UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Concentrations of He, CO_2, and O_2 in soil gases, and soil types at Roosevelt Hot Springs Known Geothermal Resource Area, Utah

By

M. E. Hinkle* and Theodore Botinelly*

Open-File Report 88-259

*U.S. Geological Survey, DFC, Box 25046, MS 973, Denver, CO 80225

1988

CONTENTS

ILLUSTRATIONS

TABLES

ABSTRACT

Soil types and concentrations of He, CO_2, and O_2 in soil gases were measured over and near the Roosevelt Hot Springs KGRA, Utah, in May, 1985, and May, 1987. This report describes the methods of sample collection and analysis, and lists the resulting data. Maps showing concentrations of soil gases in the samples and soil types are included.

INTRODUCTION

Measurement of concentrations of volatile components of soil gases is often used in geochemical exploration for geothermal resources. Anomalous concentrations of various gases, including helium (He) and carbon dioxide (CO_2) occur over many geothermal areas (Hinkle, 1980; Hinkle and Kilburn, 1980; McCarthy and others, 1986; Roberts and others, 1975). A comparison of anomalous CO_2 concentrations with oxygen (O_2) concentrations may also be useful for geochemical exploration. However, the type of soil, whether clayey or sandy, indirectly affects the concentrations of gases in the soil. Soil type affects the amount of pore space and moisture in the soil, and these directly affect the concentrations of the soil gases (Peachy and others, 1985; Reimer, 1980). This report lists concentrations of soil gases, gases desorbed from soils, and soil types for samples collected in two surveys conducted at the Roosevelt Hot Springs Known Geothermal Resource Area (KGRA).

Roosevelt Hot Springs KGRA is situated about 20 km northeast of the town of Milford, in Beaver County, southwestern Utah (fig. 1). The KGRA is associated with Quaternary silicic volcanic rocks, which occur as domes, flows, and tuffs. The hot-water-dominated system was named for a group of hot springs that discharged silica-rich waters until about 1966, when the flow stopped (Mundorff, 1970). The location of the hot springs is at the northern end of a wide north-south-trending fault zone called the Opal Mound fault. The producing part of the geothermal field is bounded by the Opal Mound fault on the west and the foothills of the Mineral Mountains on the east. The environment of the Roosevelt Hot Springs KGRA is arid. Two surveys of He, CO_2, and O_2 in soil gases and desorbed from soils were conducted in May, 1985, and May, 1987, in roughly the same area as a He survey conducted in 1980 (Hinkle, 1980). All of the surveys included the producing part of the geothermal field east of the Opal Mound fault and the background area west of the fault (figs. 1-2).

ACKNOWLEDGMENT

We thank the Chevron Resources Company, San Ramon, California, for permission to sample at Roosevelt Hot Springs, and to publish the results of our analyses.

SAMPLE COLLECTION

Soil gas samples were collected from the pore space of soils by use of the hollow stainless-steel probe developed for He sampling by the U.S. Geological Survey (Reimer and Bowles, 1979). The probe was driven 0.75 m into the ground by means of a sliding hammer attached to the shaft of the probe. After it was driven into the ground, the probe was fitted with an airtight cap and septum for withdrawal of the soil gas sample. Before removal of the first sample, 10 ml of air were withdrawn from the probe to remove air introduced

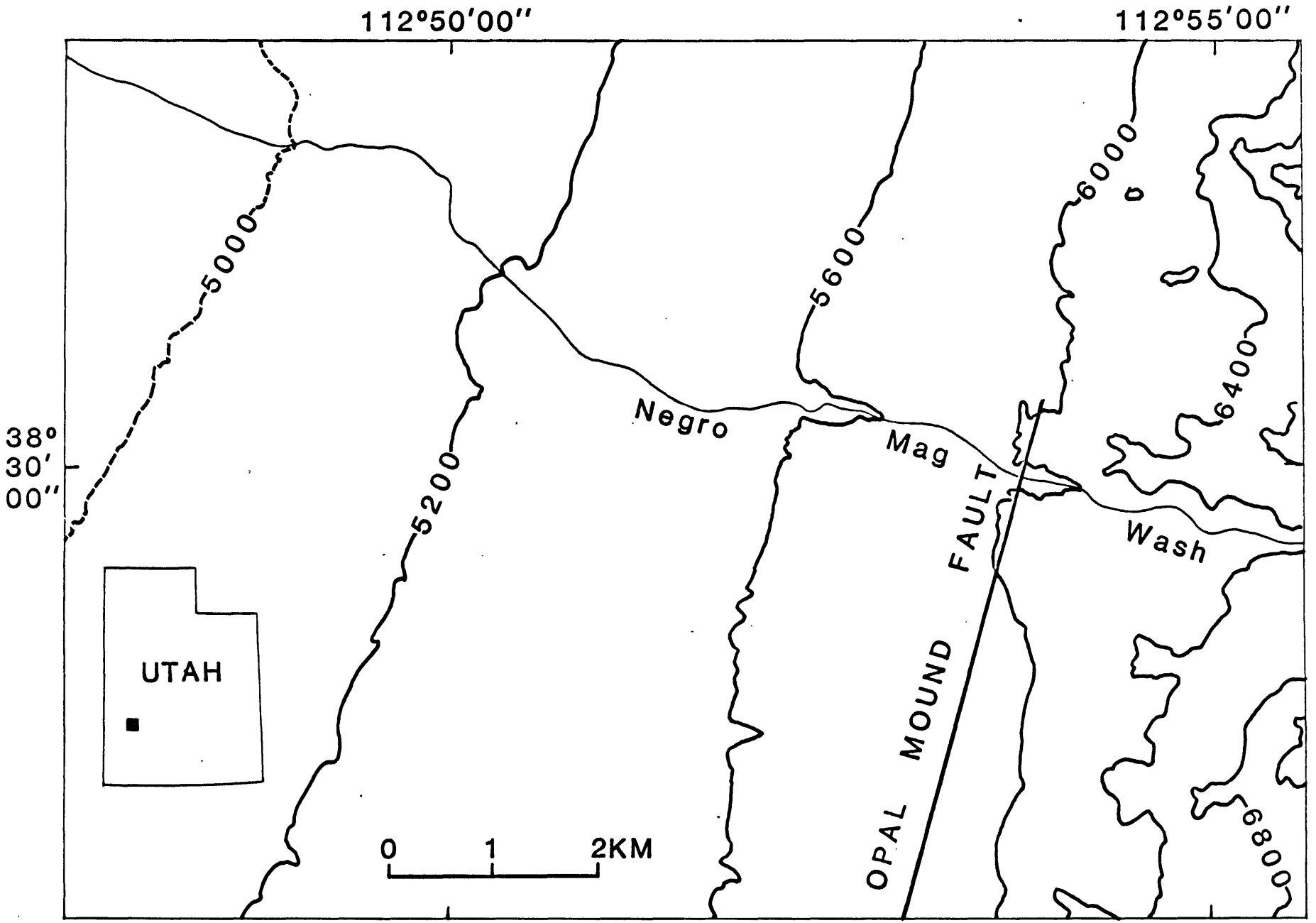

Fig. 1. Location map of Roosevelt Hot Springs, Beaver County, Utah.

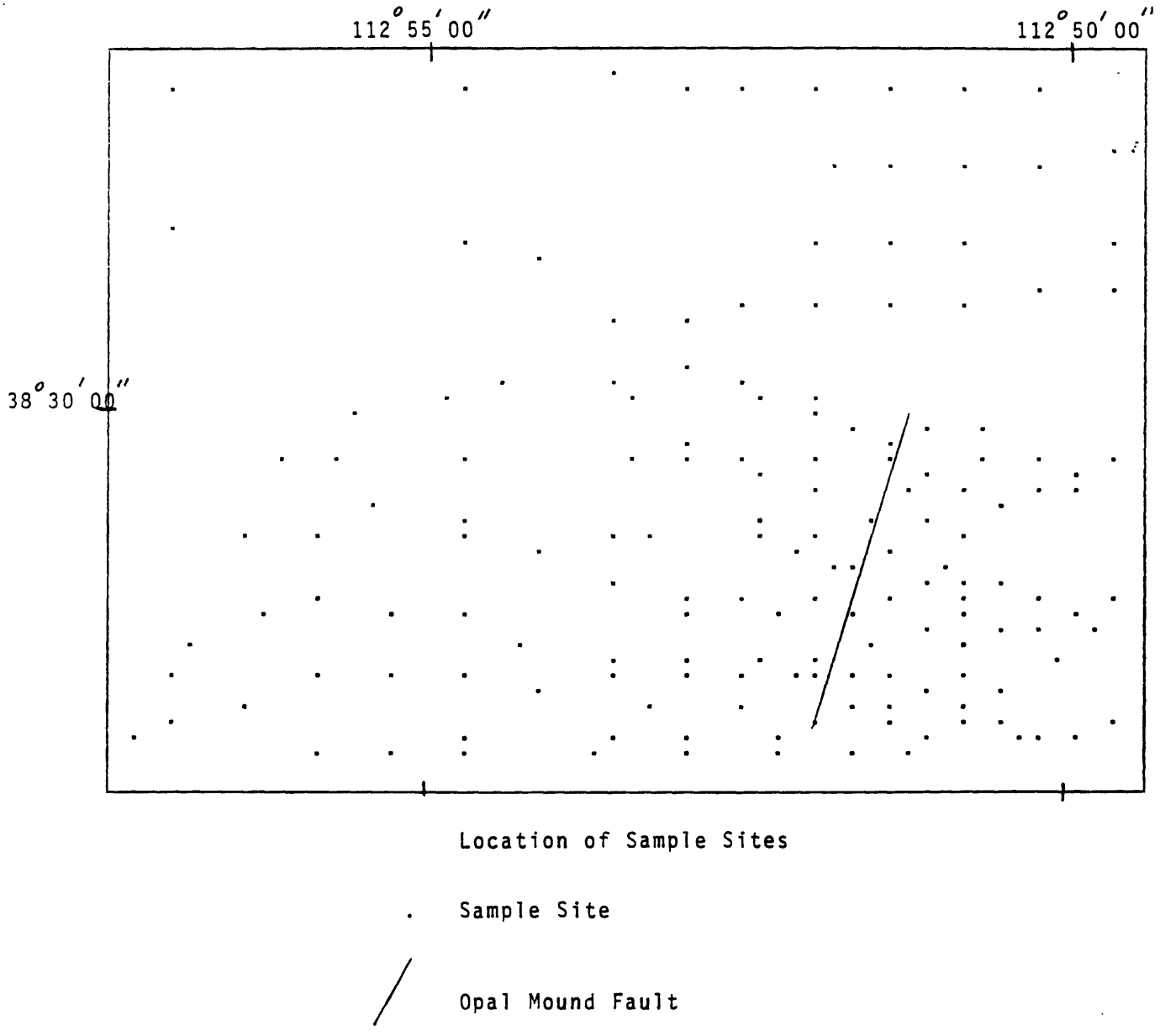

Fig. 2. Localities map of sample sites, Opal Mound Fault, Beaver County, Utah.

when the probe was emplaced in the ground. Samples were collected from the hollow probe by inserting the needle of a syringe through the septum in the cap and withdrawing 10 ml of soil gas. The soil gas samples were transferred to two 5 ml size evacuated blood sampling tubes for storage, by inserting the needle of the syringe containing the gas sample through the rubber cap of the evacuated tube and allowing the sample in the syringe to be drawn inside. The needle hole was covered with silicone glue. Soil gas samples can be stored in these evacuated tubes for as long as 2 months without leakage (Hinkle and Kilburn, 1979). Two tubes were filled with the soil gas sample collected at each site--one tube for He analysis and one tube for CO_2 and O_2 analysis.

Soil samples were collected for analysis of gases adsorbed on the soils--a procedure that uses the soil as a natural trap to concentrate gases rising from below. Samples were collected by scraping away surficial debris and collecting the soil at 0-5 cm depth. Soils were sieved to minus 30 mesh (less than 600 m) at each sample site, so that the samples would be the same grain size for gas analysis. The samples for gas analysis were stored in 20 ml size blood sampling tubes; at each site one tube was collected for He analysis and one tube was collected for CO_2 and O_2 analysis. The samples for other analyses were stored in plastic bags. Measurements of soil temperature and time of day were made at each sample site. Barometric pressure measurements for the times of day of sample collection were obtained from the National Oceanic and Atmospheric Administration weather station at Milford, Utah.

SAMPLE ANALYSIS

Gas in the vials was removed by injecting a volume of air equal to the volume of the vial into the vial and removing the mixture of air and soil gas. The samples were analyzed for He using a modified mass spectrometer (Friedman and Denton, 1975; Reimer and Denton, 1978). Standard samples of air containing known concentrations of He were run several times per day to insure stability of the instrument. Concentrations of He were reported as differences compared to the concentration of He in air; these differences were positive or negative, depending on whether the measured concentration was above or below the concentration of He in air (5,240 parts per billion) (Glueckhauf, 1946; Oliver and others, 1984). The reproducibility of the determination ranged from 20 ppb to 100 ppb above or below the concentration of He in air. The tubes used for sample storage were approximately 80% evacuated. They contained a residual concentration of He, probably introduced during the manufacturing process, that was the same for all the tubes in each lot produced by the manufacturer. This residual He concentration was measured and subtracted from the raw measurement of He in soil gas.

Soil gas samples were analyzed for CO_2 and O_2 by gas chromatography; operating conditions for the gas chromatograph are shown in table 1. Concentrations of CO_2 and O_2 were measured compared to standard curves, and are reported as volume percents of the total gas sample. Standard samples containing known concentrations of CO_2 and O_2 were analyzed several times per day to insure stability of the instrument. Reproducibility of the CO_2 and O_2 measurements was +/- 10% by volume, for samples collected by probe.

The gases adsorbed on soils samples in the tubes were analyzed for He, CO_2, and O_2 by injecting 5 ml of ambient air with a syringe through the rubber stopper into the tube, stirring the contents of the tube on a vortex mixer to mix the added air with the gas sample, removing a mixed air-and-gas sample from the tube with a syringe, and analyzing the contents of the syringe. Gas samples desorbed from soils were analyzed for He, CO_2, and O_2 by the same

methods used for analysis of the soil gas samples. Measurements of laboratory temperature and barometric pressure were made. Dead-space volume of the tubes containing the soil samples was measured by the method of Hinkle and Kilburn (1979). Moisture contents of the soil samples were determined by differences in weight after drying the samples overnight at 105°C. The He content in excess of He in air, along with the measurements made of barometric pressure, soil temperature, air temperature, dead-space volume, and soil moisture were used to calculate the concentration of He in the original pore space of the soil samples (Green, 1984; Hinkle and Kilburn, 1979). Concentrations of CO_2 and O_2 in the pore spaces of the soils were calculated by a modification of the method of Hinkle and Kilburn (1979). These calculations yielded values of over 100 percent O_2 for some of the samples; the calculated O_2 in soil values should be considered relative and not absolute. Reproducibility of the He, CO_2, and O_2 measurements in gases desorbed from soils was +/- 25% by volume.

