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MASTER

National Uranium Resource Evaluation

**Airborne Gamma-Ray Spectrometer
And Magnetometer Survey
Sioux Falls Quadrangle, South Dakota**

Final Report - Volume I

**Aero Service Division
Western Geophysical Company of America
Houston, Texas 77001**

April 1981

**PREPARED FOR U.S. DEPARTMENT OF ENERGY
Assistant Secretary for Resource Applications
Grand Junction Office, Colorado**

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This report is a result of work performed by Aero Service Division Western Geophysical Company of America through a Bendix Field Engineering Corporation Subcontract, as part of the National Uranium Resource Evaluation. NURE is a program of the U.S. Department of Energy's Grand Junction, Colorado, Office to acquire and compile geologic and other information with which to assess the magnitude and distribution of uranium resources and to determine areas favorable for the occurrence of uranium in the United States.

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AIRBORNE GAMMA-RAY SPECTROMETER
AND
MAGNETOMETER SURVEY

SIOUX FALLS QUADRANGLE
SOUTH DAKOTA, IOWA, MINNESOTA

FINAL REPORT
VOLUME I

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AERO SERVICE DIVISION
WESTERN GEOPHYSICAL COMPANY
OF AMERICA
HOUSTON, TEXAS

MAY, 1981

PREPARED FOR THE U. S. DEPARTMENT OF ENERGY
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GRAND JUNCTION OFFICE, COLORADO
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AND BENDIX FIELD ENGINEERING CORPORATION
SUBCONTRACT NO. 80-449-L
PROJECT NO. IGO207-PROJECT A

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INTRODUCTION

During the months of June through October, 1980, Aero Service Division Western Geophysical Company of America conducted an airborne high sensitivity gamma-ray spectrometer and magnetometer survey over eleven (11) 2° x 1° NTMS quadrangles located in the states of Minnesota and Wisconsin and seven (7) 2° x 1° NTMS quadrangles in North and South Dakota. These include the Kenora, Roseau, International Falls, Quetico, Bemidji, Hibbing, Two Harbors, Brainerd, Duluth, Stillwater, and St. Paul quadrangles of Minnesota and Wisconsin. The quadrangles located within the North and South Dakota survey area include Devil's Lake, New Rockford, Jamestown, Aberdeen, Huron, Mitchell, and Sioux Falls. This report discusses the results obtained over the Sioux Falls map area.

Traverse lines were flown in an east-west direction at a line spacing of six (6) miles. Tie lines were flown north-south approximately twenty-four (24) miles apart. A total of 21,481 line miles of geophysical data were acquired, compiled, and interpreted during the survey, of which 1479 line miles are in this quadrangle.

This report is a result of work performed under Bendix Field Engineering Corporation Subcontract No. 80-449-L, Project No. IG0207-Project A, as part of the National Uranium Resources Evaluation. NURE is a program of the U. S. Department of Energy's Grand Junction, Colorado, office to acquire and compile geologic and other information with which to assess the magnitude and distribution of uranium resources and to determine areas favorable for the occurrence of uranium in the United States.

The data were reduced and compiled in accordance with the technical specifications of the contract as stated in BFEC 1200-C and BFEC 1250-A. The parameters used in the processing of the radiometric data have been substantiated in a previously submitted calibration report of the Douglas DC-3 installed airborne gamma-ray spectrometer system.

DATA ACQUISITION

Aircraft

The survey was conducted using a Douglas DC-3 fixed wing aircraft, registration N5000E, owned and operated by Aero Service Division Western Geophysical Company of America. The flight crew consisted of a pilot, a navigator and an electronic operator. Some of the more pertinent characteristics and specifications of the aircraft are listed below:

T A B L E I

Aircraft Specifications and Characteristics

Aircraft	Douglas DC-3 - N5000E
Power Plant	2 ea. - Pratt Whitney - R1830-94 Engines, Twin Row, Radial - 1,350 H. P.
Allowable Gross Weight	26,900 lbs.
Empty Weight - Survey Configuration	23,000 lbs.
Avionics - Dual RT41A VHF Comm Transceiver	
Dual Collins 51V VOR/LOC/RMI Receiver	
Dual Collins Glide Scope Receiver	
1 KDM 705 DME	
1 KXP 750 Transponder	
1 618T3B H.F. Transceiver	
Sperry A-12 Autopilot System	
Bendix Doppler Navigation System	
Honeywell Radar Altimeter	
Cruise Airspeed	120 to 165 M.P.H.
Rate of Climb	1,200 f.p.m.
Service Ceiling	24,000 Feet
Fuel	100/130 Octane
Fuel Consumption	Approx. 100 Gal. Per Hour

Gamma-Ray Spectrometer System

The survey was carried out using Aero Service's HISENS A(irborne) G(amma)-R(ay) S(pectrometer) 3000F system, shown in block diagrammatic form in Figure 3, page 12.

-12-

Figure 3

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AERO SERVICE DIVISION
WESTERN GEOPHYSICAL
HOUSTON, TEXAS 77002

OWN
CHKD
APVD

DATE
12/76

TITLE
BLOCK DIAGRAM,
HISENS AGRS 3000F SYSTEM

SIZE
B

DRAWING NO.

230-548-002

REV SHE

16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

The primary detector package consists of 14 logs of 4" x 4" x 15" of Polyscin®, NaI(Tl), each log hermetically sealed in a stainless steel container and coupled to a high quality photo-multiplier tube. The logs are assembled in 3 slabs of respectively 4, 4 and 6 logs each. Each slab is enclosed in a heated and thermally stabilized container. Total volume of the primary detector is 3360 cubic inches (55.06 liters). The upward looking (2π) detector consists of two 4" x 4" x 16" logs of Polyscin®, NaI(Tl), also hermetically sealed in a steel container and coupled to high quality photo-multiplier tubes. The two logs are enclosed as a slab in the same container that houses the slab of 6 logs of Polyscin®. The upward looking crystals are mounted on top of the 4π sensor, separated by a 0.75" slab of lead shielding, in order to obtain the prescribed shielding effect of 85% @ 3000KeV.

The preamplifiers, which with the photo-multipliers provide virtually the total signal amplification, are also enclosed in the thermally stabilized packages, to ensure maximum signal stability. The output of the preamplifiers is fed into the amplifiers, whose main function is to shape the incoming pulses into a bipolar gaussian form.

The mixer/router, the 50 MHz Wilkinson ramp analog to digital converter and the multi-channel analyzer of both the primary and 2π spectrometer systems are commercially available units, supplied by Canberra Industries. The data from the two spectrometers are output to the data controller, formed by a Hewlett Packard 21 MX minicomputer system, which stores the data, formats them, outputs them on tape and compares the tape recorded data with the data stored in memory. Additional data recorded on tape are radar altitude, barometric pressure, atmospheric temperature, magnetometer data, real time, gamma-ray spectrometer system live-time and other ancillary data such as additional navigational data. Two tape drives were employed and automatic switching between the two occurs as each tape ends. Additional ancillary equipment includes a cathode ray tube display, a Clevite Brush 6-channel analog recorder and a 35mm frame camera, triggered by the data controller at a preset interval.

Magnetometer

The magnetic sensor used for the survey was a Geometrics G-803 proton free-precession magnetometer, housed in a high-drag, fiberglass bird and towed approximately 100' behind and .25' below the aircraft, in order to assure reliable data with minimal aircraft compensation.

PRODUCTION SUMMARY

The 2° x 1° NTMS quadrangle of Sioux Falls, located in South Dakota, Minnesota and Iowa, was surveyed as part of a subcontract covering eleven (11) quadrangles located in Minnesota and Wisconsin along with seven (7) quadrangles in North and South Dakota. The subcontract covered the flying of a total of 21,481 line miles of geophysical data, of which 1479 miles are in the Sioux Falls quadrangle.

The main base of operations of all survey flights was located between the two survey areas at Fargo, North Dakota.

The aircraft arrived on site on June 28, 1980. The first production flight was made on July 1, 1980, with the last flight being completed on October 25, 1980. Production operations within these survey areas were interrupted over the period of July 11, 1980, through August 10, 1980, during which time the aircraft was conducting a similar NURE program of airborne radiometric surveying over twelve (12) quadrangles located in northern Alaska. The aircraft and crew were on site, carrying out flight operations in the Minnesota, Wisconsin and Dakotas areas for a total of eighty-eight days. It was not possible to complete production flights on fifty-nine of these days. Twenty-two days were lost due to inclement weather or atmospheric conditions. Six days were lost due to electronic equipment maintenance and thirty-one days were lost due to aircraft maintenance including twenty-three days for multiple engine changes. A complete summary of daily flight operations is given in Table II, pages 16, 17, 18 and 19.

Production averaged 75.8 miles per hour of flight time. An average of 740.7 miles of data was acquired each actual production day. When computed over the total number of days on site, data acquisition averaged 244.1 miles per day.

Flight line directions and spacing for the Sioux Falls quadrangle were east-west traverse lines 6 miles apart and north-south tie lines flown at 24 mile intervals. The nominal terrain clearance for the survey was 400 feet. Figure 4 shows a histogram of the terrain clearance of the aircraft as recorded by the radar altimeter. The histogram takes into account all final samples in this quadrangle. The mean terrain clearance, as observed, is approximately 400 feet. The ground speed of the aircraft, as determined from the distances between samples based on their final X-Y positions, is depicted in graphic form in the histogram of Figure 5, page 21.

T A B L E II
Daily Production Summary

<u>DATE</u>	<u>BASE</u>	<u>ACTIVITY</u>	<u>FLIGHT NO.</u>
06/28/80	Fargo, North Dakota	Arrive Fargo	
06/29/80	Fargo, North Dakota	Weather	
06/30/80	Fargo, North Dakota	Aircraft maintenance	
07/01/80	Fargo, North Dakota	Production	4, 5
07/02/80	Fargo, North Dakota	Production	6
07/03/80	Fargo, North Dakota	Production	7
07/04/80	Fargo, North Dakota	Electronic maintenance	
07/05/80	Fargo, North Dakota	Production	8
07/06/80	Fargo, North Dakota	Weather	
07/07/80	Fargo, North Dakota	Aircraft maintenance and tests	9, 10
07/08/80	Fargo, North Dakota	Production	11, 12
07/09/80	Fargo, North Dakota	Production	13
07/10/80	Fargo, North Dakota	Electronic maintenance	
07/11/80	Fargo, North Dakota	Depart for Alaska	
07/12/80		Operations in North	
to		Slope airborne survey	
08/09/80		quadrangles	
08/10/80	Fargo, North Dakota	Arrive Fargo	31
08/11/80	Fargo, North Dakota	Aircraft maintenance	
08/12/80	Fargo, North Dakota	Aircraft maintenance	
08/13/80	Fargo, North Dakota	Aircraft maintenance	
08/14/80	Fargo, North Dakota	Aircraft test flight	32
08/15/80	Fargo, North Dakota	Production	33, 34
08/16/80	Fargo, North Dakota	Weather	
08/17/80	Fargo, North Dakota	Weather	
08/18/80	Fargo, North Dakota	Production	35
08/19/80	Fargo, North Dakota	Production	36

Daily Production Summary

<u>DATE</u>	<u>BASE</u>	<u>ACTIVITY</u>	<u>FLIGHT NO.</u>
08/20/80	Fargo, North Dakota	Weather	
08/21/80	Fargo, North Dakota	Weather	
08/22/80	Fargo, North Dakota	Production	37, 38
08/23/80	Fargo, North Dakota	Weather	
08/24/80	Fargo, North Dakota	Excessive radon	39, 40
08/25/80	Fargo, North Dakota	Weather	
08/26/80	Fargo, North Dakota	Production	41
08/27/80	Fargo, North Dakota	Aircraft maintenance	
08/28/80	Fargo, North Dakota	Aircraft maintenance	
08/29/80	Fargo, North Dakota	Aircraft test flight	42
08/30/80	Minneapolis, Minnesota	Aircraft engine change #1	
08/31/80	Minneapolis, Minnesota	Aircraft engine change #1	
09/01/80	Minneapolis, Minnesota	Aircraft engine change #1	
09/02/80	Minneapolis, Minnesota	Aircraft engine change #1	
09/03/80	Minneapolis, Minnesota	Aircraft engine change #1	
09/04/80	Minneapolis, Minnesota	Aircraft engine change #1	
09/05/80	Minneapolis, Minnesota	Aircraft engine change #1	
09/06/80	Minneapolis, Minnesota	Aircraft engine change #1	
09/07/80	Minneapolis, Minnesota	Aircraft test flight	44
09/08/80	Minneapolis, Minnesota	Aircraft engine change #2	
09/09/80	Minneapolis, Minnesota	Aircraft engine change #2	
09/10/80	Minneapolis, Minnesota	Aircraft test flight	45
09/11/80	Minneapolis, Minnesota	Aircraft maintenance	
09/12/80	Minneapolis, Minnesota	Aircraft maintenance	
09/13/80	Fargo, North Dakota	Ferry to Fargo	46
09/14/80	Fargo, North Dakota	Weather	
09/15/80	Fargo, North Dakota	Abort - Count rates too high	47
09/16/80	Fargo, North Dakota	Abort electronics	48
09/17/80	Fargo, North Dakota	Weather	49
09/18/80	Fargo, North Dakota	Production	50
09/19/80	Fargo, North Dakota	Production	51

Daily Production Summary

<u>DATE</u>	<u>BASE</u>	<u>ACTIVITY</u>	<u>FLIGHT NO.</u>
09/20/80	Fargo, North Dakota	Weather	
09/21/80	Fargo, North Dakota	Fog then production	52
09/22/80	Fargo, North Dakota	Aircraft Maintenance	
09/23/80	Fargo, North Dakota	Production and reflights	53
09/24/80	Fargo, North Dakota	Production then rain	54
09/25/80	Fargo, North Dakota	Electronic maintenance	
09/26/80	Fargo, North Dakota	Production and reflights	55
09/27/80	Fargo, North Dakota	Abort, electronics	56
09/28/80	Fargo, North Dakota	Electronic maintenance	
09/29/80	Fargo, North Dakota	Abort, excessive radon	57
09/30/80	Fargo, North Dakota	Production	58
10/01/80	Fargo, North Dakota	Production	59
10/02/80	Fargo, North Dakota	Weather	
10/03/80	Fargo, North Dakota	Production	60
10/04/80	Fargo, North Dakota	Production	61
10/05/80	Fargo, North Dakota	Production	62
10/06/80	Fargo, North Dakota	Production	63
10/07/80	Fargo, North Dakota	Production	64
10/08/80	Fargo, North Dakota	Abort, engine out	65
10/09/80	Fargo, North Dakota	Aircraft engine change #3	
10/10/80	Fargo, North Dakota	Aircraft engine change #3	
10/11/80	Fargo, North Dakota	Aircraft engine change #3	
10/12/80	Fargo, North Dakota	Aircraft engine test flight	66
10/13/80	Fargo, North Dakota	Reflights	67
10/14/80	Fargo, North Dakota	Weather	
10/15/80	Fargo, North Dakota	Weather	
10/16/80	Fargo, North Dakota	Weather	
10/17/80	Fargo, North Dakota	Weather	
10/18/80	Fargo, North Dakota	Aircraft maintenance	
10/19/80	Fargo, North Dakota	Production	68
10/20/80	Fargo, North Dakota	Production	69

Daily Production Summary

<u>DATE</u>	<u>BASE</u>	<u>ACTIVITY</u>	<u>FLIGHT NO.</u>
10/21/80	Fargo, North Dakota	Production and reflights	70
10/22/80	Fargo, North Dakota	Weather	
10/23/80	Fargo, North Dakota	Weather	
10/24/80	Fargo, North Dakota	Weather	
10/25/80	Fargo, North Dakota	Reflights	71
		Complete Airborne Operations	

AERC SERVICE
QUAD SICUX FALLS

TERRAIN CLEARANCE HISTOGRAM
JOB 624

Figure 4

RADAR
ALTIMETER
FEET

AERC SERVICE
QUAD SICUX FALLS

GROUND SPEED
JOB 624

HISTOGRAM

NUMBER OF DATA POINTS

1100 2200 3300 4400 5500 6600 7700 8800 9900 11000 12100

21/22

Figure 5

DATA REDUCTION

The data reduction process as used in the processing of the airborne gamma-ray spectrometer and magnetometer data obtained within the Department of Energy (DOE) National Uranium Resource Evaluation (NURE) program is shown in flow chart form in Figure 6, page 24.

