Basic program "IPFLTR" for induced polarization data reduction and filtering

by

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1/ U.S. Geological Survey Mission, Jiddah, Saudi Arabia
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BASIC PROGRAM "IPFLTR" FOR INDUCED POLARIZATION DATA REDUCTION AND FILTERING

by

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ABSTRACT

The recently developed induced polarization (IP) mapping technique can be successfully applied to IP dipole-dipole data and includes three types of filters that can be applied to IP pseudosections that have IP anomalies caused by different types of sources. The technique yields a single output value per station; this value reflects all levels of the pseudosection and is suitable for contouring in plan view. It also provides a quantitative picture of IP anomalies in their background or regional settings.

In the "IPFLTR" program, the application of the three types of IP filters to the IP pseudosection data was programmed in BASIC. The program allows the user to reduce IP field data and to produce IP pseudosections. It includes three filter subprograms, which calculate output data from each filter. The filtered data include a single reading for each station along the pseudosection. These data can be presented as individual IP profiles, or several profiles can be contoured together to produce an IP map. The program can optionally provide simple or complex plots either of the filtered data or of any selected level in the pseudosection.

INTRODUCTION

The dipole-dipole induced polarization (IP) technique has been described in most geophysical exploration text books (see, for example, Telford and others, 1975, p. 702-735). IP data are generally presented as either pseudosections or multilevel profiles. In most cases, these methods of presentation are not desirable because the most anomalous values are displaced laterally and do not coincide with the source body.

A new technique of IP mapping (Fraser, 1981) provides a qualitative presentation of dipole-dipole IP data in map form and includes three averaging filters suitable for different types of IP sources. Any selected filter yields a single value per station; this value reflects data from all levels of the pseudosection. If these values are plotted, the most anomalous values calculated from the pseudosections overlie the source body.

Because IP data produced in a survey along a single profile are generally presented in at least three pseudosections

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(apparent resistivity, percent frequency effect or charge-
ability, and metal factor), the manual application of these
filters to the pseudosections of a surveyed IP profile is
time consuming and impractical.

For this reason, a computer program was designed to carry
out the following operations:

1. Reduce IP field results and calculate pseudosections
   of either resistivity, percent frequency effect or
   chargeability, metal factor, or phase.

2. Apply any of the three filters suggested by Fraser

3. Allow single or overlapped x-y plotting of the fil-
   tered data or any selected level in a particular
   pseudosection.

ALGORITHM

Reduction

The computer program allows the user to reduce dipole-
dipole IP field data to yield the quantities: resistivity
($\rho$), percent frequency effect (PFE) or chargeability (M), and
metal factor (MF). The potential difference, $\Delta V$, measured
between two-receiver electrodes (fig. 1) when a current $I$ is
passed between the two current electrodes is given by

$$\Delta V = \frac{I \rho}{2\pi G}$$

where

$\rho$ is the resistivity of the ground and

G is the geometric factor

$$G = \frac{1}{(\frac{1}{n} - \frac{2}{n+1} - \frac{1}{n+2})}$$

where $n$ represents the number of IP levels.

Setting

$$K = 2\pi Ga$$

where $a$ is the dipole length, then

$$\rho = K(\frac{\Delta V}{I})$$

which is Ohm's law. In this case, $K$ is known as the K factor
Figure 1.—Diagram showing method of construction of dipole-dipole pseudosections for N=2, plot point P and first-station location S₁. N, level number; M, dipole number; a, dipole spacing.
(Telford and others, 1975, p. 716). If $V$ is expressed in millivolts, then $K$ is divided by 1,000.

The computer program enables the user to reduce the following three types of IP dipole-dipole field data.

1. **Time-domain IP**

If a direct-current pulse, $I$, is transmitted between the two current electrodes (fig. 1), then the measured quantities at the receiver will be $\Delta V$ (primary received voltage) and $M$. The direct-current resistivity, $\rho_{DC}$, is given by

$$\rho_{DC} = K\left(\frac{\Delta V}{I}\right)$$

and the metal factor is expressed as

$$MF = 1000 \times \frac{M}{\rho_{DC}}$$

2. **Frequency-domain IP**

(a) **Standard frequency-domain IP**

The first-developed and most common method of IP measurement in the frequency domain entails the comparison of earth resistivities at two widely spaced frequencies, often a decade apart. Such comparison requires measurements of the currents, $I_f^1$ and $I_f^2$, and voltages, $V_f^1$ and $V_f^2$, by use of sequential transmission of current at frequencies $f_1$ and $f_2$, respectively. The apparent resistivities at frequencies $f_1$ and $f_2$ are given as

$$\rho_{af}^1 = K\left(\frac{\Delta V}{I_f^1}\right), \text{ and}$$

$$\rho_{af}^2 = K\left(\frac{\Delta V}{I_f^2}\right).$$

The traditional frequency-domain method produces percent-frequency effect as the measured quantity (Telford and others, 1975). This quantity is equivalent to chargeability in the time-domain IP and is defined as

$$PFE = \frac{\rho_{af}^1 - \rho_{af}^2}{\rho_{af}^1}.$$

According to Parasnis (1979), the metal factor is given either as

$$MF = 1000 \frac{PFE}{\rho_a}.$$
or as

\[ MF = 1000 \frac{\text{PFE}}{\left(\frac{\rho_a}{2\pi}\right)} \]

