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**AREA 5 SITE CHARACTERIZATION PROJECT-
REPORT OF HYDRAULIC PROPERTY ANALYSIS
THROUGH AUGUST 1993**

by

Rocio Estrella
Scott Tyler
Jenny Chapman
Mary Miller

DECEMBER 1993

Publication #45121

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Publication No. 45121

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Nevada Operations Office
U.S. Department of Energy
Las Vegas, Nevada

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MASTER

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INTRODUCTION

The Area 5 Site Characterization Project is designed to determine the suitability of the Radioactive Waste Management Site (RWMS) for disposal of low-level waste (LLW), mixed waste (MW) and transuranic waste (TRU). The Desert Research Institute (DRI) has supported the Area 5 Site Characterization Project for the U.S. Department of Energy, Nevada Operations Office (DOE/NV), Environmental Restoration and Waste Management Division (ERWM), Waste Operations Branch (WOB). The purpose of DRI's Area 5 Site Characterization Project is to characterize important properties of the upper vadose zone which influence infiltration and redistribution of water and transport of solutes as well as to characterize the water quality and hydrologic conditions of the uppermost aquifer.

This report describes methods and presents a summary of all data and results from laboratory physical and chemical testing from Pilot Wells and Science Trench borehole samples through August 1993. DRI laboratories performed soil water content, soil water potential, soil bulk density, soil water extract isotope analyses and soil water chemistry analyses.

Site Description

Area 5 is located in the southeast quarter of the Nevada Test Site (NTS) and is one of two areas at the NTS designated as Radioactive Waste Management Sites (RWMS). The Area 5 RWMS encompasses 2.96 Km² (732 acres) on an alluvial fan within the Frenchman Flat drainage basin. Area 5 averages 11.7 cm (4.6 in) of precipitation annually, and the vadose zone is approximately 240 m (780 ft) thick (Winograd and Thordarson, 1975) (Figure 1).

Pilot Wells and Science Trench Boreholes Description

To characterize the vadose zone and uppermost aquifer at the Area 5 RWMS, three pilot wells and a series of science trench boreholes were drilled. The pilot wells are located at the approximate apexes of an equilateral triangle and are separated by approximately 1.6 Km (1 mi). This spacing allows maximum resolution of the water table. Ue5PW-2 and Ue5PW-3 were positioned at the expected upgradient side of the RWMS given the direction of flow in the regional aquifer. Ue5PW-1 and Ue5PW-2 are both located on older pediment surfaces where early stages of desert varnish have developed. However, Ue5PW-3 is located on a much younger alluvial fan (Figure 2). Boreholes Ue5ST-1 through Ue5ST-7 are located on a 60.96 m (200 ft) long transect approximately aligned with the principal sediment transport direction (Figure 2). The Pilot Well and Science Trench borehole depths and coordinates are listed in Table 1.

The three pilot wells were drilled by Tonto Drilling Company with an Ingersol-Rand T-4W rig using telescopic ODEX drilling system. Only air was used in the drilling. Air rotary coring was employed for coring the tuff formation and drive core method was used for collecting samples from the alluvium. The Science Trench boreholes (Ue5ST-1 through Ue5ST-7) were drilled and completed by Boyles Brothers Drilling Company using hollow-stem auger and ODEX drilling systems. Detailed procedures used for drilling, coring, and sampling of the Pilot Wells and the Science Trench boreholes are given in the Reynolds Electrical and Engineering Company (REECo) Quality Assurance Standard Operating Procedures (SOPs) and Test Plans (TPs) (REECo, 1993a and 1993b).

Figure 1. Location of the Area 5 Radioactive Waste Management Site (RWMS) at the Nevada Test Site (NTS).

Figure 2. Location of Pilot Wells and Science Trench boreholes.

LABORATORY TESTING METHODS

A brief description of the laboratory testing methods and references used to obtain the data contained in this report is presented here. Detailed methods can be found in DRI Quality Assurance Standard Operating Procedures (SOPs).

Water Content Analysis

Soil water content refers to the amount of water contained in a unit mass or volume of soil. The fractional content of water in the soil can be expressed in terms of either mass (kg kg^{-1}) or volume ($\text{m}^3 \text{m}^{-3}$). The traditional gravimetric method of measuring mass wetness consists of determining a sample's moist and dry weights. The moist weight is determined by weighing the sample at the time of sampling and the dry weight is obtained after drying the sample to a constant weight. The standard method of drying the soil consists of drying the samples in an oven at 105°C for 24 hours (Hillel, 1982). The mass wetness (w) or gravimetric wetness (θ_m) is the ratio of the weight loss in drying to the dry weight of the sample. If the bulk density of the sample is known, the volumetric water content (θ_v) can also be determined.

Table 1. Nevada state central zone coordinates and depths of Pilot Wells and Science Trench boreholes at the Area 5 Radioactive Waste Management Site (RWMS, Nevada Test Site (NTS)).

Borehole	Survey Coordinates			Total Depth (ft)
	Northing (ft)	Easting (ft)	Elevation (ft)	
Ue5ST-1	765502.85	709847.12	3176.82	117.50
Ue5ST-2	765545.80	709870.48	3176.46	123.75
Ue5ST-2A	765550.23	709874.08	3177.76	120.00
Ue5ST-3	765589.57	709896.25	3177.93	14.25
Ue5ST-4	765632.97	709920.75	3178.74	113.75
Ue5ST-4A	765629.58	709918.33	3179.06	120.00
Ue5ST-5	765675.78	709944.10	3179.27	37.50
Ue5ST-6	765504.23	709900.82	3176.31	116.17
Ue5ST-6A	765505.72	709897.33	3176.67	120.00
Ue5ST-7	765708.46	710084.42	3178.91	35.00
Ue5PW-1	765702.19	709831.57	3180.35	839.00
Ue5PW-2	770290.92	709893.63	3248.42	919.50
Ue5PW-3	771290.92	703460.07	3300.89	955.00

Soil Bulk Density

Soil bulk density, ρ_b , is the ratio of the mass of dry solids to the bulk volume of the soil. The mass is determined after drying to constant weight at 105°C, and the volume of the sample as taken in the field (Blake and Hartge, 1986). Bulk density was determined only on core samples with 100% recovery. No analyses were performed on cutting samples.

Soil Water Potential

Soil water can contain energy in different quantities and forms. The potential energy, caused by position or internal conditions, is of primary importance in determining the state and movement of water in the soil (Hillel, 1982). All forms of water transfer occur as a result of potential differences with movement from regions of higher to lower potential. The concept of soil water potential refers to the relationship between the retention of water by soil and the soil water energy level.

All methods for measuring water potential in soils require that some medium, whose water potential can be determined, be in equilibrium with soil water. The soil water potential is then found from the known water potential of the medium (Campbell and Gee, 1986). Soil water potential for the Area 5 Project is being determined via (1) filter paper and (2) a CX-2 water activity meter. For the first method, filter paper is used as a standard matrix and equilibrated with soil water to calculate soil water potential (Graecen et al., 1989). The CX-2 water activity meter uses a cooled mirror to

sense the dew point of water vapor in a closed chamber containing a soil sample. Dew-point-derived water activities are converted to total water potential using the Kelvin equation (Gee et al., 1992).

The CX-2 method was used on all samples below a water potential of -0.5 MPa. Filter paper analyses were conducted for selected Science Trench borehole samples and for Pilot Well borehole samples between -1.0 and 0.0 MPa.

