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GJBX--387-81 Vol. 1

DE82 005535

National Uranium Resource Evaluation

**Airborne Gamma-Ray Spectrometer
And Magnetometer Survey
New Rockford Quadrangle, North 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

NEW ROCKFORD QUADRANGLE
NORTH DAKOTA

FINAL REPORT
VOLUME I

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AERO SERVICE DIVISION
WESTERN GEOPHYSICAL COMPANY
OF AMERICA
HOUSTON, TEXAS

APRIL, 1981

PREPARED FOR THE U. S. DEPARTMENT OF ENERGY
ASSISTANT SECRETARY FOR RESOURCE APPLICATIONS
GRAND JUNCTION OFFICE, COLORADO
UNDER CONTRACT NO. DE-AC13-76GJ01664
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 New Rockford 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 1397 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.

AERO SERVICE
HOUSTON, TEXAS 77001

X.....FILM IDENTIFIED INVERSE/11E LINE INTERSECTION
 .....FILM IDENTIFIED GROUND CONTROL
 .....INDEX FIDUCIAL (100 FIDUCIAL INTERVALS)
 FLOTH 1020

FLIGHT PATH
 NEW ROCKFORD
 NL 14-5
 DOE/NURE

FIGURE 2
 9/10

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.

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AERO SERVICE DIVISION
WESTERN GEOPHYSICAL
HOUSTON TEXAS 77002

DWN
CWD
APVD

DATE
11/78

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 New Rockford, North Dakota, 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 1397 miles are in the New Rockford 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 New Rockford 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 420 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 to 08/09/80		Operations in North Slope airborne survey 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 NEW ROCKFORD

TERRAIN CLEARANCE HISTOGRAM
JOB 624

NUMBER OF DATA POINTS

RADAR
ALTIMETER
FEET

-20-

Figure 4

AERC SERVICE
QUAC NEW ROCKFORD

GROUND SPEED
JOB 624

HISTOGRAM

NUMBER OF DATA POINTS

500 1800 2700 3600 4500 5400 6300 7200 8100 9000 9900

0.....

40.

~~80.~~

120. xxx

160.

200.

240.

280.

~~320.~~

360.

400.5

MILES
PER
FOUR

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 Biair Count rate is then:

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

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:

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

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 made 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 $2^{\circ} \times 1^{\circ}$ NTMS quadrangle only. The REGROUP program then eliminates all duplicate line segments, inserts reflight segments where required, orders the remaining line segments and rennumbers 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 tie 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 overflown 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 geology of the New Rockford quadrangle was compiled by Amuedo & Ivey, consulting geologists; for the United States Department of Energy from North Dakota Geol. Survey Bulletins.

The New Rockford quadrangle includes the area between 47° - 48°N latitude and 98° - 100°W longitude.

The geomorphology of this area is largely a product of glacial erosion and deposition of the Wisconsin Ice Sheet. The landforms of glacial geomorphology can be broken down into two basic types: glacial landforms which include ground moraines, end moraines, eskers and disintegration ridges, and kames and pro-glacial landforms including outwash plains, meltwater channels and lake plains. The glacial landforms are comprised chiefly of till and drift. Ground moraines tend to produce gentle slopes, smooth topography, and an average relief of 5-10 feet in a square mile. End moraines produce ridge-like features with moderate to high local relief. Eskers tend to be sinuous, and several miles long although discontinuous. Disintegration ridges are rectilinear, circular, or arcuate deposits of drift. Kames are composed mostly of gravel or sand whose form has been a result of slumping of sediments from ice disintegration. Pro-glacial landforms are landforms which include outwash plains, meltwater channels, and lake plains. These have basically the same lithology as the glacial landforms but tend to show sorting, stratification, and produce landforms which are nearly flat. An outwash plain is a broad body of washed and stratified drift deposited by glacial melt flowing in streams beyond the glacier terminus. Lake plains consist of clay overlying medium to coarse sand and gravel. Fossils may be present below the plain surface. Meltwater channels are erosional products of glacial melt flowing in channels or pathways beyond the glacier margins. Recent alluvial silt of unknown thickness line these meltwater channels.

Stratigraphy

The oldest exposed mapped rock unit in the New Rockford quadrangle is the Upper Cretaceous Pierre Formation (Kp). This formation can be found along the eastern portion of the New Rockford quadrangle. All other exposed rock types are Pleistocene glacial or pro-glacial sediment and Recent alluvial sediments.

A lithologic description of the rock types mapped is listed below, oldest to youngest.

Pierre Formation (Kp)

The Pierre Formation is the oldest rock type exposed in this quadrangle. Its exposure is only mapped as outcropping in the eastern portion of this quadrangle. It lies conformably above older Cretaceous formations and is directly under the glacial till. Its thickness ranges from 250 feet to 1,100 feet. It is described as a medium gray, massive to fissile, noncalcareous shale and siltstone, with creamy and bluish-white bentonite beds. It weathers to shale flakes and chips which are light when dry and dark when wet. The bentonite turns to a granular yellowish to light brown surface. Limonite stains are common on weathered surfaces. Small iron concretions are abundant in the outcrops.

Coleharbor Formation (Qc)

The Coleharbor Formation is abundantly exposed throughout the New Rockford quadrangle. It is broken down into 3 facies, till; till, sand, and silt; and sand and clay facies. These glacial sediments have about 90% of their volume as sand/silt/clay. The other 10% is in the form of boulders, cobbles, and pebbles.

The boulder and pebbles were broken down into igneous, metamorphic, and carbonates. The boulders were at an average 60.7% igneous, 26.3% metamorphic, and 12.9% carbonates. The pebbles on an average are 41.7% igneous, 46.4% metamorphic, and 11.8% carbonates. The sand/silt/clay percentage averages are 37% sand, 38% silt, and 25% clay.

The mineralogy of the silt and clay is: quartz ranges from 21% to 49%, plagioclase from 2% to 6%, k-feldspar is 1% to 6%, dolomite is 4% to 10%, calcite is 4% to 15%, kaolinite is 1% to 2%, montmorillonite is 12% to 21%, and illite is 9% to 18%.

Depth of oxidation ranges from 20 to 30 feet in till, and leaching usually was less than a foot. Leaching could go deeper though in more porous areas.

Landforms associated with this formation are glacial landforms such as moraines, kames, eskers, drumlins, and disintegration ridges.

Moraines usually show a relief of less than 50 feet per square mile and on an average exhibit only 5-10 feet of relief per square mile.

Also associated with this formation is the pro-glacial landform, lake plains. The lake plain has a similar lithology to the till but it has a much higher silt and clay percentage. Also graded bedding and stratification are present and fossils may also be present. These landforms are normally very flat but may have some relief, a hammocky surface, and fractures and folding of the stratified beds if they were formed in a dead ice environment.

Glacial Outwash and Colluvium (Qoc)

Glacial outwash and colluvium consists of lithology derived from the glacial till. Its lithology is thus similar but sediments vary from coarse, poorly sorted gravel adjacent to the end moraine to well sorted fine grained further away from the moraine. Landforms associated with this group are outwash plains, outwash deltas and pitted outwash plains. These features are basically flat, of little or no local relief and very gently sloping.

Dune Sand (Qsd)

Sand dunes occur mostly in the east northeastern portion of the New Rockford quadrangle. These are small longitudinal sand hills with a basic northwest trend and a local relief of about five feet. They consist chiefly of medium brown, fine grained quartz sand and some black silt. Vague horizontal color banding can be seen in a few exposures. Sand is the major constituent of this landform but exact ratios of sand to silt are undetermined. These dunes are commonly well weathered.

Fluviatile Deposits (Qt)

Fluviatile terrace deposits can be found on or near the present alluvial floodplain. They can be found sparsely scattered throughout this quadrangle. These terraces are anywhere from 10 feet to 100 feet above the present floodplain. They have sporadic occurrences of sand and gravel and cross-bedding in places along the till surface. Cobble surfaces and heavy scarring by shallow abandoned channels can be seen.

Alluvium (Qal)

Alluvium is mostly a calcareous montmorillonite with small traces of quartz, feldspar, and shale. It is high in its organic content and tends to

produce a dark gray to black sediment. It has thin bedding of 1-4 mm and fragments of wood and shells are common. Sediments are well oxidized and leached. Several test holes shows a thickness of over 50 feet of alluvial fill near valleys and less than 15 feet of fill at valley margins. Fill thickness in most places, though, is unknown.

Structure

There is not a great deal known about the bedrock structure in the New Rockford quadrangle. This is largely due to the extent of the glacial cover. As mentioned earlier, the glacial deposits cover the entire quadrangle, with minor exceptions in its eastern border. The depth of these deposits largely depends upon the bedrock topography. Well data has shown till thickness to range from a few feet to 300-400 feet.

Precambrian basement lies 1000 to 5000 feet below the surface, deepening to the northwest. Paleozoic and Mesozoic sedimentary rocks lie unconformably above the Precambrian.

The largest regional structure is the Williston Basin in northwestern North Dakota. Bedrock in this quadrangle shows about a 10-15 foot drop per mile toward the basin. Locally, bedding planes have been recorded dipping up to 50 feet per mile, but lack of detailed drilling prevent interpretation of these features. Thickening of bedding planes is also common in a northwesterly direction.

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

A total of six geologic map units are recognized in the New Rockford quadrangle and all six have been sampled in this survey. All units produce very clean distribution curves with the exception of unit Qt, Holocene fluviatile terrace deposits. The irregularity here is due to the limited number of samples taken (62), a result of the relatively limited occurrence of the unit within the quadrangle. Based on calculations of the ratios of the standard deviations over the means for the uranium distributions of the six units sampled, along with generally low mean values, none of the units mapped in the New Rockford quadrangle can be considered favorable sources likely to be enriched in uranium.

A total of thirty-four (34) uranium anomalies are outlined on the interpretation map. The geologic unit with the greatest number of anomalies is Qc, Coleharbor Formation, with twenty-four anomalies. The unit with the greatest number of anomalies per thousand samples is unit Qoc, Pleistocene glacial outwash and colluvium with 1.31 anomalies, followed by Qc with 0.97 anomalies per thousand samples.

Computer Printer and Anomaly Map Analysis

Computer printer maps of the total magnetic intensity and of the six radiometric parameters were prepared at a scale of 1:500,000 in addition to the radiometric anomaly maps of the area. The grid spacing of the computer printer maps is relatively wide at 2117 by 2170 meters. As a result, only broad features can be seen on these maps and narrow events are generally not noticeable.

