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National Uranium Resource Evaluation

AERIAL GAMMA RAY AND MAGNETIC SURVEY
FORT SMITH QUADRANGLE
OKLAHOMA AND ARKANSAS

FINAL REPORT

EG&G GEOMETRICS
Sunnyvale, California 94086

September 1980

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

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AERIAL GAMMA RAY AND MAGNETIC SURVEY
MISSISSIPPI AND FLORIDA AIRBORNE SURVEY
FORT SMITH QUADRANGLE
OKLAHOMA AND ARKANSAS

FINAL REPORT

Prepared by
EG&G geoMetrics
Sunnyvale, California

September, 1980

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Assistant Secretary for Resource Applications
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ABSTRACT

The Fort Smith quadrangle in western Arkansas and eastern Oklahoma overlies thick Paleozoic sediments of the Arkoma Basin. These Paleozoics dominate surface exposure except where covered by Quaternary Alluvial materials.

Examination of available literature shows no known uranium deposits (or occurrences) within the quadrangle.

Seventy-five (75) groups of uranium samples were defined as anomalies and discussed briefly in this report. None were considered significant, and most appeared to be of cultural origin.

Magnetic data show character that suggest structural and/or lithologic complexity, but imply relatively deep-seated sources.

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INTRODUCTION

General

The Fort Smith quadrangle comprises a 7,550 square mile region in eastern Oklahoma and western Arkansas (see Figure 1).

The geologic base map used was compiled by Martel Laboratories in 1980. Geologic map unit descriptions, found in Appendix C, were taken directly from the accompanying map legend. Supplementary geologic information was taken from Fairbridge (ed.) 1975, and Cohee and others (1962). Cultural and physiographic information was taken from the 1:250,000 scale Fort Smith topographic map (1978 version).

Radiometric and magnetic data for the Fort Smith quadrangle were acquired in July and processed in August of 1980. A detailed summary of data acquisition, processing, interpretation, and presentation methods is contained in Appendix A. Appendix B contains a flight summary for the Fort Smith quadrangle.

Physiography

The region covered by the Fort Smith quadrangle contains portions of the Ozark Plateau and the Ouachita Mountains of the southern Midwestern Physiographic Province. The area is drained by the Arkansas River, which flows southeasterly through the center of the quadrangle. The largest tributary to the Arkansas River is the Canadian River, which flows in an easterly direction, and joins the Arkansas near the center of the quadrangle. The western portion of the quadrangle contains flat-lying to gently rolling topography. Steepest slopes are found in the mountainous areas to the south and east. A relatively narrow flood plain lies adjacent to the Arkansas River in the east.

Elevations range from less than 400 feet at the easternmost base level of the Arkansas River, to over 2,000 feet atop Cavanal Mountain near the central southern border and several other areas in the northeastern uplands.

The area is moderately developed culturally. The largest towns in the area are Fort Smith (population 63,000) and Muskogee (population 37,000). Most places can be accessed by either road or railroad. Interstate 40 connects several towns and cities in the southern half of the quadrangle. Large reservoirs have been established on the Arkansas and Canadian Rivers.

GEOLOGY

Structure

The area covered by the Fort Smith quadrangle lies in the central

portion of the Arkoma Basin, which contains Paleozoic sediments that increase in thickness from approximately 500 feet along the northern border, to over 10,000 feet in the southeast. More southerly regions of the basin, bordering the Ouachita Tectonic Zone, are so deformed that sediment thicknesses are difficult to estimate (see Figure 2).

Faults of undefined displacement and thrust faults strike easterly and northeasterly through the uplifted portions of the quadrangle. Though displacement in the Paleozoic section appears severe as mapped, overlying Quaternary sediments show no displacement.

Surface Geology

As mapped by Martel Laboratories, the surficial geology of the Fort Smith quadrangle is dominated by Paleozoic carbonates and sandstones. The northeastern quadrant contains substantial exposures of Ordovician through Mississippian limestones, sandstones, and shales. Southern and western areas are largely covered with Pennsylvanian sediments of a wide variety of lithologies. Altogether the Paleozoic section covers approximately 95 percent of the quadrangle.

Quaternary sediments, consisting of Recent alluvium and Pleistocene terrace deposits, are mapped along side the major rivers of the area. The Quaternary section accounts for the remaining 5 percent of the quadrangle as mapped.

Uranium

According to available sources, there are no known uranium deposits in the Fort Smith quadrangle. Outcrops of the Chattanooga Shale, which has been the subject of several studies as a host of uraniferous minerals, are known to occur within the Fort Smith quadrangle.

INTERPRETATION OF GEOPHYSICAL DATA

Radiometric Data

A total of 75 groups of uranium (Bi214) samples meet the minimum statistical requirements, set forth in the data interpretation section of Appendix A, used to define anomalies. These are displayed, along with all other anomalous samples and pertinent data, on Figure 3. The anomalies are summarized in a table in Appendix G. The potassium, uranium, thorium, and ratio pseudo-contour maps, which reflect radiometric responses for the entire quadrangle, are found in Appendix H. Discussion of the abundances of potassium, uranium, and thorium are in terms of apparent equivalent percent and apparent equivalent ppm. These equivalent units are derived from scaling of counts per second data by the sensitivities calculated for the detection system. They do not directly correspond to real geochemical data.

The apparent concentrations of the three radioactive isotopes are uniformly low over most of the Fort Smith quadrangle. The average uranium concentration is 2.2 ppmeU. The average potassium and thorium concentrations are 0.6 percent and 6.7 ppmeT respectively. Areas with uranium concentrations in excess of 3.0 ppmeU (2 or more standard deviations above the mean) are few and are extremely small. Areas of highest uranium concentration occur within, or near, culturally developed areas. Uniformly high concentrations of thorium occur over map units IPBY (Pennsylvanian Boggy Formation) and IPSN (Pennsylvanian Senora Formation). Highest average thorium values occur in map unit IPHD (Pennsylvanian Holdenville Shale) at 7.9 ppmeT, but several of the Paleozoic units have average thorium values in excess of 7.0 ppmeT. The highest average potassium concentrations (1.0 percent) are found in map unit QAL (Recent alluvium) of the Arkansas River. Highest peak concentrations of potassium are found in map unit IPMA (Pennsylvanian McAlester Formation) at 2.0 percent, which also contains the highest peak concentrations of thorium at 13.3 ppmeT. Map unit QAL is strongly bimodal in terms of potassium. It is apparent from examination of the pseudo-contour maps that this is a reflection of the difference in lithology of the alluvial deposits of the Arkansas and Canadian Rivers, and suggests that the deposits have different source regions.

Anomalies are scattered throughout the quadrangle, and have peak uranium concentrations ranging from 2.8 to 4.3 ppmeU. All are associated with cultural features of some sort (roads, railroads, pipelines, etc.). None appear to have any geologic significance. The strong correlation of the anomalies with cultural activity, coupled with the extremely low uranium concentration levels, suggest that none of the anomalies depicted in this report should be considered as reflecting significant uranium concentrations in bedrock units.

Magnetic Data

The magnetic field pseudo-contour map appears in Appendix H. The Fort Smith quadrangle contains a relatively thick Paleozoic sequence that has in some areas, been subjected to extreme deformation and fault displacement.

Magnetic data are dominated by extremely low gradients, but the wavelengths are relatively short. In some areas isolated bodies as well as some east-west linear features are suggested, any of which could be lithologic and/or structural in origin. It is possible that the mapped surface faults displace portions of the apparent magnetic basement. In general sources appear to be deeply seated.

URANIUM ANOMALY/ INTERPRETATION MAP

FORT SMITH QUADRANGLE
U.S. DEPARTMENT OF ENERGY

APPROXIMATE SCALE 1:500,000

EXPLANATION

- - CITY OR TOWN
- - URANIUM SAMPLE MEETING FOLLOWING CRITERIA:
 - (1) $1.0 \leq U \leq 100$
 - (2) $-1.0 \leq T \leq 100$
 - (3) $1.0 \leq U/T \leq 100$
- IN STANDARD DEVIATION UNITS.
EACH SQUARE REPRESENTS 1 STANDARD DEVIATION.
- - URANIUM ANOMALY:
A SINGLE SAMPLE OF 3 OR MORE STANDARD DEVIATIONS OR GROUP OF ADJOINING SAMPLES WHICH TOGETHER TOTAL 4 OR MORE STANDARD DEVIATIONS, $4.0 \leq \text{sum} \leq 100$, WITH AT LEAST ONE SAMPLE OF 2 OR MORE STANDARD DEVIATIONS.

SURVEY AND
COMPILED BY:

EG&G GEOMETRICS

Figure 3 - Uranium Anomaly/Interpretation Map - Fort Smith Quadrangle

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**APPENDIX A - Data Acquisition, Processing, and
Interpretation Methods**

INTRODUCTION

General

Under the U.S. Department of Energy's (DoE), National Uranium Resource Evaluation (NURE) Program, geoMetrics, Inc., conducted a high sensitivity airborne radiometric and magnetic survey. The data collection and processing were conducted under requirements set forth in Bendix Field Engineering Corporation specification 1200-C, dated February, 1979. The objectives of the (DoE)/NURE program, of which this project is a small part, may be summarized as follows:

"To develop 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." (DoE)

As an integral part of the DoE/NURE Program, the National Airborne Radiometric Program is designed to provide cost effective, semiquantitative reconnaissance radio element distribution information to aid in the assessment of regional distribution of uraniferous materials within the United States.

All Airborne data collected by geoMetrics during the course of this project were done so utilizing a Beechcraft B65 Queen Air Airplane (U.S. Registry No. N827Q). The Queen Air used 3584 cubic inches of NaI crystal and a high sensitivity proton magnetometer (0.25 gamma).

Each report contains a detailed geologic summary, interpretation report, reduced scale copies of all maps and profiles, histograms, and statistical tables for each quadrangle contained within the project. In addition, each report contains an appendix detailing the survey description, specifications, data collection and processing methods, and interpretation methods.

All data processing, statistical analyses, and interpretation were performed at the geoMetrics computer facility, Sunnyvale, California. After processing, the corrected data were statistically evaluated to define those areas which were radiometrically anomalous relative to other areas within each computer map unit. Standard deviation maps and radiometric and magnetic profile data were first evaluated individually and then integrated into a final interpretation map for each NTMS quadrangle.

Corrected profiles of all radiometric variables (total count, potassium, uranium, thorium, uranium/thorium, uranium/potassium, and thorium

potassium, ratios), magnetic data, radar altimeter data, barometric altimeter data, air temperature, and airborne bismuth contributions are presented as profiles in this report. Single record and averaged data are presented on microfiche in report. These data are given at 1.0 second sample intervals, corrected for Compton Scatter, referenced to 400 foot mean terrain clearance as Standard Temperature and Pressure and corrected for atmospheric bismuth. Digital magnetic tapes are available containing raw spectral data, single record data, magnetic data, and statistical analysis results.

OPERATIONS

PRODUCTION SUMMARY

For the forty three quadrangles a total of 63,748 line miles, excluding reflights and overlaps and missing data, were flown by the Queen Air. The production summary presented below and the detailed daily production in Appendix B describes a portion of the total project.

Prior to the start of the survey operations, the airplane was calibrated at the DoE test pads and Dynamic Test Range in April, 1980. Requirements for system calibrations are listed in the 1250-A specifications from BFEC.

Throughout the course of the overall project, the average ground speed maintained by the Queen Air was 140 mph.

Nearly 100% of the data collected were within the specification limits of 200-700 feet. Several deviations over short distances were required to meet military regulations, FAA safety requirements, and to ensure that livestock were not endangered due to low flying aircraft. A sample altitude statistical distribution is shown in Figure I.

DATA COLLECTION PROCEDURES

Operating Parameters/Sampling Procedures

This survey was conducted using data collection parameters summarized below:

1. Data sampling was performed by a time-base system using 1.0 second sample intervals. All sensor data with analog output were digitally sampled at each scan based upon the clock timing rate of 1.0 seconds. The data so collected are the instantaneous values of the altimeter, temperature, pressure, and magnetometer parameters determined at the time of the data scan, but represent a count time of 1.0 seconds for the gamma ray spectrometer data.
2. The airplane's objective ground speed was 140 mph and was not exceeded unless dictated by safety.
3. The airplane's downward looking crystal volume was 3,072 cubic inches providing an objective V/V (crystal volume in cubic inches divided by ground speed in miles per hour) of 22.0 at 140 m.p.h.
4. The upward looking crystal volume was 512 cubic inches.

NUMBER OF OCCURRENCES

Navigation/Flight Path Recovery

For all of the quadrangles, profiles were flown east-west at 6 mile (9.6 km) spacing. North-south tie lines were flown at 18 mile (28.8 km) spacing.

Navigation was accomplished using visual navigation techniques. Flight lines were drawn on 1:250,000 quadrangles and the pilot/navigator utilized these maps to provide visual navigation features.

Simultaneously, a 35 mm tracking camera was used to record actual flight position. This camera's fiducial numbering system was directly synchronized to the digital recording system such that a one-to-one correlation between position and data could be made. Upon completion of a data collection flight, the 35 mm film was processed and actual flight path positions located on the appropriate scale map sheets.

Infield System Calibration

Due to the complex nature of both the system and the required data interpretation, much emphasis was placed on infield calibration of the data collection system. The objective of this calibration was to ensure continuous high quality of the data collected. The daily calibration procedures used are summarized below:

A. Pre Flight

1. Use cesium sources (same positioning on crystals every day), peak each Photomultiplier tube/crystal using the digital split-window detector of the GR-800. Then using thallium sources, repeat the tuning of the individual crystals.
2. Run full cesium spectrum on analog recorder for both down and up looking crystals. Calculate the cesium resolution (see sample in Figure II). Run spectrum out past the K40 peak on down crystals for evaluation of system tuning.
3. Finally run a full thorium analog spectrum of the down crystals and check for centering of K40 and Tl208 peaks in spectrum.
4. Repeat 1-3 until system is within contract specifications.

B. During Flight

1. Fly test line at survey altitude (400 ft), for approximately five miles, prior to production data collection (record both analog and digital).
2. Prior to production data collection, the above data are evaluated to ensure +20% limits on total count compared to average of all test flights from that base of operations.

DATA COLLECTION SYSTEM

3. During production data collection, monitor radon analog data for unusual increases. Visually correlate these with temperature and barometric pressure.
4. Upon completion of production data collection, reflow test line at survey altitude (400 ft). Record both analog and digital.

C. Post Flight

1. Verify test line total count within 20% of average for all test lines at that base of operations.
2. Using cesium sources (same position as pre-flight), run full cesium spectrum for both down and up crystals (allow it to record through the K40 peak in the down crystals). Repeat the procedure using thallium sources and examine the Tl208 window.
3. Calculate the resolution of down and up crystal pack.
4. Determine shift, if any, in Tl208 peak position.

Field Digital Data Verification

At the completion of each flight, the raw digital data tapes were checked for data quality and completeness on geoMetrics' G-725. The G-725 system is a totally portable mini computer (and peripherals) consisting of; an Interdata 516, two 9 track tape drives, a CRT, a line printer, and two floppy discs. Any digital problems encountered were immediately evaluated by the electronics operator and data man, thus assuring optimum data quality. In addition, histogram information for each measured variable was generated. Thus a summary display of altitude, etc., is available for immediate evaluation.

AIRCRAFT

The aircraft used for this survey was a Beechcraft Queen Air Model 65, U.S. Registry Number N827Q. This aircraft, being a medium twin engine aircraft, possesses overall performance and safety features which makes it ideal for low level, fixed-winged airborne geophysical survey work within areas of up to moderately rough topographic relief. It can carry the adequate payload at the necessary lower constant airspeeds and still maintain a wide envelope of safety, all while operating economically. Performance data for the Queen Air Model 65 in its present survey configuration are give below:

Maximum Aircraft Gross Weight	7,700 lbs.
Aircraft Empty (dry)	4,640 lbs.
Max. useful load including fuel	<u>3,060 lbs.</u>
Geophysical Package	1,110 lbs.
Navigation Eqpt. & Extra Avionics	125 lbs.
Main Fuel Tanks	528 lbs.
Aux. Fuel Tanks	864 lbs.
Pilot	175 lbs.
Electronics Operator	<u>175 lbs.</u>
Total	2,977 lbs.

Minimum Control Speed	95 MPH	*IAS at	Gross Weight
Safe Single Engine Speed	105 MPH	IAS at	Gross Weight
Rate of climb both engines	1,300	*FPM at	Gross Weight
Rate of climb single engine	210	FPM at	Gross Weight

*IAS = Indicated Air Speed

*FPM = Feet Per Minute

Avgas consumption = 36 U.S. gallons [216 lbs] per hour [at 75% power]
Endurance at 36 gallons [216 lbs.] per hour 75% power = 6 hrs. 6 mins.
Range of cruise at 75% power with 45 min. reserve = 1,200 miles

Cruise configuration stalling speed at Gross Weight [7700 lbs] at 0°
Bank = 80 MPH IAS at 45° Bank = 95 MPH IAS

Electronics

The major components of the airborne data collection system are summarized below (shown schematically in Figure III):

1. Gamma Ray Spectrometer, geoMetrics GR-800, utilizing a dual 256 channel capability to provide spectral data in the 0.4 to 3.0 MeV range for both the downward looking and the upward looking crystal packages and coverage in the 3.0 to 6.0 MeV range for cosmic background.
2. Crystal Detector, geoMetrics Model DET-3072/512R consisting of 3072 cubic inches in the downward looking configuration and 512 cubic inches appropriately shielded in an upward looking configuration.
3. A geoMetrics Digital Data Acquisition System, Model G-714 with "read-after-write" data verification, recording the following on magnetic tape:
 - a. 512 channels of gamma ray spectrometer data
 - b. Total magnetic intensity
 - c. Fiducial number from data system/camera
 - d. Manually inserted information, i.e. date, survey area, and flight line number
 - e. Altitude from radar altimeter and barometric altimeter (by analog-to-digital conversion)
 - f. Time in days, hours, minutes and seconds
 - g. Outside air temperature
4. Magnetometer, geoMetrics Airborne Model G-803, capable of 0.125 gamma sensitivity, but operated at 0.25 gamma sensitivity.
5. Radar Altimeter, Bonzer Model Mark 10 with recording output and display operating over an altitude range of 0 to 2,500 feet.
6. Rosemont Barometric Altimeter with recording output and display.
7. Recording Thermometer for monitoring outside air temperature.
8. Tracking Camera. Automax 35 mm framing camera with wide angle lens and 10 character fiducial/line number display to provide flight path recovery data.

FIGURE III

SYSTEM CALIBRATION

9. Analog Recorder geoMetrics (MARS 6) to record the following data:

- a. Bi214 using a window about the 1.76 MeV peak from the downward looking system.
- b. Bi air background from the upward looking system.
- c. Magnetometer
- d. Radar Altitude
- e. Total count for downward looking system (0.4 to 3.0 MeV)
- f. Barometric Altitude
- g. Time markers

10. HP 7155 single channel analog recorder during pre and post flight calibrations, this recorder is used to plot a full analog spectra for both the down and up crystal systems via the GR-800. Thus, a hard copy record of the data used for resolution, drift, etc., checks are available at all times. This approach provides instant verification of system parameters (refer to Figure II).

AIRCRAFT AND COSMIC BACKGROUND

Full spectral data are collected at five (5) altitudes over water (14,000 feet, 12,000 feet; 10,000 feet; 8,000 feet and 6,000 feet) in an area where the existence of no airborne Bi214 can be assured (off shore over the Pacific Ocean). This results in separate spectra as shown schematically in Figure 10. We define $S(12,000)$ to be the spectra at 12,000 feet from 0.4 MeV to 3.0 MeV with $S(8,000)$ the same spectra at a lower altitude (8,000) and $C_i(h)$ the total count between 3.0 and 6.0 MeV at respective altitudes. Since the aircraft background is constant, the difference between any two altitudes separated sufficiently - typically, 2,000 feet - yields the cosmic spectral curve shape as shown schematically in Figure VI. Thus

$$S(12,000) - S(8,000) = \Delta S$$

and

$$\sum C_{12}(h_i) - \sum C_8(h_i) = \Delta C$$

This cosmic spectral curve is scaled back to 12,000 feet as follows:

$$\frac{C_{12}(h_i)}{\Delta C} \times \Delta S = \Delta C(12,000) \text{ the Cosmic Spectrum (shape and magnitude at 12,000 feet)}$$

The aircraft background is derived as follows:

$$S(12,000) - C(12,000) = A/C \text{ Background}$$

Since data were collected at five altitudes, this procedure was repeated for each combination of altitudes and results averaged. Typical aircraft and cosmic spectra are shown in Figures V, AND VI respectively.

SYSTEM CONSTANTS

System constants were determined by occupation of the DoE Walker Field Test Pads. (See Ward, 1978, and Stromswold, 1978, for complete descriptions of the building and monitoring of the pads). The five test pads contained varying concentrations of K, U, and T as presented by BFEC:

FIGURE IV - Multiple altitude spectra schematic

<u>PAD</u>	<u>K</u>	<u>U</u>	<u>I</u>
Matrix	1.45%	2.19 ppm	6.26 ppm
K	5.14%	5.09 ppm	8.48 ppm
U	2.03%	30.29 ppm	9.19 ppm
T	2.01%	5.14 ppm	45.33 ppm
Mixed	4.11%	20.39 ppm	17.52 ppm

Since the measurements were taken over a relatively short time period (a few hours), it was assumed that the matrix pad measurements contain not only the effects of the matrix pad itself, but also aircraft background (which is a constant), cosmic background (constant over the time period of interest), and all other local background (e.g. BiAir, etc.) effects. (The matrix pad is constructed with only the basic concrete mix without the additional elemental minerals). Thus, by subtracting the matrix pad count rates from the count rates in the four pads, we have eliminated aircraft and cosmic background and BiAir effects for the four pads. The pad concentrations are then modified in a similar fashion by the subtraction of the matrix pad concentrations. The differential concentrations in the pads are given in the table below.

