium to calcium ratios > 0.6 indicating a flow path from the Ccr to the Cmn.

Generalized maps of the inferred distribution of quick-flow regimes in the Ccr and the Cmn were constructed based on the chemical characteristics of the waters. Knowledge of the location and distribution of quick-flow zones is necessary for proper numerical flow modeling to be conducted. The constructed maps are a first approximation of the distribution of quick-flow zones, and additional studies are planned (i.e., cross-borehole tests to identify interconnection between wells), which will help to refine the interpretations made from the chemical analyses of waters in these karst aquifers. The preliminary data suggest that the Cmn is composed of a complicated network of interconnected, perhaps anastomosing, cavities. The conduit network is likely to be very complicated, and the maps presented here represent a very simplistic, first approximation of the distribution of cavities at the Y-12 Plant. The degree of interconnection between the identified cavities is yet to be determined, although it is expected that there is a significant vertical and lateral interconnection between the cavities located at shallow depths in the Cmn throughout Bear Creek Valley and the Y-12 Plant area.

INTRODUCTION

Profound effects on contaminant transport rates may result when waste disposal facilities are located on or adjacent to karst aquifers. Several waste disposal sites are located adjacent to a karst aquifer composed of the Cambrian Maynardville Limestone (Cmn) and the Cambrian Copper Ridge Dolomite (Ccr) at the U.S. Department of Energy Y-12 Plant in Oak Ridge, TN.

The chemical characteristics of waters sampled by wells in karst aquifers can provide insight into the behavior of the aquifer system. Highly variable chemical characteristics (e.g. hardness) can indicate that the portion of the aquifer sampled by a particular well is subject to a quick-flow component where recharge to the system is rapid and water quality changes rapidly in response to precipitation events.

Several ideas and concepts pertaining to the nature, extent, and the behavior the karst aquifers at the Y-12 Plant require refinement. Interpretation of the geochemical characteristics of the groundwaters is one component in the overall effort of aquifer characterization. The purpose of this work is to (1) better define groundwater interaction between the Cmn and Ccr, (2) identify portions of the aquifer which may currently be subject to solutional enlargement, and (3) identify portions of the aquifer which are likely to be subject to a rapid component of flow (quick flow). The ultimate objective of the studies is to map the generalized configuration of the conduit systems and portions subjected to a significant quick flow component (i.e., higher hydraulic conductivity zones). The resultant generalized map will be useful in constructing numerical models to be used to predict groundwater flow paths, and hence, potential contaminant migration pathways.

BACKGROUND

To effectively evaluate groundwater and surface water contamination and contaminant migration from waste sites at the Y-12 Plant, a Comprehensive Groundwater Monitoring Plan (Comprehensive Plan) was developed to guide monitoring of surface water and groundwater quality (Geraghty and Miller, 1990a). A previous report (Shevenell et al., 1992) describes the implementation of the Maynardville Limestone exit pathways project, which is a portion of the Comprehensive Plan (Maynardville Project). The Cmn, which underlies the southern portion of Bear Creek Valley (BCV), is considered to be the primary pathway for groundwater leaving the Y-12 Plant (King and Haase, 1988). Because water in the Cmn is believed to interact with that in the Ccr, the chemical characteristics of both formations are investigated in this report. Description of geologic features of the Cmn can be found in Shevenell et al. (1992).

METHODOLOGY

Historical data from wells at the Y-12 Plant were compiled and evaluated for general chemical characteristics and temporal variability. The data were obtained from several sources: Groundwater Quality Assessment Reports (GWQARs) (HSW, 1991a, 1991b, 1991c, 1992a, 1992b, 1992c), a SAS data base maintained in the Environmental Sciences Division, Oak Ridge National Laboratory (Thompson, 1993), and data from multilevel (Westbay) monitoring wells (Dreier et al., 1993; Shevenell and Dreier, unpub. Westbay monitoring data). The wells selected are completed in either the Ccr or the Cmn and well completion data are found in Jones et al. (1992). Most of the available data are in the form of chemical analyses obtained from quarterly sampling of individual wells. It is noted that variations in chemical characteristics can indicate rapid response of the system to storms, whereas lack of chemical variability is inconclusive due to the manner in which samples were collected. When possible, karst aquifer characteristics should be evaluated from data collected over short time intervals (hourly, daily) rather than quarterly because different portions of the system can respond quite rapidly to precipitation, and the correlatable changes would likely be missed during quarterly sampling. However, in the current work, this type of data was not available.

All available data were compiled and charge balances were calculated for each sample. All samples which had a charge balance in excess of ±10 percent were eliminated from the data set. A total of 15.4 percent of the analyses were removed due to poor charge balances, resulting in a data set containing 99 wells or multiport zones which have been sampled between 1 and 20 times between 1986 and the first two quarters of 1992.

Saturation indices were calculated to determine those portions of the flow system that may currently be subject to enlargement of fractures and conduits by dissolution. Saturation Indices (SI) and carbon dioxide partial pressures (P_{CO2}) were calculated using the equilibrium aqueous speciation model SOLMINEQ.88 (Kharaka et al., 1988). Data for calculation of dolomite SI in SOLMINEQ.88 were substituted with equilibrium constant data for dolomite from Langmuir (1971) where:

$$pK_d = 0.0207T\ (°C) + 16.513 \quad (R^2 = 0.987). \tag{1}$$

In order to evaluate the variability of hardness between sampling events, the equivalent $CaCO_3$ hardness (in mg/L) was calculated from the following after Drever (1982):

$$\text{equivalent } CaCO_3 = 2.5\ (mg/L\ \ Ca) + 4.1\ (mg/L\ \ Mg). \tag{2}$$

Using these calculated values, the coefficient of variation of hardness (CV; standard deviation divided by the mean) was calculated for each well. The flow-through time (recharge to point of measurement) was then estimated using Ternan's (1972) power law which is based on the carbonate content of springs and flow-through time determined by Pitty (1968, 1971). The Ternan relationship is

$$CV = 35\ t^{-0.524}, \tag{4}$$

where t is the flow-through time in days. Equation 4 is expected to yield reasonable results for small drainage basins (<100 km^2) in temperate climates (White, 1988).

The discharge (Q in m^3/s) associated with a water's hardness can be estimated from which discharge at different well locations can be compared. Bassett and Ruhe (1973) studied the Lost River watershed in southern Indiana and found that hardness (H_d) is related to discharge at springs based on equation 5:

$$H_d = 402.7 - 113.2\log(Q), \qquad R^2 = 0.81. \tag{5}$$

Although the empirical expressions in equations (4) and (5) were not developed using well data, the results should provide order-of-magnitude estimates and values to be used for comparative purposes for the flow through times and volumes of water flow expected in different portions of a system.

Comparisons among different variables (saturation indices, Mg/Ca ratio, formation, etc.) and among wells were conducted using cluster analysis (Romesburg, 1984). The cluster analyses were conducted for the purpose of identifying similarities and differences among different portions of the aquifer system, and to evaluate data types for their utility in understanding the behavior of the karst system. The cluster analyses were also conducted in order to evaluate the hypotheses that (1) the Mg/Ca ratio is dependent on geologic formation, and (2) interactions between the Cmn and Ccr may be identified with the use of this ratio.

All cluster analyses were performed with the computer program Multi-Variate Statistical Package (Kovach, 1991). Both R-analysis, which is cluster analysis of attributes or variables, and Q-analysis, which is cluster analysis of objects (wells) (Sneath and Sokal, 1973) were performed and dendrograms constructed. The following variables were selected for evaluation: CV, dolomite saturation index (SIdol), calcite saturation index (SIcal), the difference between the minimum and maximum calculated saturation indices for both calcite and dolomite (delCAL, delDOL), Mg/Ca ratio, hardness, well completion depth (Depth), completion interval type (Type: cavity, fracture, water zone), geologic formation (Fm: Cmn or Ccr). One value for each of the variables CV, delCAL, and delDOL is associated with each well. The average value of all hardnesses and all Mg/Ca ratios for each well are used in the data set. The following variables were redefined for ease of computation: Type (0 = water zone, 1 = fracture, 2 = cavity), Fm (0 = Cmn, 1 = Ccr), SIcal and SIdol (-1 = consistently negative SI, +1 = consistently positive SI, 0 = equilibrium SI, 2 = SI varies between positive and negative). Because the values of the other variables ranged from ≈-4 (SIdol) to ≈2500 (hardness), the values were standardized using a common standardizing function. The mean of all the data in a particular category (i.e., CV) was subtracted from the individual data value and divided by the standard deviation (Romesburg, 1984, pg. 78) to obtain the standardized value.

Wells with only one chemical analysis were omitted from the cluster analysis because values of CV, delCAL and delDOL would be meaningless. Water zone completion types (cavity, fracture, water) were often not noted (unknown) for the older (numbers lower than GW-225) wells (Jones et al., 1992). Hence, to identify a particular well with a completion interval type, weekly water level data, collected between 1985 to 1987, were used under the assumption that larger water level fluctuations are associated with wells which intersect cavities and are rapidly recharged (contain a component of quick flow). Conversely, smaller water level fluctuations are associated with wells completed in slower flowing "water zones" to which recharge is slower and more dispersed. It is noted that this assumption may bias the data. For instance, shallow wells my tend to have larger water level fluctuations than deeper wells completed in the same type of water zone because the shallow wells tap a more active portion of the flow system. This biased assumption would only appear to cast doubt on three of the entries in Table 1 (GW-095, GW-151, and GW-099), and this should not significantly affect the overall conclusions made from the cluster analyses.

If a 12 month water level fluctuation in the Ccr was less than 5 ft, the zone was considered a "water" zone; if the fluctuation was between 5 and 10 ft, the zone was identified as a "fracture"; if the fluctuation was 10 ft, it was considered a "cavity." When a 12 month water level fluctuation in the Cmn was <3 ft, the zone was considered a "water" zone; if the fluctuation was between 3 and 5 ft, the zone was identified as a "fracture"; if the fluctuation was >5 ft, it was considered a "cavity." The distinction was made between the Ccr and Cmn because larger yearly water level fluctuations are commonly observed in wells located on Chestnut Ridge, where the Ccr occurs at the Y-12 Plant, and smaller fluctuations are associated with valley wells (i.e., in the Cmn). Table 1 lists 15 wells (of 102) for which this assumption was made solely for the purposes of the cluster analyses, along with the water level variabilities and assigned zone types for wells in which data on zone type were lacking.

It should be noted that large water level fluctuations over the course of one year are not exclusively associated with the presence of a cavity because water level fluctuations are a function of transmissivity and storage. A relatively impermeable unit with low storage (or dead-end fractures) could also respond with large water level changes. The similar responses in these two different situations can be distinguished by measurement of water level, temperature and specific conductance (SC) during a storm event and identifying the lag time between precipitation and water level rise, and between water level rise and changes in SC and temperature. In a low permeability formation, water level changes may not be associated with changes in SC and temperature, and hence, groundwater flow, but may simply reflect a pressure change within the aquifer. This type of monitoring data is not currently available, but is planned as part of future studies.

RESULTS

Hardness

Equivalent $CaCO_3$ hardnesses of sampled waters were calculated using equation (2) and results appear in Appendix A. Most hardness values fall in the range of 100 to 500 mg/L in both the Ccr and Cmn. The highest values (>1000 mg/L) are associated with eight of the deeper (>450 ft) wells, which contain high concentrations of SO_4 and Cl suggesting that these wells monitor groundwater that interacts to varying degrees with the underlying brine (Haase, 1991).

The calculated CV ranged from 0 to 0.47 indicating that several of the wells intersect zones subject to a significant quick flow component. The highest CV values (≥0.20) are generally found in wells which intersect cavities or fractures. For instance, the highest CV (0.47) is found in GW-734 which intersects a large, mud-filled cavity exhibiting rapid, short-duration flashy water level responses in response to precipitation. However, another well (GW-223) intersects a water zone but also has a very high CV (CV= 0.26, for filtered samples). The high CV in GW-223 probably reflects some influence from quick flow near the location of the well bore. GW-223 is a relatively shallow well (90 ft) located adjacent to East Fork Poplar Creek and may be located within the old stream channel which was moved during Plant construction activities. Hence, this well is quite likely to be near a relatively permeable feature.

The estimated flow-through times (Appendix A) from equation 4 are based on the CV and subject to limitations resulting from timing of sample collection (i.e., quarterly rather than daily or hourly). The values of flow-through can be used in a relative sense. For instance, flow from recharge to the location of well GW-061 (depth = 25 ft) could be as rapid as 1.5 days, suggesting a large quick flow component. Longer transit times of 11 to 25 days are suggested for GW-056 (depth = 55.0 ft). Several wells (1090, GW-154, GW-155, GW-174, GW-298) have much higher CV for the unfiltered samples when compared to the filtered samples indicating either transport of colloids or larger particulates with the aquifer water, or possibly disturbance of colloids or particulates in the aquifer near the well bore during sampling.

Estimations of discharge (Q) are listed in Appendix A, and are for comparative purposes only. The calculated discharge associated with GW-174 is an order of magnitude larger than that estimated at GW-179, which may be reasonable given that water level fluctuations over the course of one year are 30 ft in GW-174 and ≤10 ft in GW-179 (both of which are located at the Chestnut Ridge Security Pits at depths of 145 ft and 117 ft, respectively). GW-179 experiences less influence from quick flow, which is also suggested by P_{CO2} data discussed in the next section. GW-174 has P_{CO2} values near atmospheric, whereas GW-179 does not suggesting longer average residence time of the GW-179 water. Without independent estimates for the volume of flow through a particular cross-sectional area, it is impossible to determine the extent to which the numbers reflect reality. It may be possible to calibrate Equation 5 to conditions encountered on the ORR. Point dilution tests can be used to estimate specific discharge (q) or volumetric discharge ($Q = qA$) in a bore hole interval (Hicks et al., 1992). The values of Q could be compared between the two methods to determine the extent to which Equation 5 may be valid on the ORR.

Saturation Indices

Dolomite and calcite SI's for water samples from the wells in the study area appear in Appendix A-2. The appendix table also includes partial pressures of CO_2 (P_{CO2} in atm), the activities of Mg and Ca, and the activity ratio of Mg to Ca.

The SI's are calculated to determine which well waters are undersaturated with respect to calcite. These values provide an indication of whether a particular zone tapped is currently subject to calcite dissolution. Equilibrium and supersaturation with respect to dolomite provide a rough indication of fluid residence times. It is expected that waters require tens to hundreds of years to attain saturation with respect to dolomite because the kinetics of dissolution are very slow at SI greater than ≈-2 (Busenberg and Plummer, 1982). Waters saturated with respect to dolomite are likely to be of the slow-flow type, perhaps recharged by slow percolation through the vadose zone, and subsequently flowing through less permeable regions of the aquifer, thus allowing sufficient interaction time with aquifer rocks during which equilibrium can be attained. Waters that exhibit fluctuations in their dolomite saturation indices between supersaturation and undersaturation are suggestive of changing flow conditions between the sampling events. At times of supersaturation, waters sampled are likely to reflect baseflow conditions when sufficient time for equilibration is available. During these times, samples are dominantly matrix water which has not been significantly diluted with recently recharged waters. When these same well waters exhibit undersaturation during subsequent sampling, this suggests that the zone tapped is subject to a relatively quick flow component which dominates during precipitation events when less time is available for recharging waters to interact with the aquifer rocks, and aquifer waters in the conduits and fractures become diluted.

Consistent undersaturation with respect to calcite is suggestive of relatively young, quick-flowing water because only a few days are typically required to reach calcite saturation. Several wells have been consistently undersaturated with respect to calcite (Table 2 and Appendix A-2) over the sampling events, and the zones tapped may currently be subject to dissolution: 1090 (U only), GW-056 (F only), GW-057, GW-155 (U only), GW-309, GW-316 (F only), GW-350, GW-604 (F only), GW-683 (U only), GW-694, and GW-734, where all wells, except 1090, GW-155, and GW-683, are in the Cmn (U refers to unfiltered samples, F refers to filtered samples). Waters in five other wells have been undersaturated or near equilibrium (GW-299, GW-306, GW-365, GW-603, GW-685), and undersaturation with respect to calcite has been noted in other wells, yet only one reliable analysis is available from each (GW-225, GW-521 GW-722-02, GW-722-10, GW-722-17, GW-722-22, GW-722-30, GW-722-33, GW-735, and GW-739).

Many cavities in the Cmn are mud filled (i.e., GW-734) suggesting that at some time in the past, flow velocities either decreased as the conduit size increased through dissolution, or as a result of decreases in hydraulic gradients. Note that decreases in the hydraulic gradient in the system occurred within the past 50 to 60 years as the base level (Clinch River) rose following construction of Watts Bar and Melton Hill Dams. As fluid velocities decreased, it is likely that sediment accumulated on the floors of the conduits, and solutional attack continued on the ceiling as the sediment accumulated (paragenesis; Ford and Ewers, 1978). Upward dissolution of carbonates in the Cmn conduits may continue until the top of the passage intersects the piezometric surface.

The minimum (Min) and maximum (Max) measured SI for calcite and dolomite, the number of analyses available (# of Values), and the maximum variability in the saturation calculated by subtracting the minimum SI from the maximum SI (Min-Max) appear in Table 2. Of the well waters for which repeat analyses are available, the following are consistently supersaturated with respect to dolomite and, therefore, must have relatively long mean residence times: GW-511, GW-695, GW-704, GW-712 (only 2 samples). However, a small component of quick flow may occur in three of the wells (GW-511, GW-695, and GW-704) as suggested by CV $\geq$ 0.10 in each of these wells, but insufficient numbers of samples may have been collected thus far from which to detect the quick flow effects. Twenty-two other wells (see Table 2) only have one reliable analysis, yet also indicate supersaturation with respect to dolomite. The SI in 46 wells fluctuates from supersaturated to undersaturated with respect to dolomite: 1090, GW-056, GW-058, GW-061, GW-064, GW-099, GW-135-03, GW-135-30, GW-141, GW-151, GW-152, GW-153, GW-154, GW-155, GW-158, GW-167, GW-173, GW-174, GW-179, GW-181, GW-220, GW-221, GW-223, GW-226, GW-228, GW-229, GW-240, GW-241, GW-278, GW-293, GW-298, GW-299, GW-300, GW-313, GW-316, GW-317, GW-322, GW-323, GW-513, GW-603, GW-604, GW-621, GW-683, GW-684, GW-703, GW-706, GW-711. Surprisingly, this list includes GW-711 (TD=666 ft, water type = Na-Ca-Mg-SO_4-Cl>>HCO_3) and GW-278 (TD=21.1 ft, water zone in Cmn). The depth and water type of GW-711 suggest this well taps a sluggish portion of the system which is interacting with the underlying brine, and hence not likely to experience quick flow. Hydrograph data show pressure responses to storm events in this well, yet it is believed that the pressure increases are in response to increasing pressures in the overlying, shallow bedrock, and not a result of direct, rapid recharge to this well (Shevenell and McMaster, in prep). Because GW-278 is a shallow well (21.1 ft), finished within the Cmn, and has a low a(Mg)/a(Ca) ratio, attainment of supersaturation with respect to dolomite seems unlikely. Hence, the dolomite saturation results from these two wells are somewhat anomalous.

Partial Pressure of CO_2 (P_{CO2})

It is reasonably assumed that P_{CO2} values near atmospheric (i.e., $-\log(P_{CO2}) \approx 3.5$ atm (Drever, 1988, p. 56)) are indicative of waters in quick flow regimes where insufficient time has elapsed for waters to deviate from equilibrium with atmospheric CO_2 since recharge. For instance, CO_2 concentrations in soil gases can be 6 to 10 times greater than that in the atmosphere (Russell and Appleyard, 1915; Boynton and Reuther, 1938). Hence, waters recharging an aquifer through the soil zone can acquire significant CO_2 concentrations as waters interact with soil gases. Near atmospheric CO_2 suggested limited residence times in the soil zone, and hence, rapid recharge to the aquifer. Twelve well waters had close to atmospheric P_{CO2} values (3.5 ±0.3 atm) during at least one sampling event: GW-153, GW-173, GW-174, GW-221, GW-241, GW-513, GW-603, GW-604, GW-684, GW-695, and GW-733. A relatively short fluid residence time between recharge and the well location is suggested in these cases.

Some of the waters have P_{CO2} much less than atmospheric for one or more sampling events (GW-099, P_{CO2} = 4.22; GW-158, P_{CO2} = 4.28; GW-174, P_{CO2} = 4.00; GW-511, P_{CO2} = 4.21 to 5.56; and GW-723, P_{CO2} = 4.08; see Appendix A-2). Closed system dissolution of calcite could result in low P_{CO2} values such as these (Drever, 1988, pg 68-69), yet, except for GW-511, a low P_{CO2} value was only calculated for one of the sampling events. Because the results appear anomalous for GW-099, GW-158 and GW-174, it is believed that the P_{CO2} data suggest closed system dissolution of calcite for only GW-511, and perhaps GW-723 for which only one analysis is available.

Magnesium to Calcium Ratios

The ratios of Mg to Ca activities appear in Appendix A-2. The a_{Mg}/a_{Ca} in individual wells ranges from 0.08 to 1.62 in Cmn wells, and between 0.26 and 4.11 in Ccr wells. The values of 4.01 and 4.11 in GW-158 on 10/10/87 appear unrealistic because all others are between ≈1.3 and 1.5. The lower a_{Mg}/a_{Ca} ratios obtained from the Ccr wells GW-323 (0.26 on 3/8/88), GW-135-23 (0.4 on 5/7/91), and GW-683 (0.41 to 0.59) also appear anomalous. It is not clear why the ratio in GW-135-23 is anomalous. However, the 0.26 value for GW-323 may not be realistic because all other ratios have been in the range of 0.88 to 1.12. Of eight Mg measurements at this well, seven of the measured Mg concentrations are between 24 and 27 mg/L, whereas the Mg content for the sample associated with the a_{Mg}/a_{Ca} of 0.26 is only 9.6 mg/L, casting doubt on this isolated value. The lower Mg to Ca ratios in GW-683 may be suggestive of relatively short residence times in the Ccr. During drilling of this well, there was significant water production from the completion zone, and an increase in turbidity occurred in two springs 425 ft north of the well (Shevenell et al., 1992) suggesting an interconnected, quick flow system was tapped by GW-683. Also, the a_{Mg}/a_{Ca} ratio in GW-683 of 0.47 ± 0.06 suggests flow from the Cmn to the Ccr under Chestnut Ridge in the vicinity of Picket A (Figure 1; the pickets were introduced in Shevenell et al., 1992). This interaction is corroborated by NO_3 analyses which show this well contains 3 to 22 mg/L NO_3. The only source for the NO_3 is the S-3 Ponds plume which is migrating westward, along strike in the Cmn (HSW, 1992a), and apparently entering the Ccr at or to the east of Picket A.

Generally higher a_{Mg}/a_{Ca} ratios in the Ccr are to be expected because the formation is a dolomite. A ratio ≥ 0.6 in waters is expected when dolomite is more stable than calcite (Drever, 1988), and these higher ratios are believed to be representative of waters in the Ccr in this study.

Thirty-three of the 73 (45 percent) Cmn sampling zones have a_{Mg}/a_{Ca} ratios of >0.6 (Table 3). Wells containing an "F" in the column "Consistent or Fluctuating" did not consistently have a_{Mg}/a_{Ca} > 0.6; all of these wells also showed fluctuations in the dolomite SI's. The wells followed by "Y" in the "Drilled Through the Ccr" column were drilled on Chestnut Ridge through the Ccr, and recharge to these zones in the Cmn is likely to have passed through the Ccr, acquiring chemical characteristics of this formation. The other wells are drilled at the base of Chestnut Ridge, or in Bear Creek Valley, entirely within the Cmn. The higher a_{Mg}/a_{Ca} ratio in the wells listed suggests that a portion of the recharge water in these zones is through the Ccr. Flow toward these wells from the Ccr is apparently sufficient to dominate the water chemistry in the Cmn wells in that the Ccr fluid is not significantly diluted relative to Mg once entering the Cmn. Note that Cmn wells throughout BCV show interaction with the Ccr.

Two Cmn zones (GW-135-06 and GW-135-11) have a_{Mg}/a_{Ca} <0.6, yet these zones are also located beneath the Ccr. GW-135-06 is a water which has apparently undergone a small amount of mixing with the underlying brine (GW-135-06 Cl=580 mg/L, Na=510 mg/L) as well as having encountered gypsum along a flow path (SO_4 = 1623 mg/L). Relatively high SO_4 (700 mg/L) in GW-135-11 indicates this water also dissolved gypsum along its flow path. Hence, each of these waters likely has excess Ca as a result of dissolution of $CaSO_4$, thus altering the a_{Mg}/a_{Ca} ratio expected from a purely dolomitic host rock.

Use of simple mixing models (measured value = x(Cmn) + (1-x)(Ccr)) to predict the percentage of Ccr water mixed with the Cmn water was unsuccessful. The average of all Cmn waters with a_{Mg}/a_{Ca} < 0.6 is 0.35 ±0.14, whereas the average of all Ccr with a_{Mg}/a_{Ca} > 0.6 is 1.03 ±0.09. If only equilibrated waters are used to calculate the a_{Mg}/a_{Ca} ratio, the average in the Cmn for water at equilibrium or supersaturated with respect to calcite is 0.573 ±0.28, and that for the Ccr for water at equilibrium or supersaturated with respect to dolomite is 1.0 ±0.12. The measured ratios in several Cmn wells with a_{Mg}/a_{Ca}>0.6 (i.e., GW-695, GW-703, GW-704, GW-722-20, GW-723, and GW-733) are greater than the average in the Ccr. Hence the calculated averages for the Cmn and Ccr are not true end-members in a mixing model. This suggests a simplistic mixing model is not appropriate to describe the interaction between the Ccr and Cmn in these wells, which is understandable considering the dynamic chemical behavior in each formation. Other end-member a_{Mg}/a_{Ca} values such as the average Cmn water without wells which may have an influence from the Ccr (a_{Mg}/a_{Ca}=0.34 ± 0.14) show the same discrepancies.

Stable Isotopes

Stable isotope ratios have only been measured in a small percentage of groundwaters at the Y-12 Plant, and the data appear in Table 4. The data show little variation in $\delta^{18}O$ (-7.72 to -6.54 per mil), likely because recharge elevations are approximately the same for all sampled waters. Figure 2 is a plot of δD versus $\delta^{18}O$ where the "X" symbols are the results from both the Cmn and Ccr, and the circles are results from water zones in the Nolichucky Shale for comparison. The deeper Cn zones (GW-134-3, 11, 18) have $\delta^{18}O$ < 7 per mil whereas the shallower zones (GW-134-25, 29, 33) have $\delta^{18}O \geq 7$ per mil perhaps suggesting longer residence times and differing amounts of water-rock interactions. The triangles represent the data for GW-734 and GW-722-32 and GW-722-33. No correlations of δD and $\delta^{18}O$ with season sampled, geologic formation or water zone type (fracture cavity or water zone) are apparent from the data. However, there is a poor correlation (R^2 = 0.31) between δD and depth, with a slight increase in δD occurring with increasing depth (δD = 0.0065(Depth) - 36.28). No similar trend with $\delta^{18}O$ occurs ($\delta^{18}O$ = - 0.00013(Depth) - 7.13; R^2 = 0.02). Figure 2 shows that all samples are either shifted in δD or $\delta^{18}O$ relative to the World Meteoric Water Line (WMWL; Craig, 1961). Waters in other areas of the Oak Ridge Reservation (ORR) also exhibit similar characteristics (Dreier and Toran, 1989; D. Marsh, pers. comm., 1992).

The shifted stable isotope data likely reflect regional isotopic compositions indicative of source areas of the recharged precipitation. More isotopically depleted values are found with increasing distance from oceans, and in arctic air masses (Epstein and Mayeda, 1953; Friedman, 1953, Craig, 1963). Air masses moving from the Gulf of Mexico northward to the continental U.S. are isotopically enriched compared with arctic air masses moving southward. Data compiled and contoured by Taylor (1974) show that an average δD in Tennessee is relatively enriched at ≈ -30 per mil, similar to the average value of -33.33 per mil noted in Table 3 suggesting the dominant source of moisture which falls as precipitation and recharges local groundwaters is from the Gulf of Mexico. Unpublished studies by S. Lindberg show that the majority (≥85 percent) of the moisture for local precipitation originates from the Gulf of Mexico, and only a small percent (≤15 percent) originates from the direction of the Atlantic Ocean (S. Lindberg, pers. comm., 1993).

The -30 per mil contour extends up the eastern coast of the U.S., and down the Gulf coast into Mexico and Central America (Taylor, 1974). The International Atomic Energy Agency (IAEA) reports $\delta^{18}O$ and δD for three stations within the 30 per mil contour which may have similar stable isotope contents as those found in Tennessee. Stable isotope data (IAEA, 1969, 1970, 1971, 1973, 1979, 1983, 1986, 1990) from these stations (Veracruz, Mexico, Hatteras, NC, and Waco, TX) are plotted on Figures 3 and 4. Although San Juan, Puerto Rico has significantly less data, it is include for comparison because precipitation at this location must be dominated by isotopically enriched oceanic air masses. Figure 4 shows a blow-up of Figure 3, giving it a $\delta^{18}O$ range similar to that seen in Figure 2 for the ORR samples. Many of the data points in Figure 4 are also shifted from the WMWL.

Recharge to the ORR aquifers occurs predominantly during the wetter, winter months (Moore and Toran, 1992, p 7), hence, the IAEA data is evaluated based on season. The number of data points from each station on Figures 3 and 4 which have a δD enriched (by greater than 1 per mil) relative to the WMWL were summed for the winter and summer months, and the percentage of data points which exhibit enriched δD calculated (Table 5). A total of ≈70 percent of the precipitation in the October to March season has had enriched deuterium at the listed stations between 1953 and 1987, whereas ≈75 percent of the precipitation during the summer months is depleted relative to the WMWL. Because the majority of the current recharge on the ORR occurs during the winter season, it is reasonable to expect that groundwaters would exhibit isotopic enrichment relative to the WMWL, as is observed in Figure 1. Hence, the shifted isotopic compositions of the ORR waters reflect natural, regional isotopic compositions, rather than local effects. Older waters, perhaps associated with or mixed with brine at depths >100 ft in BCV, may have different (more enriched) isotopic signatures suggestive of different climatic conditions, and perhaps, evaporative processes. This effect may be seen in a sample from GW-135-03 (depth = 1206 ft) which has a high Cl content (15,000 to 20,000 mg/L) suggestive of interaction with the underlying brine, and a relatively enriched δD of -25.7 per mil. Additional data from deep waters is required to more fully investigate this possibility.

In many cases, a local meteoric water line can be identified using groundwater data because groundwaters in porous media are often good integrators for the variable concentrations associated with different precipitation events and seasons. No consistent correlation ($R^2 = 0.04$; $\delta D = 2.66\delta^{18}O - 14.39$, where the equation for the WMWL is $\delta D = 8\delta^{18}O + 10$) is identified by the samples (Table 4), showing that, either insufficient data have been obtained, or the flow system in the Cmn and Ccr is not a good integrator and may consist of some very quick flow through zones where the δD and $\delta^{18}O$ may closely approximate the compositions in individual precipitation events.

The large, mud filled cavity intersected by GW-734 (elevation = 837 to 881 ft) occurs at approximately the same elevation as smaller cavities in GW-722-32 (elevation = 821 to 855 ft) and GW-722-33 (elevation = 858 to 870 ft). However, δD between the wells differs by up to 7 per mil (triangles on Figure 1). The conduits in the two wells, which are located 150 ft apart, may be connected, and, if so, the δD values from the wells for two different dates may show the isotopic signatures of two separate, poorly mixed, precipitation events. Additional, more frequently collected samples (i.e., hourly during a storm) are required to more fully evaluate the timing of the link between precipitation and conduit waters.

Carbon-13 ($\delta^{13}C$, per mil PDB) values are also listed in Table 4. The average $\delta^{13}C$ in Ccr water zones is -10.55 ±1.7, whereas that for Cmn zones is -9.31 ±2.6. In order to evaluate the $\delta^{13}C$ data, three models were used to calculate expected $\delta^{13}C$ values given the known isotopic composition of the Cmn and Ccr and local vegetation. Although data are limited, the isotopic composition of local carbonate rocks averages about -1 per mil (Foreman, 1991). Foreman reports $\delta^{13}C$ for calcite and dolomite in the Cn as averaging -1.97 per mil (n=6) and -0.84 per mil (n=8), as well as whole rock $\delta^{13}C$ for five Cmn samples ($\delta^{13}C \approx +0.13$ per mil). The average $\delta^{13}C$ in leaves from 3 species located on ridges, slopes and riparian zones (46 samples collected in July) in nearby Melton Valley in 1989 is ≈-29 per mil (Garten and Taylor, 1992). It is assumed that the same species dominate in BCV. Soil CO_2 is generally enriched in $\delta^{13}C$ relative to the associated vegetation by about 5 per mil (Coleman and Fry, 1991), suggesting that $\delta^{13}C$-CO_2 in the soil is on the order of -25 per mil during the summer months. The samples collected by Garten and Taylor (1992) represent minimum values because they are from leaves collected during the summer. Studies by Rightmire (1978) show that $\delta^{13}C$ in CO_2 soil gas varies with P_{CO2} and can be 10 to 12 per mil more enriched during the winter months. Hence, soil gases in the ORR area may have $\delta^{13}C$ values between about -25 to -13 per mil, depending on the season.

The three models selected for simulating $\delta^{13}C$ are (1) open system dissolution of calcium carbonate, (2) initial open system dissolution of calcium carbonate, followed by closed system dissolution (Salomons and Mook, 1980; referred to as Closed CaCO3 on Table 6), and (3) initial open system dissolution of calcite and dolomite, followed by closed system dissolution (Reardon and Fritz, 1978; referred to as Closed Cal/Dol on Table 6). Two separate calculations are made for the open-closed system scenarios. The first calculation assumes all $\delta^{13}C$ of carbonate rocks with which fluids interact have a value of -1 per mil which is the average of calcite and dolomite in the Cn and limestones of the Cmn. The second calculation uses a whole rock Cmn $\delta^{13}C$ of 0.13 per mil for the calculations of closed system dissolution of $CaCO_3$. The second open-closed system model uses $\delta^{13}C_{calcite}$ (from the Cn) of -1.97 per mil and $\delta^{13}C_{dolomite}$ (from the Cn) of -0.84 per mil and for comparison.

Table 6 lists the measured values with those of the different model results for estimated winter (recharge temperatures and fractionation factors for 5°C) and summer (recharge temperatures and fractionation factors for 25°C) $\delta^{13}C$ values in soil CO_2. Calculated numbers in bold most closely match measured values. The % error column identifies the error of the modeled versus the measured value. Similar results are obtained from the two calculations which assume different rock $\delta^{13}C$, although slightly better matches are obtained with the second calculations.

None of the models described above suitably predicted the ^{13}C values for GW-131-28, GW-135-03, or GW-135-11. All three of these waters contain relatively high TDS (1200 to 10,000 mg/L), and SO_4 concentrations (700 to 1000 mg/L), suggesting dissolution of gypsum along a flow path. GW-131-28 is completed in the Ccr, but both GW-135-03 and -11 are completed in the Cmn. The previous models are not appropriate for use in systems in which there has been significant gypsum dissolution (Reardon and Fritz, 1978). All three of these zones appear to sample waters which have relatively long residence times, and the GW-135-03 and GW-135-11 zones show some interaction with the underlying brine based on high Cl contents (up to 20,000 mg/L). A final model was selected which is suitable for open-closed system dissolution of calcite, dolomite and gypsum (Reardon and Fritz, 1978), and these results are followed by an "*" in Table 6. The $\delta^{13}C$ values in GW-131-28 and GW-135-11 are more closely predicted (within 3.9 percent and 12.1 percent, respectively) with the model incorporating gypsum dissolution.

Zones GW-722-02, -06 and -20 are most closely matched with closed system dissolution of $CaCO_3$ by water recharged during the winter months. The ^{13}C in GW-722-17, GW-722-33, GW-131-12, GW-135-30 and GW-722-30 suggests closed system dissolution of calcite and dolomite by water recharged during winter months. The fact that most of the zones (Table 6) suggest waters recharge the system during winter months is reasonable because more recharge is expected during the winter when plants demand significantly less water. Zones GW-722-30 and -33 were sampled during the winter months suggesting recharge to these two zones may be relatively rapid. Only one zone suggests closed system dissolution of carbonates by water recharged during summer months (GW-135-41). This zone monitors an open interval between 0 and 175 ft deep (topmost Westbay packer is located at 175 ft in GW-135) in the Ccr, and the ^{13}C sample was obtained in June, 1992, suggesting the possibility of relatively rapid flow from recharge during the spring and summer months, to the time of sampling. However, the measured ^{13}C may indicate that water in this zone was recharged during a previous summer. None of the zones sampled have $\delta^{13}C$ values suggestive of open system dissolution of calcite (Table 6).

Analysis of Mud

The mud filling the cavity intersected by GW-734 was sampled on 3/11/93 by forcing a 2-inch, stainless steel casing into the mud with a hammer. A soupy mud was encountered at 60 ft, and then a much denser material at about 65 ft. Between 65 and 80 ft below top of casing, progress was slow with one slightly softer zone being encountered at about 73 ft. The "coring" with the 2-inch, stainless pipe was terminated at 80 ft when a very hard zone (perhaps a rock) was encountered.

Before removing the pipe from the well, the mud level was tagged inside of the 2 inch pipe, and mud was identified at 70 ft; hence only the bottom 10 ft of the pipe had collected mud, although 20 ft of mud had been penetrated indicating the mud may have been compacted during sampling. No mud was lost from the pipe during retrieval up the hole. Three samples were collected from the final 10-foot length: at the top, 5 ft from the top, and at 10 ft (at the bottom). Presumably these samples represent well depths of about 60, 65 and 70 (+) ft. The top sample was quite fluid, though opaque, with fine mud, and mud clots. The lower two samples were dense and appeared to have a low water content compared to the upper sample. These mud samples retained their shape, and did not flow. The top sample at 60 ft had a density of 1.25 gm/cm^3 (percent solids of 24.8 percent) whereas the samples at 65 and 70 ft had densities of 1.53 (percent solids of 68.4 percent) and 1.60 gm/cm^3 (percent solids of 67.4 percent) respectively.