(b) Phase IP

More recently, a second method of IP measurement in the frequency domain has come into use; in this method, the phase angle, \( \phi \), between the measured voltage in the ground and the primary current is measured. Zong and others (1972) and Hallof (1974) showed the general equivalence between the phase angle measured at a specific frequency in the IP range and the percent-frequency effect measured at two frequencies spanning this range. Moreover, they were able to use a single frequency to obtain percent frequency effect rather than two sequential frequencies, as in standard IP frequency-domain techniques.

In the phase-IP method, the quantities actually measured by using specifically manufactured receivers, such as the Scintrex IPRF2\(^*\), are as follows.

(i) The apparent resistivity, \( \rho_a \), using single frequency, defined as

\[ \frac{K(\Delta V)}{I} \]

(ii) The PFE, defined as

\[ \frac{A_1 - 3A_3}{3A_3} \times 100 \]

where \( A_1 \) and \( A_3 \) are the amplitudes of the fundamental and third harmonic ground signal, respectively.

(iii) The phase defined as the phase angle between the measured voltage, \( \Delta V \), and the primary current, \( I \).

Some receivers also measure the relative phase shift (RPS). This quantity is defined as

\[ 3\phi_1 - \phi_3 \]

where \( \phi_1 \) and \( \phi_3 \) are the phase angle of the fundamental and third harmonic, respectively, relative to the transmitted component of the current.

(iv) The metal factor calculated as

\[ MF = 1000 \times \frac{\text{PFE}}{\left(\frac{\rho_a}{2\pi}\right)} \]

*Use of specific manufacturers' names does not constitute endorsement by the U.S. Geological Survey and is used for information purposes only.
Filtering

Fraser (1981) suggested three types of IP filters, each of which provides a single IP value per station for any given dipole-dipole IP pseudosection.

1. **Average levels filter**

   This filter (fig. 2A) is a simple averaging filter that is applied to each level. The average of two adjacent values is taken for the second level, that of three values for the third level, and so forth. The first level remains the same. The shape of the window filter was chosen to crudely approximate the pseudosection anomaly pattern that commonly results from thin, steeply dipping bodies. Final output for each point is the average of the averages for all levels.

2. **Total average filter**

   This filter is equivalent to a simple application of the arithmetic average of all values in the triangular window (fig. 2B). Because more points come from the deeper levels, the output of this filter is progressively weighted toward the deeper levels of the pseudosection. This shift could be an advantage if the target body is evident only on the deeper levels.

3. **Average of triangle sides filter**

   This filter provides a simple arithmetic average of all the values in the window (fig. 2C). Its primary disadvantage is that its output can oscillate if a single large value occurs on one of the deeper levels of the input pseudosection.

The program allows the user to move any one of these three filters over any given IP pseudosection and to obtain a single IP value per station. If some stations within a window have no values, for example, at the ends of lines where data are typically absent on the deeper levels (fig. 2), then the average of fewer values will be considered.

**COMPUTER PROGRAM**

**Description**

The program (appendix 1) was written specifically for use with the Hewlett Packard (HP) model 85. This machine is extensively used either as an individual minicomputer or coupled with other devices such as field geophysical equipment. The program was written in BASIC and can be modified to operate on any other machine that uses the same computer language. Conversion of the plotting subprograms may be some-
Figure 2.—Diagram showing the types of filters that can be used to produce contour maps and IP data: (A) average levels filter; (B) total average filter; (C) average of triangle sides filter. Diagram modified from Fraser, 1981.
what difficult, inasmuch as many of the plotting commands are not unique in all devices.

The program is conversational and allows the user a wide degree of latitude as to data input, filters, and plotting, simply by answering prompted questions.

The pseudosection, the filtered data, and a simple or complex x-y plot of the previous data are computed during program execution.