Upon arrival in the Houston office, the digital data are edited and a back-up tape is generally produced. The EDIT consists partly of a data quality check, enabling the elimination of single record spikes in any field, outside a specified preselected limit. The EDIT program further checks for data continuity and flags all data acquired at terrain clearances exceeding the survey specification. The EDIT further sums a preselected number of spectral records at the beginning and end of each survey line and fits a gaussian curve to diagnostic photopeaks, such as the Tl^{208} peak at 2614.5 KeV and the K^{40} peak at 1460 KeV for low altitude lines and the annihilation peak at 511 KeV and the K^{40} peak at 1460 KeV for high altitude lines. The position of these photopeaks is determined with an accuracy of better than 0.1 of a channel and is used to determine the exact position of the energy windows with regard to channel numbers. At the same time the calculated standard deviations of the fitted gaussian curves serve to obtain the system resolution at the photopeaks used. The window count rates are normalized for live time and are calculated as follows:

K	:	1362 KeV - 1566 KeV (Channel 114 → 130, @ 12 KeV/Channel)
U	:	1662 KeV - 1866 KeV (Channel 139 → 155, @ 12 KeV/Channel)
T	:	2406 KeV - 2826 KeV (Channel 201 → 235, @ 12 KeV/Channel)
T.C.	:	390 KeV - 2982 KeV (Channel 33 → 248, @ 12 KeV/Channel)
Cosmic	:	2994 KeV - 6138 KeV (Channel 250 → 512, @ 12 KeV/Channel)
$U_{2\pi}$	:	1662 KeV - 1866 KeV (Channel 139 → 155, @ 12 KeV/Channel)

The above channel numbers are valid only if system gain corresponds exactly to 12 KeV per channel and there is no zero shift.

The CORRECT program applies the background and cosmic corrections to the single record window count rates, corrects the data for Compton scatter and atmospheric radon, and normalizes the terrain clearance. Background count rates and cosmic factors were determined from high altitude test data acquired over the Pacific Ocean, offshore California.

Potassium Background	=	32.01 counts per second
Uranium Background	=	10.09 counts per second
Thorium Background	=	6.86 counts per second
Total Count Background	=	278.04 counts per second
2 π Bismuth Background	=	1.55 counts per second

Potassium Cosmic factor	=	0.20 c.p.s. per count 4 π cosmic
Uranium Cosmic factor	=	0.165 c.p.s./cps 4 π cosmic
Thorium Cosmic factor	=	0.22 c.p.s./cps 4 π cosmic
Total Count Cosmic factor	=	3.64 c.p.s./cps 4 π cosmic
2 π Bismuth Cosmic factor	=	0.0344 c.p.s./cps 4 π cosmic

The Compton scatter functions were determined from data obtained over the Grand Junction test pads, using the radiometric analysis of the bulk sample with natural water content.

$$\begin{aligned} T/U &= \tau = 0.076 \\ U/T &= \alpha = 0.35 + 0.02 + 0.000076H \\ K/T &= \beta = 0.44 \\ K/U &= \gamma = 0.96 \end{aligned}$$

The 2 π and 4 π uranium window count rates are related through the geometric or equivalency factor. For the present system, installed in the Douglas DC-3, this factor, $f = 6.0$. Part of the terrestrial radiation of energy higher than 1662 KeV - the lower threshold of the uranium window - is detected in the uranium window of the upward looking detector, due to incomplete shielding, skyshine and shine-around. This shine-through/shine-around effect is assumed to be a function of both the intensity of the terrestrial uranium and thorium radiation and of the aircraft terrain clearance. From multi-altitude data acquired over the Lake Mead Dynamic Test Range the shine-through/shine-around effect was determined for each altitude level. The data provided a best fit for a linear terrain clearance function as follows:

$$\text{shine-through/shine-around} = (0.05 - 3.8 \times 10^{-5}H) (U_{4\pi} + 0.35T_{4\pi})$$

The shine-through/shine-around corrected Blair Count rate is then:

$$U_{2\pi} \text{ c} = \frac{U_{2\pi} - (U_{4\pi} + 0.35T) (0.05 - 3.8 \times 10^{-5}H)}{1 - 6.0 (0.05 - 3.8 \times 10^{-5}H)}$$

The shine-through/shine-around correction is applied to the $U_{2\pi}$ count rate at each single record. The single record $U_{2\pi}$ count rates are then averaged over 35 records to make them statistically compatible with the data of the primary system. The atmospheric radon correction is applied to both the $U_{4\pi}$ and the Total Count count rates. The equivalency factor for the $U_{4\pi}/U_{2\pi} = 6.0$, for Total Count/ $U_{2\pi}$ it is 61.75.

Within the CORRECT program the data are normalized to a common datum of 400 feet terrain clearance. An exponential formula is used, based on an air column reduced to a standard temperature and pressure of 0°C and 760mm Hg. (32°F and 29.92" Hg). The air absorption coefficients used are those derived from the multiple altitude flight over the Lake Mead Dynamic Test Range for thorium, potassium and Total Count. The air absorption factor for uranium is obtained by straight interpolation between the potassium and thorium air absorption factors. Their values are respectively:

$$\begin{aligned}\mu_K &= 2.71 \times 10^{-3} \text{ per foot} \\ \mu_U &= 2.56 \times 10^{-3} \text{ per foot} \\ \mu_T &= 2.15 \times 10^{-3} \text{ per foot} \\ \mu_{TC} &= 2.16 \times 10^{-3} \text{ per foot}\end{aligned}$$

The formula used for the altitude normalization is:

$$N_{400} = N_H \cdot e^{\mu \left(400 - \frac{273}{273+t} \cdot \frac{P}{29.92} \cdot H \right)}$$

Where N_{400} , N_H are respectively the count rates at 400 feet and at altitude H, μ is air absorption factor, t is temperature in degrees Celsius and P is barometric pressure in inches Hg.

The last operation in the CORRECT program is the determination of statistical adequacy of the data. The criteria for adequacy of the data are based on the work of Lloyd A. Currie (op.cit.). A critical level is recognized, below which all observations may fail to detect a signal, i.e. 95% of all measurements fall within the "normal" distribution of "noise". The detection level is similarly defined as the level above which 95% of the measurements made fall within the normal Poisson distribution of "signal". Currie's critical level has been adopted as the count rate level below which data are inadequate. Data with count rates above the critical level but below

the detection level are considered marginal. Above the detection level data are considered adequate. For the single record data the formulas are then:

Count Rate ≤ 2.33 (Sum Corrections)^{1/2}: data inadequate

2.33 (Sum Corrections)^{1/2} < Count Rate $\leq 2.71 + 4.65$ (Sum Corrections)^{1/2}:
data marginal

Count Rate > $2.71 + 4.65$ (Sum Corrections)^{1/2}: data adequate

No ratios have been calculated involving inadequate data in either numerator or denominator. Ratios have been calculated when the data in the numerator are marginal, provided the data in the denominator are adequate.

The thorium, uranium and potassium data are subsequently averaged over 9 records in the SPECAVG program. The output is a spectrometer master tape containing both averaged and single record data.

Parallel with the radiometric data reduction process, the magnetic data are edited and processed. Using the recovered film intersections and the established ground identities, preliminary flight paths are prepared. The flight path is refined in the magnetic adjustment program until an accurate final flight path has been obtained. The reduced spectrometer data are then merged with the final X-Y position of the data points, the reduced magnetic data and the digitized geology, and a master tape is produced with data that pertain to each 2° x 1° NTMS quadrangle only. The REGROUP program then eliminates all duplicate line segments, inserts reflight segments where required, orders the remaining line segments and renumbers the fiducials of these segments such that the resulting line is directionally consistent with location sequential sample numbers. The renumbered fiducials increase from west to east for traverse lines and south to north for tie lines. A listing relating the renumbered fiducials to the original fiducial numbers as recorded in flight is included in this volume as Appendix N and can also be found in the back of Volume II. This listing gives both the line number as it appears on all final data and the line number as recorded in flight. Similarly, the start and end fiducials of each final line and/or line segment shown on the flight path base map are given along with the corresponding start and end fiducials as recorded in flight. When correlated with the final fiducial numbers, the original fiducials will increase sequentially for lines flown west to east or south to north and decrease for lines flown in the opposite

directions.

The following processing steps are STATANAL and HISTGRM. HISTGRM groups the radiometric data by geological cell units, determines the distribution of the data as normal or lognormal, calculates the mean (for normally distributed data) or the mode (for lognormal distributions) as well as the standard deviations. The results from HISTGRM are used in the STATANAL program, which calculates the signed standard deviation from the mean for each averaged sample for each of the six radiometric parameters. Its output is the Final Spectrometer Master Tape, from which the anomaly maps, the statistical analysis tape, the averaged record and single record reduced data tapes and listings, the flight path maps and the radiometric and magnetic profiles are produced.

High 2π uranium count rates were encountered during many of the data acquisition flights over this quadrangle. This resulted in correspondingly high atmospheric radon corrections to the 4π uranium data reducing this data to very low count rate levels which fell, for the most part, in the range of statistically marginal to inadequate data. The data of both the 4π and 2π acquisition systems were extensively tested and all possible system malfunctions were eliminated as the source of the high $U_{2\pi}$ count rates recorded in flight.

After consultation with BFEC, it was agreed that the fully corrected single record $U_{4\pi}$ data would be adjusted upward to levels corresponding to $U_{4\pi}$ concentrations obtained over those quadrangles bordering this area on the east and west. The normalization factors as applied to the data were obtained by comparing $U_{4\pi}$ data levels averaged over 200 samples at the east and west ends of the traverse lines with similar averages over the nearest lines within the adjacent quadrangles. The east and west end factors were in turn averaged to obtain the final normalization factor. After adjustment of the single record $U_{4\pi}$ count rates, the data were again tested for statistical adequacy and the two uranium ratios were re-computed. The data along the tic lines were adjusted in a similar manner using the normalized $U_{4\pi}$ data along the northernmost and southernmost traverse with this quadrangle.

The single record data were then averaged over 9 records using the SPECAVG program. All subsequent processing steps were then followed as outlined above.

DATA PRESENTATION

General

The final data are presented in four different forms: on magnetic tape; on microfiche; in graphic form as profiles and histograms; and in map form as anomaly maps, flight path maps, and computer printer maps.

The histograms and the multiparameter profiles are presented with the anomaly maps and flight path map in a separate bound volume. Complete data listings of both the reduced single record and the reduced averaged record data are found in the back of this report. The format of the printout of the microfiches and the format of the data files delivered on magnetic tape are in accordance with the specifications of the BFEC 1200-C and are described in appendices F through L of this report.

Radiometric Multiple-Parameter Stacked Profiles

The radiometric profiles have been prepared at the horizontal scales of 1:250,000 and 1:500,000 on an automated flatbed plotter. Displayed are from top to bottom: total magnetic intensity, IGRF removed, in gammas; radar altimeter, in feet; ratio of eT concentration in ppm/potassium concentration in %; ratio of eU/K; eU/eT ratio, atmospheric radon (BIAC) in counts per second, equivalenced to the 4π count rate; apparent concentration of terrestrial eT in ppm, apparent concentration of terrestrial eU in ppm; apparent concentration of potassium in %; "Total Count" count rate. Flags are indicated, where needed, below the base line of the corresponding parameter. A short flag indicates marginal data, including terrain clearances between 700 and 1000 feet, while a long flag indicates inadequate data. Fiducial markers are plotted every 200 records, along the top of the profile, every 10 records near the bottom.

The flight path and the geologic formations overflowed along the line are shown on the bottom of both the radiometric and magnetic multiple-parameter stacked profiles below the lower fiducial markers. Six tiers of formation identifiers along with short markers on the flight line are used to indicate changes along the profile with the base of the identifier letters aligned with the corresponding marker. The first identifier found on the westernmost end of the profile applies to the start of the line and this formation continues until the next marker is encountered. Subsequent changes to the geology are similarly indicated along the profile.

Magnetic and Ancillary Parameter Stacked Profiles

The magnetic profiles have also been plotted at scales of 1:250,000 and 1:500,000 on an automated flatbed plotter. The plotting sequence of the profiles is, from top to bottom: barometric pressure at aircraft altitude in mm Hg; atmospheric ambient temperature in degrees Celsius, terrain clearance in feet; magnetic variations at base station, in gammas; total magnetic intensity, IGRF removed, plotted at 50 gammas per scale division. Fiducial markers are again plotted every 200 records along the top of the profiles, every 10 records near the bottom.

Histograms

Histograms have been prepared for the six radiometric parameters for each geologic cell unit of the NTMS quadrangle area. The horizontal scale of the plots is constant for each of the parameters. Frequency grouping has generally been done in 100 groups per full scale, although in some cases more groups may have been used for better definition. In all cases the vertical scale was normalized to the number of samples observed in the group with the highest sample frequency.

For each histogram the frequency distribution type (normal or lognormal) is listed, as well as the mean (or mode in case of lognormal distribution) and the signed standard deviations. Note that for both the normal and lognormal distribution curves the standard deviation is given in terms of the parameter value (K, eU, eT, eU/K, eU/eT and eT/K). The actual standard deviation is obtained by subtracting the mean parameter value from the +1 standard deviation figure in case of a normal distribution, by dividing the mode value into the +1 standard deviation figure in case of a lognormal distribution. In case of lognormal distribution curves the standard deviation is thus a multiplication factor.

Each histogram further lists the total number of samples observed in the geologic unit and the number of statistically adequate/marginal data samples in each parameter plot.

Anomaly Maps

The anomaly maps have been prepared at scales of 1:250,000 and 1:500,000 on an automated flatbed plotter. The fiducial numbers along the flight lines match those of the corresponding profiles. Positive signed deviations of the

mean are indicated by a plus sign to the north or west of the flight lines, while negative signed deviations are indicated by a minus, plotted to the south or east of the line. The number of pluses or minuses corresponds with the levels of standard deviation from the mean. To avoid crowding, standard deviation signs are calculated and plotted for every fifth sample only.

Computer Printer Maps

Computer printer plots are produced for the total field and the six radiometric channels. Upper and lower limits were chosen based on the minimum and maximum values of the gridded data. Ten intervals are represented by the contour values 0 to 9. A minus (-) or a plus (+) sign represents those values less than the lower limit or those values higher than the upper limit.

The interval for each integer contour is further divided into two groups. For those values less than .5, the contour is printed; e.g. for values 4.0 to 4.5, the value 4 is printed, while values of 4.6 through 4.9 are left blank.

GEOLOGY

General

The Sioux Falls quadrangle includes the area between 43° to 44°N latitude and 96° to 98°W longitude. This quadrangle includes portions of South Dakota, Iowa, and Minnesota. The geology of the Sioux Falls quadrangle was compiled in 1980 by AAA Engineering and Drafting, Inc. for the United States Department of Energy. Reference sources include South Dakota Geological Survey Bulletins and Maps, U. S. Geology Survey Professional Papers, U. S. Geology Survey Hydrological Investigation Atlas HA-195, and an Iowa Geology Survey unpublished map.

The geomorphology of this area is largely a product of glacial erosion and deposition. Three major topographic features are present in this quadrangle: the James Basin, the Coteau Des Prairies, and a small portion of the James River Highlands. The James Basin, which is in the western portion of this area, is predominantly a broad lowland of gently undulating to relatively flat topography. The James River Highlands, in the south central area, is an abrupt ridge system standing generally 300 feet above the James Basin. In the eastern portion of this survey area, Coteau Des Prairies is a highly dissected, fluvially eroded, topographic feature consisting mostly of loess and glacial drift. This area generally stands 100 to 200 feet above the James Basin, but higher elevations are present in the northeastern portion of this area.

Locally, drainage varies from the southeast to the southwest and most local drainage systems are seasonal or intermittent. Two major drainage systems, the James River in the west which flows southeast, and the Big Sioux River in the east, which flows south, are present in this quadrangle.

Almost all of the mapped surface lithology is Quaternary glacial fill and drift. The thickness of these sediments varies considerably depending mostly on glacial landform type and bedrock topography. Generally, glacial sediments are thickest in the western portion of this area and thin to the east.