Chemical analyses of the mud showed no contaminants were present and all analyses of volatile organic compounds in both the water above the mud, and in mud, were below detection limits. Total α and β in the water was 5.53 pCi/L and 16.3 pCi/L, whereas the values in the mud ranged from 0 to 8.37 pCi/L α and 0.4 to 4.92 pCi/L β. Relatively high concentrations of some metals are associated with the unfiltered samples suggesting some sediment may be transported by the water (Table 7).

A decrease in concentration of Al, Be, Ca, Fe, Mg, Hg, and Sr occurs upwards in the cored section of mud as the percent solids decreases. The following constituents remained about the same, or showed no consistent trend, over the three depths (about 60, 65 and 70 ft): Ba, β activity, B, Cd, Mn, Ni, K, U, and Zn. The following increased upward in the core: Cu (from 31 to 62 ug/g) and Pb (from 93 to 209 ug/g). The mud contains high concentrations of Pb and Zn ($Pb \leq 209$ ppm, $Zn \leq 170$ ppm) (Table 6) when compared to background soils in the Nolichucky Shale (Watkins et al., 1993). However, relatively high values ($Pb \leq 165$ ppm, $Zn \leq 170$ ppm) are also present in the Ccr soils. Note that the soil data of Table 7 represent variably weathered horizons where constituents such as Ca, Mg, Pb, Zn, etc. have been preferentially weathered from the original rock, suggesting that Pb and Zn contents in unweathered Ccr may be higher than those reported in the table. Deposits of Pb and Zn have been identified in the Ordovician and Cambrian limestones and dolomites of the Knox and Conasauga Groups throughout east Tennessee (Floyd, 1965), suggesting the possibility of naturally occurring, high concentrations of Pb and Zn in local waters and muds resulting from weathering of the limestones and dolomites. In addition, disseminated sulfides in the Cmn and Ccr were noted during drilling of the Cmn Picket wells, and trace amounts of sphalerite and galena may be present with the pyrite (Jago, pers. comm., 1994; Shevenell et al., 1992).

DISCUSSION

Cluster analyses were performed based on wells (Q-analysis) and variables (R-analysis). The Q-analysis provided little insight in identifying similarities between different portions of the aquifer system, yet the R-analysis for all wells (both Cmn and Ccr) shows that geologic formation is most similar to the Mg to Ca ratio (Figure 5). This supports the original assumption that higher Mg to Ca ratios are associated with the Ccr. Also, as expected the calcite and dolomite SI are very similar (see Figure 6; R^2=0.95), as are the variability (delCAL, delDOL) in calcite and dolomite SI's (see Figure 7; R^2=0.96). More loosely grouped are the water types (Type refers to cavity, fracture, or water zone) and the CV. This suggests that a high CV can be associated with wells which do not intersect cavities. However, a high CV may suggest proximity to a cavity or influences on water from a component of quick flowing groundwater.

Separate cluster analyses were performed by separating the data sets by formation (Figures 8 and 9). In the Cmn wells, similar relationships are seen between the SI's. Hardness and depth are similar, and the Mg/Ca ratio clusters with these two parameters. Type, delCAL and delDOL cluster together in the Cmn wells. For both delCAL and delDOL, all water zone types (cavity, fracture, water) show similar ranges in values, with delCAL and delDOL varying between ≈0.1 and -3, and ≈0.1 and -2 or -3, respectively. The largest absolute value of the variability was identified in GW-167 (delDOL=-5.68; Table 2). Note that some cavities may not have been noted during drilling, and also that relatively quick flow in fractures adjacent to conduits may occur.

In the Ccr wells, the SI's remain similar, as expected, and depth and hardness are similar, yet the importance of the CV differs from that in the Cmn wells (Figure 9). Water zone type, Mg/Ca, and the SI's cluster together, whereas the type and the variability in the SI's form a cluster in the Cmn wells.

In order to conduct flow modeling, it is necessary to map the distribution of quick flow (higher hydraulic conductivities), and slower flow zones. Table 8 lists parameters which are believed to be water zones which are subject to quick flow. An "X" in a column shows that the indicated variable is suggestive of a quick flow regime in the sampled interval of the well. An X in the "SI(dol) Fluctuation" column indicates that the dolomite SI fluctuates between super- and under-saturation between sampling events. The P_{CO2} column is marked if the calculated P_{CO2} is near the atmospheric value ($-\log(P_{CO2}) = 3.5 \pm 0.3$ atm). Consistent undersaturation with respect to calcite in all sampling events is noted by an X in the "Undersat wrt Calcite" column. If a well is known to be completed in a cavity, the appropriate column contains an X. Finally, an X in the CV > 0.10 column indicates a coefficient of variation of hardness of >10 percent, which is indicative of quick flow.

Eighty-one wells listed in Table 8 are not noted as having been completed in a cavity. Forty-four of these wells have at least one geochemical parameter suggestive of quick flow indicating (1) poor records for the older wells may have omitted notations for cavities when they were actually present, (2) relatively quick flow may be associated with fractures in proximity to cavities. Seventy-one of the 99 (71.7 percent) wells show at least one geochemical parameter suggestive of quick flow, 37 of which only have one such parameter. Twenty-three of the wells have 2 parameters suggestive of quick flow, whereas 10 wells show 3 parameters. Hence, relatively few wells have multiple indications of quick flow. Only one (GW-722-32) of the 18 zones noted to have a cavity in the completion zone showed no geochemical parameters indicative of quick flow, likely because this zone has only been sampled once. Not many water zones (16.7 percent) have P_{CO2} near atmospheric, which is not surprising considering that any residence time in the root zone will likely increase P_{CO2} above atmospheric.

Using Table 8, the results of the previous sections, locations of sinkholes, identification of cavities in other wells (Table 9), and locations and interconnections between cavities noted during drilling and purging of the wells, maps are constructed noting the probable (2-D) locations of quick flow zones (i.e., high hydraulic conductivity and specific discharge). Figure 10 is a base map showing the locations of the more detailed cavity maps from east to west (Maps 1 through 6) in Figures 11 through 16, and Figure 17 identifies the symbols on Figures 11 through 16. Geologic contacts on the maps are based on the geologic map of Hatcher et al (1992), and the contacts identified during drilling the Cmn exit pathway pickets (Shevenell et al., 1992). Conduits connecting individual wells are inferred and based on several assumptions believed to be realistic at this site. It is assumed that the dominant flow direction in the Cmn is strike-parallel, with localized strike-perpendicular solution enlarged zones feeding into the main conduit system in the valley. Piezometric surface maps (HSW, 1992a, 1992b) support the assumption that groundwater flow is from the ridges toward the valley, with strike-parallel flow dominating in the Cmn in BCV. Strike parallel flow is also supported by the presence of contaminants in numerous Cmn wells (Table 10). For instance, NO_3 contamination at Picket A (GW-683 and GW-684) shows that contaminants have migrated nearly 11,000 ft along strike from the S-3 Ponds. Both wells at Picket A (Figure 1) are completed in cavities which exhibit quick flow behavior based on geochemical evidence. Cavities in the Ccr are assumed to feed into the Cmn. Where no data are available, it is assumed that the Ccr feeder conduits mimic the surface drainages, following the trend of tributary streams.

It is emphasized that the maps in Figures 11 through 16 show one conceptual model of cavity occurrence based on the assumptions noted above. In most cases, it is not known which particular cavities are connected to one another. However, because data from drilling, cross borehole testing, and hydrographs indicate a well interconnected cavity system in the Cmn (Shevenell, et al., in prep.), wells which show some evidence for quick flow are connected on these maps. No data are available between Pickets A and W, yet a connection is inferred on Figure 16 because flow is known to be dominantly along strike and cavities are known to occur in all other portions of BCV. The connection noted on Figure 16 merely indicates one potential flow path, and not an individual conduit. Note that carbon tetrachloride contamination has been noted at Lake Reality (Figure 11), yet this is not a result of conduit flow. A pump operates at Lake Reality which draws water toward that location, and hence the flow paths are not natural, but induced by a pump. Therefore, no conduits are inferred in this area.

Similar assumptions were made for the Ccr. Numerous connections are noted in Figure 12 at the Chestnut Ridge Security Pits, yet it is unknown where the actual conduits may be. For instance, tests in which dye tracers were introduced into GW-178 indicated that slow flow away from this well occurred, and no definitive connections to other wells were noted (Geraghty and Miller, 1990b; Goldstrand and Haas, 1994). Hence, the connections illustrated on Figure 12, and the other figures, merely represent a conceptual model of conduit occurrence and not the actual locations of known conduits.

Based on a number of observations, the cavities in the Cmn appear to be maze passages (White, 1988), probably with an anastomotic pattern based on the following information obtained during drilling and purging of some Cmn wells. During drilling of both GW-683 (depth 149 to 158 ft) and GW-684 (depth = 122 to 124 ft; Picket A), increased turbidity in spring SS-5 was observed. This spring is located 425 ft north of GW-683, and ≈100 ft north of GW-684. Apparently there are fractures connecting the Ccr and Cmn in this location (Shevenell et al., 1992). One well in Picket C (GW-738) was found to have a natural hydraulic connection to the surface. During drilling at depths >55 ft., water and air emerged at the surface in old Bear Creek Road ≈ 10 to 20 ft. south of the drilling rig.

In several cases, wells could not be completed past a shallow, cavernous zone due to excess water production and caving of the well bore. For instance, the first two attempts to complete GW-705 (Picket B; Figure 1) to the target depth failed. The two initial wells were located along strike from one another, and the third, successful, attempt was sited 55 ft south of the first two wells in order to displace it from the along strike cavity zone intersected by the first two wells. Three attempts were also required to complete GW-724 (Picket C). During drilling of the second well, return water was lost, and was found to be emerging in the first well; ultimately both of the wells had to be plugged and abandoned. Hydraulic interconnection has also been observed during purging of the wells. The water level in GW-736 responded to purging activities in GW-737, located 40 ft away. Subsequently, 125 gal of water were removed from GW-736, upon which a 3.9 ft. water level decline in GW-737 was observed. Significant difficulties in completing GW-728 (south of the Burial Grounds) required attempts to seal a series of small cavities at 105 to 136 ft, and a large cavity at 163 to 171 ft, with bentonite and grout and case off the cavernous zones. During drilling of GW-790 (located ≈100 ft. south of GW-728) one to two months later, bentonite from GW-728 was encountered in two separate cavernous zones at about 120 and 212 ft. (R. Dreier, pers. comm., 1993). In summary, numerous examples exist which suggest that the conduit system in the Cmn is well interconnected, either honeycombed or anastomosing, and where sufficient data are available, the maps of Figures 11 through 16 reflect this.

In locations which contain a large number of wells in a relatively small area (see Map 2, Figure 12, in the Y-12 Plant area), the cavity system appears to be a complicated, anastomosing network of cavities. Note that the maps are drawn assuming cavities in nearby wells are interconnected. It is certainly possible that the connections shown on Maps 1 through 6 are not accurate and that the noted cavities may be in direct hydrologic communication with other, undiscovered cavities. However, it is the opinion of the author that the conduit network is considerably more complicated than that shown in Figures 11 through 16, and that the maps represent a very simplistic, first approximation to the distribution of cavities at the Y-12 Plant. Planned cross-borehole testing should assist in understanding the degree to which cavities are interconnected.

CONCLUSIONS

Water zones in wells at the Y-12 Plant that exhibit quick flow behavior were identified based on their geochemical characteristics and variability in geochemical parameters, and observations made during drilling of the wells. Generalized maps of the inferred distribution of quick flow regimes in the Ccr and Cmn were constructed based on the chemical characteristics of the waters. The maps are a first approximation to the distribution of quick flow zones, and additional studies are planned (i.e., cross borehole tests to identify interconnection between wells) which will help to refine the interpretations made from the chemical analyses of waters in these karst aquifers. The preliminary data suggest that the Cmn is composed of a complicated network, of interconnected, perhaps anastomosing, cavities. The degree of interconnection between the identified cavities is yet to be determined, although it is expected that there is significant vertical and lateral interconnection between the cavities located throughout BCV and the Y-12 Plant areas which are underlain by the Cmn. Generally, groundwater flows from the Ccr to the Cmn, except near Picket A where there is evidence from NO_3 and a_{Mg}/a_{Ca} data which suggests groundwater flow from the Cmn into the Ccr. As is typical in other karst settings, a significant quick flow component can be identified with portions of the aquifer, whereas other portions of the aquifer are typified by slowly flowing, long residence time waters.

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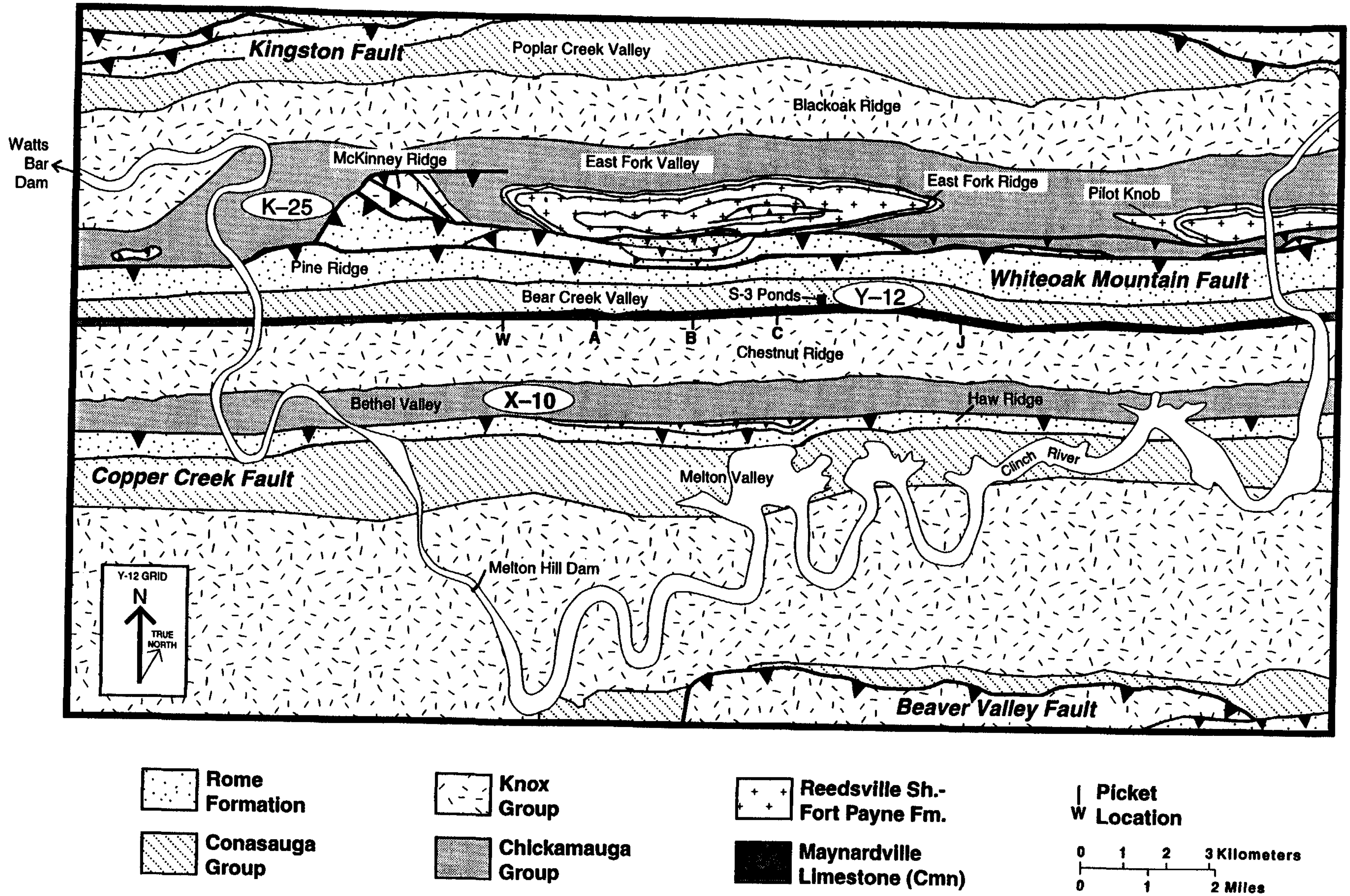

Figure 1. Generalized geologic map showing Maynardville Limestone Picket locations. Modified from Hatcher, et al. (1992).

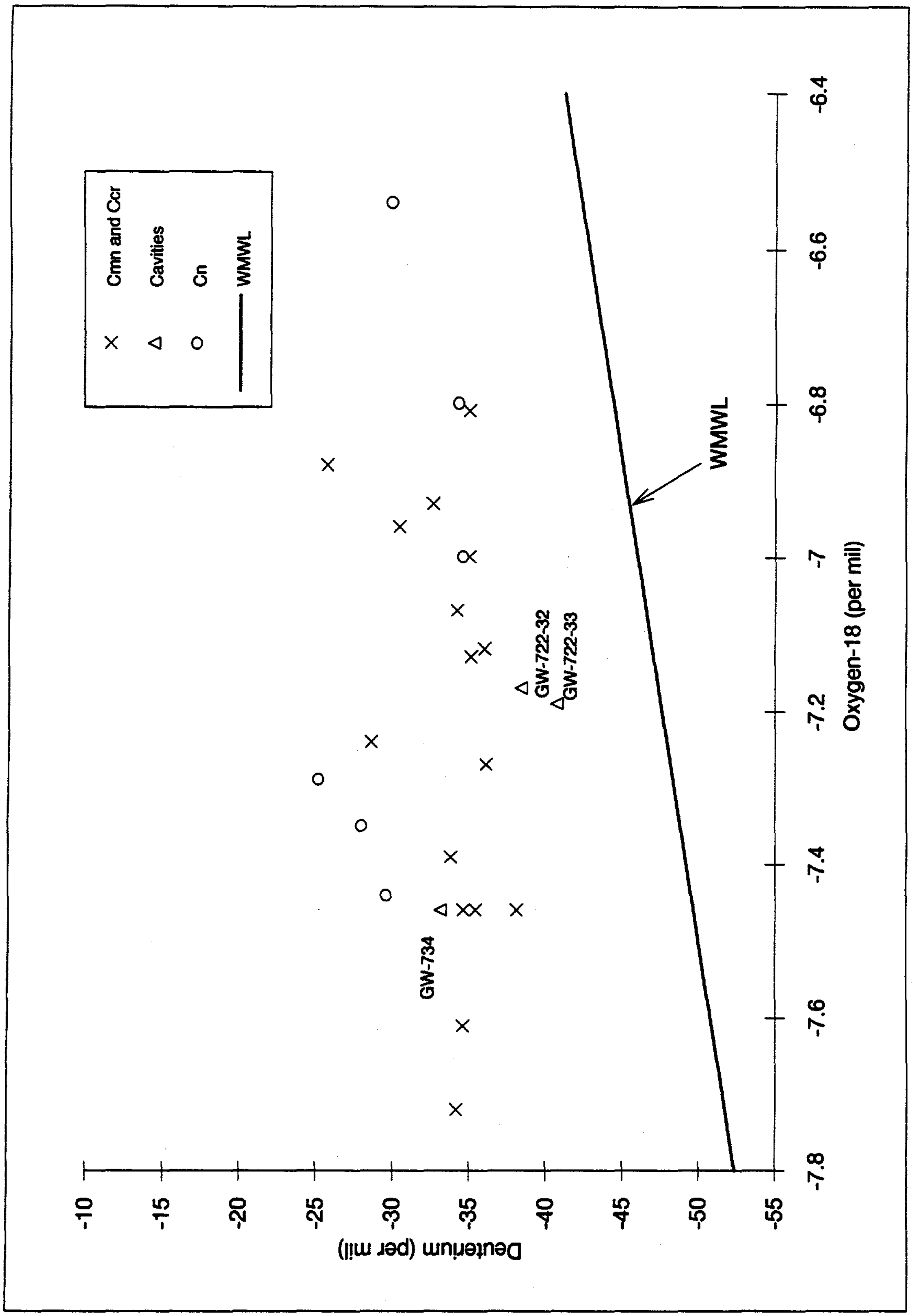

Figure 2. Deuterium versus oxygen-18 in wells at the Y-12 Plant.

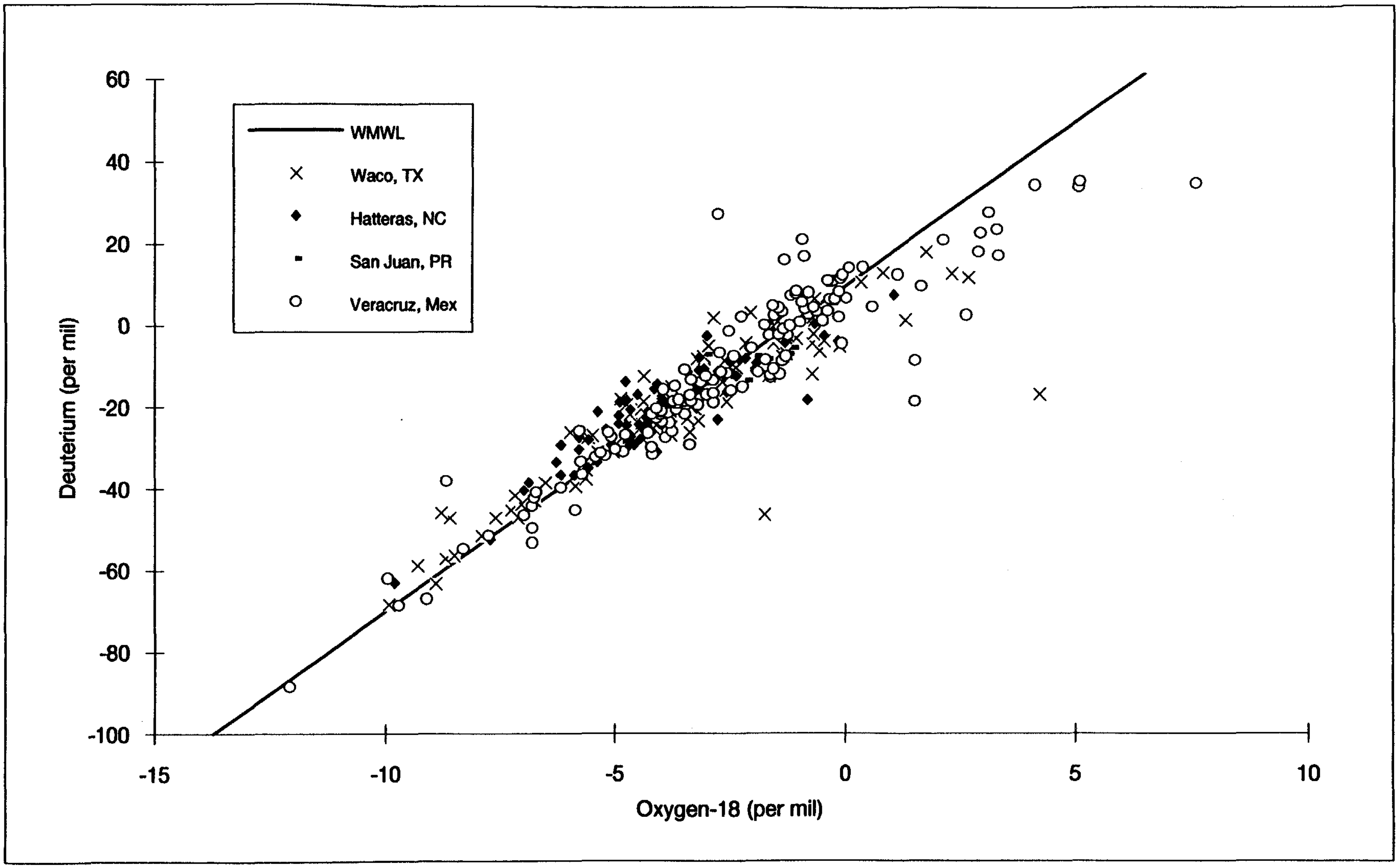

Figure 3. Deuterium versus oxygen-18 for four stations between 1953 and 1987.

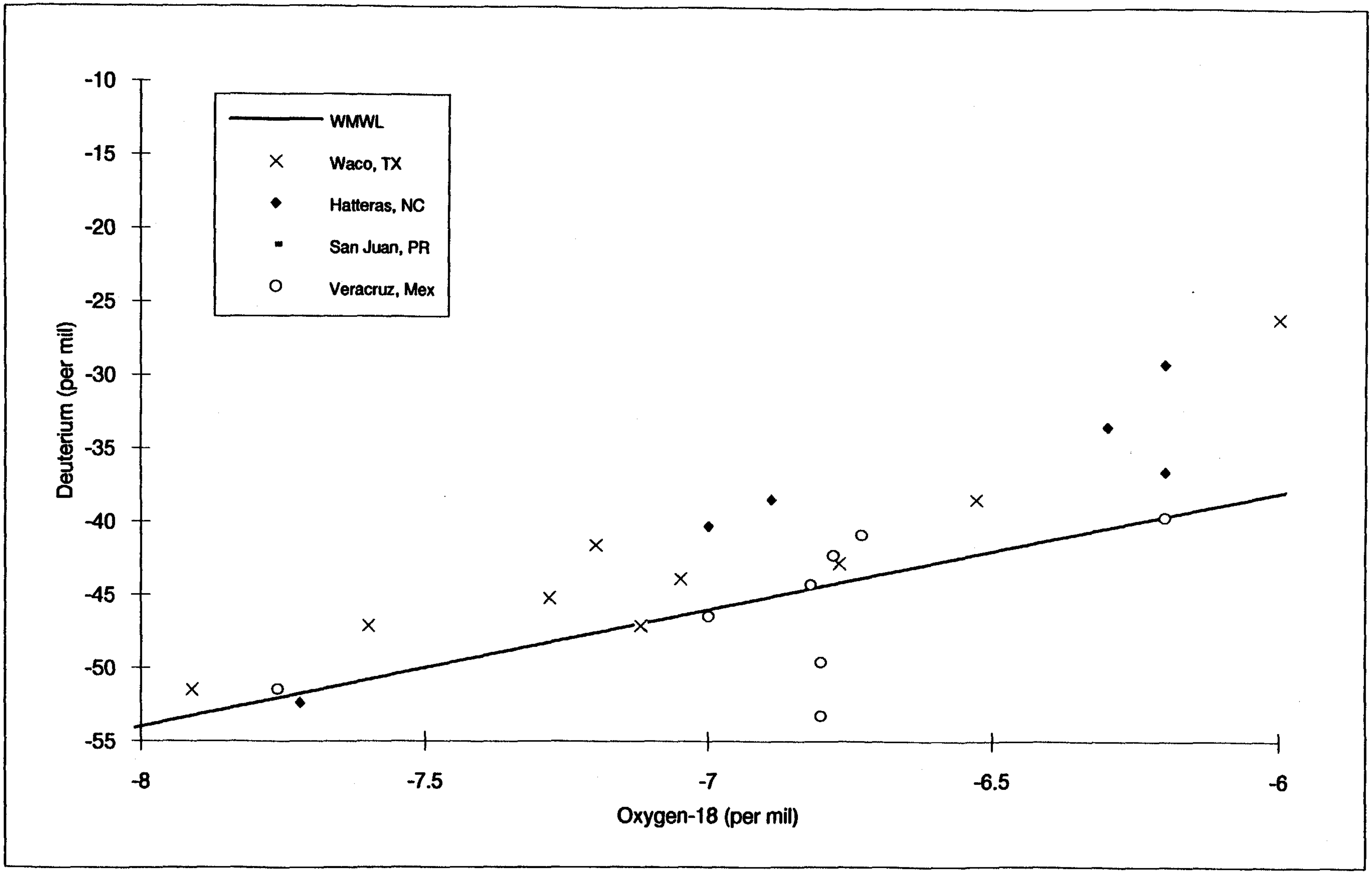

Figure 4. Deuterium versus oxygen-18 for four stations. Scale changed to that which appears in Figure 2.

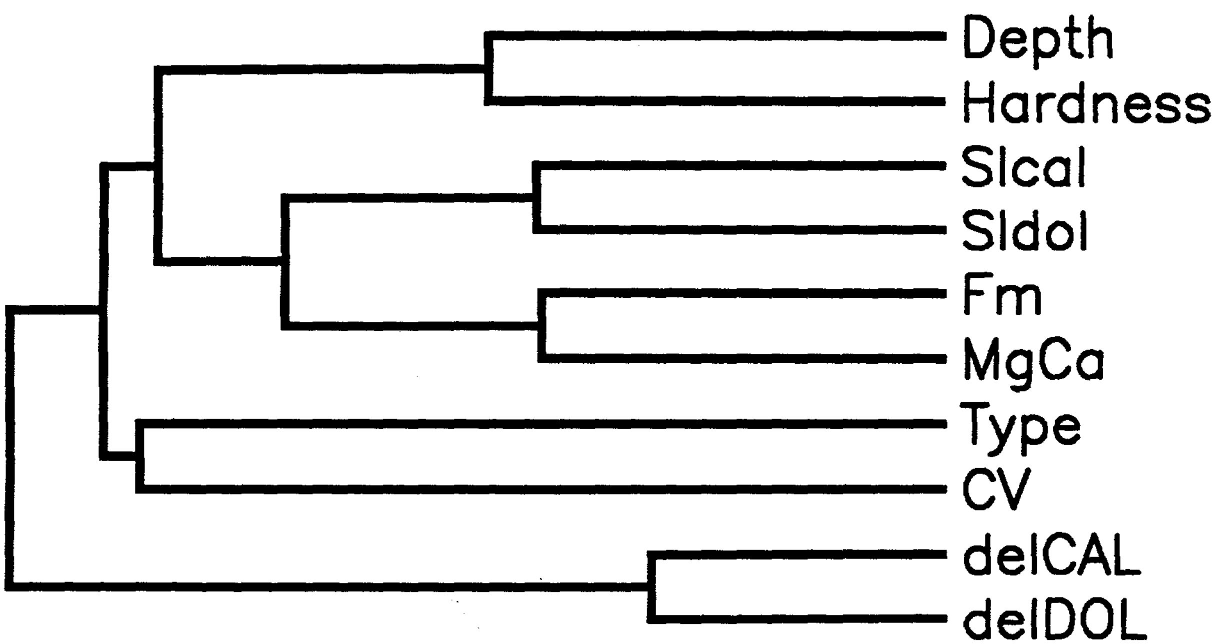

Figure 5. Dendogram which includes parameters for wells in the Ccr and Cmn.

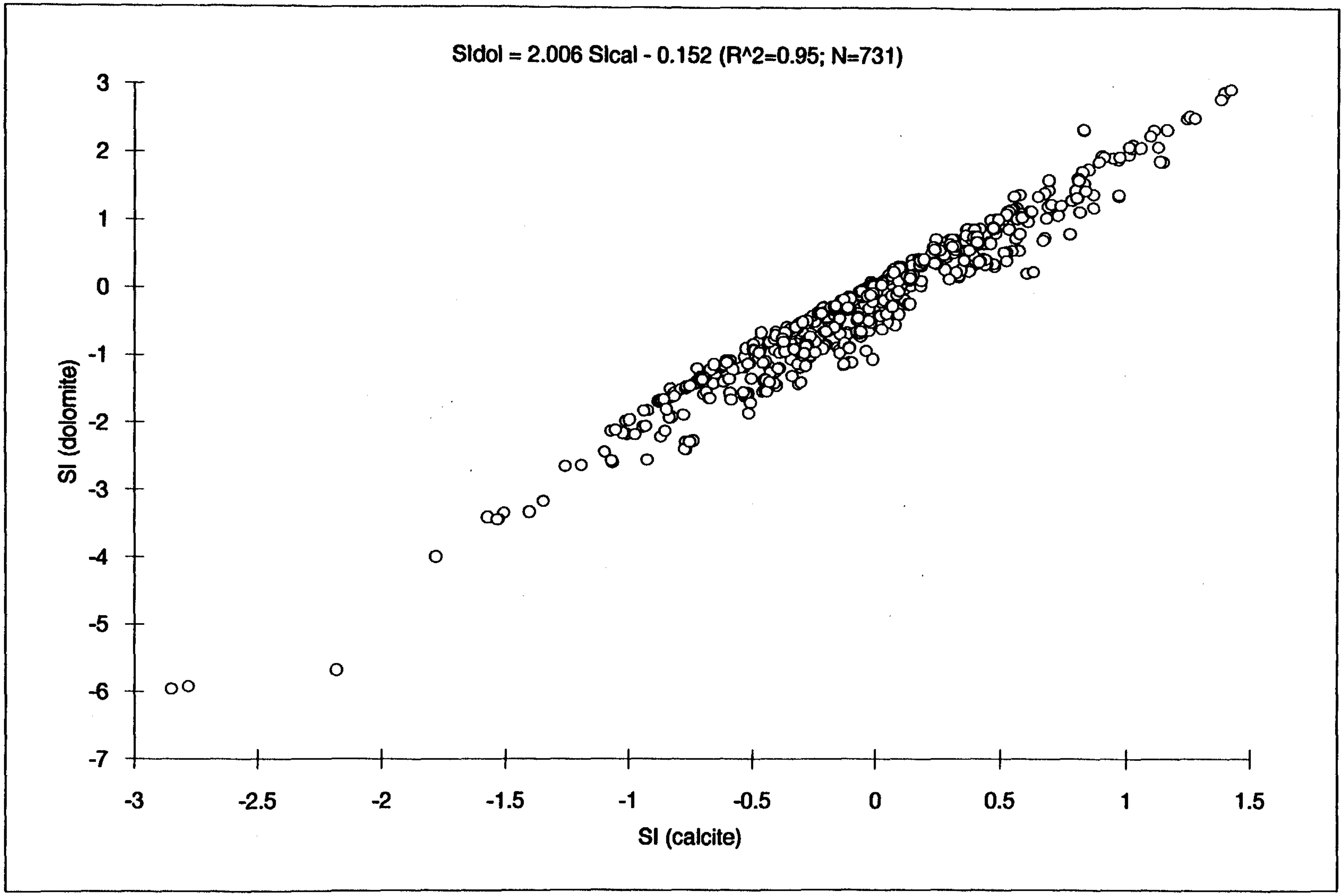

Figure 6. Calcite saturation indices versus dolomite saturation indices.

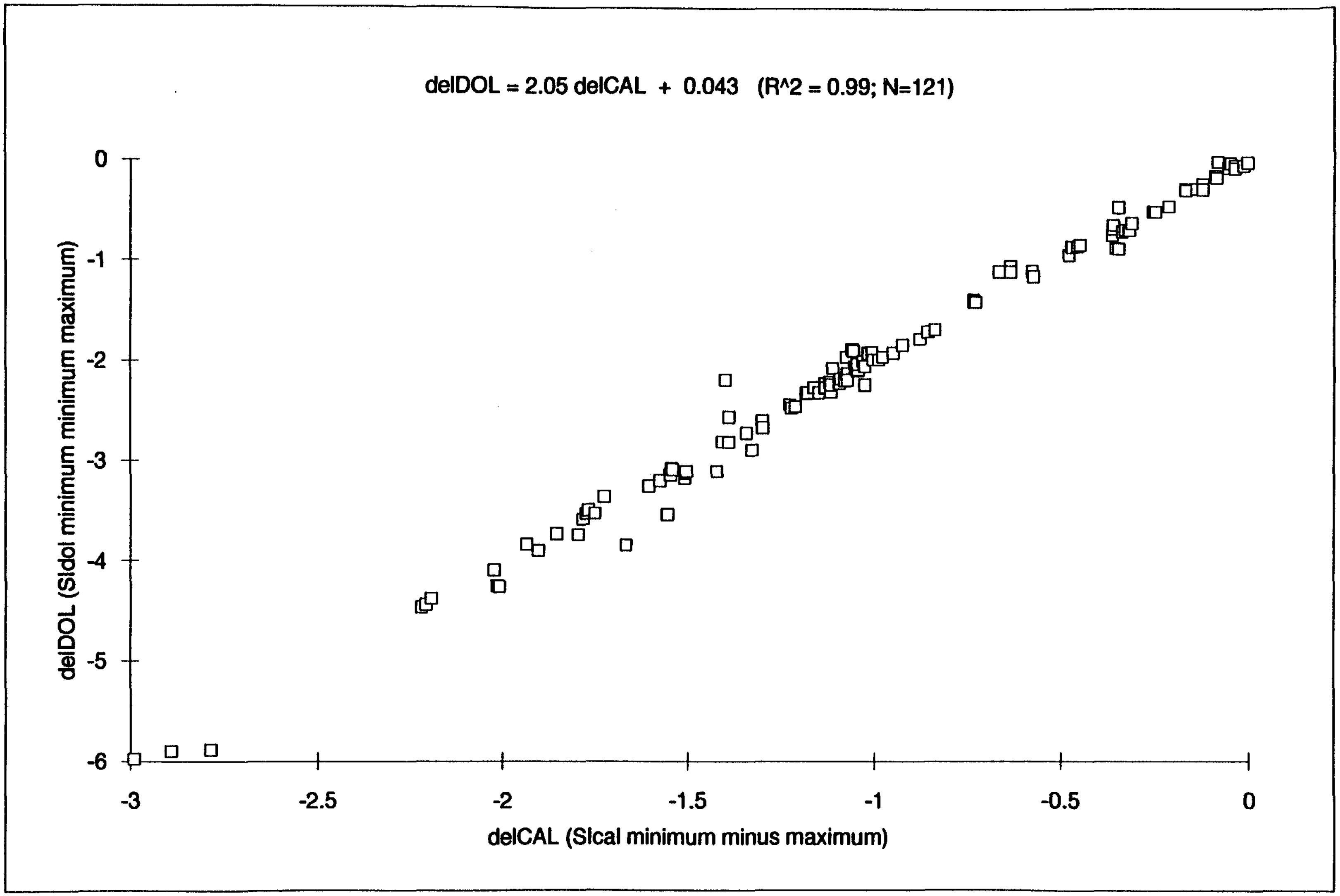

Figure 7. Variation in calcite saturation indices versus variation in dolomite saturation indices (delCAL vs delDOL)

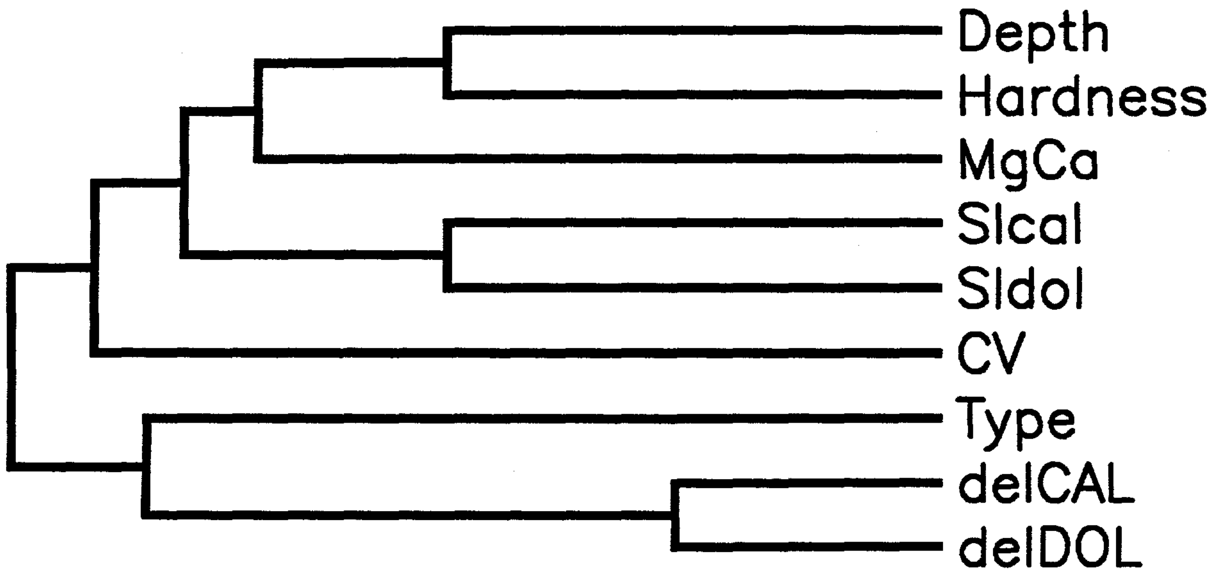

Figure 8. Dendogram which includes parameters for wells in the Cmn.