The input/output (I/O) quantities are as follows:

Numeric constants

M: number of dipoles along surveyed profile (index J = 1, ...., M) (M max = 50)

N: number of levels in a pseudosection (index I = 1, ...., N) (N max = 6)

SI: first station value, numeric value, south and west values are negative

A: dipole spacing, in meters or feet

W1: =1 for (average levels filter); =2 for (total average filter); =3 for 2 triangle sides filter

W2: =1 for resistivity; =2 for percent frequency effect or chargeability; =3 for metal factor; =4 for phase

Strings

A$: string of area name

L$: string of line name

T$: string of type of survey; frequency (F) or time (T) domain

O$: station order, increase or decrease from the value of SI

Arrays

R (I,J): array of resistivity pseudosection data

F (I,J): array of percent frequency effect or chargeability pseudosection data
K (I,J): array of metal-factor pseudosection data

P (I,J): array of phase or phase-shift pseudosection data

W (J): array of filtered data

Z (I,J): working array

where J=1,...,M and I=1,...,N

The maximum number of dipoles (M) is 50, and the maximum number of levels (N) is 6. These values are suitable for use with most of IP field surveys. However, these values can be changed if the computer used has sufficient memory capability.

Operation

The program is operated using eight independent key modes. Each key mode includes one or more specially designed subprograms. The user can carry out one specific operation per key mode, such as data input, filtering, printing, storage, and so forth.

1. Key mode 1 (input key)

Key mode 1 allows the user to input IP data from either the keyboard or a tape file. The subprogram prompts the user for file name, area, line, and other information used to identify the input data. The input IP data itself may exist in any of the following forms:

(a) Reduced IP pseudosection data (time or frequency domain). These will be stored in R, F, K and P arrays, for resistivity, chargeability or percent frequency effect, metal factor, and phase or relative phase shift, respectively.

(b) Nonreduced IP pseudosection data (time or frequency domain) obtained from field surveys. These will be stored in R, F, K or P arrays.

(c) Filtered profile data obtained from any of the R, F, K or P pseudosections. These will be stored in array W.

An explanation of IP data input entry is shown on figure 3. The operation of key mode 1 is illustrated on the flow chart (fig. 4), and an example is provided in appendix 2.
Figure 3.—Pseudosections showing sequence of input data to the computer program: R, apparent resistivity; F, chargeability or percent frequency effect, K, metal factor; and P, phase shift or phase. See text for an explanation of the quantities J, M, I, and N.
Figure 4.—Flow chart showing key mode 1 (input key).
2. **Key mode 2 (data storage key)**

Key mode 2 allows data storage on a specific file of a magnetic tape. By use of this key mode, nonreduced field IP data, pseudosection data, or filtered data can be stored.

The operation of key mode 2 is illustrated on the flow chart (fig. 5), and an example is provided in appendix 2.

3. **Key mode 3 (data print-out key)**

Key mode 3 allows the user to print out any of the three previously mentioned data forms. Key 3 mode is illustrated in the flow chart (fig. 6), and an example is shown in appendix 2.

4. **Key mode 4 (input data correction key)**

Key mode 4 allows the user to correct the various types of the input data.

Key mode 4 is explained in the flow chart (fig. 7), and an example is given in appendix 2.

5. **Key mode 5 (data reduction key)**

Key mode 5 allows the user to reduce IP field data, which may exist in one of the following forms:

- (a) Time-domain IP data, which includes values of \( V_p \) (voltage) and \( I \) (current) for calculation of direct-current resistivity and metal factor.

- (b) Frequency-domain IP data, which are measured by using one frequency and include phase-shift measurements. The apparent resistivity and metal factor are also calculated by using a single set of \( V_p \) and \( I \) values.

- (c) Standard frequency-domain IP data, which are measured by using two different frequencies; at each frequency, \( V_p \) and \( I \) values are measured. Two apparent resistivity values and the metal factor are calculated.

The key mode is explained in the flow chart (fig. 8), and an example is shown in appendix 2.

6. **Key mode 6 (filtering key)**

Key mode 6 allows the user to obtain filtered data for any selected IP pseudosection. The mode includes three sub-
Figure 5.—Flow chart showing key mode 2 (data storage key).
Figure 6.—Flow chart showing key mode 3 (data print-out key).
Figure 7.—Flow chart showing key mode 4 (input data correction key).
Figure 8.—Flow chart showing key mode 5 (data reduction key).
Figure 9.—Flow chart showing key mode 6 (filtering key).
Figure 10.—Flow chart showing key mode 7 (x-y plot key).
programs, each of which allow the application of one of the three filters suggested by Fraser (1981). The output-filtered data are printed automatically during operation of the key. Key mode 6 is explained in the flow chart (fig. 9), and an example is shown in appendix 2.

7. **Key mode 7 (x-y plot key)**

Key mode 7 allows the user to produce either a simple or complex x-y plot of either any level of any specific pseudo-section or any filtered data stored in array W.