Stratigraphy

The surface lithology of this quadrangle consists almost entirely of glacial sediments, but rare outcroppings of Cretaceous bedrock and Precambrian basement and intrusives are found scattered throughout the quadrangle. A

(
description of the various geologic rock types in this area follows beginning with the oldest.

Precambrian

Corson Intrusive (P6c)

The Corson Intrusive is a coarse to medium-grained gabbroic diabase. Mineralogically, it consists predominantly of labradorite and clinopyroxene. Accessory minerals are usually apatite and magnetite or ilmenite.

Sioux Formation (P6s)

The most commonly encountered basement surface in southeastern South Dakota is the Sioux Formation. It is an orthoquartzite with pink, very tightly cemented sand grains, and is interbedded with mudstone, conglomerate, and red to purple shale. It is approximately 1.2 billion years old. Exposures of this rock type are found sparsely scattered throughout this quadrangle.

Cretaceous

Carlile Shale (Kc)

The Carlile Shale is comprised of medium gray, noncalcareous, plastic, fissile shale. Sandstone layers up to 100 feet thick are also found within the formation.

Niobrara Formation (Kn)

This unit consists of a medium to dark-gray, calcareous marl and contains a lower section of gray-chalky, fossiliferous limestone.

Quaternary

Illinoian Ground Moraine (Qig)

Illinoian till is generally dark gray (unoxidized), hard, blocky, pebbly, and calcareous. Jointing with distinct widespacing is common, and frequently gypsum or carbonate filling is present. Oxidation extends for a depth of 2 to 6 inches. This till shows a particular scarcity of large-size rock fragments, pronounced compaction, dark coloring, distinctive hue, and greater thickness as compared to Wisconsin tills.

The physical characteristics of the Wisconsin Stage tills are very

similar to each other and distinguishing one till from another is very difficult. Lateral changes within a single till are more conspicuous than changes between separate tills. Wisconsin tills possess weak fissility parallel to their surfaces, are less compact, and joints are less abundant or continuous as compared with older pre-Wisconsin tills. Also, rock fragments of pebble, cobble, and boulder size are more abundant in Wisconsin tills than in pre-Wisconsin tills. Boulders of the Wisconsin tills are described as numerous, large, and easily seen. The average thickness of the drift is 50 to 100 feet, but variations can range from over 300 feet to zero feet.

Lower Wisconsin Ground Moraine (Qlwg)

This unit is composed of till with a much lower concentration of boulders than found in end moraines. Ground moraines are subglacial products, thus most of the larger rocks are abraded and disintegrated resulting in a lower boulder/clay ratio. Ground moraine landforms are generally in the form of a gently undulating topography.

Lower Wisconsin End Moraine (Qlwe)

This unit is composed of till with a high concentration of boulders. Here, landforms with frequent boulders produce steeper slopes, and are more ridge-like than the ground moraine landforms.

These landforms are generally representative of the terminus or boundaries of the Wisconsin glacier. This landform is only seen in the north central area of this quadrangle.

Wisconsin Kame (Qwk)

The Wisconsin Kame unit is composed of till associated with Wisconsin glaciation. Kame landforms include irregularly shaped hills and ridges, and are a product of ice contact disintegration. This landform is only found in a few places in the central area of the Sioux Falls quadrangle.

Upper Wisconsin Ground Moraine (Quwg)

This unit is composed of till and has a much lower concentration of boulders than found in end moraines. It is found in landforms which are similar in topography and etiology to the lower Wisconsin Ground Moraines. Separation of lower and upper Wisconsin Moraines is largely based on stratigraphic evidence.

Upper Wisconsin End Moraine (Quwe)

This unit is composed of till with a high concentration of boulders. This landform has similar topographic and etiologic features to the lower Wisconsin End Moraines, but is far more abundant in this quadrangle.

Undivided Glacial Drift (Qugd)

This unit is composed of somewhat sorted and stratified glacial till sediments, however, this unit grades into till which is not stratified even though it is partially sorted. These sediments are either outwash deposits, ice contact deposits, or ice-free deposits. Thus, the resulting topography can range from nearly flat to hummocky.

Lake Bed (Qlb)

Lake bed deposits are found only in the north central portion of this quadrangle. They consist of parallel-bedded silt and clay deposits. Most of these glacial lakes were small and short lived, and many have no shoreline or strandlines. In larger glacial lake environments, minor amounts of coarse sediments may be found within the silt and clay beddings. These may come from sediments being dropped from floating ice. The thickness of glacial lake bed deposits vary greatly, dependent upon glacial lake duration and sediment supply. This landform tends to be flat or nearly flat. Slumping and collapse features are common at its margins.

Loess (Ql)

Loess deposits are found extensively in the southeastern portion of this quadrangle. These deposits consist primarily of wind reworked glacial lake silts and minor amounts of fine sand and clay. The silt is grayish-yellow to yellowish-gray and is slightly compacted. Its bedding is laminated and parallel subhorizontally, except in the uppermost two feet where lamination is absent possibly due to mechanical erosional factors. Loess produces rather flat landforms with some irregularities such as periodic sand dunes.

Undivided Outwash and Alluvium (Qoa)

These sediments are largely post-glacial fluvial deposits. Most of these sediments are found along relatively recent stream beds, and consist of fine-grained sands, silts, and clays. Alluvium and outwash are not differentiated due to the scale of mapping.

Sand Dunes (Qd)

These landforms are composed mostly of windblown sands. They form an irregular hummock topography with generally 10 feet or less relief. Sand dunes are only mapped in the southwestern corner of this quadrangle.

Structure

The Sioux Falls quadrangle, which is almost entirely under glacial deposits, has limited basement structural information. It is known, however, that basement reaches a local structural high in this quadrangle. This high, the Sioux Uplift, is separated from the Black Hills Uplift in western South Dakota by the Williston Basin. The axis of the basin, which trends northwest, plunges at an average of 30-40 feet per mile.

INTERPRETATION

General

The airborne gamma-ray spectrometer survey is conducted in support of the Department of Energy's National Uranium Resource Evaluation (NURE) program. The primary purpose of the survey is regional resource evaluation as opposed to local anomaly identifications. The interpretation of the radiometric data is directed towards determining zones of possible depletion of uranium which may have served as possible uranium sources, outlining areas of regional enrichment in uranium and indicating the geological formations which are most likely to be mineralized within a possible uranium province.

The areas of possible uranium depletion/enrichment are outlined with the aid of anomaly maps, which have been previously described. Enrichment or depletion of uranium on a regional scale is assumed to have taken place if the U/T and U/K ratio values remain higher/lower than at least one standard deviation above/below the mean for a distance of at least a mile, provided the K, U and T count rates are at the same time not less than one standard deviation below the mean. One mile equals approximately 25 samples.

The probability of a geologic formation to be mineralized by a given element may be estimated from the dispersion of the geochemical distribution curve. The smaller the ratio of the standard deviation over the mean, the less the likelihood that an extremely high concentration of that element exists within that formation. Obviously, the opposite holds true as well.

The decision of both the "favorability" of a formation and of the presence of a regional geochemical anomaly is influenced to a large extent by the choice of the geological cell units used in the correlation of the radiometric and geologic data.

The radiometric parameters used in the present report are concentrations in parts per million of equivalent uranium and equivalent thorium and in percent of potassium and their ratios. The radiometric count rates of the Douglas DC-3 borne A.G.R.S. (Airborne Gamma-Ray Spectrometer) system were calibrated at the Lake Mead Dynamic Test Range against sources of known concentrations of potassium, uranium and thorium. The sensitivities of the A.G.R.S. system, normalized to 400 feet terrain clearance at standard temperature and pressure are:

<u>Radioelement</u>	<u>Count Rate</u>	<u>Concentration</u>
Potassium	96.42 cps	1%K
Uranium	12.02 cps	1ppm eU
Thorium	6.31 cps	1ppm eT

Geochemical Analysis

The geologic map of the Sioux Falls quadrangle distinguishes fifteen geologic units. Four of these units were not sampled during the survey. These include Pleistocene lake beds (Qlb), Wisconsin kame (Qwk), lower Wisconsin end moraine (Qlwe), and the Cretaceous Carlile shale (Kc).

Histograms depicting radioelement concentration distributions for uranium thorium, and potassium, along with distribution curves of their comparative ratios, were prepared for the eleven digitized geologic units encountered in the course of the survey. Additionally, a set of curves was also prepared for a unit corresponding to water.

Those units, corresponding to Recent dune sand (Qd), the Cretaceous Niobrara Formation (KN), and the Precambrian Corson intrusive (PCC), contain too few samples to permit reliable analysis.

All of the remaining geologic units produce very clean curves with normal distributions in all six radiometric parameters. The unit of glacial drift along with those of ground and end moraine deposits (QUGD, QUWG, QUWE, QLWG, and QIG) all display very similar distributions. Mean concentration values average on the order of 2.20 ± 0.59 ppm eU, 6.24 ± 0.89 ppm eTh and $1.18 \pm 0.12\%$ K. The Precambrian Carlile shale (PCS) crops out primarily in two areas in the northeastern corner of the quadrangle. Any other exposures of this unit are of very limited areal extent. Any slight local inaccuracies in the mapped flight in the areas of these smaller exposures may have contributed the minor irregularities in the uranium and thorium histograms for this unit.

Computer Contour and Anomaly Map Analysis

Computer printer maps of the magnetic total intensity and the six radiometric parameters have been prepared in addition to the radiometric anomaly maps for this area. These pseudo-contour maps, at a scale of 1:500,000, are included in this report as Figures 7 through 13. The grid spacing of these maps is relatively wide at 2117 by 1270 meters. As a result,

TABLE III

LEGEND TO TOTAL FIELD MAP (GAMMAS)

<u>CONTOUR VALUE</u>	<u>LOWER LIMIT</u>	<u>UPPER LIMIT</u>
-		58500.0
0	58500.0	58625.0
1	58625.0	58750.0
2	58750.0	58875.0
3	58875.0	59000.0
4	59000.0	59125.0
5	59125.0	59250.0
6	59250.0	59375.0
7	59375.0	59500.0
8	59500.0	59625.0
9	59625.0	59750.0
+	59750.0	

TOTAL FIELD

x3= 742561.0

$$Y3 = 4878669.0$$

X2= 742560.0

Y2= 4758000.0

Y2= 4758000.0

 

TABLE IV

LEGEND TO POTASSIUM AVERAGE MAP (PERCENT)

CONTOUR VALUE	LOWER LIMIT	UPPER LIMIT
-		0.90
0	0.90	0.96
1	0.96	1.02
2	1.02	1.08
3	1.08	1.14
4	1.14	1.20
5	1.20	1.26
6	1.26	1.32
7	1.32	1.38
8	1.38	1.44
9	1.44	1.50
+	1.50	

POTASSIUM AVERAGE

X3= 742560.0

Y3= 4878669.0

```

+.....+
+
+
+
+
77
-
44
33
442 2344
.75 7776 766 775 66 65 7875555 6 665 6787665555 35 64 3454-- 345 3555 4 433 3 34665 55 5 54 3 4 4 433 2 33 344 .
.76 677 7 6 6 5 67 76 66 67 76 5 43 345543 441 2443 4 4 44 3 45 55 55 5 4 44 44 543 33 3 44 .
.766 7 7 6 55 5 67 76 6 66 66665 43 34554 4431 1343 4 4444 45 5 444 5 5 4 44444 4 4 3 22 3 43 .
.66 7 7 65 56 6 6 6 55 4 32 23455 4 4321 1233 3 333 456554 45 5 4 45 5 4 4 4 44 4432 2 3 432 .
.66 7 7 6 5 5 6 66 66 6 6 5 4 3 345 5 4 433 34 3 3 45676555 6654 456 5 4 4 5 4 44 5432 2 3 432 .
.56 7 7 77777665 6 66 65 4 3 3 5 65 4 44 3 3 457776 665 4 456 5 4 4 5 4 4 4444 43 22 3 3 .
.56 7 8 7 7 7 7 6 6777 6 5 4 3 2 3455 44 444 3333 3 456776 555 5 4 4 5 5 4 3 4 4 555 44 3 333 3 .
.66 7 7 7 7 776 555 55 67 7 6 55 4 32 234 4 4 4444 33 4 5665 44 5 554 5 54 3 3 4 5 54 3 3 332 .
.66 77 77 65 5 56 7 65 4 55 4432 23 4 4 4 55544444 4 5 54 4 5 5 5 54 34 44 33 3 3 3 .
.66 7765 4 45 55 65 4 4 433 3 4 444 33 45 6655 57776 4 5 665 55 43 34 4 3 222222 3 .
.6 7 77 7888764 33 4 4 55 43 3 4 4432 11 23 33 3 456655 444 5 6 654 4 5 665 5 5 4 444 55 4 32 1 1 12 34 .
.67 777 7777 7 89 8653 2 3 333333 2 2 3 3210 0 2 3 3 22 3 45665 4 3 45 54 33 456 65 5 54 4 5555 5 4 44321 1 10 012345 .
.57888 888 7 66 7 7643 2 222 2 1 12 210 01233 2 2 3 4666543 3456 53 3456 65 5 54 45 66666 5 4 4321 1 10 012345 .
.478 8 8 8 7 6 6 642 2 2 21 1 2 210 0123 32 2 3 4566543 456665433 4 566 55 54 45 6 6 5 4 3332 1 21 123 4 .
.4678 77777 6 5 6 642 2 21 1 22 1 0 0 123 3 22 3 45665 4 34567654 45 5 54 4 5 6 65 5 43 2 2 3321 23444 .
.356 66 6 6 5 4 5 6 7643222222 2 33221 2333221 0 12 344233 444 5 543 345 66544 3 4 5 54 4 4 56 65 432 2 34432 34443 .
.34 4444 3333 3 45676543 3 4332 3444433 45554321 1 2344 444 55 5 5 543 34 5554 3 2 345 54 44 4 56 5 432 2345433 455432 .
.33 2222 22 23456765 4 54 3 566654 567766532 2 3 4 55 55 55 5 5 543 34 4 3 2 2 45 5 4 44 4565 432 234544 454431 .
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.21 1 2332 3467 754 45654 56666 6 7776543 34 5 5 555 5 554433 44 54 22 2 34 5 5 55 44 43 3 44 4 3332 .
.31 1 22 3 433 5677654 4 55544 55 66666542 344 5 5 55 55 444 44321 1233 4 55 55555 4 4 33 4 4 4 3 210 .
.31 123443 4444 567765 4 55 55 65433 455 55 5555543210 02344 5 55 4 4444 5544 44 32 2 .
.31 256544 566 65 55 5666 543 45 5 555 55 65431 0 1244 5 5 66 5 4 4 55 544 4 43 2 1 .
.311 35665 55 6 6 5 55 55 666 54 4 55 555555 555 55 54 3211 23455 55 5 6 6 55 4 5 544 4 43 22 .
.42 235665 5 6 6 55 66 6 666 554 44 55 5 66655 55 5 4 332 34 55 555 5 6 6 5 44 4 45543333 .
.533 45655 5 6 666666 66 66 66 5 4 4 5 5 6 7 66666 5 4 43 4 55 5 5 5 5 677 66665 4 4 4 455 4 4 .
.554 55 54 4 5 55 6 777 6 6 65 4 455 5 677 6 5 44 44 55 5 5 5 67 7 65 4 45 4 455 4 33 .
.6655 54 4 5 5 56 7 7 6 6 7 6 5 4 3 4 5 6 77 6 5 555 55 5 67 7 77655 44 5 4 455 4 33 .
.66666 54 4 5 5 5 6 77 66 7 6 5 43 3455 6 6 6 66 5 5 55 5 6 67 77 7655 555 554 4 4 3 3 .
.66 6 544 5 5 5 6 6 5 67 7 6 6 543 34 5 5 5 6 6 66 5 5 5 5 6 66 6 7 755 5 55 5 4 4 43 35 .
.66 766555 5 5 5 567 7 6 66 6654 345 5 4 4 5 6 6 6 7 6 55 6 5 5 6 6 5 6 7 75 55 5 44 43 35 .
.76 7776 5 55 44 5 5 567 7 6 67653 456 5 54 33 45 6 6 6 7 6 6665 5 6 66 5 56 7 7655 5 55 66 5 4 3 3 .
.76 777666 5 444 45 5 567 7 6 6765 3 45 55432 23456 6 6 66 6 6665 5 555 5 5 6 6 77 6 5 4 5 5 4 33 .
.66 7 7 6 5 4 333 45 5 67 7 66 5 66542 23 45 531 13456 6 6 6 6 6 5 444 4 5 5 5 6 666 55 4 45 5 5 55443 .
.66 7 7 6 543 22 345 677 88 7 6 5 5654 2 3456640 1356 6 5 6 6 5 4 3 2 345 5 5 5 6666 4 3 455 5 54 3 .
.6666 7 7 6 5432 345 78888 7 65 666443 3456740 02456 6 5 56 6 5 5 42 2346 5 5 6 654 3 455 5 5 43 .
.56 6 7 7 6 5432 34566 7888 7 65 67654 3 3456751 2456 6 5 56 65 5 5 42 246 5 5 55555 43 45 5 543 .
.55 6 7 87 6 543 456 788 7777 66665 56543 3456752 0345 6 5 6 6 5 5 4322 3455 4 5 5 44444 4 5 543 .
.55 6 7 7 6 654 45 6 77 77 66 6 55555 55432 2 34566541 1345 6 77 6 5 433 45 54 4 5 665 4 33 4 5 66 54 3 .
.5 5 6 7 6 66544 456 777 6 66 5 55 43 3 4 5 66543 4566 6 777 6 6 5 44 5 5 4 456 654 3 3 4 56 6 5 4 3 .
.5 5 6 6 6 765 4 56 7876 5 555 4 3 4 55 666655 6 6 6 777 666 5 5 5 4 456 6 54 34 56 6 55555 443 .
.55 
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TABLE V

LEGEND TO URANIUM AVERAGE MAP (PPM)

CONTOUR VALUE	LOWER LIMIT	UPPER LIMIT
-		1.20
0	1.20	1.40
1	1.40	1.60
2	1.60	1.80
3	1.80	2.00
4	2.00	2.20
5	2.20	2.40
6	2.40	2.60
7	2.60	2.80
8	2.80	3.00
9	3.00	3.20
+	3.20	

URANIUM AVERAGE

X3= 742560.0

$$Y3 = 4878669.0$$

Figure 9

X2= 742560.0 51/52

Y2= 4758000.0

TABLE VI

LEGEND TO THORIUM AVERAGE MAP (PPM)

CONTOUR VALUE	LOWER LIMIT	UPPER LIMIT
-		4.70
0	4.70	5.00
1	5.00	5.30
2	5.30	5.60
3	5.60	5.90
4	5.90	6.20
5	6.20	6.50
6	6.50	6.80
7	6.80	7.10
8	7.10	7.40
9	7.40	7.70
+	7.70	

THORIUM AVERAGE