The total magnetic intensity map displays a broad zone of low frequency anomalies from the central eastern margin extending westward to at least the center of the quadrangle. Three other anomalous zones exist, two in the southeast and southwest corners of the quadrangle, and one along the central portion of the northern margin. The anomalies may indicate the approximate location of buried Precambrian serpentinite bodies or areas of granite with a

TABLE III

LEGEND TO TOTAL FIELD MAP (GAMMAS)

CONTOUR VALUE	LOWER LIMIT	UPPER LIMIT
-		58775.0
0	58775.0	58825.0
1	58825.0	58875.0
2	58875.0	58925.0
3	58925.0	58975.0
4	58975.0	59025.0
5	59025.0	59075.0
6	59075.0	59125.0
7	59125.0	59175.0
8	59175.0	59225.0
9	59225.0	59275.0
+	59275.0	

X4= 422000.0
Y4= 5323669.0

X3= 584560.0
Y3= 5323669.0

X1= 422000.0
Y1= 5203000.0

X2= 584560.0
Y2= 5203000.0

Figure 7
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TABLE IV

LEGEND TO POTASSIUM AVERAGE MAP (PERCENT)

CONTOUR VALUE	LOWER LIMIT	UPPER LIMIT
-		0.72
0	0.72	0.77
1	0.77	0.82
2	0.82	0.87
3	0.87	0.92
4	0.92	0.97
5	0.97	1.02
6	1.02	1.07
7	1.07	1.12
8	1.12	1.17
9	1.17	1.22
+	1.22	

```
X2= 584560.0
Y2= 5203000.0
```

TABLE V

LEGEND TO URANIUM AVERAGE MAP (PPM)

CONTOUR VALUE	LOWER LIMIT	UPPER LIMIT
-		0.65
0	0.65	0.80
1	0.80	0.95
2	0.95	1.10
3	1.10	1.25
4	1.25	1.40
5	1.40	1.55
6	1.55	1.70
7	1.70	1.85
8	1.85	2.00
9	2.00	2.15
+	2.15	

NEW ROCKFORD NORTH DAKOTA URANIUM AVERAGE

X4= 422000.0

X3= 584560.0

Y4= 5323669.0

Y3= 5323669.0

.....+
.
.
.
3
655 654 55 5 11 77 77666
665444 65 666 789998 98 98 689986 454 3466 3 86 67 555 7642- 012685 575- 1573 15 7 9 7+ 99++ 98 8++ 97 7 6 773 26 6
654 55 55 6 789 9 8876 788764 43 56 688 6 65 654200 13565 5643 4652 1467987 9 9 9 9 988 76 6643 56 6
6 5 5 5 5 678 9 88 7 7 88765 4 5 67887 6 55321 12345 55 55 6653 2367887 8 99 98 8 9998876654 4 56 7
55 5 5 5 677 8 8 87 6 67 7765 5 6 789 8 6 5 4 3222 3 4 5 5543 345666 66 7 8 8 88 9 98876 544 45 68
4 5 5 567888 8 8 8875 456 6 65 56 6 78 87 666 54 3 4443 2 345 5 4 45 543 333 456 66 7 77 7765 54 3 469
34 5 5 57 8 8 8 764 345 6 5 44 56 5 6787 6 665 43 3 45543 1 235 55 4 3 45 5431 11 2 34 5 665 5 54 458+
3 4 5 55 567777777777643 345 555 4 4555 56 6 5 6 54 3 4 55421 1 234 4 3 2 34 4321 1 23 4 55 5 5433 48
23455-44 567 7 6 6 43 45 4 33333 45 5 5665 4 56 54 45554321 0 12 3 32 2 332 1 1 1 12 34 555 55 6 55 4 46
2 35 54 45676 5 6 6 4 44 42 2 345665 67643 35665 4 5654310 0 12332 1 12 2 1 11 0000 12345 5555 5 55 43 5
1 245654 45665 4 56 654 4 55432 2 46775 6764 5665 5654310 0134442 1 122 1 10 01345 5 4 5 5 5543 34
1 235654 45654 456 65 4 5 5 42 2 46775 6764 566 5 5654310 0235543 1 12 2 10 01245 4 45 5543 34
3 35 54 456655 5 67766555 5 5432 3443 45665 56543 345 5 44443210 0134555322111 2 2 22221100 124 54 45 5 5542 3
4 45 654 5677666 788877665 5 554 56654 5 5 55 433 34 43 34443100 24555 4333322 2 344321 134 555555 5 5542 2
754 56654 46887 6 789998765 5666 6 7765 55 4 4555432 23442 2565420 134 444 444433333 34665311 134 5 665 5543 2
75 56654 457876 6789 98765 56 6 6 7765 44 45666432 3443 2566420 1234 4 43 3 4567642 234 5 5 56532 2
6 5 54 456776 6789 9876 5 66 6 7765 4 45777543 4 432 2555420 123 455 433 456665322 34 55 6665 44 56542 1
6 5 544 56776 5 78 876 6 5 5 66654 3 45 6 7765544 5 43 34 43210 01 234 44443 2 456665443 4 56777654 45665321
65 4 5665 4 67 76 5 66654 4 55 543 34677765 5555 5 4 4 4 320 0123 3 3 4 455 666544 56776543 35676430
355 4 4 3 45 4 456765 4 66 54 45 543 468875 45 6 5 4 5 43210 123 3 3 444 55 67765 56 6543 35677530-
35 5 4 4 43 344 56 654 45654 45 543 3578753 3566 5555 43210 123 3 3 4 5555 67765 577754 3 35677541-
6 5 4 4 4 3 4554 45 54 3 5 54 4566532 35676543 56 6 5 4432111 234 3 4 5555 5 5 6765 579 9765544 6665541
66 54 4 44 67654 3 443 2455 4 456 6433 4566543 46 6 5 6666655544333 3 44 56777665 5 654 469 98766 666 5 43
666 54 45 44 677643 3 32 2345 4 4567654444 56643 46765 56777 66666654 3 3 4 5 6788876 54 45 54 6 988776 65 4 43
666 54 4543 3466543 3 3 2 2355 4 4567654 56 53 46 65 567 7 6543 34 5 677 876 54 4 554 359 877776 654 443
5 5 44 543 345654 3 3 2 3455 4 456654 444 56654 456 5 567 666666655544444 4 5 6 66665 44 443 3589987 6 666654 4
45 44 5 66544444 3 3455554 4 444 56666 6544444 5 55 5 55555 665554 33 4 4 56665 333 2 456 6 66 55 543 3
34 5 5 6 6555 4433 4566654 3 467 8777654 4 4 455 4 4 444 5 653 1111 2467754 2 2 34 5 554 45543 3
33 4 5 5 6 5 6 555543 46 7654 3 34567 7655 4 4 4543 3 4 4 5666531 146886432 2 345 5 43 35543 3
33 4 55 5 66 56 5 4 46 7654 3 3 4567 6554 4 4 4 43 3 4 45 6 76531 136886432 2 34 44 3 34543 3
23 4 555 6665 44 5 54 4566 6 444 333 4 5 55 54 4 4 4 43 3 4 4 56 66 6432222 3467766532 2 33 33 443 4 4321
13 4 5 66 7643 345 6654 456665 555544444 33 3 56664 5 43 3 4 56 76 6 6544444 566 776532 23 3 34544 4 30
134 55 5 6 666632 235 6 64 457654 456665555432 256775 55 5 4 3 4 567765 56776 66666 5 788642 244443 3455 431-
-135655 566 53 245 6654 45765 3 56 65 5432 256776 5 5 4 4568865 567766 6 5 57886422 34 43 345 5 431-
-246765 5 555542 245 6 5 456543 3456 5 4322 35677655 5 5 4 4567765 56666 6665 4 688643 3 33 45 5 41
256665 444 5532 345 543 35 543 34 5 6655444 56 65 5 444 4 3 567765 4 5 6 55 4 4566643 3 44 4555 5 41
356665 4 3 4 5543 45 543 34 43 22 3 4567776655 6 6654 3 4 4 3 34678753 2 345 5 44 3 3455433 2 35665544 5 5 42
55 54 3 2 345544 566531 12343 2 1 2 345666 7776 55 6654 3555543 3577642 1 2345 4 3 2 34 432 24666 4 456654 3
665 5 4 32 23444 566531 1234 2 1 1 234 444 678765 577643 35 6653 46653 1 1345 43 2 234 432 12455 3 35665 4 3
55 5 4432 23 456643 1 233 2 1 233 2 246776 55 67754 355554 3 45531 0 0235 5 43 2 234555421 13454 33 35665 4
45 5 56654333 4 5 54322 22 22 322 2 1 124566 78764 5543 2 3455 531 01356666554 3 5677642 1356543 3455 6
23455 567765444 455 44332 23 4 3 21 12345 5 5 79986 5543 2456554310 1246 7776543 46787642 134553 2 2455 68
23455 5677655 4 45 5432 23454 33 22 34 5 5 5 57 96 4 532 34666655433 45677 8764 457876421 134543 3465 68
2455 567765 4 4 4 4 5 532 2 35544 3 3 5555 5665 57 96 3 4444 5677 898655 6777 87654 577642 23454 3 456654 6
2455 56765 45554 3 4 5 53 2 34 55 43 22 345 5 6665 689853 34677776 789 87 77 7 666 54 577642 23 4 4 3 3468754 5
145 54 466653 57874 2 356653 344 5 432 2344 567775 4677543 58 86 579987 88875 4 5 78653333 4 554 579964 4
124565 45665 689852 235665 3 44 55432 34555 689874 345654 469 952 358 86 898642 234 5 68764 44 56643 58 574 32
1245654 45665 689852 1356654 44 55 54 2 35555 689864 345554 458 952 257886 89863 3 45 6876 44 567653 358 9743 2
145 54 456543 467642 2456654 3 4 566543 3444 5678763 3 44 4 457 9631 46776 787532 23 4 567754 4 5 777653 567764 3
34 44 5 6543 3443 345 6543 2 345676543 3 4 566643 3 44 4 57887532 246 6 6654 333 3 45765 4 5 6776654 5 55432
444 45 66543 2 2 34 5 532 1367765543 4 5543 3 33 4 44 566543 356 5 4 3 45543 3566544 65 4566 655 455421
244 4665 6542 11 2355 5 541 035876 6433 4 4 543 343 3 44 4576433 4664 3 46543 2 46765 595 24 56 7754 365421
256 34 4774 76422 12455 565 4 026787 43 33 64 5543 54 3 24 4 4 587 77 773 53 1477 24 487 765 5 6
.....+

X1= 422000.0

X2= 584560.0

Y1= 5203000.0

Y2= 5203000.0

Figure 9

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TABLE VI

LEGEND TO THORIUM AVERAGE MAP (PPM)