<u>PAD</u>	<u>K</u>	<u>U</u>	<u>I</u>
K-Matrix	3.7%	2.9 ppm	2.2 ppm
U-Matrix	0.6%	28.5 ppm	2.9 ppm
T-Matrix	0.6%	3.0 ppm	39.0 ppm
Mixed-Matrix	2.7%	18.8 ppm	11.3 ppm

Considering the above, we can define a functional relationship between the differential concentrations and the residual count rates which will provide a method of determining the calibration constants for the spectrometer system. These calibration constants are the six (6) stripping coefficients which account for the interactions occurring between the elemental channels in the system (Compton scatter coefficients, etc.).

On the basis of an ideal situation, one would anticipate that some of these interactions should be negligible. This is not totally the case, since we are dealing with a system which has less than infinite resolving power (i.e. the energies are smeared to some extent).

DERIVED AIRCRAFT BACKGROUND SPECTRUM FROM PACIFIC OCEAN DATA
DOWNWARD-LOOKING CRYSTAL SPECTRUM FOR LINE AC BGD, DATED 072577

TC (0-6 MEV) 184.07 TC (0.4-3.0 MEV) 141.17 COSMIC (3-6 MEV) 0.00
U (1.12 MEV) 9.91 K (1.46 MEV) 14.54 U (1.76 MEV) 4.36 T (2.62 MEV) 4.20

AIRCRAFT BACKGROUND
ROTARY WING AIRCRAFT
DOWNWARD-LOOKING CRYSTAL
2048 CUBIC INCHES
DATE: 25 JULY 1977

CH	0	(0.000 MEV)	0.000 CPS	1
CH	1	(0.015 MEV)	0.000 CPS	1
CH	2	(0.030 MEV)	0.000 CPS	1
CH	3	(0.045 MEV)	0.000 CPS	1
CH	4	(0.060 MEV)	0.000 CPS	1
CH	5	(0.075 MEV)	0.000 CPS	1
CH	6	(0.090 MEV)	0.000 CPS	1
CH	7	(0.105 MEV)	0.000 CPS	1
CH	8	(0.120 MEV)	0.000 CPS	1
CH	9	(0.135 MEV)	0.000 CPS	1
CH	10	(0.150 MEV)	0.000 CPS	1
CH	11	(0.165 MEV)	0.000 CPS	1
CH	12	(0.180 MEV)	0.000 CPS	1
CH	13	(0.195 MEV)	0.000 CPS	1
CH	14	(0.210 MEV)	0.000 CPS	1
CH	15	(0.225 MEV)	0.000 CPS	1
CH	16	(0.240 MEV)	0.000 CPS	1
CH	17	(0.255 MEV)	0.000 CPS	1
CH	18	(0.270 MEV)	0.000 CPS	1
CH	19	(0.285 MEV)	0.000 CPS	1
CH	20	(0.300 MEV)	0.000 CPS	1
CH	21	(0.315 MEV)	1.401 CPS	1
CH	22	(0.330 MEV)	3.790 CPS	1
CH	23	(0.345 MEV)	4.280 CPS	1
CH	24	(0.360 MEV)	4.334 CPS	1
CH	25	(0.375 MEV)	3.748 CPS	1
CH	26	(0.390 MEV)	3.907 CPS	1
CH	27	(0.405 MEV)	3.818 CPS	1
CH	28	(0.420 MEV)	4.236 CPS	1
CH	29	(0.435 MEV)	3.433 CPS	1
CH	30	(0.450 MEV)	2.996 CPS	1
CH	31	(0.465 MEV)	2.559 CPS	1
CH	32	(0.480 MEV)	2.260 CPS	1
CH	33	(0.495 MEV)	2.081 CPS	1
CH	34	(0.510 MEV)	2.121 CPS	1
CH	35	(0.525 MEV)	2.114 CPS	1
CH	36	(0.540 MEV)	1.976 CPS	1
CH	37	(0.555 MEV)	2.090 CPS	1
CH	38	(0.570 MEV)	2.158 CPS	1
CH	39	(0.585 MEV)	2.226 CPS	1
CH	40	(0.600 MEV)	1.983 CPS	1
CH	41	(0.615 MEV)	2.155 CPS	1
CH	42	(0.630 MEV)	2.158 CPS	1
CH	43	(0.645 MEV)	2.267 CPS	1
CH	44	(0.660 MEV)	2.217 CPS	1
CH	45	(0.675 MEV)	1.997 CPS	1
CH	46	(0.690 MEV)	2.447 CPS	1
CH	47	(0.705 MEV)	2.540 CPS	1
CH	48	(0.720 MEV)	2.588 CPS	1
CH	49	(0.735 MEV)	2.708 CPS	1
CH	50	(0.750 MEV)	2.481 CPS	1
CH	51	(0.765 MEV)	2.372 CPS	1
CH	52	(0.780 MEV)	1.866 CPS	1
CH	53	(0.795 MEV)	1.682 CPS	1
CH	54	(0.810 MEV)	1.681 CPS	1
CH	55	(0.825 MEV)	1.488 CPS	1
CH	56	(0.840 MEV)	1.474 CPS	1
CH	57	(0.855 MEV)	1.447 CPS	1
CH	58	(0.870 MEV)	1.431 CPS	1
CH	59	(0.885 MEV)	1.476 CPS	1
CH	60	(0.900 MEV)	1.453 CPS	1
CH	61	(0.915 MEV)	1.467 CPS	1
CH	62	(0.930 MEV)	1.579 CPS	1
CH	63	(0.945 MEV)	1.497 CPS	1
CH	64	(0.960 MEV)	1.548 CPS	1
CH	65	(0.975 MEV)	1.421 CPS	1
CH	66	(0.990 MEV)	1.282 CPS	1
CH	67	(1.005 MEV)	1.155 CPS	1
CH	68	(1.020 MEV)	1.046 CPS	1
CH	69	(1.035 MEV)	1.045 CPS	1
CH	70	(1.050 MEV)	1.231 CPS	1
CH	71	(1.065 MEV)	1.231 CPS	1
CH	72	(1.080 MEV)	1.452 CPS	1
CH	73	(1.095 MEV)	1.452 CPS	1
CH	74	(1.110 MEV)	1.452 CPS	1
CH	75	(1.125 MEV)	1.452 CPS	1
CH	76	(1.140 MEV)	1.452 CPS	1
CH	77	(1.155 MEV)	1.443 CPS	1
CH	78	(1.170 MEV)	1.364 CPS	1
CH	79	(1.185 MEV)	1.289 CPS	1
CH	80	(1.200 MEV)	1.150 CPS	1
CH	81	(1.215 MEV)	1.144 CPS	1
CH	82	(1.230 MEV)	1.065 CPS	1
CH	83	(1.245 MEV)	1.061 CPS	1
CH	84	(1.260 MEV)	0.841 CPS	1
CH	85	(1.275 MEV)	0.919 CPS	1
CH	86	(1.290 MEV)	0.822 CPS	1
CH	87	(1.305 MEV)	0.816 CPS	1
CH	88	(1.320 MEV)	0.853 CPS	1
CH	89	(1.335 MEV)	0.901 CPS	1
CH	90	(1.350 MEV)	0.822 CPS	1
CH	91	(1.365 MEV)	0.867 CPS	1
CH	92	(1.380 MEV)	0.969 CPS	1
CH	93	(1.395 MEV)	0.851 CPS	1
CH	94	(1.410 MEV)	0.905 CPS	1
CH	95	(1.425 MEV)	0.847 CPS	1
CH	96	(1.440 MEV)	0.861 CPS	1
CH	97	(1.455 MEV)	0.808 CPS	1
CH	98	(1.470 MEV)	0.727 CPS	1
CH	99	(1.485 MEV)	0.757 CPS	1
CH	100	(1.500 MEV)	0.687 CPS	1
CH	101	(1.515 MEV)	0.663 CPS	1
CH	102	(1.530 MEV)	0.657 CPS	1
CH	103	(1.545 MEV)	0.633 CPS	1
CH	104	(1.560 MEV)	0.719 CPS	1
CH	105	(1.575 MEV)	0.671 CPS	1
CH	106	(1.590 MEV)	0.475 CPS	1
CH	107	(1.605 MEV)	0.601 CPS	1
CH	108	(1.620 MEV)	0.661 CPS	1
CH	109	(1.635 MEV)	0.669 CPS	1
CH	110	(1.650 MEV)	0.606 CPS	1
CH	111	(1.665 MEV)	0.638 CPS	1
CH	112	(1.680 MEV)	0.652 CPS	1
CH	113	(1.695 MEV)	0.644 CPS	1
CH	114	(1.710 MEV)	0.652 CPS	1
CH	115	(1.725 MEV)	0.791 CPS	1
CH	116	(1.740 MEV)	0.787 CPS	1
CH	117	(1.755 MEV)	0.934 CPS	1
CH	118	(1.770 MEV)	0.984 CPS	1
CH	119	(1.785 MEV)	1.072 CPS	1
CH	120	(1.800 MEV)	1.184 CPS	1
CH	121	(1.815 MEV)	1.088 CPS	1
CH	122	(1.830 MEV)	1.210 CPS	1
CH	123	(1.845 MEV)	1.231 CPS	1
CH	124	(1.860 MEV)	1.207 CPS	1
CH	125	(1.875 MEV)	0.995 CPS	1
CH	126	(1.890 MEV)	0.887 CPS	1
CH	127	(1.905 MEV)	0.684 CPS	1
CH	128	(1.920 MEV)	0.535 CPS	1
CH	129	(1.935 MEV)	0.515 CPS	1
CH	130	(1.950 MEV)	0.488 CPS	1
CH	131	(1.965 MEV)	0.489 CPS	1
CH	132	(1.980 MEV)	0.369 CPS	1
CH	133	(1.995 MEV)	0.339 CPS	1
CH	134	(2.010 MEV)	0.438 CPS	1
CH	135	(2.025 MEV)	0.318 CPS	1
CH	136	(2.040 MEV)	0.259 CPS	1
CH	137	(2.055 MEV)	0.259 CPS	1
CH	138	(2.070 MEV)	0.353 CPS	1
CH	139	(2.085 MEV)	0.323 CPS	1
CH	140	(2.100 MEV)	0.332 CPS	1
CH	141	(2.115 MEV)	0.326 CPS	1
CH	142	(2.130 MEV)	0.267 CPS	1
CH	143	(2.145 MEV)	0.275 CPS	1
CH	144	(2.160 MEV)	0.245 CPS	1
CH	145	(2.175 MEV)	0.347 CPS	1
CH	146	(2.190 MEV)	0.352 CPS	1
CH	147	(2.205 MEV)	0.293 CPS	1
CH	148	(2.220 MEV)	0.359 CPS	1
CH	149	(2.235 MEV)	0.270 CPS	1
CH	150	(2.250 MEV)	0.334 CPS	1
CH	151	(2.265 MEV)	0.245 CPS	1
CH	152	(2.280 MEV)	0.255 CPS	1
CH	153	(2.295 MEV)	0.174 CPS	1
CH	154	(2.310 MEV)	0.288 CPS	1
CH	155	(2.325 MEV)	0.188 CPS	1
CH	156	(2.340 MEV)	0.115 CPS	1
CH	157	(2.355 MEV)	0.084 CPS	1
CH	158	(2.370 MEV)	0.147 CPS	1
CH	159	(2.385 MEV)	0.147 CPS	1
CH	160	(2.400 MEV)	0.139 CPS	1
CH	161	(2.415 MEV)	0.109 CPS	1
CH	162	(2.430 MEV)	0.091 CPS	1
CH	163	(2.445 MEV)	0.151 CPS	1
CH	164	(2.460 MEV)	0.098 CPS	1
CH	165	(2.475 MEV)	0.136 CPS	1
CH	166	(2.490 MEV)	0.157 CPS	1
CH	167	(2.505 MEV)	0.119 CPS	1
CH	168	(2.520 MEV)	0.109 CPS	1
CH	169	(2.535 MEV)	0.113 CPS	1
CH	170	(2.550 MEV)	0.106 CPS	1
CH	171	(2.565 MEV)	0.147 CPS	1
CH	172	(2.580 MEV)	0.137 CPS	1
CH	173	(2.595 MEV)	0.171 CPS	1
CH	174	(2.610 MEV)	0.154 CPS	1
CH	175	(2.625 MEV)	0.188 CPS	1
CH	176	(2.640 MEV)	0.162 CPS	1
CH	177	(2.655 MEV)	0.164 CPS	1
CH	178	(2.670 MEV)	0.138 CPS	1
CH	179	(2.685 MEV)	0.137 CPS	1
CH	180	(2.700 MEV)	0.119 CPS	1
CH	181	(2.715 MEV)	0.099 CPS	1
CH	182	(2.730 MEV)	0.148 CPS	1
CH	183	(2.745 MEV)	0.101 CPS	1
CH	184	(2.760 MEV)	0.114 CPS	1
CH	185	(2.775 MEV)	0.088 CPS	1
CH	186	(2.790 MEV)	0.101 CPS	1
CH	187	(2.805 MEV)	0.095 CPS	1
CH	188	(2.820 MEV)	0.130 CPS	1
CH	189	(2.835 MEV)	0.117 CPS	1
CH	190	(2.850 MEV)	0.113 CPS	1
CH	191	(2.865 MEV)	0.116 CPS	1
CH	192	(2.880 MEV)	0.089 CPS	1
CH	193	(2.895 MEV)	0.097 CPS	1
CH	194	(2.910 MEV)	0.095 CPS	1
CH	195	(2.925 MEV)	0.087 CPS	1
CH	196	(2.940 MEV)	0.059 CPS	1
CH	197	(2.955 MEV)	0.015 CPS	1
CH	198	(2.970 MEV)	0.041 CPS	1
CH	199	(2.985 MEV)	0.070 CPS	1
CH	200	(2.999 MEV)	0.087 CPS	1
CH	201	(3.014 MEV)	0.085 CPS	1
CH	202	(3.029 MEV)	0.084 CPS	1
CH	203	(3.044 MEV)	0.064 CPS	1
CH	204	(3.059 MEV)	0.123 CPS	1
CH	205	(3.074 MEV)	0.076 CPS	1
CH	206	(3.089 MEV)	0.116 CPS	1
CH	207	(3.104 MEV)	0.147 CPS	1
CH	208	(3.119 MEV)	0.108 CPS	1
CH	209	(3.134 MEV)	0.120 CPS	1
CH	210	(3.149 MEV)	0.092 CPS	1
CH	211	(3.164 MEV)	0.127 CPS	1
CH	212	(3.179 MEV)	0.169 CPS	1
CH	213	(3.194 MEV)	0.206 CPS	1
CH	214	(3.209 MEV)	0.262 CPS	1
CH	215	(3.224 MEV)	0.184 CPS	1
CH	216	(3.239 MEV)	0.205 CPS	1
CH	217	(3.254 MEV)	0.195 CPS	1
CH	218	(3.269 MEV)	0.173 CPS	1
CH	219	(3.284 MEV)	0.201 CPS	1
CH	220	(3.299 MEV)	0.329 CPS	1
CH	221	(3.314 MEV)	0.232 CPS	1
CH	222	(3.329 MEV)	0.187 CPS	1
CH	223	(3.344 MEV)	0.171 CPS	1
CH	224	(3.359 MEV)	0.177 CPS	1
CH	225	(3.374 MEV)	0.099 CPS	1
CH	226	(3.389 MEV)	0.122 CPS	1
CH	227	(3.404 MEV)	0.114 CPS	1
CH	228	(3.419 MEV)	0.131 CPS	1
CH	229	(3.434 MEV)	0.090 CPS	1
CH	230	(3.449 MEV)	0.087 CPS	1
CH	231	(3.464 MEV)	0.012 CPS	1
CH	232	(3.479 MEV)	-0.025 CPS	1
CH	233	(3.494 MEV)	-0.024 CPS	1
CH	234	(3.509 MEV)	0.038 CPS	1
CH	235	(3.524 MEV)	0.003 CPS	1
CH	236	(3.539 MEV)	0.060 CPS	1
CH	237	(3.554 MEV)	0.038 CPS	1
CH	238	(3.569 MEV)	0.023 CPS	1
CH	239	(3.584 MEV)	0.008 CPS	1
CH	240	(3.599 MEV)	0.078 CPS	1
CH	241	(3.614 MEV)	0.027 CPS	1
CH	242	(3.629 MEV)	0.047 CPS	1
CH	243	(3.644 MEV)	0.039 CPS	1
CH	244	(3.659 MEV)	0.084 CPS	1
CH	245	(3.674 MEV)	0.025 CPS	1
CH	246	(3.689 MEV)	0.025 CPS	1
CH	247	(3.704 MEV)	-0.015 CPS	1
CH	248	(3.719 MEV)	0.031 CPS	1
CH	249	(3.734 MEV)	-0.005 CPS	1
CH	250	(3.749 MEV)	0.042 CPS	1
CH	251	(3.764 MEV)	0.005 CPS	1
CH	252	(3.779 MEV)	-0.018 CPS	1
CH	253	(3.794 MEV)	0.031 CPS	1
CH	254	(3.809 MEV)	-0.106 CPS	1
CH	255	(3.824 MEV)	0.000 CPS	1

THALLIUM 208

THALLIUM 208

TOTAL COUNT

DOWNWARD-LOOKING CRYSTAL SPECTRUM FOR LINE COSMIC, DATED 072577				COSMIC SPECTRUM			
TC (0-8 MEV) 5275.09 TC (0.4-3.0 MEV) 3245.27 COSMIC (3-6 MEV) 1000.00				ROTARY WING AIRCRAFT			
U (1.12 MEV) 165.91 K (1.46 MEV) 181.83 U (1.76 MEV) 157.56 T (2.62 MEV) 213.66				DOWNWARD LOOKING CRYSTAL			
				2048 CUBIC INCHES			
				DATE: 25 JULY 1977			
CH 0 (0.000 MEV)	0.000	CPS	X				
CH 1 (0.010 MEV)	0.000	CPS	X				
CH 2 (0.024 MEV)	0.000	CPS	X				
CH 3 (0.035 MEV)	0.000	CPS	X				
CH 4 (0.047 MEV)	0.000	CPS	X				
CH 5 (0.059 MEV)	0.000	CPS	X				
CH 6 (0.071 MEV)	0.000	CPS	X				
CH 7 (0.083 MEV)	0.000	CPS	X				
CH 8 (0.095 MEV)	0.000	CPS	X				
CH 9 (0.107 MEV)	0.000	CPS	X				
CH 10 (0.119 MEV)	0.000	CPS	X				
CH 11 (0.130 MEV)	0.000	CPS	X				
CH 12 (0.142 MEV)	0.000	CPS	X				
CH 13 (0.154 MEV)	0.000	CPS	X				
CH 14 (0.165 MEV)	0.000	CPS	X				
CH 15 (0.177 MEV)	0.000	CPS	X				
CH 16 (0.189 MEV)	0.000	CPS	X				
CH 17 (0.201 MEV)	0.000	CPS	X				
CH 18 (0.213 MEV)	1.091	CPS	XX				
CH 19 (0.225 MEV)	1.313	CPS	XX				
CH 20 (0.236 MEV)	2.226	CPS	XXX				
CH 21 (0.248 MEV)	31.345	CPS	XX				

Thus, energy peaks within a spectrum of a given element are Gaussian shaped rather than pure line spectra. Additionally, we are dealing with finite spectral windows, multiple peaked spectra, and pulse pileup; all tend to couple each window's response to the other.

Keeping in mind that we are dealing with the count rates corresponding to the concentrations presented in the last table, we define the following:

KC_i = uncorrected system count rate for the K channel

UC_i = uncorrected system count rate for the U channel

TC_i = uncorrected system count rate for the T channel

K_i = the percent differential concentration of potassium

U_i = ppm differential concentration of uranium

T_i = ppm differential concentration of thorium

where "i" refers to the ith pad.

We also define the following:

ζ_{kk} = sensitivity of KC_i to concentrations of K_i

ζ_{ku} = sensitivity of KC_i to concentrations of U_i

ζ_{kt} = sensitivity of KC_i to concentrations of T_i

ζ_{uk} = sensitivity of UC_i to concentrations of K_i

ζ_{uu} = sensitivity of UC_i to concentrations of U_i

ζ_{ut} = sensitivity of UC_i to concentrations of T_i

ζ_{tk} = sensitivity of TC_i to concentrations of K_i

ζ_{tu} = sensitivity of TC_i to concentrations of U_i

ζ_{tt} = sensitivity of TC_i to concentrations of T_i

Using the above definitions, we now construct the functional relationship by means of the following nine (9) equations in sets of three (3) per pad.

$$\underline{K \text{ pad}} \quad KC_k = \zeta_{kk}K + \zeta_{ku}U + \zeta_{kt}T$$

$$UC_k = \zeta_{uk}K + \zeta_{uu}U + \zeta_{ut}T$$

$$TC_k = \zeta_{tk}K + \zeta_{tu}U + \zeta_{tt}T$$

$$\underline{U \text{ pad}} \quad KC_u = \zeta_{kk}K + \zeta_{ku}U + \zeta_{kt}T$$

$$UC_u = \zeta_{uk}K + \zeta_{uu}U + \zeta_{ut}T$$

$$TC_u = \zeta_{tk}K + \zeta_{tu}U + \zeta_{tt}T$$

$$\underline{T \text{ pad}} \quad KC_t = \zeta_{kk}K + \zeta_{ku}U + \zeta_{kt}T$$

$$UC_t = \zeta_{uk}K + \zeta_{uu}U + \zeta_{ut}T$$

$$TC_t = \zeta_{tk}K + \zeta_{tu}U + \zeta_{tt}T$$

Separating these equation into consistent groups, we get for the uncorrected count rates in the K channel

$$(K \text{ pad}) \quad KC_k = \zeta_{kk}K_k + \zeta_{ku}U_k + \zeta_{kt}T_k$$

$$(U \text{ pad}) \quad KC_u = \zeta_{kk}K_u + \zeta_{ku}U_u + \zeta_{kt}T_u$$

$$(T \text{ pad}) \quad KC_t = \zeta_{kk}K_t + \zeta_{ku}U_t + \zeta_{kt}T_t$$

The equations can be expressed in matrix notation

$$\begin{bmatrix} KC_k \\ KC_u \\ KC_t \end{bmatrix} = \begin{bmatrix} K_k & U_k & T_k \\ K_u & U_u & T_u \\ K_t & U_t & T_t \end{bmatrix} \cdot \begin{bmatrix} \zeta_{kk} \\ \zeta_{ku} \\ \zeta_{kt} \end{bmatrix}$$

Where the k, u and t subscripts represent the K, U and T pads.