Soil samples were subjected to particle-size analysis to determine the contents of sand, silt, and clay. The hydrometer method was used for the particle-size analysis (Day, 1965; Grigal, 1973); the sand fraction was determined by weight, the suspended clay fraction by the hydrometer reading, and the silt fraction by difference. A portion of the clay fraction was dried and subjected to X-ray analysis.

DESCRIPTION OF DATA TABLES

Data from the analyses were entered into an IBM personal computer and stored on disks, using STATPAC programs developed for personal computers by the U.S. Geological Survey (1986).

Data listed in table 2 include latitude and longitude for each site, soil temperature (°C), percent moisture in the soil, percent CO_2 and percent O_2 (probe), ppb He (probe), percent CO_2 and O_2 (pore space of dried soil), ppb He (pore space of dried soil), percents of sand, silt, and clay in the soil; samples collected by probe are identified by "(p)" and gases desorbed from soils are identified by "(s)". The table also includes relative amounts of montmorillonite, mica, kaolinite, quartz, feldspar, and calcite determined by X-ray analysis. Values given for montmorillonite, mica, kaolinite, quartz, feldspar, and calcite are based on peak heights in the X-ray diffraction pattern and show the relative change in amounts of each mineral from sample to sample. Because of the formatting used in the computer program that produced table 2, the data listed carry two to four nonsignificant digits to the right of the significant digits; these data were not determined to the accuracy suggested by the extra zeros. The letter B following the zeros in the data indicates that no analysis was performed for that particular parameter.

Samples RHS 1001-1074 were collected in May, 1985. Samples RHS 2001-2100 were collected in May, 1987. Figures 3-17 show the distribution of CO_2(p), O_2(p), He(p), CO_2(s), O_2(s), He(s), sand, silt, clay, montmorillonite, mica, kaolinite, quartz, feldspar, and calcite in the samples. Data from both the 1985 and 1987 sample sets were combined, and class boundaries of the 50th, 80th, and 95th percentiles were used to prepare figures 3-17.

REFERENCES CITED

Day, P.R., 1965, Particle fractionation and particle-size analysis, in Black, C.A., editor, Methods of soil analysis: Agronomy vol. 9, p. 545-567.

Friedman, Irving, and Denton, E.H., 1975, A portable helium sniffer: U.S. Geological Survey Open-File Report 75-532, 6 p.

Glueckhauf, E., 1946, A micro-analysis of the helium and neon contents of air: Proceedings of the Royal Society (London), v. 185, p. 98-119.

Green, K.R., 1984, An algorithm for determining soil and water helium concentrations from headspace analyses: Examples of geochemical applications in Long Valley, California, and the Fiji Islands: M.S. Thesis, Colorado School of Mines, Golden, Colorado, 197 p.

Grigal, D.F., 1973, Note on the hydrometer method of particle-size analysis. Minnesota forestry research notes, no. 245: Scientific Journal Series Paper no. 8438, University of Minnesota Agricultural Experimental Station, 4 p.

Hinkle, M.E., 1980, Survey of helium in soils and soil gases and mercury in soils at Roosevelt Hot Springs Known Geothermal Resource Area, Utah: U.S. Geological Survey Open-File Report 80-613, 31 p.

Hinkle, M.E., and Kilburn, J.E., 1979, The use of vacutainer tubes for collection of soil samples for helium analysis: U.S. Geological Survey Open-File Report 79-1441, 23 p.

Hinkle, M.E., and Kilburn, J.E., 1980, Survey of helium in soil gases of Long Valley, California: U.S. Geological Survey Open-File Report 80-612, 21 p.

McCarthy, J.H., Jr., and Reimer, G.M., 1986, Advances in soil gas geochemical exploration for natural resources: Some current examples and practices: Journal of Geophysical Research, v. 91, no. B12, pp. 12,327-12,338.

Reimer, G.M., and Bowles, C.G., 1979, Soil gas helium concentrations in the vicinity of a uranium deposit, Red Desert, Wyoming: U.S. Geological Survey Open-File Report 79-975, 9 p.

Reimer, G.M., and Denton, E.H., 1978, Improved inlet system for the U.S. Geological Survey helium sniffer: U.S. Geological Survey Open-File Report 78-588, 4 p.

Roberts, A.A., Friedman, Irving, Donovan, T.J., and Denton, E.H., Helium survey a possible technique for locating geothermal reservoirs: Geophysical Research Letters, v. 2, no. 6, pp. 209-210.

U.S. Geological Survey, 1986, Brief descriptions of STATPAC and related statistical programs for the IBM personal computer, update of November 5, 1986: Unpublished document, 26 p.

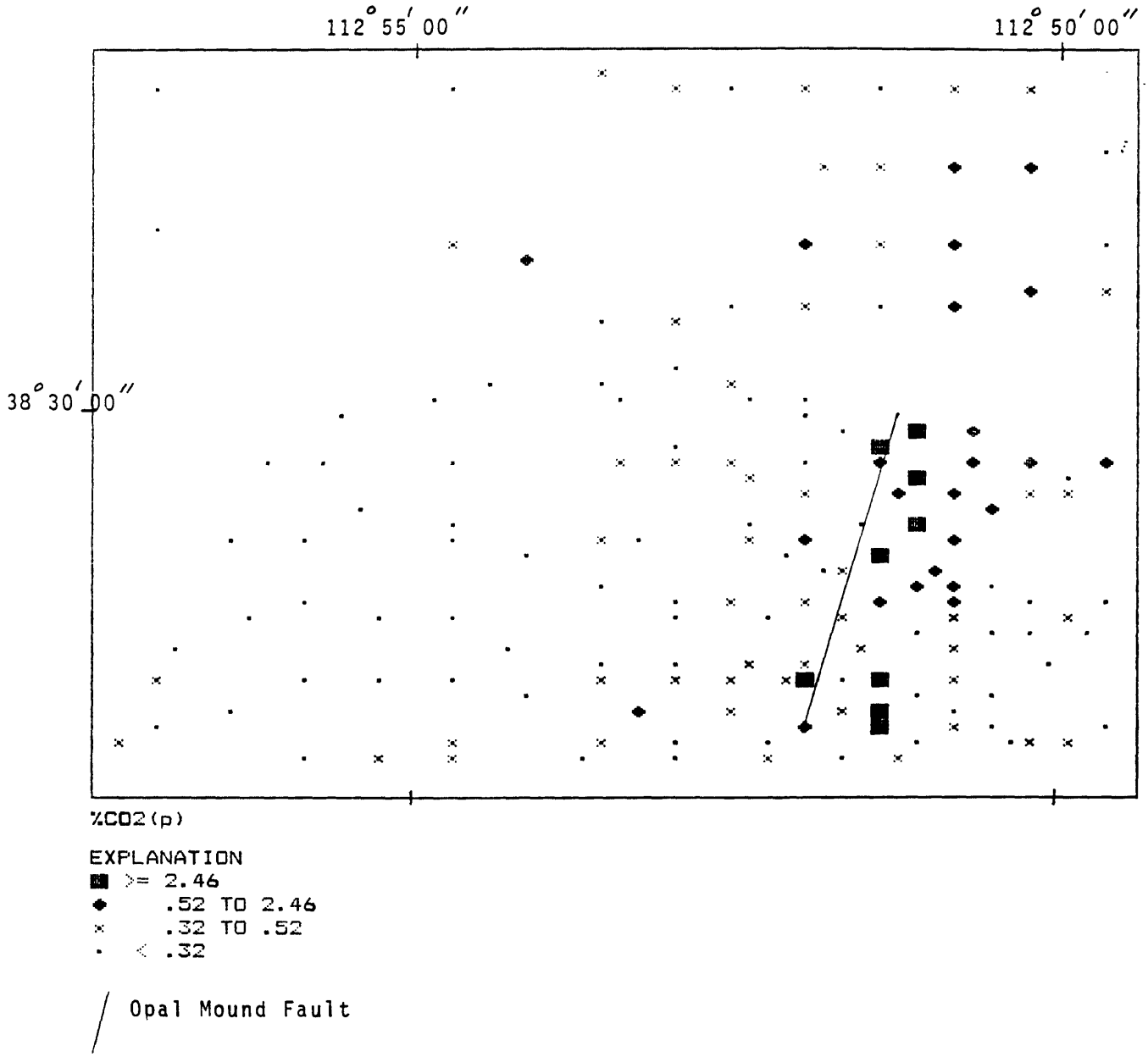

Figure 3. Sample sites for $\%Co_2(p)$

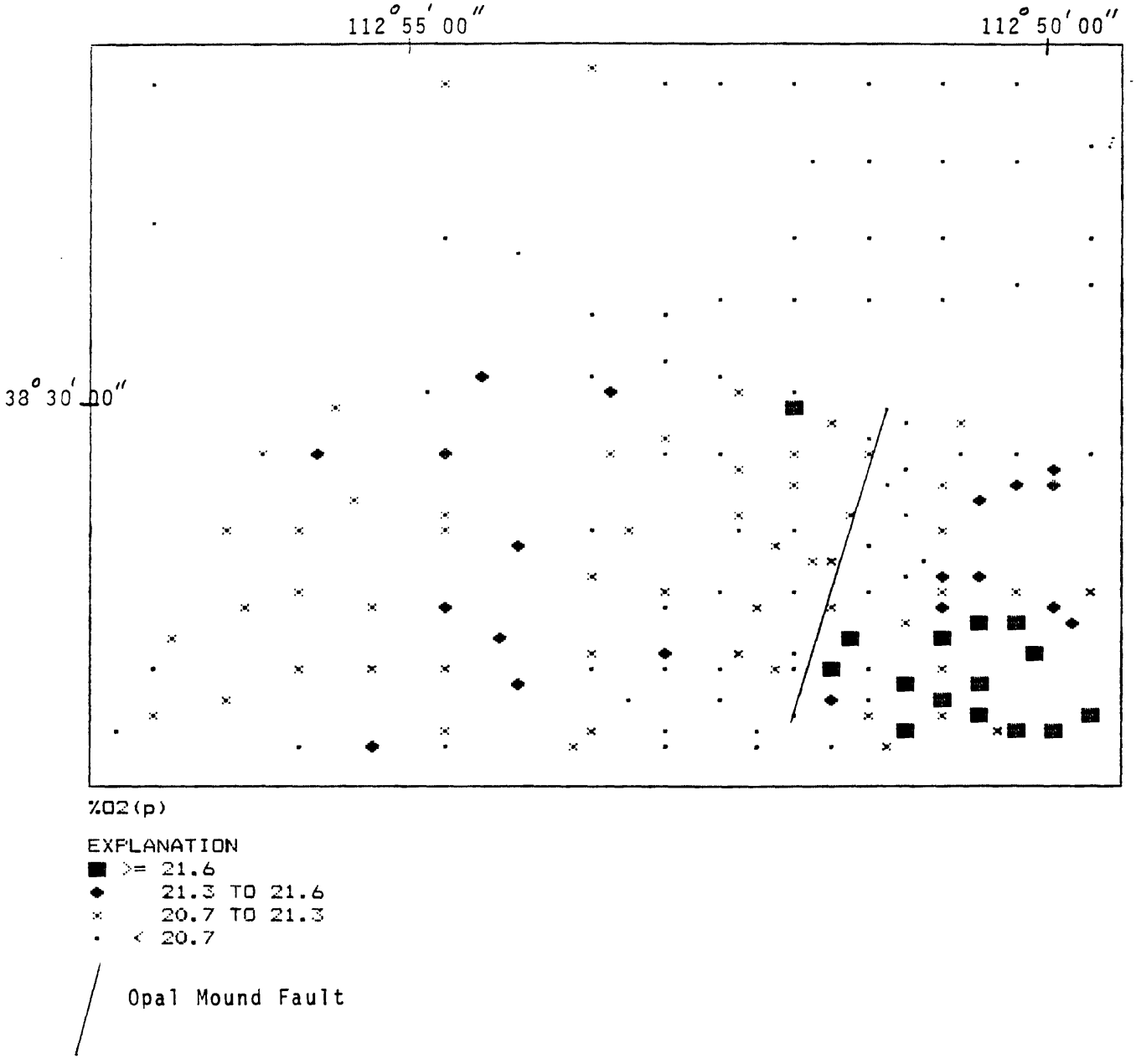

Figure 4. Sample sites for $\%O_2(p)$

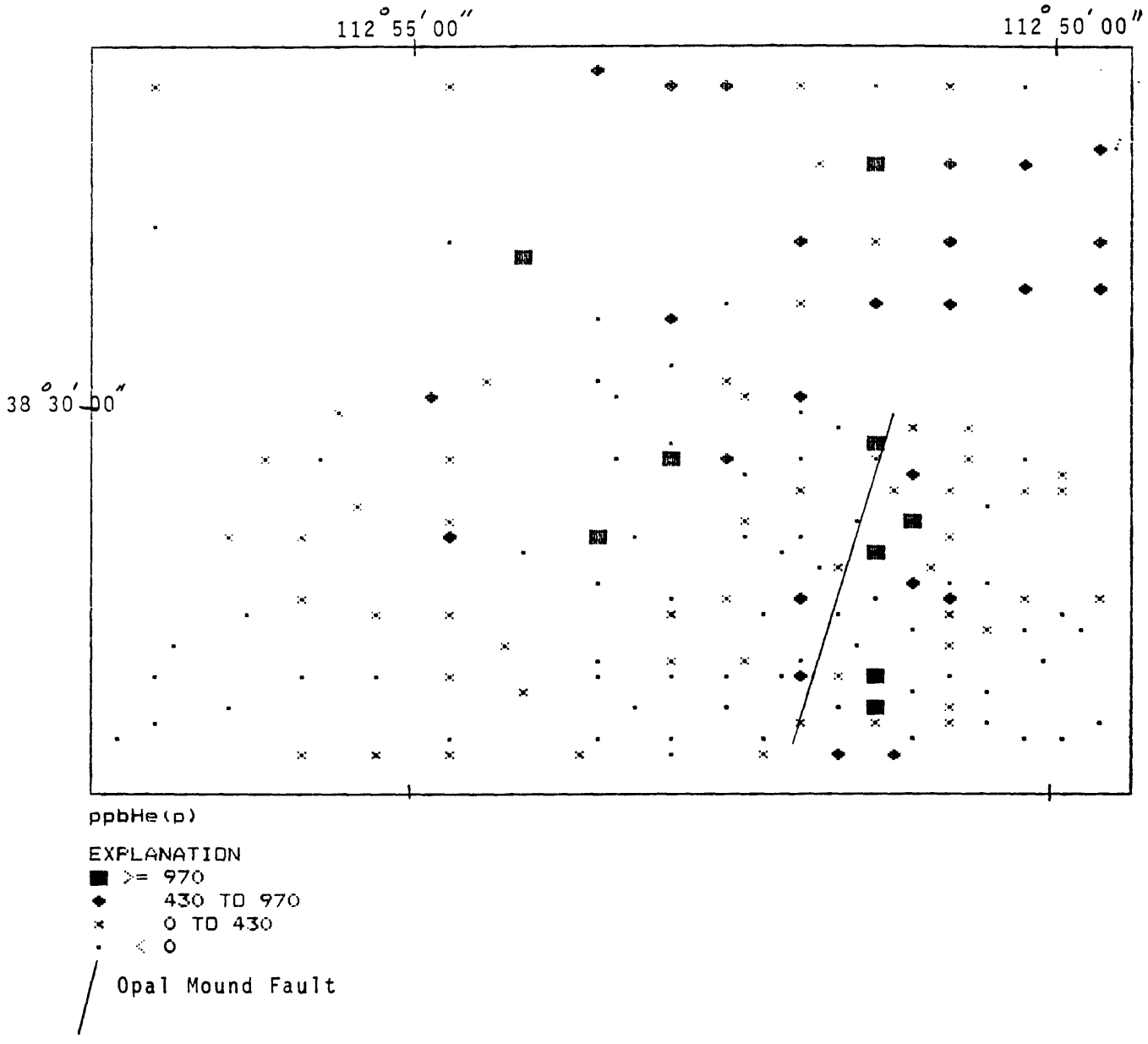

Figure 5. Sample sites for ppbHe(p)