```
X4= 580000.0
Y4= 4878669.0
```

```
X3= 742560.0
Y3= 4878669.0
```

```

X1= 580000.0
Y1= 4753000.0

```

```
X2= 742560.0
Y2= 4758000.0
```

TABLE VII

LEGEND TO URANIUM/POTASSIUM RATIO MAP

<u>CONTOUR VALUE</u>	<u>LOWER LIMIT</u>	<u>UPPER LIMIT</u>
-		1.00
0	1.00	1.18
1	1.18	1.36
2	1.36	1.54
3	1.54	1.72
4	1.72	1.90
5	1.90	2.08
6	2.08	2.26
7	2.26	2.44
8	2.44	2.62
9	2.62	2.80
+	2.80	

TABLE VIII

LEGEND TO URANIUM/THORIUM RATIO MAP

CONTOUR VALUE	LOWER LIMIT	UPPER LIMIT
-		0.18
0	0.18	0.22
1	0.22	0.26
2	0.26	0.30
3	0.30	0.34
4	0.34	0.38
5	0.38	0.42
6	0.42	0.46
7	0.46	0.50
8	0.50	0.54
9	0.54	0.58
+	0.58	

X4= 58.1000.0
Y4= 487866.0.0

```
X3= 742560.0
Y3= 4878669.0
```

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+.....+  
+.  
.                                     66                                44                               55 66 67 .  
.                                     +                                   45666655 6754 44 5763221 33333332 561 2444 45 795   6 6 7 .  
.          33                                     5653332 2458666 550 342 46753222 2 451 3 37630 01234578653 5788775 6 6    65 4    5654 2 23      3 3442 234 4 5 776     6 7 .  
.464 5653332 2458666 550 342 46753222 2 451 3 37630 01234578653 5788775 6 6    65 4    5654 2 23      3 3442 234 4 5 776     6 7 .  
.45 5 54 3 34677765542 23 456653      2 34 43 3 44310 1234577654 578 8766 6 6    6 5    5 6543 2 34444    4 432 345 567766 6 8 .  
.45 5 543 346788765322 24 56654433 34 56554 5543222 3467765 56789987 6    6666 665 56 654 555 66544 4 43 456655 67 77777 8 .  
.55 5 5433 456899876423 44 6 6655444 678876666655444 56 7766 78 9 988777 777655 67 66 77777765 4    567875 567888887 79 .  
.5555 66 544 547888887655554 56 77665 56899987777777655 6 77 7 8 99 9 887 6666 7765 67 7 8 88765 555 6 76 56 7 77 7 79 .  
.65 677765 5 6666 78876 776666 77 65 5689 98      7 6 6 7 7 8 99999 8876    6 6655 6 66 777777765 55 55 5 6 66 77 7 .  
.65 6777655 6665 567877 7888777 66 65 56789 98888 77 6 5 6 6 7 8 888 7 6    5555 5 55555555 665 55 44 5555 4 56 65 .  
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.3 44 3 34 44 4 54 33 4 5 554 2 2 3 32 1 2456654 33 4 4 44 43 3 33 4 4 3 333 332222 33 4    4 5665 44444 554 .  
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.1 2 2 210 112 1 0 233 2 1 0 00 0 13 3 1 2 244 454 444444 5 65 4 3 34555 4 56665 4    456776 5 5 43 .  
.11 2 11 1222210 12 2 1 00 0 12321 123 344 454444 5 66 4 3 45 5 44 56 65 4 44 45665 5 5 4 .  
.11 2 22 11 02 33210 123 22111 0 0 1 233 233333 4 4 4 55 4 5 55 4 44 4 3 456 654 33 44 455 4 4 55 4 .  
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.4444 55443 34 54 555432 35677665 7765322 3 4578655 6765 5665 5677666543 345 5 44 4 3 3456654 34664 3 3 3 3455 5 .  
.56 6 77754 56775 677643 4675987 78 85333 4568986 6 786 5676 4 67776 643 345666 54 4 44433 456 54 345543 3 33 34 4 .  
.6777 88865 67886 677643 5689987 79 864 4 568875 6886 56654 45777666643 3466 6 54 4 5544 455 43 34 44 3 22 3 4 4 .  
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.677 888 777 78764 4 4 4 56 777 78998654 456788766 654 333 2 23 4 5 54 3 45 66543 3 3 2 2 3 44432 23 3 2 2 3 455 .  
.577 7 6 77 6 654 2 4 444 5 5 67 7654 4 678876 665 4 3 2 23 4 4 4 5 6653 33 2 2 2 23 45431 1233 222 33 4551 .  
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.567 75 56 6 6665544433 4 5 6 654 4 5555 5 54 3 2 222 3 4 56666 543 3 433 2 2 34 432 2 3 3 4 555554 4 4 .  
.567765 4 55 4 567665432 3 4 44 5 5 4 4 444 3 4 42 2 2 3333 4 4 56 543 34544333 344 3 34444 555 5 6654 3 .  
.56665 4 33 346 654321 2 3444 4 5 5 4 4 33 34 432 34444444 4 4 4 5 5 43 34555 444333 4 3 3 4 44 566 5 56655 3 4 .  
.55 55 4 32 236 653210 1234 4 4 4 5 5 4 3 3 34 43 235555554 443 3 45 5 43 34565 4443 4 3 3444 45666 5 6654 3 4 .  
.555 44432 2367764320 1234 4 44 4 5 5 4 33 33 34 432 345 66 54 443 345 5433 45554 3 44 3 3 33 3456 5 5 55 4 32 .  
.55 5555432 367 764211 34 4 4 4 5 5 4444443 2 4 443 4 55 54 33 4 3 345 6 54 4543 3 4 4 3 33 2 2344 4 3 .  
.44 5 6653 457 76422 245 44 55 5 5 444432 35666655 6 543 3 33 456 66543 34432 344 54 3 32 2 3 4 4 3 .  
.34 5 5 66654 567887543 4555 55 55 5 555 4 3 32 35788876 6 543 3 44 5 6 776543 3422 345554 3 222 3 45 443 .  
.3 4 55 57765 567 8764 4555 5 6 5 55 43 34443 45789876 542 3 456 777 7 65 3 422 345 54 33 443 4555 5 .  
.32 455 57765 5 67654 455 44 55 5 444 44 566555 78 986 555 54 3 3 467888 7 654 4442 34 4 44 3 44 455 55 4 55 .  
.23 45 5676555 5 544 45 4 3 45 5 4 4 4 56788765 4 567886 4 45 5443 46898 7 6 65555432 34 43 3 
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• Figure 12
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TABLE IX

LEGEND TO THORIUM/POTASSIUM RATIO MAP

CONTOUR VALUE	LOWER LIMIT	UPPER LIMIT
-		4.10
0	4.10	4.34
1	4.34	4.58
2	4.58	4.82
3	4.82	5.06
4	5.06	5.30
5	5.30	5.54
6	5.54	5.78
7	5.78	6.02
8	6.02	6.26
9	6.26	6.50
+	6.50	

only the broader features of the area can be seen on these maps and narrow events are normally not noticeable.

The magnetic total intensity map displays a rather subdued response pattern of broad low amplitude anomalies over much of the area with an average magnetic intensity of approximately 58,900 *gammas*. The steepest gradients, on the order of 300 to 350 *gammas* per mile, are encountered in the southwestern quadrant of the area where two prominent positive anomalies are mapped along traverse lines 1700 and 1710. Three smaller positive anomalies ranging between 700 and 900 *gammas* are found in the southeastern corner of the area. These features are, most likely, related to igneous intrusions within the Precambrian basement. A much broader positive anomaly exceeding 1000 *gammas* is located along the western margin of the quadrangle.

The radiometric response over much of the area is relatively low. Equivalent concentrations of uranium, thorium and potassium only rarely exceed 3.2 ppm, 7.5 ppm and 1.4% respectively. The highest response levels in potassium are found over the southwestern and south central portions of the quadrangle and, to a lesser extent, in the northwestern corner. Relatively higher levels of thorium response are also found in the southwestern and south central portions of the area. More significantly, the thorium pseudo-contour map shows higher than average responses over much of the eastern half of the quadrangle in the Coteau Des Prairies region. The map for uranium also shows zones of increased concentration within the Coteau Des Prairies. Traverse line 1610, flown along the northern part of the area, shows a number of zones having locally increased uranium concentrations. The majority of these are found where deposits of the upper Wisconsin and ground moraines are cut by water channels bordered by outwash and alluvium deposits. Overall uranium levels along this line may, in general, be slightly higher than would be expected due to the manner in which the data were normalized to match the uranium levels of the adjacent quadrangles. Nevertheless, the local zones of increased uranium are felt to be bonafide.

A number of these zones of increased uranium concentrations show corresponding anomalous responses on the uranium/potassium and/or uranium/thorium pseudo-contour maps. Based on this set of computer printer maps alone however, it is, at times, difficult to discern the contribution of coinciding local decreases in the potassium and thorium parameters to these

ratio anomalies.

Based on the criteria stated in the general section on interpretation, a total of seven uranium and seven thorium anomalies have been outlined on the interpretation map. All of these features, described in Appendix B, exhibit only weakly to moderately anomalous responses.

Due to the generally low radiometric levels encountered throughout the quadrangle along with the lack of any favorable indications for enriched accumulation of either uranium or thorium as seen in their radioelement distributions when correlated with the mapped geology and the weak, at best, evidence of preferential accumulations of either parameter, no follow-up work is recommended.

AERO SERVICE

LEGEND
 ③ URANIUM ANOMALY NO. 3
 III THORIUM ANOMALY NO. 3

INTERPRETATION MAP
 SIOUX FALLS QUADRANGLE
 U.S. DEPARTMENT OF ENERGY

FIGURE 14
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A P P E N D I X A

Geologic Legend

G E O L O G I C L E G E N D

<u>Aero Symbol</u>	<u>Map Symbol</u>	<u>Unit Description</u>
QD	Qd	Recent Dune Sand
QOA	Qoa	Pleistocene to recent outwash and alluvium, undivided
QL	Ql	Pleistocene loess
	Qlb	Pleistocene lake beds
QUGD	Qugd	Undivided Pleistocene glacial drift
QUWG	Quwg	Upper Wisconsin ground moraine
QUWE	Quwe	Upper Wisconsin end moraine
	Qwk	Wisconsin kame
QLWG	Qlwg	Lower Wisconsin ground moraine
	Qlwe	Lower Wisconsin End moraine
QIG	Qig	Illinoian ground moraine
KN	Kn	Cretaceous Niobrara Formation
	Kc	Cretaceous Carlile shale
PCS	pEs	Precambrian Sioux Formation
PCC	pEc	Precambrian Corson intrusive
W		Water

A P P E N D I X B

List of Geologic Units by Anomaly

List of Geologic Units by Anomaly

<u>ANOMALY</u>	<u>GEOLOGIC UNIT</u>	<u>LOCATION</u>		<u>BRIEF DESCRIPTION</u>
		<u>t-traverse</u> <u>tl-tie line</u>	<u>FID</u>	
<u>URANIUM ANOMALIES</u>				
1	Quwg Quwe	t-1610	140-220	Broad weak to moderate U anomaly and U/T and U/K anomalies
2	Quwe	t-1610	530-580	Weak to moderate U anomaly with supportive U/T anomaly on west end
3	Quwg Qoa	t-1610	1190-1230	Weak to moderate U/T and U/K anomalies in area of normal U responses
4	Qoa Quwg Quwe Qlwg	t-1610 (tl-5060)	1250-1510	Very broad weak to moderate U anomaly with scattered weak to moderate U/T and U/K anomalies and very good support along approx. 7 km. of intersecting tl-5060
5	Quwg	tl-5060	7520-7610	Broad weak to moderate U and U/K anomalies with some U/T support
6	Qoa Q1	tl-5070	5220-5260	Weak to moderate U/K and weak U and U/T anomalies
7	Quwe Quwg Qoa	t-1710	1020-1060	Weak U, U/T and U/K anomalies
<u>THORIUM ANOMALIES</u>				
I	Quwe	t-1640	8680-8710	Weak T & T/K anomalies
II	Quwe	t-1660	18915-18940	Weak to moderate T & T/K anomalies in area of normal U & U/T response
III	Quwe	t-1700	18810-18890	Weak to moderate T & T/K anomalies in area of normal U and U/T expression
IV	Qumg Quwe	t-1700	19050-19100	Weak T and T/K anomalies which may be part of much broader anomalous concentration to the east
V	Quwe	t-1700	19140-19200	Broad, weak to moderate T and T/K anomalies in area of normal U and U/T response

VI	Q1wg	t-1700	19350-19380	Narrow weak T & T/K anomalies in area of normal U and U/T expression
VII	Q1	t-1700	19760-19800	Very narrow, weak T and T/K anomalies

A P P E N D I X C

List of Anomalies by Geologic Unit

List of Anomalies by Geologic Unit

<u>FORMATION</u>	<u>NO.OF SAMPLES</u>	<u>NO. OF U Anomalies</u>	<u>NO. OF TH. Anomalies</u>
Qd	39		
Qoa	4616	4	
Q1	4234	1	1
Q1b			
Qugd	2572		
Quwg	4560	5	1
Quwe	15732	4	5
Qwk			
Qlwg	1390	1	1
Qlwe			
Qig	1816		
Kn	15		
Kc			
pēs	215		
pēc	2		

A P P E N D I X D

Mean Radiometric Values by Geologic Unit

MEAN VALUE BY GEOLOGIC MAP UNIT

URIAH

QUAD

LINE 1600

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
QUWE	0.41	2.23	19.02	0.366	1.821	5.027
QOA	0.40	1.85	17.98	0.315	1.621	5.196
W	0.16	1.16	7.13	0.432	2.740	6.526

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
CUWG	0.42	2.06	18.33	0.321	1.717	5.347
CLWG	0.42	2.27	18.12	0.361	1.920	5.418
CUCD	0.42	2.31	16.96	0.364	2.103	5.836

LINE 1610

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
QOA	0.36	2.54	17.04	0.471	2.307	4.992
QUWG	0.40	2.65	18.27	0.440	2.243	5.139
QUWE	0.42	2.88	19.05	0.462	2.322	5.081
PCS	0.43	2.69	17.05	0.418	2.416	5.862

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
W	0.37	2.12	17.54	0.379	1.856	4.947
CLWG	0.44	2.94	18.07	0.449	2.477	5.595
CUCD	0.43	2.88	17.31	0.450	2.570	5.741

LINE 1620

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
QUWG	0.41	2.18	19.39	0.358	1.724	4.857
QUWE	0.40	2.13	18.52	0.358	1.777	5.034
QOA	0.36	1.99	17.07	0.364	1.792	4.987
W	0.31	2.16	15.94	0.480	2.088	4.535

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
CIG	0.45	2.30	18.57	0.339	1.896	5.629
PCS	0.35	1.93	16.97	0.325	1.760	5.432
CLWG	0.43	1.86	18.12	0.288	1.577	5.529
CUCD	0.43	2.20	17.00	0.342	1.993	5.863

LINE 1630

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
QOA	0.36	1.71	15.28	0.309	1.712	5.560
QUWG	0.40	1.48	18.73	0.247	1.224	4.955
QUWF	0.35	1.36	16.28	0.251	1.269	5.104
PCS	0.41	2.76	16.40	0.446	2.615	5.917

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
W	0.19	1.19	8.01	0.369	2.169	5.711
CIG	0.44	2.49	18.64	0.372	2.062	5.576
CUCD	0.43	2.44	17.46	0.382	2.179	5.746

MEAN VALUE BY GEOLOGIC MAP UNIT

UKIAH

QUAC

LINE 1640

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
QUWE	0.39	2.57	18.15	0.440	2.187	5.064
QUWG	0.34	2.30	16.76	0.448	2.116	4.782
QQA	0.38	2.15	16.41	0.379	2.016	5.390
PCS	0.32	1.48	14.60	0.306	1.557	5.097
QUGD	0.43	2.14	17.28	0.326	1.903	5.875

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