The plot is produced on the screen, and a copy can be made on the thermal printer. The key mode allows the user a wide range of plot specifications in both the x- and y-dimensions.

The operation of key mode 7 is illustrated on the flow chart (fig. 10), and an example is shown in appendix 2.

8. **Key mode 8 (stop key)**

Key mode 8 allows the user to stop program execution.

**ACKNOWLEDGMENTS AND DATA STORAGE**

The work on which this report is based was performed in accordance with a work agreement between the U.S. Geological Survey (USGS) and the Saudi Arabian Ministry of Petroleum and Mineral Resources. No base data files were established for this report, and no entries were made to the Mineral Occurrence Documentation System (MODS) as a result of this report.
REFERENCES CITED

Fraser, D. C., 1981, Contour map presentation of dipole-dipole induced polarization data: Geophysical Prospecting, v. 29, p. 639-651.


Appendix 1. Program listing

10 ! PROGRAM IPFLTR
20 OPTION BASE 1
30 DIM R(6,50), F(6), M(6,50), P(6,50), C(6), W(50), Z(6,50), F2(6), F3(6)
40 PRINT "IP DATA CALCULATIONS"
50 PRINT "================================";
60 CLEAR
70 DISP " "
80 DISP "SELECT THE MODE OF OPERATION BY"
100 DISP "THE KEY BELOW (ONE AT A TIME)"
110 ON KEY* 1, "INPUT" GOSUB 210
120 ON KEY* 2, "STORE" GOSUB 2080
130 ON KEY* 3, "PRINT" GOSUB 1760
140 ON KEY* 4, "MISTAKES" GOSUB 1230
150 ON KEY* 5, "REDUCE" GOSUB 150
160 ON KEY* 6, "FILTER" GOSUB 2350
170 ON KEY* 7, "PLOT" GOSUB 3940
180 ON KEY* 8, "STOP" GOSUB 4740
190 KEY LABEL
200 GOTO 110
210 ! SUBPROGRAM INPUT
220 CLEAR
230 DISP "THIS SUBPROGRAM ALLOWS DATA INPUT FROM TAPE OR KEYBOARD"
240 DISP "OPERATE KEY?<Y/N>:"
250 INPUT Kl$
260 IF Kl$="N" THEN 1200
270 DISP "AREA NAME?:"
280 INPUT A$
290 DISP "LINE NAME?:"
300 INPUT L$
310 DISP "TYPE OF SURVEY, TIME DOMAIN(T) OR FREQUENCY DOMAIN(F)?"
320 INPUT T$
330 IF T$="F" THEN T1$="PFE" ELSE T1$="CHRG"
340 IF T$="T" THEN PRINT "TIME DOMAIN IP SURVEY"
350 IF T$="F" THEN PRINT "FREQUENCY DOMAIN IP SURVEY"
360 PRINT "AREA:"; A$
370 PRINT "LINE:"; L$
380 PRINT "FIRST STATION LOCATION WILL BE -VE FOR S&W AND +VE FOR N&E"
390 PRINT "STATION LOCATION WILL BE -VE FOR S&W AND +VE FOR N&E"
400 PRINT "STATION ORDER DECREASE (D) OR INCREASE (I)?:"
410 INPUT 0$
420 PRINT "NO. OF DIPOLES ALONG PROFILE?"
430 INPUT N
440 PRINT "DIPOLE LENGTH?"
450 INPUT D
460 PRINT "NO OF IP LEVELS(N=)?:"
470 INPUT M
480 D1=D
490 IF D$="D" THEN 520
500 S2=S1+3*D/2
510 GOTO 530
520 S2=S1-3*D/2
e D=-D
530 IF T$="T" THEN PRINT "TIME DOMAIN IP SURVEY"
540 IF T$="F" THEN PRINT "FREQUENCY DOMAIN IP SURVEY"
550 PRINT "AREA:"; A$
560 PRINT "LINE:"; L$
570 PRINT "NO. OF DIPOLES:"; N$
580 PRINT "MISTAKES?:"
590 PRINT "ONE FREQUENCY USED?(Y/N):"
600 IF I1$="Y" THEN PRINT "ONE FREQUENCY USED?(Y/N):"
610 PRINT "ONE FREQUENCY USED?(Y/N):"
620 INPUT G$
630 IF T$="T" THEN D$="0" @ GOTO 660
640 IF T$="F" THEN PRINT "FREQUENCY DOMAIN IP SURVEY"
650 PRINT "AREA:"; A$
660 PRINT "LINE:"; L$
670 PRINT "FIRST STATION LOCATION WILL BE -VE FOR S&W AND +VE FOR N&E"
680 PRINT "FIRST STATION LOCATION WILL BE -VE FOR S&W AND +VE FOR N&E"
690 PRINT "STATION ORDER DECREASE (D) OR INCREASE (I)?:"
700 INPUT 0$
710 PRINT "NO. OF DIPOLES ALONG PROFILE?"
720 PRINT "DIPOLE LENGTH?"
730 PRINT "NO. OF IP LEVELS(N=)?:"
740 IF T$="T" THEN PRINT "TIME DOMAIN IP SURVEY"
750 IF T$="F" THEN PRINT "FREQUENCY DOMAIN IP SURVEY"
760 PRINT "AREA:"; A$
770 PRINT "LINE:"; L$
780 PRINT "FIRST STATION LOCATION WILL BE -VE FOR S&W AND +VE FOR N&E"
790 PRINT "FIRST STATION LOCATION WILL BE -VE FOR S&W AND +VE FOR N&E"
800 PRINT "STATION ORDER DECREASE (D) OR INCREASE (I)?:"
810 INPUT 0$
820 PRINT "NO. OF DIPOLES ALONG PROFILE?"
830 PRINT "DIPOLE LENGTH?"
840 PRINT "NO. OF IP LEVELS(N=)?:"
850 PRINT "MISTAKES?:"
860 PRINT "ONE FREQUENCY USED?(Y/N):"
870 PRINT "ONE FREQUENCY USED?(Y/N):"
880 IF I1$="Y" THEN PRINT "ONE FREQUENCY USED?(Y/N):"
890 PRINT "ONE FREQUENCY USED?(Y/N):"
900 IF T$="T" THEN PRINT "TIME DOMAIN IP SURVEY"
910 IF T$="F" THEN PRINT "FREQUENCY DOMAIN IP SURVEY"
920 PRINT "AREA:"; A$
930 PRINT "LINE:"; L$
940 PRINT "NO. OF DIPOLES:"; N$
950 PRINT "MISTAKES?:" 21
Appendix 1.--Program listing--Continued

