STATISTICAL EVALUATION OF ADDITIONAL HYDROCHEMICAL DATA

FROM THE

SADDLE MOUNTAINS, WANAPUM AND GRANDE RONDE BASALTS

BASALT WASTE ISOLATION PROJECT

HANFORD SITE

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Williams and Associates, Inc.

Viola, Idaho

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1. INTRODUCTION

This report is the second of two reports in which the hydrochemical data from the Basalt Waste Isolation Project (BWIP) have been analyzed statistically. The first report (Williams and Associates, Inc., 1983) analyzed BWIP hydrochemical data obtained by the Nuclear Regulatory Commission from Rockwell Hanford Operations during the workshop held in Richland, Washington, in July 1982. These data comprise the results of chemical analyses of water samples obtained by Rockwell during their drilling and testing program at the BWIP site prior to that date. These data include analyses of samples from the Saddle Mountains, Wanapum and Grande Ronde Formations, mainly within the Hanford Site boundaries. The first data set includes few data, especially from the Grande Ronde Basalts in the vicinity of the Reference Repository Location (RRL). Isotopic data also were obtained at the July 1982 workshop but the isotopic data were not used in this study.

Additional data have been collected since the July 1982 workshop. It was deemed appropriate for the NRC to obtain these additional data for evaluation in mid 1984. The water quality sampling program was interrupted in March of 1984 in order to allow other programs to proceed without

interference.

A significant amount of data has been added to the pre-July 1982 data base. This contribution is important especially with respect to the samples collected in the vicinity of the RRL. Additional samples have been collected from the Grande Ronde Formation which increase the vertical distribution of data. The target repository horizon is the Cohassett Flow interior in the Grande Ronde Formation.

As noted in the first report (Williams and Associates, Inc., 1983), Rockwell asserted that waters in the major geologic units (Saddle Mountains, Wanapum and Grande Ronde Formations) are distinguishable on the basis of hydrochemistry (U. S. Dept. of Energy, 1982, p. 5.1-184 & 202). The purpose of the first study was to test this assertion using statistical procedures applied to Rockwell's data base. The purpose of the present study is to expand this effort using the new expanded data base.

The issue of hydrochemical distinguishability of basalt formations is important because of its implications to aquifer isolation. Rockwell states in the BWIP Site Characterization Report (U. S. Dept. of Energy, 1982, p. 5.1-139 & 5.1-184) that the differences in hydrochemical data among basalt formations constitute evidence that the basalt formations are isolated hydraulically. Specifically, Rockwell concludes in the SCR (U. S. Dept. of Energy, 1982, p. 5.1-139 & 5.1-184) that the hydrochemical data indicate that mixing of waters among basalt formations does not occur at the BWIP site. The NRC has concluded in the Draft Site Characterization Analysis (U. S. Nuclear Regulatory Commission, 1983) that many factors can influence whether or not mixing occurs among aquifers in a multilayer aquifer system.

Williams and Associates has concluded that the problem of determining whether or not mixing occurs on the basis of hydrochemical data is sufficiently complex that the problem must be broken into parts in order to understand whether or not mixing occurs.

We have concluded that the first necessary step is to determine with the maximum possible degree of confidence whether the existing hydrochemical data base is distinct by formation. The term "distinct" must not be confused with hydraulic isolation. If it is possible to demonstrate statistically that the ground waters in the Saddle Mountains Formation, the Wanapum Formation and the Grande Ronde Formation can be distinguished from one another then it is permissible to proceed to the second step of the problem. The second step of the problem requires evaluating other factors such as vertical saturated hydraulic conductivity data, vertical head distribution data, the natural evolution of the hydrochemistry in different units due to, e.g., the geothermal gradient, pH changes, Eh changes, and other chemical factors, and structural mapping data in order to determine whether these data are compatible with hydrochemical distinctness among basalt formations. It was specifically not the intent of the first report nor is it the intent of this second report to address the second step of the problem. We investigate only whether or not the hydrochemical data are distinct according to basalt formation. Without quantification of this information it is not reasonable to address step 2. This second report analyzes a larger and better distributed data base than the first report.

Univariate and multivariate analyses were performed on the data base described above in order to investigate hydrochemical distinctness among

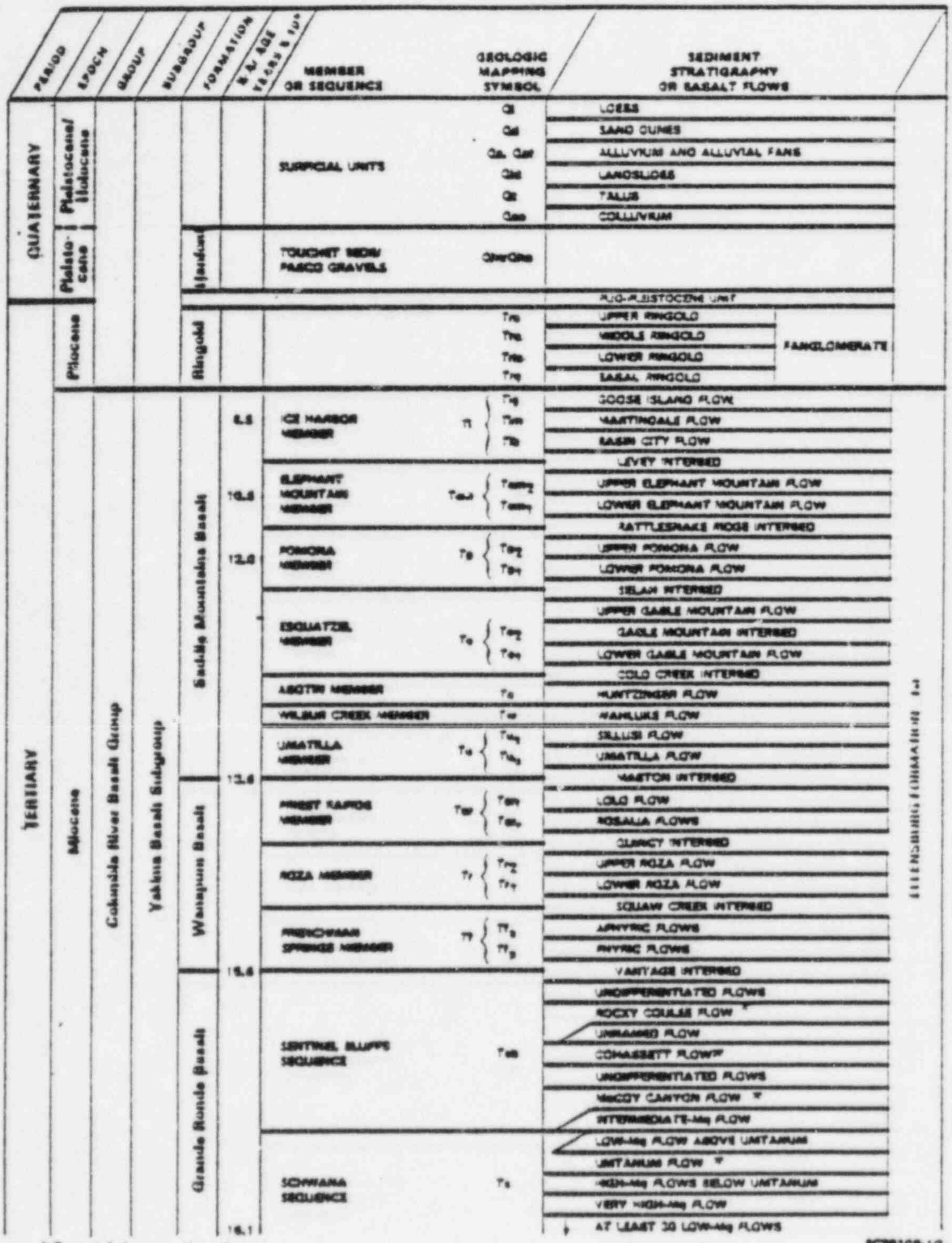
basalt formations at the BWIP site. Williams (1982) performed a similar evaluation in a different hydrogeologic environment. Williams showed that structural mapping and mineralogical mapping can be combined with statistical analysis of water quality data to interpret flow pathways and controls on the pathways within Mt. Emmons, Colorado.

2. GEOLOGY

The following geologic description is repeated in its entirety from the first report. This repetition minimizes the necessity for the reader to refer to the first report for background information.

The upper geologic units at the Hanford site consist of the suprabasalt sediments (Figure 2.1). These sedimentary deposits include the Hanford and Ringold Formations. The geologic units of primary interest in this report are the underlying basalts. Principal basalt units include the Saddle Mountains, Wanapum, and Grande Ronde. The sedimentary interbeds of the Ellensburg Formation are intercalated within these basalt units. The majority of the interbeds occur within the Saddle Mountains and Wanapum basalts. The distribution of the interbeds within the geologic section is shown on Figure 2.1. No attempt is made in this analysis to distinguish between the water quality of samples obtained from basalts and from sediments. Most of the samples obtained from the Saddle Mountains Formation are from the sediments. This may account for some of the distinctness of the samples from the Saddle Mountains Formation as discussed subsequently. We could not test the relationship between the sediments and the basalts because too few groundwater samples are available from basalt flows in the Saddle Mountains Formation.

The Umtanum flow within the Schwana sequence (Grande Ronde Formation), the McCoy Canyon flow (Grande Ronde Formation) and the Middle Sentinel Bluffs flow (Grande Ronde Formation) are the major geologic units of interest. The Umtanum flow and the Middle Sentinel Bluffs flow (recently named the Cohassett flow) constitute potential repository horizons for the



*Candidate Horizon

Figure 2.1. Pasco Basin stratigraphy (Jackson et al., 1984).

BWIP site. Those geologic units overlying the repository horizons also are of considerable interest because these units are the probable avenues of waste migration via groundwater movement.

Geochemistry of the basalt rocks is illustrated on Tables 2.1 and 2.2. These tables present the general chemical make-up of the Saddle Mountains, Wanapum, and Grande Ronde Formations. A geochemical evolution of the groundwater is not addressed. We consider this to be a separate issue that cannot be addressed adequately until the data are analyzed to show quantitatively that the formations are or are not hydrochemically distinct. It should be noted that the geothermal gradient at the Hanford site has been measured at 35 to 45 degrees Centigrade per 1,000 meters (U. S. Dept. of Energy, 1982, p. 3.6-20). The mean unconfined groundwater temperature at the site is about 19 degrees Centigrade which is higher than the mean annual air temperature of 11.7 degrees Centigrade (U. S. Dept. of Energy, 1982, p. 5.1-90). The high temperatures may be pertinent because most minerals other than calcite, dolomite and a few sulfates are more soluble at higher temperatures.

The frequency of interbeds decreases with depth. DOE's Site Characterization Report (U. S. Dept. of Energy, 1982) indicates that 24% of the thickness of the Saddle Mountains Formation is interbeds (U. S. Dept. of Energy, 1982, p. 5.1-28), whereas no percentage thickness of interbeds is shown for the Wanapum or Grande Ronde Formations (Figure 2.1). Interbeds consist of clastic and volcaniclastic sediments (U. S. Dept. of Energy, 1982, p. 3.5-4). The volcaniclastic sediments were deposited as ashfall and by rivers flowing on the plateau (Rockwell International, 1981, p. 3-30).

Table 2.1 Basalt geochemistry, Grande Ronde (wt%) (Rockwell International, 1981, Table 4-1)

	N	Mean	Standard deviation	Minimum** value	Maximum** value	Standard error of mean
High-Mg Flows						
SiO_2	50	53.61	0.43	52.61	54.45	0.06
Al_2O_3	50	14.88	0.27	14.25	15.51	0.04
FeO*	50	12.01	0.52	10.89	12.89	0.07
MgO	50	4.88	0.20	4.38	5.34	0.03
CaO	50	8.75	0.19	8.36	9.20	0.03
Na_2O	50	2.60	0.17	2.13	3.17	0.02
K_2O	50	0.97	0.15	0.51	1.31	0.02
TiO_2	50	1.81	0.10	1.62	1.96	0.01
P_2O_5	50	0.28	0.02	0.25	0.38	0.00
MnO	50	0.21	0.01	0.19	0.23	0.00
Low-Mg Flows						
SiO_2	13	55.45	0.63	53.82	56.01	0.18
Al_2O_3	13	14.88	0.19	14.44	15.19	0.05
FeO	13	11.95	0.30	11.25	12.40	0.08
MgO	13	3.55	0.12	3.41	3.84	0.03
CaO	13	7.35	0.13	7.11	7.55	0.04
Na_2O	13	2.82	0.18	2.45	3.11	0.05
K_2O	13	1.63	0.33	1.17	2.47	0.09
TiO_2	13	1.91	0.03	1.87	1.96	0.01
P_2O_5	13	0.30	0.01	0.28	0.32	0.00
MnO	13	0.20	0.01	0.19	0.21	0.00
Umtanum Flow						
SiO_2	13	54.90	0.25	54.45	55.45	0.07
Al_2O_3	13	14.34	0.15	14.08	14.59	0.04
FeO	13	13.10	0.21	12.70	13.39	0.06
MgO	13	3.48	0.09	3.38	3.71	0.03
CaO	13	7.30	0.14	7.14	7.64	0.04
Na_2O	13	2.66	0.26	1.86	2.95	0.07
K_2O	13	1.48	0.24	0.94	1.71	0.07
TiO_2	13	2.17	0.04	2.12	2.23	0.01
P_2O_5	13	0.35	0.01	0.33	0.36	0.00
MnO	13	0.22	0.00	0.21	0.23	0.00
Very-High-Mg Flow						
SiO_2	10	51.87	0.42	50.82	52.42	0.13
Al_2O_3	10	15.09	0.24	14.79	15.57	0.07
FeO	10	11.89	0.21	11.50	12.16	0.07
MgO	10	5.75	0.15	5.53	6.02	0.05
CaO	10	9.93	0.22	9.68	10.43	0.07
Na_2O	10	2.80	0.18	2.50	3.01	0.06
K_2O	10	0.53	0.17	0.29	0.76	0.05
TiO_2	10	1.64	0.07	1.57	1.79	0.02
P_2O_5	10	0.27	0.02	0.25	0.30	0.01
MnO	10	0.22	0.03	0.20	0.30	0.01

*Total Fe given as FeO.

**Maximum and minimum values are for individual oxides.

Table 2.2 Basalt geochemistry, Wanapum & Saddle Mountains (wt%) (Rockwell International, 1981, Table 4-1)

Flow	Esquatzel Member		Asotin Member Huntzinger flow		Pomona Member		Elephant Mountain Member Lower flow	
	N = 44		N = 45		N = 67		N = 23	
Mean, One Std. Dev.	$\bar{X}$	1σ	$\bar{X}$	1σ	$\bar{X}$	1σ	$\bar{X}$	1σ
SiO_2	52.78	0.47	51.43	0.82	51.81	0.38	50.76	0.33
AL_2O_3	14.24	0.27	16.06	0.56	15.41	0.28	13.76	0.30
TiO_2	3.02	0.10	1.58	0.12	1.63	0.06	3.49	0.06
FeO*	11.68	0.50	8.32	0.54	8.68	0.39	13.08	0.51
MnO	0.21	0.02	0.18	0.02	0.19	0.01	0.23	0.01
CaO	7.65	0.22	10.51	0.69	10.62	0.30	8.38	0.19
MgO	3.75	0.22	6.82	0.97	6.73	0.27	4.22	0.14
K_2O	1.78	0.13	0.67	0.42	0.53	0.10	1.30	0.10
NA_2O	2.50	0.14	2.16	0.20	2.16	0.12	2.29	0.21
P_2O_5	0.37	0.02	0.26	0.06	0.24	0.02	0.49	0.01

Flow	Elephant Mountain Member upper flow (Ward Gap)		Ice Harbor Member Basin City flow		Ice Harbor Member Martindale flow		Ice Harbor Member Goose Island flow	
	N = 10		N = 8		N = 14		N = 4	
Mean, One Std. Dev.	$\bar{X}$	1σ	$\bar{X}$	1σ	$\bar{X}$	1σ	$\bar{X}$	1σ
SiO_2	50.57	0.28	47.62	0.29	48.44	0.49	47.46	0.67
AL_2O_3	13.78	0.22	14.04	0.21	14.18	0.36	13.17	0.39
TiO_2	3.43	0.08	3.59	0.04	3.25	0.17	3.64	0.05
FeO*	13.26	0.39	13.54	0.28	12.38	0.87	15.32	0.44
MnO	0.22	0.01	0.23	0.01	0.23	0.01	0.28	0.01
CaO	8.54	0.13	9.71	0.28	10.20	0.59	8.85	0.11
MgO	4.26	0.24	5.57	0.20	5.65	0.36	4.31	0.15
K_2O	1.20	0.12	0.68	0.11	0.68	0.17	1.22	0.06
NA_2O	2.27	0.14	2.23	0.11	2.30	0.13	2.25	0.16
P_2O_5	0.47	0.02	0.78	0.04	0.68	0.04	1.49	0.04

NOTE: Analyses are in wt%. Samples are core that was collected from drill holes and specimens from type localities.

*Total Fe expressed as FeO.

Table 2.2 Cont'd

Flow	Frenchman Springs Member plagioclase phyric flows		Frenchman Springs Member aphyric flows		Roza Member		Priest Rapids Member Rosalia flow	
	N = 43		N = 28		N = 13		N = 15	
Mean, One Std. Dev.	$\bar{X}$	1σ	$\bar{X}$	1σ	$\bar{X}$	1σ	$\bar{X}$	1σ
SiO_2	51.24	0.37	51.27	0.39	50.60	0.35	49.85	0.35
AL_2O_3	13.93	0.29	14.04	0.32	14.35	0.37	13.70	0.21
TiO_2	2.98	0.08	2.92	0.08	3.01	0.11	3.48	0.05
FeO*	12.83	0.44	12.69	0.37	12.44	0.54	13.47	0.31
MnO	0.24	0.01	0.23	0.01	0.23	0.01	0.24	0.01
CaO	8.34	0.17	8.34	0.15	8.65	0.20	8.55	0.19
MgO	4.22	0.25	4.21	0.23	4.59	0.31	4.49	0.22
K_2O	1.15	0.14	1.29	0.12	1.17	0.13	1.05	0.20
NA_2O	2.54	0.14	2.49	0.17	2.43	0.20	2.50	0.22
P_2O_5	0.53	0.05	0.52	0.04	0.54	0.03	0.66	0.02
Flow	**Priest Rapids Member Lolo flow**		**Umatilla Member Sillusi flow**		**Umatilla Member Umatilla flow**		**Wilbur Creek Member Wahluke flow**	
	N = 19		N = 26		N = 24		N = 4	
Mean, One Std. Dev.	$\bar{X}$	1σ	$\bar{X}$	1σ	$\bar{X}$	1σ	$\bar{X}$	1σ
SiO_2	49.87	0.53	54.31	0.73	53.65	0.59	53.43	0.35
AL_2O_3	14.28	0.30	14.70	0.60	14.51	0.27	15.01	0.28
TiO_2	3.15	0.09	2.83	0.30	2.99	0.11	1.87	0.02
FeO*	12.20	0.45	10.48	0.92	10.87	0.72	9.66	0.21
MnO	0.24	0.01	0.22	0.02	0.22	0.05	0.19	0.01
CaO	9.00	0.63	6.60	0.64	6.68	0.37	8.50	0.19
MgO	5.18	0.31	2.61	0.26	3.00	0.31	4.61	0.25
K_2O	0.98	0.11	2.62	0.36	2.52	0.14	1.90	0.16
NA_2O	2.45	0.17	2.82	0.25	2.84	0.24	2.37	0.15
P_2O_5	0.66	0.02	0.81	0.05	0.72	0.02	0.45	0.01

Clastic sediments derived from the plutonic and metamorphic rocks of the Rocky Mountain terrain also are present (Rockwell International, 1981, p. 3-30).

Several known and some potential geologic structures exist at the Hanford site. Several hydrogeochemical implications are possible in view of the potential effect these structures might have on groundwater flow. These structures might have no discernable effect on groundwater quality; but it is arguable also that these structures might retard lateral groundwater flow or provide preferential hydraulic conductivity pathways for groundwater flow in the vertical direction. The major hydrogeochemical issue addressed is whether the major basalt formations (Saddle Mountains, Wanapum, and Grande Ronde) are isolated hydraulically from each other by flow interiors with low vertical saturated hydraulic conductivity or whether there is a significant vertical exchange of groundwater among these formations. This issue cannot be addressed until the hydrochemical distinctness of the waters in the basalt formations is resolved in a defensible quantitative manner.

3. DATA

The boreholes used for the collection of data for this evaluation are widely scattered on and around the Hanford site (Figure 3.1). Numerous geologic units are represented by water chemistry analyses from different boreholes but few boreholes offer a comprehensive representation of water chemistry analyses for the entire geologic section. The distribution of boreholes is not random which presents some difficulty in testing hypotheses as noted later in this report. The distribution of boreholes for the current data base is better than the distribution that was available for the study presented in Williams and Assoc., Inc. (1983). The geologic units that constitute sample sources range from the Saddle Mountains Formation through the Grande Ronde Formation. The computer code used to designate the stratigraphic units is presented in Appendix A. Interbeds dominate the sample sources in the Saddle Mountains Formation. Flow tops dominate the sample sources in the Wanapum and Grande Ronde Formations. This observation may be important to the interpretation of water chemistry data as noted subsequently herein.

The chemical data in the appendix contain concentrations of some constituents that were reported as being less than some detection limit. For purposes of a consistent data base these values are shown in the appendices as being equal to the detection limit. Detection limits are indicated by a minus sign preceding the concentration value in Appendix B. In addition the detection limits are not always constant for the same variable; this inconsistency is a consequence of the fact that multiple samples were sent to different laboratories with different analytical

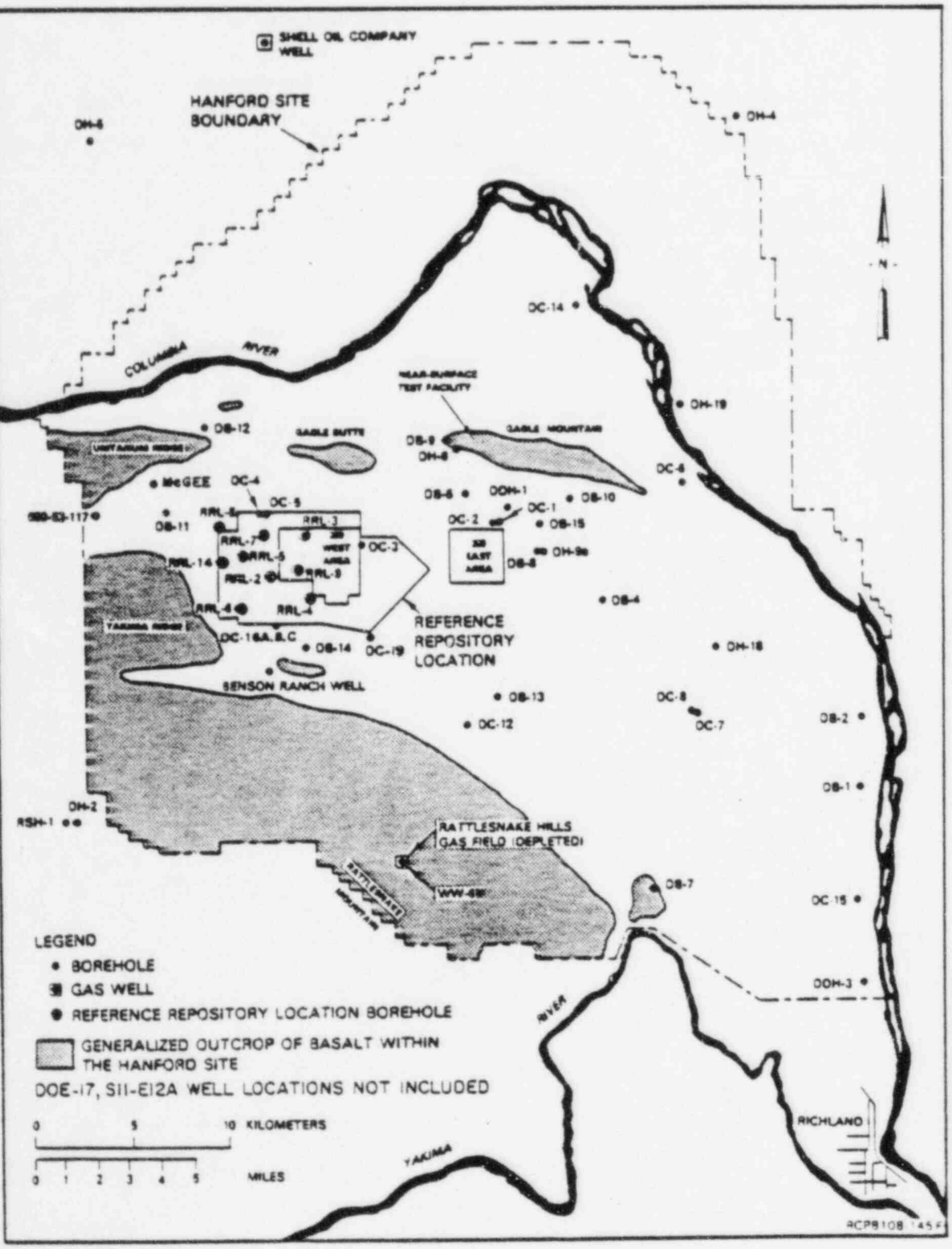


Figure 3.1. Selected borehole and well locations (modified after BWIP handout).

capabilities. From a statistical analysis viewpoint these procedures should not be deleterious.

The hydrochemical data list received by the NRC contains many instances in which the same interval and basalt flow were sampled on several occasions in the same borehole. Multiple sampling is particularly prevalent with respect to borehole DC-14. A continuous flowing discharge test resulted in approximately 35 samples and analyses appearing in the data listing in addition to the multiple samples and analyses that occurred during normal drilling and testing. The multiple analysis presented in the data from borehole DB-1 is a more common type of occurrence. The Mabton interbed was sampled and analyzed 4 times between July 1978 and May 1981. In cases such as these the samples selected for statistical evaluation in this report were selected based on several judgemental factors with a single primary objective. This objective is to represent each sampled basalt flow from each borehole with one sample and corresponding valid analysis. Each sample is identified by a record number. Borehole DC-14 is an exception to this criteria. Two samples from the end points of the testing period were selected to evaluate the possible effects of contamination by drilling fluid on groundwater quality. These two samples were selected in addition to samples obtained during the normal drill and test sequence. The multiple samples from each basalt flow-borehole were culled based on the time interval between drilling and sampling. The most recent sample was selected except where the sampling method shed doubt on the validity of the sample. Multiple methods of sampling have been employed at the BWIP site. These methods include swabbing, air lift pumping, pumping with a submersible pump,

and free flowing discharge from artesian wells with a hydraulic head above ground surface. Samples were selected based on the most desirable method of sampling; the methods are listed in order from the least desirable to the most desirable.

A cation-anion balance could not be performed on the data presented in Appendix B because two major anions are missing from the chemical analysis listing. These major anions are bicarbonate (HCO_3) and carbonate (CO_3). All data in Appendix B are considered in the evaluation; the sequence of data evaluation procedures is described in Section 4.2 Statistical Procedures. An ion balance was performed on the data used in the first report (Williams and Associates, Inc., 1983). Only 5 samples did not meet the 10% balance criteria used in the first report.

The hydrochemical data are influenced by many factors such as temperature. The geothermal gradient at the BWIP site appears to be uniform and fairly consistent. This gradient results in groundwater temperatures of approximately 15^{o}C in the shallowest basalt units to 60^{o}C in the deeper Grande Ronde flows. This temperature variation, which appears to increase linearly with depth, may have a significant impact on various ion concentrations in the water samples. The interrelationships of physical variables, geochemical variables, and hydrochemical variables is extremely complex.

Several hydrochemical variables were selected based on subsequent statistical analyses of the data. The selected hydrochemical variables are plotted as ion concentrations versus depth below land surface (Appendix C). The variables selected for this qualitative examination of the

interrelationship of physical, geochemical, and hydrochemical variables are pH, insitu temperature, boron (B), chloride (Cl), fluoride (F), magnesium (Mg), potassium (K), sodium (Na), and sulfate (SO_4). Four borehole locations were selected for this qualitative examination. These borehole locations are DC-16a and c and RRL-2 which are within or near the RRL and DC-14 and DC-15 which are adjacent to the Columbia River. Boreholes DC-16a and DC-16c are considered as one borehole due to their close areal proximity. Their combined data bases result in an extensive depth and stratigraphic representation of hydrochemical and temperature data. These four borehole locations are the only boreholes that have a reasonably comprehensive representation of data over the greatest depth of interest.

These plots of ion concentrations, pH, and temperature versus depth do not illustrate a clear cut relationship between any of the variables. The specific relationship of interest is the ion concentrations to temperature. There is no apparent relationship of ion concentrations or pH to temperature.

3.1 Hydrochemical Data

The data used in this study consist of 253 water sample analyses reported in the BWIP Hydrochemistry Data Base as chemical data printouts dated February 22, 1984. Record number, sample number, formation identity, pH, specific conductivity, field alkalinity, chloride, fluoride, sulfate, sodium, potassium, calcium, magnesium, silicon, total carbon, aluminum, barium, boron, cobalt, chromium, copper, iron, lithium, manganese, molybdenum, nickel, lead, strontium, and zinc were converted to machine

readable form (Appendix B) for use in the study.

3.2 Isotopic Data

The isotopic data collected at the BWIP site were not evaluated statistically. Primary emphasis was placed on the chemical data. Conceivably the separate analysis of the isotopic data could be informative; this analysis should be considered for future research. Emphasis is placed on the chemical data because the data base is larger and fewer questions exist concerning the validity of sampling procedures and subsequent analyses.

4. DATA ANALYSIS

4.1 Working Hypotheses

The following hypotheses are the same as those stated in our first report (Williams and Assoc., Inc., 1983). The primary issue is whether the hydrochemistry data can be distinguished according to basalt formations; but the statistical method used can segregate data areally as well as vertically. Consequently two sets of working hypotheses are of interest. These hypotheses are:

A1. Fracturing or vertical mixing caused by other factors preclude quantitatively distinguishing groundwaters among basalt formations (or flows) under the Hanford Reservation using concentrations of dissolved constituents in water samples obtained from each formation (or flow).

A2. Groundwaters as represented by water samples from different basalt formations (or flows) under the Hanford Reservation are largely distinct and can be distinguished by the concentrations of their dissolved chemical constituents.

If hypothesis A2 is valid, then one is justified in pursuing further the implication that the samples were derived from different flow paths that are isolated or semi-isolated vertically. However even under this condition some vertical mixing among nearly horizontal flow pathways could occur across confining layers even though the upper and lower hydrostratigraphic units have statistically significantly different concentrations of dissolved constituents. In a mathematical sense this condition can be viewed as necessary but not completely sufficient for hydraulic isolation. For this

reason we have used the words hydrostratigraphic unit distinctness as opposed to hydrostratigraphic unit isolation to deal with working hypothesis A2 throughout this report.

B1. Water samples from wells on the Hanford Reservation statistically cannot be grouped spatially (areally) and

B2. Water samples from wells on the Hanford Reservation statistically can be grouped spatially (areally).

We reemphasize the fact that samples from the Saddle Mountains Formation are derived primarily from interbeds; consequently for the Saddle Mountains Formation working hypotheses A1 and A2 may simply reflect the effect of nonbasalt rock types on hydrochemistry. The possible implications of this observation should be researched further when more data become available.

4.2 Statistical Procedures

The analysis is divided into two parts: exploratory and confirmatory. In the exploratory analysis we calculate descriptive statistics in order to detect any coding errors or outliers in the data base and to determine if the data should be transformed. After transformation the data are standardized following which cluster analysis is performed to segregate the samples into relatively homogeneous groups or clusters of samples. Since hypotheses A1, A2 and B1, B2 concern the similarity or dissimilarity of chemical characteristics of samples, we are interested in clustering samples, not variables. Cluster analysis is useful for this purpose. Multivariate principal component analysis and factor analysis examine

relationships among variables and, hence, are not directly applicable. We perform two cluster analyses in this study. A preliminary cluster analysis is conducted on a subset of the data having complete information on most of the hydrochemical constituents. Only 85% of the data are used in this analysis. We performed a second cluster analysis on 94% of the data after deleting hydrochemical constituents that do not help to explain the preliminary clusters. Using a preliminary and final cluster analysis allows us to use as much of the data base as possible.

The result of the cluster analysis is a set of clusters or groups of samples which, if they survive additional scrutinous analysis, may support or deny the hypotheses discussed above. The confirmatory part of the analysis tests the statistical significance of differences among the clusters. Confirmatory analysis has two other purposes as well. We can determine which hydrochemical constituents or combination of constituents are important in differentiating among the clusters by using stepwise MANOVA and canonical analysis (Johnson and Wichern, 1982, ch. 10). The canonical analysis defines canonical variables much like principal components or factors. The new composite variables differ because the canonical variables define the dimensions along which the clusters can be segregated. Principal components or factors define the dimensions associated with the overall variability in the data. Secondly, we use discriminant analysis to clarify "gray" areas of the cluster analysis. Inevitably, some samples fall between clusters or fall into clusters that are made up of samples of an apparently different type. The discriminant analysis either substantiates or corrects the original placement of these statistically "anomalous" samples.

