UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Helium and C_1-C_3 Hydrocarbon Concentrations in Permafrost Ice, Marsh Creek Area, Arctic National Wildlife Refuge, Alaska

by

K.I. Cunningham[1] and Alan A. Roberts[2]

Open-File Report 88-001

[1]USGS, Denver, CO
[2]Comap Exploration Services Inc., Lakewood, CO., 80225

1988

CONTENTS

ILLUSTRATIONS

TABLES

Helium and C_1-C_3 Hydrocarbon Concentrations in Permafrost Ice, Marsh Creek area, Arctic National Wildlife Refuge, Alaska

by

K.I. Cunningham and Alan A. Roberts

ABSTRACT

A survey was conducted in 1983 by the USGS over a part of the western Arctic National Wildlife Refuge (ANWR) coastal plain to (1) map variations in the near-surface (<1 m) concentrations of helium and C_1-C_3 hydrocarbons, and (2) to determine if associations existed with near-surface magnetic and gravity anomalies delineated from earlier surveys. The hydrocarbon data is ambiguous due to probable near-surface sourcing of methane due to microbiological decay processes and lack of stable carbon and oxygen isotope data to substantiate thermogenic contribution. The helium data correlates significantly with the gravity and magnetic anomalies and supports a model in which hydrocarbons have been generated in the coastal plain subsurface and migrated into the structure along faults.

INTRODUCTION

This report presents the data from an August, 1983 helium and light hydrocarbon (C_1-C_3) soil-gas survey conducted on the western coastal plain of the Arctic National Wildlife Refuge (ANWR) in the vicinity of the Marsh Creek anticline (fig. 1). The survey area was selected on the basis of an aeromagnetic mission flown in 1981 which mapped areas of significant near-surface magnetic signal thought to be related to a hydrocarbon microseepage (HCMS) process involving the development of epigenetic magnetic minerals (Donovan and others, 1984).

Soil-gas geochemists have reported anomalous concentrations of helium in soils associated with petroleum accumulations (Debnam, 1969; Ball and Snowdon, 1973; Dyck, 1976; Roberts, 1981; Roberts and Cunningham, 1985), uranium and thorium deposits (Clarke and Kugler, 1973; Dyck, 1976; Clarke and others, 1977; Dyck and Tan, 1978; Reimer and others, 1979; Pogorski and Quirt, 1980; Reimer and Roberts, 1985), geothermal waters (Mazor, 1974; Roberts and others, 1975; Hinkle, 1980), and fault and fracture systems (Pierce and others, 1964; Eremeev and others, 1973; Ovchinnikov and others, 1973; Jones and Drozd, 1983; Roberts and Roen, 1985). Anomalous helium in near-surface soil gas is derived from two main sources: primordial helium from mantle outgassing, and alpha particle production via decay of crustal uranium and thorium. This helium migrates to the earth's surface with eventual loss to outer space. Because this process has been occurring over geologic time, a steady state concentration of helium in the atmosphere of 5.24 ppm (by volume) results from equilibration between helium from the soil column and that lost to outer space. Since the shallow (< 1 m) helium is in constant communication with the atmosphere, soil-gas helium concentrations are very close to the 5.24 ppm by volume atmospheric level. Helium is present in significant concentrations (>100 ppm by volume) in most petroleum and natural gas reservoirs (Dyck, 1976; Moore, 1976, 1982) and previous work has demonstrated that the soil-gas concentration can be significantly perturbed by the addition of helium from

underlying petroleum reservoirs. These contributions can be on the order of tens or hundreds of parts per billion (ppb) by volume above the normal atmospheric background. By eliminating other source possibilities such as uranium/thorium deposits and geothermal systems, it can be demonstrated that near-surface anomalies in the Marsh Creek survey are probably related to a combination of faults and probable petroleum accumulations (Cunningham and others, 1987).

GEOLOGIC SETTING

The coastal plain of the Arctic National Wildlife Refuge (ANWR), or 1002 area, represents the subsiding, passive northern margin of the eastern Brooks Range fold-and-fault belt. Recent seismic interpretation shows that the northwestern area of the coastal plain is relatively undeformed, while large-scale folding and thrust-faulting occurs throughout much of the central and eastern coastal plain. The Marsh Creek anticline lies in the structural triangle zone marking the boundary between these two styles and plunges northeast into the Camden basin. Undeformed, northerly dipping strata north of the anticlinal crest contrast with the imbricated, deformed rocks to the south.

The survey area is located south of Camden Bay in the western section of the 1002 area (fig. 1) and approximately centered over the Marsh Creek anticline. The area is characterized by low-relief tundra and numerous north flowing high-gradient streams and rivers. The survey area rises from sea-level at Camden Bay to approximately 305 m (1000 ft) near the foothills of the Sadlerochit Mountains. The Marsh Creek anticline trends from southwest to northeast across this section of the coastal plain with outcrops located along Carter Creek and Marsh Creek, and farther west along the upper and lower Katakturuk River. These outcrops have been described by Leffingwell (1919) and Morris (1953), and recent reviews or maps primarily concerned with adjoining areas or regional emphasis also mention some of these sections (Detterman and others, 1975; Molenaar and others, 1983, 1984; Craig and others, 1985; Bader and Bird, 1986; Molenaar and others, 1987). A generalized stratigraphic section for the coastal plain and adjacent mountains is shown in fig. 2.

The Carter Creek and Marsh Creek outcrops are located toward the northeastern end of the Marsh Creek anticlinal axis (fig. 4). The Carter Creek section is composed of nearly 1500 m (4921 ft) of poorly consolidated Eocene (Canning Formation) to Miocene-Pliocene (Nuwok Member of the Sagavanirktok Formation) siltstones, mudstones, sandstones, and minor amounts of conglomerate and coal. Local iron and calcite cementation is present. The outcrops along Marsh Creek are similar, however stratigraphic relationships suggest that Tertiary rocks of mid-Eocene age may be present. Farther west along the Katakturuk River, early Eocene rocks further document the northeast plunging character of the structure (Molenaar and others, 1984, 1987; Patton and Christiansen, 1986).

EXPERIMENTAL

Seven hundred and two permafrost samples were collected on a 1.6 km (1 mi.) grid over an area of 1828 km^2 (703 mi^2) which is rectangular in shape (fig. 4). The samples were acquired utilizing a power auger with a permafrost coring barrel. The average sampling depth was 0.75 m (29.5 in). The samples consisted primarily of a frozen mixture of ice, sands, silts, clays, peat, and various lithic fragments. The collected samples were preserved in hermetically sealed aluminum containers having a diameter of 38.1 mm (1.5 in) and a length

of 177.8 mm (7.0 in). During sampling the station air pressure, air temperature, permafrost melt depth, and gross sample composition were recorded. The air temperature during the sampling period varied from 1°C to 22°C, and the barometric pressure varied from 964.9 mbar (28.49 in Hg) to 1024.5 mbar (30.25 in Hg). No precipitation occurred during the sampling period. The weight of the samples ranged from 37g to 222g and the ice content varied from 20% to 100%.

ANALYTICAL

The permafrost samples were analyzed by Chemical Projects Ltd./Helium Surveys, Inc. of Grand Island, New York for helium, methane, ethane, ethene, and total C_3 (propane + propene) hydrocarbons. The samples were vigorously shaken and then allowed to equilibrate for 36 hours at 30°C (86°F). Two sets of gas samples were extracted from the headspace of each sample container. One of these samples was analyzed for helium content using a mass spectrometer equipped with a proprietary helium separator. During each analysis the concentration was compared with that of standards having concentrations of 5200 ±30 and 8300 ±50 ppb helium (by volume). The other sample was analyzed for light hydrocarbons using a gas chromatograph. The analytical precision for helium is ±10ppb (by volume), and for the hydrocarbons, if present at levels less than 10,000 ppm, is ±1ppm (by volume). At higher hydrocarbon concentration levels (>10,000 ppm) the precision is ±500 ppm (by volume). The individual gas concentrations in permafrost ice (water) were calculated from the measured headspace concentration and the volume of water in the sample and reported from the contractor as cc gas @NTP/cc $H_2O \times 10^{-8}$, and is equivalent to nanoliters gas @NTP/liter $H_2O \times 10\text{-}1$ (table 2). All values in the text and on figures are reported as nanoliters of gas @NTP/liter H_2O.

BACKGROUND CALCULATION

Background and anomalous levels were calculated for the helium data. All concentrations were first sorted in ascending order (X_i). The mean (X_t) was then calculated for the entire set of values. The subset of data having values equal to or less than X_t was then defined. The mean (X_b) and standard deviation (S_b) for this subset were calculated and defined as the background mean and standard deviation. Anomalous values are taken to be those results that exceeded the background mean by more than one standard deviation of the background population, i.e., data greater than $X_b + S_b$ are defined as anomalous. The helium background level and standard deviation were determined to be approximately 410 nanoliters helium @NTP/liter H_2O (nL/L) and 154.0 nL/L respectively, with anomalous helium occurring above 564.0 nL/L. Background and standard deviation values calculated from earlier North Slope helium surveys in the Barrow, Cape Simpson, Camp Lonely, and Prudhoe Bay areas are in agreement with Marsh Creek background levels (table 1). The larger Marsh Creek standard deviation reflects a significant departure from the western North Slope data. The helium values obtained from the Marsh Creek survey in 1983 comprise the highest helium concentrations in soil-gas found to date on the North Slope.

The sample location data were projected in the Universal Transverse Mercator (UTM) system and gridded. Standard contouring procedures were applied utilizing software by the USGS Branch of Geophysics and Dynamic Graphics, Inc. Interactive Surface Modeling.

Table 1. Background and standard deviations from North Slope helium surveys, 1978-1983.

Survey name and year	Background (nL/L)	Standard deviation (nL/L)
Prudhoe Bay - 1976	399.0	68.0
Barrow - 1978	339.0	64.6
Camp Lonely - 1978	251.0	80.9
Cape Simpson - 1979	470.5	99.7
South Barrow - 1980	347.0	92.4
Marsh Creek - 1983	410.0	154.0
Average	369.4	93.2

DISCUSSION

The migration of hydrocarbons through a rock column induces multiple effects that can be measured by geophysical and geochemical methods and qualified by geologic observations. The chemical and biological environment associated with the presence and migration of hydrocarbons initiates mineralization and alteration processes (Donovan and others, 1984) which include:

(1) the reduction, dissolution, and partial removal of iron from iron-bearing minerals,
(2) the mobilization and redistribution of transition elements such as iron and manganese,
(3) the transformation of mineral phases by reduction, and
(4) the precipitation of isotopically distinctive pore-filling carbonate cements.

These rock column modifications can be detected by surface occurrences of bleached redbeds (Donovan, 1972; Donovan, 1974; Donovan and others, 1979; Donovan and others, 1981), trace element mapping of iron and manganese in plants and soils (Dalziel and Donovan, 1980), aeromagnetic mapping of the magnetic signal from altered iron minerals (Donovan and others, 1979; Donovan and others, 1984), gravity mapping of near-surface anomalies due to localized accumulations of pore-filling carbonate cements (McCulloh, 1969), and stable isotope mapping of the relative abundances of ^{13}C and ^{18}O in calcite cements (Donovan, 1974; Donovan and others, 1974).

The ANWR coastal plain area (fig. 1) was the subject of an experimental magnetic survey conducted by the USGS during the 1981 summer field season utilizing a triple-sensor (left/right wing and tail stinger) proton-precession magnetometer flown at 90 m (300 ft) above ground level (AGL). This survey delineated 3 major high-wavenumber, low-amplitude magnetic anomalies which the investigators attributed to epigenetic magnetic mineralization due to microseeping hydrocarbons (Donovan and others, 1984). An areally large anomaly is coincident with the Marsh Creek structure in the western section of the coastal plain. Subsequent work used the total field data from the tail stinger magnetometer to calculate psuedo-longitudinal gradient values that excluded spurious signals induced from wing-chop or light aircraft turbulence (Cunningham and others, 1987). The Marsh Creek area is clearly anomalous with

this treatment (fig. 3). Overlay of post-Cretaceous faulting interpreted from industry-acquired seismic profiles (Bruns and others, 1987, fig. 19.3) indicates a significant correlation between the major SW-NE trending Marsh Creek fault-anticline couplets and the magnetic anomalies, and suggests a fault-controlled mechanism for development (Cunningham and others, 1987). If these anomalies are the result of petroleum generation and migration in the 1002 area subsurface, then other microseepage processes should be attendant. Recently acquired gravity data on the coastal plain indicated a significant near-surface anomaly along the crest of the Marsh Creek anticline (Robbins, 1987). Computer modelling of the anomaly describes a shallow linear body along the anticlinal crest consisting of a 0.24 gm/cc positive density contrast with the underlying Cretaceous and Tertiary rocks. This body of anomalous density may be the result of biologically mediated oxidation of hydrocarbons and precipitation of pore-filling carbonate cement in the near-surface (<350 m). Petroleum macroseeps on the coastal plain (fig. 1) provide additional evidence that hydrocarbons have been generated and migrated to the near-surface and that the magnetic anomalies are not due entirely to expelled hydrocarbon-bearing deep basin compactional waters. If the magnetic and gravity anomalies are the result of microseepage processes in the ANWR coastal plain subsurface, then the Marsh Creek structure has leaked hydrocarbons at some period after or during the development of the extensive fault network. Timing constraints on the development of the Marsh Creek anticline are obtained from recent seismic and stratigraphic interpretations that indicate a discontinuity between the complexly folded Cretaceous and Paleocene rocks below and the gently deformed Eocene rocks above (Patton and Christiansen, 1986). This discontinuity suggests a major deformation episode in late Paleocene to Eocene time. Bed attitudes on the north flank of the Marsh Creek structure decrease from 60^{o} (Eocene) to 15^{o} (Pliocene) providing additional evidence for episodic deformation throughout the Tertiary and establishing the earliest date that petroleum might have entered the structure. The magnetic and gravity anomalies only indicate that faulting preceded anomaly development. Because both types of anomalies could represent discrete paleo-leakage events, it is not possible to determine from these data if modern migration is occurring. In order to test this hypothesis of the origin of the magnetic and gravity anomalies, the variations in the near-surface (< 1 m) concentration of helium were mapped and are reproduced in this report. The hydrocarbon data are included (table 2) but without isotopic determinations the utility of this data is limited. Additionally, biogenic sources of methane are highly probable in this survey owing to extreme levels of near-surface biologic activity during the thaw months (June through September).

Analytical helium values were corrected at the contractor's site for barometric pressure and temperature differences between the analytical laboratory and the collection site in the field. These raw data were contoured with an interval of 100 nL/L (figure 5). The observed variations are due to helium from all sources including the atmosphere. A contour map of the same data but with an initial contour level of 400 nL/L (approximately equal to the calculated background of 410 nL/L) emphasizes perturbations related to probable subsurface sources of helium (figure 6). We have interpreted this map to consist of several areas characterized by the magnitude of gas concentration and areawide-gradient:

(1) a low-value, low-gradient area in the eastern survey area,
(2) a very high-value, high-gradient area to the west which partly encircles the southwest arm of the structure, and

(3) a medium-value, medium-gradient area lying directly over the main body of the anticline.

Some areas within the anticlinal core are above the 410 nL/L background, but display irregular gradients and lower overall values than the flanking concentrations. We interpret this as preferential gas migration to the outside of the structural core. In order to more accurately define only those anomalies that might be related to localized as opposed to regional sources, the regional gradient of approximately 12 nL/L helium/km (19 nL/L helium/mi) was used to correct the raw data surface for regional background effects (fig. 7). The map of residual helium concentrations in permafrost ice (fig. 8) consists of three anomaly types:

(1) AREA 1: High-permeability structural flank zone - Abnormally high helium values 0-1110 nL/L above the regional gradient exhibiting highly variable concentration gradients and interpreted as zones of differentially permeable sediments characterized by relatively unrestricted helium migration.

(2) AREA 2: Reduced-permeability structural core - An area directly over the anticlinal crest with values at or near regional. The localized, higher gradient western section anomalies probably represent discrete faulting perpendicular to structural strike. We interpret this zone as an area of high fracture density with reduced permeability due to diagenetic cementation.

(3) AREA 3: Low-permeability zones - small, discontinuous areas at or below the regional gradient that signify minimal helium migration and are interpreted as zones of low fracture density and low lithologic permeability.

The unique correlation observed between the residual helium values and the near-surface magnetic anomalies (fig. 9) suggests that the Marsh Creek anticline displays characteristic geophysical and geochemical signatures indicating that hydrocarbons have been generated and migrated along major fault planes to the surface. The migration of helium through the structure is occluded over the anticlinal crest. This helium anomaly pattern may represent relatively lower, impeded gas flow around a diagenetic barrier due to the near-surface emplacement of carbonate cement as a digestive byproduct of microbial attack on vertically migrating hydrocarbons.

REFERENCES

Bader, J.W., and Bird, K.J., 1986, Geologic map of the Demarcation Point, Mt. Michelson, Flaxman Island, and Barter Island quadrangles, northeastern Alaska: U.S. Geological Survey Miscellaneous Field Investigations Map I-1791, scale 1:250,000.

Ball, N.L., and Snowdon, L.R., 1973, A preliminary evaluation of the applicability of the helium survey technique to prospecting for petroleum: Geological Survey of Canada Paper 73-1B, p. 199-202.

Bruns, T.R., Fisher, M.A., Leinbach, J., and Miller, J.J., 1987, Regional structure interpretation from multichannel seismic reflection data, in Bird, Kenneth B., and Magoon, Leslie B., eds., Petroleum Geology of the Northern Part of the Arctic National Wildlife Refuge, Northeastern Alaska: U.S. Geological Survey Bulletin 1778, ch. 19.

Clarke, W.B., and Kugler, G., 1973, Dissolved helium in groundwater -- A possible method for uranium and thorium prospecting: Economic Geology, v. 68, p. 243-251.

Clarke, W.B., Top, Z., Beavan, A.P., and Ghandi, S.S., 1977, Dissolved helium in lakes -- uranium prospecting in the Precambrian terrain of central Labrador: Economic Geology, v. 72, p. 233-242.

