SOIL GAS ALKANE SURVEY
OP 238

PEDIRKA BASIN, N.T.

for
OP 238 Joint Venture
Sydney Oil Company (Pedirka) Pty Ltd (Operator)

April 1987

Petrofocus Pty Limited
44 Margaret Street
Sydney NSW 2000

CONTENTS

FIGURES

TABLES

1. SUMMARY

A detailed helicopter supported soil gas alkane survey over four seismic grids and two regional lines in OP 238 resulted in the detection of five zones containing anomalous concentrations of methane, ethane, propane and butane.

These zones are present over two seismic grids and one regional line in the central and western parts of the permit where clusters of anomalous samples occur. Samples over the two seismic grids in the east of OP 238 have anomalous concentrations of only one or two of the light alkanes and do not form clusters. No samples with anomalous concentrations of the light alkanes are present on the second regional line.

The ratios of methane to ethane, propane and butane concentrations suggest an oil-rich source for the hydrocarbons in Zones B, D and E. However, the ratios of the light alkanes in Zones A and C suggest a source for the hydrocarbons that is gas rich. It is possible that some of the methane may be derived from a remote gas source and migrated to traps within the vicinity of Zones A and C.

2. INTRODUCTION

Sydney Oil Company (Pedirka) Pty Ltd, operator of the OP 238 Joint Venture, commissioned Petrofocus Pty Ltd to carry out a detailed soil gas alkane survey on four seismic grids over prospects within the permit. Two regional lines were also commissioned to test the prospective nature of possible stratigraphic traps with little seismic coverage.

Only one soil gas survey has previously been conducted by Petrofocus in OP 238. During June 1985 a reconnaissance scale survey was carried out over the 1985 Colson seismic survey grid to evaluate the prospectivity of an area near Colson #1 well and an area to the northeast of the well. Two zones containing anomalous concentrations of the light alkanes were defined to the north and northeast of the Colson #1 well.

Navigation problems in OP 238 were minimal as most work was carried out on recent 1985 and 1986 seismic lines which are still prominent in the monotonous sand dune terrain. Sampling locations on the recent seismic lines and the early 1960's seismic lines could be fairly accurately determined. However, sampling locations on the regional lines could only be determined to about ± 2km.

Since 1981, Petrofocus and its predecessor Petrosearch, have carried out soil gas geochemical surveys, both in a broad-spaced reconnaissance mode in wildcat regions, and detailed, intensive sampling surveys over seismic survey leads and prospects. In addition, over 15 orientation surveys have been carried out over and adjacent to known oil and gas fields in the Surat, Eromanga, Canning and Amadeus Basins, and these show enhanced concentrations of the light alkane gases to be present in soils above or peripheral to the fields.

3. SURVEY METHODS

3.1 Introduction

Although success has been claimed over the past thirty or more years for various geochemical exploration techniques, enthusiasm for their employment is not widely shared by professionals in the petroleum industry.

Anomalous concentrations of hydrocarbon gases were first reported above petroleum reservoirs in the 1930's (Laubmeyer, 1933; Sokolov, 1933; Horvitz, 1939). These results quickly lead to the development of techniques for use in petroleum exploration, and in 1959 Sokolov summarised successful applications of the techniques in the U.S.S.R. as follows:

> "Under favourable geological conditions, the proportion of correct predictions (from geochemical surveys) is rather high - about 70 percent. For instance, in the North Caucasus (Kuban), predictions made by gas surveys were confirmed in thirteen cases out of seventeen."

Although successful uses of geochemical techniques have been documented in the western literature results obtained by industry users in the course of normal exploration have commonly produced negative or, at best, equivocal results which have led the techniques to disfavour. In many instances the unsatisfactory results can be attributed to poor sample collection, storage, preparation and analytical procedures. Most importantly, however, results of many surveys have not been interpreted properly. There is, in general, a poor understanding of what can be expected from geochemical methods and, particularly, of their limitations.

Within the past few years there has been, however, renewed interest in geochemical exploration techniques following the successful identification of surface anomalies above petroleum reservoirs by the Geosat Committee's study in which the Multispectral Scanner and the Thematic Mapper, now aboard Landsat 4, were flown over three test sites in the USA. The alteration features, verified on the ground, in soils, rocks and/or vegetation have been shown to result from leakage of light hydrocarbon gases from the moderately deep reservoirs (Rock, 1984; Patton and Manwaring, 1984; Matthews et al., 1984).

3.2 Microseeps

Successful employment of geochemical exploration techniques relies upon the phenomenon of vertical migration of light hydrocarbons that leak in trace amounts from petroleum reservoirs. This has been a hotly disputed issue, but the weight of evidence from reliable sources clearly demonstrates that vertical migration does, in fact, occur. It must now be conceded that light hydrocarbon gases do leak from at least some moderately deep to deep petroleum reservoirs and can be detected as microseeps located vertically above, or peripheral to, the surface projection of the reservoir as -

(i) free gas in the soil or absorbed to soil minerals (Debnam, 1969; Devine and Sears, 1977; Horvitz, 1972, 1979; Jones and Drozd, 1983; Richers et al., 1982; Rock, 1984; Matthews et al., 1984), or

(ii) as a chemical or mineralogical alteration of soil and surface rocks (Karstev, 1959; Donovan, 1974), or

(iii) in vegetation as either morphological or chemical effects (Donovan and Dalziel, 1977; Richers et al., 1982; Rock, 1984).

In addition, case studies conducted by Petrofocus since 1980 unambiguously show anomalous concentrations of light hydrocarbon gases directly above or immediately peripheral to the surface projection of 14 known petroleum reservoirs in the Surat, Cooper, Eromanga and Amadeus Basins.

3.3 Detection of Hydrocarbon Gas Microseeps

There are now in use several indirect techniques which exploit various manifestations of the vertical migration of hydrocarbons or associated gases leaking from deep petroleum reservoirs. These include magnetic, electrical (electromagnetic and induced polarization), radiometric and helium emanometry methods. However, the principal disadvantage in employing these methods is that the effects they respond to can also be produced by causes unrelated to the leakage of hydrocarbon gases.

Clearly, it is advantageous to detect and quantify the hydrocarbon microseeps themselves - this is the approach adopted by Petrosearch in which the light hydrocarbon gases in the soil gas are detected.

The detection of the light hydrocarbon gases was selected as the most reliable sampling medium since only gaseous hydrocarbons can pass directly through aquifers which are commonly present above petroleum reservoirs in many Australian sedimentary basins. On the other hand, hydrocarbons transported in solution, including dissolved gases, will be entrained in the aquifer or in the surficial groundwater system and may be released at some remote location which cannot be related to the parent petroleum reservoir.

In Petrofocus surveys soil gas samples are carefully collected from depths ranging from 0.5 to 1 metres using a probe of proprietary design and pre-prepared microsyringes. The gas samples are carefully packed in airtight containers for shipment to the analytical facility, which is located at the field base camp. Samples are analysed for the light alkanes methane through pentane by a gas chromatographic technique. The sensitivity of the chromatograph, as presently employed, is approximately 0.5 ppmv methane, 0.05 ppmv ethane, 0.02 ppmv propane, and 0.005 ppmv butane. The alkane concentrations of samples are determined by comparison with known concentrations in a specially prepared gas standard. Reproducibility of results is typically better than $\pm 5\%$.

