UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

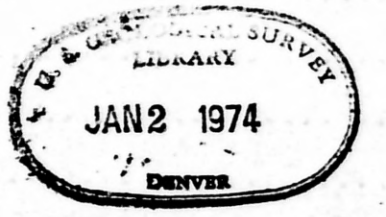
RADPAC SYSTEM DOCUMENTATION

PART I-DESCRIPTION

PART II-USER'S MANUAL

by

Gary I. Selner and Vincent J. Flanigan



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ABSTRACT

A system of computer programs has been developed by the U. S. Geological Survey for reduction of digital data from airborne gamma-radiation surveys of the Arabian Shield. The data reduction system, known by the acronym "RADPAC" (radiation package), processes observed radiation data, makes corrections, adjustments, filters the data, computes interchannel ratios, and presents the results in visual forms as nested profiles and contour maps.

INTRODUCTION

A data reduction system called RADPAC has been developed by the U. S. Geological Survey Saudi Arabian Project to reduce and compile geophysical data recorded digitally on magnetic tape. RADPAC is used specifically to compile spectrometer data from airborne gamma-radiation surveys on the Arabian Shield. The system may be used with modifications to compile other types of geophysical data such as airborne magnetic data. It is designed to compile flight line data, make necessary correction and adjustments, and produce visual data displays in the form of nested profiles and contour maps.

RADPAC consists of a master control section and a series of subroutines combined in a catalogue procedure and overlay program structure to produce a system which is easy to use and requires a minimum number of Job Control Language (JCL) Cards.

The series of computer subroutines described here are designed to process radiation data collected digitally by airborne instruments. Subroutines have been kept general so that they may be useful in working with other types of data such as magnetic intensity readings. Their specific purpose, however, is to handle five channels of radiation data: total count, potassium, uranium, thorium, and radar altimeter. Interaction of the entire system is illustrated in figure 1.

This report describes the RADPAC system (Part I) and includes a User's Manual (Part II).

The RADPAC system preliminarily described by Andreasen and Flanigan (1969) was developed under a work agreement between the U. S. Geological Survey and the Ministry of Petroleum and Mineral Resources, Kingdom of Saudi Arabia. Appreciation is expressed to the Ministry for logistical and other support received during the course of the work.

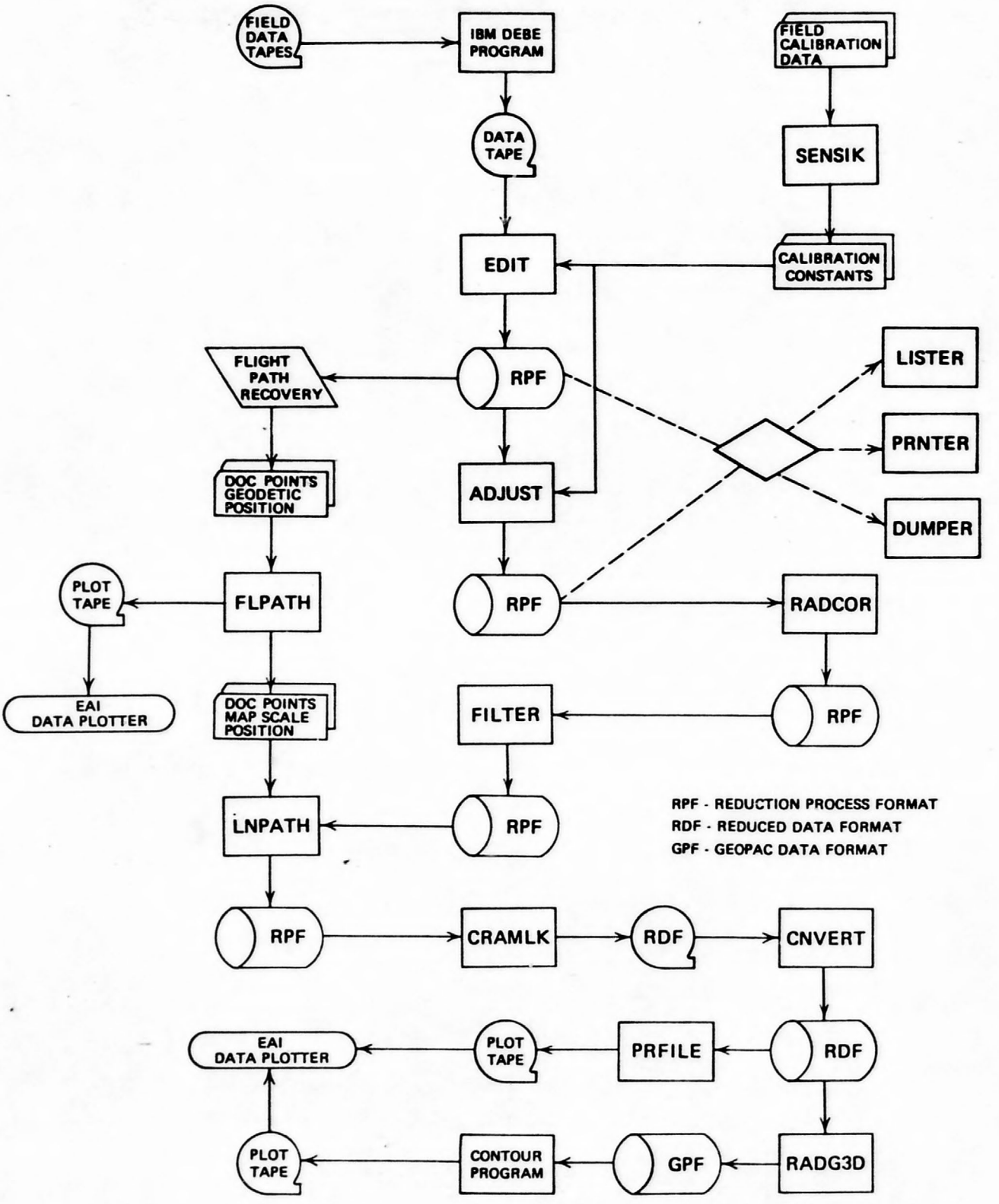

Figure 1.- Interaction of the RADPAC system.

PART I

DESCRIPTION

MASTER CONTROL SECTION

The RADPAC system utilizes a number of available subroutines and data files which are managed through the Master Control Section. The user specifies on an EXECUTE card the subroutine he wishes to execute and the files to be utilized. The Master Control Section reads the EXECUTE card and calls the appropriate subroutine from a library on disk into core memory for execution. Upon completion of the subroutine, control returns to the Master Control Section. If another EXECUTE card is supplied by the user, the requested subroutine is called into core memory, overlaying the previous one. This logic is followed until all the requested subroutines have been executed. The Master Control Section then terminates the run and control is returned to the operating system.

DATA REDUCTION AND UTILITY SUBROUTINES

The following subroutines are designed to process the data recorded on magnetic tape by applying the necessary corrections. They combine flight position data with the data recorded on several individual survey flights into one complete data file.

The field data tapes processed by these subroutines will have been copied to eliminate any unreadable records due to tape defects or equipment recording errors. This copying process is described in detail in the User's Manual (Part II) under Field Data Tape DEBE Process. Each field tape consists of three data files. Files 1 and 3 are recorded at an altitude above the ground where only gamma-radiation from cosmic sources are observed, hence are referred to as cosmic background data. File 2 is recorded at survey altitude and gamma radiation from terrestrial and cosmic sources are observed.

SENSIK

SENSIK (sensitivity K = constant) is a utility subroutine which reads from input cards field calibration data for the gamma-spectrometer and computes sensitivity constants for converting the digital data to counts per minute (CPM).

EDIT

EDIT subroutine reads the field data tape file 1 and computes and prints out an average of the cosmic data values for each data channel on the tape. It then reads file 2 and prints a list of events such as changes of line and documentation numbers and time of occurrence. The data is also written on a user-specified output file. File 3 is read and the average of the data values computed and printed for each data channel. Data recorded on files 1 and 3 in the radiation channels are used to compute cosmic radiation corrections to be removed from the data observed at survey altitude and recorded on file 2.