Craig, J.D., Sherwood, K. W., and Johnson, P.P., 1985, Geologic report for the Beaufort Sea planning area, Alaska - Regional geology, petroleum geology, environmental geology: United States Department of the Interior, Minerals Management Service, Alaska OCS Region, OCS Report MMS 85-0111, 192 p.

Cunningham, K.I., Roberts, A.A., and Donovan, T.J., 1987, Horizontal gradient magnetic and helium surveys, in Bird, Kenneth B., and Magoon, Leslie B., eds., Petroleum Geology of the Northern Part of the Arctic National Wildlife Refuge, Northeastern Alaska: U.S. Geological Survey Bulletin 1778, ch. 14.

Dalziel, M.C., and Donovan, T.J., 1980, Biogeochemical evidence for subsurface hydrocarbon occurrence, Recluse oil field, Wyoming -- preliminary results: U.S. Geological Survey Circular 837, 11 p.

Debnam, A.H., 1969, Geochemical prospecting for petroleum and natural gas in Canada: Geological Survey of Canada, Bulletin, v. 177, p. 1-26.

Detterman, R.L., Reiser, H.N., Brosge, W.P., and Dutro, J.T., Jr., 1975, Post-Carboniferous stratigraphy, northeastern Alaska: U.S. Geological Survey Professional Paper 886, 46 p.

Donovan, T.J., 1972, Surface mineralogical and chemical evidence for buried hydrocarbons, Cement Field, Oklahoma: Ph.D. dissertation, University of California, Los Angeles, 117 p.

Donovan, T.J., 1974, Petroleum microseepage at Cement, Oklahoma--evidence and mechanism: American Association of Petroleum Geologist Bulletin v. 58, no. 3, p. 429-466.

Donovan, T.J., Friedman, I., and Gleason, J.D., 1974, Recognition of petroleum-bearing traps by unusual isotopic compositions of carbonate-cemented surface rocks: Geology, v. 2, 351-354.

Donovan, T.J., Forgey, R.L., and Roberts, A.A., 1979, Aeromagnetic detection of diagenetic magnetite over oil fields: American Association of Petroleum Geologists Bulletin v. 63, no. 2, p. 245-248.

Donovan, T.J., Roberts, A.A., and Dalziel, M.C., 1981, Epigenetic zoning resulting from seepage-induced redox gradients in surface and near-surface rocks, Velma oil field, Oklahoma--a synopsis: Shale Shaker, v. 32. p. 1-7.

Donovan, T.J., Hendricks, J.D., Roberts, A.A., and Eliason, P.T., 1984, Low-altitude aeromagnetic reconnaissance for petroleum in the Arctic National Wildlife Refuge, Alaska: Geophysics, v. 49, no. 8, p. 1338-1353.

Dyck, W., 1976, The use of helium in mineral exploration: Journal of Geochemical Exploration, v. 5, p. 3-20.

Dyck, W., and Tan, B., 1978, Seasonal variations in helium, radon, and uranium in lake waters near the Key Lake uranium deposit, Saskatchewan: Journal of Geochemical Exploration, v. 10, p. 153-167.

Eremeev, A.N., Sokolov, V.A., Solovov, A.P., and Yanitski, I.N., 1973, Application of helium surveying to structural mapping and ore deposit forecasting, in Jones, M.J., ed., Geochemical exploration 1972: London, Institute of Mineralogy and Metallurgy, p. 183-192.

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

Jones, V.T., and Drozd, R.J., 1983, Predictions of oil or gas potential by near-surface geochemistry: American Association of Petroleum Geologists Bulletin, v. 67, p. 932-952.

Leffingwell, E. de K., 1919, The Canning River Region, northern Alaska: U.S. Geolgoical Survey Professional Paper 109, 251 p.

Mazor, E., 1974, Atmospheric and radiogenic noble gases in thermal waters -- Their potential application to prospecting and steam production studies: United Nations Symposium on the Development and Use of Geothermal Resources, Proceedings, p. 793-802.

McCulloh, T.H., 1969, Oil fields, gravity anomalies, and surface chemical manifestations--correlations, causes, and exploration significance [abs]: Society of Exploration Geophysicists, Program, Pacific Section, 44th Annual Meeting, Los Angeles, CA., p. 17-18.

Molenaar, C.M., 1983, Depositional relations of Cretaceous and lower Tertiary rocks, northeastern Alaska: American Association of Petroleum Geologists Bulletin, v. 67, no. 7, p. 1066-1080.

Molenaar, C.M., Kirk, A.R., Magoon, L.A., and Huffman, A.C., 1984, Twenty-two measured sections of Cretaceous-lower Tertiary rocks, eastern North Slope, Alaska: U.S. Geological Survey Open-File Report 84-695, 19 p.

Molenaar, C.M., Bird, K.J., and Kirk, A.R., 1987, Cretaceous and Tertiary startigraphy of northeastern Alaska, in Tailleur, I.L., and Weimer, Paul, eds., North Slope Geology: Pacific Section, Society of Economic Paleontologists and Mineralogists and Alaska Geological Society, v. 50, 40 p.

Moore, B.J., 1976, Analyses of natural gases: U.S. Bureau of Mines computer printout, p. 1-76.

Moore, B.J., 1982, Analyses of natural gases, 1917-1980: U.S. Bureau of Mines Information Circular IC 8870, 1055 p.

Morris, R.H., 1953, Reconnaissance study of the Marsh Creek anticline, northern Alaska: U.S. Geological Survey Open-File Report, 6 p.

Ovchinokov, L.M., Sokolov, V.A., Fridman, A.I., and Yanitski, I.N., 1973, Gaseous geochemical methods in structural mapping and prospecting for ore deposits, in Jones, M.J., ed., Geochemical exploration 1972: London, Institute of Mineralogy and Metallurgy, p. 177-182.

Patton, P.C., and Christiansen, A.C., eds., 1986, Arctic National Wildlife Refuge, Alaska, coastal plain resource assessment -- Draft report and recommendation to the Congress of the United States and legislative environmental impact statement: Washington, D.C., U.S. Fish and Wildlife Service, U.S. Geological Survey, and Bureau of Land Management, 172 p., November 1986.

Pierce, A.P., Gott, G.B., and Mytton, F.W., 1964, Uranium and helium in the Panhandle gas field, Texas and adjacent areas: U.S. Geological Survey Professional Paper 454-G, 47 p.

Pogorski, L.A., and Quirt, G.S., 1980, Helium surveying for deeply buried uranium deposits: American Association of Petroleum Geologists, Bulletin, v. 65, p. 766-767.

Reimer, G.M., and Denton, E.H., Friedman, I., and Otton, J.K., 1979, Recent developments in uranium exploration using the U.S. Geological Survey's mobile helium detector: Journal of Geochemical Exploration, v. 11, p. 1-12.

Reimer, G.M., and Roberts, A.A., 1985, Correcting soil gas helium concentrations for diurnal variations: Association of Petroleum Geochemical Explorationists Bulletin, v. 1, no. 1, p. 1-17.

Robbins, S.L., 1987, Gravity interpretation of the coastal plain, in Bird, Kenneth B., and Magoon, L.B., Petroleum Geology of the Northern Part of the Arctic National Wildlife Refuge, Northeastern Alaska: U.S. Geological Survey Bulletin 1778, ch. 15.

Roberts, A.A., Friedman, I., Donovan, T.J., and Denton, E.H., 1975, Helium surveying, a possible technique for locating geothermal reservoirs: Geophysical Research Letters, v. 2, no. 6, p. 209-210.

Roberts, A.A., 1981, Helium emanometry in exploring for hydrocarbons - part II, in Gottlieb, B.M., ed., Symposium II, Unconventional methods in exploration for petroleum and natural gas: Dallas, TX, Southern Methodist University Press, p. 136-149.

Roberts, A.A., and Cunningham, K.I., 1985 (in press), Helium surveying, a geochemical exploration technique for petroleum on the North Slope, in Gryc, George, ed., Geology of the National Petroleum Reserve in Alaska: U.S. Geological Survey Professional Paper 1399.

Roberts, A.A., and Roen, J.B., 1985, Near-surface helium anomalies associated with faults and natural gas accumulations in western Pennsylvania: U.S. Geological Survey Open-File Report 85-546, 25 p.

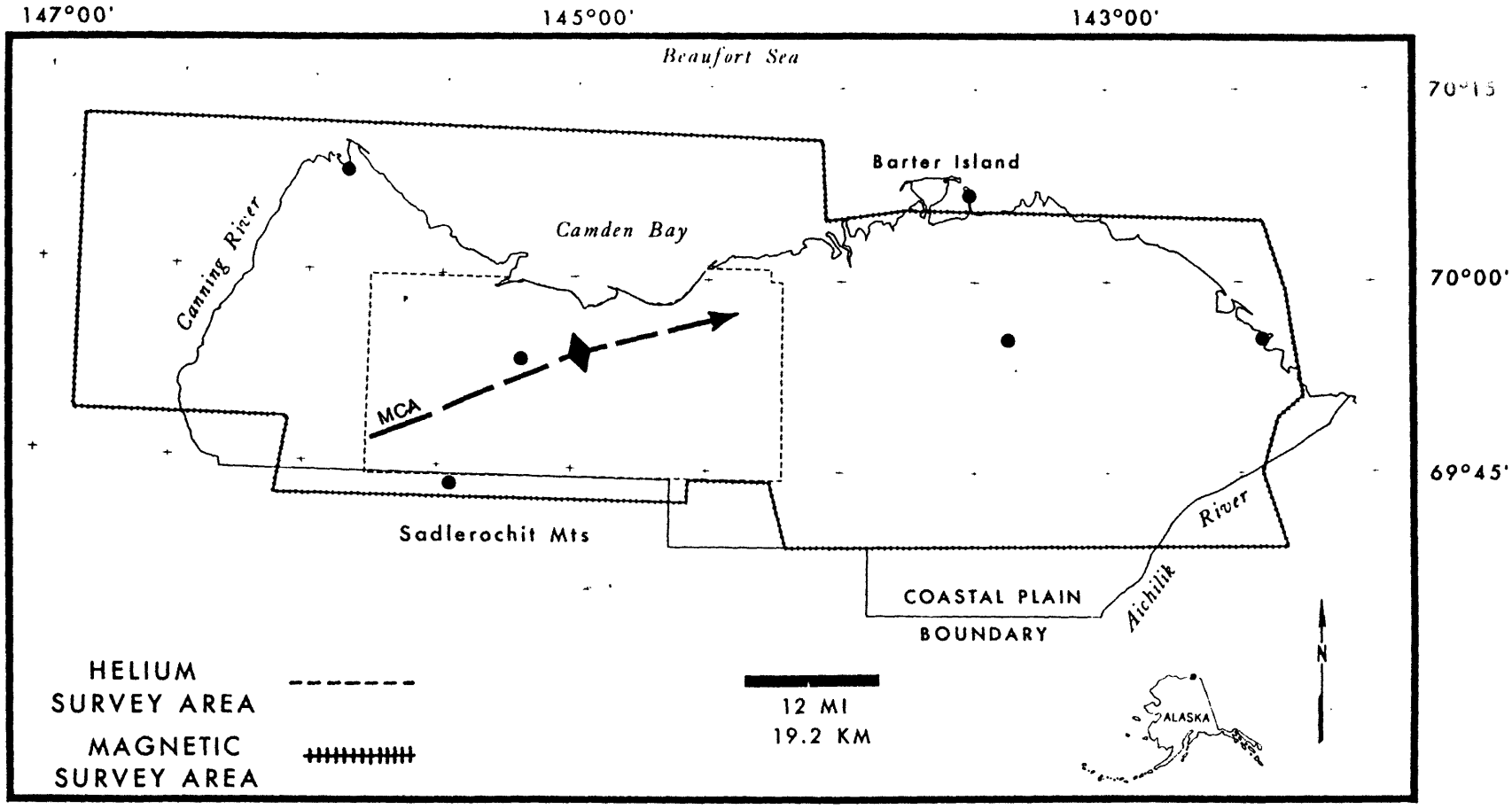

Figure 1. Index map showing helium and low-level magnetic survey areas, Arctic National Wildlife Refuge, northeast Alaska. Heavy dashed line is axial trend of Marsh Creek anticline. Black dots are locations of oil-impregnated sands or oil seeps.

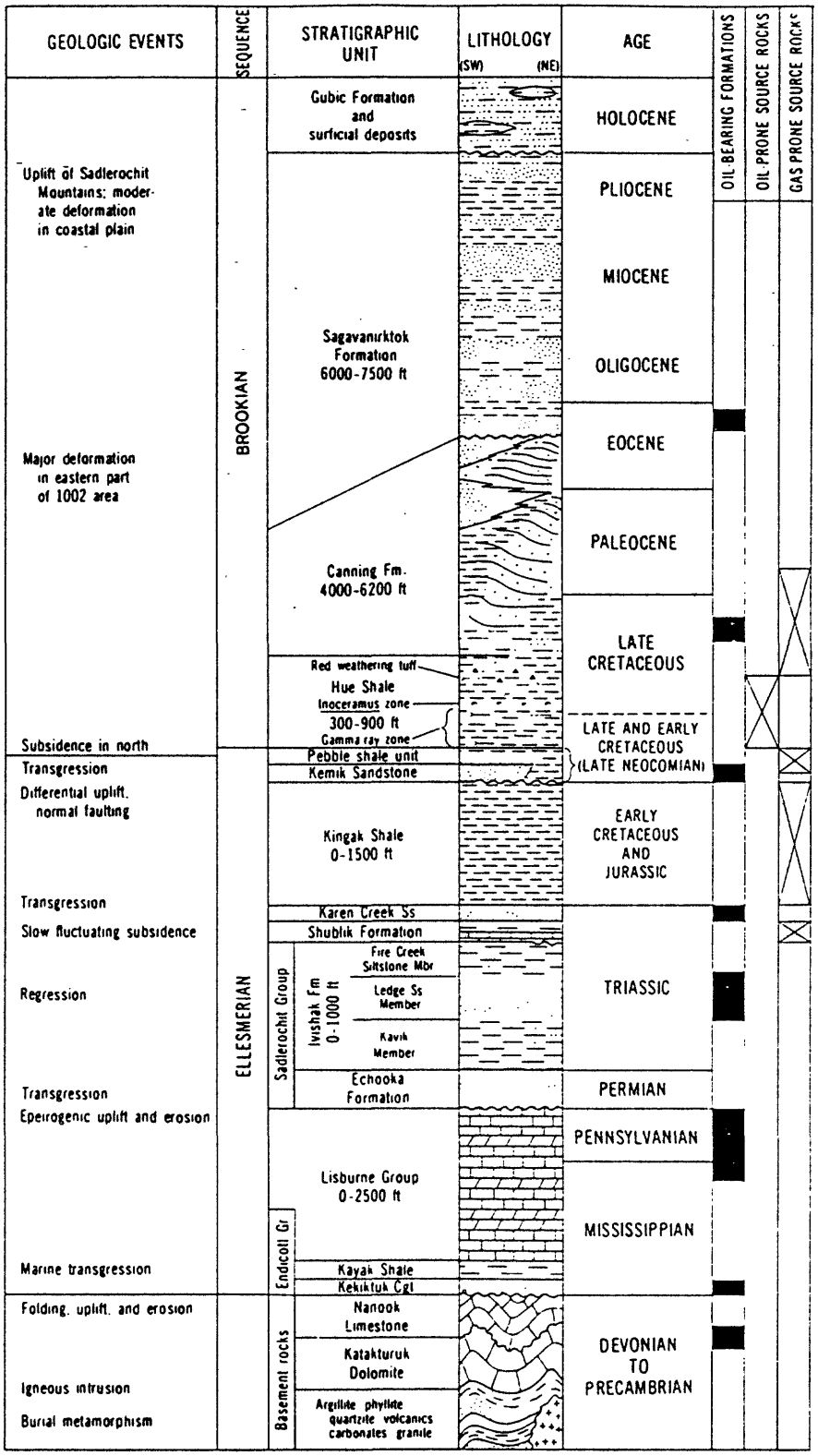

Figure 2. Generalized stratigraphic column for the 1002 coastal plain section of the Arctic National Wildlife Refuge and adjacent areas showing significant geologic events, oil-bearing formations west of the ANWR, and potential source rocks. From Christiansen and Patton, 1986.