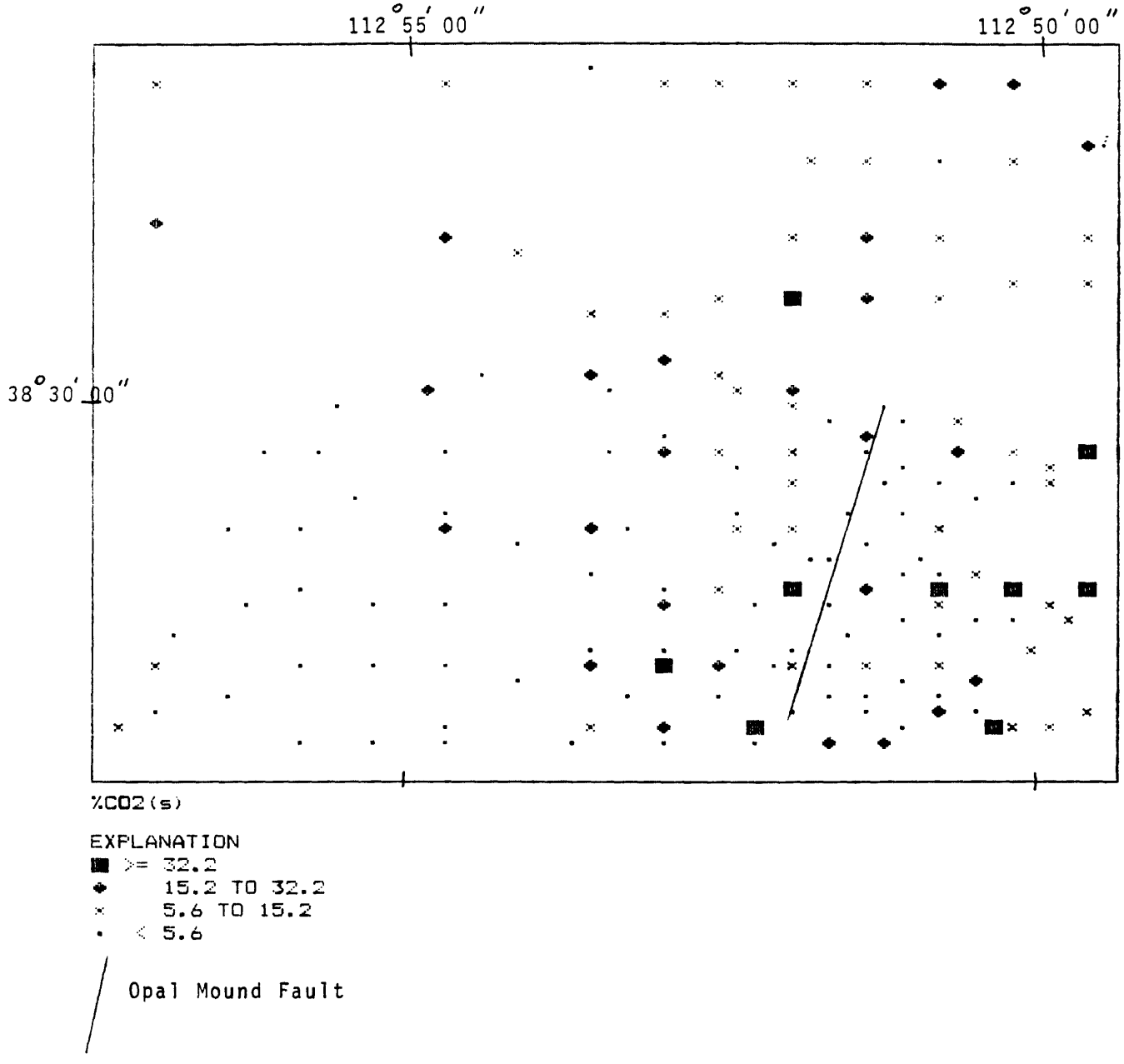

Figure 6. Sample sites for $\%CO_2(s)$

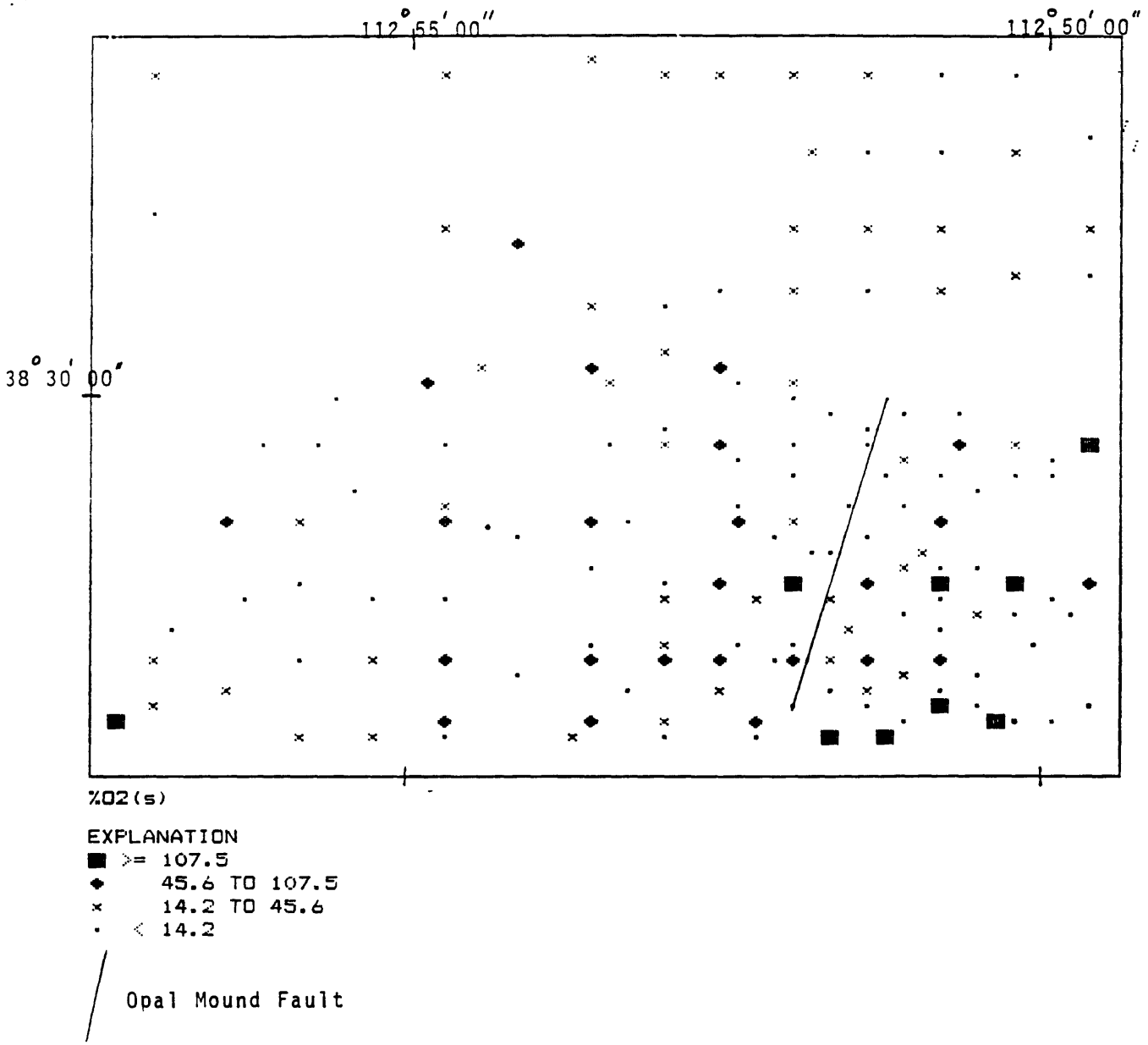

Figure 7. Sample sites for $\%O_2(s)$

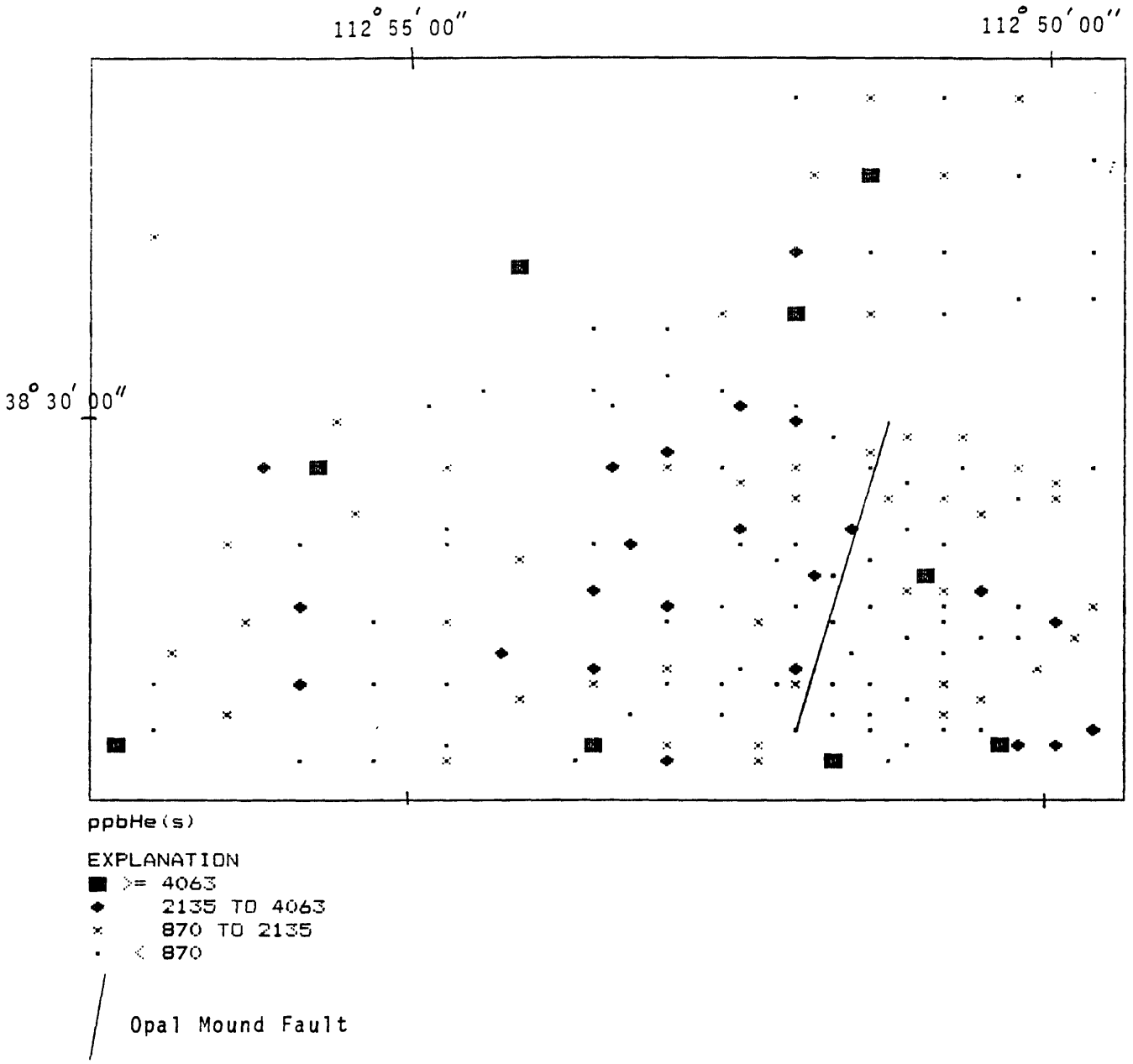

Figure 8. Sample sites for ppbHe(s)