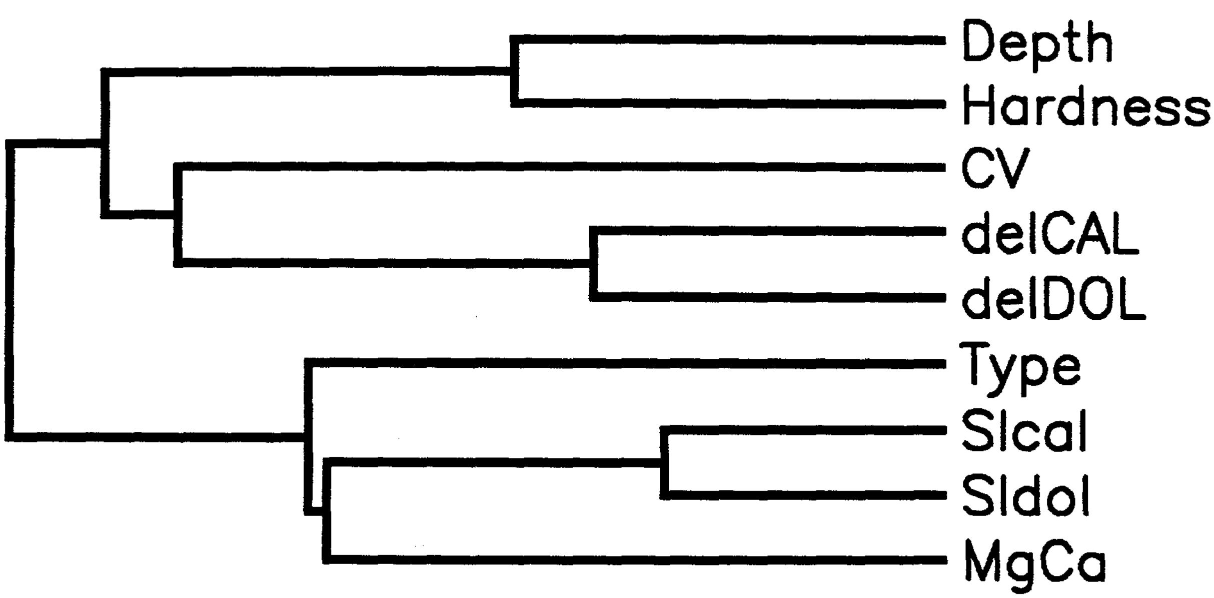

Figure 9. Dendogram which includes parameters for wells in the Ccr.

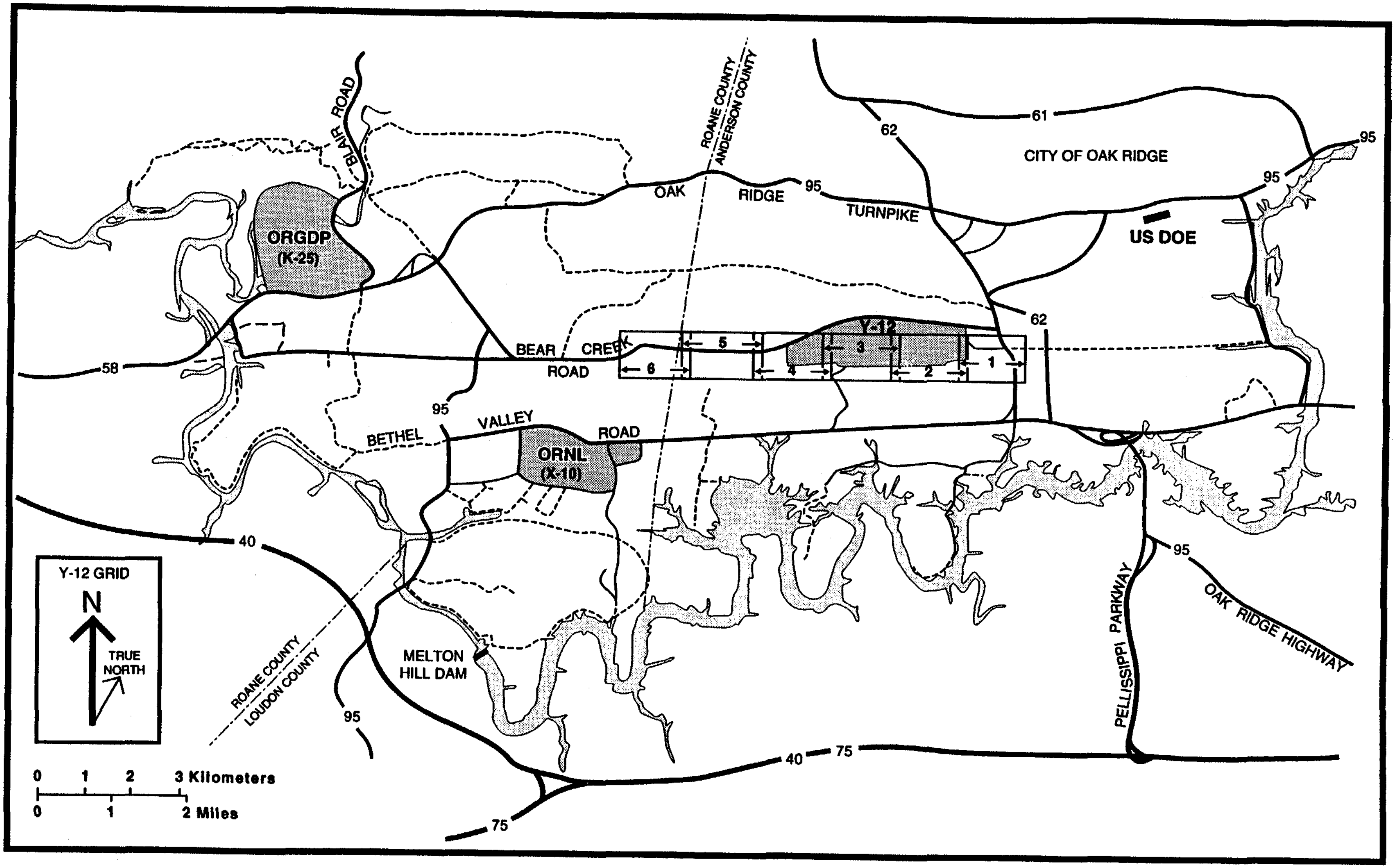

Figure 10. Base map showing the locations of the more detailed maps in Figures 11 through 16.

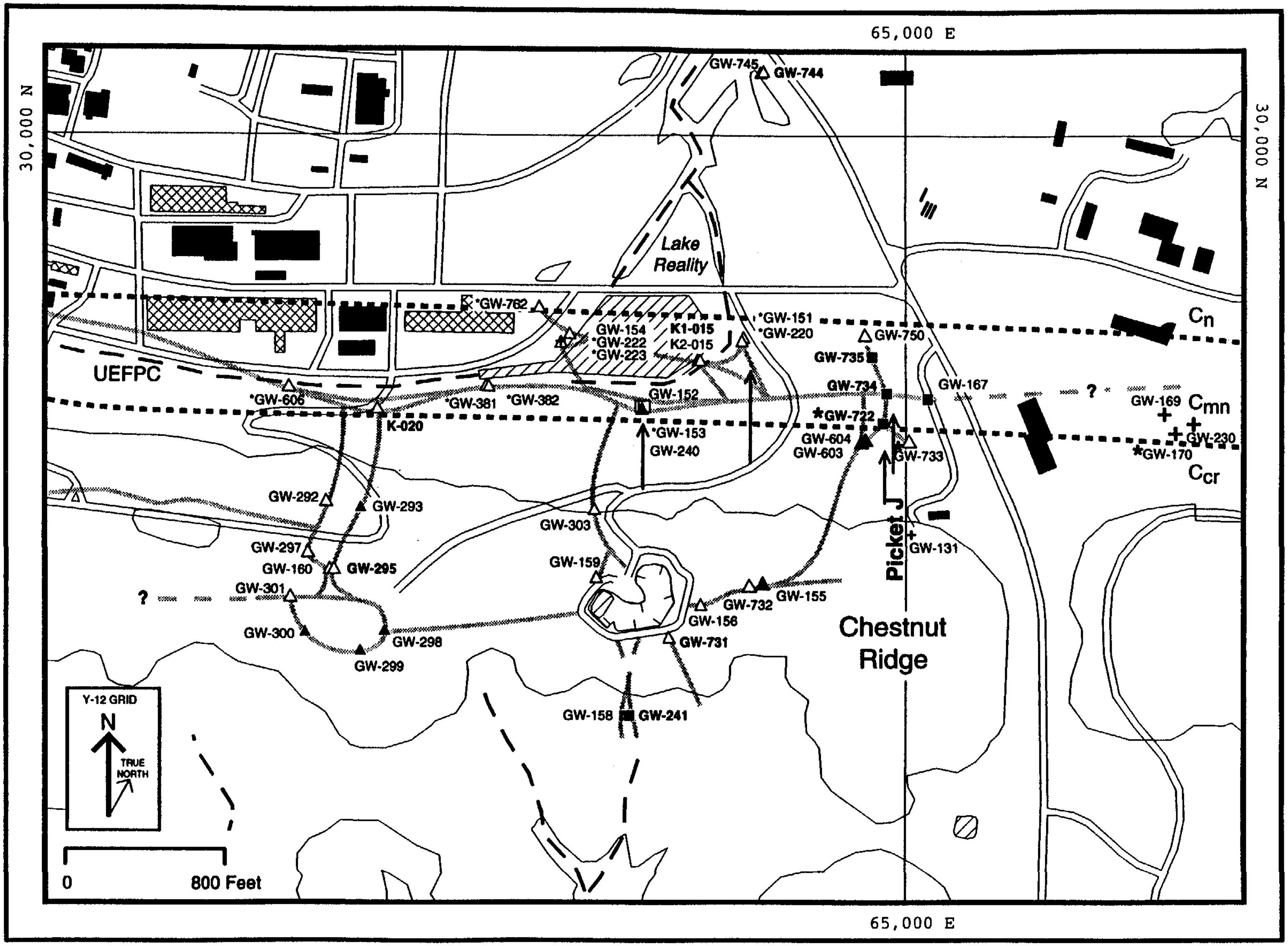

Figure 11. Location of cavities, Map 1.

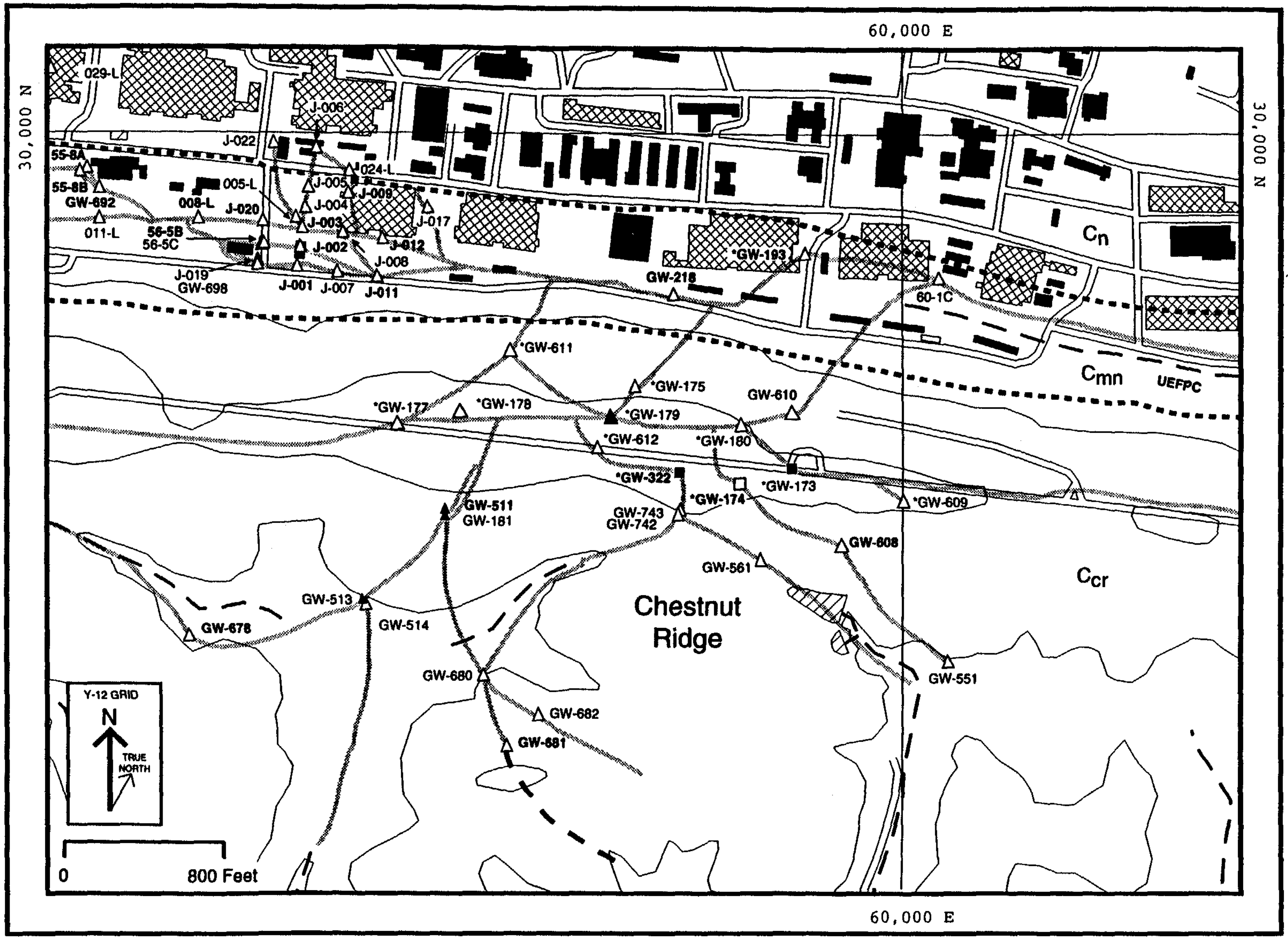

Figure 12. Location of cavities, Map 2.

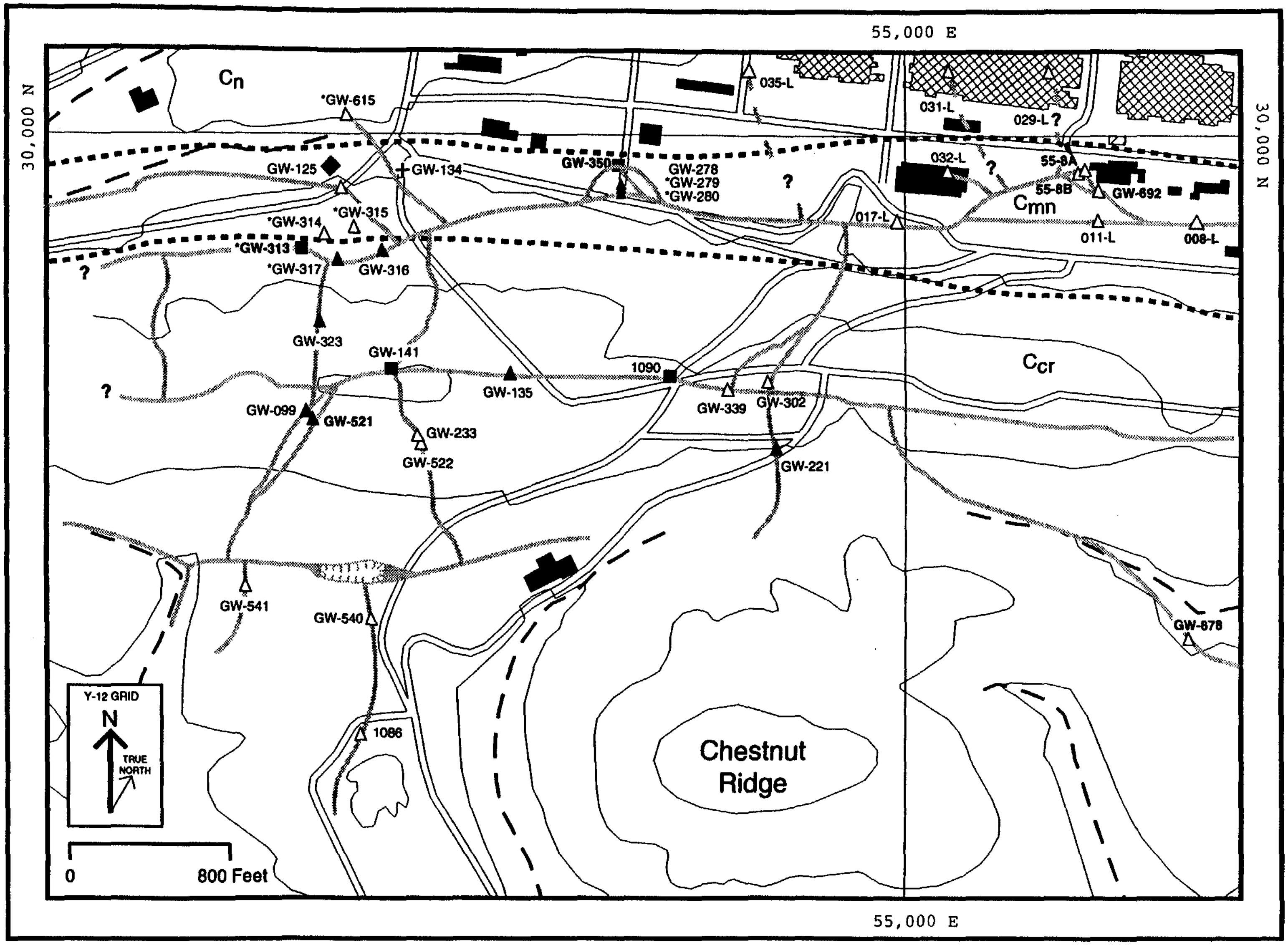

Figure 13. Location of cavities, Map 3.

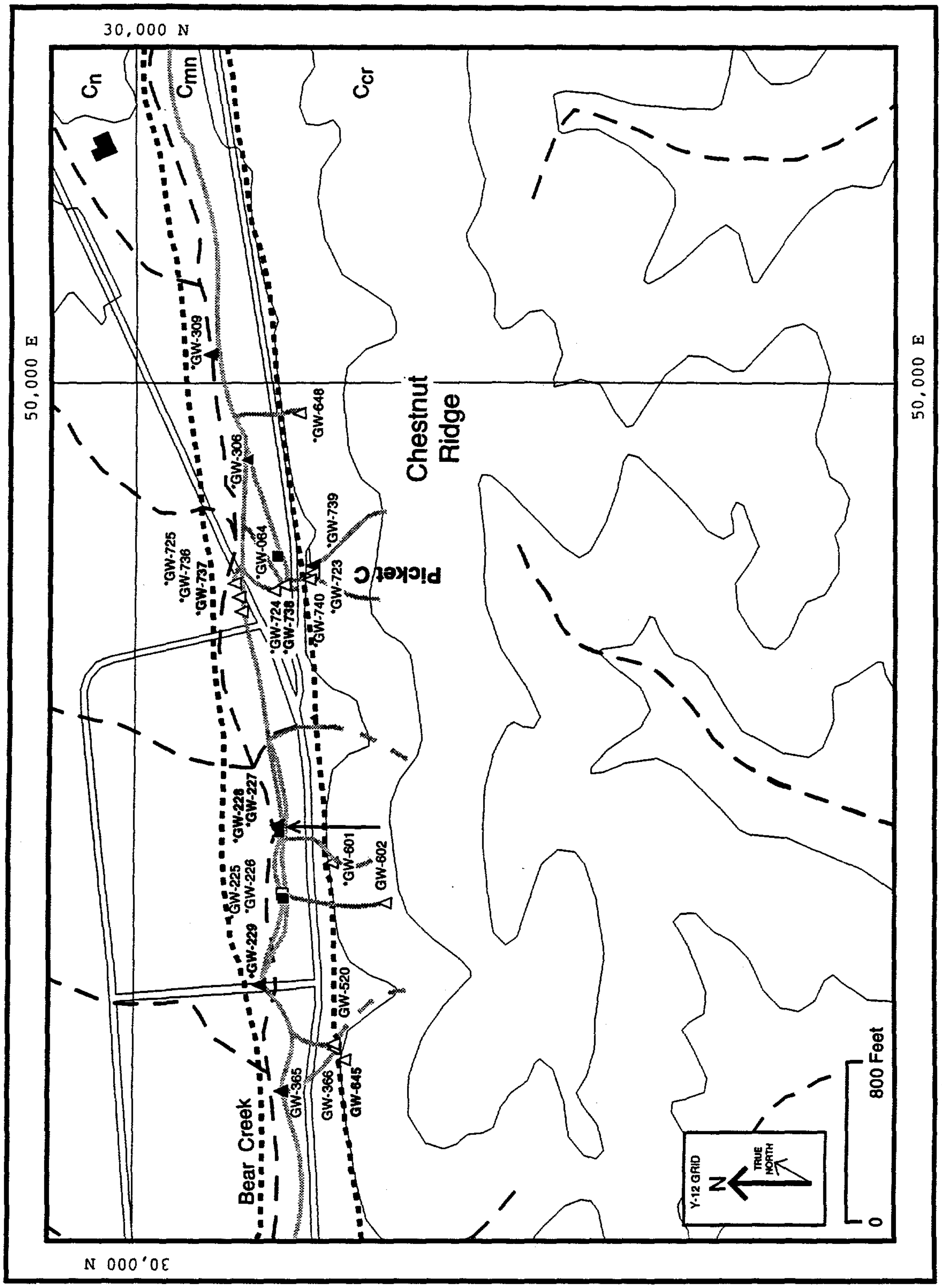

Figure 14. Location of cavities, Map 4.

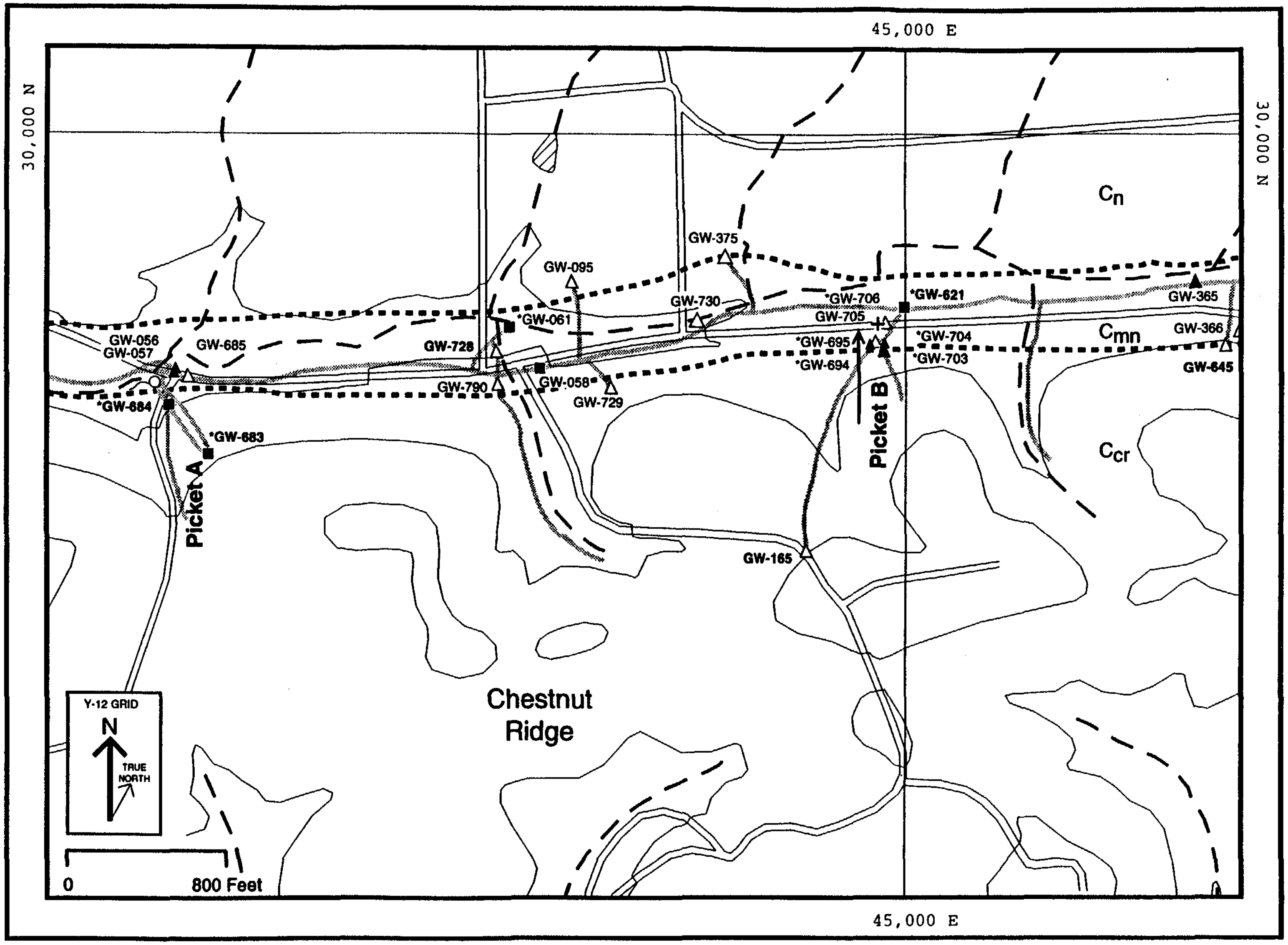

Figure 15. Location of cavities, Map 5.

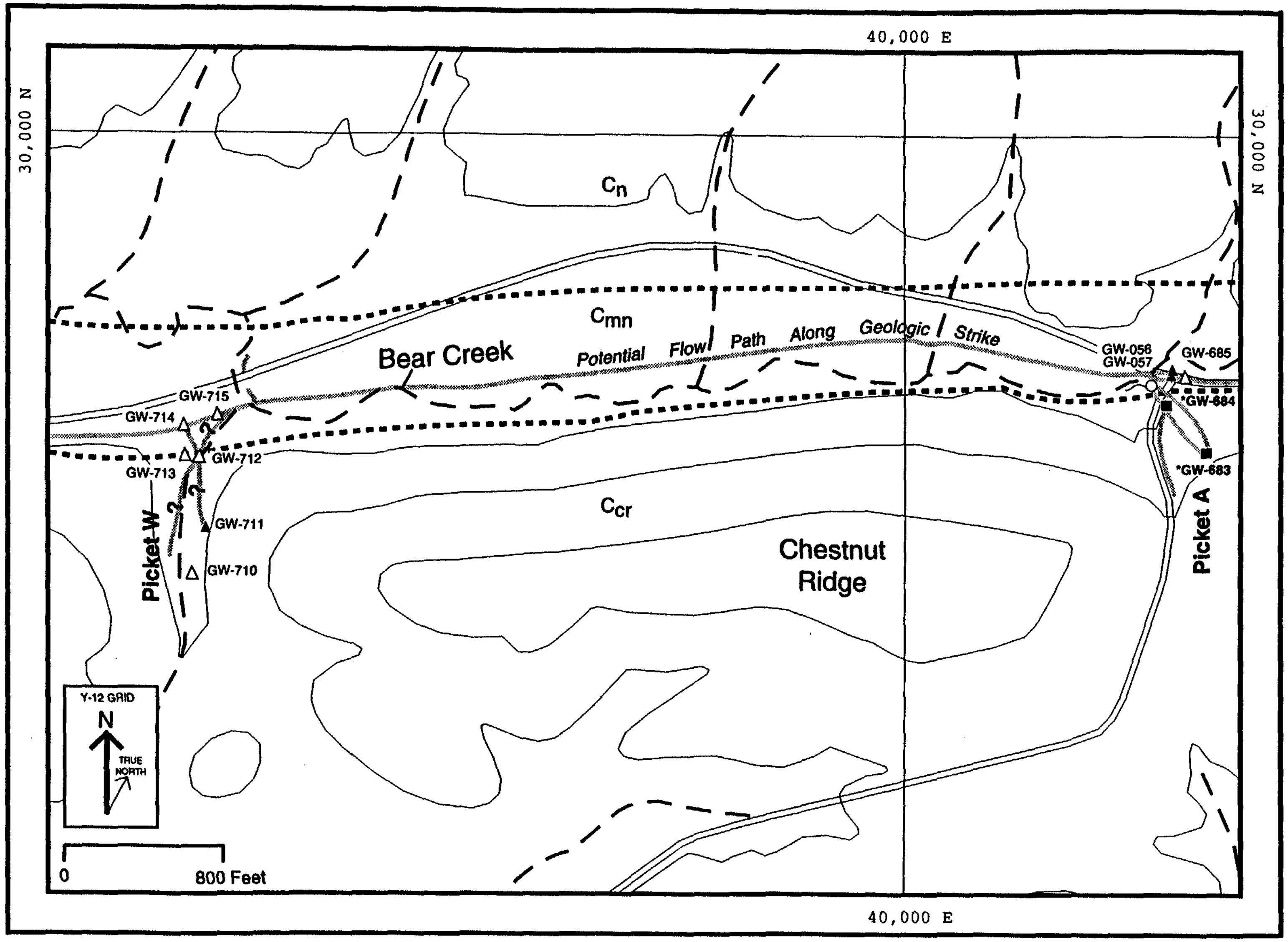

Figure 16. Location of cavities, Map 6.

LEGEND

+	Well location
△	Cavity intersected by well; no geochemical data substantiating quick flow
▲	Possible quick flow; 1 or 2 geochemical parameters suggest quick flow
□	Probable quick flow; 3 or 4 geochemical parameters suggest quick flow
■	Cavity in completion interval; 1 to 4 geochemical parameters suggest quick flow
——	Inferred position of conduits
——▶	Evidence for flow from Ccr; $^{a}Mg/^{a}Ca > 0.6$
— — —	Stream
	Spring
········	Geologic contact
	Buildings
	Contour line
═══	Road
GW-731	Well completed in a cavity
*GW-683	Contaminants have been detected in this well (See Table 10)

Figure 17. Symbols used in Figures 8 through 13.

Table 1. Water level fluctuations in wells for which water zone types are unknown.

Wells in the Maynardville Limestone				Wells in the Copper Ridge Dolomite			
Well ID	Water* Level (ft)	Zone Type	TD (ft)	Well ID	Water* Level (ft)	Zone Type	TD (ft)
GW-056	3.84	F	55.2	1090	18.04	C	96.7
GW-057	4.30	F	25	GW-058	12.86	C	27
GW-061	12.00	C	25	GW-099+	4.63	W	127
GW-095+	1.15	W	156	GW-158	29.69	C	441
GW-151+	1.84	W	96.5				
GW-152	4.00	F	17.3				
GW-153	4.04	F	60				
GW-167	10.70	C	30.1				
GW-220	2.40	W	45.2				
GW-222	1.67	W	25				
GW-223	0.79	W	90.5				
GW-225	11.84	C	200				

Note: C = cavity, F = fracture, W = water.

* Maximum water level minus the minimum measured in a 12 month period.

\+ Because these wells are relatively deep, the small water level changes may nevertheless indicate the presence of a fracture. Smaller water level changes may be associated with fractures at greater depths.

Table 2. Calcite and dolomite saturation indices.