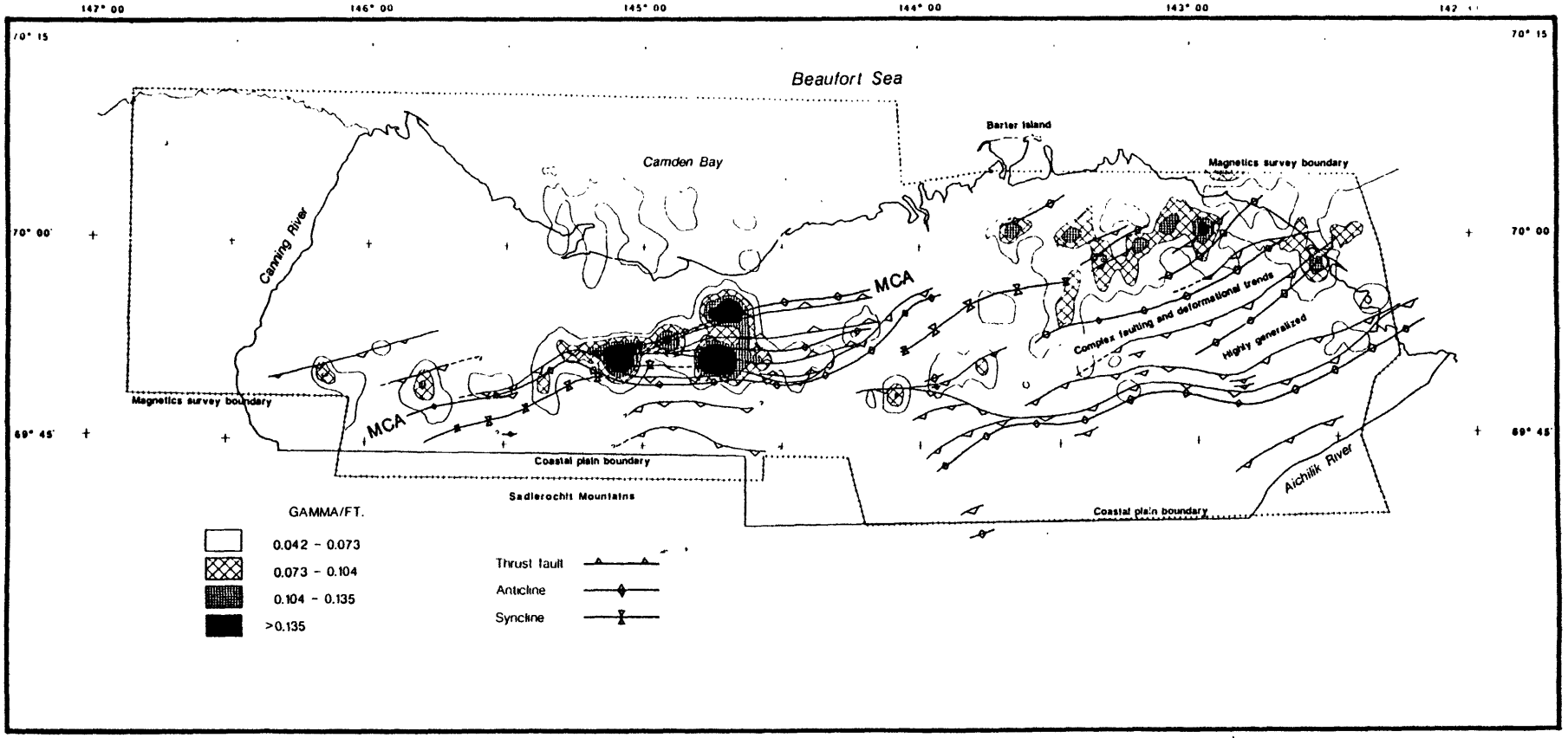

Figure 3. Contour map of longitudinal difference magnetic data superimposed on major Brookian structural features, ANWR coastal plain, northeast Alaska. Magnetic contour interval = 0.031 gamma/ft. Patterned areas indicate near-surface magnetic anomalies > 0.073 gamma/ft."MCA" is axial trend of the Marsh Creek anticline. Structural interpretation after Bruns and others, 1987.

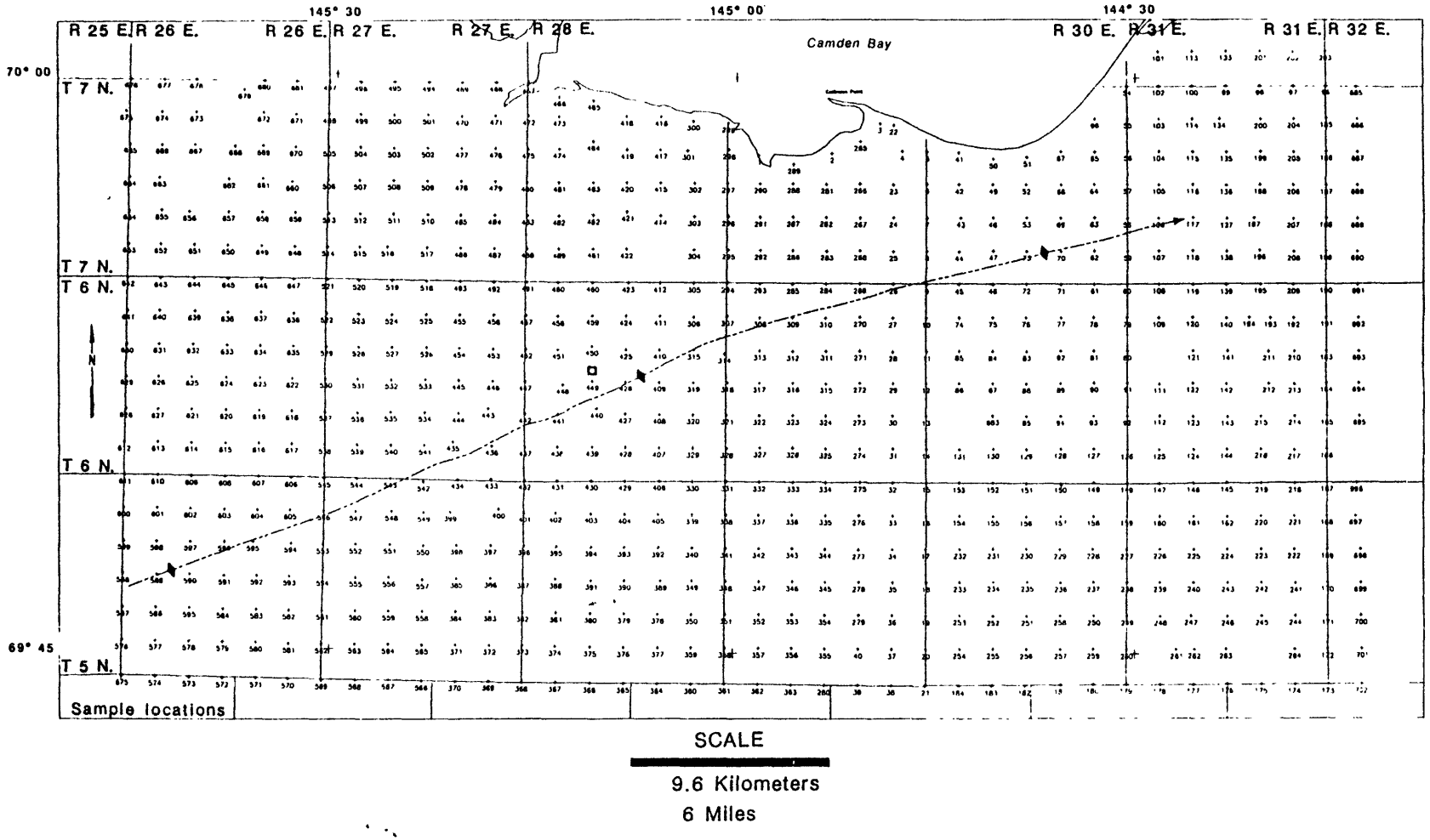

Figure 4. Index map of helium and C_1-C_3 hydrocarbon sample locations, western ANWR coastal plain, northeast Alaska. Dashed line represents axial trend of the Marsh Creek anticline. Square symbol north of sample #449 is Eocene age oil-stained sandstone.

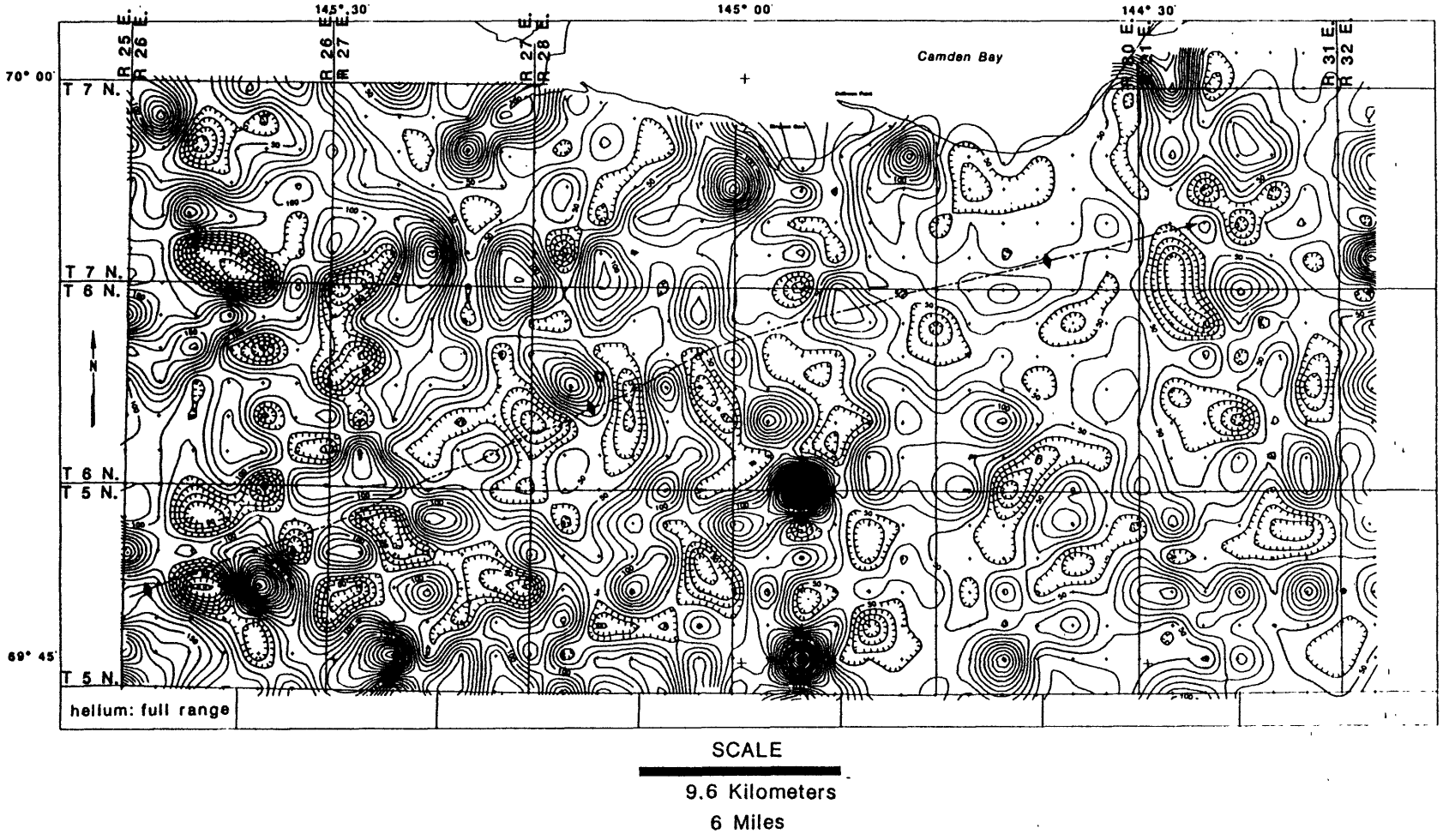

Figure 5. Contour map of helium concentrations in permafrost ice, Marsh Creek area, western ANWR coastal plain, northeast Alaska. Contour interval = 10 nanoliters helium @NTP/liter H_2O x 10. This map depicts the full range of helium concentrations across the area. Dashed line is axial trend of the Marsh Creek anticline. Square symbol is Eocene age oil-stained sandstone.

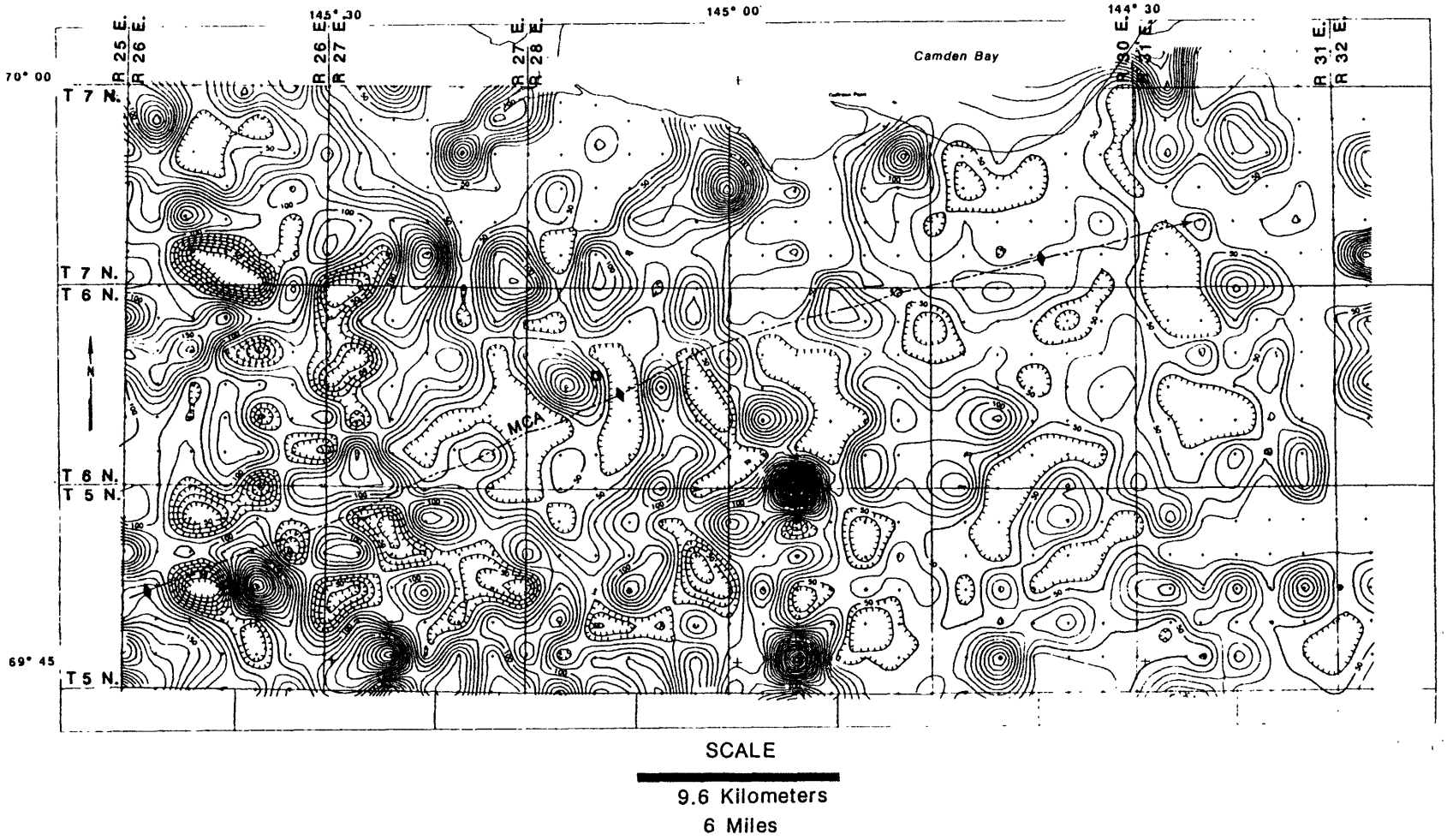

Figure 6. Map of helium concentrations in permafrost ice contoured above the 400 nl/l background level (see text, Background Calculation), Marsh Creek area, western ANWR coastal plain, northeast Alaska. Contour interval = 10 nanoliters helium @NTP/liter H_2O x 10. Dashed line is axial trend of Marsh Creek anticline. Square symbol is location of Eocene age oil-stained sandstone.

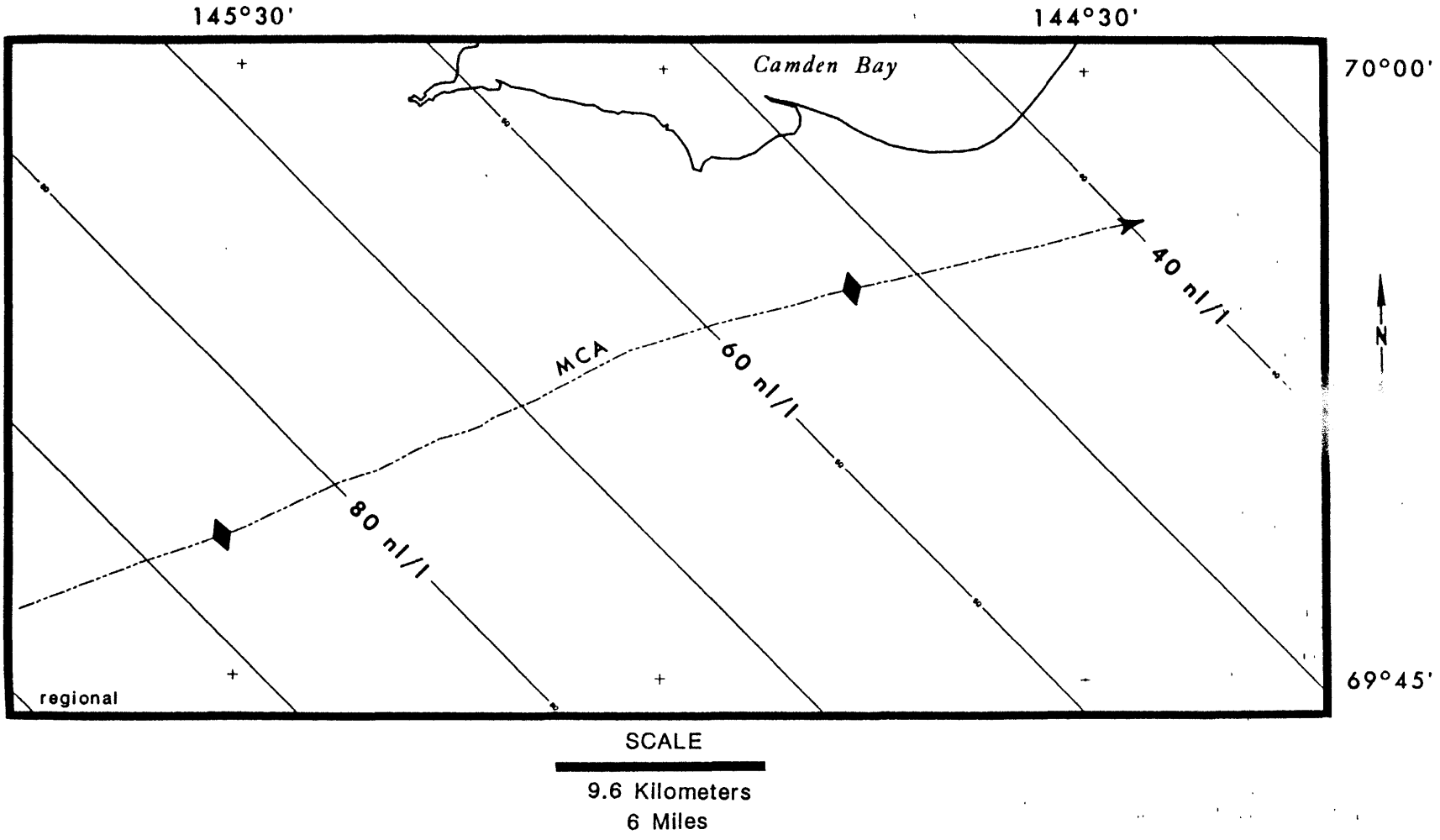

Figure 7. Contour map of the regional helium gradient, Marsh Creek area, western ANWR coastal plain, northeast Alaska. Contour interval = 10 nanoliters helium @NTP/liter H_2O x 10. Dashed line is axial trend of Marsh Creek anticline (MCA).

