NURE AERIAL GAMMA-RAY AND MAGNETIC
RECONNAISSANCE SURVEY

NE WASHINGTON AREA

OKANOGAN NM II-10, SANDPOINT NM II-11 QUADRANGLES

VOLUME I - NARRATIVE REPORT

MASTER

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ABSTRACT

As part of the Department of Energy (DoE) National Uranium Resource Evaluation (NURE) Program, LKB Resources, Inc. has performed a rotary-wing, reconnaissance high sensitivity radiometric and magnetic survey in north-east Washington. Three (3) 1:250,000 scale NTMS quadrangles (Spokane, Sandpoint and Okanogan) were surveyed. A total of 14,421 line miles (23,203 kilometers) of data were collected utilizing a Sikorsky S58T helicopter. Traverse lines were flown in an east-west direction at 1.0 and 3.0 mile (1.6 and 4.8 kilometers) spacing, with tie lines flown in a north-south direction at 12 mile (20 kilometer) spacing. The data were digitally recorded at 1.0 second intervals. The NaI terrestrial detectors used in this survey had a total volume of 2,154 cubic inches. The magnetometer employed was a modified ASQ-10 fluxgate system.

This report covers only the Okanogan and Sandpoint 1:250,000 scale NTMS quadrangles. Spokane 1:250,000 scale NTMS quadrangle is covered in a separate report.

The radiometric data was normalized to 400 feet terrain clearance. The data is presented in the form of computer listings on microfiche and as stacked profile plots. Profile plots are contained in Volume II of this report. A geologic interpretation of the radiometric and magnetic data is included as part of this report.

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SECTION 1.0

INTRODUCTION

During the 1977 flying season, an area in north-eastern Washington covering the Spokane, Sandpoint and Okanogan Quadrangles was flown. (See Figure 1). This report covers the Okanogan and Sandpoint quadrangles 1:250,000 NTMS quadrangles in which 10,626 line miles (17,097 line kilometers) of data were collected. Traverse lines were flown east-west at 1.0 mile (1.6 kilometers) spacing and 3.0 mile (4.8 kilometers) spacing. Tie lines were flown in a north-south direction at 12 mile (20 kilometer) spacing. Figure 2 indicates the location of individual traverses and tie lines within the NTMS 1:250,000 quadrangles.

This survey was performed under the United States Department of Energy's National Uranium Resource Evaluation (NURE) program, which is designed to provide reconnaissance radioelement distribution information to assist in assessing the uraniferous material potential in the United States. All phases of this work were performed for the Grand Junction office of Bendix Field Engineering Corporation under subcontract #77-079-S.

FIGURE - 2 INDEX TO TRAVERSE LOCATIONS

SECTION 2.0

THE AIRBORNE SYSTEM

2.1 ROTARY-WING AIRCRAFT

The Sikorsky S58T Twin Turbine helicopter was utilized during the 1977 flying season when the north-east Washington area was surveyed. See Figure 3.

All equipment was located within the cabin of the aircraft with the exception of the magnetometer which was rigidly mounted to the exterior. See Figure 4.

2.2 INSTRUMENTATION

The primary system components include the following (See Figure 5):

- (1) Terrestrial Gamma-Ray Sensor
- (2) Atmospheric Gamma-Ray Sensor
- (3) Magnetometer
- (4) Barometric Pressure Altimeter
- (5) Radar Altimeter
- (6) Temperature Sensor
- (7) Data Acquisition System
- (8) Recording System
- (9) 35mm Tracking Camera

2.2.1 Terrestrial Sensor

This sub-system consists of two identical Scintrex GSA-77 sensors, each containing seven crystals measuring 7 inches in diameter X 4 inches thick. The seven NaI (Tl) crystals in each sensor are arranged with six crystals mounted in a circle around one in the center. Each sensor incorporates an ultra-stable high voltage supply, seven preamplifiers, a temperature control unit and a detector signal mixing circuit.

The detectors are housed in an appropriately insulated container. A heating element inside each container provides temperature stabilization to maintain detector balance. A temperature range control offers six switch-selectable temperature settings, and a temperature meter permits continued monitoring. A temperature setting of 27.5 °C was maintained for most of the survey.

The central detector in each sensor contains a light emitting diode which allows the injection of a stabilization pulse which can be monitored and stabilized at any location on the pulse height spectrum. Although two such stabilization sources are available (one in each sensor) only one is used at any given time. A location above 6 MeV is used for this LED pulse.

Each of the two sensors provides a sensitive volume of 1077 inches³ and weighs 350 lbs. These sensors draw power from the 28V helicopter system when in flight. When not flying, the sensor heaters are plugged into an external 115V power source through a 28V D.C. converter to maintain temperature control.

2.2.2 Atmospheric Sensor

This sub-system is mounted directly over a lead slab measuring 12 inches X 12 inches X 3 inches such that its field of view is limited to a solid angle of approximately 2 π in the upward direction.

The detector consists of one 9 inch diameter X 5 inch thick NaI (Tl) crystal having a total sensitive volume of 318 inches³, and containing a light emitting diode system to provide a stabilization pulse. The weight of the atmospheric detector, including the lead shield is approximately 300 lbs.

2.2.3 Magnetometer

A modified ASQ-10 fluxgate magnetometer was employed in this system, with the observed magnetic field measurements obtained in units of 0.1 gamma.

2.2.4 Barometric Altitude Transducer

The barometric pressure instrumentation consists of an elastic pressure sensing element acting as a prime mover for positioning an electro-mechanical transducer.

2.2.5 Radar Altimeter

A Minneapolis Honeywell altimeter is used to measure helicopter to ground distance. The antennae are mounted on the underside of the helicopter. Altitude measurements are recorded to 1.0 foot. The recording range is 0-5,000 feet with an accuracy of ± 5 feet + 3% at actual altitude.

2.2.6 Temperature Sensor

A platinum resistance thermometer was utilized to record outside air temperature with an accuracy of 0.01 °C.

2.2.7 Data Acquisition System

Signals from the terrestrial and atmospheric sensors are amplified, digitized and stored in the digital processor contained in the 1024 channel pulse height analyzer. Each sensor calibration is such that a 400 channel block contains gamma-ray intensity information for the energies 0-3 MeV and 3-6 MeV. The last 112 channels in each block are reserved for storing the stabilization pulses for the individual LED's. Two independent digital stabilizers are latched onto their appropriate LED pulse to achieve stability of the entire gamma-ray energy calibration. An oscilloscope display is available to monitor the accumulation of gamma-ray pulses during each acquisition period.

Data from the magnetometer, temperature probe, barometric altimeter, radar altimeter, clock and the preset data is fed through an A/D converter into the 1024 channel digital processor.

2.2.8 Recording System

The collected data is fed through a magnetic tape control to the tape unit. The data is recorded in 7 track BCD code at 556 BPI density. After each readout cycle, the system is automatically reset and a new data acquisition cycle is begun.

A permanent record of the following information is obtained for each acquisition cycle.

1. Acquisition Identification
 - Four sets of six digit presettable data for
 - a. Julian day
 - b. Line number
 - c. Reference number (job no.)
 - d. Azimuth (flight direction)
2. Record number - (Sequential Record Count)
3. Time of day (correlates with camera fiducials)
4. Temperature
5. Barometric altitude
6. Radar altitude
7. Scan time (presettable - 2.0 seconds for this project)
8. Observed aeromagnetic reading
9. Live time in milliseconds for both terrestrial and atmospheric sensors
10. Full gamma-ray spectrum for each sensor package

FIGURE-3 S-58T HELICOPTER

FIGURE - 4 S-58 T HELICOPTER (CABIN LAYOUT)

FIGURE-5
SYSTEM BLOCK DIAGRAM

SECTION 3.0

FIELD OPERATIONS

3.1 FLIGHT SPECIFICATIONS

Traverse and tie-line locations were drawn on 1:24,000 scale U.S. Geological Survey topographic Maps for use by the navigator in directing the pilot down line.

Terrain clearance was held as close to 400 feet as possible. Considering the aircrafts' performance and flight safety parameters 400 feet clearance was not always possible due to the topographic relief and high elevations in certain areas. Occasionally, traverses were interrupted and restarted in order to maintain the prescribed flight altitude limits.

The aircraft speed was limited to a mean of 90.0 miles per hour in accordance with the requirement to maintain a crystal detector volume/aircraft speed (V/v) factor of 20 or better. Air speed and altitude histograms are presented in appendix A.

3.2 DAILY PROCEDURE

The heating elements in the terrestrial and atmospheric detectors were in operation, using external 115V power, during all periods the aircraft was on the ground. The aircraft power was utilized to maintain temperature stabilization while in flight.

The entire system was checked before each days flying by an LKB technician. This complete system check-out required about one hour. Prior to production flying, a pre-selected test line near the base of operations was flown at survey altitude and speed.

The test line was reflown upon completion of the days production flying. The purpose of this test was to provide data necessary to evaluate ground moisture effects and/or atmospheric radon conditions in terms of system repeatability.

3.3

STATISTICAL DATA

Flying of the Okanogan and Sandpoint Quadrangles was performed during September and October 1977.

Average hours flown per production day	6.7
Average line miles per production day	287
Percentage of Weather days	21%
Days on the Project	56 A/C Days
Miles flown	10,626

3.4

PERSONNEL

The field crew was composed of two electronic technicians, a pilot, a navigator, a mechanic and a data analyst/field manager who was responsible for timely inspection of the data and flight path recovery.

SECTION 4.0

DATA REDUCTION

4.1 GENERAL

Figure 6 outlines the processing sequence followed to locate, identify and reduce the gamma-ray survey data. The following sections describe the main data reduction steps consisting of the following principal operations:

- (1) Path recovery and geologic correlation
- (2) Digital data edit
- (3) Radiometric corrections
- (4) Magnetism adjustment
- (5) Statistical analysis

4.2 PATH RECOVERY

The aircraft track was established by manual identification and correlation of the 35mm tracking camera imagery with existing USGS topographic map sheets. The film images were identified on 1:62,500 and 1:24,000 scale maps from which the UTM X, Y coordinates were read.

The coordinate data was edited by plotting the recovered path from the scaled X, Y coordinates. This was accomplished via the card edit plot program. The plotted path was inspected, any erratic variations were checked and if found in error, corrected and replotted.

The edited positional data was then transferred to the geologic map sheets from which the geologic rock units were read and correlated with the digital data by means of the common fiducial number.

4.3 DIGITAL DATA EDIT

The airborne data tapes are processed by the edit program which decodes and translates the recorded data. The multi-channel spectra for both atmospheric and terrestrial gamma-ray sensors are summed over the entire time interval required to traverse the surveyed line. The resulting spectrum is smooth enough to fit a least squares polynomial to the potassium and thorium photopeaks so as to accurately locate the channels corresponding to the maximum power points. The energy per channel is determined and the channel limits corresponding to the primary energy bands are computed.

K = 1.37 - 1.57 MeV
U = 1.66 - 1.86 MeV
T = 2.41 - 2.81 MeV

The computation of the photopeak limits effectively compensates for any spectrum drift.

The counts/channel within each photopeak are summed, as are the total count (.4 - 3.0 MeV) and the cosmic counts (3.0 - 6.0 MeV). The summed counts are all normalized to counts per second by dividing each sum by the recorded net live time.

The ancilliary data (barometric, radar, temperature and magnetometer) are all converted to appropriate units and tested for validity. The standard deviation of the median values of the first and second differences and of the absolute values are computed for groups of 56 samples. All samples within a given group for which three or more data words deviate more than six times the standard deviation of the appropriate median are flagged as being of suspect data quality. The suspect data words are replaced by linearly interpolated values.

Program outputs consist of a raw spectral data file and a single record data file containing the summed, normalized raw spectral data. In addition, a comprehensive edit listing is generated which is reviewed for possible additional edit corrections and further provides a detailed list of the magnetic field data which is utilized for the determination of the magnetic level corrections.

4.4 RADIOMETRIC CORRECTIONS

The reformatted data, having been summed and normalized to counts per second, was further processed to remove the effects of aircraft background, cosmic radiation and atmospheric bismuth. In addition, the Compton scattering of the higher energy levels into the lower spectral windows was corrected using the spectral stripping method. The net reduced count was then tested for statistical adequacy and normalized to 400 feet altitude at standard temperature and pressure.

4.4.1 Background Corrections

The effects of aircraft background and cosmic radiation was removed by computing their contribution to each of the primary energy windows, from empirically derived correction parameters.

The parameters, defining the contribution of these non-terrestrial radiation sources to the airborne gamma-ray measurements were determined from data obtained from high altitude overwater flights.

To derive the cosmic and aircraft background correction parameters several assumptions must be made:

- (1) The background radiation, emanating from onboard sources, is a constant.

- (2) Atmospheric and terrestrial radiation are effectively eliminated by flying at high altitudes over deep bodies of water.
- (3) The observed count rate varies linearly with respect to the cosmic count as measured by summing over the energy band from 3.0 to 6.0 MeV.

Using these assumptions, the spectrums obtained are considered to be composed of only two components, cosmic radiation and aircraft background.

The count rate for any given window may then be expressed by the following equation:

$$(1) \quad C_{ij} = B_i + R_i \cos_j$$

where:

i, j are the subscripts identifying the window and observation respectively.

C_{ij} is the mean count for window i , observation j

B_i is the background constant corresponding to window i .

R_i is the cosmic ratio corresponding to window i .

$\cos_j$ is the summed cosmic count corresponding to observation j .

A system of observation equations was formed for each of the principal windows and solved simultaneously for the most probable values of the cosmic and background correction parameters.

4.4.2 Compton Scatter Corrections

The effects of the Compton scattering of the higher energy radiation into the lower energy bands of interest were removed by computing the scattered radiation count utilizing the following correction equations.

$$(1) \quad T_c = T_o - bU_c$$

$$(2) \quad U_c = U_o - T_c \alpha_o - T_c \alpha_1 H$$

$$(3) \quad K_c = K_o - T_c B_o - T_c B_1 H - U_c \gamma$$

where:

U_c = Corrected uranium count

U_o = Uranium count corrected for aircraft background and cosmic radiation

T_o = Thorium count corrected for aircraft background and cosmic radiation.

- T_c = Thorium count corrected for aircraft background, cosmic radiation and scattered uranium at 2.43 MeV appearing in the thorium window
 K_o = Potassium count corrected for aircraft background and cosmic radiation
 K_c = Corrected potassium count
 b = Fraction of uranium counts appearing in the thorium window (R. L. Grasty - A Calibration Procedure for an Airborne Gamma-ray Spectrometer)
 α_o = Stripping ratio (uranium counts per thorium count at zero altitude)
 α_1 = Rate of change of the uranium stripping ratio with altitude H
 B_o = Stripping ratio (potassium counts per thorium count at zero altitude)
 B_1 = Rate of change of the potassium stripping ratio, beta, with altitude
 γ = Stripping ratio (potassium counts per uranium count)

The stripping ratios α_o , B_o , γ_o and b were determined from data obtained at the Walker Field test pads. The five test pads, each having known concentrations of K, U, T, provided the necessary redundant data for the solution of the stripping ratios α_o , B_o , γ and the system sensitivities K_1 , K_2 , K_3 . The several equations relating the count rates with their corresponding concentrations are as follows:

$$(4) \quad T = K_1 \times T_{ppm} + U_c \times b$$

$$(5) \quad U = K_2 \times U_{ppm} + T_c \times \alpha_o$$

$$(6) \quad K = K_3 \times K_{pct} + T_c B_o + U_c \gamma_o$$

where:

T, U, K = Observed counts corrected for the local background as measured at Matrix Pad No. 1.

$T_{ppm}, U_{ppm}, K_{pct}$ = Concentration values after subtracting the Matrix Pad concentration values.

$\alpha_0, B_0, \gamma_0, b$ = Unknown stripping ratios.

* K_1, K_2, K_3 = Unknown sensitivities.

The equations presented above were solved sequentially in the order presented. A system of observation equations was generated for each of the principal sets of unknowns. The number of equations being greater than the number of unknowns, the system was normalized and the unknowns computed and substituted into the next sequential set of observation equations.

The increase of the stripping ratios with altitude was determined empirically from multi-altitude test data obtained over a pre-selected test line located in the Chesapeake Bay area. The extent of the test line was approximately seven miles, the last two miles extending out over water.

The test consisted of 16 passes over the test line, two passes at each of eight altitudes, 200, 300, 400, 500, 600, 700, 800 and 1,000 feet.

The over land and over water portions were averaged for each pass. The averaged over water count was applied as a total background correction, effectively compensating for atmospheric bismuth, cosmic radiation and aircraft and system background.

The corrected mean count at any altitude is related to any other altitude by the following equation.

$$(7) \quad C_i = C_j \exp(-u_i H_i) / \exp(-u_j H_j)$$

where:

C_i, C_j = fully corrected counts at levels i and j

u_i, u_j = altitude attenuation coefficients adjusted for existing temperature and pressure

H_i, H_j = height in feet of levels i and j

letting $E = \exp(-u_i H_i) / \exp(-u_j H_j)$

and replacing the corrected count by an equation of the form presented in (2), we may write:

$$U_i - TC_i \alpha_0 = TC_i \alpha_1 H_i = (U_j - TC_j \alpha_0 - TC_j \alpha_1 H_j) E$$

rearranging:

$$(8) \quad \alpha_1 = (U_i - TC_i \alpha_0 - U_j E - TC_j E \alpha_0) / (TC_i H_i - TC_j H_j E)$$

* The sensitivities @ 400 feet as derived from the dynamic test range data are as follows:

$$K = 71.90 \text{ CPS/\%}, U = 7.36 \text{ CPS/Ppm}, T = 5.05 \text{ CPS/Ppm}$$

where:

U_i, U_j = Uranium count at levels i and j corrected for local background.

TC_i, TC_j = fully corrected thorium count at levels i and j .

Each pair of observations results in a single equation of the form defined in (8). A similar procedure was followed in the determination of the increase of Beta with altitude.

4.4.3 Atmospheric Bismuth Correction

The atmospheric detector data was sampled at the same time interval as the terrestrial detector data, 1.0 seconds per scan. However, the relative precision of the atmospheric data is significantly less than the terrestrial data. This results from the fact that the volume of the atmospheric detector is approximately one seventh that of the terrestrial system.

Since the precision index varies directly as the square root of the number of observations, the atmospheric precision was increased by averaging over a 49 sample period. This period provides a seven fold increase in the precision of the atmospheric data which approaches the precision of the terrestrial sensor.

The averaged atmospheric data was then corrected for aircraft background, cosmic radiation and Compton scatter effects resulting from possible thorium shine-around, scattering into the atmospheric uranium window. Additionally, correction was made for terrestrial uranium shine-around which was considered to vary exponentially with altitude. The terrestrial shine-around computation is iterated so as to eliminate the first order effects of the presence of any atmospheric bismuth.

The actual calculations are defined by the following expression:

$$Bi \text{ AIR} = (AUC - TUC \times Sh) R$$

where:

AUC = Atmospheric uranium count corrected for cosmic radiation, aircraft background and Compton scattering of thorium into the uranium window.

TUC = Terrestrial uranium count corrected for cosmic radiation, aircraft background, Compton scattering of thorium into the uranium window and corrected for atmospheric bismuth.

SH = Exponential shine-around equation

$$SH = .071 \times \text{EXP} (uH)$$

and u is the empirically derived exponential coefficient.

R = Response ratio equating the atmospheric and terrestrial counts.

4.4.4 Statistical Adequacy Test

The reduced single record count rates, (K, U, T) derived as described in the preceding sections, were tested to determine the significance of the net count rate values.

In this case significance is measured in terms of whether the net count exceeds some specified multiple of the computed standard deviation of the net count. From the paper presented by Currie (Analytical Chemistry 1968), the standard deviation of the net count may be expressed as:

$$\sigma_{\text{NET}} = 1.41 (B)^{\frac{1}{2}}$$

where B is the total background which in the context of this discussion is considered to be the sum of the corrections applied to the observed count.

The confidence level, suggested by Currie and commonly adopted as a standard statistical measure, is .95 or 95%. The standard normal variable (multiple of standard deviation) corresponding to the 95% confidence level is 1.64. The statistical adequacy test employed to evaluate the single record data is therefore:

$$2.33 (\text{obs. count} - \text{net count})^{\frac{1}{2}}$$

In summation, if the net count is less than 2.33 times the total applied correction (background) the sample is considered statistically inadequate and is flagged. The net counts are normalized to 400 feet and the ratios, U/K, U/T and T/K, are computed for all single record samples. The single record data are presented in the form of microfiche copies of the computer listings.

4.4.5 Altitude Normalization

The intensity of gamma radiation is considered to decrease exponentially with increasing distance from the source. This decrease in intensity may be defined as follows:

$$(1) \quad C_h = S \exp (-u_h h)$$

where:

C_h = the reduced count rate measured at height h above the source.

S = Source concentration expressed in counts/second.

u_h = The total attenuation coefficient compensated for air density as derived from the observed temperature and pressure.

The count rate observed at 400 feet above the source, at standard temperature of 0°C and standard pressure of 1013 milibars, is also expressed exponentially.

$$(2) \quad C_{400} = S \exp (-u_0 400)$$

where:

u_0 = the total attenuation coefficient at standard temperature and pressure.

Equating equations 1 and 2.

$$(3) \quad C_{400} = C_h \exp (-u_0 400) / \exp (-u_h h)$$

and since $\exp (-u_0 400)$ is a constant = K

$$(4) \quad C_{400} = K C_h / \exp (-u_h h)$$

4.4.6 Record Averaging

The single record data was averaged over successive groups of five samples each. The averaging interval is determined by the following criteria.

- (1) The interval over which the data is averaged must be less than 1200 feet.
- (2) Ninety percent of the averaged uranium data must pass the statistical adequacy test.

$$2.33 (\text{average correction}/N)^{1/2}$$

The average correction is determined from the reduced count prior to normalization to 400 feet. Single records failing the statistical adequacy test are included when calculating the averaged record sample; the only restriction imposed is that the single record data be within the altitude limits of 200 to 1000 feet.

The averaged data values failing the test are flagged and excluded from all further analysis.

4.5 STATISTICAL ANALYSIS

The purpose of this phase of the data processing sequence is to identify potentially anomalous averaged record data. This is accomplished by the statistical evaluation of the averaged record data which is predicated on the assumption that the averaged count is normally distributed about the mean count of the geologic unit to which the record belongs.

This assumption is valid for all large samples consisting of 30 or more records. Statistics relating to samples consisting of fewer than 30 records are at best suspect.

All averaged data records corresponding to the same geologic unit are grouped and processed as a single statistical sample.

The pertinent statistics defining a given sample are the mean and standard deviation. These statistics are computed for each data parameter (K, U, T, U/T, T/K, T/K) utilizing only those data values determined to be statistically adequate.

Each averaged record data parameter was evaluated, relative to its sample mean and standard deviation, by computing the standard normal variable Z.

$$Z_K = (X_K - M_K) / \text{Sigma}_K$$

where K = subscript identifying data parameter

X_K = Averaged record value

M_K = Mean value of parameter K

Sigma_K = Standard deviation of parameter K

Z_K = Standard normal variable of averaged record parameter K

The standard normal variable is considered to have a normal distribution with a mean of zero and standard deviation of ± 1 . Values of the standard normal variable greater than ± 1 are considered potentially anomalous and plotted on the anomaly maps.

Although the departure of the averaged record count from the mean of its corresponding geologic unit may be classified as potentially anomalous, it remains for the geologic interpreter to evaluate each anomaly so as to eliminate those which are obviously caused by climatic or topographic conditions.

4.6 MAGNETIC DATA PROCESSING

The recorded magnetic total field is edited simultaneously with the gamma-ray data. The edit listing generated by the digital edit program together with the identified film intersections are the basic information required to adjust the magnetics network.

Initially a tie-line is selected as a datum to which all intersecting traverses are adjusted. All other tie-line and traverse line intersection values are evaluated in terms of the magnitude and linearity of the level corrections required to adjust each traverse line to agree with the corresponding tie-line value.

Excessively large non-linear corrections generally indicate erroneous positional information. In practice slight positional adjustments are usually applied so as to insure the required level corrections approach linearity.

The last step in the adjustment processes was the calculation and removal of the earth's regional magnetic field component. This was computed using the 1965 IGRF Model updated to 1977.

A datum of 56,000 gammas was added after removal of the regional field so as to approximate the absolute values expected in this area.

DATA PROCESSING FLOW CHART

FIGURE-6

SECTION 5.0

5.1 GRAPHIC DATA PRESENTATION

All graphic and numeric data is organized according to individual NTMS 1:250,000 scale map sheets, and is identified by quadrangle name and number. The graphic data, produced at a scale of 1:250,000 and reduced to 1:500,000 is contained in Volume II of this report. The data presented consists of the following specific items:

- (1) Radiometric Multiple-Parameter Stacked Profiles
- (2) Magnetic Multiple Parameter Stacked Profiles
- (3) Anomaly Maps
- (4) Count Rate Histograms
- (5) Single Record Data Listings
- (6) Averaged Record Data Listings

5.2 RADIOMETRIC MULTIPLE-PARAMETER STACKED PROFILES

The profiles of the averaged record data contain the following information:

- Flight Line Number
- Appropriate Title Information
- Fiducial Numbers
- Residual Magnetic Profile
- Radar Altimeter
- Corrected total Count in CPS
- Atmospheric Bismuth (Bi Air) Correction in CPS
- Corrected U in CPS
- Corrected T in CPS
- Corrected K in CPS
- Ratio U/K
- Ratio U/T
- Ratio T/K
- Geologic Strip Map with Flight Path

Flags appearing under the K, U, and T traces indicate that the computed average record value for the corresponding element has failed the calculated statistical adequacy test. Flags appearing under the altitude trace indicate the averaged record has exceeded the altitude limits of 200 and 700 feet.

5.3 MAGNETIC MULTIPLE PARAMETER STACKED PROFILES

The magnetic data profiles were generated from the single record data file and contain the following information:

Flight Line Number
Appropriate Title Information
Fiducial Numbers
Barometric Altitude in feet
Temperature in degrees centigrade
Radar Altimeter in feet
Geologic Interpretation of Magnetic Profile (Source Depths)
Residual Magnetic Profile in gammas
Geologic Map Strip with Flight Path

Samples obtained at terrain clearances less than 200 feet and greater than 700 feet are identified by a plotted symbol appearing at the bottom of the radar altimeter trace.

5.4 ANOMALY MAPS

The anomaly maps generated are Uranium, Uranium/Thorium, Uranium/Potassium, Thorium, Potassium and Thorium/Potassium. The mean and its standard deviation were computed for each element and ratio of each lithologic unit. Only those averaged samples determined to be statistically adequate were used. Standard normal deviations greater than 11 were considered potentially anomalous and were plotted.

Along east-west lines positive anomalies are plotted on the north side. Along north-south lines positive anomalies are plotted on the east side.

5.5 HISTOGRAMS

The histograms of the count rate distribution of Uranium, Uranium/Thorium, Uranium/Potassium, Thorium, Potassium and Thorium/Potassium for each lithologic unit were computed for each quadrangle and are included in Volume II. Additional information presented are the mean, standard deviation and number of records contained in each distribution plot.

5.6 DATA LISTINGS

The data listings from the reduced data tapes covering each NTMS 1:250,000 sheet are produced on microfiche and included in this report. Each printer page is identified by a header label specifying the NTMS quadrangle, survey company, survey area, year survey was flown, and line number.

5.6.1 Single Record Reduced Data Listings

The following elements are listed for each record:

<u>HEADING</u>	<u>DESCRIPTION</u>
REC	Fiducial Number (Time in seconds past midnight)
AF	Altitude Flag (greater than 700 and less than 200 feet)
KF	Potassium Flag (Failed statistical adequacy test)

HEADINGDESCRIPTION

UF	Uranium Flag (Failed statistical adequacy test)
TF	Thorium Flag (Failed statistical adequacy test)
UNIT	Geologic Unit Code
LAT	Latitude in decimal degrees
LONG	Longitude in decimal degrees
TEMP	Temperature in Degrees Centigrade
BARM	Barometric Pressure Height in Feet
RADR	Radar Terrain Clearance in Feet
MAG	Total Magnetic Field in Gammas
GROSS	Total Count (.4 to 3.0 MeV) in Counts/Second
K	Potassium Counts/Second
U	Uranium Counts/Second
T	Thorium Counts/Second
U/K	Ratio Uranium/Potassium
U/T	Ratio Uranium/Thorium
T/K	Ratio Thorium/Potassium
COS	Cosmic Count (3 to 6 MeV) in Counts/Second
Bi	Atmospheric Bismuth Correction in Counts/Second

5.6.2 Averaged Record Data Listings

The following elements are listed for each averaged record:

HEADINGDESCRIPTION

REC	Fiducial Number of Central Records (time in seconds past midnight)
AF	Altitude Flag (Greater than 700 or less than 200 feet)
KF	Potassium Flag (Failed statistical adequacy test)
UF	Uranium Flag (Failed statistical adequacy test)
TF	Thorium Flag (Failed statistical adequacy test)
UNIT	Geologic Unit Code
LAT	Latitude in decimal degrees
LONG	Longitude in decimal degrees
RADR	Radar Terrain Clearance in feet
MAC	Total Magnetic Field in Gammas
TC	Total Count (.4 to 3.0 MeV) in Counts/Second
K	Potassium Counts/Second
U	Uranium Counts/Second
T	Thorium Counts/Second
U/K	Ratio Uranium/Potassium
U/T	Ratio Uranium/Thorium
T/K	Ratio Thorium/Potassium
COS	Cosmic Counts/Second (3.0 to 6.0 MeV)
Bi	Atmospheric Bismuth Correction in Counts/Second
K	Potassium Standard Deviation units from the mean
U	Uranium Standard Deviation units from the mean
T	Thorium Standard Deviation units from the mean
U/K	Ratio Standard Deviation units from the mean
U/T	Ratio Standard Deviation units from the mean
T/K	Ratio Standard Deviation units from the mean

SECTION 6.0

GEOLOGY AND RADIOACTIVE MINERAL RESOURCES

6.1 GEOLOGY

The Okanogan and Sandpoint 1:250,000 scale NTMS quadrangles encompass portions of several major geologic units of regional extent in eastern Washington and northern Idaho. The principal geologic features of the area are illustrated in Figure 7.

The major part of the area lies within the Okanogan Highlands physiographic province, a broad upland region extending over most of northeastern Washington State. The highlands are underlain by the Loon Lake and Colville batholiths, two large plutons of Mesozoic and early Cenozoic age composed of granodiorite, quartz monzonite and granite, which are generally regarded sufficiently similar to the Idaho batholith to be connected with it genetically and to bridge it to the Nelson batholith in British Columbia. As described by Castor and others (1978), these plutons intrude two distinct depositional provinces in the area, an eastern province of Precambrian metasediments of the Belt and Windermere Supergroups unconformably overlain by miogeosynclinal Paleozoic rocks, and a western province of eugeosynclinal upper Paleozoic and Mesozoic rocks. The two provinces meet in the region between 117° and 118° W. longitude, east of the Columbia River.

The following excerpts from the recent report by Castor, Berry and Robins (1978) on the granitic rocks of this area provide a very concise summary of the local geology.

"K-Ar ages of plutonic rocks in the eastern province indicate four distinct periods of intrusion at about 200+ m.y., 170 m.y., and 50 m.y. ago. Most plutons were emplaced during the latter two intrusive periods (Miller and Engels, 1975). Radiometric ages of plutonic rocks in the western province suggest a complex history of plutonism and metamorphism beginning in late Triassic time and extending into Eocene time (Fox and others, 1977).

"Tertiary volcanic rocks occur in both the eastern and western provinces. Early to middle Tertiary, felsic to intermediate volcanic rocks are mostly restricted to lowland areas such as the Okanogan, Sanpoil River, and lower Spokane River valleys. Some of these extrusives have hypabyssal to plutonic equivalents, such as the Oligocene Scatter Creek Formation in the Republic-Oroville area, which has been included in this study. Exposures of pre-Miocene bedrock are terminated on the south by overlying flows of the late Tertiary Columbia River Basalt Group.

"Exposures of Tertiary sedimentary rocks are generally restricted to the major river valleys in the project area. Unconsolidated glacial deposits mask bedrock geology in much of the area.

EXPLANATION

- GENERALIZED BOUNDARIES OF MAJOR PLUTONS
- FAULT
- APPROXIMATE WESTERN LIMIT OF EXPOSURES OF PRECAMBRIAN METASEDIMENTS OF THE BELT BASIN

APPROXIMATE SCALE
1:1,270,000

FIGURE-7 MAJOR GEOLOGIC FEATURES OF THE OKANOGAN AND SANDPOINT QUADRANGLES

"The eastern and western depositional provinces are distinguished by different structural patterns. The eastern province is equivalent to the Kootenai arc structural subprovince of Yates and others (1966), a belt of northeast-trending folds and faults in the United States, which gradually takes on a northwest trend in Canada. Deformation ranges from thrusting and tight folding in the western part of the Kootenai arc to homoclinal warping in the eastern part.

"Structure in the western province is characterized by north- to northwest-trending folds, although some folds trend northeast near the eastern boundary of the province. The western province contains the Okanogan gneiss dome and similar structures which form the southernmost part of the Shuswap terrane, a north-trending belt of high-grade metamorphic rocks and gneiss domes in Canada.

"High-angle normal faults of late Cretaceous and (or) early Tertiary age, most of which trend north-northeast, cut both provinces. This faulting produced down-dropped linear structures, such as the Republic graben."

6.2 DESCRIPTION OF MAP UNITS

6.2.1 Okanogan Quadrangle

SEDIMENTARY ROCKS

Q	RECENT DEPOSITS UNDIVIDED (QUATERNARY)
Qal	ALLUVIAL DEPOSITS (QUATERNARY)
Qt	GLACIAL TILL (QUATERNARY)
Qg	GLACIAL DEPOSITS UNDIVIDED (QUATERNARY)
Tob	OBRIAN CREEK FORMATION (EOCENE) Mainly sedimentary tuff.
Tsa	SANDSTONE, ARKOSE, SILTSTONE, CONGLOMERATE (MAINLY EOCENE)
TrPb	BLACK SHALE (TRIASSIC TO PERMIAN)
Pbm	BULLFROG MOUNTAIN FORMATION (PERMIAN) Conglomerate.
Ps	SPECTACLE FORMATION (PERMIAN) Conglomerate and limestone; includes slate, phyllite and marble.
Pzls	LIMESTONE (PENNSYLVANIAN TO MISSISSIPPIAN)

Pza	ARGILLITE (MISSISSIPPIAN) Includes Mission argillite
Ol	LIMESTONE AND SLATE (ORDOVICIAN)
Oec	CHERT (ORDOVICIAN TO CAMBRIAN)
Eod	OLD DOMINION LIMESTONE OF WEAVER (CAMBRIAN)
pEe	EDNA DOLOMITE (PRECAMBRIAN) Includes some slate and quartzite.
<u>INTRUSIVE IGNEOUS ROCKS</u>	
Ti	INTRUSIVES UNDIVIDED (TERTIARY) Mainly diorite and granodiorite.
Tmg	MALIGNITE AND MALIGNITE BRECCIA (TERTIARY)
Tg	GEROME ANDESITE (TERTIARY) Includes flow rocks and sediments.
To	OKANOGAN INTRUSIVES (TERTIARY) Includes gneiss, granodiorite, gabbro, and syenite.
Tqm	QUARTZ MONZONITE (TERTIARY)
Tp	PORPHYRITIC INTRUSIVES (TERTIARY)
Td	DIORITE AND HORNBLENDE DACITE (TERTIARY) Includes some diabase.
Tsc	SCATTER CREEK RHYODACITE (TERTIARY)
TKqm	QUARTZ MONZONITE (TERTIARY TO CRETACEOUS)
TJbm	BRECCIATED MONZONITE (TERTIARY TO JURASSIC)
Kgd	GRANODIORITE (CRETACEOUS)
Kg	GRANODIORITE AND QUARTZ MONZONITE (CRETACEOUS)
Kd	DIORITE (CRETACEOUS)
Kcg	CONCONULLY PLUTON (CRETACEOUS) Granodiorite
Kg	QUARTZ MONZONITE (CRETACEOUS)
Kc	CATHEDRAL PLUTON (CRETACEOUS) Quartz monzonite.
Kob	OLD BALDY PLUTON (CRETACEOUS) Includes minor gneiss.