4.3 Exploratory Analysis

Summary statistics, stem and leaf plots (histograms), and box plots were calculated on each numerical response variable (SAS Institute Inc., 1982). Total carbon, cobalt, chromium, copper, lithium, nickel, and lead were deleted from the analysis because of large numbers of missing values and/or because many values are at or below detection limits. All the other variables except pH and field alkalinity have a skewed distribution; these variables were transformed logarithmically ($Y = \ln(X + 1)$). The variables pH and field alkalinity do not require transformation. The 253 data vectors were derived from 146 distinct water samples represented by one, two, and occasionally three laboratory analyses. The 253 data points were averaged to yield 146 observations -- one corresponding to each water sample. Not all 146 observations have values for each of the variables. However, 124 observations have complete data for pH, logarithm of specific conductance, field alkalinity, and logarithm of ion concentrations for chloride, fluoride, sodium, potassium, calcium, magnesium, aluminum, boron, and iron. Except for silicon and titanium, these ions constitute the major geochemical constituents of the basalt flows under the RRL. Silicon dioxide comprises about half of the basalts by weight but it does not provide a great deal of information about differences between basalt layers. Titanium was not assayed.

This study was initiated by conducting a preliminary cluster analysis using these 124 observations on 12 variables. The variables were standardized by converting raw data to Z scores according to:

$$Z = \frac{X - \overline{X}}{S},$$

where X is the observation on a variable and $\overline{X}$ and S are the mean and standard deviation, respectively. This procedure gives each variable equal weight in the analysis. We calculated distances between observations as Euclidean distances and used a hierarchical complete linkage clustering algorithm (Dixon, 1981, BMDP1M). Four preliminary clusters were identified.

Stepwise MANOVA (SPSS Inc., 1983, Discriminant Procedure) identified seven variables (Cl, Mg, K, pH, F, Na, and alkalinity) as discriminators among the four groups. In fact, 96.1% of the observations were classified into their correct clusters using only chloride, magnesium, potassium, pH, and fluoride. The four clusters identified generally represent two Saddle Mountain-Wanapum Formation groupings and two Wanapum-Grande Ronde Formation clusters. The fact that five variables are sufficient to identify the four clusters is not surprising if one examines the 12 x 12 correlation matrix in Table 4.3.1. The pattern of correlations suggests an association 1) among specific conductance, alkalinity, chloride, fluoride, sodium, and boron; 2) between calcium and magnesium; and 3) between aluminum and iron. Chloride and fluoride represent the information in variable association 1) and magnesium represents association 2). Aluminum and iron do not help differentiate these clusters. Most of the information content is captured if potassium and pH are evaluated in conjunction with chloride, fluoride, and magnesium. That is not to say that specific conductance, alkalinity, sodium, boron, and calcium are unimportant; but the information content of these five variables is represented adequately by the other five variables.

Table 4.3.1. Pooled within-groups correlation matrix.

	PH	SC	ALK	CL	F	NA	K	CA	MG	AL	B	FE
PH	1.000											
SC	-0.144	1.000										
ALK	0.083	-0.460	1.000									
CL	-0.342	0.653	-0.282	1.000								
F	0.209	0.493	-0.123	0.468	1.000							
NA	-0.201	0.687	-0.179	0.659	0.594	1.060						
K	-0.199	0.098	-0.155	0.317	0.015	0.103	1.000					
CA	-0.211	0.378	-0.316	0.115	-0.184	0.076	0.046	1.000				
MG	-0.142	0.036	0.146	-0.143	-0.371	-0.354	-0.198	0.602	1.000			
AL	-0.001	-0.177	0.258	-0.143	-0.105	-0.167	-0.099	-0.026	0.208	1.000		
B	-0.038	0.316	-0.128	0.316	0.447	0.402	0.011	0.008	-0.079	-0.125	1.000	
FE	-0.151	0.163	0.088	0.174	0.035	0.145	0.083	0.046	0.112	0.470	0.016	1.000

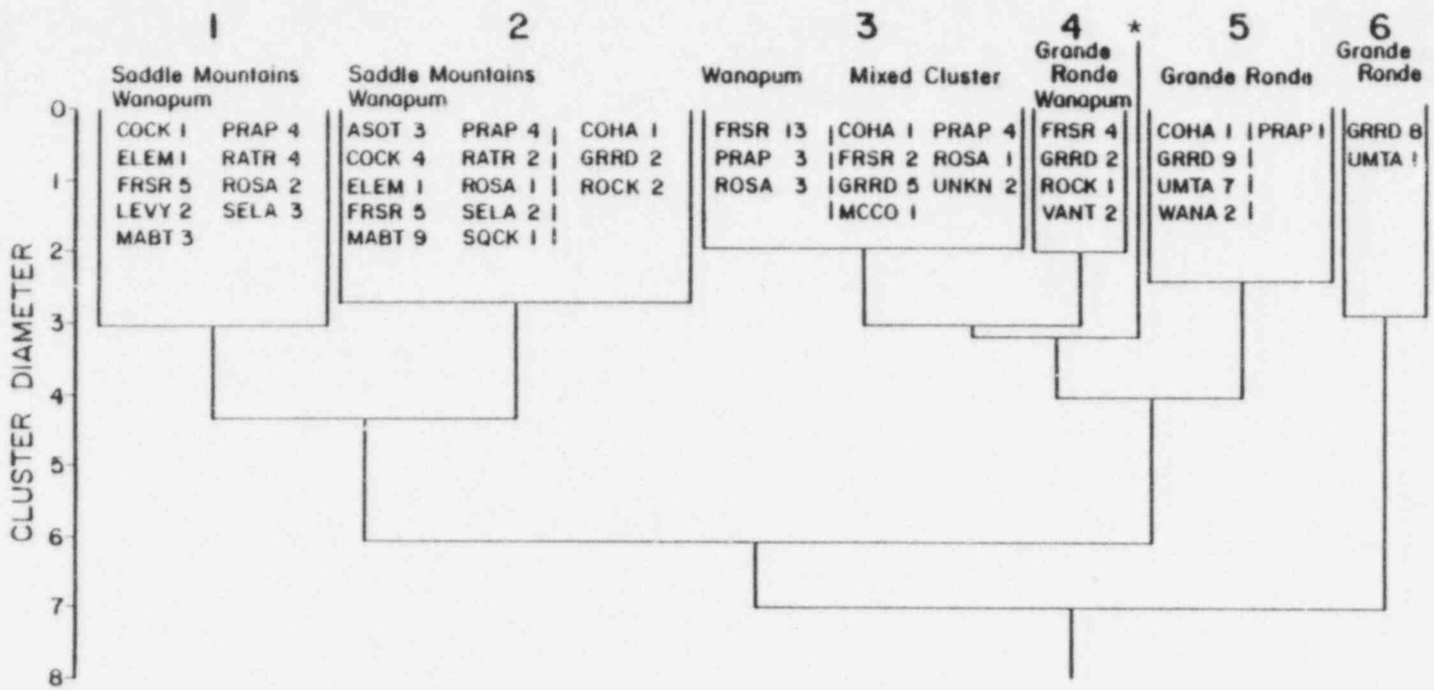
Complete data for chloride, magnesium, potassium, pH, and fluoride exist in 138 of the 146 observations. A cluster analysis of this larger data set using the approach described above identified six clusters instead of four (Figure 4.3.1). The additional two clusters are due in part to the additional samples and in part due to using five variables instead of twelve. The means of each of the five variables for each cluster are presented in Table 4.3.2.

Table 4.3.2. Group means[1)] for the clusters of Fig. 4.3.1

CLUS	pH	CL	F	K	MG
1	7.93	1.782	0.433	2.219	2.071
2	8.67	2.301	0.998	2.608	0.362
3	9.42	4.407	2.459	2.846	0.125
4	8.99	5.930	3.046	3.319	0.111
5	9.59	5.230	3.137	2.276	0.077
6	9.78	4.839	3.408	1.422	0.057
TOTAL	8.89	3.498	1.814	2.467	0.619

1) ln (mg/l + 1) except pH

The first two clusters contain samples from the Saddle Mountain and Wanapum Formations. The two clusters have relatively low pHs and low chloride and fluoride levels. Cluster 1 is characterized also by samples that are high in magnesium. Cluster 2 contains five apparently anomalous samples from Grande Ronde Basalts. Clusters 5 and 6 reflect samples collected from greater depths. Cluster 6 contains nine Grande Ronde Formation samples and cluster 5 contains 17 samples that were obtained from the Grande Ronde Formation (out of 20 samples in the cluster). One Priest Rapids flow sample appears in cluster 5. It is a relatively shallow Wanapum sample compared to the other samples in cluster 5. It is treated as an anomaly in the



* unidentified formation by Rockwell

Figure 4.3.1. Cluster diagram (see Appendix A for formation code).

discussion below. The five means for cluster 4 indicate that it is a cluster high in chloride, fluoride, and potassium. It contains four Wanapum basalt samples and five Grande Ronde Basalt samples. Cluster 3 contains a cohesive group of 19 samples from the Frenchman Springs, Priest Rapids, and Rosa strata. It also contains a group of 16 samples from a variety of Wanapum and Grande Ronde samples mixed together indiscriminantly (labeled "mixed cluster" in Figure 4.3.1). This mixed group of samples is treated as an anomaly in the MANOVA, canonical analysis, and discriminant analysis discussed below. If one counts the unknown formation sample between clusters 4 and 5, 23 of the 138 samples are not clearly placed via the cluster analysis.

4.4 Confirmatory Analysis

The remaining (138 - 23 =) 115 samples were subjected to a stepwise MANOVA in order to identify the hydrochemical constituents most responsible for cluster differences and to test for differences among the clusters. The results appear in Table 4.4.1. MANOVA identifies the clusters as being significantly different, but clusters 3, 4, 5, and 6 are less so. A canonical analysis was used to identify a rotation of the five original axes (variables) to axes most aligned with differences among groups. The first two axes are associated with eigenvalues representing 89.4% of the eigenvalue total. A plot of the data using canonical axes 1 and 2 is presented in Figure 4.4.1.

Table 4.4.1 Summary of stepwise MANOVA on six clusters

Summary of action at each step

STEP	ACTION ENTERED	ACTION REMOVED	VARS IN	WILKS' LAMBDA	SIG.
1	CL		1	0.087955	0.0000
2	MG		2	0.017427	0.0
3	K		3	0.003938	0.0
4	PH		4	0.002801	0.0
5	F		5	0.002526	0.0

F Statistics and significances between pairs of groups
Each F statistic has 5 and 105.0 degrees of freedom.

GROUP	1	2	3	4	5
2	103.3				
3	184.3	69.1			
4	170.2	96.9	15.0		
5	253.6	140.6	20.4	24.4	
6	180.0	115.1	48.4	56.6	15.3

Each F is significant at the .0001 level.

The details of the canonical analysis are presented in Table 4.4.2. Examination of the standardized discriminant function coefficients and the structure matrix facilitates interpretation of the canonical axes. A sample will have a high value on canonical axis 1 if it is high in chloride and fluoride, (relatively) high in pH, and low in magnesium. A sample will have a high value on canonical axis 2 if it is low in potassium and/or high in magnesium. The figure shows that in general water samples are organized into groups of samples from generally shallower basalt flows and from generally deeper basalt flows.

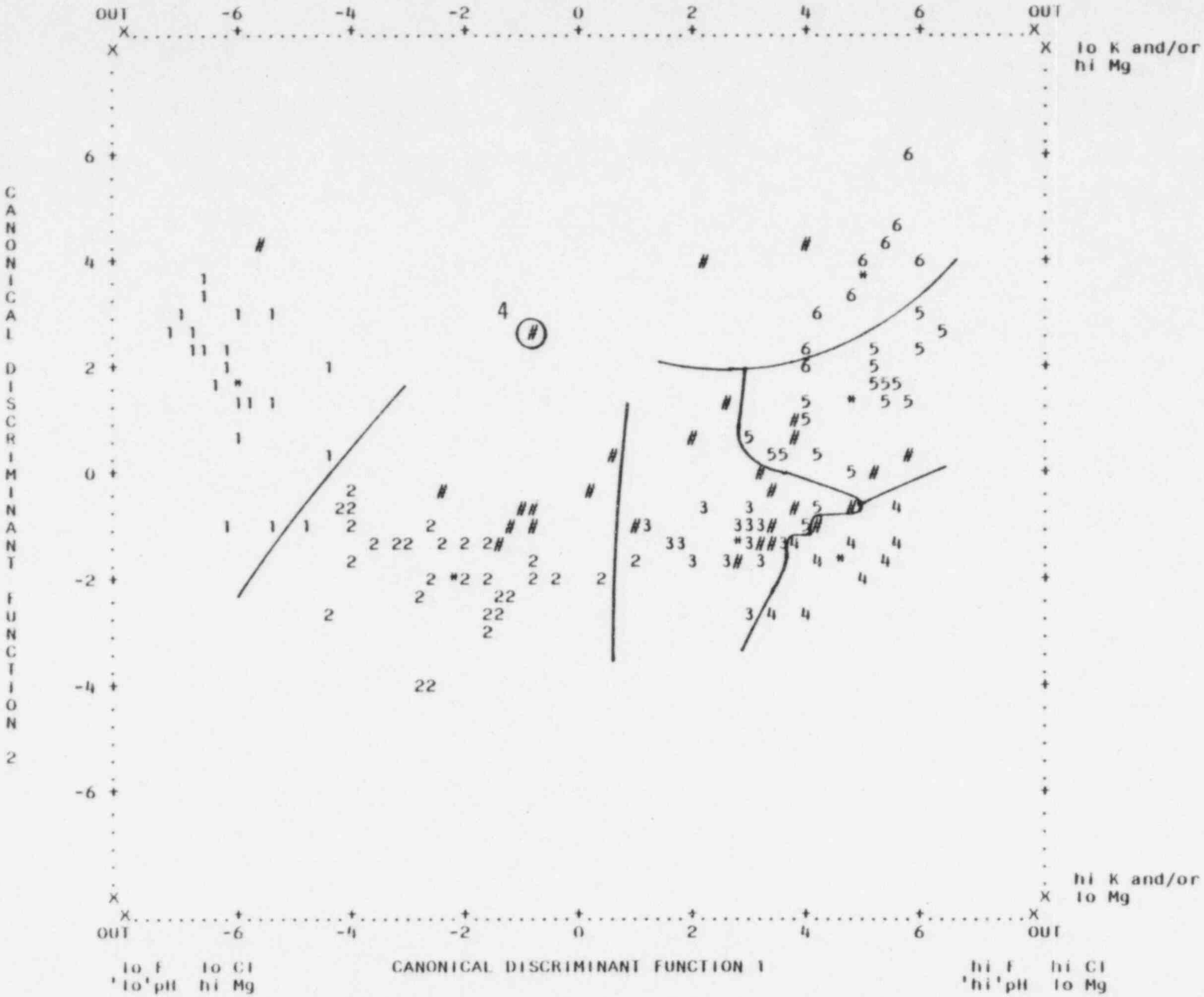


Figure 4.4.1. Map of six clusters plus unknowns in canonical space.

Table 4.4.2 Summary of canonical analysis on six clusters

CANONICAL DISCRIMINANT FUNCTIONS

Function	Eigenvalue	Percent of Variance	Cumulative Percent	Canonical Correlation
1*	19.31222	74.57	74.57	0.9750736
2*	3.84723	14.85	89.42	0.8908965
3*	2.63470	10.17	99.59	0.8513955
4*	0.09459	0.37	99.96	0.2939717
5*	0.01061	0.04	100.00	0.1024425

STANDARDIZED CANONICAL DISCRIMINANT FUNCTION COEFFICIENTS

	FUNC 1	FUNC 2	FUNC 3	FUNC 4	FUNC 5
PH	0.42623	0.01111	-0.09556	0.89781	-0.42809
CL	0.69226	0.23672	0.31356	-0.22120	-0.88815
F	0.22192	0.21374	0.26317	0.01665	1.15659
K	-0.10724	-0.74282	0.66476	0.22249	0.27754
MG	-0.39221	0.54455	0.74255	0.32962	0.08463

STRUCTURE MATRIX

	FUNC 1	FUNC 2	FUNC 3	FUNC 4	FUNC 5
CL	0.70672*	0.12083	0.49712	-0.41052	-0.26514
F	0.70173*	0.24751	0.11871	-0.01013	0.65736
K	0.03872	-0.80727*	0.58604	0.05759	0.00758
MG	-0.53694	0.58529*	0.54128	0.24244	-0.13179
PH	0.34864	0.01035	-0.22368	0.90959*	-0.03101

A discriminant analysis was conducted in order to place the 23 samples that were not placed clearly by the cluster analysis into one of the six clusters described above. The discriminant analysis also was used to place each of the 115 samples analyzed in the MANOVA-canonical analysis in order to check the discriminating power of the five variables. The incidence matrix is presented in Table 4.4.3. The boundary lines in Figure 4.4.1 were drawn using the results of the discriminant analysis. The boundaries visually confirm the tabular results listed in the incidence matrix. One sample in cluster 1 is designated as belonging to cluster 2. Similarly one

Table 4.4.3. Incidence matrix from the six cluster discriminant analysis.

ACTUAL GROUP	NO. OF CASES	PREDICTED GROUP MEMBERSHIP 1	2	3	4	5	6
GROUP 1	26	25 96.2%	1 3.8%	0 0.0%	0 0.0%	0 0.0%	0 0.0%
GROUP 2	33	0 0.0%	32 97.0%	1 3.0%	0 0.0%	0 0.0%	0 0.0%
GROUP 3	19	0 0.0%	0 0.0%	19 100.0%	0 0.0%	0 0.0%	0 0.0%
GROUP 4	9	0 0.0%	0 0.0%	0 0.0%	9 100.0%	0 0.0%	0 0.0%
GROUP 5	19	0 0.0%	0 0.0%	2 10.5%	0 0.0%	17 89.5%	0 0.0%
GROUP 6	9	0 0.0%	0 0.0%	0 0.0%	0 0.0%	1 11.1%	8 88.9%
UNGROUPED CASES	31	1 3.2%	9 29.0%	13 41.9%	2 6.5%	4 12.9%	2 6.5%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 95.65%

cluster 2 sample is classified into cluster 3. All cluster 3 and 4 samples remain within their respective borders. Two cluster 5 samples fall within the cluster 3 region, but this placement probably is due to the unknown (anomalous) sample that occurs in the "cul de sac" of cluster 3 near the cluster 4-5 border. This sample is record number 128 which comes from an unknown formation in borehole DC-14. The discriminant analysis gives this sample a 0.45 probability of being in group 3 and a 0.42 probability of being from group 4. One cluster 6 sample is misplaced in cluster 5. Overall, the discriminant analysis correctly classifies 95.65% of the 115 samples.

In addition to the 23 set aside samples explained above, 8 samples were omitted from the cluster analysis because data were missing for one or more of the five variables. This total of 31 samples have group memberships as predicted in Table 4.4.4 and as detailed on Figure 4.4.1. Eighteen of the set of 23 samples not clearly placed in the cluster analysis are placed into the same groups as in the cluster analysis. Five of the 23 samples were not placed into the same clusters. Record number 178 appears in cluster 3; the discriminant analysis places it into cluster 5. Record number 180 appears in cluster 3; the discriminant analysis places it into cluster 4. The single sample clustered between clusters 3 and 4 is record number 205 from an unknown formation in borehole DC-2. It was discriminated as an isolated cluster 4 point (see Figure 4.4.1). It has a 0.46 probability of being in cluster 4 and a 0.35 probability of being in cluster 1. Visually it appears to be a cluster 2 point. This apparent singularity occurs because this sample has a value of 7.1 on canonical axis 3 which is not depicted in the

Table 4.4.4 Disposition of unknown (#) samples

Rec No	Formation	Borehole	Cluster	Fig 4.4.1	Fig 4.4.2
37	PRAP	DB-14	3	3	3-6
42	UMAT	DB-15	N/A	2	2
46	PRAP	DB-15	3	3	3-6
47	PRAP	DB-15	3	3	3-6
50	FRSR	DB-15	3	3	3-6
79	POMO	DC-1	N/A	2	2
86	COUM	DC-1	N/A	2	2
87	UMAT	DC-1	N/A	3	3-6
88	PRAP	DC-1	5	5	3-6
91	GRRD	DC-1	2	2	2
92	GRRD	DC-1	N/A	6	3-6
96	GRRD	DC-1	N/A	6	3-6
104	GRRD	DC-12	3	3	3-6
106	GRRD	DC-12	3	3	3-6
128	UNKN	DC-14	3	3	3-6
178	GRRD	DC-15	3	5	3-6
180	GRRD	DC-15	3	4	3-6
189	PRRZ	DC-16A	3	3	3-6
190	FRSR	DC-16A	3	3	3-6
202	MCCO	DC-16C	3	3	3-6
205	UNKN	DC-2	X	4	1
208	UNKN	DC-6	3	3	3-6
212	GRRD	DC-6	3	5	3-6
214	GRRD	DC-6	N/A	2	2
229	SBFL	DOE-17	N/A	1	1
242	GRRD	MCGEE	2	2	2
243	GRRD	MCGEE	2	2	2
244	GRRD	MCGEE	2	2	2
245	GRRD	MCGEE	2	2	2
250	PRAP	RRL-2	3	3	3-6
254	COHA	RRL-2	3	5	3-6

figure. Record numbers 212 and 254 appear in cluster 3 and were discriminated into cluster 5.

The confirmatory MANOVA above showed relatively less significance among clusters 3, 4, 5, and 6; consequently we performed another MANOVA-canonical analysis using clusters 1, 2, and a combined 3-4-5-6 cluster. The results appear in Tables 4.4.5 and 4.4.6 and Figure 4.4.2. Only magnesium, chloride, pH, and fluoride are required to differentiate the three groups. The average potassium levels do not vary greatly among them. The net result of this second MANOVA-canonical analysis-discriminant analysis is that one cluster 1 sample is confused with cluster 2 and vice-versa. One cluster 2 sample is predicted as combination cluster 3-4-5-6. All of the 3-4-5-6 samples were predicted as cluster 3-4-5-6. Irregular record number 205 shown in Figure 4.4.1 is predicted as a cluster 1 sample in this case; however, it is a distant point in cluster 1. Using this second canonical-discriminant analysis, group membership for the 31 unclearly clustered samples appears in the last column of Table 4.4.4.

4.5 Hydrogeologic Significance of Cluster Analysis

Several samples (record numbers) did not group in the expected cluster. For example, some samples which were obtained from the Grande Ronde Formation did not fall in the cluster with the rest of the Grande Ronde. The anomalous placement of these samples is discussed below with respect to their possible hydrogeologic significance. The record numbers of interest are 128 (borehole DC-14), 178 and 180 (borehole DC-15), 88 and 91 (borehole DC-1), 104 and 106 (borehole DC-12), 242, 243, 244, and 245 (McGee well),

Table 4.4.5 Summary of MANOVA- canonical analysis on three clusters

Summary of action at each step

STEP	ACTION ENTERED	ACTION REMOVED	VARS IN	WILKS' LAMBDA	SIG.
1	MG		1	0.115899	0.0
2	CL		2	0.028272	0.0
3	PH		3	0.020142	0.0
4	F		4	0.018597	0.0

F Statistics and significances between pairs of groups
Each F statistic has 4 and 109.0 degrees of freedom.

GROUP	1	2
GROUP		
2	131.79	
3	378.65	158.41

Each F is significant at the .0001 level.

CANONICAL DISCRIMINANT FUNCTIONS

Function	Eigenvalue	Percent of Variance	Cumulative Percent	Canonical Correlation
1*	14.39569	85.24	85.24	0.9669782
2*	2.49260	14.76	100.00	0.8447959

STANDARDIZED CANONICAL DISCRIMINANT FUNCTION COEFFICIENTS

	FUNC 1	FUNC 2
CL	0.66285	0.42514
MG	-0.54294	0.85375
PH	0.49376	0.12025
F	0.07367	0.41367

STRUCTURE MATRIX:

	FUNC 1	FUNC 2
F	0.63765*	0.43699
CL	0.61246*	0.51126
PH	0.37478*	0.02047
MG	-0.66674	0.70209*
K	-0.05695	-0.13998*

Table 4.4.6. Incidence matrix from the three cluster discriminant analysis.

ACTUAL GROUP	NO. OF CASES	PREDICTED GROUP MEMBERSHIP 1	2	3
GROUP 1	26	25 96.2%	1 3.8%	0 0.0%
GROUP 2	33	1 3.0%	31 93.9%	1 3.0%
GROUP 3	56	0 0.0%	0 0.0%	56 100 0%
UNGROUPED CASES	31	2 6.5%	9 29.0%	20 64.5%

PERCENT OF "GROUPED" CASES CORRECTLY CLASSIFIED: 97.39%

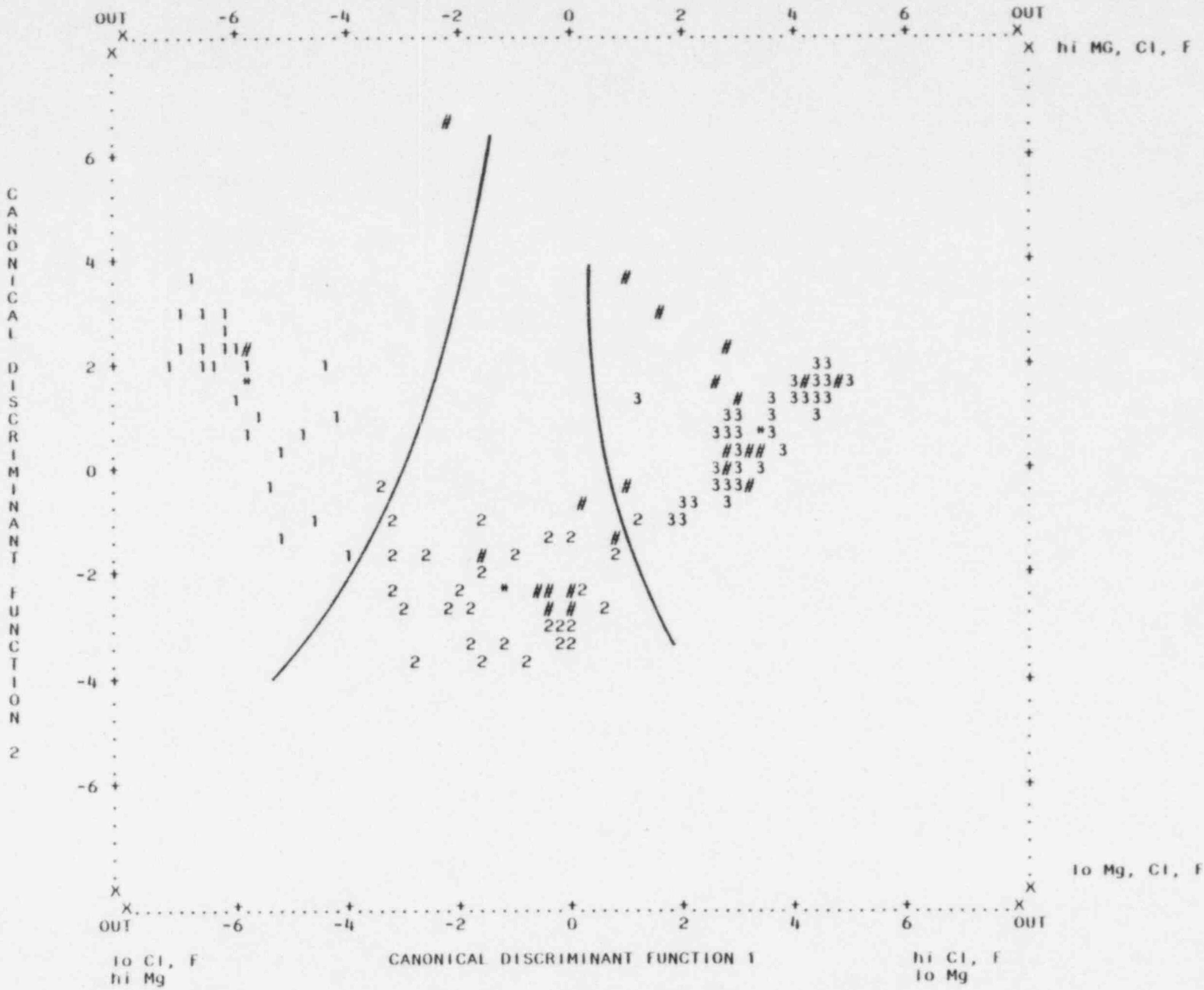


Figure 4.4.2. Map of three clusters plus unknowns in canonical space.

214 (borehole DC-6), and 205 (borehole DC-2).

Details about borehole DOE-17 are not available. Details about boreholes DC-1, DC-6, DC-12, DC-14, DC-15, and the McGee well are relevant to the consideration of the above analyses. Boreholes DC-6, DC-14, and DC-15 are located in close proximity to the Columbia River (Figure 3.1). Borehole DC-1 is located north of the 200 East Area. Borehole DC-12 is located southeast of the RRL and south of the 200 East Area. The McGee well is located between Umtanum Ridge and the RRL.

Borehole DC-14 is a flowing well that has been allowed to discharge over an extended period of time. A free flow discharge test was conducted in it to investigate the possibility of contamination of the groundwaters in the basalt flows by injection of drilling fluid. Record number 128, as discussed above, is a misplaced sample from a formation that the data base does not identify. Record number 128 predates this free flow discharge test. Record number 128 reportedly was extracted from a depth of 2,410 ft to 2,513 ft (735-766 meters). This depth should place the sample interval at the top of the Middle Sentinel Bluffs sequence (Figure 4.5.1) within the Grande Ronde Formation. Record number 132 was selected as a sample that represents the groundwaters at a deeper interval in the Grande Ronde Formation near the beginning of the free flow discharge test. Record number 166 collected near the end of the free flow discharge test was included in our analysis also. This sample (record number 166) is grouped appropriately in the Grande Ronde Formation cluster. Record number 132 is placed in the same cluster as record number 166 but much closer to record number 128. This difference in clustering of these three samples from the Grande Ronde

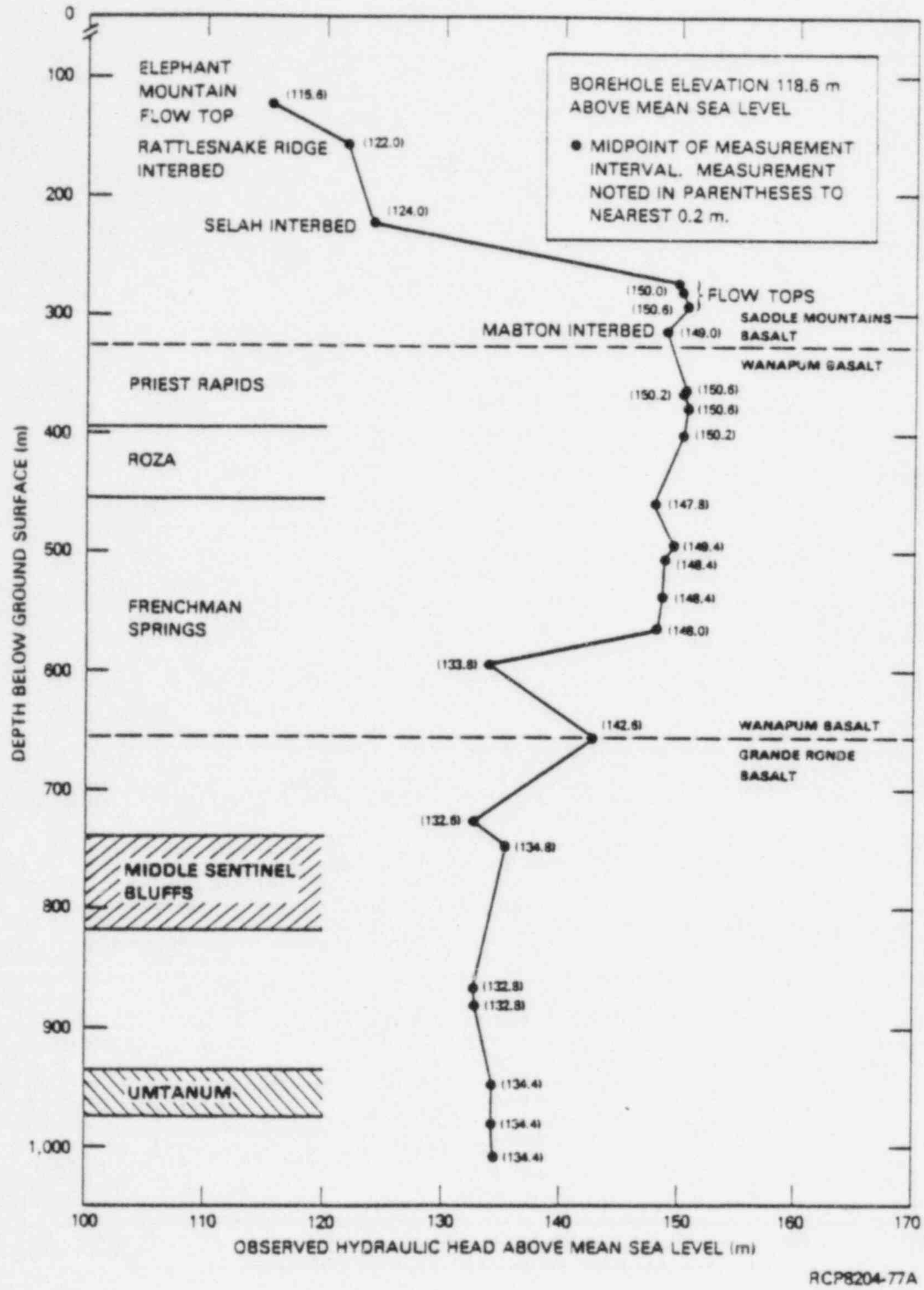


Figure 4.5.1. Hydraulic head measurements within the Columbia River Basalts in borehole DC-14 (U.S. Dept. of Energy, 1982, p. 5.1-69).