CONTOUR VALUE	LOWER LIMIT	UPPER LIMIT
-		3.00
0	3.00	3.25
1	3.25	3.50
2	3.50	3.75
3	3.75	4.00
4	4.00	4.25
5	4.25	4.50
6	4.50	4.75
7	4.75	5.00
8	5.00	5.25
9	5.25	5.50
+	5.50	


```
X2= 584560.0
Y2= 5203000.0
```

TABLE VII

LEGEND TO URANIUM/POTASSIUM RATIO MAP

CONTOUR VALUE	LOWER LIMIT	UPPER LIMIT
-		0.75
0	0.75	0.89
1	0.89	1.03
2	1.03	1.17
3	1.17	1.31
4	1.31	1.45
5	1.45	1.59
6	1.59	1.73
7	1.73	1.87
8	1.87	2.01
9	2.01	2.15
+	2.15	

NEW ROCKFORD NORTH DAKOTA URANIUM/POTASSIUM RATIO

X4= 422000.0

Y4= 5323669.0

X3= 584560.0

Y3= 5323669.0

.....+
.
.
.
1
543 543 44 3 22 ++ 55 7 7 598 9+
555544 54 66 677 89877 857 67+ 865 65 4887 6 96 76 67 699642 4 6+++ 5 90 574 76 7+ 68+++++ 88 8++ 998888 996 48 9+
455 44 4 566 7 8 8 8E76 89986 54 467 7 9766 6 7886433 47 987 7887 5 7 799 9 9 9 999 8 8854 678 9
455 4 4 5 6 78 8 777 6 78 8765 5 6788766 6 7 7653 457 975 444 5 6 78 99 9 9 999 887 5 5678+
4 4 45 6 7 87 66 677776 5 4 5 66 78 87 66 666 5 6777 777766 4 455 6 77 6 7899 9 999999999 8 765 568+
4 44 4 456 7 765 3 45 6 654 45 55 688 7 65 44 68 9743 45676555 665 6 643 3467888 9 98 77 77 7 754 57+
54 4 4 5 6 6 7 7764 34 5 5 33 45 4 5677 76543 359 730 135776 6 76555 6541 12456 789876 44 5 6 7 7642 369+
4444 44 45 66 6 654 3 444 543 34 43 3456 66 6 5 3 68 730 02455 4 555444 5431 1344 5 677654 456 77643 348
4 4 33 4 55555 665 432 4 4 3333 34 43 345 5 6 654 45898631 0122 2343 2 3 3211 2 22 3 4 4 4444 5 6 665433 6
35554 2 34555 4 5 54 444 43 22 2 2345433 55 56 65 56776410 0 1 23 321 1332 11111 234 5 4 5 5 654 4
2356642 345 43 345 54 4 542 2 2 235 54 455 56 65 56764310 0124 54320 01232 1 00 123455 4 45 56642 24
2356642 34 43 345654 4 5542 2 2 34554 56655 56 6555 654210 0245654321 0232 21 0 0 134 4 45 56652 24
2455432 3455433 45665444 44 4222 3333 4 44 478865 44 5 5 444432100 124567654321 12 2 33321100 1234 5 6655 6642 2
3 4 5543 3456544 567776654 4 433 45544 4 47 8543 345 43 3554311 34677765443222 356543211 234 5678876 6642 1
433 455543 4566555 678887643 34 4 5 6655 4 59 6432 24 43 367642 2457776 55 4333 3467764322 345 4 579 98 665421 1
433 455433 4565 5678 87643 34 5 6665 4 59 86532 3543 367642 24566 5 5 4 333 5688754333 45 4 468998 6532 1
4 3 4 433 3455 5 5678 754 3 4 4 5 66 543 26 8753 3443 256532 2 45 5 444444 567875544 44 4 568997 6 654211
43 33333 3 45 5 4 5677654 4 4 455 5421 148 98764 4 4322 44 321 1234 3 3 3 44444 5665 554 5 67776 6765321
53 3 34554 456654 4 4 4 55432 2489976 6655 4333 3210 01 233 3 4 55555 6655 5 6665 56776530
354 3 2 24 4 3 5654 3 4 4 33 4 432 358875 45665 4 3 210 13444 3 4555 55 56 65 5 5 56787541-
354 3 2 2 234 3 345 43 44 3 3 4 432 2477643 45665 44 3 210 02444 3 45 5 555 56765 56666 5 56787541-
54422 2 2 234 43 3443 2 34 3 3 4 421 2356643 35665 4 4 33321110 1244 33 456665 5 4 56765 5688877665 56776541
55422 2 333 345543 2 332 2 3 3 3 4554322 35 543 46654 4 55544 5543222 3444444 56776 5 4 456765 68 9888765 7765442
655432 234 3 345 532 2 32 23 33 45 5 3 345543 4565 566 5 666654444 44 55 5 67 765 4 56 6 4 7 9 86 6 654321
65543 2 3442 245432 2 2 23 45543 45543 3564 466 5 6 7654 4 455 5677 65 4 5 654 46 9888765 6 643 31
4543 3432 24 43 2 2 23 3 4 4 333 345543 3454 4565 56 654 44444 5 4 45 6 55 44 5 54 468987 76 55 6543 3
34 3 33 3 3 4 4 33333 2 2344 3 3 333 45555 543 3 33 45 4 4 55444 4 543 3 33 4555 44443 3566 5 5 55 4 5543 5
23 333 344 4 32 234 44 3 2 2356666654332 233 3 443 3 44 3 3 4 542 0 1 235665 3 34 4 43 34 43 6
2 3 3 43 344 344 44 322 34 4 3 2 245 6 654332 233 34432 23 3 3 455420 0 136775 3 3 455 43 344 6+
23 33 344 33 44 34 4 432 35 5 4 3 2 2 345 54332 2 3 3 3 2 33 344 5 6420 0 1367654 3 3 455432 244 6+
355544 44 4443 3 4 42 4555 4 332222 3 333 4322 3 3 333 3 4 555 55321111 245665544 2 3 333 443 3 5
478765 5 4 543 3 4 543 44 55554443333 2 1 23554 3 3 44444 4 5 654 455433 4 4555 666532 234 3 345433 3 43
489975 55 444 22 34 5 53 44 5 55 444 3 210 0135653 3 3 35 654 456665 4566555555 5 5677532 244 3 34543 3 4432
346776 4 5554 22 24 5543 34 5 6 5 4 32 10 145654 33 356654 4567764 45665 654 4678632 23 33 4 5433 3 4432
345 54 45554 22 234 422 34 5 6 5 4 4443321 2456643 33 356654 4567764 4 565 54 4577532 23 3 345 4 3 452
4 4 4 55 4 3 2 34 432 234 4 5 54 4 5 655433 456554333 3 4665 44 56764 3 4 5 555 4 45653 2 2 3333 45 44 443
45 444 45 4433 455 432 23 3 4 55 33 45677766654 5554443 2 3 45 54 457 753 2 34 5 4443 34 433 2 23567654444 544 43
5 5554 4 5 5444 555421 12 2 355432 235677 88875 56543 234555 43 356754 2 1 34 4 3 2 23 3 1 3577643 345554 3
56666 5 4 5444 56542 123 345432 135677 899765 566432 24 5554 3 35543 1 124 4 3 2 1 13 4432 135 53 2 346664 32
5 665 44444 44 4555421 1 22 345532 2 4 5 678875 5665432 44 54 33 4431 00 1345 443 2 3455531 123432 246654 4
35 5 5554 3 3455432222 234564 2 2 23467765 4 566533 4 43 3 4555430 1345665553 34677642 134 32 1 246654 6
1245 55 6654 3 345 44422 2356653 210 02467654 4 457765 443 345 5421 0246 777654 346788641 133 2 1 24676 69
1245 5 56665 44 33 45 43 35665432 1 1467765 554 58875 3 4433 4566655322 4577 887543 46776421 13443 2 1 25776 69
245 5 5677654 4 4 5553 235665432 23577765 5 5 58974 2 45544 57 888754 5678 87543 566531 12454 3 2 368764 6
25 5 5678974 345655 4 5 532 2 345 5432 1 2356 66 7875 577642 2467766 6789 9866 7887 6 54 456653 235675 3 2 479864 4
356 5 58 96 46898654 45653 33 4 43321 12345 68 975 565432 58 974 4578876 899864 43 4567643 358 964 3 358 964 3
135 5 57 7 68 74 46653 3 4 4 432 235654 56 86 5443 358 742 35777 68 852 23 45677543 6 753 59 74 2
135 5 57 7 68 964 46653 3 44 43 357875 6 86 44 43 347 741 24666 689 852 2 345677653 6 754 359 74 2
345 44 578 95 4589864 456533 33 4 56543 356765 69 9754 432 469 9742 356765 788752 2 3 4576543 58 86643 578753 2
344 3 4567874 2 4 54 45 54 3 34578753 34554 567765 4 3 3456 65 677765 56665332 2 356543 3457766 6544 554321
3 3 34 567753 111 23 4 5543 2 23589974 3 44 4 5443 34 43 34 567888754 4 5 543 2 24554 4 544 5 6655543 344210
133 356 68752 0 1234 45543 2 358 833 2 3455 4542 3 4 4 3 2 45 6776 53 45 5542 1 4565 5684 34566 6643 3542 0
134 23 367 4974 1 01 244 664 4 1 268 + 43 32 95 4652 04 64 43 2 22 475 99 761 3 56 65 12 475 677 555
.....+

X1= 422000.0

Y1= 5203000.0

X2= 584560.0

Y2= 5203000.0

Figure 11

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TABLE VIII

LEGEND TO URANIUM/THORIUM RATIO MAP

CONTOUR VALUE	LOWER LIMIT	UPPER LIMIT
-		0.17
0	0.17	0.20
1	0.20	0.23
2	0.23	0.26
3	0.26	0.29
4	0.29	0.32
5	0.32	0.35
6	0.35	0.38
7	0.38	0.41
8	0.41	0.44
9	0.44	0.47
+	0.47	