h	0.28	2.37	12.49	0.567	3.085	5.394
CIG	0.42	2.22	17.23	0.353	1.988	5.681
PCC	0.38	2.70	17.58	0.469	2.359	5.068
CL	0.41	1.93	17.01	0.313	1.736	5.588

LINE 1650

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
QUWE	0.41	2.11	18.53	0.341	1.751	5.187
QUWG	0.37	2.35	18.06	0.422	2.014	4.832
KN	0.32	2.24	14.46	0.475	2.645	5.772
QUGD	0.41	2.17	16.46	0.351	2.068	5.512

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
CCA	0.39	1.84	16.69	0.323	1.714	5.405
CIG	0.40	1.90	16.84	0.331	1.789	5.474
CL	0.46	1.98	18.45	0.284	1.648	5.879

LINE 1660

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
QUWE	0.41	2.12	19.11	0.341	1.708	5.059
QQA	0.40	2.20	17.65	0.371	1.927	5.250
QUGD	0.40	2.57	17.78	0.422	2.200	5.222

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
QUWG	0.41	2.03	19.28	0.329	1.630	4.988
CL	0.46	2.46	18.51	0.357	2.051	5.780

LINE 1670

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
QUWE	0.42	2.32	19.25	0.369	1.855	5.056
QQA	0.41	2.28	17.82	0.382	1.981	5.235

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
QUWG	0.44	2.67	19.05	0.407	2.162	5.370
CL	0.46	2.56	18.94	0.365	2.077	5.733

MEAN VALUE BY GEOLOGIC MAP UNIT

UKIAF

QUAC

LINE 1680

UNIT	E THOR	E URN	POT PCT	U/TH	U/K	TH/K
QUWE	0.42	2.05	19.43	0.327	1.619	5.039
QOA	0.37	2.06	15.81	0.382	1.969	5.184

UNIT	E THOR	E URN	POT PCT	U/TH	U/K	TH/K
QUWG	0.41	2.08	18.36	0.338	1.759	5.250
CL	0.45	2.33	18.62	0.346	1.925	5.620

LINE 1690

UNIT	E THOR	E URN	POT PCT	U/TH	U/K	TH/K
QUWG	0.43	2.08	19.54	0.321	1.646	5.121
QOA	0.39	1.90	17.78	0.328	1.658	5.088
QUWE	0.42	1.91	18.89	0.303	1.560	5.161

UNIT	E THOR	E URN	POT PCT	U/TH	U/K	TH/K
W	0.42	1.22	19.43	0.208	1.034	4.967
CLWG	0.45	2.11	18.53	0.313	1.751	5.692
CL	0.44	2.11	18.40	0.323	1.773	5.558

LINE 1700

UNIT	E THOR	E URN	POT PCT	U/TH	U/K	TH/K
QOA	0.44	2.09	19.03	0.313	1.710	5.488
QUWG	0.47	2.01	22.24	0.283	1.387	4.938
QL	0.45	2.11	17.59	0.316	1.862	5.974

UNIT	E THOR	E URN	POT PCT	U/TH	U/K	TH/K
QUWE	0.47	2.07	20.42	0.294	1.565	5.354
CLWG	0.51	2.39	19.46	0.308	1.893	6.155

LINE 1710

UNIT	E THOR	E URN	POT PCT	U/TH	U/K	TH/K
QUWG	0.43	2.31	21.25	0.363	1.692	4.680
QOA	0.39	2.36	13.26	0.418	2.005	4.910
QL	0.40	2.29	18.62	0.381	1.884	5.032

UNIT	E THOR	E URN	POT PCT	U/TH	U/K	TH/K
QUWE	0.43	2.14	20.99	0.337	1.575	4.731
CLWG	0.41	2.34	18.62	0.379	1.930	5.174

MEAN VALUE BY GEOLOGIC MAP UNIT

UNITA-

QUAC

LINE 5040

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
QUWE	0.39	2.35	18.91	0.402	1.914	4.784
QUWG	0.34	2.13	17.36	0.412	1.862	4.556
W	0.39	2.56	19.65	0.449	2.001	4.556

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
CCA	0.37	2.29	17.75	0.424	2.015	4.791
CD	0.30	1.87	15.52	0.420	1.852	4.495

LINE 5050

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
QQA	0.30	2.19	13.62	0.491	2.451	5.042
QUWG	0.34	2.34	15.56	0.449	2.301	5.134

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
QUWE	0.34	2.16	15.21	0.431	2.186	5.141

LINE 5060

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
QLWG	0.43	2.70	17.91	0.414	2.318	5.652
QUWE	0.44	2.80	18.21	0.425	2.368	5.596
QTG	0.46	2.82	19.10	0.409	2.282	5.647

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
QUWG	0.44	3.07	19.13	0.463	2.469	5.391
CCA	0.39	2.75	16.57	0.472	2.610	5.624

LINE 5070

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
QL	0.46	2.33	18.25	0.338	1.963	5.852
QUWG	0.44	2.26	17.51	0.340	1.985	5.885

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
CCA	0.43	2.06	17.72	0.319	1.767	5.571

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A P P E N D I X E

Standard Deviation Table

SICUX FALLS

QUAD

DATA	SAMPLES	MEAN		FORMATION		QD				
				-3	-2	-1	+1	+2	+3	
E THORIUM	39	4.31	NORMAL	2.70	3.23	3.77	4.85	5.39	5.92	
E URANIUM	39	1.78	NORMAL	0.66	1.04	1.41	2.16	2.53	2.90	
POTASSIUM	39	0.99	NORMAL	0.79	0.86	0.93	1.06	1.13	1.20	
EU/K	39	1.74	NORMAL	0.26	0.75	1.25	2.24	2.73	3.23	
EU/ETH	39	0.40	NORMAL	0.01	0.14	0.27	0.54	0.67	0.80	
ETH/K	39	4.15	NORMAL	2.62	3.13	3.64	4.66	5.17	5.68	

DATA	SAMPLES	MEAN		FORMATION		CCA				
				-3	-2	-1	+1	+2	+3	
E THORIUM	4612	5.62	NORMAL	2.35	3.44	4.53	6.71	7.80	8.89	
E URANIUM	4608	2.05	NORMAL	0.18	0.81	1.43	2.67	3.29	3.91	
POTASSIUM	4612	1.10	NORMAL	0.64	0.79	0.95	1.26	1.41	1.56	
EU/K	4608	1.81	NORMAL	0.02	0.62	1.22	2.41	3.01	3.61	
EU/ETH	4608	0.36	NORMAL	-0.01	0.12	0.24	0.48	0.60	0.72	
ETH/K	4608	4.87	NORMAL	2.43	3.24	4.06	5.69	5.50	7.31	

DATA	SAMPLES	MEAN		FORMATION		QL				
				-3	-2	-1	+1	+2	+3	
E THORIUM	4233	6.56	NORMAL	4.36	5.09	5.82	7.29	8.03	8.76	
E URANIUM	4232	2.20	NORMAL	0.51	1.07	1.63	2.76	3.32	3.88	
POTASSIUM	4233	1.18	NORMAL	0.87	0.98	1.08	1.28	1.38	1.49	
EU/K	4232	1.75	NORMAL	0.25	0.77	1.28	2.30	2.81	3.32	
EU/ETH	4232	0.32	NORMAL	0.04	0.13	0.23	0.42	0.51	0.61	
ETH/K	4232	5.31	NORMAL	3.10	3.84	4.57	6.05	5.79	7.52	

DATA	SAMPLES	MEAN		FORMATION		QUGO				
				-3	-2	-1	+1	+2	+3	
E THORIUM	2572	6.27	NORMAL	4.09	4.82	5.54	6.99	7.72	8.44	
E URANIUM	2572	2.30	NORMAL	0.59	1.16	1.73	2.87	3.44	4.01	
POTASSIUM	2572	1.10	NORMAL	0.80	0.90	1.00	1.21	1.31	1.41	
EU/K	2572	2.01	NORMAL	0.28	0.86	1.44	2.55	3.17	3.75	
EU/ETH	2572	0.35	NORMAL	0.05	0.15	0.25	0.46	0.56	0.66	
ETH/K	2572	5.42	NORMAL	3.23	3.96	4.69	6.16	5.89	7.63	

SIOUX FALLS

CUAD

DATA	SAMPLES	MEAN		FORMATION		QUWG			
				-3	-2	-1	+1	+2	+3
E THORIUM	4557	6.06	NORMAL	3.18	4.14	5.10	7.02	7.98	8.94
E URANIUM	4547	2.14	NORMAL	0.17	0.83	1.49	2.80	3.46	4.12
POTASSIUM	4557	1.24	NORMAL	0.78	0.93	1.08	1.39	1.55	1.70
EU/K	4547	1.68	NORMAL	-0.11	0.49	1.09	2.28	2.87	3.47
EU/ETH	4547	0.34	NORMAL	-0.01	0.11	0.23	0.46	0.58	0.70
ETH/K	4547	4.65	NORMAL	2.62	3.30	3.97	5.33	6.00	6.68

DATA	SAMPLES	MEAN		FORMATION		QUWE			
				-3	-2	-1	+1	+2	+3
E THORIUM	15725	5.90	NORMAL	3.28	4.15	5.03	6.77	7.65	8.52
E URANIUM	15695	2.12	NORMAL	0.33	0.93	1.53	2.73	3.32	3.92
POTASSIUM	15725	1.19	NORMAL	0.77	0.91	1.05	1.34	1.48	1.62
EU/K	15695	1.72	NORMAL	0.04	0.60	1.16	2.28	2.84	3.40
EU/ETH	15695	0.35	NORMAL	0.01	0.13	0.24	0.46	0.58	0.69
ETH/K	15695	4.69	NORMAL	2.60	3.30	4.00	5.39	6.09	6.79

DATA	SAMPLES	MEAN		FORMATION		CLWG			
				-3	-2	-1	+1	+2	+3
E THORIUM	1389	6.52	NORMAL	3.58	4.56	5.54	7.50	8.48	9.46
E URANIUM	1389	2.22	NORMAL	0.55	1.11	1.66	2.78	3.33	3.89
POTASSIUM	1389	1.19	NORMAL	0.89	0.99	1.09	1.29	1.39	1.49
EU/K	1389	1.80	NORMAL	0.25	0.77	1.28	2.31	2.82	3.34
EU/ETH	1389	0.32	NORMAL	0.04	0.14	0.23	0.43	0.52	0.62
ETH/K	1389	5.23	NORMAL	2.88	3.66	4.45	6.02	6.80	7.58

DATA	SAMPLES	MEAN		FORMATION		QIG			
				-3	-2	-1	+1	+2	+3
E THORIUM	1816	6.36	NORMAL	3.61	4.53	5.44	7.27	8.19	9.10
E URANIUM	1816	2.30	NORMAL	0.59	1.16	1.73	2.87	3.44	4.01
POTASSIUM	1816	1.16	NORMAL	0.77	0.90	1.02	1.29	1.42	1.55
EU/K	1816	1.91	NORMAL	0.37	0.88	1.40	2.42	2.94	3.45
EU/ETH	1816	0.35	NORMAL	0.07	0.16	0.26	0.44	0.54	0.63
ETH/K	1816	5.22	NORMAL	3.06	3.78	4.50	5.94	6.66	7.38

SIOUX FALLS

CUAD

DATA	SAMPLES	MEAN		FORMATION		KN			
				-3	-2	-1	+1	+2	+3
E THORIUM	15	4.66	NORMAL	2.47	3.20	3.93	5.39	6.12	6.85
E URANIUM	15	1.61	LOGNORMAL	0.78	1.00	1.27	2.05	2.61	3.33
POTASSIUM	15	0.92	NORMAL	0.20	0.44	0.68	1.16	1.40	1.65
EU/K	15	1.36	LOGNORMAL	0.39	0.59	0.90	2.08	3.16	4.81
EU/ETH	15	0.35	LOGNORMAL	0.15	0.20	0.26	0.46	0.61	0.81
ETH/K	15	5.01	NORMAL	2.23	3.16	4.08	5.94	6.86	7.79

DATA	SAMPLES	MEAN		FORMATION		PCC			
				-3	-2	-1	+1	+2	+3
E THORIUM	2	5.53	NORMAL	4.88	5.10	5.31	5.75	5.96	6.18
E URANIUM	2	2.62	NORMAL	2.20	2.34	2.48	2.76	2.90	3.04
POTASSIUM	2	1.12	NORMAL	0.98	1.02	1.07	1.17	1.22	1.27
EU/K	2	2.25	NORMAL	2.08	2.14	2.19	2.30	2.36	2.41
EU/ETH	2	0.46	NORMAL	0.33	0.37	0.42	0.50	0.55	0.59
ETH/K	2	4.58	NORMAL	3.33	3.75	4.16	5.00	5.41	5.83

DATA	SAMPLES	MEAN		FORMATION		PCS			
				-3	-2	-1	+1	+2	+3
E THORIUM	215	5.90	NORMAL	3.04	3.99	4.95	6.86	7.81	8.77
E URANIUM	215	2.30	NORMAL	0.41	1.04	1.67	2.94	3.57	4.20
POTASSIUM	215	1.07	NORMAL	0.73	0.84	0.95	1.18	1.30	1.41
EU/K	215	2.11	NORMAL	0.35	0.94	1.52	2.69	3.27	3.86
EU/ETH	215	0.37	NORMAL	0.06	0.17	0.27	0.48	0.58	0.69
ETH/K	215	5.31	NORMAL	3.09	3.83	4.57	6.05	6.79	7.53

DATA	SAMPLES	MEAN		FORMATION		W			
				-3	-2	-1	+1	+2	+3
E THORIUM	47	0.45	LOGNORMAL	0.05	0.11	0.23	1.04	2.22	4.72
E URANIUM	42	0.88	NORMAL	0.08	0.35	0.62	1.15	1.42	1.68
POTASSIUM	39	0.08	LOGNORMAL	0.01	0.02	0.03	0.17	0.38	0.83
EU/K	21	2.85	NORMAL	-0.68	0.50	1.67	4.03	5.20	6.38
EU/ETH	22	0.41	NORMAL	0.07	0.18	0.29	0.52	0.64	0.75
ETH/K	21	6.62	NORMAL	2.20	3.68	5.16	8.11	9.58	11.06

A P P E N D I X F

Format, Single Record Data Listing

REC NO.	LAT	LONG	RESID MAG GAMMA	TERR CL FEET	FLG	GEOL UNIT	CUSM CPS	AIM U CPS	TOTAL COUNT CPS	FLG	ETH PPM	FLG	EU PPM	FLG	K PCT	FLG	LU/ETH	EU/K	ETH/K	TEMP CELCIUS	BARO PRES MMHG
5079	64.0086	-160.9193	55305	763	MAR	W	31	1	-12	NAU	-1.1	NAU	-0.5	NAU	0.0	NAD	0.0	0.0	0.0	12.7	746.8
5080	64.0087	-160.9189	55305	751	MAR	W	28	1	36	MAR	0.0	NAD	0.1	NAD	0.1	NAD	0.0	0.0	0.0	12.7	747.1
5081	64.0087	-160.9176	55305	741	MAR	W	26	1	4	NAU	0.2	NAD	0.1	NAD	-0.1	NAD	0.0	0.0	0.0	12.7	747.4
5082	64.0088	-160.9166	55305	730	MAR	W	35	1	-60	NAU	0.0	NAU	0.3	NAU	-0.1	NAD	0.0	0.0	0.0	12.7	747.7
5083	64.0088	-160.9154	55305	722	MAR	W	26	1	-4	NAD	-2.7	NAD	2.3		-0.4	NAD	0.0	0.0	0.0	12.7	748.0
5084	64.0089	-160.9144	55305	712	MAR	W	28	1	-12	NAU	0.5	NAU	-1.7	NAU	0.0	NAD	0.0	0.0	0.0	12.7	748.1
5085	64.0089	-160.9131	55305	702	MAR	W	23	1	37	MAR	0.0	NAD	0.4	NAU	-0.3	NAD	0.0	0.0	0.0	12.7	748.5
5086	64.0090	-160.9121	55305	691		W	22	1	50		0.3	NAD	-0.1	NAD	0.0	NAD	0.0	0.0	0.0	12.7	748.8
5087	64.0091	-160.9109	55305	680		W	23	1	46		0.3	NAU	0.0	NAU	-0.0	NAD	0.0	0.0	0.0	12.7	749.1
5088	64.0092	-160.9099	55305	673		W	17	1	72		0.6	MAR	0.3	NAU	-0.3	NAD	0.0	0.0	0.0	12.8	749.3
5089	64.0092	-160.9087	55305	668		W	20	1	156		-1.6	NAD	0.7	MAR	-0.0	NAD	0.0	0.0	0.0	12.8	749.4
5090	64.0093	-160.9075	55304	666		W	32	1	113		0.0	NAU	0.6	MAR	0.0	NAD	0.0	0.0	0.0	12.8	749.4
5091	64.0093	-160.9064	55304	667		W	30	1	247		-0.2	NAU	0.6	MAR	0.1	NAD	0.0	0.0	0.0	12.8	749.3
5092	64.0094	-160.9052	55304	671		W	29	1	343		0.2	NAU	1.1		0.3		0.0	4.0	0.0	12.8	749.2
5093	64.0094	-160.9042	55304	679		W	23	1	659		2.9		-0.8	NAD	0.8		0.0	0.0	3.5	12.8	748.9
5094	64.0095	-160.9030	55304	683		W	34	0	965		3.2		1.4		0.8		0.5	1.9	4.1	12.9	748.5
5095	64.0096	-160.9017	55305	647		KS	24	0	1208		8.6		0.0	NAD	0.5		0.0	0.0	18.3	12.9	748.1
5096	64.0096	-160.9007	55305	463		KS	12	0	945		2.5		1.7		0.5		0.7	3.5	5.2	12.9	747.8
5097	64.0098	-160.8995	55305	455		KS	20	0	831		3.0		1.5		0.6		0.5	2.8	5.5	12.9	747.6
5098	64.0098	-160.8985	55305	457		KS	22	0	759		2.2		1.4		0.3		0.8	5.1	8.1	12.9	747.1
5099	64.0099	-160.8973	55305	465		KS	29	0	699		1.7		2.0		0.5		1.1	4.4	4.1	12.9	746.5
5100	64.0100	-160.8962	55305	479		KS	28	0	610		0.5	NAD	1.3		0.4		0.0	3.7	0.0	12.9	746.1
5101	64.0100	-160.8950	55305	497		KS	26	0	581		2.2		0.5	MAR	0.3		0.2	1.6	7.0	12.9	746.0
5102	64.0101	-160.8940	55304	518		KS	35	0	512		1.3		-0.2	NAD	0.3		0.0	0.0	4.2	12.9	745.7
5103	64.0101	-160.8928	55303	540		KS	20	0	677		2.1		1.0		0.2		0.5	5.6	11.2	12.8	745.5
5104	64.0102	-160.8918	55303	569		KS	26	0	579		1.7		1.2		0.1	MAR	0.7	12.6	17.6	12.8	745.5
5105	64.0103	-160.8905	55304	608		KS	21	-1	611		3.2		3.1		0.0	NAU	1.0	0.0	0.0	12.8	745.6
5106	64.0103	-160.8895	55303	614		KS	16	-1	551		3.7		0.2	NAD	0.3		0.0	0.0	11.1	12.8	745.5
5107	64.0104	-160.8883	55304	595		KS	37	-1	488		1.6		2.4		0.1	MAR	1.5	18.6	12.5	12.8	745.4
5108	64.0105	-160.8873	55302	575		KS	22	-1	510		0.2	NAD	1.3		0.3		0.0	5.1	0.0	12.8	745.3
5109	64.0106	-160.8860	55304	552		KS	28	-1	437		0.0	NAD	1.0		0.1	MAR	0.0	9.0	0.0	12.8	745.2
5110	64.0107	-160.8848	55305	532		KS	25	-1	405		0.5	NAD	1.1		0.3		0.0	4.0	0.0	12.8	745.1
5111	64.0107	-160.8838	55305	514		KS	25	-1	379		1.0	MAR	-0.1	NAD	0.3		0.0	0.0	3.0	12.8	744.7
5112	64.0108	-160.8826	55305	501		KS	35	-1	325		0.5	MAR	1.4		0.1	MAR	2.5	13.6	5.5	12.8	744.5
5113	64.0108	-160.8816	55305	490		KS	20	-1	411		0.0	NAD	1.1		0.0	NAD	0.0	0.0	0.0	12.8	744.3
5114	64.0109	-160.8803	55305	481		KS	22	-1	417		1.0		1.0		0.1	MAR	1.0	12.7	12.9	12.8	744.3
5115	64.0110	-160.8791	55305	477		KS	28	-1	517		0.8	MAR	1.1		0.3		1.3	4.0	3.1	12.8	744.1
5116	64.0110	-160.8781	55304	479		KS	17	0	616		1.4		0.7		0.5		0.5	1.4	2.8	12.8	744.0
5117	64.0111	-160.8769	55304	486		KS	23	0	623		4.3		0.8		0.6		0.2	1.4	7.0	12.8	743.9
5118	64.0111	-160.8759	55303	493		KS	22	0	607		2.5		1.5		0.1		0.6	10.2	17.5	12.8	744.0
5119	64.0112	-160.8746	55303	500		KS	21	0	693		3.5		0.5	MAR	0.5		0.2	1.1	7.4	12.8	744.2
5120	64.0113	-160.8734	55303	509		KS	22	-1	633		2.2		2.6		0.3		1.2	8.6	7.2	12.8	744.2
5121	64.0113	-160.8724	55302	516		KS	30	-1	636		3.7		0.2	NAD	0.3		0.0	0.0	10.9	12.8	744.5
5122	64.0113	-160.8712	55302	519		KS	25	-2	777		5.1		1.5		0.3		0.3	9.9	20.2	12.8	744.9
5123	64.0113	-160.8701	55302	518		KS	26	-2	658		3.8		0.9		0.4		0.2	2.2	9.0	12.8	745.1
5124	64.0113	-160.8689	55302	517		KS	32	-2	718		0.8	MAR	1.9		0.7		2.1	2.8	1.3	12.8	745.6
5125	64.0113	-160.8677	55302	523		KS	32	-2	763		2.7		2.2		0.2		0.8	13.0	16.0	12.8	746.1
5126	64.0114	-160.8667	55302	541		KS	25	-1	781		3.2		1.3		0.6		0.4	2.4	5.9	12.8	746.4
5127	64.0114	-160.8654	55301	559		KS	26	-1	736		1.1	MAR	2.6		0.3		2.2	8.2	3.8	12.9	746.8