Formation collected at different times suggests that the record number 128 sample may not have been representative of the hydrochemistry of the Grande Ronde Formation. Record number 132 is not fully representative of the hydrostratigraphic unit whose quality was reflected by the later sample (record number 166) as a consequence of the free flow discharge test. The hydraulic head distribution from the drill and test sequence at borehole DC-14 indicates that a downward component of flow may exist (Figure 4.5.1). The hydraulic head data in this figure must be considered preliminary due to the short time intervals that were available during the testing of this borehole. The grouping of the later sample (record number 166) from the free flow discharge test is not consistent with a significant downward component of flow in the vicinity of borehole DC-14.

A hypothesis can be proposed and defended regarding the aforementioned anomalous grouping of record numbers 178 and 180 from borehole DC-15. These two samples were not placed in the expected Grande Ronde grouping with other Grande Ronde samples by our analysis. Borehole DC-15 is located near the Columbia River. The possibility exists that some vertically extensive oriented geologic structure exists in the vicinity of the Columbia River that permits vertical mixing of the groundwaters in this area. The hypothesis that there is vertical mixing of the groundwaters in the vicinity of the Columbia River is inconsistent with the concept that the Columbia River is a regional discharge sink. The concept that the river is a regional discharge sink requires that the groundwaters discharge upward. In the classical sense (homogeneous and isotropic hydraulic properties), all groundwater flow systems and hence flow paths must discharge upward to the

river. The upward discharge concept virtually eliminates the possibility of vertical mixing if the river is a regional line sink. The hydraulic head distribution within borehole DC-15 indicates that the overall potential for groundwater flow is upward within the formations tested. Several basalt flows appear to behave as hydraulic sinks based on these preliminary data (Figure 4.5.2). These data must be considered preliminary because a short time interval was allowed for head equilibration in the drill and test sequence employed at the site. Alternatively, the samples may not be representative of the true hydrochemistry of the Grande Ronde hydrostratigraphic unit sampled in this borehole. The samples may be contaminated by drilling fluids as evidenced in the previous discussion of DC-14 samples.

Borehole DC-1 was drilled originally under the supervision of the U. S. Geological Survey under the identification number ARH-DC-1 in 1969. The samples in the data base are from the original U. S. Geological Survey work. Gephart et al (1979, p. III-170) state that "The significant level of drilling fluid contamination within the aquifer waters analyzed, as noted by LaSala and Doty (1971) and the degree to which cross-aquifer communication took place within the borehole make any quantitative interpretation of these data highly suspect." Our statistical analysis apparently detected this contamination and/or cross-aquifer communication and could not fit the samples properly.

Borehole DC-12 is located near the projected axis of the Benson Ranch Syncline (Figure 4.5.3). Tectonic stresses associated with folding usually are assumed to create the greatest possibility of fracturing near the axis

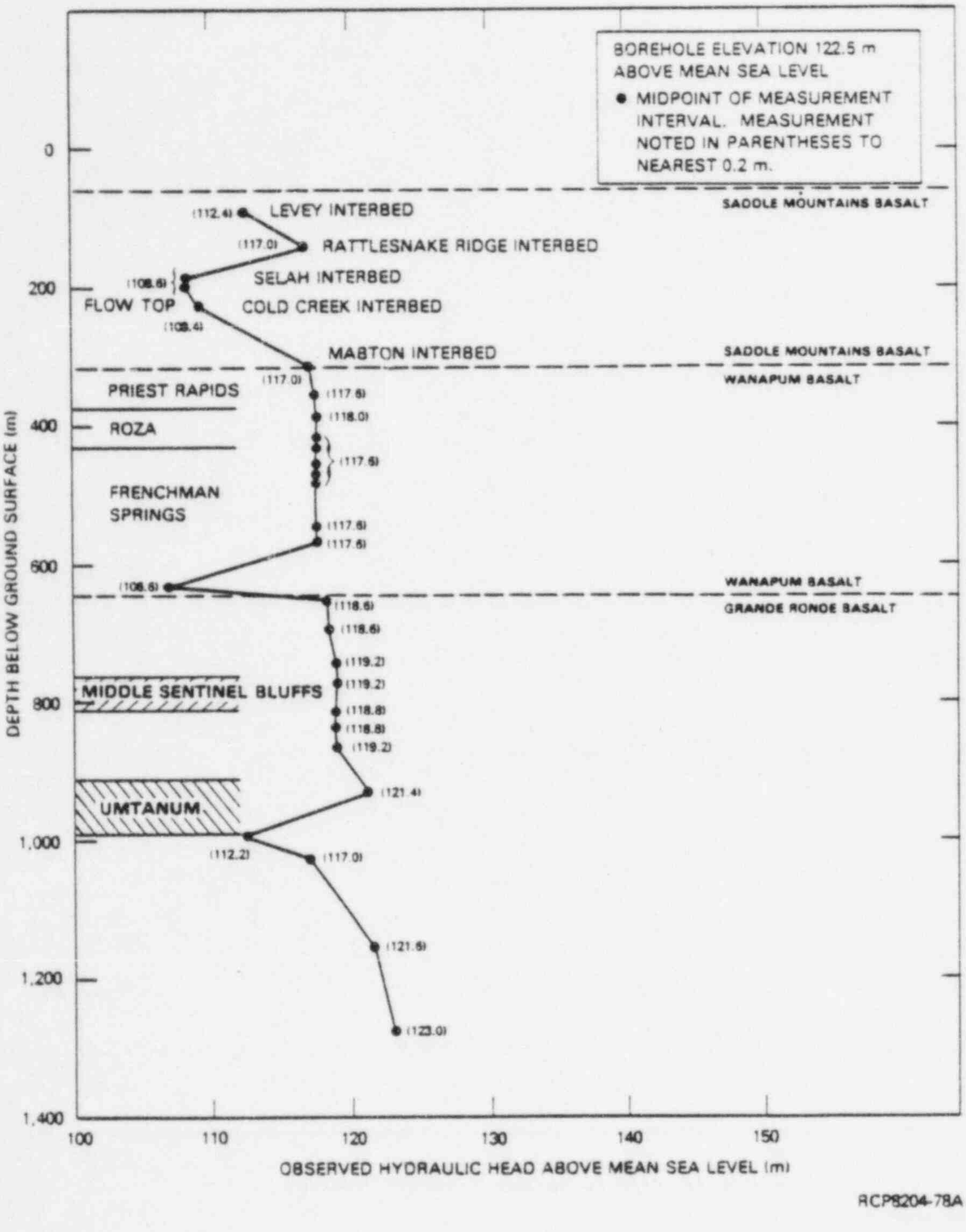


Figure 4.5.2. Hydraulic head measurement within the Columbia River Basalts in borehole DC-15 (U.S. Dept. of Energy, 1982, p. 5.1-70).

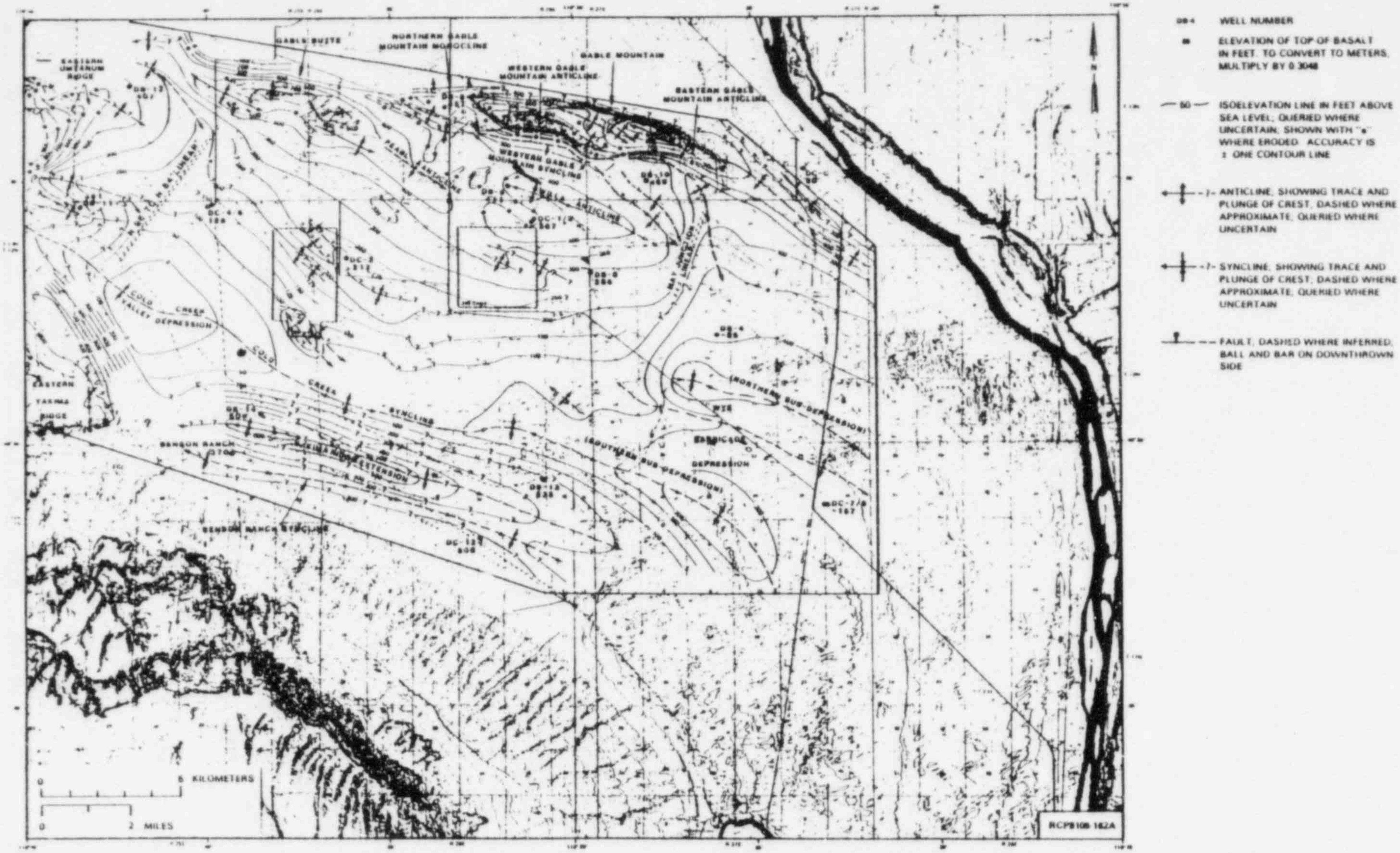


Figure 4.5.3. Top-of-basalt contour map (U.S. Dept. of Energy, 1982, p. 3.7-27).

of a syncline or anticline. The data suggest that the record numbers 104 and 106 represent a shallower water than what was sampled in borehole DC-12 from the Grande Ronde Basalts. The samples may indicate the vertical mixing of groundwaters in the vicinity of this borehole, possibly due to the influence of the stresses and associated fracturing near the synclinal axis. Figure 4.5.4 illustrates the concept that vertical mixing may occur in the vicinity of borehole DC-12. The distribution of hydraulic head in this borehole is essentially constant with depth; the differences in hydraulic heads measured in this borehole are within the range of possible measurement error. As noted previously, these data must be considered preliminary due to testing procedures employed at the BWIP site.

The deepened McGee well has been sampled within the Grande Ronde Formation since the completion of the report by Williams and Assoc., Inc. (1983). The record numbers 242 through 245 from this well do not fall within the Grande Ronde cluster even though the samples were collected from the Grande Ronde Formation. These samples fall in the Saddle Mountains-Wanapum cluster 2. The McGee well lies to the northwest of the so called Cold Creek "Barrier" which has been postulated on the basis of water level data, hydrogeologic pump test data, and geophysical data. The Cold Creek "Barrier" is indicated on Figure 4.5.3 as "N 96 to N 84 linear". The Cold Creek Barrier is the new designation for this postulated feature (U. S. Dept. of Energy, 1984, p. 3-79). It has been referred to previously as the Y Barricade and/or the Nancy Linear. The data discussed herein suggest that the Grande Ronde Formation groundwaters are different to the west and to the east of this feature.

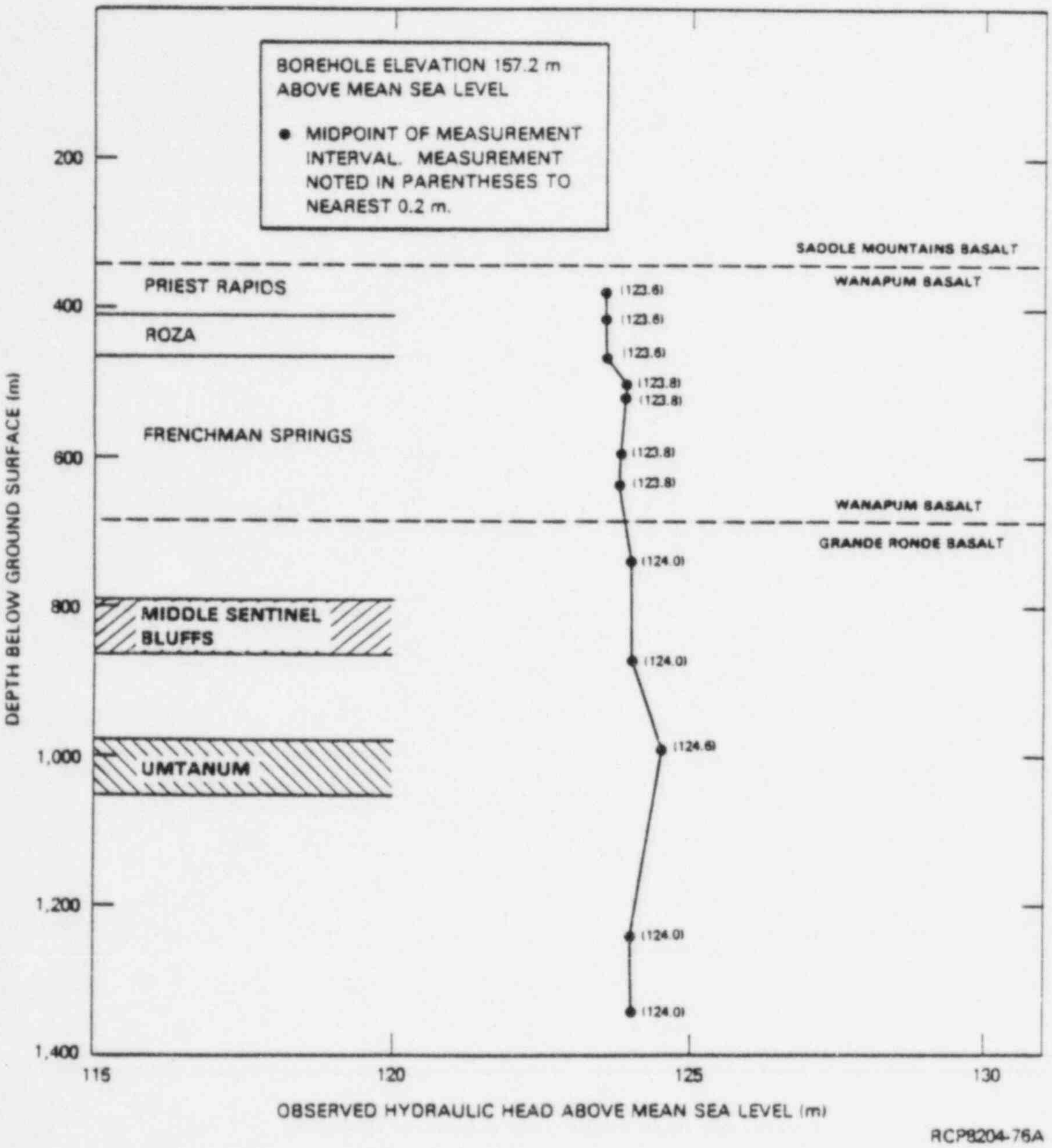


Figure 4.5.4. Hydraulic head measurements within the Wanapum and Grande Ronde Basalts in borehole DC-12 (U.S. Dept. of Energy, 1982, p. 5.1-68).

Record number 214 (borehole DC-6) does not group with the Grande Ronde cluster 6 as it should. This sample falls in cluster 2 which is characteristic of shallower Saddle Mountains and Wanapum Formation samples. No obvious explanation for this anomaly is apparent. The preliminary hydraulic head distribution (Figure 4.5.5) in this borehole does not support the concept that there is a significant downward component of groundwater flow in the vicinity of this borehole. The general direction of groundwater flow in this borehole is upward. As previously stated, these data must be considered preliminary. It is possible that this sample is not representative of Grande Ronde Formation waters due to inadequate borehole development. Vertical groundwater mixing does not seem probable because other Grande Ronde samples from this borehole cluster in or near cluster 5 as they should.

Record number 205 is from borehole DC-2 which is 60 feet southwest (at ground surface) of borehole DC-1. This hole was cored in basalt between May and September of 1977. The borehole was left open (uncased) between depths of 2,200 and 3,300 feet below ground surface (Gephart et al, 1979, p. III-116). Figure III-29 (Gephart et al, 1979) indicates that this depth interval is within the Grande Ronde Basalts. The 1979 sampling was, in all probability, from the Grande Ronde Basalts. A plausible explanation for the anomalous grouping of this sample is not clear. It is possible that contaminating fluids from drilling still remained in the vicinity of the borehole 2 years later.

Additional explanations must be considered for the anomalous grouping of these samples. For example the anomalous grouping may be the result of

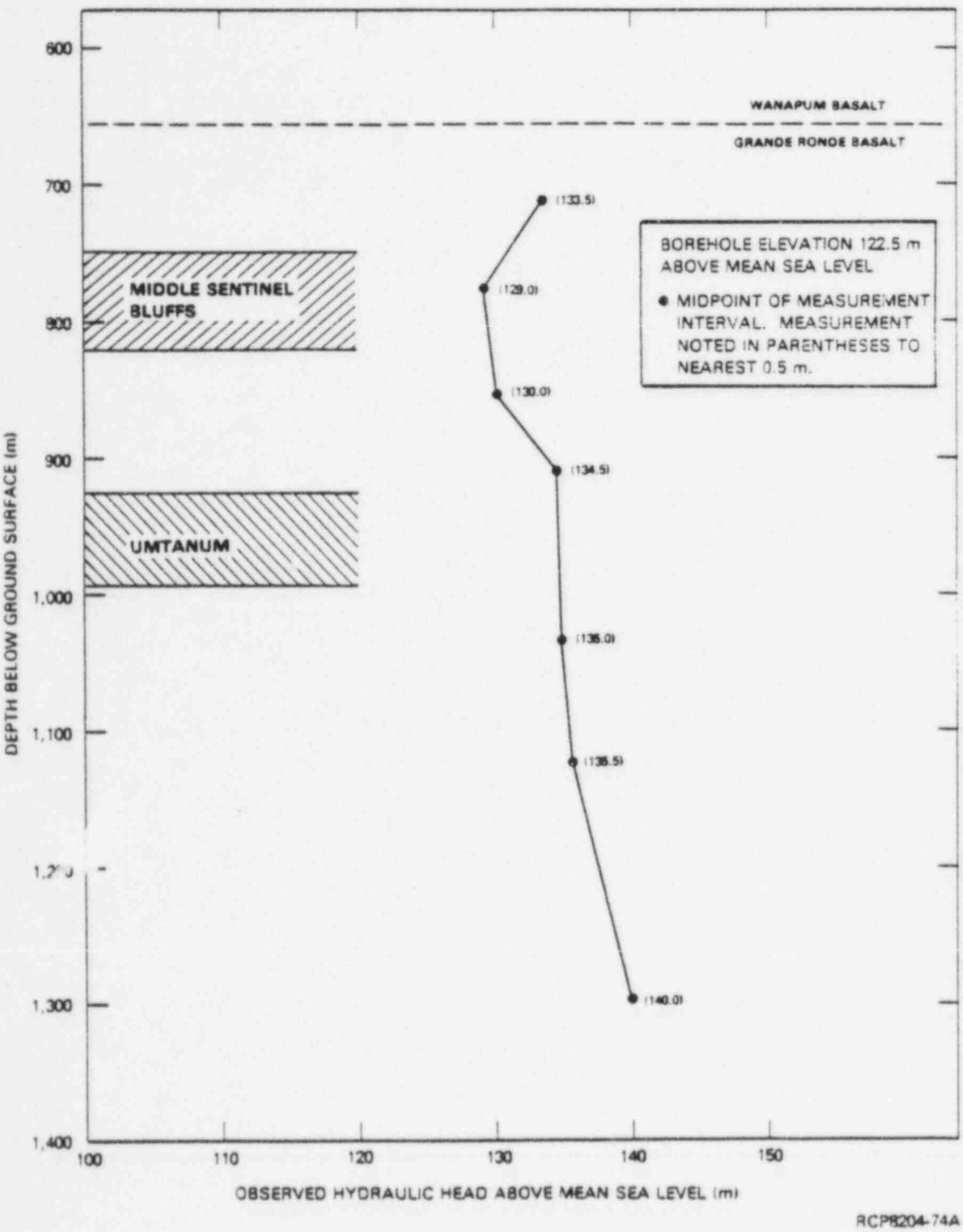


Figure 4.5.5. Hydraulic head measurements within the Grande Ronde Basalt in borehole DC-6 (U.S. Dept. of Energy, 1982, p. 5.1-66).

incorrectly identified samples. On the other hand the samples may have been correlated incorrectly with respect to depth, borehole number, and basalt flow sampled. In some cases the anomalous samples may have been contaminated by drilling fluids or the samples may not be representative of the hydrochemistry of the flow due to extensive periods of time during which the borehole was left open to cross formational flow. Sampling and analysis procedures may have resulted in inaccurate concentrations which normally could be detected by calculating an ion balance for each sample. An ion balance could not be calculated for this sample set because two major ions were not measured (presented).

5. DISCUSSION

In general, hydrochemistry data for the BWIP Site basalts can be used to distinguish formations statistically. The ability to distinguish the formations from which the water samples were derived is based on the distinctness of the hydrochemistry of these groundwaters. This distinctness should not be construed as being synonymous with hydraulic isolation. Two clusters of samples can be identified for the shallow basalts. The hydrochemistry of both clusters is characterized by low pH, low chloride (Cl), and low fluoride (F) concentrations. The clusters differ with respect to magnesium (Mg) concentrations. Cluster 1 typically has high magnesium concentrations compared to cluster 2; cluster 2 is slightly higher in magnesium concentrations than the concentrations in clusters containing deeper samples.

Clusters 5 and 6 represent samples from Grande Ronde Basalts. Clusters 3 and 4 are intermediate between clusters 1 and 2 and clusters 5 and 6. The Saddle Mountains and Grande Ronde samples are reasonably distinct except for the McGee samples discussed previously. These findings lend empirical support to hypothesis A2. That is, statistical procedures can distinguish among basalt formations at the BWIP site when applied to hydrochemical data.

The samples do not cluster in an areal spatial sense. This general conclusion is drawn from the spatial distribution of samples in the clusters. However the area to the west of the so called (or proposed) Cold Creek Barrier, which currently is represented only by the McGee well samples constitute a possible exception to this statement. No other samples are available from this area to support or refute the possibility of this

exception. This anomaly should be investigated further if more data become available. The statistical approach used herein may have identified an impact of the proposed Cold Creek Barrier on hydrochemistry. With this exception, hypothesis B1 is supported over hypothesis B2.

Several hydrogeologic implications are apparent from this analysis. The groundwaters in the Grande Ronde Basalts appear to exhibit a significant statistical difference on either side of the proposed Cold Creek Barrier. The anomalous placement of samples from borehole DC-12 in clusters suggests that vertical groundwater mixing occurs in the vicinity of borehole DC-12. The anomalous placement of the borehole DC-14 sample (record number 128) supports the conclusion that for some unknown reason the groundwater sample was not representative of the true groundwater quality of the formation from which it was collected.

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APPENDIX A
Computer Coding for Geologic Units

COMPUTER CODING FOR GEOLOGIC UNITS

Geologic unit or sampling designation	Computer code
Levey Interbed	LEVY
Elephant Mountain	ELEM
Rattlesnake Ridge Interbed	RATR
Selah Interbed	SELA
Cold Creek Interbed	COCK
Asotin	ASOT
Huntzinger	HUNT
Huntzinger #1	HUN1
Asotin-Umatilla	ASUM
Umatilla	UMAT
Umatilla #2	UMA2
Umatilla (annulus)	UMAA
Mabton Interbed	MABT
Mabton O Interbed	MABO
Priest Rapids (top)	PRRT
Priest Rapids #1	PRA1
Priest Rapids #2	PRA2
Priest Rapids-Roza	PRRZ
Priest Rapids	PRAP
Priest Rapids (annulus)	PRAA
Priest Rapids (packed)	PRPK
Roza Flow top	ROZT
Roza	ROZA
Roza-Frenchman Springs	RZFS
Squaw Creek Interbed	SQCK
Frenchman Springs #2	FRS2
Frenchman Springs #3	FRS3
Frenchman Springs #4	FRS4
Frenchman Springs #5	FRS5
Frenchman Springs #6	FRS6
Frenchman Springs #7	FRS7
Frenchman Springs #8	FRS8
Frenchman Springs	FRSR
Vantage Interbed	VANT
Sentinel Bluffs (top)	SENT
Sentinel Bluffs (bottom)	SENB
Grande Ronde	GRRD
Grande Ronde #2	GRR2
Grande Ronde #4	GRR4
Grande Ronde #6	GRR6
Grande Ronde #7	GRR7
Grande Ronde #8	GRR8

Grande Ronde #10	GR10
Grande Ronde #11	GR11
Grande Ronde Um	UMTA
Grande Ronde (lower)	GRRL
Grande Ronde (lower-composite)	GRLC
Grande Ronde (upper)	GRRU
Umtanum	UMTA
Umtanum (top)	UMTT
Umtanum (lower)	UMTL
Umtanum (bottom)	UMTB
N2R2 (high transmissivity)	N2R2

NEW UNIT DESIGNATIONS

Gable Mtn/Cold Creek	GACO
Cold Creek/Umatilla	COUM
Wanapum	WANA
Rocky Coulee top	ROCT
Rocky Coulee	ROCK
Rocky Coulee bottom	ROCB
Cohassett top	COHT
Cohassett	COHA
Cohassett bottom	COHB
McCoy Canyon	MCCO

APPENDIX B
Concentration Data for Selected Dissolved Ions plus pH and TDS in Groundwater Samples from the BWIP Site

The following abbreviations are used in the data listing.

OBS = Observation number
SAMPLE = BWIP sample number
FORM = Formation
RECNO = Record number

The remaining abbreviations are chemical symbols.

SAS 10:22 THURSDAY, MARCH 28, 1985

OBS	SAMPLE	FORM	RECNO	PH	SC	F_ALK	CL	F	SO4	NA	K	CA	MG	SI	TOTC	AL
1	CP73	MABT	2	8.36	401.0	202.0	16.0	3.1	0.5	94.8	12.7	2.00	0.550	31.8	47.37	-0.05
2	CP82	MABT	2	8.39	389.0	208.0	16.2	3.1	0.5	96.9	13.0	1.30	0.410	30.9	.	-0.05
3	81-19	MABT	4	8.24	438.0	191.0	16.1	3.6	0.3	100.6	13.2	1.80	0.490	27.9	.	-0.01
4	82-27	PRAP	5	8.67	473.0	186.0	46.6	7.1	16.3	99.7	15.3	0.43	0.100	35.4	.	-0.08
5	82-87	PRAP	5	8.67	473.0	186.0	47.5	7.1	16.6	100.2	15.3	0.49	0.100	35.3	.	-0.08
6	81-57	PRAP	11	8.19	277.0	141.0	4.6	0.7	.	33.3	9.9	15.30	7.500	32.2	.	0.04
7	63-95	SELA	12	8.05	320.0	145.0	4.6	0.0	19.1	16.8	7.1	25.30	13.500	14.9	.	-0.02
8	CP66	MABT	14	8.27	335.0	159.0	6.6	0.4	15.8	36.0	7.9	20.10	11.880	26.3	37.51	0.11
9	CP67	PRAP	16	8.23	315.0	162.0	5.0	0.6	0.5	33.0	10.7	17.70	10.290	26.1	38.99	0.09
10	CP69	ELEM	18	8.29	320.0	153.0	4.1	0.4	18.9	18.5	6.2	32.20	12.400	28.2	35.93	-0.02
11	CP72	RATR	21	8.05	300.0	150.0	3.7	0.4	7.6	26.7	7.2	21.60	9.250	28.6	35.54	0.11
12	CP91	SELA	22	8.35	262.0	160.0	3.7	0.6	6.5	62.5	8.8	6.40	1.230	29.3	37.59	1.50
13	CP92	COCK	23	8.28	306.0	170.0	3.9	0.5	0.6	63.9	14.7	10.90	0.950	31.2	39.88	0.14
14	CP97A	MABT	27	7.25	315.0	161.6	4.6	0.1	2.3	64.2	11.9	10.50	2.710	26.8	.	-0.02
15	CP97B	MABT	27	7.40	313.0	161.6	4.6	0.1	2.3	63.6	11.5	10.30	2.680	26.5	.	-0.02
16	CP93	RATR	29	8.41	388.0	152.0	5.4	0.3	38.6	17.0	6.4	42.00	15.750	31.3	35.34	0.14
17	CP94	RATR	29	8.42	367.0	152.0	5.2	0.3	39.7	17.1	6.4	42.90	15.930	31.7	.	0.13
18	CP98	SELA	30	8.40	289.0	159.0	3.3	0.2	6.5	32.5	7.2	20.10	7.690	29.1	.	0.78
19	CP101	COCK	33	8.66	271.0	150.0	3.7	0.4	0.7	40.6	7.8	14.02	5.200	28.0	33.60	0.02
20	CP103	MABT	36	8.01	303.0	159.0	10.9	0.1	2.4	67.9	10.0	2.17	0.710	29.7	37.74	0.32
21	81-139	PRAP	37	9.31	714.0	128.4	129.9	9.5	-0.5	136.7	17.6	2.03	-0.025	36.2	.	0.03
22	81-162	PRAP	37	9.31	714.0	128.4	129.0	9.4	-0.5	130.9	16.4	1.91	-0.025	36.6	24.31	0.00
23	79-17	RATR	38	7.00	335.0	125.9	7.7	-0.3	37.1	44.4	10.4	18.90	4.900	25.0	.	-0.01
24	79-22	RATR	38	7.00	317.8	98.4	.	.	.	.	.	.	.	.	.	.
25	79-4	RATR	38	7.80	340.0	127.0	7.8	-0.3	39.7	42.0	11.6	19.60	5.100	26.0	.	0.04
26	79-20	SELA	39	7.80	327.0	171.5	3.5	0.9	-1.2	78.4	7.1	2.36	0.390	20.7	.	-0.01

