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# ANALYTICAL RESULTS FOR MONITORED SOIL-GAS CONCENTRATIONS (1991-1992) AND FOR ANALYSES OF SOIL SAMPLES COLLECTED AT THE KOKOMO MINE, CENTRAL CITY, COLORADO

By

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## ABSTRACT

In this study, variations of soil-gas concentrations were monitored within a mineralized area to see how these concentrations differ from soil-gas concentrations in nonmineralized areas. Concentrations of $N_2$, $O_2$, $CO_2$, and He in soil gases were monitored, along with soil and air temperatures, for a period of several months at sites along two traverses over a precious- and base-metal-bearing quartz vein at the Kokomo mine, near Central City, Colorado. Soil samples were collected and anlyzed for elemental content, in order to study the geochemical processes that produce and affect soil-gas constituents.

Soil-gas concentrations at the Kokomo mine were affected by the same environmental conditions as soil gases in nonmineralized areas. Concentrations of the gases were affected primarily by soil moisture and secondarily by soil and air temperatures. Because snow and snow-melt caused significantly decreased soil-gas concentrations in the winter and early spring, only summertime soil-gas concentrations were considered to be useful for geochemical studies at the Kokomo mine.

## INTRODUCTION

Concentrations of $N_2$, $O_2$, $CO_2$, and He in soil gases have been measured and meteorological parameters monitored on a long-term basis at several nonmineralized sites in both dry and humid environments (Hinkle, 1994). The purpose of these studies was to better understand the effects of environmental conditions on concentrations of soil gas components used to study geochemical processes over and near mineral deposits and geothermal resources. Results of the long-term monitoring studies indicated that soil moisture and soil and air temperatures have the greatest impact on soil-gas concentrations. High soil moisture tends to either flush gases from the soil pores or to dissolve the gases; the effect in both cases is decreased concentration of gases in the soil. Increased concentrations of soil-gas $CO_2$ generally occur with increased soil temperature in summer, whereas He concentrations generally decline as soil temperature increases (Hinkle, 1994).

The present study was undertaken to observe variations of soil-gas concentrations within a mineralized area to see how these concentrations differ from soil-gas concentrations in nonmineralized areas. In this study, concentrations of $N_2$, $O_2$, $CO_2$, and He in soil gases were monitored for a period of several months at sites along two traverses over a precious- and base-metal-bearing quartz vein at the Kokomo mine near Central City, Colorado (fig. 1). Soil samples were collected and anlyzed for elemental compositions in order to study the geochemical processes that produce and affect soil-gas constituents.

The Kokomo mine was selected for this study because geological information exists about the vein-system at the mine and because the site was currently under study by the U.S. Geological Survey (Smith and others, 1993). The Kokomo mine is in the Central City Mining District within the central part of the Front Range mineral belt. The mine was developed on one of the veins of the Frontenac-Aduddell-Druid-Kokomo vein system. The Kokomo vein contains gold and silver in pyrite or enargite, along with galena and sphalerite (Bastin and Hill, 1917). The vein is covered with 3m of colluvial soil and weathered bedrock in the area studied.

## SAMPLE COLLECTION

Thirteen sites were used for soil-gas monitoring. Ten sites along traverses used for the CHIM electrogeochemical-method study (Smith and others, 1993) were selected for monitoring; seven of the sites were located along CHIM traverse-1 and three sites were along CHIM traverse-2. Three additional sites were located at a 3m deep trench that was excavated parallel to traverse-1 for the CHIM study. The trench sites were at (1) the top of the tench, about 5m west of the mid-point of traverse-1, (2) within the side of the trench at approximately 1.3m depth, and (3) at the bottom of the trench at 2.8m depth near the side of a tunnel excavated in the 1890's to remove ore (the top of the tunnel lay less than 1m beneath the trench).

The hollow probes used in the study were described by Reimer and Bowles (1979) and have been widely used for collecting soil-gas samples. The probes were driven into the ground by means of a sliding hammer attached to the shaft of the probe. After the probe was driven into the ground, it was fitted with an airtight cap and septum for withdrawal of the soil-gas sample. A PVC pipe was placed over the probe and cap, and the pipe was covered with an inverted plastic beaker to protect the probe from the weather. The probes were left in place for the duration of the monitoring study. Soil-gas samples were collected periodically from late July 1991, until September 1992.

Before removal of the first sample 10 mL of air were withdrawn from the probe to remove air introduced when the probe was emplaced in the ground; 10 mL of air were also removed from the probe whenever the rubber septum was changed. All soil-gas samples, except those collected on the first day, had equilibrated for at least several days before collection. 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 the soil gas. The soil-gas samples were transferred to 5-mL evacuated blood-sampling vials for storage by inserting the needle of the syringe containing the gas sample through the rubber cap of the evacuated vial 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 vials for as long as 2 months without leakage (Hinkle and Kilburn, 1979).

Air temperature was measured using a dial-type metal thermometer attached to the inside of the PVC pipe over the probe located at the mid-point of traverse-1. Soil-temperature was measured at the same site, using a second dial-type metal thermometer emplaced in the ground with the tip of the thermometer stem at about 20-cm depth. Only a few measurements of relative humidity and barometric pressure were taken at the beginning of the monitoring period before the gauges malfunctioned; those measurements are not listed in this report.

In addition to the soil-gas and temperature measurements, a total of 38 surficial soil samples were collected at the sites. Soil samples were collected at the 13 monitoring sites in September 1992. In September 1993, a set of 25 soil-gas samples was collected at 5 m spacings, at sites established for the CHIM studies along traverse-1 (including the seven monitoring sites along this traverse).The soil samples were collected at approximately 5-10 cm depth, after scraping away debris on the ground surface.

## SAMPLE ANALYSIS

All the gas samples were analyzed within one week after collection. Gas in the vials was removed by injecting 5 mL 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 mass spectrometry (Reimer and Denton, 1978). Standard samples of air containing known concentrations of He were analyzed several times per day to ensure stability of the instrument. Concentrations of He were reported as variations from the concentrations of He in air (5,240 ppb) (Glueckhauf, 1946; Oliver and others, 1984). The reproducibility of measurement was ± 10 ppb. The tubes used for sample storage were approximately 80 percent evacuated. They contained a residual concentration of He 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 the soil gas.

Soil-gas samples were analyzed for $N_2$, $O_2$, and $CO_2$ using gas chromatography; operating conditions for the gas chromatograph are shown in table 1. Concentrations of $N_2$, $O_2$, and $CO_2$ were measured compared to standard curves and are reported as volume percents. Standard samples containing known concentrations of the gases were analyzed several times per day to ensure stability of the instrument.

Soil samples were prepared by sieving to -80 mesh (<180 um) and then pulverizing to -100 mesh (<150um). The soils were subjected to particle-size analysis to determine the contents of sand, silt, and clay, using the hydrometer methods of Day (1965) and Grigal (1973). The sand fraction was determined by weight, the suspended clay fraction by the hydrometer reading, and the silt fraction by difference.

The methods used for elemental analyses and the lower limits of determination are summarized in table 2. The soil samples were analyzed for hydrogen-ion content by pH analysis. Organic-carbon content was measured as the difference between the total carbon and carbonate carbon contents. The samples were analyzed for total element composition by an Induction-Coupled Plasma (ICP) method. They were also analyzed by a partial-analysis ICP method that isolates and measures the secondary oxide-related metallic-element content of the sample; metal content related to the silicate lattice of common rock-forming minerals is not measured by the partial-analysis technique. Lower limits of determination for the ICP methods are listed in tables 3a and 3b. The samples were also analyzed for mercury content (lower limit of determination = 0.02 ppm).

## DESCRIPTION OF THE DATA TABLES

Data from all the analyses were entered into an IBM personal computer and stored on a disk, using STATPAC programs developed for personal computers by Grundy and Miesch (1988). Table 4 includes data for all soil-gas measurements: date of sample collection, air temperature, soil temperature at 20-cm depth ($^0$C), and volume/volume concentrations of $N_2$ (%), $O_2$ (%), $CO_2$ (%), and He (ppb) at each site.

On occasions when heavy rain or melted snow saturated the ground so that no soil gas could be extracted at a site, the soil-gas concentrations are shown as zeros. A blank space indicates that no measurement was made for that particular variable. Table 4 also contains average and standard deviation values of the measurements for the individual sites. Year-around, summer-only, and winter-only concentration averages are listed because summer and winter concentrations of different soil gases vary on a seasonal basis (Hinkle, 1994).

Data from the analyses of the soil samples are listed in table 5. Measurements of soil gases collected in September 1993 and summertime average concentrations of all the soil-gas samples collected at the monitored sites from 1991 through 1993 are also listed. A blank space indicates that no analysis was performed for that particular variable (generally because no sample was collected or because of insufficient sample).

Data shown in tables 4 and 5 are in .WQ1 Quattro-Pro format (Borland International, Inc.). These tables are presented in the .WQ1 format and also in the more generic U.S. Geological Survey .stp format (Grundy and Miesch, 1988) on the disk accompanying the report. The data may be easily converted from .stp into other formats by use of the STP2DAT conversion program included on the disk. The conversion of Quattro-Pro to .stp format for the disk required several changes in data presentation: (1) Labels were contracted in order to fit into eight-digit spaces; for example, site 1-65S (1993) became 165S(93), Trench Top became TrTop, and N2 + O2 became N2O2. (2) Seasonal averages, standard deviations, and footnotes are not included on the disk. (3) The blank spaces denoting no analysis became the letter "B", and concentrations below the limit of detection became the letter "L" plus the value of the lowest level of detection (tables 3a and 3b).

## RESULTS

Soil-gas concentrations at the Kokomo mine were affected by the same environmental conditions that affect soil gases in nonmineralized areas. Concentrations of the gases were affected primarily by soil moisture and secondarily by soil and air temperatures. For example, no soil gases could be extracted from some of the sites during the winter and early spring months when approximately 0.5 m of snow covered the ground. Frozen soil moisture or melted snow probably saturated the ground and flushed out soil gases at these sites.

A plot of the sum of N2 + O2 in soil gases versus the hydrogen-ion content of the soil shows an inverse relationship, especially near the Kokomo vein (site 00) and in the vicinity of site 30N where there is evidence for sulfide mineralization (fig. 2) (Smith and others, 1993). Higher hydrogen-ion concentrations in soils over the veins is evidence for oxidation of sulfide minerals; rain water containing dissolved air enters the rock through fractures associated with mineral emplacement and oxidizes the sulfide minerals to sulfuric acid, which increases the hydrogen-ion content in the overlying soil. The water-filled fractures prevent the entry of atmospheric air, resulting in anomalously low sums of $N_2$ + $O_2$ over the fractured rock.

Average concentrations of $CO_2$ were highest during the summer and dropped to nearly zero at most sites during the winter; figure 3 shows these measurements at site 1-00, which is directly over the Kokomo vein at the mid-point of traverse-1. Hinkle (1994) noted that $CO_2$ concentrations in soil gas are essentially nil when soil and air temperatures are below $10^0$ C, probably due to lack of bacterial activity at low temperatures. Average summer concentrations of $CO_2$ were highest directly over the vein (site 0) and were also high at site 35N near an anomaly noted by the CHIM studies (Smith and others, 1993).

Average concentrations of He were higher during the winter than during the summer, as is typical of nonmineralized areas (Hinkle, 1994). However, the He concentrations were more variable than in nonmineralized areas. Summer He concentrations were highest in a wide region south and north of the Kokomo vein.

Because soil and snow-melt caused significantly decreased soil-gas concentrations in the winter and early spring, only the summer concentrations were considered to be useful for soil-gas geochemical studies at the Kokomo mine. Therefore, table 4 lists only the summertime soil-gas concentrations for comparison with element concentrations.