NEW ROCKFORD NORTH DAKOTA URANIUM/THORIUM RATIO

X4= 422000.0
Y4= 5223669.0X3= 584560.0
Y3= 5323669.0

.....+
.
.
.
2
44
5 7 +8 877
. 654 54 345 4
. 6 7744 543 66 7777 886 78 7 56 8755 75 3777 7 86 87 9 999963 1 35++ 75 7 96 84 +9 7 9 6+ 9+++ 88 9++ 987 9 8+ 63 8 8 7
. 5775 5 4 67777 8877 8875 78876 543 56 68 9 6 8 998631 237 88887 66 8 9 7987 9 9 9 8 8 9999996 57 8 7
. 676555 4 45 6 7 77765 67 76 5 4 4 5678987 789987542 347 9876 5 56 888887 7 89 888 99 8 98765 67 8
. 565 6 54 4 56 7 887 65 56 7 65 4 4 56 79987 77776 5 55 6 7888765 4 5677777 87 6 7 8999 99999998 77 7655 6789
. 55 6765 456777 8 8643 35 6 6543 3 45 67887 6666654 57886 4 567 65 6899666 8865 45 6 78 8 7777 66 67 764 457+
. 65 567775 56 77 89 863 24 56654 344 467876 543 3589963 23457 6 8 65 67864 34 567 76 55 4 5 67 764 469+
. 5 5 67654 456 7 6 7 77532 244 5543 3 3 34676 5 54 3 7999631 1345 5 789854 577643 3 45 6 654 456 66643 359
. 45 55 5 6 66 55 665 422 344 3333 2 3 3 35 5 566665 68 8531 123 3 4 553 35775433 3333 4 4 44 45 6 5 543 47
. 466 54 45 6665 44 5 5 423 3 2 2 34443 4654 46776 68 7410 01 2344 32 2478653 3 22 2 3455 44 5 5 53 6
. 346665 4 6654 33 4 4 4 4 3 2 2 2 34543 5764 6786 79 741 0245553 1 1478754 32 1 1 245 5 5 54 4554 47
. 346665 4 55432 234 4 4 444 32 2 2 235554 5764 678 78 641 1356653 1 1467754444321 124 5 5654 45543 47
. 3666544 5543 2 345555554 3 3 2 333 345554 68864 45 6 6 789865310 013577763221 246 65 55543211 2 34 4 56 5 56642 3
. 6 56 6655 555443 4567776543 34433 4444 5 5 58 8544 45 555 77542 125788764333 455 4 567754322 33 44 4 5666 66643 2
. 865 6776 55 6654 567888754 34 44 55555 5 4 7+ 7543 4554 359 8631 368987 55 555 54 5788643 3 44 45677 6 76531 0
. 86 5 6 765 56654 567888753 34 55 54 47+ 8764 3554 49 963 2368986 44 5 6 5 57997533 44 456777 777532 0
. 6 56 65 56765 56788875 23 4 44 55 5543 358 98753 3554 3787542 369 864 3 45 54 5788754444 4 44 56777 7764210
. 5 44 5 54 4567665 56 7764 44 4 4 5 5 432 24799877643 45543 555442 24786532 2345 5 44 67 6 6655 4 4 555 677 7 7542-
. 54 4 4 3 45 5 5 65 4 455 4 44 432 1257876 6 654 56654 4 322 2344 432 2345 5 5 55 67765 44 555 566 677653-
. 24 3 2 34 5 54 455 4 3 4 431 1368764 56 655 66654 3221 12355542 3456 5 55 567765 55 5 4 55 578853 -
. 244 432 234 5 54 456 43 3 4 421 357754 46765 566654 32 1 34554 3 4566 555 567765 56 76 55 5 5787540-
. 554 33 4 432 35675 5 5 4 554 3 3 4 4321 2456543 45665 5665 4 5543222 356542 45677766 5 567765 56799877775 6765540
. 6654 345543 58 986 54 3 4 4 3 4 54322 345 543 46 6 4 565 5 67643 44 5 555 6788887654 4566 5 579 9 9986 7654442
. +8764 356654 7 97 6543 3 44 45 543 345543 46764 4655 788865 555555 66 7 899 865 4 45 5 5 8 99 8 6433 32
. +8764 356653 6 97 6543 355 4 554 2 245543 35654 465 788865 554 4577 789 887 54 4 5 58 98 998 66543 332
. 6654 356642 48 86 55543 3554444 4 4 3333 5 543 34554 455 6787655 555 677 6 7777776654 4444 579976 6787 55543 3
. 5543 345 43 4578755 4 3566654 33333 45666665333 4 4 45 66655 5 6 7 7875 5 55 678864 33 56765 665 4 543 3
. 3 33 344 5 55 4 543 3577765 3 2 235678776543 2 344 4565 44 55 44 5 68875 3333 358 85 3 345 5 5 43 34432 2
. 12 344 3 34 4 4 43 357776543 2 1 3567 765442 2344 5654 44 4 4689853 2 249 954 3455 555543 23432 4
. 12 3 44 3 3 4 4 43 35777654 32 1 124566 5443 23 4 5654 44 4 5788753 2 48 9643 345 5 666532 23432 4
. 233 4 4 44444 2 3 4543 357776544 33211 234 44 5543 3 4 455 444 444 5 6 77543 332 47998653 345 67 8754322 33321
. 245554 4 5532 23 45522 566 5 555543222 33 2 356753 3 45 555 4 45 665 6 654 4444 56 66543 346 78887 543 22 3 3-
. 346664 45555542 23455523 454 5 66 543333 21 2578743 4 666654 456765 46 65 555554 456653 46 7876 5 532 23430-
. 2356764 45 5 431 123 45543 34544 5665 43 43 21 257875 4 56765 567754 456654 5 54 3 56653 356 65 4 5432 23430-
. 2356764 455 4 3 1 234 4 2 44 4 5 55 44 43321 3578754 456765 467654 45 54 55 43 45543 34 443 34 54322 344-
. 45 654 4 5 4 322 344 432 234 455 4 4 5 665433 56766544 3 45 665 467654 3 4 4 44 3 34443 3 3 3 45433 33 3-
. 455 544 4 4 4443 455 432 1 23 3 4 4 3 34689987654 5 66 5543 34 5 54 3 4577753 2 3 4 4 332 23 3 22 34554444 3 320
. 6 5 4 3 4 5555 665431 12 2 34432 1 3689988875 5676543 345 5432 357764 2 1 2443 221 123 21 124565 3 3 444320
. 56 5 4 3 3 5 55 6664210 012 344321 135677 8875 4 4677643 4 5 543 2 46653 1 1244 32 1 12 3321 134543 35553210
. 5 5 54432 234 4 565431 1 2 34431 1234 567764 45677664 34 543 3 45531 013454 322 1 3466531 12443 2 45653 2
. 356 55 66522 2 34554 322 1 2345532222 1 235665 4 5 677644 43 34566530 135 665443 2357 952 2343 2 246654 4
. 02566 67875 22 3455 444321 123455433210 01356 5 568876 54 35676520 024677765432 369 952 0233 2 146764 45
. 02566 68986433333 4555 5431 123565543 21 135665 555 69986 4 543 3 567655422 46787 7643 346787520 0233 2 147764 45
. 15676 7899754 4 5 65 5 53 1 2456654 3 2 346 65 5 5 69985 3 45554 567 89975 6 8877764 3 465420 013443 332 257754 4
. 146777 8 85 46887655 565422 345 5432 1 235 6 67875 578743 34799865 789 97 788766654 46531 134 4 3 3 367753 3
. 146888 8 7 6 75 566543 344 5 4321 23 45 68 865 5654 3 59 85 4689 87 89875 33333 567531 124565543 2 468752 2
. 1246898 7 69 85 566543 44 431 1344 57 75 4 44 469 95 26777 6899742 12 45688542 357 87643 2478742 1
. 1246898 7 7 85 5 66643 44 555532 24666 57 975 4 3 59 50 14666 6899741 1 2 34688642 3678876532 478742 1
. 246788 8 9 8 865 67654444 5677642 246765 579 864 3 347 952 24565 57886421 2 3467753 345677 6542 456532 1
. 45666 78 6 799876666 77544 4579 963 235665 5678864 3 35688766 77765 566543222 2 356643 34 55 55433 3 3 320
. 56 5 568 976 5 677 6 776543 358 742 3 4555 56653 3 3 35 68998764 3 4 5544332 23554 465 3 4 44 32 2342 0
. 4665 59 964 45787 6886443 248 84333 455 4674 23 3 2 57 875 44 345 543 2 35654 495 3 5 5443 1442 0
. 469 6 4 9 + 8 7 4 8 7 4 5 532 4 +++ 44 32 95 4784 04 53 23 222 4 72 92 651 4 55 66 23 376 5 3 444
.....+

X1= 422000.0
Y1= 5203000.0X2= 584560.0
Y2= 5203000.0Figure 12
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TABLE IX

LEGEND TO THORIUM/POTASSIUM RATIO MAP

CONTOUR VALUE	LOWER LIMIT	UPPER LIMIT
-		3.20
0	3.20	3.43
1	3.43	3.66
2	3.66	3.89
3	3.89	4.12
4	4.12	4.35
5	4.35	4.58
6	4.58	4.81
7	4.81	5.04
8	5.04	5.27
9	5.27	5.50
+	5.50	