In a similar manner we can write two other matrix equations for UC_i and TC_i respectively.

$$\begin{bmatrix} UC_k \\ UC_u \\ UC_t \end{bmatrix} = \begin{bmatrix} K_k & U_k & T_k \\ K_u & U_u & T_u \\ K_t & U_t & T_t \end{bmatrix} \cdot \begin{bmatrix} \zeta_{uk} \\ \zeta_{uu} \\ \zeta_{ut} \end{bmatrix}$$

$$\begin{bmatrix} TC_k \\ TC_u \\ TC_t \end{bmatrix} = \begin{bmatrix} K_k & U_k & T_k \\ K_u & U_u & T_u \\ K_t & U_t & T_t \end{bmatrix} \cdot \begin{bmatrix} \zeta_{tk} \\ \zeta_{tu} \\ \zeta_{tt} \end{bmatrix}$$

Collecting the above, these equations can be expressed in matrix form as

$$\begin{bmatrix} KC_k & UC_k & TC_k \\ KC_u & UC_u & TC_u \\ KC_t & UC_t & TC_t \end{bmatrix} = \begin{bmatrix} K_t & U_k & T_k \\ K_u & U_u & T_u \\ K_t & U_t & T_t \end{bmatrix} \cdot \begin{bmatrix} \zeta_{kk} & \zeta_{uk} & \zeta_{tk} \\ \zeta_{ku} & \zeta_{uu} & \zeta_{tu} \\ \zeta_{kt} & \zeta_{ut} & \zeta_{tt} \end{bmatrix}$$

or

$$\bar{A} = \bar{B} \cdot \bar{\zeta}$$

where $\bar{A}$ is the residual count rate matrix, $\bar{B}$ is the matrix of the known differential concentrations and $\bar{\zeta}$ the sensitivity matrix.

Rearranging the above equations we have

$$\bar{B} = \bar{A} \cdot \bar{\zeta}^{-1}$$

We now define

$$\bar{\zeta}^{-1} = \bar{\Delta}$$

Eliminating $\bar{\zeta}$, we get

$$\bar{B} = \bar{A} \cdot \bar{\Delta}$$

We can now solve for $\bar{\Delta}$ by matrix inversion.

Therefore, the differential concentrations in the mixed pad can be derived from the k,u,t pads to check the computed $\bar{\Delta}$.

$$\begin{bmatrix} K_m \\ U_m \\ T_m \end{bmatrix} = \begin{bmatrix} \Delta_{kk} & \Delta_{ku} & \Delta_{kt} \\ \Delta_{uk} & \Delta_{uu} & \Delta_{ut} \\ \Delta_{tk} & \Delta_{tu} & \Delta_{tt} \end{bmatrix} \cdot \begin{bmatrix} KC_m \\ UC_m \\ TC_m \end{bmatrix}$$

where the subscript m refers to the mixed pad. Expanding this in algebraic form we obtain the following set of equations:

$$K_m = \Delta_{kk}(KC_m) + \frac{\Delta_{ku}UC_m}{\Delta_{kk}} + \frac{\Delta_{kt}TC_m}{\Delta_{kk}}$$

$$U_m = \Delta_{uu}(UC_m) + \frac{\Delta_{ut}TC_m}{\Delta_{kk}} + \frac{\Delta_{uk}KC_m}{\Delta_{uu}}$$

$$T_m = \Delta_{tt}(TC_m) + \frac{\Delta_{tu}UC_m}{\Delta_{tt}} + \frac{\Delta_{tk}KC_m}{\Delta_{tt}}$$

The terms in parentheses in the above 3 equations are the "corrected stripped count rates" for the system, and the stripping coefficients are as follows:

$$S_{ku} = \frac{\Delta_{ku}}{\Delta_{kk}} \quad (\text{effect of uranium on potassium})$$

$$S_{kt} = \frac{\Delta_{kt}}{\Delta_{kk}} \quad (\text{effect of thorium on potassium})$$

$$S_{ut} = \frac{\Delta_{ut}}{\Delta_{uu}} \quad (\text{effect of thorium on uranium})$$

$$S_{uk} = \frac{\Delta_{uk}}{\Delta_{uu}} \quad (\text{effect of potassium on uranium})$$

$$S_{tu} = \frac{\Delta_{tu}}{\Delta_{tt}} \quad (\text{effect of uranium on thorium})$$

$$S_{tk} = \frac{\Delta_{tk}}{\Delta_{tt}} \quad (\text{effect of potassium on thorium})$$

These stripping coefficients are defined in terms of S_{ij} in order to eliminate confusion with α , β , and γ , which are sometimes defined slightly differently.

ATMOSPHERIC RADON CORRECTION

Consider the crystal configuration shown below:

Let 1 and 2 designate the down and up crystal respectively. The down crystal sees radiation rates of I_1 composed of the air signal I_a and the ground signal I_g plus aircraft and cosmic background.

$$\text{Therefore } I_1 = I_g + I_a + A_1 + C_1$$

Similarly, the up crystal sees the air signal and ground signal (both somewhat attenuated) plus an aircraft and cosmic background.

$$\text{Therefore } I_2 = \lambda I_g + m I_a + A_2 + C_2$$

Where m is the response to the air signal and λ is the % of the ground signal getting through to the up detector.

Using the test pad data, the factor λ can be determined. Consider the two previous equations. When we subtract the matrix pad data from the K, U, and T pad data, we have essentially set A_1 , A_2 , C_1 , and C_2 and I_a equal to zero.

$$\begin{aligned} \text{Therefore } I_1 &= I_g \\ I_2 &= \lambda I_g \\ &= \left(\frac{I_2}{I_1} \right) \end{aligned}$$

Instead of using the count rates we can use the resultant sensitivities $1/\Delta_{uu}$ to determine λ for the elemental channel U.

$$= \frac{1/\Delta_{uu} \text{ (up)}}{1/\Delta_{uu} \text{ (down)}}$$

It should be noted that due to "shine around" (since the shielding is not an infinite plane, the upward looking crystal responds to the surrounding terrain) on the test pads, as altitude increases, should decrease, thus $\lambda = f(h)$.

Only the factor m remains to be determined. This unfortunately cannot be determined from test pad data. It can however be determined by flying over water (e.g. use of the Lake Mead over-water data).

Consider the equations for I_1 and I_2 again

$$I_1 = I_g + I_a + A_1 + C_1$$

$$I_2 = \lambda I_g + m I_a + A_2 + C_2$$

Over water $I_g = 0$

We have A_1 , A_2 , C_1 , and C_2 defined.

Removing the aircraft and cosmic background from the over water data and we are left with

$$I_1 = I_a$$

$$I_2 = m I_a$$

Since m is the shielding factor response to the air signal, we should have an air signal to "shield". Thus m is best determined if there is radon present.

Both up and down counting rates are corrected for aircraft and cosmic background and so we can solve the following two equations for I_a .

$$I_1 = I_g + I_a$$

$$I_2 = \lambda I_g + m I_a$$

$$m I_a = I_2 - \lambda I_g$$

$$\text{but } I_g = I_1 - I_a$$

$$\text{then } I_a (m - \lambda) = I_2 - \lambda I_1$$

$$\text{or } I_a = \frac{I_2 - \lambda I_1}{m - \lambda} = \text{Bi Air}$$

and I_a is then the Bi Air contribution from the surrounding air. This is then subtracted from the down looking U count resulting in corrected data.

DATA PROCESSING

DATA PREPARATION

The following sections summarize the techniques used for reduction and processing of the airborne data collected by geoMetrics.

Field Tape Verification and Edit

The field data tapes containing the airborne data are read on a computer to verify the recording and data quality. Data recovery is essentially 100% from the field tapes. During this phase, statistics are generated summarizing all the variables recorded for each flight line. Simultaneously, the spectral peaks are evaluated for shifts using a centroid calculation and the particular window's peak channel. The data are also checked for correct scan lengths and proper justification of data fields within each scan and live time calculations are made. During this process, the desired window data fields are extracted from each spectrum and rewritten as a reformatted copy tape. (Portions of this operation were performed in the field using the G-725 field computer system.)

The reformatted raw data for each flight line (with aborted or unnecessary flight line data edited out) are then checked for consistency, data spikes, gradients, etc. Every correction suggested by the computer is evaluated by the data processing personnel prior to implementation. Upon completion of the phase, the data on the output tape are "clean" and ready for subsequent correction of the radiometrics and tying of the magnetics.

Flight Line Location

A single frame 35 mm camera is used for obtaining position recovery information. The photo locations are spotted or transferred to a suitable base map and are digitized. The fiducial numbers of the spotted points along each line are entered during the digitizing process. A computer program is used to check the consistency of these data using calculated intersections from tie line to tie line and from traverse to traverse. This program allows easy detection of entry errors as well as potential flight path recovery errors.

A computer program then calculates the map location for each intersection and the beginning and end of each line based on the fiducial numbers and the control line/tie grid. A computer plot is made of these locations to check against the field plot and correct editing

information. These flight lines are then overlain on the geologic base map and each map unit is digitized such that each sample falls within a single unit. This resulting location information is then merged with the geophysical data using the fiducial numbers as common reference.

RADIOMETRIC DATA REDUCTION

Reduction of the raw window data was carried out utilizing system calibration constants as derived from high altitude over water flights, Lake Mead Dynamic Test Range, and the Walker Field Test Pads. The data reduction sequence used is summarized in Figure VII. Processing of the data was performed using the window energies given below:

Total count - 0.4 to 3.0 MeV

K - 1.37 to 1.57 MeV

U - 1.66 to 1.87 MeV (downward looking system)

U_{up} - 1.04 to 1.21 MeV and 1.65 to 2.42 MeV (upward looking system)

T - 2.41 to 2.81 MeV

Cosmic - 3 to 6 MeV (downward and upward looking system)

Aircraft and Cosmic background for the Queen Air over these windows are as follows:

<u>QUEEN AIR</u>			
		Aircraft	Cosmic*
TC	(cps)	152.04	2.3833
K	(cps)	16.06	0.1322
U _{dn}	(cps)	6.50	0.1098
U _{up}	(cps)	3.17	0.5540
T	(cps)	3.42	0.1503

*Cosmic background values are in cps per 1.0 cps in the 3-6 MeV window.

DATA PROCESSING FLOW DIAGRAM

FIGURE VII

Compton corrections to the down data were made using the following constants:

<u>S_{ij}</u>	<u>QUEEN AIR</u>
S _{ku}	0.8437
S _{kt}	0.1584
S _{ut}	0.2703
S _{uk}	0.0
S _{tu}	0.05614
S _{tk}	0.0

The ij subscripts represent the influence of the jth window on the ith window.

All parameters except for S_{ut} are considered constants. S_{ut} was considered an altitude dependent parameter utilizing the following expression (after Grasty, 1975).

$$S_{ut} = S_{ut_0} + 0.0076h, \text{ where } h \text{ is the altitude in hundreds of feet.}$$

Altitude attenuation coefficients used are defined as follows:

ALTITUDE ATTENUATION COEFFICIENTS

		<u>QUEEN AIR</u>
TC	(per foot)	0.002011
K	(per foot)	0.002740
U	(per foot)	0.002479
T	(per foot)	0.002048

All radiometric data presented in the strip charts have been normalized to 400 feet mean terrain clearance at STP using the expression:

$$\exp - u_i \frac{273.15}{760} \times \frac{P}{T} (h - 400)$$

where h is the height in feet, u_i is the appropriate altitude attenuation coefficient, P is in mm of Hg, and T is in degrees Kelvin. In cases where the altitude exceeds 1,000 feet, the correction coefficients were limited to the 1,000 foot value.

Bi Air calculations are made using the following expressions:

$$U_{up} = (R_{us} + \frac{C'_{uk}}{C'_{uu}} R_{ks} + \frac{C'_{ut}}{C'_{uu}} R_{ts}) \ell$$

$$Bi_{Air} = \frac{\hspace{10em}}{m - \ell}$$

- Where U_{up} = count rate from upward detectors
ℓ = crystal coupling constant
m = crystal geometric factor

C'_{uk}, C'_{ut}, C'_{uu} = stripping coefficients relating down data to up data

- R_{us} = stripped uranium count rate - down system
R_{ks} = stripped potassium count rate - down system
R_{ts} = stripped thorium count rate - down system

The numerical values for the constants ℓ, m, C'_{uk}, and C'_{uu} are given below:

	<u>QUEEN AIR</u>
ℓ	0.1101
m	0.596
C' _{uk}	.00947
C' _{uu}	.07136
C' _{ut}	.04636
μℓ	-0.000032
μm	-0.000192

μl & μm are altitude dependent as follows:

$$l = l - \mu l \times h, \text{ where } h \text{ is in feet}$$

$$m = m - \mu m \times h, \text{ where } h \text{ is in feet}$$

These Bi Air data are filtered and the filtered results are then removed on a point by point basis from the corrected uranium window data.

The window data are then evaluated for statistical adequacy prior to altitude correction to ensure they are significant within the context of the anticipated errors in count statistics.

Statistical Adequacy Test

The statistical adequacy test is made to determine whether the corrected data sample is sufficiently greater than the "noise" to represent the "signal" of interest.

We can define three separate criteria for detection thresholds (ref. Currie, Analytical Chemistry, Volume 40, No. 3, March 1968) of which only one is directly applicable to our case; this is the "critical level". This is the level at which the decision is made that a signal is "detected". We thus define this critical level as that level at which the data are statistically adequate.

Setting the actual levels in counts per second, "a priori" for each elemental window is difficult at best since the full effect of all parameters affecting the counts is not known to a sufficient degree of certainty. If the corrections to the data are a significant portion of the count rate, most of the error (exclusive of systematic errors due to electronics, etc.) in the corrected data can be ascribed to random errors within the applied corrections. The corrections are basically the results of counting radioactive decay products (gamma rays) and are therefore assumed to follow the classical Poisson distribution. The following assumptions concerning these corrections are:

1. In the best case, the error in each correction is additive.
2. The sum of these corrections also follows a Poisson distribution.
3. The uncertainty in the correction itself is equal to the square root of the correction applied.
4. This uncertainty is directly reflected in the corrected single record count rate.

With these assumptions in mind, the criterion for determining the statistical adequacy of a given data sample is defined as follows:

"If a corrected single record data sample exceeds 1.5 times the square root of the summed correction applied to that data sample, then that data sample is statistically adequate."

Since any calculation using statistically inadequate data (such as ratios) is also inadequate, the adequacy of each element of the single sample record data is tested prior to the calculation. This is done during the course of the processing by retaining all corrections applied to each data sample and determining its adequacy as explained above.

Not only are the results of this statistical adequacy test used to insure that calculated ratios will be meaningful but they are also utilized to determine the optimum interval over which the data should be averaged (e.g. 5 seconds or 7 seconds, etc.) to improve the overall data statistical adequacy. In the case of this project, the resulting averaging sample interval was 7 seconds.

Conversion to Equivalent ppm and Percent

At this point the data are single record corrected samples in units of counts per second. These data are then converted to equivalent ppm (parts per million) uranium, thorium and percent potassium. The conversion factors are the sensitivities derived from the Lake Mead Dynamic Test Range data at 400 feet mean terrain clearance.

<u>Radioelement</u>	<u>Equivalent Percent/ppm</u>	<u>Queen Air Counts/Second</u>
K	1%K	91.5
U	1 ppmeu	10.4
T	1 ppmeT	6.4

DATA PRESENTATION

MAGNETIC DATA REDUCTION

The magnetic data reduction processes are: correction for diurnal variation, tying to a common magnetic datum, and subtraction of the regional magnetic field as defined by the International Geomagnetic Reference Field (IGRF). During data acquisition, the magnetic field is monitored by a ground-based diurnal magnetometer that samples every four seconds at a sensitivity of one-quarter gamma. These data are recorded on magnetic tape along with the time for synchronization with the airborne data.

The diurnal data are edited to keep only samples taken during flight time and remove spikes and man-made magnetic events. After editing, these data are displayed in profile form to ensure that all corrections necessary have been made. Next, the data are synchronized in time with the airborne data, interpolated, and subtracted from the airborne magnetic data.

The diurnally corrected magnetic data are then processed by a tying program that compares the magnetic differences at intersections of flight lines and tie lines. This program calculates individual magnetic field biases for each flight tie line based on tie line intersections. This allows miss-ties to be minimized throughout the survey. These biases usually represent, after diurnal correction, systematic magnetic changes caused by such things as heading error, changes in location of the ground-based magnetometer, or changes in the airborne equipment. The biases are manually evaluated and selectively applied.

General

The majority of the data products are presented in this report. These include the uranium anomaly/interpretation maps and pseudo-contour maps of potassium, uranium, thorium, and magnetic data which are integrated as part of the text in the interpretation section. In addition to these data, this report contains data presented in the form of radiometric profiles, flight path recovery maps, standard deviation maps, and histograms. Microfiche data are contained in the back cover of each report. Data tapes are available separately.

Radiometric Profiles

Stacked profiles were prepared from the averaged data for each traverse and tie line. These stacked profiles, plotted at a linear scale of 1:250,000, contain the following parameters: corrected Total Count, percent potassium, equivalent ppm uranium, equivalent ppm thorium, eU/eT, eU/%K, and eT/%K ratios, equivalent ppm Bi Air, radar altimeter, and magnetometer data. Each of the stacked profile sheets contains a plot of the flight path superimposed on a geologic strip map. Included along these profiles are the fiducial numbers which correspond to flight path position as displayed on the flight path recovery maps. Each of the stacked profiles represents the data contained on the specific flight line within the boundaries of the specified NTMS Quadrangle sheet.

Radiometric traces on the stacked profiles contain an indicator showing those data which are statistically inadequate. These statistically inadequate data are marked by a small vertical tick at the sample location. The altitude profile has been limited in display to 1,000 feet. A dashed line at the 700 foot level is presented to show those data which do not meet the altitude specifications. The vertical scale of each variable remains constant on all stacked profiles. When overranging occurs, the trace is stepped and the step labeled showing the actual value. A pictorial representation of such a stepping profile is shown in Figure VIII. At the end of each stacked profile, a statistical summary of the minimum value, maximum value, mean, and standard deviation for that variable is presented.

This report contains an equivalent set of stacked profiles for each quadrangle, photographically reduced to an approximate scale of 1:500,000.

MAGNETIC PROFILES

A set of profiles containing the magnetic data (corrected, with IGRF removed), barometric altimeter data, radar altimeter data, diurnal monitor data, and temperature data are available at a linear scale of 1:250,000. Each of the stacked profiles contains a plot of the flight path superimposed on the geology over which the aircraft flew. Reduced scale (1:500,000) copies of these are presented in of this report.

FIGURE VIII Plotter Step Value Labeling

FLIGHT PATH MAPS

For each of the NTMS quadrangle sheets covered by this survey, a flight path position map is available at a scale of 1:250,000. The actual flight path has been superimposed on the geologic quadrangle maps. Flight lines and tie lines are annotated along with fiducial numbers of located positions. Reduced scale (1:500,000) copies of these can be found in this report.

STANDARD DEVIATION MAPS

Gamma ray standard deviation maps have been prepared for each NTMS quadrangle included in this survey. The six maps generated represent the following parameters: percent potassium, equivalent ppm uranium, equivalent ppm thorium, and eU/eT, eU/%K and eT/%K ratios. The data contained in each map represent only those data which are considered statistically adequate. This automatically excludes all data collected over water or data which falls outside of altitude specifications (i.e. altitude greater than 700 and less than 200 feet). The symbolism of each of the six maps is identical. The center of each circle represents the central averaged sample since the data had been averaged over a 7 second interval. The small boxes adjacent to each of the circles represents one standard deviation from the mean for that specific data sample. In order to determine whether the data shown are represented by positive or negative standard deviations, consider each map with north pointing away from the viewer. For east/west lines (traverse lines) positive standard deviations lie above or to the north of the traverse line with negative standard deviation below or to the south. On the north/south lines (tie lines) positive standard deviations are to the left of the viewer (west) with negative standard deviations to the right (east).

These maps were generated at a scale of 1:250,000 for each NTMS sheet and in addition, are presented in each report at a reduced scale of approximately 1:500,000.

HISTOGRAMS

Computer generated histograms, showing the equivalent ppm and percent distributions for the three gamma ray emitters and their ratios measured and calculated as a function of computer map unit are presented in this report (See Figure IX). Information contained on these histograms includes the standard deviation as calculated about the arithmetic mean (or median), and the total number of samples from which the statistics were derived.