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## REFERENCES CITED


Bastin, E.S., and Hill, J.M., 1917, Economic geology of Gilpin County and adjacent parts of Clear Creek and Boulder Counties, Colorado: U.S. Geological Survey Professional Paper 94, 379 p.

Brandt, Elaine, Aruscavage, Phillip, and Papp, Clara, 1990, Determination of carbonate carbon in geologic materials by coulmoetric titration, in Arbogast, B.F., ed., Quality assurance manual for the Branch of Geochemistry: U.S. Geological Survey Open-File Report 90-668, p. 68-72.

Briggs, Paul, 1990, Elemental analysis of geological material by inductively coupled plasma-atomic emission spectrometry, in Arbogast, B.F., ed., Quality assurance manual for the Branch of Geochemistry: U.S. Geological Survey Open-File Report 90-668, p. 83-91.

Curry, K.J., 1990, Determination of total carbon in geologic materials by combustion, in Arbogast, B.F., ed., Quality assurance manual for the Branch of Geochemistry: U.S. Geological Survey Open-File Report 90-668, p. 114-118.

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.

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.

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.

Grundy, W.D., and Miesch, A.T., 1988, Brief descriptions of STATPAC and related statistical programs for the IBM Personal Computer: U.S. Geological Survey Open-File Report 88-411-A, 34 p.

Hinkle, M.E., 1994, Environmental conditions affecting concentrations of He, $CO_2$, $O_2$, and $N_2$ in soil gases: Journal of Applied Geochemistry, v. 9, no. 1, p. 53-63.

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.

Jackson, M.L., 1958, Soil chemical analysis: Englewood Cliffs, NJ, Prentic-Hall, p. 41-48.

Motooka, Jerry, 1990, Organometallic halide extraction applied to the analysis of geologic materials for 10 elements by inductively coupled plasma-atomic emission spectrometry, in Arbogast, B.F., ed., Quality assurance manual for the Branch of Geochemistry: U.S. Geological Survey Open-File Report 90-668, p. 92-96.

O'Leary, R.M., Crock, J.G., and Kennedy, K.R., 1990, Determination of mercury in geologic materials by continuous flow-cold vapor-atomic absorption spectrophotometry, in Arbogast, B.F., ed., Quality assurance manual for the Branch of Geochemistry: U.S. Geological Survey Open-File Report 90-668, p. 60-67.

Oliver, B.M., Bradley, J.G., and Farrar, Harry IV, 1984, Helium concentration in the Earth's lower atmosphere: Geochmicia et Cosmochimica Acta, v. 48, p. 1759-1767.

Reimer, G.M., 1979, The use of soil-gas helium concentrations for earthquake prediction: Studies of factors causing diurnal variation: U.S. Geological Survey Open-File Report 79-1623, 68 p.

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.

Smith, D.B., Hoover D.B., and Sanzolone, R.F., 1993, Preliminary studies of the CHIM electrogeochemical method at the Kokomo Mine, Russell Gulch, Colorado: Journal of Geochemical Exploration, v. 46, no.3, p. 257-278.

Tooker, E.W., 1963, Altered wall rocks in the central part of the Front Range mineral belt, Gilpin and Clear Creek Counties, Colorado: U.S. Geological Survey Professional Paper 439, 102 p.

Table 1. Operating conditions for the gas chromatograph

($^{0}C$ = degrees Celsius; mL = milliliter; in. = inches, % = percent)

| | |
|---|---|
| Type of gas chromatograph | Carle AGC-100 |
| Detector | thermistor detector |
| Lower limit of detection | 1% $N_2$ or $O_2$, 0.03% $CO_2$ |
| Reproducibility | ± 5% |
| Column | concentric stainless steel, |
| | outer column 72 in. x 1/4 in. |
| | molecular sieve |
| | inner column 72 in. x 1/8 in. |
| | porapak mixture |
| Carrier gas | helium at 60 mL/minute |
| Temperature | column: $60^{0}$ C |
| | detector: "low" mode |

Table 2. Analytical methods used for the soil samples.

| Analytical Method | Reference |
| --- | --- |
| Hydrogen ion | Jackson (1958) |
| Hg | O'Leary and others (1990) |
| ICP-total | Briggs (1990) |
| ICP-partial extraction | Motooka (1990) |
| Organic carbon (difference between total carbon and carbonate carbon | Brandt and others (1990) and Curry (1990) |

Table 3a. ICP-AES Detection Limits for 40 Elements

| Element | Lower Limit of Determination |
| --- | --- |
| Al | % .005 |
| Ca | % .005 |
| Fe | % .005 |
| K | % .05 |
| Mg | % .005 |
| Na | % .005 |
| P | % .005 |
| Ti | % .005 |
| Ag | ppm 2 |
| As | ppm 10 |
| Au | ppm 8 |
| Ba | ppm 1 |
| Be | ppm 1 |
| Bi | ppm 10 |
| Cd | ppm 2 |
| Ce | ppm 4 |
| Co | ppm 1 |
| Cr | ppm 1 |
| Cu | ppm 1 |
| Eu | ppm 2 |
| Ga | ppm 4 |
| Ho | ppm 4 |
| La | ppm 2 |
| Li | ppm 2 |
| Mn | ppm 4 |
| Mo | ppm 2 |
| Nb | ppm 4 |
| Nd | ppm 4 |
| Ni | ppm 2 |
| Pb | ppm 4 |
| Sn | ppm 5 |
| Sc | ppm 2 |
| Sr | ppm 2 |
| Ta | ppm 40 |
| Th | ppm 4 |
| U | ppm 100 |
| V | ppm 2 |
| Y | ppm 2 |
| Yb | ppm 1 |
| Zn | ppm 2 |

Table 3b. ICP-AES Detection Limits for 10 Elements: Partial-Extraction Method. (These elements have the prefix "x" in tables 4 and 5).

| Element | Lower Limit of Determination |
| --- | --- |
| Ag | ppm 0.045 |
| As | ppm 0.600 |
| Au | ppm 0.100 |
| Bi | ppm 0.670 |
| Cd | ppm 0.050 |
| Cu | ppm 0.050 |
| Mo | ppm 0.090 |
| Pb | ppm 0.600 |
| Sb | ppm 0.670 |
| Zn | ppm 0.050 |

Table 4. Soil Gas Concentrations (1991-1993)

| | Air | Soil | ***** | ***** | 1-65S | ***** | ***** | +++++ | +++++ | 1-45S | +++++ | +++++ | ***** | ***** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Temp(C) | Temp(C) | N2(%) | O2(%) | N2+O2(%) | CO2(%) | He(ppb) | N2(%) | O2(%) | N2+O2(%) | CO2(%) | He(ppb) | N2(%) | O2(%) |
| 07/25/91 | (1) | | | | | | | | | | | | | |
| 08/14/91 | 13.0 | 12.0 | 62 | 17 | 80 | 0.57 | 5560 | 63 | 17 | 80 | 0.84 | 5526 | 66 | 18 |
| 08/15/91 | 18.0 | 12.0 | 61 | 17 | 78 | 0.51 | 5492 | 58 | 16 | 74 | 0.68 | 5560 | 55 | 15 |
| 08/22/91 | 14.0 | 12.0 | 62 | 17 | 79 | 0.44 | 5526 | 61 | 17 | 77 | 0.68 | 5494 | 63 | 17 |
| 08/29/91 | 12.0 | 11.5 | 59 | 17 | 75 | 0.35 | 5310 | 56 | 16 | 72 | 0.42 | 5400 | 62 | 17 |
| 09/04/91 | 12.0 | 12.0 | 70 | 20 | 89 | 0.48 | 5634 | 59 | 16 | 75 | 0.42 | 5454 | 58 | 16 |
| 09/10/91 | 9.0 | 11.5 | 61 | 17 | 78 | 0.15 | 5490 | 59 | 17 | 76 | 0.17 | 5274 | 58 | 16 |
| 09/19/91 | 0.0 | 6.0 | 74 | 21 | 95 | 0.44 | 5490 | 74 | 21 | 95 | 0.48 | 5598 | 74 | 21 |
| 09/25/91 | 4.0 | 7.0 | 64 | 18 | 82 | 0.31 | 5316 | 71 | 20 | 90 | 0.48 | 5280 | 75 | 21 |
| 10/02/91 | 9.0 | 8.0 | 59 | 16 | 75 | 0.20 | 5316 | 53 | 14 | 68 | 0.24 | 5352 | 61 | 17 |
| 10/09/91 | 6.0 | 6.0 | 56 | 15 | 71 | 0.13 | 5336 | 69 | 19 | 89 | 0.31 | 5210 | 64 | 18 |
| 10/17/91 | 11.0 | 8.0 | 57 | 16 | 73 | 0.15 | 5224 | 62 | 17 | 80 | 0.26 | 5316 | 72 | 20 |
| 10/23/91 | 6.0 | 6.0 | 54 | 15 | 69 | 0.13 | 5316 | 60 | 17 | 77 | 0.22 | 5316 | 57 | 16 |
| 11/13/91 | 6.0 | 2.0 | 62 | 17 | 79 | 0.13 | 5100 | 64 | 18 | 82 | 0.26 | 5016 | 73 | 21 |
| 12/10/91 | 6.0 | -1.0 | 68 | 19 | 87 | 0.15 | 5100 | 68 | 19 | 87 | 0.20 | 5100 | 68 | 19 |
| 01/31/92 | 4.0 | -2.0 | 56 | 16 | 71 | 0.09 | 5346 | 47 | 13 | 60 | 0.07 | 5270 | 52 | 14 |
| 02/21/92 | 0.0 | -2.0 | 68 | 19 | 87 | 0.22 | 5288 | 59 | 17 | 76 | 0.09 | 5288 | 67 | 19 |
| 03/20/92 | -5.0 | -2.0 | 56 | 16 | 72 | 0.09 | 5414 | 69 | 19 | 88 | 0.13 | 5330 | 61 | 17 |
| 04/10/92 | 6.0 | 0.0 | 73 | 21 | 93 | 0.31 | 5040 | 42 | 1 | 43 | 0.02 | 5160 | 44 | 12 |
| 04/30/92 | 13.0 | 6.0 | 51 | 14 | 65 | 0.18 | 5000 | 62 | 17 | 79 | 0.37 | 5280 | 61 | 17 |
| 05/22/92 | 6.0 | 8.0 | 56 | 16 | 72 | 0.15 | 5346 | 61 | 17 | 78 | 0.33 | 5266 | 71 | 20 |
| 06/12/92 | 9.0 | 7.0 | 61 | 17 | 78 | 0.20 | 5306 | 57 | 15 | 72 | 0.40 | 5466 | 71 | 20 |
| 06/23/92 | 16.0 | 12.0 | 57 | 16 | 73 | 0.22 | 5160 | 68 | 17 | 85 | 0.51 | 5126 | 59 | 16 |
| 07/10/92 | 10.0 | 12.5 | 66 | 19 | 85 | 0.31 | 5188 | 72 | 20 | 92 | 0.64 | 5104 | 75 | 21 |
| 08/12/92 | 10.0 | 11.0 | 77 | 22 | 99 | 0.44 | 5400 | 79 | 22 | 102 | 0.35 | 5400 | 66 | 18 |
| 09/17/92 | 9.0 | 10.0 | 70 | 20 | 90 | 0.31 | 5060 | 77 | 22 | 99 | 0.59 | 5300 | 68 | 19 |
| 09/01/93 | | | 67 | 17 | 84 | 0.16 | 5586 | 78 | 20 | 98 | 0.37 | 5348 | 72 | 18 |
| Average-All Values | 7.8 | 6.9 | 63 | 17 | 80 | 0.26 | 5321 | 63 | 17 | 80 | 0.37 | 5317 | 64 | 18 |
| Std.Dev.-All Values | 5.3 | 4.9 | 7 | 2 | 9 | 0.14 | 172 | 9 | 4 | 12 | 0.20 | 144 | 8 | 2 |
| Average-Summer (2) | 10.3 | 11.1 | 66 | 18 | 84 | 0.26 | 5321 | 67 | 18 | 85 | 0.51 | 5382 | 65 | 18 |
| Std.Dev.-Summer | 5.3 | 1.7 | 6 | 2 | 8 | 0.13 | 178 | 8 | 2 | 11 | 0.18 | 153 | 6 | 2 |
| Average-Winter (3) | -0.3 | -2.0 | 60 | 17 | 77 | 0.13 | 5349 | 58 | 16 | 75 | 0.10 | 5296 | 60 | 17 |
| Std.Dev.-Winter | 3.7 | 0.0 | 6 | 2 | 7 | 0.06 | 51 | 9 | 3 | 12 | 0.02 | 25 | 6 | 2 |