OBS	BA	B	CO	CR	CU	FE	LI	MN	MO	NI	PB	SR	ZN
1	0.013	0.206	-0.010	-0.005	-0.005	0.178	.	-0.100	-0.10	.	.	.	-0.005
2	0.012	0.089	-0.010	-0.005	-0.005	0.363	.	-0.100	-0.10	.	.	.	-0.005
3	0.010	0.130	-0.010	-0.003	-0.002	0.050	-0.020	-0.100	-0.03	-0.020	-0.010	0.010	-0.002
4	0.010	0.210	-0.020	-0.036	-0.006	0.120	0.015	-0.003	0.10	-0.030	-0.150	0.002	-0.020
5	0.010	0.200	-0.020	-0.036	-0.006	0.130	0.014	-0.003	0.10	-0.030	-0.150	0.002	-0.020
6	0.023	0.030	-0.010	0.004	-0.002	0.110	.	0.340	0.13	-0.020	-0.100	0.060	0.070
7	0.043	0.022	0.020	-0.005	-0.005	-0.005	.	.	-0.02	.	.	.	-0.005
8	0.065	0.034	-0.020	-0.005	-0.005	0.232	.	0.057	-0.02	.	.	.	0.037
9	0.052	0.013	-0.020	-0.005	-0.005	0.181	.	0.044	-0.02	.	.	.	0.015
10	0.118	-0.005	-0.005	-0.005	-0.005	0.033	.	0.070	-0.01	.	.	.	0.048
11	0.146	-0.005	-0.005	-0.005	-0.005	1.367	.	0.060	0.13	.	.	.	0.050
12	0.045	-0.005	-0.010	-0.005	0.010	2.755	.	0.100	0.10	.	.	.	-0.005
13	0.540	-0.005	-0.020	-0.005	-0.005	0.119	.	-0.500	0.07	.	.	.	-0.005
14	0.030	-0.005	-0.020	-0.005	-0.005	0.164	.	.	-0.02	.	.	.	-0.005
15	0.030	-0.005	-0.020	-0.005	-0.005	0.164	.	.	-0.02	.	.	.	-0.005
16	0.034	-0.005	-0.020	-0.005	.	-0.005	.	-0.500	0.13	.	.	.	0.018
17	0.038	-0.005	-0.020	-0.005	-0.005	-0.005	.	-0.500	0.10	.	.	.	0.015
18	0.031	0.019	-0.020	-0.005	-0.005	0.760	.	0.062	-0.02	.	.	.	0.129
19	0.023	0.032	-0.020	-0.005	-0.005	0.093	.	0.036	-0.02	.	-0.020	.	0.109
20	0.023	0.040	-0.020	-0.005	-0.005	0.734	.	-0.010	-0.02	.	-0.020	.	0.093
21	0.006	0.530	-0.004	-0.006	-0.003	0.160	0.002	0.008	0.11	-0.008	-0.043	0.007	0.003
22	0.004	0.530	-0.004	-0.006	-0.003	0.170	0.003	0.007	0.11	-0.008	-0.043	0.007	0.006
23	0.110	-0.005	-0.010	.	-0.002	0.018	-0.020	-0.020	.	-0.020	-0.100	.	.
24	.	.	.	.	.	.	.	.	.	.	.	.	.
25	0.120	.	.	.	.	0.024	.	-0.020	.	.	.	.	.
26	0.020	-0.005	-0.010	-3.000	-0.002	0.050	-0.020	-0.020	-0.03	-0.020	-0.100	0.120	0.060

OBS	SAMPLE	FORM	RECNO	PH	SC	F_ALK	CL	F	SO4	NA	K	CA	MG	SI	TOTC	AL
27	79-35	SELA	39	8.10	332.0	173.0	3.4	0.8	-1.2	78.5	7.1	2.40	0.390	20.0	.	-0.01
28	79-27	COCK	40	8.10	370.0	174.0	7.2	3.0	-1.2	82.7	8.7	2.00	0.390	31.6	.	-0.01
29	79-33	COCK	40	8.10	380.0	174.2	7.4	3.0	-1.2	87.3	8.7	2.00	0.400	25.6	.	-0.01
30	79-15	ASUM	41	8.20	382.0	191.3	8.8	3.0	-1.2	89.9	10.6	1.60	0.460	29.4	.	0.33
31	79-46	ASUM	41	8.20	382.0	191.3	9.4	2.9	-1.2	90.7	10.6	1.63	0.470	29.7	.	0.33
32	79-8	UMAT	42	8.70	427.5	207.7	.	.	.	97.6	10.8	1.90	0.470	28.8	.	0.37
33	79-74	PRAP	46	9.67	715.0	156.7	105.1	19.0	9.6	178.8	15.4	2.98	0.820	57.8	.	[illegible].38
34	79-85	PRAP	46	9.67	798.2	156.6	105.5	19.1	10.2	176.0	15.6	3.04	0.550	59.0	.	[illegible].47
35	79-80	PRRZ	47	9.63	850.0	149.0	104.8	19.0	6.8	170.8	14.9	2.00	0.300	58.0	.	0.45
36	79-99	PRRZ	47	9.63	850.0	149.6	104.6	19.0	6.8	170.1	14.7	1.90	0.300	57.2	.	0.60
37	79-62	FRSR	48	9.38	741.6	146.8	97.8	16.9	20.1	155.0	14.5	2.20	0.240	41.0	.	0.14
38	79-84	FRSR	48	9.38	741.6	146.8	98.0	17.0	20.1	159.6	17.0	2.40	0.300	40.3	.	0.07
39	80-35	FRSR	50	9.41	747.1	158.6	109.0	18.4	16.3	169.7	18.6	4.30	2.200	94.5	.	10.60
40	80-41	FRSR	50	9.41	747.1	158.6	103.0	18.0	16.5	169.0	18.1	3.90	2.000	85.4	.	9.10
41	80-24	FRSR	51	9.53	758.8	154.2	111.0	19.5	17.8	162.9	19.3	1.30	0.060	46.6	.	-0.01
42	80-74	FRSR	51	9.53	758.8	154.2	108.0	19.3	17.5	158.5	19.2	1.30	0.060	47.5	.	-0.01
43	80-42	FRSR	52	9.36	737.3	168.6	102.0	17.4	18.4	161.9	19.2	1.40	0.190	45.0	.	0.02
44	80-77	FRSR	52	9.36	737.3	168.6	101.0	17.6	18.7	160.6	18.3	1.40	0.180	44.3	.	0.01
45	80-1	FRSR	53	9.44	764.4	148.2	105.0	19.8	9.4	164.2	17.7	1.30	0.110	45.6	.	0.03
46	80-51	FRSR	53	9.44	764.4	148.2	105.3	19.5	9.4	164.5	17.6	1.20	0.100	46.0	.	-0.01
47	81-11	PRAP	58	8.43	463.0	134.2	29.9	5.1	35.7	98.7	17.0	0.73	0.290	29.6	.	0.20
48	81-13	PRAP	58	8.43	463.0	134.2	29.7	5.1	35.6	99.4	17.3	0.75	0.360	29.7	.	0.20
49	81-10	ROZA	59	8.67	496.0	134.2	31.9	5.8	38.2	103.4	16.3	0.59	0.090	34.2	.	0.07
50	81-7	ROZA	59	8.67	496.0	134.2	31.9	5.8	38.5	104.5	16.5	0.60	0.090	34.3	.	0.09
51	CP116	MABT	63	8.40	390.0	182.0	6.4	1.1	1.1	77.8	10.6	0.56	0.160	48.6	.	0.10
52	CP117	MABT	63	8.30	405.0	175.0	7.2	0.6	-1.2	84.8	11.6	0.60	0.180	50.5	.	0.12

OBS	BA	B	CO	CR	CU	FE	LI	MN	MO	NI	PB	SR	ZN
27	0.020	-0.005	-0.010	-0.003	-0.002	0.050	.	-0.020	-0.03	-0.02	-0.10	.	0.060
28	-0.005	0.114	0.025	0.045	.	0.156	.	-0.020	0.98	.	-0.10	.	.
29	-0.005	0.114	.	.	.	0.140	.	-0.020	0.98	.	.	.	.
30	0.260	0.110	0.050	0.080	0.050	0.180	-0.02	0.060	0.27	0.03	0.29	0.060	0.060
31	0.265	0.110	0.050	0.080	0.060	0.200	-0.02	0.060	0.31	0.04	0.34	0.060	0.060
32	0.260	0.090	0.050	0.070	0.053	0.240	-0.02	0.060	0.21	0.02	0.30	0.059	0.060
33	0.097	1.270	-0.010	-0.003	-0.002	3.280	.	0.050	0.50	.	.	.	0.100
34	0.046	1.300	-0.010	-0.003	-0.002	3.320	-0.02	0.060	0.60	-0.02	-0.10	0.013	0.200
35	-0.005	1.300	-0.010	-0.003	-0.002	1.700	.	0.030	-0.03	.	.	.	0.040
36	-0.005	1.270	-0.010	0.020	-0.002	2.400	.	0.040	0.50	.	.	.	0.050
37	0.034	0.900	-0.010	0.020	0.020	0.320	-0.02	0.290	-0.03	-0.02	-0.10	0.011	0.080
38	0.150	0.960	-0.010	0.020	0.030	0.190	-0.02	0.280	0.40	-0.02	-0.10	0.011	0.080
39	0.200	0.910	-0.010	0.020	-0.002	6.300	-0.02	0.130	-0.03	-0.02	-0.10	0.016	0.600
40	0.160	0.870	-0.010	0.020	0.010	5.600	-0.02	-0.020	0.30	-0.02	0.12	0.015	0.620
41	-0.005	0.950	-0.010	-0.003	-0.002	0.090	-0.02	-0.020	-0.03	-0.02	0.12	-0.001	0.040
42	-0.005	0.910	-0.010	-0.003	0.100	0.100	-0.02	-0.020	-0.03	-0.02	0.14	-0.001	0.010
43	-0.005	0.820	-0.010	-0.003	-0.002	0.080	-0.02	-0.020	0.20	-0.02	-0.10	0.007	0.020
44	-0.005	0.810	-0.010	-0.003	-0.002	0.080	-0.02	-0.020	-0.03	-0.02	-0.10	0.007	0.020
45	0.016	1.300	-0.010	-0.003	-0.002	0.270	-0.02	-0.020	-0.03	-0.02	-0.10	0.006	-0.010
46	-0.005	1.300	-0.010	-0.030	-0.002	0.110	-0.02	-0.020	0.30	-0.02	-0.10	0.005	-0.010
47	0.190	0.150	-0.010	0.010	0.009	0.680	.	0.370	0.27	-0.01	-0.10	0.004	0.030
48	0.200	0.150	-0.010	0.005	-0.005	0.690	.	0.400	0.28	-0.01	-0.10	0.004	0.030
49	0.220	0.140	-0.010	0.004	-0.005	0.130	.	0.340	0.26	-0.01	-0.10	0.002	0.020
50	0.190	0.150	-0.010	0.005	0.005	0.130	.	0.370	0.24	-0.01	-0.10	0.003	0.020
51	2.800	0.190	-0.010	-0.003	0.024	1.980	.	-0.024	-0.03	.	.	.	0.100
52	-0.005	0.160	-0.010	-0.003	0.010	2.300	.	-0.020	-0.03	.	.	.	0.090

OBS	SAMPLE	FORM	RECNO	PH	SC	F_ALK	CL	F	SO4	NA	K	CA	MG	SI	TOTC	AL
53	CP113	MABT	66	8.00	385.0	187.7	40.3	2.1	-1.2	98.4	14.6	1.40	0.430	0.0	.	0.19
54	83-472	MABT	72	8.50	311.0	139.0	10.1	0.8	14.4	71.0	10.5	0.45	-0.100	27.4	.	-0.08
55	DC-5	POMO	79	.	314.0	122.0	11.0	0.5	19.0	60.0	8.8	4.70	1.200	11.0	.	0.10
56	DC-7	GACO	85	8.60	344.0	180.0	4.2	1.0	.	79.0	7.8	2.10	0.300	21.0	.	0.10
57	DC-8	COUM	86	.	402.0	192.0	13.0	1.7	.	90.0	9.9	1.70	0.400	26.0	.	0.10
58	DC-9	UMAT	87	.	552.0	182.0	49.0	7.5	1.6	114.0	14.0	1.70	0.400	27.0	.	0.40
59	DC-10	PRAP	88	9.70	773.0	157.0	120.0	16.0	2.0	164.0	10.0	0.90	0.400	42.0	.	.
60	DC-11	WANA	89	10.50	904.0	153.0	120.0	20.0	10.0	177.0	12.0	5.80	0.100	42.0	.	1.10
61	DC-12	WANA	90	9.94	839.0	168.0	110.0	20.0	12.0	163.0	15.0	5.00	0.100	38.0	.	1.10
62	DC-13	GRRD	91	9.10	408.0	179.0	13.0	2.0	3.6	87.0	8.0	1.20	0.200	22.0	.	0.10
63	DC-14	GRRD	92	10.10	867.0	208.0	98.0	21.0	13.0	182.0	3.3	0.80	.	54.0	8.68	1.10
64	DC-15	UMTA	93	9.78	860.0	208.0	94.0	20.0	12.0	181.0	3.9	0.70	0.100	56.0	10.16	1.10
65	DC-16	GRRD	94	9.72	852.0	202.0	98.0	20.0	10.0	176.0	5.9	0.60	0.100	49.0	.	1.10
66	DC-17	GRRD	95	9.70	800.0	180.0	90.0	18.1	14.0	166.0	4.7	0.20	0.100	29.0	18.18	0.90
67	DC-18	GRRD	96	9.10	630.0	161.0	68.0	11.0	21.0	134.0	3.0	0.20	.	31.0	31.10	1.30
68	80-62	PRAP	97	9.21	672.8	137.1	103.0	10.3	3.3	142.4	15.2	1.08	0.090	32.6	.	0.05
69	80-80	PRAP	97	9.21	672.8	137.1	104.0	10.1	2.8	145.0	15.1	1.09	0.100	32.6	.	0.04
70	80-100	PRRZ	98	9.40	653.2	139.7	96.5	8.9	.	123.0	13.8	1.31	0.046	34.1	.	-0.01
71	80-63	PRRZ	98	9.40	653.2	139.7	95.6	8.9	.	123.4	16.3	1.38	0.052	37.6	.	-0.01
72	80-73	RZFS	99	9.46	.	143.4	105.0	8.2	1.4	125.9	13.8	1.60	0.098	31.3	.	-0.01
73	80-97	RZFS	99	9.46	.	143.4	103.0	8.2	1.2	122.8	13.7	1.56	0.094	31.2	.	-0.01
74	80-32	FRSR	100	9.52	726.1	173.3	.	.	.	243.8	26.5	3.88	0.180	86.3	.	-0.01
75	80-68	FRSR	100	9.52	726.1	173.3	109.1	9.5	5.9	242.1	26.1	3.78	0.180	86.1	.	-0.01
76	80-23	FRSR	101	9.45	707.0	147.4	89.5	6.0	-0.5	134.9	17.1	1.54	0.120	33.0	.	-0.01
77	80-82	FRSR	101	9.45	707.0	147.4	89.6	6.6	-0.5	135.1	17.4	1.52	0.120	32.4	.	-0.01
78	80-102	FRSR	102	9.38	661.5	139.7	102.3	10.3	.	135.1	16.3	1.16	0.076	35.3	.	0.08

OBS	BA	B	CO	CR	CU	FE	LI	MN	MO	NI	PB	SR	ZN
53	0.028	0.170	-0.010	-0.003	0.033	0.970	.	-0.020	-0.03	.	.	.	0.030
54	0.010	-0.020	-0.010	-0.040	-0.010	0.040	0.010	0.010	-0.02	-0.030	-0.15	0.003	-0.010
55	.	0.060	.	.	.	0.250	.	.	.	.	.	.	.
56	.	0.060	.	.	.	0.100	.	.	.	.	.	.	.
57	.	0.100	.	.	.	1.400	.	.	.	.	.	.	.
58	.	0.450	.	.	.	0.570	.	.	.	.	.	.	.
59	.	0.940	.	.	.	0.030	.	.	.	.	.	.	.
60	.	0.730	.	.	.	.	.	.	.	.	.	.	.
61	.	.	.	.	.	0.200	.	.	.	.	.	.	.
62	.	.	.	.	.	1.000	.	.	.	.	.	.	.
63	.	0.720	.	.	.	0.100	.	.	.	.	.	.	.
64	.	0.650	.	.	.	0.150	.	.	.	.	.	.	.
65	.	0.170	.	.	.	0.650	.	.	.	.	.	.	.
66	.	0.660	.	.	.	1.800	.	.	.	.	.	.	.
67	.	0.380	.	.	.	2.100	.	.	.	.	.	.	.
68	-0.005	0.940	-0.010	-0.003	-0.002	0.070	-0.020	-0.020	0.24	-0.020	-0.10	0.010	-0.010
69	0.014	0.930	-0.010	-0.003	-0.002	0.080	-0.020	-0.020	0.21	-0.020	-0.10	0.010	-0.010
70	-0.005	0.860	-0.010	-0.003	-0.002	-0.002	-0.020	-0.020	-0.03	-0.020	-0.10	0.005	-0.002
71	-0.005	0.940	-0.010	-0.003	-0.002	0.014	-0.020	0.042	0.05	-0.020	-0.10	0.009	-0.002
72	-0.005	0.760	-0.010	-0.003	-0.002	0.014	-0.020	-0.020	-0.03	-0.020	-0.10	0.031	-0.002
73	-0.005	0.760	-0.010	-0.003	-0.002	0.014	-0.020	-0.020	-0.03	-0.020	-0.10	0.030	-0.002
74	-0.005	1.280	-0.010	-0.003	-0.002	0.210	.	-0.020	-0.03	-0.020	-0.10	0.025	-0.002
75	1.090	1.330	-0.010	-0.003	-0.002	0.200	.	-0.020	-0.03	-0.020	-0.10	0.025	-0.002
76	-0.005	0.810	-0.010	-0.003	-0.002	0.045	-0.020	-0.020	-0.03	-0.020	-0.10	0.025	-0.002
77	-0.005	0.800	-0.010	0.005	-0.002	0.180	-0.020	-0.020	-0.03	-0.020	-0.10	0.025	-0.002
78	0.007	0.860	-0.010	-0.003	0.009	0.082	-0.020	-0.020	0.26	-0.020	-0.10	-0.012	-0.002

OBS	SAMPLE	FORM	RECNO	PH	SC	F_ALK	CL	F	SO4	NA	K	CA	MG	SI	TOTC	AL
79	80-124	FRSR	102	9.38	661.5	139.7	103.0	9.8	.	131.0	16.3	1.12	0.070	35.0	.	0.08
80	80-174	GRRD	104	9.57	705.1	144.7	127.6	13.6	1.7	148.2	15.0	1.17	0.051	28.9	.	-0.01
81	80-233	GRRD	106	9.64	.	157.4	117.0	10.7	4.0	138.2	13.0	1.64	0.160	46.3	.	0.04
82	80-243	GRRD	106	9.46	.	157.4	117.0	10.7	4.0	139.4	13.7	1.77	0.170	50.0	.	0.05
83	80-208	GRRD	107	10.18	807.0	210.6	104.4	12.3	15.4	158.6	16.0	5.00	0.051	54.5	.	0.05
84	80-234	GRRD	107	10.18	807.0	210.6	103.1	12.6	13.5	156.9	15.7	5.00	0.051	53.8	.	0.06
85	81-61	GRRD	108	9.52	776.0	150.0	130.7	12.9	4.2	161.4	7.6	1.07	-0.020	54.9	.	0.01
86	81-72	GRRD	108	9.52	776.0	150.0	130.8	13.0	4.2	162.8	7.6	1.05	0.010	56.0	.	0.03
87	82-47	GRRD	109	9.52	744.0	151.8	127.6	13.7	3.0	166.4	7.5	1.28	-0.100	63.2	.	0.19
88	82-85	GRRD	109	9.52	744.0	151.8	132.0	13.7	3.3	167.1	7.6	1.28	-0.100	63.0	.	0.22
89	80-3	ELEM	112	8.35	.	132.4	5.9	1.1	28.1	58.5	10.0	9.95	1.870	27.7	.	0.05
90	80-34	ELEM	112	8.35	.	132.4	5.7	1.0	28.1	58.3	10.0	9.00	1.780	27.8	.	0.06
91	80-16	RATR	113	8.10	.	109.3	6.7	0.8	24.0	49.8	13.4	6.70	1.470	32.4	.	0.03
92	80-53	RATR	113	8.10	.	109.3	6.5	0.8	23.5	48.8	13.1	6.50	1.440	31.8	.	0.03
93	80-47	SELA	114	7.65	263.6	107.8	4.9	0.6	17.6	30.5	12.0	15.10	2.470	32.4	.	0.06
94	80-85	SELA	114	7.65	263.6	107.8	5.0	0.6	18.1	31.9	13.0	16.00	2.600	33.9	.	0.03
95	80-69	ASOT	115	9.41	353.6	144.6	5.9	1.5	17.6	78.0	13.1	1.45	0.077	25.1	.	-0.01
96	80-83	ASOT	115	9.41	353.6	144.6	7.4	2.9	18.8	79.0	12.8	1.46	0.077	25.0	.	-0.01
97	80-36	ASOT	116	9.22	351.7	149.6	7.0	2.9	14.3	81.8	12.2	0.95	0.031	25.6	.	-0.01
98	80-89	ASOT	116	9.22	351.7	149.6	5.5	2.1	19.3	83.5	13.1	0.96	0.081	26.0	.	-0.01
99	80-2	MABT	117	9.44	396.0	151.8	11.9	1.6	29.1	79.4	12.8	7.00	0.260	26.2	.	0.02
100	80-71	MABT	117	9.44	396.0	151.8	11.8	1.5	29.1	79.6	12.7	7.03	0.260	26.1	.	0.04
101	80-136	PRAP	118	8.84	315.8	134.2	6.2	0.9	21.8	64.0	20.0	2.44	0.250	27.8	.	0.04
102	80-144	PRAP	118	8.84	315.8	134.2	6.3	1.0	21.2	65.6	20.4	2.74	0.290	26.8	.	0.04
103	80-127	PRAP	119	8.80	325.9	140.8	6.2	1.0	24.2	65.5	22.1	3.53	0.300	27.4	.	0.03
104	80-189	PRAP	119	8.80	350.0	140.7	6.3	1.0	24.2	64.5	20.6	3.42	0.290	27.0	31.92	0.02

OBS	BA	B	CO	CR	CU	FE	LI	MN	MO	NI	PB	SR	ZN
79	-0.005	0.840	-0.010	0.006	0.010	0.061	-0.020	-0.020	0.31	-0.020	0.12	0.012	-0.002
80	0.196	0.800	-0.010	-0.003	-0.002	0.175	-0.020	-0.020	-0.03	-0.020	-0.10	0.001	0.007
81	0.008	0.780	-0.010	0.020	-0.002	2.000	.	0.030	0.20	-0.020	-0.10	0.007	0.130
82	-0.005	0.860	-0.010	0.020	0.008	2.150	.	0.030	0.20	-0.020	-0.10	0.008	0.140
83	-0.005	0.790	-0.005	-0.005	-0.005	0.050	.	0.242	0.24	-0.010	-0.10	0.020	-0.005
84	-0.005	0.780	-0.005	-0.005	-0.005	0.040	.	0.220	0.17	-0.010	-0.10	0.015	-0.005
85	-0.005	0.700	-0.010	0.007	-0.002	0.062	-0.100	-0.100	-0.03	-0.020	-0.10	0.004	-0.002
86	-0.005	0.750	-0.010	0.004	-0.002	0.056	-0.100	-0.100	-0.03	-0.020	-0.10	0.004	-0.002
87	0.003	0.860	-0.015	-0.036	-0.006	0.270	0.024	0.006	0.16	-0.026	-0.16	0.003	-0.015
88	0.003	0.860	-0.015	-0.036	-0.006	0.300	0.024	0.006	0.16	-0.026	-0.16	0.003	-0.015
89	0.054	0.120	-0.010	-0.003	-0.002	0.160	-0.020	-0.020	0.17	-0.020	-0.10	0.090	-0.010
90	0.053	0.130	-0.010	-0.003	-0.002	0.170	0.020	-0.020	0.25	-0.020	-0.10	0.085	-0.010
91	0.064	-0.005	-0.010	-0.003	-0.002	0.650	-0.020	-0.020	0.04	-0.020	-0.10	0.049	0.020
92	0.061	-0.005	-0.010	-0.003	-0.002	0.061	-0.020	-0.020	0.07	-0.020	-0.10	0.048	0.020
93	0.058	-0.005	-0.010	-0.003	0.005	0.290	-0.020	0.070	0.18	-0.020	-0.10	0.102	0.040
94	0.059	-0.005	-0.010	-0.003	-0.002	0.310	-0.020	0.068	0.06	-0.020	-0.10	0.107	0.045
95	-0.005	0.070	-0.010	0.011	-0.002	0.040	-0.020	-0.020	-0.03	-0.020	-0.10	0.011	0.006
96	-0.005	0.066	-0.010	-0.003	-0.002	0.042	-0.020	-0.020	-0.03	-0.020	-0.10	0.011	-0.002
97	0.235	0.068	0.010	0.010	-0.002	0.012	-0.020	-0.002	-0.03	-0.020	-0.10	0.009	-0.002
98	-0.005	0.069	-0.010	0.010	-0.002	0.009	-0.020	-0.020	-0.03	-0.020	-0.10	0.009	-0.002
99	0.028	0.040	-0.010	-0.003	-0.002	0.028	-0.020	-0.020	-0.03	-0.020	-0.10	0.048	-0.002
100	0.031	0.042	-0.010	0.008	-0.002	0.048	-0.020	-0.020	-0.03	-0.020	-0.10	0.049	0.006
101	0.016	0.030	-0.010	-0.003	-0.002	0.050	-0.020	-0.020	-0.03	-0.020	-0.10	0.017	-0.002
102	0.012	0.030	-0.010	-0.003	-0.002	0.070	0.030	-0.020	-0.03	-0.020	-0.10	0.019	0.017
103	0.013	0.025	-0.010	-0.003	-0.002	0.040	-0.020	-0.020	-0.03	-0.020	-0.10	0.017	0.010
104	0.006	0.026	-0.010	-0.003	-0.002	0.019	.	-0.020	-0.03	.	-0.10	.	-0.002

OBS	SAMPLE	FORM	RECNO	PH	SC	F_ALK	CL	F	SO4	NA	K	CA	MG	SI	TOTC	AL
105	80-112	ROZA	120	8.75	323.0	134.2	6.6	0.8	16.6	62.7	21.3	3.19	0.210	30.8	.	0.03
106	80-168	ROZA	120	8.75	323.0	134.2	6.9	0.9	16.6	61.3	20.4	3.15	0.200	29.8	.	-0.01
107	80-157	SQCK	121	9.46	357.5	145.2	7.0	2.2	18.9	72.5	13.1	3.99	0.382	19.8	.	-0.01
108	80-183	SQCK	121	9.46	357.5	145.2	7.0	2.2	18.9	71.9	13.2	4.10	0.400	20.0	.	-0.01
109	80-155	FRSR	122	9.41	361.0	145.8	6.9	2.2	20.5	76.1	11.9	1.17	0.053	42.4	.	-0.01
110	80-185	FRSR	122	9.41	361.0	145.8	6.9	2.2	20.5	79.2	12.7	1.23	0.054	42.1	.	-0.01
111	80-104	FRSR	123	9.57	359.2	148.5	5.6	1.8	26.1	80.1	11.6	2.10	0.100	38.7	.	-0.01
112	80-125	FRSR	123	9.57	359.2	148.5	5.6	1.8	26.1	80.1	11.6	2.10	0.100	38.5	.	-0.01
113	80-115	FRSR	124	9.44	358.5	146.3	5.8	2.3	22.9	73.2	11.3	0.95	0.020	58.8	.	0.10
114	80-129	FRSR	124	9.44	358.9	146.3	5.8	2.3	22.9	74.7	11.8	1.01	0.020	60.4	.	0.12
115	80-156	FRSR	125	9.38	351.4	171.0	5.1	2.2	18.6	79.3	13.6	0.88	0.010	60.9	.	-0.01
116	80-170	FRSR	125	9.38	351.4	171.0	5.8	2.3	23.5	78.2	14.1	0.86	0.020	61.2	.	0.07
117	80-117	FRSR	126	9.65	421.4	187.6	8.4	3.9	31.0	113.8	11.7	0.71	0.020	68.7	.	-0.01
118	80-151	FRSR	126	9.65	421.4	187.6	8.4	3.9	31.0	116.1	11.5	0.72	0.020	68.8	.	-0.01
119	80-213	GRRD	127	9.69	757.4	206.6	60.9	24.3	19.8	148.5	9.6	1.25	0.050	72.5	.	0.21
120	80-236	GRRD	127	9.69	757.4	206.6	70.6	24.4	18.7	150.8	9.6	1.32	0.050	75.6	.	0.11
121	81-20	UNKN	128	9.61	1340.0	150.9	222.0	22.0	169.0	263.5	18.0	3.80	0.100	48.4	.	0.10
122	81-22	UNKN	128	9.61	1340.0	150.9	217.0	21.6	166.0	270.0	18.4	3.90	0.100	49.2	.	-0.08
123	81-16	UMTA	129	9.59	1458.0	109.0	231.8	40.7	145.1	315.7	8.3	4.25	0.040	57.3	.	0.11
124	81-30	UMTA	129	9.59	1458.0	109.0	231.4	40.6	144.8	315.6	8.1	4.14	0.040	56.0	.	0.11
125	81-141	UMTB	131	9.74	1532.0	106.4	258.0	50.1	112.8	343.5	7.3	1.82	-0.087	54.2	.	-0.06
126	81-21	GRRD	132	9.39	724.0	168.0	66.4	15.0	58.0	149.6	8.2	1.70	0.030	39.8	.	-0.01
127	81-29	GRRD	132	9.39	724.0	168.0	65.4	15.7	57.2	144.5	8.0	1.60	0.030	39.7	.	-0.01
128	83-411	GRRD	166	9.65	1547.0	114.0	256.1	49.5	150.6	338.9	5.7	1.36	-0.100	52.3	12.46	-0.08
129	83-464	GRRD	166	9.65	1537.0	113.0	256.7	49.7	150.6	337.1	5.7	1.36	-0.100	52.4	.	-0.08
130	80-31	LEVY	167	7.80	364.1	167.5	11.2	1.2	-0.5	60.3	12.6	10.50	3.800	23.1	.	-0.01

OBS	BA	B	CO	CR	CU	FE	LI	MN	MO	NI	PB	SR	ZN
105	0.011	0.030	-0.010	0.006	0.007	0.024	0.020	-0.020	-0.03	-0.020	-0.100	0.012	-0.002
106	-0.005	-0.010	-0.019	-0.003	-0.002	-0.005	-0.030	-0.020	-0.03	-0.020	-0.100	0.008	-0.002
107	-0.005	0.036	-0.010	-0.003	-0.002	0.065	-0.020	-0.020	-0.03	-0.020	-0.100	0.064	-0.002
108	-0.005	0.036	-0.010	-0.003	-0.002	0.186	-0.020	-0.020	-0.03	-0.020	-0.100	0.066	-0.002
109	-0.005	0.053	-0.010	-0.010	-0.002	-0.010	-0.020	-0.020	-0.03	-0.020	-0.100	0.010	-0.007
110	-0.005	0.032	-0.010	-0.003	-0.002	-0.005	-0.020	-0.020	-0.03	-0.020	-0.100	0.008	-0.002
111	-0.005	0.030	-0.010	-0.003	-0.002	0.015	.	-0.020	-0.03	-0.020	-0.100	0.010	-0.002
112	-0.005	0.034	-0.010	-0.003	-0.002	0.043	-0.020	-0.020	-0.03	-0.020	-0.100	0.013	-0.002
113	-0.005	0.060	-0.010	-0.003	-0.002	0.030	.	0.030	0.22	-0.020	0.180	-0.001	-0.002
114	-0.005	0.070	-0.010	0.010	-0.002	0.010	.	0.020	0.27	-0.020	0.180	-0.001	-0.002
115	-0.005	0.030	-0.010	-0.003	-0.002	-0.010	.	-0.020	-0.03	-0.020	-0.100	-0.001	-0.002
116	-0.005	0.060	-0.010	0.010	-0.007	0.010	.	0.050	0.19	-0.020	0.230	-0.001	0.020
117	-0.005	-0.010	-0.010	-0.003	-0.002	0.074	.	-0.020	-0.03	-0.020	-0.100	0.005	-0.002
118	-0.005	-0.010	-0.010	0.007	-0.002	0.080	.	-0.020	-0.03	-0.020	-0.100	0.005	-0.002
119	0.023	0.580	0.020	0.030	0.030	0.100	.	-0.020	0.94	0.050	0.370	0.014	0.010
120	-0.005	0.590	-0.010	0.010	-0.002	0.080	.	-0.020	0.26	0.020	0.170	0.012	-0.002
121	0.020	0.500	-0.005	-0.005	0.007	0.100	.	0.300	0.80	-0.010	-0.100	0.040	0.005
122	0.020	0.500	-0.005	-0.005	-0.005	0.100	.	0.300	0.75	-0.010	-0.100	0.050	-0.005
123	0.020	0.990	-0.010	-0.010	-0.005	0.030	.	0.280	0.87	-0.010	0.100	0.030	0.010
124	0.020	0.980	-0.010	0.010	-0.005	0.010	.	0.320	0.91	-0.010	-0.100	0.030	0.007
125	0.003	1.390	-0.030	-0.040	-0.005	0.030	0.010	-0.003	0.61	-0.030	-0.120	0.005	0.020
126	0.008	0.450	-0.010	-0.003	0.002	0.010	-0.020	-0.100	0.15	-0.020	0.100	0.020	-0.020
127	0.009	0.440	0.010	-0.003	-0.002	0.010	-0.020	-0.100	0.19	-0.020	0.100	0.020	-0.002
128	0.004	1.090	-0.010	-0.040	-0.010	-0.010	0.030	-0.004	0.62	-0.030	-0.150	0.010	-0.010
129	0.004	1.090	-0.010	-0.040	-0.010	-0.010	0.030	-0.004	0.63	-0.030	-0.150	0.010	-0.010
130	0.061	0.050	-0.010	-0.003	-0.002	0.110	-0.020	0.050	-0.03	-0.020	-0.100	0.064	0.110