NEW ROCKFORD NORTH DAKOTA THORIUM/POTASSIUM RATIO

X4= 422000.0

X3= 584560.0

Y4= 5323669.0

Y3= 5323669.0

.....+
.
.
.
3
532 465444 3 00 88 886 4887++
53 355 5 55 444 586 7655 7988 87666 6788753 5666 5631 2566+ 8 8755+ 7 62 6 5 6 66 7898 885 6 675 5 78875 3454 6 6789+
33 4 5 5 56 6 6 78 8 7 6 78 754 56 65 532 34579 97 78865 5786 7875 6 78 88766 6 6 5 677654 45 5 5 679
33 4 55 55555 6 666 67 88 77 787654 5 6 532 346789998 6 77654 5 5 6776 67 8 8 7 6 6 76655 5 5 79
33 4 5 6666 66 66 7 88 7 6666 787 655 66544 567 8 876 5 55 5 56 6 555 6 7887 66 5 6788766 5 5 68
44 3 345 6 6 5 55 6788 8 6 6 78 7 666 55 6776 6 77 7 7643 34566654 46 654 33 45799987 765 67887 6 5 5 7
3443 4 56 55 5 5 567899865 5 678876 665 578776 77 66 7642 356654 2 3677532 2 468 987 7 6 5 67776 6 5 5 8
4442 34 44 566 5 56789986 5 67876 5 5777 6666 5 565432 455432 23566421 12346776 6 666 6 6 66 55 5
44 43 34 4 4677665 5 68 876 55 67 7 666 5 56 7 6 5 4 4 555555432 235665310 0 1 2344 4 5 6 6 5 666666 54
5 5 4 22 344 56888655 5789765 5 6 77 65 56 6 55432 234567766432 235776420 01 11 2 34 5 665 5677 653
34 5543 234 4 57898765 578875 5 677 666665 56 6 5 43 1 123568876543 46898741 0 1 123 4 5 5 567 7776531
34 5543 23555 68998765 578875 5 6776 555 5 56 6 5 42 1 1235688765 567999741 0 11 2 3 45 5 567 7776531
4 4 432 235777 8988765 5 78876555 6 6 5 4 5 55 66 5 55432 1 234578865 67898631 0111 211 233 456666 776 7766666653
123 44222 3578 8887765 6 7 776 6 765 4 45676 5 4 56 543222 3457875 4 56776531 12333333 4444 46787 7899876 555 54
0123 422 3467 777 6 6 7 7 6 66 77654 45788764 45665 4333 3467754 4676542 235544 45665 56887 78 985 5 7
012 3 22 345 6 66 677 666 6 777654 4568876544 5665 43 3 457653 3577543 24555 4 56665 578976 679 985 5 67
2 3 22 3 4 5 55 6 66 6 7765 4 4567776555 666543 3 3 45531 135776532 24565 5 66665 56887 789975 5 68
44 4 3 33 4 55 5 6666 555 6 65544 56777666 6665 3 4 433 2221 13577765444 55 5 555 56776 678876 555 79
65443 3 4 4 4 56 6 5 4 5 6 6666 6 77 6 66643 34 54210 0 13567 655 55 66 5 5 55 678987 6666 67+
875543 34 44 55 4 456654 4 5 6 6 5 6777 6 6643 3455420 0 1 2456 6 5 5 665 5 5 5 78887 7776 67 +
8765 43 34 55543 35 5 4 4 5 6 665 5 7776 6543 3455421 01 2346 66 5 5 5 665 55 5 67776 7 87 6 7 +
655 43 3 4 443 2 2344 3 4 5 6 66 5 56 666 543 45554321111 245 5555 5 5 555 5 5665 6 7777 8
444 43 2 3 321 0 01 2 2 4 5 666 6 5 5 66 555 5 6654 4433222 34 4444 444 5 6 7765 4 5 65 4567887 6
-23 4 42 2 210 0 1 2 3 45 66 66 5 5 5 66 5 56 775 45664333 4554 33 4 4 4 5678875 4 56665 45689986 5
-234 5 4 2 10 0 12 345 6 665 5 666555 5 56 775 456654 4554 3 2 333 4 678875 45688754 45689986 5
3 4 5543 22 3210 0 111 2 3 45 5 5 4 5 55 5 566665 4566543 3333 2222 33 2 3 578875 3 4678876 5 6799876
44 55543 34554211 23322 32 2 3 45 54 4 5 5 56 54 3 45553 2 2 11 1 2 2 2 3577653 34567 7655 6 7 8 9+
5555 53 45675433 454433 32 2 45 5 6654 4 4 55 4 5 5 33 344 433322 1 0 0 1 2 2456653 34 56 666 78 +
7666 6654 5666543 466654 32 23455 5 6776544 4 4 5 4 4554 2 3 4 4 543210 0 1 2 1 1356653 34 4 56 7 8 +
777 6 6 65 5666544 567654444 3 2 3455 5 67765 44 4 4 4 44 42 23 4 5 54 210 011 2 2 1 356653 33 3456 7 7 8 +
89977 76555 66555 6776 5 4 32 3 45 5 5 6 664 4 4 4 554 2 3 4 55 5 433221 222 44433 456653 210 01356 7 7 78 +
8 87 765 5 6666 77 6 5 4 4 555 5 66 54 4 553 2 34 56 5 5 55444 44444 5666 6 77653 210 2567 88 78 +
7 87 764 456 777 65 4 456665 5 665 4 444 4 55532 2345666 5 6666555 66666 8887 8 76543210 0356 7886 8 +
57987 67876 4 56 777 6 54 4567765 56 65 4 4 4 5553 2 345676 6 666 77 77 89 88 876543 221 2 456 7886 8 +
56643 467765 5 6 66 77 6 5 4 5677765 5 6 6555555 444 543 3 56 776 6 777 8 99 8 76543333 44 567 88 78 +
653 3577655 666 66 6 555 67776 5 66 66555 6655 444 4 33 456 7 6666 666 77 88 88888 765544 566666 7 887 8 +
55444 56 666 6 555 66 66 7 76 66 654 4 56766555 4 4 444 56 7 6 66 66 7 8 88 7665 67777 7887 8 +
567776 5 5677754 45 6666 678 76 77654 45678776 5 4 33 45555 6 776 55 6 6 7 8 777 88 7766 7 887 66 788 89+
7 7 8875 5678865 45 6 65 7 8 777 7666 77 8887 654 3 3456 6776 5 56 6 788 7 7 8 88 7 6 77 6 67 89 +
567 765 568997644 5 6 65 678 7 7 7 888888887 65 4 33 4566 6765 4 56 66 6 7 8 7 666 7 7 6 6 6 67 77 8+
6 6 65 4 689986666666 6 6 67 7 66 6 78 8 76 5 444 4 5 6664 45777 6 6 7 7 654 45676 6 55 677 8+
76 55 54 4678 76 6666 66 67 76 5 5 67 8 77765 4 45 5 6654 46777 6 6 7 7 65 4676 665 5677 78+
765 554 4567 66 5555 6 55 66 55 67765 4 567 7 65 554 455 566654 66666 6 7 7 655 67 7666665 6 77 78+
75 44 3 456 66 5 444 5 5 5 65 567 654 4 5 67 7 65 5 54 4 56 6 665 4 5 6 7 7 7777 888 7 6 5 67 77 78
8643 2 3 4 5 55 4 45 5 5 5 5 6 6 55 566 7 66 655 54 4 4 56 6654 45 666 7 7 7 8 9999886 66 788887 8
9752 1234 4443 2 3 33 455 44 5 5 6 7 87776 6 7766666654 4 4 45 5 44 5 6 7 7 6 6789 9766 77 89 98 7
69752 123 33332 1 2 3455 4 4 56 89 9976 67877 7765 4 4 456 5 555 6 7 7 765 56899 877 8 8 8
68742 123 22221 1 2 2 3554 4 444 56 79988 76 5 6788 7 7 7644 4 56766666 6 7 7 765 56899 8 8 8 8 8
76420 1 2 1 00 0 1 234 4 4 4 33 456777 6 555 5 677 7 8875 4 567777776666 77 65 67 89 87 8 8 9 98 6
43 2 22 10 0 13 4 43 34 6 6 5 4 567 88 86555 444 5 6 7 7 6 6 666 7 6 66 5 788 888 8 8 886 6
1 1 33320 0123 3 45543 34 5 5 4 3 467 8 9876 555 4 4678876 6 6 6776 665 6899 9 8 8 8876 66
-0 134410 133 3 45542 2455 5 4 555 443 34678 8 9976 5 54 4688876 5 6776 5 776 67984 6899 7 9 8 8 566
-00 12651 -- 1 ----- 233 23 674 256 5 56 54 64 256 88 7 665 56 5 3 4698 77 5 587 5 6 5886 58 + 7 8
.....+

Figure 13

X1= 422000.0

X2= 584560.0 65/66

Y1= 5203000.0

Y2= 5203000.0

higher susceptibility. There are indications that the magnetics may confirm the regional basement structure of deepening to the west and northwest, into the Williston Basin. The overall magnetic intensity averages approximately 59,100 gammas.

The radiometric response, as shown on the computer printer maps for uranium, thorium and potassium, is relatively low over much of this area, averaging on the order of 1.5 ppm eU, 4.5 ppm eTh and 1.0% K.

All three parameters attain relatively higher levels of equivalent concentrations over a broad zone extending diagonally across the quadrangle in a northwest-southeast direction, along with a smaller zone in the vicinity of Lake Norway in the eastern central portion of the quadrangle. Both areas lie mostly over the Coleharbor Formation. Within these areas, uranium, thorium and potassium concentrations can exceed 1.7 ppm, 4.8 ppm and 1.1% respectively. There are seven areas where all three parameters exceed these concentration levels while at least one uranium ratio (U/Th or U/K) is relatively high. Three areas are geographically related to uranium anomalies 16, 21 and 26 (discussed further below). The other four are located on lines 1120, 1130, 1150 and 1210 respectively at fiducials 1260, 5930, 450 and 1990.

There are three areas where uranium and potassium concentrations and the U/K ratio are high, including two areas which coincide with uranium anomalies 28 and 29 and one on line 1280 at fiducial 3000. There are eight distinct areas where uranium and thorium concentrations and the U/Th ratio are high, including three areas which coincide with uranium anomalies 4, 5 and 32, and five possibly less significant areas on line 1120, fiducials 1380, 2580 and 2700, line 5030, fiducial 2840, and line 1160, fiducial 20780. Uranium may be concentrated in some mapped and unmapped, though suspected, alluvial deposits along drainage channels originating in morainal deposits.

Other zones exhibiting anomalous responses in either of the two ratios are the result of low thorium and/or potassium concentrations.

Using the criteria outlined in the general section on interpretation, a total of 34 uranium anomalies have been outlined on the interpretation map. Many of the 34 uranium anomalies outlined consist of anomalous responses in only one of the two uranium/potassium and uranium/thorium ratios, with the other ratio being either normal or anomalous due to low thorium or potassium

values. These also have little or no expression on the uranium anomaly map. These anomalies include zones 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 15, 16, 18, 20, 21, 22, 24, 26, 27, 28, 30, 31, 32, 33 and 34. They are considered to have been adequately described in the anomaly listing of Appendix B and are not further discussed in this report.

Anomaly 5 is a broad zone of weak to moderate U/K, U/Th and U response. There is little to no U or U/Th response in the center of the zone. Anomaly 6 has moderate to good U/K and U, and weak to moderate U/Th response. There is possibly some expression on the profiles. The U/K anomaly may extend eastward. Anomaly 17 has weak to moderate U/K and U and weak U/Th responses. Anomalies 19, 23 and 25 have generally low U/K and U response and are only weakly recognized on the profiles. Anomaly 29 has weak to moderate U/K, U/Th and U responses and limited expression on the profiles.

Anomaly 14 has moderate to good U/Th response and is therefore mentioned separately.

Overall, the best anomalies are 5, 6 and 29 although these may be due to local variations in ground material moisture content. Throughout the survey area, radiometric responses are too low and of such limited extent, that none are thought to be indicative of local uranium or thorium enrichment. No follow-up work is recommended.