870 PRINT USING 880; I,R(I,J),F(I,J),M(I,J),P(I,J)
880 IMAGE DD,1X,DDD.D,1X,DDD.D,1X,DDD.D,1X,DDD.D
890 NEXT I
900 NEXT J
910 GOTO 1200
920 DISP "FILTER OF AVERAGE LEVEL(1) OR TOTAL AVERAGE(2)?"; INPUT W1
930 DISP "FILTERED DATA RES.(1), PFE(2),MF(3) OR RPS?<4>?"; INPUT W2
940 PRINT "STATION MAP VALUE"
950 S2=S1+3*D/2
960 FOR J=1 TO N
970 S3=S2+D*(J-1)
980 NEXT J
990 PRINT USING 2640; J,S3,W(J)
1000 GOTO 1200
1010 DISP "INPUT FILENAME:"; INPUT F2*
1020 ASSIGN* 2 TO F2*
1030 READ* 2,1; A*,L*,T*,D*,0*,T1*,I2$,G*
1040 READ* 2,2; N,M,D,S1
1050 S2=S1+3*D/2
1060 IF I2*="W" THEN READ* 2,3; W1,U2,U1*
1070 FOR J=1 TO N
1080 IF I2*="U" THEN READ* 2; U(J)
1090 FOR I=1 TO M
1100 IF I2*="P" THEN READ* 2; R(I,J),M(I,J),P(I,J)
1110 NEXT I
1120 NEXT J
1130 GOTO 490
1140 GOTO 1280
1150 CLEAR
1160 RETURN
1170 ! SUBPROGRAM MISTAKES
1180 CLEAR
1190 DISP "THIS SUBPROGRAM ALLOWS CORRECTION OF MISTAKES IN INPUT DATA";
1200 INPUT K1*
1210 IF K1*="N" THEN 1480
1220 IF G*="Y" THEN PRINT "MISTAKES IN PSEUDO?(Y/N):"; INPUT M2*
1230 IF M2*="N" THEN 1430
1240 IF M2*="Y" THEN PRINT "OPERATE KEY?(Y/N):"; INPUT K1*
1250 IF K1*="N" THEN 1470
1260 IF M*="N" THEN 1480
1270 IF M*="Y" THEN 1470
1280 IF M*="N" THEN 1480
1290 IF M*="Y" THEN 1470
1300 IF K*="N" THEN 1480
1310 IF K*="Y" THEN 1470
1320 IF M*="N" THEN 1480
1330 DISP "WHICH DIPOLE(J) AND N(I)?";
1340 INPUT J5,I5
1350 PRINT "CORRECTION OF INPUT VALUE OF DIPOLE;"; J5,"N="; I5
1360 PRINT "WRONG VALUE;";
1370 PRINT R(I5,J5);F(I5,J5);M(I5,J5);P(I5,J5)
1380 PRINT "ENTER NEW VALUES;";
1390 INPUT R(I5,J5);F(I5,J5);M(I5,J5);P(I5,J5)
1400 PRINT "ORIGINAL CORRECTION VALUE;";
1410 PRINT R(I5,J5);F(I5,J5);M(I5,J5);P(I5,J5)
1420 GOTO 1280
1430 PRINT "WHICH ROW NO."; INPUT T IS
1440 PRINT "WRONG VALUE;"; INPUT W(J)
1450 PRINT "ENTER CORRECT VALUE";
1460 PRINT "CORRECT VALUE:"; W(J)
1470 GOTO 1280
1480 CLEAR
1490 RETURN
1500 ! SUBPROGRAM REDUCTION
1510 CLEAR
1520 DISP "THIS ROUTINE ALLOWS REDUCION OF PSEUDOSECTION DATA"
1530 PRINT "OPERATE KEY?(Y/N):"; INPUT K1*
1540 IF K1*="N" THEN 1740
1550 FOR I=1 TO M
1560 F7 = 1/I2/(I+2)+1/(I+2).6 F7 = 1/F7
1570 C(I)=2*PI*D*1000/R(I,J)
1580 NEXT I
1590 PRINT "MULTIPLY METAL FACTOR BY 2PI7(Y/N):"; INPUT M5*
1600 FOR J=1 TO N
1610 FOR I=1 TO M
1620 IF T*="T" THEN 1640
1630 IF D*="N" THEN 1660
1640 R(I,J)*R(I,J)*C(I)/F(I,J) 6 R(I,J) = F(I,J)*1000/R(I,J)
1650 M(I,J)=1000*R(I,J)/R1
1660 M(I,J)=1000*R(I,J)/R1
1670 IF M5*="Y" THEN K(I,J)=K(I,J)*2*PI
1680 NEXT I
1690 NEXT J
1700 GOTO 1710
1710 PRINT "CORRECT VALUE:"; W(J)
1720 GOTO 1280
1730 CLEAR
1740 RETURN
1750 ! SUBPROGRAM PRINT
1760 CLEAR
1770 PRINT "THIS ROUTINE PROVIDES PRINTOUTS OF PSEUDOSECTIONS OR FILTERED DATA"
1780 PRINT "OPERATE KEY?(Y/N):"; INPUT K1*
1790 IF K1*="N" THEN 1840
1800 FOR J=1 TO N
1810 FOR I=1 TO M
1820 IF T*="T" THEN 1840
1830 IF D*="N" THEN 1860
1840 R(I,J);R(I,J)*C(I)/F(I,J);R2=C(I)*M(I,J);P(I,J);R2=C(I)*M(I,J);P(I,J)
1850 R(I,J)=R(I,J)+P(I,J)
1860 R(I,J)=R(I,J)+P(I,J)
1870 R(I,J)=R(I,J)+P(I,J)
1880 IF M5*="Y" THEN K(I,J)+K(I,J)+K(I,J)
1890 K(I,J)*2*PI
1900 NEXT I
1910 NEXT J
1920 CLEAR
1930 RETURN
1940 "SUBPROGRAM PRINT";
1950 CLEAR
1960 DISP "THIS ROUTINE PROVIDES PRINTOUTS OF PSEUDOSECTIONS OR FILTERED DATA"
1970 PRINT "OPERATE KEY?(Y/N):"; INPUT K1*
Appendix 1. Program listing—Continued