(1)Blank=no analysis

(2) Summer =
June 21- Sept. 21

(3) Winter =
Dec. 21 - March 21

Table 4. Soil Gas Concentrations (1991-1993)

| | 1-25S | ***** | ***** | +++++ | +++++ | 1-00 | +++++ | +++++ | ***** | ***** | 1-25N | ***** | ***** | +++++ | +++++ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | N2+O2(%) | CO2(%) | He(ppb) | N2(%) | O2(%) | N2+O2(%) | CO2(%) | He(ppb) | N2(%) | O2(%) | N2+O2(%) | CO2(%) | He(ppb) | N2(%) | O2(%) |
| 07/25/91 | | | | | | | | | | | | | | | |
| 08/14/91 | 84 | 0.86 | 5492 | 62 | 17 | 79 | 1.12 | 5560 | 61 | 17 | 77 | 0.75 | 5492 | 58 | 16 |
| 08/15/91 | 70 | 0.57 | 5424 | 61 | 17 | 77 | 0.99 | 5526 | 62 | 17 | 79 | 0.79 | 5458 | 62 | 17 |
| 08/22/91 | 80 | 0.68 | 5662 | 62 | 17 | 79 | 1.03 | 5900 | 61 | 17 | 78 | 0.66 | 5662 | 55 | 15 |
| 08/29/91 | 79 | 0.42 | 5400 | 63 | 17 | 80 | 0.77 | 5010 | 59 | 16 | 75 | 0.48 | 5310 | 67 | 19 |
| 09/04/91 | 74 | 0.37 | 5418 | 60 | 17 | 76 | 0.62 | 5454 | 56 | 16 | 72 | 0.46 | 5526 | 63 | 18 |
| 09/10/91 | 75 | 0.37 | 5490 | 60 | 17 | 76 | 0.51 | 5562 | 62 | 17 | 79 | 0.44 | 5490 | 56 | 16 |
| 09/19/91 | 95 | 0.55 | 5454 | 72 | 20 | 92 | 0.73 | 5346 | 61 | 17 | 78 | 0.42 | 5418 | 68 | 19 |
| 09/25/91 | 96 | 0.48 | 5244 | 69 | 19 | 87 | 0.59 | 5352 | 74 | 21 | 95 | 0.59 | 5352 | 65 | 18 |
| 10/02/91 | 77 | 0.33 | 5316 | 59 | 16 | 75 | 0.35 | 5280 | 59 | 16 | 75 | 0.37 | 5280 | 63 | 17 |
| 10/09/91 | 81 | 0.22 | 5210 | 59 | 16 | 75 | 0.26 | 5252 | 58 | 16 | 74 | 0.22 | 5252 | 61 | 17 |
| 10/17/91 | 92 | 0.37 | 5316 | 68 | 17 | 85 | 0.26 | 5270 | 69 | 17 | 86 | 0.26 | 5316 | 58 | 16 |
| 10/23/91 | 72 | 0.22 | 5224 | 62 | 17 | 79 | 0.26 | 5362 | 63 | 17 | 81 | 0.26 | 5362 | 63 | 18 |
| 11/13/91 | 94 | 0.22 | 5058 | 65 | 18 | 83 | 0.18 | 4974 | 65 | 18 | 82 | 0.22 | 5100 | 59 | 16 |
| 12/10/91 | 87 | 0.13 | 5058 | 72 | 20 | 92 | 0.18 | 5058 | 62 | 18 | 80 | 0.15 | 5100 | 63 | 17 |
| 01/31/92 | 66 | 0.04 | 5194 | 55 | 15 | 70 | 0.07 | 5270 | 57 | 16 | 73 | 0.07 | 5308 | 61 | 17 |
| 02/21/92 | 86 | 0.15 | 5288 | 60 | 17 | 76 | 0.09 | 5288 | 58 | 16 | 74 | 0.09 | 5330 | 59 | 16 |
| 03/20/92 | 78 | 0.09 | 5330 | 60 | 17 | 77 | 0.11 | 5540 | 55 | 15 | 70 | 0.11 | 5330 | 58 | 16 |
| 04/10/92 | 56 | 0.00 | 5040 | 0 | 0 | 0 | 0.00 | 0 | 63 | 18 | 80 | 0.24 | 5040 | 52 | 14 |
| 04/30/92 | 77 | 0.22 | 5200 | 63 | 18 | 81 | 0.26 | 5160 | 67 | 19 | 85 | 0.24 | 5160 | 65 | 18 |
| 05/22/92 | 91 | 0.26 | 5306 | 63 | 17 | 80 | 0.40 | 5226 | 56 | 16 | 72 | 0.18 | 5346 | 73 | 21 |
| 06/12/92 | 90 | 0.44 | 5386 | 63 | 17 | 80 | 0.59 | 5306 | 72 | 20 | 93 | 0.51 | 5426 | 72 | 20 |
| 06/23/92 | 76 | 0.24 | 5126 | 57 | 16 | 73 | 0.48 | 5058 | 69 | 18 | 86 | 0.33 | 5092 | 65 | 18 |
| 07/10/92 | 96 | 0.48 | 5314 | 75 | 21 | 96 | 0.92 | 5356 | 68 | 19 | 87 | 0.44 | 5188 | 71 | 20 |
| 08/12/92 | 84 | 0.40 | 5000 | 73 | 20 | 93 | 0.73 | 5120 | 74 | 21 | 95 | 0.51 | 5400 | 68 | 19 |
| 09/17/92 | 87 | 0.55 | 5540 | 77 | 22 | 99 | 0.88 | 5260 | 71 | 20 | 91 | 0.46 | 5540 | 72 | 20 |
| 09/01/93 | 90 | 0.22 | 5400 | 73 | 19 | 92 | 0.42 | 5580 | 78 | 20 | 98 | 0.33 | 5652 | 74 | 19 |
| Average-All Values | 82 | 0.34 | 5303 | 62 | 17 | 79 | 0.49 | 5118 | 64 | 18 | 81 | 0.37 | 5343 | 63 | 18 |
| Std.Dev.-All Values | 10 | 0.20 | 163 | 14 | 4 | 17 | 0.32 | 1044 | 6 | 2 | 8 | 0.19 | 163 | 6 | 2 |
| Average-Summer (2) | 82 | 0.48 | 5393 | 62 | 18 | 84 | 0.77 | 5394 | 65 | 18 | 83 | 0.51 | 5436 | 65 | 18 |
| Std.Dev.-Summer | 8 | 0.17 | 171 | 7 | 2 | 9 | 0.22 | 246 | 6 | 2 | 8 | 0.14 | 163 | 6 | 2 |
| Average-Winter (3) | 77 | 0.09 | 5271 | 58 | 16 | 74 | 0.09 | 5366 | 57 | 16 | 72 | 0.09 | 5323 | 59 | 16 |
| Std.Dev.-Winter | 8 | 0.04 | 57 | 2 | 1 | 3 | 0.02 | 123 | 1 | 0 | 2 | 0.02 | 10 | 1 | 0 |

(1)Blank=no analysis

(2) Summer =
June 21- Sept. 21

(3) Winter =
Dec. 21 - March 21

Table 4. Soil Gas Concentrations (1991-1993)

| | 1-45N | +++++ | +++++ | ***** | ***** | 1-65N | ***** | ***** | +++++ | +++++ | 2-45S | +++++ | +++++ | ***** | ***** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | N2+02(%) | C02(%) | He(ppb) | N2(%) | 02(%) | N2+02(%) | C02(%) | He(ppb) | N2(%) | 02(%) | N2+02(%) | C02(%) | He(ppb) | N2(%) | 02(%) |
| 07/25/91 | | | | | | | | | 65 | 18 | 77 | 0.51 | | 66 | 18 |
| 08/14/91 | 74 | 0.46 | 5594 | 57 | 16 | 73 | 0.35 | 5492 | 60 | 17 | 80 | 0.51 | 5560 | 61 | 17 |
| 08/15/91 | 80 | 0.44 | 5594 | 63 | 18 | 81 | 0.53 | 5492 | 62 | 17 | 80 | 0.59 | 5560 | 71 | 20 |
| 08/22/91 | 71 | 0.31 | 5662 | 62 | 17 | 80 | 0.44 | 5628 | 63 | 17 | 79 | 0.51 | 5424 | 62 | 17 |
| 08/29/91 | 86 | 0.40 | 5220 | 56 | 16 | 72 | 0.29 | 5370 | 61 | 17 | 82 | 0.44 | 5370 | 59 | 16 |
| 09/04/91 | 80 | 0.31 | 5310 | 61 | 17 | 78 | 0.35 | 5526 | 64 | 18 | 79 | 0.37 | 5526 | 68 | 19 |
| 09/10/91 | 72 | 0.24 | 5490 | 61 | 17 | 78 | 0.31 | 5310 | 62 | 17 | 75 | 0.33 | 5526 | 66 | 19 |
| 09/19/91 | 87 | 0.40 | 5238 | 62 | 17 | 79 | 0.26 | 5490 | 59 | 16 | 86 | 0.29 | 5310 | 58 | 16 |
| 09/25/91 | 83 | 0.31 | 5244 | 79 | 22 | 101 | 0.40 | 5316 | 68 | 19 | 80 | 0.42 | 5352 | 73 | 20 |
| 10/02/91 | 80 | 0.24 | 5316 | 58 | 16 | 74 | 0.22 | 5280 | 62 | 17 | 86 | 0.29 | 5280 | 59 | 16 |
| 10/09/91 | 78 | 0.22 | 5294 | 63 | 18 | 81 | 0.20 | 5252 | 67 | 19 | 81 | 0.22 | 5252 | 59 | 16 |
| 10/17/91 | 74 | 0.15 | 5132 | 66 | 18 | 84 | 0.18 | 5316 | 63 | 18 | 90 | 0.22 | 5224 | 59 | 16 |
| 10/23/91 | 81 | 0.18 | 5336 | 63 | 17 | 80 | 0.22 | 5252 | 70 | 20 | 84 | 0.29 | 5252 | 62 | 17 |
| 11/13/91 | 76 | 0.13 | 5016 | 63 | 18 | 80 | 0.11 | 4932 | 66 | 18 | 95 | 0.18 | 5142 | 62 | 17 |
| 12/10/91 | 80 | 0.11 | 5016 | 67 | 19 | 86 | 0.11 | 5142 | 74 | 21 | 69 | 0.20 | 5016 | 72 | 20 |
| 01/31/92 | 78 | 0.07 | 5270 | 67 | 19 | 86 | 0.09 | 5156 | 54 | 15 | 86 | 0.07 | 5346 | 58 | 16 |
| 02/21/92 | 75 | 0.09 | 5372 | 58 | 16 | 75 | 0.07 | 5330 | 67 | 19 | 85 | 0.11 | 5456 | 61 | 17 |
| 03/20/92 | 73 | 0.09 | 5456 | 58 | 16 | 75 | 0.09 | 5498 | 67 | 19 | 84 | 0.11 | 5414 | 65 | 18 |
| 04/10/92 | 66 | 0.13 | 5040 | 72 | 20 | 93 | 0.22 | 5240 | 66 | 18 | 91 | 0.20 | 5160 | 64 | 18 |
| 04/30/92 | 83 | 0.22 | 5080 | 68 | 19 | 86 | 0.22 | 5240 | 71 | 20 | 82 | 0.29 | 5160 | 64 | 18 |
| 05/22/92 | 94 | 0.29 | 5226 | 76 | 22 | 98 | 0.31 | 5226 | 64 | 18 | 74 | 0.26 | 5386 | 66 | 18 |
| 06/12/92 | 93 | 0.33 | 5466 | 68 | 17 | 85 | 0.20 | 5346 | 58 | 16 | 86 | 0.29 | 5026 | 70 | 18 |
| 06/23/92 | 83 | 0.24 | 5228 | 59 | 17 | 76 | 0.13 | 5194 | 69 | 17 | 84 | 0.40 | 5160 | 59 | 16 |
| 07/10/92 | 91 | 0.31 | 5188 | 75 | 21 | 96 | 0.37 | 5188 | 66 | 18 | 89 | 0.44 | 5272 | 78 | 22 |
| 08/12/92 | 87 | 0.33 | 5440 | 71 | 20 | 91 | 0.33 | 5400 | 70 | 20 | 95 | 0.68 | 5320 | 70 | 20 |
| 09/17/92 | 92 | 0.35 | 5420 | 73 | 21 | 94 | 0.35 | 5260 | 74 | 21 | 90 | 0.44 | 5460 | 74 | 21 |
| 09/01/93 | 93 | 0.16 | 5654 | 70 | 18 | 87 | 0.16 | 5128 | 72 | 18 | 90 | 0.24 | 5416 | 76 | 20 |
| Average-All Values | 81 | 0.25 | 5319 | 65 | 18 | 83 | 0.25 | 5308 | 65 | 18 | 84 | 0.33 | 5322 | 65 | 18 |
| Std.Dev.-All Values | 7 | 0.11 | 185 | 6 | 2 | 8 | 0.12 | 149 | 5 | 1 | 6 | 0.15 | 150 | 6 | 2 |
| Average-Summer (2) | 83 | 0.33 | 5420 | 64 | 18 | 82 | 0.32 | 5373 | 65 | 18 | 84 | 0.44 | 5409 | 67 | 18 |
| Std.Dev.-Summer | 7 | 0.08 | 172 | 6 | 2 | 8 | 0.10 | 151 | 5 | 1 | 6 | 0.12 | 121 | 6 | 2 |
| Average-Winter (3) | 75 | 0.08 | 5366 | 61 | 17 | 78 | 0.08 | 5328 | 63 | 17 | 85 | 0.10 | 5405 | 61 | 17 |
| Std.Dev.-Winter | 2 | 0.01 | 76 | 4 | 1 | 5 | 0.01 | 140 | 6 | 2 | 1 | 0.02 | 45 | 3 | 1 |