5128	64.0114	-160.8644	55300	574		KS	23	-1	668		3.2		0.2	NAD	0.4		0.0	0.0	7.4	12.9	747.1
5129	64.0114	-160.8632	55300	592		KS	21	0	640		2.4		3.5		-0.0	NAD	1.4	0.0	0.0	12.9	747.3
5130	64.0113	-160.8620	55300	606		KS	14	0	696		1.9		1.9		0.3		1.0	7.1	6.9	12.9	747.3
5131	64.0113	-160.8609	55302	617		KS	27	0	595		1.4		0.7	MAR	0.3		0.5	2.4	4.4	13.0	747.7

SINGLE RECORD DATA

LINE

240

PAGE

1

FINISHED OUTPUTTING LINE 240

LINE 220 FIDS 2935 TO 4865 OUTPUT TO SARD TAPE

A P P E N D I X G

Format, Average Record Data Listing

RECORD NUMBER	LATITUDE	LONGITUDE	REL STD	GENL UNIT	COSM	ATM. TRAN	TOTAL COUNT	ETH PPM	STD FLG	STD DEV	STD FLG	STD DEV	POT FLG	POT DEV	STD FLG	STD DEV	EU	STD	EU	STD	ETH	STD
			TOTAL FIELD GAMA														RATIO	STD DEV	RATIO	STD DEV	RATIO	STD DEV
5238	64.0098	-160.7455	55285	W	33	-6	790	3.7	1	1.9	2	0.7	1	0.5	0	2.8	0	5.2	0			
5239	64.0098	-160.7444	55283	KS	43	-6	952	3.7	0	1.9	0	0.7	0	0.5	1	2.9	0	5.3	0			
5240	64.0098	-160.7434	55285	KS	27	-5	998	3.7	0	2.1	0	0.7	0	0.6	2	3.1	1	5.3	0			
5241	64.0098	-160.7422	55287	KS	33	-5	1047	3.5	0	2.2	0	0.7	0	0.6	2	3.2	1	5.2	0			
5242	64.0098	-160.7412	55298	KS	31	-5	1083	3.5	0	2.1	0	0.7	0	0.6	2	2.9	0	4.8	0			
5243	64.0097	-160.7399	55287	KS	30	-4	1156	3.7	0	1.9	0	0.7	0	0.5	1	2.7	0	5.0	0			
5244	64.0097	-160.7389	55287	KS	31	-4	1182	4.1	0	1.9	0	0.8	0	0.5	1	2.5	0	5.3	0			
5245	64.0097	-160.7379	55286	KS	26	-4	1245	4.0	0	1.7	0	0.8	0	0.4	0	2.1	0	4.9	0			
5246	64.0096	-160.7366	55285	KS	38	-4	1148	3.8	0	1.6	0	0.8	0	0.4	0	2.1	0	4.8	0			
5247	64.0097	-160.7356	55285	KS	30	-3	1211	3.7	0	1.5	0	0.8	0	0.4	0	1.9	0	4.5	0			
5248	64.0096	-160.7344	55295	KS	30	-3	1076	3.8	0	1.5	0	0.8	0	0.4	0	1.9	0	4.7	0			
5249	64.0096	-160.7334	55284	KS	29	-3	1016	3.7	0	1.3	0	0.8	0	0.4	0	1.6	0	4.6	0			
5250	64.0096	-160.7324	55283	KS	33	-3	975	3.7	0	1.2	0	0.8	0	0.3	0	1.6	0	4.8	0			
5251	64.0095	-160.7311	55283	KS	23	-3	976	3.5	0	1.2	0	0.7	0	0.3	0	1.7	0	5.0	0			
5252	64.0095	-160.7301	55283	KS	30	-3	948	3.7	0	1.1	0	0.7	0	0.3	0	1.6	0	5.1	0			
5253	64.0095	-160.7289	55284	KS	33	-3	921	3.8	0	1.0	-1	0.7	0	0.3	0	1.4	-1	5.2	0			
5254	64.0095	-160.7278	55284	KS	37	-2	803	4.0	0	1.0	-1	0.7	0	0.3	0	1.5	-1	5.6	0			
5255	64.0095	-160.7266	55283	KS	23	-2	954	4.1	0	1.0	-1	0.7	0	0.3	-1	1.4	-1	5.5	0			
5256	64.0094	-160.7256	55293	KS	29	-1	1006	4.3	0	1.0	-1	0.7	0	0.2	-1	1.3	-1	5.8	0			
5257	64.0094	-160.7244	55283	KS	37	-1	1133	4.0	0	1.0	-1	0.7	0	0.2	-1	1.3	-1	5.5	0			
5258	64.0094	-160.7233	55284	KS	23	0	1106	4.1	0	1.0	-1	0.7	0	0.2	-1	1.4	-1	5.9	0			
5259	64.0094	-160.7221	55285	KS	28	0	1034	4.1	0	0.8	-1	0.7	0	0.2	-1	1.2	-1	6.1	0			
5260	64.0094	-160.7211	55284	KS	21	0	963	4.1	0	0.8	-1	0.7	0	0.2	-1	1.3	-1	6.2	0			
5261	64.0093	-160.7199	55294	KS	27	0	840	3.7	0	0.8	-1	0.6	0	0.2	-1	1.3	-1	6.1	0			
5262	64.0093	-160.7188	55294	KS	29	0	718	3.2	0	0.9	-1	0.5	-1	0.3	0	1.7	0	6.0	0			
5263	64.0092	-160.7176	55284	KS	33	0	605	2.5	-1	0.9	-1	0.5	-1	0.4	0	1.8	0	5.2	0			
5264	64.0092	-160.7166	55294	KS	32	0	635	2.1	-1	0.8	-1	0.4	-1	0.4	0	1.9	0	5.2	0			
5265	64.0093	-160.7156	55283	KS	35	0	507	1.7	-1	0.7	-1	0.3	-1	0.4	0	2.2	0	5.3	0			
5266	64.0092	-160.7143	55283	KS	26	-1	521	1.6	-1	0.7	-1	0.3	-1	0.3	1	2.5	0	5.4	0			
5267	64.0092	-160.7133	55283	KS	19	-1	465	1.4	-1	0.8	-1	0.3	-1	0.6	2	2.9	1	5.1	0			
5268	64.0091	-160.7121	55283	W	34	-1	287	1.3	0	0.9	1	0.3	1	0.7	1	3.1	0	4.6	-1			
5269	64.0091	-160.7110	55292	KS	29	-1	398	1.3	-1	1.0	-1	0.3	-1	0.8	3	3.4	1	4.4	0			
5270	64.0092	-160.7100	55282	KS	42	-1	516	1.7	-1	1.1	0	0.3	-1	0.6	2	3.2	1	5.1	0			
5271	64.0092	-160.7090	55283	KS	29	0	716	1.9	-1	1.0	-1	0.4	-1	0.6	2	2.8	0	5.1	0			
5272	64.0092	-160.7078	55283	KS	25	0	781	2.1	-1	1.1	0	0.4	-1	0.5	1	2.9	0	5.2	0			
5273	64.0092	-160.7068	55282	KS	32	0	738	2.4	-1	1.1	0	0.4	-1	0.5	1	2.7	0	6.0	0			
5274	64.0091	-160.7057	55281	KS	25	0	853	2.5	-1	1.1	0	0.4	-1	0.5	1	2.7	0	5.9	0			
5275	64.0091	-160.7047	55282	KS	22	0	796	2.5	-1	1.1	0	0.5	-1	0.4	0	2.4	0	5.8	0			
5276	64.0091	-160.7037	55281	KS	21	0	904	2.9	-1	1.0	-1	0.5	-1	0.4	0	2.2	0	6.1	0			
5277	64.0092	-160.7025	55281	KS	37	1	810	2.9	-1	1.0	-1	0.4	-1	0.4	0	2.3	0	6.5	0			
5278	64.0092	-160.7014	55280	KS	27	2	764	3.0	0	0.9	-1	0.5	-1	0.3	0	1.9	0	6.3	0			
5279	64.0092	-160.7004	55292	KS	31	1	750	2.9	-1	0.9	-1	0.5	-1	0.3	0	2.0	0	6.0	0			
5280	64.0092	-160.6994	55283	KS	33	1	790	2.9	-1	1.0	-1	0.5	-1	0.3	0	2.1	0	6.2	0			
5281	64.0092	-160.6984	55283	KS	32	1	745	3.3	0	0.8	-1	0.5	-1	0.2	-1	1.7	0	7.1	0			
5282	64.0092	-160.6973	55283	KS	36	1	779	3.7	0	0.8	-1	0.5	0	0.2	-1	1.5	-1	6.5	0			
5283	64.0092	-160.6963	55283	KS	31	1	821	3.8	0	0.8	-1	0.6	0	0.2	-1	1.4	-1	6.6	0			
5284	64.0092	-160.6951	55283	KS	31	1	858	3.8	0	1.0	-1	0.6	0	0.3	0	1.8	0	6.5	0			
5285	64.0092	-160.6941	55284	KS	30	1	948	3.7	0	1.2	0	0.6	0	0.3	0	2.0	0	6.0	0			
5286	64.0093	-160.6931	55284	KS	26	0	1054	3.7	0	1.3	0	0.6	0	0.3	0	2.1	0	6.0	0			
5287	64.0093	-160.6920	55282	KS	32	0	963	3.3	0	1.5	0	0.6	0	0.4	0	2.4	0	5.7	0			
5288	64.0093	-160.6910	55281	KS	30	0	1040	3.3	0	1.3	0	0.6	0	0.4	0	2.1	0	5.5	0			
5289	64.0093	-160.6900	55281	KS	25	0	997	3.3	0	1.3	0	0.6	0	0.4	0	2.2	0	5.5	0			
5290	64.0093	-160.6890	55281	KS	32	0	944	3.0	0	1.5	0	0.6	0	0.5	1	2.5	0	5.0	0			

A P P E N D I X H

Format, DOE SINGLE RECORD REDUCED DATA TAPE

DOE SINGLE RECORD REDUCED DATA TAPE

Line Character Number
 Number 12345678901234567890123456789012345678901234567890123456789012

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1 02 0978 (DATA TAPE TYPE AND FORMAT SPECIFICATION DATE CODES)
2
3 SINGLE RECORD REDUCED DATA TAPE
4
5 FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK)
6
7 ITEM      FORMAT  DESCRIPTION
8 1         A40     QUADRANGLE NAME AS PROJECT IDENTIFICATION
9 2         A20     NAME OF SUBCONTRACTOR
10 3        I4      APPROXIMATE DATE OF SURVEY (MONTH, YEAR)
11 4        I1      NUMBER OF AERIAL SYSTEMS USED TO COLLECT DATA FOR
12                THIS QUADRANGLE
13 5        I1      AERIAL SYSTEM IDENTIFICATION CODE FOR FIRST SYSTEM
14 6        A20     AIRCRAFT IDENTIFICATION BY TYPE AND FAA NUMBER FOR
15                FIRST SYSTEM
16 7        F6.1    NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO
17                TERRESTRIAL POTASSIUM (K-40) TO ONE DECIMAL PLACE
18                IN CPS PER PERCENT K FOR FIRST SYSTEM
19 8        F6.1    NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO
20                TERRESTRIAL URANIUM (BI-214) TO ONE DECIMAL PLACE
21                IN CPS PER PPM EQUIVALENT U
22 9        F6.1    NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO
23                TERRESTRIAL THORIUM (TL-208) TO ONE DECIMAL PLACE
24                IN CPS PER PPM EQUIVALENT TH
25 10       I6      BLANK FIELD (999999)
26 11       F6.3    4PI-SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL
27                PLACES IN SECONDS FOR FIRST SYSTEM
28 12       F6.3    2PI-SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL
29                PLACES IN SECONDS FOR FIRST SYSTEM
30 13       I3      NUMBER OF CHANNELS (0-3 MEV) IN 4 PI SYSTEM FOR FIRST
31                AERIAL SYSTEM
32 14       I3      NUMBER OF CHANNELS (0-3 MEV) IN 2 PI SYSTEM FOR FIRST
33                AERIAL SYSTEM
34 15-24    (SAME)  REPEAT OF ITEMS 5-14 FOR SECOND AERIAL SYSTEM
35 *        *
36 *        *
37 *        *
38 85-94    (SAME)  REPEAT OF ITEMS 5-14 FOR NINTH AERIAL SYSTEM
39 95       I3      NUMBER OF FLIGHT LINES ON THIS TAPE
40 96       I4      FIRST FLIGHT LINE NUMBER ON THIS TAPE
41 97       I6      FIRST RECORD NUMBER OF FIRST FLIGHT LINE
42 98       I3      JULIAN DATE (DAY OF YEAR) FIRST FLIGHT-LINE DATA WAS
43                COLLECTED
44 99-101   I4,6, &3 REPEAT OF ITEMS 96-98 FOR SECOND FLIGHT LINE ON THIS
45                TAPE
46 *        *
47 *        *
49 390-392  I4,6, &3 REPEAT OF ITEMS 96-98 FOR 99TH FLIGHT LINE ON THIS
50                TAPE
51

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Line	Character Number											
Number	1	2	3	4	5	6	7	8	9	0	1	2

52	FORMAT FOR SINGLE RECORD REDUCED DATA RECORD (THIRD THRU LAST BLOCK)											
53												
54	ITEM	FORMAT	DESCRIPTION									
55	1	I1	AERIAL SYSTEM IDENTIFICATION CODE									
56	2	I4	FLIGHT LINE NUMBER									
57	3	I6	RECORD IDENTIFICATION NUMBER									
58	4	I6	GMT TIME OF DAY (HHMMSS)									
59	5	F8.4	LATITUDE TO FOUR DECIMAL PLACES IN DEGREES									
60	6	F8.4	LONGITUDE TO FOUR DECIMAL PLACES IN DEGREES									
61	7	F6.1	TERRAIN CLEARANCE TO ONE DECIMAL PLACE IN METERS									
62	8	F7.1	RESIDUAL (IGRF REMOVED) MAGNETIC FIELD INTENSITY									
63			TO ONE DECIMAL PLACE IN GAMMAS									
64	9	A8	SURFACE GEOLOGIC MAP UNIT CODE									
65	10	I4	QUALITY FLAG CODES									
66	11	F6.1	APPARENT CONCENTRATION OF TERRESTRIAL POTASSIUM									
67			(K-40) TO ONE DECIMAL PLACE IN PERCENT K									
68	12	F4.1	UNCERTAINTY IN TERRESTRIAL POTASSIUM TO ONE DECIMAL									
69			PLACE IN PERCENT K									
70	13	F6.1	APPARENT CONCENTRATION OF TERRESTRIAL URANIUM									
71			(BI-214) TO ONE DECIMAL PLACE IN PPM EQUIVALENT U									
72	14	F4.1	UNCERTAINTY IN TERRESTRIAL URANIUM TO ONE DECIMAL									
73			PLACE IN PPM EQUIVALENT U									
74	15	F6.1	APPARENT CONCENTRATION OF TERRESTRIAL THORIUM									
75			(TL-208) TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH									
76	16	F4.1	UNCERTAINTY IN TERRESTRIAL THORIUM TO ONE DECIMAL									
77			PLACE IN PPM EQUIVALENT TH									
78	17	F6.1	URANIUM-TO-THORIUM RATIO TO ONE DECIMAL PLACE IN									
79			PPM EQUIVALENT U PER PPM EQUIVALENT TH									
80	18	F6.1	URANIUM-TO-POSTASSIUM RATIO TO ONE DECIMAL PLACE IN									
81			PPM EQUIVALENT U PER PERCENT K									
82	19	F6.1	THORIUM-TO-POTASSIUM RATIO TO ONE DECIMAL PLACE IN									
83			PPM EQUIVALENT TH PER PERCENT K									
84	20	F8.1	GROSS GAMMA (0.4-3.0 MEV) COUNT RATE TO ONE DECIMAL									
85			PLACE IN COUNTS PER SECOND									
86	21	F6.1	UNCERTAINTY IN GROSS GAMMA COUNT RATE TO ONE DECIMAL									
87			PLACE IN COUNTS PER SECOND									
88	22	F5.1	ATMOSPHERIC BI-214 4PI CORRECTION TO ONE DECIMAL									
89			PLACE IN PPM EQUIVALENT U									
90	23	F4.1	UNCERTAINTY IN ATMOSPHERIC BI-214 4PI CORRECTION									
91			TO ONE DECIMAL PLACE IN PPM EQUIVALENT U									
92	24	F4.1	OUTSIDE AIR TEMPERATURE TO ONE DECIMAL PLACE IN									
93			DEGREES CELSIUS									
94	25	F5.1	OUTSIDE AIR PRESSURE TO ONE DECIMAL PLACE IN MMHG									

A P P E N D I X I

Format, DOE RAW SPECTRAL DATA TAPE

DOE RAW SPECTRAL DATA TAPE

Line Character number
Number 12345678901234567890123456789012345678901234567890123456789012

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1 01 0978 (DATA TAPE TYPE AND FORMAT SPECIFICATION DATE CODES)
2
3 RAW SPECTRAL DATA TAPE
4
5 FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK ON TAPE)
6
7 ITEM      FORMAT  DESCRIPTION
8 1         A40     QUADRANGLE NAME AS PROJECT IDENTIFICATION
9 2         A20     NAME OF SUBCONTRACTOR
10 3        I4      APPROXIMATE DATE OF SURVEY (MONTH, YEAR)
11 4        I1      AERIAL SYSTEM IDENTIFICATION CODE
12 5        A20     AIRCRAFT IDENTIFICATION BY TYPE AND FAA NUMBER
13 6        I3      BFEC CALIBRATION REPORT NUMBER
14 7        F6.3    4PI SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL
15                PLACES IN SECONDS
16 8        F6.3    2PI SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL
17                PLACES IN SECONDS
18 9        I3      NUMBER OF CHANNELS (0-3 MEV) FOR 4PI SYSTEM
19 10       I3      NUMBER OF CHANNELS (0-3 MEV) FOR 2PI SYSTEM
20 11       I3      NUMBER OF FLIGHT LINES ON THIS TAPE
21 12       I4      FIRST FLIGHT LINE NUMBER ON THIS TAPE
22 13       I6      FIRST RECORD NUMBER OF FIRST FLIGHT LINE
23 14       I3      JULIAN DATE (DAY OF YEAR) FIRST FLIGHT LINE WAS
24                COLLECTED
25 15-17    I4,6 &3 REPEAT OF ITEMS 12-14 FOR SECOND FLIGHT LINE ON THIS
26                TAPE
27 *        *              *
28 *        *              *
29 *        *              *
30 306-308  I4,6 &3 REPEAT OF ITEMS 12-14 FOR 99TH FLIGHT LINE ON THIS
31                TAPE
32
33 FORMAT FOR RAW SPECTRAL DATA RECORD (THIRD THRU LAST BLOCK ON TAPE)
34
35 ITEM      FORMAT  DESCRIPTION
36 1         I1      AERIAL SYSTEM IDENTIFICATION CODE
37 2         I4      FLIGHT LINE NUMBER
38 3         I6      RECORD IDENTIFICATION NUMBER
39 4         I6      GMT TIME OF DAY (HHMMSS)
40 5         F8.4    LATITUDE TO FOUR DECIMAL PLACES IN DEGREES
41 6         F8.4    LONGITUDE TO FOUR DECIMAL PLACES IN DEGREES
42 7         F6.2    TERRAIN CLEARANCE TO ONE DECIMAL PLACE IN METERS
43 8         F7.1    TOTAL MAGNETIC FIELD INTENSITY TO ONE DECIMAL PLACE
44                IN GAMMAS
45 9         A8      SURFACE GEOLOGIC MAP UNIT CODE
46 10        I4      QUALITY FLAG CODES
47 11        F4.1    OUTSIDE AIR TEMPERATURE TO ONE DECIMAL PLACE IN
48                DEGREES CELSIUS
49 12        F5.1    OUTSIDE AIR PRESSURE TO ONE DECIMAL PLACE IN MMHG
50 13        F5.3    LIVE TIME COUNTING PERIOD TO THREE DECIMAL PLACES IN
51                SECONDS