1800 IF K1$="N" THEN 2060
1810 DISP "PRINT PSEUDO(P) OR WINDOW(W)"
1820 INPUT P2$  
1830 IF P2$="W" THEN 1790
1840 IF G$="Y" THEN PRINT "PSEUDO SECTION DATA"
1850 IF G$="N" THEN PRINT "IP FIELD DATA"
1860 FOR J=1 TO N
1870 S3=S2+(J-1)*D
1880 PRINT "DIPOLE: ";J;" STATION: ";S3
1890 IF G$="Y" THEN PRINT "RES. ";T1$j" MF RPS"
1900 IF D$="N" THEN PRINT "VP CR ";T1*j;" RPS"
1910 IF D$="N" THEN PRINT "VP1 CR1 VP2 CR2"
1920 FOR I=1 TO M
1930 PRINT USING 1220 ; I,R(I,J),P(I,J)
1940 NEXT I
1950 NEXT J
1960 GOTO 2060
1970 PRINT "FILTERED DATA"
1980 IF W1 = 1 THEN PRINT "AVERAGE LEVELS FILTER OF LINE:";L$  
1990 IF W1=2 THEN PRINT "TOTAL AVERAGE FILTER OF LINE:";L$  
2000 PRINT "--------------------"
2010 S2=S1+3*D/2
2020 FOR J=1 TO N
2030 S3=S2+(J-1)*D
2040 PRINT USING 2640 ; S3,W(I)
2050 NEXT J
2060 CLEAR
2070 RETURN
2080 ! SUBPROGRAM STORE DATA
2090 CLEAR  
2100 DISP "THIS ROUTINE ALLOWS STORAGE OF ANY PART OR ALL OF INPUT AND/OR OUTPUT DATA ON TAPE"  
2110 DISP "OPERATE KEY?(Y/N):"  
2120 IF K1$="N" THEN 2330  
2130 INPUT F3*  
2140 CREATE F3*,R3  
2150 PRINT "STORE PSEUDO(P) OR WINDOW(W) DATA?:"  
2160 INPUT I2$  
2170 PRINT$ 1,1 ; A$,L$,T$,D$,O$,  
2180 PRINT$ 1,2 ; N,M,D,S1  
2190 IF I2$="W" THEN PRINT$ 1,3  
2191 PRINT$ 1,4 ; W,I,J,P(I,J)
2200 J=j+3
2210 IF I2$="W" THEN PRINT$ 1,1  
2220 GOTO 2250
2230 FOR I=1 TO M
2240 NEXT I
2250 NEXT J
2260 PRINT "--------------------"