ADJUST

In the ADJUST subroutine, constants derived from preflight instrument calibration by the SENSIK subroutine are applied to the digital data recorded on file 2 of the field tape, converting the data to counts per minute (CPM). ADJUST also applies a base correction to the data, utilizing the average cosmic background data values computed by EDIT from data recorded on files 1 and 3 of the field tapes. Base correction values are computed on a time-linear basis over the period of each survey flight. Hence, for example, if the average cosmic background for the potassium channel from file 1 were 540 CPM, and the average at the end of the day's flight from data on file 3 is 580 CPM, the cosmic base correction would be from

540 to 580 CPM computed linearly over the period of the flight. Thus at the halfway point of the flight, the base correction factor would be 560 CPM.

RADCOR

RADCOR (Radiation correction) subroutine performs the following basic functions: (1) base adjustment; (2) altitude compensation; (3) Compton's scatter correction; and (4) computation of interchannel ratios.

(1) Base adjustment - A constant base adjustment may be made to the data channels if desired. The adjustment permits all the values in a data channel to be reduced or increased by a constant amount. The program algorithm is as follows: Z=Z+BG, where Z is the data value and BG is the base adjustment value.

(2) Altitude compensation - The radiation data are compensated for changes in the mean terrane clearance by the survey aircraft. The user establishes the datum to which the data are corrected. The user also establishes the factors necessary for converting the digital data in the altimeter channel to feet, and the coefficients of a polynomial fitted to experimental curves for the attenuation in air of the gamma energies of interest.

(3) Compton's scatter - The potassium and uranium channels are corrected for the counts contributed to these channels by higher gamma energies. The user supplies three constants by which these interchannel corrections are made. The constants, called stripping ratios, are described by Grasty (1971).

(4) Interchannel ratios - The user may, if he desires, compute ratios between any two data channels. The selected ratios are

computed on a single observation basis, for example, for each observation in the thorium channel, the corresponding observation in the uranium channel is used to compute a ratio: Z(Th)/Z(U)= R, where Z(Th) is the data value in the thorium channel; Z(U) is the data value in the uranium channel and R = ratio.

FILTER

A low pass filter designed to separate noise from signal is applied to the data by this subroutine. A predefined filter is generally used, but the user may supply a set of special filter weights if desired.

LNPATH

LNPATH (linear path) subroutine reads data cards containing positional data which are used to compute the position of each data observation in the input file. These computed positions and channel data observations are written on the specified output file.

CRAMLK

All points of observation and associated channel data within a specified area of interest are selected by the CRAMLK(cram link) subroutine. The data may be rotated in reference to the X, Y ordinate axis. The data is written on the output file in a format that is acceptable to the Visual Display subroutines.

LISTER

LISTER subroutine prints the contents of the input data file for checking during processing, if desired. The user can list all or selected data channels within a specified time interval or flight line number.

PRNTER

PRNTER is a utility subroutine which can be used to make a printer profile plot of the flight line data. Up to four channels of data may be plotted for each flight line selected. There are no limits on the number of flight lines selected for plotting.

DUMPER

DUMPER is a utility subroutine which can be used to print on the line printer the entire contents of a specified data file.

CNVERT

CNVERT (convert) subroutine reads the reduced data file and converts on option the spectral data, that is the potassium, uranium, and thorium counts per minute to percent potassium, ppm (parts per million) throium, and ppm uranium. The conversion constants must be supplied by the user. Ratios between the spectral data channels are computed at this time if desired. Ratios are computed using a three point moving average on the two data channels. The user must set limits (upper and lower) for the three spectral data channels and in the event the data in one of the data channels is outside the specified limits; the appropriate limit is substituted.

The original channel data and the ratio data are written on disk for input to the visual display subroutines.

DELETE

DELETE is a subroutine which reads and deletes selected lines from the CRAMLK data file, in the event that further adjustments must be made to the data on one of the field data tapes.

VISUAL DISPLAY SUBROUTINES

Visual display subroutines described in following paragraphs are written to display the reduced data in a visual manner. The subroutines utilize the software for the Electronic Associates, Inc. (EAI) model 430 Data-Plotter but could be converted to operate on any other data-plotter.

FLPATH

FLPATH (flight path) subroutine processes the data deck that is key punched from the flight path recovery step (Part II - User's manual). The subroutine reads the documentation points, their geodetic position in latitude and longitude, the time the observation was made, the line number, and projects the positions to a Lambert conformal projection referenced to a given central meridian. Positions are converted to the given map scale that is referenced to a lower left hand corner orientation point supplied by the user. The observational time of the documentation points is adjusted to correct for time constant data lag in the flight direction. As output, the subroutine prints the documentation points and their projected position in inches at map scale and punches on IBM cards the documentation numbers, adjusted times, line numbers, and the positions at the map scale. The punched data deck is kept for input into the LNPATH subroutine. A plot tape may be generated which produces a flight line map on the EAI data-plotter. The flight line map is used to check the positions of the documentation points determined manually by comparison to the original positions plotted on a photomosaic of the area flown.

PRFILE

PRFILE (Profile) subroutine reads scale information for desired nested profiles from punched cards and the data from the CNVERT subroutine. It then produces a plotter tape on which data from a selected channel is plotted versus flight line distance from a computed central meridian.

RADG3D

RADG3D (radiation grid 3-dimensional) subroutine is a version of the U. S. Geological Survey Computer program W9322 (unpublished computer program documentation). It inputs grid control parameters from punched cards and the output file of CNVERT subroutine. In addition to a printer contour map, it generates an orthogonal grid of data values which are written on an output file for entry into other contour programs.

DATA FILES

RADPAC utilizes nine data files. The processing sequence of RADPAC is such that data from one subroutine flows into the succeeding subroutine from a data storage file. These files may be either magnetic tape or disk storage area. The user is allowed to select the input-output file he wishes to use except in those subroutines in which the input or output file is set by the subroutine, such as EDIT, CRAMLK, and the visual display subroutines. Table 1 shows how the data files may be utilized. Files 10, 11, and 13 may be selected by the user as either input or output as he desires. Files 8 and 16 are set in the EDIT and CRAMLK subroutines respectively as input and output files. Thus if he selects file 10 as the output file for ADJUST, file 10 must be selected as the input file for the next subroutine which he wishes to use, he then selects another file, such as 11, for the output file of the next subroutine he uses, etc.

Table 1. File utilization

	Program name	File number								
		8	9	10	11	12	13	14	15	16
DATA REDUCTION SUBROUTINES	EDIT	I_1	-	O_2	O_2	-	O_2	-	W	-
	ADJUST	-	-	U_2	U_2	-	U_2	-	-	-
	RADCOR	-	-	U_2	U_2	-	U_2	-	-	-
	FILTER	-	-	U_2	U_2	-	U_2	-	-	-
	LNPATH	-	-	U_2	U_2	-	U_2	-	W	-
	LISTER	-	-	I_2	I_2	-	I_2	-	-	-
	PRNTER	-	-	I_2	I_2	-	I_2	-	-	-
	DUMPER	-	-	I_2	I_2	-	I_2	-	-	-
	CNVERT	-	-	-	-	O_3	-	-	-	I_3
	DELETE	-	O^*_3	-	-	-	-	-	-	I_3
	CRAMLK	-	-	I_2	I_2	-	I_2	-	-	O_3
VISUAL DISPLAY SUBROUTINES	FLPATH	-	O_4	-	-	-	-	-	W	-
	PRFILE	-	O_4	-	-	I_3	-	-	-	-
	RADG3D	-	-	-	-	I_3	-	O_5	-	-
DEVICE TYPE		T_7	T_9	*	*	*	*	*	*	*

I = Input.
U = Input or output.
W = Work.
O = Output.
1 = Incre-Data format.
2 = Reduction process format.
3 = Reduced data format.
4 = EAI plotter format
5 = Grid data format
T7 = 7-track magnetic tape
T9 = 9-track magnetic tape
* = May be magnetic tape or disc.

DATA FILE FORMATS

RADPAC utilizes three data file formats: (1) a reduction process file, (2) a reduced data file, and (3) a gridded data file.