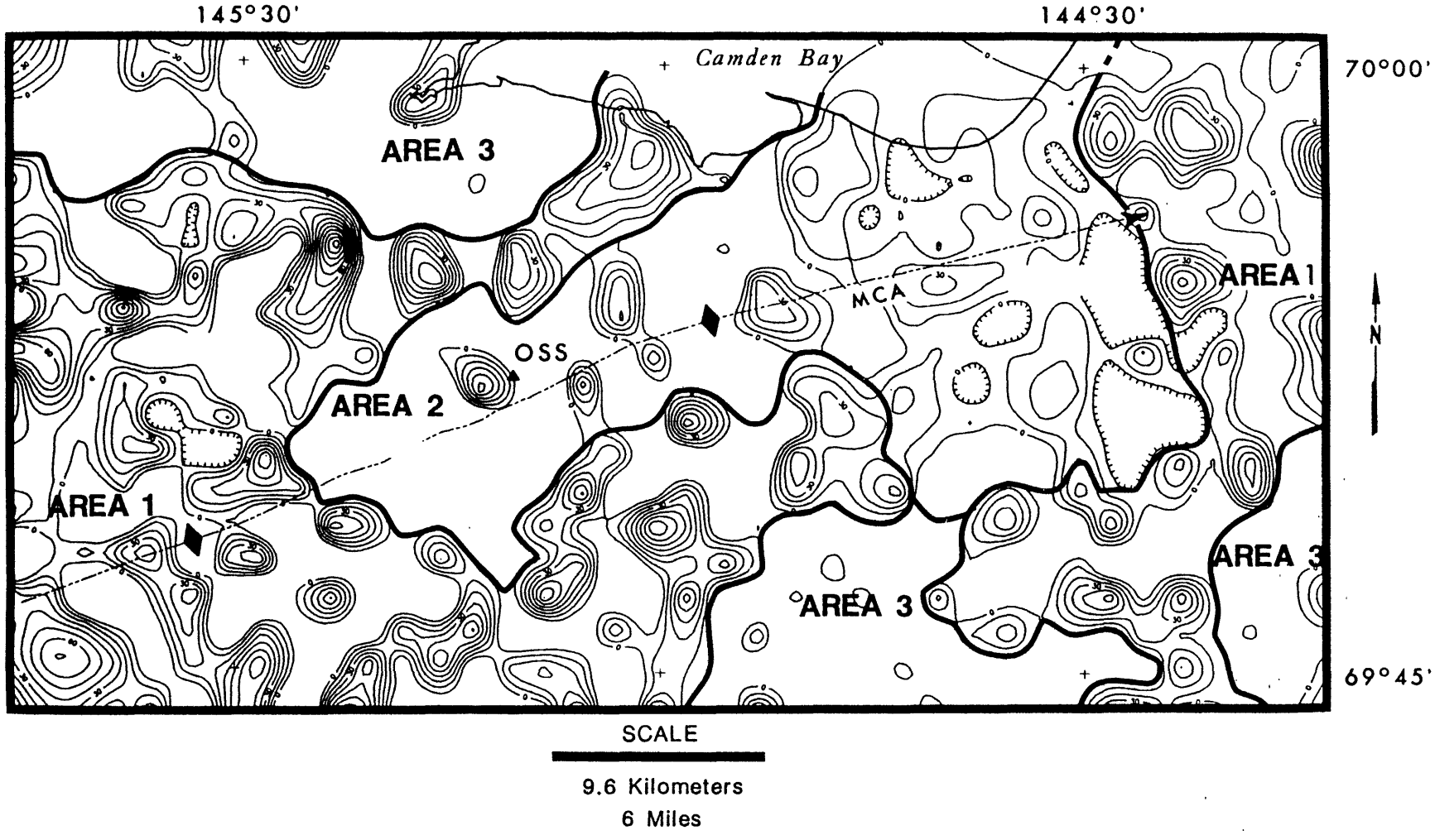

Figure 8. Contour map of 1st order residual helium concentrations above the regional gradient, Marsh Creek area, western ANWR coastal plain, northeast Alaska. Heavy line separates anomalous areas described in text. Contour interval = 10 nanoliters helium @NTP/liter H_2O x 10. Dashed line is axial trend of Marsh Creek anticline. "OSS" is Eocene age oil-stained sandstone.

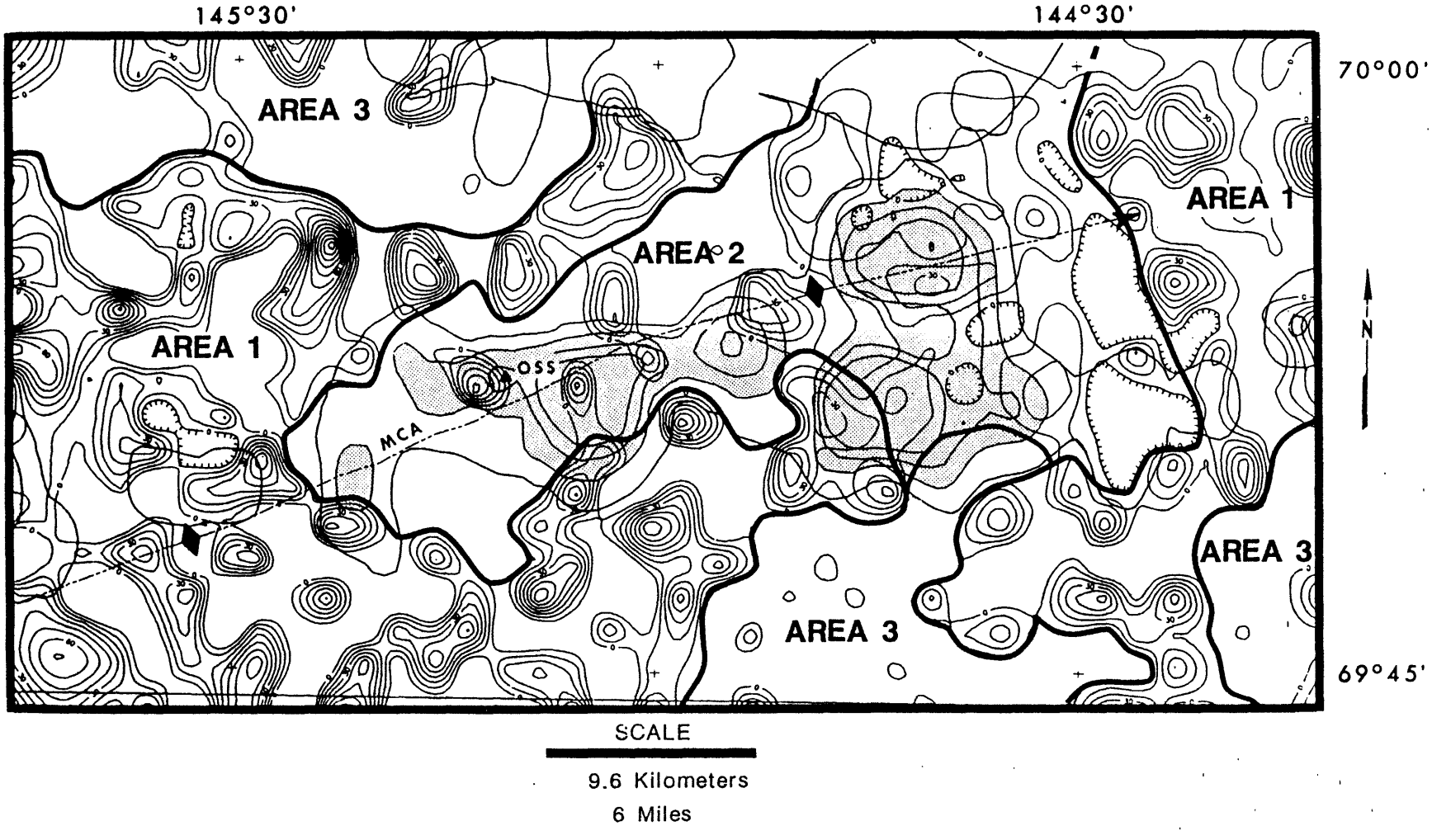

Figure 9. Map comparing helium first-order residuals and longitudinal difference magnetic anomalies, Marsh Creek area, western ANWR coastal plain, northeast Alaska. Helium contour interval = 10 nanoliters helium @NTP/liter H_2O x 10. Heavy line separates anomalous helium areas described in text. Magnetic contour interval = 0.031 gamma/ft. Patterned area indicates near-surface magnetic anomalies > 0.073 gamma/ft. Dashed line is axial trend of Marsh Creek anticline. "OSS" is Eocene age oil-stained sandstone.

Table 2: Concentrations of helium, methane, ethane, ethene, and total C_3 hydrocarbons in permafrost ice and sampling variables.

ID	=	Unique station identifier for all sample locations
LONG	=	Longitudinal coordinate in decimal degree minutes (D.M)
LAT	=	Latitudinal coordinate in decimal degree minutes (D.M)
BP	=	Barometric pressure (in. Hg) at time of sampling
T	=	Air temperature (^{o}C) at time of sampling
WT	=	sample weight (gm.)
MD	=	measured depth of permafrost melt at time of sampling (in.)
%H_2O	=	percentage of water (ice) by volume in sample
HE	=	concentration of helium dissolved in permafrost ice expressed as nanoliters helium @NTP/liter H_2O x 10-1
METH	=	concentration of methane dissolved in permafrost ice expressed as nanoliters methane @NTP/liter H_2O x 10-1
ETH	=	concentration of ethane dissolved in permafrost ice expressed as nanoliters ethane @NTP/liter H_2O x 10-1
ETHE	=	concentration of ethene dissolved in permafrost ice expressed as nanoliters ethene @NTP/liter H_2O x 10-1
C_3	=	concentration of total C_3 hydrocarbons in permafrost ice expressed as nanoliters total C_3 @NTP/liter H_2O x 10-1

ID	LONG	LAT	BP	T	WT	MD	%H_2O	HE	METH	ETH	ETHE	C_3
1	144.9722	69.9658	30.11	3.0	104	8	92.3	47.1	27100.	79.	85.	0.
2	144.8802	69.9669	30.09	5.0	150	12	77.3	44.2	5430.	0.	46.	0.
3	144.8200	69.9800	30.08	2.0	146	12	80.1	44.0	365000.	37.	43.	0.
4	144.7921	69.9679	30.08	2.0	86	12	30.2	165.0	2970000.	460.	932.	472.
5	144.7609	69.9678	29.85	1.0	105	12	91.4	62.3	136000.	0.	88.	0.
6	144.7610	69.9537	29.82	0.0	108	12	92.6	74.2	11900.	0.	84.	0.
7	144.7608	69.9391	29.64	0.0	186	6	55.9	44.8	93000.	0.	45.	0.
8	144.7610	69.9246	29.61	0.0	210	6	47.1	57.0	218000.	41.	240.	0.
9	144.7608	69.9103	29.53	0.0	126	6	77.0	67.6	583000.	72.	552.	172.
10	144.7609	69.8959	29.44	0.0	145	18	55.9	25.9	273000.	0.	89.	0.
11	144.7608	69.8814	29.47	1.0	110	6	100.0	47.8	7130.	0.	0.	0.
12	144.7610	69.8671	29.48	2.0	134	9	64.2	58.3	1260000.	181.	487.	0.
13	144.7608	69.8527	29.46	2.0	157	9	70.1	83.2	585000.	52.	295.	0.
14	144.7606	69.8384	29.39	3.0	222	6	45.5	76.7	991000.	219.	311.	181.
15	144.7605	69.8240	29.30	4.0	110	6	99.1	82.8	12300.	0.	151.	0.
16	144.7606	69.8095	29.22	5.0	110	12	100.0	53.5	12200.	0.	0.	0.
17	144.7608	69.7951	29.11	4.0	120	4	82.5	48.4	1050000.	69.	524.	81.
18	144.7605	69.7808	29.00	4.0	163	6	69.9	70.0	318000.	40.	277.	0.
19	144.7604	69.7664	28.94	6.0	123	6	77.2	51.0	515000.	70.	151.	0.
20	144.7604	69.7520	28.88	5.0	170	4	62.9	53.2	102000.	41.	141.	53.
21	144.7609	69.7366	28.74	3.0	167	18	50.3	66.7	43700.	0.	80.	0.
22	144.8031	69.9793	29.91	8.0	160	9	50.0	69.0	93000.	93.	100.	0.
23	144.8028	69.9534	29.80	10.0	122	9	69.7	74.2	21.	0.	0.	0.
24	144.8028	69.9391	29.77	12.0	216	9	41.2	69.4	86200.	0.	185.	0.
25	144.8028	69.9245	29.74	12.0	141	9	75.2	68.9	541000.	0.	130.	0.
26	144.8025	69.9104	29.70	12.0	168	9	66.7	48.6	229000.	35.	121.	0.
27	144.8028	69.8959	29.64	12.0	192	6	57.8	57.5	31800.	0.	0.	0.
28	144.8025	69.8812	29.52	12.0	141	18	54.6	53.3	130000.	0.	101.	0.
29	144.8023	69.8671	29.47	12.0	168	18	62.5	85.3	45600.	0.	0.	63.
30	144.8024	69.8528	29.40	12.0	132	12	73.5	100.0	96700.	0.	79.	0.
31	144.8025	69.8385	29.35	14.0	201	12	52.2	72.9	439000.	0.	136.	0.
32	144.8025	69.8240	29.25	14.0	124	12	75.0	65.3	23900.	0.	79.	0.
33	144.8020	69.8095	29.29	15.0	178	11	60.7	51.4	95400.	37.	42.	48.
34	144.8020	69.7951	29.13	15.0	144	16	65.3	73.1	939000.	73.	637.	87.
35	144.8020	69.7807	29.00	13.0	169	12	68.0	50.8	147000.	35.	80.	0.
36	144.8021	69.7665	28.93	12.0	156	12	79.5	48.0	120000.	31.	108.	42.
37	144.8022	69.7521	29.11	13.0	135	12	99.3	47.6	7430.	0.	0.	0.
38	144.8031	69.7367	28.87	13.0	149	12	69.8	53.0	397000.	98.	437.	61.
39	144.8444	69.7367	28.93	14.0	149	12	71.8	59.8	573000.	51.	114.	63.
40	144.8440	69.7521	29.04	14.0	149	12	77.9	50.3	241000.	39.	177.	0.
41	144.7220	69.9673	29.64	8.0	140	12	90.7	41.6	58000.	31.	73.	42.
42	144.7212	69.9534	29.62	10.0	158	12	37.3	32.3	1180.	0.	137.	143.
43	144.7191	69.9390	29.54	19.0	145	12	73.1	60.3	641000.	51.	115.	0.
44	144.7211	69.9243	29.42	20.0	137	12	70.8	65.0	113000.	0.	70.	0.
45	144.7208	69.9102	29.31	19.0	123	8	77.2	71.5	1210000.	71.	541.	0.
46	144.6789	69.9103	29.40	19.5	145	12	80.0	86.5	254000.	0.	100.	0.
47	144.6786	69.9247	29.54	14.0	121	12	90.1	48.2	171000.	0.	59.	0.
48	144.6791	69.9390	29.52	13.0	151	12	67.5	54.3	331000.	0.	115.	0.
49	144.6788	69.9535	29.43	10.0	116	16	87.9	43.0	1770.	0.	65.	0.
50	144.6789	69.9646	29.64	3.0	143	12	73.4	61.6	111000.	0.	59.	0.