(1)Blank=no analysis

(2) Summer =
June 21- Sept. 21

(3) Winter =
Dec. 21 - March 21

Table 4. Soil Gas Concentrations (1991-1993)

| Date | 2-00 N2+O2(%) | ***** CO2(%) | ***** He(ppb) | +++++ N2(%) | +++++ O2(%) | 2-45N N2+O2(%) | +++++ CO2(%) | +++++ He(ppb) | ***** N2(%) | ***** O2(%) | TrenchTop N2+O2(%) | ***** CO2(%) | ***** He(ppb) | +++++ N2(%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 07/25/91 | 84 | 0.79 | | 61 | 17 | 78 | 0.53 | | | | | | | |
| 08/14/91 | 78 | 0.70 | 5315 | 69 | 20 | 88 | 0.64 | 5560 | | | | | | |
| 08/15/91 | 90 | 0.66 | 5526 | 63 | 17 | 80 | 0.79 | 5526 | | | | | | |
| 08/22/91 | 80 | 0.68 | 5494 | 64 | 18 | 81 | 0.81 | 5458 | 63 | 18 | 80 | 0.75 | 5494 | 66 |
| 08/29/91 | 75 | 0.51 | 5250 | 65 | 18 | 83 | 0.62 | 5310 | 65 | 18 | 83 | 0.68 | 5310 | 67 |
| 09/04/91 | 87 | 0.53 | 5526 | 65 | 18 | 83 | 0.57 | 5310 | 66 | 18 | 84 | 0.75 | 5562 | 65 |
| 09/10/91 | 84 | 0.46 | 5454 | 62 | 17 | 80 | 0.44 | 5418 | 66 | 18 | 84 | 0.64 | 5490 | 65 |
| 09/19/91 | 74 | 0.31 | 5274 | 63 | 18 | 81 | 0.35 | 5490 | 64 | 18 | 83 | 0.44 | 5382 | 66 |
| 09/25/91 | 93 | 0.55 | 5244 | 68 | 19 | 87 | 0.44 | 5280 | 65 | 18 | 83 | 0.48 | 5280 | 72 |
| 10/02/91 | 75 | 0.33 | 5172 | 63 | 17 | 81 | 0.33 | 5280 | 59 | 16 | 76 | 0.35 | 5244 | 59 |
| 10/09/91 | 75 | 0.31 | 5210 | 60 | 17 | 77 | 0.24 | 5252 | 62 | 17 | 79 | 0.31 | 5132 | 63 |
| 10/17/91 | 75 | 0.22 | 5454 | 70 | 20 | 90 | 0.35 | 5270 | 65 | 18 | 83 | 0.29 | 5316 | 62 |
| 10/23/91 | 79 | 0.22 | 5294 | 66 | 18 | 84 | 0.24 | 5294 | 62 | 17 | 79 | 0.22 | 5294 | 68 |
| 11/13/91 | 79 | 0.20 | 5058 | 66 | 18 | 84 | 0.20 | 5016 | 65 | 18 | 82 | 0.18 | 5016 | 71 |
| 12/10/91 | 92 | 0.22 | 5100 | 65 | 18 | 82 | 0.20 | 5100 | 67 | 19 | 85 | 0.13 | 5226 | 68 |
| 01/31/92 | 74 | 0.09 | 5270 | | | | | | 59 | 16 | 75 | 0.09 | 5232 | 61 |
| 02/21/92 | 77 | 0.09 | 5288 | 71 | 20 | 91 | 0.20 | 5288 | 63 | 18 | 80 | 0.07 | 5330 | 68 |
| 03/20/92 | 84 | 0.15 | 5456 | 68 | 19 | 87 | 0.20 | 5372 | 52 | 14 | 67 | 0.07 | 5162 | 60 |
| 04/10/92 | 82 | 0.26 | 5200 | 55 | 15 | 70 | 0.15 | 5120 | 60 | 17 | 76 | 0.11 | 5080 | 58 |
| 04/30/92 | 82 | 0.37 | 5080 | 58 | 16 | 74 | 0.26 | 5040 | 68 | 19 | 87 | 0.37 | 5200 | 73 |
| 05/22/92 | 84 | 0.35 | 5346 | 71 | 20 | 91 | 0.35 | 5306 | 70 | 19 | 89 | 0.44 | 5306 | 72 |
| 06/12/92 | 88 | 0.51 | 5306 | 69 | 19 | 88 | 0.53 | 5346 | 71 | 20 | 91 | 0.59 | 5346 | 69 |
| 06/23/92 | 75 | 0.35 | 5126 | 69 | 19 | 88 | 0.44 | 5258 | 70 | 18 | 87 | 0.46 | 5092 | 59 |
| 07/10/92 | 100 | 0.64 | 5230 | 77 | 22 | 99 | 0.66 | 5272 | 69 | 19 | 89 | 0.68 | 5188 | 74 |
| 08/12/92 | 89 | 0.48 | 5240 | 65 | 18 | 84 | 0.35 | 5360 | 72 | 20 | 92 | 0.57 | 5440 | 73 |
| 09/17/92 | 95 | 0.48 | 5420 | 78 | 22 | 100 | 0.48 | 5460 | 74 | 21 | 94 | 0.59 | 5460 | 72 |
| 09/01/93 | 95 | 0.33 | 5620 | 74 | 19 | 93 | 0.28 | 5586 | 66 | 17 | 83 | 0.32 | 5652 | 72 |
| | | | | | | | | | | | | | | |
| Average-All Values | 83 | 0.40 | 5306 | 66 | 18 | 85 | 0.41 | 5319 | 65 | 18 | 83 | 0.40 | 5301 | 67 |
| Std.Dev.-All Values | 7 | 0.19 | 146 | 5 | 2 | 7 | 0.18 | 146 | 5 | 1 | 6 | 0.22 | 155 | 5 |
| | | | | | | | | | | | | | | |
| Average-Summer (2) | 85 | 0.53 | 5373 | 67 | 19 | 86 | 0.54 | 5417 | 67 | 19 | 86 | 0.59 | 5407 | 68 |
| Std.Dev.-Summer | 8 | 0.15 | 147 | 6 | 2 | 7 | 0.16 | 109 | 3 | 1 | 4 | 0.14 | 161 | 4 |
| | | | | | | | | | | | | | | |
| Average-Winter (3) | 78 | 0.11 | 5338 | 70 | 20 | 89 | 0.20 | 5330 | 58 | 16 | 74 | 0.08 | 5241 | 63 |
| Std.Dev.-Winter | 4 | 0.03 | 84 | 2 | 0 | 2 | 0.00 | 42 | 4 | 1 | 6 | 0.01 | 69 | 3 |

(1)Blank=no analysis

(2) Summer =
June 21- Sept. 21

(3) Winter =
Dec. 21 - March 21

Table 4. Soil Gas Concentrations (1991-1993)