	# Values	SI(cal) Min.	SI(cal) Max.	SI(dol) Min.	SI(dol) Max.	SI(cal) Min-Max	SI(dol) Min-Max
1090--F	10	-0.884	0.240	-1.703	0.518	-1.12	-2.22
1090--U	8	-0.877	-0.017	-1.703	0.018	-0.86	-1.72
GW-056---F	4	-0.334	0.800	-0.896	1.378	-1.13	-2.27
GW-056--U	5	-1.195	0.826	-2.644	1.447	-2.02	-4.09
GW-057--F	2	-0.204	-0.117	-0.864	-0.677	-0.09	-0.19
GW-057--U	2	-0.213	-0.121	-0.872	-0.707	-0.09	-0.17
GW-058---F	5	-0.252	0.823	-0.695	1.511	-1.08	-2.21
GW-058--U	4	-0.265	0.831	-0.709	1.529	-1.10	-2.24
GW-061---F	4	-0.463	0.673	-1.562	0.722	-1.14	-2.28
GW-061---U	4	-0.453	0.667	-1.550	0.697	-1.12	-2.25
GW-064---F	4	-0.062	0.968	-0.728	1.334	-1.03	-2.06
GW-064---U	5	-0.082	0.966	-0.738	1.356	-1.05	-2.09
GW-099--F	2	-0.531	1.245	-1.032	2.495	-1.78	-3.53
GW-099--U	2	-0.530	1.254	-1.057	2.528	-1.78	-3.59
GW-131-04-F	1	0.313		0.713			
GW-131-08--F	1	0.077		0.194			
GW-131-12--F	1	-0.040		-0.034			
GW-131-15--F	1	0.522		1.064			
GW-131-24--F	1	0.416		0.867			
GW-131-28--F	1	0.480		1.010			
GW-131-32-F	1	0.267		0.518			
GW-135-03--F	4	-1.261	0.593	-2.660	1.071	-1.85	-3.73
GW-135-06--F	1	0.453		0.671			
GW-135-11--F	1	0.429		0.638			
GW-135-19--F	1	0.381		0.716			
GW-135-23--F	1	0.867		1.370			
GW-135-30--F	2	-0.656	0.690	-1.292	1.436	-1.35	-2.73
GW-135-34--F	1	0.566		1.169			
GW-135-39--F	1	0.235		0.495			
GW-141--F	20	-0.631	0.555	-1.192	1.146	-1.19	-2.34
GW-141--U	20	-0.629	0.554	-1.186	1.143	-1.18	-2.33
GW-151----F	8	-0.413	0.617	-1.120	1.132	-1.03	-2.25
GW-151---U	6	-0.413	0.617	-1.120	1.132	-1.03	-2.25
GW-152--F	12	-0.946	0.781	-2.080	1.284	-1.73	-3.36
GW-152--U	14	-0.935	0.835	-2.070	1.420	-1.77	-3.49
GW-153--F	16	-0.663	0.848	-1.437	1.746	-1.51	-3.18
GW-153--U	18	-0.539	1.011	-1.187	1.957	-1.55	-3.14
GW-154--F	2	0.331	0.812	0.148	1.105	-0.48	-0.96
GW-154--U	4	-0.929	0.868	-2.566	1.170	-1.80	-3.74
GW-155--F	11	-0.805	0.229	-1.561	0.461	-1.03	-2.02
GW-155--U	5	-0.767	-0.188	-1.480	-0.364	-0.58	-1.12
GW-158--F	8	-0.727	0.829	-1.217	2.323	-1.56	-3.54

	# Values	SI(cal) Min.	SI(cal) Max.	SI(dol) Min.	SI(dol) Max.	SI(cal) Min-Max	SI(dol) Min-Max
GW-158--U	9	-0.836	0.831	-1.512	2.335	-1.67	-3.85
GW-167--F	3	-2.181	0.602	-5.688	0.200	-2.78	-5.89
GW-167--U	1	0.627		0.225			
GW-173--F	10	-0.794	1.110	-1.578	2.318	-1.90	-3.90
GW-173--U	6	-0.773	1.162	-1.511	2.327	-1.94	-3.84
GW-174--F	8	-0.113	1.394	-0.235	2.880	-1.51	-3.12
GW-174--U	6	-0.094	1.417	-0.206	2.926	-1.51	-3.13
GW-179--F	4	-0.173	0.948	-0.415	1.908	-1.12	-2.32
GW-181--F	9	-0.831	0.176	-1.643	0.357	-1.01	-2.00
GW-181--U	9	-0.817	0.164	-1.630	0.346	-0.98	-1.98
GW-220--F	5	-0.264	0.688	-0.738	1.192	-0.95	-1.93
GW-220---U	4	-0.287	0.704	-0.775	1.223	-0.99	-2.00
GW-221--F	8	-0.769	0.456	-1.484	0.994	-1.23	-2.48
GW-221--U	8	-0.757	0.456	-1.474	0.994	-1.21	-2.47
GW-222--F	1	0.178		0.021			
GW-222--U	1	0.182		0.095			
GW-223--F	7	-0.539	0.471	-1.619	0.305	-1.01	-1.92
GW-223--U	8	-7.051	0.470	-14.705	0.340	-7.52	-15.05
GW-225--U	1	-1.347		-3.178			
GW-226--F	10	-1.070	1.147	-2.610	1.855	-2.22	-4.47
GW-226--U	11	-1.072	1.134	-2.575	1.864	-2.21	-4.44
GW-227--F	2	0.002	0.128	-0.508	-0.253	-0.13	-0.26
GW-227--U	3	0.003	0.129	-0.570	-0.269	-0.13	-0.30
GW-228--F	5	-0.059	0.608	-0.150	0.969	-0.67	-1.12
GW-228--U	2	0.372	0.387	0.469	0.538	-0.02	-0.07
GW-229--F	8	-0.451	0.570	-1.391	0.541	-1.02	-1.93
GW-229--U	8	-0.450	0.569	-1.404	0.539	-1.02	-1.94
GW-240--F	9	-1.009	0.142	-2.196	0.132	-1.15	-2.33
GW-240--U	8	-1.028	0.138	-2.166	0.108	-1.17	-2.27
GW-241--F	10	-0.928	0.823	-1.829	1.700	-1.75	-3.53
GW-241--U	6	-0.941	0.195	-1.841	0.397	-1.14	-2.24
GW-278--F	3	-0.772	0.773	-2.300	0.783	-1.55	-3.08
GW-278--U	3	-0.771	0.773	-2.300	0.790	-1.54	-3.09
GW-279--F	1	1.277		2.503			
GW-293--F	10	-0.680	0.373	-1.250	0.817	-1.05	-2.07
GW-293--U	9	-0.673	0.374	-1.231	0.813	-1.05	-2.04
GW-298--F	8	-0.717	0.366	-1.349	0.863	-1.08	-2.21
GW-298--U	3	0.050	0.192	0.115	0.413	-0.14	-0.30
GW-299--F	10	-0.865	0.064	-1.692	0.158	-0.93	-1.85
GW-299--U	10	-0.865	0.064	-1.693	0.158	-0.93	-1.85
GW-300--F	9	-1.075	0.532	-2.141	1.117	-1.61	-3.26
GW-300--U	9	-1.056	0.521	-2.123	1.084	-1.58	-3.21
GW-306--F	4	-0.345	0.021	-1.328	-0.628	-0.37	-0.70
GW-306--U	2	-0.063	0.021	-0.656	-0.628	-0.08	-0.03

	# Values	SI(cal) Min.	SI(cal) Max.	SI(dol) Min.	SI(dol) Max.	SI(cal) Min-Max	SI(dol) Min-Max
GW-309--F	3	-0.149	-0.111	-0.981	-0.892	-0.04	-0.09
GW-309--U	3	-0.149	-0.110	-0.980	-0.908	-0.04	-0.07
GW-313--F	2	-0.023	0.290	-0.522	0.118	-0.31	-0.64
GW-313--U	3	-0.591	0.290	-1.675	0.118	-0.88	-1.79
GW-314--F	1	-0.080		-0.495			
GW-314--U	1	-0.072		-0.468			
GW-315--F	1	0.438		0.405			
GW-315--U	1	0.438		0.405			
GW-316--F	3	-0.574	-0.517	-1.222	-1.138	-0.06	-0.08
GW-316--U	4	-0.583	0.532	-1.230	0.857	-1.12	-2.09
GW-317--F	6	-0.502	0.576	-0.930	1.041	-1.08	-1.97
GW-317--U	5	0.124	0.583	0.158	1.032	-0.46	-0.87
GW-322--F	10	-1.016	0.395	-1.990	0.828	-1.41	-2.82
GW-322--U	7	-1.002	0.393	-1.976	0.848	-1.40	-2.82
GW-323--F	4	-0.870	0.359	-1.679	0.770	-1.23	-2.45
GW-323--U	4	-0.860	0.544	-1.669	0.538	-1.40	-2.21
GW-350--F	3	-0.772	-0.520	-2.411	-1.884	-0.25	-0.53
GW-350--U	3	-0.777	-0.520	-2.415	-1.884	-0.26	-0.53
GW-365--F	4	-0.411	0.041	-1.260	-0.402	-0.45	-0.86
GW-365--U	4	-0.432	0.041	-1.278	-0.402	-0.47	-0.88
GW-511--F	4	0.805	1.379	1.610	2.779	-0.57	-1.17
GW-511--U	3	0.807	1.023	1.575	2.051	-0.22	-0.48
GW-513--F	6	-0.280	1.024	-0.501	2.104	-1.30	-2.61
GW-513--U	7	-0.381	1.012	-0.501	2.073	-1.39	-2.57
GW-521--F	1	-0.300		-0.524			
GW-521--U	1	-0.300		-0.524			
GW-603---F	2	-1.406	0.020	-3.342	-0.230	-1.43	-3.11
GW-603--U	4	-0.337	0.739	-0.928	1.207	-1.08	-2.14
GW-604--F	4	-1.780	-0.450	-4.010	-1.110	-1.33	-2.90
GW-604--U	4	-0.689	0.406	-1.563	0.629	-1.10	-2.19
GW-621--F	3	-0.530	0.520	-1.590	0.520	-1.05	-2.11
GW-621---U	2	-0.542	0.512	-1.564	0.511	-1.05	-2.08
GW-683--F	4	-1.510	0.680	-3.360	1.020	-2.19	-4.38
GW-683--U	3	-1.571	-0.270	-3.421	-0.740	-1.30	-2.68
GW-684---F	3	-1.530	0.480	-3.450	0.810	-2.01	-4.26
GW-684--U	3	-1.535	0.480	-3.451	0.800	-2.02	-4.25
GW-685---F	4	-0.280	0.060	-0.860	-0.130	-0.34	-0.73
GW-685--U	4	-0.287	0.080	-0.887	-0.120	-0.37	-0.77
GW-694--F	3	-0.300	-0.250	-1.010	-0.970	-0.05	-0.04
GW-694--U	2	-0.300	-0.294	-1.020	-0.989	-0.01	-0.03
GW-695---F	4	0.070	0.910	0.220	1.920	-0.84	-1.70
GW-695---U	3	0.490	1.127	1.000	2.067	-0.64	-1.07
GW-703---F	4	-0.660	0.400	-1.160	0.750	-1.06	-1.91
GW-703---U	3	-0.660	0.404	-1.150	0.746	-1.06	-1.90

	# Values	SI(cal) Min.	SI(cal) Max.	SI(dol) Min.	SI(dol) Max.	SI(cal) Min-Max	SI(dol) Min-Max
GW-704---F	4	0.148	0.470	0.175	0.890	-0.32	-0.72
GW-704---U	4	0.140	0.473	0.168	0.878	-0.33	-0.71
GW-706---F	3	0.060	0.416	-0.280	0.610	-0.36	-0.89
GW-706--U	3	0.063	0.411	-0.289	0.611	-0.35	-0.90
GW-710---F	1	0.364		0.543			
GW-710---U	1	0.371		0.548			
GW-711---F	3	-0.110	0.619	-0.310	1.113	-0.73	-1.42
GW-711--U	2	-0.114	0.621	-0.305	1.122	-0.74	-1.43
GW-712---F	2	0.235	0.406	0.365	0.673	-0.17	-0.31
GW-712---U	2	0.236	0.406	0.350	0.665	-0.17	-0.32
GW-722-02---	1	-0.378		-0.812			
GW-722-06--F	1	0.022		0.029			
GW-722-10--F	1	-0.476		-0.982			
GW-722-17--F	1	-0.608		-1.131			
GW-722-20-F	1	0.303		0.599			
GW-722-22--F	1	-0.848		-1.818			
GW-722-26--F	1	-0.038		-0.137			
GW-722-30--F	1	-1.101		-2.449			
GW-722-32--F	1	0.521		0.391			
GW-722-33--F	1	-0.513		-1.727			
GW-723---F	1	0.693		1.590			
GW-733---U	1	0.575		1.366			
GW-733--F	1	0.553		1.347			
GW-734 --F	1	-0.447		-1.559			
GW-734 --U	2	-0.783	-0.435	-1.900	-1.419	-0.35	-0.48
GW-735---U	1	-0.133		-1.159			
GW-735--F	1	-0.133		-1.143			
GW-739--F	1	-0.123		-0.326			
GW-739--U	1	-0.118		-0.307			
GW-740---F	1	-0.015		-0.099			
GW-740--U	1	-0.025		-0.120			

Note: U refers to the unfiltered samples, F refers to the filtered samples.

Table 3: Wells With Magnesium to Calcium Ratios Suggestive of Flow from the Ccr

Well	Average a(Mg)/a(Ca)	Minimum a(Mg)/a(Ca)	Maximum a(Mg)/a(Ca)	Consistent or Fluctuating	Drilled Through the Ccr
Picket W Area:					
GW-710	0.61	0.60	0.61	C	Y
GW-711	0.71	0.65	0.76	C	Y
GW-712	0.69	0.65	0.75	C	Y
Picket A Area:					
GW-684	0.51	0.38	0.65	F	Y
Picket B Area:					
GW-703	1.04	0.78	1.42	C	Y
GW-704	0.86	0.73	1.21	C	N
GW-706	0.52	0.35	0.86	F	N
Picket C Area:					
GW-228	0.59	0.46	0.95	F	N
GW-723	1.47	--	--	C	Y
GW-739	0.77	0.76	0.78	C	Y
GW-740	0.76	0.76	0.76	C	Y
S-3 Ponds Area:					
GW-135-03	0.62	0.56	0.71	C	Y
GW-135-19	0.83	--	--	?	Y
GW-279	0.75	--	--	C	N
GW-316	0.71	0.61	0.78	C	Y
GW-317	0.74	0.67	1.06	C	Y
Picket J Area:					
GW-131-4	0.92	--	--	?	Y
GW-131-8	0.92	--	--	?	Y
GW-131-12	0.93	--	--	?	Y
GW-131-15	0.88	--	--	?	Y
GW-151	0.70	0.65	0.71	C	N
GW-153	0.77	0.71	1.00	C	N
GW-240	0.65	0.52	0.80	F	N
GW-604	0.60	0.55	0.64	F	Y
GW-722-02	0.75	--	--	?	N
GW-722-06	0.98	--	--	?	N
GW-722-10	1.04	--	--	?	N
GW-722-17	1.03	--	--	?	N
GW-722-20	1.06	--	--	?	N
GW-722-22	0.86	--	--	?	N
GW-722-26	0.75	--	--	?	N
GW-722-30	0.68	--	--	?	N
GW-733	1.58	1.53	1.62	C	Y

Note: A "?" in the fifth column indicates only one analysis is available.

Table 4. Deuterium (D), oxygen-18 (O-18), and carbon-13 (C-13) in the Maynardville Limestone (Cmn) and Copper Ridge Dolomite (Ccr).

Well	Depth (ft)	Complete	Fm	Date	O-18 (per mil)	D (per mil)	C-13 (per mil)
GW-131-12	780	F	Ccr	5/19/92	-6.93	-32.6	-9.53
GW-131-24	458	F	Ccr	5/19/92	-7.13	-35.1	--
GW-131-28	376	N	Ccr	5/19/92	-7.07	-34.2	-9.02
GW-134-11	578	F	Cn	6/25/92	-7.44	-29.6	-6.75
GW-134-15	486	F	Cn	6/23/92	--	--	-11.78
GW-134-18	426	F	Cn	4/13/92	-7.35	-28	--
GW-134-25	286	F	Cn	5/5/92	-7	-34.6	-3.59
GW-134-29	171	F	Cn	5/11/92	-6.54	-29.9	--
GW-134-3	785	F	Cn	5/4/92	-7.29	-25.2	--
GW-134-33	106	F	Cn	5/11/92	-6.8	-34.3	--
GW-135-03	1206	N	Cmn	2/13/92	-7.24	-28.6	-14.17*
GW-135-03	1206	N	Cmn	6/2/92	-6.88	-25.7	--
GW-135-11	965	F	Cmn	6/8/92	-7.72	-34.2	-10.65*
GW-135-30	459	F	Ccr	6/9/92	-7.46	-35.4	-10.8
GW-135-41	164	F	Ccr	2/13/92	-7.46	-34.6	-12.83
GW-722-02	620	N	Cmn	5/27/92	-7.61	-34.6	-5.66
GW-722-06	560	N	Cmn	1/7/92	-7.46	-38.1	-7.22
GW-722-10	500	F	Cmn	1/20/92	-7.12	-36	--
GW-722-17	385	F	Cmn	5/28/92	-6.96	-30.4	-8.22
GW-722-20	333	F	Cmn	1/21/92	-6.81	-35	-6.15
GW-722-22	313	F	Cmn	1/27/92	-7	-35	--
GW-722-26	216	N	Cmn	5/21/92	-7.39	-33.8	--
GW-722-30	151	F	Cmn	1/29/92	-7.27	-36.1	-10.01
GW-722-32	107	C	Cmn	1/29/92	-7.17	-38.4	--
GW-722-33	87	C	Cmn	2/4/92	-7.19	-40.7	-8.77
GW-734	65	C	Cmn	3/24/92	-7.46	-33.1	--
				Average (all):	-7.19	-33.33	-8.49
				Std. Deviation	0.28	3.8	2.60
				Average (Cmn)	-7.23	-34.26	-7.67
				Std. Deviation	0.27	3.95	1.65
				Average (Ccr)	-7.21	-34.38	-10.55
				Std. Deviation	0.24	1.10	1.70

Note: *Low yield

GW-134 is completed in the Nolichucky Shale (Cn).

Fm = geologic formation.

Completed in fracture (F), cavity (C), or neither (N)

Table 5. Percentage of total data points by season having deuterium enriched (>1 per mil) or depleted (>-1 per mil) relative to the WMWL

	Hatteras, NC	Waco, TX	San Juan, Puerto Rico	Veracruz, Mexico	Average*	Average+
Above WMWL (>1 per mil)						
April to Sept.	28.6%	33.0%	12.5%	45.0%	24.7%	29.8%
Oct. to March	71.4%	66.0%	87.5%	55.0%	75.0%	70.0%
Number of Values	49	42	8	51		
Below WMWL (>-1 per mil)						
April to Sept.	81.0%	71.4%	85.7%	61.0%	79.4%	74.8%
Oct. to March	18.5%	28.6%	14.3%	39.0%	20.5%	25.1%
Number of Values	27	42	7	56		

Average* is average of Hatteras, Waco, San Juan
Average+ is average of Hatteras, Waco, San Juan, Veracruz

Table 6. Measured and modeled carbon-13 (per mil PDB) under open and closed system dissolution conditions.

Assume: Closed System C-13 Carbonate = -1.0 per mil. Closed System C-13 Calcite and Dolomite = -1.0 per mil

Zone	Date	Measured C-13	Initial C-13 CO2 = -25 per mil Recharge T = 25 C			Initial C-13 CO2 = -13 per mil Recharge T = 5 C			Initial C-13 CO2 = -15 per mil Recharge T = 5 C			Percent Error
			Open System	Closed CaCO3	Closed Cal/Dol	Open System	Closed CaCO3	Closed Cal/Dol	Open System	Closed CaCO3	Closed Cal/Dol	
GW-131-12	5/19/92	**-9.53**	-17.08	-13.40	-15.96	-2.80	-6.56	**-9.38***	-4.8	-7.66	-9.73	1.6%
GW-131-28	5/19/92	**-9.02**		-13.23	18.68		-6.71	**-9.48***		-7.77	10.48	4.9%
GW-135-03	2/13/92	**-14.17**		-16.43	169.20		-3.48	84.10		-5.32	98.28	
GW-135-11	6/8/92	**-10.65**		-13.27	4.76		-6.69	**-12.92***		-7.75	2.36	17.6%
GW-135-30	6/9/92	**-10.8**		-13.80	-15.23		-6.16	-8.11		-7.36	**-9.30**	14.0%
GW-135-41	2/13/92	**-12.83**		**-12.93**	-9.42		-6.85	-5.21		-7.86	-5.91	0.8%
GW-722-02	5/27/92	**-5.66**		-12.99	-24.46		**-6.85**	-12.73		-7.86	-14.69	17.4%
GW-722-06	1/7/92	**-7.22**		-12.96	-20.51		**-6.85**	-10.76		-7.86	-12.38	5.4%
GW-722-17	5/28/92	**-8.22**		-14.07	-15.06		-5.89	**-8.03**		-7.16	-9.20	2.4%
GW-722-20	1/21/92	**-6.15**		-13.11	-13.65		**-6.80**	-7.33		-7.84	-8.38	9.6%
GW-722-30	1/29/92	**-10.01**		-14.47	-17.18		-5.48	-9.09		-6.84	**-10.44**	4.1%
GW-722-33	2/4/92	**-8.77**		-13.94	-15.72		-6.03	**-8.36**		-7.26	-9.58	4.9%

Assume: Closed System C-13 Carbonate (Cmn) = 0.13 per mil. Closed System C-13 Calcite =-1.97 per mil, and Dolomite = -0.84 per mil

Zone	Date	Measured C-13	Initial C-13 CO2 = -25 per mil Recharge T = 25 C			Initial C-13 CO2 = -13 per mil Recharge T = 5 C			Initial C-13 CO2 = -15 per mil Recharge T = 5 C			Percent Error
			Open System	Closed CaCO3	Closed Cal/Dol	Open System	Closed CaCO3	Closed Cal/Dol	Open System	Closed CaCO3	Closed Cal/Dol	
GW-131-12	5/19/92	**-9.53**	-17.08	-12.90	-15.92	-2.80	-6.05	-8.44	-4.8	-7.16	**-9.68**	1.5%
GW-131-28	5/19/92	**-9.02**		-12.70	18.71		-6.19	8.87		-7.25	**-9.39***	3.9%
GW-135-03	2/13/92	**-14.17**		-16.34	168.41		-3.39	83.31		-5.23	97.49	
GW-135-11	6/8/92	**-10.65**		-12.68	4.37		-6.16	**-12.12***		-7.23	1.97	12.1%
GW-135-30	6/9/92	**-10.8**		-13.35	-15.16		-5.71	-8.04		-6.91	**-9.37***	13.2%
GW-135-41	2/13/92	**-12.83**		**-12.38**	-9.43		-6.31	-5.23		-7.31	-5.93	3.6%
GW-722-02	5/27/92	**-5.66**		-12.44	-24.46		**-6.30**	-12.73		-7.32	-14.69	11.3%
GW-722-06	1/7/92	**-7.22**		-12.42	-20.48		-6.31	-10.73		**-7.32**	-12.35	1.4%
GW-722-17	5/28/92	**-8.22**		-13.66	-14.98		-5.48	**-8.42***		-6.74	-9.12	2.4%
GW-722-20	1/21/92	**-6.15**		-12.57	-13.55		**-6.26**	-7.23		-7.30	-8.28	1.8%
GW-722-30	1/29/92	**-10.01**		-14.11	-17.29		-5.12	-9.11		-6.49	**-10.46**	4.5%
GW-722-33	2/4/92	**-8.77**		-13.51	-15.91		-5.60	**-8.55**		-6.83	-9.78	2.6%

Note: Calculated values in bold are the most similar to the measured value in the row.

* Includes dissolution of gypsum.

Table 7. Summary of water and mud chemistry in GW-734.

	GW-734 Water (mg/L)	GW-734 Mud (ug/g)	Copper Ridge Dolomite Soil (ug/g)	Nolichucky Soil (ug/g)
Al	21 (U)	6,800 - 14,000	8120 - 28,600	20,800 - 25,100
	<0.02 (F)			
Ba	.092 (U)	35 -67	9.1 - 196	59.7 - 106
	.017 (F)			
Be	0.047 (U)	1.1 - 2.9	0.31 - 1.2	0.73 - 0.85
	0.017 (F)			
Ca	41 (U)	3,100 - 25,000	151 - 1730	498 - 952
	32 (F)			
Cr	0.025 (U)	22 - 52	10.5 - 60.4	26.4 - 29.9
	<0.01 (F)			
Co	0.027 (U)	9.7 - 31	1.1 - 35.3	11.11 - 17.5
	<0.005 (F)			
Cu	0.071 (U)	31 - 62	2.7 - 54.2	11 - 12.7
	<0.004 (F)			
Fe	66 (U)	16,000 - 34,000	9030 - 53,900	23,000 - 32,100
	0.033 (F)			
Hg	<0.002 (U)	0.039 - 0.16	0.1 - 0.3	0.18 - 0.19
	<0.002 (F)			
K	6.2 (U)	1400	253 - 1240	2640 - 3230
	1.4 (F)			
Mg	6.7 (U)	1000 - 13,000	276 - 1090	1730 - 2410
	4 (F)			
Mn	1.1 (U)	560 - 1600	41.7 - 3470	405 - 935
	0.15 (F)			
Ni	0.05 (U)	14 - 52	4.9 - 33.5	15.2 - 20
	<0.01			
Pb	0.22 (U)	132 - 209	6.5 - 165	15.3 - 20.4
	<0.004 (F)			
Sr	0.064 (U)	5.2 - 17	0.25 - 7.7	3.2 - 6.1
	0.047 (F)			
Total U	<0.001 (U)	5.1 - 5.4		
	<0.001 (F)			
Zn	0.28 (U)	150 - 160	21.2 - 170	33.9 - 40.7
	0.0029 (F)			

Note: U refers to the unfiltered sample, F refers to the filtered sample
Copper Ridge Dolomite soil and Nolichucky soil data from Watkins et al., 1993.

Table 8. Wells which may reflect a quick flow environment as suggested by geochemical indicator parameters.

Well	Formation	SI(dol) Fluctuation	Pco2	Undersat wrt Calcite	CV > 0.10	Cavity
1090	Ccr	X		X	X	
GW-056	Cmn	X		X	X	
GW-057	Cmn			X		
GW-058	Cmn	X				
GW-061	Cmn	X			X	
GW-064	Cmn	X				
GW-099	Ccr	X				
GW-131-01	Cmn	?			?	
GW-131-04	Cmn	?			?	
GW-131-08	Cmn	?			?	
GW-131-12	Cmn	?			?	
GW-131-15	Cmn	?			?	
GW-131-20	Ccr	?			?	
GW-131-21	Ccr	?			?	
GW-131-24	Ccr	?			?	
GW-131-28	Ccr	?			?	
GW-131-32	Ccr	?			?	
GW-135-03	Cmn	X			?	
GW-135-06	Cmn	?			?	
GW-135-11	Cmn	?			?	
GW-135-19	Cmn	?			?	
GW-135-23	Ccr	?			?	
GW-135-30	Ccr	X			?	
GW-135-34	Ccr	?			?	
GW-135-39	Ccr	?			?	
GW-141	Ccr	X				X
GW-151	Cmn					
GW-152	Cmn	X			X	
GW-153	Cmn	X	X		X	
GW-154	Cmn	X			X	
GW-155	Ccr	X		X	X	
GW-158	Ccr	X			X	
GW-167	Cmn	X			X	
GW-173	Ccr	X	X			
GW-174	Ccr	X	X		X	X
GW-179	Ccr	X			X	
GW-181	Ccr	X			X	
GW-220	Cmn	X				
GW-221	Ccr	X	X			
GW-222	Cmn	?				
GW-223	Cmn	X			X	
GW-225	Cmn	?		X	?	X*
GW-226	Cmn	X			X	
GW-227	Cmn				X	X
GW-228	Cmn	X			X	X
GW-229	Cmn	X			X	X
GW-240	Cmn	X			X	
GW-241	Ccr	X	X			X
GW-278	Cmn	X				
GW-279	Cmn	?			?	
GW-293	Ccr	X				
GW-298	Ccr	X				
GW-299	Ccr	X		X		
GW-300	Ccr	X			X	

Well	Formation	SI(dol) Fluctuation	Pco2	Undersat wrt Calcite	CV > 0.10	Cavity
GW-306	Cmn			X	X	
GW-309	Cmn			X		
GW-313	Cmn	X				X
GW-314	Cmn	?				
GW-315	Cmn	?			?	
GW-316	Cmn	X-U		X-F	X	
GW-317	Cmn	X-F				
GW-322	Ccr	X				X
GW-323	Ccr	X				
GW-350	Cmn			X	X	X
GW-365	Cmn				X	
GW-511	Ccr				X	X
GW-513	Ccr	X	X			
GW-520	Cmn	?			?	
GW-521	Ccr	?		X	?	X
GW-603	Cmn	X-U	X	X-F		
GW-604	Cmn	X-U	X	X-F		
GW-621	Cmn	X			X	X
GW-683	Ccr	X-F		X-U	X	X
GW-684	Cmn	X	X		X	X
GW-685	Cmn			X		
GW-694	Cmn			X	?	
GW-695	Cmn		X		X	
GW-703	Cmn	X			X	
GW-704	Cmn				X	
GW-706	Cmn	X			?	
GW-710	Ccr	?			?	
GW-711	Cmn	X				
GW-712	Cmn					
GW-722-02	Cmn	?		X	?	
GW-722-06	Cmn	?			?	
GW-722-10	Cmn	?		X	?	
GW-722-17	Cmn	?		X	?	
GW-722-20	Cmn	?			?	
GW-722-22	Cmn	?		X	?	
GW-722-26	Cmn	?			?	
GW-722-30	Cmn	?		X	?	
GW-722-32	Cmn	?			?	X
GW-722-33	Cmn	?		X	?	X
GW-723	Cmn	?			?	
GW-733	Cmn	?	X		?	
GW-734	Cmn			X	?	X
GW-735	Cmn/Cn	?		X	?	X
GW-739	Cmn	?		X	?	
GW-740	Cmn	?			?	

A "?" in the above columns indicates that insufficient temporal data are available for the particular well.

A blank in a column indicates data are available for the parameter, yet no indications of quick flow can be inferred

X-U - indicates the "X" is true for the unfiltered samples only.

X-F - indicates the "X" is true for the filtered samples only.

Table 9. List of wells that intersected cavities during drilling, and for which there is no other relevant or supporting information from which to interpret quickflow.

Well	Completed in a Cavity	Comment	Well	Completed in a Cavity	Comment
1082		Och	GW-233		
1085			GW-235	Yes	
1086			GW-238		
1087			GW-260		
005-L			GW-280	Yes	
008-L	Yes		GW-292		
011-L			GW-295	Yes	
017-L			GW-297		
024-L			GW-301		
029-L			GW-302		
031-L			GW-302		
032-L			GW-303		
035-L			GW-339		
55-8A	Yes		GW-343		Cr
55-8B	Yes		GW-366		
56-5B	Yes		GW-375		
56-5C			GW-381		
60-1C			GW-382		
BC-49			GW-443	Yes	
BC-50			GW-514		
BC-57			GW-522		
GW-114			GW-534		
GW-125			GW-538	Yes	
GW-156			GW-540		
GW-159			GW-541		
GW-160	Yes		GW-551	Yes	
GW-165	Yes		GW-551		
GW-172			GW-554		
GW-175			GW-558		
GW-177			GW-561	Yes	
GW-178			GW-561		
GW-180			GW-601		
GW-180			GW-602		
GW-188		Och	GW-606		
GW-193	Yes		GW-608	Yes	
GW-210		Cr	GW-609		
GW-211		Cr	GW-610		
GW-213			GW-611		
GW-214			GW-612		
GW-218	Yes		GW-615		Cn
GW-230			GW-645	Yes	
GW-673	Yes		GW-648		

Well	Completed in a Cavity	Comment
GW-678	Yes	
GW-678		
GW-680		
GW-681	Yes	
GW-682		
GW-692	Yes	
GW-698		
GW-713		
GW-724		
GW-727		WB
GW-728	Yes	
GW-730		WB
GW-731	Yes	
GW-732		
GW-737	Yes	
GW-738	Yes	
GW-742		
GW-743		
GW-744	Yes	
GW-745	Yes	
GW-750		
GW-762		Cn

Well	Completed in a Cavity	Comment
GW-790		WB
J-001	Yes	
J-002	Yes	
J-003	Yes	
J-004		
J-005		Cn
J-006		Cn
J-007		
J-008		
J-009	Yes	
J-011	Yes	
J-012	Yes	
J-017		
J-019		
J-020	Yes	
J-022		
K-020	Yes	
K1-015	Yes	
K2-015		

Note: WB = Westbay installation, Och = Chickamauga Group, Cr = Rome formation, Cn = Nolichucky Shale.

Table 10. Detected contaminants in Ccr and Cmn wells.

	Year Sampled	Nitrate	TCE	PCE	111TCA	Xylenes	Ethyl-Benzene	Toluene	Carbon Tet.
1090	1992	0.87	<5	<5					
1086	1991	0.6	<5	<5	<5				
GW-056	1992	<.2	<5	<5					
GW-057	1991	<0.2	<5	<5	<5				
GW-058	1992	3.1	<5	<5					
GW-061	1992	27.2	<5	<5					
GW-064	1992	9.4	130	2					
GW-095	1992	<.2	<5	<5					
GW-099	1988	0.22							
GW-125	1992	3.6	<5	<5					
GW-131-04	1990	<10							
GW-131-08	1990	<10							
GW-131-12	1992	<1							
GW-131-15	1990	<10							
GW-131-24	1992	<22.6							
GW-131-28	1992	<22.6							
GW-131-32	1990	2							
GW-135-03	1991	135							
GW-135-06	1991	<10							
GW-135-11	1991	<10							
GW-135-19	1991	<1							
GW-135-23	1991	<100							
GW-135-30	1992	<1							
GW-135-34	1991	<1							
GW-135-39	1991	1							
GW-141	1992	0.5	<5	<5					
GW-151	1992	0.74	2	19	<10				
GW-152	1990	0.6	<5	<5	<5				
GW-153	1991	1.2	<5	5	<5				120
GW-154	1991	0.49	<5	<5	<5				<5
GW-155	1991	0.2	<5	<5	<5				
GW-156	1992	0.3	<5	<5					
GW-158	1992	<0.2	<5	<5					
GW-159	1992	<0.2	<5	<5					
GW-160	1992	0.5	<5	<5					
GW-165	1991	<0.2	<5	<5	<5				
GW-167	1991	0.91	<5	<5	<5				
GW-169	1993	1.1	3	3					
GW-170	1993	1.1	3	7					39
GW-173	1992	1.3	<5	12	<5				
GW-174	1992	0.72	<5	32	2				
GW-175	1992	0.24	<5	29	8				
GW-176	1992	0.6	<5	16	110				

	Year Sampled	Nitrate	TCE	PCE	111TCA	Xylenes	Ethyl-Benzene	Toluene	Carbon Tet.
GW-177	1992	0.25	<5	<5	24				
GW-178	1992	0.5	<5	<5	23				
GW-179	1992	0.5	<5	5	180				
GW-180	1992	<0.2	1	44	2				
GW-181	1992	<0.2	<5	<5	<5				
GW-193	1992	<0.2	<100	<100	<100	1200	830	2100	
GW-220	1992	0.78	7	35					280*
GW-221	1992	1.3	<5	<5					
GW-222	1991	<2	3	15	<5				
GW-223	1991	<0.2	42	190	<5				30
GW-225	1992	74.8	370	3					
GW-226	1990	2	16	7	<5				
GW-227	1992	35	88	<5					
GW-228	1990	30	79	2	1				
GW-229	1987	<0.2	4	24	<5				
GW-240	1992	5	<5	<5	<5				
GW-241	1992	<0.2	<5	<5	<5				
GW-278	1987	2.2	<5	<5	<5				
GW-279	1987	7.6	4	5	<5				
GW-280	1986	83.5	140	110	<5				
GW-292	1992	0.4	<5	<5	<5				
GW-293	1992	0.42	<5	<5	<5				
GW-295	1992	0.73	<5	<5	<5				
GW-298	1992	<0.2	<5	<5	<5				
GW-299	1992	<0.2	<5	<5	<5				
GW-300	1992	<0.2	<5	<5	<5				
GW-301	1992	0.35	<5	<5	<5				
GW-302	1992	1.14	<5	<5					
GW-303	1992	<0.2	<5	<5	<5				
GW-306	1991	7	71	1	2				
GW-309	1992	18	3	<5					
GW-313	1992	9.82	10	18					
GW-314	1992	31.41	5	10					
GW-315	1992	34.05	11	20					
GW-316	1992	0.42	<5	<5					
GW-317	1992	<0.2	4	7					
GW-322	1992	<0.2	<30	7	410				
GW-323	1992	<0.2	<5	<5					
GW-339	1992	0.92	<5	<5					
GW-350	1990	<0.2	<5	2	<5				
GW-365	1992	2.6	87	2					
GW-366	1992	<0.2	<5	<5					
GW-380	1992	2.26	<5	<5	<5				
GW-381	1992	<0.2	<300	<300	<300				6100

	Year Sampled	Nitrate	TCE	PCE	111TCA	Xylenes	Ethyl-Benzene	Toluene	Carbon Tet.
GW-382	1992	2.6	24	260	<5				
GW-511	1992	<0.2	<5	<5	<5				
GW-513	1992	<0.2	<5	<5	<5				
GW-514	1992	<0.2	<5	<5	2				
GW-520	1992	<0.2	<5	<5					
GW-521	1992	<0.2	<5	<5					
GW-522	1992	0.31	<5	<5					
GW-540	1992	<0.2	<5	<5					
GW-541	1992	<0.2	<5	<5					
GW-601	1992	34	150	<5					
GW-602	1992	0.26	<5	<5					
GW-603	1992	0.81	<5	<5					
GW-604	1992	0.51	<5	<5					
GW-606	1992	0.94	<5	6	<5	<5	<5	25	1500
GW-608	1992	<0.2	<5	2	4				
GW-609	1992	0.94	2	21	1				
GW-610	1992	0.56	<5	<5	<5				
GW-611	1992	3	<5	<5	12				
GW-612	1992	0	<5	9	200				
GW-615	1992	11,371	<5	<5	Cn				
GW-621	1992	7	<5	<5					
GW-645	1992	<0.2	<5	<5					
GW-648	1992	<0.2	<5	<5					
GW-683	1992	22	<5	<5					
GW-684	1992	18	<5	<5					
GW-685	1992	1.96	<5	<5					
GW-694	1992	48.9	16	<5					
GW-695	1992	2.40	2	<5					
GW-703	1992	23.8	25	<5					
GW-704	1992	19	95	<5					
GW-705	1992	0.61	<5	<5					
GW-706	1992	49	30	<5					
GW-710	1992	<2.26	<5	<5					
GW-711	1992	<11	<5	<5					
GW-712	1992	<.2	<5	<5					
GW-713	1992	<.2	<5	<5					
GW-714	1992	4.8	<5	<5					
GW-715	1992	0.94	<5	<5					
GW-722-02	1992	<1							
GW-722-06	1992	<2							
GW-722-10	1994	<1	2	11					13
GW-722-14	1994		4	27					140
GW-722-17	1994	11	5	43					350
GW-722-20	1994	<1	5	54	2			1	260

	Year Sampled	Nitrate	TCE	PCE	111TCA	Xylenes	Ethyl-Benzene	Toluene	Carbon Tet.
GW-722-22	1994	<6.4	4	31	1				310
GW-722-26	1994	6				1	2	3	3
GW-722-30	1994	<.2	2	6			1		81
GW-722-32	1994	<.9						1	
GW-722-33	1994	<0.6						1	
GW-723	1992	20	22	<5					
GW-724	1992	54	95	<5					
GW-725	1992	55	82	<5					
GW-731	1992	0.23	<5	<5	<5				
GW-732	1992	0.3	<5	<5	<5				
GW-733	1993	0.2	1	3					87
GW-735	1992	<0.2	<5	<5	<5				
GW-736	1992	54	21	4					
GW-737	1992	61	21	5					
GW-738	1992	27	96	<5					
GW-739	1992	7.7	58	<5					
GW-740	1992	4	77	<5					
GW-742	1992	<0.2	<5	<5	<5				
GW-743	1992	<0.2	<5	<5	<5				
GW-744	1992	<0.2	<5	<5	<5				
GW-745	1992	<0.2	<5	<5	<5				
GW-750	1992	<0.2	<5	<5	<5				
GW-762	1992	<0.2	28	1000	5				

Note: TCE = trichloroethene, PCE = tetrachloroethene, 111TCA = 1,1,1-trichloroethane,
Carbon Tet. = Carbon Tetrachloride

* Data value from 1991

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Appendix A: Calculated hardnesses, coefficients of variation of hardness, and flow through times for waters in the Maynardville Limestone and Copper Ridge Dolomite.
F refers to the filtered sample. U refers to the unfiltered sample.