Table 2-2

ID	LONG	LAT	BP	T	WT	MD	%H_2O	HE	METH	ETH	ETHE	C_3
51	144.6369	69.9655	29.64	5.0	171	12	56.7	46.9	81200.	0.	56.	0.
52	144.6371	69.9535	29.44	9.5	152	12	80.3	43.5	33400.	0.	37.	0.
53	144.6369	69.9391	29.46	16.0	190	12	55.8	59.2	17400.	78.	45.	0.
54	144.5098	69.9963	29.67	4.0	117	12	59.0	35.3	16000.	0.	128.	0.
55	144.5096	69.9821	29.67	6.0	111	12	100.0	38.0	188.	0.	0.	0.
56	144.5095	69.9679	29.64	7.0	130	14	80.8	47.2	184.	0.	0.	0.
57	144.5096	69.9534	29.50	8.0	147	18	69.4	34.7	131000.	0.	56.	0.
58	144.5099	69.9390	29.42	8.0	109	24	99.1	52.0	84.	0.	0.	0.
59	144.5094	69.9246	29.47	10.0	144	12	71.5	55.5	67800.	0.	0.	0.
60	144.5098	69.9103	29.46	11.0	104	12	100.0	47.4	4120.	0.	0.	0.
61	144.5510	69.9103	29.43	12.0	85	12	100.0	47.1	124.	0.	0.	0.
62	144.5511	69.9247	29.34	10.0	139	16	69.1	51.7	11600.	0.	0.	0.
63	144.5513	69.9391	29.30	12.0	51	18	66.7	77.8	411.	0.	0.	0.
64	144.5514	69.9534	29.40	10.0	141	24	68.1	50.5	343000.	0.	66.	73.
65	144.5510	69.9677	29.56	6.0	100	16	77.0	40.8	18000.	0.	0.	0.
66	144.5509	69.9821	29.69	6.0	147	12	71.4	51.5	118000.	0.	57.	0.
67	144.5938	69.9679	29.70	2.0	144	16	68.1	56.7	2480000.	129.	284.	0.
68	144.5933	69.9534	29.44	12.0	139	18	69.8	58.8	672000.	64.	280.	76.
69	144.5936	69.9391	29.39	11.0	128	18	58.6	52.6	53800.	0.	108.	0.
70	144.5934	69.9246	29.24	15.0	105	16	100.0	64.3	15700.	0.	74.	0.
71	144.5935	69.9103	29.41	15.0	121	16	67.8	63.7	264000.	0.	97.	0.
72	144.6369	69.9104	29.45	15.0	111	12	46.8	75.3	426000.	0.	400.	0.
73	144.6370	69.9246	29.52	17.0	111	20	100.0	57.7	12000.	0.	0.	0.
74	144.7203	69.8958	29.46	18.0	125	24	74.4	64.4	198000.	0.	317.	0.
75	144.6786	69.8960	29.53	17.5	126	16	81.7	58.4	379000.	0.	325.	71.
76	144.6372	69.8960	29.46	14.0	144	18	72.9	53.0	555000.	0.	117.	0.
77	144.5931	69.8961	29.40	15.0	153	18	70.6	32.8	114000.	0.	93.	52.
78	144.5514	69.8959	29.43	15.0	132	12	82.6	54.6	184000.	0.	57.	0.
79	144.5095	69.8959	29.40	14.0	110	14	72.7	62.1	5850.	0.	107.	0.
80	144.5094	69.8815	29.43	15.0	151	18	64.9	64.4	287000.	58.	319.	70.
81	144.5516	69.8816	29.36	16.0	117	18	79.5	59.8	170000.	0.	160.	0.
82	144.5931	69.8817	29.35	18.0	129	14	78.3	58.3	94500.	0.	66.	0.
83	144.6367	69.8814	29.37	17.0	141	12	73.8	53.8	41700.	0.	57.	0.
84	144.6787	69.8814	29.42	18.0	121	16	100.0	64.3	4100.	0.	0.	0.
85	144.7205	69.8814	29.33	18.0	140	18	76.4	50.4	124000.	0.	0.	0.
86	144.7203	69.8671	29.35	17.0	97	18	99.0	76.6	49800.	0.	0.	0.
87	144.6787	69.8671	29.34	17.0	120	18	99.2	64.2	5290.	0.	0.	0.
88	144.6369	69.8670	29.41	18.0	147	18	61.9	42.0	75700.	0.	70.	0.
89	144.5932	69.8672	29.42	18.0	112	16	98.2	61.2	51800.	0.	0.	0.
90	144.5511	69.8673	29.31	17.0	96	12	100.0	73.1	20500.	0.	0.	0.
91	144.5095	69.8673	29.29	13.0	153	12	41.2	69.8	4540.	0.	126.	0.
92	144.5094	69.8528	29.34	14.0	126	14	73.8	58.5	480000.	0.	154.	0.
93	144.5515	69.8528	29.31	15.0	92	12	100.0	69.4	389.	0.	0.	0.
94	144.5931	69.8528	29.39	16.0	133	12	72.9	54.3	205000.	0.	69.	0.
95	144.6365	69.8527	29.39	18.0	140	24	73.6	64.2	25500.	0.	62.	0.
96	144.2611	69.9964	29.71	7.0	122	16	62.3	31.5	18900.	0.	104.	221.
97	144.3027	69.9965	29.81	5.0	123	12	69.1	25.6	27500.	0.	344.	184.
98	144.3446	69.9965	29.80	7.0	142	12	71.8	46.1	138000.	56.	308.	136.
99	144.3864	69.9965	29.83	3.0	128	12	62.5	36.8	721.	0.	0.	0.
100	144.4287	69.9964	29.78	2.0	118	5	80.5	25.0	429000.	69.	148.	0.

Table 2-3

ID	LONG	LAT	BP	T	WT	MD	%H_2O	HE	METH	ETH	ETHE	C_3
101	144.4712	70.0116	29.86	2.0	61	4	47.5	163.0	18400.	0.	444.	0.
102	144.4703	69.9964	29.82	2.0	49	4	67.3	153.0	55300.	0.	765.	0.
103	144.4705	69.9820	29.81	4.0	118	6	61.0	76.8	2150000.	125.	792.	139.
104	144.4703	69.9678	29.69	4.0	116	12	62.1	94.3	744000.	125.	262.	0.
105	144.4700	69.9535	29.66	6.0	89	12	100.0	47.3	12100.	0.	0.	0.
106	144.4706	69.9390	29.69	4.0	88	12	98.9	41.0	6080.	0.	0.	0.
107	144.4701	69.9247	29.65	4.0	79	12	29.1	1.0	149000.	0.	570.	0.
108	144.4697	69.9105	29.66	5.0	78	12	75.6	6.3	7880.	0.	174.	0.
109	144.4695	69.8960	29.63	4.0	111	16	55.0	28.1	507000.	0.	157.	0.
111	144.4693	69.8669	29.44	5.0	121	12	57.0	26.9	146000.	0.	122.	0.
112	144.4688	69.8529	29.52	6.0	87	18	98.9	41.9	114000.	0.	0.	0.
113	144.4287	70.0117	30.14	7.0	145	12	51.0	40.5	981000.	0.	109.	0.
114	144.4287	69.9821	30.05	6.0	96	16	99.0	42.8	7240.	0.	0.	0.
115	144.4281	69.9677	30.06	6.0	98	12	79.6	50.9	468000.	0.	118.	0.
116	144.4282	69.9535	30.04	6.0	115	16	20.0	1.0	8040.	0.	511.	0.
117	144.4281	69.9391	29.96	6.0	114	16	67.5	66.6	6830.	0.	113.	0.
118	144.4281	69.9247	29.93	6.0	134	16	56.7	40.5	391.	0.	0.	0.
119	144.4279	69.9102	29.94	6.0	87	12	98.9	40.4	30300.	0.	0.	0.
120	144.4276	69.8960	29.74	6.0	67	12	46.3	1.0	358000.	0.	802.	0.
121	144.4273	69.8816	29.71	6.0	138	18	59.4	76.0	789000.	90.	383.	0.
122	144.4277	69.8672	29.69	6.0	126	16	57.9	37.6	251000.	0.	113.	0.
123	144.4274	69.8527	29.78	6.0	127	12	59.8	34.1	643000.	97.	206.	0.
124	144.4270	69.8382	29.70	6.0	96	18	97.9	44.0	6620.	0.	0.	0.
125	144.4691	69.8382	29.68	6.0	144	18	46.5	46.2	103000.	0.	128.	0.
126	144.5093	69.8381	29.67	6.0	127	16	57.5	72.3	353000.	0.	118.	0.
127	144.5515	69.8384	29.68	7.0	137	16	59.9	32.7	920000.	163.	348.	93.
128	144.5932	69.8385	29.71	8.0	92	16	98.9	33.9	2720.	0.	0.	0.
129	144.6367	69.8383	29.69	8.0	108	12	41.7	16.8	266000.	0.	228.	0.
130	144.6779	69.8384	29.68	7.0	126	12	48.4	54.1	155000.	0.	150.	0.
131	144.7200	69.8382	29.65	7.0	134	12	67.9	68.7	982000.	74.	319.	86.
133	144.3867	70.0118	29.97	6.0	101	12	62.4	39.1	25900.	0.	0.	0.
134	144.3948	69.9822	30.09	10.0	115	6	73.0	85.8	354000.	0.	208.	0.
135	144.3862	69.9676	30.09	8.0	113	6	79.6	87.2	703000.	83.	445.	96.
136	144.3862	69.9533	29.97	9.0	127	8	52.0	53.3	491000.	0.	270.	0.
137	144.3860	69.9388	30.04	9.0	60	6	70.0	1.0	225000.	0.	288.	0.
138	144.3863	69.9246	29.93	10.0	118	6	55.1	50.1	431000.	132.	276.	0.
139	144.3863	69.9102	29.94	10.0	102	6	78.4	104.0	1010000.	111.	590.	125.
140	144.3860	69.8958	29.91	8.5	86	6	86.0	63.2	320000.	130.	547.	143.
141	144.3843	69.8815	29.89	10.0	51	4	68.6	22.1	81100.	0.	722.	0.
142	144.3861	69.8670	29.85	10.0	108	6	81.5	50.1	9570.	0.	95.	0.
143	144.3851	69.8525	29.81	10.0	107	6	24.3	1.0	114000.	0.	0.	0.
144	144.3859	69.8383	29.80	9.0	102	4	74.5	77.5	244000.	0.	0.	0.
145	144.3859	69.8240	29.74	8.5	148	6	62.2	62.1	334000.	67.	147.	80.
146	144.4274	69.8239	29.75	10.0	88	6	98.9	50.9	13400.	0.	0.	0.
147	144.4692	69.8238	29.72	10.0	87	6	98.9	56.0	9940.	0.	0.	0.
148	144.5097	69.8239	29.70	12.0	126	4	67.5	86.2	1500000.	269.	575.	103.
149	144.5515	69.8240	29.71	8.5	137	6	50.4	45.5	56300.	0.	0.	0.
150	144.5931	69.8239	29.74	12.0	129	18	58.1	83.5	15900.	0.	114.	0.

Table 2-4

ID	LONG	LAT	BP	T	WT	MD	%H_2O	HE	METH	ETH	ETHE	C_3
151	144.6366	69.8238	29.64	12.0	123	6	60.2	38.5	477000.	100.	211.	0.
152	144.6782	69.8240	29.62	10.0	144	8	55.6	1.0	916000.	254.	364.	0.
153	144.7200	69.8239	29.60	12.0	116	6	62.9	103.0	221000.	0.	124.	0.
154	144.7196	69.8095	29.54	13.0	118	6	66.9	44.2	1200000.	178.	284.	100.
155	144.6777	69.8095	29.55	12.0	126	6	59.5	33.4	425000.	0.	102.	0.
156	144.6368	69.8094	29.61	11.0	141	12	58.9	66.1	1540000.	170.	549.	98.
157	144.5928	69.8095	29.58	11.0	118	12	75.4	89.6	505000.	171.	549.	196.
158	144.5514	69.8094	29.62	12.0	137	12	54.7	45.3	368000.	0.	105.	0.
159	144.5098	69.8095	29.60	12.0	124	8	66.1	26.2	95600.	0.	89.	0.
160	144.4689	69.8094	29.65	9.0	67	6	62.7	97.7	2780000.	278.	1710.	291.
161	144.4274	69.8095	29.65	10.0	139	6	55.4	38.9	293000.	0.	0.	0.
162	144.3855	69.8093	29.64	8.0	98	6	99.0	38.9	15100.	0.	0.	0.
163	144.2611	69.8815	29.95	5.0	124	6	67.7	27.4	1150000.	82.	176.	94.
164	144.2611	69.8672	29.90	6.0	95	4	100.0	44.1	25700.	0.	0.	0.
165	144.2610	69.8528	29.87	5.0	121	4	81.0	33.6	147000.	63.	138.	150.
166	144.2611	69.8383	29.83	5.0	116	2	63.8	19.6	675000.	111.	1170.	247.
167	144.2610	69.8241	29.79	5.0	93	4	83.9	16.9	407000.	105.	222.	0.
168	144.2611	69.8096	29.76	5.0	91	4	100.0	35.7	289.	0.	0.	0.
169	144.2608	69.7952	29.73	6.0	130	4	57.7	41.3	839000.	207.	548.	116.
170	144.2612	69.7807	29.68	6.0	110	4	66.4	39.9	1540000.	116.	733.	257.
171	144.2612	69.7664	29.66	6.0	94	4	98.9	38.0	36800.	0.	0.	0.
172	144.2610	69.7522	29.62	6.0	116	4	67.2	30.9	28000.	0.	108.	0.
173	144.2609	69.7372	29.55	6.0	86	4	98.8	47.2	70800.	0.	0.	0.
174	144.3028	69.7372	29.51	7.0	124	6	72.6	58.3	342000.	154.	994.	356.
175	144.3442	69.7373	29.56	7.0	138	12	44.2	53.9	1500.	0.	0.	0.
176	144.3855	69.7374	29.54	7.0	112	6	78.6	54.6	1350000.	85.	366.	98.
177	144.4274	69.7373	29.54	7.0	115	6	70.4	91.1	308000.	0.	106.	113.
178	144.4686	69.7372	29.47	7.0	121	6	58.7	96.1	9120000.	836.	882.	310.
179	144.5101	69.7372	29.43	7.0	108	18	45.4	55.5	1660000.	211.	436.	0.
180	144.5517	69.7373	29.36	7.0	114	8	71.9	33.0	536000.	87.	186.	99.
181	144.5928	69.7371	29.66	8.0	98	6	98.0	28.6	72400.	0.	0.	0.
182	144.6375	69.7366	29.20	8.0	124	6	63.7	38.2	166000.	0.	96.	0.
183	144.6788	69.7365	29.09	8.5	136	16	64.0	72.5	762000.	158.	425.	92.
184	144.7201	69.7365	29.02	9.0	129	12	66.7	46.8	1230000.	80.	601.	184.
185	144.2609	69.9823	30.19	6.0	139	12	61.9	28.4	812000.	144.	702.	168.
186	144.2609	69.9678	30.15	6.0	118	6	81.4	32.6	910000.	67.	435.	79.
187	144.2607	69.9532	30.10	6.0	137	18	60.6	24.1	6830.	0.	0.	0.
188	144.2610	69.9389	30.07	6.5	141	12	50.4	30.0	1070000.	207.	328.	0.
189	144.2612	69.9247	30.04	6.5	103	6	100.0	38.8	1840.	0.	0.	0.
190	144.2609	69.9104	30.00	6.0	107	4	88.8	26.0	511000.	70.	151.	0.
191	144.2612	69.8960	29.96	7.0	133	4	65.4	50.2	3710000.	247.	444.	95.
192	144.3024	69.8958	29.96	6.0	96	4	99.0	32.4	11800.	0.	0.	0.
193	144.3317	69.8958	30.01	6.0	131	4	74.0	40.7	353000.	0.	289.	0.
194	144.3580	69.8961	29.99	6.0	107	4	94.4	22.4	374000.	63.	274.	74.
195	144.3442	69.9104	30.04	6.5	110	4	77.3	68.5	821000.	94.	201.	107.
196	144.3454	69.9251	30.08	7.0	90	4	100.0	36.2	3370.	0.	0.	0.
197	144.3520	69.9392	30.09	6.0	121	4	82.6	40.2	200000.	63.	138.	0.
198	144.3441	69.9535	30.14	6.0	142	4	52.1	14.9	1980.	0.	0.	0.
199	144.3439	69.9679	30.18	6.5	158	4	44.9	86.0	96400.	110.	116.	0.
200	144.3441	69.9820	30.19	6.0	110	6	90.9	50.5	105000.	0.	145.	157.

Table 2-5

ID	LONG	LAT	BP	T	WT	MD	%H_2O	HE	METH	ETH	ETHE	C_3
201	144.3444	70.0117	30.24	4.0	119	6	82.4	35.4	71700.	0.	141.	0.
202	144.3029	70.0116	30.23	3.0	140	4	65.7	29.0	668000.	128.	558.	76.
203	144.2613	70.0116	30.24	3.5	98	6	95.9	27.4	712000.	74.	158.	0.
204	144.3025	69.9821	30.17	3.0	109	6	100.0	36.2	19400.	0.	0.	0.
205	144.3024	69.9678	30.14	5.0	103	6	100.0	29.4	19900.	0.	0.	0.
206	144.3026	69.9533	30.11	4.0	112	4	91.1	44.0	115000.	0.	67.	0.
207	144.3029	69.9388	30.08	4.0	135	6	68.9	50.9	182000.	70.	456.	165.
208	144.3023	69.9246	30.03	4.0	113	6	87.6	17.2	913000.	123.	201.	73.
209	144.3027	69.9103	30.00	4.0	126	12	80.2	35.4	822000.	57.	251.	69.
210	144.3019	69.8814	29.93	4.0	72	6	100.0	25.8	983.	0.	0.	0.
211	144.3342	69.8813	29.91	5.0	114	4	75.4	68.9	1780000.	184.	591.	105.
212	144.3339	69.8671	29.89	5.0	116	6	70.7	62.1	921000.	99.	211.	0.
213	144.3019	69.8669	29.87	5.0	99	4	98.0	4.2	169000.	0.	0.	0.
214	144.3020	69.8529	29.81	5.0	116	6	69.0	33.3	1280000.	95.	403.	0.
215	144.3442	69.8528	29.79	5.0	118	4	84.7	61.0	532000.	130.	640.	387.
216	144.3441	69.8384	29.81	5.5	106	4	71.7	46.6	2370000.	210.	1560.	236.
217	144.3025	69.8381	29.84	5.0	156	8	41.0	97.3	31800.	126.	133.	0.
218	144.3018	69.8238	29.78	5.5	142	6	54.2	93.6	2380.	0.	0.	0.
219	144.3436	69.8239	29.76	5.0	128	8	69.5	24.2	3390000.	143.	309.	83.
220	144.3439	69.8096	29.73	5.0	126	6	61.1	8.1	367000.	91.	192.	102.
221	144.3022	69.8097	29.73	5.0	98	6	90.8	4.0	545000.	81.	174.	0.
222	144.3027	69.7952	29.68	4.0	162	6	41.4	32.5	7280.	0.	0.	0.
223	144.3438	69.7951	29.69	4.5	124	8	62.1	27.9	1060000.	92.	294.	0.
224	144.3854	69.7950	29.66	5.0	102	12	87.3	28.3	1170000.	162.	348.	93.
225	144.4271	69.7951	29.66	5.0	108	9	77.8	32.9	2860000.	173.	369.	99.
226	144.4687	69.7952	29.65	5.0	103	24	84.5	18.1	959.	0.	0.	0.
227	144.5096	69.7950	29.59	5.0	126	12	64.3	62.8	192000.	178.	286.	0.
228	144.5518	69.7951	29.57	5.0	90	12	100.0	37.4	24000.	0.	0.	0.
229	144.5935	69.7952	29.53	5.0	103	18	76.7	19.0	221000.	194.	308.	0.
230	144.6360	69.7953	29.51	5.0	177	20	43.5	59.4	359000.	86.	92.	99.
231	144.6776	69.7952	29.47	5.0	138	18	60.9	30.9	303000.	75.	81.	0.
232	144.7188	69.7952	29.47	5.5	113	12	72.6	47.9	609000.	90.	383.	0.
233	144.7191	69.7808	29.33	5.0	133	18	63.9	30.1	268000.	77.	412.	89.
234	144.6774	69.7810	29.34	5.0	109	6	74.3	84.4	349000.	105.	334.	592.
235	144.6354	69.7810	29.47	5.0	106	6	78.3	34.4	8.	0.	0.	0.
236	144.5929	69.7808	29.40	5.0	136	4	58.1	50.2	441000.	97.	729.	222.
237	144.5518	69.7808	29.44	6.0	94	6	100.0	50.3	945.	0.	0.	0.
238	144.5095	69.7808	29.45	6.0	135	4	57.8	93.4	1130000.	99.	530.	0.
239	144.4689	69.7808	29.45	6.0	115	6	67.8	110.0	260.	0.	0.	0.
240	144.4274	69.7807	29.46	6.0	108	6	72.2	51.2	341000.	0.	209.	0.
241	144.3019	69.7805	29.65	6.0	120	6	72.5	120.0	600000.	90.	872.	208.
242	144.3438	69.7807	29.67	6.0	152	4	38.2	45.8	21300.	0.	147.	0.
243	144.3853	69.7806	29.65	6.0	86	9	98.8	110.0	8550.	0.	0.	0.
244	144.3018	69.7665	29.59	6.0	87	6	100.0	52.5	17100.	0.	0.	0.
245	144.3439	69.7664	29.60	6.0	148	12	56.1	50.3	2500.	0.	90.	0.
246	144.3855	69.7663	29.61	6.0	106	12	83.0	61.8	1310000.	178.	380.	203.
247	144.4303	69.7664	29.61	6.0	129	24	57.4	86.4	1770000.	114.	362.	0.
248	144.4680	69.7663	29.57	6.0	97	8	99.0	41.0	62900.	0.	0.	0.
249	144.5094	69.7664	29.50	5.5	123	6	61.0	56.5	8660.	0.	0.	0.
250	144.5509	69.7664	29.44	6.0	89	8	95.5	53.4	79500.	98.	104.	0.