Soil Water Extraction

Azeotropic distillation with toluene is used to extract soil water for oxygen and hydrogen isotopic analysis. The method used by the DRI Environmental Isotope Laboratory (Las Vegas) is a modification of the methods used by Revezs and Woods (1990) and Ingraham and Shadel (1992). The method is based on the fact that water and toluene form an azeotropic mixture at 84.1°C , but are immiscible at ambient temperature.

Soil Water Extract Isotope Analysis

Oxygen Isotope Analysis

Samples for oxygen isotope analysis are prepared using the guanidine hydrochloride method modified after Dugan et al. (1985). In this method, $10\text{ }\mu\text{l}$ of water are frozen into a glass reaction tube containing excess guanidine hydrochloride. The tube is then sealed at the top by melting in a torch flame. Through a series of reactions, the water is quantitatively converted into CO_2 gas. This gas is purified and analyzed on a Finnigan Model Delta-E gas-ratio mass spectrometer.

Hydrogen Isotope Analysis

Samples for hydrogen isotope analysis are prepared using the zinc-reduction method modified after Kendall and Coplen (1985). In this method, $10\text{ }\mu\text{l}$ of water are frozen and sealed into a 7 mm glass reaction tube containing 0.25 g of zinc metal shot. The water and zinc are reacted in a furnace at 450°C for one hour to produce hydrogen gas which is directly analyzed on a Nuclide Model 30/60/HD Mass Spectrometer (Gonfiantini, 1981).

Soil Water Chemistry Analysis

The standard soil water chemistry analyses performed by DRI for the Area 5 Site Characterization Project are pH, electrical conductivity, alkalinity, chloride, sulfate, sodium, potassium, calcium, magnesium, silica and nitrate. Standard Environmental Protection Agency (EPA) and United States Geological Survey (USGS) methods, as shown in Table 2, were used by the DRI Water Analysis Laboratory (Reno, NV).

RESULTS

This section presents a summary of all data and results from physical and chemical laboratory testing conducted by DRI on Pilot Well and Science Trench borehole samples. Depth increments are reported in English units (ft) as they were received from the field.

Table 2. Standard methods in use by the DRI Water Analysis Laboratory (Reno, NV).

Parameter	Standard Method
pH	EPA-600/4-79-020, Method 150.1
Specific Conductance	EPA-600/4-79-020, Method 120.1
Alkalinity	USGS, Method I-2030-85
Chloride	EPA-600/4-79-020, Method 325.1
Sulfate	EPA-600/4-84-017, Method 300.0
Sodium	EPA-600/4-79-020, Method 273.1
Potassium	EPA-600/4-79-020, Method 258.1
Calcium	EPA-600/4-79-020, Method 215.1
Magnesium	EPA-600/4-79-020, Method 242.1
Silica	USGS, Method I-2700-85
Bromide	EPA-600/4-84-017, Method 300.0
Nitrate and Nitrite	EPA-600/4-79-020, Method 353.2

Water Content Analysis

Water content on weight and volume basis was determined for Pilot Well and Science Trench boreholes. Data are presented in Appendix A.

Water content profiles from the three Pilot Wells illustrate that water content values are very low and do not change much through the unsaturated zone. There is only a slight increase in water content with depth and a very significant increase, as would be expected, near the water table (Figures 3 and 4).

Plotted vertical profiles from the Science Trench boreholes indicate that water content values are also very low and constant throughout the approximately 120 ft of alluvium penetrated. The only noticeable trend is a slight increase in water content with depth (Figures 5 and 6).

Soil Bulk Density

Bulk density is an input parameter for numerical simulations of fluid, heat, and solid transport. Bulk density data are presented in Appendix A. Plots of bulk density vs. depth for the Science Trench boreholes (Figure 7) show no consistent trend within or between boreholes except for a slight increase in bulk density with depth in the upper 20 ft of each borehole. This increase may be a sampling artifact. No consistent trend in bulk density with depth was identified in the Pilot Well boreholes (Figure 8).

Soil Water Potential

Depth profiles of water potential data from the Pilot Wells and the Science Trench boreholes are summarized in Appendix A.

Figure 3. Depth profiles of gravimetric water content for Pilot Well boreholes.

Figure 4. Depth profiles of volumetric water content for Pilot Well boreholes.

Figure 5. Depth profiles of gravimetric water content for Science Trench boreholes.

Figure 6. Depth profiles of volumetric water content for Science Trench boreholes.

Figure 7. Depth profiles of dry bulk density for Science Trench boreholes.

Figure 8. Depth profiles of dry bulk density for Pilot Well boreholes.

A comparison of water potentials measured by both the CX-2 water activity meter and filter paper method on selected samples indicates relatively good agreement between methods at higher (less negative) water potentials (e.g., 0 to -1500 KPa) (Figure 9a). However, at lower (more negative) water potentials, filter paper values are significantly less than CX-2 meter values (Figure 9b). This difference in potential may occur because the filter paper method relies primarily on vapor diffusion (a very slow process) to transfer water from the soil to the filter paper. At very low water contents, the 7-day equilibration time may not be long enough to obtain representative water potentials by this method.

Water potential data from the Science Trench boreholes (Figure 10) show an upward gradient through the top 120 ft of alluvium with the largest gradient in the upper 30 ft. These data suggest that liquid water is probably moving upward very slowly near the surface. Water potential depth profile data from the Pilot Wells (Figure 11) show a negative gradient (upward flow) to at least a depth of 100 ft, indicating that liquid water is probably moving upward in this region.

Isotope Analysis

Environmental tracer data provide an alternative and independent method for estimating hydraulic properties and hydrologic conditions. The basic principle used in this approach is that infiltrating water (from precipitation and run-off) contains dissolved natural and man-made materials that can serve as conservative (nonsorbing) tracers of water as it moves into and through the vadose zone. The concentration of these tracers is measured with depth, and the analysis of these data yields information concerning the history of the movement of water through the unsaturated zone. The stable isotopes of hydrogen and oxygen are excellent tracers of water movement because they are part of the water molecule itself.

Stable isotopes are used in unsaturated zone studies to infer the source of soil water and determine if evaporation has occurred. Data are reported as a ratio of heavy to light isotopes (D/H and $^{18}\text{O}/^{16}\text{O}$) in delta notation (δ) relative to Standard Mean Ocean Water. Fractionation (a change in the ratio) occurs during phase change processes, so condensation and evaporation are both recorded by the isotopic ratios. The condensation of precipitation from the atmosphere occurs under very nearly thermodynamic equilibrium conditions, resulting in a linear relationship between hydrogen and oxygen isotopes in worldwide precipitation known as the meteoric water line (MWL). Evaporation of water generally occurs under non-equilibrium conditions and fractionation of the oxygen isotopes is greater than that of hydrogen isotopes. The water remaining behind in the evaporation process thus develops an isotopic composition that plots to the right of the meteoric water line.

Depth profiles of stable isotopes in soil water from cores collected during drilling of the Pilot Wells are shown in Figure 12. In general, these profiles show more enrichment of heavy isotopes in the upper vadose zone, suggesting that shallow soil water has been subjected to evaporation. A plot of hydrogen isotopic ratios versus oxygen isotopic ratios for samples from the Pilot Wells and Science Trench boreholes is shown in Figure 13 with the MWL for reference. The shallow samples plot to the right of the MWL on a line with a slope between 3.5 and 4. This slope is consistent with

Figure 9. (a and b). Comparison of measured water potentials by the filter paper method and the CX-2 water activity meter.

Figure 10. Depth profiles of water potential for Science Trench boreholes.