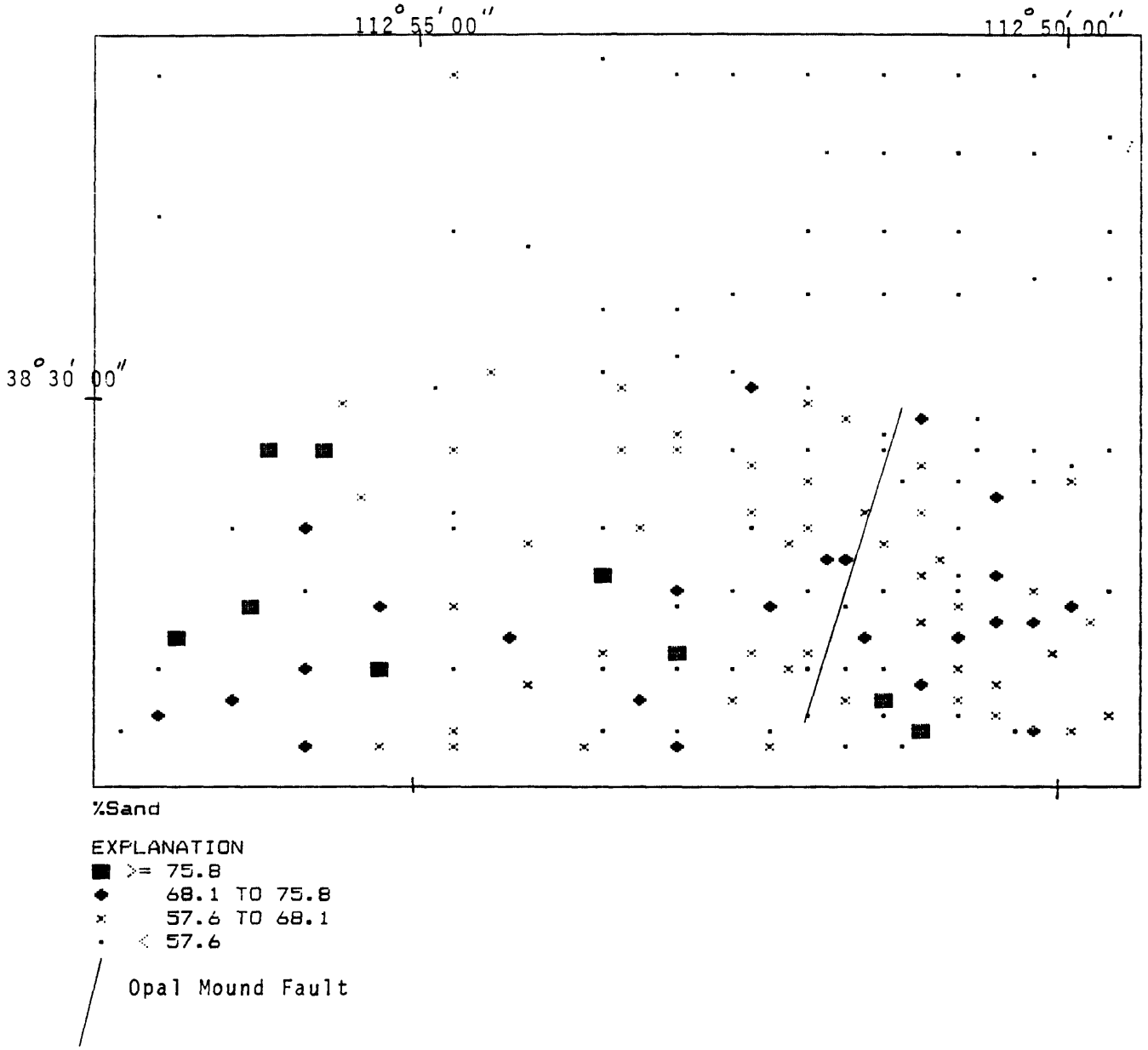

Figure 9. Sample sites for %Sand

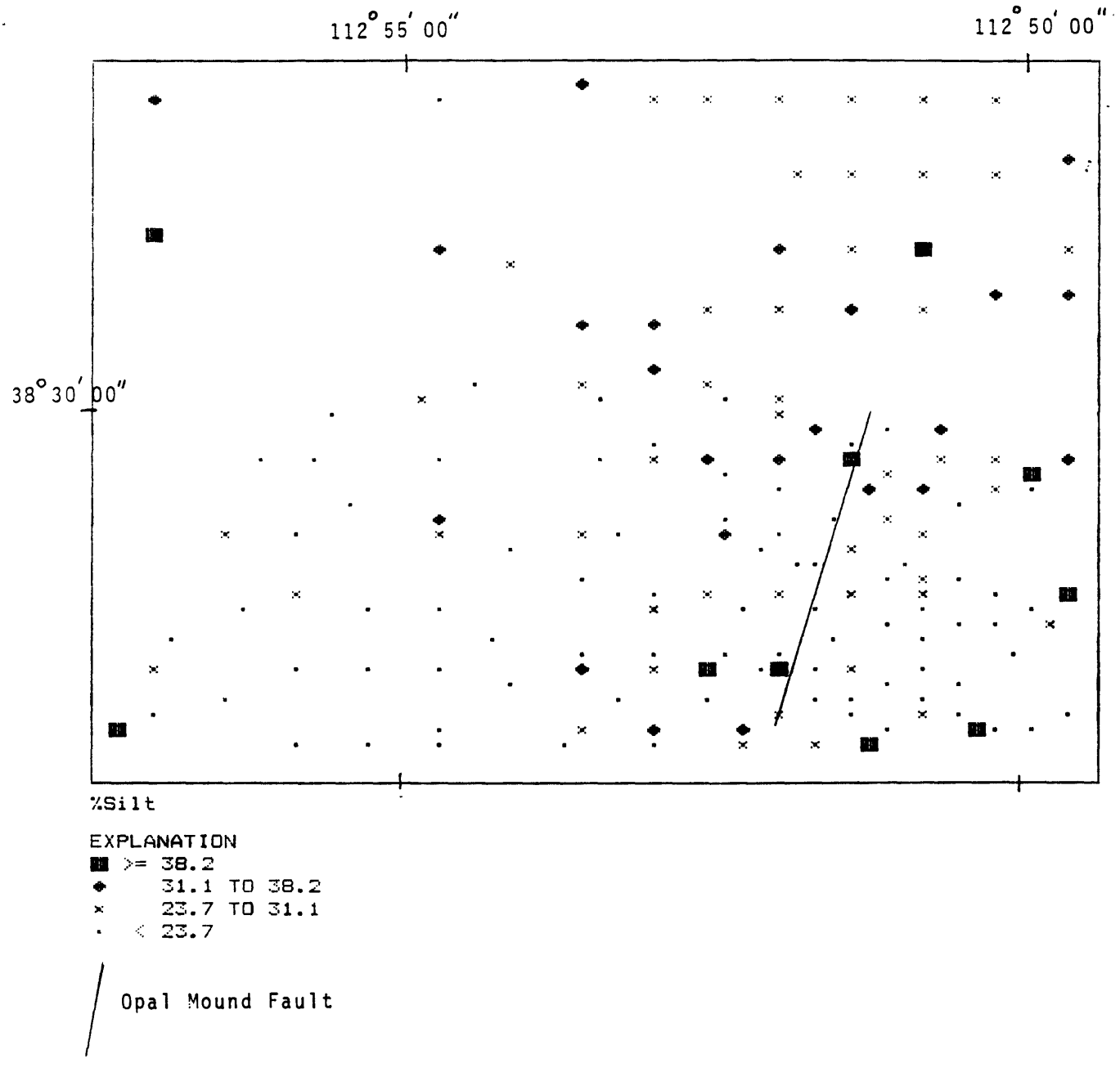

Figure 10. Sample sites for %Silt

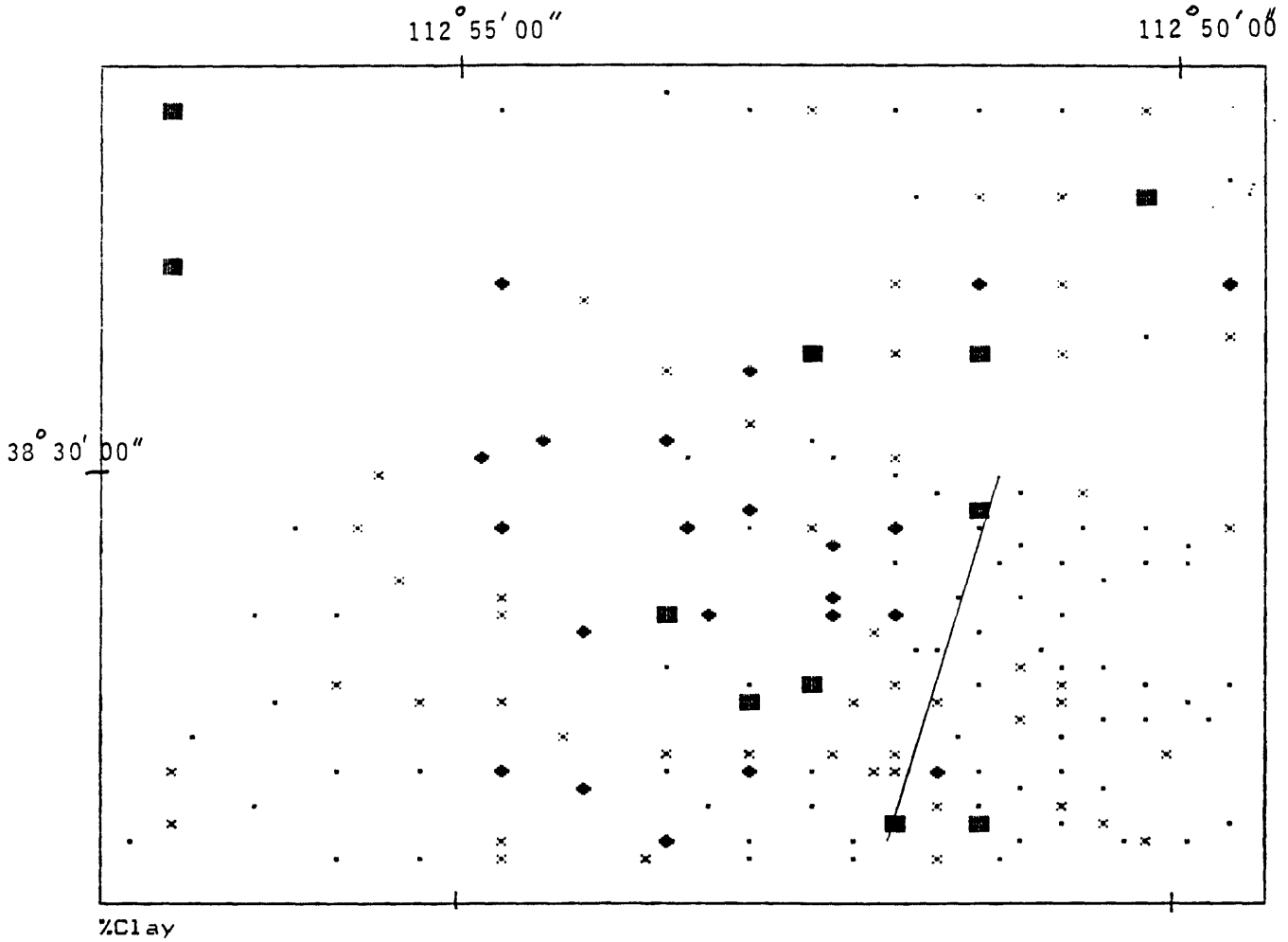

Figure 11. Sample sites for %Clay

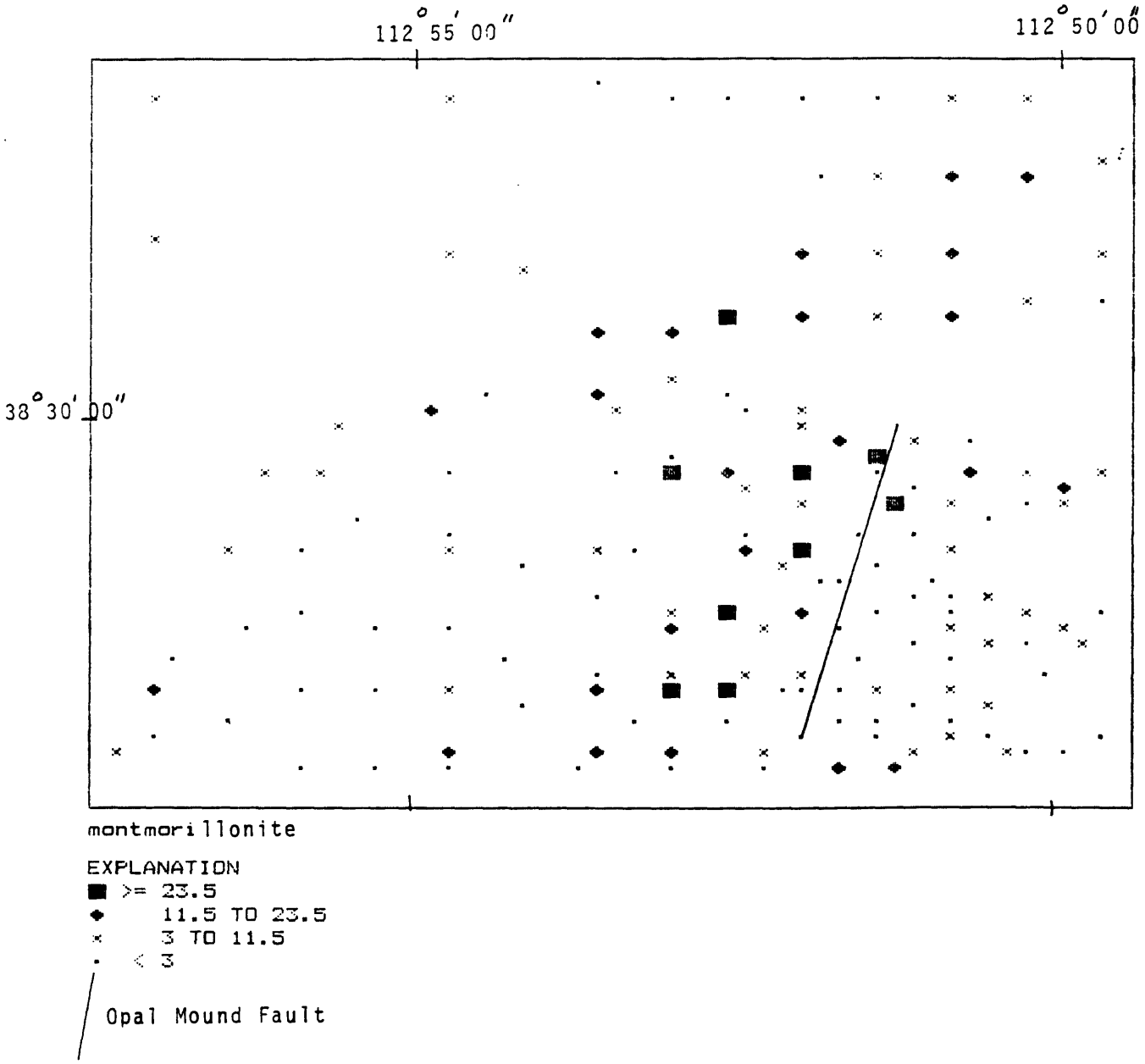

Figure 12. Sample sites for montmorillonite

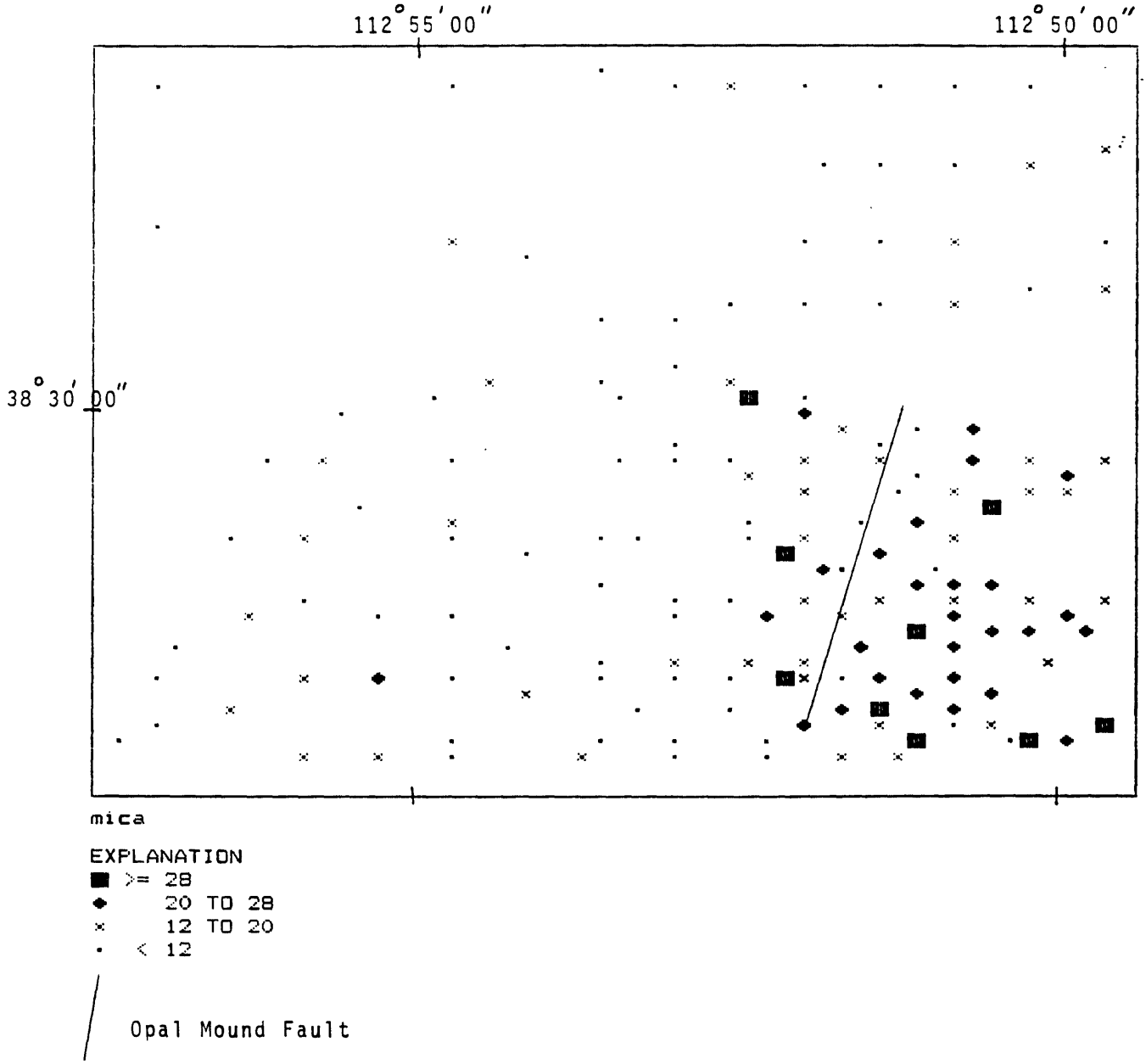

Figure 13. Sample sites for mica

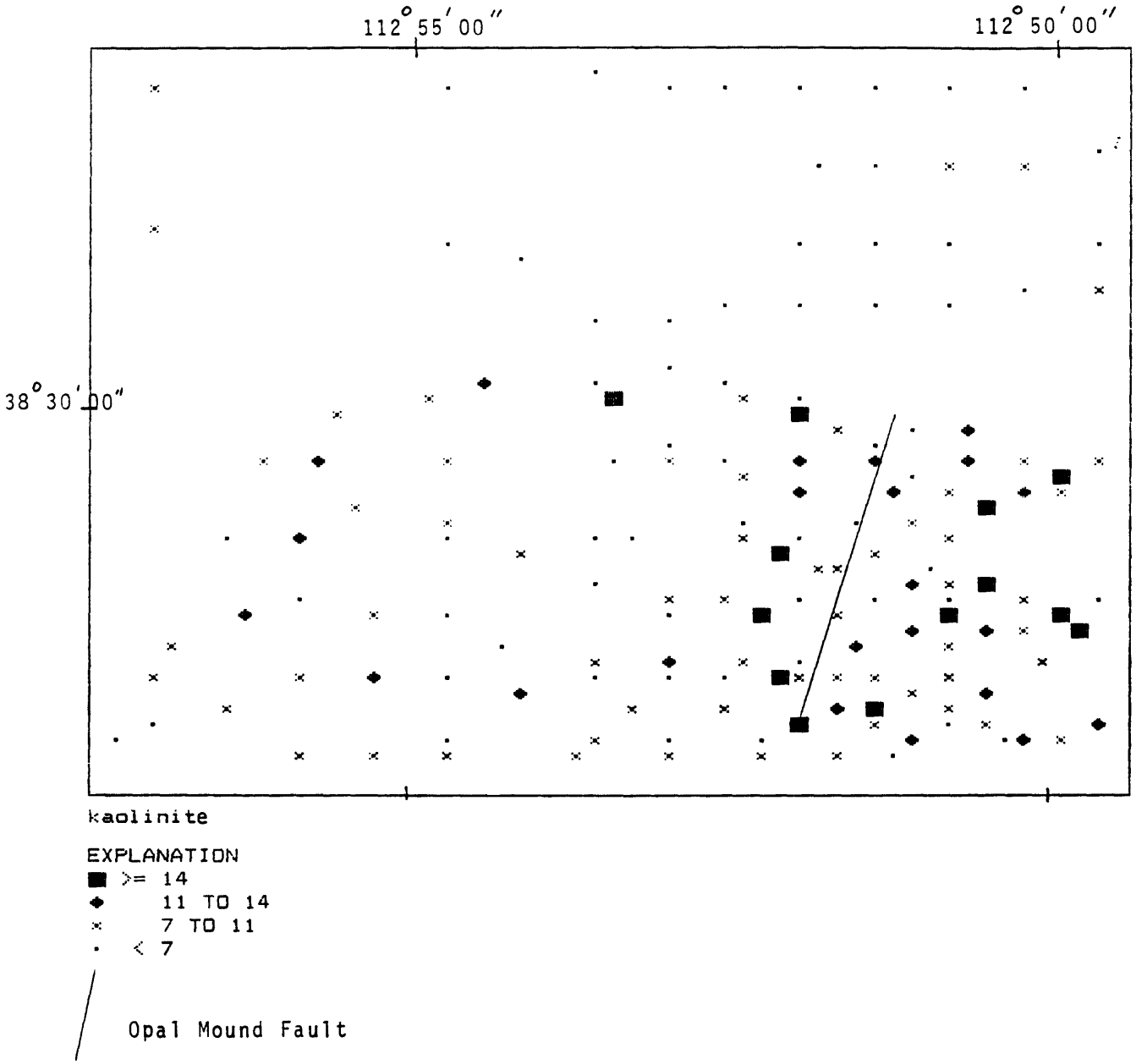

Figure 14. Sample sites for kaolinite

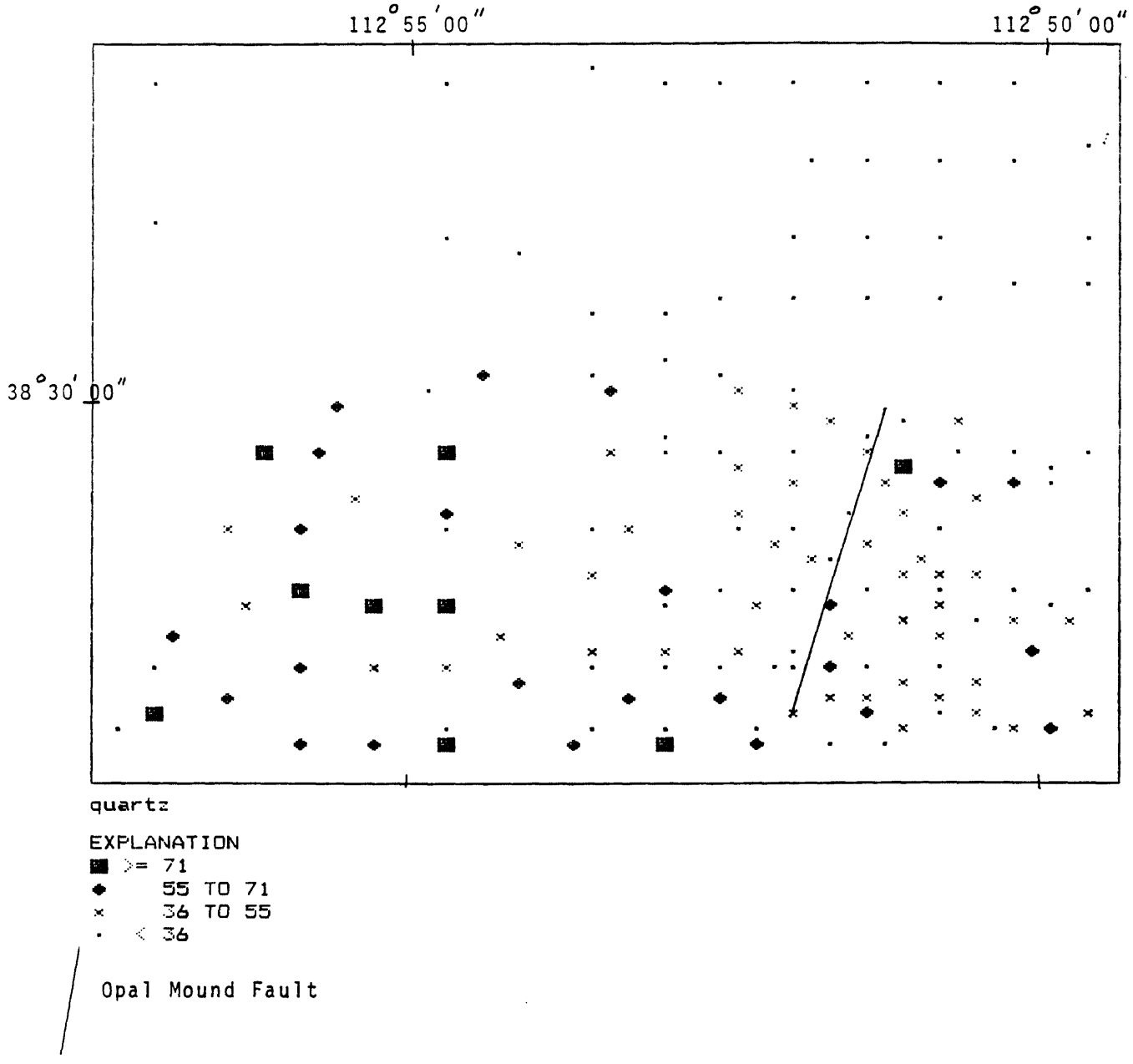

Figure 15. Sample sites for quartz

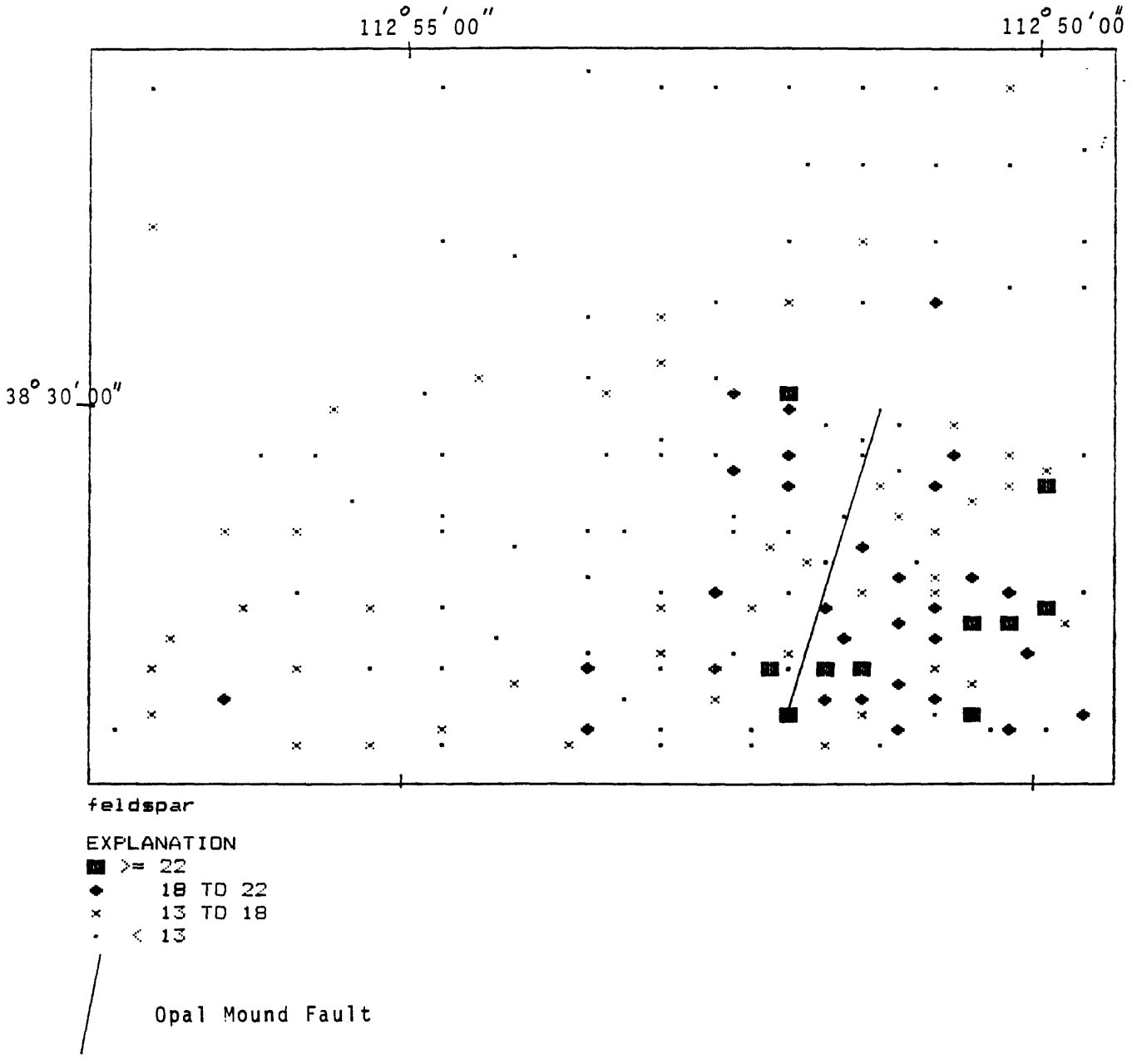

Figure 16. Sample sites for feldspar

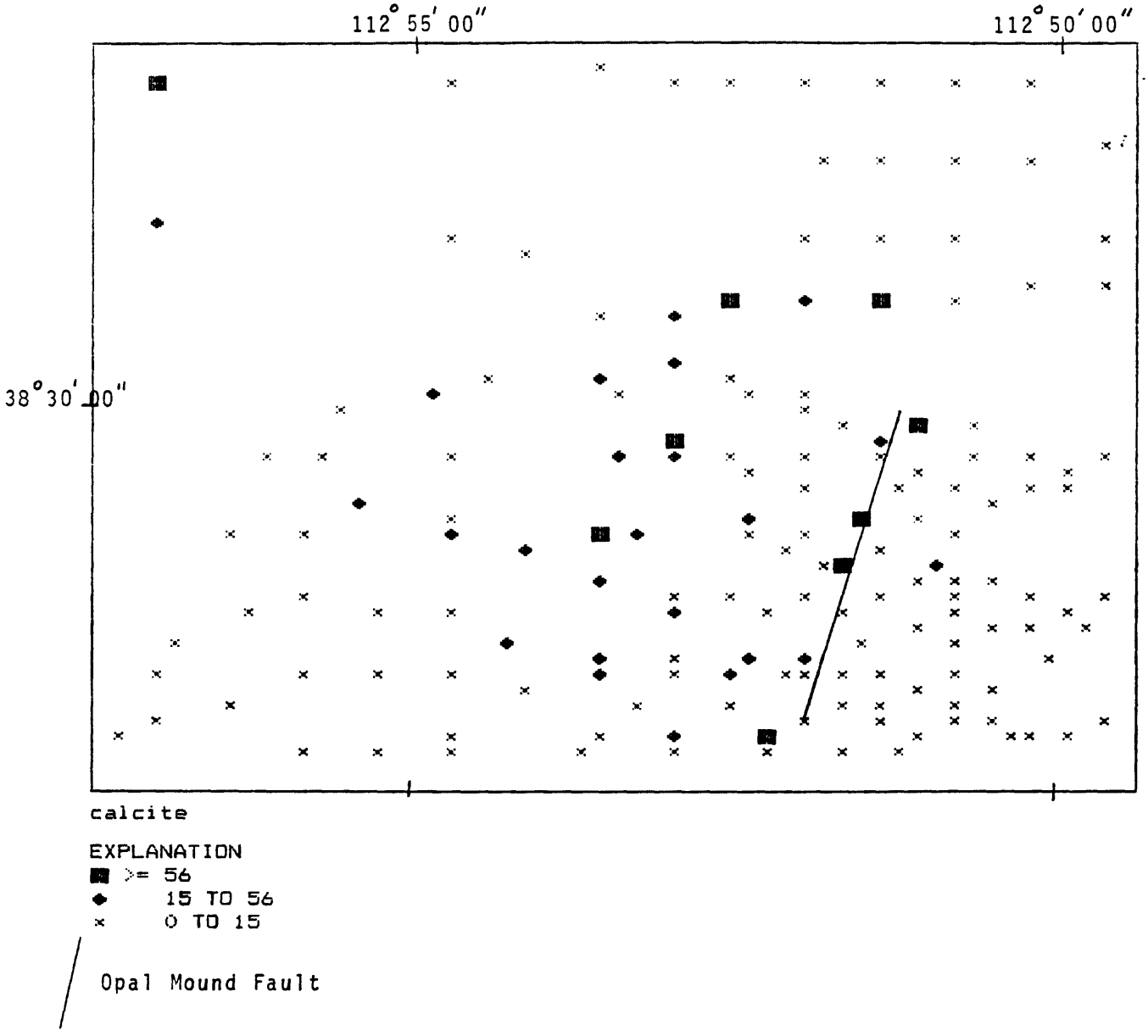

Figure 17. Sample sites for calcite

Table 1.--Operating conditions for the gas chromatograph

Type of gas chromatograph	Carle AGC-100
Detector	thermister detector
Lower limit of detection	0.03% CO_2/0.1% O_2 (vol/vol)
Reproducibility	+/-10% (probe samples), ± 25% (gases desorbed from soils)
Column	concentric stainless steel, outer column 72 in. x 1/4 in molecular sieve; inner column 72 in. x 1/8 in porapak mixture (Alltech Associates, Deerfield, IL)
Carrier gas	hellium at 90 mL/minute
Temperature	column: 70°C detector: "low" mode

Table 2. Analytical Data

ROW	ID	LAT	LONG	SoilT(C)	%Moist	%CO2(p)	%O2(p)	ppbHe(p)	%CO2(s)	%O2(s)	ppbHe(s)
1	RHS-1001	383050.00	1125711.00	17.00	6.50	.28	19.90	-90.00	24.90	10.70	917.00
2	RHS-1002	383050.00	1125457.00	21.60	5.30	.41	20.10	-280.00	24.40	41.60	-1270.00
3	RHS-1003	383144.00	1125711.00	15.50	11.90	.15	20.50	290.00	7.60	32.80	-1366.00
4	RHS-1004	383144.00	1125411.00	22.00	3.60	.21	20.70	100.00	9.70	37.90	-1814.00
5	RHS-1005	383149.00	1125348.00	23.00	2.60	.35	20.80	480.00	2.50	41.30	-2210.00
6	RHS-1006	383141.00	1125313.00	22.50	3.50	.33	20.40	670.00	6.50	29.60	-2149.00
7	RHS-1007	383141.00	1125244.00	22.50	4.60	.27	19.80	670.00	12.30	19.90	-1188.00
8	RHS-1008	383115.00	1125202.00	22.00	4.90	.43	19.80	100.00	10.40	21.90	1274.00
9	RHS-1009	383141.00	1125134.00	21.00	4.00	.30	20.00	-470.00	10.00	17.00	1159.00
10	RHS-1010	383141.00	1125207.00	22.50	5.70	.44	20.00	100.00	9.80	26.40	828.00
11	RHS-1011	383141.00	1125101.00	22.00	4.50	.39	20.30	230.00	22.80	.10	849.00
12	RHS-1012	383141.00	1125026.00	21.50	5.90	.44	20.30	-182.00	17.40	7.10	976.00
13	RHS-1013	383115.00	1125104.00	21.00	5.70	.53	20.30	642.00	3.80	12.40	1306.00
14	RHS-1014	382840.00	1125134.00	22.50	2.90	1.03	20.30	436.00	5.10	34.50	775.00
15	RHS-1015	383112.00	1125026.00	17.00	7.50	.81	19.80	642.00	10.50	15.30	864.00
16	RHS-1016	383119.00	1124955.00	16.50	6.70	.26	19.80	436.00	15.20	13.30	491.00
17	RHS-1017	383048.00	1124955.00	16.00	5.90	.30	20.10	436.00	10.40	17.60	719.00
18	RHS-1018	383031.00	1124955.00	17.00	5.00	.36	20.20	436.00	13.90	13.20	393.00
19	RHS-1019	383029.00	1125026.00	18.50	3.70	.94	19.90	848.00	7.80	18.00	381.00
20	RHS-2020	383024.00	1125101.00	17.50	4.00	.60	19.90	436.00	8.60	26.20	416.00
21	RHS-1021	383049.00	1125104.00	16.00	4.70	.61	20.10	848.00	10.20	17.40	562.00
22	RHS-1022	383114.00	1125134.00	16.00	6.70	.40	20.30	1260.00	14.90	3.80	7126.00
23	RHS-1023	383049.00	1125134.00	16.00	4.80	.39	20.20	230.00	16.10	34.20	583.00