Table 2-6

ID	LONG	LAT	BP	T	WT	MD	%H_2O	HE	METH	ETH	ETHE	C_3
251	144.6355	69.7664	29.36	6.0	106	4	62.3	71.8	1910000.	286.	449.	0.
252	144.6773	69.7663	29.30	6.0	85	4	100.0	46.9	83300.	0.	0.	0.
253	144.7191	69.7665	29.21	6.0	122	4	61.5	50.2	1220000.	208.	662.	234.
254	144.7190	69.7522	29.20	6.0	111	4	77.5	67.8	2030000.	89.	572.	102.
255	144.6773	69.7522	29.22	5.0	131	6	52.7	145.0	2940000.	837.	1180.	155.
256	144.6359	69.7521	29.29	5.5	89	12	95.5	37.6	167000.	0.	205.	0.
257	144.5926	69.7522	29.33	4.5	93	6	97.8	41.9	60200.	0.	188.	0.
258	144.5933	69.7665	29.43	4.5	97	4	85.6	87.6	118.	0.	0.	0.
259	144.5516	69.7522	29.39	4.5	109	4	81.7	45.3	375000.	0.	91.	98.
260	144.5098	69.7520	29.44	4.0	116	12	62.9	45.1	437000.	0.	119.	0.
261	144.4485	69.7520	29.50	4.0	105	12	76.2	48.6	159000.	101.	214.	0.
262	144.4264	69.7522	29.59	5.0	106	8	87.7	35.0	3280.	0.	162.	0.
263	144.3877	69.7521	29.61	4.5	103	6	100.0	95.0	41800.	0.	0.	0.
264	144.3026	69.7521	29.61	4.5	112	6	78.6	39.5	474000.	169.	1640.	195.
265	144.8446	69.9721	30.17	0.0	135	4	63.0	51.6	397000.	0.	92.	0.
266	144.8445	69.9535	30.15	0.0	103	4	63.1	85.9	9100000.	1210.	1990.	378.
267	144.8443	69.9389	30.06	0.5	102	20	66.7	68.9	3830000.	291.	1380.	160.
268	144.8445	69.9247	29.81	0.5	97	6	99.0	54.8	25500.	0.	178.	0.
269	144.8445	69.9104	29.76	2.0	126	12	59.5	51.4	2730000.	218.	2430.	245.
270	144.8438	69.8960	29.85	2.0	126	12	61.9	87.4	519000.	0.	331.	118.
271	144.8440	69.8815	29.92	3.0	111	6	77.5	56.9	859000.	176.	470.	100.
272	144.8437	69.8671	29.80	3.0	138	12	56.5	82.6	1250000.	199.	1160.	226.
273	144.8442	69.8528	29.73	3.0	122	12	73.8	30.3	776000.	74.	480.	0.
274	144.8436	69.8384	29.61	4.0	136	4	55.9	111.0	5480000.	383.	1630.	144.
275	144.8430	69.8242	29.52	4.0	99	12	39.4	101.0	626000.	317.	972.	0.
276	144.8439	69.8096	29.48	3.5	102	12	98.0	31.6	111000.	0.	76.	0.
277	144.8439	69.7948	29.45	4.0	132	18	66.7	31.5	681000.	75.	243.	0.
278	144.8437	69.7808	29.48	4.0	118	12	70.3	71.7	7610000.	988.	2700.	501.
279	144.8435	69.7666	29.25	4.0	65	12	47.7	8.7	101000.	417.	1270.	0.
280	144.8859	69.7366	28.98	3.0	131	12	70.2	111.0	981000.	165.	896.	194.
281	144.8869	69.9534	30.37	0.0	103	6	76.7	17.8	15500.	98.	311.	0.
282	144.8870	69.9391	30.25	1.0	129	12	71.3	25.4	1460000.	70.	531.	0.
283	144.8862	69.9246	30.06	0.5	100	12	97.0	7.5	249000.	0.	78.	0.
284	144.8866	69.9105	30.06	0.0	99	6	88.9	93.0	1970000.	412.	1210.	351.
285	144.9286	69.9102	30.15	1.0	138	24	22.5	1.0	21700.	661.	337.	0.
286	144.9286	69.9247	30.11	0.5	117	6	74.4	64.2	377000.	0.	279.	0.
287	144.9289	69.9391	30.33	0.5	95	12	98.9	10.8	21000.	0.	89.	0.
288	144.9287	69.9536	30.37	0.5	142	6	54.9	68.9	607000.	94.	501.	107.
289	144.9285	69.9620	30.38	0.5	89	6	59.6	1.0	1120000.	187.	1160.	199.
290	144.9703	69.9534	30.41	0.5	143	12	51.0	66.8	1620000.	107.	227.	0.
291	144.9704	69.9389	30.29	2.0	103	12	98.1	22.2	25900.	0.	73.	0.
292	144.9697	69.9247	30.17	3.0	107	12	99.1	50.4	417000.	0.	69.	0.
293	144.9698	69.9103	30.12	3.0	107	18	99.1	34.2	62200.	0.	136.	0.
294	145.0098	69.9104	29.96	3.0	158	12	43.0	37.7	254000.	104.	219.	116.
295	145.0096	69.9247	30.24	3.0	95	6	100.0	48.4	7670.	0.	0.	0.
296	145.0100	69.9391	30.35	2.5	89	12	100.0	67.2	2020.	0.	108.	0.
297	145.0105	69.9535	30.38	3.0	132	12	50.8	200.0	10300000.	802.	1680.	0.
298	145.0097	69.9680	30.38	0.5	110	12	75.5	104.0	332000.	0.	0.	0.
299	145.0108	69.9796	30.39	1.5	159	16	44.7	34.1	43400.	105.	223.	0.
300	145.0542	69.9805	30.39	0.0	100	12	69.0	94.5	9800000.	0.	810.	170.

Table 2-7

ID	LONG	LAT	BP	T	WT	MD	%H_2O	HE	METH	ETH	ETHE	C_3
301	145.0608	69.9677	30.37	2.0	126	6	72.2	80.8	1370000.	82.	268.	97.
302	145.0516	69.9535	30.35	2.0	164	9	48.2	105.0	10600.	90.	195.	0.
303	145.0520	69.9391	30.28	2.0	120	9	62.5	75.9	127000.	0.	110.	0.
304	145.0520	69.9248	30.17	2.0	96	9	100.0	58.8	89300.	0.	91.	0.
305	145.0516	69.9104	29.95	2.0	121	9	69.4	99.2	293000.	0.	299.	0.
306	145.0515	69.8958	29.87	2.5	145	6	60.7	107.0	5120000.	219.	717.	130.
307	145.0098	69.8960	29.99	1.5	137	6	49.6	35.9	85000.	117.	369.	130.
308	144.9694	69.8957	30.17	2.0	175	6	33.7	45.7	10400.	126.	264.	0.
309	144.9280	69.8958	30.11	4.0	89	6	97.8	50.0	195000.	0.	209.	0.
310	144.8866	69.8958	30.00	2.5	130	12	76.2	89.7	912000.	68.	373.	82.
311	144.8861	69.8815	30.00	2.0	113	6	48.7	33.2	15800.	167.	346.	0.
312	144.9278	69.8812	29.98	2.0	96	9	99.0	37.4	108000.	83.	89.	0.
313	144.9696	69.8814	30.07	5.5	138	9	47.1	32.1	290000.	118.	248.	0.
314	145.0132	69.8798	30.06	6.0	117	12	64.1	92.6	473000.	113.	358.	0.
315	145.0513	69.8815	30.02	0.0	150	12	62.7	38.9	619000.	179.	592.	72.
315	144.8860	69.8669	30.02	0.0	150	12	62.7	38.9	619000.	179.	592.	72.
316	144.9274	69.8671	29.94	0.0	130	6	60.8	36.8	10700.	90.	382.	102.
317	144.9698	69.8670	29.90	2.0	124	6	62.9	52.9	582000.	98.	417.	0.
318	145.0095	69.8670	29.88	0.5	93	18	58.1	57.3	2160000.	209.	866.	0.
319	145.0515	69.8671	29.90	0.5	121	18	66.1	16.0	1290000.	92.	588.	0.
320	145.0514	69.8530	29.78	1.0	88	18	100.0	52.4	16200.	0.	0.	0.
321	145.0098	69.8528	29.84	1.0	122	18	69.7	31.1	635000.	83.	265.	0.
322	144.9692	69.8527	29.87	0.5	116	18	69.0	134.0	1970000.	116.	1230.	131.
323	144.9274	69.8529	29.90	1.5	96	18	99.0	72.7	84700.	0.	96.	0.
324	144.8860	69.8528	29.99	2.0	101	4	99.0	23.3	6640.	0.	0.	0.
325	144.8860	69.8384	29.90	2.0	101	3	93.1	21.7	590000.	149.	400.	86.
326	144.9274	69.8387	29.83	2.0	135	18	57.0	41.4	763000.	96.	307.	109.
327	144.9685	69.8387	29.70	2.0	116	9	70.7	39.7	1520000.	275.	880.	104.
328	145.0094	69.8383	29.49	0.5	106	12	51.9	49.1	1210000.	184.	956.	0.
329	145.0515	69.8385	29.54	0.5	112	4	54.5	93.9	4530000.	0.	734.	0.
330	145.0516	69.8241	29.75	1.5	118	4	67.8	36.0	1940000.	484.	2370.	549.
331	145.0094	69.8241	29.83	2.0	98	18	59.2	50.3	26200.	0.	178.	0.
332	144.9689	69.8240	29.72	2.0	105	9	73.3	94.2	527000.	0.	120.	0.
333	144.9265	69.8240	29.78	1.0	138	9	55.1	313.0	2150000.	0.	161.	0.
334	144.8858	69.8240	29.78	1.0	111	4	63.1	46.1	541000.	132.	1390.	147.
335	144.8856	69.8097	29.59	5.5	88	9	98.9	66.8	13600.	0.	0.	0.
336	144.9275	69.8098	29.64	5.0	81	9	55.6	37.6	1970000.	258.	265.	0.
337	144.9691	69.8096	29.56	4.5	116	9	66.4	115.0	362000.	117.	372.	0.
338	145.0093	69.8096	29.51	4.5	117	18	59.8	150.0	3350000.	283.	745.	0.
339	145.0515	69.8096	29.53	6.0	110	9	60.0	80.5	866000.	565.	739.	0.
340	145.0513	69.7952	29.47	4.0	123	12	61.8	31.3	1140000.	100.	530.	0.
341	145.0093	69.7950	29.45	4.5	126	12	50.0	82.9	217000.	0.	0.	0.
342	144.9686	69.7951	29.47	4.0	125	9	56.0	79.5	840000.	0.	387.	0.
343	144.9268	69.7952	29.51	4.0	125	9	55.2	115.0	2680000.	137.	288.	0.
344	144.8855	69.7952	29.59	4.5	125	18	59.2	71.1	2400000.	113.	836.	127.
345	144.8856	69.7808	29.44	4.5	88	9	89.8	48.1	345000.	0.	119.	0.
346	144.9266	69.7808	29.41	4.0	139	9	61.9	29.9	6720000.	0.	366.	99.
347	144.9682	69.7808	29.48	5.5	116	9	64.7	127.0	1010000.	0.	644.	0.
348	145.0093	69.7807	29.34	6.0	146	12	53.4	44.4	1670000.	88.	662.	202.
349	145.0512	69.7809	29.36	3.5	123	9	61.0	49.1	7610000.	114.	483.	128.
350	145.0512	69.7664	29.19	6.0	140	4	51.4	104.0	6340000.	132.	701.	149.

Table 2-8

ID	LONG	LAT	BP	T	WT	MD	%H_2O	HE	METH	ETH	ETHE	C_3
351	145.0094	69.7665	29.23	4.0	116	9	71.6	71.7	3080000.	96.	411.	0.
352	144.9680	69.7665	29.24	6.0	124	12	68.5	95.9	501000.	87.	280.	0.
353	144.9265	69.7666	29.31	6.5	98	9	86.7	54.0	1520000.	108.	574.	0.
354	144.8854	69.7665	29.35	8.0	131	18	66.4	87.7	2140.	0.	0.	0.
355	144.8851	69.7522	29.27	6.5	138	9	59.4	54.9	2330000.	175.	657.	101.
356	144.9265	69.7522	29.20	6.0	116	12	68.1	273.0	7960000.	152.	646.	0.
357	144.9680	69.7521	29.05	5.0	136	18	64.0	84.0	1070000.	81.	436.	94.
358	145.0094	69.7521	28.99	6.0	133	12	61.7	86.4	19100000.	1540.	2420.	546.
359	145.0514	69.7522	28.94	4.0	143	12	65.7	35.6	2630000.	134.	587.	0.
360	145.0514	69.7367	28.84	5.0	135	6	64.4	30.8	638000.	0.	77.	0.
361	145.0102	69.7368	28.88	4.0	161	6	47.8	110.0	4880000.	526.	1130.	121.
362	144.9687	69.7368	28.96	4.5	130	6	65.4	77.2	477000.	84.	451.	0.
363	144.9273	69.7366	29.07	5.0	115	6	61.7	44.9	733000.	0.	119.	0.
364	145.0929	69.7366	28.72	10.5	115	18	68.7	125.0	1440000.	110.	585.	124.
365	145.1345	69.7367	28.77	13.0	132	12	57.6	77.8	4200000.	207.	991.	117.
366	145.1759	69.7367	28.75	14.0	155	9	54.8	64.9	18200.	0.	0.	0.
367	145.2191	69.7369	29.07	13.0	126	12	63.5	162.0	4760000.	360.	640.	0.
368	145.2608	69.7368	29.11	15.5	134	12	66.4	71.6	1020000.	78.	588.	0.
369	145.3022	69.7370	29.06	15.0	107	12	71.0	63.5	890000.	104.	767.	116.
370	145.3438	69.7369	29.11	15.0	132	12	62.1	142.0	4370000.	331.	1780.	127.
371	145.3434	69.7524	29.19	15.0	141	12	56.7	145.0	1890000.	305.	764.	117.
372	145.3014	69.7523	29.25	17.0	109	9	76.1	69.1	4670000.	201.	749.	114.
373	145.2604	69.7525	29.19	17.5	136	6	55.1	141.0	2570000.	0.	115.	122.
374	145.2194	69.7523	29.00	16.0	128	6	60.2	60.4	617000.	0.	99.	105.
375	145.1757	69.7520	29.21	12.0	149	6	57.7	103.0	104000.	0.	0.	0.
376	145.1344	69.7520	29.32	14.0	112	24	82.1	109.0	1800000.	178.	479.	0.
377	145.0922	69.7521	29.23	14.0	130	24	63.8	90.1	1180000.	89.	478.	0.
378	145.0929	69.7664	29.08	13.5	146	24	58.2	56.7	683000.	72.	77.	0.
379	145.1342	69.7664	29.14	15.0	109	12	72.5	55.3	1790000.	95.	806.	107.
380	145.1758	69.7664	29.21	16.0	129	12	72.1	47.2	1400000.	67.	366.	79.
381	145.2192	69.7666	29.05	17.0	114	12	69.3	142.0	958.	0.	0.	0.
382	145.2608	69.7666	29.24	18.0	134	16	63.4	100.0	1100000.	87.	559.	0.
383	145.3015	69.7667	29.26	18.0	105	12	79.0	122.0	1200000.	102.	217.	0.
384	145.3441	69.7666	29.32	17.0	98	12	100.0	51.7	3410.	0.	0.	0.
385	145.3440	69.7809	29.37	18.0	95	4	98.9	63.8	10400.	0.	0.	0.
386	145.3015	69.7811	29.34	18.0	108	4	92.6	44.5	29000.	0.	0.	0.
387	145.2608	69.7810	29.25	16.0	122	4	71.3	25.1	1710000.	79.	338.	0.
388	145.2199	69.7811	28.97	15.5	145	6	45.5	105.0	686000.	0.	0.	0.
389	145.0900	69.7806	29.05	17.5	193	18	35.2	79.0	1540000.	93.	594.	106.
390	145.1343	69.7807	29.04	16.0	114	18	68.4	148.0	2390000.	118.	500.	0.
391	145.1758	69.7807	29.08	18.0	136	12	61.0	70.1	1600000.	85.	457.	0.
392	145.0930	69.7951	29.21	18.0	136	12	65.4	115.0	1420000.	83.	268.	97.
393	145.1347	69.7951	29.15	18.0	127	12	69.3	81.3	1370000.	80.	432.	0.
394	145.1761	69.7952	28.97	16.5	133	9	67.7	55.5	1670000.	71.	463.	0.
395	145.2198	69.7953	28.96	16.0	133	9	57.1	76.0	2910000.	506.	324.	115.
396	145.2600	69.7954	29.26	16.5	140	12	57.1	119.0	3970000.	418.	335.	119.
397	145.3022	69.7954	29.27	17.0	139	12	65.5	63.8	2380000.	70.	381.	0.
398	145.3440	69.7954	29.37	19.0	149	6	56.4	62.2	157000.	0.	161.	0.
399	145.3526	69.8098	29.41	19.0	141	6	59.6	122.0	4020000.	100.	861.	116.
400	145.2927	69.8113	29.33	19.0	138	4	59.4	59.4	708000.	85.	182.	0.