Figure 11. Depth profiles of water potential for Pilot Well boreholes.

the range found by Allison (1982) in experiments of water evaporating from sand columns, and strongly supports the hypothesis that evaporation rates are high relative to the downward rate of water movement in the upper vadose zone under the present climate.

Soil Water Chemistry Analysis

Results from standard soil water chemistry analysis from selected depths of Pilot Well (UePW-1 and UePW-3) and Science Trench boreholes (UeST-1 and UeST-2) are presented in Appendix C.

Figure 12. Depth profiles of stable isotope data for Pilot Well boreholes.

Figure 13. Comparison of measured stable isotopes for Pilot Well and Science Trench boreholes with stable isotope data for the global Meteoric Water Line (MWL) and local MWL.

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APPENDIX A

Table A.1. Physical and hydrologic data for Ue5PW-1.

Sample ID	Borehole No.	Depth Interval (ft)	Total Potential CX-2 (KPa)	Grav. Water Content	Bulk Density (gr/cm ³)	Vol. Water Content	Water Potential Filter P. (KPa)
23807	PW#1	27.0-27.25	-8150	0.056	1.63	0.091	*
23808	PW#1	49.0-49.25	-2530	0.051	1.52	0.077	*
23809	PW#1	58.75-59.0	-2250	0.056	1.54	0.085	*
23810	PW#1	68.0-68.25	-2530	0.045	1.48	0.067	*
23811	PW#1	78.25-78.5	-1570	0.098	1.36	0.133	*
23812	PW#1	97.75-98.0	-3080	0.046	1.30	0.060	*
23813	PW#1	128.0-128.25	-3560	0.044	1.51	0.067	*
23814	PW#1	138.25-138.5	-1150	0.075	1.48	0.111	*
23815	PW#1	158.25-158.5	-1020	0.061	1.69	0.104	*
23816	PW#1	168.75-169.0	-814	0.050	1.70	0.085	*
23817	PW#1	179.25-179.5	-950	0.054	1.81	0.097	*
23818	PW#1	199.75-200.0	-882	0.057	1.67	0.096	*
23819	PW#1	219.0-219.25	-746	0.047	1.78	0.084	*
23820	PW#1	259.0-259.25	-474**	0.087	1.49	0.130	*
23821	PW#1	279.0-279.25	-406**	0.071	1.80	0.128	*
23822	PW#1	279.5-279.75	-474**	0.082	1.86	0.153	*
24191	PW#1	297.5-297.75	-203**	0.069	1.92	0.132	-109
24192	PW#1	298.0-298.25	-406**	0.072	1.74	0.126	-744
24193	PW#1	317.75-318.0	-474**	0.086	1.79	0.153	-483
24194	PW#1	318.75-319.0	-474**	0.046	1.89	0.087	-647
24195	PW#1	357.75-358.5	-1150	0.051	1.72	0.088	-2180
24196	PW#1	358.25-358.5	-1220	0.052	1.65	0.085	-2020
24197	PW#1	359.75-360.0	-339**	0.062	1.79	0.111	-747
24198	PW#1	368.75-369.0	-339**	0.098	1.60	0.157	-489
24199	PW#1	400.0-400.25	-610	0.048	1.71	0.082	-791
24200	PW#1	460.0-460.25	-406**	0.071	1.80	0.127	-534
24201	PW#1	499.75-500.0	-474**	0.063	1.64	0.104	-853
24202	PW#1	540.0-540.25	-678	0.075	1.53	0.115	-612
24203	PW#1	580.1-580.35	-950	0.037	1.50	0.056	-997
24204	PW#1	580.6-580.95	-406**	0.054	1.69	0.092	-633
24884	PW#1	618.5-618.75	-67.7**	0.074	1.70	0.126	-344
24885	PW#1	660.25-660.5	-271**	0.075	1.17	0.088	-476
24886	PW#1	701.25-701.5	-135**	0.047	1.43	0.067	-286
24887	PW#1	720.75-721.0	0	0.082	1.48	0.122	-327
24888	PW#1	726.25-726.5	-339**	0.064	1.49	0.095	-701
24889	PW#1	727.0-727.25	0	0.077	1.72	0.133	-250
24890	PW#1	739.0-739.25	0	0.064	1.90	0.122	-60.7
24891	PW#1	759.5-759.75	0	0.076	1.61	0.123	-39.9
24892	PW#1	768.75-769.0	0	0.112	1.86	0.209	-4.98
24893	PW#1	770.5-770.75	0	0.139	1.65	0.230	-3.98
24894	PW#1	788.5-788.75	0	0.158	1.81	0.286	-3.26
24895	PW#1	790.0-790.25	0	0.134	1.78	0.237	-4.14

*Water potential by filter paper method not performed.

**Approaching limits of accurate detection using CX-2 water activity meter.

Table A.2. Physical and hydrologic data for Ue5PW-2, Ue5PW-2A, Ue5PW-2B and Ue5PW-2C.

Sample ID	Borehole No.	Depth Interval (ft)	Total Potential CX-2 (KPa)	Grav. Water Content	Bulk Density (gr/cm ³)	Vol. Water Content	Water Potential Filter P. (KPa)
25164	PW#2	.75-1.0	-135 **	0.061	1.59	0.098	-802
25165	PW#2	1.25-1.50	-8660	0.043	1.72	0.073	*
25166	PW#2	29.25-29.5	-2250	0.062	1.83	0.114	*
25167	PW#2	39.5-39.75	-1770	0.063	1.63	0.102	*
25168	PW#2	40.75-41.0	-1910	0.043	1.86	0.079	*
25169	PW#2	68.5-68.75	-950	0.049	1.64	0.079	*
25170	PW#2	99.25-99.5	-542	0.051	1.65	0.084	-2630
25171	PW#2	118.75-119.0	-339 **	0.076	1.62	0.123	-2330
25172	PW#2	128.5-128.75	-406 **	0.056	1.74	0.097	-2800
25173	PW#2	199.5-199.75	-406 **	0.076	1.57	0.120	-1900
25174	PW#2	249.5-249.75	-135 **	0.065	1.48	0.096	-1150
25352	PW#2	310.25-310.5	0	0.080	1.78	0.142	-984
25353	PW#2	399.25-399.5	0	0.112	1.22	0.136	-42.4
25354	PW#2	478.5-478.75	0	0.046	1.62	0.075	-1740
25355	PW#2	499.25-499.5	0	0.073	1.46	0.107	-916
25514	PW#2	648.75-649.0	0	0.080	1.63	0.131	-307
25824	PW#2	719.0-719.25	-746	0.054	1.85	0.099	-2400
25825	PW#2	817.25-817.5	0	0.115	1.38	0.159	-26.1
25356	PW-2A	0.75-1.0	0	0.162	1.54	0.250	-4.09
25357	PW-2A	3.75-4.0	0	0.121	1.75	0.213	-4.36
25358	PW-2A	4.75-5.0	0	0.103	1.75	0.180	-3.55
25359	PW-2A	41.5-41.75	-1090	0.053	1.66	0.087	-2890
25360	PW-2B	1.0-1.25	0	0.131	1.59	0.207	-4.78
25361	PW-2C	1.25-1.5	0	0.082	1.87	0.152	-3.61
25362	PW-2C	19.0-19.25	-3770	0.026	1.52	0.039	*
25363	PW-2C	41.75-42.0	-1220	0.053	1.74	0.093	*

*Water potential by filter paper method not performed.

**Approaching limits of accurate detection using CX-2 water activity meter.

Table A.3. Physical and hydrologic data for Ue5PW-3.