24	RHS-1024	383024.00	1125134.00	16.00	11.70	.31	20.30	642.00	24.10	11.10	1870.00
25	RHS-1025	383024.00	1125207.00	16.50	5.10	.48	19.70	230.00	32.20	15.60	10794.00
26	RHS-1026	383024.00	1125244.00	16.00	7.90	.28	20.00	-920.00	14.30	5.50	870.00
27	RHS-1027	383022.00	1125313.00	17.00	7.80	.37	19.90	430.00	14.70	10.30	87.00
28	RHS-1028	383022.00	1125348.00	17.00	4.20	.28	20.00	-380.00	6.50	40.90	-67.00
29	RHS-1029	383049.00	1125207.00	16.50	5.80	1.14	19.90	430.00	10.00	18.60	3773.00
30	RHS-1030	383043.00	1125425.00	21.00	2.90	.52	20.20	970.00	8.00	107.00	5794.00
31	RHS-1031	382840.00	1125134.00	20.00	3.10	.77	20.10	430.00	13.50	39.10	1224.00
32	RHS-1032	382950.00	1125207.00	18.00	6.60	.54	20.20	-110.00	5.90	32.10	232.00
33	RHS-1033	382933.00	1125134.00	21.50	13.10	7.57	19.00	2050.00	22.40	.00	1112.00
34	RHS-1034	382838.00	1125207.00	21.00	4.00	.41	20.00	700.00	60.70	244.00	520.00
35	RHS-1035	382811.00	1125711.00	16.00	6.80	.39	20.20	-650.00	11.70	25.70	480.00
36	RHS-1036	382951.00	1125508.00	16.00	5.40	.27	20.40	430.00	28.30	97.00	320.00
37	RHS-1037	382957.00	1125348.00	16.00	6.10	.24	20.60	-380.00	20.10	73.20	826.00
38	RHS-1038	382930.00	1125313.00	16.00	8.10	.35	20.50	1510.00	25.60	26.50	896.00
39	RHS-1039	382930.00	1125244.00	16.00	4.30	.51	20.50	430.00	7.10	81.30	-141.00
40	RHS-1040	382928.00	1125207.00	16.00	7.20	.37	20.60	-280.00	13.70	28.20	452.00
41	RHS-1041	382904.00	1125235.00	16.00	5.80	.44	20.30	-90.00	11.00	66.00	239.00
42	RHS-1042	383002.00	1125313.00	16.00	8.20	.25	20.40	-850.00	21.60	41.70	18.00
43	RHS-1043	382957.00	1125244.00	16.50	2.30	.39	20.50	290.00	6.00	83.40	37.00
44	RHS-1044	382951.00	1125207.00	16.50	11.00	.25	20.10	670.00	17.10	31.60	45.00
45	RHS-1045	382838.00	1125244.00	16.50	7.20	.34	20.20	100.00	13.30	50.70	-102.00
46	RHS-1046	382835.00	1125313.00	17.00	7.70	.27	20.30	100.00	20.10	42.50	71.00
47	RHS-1047	382903.00	1125348.00	19.00	7.90	.35	20.40	1050.00	15.20	62.40	-195.00
48	RHS-1048	382903.00	1125457.00	19.00	6.20	.29	20.70	480.00	19.30	73.90	149.00
49	RHS-1049	382811.00	1125457.00	18.50	3.60	.32	20.90	480.00	9.80	88.70	125.00
50	RHS-1050	382747.00	1125455.00	17.50	2.30	.42	20.70	-90.00	.90	73.70	359.00

Table 2. Analytical Data

	ROW ID	LAT	LONG	SoilT(C)	%Moist	%CO2(p)	%O2(p)	ppbHe(p)	%CO2(s)	%O2(s)	ppbHe(s)
51	RHS-1051	382747.00	1125348.00	17.50	5.00	.47	20.70	-90.00	6.90	67.90	4618.00
52	RHS-1052	382811.00	1125313.00	18.00	6.40	.33	20.60	-470.00	34.30	75.50	288.00
53	RHS-1053	382747.00	1125309.00	18.00	7.60	.29	20.40	-90.00	29.90	40.60	1320.00
54	RHS-1054	382811.00	1125244.00	18.00	7.60	.42	20.40	-280.00	31.70	45.60	686.00
55	RHS-1055	382750.00	1125232.00	17.50	9.30	.31	20.50	-90.00	32.90	49.60	998.00
56	RHS-1056	382811.00	1125348.00	17.50	5.60	.45	20.50	-470.00	29.30	63.00	1385.00
57	RHS-1057	382840.00	1125134.00	19.50	2.80	.87	20.40	-470.00	12.50	90.80	765.00
58	RHS-1058	382747.00	1125731.00	15.50	9.00	.34	20.50	-470.00	13.90	108.00	13325.00
59	RHS-1059	382840.00	1125134.00	16.00	4.00	1.23	20.40	-660.00	63.40	74.90	575.00
60	RHS-1060	382903.00	1125059.00	18.00	3.60	2.85	20.70	-470.00	22.60	128.00	250.00
61	RHS-1061	382929.00	1124953.00	15.00	5.90	.52	20.30	-1602.00	46.60	167.00	422.00