Kpgd	PORPHYRITIC BIOTITE GRANODIORITE (CRETACEOUS)
Km	ALKALI INTRUSIVES (CRETACEOUS) Monzonite, syenite and shonkinite.
KJgd	GRANODIORITE (CRETACEOUS TO JURASSIC)
KJd	FELSITE DIKES AND PIPES (CRETACEOUS TO JURASSIC)
KJa	AENEAS CREEK PLUTON (CRETACEOUS TO JURASSIC) Granodiorite and quartz monzonite.
KJm	MALIGNITE (CRETACEOUS TO JURASSIC)
KJe	EVANS LAKE PLUTON (CRETACEOUS TO JURASSIC) Quartz monzonite and granodiorite.
Jt	TOATS COULEE PLUTON (JURASSIC) Granodiorite and quartz monzonite.
Jbg	BLUE GOAT PLUTON (JURASSIC) Granodiorite.
Jsg	SIMILKAMEEN PLUTON (JURASSIC) Granodiorite.
JTrwm	WHISKEY MOUNTAIN PLUTON (JURASSIC TO TRIASSIC) Quartz monzonite and granodiorite
JTrs	SILVER NAIL LAKE PLUTON (JURASSIC TO TRIASSIC) Quartz diorite and mafic metagabbro.
JTro	OSOYOOS PLUTON (JURASSIC TO TRIASSIC) Quartz diorite and mafic diorite.
Trl	LOOMIS PLUTON (TRIASSIC) Granodiorite and quartz diorite.
Mzi	UNDIVIDED GRANITIC ROCKS (MESOZOIC)
Mzt	TILLMAN MOUNTAIN PLUTON (MESOZOIC) Mainly quartz diorite (tonalite).
Mzb	BATTLE SPRING PLUTON (MESOZOIC) Quartz monzonite and granodiorite.
Mzh	HYBRID GRANITOID ROCKS (MESOZOIC) Mainly gneiss and granodiorite.
Mzd	DIORITE (MESOZOIC) Includes quartz diorite and gabbro.

Mzhm HORSESHOE MOUNTAIN PLUTON (MESOZOIC)
Quartz monzonite.

Mzl LONE FRANK PLUTON (MESOZOIC)
Quartz diorite.

Mzw WAUCONDA PLUTON (MESOZOIC)
Gneissic granodiorite.

Mzg GRANITE AND GRANODIORITE (MESOZOIC)
Includes Cascade granodiorite.

Mzc COLVILLE BATHOLITH (MESOZOIC)
Includes granodiorite, gneiss and mylonite.

EXTRUSIVE IGNEOUS ROCKS

Tvm MAFIC VOLCANICS (TERTIARY)

Tc CARTER MOUNTAIN DACITE FLOWS (TERTIARY)

Ta ANDESITE FLOWS (TERTIARY)
Includes andesite intrusives.

Tss SCATTER CREEK FORMATION AND SANPOIL VOLCANICS, UNDIVIDED (TERTIARY)

Tb BASALT (TERTIARY)

Ts SANPOIL VOLCANICS (TERTIARY)
Quartz flows, rhyodacite and dacite; includes minor sedimentary beds.

Tw VOLCANIC WACKE AND CONGLOMERATE (TERTIARY)

Tad ANDESITE AND DACITE (TERTIARY)

Tk KLONDIKE MOUNTAIN FORMATION (TERTIARY)
Flows, breccia and conglomerate.

KJel ELLEMEHAM FORMATION (CRETACEOUS TO JURASSIC)
Lava, tuff, silt, and conglomerate.

Mzr ROSSLAND VOLCANIC GROUP (MESOZOIC)

Mzj JUMBO VOLCANICS (MESOZOIC)
May include Tertiary rocks.

METAMORPHIC ROCKS

Kotg TONASKET GNEISS (CRETACEOUS)

Ko	OKANOAGAN GNEISS (CRETACEOUS)
Kgt	TIFFANY MOUNTAIN GNEISS (CRETACEOUS)
JTrgn	GRANITOID GNEISS (CRETACEOUS)
Mzm	METAMORPHICS UNDIVIDED (MESOZOIC) Serpentine, greenstone and amphibolite; includes some monzonite.
Mzs	SALMON MEADOWS GRANODIORITIC GNEISS (MESOZOIC)
Trga	METAGABBRO (TRIASSIC)
Trk, TrPk	KOBAU FORMATION (TRIASSIC) Greenschist, greenstone, marble and quartzite; includes TrPk, phyllite unit.
Trc	CAVE MOUNTAIN FORMATION (TRIASSIC) Slate, basalt, and metasediments.
Trkc	CONCONULLY METAMORPHIC COMPLEX (TRIASSIC) Phyllite and metasediments.
Trs	SERPENTINE (TRIASSIC)
TrPpm	PALMER MOUNTAIN GREENSTONE (TRIASSIC TO PERMIAN)
TrPs	SCHIST (TRIASSIC TO PERMIAN)
TrPp	PHYLLITE (TRIASSIC TO PERMIAN)
TrPgr	GREENSTONE (TRIASSIC TO PERMIAN)
TrPls	METALIMESTONE AND METADOLomite (TRIASSIC TO PERMIAN)
TrPsv	METASEDIMENTARY AND METAVOLCANIC ROCKS (TRIASSIC TO PERMIAN)
TrPg	GREENSTONE AND GRAYWACKE, UNDIVIDED (TRIASSIC TO PERMIAN)
TrPpq	PHYLLITIC QUARTZITE (TRIASSIC TO PERMIAN)
Pr	GREENSTONE, GRAYWACKE, ARGILLITE AND PHYLLITE (PERMIAN)
Pa, Pzan	ANARCHIST GROUP (PERMIAN) Metasiltstone, quartzite, slate, schist, and phyllite; includes older Paleozoic metamorphics, Pzan.
pPtu	METAMORPHIC ROCKS, UNDIVIDED (PENNSYLVANIAN) Include gneiss, schist and quartzite.

pPmq QUARTZITE (PENNSYLVANIAN TO MISSISSIPPIAN)

pPmf QUARTZ-FELDSPAR GNEISS (PENNSYLVANIAN TO MISSISSIPPIAN)

Pzc COLVADA GROUP (PALEOZOIC)
Graywacke, quartzite, slate and limestone.

Pzms METAMORPHIC ROCKS, UNDIVIDED (PALEOZOIC)
Mainly schist, phyllite, marble and graywacke.

Pzb BUCKHORN MOUNTAIN METAMORPHICS (PALEOZOIC)
Mainly hornfels, quartzite and marble.

Pzm MARBLE WITH ASSOCIATED GNEISS, SCHIST AND QUARTZITE
(PALEOZOIC)

Pzsm SILICEOUS MARBLE (PALEOZOIC)

Pzc SCHIST AND QUARTZITE (PALEOZOIC)
Includes minor slate.

Pzcq COLVILLE QUARTZITE (PALEOZOIC)

Pzw GRAYWACKE, QUARTZITE AND INTERBEDDED BLACK SHALE
(PALEOZOIC)

PzpCm METAMORPHIC COMPLEX (CAMBRIAN)
Mainly phyllite, schist, marble and quartzite.

Pzg GREENSTONE (CAMBRIAN)

Ca ADDY QUARTZITE (CAMBRIAN)

PCh HUCKLEBERRY FORMATION (PRECAMBRIAN)
Greenstone and conglomerate.

pCb BUFFALO HUMP FORMATION (PRECAMBRIAN)
Argillite, slate and quartzite.

pEt TOGO FORMATION (PRECAMBRIAN)
Quartzite, argillite and minor dolomite.

pCm McHALE SLATE (PRECAMBRIAN)

pCo ORIENT GNEISS (PRECAMBRIAN)

6.2.2 Sandpoint Quadrangle

SEDIMENTARY ROCKS

Qa1	STREAM ALLUVIUM (HOLOCENE)
Qt	TALUS (HOLOCENE)
Qls	LANDSLIDE DEBRIS (HOLOCENE)
Qg	GLACIAL DEPOSITS (PLEISTOCENE)
Qtg	TERRACE DEPOSITS (PLEISTOCENE)
Qag	GLACIAL, FLUVIAL, ALLUVIAL, AND TERRACE DEPOSITS (PLEISTOCENE)
Tl	LATAH FORMATION (MIOCENE) Clay, silty clay, and sandy clay.
Tg	CONGLOMERATE IN THE CAMAS AND CHEWELAH AREAS (OLIGOCENE)
Tcg	TIGER FORMATION AND GRAVELS OF SIMILAR AGE (OLIGOCENE) Gravels, conglomerate and carbonaceous shale.
To	O'BRIEN CREEK FORMATION (EOCENE) Water-laid tuffs with coaly seams and conglomerate.
Tc	CONGLOMERATE (EOCENE)
Ksm	SOPHIE MOUNTAIN FORMATION (CRETACEOUS) Conglomerate with minor sandstone and siltstone.
Ks	SANDPOINT CONGLOMERATE (CRETACEOUS)
Jl	LIMESTONE (JURASSIC) In part reworked to conglomerate.
Pmr	MOUNT ROBERTS FORMATION (PENNSYLVANIAN) Quartzite and siltite with minor tuff, chert and chert nodules.
Cx	ARGILLITE, GRAYWACKE, CHERT, GREENSTONE, AND LIMESTONE (PENNSYLVANIAN)
Pzu	CARBONATE ROCKS, UNDIFFERENTIATED (PALEOZOIC)
Cl	LAKEVIEW LIMESTONE (CAMBRIAN)
Em	METALINE FORMATION (CAMBRIAN) Limestone and dolomite. Includes units Emu, Emm, and Em1.

Emu UPPER UNIT OF METALINE FORMATION (CAMBRIAN)
 Fine-grained, light gray to white limestone.

Emm MIDDLE UNIT OF METALINE FORMATION (CAMBRIAN)
 Coarse-grained white to gray dolomite.

Em1 LOWER UNIT OF METALINE FORMATION (CAMBRIAN)
 Coarse-grained white limestone.

Cr RENNIE SHALE (CAMBRIAN)

Cgc GOLD CREEK QUARTZITE (CAMBRIAN)

Cu UNDIFFERENTIATED CAMBRIAN SEDIMENTS

IGNEOUS ROCKS

Tb BASALT OF THE COLUMBIA RIVER GROUP (MIOCENE AND PLIOCENE)

Ta ANDESITE (OLIGOCENE)

Tmv BIOTITE-BEARING BASALT OR ANDESITE FLOWS AND TUFFS (EOCENE)

Tsh SHONKINITE DIKES AND SILLS (EOCENE)

Tot OLIVINE TRACHYBASALT (EOCENE)

Tsr SANPOIL VOLCANICS (EOCENE)
 Hornblende-biotite rhyodacite to andesite with associated
 tuffs and volcanic sediments.

Trd RHYODACITE DIKES (EOCENE)

Tsg SHEPPARD GRANITE (EOCENE)
 Leucocratic microcline-albite granite.

Tcp CORYELL PLUTONIC ROCKS (EOCENE)
 Dikes and dike swarms of syenite and/or monzonite.

Tdg GRANODIORITE AND DACITE PORPHYRY DIKES (EOCENE)

Tq BIOTITE QUARTZ MONZONITE (EOCENE)

Tsp UNDIFFERENTIATED PLUTONIC ROCKS OF THE SELKIRK CREST
 (EOCENE)
 Mostly weakly foliated to massive muscovite-biotite
 quartz monzonite.

Tm MAFIC PORPHYRY DIKES (EOCENE)
 Possibly equivalent to the Silverpoint quartz monzonite.

Ti DIKES (EOCENE)
Biotite-augite diorite, lamprophyre, and felsite porphyry.

Tsq SELKIRK CREST QUARTZ MONZONITE (EOCENE)
Gneissic muscovite-biotite quartz monzonite, locally cataclastic.

Ts SILVER POINT QUARTZ MONZONITE (EOCENE)
Hornblende-biotite quartz monzonite.

Tf FINE-GRAINED HORNBLLENDE-BIOTITE QUARTZ MONZONITE (EOCENE)

TKpa PHILLIPS LAKE GRANODIORITE (PALEOCENE)
Muscovite-biotite quartz monzonite and granodiorite with associated alaskites and metamorphic rocks.

TKt MUSCOVITE-BIOTITE QUARTZ MONZONITE (PALEOCENE)

TKg BIOTITE GRANODIORITE (PALEOCENE)

TKl ALASKITE, PEGMATITE, AND QUARTZ MONZONITE (PALEOCENE)
With associated metamorphic rocks.

Kb BIOTITE QUARTZ MONZONITE (CRETACEOUS)
May be a variant of the Fan Lake granodiorite.

Kbg BOULDER MOUNTAIN GRANODIORITE (CRETACEOUS)
Biotite granodiorite.

Kgq GRANITE FALLS QUARTZ MONZONITE (CRETACEOUS)
Biotite quartz monzonite.

Kd DIABASE AND DIORITE DIKES AND SILLS (CRETACEOUS)

Kbq BLICKENSDECKER QUARTZ MONZONITE (CRETACEOUS)
Muscovite-biotite quartz monzonite.

Khm HUNGRY MOUNTAIN PLUTON (CRETACEOUS)
Muscovite-biotite quartz monzonite, generally porphyritic, weakly foliated in many places.

Kna NORTH BALDY ALASKITE (CRETACEOUS)
Leucocratic biotite-muscovite granite.

Kgd GRANODIORITE (CRETACEOUS)

Kc CONTINENTAL MOUNTAIN PLUTON (CRETACEOUS)
Biotite quartz diorite.

Kkh UNDIVIDED HORNBLLENDE-BEARING PLUTONIC ROCKS OF THE KANIKSU RANGE (CRETACEOUS)

Kpq PORPHYRITIC MUSCOVITE-BIOTITE QUARTZ MONZONITE AND ASSOCIATED ALASKITES (CRETACEOUS)

Km MUSCOVITE QUARTZ MONZONITE (CRETACEOUS)

Kf FAN LAKE GRANODIORITE (CRETACEOUS)
Hornblende-biotite granodiorite.

Kkt UNDIVIDED TWO-MICA PLUTONIC ROCKS OF THE KANIKSU RANGE (CRETACEOUS)

Ksf STARVATION FLAT QUARTZ MONZONITE (CRETACEOUS)
Hornblende-biotite quartz monzonite.

Kq MUSCOVITE-BIOTITE QUARTZ MONZONITE (CRETACEOUS)

Kg GALENA POINT GRANODIORITE (CRETACEOUS)
Biotite granodiorite carries minor hornblende locally.

Kl LITTLE ROUNDTOP PLUTON (CRETACEOUS)
Biotite quartz monzonite.

Ksp SPIRIT PLUTON (CRETACEOUS)
Hornblende-biotite granodiorite.

Kqm METAMORPHOSED MUSCOVITE-BIOTITE QUARTZ MONZONITE (CRETACEOUS)

Kga GRANITE PASS ALASKITE (CRETACEOUS)
Leucocratic muscovite granite.

Kgp GLEASON MOUNTAIN QUARTZ MONZONITE (CRETACEOUS)
Fine-grained muscovite-biotite quartz monzonite.

Ktm TWENTYMILE CREEK QUARTZ MONZONITE (CRETACEOUS)
Fine-grained muscovite-biotite quartz monzonite.

Ktq TANGO CREEK PLUTON (CRETACEOUS)
Porphyritic biotite quartz monzonite.

Kws WALL MOUNTAIN SYENITE (CRETACEOUS)

hb HORNBLLENDE-BIOTITE QUARTZ DIORITE (CRETACEOUS)

Jr ROSSLAND GROUP (JURASSIC)
Mafic lavas, flow breccias, and tuffs with associated marine sedimentary rocks.

Jd HORNBLLENDE QUARTZ DIORITE (JURASSIC)

Jmi MAFIC INTRUSIVE ROCKS (JURASSIC)

JTrf FLOWERY TRAIL GRANODIORITE (JURASSIC AND TRIASSIC)
Hornblende-biotite granodiorite.

JTrp LANE MOUNTAIN PLUTON (JURASSIC AND TRIASSIC)
Hornblende-biotite granodiorite.

METAMORPHIC ROCKS

Tca MYLONITE AND CATACLASTIC ROCK (EOCENE)
Inside the Newport fault zone.

Tbr TECTONIC BRECCIA (EOCENE)
Associated with the Newport fault zone.

Cp PEND d'OREILLE SEQUENCE (PENNSYLVANIAN)
Argillite, phyllite, greenstone, and limestone.

Cf FLAGSTAFF MOUNTAIN SEQUENCE (PENNSYLVANIAN)
Argillite, phyllite, greenstone, and limestone.

Cg GRASS MOUNTAIN SEQUENCE (MISSISSIPPIAN)
Argillite and limestone.

Da ARGILLITE (DEVONIAN)
With quartzite and limestone.

DS BLACK ARGILLITE AND SLATE (DEVONIAN AND SILURIAN)
With limestone, conglomerate, and sandstone.

Olu LEDBETTER SLATE (ORDOVICIAN)
Slate, argillite, quartzite, and argillaceous limestone.

εma MAITLEN PHYLLITE (CAMBRIAN)
Includes units εmp and εmr.

εmp PHYLLITE WITH THIN LIMESTONE BEDS (CAMBRIAN)

εmr REEVES LIMESTONE MEMBER (CAMBRIAN)

εq QUARTZITE (CAMBRIAN)
Includes the Gypsy and Addy quartzites.

pεh HUCKLEBERRY FORMATION (PRECAMBRIAN)
Conglomerate and greenstone. Includes units pεhg and pεhc.

pεhg GREENSTONE MEMBER (PRECAMBRIAN)

pεhc CONGLOMERATE MEMBER (PRECAMBRIAN)

pεwi WINDERMERE GROUP (PRECAMBRIAN)
Includes units pεmo, pεlv and pεsc.

pεmo MONK FORMATION (PRECAMBRIAN)
Phyllite, quartzitic limestone, and conglomerate.

pclv LEOLA VOLCANICS (PRECAMBRIAN)
Greenstone with greenschist.

pesc SHEDROFF CONGLOMERATE (PRECAMBRIAN)
Volcanic conglomerate with phyllite, quartzite,
and greenstone.

pCg GREENSTONE (PRECAMBRIAN)

pCmg PURCELL-MARSHALL-MOYIE SILLS AND DIKES (PRECAMBRIAN)
Metadiorite, diabase, and quartz diorite.

pCdt DEER TRAIL GROUP, UNDIFFERENTIATED (PRECAMBRIAN)

pCbu BELT SUPERGROUP, UNDIFFERENTIATED (PRECAMBRIAN)
Includes units pC1, pCs, pCw, pCrv, pCsr, pCr, pCb,
and pCp.

pC1 LIBBY FORMATION (PRECAMBRIAN)
Argillite, siltite, dolomite, and calcareous argillite.

pCs STRIPED PEAK FORMATION (PRECAMBRIAN)
Argillite, siltite, quartzite, and impure dolomite.

pCw WALLACE FORMATION (PRECAMBRIAN)
Argillite, quartzite, siltite, and impure carbonate
rocks.

pCrv RAVALLI GROUP (PRECAMBRIAN)
Includes units pCsr, pCr, and pCb.

pCsr ST. REGIS FORMATION (PRECAMBRIAN)
Argillite, siltite, and quartzite.

pCr REVETT FORMATION (PRECAMBRIAN)
Quartzite and siltite.

pCb BURKE FORMATION (PRECAMBRIAN)
Siltite, quartzite, and argillite.

pCp PRICHARD FORMATION (PRECAMBRIAN)
Argillite, siltite, and quartzite.

pCbr BLUE RIDGE SEQUENCE (PRECAMBRIAN)
Schist, quartzite, and limestone.

pCih LONE HILL SEQUENCE (PRECAMBRIAN)
Schist, limestone, and quartzite.

pCbc BYERS CREEK SEQUENCE (PRECAMBRIAN)
Schist, quartzite, limestone, and hornblende schist.

- pCn NEWMAN LAKE GNEISS (PRECAMBRIAN)
 Biotite granite gneiss.
- pCh HAUSER LAKE GNEISS (PRECAMBRIAN)
 Mica schist, quartzite, and alaskite.
- pCm METAMORPHIC ROCKS OF UNCERTAIN AGE
 Includes schist, quartzite, amphibolite, paragneiss,
 and migmatite.

6.3 RADIOACTIVE MINERALS

Over the past twenty-five years, a number of occurrences of radioactive minerals have been discovered in the eastern Washington-northern Idaho region, of which several have proved to be of sufficient grade and abundance to permit economic exploitation. The following excerpt from the paper "Uranium in Washington" (Weissenborn and Moen, 1974) provides an excellent synopsis of these developments.

"Until 1954, despite persistent search, no uranium occurrences of significance had been found in Washington. In the summer of 1954, uranium minerals were discovered by the LeBret brothers on the Spokane Indian Reservation in Stevens County. The discovery was made while prospecting for tungsten at night, with an ultraviolet lamp. This find became the Midnite mine and touched off a uranium boom in the state. Shortly thereafter uranium was discovered on the Dahl farm on the west slope of Mount Spokane, some 40 miles east of the Midnite mine and about 30 miles northeast of Spokane. This became the Daybreak mine and marked the discovery of a second uranium area in the State. Other discoveries were made, but none so far have proved to be of the importance of the original two. As a result of these discoveries, a mill was built in 1957 at Ford in Stevens County to treat the ores, and Washington became an important producer of uranium. Total uranium produced from the state to February 28, 1965, was 4.7 million pounds of U_3O_8 from 1.2 million tons of ore."

Most of the discoveries in Washington made to date are north of a line connecting Spokane and Seattle. The area is mountainous, and much of it is underlain by granitic intrusive rocks. The proximity of the known uranium deposits to the granitic rocks indicates that the uranium mineralization is probably related to the intrusions.

The deposits are not confined to rocks of any one age. They are found in rocks as early as Precambrian and as late as Tertiary. Most of the uranium occurrences, however, are related to the Mesozoic intrusive rocks. The host rocks include igneous, metamorphic, and sedimentary types. The acidic intrusive rocks such as granite and quartz monzonite are favorable host rocks, whereas the basic

igneous rocks such as basalt and peridotite have yielded no significant occurrences.

The deposits generally fall into one of the following geologic environments: (1) sheared and faulted zones within granitic intrusives, (2) in and near the contact of granitic rocks with sedimentary and metamorphic rocks, (3) in Tertiary sedimentary rocks, or (4) in quartz veins and pegmatitic dikes.

Several uranium deposits with environments of the first three types are of commercial or near-commercial value. The uranium mineralization of the quartz veins and pegmatitic dikes is usually not sufficient to justify mining deposits of this nature.

The principal uranium and thorium mineral occurrences in or immediately adjacent to the area of the Okanogan and Sandpoint Quadrangles are shown in Figure 8 and discussed briefly below. As noted in a recent study by Castor, Berry, and Robins (1978), granitic rocks with anomalously high uranium and (or) thorium contents in this region are concentrated in two northeast-trending belts extending between the Midnight Mine and Hall Mountain areas, and along the Republic graben, respectively. It is of interest to note that the majority of the known occurrences are also located in or near these zones.

Midnight Mine Area, Stevens County, Washington

The Midnight mine has exposed a number of ore bodies along the western contact of a tongue of schist, phyllite, and quartzite of the Precambrian Togo formation, which projects southward into porphyritic quartz monzonite of the Cretaceous Loon Lake batholith. Five of these bodies have been mined. Individual ore bodies are as much as 700 feet long, 200 feet wide, and more than 150 feet deep.

Near the surface, the uranium ore is thoroughly oxidized and consists of a mixture of secondary uranium minerals intimately associated with iron oxide films and coatings. Meta-autunite — $\text{Ca}(\text{UO}_2)_2(\text{PO}_4)_2 \cdot 8\text{H}_2\text{O}$ — is by far the most abundant mineral, occurring as thin films on fractures or as discrete crystals on iron oxide. Uranophane — $\text{Ca}(\text{UO}_2)_2(\text{SiO}_3)(\text{OH})_2 \cdot 5\text{H}_2\text{O}$ — and phosphuranylite — $\text{Ca}(\text{UO}_2)_4(\text{PO}_4)_2(\text{OH})_4 \cdot 7\text{H}_2\text{O}$ — are common, and a few other oxidized uranium minerals have been identified (Becraft and Weis, 1963):

Sooty uraninite — UO_2 — and coffinite — $\text{U}(\text{SiO}_4)_{1-x}(\text{OH})_{4x}$ — together with pyrite and marcasite have been identified in a few samples of unoxidized ore. In 1965, specimens of sooty uraninite were reported to be relatively plentiful in the Midnight open pit, and veins of dense, shiny pitchblende were quite abundant in some faces of the pit. Almost all the uranium minerals are in the metamorphosed sedimentary rock; only locally are secondary

EXPLANATION

- KNOWN OCCURRENCES
- ▨ AREAS OF NUMEROUS OCCURRENCES

- AREA NAMES:
1. MIDNITE	6. SANPOIL
2. MOUNT SPOKANE	7. LOST CREEK
3. ORIENT	8. RUBY
4. SHERMAN CREEK PASS	9. LAMB CREEK
NANCY CREEK	10. RAILWAY DIKE
ST. PETER CREEK	11. SOUTH SKOOKUM LAKE
5. AENEAS	12. STARLIGHT URANIUM
	13. HALL MOUNTAIN

APPROXIMATE SCALE
1:1,270,000

FIGURE-8 KNOWN URANIUM AND THORIUM OCCURRENCES IN THE OKANOGAN AND SANDPOINT QUADRANGLE

minerals abundant enough in the underlying quartz monzonite to constitute ore. There is some evidence to suggest that the uranium is associated with small, steep faults which cut the Togo Formation near its contact. Some of these fractures may be older than the quartz monzonite. Redistribution of uranium occurred as a result of oxidation of the primary uranium minerals by ground water.

Production from the Midnite mine began in 1955 and ceased in 1962. During this time over 1,000,000 tons of ore were produced. The mine began producing again in 1969, and since then has produced up to 100,000 tons of ore annually.

In addition to the Midnite mine itself, several other discoveries have been made in the same general area. At the Lowly lease on the Spokane River about seven miles south of the Midnite mine, uranium minerals were found in an intensely shattered zone at the contact of impure quartzite and granodiorite. About 285 tons of ore were shipped in 1956 from the mine (Becraft and Weis, 1963), but there has been no production since.

At the Big Smoke lease, a mile north of the Lowley lease, uranium minerals occur along a faulted contact between granodiorite and pyroclastic and sedimentary rocks of the Gerome andesite. Only minor amounts of uranium have been discovered here, however.

The Peters lease, also known as the Northwest Uranium mine, is about $4\frac{1}{2}$ miles southeast of the Midnite mine. At this locality, uranium ore in an entirely different geological setting was discovered in the basal member of the Gerome andesite of Oligocene age. In the mine area, the Gerome andesite consists of interbedded tuffaceous sandstone, arkose, and carbonaceous shale overlying a poorly sorted conglomerate about 100 feet thick. This formation rests on quartz monzonite of the Loon Lake batholith. The ore zone is near the base of the conglomerate, and contains much carbonaceous material in thin arkosic lenses and in irregular, sporadically distributed masses. The ore zone lies from a few feet to as much as 80 feet below the surface. Total production to the time the mine was closed in 1962 was 87,300 tons of ore containing 305,700 pounds of uranium.

Mount Spokane Area, Spokane County, Washington

The first discovery in the Mount Spokane area was reported in 1955, which became the Daybreak mine. Since then at least 28 other occurrences have been found in a belt one to one and one-half miles wide on the west and south slopes of Mount Spokane, extending from the south fork of Deadman Creek northwesterly for about 14 miles to the boundary of Spokane and Pend Oreille Counties. The deposits are situated in a pegmatitic alaskite zone bordering the intrusive contact of the Loon Lake batholith with highly metamorphosed Precambrian gneisses and schists to the east. In all the deposits, which are closely similar, coarsely crystalline

autunite — $\text{Ca}(\text{UO}_2)_2(\text{PO}_4)_2 \cdot 10\text{--}12\text{H}_2\text{O}$ — is the only uranium mineral except for very finely dispersed uraninite found in some of the autunite crystals. In all the deposits, the autunite occurs as fracture fillings and in voids in the host rocks. Also in all cases, the country rock has been bleached and altered, but hydrothermal alteration is not intense.

Most of the uranium mined from the Mount Spokane area has come from the Daybreak mine, with eight different properties contributing to the total. The total amount of ore produced up to 1964 was approximately 18,600 tons. The only operating mine in 1965 and 1966 was the Daybreak mine, which produced 1,100 tons of ore.

Orient, Stevens County, Washington

The uranium mineralization at this localized occurrence situated on the margin of the Colville batholith, consists of autunite in pegmatitic gneiss. No production has been reported.

Sherman Creek Pass - Nancy Creek - St. Peter Creek Area, Ferry County, Washington

This series of occurrences is comprised of numerous radioactivity anomalies and uraninite mineralization in pegmatite lenses in gneiss, in the area between Kettle Falls and Republic. A number of claims have been staked in the area, but there has been no production.

Aeneas, Okanogan County, Washington

This reported occurrence consists of slight radioactivity along pegmatite veins in gneiss. No further information on mineralization is available.

Sanpoil, Okanogan County, Washington

This local uranium occurrence is situated along the western margin of the Republic graben, on the Sanpoil River. The mineralization is in pegmatite, with samarskite and radioactive fluorite being in evidence.

Lost Creek Area, Pend Oreille County, Washington

The mineralization at this occurrence, located west of Blueslide, is somewhat similar to the deposits in the Mount Spokane area, consisting of autunite veins occupying open fractures in a light-colored granitic rock. Production of minor amounts of uranium has come from two properties, the Lost Creek and Quartz Ridge claims.

Ruby, Pend Oreille County, Washington

This occurrence, located near Ruby, consists of scattered autunite and uraninite grains in pegmatite dikes. No production is reported.

Lamb Creek Area, Pend Oreille County, Washington

One small shipment of uranium ore was made from the H.P.S. group of claims in this area, located west of Priest Lake near the Idaho - Washington border. Information on the mineralization is scanty, but is probably similar to the Ruby occurrence.

Railway Dike, Stevens County, Washington

The mineralization in this area occurs in a large pegmatite which locally shows intense radioactivity. One specimen from the occurrence reportedly contained uranium-bearing columbite. A few tons of beryl have been produced from this deposit, but no uranium production is reported.

South Skookum Lake, Pend Oreille County, Washington

The uranium mineralization at this occurrence, located one-half mile east of South Skookum Lake, consists of autunite in shear zones in altered granite. The area has been prospected by commercial interests, but no production has been reported.

Starlight Uranium, Pend Oreille County, Washington

The reported mineralization at this occurrence, located near Calispell Creek, consists of autunite in weathered granite. No production is known.

Hall Mountain Area, Boundary County, Idaho

Several thorium lode deposits occur along the western flank of Hall Mountain in this area, consisting of thorite-bearing fissure veins. Although first discovered in 1955, no commercial quantities of thorium ore are known to have been shipped from the locality. The area is part of a fault block, tilted gently eastward, composed of meta-sediments of the lower Belt Supergroup, Precambrian diorite sills, and Cretaceous quartz monzonite of the Nelson batholith. The fault block is cut by both northwest - and east-trending faults and joints which provided channelways for the thorium-bearing mineralizing solutions.

SECTION 7.0

DATA INTERPRETATION

7.1 GENERAL

The interpretation of the airborne gamma-ray spectrometer survey comprises an integrated analysis of the radiometric data with basic data from several disciplines. From the viewpoint of final interpretation, the geologic map and the recorded aeromagnetic profiles are the most useful auxiliary parameters. The other pertinent quantities, including altitude, barometric pressure, temperature, and atmospheric radon measurements, are integrated with the data in the analytical stage previous to the interpretation.

In the following discussions, this analysis is divided into two principal sections dealing with the stacked radiometric and magnetic profiles, and the radiometric anomaly maps. It is considered that a comprehensive evaluation must encompass study of both these principal data sets, inasmuch as they are mutually complementary to the extent that neither by itself can convey the full significance of the survey results. Several examples of the complementary nature of the anomaly maps and the profiles will illustrate this point. The anomaly maps comprise the ideal medium for the definition of anomalous zones within discrete geologic units, while in contrast, information regarding regional background radiation levels pertinent to the delineation of geological and geochemical districts can only be derived from the profile data. In another example, those anomalous situations exceeding three sigma, situations which may actually result from ore bodies, can only be evaluated on the profiles. Finally, "metallogenic provinces" are a rather commonly discernible feature on the anomaly maps because they frequently cut across time units and formational boundaries alike. While discernible in plan view, these provinces cannot be seen in the two-dimensional profile data.

The correct interpretation of the gamma-ray spectrometer data depends on a thorough understanding of the principles and theory of the survey and data processing techniques. While the major part of this required information is included in the previous sections of this report, a number of additional factors peculiar to airborne survey operations in general, and gamma-ray spectrometer surveys in particular, should also be appreciated from the standpoint of their effects on the collected data. Such factors include the variability of low count rate statistics resulting from local terrain clearance variations which are often unavoidable in airborne surveys; similar variations in count rates over equivalent geologic units caused by surface condition variants such as degree of water saturation and soil thicknesses; inaccurate statistical accumulations due to geologic unit misclassifications; and false recordings caused by locally anomalous atmospheric conditions,

particularly temperature inversions accompanied by atmospheric radon concentrations. These factors have been well-documented in previous reports on the airborne reconnaissance phases of the NURE program published by DOE, and additional comments in this text are considered redundant.

It should be recognized that the magnetic data gathered while conducting a radiometric reconnaissance survey of this type is generally not as useful as that derived from a magnetic survey conducted with typical magnetic survey specifications oriented to the definition of near-surface geologic events. First, relatively wide traverse spacings are usually employed, which preclude line-to-line correlations of anomalies caused by shallow sources. This limitation is not a characteristic of the coverage over most of the Sandpoint Quadrangle and the eastern half of the Okanogan Quadrangle, where the magnetic data could and probably should be compiled into a magnetic contour map. Secondly, the magnetic data suffer from the limited resolution due to an along-line sampling rate governed by a one second integration time at a mean terrain clearance of 400 feet. That is, at an altitude of 400 feet (the radiometric survey altitude), the field should be sampled at a ground spacing of not greater than 75 feet if one intends to define surface and near-surface geologic anomalies. Data sampled in this survey averages about 125 feet between samples.