3.4 Interpretation of Results

Because of differences in the proportion of oil and gas from reservoir to reservoir, and in the composition of the oil and gas phases, together with differences in reservoir parameters and in soil characteristics from region to region, an attempt is always made to carry out orientation surveys over known reservoirs as close as possible to the survey area. By comparing results from the survey area with those from the known reservoir an estimate can be made of the type of hydrocarbons giving rise to the microseeps detected in the survey area. Estimates of the size of the hydrocarbon reservoir in the survey area are difficult to establish and can only be attempted within areas having closely similar reservoir and soil characteristics because the magnitude of an anomaly may be determined by the ease of the migration of gases from the reservoir, rather than by the volume of gas in the reservoir. There is emerging some confidence that the ratios of the various alkanes present in soil gas can be an indication of the type of parent hydrocarbons in the reservoir (Jones and Drozd, 1983; Richers et al., 1982). The various ratios which may indicate the "oilyness" of a reservoir are determined for each anomaly detected, but this serves only as a non-definitive indicator, since the parameters which govern the amount and type of hydrocarbon gases present in near-surface environments are only imperfectly understood. They include the following:

(i) Depth of the reservoir and the nature of the overlying rocks.

(ii) Reservoir characteristics relating to the form of the reservoir, the integrity of its seal, the proportion of gas and the pressure under which it is constrained.

(iii) Soil properties, particularly the clay content, degree of compaction and moisture content of the soil.

(iv) Atmospheric variables, particularly atmospheric pressure, ambient temperature and rainfall.

When an area is re-surveyed it is commonly found that the location and intensity of soil gas anomalies has changed somewhat. The reasons for this are not always simple, but commonly conditions under which the later surveys are conducted are different from those pertaining during the original survey. The greatest effects are experienced after substantial rainfall when soil gas concentrations are greatly reduced due to their being flushed out of the near-surface zone. Anomalous areas defined by the original survey are much subdued after rainfall but generally can still be distinguished over depressed background readings.

However, the interpretation of results of soil gas surveys is more concerned the with anomaly to background contrast rather than with the absolute magnitude of anomalies. Comparison with results obtained from over known reservoirs considerably facilitates interpretation of those obtained from survey areas, but when comparisons with known reservoirs in the same region is not undertaken estimates of the commercial significance of soil gas anomalies cannot be reliably given.

4. OPERATIONS

A base camp was established within the survey area, from where all field operations and analytical services were co-ordinated. Mobilisation from Sydney to the base camp took place in two stages. The two-person crew travelled by air from Sydney to Alice Springs on March 21, and that afternoon took delivery of the 4WD to be used in the survey and obtained necessary camp supplies. At first light on March 22, the survey team drove from Alice Springs to the base camp. A camp co-ordinator was invited to ensure the fluent operation of the survey. Demobilisation from the camp commenced on March 28.

A total of 378 samples were collected employing a helicopter for transport, along seismic lines and cross-country in OP 238. Samples were collected at 1km intervals at non-contaminated sites over four recent seismic grids: Madigan Trough, Simpson Grid, Bejah Grid, and the East Border Trend. Samples were also collected along two regional lines at 2km intervals. Where possible, samples were taken from the sides of dunes 1 to 2 metres above the general level of the interdune troughs. This procedure generally permitted easy entry of the probe to the sampling depth of 0.75 to 1.0 metres and provided an airtight seal around the probe, without encountering the cemented horizons that are developed at the interdune levels. Sample locations are shown on Figures 1, 2 and 3.

Soils in the area are very poorly developed, and the entire area is covered by stabilised sand dunes, generally trending about 150°, supporting sparse native grasses and shrubs. Playa lakes are developed extensively between dunes, and these regions are characterised by the presence of incipient calcrete. There is no development of organic horizons in the sand soils and there is no reason to suspect the presence of microbially derived alkanes in soil gas samples.

Subterranean water samples were collected at the East Bore well, to the northwest of the permit area, for later chemical analysis for the possible presence of hydrocarbon compounds. It was also intended that subterranean water samples be collected at the dry oil wells Erabena #1 (to the south of the permit area), and McDills #1 (to the west of the permit area). However, the Erabena #1 pump head had dried up, thus not even permitting water flow; and surrounding the McDills #1 bore is a permanent swamp, rendering access to the pump head impossible.

During the survey, the weather was mild to hot and the nights were cool. Maximum daytime temperatures ranged from 35°C to 42°C. The previous rainfall in the region was recorded in mid-February, but those showers were typically scattered and isolated. The most recent heavy rainfall had occurred in August-September 1986.

5. RESULTS

The methane, ethane, propane and n-butane contents of the soil gas samples are listed in Table 1 and their locations are shown in Figures 1, 2 and 3. Overall the concentrations of the light hydrocarbons are low to medium. Methane concentrations range from 0.60 to 32.30 ppm, ethane from 0.10 to 1.87 ppm, propane from 0.04 to 0.70 ppm and butane from 0.01 to 0.14 ppm.

Samples with the highest concentrations of the light alkanes occur in the Simpson Grid (Zone A), the Madigan Trough (Zones B, D and E) and on regional Line A (Zone C), and are shown on Figures 1, 2 and 3. The results of the present survey are, in general, slightly lower than those obtained in previous surveys in adjacent permits. This is probably an effect of the heavy rainfall experienced in mid-1986.

Although samples with the highest concentrations of the alkanes are apparent by inspection of Table 1, the parameters that define the most anomalous population (which may be due to leakage from a petroleum reservoir at depth) are best determined by analysis of histograms and cumulative frequency plots of the concentrations of the alkanes. The histograms and cumulative frequency curves for methane, ethane, propane and butane concentrations of the 378 samples are shown in Figures 4 (a, b), 5 (a, b), 6 (a, b) and 7 (a, b) respectively.

The histogram and cumulative frequency curves indicate the presence of at least three populations, which is interpreted to mean the alkane gases have more than one source. The most anomalous population has a lower threshold limit of approximately 16.0 ppm methane, 0.09 ppm ethane, 0.35 ppm propane and 0.07 ppm butane.

Samples were collected at 1km intervals mainly on recent seismic survey lines over the Madigan Trough, East Border Trend, Simpson and Bejah seismic grids. Two regional lines were surveyed at a sample spacing of 2km. Regional line A trends at an angle of approximately 60° from the southern end of line 86-MT2 for a distance of about 75km. Regional line B trends at an angle of approximately 150° parallel to the sand dunes along 1960's seismic line 3H for a distance of approximately 100km.

Simpson Grid

One main area, Zone A, containing clusters of samples with anomalous concentrations of one or more of the light alkanes is present over the southern half of this grid located in the centre of the permit (Figure 3). This zone extends from sample 15 to sample 28 on Line 86-BT2, sample 36 to sample 44 on line 86-BT3 and sample 227 to 229 on the small line north of 86-BT3. Profiles of lines 86-BT2 and 86-BT3 are shown in Figures 9 and 10 respectively.

The ratio of light alkanes to $C_1/C_1+C_2+C_3+C_4$ is high and the percent wetness is low suggesting a gas-rich source for the hydrocarbons in Zone A.

The methane concentrations of the samples in Zone A are high compared to the concentrations of ethane, propane and butane. This suggests that some of the methane may have migrated a considerable distance from gas rich parts of the basin and been trapped in structures developed in this area. The effect of this possible dry gas migration would be to raise the light alkane ratio to indicate a source that is more oil-rich.

Other samples in the Simpson Grid that contain anomalous levels of some of the light alkanes are isolated from each other and hence their significance as indicators of a petroleum source at depth is diminished.

Madigan Trough

Clusters of samples containing anomalous concentrations of one or more of the light alkanes are present in three zones, B, D and E (Figure 1), along the southern extension of the Madigan Trough grid located near the northwestern corner of OP 238.