Reduction process file

The reduction process file format is utilized by the data reduction subroutines. This format is used when the data is in the form of a time dependent series of flight line observations. The file consists of three types of unformated binary data records which are: ID records, documentation point records, and data records. Record formating is fully discussed in the IBM System 370 Fortran IV Language Manual (1971). The record formats listed below show the variable, its type and length of the variable in bytes.

ID record

ITEM NUMBER	VARIABLE NAME	TYPE. LENGTH (bytes)	DESCRIPTION
1	ID	A*12	Twelve alphanumeric characters identifying the data.
2	NOBSOM	I*4	The maximum number of observations in any data record in this data set.
3	NCHN	I*4	The number of data channels in this data set.
4	DATF	A*4	The date of the year when this data set was created.
5	DELT	R*4	The scanning rate or time interval between observations.
6	NDOC	I*4	The number of documentation points.

Documentation point records

If NDOC in the ID record is greater than zero, there will be one or more documentation point records.

ITEM NUMBER	VARIABLE NAME	TYPE, LENGTH (bytes)	DESCRIPTION
1	$DOCNO_i$	I*4	The integer number identifying the documentation point.
2	$TIME_i$	R*4	The time at which the flight passed over the documentation point.
3	X_i	R*8	The X coordinate of the documentation point.
4	Y_i	R*8	The Y coordinate of the documentation point.

Data Records

Data records contain the values observed in each channel of the gamma spectrometer. They are in a variable-length blocked format, which consists of two parts: (1) record information; and (2) data observations:

Record information

ITEM NUMBER	VARIABLE NAME	TYPE, LENGTH (bytes)	DESCRIPTION
1	TS	I*4	An integer which gives the time of the first observation in units of DELT (time interval between observations).
2	NOBS	I*4	The number of data observations in this record.
3	SID	I*4	The identification number of segment (or flight line) on which these observations were collected.
4	XMIN	R*8	The minimum X coordinate in this record.
5	XMAX	R*8	The maximum X coordinate in this record.
6	YMIN	R*8	The minimum Y coordinate in this record.
7	YMAX	R*8	The maximum Y coordinate in this record.

Data observation

ITEM NUMBER	VARIABLE NAME	TYPE, LENGTH (bytes)	DESCRIPTION
1	X_i	R*8	The X coordinate for this observation.
2	Y_i	R*8	The Y coordinate for this observation.
3	Z_i	R*4	The value of data channel 1.
4	Z_2	R*4	The value of data channel 2.
NCHN+2	Z_{NCHN}	R*4	The value of data channel NCHN.

Reduced data file

The reduced data file consists of unformated binary data records containing individual observations and the associated data channel values reduced (processed thru the reduction subroutines) for entry into the visual display subroutines.

Record information

ITEM NUMBER	VARIABLE NAME	TYPE, LENGTH (bytes)	DESCRIPTION
1	LINE	I*4	The flight line number.
2	X	R*4	The X coordinate.
3	Y	R*4	The Y coordinate.
4	Z_1	R*4	The data value of channel 1.
5	Z_2	R*4	The data value of channel 2.
NCHN	ZNCHN	R*4	The data value of channel NCHN

Gridded data file

The gridded data file contains the orthogonal grid of data values generated by the RADG3D subroutine which may be input into a contour program. Two unformated binary records, the ID record and data record are contained in the gridded data file format.

ID record

ITEM NUMBER	VARIABLE NAME	TYPE, LENGTH (bytes)	DESCRIPTION
1	ID	A*4	4 characters.
2	NR	I*4	Number of rows.
3	NC	I*4	Number of columns.

Data record

ITEM NUMBER	VARIABLE NAME	TYPE, LENGTH (bytes)	DESCRIPTION
1	Z_{ij}	R*4	The data matrix read or written by rows.

INPUT CARD FORMATS

Job Control Language cards (JCL) are necessary to execute any subroutine in the RADPAC system. They define for the IBM operating system the number, size, and how the data will be written on the data storage files necessary for the RADPAC system. In order to simplify for the user the use of JCL cards a catalog procedure is used. The catalog procedure containing the necessary JCL cards is stored as part of the IBM operating procedure library, and is called the RADSYS procedure. Thus when the user enters a request to execute RADSYS, the IBM system retrieves from its procedure library the RADSYS catalog procedure and allocates the available hardward devices in order to execute the program. The RADPAC catalog procedure (RADSYS) is shown on figure 2.

The catalog procedure does, however, define five parameters as symbolic parameters and the user must define these parameters when he enters his request to execute the RADSYS procedures. The symbolic

```
//RADSYS PROC
//GO  EXEC PGM=RADPAC
//STEPLIB DD DSN=USG.LOADLIB,DISP=SHR
//GO.FT05F001 DD DDNAME=SYSIN
//GO.FT06F001 DD SYSOUT=A
//GO.FT07F001 DD SYSOUT=B,DCB=BLKSIZE=80
//GO.FT08F001 DD UNIT=(2400-2,,DEFER),VOL=SER=&MINI,LABEL=(1,NL),
//         DSN=A1,DISP=(OLD,KEEP)
//GO.FT08F002 DD UNIT=(2400-2,,DEFER),VOL=SER=&MINI,LABEL=(2,NL),
//         DSN=A2,DISP=(OLD,KEEP)
//GO.FT08F003 DD UNIT=(2400-2,,DEFER),VOL=SER=&MINI,LABEL=(3,NL),
//         DSN=A3,DISP=(OLD,KEEP)
//GO.FT09F001 DD UNIT=(2400,,DEFER),VOL=SER=&PLOT,LABEL=(,NL),
//     DSN=B,DISP=(NEW,KEEP),DCB=BLKSIZE=8000
//GO.FT10F001 DD UNIT=(2400,,DEFER),VOL=SER=&TAPE10,LABEL=(,NL),
//     DSN=C,DISP=(NEW,KEEP),DCB=(RECFM=VBS,BLKSIZE=2000)
//GO.FT11F001 DD DSN=&&RADI,UNIT=SYSDA,SPACE=(CYL,(20,5)),
// DCB=(RECFM=VBS,BLKSIZE=2000)
//GO.FT12F001 DD DSN=USG.CNVOUT,DISP=OLD,DCB=(RECFM=VBS,BLKSIZE=2000)
//GO.FT13F001 DD DSN=&&RAD2,UNIT=SYSDA,SPACE=(CYL,(20,5)),
// DCB=(RECFM=VBS,BLKSIZE=2000)
//GO.FT14F001 DD DSN=USG.CONGRID,DISP=OLD,DCB=(RECFM=VBS,BLKSIZE=528)
//GO.FT15F001 DD DSN=&&RAD3,UNIT=SYSDA,SPACE=(CYL,(20,5)),
// DCB=(RECFM=VBS,BLKSIZE=2000)
//GO.FT16F001 DD UNIT=AFF=FT10F001,VOL=SER=&TAPE16,LABEL=(,NL),
// DSN=E,DISP=(&STATUS,KEEP),DCB=(RECFM=VBS,BLKSIZE=1800)
//        PEND
```

Figure 2. Job Control Language Cards that make up the cataloged procedure RADSYS.

---

parameters are: (1) In the definition of file 8 (FT08F001 fig. 2). The volume-serial number of the field tape is defined as VOL=SER=&MINI, &MINI must be defined as a specific field tape number. (2) File 9 (FT09F001 fig. 2). The volume-serial of the plot tape is defined as VOL=SER=&PLOT, &PLOT must be defined as a specific plot tape number. (3) File 10 (FT10F001 fig. 2). The volume-serial of the tape file is defined as VOL=SER=&TAPE10, &TAPE10 must be defined as a specific tape number. (4) File 16 (FT16F001 fig. 2). The volume-serial of the tape file is defined as VOL=SER=&TAPE16, &TAPE16 must be defined as a specific tape number. (5) Also, in file 16 the disposition of the tape must be defined where the symbolic parameter

&STATUS is used DISP=(&STATUS,KEEP), &STATUS must be defined as either NEW or MOD. NEW means this is the first data set to be put on file 16. MOD means to add to the end of the data already entered on file 16 the next data set.