7.2 COMMENTARY ON MAGNETIC AND RADIOMETRIC PROFILES

This section is intended to call attention to specific conditions present in the stacked radiometric and magnetic profiles that can directly or indirectly relate to the radioactivity anomalies measured at the surface, but that are not generally apparent on the radiometric anomaly maps. These conditions pertain primarily to surface geologic contacts, structural elements, and to radiometric level shifts suggesting geologic or geochemical change in the surface geology. The magnetic data acquired on this survey is particularly useful in defining the boundaries of geological provinces at depth, while the radiometric data is generally adequate to establish the boundaries at the surface. The geologic map, of course, provides the basis for the provincial boundaries, but it provides only the surface form of these boundaries. Both shallow and deep subsurface variations of these boundaries carry potential significance which is often implicit in the comparison between these two data sets.

Structurally, the region covered by the Okanogan and Sandpoint quadrangles may be divided into an eastern and western depositional province, as described previously in Section 6.1 of this report. These provinces are generally similar to the extent that both are extensively intruded by Mesozoic plutons, and from a geophysical standpoint display few basic differences. However, they provide a convenient division for the following comments, which are principally directed to certain diagnostic characteristics

of major petrologic groups and important structural trends in the area as derived from study of the survey data.

7.2.1 Western Depositional Province

This province, encompassing the Okanogan Quadrangle and the northwestern portion of the Sandpoint Quadrangle, is an area of eugeo-synclinal upper Paleozoic and Mesozoic rocks which have been extensively intruded by granitic units comprising the eastern extent of the Colville batholith. The major part of the Okanogan Quadrangle is, in fact, almost exclusively underlain by these plutonic rocks.

A major structural feature of this area is the Republic graben, a southerly trending zone extending across the eastern half of the Okanogan Quadrangle. This graben contains extensive exposures of Tertiary volcanics, of which the Sanpoil volcanics are in particular evidence. All three spectral channels consistently display increased amplitudes over this feature, which is also marked by strong magnetic anomalies.

To the west and immediately east of the graben, the principal outcrops are granitic units, marked by intermediate responses in the Th and K spectral channels, and by moderately active magnetic responses. The uranium channel response over these granitic zones, as well as over the metasediments further to the east, are quite low, exhibiting count rates which are commonly below statistical significance levels. The Th and K responses, in contrast, are generally quite active over the plutonic units, and some degree of differentiation between discrete granitic units based on relative Th and K levels seems apparent. Interspersed volcanic units in these zones are generally readily identified by either abrupt increases in radiometric response (as over the Sanpoil volcanics) or by abrupt decreases (over most of the other volcanic units), accompanied by strong increases in magnetic amplitudes in both cases.

The eastern part of the province, which contains the principal exposures of Paleozoic and Mesozoic sediments and metasediments, is marked by a general decrease in intensity of the magnetic response accompanied by a very slight increase in the general level of the potassium channel response. This increase is very subtle, however, and is modified by the widespread presence of younger alluvial and glacial deposits which may be the principal cause. The Th and U response levels display little if any change over this part of the province relative to the granitic region to the west.

7.2.2 Eastern Depositional Province

This province, occupying the major part of the Sandpoint Quadrangle, is a region of Precambrian metasediments unconformably

overlain by miogeosynclinal Paleozoic rocks, which in turn have been intruded by granitic plutons comprising the northern extent of the Loon Lake batholith. The province is essentially comprised of two general zones, a western region principally underlain by Mesozoic and Tertiary granitic rocks, and an eastern region of predominantly Precambrian metasediments.

The magnetic and radiometric profiles traversing the Sandpoint Quadrangle reflect this general, two-fold division quite well. Over the granitic areas in the west, all three spectral channels display strong amplitudes and highly anomalous responses, accompanied by moderate to strong magnetic activity. This pattern is quite similar to that over the granitic areas of the Okanogan Quadrangle, except that here the uranium channel response is considerably stronger in overall aspect. This strong eU response level is reflected in the widespread occurrence of statistically significant eU anomalies in the western part of the Sandpoint Quadrangle as shown in Figure 10.

In contrast, over the older metasediments in the east, all three spectral channels show marked decreases in the general level of response, accompanied by relatively much weaker magnetic responses as well. This situation is also illustrated in Figure 10 by the relative scarcity of significant eU anomalies in the eastern part of the area.

7.3. URANIUM ANOMALY MAPS

7.3.1 Selection of Uranium Anomalies

Through an examination of the equivalent uranium anomaly maps of the two NTMS quadrangles comprising the northern portion of the Northeast Washington Area, a total of 860 significant eU anomalies have been determined in this region as shown in Figures 9 and 10, and listed in Tables 1 and 2. Of these, 386 anomalies are located in the Okanogan Quadrangle and 474 are in the Sandpoint Quadrangle. This selection was accomplished by identifying all individual, or groups of, statistically high data points on the anomaly map on the basis of a system of statistical reliability criteria. A set of criteria was developed in a previous airborne survey by Texas Instruments for the NURE program and subsequently published by DOE (open-file Document No. GJBX-18 (77)).

Accordingly, the definition of a reliable anomaly is based on certain groupings of adjacent statistically high or low points more than one standard deviation from the mean. Of these, the acceptable significant eU anomalies or anomalous zones were selected according to one or more of the following criteria:

- 1) One (averaged) data point 3 or more standard deviations (sigma) above the mean.
- 2) Two adjacent (averaged) data points between 2 and 3 sigma above the mean.
- 3) Three adjacent (averaged) points where two are between 1 and 2 sigma, and one is between 2 and 3 sigma above the mean.
- 4) Four adjacent (averaged) points between 1 and 2 sigma above the mean.

While the above criteria may be refined in the course of future analyses, they have produced satisfactory results in the case of the present survey as well as previous projects in other areas, and have the additional advantage of affording some degree of continuity and standardization with regard to the evaluation of airborne survey anomalies in the context of the NURE program.

7.3.2 Evaluation of Anomalies

Following the selection of significant eU anomalies on the uranium anomaly map, a transparent overlay of the outlined anomalous zones was prepared and examined in conjunction with the topographic and geologic maps, the supporting data tables, the stacked profiles, and the balance of the statistically derived anomaly maps to evaluate each eU anomaly in terms of its potential as an indication of true uranium enrichment deserving further investigation. The essential results of these comparative analyses are summarized in Tables 1 and 2.

7.3.3 Discussion of Anomalies

7.3.3.1 Okanogan Quadrangle

Of the total of 386 statistically significant eU anomalies determined in the Okanogan Quadrangle, 57 preferred anomalies have been selected on the basis of strength and character of their eU response as well as relative enrichment of eU over eTh and K, which appear to have increased potential as indications of true uranium enrichment. This selection has taken into account statistical adequacy of sampling, and thus excludes anomalies correlating with sparsely sampled geologic units.

The principal geologic units associated with the preferred eU anomalies in this area are noted in the following tabulation:

Quaternary deposits (Q, Qg)	7 anomaly associations
Tertiary volcanics (Ts, Td, Tk, Tb)	14 anomaly associations
Mesozoic intrusives (Mzg, Mzc, Kq, Kgd)	14 anomaly associations
Paleozoic metasediments (TrPg, Pza, Pzc, Pzcq, PzpCm, Pzm)	22 anomaly associations

The majority of these anomalies tend to occur in distinctly zoned groups along the northern and eastern margins of the Colville batholith, generally east of the Republic graben. In addition, two areas of preferred eU responses occur along the west side of the graben, in the central and north-central parts of the quadrangle.

Significant eU responses in the western half of the quadrangle are quite sparse, and only three preferred eU anomalies were selected in this part of the area.

The following notes comprise specific comments on the preferred anomalies noted in Table 1 with regard to geologic setting, surficial conditions and structural associations, where applicable.

Anomalies 4, 5, 6, 19, 20, 21, 29, 30, 36, 39, 40, 49, 51 and 56

This series of moderately strong, sharp eU responses lies within a relatively localized zone of significant eU anomalies occurring in the extreme north-central part of the quadrangle along the western flank of the Republic graben. With the exception of anomalies 40 and 51, which are associated with a Devonian marble unit, all of these preferred eU zones occur over Tertiary volcanics, most commonly those of the Sanpoil group. Although these

LEGEND

- STATISTICALLY SIGNIFICANT $\pm$ U ANOMALIES
- PREFERRED ANOMALIES

7.7

FIGURE-9A EQUIVALENT URANIUM ANOMALY MAP
WEST HALF OF OKANOGAN QUADRANGLE

LEGEND

- STATISTICALLY SIGNIFICANT • U ANOMALIES
- PREFERRED ANOMALIES

7.8

FIGURE-98 EQUIVALENT URANIUM ANOMALY MAP
EAST HALF OF OKANOGAN QUADRANGLE

TABLE 1 EQUIVALENT URANIUM ANOMALIES - OKANGGAN QUADRANGLE

Number of Points

Anom. No.	F/L No.	Geol. Fm.	eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
1	1	Ps	-	1	2	-	3	-	1	2	-	-	-	-	-	-	-
2	1&	Ts	4	8	3	5	5	4	3	1	3	4	-	-	-	-	-
	211																
3	1	Ts	4	-	1	1	-	-	1	-	-	3	1	-	-	-	-
4*	1	Ts	3	3	6	2	2	-	3	-	-	7	1	3	-	-	4
5*	1	Ts	2	1	2	2	1	-	1	-	-	2	-	2	-	-	2
6*	1	Ts	-	1	2	1	2	-	2	1	-	-	1	1	-	-	1
7	1	Tsc, Pzms	2	2	1	2	1	2	1	4	-	-	-	-	-	-	-
8	1	TrPg, Qg	6	4	5	2	1	-	4	-	-	4	2	5	-	5	2
9	1	PzpCm, Qg	2	1	2	-	1	-	3	-	-	1	1	1	-	1	1
10	1	PzpCm	2	1	1	-	-	-	-	-	-	-	1	3	-	3	1
11*	1	PzpCm	-	-	1	-	-	-	1	-	-	-	1	-	-	1	-
12	1	Qg, peo	3	4	1	4	3	1	1	6	-	-	-	-	-	-	-
13	2	Mzhm	2	1	-	-	-	-	3	-	-	-	2	-	-	-	-
14	2	TrPsv	1	2	-	1	-	-	1	-	-	2	-	-	-	-	-
15	214	Qal	3	2	-	-	3	-	-	3	-	-	-	-	-	-	-
16	2	Trk	2	1	-	1	-	-	2	-	-	-	-	-	-	-	-
17	2	Trk, Ts	4	2	-	-	-	-	-	-	-	6	-	-	-	-	-
18	2&	Ts	6	7	4	5	2	5	4	3	-	3	1	3	-	-	3
	211																
19*	2	Ts	-	1	2	1	-	-	1	-	-	-	-	3	-	-	2
20*	2	Ts	1	-	1	2	-	-	2	-	-	-	-	1	-	-	1
21*	2	Ts	2	-	1	-	-	-	2	-	-	2	-	1	-	-	1
22	2	Q, Ts	-	3	2	3	1	1	2	3	-	3	-	-	-	-	-
23	2	Qg	2	1	-	-	-	-	2	-	-	1	1	-	-	-	-
24	2	PzpCm	2	1	-	-	-	-	-	-	-	2	-	-	-	1	-
25	2	Mzr	5	-	-	-	-	-	-	-	-	2	-	2	-	-	2
26	3	Ts, Kob	3	2	1	1	2	2	1	2	2	-	-	-	-	-	-
27	3	Ts	4	1	-	1	-	-	1	2	-	3	-	-	-	-	-
28	3	Ts, Td	2	5	1	3	2	3	4	1	2	2	-	-	-	-	-
29*	3	Td	-	1	3	3	1	-	3	1	-	2	1	1	-	-	2
30*	3	Tk, Q	2	-	9	3	1	-	1	1	-	4	3	4	3	-	6
31	3	Ts, Qg, TrPg	4	4	1	3	-	-	2	3	3	3	2	1	-	2	-
32*	3	Qg, PzpCm	2	-	1	-	-	-	1	-	-	2	-	1	-	1	-

TABLE 1 EQUIVALENT URANIUM ANOMALIES - OKANOAN QUADRANGLE

Anom. No.	F/L No.	Geol. Fm.	Number of Points														
			eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
33	3	Qg	3	1	-	1	1	1	1	-	-	1	-	-	-	2	-
34	3	PzpCm, Qg, pCo	3	4	-	6	-	-	5	1	-	-	-	-	-	2	-
35	4	Ps	-	-	1	-	-	-	-	-	-	-	1	-	-	-	1
36 *	4	Ts, Tob	2	3	1	3	-	-	1	-	-	1	3	-	-	2	-
37	4	Ts	3	1	-	-	-	-	-	-	-	3	1	-	-	-	-
38	4	Tb	-	-	1	-	-	1	-	-	1	1	-	-	-	-	-
39 *	4	Tb, Tk	1	-	2	3	-	-	2	-	-	-	2	-	-	-	-
40 *	4	Pzm	3	-	1	-	-	-	-	-	-	-	2	2	3	-	1
41 *	4	Ts, Qg	6	4	3	4	-	-	6	1	-	5	1	3	-	2	3
42	4	pCo	2	1	-	-	-	-	-	-	-	1	-	1	-	2	-
43	4	Mzr	4	1	-	1	-	-	-	-	-	-	-	-	-	-	-
44	5	Kc	1	-	2	-	3	-	2	1	-	-	-	-	-	-	-
45	215	Kc	3	1	-	3	-	-	2	-	-	-	-	-	-	-	-
46	5	Mzs	3	1	-	-	-	-	-	-	-	3	1	-	-	-	-
47	5	To	3	1	-	3	-	-	1	-	-	1	-	-	-	-	-
48	5	To	1	2	-	1	-	-	-	-	-	3	-	-	-	-	-
49 *	5	Ts	1	1	1	-	-	-	-	-	-	2	-	1	-	-	1
50	5	Tk	2	1	-	-	-	-	-	-	-	1	1	-	-	-	-
51 *	5	Q, Pzm	3	4	2	2	-	-	2	1	-	-	2	4	1	-	5
52	5	Ts	4	-	-	1	-	1	-	1	-	-	-	-	-	-	-
53	5	PzpCm	1	-	1	-	-	2	1	-	1	-	-	-	-	-	-
54	6	Ts	1	-	1	2	-	-	1	-	-	1	-	-	-	-	-
55	6	Ts	-	2	-	-	-	-	-	-	-	1	-	1	-	-	-
56 *	6	Tk	1	3	1	1	-	-	3	-	-	1	3	1	-	-	-
57	6	Q, Pzg	3	3	2	1	3	1	5	2	1	2	1	-	-	-	1
58	6	PzpCm	1	1	1	1	-	2	2	-	1	-	-	-	-	-	-
59	7	Q, Pzm	3	2	-	2	-	-	2	-	-	1	-	-	-	-	-
60	7	Qg	-	-	1	-	-	1	-	-	1	-	-	-	-	-	-
61	7	Qg	-	1	1	2	-	-	1	1	-	-	-	-	-	-	-
62	7	Mzg	3	1	-	-	1	3	2	1	-	-	-	-	-	-	-
63	8	Mzs	1	3	-	-	-	-	-	-	-	3	-	1	-	-	-
64	8	Ps	4	-	-	2	-	-	1	-	-	1	-	-	-	-	-
65	8	To	3	3	-	2	-	-	5	1	-	5	-	-	-	-	-
66	8	Ko	2	1	-	1	-	-	2	1	-	1	-	-	-	-	-

TABLE 1 EQUIVALENT URANIUM ANOMALIES - GKANCGAN QUADRANGLE

Anom. No.	F/L No.	Geol. Fm.	Number of Points														
			eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
67	210	Ts	2	2	1	1	1	-	1	1	-	4	1	-	-	-	1
68	8	Tqm	4	-	-	1	1	-	2	-	-	1	1	-	-	-	-
69	8	PzpEm, Qg	4	3	-	-	3	2	2	2	2	-	-	-	-	-	-
70	208	Mzr	5	2	-	3	1	2	4	1	2	-	-	-	-	-	-
71	9	Tk	2	1	-	-	-	-	3	-	-	2	1	-	-	-	-
72	9	Pzm, Qg	2	1	-	2	1	-	3	-	-	-	-	-	-	-	-
73	9	Qg, Tss	2	1	-	1	-	-	1	1	-	-	-	-	-	-	-
74	9	Tqm	3	1	-	2	-	-	3	-	-	1	-	-	-	-	-
75	211	Ts	3	2	-	2	2	-	2	-	-	-	1	-	-	-	-
76	10	Tsa, Tk, Qg	4	-	1	3	2	-	3	1	1	-	-	-	-	-	-
77	10	Qg	4	1	-	-	3	1	3	-	2	-	-	-	-	-	-
78	10	Mzr, Tg	2	-	1	-	-	-	1	-	-	-	1	-	-	-	-
79	11&	Trl	3	2	1	2	1	1	3	1	-	1	-	-	-	-	-
	214																
80	11	Ps	1	2	-	2	-	-	3	-	-	-	-	-	-	-	-
81	11	JTrwm, Qg, Qal	2	2	-	3	-	-	3	-	-	4	-	-	-	-	1
82	210	Tk	7	2	-	1	-	-	-	-	-	8	1	-	-	-	-
83	11	Tsa	-	-	1	1	-	-	-	-	-	-	-	-	-	1	-
84	11	Tqm	1	2	-	1	2	-	1	1	-	-	-	-	-	-	-
85	11	Qg	3	2	-	2	-	-	-	-	-	-	-	-	-	-	-
86	209	Mzg, Qg	1	2	-	-	-	-	-	-	-	1	-	-	-	-	-
87	13	TKqm	1	4	-	1	3	-	4	-	-	1	-	-	-	-	-
88	210	TK	1	3	-	1	-	-	1	-	-	1	2	1	-	-	1
89	13	Qg	3	1	-	1	2	-	-	3	1	1	-	-	-	-	-
90	214	Trl	1	2	-	3	-	-	1	-	-	-	-	-	-	-	1
91	214	Trl	2	3	1	3	2	1	2	-	3	-	-	-	-	-	-
92 *	14	PzpEm, Qg	1	1	2	-	-	-	-	-	-	1	2	1	-	4	-
93	14	Mzg	1	3	1	-	-	-	3	-	-	3	-	1	-	-	-
94	14	Mzg	3	1	-	-	-	-	1	-	-	2	-	-	-	-	-
95	14	Mzg	3	1	-	2	1	-	-	-	-	-	-	-	-	-	1
96	208	Qg, Pzls	6	-	-	1	5	-	1	5	-	-	-	-	-	-	-
97 *	210	TK	2	2	2	1	-	-	1	-	-	3	1	2	-	-	2
98	208	Pzls, Pza	1	1	1	1	1	-	1	1	-	-	-	-	-	-	-
99	211	TK	-	-	1	1	-	-	1	-	-	-	1	-	-	-	-

TABLE 1 EQUIVALENT URANIUM ANOMALIES - OKANOGAN QUADRANGLE

Anom. No.	F/L No.	Geol. Fm.	Number of Points														
			eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
100	208	Qg	2	1	-	1	1	1	1	1	1	-	-	-	-	-	-
101	17	Mzb	2	1	-	3	-	-	2	1	-	-	-	-	-	-	-
102	17	Mzt	-	2	-	-	-	-	-	-	-	-	1	1	1	-	-
103	214	Trl	3	2	-	-	-	-	-	-	-	4	-	-	-	-	1
104	17	Tc	1	-	1	-	1	-	-	-	-	1	1	-	-	1	-
105	17	Ko	-	1	1	-	-	-	2	-	-	-	1	1	-	1	-
106	17	Tg	2	1	-	2	1	-	-	2	1	-	-	-	-	-	-
107	18	Mzg	2	2	1	-	2	3	3	1	-	-	-	-	-	-	-
108	19	Kpgd	1	2	-	-	-	-	1	1	-	-	3	-	-	-	-
109	210	Qg, Tsc	1	2	3	4	1	-	2	1	2	2	-	1	-	-	-
110	19	Mzg	3	1	-	1	-	-	-	-	-	1	1	-	-	-	1
111	19&	Qg	5	1	-	2	-	-	3	-	-	-	-	-	-	-	-
	208																
112	19	Qg	-	2	1	1	1	-	-	1	-	-	1	-	-	1	-
113	20	Tad	2	2	-	2	1	-	2	-	-	-	-	-	-	-	-
114	214	Trl	-	1	1	1	-	-	-	1	-	-	1	-	-	-	1
115	213	Mzc	2	-	1	2	-	1	1	2	-	1	-	-	-	-	-
116	20	Mzc, Pa, To	8	4	1	9	1	-	11	-	-	3	-	-	-	-	-
117	210	Qg, Pr	2	3	-	1	1	-	2	1	1	1	1	-	-	1	-
118	20	Mzg	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
119	20	Mzg	1	2	-	2	1	-	-	-	-	-	-	-	-	-	-
120 *	20	Pza	3	2	2	3	1	-	1	2	-	-	3	-	2	-	1
121	208	Qg	4	2	2	7	-	-	4	3	-	2	-	-	-	-	-
122	21	Kpgd, Ts	3	2	1	3	2	1	2	2	1	-	-	-	-	-	-
123	21	Pza	5	-	-	4	-	-	4	-	-	-	-	-	-	-	-
124	22	Kpgd	4	-	-	-	2	1	2	-	1	-	-	-	-	-	-
125	210	Qg	1	3	-	-	-	-	3	-	-	2	1	-	-	-	-
126	22	Mzg	3	1	-	-	2	-	-	-	-	-	-	-	-	-	-
127	22	Pza	5	1	-	2	-	-	1	-	-	3	-	-	2	-	-
128	22&	Qg	6	3	-	3	3	1	3	3	-	-	-	-	-	-	-
	208																
129	22	Qg, Pza	3	1	2	4	1	-	1	1	3	3	-	-	1	-	-
130 *	23	Mzg	4	-	1	-	-	-	-	-	-	2	1	1	-	-	1
131	23	Mzg	-	2	-	1	-	-	2	-	-	-	-	-	-	-	-

TABLE 1 EQUIVALENT URANIUM ANOMALIES - OKANCGAN QUADRANGLE

Number of Points

Anom. No.	F/L No.	Geol. Fm.	eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
132	23	Mzg, Pza	2	-	1	-	1	-	-	1	-	-	-	-	1	-	1
133 *	23	Pza	2	2	2	-	-	-	1	-	-	3	1	2	1	-	2
134	23	Pza, Qg	4	2	1	2	-	-	-	-	-	1	1	1	2	1	-
135 *	23	Pza	-	1	4	-	-	-	1	-	-	1	1	3	1	-	4
136	24	Mzc	5	-	-	-	-	-	-	-	-	4	-	-	-	-	-
137	24	Tsc	1	2	-	2	1	-	1	1	-	-	-	-	-	-	-
138	24	Mzg	5	1	-	3	-	-	-	-	-	-	-	-	-	-	-
139	25	Mzg, Pr	4	-	-	-	1	3	2	1	1	-	-	-	-	-	-
140	25	Mzg	2	1	-	2	-	-	2	1	-	-	-	-	-	-	-
141	25	Mzg	-	2	-	-	-	-	-	-	-	-	2	-	-	-	2
142	25	Mzg	-	2	-	1	-	-	-	-	-	-	-	1	-	-	-
143	25	Mzg	-	-	1	-	-	-	-	-	-	1	-	-	-	-	1
144	25	Mzg	-	2	-	-	-	-	-	-	-	1	-	-	-	-	1
145 *	25	Pza	1	-	4	-	-	-	2	2	-	-	-	4	2	-	2
146	26	Qg	2	1	-	-	-	-	-	-	-	2	-	-	-	-	-
147	26	Mzc	1	2	-	2	-	-	3	-	-	1	-	-	-	-	-
148	26	Qg	-	-	1	1	-	-	-	1	-	1	-	-	-	-	-
149	210	Pr	6	-	1	-	-	-	3	-	-	1	1	-	-	-	-
150	26	Mzg	4	-	1	3	-	-	-	-	-	1	1	-	-	-	1
151	26	Mzg	2	6	4	2	1	-	4	-	-	6	2	-	-	-	3
152	26	Mzg	1	3	3	1	-	-	1	-	-	3	1	-	-	-	1
153 *	26 & 208	Qg, Pza	6	3	2	-	-	-	2	-	-	1	2	3	2	2	-
154	26	water	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-
155	26	Tg, Td	5	-	-	-	-	-	-	-	-	1	2	-	-	-	-
156	212	Mzc	7	2	1	6	1	-	3	-	-	1	-	-	-	-	-
157	28	Mzc	5	1	-	1	-	-	4	-	-	2	-	-	-	-	-
158	28	Mzg	4	1	-	1	2	2	4	1	-	-	-	-	-	-	-
159 *	28	Mzg	5	3	1	1	-	-	2	-	-	3	1	-	-	-	1
160	28	Mzg	2	1	-	1	-	-	-	-	-	-	-	-	-	-	-
161	28	Qg	1	2	-	2	-	-	2	-	-	1	-	-	-	1	-
162	28	Qg	1	10	3	9	4	-	9	2	-	2	-	-	-	2	-
163 *	29	Mzc	3	3	2	1	-	-	1	-	-	2	3	1	-	-	1

TABLE 1 EQUIVALENT URANIUM ANOMALIES - OKANOGAN QUADRANGLE

Anom. No.	F/L No.	Geol. Fm.	Number of Points														
			eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
164	29	Mzc	4	-	-	1	-	-	3	-	-	-	-	-	-	-	-
165	29	Mzc	5	-	-	2	-	-	4	1	-	1	-	-	-	-	-
166	29	Mzg	2	2	-	-	-	-	1	-	-	1	1	-	-	-	1
167	208	water	3	1	-	1	3	-	1	3	-	-	-	-	-	-	-
168	29	Qg	4	-	-	2	-	-	3	1	-	-	-	-	-	-	-
169	29	Qg	-	2	1	2	-	-	1	-	-	2	-	-	-	1	-
170	29	Qg	7	2	-	2	7	-	-	8	1	-	-	-	-	-	-
171*	30	Pza	5	2	1	-	-	-	4	2	-	1	5	1	1	-	-
172	31	Qg	-	2	-	2	-	-	1	1	-	-	-	-	-	-	-
173	214	Trkc	3	1	-	-	-	-	-	-	-	1	2	1	-	-	2
174	32	Qg, Trc	2	2	-	1	-	-	1	-	-	1	1	-	1	-	-
175	32	Mzc	-	1	2	2	-	-	2	-	-	-	2	-	-	-	1
176*	32	Qg, Mzc	4	1	2	-	-	-	-	-	-	-	1	6	-	4	2
177	32	Qg	4	1	-	-	-	-	-	-	-	-	-	5	-	4	-
178	211	Kgd	1	-	3	2	-	-	1	1	1	1	-	3	3	-	-
179	32	Pza	-	2	-	-	-	-	-	1	1	-	2	-	-	-	-
180	32	Qg, water	3	-	1	1	1	-	1	-	2	1	-	-	-	1	-
181	208	Pza	4	1	-	-	-	-	1	-	-	2	2	-	3	-	1
182	32	Qg, Pza	-	1	1	2	-	-	1	1	-	-	-	-	-	-	-
183	33	Pzc	2	1	-	2	-	-	1	1	-	-	-	-	-	-	-
184	208	Qg	1	-	1	1	-	-	2	-	-	1	-	-	-	1	-
185	33	Qg, Pza	4	1	-	4	1	-	3	2	-	-	-	-	-	-	-
186*	34	Kq, Qg	5	4	3	-	-	-	3	4	2	4	2	5	1	2	-
187*	34	Kq	3	6	4	2	-	-	6	1	2	5	5	3	9	-	1
188*	34	Kgd	-	-	3	2	-	1	1	1	1	-	-	3	-	-	3
189	34	Pzc	-	3	-	2	-	-	2	-	-	2	-	-	-	3	-
190	34	Pzc	3	1	-	-	-	-	2	1	-	2	2	-	-	-	-
191	34	Pzc	-	2	-	-	-	-	-	-	-	-	-	2	-	1	1
192*	34	Pzc, Pza	2	-	3	-	-	-	2	-	-	2	1	2	1	1	1
193	35	Qg	1	2	-	1	1	-	3	-	-	-	-	-	-	-	-
194	35	Trc	4	-	-	1	1	-	3	-	-	-	-	-	-	-	-
195	35	Mzc	1	2	1	1	-	-	2	-	-	3	-	-	-	-	-
196	36	Qt	1	2	-	1	-	-	1	-	-	2	-	-	-	-	-

TABLE 1 EQUIVALENT URANIUM ANOMALIES - OKANOGAN QUADRANGLE

Anom. No.	F/L No.	Geol. Fm.	Number of Points														
			eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
197*	36	Kq, TrPgr	3	1	1	1	-	-	-	-	-	3	1	-	4	-	-
198	37	Pzc	1	-	1	-	-	-	-	1	-	-	-	2	-	-	-
199	37	Qg	2	2	-	-	-	-	1	-	-	2	-	-	-	-	-
200	214	Trkc	2	3	-	-	2	3	1	4	-	-	-	-	-	-	-
201	38	Trkc	2	1	-	2	-	-	3	-	-	1	-	-	-	-	-
202	38	Qg	1	1	3	2	1	2	3	2	-	-	-	-	-	-	-
203	38& 213	Mzg	4	2	-	-	-	-	4	1	-	2	3	-	-	-	-
204*	38	Q	2	3	-	-	-	-	-	-	-	-	4	1	4	-	1
205*	38	Q	5	2	-	1	-	-	1	-	-	2	1	1	2	-	-
206	38	Qg, Pzcq	1	1	2	-	-	-	4	-	-	1	2	-	-	-	-
207	38	Mzg, Qg	2	2	-	-	-	-	-	-	-	2	-	-	-	-	-
208*	39	TrPg	3	-	2	-	-	-	-	-	-	1	1	-	-	3	-
209	39	Qg, Pzcq	2	1	3	1	-	-	1	3	-	1	2	1	-	-	1
210*	40	TrPp	1	1	1	1	-	-	1	1	-	-	1	1	-	2	-
211	40	Ta	-	2	-	-	-	-	-	-	-	1	1	-	-	-	-
212	40	Mzg, Qg	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
213	41	Kob	5	1	-	3	-	-	5	-	-	-	-	-	-	-	-
214	41	JTgn	2	1	-	3	-	-	-	-	-	1	-	-	-	-	1
215	41	Qg, JTrgn	2	1	2	2	-	2	3	1	-	1	-	-	-	1	-
216	41	Ta	2	1	-	2	1	-	3	-	-	-	-	-	-	-	-
217	209	Mzg	2	2	-	-	-	-	-	-	-	1	1	1	-	-	2
218	42	Mzg	4	1	-	1	-	-	1	-	-	1	-	-	-	-	3
219	42	Mzg	2	1	-	1	-	-	-	-	-	-	-	-	-	-	-
220	42	Mzg	3	1	-	-	-	-	-	-	-	1	2	1	-	-	4
221	42	Mzg	2	1	-	-	-	-	-	-	-	-	1	-	-	-	2
222	42	Qg	3	1	-	3	1	-	-	1	-	-	-	-	-	1	-
223	42	Pza	2	1	-	1	-	-	-	-	-	1	-	-	3	-	-
224	43	Ta	-	3	-	2	1	-	2	-	-	-	-	-	-	-	-
225	43	Mzg	5	1	-	-	-	-	4	-	-	1	-	-	-	-	-
226	43	Mzg	7	-	-	-	-	-	-	-	-	2	-	-	-	-	2
227	43	Pzc, Qg	2	1	-	1	-	-	1	-	-	-	-	-	-	-	-
228	43	Pzcq, Mzg	2	1	-	-	-	-	2	-	-	1	1	1	-	-	-

TABLE 1 EQUIVALENT URANIUM ANOMALIES - OKANOGAN QUADRANGLE

			Number of Points														
Anom. No.	F/L No.	Geol. Fm.	eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
229	43	Qg	2	1	-	-	-	-	1	-	-	1	1	-	-	1	-
230	44	Kob	5	4	-	1	-	-	-	-	-	5	-	-	-	-	5
231	214	Kob	2	1	-	2	-	-	-	-	-	-	-	-	-	-	-
232	214	Kob	5	-	-	3	2	-	4	-	-	-	-	-	-	-	-
233	44	Trkc, Qg	4	1	-	2	-	-	1	-	-	1	1	-	-	-	2
234 *	44	Qg	2	2	3	1	-	-	1	-	-	3	2	-	-	4	-
235	44	Qg	3	1	-	-	-	-	-	-	-	1	2	-	-	1	-
236	44	Mzg, Qg	8	1	-	-	-	-	-	-	-	3	1	-	-	1	-
237	44	Ta	-	-	1	-	-	-	1	-	-	1	-	-	-	-	-
238	44	Qg	5	1	-	-	-	-	-	-	-	1	-	-	-	-	-
239 *	44	Mzg, Pza	2	1	7	3	-	-	4	3	-	5	1	3	-	-	1
240	45	Ts	2	1	-	1	-	-	-	-	-	2	-	-	-	-	-
241	45	Mzg	4	-	-	-	-	-	-	-	-	1	3	-	-	-	1
242	45	Mzg	1	1	1	-	-	-	-	-	-	1	1	-	-	-	2
243	45	Mzg, Qg	2	1	-	2	-	-	1	-	-	-	-	-	-	-	-
244	45	Qg	2	1	-	2	-	-	-	-	-	-	-	-	-	1	-
245	45	Pzcq	3	1	-	-	-	-	-	-	-	-	-	-	-	-	2
246 *	45	Pzc	2	3	1	-	-	-	2	1	1	2	1	2	1	2	-
247 *	45	Pza	-	2	1	-	-	-	-	-	-	-	-	3	-	-	3
248	46	Kq	-	2	1	-	-	3	1	-	-	-	-	-	3	-	-
249	46	Pza	4	-	-	2	2	-	1	-	-	-	-	-	-	-	-
250 *	46	Pzc	1	1	1	1	-	-	3	-	-	1	1	-	-	1	-
251 *	46	Pzc	-	2	-	-	-	-	-	-	-	-	1	1	-	2	-
252	47	Kob	5	1	-	4	2	-	3	3	-	-	-	-	-	-	-
253	214	Kob	5	5	2	4	8	-	3	8	-	-	-	-	-	-	-
254	47	Mzg	10	5	-	7	-	-	1	-	-	3	-	-	-	-	-
255	47	Qg, Mzg	2	3	-	-	-	-	3	-	-	3	-	-	-	-	-
256 *	47	Kq	6	9	3	3	-	-	-	-	-	7	6	5	6	1	11
257	47	TrPs, Kq	4	1	1	1	2	1	1	1	-	2	-	-	2	-	-
258	47	Kq	1	2	-	-	2	1	1	-	-	-	-	-	2	-	-
259	47	Kd, Ts	3	3	-	3	-	-	-	-	-	4	2	-	-	3	-
260	47	Mzg	2	3	-	-	-	-	-	-	-	1	1	3	-	-	4
261	47	Pzc	3	1	-	1	-	-	-	-	-	3	-	-	-	2	1