Zone B extends along line 86-MTA for a distance of about 12km. No samples with anomalous levels of the light alkanes are present on lines 86-MT2 and 86-MT4 indicating that this zone does not extend any further north or east of that shown on Figure 1. However, the western and southern extensions of Zone B are uncertain.

The ratios of the alkane concentrations and the percent wetness suggest that the light alkanes in Zone B are derived from a more oil-rich source.

The areal extent of Zones D and E, located north of Zone B on line 86-MTA, has not been determined by the present survey and may extend to the northwest and southeast. The ratios of the alkane concentrations for these zones also suggest an oil rich source.

The concentations of the light alkanes in Zones B, D and E on line 86-MTA are shown as a profile plot in Figure 8.

None of the methane concentrations of the samples in the Madigan Trough grid were found to be anomalous however they are elevated where the heavier alkanes have anomalous concentrations. All the samples in the northern half of the Madigan Trough have concentrations of all the light alkanes that are below the anomalous threshold limits.

Bejah Grid

The Bejah Grid consists of two small lines over 1960's seismic lines (Figure 3). Four samples (154, 155, 160 and 161) contain anomalous levels of propane. Apart from these, no other samples have concentrations of the light alkanes that are above the anomalous threshold limits.

The ratios of the light alkanes $C_1/C_1+C_2+C_3+C_4$ and percent wetness indicate an oil rich source for the hydrocarbons but there is no encouragement for follow-up work in this region.

East Border Trend

Several samples from the East Border Trend, situated in the northeastern corner of OP 238, contain anomalous levels of propane and butane. The majority of these samples are located in the southern half of the seismic grid, however there is very little clustering present. This tends to diminish the petroleum potential of this region. There are only two samples (65 and 132) with anomalous levels of ethane and one sample (65) with an anomalous methane concentration.

The ratios of the methane to ethane, propane and butane concentrations are low, and indicate an oil source, rather than gas, for samples on the East Border Trend.

Regional Line A

This line extends from the southern end of line 86-MT2 on the Madigan Trough grid to a point about three kilometres southwest of the Hale River #1 well site (Figures 1 and 2).

Samples with anomalous concentrations of methane, ethane, and/or butane are present at the southwestern end of this line near the Madigan Trough grid. Zone C extends along this line from samples 289 to 294. Although the concentrations of the light alkanes in sample 290 and 291 are non-anomalous, they are elevated and are interpreted as belonging to Zone C.

Sample 298 contains concentrations of methane and ethane that are above the anomalous threshold limits. The northern and southern extensions of Zone C have not been determined by this survey, so sample 298 may indicate a continuation of Zone C. The concentrations of the light alkanes in the northern half of Line A are all below the anomalous threshold limits.

The ratios of the light alkanes are high and the percent wetness is low for samples in Zone C indicating a gas rich source. As suggested for Zone A, some of the methane may be derived from a remote source therefore the hydrocarbon source may be more oil rich that the ratios indicate.

The concentrations of the light alkanes along Line A are displayed as a profile plot in Figure 11.

Regional Line B

This line extends from the northern border of OP 238 to the southern border along the 1960's seismic line 3H (Figures 2 and 3). None of the samples along this line recorded concentrations of the light alkanes that are above the anomalous threshold limit.

6. CONCLUSIONS

Five zones containing anomalous concentrations of the light alkane gases were indentified in the central and western parts of OP 238 during the present survey. The levels of methane, ethane, propane and butane are, in general, low to moderate.

Zone A is located in the southern half of the Simpson Grid and has areal dimensions of approximately 9km x 13km. The methane levels are high compared to those of ethane, propane and butane, and it is suggested that some of the methane may be derived from a remote dry gas source and has migrated to traps in this region. Hence the hydrocarbon source for this zone may be more oil rich than the ratios indicate. The Simpson Grid does not have any other clusters of samples with anomalous concentrations of the light alkanes.

Zones B, D and E are located in the southern half of the Madigan Trough Grid. Zones D and E are of uncertain areal extent and Zone B is at least 12km long but may extend further to the south or west. The ratios of methane to ethane, propane and butane concentrations are low, and indicate derivation of the light alkane gases from an oil source. The samples in the northern half of the Madigan Trough have concentrations of the light alkanes that are below the anomalous threshold limits.

Zone C is situated towards the southwestern end of regional Line A. This is at least 8km long but may be larger as its areal extent is uncertain. The methane concentrations over this zone are high and the source of the light hydrocarbons may be more oil rich that the ratios suggest.

The East Border Trend and Bejah grids contain no clustering of samples with anomalous concentrations of the light alkanes. All samples along Regional Line B contain non-anomalous levels of the light alkanes. There is no encouragement for follow-up work in the vicinity of East Border Trend, Bejah or Line B.

Due to the absence of known petroleum fields in the region over which calibration surveys can be carried out, the results of the present survey cannot provide an estimate of economic viability of the potential petroleum accumulations.

The Madigan Trough and Simpson Grid areas warrant follow-up if geological reasons are favourable to better ascertain the petroleum potential of these regions.

7. REFERENCES

Technical References

Debnam, A.H., 1969. Geochemical prospecting for petroleum and natural gas in Canada. Geol. Surv. Can. Paper 64:15.

Devine, S.B. and Sears, H.W., 1977. Soil hydrocarbon geochemistry, a potential exploration tool in the Cooper Basin, Australia. J. Geochem. Explor. 8, pp. 397-414.

Donovan, T.J., 1974. Petroleum microseepage at Cement, Oklahoma; evidence and mechanism. Bull, Amer, Assoc, Petrol, Geol., 58 pp. 429-446.

Donovan, T.J. and Dalziel, M.C., 1977. Late diagenetic indicators of buried oil and gas. U.S. Geol. Surv. Open File Rept. pp. 77-817.

Horvitz, L., 1939. On geochemical prospecting. Geophys. 4, pp. 210-225

Horvitz, L., 1972. Vegetation and geochemical prospecting for petroleum. Bull. Amer. Assoc. Petrol. Geol. 56. pp. 925-940.

Horvitz, L., 1979. Near surface evidence of hydrocarbon movement from depth. In Problems of Petroleum Migration. Amer. Assoc. Petrol. Geol. Stud. Geol., 10, pp. 241-270.

Jones, V.T. and Drozd, R.J., 1983. Predictions of oil or gas potential by near-surface geochemistry. Amer. Assoc. Petrol. Geol. Bull. 67, 932-952.

Karstev, A.A., Tabasaranski, Z.A., Subbota, M.I. and Mogilevskii, G.A., 1959. Geochemical methods of prospecting and exploration for petroleum and natural gas. UCLA Press.

Laubmeyer, G., 1933. A new geophysical prospecting method, especially for deposits of hydrocarbons. Petroleum, 29, pp. 1-4.

Matthews, M.D., Jones, V.T., and Richers, D.M., 1984. Remote sensing and surface hydrocarbon seepage. Remote Sensing for Exploration Geology Conference, Colorado Springs, April 1984. Environmental Research Institute of Michigan, pp. 1-6.

Patton, K.H. and Manwaring, M., 1984. Evaluation of a Landsat derived tonal anomaly for hydrocarbon microseepage, Southwest Kansas. Remote Sensing for Exploration Geology Conference, Colorado Springs, April 1984. Environmental Research Institute of Michigan, p. 66.

Richers, D.M., Reed, R.J., Horstman, K.C., Michels, G.D., Baker, R.N. Lundel, L., and Marrs, R.W., 1982. Landsat and soil-gas geochemical study of Patrick Draw oil field , Sweetwater Country, Wyoming. Amer. Assoc. Petrol. Geol. Bull., 66 pp. 903-922.