Table 2-9

ID	LONG	LAT	BP	T	WT	MD	%H_2O	HE	METH	ETH	ETHE	C_3
401	145.2602	69.8098	29.25	17.5	122	9	86.1	72.4	885000.	66.	732.	80.
402	145.2208	69.8098	29.45	18.0	90	9	48.9	23.7	148000.	0.	253.	0.
403	145.1765	69.8097	29.19	16.0	148	9	60.8	72.2	504000.	70.	229.	83.
404	145.1345	69.8095	29.23	15.0	113	9	69.9	109.0	1140000.	105.	223.	118.
405	145.0934	69.8097	29.35	16.0	129	9	63.6	64.1	182000.	0.	367.	0.
406	145.0926	69.8242	29.32	16.0	109	18	83.5	133.0	2390000.	98.	419.	0.
407	145.0931	69.8384	29.29	16.0	131	9	57.3	74.3	885.	0.	0.	0.
408	145.0930	69.8529	29.35	14.5	125	9	78.4	74.8	199000.	0.	72.	78.
409	145.0937	69.8671	29.43	15.5	133	4	58.6	113.0	16200000.	133.	427.	303.
410	145.0935	69.8816	29.59	15.5	111	4	76.6	53.8	1200000.	89.	285.	0.
411	145.0934	69.8961	29.65	16.0	125	4	76.0	56.1	4150.	0.	0.	0.
412	145.0938	69.9104	29.71	15.0	101	4	91.1	48.1	31000.	0.	0.	0.
414	145.0942	69.9393	29.87	14.5	130	4	66.2	90.3	3900000.	89.	191.	102.
415	145.0941	69.9536	29.93	14.0	119	12	62.2	80.8	18700000.	0.	146.	0.
416	145.0942	69.9823	30.00	3.0	98	6	100.0	38.9	12900.	0.	0.	0.
417	145.0943	69.9680	29.97	2.0	96	4	99.0	20.7	5390.	0.	0.	0.
418	145.1372	69.9823	29.97	2.0	100	2	97.0	32.2	84100.	0.	82.	0.
419	145.1362	69.9679	29.96	1.5	119	2	73.1	29.8	1500000.	80.	172.	92.
420	145.1360	69.9534	29.95	0.5	108	2	99.1	35.7	1540.	0.	0.	0.
421	145.1357	69.9409	29.88	1.0	105	9	81.9	84.7	1090000.	95.	303.	108.
422	145.1359	69.9248	29.82	0.5	113	12	77.0	57.3	1800000.	84.	451.	97.
423	145.1330	69.9103	29.70	0.5	115	9	81.7	78.8	22500000.	0.	338.	244.
424	145.1354	69.8959	29.64	0.5	89	9	98.9	41.8	24000.	0.	0.	0.
425	145.1355	69.8814	29.57	1.5	141	9	60.3	43.1	287000.	0.	86.	0.
426	145.1352	69.8671	29.49	1.0	124	18	38.7	12.8	73400.	0.	410.	0.
427	145.1352	69.8529	29.31	1.0	97	12	97.9	15.9	7980.	0.	0.	0.
428	145.1348	69.8385	29.26	0.5	109	12	77.1	30.4	4230000.	91.	681.	104.
429	145.1349	69.8239	29.16	1.0	103	12	99.0	66.9	113000.	0.	0.	0.
430	145.1765	69.8241	29.21	1.0	135	12	64.4	39.8	2170000.	178.	287.	0.
431	145.2196	69.8240	29.27	2.0	108	12	71.3	54.3	1500000.	111.	353.	0.
432	145.2603	69.8239	29.51	2.0	103	12	86.4	27.0	1690000.	82.	264.	0.
433	145.3022	69.8242	29.48	2.0	151	12	49.0	31.8	1570000.	93.	495.	105.
434	145.3442	69.8241	29.47	2.5	147	18	48.3	61.1	2340000.	0.	119.	0.
435	145.3508	69.8402	29.30	2.0	129	6	58.1	57.2	179000.	102.	108.	0.
436	145.3024	69.8385	29.49	2.5	108	2	74.1	75.3	9530000.	0.	121.	0.
437	145.2603	69.8382	29.52	2.5	93	9	100.0	28.4	15400.	0.	0.	0.
438	145.2200	69.8384	29.51	3.0	135	18	54.8	57.4	45900.	0.	0.	0.
439	145.1762	69.8385	29.31	2.5	122	9	63.9	44.1	4150000.	106.	1130.	120.
440	145.1708	69.8552	29.49	3.0	177	30	40.7	52.7	9910.	112.	716.	127.
441	145.2190	69.8526	29.60	3.0	90	12	57.8	22.7	907000.	0.	407.	0.
442	145.2607	69.8527	29.59	3.5	79	12	53.2	1.0	405000.	0.	806.	0.
443	145.3074	69.8547	29.36	2.5	162	6	48.8	36.1	242000.	175.	1320.	203.
444	145.3439	69.8526	29.32	2.5	116	6	70.7	26.0	1370000.	92.	292.	0.
445	145.3446	69.8671	29.41	2.0	108	12	70.4	74.2	1940000.	122.	386.	0.
446	145.3017	69.8669	29.45	2.0	118	12	73.7	38.8	804000.	81.	345.	0.
447	145.2611	69.8669	29.46	2.0	108	9	80.6	38.2	1120000.	85.	364.	0.
448	145.2140	69.8656	29.69	3.5	139	9	68.3	128.0	8790000.	269.	196.	0.
449	145.1769	69.8673	29.54	2.5	125	12	63.2	75.0	6140000.	116.	123.	131.
450	145.1777	69.8829	29.72	3.5	124	12	66.9	32.0	894000.	86.	184.	98.

Table 2-10

ID	LONG	LAT	BP	T	WT	MD	%H_2O	HE	METH	ETH	ETHE	C_3
451	145.2204	69.8813	29.64	3.0	117	12	64.1	70.5	2330000.	112.	832.	126.
452	145.2605	69.8814	29.51	2.5	108	12	67.6	74.5	962000.	120.	380.	0.
453	145.3019	69.8812	29.49	2.5	124	18	63.7	26.6	951000.	0.	98.	104.
454	145.3444	69.8815	29.41	2.5	126	12	57.9	95.5	1960000.	127.	673.	142.
455	145.3443	69.8959	29.69	3.0	130	12	59.2	32.9	1010000.	103.	1200.	116.
456	145.3018	69.8958	29.61	3.0	135	12	55.6	80.1	808000.	467.	372.	132.
457	145.2607	69.8959	29.65	3.5	122	12	73.8	35.1	660000.	78.	586.	90.
458	145.2206	69.8956	29.61	3.5	129	18	68.2	31.7	1030000.	79.	511.	184.
459	145.1772	69.8961	29.76	4.0	117	9	71.8	81.2	864000.	0.	104.	0.
460	145.1776	69.9103	29.76	4.0	105	6	84.8	112.0	3270000.	102.	548.	235.
461	145.1777	69.9249	29.79	4.0	70	9	71.4	112.0	143000.	220.	903.	232.
462	145.1777	69.9393	29.86	4.0	118	6	69.5	14.7	867000.	91.	483.	206.
463	145.1779	69.9535	29.87	4.0	137	6	64.2	24.7	860000.	64.	209.	152.
464	145.1784	69.9713	29.92	4.0	123	9	69.1	53.0	1680000.	89.	571.	102.
465	145.1786	69.9891	29.74	2.0	82	4	73.2	28.0	1020.	0.	0.	0.
466	145.2217	69.9904	29.76	2.0	136	4	55.9	18.8	361000.	94.	398.	0.
467	145.2609	69.9959	29.76	2.0	103	4	63.1	94.4	453000.	146.	916.	159.
468	145.3020	69.9965	29.78	2.0	116	9	64.7	47.1	1060000.	121.	1790.	405.
469	145.3448	69.9964	29.76	2.0	148	24	37.2	11.4	187000.	0.	0.	0.
470	145.3447	69.9818	29.76	3.0	143	18	58.0	33.5	2790000.	83.	268.	0.
471	145.3024	69.9821	29.74	3.0	118	9	72.0	114.0	2230000.	98.	209.	111.
472	145.2605	69.9821	29.74	3.0	81	9	100.0	89.6	1720.	0.	0.	0.
473	145.2220	69.9819	29.74	3.0	108	9	81.5	30.1	1100000.	88.	943.	201.
474	145.2212	69.9678	29.72	4.0	111	12	72.1	14.5	382000.	99.	737.	112.
475	145.2609	69.9677	29.73	4.0	105	12	74.3	25.6	340000.	108.	574.	0.
476	145.3021	69.9677	29.73	4.0	125	18	60.0	20.9	734000.	103.	764.	116.
477	145.3444	69.9677	29.74	4.0	72	24	58.3	147.0	2620000.	0.	1150.	0.
478	145.3443	69.9535	29.74	4.5	106	12	82.1	40.8	446000.	82.	350.	0.
479	145.3015	69.9534	29.69	5.0	120	9	60.8	43.4	1840000.	115.	606.	0.
480	145.2616	69.9531	29.57	5.0	109	18	82.6	38.6	1370000.	78.	251.	0.
481	145.2212	69.9532	29.69	5.0	136	12	55.1	68.5	2100000.	409.	979.	347.
482	145.2212	69.9389	29.66	6.0	116	18	73.3	54.9	1720000.	90.	577.	103.
483	145.2607	69.9389	29.64	6.0	104	18	100.0	44.6	4350.	0.	0.	0.
484	145.3023	69.9388	29.68	6.0	135	12	54.8	33.0	1280000.	0.	226.	0.
485	145.3447	69.9388	29.65	6.5	122	18	66.4	24.6	360000.	89.	567.	0.
486	145.3445	69.9247	29.62	5.5	144	18	60.4	33.1	1090000.	71.	229.	0.
487	145.3019	69.9245	29.62	6.5	77	6	51.9	115.0	583000.	0.	1720.	0.
488	145.2605	69.9246	29.63	7.0	129	18	56.6	77.3	11500000.	262.	970.	147.
489	145.2207	69.9246	29.58	7.0	121	4	63.6	1.0	27000000.	337.	1670.	633.
490	145.2210	69.9102	29.54	7.0	119	9	68.1	46.0	1570000.	92.	589.	105.
491	145.2601	69.9103	29.54	6.5	119	9	59.7	128.0	2640000.	132.	278.	0.
492	145.3020	69.9100	29.49	7.5	100	18	57.0	112.0	1150000.	186.	3090.	401.
493	145.3443	69.9103	29.51	7.5	137	12	55.5	38.1	2650000.	0.	321.	0.
494	145.3860	69.9964	29.75	6.0	85	4	98.8	35.0	1180.	0.	0.	0.
495	145.4291	69.9965	29.75	6.5	97	9	86.6	114.0	2850000.	110.	351.	0.
496	145.4711	69.9962	29.75	6.0	92	9	100.0	52.9	16700.	0.	0.	0.
497	145.5097	69.9964	29.74	6.0	121	12	52.1	33.7	1180000.	134.	419.	0.
498	145.5098	69.9821	29.72	7.0	100	12	84.0	68.7	1740000.	98.	311.	0.
499	145.4703	69.9821	29.68	7.5	109	18	56.9	29.7	1350000.	0.	309.	0.
500	145.4288	69.9821	29.71	8.0	119	24	68.9	36.2	866000.	0.	289.	0.

Table 2-11

ID	LONG	LAT	BP	T	WT	MD	%H_2O	HE	METH	ETH	ETHE	C_3
501	145.3867	69.9822	29.73	8.0	101	12	89.1	39.3	1360000.	0.	98.	0.
502	145.3867	69.9677	29.68	8.0	116	4	60.3	26.9	1640000.	122.	894.	134.
503	145.4287	69.9676	29.66	8.0	139	12	59.7	36.7	1230000.	81.	435.	93.
504	145.4703	69.9677	29.66	7.5	114	12	76.3	57.6	1670000.	84.	180.	97.
505	145.5096	69.9677	29.67	8.0	155	18	49.0	95.4	6290000.	104.	333.	119.
506	145.5097	69.9535	29.63	8.0	140	12	56.4	77.8	1160000.	93.	399.	0.
507	145.4707	69.9533	29.65	7.0	131	18	57.3	56.3	1620000.	103.	218.	231.
508	145.4287	69.9535	29.62	6.5	134	18	65.7	53.6	4290000.	83.	537.	97.
509	145.3866	69.9534	29.64	6.5	132	18	62.1	34.3	2540000.	87.	743.	99.
510	145.3860	69.9389	29.63	6.5	141	18	56.0	91.1	1840000.	99.	1060.	227.
511	145.4286	69.9390	29.60	7.5	126	12	65.9	103.0	2880000.	104.	1670.	238.
512	145.4702	69.9390	29.59	7.0	124	12	67.7	107.0	4410000.	102.	875.	117.
513	145.5093	69.9389	29.57	6.0	142	24	62.7	111.0	1050000.	79.	172.	0.
514	145.5095	69.9246	29.51	6.0	154	18	60.4	125.0	6630000.	257.	755.	207.
515	145.4700	69.9246	29.54	7.0	164	4	50.6	85.0	2000000.	166.	541.	195.
516	145.4355	69.9248	29.59	6.5	118	4	66.1	52.5	1900000.	100.	633.	112.
517	145.3863	69.9247	29.59	6.5	37	12	43.2	190.0	164000.	0.	870.	0.
518	145.3860	69.9102	29.51	6.0	133	18	60.2	133.0	1410000.	100.	213.	0.
519	145.4288	69.9103	29.51	6.0	136	12	57.4	113.0	1870000.	114.	1100.	130.
520	145.4701	69.9103	29.51	5.0	98	18	96.9	35.3	25500.	0.	81.	0.
521	145.5096	69.9105	29.49	5.0	101	18	99.0	29.9	53200.	0.	0.	0.
522	145.5096	69.8959	29.45	5.5	140	18	62.1	50.2	1490000.	75.	242.	174.
523	145.4700	69.8957	29.47	5.5	96	18	88.5	101.0	248000.	102.	217.	115.
524	145.4285	69.8957	29.46	5.5	141	4	54.6	127.0	5230000.	118.	252.	134.
525	145.3860	69.8959	29.45	5.5	136	4	52.2	93.4	1160000.	119.	505.	0.
526	145.3849	69.8816	29.29	8.0	112	18	94.6	87.6	32900.	0.	70.	0.
527	145.4277	69.8816	29.39	8.0	100	12	99.0	91.6	741.	0.	0.	0.
528	145.4693	69.8815	29.41	8.0	126	12	81.7	23.9	439000.	53.	116.	0.
529	145.5094	69.8816	29.44	8.0	130	18	67.7	65.0	2040000.	78.	508.	91.
530	145.5093	69.8672	29.28	8.0	116	18	71.6	35.4	1990000.	89.	378.	101.
531	145.4691	69.8671	29.30	8.0	129	24	76.0	76.4	1390000.	73.	159.	86.
532	145.4278	69.8671	29.32	9.0	109	12	99.1	94.8	46900.	0.	0.	0.
533	145.3859	69.8672	29.28	10.0	131	18	66.4	72.5	1320000.	80.	172.	92.
534	145.3858	69.8529	29.14	10.0	123	18	74.8	45.3	1390000.	147.	558.	172.
535	145.4277	69.8528	29.16	9.0	128	4	64.8	91.9	5410000.	195.	523.	112.
536	145.4689	69.8525	29.21	8.0	128	4	64.8	46.4	1540000.	86.	549.	0.
537	145.5093	69.8527	29.18	8.0	153	4	46.4	111.0	5440000.	123.	260.	0.
538	145.5095	69.8383	29.10	9.5	129	18	80.6	52.3	1790000.	54.	180.	132.
539	145.4692	69.8383	29.03	8.0	145	18	57.2	148.0	7260000.	210.	1020.	244.
540	145.4270	69.8384	29.04	8.0	149	9	53.7	41.6	1350000.	167.	1250.	287.
541	145.3857	69.8385	29.09	9.5	106	4	85.8	35.0	246000.	74.	239.	85.
542	145.3863	69.8229	29.12	8.0	136	4	61.0	55.6	1890000.	511.	275.	197.
543	145.4273	69.8240	29.00	9.0	135	4	70.4	117.0	2110000.	77.	1010.	184.
544	145.4687	69.8239	28.99	9.0	135	9	66.7	120.0	1840000.	86.	563.	0.
545	145.5093	69.8239	28.99	9.5	125	12	67.2	121.0	1810000.	100.	323.	0.
546	145.5093	69.8096	29.01	9.0	107	12	72.9	84.6	812000.	108.	344.	0.
547	145.4691	69.8095	28.99	8.0	147	9	57.8	47.9	2560000.	154.	500.	90.
548	145.4252	69.8097	29.08	9.0	124	12	81.5	35.4	1520000.	58.	256.	70.
549	145.3855	69.8095	29.14	10.0	121	6	74.4	139.0	1490000.	0.	402.	108.
550	145.3857	69.7951	29.15	10.0	147	4	59.2	48.2	19000.	0.	0.	0.