2270 PRINT "DATA STORED ON FILE:";F3$  
2280 IF I2$="W" THEN PRINT "FILTERED DATA OF:"  
2290 IF G$="Y" THEN PRINT "REDUCED PSEUDO SECTION OF:"  
2300 IF G$="N" THEN PRINT "IP FIELD DATA OF:"  
2310 PRINT "AREA:";A$  
2320 PRINT "LINE:";L$  
2330 CLEAR
2340 RETURN
2350 ! SUBPROGRAM IPDATA FILTER
2360 CLEAR  
2370 DISP "THIS ROUTINE ALLOWS APPLICATION OF THREE IP FILTERS"  
2380 DISP "SUGG BY FRASER (1981)"  
2390 DISP "WINDOW (!) FOR AVERAGE LEVELS (2) FOR TOTAL AVERAGE AND (3) FOR AVERAGE TRIANGLE SIDES"  
2400 PRINT "OPERATE KEY?(Y/N):"  
2410 INPUT K1*  
2420 IF K1*="N" THEN 2670  
2430 INPUT W*  
2440 IF W*="N" THEN 2670  
2450 PRINT "AV. LEV.(1) OR ALL AVG.(2) OR TRIANGLE SIDES (3):"  
2460 PRINT "TITLE OF DATA TO BE FILTERED"  
2470 INPUT U1*  
2480 PRINT "TO RES. (1),PFE(2),MF(3) OR RPS(4)?"  
2490 INPUT U2  
2500 GOSUB 4780  
2510 IF W1=1 THEN GOSUB 2690  
2520 IF W1=2 THEN GOSUB 3140  
2530 IF W1=3 THEN GOSUB 3530  
2540 PRINT "FILTERED MAP RESULTS OF:";U1*$  
2550 IF W1=1 THEN PRINT "AVERAGE LEVELS FILTER"  
2560 IF W1=2 THEN PRINT "TOTAL AVERAGE FILTER"  
2570 IF W1=3 THEN PRINT "AVERAGE SIDES FILTER"  
2580 PRINT "--------------------"
2590 PRINT "STATION","MAP VALUE"  
2600 S2=S1+3*D/2  
2610 FOR J=1 TO N  
2620  
2630 S3=S2+(J-1)*D  
2640 PRINT USING 2640 ; S3,W(I)  
2650 NEXT I  
2660 GOTO 2410  
2670 CLEAR  
2680 RETURN
2690 ! SUBPROGRAM IPDATA WINDOW-1
2700 ! AVERAGE LEVELS FILTER
2710 FOR J=1 TO N  
2720 J=j+3  
2730 IF I2$="W" THEN PRINT$ 1,1  
2740 W(I,J)  
2750 NEXT J  
2760 NEXT I  
2770 PRINT "--------------------"
Appendix 1.--Program listing--Continued