Rock, B.N., 1984. Remote detection of geobotanical anomalies associated with hydrocarbon microseepage. Remote Sensing for Exploration Geology Conference, Colorado Springs, April 1984. Environmental Research Institute of Michigan, p. 24.

Sokolov, V.A., 1933. New prospecting method for petroleum and gas. Technika. Feb. Bull. NGRI No. 1.

Sokolov, V.A., 5959. Geochemical methods of prospecting for oil and gas deposits. Izd. Akad. Nauk SSR, Moscow.

TABLE 1. Methane, ethane, propane, butane concentrations (ppmv) and derived ratios for soil gas samples

SOIL GAS ALKANE SURVEY OP 238 SOC MARCH 1987

REF NO.	LINE	SAMPLE NUMBER	C1	C2	C3	C4	C1 / C1+C2+C3+C4	C1 / C2	% Wetness C2+C3+C4 / C1+C2+C3+C4
1	86-BT2	1	18.20	.71	.62	.10	.927	25.63	7.28
2		2	4.00	.40	.37	.08	.825	10.00	17.53
3		3	3.70	.20	.10	.04	.916	18.50	8.42
4		4	10.30	.81	.12	.06	.912	12.72	8.77
5		5	7.40	.83	.11	.06	.881	8.92	11.90
6		6	14.30	1.31	.15	.08	.903	10.92	9.72
7		7	10.60	.41	.08	.04	.952	25.85	4.76
8		8	12.60	.38	.09	.03	.962	33.16	3.82
9		9	8.20	.24	.15	.02	.952	34.17	4.76
10		10	4.70	.17	.15	.03	.931	27.65	6.93
11		11	10.60	.42	.23	.05	.938	25.24	6.19
12		12	10.60	.42	.14	.04	.946	25.24	5.36
13		13	4.10	.17	.19	.04	.911	24.12	8.89
14		14	7.30	.20	.08	.03	.959	36.50	4.07
15		15	21.30	1.06	.38	.07	.934	20.09	6.62
16		16	18.20	.57	.13	.04	.961	31.93	3.91
17		17	26.70	1.21	.28	.07	.945	22.07	5.52
18		18	11.10	.41	.11	.04	.952	27.07	4.80
19		19	15.80	.72	.18	.03	.944	21.94	5.56
20		20	9.50	.48	.11	.02	.940	19.79	6.03
21		21	24.40	.82	.16	.06	.959	29.76	4.09
22		22	22.50	.90	.21	.08	.950	25.00	5.02
23		23	19.00	.66	.16	.08	.955	28.79	4.52
24		24	17.00	.79	.22	.07	.940	21.52	5.97
25		25	17.40	.61	.13	.05	.957	28.52	4.34
26		26	31.50	1.01	.22	.05	.961	31.19	3.90
27		27	23.40	.47	.19	.04	.971	49.79	2.90
28		28	22.10	.49	.18	.02	.970	45.10	3.03
29		29	12.60	.45	.09	.03	.957	28.00	4.33
30		30	15.60	.26	.10	.03	.976	60.00	2.44
31		31	17.00	.75	.16	.03	.948	22.67	5.24
32		32	16.00	.29	.14	.02	.973	55.17	2.74
33		33	13.20	.47	.11	.05	.954	28.09	4.56
34		34	11.40	.48	.13	.03	.947	23.75	5.32
35		35	12.30	.62	.12	.07	.938	19.84	6.18
36	86-BT3	36	27.40	.57	.20	.06	.971	48.07	2.94
37		37	19.90	.25	.13	.04	.979	79.60	2.07
38		38	24.30	.44	.20	.03	.973	55.23	2.68
39		39	22.10	.40	.19	.04	.972	55.25	2.77
40		40	11.00	.29	.20	.04	.954	37.93	4.60
41		41	18.50	.49	.25	.06	.959	37.76	4.15
42		42	18.70	.46	.15	.08	.964	40.65	3.56
43		43	32.30	1.08	.20	.11	.959	29.91	4.13
44		44	16.30	.59	.12	.07	.954	27.63	4.57
45		45	10.00	.26	.13	.03	.960	38.46	4.03
46		46	7.30	.32	.12	.04	.938	22.81	6.17
47		47	3.50	.18	.11	.02	.919	19.44	8.14
48		48	4.90	.16	.12	.02	.942	30.63	5.77
49		49	7.50	.33	.15	.03	.936	22.73	6.37
50		50	11.90	.26	.13	.05	.964	45.77	3.57
51		51	6.90	.32	.14	.04	.932	21.56	6.76
52		52	11.70	.36	.09	.02	.961	32.50	3.86
53	LINE 2Y	53	20.80	.70	.15	.07	.958	29.71	4.24
54		54	15.40	.42	.08	.04	.966	36.67	3.39
55		55	15.60	.63	.12	.04	.952	24.76	4.82
56		56	15.60	.49	.10	.04	.961	31.84	3.88
57		57	9.90	.29	.09	.02	.961	34.14	3.88
58		58	14.10	.38	.10	.05	.964	37.11	3.62
59		59	19.90	.63	.14	.07	.959	31.59	4.05
60		60	10.20	.38	.09	.04	.952	26.84	4.76

61		61	16.40	.63	.14	.06	.952	26.03	4.82
62		62	13.90	.64	.18	.05	.941	21.72	5.89
63		63	15.20	.54	.15	.03	.955	28.15	4.52
64		64	11.80	.49	.09	.05	.949	24.08	5.07
65	86-BT4	65	22.40	1.17	.16	.09	.940	19.15	5.96
66		66	9.90	.86	.44	.09	.877	11.51	12.31
67		67	5.50	.36	.16	.05	.906	15.28	9.39
68		68	2.40	.31	.18	.04	.819	7.74	18.09
69		69	.80	.15	.06	.02	.777	5.33	22.33
70		70	1.70	.24	.09	.06	.813	7.08	18.66
71		71	2.80	.25	.19	.06	.848	11.20	15.15
72		72	5.50	.35	.19	.03	.906	15.71	9.39
73		73	3.40	.24	.18	.05	.879	14.17	12.14
74		74	2.90	.30	.18	.05	.845	9.67	15.45
75		75	5.50	.34	.26	.04	.896	16.18	10.42
76		76	1.50	.34	.15	.04	.739	4.41	26.11
77		77	3.60	.36	.19	.06	.855	10.00	14.49
78		78	3.60	.30	.10	.04	.891	12.00	10.89
79		79	2.40	.30	.22	.05	.808	8.00	19.19
80		80	5.20	.28	.19	.04	.911	18.57	8.93
81		81	2.90	.20	.16	.03	.881	14.50	11.85
82		82	4.10	.20	.16	.04	.911	20.50	8.89
83		83	2.10	.18	.11	.04	.864	11.67	13.58
84		84	1.70	.11	.09	.03	.881	15.45	11.92
85		85	1.50	.20	.06	.03	.838	7.50	16.20
86		86	3.40	.17	.07	.04	.924	20.00	7.61
87		87	5.00	.12	.06	.02	.962	41.67	3.85
88		88	6.00	.36	.24	.06	.901	16.67	9.91
89		89	4.20	.70	.29	.06	.800	6.00	20.00
90		90	7.30	.72	.24	.09	.874	10.14	12.57
91		91	6.40	.70	.32	.08	.853	9.14	14.67
92		92	9.20	.60	.21	.06	.914	15.33	8.64
93		93	8.70	.67	.17	.05	.907	12.99	9.28
94		94	5.30	.37	.14	.02	.909	14.32	9.09
95		95	7.60	.72	.47	.08	.857	10.56	14.32
96	SD 79-9	96	8.50	.56	.15	.06	.917	15.18	8.31
97		97	5.10	.52	.16	.07	.872	9.81	12.82
98		98	6.10	.55	.16	.06	.888	11.09	11.21
99		99	6.10	.48	.18	.04	.897	12.71	10.29
100		100	6.40	.41	.15	.05	.913	15.61	8.70
101		101	6.10	.47	.11	.03	.909	12.98	9.09
102		102	4.00	.25	.07	.01	.924	16.00	7.62
103		103	6.90	.18	.05	.04	.962	38.33	3.77
104		104	7.20	.22	.07	.03	.957	32.73	4.26
105		105	8.20	.18	.08	.02	.967	45.56	3.30
106		106	4.10	.11	.05	.02	.958	37.27	4.21
107		107	4.80	.10	.06	.02	.964	48.00	3.61
108	86-BT5	108	5.80	.19	.06	.02	.956	30.53	4.45
109		109	5.70	.20	.07	.03	.950	28.50	5.00
110		110	5.00	.12	.07	.03	.958	41.67	4.21
111		111	2.30	.15	.06	.03	.906	15.33	9.45
112		112	4.60	.20	.06	.02	.943	23.00	5.74
113		113	5.50	.28	.06	.04	.935	19.64	6.46
114		114	2.90	.22	.07	.03	.901	13.18	9.94
115		115	5.00	.20	.06	.03	.945	25.00	5.48
116		116	6.00	.28	.12	.04	.932	21.43	6.83
117		117	.90	.14	.18	.03	.720	6.43	28.00
118		118	1.60	.12	.12	.03	.856	13.33	14.44
119		119	1.30	.14	.05	.02	.861	9.29	13.91
120		120	1.30	.27	.22	.03	.714	4.81	28.57
121		121	1.50	.27	.23	.06	.728	5.56	27.18
122		122	2.70	.27	.05	.03	.885	10.00	11.48
123		123	3.40	.27	.06	.03	.904	12.59	9.57
124		124	7.60	.47	.13	.04	.922	16.17	7.77
125	LINE 3E	125	8.80	.42	.21	.05	.928	20.95	7.17
126		126	9.00	.44	.15	.05	.934	20.45	6.64
127		127	6.60	.50	.18	.03	.903	13.20	9.71
128		128	2.60	.21	.16	.02	.870	12.38	13.04
129		129	4.20	.30	.15	.04	.896	14.00	10.45
130		130	7.80	.39	.15	.04	.931	20.00	6.92