```


A P P E N D I X J

Format, DOE STATISTICAL ANALYSIS DATA TAPE

DOE STATISTICAL ANALYSIS DATA TAPE

Line	Character Number
1	03 0978 (DATA TAPE TYPE AND FORMAT SPECIFICATION DATE CODES)
2	
3	STATISTICAL ANALYSIS DATA TAPE
4	
5	FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK)
6	
7	ITEM FORMAT DESCRIPTION
8	1 A40 QUADRANGLE NAME AS PROJECT IDENTIFICATION
9	2 A20 NAME OF SUBCONTRACTOR
10	3 I4 APPROXIMATE DATE OF SURVEY (MONTH, YEAR)
11	4 I1 NUMBER OF AERIAL SYSTEMS USED TO COLLECT DATA FOR
12	THIS QUADRANGLE
13	5 I1 AERIAL SYSTEM IDENTIFICATION CODE FOR FIRST SYSTEM
14	6 A20 AIRCRAFT IDENTIFICATION BY TYPE AND FAA NUMBER FOR
15	FIRST SYSTEM
16	7 F6.1 NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO
17	TERRESTRIAL POTASSIUM (K-40) TO ONE DECIMAL PLACE
18	IN CPS PER PERCENT K
19	8 F6.1 NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO
20	TERRESTRIAL URANIUM (B1-214) TO ONE DECIMAL PLACE
21	IN CPS PER PPM EQUIVALENT U
22	9 F6.1 NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO
23	TERRESTRIAL THORIUM (TL-208) TO ONE DECIMAL PLACE
24	IN CPS PER PPM EQUIVALENT TH
25	10 I6 BLANK FIELD (999999)
26	11 F6.3 4PI-SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL
27	PLACES IN SECONDS FOR FIRST SYSTEM
28	12 F6.3 2PI-SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL
29	PLACES IN SECONDS FOR FIRST SYSTEM
30	13 I3 NUMBER OF CHANNELS (0-3 MEV) IN 4 PI SYSTEM FOR FIRST
31	AERIAL SYSTEM
32	14 I3 NUMBER OF CHANNELS (0-30 MEV) IN 2 PI SYSTEM FOR FIRST
33	AERIAL SYSTEM
34	15-24 (SAME) REPEAT OF ITEMS 5-14 FOR AERIAL SYSTEM
35	* * *
36	* * *
37	* * *
38	85-94 (SAME) REPEAT OF ITEMS 5-14 FOR NINTH AERIAL SYSTEM
39	95 I3 NUMBER OF FLIGHT LINES ON THIS TAPE
40	96 I4 FIRST FLIGHT LINE NUMBER ON THIS TAPE
41	97 I6 FIRST RECORD NUMBER OF FIRST FLIGHT LINE
42	98 I3 JULIAN DATE (DAY OF YEAR) FIRST FLIGHT LINE DATA WAS
43	COLLECTED
44	99-101 I4,6 &3 REPEAT OF ITEMS 96-98 FOR SECOND FLIGHT LINE ONE THIS
45	TAPE
46	* * *
47	* * *
48	* * *
49	390-392 I4,6 &3 REPEAT OF ITEMS 96-98 FOR 99TH FLIGHT LINE ON THIS
50	TAPE
51	

Line	Character Number
Number	12345678901234567890123456789012345678901234567890123456789012