Well	Ca (mg/L)	Mg (mg/L)	Hardness (mg/L)	CV	# of Values	Flow Thru time (d)	Estimated Q (m3/s)	Ave (Q) Stdev (Q)
1090--F--01/05/89	51	30	251	0.07	10	23.62	0.63	0.69
1090--F--01/05/89	51	30	251				0.63	0.26
1090--F--02/26/88	45	27	223				1.09	
1090--F--04/11/89	56	30	263				0.49	
1090--F--04/11/89	56	30	263				0.49	
1090--F--05/04/88	51	31	255				0.58	
1090--F--07/21/88	48	30	243				0.73	
1090--F--08/14/89	52	30	253				0.60	
1090--F--10/11/88	43	27	218				1.21	
1090--F--10/13/89	55	32	269				0.43	
1090--U--01/05/89	50	31	252	0.34	10	1.08	0.61	0.58
1090--U--01/05/89	51	30	251				0.63	0.36
1090--U--02/26/88	49	27	233				0.89	
1090--U--02/26/88	45	31	240				0.78	
1090--U--04/11/89	80	55	426				0.02	
1090--U--04/11/89	97	66	513				0.00	
1090--U--07/21/88	49	30	246				0.69	
1090--U--08/14/89	52	30	253				0.60	
1090--U--10/11/88	44	27	221				1.15	
1090--U--10/13/89	55	32	269				0.43	
GW-056---F---2/26/91	62	21	241	0.10	4	11.33	0.76	0.56
GW-056---F---9/15/91	76	25	293				0.27	0.26
GW-056---F--03/13/92	61	21	239				0.80	
GW-056---F--12/11/91	70	23	269				0.43	
GW-056---U---2/26/91	82	27	316	0.06	5	25.08	0.17	0.09
GW-056---U---5/24/91	84	26	317				0.16	0.09
GW-056---U---9/15/91	82	28	320				0.15	
GW-056---U--03/13/92	72	24	278				0.36	
GW-056---U--12/11/91	87	28	332				0.12	
GW-057---F----2/26/91	83	17	277	0.02	2	263.11	0.36	0.34
GW-057---F---6/19/91	86	17	285				0.31	0.04
GW-057---U---2/26/91	81	17	272	0.02	2	399.69	0.40	0.38
GW-057---U---6/19/91	85	16	278				0.36	0.03
GW-058---F----6/20/91	76	31	317	0.04	4	80.68	0.16	0.22
GW-058---F---03/24/92	76	26	297				0.25	0.04
GW-058---F---06/22/92	76	27	301				0.23	
GW-058---F---3/19/91	73	27	293				0.26	
GW-058---U---06/22/92	77	27	303	0.06	4	34.03	0.21	0.22
GW-058---U---3/19/91	71	27	288				0.29	0.07
GW-058---U---6/20/91	78	32	326				0.13	
GW-058---U--03/24/92	75	26	294				0.26	
GW-061---F---03/27/92	65	8.7	198	0.28	4	1.50	1.82	1.15
GW-061---F---06/24/92	110	17	345				0.09	0.77
GW-061---F---3/19/91	67	9	204				1.60	
GW-061---F---6/19/91	74	9.5	224				1.08	
GW-061---U---06/24/92	110	16	341	0.28	3	1.50	0.10	0.90
GW-061---U---3/19/91	69	9.2	210				1.42	0.70

Well	Ca (mg/L)	Mg (mg/L)	Hardness (mg/L)	CV	# of Values	Flow Thru time (d)	Estimated Q (m3/s)	Ave (Q) Stdev (Q)
GW-061---U--6/19/91	73	9.1	220				1.17	
GW-064---F----2/20/91	110	16	341	0.04	3	53.62	0.10	0.12
GW-064---F----5/17/91	100	16	316				0.17	0.12
GW-064---F---06/02/92	110	16	341				0.10	
GW-064---U----2/20/91	110	16	341	0.00	3		0.10	0.10
GW-064---U---06/02/92	110	16	341				0.10	0.10
GW-064---U---10/23/91	110	16	341				0.10	
GW-095---F----3/19/91	1.4	0.43	5	0.08	6	18.16	91.90	92.89
GW-095---F----6/18/91	1.3	0.35	5				92.98	0.69
GW-095---F----9/23/91	1.1	0.36	4				93.86	
GW-095---F---03/22/92	1.3	0.41	5				92.52	
GW-095---F---06/22/92	1.3	0.39	5				92.68	
GW-095---F---12/16/91	1.2	0.36	4				93.38	
GW-095---U----9/23/91	1.3	0.42	5	0.08	6	16.99	92.44	92.25
GW-095---U---03/22/92	1.5	0.39	5				91.74	0.76
GW-095---U---06/22/92	1.2	0.38	5				93.23	
GW-095---U---12/16/91	1.4	0.42	5				91.97	
GW-095---U---3/19/91	1.5	0.46	6				91.20	
GW-095---U---6/18/91	1.3	0.36	5				92.91	
GW-099---F--02/10/88	25	15	124	0.05	2	40.91	8.21	7.52
GW-099---F--05/16/88	27	16	133				6.82	0.98
GW-099---U--02/10/88	26	16	131	0.01	2	1149.66	7.18	7.30
GW-099---U--05/16/88	27	15	129				7.42	0.17
GW-131-1--F--10/10/90	65	34	302		1		0.22	
GW-131-12--F--5/19/92	49	28	237		1		0.82	
GW-131-15--F--10/3/90	62	34	294		1		0.26	
GW-131-20--F--5/19/92	240	140	1174		1		0.00	
GW-131-21--F---4/2/91	240	120	1092		1		0.00	
GW-131-24--F--5/19/92	350	210	1736		1		0.00	
GW-131-32--F--10/1/90	34	19	163		1		3.72	
GW-131-4---F--10/9/90	61	35	296		1		0.25	
GW-131-8--F---10/9/90	35	20	170		1		3.25	
GW-132-1--F---12/7/90	0.5	0.092	2		1		98.95	
GW-132-17--F--4/22/92	0.65	0.072	2		1		98.36	
GW-132-21--F--4/14/92	1.5	0.21	5	0.26	3	1.75	93.12	94.04
GW-132-21--F--4/22/92	0.98	0.11	3				96.421027	2.0799165
GW-132-21-F--10/12/9(	1.6	0.22	5				92.58	
GW-132-25--F--4/14/92	6.4	1.6	23	0.40	2	0.78	64.64	71.86
GW-132-25--F--4/20/92	3.5	0.95	13				79.08	10.21
GW-132-5--F--10/16/90	0.82	0.11	3		1		97.21	
GW-132-9--F--10/16/90	0.51	0.057	2		1		99.19	
GW-133-1--F----1/9/91	1.6	0.48	6		1		90.59	
GW-133-10---12/20/90	0.89	0.2	3		1		96.14	
GW-133-17---12/10/90	1.6	0.41	6		1		91.12	
GW-133-24--F--12/8/90	21	5.5	75		1		22.22	
GW-133-5--F--12/20/90	1.3	0.3	4		1		93.37	
GW-134-11--F--1/31/91	15	3.9	53		1		34.46	
GW-134-18--F--1/28/91	63	14	215	0.11	2	8.76	1.29	1.88
GW-134-18--F--4/13/92	52	13	183				2.46	0.82
GW-134-25--F---5/5/92	1.6	0.42	6	0.58	2	0.39	91.04	84.30
GW-134-25--F--1/18/91	3.9	0.94	14				77.56	9.54

Well	Ca (mg/L)	Mg (mg/L)	Hardness (mg/L)	CV	# of Values	Flow Thru time (d)	Estimated Q (m3/s)	Ave (Q) Stdev (Q)
GW-134-29--F--1/18/91	1.4	0.3	5		1		92.90	
GW-134-3--F----2/2/91	130	38	481		1		0.01	
GW-134-33--F--1/16/91	280	56	930		1		0.00	
GW-134-5---6/22/92	110	32	406		1		0.03	
GW-135-11--F--5/15/91	200	58	738		1		0.00	
GW-135-19--F---5/9/91	39	20	180		1		2.66	
GW-135-23--F---5/7/91	540	130	1883		1		0.00	
GW-135-3--F----6/2/92	1700	610	6751	0.17	5	4.09	0.00	0.00
GW-135-3--F---2/13/92	1800	710	7411				0.00	0.00
GW-135-3--F---2/13/92	1800	710	7411				0.00	
GW-135-3--F---5/17/91	1300	420	4972				0.00	
GW-135-3--F---7/16/91	1500	480	5718				0.00	
GW-135-30--F---5/6/91	32	22	170	0.03	2	105.39	3.21	2.98
GW-135-30--F---6/9/92	35	22	178				2.75	0.32
GW-135-34--F---5/3/91	32	20	162		1		3.79	
GW-135-39--F---5/3/91	28	17	140		1		5.97	
GW-135-6--F---5/17/91	340	100	1260		1		0.00	
GW-141--F--02/18/88	38	24	193	0.04	10	69.95	2.00	1.82
GW-141--F--02/18/88	39	25	200				1.75	0.28
GW-141--F--03/09/89	38	25	198				1.84	
GW-141--F--03/09/89	39	26	204				1.61	
GW-141--F--05/17/88	39	24	196				1.90	
GW-141--F--05/17/88	41	26	209				1.45	
GW-141--F--05/31/89	41	26	209				1.45	
GW-141--F--08/03/88	38	25	198				1.84	
GW-141--F--08/03/88	37	25	195				1.94	
GW-141--F--10/18/88	36	23	184				2.41	
GW-141--U--02/18/88	39	25	200	0.03	10	101.90	1.75	1.74
GW-141--U--02/18/88	39	25	200				1.75	0.22
GW-141--U--03/09/89	39	26	204				1.61	
GW-141--U--03/09/89	39	26	204				1.61	
GW-141--U--05/17/88	40	24	198				1.81	
GW-141--U--05/17/88	39	24	196				1.90	
GW-141--U--05/31/89	41	27	213				1.34	
GW-141--U--08/03/88	39	26	204				1.61	
GW-141--U--08/03/88	37	25	195				1.94	
GW-141--U--10/18/88	37	24	191				2.11	
GW-151--F-----1/31/91	57	25	245	0.03	6	117.20	0.70	0.68
GW-151--F-----8/24/91	58	25	248				0.67	0.10
GW-151--F----01/25/92	60	26	257				0.55	
GW-151--F----04/21/92	55	24	236				0.84	
GW-151--F----10/23/91	57	25	245				0.70	
GW-151--F----F--5/1/91	60	25	253				0.60	
GW-151--U-----1/31/91	57	25	245	0.04	4	60.99	0.70	0.77
GW-151--U----01/25/92	57	25	245				0.70	0.17
GW-151--U----04/21/92	53	23	227				1.01	
GW-151--U----F--5/1/91	60	24	248				0.65	
GW-152--F--01/18/89	38	14	152	0.22	7	2.34	4.61	1.98
GW-152--F--03/08/88	62	23	249				0.64	1.73
GW-152--F--04/11/89	41	15	164				3.64	
GW-152--F--08/09/89	43	16	173				3.02	

Well	Ca (mg/L)	Mg (mg/L)	Hardness (mg/L)	CV	# of Values	Flow Thru time (d)	Estimated Q (m3/s)	Ave (Q) Stdev (Q)
GW-152--F--08/13/87	66	19	243				0.73	
GW-152--F--08/17/88	58	23	239				0.79	
GW-152--F--10/22/87	68	24	268				0.44	
GW-152--U--01/18/89	39	14	155	0.25	7	1.94	4.38	1.79
GW-152--U--03/08/88	64	23	254				0.58	1.68
GW-152--U--04/11/89	43	15	169				3.29	
GW-152--U--08/09/89	44	16	176				2.87	
GW-152--U--08/13/87	70	20	257				0.55	
GW-152--U--08/17/88	62	23	249				0.64	
GW-152--U--10/22/87	78	25	298				0.24	
GW-153--F--01/18/89	37	17	162	0.14	10	5.68	3.78	4.72
GW-153--F--03/08/88	43	19	185				2.35	2.51
GW-153--F--04/05/89	39	17	167				3.41	
GW-153--F--06/16/88	37	18	166				3.47	
GW-153--F--08/09/89	34	16	151				4.78	
GW-153--F--08/13/87	23	14	115				9.88	
GW-153--F--08/17/88	38	18	169				3.30	
GW-153--F--08/17/88	36	18	164				3.65	
GW-153--F--10/22/87	37	17	162				3.78	
GW-153--F--10/28/88	27	13	121				8.76	
GW-153--U--01/18/89	38	17	165	0.14	9	5.95	3.59	3.61
GW-153--U--03/08/88	43	19	185				2.35	1.51
GW-153--U--06/16/88	37	18	166				3.47	
GW-153--U--08/09/89	32	15	142				5.75	
GW-153--U--08/13/87	31	15	139				6.05	
GW-153--U--08/17/88	40	18	174				2.98	
GW-153--U--08/17/88	38	18	169				3.30	
GW-153--U--10/22/87	49	23	217				1.24	
GW-153--U--10/28/88	37	17	162				3.78	
GW-154--F--08/12/87	120	19	378	0.06	2	32.33	0.05	0.07
GW-154--F--10/22/87	110	18	349				0.08	0.03
GW-154--U--01/09/89	90	12	274	0.20	4	2.90	0.39	0.17
GW-154--U--08/12/87	140	20	432				0.02	0.16
GW-154--U--10/22/87	110	19	353				0.08	
GW-154--U--10/27/88	95	17	307				0.20	
GW-155--F--03/02/89	27	17	137	0.05	11	39.27	6.28	5.75
GW-155--F--03/23/88	32	19	158				4.12	0.79
GW-155--F--06/22/88	28	18	144				5.49	
GW-155--F--06/23/89	28	17	140				5.97	
GW-155--F--07/13/87	31	18	151				4.71	
GW-155--F--08/24/88	27	17	137				6.28	
GW-155--F--08/25/89	28	17	140				5.97	
GW-155--F--10/02/87	29	16	138				6.16	
GW-155--F--11/01/88	26	17	135				6.60	
GW-155--F--11/13/89	29	18	146				5.22	
GW-155--F--12/10/87	28	16	136				6.49	
GW-155--U--03/02/89	26	16	131	0.13	9	6.72	7.18	4.75
GW-155--U--06/22/88	29	18	146				5.22	1.52
GW-155--U--06/23/89	31	19	155				4.34	
GW-155--U--08/24/88	31	20	160				3.99	
GW-155--U--08/25/89	31	19	155				4.34	

Well	Ca (mg/L)	Mg (mg/L)	Hardness (mg/L)	CV	# of Values	Flow Thru time (d)	Estimated Q (m3/s)	Ave (Q) Stdev (Q)
GW-155--U--10/02/87	29	16	138				6.16	
GW-155--U--11/01/88	30	19	153				4.56	
GW-155--U--11/13/89	29	18	146				5.22	
GW-155--U--12/10/87	41	24	201				1.72	
GW-158--F--03/04/89	33	23	177	0.17	10	4.11	2.81	5.48
GW-158--F--03/24/88	30	22	165				3.55	3.60
GW-158--F--06/24/88	24	22	150				4.82	
GW-158--F--06/25/89	30	22	165				3.55	
GW-158--F--07/13/89	3.4	22	99				13.74	
GW-158--F--08/24/88	29	22	163				3.74	
GW-158--F--08/30/89	32	21	166				3.49	
GW-158--F--10/10/87	8.9	22	112				10.39	
GW-158--F--10/29/88	27	21	154				4.50	
GW-158--F--12/11/87	28	21	156				4.27	
GW-158--U--03/04/89	27	22	158	0.15	10	5.18	4.14	5.78
GW-158--U--03/24/88	27	21	154				4.50	3.26
GW-158--U--06/24/88	24	22	150				4.82	
GW-158--U--06/25/89	30	22	165				3.55	
GW-158--U--07/13/89	3.4	22	99				13.74	
GW-158--U--08/24/88	28	21	156				4.27	
GW-158--U--08/30/89	31	22	168				3.38	
GW-158--U--10/10/87	9.3	23	118				9.36	
GW-158--U--10/29/88	26	20	147				5.14	
GW-158--U--12/11/87	27	20	150				4.89	
GW-167----F----5/8/91	110	5.4	297	0.32	2	1.21	0.24	1.23
GW-167---F----2/14/91	69	3.9	188				2.21	1.39
GW-167---U----2/14/91	74	4.2	202		1		1.67	
GW-173--F--01/05/89	36	24	188	0.05	10	43.28	2.22	1.81
GW-173--F--03/12/88	37	25	195				1.94	0.34
GW-173--F--04/04/89	40	25	203				1.66	
GW-173--F--06/07/88	37	24	191				2.11	
GW-173--F--08/05/88	40	25	203				1.66	
GW-173--F--08/07/87	41	27	213				1.34	
GW-173--F--08/10/89	38	23	189				2.18	
GW-173--F--10/04/89	43	26	214				1.31	
GW-173--F--10/06/87	41	25	205				1.58	
GW-173--F--10/24/88	37	24	191				2.11	
GW-173--U--01/05/89	36	24	188	0.09	7	13.21	2.22	2.02
GW-173--U--04/04/89	43	26	214				1.31	0.71
GW-173--U--06/07/88	36	25	193				2.04	
GW-173--U--08/10/89	36	23	184				2.41	
GW-173--U--10/04/89	43	26	214				1.31	
GW-173--U--10/06/87	50	27	236				0.85	
GW-173--U--10/24/88	39	24	196				1.90	
GW-174--F--01/05/89	32	22	170	0.16	8	4.33	3.21	3.95
GW-174--F--03/12/88	34	23	179				2.67	3.56
GW-174--F--04/03/89	35	24	186				2.33	
GW-174--F--06/07/88	33	23	177				2.81	
GW-174--F--08/05/88	36	23	184				2.41	
GW-174--F--08/07/87	36	22	180				2.62	
GW-174--F--10/08/87	33	23	177				2.81	

Well	Ca (mg/L)	Mg (mg/L)	Hardness (mg/L)	CV	# of Values	Flow Thru time (d)	Estimated Q (m3/s)	Ave (Q) Stdev (Q)
GW-174--F--10/24/88	18	14	102				12.74	
GW-174--U--01/05/89	33	23	177	0.20	8	2.92	2.81	2.57
GW-174--U--03/12/88	35	23	182				2.53	1.99
GW-174--U--06/07/88	34	23	179				2.67	
GW-174--U--08/05/88	43	27	218				1.21	
GW-174--U--08/07/87	54	32	266				0.46	
GW-174--U--10/08/87	36	25	193				2.04	
GW-174--U--10/10/89	39	25	200				1.75	
GW-174--U--10/24/88	23	18	131				7.08	
GW-179--F--03/14/88	61	31	280	0.06	6	28.32	0.35	0.30
GW-179--F--04/20/89	61	33	288				0.29	0.09
GW-179--F--06/10/88	66	38	321				0.15	
GW-179--F--08/07/87	58	34	284				0.31	
GW-179--F--08/11/88	60	34	289				0.28	
GW-179--F--10/07/87	55	32	269				0.43	
GW-179--U--10/07/87	76	45	375				0.05	
GW-181--F--01/06/89	28	17	140	0.10	9	10.12	5.97	4.89
GW-181--F--01/06/89	27	17	137				6.28	1.46
GW-181--F--04/04/89	35	22	178				2.75	
GW-181--F--08/09/89	30	19	153				4.56	
GW-181--F--08/16/88	27	16	133				6.82	
GW-181--F--10/05/89	34	20	167				3.42	
GW-181--F--10/05/89	34	20	167				3.42	
GW-181--F--10/25/88	28	17	140				5.97	
GW-181--F--80/09/89	29	19	150				4.80	
GW-181--U--01/06/89	27	17	137	0.10	9	11.16	6.28	4.90
GW-181--U--01/06/89	27	17	137				6.28	1.48
GW-181--U--04/04/89	34	21	171				3.15	
GW-181--U--08/09/89	31	20	160				3.99	
GW-181--U--08/09/89	30	19	153				4.56	
GW-181--U--08/16/88	26	16	131				7.18	
GW-181--U--10/05/89	33	20	165				3.60	
GW-181--U--10/05/89	34	20	167				3.42	
GW-181--U--10/25/88	29	17	142				5.67	
GW-220--F-----1/29/91	75	22	278	0.08	5	16.40	0.36	0.75
GW-220--F-----4/26/91	59	22	238				0.81	0.24
GW-220--F-----8/24/91	62	22	245				0.70	
GW-220--F----04/21/92	56	22	230				0.95	
GW-220--F----10/22/91	56	22	230				0.95	
GW-220--U-----1/29/91	65	23	257				0.55	
GW-221--F--01/04/89	27	18	141	0.02	8	160.52	5.78	5.42
GW-221--F--02/26/88	28	17	140				5.97	0.39
GW-221--F--04/11/89	29	18	146				5.22	
GW-221--F--05/02/88	27	18	141				5.78	
GW-221--F--07/21/88	29	18	146				5.22	
GW-221--F--08/14/89	28	18	144				5.49	
GW-221--F--10/11/88	30	18	149				4.96	
GW-221--F--10/12/89	30	18	149				4.96	
GW-221--U--01/04/89	27	18	141	0.04	8	68.72	5.78	5.46
GW-221--U--02/26/88	27	16	133				6.82	0.65
GW-221--U--04/11/89	30	18	149				4.96	

Well	Ca (mg/L)	Mg (mg/L)	Hardness (mg/L)	CV	# of Values	Flow Thru time (d)	Estimated Q (m3/s)	Ave (Q) Stdev (Q)
GW-221--U--05/02/88	27	18	141				5.78	
GW-221--U--07/21/88	30	18	149				4.96	
GW-221--U--08/14/89	29	18	146				5.22	
GW-221--U--10/11/88	29	18	146				5.22	
GW-221--U--10/12/89	30	18	149				4.96	
GW-222--F--10/22/87	38	9.3	133				6.82	
GW-222--U--10/22/87	39	11	143				5.62	
GW-223--F--03/08/88	60	9.7	190	0.26	7	1.77	2.15	0.86
GW-223--F--03/08/88	60	9.6	189				2.17	0.92
GW-223--F--08/12/87	89	11	268				0.44	
GW-223--F--08/18/88	90	14	282				0.33	
GW-223--F--10/13/89	120	17	370				0.06	
GW-223--F--10/13/89	110	16	341				0.10	
GW-223--F--10/22/87	79	10	239				0.80	
GW-223--U--03/08/88	64	10	201	0.24	7	2.07	1.71	0.71
GW-223--U--03/08/88	59	9.4	186				2.32	0.84
GW-223--U--08/12/87	89	12	272				0.41	
GW-223--U--08/18/88	91	14	285				0.31	
GW-223--U--10/13/89	120	17	370				0.06	
GW-223--U--10/13/89	120	16	366				0.06	
GW-223--U--10/22/87	84	12	259				0.52	
GW-223--U--10/26/88	96	13	293				0.26	
GW-225--F--11/11/88	180	36	598		1		0.00	
GW-225--U--11/11/88	170	33	560		1		0.00	
GW-226--F--03/29/89	160	33	535	0.10	10	11.96	0.00	0.00
GW-226--F--04/25/88	170	36	573				0.00	0.01
GW-226--F--05/20/86	160	34	539				0.00	
GW-226--F--07/24/89	180	34	589				0.00	
GW-226--F--09/19/89	180	34	589				0.00	
GW-226--F--09/20/88	120	27	411				0.02	
GW-226--F--10/30/87	170	35	569				0.00	
GW-226--F--11/21/88	160	32	531				0.00	
GW-226--F--11/21/88	160	32	531				0.00	
GW-226--F--12/14/89	170	34	564				0.00	
GW-226--U--03/29/89	170	35	569	0.11	12	9.38	0.00	0.00
GW-226--U--04/25/88	160	34	539				0.00	0.01
GW-226--U--05/20/86	150	33	510				0.00	
GW-226--U--07/08/88	190	36	623				0.00	
GW-226--U--07/24/89	180	38	606				0.00	
GW-226--U--09/02/86	150	33	510				0.00	
GW-226--U--09/19/89	180	36	598				0.00	
GW-226--U--09/20/88	120	27	411				0.02	
GW-226--U--10/30/86	170	38	581				0.00	
GW-226--U--11/21/88	170	38	581				0.00	
GW-226--U--11/21/88	160	35	544				0.00	
GW-226--U--12/14/89	190	36	623				0.00	
GW-227--F--05/20/86	140	26	457	0.17	2	3.83	0.01	0.04
GW-227--F--09/25/89	110	20	357				0.07	0.04
GW-227--U--05/20/86	140	25	453	0.14	3	5.58	0.01	0.03
GW-227--U--09/25/89	110	19	353				0.08	0.04
GW-227--U--12/14/89	140	27	461				0.01	

Well	Ca (mg/L)	Mg (mg/L)	Hardness (mg/L)	CV	# of Values	Flow Thru time (d)	Estimated Q (m3/s)	Ave (Q) Stdev (Q)
GW-228--F--05/20/86	51	30	251	0.26	5	1.70	0.63	0.13
GW-228--F--09/05/86	95	39	397				0.03	0.28
GW-228--F--09/25/89	140	41	518				0.00	
GW-228--F--11/03/87	130	41	493				0.00	
GW-228--F--12/14/89	140	42	522				0.00	
GW-228--U--09/05/86	100	40	414	0.16	2	4.57	0.02	0.01
GW-228--U--09/25/89	140	41	518				0.00	0.01
GW-229--F--04/26/88	180	34	589	0.14	9	5.64	0.00	0.01
GW-229--F--07/08/88	210	35	669				0.00	0.01
GW-229--F--07/22/89	160	29	519				0.00	
GW-229--F--09/19/89	160	28	515				0.00	
GW-229--F--09/20/88	120	21	386				0.04	
GW-229--F--10/30/87	180	26	557				0.00	
GW-229--F--11/28/88	160	27	511				0.00	
GW-229--F--12/08/89	170	32	556				0.00	
GW-229--F--12/16/86	160	27	511				0.00	
GW-229--U--01/08/89	160	32	531	0.14	9	5.94	0.00	0.01
GW-229--U--04/26/88	180	33	585				0.00	0.01
GW-229--U--07/08/88	210	35	669				0.00	
GW-229--U--07/22/89	160	28	515				0.00	
GW-229--U--09/19/89	160	28	515				0.00	
GW-229--U--09/20/88	120	22	390				0.04	
GW-229--U--10/30/87	180	26	557				0.00	
GW-229--U--11/28/88	170	27	536				0.00	
GW-229--U--12/16/86	160	27	511				0.00	
GW-240--F--01/18/89	39	17	167	0.14	10	5.98	3.41	1.54
GW-240--F--03/08/88	52	20	212				1.37	1.04
GW-240--F--04/05/89	50	16	191				2.12	
GW-240--F--06/16/88	55	21	224				1.08	
GW-240--F--08/09/89	38	18	169				3.30	
GW-240--F--08/13/87	58	21	231				0.93	
GW-240--F--08/13/87	59	22	238				0.81	
GW-240--F--08/17/88	56	24	238				0.80	
GW-240--F--10/22/87	58	25	248				0.67	
GW-240--F--10/27/88	59	21	234				0.88	
GW-240--U--01/18/89	29	18	146	0.16	10	4.70	5.22	1.77
GW-240--U--03/08/88	50	22	215				1.28	1.41
GW-240--U--04/05/89	50	16	191				2.12	
GW-240--U--06/16/88	43	21	194				1.99	
GW-240--U--08/09/89	39	19	175				2.89	
GW-240--U--08/13/87	59	21	234				0.88	
GW-240--U--08/13/87	58	21	231				0.93	
GW-240--U--08/17/88	54	23	229				0.96	
GW-240--U--10/22/87	58	25	248				0.67	
GW-240--U--10/27/88	60	22	240				0.77	
GW-241--F--03/04/89	28	17	140	0.08	11	17.09	5.97	6.35
GW-241--F--03/22/88	29	17	142				5.67	1.73
GW-241--F--06/25/89	22	13	108				11.30	
GW-241--F--07/13/87	31	18	151				4.71	
GW-241--F--08/24/88	27	17	137				6.28	
GW-241--F--08/30/89	28	16	136				6.49	

Well	Ca (mg/L)	Mg (mg/L)	Hardness (mg/L)	CV	# of Values	Flow Thru time (d)	Estimated Q (m3/s)	Ave (Q) Stdev (Q)
GW-241--F--10/12/87	28	18	144				5.49	
GW-241--F--10/29/88	29	18	146				5.22	
GW-241--F--10/29/88	27	17	137				6.28	
GW-241--F--12/11/87	29	16	138				6.16	
GW-241--F--12/11/87	27	17	137				6.28	
GW-241--U--03/04/89	28	18	144	0.04	9	50.76	5.49	4.65
GW-241--U--03/22/88	33	19	160				3.92	0.63
GW-241--U--06/24/88	31	21	164				3.67	
GW-241--U--07/13/87	30	18	149				4.96	
GW-241--U--08/24/88	30	20	157				4.20	
GW-241--U--10/29/88	30	18	149				4.96	
GW-241--U--10/29/88	30	19	153				4.56	
GW-241--U--12/11/87	30	17	145				5.39	
GW-241--U--12/11/87	31	18	151				4.71	
GW-278--F--02/26/87	56	5	161	0.09	3	14.28	3.91	2.83
GW-278--F--05/28/87	64	5.9	184				2.41	0.94
GW-278--F--08/03/87	66	6	190				2.16	
GW-278--U--02/26/87	58	5.2	166	0.07	3	22.47	3.47	2.68
GW-278--U--05/28/87	64	5.9	184				2.41	0.70
GW-278--U--08/03/87	66	6.1	190				2.14	
GW-279--F--08/03/87	30	14	132				6.92	
GW-279--U--08/03/87	50	16	191				2.12	
GW-293--F--03/14/88	41	29	221	0.04	10	58.50	1.13	1.10
GW-293--F--03/14/88	41	29	221				1.13	0.17
GW-293--F--04/11/89	43	28	222				1.11	
GW-293--F--04/11/89	43	28	222				1.11	
GW-293--F--06/27/88	41	30	226				1.04	
GW-293--F--06/27/88	40	29	219				1.19	
GW-293--F--08/23/88	41	29	221				1.13	
GW-293--F--08/23/88	40	28	215				1.30	
GW-293--F--10/28/88	42	28	220				1.17	
GW-293--F--12/22/87	52	29	249				0.65	
GW-293--U--03/14/88	41	28	217	0.03	9	106.71	1.23	1.20
GW-293--U--03/14/88	41	29	221				1.13	0.17
GW-293--U--04/11/89	42	28	220				1.17	
GW-293--U--04/11/89	42	28	220				1.17	
GW-293--U--06/27/88	41	30	226				1.04	
GW-293--U--06/27/88	41	30	226				1.04	
GW-293--U--08/23/88	39	27	208				1.48	
GW-293--U--08/23/88	39	27	208				1.48	
GW-293--U--10/28/88	42	29	224				1.08	
GW-298--F--01/16/89	30	21	161	0.03	8	105.60	3.86	3.08
GW-298--F--02/03/88	34	21	171				3.15	0.35
GW-298--F--04/15/89	34	21	171				3.15	
GW-298--F--05/13/88	32	23	174				2.95	
GW-298--F--07/28/88	34	22	175				2.90	
GW-298--F--09/07/89	35	21	174				2.99	
GW-298--F--10/14/88	34	23	179				2.67	
GW-298--F--10/26/89	35	21	174				2.99	
GW-298--U--01/16/89	41	28	217	0.11	4	8.94	1.23	2.17
GW-298--U--02/03/88	35	21	174				2.99	0.88

Well	Ca (mg/L)	Mg (mg/L)	Hardness (mg/L)	CV	# of Values	Flow Thru time (d)	Estimated Q (m3/s)	Ave (Q) Stdev (Q)
GW-298--U--04/15/89	36	21	176				2.85	
GW-298--U--07/28/88	39	26	204				1.61	
GW-299--F--01/16/89	26	17	135	0.03	10	128.69	6.60	6.21
GW-299--F--02/03/88	29	17	142				5.67	0.47
GW-299--F--04/14/89	28	17	140				5.97	
GW-299--F--04/14/89	27	16	133				6.82	
GW-299--F--05/13/88	30	17	145				5.39	
GW-299--F--07/27/88	27	17	137				6.28	
GW-299--F--09/01/89	27	17	137				6.28	
GW-299--F--09/01/89	28	17	140				5.97	
GW-299--F--10/14/88	27	17	137				6.28	
GW-299--F--10/24/89	27	16	133				6.82	
GW-299--U--01/16/89	26	16	131	0.04	10	66.32	7.18	6.06
GW-299--U--02/03/88	29	17	142				5.67	0.68
GW-299--U--04/14/89	28	18	144				5.49	
GW-299--U--04/14/89	27	16	133				6.82	
GW-299--U--05/13/88	29	17	142				5.67	
GW-299--U--07/27/88	28	17	140				5.97	
GW-299--U--09/01/89	29	18	146				5.22	
GW-299--U--09/01/89	28	18	144				5.49	
GW-299--U--10/14/88	27	17	137				6.28	
GW-299--U--10/24/89	27	16	133				6.82	
GW-300--F--01/16/89	21	13	106	0.13	8	6.72	11.89	6.31
GW-300--F--02/01/88	30	18	149				4.96	2.67
GW-300--F--04/14/89	28	17	140				5.97	
GW-300--F--05/12/88	32	19	158				4.12	
GW-300--F--07/23/88	24	15	122				8.64	
GW-300--F--09/01/89	30	19	153				4.56	
GW-300--F--10/11/88	29	20	155				4.42	
GW-300--F--10/23/89	28	17	140				5.97	
GW-300--U--01/16/89	22	13	108	0.13	8	6.82	11.30	6.09
GW-300--U--02/01/88	29	17	142				5.67	2.46
GW-300--U--04/14/89	27	17	137				6.28	
GW-300--U--05/12/88	31	18	151				4.71	
GW-300--U--07/23/88	25	16	128				7.55	
GW-300--U--09/01/89	33	21	169				3.31	
GW-300--U--10/11/88	29	20	155				4.42	
GW-300--U--10/23/89	28	18	144				5.49	
GW-306---F----1/14/91	130	16	391	0.17	3	3.83	0.04	0.19
GW-306---F----4/26/91	91	14	285				0.31	0.14
GW-306---F--05/09/89	100	13	303				0.21	
GW-306---U----1/14/91	130	16	391	0.19	2	3.09	0.04	0.14
GW-306---U----4/26/91	94	15	297				0.25	0.15
GW-309--F--02/09/88	200	24	598	0.03	2	152.33	0.00	0.00
GW-309--F--11/22/89	190	25	578				0.00	0.00
GW-309--U--02/09/88	200	24	598	0.03	2	107.50	0.00	0.00
GW-309--U--11/22/89	190	24	573				0.00	0.00
GW-313--F--03/08/88	110	22	365	0.02	2	358.25	0.06	0.07
GW-313--F--08/01/88	110	20	357				0.07	0.01
GW-313--U--03/08/88	110	22	365	0.04	2	76.10	0.06	0.06
GW-313--U--05/11/88	120	21	386				0.04	0.01

Well	Ca (mg/L)	Mg (mg/L)	Hardness (mg/L)	CV	# of Values	Flow Thru time (d)	Estimated Q (m3/s)	Ave (Q) Stdev (Q)
GW-313--U--08/01/88	110	21	361				0.07	
GW-314--F--03/07/88	82	21	291	0.07	4	21.31	0.27	0.21
GW-314--F--08/01/88	82	20	287				0.30	0.09
GW-314--F--10/13/88	95	22	328				0.13	
GW-314--F--10/13/88	94	22	325				0.14	
GW-314--U--03/07/88	82	21	291	0.05	4	45.63	0.27	0.19
GW-314--U--05/13/88	95	20	320				0.15	0.06
GW-314--U--05/13/88	95	20	320				0.15	
GW-314--U--08/01/88	84	21	296				0.25	
GW-314--U--10/13/88	94	22	325				0.14	
GW-314--U--10/13/88	93	22	323				0.14	
GW-315--F--03/07/88	77	14	250		1		0.63	
GW-315--U--03/07/88	77	14	250		1		0.63	
GW-316--F--03/07/88	69	26	279	0.21	5	2.72	0.35	1.03
GW-316--F--05/13/88	77	29	311				0.18	0.80
GW-316--F--08/02/88	52	22	220				1.16	
GW-316--F--08/02/88	50	22	215				1.28	
GW-316--F--10/13/88	43	20	190				2.17	
GW-316--U--03/07/88	69	26	279	0.20	5	2.80	0.35	1.07
GW-316--U--05/13/88	76	28	305				0.21	0.84
GW-316--U--08/02/88	51	22	218				1.22	
GW-316--U--08/02/88	50	22	215				1.28	
GW-316--U--10/13/88	42	20	187				2.28	
GW-317--F--03/07/88	43	18	181	0.07	6	22.77	2.56	2.74
GW-317--F--03/07/88	39	17	167				3.41	0.64
GW-317--F--05/10/88	32	21	166				3.49	
GW-317--F--05/17/89	45	21	199				1.80	
GW-317--F--08/01/88	43	19	185				2.35	
GW-317--F--10/13/88	41	18	176				2.83	
GW-317--U--03/07/88	44	18	184	0.08	5	15.47	2.43	2.56
GW-317--U--03/07/88	38	16	161				3.90	0.84
GW-317--U--05/17/89	40	19	178				2.74	
GW-317--U--08/01/88	47	20	200				1.77	
GW-317--U--10/13/88	45	20	195				1.96	
GW-322--F--01/05/89	29	20	155	0.04	10	51.89	4.42	4.60
GW-322--F--03/12/88	28	17	140				5.97	0.66
GW-322--F--04/03/89	31	20	160				3.99	
GW-322--F--04/03/89	32	20	162				3.79	
GW-322--F--06/07/88	29	19	150				4.80	
GW-322--F--08/05/88	31	19	155				4.34	
GW-322--F--08/05/88	30	19	153				4.56	
GW-322--F--08/11/89	31	19	155				4.34	
GW-322--F--10/11/89	31	19	155				4.34	
GW-322--F--10/24/88	28	18	144				5.49	
GW-322--U--01/05/89	29	19	150	0.04	7	52.95	4.80	4.62
GW-322--U--03/12/88	28	18	144				5.49	0.62
GW-322--U--04/03/89	32	20	162				3.79	
GW-322--U--04/03/89	31	20	160				3.99	
GW-322--U--08/11/89	31	18	151				4.71	
GW-322--U--10/11/89	31	19	155				4.34	
GW-322--U--10/24/88	29	18	146				5.22	

Well	Ca (mg/L)	Mg (mg/L)	Hardness (mg/L)	CV	# of Values	Flow Thru time (d)	Estimated Q (m3/s)	Ave (Q) Stdev (Q)
GW-323--F--03/08/88	39	25	200	0.02	4	172.26	1.75	1.54
GW-323--F--05/12/88	42	26	212				1.38	0.16
GW-323--F--08/02/88	40	26	207				1.53	
GW-323--F--10/13/88	39	27	208				1.48	
GW-323--U--03/08/88	60	9.6	189	0.05	4	42.20	2.17	1.63
GW-323--U--05/12/88	44	24	208				1.48	0.36
GW-323--U--08/02/88	41	26	209				1.45	
GW-323--U--10/13/88	40	27	211				1.41	
GW-350--F--09/06/88	59	4.6	166	0.14	3	5.39	3.47	2.26
GW-350--F--09/11/89	79	5.9	222				1.13	1.17
GW-350--F--12/06/89	66	5.8	189				2.20	
GW-350--U--09/06/88	59	4.6	166	0.14	3	5.58	3.47	2.37
GW-350--U--09/11/89	78	5.9	219				1.18	1.14
GW-350--U--12/06/89	64	5.7	183				2.45	
GW-365--F--09/18/89	120	23	394	0.12	4	8.17	0.03	0.09
GW-365--F--09/21/88	97	21	329				0.13	0.06
GW-365--F--09/21/88	95	20	320				0.15	
GW-365--F--12/13/89	120	24	398				0.03	
GW-365--U--09/18/89	120	23	394	0.13	4	6.34	0.03	0.10
GW-365--U--09/21/88	95	21	324				0.14	0.08
GW-365--U--09/21/88	90	20	307				0.20	
GW-365--U--12/13/89	120	24	398				0.03	
GW-511--F--01/09/89	17	10	84	0.27	5	1.66	18.71	22.03
GW-511--F--04/04/89	14	11	80				20.05	11.24
GW-511--F--08/10/89	19	10	89				16.90	
GW-511--F--08/16/88	6.4	6.9	44				41.55	
GW-511--F--10/06/89	21	12	102				12.92	
GW-511--U--04/04/89	19	11	93	0.05	3	42.52	15.55	15.50
GW-511--U--08/10/89	19	10	89				16.90	1.43
GW-511--U--10/06/89	21	11	98				14.05	
GW-513--F--01/28/89	33	21	169	0.04	6	54.57	3.31	3.42
GW-513--F--01/28/89	32	21	166				3.49	0.48
GW-513--F--06/05/89	36	22	180				2.62	
GW-513--F--08/22/89	33	21	169				3.31	
GW-513--F--12/03/88	31	20	160				3.99	
GW-513--F--12/03/88	32	20	162				3.79	
GW-513--U--01/28/89	33	21	169	0.06	7	25.98	3.31	3.48
GW-513--U--01/28/89	33	21	169				3.31	0.78
GW-513--U--06/05/89	36	22	180				2.62	
GW-513--U--08/22/89	34	21	171				3.15	
GW-513--U--11/04/89	36	21	176				2.85	
GW-513--U--12/03/88	30	19	153				4.56	
GW-513--U--12/03/88	30	19	153				4.56	
GW-520--F--09/20/88	200	0.056	500		1		0.00	
GW-521--F--09/08/89	28	18	144		1		5.49	
GW-521--U--09/08/89	28	18	144		1		5.49	
GW-603----F----11/3/91	66	21	251	0.03	6	89.48	0.62	0.47
GW-603----F----9/1/91	69	22	263				0.49	0.09
GW-603----F---1/26/91	72	22	270				0.42	
GW-603----F---4/22/91	70	21	261				0.50	
GW-603----F--01/31/92	73	23	277				0.37	