FIGURE IX Sample Computer Map Unit Histogram

DATA LISTINGS

Single record reduced and averaged record (statistical analysis) data listings have been prepared on microfiche. The microfiche are contained in each report. Each of the single record and averaged record data listings are presented for the data contained in a single quadrangle. The data contained in the single record data listings are summarized below:

1. Fiducial number
2. System/Quality (SAKUT) - The first digit identifies the system used to collect the sample. The remaining digits define the results of statistical adequacy testing for altitude, potassium, uranium, and thorium. A value of 0 indicated that the data are statistically adequate. A value of 1 indicates that the data are statistically inadequate. All data collected in excess of 700 feet and less than 200 feet are considered statistically inadequate.
3. Time - time presented in hours, minutes, and seconds
4. Altitude - altitude presented in feet above terrain
5. LAT/LONG - Latitude and Longitude presented in terms of decimal degrees
6. Magnetic field expressed in residual gammas
7. Geology - code representing geologic units
8. %K, eU, eT - percent potassium, equivalent ppm of uranium and thorium
9. eU/eTH, eU/%K, eTH/%K - calculated ratios of the three parameters
10. Total count - corrected total count data (0.4 to 3.0 MeV)
11. COS - downward looking cosmic count rate in the 3-6 MeV channel
12. Uair - atmospheric Bi-214 equivalent ppm
13. Temperature - outside air temperature in degrees centigrade
14. Press - barometric pressure in mm of mercury

The averaged record (statistical analysis) data listings are summarized below:

1. Fiducial number
2. System/Quality (SAKUT) - The first digit identifies the system used to collect the sample. The remaining digits define the results of statistical adequacy testing for altitude, potassium, uranium, and thorium. A value of 0 indicated that the data are statistically adequate. A value of 1 indicates that the data are statistically inadequate. All data collected in excess of 700 feet and less than 200 feet are considered statistically inadequate.
3. LAT/LONG - Latitude and longitude presented in terms of decimal degrees
4. Magnetic field expressed in residual gammas
5. Geology - code representing geologic formations
6. %K, eU, eT - percent potassium, equivalent ppm of uranium and thorium data and the number of (+) standard deviations from the mean
7. eU/eTh, eU/%K, eTh/%K - calculated ratios of the three parameters, and the number of (+) standard deviations from the mean
8. Total count - corrected total count data (0.4 to 3.0 MeV)
9. COS - downward looking cosmic count rate in the 3-6 MeV channel
10. Uair - atmospheric Bi-214 in equivalent ppm

DATA TAPES

Data tape files have been generated for each of the 1:250,000 NTMS quadrangle sheets. The tapes are IBM compatible and recorded on 9 track EBCDIC at 800 bpi. Five separate types of data tapes are presented: raw spectral data tapes, single record reduced data tapes, statistical analysis tapes, magnetic data tapes and a statistical analysis summary tape. Detailed descriptions of the data tape formats follow this discussion.

DATA INTERPRETATION METHODS

General

The stated objective of the NURE Program is the evaluation of the uranium potential of the United States. In support of this goal, high sensitivity airborne radiometric and magnetic surveys have been implemented to obtain reconnaissance information pertaining to regional distribution of uraniferous materials. Within this context, data interpretation has been oriented toward regional detection and description of anomalously high concentrations of uranium.

By far the most significant natural sources of gamma radiation in the geologic environment are the radioactive decay series of potassium 40 (K40), thorium 232 (Th232) and uranium 238 (U238) of which 0.7% is uranium 235. Potassium 40 is the largest contributor to natural radioactivity, accounting for nearly 98%, as it is the most abundant gamma ray emitter-.012% of all potassium in nature. (Refer to GSA Memoir 97 for abundances of uranium, thorium, and potassium).

Potassium 40 is directly identified by the airborne spectrometer from a single clear peak at 1.46 mev (million electron volts) in its gamma ray spectrum. However, thorium 232 and uranium 238 do not have any clear, distinct peaks at sufficiently high energies to allow direct detection from airborne systems. Instead, daughter products which do have distinct peaks are measured as representing the abundance of the parent element. For thorium 232, the daughter nuclide thallium 208 (Tl208) has a distinct peak at 2.62 mev while uranium 238 has a daughter, bismuth 214 (Bi214) possessing a clear peak at 1.76 mev (see Figure 7 for a composite decay series spectrum). Consequently the fundamental assumption implicit to airborne uranium and thorium measurements is that the measured daughter products are in radioactive equilibrium - the number of atoms of disintegrating daughter nuclides are equal to the number being formed (see Adams and Gasparini, 1970).

An airborne gamma ray measurement is the sum of photons counted during a specified time interval from a multitude of gamma ray sources which include the three geologic emitters that are being sought plus other interfering sources. These others include, but are not limited to higher energy cosmic rays, aircraft and instruments, contributions from overlapping decay series and airborne radon 222. (See Burson, 1974 and McSharry, 1973 for a more complete discussion of airborne radiometric measurements, and Radiometric Data Reduction in this volume for a complete description of data correction procedures).

When correlating ground data (geochemical, geological, etc.) with the corrected data derived from raw airborne measurements, the interpreter must remember what an individual airborne gamma ray sample physically measures. First, the terrestrial component of the gamma radiation measured by the airborne detector emanated primarily from the upper 18 inches of material on the earth's surface (Gregory and

Horwood, 1963). The airborne measurement cannot "see" any deeper into the underlying rock material and is essentially a measurement of the soil's or exposed (weathered) rock's radioactivity. Secondly, since each airborne sample is an accumulation of gamma rays measured on a moving platform over a fixed period of time, the individual sample represents a large areal extent of surficial material. For this survey, with specifications of 400 feet mean terrain clearance and an average ground speed of 140 miles per hour, a one second sample corresponds to an oval approximately 750 feet long by 600 feet wide (assuming an infinite, uniformly distributed source). Accordingly, averaged samples represent tremendous volumes of surficial materials.

Methodology

As described previously, the gamma ray data were located by computer map units, histograms were produced and statistical analyses performed. The basic unit for interpretation then is the averaged sample and its attendant deviations about a particular map unit's mean.

The uranium anomaly/interpretation map displays each individual averaged sample that meets the following criteria:

1. The averaged uranium sample must be greater than or equal to 1 standard deviation above its map unit mean.
2. The sample must have a U/T ratio greater than or equal to 1 standard deviation above its unit mean.
3. Each U/T ratio defined in (2) must have a corresponding thorium value lying at least greater than minus one (-1) standard deviation below the mean. If the thorium sample is less than one standard deviation below the mean, the U/T ratio is considered questionable.

All the possible anomalies displayed on the map are then examined for clusters, trends, and comparisons with all other available data.

Minimum requirements in the subsequent interpretation discussions of each quadrangle for anomalies listed in the uranium anomaly summary are defined as follows:

Two (2) consecutive averaged U samples lying two or more standard deviations above the mean or three (3) consecutive averaged U samples, two of which are one (1) or more standard deviations and the third of which is two (2) or more standard deviations above the mean.

Statistical anomalies which meet the above criteria can result from several factors or circumstances including: (1) true concentration of uraniferous minerals, (2) differential surface cover (soils and/or

vegetation) within a lithologic unit, (3) local weather conditions such as rain and snow, (4) extreme facies variation within a mapped unit, and (5) differential weathering of rocks within mapped units. Obviously an averaged sample which lies on the boundary between two map units is not truly reflecting either one, but is rather an average of both. Thus, for two markedly different units, such a sample would be anomalous relative to one of the units and not be a true indication of radioactive differences within the unit.

The percent potassium, equivalent ppm thorium and uranium, the three ratios and residual magnetic data were plotted as separate pseudo-contour maps and overlain on the geologic base map and standard deviation maps. Regional trends of each variable and average values could thus be easily and quickly determined and compared with the associated geological, magnetic, and statistical trends. Only the long wavelengths within each variable would show any line-to-line continuity on the pseudo-contour maps and thus, only regional trends will appear.

Each quadrangle's stacked profiles were also overlain on the corresponding geologic and standard deviation maps and anomaly map to further delineate trends and to allow a more detailed analysis of individual anomalies. Since the interpretation was concentrated on detection of anomalous uranium, subtle trends present in the potassium and thorium channels and ratios were only examined in a cursory manner. Even during such a brief examination of the profiles, it was evident that the spectrometer system was highly sensitive to changes in surface materials even in areas of low counting rates such as glacial drift. Thus radiometrics have a real potential for performing general surficial mapping "geochemical analysis" on a geologic unit (or soils) basis in addition to merely radioactive mineral "anomaly hunting".

TAPE FORMATS

SINGLE RECORD REDUCED DATA TAPE

REFERENCE: Paragraphs 4.7.6 and 6.1.6, BFEC 1200-C

The Single Record Tape is an unlabeled, nine track, 800 BPI, NRZI. All data are recorded as EBCDIC characters. Each tape contains but one file of format, header, data, and trailer records for no more than one quadrangle. The tape is divided into 6900-character blocks containing the following information.

Block 1 - Format Data

This block contains 6768 characters in 94 consecutive lines of 72 characters containing the following literal description.

02 0978 (DATA TAPE TYPE AND FORMAT SPECIFICATION DATE CODES)

SINGLE RECORD REDUCED DATA TAPE

FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK)

<u>ITEM</u>	<u>FORMAT</u>	<u>DESCRIPTION</u>
1.	A40	QUADRANGLE NAME AS PROJECT IDENTIFICATION
2.	A20	NAME OF SUBCONTRACTOR
3.	I4	APPROXIMATE DATE OF SURVEY (MONTH, YEAR)
4.	I1	NUMBER OF AERIAL SYSTEMS USED TO COLLECT DATA FOR THIS QUADRANGLE
5.	I1	AERIAL SYSTEM IDENTIFICATION CODE FOR FIRST SYSTEM
6.	A20	AIRCRAFT IDENTIFICATION BY TYPE AND FAA NUMBER FOR FIRST SYSTEM
7.	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO TERRESTRIAL POTASSIUM (K-40) TO ONE DECIMAL PLACE IN CPS PER PERCENT K
8.	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO TERRESTRIAL URANIUM (BI-214) TO ONE DECIMAL PLACE IN CPS PER PPM EQUIVALENT U
9.	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO TERRESTRIAL THORIUM (TL-208) TO ONE DECIMAL PLACE IN CPS PER PPM EQUIVALENT TH

<u>ITEM</u>	<u>FORMAT</u>	<u>DESCRIPTION</u>
13	I3	NUMBER OF CHANNELS (0-3 MEV) IN 4PI SYSTEM FOR FIRST AERIAL SYSTEM
14	I3	NUMBER OF CHANNELS (0-3 MEV) IN 2PI SYSTEM FOR FIRST AERIAL SYSTEM
15-24	(SAME)	REPEAT OF ITEMS 5-14 FOR SECOND AERIAL SYSTEM
*	*	*
*	*	*
*	*	*
85-94	(SAME)	REPEAT OF ITEMS 5-14 FOR NINTH AERIAL SYSTEM
95	I3	NUMBER OF FLIGHT LINES ON THIS TAPE
96	I4	FIRST FLIGHT LINE NUMBER ON THIS TAPE
97	I6	FIRST RECORD NUMBER OF FIRST FLIGHT LINE
98	I3	JULIAN DATE (DAY OF YEAR) FIRST FLIGHT-LINE DATA WAS COLLECTED
99-101	I4,I6,I3	REPEAT OF ITEMS 96-98 FOR SECOND FLIGHT LINE ON THIS TAPE
*	*	*
*	*	*
*	*	*
390-392	I4,I6,I3	REPEAT OF ITEMS 96-98 FOR 99th FLIGHT LINE ON THIS TAPE

FORMAT FOR SINGLE RECORD REDUCED DATA RECORD (THIRD THRU LAST BLOCK)

<u>ITEM</u>	<u>FORMAT</u>	<u>DESCRIPTION</u>
1	I1	AERIAL SYSTEM IDENTIFICATION CODE
2	I4	FLIGHT LINE NUMBER
3	I6	RECORD IDENTIFICATION NUMBER
4	I6	GMT TIME OF DAY (HHMMSS)
5	F8.4	LATITUDE TO FOUR DECIMAL PLACES IN DEGREES
6	F8.4	LONGITUDE TO FOUR DECIMAL PLACES IN DEGREES
7	F6.1	TERRAIN CLEARANCE TO ONE DECIMAL PLACE IN METERS
8	F7.1	RESIDUAL (IGRF REMOVED) MAGNETIC FIELD INTENSITY TO ONE DECIMAL PLACE IN GAMMAS
9	A8	SURFACE GEOLOGIC MAP UNIT CODE
10	I4	QUALITY FLAG CODES
11	F6.1	APPARENT CONCENTRATION OF TERRESTRIAL POTASSIUM (K-40) TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
14	F4.1	UNCERTAINTY IN TERRESTRIAL URANIUM TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
15	F6.1	APPARENT CONCENTRATION OF TERRESTRIAL THORIUM (TL-208) TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH
16	F4.1	UNCERTAINTY IN TERRESTRIAL THORIUM TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH
17	F6.1	URANIUM-TO-THORIUM RATIO TO ONE DECIMAL PLACE IN PPM EQUIVALENT U PER PPM EQUIVALENT TH
18	F6.1	URANIUM-TO-POTASSIUM RATIO TO ONE DECIMAL PLACE IN PPM EQUIVALENT U PER PERCENT K
19	F5.1	THORIUM-TO-POTASSIUM RATIO TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH PER PERCENT K

ITEM	FORMAT	DESCRIPTION
20	F8.1	GROSS GAMMA (0.4-3.0 MEV) COUNT RATE TO ONE DECIMAL PLACE IN COUNTS PER SECOND
21	F6.1	UNCERTAINTY IN GROSS GAMMA COUNT RATE TO ONE DECIMAL PLACE IN COUNTS PER SECOND
22	F5.1	ATMOSPHERIC BI-214 4PI CORRECTION TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
23	F4.1	UNCERTAINTY IN ATMOSPHERIC BI-214 4PI CORRECTION TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
24	F4.1	OUTSIDE AIR TEMPERATURE TO ONE DECIMAL PLACE IN DEGREES CELSIUS
25	F5.1	OUTSIDE AIR PRESSURE TO ONE DECIMAL PLACE IN MMHG

This description serves to identify the format of data on subsequent blocks on the tape. The remaining 132 characters on this block are blanks.

Block 2 - Single Record Reduced Identification Data

The second block contains the identifier information for the data contained in subsequent blocks. The identification information is written according to the format description in the first half of the first block. The remaining 4978 characters on this block are blanks.

Block 3 - Single Record Reduced Data

These blocks contain data written according to the format description in the second half of the first block. There will be 50 logical records per physical block. As of August 1979, the method for determining uncertainties specified in the data blocks remains undefined, and those values are filled with 9's under format control.

STATISTICAL ANALYSIS TAPE

REFERENCE: Paragraphs 4.7.7 and 6.1.6, BFEC 1200-C

The statistical analysis data tape is an unlabeled, nine track, 800 BPI, NRZI. All data is recorded as EBCDIC characters. The block length is 8000 characters long. Each tape contains one file of data for no more than one quadrangle.

Block 1 - Format Description Data

The first physical block on this tape contains a format description for data on subsequent blocks. The first 7560 characters on this block contains 105 lines of 72 characters exactly as written below:

03 0978 (DATA TAPE TYPE AND FORMAT SPECIFICATION DATE CODES)

STATISTICAL ANALYSIS DATA TAPE

FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK)

ITEM	FORMAT	DESCRIPTION
1	A40	QUADRANGLE NAME AS PROJECT IDENTIFICATION
2	A20	NAME OF SUBCONTRACTOR
3	I4	APPROXIMATE DATE OF SURVEY (MONTH, YEAR)
4	I1	NUMBER OF AERIAL SYSTEMS USED TO COLLECT DATA FOR THIS QUADRANGLE
5	I1	AERIAL SYSTEM IDENTIFICATION CODE FOR FIRST SYSTEM
6	A20	AIRCRAFT IDENTIFICATION BY TYPE AND FAA NUMBER FOR FIRST SYSTEM
7	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO TERRESTRIAL POTASSIUM (K-40) TO ONE DECIMAL PLACE IN CPS PER PERCENT K
8	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO TERRESTRIAL URANIUM (BI-214) TO ONE DECIMAL PLACE IN CPS PER PPM EQUIVALENT U
9	F6.1	NOMINAL ALTITUDE SYSTEM SENSITIVITY RELATIVE TO TERRESTRIAL THORIUM (TL-208) TO ONE DECIMAL PLACE IN CPS PER PPM EQUIVALENT TH
10	I6	BLANK FIELD (99999)
11	F6.3	4PI-SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL PLACES IN SECONDS FOR FIRST SYSTEM
12	F6.3	2PI-SYSTEM DATA COLLECTION INTERVAL TO THREE DECIMAL PLACES IN SECONDS FOR FIRST SYSTEM
13	I3	NUMBER OF CHANNELS (0-3 MEV) IN 4PI SYSTEM FOR FIRST AERIAL SYSTEM
14	I3	NUMBER OF CHANNELS (0-3 MEV) IN 2PI SYSTEM FOR FIRST AERIAL SYSTEM

ITEM	FORMAT	DESCRIPTION
15-24	(SAME)	REPEAT OF ITEMS 5-14 FOR SECOND AERIAL SYSTEM
*	*	*
*	*	*
*	*	*
85-94	(SAME)	REPEAT OF ITEMS 5-14 FOR NINTH AERIAL SYSTEM
95	I3	NUMBER OF FLIGHT LINES ON THIS TAPE
96	I4	FIRST FLIGHT LINE NUMBER ON THIS TAPE
97	I6	FIRST RECORD NUMBER OF FIRST FLIGHT LINE
98	I3	JULIAN DATE (DAY OF YEAR) FIRST FLIGHT-LINE DATA WAS COLLECTED
99-101	I4,I6,I3	REPEAT OF ITEMS 96-98 FOR SECOND FLIGHT LINE ON THIS TAPE
*	*	*
*	*	*
*	*	*
390-392	I4,I6,I3	REPEAT OF ITEMS 96-98 FOR 99th FLIGHT LINE ON THIS TAPE

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

ITEM	FORMAT	DESCRIPTION
1	I1	AERIAL SYSTEM IDENTIFICATION CODE
2	I4	FLIGHT LINE NUMBER
3	I6	RECORD IDENTIFICATION NUMBER
4	I6	GMT TIME OF DAY (HHMMSS)
5	F8.4	LATITUDE TO FOUR DECIMAL PLACES IN DEGREES
6	F8.4	LONGITUDE TO FOUR DECIMAL PLACES IN DEGREES
7	F6.1	TERRAIN CLEARANCE TO ONE DECIMAL PLACE IN METERS
8	F7.1	RESIDUAL (IGRF Removed) MAGNETIC FIELD INTENSITY TO ONE DECIMAL PLACE IN GAMMAS
9	A8	SURFACE GEOLOGIC MAP UNIT CODE
10	I4	QUALITY FLAG CODES
11	F6.1	APPARENT CONCENTRATION OF TERRESTRIAL POTASSIUM (K-40) TO ONE DECIMAL PLACE IN PERCENT K
12	F4.1	UNCERTAINTY IN TERRESTRIAL POTASSIUM TO ONE DECIMAL PLACE IN PERCENT K
13	F5.1	POTASSIUM STANDARD DEVIATION FROM THE MEAN TO ONE DECIMAL PLACE AND ALGEBRAICALLY SIGNED
14	F6.1	AVERAGED CONCENTRATION OF TERRESTRIAL URANIUM (BI-214) TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
15	F4.1	UNCERTAINTY IN TERRESTRIAL URANIUM TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
16	F5.1	URANIUM STANDARD DEVIATION FROM THE MEAN TO ONE DECIMAL PLACE AND ALGEBRAICALLY SIGNED
17	F6.1	AVERAGED CONCENTRATION OF TERRESTRIAL THORIUM (TL-208) TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH
18	F4.1	UNCERTAINTY IN TERRESTRIAL THORIUM TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH
19	F5.1	THORIUM STANDARD DEVIATION FROM THE MEAN TO ONE DECIMAL PLACE AND ALGEBRIACALLY SIGNED.

ITEM	FORMAT	DESCRIPTION
20	F8.1	GROSS GAMMA (0.4-3.0 MEV) COUNT RATE TO ONE DECIMAL PLACE IN COUNTS PER SECOND
21	F6.1	UNCERTAINTY IN GROSS GAMMA COUNT RATE TO ONE DECIMAL PLACE IN COUNTS PER SECOND
22	F5.1	ATMOSPHERIC BI-214 4PI CORRECTION TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
23	F4.1	UNCERTAINTY IN ATMOSPHERIC BI-214 4PI CORRECTION TO ONE DEICMAL PLACE IN PPM EQUIVALENT U
24	F4.1	AVERAGED URANIUM-TO-THORIUM RATIO TO ONE DECIMAL PLACE IN PPM EQUIVALENT U PER PPM EQUIVALENT TH
25	F5.1	URANIUM-TO-THORIUM RATIO STANDARD DEVIATION FROM THE MEAN TO ONE DECIMAL PLACE AND ALGEBRAICALLY SIGNED
26	F6.1	AVERAGED URANIUM-TO-POTASSIUM RATIO TO ONE DECIMAL PLACE IN PPM EQUIVALENT U PER PERCENT K
27	F5.1	THORIUM-TO-POTASSIUM RATIO STANDARD DEVIATION FROM THE MEAN TO ONE DECIMAL PLACE AND ALGEBRAICALLY SIGNED
D8	F6.1	AVERAGED THORIUM-TO-POTASSIUM RATIO TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH PER PERCENT K
29	F5.1	THORIUM-TO-POTASSIUM RATIO STANDARD DEVIATION FROM THE MEAN TO ONE DECIMAL PLACE AND ALGEBRAICALLY SIGNED

The remaining 440 characters in this block are blanks.