Sample ID	Borehole No.	Depth Interval (ft)	Total Potential CX-2 (KPa)	Grav. Water Content	Bulk Density (gr/cm ³)	Vol. Water Content	Water Potential Filter P. (KPa)
26519	PW-3	1.0-1.25	-1840	0.034	1.71	0.058	*
26520	PW-3	3.25-3.50	-37500	0.015	1.73	0.026	*
26521	PW-3	49.75-50.0	-7370	0.029	1.65	0.048	*
26522	PW-3	51.5-51.75	-4960	0.032	1.82	0.058	*
26523	PW-3	100.25-100.5	-1980	0.051	1.96	0.099	*
26524	PW-3	130.0-132.25	-1910	0.049	1.85	0.090	*
26525	PW-3	200.25-200.5	-1500	0.046	1.67	0.076	*
26526	PW-3	249.0-249.25	-1220	0.052	1.60	0.083	*
26527	PW-3	251.75-252.0	-1020	0.066	1.30	0.086	*
26528	PW-3	349.25-349.5	-746	0.086	1.23	0.106	-1930
26529	PW-3	399.5-399.75	-1430	0.048	1.45	0.069	*
26530	PW-3	452.0-452.25	-814	0.058	1.33	0.077	-1720
27485	PW-3	499.0-499.25	-678	0.059	1.83	0.107	-1090
27486	PW-3	550.0-550.25	-882	0.064	1.51	0.096	-1760
27590***	PW-3	620-622.5	-51600	0.021			*
27591***	PW-3	635-637.5	-6020	0.020			*
27487***	PW-3	639.0-639.25	-1630	0.016			*
27592***	PW-3	640-642.5	-19100	0.016			*
27593***	PW-3	650-652.5	-29300	0.012			*
27594***	PW-3	660-662.5	-38200	0.011			*
27595***	PW-3	680-682.5	-7510	0.012			*
27488***	PW-3	689.0-689.25	-2320	0.008			*
27596***	PW-3	700-702.5	-8950	0.006			*
27597***	PW-3	720-722.5	-2730	0.030			*
27598***	PW-3	740-742.5	-5240	0.013			*
27599***	PW-3	840-842.5	-13200	0.010			*
27600***	PW-3	860-862.5	-814	0.081			*
27601***	PW-3	872.5-875	-1090	0.051			*
27602***	PW-3	877.5-880	-14400	0.010			*
27603***	PW-3	882.5-885	-1220	0.013			*
27604***	PW-3	887.5-890	-7510	0.018			*
27605***	PW-3	892.5-895	-8950	0.016			*
27606***	PW-3	897.5-900	-12900	0.015			*
27607***	PW-3	920-922.5	-1630	0.117			*
27608***	PW-3	925-927.5	-271	0.181			*

*Water potential by filter paper method not performed.

**Approaching limits of accurate detection using CX-2 water activity system.

***Crushed rock samples, fraction > 4 mesh (5-10 mm) was analyzed.

Table A.4. Physical and hydrologic data for Ue5ST-1.

Sample ID	Borehole No.	Depth Interval (ft)	Total Potential CX-2 (KPa)	Grav. Water Content	Bulk Density (gr/cm ³)	Vol. Water Content	Water Potential Filter P. (KPa)
22891	ST#1	3.25-3.50	-8300	0.038	1.62	0.062	-31600
22893	ST#1	5.25-5.50	-6940	0.053	1.46	0.077	-32200
22895	ST#1	7.25-7.50	-8010	0.043	1.53	0.066	-17500
22897	ST#1	9.25-9.50	-7080	0.055	1.36	0.074	-10600
22977	ST#1	16.75-17.0	-5950	0.025	1.50	0.038	-12300
22978	ST#1	20.75-21.0	-3560	0.038	1.62	0.062	-5060
22979	ST#1	23.25-23.5	-3010	0.046	1.47	0.068	-5860
22980	ST#1	25.5-25.75	-2800	0.041	1.61	0.067	-5270
22981	ST#1	28.25-28.5	-2870	0.046	1.65	0.075	-6950
22982	ST#1	31.25-31.5	-2660	0.042	1.59	0.067	-4740
22983	ST#1	33.0-33.25	-3150	0.048	1.42	0.068	-4740
22984	ST#1	36.25-36.5	-2460	0.045	1.65	0.075	-5950
22985	ST#1	38.0-38.25	-2180	0.048	1.44	0.069	-5180
22986	ST#1	40.25-40.5	-2730	0.061	1.56	0.095	-5770
22987	ST#1	46.0-46.25	-2940	0.048	1.70	0.081	-5680
22988	ST#1	47.75-48.0	-2600	0.051	1.56	0.080	-5990
22989	ST#1	50.25-50.5	-2250	0.049	1.62	0.080	-6040
22990	ST#1	54.25-54.5	-2320	0.055	1.63	0.090	-4730
22991	ST#1	55.25-55.5	-2530	0.047	1.69	0.079	-4460
23083	ST#1	58.5-58.75	-2390	0.063	1.50	0.095	-2380
22992	ST#1	60.25-60.5	-3150	0.044	1.53	0.067	-5810
22993	ST#1	63.5-63.75	-2320	0.039	1.77	0.070	-4320
22994	ST#1	65.75-66.0	-2530	0.043	1.68	0.072	-5550
22995	ST#1	66.25-66.5	-2320	0.074	1.49	0.110	-3870
22996	ST#1	68.75-69.0	-2110	0.059	1.45	0.086	-3530
22997	ST#1	78.0-78.25	-1980	0.058	1.44	0.083	-2190
22998	ST#1	81.0-81.25	-1770	0.076	1.54	0.117	-2510
22999	ST#1	83.25-83.5	-2180	0.065	1.42	0.092	-2030
23000	ST#1	86.0-86.25	-2180	0.060	1.57	0.094	-2320
23001	ST#1	88.75-89.0	-1630	0.079	1.51	0.119	-2820
23002	ST#1	91.25-91.5	-1840	0.056	1.53	0.086	-2200
23003	ST#1	92.75-93.0	-1700	0.077	1.62	0.125	-2090
23004	ST#1	95.5-95.75	-1910	0.046	1.83	0.084	-2770
23060	ST#1	97.0-97.25	-1630	0.065	1.50	0.098	-1980
23061	ST#1	98.25-98.5	-1910	0.064	1.55	0.099	-1600
23062	ST#1	100.5-100.75	-1630	0.083	1.53	0.127	-1880
23063	ST#1	103.25-103.5	-1980	0.055	1.51	0.083	-2340
23064	ST#1	105.25-105.5	-1910	0.050	1.60	0.079	-2260
23065	ST#1	108.75-109.0	-1840	0.064	1.62	0.104	-2380
23066	ST#1	110.5-110.75	-1700	0.062	1.37	0.085	-2344
23067	ST#1	115.75-116.0	-1500	0.088	1.43	0.126	-2700

Table A.5. Physical and hydrologic data for Ue5ST-2.