AERO SERVICE

LEGEND

③ URANIUM ANOMALY NO. 3

INTERPRETATION MAP
NEW ROCKFORD QUADRANGLE
U.S. DEPARTMENT OF ENERGY

FIGURE 14
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SELECTED REFERENCES

- Aero Service, 1980: Report of calibration tests with the Douglas DC-3 installed gamma-ray spectrometer system. July, 1980.
- Amuedo and Ivey, 1980: Geology of the New Rockford Quadrangle. Prepared for the U. S. Dept. of Energy.
- Anderson, Sidney B., and Eastwood, William P., 1968, Natural gas in North Dakota, Natural gases of North America, Am. Assoc. Petroleum Geologists, Memoir #9, Vol. 2, pp. 1304-1326.
- Bluemle, J. P., 1965, Geology and ground-water resources of Eddy and Foster counties, North Dakota - Part 1, Geology: North Dakota Geol. Survey Bull. 44, pp. 6-64.
- Bluemle, J. P., 1975, Geology of Griggs and Steel counties, North Dakota: North Dakota Geol. Survey Bull. 64, pp. 3-47.
- Bluemle, J. P., Faigle, G. A., Kresl, R. J., and Reid, J. R., 1967, Geology and ground-water resources of Wells County, North Dakota - Part 1, Geology: North Dakota Geol. Survey Bull. 51, pp. 3-37.
- Brinck, J. W., 1974: The geochemical distribution of uranium as a primary criterion for the formation of ore deposits. in Formation of Ore Deposits. IAEA, Vienna, 1974.
- Kelley, T. E., and Block, D. A., 1967, Geology and ground-water resources of Barnes County, North Dakota - Part 1, Geology: North Dakota Geol. Survey Bull. 43, pp. 3-42.
- Rau, J. L., Bakker, W. E., Chmelik, James, and Williams, B. J., 1967, Geology and ground-water resources of Kidder County, North Dakota - Part 1, Geology: North Dakota Geol. Survey Bull. 36, pp. 6-70.
- Wijs, H. J. de, 1951: Statistics of ore distribution. Part I. Geologie en Mijnbouw, NWe Series, Jrg. 13, no. 11, pp. 365-375.
- Wijs, H. J. de, 1953: Statistics of ore distribution. Part II. Geologie en Mijnbouw, NWe Series, Jrg. 15, no. 1, pp. 12-24.
- Winters, H. R., 1963, Geology and ground-water resources of Stutsman County, North Dakota - Part 1, Geology: North Dakota Geol. Survey Bull. 41, pp. 9-78.

A P P E N D I X A

Geologic Legend

GEOLOGIC LEGEND

<u>Aero Symbol</u>	<u>Map Symbol</u>	<u>Description</u>
QAL	Qal	Holocene alluvium: sand, silt and gravel of present drainage
QT	Qt	Holocene fluviatile terrace deposits: sand and gravel
QSD	Qsd	Holocene sand dunes: medium brown fine-grained quartz
QOC	Qoc	Pleistocene glacial outwash and colluvium: chiefly sand and gravel
QC	Qc	Pleistocene Coleharbor Formation: glacial sediments and sediments related to glaciation, gravel, sand silt and clay with boulders and cobbles
KP	Kp	Upper Cretaceous Pierre Formation: marine shale with iron concretions
W		Water

A P P E N D I X B

List of Geologic Units by Anomaly

List of Geologic Units by Anomaly

(Uranium Anomalies)

<u>Anomaly</u>	<u>Geologic Unit</u>	<u>t-traverse tl-tie line</u>	<u>Fid.</u>	<u>Brief Description</u>
1	Qoc	t-1120	10200	weak to moderate U/K and U anomaly
2	Qc	t-1120	10485	weak and weak to moderate U/K and U anomaly
3	Qc	t-1120	10750	weak to moderate U/Th expression, and weak U/K and U anomaly, with possibly low Th response
4	Qc	t-1120	11410	weak to moderate and weak U/K and U anomaly
5	Qc	t-1120	11510	broad zone of variable weak to moderate U/K, U/Th and U anomalies, no U or U/Th response in the center of the zone, some support on the profiles particularly to the west
6	Qc	t-1120	11655	moderate to good U/K and U anomaly, with weak to moderate U/Th anomaly U/K anomaly may extend eastward
7	Qc	t-1120	11780	weak U/Th anomaly
8	Qc	t-1120	11955	weak U/K anomaly
9	Qc	t-1130	5715	weak U/K anomaly
10	Qoc	t-1130	6470	weak U/K anomaly
11	Qoc	tl-5000	16070	weak U/K and U anomaly
12	Qal	t-1150	2100	weak to moderate U/K anomaly in area of low K response
13	Qc	t-1160	21860	weak U/K anomaly
14	Qc	t-1170	17640	moderate to good U/Th anomaly, with possibly low Th response

<u>Anomaly</u>	<u>Geologic Unit</u>	<u>t-traverse tl-tie line</u>	<u>Fid.</u>	<u>Brief Description</u>
15	Qc	t-1170	18660	weak U/K and U/Th anomaly, with possibly low Th response
16	Qc	t-1170 tl-5030	19380 2255	weak to moderate U/K and weak to good U anomaly on the traverse with weak U support on the intersecting tie line
17	Qoc	tl-5000	15525	weak to moderate U/K and U, and weak U/Th anomaly
18	Qc	tl-5020	1690	weak U/Th and U/K, and weak to moderate U anomaly
19	Qc	t-1190	12490	weak to moderate U/K, and weak U anomaly
20	Qc	tl-5020	1570	weak to moderate U/Th and U anomaly
21	Qc	t-1190	14205	weak U/K and weak to moderate U anomaly
22	Qc	t-1200	9615	weak to moderate U/K anomaly
23	Qc	tl-5020	1430	weak U/K and U anomaly, weakly recognized on profile
24	Qc	t-1200	10615	weak U/K anomaly
25	Qc	t-1210	7005	weak to moderate U/K anomaly, with possible low K response. anomaly visible on profile
26	Qc	t-1210	7260	weak to moderate U/K and U anomaly
27	Qoc	t-1220	3810	moderate U/Th, and weak to moderate U anomaly
28	Qoc	t-1220	3940	weak to moderate U/Th and U anomaly
29	Qoc	t-1220	4870	weak to moderate U/Th, U/K and U anomalies, with expression on profiles

<u>Anomaly</u>	<u>Geologic Unit</u>	<u>t-traverse tl-tie line</u>	<u>Fid.</u>	<u>Brief Description</u>
30	Qc	t-1220	5135	weak to moderate U/K, and weak U anomaly
31	Qc	t-1220	5450	weak to moderate U/K anomaly
32	Qc	t-1220	5700	weak to moderate U/K and U anomalies
33	Qoc	t-1230	1065	weak to moderate U/Th anomaly
34	Qoc	t-1230	1655	weak to moderate U/Th anomaly

A P P E N D I X C

List of Anomalies by Geologic Unit

List of Anomalies by Geologic Unit

<u>Aero Symbol</u>	<u>Map Symbol</u>	<u>No. of Samples</u>	<u>No. of U. Anomalies</u>	<u>No. of Th. Anomalies</u>
QAL	Qal	1140	1	-
QT	Qt	62	-	-
QSD	Qsd	188	-	-
QOC	Qoc	6849	9	-
QC	Qc	24729	24	-
KP	Kp	151	-	-

A P P E N D I X D

Mean Radiometric Values by Geologic Unit

MEAN VALUE BY GEOLOGIC MAP UNIT

NEW ROCKFORD QUAD

LINE 1120

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
QC	0.27	1.64	13.94	0.400	1.805	4.592
QCC	0.25	1.70	13.77	0.468	1.915	4.166

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
CAL	0.27	1.51	13.17	0.380	1.865	4.857
h	0.15	0.75	10.33	0.297	1.418	4.790

LINE 1130

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
QC	0.29	1.51	15.37	0.344	1.522	4.472
QCC	0.25	1.29	13.76	0.354	1.536	4.325

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
W	0.18	0.96	9.11	0.371	1.662	4.348
CAL	0.30	1.27	14.50	0.288	1.339	4.805

LINE 1140

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
QCC	0.25	1.13	14.55	0.306	1.185	3.956
QAL	0.28	1.21	13.58	0.285	1.305	4.776
QC	0.30	1.32	15.21	0.295	1.323	4.545
KP	0.21	1.00	10.81	0.313	1.471	4.757

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
h	0.16	0.54	7.77	0.182	0.902	4.586
CT	0.33	1.43	15.47	0.289	1.413	4.912
CSE	0.17	0.99	12.69	0.402	1.188	3.019

LINE 1150

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
QCC	0.25	1.22	13.75	0.338	1.437	4.248
QAL	0.22	1.46	10.90	0.427	2.228	4.534
KP	0.28	1.40	13.30	0.336	1.641	4.895

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
CC	0.30	1.48	15.96	0.324	1.422	4.448
h	0.18	1.08	10.52	0.424	1.567	3.902

MEAN VALUE BY GEOLOGIC MAP UNIT

NEW ROCKFORD QUAD

LINE 1160

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
QOC	0.27	1.26	15.60	0.312	1.232	3.972
QC	0.31	1.41	16.13	0.313	1.370	4.456
KP	0.27	1.23	13.13	0.312	1.427	4.824

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
CAL	0.26	1.20	13.29	0.312	1.407	4.656
W	0.22	1.14	12.17	0.335	1.320	3.966

LINE 1170

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
QC	0.29	1.49	16.18	0.341	1.413	4.225
QOC	0.27	1.29	15.25	0.324	1.309	4.158
W	0.18	1.50	10.65	0.582	2.125	3.894

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
CAL	0.30	1.01	13.12	0.227	1.173	5.324
CT	0.23	1.89	16.92	0.372	1.699	4.573
KP	0.23	1.76	15.07	0.354	1.779	5.044

LINE 1180

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
QC	0.30	1.37	16.60	0.301	1.275	4.231
W	0.22	1.40	11.60	0.414	1.998	4.607
KP	0.31	0.68	13.25	0.194	1.007	5.475

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
QOC	0.26	1.28	14.77	0.340	1.333	4.059
CAL	0.25	1.07	13.73	0.249	1.218	5.032

LINE 1190

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
QC	0.31	1.53	16.23	0.325	1.454	4.538
W	0.22	1.39	10.72	0.436	2.072	4.897
QOC	0.27	1.24	14.81	0.311	1.294	4.282

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
CAL	0.28	1.19	14.26	0.283	1.284	4.635
CSC	0.24	1.16	14.27	0.332	1.255	3.847
KP	0.40	1.60	15.51	0.258	1.565	6.022

MEAN VALUE BY GEOLOGIC MAP UNIT

NEW ROCKFORD QUAD

LINE 1200

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
QC	0.31	1.28	15.65	0.276	1.276	4.676
W	0.19	0.59	9.28	0.314	1.560	4.885

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
CCC	0.26	1.27	14.57	0.322	1.314	4.153
CAL	0.25	1.17	13.38	0.339	1.385	4.277