Block 2 - Statistical Analysis Identification Data

The second block contains the identifier information for the data contained in subsequent blocks according to the format specification in the first part of Block 1. The final 6078 characters on this block are blanks.

Block 3 - Statistical Analysis Data

The third and subsequent blocks contain statistical analysis data in the format specified by the second part of the Block 1. Fifty logical records are allowed per block. The method for determining uncertainty values shown, as of August 1979, remains undefined. These values are filled with 9's under format control.

MAGNETIC DATA TAPE

REFERENCE: Paragraphs 4.7.8 and 6.1.6, BFEC 1200-C

The Magentic Data Tape is an unlabeled, nine track, 800 BPI, NRZI. All data are recorded as EBCDIC characters. Each tape contains data for no more than one quadrangle and are divided into 8000-character blocks as described below.

Block 1 - Tape Format Description

The first block contains 3384 characters of format information in exactly the following format:

04 0978 (DATA TAPE TYPE AND FORMAT SPECIFICATION DATE CODES)

MAGNETIC DATA TAPE

FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK)

ITEM	FORMAT	DESCRIPTION
1	A40	QUADRANGLE NAME AS PROJECT IDENTIFICATION
2	A20	NAME OF SUBCONTRACTOR
3	I4	APPROXIMATE DATE OF SURVEY (MONTH., YEAR
4	I3	NUMBER OF FLIGHT LINES ON THIS TAPE
5	I4	FIRST FLIGHT LINE ON THIS TAPE
6	I6	FIRST RECORD NUMBER OF FIRST FLIGHT LINE
7	I3	JULIAN DATE (DAY OF YEAR) FIRST FLIGHT-LINE DATA WAS COLLECTED
8	F8.4	LATITUDE OF GROUND BASE STATION TO FOUR DECIMAL PLACES IN DEGREES FOR FIRST FLIGHT LINE
9	F8.4	LONGITUDE OF GROUND BASE STATION TO FOUR DECIMAL PLACES IN DEGREES FOR FIRST FLIGHT LINE
10-14	(SAME)	REPEAT OF ITEMS 5-9 FOR SECOND FLIGHT LINE ON THIS TAPE
*	*	*
*	*	*
*	*	*
495-499	(SAME)	REPEAT OF ITEMS 5-9 FOR 99th FLIGHT LINE ON THIS TAPE

FORMAT FOR MAGNETIC DATA RECORD (THIRD THRU LAST BLOCK)

ITEM	FORMAT	DESCRIPTION
1	I1	AERIAL SYSTEM IDENTIFICATION CODE
2	I4	FLIGHT LINE NUMBER
3	I6	RECORD IDENTIFICATION NUMBER
4	I6	GMT TIME OF DAY (HHMMSS)
5	F8.4	LATITUDE TO FOUR DECIMAL PLACES IN DEGREES

ITEM	FORMAT	DESCRIPTION
6	F8.4	LONGITUDE TO FOUR DECIMAL PLACES IN DEGREES
7	F6.1	TERRAIN CLEARANCE TO ONE DECIMAL PLACE IN METERS
8	F5.1	OUTSIDE AIR PRESSURE TO ONE DECIMAL PLACE IN MMHG
9	A8	SURFACE GEOLOGIC MAP UNIT CODE
10	F7.1	TOTAL MAGNETIC FIELD INTENSITY TO ONE DECIMAL PLACE IN GAMMAS
11	F7.1	RESIDUAL (IGRF REMOVED) MAGNETIC FIELD INTENSITY TO ONE DECIMAL PLACE IN GAMMAS
12	F7.1	DIURNAL MAGNETIC INTENSITY VARIATION TO ONE DECIMAL PLACE IN GAMMAS
13	F7.1	MAGNETIC DEPTH-TO-BASEMENT TO ONE DECIMAL PLACE IN METERS (IF REQUIRED)

The remaining 4616 characters in this block are blanks.

Block 2 - Magnetic Tape Identification Data

This block contains information about the data in subsequent blocks organized according to the format specification in the first half of Block 1.

Block 3 - Magnetic Data

This block and subsequent block contains magnetic data for the quadrangle organized according to the format specifications in the second half of Block 1. There will be 100 logical records per physical block.

STATISTIC ANALYSIS SUMMARY TAPE

REFERENCE: Paragraphs 4.7.9, BFEC 1200-C

The statistical analysis summary tape is an unlabeled, nine track, 800 BPI, NRZI. All data is recorded as EBCDIC characters. The block length is 700 characters long. Each tape contains one file of data for no more than one quadrangle.

Block 1 - Format Description Data

The first physical block on this tape contains a format description for data on subsequent blocks. The first 4320 characters on this block contains 60 lines of 72 characters exactly as written below:

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

STATISTICAL ANALYSIS SUMMARY TAPE (OR FILE)

FORMAT FOR TAPE IDENTIFICATION BLOCK (SECOND BLOCK)

ITEM	FORMAT	DESCRIPTION
1	A40	QUADRANGLE NAME AS PROJECT IDENTIFICATION
2	A20	NAME OF SUBCONTRACTOR
3	I4	APPROXIMATE DATE OF SURVEY (MONTH, YEAR)
4	I6	NUMBER OF GEOLOGIC MAP UNITS USED FOR THIS QUADRANGLE

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

ITEM	FORMAT	DESCRIPTION
1	A8	SURFACE GEOLOGIC MAP UNIT IDENTIFYING CODE
2	I6	TOTAL RECORDS FOR GEOLOGIC MAP UNIT
3	I6	NUMBER OF POTASSIUM RECORDS COMPUTED FOR GEOLOGIC UNIT
4	F6.1	POTASSIUM CONCENTRATION MEAN TO ONE DECIMAL PLACE IN PERCENT K
5	F6.1	POTASSIUM CONCENTRATION STANDARD DEVIATION TO ONE DECIMAL PLACE IN PERCENT K
6	A3	POTASSIUM CONCENTRATION DISTRIBUTION CODE
7	I6	NUMBER OF URANIUM RECORDS COMPUTED FOR GEOLOGIC UNIT
8	F6.1	URANIUM CONCENTRATION MEAN TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
9	F6.1	URANIUM CONCENTRATION STANDARD DEVIATION TO ONE DECIMAL PLACE IN PPM EQUIVALENT U
10	A3	URANIUM CONCENTRATION DISTRIBUTION CODE
11	I6	NUMBER OF THORIUM RECORDS COMPUTED FOR GEOLOGIC UNIT
12	F6.1	THORIUM CONCENTRATION MEAN TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH
13	F6.1	THORIUM CONCENTRATION STANDARD DEVIATION TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH
14	A3	THORIUM CONCENTRATION DISTRIBUTION CODE
15	I6	NUMBER OF URANIUM-TO-THORIUM RATIO RECORDS COMPUTED FOR GEOLOGIC UNIT

16	F6.1	URANIUM-TO-THORIUM RATIO MEAN TO ONE DECIMAL PLACE IN PPM EQUIVALENT U PER PPM EQUIVALENT U PER PPM EQUIVALENT TH
17	F6.1	URANIUM-TO-THORIUM RATIO STANDARD DEVIATION TO ONE DECIMAL PLACE IN PPM EQUIVALENT U PER PPM EQUIVALENT TH
18	A3	URANIUM-TO-THORIUM RATIO DISTRIBUTION CODE
19	I6	NUMBER OF URANIUM-TO-POTASSIUM RATIO RECORDS COMPUTED FOR GEOLOGIC UNIT
20	F6.1	URANIUM -TO-POTASSIUM RATIO MEAN TO ONE DECIMAL PLACE IN PPM EQUIVALENT U PER PERCENT K
21	F6.1	URANIUM-TO-POTASSIUM RATIO STANDARD DEVIATION TO ONE DECIMAL PLACE IN PPM EQUIVALENT U PER PERCENT K
22	A3	URANIUM-TO-POTASSIUM RATIO DISTRIBUTION CODE
23	I6	NUMBER OF THORIUM-TO-POTASSIUM RATIO RECORDS COMPUTED FOR GEOLOGIC UNIT
24	F6.1	THORIUM-TO-POTASSIUM RATIO MEAN TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH PER PERCENT K
25	F6.1	THORIUM-TO-POTASSIUM RATIO STANDARD DEVIATION TO ONE DECIMAL PLACE IN PPM EQUIVALENT TH PER PERCENT K
26	A3	THORIUM-TO-POTASSIUM RATIO DISTRIBUTION CODE

The remaining 2680 characters on this block shall be blanks.

Block 2 - Statistical Analysis Identification Data

The second block contains the identifier information for the data contained in subsequent blocks according to the format specification in the first part of Block 1. The final 6930 characters on this block are blanks.

Block 3 - Statistical Analysis Summary Data

The third and subsequent blocks contain statistical analysis data in the format specified by the second part of the Block 1. Fifty logical records are allowed per block.

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- Gregory, A. F., and Horwood, J. L., 1963, A Spectrometric Study of the Attenuation in Air of Gamma Rays from Mineral Resources; U.S. Atomic Energy Commission Report CEX-60-3, Washington, D.C.
- McSharry, P. J. and Emerson, D. W., The Collection and Processing of Gamma Ray Spectrometer Data; 2nd International Conference on Geophysics of the Earth and Oceans, Sydney, Australia, January 1973.

APPENDIX B - Flight Summary

APPENDIX B

DAILY PRODUCTION SUMMARY JUNE AND JULY, 1980

EL DORADO, GREENWOOD, WEST POINT, HELENA, MEMPHIS,

RUSSELLVILLE, AND FORTH SMITH QUADRANGLES

QUEEN AIR N9AG

6-14-80	Ferry to Greenville, Mississippi
6-15-80	755 miles El Dorado, Greenwood, West Point
6-16-80	698 miles El Dorado, Greenwood, West Point, Helena
6-17-80	698 miles " " " "
6-18-80	698 miles " " " "
6-19-80	249 miles Greenwood, Helena, West Point
6-20-80 to 6-21-80	Weather - nil production
6-22-80	607 miles Greenwood, Helena, West Point
6-23-80 to 6-24-80	Weather - nil production
6-25-80	676 miles Greenwood, El Dorado, West Point
6-26-80	902 miles El Dorado, Greenwood, West Point, Helena
6-27-80	1,025 miles Greenwood, Helena, Memphis
6-28-80	587 miles " " " "
6-29-80 to 7-1-80	Ferry to Fort Smith, Arkansas
7-2-80	678 miles Fort Smith, Russellville, Memphis
7-3-80	Equipment malfunctions - nil production
7-4-80	941 miles Fort Smith, Russellville, Memphis, Helena
7-5-80	678 miles Fort Smith, Russellville, Memphis
7-6-80	1,039 miles Fort Smith, Russellville, Memphis, Helena
7-7-80	736 miles Fort Smith, Russellville, Memphis
7-8-80 to 7-10-80	Equipment Repairs - nil production
7-11-80	2645 miles Fort Smith
7-12-80	1,086 miles Fort Smith, Russellville, Memphis, Helena
7-13-80	528 miles Fort Smith, Russellville

Total for the above period - 12,825 miles as recorded by the flight crew.

Total from May, 1980 for Russellville quadrangle - 109 miles.

Total miles for the included quadrangles:

El Dorado	1,867
Greenwood	1,867
West Point	1,867
Helena	1,851
Fort Smith	1,834
Russellville	1,834
Memphis	1,834

APPENDIX C - Flight Path and Geologic Map

FORT SMITH

SURVEY AND
COMPILED BY:
EG&G GEOMETRICS

SCALE 1:500,000
MILES 0 5 10 15 20
KILOMETRES 0 5 10 15 20
FLIGHT LINE SPACING 8.0 MILES
FLIGHT ALTITUDE 400 FEET AMT
FLOWN AND COMPILED 1980

FLIGHT PATH RECOVERY

MISSISSIPPI / FLORIDA PROJECT

U. S. DEPARTMENT OF ENERGY

GEOLOGIC MAP EXPLANATION
FORT SMITH QUADRANGLE
(from Martel Laboratories, 1980)

APPENDIX D - Profiles

LINE 260
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80186

LINE 270
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80188

LINE 280
FCRT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80188

LINE 290
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80184

LINE 300
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80184

MIN	4.415
MAX	24.68
MEAN	13.22
STD DEV	2.645

MIN	.0000
MAX	9.997
MEAN	4.501
STD DEV	1.390

MIN	.0000
MAX	.7846
MEAN	.3386
STD DEV	.0691

MIN	359.1
MAX	1756
MEAN	6266
STD DEV	199.3

MIN	1.069
MAX	1.481
MEAN	.5321
STD DEV	.1759

MIN	.7025
MAX	3.862
MEAN	2.225
STD DEV	.1700

MIN	1.020
MAX	10.57
MEAN	6.698
STD DEV	1.407

MIN	.4111
MAX	1.653
MEAN	.8782
STD DEV	.2213

MIN	-659.9
MAX	-263.0
MEAN	-456.8
STD DEV	90.64

MIN	254.2
MAX	592.9
MEAN	399.0
STD DEV	56.59

LINE 310

LINE 320
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80187

BI AIR CORR 21
9. EQ. PM 10. EQ. PM

LINE 350
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80194

LINE 360
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80194

LINE 1020
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80195

TL/K	
MIN	.0000
MAX	25.62
MEAN	11.50
STD DEV	3.481

BI/K	
MIN	.0000
MAX	11.43
MEAN	3.689
STD DEV	1.333

BI/TL	
MIN	.0000
MAX	.9499
MEAN	.3167
STD DEV	.0774

TOTAL COUNTS	
CTS/SEC	
MIN	178.9
MAX	1886
MEAN	1325
STD DEV	280.9

POTASSIUM	40
PERCENT	
MIN	.0901
MAX	1.379
MEAN	.6566
STD DEV	.1960

BISMUTH 214	
EQ. PPM	
MIN	.5723
MAX	3.849
MEAN	2.327
STD DEV	.5806

THALLIUM 208	
EQ. PPM	
MIN	.6544
MAX	10.88
MEAN	7.232
STD DEV	1.752

BI AIR CORR	
EQ. PPM	
MIN	.3781
MAX	1.297
MEAN	.7521
STD DEV	.2058

RESID MAG	
GAMMAS	
MIN	-792.1
MAX	-342.9
MEAN	-456.1
STD DEV	95.27

KHUAR ALTMTR	
FEET	
MIN	237.5
MAX	528.1
MEAN	388.8
STD DEV	51.33

LINE 1040
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80193

LINE 1040

QBI AIR CORR Z,
6 19
EQ. PPH

LINE 1060
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80193

LINE 250
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80186

BARO PRESSURE
MM HG
MIN 697.5
MAX 733.4
MEAN 718.4
STD DEV 7.522

AIR TEMPERATURE
DEG C
MIN 31.00
MAX 35.00
MEAN 33.35
STD DEV 1.020

RESIDUAL MAG
GAMMAS
MIN -693.8
MAX -285.7
MEAN -508.8
STD DEV 03.00

DIURNAL
GAMMAS
MIN 54370
MAX 54374
MEAN 54368
STD DEV 3.963

RADAR ALTIMTR
FEET
MIN 187.7
MAX 639.2
MEAN 375.9
STD DEV 55.92

LINE 260
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80186

BARO PRESSURE
MM HG
MIN 691.8
MAX 733.7
MEAN 717.3
STD DEV 9.137

AIR TEMPERATURE
DEG C
MIN 25.00
MAX 35.00
MEAN 31.43
STD DEV 3.444

RESIDUAL MAG
GAMMAS
MIN -695.2
MAX -317.1
MEAN -496.3
STD DEV 73.36

DIURNAL
GAMMAS
MIN 54352
MAX 54375
MEAN 54363
STD DEV 10.62

RADAR ALTMTR
FEET
MIN 211.9
MAX 674.1
MEAN 388.7
STD DEV 67.02

LINE 270
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80188

LINE 280
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80188

LINE 290
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80184

BARO PRESSURE	
MM HG	
MIN	714.3
MAX	737.2
MEAN	725.2
STD DEV	3.150

AIR TEMPERATURE	
DEG C	
MIN	29.00
MAX	38.00
MEAN	33.61
STD DEV	2.876

RESIDUAL MAG	
GAMMAS	
MIN	-659.9
MAX	-263.0
MEAN	-456.8
STD DEV	90.64

DIURNAL	
GAMMAS	
MIN	54357
MAX	54369
MEAN	54353
STD DEV	9.822

RADAR ALTMTR	
FEET	
MIN	254.2
MAX	592.9
MEAN	399.0
STD DEV	56.59

LINE 300

LINE 310
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80187

BARO PRESSURE
MIN 715.6
MAX 740.4
MEAN 729.0
STD DEV 3.397

AIR TEMPERATURE
MIN 31.00
MAX 33.00
MEAN 32.20
STD DEV .4872

RESIDUAL MAG
MIN -549.3
MAX -213.2
MEAN -400.0
STD DEV 65.36

DIURNAL
MIN 54348
MAX 54360
MEAN 54348
STD DEV 6.374

RADAR ALTMTR
MIN 253.3
MAX 609.3
MEAN 412.4
STD DEV 47.70

LINE 320
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80187

BARO PRESSURE
MM HG
MIN 711.9
MAX 743.8
MEAN 729.3
STD DEV 4.485

AIR TEMPERATURE
DEG C
MIN 27.00
MAX 33.00
MEAN 30.97
STD DEV 2.214

RESIDUAL MAG
GAMMAS
MIN -472.4
MAX -212.5
MEAN -358.5
STD DEV 59.30

DIURNAL
GAMMAS
MIN 54361
MAX 54369
MEAN 54358
STD DEV 8.222

RADAR ALTHTR
FEET
MIN 238.9
MAX 1047
MEAN 428.3
STD DEV 134.3

LINE 330
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80189

BARO PRESSURE
MM HG
MIN 717.8
MAX 746.5
MEAN 728.7
STD DEV 4.173

AIR TEMPERATURE
DEG C
MIN 29.00
MAX 34.00
MEAN 31.44
STD DEV 1.676

RESIDUAL MAG
GAMMAS
MIN -542.2
MAX -56.57
MEAN -344.8
STD DEV 82.88

DIURNAL
GAMMAS
MIN 54332
MAX 54364
MEAN 54336
STD DEV 16.36

RADAR ALTMTR
FEET
MIN 263.7
MAX 530.6
MEAN 389.5
STD DEV 40.12

LINE 340
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80189

LINE 350
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80194

BARO PRESSURE
MM HG
MIN 704.1
MAX 736.1
MEAN 723.7
STD DEV 4.508

AIR TEMPERATURE
DEG C
MIN 30.00
MAX 38.00
MEAN 34.79
STD DEV 2.832

RESIDUAL MAG
GAMMAS
MIN -471.2
MAX -265.5
MEAN -345.9
STD DEV 43.52

DIURNAL
GAMMAS
MIN 54352
MAX 54375
MEAN 54362
STD DEV 10.25

RADAR ALTMTR
FEET
MIN 244.3
MAX 571.6
MEAN 391.6
STD DEV 48.96

LINE 350

LINE 360
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80194

BARO PRESSURE MM HG	
MIN	704.8
MAX	735.0
MEAN	719.3
STD DEV	5.263

AIR TEMPERATURE DEG C	
MIN	35.00
MAX	38.00
MEAN	36.86
STD DEV	.8623

RESIDUAL MAG GAMMAS	
MIN	-484.2
MAX	-219.1
MEAN	-332.5
STD DEV	64.56

DIURNAL GAMMAS	
MIN	54366
MAX	54373
MEAN	54369
STD DEV	2.016

RADAR ALTMTR FEET	
MIN	145.0
MAX	690.4
MEAN	382.3
STD DEV	69.35

LINE 1010
FCRT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80195

LINE 1020
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80195

LINE 1030
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80193

LINE 1040
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80193

LINE 1050
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80193

LINE 1060
FORT SMITH QUADRANGLE - NTMS NI 15-1
DATA ACQUIRED 80193

APPENDIX E - Standard Deviation Maps

FORT SMITH

SCALE 1:500,000

SURVEY AND
COMPILED BY:

EG&G GEOMETRICS

NOTE: ON E-W LINES, +σ TO NORTH, -σ TO SOUTH.
ON N-S LINES, +σ TO WEST, -σ TO EAST.

POTASSIUM STANDARD DEVIATION MAP

MISSISSIPPI / FLORIDA PROJECT

U. S. DEPARTMENT OF ENERGY

FORT SMITH

URANIUM STANDARD DEVIATION MAP

MISSISSIPPI / FLORIDA PROJECT

U. S. DEPARTMENT OF ENERGY

SURVEY AND
COMPILED BY:

EB&G GEOMETRICS

FORT SMITH

SCALE 1:500,000

○ DATA STATISTICALLY ADEQUATE
 ⊕ DATA STATISTICALLY INADEQUATE
 ⊕ 1 σ ABOUT MEASURE OF CENTRAL TENDENCY
 NOTE: ON E-W LINES, ⊕ TO NORTH, ⊖ TO SOUTH.
 ON N-S LINES, ⊕ TO WEST, ⊖ TO EAST.

THORIUM STANDARD DEVIATION MAP

MISSISSIPPI / FLORIDA PROJECT

U. S. DEPARTMENT OF ENERGY

SURVEY AND
COMPILATION BY:

EG&G GEOMETRICS

FORT SMITH

SCALE 1:500,000

NOTE: ON E-W LINES, +σ TO NORTH, -σ TO SOUTH.
ON N-S LINES, +σ TO WEST, -σ TO EAST.

THORIUM/POTASSIUM STANDARD DEVIATION MAP

MISSISSIPPI / FLORIDA PROJECT

U. S. DEPARTMENT OF ENERGY

SURVEY AND
COMPILED BY:

EG&G GEOMETRICS

FORT SMITH

E5
rB

SCALE 1:500,000

○ - DATA STATISTICALLY ADEQUATE
+ - DATA STATISTICALLY INADEQUATE
· - MEASURE OF CENTRAL TENDENCY
NOTE: ON E-W LINES, + to NORTH, - to SOUTH.
ON N-S LINES, + to WEST, - to EAST.