The execute statement which the user would use might be as follows: //EXEC RADSYS,F8=RD156,F9=5004,F10=5001,F16=40,STATUS=NEW.

DATA CHANNELS

The sequence of data channels and the generation of new data channels by the RADPAC subroutines is listed in table 2. As shown the RADPAC subroutine input and output data channel sequence is listed in the normal processing sequence. If the user desires, inter-channel ratios may be computed in RADCOR, in this case the ratio channels (R_1,R_2,R_3) would be stored as channel 1,2,3, and the sequence would then follow in that order.

The user selects data channels as input to CRAMLK (limit is 7) the output of CRAMLK is the same sequence as the selected input, that is, if channels 6,7,8, and 9 (FK, FTH, FU, FTC) were selected as input, to CRAMLK, the output would be channel 1,2,3, and 4 (FK,FTH,FU,FTC).

Subroutines RADG3D and PRFILE are not shown in table 2. One channel at a time is selected from the output of CNVERT as input to either RADG3D or PRFILE subroutines.

LIMITATIONS

There are no limitations to the number of observations in a data set processed by the RADPAC subroutines. The disk files however have a physical allocation size which may restrict the number of observations that can be processed using files 10,11, and 13. The region size of RADPAC with the buffers as specified in the cataloged procedure (fig. 2) is 195k bytes of storage.

Table 2. RADPAC data channels

INPUT DATA CHANNEL NUMBER										SUBROUTINE	OUTPUT DATA CHANNEL NUMBER									
1	2	3	4	5	6	7	8	9	10		1	2	3	4	5	6	7	8	9	10
K	TH	U	TC	ALT						EDIT	K	TH	U	TC	ALT					
K	TH	U	TC	ALT						ADJUST	K	TH	U	TC	ALT					
K	TH	U	TC	ALT						RADCOR	K	TH	U	TC	ALT					
K	TH	U	TC	ALT						FILTER	K	TH	U	TC	ALT	FK	FTH	FU	FTC	FALT
K	TH	U	TC	ALT	FK	FTH	FU	FTC	FALT	LNPATH	K	TH	U	TC	ALT	FK	FTH	FU	FTC	FALT
					* FK	* FTH	* FU	* FTC		CRAMLK	FK	FTH	FU	FTC						
					FK	FTH	FU	FTC		CNVERT	FK	FTH	FU	FTC	** R1	** R2	** R3			

EXPLANATION:

K - Potassium data

TH - Thorium data

U - Uranium data

TC - Total Count data

ALT - Altimeter data

FK, FTH, FU, FTC, indicates the data in that particular data channel has been filtered by a digital filter process.

R1 = Ratio 1

R2 - Ratio 2

R3 = Ratio 3

* User selects input to CRAMLK, limit 7 data channels.

** Interchannel ratios or option of user.

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PART II

USER'S MANUAL

PROCESSING DATA BY RADPAC

The field data tapes contain three data files. Files 1 and 3 are recorded at an elevation above the ground where only the contribution from cosmic radiation is observed by the gamma-spectrometer, and hence is referred to as the cosmic background data. File 2 is recorded at survey altitude and the spectrometer records both the terrestrial and the cosmic gamma radiation. One field data tape is generated for each survey flight, so if it were necessary to make five daily flights to cover a particular area, five field data tapes would be generated. Each of the field data tapes must be processed through the RADPAC system separately and are combined into one data file of reduced data by the CRAMLK subroutine.

The sequence of processing data by RADPAC subroutines is shown in figure 3. The RADPAC subroutines are described in the following pages in this general sequence, except for DUMPER, LISTER, PRNTER, and DELETE subroutines which are utility subroutines that are used only when necessary to check the data during processing.

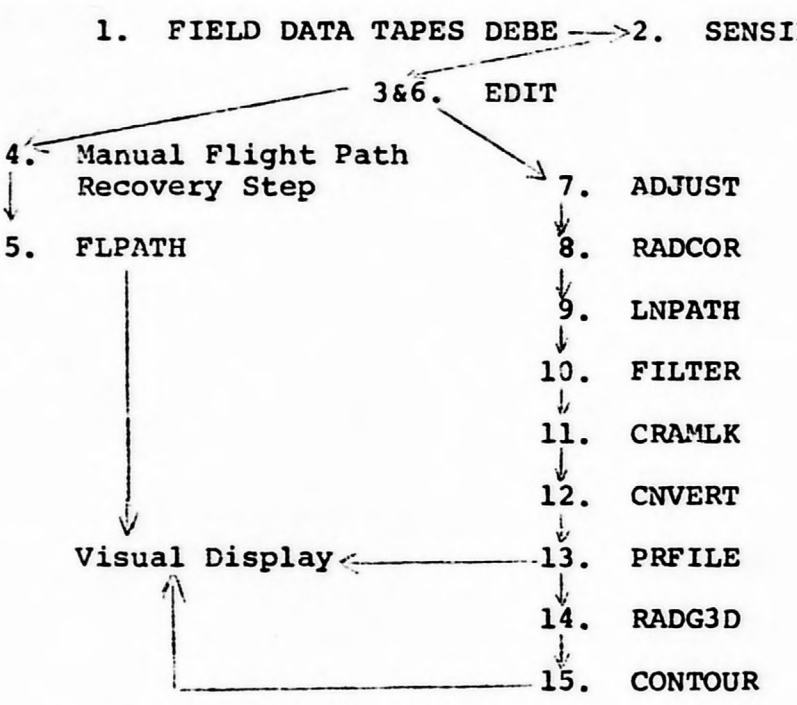

Figure 3. Data processing sequence

The reader is referred to figure 1 to see the interaction of the subroutines. Data is passed from one routine to the following one automatically except in the following two cases:

1. The appropriate sensitivity constants computed in SENSIK subroutine must be input by keypunched cards into EDIT routine for conversion of the digital cosmic data (files 1 and 3 of field tapes) to counts per minute. Another set of sensitivity conversion constants are input into the ADJUST subroutine for conversion of survey data (file 2 of field tapes) to counts per minute.
2. Data cards generated in the FLPATH subroutine must be input into the LNPATH subroutine; that is, only data from the survey lines that correspond to the data on the field tape being processed. For example, if tape 1 contained survey

lines 1 through 12, only data from lines 1 through 12 are used for input into LNPATH at that time. When the next field tape is processed the corresponding line data from FLPATH is used for the second tape, etc.

FIELD DATA TAPE DEBE PROCESS

Field data tapes must be verified for readability and edited to remove any records that cannot ne read due to parity errors or other tape defects. The editing process uses an IBM supplied program called "DEBE." DEBE is a simplified operating system, not under OS 360. Commands are typed on the console typewriter in response to typed messages. Messages and replies used to edit the field data are listed below:

Message	Reply	Explanation
ENTER PROGRAM ID	TD	Tape to printer
	TT	Tape to tape
	SF	Skip file
	SR	Skip record
	RW	Rewind tape
ENTER ADDRESS OF INPUT UNIT	30382	Address of unit 382
	00381	Address of unit 381
ENTER ADDRESS OF OUTPUT UNIT	00381	Address of unit 381
	30382	Address of unit 382
ENTER NO OF RECORDS TO BE SKIPPED	0001	1 record skipped
	0002	2 records skipped

Computer set-up

1. Mount DEBE program on unit 380 and make ready
2. Mount field data tape on unit 382 and make ready
3. Mount scratch tape (9 track) on unit 381 and make ready
4. Depress SYSTEM RESET button
5. Dial unit 380 on the IPL knobs on computer processing unit (CPU).

Check readability

After setting up the computer as outlined in steps 1-5 above, the three files of data on the field tapes are checked for readability as follows:

1. Depress the "LOAD" button on the CPU console. Message is typed "ENTER PROGRAM ID"
2. Reply "TD" and then hold down "ALTN CODING" key and depress "EOB" key
3. Message is typed "ENTER ADDRESS OF INPUT UNIT"
4. Reply 30382 and EOB (see 2)
5. After about 2 records are printed, depress "SYSTEM" reset and "LOAD" buttons. Check printer output; first record should be 24 characters in length, second record 4088 characters in length.
6. Reply "SF and "EOB" to message "ENTER PROGRAM ID"; message is typed "ENTER ADDRESS OF INPUT UNIT"
7. Reply 30382 and "EOB". The remainder of file 1 is skipped and tape is positioned at the start of file 2. Repeat steps 1-7 for data files 2 and 3
8. Reply "RW" and "EOB" to message "ENTER PROGRAM ID"
9. Reply 30382 and "EOB" to message "ENTER ADDRESS OF INPUT UNIT." Field tape is rewound and positioned at start of file 1.