Well	Ca (mg/L)	Mg (mg/L)	Hardness (mg/L)	CV	# of Values	Flow Thru time (d)	Estimated Q (m3/s)	Ave (Q) Stdev (Q)
GW-603----F--04/26/92	71	22	268				0.44	
GW-603----U----4/22/91	66	20	247	0.04	4	56.93	0.67	0.51
GW-603----U---1/26/91	71	22	268				0.44	0.12
GW-603----U--01/31/92	71	23	272				0.41	
GW-603----U--04/26/92	69	21	259				0.53	
GW-604----F---1/26/91	41	16	168	0.10	3	10.81	3.35	3.04
GW-604----F---11/3/91	40	15	162				3.83	0.98
GW-604----F---4/22/91	50	17	195				1.95	
GW-604----U---1/26/91	44	17	180	0.05	3	45.16	2.64	2.35
GW-604----U---4/22/91	49	17	192				2.05	0.42
GW-621----F---6/20/91	35	8.2	121	0.25	2	1.95	8.71	5.89
GW-621----F--06/16/92	53	9.7	172				3.08	3.98
GW-621----U---6/20/91	35	8.2	121	0.24	2	1.98	8.71	5.90
GW-621----U--06/16/92	53	9.6	172				3.10	3.96
GW-683----F---5/24/91	51	15	189	0.14	3	5.89	2.19	1.97
GW-683----F--06/15/92	64	17	230				0.96	0.93
GW-683----F--12/12/91	48	14	177				2.77	
GW-683----U--03/26/92	39	14	155	0.10	3	11.86	4.38	3.58
GW-683----U--12/12/91	48	14	177				2.77	1.14
GW-684----F---5/30/91	56	13	193	0.25	3	1.96	2.01	5.58
GW-684----F--12/12/91	36	11	135				6.55	3.20
GW-684----F-03/27/92	30	12	124				8.18	
GW-684----U--03/27/92	30	12	124	0.25	3	1.88	8.18	5.69
GW-684----U--12/12/91	35	11	133				6.89	3.26
GW-684----U--5/30/91	56	13	193				2.01	
GW-685----F----6/1/91	78	25	298	0.05	5	44.23	0.24	0.30
GW-685----F---9/18/91	76	24	288				0.29	0.09
GW-685----F--03/25/92	82	24	303				0.21	
GW-685----F--06/14/92	76	22	280				0.34	
GW-685----F--12/12/91	73	21	269				0.43	
GW-685----U---9/18/91	77	24	291	0.08	4	15.68	0.28	0.35
GW-685----U--03/25/92	84	25	313				0.18	0.15
GW-685----U--06/14/92	72	22	270				0.42	
GW-685----U--12/12/91	71	20	260				0.52	
GW-694----F--03/24/92	71	16	243		1		0.73	
GW-694----U--03/24/92	72	16	246		1		0.69	
GW-695----F---6/18/91	17	12	92	0.22	4	2.47	15.84	11.94
GW-695----F---9/13/91	22	14	112				10.40	4.90
GW-695----F--06/21/92	29	17	142				5.67	
GW-695----F--11/22/91	17	12	92				15.84	
GW-695----U---6/18/91	25	12	112	0.17	3	4.01	10.55	7.55
GW-695----U--06/21/92	31	19	155				4.34	3.11
GW-695----U--11/22/91	31	12	127				7.77	
GW-703----F---6/18/91	32	20	162	0.20	4	2.95	3.79	2.24
GW-703----F---9/11/91	44	21	196				1.89	1.34
GW-703----F--03/24/92	29	26	179				2.68	
GW-703----F--06/20/92	55	28	252				0.60	
GW-703----U---6/18/91	33	20	165	0.04	2	52.93	3.60	3.26
GW-703----U--03/24/92	29	25	175				2.91	0.49
GW-704----F---6/20/91	35	26	194	0.10	4	10.05	1.97	1.12
GW-704----F---9/12/91	51	24	226				1.03	0.59

Well	Ca (mg/L)	Mg (mg/L)	Hardness (mg/L)	CV	# of Values	Flow Thru time (d)	Estimated Q (m3/s)	Ave (Q) Stdev (Q)
GW-704----F--03/23/92	54	25	238				0.82	
GW-704----F--06/19/92	57	26	249				0.64	
GW-704----U---6/20/91	35	24	186	0.18	2	3.57	2.33	1.55
GW-704----U--03/23/92	55	25	240				0.78	1.10
GW-705----F---6/20/91	2.7	0.76	10	0.19	4	3.26	83.68	85.65
GW-705----F---9/10/91	1.9	0.76	8				87.16	2.88
GW-705----F--03/24/92	3	0.7	10				82.83	
GW-705----F--06/21/92	1.8	0.58	7				88.93	
GW-705----U---9/10/91	4.2	1	15	0.58	3	0.38	76.00	85.91
GW-705----U--03/24/92	1.6	0.5	6				90.44	8.59
GW-705----U--06/21/92	1.4	0.51	6				91.29	
GW-706----F---6/20/91	36	19	168		1		3.36	
GW-706----U---6/20/91	36	19	168		1		3.36	
GW-710---F--03/18/92	580	210	2311		1		0.00	
GW-710---U--03/18/92	570	210	2286		1		0.00	
GW-711---F---06/11/92	600	240	2484	0.08	3	18.32	0.00	0.00
GW-711---F---12/10/91	510	220	2177				0.00	0.00
GW-711---F--03/21/92	590	250	2500				0.00	
GW-711---U---03/21/92	580	240	2434	0.09	3	13.48	0.00	0.00
GW-711---U---06/11/92	640	250	2625				0.00	0.00
GW-711---U---12/10/91	500	230	2193				0.00	
GW-712---F---03/21/92	110	48	472	0.04	2	74.75	0.01	0.01
GW-712---F---06/13/92	120	48	497				0.00	0.00
GW-712---U---03/21/92	110	50	480	0.03	2	107.77	0.01	0.00
GW-712---U---06/13/92	120	49	501				0.00	0.00
GW-722-10--F--1/20/92	39	25	200		1		1.75	
GW-722-17--F--5/28/92	47	30	241		1		0.77	
GW-722-20--F--1/21/92	47	31	245		1		0.71	
GW-722-22--F--1/27/92	47	25	220		1		1.17	
GW-722-26--F--5/21/92	43	20	190		1		2.17	
GW-722-30--F--1/29/92	36	15	152		1		4.69	
GW-722-32--F--1/29/92	61	10	194		1		2.00	
GW-722-33--F---2/4/92	62	10	196		1		1.90	
GW-722-6--F----1/7/92	15	9.1	75		1		22.33	
GW-723---F---05/27/92	19	17	117		1		9.43	
GW-724---F---05/20/92	94	38	391		1		0.04	
GW-725---F---05/21/92	160	25	503		1		0.00	
GW-733--U---04/28/92	18	17	115	0.02	1	379.40	9.92	10.18
GW-733-F----04/28/92	17	17	112		1		10.44	0.37
GW-734--F----3/26/92	13	3.9	48	0.47	2	0.58	38.15	26.27
GW-734--F---1/28/93	32	4	96				14.39	16.79
GW-735--U---04/28/92	110	8.1	308		1		0.19	
GW-735-F----04/28/92	110	8.4	309		1		0.19	
GW-736--U---05/22/92	170	20	507		1		0.00	
GW-737---U--05/22/92	180	24	548		1		0.00	
GW-738---U--05/26/92	110	24	373		1		0.05	
GW-739---U--05/27/92	56	27	251		1		0.62	
GW-739---F--05/27/92	55	26	244		1		0.71	
GW-740---U--06/02/92	59	28	262		1		0.49	
GW-740---F--06/02/92	61	29	271		1		0.41	

Appendix B: Calculated Saturation Indices for Dolomite and Calcite, Pco2, and a(Mg)/a(Ca) ratios for Waters in the Maynardville Limestone and Copper Ridge Dolomite.

	Pco2 (atm)	-LOG(Pco2)	a (Ca)	a (Mg)	Mg/Ca	SI(cal)	SI(dol)	Balance	Fm
1090--F--01/05/89	8.85E-03	2.05	9.00E-04	8.57E-04	0.95	-0.077	-0.134	5.31	Ccr
1090--F--01/05/89	8.74E-03	2.06	9.01E-04	8.58E-04	0.95	-0.090	-0.164	6.86	Ccr
1090--F--02/26/88	5.15E-03	2.29	8.04E-04	7.79E-04	0.97	0.240	0.518	-4.52	Ccr
1090--F--04/11/89	1.37E-02	1.86	9.73E-04	8.51E-04	0.87	-0.269	-0.563	6.91	Ccr
1090--F--04/11/89	1.37E-02	1.86	9.72E-04	8.51E-04	0.88	-0.269	-0.564	7.25	Ccr
1090--F--05/04/88	1.12E-02	1.95	8.99E-04	8.84E-04	0.98	-0.179	-0.324	6.83	Ccr
1090--F--07/21/88	5.64E-02	1.25	8.42E-04	8.60E-04	1.02	-0.884	-1.703	3.79	Ccr
1090--F--08/14/89	2.14E-02	1.67	9.07E-04	8.43E-04	0.93	-0.274	-0.529	-1.29	Ccr
1090--F--10/11/88	6.85E-03	2.16	7.73E-04	7.87E-04	1.02	-0.026	0.011	2.52	Ccr
1090--F--10/13/89	1.85E-02	1.73	9.61E-04	9.00E-04	0.94	-0.112	-0.201	3.84	Ccr
1090--U--01/05/89	8.85E-03	2.05	9.00E-04	8.57E-04	0.95	-0.077	-0.134	5.31	Ccr
1090--U--01/05/89	8.74E-03	2.06	8.82E-04	8.85E-04	1.00	-0.099	-0.160	7.55	Ccr
1090--U--02/26/88	5.14E-03	2.29	8.71E-04	7.68E-04	0.88	0.278	0.545	-2.44	Ccr
1090--U--02/26/88	1.12E-02	1.95	7.99E-04	8.90E-04	1.11	-0.229	-0.370	5.85	Ccr
1090--U--07/21/88	5.63E-02	1.25	8.57E-04	8.57E-04	1.00	-0.877	-1.703	4.65	Ccr
1090--U--08/14/89	2.14E-02	1.67	9.07E-04	8.43E-04	0.93	-0.274	-0.529	-1.44	Ccr
1090--U--10/11/88	6.84E-03	2.16	7.90E-04	7.86E-04	0.99	-0.017	0.018	3.39	Ccr
1090--U--10/13/89	1.85E-02	1.73	9.61E-04	9.00E-04	0.94	-0.112	-0.201	3.86	Ccr
GW-056---F--03/13/92	5.64E-03	2.25	1.05E-03	5.87E-04	0.56	0.380	0.530	-9.16	Cmn
GW-056--F----2/26/91	2.70E-02	1.57	1.07E-03	5.87E-04	0.55	-0.334	-0.896	-5.30	Cmn
GW-056--F----9/15/91	2.80E-03	2.55	1.28E-03	6.81E-04	0.53	0.800	1.378	-1.62	Cmn
GW-056--F--12/11/91	2.76E-02	1.56	1.19E-03	6.31E-04	0.53	-0.278	-0.798	-6.48	Cmn
GW-056--U----2/26/91	2.67E-02	1.57	1.38E-03	7.34E-04	0.53	-0.229	-0.699	4.35	Cmn
GW-056--U----5/24/91	2.68E-01	0.57	1.39E-03	6.99E-04	0.50	-1.195	-2.644	1.16	Cmn
GW-056--U----9/15/91	2.78E-03	2.56	1.37E-03	7.55E-04	0.55	0.826	1.447	1.58	Cmn
GW-056--U---03/13/92	5.60E-03	2.25	1.22E-03	6.56E-04	0.54	0.440	0.640	-4.53	Cmn
GW-056--U--12/11/91	2.74E-02	1.56	1.44E-03	7.50E-04	0.52	-0.199	-0.649	2.46	Cmn
GW-057--F----2/26/91	2.91E-02	1.54	1.38E-03	4.57E-04	0.33	-0.204	-0.864	2.08	Cmn
GW-057--F----6/19/91	3.03E-02	1.52	1.43E-03	4.58E-04	0.32	-0.117	-0.677	-3.30	Cmn
GW-057--U----2/26/91	2.92E-02	1.53	1.35E-03	4.59E-04	0.34	-0.213	-0.872	1.16	Cmn
GW-057--U----6/19/91	3.03E-02	1.52	1.42E-03	4.31E-04	0.30	-0.121	-0.707	-3.58	Cmn
GW-058---F--03/24/92	2.15E-02	1.67	1.28E-03	7.13E-04	0.56	-0.160	-0.560	1.60	Cmn
GW-058--F----3/19/91	2.80E-02	1.55	1.25E-03	7.46E-04	0.60	-0.252	-0.695	0.52	Cmn
GW-058--F----6/20/91	3.03E-03	2.52	1.29E-03	8.47E-04	0.66	0.823	1.511	1.00	Cmn
GW-058--F----9/20/91	2.89E-03	2.54	1.42E-03	8.89E-04	0.63	0.819	1.467	6.76	Cmn
GW-058--F---06/22/92	4.04E-02	1.39	1.31E-03	7.39E-04	0.56	-0.240	-0.680	-3.57	Cmn
GW-058--U----3/19/91	2.80E-02	1.55	1.21E-03	7.44E-04	0.61	-0.265	-0.709	-0.40	Cmn
GW-058--U----6/20/91	3.02E-03	2.52	1.32E-03	8.69E-04	0.66	0.831	1.529	2.42	Cmn
GW-058--U----9/20/91	2.90E-03	2.54	1.35E-03	8.60E-04	0.64	0.798	1.432	4.83	Cmn
GW-058--U---06/22/92	4.04E-02	1.39	1.28E-03	7.33E-04	0.57	-0.250	-0.700	-3.84	Cmn

	Pco2 (atm)	-LOG(Pco2)	a (Ca)	a (Mg)	Mg/Ca	SI(cal)	SI(dol)	Balance	Fm
GW-061---F--06/24/92	1.37E-02	1.86	1.80E-03	4.24E-04	0.24	0.020	-0.540	-0.83	Cmn
GW-061---U--06/24/92	1.37E-02	1.86	1.78E-03	4.48E-04	0.25	0.020	-0.520	-0.31	Cmn
GW-061--F----2/21/91	1.84E-02	1.74	1.37E-03	2.88E-04	0.21	-0.406	-1.468	6.97	Cmn
GW-061--F----3/19/91	1.84E-02	1.74	1.21E-03	2.65E-04	0.22	-0.463	-1.562	1.13	Cmn
GW-061--F----6/19/91	1.97E-03	2.70	1.32E-03	2.74E-04	0.21	0.673	0.722	3.53	Cmn
GW-061--U----2/21/91	1.84E-02	1.74	1.35E-03	3.16E-04	0.23	-0.413	-1.435	7.76	Cmn
GW-061--U----3/19/91	1.83E-02	1.74	1.24E-03	2.67E-04	0.22	-0.453	-1.550	2.57	Cmn
GW-061--U----6/19/91	1.97E-03	2.70	1.30E-03	2.63E-04	0.20	0.667	0.697	2.44	Cmn
GW-064---F*-06/02/92	2.45E-02	1.61	1.84E-03	4.32E-04	0.23	0.090	-0.410	3.39	Cmn
GW-064---U*-06/02/92	2.45E-02	1.61	1.84E-03	4.32E-04	0.23	0.090	-0.410	3.03	Cmn
GW-064--F----2/20/91	3.04E-02	1.52	1.84E-03	4.32E-04	0.23	-0.061	-0.728	1.87	Cmn
GW-064--F----5/17/91	2.98E-02	1.53	1.70E-03	4.40E-04	0.26	-0.062	-0.668	7.62	Cmn
GW-064--F----8/14/91	2.83E-03	2.55	1.98E-03	4.53E-04	0.23	0.968	1.334	8.63	Cmn
GW-064--U----2/20/91	3.04E-02	1.52	1.82E-03	4.28E-04	0.24	-0.066	-0.738	2.12	Cmn
GW-064--U----5/17/91	2.98E-02	1.53	1.63E-03	4.44E-04	0.27	-0.082	-0.680	6.01	Cmn
GW-064--U----8/14/91	2.82E-03	2.55	1.98E-03	4.78E-04	0.24	0.966	1.356	9.43	Cmn
GW-064--U---10/23/91	2.98E-02	1.53	1.83E-03	4.31E-04	0.24	-0.030	-0.641	3.39	Cmn
GW-099--F--02/10/88	5.95E-05	4.23?	4.86E-04	4.73E-04	0.97	1.245	2.495	-6.58	Ccr
GW-099--F--05/16/88	5.29E-03	2.28	5.20E-04	5.02E-04	0.97	-0.531	-1.032	4.66	Ccr
GW-099--U--02/10/88	5.91E-05	4.23?	4.49E-04	5.02E-04	1.12	1.254	2.528	-2.73	Ccr
GW-099--U--05/16/88	5.29E-03	2.28	5.21E-04	4.72E-04	0.91	-0.530	-1.057	3.34	Ccr
GW-131-04-F---10/9/90	9.57E-03	2.01	9.98E-04	9.21E-04	0.92	0.313	0.713	-4.53	Cmn
GW-131-08--F--10/9/90	6.81E-03	2.16	5.72E-04	5.28E-04	0.92	0.077	0.194	-8.77	Cmn
GW-131-12--F--5/19/92	1.40E-02	1.85	8.18E-04	7.58E-04	0.93	-0.040	-0.034	-2.21	Cmn
GW-131-15--F--10/3/90	4.07E-03	2.39	1.03E-03	9.10E-04	0.88	0.522	1.064	-4.32	Cmn
GW-131-24--F--5/19/92	3.98E-03	2.39	3.42E-03	3.36E-03	0.98	0.416	0.867	-0.35	Ccr
GW-131-28--F---5/19/92	4.96E-03	2.30	2.65E-03	2.57E-03	0.97	0.480	1.010	-0.89	Ccr
GW-131-32-F--10/1/90	2.41E-03	2.61	6.38E-04	5.75E-04	0.90	0.267	0.518	-5.77	Ccr
GW-135-03--F--2/13/92	1.47E-01	0.83	9.33E-03	6.66E-03	0.71	-1.261	-2.660	1.63	Cmn
GW-135-03--F--7/16/91	2.23E-02	1.65	8.32E-03	4.65E-03	0.56	-0.623	-1.394	5.29	Cmn
GW-135-03-F----6/2/92	2.34E-03	2.63	8.90E-03	5.72E-03	0.64	0.593	1.071	0.99	Cmn
GW-135-03-U--5/17/91	2.51E-03	2.60	7.23E-03	4.09E-03	0.57	0.351	0.547	4.50	Cmn
GW-135-06--F--5/17/91	4.45E-03	2.35	3.28E-03	1.57E-03	0.48	0.453	0.671	-5.79	Cmn
GW-135-11--F--5/15/91	5.20E-03	2.28	2.51E-03	1.21E-03	0.48	0.429	0.638	-6.94	Cmn
GW-135-19--F---5/9/91	1.83E-03	2.74	7.19E-04	5.94E-04	0.83	0.381	0.716	-3.45	Cmn
GW-135-23--F---5/7/91	1.23E-03	2.91	5.10E-03	2.03E-03	0.40	0.867	1.370	-1.41	Ccr
GW-135-30--F---5/6/91	7.36E-04	3.13	5.98E-04	6.68E-04	1.12	0.690	1.436	3.69	Ccr
GW-135-30--F---6/9/92	1.89E-02	1.72	6.54E-04	6.66E-04	1.02	-0.656	-1.292	3.58	Ccr
GW-135-34--F---5/3/91	8.11E-04	3.09	6.00E-04	6.10E-04	1.02	0.566	1.169	3.10	Ccr
GW-135-39--F---5/3/91	1.68E-03	2.78	5.33E-04	5.29E-04	0.99	0.235	0.495	-4.99	Ccr
GW-141--F--02/18/88	1.30E-03	2.89	6.99E-04	7.12E-04	1.02	0.546	1.122	-0.76	Ccr
GW-141--F--02/18/88	1.30E-03	2.89	7.00E-04	7.12E-04	1.02	0.546	1.121	-0.74	Ccr
GW-141--F--02/18/88	1.29E-03	2.89	7.15E-04	7.40E-04	1.03	0.555	1.146	0.99	Ccr

	Pco2 (atm)	-LOG(Pco2)	a (Ca)	a (Mg)	Mg/Ca	SI(cal)	SI(dol)	Balance	Fm
GW-141--F--02/18/88	1.29E-03	2.89	7.15E-04	7.40E-04	1.03	0.555	1.146	1.01	Ccr
GW-141--F--03/09/89	2.02E-02	1.69	6.94E-04	7.40E-04	1.07	-0.631	-1.192	2.44	Ccr
GW-141--F--03/09/89	2.01E-02	1.70	7.11E-04	7.67E-04	1.08	-0.629	-1.187	3.99	Ccr
GW-141--F--05/17/88	1.23E-02	1.91	7.17E-04	7.15E-04	1.00	-0.434	-0.829	4.24	Ccr
GW-141--F--05/17/88	1.23E-02	1.91	7.17E-04	7.15E-04	1.00	-0.435	-0.831	4.33	Ccr
GW-141--F--05/17/88	1.54E-02	1.81	7.49E-04	7.70E-04	1.03	-0.521	-0.992	7.71	Ccr
GW-141--F--05/17/88	1.54E-02	1.81	7.49E-04	7.70E-04	1.03	-0.522	-0.993	7.75	Ccr
GW-141--F--05/31/89	6.32E-03	2.20	7.49E-04	7.65E-04	1.02	-0.018	0.041	7.69	Ccr
GW-141--F--05/31/89	6.32E-03	2.20	7.49E-04	7.65E-04	1.02	-0.019	0.040	7.75	Ccr
GW-141--F--08/03/88	7.73E-03	2.11	6.79E-04	7.45E-04	1.10	-0.238	-0.384	5.13	Ccr
GW-141--F--08/03/88	7.72E-03	2.11	6.79E-04	7.45E-04	1.10	-0.238	-0.385	5.19	Ccr
GW-141--F--08/03/88	7.72E-03	2.11	6.97E-04	7.44E-04	1.07	-0.227	-0.374	5.76	Ccr
GW-141--F--08/03/88	7.71E-03	2.11	7.00E-04	7.44E-04	1.06	-0.227	-0.375	5.83	Ccr
GW-141--F--10/18/88	1.21E-02	1.92	6.67E-04	6.91E-04	1.04	-0.484	-0.918	2.57	Ccr
GW-141--F--10/18/88	1.20E-02	1.92	6.67E-04	6.91E-04	1.04	-0.485	-0.920	2.69	Ccr
GW-141--U--02/18/88	1.29E-03	2.89	7.13E-04	7.38E-04	1.04	0.546	1.143	0.89	Ccr
GW-141--U--02/18/88	1.29E-03	2.89	7.13E-04	7.38E-04	1.04	0.553	1.143	0.91	Ccr
GW-141--U--02/18/88	1.29E-03	2.89	7.13E-04	7.38E-04	1.04	0.554	1.143	1.17	Ccr
GW-141--U--02/18/88	1.29E-03	2.89	7.13E-04	7.38E-04	1.04	0.553	1.143	1.19	Ccr
GW-141--U--03/09/89	2.02E-02	1.69	7.10E-04	7.67E-04	1.08	-0.628	-1.185	3.54	Ccr
GW-141--U--03/09/89	2.02E-02	1.69	7.10E-04	7.67E-04	1.08	-0.621	-1.167	3.83	Ccr
GW-141--U--05/17/88	1.55E-02	1.81	7.17E-04	7.15E-04	1.00	-0.539	-1.041	4.56	Ccr
GW-141--U--05/17/88	1.54E-02	1.81	7.18E-04	7.16E-04	1.00	-0.539	-1.041	4.60	Ccr
GW-141--U--05/17/88	1.23E-02	1.91	7.34E-04	7.14E-04	0.97	-0.424	-0.820	4.93	Ccr
GW-141--U--05/17/88	1.23E-02	1.91	7.34E-04	7.14E-04	0.97	-0.425	-0.821	5.01	Ccr
GW-141--U--05/31/89	6.32E-03	2.20	7.47E-04	7.93E-04	1.06	-0.020	0.055	8.69	Ccr
GW-141--U--05/31/89	6.31E-03	2.20	7.47E-04	7.93E-04	1.06	-0.020	0.054	8.76	Ccr
GW-141--U--08/03/88	7.73E-03	2.11	6.79E-04	7.44E-04	1.10	-0.238	-0.384	5.21	Ccr
GW-141--U--08/03/88	7.72E-03	2.11	6.79E-04	7.45E-04	1.10	-0.238	-0.385	5.27	Ccr
GW-141--U--08/03/88	7.71E-03	2.11	7.12E-04	7.71E-04	1.08	-0.218	-0.350	7.32	Ccr
GW-141--U--08/03/88	7.70E-03	2.11	7.12E-04	7.71E-04	1.08	-0.218	-0.351	7.38	Ccr
GW-141--U--10/18/88	1.20E-02	1.92	6.82E-04	7.17E-04	1.05	-0.475	-0.894	4.36	Ccr
GW-141--U--10/18/88	1.20E-02	1.92	6.82E-04	7.17E-04	1.05	-0.476	-0.896	4.48	Ccr
GW-151---F-----5/1/91	2.43E-02	1.61	1.05E-03	7.11E-04	0.68	-0.350	-0.816	1.66	Cmn
GW-151---F----1/31/91	2.40E-02	1.62	1.00E-03	7.09E-04	0.71	-0.413	-0.945	0.02	Cmn
GW-151---F----8/24/91	2.24E-03	2.65	1.02E-03	7.08E-04	0.69	0.617	1.132	3.67	Cmn
GW-151---F---10/23/91	2.27E-03	2.64	1.01E-03	7.10E-04	0.70	0.591	1.077	3.39	Cmn
GW-151---F--01/25/92	6.04E-03	2.22	1.01E-03	7.10E-04	0.70	0.180	0.310	0.18	Cmn
GW-151---F--01/25/92	4.75E-03	2.32	1.00E-03	7.10E-04	0.71	0.280	0.440	0.50	Cmn
GW-151---F--04/21/92	1.20E-02	1.92	9.43E-04	6.58E-04	0.70	-0.120	-0.345	-3.80	Cmn
GW-151---F-04/21/92	1.22E-02	1.91	9.42E-04	6.58E-04	0.70	-0.110	-1.120	-4.31	Cmn
GW-151---U-----5/1/91	2.43E-02	1.61	1.05E-03	6.84E-04	0.65	-0.349	-0.831	0.84	Cmn
GW-151---U----1/31/91	2.40E-02	1.62	1.00E-03	7.09E-04	0.71	-0.413	-0.944	-0.07	Cmn

	Pco2 (atm)	-LOG(Pco2)	a (Ca)	a (Mg)	Mg/Ca	SI(cal)	SI(dol)	Balance	Fm
GW-151---U----8/24/91	2.24E-03	2.65	1.02E-03	7.09E-04	0.70	0.617	1.132	3.62	Cmn
GW-151---U--01/25/92	4.75E-03	2.32	1.02E-03	7.09E-04	0.70	0.290	0.580	0.92	Cmn
GW-151---U--04/21/92	1.21E-02	1.92	9.74E-04	6.84E-04	0.70	-0.111	-0.334	-2.42	Cmn
GW-151---U--04/21/92	1.20E-02	1.92	9.74E-04	6.84E-04	0.70	-0.100	-1.120	-1.91	Cmn
GW-152--F--01/18/89	6.41E-03	2.19	7.06E-04	4.22E-04	0.60	-0.363	-0.933	7.73	Cmn
GW-152--F--01/18/89	6.40E-03	2.19	7.06E-04	4.23E-04	0.60	-0.364	-0.935	7.83	Cmn
GW-152--F--03/08/88	4.38E-02	1.36	1.03E-03	6.24E-04	0.61	-0.945	-2.077	-6.02	Cmn
GW-152--F--03/08/88	4.38E-02	1.36	1.03E-03	6.24E-04	0.61	-0.946	-2.080	-6.00	Cmn
GW-152--F--04/11/89	8.44E-03	2.07	7.60E-04	4.51E-04	0.59	-0.391	-0.977	7.10	Cmn
GW-152--F--04/11/89	8.43E-03	2.07	7.60E-04	4.51E-04	0.59	-0.391	-0.978	7.13	Cmn
GW-152--F--08/09/89	7.39E-03	2.13	7.83E-04	4.77E-04	0.61	-0.217	-0.609	5.85	Cmn
GW-152--F--08/09/89	7.37E-03	2.13	7.83E-04	4.77E-04	0.61	-0.218	-0.611	5.94	Cmn
GW-152--F--08/13/87	1.23E-03	2.91	1.13E-03	5.28E-04	0.47	0.781	1.284	-1.79	Cmn
GW-152--F--08/13/87	1.23E-03	2.91	1.13E-03	5.28E-04	0.47	0.781	1.283	-1.75	Cmn
GW-152--F--08/17/88	4.40E-03	2.36	9.62E-04	6.20E-04	0.64	0.074	-0.569	5.06	Cmn
GW-152--F--08/17/88	4.39E-02	1.36	9.62E-04	6.20E-04	0.64	0.074	0.011	5.07	Cmn
GW-152--U--01/18/89	6.41E-03	2.19	7.24E-04	4.22E-04	0.58	-0.352	-0.922	7.18	Cmn
GW-152--U--01/18/89	6.40E-03	2.19	7.24E-04	4.22E-04	0.58	-0.353	-0.924	7.28	Cmn
GW-152--U--03/08/88	4.38E-02	1.36	1.06E-03	6.22E-04	0.59	-0.934	-2.068	-3.95	Cmn
GW-152--U--03/08/88	4.37E-02	1.36	1.06E-03	6.22E-04	0.59	-0.935	-2.070	-3.93	Cmn
GW-152--U--04/11/89	8.39E-03	2.08	7.96E-04	4.51E-04	0.57	-0.371	-0.958	6.58	Cmn
GW-152--U--04/11/89	8.43E-03	2.07	8.00E-04	4.51E-04	0.56	-0.371	-0.958	6.61	Cmn
GW-152--U--08/09/89	7.39E-03	2.13	8.02E-04	4.77E-04	0.59	-0.207	-0.599	4.71	Cmn
GW-152--U--08/09/89	7.37E-03	2.13	8.02E-04	4.77E-04	0.59	-0.208	-0.600	4.80	Cmn
GW-152--U--08/13/87	1.23E-03	2.91	1.19E-03	5.52E-04	0.46	0.803	1.323	0.31	Cmn
GW-152--U--08/13/87	1.23E-03	2.91	1.19E-03	5.52E-04	0.46	0.802	1.322	0.36	Cmn
GW-152--U--08/17/88	4.39E-02	1.36	1.03E-03	6.19E-04	0.60	0.102	0.038	4.63	Cmn
GW-152--U--10/22/87	1.31E-03	2.88	1.28E-03	6.59E-04	0.51	0.835	1.420	-6.39	Cmn
GW-152--U--10/22/87	1.31E-03	2.88	1.28E-03	6.60E-04	0.52	0.835	1.420	-6.38	Cmn
GW-153--F--01/18/89	1.18E-03	2.93	6.69E-04	5.01E-04	0.75	0.298	0.498	1.51	Cmn
GW-153--F--01/18/89	1.18E-03	2.93	6.69E-04	5.01E-04	0.75	0.297	0.497	1.55	Cmn
GW-153--F--03/08/88	9.61E-03	2.02	7.41E-04	5.32E-04	0.72	-0.538	-1.186	-2.74	Cmn
GW-153--F--03/08/88	9.59E-03	2.02	7.41E-04	5.32E-04	0.72	-0.539	-1.187	-2.72	Cmn
GW-153--F--04/05/89	1.16E-02	1.93	7.15E-04	5.06E-04	0.71	-0.662	-1.434	5.37	Cmn
GW-153--F--04/05/89	1.16E-02	1.93	7.15E-04	5.06E-04	0.71	-0.663	-1.437	5.47	Cmn
GW-153--F--06/16/88	7.08E-04	3.15	6.58E-04	5.18E-04	0.79	0.500	0.943	0.98	Cmn
GW-153--F--06/16/88	7.06E-04	3.15	6.58E-04	5.18E-04	0.79	0.499	0.941	1.05	Cmn
GW-153--F--08/09/89	5.68E-04	3.25	6.27E-04	4.79E-04	0.76	0.580	1.088	0.44	Cmn
GW-153--F--08/09/89	5.67E-04	3.25	6.27E-04	4.79E-04	0.76	0.579	1.087	0.50	Cmn
GW-153--F--08/13/87	1.56E-04	3.81	4.20E-04	4.22E-04	1.00	0.848	1.746	-7.76	Cmn
GW-153--F--08/13/87	1.56E-04	3.81	4.20E-04	4.22E-04	1.00	0.848	1.744	-7.71	Cmn
GW-153--F--08/17/88	2.21E-03	2.66	6.26E-04	5.09E-04	0.81	-0.022	-0.085	-4.61	Cmn
GW-153--F--08/17/88	2.20E-03	2.66	6.26E-04	5.09E-04	0.81	-0.023	-0.087	-4.56	Cmn

	Pco2 (atm)	-LOG(Pco2)	a (Ca)	a (Mg)	Mg/Ca	SI(cal)	SI(dol)	Balance	Fm
GW-153--F--08/17/88	2.78E-03	2.56	6.62E-04	5.10E-04	0.77	-0.095	-0.254	-3.60	Cmn
GW-153--F--08/17/88	2.78E-03	2.56	6.62E-04	5.10E-04	0.77	-0.097	-0.256	-3.56	Cmn
GW-153--U--01/18/89	1.18E-03	2.93	6.86E-04	5.00E-04	0.73	0.309	0.508	2.05	Cmn
GW-153--U--01/18/89	1.18E-03	2.93	6.86E-04	5.00E-04	0.73	0.308	0.507	2.09	Cmn
GW-153--U--03/08/88	9.61E-03	2.02	7.41E-04	5.32E-04	0.72	-0.538	-1.186	-2.71	Cmn
GW-153--U--03/08/88	9.59E-03	2.02	7.41E-04	5.32E-04	0.72	-0.539	-1.187	-2.68	Cmn
GW-153--U--06/16/88	7.09E-04	3.15	6.60E-04	5.19E-04	0.79	0.501	0.946	-0.78	Cmn
GW-153--U--06/16/88	7.07E-04	3.15	6.60E-04	5.19E-04	0.79	0.500	0.943	-0.71	Cmn
GW-153--U--08/09/89	5.70E-04	3.24	5.93E-04	4.51E-04	0.76	0.558	1.042	-2.66	Cmn
GW-153--U--08/09/89	5.69E-04	3.24	5.94E-04	4.51E-04	0.76	0.557	1.040	-2.59	Cmn
GW-153--U--08/13/87	1.54E-04	3.81	5.59E-04	4.46E-04	0.80	0.965	1.879	-0.96	Cmn
GW-153--U--08/13/87	1.53E-04	3.82	5.59E-04	4.46E-04	0.80	0.965	1.878	-0.91	Cmn
GW-153--U--08/17/88	2.21E-03	2.66	6.60E-04	5.09E-04	0.77	0.001	-0.063	-4.95	Cmn
GW-153--U--08/17/88	2.20E-03	2.66	6.60E-04	5.09E-04	0.77	0.000	-0.065	-4.90	Cmn
GW-153--U--08/17/88	2.78E-03	2.56	6.96E-04	5.10E-04	0.73	-0.074	-0.234	-3.46	Cmn
GW-153--U--08/17/88	2.77E-03	2.56	6.96E-04	5.10E-04	0.73	-0.075	-0.236	-3.41	Cmn
GW-153--U--10/22/87	4.29E-04	3.37	8.40E-04	6.37E-04	0.76	1.011	1.957	0.38	Cmn
GW-153--U--10/22/87	4.28E-04	3.37	8.40E-04	6.37E-04	0.76	1.010	1.956	0.42	Cmn
GW-153--U--10/28/88	1.73E-03	2.76	6.61E-04	4.94E-04	0.75	0.066	0.040	2.74	Cmn
GW-153--U--10/28/88	1.73E-03	2.76	6.61E-04	4.95E-04	0.75	0.065	0.039	2.77	Cmn
GW-154--F--08/12/87	6.11E-03	2.21	1.84E-03	4.74E-04	0.26	0.812	1.105	-8.69	Cmn
GW-154--F--10/22/87	1.61E-02	1.79	1.73E-03	4.54E-04	0.26	0.331	0.148	-9.52	Cmn
GW-154--U--01/09/89	9.66E-02	1.01	1.49E-03	3.28E-04	0.22	-0.929	-2.566	-5.39	Cmn
GW-154--U--08/12/87	6.05E-03	2.22	2.12E-03	4.91E-04	0.23	0.868	1.170	-2.37	Cmn
GW-154--U--10/22/87	1.61E-02	1.79	1.72E-03	4.78E-04	0.28	0.330	0.167	-7.75	Cmn
GW-154--U--10/27/88	3.33E-02	1.48	1.52E-03	4.38E-04	0.29	-0.219	-0.916	-2.27	Cmn
GW-155--F--03/02/89	4.17E-03	2.38	5.19E-04	5.32E-04	1.03	-0.467	-0.894	6.60	Ccr
GW-155--F--03/23/88	1.92E-03	2.72	6.03E-04	5.84E-04	0.97	0.118	0.278	6.72	Ccr
GW-155--F--06/22/88	8.65E-03	2.06	5.35E-04	5.60E-04	1.05	-0.707	-1.349	7.28	Ccr
GW-155--F--06/23/89	3.40E-03	2.47	5.40E-04	5.30E-04	0.98	-0.264	-0.476	7.01	Ccr
GW-155--F--07/13/87	3.56E-03	2.45	5.86E-04	5.51E-04	0.94	0.036	0.114	-1.96	Ccr
GW-155--F--08/24/88	3.60E-03	2.44	5.20E-04	5.34E-04	1.03	-0.277	-0.489	3.63	Ccr
GW-155--F--08/25/89	1.64E-02	1.79	5.37E-04	5.30E-04	0.99	-0.805	-1.561	-2.74	Ccr
GW-155--F--10/02/87	4.02E-03	2.40	5.50E-04	4.99E-04	0.91	-0.188	-0.364	-2.14	Ccr
GW-155--F--11/01/88	2.71E-03	2.57	4.99E-04	5.37E-04	1.08	-0.267	-0.473	4.02	Ccr
GW-155--F--11/13/89	6.41E-03	2.19	5.54E-04	5.59E-04	1.01	-0.433	-0.823	-0.09	Ccr
GW-155--F--12/10/87	1.22E-03	2.91	5.39E-04	4.98E-04	0.92	0.229	0.461	-2.04	Ccr
GW-155--U--03/02/89	4.17E-03	2.38	5.02E-04	5.03E-04	1.00	-0.481	-0.932	4.31	Ccr
GW-155--U--06/22/88	8.64E-03	2.06	5.53E-04	5.60E-04	1.01	-0.692	-1.335	7.93	Ccr
GW-155--U--08/25/89	1.64E-02	1.79	5.88E-04	5.86E-04	1.00	-0.767	-1.480	3.17	Ccr
GW-155--U--10/02/87	4.02E-03	2.40	5.55E-04	4.99E-04	0.90	-0.188	-0.364	-2.07	Ccr
GW-155--U--11/13/89	6.41E-03	2.19	5.54E-04	5.59E-04	1.01	-0.433	-0.824	-0.10	Ccr
GW-158--F--03/24/88	4.48E-03	2.35	5.62E-04	6.71E-04	1.19	-0.363	-0.601	9.93	Ccr