SURVEY AND
COMPILATION BY:

EG&G GEOMETRICS

URANIUM/POTASSIUM STANDARD DEVIATION MAP

MISSISSIPPI / FLORIDA PROJECT

U. S. DEPARTMENT OF ENERGY

FORT SMITH

SCALE 1:500,000

NOTE: ON E-W LINES, +σ TO NORTH, -σ TO SOUTH.
ON N-S LINES, +σ TO WEST, -σ TO EAST.

URANIUM/THORIUM STANDARD DEVIATION MAP

MISSISSIPPI / FLORIDA PROJECT

U. S. DEPARTMENT OF ENERGY

SURVEY AND
COMPILED BY:

EG&G GEOMETRICS

**APPENDIX F - Histograms and Map Unit Conversion
Table**

NTMS NI 15-1 FORT SMITH

MAP UNIT : QAL

TOTAL NUMBER OF SAMPLES 3959

NTMS NI 15-1 FORT SMITH

MAP UNIT : QTS

TOTAL NUMBER
OF SAMPLES 1887

NTMS NI 15-1 FORT SMITH

MAP UNIT : IPHD TOTAL NUMBER OF SAMPLES 226

NTMS NI 15-1 FORT SMITH

MAP UNIT : IPWK

TOTAL NUMBER
OF SAMPLES

745

NTMS NI 15-1 FORT SMITH

MAP UNIT : IPWT

TOTAL NUMBER OF SAMPLES 101

NTMS NI 15-1 FORT SMITH

MAP UNIT : IPCV

TOTAL NUMBER
OF SAMPLES 517

NTMS NI 15-1 FORT SMITH

MAP UNIT : IPSN

TOTAL NUMBER
OF SAMPLES 2883

NTMS NI 15-1 FORT SMITH

MAP UNIT : IPST

TOTAL NUMBER
OF SAMPLES

187

NTMS NI 15-1 FORT SMITH

MAP UNIT : IPT

TOTAL NUMBER
OF SAMPLES 371

NTMS NI 15-1 FORT SMITH

MAP UNIT : IPBY

TOTAL NUMBER
OF SAMPLES 4477

NTMS NI 15-1 FORT SMITH

MAP UNIT : IPBJ

TOTAL NUMBER OF SAMPLES 966

NTMS NI 15-1 FORT SMITH

MAP UNIT : IPSV

TOTAL NUMBER
OF SAMPLES 2551

THORIUM

URANIUM

POTASSIUM

U/K

U/TH

TH/K

NTMS NI 15-1 FORT SMITH

MAP UNIT : IPMA

TOTAL NUMBER OF SAMPLES 6751

NTMS NI 15-1 FORT SMITH

MAP UNIT : IPHS

TOTAL NUMBER
OF SAMPLES

784

NTMS NI 15-1 FORT SMITH

MAP UNIT : IPA

TOTAL NUMBER
OF SAMPLES 9031

NTMS NI 15-1 FORT SMITH

MAP UNIT : IPAU

TOTAL NUMBER
OF SAMPLES 1143

NTMS NI 15-1 FORT SMITH

MAP UNIT : IPAM

TOTAL NUMBER
OF SAMPLES 157

THORIUM

URANIUM

POTASSIUM

U/K

U/TH

TH/K

NTMS NI 15-1 FORT SMITH

MAP UNIT : IPAL

TOTAL NUMBER OF SAMPLES 130

THORIUM

URANIUM

POTASSIUM

U/K

U/TH

TH/K

NTMS NI 15-1 FORT SMITH

MAP UNIT : IPSI

TOTAL NUMBER
OF SAMPLES

76

F21
fs

THORIUM

URANIUM

POTASSIUM

U/K

U/TH

TH/K

NTMS NI 15-1 FORT SMITH

MAP UNIT : MPFB

TOTAL NUMBER
OF SAMPLES 1519

F22
f8

NTMS NI 15-1 FORT SMITH

MAP UNIT : MB

TOTAL NUMBER OF SAMPLES 2666

NTMS NI 15-1 FORT SMITH

MAP UNIT : MDC

TOTAL NUMBER
OF SAMPLES 87

THORIUM

URANIUM

POTASSIUM

U/K

U/TH

TH/K

NTMS NI 15-1 FORT SMITH

MAP UNIT : OS

TOTAL NUMBER
OF SAMPLES 78

FORT SMITH QUADRANGLEComputer Map Unit Symbol Conversion Table

<u>Computer Map Unit Symbol</u>	<u>Geologic Map Unit Symbol</u>
QAL	Qa1
QTS	Qts
* QS	Qs
IPHD	IPhd
IPWK	IPwk
IPWT	IPwt
IPCV	IPcv
IPSN	IPsn
IPST	IPst
IPT	IPt
IPBY	IPby
IPBJ	IPbj
IPSV	IPsv
IPMA	IPma
IPHS	IPhs
IPA	IPa
IPAU	IPau
IPAM	IPam
IPAL	IPal
IPBH	IPbh
IPHC	IPhc
IPSI	IPsi
MPFB	MPfb
MB	Mb
MDC	MDC
* SSC	Ssc
OS	Os

NOTES:

On the following pages, histograms for each computer map unit are included in the same order as they appear on the above list.

Geologic descriptions of the original geologic map units are in Appendix A.

Areas over water or cultural features were assigned separate map unit symbols and were removed from the data block during processing.

* A statistical analysis was not done due to an inadequate number of samples. Therefore, there are no histograms for units marked in this way.

**APPENDIX G - Uranium Anomaly Summary and
Statistical Tables**

ANOMALY SUMMARY TABLE

ANOMALY	FLIGHT	COMPUTER MAP UNIT AND NO.	ANOMALOUS SAMPLES IN UNIT
---------	--------	---------------------------	---------------------------

1 C	250	IPBJ	/ 1 / 0
2 C	250	IPA	/ 2MPFB / 2
3 C	250	IPBH	/ 1 / 0
4 C	260	QTS	/ 2 / 0
5 C	260	IPBY	/ 2 / 0
6 C	260	QTS	/ 2 / 0
7 C	260	IPSV	/ 3 / 0
8 C	260	IPMA	/ 1 / 0
9 C	260	MPFB	/ 4 / 0
10 C	260	MPFB	/ 2 / 0
11 C	260	IPA	/ 2 / 0
12 C	270	IPA	/ 2MB / 1
13 C	270	IPBH	/ 1 / 0
14 C	280	IPBH	/ 1MPFB / 2
15 C	280	IPHC	/ 1IPA / 1
16 C	280	IPA	/ 3IPBH / 1
17 C	280	IPA	/ 5 / 0
18 C	300	IPBY	/ 4 / 0
19 C	300	IPA	/ 2 / 0
20 C	300	IPA	/ 1 / 0
21 C	300	IPA	/ 3 / 0
22 C	300	IPA	/ 3 / 0
23 C	300	IPA	/ 2 / 0
24 C	310	IPSN	/ 1 / 0
25 C	310	IPBY	/ 3 / 0
26 C	310	IPBY	/ 2 / 0
27 C	310	QTS	/ 1IPA / 1
28 C	310	IPA	/ 3 / 0
29 C	320	IPMA	/ 2 / 0
30 C	320	IPSV	/ 5 / 0
31 C	320	IPSV	/ 3 / 0
32 C	320	QAL	/ 2 / 0
33 C	320	IPMA	/ 3 / 0
34 C	320	IPMA	/ 1 / 0
35 C	330	IPSN	/ 4 / 0
36 C	330	QTS	/ 1 / 0
37 C	330	QAL	/ 2IPMA / 1
38 C	330	IPMA	/ 3 / 0
39 C	340	IPMA	/ 1 / 0
40 C	340	IPMA	/ 4 / 0
41 C	340	IPMA	/ 3 / 0
42 C	340	IPA	/ 2 / 0
43 C	350	IPMA	/ 5 / 0
44 C	350	IPAU	/ 1 / 0
45 C	350	IPAU	/ 6 / 0
46 C	360	QAL	/ 4 / 0
47 C	1010	IPCV	/ 1 / 0
48 C	1010	IPCV	/ 3 / 0
49 C	1020	IPBY	/ 3 / 0
50 C	1020	IPBY	/ 1 / 0

PEAK PPM	NUMBER OF SAMPLES WITH A STANDARD DEVIATION OF :						
	1	2	3	4	5	6	7 @7
3.1	0	0	1	0	0	0	0
3.4	1	2	1	0	0	0	0
3.2	0	0	1	0	0	0	0
3.4	0	2	0	0	0	0	0
4.3	0	0	2	0	0	0	0
3.5	0	2	0	0	0	0	0
3.3	0	3	0	0	0	0	0
3.5	0	0	1	0	0	0	0
3.4	1	3	0	0	0	0	0
3.4	0	2	0	0	0	0	0
3.2	1	0	1	0	0	0	0
2.8	2	1	0	0	0	0	0
3.4	0	0	1	0	0	0	0
3.2	2	1	0	0	0	0	0
3.4	0	1	1	0	0	0	0
3.1	2	2	0	0	0	0	0
3.2	2	2	1	0	0	0	0
3.3	3	1	0	0	0	0	0
3.1	0	2	0	0	0	0	0
3.3	0	0	1	0	0	0	0
2.9	1	2	0	0	0	0	0
3.0	2	1	0	0	0	0	0
2.9	0	2	0	0	0	0	0
3.9	0	0	0	1	0	0	0
3.4	2	1	0	0	0	0	0
3.3	0	2	0	0	0	0	0
3.2	0	2	0	0	0	0	0
2.8	2	1	0	0	0	0	0
3.5	0	2	0	0	0	0	0
3.1	4	1	0	0	0	0	0
3.1	1	2	0	0	0	0	0
3.6	1	0	1	0	0	0	0
3.1	1	2	0	0	0	0	0
3.8	0	0	1	0	0	0	0
3.3	1	3	0	0	0	0	0
3.9	0	0	1	0	0	0	0
3.5	1	2	0	0	0	0	0
3.1	0	3	0	0	0	0	0
4.0	0	0	0	1	0	0	0
3.7	0	3	1	0	0	0	0
3.3	0	3	0	0	0	0	0
3.1	0	2	0	0	0	0	0
3.4	3	2	0	0	0	0	0
3.5	0	0	1	0	0	0	0
3.2	1	5	0	0	0	0	0
3.2	1	3	0	0	0	0	0
3.4	0	0	1	0	0	0	0
3.0	2	1	0	0	0	0	0
3.5	1	2	0	0	0	0	0
3.8	0	0	1	0	0	0	0

ANOMALY SUMMARY TABLE

ANOMALY	FLIGHT	COMPUTER	MAP	UNIT AND NO.	ANOMALOUS SAMPLES IN UNIT
---------	--------	----------	-----	--------------	---------------------------

ANOMALY	FLIGHT	COMPUTER	MAP	UNIT AND NO.	ANOMALOUS SAMPLES IN UNIT	PEAK PPM	NUMBER OF SAMPLES WITH A STANDARD DEVIATION OF :							
							1	2	3	4	5	6	7	GT7
51 C	1020	IPBY	/	3	/ 0	3.7	2	1	0	0	0	0	0	0
52 C	1020	IPBY	/	3	/ 0	3.4	2	1	0	0	0	0	0	0
53 C	1020	IPBY	/	3	/ 0	3.8	0	3	0	0	0	0	0	0
54 C	1020	IPBY	/	2IPBJ	/ 1	3.2	2	0	1	0	0	0	0	0
55 C	1030	IPHS	/	1IPA	/ 1	3.0	0	2	0	0	0	0	0	0
56 C	1030	IPA	/	4	/ 0	3.7	0	2	1	1	0	0	0	0
57 C	1030	IPA	/	1	/ 0	3.3	0	0	1	0	0	0	0	0
58 C	1030	IPMA	/	3	/ 0	3.6	0	2	1	0	0	0	0	0
59 C	1030	IPA	/	1	/ 0	3.5	0	0	1	0	0	0	0	0
60 C	1030	IPA	/	1	/ 0	3.2	0	0	1	0	0	0	0	0
61 C	1030	IPA	/	1	/ 0	3.4	0	0	1	0	0	0	0	0
62 C	1030	IPA	/	1	/ 0	3.3	0	0	1	0	0	0	0	0
63 C	1030	QTS	/	4	/ 0	3.3	3	1	0	0	0	0	0	0
64 C	1040	IPBH	/	1MPFB	/ 4MB	4.3	0	3	2	1	1	0	0	0
65 C	1040	IPBH	/	2	/ 0	3.2	1	0	1	0	0	0	0	0
66 C	1040	IPBH	/	1	/ 0	4.0	0	0	0	1	0	0	0	0
67 C	1040	MB	/	2	/ 0	4.1	1	0	0	1	0	0	0	0
68 C	1050	IPSV	/	3	/ 0	3.2	2	1	0	0	0	0	0	0
69 C	1050	IPHS	/	2IPMA	/ 2IPA	4.1	0	2	2	1	0	0	0	0
70 C	1050	IPA	/	2	/ 0	3.4	0	1	1	0	0	0	0	0
71 C	1050	IPA	/	4	/ 0	3.6	0	2	2	0	0	0	0	0
72 C	1050	IPA	/	2	/ 0	3.3	0	1	1	0	0	0	0	0
73 C	1060	IPA	/	3	/ 0	2.9	1	2	0	0	0	0	0	0
74 C	1070	IPAL	/	1	/ 0	3.1	0	0	1	0	0	0	0	0
75 C	1070	IPSV	/	4	/ 0	3.2	2	2	0	0	0	0	0	0

NOTES: M INDICATES THAT THE ANOMALY LIES OVER
A URANIUM MINE OR PROSPECT.

C INDICATES THAT THE ANOMALY LIES OVER A CULTURAL FEATURE.

W INDICATES POSSIBLE INTERFERENCE BY WEATHER PHENOMENA.

			MAP UNIT GAL						
			-3	-2	-1	0	+1	+2	+3
POTASium	DIST	NORMAL	-0.3445	0.1153	0.5751	1.0349	1.4947	1.9545	2.4143
URANIUM	DIST	NORMAL	0.3512	0.9367	1.5222	2.1077	2.6932	3.2787	3.8642
THORIUM	DIST	NORMAL	-0.4354	1.8959	4.2272	6.5585	8.8898	11.2211	13.5524
U/K	DIST	NORMAL	-1.1183	0.0424	1.2031	2.3638	3.5245	4.6852	5.8459
U/TH	DIST	NORMAL	0.0642	0.1518	0.2394	0.3270	0.4146	0.5022	0.5898
TH/K	DIST	NORMAL	-2.7257	0.6382	4.0021	7.3660	10.7299	14.0938	17.4577

			MAP UNIT QTS						
			-3	-2	-1	0	+1	+2	+3
POTASium	DIST	NORMAL	-0.0728	0.2370	0.5468	0.8566	1.1664	1.4762	1.7860
URANIUM	DIST	NORMAL	0.4491	1.0438	1.6385	2.2332	2.8279	3.4226	4.0173
THORIUM	DIST	NORMAL	1.0505	2.9045	4.7585	6.6125	8.4665	10.3205	12.1745
U/K	DIST	NORMAL	-0.9705	0.3256	1.6217	2.9178	4.2139	5.5100	6.8061
U/TH	DIST	NORMAL	0.1563	0.2168	0.2773	0.3378	0.3983	0.4588	0.5193
TH/K	DIST	NORMAL	-2.3398	1.3181	4.9760	8.6339	12.2918	15.9497	19.6076

			MAP UNIT IPHD						
			-3	-2	-1	0	+1	+2	+3
POTASium	DIST	NORMAL	0.3300	0.4882	0.6464	0.8046	0.9628	1.1210	1.2792
URANIUM	DIST	NORMAL	0.6649	1.2306	1.7963	2.3620	2.9277	3.4934	4.0591
THORIUM	DIST	NORMAL	4.8479	5.8793	6.9107	7.9421	8.9735	10.0049	11.0363
U/K	DIST	NORMAL	0.9338	1.6164	2.2990	2.9816	3.6642	4.3468	5.0294
U/TH	DIST	NORMAL	0.1271	0.1835	0.2399	0.2963	0.3527	0.4091	0.4655
TH/K	DIST	NORMAL	5.8687	7.2726	8.6765	10.0804	11.4843	12.8882	14.2921

			MAP UNIT IPWK						
			-3	-2	-1	0	+1	+2	+3
POTASium	DIST	NORMAL	-0.0005	0.1919	0.3843	0.5767	0.7691	0.9615	1.1539
URANIUM	DIST	NORMAL	0.5638	1.0257	1.4876	1.9495	2.4114	2.8733	3.3352
THORIUM	DIST	NORMAL	1.2386	3.0411	4.8436	6.6461	8.4486	10.2511	12.0536
U/K	DIST	NORMAL	0.8421	1.7574	2.6727	3.5880	4.5033	5.4186	6.3339
U/TH	DIST	NORMAL	0.1238	0.1829	0.2420	0.3011	0.3602	0.4193	0.4784
TH/K	DIST	NORMAL	6.0303	7.9965	9.9627	11.9289	13.8951	15.8613	17.8275

			MAP UNIT IPWT						
			-3	-2	-1	0	+1	+2	+3
POTASium	DIST	NORMAL	0.4278	0.5140	0.6002	0.6864	0.7726	0.8588	0.9450
URANIUM	DIST	NORMAL	1.1551	1.4533	1.7515	2.0497	2.3479	2.6461	2.9443
THORIUM	DIST	NORMAL	4.9086	5.7669	6.6252	7.4835	8.3418	9.2001	10.0584
U/K	DIST	NORMAL	1.6971	2.1342	2.5713	3.0084	3.4455	3.8826	4.3197
U/TH	DIST	NORMAL	0.1820	0.2128	0.2436	0.2744	0.3052	0.3360	0.3668
TH/K	DIST	NORMAL	7.7245	8.8064	9.8883	10.9702	12.0521	13.1340	14.2159

			MAP UNIT IPCV						
			-3	-2	-1	0	+1	+2	+3
POTASium	DIST	NORMAL	0. 1737	0. 3110	0. 4483	0. 5856	0. 7229	0. 8602	0. 9975
URANIUM	DIST	NORMAL	0. 7823	1. 2469	1. 7115	2. 1761	2. 6407	3. 1053	3. 5699
THORIUM	DIST	NORMAL	3. 2698	4. 4203	5. 5708	6. 7213	7. 8718	9. 0223	10. 1728
U/K	DIST	NORMAL	0. 4968	1. 6248	2. 7528	3. 8808	5. 0088	6. 1368	7. 2648
U/TH	DIST	NORMAL	0. 1187	0. 1885	0. 2583	0. 3281	0. 3979	0. 4677	0. 5375
TH/K	DIST	NORMAL	5. 9424	7. 8955	9. 8486	11. 8017	13. 7548	15. 7079	17. 6610

			MAP UNIT IPSN						
			-3	-2	-1	0	+1	+2	+3
POTASIUM	DIST	NORMAL	0.0985	0.2861	0.4737	0.6613	0.8489	1.0365	1.2241
URANIUM	DIST	NORMAL	0.9820	1.4283	1.8746	2.3209	2.7672	3.2135	3.6598
THORIUM	DIST	NORMAL	3.0917	4.5323	5.9729	7.4135	8.8541	10.2947	11.7353
U/K	DIST	NORMAL	0.6717	1.6870	2.7023	3.7176	4.7329	5.7482	6.7635
U/TH	DIST	NORMAL	0.1387	0.1986	0.2585	0.3184	0.3783	0.4382	0.4981
TH/K	DIST	NORMAL	4.6715	7.0110	9.3505	11.6900	14.0295	16.3690	18.7085

			MAP UNIT IPST						
			-3	-2	-1	0	+1	+2	+3
POTASium	DIST	NORMAL	0. 3970	0. 5012	0. 6054	0. 7096	0. 8138	0. 9180	1. 0222
URANIUM	DIST	NORMAL	1. 5587	2. 0498	2. 5409	3. 0320	3. 5231	4. 0142	4. 5053
THORIUM	DIST	NORMAL	5. 9134	6. 9232	7. 9330	8. 9428	9. 9526	10. 9624	11. 9722
U/K	DIST	NORMAL	1. 7173	2. 5912	3. 4651	4. 3390	5. 2129	6. 0868	6. 9607
U/TH	DIST	NORMAL	0. 2071	0. 2511	0. 2951	0. 3391	0. 3831	0. 4271	0. 4711
TH/K	DIST	NORMAL	7. 5311	9. 2773	11. 0235	12. 7697	14. 5159	16. 2621	18. 0083

			MAP UNIT IPT						
			-3	-2	-1	0	+1	+2	+3
POTASIUM	DIST	NORMAL	0.1277	0.2926	0.4575	0.6224	0.7873	0.9522	1.1171
URANIUM	DIST	NORMAL	1.0003	1.3659	1.7315	2.0971	2.4627	2.8283	3.1939
THORIUM	DIST	NORMAL	3.5420	4.6504	5.7588	6.8672	7.9756	9.0840	10.1924
U/K	DIST	NORMAL	0.1931	1.3345	2.4759	3.6173	4.7587	5.9001	7.0415
U/TH	DIST	NORMAL	0.1563	0.2071	0.2579	0.3087	0.3595	0.4103	0.4611
TH/K	DIST	NORMAL	3.8312	6.4273	9.0234	11.6195	14.2156	16.8117	19.4078