OBS	SAMPLE	FORM	RECNO	PH	SC	F_ALK	CL	F	SO4	NA	K	CA	MG	SI	TOTC	AL
131	80-56	LEVY	167	7.80	364.1	167.5	11.3	1.2	-0.5	61.3	12.4	10.70	3.840	25.5	.	-0.01
132	80-54	RATR	168	8.25	301.9	157.9	8.4	1.0	-0.5	58.2	12.6	8.97	2.450	25.5	.	-0.02
133	80-76	RATR	168	8.25	301.9	157.9	7.8	1.0	-0.5	59.0	12.6	9.17	2.500	26.0	.	-0.02
134	80-57	COCK	169	8.06	179.5	248.6	15.5	1.1	-0.5	112.3	12.1	3.08	0.510	32.8	.	-0.01
135	80-65	COCK	169	8.06	179.5	248.6	9.8	0.7	-0.5	122.7	12.9	3.44	0.550	33.7	.	-0.01
136	80-87	MABT	170	8.27	477.0	232.6	17.9	2.0	.	108.5	13.6	2.58	0.950	28.5	.	-0.01
137	80-94	MABT	170	8.27	477.0	232.6	17.8	2.0	.	109.6	13.8	2.59	0.950	28.6	.	-0.01
138	80-137	PRRZ	171	9.42	419.5	130.1	46.0	11.5	2.0	89.1	11.1	1.08	0.032	32.6	.	0.04
139	80-197	PRRZ	171	9.42	419.5	130.1	46.9	11.4	2.4	91.3	11.0	1.07	0.032	32.8	.	0.03
140	80-130	ROZA	172	9.31	450.0	138.6	35.9	9.0	-0.5	97.7	14.2	1.06	0.034	32.5	.	0.03
141	80-176	ROZA	172	9.31	450.0	138.6	38.6	9.5	-0.5	97.5	14.2	1.04	0.034	32.1	.	-0.01
142	80-135	FRSR	173	9.43	.	148.4	40.1	9.1	2.7	98.1	14.5	1.54	0.038	37.8	.	0.07
143	80-149	FRSR	173	9.43	.	148.5	39.7	9.3	.	97.8	13.3	1.67	0.040	36.3	.	0.05
144	80-120	FRSR	174	9.36	515.7	162.3	44.5	10.9	1.3	101.7	15.9	1.33	0.055	37.7	.	-0.01
145	80-139	FRSR	174	9.36	515.7	162.3	44.5	10.9	1.3	100.2	15.4	1.33	0.054	37.7	.	-0.01
146	80-108	FRSR	175	9.54	583.6	151.8	66.0	12.1	7.5	111.2	14.0	0.95	0.030	55.7	.	0.10
147	80-131	FRSR	175	9.54	583.6	151.8	64.7	11.8	7.5	117.3	13.6	0.96	0.030	56.1	.	0.07
148	80-114	FRSR	176	9.63	627.6	184.8	70.7	8.6	4.8	122.0	12.8	1.60	0.032	58.0	.	-0.01
149	80-193	FRSR	176	9.63	627.6	184.8	72.2	8.6	4.8	120.0	13.3	1.60	0.033	59.2	.	-0.01
150	81-24	GRRD	177	9.13	1070.0	94.4	170.0	11.5	140.0	199.0	10.6	3.50	0.230	40.8	.	0.07
151	81-41	GRRD	177	9.13	1070.0	94.4	165.0	11.5	141.0	199.7	10.8	3.50	0.220	41.2	.	0.11
152	81-2	GRRD	178	9.34	1148.0	86.2	224.0	18.4	119.0	213.0	14.6	5.90	0.800	43.4	.	0.70
153	81-36	GRRD	178	9.34	1148.0	86.2	224.0	18.3	119.0	217.4	15.0	6.00	0.800	44.5	.	0.70
154	81-46	COHA	179	9.27	1119.0	78.3	183.4	17.5	139.6	229.2	11.9	10.40	0.080	38.3	.	0.15
155	81-50	COHA	179	9.27	1119.0	78.3	182.5	17.4	139.6	229.9	11.7	10.30	0.080	38.0	.	0.15
156	81-32	GRRD	180	9.13	1248.0	52.3	206.2	22.9	198.8	234.7	14.8	7.90	0.030	43.9	.	0.10

OBS	BA	B	CO	CR	CU	FE	LI	MN	MO	NI	PB	SR	ZN
131	0.063	0.050	-0.010	-0.003	-0.002	0.120	-0.020	0.060	-0.03	-0.020	-0.100	0.065	0.110
132	0.068	0.020	-0.010	-0.003	-0.002	0.050	-0.020	-0.020	-0.03	-0.020	-0.100	0.061	0.020
133	0.074	-0.010	-0.010	-0.003	-0.002	0.060	-0.020	-0.020	-0.03	-0.020	-0.100	0.052	0.020
134	0.058	0.045	-0.010	0.007	-0.002	0.320	-0.020	0.030	-0.03	-0.020	-0.100	0.032	0.080
135	0.065	0.038	-0.010	-0.003	-0.002	0.320	-0.020	0.034	-0.03	-0.020	-0.100	0.034	0.070
136	0.033	0.085	-0.010	0.005	-0.002	0.500	0.030	0.038	-0.03	-0.020	-0.100	0.018	0.040
137	0.017	0.086	-0.010	-0.003	-0.002	0.490	0.050	0.039	-0.03	-0.020	-0.100	0.018	0.043
138	-0.005	0.260	-0.012	-0.003	-0.002	0.020	-0.020	-0.020	0.10	-0.020	-0.100	0.003	-0.002
139	-0.005	0.260	-0.010	-0.003	-0.002	0.015	-0.020	-0.020	-0.03	-0.020	-0.100	0.003	-0.002
140	0.009	0.220	-0.010	-0.003	0.008	0.030	-0.020	-0.020	0.14	-0.020	-0.100	0.005	-0.002
141	-0.005	0.210	-0.010	-0.003	-0.002	0.010	-0.020	-0.020	-0.03	-0.020	-0.100	0.002	-0.002
142	0.008	0.220	-0.010	-0.003	0.010	0.097	-0.020	-0.020	0.19	-0.020	-0.100	0.005	-0.002
143	-0.005	0.230	-0.010	-0.003	-0.002	0.110	-0.020	-0.020	-0.03	-0.020	-0.100	0.005	-0.002
144	0.012	0.220	-0.010	-0.003	-0.002	0.062	-0.020	-0.020	-0.03	-0.020	-0.100	0.004	-0.002
145	-0.005	0.210	-0.010	-0.003	-0.002	0.058	-0.020	-0.020	-0.03	-0.020	0.100	0.004	-0.002
146	-0.005	0.290	-0.010	-0.003	-0.002	0.060	.	0.050	0.29	-0.020	-0.100	-0.001	-0.002
147	-0.005	0.290	-0.010	-0.003	-0.002	0.050	.	0.040	0.20	-0.020	0.180	-0.001	-0.002
148	-0.005	0.190	-0.010	-0.003	-0.002	0.040	.	-0.020	-0.03	-0.020	-0.100	-0.001	0.030
149	-0.005	0.210	-0.010	-0.003	-0.002	0.040	.	0.050	-0.03	-0.020	-0.100	0.002	0.030
150	0.010	0.350	-0.005	-0.005	0.008	0.150	.	0.260	0.72	0.010	-0.100	0.030	0.030
151	0.010	0.360	0.007	0.010	0.014	0.160	.	0.270	0.83	0.010	-0.100	0.030	0.029
152	0.030	0.500	-0.005	0.030	0.010	15.030	.	0.300	0.80	-0.010	-0.100	0.030	0.300
153	0.030	0.500	0.006	0.030	0.020	15.400	.	0.300	0.90	-0.010	-0.100	0.030	0.300
154	0.020	0.650	-0.010	0.008	-0.005	0.200	.	0.370	0.83	-0.010	-0.100	0.040	0.008
155	0.020	0.650	-0.010	0.010	-0.005	0.200	.	0.390	0.83	0.010	-0.100	0.040	0.010
156	0.030	0.810	-0.010	0.008	-0.005	0.080	.	0.360	0.98	-0.010	0.610	0.030	0.010

OBS	SAMPLE	FORM	RECNO	PH	SC	F_ALK	CL	F	SO4	NA	K	CA	MG	SI	TOTC
157	81-33	CRRD	180	9.13	1248.0	52.3	205.7	22.8	198.8	251.6	23.6	7.80	0.030	42.5	.
158	81-27	UMTA	181	9.46	1246.0	104.0	189.0	32.6	131.8	259.4	5.8	2.08	0.020	51.6	.
159	81-74	UMTA	181	9.46	1246.0	104.0	190.0	32.8	133.8	262.4	5.6	2.11	-0.025	54.8	.
160	81-64	UMTA	182	9.20	1771.0	75.0	308.1	23.5	214.9	361.6	8.1	4.30	0.090	40.6	.
161	81-69	GRRD	184	9.02	1334.0	86.0	224.8	21.8	175.6	271.2	3.9	2.22	0.027	37.6	.
162	81-84	GRRD	184	9.02	1334.0	86.0	224.8	21.8	175.8	263.2	3.7	2.11	0.028	36.8	.
163	82-41	GRRD	185	9.81	1192.0	146.3	138.2	46.9	105.9	265.3	2.7	1.80	-0.100	54.7	.
164	82-94	GRRD	185	9.81	1192.0	146.3	137.2	46.3	107.2	271.2	2.9	1.80	-0.100	54.0	.
165	81-109	RAIR	186	8.32	494.0	224.0	3.6	0.5	22.1	104.0	4.2	10.80	4.900	22.2	.
166	81-167	RAIR	186	8.32	494.0	223.5	3.6	0.5	21.9	98.2	3.9	10.10	4.600	22.2	.
167	82-17	SELA	187	7.25	293.0	148.0	3.6	0.5	4.4	46.6	6.4	14.90	3.500	9.9	.
168	82-55	SELA	187	8.04	293.0	140.5	3.6	0.5	4.4	46.8	6.4	15.00	3.500	9.9	.
169	82-45	MABT	188	8.86	340.0	184.0	5.1	0.7	4.6	68.6	11.6	6.00	1.500	33.9	.
170	82-93	MABT	188	8.86	340.0	184.0	4.9	0.6	4.6	68.7	11.6	6.00	1.500	34.2	.
171	82-19	RZFS	189	9.14	795.0	150.0	146.0	9.5	2.0	164.7	17.0	2.00	-0.100	38.3	.
172	82-88	RZFS	189	9.14	795.0	150.0	147.0	9.9	2.0	166.1	16.9	2.00	-0.100	39.4	.
173	82-140	FRSR	190	9.40	878.0	151.0	170.0	9.9	1.2	179.5	18.2	1.67	-0.100	36.1	.
174	82-188	FRSR	190	9.40	878.0	151.0	172.0	10.0	1.2	180.1	18.3	1.67	-0.100	36.1	.
175	82-124	FRSR	191	9.39	697.0	144.0	110.0	13.0	1.9	141.6	20.3	1.70	-0.100	40.8	.
176	82-172	FRSR	191	9.39	697.0	144.0	109.0	13.0	1.9	140.6	20.1	1.70	-0.100	40.6	.
177	82-126	FRSR	192	9.40	1236.0	102.0	308.0	10.9	6.7	231.5	34.4	4.80	-0.100	37.7	.
178	82-143	FRSR	192	9.40	1216.0	102.0	309.0	10.8	6.5	232.2	34.6	4.90	-0.100	38.0	.
179	82-183	FRSR	192	.	.	.	4.3	0.6	.	29.5	8.0	17.00	8.900	29.6	.
180	82-202	FRSR	194	9.10	1230.0	107.6	264.0	12.4	6.1	217.0	30.2	3.90	-0.100	33.7	.
181	82-228	FRSR	194	9.10	1230.0	107.6	265.0	12.4	6.0	227.0	31.5	4.10	-0.100	34.2	.
182	82-322	FRSR	195	9.11	1673.0	90.0	442.0	24.2	2.3	324.0	32.0	3.89	-0.100	37.9	.

OBS	AL	BA	B	CO	CR	CU	FE	LI	MN	MO	NI	PB	SR	ZN
157	0.11	0.020	0.77	-0.010	0.010	-0.005	0.080	.	0.470	0.99	0.010	-0.100	0.030	-0.005
158	0.05	-0.005	0.76	-0.010	-0.003	-0.002	0.043	-0.100	-0.100	-0.03	-0.020	-0.100	0.008	-0.002
159	0.05	0.004	0.91	-0.004	-0.006	-0.003	0.034	0.006	-0.001	-0.03	-0.008	-0.043	0.008	-0.004
160	0.14	0.020	0.81	-0.010	0.009	-0.002	0.500	0.100	0.310	1.22	-0.020	-0.100	0.020	0.003
161	0.06	0.007	0.78	-0.010	-0.003	-0.002	0.055	0.103	-0.100	-0.03	-0.020	-0.100	0.011	0.002
162	0.04	-0.005	0.74	-0.010	0.007	-0.002	0.047	0.110	-0.100	-0.03	-0.020	-0.100	0.010	0.007
163	0.36	0.009	2.34	-0.015	-0.036	-0.006	0.140	0.020	-0.003	0.47	-0.026	-0.150	0.012	-0.015
164	0.36	0.013	2.32	-0.015	-0.036	-0.006	0.160	0.020	0.004	0.47	-0.026	-0.150	0.012	-0.015
165	-9.08	0.030	-0.02	-0.020	0.230	-0.006	0.080	0.007	0.020	-0.02	-0.030	-0.150	0.060	-0.020
166	0.08	0.030	-0.02	-0.020	0.220	-0.006	0.080	0.007	0.020	-0.02	-0.030	-0.150	0.060	-0.020
167	-0.08	0.003	0.02	-0.020	-0.040	-0.006	0.070	0.020	0.030	-0.02	0.030	-0.160	0.040	-0.020
168	-0.08	0.007	-0.02	-0.020	-0.040	-0.006	0.060	0.020	0.030	-0.02	-0.030	-0.160	0.040	-0.020
169	-0.08	0.024	0.05	-0.010	-0.030	-0.006	0.090	0.030	0.040	-0.02	-0.030	-9.150	0.044	-0.010
170	-0.08	0.024	0.05	-0.010	-0.030	-0.006	0.090	0.030	0.040	-0.02	-0.030	-0.150	0.043	-0.010
171	-0.08	0.008	0.50	-0.010	0.080	-0.006	0.100	-0.006	-0.003	0.15	-0.020	-0.150	0.015	-0.010
172	-0.08	0.007	0.51	-0.010	0.080	-0.006	0.110	-0.006	-0.003	0.15	-0.020	-0.150	0.015	-0.010
173	-0.08	0.006	0.60	-0.010	-0.030	-0.006	0.070	-0.006	0.004	0.20	-0.020	-0.150	0.011	-0.010
174	-0.08	0.005	0.60	-0.010	-0.030	-0.006	0.070	-0.006	0.005	0.21	-0.020	-0.150	0.011	-0.010
175	-0.08	0.007	0.63	-0.010	0.050	-0.006	0.050	0.007	0.004	0.10	-0.020	-0.150	0.011	-0.010
176	-0.08	0.007	0.62	-0.010	0.050	-0.006	0.050	0.010	0.004	0.10	-0.020	-0.150	0.011	-0.010
177	-0.08	0.026	0.61	-0.010	0.060	-0.006	0.070	0.020	-0.003	0.13	-0.020	-0.150	0.017	-0.010
178	-0.08	0.028	0.62	-0.010	0.060	-0.006	0.057	0.020	-0.003	0.14	-0.020	-0.150	0.017	-0.010
179	-0.08	0.024	-0.02	-0.010	-0.030	-0.006	0.050	0.014	0.060	-0.02	-0.020	-0.150	0.062	0.190
180	-0.07	0.017	0.54	-0.010	0.100	-0.006	1.810	0.010	0.069	0.04	-0.020	-0.150	0.014	-0.010
181	-0.07	0.017	0.54	-0.010	0.090	-0.006	2.260	0.010	0.080	0.04	-0.020	-0.150	0.015	-0.010
182	-0.08	0.014	1.43	-0.010	-0.030	-0.006	0.030	0.110	-0.003	0.18	-0.020	-0.150	0.019	-0.010

OBS	SAMPLE	FORM	RECNO	PH	SC	F_ALK	CL	F	SO4	NA	K	CA	MG	SI	TOTC
183	82-361	FRSR	195	9.11	1673.0	90.0	438.7	24.0	2.3	320.1	31.6	3.82	-0.100	37.5	.
184	82-332	FRSR	196	9.30	1663.0	126.0	451.8	25.9	2.5	322.6	29.4	4.30	-0.100	34.0	.
185	82-358	FRSR	196	9.30	1663.0	126.0	451.8	26.1	2.6	324.9	29.5	4.30	-0.100	34.4	.
186	82-430	VANT	198	9.46	1738.0	150.0	412.0	27.3	8.4	346.5	20.0	2.70	-0.100	28.6	.
187	82-473	VANT	198	9.46	1738.0	147.0	415.0	27.7	8.4	355.0	20.4	2.80	-0.100	29.2	.
188	83-29	ROCK	199	9.51	1746.0	.	422.0	26.6	5.5	355.0	24.3	2.60	-0.100	45.9	36.19
189	83-147	MABT	200	7.28	288.0	146.7	7.4	0.7	.	56.3	11.4	4.80	1.460	33.4	.
190	83-100	GRRD	201	9.20	.	124.0	367.0	23.9	4.0	300.0	9.1	1.50	-0.100	42.7	.
191	83-215	MCCO	202	8.80	920.0	130.0	188.8	11.2	1.6	180.3	17.3	1.63	-0.100	38.0	.
192	83-259	MCCO	202	8.80	920.0	130.0	188.8	11.2	1.6	180.0	17.3	1.74	-0.100	37.8	54.32
193	80-25	UNKN	205	8.80	.	390.2	75.5	17.7	44.2	287.0	19.9	55.70	11.700	124.2	.
194	80-4	UNKN	205	8.80	.	390.2	74.6	20.8	45.3	262.8	17.1	35.30	7.400	93.6	.
195	79-30	VANT	207	8.80	1700.0	.	366.0	14.0	-0.5	278.2	23.9	13.00	0.110	35.0	.
196	79-32	VANT	207	8.80	1700.0	.	364.0	13.3	-0.5	286.0	23.1	12.60	0.090	33.6	.
197	80-22	UNKN	208	8.80	1150.0	132.0	130.0	30.6	113.0	233.0	13.3	3.70	1.140	22.1	.
198	80-72	UNKN	208	9.00	1150.0	132.0	130.0	31.1	111.0	232.7	13.7	4.50	1.150	22.5	.
199	80-186	GRRD	212	9.62	1326.8	147.0	296.8	22.4	197.4	349.5	15.9	4.51	0.170	63.1	.
200	80-191	GRRD	212	9.62	1326.0	147.0	290.8	22.2	194.0	365.3	16.3	4.32	0.170	59.5	.
201	80-13	GRRD	213	8.55	2100.0	137.0	258.0	21.4	111.0	431.9	22.1	6.50	0.120	54.9	.
202	80-58	GRRD	213	8.55	2100.0	137.0	259.0	21.5	111.0	445.2	22.6	6.30	0.140	53.4	.
203	79-59	GRRD	214	.	.	.	.	.	.	299.8	7.3	2.00	0.170	50.5	.
204	79-97	GRRD	214	8.80	.	.	.	.	.	281.4	7.4	1.90	0.170	48.7	.
205	80-118	GRRD	215	9.71	1539.0	114.4	166.1	42.2	190.6	310.2	6.7	1.66	0.012	50.0	.
206	80-133	GRRD	215	9.71	1539.0	114.4	152.8	36.6	193.9	310.5	6.5	1.49	0.013	46.1	.
207	81-76	GRRD	216	9.40	1666.0	84.0	289.1	35.6	177.2	358.9	3.4	2.63	-0.001	38.5	.
208	81-82	GRRD	216	9.40	1666.0	84.0	289.1	35.6	177.2	359.7	3.4	2.70	-0.001	38.5	.

OBS	AL	BA	B	CO	CR	CU	FE	LI	MN	MO	NI	PB	SR	ZN
183	-0.08	0.014	1.410	-0.010	-0.030	-0.006	0.025	0.110	-0.003	0.16	-0.02	-0.15	0.018	-0.010
184	-0.08	0.020	1.500	-0.010	-0.030	-0.006	9.300	0.025	0.140	0.15	-0.02	-0.15	0.017	-0.010
185	-0.08	0.019	1.500	-0.010	-0.030	-0.006	8.500	0.024	0.130	0.15	-0.02	-0.15	0.017	-0.010
186	0.29	0.013	2.600	-0.010	0.160	-0.006	0.100	-0.006	0.007	0.25	-0.02	-0.15	0.017	-0.010
187	0.28	0.013	2.600	-0.010	0.160	-0.006	0.100	-0.006	0.008	0.25	-0.02	-0.15	0.017	-0.010
188	-0.08	0.010	2.570	-0.010	0.060	-0.010	0.080	0.010	0.010	0.24	-0.03	-0.15	0.020	-0.010
189	-0.08	0.020	0.080	-0.010	-0.040	-0.010	0.430	0.030	0.040	0.03	-0.03	-0.15	0.030	-0.010
190	0.25	0.050	3.900	-0.010	-0.040	-0.010	3.600	0.010	0.090	0.39	-0.03	-0.15	0.000	-0.010
191	-0.08	0.010	0.810	-0.010	-0.040	-0.010	1.070	0.010	0.030	0.19	-0.03	-0.15	0.005	-0.010
192	-0.08	0.020	0.800	-0.010	-0.040	-0.010	1.060	0.010	0.030	0.18	-0.03	-0.15	0.005	-0.010
193	77.10	0.330	1.400	-0.010	0.090	0.060	48.600	-0.020	0.900	0.50	-0.02	'.30	0.217	2.960
194	13.80	0.430	1.100	0.010	0.080	0.110	32.300	-0.020	0.600	0.50	-0.02	0.85	0.119	2.200
195	0.30	0.020	0.500	-0.010	-0.003	0.016	0.400	.	-0.020	-0.03	.	.	.	-0.020
196	0.21	0.020	0.500	-0.010	-0.003	-0.002	0.250	0.100	-0.020	-0.03	-0.02	-0.10	0.210	-0.020
197	0.49	0.280	1.300	0.010	0.090	0.050	46.900	-0.020	2.300	0.50	0.16	0.30	0.010	3.100
198	57.10	0.130	1.600	0.020	0.090	0.040	51.500	-0.020	2.300	0.60	0.15	0.40	0.014	3.400
199	0.06	-0.005	0.860	-0.010	-0.003	-0.002	0.060	.	0.050	0.58	-0.02	-0.10	0.007	0.030
200	-0.01	-0.005	0.770	-0.010	-0.003	-0.002	0.040	.	-0.020	-0.03	-0.02	-0.10	0.003	-0.002
201	0.04	-0.005	1.000	-0.010	-0.003	-0.002	4.100	-0.020	0.200	0.70	-0.02	-0.10	0.016	0.080
202	0.10	-0.005	0.980	-0.010	0.030	-0.002	4.100	-0.020	0.160	0.90	-0.02	-0.10	0.017	0.090
203	0.17	-0.005	1.040	-0.010	0.003	-0.002	0.760	-0.020	0.030	0.40	-0.02	-0.10	0.009	0.040
204	0.16	-0.005	1.000	0.010	0.010	-0.002	0.700	-0.020	0.020	0.40	-0.02	-0.10	0.009	0.030
205	0.07	-0.005	1.210	-0.010	-0.003	0.009	0.200	-0.020	-0.020	0.66	-0.02	0.11	0.008	0.200
206	0.14	0.010	1.130	0.010	0.020	0.025	0.140	-0.020	-0.020	0.90	0.03	0.19	0.009	0.110
207	0.00	0.010	1.310	-0.010	0.007	-0.002	0.002	0.013	-0.001	0.61	-0.02	-0.10	0.006	-0.001
208	0.01	0.004	1.310	-0.010	0.005	-0.002	0.009	0.012	0.001	0.60	-0.02	-0.10	0.007	0.010

OBS	SAMPLE	FORM	RECNO	PH	SC	F_ALK	CL	F	SO4	NA	K	CA	MG	SI	TOTC
209	80-29	GRRD	218	10.44	966.7	151.8	96.3	34.0	79.5	209.1	1.7	0.95	0.006	54.1	.
210	80-37	GRRD	218	10.40	966.7	151.8	96.3	39.0	79.0	218.5	0.3	0.97	0.006	51.9	.
211	80-45	GRRD	220	10.60	1062.0	173.4	76.9	40.4	157.0	241.5	1.9	0.95	-0.005	51.6	.
212	80-75	GRRD	220	10.60	1062.0	173.4	79.0	41.1	157.0	240.8	1.9	0.93	-0.005	50.2	.
213	82-10	GRRD	227	9.57	1126.0	160.0	137.0	39.0	83.0	258.7	3.3	3.50	-0.100	45.0	.
214	82-33	GRRD	227	9.57	1126.0	160.0	136.0	39.0	83.0	258.0	3.3	3.50	-0.100	45.0	.
215	80-60	SBFL	229	.	233.0	.	1.4	4.0	18.7	23.6	3.5	16.10	7.210	21.6	.
216	80-90	SBFL	229	.	318.0	.	0.8	4.0	18.7	23.8	3.6	16.40	7.360	21.8	.
217	82-52	PRAP	232	7.66	283.0	145.0	4.4	0.6	.	28.3	7.6	15.90	8.400	29.8	.
218	82-7	PRAP	232	7.66	283.0	145.0	4.6	0.7	.	27.7	7.3	15.60	8.300	29.8	.
219	82-11	PRAP	234	7.68	280.0	133.0	4.8	0.7	.	29.9	8.1	16.80	8.800	29.6	.
220	82-64	PRAP	234	7.68	280.0	133.0	4.7	0.7	.	29.7	8.0	16.60	8.700	29.3	.
221	82-263	ROZA	235	7.70	271.0	139.0	4.1	0.6	.	27.4	7.1	16.70	8.700	28.8	.
222	82-283	ROZA	235	7.70	271.0	139.0	0.6	4.1	.	27.0	7.0	16.40	8.600	28.5	.
223	82-325	RZFS	236	8.11	283.0	142.0	4.5	0.6	.	28.3	7.4	16.40	8.900	28.9	.
224	82-397	RZFS	236	8.11	283.0	142.0	4.9	0.6	.	28.6	7.5	16.50	9.000	29.1	.
225	82-424	FRSR	237	7.45	284.0	146.0	5.1	0.7	.	28.1	7.7	17.30	9.500	29.2	.
226	82-474	FRSR	237	7.45	284.0	146.0	4.9	0.6	.	28.1	7.7	17.60	9.600	29.6	.
227	82-436	FRSR	238	7.80	288.0	148.0	4.2	0.7	0.2	28.2	7.8	17.20	9.200	29.2	36.60
228	82-498	FRSR	238	7.80	288.0	148.0	4.3	0.7	0.2	28.3	7.8	17.40	9.300	29.6	0.54
229	83-32	FRSR	239	7.56	281.0	148.0	4.6	0.6	0.1	27.5	7.8	17.70	8.500	29.9	36.60
230	83-83	FRSR	240	8.16	288.0	151.0	5.0	0.6	0.1	28.7	7.8	17.90	9.300	29.9	38.69
231	83-188	FRSR	241	8.00	282.0	150.0	4.9	0.6	.	31.8	9.2	17.80	5.800	31.0	40.50
232	83-373	GRRD	242	9.40	388.0	193.0	6.8	3.7	1.7	85.4	8.1	2.66	0.260	40.9	.
233	83-331	ROCT	243	9.05	380.0	185.0	7.5	3.4	1.6	87.1	8.1	1.06	-0.100	43.5	.
234	83-460	ROCB	244	9.45	395.0	191.0	7.1	3.5	0.3	89.1	8.2	0.82	-0.100	46.9	.

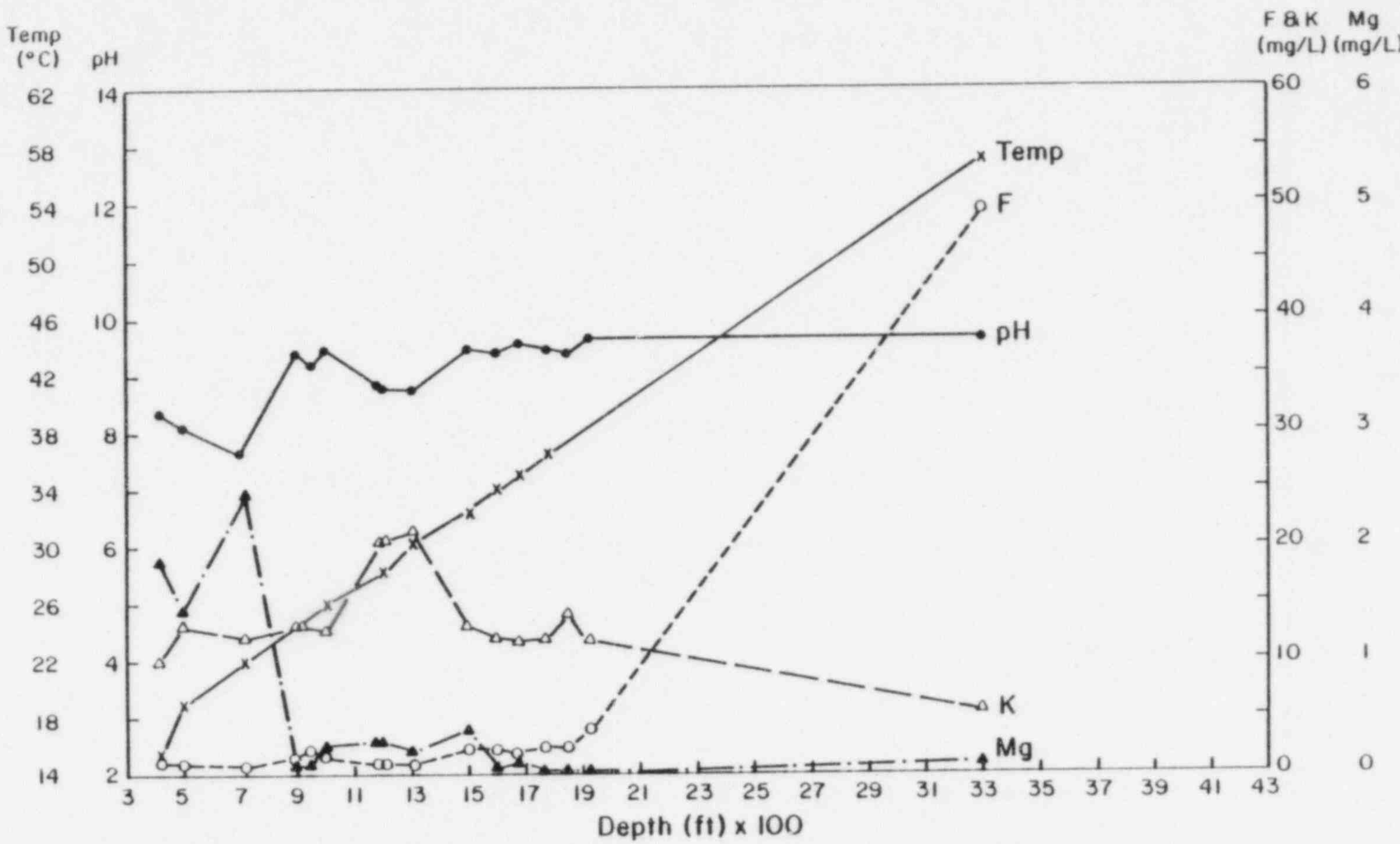
OBS	AL	BA	B	CO	CR	CU	FE	LI	MN	MO	NI	PB	SR	ZN
209	0.11	-0.005	1.520	-0.010	-0.003	0.002	0.004	-0.020	0.040	0.42	-0.02	-0.10	0.004	0.002
210	-0.01	-0.005	1.450	-0.010	-0.003	-0.002	-0.002	-0.020	-0.020	-0.03	-0.02	-0.10	-0.001	-0.002
211	0.05	-0.005	1.200	-0.010	-0.003	-0.002	0.007	.	-0.020	0.16	-0.02	-0.10	0.007	0.010
212	0.05	-0.005	1.170	-0.010	-0.003	-0.002	-0.002	.	-0.020	0.23	-0.02	-0.10	0.007	0.010
213	0.36	0.015	1.870	-0.010	-0.030	-0.006	0.170	-0.006	-0.003	0.47	-0.02	-0.15	0.010	0.050
214	0.38	0.015	1.870	-0.010	-0.030	-0.006	0.190	-0.006	-0.003	0.44	-0.02	-0.15	0.010	0.050
215	0.02	-0.005	-0.005	-0.010	0.024	-0.002	0.063	-0.020	-0.020	-0.03	-0.02	-0.10	0.056	0.006
216	0.03	-0.005	-0.005	-0.010	0.024	-0.002	0.065	-0.020	-0.020	-0.03	-0.02	-0.10	0.057	-0.005
217	-0.08	0.021	-0.020	-0.010	-0.030	-0.006	0.060	0.013	0.060	-0.02	-0.02	-0.15	0.059	-0.010
218	-0.08	0.021	-0.020	-0.010	-0.030	-0.006	0.060	0.014	0.050	-0.02	-0.02	-0.15	0.057	-0.010
219	-0.08	0.022	-0.020	-0.010	-0.030	-0.006	0.050	0.013	0.060	-0.02	-0.02	-0.15	0.062	-0.010
220	-0.08	0.021	-0.020	-0.010	-0.030	-0.006	0.050	0.010	0.060	-0.02	-0.02	-0.15	0.062	-0.010
221	-0.08	0.008	-0.020	-0.010	-0.030	-0.006	0.170	0.010	0.049	-0.01	-0.02	-0.15	0.058	0.040
222	-0.08	0.008	-0.020	-0.010	-0.030	-0.006	0.160	0.010	0.048	-0.01	-0.02	-0.15	0.057	-0.010
223	-0.08	0.011	0.020	-0.010	-0.030	-0.006	0.100	0.020	0.050	-0.02	-0.02	-0.15	0.061	-0.010
224	-0.08	0.011	0.020	-0.010	-0.030	-0.006	0.100	0.017	0.050	-0.02	-0.02	-0.15	0.061	-0.010
225	0.25	0.006	-0.020	-0.010	-0.030	-0.006	0.160	0.009	0.045	-0.02	-0.02	0.17	0.061	-0.010
226	0.26	0.006	-0.020	-0.010	-0.030	-0.006	0.160	0.010	0.046	-0.02	-0.02	-0.15	0.062	-0.010
227	0.25	0.005	-0.020	-0.010	-0.030	-0.006	0.060	0.010	0.040	-0.02	-0.02	0.16	0.060	-0.010
228	0.24	0.005	-0.020	-0.010	-0.030	-0.006	0.060	0.010	0.050	-0.02	-0.02	0.16	0.062	-0.010
229	-0.08	0.010	-0.020	-0.012	-0.040	-0.010	0.490	0.010	0.060	-0.02	-0.03	-0.15	0.060	-0.010
230	-0.08	0.010	-0.020	-0.010	-0.040	-0.010	0.120	0.010	0.050	-0.02	-0.03	-0.15	0.060	-0.010
231	-0.08	0.010	-0.020	-0.010	-0.040	-0.010	0.110	0.020	0.040	-0.02	-0.03	-0.15	0.050	-0.010
232	-0.08	0.010	0.030	-0.010	-0.040	-0.010	0.060	0.010	-0.004	-0.02	-0.03	-0.15	0.020	-0.010
233	-0.08	-0.001	0.060	-0.010	-0.040	-0.010	-0.080	0.020	-0.004	-0.02	-0.03	-0.15	-0.003	-0.010
234	-0.08	0.004	0.060	-0.010	-0.040	-0.010	0.060	0.020	-0.004	-0.02	-0.03	-0.15	0.002	-0.010