LINE 1210

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
QC	0.31	1.43	15.53	0.316	1.422	4.599
W	0.24	1.14	11.76	0.318	1.485	4.827
KP	0.30	1.48	15.76	0.328	1.450	4.405

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
CCC	0.30	1.51	15.96	0.347	1.433	4.385
CAL	0.31	1.11	14.72	0.236	1.150	4.874

LINE 1220

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
QOC	0.26	1.48	14.75	0.358	1.611	4.056
W	0.21	1.37	11.15	0.462	2.018	4.412
KP	0.36	2.15	16.68	0.355	1.970	5.137

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
CC	0.31	1.43	15.25	0.322	1.515	4.774
CAL	0.31	1.49	15.06	0.321	1.513	4.755

LINE 1230

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
QC	0.31	1.37	15.97	0.304	1.342	4.536
QOC	0.23	1.15	15.22	0.342	1.200	3.550
W	0.20	1.28	11.17	0.457	1.805	4.111

UNIT	E THOR	E URN	PCT PCT	U/TH	U/K	TH/K
CSC	0.17	1.16	15.07	0.468	1.254	2.617
CAL	0.31	1.24	15.43	0.265	1.262	4.779
CT	0.37	1.26	17.03	0.219	1.137	5.134

MEAN VALUE BY GEOLOGIC MAP UNIT

NEW ROCKFORD QUAD

LINE 5000

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K	UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
W	0.23	1.51	15.31	0.453	1.558	3.500	CSC	0.21	1.71	14.47	0.557	1.813	3.369
QCC	0.28	1.43	16.90	0.344	1.304	3.913	CC	0.35	1.68	17.85	0.321	1.447	4.614
QAL	0.31	1.52	15.52	0.326	1.554	4.657							

LINE 5010

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K	UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
QC	0.30	1.38	15.51	0.316	1.384	4.458	CCC	0.29	1.30	15.58	0.307	1.306	4.298
W	0.23	1.11	10.71	0.323	1.587	5.072	CAL	0.21	1.11	11.23	0.356	1.493	4.484
QT	0.35	1.25	16.40	0.245	1.202	4.958							

LINE 5020

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K	UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
QC	0.31	1.66	16.27	0.362	1.573	4.407	CAL	0.24	1.40	12.03	0.387	1.807	4.785
W	0.12	0.88	5.88	0.426	2.488	5.138	CCC	0.25	1.30	15.73	0.351	1.267	3.695

LINE 5030

UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K	UNIT	E THCR	E URN	PCT PCT	U/TH	U/K	TH/K
QC	0.33	1.69	16.31	0.348	1.604	4.689	CAL	0.29	1.66	14.41	0.388	1.836	4.796
W	0.25	1.39	14.24	0.358	1.568	4.109	CCC	0.26	1.28	15.07	0.352	1.414	4.113
KP	0.32	1.75	15.10	0.379	1.797	5.015							

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A P P E N D I X E

Standard Deviation Table

NEW ROCKFORD

QUAD

FORMATION QAL

DATA	SAMPLES	MEAN		-3	-2	-1	+1	+2	+3
E THORIUM	1140	3.93	NORMAL	1.12	2.06	2.99	4.87	5.80	6.74
E URANIUM	1116	1.23	NORMAL	-0.24	0.25	0.74	1.72	2.21	2.70
POTASSIUM	1140	0.86	NORMAL	0.28	0.48	0.67	1.05	1.24	1.44
EU/K	1116	1.44	NORMAL	-0.45	0.18	0.81	2.06	2.69	3.32
EU/ETH	1111	0.31	NORMAL	-0.10	0.04	0.17	0.45	0.59	0.73
ETH/K	1116	4.42	NORMAL	1.89	2.74	3.58	5.26	6.10	6.94

FORMATION QT

DATA	SAMPLES	MEAN		-3	-2	-1	+1	+2	+3
E THORIUM	62	4.88	NORMAL	3.06	3.67	4.28	5.49	6.10	6.70
E URANIUM	62	1.33	NORMAL	-0.34	0.21	0.77	1.89	2.45	3.01
POTASSIUM	62	1.02	NORMAL	0.82	0.89	0.96	1.09	1.16	1.23
EU/K	62	1.23	NORMAL	-0.47	0.10	0.66	1.80	2.37	2.94
EU/ETH	62	0.26	NORMAL	-0.11	0.01	0.14	0.39	0.51	0.63
ETH/K	62	4.55	NORMAL	2.86	3.42	3.99	5.12	5.68	6.24

FORMATION QSD

DATA	SAMPLES	MEAN		-3	-2	-1	+1	+2	+3
E THORIUM	188	2.93	NORMAL	0.91	1.58	2.26	3.60	4.27	4.94
E URANIUM	188	1.21	NORMAL	-0.15	0.30	0.75	1.66	2.11	2.56
POTASSIUM	188	0.90	NORMAL	0.59	0.69	0.80	1.01	1.11	1.22
EU/K	188	1.29	NORMAL	-0.27	0.25	0.77	1.81	2.33	2.85
EU/ETH	188	0.41	NORMAL	-0.07	0.09	0.25	0.56	0.72	0.88
ETH/K	188	3.09	NORMAL	0.82	1.58	2.34	3.85	4.61	5.37

FORMATION QCC

DATA	SAMPLES	MEAN		-3	-2	-1	+1	+2	+3
E THORIUM	6844	3.65	NORMAL	0.84	1.78	2.71	4.58	5.52	6.45
E URANIUM	6711	1.21	NORMAL	-0.18	0.28	0.75	1.68	2.14	2.60
POTASSIUM	6844	0.95	NORMAL	0.50	0.65	0.80	1.10	1.25	1.40
EU/K	6710	1.26	NORMAL	-0.27	0.24	0.75	1.76	2.27	2.78
EU/ETH	6634	0.33	NORMAL	-0.06	0.07	0.20	0.46	0.59	0.72
ETH/K	6710	3.66	NORMAL	1.20	2.02	2.84	4.49	5.31	6.13

NEW ROCKFORD

QUAD

FORMATION

QC

DATA	SAMPLES	MEAN		-3	-2	-1	+1	+2	+3
E THORIUM	24710	4.40	NORMAL	2.06	2.84	3.62	5.18	5.96	6.74
E URANIUM	24482	1.35	NORMAL	-0.02	0.45	0.92	1.86	2.33	2.80
POTASSIUM	24713	1.01	NORMAL	0.63	0.76	0.88	1.14	1.27	1.40
EU/K	24470	1.33	NORMAL	-0.14	0.35	0.84	1.82	2.31	2.80
EU/ETH	24465	0.31	NORMAL	-0.03	0.08	0.20	0.43	0.54	0.65
ETH/K	24470	4.13	NORMAL	1.98	2.69	3.41	4.85	5.57	6.28

FORMATION

KP

DATA	SAMPLES	MEAN		-3	-2	-1	+1	+2	+3
E THORIUM	151	4.16	NORMAL	1.80	2.59	3.37	4.95	5.73	6.52
E URANIUM	151	1.23	NORMAL	-0.09	0.35	0.79	1.67	2.11	2.55
POTASSIUM	151	0.86	NORMAL	0.48	0.61	0.73	0.99	1.11	1.24
EU/K	151	1.36	NORMAL	0.08	0.51	0.94	1.79	2.22	2.64
EU/ETH	151	0.25	NORMAL	-0.05	0.07	0.18	0.40	0.51	0.63
ETH/K	151	4.66	NORMAL	1.65	2.65	3.66	5.66	6.67	7.67

FORMATION

W

DATA	SAMPLES	MEAN		-3	-2	-1	+1	+2	+3
E THORIUM	549	1.64	NORMAL	-1.23	-0.28	0.68	2.60	3.55	4.51
E URANIUM	469	0.69	NORMAL	-0.50	-0.10	0.30	1.09	1.49	1.89
POTASSIUM	569	0.35	NORMAL	-0.40	-0.15	0.10	0.60	0.85	1.10
EU/K	369	1.22	LOGNORMAL	0.20	0.36	0.66	2.23	4.08	7.46
EU/ETH	305	0.37	NORMAL	-0.23	-0.03	0.17	0.57	0.77	0.97
ETH/K	362	4.62	NORMAL	0.60	1.94	3.28	5.96	7.29	8.63

A P P E N D I X F

Format, Single Record Data Listing

REC NO.	LAT	LONG	RESID MAG	TERR CL	FLG	GEOL UNIT	CUSH CPS	AIM U CPS	TOTAL COUNT CPS	FLG	ETH PPM	ILG	EU PPM	FLG	K PCT	FLG	LU/ETH	EU/K	ETH/K	TEMP CELCIUS	BAKU PRES MMHG
5079	64.0086	-160.9199	55305	763	MAR	W	31	1	-12	NAU	-1.1	NAU	-0.5	NAU	0.0	NAU	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	NAU	0.1	NAU	0.1	NAU	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	NAU	0.1	NAU	-0.1	NAU	0.0	0.0	0.0	12.7	747.4
5082	64.0088	-160.9160	55305	730	MAR	W	35	1	-60	NAU	0.0	NAU	0.3	NAU	-0.1	NAU	0.0	0.0	0.0	12.7	747.7
5083	64.0088	-160.9154	55305	722	MAR	W	26	1	-4	NAU	-2.7	NAU	2.3		-0.4	NAU	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	NAU	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	NAU	0.4	NAU	-0.3	NAU	0.0	0.0	0.0	12.7	748.5
5086	64.0090	-160.9121	55305	691		W	22	1	50		0.3	NAU	-0.1	NAU	0.0	NAU	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	NAU	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	NAU	0.0	0.0	0.0	12.8	749.3
5089	64.0092	-160.9087	55305	668		W	20	1	156		-1.6	NAU	0.7	MAR	-0.0	NAU	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	NAU	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	NAU	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	NAU	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	NAU	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	NAU	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	NAU	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	NAU	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	NAU	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	NAU	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	NAU	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	NAU	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	NAU	1.1		0.0	NAU	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	NAU	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	5.9	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	745.1
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	NAU	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	NAU	1.4	0.0	0.0	12.9	747.3
5130	64.0113	-160.8620	55303	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 FINDS 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. TD TOTAL FIELD GAMMA	GLBL UNIT	COSM CPS	ATM. TRAN CPS	TOTAL COUNT CPS	ETH PPM	STD FLG	STD DEV	ETH FLG	STD DEV	POT FLG	STD DEV	FU ETH RATIO	STD DEV	FU POTA RATIO	STD DEV	ETH POTA RATIO	STD DEV
5238	64.0098	-160.7455	55235	M	33	-6	990	3.7	1	1.9	2	0.7	1	0.5	0	2.8	0	5.2	0	
5239	64.0098	-160.7444	55233	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	55283	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	M	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	55282	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	55282	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		
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 THIS QUADRANGLE
12			
13	5	I1	AERIAL SYSTEM IDENTIFICATION CODE FOR FIRST SYSTEM
14	6	A20	AIRCRAFT IDENTIFICATION BY TYPE AND FAA NUMBER FOR FIRST SYSTEM
15			
16	7	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO TERRESTRIAL POTASSIUM (K-40) TO ONE DECIMAL PLACE
17			IN CPS PER PERCENT K FOR FIRST SYSTEM
18			
19	8	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO TERRESTRIAL URANIUM (BI-214) TO ONE DECIMAL PLACE
20			IN CPS PER PPM EQUIVALENT U
21			
22	9	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO TERRESTRIAL THORIUM (TL-208) TO ONE DECIMAL PLACE
23			IN CPS PER PPM EQUIVALENT TH
24			
25	10	I6	BLANK FIELD (999999)
26	11	F6.3	4PI-SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL PLACES IN SECONDS FOR FIRST SYSTEM
27			
28	12	F6.3	2PI-SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL PLACES IN SECONDS FOR FIRST SYSTEM
29			
30	13	I3	NUMBER OF CHANNELS (0-3 MEV) IN 4 PI SYSTEM FOR FIRST AERIAL SYSTEM
31			
32	14	I3	NUMBER OF CHANNELS (0-3 MEV) IN 2 PI SYSTEM FOR FIRST AERIAL SYSTEM
33			
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 COLLECTED
43			
44	99-101	I4,6, &3	REPEAT OF ITEMS 96-98 FOR SECOND FLIGHT LINE ON THIS TAPE
45			
46	*	*	*
47	*	*	*
48			
49	390-392	I4,6, &3	REPEAT OF ITEMS 96-98 FOR 99TH FLIGHT LINE ON THIS TAPE
50			
51			