	Pco2 (atm)	-LOG(Pco2)	a (Ca)	a (Mg)	Mg/Ca	SI(cal)	SI(dol)	Balance	Fm
GW-158--F--06/24/88	8.93E-03	2.05	4.51E-04	6.78E-04	1.50	-0.727	-1.217	6.39	Ccr
GW-158--F--06/25/89	3.90E-03	2.41	5.64E-04	6.72E-04	1.19	-0.214	-0.300	5.54	Ccr
GW-158--F--08/24/88	7.77E-03	2.11	5.46E-04	6.74E-04	1.23	-0.505	-0.858	5.48	Ccr
GW-158--F--08/30/89	1.43E-02	1.84	5.96E-04	6.35E-04	1.07	-0.593	-1.097	-1.06	Ccr
GW-158--F--10/10/87	5.27E-05	4.28?	1.74E-04	6.97E-04	4.01?	0.829	2.323	-6.53	Ccr
GW-158--F--10/29/88	6.01E-03	2.22	5.09E-04	6.49E-04	1.28	-0.484	-0.816	2.95	Ccr
GW-158--F--12/11/87	2.25E-03	2.65	5.28E-04	6.42E-04	1.22	0.090	0.304	-4.97	Ccr
GW-158--U--03/04/89	1.12E-02	1.95	5.04E-04	6.67E-04	1.32	-0.836	-1.512	8.52	Ccr
GW-158--U--03/24/88	4.48E-03	2.35	5.06E-04	6.40E-04	1.26	-0.409	-0.667	6.49	Ccr
GW-158--U--06/24/88	8.93E-03	2.05	4.50E-04	6.78E-04	1.51	-0.728	-1.217	6.23	Ccr
GW-158--U--06/25/89	3.89E-03	2.41	5.59E-04	6.67E-04	1.19	-0.218	-0.308	5.50	Ccr
GW-158--U--08/24/88	7.73E-03	2.11	5.16E-04	6.29E-04	1.22	-0.532	-0.918	3.47	Ccr
GW-158--U--08/30/89	1.43E-02	1.84	5.73E-04	6.60E-04	1.15	-0.611	-1.099	-0.46	Ccr
GW-158--U--10/10/87	5.23E-05	4.28?	1.76E-04	7.20E-04	4.09?	0.831	2.335	-4.70	Ccr
GW-158--U--10/29/88	6.00E-03	2.22	4.88E-04	6.16E-04	1.26	-0.502	-0.857	0.77	Ccr
GW-158--U--12/11/87	2.25E-03	2.65	5.01E-04	6.07E-04	1.21	0.067	0.257	-6.69	Ccr
GW-167--F-----5/8/91	2.93E-02	1.53	1.87E-03	1.49E-04	0.08	-0.015	-1.077	1.38	Cmn
GW-167--F----2/14/91	1.98E-03	2.70	1.26E-03	1.15E-04	0.09	0.602	0.200	-0.97	Cmn
GW-167--F----8/31/91	2.91E-03	2.54	2.39E-04	2.00E-05	0.08	-2.181	-5.688	5.81	Cmn
GW-167--U----2/14/91	1.97E-03	2.70	1.34E-03	1.23E-04	0.09	0.627	0.225	1.49	Cmn
GW-173--F--01/05/89	1.81E-02	1.74	6.62E-04	7.15E-04	1.08	-0.729	-1.402	[illegible]	Ccr
GW-173--F--03/12/88	2.16E-03	2.67	6.74E-04	7.47E-04	1.11	0.166	0.406	[illegible]	Ccr
GW-173--F--04/04/89	8.97E-03	2.05	7.30E-04	7.41E-04	1.02	-0.315	-0.563	[illegible]	Ccr
GW-173--F--06/07/88	2.86E-03	2.54	6.78E-04	7.15E-04	1.05	0.157	0.399	4.88	Ccr
GW-173--F--08/05/88	2.88E-03	2.54	7.28E-04	7.37E-04	1.01	-0.820	-1.578	7.24	Ccr
GW-173--F--08/07/87	5.32E-04	3.27	7.32E-04	7.85E-04	1.07	1.110	2.318	-0.45	Ccr
GW-173--F--08/10/89	5.80E-03	2.24	6.99E-04	6.86E-04	0.98	-0.158	-0.275	3.49	Ccr
GW-173--F--10/04/89	8.75E-03	2.06	7.73E-04	7.63E-04	0.99	-0.135	-0.228	0.87	Ccr
GW-173--F--10/06/87	3.73E-04	3.43	7.41E-04	7.32E-04	0.99	1.094	2.238	1.16	Ccr
GW-173--F--10/24/88	2.30E-02	1.64	6.80E-04	7.13E-04	1.05	-0.794	-1.531	4.01	Ccr
GW-173--U--01/05/89	1.81E-02	1.74	6.62E-04	7.15E-04	1.08	-0.729	-1.401	4.05	Ccr
GW-173--U--06/07/88	2.86E-03	2.54	6.59E-04	7.44E-04	1.13	0.145	0.404	5.28	Ccr
GW-173--U--08/10/89	5.80E-03	2.24	6.63E-04	6.87E-04	1.04	-0.180	-0.296	2.55	Ccr
GW-173--U--10/04/89	8.75E-03	2.06	7.73E-04	7.63E-04	0.99	-0.135	-0.228	1.27	Ccr
GW-173--U--10/06/87	3.67E-04	3.44	8.79E-04	7.79E-04	0.89	1.162	2.327	7.86	Ccr
GW-173--U--10/24/88	2.30E-02	1.64	7.15E-04	7.12E-04	1.00	-0.773	-1.511	5.08	Ccr
GW-174--F--01/05/89	2.68E-04	3.57	5.93E-04	6.64E-04	1.12	-0.105	-0.235	4.30	Ccr
GW-174--F--03/12/88	8.26E-04	3.08	6.31E-04	6.92E-04	1.10	0.529	1.134	6.96	Ccr
GW-174--F--04/03/89	4.51E-03	2.35	6.45E-04	7.14E-04	1.11	-0.020	0.073	7.38	Ccr
GW-174--F--06/07/88	1.71E-03	2.77	6.10E-04	6.94E-04	1.14	0.293	0.703	6.21	Ccr
GW-174--F--08/05/88	5.65E-03	2.25	6.64E-04	6.84E-04	1.03	-0.113	-0.143	7.76	Ccr
GW-174--F--08/07/87	3.44E-03	2.46	6.61E-04	6.52E-04	0.99	0.267	0.597	-0.27	Ccr
GW-174--F--10/08/87	9.97E-05	4.00	6.08E-04	6.91E-04	1.14	1.394	2.880	-2.07	Ccr

	Pco2 (atm)	-LOG(Pco2)	a (Ca)	a (Mg)	Mg/Ca	SI(cal)	SI(dol)	Balance	Fm
GW-174--F--10/24/88	8.49E-04	3.07	3.42E-04	4.34E-04	1.27	0.263	0.660	2.09	Ccr
GW-174--U--01/05/89	2.68E-04	3.57	6.10E-04	6.91E-04	1.13	-0.094	-0.206	5.36	Ccr
GW-174--U--03/12/88	8.25E-04	3.08	6.49E-04	6.91E-04	1.06	0.541	1.145	7.59	Ccr
GW-174--U--06/07/88	1.71E-03	2.77	6.27E-04	6.93E-04	1.11	0.304	0.713	7.77	Ccr
GW-174--U--10/08/87	9.79E-05	4.01	6.50E-04	7.37E-04	1.13	1.417	2.926	2.50	Ccr
GW-174--U--10/10/89	4.50E-03	2.35	7.12E-04	7.30E-04	1.03	0.169	0.409	-4.02	Ccr
GW-174--U--10/24/88	8.42E-04	3.07	4.32E-04	5.53E-04	1.28	0.362	0.860	3.67	Ccr
GW-179--F--03/14/88	1.67E-03	2.78	1.06E-03	8.73E-04	0.82	-0.173	-0.415	5.39	Ccr
GW-179--F--04/20/89	4.32E-03	2.36	1.06E-03	9.19E-04	0.87	0.508	1.007	6.54	Ccr
GW-179--F--08/07/87	9.64E-03	2.02	1.01E-03	9.51E-04	0.94	0.275	0.590	0.69	Ccr
GW-179--F--10/07/87	1.40E-03	2.85	9.62E-04	9.02E-04	0.94	0.948	1.908	-0.85	Ccr
GW-181--F--01/06/89	8.79E-03	2.06	5.17E-04	5.30E-04	1.03	-0.740	-1.439	4.51	Ccr
GW-181--F--01/06/89	8.77E-03	2.06	5.35E-04	5.29E-04	0.99	-0.729	-1.434	6.35	Ccr
GW-181--F--04/04/89	4.07E-03	2.39	6.54E-04	6.69E-04	1.02	-0.162	-0.278	9.75	Ccr
GW-181--F--08/09/89	2.48E-03	2.61	5.69E-04	5.87E-04	1.03	-0.037	-0.024	3.87	Ccr
GW-181--F--08/16/88	2.13E-03	2.67	5.20E-04	5.03E-04	0.97	-0.117	-0.198	3.46	Ccr
GW-181--F--10/05/89	2.95E-03	2.53	6.38E-04	6.10E-04	0.96	0.075	0.160	-1.88	Ccr
GW-181--F--10/05/89	2.34E-03	2.63	6.38E-04	6.05E-04	0.95	0.176	0.357	-1.65	Ccr
GW-181--F--10/25/88	1.12E-02	1.95	5.35E-04	5.29E-04	0.99	-0.831	-1.643	5.61	Ccr
GW-181--F--80/09/89	2.47E-03	2.61	5.51E-04	5.88E-04	1.07	-0.051	-0.035	3.10	Ccr
GW-181--U--01/06/89	8.79E-03	2.06	5.17E-04	5.30E-04	1.03	-0.740	-1.438	4.43	Ccr
GW-181--U--01/06/89	8.78E-03	2.06	5.17E-04	5.30E-04	1.03	-0.743	-1.447	5.32	Ccr
GW-181--U--04/04/89	4.07E-03	2.39	6.40E-04	6.41E-04	1.00	-0.173	-0.306	8.18	Ccr
GW-181--U--08/09/89	2.48E-03	2.61	5.69E-04	5.87E-04	1.03	-0.037	-0.024	3.65	Ccr
GW-181--U--08/09/89	2.46E-03	2.61	5.86E-04	6.15E-04	1.05	-0.025	0.010	5.69	Ccr
GW-181--U--08/16/88	2.13E-03	2.67	5.02E-04	5.04E-04	1.00	-0.132	-0.212	2.56	Ccr
GW-181--U--10/05/89	2.35E-03	2.63	6.20E-04	6.06E-04	0.98	0.164	0.346	-2.51	Ccr
GW-181--U--10/05/89	2.95E-03	2.53	6.38E-04	6.10E-04	0.96	0.075	0.160	-1.88	Ccr
GW-181--U--10/25/88	1.12E-02	1.95	5.53E-04	5.28E-04	0.95	-0.817	-1.630	6.71	Ccr
GW-220---F--04/21/92	1.30E-02	1.89	9.97E-04	6.30E-04	0.63	-0.050	-0.250	-5.52	Cmn
GW-220---U*-04/21/92	1.29E-02	1.89	1.29E-03	6.36E-04	0.49	0.060	-0.150	4.79	Cmn
GW-220--F----1/29/91	2.75E-02	1.56	1.30E-03	6.17E-04	0.47	-0.228	-0.738	1.16	Cmn
GW-220--F----4/26/91	2.72E-02	1.56	1.05E-03	6.27E-04	0.60	-0.264	-0.686	-4.33	Cmn
GW-220--F----8/24/91	2.38E-03	2.62	1.10E-03	6.26E-04	0.57	0.688	1.192	1.88	Cmn
GW-220--F---10/22/91	2.30E-03	2.64	9.97E-04	6.35E-04	0.64	0.605	1.067	0.46	Cmn
GW-220--U----1/29/91	2.76E-02	1.56	1.13E-03	6.48E-04	0.57	-0.287	-0.775	-2.55	Cmn
GW-220--U----4/26/91	2.68E-02	1.57	1.22E-03	6.53E-04	0.54	-0.204	-0.614	3.48	Cmn
GW-220--U----8/24/91	2.38E-03	2.62	1.14E-03	6.50E-04	0.57	0.704	1.223	4.03	Cmn
GW-221--F--01/04/89	1.74E-03	2.76	5.18E-04	5.64E-04	1.09	-0.032	0.011	6.08	Ccr
GW-221--F--02/26/88	3.16E-03	2.50	5.36E-04	5.30E-04	0.99	-0.165	-0.302	-1.64	Ccr
GW-221--F--04/11/89	3.39E-03	2.47	5.53E-04	5.60E-04	1.01	-0.360	-0.710	7.61	Ccr
GW-221--F--05/02/88	5.23E-04	3.28	5.16E-04	5.65E-04	1.09	0.456	0.994	6.93	Ccr
GW-221--F--07/21/88	1.13E-02	1.95	5.52E-04	5.58E-04	1.01	-0.769	-1.484	6.90	Ccr

	Pco2 (atm)	-LOG(Pco2)	a (Ca)	a (Mg)	Mg/Ca	SI(cal)	SI(dol)	Balance	Fm
GW-221--F--08/14/89	5.28E-03	2.28	5.34E-04	5.58E-04	1.04	-0.314	-0.560	-2.68	Ccr
GW-221--F--10/11/88	1.11E-03	2.96	5.70E-04	5.59E-04	0.98	0.236	0.513	8.14	Ccr
GW-221--F--10/12/89	5.65E-03	2.25	5.67E-04	5.53E-04	0.98	-0.234	-0.442	-2.72	Ccr
GW-221--U--01/04/89	1.74E-03	2.76	5.18E-04	5.64E-04	1.09	-0.032	0.011	6.02	Ccr
GW-221--U--02/26/88	3.16E-03	2.50	5.19E-04	5.01E-04	0.97	-0.178	-0.339	-3.96	Ccr
GW-221--U--04/11/89	3.39E-03	2.47	5.71E-04	5.59E-04	0.98	-0.346	-0.697	8.88	Ccr
GW-221--U--05/02/88	5.23E-04	3.28	5.16E-04	5.65E-04	1.09	0.456	0.994	6.79	Ccr
GW-221--U--07/21/88	1.13E-02	1.95	5.68E-04	5.55E-04	0.98	-0.757	-1.474	8.30	Ccr
GW-221--U--08/14/89	5.27E-03	2.28	5.52E-04	5.57E-04	1.01	-0.300	-0.547	-1.91	Ccr
GW-221--U--10/11/88	1.11E-03	2.96	5.52E-04	5.60E-04	1.01	0.222	0.500	7.26	Ccr
GW-221--U--10/12/89	5.65E-03	2.25	5.67E-04	5.53E-04	0.98	-0.234	-0.441	-2.80	Ccr
GW-222--F--10/22/87	1.68E-03	2.78	7.03E-04	2.78E-04	0.40	0.178	0.021	-6.48	Cmn
GW-222--U--10/22/87	1.68E-03	2.78	7.12E-04	3.28E-04	0.46	0.182	0.095	-3.42	Cmn
GW-223--F--03/08/88	7.95E-03	2.10	1.07E-03	2.81E-04	0.26	0.002	-0.515	-3.75	Cmn
GW-223--F--03/08/88	7.95E-03	2.10	1.07E-03	2.78E-04	0.26	0.002	-0.520	-3.56	Cmn
GW-223--F--08/12/87	6.34E-03	2.20	1.53E-03	3.05E-04	0.20	0.471	0.305	0.52	Cmn
GW-223--F--08/18/88	6.37E-02	1.20	1.54E-03	3.85E-04	0.25	-0.539	-1.619	2.90	Cmn
GW-223--F--10/13/89	5.58E-02	1.25	1.82E-03	4.25E-04	0.23	-0.158	-0.898	-6.57	Cmn
GW-223--F--10/13/89	5.49E-02	1.26	1.97E-03	4.48E-04	0.23	-0.131	-0.855	-1.99	Cmn
GW-223--F--10/22/87	2.75E-02	1.56	1.37E-03	2.81E-04	0.21	-0.152	-0.933	-8.30	Cmn
GW-223--U--03/08/88	7.95E-03	2.10	1.05E-03	2.73E-04	0.26	-0.005	-0.534	-4.55	Cmn
GW-223--U--03/08/88	7.93E-03	2.10	1.14E-03	2.88E-04	0.25	0.027	-0.480	-1.78	Cmn
GW-223--U--08/12/87	6.33E-03	2.20	1.53E-03	3.32E-04	0.22	0.470	0.340	1.70	Cmn
GW-223--U--08/18/88	6.37E-02	1.20	1.56E-03	3.85E-04	0.25	-0.534	-1.616	3.12	Cmn
GW-223--U--10/13/89	5.56E-02	1.26	1.97E-03	4.21E-04	0.21	-0.125	-0.871	-3.22	Cmn
GW-223--U--10/13/89	5.49E-02	1.26	1.97E-03	4.48E-04	0.23	-0.131	-0.855	-2.03	Cmn
GW-223--U--10/22/87	2.74E-02	1.56	1.45E-03	3.35E-04	0.23	-0.130	-0.836	-5.07	Cmn
GW-223--U--10/26/88	2.58E+05	-5.41?	1.96E-03	4.35E-04	0.22	-7.051	-14.705	5.05	Cmn
GW-225--U--11/11/88	1.76E+00	-0.24?	2.60E-03	8.07E-04	0.31	-1.347	-3.178	6.88	Cmn
GW-226--F--03/29/89	3.75E-02	1.43	2.46E-03	8.02E-04	0.33	0.404	0.372	2.57	Cmn
GW-226--F--04/25/88	3.47E-02	1.46	2.58E-03	8.76E-04	0.34	0.390	0.360	8.96	Cmn
GW-226--F--05/20/86	5.63E-02	1.25	2.45E-03	8.16E-04	0.33	0.362	0.289	-4.65	Cmn
GW-226--F--07/24/89	9.53E-02	1.02	2.72E-03	8.15E-04	0.30	0.114	-0.229	6.36	Cmn
GW-226--F--09/19/89	1.39E-01	0.86	2.70E-03	8.00E-04	0.30	0.014	-0.449	-1.94	Cmn
GW-226--F--09/20/88	2.90E-01	0.54	1.92E-03	6.86E-04	0.36	-0.596	-1.583	-8.46	Cmn
GW-226--F--10/30/87	8.03E-03	2.10	2.57E-03	8.40E-04	0.33	1.147	1.855	1.68	Cmn
GW-226--F--11/21/88	5.53E-01	0.26	2.47E-03	7.88E-04	0.32	-0.874	-2.221	4.14	Cmn
GW-226--F--11/21/88	8.77E-01	0.06	2.46E-03	7.87E-04	0.32	-1.070	-2.610	5.17	Cmn
GW-226--F--12/14/89	8.68E-02	1.06	2.51E-03	8.11E-04	0.32	0.006	-0.584	-3.95	Cmn
GW-226--U--03/29/89	3.73E-02	1.43	2.59E-03	8.44E-04	0.33	0.425	0.413	5.42	Cmn
GW-226--U--04/25/88	3.48E-02	1.46	2.48E-03	8.35E-04	0.34	0.374	0.235	5.86	Cmn
GW-226--U--05/20/86	5.65E-02	1.25	2.31E-03	7.98E-04	0.35	0.338	0.257	-7.30	Cmn
GW-226--U--07/24/89	9.51E-02	1.02	2.70E-03	9.06E-04	0.34	0.110	-0.187	8.20	Cmn

	Pco2 (atm)	-LOG(Pco2)	a (Ca)	a (Mg)	Mg/Ca	SI(cal)	SI(dol)	Balance	Fm
GW-226--U--09/02/86	5.41E-02	1.27	2.31E-03	7.98E-04	0.35	0.319	0.220	-5.31	Cmn
GW-226--U--09/19/89	1.39E-01	0.86	2.69E-03	8.45E-04	0.31	0.013	-0.427	-1.10	Cmn
GW-226--U--09/20/88	2.90E-01	0.54	1.93E-03	6.86E-04	0.36	-0.596	-1.583	-8.44	Cmn
GW-226--U--10/30/86	7.98E-03	2.10	2.51E-03	8.89E-04	0.35	1.134	1.864	3.05	Cmn
GW-226--U--11/21/88	8.76E-01	0.06	2.46E-03	8.58E-04	0.35	-1.072	-2.575	5.94	Cmn
GW-226--U--11/21/88	5.50E-01	0.26	2.59E-03	9.24E-04	0.36	-0.856	-2.137	8.16	Cmn
GW-226--U--12/14/89	8.63E-02	1.06	2.77E-03	8.47E-04	0.31	0.045	-0.529	0.82	Cmn
GW-227--F--05/20/86	2.56E-02	1.59	2.20E-03	6.58E-04	0.30	0.128	-0.253	6.12	Cmn
GW-227--F--09/25/89	2.27E-02	1.64	1.82E-03	5.34E-04	0.29	0.002	-0.508	4.17	Cmn
GW-227--U--05/20/86	2.56E-02	1.59	2.20E-03	6.34E-04	0.29	0.129	-0.269	5.41	Cmn
GW-227--U--09/25/89	2.27E-02	1.64	1.82E-03	5.08E-04	0.28	0.003	-0.528	3.35	Cmn
GW-227--U--12/14/89	2.83E-02	1.55	2.17E-03	6.75E-04	0.31	0.008	-0.570	-0.05	Cmn
GW-228--F--05/20/86	7.08E-03	2.15	8.76E-04	8.35E-04	0.95	-0.059	-0.150	-4.32	Cmn
GW-228--F--09/05/86	1.05E-02	1.98	1.53E-03	1.00E-03	0.65	0.354	0.513	1.31	Cmn
GW-228--F--09/25/89	1.82E-02	1.74	2.15E-03	9.98E-04	0.46	0.387	0.469	6.67	Cmn
GW-228--F--11/03/87	1.13E-02	1.95	2.03E-03	1.02E-03	0.50	0.608	0.969	9.58	Cmn
GW-228--F--12/14/89	8.88E-03	2.05	2.12E-03	1.03E-03	0.49	0.558	0.719	6.49	Cmn
GW-228--U--09/05/86	1.05E-02	1.98	1.60E-03	1.02E-03	0.64	0.372	0.538	3.29	Cmn
GW-228--U--09/25/89	1.82E-02	1.74	2.15E-03	9.99E-04	0.46	0.387	0.469	6.43	Cmn
GW-229--F--04/26/88	1.91E-01	0.72	2.65E-03	7.93E-04	0.30	-0.264	-1.006	3.99	Cmn
GW-229--F--07/08/88	9.75E-02	1.01	3.03E-03	8.01E-04	0.26	0.134	-0.252	9.19	Cmn
GW-229--F--07/22/89	3.25E-01	0.49	2.44E-03	6.97E-04	0.29	-0.451	-1.391	-1.90	Cmn
GW-229--F--09/19/89	2.70E-01	0.57	2.44E-03	6.72E-04	0.28	-0.321	-1.144	-4.66	Cmn
GW-229--F--10/30/87	3.24E-02	1.49	2.71E-03	6.17E-04	0.23	0.570	0.541	-1.16	Cmn
GW-229--F--11/28/88	1.41E-01	0.85	2.44E-03	6.59E-04	0.27	-0.309	-1.193	2.96	Cmn
GW-229--F--12/08/89	2.10E-01	0.68	2.53E-03	7.49E-04	0.30	-0.269	-1.033	-6.20	Cmn
GW-229--F--12/16/86	4.35E-02	1.36	2.43E-03	6.51E-04	0.27	0.439	0.343	-4.21	Cmn
GW-229--U--01/08/89	2.11E-01	0.68	2.40E-03	7.55E-04	0.31	-0.290	-1.050	-8.49	Cmn
GW-229--U--04/26/88	1.91E-01	0.72	2.66E-03	7.70E-04	0.29	-0.263	-1.017	3.44	Cmn
GW-229--U--07/08/88	9.75E-02	1.01	3.03E-03	8.01E-04	0.26	0.134	-0.252	9.19	Cmn
GW-229--U--07/22/89	3.26E-01	0.49	2.44E-03	6.74E-04	0.28	-0.450	-1.404	-2.63	Cmn
GW-229--U--09/19/89	2.70E-01	0.57	2.44E-03	6.72E-04	0.28	-0.321	-1.145	-4.41	Cmn
GW-229--U--10/30/87	3.23E-02	1.49	2.71E-03	6.16E-04	0.23	0.569	0.539	-1.11	Cmn
GW-229--U--11/28/88	1.40E-01	0.85	2.57E-03	6.54E-04	0.25	-0.287	-1.175	5.00	Cmn
GW-229--U--12/16/86	4.34E-02	1.36	2.41E-03	6.45E-04	0.27	0.434	0.334	-4.03	Cmn
GW-240--F--01/18/89	3.56E-03	2.45	7.10E-04	5.02E-04	0.71	-0.021	-0.182	1.21	Cmn
GW-240--F--03/08/88	4.35E-02	1.36	8.74E-04	5.45E-04	0.62	-1.009	-2.189	-0.64	Cmn
GW-240--F--04/05/89	4.52E-02	1.34	9.11E-04	4.77E-04	0.52	-0.975	-2.196	6.37	Cmn
GW-240--F--06/16/88	6.78E-03	2.17	9.27E-04	5.80E-04	0.63	-0.152	-0.458	0.10	Cmn
GW-240--F--08/09/89	7.02E-03	2.15	6.63E-04	5.15E-04	0.78	-0.313	-0.694	-1.83	Cmn
GW-240--F--08/13/87	6.99E-03	2.16	9.83E-04	5.77E-04	0.59	0.132	0.098	-3.38	Cmn
GW-240--F--08/13/87	7.07E-03	2.15	9.97E-04	6.03E-04	0.60	0.142	0.132	-2.11	Cmn
GW-240--F--10/22/87	1.39E-02	1.86	9.54E-04	6.64E-04	0.70	-0.236	-0.579	-2.56	Cmn

	Pco2 (atm)	-LOG(Pco2)	a (Ca)	a (Mg)	Mg/Ca	SI(cal)	SI(dol)	Balance	Fm
GW-240--F--10/27/88	9.84E-03	2.01	1.04E-03	5.98E-04	0.58	-0.153	-0.497	6.94	Cmn
GW-240--U--03/08/88	4.34E-02	1.36	8.39E-04	5.98E-04	0.71	-1.028	-2.166	0.06	Cmn
GW-240--U--04/05/89	4.52E-02	1.34	9.11E-04	4.77E-04	0.52	-0.975	-2.195	5.86	Cmn
GW-240--U--06/16/88	6.92E-03	2.16	7.31E-04	5.84E-04	0.80	-0.254	-0.553	-1.91	Cmn
GW-240--U--08/09/89	7.01E-03	2.15	6.78E-04	5.42E-04	0.80	-0.303	-0.663	-0.86	Cmn
GW-240--U--08/13/87	7.08E-03	2.15	9.83E-04	5.77E-04	0.59	0.137	0.108	-3.34	Cmn
GW-240--U--08/13/87	6.99E-03	2.16	9.99E-04	5.77E-04	0.58	0.138	0.104	-2.73	Cmn
GW-240--U--10/22/87	1.39E-02	1.86	9.54E-04	6.64E-04	0.70	-0.236	-0.579	-2.51	Cmn
GW-240--U--10/27/88	9.82E-03	2.01	1.05E-03	6.23E-04	0.59	-0.149	-0.475	9.36	Cmn
GW-241--F--03/22/88	2.47E-03	2.61	5.53E-04	5.29E-04	0.96	-0.020	-0.007	1.27	Ccr
GW-241--F--06/25/89	6.66E-03	2.18	4.28E-04	4.12E-04	0.96	-0.710	-1.389	0.77	Ccr
GW-241--F--07/13/87	2.88E-02	1.54	5.87E-04	5.53E-04	0.94	-0.928	-1.829	-2.77	Ccr
GW-241--F--08/24/88	2.91E-03	2.54	5.18E-04	5.32E-04	1.03	-0.187	-0.316	2.97	Ccr
GW-241--F--08/30/89	5.25E-03	2.28	5.35E-04	4.98E-04	0.93	-0.281	-0.532	-2.65	Ccr
GW-241--F--10/12/87	3.05E-04	3.52	5.36E-04	5.60E-04	1.04	0.823	1.700	-1.61	Ccr
GW-241--F--10/29/88	4.61E-03	2.34	5.21E-04	5.34E-04	1.02	-0.393	-0.731	2.97	Ccr
GW-241--F--10/29/88	4.60E-03	2.34	5.56E-04	5.62E-04	1.01	-0.369	-0.690	6.19	Ccr
GW-241--F--12/11/87	1.66E-03	2.78	5.18E-04	5.26E-04	1.02	0.142	0.326	-3.37	Ccr
GW-241--F--12/11/87	1.66E-03	2.78	5.58E-04	4.97E-04	0.89	0.174	0.333	-2.71	Ccr
GW-241--U--03/22/88	2.46E-03	2.61	6.20E-04	5.82E-04	0.94	0.027	0.080	7.35	Ccr
GW-241--U--07/13/87	2.88E-02	1.54	5.69E-04	5.54E-04	0.97	-0.941	-1.841	-3.43	Ccr
GW-241--U--10/29/88	4.59E-03	2.34	5.73E-04	5.60E-04	0.98	-0.470	-0.680	7.09	Ccr
GW-241--U--10/29/88	4.59E-03	2.34	5.70E-04	5.88E-04	1.03	-0.356	-0.654	8.27	Ccr
GW-241--U--12/11/87	1.65E-03	2.78	5.74E-04	5.25E-04	0.91	0.185	0.367	-0.56	Ccr
GW-241--U--12/11/87	1.65E-03	2.78	5.88E-04	5.51E-04	0.94	0.195	0.397	1.14	Ccr
GW-278--F--02/26/87	1.15E-02	1.94	1.03E-03	1.51E-04	0.15	-0.320	-1.445	-7.78	Cmn
GW-278--F--05/28/87	4.75E-02	1.32	1.16E-03	1.75E-04	0.15	-0.772	-2.300	-0.40	Cmn
GW-278--F--08/03/87	1.59E-03	2.80	1.19E-03	1.77E-04	0.15	0.773	0.783	-3.10	Cmn
GW-278--U--02/26/87	1.15E-02	1.94	1.07E-03	1.56E-04	0.15	-0.307	-1.417	-6.11	Cmn
GW-278--U--05/28/87	4.75E-02	1.32	1.16E-03	1.75E-04	0.15	-0.771	-2.300	-0.60	Cmn
GW-278--U--08/03/87	1.59E-03	2.80	1.19E-03	1.80E-04	0.15	0.773	0.790	-3.61	Cmn
GW-279--F--08/03/87	1.10E-04	3.96	5.61E-04	4.23E-04	0.75	1.277	2.503	-1.13	Cmn
GW-293--F--03/14/88	2.15E-03	2.67	7.35E-04	8.44E-04	1.15	0.373	0.817	3.54	Ccr
GW-293--F--03/14/88	2.14E-03	2.67	7.36E-04	8.45E-04	1.15	0.372	0.815	3.94	Ccr
GW-293--F--04/11/89	1.39E-02	1.86	7.76E-04	8.17E-04	1.05	-0.312	-0.545	4.60	Ccr
GW-293--F--04/11/89	1.39E-02	1.86	7.75E-04	8.17E-04	1.05	-0.305	-0.529	4.75	Ccr
GW-293--F--06/27/88	2.74E-02	1.56	7.25E-04	8.50E-04	1.17	-0.680	-1.250	4.20	Ccr
GW-293--F--06/27/88	2.74E-02	1.56	7.40E-04	8.76E-04	1.18	-0.662	-1.206	5.70	Ccr
GW-293--F--08/23/88	8.62E-03	2.06	7.20E-04	8.23E-04	1.14	-0.274	-0.516	2.41	Ccr
GW-293--F--08/23/88	4.31E-03	2.37	7.40E-04	8.48E-04	1.15	0.074	0.214	3.64	Ccr
GW-293--F--10/28/88	1.13E-02	1.95	7.59E-04	8.18E-04	1.08	-0.257	-0.445	1.88	Ccr
GW-293--F--12/22/87	1.56E-01	0.81	9.23E-04	8.30E-04	0.90	-0.249	-0.521	2.78	Ccr
GW-293--U--03/14/88	2.15E-03	2.67	7.36E-04	8.16E-04	1.11	0.374	0.803	2.64	Ccr