Copy field data tape

The next step is to copy the 7-track field data tape to the 9-track unit 381. If any bad records are encountered they must be skipped so that only readable records are copied. Proceed as follows:

1. Depress "SYSTEM" reset and "LOAD"
2. Reply TT and "EOB" to message "ENTER PROGRAM ID"
3. Reply 00381 and "EOB" to message "ENTER ADDRESS OF OUTPUT UNIT"
4. Reply 30382 and "EOB" to message "ENTER ADDRESS OF INPUT UNIT".

File 1 is copied. Repeat 1-4 for files 2 and 3. If no bad records are encountered rewind both tapes (see "check readability" steps 8 and 9 and copy the data on unit 381 (9 track)) to a NEW 7-track tape on 382. This gives a backup tape of the field data. REMEMBER 30382 is now the output unit and 00381 is the input unit. If bad records are encountered in any of the data files during copying (steps 1-4), the unit will "hunt", move back and forward, and the record must be skipped. If this occurs proceed as follows:

5. Depress "SYSTEM" reset and "LOAD" buttons
6. Reply "SR" and "EOB" to message "ENTER PROGRAM ID"
7. Reply 30382 and "EOB" to message "ENTER ADDRESS OF INPUT UNIT"
8. Reply 0001 and "EOB" to message "NUMBER OF RECORDS TO BE SKIPPED"; 1 record will be skipped. Proceed with steps 1-4 to complete copying of the data files.

Repeat the edit processess for each field data tape.

SENSIK SUBROUTINE

The SENSIK subroutine computes sensitivity constants which are used in EDIT and ADJUST subroutines to convert digital channel data to counts per minute. Input data for SENSIK comes from inflight calibration of the gamma spectrometer.

DATA DECK

Card 1 - Program Control Card

Column	Format	Variable	Description
1-10	10X		EXECUTE
11-18	A8	PRGID	SENSIK (program ID)
38-39	I2	INPUT	NOT NEEDED
61-62	I2	OUTPUT	NOT NEEDED

Card 2 - Title Card

Column	Format	Variable	Description
1-80	20A4	INDENT	Title, any 80 alphanumeric characters

Card 3 - Calibration Data Card

1-20	5A4	TITLE	Channel number or numbers
21-30	F10.0	FS	Count-rate meter (CRM) full scale setting at which calibration was made
31-40	F10.0	CYCLE	Calibration frequency as read from the CRM in counts/second (CPS)
41-50	F10.0	DEC	Decimal number converted from octal number displayed on the Incre-Data recorder indicator lights. Incre-Data is the digital tape recorder

Card 4-6

One calibration data card, such as card 3, must be supplied for each data channel (1-4) if the calibration data is different in each of the channels. If the calibration data is the same in two or more of the channels, one card will be sufficient for computation of the sensitivity constants of these channels.

EDIT SUBROUTINE

The EDIT subroutine computes the average of the data values for each channel recorded on files 1 and 3 of the field data tapes. In addition, EDIT lists the documentation points, line numbers, and the time recorded on the tape when the documentation point was made or the line number was changed. EDIT writes all of the tape data onto an output file in the data reduction format.

DATA DECK

Card 1 - Program Control Card

Column	Format	Variable	Description
1-10	10X	--	EXECUTE
11-18	A8	PRGID	EDIT (Program ID)
38-39	I2	INPUT	Input file set in program
61-62	I2	OUTPUT	Output file number

Card 2 - Channel Conversion Card for data on file 1

Column	Format	Variable	Description
1-10	F10.0	CONS(I)	Sensitivity constant for channel 1
11-20	F10.0	CONS(I)	Sensitivity constant for channel 2
21-30	F10.0	CONS(I)	Sensitivity constant for channel 3
31-40	F10.0	CONS(I)	Sensitivity constant for channel 4

Card 3 - Channel Conversion Card for data on file 3

Column	Format	Variable	Description
1-10	F10.0	CONS(I)	Sensitivity constant for channel 1
11-20	F10.0	CONS(I)	Sensitivity constant for channel 2
21-30	F10.0	CONS(I)	Sensitivity constant for channel 3
31-40	F10.0	CONS(I)	Sensitivity constant for channel 4

FLIGHT PATH RECOVERY STEP

Flight path recovery is a manual process which utilizes the film from the tracking camera, the flight logs, and the field photographs to establish position in latitude and longitude of each of

the documentation points. The documentation points, times as listed from the EDIT subroutine, and the geodetic positions as determined from above recovery step are key-punched on IBM cards, one to a card, at the format listed below. These cards are input data for the FLPATH subroutine.

Documentation Point Cards

Column	Format	Variable	Description
1-5	I5	DOCNO	Documentation (DOC) point number
6-15	F10.2	TIME	Time of occurrence of DOC point
16-18	F3.0	LATD	Degrees of latitude
19-24	F6.2	LATM	Minutes of latitude to hundredths of a minute
25-27	F3.0	LONGD	Degrees of longitude
28-33	F6.2	LONGM	Minutes of longitude to hundredths of a minute
34-40	I7	NLINE	Line number

FLPATH SUBROUTINE

Functions of the FLPATH (flight path) subroutine are as follows:

A) Convert geodetic positions of documentation points to desired map projection and scale.

B) Adjust time of occurrence of documentation points.

C) Generate plot tape of survey flight lines.

DATA DECK

Card 1 - Program Control Card

Column	Format	Variable	Description
1-10	10X	--	Execute
11-18	A8	PRGID	FLPATH (Program ID)

Card 1 - Program Control Card (cont'd.)

Column	Format	Variable	Description
38-39	I2	INPUT	Input file number
61-62	I2	OUTPUT	Output file number

Card 2 - Title Card

1-80	20A4	TITLE	Title for flight path map - any 80 alphanumeric characters

Card 3 - Parameter Card

Column	Format	Variable	Description
25-27	F3.0	CMD	Degrees of central meridian of survey area
28-33	F6.2	CMM	Minutes of central meridian to hundredths of a minute
41-44	A4	IPLOT	Plot option; put in word "Plot." If left blank no plot tape will be made
51-60	F10.0	SCALE	Map scale. Example: 100000.= 1:100,000 scale
61-70	F10.0	DELTT	Time in seconds to be subtracted from documentation point times to account for data lag due to the integration time (time CONSTANT) of the electronics
71-80	F10.0	DEG	The angle that the flight line number will be printed. Use 90.0 for N-S lines, leave blank for E-W lines

Cards 4-7 - Orientation Point Cards

One card for each point beginning with the lower left corner and going counter clockwise.

Column	Format	Variable	Description
16-18	F3.0	LATD	Degrees of latitude
19-24	F6.2	LATM	Minutes of latitude to hundredths of a minute

Cards 4-7 - Orientation Point Cards (cont'd.)

Column	Format	Variable	Description
25-27	F3.0	LONGD	Degrees of longitude
28-33	F6.2	LONGM	Minutes of longitude to hundredths of a minute

Card 8-N - Documentation Point Card produced in the flight path recovery step.

Card N+1 - Delimeter Card - Must have 9999 in columns 2-5

ADJUST SUBROUTINE

ADJUST subroutine converts the digital data on channels 1-4 of file 2 to counts per minute. It also applies a base correction to the data which represents the contribution of cosmic radiation sources to the data observed at survey height. Thus, the raw data observed (D_o) is reduced by the amount of the cosmic background counts (C_{bg}) to give net counts in each data channel (D_n) as follows: $D_o - C_{bg} = D_n$; D_n then represents only the gamma-radiation from terrestrial sources.