TABLE 1 EQUIVALENT URANIUM ANOMALIES - OKANOGAN QUADRANGLE

Number of Points

Anom. No.	F/L No.	Geol. Fm.	eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
262	47	Qg	1	4	-	-	-	-	-	-	-	4	1	-	-	2	3
263 *	47	Qg, Pzc	4	6	8	6	-	-	-	-	-	10	4	2	-	9	9
264	47	Qg, water	1	2	1	2	1	-	1	-	-	-	-	-	-	2	-
265	47	Qg	1	-	1	-	-	-	1	-	-	1	-	-	-	-	-
266	48	TrPb	2	1	-	-	2	-	2	-	-	-	-	-	-	-	-
267	48	Qg, Ts	-	2	-	-	-	-	-	-	-	1	-	1	-	1	1
268	48	Td	4	-	-	1	-	-	3	-	-	2	-	-	-	-	-
269	48	Mzg	2	1	-	-	-	-	-	-	-	2	1	-	-	-	-
270	48	Mzg	4	2	1	-	-	-	-	-	-	4	1	-	-	-	3
271	48	Mzg	-	2	-	-	-	-	-	-	-	-	1	1	-	-	1
272 *	48	Mzg	-	3	5	-	-	-	-	2	-	1	3	4	-	-	7
273	48	Pzc	-	3	-	1	-	-	-	-	-	1	-	2	-	3	-
274	48	Pzc	1	3	-	1	1	-	-	-	-	2	-	-	-	2	-
275	48	Qg	4	1	-	5	-	-	-	-	-	-	-	-	-	1	-
276	48	Qg	1	-	1	2	-	-	2	-	-	1	-	-	-	-	-
277	49	Qg	2	1	-	-	-	-	-	-	-	1	-	-	-	2	-
278	49	Td	2	1	-	-	1	1	1	1	-	-	1	-	-	-	-
279	49	Mzg	12	9	-	-	-	-	-	-	-	8	7	3	-	-	7
280 *	209	Mzg	2	1	-	-	-	-	-	-	-	2	-	1	-	-	2
281	49	Qg	5	1	-	-	-	-	-	-	-	2	2	-	-	2	4
282	49	Qg	1	2	1	1	-	-	-	-	-	1	1	-	-	3	1
283	49	Qg, Pzc	3	5	3	7	-	-	-	-	-	1	3	-	-	5	2
284	50	Kob	4	-	-	3	1	-	2	2	-	-	-	-	-	-	-
285	214	Qg	3	1	-	-	-	-	-	-	-	1	2	1	-	-	-
286 *	50	Mzg	-	-	3	1	2	-	1	1	1	2	1	-	-	-	2
287	50	Mzg	1	4	-	2	1	-	-	-	-	1	-	-	-	-	-
288	213	Mzg, Tb	5	7	6	3	9	4	7	4	-	1	1	-	-	-	-
289	50	Pzc	2	2	-	1	-	-	1	2	-	3	-	-	-	1	-
290	51	Mzg	5	1	-	-	-	-	-	-	-	1	-	-	-	-	3
291	51	Kg, Qg	4	1	-	1	-	-	-	-	-	2	-	-	-	2	3
292 *	51	Pzcq	2	-	1	-	-	-	-	-	-	2	1	-	-	-	2
293	51	Pza	4	1	-	-	-	-	1	-	-	2	-	-	4	-	-
294	52	Mzg	-	2	-	1	-	-	1	-	-	1	-	-	-	-	1

TABLE 1 EQUIVALENT URANIUM ANOMALIES - OKANOGAN QUADRANGLE

Number of Points

Anom. No.	F/L No.	Geol. Fm.	eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
295 *	214	Mzg	1	1	1	1	-	-	1	-	-	1	1	-	-	-	1
296	53	Mzg	2	1	-	-	-	-	2	1	-	1	-	-	-	-	-
297	213	Tb	2	1	-	1	2	-	-	-	-	1	-	-	-	-	-
298	53	Mzg, Tb	1	2	-	-	1	1	2	-	-	-	-	-	-	-	-
299	53	Qg, Mzg	4	3	-	5	2	-	6	-	-	-	-	-	-	-	-
300	53	Qg	1	3	2	2	1	-	-	-	-	4	-	-	-	4	-
301	53	Pzg, Qg, Kg	5	1	1	-	2	2	-	2	-	-	1	-	1	2	-
302	53	Pza, Cod	4	1	-	-	-	-	-	-	-	1	-	-	3	-	-
303 *	54	Pzc	-	-	1	-	-	-	1	-	-	-	-	1	-	1	-
304	54	Pzw	2	2	-	2	1	-	1	2	-	2	-	-	-	-	-
305	55	Tp	-	2	-	-	-	-	1	-	-	-	1	1	-	-	-
306	55	Mzg, Tp, Td	4	1	-	1	-	-	-	-	-	2	1	-	-	-	1
307	55	Qg, Pzc	4	-	-	-	-	-	-	-	-	3	-	-	-	3	-
308	56	Pzc	2	1	-	-	-	-	-	-	-	-	2	1	-	2	-
309	56	Mzg, Pzc	4	1	-	-	2	1	-	2	-	1	-	-	-	-	-
310	56	Qg	4	-	-	-	-	-	-	-	-	3	-	-	-	4	-
311	56	Pzc, Qg	4	-	-	2	-	-	-	-	-	1	-	-	-	3	-
312	56	Qg	5	1	-	-	-	-	-	-	-	-	-	-	-	1	-
313	56	Qg	2	2	1	1	-	-	-	-	-	1	-	1	-	1	1
314	57	Tp, Qg	4	-	-	-	-	-	3	1	-	1	-	-	-	-	-
315	57	Tb	1	2	1	3	-	-	3	1	-	4	-	-	-	-	-
316	57	Qg	2	2	1	1	-	-	-	-	-	2	-	-	-	2	-
317	57	Qg, Pzw	2	1	-	1	-	-	-	-	-	1	-	-	-	1	-
318	57	Qg	4	1	-	2	-	-	-	-	-	1	-	-	-	1	-
319	58	Mzg	3	1	-	1	-	-	-	-	-	-	-	-	-	-	-
320	58	Q	2	1	-	-	-	-	-	-	-	1	1	-	2	-	-
321	58	Qg	4	3	-	3	1	-	1	-	-	-	-	-	-	4	-
322	58	Qg	5	2	-	2	-	-	-	-	-	1	-	-	-	2	-
323	58	Qg	6	-	-	3	-	-	-	-	-	-	1	-	-	1	-
324	58	Qg	2	1	-	-	-	-	-	-	-	1	-	-	-	2	-
325	59	Mzg	4	-	-	2	2	-	4	-	-	-	-	-	-	-	-
326	59	Mzg	8	2	1	2	7	2	7	3	1	-	-	-	-	-	-
327	59	Qg	2	1	-	-	-	-	-	-	-	1	-	-	-	1	-

TABLE 1 EQUIVALENT URANIUM ANOMALIES - OKANCGAN QUADRANGLE

Number of Points

Anom. No.	F/L No.	Geol. Fm.	eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
328	59	Qg	3	-	1	1	-	-	-	-	-	1	-	-	-	2	-
329	59	Qg	2	1	3	5	-	-	1	1	-	2	1	-	-	3	-
330	60	Ta	3	1	-	-	-	-	1	-	-	3	-	-	-	-	-
331	60	Mzg, Pzc	3	4	-	1	-	-	-	-	-	5	1	-	-	-	5
332	60	Pzc	4	-	-	1	3	-	1	2	-	-	-	-	-	-	-
333	60	Pzc, Qg	7	-	-	4	-	-	3	-	-	2	-	-	-	-	-
334	60	Qg	5	2	-	3	-	-	-	-	-	2	-	-	-	3	-
335	60	Qg	4	-	-	1	-	-	2	-	-	-	-	-	-	-	-
336	61	Ta	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-
337 *	61	Pzc	2	-	1	-	-	-	-	-	-	1	1	1	-	2	1
338 *	61	Pzc, Qg	6	3	2	3	1	-	2	1	-	3	1	-	-	5	2
339	61	Pzc	2	1	-	-	3	-	2	1	-	-	-	-	-	1	-
340	61	Pzc	1	2	-	1	-	-	-	-	-	2	-	-	-	2	-
341	61	Qg	4	1	-	2	-	-	1	-	-	2	-	-	-	1	-
342	61	Qg	2	1	-	1	-	-	-	-	-	-	-	-	-	1	-
343	62	Tb	2	1	-	-	-	-	-	-	-	1	1	1	-	-	-
344	62	Tb	2	1	-	-	-	-	-	-	-	2	-	1	-	-	-
345	62	Qg	4	2	-	2	-	-	4	-	-	1	-	-	-	-	-
346	62	Qg	4	-	-	3	-	-	4	-	-	-	-	-	-	-	-
347	62	Qg	2	3	-	5	-	-	3	1	-	-	-	-	-	-	-
348	62	Qg	2	3	-	4	-	-	3	-	-	-	-	-	-	-	-
349	62	Qg	3	2	-	4	-	-	4	1	-	-	-	-	-	-	-
350	62	Tb	1	2	-	-	-	-	-	-	-	-	2	1	-	-	1
351	62	Mzg	2	-	1	1	2	-	3	-	-	-	-	-	-	-	-
352	62	Mzg	4	2	-	1	3	2	-	3	3	-	-	-	-	-	-
353	62	Mzg	1	3	-	2	2	-	1	2	1	-	-	-	-	-	-
354	62	Pzc	2	2	1	-	-	-	3	1	-	4	1	-	-	1	-
355	62	Qg	3	1	-	-	-	-	-	-	-	2	-	-	-	1	-
356	62	Kg, Qg	5	1	-	-	-	-	-	-	-	4	-	-	-	-	-
357	63	Ta	2	1	-	-	-	-	1	-	-	1	1	-	-	-	-
358	63	Kg, Qg	3	1	-	-	-	4	1	3	-	-	-	-	-	-	-
359	63	Pzc	4	-	-	3	1	-	3	-	-	-	-	-	-	-	-
360	64	Mzg	-	2	-	-	1	1	-	2	-	-	-	-	-	-	-

TABLE 1 EQUIVALENT URANIUM ANOMALIES - CKANOGAN QUADRANGLE

Number of Points

Anom. No.	F/L No.	Geol. Fm.	eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
361 *	64	Pzc, Kg	-	-	2	1	-	-	1	1	-	-	2	-	-	1	-
362	64	Qg	7	2	-	3	-	-	-	-	-	3	-	-	-	3	-
363	64	Qg	5	-	-	5	-	-	2	-	-	-	-	-	-	-	-
364	65	Tb	2	1	-	-	-	-	-	-	-	2	-	-	-	-	-
365	65	Qg, Kg	-	2	-	2	-	-	1	-	-	1	-	-	-	-	-
366	65	Qg, water	2	1	-	2	-	-	1	1	-	-	-	-	-	-	-
367	65	Qg	3	1	-	3	-	-	2	-	-	-	-	-	-	-	-
368	66	Qg, Tb	4	-	-	2	-	1	1	1	1	-	-	-	-	-	-
369	66	Tb	-	-	1	1	-	-	1	-	-	-	1	-	-	-	-
370	67	Mzg	4	1	-	2	3	-	5	-	-	-	-	-	-	-	-
371	210	Ta	-	2	-	-	-	-	-	-	-	2	-	-	-	-	-
372 *	67	Mzg	4	2	1	-	-	-	2	-	-	4	-	3	-	-	2
373	67	Mzg	-	2	-	-	-	-	1	-	-	1	1	-	-	-	-
374	67	Qg, Kg	3	2	-	3	2	-	1	-	-	-	-	-	-	1	-
375	68	Mzg	3	3	-	3	3	-	3	2	-	-	-	-	-	-	-
376	68	Tb	2	1	-	1	-	-	-	-	-	2	1	-	-	-	-
377	68	Tb	2	1	-	-	-	-	-	-	-	2	-	-	-	-	-
378	68	Tb	3	1	-	1	2	1	-	2	2	1	-	-	-	-	-
379	68	Q, Mzg	4	-	-	4	-	-	1	-	-	-	-	-	-	-	-
380	68	Kg, Kq	5	3	-	1	4	1	3	1	2	1	5	-	1	-	-
381	68	pCt	1	1	1	-	3	-	1	2	-	2	-	-	-	2	-
382 *	69	Mzg	-	3	-	-	-	-	-	-	-	-	1	2	-	-	3
383	69	Mzg	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-
384	69	Pzc, Qg	2	2	-	1	2	1	2	1	-	-	-	-	-	-	-
385	69	Qg	-	3	-	2	-	-	-	-	-	-	-	-	-	2	-
386	208	pCe	4	-	-	2	-	-	1	-	-	1	-	-	-	-	-

* Preferred Anomaly

volcanic units are also commonly characterized by moderate eTh and K responses as well, the preferred eU responses in this group are distinguished by strong eU/eTh and eU/K ratios.

Anomalies 11, 32 and 41

These three anomalies occur within a local group of significant eU responses at the northern end of the Republic graben. Anomalies 11 and 32 are relatively local, sharp features associated with Cambrian metasediments, while Anomaly 41 is a broader zone occurring over the Sanpoil volcanics. All three anomalies display moderate amplitudes in the uranium channel, and favorable eU/eTh and eU/K ratios.

Anomaly 92

Moderate eU response accompanied by strong eU/eTh and eU/K ratios, situated along the eastern margin of the Republic graben. The anomaly occurs over Cambrian metasediments not far from their contact with Mesozoic granitic rocks.

Anomaly 97

Sharp, somewhat isolated eU response over Tertiary volcanics of the Klondike Mountain formation, located within the central portion of the Republic graben. Distinguished by strong eU/eTh ratios and favorable eU/K ratios.

Anomalies 130, 159, 272, 280, 372 and 382

This series of preferred anomalies is considered as a group, inasmuch as the responses comprise a general zone along the eastern margin of the Colville batholith. All of the anomalies noted occur over Mesozoic granitic rocks of unit Mzg, near the contact with older metasediments. Anomalies 272 and 372 of this group display particularly strong, sharp eU responses, while the remainder are more subdued, typical of the relatively weak to moderate uranium channel responses over the Mzg unit. All of the anomalies noted, however, display very strong eU/eTh and eU/K ratios.

Anomalies 120, 133, 135, 145, 153, 171, 192, 239, 246, 247, 250, 251, 263, 292, 303, 337, 338 and 361

This series of preferred eU responses, similar to the group discussed above, is also distributed along the eastern margin of the Colville batholith. These anomalies, however, are all associated with middle Paleozoic metasediments fringing the granitic rocks of the batholith to the east. In general, all the anomalies noted are distinguished by moderate to strong eU responses and strong eU/eTh and eU/K ratios. Anomalies 120, 145, 192 and 337 display particularly strong, sharp anomalous responses in the uranium channel, as well as good to excellent spectral ratios, which recommends them for early initial follow-up.

Anomalies 163, 176, 186, 187, 188, 197 and 256

This series of preferred eU responses occurs along the west side of the Republic graben in the central portion of the area. The main part of the group, including Anomalies 176 through 197, is located in the general vicinity of the Sanpoil uranium occurrence. Anomaly 256 lies to the south along the projection of the graben, while Anomaly 163 occurs further to the northwest, perhaps corresponding with the Aeneas occurrence. All the anomalies noted are associated with Mesozoic intrusives, and are distinguished by moderate to strong eU responses accompanied by strong eU/eTh and eU/K ratios. Anomaly 188 displays the sharpest eU response of this group. Together with Anomalies 186 and 187, this feature is accompanied by anomalous eTh and K responses as well, although the spectral ratios are quite favorable.

Anomalies 204, 205, 208 and 210

These preferred eU responses comprise a localized group distributed along Gold Creek in the center of the quadrangle area. Anomalies 204 and 205 occur over Recent alluvium, while zones 208 and 210 are associated with Paleozoic metasediments. However, Tertiary volcanics of the Sanpoil group are widespread throughout this locality. Both Anomalies 208 and 210 display strong, sharp eU responses. Anomalies 204 and 205 are more subdued, but are similarly distinguished by favorable eU/eTh and eU/K ratios.

Anomaly 234

Moderate eU response over Quaternary glacial deposits immediately west of the town of Okanogan, near a local outcrop of Triassic metasediments. Distinguished by strong spectral ratios.

Anomalies 286 and 295

Sharp, isolated eU responses situated along the western flank of Soap Lake Mountain in the southwest portion of the quadrangle, over Mesozoic granitic rocks. Distinguished by moderate to strong eU/eTh and eU/K ratios.

7.3.3.2 Sandpoint Quadrangle

Of the total of 474 statistically significant eU anomalies determined in the Sandpoint Quadrangle, 43 preferred anomalies have been selected on the basis of strength and character of their eU response as well as relative enrichment of eU over eTh and K, which appear to have the greatest potential as indications of true uranium enrichment. This selection has taken into account statistical adequacy of sampling, and thus excludes anomalies correlating with sparsely sampled geologic units.

The geologic units associated with these preferred anomalies are noted in the following tabulation:

Quaternary alluvial and glacial deposits (Qal, Qg, Qag)	18 anomaly associations
Tertiary volcanics (Tb)	2 anomaly associations
Cretaceous and Tertiary intrusives (Tsp, TKpa, Khm, Kkh, Kkt, Kg, Ksp)	16 anomaly associations
Upper Paleozoic meta- sediments (Cp)	1 anomaly association
Lower Paleozoic sedi- ments (Em)	2 anomaly associations
Precambrian metasedi- ments (pEdt, pEbu)	4 anomaly associations

As shown by the above listing, the majority of the preferred eU zones are either associated directly with granitic intrusive units of the Loon Lake batholith, or with Quaternary deposits. Study of the Quaternary anomalous occurrences reveals that most of these are situated in areas principally underlain by intrusives, as well. In addition, the vast majority of the statistically significant eU anomalies in this area, as well as the preferred anomalies, are concentrated along a northeasterly-trending zone extending from the Midnite mine to the Hall Mountain district (the Midnite-Hall Mountain belt identified by Castor and others, 1978). Approximately 70% of the preferred anomalies lie on or very near the axis of this belt, while the remaining significant eU zones have a somewhat wider distribution. Both the general vicinity of the Midnite district and that of the Hall Mountain district are defined by significant eU responses, as are most of the other more localized uranium occurrences shown on Figure 8. Notably, no preferred eU anomalies were selected in the Hall Mountain area, which is primarily a thorium prospect. The Midnite area, in contrast, displays a concentration of preferred zones, as do the Lamb Creek and Railway Dike uranium occurrences.

The following notes comprise specific comments on the preferred anomalies noted in Table 2 with regard to geologic setting, surficial conditions and structural associations, where applicable.

Anomaly 4

Strong, sharp eU response over lower Paleozoic sediments and meta-sediments, situated within a structurally complex, highly faulted locality along the northern margin of the quadrangle. Distinguished

LEGEND

- STATISTICALLY SIGNIFICANT $\pm$ U ANOMALIES
- PREFERRED ANOMALIES

FIGURE-10A EQUIVALENT URANIUM ANOMALY MAP
WEST HALF OF SANDPOINT QUADRANGLE

LEGEND

— STATISTICALLY SIGNIFICANT &U ANOMALIES

- - - PREFERRED ANOMALIES

FIGURE 10B EQUIVALENT URANIUM ANOMALY MAP
EAST HALF OF SANDPOINT QUADRANGLE

TABLE 2 EQUIVALENT URANIUM ANOMALIES - SANDPOINT QUADRANGLE

Anom. No.	F/L No.	Geol. Fm.	Number of Points														
			eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
1	1	Ksm	3	2	1	2	3	1	1	5	-	-	-	-	-	-	-
2	1	Ksm	2	2	-	-	3	-	1	2	-	-	-	-	-	-	-
3	1	Tsg	-	-	1	1	-	-	1	-	-	1	-	-	-	-	-
4 *	1	Cm	1	1	1	-	-	-	-	-	-	1	-	2	-	1	1
5	1	Qg, Tsp	3	-	-	1	1	-	-	-	-	-	-	-	-	-	-
6	2	Pmr	1	-	2	1	-	2	1	1	1	-	-	-	-	-	-
7	2	Qag, Jr	-	2	1	-	-	3	-	-	3	-	-	-	-	-	-
8	2	Cma	2	1	-	-	-	-	-	-	-	-	-	3	-	-	-
9	2	Cma	2	1	1	-	-	-	-	-	-	-	-	4	-	-	2
10	4	Pmr	-	-	1	1	-	-	-	1	-	1	-	-	-	-	-
11	4	Tsp	-	1	1	1	1	-	-	1	-	1	-	-	-	-	-
12	4	Tsp	-	3	-	2	-	-	-	-	-	1	-	-	1	-	-
13	4	Qg, Qal	3	1	1	-	3	2	1	1	3	1	-	-	-	-	-
14	4	Qg, Qal, pCm, pCbu	1	3	4	3	2	6	5	3	3	4	-	-	1	-	-
15	5	Kc	4	-	-	3	-	-	3	-	-	1	-	-	-	-	-
16	5	Kc	4	-	-	1	3	-	3	1	-	-	-	-	-	-	-
17	5 &	Tsp, Qg	5	5	1	-	-	-	3	1	-	6	-	1	2	-	-
	203																
18	5	Tsp	2	2	-	1	1	2	1	2	1	-	-	-	-	-	-
19	5	Qal, Tsp, pCm, pCbu	2	4	9	10	4	-	9	2	-	6	3	-	7	1	1
20	5	Qal	7	-	-	5	1	-	5	-	-	-	-	-	-	-	-
21	7	Tsp	4	-	-	2	-	-	2	1	1	-	-	-	-	-	-
22	7	Tsp	2	1	-	-	2	1	-	3	-	-	-	-	-	-	-
23	7	Kgd, pCbu	2	1	-	1	2	-	-	-	-	-	-	-	1	-	-
24	7	Qg, pCbu	4	2	-	2	-	-	-	-	-	2	-	-	-	-	-
25	7	pCmg	-	2	-	-	-	-	-	-	-	-	-	2	2	-	-
26	8 &																
	207																
		Cf	7	5	-	-	-	-	5	1	-	4	5	-	-	5	-
27	8	Qg	-	2	-	1	-	-	2	-	-	1	1	-	-	-	-
28 *	8	Tsp	2	-	3	-	-	-	-	3	-	1	2	1	1	-	-
29	8	Tsp	1	-	1	2	-	-	1	1	-	-	-	-	-	-	-
30	8	Qls	-	-	1	-	-	-	1	-	-	-	1	-	-	-	-
31	8	Tsp	2	1	-	-	2	1	3	-	-	-	-	-	-	-	-
32	8	Tsp	2	1	-	-	2	1	3	-	-	-	-	-	-	-	-

TABLE 2 EQUIVALENT URANIUM ANOMALIES - SANDPOINT QUADRANGLE

Anom. No.	F/L No.	Geol. Fm.	Number of Points									eU/eTh			eU/K		
			eU			eTh			K								
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
33	8	Tsp	2	3	-	3	-	-	3	-	1	2	-	-	-	-	-
34	8	Tsp	2	2	-	-	-	-	1	-	-	3	1	-	1	-	-
35	8	pCm	5	2	-	3	1	-	4	2	-	1	-	-	1	-	-
36	8	Qg	1	1	2	4	-	-	2	2	-	1	1	-	-	-	-
37	8	Qg	6	6	4	6	6	-	6	6	1	2	1	2	-	1	-
38	8	Qg	2	5	4	1	2	7	2	1	8	2	-	-	-	-	-
39	8	Qg	2	-	1	-	-	3	1	2	-	-	-	-	-	-	-
40	9	Em, Cg	1	3	-	-	-	-	2	1	1	-	4	-	1	-	-
41	9	pEbu	-	1	2	3	-	-	-	1	2	2	-	-	-	-	-
42	9	Tsp	-	4	-	-	-	-	1	3	-	4	-	-	-	-	-
43	203	Qg	1	1	2	2	1	1	2	1	1	-	2	-	2	-	-
44	9	Qal	3	2	-	4	1	-	3	-	-	1	-	-	-	-	-
45	9	Qal	2	3	-	3	1	1	1	1	3	-	-	-	-	-	-
46	9	Qal, Kgd	6	4	-	5	4	-	8	1	-	2	-	-	1	-	-
47	9	Qg	1	3	-	-	-	-	-	-	-	3	1	-	1	-	-
48 *	10	Cp	1	1	3	-	-	-	3	-	-	2	-	3	1	-	2
49	10	Cg	1	-	1	-	-	-	-	-	-	1	1	-	1	-	-
50	10	Ksp	4	-	-	1	-	-	-	-	-	1	-	-	-	-	-
51	10	Em	1	2	-	-	-	-	-	-	-	3	-	-	-	-	-
52	10	Em	1	2	-	-	-	-	-	-	-	2	-	-	-	-	-
53	10	Tsp	-	-	3	-	-	-	-	-	3	1	-	-	-	-	-
54	10	Tsp	2	1	-	-	-	-	1	1	-	3	-	-	-	-	-
55 *	10	Tsp	3	2	5	-	-	-	3	6	-	4	4	1	1	-	-
56	10	Tsp	4	2	-	-	-	6	-	3	3	-	-	-	-	-	-
57	10	Qal	2	2	1	1	-	-	2	-	-	1	-	3	-	3	-
58	10	Qal	3	3	1	6	1	-	4	2	-	1	-	-	-	-	-
59	10	Qal, Kgd	9	3	1	6	4	1	1	1	4	2	1	-	3	-	1
60	11	Qag, Cf, Em	6	1	1	-	-	-	2	-	-	5	1	1	2	4	-
61	11	Em	-	1	1	-	-	-	1	-	-	1	1	-	-	-	-
62	11	Qag	2	1	-	2	-	-	2	-	-	-	-	-	1	-	-
63	11	Qag, Olu	2	1	-	-	3	-	2	1	-	-	-	-	-	-	-
64	11	Em	4	-	-	3	-	-	2	1	-	-	-	-	-	-	-
65 *	11	Qag	2	-	1	-	-	-	-	-	-	-	-	2	1	1	1
66 *	11&	Em	3	4	6	-	-	-	2	-	-	7	2	1	5	1	-

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TABLE 2 EQUIVALENT URANIUM ANOMALIES - SANDPOINT QUADRANGLE

Number of Points

Anom. No.	F/L No.	Geol. Fm.	eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
67	11	€ma	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-
68	11	Qal	7	5	9	10	2	-	10	4	-	7	3	5	-	4	-
69	11	Qal	2	1	-	2	-	-	2	1	-	-	-	-	-	-	-
70	12	€ma	3	1	1	1	-	-	1	3	-	2	-	-	-	-	-
71	12	Ksp	3	4	-	1	-	-	3	-	-	3	2	1	-	-	1
72	12	Qg, Kgd	4	-	-	-	1	-	4	-	-	-	-	-	-	-	-
73	12	p€bu	2	-	1	1	1	-	2	-	-	-	-	-	-	-	-
74	13	€m, €ma	4	1	-	-	1	-	2	1	-	1	-	-	-	-	-
75	13&																
	207	Ksp, Olu	8	5	1	3	-	-	1	-	-	4	2	1	3	2	3
76	13	Tsp	3	1	-	-	-	-	-	-	-	3	1	-	1	-	-
77	13	Kgd	4	-	-	-	-	-	2	-	-	-	-	-	-	-	-
78 *	14	Ksp	1	-	1	-	1	-	1	-	-	-	1	-	-	-	1
79	14	Kga	5	-	-	2	1	-	3	2	-	1	-	-	3	-	-
80	14	p€bu	1	-	1	-	-	-	-	-	-	1	-	1	-	-	-
81	14	Tsp	4	-	-	-	-	-	2	-	-	3	1	-	-	-	-
82	15	€ma	2	2	-	-	-	-	2	-	-	2	-	-	-	-	-
83	15	Kga, p€bu	1	4	1	2	-	-	3	-	-	3	2	-	2	1	-
84	15	Tsp	2	1	-	-	-	-	-	-	-	1	2	-	-	-	-
85	15	Qg, p€m	4	3	2	3	-	-	7	-	-	7	-	-	5	-	-
86	15	Qal	4	2	-	1	-	-	1	-	-	3	1	-	-	1	-
87	16	€ma	1	2	-	1	1	-	1	-	1	1	-	-	-	-	-
88	16	€ma	-	-	1	1	-	-	-	1	-	-	-	-	-	-	-
89	16	Qal	4	1	-	2	-	-	-	-	-	2	-	-	-	-	-
90	16	p€mg, p€bu	3	1	-	2	-	-	2	-	-	-	-	1	-	-	-
91	16	Qg	2	1	-	-	-	-	-	-	-	2	1	-	-	-	-
92	17	To	2	-	1	2	-	-	2	-	-	1	-	-	-	-	-
93	17	To, Ts	3	1	-	-	-	-	2	1	1	2	1	-	-	-	-
94	17	Qag, Ksp	4	1	-	2	1	-	1	1	-	1	-	-	1	-	-
95	17	Kbg	4	-	-	1	1	-	-	-	-	1	-	-	-	-	-
96	17	p€bu	4	-	-	1	1	-	1	1	-	1	-	-	-	-	-
97	207	Ksp	-	2	-	1	1	-	1	1	-	-	-	-	-	-	-
98	18	p€bc	-	-	1	-	-	-	-	-	-	1	-	-	-	1	-
99 *	18	Tsp	6	2	9	-	-	-	-	-	-	3	5	9	16	1	-
100 *	18	Qal	-	1	8	2	-	-	-	-	-	1	2	6	-	1	8

TABLE 2 EQUIVALENT URANIUM ANOMALIES - SANDPOINT QUADRANGLE

Anom. No.	F/L No.	Geol. Fm.	<u>Number of Points</u>														
			eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
101	19	€ma	2	1	-	-	-	-	2	-	-	2	-	-	-	-	-
102	19	€ma	1	-	1	-	-	-	-	-	-	1	1	-	-	-	1
103	19	p€wi	-	1	1	1	-	-	-	2	-	1	-	-	-	-	-
104	20	Qag	4	-	-	-	-	-	-	-	-	2	-	-	2	-	-
105	207	€m	1	3	1	-	-	-	2	2	-	2	-	1	1	-	-
106	20	Ktq	2	3	-	2	2	-	3	-	-	-	-	-	5	-	-
107	20&	Tsp, Qag	4	3	6	2	2	-	2	3	-	6	5	-	6	-	-
	203																
108	207	Olu	1	2	-	-	-	-	1	2	-	3	-	-	1	-	-
109	207	Olu	1	2	-	-	-	-	2	1	-	2	-	-	1	-	-
110	205	Kkt	3	2	2	6	1	-	1	3	3	3	-	-	-	-	-
111	22	€ma	-	1	2	-	-	-	-	-	-	1	1	1	-	-	1
112	22	Qag	5	-	-	1	-	-	1	-	-	1	-	-	2	2	-
113	22	p€wi	2	-	1	1	-	-	-	-	-	1	-	-	-	1	-
114	23	€ma	3	1	-	-	-	-	1	1	-	3	1	-	-	-	-
115	23	€ma	-	-	1	1	-	-	-	-	-	1	-	-	-	-	1
116	23	Qag, Ktq	2	1	-	2	-	-	2	-	-	-	1	-	2	-	-
117	23	Tsp	3	1	1	1	2	2	1	4	-	-	-	-	-	-	-
118	24	€ma	2	-	1	2	-	-	-	-	-	1	-	-	-	-	-
119	24	€ma	3	1	-	1	1	1	1	1	-	-	-	-	-	-	-
120 *	24	Qag	3	3	4	2	-	-	4	-	-	3	2	2	6	3	-
121	24	Tsp	6	-	-	-	2	2	4	2	-	1	-	-	-	-	-
122 *	25	Qag	1	2	-	-	-	-	-	-	-	1	1	1	2	-	1
123	25	p€bu	5	-	-	-	-	-	-	-	-	3	1	-	-	-	-
124	25	Kkh	4	-	-	-	-	-	-	-	-	-	3	1	4	-	-
125	203	Tsp	1	-	1	-	-	-	2	-	-	1	-	1	-	-	-
126	25	Qal	3	2	-	2	-	-	2	-	-	1	1	-	-	-	-
127	25	Qal	2	1	-	1	-	-	1	-	-	1	-	-	-	-	-
128	26	Tcg	4	-	-	1	3	-	1	2	1	-	-	-	-	-	-
129	26	Qag, Tcg	1	2	1	2	-	-	3	-	-	1	1	-	2	1	-
130	26	Kkh	3	1	1	3	-	-	2	-	-	-	-	-	3	-	-
131	26	Qag, water	2	1	-	-	-	-	2	-	-	-	-	1	-	1	-
132	26	Tsp	1	2	-	-	-	-	-	-	-	3	-	-	2	-	-
133 *	26	Tsp, Tsq, Qal	5	6	11	-	-	-	-	-	-	2	6	14	5	3	12
134 *	26	p€bu, Kgd	8	7	3	2	-	-	-	-	-	4	6	7	-	7	10

TABLE 2 EQUIVALENT URANIUM ANOMALIES - SANDPOINT QUADRANGLE

Anom. No.	F/L No.	Geol. Fm.	Number of Points														
			eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
135 *	26	pEbu, pEmg	2	1	13	-	-	-	-	-	-	-	-	16	-	-	16
136 *	26	pEbu, Qg	1	-	7	-	-	-	-	-	-	1	-	7	-	-	7
137	27	Qag, E _q , uncla.	4	3	1	-	-	-	2	-	-	2	1	4	7	-	-
138	27	TKpa	-	2	-	-	-	2	-	2	-	-	-	-	-	-	-
139	27	TKpa	1	-	1	1	-	-	2	-	-	1	-	-	1	-	-
140	27	Qag	2	2	-	1	-	-	-	-	-	2	1	-	3	1	-
141	27	Qag, Kkh	7	3	-	3	1	-	2	-	-	3	1	3	2	2	3
142	27	Qag, Kkh	4	2	-	3	-	-	-	-	-	-	-	-	6	-	-
143	27&	Tsp	4	4	1	1	-	-	3	-	-	3	1	-	2	-	-
	203																
144	27	Tsp	1	-	1	1	-	-	1	-	-	-	-	-	-	-	-
145 *	27	Qg	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-
146	27	Qg, pEbu	2	2	-	-	-	-	-	-	-	1	2	1	-	-	-
147	207	E _q	2	2	-	-	-	4	-	2	2	-	-	-	-	-	-
148	207	E _q , Qag	1	3	-	1	2	1	2	2	-	-	-	-	-	-	-
149	28	TKoa	2	2	-	2	-	-	1	-	-	1	-	-	4	-	-
150	28	TKpa	1	2	-	2	1	-	2	1	-	-	-	-	-	-	-
151	28&	Qag, Kkh	2	4	-	1	2	2	2	-	3	1	-	-	1	-	-
	205																
152	28	Qag, Kkh	2	1	-	-	-	-	-	-	-	-	1	-	2	-	-
153	28	Kkh	4	1	-	-	-	-	-	-	-	1	1	3	4	-	-
154 *	28	Kkh, water	2	6	3	-	-	-	1	1	-	1	5	5	7	-	2
155 *	28&	Tsp	5	5	2	-	-	-	-	-	-	5	-	4	4	-	1
	203																
156	28	Qal, Kgd	5	-	-	-	-	-	-	-	-	1	2	-	1	-	-
157	28	pEbu	5	-	-	-	-	-	-	-	-	-	2	1	-	-	-
158	28	Qg, pEbu	3	1	-	2	-	-	3	-	-	2	-	-	-	-	-
159	29	Kkh, Qag	3	1	-	1	2	1	-	3	1	-	-	-	-	-	-
160	29	Kkm	2	1	-	-	-	-	-	-	-	3	-	-	-	2	-
161	29	Kkh	6	1	-	-	-	-	-	-	-	1	5	1	7	-	-
162	29	Qag, Kkh, water	1	3	-	-	-	-	1	-	-	1	2	1	3	-	-
163	30	E _q	1	2	1	1	-	-	3	-	-	2	-	-	-	-	-
164	30	Qag, TKpa	1	2	-	1	-	-	3	-	-	1	1	-	-	-	-
165	30	Kgp	1	2	-	3	-	-	1	1	-	-	-	-	2	-	-
166	31	Qag, Ksf	4	-	-	2	1	1	1	-	-	-	-	-	-	-	-