| Date | +++++ TrenchMiddle +++++ O2(%) | N2+O2(%) | CO2(%) | +++++ He(ppb) | ***** N2(%) | ***** TrenchBottom ***** O2(%) | N2+O2(%) | CO2(%) | **** He(ppb) |
|---|---|---|---|---|---|---|---|---|---|
| 07/25/91 | | | | | | | | | |
| 08/14/91 | | | | | | | | | |
| 08/15/91 | | | | | | | | | |
| 08/22/91 | 19 | 85 | 0.59 | 5662 | 62 | 18 | 80 | 0.13 | 5662 |
| 08/29/91 | 19 | 86 | 0.70 | 5190 | 57 | 16 | 72 | 0.11 | 5310 |
| 09/04/91 | 18 | 83 | 0.73 | 5454 | 0 | 0 | 0 | 0.00 | 0 |
| 09/10/91 | 18 | 83 | 0.64 | 5346 | 60 | 17 | 77 | 0.20 | 5310 |
| 09/19/91 | 18 | 84 | 0.46 | 5490 | 64 | 16 | 80 | 0.13 | 5562 |
| 09/25/91 | 20 | 91 | 0.59 | 5316 | 75 | 21 | 95 | 0.22 | 5460 |
| 10/02/91 | 16 | 76 | 0.37 | 5280 | 68 | 17 | 84 | 0.13 | 5280 |
| 10/09/91 | 17 | 80 | 0.31 | 5178 | 63 | 16 | 78 | 0.09 | 5408 |
| 10/17/91 | 17 | 79 | 0.29 | 5316 | 63 | 17 | 81 | 0.07 | 5316 |
| 10/23/91 | 19 | 88 | 0.29 | 5336 | 58 | 16 | 74 | 0.07 | 5252 |
| 11/13/91 | 20 | 91 | 0.18 | 5016 | 64 | 18 | 81 | 0.13 | 4974 |
| 12/10/91 | 19 | 87 | 0.18 | 5100 | 75 | 21 | 96 | 0.11 | 5184 |
| 01/31/92 | 17 | 78 | 0.09 | 5232 | 37 | 10 | 46 | 0.00 | 5802 |
| 02/21/92 | 19 | 87 | 0.07 | 5246 | 67 | 19 | 85 | 0.07 | 5288 |
| 03/20/92 | 17 | 77 | 0.09 | 5624 | 59 | 17 | 76 | 0.04 | 5330 |
| 04/10/92 | 16 | 75 | 0.07 | 5160 | 68 | 19 | 87 | 0.09 | 5080 |
| 04/30/92 | 21 | 94 | 0.22 | 5240 | 72 | 20 | 92 | 0.07 | 5200 |
| 05/22/92 | 20 | 93 | 0.24 | 5386 | 70 | 20 | 89 | 0.18 | 5346 |
| 06/12/92 | 18 | 87 | 0.24 | 5346 | 69 | 18 | 87 | 0.09 | 5346 |
| 06/23/92 | 15 | 74 | 0.22 | 5126 | 69 | 18 | 87 | 0.15 | 5092 |
| 07/10/92 | 21 | 94 | 0.48 | 5188 | 72 | 20 | 93 | 0.26 | 5230 |
| 08/12/92 | 21 | 94 | 0.66 | 5240 | 69 | 20 | 89 | 0.29 | 5240 |
| 09/17/92 | 20 | 92 | 0.51 | 5420 | 71 | 20 | 91 | 0.26 | 5420 |
| 09/01/93 | 18 | 91 | 0.43 | 5552 | 72 | 18 | 90 | 0.20 | 5212 |
| Average-All Values | 18 | 85 | 0.36 | 5310 | 63 | 17 | 80 | 0.13 | 5096 |
| Std.Dev.-All Values | 2 | 6 | 0.21 | 172 | 17 | 4 | 19 | 0.08 | 1077 |
| Average-Summer (2) | 19 | 86 | 0.54 | 5367 | 60 | 16 | 76 | 0.17 | 4804 |
| Std.Dev.-Summer | 2 | 6 | 0.15 | 169 | 21 | 6 | 26 | 0.08 | 1609 |
| Average-Winter (3) | 17 | 80 | 0.08 | 5367 | 54 | 15 | 69 | 0.04 | 5473 |
| Std.Dev.-Winter | 1 | 4 | 0.01 | 182 | 13 | 4 | 16 | 0.03 | 233 |

(1)Blank=no analysis

(2) Summer =
June 21- Sept. 21

(3) Winter =
Dec. 21 - March 21

Table 5. Concentrations of soil-gases and elements in soil.

| Site | Distance(m) | He(ppb) | N2(%) | O2(%) | N2+O2(%) | CO2(%) | organic-C(%) | H+(ppb) | xAg | xAs | xAu | xBi |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1-65S (1993) | -65 | 5586 | 67 | 17 | 84 | 0.16 | 2.03 | 1000 | 0.84 | 8.2 | L0.1 (2) | 0.84 |
| 1-60S (1993) | -60 | 5212 | 74 | 19 | 93 | 0.24 | 1.03 | 7079 | 0.57 | 3.5 | L0.1 | 0.89 |
| 1-55S (1993) | -55 | 5518 | 75 | 19 | 95 | 0.37 | 1.96 | 251 | 0.62 | 6.5 | L0.1 | 0.10 |
| 1-50S (1993) | -50 | 5450 | 70 | 18 | 88 | 0.15 | 1.64 | 708 | 0.39 | 4.7 | L0.1 | 0.74 |
| 1-45S (1993) | -45 | 5348 | 78 | 20 | 98 | 0.37 | 2.72 | 631 | 0.91 | 10.0 | L0.1 | 1.00 |
| 1-40S (1993) | -40 | 5518 | 69 | 18 | 87 | 0.25 | 1.71 | 316 | 0.73 | 6.2 | L0.1 | 0.82 |
| 1-35S (1993) | -35 | 5552 | 71 | 18 | 90 | 0.16 | 1.32 | 316 | 0.47 | 6.5 | L0.1 | 0.86 |
| 1-30S (1993) | -30 | 5518 | 66 | 17 | 82 | 0.17 | 1.64 | 1413 | 0.74 | 5.5 | L0.1 | 0.83 |
| 1-25S (1993) | -25 | 5400 | 72 | 18 | 90 | 0.22 | 1.05 | 316 | 0.68 | 16.0 | L0.1 | 0.86 |
| 1-20S (1993) | -20 | 5544 | 73 | 19 | 92 | 0.23 | 1.29 | 3981 | 0.71 | 9.2 | L0.1 | 0.93 |
| 1-10S (1993) | -10 | 5616 | 65 | 17 | 82 | 0.17 | 1.13 | 2239 | 1.10 | 16.0 | L0.1 | 0.79 |
| 1-05S (1993) | -5 | 5652 | 66 | 17 | 83 | 0.32 | 1.11 | 11220 | 1.80 | 18.0 | L0.1 | 1.20 |
| 1-00 (1993) | 0 | 5580 | 73 | 19 | 92 | 0.42 | 0.67 | 7079 | 1.30 | 8.8 | 0.10 | 1.30 |
| 1-20N (1993) | 20 | 5580 | 76 | 20 | 96 | 0.34 | 3.10 | 4467 | 0.93 | 13.0 | L0.1 | 0.81 |
| 1-25N (1993) | 25 | 5652 | 78 | 20 | 98 | 0.33 | 1.05 | 2239 | 1.20 | 26.0 | L0.1 | 0.85 |
| 1-30N (1993) | 30 | 5580 | 69 | 18 | 87 | 0.26 | 0.74 | 10000 | 5.90 | 130.0 | 0.14 | 1.60 |
| 1-35N (1993) | 35 | 5472 | 68 | 17 | 86 | 0.30 | 0.71 | 3162 | 4.40 | 90.0 | 0.14 | 2.40 |
| 1-40N (1993) | 40 | 5552 | 77 | 20 | 97 | 0.27 | 1.07 | 4467 | 2.20 | 46.0 | 0.14 | 2.60 |
| 1-45N (1993) | 45 | 5654 | 74 | 19 | 93 | 0.16 | 2.01 | 4467 | 1.70 | 35.0 | 0.16 | 1.70 |
| 1-50N (1993) | 50 | 5178 | 70 | 18 | 87 | 0.18 | 1.22 | 6310 | 1.50 | 30.0 | 0.31 | 2.20 |
| 1-55N (1993) | 55 | 5320 | 68 | 18 | 86 | 0.22 | 1.35 | 10000 | 0.70 | 20.0 | 0.14 | 2.10 |
| 1-60N (1993) | 60 | 5288 | 73 | 19 | 91 | 0.14 | 1.41 | 2512 | 0.79 | 14.0 | L0.1 | 0.84 |
| 1-65N (1993) | 65 | 5128 | 70 | 18 | 87 | 0.16 | 1.27 | 3981 | 0.54 | 12.0 | 0.11 | 1.10 |
| 1-70N (1993) | 70 | 5382 | 70 | 18 | 87 | 0.26 | 0.77 | 6310 | 0.63 | 13.0 | L0.1 | 1.30 |
| 2-45S (1993) | -45 | 5416 | 72 | 18 | 90 | 0.24 | Empty spaces | | | | | |
| 2-00 (1993) | 0 | 5620 | 76 | 20 | 95 | 0.33 | indicate | | | | | |
| 2-45N (1993) | 45 | 5586 | 74 | 19 | 93 | 0.28 | no analyses | | | | | |
| Trench Top (1993) | 2.8 | 5652 | 66 | 17 | 83 | 0.32 | for those | | | | | |
| Trench Middle (1993) | 1.3 | 5552 | 72 | 18 | 91 | 0.43 | variables | | | | | |
| Trench Bottom (1993) | 0 | 5212 | 72 | 18 | 90 | 0.20 | | | | | | |
| 1-65S (1992) (1) | -65 | 5321 | 66 | 18 | 84 | 0.26 | 6.98 | 891 | 2.30 | 40.0 | L0.1 | 2.60 |
| 1-45S (1992) | -45 | 5382 | 67 | 18 | 85 | 0.48 | 7.76 | 2239 | 2.70 | 55.0 | L0.1 | 2.50 |
| 1-25S (1992) | -25 | 5393 | 65 | 18 | 82 | 0.46 | 2.52 | 708 | 2.60 | 98.0 | L0.1 | 2.00 |
| 1-00 (1992) | 0 | 5394 | 62 | 18 | 80 | 0.74 | 1.90 | 2239 | 7.90 | 95.0 | L0.1 | 2.10 |
| 1-25N (1992) | 25 | 5436 | 65 | 18 | 83 | 0.48 | 2.97 | 1778 | 1.90 | 65.0 | L0.1 | 0.77 |
| 1-45N (1992) | 45 | 5420 | 65 | 18 | 83 | 0.32 | 2.54 | 2818 | 2.00 | 110.0 | L0.1 | 2.60 |
| 1-65N (1992) | 65 | 5373 | 64 | 18 | 82 | 0.32 | 1.46 | 5623 | 0.51 | 24.0 | L0.1 | 1.30 |
| 2-45S (1992) | -45 | 5409 | 65 | 18 | 83 | 0.43 | 4.33 | 4467 | 1.20 | 20.0 | L0.1 | 1.20 |
| 2-00 (1992) | 0 | 5373 | 67 | 19 | 85 | 0.53 | 9.04 | 1778 | 1.80 | 35.0 | L0.1 | 2.20 |
| 2-45N (1992) | 45 | 5417 | 67 | 19 | 86 | 0.52 | 2.05 | 1122 | 0.43 | 13.0 | L0.1 | 1.20 |
| Trench Top (1992) | 2.8 | 5407 | 68 | 19 | 86 | 0.59 | 1.63 | 2239 | 7.20 | 97.0 | L0.1 | 2.20 |
| Trench Middle (1992) | 1.3 | 5367 | 68 | 19 | 86 | 0.54 | 0.18 | 562 | 1.30 | 6.6 | L0.1 | 0.00 |
| Trench Bottom (1992) | 0 | 4804 | 60 | 16 | 76 | 0.17 | 0.09 | 1995 | 0.68 | 5.4 | L0.1 | 0.00 |

(1) 1992 soil samples and 1991-1993 soil-gas summer averages (June 21-Sept.21)

(2) L = not detected at concentration shown

Table 5. Concentrations of soil-gases and elements in soil.