DATA DECK

Card 1 - Program Control Card

Column	Format	Variable	Description
1-10	10X	--	EXECUTE
11-18	A8	PRGID	ADJUST (Program ID)
38-39	I2	INPUT	Input file number (same as output file from EDIT subroutine)
61-62	I2	OUTPUT	Output file number

Card 2 - Identification Card

The ID card contains 12 characters from the header record which were written on the field tape during recording date of usage of the subroutine, and an option to change the 12 characters of the

header record identification number.

Column	Format	Variable	Description
1-12	3A4	ID1	Identification number
13-16	A4	DATE1	Date of usage - last digit of the year followed by the Julian date of the year
17	I1	IOPT	An option to permit correction of the identification number. The program checks CARD COLUMN (CC) 1-12 with the header record number; if they do not match a message is written "TAPE ID DOES NOT MATCH." If option is blank or zero (CC-17) the program terminates. If the option is set to 1 the program accepts the 12 characters supplied on the card and uses them for identification on the output data file

Card 3 - Conversion Card

Column	Format	Variable	Description
1-10	10X		Enter the word SENSITIV
11-20	I10	MC	The number of channels to be be converted from digital numbers to counts/minute, i.e., 4

Card 4 - Channel Card

1-10	10X		Enter the word CHANNEL
11-20	I10	MCH	The channel number to be converted
31-40	I10	M	Number of sensitivity data cards for this channel

Card 5 - Channel Conversion Card

There will be one or more channel conversion cards depending on the changes on sensitivity setting changes during the flight. If, for example, the sensitivity is changed on channel 1 while on line,

two sensitivity cards are necessary for channel 1. Until time 1 is reached the program uses the first conversion constant. Between TIME-1 and TIME-2 the data is deleted to allow for the electronics to settle down and remove any data associated with the mechanical-electrical switching. Until TIME-1 is reached on the second channel conversion card, the second conversion constant is used. There must be at least one channel conversion card for each channel to be converted. The channel conversion cards have the following format:

Column	Format	Variable	Description
1-10	F10.0	TB1	TIME1 - until this time is reached the conversion constant is CC. 21-30 is used
11-20	F10.0	TB2	TIME2 - delete the data in the channel from TIME1 until TIME2 and then use the conversion given on the second card until TIME1 on that card is reached
21-30	F10.0	CON	Conversion constant
Card 6 - Base Adjust Card			
1-10	10X		Enter "BASE ADJ"
11-20	I10	NC	Number of data channels to which a base adjust is to be applied
Card 7 - Base Adjust Channel Cards			
1-10	10X		Enter word "CHANNEL"
11-20	I10	NCH	The channel number to which the base adjust is to be applied
31-40	I10	N	The number of base data cards for this channel

Card 8 - Base Data Cards

There should be as many base data cards as specified by NC in card 7.

Column	Format	Variable	Description
1-10	F10.0	T1	TIME1 - until this time is reached use the base adjustment supplied in CC 11-20
11-20	F10.0	ADJ	The base value to be added in CPM (to subtract a base value enter negative number)

If a sloping base is desired, another base data card must be supplied like card 8. TIME1 on the first card is the start time of the tape. TIME1 on the second card is the end TIME of the survey data (file 2) and the program computes a sloping base adjustment for each data observation, interpolated by time between the two TIMES given, based on the two base values specified in CC 11-20 of the base data cards.

There must be the same number of base adjust channel cards as is specified in NCH on the Base Adjust Channel Card CC 11-20. That is, if a base adjustment is to be applied to 4 data channels there must be four Base Adjust Channel Cards and associated Base Data Card or cards.

RADCOR SUBROUTINE

Functions of the RADCOR (radiation correction) subroutine are:

A. Performs the following data corrections 1) Converts digital data recorded in the altimeter channel to feet; 2) Removes constant base value from radiation channels; 3) Corrects all radiation channels to a mean terrestrial clearance; and 4) Corrects potassium and uranium channels for Compton's scatter. In addition RADCOR computes interchannel ratios.

DATA DECK

Card 1 - Program Control Card

Column	Format	Variable	Description
1-10	10X	--	EXECUTE
11-18	A8	PRGID	RADCOR (program ID)
38-39	I2	INPUT	Input file number (same as output file of ADJUST Sub)
61-62	I2	OUTPUT	Output file number

Card 2 - ID Card

1-12	3A4	ID 1	Tape ID number
13-16	A4	DATE 1	Date of use (year and Julian day)
17	I1	IOPT	IOPT-1 will accept card ID number. IOPT=0 will terminate processing if card ID and tape ID do not match

Card 3 - Option Card

This card permits the user to select corrections and/or ratios to be generated.

Column	Format	Variable	Description
1-10	A4;6X	ICOR	CORRECTIONS: If corrections are to be performed place the word "CORR" in CC 1-10 and put Compton's Alpha, Beta, and gamma corrections factors in CC 41-70
21-24	A4	IRAT	RATIOS: If ratios are to be generated, place the word "RATI" in CC 21-24
41-50	F10.0	ALPHA	Compton's stripping ratio. The portion of the corrected thorium channel to be removed from the uranium channel
51-60	F10.0	BETA	Compton's stripping ratio: The portion of the corrected thorium channel to be removed from the potassium channel.

Column	Format	Variable	Description
61-70	F10.0	GAMMA	Compton's stripping ratio: The portion of the corrected uranium channel to be removed from the potassium channel

Cards 4-7 - Correction Cards

There must be one correction card for each radiation data channel in the order they appear on the tape; that is, potassium, thorium, uranium, and total count. The format of the correction cards is as follows:

Column	Format	Variable	Description
1-4	A4	ITYPE	Channel descriptor. Four characters describing the data channel. Must be "POTA," "THOR," "URAN," or "TOTA"
11-20	F10.0	BG	Constant base adjustment value, if a sloping base has been used in ADJUST subroutine, base (BG) should be left blank
21-32	E12.5	CORR (I)	In CC 21-80 the coefficients of a polynomial fitted to the altitude attenuation curve for this channel. The values listed below were determined for the gamma spectrometer in use on the USGS-Saudi Arabian Project:
33-44	E12.5	"	
45-56	E12.5	"	
57-68	E12.5	"	
69-80	E12.5	"	Potassium CC 33-44=0.001128420 Thorium CC 33-44=0.00180514 Uranium CC 33-44=0.00145512 Total count CC 33-44=0.00138607 Fields 21-32, 45-56, 57-68, and 69-80 are blank

Card 8 - Conversion Card for Altimeter Channel

Column	Format	Variable	Description
1-4	A4	ITYPE	Starting in CC 1 enter the word "ALTI"
11-20	F10.0	BG	The value of the height above the ground to which data channels 1-4 are to be corrected

Column	Format	Variable	Description
21-32	E12.5	CORR (I)	In CC 21-80 the coefficients of a polynomial relating the true
33-44	E12.5	CORR (I)	height above the ground to the recorded altimeter reading.
45-56	E12.5	CORR (I)	For the Saudi Arabian equipment they are: CC 21-32=1565.772,
57-68	E12.5	CORR (I)	CC 33-44=-2.0625, CC 45-56= 0.00104618, CC 57-68=-0.000000201,
69-80	E12.5	CORR (I) BLANK	CC 69-80=Blank

Card 9 - Altimeter Limit Card

The data in all channels will be deleted when the altitude of the survey aircraft is outside the limits set on this card.

Column	Format	Variable	Description
1-20	20X		Title such as "ALTIMETER LIMITS"
21-30	F10.0	ALTMIN	Lower acceptable altitude limit
36-45	F10.0	ALTMAX	Upper acceptable altitude limit

Card 10 - Ratio Cards

If ratios are to be computed and the word "RATIO" has been entered on the Option Card (3) col 21-24, the following card or cards must be supplied, one card for each ratio computed, N ratios requires N cards:

Column	Format	Variable	Description
1-10	10X	ITYPE	Channel description: any ten alphanumeric characters such as "ratio U/TH", to describe the card only
11-20	I10	RATIOS	The numerator channel for the ratio
21-30	I10	RATIOS	The denominator channel for the ratio
31-40	I10	RATIOS	The channel number where the ratio is to be stored on the output data set

Card N+1 - Flag Card

After the last ratio card a flag card is necessary.