62	RHS-1062	382931.00	1125026.00	16.00	5.60	.58	20.20	-562.00	19.60	73.80	441.00
63	RHS-1063	382930.00	1125053.00	17.00	4.50	1.06	20.10	270.00	50.30	113.00	1409.00
64	RHS-1064	382840.00	1124955.00	15.50	4.90	.29	20.70	270.00	53.70	90.00	1936.00
65	RHS-1065	382840.00	1125026.00	16.00	3.60	.31	20.80	478.00	70.60	249.00	1424.00
66	RHS-1066	382840.00	1125101.00	16.50	3.30	.56	20.70	894.00	40.00	176.00	256.00
67	RHS-1067	382811.00	1125101.00	18.50	2.90	.37	20.90	-502.00	21.70	129.00	636.00
68	RHS-1068	382749.00	1125033.00	17.00	4.90	.25	21.10	-1712.00	65.60	214.00	10377.00
69	RHS-1069	382755.00	1125105.00	20.00	3.80	.35	21.20	388.00	21.40	151.00	669.00
70	RHS-1070	382811.00	1125134.00	18.50	3.90	1.18	20.80	1318.00	11.40	160.00	742.00
71	RHS-1071	382811.00	1125207.00	22.00	4.50	3.49	19.90	574.00	11.90	96.70	1423.00
72	RHS-1072	382747.00	1125152.00	20.00	4.70	.41	20.80	574.00	32.10	198.00	8743.00
73	RHS-1073	382747.00	1125123.00	19.50	3.20	.45	20.90	574.00	21.10	173.00	768.00
74	RHS-1074	382902.00	1125639.00	17.50	5.70	.29	21.20	388.00	10.00	80.90	920.00
75	RHS-2001	382927.00	1125012.00	17.00	4.95	.24	21.40	.00	5.60	.40	1379.00
76	RHS-2002	382917.00	1125012.00	17.00	7.97	.32	21.40	.00	7.70	.00	1765.00
77	RHS-2003	382918.00	1125029.00	18.00	3.69	.46	21.30	162.00	2.20	11.80	531.00
78	RHS-2004	382912.00	1125042.00	19.00	1.88	.56	21.40	-98.00	2.70	11.30	887.00
79	RHS-2005	382904.00	1125058.00	19.00	2.32	1.81	21.00	584.00	3.50	12.90	-38.00
80	RHS-2006	382845.00	1125058.00	19.00	3.11	.73	21.40	-130.00	2.90	11.60	1040.00
81	RHS-2007	382846.00	1125042.00	18.00	3.20	.28	21.50	-260.00	11.20	.00	2885.00
82	RHS-2008	382841.00	1125026.00	20.00	2.71	.23	21.60	.00	1.40	12.30	-38.00
83	RHS-2009	382835.00	1125012.00	18.00	3.15	.39	21.30	-194.00	6.80	2.40	2318.00
84	RHS-2010	382828.00	1125000.00	18.00	3.94	.27	21.50	-130.00	6.60	4.40	1379.00
85	RHS-2011	382820.00	1125019.00	19.00	4.34	.27	21.70	-64.00	14.90	7.70	1089.00
86	RHS-2012	382829.00	1125026.00	18.00	2.98	.25	21.60	-162.00	3.50	11.70	618.00
87	RHS-2013	382827.00	1125042.00	19.00	1.18	.24	21.60	.00	1.70	19.90	-38.00
88	RHS-2014	382835.00	1125058.00	19.00	3.83	.32	21.50	64.00	7.70	1.30	800.00
89	RHS-2015	382822.00	1125058.00	19.00	3.16	.39	21.60	.00	2.90	8.90	-39.00
90	RHS-2016	382811.00	1125058.00	19.00	4.91	.35	21.60	-356.00	1.30	10.20	1566.00
91	RHS-2017	382805.00	1125040.00	19.00	3.85	.30	21.60	-324.00	21.30	.00	1745.00
92	RHS-2018	382749.00	1125026.00	16.00	4.08	.34	21.60	-130.00	7.50	.00	3247.00
93	RHS-2019	382749.00	1125008.00	17.00	2.62	.37	21.60	-194.00	7.40	.30	2732.00
94	RHS-2020	382753.00	1124955.00	21.00	2.20	.22	21.90	-32.00	6.90	6.40	2766.00
95	RHS-2021	382755.00	1125042.00	22.00	2.82	.24	21.70	-98.00	4.70	6.20	561.00
96	RHS-2022	382749.00	1125116.00	23.00	1.41	.26	21.80	-130.00	3.00	9.30	-38.00
97	RHS-2023	382758.00	1125101.00	23.00	3.31	.30	21.70	32.00	5.20	5.50	1741.00
98	RHS-2024	382809.00	1125116.00	24.00	1.80	.30	21.70	-32.00	.60	14.80	-38.00
99	RHS-2025	382813.00	1125132.00	24.00	2.46	8.86	19.10	3110.00	2.60	13.50	-38.00
100	RHS-2026	382822.00	1125148.00	21.00	1.72	.34	21.60	-130.00	1.20	15.20	-485.00