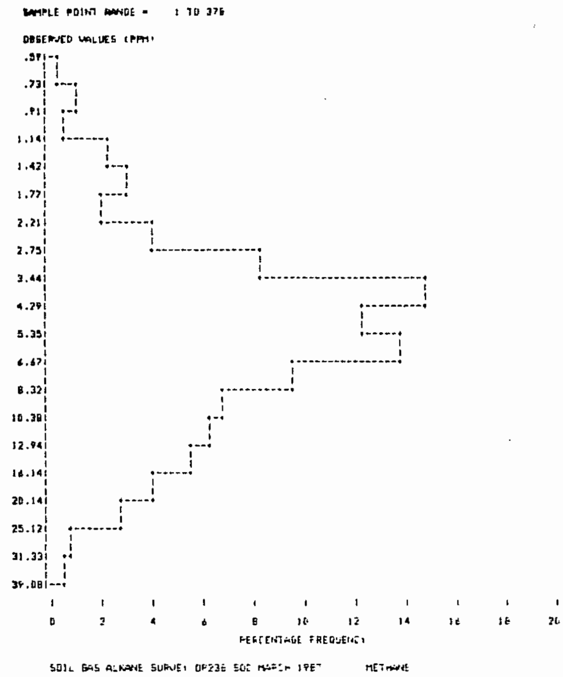
131		131	9.00	.46	.18	.05	.929	19.57	7.12
132		132	5.80	.90	.33	.11	.812	6.44	18.77
133		133	8.50	.68	.26	.09	.892	12.50	10.81
134		134	6.90	.71	.49	.14	.837	9.72	16.26
135		135	4.00	.44	.30	.08	.830	9.09	17.01
136		136	5.00	.40	.39	.10	.849	12.50	15.11
137		137	1.50	.20	.32	.05	.725	7.50	27.54
138	LINE B4	138	7.90	.25	.17	.03	.946	31.60	5.39
139		139	5.90	.40	.16	.05	.906	14.75	9.37
140		140	4.20	.47	.25	.03	.848	8.94	15.15
141		141	7.10	.49	.28	.04	.898	14.49	10.24
142		142	7.20	.37	.49	.07	.886	19.46	11.44
143		143	4.10	.42	.16	.03	.870	9.76	12.95
144		144	1.20	.20	.28	.02	.706	6.00	29.41
145		145	5.10	.36	.32	.03	.878	14.17	12.22
146		146	7.60	.63	.37	.02	.882	12.06	11.83
147		147	1.70	.26	.27	.03	.752	6.54	24.78
148		148	3.10.	.27	.26	.03	.847	11.48	15.30
149		149	4.40	.44	.32	.03	.848	10.00	15.22
150	LINE 2G	150	3.70	.29	.31	.04	.853	12.76	14.75
151		151	3.80	.31	.16	.04	.882	12.26	11.83
152		152	4.70	.49	.34	.04	.844	9.59	15.62
153		153	.90	.14	.24	.02	.692	6.43	30.77
154		154	3.80	.31	.38	.02	.843	12.26	15.74
155		155	5.60	.47	.38	.02	.866	11.91	13.45
156		156	4.70	.41	.30	.03	.864	11.46	13.60
157		157	5.90	.51	.34	.02	.871	11.57	12.85
158		158	6.60	.66	.21	.02	.881	10.00	11.88
159		159	3.50	.31	.14	.04	.877	11.29	12.28
160		160	5.80	.56	.38	.04	.855	10.36	14.45
161		161	5.00	.60	.44	.04	.822	8.33	17.76
162		162	5.10	.48	.14	.02	.889	10.62	11.15
163		163	2.90	.36	.20	.03	.831	8.06	16.91
164		164	3.20	.40	.15	.02	.849	8.00	15.12
165		165	8.40	.66	.16	.03	.908	12.73	9.19
166		166	10.50	.89	.22	.04	.901	11.80	9.87
167	86-MTB	167	3.00	.33	.13	.05	.855	9.09	14.53
168		168	1.50	.25	.10	.02	.802	6.00	19.79
169		169	4.10	.31	.21	.04	.880	13.23	12.02
170		170	3.00	.38	.13	.04	.845	7.89	15.49
171		171	1.60	.29	.11	.03	.788	5.52	21.18
172		172	1.40	.19	.12	.04	.800	7.37	20.00
173		173	1.30	.37	.09	.04	.722	3.51	27.78
174		174	4.70	.39	.23	.03	.879	12.05	12.15
175		175	3.20	.32	.12	.02	.874	10.00	12.57
176		176	2.60	.34	.08	.04	.850	7.65	15.03
177		177	3.60	.24	.07	.03	.914	15.00	8.63
178		178	6.70	.55	.14	.06	.899	12.18	10.07
179		179	3.20	.38	.15	.04	.849	8.42	15.12
180		180	5.40	.50	.13	.03	.891	10.80	10.89
181		181	7.00	.69	.15	.04	.888	10.14	11.17
182		182	7.90	.68	.14	.03	.903	11.62	9.71
183		183	10.00	.78	.20	.03	.908	12.82	9.17
184		184	9.70	.66	.16	.04	.919	14.70	8.14
185		185	3.10	.19	.12	.01	.906	16.32	9.36
186		186	3.10	.27	.08	.01	.896	11.48	10.40
187	86-MTA	187	11.30	1.23	.42	.05	.869	9.19	13.08
188		188	11.20	1.18	.36	.05	.876	9.49	12.43
189		189	3.30	.27	.08	.02	.899	12.22	10.08
190		190	5.60	.50	.14	.05	.890	11.20	10.97
191		191	4.70	.37	.09	.04	.904	12.70	9.62
192		192	1.20	.23	.06	.03	.789	5.22	21.05
193		193	5.70	.49	.17	.05	.889	11.63	11.08
194		194	3.20	.42	.06	.03	.863	7.62	13.75
195		195	12.10	1.23	.44	.05	.876	9.84	12.45
196		196	9.10	1.19	.47	.07	.840	7.65	15.97
197		197	4.80	.38	.08	.05	.904	12.63	9.60
198		198	5.60	.54	.16	.06	.881	10.37	11.95
199		199	6.10	.81	.26	.04	.846	7.53	15.40
200		200	14.00	1.61	.59	.06	.861	8.70	13.90