			MAP UNIT IPBY						
			-3	-2	-1	0	+1	+2	+3
POTASIUM	DIST	NORMAL	0.0594	0.2530	0.4466	0.6402	0.8338	1.0274	1.2210
URANIUM	DIST	NORMAL	0.4721	1.0770	1.6819	2.2868	2.8917	3.4966	4.1015
THORIUM	DIST	NORMAL	1.5441	3.4215	5.2989	7.1763	9.0537	10.9311	12.8085
U/K	DIST	NORMAL	0.5686	1.6216	2.6746	3.7276	4.7806	5.8336	6.8866
U/TH	DIST	NORMAL	0.1419	0.2012	0.2605	0.3198	0.3791	0.4384	0.4977
TH/K	DIST	NORMAL	4.3623	6.7958	9.2293	11.6628	14.0963	16.5298	18.9633

			MAP UNIT IPBJ						
			-3	-2	-1	0	+1	+2	+3
POTASium	DIST	NORMAL	-0.0134	0.1829	0.3792	0.5755	0.7718	0.9681	1.1644
URANIUM	DIST	NORMAL	0.5916	1.0231	1.4546	1.8861	2.3176	2.7491	3.1806
THORIUM	DIST	NORMAL	1.9252	3.3473	4.7694	6.1915	7.6136	9.0357	10.4578
U/K	DIST	NORMAL	0.6610	1.5971	2.5332	3.4693	4.4054	5.3415	6.2776
U/TH	DIST	NORMAL	0.1462	0.1997	0.2532	0.3067	0.3602	0.4137	0.4672
TH/K	DIST	NORMAL	4.1818	6.5554	8.9290	11.3026	13.6762	16.0498	18.4234

			MAP UNIT IPSV						
			-3	-2	-1	0	+1	+2	+3
POTASium	DIST	NORMAL	0.0537	0.2638	0.4739	0.6840	0.8941	1.1042	1.3143
URANIUM	DIST	NORMAL	0.8146	1.2868	1.7590	2.2312	2.7034	3.1756	3.6478
THORIUM	DIST	NORMAL	3.4148	4.7268	6.0388	7.3508	8.6628	9.9748	11.2868
U/K	DIST	NORMAL	0.2898	1.3608	2.4318	3.5028	4.5738	5.6448	6.7158
U/TH	DIST	NORMAL	0.1445	0.1985	0.2525	0.3065	0.3605	0.4145	0.4685
TH/K	DIST	NORMAL	3.4573	6.0978	8.7383	11.3788	14.0193	16.6598	19.3003

			MAP UNIT IPMA						
			-3	-2	-1	0	+1	+2	+3
POTASium	DIST	NORMAL	-0. 0155	0. 2132	0. 4419	0. 6706	0. 8993	1. 1280	1. 3567
URANIUM	DIST	NORMAL	0. 9777	1. 4367	1. 8957	2. 3547	2. 8137	3. 2727	3. 7317
THORIUM	DIST	NORMAL	3. 1685	4. 6040	6. 0395	7. 4750	8. 9105	10. 3460	11. 7815
U/K	DIST	NORMAL	0. 0930	1. 3330	2. 5730	3. 8130	5. 0530	6. 2930	7. 5330
U/TH	DIST	NORMAL	0. 1412	0. 2004	0. 2596	0. 3188	0. 3780	0. 4372	0. 4964
TH/K	DIST	NORMAL	3. 2794	6. 1552	9. 0310	11. 9068	14. 7826	17. 6584	20. 5342

			MAP UNIT IPHS						
			-3	-2	-1	0	+1	+2	+3
POTASium	DIST	NORMAL	0. 1137	0. 2575	0. 4013	0. 5451	0. 6889	0. 8327	0. 9765
URANIUM	DIST	NORMAL	0. 7897	1. 2649	1. 7401	2. 2153	2. 6905	3. 1657	3. 6409
THORIUM	DIST	NORMAL	2. 7048	3. 9770	5. 2492	6. 5214	7. 7936	9. 0658	10. 3380
U/K	DIST	NORMAL	0. 6051	1. 8311	3. 0571	4. 2831	5. 5091	6. 7351	7. 9611
U/TH	DIST	NORMAL	0. 1167	0. 1933	0. 2699	0. 3465	0. 4231	0. 4997	0. 5763
TH/K	DIST	NORMAL	5. 0702	7. 5002	9. 9302	12. 3602	14. 7902	17. 2202	19. 6502

			MAP UNIT IPA						
			-3	-2	-1	0	+1	+2	+3
POTASium	DIST	NORMAL	0.0914	0.2216	0.3518	0.4820	0.6122	0.7424	0.8726
URANIUM	DIST	NORMAL	0.7455	1.1972	1.6489	2.1006	2.5523	3.0040	3.4557
THORIUM	DIST	NORMAL	2.8075	4.0167	5.2259	6.4351	7.6443	8.8535	10.0627
U/K	DIST	NORMAL	0.7526	2.0228	3.2930	4.5632	5.8334	7.1036	8.3738
U/TH	DIST	NORMAL	0.1365	0.2010	0.2655	0.3300	0.3945	0.4590	0.5235
TH/K	DIST	NORMAL	5.7367	8.4343	11.1319	13.8295	16.5271	19.2247	21.9223

			MAP UNIT		IPAU					
			-3	-2	-1	0	+1	+2	+3	
POTASium	DIST	NORMAL	0. 1346	0. 3048	0. 4750	0. 6452	0. 8154	0. 9856	1. 1558	
URANIUM	DIST	NORMAL	0. 8615	1. 3140	1. 7665	2. 2190	2. 6715	3. 1240	3. 5765	
THORIUM	DIST	NORMAL	3. 1273	4. 4881	5. 8489	7. 2097	8. 5705	9. 9313	11. 2921	
U/K	DIST	NORMAL	0. 5244	1. 5594	2. 5944	3. 6294	4. 6644	5. 6994	6. 7344	
U/TH	DIST	NORMAL	0. 1242	0. 1873	0. 2504	0. 3135	0. 3766	0. 4397	0. 5028	
TH/K	DIST	NORMAL	5. 2167	7. 3271	9. 4375	11. 5479	13. 6583	15. 7687	17. 8791	

			MAP UNIT		IPAM					
			-3	-2	-1	0	+1	+2	+3	
POTASium	DIST	NORMAL	0. 2419	0. 3381	0. 4343	0. 5305	0. 6267	0. 7229	0. 8191	
URANIUM	DIST	NORMAL	1. 1533	1. 4589	1. 7645	2. 0701	2. 3757	2. 6813	2. 9869	
THORIUM	DIST	NORMAL	4. 1977	4. 9189	5. 6401	6. 3613	7. 0825	7. 8037	8. 5249	
U/K	DIST	NORMAL	1. 3403	2. 2337	3. 1271	4. 0205	4. 9139	5. 8073	6. 7007	
U/TH	DIST	NORMAL	0. 1690	0. 2220	0. 2750	0. 3280	0. 3810	0. 4340	0. 4870	
TH/K	DIST	NORMAL	4. 9148	7. 3862	9. 8576	12. 3290	14. 8004	17. 2718	19. 7432	

			MAP UNIT		IPAL					
			-3	-2	-1	0	+1	+2	+3	
POTASium	DIST	NORMAL	0. 2944	0. 3611	0. 4278	0. 4945	0. 5612	0. 6279	0. 6946	
URANIUM	DIST	NORMAL	1. 2753	1. 5751	1. 8749	2. 1747	2. 4745	2. 7743	3. 0741	
THORIUM	DIST	NORMAL	4. 4932	5. 2663	6. 0394	6. 8125	7. 5856	8. 3587	9. 1318	
U/K	DIST	NORMAL	1. 9273	2. 7782	3. 6291	4. 4800	5. 3309	6. 1818	7. 0327	
U/TH	DIST	NORMAL	0. 1442	0. 2039	0. 2636	0. 3233	0. 3830	0. 4427	0. 5024	
TH/K	DIST	NORMAL	7. 3045	9. 5303	11. 7561	13. 9819	16. 2077	18. 4335	20. 6593	

			MAP UNIT		IPBH					
			-3	-2	-1	0	+1	+2	+3	
POTASium	DIST	NORMAL	0. 1191	0. 2523	0. 3855	0. 5187	0. 6519	0. 7851	0. 9183	
URANIUM	DIST	NORMAL	0. 5017	0. 9772	1. 4527	1. 9282	2. 4037	2. 8792	3. 3547	
THORIUM	DIST	NORMAL	3. 0593	4. 0669	5. 0745	6. 0821	7. 0897	8. 0973	9. 1049	
U/K	DIST	NORMAL	0. 4190	1. 5749	2. 7308	3. 8867	5. 0426	6. 1985	7. 3544	
U/TH	DIST	NORMAL	0. 0671	0. 1520	0. 2369	0. 3218	0. 4067	0. 4916	0. 5765	
TH/K	DIST	NORMAL	4. 7365	7. 2147	9. 6929	12. 1711	14. 6493	17. 1275	19. 6057	

			MAP UNIT		IPHC					
			-3	-2	-1	0	+1	+2	+3	
POTASium	DIST	NORMAL	0. 1953	0. 2908	0. 3863	0. 4818	0. 5773	0. 6728	0. 7683	
URANIUM	DIST	NORMAL	0. 9344	1. 2537	1. 5730	1. 8923	2. 2116	2. 5309	2. 8502	
THORIUM	DIST	NORMAL	2. 9033	3. 9580	5. 0127	6. 0674	7. 1221	8. 1768	9. 2315	
U/K	DIST	NORMAL	1. 3503	2. 2486	3. 1469	4. 0452	4. 9435	5. 8418	6. 7401	
U/TH	DIST	NORMAL	0. 1255	0. 1897	0. 2539	0. 3181	0. 3823	0. 4465	0. 5107	
TH/K	DIST	NORMAL	6. 5990	8. 6724	10. 7458	12. 8192	14. 8926	16. 9660	19. 0394	

			MAP UNIT IPSI						
			-3	-2	-1	0	+1	+2	+3
POTASium	DIST	NORMAL	0.3275	0.4583	0.5891	0.7199	0.8507	0.9815	1.1123
URANIUM	DIST	NORMAL	1.2647	1.6223	1.9799	2.3375	2.6951	3.0527	3.4103
THORIUM	DIST	NORMAL	4.3233	5.4959	6.6685	7.8411	9.0137	10.1863	11.3589
U/K	DIST	NORMAL	1.7797	2.2887	2.7977	3.3067	3.8157	4.3247	4.8337
U/TH	DIST	NORMAL	0.2080	0.2386	0.2692	0.2998	0.3304	0.3610	0.3916
TH/K	DIST	NORMAL	6.9345	8.3021	9.6697	11.0373	12.4049	13.7725	15.1401

			MAP UNIT MPFB						
			-3	-2	-1	0	+1	+2	+3
POTASium	DIST	NORMAL	0.0415	0.2158	0.3901	0.5644	0.7387	0.9130	1.0873
URANIUM	DIST	NORMAL	0.5189	1.0726	1.6263	2.1800	2.7337	3.2874	3.8411
THORIUM	DIST	NORMAL	2.4666	3.7675	5.0684	6.3693	7.6702	8.9711	10.2720
U/K	DIST	NORMAL	0.7411	1.8403	2.9395	4.0387	5.1379	6.2371	7.3363
U/TH	DIST	NORMAL	0.1090	0.1876	0.2662	0.3448	0.4234	0.5020	0.5806
TH/K	DIST	NORMAL	3.1511	6.0729	8.9947	11.9165	14.8383	17.7601	20.6819

			MAP UNIT MB						
			-3	-2	-1	0	+1	+2	+3
POTASium	DIST	NORMAL	0.0103	0.1644	0.3185	0.4726	0.6267	0.7808	0.9349
URANIUM	DIST	NORMAL	0.1824	0.7705	1.3586	1.9467	2.5348	3.1229	3.7110
THORIUM	DIST	NORMAL	0.2721	2.0100	3.7479	5.4858	7.2237	8.9616	10.6995
U/K	DIST	NORMAL	1.1518	2.1926	3.2334	4.2742	5.3150	6.3558	7.3966
U/TH	DIST	NORMAL	0.1265	0.2062	0.2859	0.3656	0.4453	0.5250	0.6047
TH/K	DIST	NORMAL	5.1534	7.3771	9.6008	11.8245	14.0482	16.2719	18.4956

			MAP UNIT MDC						
			-3	-2	-1	0	+1	+2	+3
POTASium	DIST	NORMAL	0.0175	0.1603	0.3031	0.4459	0.5887	0.7315	0.8743
URANIUM	DIST	NORMAL	0.4316	0.8573	1.2830	1.7087	2.1344	2.5601	2.9858
THORIUM	DIST	NORMAL	0.8016	2.1036	3.4056	4.7076	6.0096	7.3116	8.6136
U/K	DIST	NORMAL	0.9865	1.9915	2.9965	4.0015	5.0065	6.0115	7.0165
U/TH	DIST	NORMAL	0.1068	0.1959	0.2850	0.3741	0.4632	0.5523	0.6414
TH/K	DIST	NORMAL	4.2150	6.4344	8.6538	10.8732	13.0926	15.3120	17.5314

			MAP UNIT OS						
			-3	-2	-1	0	+1	+2	+3
POTASium	DIST	NORMAL	-0.0384	0.1762	0.3908	0.6054	0.8200	1.0346	1.2492
URANIUM	DIST	NORMAL	0.8598	1.2380	1.6162	1.9944	2.3726	2.7508	3.1290
THORIUM	DIST	NORMAL	0.8767	2.3248	3.7729	5.2210	6.6691	8.1172	9.5653
U/K	DIST	NORMAL	0.9346	1.7998	2.6650	3.5302	4.3954	5.2606	6.1258
U/TH	DIST	NORMAL	0.1566	0.2372	0.3178	0.3984	0.4790	0.5596	0.6402
TH/K	DIST	NORMAL	3.6718	5.4386	7.2054	8.9722	10.7390	12.5058	14.2726

LINE BASED MEAN CONCENTRATIONS AND RATIOS PER ROCK TYPE

MAP UNIT GAL

[illegible]

MAP UNIT QTS

[illegible]

MAP UNIT QS

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.483	0.000
URANIUM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.567	0.000
THORIUM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.929	0.000
U/K	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	5.359	0.000
U/TH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.372	0.000
TH/K	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	14.376	0.000

	1040	1050	1060	1070
POTASium	0.000	0.000	0.000	0.000
URANIUM	0.000	0.000	0.000	0.000
THORIUM	0.000	0.000	0.000	0.000
U/K	0.000	0.000	0.000	0.000
U/TH	0.000	0.000	0.000	0.000
TH/K	0.000	0.000	0.000	0.000

MAP UNIT IPHD

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	1.140	0.693	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.808	0.000	0.000
URANIUM	2.615	1.780	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.547	0.000	0.000
THORIUM	8.310	7.337	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.123	0.000	0.000
U/K	2.292	2.646	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.181	0.000	0.000
U/TH	0.314	0.243	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.314	0.000	0.000
TH/K	7.288	10.773	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.137	0.000	0.000

	1040	1050	1060	1070
POTASium	0.000	0.000	0.000	0.000
URANIUM	0.000	0.000	0.000	0.000
THORIUM	0.000	0.000	0.000	0.000
U/K	0.000	0.000	0.000	0.000
U/TH	0.000	0.000	0.000	0.000
TH/K	0.000	0.000	0.000	0.000

MAP UNIT IPWK

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.000	0.667	0.423	0.446	0.000	0.664	0.000	0.000	0.000	0.000	0.000	0.000	0.595	0.000	0.000
URANIUM	0.000	2.112	1.545	1.775	0.000	1.970	0.000	0.000	0.000	0.000	0.000	0.000	2.032	0.000	0.000
THORIUM	0.000	7.505	5.260	6.074	0.000	7.017	0.000	0.000	0.000	0.000	0.000	0.000	6.678	0.000	0.000
U/K	0.000	3.298	3.926	3.982	0.000	2.969	0.000	0.000	0.000	0.000	0.000	0.000	3.624	0.000	0.000
U/TH	0.000	0.288	0.302	0.292	0.000	0.280	0.000	0.000	0.000	0.000	0.000	0.000	0.314	0.000	0.000
TH/K	0.000	11.453	12.930	13.808	0.000	10.589	0.000	0.000	0.000	0.000	0.000	0.000	11.563	0.000	0.000

	1040	1050	1060	1070
POTASium	0.000	0.000	0.000	0.000
URANIUM	0.000	0.000	0.000	0.000
THORIUM	0.000	0.000	0.000	0.000
U/K	0.000	0.000	0.000	0.000
U/TH	0.000	0.000	0.000	0.000
TH/K	0.000	0.000	0.000	0.000

MAP UNIT IPWT

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.000	0.000	0.656	0.725	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.702	0.000	0.000
URANIUM	0.000	0.000	1.966	1.950	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.241	0.000	0.000
THORIUM	0.000	0.000	7.207	7.483	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.881	0.000	0.000
U/K	0.000	0.000	3.001	2.712	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.231	0.000	0.000
U/TH	0.000	0.000	0.274	0.261	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.284	0.000	0.000
TH/K	0.000	0.000	11.029	10.389	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.303	0.000	0.000

	1040	1050	1060	1070
POTASium	0.000	0.000	0.000	0.000
URANIUM	0.000	0.000	0.000	0.000
THORIUM	0.000	0.000	0.000	0.000
U/K	0.000	0.000	0.000	0.000
U/TH	0.000	0.000	0.000	0.000
TH/K	0.000	0.000	0.000	0.000

MAP UNIT IPCV

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.000	0.459	0.535	0.616	0.572	0.588	0.954	0.398	0.000	0.000	0.000	0.000	0.604	0.000	0.000
URANIUM	0.000	1.913	1.779	2.217	2.197	1.898	1.944	1.637	0.000	0.000	0.000	0.000	2.460	0.000	0.000
THORIUM	0.000	5.402	6.299	7.546	6.100	6.648	8.082	5.391	0.000	0.000	0.000	0.000	6.912	0.000	0.000
U/K	0.000	4.331	3.368	3.656	3.881	3.475	2.036	4.116	0.000	0.000	0.000	0.000	4.278	0.000	0.000
U/TH	0.000	0.365	0.281	0.296	0.364	0.287	0.241	0.304	0.000	0.000	0.000	0.000	0.362	0.000	0.000
TH/K	0.000	11.998	11.899	12.339	10.815	11.919	8.472	13.564	0.000	0.000	0.000	0.000	11.755	0.000	0.000

	1040	1050	1060	1070
POTASium	0.000	0.000	0.000	0.000
URANIUM	0.000	0.000	0.000	0.000
THORIUM	0.000	0.000	0.000	0.000
U/K	0.000	0.000	0.000	0.000
U/TH	0.000	0.000	0.000	0.000
TH/K	0.000	0.000	0.000	0.000

MAP UNIT IPSN

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.733	0.642	0.692	0.810	0.677	0.640	0.694	0.526	0.540	0.619	0.498	0.000	0.711	0.576	0.000
URANIUM	2.542	2.283	2.296	2.532	2.605	2.453	2.174	2.029	2.242	2.376	1.863	0.000	2.211	2.452	0.000
THORIUM	8.304	6.779	8.080	8.966	8.468	7.720	6.858	6.041	6.833	7.168	6.102	0.000	7.050	6.222	0.000
U/K	3.660	3.721	3.370	3.282	3.997	4.001	3.295	4.190	4.238	4.024	3.771	0.000	3.307	4.369	0.000
U/TH	0.308	0.337	0.288	0.285	0.310	0.323	0.320	0.345	0.329	0.349	0.306	0.000	0.319	0.356	0.000
TH/K	11.843	11.030	11.759	11.514	12.886	12.420	10.302	12.106	12.916	11.688	12.365	0.000	10.433	12.292	0.000

	1040	1050	1060	1070
POTASium	0.000	0.000	0.000	0.000
URANIUM	0.000	0.000	0.000	0.000
THORIUM	0.000	0.000	0.000	0.000
U/K	0.000	0.000	0.000	0.000
U/TH	0.000	0.000	0.000	0.000
TH/K	0.000	0.000	0.000	0.000

MAP UNIT IPST

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.000	0.000	0.000	0.000	0.000	0.735	0.000	0.000	0.664	0.000	0.530	0.000	0.000	0.728	0.000
URANIUM	0.000	0.000	0.000	0.000	0.000	2.982	0.000	0.000	2.623	0.000	1.425	0.000	0.000	3.326	0.000
THORIUM	0.000	0.000	0.000	0.000	0.000	9.079	0.000	0.000	8.013	0.000	6.192	0.000	0.000	9.438	0.000
U/K	0.000	0.000	0.000	0.000	0.000	4.083	0.000	0.000	4.014	0.000	2.701	0.000	0.000	4.697	0.000
U/TH	0.000	0.000	0.000	0.000	0.000	0.331	0.000	0.000	0.328	0.000	0.233	0.000	0.000	0.354	0.000
TH/K	0.000	0.000	0.000	0.000	0.000	12.359	0.000	0.000	12.236	0.000	11.671	0.000	0.000	13.253	0.000

	1040	1050	1060	1070
POTASium	0.000	0.000	0.000	0.000
URANIUM	0.000	0.000	0.000	0.000
THORIUM	0.000	0.000	0.000	0.000
U/K	0.000	0.000	0.000	0.000
U/TH	0.000	0.000	0.000	0.000
TH/K	0.000	0.000	0.000	0.000

MAP UNIT IPT

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.675	0.524	0.655	0.000	0.000
URANIUM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.078	1.983	2.211	0.000	0.000
THORIUM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.257	6.423	6.865	0.000	0.000
U/K	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.312	3.923	3.654	0.000	0.000
U/TH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.290	0.311	0.325	0.000	0.000
TH/K	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.378	12.534	11.087	0.000	0.000