52	FORMAT FOR STATISTICAL ANALYSIS DATA RECORD (THIRD THRU LAST BLOCK)		
53			
54	ITEM	FORMAT	DESCRIPTION
55	1	I1	AERIAL SYSTEM IDENTIFICATION CODE
56	2	I4	FLIGHT LINE NUMBER
57	3	I6	RECORD IDENTIFICATION NUMBER
58	4	I6	GMT TIME OF DAY (HHMMSS)
59	5	F8.4	LATITUDE TO FOUR DECIMAL PLACES IN DEGREES
60	6	F8.4	LONGITUDE TO FOUR DECIMAL PLACES IN DEGREES
61	7	F6.1	TERRAIN CLEARANCE TO ONE DECIMAL PLACE IN METERS
62	8	F7.1	RESIDUAL (IGRF REMOVED) MAGNETIC FIELD INTENSITY
63			TO ONE DECIMAL PLACE IN GAMMAS
64	9	A8	SURFACE GEOLOGIC MAP UNIT CODE
65	10	I5	QUALITY FLAG CODES
66	11	F6.1	AVERAGED CONCENTRATION OF TERRESTRIAL POTASSIUM
67			(K-40) TO ONE DECIMAL PLACE IN PERCENT K
68	12	F4.1	UNCERTAINTY IN TERRESTRIAL POTASSIUM TO ONE DECIMAL
69			PLACE IN PERCENT K
70	13	F5.1	POTASSIUM STANDARD DEVIATION FROM THE MEAN TO ONE
71			DECIMAL PLACE AND ALGEBRAICALLY SIGNED
72	14	F6.1	AVERAGED CONCENTRATION OF TERRESTRIAL URANIUM
73			(BI-214) TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
74	15	F4.1	UNCERTAINTY IN TERRESTRIAL URANIUM TO ONE DECIMAL
75			PLACE IN PPM EQUIVALENT U
76	16	F5.1	URANIUM STANDARD DEVIATION FROM THE MEAN TO ONE
77			DECIMAL PLACE AND ALGEBRAICALLY SIGNED
78	17	F6.1	AVERAGED CONCENTRATION OF TERRESTRIAL THORIUM
79			(TL-208) TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH
80	18	F4.1	UNCERTAINTY IN TERRESTRIAL THORIUM TO ONE DECIMAL
81			PLACE IN PPM EQUIVALENT TH
82	19	F5.1	THORIUM STANDARD DEVIATION FROM THE MEAN TO ONE
83			DECIMAL PLACE AND ALGEBRAICALLY SIGNED
84	20	F8.1	GROSS GAMMA (0.4-3.0 MEV) COUNT RATE TO ONE DECIMAL
85			PLACE IN COUNTS PER SECOND
86	21	F6.1	UNCERTAINTY IN GROSS GAMMA COUNT RATE TO ONE DECIMAL
87			PLACE IN COUNTS PER SECOND
88	22	F5.1	ATMOSPHERIC BI-214 4PI CORRECTION TO ONE DECIMAL
89			PLACE IN PPM EQUIVALENT U
90	23	F4.1	UNCERTAINTY IN ATMOSPHERIC BI-214 4PI CORRECTION
91			TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
92	24	F6.1	AVERAGED URANIUM-TO-THORIUM RATIO TO ONE DECIMAL
93			PLACE IN PPM EQUIVALENT U PER PPM EQUIVALENT TH
94	25	F5.1	URANIUM-TO-THORIUM RATIO STANDARD DEVIATION FROM THE
95			MEAN TO ONE DECIMAL PLACE AND ALGEBRAICALLY SIGNED
96	26	F6.1	AVERAGED URANIUM-TO-POTASSIUM RATIO TO ONE DECIMAL
97			PLACE IN PPM EQUIVALENT U PER PERCENT K
98	27	F5.1	URANIUM-TO-POTASSIUM RATIO STANDARD DEVIATION FROM
99			THE MEAN TO ONE DECIMAL PLACE AND ALGEBRAICALLY
100			SIGNED
101	28	F6.1	AVERAGE THORIUM-TO-POTASSIUM RATIO TO ONE DECIMAL
102			PLACE IN PPM EQUIVALENT TH PER PERCENT K
103	29	F5.1	THORIUM-TO-POTASSIUM RATIO STANDARD DEVIATION FROM
104			THE MEAN TO ONE DECIMAL PLACE AND ALGEBRAICALLY
105			SIGNED

A P P E N D I X K

Format, DOE STATISTICAL ANALYSIS SUMMARY DATA TAPE

DOE STATISTICAL ANALYSIS SUMMARY DATA TAPE

Line Character Number
 Number 1234567890123456789012345678901234567890123456789012

1 05 0978 (DATA TAPE TYPE AND FORMAT SPECIFICATION DATE CODE)

2

3 STATISTICAL ANALYSIS SUMMARY TAPE (OR FILE)

4

5 FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK)

6

7 ITEM FORMAT DESCRIPTION

8 1 A40 QUADRANGLE NAME AS PROJECT IDENTIFICATION

9 2 A20 NAME OF SUBCONTRACTOR

10 3 I4 APPROXIMATE DATE OF SURVEY (MONTH, YEAR)

11 4 I6 NUMBER OF GEOLOGIC MAP UNITS USED FOR THIS
 12 QUADRANGLE

13

14 FORMAT FOR STATISTICAL ANALYSIS SUMMARY DATA RECORD (THIRD THRU LAST
 15 BLOCK)

16

17 ITEM FORMAT DESCRIPTION

18 1 A8 SURFACE GEOLOGIC MAP UNIT IDENTIFYING CODE

19 2 I6 TOTAL RECORDS FOR GEOLOGIC MAP UNIT

20 3 I6 NUMBER OF POTASSIUM RECORDS COMPUTED FOR GEOLOGIC
 21 UNITS

22 4 F6.1 POTASSIUM CONCENTRATION MEAN TO ONE DECIMAL PLACE
 23 IN PERCENT K

24 5 F6.1 POTASSIUM CONCENTRATION STANDARD DEVIATION TO ONE
 25 DECIMAL PLACE IN PERCENT K

26 6 A3 POTASSIUM CONCENTRATION DISTRIBUTION CODE

27 7 I6 NUMBER OF URANIUM RECORDS COMPUTED FOR GEOLOGIC UNIT

28 8 F6.1 URANIUM CONCENTRATION MEAN TO ONE DECIMAL PLACE
 29 IN PPM EQUIVALENT U

30 9 F6.1 URANIUM CONCENTRATION STANDARD DEVIATION TO ONE
 31 DECIMAL PLACE IN PPM EQUIVALENT U

32 10 A3 URANIUM CONCENTRATION DISTRIBUTION CODE

33 11 I6 NUMBER OF THORIUM RECORDS COMPUTED FOR GEOLOGIC UNIT

34 12 F6.1 THORIUM CONCENTRATION MEAN TO ONE DECIMAL PLACE IN
 35 PPM EQUIVALENT TH

36 13 F6.1 THORIUM CONCENTRATION STANDARD DEVIATION TO ONE
 37 DECIMAL PLACE IN PPM EQUIVALENT TH

38 14 A3 THORIUM CONCENTRATION DISTRIBUTION CODE

39 15 I6 NUMBER OF URANIUM-TO-THORIUM RATIO RECORDS COMPUTED
 40 FOR GEOLOGIC UNIT

41 16 F6.1 URANIUM-TO-THORIUM RATIO MEAN TO ONE DECIMAL PLACE
 42 IN PPM EQUIVALENT U PER PPM EQUIVALENT TH

43 17 F6.1 URANIUM-TO-THORIUM RATIO STANDARD DEVIATION TO ONE
 44 DECIMAL PLACE IN PPM EQUIVALENT U PER PPM EQUIVALENT
 45 TH

46 18 A3 URANIUM-TO-THORIUM RATIO DISTRIBUTION CODE

47 19 I6 NUMBER OF URANIUM-TO-POTASSIUM RATIO RECORDS
 48 COMPUTED FOR GEOLOGIC UNIT

49 20 F6.1 URANIUM-TO-POTASSIUM RATIO MEAN TO ONE DECIMAL PLACE
 50 IN PPM EQUIVALENT U PER PERCENT K

Line	Character Number																					
Number	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2

51	21	F6.1	URANIUM-TO-POTASSIUM RATIO STANDARD DEVIATION TO ONE
52			DECIMAL PLACE IN PPM EQUIVALENT U PER PERCENT K
53	22	A3	URANIUM-TO-POTASSIUM RATIO DISTRIBUTION CODE
54	23	I6	NUMBER OF THORIUM-TO-POTASSIUM RATIO RECORDS
55			COMPUTED FOR GEOLOGIC UNIT
56	24	F6.1	THORIUM-TO-POTASSIUM RATIO MEAN TO ONE DECIMAL PLACE
57			IN PPM EQUIVALENT TH PER PERCENT K
58	25	F6.1	THORIUM-TO-POTASSIUM RATIO STANDARD DEVIATION TO ONE
59			DECIMAL PLACE IN PPM EQUIVALENT TH PER PERCENT K
60	26	A3	THORIUM-TO-POTASSIUM RATIO DISTRIBUTION CODE

A P P E N D I X L

Format, DOE MAGNETIC DATA TAPE

DOE MAGNETIC DATA TAPE FORMAT

Line Character Number
 Number 1234567890123456789012345678901234567890123456789012

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1 04 0978 (DATA TAPE TYPE AND FORMAT SPECIFICATION DATE CODES)
2
3 MAGNETIC DATA TAPE
4
5 FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK)
6
7 ITEM      FORMAT  DESCRIPTION
8 1         A40     QUADRANGLE NAME AS PROJECT IDENTIFICATION
9 2         A20     NAME OF SUBCONTRACTOR
10 3        I4      APPROXIMATE DATE OF SURVEY (MONTH, YEAR)
11 4        I3      NUMBER OF FLIGHT LINES ON THIS TAPE
12 5        I4      FIRST FLIGHT LINE OF THIS TAPE
13 6        I6      FIRST RECORD NUMBER OF FIRST FLIGHT LINE
14 7        I3      JULIAN DATE (DAY OF YEAR) FIRST FLIGHT LINE DATA WAS
15                      COLLECTED
16 8         F8.4    LATITUDE OF GROUND BASE STATION TO FOUR DECIMAL
17                      PLACES IN DEGREES FOR FIRST FLIGHT LINE
18 9         F8.4    LONGITUDE OF GROUND BASE STATION TO FOUR DECIMAL
19                      PLACES IN DEGREES FOR FIRST FLIGHT LINE
20 10-14     (SAME)  REPEAT OF ITEMS 5-9 FOR SECOND FLIGHT LINE ON THIS
21                      TAPE
22 *         *              *
23 *         *              *
24 *         *              *
25 495-499   (SAME)  REPEAT OF ITEMS 5-9 FOR 99TH FLIGHT LINE ON THIS
26                      TAPE
27
28 FORMAT FOR MAGNETIC DATA RECORD (THIRD THRU LAST BLOCK)
29
30 ITEM      FORMAT  DESCRIPTION
31 1         I1      AERIAL SYSTEM IDENTIFICATION CODE
32 2         I4      FLIGHT LINE NUMBER
33 3         I6      RECORD IDENTIFICATION NUMBER
34 4         I6      GMT TIME OF DAY (HHMMSS)
35 5         F8.4    LATITUDE TO FOUR DECIMAL PLACES IN DEGREES
36 6         F8.4    LONGITUDE TO FOUR DECIMAL PLACES IN DEGREES
37 7         F6.1    TERRAIN CLEARANCE TO ONE DECIMAL PLACE IN METERS
38 8         F5.1    OUTSIDE AIR PRESSURE TO ONE DECIMAL PLACE IN MMHG
39 9         A8      SURFACE GEOLOGIC MAP UNIT CODE
40 10        F7.1    TOTAL MAGNETIC FIELD INTENSITY TO ONE DECIMAL PLACE
41                      IN GAMMAS
42 11        F7.1    RESIDUAL (IGRF REMOVED) MAGNETIC FIELD INTENSITY
43                      TO ONE DECIMAL PLACE IN GAMMAS
44 12        F7.1    DIURNAL MAGNETIC INTENSITY VARIATION TO ONE DECIMAL
45                      PLACE IN GAMMAS
46 13        F7.1    MAGNETIC DEPTH-TO-BASEMENT TO ONE DECIMAL PLACE
47                      IN METERS (IF REQUIRED)
  
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A P P E N D I X M

Reduced Calibration and Test Line Data

Reduced Calibration and Test Line Data

<u>Date</u>	<u>Flight</u>	<u>Res. Thor.</u> <u>583</u>	<u>Res. Thor.</u> <u>2615</u>	<u>Low Preflight</u> <u>Alt. T.C. 2π</u>	<u>Low Postflight</u> <u>Alt. T.C. 2π</u>
09/18/80	50	5.1%	9.8%	400' 2120 5	400' 2180 6
09/18/80	51	5.1%	9.8%	400' 2520 9	400' 2400 10
10/04/80	61	5.0%	9.3%	400' 2640 9	400' 1920 9
10/05/80	62	N/A	N/A	400' 2220 10	400' 2350 11
10/06/80	63	N/A	N/A	400' 2220 5	440' 2520 7

N/A = NOT AVAILABLE

A P P E N D I X N

Renumbered to Original Fiducial Correlations

SIoux FALLS QUADRANGLE

LINE 1600 FLOWN AS LINE 1608
MAP FIDUCIALS 17342 TO 19743 CORRESPOND TO ORIGINAL FIDUCIALS 19743 TO 17342

LINE 1610 FLOWN AS LINE 1610
MAP FIDUCIALS 47 TO 2298 CORRESPOND TO ORIGINAL FIDUCIALS 2298 TO 47

LINE 1620 FLOWN AS LINE 1628
MAP FIDUCIALS 7269 TO 9632 CORRESPOND TO ORIGINAL FIDUCIALS 9632 TO 7269

LINE 1630 FLOWN AS LINE 1638
MAP FIDUCIALS 4752 TO 7206 CORRESPOND TO ORIGINAL FIDUCIALS 7206 TO 4752

LINE 1640 FLOWN AS LINE 1640
MAP FIDUCIALS 7508 TO 9824 CORRESPOND TO ORIGINAL FIDUCIALS 9824 TO 7508

LINE 1650 FLOWN AS LINE 1658
MAP FIDUCIALS 15102 TO 17583 CORRESPOND TO ORIGINAL FIDUCIALS 17583 TO 15102

LINE 1660 FLOWN AS LINE 1660
MAP FIDUCIALS 17825 TO 20135 CORRESPOND TO ORIGINAL FIDUCIALS 20135 TO 17825

LINE 1670 FLOWN AS LINE 1678
MAP FIDUCIALS 2385 TO 4756 CORRESPOND TO ORIGINAL FIDUCIALS 4756 TO 2385

LINE 1680 FLOWN AS LINE 1688
MAP FIDUCIALS 12873 TO 15201 CORRESPOND TO ORIGINAL FIDUCIALS 15201 TO 12873

LINE 1690 FLOWN AS LINE 1692 AND 1691
MAP FIDUCIALS 17786 TO 18982 CORRESPOND TO ORIGINAL FIDUCIALS 18982 TO 17786
MAP FIDUCIALS 18983 TO 20387 CORRESPOND TO ORIGINAL FIDUCIALS 16899 TO 15494

LINE 1700 FLOWN AS LINE 1708
MAP FIDUCIALS 17713 TO 18200 CORRESPOND TO ORIGINAL FIDUCIALS 18200 TO 17713
MAP FIDUCIALS 18201 TO 20172 CORRESPOND TO ORIGINAL FIDUCIALS 18200 TO 20172

LINE 1710 FLOWN AS LINE 1711
MAP FIDUCIALS 57 TO 2434 CORRESPOND TO ORIGINAL FIDUCIALS 2434 TO 57

LINE 5040 FLOWN AS LINE 5040
MAP FIDUCIALS 2251 TO 3809 CORRESPOND TO ORIGINAL FIDUCIALS 3809 TO 2251

LINE 5050 FLOWN AS LINE 5050
MAP FIDUCIALS 4557 TO 6360 CORRESPOND TO ORIGINAL FIDUCIALS 6360 TO 4557

LINE 5060 FLOWN AS LINE 5061
MAP FIDUCIALS 7086 TO 8654 CORRESPOND TO ORIGINAL FIDUCIALS 8654 TO 7086

LINE 5070 FLOWN A LINE 5070
MAP FIDUCIALS 4978 TO 6562 CORRESPOND TO ORIGINAL FIDUCIALS 6562 TO 4978