| Site | xCd | xCu | xMo | xPb | xSb | xZn | Al | Ca | Fe | K | Mg | Na | P | Ti |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1-65S (1993) | 0.32 | 24 | 3.3 | 160 | 1.1 | 100 | 6.8 | 0.90 | 3.6 | 2.7 | 0.90 | 1.3 | 0.14 | 0.41 |
| 1-60S (1993) | 0.15 | 15 | 3.5 | 160 | 0.1 | 79 | 6.9 | 0.81 | 3.7 | 2.8 | 0.96 | 1.3 | 0.12 | 0.45 |
| 1-55S (1993) | 0.24 | 21 | 3.8 | 160 | 1.2 | 80 | 6.8 | 0.86 | 3.6 | 2.7 | 0.95 | 1.3 | 0.12 | 0.45 |
| 1-50S (1993) | 0.16 | 19 | 4.3 | 150 | 0.7 | 86 | 6.8 | 0.89 | 3.8 | 2.7 | 1.00 | 1.3 | 0.14 | 0.51 |
| 1-45S (1993) | 0.24 | 34 | 4.1 | 150 | 1.7 | 78 | 6.8 | 0.92 | 3.7 | 2.7 | 1.00 | 1.2 | 0.13 | 0.48 |
| 1-40S (1993) | 0.13 | 17 | 3.8 | 130 | 1.3 | 76 | 6.8 | 0.86 | 3.6 | 2.7 | 0.95 | 1.3 | 0.10 | 0.46 |
| 1-35S (1993) | 0.11 | 16 | 3.5 | 120 | 1.5 | 79 | 7.0 | 0.86 | 3.7 | 2.7 | 1.00 | 1.3 | 0.12 | 0.50 |
| 1-30S (1993) | 0.15 | 23 | 3.9 | 110 | 1.4 | 87 | 7.0 | 0.96 | 4.0 | 2.8 | 1.10 | 1.3 | 0.15 | 0.52 |
| 1-25S (1993) | 0.20 | 41 | 3.6 | 130 | 2.2 | 110 | 7.2 | 1.10 | 4.4 | 2.9 | 1.30 | 1.3 | 0.20 | 0.57 |
| 1-20S (1993) | 0.20 | 34 | 4.2 | 130 | 2.0 | 110 | 7.1 | 0.95 | 4.3 | 2.9 | 1.30 | 1.3 | 0.16 | 0.60 |
| 1-10S (1993) | 0.30 | 44 | 4.8 | 160 | 3.2 | 130 | 7.0 | 0.74 | 4.0 | 2.9 | 1.20 | 1.2 | 0.12 | 0.54 |
| 1-05S (1993) | 0.28 | 35 | 3.5 | 150 | 4.4 | 94 | 6.9 | 0.74 | 3.7 | 2.7 | 0.96 | 1.3 | 0.07 | 0.47 |
| 1-00 (1993) | 0.18 | 27 | 5.5 | 160 | 1.8 | 86 | 7.0 | 0.70 | 4.0 | 2.9 | 1.00 | 1.3 | 0.07 | 0.50 |
| 1-20N (1993) | 0.22 | 22 | 2.3 | 120 | 2.6 | 59 | 6.5 | 0.72 | 3.0 | 2.7 | 0.69 | 1.3 | 0.03 | 0.39 |
| 1-25N (1993) | 0.32 | 46 | 2.6 | 240 | 5.5 | 93 | 7.9 | 0.67 | 3.9 | 3.1 | 1.10 | 1.5 | 0.03 | 0.49 |
| 1-30N (1993) | 0.21 | 240 | 3.2 | 970 | 36.0 | 120 | 9.0 | 0.20 | 3.9 | 3.2 | 1.30 | 0.5 | 0.04 | 0.52 |
| 1-35N (1993) | 0.22 | 190 | 5.3 | 1200 | 30.0 | 93 | 8.3 | 0.34 | 3.6 | 3.1 | 0.98 | 0.8 | 0.06 | 0.44 |
| 1-40N (1993) | 0.37 | 85 | 4.9 | 750 | 12.0 | 140 | 8.3 | 0.52 | 4.8 | 3.2 | 1.10 | 1.3 | 0.04 | 0.49 |
| 1-45N (1993) | 0.36 | 48 | 3.9 | 450 | 7.1 | 96 | 7.3 | 0.66 | 3.6 | 2.8 | 0.84 | 1.3 | 0.04 | 0.39 |
| 1-50N (1993) | 0.29 | 36 | 3.9 | 360 | 4.5 | 85 | 7.4 | 0.60 | 4.0 | 2.7 | 0.69 | 1.7 | 0.04 | 0.34 |
| 1-55N (1993) | 0.74 | 34 | 3.9 | 330 | 4.1 | 110 | 7.0 | 0.69 | 3.4 | 2.8 | 0.85 | 1.4 | 0.03 | 0.40 |
| 1-60N (1993) | 0.52 | 22 | 2.0 | 190 | 2.3 | 88 | 7.0 | 0.69 | 3.4 | 2.8 | 0.85 | 1.4 | 0.03 | 0.40 |
| 1-65N (1993) | 0.41 | 19 | 2.0 | 190 | 2.3 | 110 | 7.0 | 0.71 | 3.8 | 2.7 | 0.85 | 1.5 | 0.03 | 0.44 |
| 1-70N (1993) | 0.34 | 21 | 2.6 | 200 | 2.6 | 100 | 7.0 | 0.66 | 3.7 | 2.6 | 0.80 | 1.5 | 0.03 | 0.43 |
| 2-45S (1993) | | | | | | | | | | | | | | |
| 2-00 (1993) | | | | | | | | | | | | | | |
| 2-45N (1993) | | | | | | | | | | | | | | |
| Trench Top (1993) | | | | | | | | | | | | | | |
| Trench Middle (1993) | | | | | | | | | | | | | | |
| Trench Bottom (1993) | | | | | | | | | | | | | | |
| 1-65S (1992) (1) | 1.40 | 110 | 3.3 | 360 | 5.6 | 130 | 6.4 | 1.30 | 3.6 | 2.5 | 0.87 | 1.2 | 0.13 | 0.39 |
| 1-45S (1992) | 1.50 | 170 | 4.3 | 340 | 7.3 | 140 | 6.6 | 1.30 | 3.9 | 2.5 | 1.10 | 1.2 | 0.16 | 0.46 |
| 1-25S (1992) | 1.30 | 160 | 4.9 | 290 | 11.0 | 190 | 7.1 | 1.20 | 4.6 | 2.9 | 1.20 | 1.3 | 0.23 | 0.57 |
| 1-00 (1992) | 1.20 | 150 | 5.7 | 410 | 17.0 | 170 | 6.9 | 0.79 | 4.0 | 2.9 | 0.97 | 1.3 | 0.08 | 0.54 |
| 1-25N (1992) | 1.60 | 130 | 3.2 | 230 | 8.6 | 150 | 6.7 | 0.96 | 3.6 | 2.6 | 0.77 | 1.3 | 0.05 | 0.44 |
| 1-45N (1992) | 1.60 | 140 | 5.0 | 630 | 16.0 | 190 | 7.2 | 0.74 | 3.9 | 2.8 | 0.84 | 1.3 | 0.05 | 0.44 |
| 1-65N (1992) | 0.93 | 29 | 2.4 | 270 | 3.1 | 120 | 7.2 | 0.75 | 4.0 | 2.7 | 0.85 | 1.6 | 0.04 | 0.43 |
| 2-45S (1992) | 0.82 | 56 | 4.1 | 270 | 3.0 | 99 | 6.7 | 0.89 | 3.5 | 2.4 | 0.81 | 1.2 | 0.08 | 0.41 |
| 2-00 (1992) | 1.50 | 94 | 5.5 | 260 | 5.5 | 97 | 6.3 | 1.20 | 3.2 | 2.4 | 0.83 | 1.1 | 0.09 | 0.38 |
| 2-45N (1992) | 0.60 | 24 | 1.9 | 170 | 1.9 | 80 | 6.7 | 0.88 | 3.3 | 2.7 | 0.76 | 1.4 | 0.05 | 0.44 |
| Trench Top (1992) | 1.40 | 160 | 17.0 | 360 | 17.0 | 210 | 7.2 | 0.89 | 4.1 | 2.8 | 0.99 | 1.4 | 0.09 | 0.51 |
| Trench Middle (1992) | 0.14 | 41 | 2.0 | 42 | 2.0 | 100 | 9.4 | 1.40 | 5.8 | 2.2 | 1.70 | 2.0 | 0.07 | 0.55 |
| Trench Bottom (1992) | 1.20 | 660 | 2.2 | 4300 | 2.2 | 240 | 9.4 | 1.40 | 5.4 | 2.2 | 2.10 | 1.7 | 0.16 | 0.48 |

(1) 1992 soil samples and 1991-1993 soil-gas summer averages (June 21-Sept.21)

(2) L = not detected at concentration shown

Table 5. Concentrations of soil-gases and elements in soil.