	Pco2 (atm)	-LOG(Pco2)	a (Ca)	a (Mg)	Mg/Ca	SI(cal)	SI(dol)	Balance	Fm
GW-293--U--03/14/88	2.14E-03	2.67	7.35E-04	8.44E-04	1.15	0.371	0.813	3.95	Ccr
GW-293--U--04/11/89	1.39E-02	1.86	7.58E-04	8.18E-04	1.08	-0.322	-0.555	4.21	Ccr
GW-293--U--04/11/89	1.39E-02	1.86	7.57E-04	8.17E-04	1.08	-0.315	-0.539	4.34	Ccr
GW-293--U--06/27/88	2.74E-02	1.56	7.40E-04	8.75E-04	1.18	-0.663	-1.208	5.60	Ccr
GW-293--U--06/27/88	2.73E-02	1.56	7.39E-04	8.74E-04	1.18	-0.673	-1.231	5.69	Ccr
GW-293--U--08/23/88	8.63E-03	2.06	7.03E-04	7.96E-04	1.13	-0.284	-0.540	0.61	Ccr
GW-293--U--08/23/88	4.32E-03	2.36	7.07E-04	7.93E-04	1.12	0.055	0.167	0.66	Ccr
GW-293--U--10/28/88	1.13E-02	1.95	7.55E-04	8.42E-04	1.12	-0.260	-0.437	3.14	Ccr
GW-298--F--01/16/89	1.36E-02	1.87	5.62E-04	6.38E-04	1.14	-0.717	-1.349	0.99	Ccr
GW-298--F--02/03/88	2.30E-03	2.64	6.31E-04	6.32E-04	1.00	0.181	0.403	0.99	Ccr
GW-298--F--04/15/89	2.58E-03	2.59	6.36E-04	6.39E-04	1.00	0.028	0.094	5.10	Ccr
GW-298--F--05/13/88	1.32E-03	2.88	5.91E-04	6.93E-04	1.17	0.366	0.863	5.07	Ccr
GW-298--F--07/28/88	3.62E-03	2.44	6.27E-04	6.60E-04	1.05	0.050	0.188	1.20	Ccr
GW-298--F--09/07/89	3.13E-03	2.50	6.52E-04	6.30E-04	0.97	0.177	0.400	-2.97	Ccr
GW-298--F--10/14/88	3.72E-03	2.43	6.27E-04	6.89E-04	1.10	-0.014	0.051	0.29	Ccr
GW-298--F--10/26/89	2.64E-03	2.58	6.48E-04	6.32E-04	0.98	0.295	0.637	-5.97	Ccr
GW-298--U--02/03/88	2.29E-03	2.64	6.48E-04	6.31E-04	0.97	0.192	0.413	2.56	Ccr
GW-298--U--04/15/89	2.57E-03	2.59	6.71E-04	6.37E-04	0.95	0.050	0.115	6.32	Ccr
GW-298--U--07/28/88	3.59E-03	2.44	7.09E-04	7.68E-04	1.08	0.100	0.301	8.43	Ccr
GW-299--F--01/16/89	3.39E-03	2.47	5.01E-04	5.34E-04	1.07	-0.378	-0.706	3.47	Ccr
GW-299--F--02/03/88	2.40E-03	2.62	5.52E-04	5.27E-04	0.95	-0.068	-0.121	0.52	Ccr
GW-299--F--04/14/89	3.38E-03	2.47	5.21E-04	5.03E-04	0.97	-0.342	-0.662	2.35	Ccr
GW-299--F--04/14/89	3.39E-03	2.47	5.38E-04	5.32E-04	0.99	-0.320	-0.604	4.65	Ccr
GW-299--F--05/13/88	1.72E-03	2.77	5.73E-04	5.29E-04	0.92	0.025	0.062	6.57	Ccr
GW-299--F--07/27/88	4.31E-03	2.37	5.19E-04	5.32E-04	1.03	-0.399	-0.732	4.61	Ccr
GW-299--F--09/01/89	2.45E-03	2.61	5.14E-04	5.28E-04	1.03	-0.062	-0.065	-2.60	Ccr
GW-299--F--09/01/89	2.45E-03	2.61	5.33E-04	5.27E-04	0.99	-0.052	-0.061	-1.96	Ccr
GW-299--F--10/14/88	1.08E-02	1.97	5.17E-04	5.35E-04	1.03	-0.865	-1.692	3.71	Ccr
GW-299--F--10/24/89	2.08E-03	2.68	5.20E-04	5.02E-04	0.97	0.064	0.158	-6.54	Ccr
GW-299--U--01/16/89	3.39E-03	2.47	5.03E-04	5.04E-04	1.00	-0.377	-0.729	1.60	Ccr
GW-299--U--02/03/88	2.40E-03	2.62	5.52E-04	5.27E-04	0.95	-0.069	-0.122	1.15	Ccr
GW-299--U--04/14/89	3.38E-03	2.47	5.21E-04	5.03E-04	0.97	-0.342	-0.662	2.41	Ccr
GW-299--U--04/14/89	3.39E-03	2.47	5.36E-04	5.61E-04	1.05	-0.322	-0.584	7.45	Ccr
GW-299--U--05/13/88	1.72E-03	2.77	5.54E-04	5.30E-04	0.96	0.011	0.049	5.39	Ccr
GW-299--U--07/27/88	4.30E-03	2.37	5.37E-04	5.31E-04	0.99	-0.385	-0.719	5.41	Ccr
GW-299--U--09/01/89	2.44E-03	2.61	5.31E-04	5.56E-04	1.05	-0.054	-0.040	-0.09	Ccr
GW-299--U--09/01/89	2.45E-03	2.61	5.49E-04	5.55E-04	1.01	-0.035	-0.016	0.96	Ccr
GW-299--U--10/14/88	1.08E-02	1.97	5.17E-04	5.35E-04	1.03	-0.865	-1.693	4.40	Ccr
GW-299--U--10/24/89	2.08E-03	2.68	5.20E-04	5.02E-04	0.97	0.064	0.158	-6.38	Ccr
GW-300--F--01/16/89	8.85E-03	2.05	4.14E-04	4.22E-04	1.02	-1.075	-2.141	1.65	Ccr
GW-300--F--02/01/88	2.39E-03	2.62	5.72E-04	5.59E-04	0.98	-0.035	-0.034	1.55	Ccr
GW-300--F--04/14/89	6.68E-03	2.18	5.39E-04	5.33E-04	0.99	-0.600	-1.153	6.14	Ccr
GW-300--F--05/12/88	7.13E-04	3.15	6.04E-04	5.84E-04	0.97	0.532	1.117	8.49	Ccr

	Pco2 (atm)	-LOG(Pco2)	a (Ca)	a (Mg)	Mg/Ca	SI(cal)	SI(dol)	Balance	Fm
GW-300--F--07/23/88	2.94E-03	2.53	4.68E-04	4.77E-04	1.02	-0.417	-0.773	5.04	Ccr
GW-300--F--09/01/89	7.08E-03	2.15	5.64E-04	5.80E-04	1.03	-0.348	-0.628	-3.18	Ccr
GW-300--F--10/11/88	6.55E-03	2.18	5.47E-04	6.13E-04	1.12	-0.411	-0.724	1.26	Ccr
GW-300--F--10/23/89	1.44E-02	1.84	5.32E-04	5.23E-04	0.98	-0.699	-1.367	-9.22	Ccr
GW-300--F--10/23/89	1.44E-02	1.84	5.32E-04	5.23E-04	0.98	-0.699	-1.367	-9.22	Ccr
GW-300--U--01/16/89	8.85E-03	2.05	4.33E-04	4.22E-04	0.97	-1.056	-2.123	2.75	Ccr
GW-300--U--02/01/88	2.40E-03	2.62	5.55E-04	5.30E-04	0.95	-0.047	-0.068	-0.66	Ccr
GW-300--U--04/14/89	6.68E-03	2.18	5.20E-04	5.33E-04	1.03	-0.615	-1.168	6.72	Ccr
GW-300--U--05/12/88	7.14E-04	3.15	5.87E-04	5.55E-04	0.95	0.521	1.084	6.33	Ccr
GW-300--U--07/23/88	2.93E-03	2.53	4.85E-04	5.06E-04	1.04	-0.402	-0.733	7.97	Ccr
GW-300--U--09/01/89	7.05E-03	2.15	6.15E-04	6.36E-04	1.03	-0.312	-0.554	1.39	Ccr
GW-300--U--10/11/88	6.55E-03	2.18	5.47E-04	6.13E-04	1.12	-0.411	-0.724	0.97	Ccr
GW-300--U--10/23/89	1.44E-02	1.84	5.30E-04	5.53E-04	1.04	-0.701	-1.345	-7.55	Ccr
GW-300--U--10/23/89	1.44E-02	1.84	5.30E-04	5.53E-04	1.04	-0.701	-1.345	-7.55	Ccr
GW-306--F----1/14/91	3.08E-02	1.51	2.12E-03	4.21E-04	0.20	0.021	-0.628	4.56	Cmn
GW-306--F----4/26/91	3.00E-02	1.52	1.58E-03	3.89E-04	0.25	-0.068	-0.686	-1.39	Cmn
GW-306--F--05/09/89	4.04E-02	1.39	1.70E-03	3.58E-04	0.21	-0.345	-1.328	2.79	Cmn
GW-306--F--05/09/89	4.04E-02	1.39	1.70E-03	3.58E-04	0.21	-0.345	-1.328	2.79	Cmn
GW-306--U----1/14/91	3.08E-02	1.51	2.12E-03	4.21E-04	0.20	0.021	-0.628	4.46	Cmn
GW-306--U----4/26/91	2.99E-02	1.52	1.60E-03	4.13E-04	0.26	-0.063	-0.656	0.60	Cmn
GW-309--F--02/09/88	1.47E-01	0.83	2.95E-03	5.64E-04	0.19	-0.149	-0.981	-0.52	Cmn
GW-309--F--02/09/88	1.47E-01	0.83	2.95E-03	5.64E-04	0.19	-0.149	-0.981	-0.52	Cmn
GW-309--F--11/22/89	1.17E-01	0.93	2.84E-03	5.98E-04	0.21	-0.111	-0.892	0.39	Cmn
GW-309--U--02/09/88	1.47E-01	0.83	2.96E-03	5.64E-04	0.19	-0.149	-0.980	-0.77	Cmn
GW-309--U--02/09/88	1.47E-01	0.83	2.96E-03	5.64E-04	0.19	-0.149	-0.980	-0.77	Cmn
GW-309--U--11/22/89	1.17E-01	0.93	2.48E-03	5.75E-04	0.23	-0.110	-0.908	0.05	Cmn
GW-313--F--03/08/88	1.65E-02	1.78	1.84E-03	5.90E-04	0.32	0.290	0.118	6.83	Cmn
GW-313--F--08/01/88	4.43E-02	1.35	1.84E-03	5.35E-04	0.29	-0.023	-0.522	3.83	Cmn
GW-313--U--03/08/88	1.65E-02	1.78	1.84E-03	5.90E-04	0.32	0.290	0.118	6.89	Cmn
GW-313--U--05/11/88	1.76E-01	0.76	1.99E-03	5.57E-04	0.28	-0.591	-1.675	8.44	Cmn
GW-313--U--08/01/88	4.42E-02	1.35	1.83E-03	5.61E-04	0.31	-0.033	-0.504	4.65	Cmn
GW-314--F--08/01/88	2.78E-02	1.56	1.42E-03	5.59E-04	0.39	-0.080	-0.495	5.49	Cmn
GW-314--U--08/01/88	2.78E-02	1.56	1.45E-03	5.85E-04	0.40	-0.072	-0.468	7.18	Cmn
GW-315--F--03/07/88	4.41E-03	2.36	1.36E-03	4.00E-04	0.29	0.438	0.405	7.84	Cmn
GW-315--U--03/07/88	4.41E-03	2.36	1.36E-03	4.00E-04	0.29	0.438	0.405	7.88	Cmn
GW-316--F--08/02/88	2.82E-02	1.55	9.00E-04	6.40E-04	0.71	-0.552	-1.200	3.96	Cmn
GW-316--F--08/02/88	2.81E-02	1.55	9.32E-04	6.38E-04	0.68	-0.517	-1.138	5.93	Cmn
GW-316--F--10/13/88	2.03E-02	1.69	7.80E-04	5.93E-04	0.76	-0.574	-1.222	4.98	Cmn
GW-316--U--03/07/88	3.03E-03	2.52	1.20E-03	7.32E-04	0.61	0.532	0.857	10.00	Cmn
GW-316--U--08/02/88	2.82E-02	1.55	8.99E-04	6.40E-04	0.71	-0.552	-1.201	4.56	Cmn
GW-316--U--08/02/88	2.81E-02	1.55	9.15E-04	6.39E-04	0.70	-0.524	-1.145	5.29	Cmn
GW-316--U--10/13/88	2.03E-02	1.69	7.64E-04	5.94E-04	0.78	-0.583	-1.230	3.82	Cmn
GW-317--F--03/07/88	1.23E-03	2.91	7.27E-04	5.12E-04	0.70	0.576	1.041	-1.98	Cmn

	Pco2 (atm)	-LOG(Pco2)	a (Ca)	a (Mg)	Mg/Ca	SI(cal)	SI(dol)	Balance	Fm
GW-317--F--03/07/88	1.13E-03	2.95	7.94E-04	5.42E-04	0.68	0.574	1.025	4.47	Cmn
GW-317--F--05/10/88	1.22E-02	1.91	5.99E-04	6.36E-04	1.06	-0.502	-0.930	-1.50	Cmn
GW-317--F--05/17/89	2.37E-03	2.63	8.24E-04	6.25E-04	0.76	0.314	0.553	9.18	Cmn
GW-317--F--08/01/88	5.12E-03	2.29	7.87E-04	5.64E-04	0.72	0.098	0.118	1.05	Cmn
GW-317--F--10/13/88	3.68E-03	2.43	7.55E-04	5.38E-04	0.71	0.088	0.081	7.20	Cmn
GW-317--U--03/07/88	1.23E-03	2.91	7.11E-04	4.82E-04	0.68	0.566	1.008	-3.32	Cmn
GW-317--U--03/07/88	1.13E-03	2.95	8.11E-04	5.41E-04	0.67	0.583	1.032	5.75	Cmn
GW-317--U--05/17/89	2.37E-03	2.63	7.41E-04	5.72E-04	0.77	0.270	0.472	3.72	Cmn
GW-317--U--08/01/88	5.10E-03	2.29	8.53E-04	5.89E-04	0.69	0.132	0.169	4.99	Cmn
GW-317--U--10/13/88	3.67E-03	2.44	8.23E-04	5.94E-04	0.72	0.124	0.158	9.34	Cmn
GW-322--F--01/05/89	9.34E-03	2.03	5.48E-04	6.15E-04	1.12	-0.711	-1.357	6.66	Ccr
GW-322--F--03/12/88	6.91E-04	3.16	5.37E-04	5.29E-04	0.99	0.395	0.828	3.58	Ccr
GW-322--F--04/03/89	3.70E-03	2.43	5.88E-04	6.18E-04	1.05	-0.235	-0.404	8.68	Ccr
GW-322--F--04/03/89	3.71E-03	2.43	6.06E-04	6.17E-04	1.02	-0.216	-0.378	9.50	Ccr
GW-322--F--06/07/88	1.86E-03	2.73	5.49E-04	5.88E-04	1.07	0.093	0.279	6.23	Ccr
GW-322--F--08/05/88	6.09E-03	2.22	5.88E-04	5.88E-04	1.00	-0.371	-0.679	6.61	Ccr
GW-322--F--08/05/88	4.70E-03	2.33	5.71E-04	5.89E-04	1.03	-0.330	-0.595	6.66	Ccr
GW-322--F--08/11/89	3.63E-03	2.44	5.87E-04	5.80E-04	0.99	-0.010	0.034	-2.88	Ccr
GW-322--F--10/11/89	5.01E-03	2.30	5.86E-04	5.77E-04	0.98	-0.104	-0.170	-8.48	Ccr
GW-322--F--10/24/88	1.85E-02	1.73	5.34E-04	5.59E-04	1.05	-1.016	-1.990	3.38	Ccr
GW-322--U--01/05/89	9.35E-03	2.03	5.50E-04	5.86E-04	1.07	-0.709	-1.376	5.06	Ccr
GW-322--U--03/12/88	6.91E-04	3.16	5.35E-04	5.59E-04	1.04	0.393	0.848	5.72	Ccr
GW-322--U--04/03/89	3.71E-03	2.43	5.88E-04	6.18E-04	1.05	-0.229	-0.390	8.94	Ccr
GW-322--U--04/03/89	3.70E-03	2.43	6.06E-04	6.17E-04	1.02	-0.222	-0.393	9.42	Ccr
GW-322--U--08/11/89	3.63E-03	2.44	5.89E-04	5.51E-04	0.94	-0.008	0.013	-4.15	Ccr
GW-322--U--10/11/89	5.01E-03	2.30	5.86E-04	5.77E-04	0.98	-0.104	-0.170	-8.55	Ccr
GW-322--U--10/24/88	1.84E-02	1.74	5.52E-04	5.58E-04	1.01	-1.002	-1.976	4.13	Ccr
GW-323--F--03/08/88	1.99E-03	2.70	7.11E-04	7.41E-04	1.04	0.359	0.770	3.54	Ccr
GW-323--F--05/12/88	1.58E-02	1.80	7.64E-04	7.66E-04	1.00	-0.495	-0.945	7.06	Ccr
GW-323--F--08/02/88	8.14E-03	2.09	7.30E-04	7.70E-04	1.05	-0.144	-0.200	5.68	Ccr
GW-323--F--10/13/88	3.18E-02	1.50	7.12E-04	7.97E-04	1.12	-0.870	-1.679	5.74	Ccr
GW-323--U--03/08/88	1.99E-03	2.70	1.09E-03	2.84E-04	0.26	0.544	0.538	8.37	Ccr
GW-323--U--05/12/88	1.58E-02	1.80	8.01E-04	7.08E-04	0.88	-0.474	-0.958	6.41	Ccr
GW-323--U--08/02/88	8.13E-03	2.09	7.47E-04	7.69E-04	1.03	-0.134	-0.192	6.31	Ccr
GW-323--U--10/13/88	3.18E-02	1.50	7.29E-04	7.96E-04	1.09	-0.860	-1.669	6.36	Ccr
GW-350--F--09/06/88	2.46E-02	1.61	1.10E-03	1.39E-04	0.13	-0.520	-1.884	-5.29	Cmn
GW-350--F--09/11/89	6.97E-02	1.16	1.41E-03	1.72E-04	0.12	-0.772	-2.411	0.57	Cmn
GW-350--F--12/06/89	5.57E-02	1.25	1.20E-03	1.72E-04	0.14	-0.744	-2.285	-6.77	Cmn
GW-350--U--09/06/88	2.46E-02	1.61	1.10E-03	1.39E-04	0.13	-0.520	-1.884	-5.59	Cmn
GW-350--U--09/11/89	6.98E-02	1.16	1.40E-03	1.72E-04	0.12	-0.777	-2.415	-0.05	Cmn
GW-350--U--12/06/89	5.58E-02	1.25	1.17E-03	1.69E-04	0.14	-0.756	-2.303	-8.17	Cmn
GW-365--F--09/18/89	3.08E-02	1.51	1.93E-03	5.91E-04	0.31	0.016	-0.432	-1.09	Cmn
GW-365--F--09/21/88	3.87E-02	1.41	1.58E-03	5.38E-04	0.34	-0.411	-1.260	-2.77	Cmn

	Pco2	-LOG(Pco2)	a (Ca)	a (Mg)	Mg/Ca	SI(cal)	SI(dol)	Balance	Fm
	(atm)								
GW-365--F--09/21/88	3.97E-02	1.40	1.61E-03	5.62E-04	0.35	-0.391	-1.205	-1.61	Cmn
GW-365--F--12/13/89	2.43E-02	1.61	1.93E-03	6.21E-04	0.32	0.041	-0.402	5.33	Cmn
GW-365--U--09/18/89	3.08E-02	1.51	1.93E-03	5.91E-04	0.31	0.015	-0.433	-0.76	Cmn
GW-365--U--09/21/88	3.88E-02	1.41	1.50E-03	5.40E-04	0.36	-0.432	-1.278	-4.57	Cmn
GW-365--U--09/21/88	3.97E-02	1.40	1.58E-03	5.63E-04	0.36	-0.399	-1.212	-2.25	Cmn
GW-365--U--12/13/89	2.43E-02	1.61	1.93E-03	6.22E-04	0.32	0.041	-0.402	5.06	Cmn
GW-511--F--01/09/89	2.72E-06	5.56?	3.39E-04	3.27E-04	0.96	1.379	2.779	-1.13	Ccr
GW-511--F--04/04/89	4.50E-05	4.35?	2.79E-04	3.57E-04	1.28	0.902	1.940	-7.77	Ccr
GW-511--F--08/10/89	6.03E-05	4.22?	3.76E-04	3.25E-04	0.86	0.971	1.918	-4.55	Ccr
GW-511--F--10/06/89	1.53E-04	3.82	4.13E-04	3.83E-04	0.93	0.805	1.610	-7.29	Ccr
GW-511--U--04/04/89	4.42E-05	4.35?	3.77E-04	3.54E-04	0.94	1.023	2.051	-1.13	Ccr
GW-511--U--08/10/89	6.03E-05	4.22?	3.76E-04	3.24E-04	0.86	0.971	1.918	-4.55	Ccr
GW-511--U--10/06/89	1.53E-04	3.82	4.14E-04	3.52E-04	0.85	0.807	1.575	-7.95	Ccr
GW-513--F--01/28/89	4.15E-03	2.38	6.02E-04	6.42E-04	1.07	-0.185	-0.302	3.91	Ccr
GW-513--F--01/28/89	4.15E-03	2.38	6.19E-04	6.41E-04	1.04	-0.166	-0.275	4.83	Ccr
GW-513--F--06/05/89	6.63E-03	2.18	6.70E-04	6.66E-04	0.99	-0.280	-0.501	8.52	Ccr
GW-513--F--08/22/89	4.89E-03	2.31	6.18E-04	6.38E-04	1.03	-0.070	-0.072	-2.17	Ccr
GW-513--F--12/03/88	1.81E-04	3.74	5.79E-04	6.13E-04	1.06	1.024	2.104	2.92	Ccr
GW-513--F--12/03/88	4.89E-04	3.31	6.03E-04	6.14E-04	1.02	0.674	1.389	5.04	Ccr
GW-513--U--01/28/89	4.15E-03	2.38	6.19E-04	6.41E-04	1.04	-0.173	-0.291	5.20	Ccr
GW-513--U--01/28/89	4.15E-03	2.38	6.19E-04	6.41E-04	1.04	-0.167	-0.276	5.28	Ccr
GW-513--U--06/05/89	6.63E-03	2.18	6.70E-04	6.66E-04	0.99	-0.280	-0.501	8.38	Ccr
GW-513--U--08/22/89	4.88E-03	2.31	6.35E-04	6.37E-04	1.00	-0.059	-0.063	-1.23	Ccr
GW-513--U--11/04/89	1.04E-02	1.98	6.66E-04	6.29E-04	0.94	-0.381	-0.772	-4.27	Ccr
GW-513--U--12/03/88	1.81E-04	3.74	5.61E-04	5.83E-04	1.04	1.012	2.073	2.25	Ccr
GW-513--U--12/03/88	4.90E-04	3.31	5.67E-04	5.85E-04	1.03	0.649	1.343	2.93	Ccr
GW-521--F--09/08/89	5.25E-03	2.28	5.33E-04	5.58E-04	1.05	-0.300	-0.524	-1.39	Ccr
GW-521--U--09/08/89	5.25E-03	2.28	5.33E-04	5.58E-04	1.05	-0.300	-0.524	-1.33	Ccr
GW-603---F--01/31/92	1.80E-02	1.75	1.23E-03	6.44E-04	0.52	-0.040	-0.950	-2.17	Cmn
GW-603---F--04/26/92	1.40E-02	1.85	1.20E-03	5.92E-04	0.49	0.020	-0.230	-2.02	Cmn
GW-603---U--01/31/92	1.80E-02	1.75	1.26E-03	6.42E-04	0.51	-0.030	-0.320	-1.35	Cmn
GW-603---U--04/26/92	1.39E-02	1.86	1.23E-03	6.17E-04	0.50	0.030	-0.200	-0.24	Cmn
GW-603--F-----9/1/91	2.74E-04	3.56	1.51E-04	7.92E-05	0.52	-1.406	-3.342	4.41	Cmn
GW-603--F----1/26/91	2.72E-02	1.56	1.23E-03	5.92E-04	0.48	-0.283	-0.861	0.25	Cmn
GW-603--F----11/3/91	2.48E-02	1.61	1.21E-03	5.97E-04	0.49	-0.319	-0.910	4.72	Cmn
GW-603--F----4/22/91	2.88E-02	1.54	1.22E-03	5.85E-04	0.48	-0.236	-0.750	-3.28	Cmn
GW-603--U-----9/1/91	2.52E-03	2.60	1.31E-03	6.43E-04	0.49	0.739	1.207	7.55	Cmn
GW-603--U----1/26/91	2.71E-02	1.57	1.23E-03	6.18E-04	0.50	-0.286	-0.847	0.97	Cmn
GW-603--U----1/26/91	2.71E-02	1.57	1.25E-03	6.17E-04	0.49	-0.279	-0.841	1.39	Cmn
GW-603--U----11/3/91	2.48E-02	1.61	1.16E-03	5.99E-04	0.52	-0.337	-0.928	3.28	Cmn
GW-603--U----4/22/91	2.89E-02	1.54	1.15E-03	5.66E-04	0.49	-0.258	-0.785	-6.01	Cmn
GW-604--F-----9/1/91	1.83E-04	3.74	9.64E-05	5.91E-05	0.61	-1.780	-4.010	4.35	Cmn
GW-604--F----1/26/91	1.94E-02	1.71	7.60E-04	4.85E-04	0.64	-0.620	-1.410	-3.76	Cmn

	Pco2 (atm)	-LOG(Pco2)	a (Ca)	a (Mg)	Mg/Ca	SI(cal)	SI(dol)	Balance	Fm
GW-604--F----11/3/91	1.70E-02	1.77	7.51E-04	4.57E-04	0.61	-0.700	-1.600	0.77	Cmn
GW-604--F----4/22/91	2.28E-02	1.64	9.12E-04	5.01E-04	0.55	-0.450	-1.110	-4.43	Cmn
GW-604--U-----9/1/91	1.73E-03	2.76	8.64E-04	5.09E-04	0.59	0.406	0.629	6.93	Cmn
GW-604--U----1/26/91	1.94E-02	1.71	8.06E-04	5.09E-04	0.63	-0.600	-1.368	-0.54	Cmn
GW-604--U----11/3/91	1.69E-02	1.77	7.81E-04	4.83E-04	0.62	-0.689	-1.563	3.39	Cmn
GW-604--U----4/22/91	2.28E-02	1.64	8.88E-04	4.98E-04	0.56	-0.461	-1.127	-5.08	Cmn
GW-621---F----3/20/91	1.67E-02	1.78	1.05E-03	2.76E-04	0.26	-0.523	-1.586	7.20	Cmn
GW-621---U*-06/16/92	1.33E-02	1.88	9.79E-04	2.91E-04	0.30	-0.460	-1.390	2.67	Cmn
GW-621--F*--06/16/92	1.33E-02	1.88	9.83E-04	2.89E-04	0.29	-0.450	-1.390	2.35	Cmn
GW-621--F----3/20/91	1.68E-02	1.78	1.05E-03	2.72E-04	0.26	-0.530	-1.590	6.67	Cmn
GW-621--F----9/10/91	1.71E-03	2.77	1.16E-03	3.24E-04	0.28	0.520	0.520	7.46	Cmn
GW-621--U----9/10/91	1.71E-03	2.77	1.15E-03	3.22E-04	0.28	0.512	0.511	7.44	Cmn
GW-621--U---11/16/91	1.61E-02	1.79	1.08E-03	3.27E-04	0.30	-0.542	-1.564	9.67	Cmn
GW-683--F*--06/15/92	1.20E-02	1.92	1.14E-03	4.88E-04	0.43	-0.250	-0.820	4.50	Ccr
GW-683--F----5/24/91	1.74E-01	0.76	1.08E-03	4.42E-04	0.41	-1.510	-3.360	9.13	Ccr
GW-683--F----9/19/91	2.09E-03	2.68	1.42E-03	6.08E-04	0.43	0.680	1.020	9.29	Ccr
GW-683--F---12/12/91	1.53E-02	1.81	8.87E-04	4.19E-04	0.47	-0.680	-1.650	5.21	Ccr
GW-683--U*--03/26/92	4.71E-03	2.33	7.32E-04	4.31E-04	0.59	-0.270	-0.740	3.59	Ccr
GW-683--U----5/24/91	1.75E-01	0.76	9.31E-04	4.47E-04	0.48	-1.571	-3.421	3.88	Ccr
GW-683--U---12/12/91	1.43E-02	1.84	8.86E-04	4.19E-04	0.47	-0.676	-1.653	5.05	Ccr
GW-684---F--03/27/92	5.53E-04	3.26	5.64E-04	3.69E-04	0.65	0.480	0.810	1.78	Cmn
GW-684--F----5/30/91	1.75E-01	0.76	1.01E-03	3.84E-04	0.38	-1.530	-3.450	4.27	Cmn
GW-684--F---12/12/91	1.36E-02	1.87	6.79E-04	3.37E-04	0.50	-0.830	-1.930	4.92	Cmn
GW-684--U----5/30/91	1.75E-01	0.76	1.01E-03	3.83E-04	0.38	-1.535	-3.451	5.29	Cmn
GW-684--U---03/27/92	5.53E-04	3.26	5.64E-04	3.69E-04	0.65	0.480	0.800	1.28	Cmn
GW-684--U---12/12/91	1.36E-02	1.87	6.61E-04	3.37E-04	0.51	-0.840	-1.940	4.15	Cmn
GW-685---F--06/14/92	1.35E-02	1.87	1.23E-03	6.11E-04	0.50	0.060	-0.130	-1.48	Cmn
GW-685--F-----6/1/91	2.67E-02	1.57	1.33E-03	6.85E-04	0.52	-0.180	-0.590	4.34	Cmn
GW-685--F----9/18/91	2.68E-02	1.57	1.30E-03	6.61E-04	0.51	-0.210	-0.670	1.89	Cmn
GW-685--F---12/12/91	2.61E-02	1.58	1.26E-03	5.83E-04	0.46	-0.280	-0.860	-1.50	Cmn
GW-685--U*--06/14/92	1.35E-02	1.87	1.29E-03	6.05E-04	0.47	0.080	-0.120	0.45	Cmn
GW-685--U-----6/1/91	2.67E-02	1.57	1.36E-03	6.55E-04	0.48	-0.171	-0.597	4.17	Cmn
GW-685--U----9/18/91	2.68E-02	1.57	1.32E-03	6.60E-04	0.50	-0.207	-0.662	2.27	Cmn
GW-685--U---12/12/91	2.62E-02	1.58	1.23E-03	5.57E-04	0.45	-0.287	-0.887	-2.95	Cmn
GW-694--F*--03/24/92	1.60E-02	1.80	1.27E-03	4.58E-04	0.36	-0.300	-1.010	5.88	Cmn
GW-694--F----6/19/91	2.20E-02	1.66	1.40E-03	5.04E-04	0.36	-0.290	-0.990	6.83	Cmn
GW-694--F---11/22/91	2.17E-02	1.66	1.67E-03	5.41E-04	0.32	-0.250	-0.970	8.22	Cmn
GW-694--U*--03/24/92	1.60E-02	1.80	1.25E-03	4.59E-04	0.37	-0.300	-1.020	5.11	Cmn
GW-694--U----6/19/91	2.20E-02	1.66	1.40E-03	5.04E-04	0.36	-0.294	-0.989	7.37	Cmn
GW-695---F--06/21/92	8.74E-04	3.06	5.74E-04	5.68E-04	0.99	0.520	1.080	-0.28	Cmn
GW-695---U*-06/21/92	8.75E-04	3.06	5.34E-04	5.06E-04	0.95	0.490	1.000	2.75	Cmn
GW-695--F----6/18/91	1.52E-04	3.82	3.10E-04	3.54E-04	1.14	0.910	1.920	-1.53	Cmn
GW-695--F----9/13/91	1.61E-03	2.79	4.07E-04	4.19E-04	1.03	0.070	0.220	3.67	Cmn

	Pco2 (atm)	-LOG(Pco2)	a (Ca)	a (Mg)	Mg/Ca	SI(cal)	SI(dol)	Balance	Fm
GW-695--F---11/22/91	1.63E-04	3.79	3.16E-04	3.64E-04	1.15	0.890	1.850	-6.21	Cmn
GW-695--U----6/18/91	1.50E-04	3.82	4.44E-04	3.52E-04	0.79	1.056	2.057	2.43	Cmn
GW-695--U---11/22/91	1.59E-04	3.80	5.62E-04	3.54E-04	0.63	1.127	2.067	6.53	Cmn
GW-703---F*-03/24/92	1.10E-02	1.96	5.29E-04	7.45E-04	1.41	-0.660	-1.160	2.26	Cmn
GW-703--F----6/18/91	1.72E-03	2.77	5.94E-04	6.03E-04	1.02	0.240	0.710	-2.15	Cmn
GW-703--F----9/11/91	1.80E-03	2.75	8.01E-04	6.21E-04	0.78	0.400	0.720	3.50	Cmn
GW-703--F---11/18/91	1.75E-03	2.76	8.45E-04	7.31E-04	0.87	0.390	0.750	9.71	Cmn
GW-703---U*-03/24/92	1.10E-02	1.96	5.27E-04	7.72E-04	1.46	-0.660	-1.150	2.97	Cmn
GW-703--U----6/18/91	1.72E-03	2.77	6.11E-04	6.02E-04	0.99	0.253	0.546	-1.73	Cmn
GW-703--U----9/11/91	1.79E-03	2.75	8.32E-04	6.47E-04	0.78	0.404	0.746	5.70	Cmn
GW-704---F--03/23/92	3.86E-03	2.41	9.66E-04	7.10E-04	0.73	0.148	0.175	-4.08	Cmn
GW-704--F----6/20/91	1.63E-03	2.79	6.34E-04	7.65E-04	1.21	0.230	0.590	3.71	Cmn
GW-704--F----9/12/91	1.88E-03	2.72	9.09E-04	6.94E-04	0.76	0.470	0.860	4.96	Cmn
GW-704--F---11/19/91	1.90E-03	2.72	9.39E-04	7.47E-04	0.80	0.470	0.890	5.99	Cmn
GW-704---U--03/23/92	3.86E-03	2.41	9.48E-04	7.11E-04	0.75	0.140	0.168	-4.67	Cmn
GW-704--U----6/20/91	1.63E-03	2.79	6.35E-04	7.08E-04	1.11	0.234	0.555	1.90	Cmn
GW-704--U----9/12/91	1.88E-03	2.72	9.24E-04	6.92E-04	0.75	0.473	0.868	5.25	Cmn
GW-704--U---11/19/91	1.90E-03	2.72	9.33E-04	7.42E-04	0.80	0.469	0.878	5.88	Cmn
GW-706---F*-03/23/92	4.43E-03	2.35	1.57E-03	5.45E-04	0.35	0.416	0.381	8.42	Cmn
GW-706--F----6/20/91	1.84E-03	2.74	6.59E-04	5.65E-04	0.86	0.320	0.610	-5.90	Cmn
GW-706--F----9/13/91	3.13E-02	1.50	2.16E-03	7.47E-04	0.35	0.060	-0.280	9.91	Cmn
GW-706--U*--03/23/92	4.44E-03	2.35	1.56E-03	5.45E-04	0.35	0.411	0.377	8.63	Cmn
GW-706--U----6/20/91	1.84E-03	2.74	6.59E-04	5.65E-04	0.86	0.315	0.611	-6.03	Cmn
GW-706--U----9/13/91	3.13E-02	1.50	2.16E-03	7.47E-04	0.35	0.063	-0.289	9.94	Cmn
GW-710---F--03/18/92	4.76E-03	2.32	4.83E-03	2.94E-03	0.61	0.364	0.543	-5.34	Ccr
GW-710---U--03/18/92	4.76E-03	2.32	4.91E-03	2.93E-03	0.60	0.371	0.548	-5.30	Ccr
GW-711---F--03/21/92	2.30E-03	2.64	4.55E-03	3.19E-03	0.70	0.619	1.113	-0.78	Cmn
GW-711---F--06/11/92	1.01E-02	2.00	4.82E-03	3.12E-03	0.65	0.135	0.134	-8.53	Cmn
GW-711--F---12/10/91	1.15E-02	1.94	4.13E-03	2.98E-03	0.72	-0.110	-0.310	-5.68	Cmn
GW-711--U---03/21/92	2.29E-03	2.64	4.59E-03	3.26E-03	0.71	0.621	1.122	2.27	Cmn
GW-711--U---12/10/91	1.14E-02	1.94	4.04E-03	3.09E-03	0.76	-0.114	-0.305	-4.71	Cmn
GW-712---F--03/21/92	4.39E-03	2.36	1.58E-03	1.18E-03	0.75	0.235	0.365	-4.90	Cmn
GW-712---F--06/13/92	3.60E-03	2.44	1.71E-03	1.13E-03	0.66	0.406	0.673	-7.79	Cmn
GW-712---U--03/21/92	4.40E-03	2.36	1.59E-03	1.13E-03	0.71	0.236	0.350	-5.83	Cmn
GW-712---U--06/13/92	3.60E-03	2.44	1.71E-03	1.11E-03	0.65	0.406	0.665	-8.28	Cmn
GW-722-02---F--5/27/92	3.47E-03	2.46	6.16E-05	4.65E-05	0.75	-0.378	-0.812	6.33	Cmn
GW-722-06--F---1/7/92	1.52E-03	2.82	2.64E-04	2.58E-04	0.98	0.022	0.029	3.11	Cmn
GW-722-10--F--1/20/92	1.32E-02	1.88	6.70E-04	6.96E-04	1.04	-0.476	-0.982	1.28	Cmn
GW-722-17--F--5/28/92	3.65E-02	1.44	8.17E-04	8.41E-04	1.03	-0.608	-1.131	0.41	Cmn
GW-722-20-F---1/21/92	3.86E-03	2.41	8.15E-04	8.65E-04	1.06	0.303	0.599	4.80	Cmn
GW-722-22--F--1/27/92	4.56E-02	1.34	8.25E-04	7.11E-04	0.86	-0.848	-1.818	-4.51	Cmn
GW-722-26--F--5/21/92	5.66E-03	2.25	7.80E-04	5.86E-04	0.75	-0.038	-0.137	0.85	Cmn
GW-722-30--F--1/29/92	3.21E-02	1.49	6.76E-04	4.62E-04	0.68	-1.101	-2.449	-1.47	Cmn

	Pco2 (atm)	-LOG(Pco2)	a (Ca)	a (Mg)	Mg/Ca	SI(cal)	SI(dol)	Balance	Fm
GW-722-32--F--1/29/92	2.02E-03	2.69	1.11E-03	2.95E-04	0.27	0.521	0.391	-2.39	Cmn
GW-722-33--F---2/4/92	2.04E-03	2.69	1.13E-03	2.95E-04	0.26	-0.513	-1.727	-1.19	Cmn
GW-723---F--05/27/92	8.30E-05	4.08?	3.65E-04	5.37E-04	1.47	0.693	1.590	1.79	Cmn
GW-733---U--04/28/92	1.72E-04	3.77	3.45E-04	5.28E-04	1.53	0.575	1.366	-1.35	Cmn
GW-733--F---04/28/92	1.73E-04	3.76	3.27E-04	5.31E-04	1.62	0.553	1.347	-2.37	Cmn
GW-734 --F---1/28/93	3.59E-03	2.44	6.36E-04	1.30E-04	0.20	-0.447	-1.559	-2.92	Cmn
GW-734 --U---1/28/93	3.43E-03	2.46	6.85E-04	1.83E-04	0.27	-0.435	-1.419	-2.92	Cmn
GW-734--U---3/26/92	8.91E-04	3.05	2.73E-04	1.30E-04	0.48	-0.783	-1.900	-1.36	Cmn
GW-735---U--04/28/92	3.91E-02	1.41	1.87E-03	2.23E-04	0.12	-0.133	-1.159	-1.41	Cmn
GW-735--F---04/28/92	3.91E-02	1.41	1.87E-03	2.31E-04	0.12	-0.133	-1.143	-1.27	Cmn
GW-739--F---05/27/92	1.18E-02	1.93	9.74E-04	7.42E-04	0.76	-0.123	-0.326	0.76	Cmn
GW-739--U--05/27/92	1.18E-02	1.93	9.87E-04	7.67E-04	0.78	-0.118	-0.307	2.09	Cmn
GW-740---F-06/02/92	1.34E-02	1.87	1.06E-03	8.09E-04	0.76	-0.015	-0.099	0.56	Cmn
GW-740--U---06/02/92	1.35E-02	1.87	1.03E-03	7.86E-04	0.76	-0.025	-0.120	-1.30	Cmn

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