TABLE 2 EQUIVALENT URANIUM ANOMALIES - SANDPOINT QUADRANGLE

Anom. No.	F/L No.	Geol. Fm.	Number of Points														
			eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
167	31	TKpa	3	1	-	2	-	-	2	-	-	2	-	-	1	-	-
168	31	TKpa	4	-	-	-	-	-	1	-	-	2	-	-	3	-	-
169	31	TKpa	-	2	-	-	-	-	2	-	-	-	1	1	1	-	-
170	31	Ktm	1	1	1	-	-	3	-	3	-	-	-	-	-	-	-
171*	31	Qag	6	3	2	-	-	-	-	-	-	5	3	3	3	5	3
172	31	Kkt	1	2	-	1	1	1	-	-	-	1	-	-	-	1	1
173*	31	Kkt	3	-	1	-	1	-	-	-	-	1	1	1	-	2	1
174	31	Qal	2	2	-	-	-	-	-	-	-	-	2	2	-	-	3
175	31	Qg, Kgā	4	-	-	1	-	-	4	-	-	1	-	-	-	-	-
176	31	Qq	10	4	-	-	-	-	-	-	-	4	4	6	4	1	2
177	32	Qag, Tsr	6	1	-	-	-	-	4	1	-	3	1	-	-	-	-
178	32	Tsr	1	-	1	-	-	-	1	-	-	-	-	1	-	1	-
179	32	Em	-	2	5	4	1	-	1	4	-	-	-	-	-	-	-
180	32	Qag	3	-	1	3	1	-	2	1	-	-	-	-	2	-	-
181	32	Qag, TKpa	2	3	6	3	2	1	3	3	3	2	-	2	7	-	-
182	32	Qag	1	1	1	-	-	-	2	-	-	-	2	-	2	-	-
183	32	Qag	4	-	-	2	-	-	-	-	-	-	-	-	3	-	-
184	32	TKpa	1	-	1	-	-	-	-	-	-	-	1	-	-	-	1
185	32	Qag	3	1	-	-	-	-	1	-	-	-	1	1	2	-	-
186	205	Qag	1	-	1	-	-	-	1	-	-	1	1	-	1	1	-
187	32	Kkh	2	2	1	2	-	-	1	1	-	2	-	-	4	-	-
188	32	Qag, Kg	5	1	-	2	1	-	1	-	3	1	-	-	1	-	-
189	32	Qag	3	1	-	-	-	-	-	-	-	1	1	-	1	-	-
190	32	Khm	6	-	-	-	-	-	-	-	-	5	1	-	-	1	-
191	32	Qag	1	3	-	3	1	-	-	-	-	-	-	-	4	-	-
192	32	Qag, Kkt, Kg	5	5	1	2	-	1	-	-	-	5	2	1	2	6	3
193	32	Qag	4	-	-	-	-	-	-	-	-	1	-	-	4	-	-
194	32	water	3	2	-	2	-	-	3	-	-	-	1	-	-	-	-
195	32	Tsp, pEm	4	-	-	-	-	-	-	-	-	3	-	-	3	-	-
196	33	Eq	4	-	1	3	-	-	4	1	-	2	1	-	2	-	-
197	33	Eq	4	3	-	-	-	-	-	-	-	3	2	1	3	-	-
198	33	Eq, Qag	11	2	4	2	3	1	5	-	-	1	5	4	8	2	1
199	33	Qag	8	6	1	4	1	-	9	-	-	4	2	-	8	1	-
200	33	Qag	11	1	1	4	3	-	4	-	-	2	1	-	7	1	-

TABLE 2 EQUIVALENT URANIUM ANOMALIES - SANDPOINT QUADRANGLE

Number of Points

Anom. No.	F/L No.	Geol. Fm.	eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
201	33	Qal	4	-	-	1	-	-	1	-	-	2	-	-	-	-	-
202	33	Qal	3	2	-	2	2	-	2	2	-	-	-	-	-	-	-
203	33	TKpa, Qag	3	2	-	-	-	-	-	-	-	2	1	1	3	-	2
204	33	TKpa, Qag	2	4	1	5	-	-	3	4	-	1	1	-	2	-	-
205	33	Qag	-	-	1	-	-	-	1	-	-	-	1	-	1	-	-
206*	33	Khm	3	2	1	-	-	-	-	-	-	1	2	3	-	4	1
207*	204	Khm	-	2	-	1	-	-	-	-	-	2	-	-	-	2	-
208	34	Qag	1	2	-	1	-	-	2	-	-	1	-	-	3	-	-
209	34	Qag	7	4	1	5	1	-	4	-	-	2	2	-	7	-	-
210	207	Qag	4	1	-	2	-	-	1	-	-	1	-	-	3	-	-
211	34	Qag	5	4	-	3	5	1	4	3	1	-	-	-	-	-	-
212	34	Qag, Ksf	4	2	-	2	-	-	4	-	-	2	-	-	2	-	-
213	34	Qag, Ksf	4	-	-	-	-	-	2	-	-	1	-	-	-	-	-
214	34	Kkh, Qag	2	1	-	2	-	-	-	-	-	-	-	-	2	-	-
215	34	Kkh, Qag	4	-	2	2	-	-	2	-	-	4	-	-	5	-	-
216	34	Qag	-	2	1	1	2	-	1	-	-	1	-	-	3	-	-
217	35	Qag, Ksf	6	5	-	4	4	-	7	1	-	2	1	-	2	2	-
218	35	Qag, Ksf	5	2	-	2	2	3	1	2	2	-	-	-	1	-	-
219	35	Qag	4	2	-	1	-	-	3	-	-	3	1	-	2	2	-
220	35	Qag, Ksf	3	2	-	3	-	-	1	2	1	1	-	-	1	-	-
221	35	Qag	2	1	-	1	1	-	1	1	-	-	-	-	-	-	-
222	35	Qag	2	5	2	4	1	-	4	3	-	3	1	-	5	-	-
223	35	TKoa, Qag	1	2	3	3	1	-	3	2	1	4	-	-	4	-	-
224	35	pCbu	4	1	2	-	2	1	4	1	2	4	1	-	-	-	-
225	35	pCbu	-	-	1	-	-	-	1	-	-	-	1	-	-	-	-
226*	35	Kg	-	2	2	1	-	-	-	-	-	-	3	1	3	-	1
227	35	pCbu	-	-	1	-	-	-	-	-	-	-	1	-	-	1	-
228	35	Qg	2	1	-	-	-	-	-	-	-	2	-	1	-	-	-
229	35	Qg, pCmg	1	1	2	-	-	-	3	1	-	-	1	2	-	-	-
230	36	Qag	4	1	-	-	-	-	-	-	-	-	2	3	-	4	1
231	36	Qag, Ksf	1	2	6	3	1	-	2	-	-	4	3	1	3	5	-
232	36	Qag, Ksf	2	2	-	2	1	-	3	-	-	1	-	-	1	-	-
233	36 & 207	Ksf, Qag	19	8	8	14	5	1	11	3	-	13	2	2	9	16	-

TABLE 2 EQUIVALENT URANIUM ANOMALIES - SANDPOINT QUADRANGLE

Anom. No.	F/L/ No.	Geol. Fm.	Number of Points														
			eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
234	36	Qag	4	-	-	3	1	-	2	2	-	-	-	-	-	-	-
235	36	Qag, Ksf	10	-	-	5	2	1	5	4	-	1	-	-	1	-	-
236	36	Qag	-	3	-	3	-	-	2	1	-	1	-	-	-	-	-
237	36	pCbu	4	2	-	-	2	2	1	3	2	-	-	-	-	-	-
238	36& 204	Kg, pCbu, Qag	5	4	2	3	-	1	-	-	-	6	3	-	3	-	3
239	37	Em, Qag	3	1	-	-	-	-	2	-	-	-	1	-	1	-	-
240	37	Qag	3	1	-	-	-	-	-	-	-	1	2	1	2	1	-
241	37	Ksf, Qag	3	1	3	4	-	1	1	4	-	4	-	-	1	1	-
242	38, 39&207	Ksf, Qag	12	8	4	9	3	-	12	2	-	9	3	1	9	5	-
243	37	Qag, Ksf	7	2	4	5	4	1	7	3	1	3	-	-	6	-	-
244	37	Qag, Ksf	2	1	-	2	-	-	3	-	-	1	-	-	-	-	-
245	37	Qag	2	1	-	1	-	-	2	1	-	1	1	-	1	-	-
246	37	Qag	1	2	1	2	-	-	2	1	-	-	-	1	2	-	-
247	37	Qag	3	1	-	-	-	-	-	-	-	-	2	2	-	2	2
248	38	Qag, Olu	4	-	-	-	-	-	-	-	-	1	2	1	3	1	-
249	38	Qag	4	2	1	3	3	1	4	3	-	-	-	-	1	-	-
250	38	Ksf	3	1	-	1	1	-	4	-	-	2	-	-	-	-	-
251	38	Qag	-	3	-	-	1	2	1	2	-	-	-	-	1	-	-
252	38	Qag, Ksf	5	-	-	2	1	-	4	-	-	-	-	1	-	-	-
253	38	Qag	5	2	1	-	-	-	-	-	-	3	3	2	6	2	-
254*	38	Qag	2	3	2	-	-	-	1	-	-	1	3	2	2	4	-
255	38	Qag	1	1	2	-	2	1	3	-	-	2	1	-	1	2	-
256	38	Qag, pCbu	13	7	4	5	1	-	13	-	-	9	7	2	10	4	-
257	38	pCbu	3	-	1	2	1	1	1	3	-	-	-	-	-	-	-
258	38	pCbu	-	-	1	-	1	-	1	-	-	-	-	-	-	-	-
259	38	pCbu	1	1	1	-	-	-	-	-	-	1	2	-	-	-	-
260*	38	Kg, Qag	2	2	4	1	-	-	-	-	-	2	2	3	1	7	-
261	38	pCbu	2	1	-	2	-	-	1	-	-	-	1	-	-	-	-
262	38	pEm	2	1	-	-	-	-	-	-	-	1	2	-	3	-	-
263	39	Qag	-	2	-	-	-	-	1	-	-	1	-	1	2	-	-
264	39	Qag	4	3	1	1	1	1	2	2	-	2	3	-	3	-	-
265	39	pCbu, Qag	2	1	-	1	-	-	2	-	-	1	-	-	-	-	-

TABLE 2 EQUIVALENT URANIUM ANOMALIES - SANDPOINT QUADRANGLE

Anom. No.	F/L No.	Geol. Fm.	Number of Points														
			eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
266	39	pCbu	-	-	1	-	1	-	-	-	1	-	-	-	-	-	-
267	39	pCbu	4	2	-	1	-	-	-	-	-	1	-	1	-	1	-
268	39	pCbu	2	3	2	3	2	1	4	-	-	3	-	-	-	1	-
269	39	Qag	3	1	2	-	-	-	-	-	-	2	3	-	1	4	1
270	40&	Qag, Ksf	6	-	-	2	2	1	1	4	1	1	-	-	-	-	-
	207																
271	40	Ksf	2	1	-	-	-	-	1	-	-	3	-	-	-	1	-
272	43,	Qag	16	18	16	19	5	2	13	8	1	17	9	2	22	13	-
	44, 207																
273	41	Kbq	1	-	1	-	-	-	1	1	-	2	-	-	-	-	-
274	41	Qag	1	2	1	-	-	-	-	-	-	-	-	4	-	2	2
275	41	Qag	4	-	-	-	-	-	-	-	-	2	-	-	4	-	-
276	41	Qag	3	1	-	-	-	-	-	-	-	2	1	-	1	3	-
277	41	Qag	4	-	-	-	-	-	-	-	-	-	2	-	2	1	1
278	41	Qag, pCm	6	4	-	-	-	-	-	-	-	2	7	1	3	5	2
279	42	Cq	2	1	-	-	-	-	2	-	-	-	1	-	1	-	-
280	42	pCbu	5	1	-	5	-	-	3	2	-	-	-	-	-	-	-
281	42	pCbu	-	-	1	-	-	-	1	-	-	-	2	-	-	-	-
282	43	Qag, Olu	4	-	-	-	-	-	-	-	-	1	1	-	3	1	-
283	43	Qag	3	1	-	-	-	-	1	-	-	3	-	-	4	-	-
284	43	Cq	2	1	-	-	-	-	-	-	-	1	1	1	1	-	1
285	43	pCwi	2	1	-	-	-	-	1	-	-	1	-	-	-	-	-
286	43	pCwi	-	-	1	-	-	-	-	1	-	-	1	-	-	-	-
287	43	TKpa, Qag	3	2	-	1	-	-	2	-	-	3	-	-	4	-	-
288	43	Qag, pCbu, TKpa	8	3	-	2	-	-	4	-	-	5	1	-	4	-	-
289	43	TKpa	2	1	-	-	-	-	-	-	-	3	-	-	3	-	-
290 *	43	TKpa	-	1	3	-	-	-	3	-	-	1	1	2	3	-	1
291 *	43	Qag, TKpa	6	5	3	-	-	-	4	-	-	4	7	1	9	2	2
292 *	43	Tcg, Qag, water	1	5	22	11	3	-	13	-	-	10	7	7	9	11	5
293	43	Kg, Qag	2	2	-	-	-	-	-	-	-	1	2	-	-	2	2
294	43	Qag, Kg	3	2	-	-	-	-	-	-	-	4	-	1	2	1	-
295	44	Qag	4	1	-	1	-	-	-	-	-	2	-	-	2	2	-
296	44	Qag	5	2	-	2	-	-	3	-	-	4	-	-	5	-	-
297	44	pCwi	-	1	1	-	-	-	1	1	-	2	-	-	-	-	-
298	44	Qag	4	-	-	-	-	-	3	-	-	1	1	-	1	-	-

TABLE 2 EQUIVALENT URANIUM ANOMALIES - SANDPOINT QUADRANGLE

Anom. No.	F/L No.	Geol. Fm.	Number of Points														
			eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
299	206	pEbu	4	2	2	-	-	-	-	-	-	4	1	2	-	-	2
300	44	TKpa	2	1	-	-	-	-	-	-	-	1	2	-	3	-	-
301	44	Qag	4	-	-	-	-	-	-	-	-	1	2	-	4	-	-
302	44& 205	Qag	12	10	8	10	10	-	13	-	-	9	5	1	24	1	-
303*	44	Tcg	2	3	3	2	-	-	-	-	-	2	3	2	3	3	2
304	44	pEbu	5	-	-	3	1	-	2	1	1	1	-	-	-	-	-
305	44	pEbu	1	3	-	3	-	-	2	-	-	1	-	-	-	-	-
306	44	Kg	4	1	-	1	-	-	-	-	-	3	-	-	1	-	-
307	44	Kg	2	2	-	-	-	-	-	-	-	2	2	-	3	-	-
308	44	Qag	5	1	-	-	-	-	-	-	-	5	1	-	3	1	-
309*	44	Qag	3	1	2	-	-	-	-	-	-	2	1	2	3	3	-
310	44	Qag, pEm	5	1	-	-	-	-	-	-	-	1	1	4	-	2	4
311	44	Qg	2	1	-	-	-	-	-	-	-	2	1	-	-	-	-
312	207	Qag	3	2	-	-	-	-	3	-	-	3	1	-	2	-	-
313	45	Qag	2	1	-	-	-	-	-	-	-	3	-	-	2	-	-
314	45	pEdt, TKpa, pEbu, & Qag	5	4	1	3	1	-	5	2	-	4	1	1	2	1	-
315*	45	TKpa	3	2	1	-	-	-	-	-	-	3	1	2	3	-	4
316	45	pEm	1	2	1	-	-	-	-	-	-	2	2	-	3	-	1
317	45	Qag	1	2	-	-	-	-	-	-	-	1	1	1	2	1	-
318	45	Qag	5	-	-	2	2	1	5	-	-	-	-	-	-	-	-
319	45	pEbu	3	-	1	2	-	-	1	-	-	-	-	1	-	1	-
320	45	pEbu	1	2	-	-	3	-	3	-	-	-	-	-	-	-	-
321	45	pEbu, Kg	4	-	-	1	3	-	3	-	-	-	-	-	-	-	-
322	45	Qag	3	2	-	-	-	-	-	-	-	2	1	1	2	3	-
323	45	Qag	2	1	-	-	-	-	-	-	-	2	1	-	2	1	-
324	207	Qag	6	2	-	1	-	-	2	-	-	2	1	-	4	-	-
325*	46	TKpa	-	-	1	-	-	-	-	-	-	-	-	1	-	-	1
326	46	pEm	-	-	1	-	-	-	-	-	-	-	-	1	-	-	1
327	46	Qag	5	1	-	-	-	-	-	-	-	2	3	1	5	-	-
328	46	Qag, Tcg	3	1	-	-	-	-	-	-	-	-	1	1	2	1	-
329	46	pEbu	5	2	-	1	-	-	5	-	-	2	1	-	-	-	-
330	46	pEbu	4	1	-	-	2	2	-	-	-	2	-	-	-	1	-
331	46	pEbu	4	-	-	4	-	-	4	-	-	-	-	-	-	-	-

TABLE 2 EQUIVALENT URANIUM ANOMALIES - SANDPOINT QUADRANGLE

Number of Points

Anom. No.	F/L No.	Geol. Fm.	eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
332	46	pCbu	3	1	-	-	2	2	1	3	-	-	-	-	-	-	-
333	46	pCbu	5	-	-	-	-	-	-	-	-	2	-	-	-	1	-
334	47	pCh	2	2	-	3	-	-	2	1	-	-	-	-	1	-	-
335	47	pCbu	2	1	-	1	-	-	1	1	-	2	-	-	-	-	-
336	47	Qag, pCm	1	3	-	-	-	-	1	-	-	2	1	-	3	-	-
337	205	Qag	4	-	-	1	1	-	2	-	-	-	-	-	2	-	-
338	203	Qag	4	4	-	-	-	-	-	-	-	3	3	2	5	8	-
339*	203	Qag	-	1	1	-	-	-	-	-	-	-	1	1	-	1	1
340	203	pCm	2	2	-	1	-	-	-	-	-	1	1	-	1	-	2
341	47	Qg	2	2	-	-	-	-	-	-	-	2	-	-	-	-	-
342	47	Kgd, pCmg	3	3	1	-	-	-	2	-	-	5	-	-	2	-	-
343	48	Qag, pCdt	3	1	-	4	-	-	3	1	-	-	-	-	1	-	-
344	48	pCbu	5	1	-	4	-	-	2	3	-	-	-	-	-	-	-
345	48	JTrf	1	-	1	1	-	-	2	-	-	-	1	-	-	-	-
346	51	Qag	3	2	1	-	-	-	-	-	-	2	4	-	2	3	1
347	51	Qag	4	-	-	1	-	-	3	1	-	-	-	-	-	-	-
348	51	Qag	6	1	-	2	-	-	7	-	-	2	-	-	-	-	-
349	51	pCbu	7	3	2	-	2	-	2	-	-	2	1	-	1	-	-
350	51	pCm	3	2	1	-	-	-	1	-	-	2	3	-	5	-	-
351	51	pCbu	1	-	1	1	-	-	2	-	-	1	-	-	-	-	-
352	52	Cm	1	-	1	-	-	-	2	-	-	1	-	-	-	-	-
353	52	Qag, Cq	3	1	1	-	-	-	1	-	-	-	3	1	3	-	-
354	52	pCm	4	3	1	2	1	-	5	1	-	2	1	-	2	-	-
355	205	Qag	9	-	-	2	-	-	-	-	-	-	-	-	6	-	-
356	52	Qag	2	1	-	-	3	-	-	1	2	-	-	-	-	-	-
357	53	pCbu	2	1	-	1	2	-	-	1	2	-	-	-	-	-	-
358	53	pCbu, Qag	3	2	1	2	-	-	1	1	-	2	1	-	2	-	-
359	53	pCbu	-	-	1	1	-	-	1	-	-	1	-	-	-	-	-
360	53	pCbu	5	-	-	1	-	-	2	-	-	2	-	-	-	-	-
361	53	pCm	2	1	-	2	-	-	2	1	-	2	-	-	-	-	-
362	53	Qag, pCm	5	1	-	-	-	-	-	-	-	3	-	-	2	-	-
363	53	Qag	4	1	-	1	3	-	1	1	3	-	-	-	-	-	-
364	54	pCbu	2	-	1	1	-	2	1	1	1	-	-	-	-	-	-
365	54	pCm	5	1	-	1	-	-	2	-	-	4	1	-	4	-	-
366	203	Tsp	3	-	1	-	-	-	-	-	-	-	1	3	2	1	-

TABLE 2 EQUIVALENT URANIUM ANOMALIES - SANDPOINT QUADRANGLE

Anom. No.	F/L No.	Geol. Fm.	Number of Points														
			eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
367*	56	Qg	-	1	4	-	-	-	-	-	-	-	1	4	-	1	4
368*	56	Qg	-	1	4	-	-	-	-	-	-	-	-	5	-	-	5
369	59	Qag	2	-	-	-	-	-	2	-	-	2	-	-	2	-	-
370	206	pCbu	1	2	-	2	-	-	1	1	-	-	1	-	-	-	-
371	59	pCbu	2	-	-	1	-	-	1	1	-	1	-	-	-	-	-
372	59	pCbu	4	-	-	-	-	-	1	1	-	2	-	-	-	-	-
373	59	pCbu	-	-	1	2	-	-	1	1	-	1	-	-	-	-	-
374	205	Ts	2	-	1	-	-	-	-	-	-	2	1	-	-	-	1
375	60	pCbu	2	1	-	1	-	-	3	-	-	1	-	-	-	-	-
376	60	pCbu	7	3	-	3	-	-	2	1	-	3	-	1	-	-	-
377	60	Ts	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-
378	60	Ts	2	1	-	-	-	-	-	-	-	1	1	-	-	-	2
379	61	Kl	2	1	1	2	-	-	-	2	-	3	1	-	-	-	-
380	61	pCbu	-	4	1	1	2	1	3	2	-	2	-	-	-	-	-
381	61	pCbu	3	-	1	1	1	-	2	1	-	-	-	-	-	-	-
382	61	Ts, Qag	2	3	-	1	1	-	-	-	-	3	-	-	1	-	-
283	61	Ts	1	-	1	-	-	-	-	-	-	1	1	-	-	-	1
284	61	Qag, pCng	4	2	-	1	1	-	2	-	-	1	-	-	1	-	-
385	62	Kws	1	2	-	-	3	-	2	-	-	-	-	-	-	-	-
386	62	Qag	-	3	-	1	1	-	-	-	-	1	-	-	3	-	-
387	62	pCbu	7	-	-	-	4	3	1	5	1	-	-	-	-	-	-
388	205	Qag	3	1	-	3	1	-	2	2	-	-	-	-	1	-	-
389	203	Qg	7	12	4	4	-	-	4	-	-	8	7	2	3	1	1
390	62	Tsq	1	1	3	-	-	-	-	-	-	1	1	3	1	1	3
391	62	pCbu	2	1	-	1	-	-	1	-	-	1	-	-	-	-	-
392	63	pCdt	2	1	-	2	1	-	1	-	-	-	-	-	-	-	-
393	63	pCbu	-	2	-	-	2	-	-	2	-	-	-	-	-	-	-
394	63	Kl, pCbu	2	2	3	1	3	1	2	2	-	1	1	-	-	2	-
395	63	pCbu	4	3	-	4	-	-	4	-	-	3	-	-	-	-	-
396	63	Ts	1	1	1	-	-	2	1	2	-	1	-	-	-	-	-
397	63	TKpa	1	-	1	-	-	-	1	-	-	1	1	-	1	-	-
398	64	pCdt, Qag	3	1	-	4	-	-	2	-	-	-	-	-	-	-	-
399	64	pCdt	2	1	-	2	-	-	-	-	-	1	-	-	-	2	-
400	64	pCdt	1	1	2	2	1	-	1	-	-	2	1	-	-	3	-

TABLE 2 EQUIVALENT URANIUM ANOMALIES - SANDPOINT QUADRANGLE

Anom. No.	F/L No.	Geol. Fm.	Number of Points														
			eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
401	64	Tcg, Qag	4	-	1	4	-	-	2	-	-	1	-	-	3	-	-
402	64	Qag, pEdt, Tcg	2	4	1	1	-	-	1	-	-	5	-	1	2	2	1
403	64	pEbu	6	3	-	6	1	-	1	3	3	1	1	-	-	-	-
404	64	Kl, Qag	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-
405	64	pEbu	1	2	-	3	-	-	2	-	-	-	-	-	-	-	-
406	64	pEbu	4	2	-	4	-	-	1	-	-	2	-	-	-	-	-
407	64	pEbu	3	1	2	4	1	-	4	-	-	1	-	-	-	-	-
408	64	pEbu	3	2	1	3	1	-	2	-	-	1	-	-	-	-	-
409	64	pEbu	3	-	1	3	1	-	1	3	-	1	-	-	-	-	-
410	64	pEbu	7	1	-	5	1	-	4	-	-	-	-	-	-	-	-
411	64	pEbu, Qag	6	1	-	1	-	-	3	1	-	1	-	-	1	-	-
412	64	pEm, Qag, Kb	2	1	-	1	1	-	1	1	-	1	-	-	-	-	-
413	64	pEm	1	2	-	1	-	-	1	-	-	1	-	-	3	-	-
414	64	pEm	1	1	2	4	-	-	1	2	1	2	-	-	2	-	-
415	64	pEm	2	1	-	-	1	2	-	1	2	-	-	-	-	-	-
416	64	pEm	-	2	-	1	1	-	1	1	-	-	-	-	-	-	-
417	64	TKpa	5	-	-	3	-	-	4	-	-	-	-	-	1	-	-
418	64	Qag	-	2	-	-	-	-	-	-	-	1	1	-	-	2	-
419	64	pEn	4	-	-	-	-	-	1	-	-	1	-	-	-	-	-
420*	65	pEdt, Qag	-	2	3	3	1	-	1	-	-	1	1	1	1	4	-
421	65	Tb, Qag	3	1	-	-	-	-	1	-	-	1	2	1	1	1	1
422	65	Qag	3	1	-	-	-	-	-	-	-	-	1	3	2	1	1
423	65	Kl, Qag	6	1	1	6	1	-	4	-	-	-	2	-	-	4	-
424	65	pEbu	1	4	-	4	-	-	3	1	-	3	-	-	-	-	-
425	65	pEbu	2	1	-	2	-	-	1	2	-	1	-	-	-	-	-
426	65	pEbu, Qag	8	2	-	7	-	-	5	1	-	1	-	-	-	-	-
427	65	pEbu	2	1	-	1	-	-	3	-	-	1	-	-	-	-	-
428	65	pEn	2	1	-	1	-	-	1	-	-	1	-	-	-	-	-
429	203	Qg	6	6	1	2	-	-	4	1	-	5	3	1	1	-	-
430	203	Qg	4	3	-	1	-	-	-	-	-	1	-	6	-	1	1
431	66	pEbu	4	-	-	1	1	-	2	2	-	1	-	-	-	-	-
432	66	Eg, Qac	4	1	-	-	-	-	2	-	-	1	-	-	1	-	-
433*	67	Qag, Kpq	1	-	1	1	1	-	2	-	-	-	1	-	-	1	-
434*	67	Kpq, Qag, Tb	6	6	2	4	1	2	3	-	1	5	6	-	1	8	2

TABLE 2 EQUIVALENT URANIUM ANOMALIES - SANDPOINT QUADRANGLE

Anom. No.	F/L No.	Geol. Fm.	Number of Points														
			eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
435*	67& 207	Qag	8	6	6	4	-	-	-	-	-	5	7	2	10	8	2
436	67	Qag, Cm	2	1	-	1	-	-	1	-	1	2	-	-	2	-	-
437	67	Qag, Ts	5	-	-	1	-	-	2	-	-	-	1	-	1	-	-
438	67	Qag	3	1	-	1	-	-	3	-	-	1	-	-	1	-	-
439	67	Kf	3	2	-	2	2	-	2	1	-	1	-	-	2	-	1
440	67	Qag	2	1	-	1	-	-	2	-	-	-	-	-	2	-	-
441	67	Qg	3	1	-	2	-	-	1	2	-	-	-	-	-	-	-
442*	68	Kpq, Qag	2	-	1	-	-	-	-	-	-	2	1	-	-	1	-
443*	68	Tb, Qag	5	3	1	3	1	-	4	-	-	4	2	1	-	4	1
444*	68	Qag	-	-	4	2	1	-	2	-	-	-	3	-	1	3	-
445	68	Qag, Tb	1	2	-	2	-	-	-	-	3	-	1	-	1	1	-
446	206	Ts	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-
447	68	Ts	1	2	-	-	-	-	1	-	-	-	3	-	-	-	-
448	68	Qag, Kf	8	5	4	6	4	-	10	3	-	5	1	-	8	-	-
449	68	Qag	3	1	-	1	-	-	2	-	-	-	-	-	1	-	-
450	68	Qg, pCh	3	5	3	8	1	-	9	2	-	5	1	-	1	-	-
451	203	Qg	4	1	-	-	-	-	1	-	-	4	-	-	-	-	-
452	203	Qg	4	1	-	-	-	-	-	-	-	2	1	-	-	-	-
453*	69	Qag, Kpq	-	1	1	-	-	-	2	-	-	-	1	1	-	1	-
454	69	Kpq	6	-	-	1	-	-	1	-	-	5	-	-	-	1	-
455	69	Kpq, Qag	1	-	1	1	1	-	2	-	-	1	-	-	1	-	-
456	69	Tb	2	-	1	-	-	-	-	-	-	-	1	1	-	2	-
457	69	Qag	3	1	-	-	-	-	-	-	-	-	2	-	2	2	-
458	69	Tb	1	2	-	-	-	-	-	-	-	1	-	2	-	3	-
459	69	Qag	4	-	-	-	-	-	-	-	-	3	-	-	4	-	-
460	69	Qag	3	1	-	-	-	-	-	-	-	3	1	-	3	-	-
461	69	Qag, Ts	10	5	-	2	-	-	5	2	-	8	4	-	7	-	-
462	69	Qag	4	-	-	1	-	-	2	-	-	-	-	-	1	-	-
463	69	Qag	6	-	-	-	-	-	5	-	-	-	-	-	1	-	-
464	69	Qag	5	1	-	2	-	-	5	-	-	1	-	-	-	-	-
465	69	Qag	8	-	-	-	-	-	4	-	-	2	-	-	2	-	-
466	69	Qag	2	1	-	-	-	-	3	-	-	1	1	-	1	-	-

TABLE 2 EQUIVALENT URANIUM ANOMALIES - SANDPOINT QUADRANGLE

Anom. No.	F/L No.	Geol. Fm.	Number of Points														
			eU			eTh			K			eU/eTh			eU/K		
			+	++	+++	+	++	+++	+	++	+++	+	++	+++	+	++	+++
467	69	Qag	4	2	-	1	-	-	1	-	-	2	-	-	6	-	-
468	69	Qag	8	-	-	-	-	-	-	-	-	3	-	-	4	-	-
469	69	Qag	2	1	-	-	-	-	-	-	-	-	1	-	2	-	-
470	69	Qag, Kf	6	2	-	1	-	-	1	1	-	2	2	-	7	-	-
471	69	TKt, Qag	6	6	2	2	1	-	5	1	-	6	2	-	2	1	-
472	69	Qag	3	1	-	4	-	-	3	-	-	-	-	-	-	-	-
473	69	Qg, pEn	4	7	7	4	8	3	3	5	7	4	-	-	-	-	-
474	203	Qg	7	1	-	-	-	-	2	-	-	3	-	-	-	-	-

* Preferred Anomaly

by strong eU/eTh and eU/K ratios.

Anomalies 28 and 55

These similar, strong eU responses are situated along the Midnite-Hall Mountain belt in the northern part of the quadrangle, over Tertiary monzonites and related granitic rocks. Both anomalies are characterized by moderately strong, sharp eU responses accompanied by strong eU/eTh ratios but rather weak eU/K ratios.

Anomalies 48, 65, 66 and 78

This group of strong eU anomalies is located in the northwestern corner of the quadrangle in and around the Spirit pluton, a hornblende-biotite granodiorite of Cretaceous age. Anomaly 78 is directly associated with outcropping granodiorite, while the other three anomalies occur over sediments in close association with the plutonic rocks. All four anomalies are characterized by strong, reasonably sharp eU responses and strong eU/eTh and eU/K ratios.

Anomalies 99, 100 and 133

These three preferred anomalies are considered together inasmuch as they occur along the same major fault system in the northeastern part of the quadrangle. In addition, all three appear to be associated with intrusive rocks. Anomalies 99 and 133 occur over outcropping Tertiary monzonites, while Anomaly 100 occurs over Recent alluvium of the Kootenai River valley which is immediately underlain by Cretaceous granodiorite. All three anomalies consist of broad, strong eU responses displaying very strong eU/eTh and eU/K ratios.

Anomalies 120, 122, 254, 290, 291, 292, 303, 315 and 325

This series of preferred eU anomalies occur along the Newport fault zone in the central part of the quadrangle. In addition, they lie along the Midnite-Hall Mountain belt in the general vicinity of several known uranium occurrences. The anomalies are all associated with either the Phillips Lake granodiorite, or with Pleistocene glacial deposits immediately overlying these or similar intrusive rocks. All of the anomalies display moderate to strong eU responses and very favorable eU/eTh and eU/K ratios. In general, the anomalies over the glacial deposits tend to be broader zones than those directly associated with intrusive outcrops, which are characteristically sharp, localized responses.

Anomalies 134, 135, 136 and 145

These four preferred eU anomalies comprise a group in the east-central part of the quadrangle in a structurally complex, highly faulted area principally underlain by Precambrian metasediments of the Belt supergroup. Anomaly 145, located over Pleistocene glacial deposits, consists of a strong, sharp, localized spike

in the uranium channel response which is accompanied by a moderately strong eU/eTh ratio but a rather weak eU/K ratio. Anomalies 134, 135 and 136, which all occur on Traverse 26, are much broader zones characterized by very strong eU/eTh and eU/K ratios. Anomalies 135 and 136 in particular display the strongest spectral ratios of any of the statistically significant eU anomalies in the area. The somewhat unusual coincidence of four strong eU anomalies with exceptional ratio values (i.e., Anomalies 134, 135, 136 and also 133), all occurring on one segment of the same traverse, suggests the possibility of some type of data error or instrument malfunction. Careful review of the data, however, has revealed no evidence of this and, indeed, Anomalies 133 and 136 are supported by anomalous occurrences on adjacent survey lines. Accordingly, these four anomalies must be considered as preferred responses, although subject to further verification by airborne or ground reconnaissance studies.