	1040	1050	1060	1070
POTASium	0.000	0.000	0.000	0.000
URANIUM	0.000	0.000	0.000	0.000
THORIUM	0.000	0.000	0.000	0.000
U/K	0.000	0.000	0.000	0.000
U/TH	0.000	0.000	0.000	0.000
TH/K	0.000	0.000	0.000	0.000

MAP UNIT IPBY

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.782	1.089	0.842	0.776	0.669	0.623	0.543	0.672	0.563	0.596	0.529	0.546	0.584	0.742	0.566
URANIUM	2.513	3.103	2.674	2.509	2.549	2.976	2.594	1.593	2.354	2.105	1.858	1.829	1.968	2.721	1.789
THORIUM	9.021	9.069	9.266	8.975	8.264	8.703	7.319	4.706	6.964	6.304	6.092	6.026	6.836	8.044	5.606
U/K	3.271	2.922	3.338	3.320	3.885	4.860	4.914	2.554	4.314	3.748	3.606	3.555	3.434	3.760	3.382
U/TH	0.279	0.343	0.293	0.280	0.309	0.343	0.358	0.341	0.346	0.340	0.299	0.308	0.290	0.337	0.319
TH/K	11.688	8.680	11.306	11.821	12.522	14.170	13.791	7.775	12.485	11.049	12.077	11.508	11.799	11.235	10.415

	1040	1050	1060	1070
POTASium	0.418	0.692	0.000	0.000
URANIUM	1.671	1.778	0.000	0.000
THORIUM	5.020	6.493	0.000	0.000
U/K	4.051	2.734	0.000	0.000
U/TH	0.335	0.277	0.000	0.000
TH/K	12.252	9.789	0.000	0.000

MAP UNIT IPBJ

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	1.040	0.568	0.000	0.648	0.566	0.511	0.674	0.482	0.552	0.648	0.528	0.517	0.000	0.779	0.568
URANIUM	2.356	2.248	0.000	2.480	2.464	1.765	2.212	1.351	1.570	2.149	1.893	1.891	0.000	2.584	1.871
THORIUM	8.741	7.799	0.000	7.849	7.751	5.690	6.910	4.876	5.426	6.878	6.656	6.138	0.000	8.296	5.691
U/K	2.432	4.081	0.000	3.831	4.372	3.527	3.628	2.922	2.905	3.350	3.612	3.818	0.000	3.475	3.481
U/TH	0.273	0.291	0.000	0.317	0.317	0.312	0.327	0.277	0.287	0.312	0.285	0.309	0.000	0.315	0.332
TH/K	8.754	13.954	0.000	12.124	13.741	11.375	10.906	10.513	10.214	10.779	12.682	12.341	0.000	11.061	10.563

	1040	1050	1060	1070
POTASium	0.597	0.752	0.000	0.000
URANIUM	1.944	1.748	0.000	0.000
THORIUM	6.046	6.955	0.000	0.000
U/K	3.432	2.340	0.000	0.000
U/TH	0.323	0.249	0.000	0.000
TH/K	10.764	9.291	0.000	0.000

MAP UNIT IPSV

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.000	0.589	0.000	0.706	0.685	0.538	0.814	0.782	0.657	0.625	0.689	0.622	0.000	0.591	0.718
URANIUM	0.000	2.588	0.000	2.403	2.147	1.377	2.674	2.496	2.302	2.151	2.160	2.061	0.000	1.711	2.101
THORIUM	0.000	7.399	0.000	8.114	7.169	5.667	8.290	7.690	7.577	6.969	7.527	6.983	0.000	6.044	7.160
U/K	0.000	4.390	0.000	3.599	3.171	2.559	3.298	3.502	3.613	3.508	3.273	3.661	0.000	2.975	3.091
U/TH	0.000	0.348	0.000	0.299	0.300	0.246	0.321	0.327	0.309	0.309	0.290	0.300	0.000	0.283	0.299
TH/K	0.000	12.590	0.000	11.868	10.555	10.529	10.274	10.646	11.715	11.326	11.262	12.095	0.000	10.468	10.336

	1040	1050	1060	1070
POTASium	0.569	0.624	1.387	0.688
URANIUM	1.858	2.619	1.781	2.575
THORIUM	6.385	7.307	5.895	8.006
U/K	3.487	4.437	1.285	3.907
U/TH	0.296	0.359	0.307	0.323
TH/K	11.780	12.225	4.257	12.121

MAP UNIT IPMA

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.697	0.632	0.000	0.755	0.716	0.686	0.579	0.686	0.714	0.651	0.697	0.653	0.000	0.000	0.628
URANIUM	2.904	2.697	0.000	2.735	2.401	2.058	2.469	2.433	2.367	2.306	2.363	2.055	0.000	0.000	2.378
THORIUM	9.107	8.579	0.000	7.962	8.503	7.186	7.539	7.636	7.268	7.230	7.723	6.938	0.000	0.000	7.449
U/K	4.206	4.291	0.000	3.628	3.484	3.254	4.482	3.825	3.765	3.900	3.609	3.264	0.000	0.000	3.965
U/TH	0.321	0.314	0.000	0.345	0.284	0.291	0.331	0.313	0.335	0.324	0.309	0.299	0.000	0.000	0.323
TH/K	13.171	13.699	0.000	10.607	12.254	11.081	13.558	12.179	11.217	11.829	11.619	10.891	0.000	0.000	12.367

	1040	1050	1060	1070
POTASium	0.691	0.617	0.659	0.650
URANIUM	2.314	2.419	2.136	2.657
THORIUM	7.635	7.412	6.878	8.402
U/K	3.610	4.347	3.552	4.292
U/TH	0.306	0.331	0.314	0.320
TH/K	11.688	13.093	11.351	13.296

MAP UNIT IPHS

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.000	0.000	0.000	0.000	0.000	0.779	0.520	0.426	0.467	0.632	0.500	0.596	0.000	0.000	0.696
URANIUM	0.000	0.000	0.000	0.000	0.000	2.056	2.263	2.219	2.273	2.246	2.081	2.023	0.000	0.000	2.634
THORIUM	0.000	0.000	0.000	0.000	0.000	7.901	6.781	5.875	5.448	7.139	6.146	6.514	0.000	0.000	8.372
U/K	0.000	0.000	0.000	0.000	0.000	2.676	4.431	5.302	4.851	3.584	4.191	3.537	0.000	0.000	3.975
U/TH	0.000	0.000	0.000	0.000	0.000	0.263	0.340	0.381	0.423	0.314	0.337	0.312	0.000	0.000	0.318
TH/K	0.000	0.000	0.000	0.000	0.000	10.176	13.156	13.957	11.783	11.460	12.415	11.277	0.000	0.000	12.328

	1040	1050	1060	1070
POTASium	0.000	0.521	0.700	0.424
URANIUM	0.000	2.755	2.252	1.933
THORIUM	0.000	7.122	7.328	5.684
U/K	0.000	5.639	3.308	4.852
U/TH	0.000	0.386	0.309	0.355
TH/K	0.000	14.447	10.573	13.847

MAP UNIT IPA

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.561	0.498	0.498	0.437	0.437	0.449	0.595	0.606	0.000	0.587	0.000	0.000	0.000	0.000	0.605
URANIUM	2.374	2.063	1.939	1.902	1.972	2.164	2.320	2.018	0.000	2.372	0.000	0.000	0.000	0.000	2.629
THORIUM	7.016	6.697	6.840	6.059	6.027	6.184	7.100	6.837	0.000	7.019	0.000	0.000	0.000	0.000	8.009
U/K	4.335	4.270	3.979	4.488	4.700	5.025	4.133	3.567	0.000	4.101	0.000	0.000	0.000	0.000	4.466
U/TH	0.337	0.313	0.286	0.315	0.329	0.356	0.332	0.300	0.000	0.340	0.000	0.000	0.000	0.000	0.330
TH/K	12.960	13.676	13.973	14.213	14.271	14.154	12.410	11.789	0.000	12.085	0.000	0.000	0.000	0.000	13.543

	1040	1050	1060	1070
POTASium	0.440	0.498	0.452	0.439
URANIUM	2.229	2.348	1.946	1.827
THORIUM	6.661	6.831	5.835	5.757
U/K	5.271	4.907	4.541	4.485
U/TH	0.338	0.345	0.339	0.322
TH/K	15.683	14.273	13.357	13.877

MAP UNIT IPAU

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.945	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.590	0.655	0.561	0.000	0.879	0.000
URANIUM	1.934	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.045	2.383	2.034	0.000	2.722	0.000
THORIUM	8.366	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.186	7.147	6.878	0.000	8.959	0.000
U/K	2.051	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.506	3.915	3.749	0.000	3.190	0.000
U/TH	0.231	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.285	0.343	0.301	0.000	0.305	0.000
TH/K	8.863	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	12.295	11.315	12.553	0.000	10.313	0.000

	1040	1050	1060	1070
POTASSIUM	0.000	0.000	0.797	0.663
URANIUM	0.000	0.000	2.343	2.128
THORIUM	0.000	0.000	8.190	7.185
U/K	0.000	0.000	3.034	3.339
U/TH	0.000	0.000	0.289	0.300
TH/K	0.000	0.000	10.456	11.130

MAP UNIT IPAM

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.501	0.000	0.603	0.000	0.000	0.000
URANIUM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.151	0.000	1.665	0.000	0.000	0.000
THORIUM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.372	0.000	5.841	0.000	0.000	0.000
U/K	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.351	0.000	2.765	0.000	0.000	0.000
U/TH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.340	0.000	0.286	0.000	0.000	0.000
TH/K	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	12.897	0.000	9.704	0.000	0.000	0.000

	1040	1050	1060	1070
POTASSIUM	0.000	0.000	0.492	0.550
URANIUM	0.000	0.000	2.283	2.037
THORIUM	0.000	0.000	5.394	6.573
U/K	0.000	0.000	4.669	3.851
U/TH	0.000	0.000	0.423	0.312
TH/K	0.000	0.000	11.006	12.454

MAP UNIT IPAL

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.494	0.000	0.000	0.000	0.000	0.000
URANIUM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.088	0.000	0.000	0.000	0.000	0.000
THORIUM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.934	0.000	0.000	0.000	0.000	0.000
U/K	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.317	0.000	0.000	0.000	0.000	0.000
U/TH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.303	0.000	0.000	0.000	0.000	0.000
TH/K	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	14.279	0.000	0.000	0.000	0.000	0.000

	1040	1050	1060	1070
POTASium	0.000	0.000	0.000	0.497
URANIUM	0.000	0.000	0.000	2.492
THORIUM	0.000	0.000	0.000	6.371
U/K	0.000	0.000	0.000	5.074
U/TH	0.000	0.000	0.000	0.396
TH/K	0.000	0.000	0.000	12.900

MAP UNIT IPBH

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.523	0.509	0.562	0.511	0.467	0.508	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
URANIUM	1.997	1.882	1.955	1.797	1.835	2.176	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
THORIUM	6.631	6.253	6.250	5.743	5.329	6.221	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
U/K	3.976	3.793	3.675	3.721	4.015	4.463	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
U/TH	0.303	0.302	0.323	0.318	0.347	0.354	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TH/K	13.215	12.584	11.467	11.705	11.637	12.553	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	1040	1050	1060	1070
POTASium	0.592	0.671	0.436	0.458
URANIUM	2.387	1.991	1.968	1.834
THORIUM	5.868	6.518	5.751	6.113
U/K	4.052	2.984	4.682	4.147
U/TH	0.410	0.304	0.346	0.304
TH/K	10.399	9.935	13.505	13.531

MAP UNIT IPHC

[illegible]

	1040	1050	1060	1070
POTASSIUM	0.000	0.000	0.416	0.438
URANIUM	0.000	0.000	1.985	1.885
THORIUM	0.000	0.000	5.549	6.134
U/K	0.000	0.000	4.888	4.353
U/TH	0.000	0.000	0.369	0.311
TH/K	0.000	0.000	13.316	14.080

MAP UNIT IPSI

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0. 730	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 657	0. 000	0. 000
URANIUM	2. 378	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	2. 101	0. 000	0. 000
THORIUM	7. 963	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	7. 122	0. 000	0. 000
U/K	3. 309	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	3. 292	0. 000	0. 000
U/TH	0. 300	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 296	0. 000	0. 000
TH/K	11. 028	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	0. 000	11. 095	0. 000	0. 000

	1040	1050	1060	1070
POTASSIUM	0.000	0.000	0.000	0.000
URANIUM	0.000	0.000	0.000	0.000
THORIUM	0.000	0.000	0.000	0.000
U/K	0.000	0.000	0.000	0.000
U/TH	0.000	0.000	0.000	0.000
TH/K	0.000	0.000	0.000	0.000

MAP UNIT MPFB

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.513	0.597	0.586	0.571	0.608	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
URANIUM	2.168	2.282	1.934	2.063	2.195	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
THORIUM	6.780	6.188	6.273	5.451	5.894	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
U/K	4.343	4.103	3.346	3.599	3.712	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
U/TH	0.324	0.373	0.313	0.370	0.377	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TH/K	13.513	11.150	10.886	10.048	9.903	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	1040	1050	1060	1070
POTASium	0.776	0.764	0.494	0.420
URANIUM	2.950	2.372	2.188	1.938
THORIUM	7.073	7.202	6.523	5.928
U/K	3.821	3.216	4.763	4.706
U/TH	0.422	0.335	0.339	0.328
TH/K	9.444	9.617	13.982	14.327

MAP UNIT MB

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.454	0.470	0.534	0.397	0.422	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
URANIUM	2.042	2.028	1.954	1.588	2.499	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
THORIUM	5.650	5.633	5.922	4.354	6.056	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
U/K	4.546	4.417	3.799	4.134	5.936	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
U/TH	0.368	0.370	0.339	0.374	0.415	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TH/K	12.455	12.068	11.391	11.192	14.351	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	1040	1050	1060	1070
POTASium	0.571	0.404	0.000	0.000
URANIUM	2.206	1.638	0.000	0.000
THORIUM	6.232	4.509	0.000	0.000
U/K	3.976	4.433	0.000	0.000
U/TH	0.364	0.381	0.000	0.000
TH/K	11.319	11.621	0.000	0.000

MAP UNIT MDC

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.463	0.000	0.000	0.461	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
URANIUM	1.630	0.000	0.000	2.141	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
THORIUM	4.622	0.000	0.000	5.767	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
U/K	3.685	0.000	0.000	4.774	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
U/TH	0.366	0.000	0.000	0.373	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TH/K	10.217	0.000	0.000	13.092	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	1040	1050	1060	1070
POTASium	0.000	0.343	0.000	0.000
URANIUM	0.000	1.606	0.000	0.000
THORIUM	0.000	3.908	0.000	0.000
U/K	0.000	4.706	0.000	0.000
U/TH	0.000	0.416	0.000	0.000
TH/K	0.000	11.621	0.000	0.000

MAP UNIT SSC

	250	260	270	280	290	300	310	320	330	340	350	360	1010	1020	1030
POTASium	0.000	0.000	0.000	0.421	0.434	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
URANIUM	0.000	0.000	0.000	1.447	1.916	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
THORIUM	0.000	0.000	0.000	3.933	4.613	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
U/K	0.000	0.000	0.000	3.472	4.412	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
U/TH	0.000	0.000	0.000	0.364	0.415	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TH/K	0.000	0.000	0.000	9.565	10.620	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	1040	1050	1060	1070
POTASium	0.000	0.000	0.000	0.000
URANIUM	0.000	0.000	0.000	0.000
THORIUM	0.000	0.000	0.000	0.000
U/K	0.000	0.000	0.000	0.000
U/TH	0.000	0.000	0.000	0.000
TH/K	0.000	0.000	0.000	0.000

[illegible]

APPENDIX H - Pseudo Contour Maps

FORT SMITH

Potassium Pseudo-Contour Map - Fort Smith Quadrangle

EXPLANATION

PRINT CHARACTER	VALUE
0	LE 0.0000
1	0.0000 0.1000 0.2000 0.3000 0.4000 0.5000 0.6000 0.7000 0.8000 0.9000 1.0000 1.1000 1.2000 1.3000 1.4000 1.5000 1.6000 1.7000 1.8000
2	0.3000 0.4000 0.5000 0.6000 0.7000 0.8000 0.9000 1.0000 1.1000 1.2000 1.3000 1.4000 1.5000 1.6000 1.7000 1.8000
3	0.4000 0.5000 0.6000 0.7000 0.8000 0.9000 1.0000 1.1000 1.2000 1.3000 1.4000 1.5000 1.6000 1.7000 1.8000
4	0.5000 0.6000 0.7000 0.8000 0.9000 1.0000 1.1000 1.2000 1.3000 1.4000 1.5000 1.6000 1.7000 1.8000
5	0.6000 0.7000 0.8000 0.9000 1.0000 1.1000 1.2000 1.3000 1.4000 1.5000 1.6000 1.7000 1.8000
6	0.7000 0.8000 0.9000 1.0000 1.1000 1.2000 1.3000 1.4000 1.5000 1.6000 1.7000 1.8000
7	0.8000 0.9000 1.0000 1.1000 1.2000 1.3000 1.4000 1.5000 1.6000 1.7000 1.8000
8	0.9000 1.0000 1.1000 1.2000 1.3000 1.4000 1.5000 1.6000 1.7000 1.8000
9	1.0000 1.1000 1.2000 1.3000 1.4000 1.5000 1.6000 1.7000 1.8000
GT	1.8000

SCALE IN EQUIVALENT PERCENT

FORT SMITH

EXPLANATION

PRINT CHARACTER	VALUE
0	LE 0.0000
1	0.0000 0.2500
2	0.2500 0.5000
3	0.5000 0.7500
4	0.7500 1.0000
5	1.0000 1.2500
6	1.2500 1.5000
7	1.5000 1.7500
8	1.7500 2.0000
9	2.0000 2.2500
GT	2.2500 2.5000

SCALE IN EQUIVALENT PPM

FORT SMITH

EXPLANATION

PRINT CHARACTER		VALUE
0	LE	0. 5000
	0. 5000	1. 2500
1	1. 2500	2. 0000
	2. 0000	2. 7500
2	2. 7500	3. 5000
	3. 5000	4. 2500
3	4. 2500	5. 0000
	5. 0000	5. 7500
4	5. 7500	6. 5000
	6. 5000	7. 2500
5	7. 2500	8. 0000
	8. 0000	8. 7500
6	8. 7500	9. 5000
	9. 5000	10. 2500
7	10. 2500	11. 0000
	11. 0000	11. 7500
8	11. 7500	12. 5000
	12. 5000	13. 2500
9	13. 2500	14. 0000
	GT	14. 0000

SCALE IN EQUIVALENT PPM

Thorium Pseudo-Contour Map - Fort Smith Quadrangle

FORT SMITH

Thorium/Potassium Pseudo-Contour Map - Fort Smith Quadrangle

EXPLANATION		
PRINT CHARACTER	VALUE	
0	LE	0. 0000
	0. 0000	1. 2500
1	1. 2500	2. 5000
	2. 5000	3. 7500
2	3. 7500	5. 0000
	5. 0000	6. 2500
3	6. 2500	7. 5000
	7. 5000	8. 7500
4	8. 7500	10. 0000
	10. 0000	11. 2500
5	11. 2500	12. 5000
	12. 5000	13. 7500
6	13. 7500	15. 0000
	15. 0000	16. 2500
7	16. 2500	17. 5000
	17. 5000	18. 7500
8	18. 7500	20. 0000
	20. 0000	21. 2500
9	21. 2500	22. 5000
	GT	22. 5000

FORT SMITH

[illegible]

EXPLANATION

PRINT CHARACTER		VALUE
0	LE	0. 0000
		0. 0000 0. 5000
1		0. 5000 1. 0000
		1. 0000 1. 5000
2		1. 5000 2. 0000
		2. 0000 2. 5000
3		2. 5000 3. 0000
		3. 0000 3. 5000
4		3. 5000 4. 0000
		4. 0000 4. 5000
5		4. 5000 5. 0000
		5. 0000 5. 5000
6		5. 5000 6. 0000
		6. 0000 6. 5000
7		6. 5000 7. 0000
		7. 0000 7. 5000
8		7. 5000 8. 0000
		8. 0000 8. 5000
9		8. 5000 9. 0000
	GT	9. 0000

FORT SMITH

Uranium/Thorium Pseudo-Contour Map - Fort Smith Quadrangle

EXPLANATION

PRINT CHARACTER	VALUE
0	0.0000
1	0.0400
2	0.0800
3	0.1200
4	0.1600
5	0.2000
6	0.2400
7	0.2800
8	0.3200
9	0.3600
GT	0.4000

FORT SMITH

Residual Magnetic Pseudo-Contour Map - Fort Smith Quadrangle

EXPLANATION

PRINT CHARACTER	VALUE
0	LE -700. 0000
-700. 0000	-670. 0000
1 -670. 0000	-640. 0000
-640. 0000	-610. 0000
2 -610. 0000	-580. 0000
-580. 0000	-550. 0000
3 -550. 0000	-520. 0000
-520. 0000	-490. 0000
4 -490. 0000	-460. 0000
-460. 0000	-430. 0000
5 -430. 0000	-400. 0000
-400. 0000	-370. 0000
6 -370. 0000	-340. 0000
-340. 0000	-310. 0000
7 -310. 0000	-280. 0000
-280. 0000	-250. 0000
8 -250. 0000	-220. 0000
-220. 0000	-190. 0000
9 -190. 0000	-160. 0000
GT -160. 0000	

SCALE IN GAMMAS

FORT SMITH QUADRANGLE - NTMS NI 15-1 LINE 250 30
SINGLE RECORD LISTING - GEOMETRICS DATA ACQUIRED 80186 186

FORT SMITH QUADRANGLE - NTMS NI 15-1 LINE 250
AUFRAED RECORD LISTING - GEOMETRICS DATA ACQUIRED 80186