Column	Format	Variable	Description
1-4	A4	IFINI	Enter the word "FINI"

LNPATH SUBROUTINE

The LNPATH (linear path) subroutine computes an x-y position at map scale for each data observation based on a time-linear interpolation between the documentation points.

DATA DECK

Card 1 - Program Control Card

Column	Format	Variable	Description
1-10	10X	--	EXECUTE
11-18	A8	PRGID	LNPATH (program ID)
38-39	I2	INPUT	Input file number (same as output file or RADCOR subroutine)
61-62	I2	OUTPUT	Output file

Card 2 - ID Card

Column	Format	Variable	Description
1-12	3A4	ID1	Tape ID number
13-16	A4	DATE1	Date used - year and Julian day
17	I1	IOPT	IOPT=1 accept card ID number IOPT=0 will terminate processing if card ID and tape ID do not match

Cards 3 to 3+N

Data cards punched as output of FLPATH subroutine, which relate to the tape being processed, i.e., if the tape contained lines 1-12 only, lines 1-12 should be input here.

Flag Card

Column	Format	Variable	Description
1-5	I5	DOCNO	Enter number "9999" (right justified); this indicates last data card has been read

FILTER SUBROUTINE

The FILTER subroutine applies a mathematical filter to the data to remove high frequency noise.

DATA DECK

Card 1 - Program Control Card

Column	Format	Variable	Description
1-10	10X	--	EXECUTE
11-18	A8	PRGID	FILTER(program ID)
38-39	I2	INPUT	Input file number (same as output of LNPATH subroutine)
61-62	I2	OUTPUT	Output file number

Card 2 - ID Card

Column	Format	Variable	Description
1-12	3A4	IDI	Identification number
13-16	A4	DATE1	Date used - last digit of year followed by the Julian day of the year
17	I1	IOPT	Option to permit correction of the identification number. CC 1-12 are checked with tape header record; if they do not match the processing terminates unless a "1" is put in CC 17 - then the program accepts the number on the card as tape ID
18	I1	IWTS	Option. If IWTS=0 the program uses the filter weights set in the program. If IWTS$\neq$0 the filter weights are read from a card in the following format:

Card 3 - Filter Weights, Number (Supplied only if IWTS ≠ 0)

Column	Format	Variable	Description
1-5	I5	NW	Number of weights for one side of symmetrical digital filter, excluding the center weight (WO)

Card 4 - Filter Weights Card

Column	Format	Variable	Description
1-10	F10.0	WO	Center weight of symmetrical digital filter
11-20	F10.0	WEIGHT	In CC 11-80 supply the digital
21-30	F10.0	WEIGHT	filter weights for one side of a
31-40	F10.0		digital filter, there should be
41-50	F10.0	WEIGHT	same number of weights as given
51-60	F10.0	WEIGHT	for NW, card 3. Additional
61-70	F10.0	WEIGHT	weights may be supplied on other
71-80	F10.0	WEIGHT	cards using the same format as card 4.

LISTER SUBROUTINE

The LISTER subroutine prints the data from a selected data file. All or selected channels within a specified time interval, or by line number, may be listed.

DATA DECK

Card 1 - Control Program Card

Column	Format	Variable	Description
1-10	10X		EXECUTE
11-18	A8	PRGID	LISTER (program ID)
38-39	I2	INPUT	Input file number (should be the same as the output file of the subroutine you wish to list; output is set as printer)

Card 2 - Identification Card

Column	Format	Variable	Description
1-12	3A4	ID1	Tape ID number
13-16	A4	DATE1	Date used - year and Julian day
17	I1	IOPT	IOPT=1 accepts ID number on card IØPT=0 terminates processing if card ID and tape ID do not match

Card 3 - Channel Print Card

This card permits the user to print all or selected channels.

Column	Format	Variable	Description
1-4	A4	ITYPE	Option: If ITYPE = ALL (left justified) all channels will be printed and no further information is needed on this card If ITYPE = SELE, then channels 1-20 may be selected. Supply channel desired as follows:
11-50	20A2	SEL	Channel numbers selected for printout, right justified for example: CC 11-12 enter 01, CC 13-14 = 02, CC 15-16 = 03, etc.

Card 4+N - Retrieval Cards

Retrieval cards in time and line number may be intermixed, but they must be in ascending order of time as events appear on the input file.

Retrieval by time card (one card for each time segment) as follows:

Column	Format	Variable	Description
1-4	A4	ITYPE	Enter word TIME starting in CC 1
21-30	F10.2	START	Start time; data will be printed from start time until end time
31-40	F10.2	END	End time

Card 5 - Retrieval by Line Number Card (one card for each line number).

Column	Format	Variable	Description
1-4	A4	ITYPE	Enter word SID starting in CC 1
11-20	I10	ILINE	Number of line to be retrieved

Card 6 - Flag Card

Column	Format	Variable	Description
1-4	A4	ITYPE	Enter the word FINI starting in CC 1

PRNTER SUBROUTINE

The PRNTER subroutine prints profile plots of selected flight-line or lines.

DATA DECK

Card 1 - Execute Card

Column	Format	Variable	Description
1-10	10X	--	Enter EXECUTE
11-20	A8	PRGID	Program ID (PRNTER)
38-39	I2	INPUT	Input file number
61-62	I2	OUTPUT	Not necessary, set in program.

Card 2 to N - Parameter Cards

Column	Format	Variable	Description
1-5	I5	ISL1	Selected channel, up to 4 channels can be selected (ISL1-ISL4) to be profiled
6-10	I5	ISL2	
11-15	I5	ISL3	
16-20	I5	ISL4	
21-25	I5	NL	Number of horizontal grid lines in the plot
26-30	I5	NS	Number of printer spaces plus one between horizontal grid lines, (set to 60 if left blank). The value of S in the following equation must not exceed 25,000: S=(NL*5) * (NS*20) + 4

Card 2 to N - Parameter Cards (cont'd.)

Column	Format	Variable	Description
31-35	I5	ILINE	Starting line number
36-40	I5	JLINE	Ending line number ILINE and JLINE would be equal if only one line was selected to be profiled. Any number of parameter cards may be submitted in each run, the last card must be followed by a flag card as follows:

Card N+1 - Flag Card

Column	Format	Variable	Description
1-5	I5		Enter 9999, right justified

DUMPER SUBROUTINE

The DUMPER subroutine lists on the printer the contents of a selected data file.

DATA DECK

Card 1 - Program Control Card

Column	Format	Variable	Description
1-10	19X	--	EXECUTE
11-18	A8	PRGID	DUMPER (program ID)
38-39	I2	INPUT	Input file number

DELETE SUBROUTINE

The DELETE subroutine copies the reduced data tape (output of CRAMLK subroutine) and deletes data of selected lines.

DATA DECK

Card 1 - Program Control Card

Column	Format	Variable	Description
1-10	10X	--	EXECUTE
11-18	A8	PRGID	DELETE (program ID), left justified

Card 1 - Program Control Card (cont'd.)

Column	Format	Variable	Description
38-39	I2	INPUT	Input file
61-62	I2	OUTPUT	Output file

Card 2 - Channel Card

Column	Format	Variable	Description
11-20	I10	NCHN	Number of data channels on the CRAMLK tape

Card 3-N - Line Cards

Column	Format	Variable	Description
1-10	I10	LINE	Number of line to be deleted; one card for each line to be deleted

CRAMLK SUBROUTINE

The CRAMLK (cram link) subroutine combines the processed data from several field data tapes into a single data file whose format is acceptable to the visual display subroutines; changes scale of the data if desired; and rotates the data in reference to the orientation point (lower left corner on the map).