Table 2. Analytical Data

	ROW ID	LAT	LONG	SoilT(C)	%Moist	%CO2(p)	%O2(p)	ppbHe(p)	%CO2(s)	%O2(s)	ppbHe(s)
101	RHS-2027	382811.00	1125157.00	25.00	1.87	.31	21.70	64.00	.70	18.10	-38.00
102	RHS-2028	382803.00	1125140.00	25.00	1.28	6.84	19.70	972.00	3.60	15.30	-38.00
103	RHS-2029	382753.00	1125136.00	23.00	3.19	2.46	20.90	260.00	4.10	11.90	547.00
104	RHS-2030	382759.00	1125157.00	25.00	2.46	.50	21.50	-32.00	1.30	.00	-38.00
105	RHS-2031	382744.00	1125152.00	25.00	1.85	.03	20.30	1004.00	.80	17.00	-38.00
106	RHS-2032	382758.00	1125211.00	26.00	9.10	.85	20.60	.00	4.30	3.80	861.00
107	RHS-2033	382811.00	1125224.00	24.00	3.64	.34	20.70	-194.00	1.30	12.30	461.00
108	RHS-2034	382820.00	1125214.00	26.00	4.72	.34	20.60	-64.00	.70	7.70	2170.00
109	RHS-2035	382837.00	1125153.00	26.00	1.91	.34	20.70	-98.00	.30	14.90	-38.00
110	RHS-2036	382840.00	1125132.00	25.00	1.62	.29	20.70	98.00	.20	14.70	782.00
111	RHS-2037	382829.00	1125120.00	26.00	2.93	.24	20.80	-260.00	2.20	9.40	638.00
112	RHS-2038	382846.00	1125119.00	28.00	1.59	.99	20.40	712.00	.30	16.60	1153.00
113	RHS-2039	382853.00	1125110.00	33.00	1.82	.70	20.60	.00	.40	20.20	5864.00
114	RHS-2040	382849.00	1125206.00	16.00	6.59	.22	20.70	-98.00	2.10	.00	2751.00
115	RHS-2041	382850.00	1125150.00	16.00	4.90	.37	20.70	98.00	.20	11.50	747.00
116	RHS-2042	382858.00	1125132.00	17.00	2.00	6.44	19.10	1070.00	1.90	13.10	-38.00
117	RHS-2043	382909.00	1125144.00	15.00	9.72	.20	20.80	-130.00	1.80	.00	2814.00
118	RHS-2044	382925.00	1125120.00	16.00	1.47	8.09	18.50	486.00	1.00	16.40	-38.00
119	RHS-2045	382938.00	1125120.00	16.00	8.70	5.67	19.30	194.00	2.70	3.20	1763.00
120	RHS-2046	382916.00	1125127.00	17.00	7.56	1.19	20.60	130.00	1.30	8.20	1072.00
121	RHS-2047	382928.00	1125140.00	16.00	4.95	.68	20.80	194.00	1.10	13.00	-40.00
122	RHS-2048	382939.00	1125150.00	16.00	7.82	.31	21.00	-226.00	1.70	3.00	-40.00
123	RHS-2049	382946.00	1125213.00	16.00	3.93	.24	21.80	-226.00	13.50	3.90	2366.00
124	RHS-2050	382950.00	1125241.00	15.00	2.78	.29	21.00	64.00	5.80	3.60	2190.00
125	RHS-2051	382926.00	1125241.00	15.00	5.78	.32	20.80	-130.00	5.30	2.80	991.00
126	RHS-2052	382930.00	1125214.00	14.00	5.85	.22	21.00	64.00	6.10	.00	1894.00
127	RHS-2053	382907.00	1125235.00	15.00	10.30	.20	21.00	130.00	2.40	.00	3529.00
128	RHS-2054	382859.00	1125222.00	16.00	5.81	.31	21.00	-64.00	3.70	7.60	777.00
129	RHS-2055	382837.00	1125226.00	15.00	2.88	.28	21.10	-64.00	.80	15.00	1083.00
130	RHS-2056	382818.00	1125241.00	16.00	4.87	.33	21.10	.00	.10	9.90	814.00
131	RHS-2057	382819.00	1125311.00	15.00	2.94	.22	21.30	130.00	.40	16.10	1444.00
132	RHS-2058	382819.00	1125346.00	15.00	5.33	.23	21.20	-64.00	2.10	.00	2814.00
133	RHS-2059	382821.00	1125425.00	15.00	5.27	.19	21.30	32.00	.00B	.00B	3524.00
134	RHS-2060	382813.00	1125459.00	16.00	4.24	.24	21.20	130.00	.10	13.10	953.00
135	RHS-2061	382835.00	1125459.00	16.00	4.53	.16	21.40	64.00	2.50	4.80	1551.00
136	RHS-2062	382909.00	1125455.00	20.00	2.72	.29	21.20	130.00	.60	17.40	641.00
137	RHS-2063	382859.00	1125420.00	17.00	5.23	.19	21.30	-64.00	.20	11.30	1100.00
138	RHS-2064	382929.00	1125454.00	17.00	4.24	.19	21.30	64.00	.30	12.10	1659.00
139	RHS-2065	382955.00	1125443.00	19.00	3.41	.25	21.30	64.00	.80	18.50	473.00
140	RHS-2066	382954.00	1125336.00	19.00	4.06	.27	21.40	-64.00	.90	14.20	867.00
141	RHS-2067	382933.00	1125307.00	16.00	10.21	.23	21.20	-98.00	2.00	.00	3192.00
142	RHS-2068	382931.00	1125336.00	18.00	8.62	.36	21.10	-194.00	1.60	.00	3952.00
143	RHS-2069	382931.00	1125601.00	19.00	2.54	.22	21.30	-162.00	1.70	5.20	4063.00
144	RHS-2070	382901.00	1125327.00	18.00	5.47	.29	21.10	-64.00	1.10	7.30	2457.00
145	RHS-2071	382847.00	1125346.00	18.00	7.50	.18	20.80	-130.00	1.30	.70	2490.00
146	RHS-2072	382839.00	1125311.00	19.00	4.97	.27	20.70	-130.00	1.20	5.60	2798.00
147	RHS-2073	382917.00	1125208.00	18.00	3.40	.38	21.10	130.00	5.80	2.30	1730.00
148	RHS-2074	382931.00	1125029.00	14.00	4.18	.75	21.00	260.00	9.90	.00	2319.00
149	RHS-2075	382931.00	1125050.00	16.00	3.52	2.45	18.80	-64.00	2.90	17.60	-39.00
150	RHS-2076	382942.00	1125049.00	15.00	10.16	1.47	20.70	.00	10.40	.00	1060.00

Table 2. Analytical Data

	ROW ID	LAT	LONG	SoilT(C)	%Moist	%CO2(p)	%O2(p)	ppbHe(p)	%CO2(s)	%O2(s)	ppbHe(s)
151	RHS-2077	382919.00	1125058.00	15.00	3.53	.71	21.10	.00	1.20	12.90	1055.00
152	RHS-2078	382908.00	1125116.00	15.00	2.80	3.12	20.40	1264.00	2.60	13.40	-38.00
153	RHS-2079	382745.00	1125228.00	15.00	5.29	.38	20.40	162.00	1.10	9.20	1681.00
154	RHS-2080	382759.00	1125249.00	15.00	2.90	.33	20.50	-64.00	.30	18.00	-39.00
155	RHS-2081	382744.00	1125313.00	15.00	4.61	.25	20.50	-32.00	.70	11.80	2281.00
156	RHS-2082	382803.00	1125328.00	14.00	4.49	2.00	20.60	-32.00	.40	10.70	808.00
157	RHS-2083	382743.00	1125356.00	15.00	3.02	.26	20.80	98.00	.70	22.50	-39.00
158	RHS-2084	382746.00	1125459.00	15.00	4.40	.41	20.30	226.00	.70	7.70	1595.00
159	RHS-2085	382808.00	1125420.00	15.00	6.51	.27	21.30	64.00	2.60	4.00	1580.00
160	RHS-2086	382746.00	1125532.00	15.00	2.00	.34	21.30	.00	.00	21.00	642.00
161	RHS-2087	382746.00	1125602.00	16.00	2.24	.22	20.40	260.00	.20	15.00	-38.00
162	RHS-2088	382811.00	1125607.00	15.00	2.89	.22	20.80	-324.00	.90	12.90	2379.00
163	RHS-2089	382811.00	1125532.00	17.00	1.51	.19	20.90	-98.00	.00	19.00	-38.00
164	RHS-2090	382834.00	1125533.00	14.00	3.84	.26	20.70	32.00	.70	10.70	723.00
165	RHS-2091	382840.00	1125602.00	15.00	3.97	.24	20.90	32.00	1.50	4.30	3247.00
166	RHS-2092	382859.00	1125607.00	11.00	2.36	.23	20.90	226.00	1.70	17.10	755.00
167	RHS-2093	382911.00	1125537.00	10.00	6.61	.22	20.70	98.00	.20	12.20	980.00
168	RHS-2094	382944.00	1125552.00	11.00	4.64	.15	20.80	260.00	1.20	9.20	1833.00
169	RHS-2095	382928.00	1125622.00	11.00	2.76	.18	21.00	.00	1.00	11.30	2135.00
170	RHS-2096	382902.00	1125638.00	11.00	3.34	.16	21.00	130.00	.80	14.00	1514.00
171	RHS-2097	382835.00	1125632.00	9.00	2.14	.15	20.90	-98.00	.30	11.10	1632.00
172	RHS-2098	382821.00	1125703.00	8.00	2.73	.17	20.90	-130.00	.70	13.00	1513.00
173	RHS-2099	382802.00	1125636.00	7.00	1.54	.25	20.90	-98.00	.10	23.40	893.00
174	RHS-2100	382755.00	1125711.00	8.00	1.98	.18	21.10	-64.00	.10	20.10	-38.00

Table 2. Analytical Data

	ROW ID	%Sand	%Silt	%Clay	montmorillonite	mica	kaolinite	quartz	feldspar	calcite
1	RHS-1001	21.10	45.20	33.80	10.00	9.00	8.00	16.00	15.00	24.00
2	RHS-1002	41.80	32.50	25.80	8.00	12.00	6.00	11.00	11.00	.00
3	RHS-1003	34.20	32.10	33.80	3.00	4.00	7.00	7.00	5.00	70.00
4	RHS-1004	62.50	19.80	17.80	3.00	10.00	6.00	3.00	3.00	.00
5	RHS-1005	51.50	31.10	17.80	.00	10.00	6.00	6.00	12.00	.00
6	RHS-1006	57.50	24.70	17.80	.00	11.00	5.00	8.00	12.00	.00
7	RHS-1007	50.80	27.40	21.80	.00	14.00	6.00	6.00	10.00	.00
8	RHS-1008	53.70	28.50	17.80	.00	11.00	5.00	6.00	10.00	.00
9	RHS-1009	54.60	27.60	17.80	.00	9.00	5.00	6.00	8.00	.00
10	RHS-1010	56.10	26.20	17.80	.00	10.00	5.00	6.00	7.00	.00
11	RHS-1011	54.10	28.20	17.80	8.00	10.00	5.00	7.00	12.00	.00
12	RHS-1012	53.00	25.20	21.80	5.00	9.00	3.00	5.00	15.00	.00
13	RHS-1013	49.00	29.30	21.80	20.00	8.00	8.00	6.00	10.00	.00
14	RHS-1014	42.60	39.70	17.80	.00	12.00	6.00	7.00	17.00	.00
15	RHS-1015	39.60	30.70	29.80	12.00	14.00	8.00	9.00	5.00	.00
16	RHS-1016	48.90	33.40	17.80	5.00	13.00	3.00	5.00	7.00	.00
17	RHS-1017	49.00	25.30	25.80	7.00	9.00	6.00	6.00	12.00	.00
18	RHS-1018	41.80	36.40	21.80	.00	17.00	7.00	10.00	6.00	2.00
19	RHS-1019	45.80	36.50	17.80	5.00	10.00	6.00	7.00	7.00	.00
20	RHS-2020	49.50	28.70	21.80	12.00	16.00	3.00	5.00	18.00	3.00
21	RHS-1021	40.00	38.20	21.80	12.00	12.00	5.00	9.00	12.00	.00
22	RHS-1022	52.10	26.20	21.80	10.00	7.00	6.00	7.00	8.00	.00
23	RHS-1023	46.60	30.60	22.90	7.00	9.00	5.00	7.00	15.00	.00
24	RHS-1024	40.10	33.00	26.90	11.00	2.00	2.00	4.00	3.00	80.00
25	RHS-1025	52.50	28.60	18.90	18.00	3.00	4.00	8.00	15.00	16.00
26	RHS-1026	47.20	25.90	26.90	24.00	5.00	3.00	7.00	12.00	59.00
27	RHS-1027	42.10	35.00	22.90	22.00	5.00	6.00	7.00	15.00	15.00
28	RHS-1028	43.60	37.60	18.90	16.00	10.00	5.00	10.00	10.00	.00
29	RHS-1029	48.00	33.10	18.90	16.00	10.00	5.00	4.00	7.00	.00
30	RHS-1030	51.80	29.30	18.90	7.00	6.00	4.00	8.00	10.00	.00
31	RHS-1031	59.00	26.10	14.90	.00	16.00	5.00	8.00	8.00	.00
32	RHS-1032	58.00	19.10	22.90	124.00	13.00	6.00	3.00	5.00	.00
33	RHS-1033	45.30	.00	55.70	100.00	8.00	6.00	2.00	5.00	15.00
34	RHS-1034	51.60	28.80	19.60	14.00	12.00	6.00	7.00	8.00	.00
35	RHS-1035	53.10	27.30	19.60	18.00	8.00	7.00	10.00	13.00	.00
36	RHS-1036	52.60	23.80	23.60	16.00	5.00	8.00	7.00	12.00	51.00
37	RHS-1037	47.90	28.50	23.60	17.00	5.00	6.00	7.00	10.00	45.00
38	RHS-1038	58.50	25.90	15.60	26.00	5.00	7.00	8.00	9.00	15.00
39	RHS-1039	47.90	32.50	19.60	23.00	10.00	6.00	8.00	12.00	.00
40	RHS-1040	36.40	40.00	23.60	41.00	7.00	7.00	8.00	20.00	.00
41	RHS-1041	44.60	31.80	23.60	22.00	7.00	7.00	8.00	8.00	.00
42	RHS-1042	46.30	34.10	19.60	3.00	3.00	1.00	7.00	14.00	50.00
43	RHS-1043	53.90	29.80	16.30	.00	13.00	5.00	8.00	10.00	.00
44	RHS-1044	49.60	30.00	20.30	8.00	8.00	5.00	12.00	30.00	.00
45	RHS-1045	46.30	25.40	28.30	34.00	5.00	7.00	10.00	18.00	14.00
46	RHS-1046	40.80	30.90	28.30	13.00	6.00	4.00	8.00	17.00	55.00
47	RHS-1047	43.20	28.40	28.30	6.00	4.00	4.00	7.00	8.00	60.00
48	RHS-1048	54.90	24.80	20.30	10.00	5.00	6.00	7.00	8.00	50.00
49	RHS-1049	43.90	31.80	24.30	12.00	5.00	5.00	11.00	17.00	.00
50	RHS-1050	58.30	21.40	20.30	21.00	9.00	5.00	10.00	15.00	.00