| Site | Mn | Ag | As | Ba | Be | Ce | Co | Cr | Cu | Eu | Ga | La | Li | Mo | Nb | Nd | Ni | Pb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1-65S (1993) | 630 | L2 | 11 | 1100 | 2 | 190 | 14 | 75 | 30 | L2 | 18 | 100 | 32 | L2 | 17 | 83 | 29 | 190 |
| 1-60S (1993) | 490 | L2 | L10 | 1100 | 2 | 190 | 14 | 75 | 21 | L2 | 18 | 100 | 33 | L2 | 18 | 82 | 31 | 180 |
| 1-55S (1993) | 570 | L2 | L10 | 1200 | 2 | 170 | 14 | 71 | 28 | L2 | 19 | 90 | 34 | 2 | 17 | 76 | 30 | 190 |
| 1-50S (1993) | 670 | L2 | 10 | 1200 | 2 | 210 | 15 | 66 | 22 | L2 | 18 | 110 | 33 | L2 | 18 | 95 | 31 | 160 |
| 1-45S (1993) | 660 | L2 | 16 | 1200 | 2 | 190 | 15 | 62 | 40 | L2 | 19 | 100 | 33 | 2 | 18 | 87 | 30 | 170 |
| 1-40S (1993) | 530 | L2 | 13 | 1100 | 2 | 180 | 15 | 69 | 23 | L2 | 18 | 94 | 34 | L2 | 18 | 78 | 32 | 150 |
| 1-35S (1993) | 500 | L2 | 12 | 1200 | 2 | 190 | 15 | 69 | 21 | L2 | 18 | 100 | 35 | L2 | 18 | 86 | 31 | 140 |
| 1-30S (1993) | 540 | L2 | 10 | 1200 | 2 | 220 | 16 | 67 | 27 | 2 | 18 | 120 | 31 | 3 | 18 | 100 | 34 | 130 |
| 1-25S (1993) | 560 | L2 | 19 | 1300 | 2 | 260 | 17 | 76 | 47 | 2 | 18 | 140 | 31 | 3 | 20 | 120 | 38 | 140 |
| 1-20S (1993) | 490 | L2 | 12 | 1400 | 2 | 260 | 17 | 56 | 39 | 2 | 19 | 140 | 34 | 3 | 18 | 110 | 37 | 150 |
| 1-10S (1993) | 550 | L2 | 17 | 1200 | 2 | 240 | 15 | 64 | 52 | 2 | 19 | 130 | 34 | 4 | 18 | 110 | 35 | 180 |
| 1-05S (1993) | 480 | L2 | 20 | 1000 | 2 | 200 | 15 | 71 | 39 | L2 | 19 | 110 | 34 | L2 | 17 | 85 | 31 | 170 |
| 1-00 (1993) | 470 | L2 | 12 | 1000 | 2 | 210 | 14 | 71 | 30 | L2 | 18 | 110 | 32 | 4 | 20 | 94 | 34 | 170 |
| 1-20N (1993) | 380 | L2 | 19 | 810 | 2 | 160 | 10 | 83 | 29 | L2 | 18 | 90 | 27 | L2 | 16 | 71 | 27 | 150 |
| 1-25N (1993) | 410 | L2 | 30 | 670 | 2 | 140 | 15 | 150 | 51 | L2 | 22 | 83 | 29 | L2 | 21 | 59 | 49 | 240 |
| 1-30N (1993) | 370 | 5 | 140 | 650 | 2 | 100 | 13 | 98 | 270 | L2 | 22 | 67 | 17 | L2 | 13 | 38 | 42 | 980 |
| 1-35N (1993) | 280 | 4 | 94 | 590 | 2 | 140 | 10 | 120 | 210 | L2 | 20 | 88 | 19 | 4 | 15 | 52 | 39 | 1200 |
| 1-40N (1993) | 390 | L2 | 48 | 570 | 2 | 140 | 13 | 180 | 97 | L2 | 24 | 89 | 23 | 3 | 19 | 59 | 53 | 730 |
| 1-45N (1993) | 380 | L2 | 41 | 750 | 2 | 120 | 12 | 110 | 59 | L2 | 19 | 71 | 27 | 2 | 16 | 49 | 35 | 480 |
| 1-50N (1993) | 310 | L2 | 27 | 590 | 2 | 150 | 10 | 110 | 41 | L2 | 21 | 89 | 23 | 2 | 16 | 61 | 34 | 340 |
| 1-55N (1993) | 440 | L2 | 19 | 720 | 2 | 150 | 12 | 110 | 29 | L2 | 19 | 83 | 30 | L2 | 17 | 62 | 37 | 210 |
| 1-60N (1993) | 440 | L2 | 19 | 720 | 2 | 150 | 12 | 110 | 29 | L2 | 19 | 83 | 30 | L2 | 17 | 62 | 37 | 210 |
| 1-65N (1993) | 490 | L2 | 20 | 720 | 2 | 160 | 13 | 120 | 24 | L2 | 19 | 90 | 31 | L2 | 20 | 67 | 37 | 210 |
| 1-70N (1993) | 420 | L2 | 19 | 710 | 2 | 160 | 12 | 110 | 26 | L2 | 18 | 91 | 30 | L2 | 19 | 68 | 34 | 210 |
| 2-45S (1993) | | | | | | | | | | | | | | | | | | |
| 2-00 (1993) | | | | | | | | | | | | | | | | | | |
| 2-45N (1993) | | | | | | | | | | | | | | | | | | |
| Trench Top (1993) | | | | | | | | | | | | | | | | | | |
| Trench Middle (1993) | | | | | | | | | | | | | | | | | | |
| Trench Bottom (1993) | | | | | | | | | | | | | | | | | | |
| 1-65S (1992) (1) | 1200 | L2 | 37 | 1200 | 2 | 150 | 15 | 85 | 120 | L2 | 19 | 82 | 28 | L2 | 13 | 67 | 28 | 340 |
| 1-45S (1992) | 1100 | L2 | 45 | 1400 | 2 | 170 | 18 | 74 | 160 | L2 | 20 | 92 | 28 | 2 | 12 | 76 | 34 | 300 |
| 1-25S (1992) | 780 | L2 | 74 | 1300 | 2 | 240 | 17 | 79 | 150 | 2 | 20 | 130 | 29 | 2 | 14 | 110 | 36 | 270 |
| 1-00 (1992) | 610 | 6 | 64 | 1100 | 2 | 200 | 15 | 77 | 130 | L2 | 20 | 110 | 33 | L2 | 15 | 89 | 30 | 340 |
| 1-25N (1992) | 710 | L2 | 47 | 940 | 2 | 180 | 16 | 96 | 110 | L2 | 19 | 100 | 30 | L2 | 13 | 82 | 28 | 200 |
| 1-45N (1992) | 630 | L2 | 78 | 710 | 2 | 150 | 13 | 130 | 130 | L2 | 21 | 92 | 27 | L2 | 12 | 66 | 39 | 520 |
| 1-65N (1992) | 620 | L2 | 21 | 730 | 2 | 190 | 13 | 130 | 30 | L2 | 21 | 110 | 30 | L2 | 12 | 84 | 39 | 220 |
| 2-45S (1992) | 930 | L2 | 17 | 840 | 2 | 140 | 14 | 100 | 60 | L2 | 21 | 79 | 28 | L2 | 11 | 64 | 30 | 240 |
| 2-00 (1992) | 1300 | L2 | 32 | 910 | 2 | 120 | 17 | 85 | 110 | L2 | 19 | 64 | 26 | 2 | 12 | 52 | 30 | 260 |
| 2-45N (1992) | 540 | L2 | 13 | 760 | 2 | 180 | 13 | 100 | 27 | L2 | 17 | 100 | 29 | L2 | 13 | 82 | 35 | 160 |
| Trench Top (1992) | 600 | 4 | 75 | 1100 | 2 | 210 | 16 | 85 | 150 | L2 | 21 | 120 | 31 | 2 | 14 | 94 | 31 | 320 |
| Trench Middle (1992) | 410 | L2 | L10 | 880 | 3 | 130 | 20 | 200 | 36 | 2 | 24 | 78 | 18 | L2 | 11 | 70 | 79 | 44 |
| Trench Bottom (1992) | 530 | L2 | L10 | 730 | 2 | 120 | 19 | 320 | 590 | L2 | 22 | 74 | 16 | L2 | 10 | 66 | 150 | 3200 |

(1) 1992 soil samples and 1991-1993 soil-gas summer averages (June 21-Sept.21)

(2) L = not detected at concentration shown

Table 5. Concentrations of soil-gases and elements in soil.

| Site | Sc | Sn | Sr | Th | V | Y | Yb | Zn | Hg | Sand | Silt | Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1-65S (1993) | 11 | L2 | 290 | 30 | 79 | 20 | 2 | 150 | 0.05 | 55.8 | 21.5 | 22.7 |
| 1-60S (1993) | 12 | L2 | 290 | 28 | 82 | 19 | 2 | 110 | 0.05 | 56.4 | 21.0 | 22.7 |
| 1-55S (1993) | 11 | L2 | 320 | 25 | 82 | 18 | 2 | 120 | 0.03 | 62.5 | 14.9 | 22.7 |
| 1-50S (1993) | 12 | L2 | 360 | 26 | 84 | 21 | 2 | 110 | 0.02 | 51.3 | 26.0 | 22.7 |
| 1-45S (1993) | 12 | L2 | 370 | 24 | 83 | 19 | 2 | 120 | 0.05 | 54.6 | 22.7 | 22.7 |
| 1-40S (1993) | 12 | L2 | 330 | 24 | 82 | 18 | 1 | 100 | 0.02 | 56.9 | 22.1 | 21.0 |
| 1-35S (1993) | 12 | L2 | 360 | 27 | 85 | 19 | 1 | 110 | 0.01 | 58.3 | 19.1 | 22.7 |
| 1-30S (1993) | 12 | L2 | 430 | 27 | 92 | 21 | 2 | 110 | 0.03 | 63.1 | 17.6 | 19.3 |
| 1-25S (1993) | 13 | L2 | 530 | 31 | 100 | 24 | 2 | 150 | 0.02 | 63.7 | 13.7 | 22.7 |
| 1-20S (1993) | 13 | L2 | 490 | 26 | 98 | 22 | 2 | 140 | 0.07 | 54.7 | 20.9 | 24.3 |
| 1-10S (1993) | 13 | L2 | 370 | 30 | 91 | 21 | 2 | 170 | 0.06 | 52.0 | 25.4 | 22.7 |
| 1-05S (1993) | 12 | L2 | 330 | 25 | 84 | 18 | 1 | 130 | 0.15 | 51.9 | 28.7 | 19.3 |
| 1-00 (1993) | 12 | L2 | 320 | 31 | 90 | 20 | 1 | 110 | 0.04 | 55.1 | 25.5 | 19.3 |
| 1-20N (1993) | 11 | L2 | 220 | 27 | 75 | 16 | 1 | 94 | 0.03 | 62.6 | 18.1 | 19.3 |
| 1-25N (1993) | 17 | 11 | 200 | 19 | 100 | 13 | 1 | 140 | 0.05 | 58.1 | 22.6 | 19.3 |
| 1-30N (1993) | 13 | L2 | 170 | 9 | 110 | 6 | 1 | 340 | 0.20 | 53.4 | 18.9 | 27.7 |
| 1-35N (1993) | 14 | L2 | 260 | 11 | 100 | 9 | 1 | 240 | 0.21 | 54.6 | 21.1 | 24.3 |
| 1-40N (1993) | 18 | 9 | 180 | 20 | 110 | 11 | 1 | 300 | 0.08 | 59.2 | 18.2 | 22.7 |
| 1-45N (1993) | 13 | L2 | 200 | 17 | 89 | 11 | 1 | 180 | 0.06 | 61.7 | 15.6 | 22.7 |
| 1-50N (1993) | 11 | 9 | 170 | 22 | 76 | 13 | 1 | 200 | 0.04 | 49.3 | 31.4 | 19.3 |
| 1-55N (1993) | 12 | 5 | 180 | 22 | 80 | 15 | 1 | 150 | 0.06 | 60.1 | 20.5 | 19.3 |
| 1-60N (1993) | 12 | 5 | 180 | 22 | 80 | 15 | 1 | 150 | 0.03 | 57.0 | 23.7 | 19.3 |
| 1-65N (1993) | 12 | 5 | 190 | 23 | 85 | 16 | 1 | 180 | 0.01 | 57.8 | 22.8 | 19.3 |
| 1-70N (1993) | 12 | 5 | 180 | 22 | 86 | 15 | 1 | 160 | 0.01 | 55.6 | 25.0 | 19.3 |
| 2-45S (1993) | | | | | | | | | | | | |
| 2-00 (1993) | | | | | | | | | | | | |
| 2-45N (1993) | | | | | | | | | | | | |
| Trench Top (1993) | | | | | | | | | | | | |
| Trench Middle (1993) | | | | | | | | | | | | |
| Trench Bottom (1993) | | | | | | | | | | | | |
| 1-65S (1992) (1) | 11 | L2 | 320 | 26 | 75 | 18 | 2 | 260 | 0.24 | | | |
| 1-45S (1992) | 12 | L2 | 420 | 24 | 83 | 20 | 2 | 250 | 0.24 | | | |
| 1-25S (1992) | 12 | L2 | 500 | 30 | 100 | 24 | 2 | 280 | 0.22 | 51.3 | 22.7 | 26.0 |
| 1-00 (1992) | 11 | L2 | 360 | 30 | 89 | 19 | 2 | 220 | 0.31 | 52.7 | 24.6 | 22.7 |
| 1-25N (1992) | 10 | L2 | 300 | 29 | 82 | 19 | 2 | 200 | 0.18 | 54.1 | 23.2 | 22.7 |
| 1-45N (1992) | 12 | L2 | 240 | 24 | 92 | 16 | 2 | 290 | 0.15 | 53.7 | 20.3 | 26.0 |
| 1-65N (1992) | 12 | L2 | 200 | 31 | 85 | 19 | 2 | 200 | 0.02 | 50.9 | 26.4 | 22.7 |
| 2-45S (1992) | 11 | L2 | 220 | 27 | 79 | 16 | 1 | 160 | 0.09 | 50.8 | 26.5 | 22.7 |
| 2-00 (1992) | 10 | L2 | 250 | 19 | 72 | 16 | 1 | 200 | 0.24 | | | |
| 2-45N (1992) | 11 | L2 | 230 | 34 | 77 | 20 | 2 | 140 | 0.02 | 52.5 | 24.8 | 22.7 |
| Trench Top (1992) | 12 | L2 | 380 | 30 | 91 | 20 | 2 | 270 | 0.44 | 45.0 | 29.0 | 26.0 |
| Trench Middle (1992) | 21 | L2 | 320 | 18 | 130 | 22 | 2 | 140 | 0.04 | 56.6 | 15.7 | 27.7 |
| Trench Bottom (1992) | 23 | L2 | 320 | 14 | 130 | 27 | 2 | 980 | 0.04 | 51.5 | 19.2 | 29.3 |

(1) 1992 soil samples and 1991-1993 soil-gas summer averages (June 21-Sept.21)