Anomalies 154, 155, 171, 173, 206, 207, 226 and 260

This series of preferred eU anomalies is located in the central portion of the quadrangle, near and immediately west of Priest Lake along the Washington - Idaho boundary. Anomalies 171 and 207 occur in the general vicinity of the Lamb Creek uranium occurrence. All of the anomalies are either directly or very closely associated with granitic intrusive units, and are characterized by sharp, moderate to strong eU responses accompanied by strong eU/eTh and eU/K ratios.

Anomalies 309 and 339

These anomalies occur over Pleistocene glacial deposits comprising the valley fill along the Priest River. Anomaly 309 is located near an outcrop of the Galena Point granodiorite, while Anomaly 339 occurs near exposed Precambrian metamorphics. Both features consist of moderately strong, abrupt eU responses distinguished by strong eU/eTh and eU/K ratios.

Anomalies 367 and 368

These two strong, very abrupt eU anomalies are located immediately west of Lake Pend Oreille in the southeastern corner of the quadrangle. Although both anomalies occur over glacial deposits, the surrounding locality is principally underlain by various Precambrian metasediments which are complexly faulted and folded. Both anomalies are characterized by very strong eU/eTh and eU/K ratios.

Anomalies 420, 433, 434, 435, 442, 443, 444 and 453

This series of anomalies forms a group of preferred eU responses situated a few miles northeast of the Midnite district. The general locality is extensively intruded by Cretaceous monzonite and alaskite, and although not all of the anomalies are specifically

associated with these rocks, it seems probable that they comprise the primary sources of the anomalous values. All of the anomalies in this group display moderate to strong, generally sharp eU responses and favorable eU/eTh and eU/K ratios.

7/4

CONCLUSIONS

The results of the gamma-ray spectrometer survey of the Okanogan and Sandpoint Quadrangles, comprising the northern portion of the Northeast Washington Area, have defined reasonably well the known occurrences of uranium in this region as well as the zones where known uranium occurrences exist, including the Republic graben trend and the Midnite-Hall Mountain belt, and have indicated a number of discrete localities within these zones as well as in several additional areas where further exploration should be concentrated. In the Okanogan Quadrangle, these would include the region west of the Republic graben in the general vicinity of Gold Creek, the northern margin of the Colville batholith west of the Kettle River, and the eastern margin of the batholith, generally along the Columbia River. In the Sandpoint Quadrangle, the majority of the most interesting zones defined by the survey occur along the Midnite-Hall Mountain belt. There is a distinct tendency for the significant eU anomalies to form localized clusters, which should expedite field verification to some degree. In addition to the Midnite-Hall Mountain belt, a number of interesting eU anomalies occur in the northwestern part of the quadrangle in and around the Spirit pluton, and several other scattered responses are located in the east, associated with older metamorphic units.

7.5

SUGGESTIONS FOR FURTHER WORK

Inasmuch as the Northeast Washington Area is an established uraniumiferous province, and has been the subject of a considerable amount of prospecting, detailed field studies and sampling programs over the past several years, specific suggestions for additional follow-up work to the present airborne survey are precluded to a certain extent. Certainly follow-up investigations of the recorded anomalies that cannot be directly related to mines and known prospects are in order, with particular emphasis on those localities containing preferred eU anomalies as established by the present analysis. In view of the fairly detailed coverage of the airborne survey, plus the fact that many of the statistically significant anomalies tend to occur in local groupings, ground studies incorporating geochemical and radiometric techniques may comprise the most effective means for accomplishing these evaluations.

SECTION 8.0

REFERENCES

8.1 GENERAL BIBLIOGRAPHY

Adams, J. A. S., Kline, M. C., Richardson, K. A., and Rogers, J. J. W. - THE CONWAY GRANITE OF NEW HAMPSHIRE AS A MAJOR LOW-GRADE THORIUM RESOURCE - Nat'l Acad. of Sciences Bull., Vol. 48, No. 11, pp. 1898-1905, November, 1962.

Adams, John S. and Gasparini, Paolo - GAMMA-RAY SPECTROMETRY OF ROCKS - Elsevier Publ. Co. N. Y., 1970.

Adkinson, C. W. and Reimer, G. M. - HELIUM AND RADON-EMANATION BIBLIOGRAPHY - U. S. Geol. Survey Open-File Report 76-860, 1976.

Anderson, Paul L., and Cho, Namok - ANALYSIS OF COPPER, LEAD, AND ZINC BY ATOMIC ABSORPTION SPECTROPHOTOMETRY - Alaska State Div. of Mines & Geol., Lab. Report No. 2, May 1969.

Anderson, Paul L., and Mitchell, Michael Jr., - A RAPID RADIO-METRIC ANALYSIS FOR EQUIVALENT URANIUM - Alaska State Div. of Mines & Geol., Lab. Report No. 1, May 1969.

Baird-Atomic Applications Laboratory - SCINTILLATION COUNTING - Tech. Report AL - 3A, June 1966.

Bowie, S. H. Jr., Davis, Michael, and Ostle, Dennis (editors) - URANIUM PROSPECTING HANDBOOK - publ. by The Institution of Mining and Metallurgy, London, 1972 (reprinted 1974).

Breiner, S., Lindow, J. T., and Kaldenbach, R. J. - GAMMA RAY MEASUREMENT AND DATA REDUCTION CONSIDERATIONS FOR AIRBORNE RADIO-METRIC SURVEYS - Abstract, Paper No. 34, Internat'l Symposium on Exploration of Uranium Ore Deposits, Vienna March 29 - April 2, 1976.

Burrus, Walter R. - UNSCRAMBLING SCINTILLATION SPECTROMETER DATA - IRE Trans. on Nuclear Science, pp. 102-110, approx. 1960.

Curtiss, Leon F. - MEASUREMENTS OF RADIOACTIVITY - Nat'l Bur. of Standards Circ. 476, October 15, 1949.

Donn, Jack J. and Wolke, Robert L. - STATISTICAL INTERPRETATION OF COUNTING DATA FROM MEASUREMENTS OF LOW LEVEL RADIOACTIVITY - in HEALTH PHYSICS, Vol. 32, pp. 1-14, January 1977.

Gabelman, John W. - MIGRATION OF URANIUM AND THORIUM - EXPLORATION SIGNIFICANCE - Studies in Geology 3, AAPG, 1977.

Geodata International Incorp. - THE DEVELOPMENT OF AN ATMOSPHERIC ²¹⁴Pb/Bi MEASURING INSTRUMENT - Prepared for U.S. ERDA, November 7, 1965.

Goldak, G. R. - HELIUM-4 MASS SPECTROMETRY FOR URANIUM EXPLORATION - Tech. Paper 74-L-44, AIME Annual Meeting, February 1974.

Grasty, R. L. - A CALIBRATION PROCEDURE FOR AN AIRBORNE GAMMA-RAY SPECTROMETER - Geol. Survey of Canada, Tech. Paper.

_____, - ATMOSPHERIC ABSORPTION OF 2.62 MEV GAMMA-RAY PHOTONS EMITTED FROM THE GROUND - Geophysics, Vol. 40, No. 6, pp. 1058-1065, December 1975.

_____, - THE CIRCLE OF INVESTIGATION OF AIRBORNE GAMMA-RAY SPECTROMETERS - Geol. Survey of Canada, Project 720084.

_____, - THE 'FIELD OF VIEW' OF GAMMA-RAY DETECTORS - A DISCUSSION - Project 720084, Geol. Survey of Canada.

_____, - URANIUM MEASUREMENTS BY AIRBORNE GAMMA-RAY SPECTROMETRY - Geophysics, Vol. 40, No. 3, pp. 503-519, June 1975.

_____, - URANIUM STRIPPING DETERMINATION AU NATUREL FOR AIRBORNE GAMMA-RAY SPECTROMETRY - Geol. Survey of Canada, Paper 75-1, Part A.

Grasty, R. L., and Darnley, A. G. - THE CALIBRATION OF GAMMA-RAY SPECTROMETERS FOR GROUND AND AIRBORNE USE - Geol. Survey of Canada, Paper 71-17, 1971.

Gross, W. H. - RADIOACTIVITY AS A GUIDE TO ORE - Economic Geology, Vol. 47, No. 7, November 1952.

Harriss, Robert C. and Adams, John A. S. - GEOCHEMICAL AND MINERALOGICAL STUDIES ON THE WEATHERING OF GRANITIC ROCKS - Amer. Jour. of Science, Vol. 264, pp. 146-173, February 1966.

H. E. W. Division of Radiological Health, - RADIOLOGICAL HEALTH HANDBOOK - pp. 144-146, September 1960.

Holmberg, P., Blomster, K., and Rieppo, R. - CALCULATION OF YIELD CURVES FOR AIRBORNE GAMMA-RAY SPECTROMETERS - Geoexploration, Elsevier Scientific Publ. Co., Amsterdam, The Netherlands, December 1974.

Hubbell, J. H., and Scofield, N. E. - UNSCRAMBLING OF GAMMA-RAY SCINTILLATION SPECTROMETER PULSE-HEIGHT DISTRIBUTIONS - IRE Transactions on Nuclear Science, pp. 156-158, December 1958.

Hultqvist, Bengt - CALCULATION OF THE IONIZATION DUE TO RADIOACTIVE SUBSTANCES IN THE GROUND - Quarterly Jour. of Geophysics, February 1952.

International Atomic Energy Agency, Vienna - RECOGNITION AND EVALUATION OF URANIFEROUS AREAS - Proceedings of a Tech. Committee Meeting, Vienna, 17-21 November, 1975, publ. by IAEA, Austria, February 1977.

Jaffe, Howard W., Gottfried, David, Waring, Claude I., and Worthing, Helen W. - LEAD-ALPHA AGE DETERMINATIONS OF ACCESSORY MINERALS OF IGNEOUS ROCKS (1953-1957), STUDIES IN GEOCHRONOLOGY - U.S.G.S. Bull. 1097-B, 1959.

Khattab, Mansour M. Khattab - ANALYSIS OF URANIUM AND THORIUM AND THEIR DAUGHTER NUCLIDES IN URANIUM-THORIUM ORES BY HIGH-RESOLUTION GAMMA-RAY SPECTROMETRY - A thesis in geochemistry, The Graduate School of the Pennsylvania State University, March 1970.

Killeen, P. G. and Carmichael, C. M. - GAMMA-RAY SPECTROMETER CALIBRATION FOR FIELD ANALYSIS OF THORIUM, URANIUM AND POTASSIUM - Prof. Paper from the Canadian Jour. of Earth Science, Vol. 7, pp. 1093-1098, 1970.

King, Dhi-Yu - RADON EMANATION ON ACTIVE FAULTS - U. S. Geol. Survey Open-File Report 76-875, 1976.

Leopold, L. B., Clark, R. E., Hanshaw, B. B. and Balsley, J. R. - A PROCEDURE FOR EVALUATING ENVIRONMENTAL IMPACT - U. S. Geol. Survey Circ. 645, 1971 (Reprint).

Lovborg, L., Kirkegaard, P., Christiansen, E. Mose - THE DESIGN OF NaI (TL) SCINTILLATION DETECTORS FOR USE IN GAMMA-RAY SURVEYS OF GEOLOGICAL SOURCES - Danish Atomic Energy Commission Research Establ., Denmark, Paper Presented at IAEA/NEA - Vienna, April 1976.

Marshall, R. R. - COSMIC RADIATION AND THE K^{40} - A^{40} "AGES" OF IRON METEORITES - Tech. Report No. 32-147, Jet Propulsion Lab., Cal. Inst. of Tech., August 10, 1961.

McSharry, P. J. - REDUCING ERRORS IN AIRBORNE GAMMA-RAY SPECTROMETRY - Bull. Austr. Soc. Exploration Geophys. Vol. 4, No. 1, pp. 31-41, March 1973.

McSharry, P. J. and Emerson, D. W. - THE COLLECTION AND PROCESSING OF GAMMA-RAY SPECTROMETER DATA - Paper delivered at 2nd Internat'l Conf. on Geophys. of the Earth and Oceans, Sydney, Austr., January 1973.

Merian, R. F., Lackey, J. G., and Hand, J. E. - AERIAL RADIOLOGICAL MONITORING SYSTEM. 1. THEORETICAL ANALYSIS, DESIGN, AND OPERATION OF A REVISED SYSTEM - CEX-59.4, Civil Effects Test Operations, U. S. AEC, February 1961.

Moxham, R. M. - GEOLOGIC EVALUATION OF AIRBORNE RADIOACTIVITY SURVEY DATA - U. S. G. S. Bull. P/1970.

Reimer, G. M. - FIXED-VOLUME GAS INLET SYSTEM FOR AN ALPHA-SENSITIVE CELL ADAPTED FOR RADON MEASUREMENT - U. S. Geol. Survey Open-File Report 77-409, 1977.

Tammenmaa, J., Grasty, R. L. and Peltoniemi, R. - THE REDUCTION OF STATISTICAL NOISE IN AIRBORNE RADIOMETRIC DATA - Abs. from the Canadian Jour. of Earth Science (in Press).

Tanner, A. B., Moxham, R. M., and Senftle, F. E. - ASSAY FOR URANIUM AND DETERMINATION OF DISEQUILIBRIUM BY MEANS OF IN SITU HIGH-RESOLUTION GAMMA-RAY SPECTROMETRY - U. S. Geol. Survey Open-File Report No. 77-571, 1977.

Zeller, E. J., Deschhoff, G., Angino, E., Holdoway, K., Hakes, W., Jayaprakash, G., and Crisler, K. - POTENTIAL URANIUM HOST ROCKS AND STRUCTURES IN THE CENTRAL GREAT PLAINS - Univ. of Kansas prep. for ERDA, November 15, 1975.

8.2 BIBLIOGRAPHY - WASHINGTON/IDAHO AREA

Abbott, Agatin T. - MONAZITE DEPOSITS IN CALCAREOUS ROCKS IN NORTHERN LEMHI COUNTY, IDAHO - Pamph. 99, Idaho Bur. of Mines & Geology, 1954.

Adams, C. N., Anderson, A. L. and Shively, J. S. - STUDY OF TWO IDAHO THORITE DEPOSITS - Pamph. 122, Idaho Bur. of Mines & Geology, 1960.

Alden, W. C. - PHYSIOGRAPHY AND GLACIAL GEOLOGY OF WESTERN MONTANA AND ADJACENT AREAS - U. S. Geol. Survey Prof. Paper 231, 1953.

Anderson, A. L. - A PRELIMINARY REPORT ON THE FLUORSPAR MINERALIZATION NEAR CHALLIS, CUSTER COUNTY - Pamph. 101, Idaho Bur. of Mines & Geology, 1954.

_____- GEOLOGY AND METALLIFEROUS DEPOSITS OF KOOTENAI COUNTY, IDAHO - Idaho Bur. Mines and Geology, Pamph. 53, 1940.

Anderson, A. L. and Wagner, Warren R. - RECONNAISSANCE GEOLOGY AND ORE DEPOSITS OF THE MINERAL DISTRICT, WASHINGTON COUNTY, IDAHO - Pamph. 95, Idaho Bur. of Mines & Geology, 1952.

Anderson, Donald L. - MARKETING OF METALLIC AND NON-METALLIC MINERALS - Bull. 39, Washington State Div. of Geol. & Earth Resources, 1963.

Anderson, Roy A. - RECONNAISSANCE SURVEY OF THE GEOLOGY AND ORE DEPOSITS OF THE SOUTHWESTERN PORTION OF LEMHI RANGE, IDAHO - Pamph. 80, Idaho Bur. of Mines & Geology, 1948.

Austin, S. R., Hetland, D. L. and Sharp, B. J. - MINERALOGY OF THE LEMHI PASS THORIUM AND RARE-EARTH DEPOSITS - Mineral Resources Report 11, Idaho Bur. of Mines & Geology, 1970.

Barksdale, Julian D. - GEOLOGY OF THE METHOW VALLEY, OKANOGAN COUNTY, WASHINGTON - Bull. 68, Washington State Div. of Geol. & Earth Resources, 1975.

Becraft, G. E. and Weis, P. L. - GEOLOGY AND MINERAL DEPOSITS OF THE TURTLE LAKE QUADRANGLE, WASHINGTON - U. S. Geol. Survey Bull. 1131, 1963.

Bennett, W. A. G. - CHARACTER AND TONNAGE OF THE TURK MAGNESITE DEPOSIT - Washington State Div. of Geol. & Earth Resources Report of Investigations No. 7, 1943.

_____, - MINERALOGY AND GEOCHEMISTRY OF THE READ MAGNETITE DEPOSIT, SOUTHWESTERN STEVENS COUNTY, WASHINGTON - Bull. 7, Washington State Div. of Geol. & Earth Resources, 1962.

Bingham, J. W. and Walters, K. L. - STRATIGRAPHY OF THE UPPER PART OF THE YAKIMA BASALT IN WHITMAN AND EASTERN FRANKLIN COUNTIES, WASHINGTON - U. S. Geol. Survey Prof. Paper 525-C, pp. C87-C90, 1965.

Bishop, D. T. - STRATIGRAPHY AND DISTRIBUTION OF BASALT, BENEWAH COUNTY, IDAHO - Idaho Bur. of Mines & Geology Pamph. 140, 1969.

_____, - PETROLOGY AND GEOCHEMISTRY OF THE PURCELL SILLS IN BOUNDARY COUNTY, IDAHO AND ADJACENT AREAS - in BELT SYMPOSIUM, vol. 1, Dep't of Geology, Univ. of Idaho, Idaho Bur. of Mines & Geol., pp. 204-205, 1973.

Blackwell, David D. - TERRESTRIAL HEAT FLOW AND ITS IMPLICATIONS ON THE LOCATION OF GEOTHERMAL RESERVOIRS IN WASHINGTON - in ENERGY RESOURCES OF WASHINGTON - Washington State Div. of Geol. & Earth Resources, Inform. Circ. No. 50, 1974.

Bretz, J. H. - WASHINGTON'S CHANNELED SCABLANDS - Washington Dep't Conserv., Div. Mines & Geol., Bull. No. 45, 1959.

Bretz, J. H., Smith, H. T. O., and Neff, G. E. - CHANNELED SCABLANDS - NEW DATA AND INTERPRETATIONS - Geol. Soc. Amer. Bull., Vol. 67, No. 8, pp. 937-1050, 1956.

Calkins, F. C. and Jones, E. L. Jr. - GEOLOGY OF THE ST. JOE-CLEAR WATER REGION, IDAHO - U. S. Geol. Survey Bull. 530-G, pp. 75-86, 1913.

Campbell, A. B., and Good, S. E. - GEOLOGY AND MINERAL DEPOSITS OF THE TWIN CRAGS QUADRANGLE, IDAHO - U. S. Geol. Survey Bull. 1142-A, pp. A1-A33, 1963.

Campbell, Charles D. - INTRODUCTION TO WASHINGTON GEOLOGY AND RESOURCES - Bull. 22R, Washington State Div. of Geol. & Earth Resources, 1962.

Castor, S. B., Berry, M. R., and Robins, J. W. - PRELIMINARY REPORT ON URANIUM AND THORIUM CONTENT OF INTRUSIVE ROCKS IN NORTH-EASTERN WASHINGTON AND NORTHERN IDAHO - Bendix Field Engineering Corp, Open-File Rept. GJBX-89(77)R, 1978.

Chaney, R. W. - MIOCENE FLORAS OF THE COLUMBIA PLATEAU - Part I, COMPOSITION AND INTERPRETATION - Carnegie Inst. Washington Publ. 617, Contr. Paleontology, 1959.

Crosby, G. M. - COEUR D'ALENE ORES AND BELT ROCKS - in BELT SYMPOSIUM, vol. 1, 1973, Dep't of Geol., Univ. of Idaho, Idaho Bur. of Mines & Geol., p. 180, 1973.

Domenico, J. A. - ASSOCIATION OF COPPER MINERALIZATION IN MIOGEO-SYNCLINAL CLASTICS OF THE BELT SUPERGROUP - in BELT SYMPOSIUM, Vol. 1, Dep't of Geol., Univ. of Idaho, Idaho Bur. of Mines & Geol., pp. 113-115, 1973.

Dort, Wakefield, Jr. - LATE CENOZOIC VOLCANISM, ST. JOE VALLEY, IDAHO - Northwest Science, Vol. 41, pp. 141-151, 1967.

_____, - GLACIATION OF THE COEUR D'ALENE DISTRICT, IDAHO - Geol. Soc. Amer. Bull. Vol. 73, No. 7, pp. 889-906, 1962.

Flint, R. R. - ORIGIN OF THE CHENEY-PALOUSE SCABLAND TRACT, WASHINGTON - Geol. Soc. Amer. Bull. Vol. 49, No. 3, pp. 461-523, 1938.

_____, - STRATIFIED DRIFT AND DEGLACIATION IN EASTERN WASHINGTON - Geol. Soc. Amer. Bull. Vol. 47, No. 12, pp. 1849-1884, 1936.

Fox, Kenneth F. Jr., and Rinehart, C. Dean - DISTRIBUTION OF COPPER AND OTHER METALS IN GULLY SEDIMENTS OF PART OF OKANOGAN COUNTY, WASHINGTON - Bull. 65, Washington State Div. of Geol. & Earth Resources, 1972.

Green, William R. - DELINEATION OF MINERAL BELTS OF NORTHERN AND CENTRAL IDAHO - Inform. Circ. 22, Idaho Bur. of Mines & Geology, 1972.

Greenwood, William R. and Morrison, Donald A. - RECONNAISSANCE OF THE SELWAY-BITTERROOT WILDERNESS AREA - Pamph. 154, Idaho Bur. of Mines & Geology, 1973.

Griggs, A. B. - THE BELT SUPERGROUP IN THE SPOKANE QUADRANGLE - in BELT SYMPOSIUM, Vol. 1, 1973, Dep't of Geol., Univ. of Idaho, Idaho Bur. of Mines & Geology, p. 76, 1973.

Harrison, J. E. and Campbell, A. B. - CORRELATIONS AND PROBLEMS IN BELT SERIES STRATIGRAPHY, NORTHERN IDAHO AND WESTERN MONTANA - Geol. Soc. of Amer. Bull., Vol. 74, No. 12, pp. 1413-1428, 1963.

Harrison, J. E., Griggs, A. B., and Wells, J. D. - TECTONIC FEATURES OF THE PRECAMBRIAN BELT BASIN AND THEIR INFLUENCE ON POST-BELT STRUCTURES - U. S. Geol. Survey Prof. Paper 866, 1974.

Harrison, J. E. and Jobin, D. A. - GEOLOGY AND ORE DEPOSITS OF THE CLARK FORK QUADRANGLE, IDAHO-MONTANA - U. S. Geol. Survey Bull. 1141-K, 1963.

Hietanen, Anna - ANORTHOSITE AND ASSOCIATED ROCKS IN THE BOEHLS BUTTE QUADRANGLE AND VICINITY, IDAHO - U. S. Geol. Survey Prof. Paper 450-C, 1963.

_____, - METAMORPHISM OF THE BELT SERIES IN THE ELK RIVER-CLARKIA AREA, IDAHO - U. S. Geol. Survey Prof. Paper 344-C, 1963 (1964).

_____, - SCAPOLITE IN THE BELT SERIES IN THE ST. JOE-CLEARWATER REGION, IDAHO - Geol. Soc. Amer. Spec. Paper 86, 1967.

_____, - BELT SERIES IN THE REGION AROUND SNOW PEAK AND MALLARD PEAK, IDAHO - U. S. Geol. Survey Prof. Paper 344-D, 1968.

Hobbs, S. W., Griggs, A. B., Wallace, R. E., and Campbell, A. B. - GEOLOGY OF THE COEUR D'ALENE DISTRICT, IDAHO - U. S. Geol. Survey Prof. Paper 478, 1965.

Hosterman, J. W. - CLAY DEPOSITS OF SPOKANE COUNTY, WASHINGTON, U. S. Geol. Survey Bull. 1270, 1969.

Hubbard, Charles R. - GEOLOGY AND MINERAL RESOURCES OF NEZ PERCE COUNTY - County Report No. 1, Idaho Bur. of Mines & Geology, 1956.

Hunting Geophysical Services, Inc. - AIRBORNE MAGNETOMETER AND SCINTILLOMETER SURVEY - MT. BONAPARTE, BODIE MOUNTAIN, CURLEW, AENEAS, AND REPUBLIC QUADRANGLES, OKANOGAN AND FERRY COUNTIES, WASHINGTON - Washington State Div. of Mines & Geol., Report of Investigations No. 20, 1960.

_____, - GEOLOGICAL INTERPRETATION OF AIRBORNE MAGNETOMETER AND SCINTILLOMETER AND SCINTILLOMETER SURVEY (OF) MT. BONAPARTE, BODIE MOUNTAIN, CURLEW, AENEAS, AND REPUBLIC QUADRANGLES, OKANOGAN AND FERRY COUNTIES, WASHINGTON - Washington State Div. of Geol. & Earth Resources Report of Investigations No. 20, 1960.

Idaho Bureau of Mines & Geology - THE COEUR D'ALENE MINING DISTRICT IN 1963 - Idaho Bur. of Mines & Geology, Pamph. 133, (Collection of 27 Papers) 1963.

Kern, B. F. - GEOLOGY OF THE URANIUM DEPOSITS NEAR STANLEY, CUSTER COUNTY, IDAHO - Idaho Bur. of Mines & Geol., Pamph. 117, 1959.

Kiilsgaard, Thor H. - THE GEOLOGY AND ORE DEPOSITS OF THE BOULDER CREEK MINING DISTRICT, CUSTER COUNTY, IDAHO - Idaho Bur. of Mines & Geology, Pamph. 88, 1949.

King, E. R., Harrison, J. E., and Griggs, A. B. - GEOLOGIC IMPLICATIONS OF THE AEROMAGNETIC DATA IN THE PEND OREILLE AREA, IDAHO - U. S. Geol. Survey Prof. Paper 646-D, 1970.

Kirkham, V. R. D. and Hohnson, M. M. - THE LATAH FORMATION IN IDAHO - Jour. Geology, Vol. 37, pp. 483-504

Kopp, R. S. - STRATIGRAPHY, PRIMARY SEDIMENTARY STRUCTURES, AND DEPOSITIONAL ENVIRONMENT OF METASEDIMENTARY ROCKS OF THE GOSPEL PEAK AREA, IDAHO COUNTY, IDAHO - in BELT SYMPOSIUM, Vol. 1, Dep't of Geol., Univ. of Idaho, Idaho Bur. of Mines & Geology, pp. 206-207, 1973.

Kun, Peter - GEOLOGY AND MINERAL RESOURCES OF THE LAKEVIEW MINING DISTRICT - Idaho Bur. of Mines & Geology, 1974.

Leo, G. W. - AUTUNITE FROM MT. SPOKANE, WASHINGTON - in American Mineralogist, Vol. 45, No. 1-2, pp. 99-128, 1960.

Miller, F. K. - THE AGE OF THE WINDERMERE GROUP AND ITS RELATION TO THE BELT SUPERGROUP IN NORTHEASTERN WASHINGTON - in BELT SYMPOSIUM, Vol. 1, 1973, Dep't of Geol., Univ. of Idaho, Idaho Bur. of Mines & Geology, p. 221, 1973.

Mills, Joseph W. - HIGH-CALCIUM LIMESTONES OF EASTERN WASHINGTON - Washington State Div. of Geol. & Earth Resources, Bull. 48, 1962.

Moen, Wayne S. - SILVER OCCURRENCES OF WASHINGTON - Washington State Div. of Geol. & Earth Resources, Bull. 69, 1976.

Moen, Wayne S. and Huntting, Marshall T. - HANDBOOK FOR GOLD PROSPECTORS IN WASHINGTON - Washington State Div. of Geol. & Earth Resources, Inform. Circ. 57, 1975.

Nash, J. T. - GEOLOGY OF THE MIDNITE URANIUM MINE AREA, WASHINGTON - U. S. Geol. Survey Open-File Report 77-592, 1977.

Newton, Joseph, LeMoine, Denis, Adams, C. N., Anderson, A. L., and Shively, J. S. - A STUDY OF TWO IDAHO THORITE DEPOSITS - Idaho Bur. of Mines & Geology Pamph. 122, September 1960.

Obradovich, J. D. and Peterman, Z. E. - A REVIEW OF THE GEO-CHRONOLOGY OF BELT AND PURCELL ROCKS - in BELT SYMPOSIUM, Vol. 1, 1973, pp. 8-9, sponsored by Dep't of Geol., Univ. of Idaho, Idaho Bur. of Mines & Geol., 1973.

Pardee, J. T. and Bryan, Kirk - GEOLOGY OF THE LATAH FORMATION IN RELATION TO THE LAVAS OF THE COLUMBIA PLATEAU NEAR SPOKANE, WASHINGTON - U. S. Geol. Survey Prof. Paper 140, 1926.

Purdy, C. Phillips Jr. - MOLYBDENUM OCCURRENCES OF WASHINGTON - Washington State Div. of Geol. & Earth Resources Report of Investigations No. 18, 1954.

Ransome, F. L. and Calkins, F. C. - THE GEOLOGY AND ORE DEPOSITS OF THE COEUR D'ALENE DISTRICT, IDAHO - U. S. Geol. Survey Prof. Paper 62, 1908.

Reid, Rolland R. - PLACER DEPOSITS OF THE ELK CITY REGION - Idaho Bur. of Mines & Geology, Pamph. 121, 1960.

Reid, Rolland R. and Greenwood, W. R. - MULTIPLE DEFORMATION AND ASSOCIATED PROGRESSIVE POLYMETAMORPHISM IN THE BELTIAN ROCKS NORTH OF THE IDAHO BATHOLITH, IDAHO, U.S.A. - Internat'l Geol. Congr. 23rd, Prague, Czechoslovakia, Vol. 4, pp. 75-87, 1968.

Richmond, G. M., Fryxell, Roald, Neff, G. E., and Weis, P. L. - THE CORDILLERAN ICE SHEET OF THE NORTHERN ROCKY MOUNTAINS AND RELATED QUATERNARY HISTORY OF THE COLUMBIA PLATEAU - in THE QUATERNARY OF THE UNITED STATES, (A Review Volume for the VII Congress of the Internat'l Assoc. for the Quaternary Research), eds. Wright, H. E. Jr. and Frye, D. G., Princeton Univ. Press, pp. 231-242

Rinehart, C. D. and Fox, K. F., Jr. - BEDROCK GEOLOGY OF THE CONCONULLY QUADRANGLE, OKANOGAN COUNTY, WASHINGTON - The U. S. Geol. Survey Bull. 1402, 1976.

_____, - GEOLOGY AND MINERAL DEPOSITS OF THE LOOMIS QUADRANGLE, OKANOGAN COUNTY, WASHINGTON - Washington State Div. of Geol. & Earth Resources, Bull. 64, 1972.

Ringe, Don - SUB-LOESS BASALT TOPOGRAPHY IN THE PALOUSE HILLS, SOUTHEASTERN WASHINGTON - Geol. Soc. of Amer. Bull. Vol. 81, No. 10, pp. 3049-3060, 1970.

Ross, Clyde P. - THE METAL AND COAL MINING DISTRICTS OF IDAHO, with Notes on THE NONMETALLIC MINERAL RESOURCES OF THE STATE, Parts I, II, and III. Idaho Bur. of Mines & Geology, Pamph. 57, 1941.

Ross, Clyde P. and Forrester, J. D. - OUTLINE OF THE GEOLOGY OF IDAHO - Idaho Bur. of Mines & Geology Bull. 15, 1958.

Treves, Samuel B. and Melear, John D. - THE GEOLOGY AND ORE DEPOSITS OF THE SEAFOAM MINING DISTRICT, CUSTER COUNTY, IDAHO - Idaho Bur. of Mines & Geology Pamph. 96, 1953.

Tullis, E. L. - CONTRIBUTIONS TO GEOLOGY OF LATAH COUNTY, IDAHO - Geol. Soc. Amer. Bull. Vol. 55, No. 2, pp. 131-164, 1944.

Umpleby, J. F. and Jones, E. L. - GEOLOGY AND ORE DEPOSITS OF SHOSHONE COUNTY, IDAHO - U. S. Geol. Survey Bull. 732, 1923.

Wagner, W. R. - THE GEOLOGY OF PART OF SOUTH SLOPE OF ST. JOE MOUNTAINS, SHOSHONE COUNTY, IDAHO - Idaho Bur. Mines and Geology Pamph. 82, 1949.

Washington Division of Geology & Earth Resources - ENERGY RESOURCES OF WASHINGTON - Washington Div. of Geol. & Earth Resources Bull. 50, 1974.

Waters, A. C. - STRATIGRAPHIC AND LITHOLOGIC VARIATIONS IN THE COLUMBIA RIVER BASALT - Amer. Jour. Sci. Vol. 259, pp. 583-611, 1961.

Weis, P. L., and Richmond, G. M. - MAXIMUM EXTENT OF LATE PLEISTOCENE CORDILLERAN GLACIATION IN NORTHEASTERN WASHINGTON AND NORTHERN IDAHO - U. S. Geol. Survey Prof. Paper 525-C, pp. C128-C132, 1965.

Weissenborn, A. E. and Moen, Wayne S. - URANIUM IN WASHINGTON - in ENERGY RESOURCES OF WASHINGTON - Washington State Div. of Geol. & Earth Resources Inform. Circ. No. 50, 1974.

Wilmarth, M. G. - CORRELATION CHART OF WASHINGTON - U. S. Geol. Survey, 1934.

Winston, D. - THE PRECAMBRIAN MISSOULA GROUP OF MONTANA AS A BRAIDED STREAM AND SEA-MARGIN SEQUENCE - in BELT SYMPOSIUM, Vol. 1, Dep't of Geol., Univ. of Idaho, Idaho Bur. of Mines & Geology, pp. 208-220, 1973.

8.3 MAPS

GEOLOGIC MAP OF WASHINGTON - Compiled by Marshall T. Huntting, W. A. G. Bennett, Vaughn E. Livingston, Jr., and Wayne S. Moen, Washington State Div. of Mines & Geology, scale 1:500,000, 1961.

STATE OF IDAHO GEOLOGIC MAP - Open-File Release, Idaho Bur. of Mines & Geology, scale 1:500,000, 1977.

GEOLOGY OF THE OKANOGAN, WASHINGTON QUADRANGLE - Compiled by Wilde, Inc. for the U.S. Dep't of Energy, scale 1:250,000, 1978.

GEOLOGY OF THE SANDPOINT QUADRANGLE - Compiled by Idaho Bureau of Mines & Geology for the U.S. Dep't of Energy, scale 1:250,000, 1978.

PRELIMINARY TECTONIC MAP OF IDAHO - Idaho Bur. of Mines & Geology, Gen. Ref. Map #3, scale 1:1,000,000, 1964

GEOLOGIC MAP OF MONTANA - Compiled by Clyde P. Ross, David A. Andrews, and Irving J. Witkind, Montana State Bur. of Mines & Geology, scale 1:500,000, reprinted 1958.