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 TO ONE DECIMAL PLACE IN GAMMAS									
63												
64	9	A8	SURFACE GEOLOGIC MAP UNIT CODE									
65	10	I4	QUALITY FLAG CODES									
66	11	F6.1	APPARENT CONCENTRATION OF TERRESTRIAL POTASSIUM (K-40) TO ONE DECIMAL PLACE IN PERCENT K									
67												
68	12	F4.1	UNCERTAINTY IN TERRESTRIAL POTASSIUM TO ONE DECIMAL PLACE IN PERCENT K									
69												
70	13	F6.1	APPARENT CONCENTRATION OF TERRESTRIAL URANIUM (BI-214) TO ONE DECIMAL PLACE IN PPM EQUIVALENT U									
71												
72	14	F4.1	UNCERTAINTY IN TERRESTRIAL URANIUM TO ONE DECIMAL PLACE IN PPM EQUIVALENT U									
73												
74	15	F6.1	APPARENT CONCENTRATION OF TERRESTRIAL THORIUM (TL-208) TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH									
75												
76	16	F4.1	UNCERTAINTY IN TERRESTRIAL THORIUM TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH									
77												
78	17	F6.1	URANIUM-TO-THORIUM RATIO TO ONE DECIMAL PLACE IN PPM EQUIVALENT U PER PPM EQUIVALENT TH									
79												
80	18	F6.1	URANIUM-TO-POTASSIUM RATIO TO ONE DECIMAL PLACE IN PPM EQUIVALENT U PER PERCENT K									
81												
82	19	F6.1	THORIUM-TO-POTASSIUM RATIO TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH PER PERCENT K									
83												
84	20	F8.1	GROSS GAMMA (0.4-3.0 MEV) COUNT RATE TO ONE DECIMAL PLACE IN COUNTS PER SECOND									
85												
86	21	F6.1	UNCERTAINTY IN GROSS GAMMA COUNT RATE TO ONE DECIMAL PLACE IN COUNTS PER SECOND									
87												
88	22	F5.1	ATMOSPHERIC BI-214 4PI CORRECTION TO ONE DECIMAL PLACE IN PPM EQUIVALENT U									
89												
90	23	F4.1	UNCERTAINTY IN ATMOSPHERIC BI-214 4PI CORRECTION TO ONE DECIMAL PLACE IN PPM EQUIVALENT U									
91												
92	24	F4.1	OUTSIDE AIR TEMPERATURE TO ONE DECIMAL PLACE IN DEGREES CELSIUS									
93												
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

```

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
  
```

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
52	14		I4	SUMMED RAW OUTPUT FROM COSMIC CHANNELS (3-6 MEV) IN																		
53				COUNTS																		
54	15		I4	RAW OUTPUT FROM CHANNEL 1 IN COUNTS																		
55	16		I4	RAW OUTPUT FROM CHANNEL 2 IN COUNTS																		
56	*		*	*																		
57	*		*	*																		
58	*		*	*																		
59	270		I4	RAW OUTPUT FROM CHANNEL 256 IN COUNTS																		

A P P E N D I X J

Format, DOE STATISTICAL ANALYSIS DATA TAPE

DOE STATISTICAL ANALYSIS DATA TAPE

Line	Character Number			
Number	12345678901	2345678901	2345678901	23456789012345678901234567890123456789012
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 THIS QUADRANGLE	
12				
13	5	I1	AERIAL SYSTEM IDENTIFICATION CODE FOR FIRST SYSTEM	
14	6	A20	AIRCRAFT IDENTIFICATION BY TYPE AND FAA NUMBER FOR FIRST SYSTEM	
15				
16	7	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO TERRESTRIAL POTASSIUM (K-40) TO ONE DECIMAL PLACE IN CPS PER PERCENT K	
17				
18				
19	8	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO TERRESTRIAL URANIUM (B1-214) TO ONE DECIMAL PLACE IN CPS PER PPM EQUIVALENT U	
20				
21				
22	9	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO TERRESTRIAL THORIUM (TL-208) TO ONE DECIMAL PLACE IN CPS PER PPM EQUIVALENT TH	
23				
24				
25	10	I6	BLANK FIELD (999999)	
26	11	F6.3	4PI-SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL PLACES IN SECONDS FOR FIRST SYSTEM	
27				
28	12	F6.3	2PI-SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL PLACES IN SECONDS FOR FIRST SYSTEM	
29				
30	13	I3	NUMBER OF CHANNELS (0-3 MEV) IN 4 PI SYSTEM FOR FIRST AERIAL SYSTEM	
31				
32	14	I3	NUMBER OF CHANNELS (0-30 MEV) IN 2 PI SYSTEM FOR FIRST AERIAL SYSTEM	
33				
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 COLLECTED	
43				
44	99-101	I4,6 &3	REPEAT OF ITEMS 96-98 FOR SECOND FLIGHT LINE ONE THIS TAPE	
45				
46	*	*	*	
47	*	*	*	
48	*	*	*	
49	390-392	I4,6 &3	REPEAT OF ITEMS 96-98 FOR 99TH FLIGHT LINE ON THIS TAPE	
50				
51				

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	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0

52   FORMAT FOR STATISTICAL ANALYSIS DATA RECORD   (THIRD THRU LAST BLOCK)

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

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 14 APPROXIMATE DATE OF SURVEY (MONTH, YEAR)

11 4 16 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 12345678901234567890123456789012345678901234567890123456789012

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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>
08/19/80	36	5.5%	9.5%	360' 2940 7	400' 2900 8
10/01/80	59	5.0%	9.6%	400' 2220 6	400' 2100 6
10/03/80	60	4.8%	9.6%	400' 2220 N/A	400' 2100 N/A

N/A = NOT AVAILABLE

A P P E N D I X N

Renumbered to Original Fiducial Correlations

NEW ROCKFORD QUADRANGLE

LINE 1120 FLOWN AS LINE 1120
MAP FIDUCIALS 9947 TO 11990 CORRESPOND TO ORIGINAL FIDUCIALS 11990 TO 9947

LINE 1130 FLOWN AS LINE 1130
MAP FIDUCIALS 5044 TO 7338 CORRESPOND TO ORIGINAL FIDUCIALS 7338 TO 5044

LINE 1140 FLOWN AS LINE 1140
MAP FIDUCIALS 2648 TO 4831 CORRESPOND TO ORIGINAL FIDUCIALS 4831 TO 2648

LINE 1150 FLOWN AS LINE 1150
MAP FIDUCIALS 35 TO 2286 CORRESPOND TO ORIGINAL FIDUCIALS 2286 TO 35

LINE 1160 FLOWN AS LINE 1160
MAP FIDUCIALS 19959 TO 22124 CORRESPOND TO ORIGINAL FIDUCIALS 22124 TO 19959

LINE 1170 FLOWN AS LINE 1170
MAP FIDUCIALS 17312 TO 19663 CORRESPOND TO ORIGINAL FIDUCIALS 19663 TO 17312

LINE 1180 FLOWN AS LINE 1180
MAP FIDUCIALS 14941 TO 17081 CORRESPOND TO ORIGINAL FIDUCIALS 17081 TO 14941

LINE 1190 FLOWN AS LINE 1190
MAP FIDUCIALS 12256 TO 14673 CORRESPOND TO ORIGINAL FIDUCIALS 14673 TO 12256

LINE 1200 FLOWN AS LINE 1200
MAP FIDUCIALS 8725 TO 11897 CORRESPOND TO ORIGINAL FIDUCIALS 11897 TO 8725

LINE 1210 FLOWN AS LINE 1210
MAP FIDUCIALS 5999 TO 8445 CORRESPOND TO ORIGINAL FIDUCIALS 8445 TO 5999

LINE 1220 FLOWN AS LINE 1220
MAP FIDUCIALS 3616 TO 5787 CORRESPOND TO ORIGINAL FIDUCIALS 5787 TO 3616

LINE 1230 FLOWN AS LINE 1230
MAP FIDUCIALS 852 TO 3361 CORRESPOND TO ORIGINAL FIDUCIALS 3361 TO 852

LINE 5000 FLOWN AS LINE 5000
MAP FIDUCIALS 14665 TO 16346 CORRESPOND TO ORIGINAL FIDUCIALS 16346 TO 14665

LINE 5010 FLOWN AS LINE 5011
MAP FIDUCIALS 9232 TO 10793 CORRESPOND TO ORIGINAL FIDUCIALS 10793 TO 9232

LINE 5020 FLOWN AS LINE 5021
MAP FIDUCIALS 861 TO 2671 CORRESPOND TO ORIGINAL FIDUCIALS 2671 TO 861

LINE 5030 FLOWN AS LINE 5030
MAP FIDUCIALS 1358 TO 2955 CORRESPOND TO ORIGINAL FIDUCIALS 2955 TO 1358