Table 2-12

ID	LONG	LAT	BP	T	WT	MD	%H_2O	HE	METH	ETH	ETHE	C_3
551	145.4270	69.7953	29.00	9.5	103	4	99.0	41.7	40200.	0.	0.	0.
552	145.4687	69.7952	28.95	10.0	140	18	61.4	130.0	1390000.	176.	477.	103.
553	145.5097	69.7950	28.95	10.0	134	12	60.4	123.0	1880000.	102.	763.	233.
554	145.5095	69.7811	28.91	10.0	97	4	99.0	49.8	13800.	0.	0.	0.
555	145.4682	69.7809	28.90	10.0	136	4	58.8	34.7	1480000.	86.	739.	198.
556	145.4270	69.7810	28.95	10.0	143	12	62.9	88.1	1850000.	225.	1220.	177.
557	145.3858	69.7802	29.11	11.0	140	9	53.6	135.0	8920000.	247.	656.	278.
558	145.3854	69.7666	29.04	9.5	110	9	99.1	75.7	8750.	0.	0.	0.
559	145.4267	69.7666	28.90	10.0	139	18	56.8	73.2	2040.	0.	0.	0.
560	145.4680	69.7665	28.84	10.5	133	18	65.4	111.0	1680000.	90.	386.	208.
561	145.5097	69.7665	28.87	10.5	133	4	63.9	42.0	1100000.	77.	831.	178.
562	145.5094	69.7521	28.65	11.5	137	18	59.9	112.0	1900000.	195.	626.	223.
563	145.4679	69.7522	28.72	12.0	147	18	61.2	156.0	9240000.	97.	741.	230.
564	145.4265	69.7523	28.79	10.0	152	9	46.7	235.0	14300000.	948.	504.	535.
565	145.3852	69.7523	29.04	12.0	121	18	75.2	67.2	5740000.	166.	539.	97.
566	145.3851	69.7369	28.98	12.5	134	2	75.4	129.0	8610000.	161.	712.	195.
567	145.4261	69.7370	28.75	9.0	110	2	86.4	33.5	570000.	68.	148.	79.
568	145.4671	69.7369	28.68	9.5	143	12	60.1	131.0	1990000.	93.	1110.	217.
569	145.5090	69.7368	28.67	8.5	134	12	57.5	125.0	2220000.	218.	1280.	247.
570	145.5510	69.7369	28.70	13.0	125	9	79.2	65.5	218000.	65.	1060.	153.
571	145.5925	69.7370	28.79	12.0	130	12	73.1	118.0	12800000.	193.	1050.	458.
572	145.6337	69.7368	28.95	14.0	111	9	91.0	108.0	143000.	0.	0.	0.
573	145.6749	69.7369	28.89	14.0	127	12	70.1	134.0	1160000.	91.	293.	0.
574	145.7164	69.7368	28.94	14.0	151	4	57.6	191.0	8440000.	666.	0.	130.
575	145.7573	69.7369	29.05	12.0	134	4	70.9	98.1	1670000.	72.	783.	170.
576	145.7579	69.7522	29.03	12.0	134	4	56.0	231.0	27900000.	731.	194.	413.
577	145.7164	69.7523	29.15	12.5	137	4	65.7	165.0	4200000.	94.	409.	110.
578	145.6752	69.7524	29.05	12.0	119	12	80.7	160.0	2630000.	185.	1200.	326.
579	145.6336	69.7523	29.14	10.0	131	12	67.9	127.0	3100000.	100.	759.	117.
580	145.5921	69.7522	28.87	10.0	143	6	60.8	68.7	3770000.	79.	686.	93.
581	145.5506	69.7521	28.81	9.5	114	12	68.4	118.0	1580000.	112.	475.	126.
582	145.5506	69.7664	28.91	9.0	123	9	76.4	124.0	7020000.	204.	774.	120.
583	145.5920	69.7664	28.92	8.0	146	6	50.7	84.8	5970000.	119.	636.	135.
584	145.6338	69.7664	29.16	8.0	106	9	99.1	88.6	9060.	0.	0.	0.
585	145.6753	69.7666	29.15	8.0	142	6	62.0	122.0	968000.	86.	742.	100.
586	145.7166	69.7666	29.16	8.0	131	6	63.4	142.0	1910000.	105.	562.	120.
587	145.7577	69.7665	28.94	8.0	141	6	53.2	127.0	2210000.	115.	1220.	130.
588	145.7580	69.7810	29.00	7.0	123	9	63.4	120.0	2990.	0.	0.	0.
589	145.7166	69.7808	29.03	9.0	119	18	64.7	120.0	2160000.	121.	638.	135.
590	145.6753	69.7811	29.06	7.0	139	2	48.9	26.4	568.	0.	0.	0.
591	145.6334	69.7809	29.22	9.5	112	9	89.3	50.2	1250.	0.	0.	0.
592	145.5926	69.7810	29.07	8.0	121	9	77.7	253.0	19600000.	0.	0.	162.
593	145.5509	69.7810	29.00	8.0	134	9	73.1	137.0	1850000.	81.	531.	193.
594	145.5498	69.7953	29.14	7.0	133	9	63.2	44.0	3440.	0.	0.	0.
595	145.5980	69.7956	29.41	5.0	131	4	72.5	135.0	12700000.	297.	754.	117.
596	145.6338	69.7955	29.27	3.0	167	4	48.5	123.0	1250000.	92.	296.	106.
597	145.6755	69.7954	29.18	2.5	136	9	63.2	108.0	137.	0.	0.	0.
598	145.7168	69.7952	29.11	2.5	98	4	99.0	91.5	108.	0.	0.	0.
599	145.7576	69.7953	29.16	2.5	120	4	98.3	16.6	16200.	0.	44.	0.
600	145.7582	69.8097	29.19	4.0	172	28	52.3	118.0	3850000.	312.	172.	94.

Table 2-13

ID	LONG	LAT	BP	T	WT	MD	%H_2O	HE	METH	ETH	ETHE	C_3
601	145.7170	69.8099	29.24	2.5	167	4	55.1	102.0	2290000.	73.	1050.	178.
602	145.6759	69.8098	29.29	3.5	146	4	51.4	37.8	613000.	96.	615.	218.
603	145.6340	69.8098	29.25	3.5	122	4	79.5	51.8	774000.	76.	166.	90.
604	145.5929	69.8097	29.37	4.0	151	4	53.0	97.8	1980.	0.	0.	0.
605	145.5510	69.8098	29.22	4.5	136	4	67.6	81.9	3190000.	81.	440.	96.
606	145.5508	69.8239	29.45	4.5	184	18	38.0	113.0	1470000.	107.	459.	122.
607	145.5925	69.8241	29.40	5.5	133	4	74.4	33.4	1150000.	58.	320.	140.
608	145.6339	69.8240	29.34	4.0	128	12	72.7	103.0	473000.	78.	84.	0.
609	145.6756	69.8240	29.29	5.0	105	12	99.0	70.9	38300.	0.	0.	0.
610	145.7173	69.8241	29.29	5.5	155	12	54.8	102.0	5120000.	788.	107.	116.
611	145.7582	69.8240	29.28	3.0	128	12	62.5	107.0	1850000.	217.	1040.	246.
612	145.7595	69.8382	29.28	4.0	137	12	70.1	103.0	953000.	149.	650.	177.
613	145.7175	69.8384	29.35	4.5	97	12	95.9	101.0	2680000.	96.	103.	0.
614	145.6761	69.8384	29.38	5.0	97	12	99.0	87.9	42500.	0.	0.	0.
615	145.6344	69.8383	29.46	6.0	139	18	61.2	127.0	3110000.	298.	2250.	346.
616	145.5927	69.8385	29.52	5.0	152	18	48.7	128.0	10900000.	260.	139.	295.
617	145.5509	69.8384	29.49	5.5	131	9	67.9	68.4	2560.	0.	0.	0.
618	145.5511	69.8528	29.52	8.0	127	18	71.7	94.6	1370000.	82.	618.	191.
619	145.5929	69.8528	29.60	8.0	118	9	83.1	55.6	2850000.	69.	224.	81.
620	145.6341	69.8529	29.46	8.0	140	9	54.3	124.0	1990000.	229.	1950.	518.
621	145.6763	69.8529	29.40	8.5	132	12	68.2	89.1	690000.	80.	172.	0.
622	145.5510	69.8671	29.57	5.5	127	12	79.5	93.9	708000.	72.	393.	86.
623	145.5925	69.8672	29.64	8.0	146	4	65.1	107.0	1550000.	75.	411.	90.
624	145.6342	69.8673	29.54	6.0	130	9	73.8	116.0	1970000.	325.	266.	96.
625	145.6766	69.8672	29.51	5.5	108	9	98.1	86.0	60900.	0.	0.	0.
626	145.7181	69.8673	29.54	5.5	143	9	53.1	155.0	3870000.	262.	140.	149.
627	145.7187	69.8527	29.43	5.5	145	12	61.4	108.0	1840000.	88.	766.	207.
628	145.7579	69.8528	29.38	8.0	111	12	99.1	92.0	259000.	65.	72.	0.
629	145.7578	69.8672	29.60	10.0	128	24	68.0	101.0	1260000.	90.	481.	103.
630	145.7581	69.8815	29.56	7.5	154	2	48.7	156.0	10800000.	270.	288.	307.
631	145.7186	69.8817	29.65	7.5	140	9	70.0	135.0	2370.	0.	0.	0.
632	145.6766	69.8818	29.61	7.0	128	9	68.0	177.0	10500000.	504.	0.	146.
633	145.6347	69.8816	29.61	7.0	116	9	88.8	67.7	783000.	64.	209.	76.
634	145.5930	69.8815	29.66	8.0	102	9	96.1	33.4	588.	0.	0.	0.
635	145.5511	69.8816	29.64	5.0	130	18	82.3	78.2	378000.	64.	286.	158.
636	145.5515	69.8957	29.72	5.5	161	12	55.3	103.0	2030000.	84.	640.	100.
637	145.5930	69.8960	29.73	9.0	131	12	67.2	107.0	2150000.	95.	411.	111.
638	145.6345	69.8958	29.72	8.5	135	12	65.9	164.0	9150000.	220.	119.	129.
639	145.6753	69.8960	29.74	9.5	141	12	57.4	111.0	1430000.	98.	524.	112.
640	145.7185	69.8960	29.61	8.0	155	12	59.4	116.0	2860000.	83.	1450.	198.
641	145.7579	69.8959	29.67	7.5	144	18	61.8	45.6	4090000.	76.	329.	89.
642	145.7584	69.9103	29.84	7.0	121	9	76.0	131.0	1510000.	92.	398.	107.
643	145.7182	69.9100	29.76	7.5	145	9	53.8	115.0	750000.	100.	214.	114.
644	145.6766	69.9103	29.77	7.5	131	9	60.3	92.8	2160000.	104.	773.	118.
645	145.6345	69.9103	29.78	6.0	158	30	51.9	37.6	190000.	78.	338.	91.
646	145.5932	69.9102	29.75	6.0	131	18	61.8	32.0	1260000.	173.	924.	99.
647	145.5517	69.9104	29.77	6.0	147	12	55.8	133.0	8690000.	341.	489.	263.
648	145.5511	69.9245	29.78	6.5	109	12	99.1	83.7	11800.	0.	0.	0.
649	145.5928	69.9246	29.79	6.5	131	12	76.3	94.0	937000.	68.	223.	81.
650	145.6352	69.9246	29.81	6.5	119	9	76.5	43.3	635.	0.	0.	0.

Table 2-14

ID	LONG	LAT	BP	T	WT	MD	%H_2O	HE	METH	ETH	ETHE	C_3
651	145.6772	69.9247	29.93	5.0	124	24	63.7	32.9	119000.	0.	201.	0.
652	145.7186	69.9246	29.96	3.0	131	9	64.9	112.0	230.	0.	0.	0.
653	145.7578	69.9247	29.98	4.0	122	9	66.4	114.0	3220000.	116.	247.	132.
654	145.7582	69.9389	30.02	5.0	140	9	60.7	100.0	2210000.	91.	294.	105.
655	145.7186	69.9391	29.95	3.0	156	12	52.6	86.7	3020000.	174.	564.	202.
656	145.6841	69.9388	29.28	4.0	137	6	60.6	161.0	9180000.	119.	128.	137.
657	145.6356	69.9390	29.95	4.0	116	18	75.0	116.0	1500000.	99.	1060.	228.
658	145.5936	69.9390	29.93	3.5	123	18	67.5	100.0	1590000.	101.	542.	231.
659	145.5516	69.9391	30.01	5.5	146	18	57.5	82.7	3030000.	92.	1200.	215.
660	145.5556	69.9524	29.93	6.0	146	18	63.0	113.0	1070000.	77.	337.	92.
661	145.5933	69.9535	29.96	6.0	132	12	65.9	87.6	1560000.	91.	392.	105.
662	145.6354	69.9532	29.99	4.0	134	6	76.1	40.3	1360000.	55.	241.	66.
663	145.7213	69.9533	30.02	4.0	135	36	45.2	68.5	10200000.	155.	810.	339.
664	145.7582	69.9534	30.07	4.0	192	24	38.5	105.0	32800.	332.	178.	96.
665	145.7584	69.9678	30.05	5.0	144	6	67.4	40.1	1950000.	60.	527.	72.
666	145.7192	69.9677	30.07	5.0	201	4	32.3	72.6	261000.	510.	435.	116.
667	145.6773	69.9679	30.05	3.5	196	36	31.1	1.0	3220.	0.	0.	0.
668	145.6280	69.9676	30.06	3.5	123	6	66.7	53.3	1140000.	95.	305.	0.
669	145.5930	69.9677	30.05	3.0	148	12	58.8	56.7	3630000.	78.	597.	93.
670	145.5518	69.9676	30.04	3.5	106	12	72.6	51.4	2990000.	110.	936.	248.
671	145.5517	69.9818	30.09	4.0	113	6	73.5	70.7	1700000.	95.	404.	108.
672	145.5933	69.9823	30.08	3.0	132	18	70.5	28.6	383000.	133.	505.	157.
673	145.6776	69.9821	30.09	3.5	100	12	99.0	37.9	513.	0.	0.	0.
674	145.7200	69.9820	30.10	3.0	140	12	58.6	159.0	18400000.	0.	284.	153.
675	145.7642	69.9821	30.12	3.0	101	24	99.0	74.4	27700.	0.	0.	0.
676	145.7584	69.9963	30.12	3.0	125	12	78.4	106.0	1090000.	77.	755.	91.
677	145.7174	69.9963	30.15	2.5	104	2	99.0	77.7	6200.	0.	0.	0.
678	145.6780	69.9964	30.14	2.5	100	12	97.0	39.9	1450000.	0.	0.	0.
679	145.6182	69.9922	30.15	2.5	141	18	61.7	103.0	3010000.	87.	187.	101.
680	145.5936	69.9964	30.15	2.5	105	2	99.0	81.1	5240.	0.	0.	0.
681	145.5516	69.9962	30.14	2.5	116	2	87.1	107.0	1140000.	74.	566.	264.
683	144.6785	69.8529	29.86	1.5	127	18	77.2	125.0	3310000.	82.	358.	97.
684	144.5921	69.8231	29.76	3.0	136	9	66.9	67.3	640000.	74.	240.	86.
685	144.2221	69.9962	30.25	0.5	100	18	82.0	16.7	1120.	0.	0.	0.
686	144.2217	69.9820	30.21	0.0	81	18	98.8	9.8	666.	0.	0.	0.
687	144.2215	69.9676	30.17	0.0	111	18	75.7	82.5	1150000.	102.	765.	116.
688	144.2220	69.9533	30.16	0.0	100	12	99.0	70.2	541.	0.	0.	0.
689	144.2219	69.9387	30.14	0.0	69	6	98.6	1.0	991.	0.	0.	0.
690	144.2218	69.9245	30.11	0.0	126	12	69.8	150.0	36000000.	0.	168.	181.
691	144.2214	69.9103	30.06	2.0	237	6	21.5	12.7	41200.	0.	113.	0.
692	144.2208	69.8958	30.06	2.0	99	6	99.0	79.1	5980.	0.	0.	0.
693	144.2206	69.8814	29.98	3.0	91	6	98.9	67.8	1990.	0.	0.	0.
694	144.2207	69.8672	29.96	4.0	133	12	59.4	108.0	56800000.	0.	556.	198.
695	144.2205	69.8527	29.94	3.0	133	12	39.8	43.6	21300000.	0.	211.	0.
696	144.2244	69.8240	29.83	6.0	125	12	60.8	38.8	1970000.	105.	556.	118.
697	144.2253	69.8096	29.75	3.0	152	24	48.7	1.0	1760000.	103.	770.	117.
698	144.2197	69.7951	29.74	4.0	96	9	96.9	40.8	6400.	0.	0.	0.
699	144.2201	69.7805	29.66	4.0	106	9	99.1	75.7	6980.	0.	0.	0.
700	144.2196	69.7664	29.63	4.0	126	9	69.8	42.8	571.	0.	0.	0.
701	144.2190	69.7523	29.60	4.0	122	12	48.4	56.4	2650000.	168.	1750.	546.
702	144.2196	69.7373	29.55	5.0	101	9	99.0	71.9	673.	0.	0.	0.

Table 2-15