INTRUSIVE IGNEOUS ROCKS OF NORTHEASTERN WASHINGTON AND NORTHERN IDAHO - by S. D. Castor, M. R. Berry, and J. W. Robins, BFEC Compilation, scale 1:250,000, 1977.

MISCELLANEOUS INVESTIGATIONS SERIES
U. S. GEOLOGICAL SURVEY

I-464 RECONNAISSANCE GEOLOGIC MAP OF THE WEST HALF OF THE SPOKANE QUADRANGLE, WASHINGTON AND IDAHO - by A. B. Griggs. Scale 1:125,000, 1966.

I-583 GEOLOGIC MAP OF WASHINGTON - Compiled by A. E. Weissenborn. Scale 1: 2,000,000, 1969.

I-768 GEOLOGIC MAP OF THE SPOKANE QUADRANGLE, WASHINGTON, IDAHO, AND MONTANA - by A. B. Griggs. Scale 1:250,000, 1973.

GEOPHYSICAL INVESTIGATIONS MAPS
U. S. GEOLOGICAL SURVEY

GP-446 NATURAL GAMMA AERORADIOACTIVITY OF THE NATIONAL REACTOR TESTING STATION AREA, IDAHO - by R. G. Bates. Scale 1:250,000, 1964.

GP-682 AEROMAGNETIC MAP OF THE LIBBY AND MT. PEND OREILLE QUADRANGLES, LINCOLN AND SANDERS COUNTIES, MONTANA, AND BONNER COUNTY, IDAHO. Scale 1:62,500, 1969.

GP-914 BOUGUER GRAVITY MAP OF THE OKANOGAN, SANDPOINT, RITZVILLE, AND SPOKANE 1° by 2° QUADRANGLES, NORTHEASTERN WASHINGTON AND NORTHERN IDAHO - by J. W. Cady, and R. F. Meyer. Scale 1:250,000, 1976.

GEOLOGIC MAPS - Scale 1:62,500
WASHINGTON STATE DIV. OF GEOL. & EARTH RESOURCES

GM-5 PRELIMINARY GEOLOGIC MAP OF THE CHEWELAH MOUNTAIN QUADRANGLE, STEVENS COUNTY, WASHINGTON - by Lorin D. Clark and Fred K. Miller, 1968.

GM-6 PRELIMINARY GEOLOGIC MAP OF THE LOON LAKE QUADRANGLE, STEVENS AND SPOKANE COUNTIES, WASHINGTON - by F. K. Miller, 1969.

GM-7 PRELIMINARY GEOLOGIC MAP OF THE NEWPORT NUMBER 1 QUADRANGLE, PEND OREILLE COUNTY, WASHINGTON AND BONNER COUNTY, IDAHO - by Fred K. Miller, 1974.

GM-8 PRELIMINARY GEOLOGIC MAP OF THE NEWPORT NUMBER 2 QUADRANGLE, PEND OREILLE AND STEVENS COUNTIES, WASHINGTON - by Fred K. Miller, 1974.

GM-9 PRELIMINARY GEOLOGIC MAP OF THE NEWPORT NUMBER 3 QUADRANGLE, PEND OREILLE, STEVENS, AND SPOKANE COUNTIES, WASHINGTON, by Fred K. Miller, 1974.

GM-10 PRELIMINARY GEOLOGIC MAP OF THE NEWPORT NUMBER 4 QUADRANGLE, SPOKANE AND PEND OREILLE COUNTIES, WASHINGTON, AND BONNER COUNTY, IDAHO - by Fred K. Miller, 1974.

GM-11 COMPLETE BOUGUER GRAVITY ANOMALY MAP OF WASHINGTON - by W. E. Bonini, D. W. Hughes, and Z. F. Danes, 1974.

GEOLOGIC QUADRANGLE MAPS - Scale 1:62,500
U. S. GEOLOGICAL SURVEY

GQ-375 - GEOLOGIC MAP OF THE PACKSADDLE MOUNTAIN QUADRANGLE, IDAHO - by J. E. Harrison and D. A. Jobin, 1965.

GQ-734 - GEOLOGIC MAP OF THE GREENACRES QUADRANGLE, WASHINGTON AND IDAHO - by P. L. Weis, 1968.

GQ-953 - GEOLOGIC MAP OF THE ELMIRA QUADRANGLE, BONNER COUNTY, IDAHO - by J. E. Harrison and P. W. Schmidt, 1971.

MISCELLANEOUS FIELD STUDIES MAPS
U. S. GEOLOGICAL SURVEY

MF-117 - PRELIMINARY GEOLOGIC MAP AND SECTIONS OF THE MAGNESITE BELT, STEVENS COUNTY, WASHINGTON - by Ian Campbell and J. S. Loofbourov, Jr. Scale 1:36,000, 1957.

MF-135 - PRELIMINARY GEOLOGIC MAP OF PART OF THE TURTLE LAKE QUADRANGLE, LINCOLN AND STEVENS COUNTIES, WASHINGTON - by George E. Becraft and Paul L. Weis. Scale 1:48,000, 1957.

MF-137 - PRELIMINARY GEOLOGIC MAP OF THE LEADPOINT QUADRANGLE, STEVENS COUNTY, WASHINGTON - by R. G. Yates and J. F. Robertson. Scale 1:24,000, 1958.

MF-237 - PRELIMINARY GEOLOGIC MAP OF THE DEEP LAKE QUADRANGLE, STEVENS AND PEND OREILLE COUNTIES, WASHINGTON - by R. G. Yates and A. E. Ford. Scale 1:24,000, 1960.

MF-276 - PRELIMINARY GEOLOGIC MAP OF THE HUNTERS QUADRANGLE, STEVENS AND FERRY COUNTIES, WASHINGTON - by A. B. Campbell and O. B. Raup. Scale 1:48,000, 1964.

MF-283 - PRELIMINARY GEOLOGIC MAP OF THE WILMONT CREEK QUAD-
RANGLE, FERRY AND STEVENS COUNTIES, WASHINGTON - by G. E.
Becraft. Scale 1:48,000, 1964.

MF-943 - GEOLOGIC MAP & CROSS SECTIONS OF THE MIDNITE URANIUM
MINE, STEVENS COUNTY, WASHINGTON - by J. T. Nash.
Scale 1:1,200 (Sheet 1) and 1:600 (Sheet 2), 1978.

MINERAL INVESTIGATIONS RESOURCE MAPS
U. S. GEOLOGICAL SURVEY

Mr-2 - URANIUM DEPOSITS - compiled by R. W. Schnabel.
Scale 1:5,000,000, 1955.

APPENDIX A

OKANOGAN AND SANDPOINT QUADRANGLES

PRODUCTION SUMMARY

APPENDIX A
OKANOGAN AND SANDPOINT QUADRANGLES
PRODUCTION SUMMARY

	Start	End
Flying	9/2/77	10/14/77
Data Processing	9/15/77	6/30/79
Data Interpretation	3/25/78	5/30/79
Total Mileage		10,626
Total Days on Location		56 aircraft days
Production Time		66%
Non-Production Time		24%
Average Daily Mileage		190
Weather Days		12

OKANOGAN AIRSPEED HISTOGRAM

OKANOAGAN
RADAR ALTITUDE HISTOGRAM

APPENDIX B

TAPE FORMATS

APPENDIX B

TAPE FORMATS

All tape files are 9 track EBCDIC written at a density of 800 BPI and have a fixed word length of 9 characters.

TAPE HEADER

The first record of each tape file is a tape label of 972 characters containing the following standard information:

(1)	Project Identification	Characters 1-45
(2)	I. K B Resources, Inc.	Characters 46-63
(3)	Date of Survey	Characters 64-72
(4)	Sequence of lines in this file	Characters 73-972

LINE HEADER

A standard 10 word line header preceeds and identifies each line contained in the file.

<u>Word</u>	<u>Definition</u>
1	Line Number
2	Start Fiducial Number
3	End Fiducial Number
4	4 π Sampling Interval (millisecs)
5	2 π Sampling Interval (millisecs)
6	Date (YYDDD)
7	Number of Samples
8-10	Not used

RAW SPECTRAL DATA FILE

The raw data sub-set will immediately follow the line header and will contain 416 words per logical record.

<u>Word</u>	<u>Definition</u>
1	Record Number
2	Latitude (.0001 degrees)
3	Longitude (.0001 degrees)
4	Time (seconds past midnight)
5	Magnetic Field (.1 gamma)
6	Terrain Clearance (feet)
7	Barometric Pressure (feet)
8	Temperature (.1 degree C)
9	* Altitude Flag
10	* K Flag
11	* U Flag
12	* T Flag
13-212	Terrestrial Detector 0 to 3 MeV
213	Terrestrial Detector LIVE time (millisecs)
	B.1

214-413	Atmos. Detector 0 to 3 MeV
414	Atmos. Detector LIVE time (millisecs.)
415	** Terrestrial Detector Cosmic Sum
416	** Atmos. Detector Cosmic Sum (.1 Count)

SINGLE RECORD DATA FILE

The single record data will be blocked 10 logical records per block. Each logical record will contain 16 words defined as follows:

<u>Word</u>	<u>Definition</u>
1	Record Number
2	Latitude (.0001 degrees)
3	Longitude (.0001 degrees)
4	Magnetic Field (.1 Gamma)
5	Terrain Clearance
6	Geologic Unit Code
7	* Altitude Flag
8	* K Flag
9	* U Flag
10	* T Flag
11	Terrestrial Cosmic Sum
12	Atmos. Bi ²¹⁴ Correction (.1 Count)
13	Terrestrial Gross Count
14	Terrestrial Thorium Count
15	Terrestrial Uranium Count
16	Terrestrial Potassium Count
17	Ratio U/K (.1 Count)
18	Ratio U/T (.1 Count)
19	Ratio T/K (.1 Count)

STATISTICAL ANALYSIS TAPE

The statistical data file contains an additional tape header record which identifies the statistical parameters relative to each geologic map unit.

The data associated with a single geologic map unit is considered as one logical record and contains 14 words.

The logical records are blocked 200 thus the physical record is 2800 words.

The statistical header is defined as follows:

<u>Word</u>	<u>Definition</u>
1	Map Unit Code
2	Number of Records

3	K Mean Value
4	K Standard Deviate
5	U Mean Value
6	U Standard Deviate
7	T Mean Value
8	T Standard Deviate
9	U/K Mean Ratio (.1 Count)
10	U/K Standard Deviate (.1 Count)
11	U/T Mean Ratio (.1 Count)
12	U/T Standard Deviate (.1 Count)
13	T/K Mean Ratio (.1 Count)
14	T/K Standard Deviate (.1 Count)

STATISTICAL DATA RECORD

The statistical data record contains the averaged reduced data records. Each averaged record is considered a logical record having 22 words. The logical records are blocked 10 per physical record.

<u>Word</u>	<u>Definition</u>
1	Record Number
2	Latitude (.0001 Degrees)
3	Longitude (.0001 Degrees)
4	Magnetic Total Field (.1 Gamma)
5	Geologic Map Unit Code
6	* Altitude Flag
7	* K Flag
8	* U Flag
9	* T Flag
10	Gross Count
11	Thorium Count
12	Thorium Standard Deviate (.1 Count)
13	Uranium Count
14	Uranium Standard Deviate (.1 Count)
15	Potassium Count
16	Potassium Standard Deviate (.1 Count)
17	U/T Ratio (.1 Counts)
18	U/T Standard Deviate (.1 Count)
19	U/K Ratio (.1 Counts)
20	U/K Standard Deviate (.1 Count)
21	T/K Ratio (.1 Count)
22	T/K Standard Deviate (.1 Count)

MAGNETIC DATA TAPES

The magnetic data record contains 10 words per logical record and is blocked 50 logical records per physical record.

<u>Word</u>	<u>Definition</u>
1	Record Number
2	Latitude (.0001 degrees)
3	Longitude (.0001 degrees)
4	Time (seconds past midnight)
5	Terrain Clearance (feet)
6	Barometric Pressure (feet)

7	Geologic Code
8	Observed Magnetic Field (.1 Gamma)
9	Corrected Magnetic Field (.1 Gamma)
10	Filler word or Diurnal (if required)

* Quality Flag Code: 1 = Record exceeds altitude specifications
or failed statistical significance test.
0 = Data is acceptable.

** Cosmic sums have been corrected for live time.

APPENDIX C
STATISTICAL SUMMARY OF GEOLOGIC UNITS
BY ROCK TYPE

STATISTICAL SUMMARY

CODE	UNIT	RECS	*** K ***			*** U ***			*** T ***			** U/K*10 **		** U/T*10 **		** T/K*10 **	
			MEAN	ST.DEV.		MEAN	ST.DEV.		MEAN	ST.DEV.		MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.
1.	WATER	196.0	37.6	41.2		10.8	6.0		16.4	12.3		3.5	3.7	7.0	5.9	2.2	.9
3.	UNMAP	401.0	107.3	39.8		17.7	10.0		27.4	14.3		1.3	.6	5.5	3.0	2.0	.7
101.	Q	530.0	145.6	30.0		15.7	7.7		31.6	8.8		1.1	.4	4.7	2.9	1.6	.6
102.	QAL	56.0	113.5	36.7		12.5	5.4		21.8	7.3		1.0	.2	5.4	2.3	1.4	.5
103.	QG	5675.0	128.4	30.5		14.3	6.2		32.0	10.6		1.1	.4	4.1	2.1	1.9	.7
104.	OT	46.0	107.9	14.8		10.3	3.3		20.7	3.1		1.0	.0	4.5	1.8	1.3	.5
105.	TOB	46.0	122.7	29.2		11.4	5.5		27.1	7.1		1.1	.4	3.6	1.5	1.7	.6
106.	TSA	43.0	145.0	36.2		15.4	7.4		33.9	13.0		1.1	.3	4.5	2.8	1.7	.5
108.	TI	5.0	103.0	11.1		10.4	3.6		27.7	6.8		1.0	.0	3.8	1.5	2.2	.8
109.	TG	100.0	110.9	36.5		12.9	4.9		27.4	13.1		1.0	.2	4.9	2.5	1.8	.7
110.	TQM	179.0	157.1	39.7		14.3	4.6		47.6	18.3		1.0	.0	2.7	1.1	2.4	.7
111.	TD	231.0	113.0	33.1		11.2	5.8		23.5	7.8		1.0	.2	3.9	1.8	1.5	.5
113.	TO	204.0	136.7	23.3		10.7	4.4		29.6	7.0		1.0	.0	3.2	1.5	1.6	.5
114.	TP	127.0	135.7	18.2		10.1	4.4		26.4	5.4		1.0	.0	3.3	1.7	1.4	.5
115.	TSC	124.0	125.0	33.1		11.1	5.0		26.9	10.1		1.0	.0	3.7	1.5	1.6	.6
117.	TC	24.0	137.7	17.9		11.2	6.8		25.3	4.7		1.2	.4	3.6	1.8	1.3	.5
118.	TSS	30.0	185.1	20.3		16.9	4.9		48.2	7.2		1.0	.0	3.0	1.2	2.0	.2
119.	TS	1769.0	134.2	30.4		11.8	5.8		29.7	9.0		1.1	.2	3.6	1.8	1.6	.5
120.	TAD	58.0	80.5	13.4		7.1	2.7		16.1	4.3		1.0	.0	4.4	2.0	1.4	.5
121.	TA	363.0	138.1	24.6		10.4	3.8		28.8	6.4		1.0	.0	3.1	1.5	1.5	.5
122.	TR	721.0	123.2	19.9		11.2	4.0		28.5	5.7		1.0	.1	3.5	1.5	1.8	.4
123.	TW	13.0	144.9	13.1		10.7	3.6		26.3	3.7		.0	.0	3.6	1.0	1.2	.4
124.	TK	654.0	144.8	27.3		14.4	6.3		31.7	7.3		1.0	.2	4.1	1.8	1.7	.5
125.	TKQM	75.0	138.5	26.2		11.5	4.5		39.8	15.8		1.0	.0	2.6	1.4	2.2	.7
201.	KGD	313.0	132.9	24.4		13.8	10.3		23.1	5.0		1.2	.7	5.5	3.5	1.2	.4
202.	KD	38.0	115.1	19.6		12.9	5.1		27.8	5.7		1.2	.4	4.1	1.5	1.9	.6
203.	KQ	576.0	114.4	23.9		12.7	8.3		24.2	8.2		1.3	.6	4.7	2.9	1.5	.7
204.	KOB	371.0	81.9	27.0		8.3	4.4		14.1	8.7		1.1	.2	4.8	3.2	1.4	.5
206.	KG	223.0	132.5	28.4		14.6	5.9		38.0	10.3		1.1	.3	3.4	1.5	2.4	.7
208.	KC	133.0	133.7	34.8		8.1	3.6		21.9	9.0		1.0	.0	3.0	1.3	1.1	.3
209.	KPGD	103.0	126.0	23.6		10.6	4.4		27.9	9.0		1.0	.0	3.3	1.3	1.6	.6
210.	KOTG	8.0	118.1	14.0		8.1	2.9		20.7	6.4		.0	.0	3.8	1.8	1.2	.4
211.	KO	62.0	105.7	18.0		8.0	4.1		21.9	4.2		1.1	.3	3.3	1.8	1.6	.5
213.	KJGD	18.0	183.8	31.5		17.3	2.7		30.2	8.8		1.0	.0	5.7	2.3	1.1	.2
215.	KJA	8.0	119.7	9.0		20.6	3.6		39.2	5.4		1.1	.4	4.7	1.0	2.7	.5
217.	KJE	22.0	155.5	35.7		19.9	10.3		44.5	19.1		1.2	.4	4.0	2.0	2.2	.7
218.	KJEL	15.0	106.9	36.0		8.5	3.2		19.4	5.9		1.0	.0	4.1	1.3	1.3	.5
219.	JT	21.0	143.3	28.1		13.7	4.3		28.3	8.6		1.0	.0	4.4	1.4	1.2	.4
220.	JRG	27.0	132.7	21.7		12.0	3.6		21.4	3.9		1.0	.0	5.1	1.6	1.1	.3
221.	JSG	9.0	118.6	24.9		11.4	4.0		17.2	2.3		1.0	.0	6.2	1.8	1.1	.3
222.	JTRVM	23.0	152.2	29.9		16.4	7.9		27.9	8.7		1.1	.3	5.4	1.8	1.3	.4
224.	JTRO	4.0	126.2	15.1		15.7	2.2		30.2	4.3		1.0	.0	4.7	1.3	2.0	.0
225.	JTRGN	58.0	167.7	41.3		22.0	7.3		52.2	15.0		1.0	.2	3.7	1.1	2.5	.5
227.	MZT	32.0	79.9	17.9		7.5	2.6		14.9	4.4		1.2	.4	4.4	1.8	1.3	.5
228.	MZH	31.0	76.7	11.0		6.5	2.0		17.3	4.3		1.0	.0	3.5	1.7	1.7	.6
229.	MZHM	37.0	112.4	30.0		9.8	4.6		16.7	5.6		1.0	.0	5.1	2.7	1.2	.4
230.	MZW	5.0	103.3	17.0		8.6	3.0		18.5	5.6		.0	.0	4.6	2.4	1.3	.5
231.	MZC	685.0	114.3	23.8		10.3	4.5		22.5	7.3		1.0	.2	4.3	2.1	1.4	.5
233.	MZB	19.0	97.3	31.4		8.8	4.4		25.8	14.4		1.0	.0	2.8	1.4	1.8	.8

STATISTICAL SUMMARY

CODE	UNIT	RECS	*** K ***		*** U ***		*** T ***		*** U/K*10 ***		*** U/T*10 ***		*** T/K*10 ***	
			MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.
235.	MZL	14.0	137.4	14.4	11.3	4.2	30.6	3.2	1.0	.0	3.1	1.4	1.6	.5
236.	MZG	4706.0	120.0	31.6	11.7	5.1	26.4	10.1	1.1	.3	4.0	2.0	1.7	.6
237.	MZR	261.0	124.5	34.3	14.2	5.3	31.6	15.2	1.0	.2	4.7	2.7	1.9	.7
238.	MZJ	49.0	117.6	20.0	15.1	5.9	30.2	7.7	1.1	.3	4.6	2.2	2.0	.6
239.	MZM	30.0	109.9	38.0	10.7	6.0	20.0	7.5	1.2	.4	5.0	2.7	1.4	.7
240.	MZS	79.0	99.2	21.8	7.8	3.0	16.7	4.4	1.1	.2	4.5	2.5	1.2	.4
241.	TRL	224.0	98.5	20.9	11.0	4.6	17.6	5.7	1.1	.2	5.9	2.7	1.2	.4
243.	TRK	104.0	117.5	19.6	10.2	3.6	21.7	7.4	1.0	.0	4.5	2.3	1.4	.5
244.	TRC	57.0	91.4	28.0	13.6	5.6	19.2	8.9	1.2	.6	7.6	5.1	1.5	.6
245.	TRKC	215.0	113.1	27.0	14.1	6.0	26.4	10.9	1.1	.3	4.8	2.0	1.8	.6
246.	TRS	6.0	104.2	31.4	15.5	9.1	20.2	4.6	1.5	.6	7.3	4.3	1.4	.5
248.	TRPB	40.0	105.0	22.7	12.5	3.2	27.0	5.3	1.0	.0	4.2	1.5	2.1	.6
249.	TRPSV	35.0	92.5	25.9	8.9	2.9	16.5	6.5	1.0	.0	4.8	1.8	1.2	.4
250.	TRPPM	17.0	54.1	33.4	9.1	3.3	12.7	10.3	1.0	.0	7.5	3.7	1.5	.8
251.	TRPP	44.0	98.0	13.9	12.6	6.1	29.3	8.1	1.1	.4	4.0	2.0	2.4	.8
252.	TRPG	74.0	116.0	43.9	13.1	7.3	23.0	7.9	1.3	.7	5.7	4.2	1.7	.8
253.	TRPS	48.0	89.9	21.3	14.5	5.6	29.5	7.2	1.4	.6	4.6	2.0	2.7	.5
254.	TRPGR	7.0	86.7	16.7	16.4	10.3	21.0	7.1	1.7	1.0	6.6	2.2	1.9	.7
255.	TRPPQ	15.0	96.9	30.3	13.6	4.0	25.5	11.1	1.2	.4	5.1	2.3	2.0	.7
301.	PBM	35.0	97.2	25.3	8.6	3.1	17.2	6.4	1.0	.0	5.0	2.6	1.3	.4
302.	PS	198.0	112.0	29.2	12.1	5.2	21.2	7.3	1.1	.3	5.6	3.1	1.3	.5
303.	PR	107.0	123.1	25.0	11.2	4.5	26.9	7.5	1.0	.0	3.9	2.2	1.6	.5
304.	PA	50.0	104.4	34.0	11.7	4.2	21.2	9.7	1.0	.2	6.1	3.3	1.5	.5
305.	PPTU	33.0	120.5	19.4	11.0	3.6	27.5	7.5	1.0	.0	3.7	1.7	1.7	.6
306.	PPMQ	28.0	150.0	25.5	16.2	6.3	35.3	8.0	1.0	.0	4.2	2.2	1.8	.6
308.	PZLS	61.0	112.5	38.9	12.4	4.9	31.7	12.2	1.1	.3	3.6	2.1	2.2	.6
309.	PZA	1287.0	117.3	32.2	15.5	6.8	32.0	9.1	1.2	.4	4.6	2.5	2.2	.6
310.	PZC	1518.0	106.7	27.3	14.6	5.9	33.3	10.6	1.1	.4	4.0	1.9	2.6	.7
312.	PZSM	4.0	98.7	10.8	17.7	8.3	20.2	6.4	1.7	.6	9.0	6.5	1.5	.6
313.	PZCQ	233.0	112.3	27.5	13.3	5.1	35.6	10.3	1.1	.3	3.4	1.7	2.6	.7
314.	PZPCM	479.0	114.9	29.9	14.7	6.3	32.9	12.0	1.1	.3	4.2	2.3	2.3	.7
315.	PZMS	29.0	117.6	22.3	11.0	4.6	23.4	7.1	1.0	.0	4.7	3.9	1.4	.5
316.	PZM	119.0	115.1	46.5	15.3	7.1	27.2	15.0	1.2	.4	6.1	4.1	1.7	.5
317.	PZS	26.0	135.3	29.5	13.6	4.7	34.1	13.2	1.0	.0	3.8	2.0	1.9	.7
318.	PZW	102.0	123.4	20.6	17.2	6.0	40.8	7.7	1.1	.3	3.8	1.7	2.8	.5
319.	PZG	89.0	97.4	21.3	13.3	5.9	25.8	8.3	1.1	.2	4.7	1.9	2.1	.6
320.	CA	24.0	89.1	25.9	9.7	3.9	28.9	8.5	1.1	.3	3.0	1.2	2.8	.8
321.	COD	19.0	107.4	19.6	12.1	4.7	32.0	7.9	1.1	.3	3.5	1.5	2.5	.7
322.	OL	10.0	119.6	11.2	17.2	4.1	35.5	4.9	1.0	.0	4.5	1.4	2.4	.5
323.	OCC	5.0	99.4	16.7	10.0	3.1	27.0	7.1	1.0	.0	3.4	1.1	2.2	.4
401.	PCE	21.0	130.0	21.6	12.1	3.8	25.7	5.4	1.0	.0	4.3	1.7	1.4	.5
402.	PCH	11.0	128.1	43.6	11.6	4.7	33.6	14.3	1.0	.0	3.2	1.8	1.9	.5
403.	PCM	19.0	117.5	26.5	9.9	4.5	27.5	8.4	1.0	.0	3.3	1.9	1.8	.6
404.	PCO	42.0	145.5	28.0	22.5	6.7	39.2	9.4	1.1	.3	5.4	2.1	2.1	.5
405.	PCB	26.0	92.6	33.8	10.2	3.0	26.7	10.1	1.1	.4	3.4	1.6	2.3	.5
406.	PCT	38.0	121.3	29.5	18.4	9.5	32.4	10.7	1.1	.4	4.8	1.7	2.1	.7

STATISTICAL SUMMARY

CODE	UNIT	RECS	*** K ***	*** U ***	*** T ***	*** U/K*10 ***	*** U/T*10 ***	*** T/K*10 ***
			MEAN ST.DEV.	MEAN ST.DEV.	MEAN ST.DEV.	MEAN ST.DEV.	MEAN ST.DEV.	MEAN ST.DEV.
1.	WATER	280.0	34.0 34.5	11.4 7.2	16.2 9.9	4.9 5.0	9.2 9.1	2.4 1.3
3.	UNCLA	1583.0	120.7 32.7	16.5 7.0	33.8 11.0	1.2 .6	4.6 2.6	2.2 .7
101.	QAL	1627.0	109.2 35.0	15.3 7.3	34.1 9.8	1.3 .8	4.1 2.3	2.6 .6
102.	QT	4.0	78.7 9.9	6.5 1.3	26.3 6.2	.0 .0	2.5 .6	2.7 .5
103.	QLS	68.0	102.3 36.9	10.5 3.9	35.0 13.3	1.0 .0	2.5 1.1	2.9 .7
104.	QG	2615.0	89.6 29.5	12.1 6.3	27.3 9.3	1.3 .9	4.0 2.3	2.5 .7
106.	QAG	10332.0	122.8 34.8	17.8 8.2	35.6 11.1	1.3 .7	4.7 2.6	2.3 .7
107.	TB	217.0	95.9 20.2	16.2 9.1	27.8 6.9	1.5 .7	5.3 2.8	2.4 .6
109.	TG	11.0	132.6 38.1	38.1 18.2	44.3 8.6	2.3 .8	7.5 2.8	2.8 .4
111.	TCG	134.0	120.9 27.4	19.7 7.6	35.4 9.2	1.2 .5	5.2 2.3	2.4 .6
112.	TO	57.0	151.0 33.0	14.8 4.8	33.6 9.8	1.0 .0	4.1 1.7	1.7 .6
113.	TC	4.0	132.5 1.7	17.2 6.6	34.5 6.4	1.0 .0	4.7 2.2	2.2 .5
114.	TMV	28.0	155.0 20.1	15.6 4.9	37.7 5.6	1.0 .0	3.5 1.1	1.9 .3
115.	TSR	54.0	142.5 18.4	16.3 6.9	32.8 6.4	1.1 .3	4.6 2.6	1.8 .5
118.	TS	587.0	150.9 31.4	17.3 5.2	46.4 9.7	1.0 .2	3.3 1.3	2.6 .6
119.	TSH	7.0	187.0 36.2	17.3 3.7	40.2 7.0	.0 .0	3.6 1.0	1.7 .5
121.	TSG	82.0	120.1 32.4	12.7 4.8	32.0 7.0	1.1 .3	3.5 1.5	2.2 .5
122.	TQ	7.0	134.1 19.8	29.4 2.9	38.7 9.0	1.6 .5	7.4 1.5	2.3 .5
127.	TSP	2332.0	114.9 34.8	11.9 6.1	37.6 15.5	1.2 .6	2.9 1.9	2.7 .9
128.	TSQ	245.0	97.6 22.9	11.2 6.6	29.0 8.0	1.4 1.5	3.6 2.7	2.4 .7
129.	TCA	8.0	126.2 23.1	18.0 9.9	40.5 9.2	1.3 .5	3.8 2.1	2.6 1.1
130.	TBR	7.0	164.4 90.6	15.6 5.4	33.0 8.7	1.3 .6	5.3 5.2	1.7 .8
131.	TKPA	1356.0	121.3 26.4	17.6 7.0	32.7 10.1	1.2 .4	5.1 2.4	2.1 .6
132.	TKT	173.0	152.0 36.0	17.3 6.7	40.6 11.3	1.1 .3	3.9 1.9	2.1 .6
201.	KSM	94.0	125.3 41.3	16.5 7.0	38.2 18.0	1.0 .2	4.1 1.7	2.4 .6
203.	KB	27.0	150.0 18.5	18.4 4.6	45.4 6.0	1.0 .0	3.7 1.2	2.4 .5
205.	KGD	389.0	100.3 28.4	13.1 5.8	27.8 8.4	1.2 .5	4.3 2.0	2.2 .6
206.	KH	13.0	148.4 14.2	30.9 7.1	43.7 4.8	1.7 .6	6.6 2.0	2.4 .5
208.	KQM	38.0	137.9 27.9	20.1 4.8	35.8 5.8	1.2 .4	5.2 1.5	2.1 .6
209.	KRG	38.0	98.5 18.0	10.5 3.7	22.6 4.0	1.1 .3	4.3 1.3	1.8 .5
210.	KBQ	52.0	118.2 25.2	18.6 5.0	21.3 4.8	1.1 .4	8.7 3.0	1.3 .6
211.	KC	37.0	66.3 25.5	8.1 3.0	16.7 7.0	1.1 .2	4.1 1.6	2.1 .8
212.	KF	93.0	147.0 25.8	23.9 8.4	44.7 9.9	1.2 .5	4.9 2.0	2.5 .5
213.	KG	506.0	113.5 27.5	19.2 8.1	35.5 8.7	1.5 .8	5.1 2.6	2.6 .7
214.	KGA	64.0	122.5 28.3	24.0 8.8	29.2 7.3	1.4 .5	7.8 2.7	1.9 .4
215.	KTQ	86.0	110.5 25.2	20.6 7.5	43.2 12.3	1.4 .5	4.2 1.3	3.3 .7
216.	KGQ	4.0	91.2 55.5	12.2 5.1	25.0 15.4	1.0 .0	5.0 2.7	2.2 1.0
217.	KHM	243.0	141.4 30.9	24.8 9.7	55.3 13.2	1.4 .6	4.1 1.9	3.3 .7
218.	KKH	726.0	118.3 30.3	17.9 7.1	37.6 11.9	1.2 .5	4.6 2.6	2.6 .7
219.	KKT	244.0	108.9 30.7	14.4 6.3	26.5 7.7	1.1 .4	5.0 2.3	2.0 .8
220.	KL	140.0	156.0 27.4	19.7 7.8	46.3 10.0	1.1 .3	3.7 1.4	2.4 .6
221.	KGP	35.0	109.4 25.2	18.8 6.5	37.9 8.8	1.3 .5	4.5 1.5	2.9 .3
222.	KVS	22.0	127.5 41.5	15.5 5.9	29.7 12.7	1.0 .0	5.0 1.5	1.8 .8
223.	KNA	17.0	181.1 35.9	27.4 4.2	77.4 33.0	1.1 .3	3.8 2.5	3.6 1.3
224.	KPQ	76.0	149.9 33.3	44.3 15.8	45.6 10.4	2.4 .8	9.1 2.8	2.5 .5
225.	KSF	527.0	147.0 28.1	21.8 7.9	46.8 10.3	1.1 .3	4.1 1.6	2.6 .6
226.	KSP	241.0	136.8 31.5	16.5 7.4	43.5 10.1	1.1 .3	3.3 1.7	2.6 .6
227.	KTM	42.0	88.1 20.0	8.8 3.5	20.9 9.6	1.0 .0	3.8 1.3	1.8 .9
230.		41.0	97.6 35.4	10.9 5.4	25.1 13.2	1.0 .2	3.9 1.7	2.0 .6

STATISTICAL SUMMARY

CODE	UNIT	RECS	* * * K * * *		* * * U * * *		* * * T * * *		* * U/K*10 * *		* * U/T*10 * *		* * T/K*10 * *	
			MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.
233.	JTRF	54.0	118.3	30.7	13.2	4.4	29.3	6.1	1.0	.2	3.9	1.5	2.0	.6
234.	JTRP	17.0	109.4	11.9	13.8	3.0	25.7	5.6	1.0	.0	5.0	1.6	1.8	.7
301.	PPMR	99.0	117.6	28.8	13.1	6.0	31.6	11.7	1.0	.1	3.8	1.5	2.0	.6
302.	CX	65.0	133.8	45.0	15.3	6.2	34.4	8.8	1.0	.2	4.0	1.4	2.1	.7
303.	PZU	27.0	105.3	36.9	14.9	4.9	29.3	6.7	1.3	.5	4.7	2.4	2.3	.7
304.	CP	137.0	116.9	32.7	13.8	6.1	34.5	10.2	1.1	.6	3.7	2.2	2.4	.5
305.	CF	81.0	124.5	26.5	17.0	6.9	34.0	8.1	1.2	.4	4.7	2.6	2.2	.5
306.	CG	92.0	93.8	19.9	14.5	5.8	25.7	6.8	1.2	.5	5.5	3.1	2.2	.6
308.	DS	16.0	92.2	22.0	13.9	3.9	19.1	5.1	1.0	.0	7.1	2.3	1.6	.5
309.	OLU	233.0	112.7	30.4	19.1	7.5	27.9	7.7	1.3	.6	6.6	3.2	1.9	.6
311.	CM	547.0	83.6	33.0	12.3	6.8	24.0	11.4	1.4	.9	5.6	4.6	2.3	.7
317.	CU	8.0	75.4	13.5	8.5	1.8	26.4	3.2	1.0	.0	2.9	.6	2.8	.7
318.	CMA	946.0	104.3	22.1	10.8	3.9	39.7	10.3	1.0	.2	2.4	1.5	3.3	.8
321.	CQ	685.0	85.1	35.4	11.7	5.6	28.7	13.5	1.2	.5	3.6	2.1	2.9	1.0
401.	PCWI	258.0	76.4	34.5	8.3	3.7	21.4	11.9	1.2	.4	3.5	2.3	2.2	.8
404.	PCH	184.0	90.9	29.1	13.6	5.5	24.7	9.6	1.2	.5	5.3	2.9	2.2	.7
408.	PCMG	333.0	70.6	27.1	11.2	5.2	21.4	8.9	1.5	1.3	4.8	3.0	2.5	.8
409.	PCDT	386.0	125.6	28.3	15.3	6.8	33.1	10.3	1.1	.4	4.1	1.8	2.1	.7
410.	PCBU	4535.0	94.1	32.7	12.7	6.3	28.6	10.0	1.2	.8	3.9	2.1	2.5	.7
422.	PCBC	58.0	86.7	29.9	9.9	3.6	28.0	11.9	1.1	.3	3.4	1.9	2.6	.8
423.	PCN	65.0	136.2	25.8	17.1	5.5	45.4	9.9	1.0	.2	3.4	1.3	2.7	.7
425.	PCM	1128.0	107.3	27.5	15.4	7.1	31.8	8.5	1.2	.5	4.4	2.3	2.4	.7