DATA DECK

Card 1 - Program Control Card

Column	Format	Variable	Description
1-10	10X	--	EXECUTE
11-18	A8	PRGID	CRAMLK (program ID) left justified
38-39	I2	INPUT	Input file; should be the same as output file of preceeding subroutine
61-62	I2	OUTPUT	Output file; the output file is set in the catalog procedures

Card 2 - Identification Card

Column	Format	Variable	Description
1-12	3A4	ID1	Tape ID number
13-16	A4	DATE1	Date used (year and Julian day)
17	I1	IOPT	IOPT=1 accepts card ID number. IOPT=0 terminates processing if card ID and tape ID do not match

Card 3 - Parameter Card

Column	Format	Variable	Description
1-10	F10.0	XLOW	Minimum X coordinate in inches at map scale
11-20	F10.0	YLOW	Minimum Y coordinate in inches at map scale
21-30	F10.0	SCALE	Scale factor. Factor = 1.0 must be used if no change in scale. If scale factor = 0.5 the output value is twice that of the input value. X'= X/scale and Y'=Y/scale
31-40	F10.0	ANGLE	Angle of rotation in degrees

Card 4 - Channel Selection Card

Column	Format	Variable	Description
11-20	I10	ICHN	Number of data channels to be put on CRAMLK tape; (maximum is 7 channels)

Column	Format	Variable	Description
21-25	I5	ISEL	Number of 1st channel selected
26-30	I5	ISEL	Number of 2nd channel selected
31-35	I5	ISEL	Number of 3rd channel selected
36-40	I5	ISEL	Number of 4th channel selected
41-45	I5	ISEL	Number of 5th channel selected
46-50	I5	ISEL	Number of 6th channel selected
51-55	I5	ISEL	Number of 7th channel selected

CNVERT SUBROUTINE

The CNVERT (convert) subroutine converts spectral data from CPM to percent potassium and PPM uranium and thorium and computes interchannel ratios.

DATA DECK

Card 1 - Program Control Card

Column	Format	Variable	Description
1-10	10X	--	EXECUTE
11-18	A8	PRGID	CNVERT (program ID) left justified
38-39	I2	INPUT	Input channel
61-62	I2	OUTPUT	Output file

Card 2 - Ratio-Option Card

Column	Format	Variable	Description
1-12	3A4	ID	Identification of output data file
13-15	I3	NCHN	The number of input data channels
16-20	I5	R	The number of the data channel for 1st ratio numerator
21-25	I5	R	The number of the data channel for 1st ratio denominator
26-30	I5	R	The number of the data channel for 2nd ratio numerator
31-35	I5	R	The number of the data channel for 2nd ratio denominator
36-40	I5	R	The number of the data channel for 3rd ratio numerator
41-45	I5	R	The number of the data channel for 3rd ratio denominator

CC 46-50, 51-55, 56-60, 61-65, 66-70, 71-75 may be used to compute other ratios, limit is 6. If ratios are not to be computed card columns 13-75 may be left blank.

Column	Format	Variable	Description
80	I1	IOP	Option if IOP=0 convert to ppm or percent. If IOP=1 do not convert.

Card 3 - MAX-MIN Card

Column	Format	Variable	Description
1-10	F10.0	XMIN	XLOW, minimum X value
11-20	F10.0	XMAX	XHIGH, maximum X value
21-30	F10.0	YMIN	YLOW, minimum Y value
31-40	F10.0	YMAX	YHIGH, maximum Y value

Card 4 - Conversion Constant Card

If IOP=0 (card 2) conversion constants must be supplied. If IOP=1 (card 2) this card is not necessary.

Column	Format	Variable	Description
1-10	F10.0	STRIP	Conversion constant for channel 1 (K). To convert CPM (K) to % K
11-20	F10.0	STRIP	Conversion constant for channel 2 (Th). To convert CPM (Th) to ppm Th
21-30	F10.0	STRIP	Conversion constant for channel 3 (U). To convert CPM (U) to ppm U

Card 5 - Ratio Limits Card

This card is not necessary if ratios are not computed; that is, if "R" of card 2, CC 16-20 and 21-25 is equal to 0, or left blank. If IOP=0 (card 2) and ratios are to be computed, upper and lower limits for data values between which ratios are to be computed must

be supplied in ppm for the thorium and uranium channels (2 and 3) and in percent for the potassium channel (1). If IOP=1, limits are supplied in counts/minute from all channels.

Column	Format	Variable	Description
1-10	F10.0	XLIM	Upper limit on channel 1
11-20	F10.0	XLIM	Lower limit on channel 1
21-30	F10.0	XLIM	Upper limit on channel 2
31-40	F10.0	XLIM	Lower limit on channel 2
41-50	F10.0	XLIM	Upper limit on channel 3
51-60	F10.0	XLIM	Lower limit on channel 3
61-70	F10.0	XLIM	Upper limit on channel 4
71-80	F10.0	XLIM	Lower limit on channel 4

PRFILE SUBROUTINE

The PRFILE (profile) subroutine generates a plot tape to display flight line data as nested profiles. Each profile is referenced to the mid-point of the X-low, X-high values supplied in CNVERT subroutine. Horizontal and vertical scale as well as the vertical base reference value are supplied by the user. The program plots 18 profiles vertically stacked, then moves to the right to plot 18 more. If the horizontal scale does not permit more than 18 profiles per page (page size 36"), the plotter goes into "stand-by" mode permitting the operator to replace the paper before resuming plotting of the next set of 18 profiles.

DATA DECK

Card 1 - Program Control Card

Column	Format	Variable	Description
1-10	10X	--	EXECUTE

Card 1 - Program Control Card (cont'd.)

Column	Format	Variable	Description
11-18	A8	PRGID	PRFILE (program ID) left justified
38-39	I2	INPUT	Input file (same as output of CNVERT subroutines)
61-62	I2	OUTPUT	Output file (should be a tape file)

Card 2 - Title Card

Column	Format	Variable	Description
1-80	80A1	LEGEND	Legend information

Card 3 - Channel Select and Horizontal Scale Card

Column	Format	Variable	Description
11-20	I10	ICHN	Number of channel selected for profiling
31-40	F10.0	SCALE	Horizontal scale factor. If set at 1.0 horizontal scale will be the same as input data scale; if set at 2.0 output will be half of input scale; at 0.5 output scale will be twice input scale
41-50	I10	INOR	Plot every INOR data point
51-60	I10	JOPT	Enter non-zero to suppress borders and line number on right side of each profile. (Line number printed on left side only)

Card 4 - Line Cards

One must be supplied for each set of lines to be plotted - base value and vertical scale may be different for each set of lines if desired.

Column	Format	Variable	Description
1-10	I10	ISTART	Starting line number to be plotted
11-20	I10	IEND	Ending line number to be plotted for one line the above two are equal
21-30	F10.0	UBASE	Base value for vertical scale
31-40	F10.0	USCALE	Vertical scale, i.e., xxx units inch
41-50	F10.0	SPACE	The vertical spacing in inches from the last line plotted. If left blank it is set to 1.5 inches

Card N+1 - Flag Card

Column	Format	Variable	Description
1-10	I10	LENE	Enter "9999" Left justified

RADG3D SUBROUTINE

The RADG3D (radiation grid 3D) subroutine computes grid intersection points over a defined region of any dimension from random data.

DATA DECK

Card 1 - Program Control Card

Column	Format	Variable	Description
1-10	10X	--	EXECUTE
11-18	A8	PRGID	RADG3D
38-39	I2	INPUT	Input file number
61-62	I2	OUTPUT	Output file number

Card 2 - Parameter Card

Column	Format	Variable	Description
1-20	5A4	ID	Identity of channel selected for gridding

Card 2 - Parameter Card (cont'd.)

Column	Format	Variable	Description
21-25	I5	IZI	Number of channel selected for gridding
26-30	I5	M	Number of rows to be gridded in "Y" direction
31-35	I5	N	Number of columns to be gridded in "X" direction
36-40	I5	IRPT	Option: If option=1, grid values will be printed; if OPT=0, grid values will not be printed

CONTOUR PROGRAMS

Several contour programs are available which can be used to contour the grid matrix generated by the RADG3D subroutine. These stand-alone programs on the USGS load library are:

(1) EVCONT; a version of the program written by Evendon, USGS, Denver.

(2) CANTUR; a version of the Bensen-Lehner contour program.

(3) WOLF; a version of the NASA-Wolf program.

The user is referred to the individual documentations for use of these programs.