Sample ID	Borehole No.	Depth Interval (ft)	Total Potential CX-2 (KPa)	Grav. Water Content	Bulk Density (gr/cm ³)	Vol. Water Content	Water Potential Filter P. (KPa)
22900	ST#2	5.75-6.00	-6650	0.047	1.50	0.071	-18900
22902	ST#2	8.25-8.50	-7010	0.034	1.56	0.053	-11900
23068	ST#2	11.5-11.75	-6370	0.032	1.59	0.051	*
23069	ST#2	13.0-13.25	-6940	0.033	1.62	0.054	*
23070	ST#2	15.75-16.0	-5590	0.028	1.70	0.047	*
23071	ST#2	19.0-19.25	-4820	0.032	1.79	0.058	*
23072	ST#2	23.25-23.5	-4750	0.027	1.84	0.050	*
23073	ST#2	24.0-24.25	-3980	0.050	1.53	0.077	*
23074	ST#2	26.25-26.5	-3420	0.042	1.53	0.064	*
23075	ST#2	28.25-28.5	-3290	0.039	1.60	0.062	*
23076	ST#2	32.25-32.5	-3220	0.044	1.52	0.066	*
23077	ST#2	34.75-35.0	-3220	0.049	1.56	0.077	*
23078	ST#2	36.0-36.25	-3420	0.041	1.66	0.069	*
23079	ST#2	37.0-37.25	-3360	0.045	1.66	0.075	*
23080	ST#2	38.0-38.25	-3490	0.043	1.64	0.070	*
23081	ST#2	38.75-39.0	-3010	0.053	1.63	0.086	*
23082	ST#2	43.25-43.5	-3150	0.044	1.63	0.072	*
23107	ST#2	46.75-47.0	-3010	0.045	1.67	0.076	*
23108	ST#2	48.5-48.75	-2870	0.053	1.60	0.084	*
23109	ST#2	50.0-50.25	-2800	0.054	1.55	0.084	*
23110	ST#2	61.25-61.5	-2800	0.039	1.62	0.063	*
23111	ST#2	62.0-62.25	-3290	0.043	1.55	0.066	*
23112	ST#2	63.5-63.75	-3010	0.045	1.59	0.071	*
23113	ST#2	65.25-65.5	-3010	0.040	1.48	0.059	*
23114	ST#2	65.75-66.0	-2530	0.045	1.53	0.068	*
23115	ST#2	68.75-69.0	-2460	0.062	1.56	0.096	*
23116	ST#2	71.25-71.5	-2600	0.050	1.60	0.080	*
23117	ST#2	73.0-73.25	-2460	0.045	1.51	0.069	*
23118	ST#2	73.25-73.5	-2660	0.051	1.57	0.080	*
23119	ST#2	73.75-74.0	-2460	0.050	1.48	0.074	*
23120	ST#2	76.75-77.0	-2460	0.046	1.66	0.076	*
23121	ST#2	78.75-79.0	-2390	0.042	1.59	0.067	*
23122	ST#2	79.25-79.5	-2320	0.043	1.67	0.071	*
23123	ST#2	80.75-81.0	-1980	0.067	1.48	0.099	*
23124	ST#2	83.5-83.75	-2110	0.078	1.27	0.099	*
23125	ST#2	84.0-84.25	-2600	0.059	1.32	0.078	*
23126	ST#2	86.0-86.25	-2730	0.045	1.66	0.075	*
23127	ST#2	86.5-86.75	-2320	0.050	1.55	0.078	*
23128	ST#2	88.5-88.75	-2600	0.054	1.52	0.082	*
23129	ST#2	89.0-89.25	-2390	0.059	1.47	0.087	*
23130	ST#2	91.5-91.75	-2320	0.035	1.82	0.064	*
23131	ST#2	94.0-94.25	-2044	0.058	1.59	0.091	*
23132	ST#2	96.5-96.75	-1910	0.059	1.70	0.100	*

Table A.5. Physical and hydrologic data for Ue5ST-2 (continued).

Sample ID	Borehole No.	Depth Interval (ft)	Total Potential CX-2 (KPa)	Grav. Water Content	Bulk Density (gr/cm ³)	Vol. Water Content	Water Potential Filter P. (KPa)
23133	ST#2	99.0-99.25	-1910	0.067	1.56	0.105	*
23134	ST#2	101.5-101.75	-1430	0.074	1.55	0.115	*
23135	ST#2	102.75-103.0	-1710	0.059	1.50	0.088	*
23136	ST#2	106.25-106.5	-1980	0.079	1.35	0.106	*
23137	ST#2	109.25-109.5	-1630	0.053	1.62	0.086	*
23138	ST#2	110.75-111.0	-2030	0.061	1.69	0.103	*
23139	ST#2	111.5-111.75	-1840	0.056	1.56	0.088	*
23140	ST#2	113.5-113.75	-2180	0.056	1.53	0.086	*
23141	ST#2	117.0-117.25	-1700	0.060	1.49	0.089	*
23142	ST#2	119.25-119.5	-1430	0.067	1.55	0.103	*
23143	ST#2	121.5-121.75	-1560	0.079	1.57	0.123	*
23144	ST#2	123.0-123.25	-1770	0.110	1.39	0.153	*

*Water potential by filter paper method not performed.

Table A.6. Physical and hydrologic data for Ue5ST-3.

Sample ID	Borehole No.	Depth Interval (ft)	Total Potential CX-2 (KPa)	Grav. Water Content	Bulk Density (gr/cm ³)	Vol. Water Content	Water Potential Filter P. (KPa)
22904	ST#3	0.75-1.00	-24800	0.029	1.52	0.044	-60520
22906	ST#3	3.25-3.50	-6580	0.047	1.53	0.073	-14070
22908	ST#3	6.0-6.25	-6020	0.048	1.60	0.077	-14700
22910	ST#3	8.25-8.50	-6580	0.033	1.54	0.051	-15800

Table A.7. Physical and hydrologic data for Ue5ST-4.

Sample ID	Borehole No.	Depth Interval (ft)	Total Potential CX-2 (KPa)	Grav. Water Content	Bulk Density (gr/cm ³)	Vol. Water Content	Water Potential Filter P. (KPa)
22930	ST#4	0.75-1.0	-16400	0.030	1.46	0.044	-38200
22932	ST#4	3.25-3.5	-8440	0.039	1.48	0.057	-19800
22934	ST#4	5.5-5.75	-6940	0.048	1.42	0.068	-11300
23145	ST#4	11.25-11.5	-11100	0.036	1.61	0.058	*
23146	ST#4	11.5-11.75	-7440	0.034	1.59	0.054	*
23147	ST#4	18.75-19.0	-4260	0.036	1.69	0.062	*
23148	ST#4	21.5-21.75	-6580	0.036	1.63	0.059	*
23149	ST#4	24.0-24.25	-5240	0.058	1.53	0.089	*
23150	ST#4	26.25-26.5	-5100	0.045	1.58	0.071	*
23151	ST#4	29.0-29.25	-4610	0.035	1.66	0.058	*
23152	ST#4	31.5-31.75	-4050	0.032	1.56	0.050	*
23153	ST#4	34.0-34.25	-3360	0.062	1.52	0.093	*
23154	ST#4	35.25-35.5	-3420	0.047	1.39	0.066	*
23155	ST#4	38.75-39.0	-2590	0.059	1.43	0.085	*
23206	ST#4	41.25-41.5	-2870	0.052	1.70	0.089	*
23207	ST#4	44.0-44.25	-2730	0.047	1.54	0.073	*
23208	ST#4	46.25-46.5	-2660	0.048	1.66	0.080	*
23209	ST#4	48.5-48.75	-2590	0.057	1.57	0.089	*
23210	ST#4	51.25-51.5	-2590	0.058	1.54	0.089	*
23211	ST#4	54.0-54.25	-2320	0.068	1.52	0.104	*
23212	ST#4	56.25-56.5	-2250	0.047	1.54	0.073	*
23213	ST#4	58.25-58.75	-2180	0.061	1.45	0.089	*
23214	ST#4	61.25-61.5	-3220	0.050	1.62	0.080	*
23215	ST#4	63.0-63.25	-3490	0.037	1.59	0.058	*
23216	ST#4	64.25-64.5	-2530	0.044	1.63	0.072	*
23218	ST#4	67.0-67.25	-2320	0.057	1.63	0.093	*
23219	ST#4	68.0-68.25	-2040	0.071	1.40	0.100	*
23220	ST#4	70.75-71.0	-2040	0.072	1.61	0.117	*
23221	ST#4	72.5-72.75	-2180	0.057	1.43	0.081	*
23222	ST#4	75.0-75.25	-2040	0.053	1.45	0.077	*
23223	ST#4	78.5-78.75	-1910	0.045	1.58	0.071	*
23224	ST#4	80.5-80.75	-1770	0.063	1.60	0.102	*
23225	ST#4	83.0-83.25	-1910	0.088	1.42	0.125	*
23226	ST#4	86.5-86.75	-2110	0.055	1.49	0.082	*
23227	ST#4	89.0-89.25	-1840	0.058	1.60	0.093	*
23228	ST#4	91.5-91.75	-1700	0.052	1.41	0.073	*
23229	ST#4	97.75-98.0	-1500	0.087	1.43	0.124	*
23230	ST#4	99.0-99.25**	-1560	0.064	1.45	0.093	*
23231	ST#4	106.75-107.0	-1630	0.056	1.55	0.087	*
23232	ST#4	111.5-111.75	-1770	0.047	1.43	0.067	*