(2) L = not detected at concentration shown

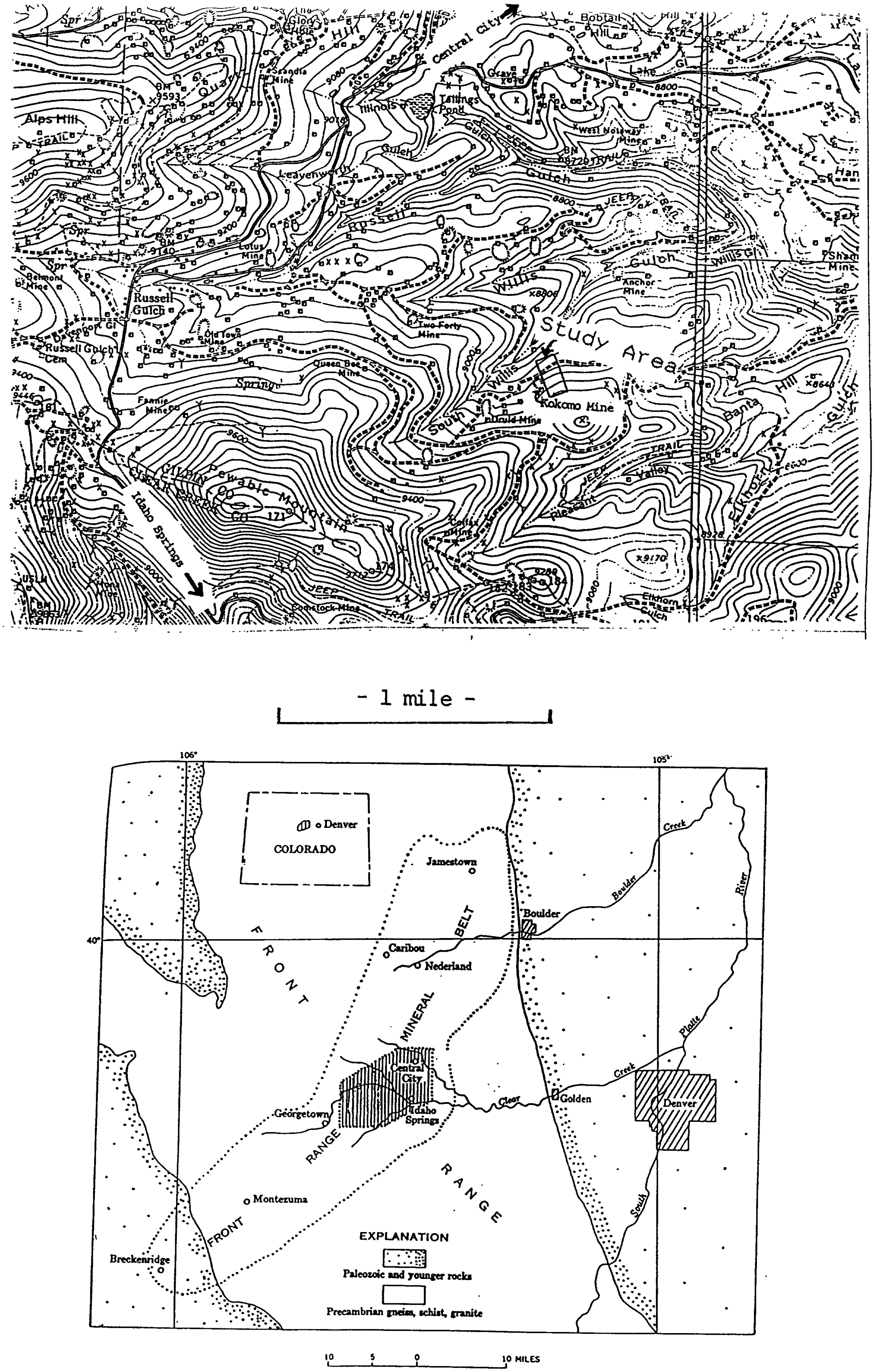
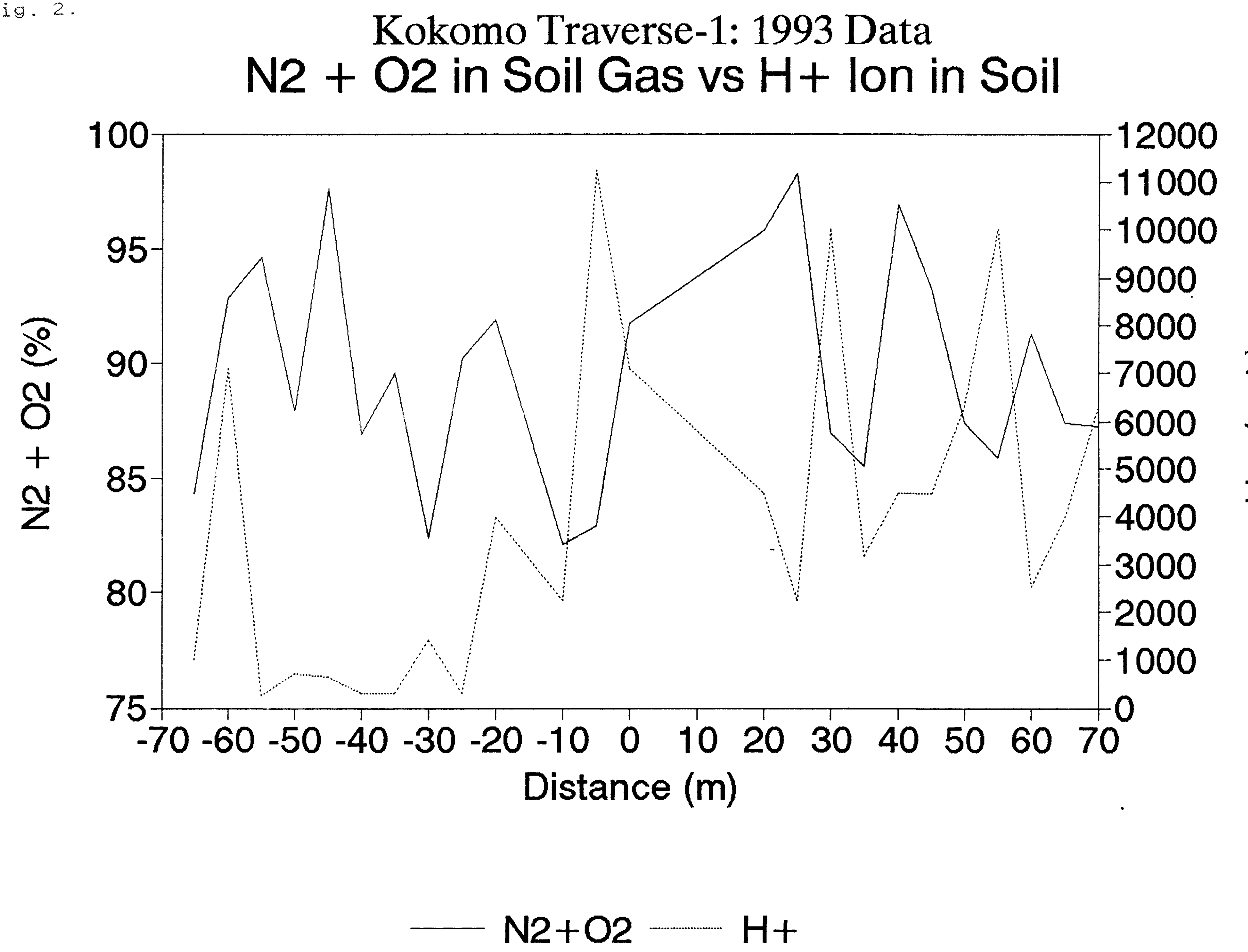


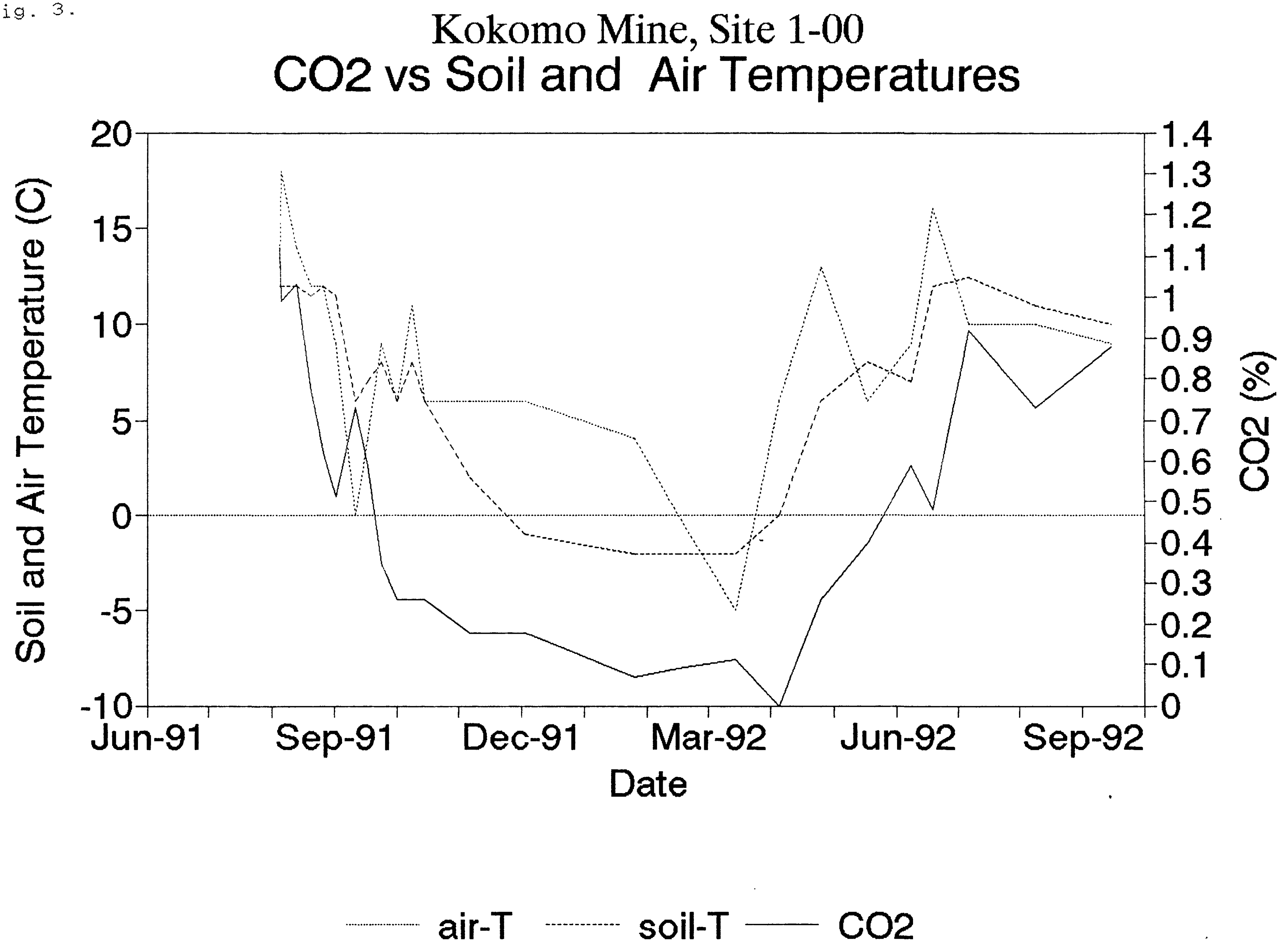

Fig. 1. The study area and map showing its location within the Central City mining district and the Front Range mineral belt [from Tooker (1963)].

Fig. 2.



Kokomo Traverse-1: 1993 Data
N2 + O2 in Soil Gas vs H+ Ion in Soil
N2 + O2 (%)
H+ (ppb)
Distance (m)
N2+O2
H+

Fig. 3.



Kokomo Mine, Site 1-00
CO2 vs Soil and Air Temperatures
Soil and Air Temperature (C)
20
15
10
5
0
-5
-10
CO2 (%)
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jun-91
Sep-91
Dec-91
Mar-92
Jun-92
Sep-92
Date
air-T
soil-T
CO2