OBS	SAMPLE	FORM	RECNO	PH	SC	F_ALK	CL	F	SO4	NA	K	CA	MG	SI	TOTC
235	83-476	COHT	245	9.40	388.0	181.0	7.6	3.5	0.5	90.9	8.4	0.87	-0.10	45.0	.
236	82-28	PRAP	250	9.14	810.0	173.0	133.0	8.5	1.6	161.5	20.9	2.00	0.20	29.8	.
237	82-68	PRAP	250	9.14	810.0	173.0	133.0	8.5	1.6	161.6	20.9	2.00	0.19	29.8	.
238	82-65	ROZA	251	9.30	683.0	155.0	122.0	8.6	2.0	141.1	15.5	1.90	-0.10	34.0	.
239	82-75	ROZA	251	9.30	683.0	155.0	123.0	9.4	2.0	139.3	15.4	1.90	-0.10	33.4	.
240	82-163	FRSR	252	8.30	1408.0	93.0	326.0	15.0	21.0	286.4	35.6	9.60	0.23	27.0	.
241	82-170	FRSR	252	8.30	1408.0	93.0	344.0	15.0	21.0	282.2	35.1	9.40	0.23	26.6	.
242	82-122	GRRD	253	8.76	1856.0	86.0	507.0	20.0	1.4	373.8	25.3	2.90	-0.10	34.6	.
243	82-192	GRRD	253	8.77	1856.0	85.0	508.0	21.0	1.5	379.4	25.6	2.90	-0.10	35.3	.
244	82-401	COHB	254	9.71	1616.0	165.0	403.9	20.0	4.2	336.8	13.8	2.22	-0.10	44.7	29.80
245	82-479	COHB	254	9.71	1616.0	165.0	406.5	20.0	4.2	336.8	13.9	2.19	-0.10	44.5	29.80
246	82-364	UMIT	255	9.45	1740.0	136.0	451.0	18.2	1.7	354.9	9.4	1.63	-0.10	47.7	.
247	82-381	UMIT	255	9.45	1740.0	136.0	448.0	18.0	1.7	361.1	9.6	1.72	-0.10	48.8	.
248	82-309	UMIA	256	9.34	.	132.0	384.5	17.3	3.5	335.5	8.5	2.84	0.14	36.1	.
249	82-351	UMIA	256	9.34	.	136.0	383.2	17.2	3.7	328.9	8.4	2.80	0.15	35.4	.
250	82-413	UMIB	257	9.78	1747.0	135.0	454.7	20.1	2.4	358.2	5.8	1.85	-0.10	37.1	.
251	82-456	UMIB	257	9.78	1747.0	135.0	455.3	20.1	2.4	363.5	5.9	1.83	-0.10	37.3	24.43
252	80-61	LEVY	260	8.15	347.8	170.5	13.8	0.7	-0.5	50.3	8.7	22.40	6.05	21.2	.
253	80-7	LEVY	260	8.15	347.8	170.5	13.8	0.7	-0.5	51.3	8.9	22.90	6.17	21.5	.

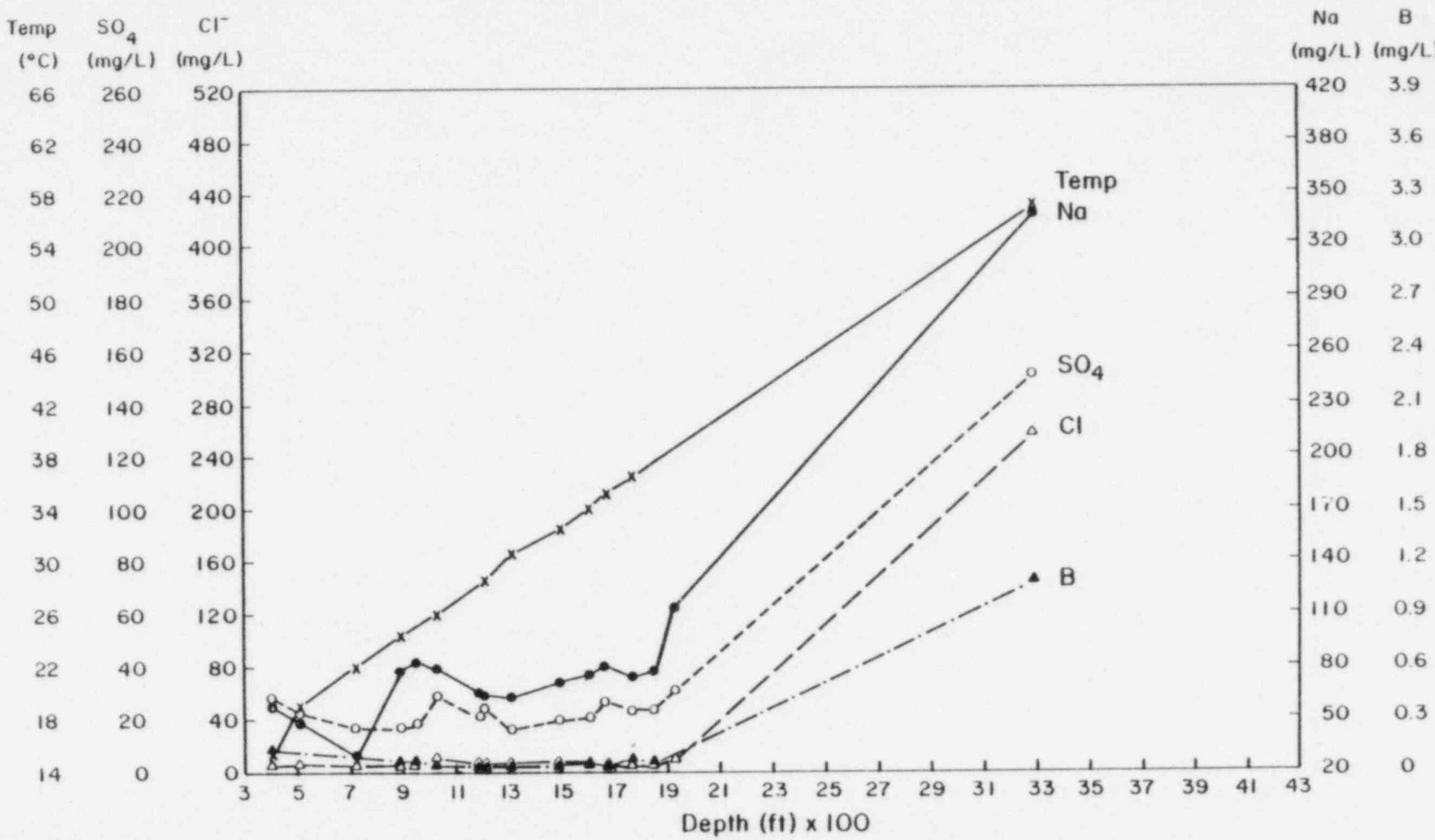
OBS	AL	BA	B	CO	CR	CU	FE	LI	MN	MO	NI	PB	SR	ZN
235	-0.08	0.003	0.040	-0.01	-0.040	-0.010	0.060	0.010	-0.004	-0.02	-0.03	-0.15	-0.003	-0.010
236	-0.08	0.047	0.380	-0.01	0.040	-0.006	6.300	0.010	0.080	0.10	-0.03	-0.15	0.009	0.050
237	-0.08	0.019	0.380	-0.01	0.040	-0.006	6.600	0.010	0.080	0.10	-0.03	-0.15	0.009	0.050
238	-0.08	0.005	0.360	-0.01	-0.030	-0.006	0.390	0.007	0.010	0.12	-0.02	-0.15	0.005	0.020
239	-0.08	0.002	0.350	-0.01	-0.030	-0.006	0.320	0.007	0.009	0.11	-0.02	-0.15	0.005	-0.010
240	-0.08	0.025	1.110	-0.01	-0.030	-0.006	0.100	0.020	0.016	0.05	-0.02	-0.15	0.040	-0.010
241	-0.08	0.024	1.090	-0.01	-0.030	-0.006	0.110	0.017	0.015	0.05	-0.02	-0.15	0.040	-0.010
242	-0.08	0.004	2.600	-0.01	-0.030	-0.006	0.820	0.020	0.032	0.13	-0.02	0.15	0.010	-0.010
243	-0.08	0.003	2.700	-0.01	-0.030	-0.006	0.810	0.020	0.031	0.13	-0.02	0.15	0.010	-0.010
244	0.41	0.002	3.500	-0.01	-0.030	-0.006	0.130	0.030	0.004	0.28	-0.02	-0.15	0.009	-0.010
245	0.41	0.002	3.500	-0.01	-0.030	-0.006	0.130	0.030	0.004	0.27	-0.02	-0.15	0.009	-0.010
246	-0.07	0.004	3.440	-0.01	-0.030	-0.006	0.048	0.040	-0.003	0.27	-0.02	-0.15	0.005	-0.010
247	0.08	0.005	3.520	-0.01	-0.030	-0.006	0.086	0.040	-0.003	0.28	-0.02	-0.15	0.006	0.020
248	0.11	0.003	3.140	-0.01	-0.030	-0.006	0.140	0.030	0.007	0.24	-0.02	-0.15	0.011	0.020
249	0.10	0.007	3.090	-0.01	-0.030	-0.006	0.120	0.030	0.007	0.24	-0.02	-0.15	0.011	0.020
250	0.35	0.002	3.480	-0.01	-0.030	-0.006	0.060	0.040	-0.004	0.26	-0.02	-0.15	0.011	-0.010
251	0.33	0.005	3.510	-0.01	-0.030	-0.006	0.050	0.040	-0.004	0.26	-0.02	-0.15	0.010	-0.010
252	0.05	0.049	0.043	-0.01	0.009	0.002	0.074	-0.020	0.052	-0.03	-0.02	-0.10	0.115	0.010
253	0.03	0.048	0.043	-0.01	0.008	-0.002	0.084	-0.020	0.052	-0.03	-0.02	-0.10	0.118	0.006

APPENDIX C

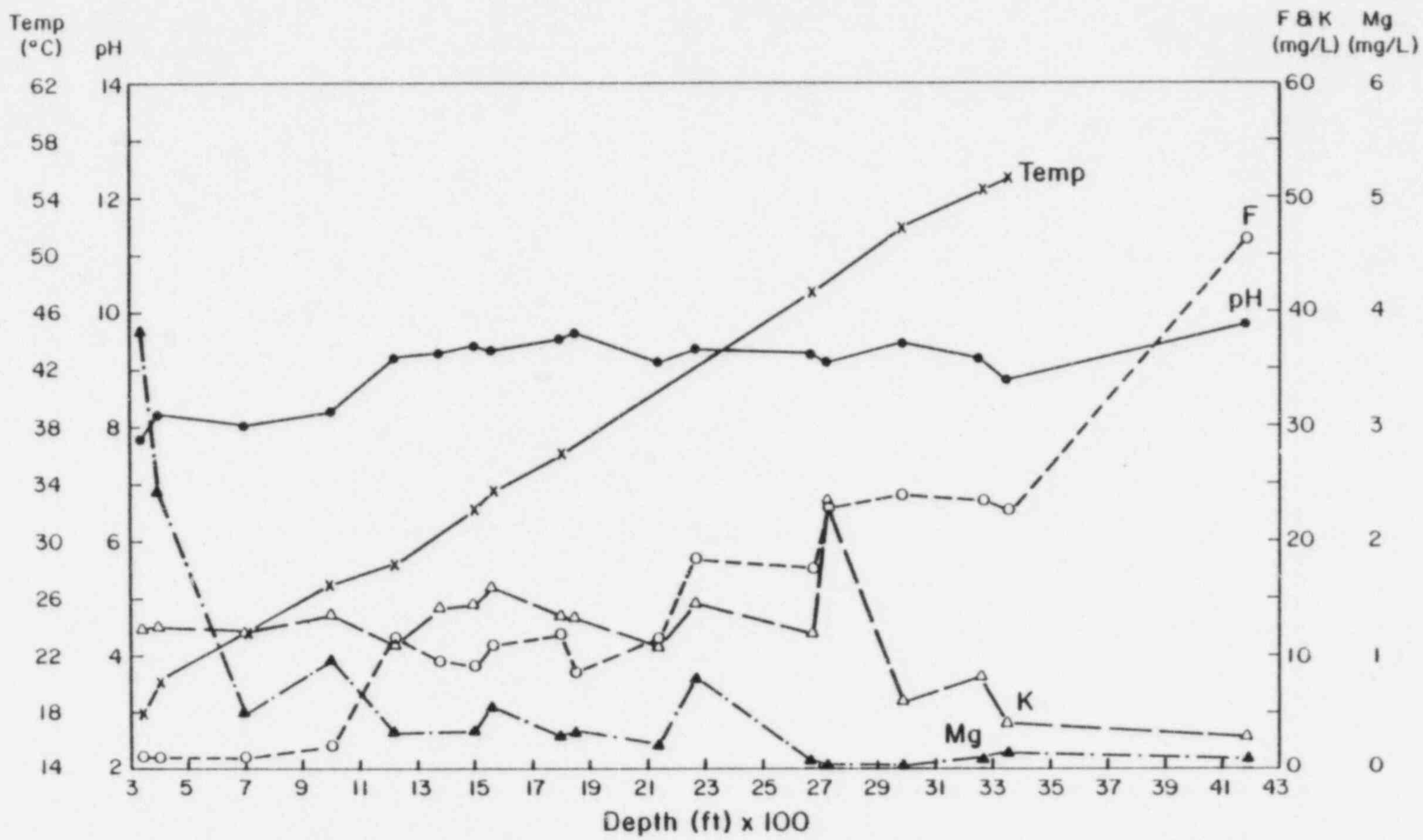
Data Plots of Insitu Temperature, pH, and Concentrations of Magnesium, Fluoride, Potassium, Chloride, Boron, Sodium, and Sulfate Versus Depth Below Land Surface



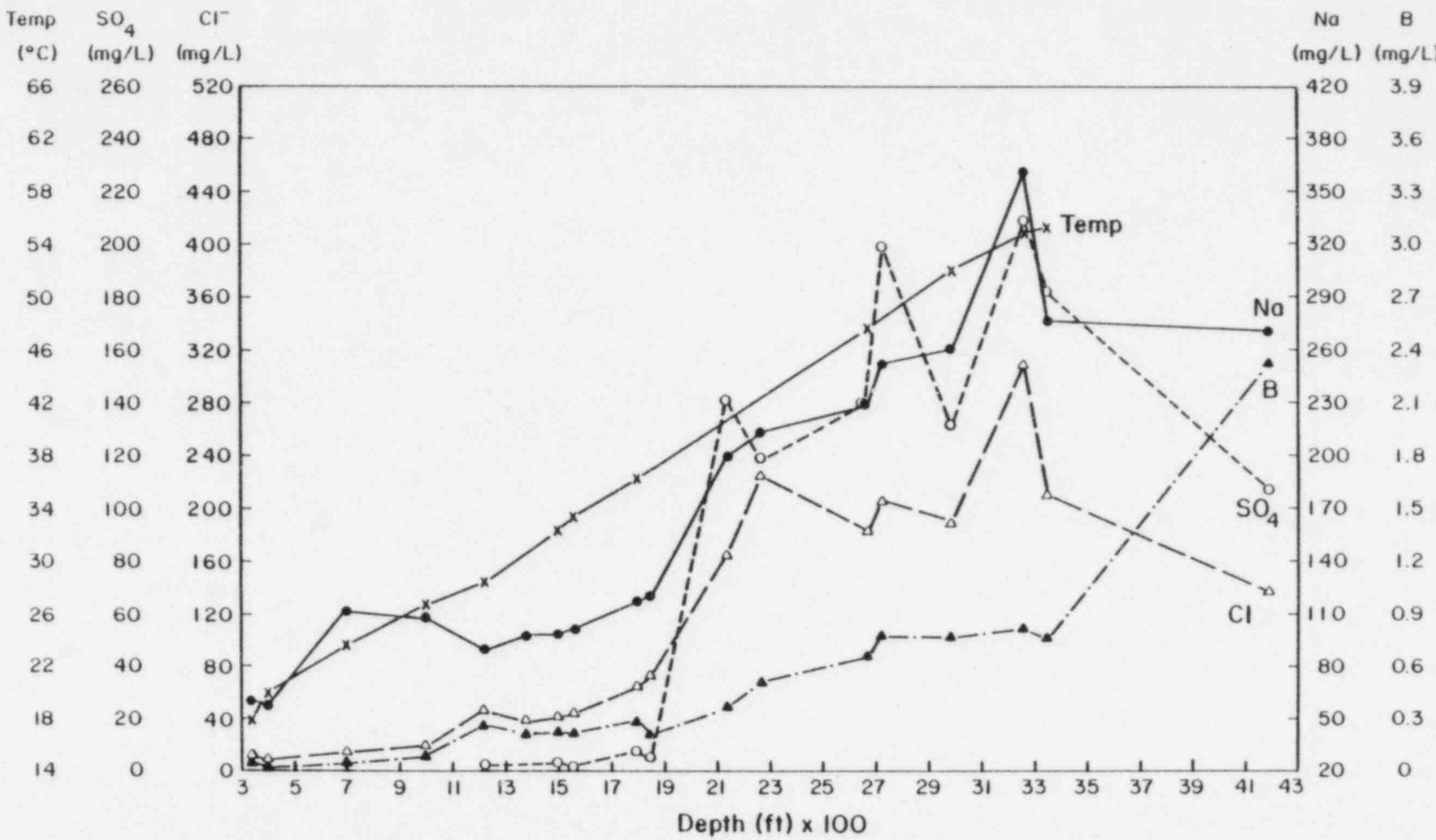
Fluoride, Potassium, and Magnesium Concentrations and pH and Insitu Temperature Versus Depth in Borehole DC-14



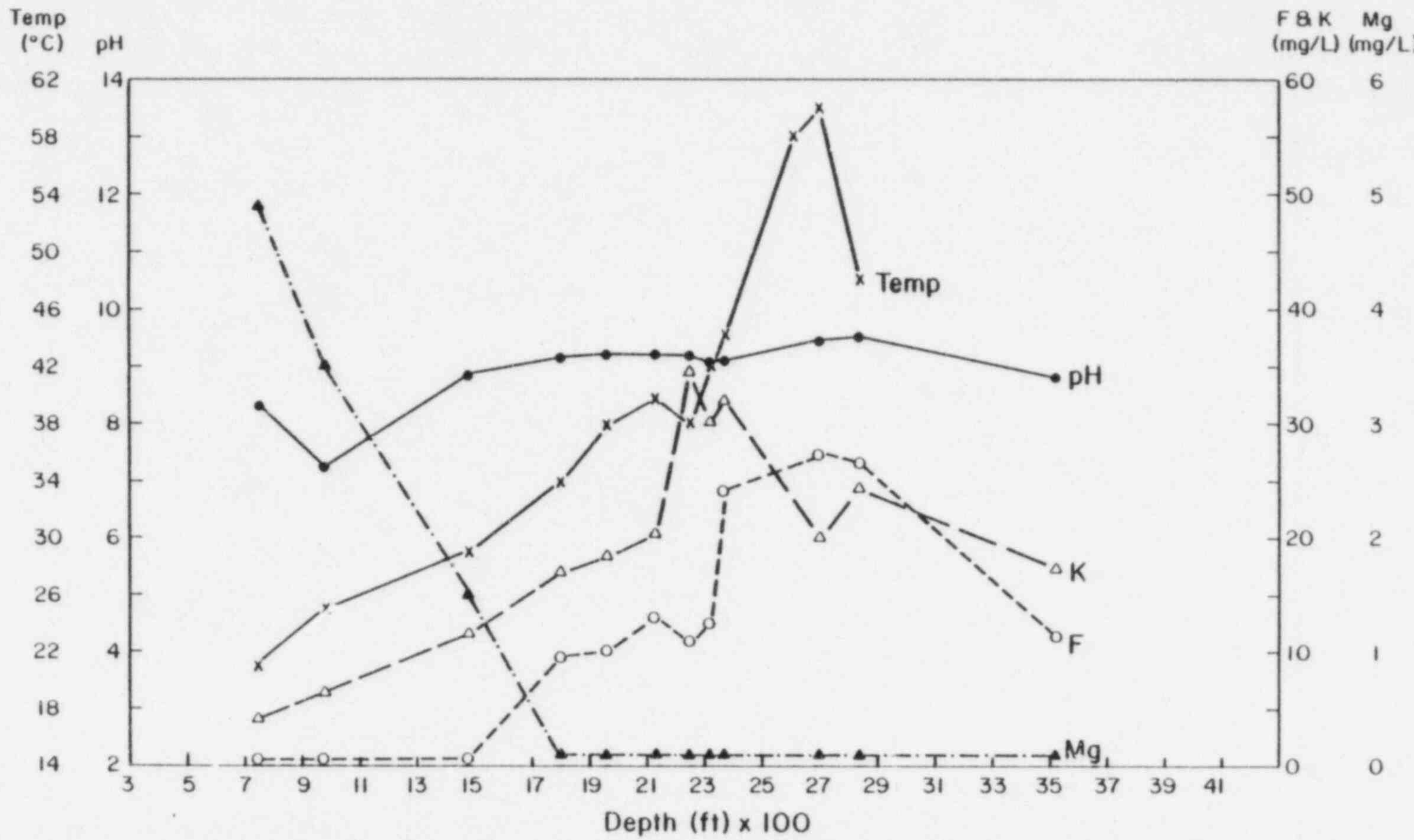
Boron, Chloride, Sodium, and Sulfate Concentrations and Insitu Temperature Versus Depth in Borehole DC-14



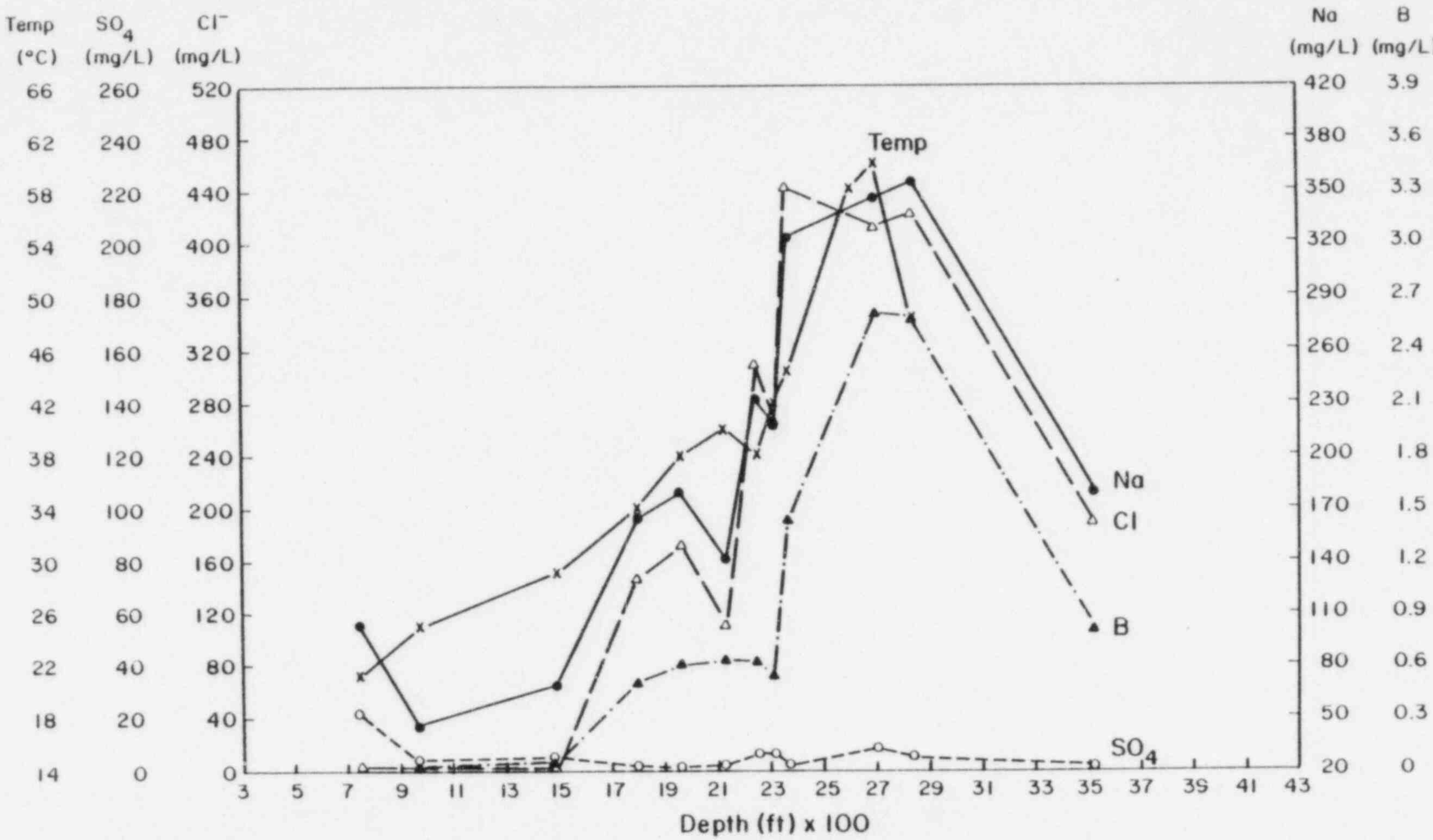
Fluoride, Potassium, and Magnesium Concentrations and pH and Insitu Temperature Versus Depth in Borehole DC-15



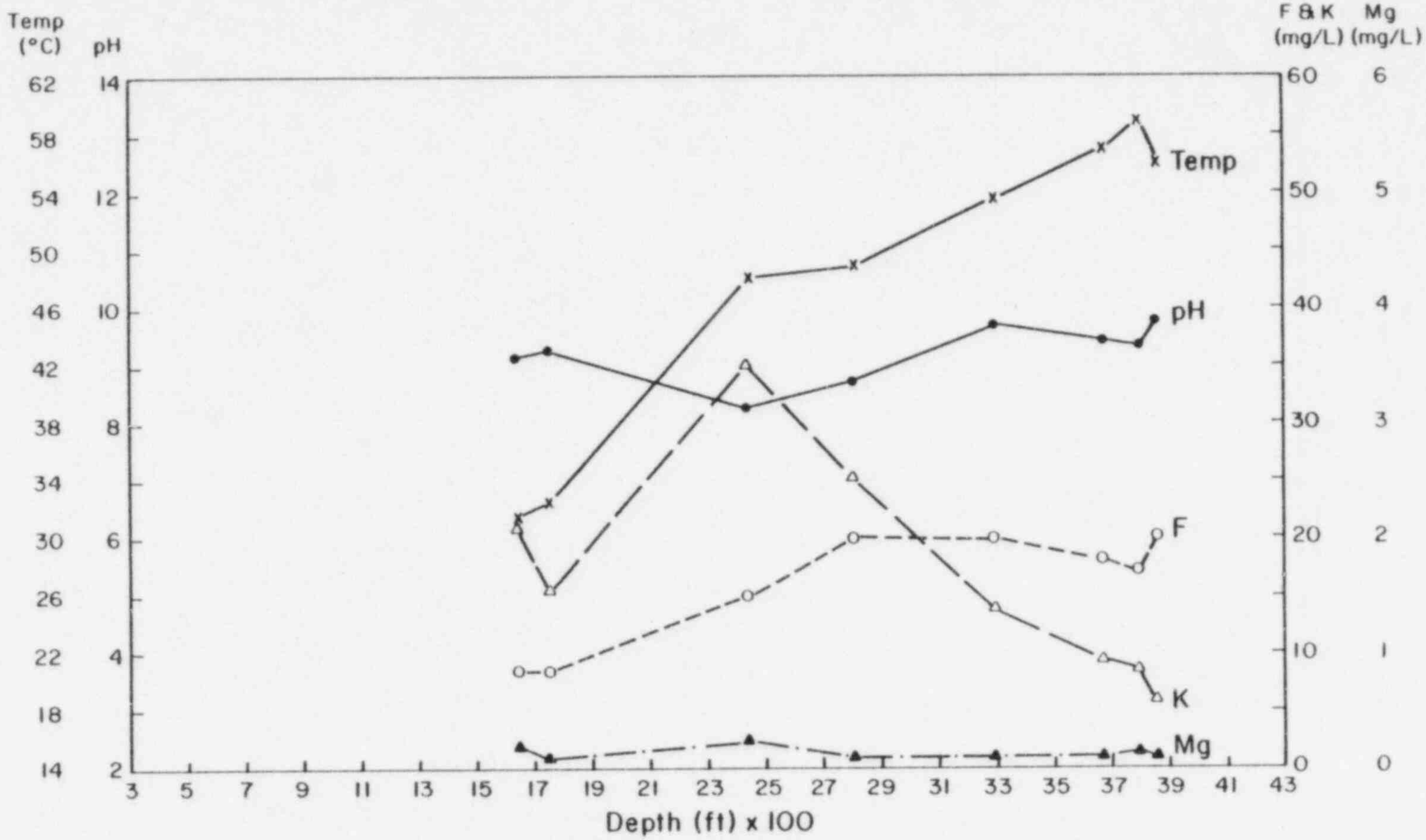
Boron, Chloride, Sodium, and Sulfate Concentrations and Insitu Temperature Versus Depth in Borehole DC-15