APPENDIX D

STATISTICAL SUMMARY OF GEOLOGIC UNITS

BY LINE

STATISTICAL SUMMARY BY LINE

LINE	RECS	* * * K * * *		* * * U * * *		* * * T * * *		* * U/K*10 * *		* * U/T*10 * *		* * T/K*10 * *	
		MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.
1.	228.	132.3	38.5	19.4	9.3	34.3	14.7	.9	.7	5.6	3.6	2.0	.7
2.	507.	130.5	36.8	14.1	6.5	28.1	10.0	.5	.6	4.7	2.3	1.5	.6
3.	239.	128.0	42.6	17.8	9.6	30.7	11.8	.8	.6	5.5	2.9	1.9	.8
4.	244.	114.2	34.6	15.9	7.3	26.9	11.6	.8	.6	5.0	3.3	1.7	.7
5.	526.	116.5	36.1	12.2	6.3	26.5	11.6	.4	.6	4.4	3.0	1.7	.7
6.	230.	125.4	33.3	15.1	6.6	30.3	12.2	.6	.5	4.7	2.2	1.8	.7
7.	248.	129.7	37.5	14.5	5.6	34.5	13.9	.5	.5	4.0	1.8	2.1	.7
8.	466.	120.6	36.6	12.2	5.4	27.1	12.7	.5	.6	4.5	2.9	1.6	.7
9.	239.	140.9	34.7	15.9	5.3	40.1	11.2	.5	.5	3.6	1.4	2.1	.6
10.	239.	132.1	33.2	13.5	6.8	35.5	11.2	.4	.7	3.5	2.6	2.1	.6
11.	520.	128.6	31.5	11.7	5.2	28.4	11.7	.3	.5	3.8	1.9	1.6	.7
12.	261.	131.4	32.7	12.1	4.7	35.0	11.1	.3	.5	3.1	1.6	2.1	.5
13.	199.	144.0	30.3	13.4	4.7	35.2	12.2	.3	.5	3.5	1.5	1.9	.7
14.	471.	122.8	34.7	11.7	5.0	27.4	12.2	.3	.5	3.8	1.8	1.6	.7
15.	193.	143.4	37.3	12.2	4.1	34.8	10.3	.2	.4	3.2	1.5	1.8	.5
16.	227.	138.3	35.6	11.3	3.9	34.2	9.8	.2	.4	2.9	1.4	1.9	.5
17.	442.	125.0	35.3	11.3	4.3	28.1	11.0	.2	.4	3.6	1.8	1.6	.6
18.	232.	131.7	34.1	11.2	4.2	32.7	10.3	.2	.4	3.0	1.4	1.9	.6
19.	236.	123.0	31.3	12.6	5.3	31.2	10.6	.4	.6	3.7	1.8	2.0	.6
20.	467.	113.4	33.8	11.8	5.6	26.1	10.3	.4	.5	4.1	2.1	1.7	.6
21.	226.	128.3	33.7	12.9	5.4	32.2	10.7	.4	.8	3.5	1.4	1.9	.7
22.	222.	130.2	34.9	13.4	5.9	31.9	9.5	.4	.9	3.7	1.5	1.9	.6
23.	412.	116.4	39.4	11.6	6.6	25.3	10.7	.4	.7	4.1	2.5	1.5	.6
24.	225.	128.1	35.5	13.7	5.2	29.5	9.2	.5	.6	4.4	2.5	1.7	.6
25.	244.	123.9	33.1	14.1	6.4	29.7	9.4	.6	.8	4.5	2.4	1.8	.6
26.	497.	114.2	31.7	12.2	6.0	25.1	9.1	.5	.5	4.6	2.7	1.6	.7
27.	167.	124.8	30.8	9.6	3.2	28.0	8.9	.1	.2	3.1	1.4	1.7	.6
28.	215.	124.9	29.2	14.1	7.2	28.9	10.3	.5	.6	4.3	2.1	1.7	.6
29.	403.	120.1	31.3	12.3	5.9	25.9	9.3	.4	.5	4.2	1.9	1.5	.6
30.	228.	121.0	32.2	12.2	5.2	28.0	8.1	.4	.5	4.0	2.2	1.7	.7
31.	199.	124.1	33.0	11.9	5.4	28.2	8.8	.4	.5	3.9	2.0	1.7	.7
32.	470.	110.1	31.1	12.7	6.1	23.5	8.7	.6	.6	5.3	4.0	1.6	.7
33.	208.	119.7	32.1	12.4	5.5	28.7	10.5	.4	.5	4.0	2.1	1.8	.7
34.	242.	116.1	37.1	17.2	12.7	27.6	9.2	1.2	2.3	5.9	4.4	1.8	.7
35.	504.	110.4	30.5	12.7	6.7	26.2	11.0	.5	.6	4.2	2.0	1.8	.7
36.	320.	116.7	30.5	12.8	8.4	29.9	10.2	.5	.7	3.8	2.5	1.9	.7
37.	330.	119.3	26.6	13.0	6.9	27.9	8.2	.5	.6	4.2	2.2	1.8	.6
38.	542.	112.5	35.2	13.5	7.7	25.6	11.2	.5	.6	4.4	2.2	1.6	.7
39.	306.	112.4	29.6	12.0	6.0	27.6	8.0	.5	.6	3.8	2.0	1.9	.7
40.	292.	105.3	25.2	12.4	5.5	28.0	8.2	.6	.6	4.0	1.8	2.1	.9
41.	520.	108.1	32.3	11.8	5.4	25.5	11.8	.5	.5	4.1	1.8	1.7	.8
42.	280.	97.3	25.3	12.8	5.2	27.3	8.1	.7	.7	4.3	2.0	2.3	.9
43.	282.	105.1	29.3	12.5	4.8	28.3	8.3	.6	.5	4.0	1.8	2.2	.8
44.	546.	112.8	28.2	12.9	6.3	25.5	9.8	.6	.5	4.8	2.6	1.7	.8
45.	283.	107.0	26.8	14.3	5.8	28.3	8.8	.8	.7	4.8	2.5	2.1	.8
46.	269.	109.7	28.1	12.0	6.1	29.0	9.8	.5	.5	3.7	1.9	2.0	.9
47.	527.	107.9	26.4	15.1	7.6	25.3	9.8	.9	.9	5.3	2.9	1.8	.9
48.	239.	112.2	25.2	16.0	7.0	28.3	9.4	.9	.9	5.3	2.3	2.0	.9
49.	222.	101.7	27.5	15.0	6.9	27.2	9.6	1.0	1.0	5.3	2.6	2.1	.9
50.	485.	116.7	33.0	11.1	5.4	25.4	10.5	.3	.5	3.7	1.7	1.5	.8

STATISTICAL SUMMARY BY LINE

LINE	RECS	* * * K * * *		* * * U * * *		* * * T * * *		* * U/K*10 * *		* * U/T*10 * *		* * T/K*10 * *	
		MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.
51.	248.	111.2	27.5	15.0	5.9	28.7	9.3	.9	1.2	5.0	2.2	2.1	.8
52.	271.	116.6	26.9	12.7	5.3	28.1	9.1	.5	.6	4.1	1.5	1.8	.8
53.	467.	122.2	31.3	11.5	6.0	25.8	10.9	.3	.5	3.7	1.9	1.5	.8
54.	278.	121.6	32.5	12.7	5.7	28.4	9.7	.5	.6	3.9	1.7	1.8	.8
55.	243.	110.6	31.7	12.4	4.5	29.6	10.9	.5	.5	3.8	1.8	2.1	.8
56.	521.	121.5	33.5	12.4	5.6	27.6	11.2	.4	.7	4.0	2.1	1.7	.8
57.	232.	114.5	29.7	15.0	6.0	30.5	9.7	.7	.9	4.5	2.1	2.1	.8
58.	257.	117.1	25.8	15.3	6.0	32.7	10.2	.8	.6	4.4	2.1	2.2	.8
59.	441.	123.3	34.7	13.1	5.9	29.0	12.8	.5	.7	3.9	1.7	1.7	.9
60.	227.	121.9	36.6	15.4	6.3	31.7	10.6	.8	1.1	4.4	1.9	2.0	.8
61.	222.	123.9	33.1	15.3	6.7	32.1	9.5	.7	1.0	4.3	2.3	2.0	.9
62.	474.	127.3	33.7	14.2	6.1	30.3	12.0	.5	.6	4.5	2.3	1.8	.8
63.	232.	135.6	33.9	13.8	4.9	35.7	11.7	.4	.5	3.4	1.2	2.0	.8
64.	226.	135.4	32.4	14.2	5.8	35.6	9.9	.4	.6	3.5	1.5	2.0	.8
65.	517.	127.7	35.5	12.1	4.8	30.5	10.7	.3	.5	3.5	1.4	1.8	.6
66.	218.	130.9	38.9	12.6	4.1	32.6	8.7	.3	.5	3.4	1.3	1.9	.6
67.	233.	134.8	33.4	14.1	5.7	33.9	9.7	.4	.6	3.7	1.8	2.0	.6
68.	551.	130.6	34.5	12.6	5.3	30.8	9.5	.4	.5	3.8	1.8	1.8	.6
69.	199.	136.6	33.5	14.5	5.6	35.5	10.1	.5	.6	3.7	1.9	2.0	.7
208.	393.	128.7	35.5	15.6	5.8	38.0	11.9	.7	.7	3.9	2.2	2.4	.7
209.	355.	104.5	37.9	12.1	4.4	32.6	11.8	.5	.6	3.4	1.7	2.4	.7
210.	334.	134.0	31.2	13.5	7.1	27.5	8.6	.4	.5	4.4	2.1	1.4	.5
211.	321.	134.8	25.5	12.9	6.9	28.4	8.6	.3	.5	4.1	2.5	1.5	.6
212.	300.	120.3	30.0	9.3	4.1	26.0	7.8	.2	.4	3.0	1.4	1.6	.5
213.	440.	127.0	30.1	11.4	5.2	26.7	9.4	.3	.5	3.8	1.8	1.5	.6
214.	459.	123.2	32.4	14.5	5.3	26.0	11.1	.6	.5	5.5	2.4	1.5	.7
215.	193.	85.8	33.7	7.0	2.8	11.9	7.5	.1	.3	5.0	2.9	.8	.6

STATISTICAL SUMMARY BY LINE

LINE	RECS	* * * K * * *		* * * U * * *		* * * T * * *		* * U/K*10 * *		* * U/T*10 * *		* * T/K*10 * *	
		MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.
1.	574.	91.9	42.2	12.3	6.5	28.7	14.8	.7	.7	4.0	2.7	2.6	.8
2.	580.	87.0	42.0	12.0	5.3	25.8	12.9	.8	.6	4.3	2.6	2.5	.9
3.	459.	79.4	36.8	10.7	5.1	25.2	11.2	.8	.6	3.8	2.1	2.7	.9
4.	571.	103.4	38.9	12.9	6.4	31.8	13.3	.6	.6	3.5	1.6	2.5	.7
5.	560.	100.6	39.4	13.3	6.7	31.1	14.4	.7	.6	3.8	2.2	2.5	.8
6.	484.	80.4	32.5	10.6	4.8	26.2	12.5	.7	.6	3.6	2.5	2.7	1.0
7.	423.	109.5	38.0	13.7	5.5	33.3	14.6	.7	.6	4.0	2.4	2.4	.8
8.	460.	115.7	41.2	14.5	7.5	34.9	16.6	.6	.6	3.7	2.5	2.4	.9
9.	389.	119.3	41.4	15.6	6.7	35.7	16.0	.7	.6	4.3	2.7	2.4	.8
10.	422.	109.4	43.4	15.5	7.6	33.7	15.4	.8	.9	4.3	3.0	2.5	.8
11.	454.	114.4	39.1	16.3	8.7	34.8	14.3	.9	.9	4.5	3.4	2.5	.8
12.	486.	116.9	35.8	13.4	5.5	35.9	11.5	.6	.6	3.3	1.6	2.6	.7
13.	468.	112.2	35.2	13.1	4.9	34.2	12.3	.6	.6	3.7	1.9	2.5	.7
14.	518.	123.3	33.9	14.2	6.3	36.1	12.6	.6	.6	3.7	2.4	2.4	.8
15.	554.	114.3	34.7	14.4	6.9	34.1	11.6	.7	.7	4.0	2.4	2.4	.7
16.	536.	107.6	31.5	13.1	5.3	33.5	11.1	.7	.8	3.8	2.7	2.6	.8
17.	511.	106.7	34.9	12.1	5.5	32.1	11.8	.5	.5	3.4	1.5	2.5	.8
18.	443.	99.5	37.8	12.9	8.6	30.1	11.3	.8	1.4	3.7	2.5	2.5	1.0
19.	508.	103.3	28.7	11.0	4.1	32.4	9.9	.5	.6	3.0	1.6	2.6	.8
20.	541.	101.1	28.2	12.5	6.0	32.1	10.1	.6	.6	3.5	1.9	2.6	.8
21.	599.	103.5	26.5	12.2	4.7	32.1	10.2	.6	.5	3.5	1.7	2.5	.8
22.	481.	103.0	26.2	12.5	5.5	33.6	11.7	.7	.6	3.4	1.7	2.7	.7
23.	526.	102.9	25.1	12.4	5.5	33.4	11.1	.6	.7	3.3	1.6	2.7	.8
24.	533.	97.4	30.8	12.3	6.0	31.8	11.6	.7	.6	3.6	1.9	2.7	.7
25.	605.	101.1	31.3	14.5	6.2	32.1	11.3	.9	.5	4.5	2.8	2.6	.8
26.	520.	98.4	40.0	17.6	9.4	33.5	15.8	1.8	2.3	6.2	5.0	2.9	1.1
27.	633.	109.4	35.8	15.7	7.1	36.4	15.3	1.0	1.1	4.5	3.1	2.7	.8
28.	585.	104.1	35.3	15.0	7.8	34.1	13.7	1.0	1.1	4.2	3.0	2.7	.8
29.	593.	115.8	48.0	15.4	7.5	35.7	13.5	.8	.9	4.1	2.4	2.5	.7
30.	555.	107.5	41.8	15.3	7.3	33.1	14.8	1.0	1.2	4.6	2.7	2.5	.7
31.	559.	112.7	36.2	17.1	8.0	34.5	13.0	1.2	1.8	4.9	3.2	2.5	.7
32.	545.	116.4	41.6	20.2	9.8	35.1	16.0	1.3	1.7	5.4	2.8	2.4	.7
33.	532.	107.1	33.1	17.7	9.9	31.9	12.2	.9	.7	4.7	2.3	2.4	.7
34.	489.	112.3	33.1	16.3	8.5	32.4	12.2	.8	.6	4.3	2.0	2.3	.7
35.	610.	112.2	42.3	17.0	8.9	31.3	12.6	.9	.9	5.0	2.6	2.2	.6
36.	331.	132.8	35.4	22.3	9.9	38.7	11.7	1.1	.3	5.4	2.7	2.3	.6
37.	340.	127.3	35.6	20.6	8.5	35.7	11.0	1.0	.7	5.5	2.4	2.3	1.0
38.	668.	108.2	35.7	18.3	9.3	31.1	11.3	1.1	.3	5.4	2.7	2.3	.6
39.	362.	126.5	32.0	18.7	6.9	35.2	10.8	1.0	.7	5.1	2.4	2.2	.7
40.	377.	127.1	30.3	17.8	5.7	34.8	11.5	.9	.5	4.9	2.2	2.1	.6
41.	604.	110.2	35.9	16.1	6.9	30.6	10.9	1.0	.8	5.0	2.8	2.2	.7
42.	339.	124.5	26.8	16.6	5.6	32.9	9.3	.8	.6	4.9	2.5	2.1	.7
43.	321.	114.7	31.3	23.5	12.6	33.0	9.1	1.6	1.8	6.6	3.3	2.4	.7
44.	625.	107.5	31.5	19.0	5.9	30.5	9.9	1.2	1.3	5.7	3.8	2.3	.7
45.	349.	113.1	31.8	20.5	7.4	32.8	10.7	1.3	.8	6.2	3.2	2.3	.7
46.	360.	111.6	32.4	19.6	6.9	32.4	10.5	1.2	.7	5.9	2.6	2.3	.7
47.	534.	100.5	29.5	14.4	6.3	30.2	9.8	.8	.7	4.2	2.0	2.5	.7
48.	309.	123.7	33.8	16.7	5.6	36.0	9.9	.8	.6	4.3	1.7	2.4	.7
49.	353.	126.3	31.9	13.5	4.7	36.8	10.4	.5	.5	3.3	1.3	2.3	.6
50.	517.	111.7	35.9	12.0	4.7	33.4	9.9	.4	.5	3.0	1.4	2.4	.7

STATISTICAL SUMMARY BY LINE

LINE	RECS	*** K ***		*** U ***		*** T ***		*** U/K*10 ***		*** U/T*10 ***		*** T/K*10 ***	
		MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.	MEAN	ST.DEV.
51.	303.	112.9	36.5	18.9	7.7	33.8	10.3	1.2	1.1	5.2	2.5	2.5	.7
52.	315.	124.4	39.3	18.7	7.1	36.7	10.8	1.1	1.0	4.8	2.4	2.4	.8
53.	505.	106.6	39.4	16.0	7.4	32.6	10.7	.8	.7	4.2	2.0	2.4	.7
54.	388.	117.2	32.3	17.0	5.8	34.0	10.3	.9	.6	4.7	2.3	2.4	.6
55.	319.	119.3	29.1	13.2	4.4	35.1	9.2	.5	.5	3.3	1.4	2.4	.6
56.	547.	104.6	34.3	11.9	5.9	33.1	10.0	.6	1.3	3.2	2.3	2.6	.7
57.	318.	126.4	34.6	12.3	4.5	35.8	11.1	.4	.5	3.2	1.6	2.3	.6
58.	327.	115.3	25.5	11.9	4.2	33.4	10.2	.4	.5	3.1	1.3	2.3	.7
59.	542.	104.9	40.5	13.1	5.5	32.2	9.9	.6	.6	3.6	1.9	2.4	.7
60.	337.	122.8	29.6	14.3	5.4	35.4	11.5	.6	.5	3.8	1.6	2.3	.6
61.	322.	126.6	31.4	18.7	6.2	35.5	11.1	.9	.6	5.0	1.8	2.2	.6
62.	523.	117.8	35.1	13.7	6.6	35.4	11.1	.6	.9	3.4	2.0	2.4	.6
63.	327.	136.7	34.2	17.0	6.2	38.7	11.7	.7	.6	4.0	1.7	2.4	.6
64.	403.	126.8	29.3	21.5	6.2	38.4	9.2	1.2	.6	5.2	1.8	2.5	.6
65.	630.	110.9	31.0	16.9	8.0	34.0	9.2	.9	.7	4.4	2.4	2.5	.6
66.	338.	135.0	33.8	15.9	5.1	39.7	9.4	.6	.6	3.5	1.4	2.3	.6
67.	359.	143.5	37.4	23.2	11.4	41.3	10.5	1.1	.9	5.1	2.4	2.3	.6
68.	565.	120.7	36.6	18.4	10.5	34.9	9.7	.9	.9	4.7	2.6	2.4	.6
69.	363.	154.7	33.1	26.7	10.4	42.3	9.2	1.2	.8	6.0	2.6	2.2	.5
200.	297.	86.5	24.5	11.4	4.1	26.4	7.9	.7	.6	3.9	1.8	2.5	.6
201.	340.	90.5	28.5	10.9	4.4	26.1	8.0	.5	.6	3.7	1.7	2.2	.6
202.	359.	91.5	23.7	10.0	4.0	31.4	12.4	.5	.6	2.8	1.5	2.9	1.1
203.	426.	111.5	35.1	16.7	8.0	32.1	10.8	1.0	1.0	4.9	3.0	2.3	.7
204.	331.	115.1	34.9	14.7	6.8	37.1	13.7	.7	.6	3.3	1.5	2.6	.8
205.	467.	111.0	37.0	17.2	7.5	33.2	12.0	1.0	.9	5.1	3.3	2.4	.8
206.	469.	115.4	33.5	15.9	6.2	32.2	9.9	.9	.7	4.7	2.4	2.2	.6
207.	456.	122.7	40.3	20.6	10.5	35.6	13.6	1.1	.8	5.4	3.1	2.3	.7

APPENDIX E
COMPARISON OF GEOLOGIC MAP SYMBOLS
WITH COMPUTER DESIGNATIONS

APPENDIX E-1

COMPARISON OF GEOLOGIC MAP SYMBOLS WITH COMPUTER DESIGNATIONS

- OKANOGAN QUADRANGLE -

<u>Computer Numeric Code</u>	<u>Computer Letter Code</u>	<u>Map Code</u>
1	WATER	(water)
3	UNMAP	(unclassified) *
101	Q	Q
102	QAL	Qal
103	QG	Qg
104	QT	Qt
105	TOB	Tob
106	TSA	Tsa
108	TI	Ti
109	TG	Tg
110	TQM	Tqm
111	TD	Td
112	TMG	Tmg
113	TO	To
114	TP	Tp
115	TSC	Tsc
116	TVM	Tvm
117	TC	Tc
118	TSS	Tss
119	TS	Ts
120	TAD	Tad
121	TA	Ta
122	TB	Tb
123	TW	Tw
124	TK	Tk
125	TKQM	TKqm
126	TJBM	TJbm
201	KGD	Kgd
202	KD	Kd
203	KQ	Kq
204	KOB	Kob
205	KM	Km
206	KG	Kg
207	KCG	Kcg
208	KC	Kc
209	KPGD	Kpgd
210	KOTG	Kotg
211	KO	Ko
212	KGT	Kgt
213	KJGD	KJgd
214	KJD	KJd
215	KJA	KJa
216	KJM	KJm
217	KJE	KJe
218	KJEL	KJel
219	JT	Jt
220	JBG	Jbg

APPENDIX E-1 CONT'D

<u>Computer Numeric Code</u>	<u>Computer Letter Code</u>	<u>Map Code</u>
221	JSG	Jsg
222	JTRWM	JTrwm
223	JTRS	JTrs
224	JTRO	JTro
225	JTRGN	JTrgn
226	MZI	Mzi
227	MZT	Mzt
228	MZH	Mzh
229	MZHM	Mzhm
230	MZW	Mzw
231	MZC	Mzc
233	MZB	Mzb
234	MZD	Mzd
235	MZL	Mzl
236	MZG	Mzg
237	MZR	Mzr
238	MZJ	Mzj
239	MZM	Mzm
240	MZS	Mzs
241	TRL	Trl
242	TRGA	Trga
243	TRK	Trk, TrPk
244	TRC	Trc
245	TRKC	Trkc
246	TRS	Trs
247	TRPLS	TrPls
248	TRPB	TrPb
249	TRPSV	TrPsv
250	TRPPM	TrPpm
251	TRPP	TrPp
252	TRPG	TrPg
253	TRPS	TrPs
254	TRPGR	TrPgr
255	TRPPQ	TrPpq
301	PBM	Pbm
302	PS	Ps
303	PR	Pr
304	PA	Pa, Pzan
305	PPTU	pPtU
306	PPMQ	pPmq
307	PPMF	pPmf
308	PZLS	Pzls
309	PZA	Pza
310	PZC	Pzc
311	PZB	Pzb
312	PZSM	Pzsm
313	PZCQ	Pzcq
314	PZPCM	PzpCm
315	PZMS	Pzms

APPENDIX E-1 CONT'D

<u>Computer Numeric Code</u>	<u>Computer Letter Code</u>	<u>Map Code</u>
316	PZM	Pzm
317	PZS	Pzs
318	PZW	Pzw
319	PZG	Pzg
320	CA	Ca
321	COD	Cod
322	OL	Ol
323	OCC	Occ
401	PCE	pce
402	PCH	pch
403	PCM	pcm
404	PCO	pco
405	PCB	pcb
406	PCT	pct

* The unclassified map unit category occurs only in areas beyond the quadrangle boundaries, and is not included in the map legend.

APPENDIX E-2

COMPARISON OF GEOLOGIC MAP SYMBOLS WITH COMPUTER DESIGNATIONS

- SANDPOINT QUADRANGLE -

<u>Computer Numeric Code</u>	<u>Computer Letter Code</u>	<u>Map Code</u>
1	WATER	(water)
3	UNCLA	unclassified *
101	QAL	Qal
102	QT	Qt
103	QLS	Qls
104	QG	Qg
105	QTG	Qtg
106	QAG	Qag
107	TB	Tb
108	TL	Tl
109	TG	Tg
110	TA	Ta
111	TCG	Tcg
112	TO	To
113	TC	Tc
114	TMV	Tmv
115	TSR	Tsr
116	TDG	Tdg
117	TM	Tm
118	TS	Ts
119	TSH	Tsh
120	TRD	Trd
121	TSG	Tsg
122	TQ	Tq
123	TI	Ti
124	TF	Tf
125	TOT	Tot
126	TCP	Tcp
127	TSP	Tsp
128	TSQ	Tsq
129	TCA	Tca
130	TBR	Tbr
131	TKPA	TKpa
132	TKT	TKt
133	TKG	TKg
134	TKL	TKl
201	KSM	Ksm
202	KS	Ks
203	KB	Kb
204	KD	Kd
205	KGD	Kgd
206	KM	Km
207	KQ	Kq
208	KQM	Kqm

APPENDIX E-2 CONT'D

<u>Computer Numeric Code</u>	<u>Computer Letter Code</u>	<u>Map Code</u>
209	KBG	Kbg
210	KBQ	Kbq
211	KC	Kc
212	KF	Kf
213	KG	Kg
214	KGA	Kga
215	KTQ	Ktq
216	KGQ	Kgq
217	KHM	Khm
218	KKH	Kkh
219	KKT	Kkt
220	KL	Kl
221	KGP	Kgp
222	KWS	Kws
223	KNA	Kna
224	KPQ	Kpq
225	KSF	Ksf
226	KSP	Ksp
227	KTM	Ktm
228	HB	hb
229	JL	Jl
230	JR	Jr
231	JD	Jd
232	JMI	Jmi
233	JTRF	JTrf
234	JTRP	JTrp
301	PPMR	Pmr
302	CX	Cx
303	PZU	Pzu
304	CP	Cp
305	CF	Cf
306	CG	Cg
307	DA	Da
308	DS	Ds
309	OLU	Olu
310	CL	cl
311	CM	cm
315	Cr	cr
316	CGC	cgc
317	CU	cu
318	CMA	ema
321	CQ	eq
401	PCWI	pwi
404	PCH	peh
407	PCG	peg
408	PCMG	pcmg

APPENDIX E-2 CONT'D

<u>Computer Numeric Code</u>	<u>Computer Letter Code</u>	<u>Map Code</u>
409	PCDT	pCdt
410	PCBU	pCbu
419	PCAG	pCag
420	PCBR	pCbr
421	PCIH	pCih
422	PCBC	pCbc
423	PCN	pCn
424	PCH	pCh
425	PCM	pCm

- * The unclassified map unit category occurs only in areas beyond the quadrangle boundaries, and is not included in the map legend.

APPENDIX F

NUMBER OF SAMPLES USED TO GENERATE
MEAN AND STANDARD DEVIATIONS

APPENDIX F-1

NUMBER OF SAMPLES USED TO GENERATE MEAN AND STANDARD DEVIATION

- OKANOGAN QUADRANGLE -

<u>Map Code</u>	<u>K</u>	<u>U</u>	<u>Th</u>
(water)	336	188	173
Unclassified**	498	401	493
Q	552	524	550
Qal	51	50	51
Qg	6022	5663	5991
Qt	49	46	49
Tob	55	46	55
Tsa	42	41	42
Ti*	6	5	6
Tg	104	100	104
Tgm	182	179	182
Td	297	219	297
Tmg*	0	0	0
To	226	204	226
Tp	150	123	148
Tsc	162	143	162
Tvm*	0	0	0
Tc	35	24	35
Tss	30	30	30
Ts	1931	1772	1931
Tad	83	58	83
Ta	429	379	429
Tb	758	724	758
Tw*	13	13	13
Tk	680	656	680
TKqm	85	75	85
TJbm*	1	1	1
Kgd	327	313	327
Kd	43	39	43
Kq	626	558	626
Kob	771	371	754
Km*	3	3	3
Kg	249	240	249
Kcg*	0	0	0
Kc	191	133	190
Kpgd	117	104	117
Koty*	9	8	9
Ko	83	62	83
Kgt*	1	1	1
KJgd	18	18	18
KJd*	3	3	3
KJa*	8	8	8
KJm*	0	0	0
KJe	23	22	23
KJel	16	15	16

APPENDIX F-1 CONT'D

<u>Map Code</u>	<u>K</u>	<u>U</u>	<u>Th</u>
Jt*	4	4	4
Jbg	30	27	30
Jsg*	9	9	9
JTrwm	24	23	24
JTrs*	2	2	2
JTro*	4	4	4
JTrgn	57	57	57
Mzi*	0	0	0
Mzt	54	32	54
Mzh	50	33	50
Mzhm	48	37	48
Mzw*	6	5	6
Mzc	819	685	819
Mzb	28	19	28
Mzd*	3	2	3
Mzl	14	14	14
Mzg	5412	4708	5403
Mzr	277	261	277
Mzj	49	49	49
Mzm	34	30	34
Mzs	118	79	118
Trl	271	240	267
Trga*	3	3	3
Trk, TrPk	118	105	118
Trc	60	56	60
Trkc	228	213	227
Trs*	8	6	8
TrPls*	2	2	2
TrPb	41	40	41
TrPsv	47	35	47
TrPpm	34	17	24
TrPp	47	44	47
TrPg	57	54	57
TrPs	48	48	48
TrPgr	28	27	28
TrPpq	16	15	16
Pbm	39	35	39
Ps	208	198	208
Pr	97	89	97
Pa, Pzan	52	50	52
pPtU	37	33	37
pPmq	30	28	30
pPmf*	2	2	2
Pzls	68	61	67
Pza	1313	1283	1313
Pzc	1574	1525	1574
Pzb*	4	3	4
Pzsm*	4	4	4
Pzcq	245	233	245

APPENDIX F-1 CONT'D

<u>Map Code</u>	<u>K</u>	<u>U</u>	<u>Th</u>
PzpCm	503	479	503
Pzms	30	29	30
Pzm	125	119	125
Pzs	27	26	27
Pzw	108	106	108
Pzg	108	106	108
Ca	27	24	27
Cod	22	19	22
Ol*	10	10	10
OCC*	5	5	5
pCe	22	21	22
pCh*	16	11	16
pCm	24	19	24
pCo	42	42	42
pCb	35	26	35
pCt	43	38	43

* Unit not sampled sufficiently to permit accurate computation of mean and standard deviation.

** The unclassified map unit category occurs only in areas beyond the quadrangle boundaries, and is not included in the map legend.

APPENDIX F-2

NUMBER OF SAMPLES USED TO GENERATE MEAN AND STANDARD DEVIATION

- SANDPOINT QUADRANGLE -

<u>Map Code</u>	<u>K</u>	<u>U</u>	<u>Th</u>
(water)	459	280	233
Unclassified**	1744	1583	1742
Qal	1705	1627	1702
Qt*	6	4	6
Qls	82	68	82
Qg	3218	2615	3207
Qtg*	0	0	0
Qag	11106	10332	11080
Tb	227	217	227
Tl*	0	0	0
Tg*	11	11	11
Ta*	0	0	0
Tcg	140	134	140
To	59	57	59
Tc*	4	4	4
Tmv	28	28	28
Tsr	57	54	57
Tdg*	0	0	0
Tm*	0	0	0
Ts	599	587	599
Tsh*	9	7	9
Trd*	0	0	0
Tsg	85	82	85
Tq*	7	7	7
Ti*	0	0	0
Tf*	0	0	0
Tot*	0	0	0
Tcp*	0	0	0
Tsp	3219	2332	3217
Tsq	311	245	311
Tca*	8	8	8
Tbr*	7	7	7
TKpa	1407	1356	1407
TKt	182	173	182
TKg*	0	0	0
TKl*	0	0	0
Ksm	95	94	95
Ks*	0	0	0
Kb	27	27	27
Kd*	0	0	0
Kgd	437	389	437
Km	13	13	13
Kq*	0	0	0
Kqm	38	38	38
Kbg	45	38	45

APPENDIX F-2 CONT'D

<u>Map Code</u>	<u>K</u>	<u>U</u>	<u>Th</u>
Kbq	53	52	53
Kc	71	37	71
Kf	93	93	93
Kg	538	506	538
Kga	64	64	64
Ktq	86	86	86
Kgq*	4	4	4
Khm	247	243	247
Kkh	758	726	756
Kkt	278	244	278
Kl	140	140	140
Kgp	36	35	36
Kws	22	22	22
Kna	17	17	17
Kpq	78	76	78
Ksf	534	527	534
Ksp	263	241	263
Ktm	65	42	65
hb*	0	0	0
Jl*	0	0	0
Jr	55	41	55
Jd*	0	0	0
Jmi*	0	0	0
JTrf	65	54	65
JTrp	18	17	18
Pmr	103	99	103
Cx	67	65	67
Pzu	32	27	32
Cp	146	137	146
Cf	87	81	87
Cg	95	92	95
Da*	0	0	0
DS	16	16	16
Olu	237	233	235
el*	1	1	1
cm	680	547	678
cr*	0	0	0
egc*	1	1	1
eu*	9	8	9
ema	1142	946	1142
eq	970	685	969
pewi	599	258	582
pch	227	184	227

APPENDIX F-2 CONT'D

<u>Map Code</u>	<u>K</u>	<u>U</u>	<u>Th</u>
pCg*	2	0	2
pCmg	431	333	431
pCdt	423	386	423
pCbu	5585	4535	5576
pCag*	0	0	0
pCbr*	0	0	0
pCih*	0	0	0
pCbc	93	58	93
pCn	68	65	68
pCh*	2	2	2
pCm	1266	1128	1265

* Unit not sampled sufficiently to permit accurate computation of mean and standard deviation.

** The unclassified map unit category occurs only in areas beyond the quadrangle boundaries, and is not included in the map legend.

APPENDIX G

MICROFICHE SINGLE RECORD
AND AVERAGE RECORD LISTINGS