*Water potential by filter paper method not performed.

**Listed as 100.5'-100.75' on original core top.

Table A.8. Physical and hydrologic data for Ue5ST-4A.

Sample ID	Borehole No.	Depth Interval (ft)	Total Potential CX-2 (KPa)	Grav. Water Content
23304	ST#4A	10.25-12.5	-3950	0.048
23305	ST#4A	20.0-22.5	-3980	0.033
23306	ST#4A	30.0-32.5	-3910	0.043
23307	ST#4A	40.0-42.5	-2800	0.410
23308	ST#4A	50.0-52.5	-2320	0.520
23309	ST#4A	60.0-62.5	-2040	0.500
23310	ST#4A	70.0-72.5	-1700	0.600
23311	ST#4A	80.0-82.5	-1500	0.730
23312	ST#4A	90.0-92.5	-1430	0.550
23313	ST#4A	100.0-102.5	-1290	0.730
23314	ST#4A	110.0-112.5	-1560	0.540
23315	ST#4A	117.5-120.0	-1560	0.540

Table A.9. Physical and hydrologic data for Ue5ST-5.

Sample ID	Borehole No.	Depth Interval (ft)	Total Potential CX-2 (KPa)	Grav. Water Content	Bulk Density (gr/cm ³)	Vol. Water Content	Water Potential Filter P. (KPa)
22936	ST#5	0.5-0.75	-3840	0.040	1.44	0.057	-7760
22938	ST#5	3.0-3.25	-7940	0.038	1.60	0.061	-17500
22940	ST#5	5.5-5.75	-6440	0.048	1.45	0.070	-12200
22942	ST#5	8.0-8.25	-6580	0.037	1.59	0.059	-10100
23217	ST#5	12.0-12.25	-9090	0.029	1.62	0.047	*
23349	ST#5	15.25-15.5	-6300	0.036	1.46	0.052	*
23350	ST#5	15.75-16.	-6230	0.029	1.87	0.055	*
23351	ST#5	20.5-20.75	-5730	0.036	1.65	0.059	*
23352	ST#5	21.5-21.75	-3840	0.042	1.66	0.071	*
23353	ST#5	21.75-22.0	-4960	0.039	1.68	0.066	*
23354	ST#5	22.25-22.5	-5170	0.025	1.66	0.041	*
23355	ST#5	30.25-30.5	-3840	0.046	1.54	0.071	*
23356	ST#5	31.75-32.0	-3490	0.036	1.66	0.059	*
23357	ST#5	36.25-36.5	-3080	0.047	1.70	0.080	*

*Water potential by filter paper method not performed.

Table A.10. Physical and hydrologic data for Ue5ST-6.

Sample ID	Borehole No.	Depth Interval (ft)	Total Potential CX-2 (KPa)	Grav. Water Content	Bulk Density (gr/cm ³)	Vol. Water Content
23280	ST#6	1.25-1.5	-15080	0.038	1.64	0.062
23281	ST#6	4.0-4.25	-5520	0.066	1.54	0.101
23282	ST#6	8.75-9.0	-6300	0.044	1.52	0.067
23283	ST#6	10.25-10.5	-7080	0.042	1.50	0.063
23284	ST#6	11.0-11.25	-7510	0.046	1.59	0.074
23285	ST#6	14.0-14.25	-8730	0.027	1.79	0.049
23286	ST#6	16.5-16.75	-5450	0.025	1.80	0.045
23287	ST#6	19.0-19.25	-6370	0.036	1.77	0.064
23288	ST#6	21.75-22.0	-4329	0.043	1.58	0.068
23289	ST#6	24.0-24.25	-3560	0.043	1.63	0.070
23290	ST#6	26.75-27.0	-3490	0.045	1.69	0.075
23291	ST#6	28.0-28.25	-3560	0.039	1.61	0.063
23292	ST#6	28.5-28.75	-3150	0.045	1.58	0.071
23293	ST#6	41.0-41.25	-2940	0.054	1.50	0.081
23294	ST#6	51.75-52.0	-2660	0.055	1.72	0.094
23295	ST#6	60.25-60.5	-3080	0.051	1.50	0.076
23296	ST#6	71.25-71.5	-2390	0.058	1.57	0.091
23297	ST#6	81.25-81.5	-2040	0.077	1.48	0.114
23298	ST#6	91.25-91.5	-2110	0.056	1.62	0.090
23299	ST#6	91.75-92.0	-2040	0.051	1.58	0.081
23300	ST#6	101.5-101.75	-1840	0.057	1.79	0.103
23301	ST#6	111.5-111.75	-1980	0.050	1.69	0.085
23302	ST#6	115.5-115.75	-1360	0.073	1.67	0.122

Table A.11. Physical and hydrologic data for Ue5ST-7.

Sample ID	Borehole No.	Depth Interval (ft)	Total Potential CX-2 (KPa)	Grav. Water Content	Bulk Density (gr/cm ³)	Vol. Water Content
23303	ST#7	4.5-4.75	-10100	0.034	1.53	0.053
23338	ST#7	8.75-9.0	-9740	0.033	1.62	0.054
23340	ST#7	13.75-14.0	-6510	0.030	1.80	0.055
23341	ST#7	16.75-17.0	-5450	0.032	1.74	0.055
23342	ST#7	18.75-19.0	-5730	0.026	1.83	0.047
23343	ST#7	21.75-22.0	-4680	0.035	1.63	0.058
23344	ST#7	24.0-24.25	-4400	0.039	1.63	0.064
23345	ST#7	26.0-26.25	-5310	0.027	1.69	0.045
23346	ST#7	29.0-29.25	-4470	0.044	1.50	0.067
23347	ST#7	31.75-32.0	-4400	0.041	1.53	0.063
23348	ST#7	34.0-34.25	-5450	0.04	1.58	0.063

APPENDIX B

Table B.1. Stable isotope data for Pilot Well boreholes.