201		201	15.10	1.87	.70	.08	.851	8.07	14.93
202		202	5.50	.51	.09	.03	.897	10.78	10.28
203		203	4.20	.58	.38	.03	.809	7.24	19.08
204		204	11.40	1.35	.55	.07	.853	8.44	14.73
205		205	14.50	1.58	.48	.03	.874	9.18	12.60
206		206	3.50	.50	.18	.03	.831	7.00	16.86
207		207	10.00	.90	.32	.07	.886	11.11	11.43
208		208	6.60	1.07	.38	.03	.817	6.17	18.32
209		209	3.90	.43	.26	.04	.842	9.07	15.77
210		210	9.90	.99	.19	.03	.891	10.00	10.89
211		211	10.30	1.50	.32	.05	.846	6.87	15.37
212		212	13.50	1.17	.42	.08	.890	11.54	11.01
213	86-BT1	213	1.90	.36	.10	.02	.798	5.28	20.17
214		214	7.50	.26	.17	.05	.940	28.85	6.02
215		215	6.50	.18	.06	.04	.959	36.11	4.13
216		216	.60	.11	.07	.02	.750	5.45	25.00
217		217	5.70	.33	.10	.03	.925	17.27	7.47
218		218	6.50	.30	.14	.03	.933	21.67	6.74
219		219	8.20	.39	.14	.04	.935	21.03	6.50
220		220	2.10	.11	.09	.03	.901	19.09	9.87
221		221	2.60	.13	.15	.04	.890	20.00	10.96
222		222	5.00	.26	.09	.03	.929	19.23	7.06
223		223	4.20	.40	.08	.03	.892	10.50	10.83
224		224	16.90	.41	.20	.04	.963	41.22	3.70
225		225	7.70	.51	.11	.04	.921	15.10	7.89
226		226	6.90	.53	.14	.04	.907	13.02	9.33
227	CROSS LINE	227	18.50	1.22	.42	.09	.914	15.16	8.55
228		228	6.30	.58	.30	.08	.868	10.86	13.22
229		229	8.50	.52	.39	.02	.901	16.35	9.86
230		230	3.40	.31	.20	.04	.861	10.97	13.92
231		231	2.20	.22	.14	.03	.849	10.00	15.06
232		232	5.90	.38	.20	.06	.902	15.53	9.79
233		233	4.00	.28	.18	.04	.889	14.29	11.11
234		234	6.60	.29	.15	.02	.935	22.76	6.52
235	CROSS LINE	235	10.70	.81	.38	.08	.894	13.21	10.61
236		236	6.10	.74	.24	.03	.858	8.24	14.21
237		237	3.70	.39	.19	.03	.858	9.49	14.15
238		238	3.20	.28	.06	.04	.894	11.43	10.61
239		239	3.80	.36	.08	.04	.888	10.56	11.21
240	86-MT2	240	1.00	.36	.10	.06	.658	2.78	34.21
241		241	1.90	.48	.07	.06	.757	3.96	24.30
242		242	2.50	.40	.08	.01	.836	6.25	16.39
243		243	.90	.20	.07	.01	.763	4.50	23.73
244		244	3.00	.21	.08	.03	.904	14.29	9.64
245		245	1.90	.36	.07	.02	.809	5.28	19.15
246		246	1.90	.28	.12	.04	.812	6.79	18.80
247		247	2.20	.42	.10	.02	.803	5.24	19.71
248		248	1.40	.18	.06	.02	.843	7.78	15.66
249		249	4.10	.45	.12	.06	.867	9.11	13.32
250	86-MT4	250	2.50	.36	.08	.02	.845	6.94	15.54
251		251	4.00	.37	.12	.03	.885	10.81	11.50
252		252	3.60	.30	.15	.04	.880	12.00	11.98
253		253	3.00	.38	.07	.04	.860	7.89	14.04
254		254	3.60	.25	.05	.02	.918	14.40	8.16
255		255	3.70	.26	.07	.02	.914	14.23	8.64
256		256	4.40	.60	.17	.06	.841	7.33	15.87
257		257	5.70	.43	.20	.05	.893	13.26	10.66
258		258	5.50	.66	.24	.04	.854	8.33	14.60
259		259	1.40	.20	.06	.02	.833	7.00	16.67
260	86-MT6	260	1.10	.19	.04	.02	.815	5.79	18.52
261		261	2.40	.27	.06	.02	.873	8.89	12.73
262		262	4.50	.38	.13	.03	.893	11.84	10.71
263		263	3.60	.44	.16	.04	.849	8.18	15.09
264		264	3.10	.32	.14	.03	.864	9.69	13.65
265		265	7.10	.37	.13	.04	.929	19.19	7.07
266		266	4.20	.34	.11	.03	.897	12.35	10.26
267		267	3.30	.21	.07	.02	.917	15.71	8.33
268		268	5.20	.47	.18	.05	.881	11.06	11.86
269		269	6.90	.69	.30	.07	.867	10.00	13.32
270		270	4.00	.34	.27	.04	.860	11.76	13.98