Table 2. Analytical Data

	ROW ID	%Sand	%Silt	%Clay	montmorillonite	mica	kaolinite	quartz	feldspar	calcite
51	RHS-1051	47.10	28.60	24.30	15.00	8.00	7.00	11.00	20.00	.00
52	RHS-1052	49.40	26.30	24.30	34.00	7.00	5.00	6.00	10.00	.00
53	RHS-1053	52.00	32.40	15.70	21.00	5.00	4.00	7.00	8.00	35.00
54	RHS-1054	42.60	41.80	15.70	29.00	10.00	5.00	9.00	20.00	28.00
55	RHS-1055	52.70	35.60	11.70	10.00	7.00	5.00	6.00	9.00	60.00
56	RHS-1056	49.40	34.90	15.70	21.00	8.00	5.00	11.00	18.00	27.00
57	RHS-1057	61.00	31.30	7.70	.00	11.00	4.00	6.00	8.00	.00
58	RHS-1058	45.60	45.20	9.20	6.00	8.00	6.00	8.00	10.00	.00
59	RHS-1059	.00B	.00B	.00B	.00B	.00B	.00B	.00B	.00B	.00B
60	RHS-1060	51.60	28.70	19.70	11.00	12.00	5.00	9.00	16.00	.00
61	RHS-1061	44.80	35.50	19.70	11.00	15.00	7.00	12.00	8.00	.00
62	RHS-1062	42.40	37.90	19.70	7.00	13.00	5.00	7.00	3.00	.00
63	RHS-1063	52.10	29.00	18.90	25.00	5.00	5.00	10.00	22.00	.00
64	RHS-1064	40.50	44.60	14.90	.00	13.00	3.00	5.00	10.00	.00
65	RHS-1065	62.40	22.70	14.90	13.00	7.00	3.00	5.00	17.00	.00
66	RHS-1066	52.40	28.50	18.90	.00	12.00	5.00	7.00	13.00	.00
67	RHS-1067	50.00	35.10	14.90	11.00	9.00	2.00	5.00	14.00	.00
68	RHS-1068	46.40	38.70	14.90	10.00	8.00	4.00	4.00	5.00	.00
69	RHS-1069	56.60	28.60	14.90	6.00	11.00	4.00	5.00	10.00	.00
70	RHS-1070	45.00	40.20	14.90	14.00	14.00	5.00	7.00	17.00	.00
71	RHS-1071	34.00	47.10	18.90	.00	13.00	7.00	12.00	3.00	.00
72	RHS-1072	47.60	33.50	18.90	23.00	15.00	7.00	8.00	10.00	.00
73	RHS-1073	43.60	40.10	16.30	13.00	14.00	6.00	9.00	10.00	.00
74	RHS-1074	45.10	34.60	20.30	8.00	11.00	5.00	11.00	18.00	.00
75	RHS-2001	47.00	38.20	14.80	12.00	24.00	16.00	32.00	16.00	.00
76	RHS-2002	64.80	20.40	14.80	5.00	15.00	10.00	35.00	30.00	.00
77	RHS-2003	55.40	29.80	14.80	.00	15.00	11.00	58.00	16.00	.00
78	RHS-2004	68.60	19.90	11.50	.00	30.00	14.00	39.00	17.00	.00
79	RHS-2005	62.60	25.90	11.50	.00	24.00	14.00	45.00	17.00	.00
80	RHS-2006	57.40	27.80	14.80	2.00	24.00	10.00	50.00	14.00	.00
81	RHS-2007	72.80	15.70	11.50	6.00	23.00	14.00	37.00	20.00	.00
82	RHS-2008	70.40	18.10	11.50	3.00	29.00	13.00	35.00	19.00	.00
83	RHS-2009	71.10	14.10	14.80	3.00	24.00	16.00	35.00	22.00	.00
84	RHS-2010	60.80	24.40	14.80	5.00	23.00	15.00	44.00	13.00	.00
85	RHS-2011	59.90	18.70	21.50	1.00	17.00	7.00	56.00	18.00	1.00
86	RHS-2012	68.10	13.70	18.10	2.00	20.00	8.00	48.00	22.00	.00
87	RHS-2013	68.60	13.20	18.10	3.00	26.00	12.00	35.00	24.00	.00
88	RHS-2014	60.40	18.10	21.50	3.00	27.00	14.00	38.00	19.00	.00
89	RHS-2015	68.10	13.70	18.10	.00	23.00	10.00	46.00	21.00	.00
90	RHS-2016	71.50	7.10	21.50	5.00	36.00	14.00	27.00	18.00	.00
91	RHS-2017	66.50	15.30	18.10	3.00	24.00	12.00	45.00	15.00	.00
92	RHS-2018	69.90	8.70	21.50	.00	31.00	11.00	37.00	20.00	.00
93	RHS-2019	68.00	13.90	18.10	1.00	20.00	10.00	57.00	9.00	2.00
94	RHS-2020	64.60	17.30	18.10	.00	31.00	11.00	39.00	19.00	.00
95	RHS-2021	67.70	12.00	20.30	.00	19.00	7.00	47.00	24.00	3.00
96	RHS-2022	79.60	3.50	16.90	6.00	28.00	11.00	36.00	19.00	.00
97	RHS-2023	68.00	11.70	20.30	2.00	20.00	8.00	52.00	18.00	.00
98	RHS-2024	70.00	13.00	16.90	.00	20.00	9.00	52.00	20.00	.00
99	RHS-2025	64.90	14.80	20.30	.00	28.00	10.00	46.00	48.00	.00
100	RHS-2026	73.30	9.80	16.90	.00	26.00	13.00	39.00	21.00	.00

Table 2. Analytical Data

	ROW ID	%Sand	%Silt	%Clay	montmorillonite	mica	kaolinite	quartz	feldspar	calcite
101	RHS-2027	56.00	20.40	23.60	.00	10.00	10.00	57.00	24.00	.00
102	RHS-2028	75.80	7.30	16.90	.00	28.00	15.00	38.00	18.00	.00
103	RHS-2029	55.70	17.40	26.90	.00	19.00	8.00	57.00	13.00	3.00
104	RHS-2030	62.60	17.10	20.30	.00	21.00	11.00	47.00	19.00	2.00
105	RHS-2031	55.50	23.60	20.90	.00	19.00	9.00	53.00	17.00	2.00
106	RHS-2032	45.50	23.70	30.90	.00	25.00	14.00	39.00	22.00	.00
107	RHS-2033	62.00	17.10	20.90	.00	32.00	14.00	32.00	23.00	.00
108	RHS-2034	67.60	11.50	20.90	3.00	14.00	6.00	31.00	14.00	33.00
109	RHS-2035	56.90	22.20	20.90	.00	18.00	8.00	57.00	18.00	.00
110	RHS-2036	54.70	24.40	20.90	.00	18.00	9.00	54.00	20.00	.00
111	RHS-2037	63.10	16.10	20.90	2.00	57.00	11.00	40.00	20.00	.00
112	RHS-2038	58.60	20.50	20.90	.00	23.00	11.00	45.00	21.00	.00
113	RHS-2039	66.20	16.30	17.50	.00	9.00	6.00	54.00	11.00	20.00
114	RHS-2040	71.90	10.50	17.50	.00	21.00	10.00	52.00	17.00	.00
115	RHS-2041	69.40	19.10	11.50	.00	6.00	10.00	20.00	6.00	58.00
116	RHS-2042	61.00	30.90	8.10	.00	21.00	10.00	51.00	18.00	.00
117	RHS-2043	65.80	22.80	11.50	2.00	4.00	5.00	25.00	4.00	61.00
118	RHS-2044	63.90	27.90	8.10	.00	6.00	6.00	74.00	9.00	4.00
119	RHS-2045	70.40	14.80	14.80	10.00	2.00	5.00	12.00	2.00	68.00
120	RHS-2046	53.10	35.50	11.50	26.00	7.00	13.00	37.00	15.00	2.00
121	RHS-2047	42.80	39.10	18.10	.00	15.00	13.00	52.00	12.00	8.00
122	RHS-2048	57.60	34.20	8.10	21.00	13.00	10.00	36.00	8.00	13.00
123	RHS-2049	66.50	25.40	8.10	4.00	21.00	17.00	38.00	21.00	.00
124	RHS-2050	69.70	22.20	8.10	.00	28.00	10.00	36.00	20.00	.00
125	RHS-2051	57.60	18.50	23.90	4.00	17.00	9.00	49.00	21.00	.00
126	RHS-2052	56.20	23.30	20.50	6.00	19.00	16.00	39.00	19.00	.00
127	RHS-2053	61.00	15.10	23.90	2.00	8.00	6.00	39.00	8.00	28.00
128	RHS-2054	61.00	18.50	20.50	8.00	28.00	21.00	45.00	17.00	.00
129	RHS-2055	75.40	5.70	18.90	8.00	22.00	17.00	37.00	15.00	.00
130	RHS-2056	58.40	21.10	20.50	4.00	13.00	10.00	45.00	12.00	17.00
131	RHS-2057	80.30	.00	20.50	4.00	15.00	12.00	48.00	15.00	6.00
132	RHS-2058	65.20	14.30	20.50	2.00	10.00	9.00	43.00	7.00	28.00
133	RHS-2059	69.00	10.50	20.50	2.00	6.00	6.00	36.00	5.00	45.00
134	RHS-2060	60.70	15.50	23.90	1.00	6.00	5.00	67.00	8.00	14.00
135	RHS-2061	66.40	14.30	19.30	.00	6.00	6.00	76.00	11.00	.00
136	RHS-2062	49.00	31.60	19.30	2.00	12.00	8.00	67.00	10.00	.00
137	RHS-2063	61.50	15.80	22.70	2.00	8.00	7.00	52.00	8.00	22.00
138	RHS-2064	63.50	13.90	22.70	2.00	8.00	7.00	71.00	12.00	.00
139	RHS-2065	61.50	15.80	22.70	2.00	15.00	11.00	56.00	15.00	.00
140	RHS-2066	68.00	14.40	17.70	5.00	11.00	14.00	58.00	14.00	.00
141	RHS-2067	64.80	12.50	22.70	2.00	3.00	4.00	30.00	5.00	56.00
142	RHS-2068	59.40	14.60	26.00	2.00	5.00	5.00	46.00	7.00	35.00
143	RHS-2069	77.50	3.20	19.30	4.00	12.00	12.00	61.00	12.00	.00
144	RHS-2070	65.60	11.70	22.70	1.00	4.00	6.00	51.00	6.00	31.00
145	RHS-2071	75.80	10.60	13.60	2.00	5.00	6.00	37.00	8.00	42.00
146	RHS-2072	70.20	16.20	13.60	3.00	8.00	8.00	58.00	11.00	12.00
147	RHS-2073	66.70	19.70	13.60	10.00	17.00	13.00	39.00	21.00	.00
148	RHS-2074	62.30	20.80	16.90	2.00	16.00	10.00	48.00	23.00	.00
149	RHS-2075	60.30	22.80	16.90	6.00	36.00	20.00	16.00	21.00	.00
150	RHS-2076	44.10	35.60	20.30	.00	20.00	12.00	53.00	15.00	.00

Table 2. Analytical Data

	ROW ID	%Sand	%Silt	%Clay	montmorillonite	mica	kaolinite	quartz	feldspar	calcite
151	RHS-2077	47.80	35.30	16.90	3.00	14.00	9.00	55.00	20.00	.00
152	RHS-2078	59.80	26.60	13.60	.00	21.00	8.00	54.00	17.00	.00
153	RHS-2079	62.20	24.20	13.60	2.00	4.00	7.00	58.00	8.00	.00
154	RHS-2080	63.30	23.10	13.60	.00	10.00	9.00	68.00	13.00	.00
155	RHS-2081	72.70	10.40	16.90	2.00	7.00	7.00	73.00	12.00	.00
156	RHS-2082	74.70	8.40	16.90	1.00	11.00	10.00	56.00	12.00	.00
157	RHS-2083	65.30	14.50	20.30	1.00	12.00	8.00	63.00	15.00	.00
158	RHS-2084	63.10	16.60	20.30	1.00	8.00	7.00	73.00	11.00	.00
159	RHS-2085	65.80	10.60	23.60	2.00	13.00	11.00	57.00	17.00	.00
160	RHS-2086	64.90	18.20	16.90	.00	15.00	9.00	61.00	15.00	.00
161	RHS-2087	73.90	9.20	16.90	.00	12.00	7.00	66.00	15.00	.00
162	RHS-2088	71.40	11.70	16.90	.00	13.00	9.00	62.00	15.00	.00
163	RHS-2089	76.40	10.00	13.60	.00	21.00	12.00	54.00	12.00	.00
164	RHS-2090	70.40	9.40	20.30	.00	8.00	7.00	71.00	14.00	.00
165	RHS-2091	56.20	25.20	18.60	.00	6.00	5.00	78.00	11.00	.00
166	RHS-2092	68.70	17.70	13.60	1.00	15.00	11.00	59.00	14.00	.00
167	RHS-2093	67.20	14.20	18.60	2.00	5.00	7.00	53.00	11.00	21.00
168	RHS-2094	67.40	14.00	18.60	3.00	11.00	8.00	65.00	14.00	.00
169	RHS-2095	76.60	8.10	15.30	4.00	7.00	7.00	76.00	10.00	.00
170	RHS-2096	66.70	18.10	15.30	.00	4.00	7.00	75.00	13.00	.00
171	RHS-2097	82.90	1.80	15.30	2.00	15.00	11.00	49.00	13.00	11.00
172	RHS-2098	76.40	8.30	15.30	.00	11.00	10.00	66.00	13.00	.00
173	RHS-2099	68.10	16.60	15.30	.00	16.00	7.00	57.00	20.00	.00
174	RHS-2100	71.10	10.30	18.60	.00	8.00	4.00	75.00	13.00	.00