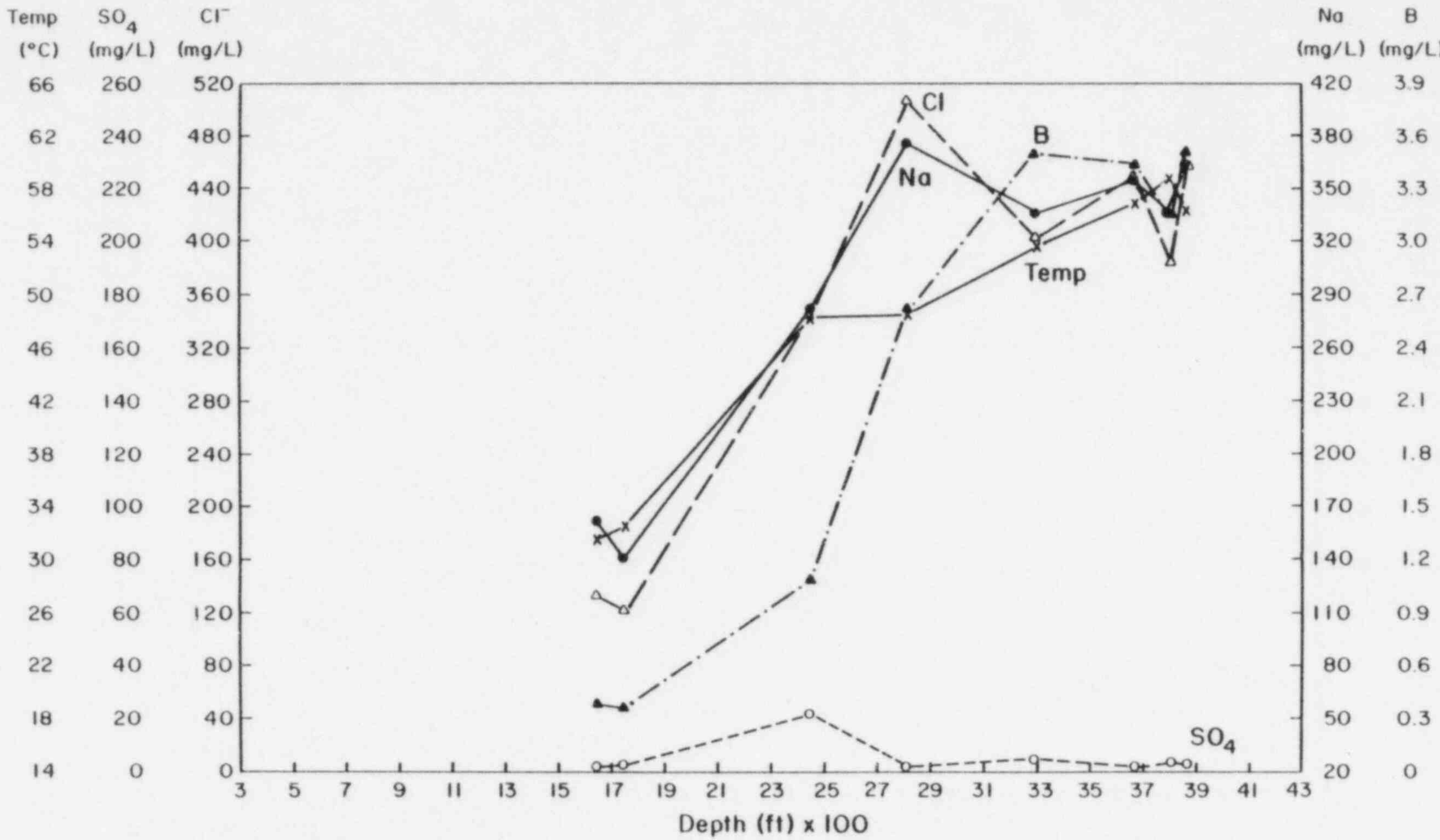
Fluoride, Potassium, and Magnesium Concentrations and pH and Insitu Temperature versus depth in Borehole DC-16A and C



Boron, Chloride, Sodium, and Sulfate Concentrations and Insitu Temperature Versus Depth in Borehole DC-16A and C



Fluoride, Potassium, and Magnesium Concentrations and pH and Insitu Temperature Versus Depth in Borehole RRL-2



Boron, Chloride, Sodium, and Sulfate Concentrations and Insitu Temperature Versus Depth in Borehole RRL-2

APPENDIX D
Summary Statistics for 253 Variables on 26 Variables

(Negative values, designating detection limits, are included as negative values in the following data plots. These small negative values should not affect the summary statistics significantly.)

```
                                                     SAS

                                                 UNIVARIATE

VARIABLE=PH

               MOMENTS                                        QUANTILES(DEF=4)                                 EXTREMES

N              246   SUM WGTS         246      100% MAX      10.6      99%      10.553           LOWEST     ID        HIGHEST     ID
MEAN       8.98337   SUM          2209.91       75% Q3       9.46      95%        9.78               7(      38)        10.4(     218)
STD DEV   0.720264   VARIANCE     0.51878       50% MED     9.285      90%       9.676               7(      38)       10.44(     218)
SKEWNESS -0.586235   KURTOSIS   -0.266021       25% Q1     8.3575      10%           8            7.25(     187)        10.5(      89)
USS        19979.5   CSS          127.101        0% MIN         7       5%        7.66            7.25(      27)        10.6(     220)
CV         8.01774   STD MEAN   0.0459223                              1%      7.1175            7.28(     200)        10.6(     220)
T:MEAN=0   195.621   PROB>|T|      0.0001      RANGE          3.6
SGN RANK   15190.5   PROB>|S|      0.0001      Q3-Q1       1.1025
NUM ^= 0       246                             MODE           8.8
D:NORMAL  0.169886   PROB>D         <0.01

                                                      MISSING VALUE         .
                                                              COUNT         7
                                                       % COUNT/NOBS      2.77

          BAR CHART                          #       BOXPLOT                              NORMAL PROBABILITY PLOT
    10.7+*                                   2          |             10.7+                                                         + +
        .**                                  3          |                 |                                                     ++** *
        .                                               |                 |                                                  +++ *
        .**                                  3          |                 |                                                ++  **
        .**                                  3          |                 |                                             +++  **
        .**************                     28          |                 |                                          +*********
        .*****************************      58       +-----+              |                                   *******
        .*****************                  34       *-----*              |                              *****++
        .*********                          18       |     |              |                            *** +++
     8.9+*******                            14       |  +  |           8.9+                            *+++
        .******                             11       |     |              |                          **+
        .*****                               9       |     |              |                       ++**
        .***********                        21       +-----+              |                     +***
        .**********                         19          |                 |                 ****
        .***                                 6          |                 |               +++
        .****                                8          |                 |            +******
        .**                                  4          |                 |          +***
        .**                                  3          |                 |        ***
     7.1+*                                   2          |              7.1+*
         ----+----+----+----+----+----                                     +----+----+----+----+----+----+----+----+----+----+
         * MAY REPRESENT UP TO 2 COUNTS                                         -2        -1        +0        +1        +2
```

SAS

UNIVARIATE

VARIABLE=SC

MOMENTS

N	235	SUM WGTS	235
MEAN	737.397	SUM	173288
STD DEV	471.593	VARIANCE	222400
SKEWNESS	0.989971	KURTOSIS	-0.0914341
USS	179823924	CSS	52041648
CV	63.9538	STD MEAN	30.7634
T:MEAN=0	23.97	PROB>|T|	0.0001
SGN RANK	13865	PROB>|S|	0.0001
NUM ¬= 0	235		
D:NORMAL	0.163714	PROB>D	<0.01

QUANTILES(DEF=4)

100% MAX	2100	99%	2012.16
75% Q3	1062	95%	1738
50% MED	630	90%	1542.2
25% Q1	351.4	10%	288
0% MIN	179.5	5%	280
		1%	198.76
RANGE	1920.5		
Q3-Q1	710.6		
MODE	283		

EXTREMES

LOWEST	ID	HIGHEST	ID
179.5(	169)	1771(	182)
179.5(	169)	1856(	253)
233(	229)	1856(	253)
262(	22)	2100(	213)
263.6(	114)	2100(	213)

MISSING VALUE .
COUNT 18
% COUNT/NOBS 7.11

```
     BAR CHART                            #     BOXPLOT
2150+*                                    2        |
    .                                              |
1950+                                              |
    .*                                    2        |
1750+*****                               10        |
    .****                                 8        |
1550+***                                  5        |
    .**                                   4        |
1350+***                                  6        |
    .****                                 8        |
1150+*****                               10        |
    .**                                   4     +-----+
 950+***                                  5     |     |
    .*******                             14     |     |
 750+****************                    31     |  +  |
    .******                              11     *-----*
 550+****                                 7     |     |
    .***********                         22     |     |
 350+******************************      59     +-----+
    .*************                       25        |
 150+*                                    2        |
     ----+----+----+----+----+----+
     * MAY REPRESENT UP TO 2 COUNTS
```

```
                         NORMAL PROBABILITY PLOT
2150+                                                  *
    |
1950+                                                  +
    |                                               **
1750+                                         ******+
    |                                      ***   ++
1550+                                     **   ++
    |                                    **  ++
1350+                                   **+++
    |                                  *++
1150+                                **+
    |                               ++
 950+                             ++**
    |                           ++ **
 750+                         +****
    |                       ++**
 550+                    +++ **
    |                  ++  ***
 350+             **********
    |  *************++
 150+* ++++++++++++
     +----+----+----+----+----+----+----+----+----+----+
         -2        -1        +0        +1        +2
```

```
                                                   SAS

                                                UNIVARIATE

VARIABLE=F_ALK

                MOMENTS                                      QUANTILES(DEF=4)                                    EXTREMES

N                 245   SUM WGTS         245     100% MAX      390.2      99%       325.061          LOWEST     ID          HIGHEST     ID
MEAN          150.569   SUM          36889.3      75% Q3      167.75      95%           208            52.3(     180)          232.6(      170)
STD DEV       38.8628   VARIANCE     1510.32      50% MED      148.4      90%        189.02            52.3(     180)          248.6(      169)
SKEWNESS         1.84   KURTOSIS     11.0114      25% Q1       134.2      10%        105.44              75(     182)          248.6(      169)
USS           5922887   CSS           368518       0% MIN       52.3       5%          86.2            78.3(     179)          390.2(      205)
CV            25.8107   STD MEAN     2.48286                               1%        62.742            78.3(     179)          390.2(      205)
T:MEAN=0      60.6433   PROB>|T|      0.0001     RANGE         337.9
SGN RANK      15067.5   PROB>|S|      0.0001     Q3-Q1         33.55
NUM ^= 0          245                            MODE          134.2
D:NORMAL     0.116398   PROB>D         <0.01

                                                 MISSING VALUE        .
                                                         COUNT        8
                                                  % COUNT/NOBS     3.16

         BAR CHART                                       # BOXPLOT                        NORMAL PROBABILITY PLOT
   390+*                                                 2     *        390+                                                         *
      .                                                                    |
      .                                                                    |
      .                                                                    |
      .                                                                    |
      .                                                                    |
      .*                                                 2     0           |                                                   ** +
      .**                                                4     0           |                                               +****++
      .*****                                            10     |           |                                          ++****
      .***********                                      21     |           |                                     ++*****
      .******************                               35  +-----+        |                                ++******
      .***********************************************  93  *--+--*        |                         *********
      .*********************                            41  +-----+        |                    ******++
      .*********                                        17     |           |               ****+++
      .********                                         15     |           |          ******+
      .**                                                3     0           |     ***++
    50+*                                                 2     0         50+*
       ----+----+----+----+----+----+----+----+----+--                     +----+----+----+----+----+----+----+----+----+----+
       * MAY REPRESENT UP TO 2 COUNTS                                            -2        -1        +0        +1        +2
```

SAS

UNIVARIATE

VARIABLE=CL

MOMENTS

N	248	SUM WGTS	248
MEAN	106.296	SUM	26361.4
STD DEV	126.003	VARIANCE	15876.8
SKEWNESS	1.43553	KURTOSIS	1.29692
USS	6723679	CSS	3921568
CV	118.54	STD MEAN	8.00121
T:MEAN=0	13.285	PROB>|T|	0.0001
SGN RANK	15438	PROB>|S|	0.0001
NUM ¬= 0	248		
D:NORMAL	0.200781	PROB>D	<0.01

QUANTILES(DEF=4)

100% MAX	508	99%	481.666
75% Q3	137.15	95%	413.65
50% MED	69.3	90%	308.01
25% Q1	6.825	10%	4.6
0% MIN	0.6	5%	3.7
		1%	1.094
RANGE	507.4		
Q3-Q1	130.325		
MODE	4.6		

EXTREMES

LOWEST	ID	HIGHEST	ID
0.6(	235)	451.8(	196)
0.8(	229)	454.7(	257)
1.4(	229)	455.3(	257)
3.3(	30)	507(	253)
3.4(	39)	508(	253)

MISSING VALUE .
COUNT 5
% COUNT/NOBS 1.98

```
     BAR CHART                                   #     BOXPLOT              NORMAL PROBABILITY PLOT
 510+*                                           2        0        510+                                              *
    .                                                                 |
    .                                                                 |
    .***                                         7        0           |                                       ******
    .*                                           2        0           |                                     **     +
 410+**                                          4        0        410+                                    **
    .*                                           2        0           |                                   *    ++
    .*                                           3        0           |                                  **  +
    .*                                           1        0           |                                  *  ++
    .*                                           1        |           |                                  *  ++
 310+*                                           3        |        310+                                 *  +
    .**                                          4        |           |                                ****+
    .*                                           2        |           |                                **+
    .**                                          5        |           |                               *+
    .***                                         7        |           |                             **
 210+*                                           3        |        210+                            ++
    .**                                          6        |           |                          ++**
    .**                                          5        |           |                         +  **
    .*                                           3        |           |                       ++   *
    .*******                                    19     +-----+        |                      +   ***
 110+*********                                  26     |  +  |     110+                    ++****
    .****                                       12     |     |        |                  ++ **
    .*****                                      13     *-----*        |                 + ***
    .****                                       10     |     |        |               ++  *
    .**                                          6     |     |        |              +   *
  10+**********************************        102     +-----+      10+* *********************
     ----+----+----+----+----+----+----+----                          +----+----+----+----+----+----+----+----+----+----+
     * MAY REPRESENT UP TO 3 COUNTS                                       -2        -1        +0        +1        +2
```

SAS

UNIVARIATE

VARIABLE=F

MOMENTS

N	248	SUM WGTS	248
MEAN	11.5161	SUM	2856
STD DEV	11.71	VARIANCE	137.123
SKEWNESS	1.2142	KURTOSIS	1.11212
USS	66759.5	CSS	33869.4
CV	101.683	STD MEAN	0.743583
T:MEAN=0	15.4874	PROB>|T|	0.0001
SGN RANK	15301	PROB>|S|	0.0001
NUM ^= 0	247		
D:NORMAL	0.156471	PROB>D	<0.01

QUANTILES(DEF=4)

100% MAX	50.1	99%	49.602
75% Q3	18.85	95%	39
50% MED	9.35	90%	26.15
25% Q1	1.1	10%	0.6
0% MIN	-0.3	5%	0.4
		1%	-0.153
RANGE	50.4		
Q3-Q1	17.75		
MODE	0.6		

EXTREMES

LOWEST	ID	HIGHEST	ID
-0.3(	38)	46.3(	185)
-0.3(	38)	46.9(	185)
0(	12)	49.5(	166)
0.1(	36)	49.7(	166)
0.1(	27)	50.1(	131)

MISSING VALUE .
COUNT 5
% COUNT/NOBS 1.98

```
    BAR CHART                                   #     BOXPLOT
 51+*                                           1        0
   .*                                           2        0
   .*                                           2        0
   .
   .*                                           1        |
   .**                                          4        |
   .**                                          3        |
   .*                                           1        |
   .**                                          3        |
   .*                                           2        |
   .*                                           2        |
   .                                                     |
   .**                                          4        |
 25+***                                         5        |
   .****                                        7        |
   .*********                                  17        |
   .********                                   15     +-----+
   .*****                                      10     |     |
   .***                                         5     |     |
   .*******                                    13     |     |
   .*********                                  18     |  +  |
   .***********                                21     *-----*
   .***                                         5     |     |
   .****                                        7     |     |
   .**************                             28     |     |
   .***********************************        69     +-----+
 -1+**                                          3        |
    ----+----+----+----+----+----+----+
    * MAY REPRESENT UP TO 2 COUNTS
```

```
                         NORMAL PROBABILITY PLOT
51+                                                            *
  |                                                          * *
  |                                                       **
  |
  |                                                      *
  |                                                    **      +
  |                                                 **       +
  |                                                 *     ++
  |                                                **    +
  |                                               **   ++
  |                                               * ++
  |                                                +
  |                                              *+
25+                                           +**
  |                                         +***
  |                                        ***
  |                                     ***
  |                                   +**
  |                                  +**
  |                               ++**
  |                             ++***
  |                           ++***
  |                         +  **
  |                       ++   *
  |                     ++ ****
  |  *********************
-1+*  ++++++++++++++++
   +-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
        -2          -1          +0          +1          +2
```

SAS

UNIVARIATE

VARIABLE=SO4

MOMENTS			
N	225	SUM WGTS	225
MEAN	33.3418	SUM	7501.9
STD DEV	53.689	VARIANCE	2882.51
SKEWNESS	1.92421	KURTOSIS	2.44321
USS	895809	CSS	645683
CV	161.026	STD MEAN	3.57927
T:MEAN=0	9.31525	PROB>|T|	0.0001
SGN RANK	12168.5	PROB>|S|	0.0001
NUM ¬= 0	225		
D:NORMAL	0.309822	PROB>D	<0.01

QUANTILES(DEF=4)			
100% MAX	214.9	99%	198.8
75% Q3	27.1	95%	173.62
50% MED	10	90%	139.6
25% Q1	1.9	10%	-0.5
0% MIN	-1.2	5%	-0.5
		1%	-1.2
RANGE	216.1		
Q3-Q1	25.2		
MODE	-0.5		

EXTREMES			
LOWEST	ID	HIGHEST	ID
-1.2(	41)	194(	212)
-1.2(	39)	197.4(	212)
-1.2(	40)	198.8(	180)
-1.2(	40)	198.8(	180)
-1.2(	39)	214.9(	182)

MISSING VALUE .
COUNT 28
% COUNT/NOBS 11.07

```
              BAR CHART                                   #     BOXPLOT
 215+*                                                    1        *
    .
    .***                                                  6        *
    .
    .**                                                   4        *
    .*                                                    2        *
    .**                                                   4        *
    .***                                                  6        *
    .*                                                    2        *
    .
    .****                                                 7        *
 105+*                                                    2        *
    .
    .*                                                    2        0
    .*                                                    2        0
    .
    .*                                                    2        |
    .**                                                   4        |
    .****                                                 8        +
    .*************                                       25     +-----+
    .*******************                                 37     *-----*
    .***************************************             77     +-----+
  -5+*****************                                   34        |
     ----+----+----+----+----+----+----+----+----
     * MAY REPRESENT UP TO 2 COUNTS
```

```
                          NORMAL PROBABILITY PLOT
 215+                                                      *
    |
    |                                               *** **
    |
    |                                            **
    |                                           *        ++
    |                                         ***       +
    |                                        **      ++
    |                                       **     +
    |                                            ++
    |                                      **  ++
 105+                                     ** ++
    |                                      ++
    |                                     ++
    |                                   ++ *
    |                                 ++
    |                                +     *
    |                              ++      *
    |                            ++      ***
    |                          ++    ****
    |                        ++ *****
    |               ************
  -5+************++++++
     +----+----+----+----+----+----+----+----+----+----+
         -2        -1        +0        +1        +2
```

```
                                                                SAS

                                                             UNIVARIATE

VARIABLE=NA

                MOMENTS                                 QUANTILES(DEF=4)                                      EXTREMES

N               252   SUM WGTS        252     100% MAX     445.2     99%     404.074         LOWEST    ID        HIGHEST    ID
MEAN        151.656   SUM         38217.4      75% Q3    224.875     95%         355            16.8(       12)      365.3(      212)
STD DEV     101.927   VARIANCE    10389.1      50% MED    124.65     90%      323.58              17(       29)      373.8(      253)
SKEWNESS   0.779924   KURTOSIS  -0.371724      25% Q1     73.575     10%       32.08            17.1(       29)      379.4(      253)
USS         8403570   CSS         2607659       0% MIN      16.8      5%        28.1            18.5(       18)      431.9(      213)
CV          67.2091   STD MEAN    6.42079                             1%      17.053            23.6(      229)      445.2(      213)
T:MEAN=0    23.6196   PROB>|T|     0.0001     RANGE        428.4
SGN RANK      15939   PROB>|S|     0.0001     Q3-Q1        151.3
NUM ^= 0        252                           MODE          28.3
D:NORMAL   0.122635   PROB>D        <0.01

                                                        MISSING VALUE       .
                                                                COUNT       1
                                                         % COUNT/NOBS    0.40

     STEM LEAF                                 #      BOXPLOT                           NORMAL PROBABILITY PLOT
       44 5                                    1         |            450+                                                  *
       42 2                                    1         |               |                                                  *
       40                                                |               |                                                  +
       38                                                |               |                                                +
       36 0124549                              7         |               |                                            *****
       34 47055589                             8         |               |                                        ****++
       32 0345967779                          10         |               |                                      *** ++
       30 000166                               6         |               |                                    **  ++
       28 12667                                5         |               |                                   ** ++
       26 233450118                            9         |               |                                  **++
       24 12242899                             8         |               |                                 *++
       22 79022335                             8      +-----+         230+                                *+
       20 093779                               6      |     |            |                              +**
       18 1000129                              7      |     |            |                            ++**
       16 0112223334455666790016679           25      |     |            |                          ++***
       14 11225589015799                      14      |  +  |            |                        ++***
       12 02333361145557899                   17      *-----*            |                      ++***
       10 0001234590124467                    16      |     |            |                    ++ **
        8 00023455777990011157888888899       29      |     |            |                  ++****
        6 00113344445668991233568888999999    32      +-----+            |                *****
        4 12477900168899                      14         |               |             ***+
        2 4477788888888990001223336           25         |               |    *********++
        0 7779                                 4         |             10+* **+++++++++
          ----+----+----+----+----+----+--                                +----+----+----+----+----+----+----+----+----+----+
          MULTIPLY STEM.LEAF BY 10**+01                                       -2        -1        +0        +1        +2
```

```
                                                              SAS

                                                           UNIVARIATE

VARIABLE=K

               MOMENTS                                QUANTILES(DEF=4)                                EXTREMES

N               252   SUM WGTS        252    100% MAX      35.6     99%      34.835        LOWEST    ID       HIGHEST    ID
MEAN        12.8901   SUM          3248.3     75% Q3     16.225     95%      25.775           0.3(     218)         32(     195)
STD DEV     6.54651   VARIANCE    42.8568     50% MED      12.5     90%       20.54           1.7(     218)       34.4(     192)
SKEWNESS    1.02684   KURTOSIS    1.56405     25% Q1          8     10%        5.83           1.9(     220)       34.6(     192)
USS         52627.9   CSS           10757      0% MIN       0.3      5%       3.465           1.9(     220)       35.1(     252)
CV          50.7872   STD MEAN   0.412391                            1%       1.806           2.7(     185)       35.6(     252)
T:MEAN=0    31.2569   PROB>|T|     0.0001    RANGE         35.3
SGN RANK      15939   PROB>|S|     0.0001    Q3-Q1      8.22499
NUM ^= 0        252                          MODE           7.8
D:NORMAL  0.0769008   PROB>D        <0.01

                                                      MISSING VALUE        .
                                                              COUNT        1
                                                       % COUNT/NOBS     0.40

   STEM LEAF                                      #    BOXPLOT                         NORMAL PROBABILITY PLOT
     34 4616                                      4       0           35+                                              ** *
     32 0                                         1       0             |                                             *
     30 256                                        3       0             |                                           **
     28 45                                        2       0             |                                          *      +
     26 15                                        2       |             |                                         *  +++
     24 336                                       3       |             |                                        *++++
     22 116169                                    6       |             |                                      **+
     20 00134446993                              11       |             |                                   ****
     18 01233462239                              11       |             |                                 ++**
     16 0333334590001133334667                   21    +-----+          |                              ++***
     14 0012255667789000123344456799             28    |     |          |                           +*****
     12 00124666777888900011112233346667778889   39    *--+--*          |                        +****
     10 0000456666788013455666666778999          31    |     |          |                     ****
      8 00001111122344577788912466699            29    +-----+          |                  ****
      6 2444457011112233344556666778888889       34       |             |             ******
      4 276778899                                 9       |             |           **++
      2 79033344567999                           14       |             |    *******+
      0 3799                                      4       |            1+* **+++++
        ----+----+----+----+----+----+----+----                         +----+----+----+----+----+----+----+----+----+----+
                                                                            -2        -1        +0        +1        +2
```

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                                                    SAS

                                                UNIVARIATE

VARIABLE=CA

            MOMENTS                                      QUANTILES(DEF=4)                               EXTREMES

N                 252  SUM WGTS        252    100% MAX       55.7     99%       42.423      LOWEST    ID       HIGHEST    ID
MEAN          5.71234  SUM         1439.51     75% Q3       6.375     95%       19.145         0.2(     95)       32.2(      18)
STD DEV       7.66427  VARIANCE     58.741     50% MED       2.29     90%        16.57         0.2(     96)       35.3(     205)
SKEWNESS      2.88437  KURTOSIS    11.2588     25% Q1         1.4     10%         0.95        0.43(      5)         42(      29)
USS             22967  CSS           14744      0% MIN        0.2      5%       0.7165        0.45(     72)       42.9(      29)
CV             134.17  STD MEAN   0.482803                             1%       0.3219        0.49(      5)       55.7(     205)
T:MEAN=0      11.8316  PROB>|T|     0.0001    RANGE          55.5
SGN RANK        15939  PROB>|S|     0.0001    Q3-Q1         4.975
NUM ~= 0          252                         MODE              2
D:NORMAL     0.263214  PROB>D        <0.01

                                              MISSING VALUE         .
                                                      COUNT         1
                                               % COUNT/NOBS      0.40

        BAR CHART                              #  BOXPLOT                         NORMAL PROBABILITY PLOT
   57.5+*                                      1     *          57.5+                                                   *
       .                                                            |
       .                                                            |
       .*                                      2     *              |                                                 * *
       .*                                      1     *              |                                                *
       .*                                      1     *              |                                               *
       .*                                      1     *              |                                              *
       .**                                     6     *              |                                            ***++++ +
       .*******                               25     0              |                                   ******++
       .****                                  14     0              |                             +++**++
       .*******                               26  +--+--+           |                       ++++++****
    2.5+*******************************************   175  *-----*    2.5+* ****************************
        ----+----+----+----+----+----+----+----+----                +----+----+----+----+----+----+----+----+----+----+
        * MAY REPRESENT UP TO 4 COUNTS                                    -2        -1        +0        +1        +2
```

SAS

UNIVARIATE

VARIABLE=MG

MOMENTS

N	250	SUM WGTS	250
MEAN	1.54926	SUM	387.316
STD DEV	3.19705	VARIANCE	10.2211
SKEWNESS	2.36274	KURTOSIS	4.94801
USS	3145.11	CSS	2545.06
CV	206.359	STD MEAN	0.202199
T:MEAN=0	7.66208	PROB>|T|	0.0001
SGN RANK	11556.5	PROB>|S|	0.0001
NUM ^= 0	250		
D:NORMAL	0.358689	PROB>D	<0.01

QUANTILES(DEF=4)

100% MAX	15.93	99%	14.6024
75% Q3	0.8525	95%	9.2225
50% MED	0.12	90%	7.49
25% Q1	0.02	10%	-0.1
0% MIN	-0.1	5%	-0.1
		1%	-0.1
RANGE	16.03		
Q3-Q1	0.8325		
MODE	-0.1		

EXTREMES

LOWEST	ID	HIGHEST	ID
-0.1(	245)	11.88(	14)
-0.1(	72)	12.4(	18)
-0.1(	166)	13.5(	12)
-0.1(	244)	15.75(	29)
-0.1(	166)	15.93(	29)

MISSING VALUE .
COUNT 3
% COUNT/NOBS 1.19

```
      BAR CHART                                          #    BOXPLOT          NORMAL PROBABILITY PLOT
 15.5+*                                                  2       *        15.5+                                                        *
     .                                                                        |
     .*                                                  1       *            |                                                    *
     .*                                                  1       *            |                                                   *
     .*                                                  2       *            |                                                 **
     .*                                                  1       *            |                                                *
     .***                                                7       *            |                                             ****       +
     .***                                                9       *            |                                          ****     +++
  7.5+**                                                 5       *         7.5+                                          **    +++
     .*                                                  2       *            |                                          * ++++
     .*                                                  3       *            |                                         *++
     .*                                                  3       *            |                                      +++*
     .**                                                 4       *            |                                   +++  **
     .***                                                8       0            |                                +++    **
     .****                                              11       +            |                             +++     ***
     .***********************************              107    *-----*         |                 ***************
 -0.5+****************************                      84       |       -0.5+*****************++++
      ----+----+----+----+----+----+----+-                                   +----+----+----+----+----+----+----+----+----+----+
      * MAY REPRESENT UP TO 3 COUNTS                                               -2        -1        +0        +1        +2
```

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                                                          SAS

                                                      UNIVARIATE

VARIABLE=SI

                MOMENTS                                         QUANTILES(DEF=4)                                          EXTREMES

N                 252   SUM WGTS          252     100% MAX      124.2        99%       94.023           LOWEST     ID         HIGHEST     ID
MEAN          38.7956   SUM            9776.5      75% Q3      46.075        95%       63.035               0(      66)         86.1(      100)
STD DEV       15.0029   VARIANCE      225.088      50% MED       35.3        90%        56.87             9.9(     187)         86.3(      100)
SKEWNESS      1.59476   KURTOSIS      5.25131      25% Q1        29.2        10%        25.53             9.9(     187)         93.6(      205)
USS            435783   CSS           56497.1       0% MIN          0         5%       21.565              11(      79)         94.5(       50)
CV            38.6717   STD MEAN     0.945096                                 1%          9.9            14.9(      12)        124.2(      205)
T:MEAN=0      41.0494   PROB>|T|       0.0001     RANGE         124.2
SGN RANK        15813   PROB>|S|       0.0001     Q3-Q1        16.875
NUM ^= 0          251                             MODE           29.6
D:NORMAL     0.130875   PROB>D          <0.01

                                                           MISSING VALUE         .
                                                                   COUNT         1
                                                           % COUNT/NOBS       0.40

              BAR CHART                         #       BOXPLOT                                NORMAL PROBABILITY PLOT
   122.5+*                                      1          *               122.5+                                                         *
        .                                                                       |
        .                                                                       |
        .                                                                       |
        .                                                                       |
        .                                                                       |
        .*                                      2          0                    |                                                    *  *
        .**                                     3          0                    |                                                  ***
        .                                                                       |
        .*                                      1          0                    |                                                  *      +
        .*                                      1          0                    |                                                  *  +++
        .*                                      2          |                    |                                                *++
    62.5+***                                    6          |                62.5+                                             ***
        .*********                             18          |                    |                                         +****
        .*********                             17          |                    |                                     *****
        .**********                            20       +-----+                 |                                 +***
        .***********                           22       |     |                 |                            +++***
        .*******************                   37       *--+--*                 |                        ++****
        .***************************           54       |     |                 |                    +*****
        .************************              48       +-----+                 |           ***********
        .********                              15          |                    |      ****** +++
        .*                                      1          |                    |     *    +++
        .**                                     3          |                    |   ** ++++
        .                                                  |                    |***+++
     2.5+*                                      1          0                 2.5++++
         ----+----+----+----+----+--                                            +----+----+----+----+----+----+----+----+----+----+
         * MAY REPRESENT UP TO 2 COUNTS                                                -2        -1        +0        +1        +2
```

SAS

UNIVARIATE

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VARIABLE=TOTC

             MOMENTS                                      QUANTILES(DEF=4)                                      EXTREMES

N                27   SUM WGTS          27       100% MAX      54.32       99%        54.32          LOWEST     ID         HIGHEST     ID
MEAN        31.2507   SUM           843.77        75% Q3       37.74       95%      51.5399            0.54(    238)        38.99(      16)
STD DEV     12.1744   VARIANCE     148.216        50% MED      35.54       90%       41.874            8.68(     92)        39.88(      23)
SKEWNESS  -0.900844   KURTOSIS    0.775685        25% Q1       24.43       10%        9.864           10.16(     93)         40.5(     241)
USS         30222.1   CSS          3853.63         0% MIN       0.54        5%        3.796           12.46(    166)        47.37(       2)
CV          38.9572   STD MEAN     2.34297                                  1%         0.54           18.18(     95)        54.32(     202)
T:MEAN=0    13.3381   PROB>|T|      0.0001       RANGE         53.78
SGN RANK        189   PROB>|S|      0.0001       Q3-Q1         13.31
NUM ^= 0         27                              MODE           29.8
W:NORMAL   0.902423   PROB<W         0.017

                                                 MISSING VALUE        .
                                                         COUNT      226
                                                  % COUNT/NOBS    89.33