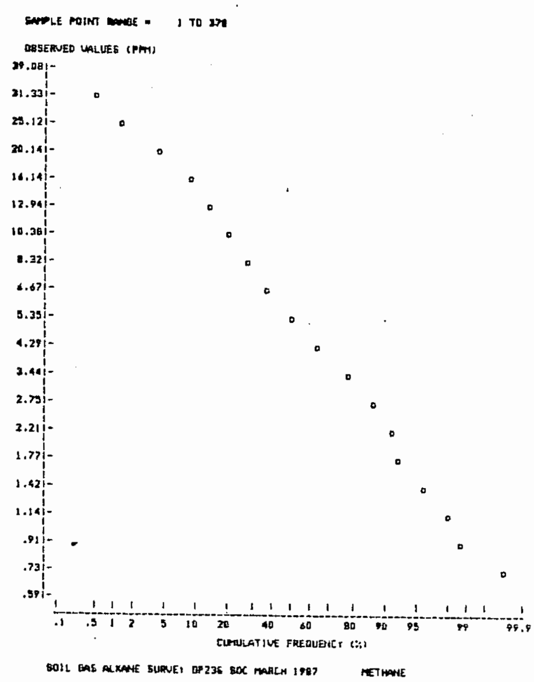
271	86-MT8	271	6.60	.86	.34	.09	.837	7.67	16.35
272		272	8.90	.82	.26	.06	.886	10.85	11.35
273		273	4.80	.94	.30	.05	.788	5.11	21.18
274		274	5.10	.66	.11	.04	.863	7.73	13.71
275		275	2.50	.23	.07	.04	.880	10.87	11.97
276		276	3.90	.46	.25	.04	.839	8.48	16.13
277		277	3.60	.28	.14	.05	.885	12.86	11.55
278		278	4.10	.31	.08	.04	.905	13.23	9.49
279		279	1.50	.20	.05	.01	.852	7.50	14.77
280		280	5.80	.64	.34	.08	.845	9.06	15.45
281		281	6.10	.52	.21	.05	.887	11.73	11.34
282		282	4.90	.42	.15	.04	.889	11.67	11.07
283	REGIONAL	283	10.40	.66	.16	.04	.924	15.76	7.64
284	LINE A	284	5.50	.35	.06	.03	.926	15.71	7.41
285		285	4.00	.42	.08	.03	.883	9.52	11.70
286		286	7.20	.47	.10	.05	.921	15.32	7.93
287		287	14.40	.93	.17	.05	.926	15.48	7.40
288		288	11.90	.85	.14	.04	.920	14.00	7.97
289		289	18.10	.91	.14	.07	.942	19.89	5.83
290		290	15.10	.88	.11	.04	.936	17.16	6.39
291		291	15.20	.70	.10	.04	.948	21.71	5.24
292		292	17.30	.81	.10	.03	.948	21.36	5.15
293		293	20.80	.74	.12	.05	.958	28.11	4.19
294		294	20.60	1.10	.14	.05	.941	18.73	5.89
295		295	9.30	.43	.09	.03	.944	21.63	5.58
296		296	13.90	.73	.10	.04	.941	19.04	5.89
297		297	10.40	.76	.11	.08	.916	13.68	8.37
298		298	30.10	.96	.15	.06	.963	31.35	3.74
299		299	15.00	.63	.09	.06	.951	23.81	4.94
300		300	15.60	.83	.09	.05	.941	18.80	5.85
301		301	12.40	.69	.08	.04	.939	17.97	6.13
302		302	5.10	.31	.07	.04	.924	16.45	7.61
303		303	6.80	.49	.18	.05	.904	13.88	9.57
304		304	5.50	.38	.08	.03	.918	14.47	8.18
305		305	7.10	.36	.06	.04	.939	19.72	6.08
306		306	5.60	.41	.13	.03	.908	13.66	9.24
307		307	7.50	.40	.05	.04	.939	18.75	6.13
308		308	5.80	.46	.18	.02	.898	12.61	10.22
309		309	5.60	.32	.07	.03	.930	17.50	6.98
310		310	4.40	.44	.17	.05	.870	10.00	13.04
311		311	6.80	.37	.10	.04	.930	18.38	6.98
312		312	6.40	.46	.16	.04	.907	13.91	9.35
313		313	3.80	.17	.06	.02	.938	22.35	6.17
314		314	5.00	.31	.06	.03	.926	16.13	7.41
315		315	8.00	.38	.05	.03	.946	21.05	5.44
316		316	4.60	.46	.17	.03	.875	10.00	12.55
317		317	6.60	.40	.12	.03	.923	16.50	7.69
318		318	5.10	.34	.20	.05	.896	15.00	10.37
319		319	3.50	.15	.05	.02	.941	23.33	5.91
320	REGIONAL	320	4.00	.26	.07	.02	.920	15.38	8.05
321	LINE B	321	5.10	.42	.16	.03	.893	12.14	10.68
322		322	3.30	.29	.09	.04	.887	11.38	11.29
323		323	2.70	.18	.07	.02	.909	15.00	9.09
324		324	1.70	.11	.05	.02	.904	15.45	9.57
325		325	3.50	.19	.09	.04	.916	18.42	8.38
326		326	4.20	.32	.07	.03	.909	13.12	9.09
327		327	4.10	.31	.14	.04	.893	13.23	10.68
328		328	3.90	.25	.07	.03	.918	15.60	8.24
329		329	3.80	.29	.12	.03	.896	13.10	10.38
330		330	2.50	.20	.06	.02	.899	12.50	10.07
331		331	3.60	.14	.08	.04	.933	25.71	6.74
332		332	5.80	.42	.22	.08	.890	13.81	11.04
333		333	4.00	.24	.09	.04	.915	16.67	8.47
334		334	4.20	.25	.09	.03	.919	16.80	8.10
335		335	3.30	.19	.07	.03	.919	17.37	8.08
336		336	4.60	.22	.09	.03	.931	20.91	6.88
337		337	4.40	.32	.09	.03	.909	13.75	9.09
338		338	5.10	.27	.10	.04	.926	18.89	7.44
339		339	4.50	.37	.14	.05	.889	12.16	11.07
340		340	4.70	.25	.10	.04	.923	18.80	7.66

341		341	5.70	.31	.14	.05	.919	18.39	8.06
342		342	5.00	.23	.09	.03	.935	21.74	6.54
343		343	2.40	.20	.10	.02	.882	12.00	11.76
344		344	4.90	.22	.06	.04	.939	22.27	6.13
345		345	4.20	.30	.11	.04	.903	14.00	9.68
346		346	1.20	.12	.05	.01	.870	10.00	13.04
347		347	2.50	.14	.06	.02	.919	17.86	8.09
348		348	3.90	.26	.09	.03	.911	15.00	8.88
349		349	3.10	.13	.05	.02	.939	23.85	6.06
350		350	3.10	.24	.10	.04	.891	12.92	10.92
351		351	4.70	.26	.10	.03	.923	18.08	7.66
352		352	6.00	.43	.13	.04	.909	13.95	9.09
353		353	7.60	.41	.12	.03	.931	18.54	6.86
354		354	4.90	.28	.10	.03	.923	17.50	7.72
355		355	5.80	.34	.15	.07	.912	17.06	8.81
356		356	2.30	.14	.09	.04	.895	16.43	10.51
357		357	3.90	.17	.08	.02	.935	22.94	6.47
358		358	4.60	.20	.07	.02	.941	23.00	5.93
359		359	4.60	.12	.08	.04	.950	38.33	4.96
360		360	3.20	.14	.05	.02	.938	22.86	6.16
361		361	4.60	.11	.06	.03	.958	41.82	4.17
362		362	4.10	.19	.10	.04	.926	21.58	7.45
363		363	3.00	.11	.05	.03	.940	27.27	5.96
364		364	4.20	.13	.07	.03	.948	32.31	5.19
365		365	4.10	.15	.05	.02	.949	27.33	5.09
366		366	4.90	.13	.05	.02	.961	37.69	3.92
367		367	3.40	.15	.06	.02	.937	22.67	6.34
368		368	2.80	.16	.05	.02	.924	17.50	7.59
369		369	5.70	.22	.09	.02	.945	25.91	5.47
370	LINE B4	370	6.70	.25	.19	.02	.936	26.80	6.42
371		371	10.70	.72	.47	.08	.894	14.86	10.61
372		372	9.00	.62	.39	.05	.895	14.52	10.54
373		373	7.90	.17	.06	.02	.969	46.47	3.07
374		374	6.10	.15	.09	.04	.956	40.67	4.39
375		375	4.50	.10	.06	.02	.962	45.00	3.85
376		376	9.00	.16	.05	.02	.975	56.25	2.49
377		377	8.40	.26	.12	.03	.953	32.31	4.65
378		378	11.70	.28	.11	.04	.965	41.79	3.54