SITE #	DEPTH INTERVAL (ft)	VSMOW $\delta^{18}\text{O}$ (‰)	VSMOW δD (‰)
Ue5PW-1	27.75-28.0	-6.6	-89
	48.25-48.5	-8.6	-94
	67.75-68.0	-9.2	-97
	97.5-97.75	-9.7	-98
	127.75-128.0	-10.4	-99
	158.75-158.0	-12.3	-107
	178.75-179.0	-12.4	-108
	198.75-199.0	-13.1	-109
	218.75-219.0	-13.8	-111
	258.5-258.75	-13.9	-111
	298.5-298.75	-14.4	-114
	358.75-359.0	-14.0	-109
	400.25-400.5	-14.5	-113
	459.75-460.0	-13.9	-112
	498.25-498.5	-13.7	-109
	540.25-540.5	-13.8	-111
	580.95-581.1	-13.9	-109
	618.25-618.5	-13.7	-109
	659.25-659.5	-12.8	-108
	701.0-701.25	-13.9	-112
	739.25-739.5	-12.5	-100
	788.25-788.5	-13.6	-108
	800.0-800.25	-13.6	-106

Table B.1. Stable isotope data for Pilot Well boreholes (continued).

SITE #	DEPTH INTERVAL (ft)	VSMOW $\delta^{18}\text{O}$ (‰)	VSMOW δD (‰)
UeSPW-2	2.0-2.25	-1.5	-66
	29.5-29.75	-6.6	-87
	40.25-40.5	-8.2	-95
	41.25-41.5	-8.4	-95
	58.75-69.0	-12.7	-112
	99.5-99.75	-14.2	-119
	119.0-119.25	-13.9	-120
	128.75-129.0	-15.6	-124
	199.75-200.0	-15.7	-127
	249.75-250.0	-14.1	-118
	310.5-310.75	-14.6	-119
	399.5-399.75	-14.4	-115
	478.75-479.0	-11.8	-101
	499.0-499.25	-13.8	-112
	718.5-718.75	-9.6	-78
	817.75-818.0	-11.2	-95

Table B.1. Stable isotope data for Pilot Well boreholes (continued).

SITE #	DEPTH INTERVAL (ft)	VSMOW $\delta^{18}\text{O}$ (‰)	VSMOW δD (‰)
Ue5PW-3	0.25-0.5	+4.8	-53
	3.0-3.25	+2.3	-57
	50.0-50.25	-8.4	-94
	52.0-52.25	-10.2	-100
	100.0-100.25	-13.1	-115
	130.75-131.0	-13.9	-119
	199.0-199.25	-14.0	-119
	200.0-200.25	-14.2	-119
	249.75-250.0	-14.1	-119
	250.5-250.75	-14.6	-122
	349.5-349.75	-14.3	-118
	399.75-400.0	-13.3	-115
	452.25-452.5	-12.7	-110
	499.25-499.5	-13.5	-112
	549.75-550.0	-12.9	-110
	638.25-638.5	-10.8	-97
	918.0-918.25	-13.3	-103

Table B.2. Stable isotope data for Science Trench boreholes.

SITE #	DEPTH INTERVAL (ft)	VSMOW $\delta^{18}\text{O}$ (‰)	VSMOW δD (‰)
Ue5ST-1	12.5-12.75	-5.1	-82
	20.5-20.75	-5.0	-83
	29.5-29.75	-6.0	-86
	37.75-38.0	-7.0	-91
	49.75-50.0	-8.0	-95
	58.25-58.5	-9.1	-98
	67.5-67.75	-9.7	-98
	81.25-81.5	-10.5	-101
	91.0-91.25	-10.8	-102
	98.0-98.25	-11.0	-104
	110.25-100.5	-11.0	-105
Ue5ST-2	116.25-116.5	-11.1	-103
	11.75-12.0	-3.4	-77
	15.25-15.5	-5.3	-82
	42.5-42.75	-7.6	-90
	61.0-61.25	-8.9	-99
	80.5-80.75	-10.4	-104
	99.25-99.5	-10.5	-103
Ue5ST-2A	121.0-121.25	-10.6	-105
	10.0-12.5	-3.6	-75
	25.75-26.0	-5.7	-83
	36.5-36.75	-7.7	-90
	60.0-62.25	-9.1	-95
	77.5-80.0	-9.3	-98
	96.5-96.75	-10.8	-104
	110.0-112.5	-5.4	-90
Ue5ST-4	12.5-12.75	-4.6	-78
	21.75-22.0	-5.7	-85
	41.5-41.75	-7.7	-93
	66.75-67.0	-10.2	-103
	80.25-80.5	-10.6	-102
	101.5-101.75	-11.8	-110
	112.5-112.75	-12.0	-111

APPENDIX C

Table C.1. Groundwater chemical data for selected depths of Pilot Well boreholes.

Sample #	27879		27880	
Sample Date:	Jan.20, 1993		Jan.20, 1993	
Sample Name:	Ue5PW-1 (800')		Ue5PW-3 (918')	
EC	387		384	
SiO₂	49.1		39.1	
pH	8.34		8.25	
	(mg/l)	(epm)	(mg/l)	(epm)
HCO₃	169	2.770	171	2.803
CO₃	1.3	0.043		
Cl	10.0	0.282	9.2	0.259
SO₄	38.5	0.802	35.3	0.735
NO₃	11.0	0.178	14.7	0.237
Br	<0.01		<0.01	
Total Anions		4.075		4.034
Na	56.9	2.475	56.7	2.466
K	6.62	0.169	6.15	0.157
Ca	17.6	0.878	18.3	0.913
Mg	5.83	0.479	5.58	0.459
Total Cations		4.002		3.996
Anions/Cations		1.018		1.010

Table C.2. 1:1 dilution extract analysis for selected depths of Science Trench boreholes.

Sample #	24497	
Sample Date:	May 26, 1992	
Sample Name:	Ue5ST-2 (1.25'-1.5')	
EC		191
SiO ₂		61.0
pH		9.10
	(mg/l)	(epm)
HCO ₃	77.8	1.25
CO ₃	20.4	0.680
Cl	1.1	0.031
SO ₄	0.90	0.019
NO ₃	3.06	0.049
Br	< 0.1	
Total Anions		2.054
Na	24.6	1.070
K	25.6	0.655
Ca	5.51	0.275
Mg	1.12	0.092
Total Cations		2.092
Anions/Cations		0.982

Table C.2. 1:1 dilution extract analysis for selected depths of Science Trench boreholes (continued).

Sample #	24493	
Sample Date:	May 26, 1992	
Sample Name:	Ue5ST-2 (6.75'-7.0')	
EC		1240
SiO ₂		40.0
pH		9.05
	(mg/l)	(epm)
HCO ₃	43.0	0.705
CO ₃	17.5	0.583
Cl	309	8.714
SO ₄	69.9	1.455
NO ₃	2.22	0.036
Br	2.6	
Total Anions		11.493
Na	234	10.179
K	7.40	0.189
Ca	9.03	0.415
Mg	4.10	0.337
Total Cations		11.156
Anions/Cations		1.030

Table C.2. 1:1 dilution extract analysis for selected depths of Science Trench boreholes (continued).

Sample #	24498	
Sample Date:	May 26, 1992	
Sample Name:	Ue5ST-3 (10.0'-10.25')	
EC		1520
SiO ₂		44.1
pH		8.55
	(mg/l)	(epm)
HCO ₃	58.4	0.957
CO ₃	5.2	0.173
Cl	214	6.035
SO ₄	342	7.120
NO ₃	0.35	0.006
Br	1.9	
Total Anions		14.291
Na	261	11.353
K	11.3	0.289
Ca	32.2	1.607
Mg	10.9	0.896
Total Cations		14.146
Anions/Cations		1.010

Table C.2. 1:1 dilution extract analysis for selected depths of Science Trench boreholes
(continued).