       STEM LEAF                   #        BOXPLOT                             NORMAL PROBABILITY PLOT
          5 4                      1           |              55+                                                    +    *
          4 007                    3           |                |                                          + ++  *   *
          3 0012456667788899      16        *--+--*             |                                 ************* **
          2 44                     2        +-----+             |                           ****+++
          1 028                    3           |                |                     +  * **
          0 19                     2           0               5+         *     *
            ----+----+----+----+                                 +----+----+----+----+----+----+----+----+----+----+
            MULTIPLY STEM.LEAF BY 10**+01                                 -2        -1        +0        +1        +2
```

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                                                           SAS

                                                        UNIVARIATE

VARIABLE=AL

                 MOMENTS                                                  QUANTILES(DEF=4)                                        EXTREMES

N                   251   SUM WGTS          251        100% MAX        77.1         99%         34.5831             LOWEST      ID          HIGHEST      ID
MEAN            0.76992   SUM            193.25         75% Q3         0.11         95%             1.1              -0.08(     240)            9.1(       50)
STD DEV         6.15232   VARIANCE       37.851         50% MED        0.03         90%           0.378              -0.08(     245)           10.6(       50)
SKEWNESS        10.8582   KURTOSIS      122.956         25% Q1        -0.02         10%           -0.08              -0.08(      72)           13.8(      205)
USS             9611.54   CSS           9462.75          0% MIN       -0.08          5%           -0.08              -0.08(     166)           57.1(      208)
CV              799.085   STD MEAN     0.388331                                      1%           -0.08              -0.08(     244)           77.1(      205)
T:MEAN=0        1.98264   PROB>|T|    0.0485022        RANGE          77.18
SGN RANK           6342   PROB>|S|       0.0001        Q3-Q1           0.13
NUM ¬= 0            249                                MODE           -0.08
D:NORMAL       0.445062   PROB>D          <0.01

                                                                 MISSING VALUE           .
                                                                         COUNT           2
                                                                  % COUNT/NOBS        0.79

         BAR CHART                                                        # BOXPLOT                          NORMAL PROBABILITY PLOT
   77.5+*                                                                 1     *        77.5+                                                         *
       .                                                                                     |
       .                                                                                     |
       .*                                                                 1     *            |                                                         *
       .                                                                                     |
       .                                                                                     |
   37.5+                                                                                 37.5+
       .                                                                                     |
       .                                                                                     |
       .                                                                                     |                                                         +
       .*                                                                 2     *            |                                              +++++++**
       .*                                                                 1     *            |                                 +++++++++      *
       .***                                                              14  *--*--*         |                      **********************
   -2.5+***********************************************                 232  +-----+     -2.5+**********************+
        ----+----+----+----+----+----+----+----+----+--                                      +----+----+----+----+----+----+----+----+----+----+
        * MAY REPRESENT UP TO 5 COUNTS                                                              -2        -1        +0        +1        +2
```

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                                                                        SAS

                                                                     UNIVARIATE

VARIABLE=BA

                  MOMENTS                                         QUANTILES(DEF=4)                                          EXTREMES

N                 239   SUM WGTS          239      100% MAX        2.8        99%    0.869986          LOWEST      ID         HIGHEST      ID
MEAN        0.0477197   SUM            11.405       75% Q3       0.028        95%         0.2          -0.005(      184)        0.33(      205)
STD DEV      0.203848   VARIANCE    0.0415539       50% MED       0.01        90%   0.0969996          -0.005(      108)        0.43(      205)
SKEWNESS      11.1237   KURTOSIS      143.352       25% Q1      -0.005        10%      -0.005          -0.005(      108)        0.54(       23)
USS           10.4341   CSS           9.88983        0% MIN     -0.005         5%      -0.005          -0.005(      181)        1.09(      100)
CV            427.178   STD MEAN    0.0131858                                1%      -0.005          -0.005(       99)         2.8(       63)
T:MEAN=0      3.61902   PROB>|T|  .000361196     RANGE           2.805
SGN RANK        10699   PROB>|S|       0.0001    Q3-Q1           0.033
NUM ¬= 0          239                            MODE           -0.005
D:NORMAL     0.397963   PROB>D          <0.01

                                                           MISSING VALUE         .
                                                                   COUNT        14
                                                            % COUNT/NOBS      5.53

           BAR CHART                                               #  BOXPLOT                                  NORMAL PROBABILITY PLOT
    2.9+*                                                          1     *         2.9+                                                             *
       .                                                                              |
       .                                                                              |
    2.3+                                                                           2.3+
       .                                                                              |
       .                                                                              |
    1.7+                                                                           1.7+
       .                                                                              |
       .                                                                              |
    1.1+*                                                          1     *         1.1+                                                             *
       .                                                                              |
       .                                                                              |
    0.5+*                                                          2     *         0.5+                                                     +++++** +
       .****                                                      10     *            |                                        +++++++++******
       .*********************************************            134  *--*--*         |                       *********************
   -0.1+*******************************                            91  +-----+       -0.1+*******************++++
        ----+----+----+----+----+----+----+----+----+                                   +----+----+----+----+----+----+----+----+----+----+
        * MAY REPRESENT UP TO 3 COUNTS                                                       -2        -1        +0        +1        +2
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                                                    SAS

                                                UNIVARIATE

VARIABLE=B

            MOMENTS                                    QUANTILES(DEF=4)                                 EXTREMES

N                249  SUM WGTS          249     100% MAX        3.9      99%        3.515      LOWEST    ID        HIGHEST     ID
MEAN        0.623273  SUM           155.195      75% Q3       0.905      95%          2.6      -0.02(   240)        3.5(     254)
STD DEV     0.796996  VARIANCE     0.635203      50% MED       0.36      90%         1.41      -0.02(    72)        3.5(     254)
SKEWNESS     2.00053  KURTOSIS      4.34182      25% Q1       0.039      10%       -0.005      -0.02(   239)       3.51(     257)
USS          254.259  CSS            157.53       0% MIN      -0.02       5%        -0.02      -0.02(   241)       3.52(     255)
CV           127.873  STD MEAN    0.0505076                               1%        -0.02      -0.02(   232)        3.9(     201)
T:MEAN=0     12.3402  PROB>|T|       0.0001      RANGE         3.92
SGN RANK     14710.5  PROB>|S|       0.0001      Q3-Q1        0.866
NUM ¬= 0         249                             MODE         -0.02
D:NORMAL    0.209798  PROB>D          <0.01

                                                 MISSING VALUE          .
                                                         COUNT          4
                                                  % COUNT/NOBS       1.58

        BAR CHART                                #       BOXPLOT               NORMAL PROBABILITY PLOT
   3.9+*                                         1          *       3.9+                                                  *
      .                                                                |
   3.5+***                                       6          *       3.5+                                          ***** *
      .                                                                |
   3.1+*                                         2          0       3.1+                                         **
      .                                                                |
   2.7+**                                        4          0       2.7+                                       ***    +
      .*                                         1          0          |                                       *    +
   2.3+*                                         2          0       2.3+                                      **  +++
      .                                                     |          |                                        ++
   1.9+*                                         2          |       1.9+                                      +++
      .*                                         1          |          |                                    ++
   1.5+****                                      7          |       1.5+                                  +++**
      .*******                                  14          |          |                                +*****
   1.1+*****                                    10          |       1.1+                             +++***
      .***************                          30       +-----+       |                           ++****
   0.7+************                             24       |  +  |    0.7+                        ++*****
      .*********                                17       |     |       |                      ++***
   0.3+***********                              21       *-----*    0.3+                   +++***
      .**********************************       68       +-----+       |              *********
  -0.1+********************                     39          |      -0.1+***************+++
       ----+----+----+----+----+----+----                               +----+----+----+----+----+----+----+----+----+----+
       * MAY REPRESENT UP TO 2 COUNTS                                        -2        -1        +0        +1        +2
```

```
                                                      SAS

                                                  UNIVARIATE

VARIABLE=CO

                  MOMENTS                                          QUANTILES(DEF=4)                                        EXTREMES

N               237       SUM WGTS        237         100% MAX       0.05        99%        0.05              LOWEST        HIGHEST
MEAN     -.00876793       SUM          -2.078          75% Q3       -0.01        95%        0.01               -0.03           0.02
STD DEV  0.00904936       VARIANCE .000081891          50% MED      -0.01        90%      -0.005               -0.02          0.025
SKEWNESS    4.18731       KURTOSIS    23.1042          25% Q1       -0.01        10%     -0.0104               -0.02           0.05
USS        0.037546       CSS       0.0193262           0% MIN      -0.03         5%       -0.02               -0.02           0.05
CV          -103.21       STD MEAN .000587819                                     1%       -0.02               -0.02           0.05
T:MEAN=0    -14.916       PROB>|T|     0.0001         RANGE          0.08
SGN RANK     -11914       PROB>|S|     0.0001         Q3-Q1             0
NUM ¬= 0        237                                   MODE          -0.01
D:NORMAL   0.448663       PROB>D        <0.01
                                                      MISSING VALUE        .
                                                              COUNT       16
                                                       % COUNT/NOBS     6.32

          BAR CHART                                           # BOXPLOT                       NORMAL PROBABILITY PLOT
 0.0525+*                                                     3     *      0.0525+                                                     ***
       .                                                                         |
       .                                                                         |
       .                                                                         |
       .                                                                         |
       .*                                                     1     *            |                                                  *
       .*                                                     3     *            |                                                ***
 0.0125+**                                                    5     *      0.0125+                                              *** +++++
       .*                                                     2     *            |                                             *++++
       .                                                                         |                                         ++++++
       .*                                                     3     *            |                                  +++++    ***
       .**                                                    8  *--+--*         |            *************************
       .**********************************************      191     *            |          **      +++++
       .*                                                     4     *            |***********   ++++++
       .****                                                 16                  |       +++++
-0.0275+*                                                     1     *     -0.0275+++++++++
        ----+----+----+----+----+----+----+----+----+---                          +----+----+----+----+----+----+----+----+----+----+
        * MAY REPRESENT UP TO 4 COUNTS                                                 -2         -1        +0         +1         +2
```

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VARIABLE=CR

MOMENTS

N	236	SUM WGTS	236
MEAN	0.00117797	SUM	0.278
STD DEV	0.0376602	VARIANCE	0.00141829
SKEWNESS	2.85898	KURTOSIS	12.202
USS	0.333626	CSS	0.333299
CV	3197.05	STD MEAN	0.00245147
T:MEAN=0	0.480514	PROB>|T|	0.631309
SGN RANK	-2841.5	PROB>|S|	0.00650322
NUM ^= 0	236		
D:NORMAL	0.246376	PROB>D	<0.01

QUANTILES(DEF=4)

100% MAX	0.23	99%	0.197798
75% Q3	0.007	95%	0.08
50% MED	-0.003	90%	0.0329999
25% Q1	-0.03	10%	-0.0318001
0% MIN	-0.04	5%	-0.04
		1%	-0.04
RANGE	0.27		
Q3-Q1	0.037		
MODE	-0.003		

EXTREMES

LOWEST	HIGHEST
-0.04	0.1
-0.04	0.16
-0.04	0.16
-0.04	0.22
-0.04	0.23

MISSING VALUE	.
COUNT	17
% COUNT/NOBS	6.72

```
          BAR CHART                                  #     BOXPLOT
  0.235+*                                            1        *
       .*                                            1        *
       .
  0.205+
       .
       .
  0.175+
       .*                                            2        *
       .
  0.145+
       .
       .
  0.115+
       .*                                            1        0
       .**                                           4        0
  0.085+**                                           5        0
       .*                                            1        0
       .*                                            3        |
  0.055+*                                            2        |
       .*                                            3        |
       .**                                           4        |
  0.025+****                                        10        |
       .****                                        12        |
       .********                                    22     +--+--+
 -0.005+**********************************         102     *-----*
       .*                                            2     |     |
       .                                                   +-----+
 -0.035+*********************                       61        |
        ----+----+----+----+----+----+----+----
        * MAY REPRESENT UP TO 3 COUNTS
```

```
                           NORMAL PROBABILITY PLOT
  0.235+                                                        *
       |                                                        *
       |
  0.205+
       |
       |
  0.175+
       |                                                      **
       |
  0.145+
       |
       |
  0.115+
       |                                                  *
       |                                                ***     +
  0.085+                                              **  +++
       |                                             *  ++
       |                                             **+++
  0.055+                                           +++
       |                                         ++**
       |                                      +++ **
  0.025+                                   +++  ***
       |                                 ++  ***
       |                             +++  ****
 -0.005+                         ************
       |                          +++
       |                 *******+
 -0.035+***********+++++
        +----+----+----+----+----+----+----+----+----+----+
            -2        -1        +0        +1        +2
```

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                                                         SAS

                                                      UNIVARIATE

VARIABLE=CU

               MOMENTS                                          QUANTILES(DEF=4)                                         EXTREMES

N                 235   SUM WGTS          235        100% MAX        0.11       99%   0.0855993          LOWEST     ID          HIGHEST     ID
MEAN       .000153191   SUM             0.036         75% Q3       -0.002       95%       0.026          -0.01(    240)         0.053(      42)
STD DEV     0.0146133   VARIANCE .000213549           50% MED      -0.002       90%  0.00939999          -0.01(    245)          0.06(      41)
SKEWNESS      4.59054   KURTOSIS      25.5674         25% Q1       -0.006       10%      -0.006          -0.01(     72)          0.06(     205)
USS          0.049976   CSS         0.0499705          0% MIN       -0.01        5%       -0.01          -0.01(    166)           0.1(      51)
CV            9539.25   STD MEAN .000953268                                      1%       -0.01          -0.01(    244)          0.11(     205)
T:MEAN=0     0.160701   PROB>|T|     0.872467        RANGE           0.12
SGN RANK      -6831.5   PROB>|S|       0.0001        Q3-Q1          0.004
NUM ¬= 0          235                                MODE          -0.002
D:NORMAL     0.405378   PROB>D          <0.01

                                                        MISSING VALUE        .
                                                                COUNT       18
                                                         % COUNT/NOBS     7.11

              BAR CHART                             #      BOXPLOT                          NORMAL PROBABILITY PLOT
   0.1125+*                                         1         *           0.1125+                                                      *
         .                                                                      |
         .*                                         1         *                 |                                                      *
         .                                                                      |
         .                                                                      |
         .                                                                      |
         .                                                                      |
         .                                                                      |
         .                                                                      |
         .*                                         2         *                 |                                                   **
         .                                                                      |
   0.0525+*                                         3         *           0.0525+                                                ***
         .                                                                      |
         .*                                         1         *                 |                                               *
         .                                                                      |                                                      +
         .*                                         3         *                 |                                              **  +++
         .*                                         1         *                 |                                              *+++
         .*                                         3         *                 |                                          +**+
         .*                                         1         *                 |                                      +++ *
         .***                                       7         *                 |                                  ++++  ***
         .****                                     10         0                 |                              +++    ***
         .*                                         3         +                 |                         ++++       **
         .********************************         98      *-----*              |                    +************
  -0.0075+*********************************       101      +-----+       -0.0075+**********************
          ----+----+----+----+----+----+----                                     +----+----+----+----+----+----+----+----+----+----+
          * MAY REPRESENT UP TO 3 COUNTS                                              -2        -1        +0        +1        +2
```

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                                                             SAS

                                                         UNIVARIATE

VARIABLE=FE

              MOMENTS                                      QUANTILES(DEF=4)                                       EXTREMES

N               251  SUM WGTS         251       100% MAX       51.5       99%       47.716           LOWEST     ID          HIGHEST      ID
MEAN        1.31595  SUM          330.304        75% Q3        0.25       95%      4.69999           -0.08(    243)          15.4(     178)
STD DEV     5.91103  VARIANCE     34.9403        50% MED        0.1       90%        1.946           -0.01(    166)          32.3(     205)
SKEWNESS    7.08672  KURTOSIS     52.8924        25% Q1        0.05       10%       0.0124           -0.01(    166)          46.9(     208)
USS         9169.75  CSS          8735.08         0% MIN      -0.08        5%       -0.002           -0.01(    125)          48.6(     205)
CV          449.183  STD MEAN    0.373101                                  1%        -0.01           -0.01(    122)          51.5(     208)
T:MEAN=0    3.52707  PROB>|T| .000499801        RANGE         51.58
SGN RANK    15583.5  PROB>|S|      0.0001        Q3-Q1           0.2
NUM ^= 0        251                              MODE           0.05
D:NORMAL   0.407271  PROB>D         <0.01

                                                          MISSING VALUE           .
                                                                  COUNT           2
                                                           % COUNT/NOBS        0.79

         BAR CHART                                          #   BOXPLOT
   51+*                                                     1      *
     .*                                                     1      *
     .*                                                     1      *
     .
     .
     .
     .
     .
     .*                                                     1      *
     .
     .
     .
   25+
     .
     .
     .
     .*                                                     2      *
     .
     .*                                                     2      *
     .*                                                     3      *
     .*                                                     3      *
     .***                                                  11      *
     .***************************************             154   *--*--*
   -1+******************                                   72      |
      ----+----+----+----+----+----+----+----
      * MAY REPRESENT UP TO 4 COUNTS

                         NORMAL PROBABILITY PLOT
   51+                                                   *
     |                                                   *
     |                                                 *
     |
     |
     |
     |
     |
     |                                                *
     |
     |
     |
   25+
     |
     |
     |
     |                                                   +
     |                                              **++
     |                                             +++
     |                                         ++++
     |                                      +++    *
     |                                  ++++     **
     |                               +++        **
     |                            +++      ****
     |          ******************************
   -1+*********++++++++++++++
      +----+----+----+----+----+----+----+----+----+----+
              -2        -1        +0        +1        +2
```

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VARIABLE=LI

MOMENTS

N	171	SUM WGTS	171
MEAN	0.00022807	SUM	0.039
STD DEV	0.0307703	VARIANCE	.000946812
SKEWNESS	0.864469	KURTOSIS	4.36261
USS	0.160967	CSS	0.160958
CV	13491.6	STD MEAN	0.00235306
T:MEAN=0	0.0969247	PROB>|T|	0.9229
SGN RANK	-759.5	PROB>|S|	0.232046
NUM ^= 0	171		
D:NORMAL	0.232074	PROB>D	<0.01

QUANTILES(DEF=4)

100% MAX	0.11	99%	0.11
75% Q3	0.017	95%	0.04
50% MED	-0.006	90%	0.03
25% Q1	-0.02	10%	-0.02
0% MIN	-0.1	5%	-0.02
		1%	-0.1
RANGE	0.21		
Q3-Q1	0.037		
MODE	-0.02		

EXTREMES

LOWEST	ID	HIGHEST	ID
-0.1(	108)	0.1(	182)
-0.1(	108)	0.103(	184)
-0.1(	181)	0.11(	184)
-0.03(	120)	0.11(	195)
-0.02(	132)	0.11(	195)

MISSING VALUE .
COUNT 82
% COUNT/NOBS 32.41

```
          BAR CHART                                   #    BOXPLOT              NORMAL PROBABILITY PLOT
  0.115+**                                            3      0       0.115+                                            ****
       .**                                            3      0            |                                       ***
       .                                                                  |
       .                                                                  |
       .                                                                  |                                              +++
       .*                                             1      |            |                                          +  +
  0.045+**                                            4      |       0.045+                                      +++
       .******                                       11      |            |                                  ++***
       .**********                                   19      |            |                              +*****
       .****************                             31   +-----+         |                          *****
       .*****                                         9   |  +  |         |                     ******
       .****                                          8   *-----*         |                  +*++
       .                                                  |     |         |               +++**
 -0.025+***************************************      78   +-----+   -0.025+            +++
       .*                                             1      |            |    ******************
       .                                                                  |    *     ++++
       .                                                                  |       +++
       .                                                                  |    +++
       .                                                                  |  + +
       .                                                                  |+++
 -0.095+**                                            3      0      -0.095+****
        ----+----+----+----+----+----+----+----                         +----+----+----+----+----+----+----+----+----+----+
        * MAY REPRESENT UP TO 2 COUNTS                                        -2        -1        +0        +1        +2
```

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                                                        SAS

                                                     UNIVARIATE

VARIABLE=MN

               MOMENTS                                      QUANTILES(DEF=4)                                 EXTREMES

N                 236   SUM WGTS          236      100% MAX       2.3      99%      1.78196         LOWEST      ID        HIGHEST      ID
MEAN        0.0564831   SUM             13.33       75% Q3       0.05      95%        0.343           -0.5(      29)        0.47(      180)
STD DEV      0.248646   VARIANCE    0.0618247       50% MED     0.004      90%        0.263           -0.5(      29)         0.6(      205)
SKEWNESS      6.48375   KURTOSIS      56.0104       25% Q1      -0.02      10%        -0.02           -0.5(      23)         0.9(      205)
USS           15.2817   CSS           14.5288        0% MIN      -0.5       5%         -0.1           -0.1(     184)         2.3(      208)
CV            440.213   STD MEAN    0.0161855                               1%         -0.5           -0.1(     108)         2.3(      208)
T:MEAN=0      3.48974   PROB>|T|  .000577201       RANGE          2.8
SGN RANK       4300.5   PROB>|S|       0.0001      Q3-Q1         0.07
NUM ^= 0          236                              MODE         -0.02
D:NORMAL     0.325779   PROB>D          <0.01

                                                        MISSING VALUE        .
                                                                COUNT       17
                                                         % COUNT/NOBS     6.72

        BAR CHART                                    #      BOXPLOT                        NORMAL PROBABILITY PLOT
  2.3+*                                              2         *         2.3+                                                         *
     .                                                                      |
     .                                                                      |
     .                                                                      |
     .                                                                      |
     .                                                                      |
  0.9+*                                              1         *         0.9+                                                      *
     .*                                              1         *            |                                                     *+ +
     .*                                              2         *            |                                              +++++++**
     .*******                                       21         *            |                                    ++++++********
     .***************************                   87      *--0--*         |                     ++*************
     .*************************************        119      +-----+         |   *********************
     .                                                                      |       ++++++++
 -0.5+*                                              3         *        -0.5+***++++
      ----+----+----+----+----+----+----+----                                +----+----+----+----+----+----+----+----+----+----+
      * MAY REPRESENT UP TO 3 COUNTS                                              -2        -1        +0        +1        +2
```

SAS

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VARIABLE=MO

MOMENTS			
N	237	SUM WGTS	237
MEAN	0.172532	SUM	40.89
STD DEV	0.273735	VARIANCE	0.0749309
SKEWNESS	1.60339	KURTOSIS	1.93171
USS	24.7385	CSS	17.6837
CV	158.658	STD MEAN	0.017781
T:MEAN=0	9.70315	PROB>|T|	0.0001
SGN RANK	8042	PROB>|S|	0.0001
NUM ^= 0	237		
D:NORMAL	0.221247	PROB>D	<0.01

QUANTILES(DEF=4)			
100% MAX	1.22	99%	0.9862
75% Q3	0.26	95%	0.834
50% MED	0.07	90%	0.61
25% Q1	-0.03	10%	-0.03
0% MIN	-0.1	5%	-0.03
		1%	-0.0734
RANGE	1.32		
Q3-Q1	0.29		
MODE	-0.03		

EXTREMES			
LOWEST	ID	HIGHEST	ID
-0.1(	2)	0.98(	40)
-0.1(	2)	0.98(	40)
-0.03(	184)	0.98(	180)
-0.03(	181)	0.99(	180)
-0.03(	108)	1.22(	182)

MISSING VALUE .
COUNT 16
% COUNT/NOBS 6.32

```
         BAR CHART                                       #     BOXPLOT
  1.225+*                                                1        *
       .
       .
       .
       .
       .**                                               4        0
       .**                                               5        0
       .*                                                1        0
       .**                                               5        0
       .*                                                1        0
       .*                                                2        0
       .*                                                1        |
       .***                                              7        |
  0.575+*                                                1        |
       .**                                               5        |
       .*                                                3        |
       .**                                               5        |
       .*                                                1        |
       .**                                               4        |
       .******                                          17     +-----+
       .******                                          16     |     |
       .******                                          18     |  +  |
       .*******                                         21     |     |
       .**                                               6     *-----*
       .**                                               4     |     |
       .***********************************            107     +-----+
 -0.075+*                                                2        |
        ----+----+----+----+----+----+----+-
        * MAY REPRESENT UP TO 3 COUNTS

                     NORMAL PROBABILITY PLOT
  1.225+                                                  *
       |
       |
       |
       |
       |                                             *** *
       |                                           ****
       |                                           *      +
       |                                          ***    +
       |                                          *     +
       |                                         *    ++
       |                                         *   ++
       |                                        *** ++
  0.575+                                        * ++
       |                                       *++
       |                                      *+
       |                                     *+
       |                                   ++*
       |                                 ++  *
       |                                ++ ****
       |                               + ***
       |                             ++***
       |                           ++***
       |                         ++  **
       |                       ++    *
       |  **********************
 -0.075+* +++++++++++++++
        +----+----+----+----+----+----+----+----+----+----+
            -2        -1        +0        +1        +2
```

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                                                    SAS

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VARIABLE=NI

              MOMENTS                                  QUANTILES(DEF=4)                                        EXTREMES

N                212   SUM WGTS          212     100% MAX       0.16        99%     0.136998         LOWEST     ID          HIGHEST     ID
MEAN      -0.0165472   SUM            -3.508      75% Q3       -0.02        95%         0.01          -0.03(    240)          0.03(    187)
STD DEV    0.0201944   VARIANCE .000407813        50% MED      -0.02        90%        -0.01          -0.03(    245)          0.04(     41)
SKEWNESS      6.3953   KURTOSIS       49.475      25% Q1       -0.02        10%        -0.03          -0.03(     72)          0.05(    127)
USS         0.144096   CSS         0.0860485       0% MIN      -0.03         5%        -0.03          -0.03(    166)          0.15(    208)
CV          -122.041   STD MEAN 0.00138696                                   1%        -0.03          -0.03(    244)          0.16(    208)
T:MEAN=0    -11.9306   PROB>|T|       0.0001     RANGE          0.19
SGN RANK     -9615.5   PROB>|S|       0.0001     Q3-Q1             0
NUM ^= 0         212                             MODE          -0.02
D:NORMAL     0.42637   PROB>D          <0.01

                                                 MISSING VALUE          .
                                                         COUNT         41
                                                  % COUNT/NOBS      16.21

             BAR CHART                                #  BOXPLOT                           NORMAL PROBABILITY PLOT
  0.165+*                                             1     *        0.165+                                                          *
       .*                                             1     *             |                                                         *
       .                                                                  |
       .                                                                  |
       .                                                                  |
       .                                                                  |
       .                                                                  |
       .                                                                  |
       .                                                                  |
       .                                                                  |
       .                                                                  |
       .*                                             1     *             |                                                    *
       .*                                             1     *             |                                                   *
       .*                                             3     *             |                                                 **    ++
       .*                                             2     *             |                                               **++++
       .*                                             4     *             |                                           ++*++
       .                                                                  |                                      +++++
       .*                                             3     *             |                                 +++++  *****
       .****                                         14  *--+--*          |           **********************
 -0.025+**********************************************  182     *     -0.025+***************++++++++++
        ----+----+----+----+----+----+----+----+----+-                     +----+----+----+----+----+----+----+----+----+----+
        * MAY REPRESENT UP TO 4 COUNTS                                          -2        -1        +0        +1        +2
```

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                                                        SAS

                                                    UNIVARIATE

VARIABLE=PB

                MOMENTS                                         QUANTILES(DEF=4)                                      EXTREMES

N                 216  SUM WGTS         216       100% MAX        1.3       99%   0.809197          LOWEST    ID           HIGHEST    ID
MEAN       -0.0652731  SUM          -14.099        75% Q3        -0.1       95%      0.196           -0.16(    109)          0.37(     127)
STD DEV      0.162706  VARIANCE   0.0264733        50% MED       -0.1       90%      0.126           -0.16(    187)           0.4(     208)
SKEWNESS      4.54587  KURTOSIS     28.3277        25% Q1       -0.15       10%      -0.15           -0.16(    109)          0.61(     180)
USS           6.61205  CSS          5.69176         0% MIN      -0.16        5%      -0.15           -0.16(    187)          0.85(     205)
CV            -249.27  STD MEAN   0.0110708                                  1%      -0.16           -0.15(    240)           1.3(     205)
T:MEAN=0       -5.896  PROB>|T|      0.0001       RANGE          1.46
SGN RANK      -6786.5  PROB>|S|      0.0001       Q3-Q1          0.05
NUM ^= 0          216                             MODE           -0.1
D:NORMAL     0.422468  PROB>D         <0.01

                                                  MISSING VALUE       .
                                                          COUNT      37
                                                   % COUNT/NOBS   14.62

          BAR CHART                                     #  BOXPLOT                          NORMAL PROBABILITY PLOT
   1.35+*                                               1     *      1.35+                                                       *
       .                                                                 |
       .                                                                 |
   1.05+                                                             1.05+
       .                                                                 |
       .*                                               1     *          |                                                      *
   0.75+                                                             0.75+
       .*                                               1     *          |                                                    *
       .                                                                 |
   0.45+*                                               1     *      0.45+                                                  *
       .*                                               4     *          |                                              ***  +++
       .*                                               2     *          |                                             *++++
   0.15+*****                                          19     *      0.15+                                       *******
       .                                                                 |                                  ++++++
       .**                                              6  *--0--*       |                          ***************
  -0.15+*********************************************** 181  +-----+    -0.15+*********************++
        ----+----+----+----+----+----+----+----+----+-                   +----+----+----+----+----+----+----+----+----+----+
        * MAY REPRESENT UP TO 4 COUNTS                                        -2        -1        +0        +1        +2
```

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VARIABLE=SR

MOMENTS

N	210	SUM WGTS	210
MEAN	0.0256143	SUM	5.379
STD DEV	0.0317883	VARIANCE	0.0010105
SKEWNESS	2.75047	KURTOSIS	11.2513
USS	0.348973	CSS	0.211194
CV	124.104	STD MEAN	0.0021936
T:MEAN=0	11.6768	PROB>|T|	0.0001
SGN RANK	10765	PROB>|S|	0.0001
NUM ¬= 0	209		
D:NORMAL	0.231999	PROB>D	<0.01

QUANTILES(DEF=4)

100% MAX	0.217	99%	0.200099
75% Q3	0.04	95%	0.0745499
50% MED	0.012	90%	0.061
25% Q1	0.007	10%	0.00209999
0% MIN	-0.012	5%	-0.001
		1%	-0.003
RANGE	0.229		
Q3-Q1	0.033		
MODE	0.01		

EXTREMES

LOWEST	ID	HIGHEST	ID
-0.012(	102)	0.118(	260)
-0.003(	245)	0.119(	205)
-0.003(	243)	0.12(	39)
-0.001(	51)	0.21(	207)
-0.001(	218)	0.217(	205)

MISSING VALUE .
COUNT 43
% COUNT/NOBS 17.00

```
        BAR CHART                            #     BOXPLOT
 0.215+*                                     2        *
      .
      .
      .
      .
      .
      .
      .
      .
      .*                                     1
      .**                                    3        0
      .*                                     2        0
      .*                                     1
      .*                                     1        0
      .                                               |
      .***********                          21        |
      .*****                                10        |
      .*******                              13     +-----+
      .*******                              13     |     |
      .*****                                10     |  +  |
      .*****************************        57     *-----*
      .********************************     62     +-----+
      .*******                              13        |
-0.015+*                                     1        |
       ----+----+----+----+----+----+-
       * MAY REPRESENT UP TO 2 COUNTS
```

```
                      NORMAL PROBABILITY PLOT
 0.215+                                                   **
      |
      |
      |
      |
      |
      |
      |
      |
      |
      |                                             ****
      |                                            **     ++
      |                                               ++
      |                                           *+++
      |                                        ++++
      |                                     ******
      |                                  +**
      |                               ++**
      |                            +++**
      |                         +++ ***
      |                      ++******
      |           **************
      | **********    +++
-0.015+*+++++++++++++
       +----+----+----+----+----+----+----+----+----+----+
           -2        -1        +0        +1        +2
```

```
                                                       SAS

                                                   UNIVARIATE

VARIABLE=ZN

                  MOMENTS                                       QUANTILES(DEF=4)                                     EXTREMES

N                 235   SUM WGTS          235      100% MAX       3.4       99%         3.0496          LOWEST    ID           HIGHEST    ID
MEAN           0.0708   SUM            16.638       75% Q3      0.029       95%           0.15          -0.02(       5)          0.62(        50)
STD DEV      0.386155   VARIANCE     0.149116       50% MED    -0.002       90%      0.0839999          -0.02(     187)           2.2(       205)
SKEWNESS      7.39072   KURTOSIS      55.6158       25% Q1      -0.01       10%          -0.01          -0.02(       5)          2.96(       205)
USS            36.071   CSS            34.893        0% MIN     -0.02        5%         -0.015          -0.02(     187)           3.1(       208)
CV            545.416   STD MEAN      0.02519                                1%          -0.02          -0.02(     132)           3.4(       208)
T:MEAN=0      2.81064   PROB>|T| 0.00536306         RANGE        3.42
SGN RANK       3149.5   PROB>|S| 0.00242892         Q3-Q1       0.039
NUM ^= 0          235                               MODE        -0.01
D:NORMAL     0.407051   PROB>D          <0.01

                                                         MISSING VALUE         .
                                                                 COUNT        18
                                                         % COUNT/NOBS       7.11

            BAR CHART                                            # BOXPLOT                        NORMAL PROBABILITY PLOT
   3.5+*                                                         1     *      3.5+                                                         *
      .                                                                           |
      .*                                                         1     *          |                                                         *
      .*                                                         1     *          |                                                       *
      .                                                                           |
      .                                                                           |
      .*                                                         1     *          |                                                     *
      .                                                                           |
      .                                                                           |
   1.7+                                                                       1.7+
      .                                                                           |
      .                                                                           |
      .                                                                           |                                                          +
      .                                                                           |                                                 +++++
      .*                                                         2     *          |                                            +++++ **
      .                                                                           |                                       +++++
      .**                                                        4     *          |                                  +++++      ***
      .****************************                             86  +--*--+       |                             +++****************
  -0.1+*************************************************       139  *-----*  -0.1+****************************
       ----+----+----+----+----+----+----+----+----+--                            +----+----+----+----+----+----+----+----+----+----+
       * MAY REPRESENT UP TO 3 COUNTS                                                  -2        -1       +0        +1        +2
```