MAXIMUM	32.30	1.87	.70	.14
MINIMUM	.60	.10	.04	.01
MEAN	7.19	.44	.16	.04
STD. DEVN.	5.57	.28	.11	.02



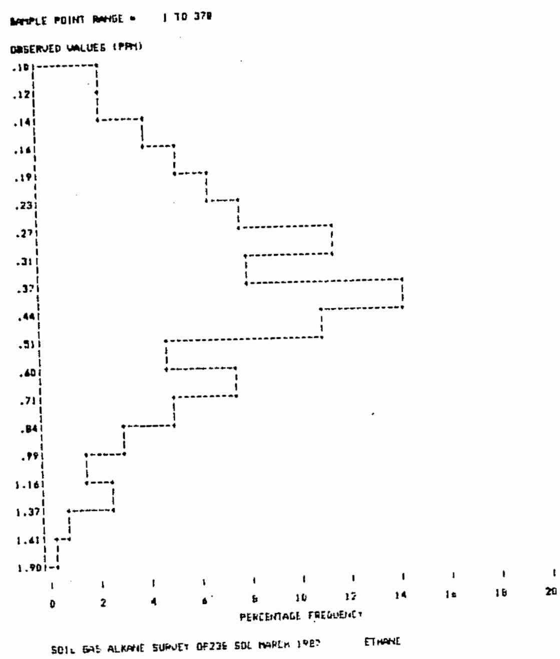
a



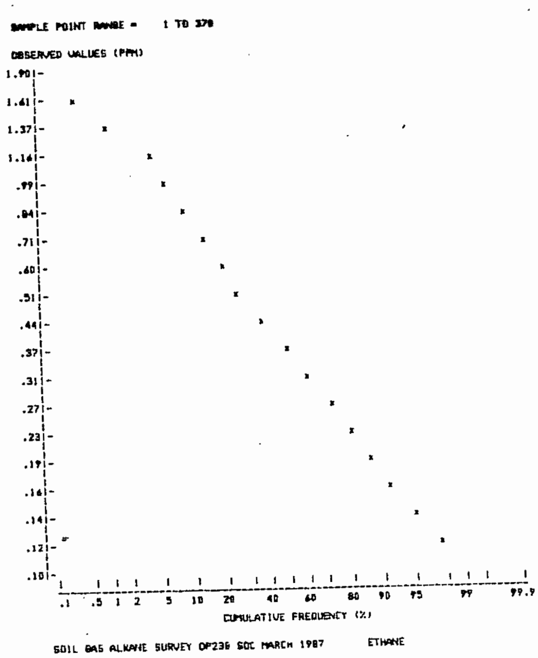
b

FIGURE 4a. Histogram of methane concentrations of 378 soil gas samples

b. Cumulative frequency curve derived from 4a.



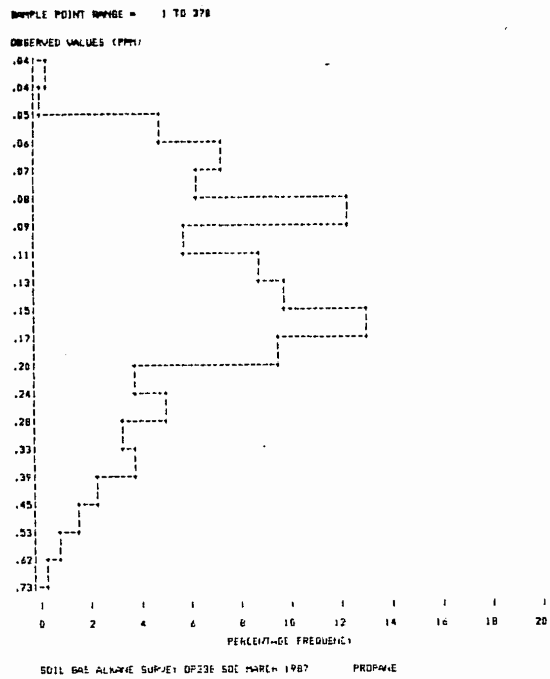
a



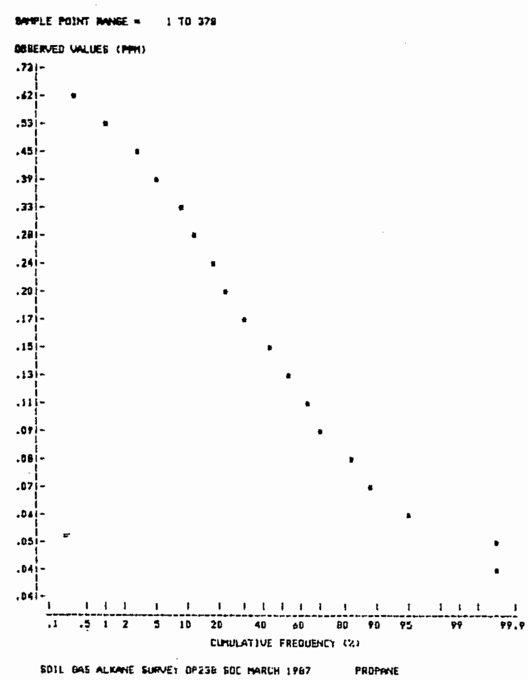
b

FIGURE 5a. Histogram of ethane concentrations of 378 soil gas samples

b. Cumulative frequency curve derived from 5a.



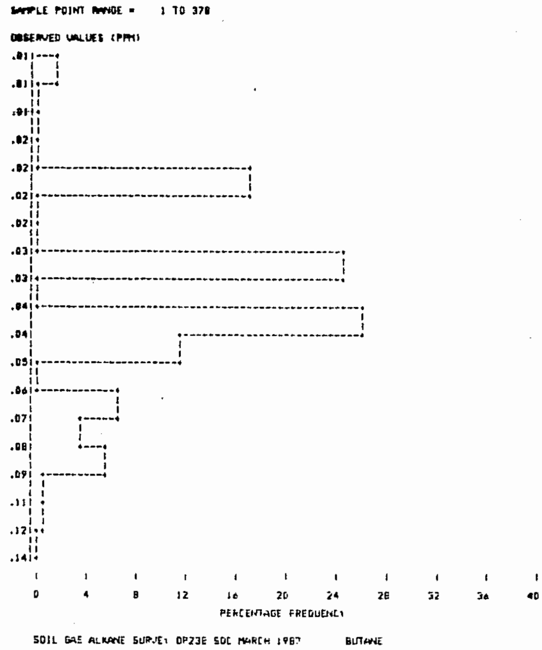
a



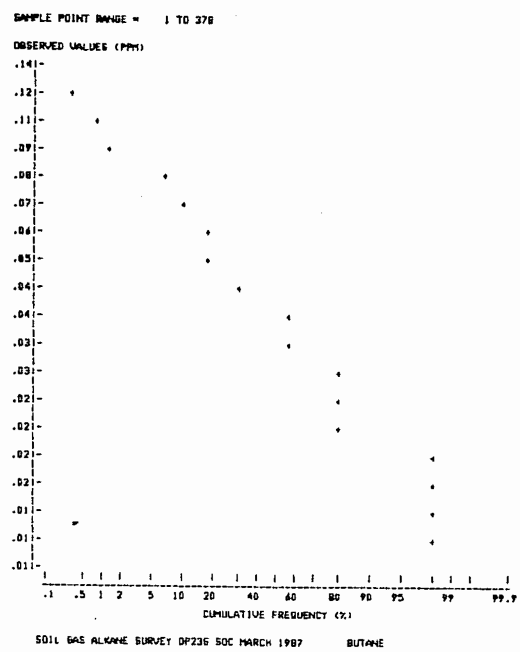
b

FIGURE 6a. Histogram of propane concentrations of 378 soil gas samples

b. Cumulative frequency curve derived from 6a.



a



b

FIGURE 7a. Histogram of butane concentrations of 378 soil gas samples

b. Cumulative frequency curve derived from 7a.