Sample #	24491	
Sample Date:	May 26, 1992	
Sample Name:	Uc5ST-2 (20.0'-20.25')	
EC		1050
SiO ₂		29.6
pH		8.68
	(mg/l)	(epm)
HCO ₃	32.9	0.539
CO ₃	6.8	0.227
Cl	180	5.076
SO ₄	175	3.644
NO ₃	3.59	0.058
Br	1.7	
Total Anions		9.543
Na	164	7.134
K	9.17	0.235
Ca	33.3	1.662
Mg	8.64	0.711
Total Cations		9.741
Anions/Cations		0.980

Table C.2. 1:1 dilution extract analysis for selected depths of Science Trench boreholes
(continued).

Sample #	24496	
Sample Date:	May 26, 1992	
Sample Name:	Ue5ST-1 (29.75'-30.0')	
EC		877
SiO ₂		33.6
pH		8.24
	(mg/l)	(epm)
HCO ₃	47.3	0.755
CO ₃		
Cl	200	5.640
SO ₄	63.9	1.330
NO ₃	4.16	0.067
Br	1.8	
Total Anions		7.813
Na	104	4.524
K	8.48	0.217
Ca	42.4	2.116
Mg	12.1	0.995
Total Cations		7.852
Anions/Cations.		0.995

Table C.2. 1:1 dilution extract analysis for selected depths of Science Trench boreholes (continued).

Sample #	24492	
Sample Date:	May 26, 1992	
Sample Name:	Ue5ST-1 (42.25'-42.5')	
EC		608
SiO₂		26.8
pH		8.57
	(mg/l)	(epm)
HCO₃	32.7	0.536
CO₃	3.9	0.130
Cl	132	3.722
SO₄	47.5	0.989
NO₃	2.70	0.044
Br	3.0	
Total Anions		5.421
Na	69.5	3.023
K	10.4	0.266
Ca	29.0	1.447
Mg	8.75	0.720
Total Cations		5.456
Anions/Cations		0.994

**Table C.2. 1:1 dilution extract analysis for selected depths of Science Trench boreholes
(continued).**

Sample #	24495	
Sample Date:	May 26, 1992	
Sample Name:	Ue5ST-1 (59.5'–59.75')	
EC		563
SiO₂		42.6
pH		8.90
	(mg/l)	(epm)
HCO₃	51.3	0.841
CO₃	12.6	0.420
Cl	99.6	2.809
SO₄	55.3	1.151
NO₃	1.86	0.030
Br	0.8	
Total Anions		5.251
Na	99.5	4.328
K	7.97	0.204
Ca	10.1	0.504
Mg	5.75	0.473
Total Cations		5.509
Anions/Cations		0.953

Table C.2. 1:1 dilution extract analysis for selected depths of Science Trench boreholes
(continued).

Sample #	24499	
Sample Date:	May 26, 1992	
Sample Name:	Uc5ST-1 (82.5'-82.75')	
EC		869
SiO ₂		56.9
pH		8.98
	(mg/l)	(epm)
HCO ₃	99.0	1.62
CO ₃	19.2	0.640
Cl	181	5.104
SO ₄	31.8	0.662
NO ₃	2.04	0.033
Br	1.3	
Total Anions		8.062
Na	170	7.395
K	8.65	0.221
Ca	3.75	0.187
Mg	2.34	0.197
Total Cations		8.00
Anions/Cations		1.008

Table C.2. 1:1 dilution extract analysis for selected depths of Science Trench boreholes (continued).

Sample #	24494	
Sample Date:	May 26, 1992	
Sample Name:	Ue5ST-1 (115.0'-115.25')	
EC		645
SiO₂		47.9
pH		8.45
	(mg/l)	(epm)
HCO₃	80.2	1.314
CO₃	2.9	0.097
Cl	147	4.145
SO₄	17.6	0.366
NO₃	0.18	0.033
Br	1.1	
Total Anions		5.926
Na	109	4.741
K	6.56	0.168
Ca	12.9	0.644
Mg	5.86	0.482
Total Cations		6.035
Anions/Cations		0.982

Table C.3. Soil solution chemistry from selected depths of Science Trench boreholes. Analysis represent actual concentration in soil solution based on 1:1 dilution extracts and initial water content.

Sample #	24497	24493
Sample Date:	May 26, 1992	May 26, 1992
Sample Name:	Ue5ST-2 (1.25'-1.5')	Ue5ST-2 (6.75'-7.0)
Gravimetric Water Content (ω)	0.031	0.041
	(mg/l)	(mg/l)
HCO₃	2590	1090
CO₃	679	444
Cl	37	7850
SO₄	30	1770
NO₃	102	56.4
Br		66
Na	818	5940
K	851	188
Ca	183	229
Mg	37.3	104

Table C.3. Soil solution chemistry from selected depths of Science Trench boreholes. Analysis represent actual concentration in soil solution based on 1:1 dilution extracts and initial water content (continued).

Sample #	24498	24491
Sample Date:	May 26, 1992	May 26, 1992
Sample Name:	Ue5ST-3 (10.0'-10.25')	Ue5ST-2 (20.0'-20.25')
Gravimetric Water Content (ω)	0.050 (mg/l)	0.034 (mg/l)
HCO ₃	1230	1000
CO ₃	110	210
Cl	4490	5470
SO ₄	7150	5320
NO ₃	7.4	109
Br	40	52
Na	5480	4990
K	237	279
Ca	676	1010
Mg	229	263

Table C.3. Soil solution chemistry from selected depths of Science Trench boreholes. Analysis represent actual concentration in soil solution based on 1:1 dilution extracts and initial water content (continued).

Sample #	24496	24492
Sample Date:	May 26, 1992	May 26, 1992
Sample Name:	Ue5ST-1 (29.75'-30.0')	Ue5ST-1 (42.25'-42.5')
Gravimetric Water Content (ω)	0.043 (mg/l)	0.041 (mg/l)
HCO₃	1150	830
CO₃		99
Cl	4850	3350
SO₄	1550	1210
NO₃	101	69
Br	44	76
Na	2520	1770
K	206	264
Ca	1030	736
Mg	294	222

Table C.3. Soil solution chemistry from selected depths of Science Trench boreholes. Analysis represent actual concentration in soil solution based on 1:1 dilution extracts and initial water content (continued).

Sample #	24495	24499
Sample Date:	May 26, 1992	May 26, 1992
Sample Name:	Ue5ST-1 (59.5'-59.75')	Ue5ST-1 (82.5'-82.75')
Gravimetric Water Content (ω)	0.037	0.093
	(mg/l)	(mg/l)
HCO ₃	1440	1160
CO ₃	360	226
Cl	2790	2130
SO ₄	1550	373
NO ₃	52.1	24.0
Br	20	15
Na	2790	2000
K	223	102
Ca	283	44.1
Mg	161	28.1

Table C.3. Soil solution chemistry from selected depths of Science Trench boreholes. Analysis represent actual concentration in soil solution based on 1:1 dilution extracts and initial water content (continued).

Sample #	24494
Sample Date:	May 26, 1992
Sample Name:	Ue5ST-1 (115.0'-115.25')
Gravimetric Water Content (ω)	0.068
	(mg/l)
HCO₃	1260
CO₃	46
Cl	2310
SO₄	276
NO₃	2.8
Br	17
Na	1710
K	104
Ca	203
Mg	92.0

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