2730 IF J>M THEN 2870
2740 N2=N-M+1
2750 IF J>N2 THEN 2990
2760 FOR I=1 TO M
2770 I1=1
2780 B2=0 8 B3=0
2790 FOR K=1 TO I1
2800 J1=J-K+1
2810 B3=B3+Z(I,J1) 8 B2=B2+1
2820 NEXT K
2830 V1=B3/B2 8 B1=B1+V1
2840 NEXT I
2850 W(J)=B1/M
2860 GOTO 3120
2870 FOR I=1 TO M
2880 I1=1
2890 IF I1=I THEN I1=J
2900 B2=0 8 B3=0
2910 FOR K=1 TO I1
2920 J1=J-K+1
2930 B3=B3+Z(I,J1) 8 B2=B2+1
2940 NEXT K
2950 V1=B3/B2 8 B1=B1+V1
2960 NEXT I
2970 W(J)=B1/M
2980 GOTO 3120
2990 J=J+1
3000 FOR I=1 TO M
3010 IF I1=I THEN I1=J
3020 J2=J-I
3030 FOR K=1 TO I1
3040 J3=J2+K
3050 B3=B3+Z(I,J3) 8 B2=B2+1
3060 NEXT K
3070 W(J)=B3/B2
3080 NEXT J
3090 RETURN
3100 ! SUBPROGRAM IPWINDOW-2
3110 ! TOTAL AVERAGE FILTER
3120 FOR J=1 TO N
3130 B2=0 8 B3=0
3140 IF J>M THEN 3300
3150 N2=N-M+1
3160 IF J+N2 THEN 3400
3170 FOR I=1 TO M
3180 I1=I
3190 FOR K=1 TO I1
3200 J1=J-K+1
3210 FOR I=1 TO M
3220 W(J)=B3/B2
3230 GOTO 3510
3240 FOR I=1 TO M
3250 IF I1=I THEN I1=J
3260 FOR K=1 TO I1
3270 J1=J-K+1
3280 B3=B3+Z(I,J1) 8 B2=B2+1
3290 NEXT K
3300 NEXT I
3310 RETURN
3320 ! SUBPROGRAM IPWINDOW-3
3330 ! AVERAGE SIDES FILTER
3340 FOR J=1 TO N
3350 B2=0 8 B3=0
3360 IF J<M THEN 3700
3370 B2=0 8 B3=0
3380 FOR I=1 TO M
3390 I1=I
3400 IF I1=I THEN I1=J
3410 J2=J-I
3420 FOR K=1 TO I1
3430 J3=J2+K
3440 B3=B3+Z(I,J3) 8 B2=B2+1
3450 NEXT K
3460 W(J)=B3/B2
3470 NEXT J
3480 RETURN
3490 ! SUBPROGRAM PLOT
3500 CLEAR
3510 IF M=0 THEN 3650
3520 IF M=0 THEN 3700
3530 IF M=0 THEN 3750
3540 IF M=0 THEN 3800
3550 IF M=0 THEN 3850
3560 IF M=0 THEN 3900
3570 PRINT "THIS ROUTINE ALLOWS X-Y PLOTS OF IP OUTPUT DATA ALONG PROFILE IN LOG OR NORM. SCALE"
3580 PRINT "OPERATE KEY? (Y/N)" 6 INPUT K1$
3590 IF K1$="N" THEN 3650
3600 IF K1$="N" THEN 3700
3610 IF K1$="N" THEN 3750
3620 IF K1$="N" THEN 3800
3630 IF K1$="N" THEN 3850
3640 IF K1$="N" THEN 3900
3650 PRINT "NORMAL(N) OR LOG(L) PLOT? " 6 INPUT P$
Appendix 1.--Program listing--Continued

4000 DISP "PLOT WINDOW(W) OR PSEUDO LEVEL(P)" @ INPUT P5
4010 IF P5$="W" AND P6$="L" THEN 4140
4020 IF P5$="W" AND P6$="L" THEN 4060
4030 IF P5$="P" THEN 4140
4040 IF P5$="P" THEN 4100
4050 GOSUB 4780
4060 FOR J=1 TO N
4070 IF P5$="P" THEN 4100
4080 IF U(J)=0 THEN 4130
4090 W(J)=LGT(W(J)) 6 GOTO 4130
4100 W(J)=Z(I5,J)
4110 IF W(J)=0 THEN 4130
4120 IF P6$="L" THEN W(J)=LGT(W(J))
4130 NEXT J
4140 GOSUB 4670
4150 M2=CEIL(M2)
4160 M1=FLOOR(M1)
4170 PRINT "                 
4180 PRINT "PLOT OF LINE:";L$ @ PRINT "AREA:";A$
4190 PRINT "PLOT PARAMETERS:",M1,M2
4200 PRINT "Y-MAX=";M2;" Y-MIN=";M1 @ PRINT "Y-RANGE=";M2-M1
4210 DISP "CHANGE Y-LIMITS?(Y/N)" @ INPUT C3$
4220 IF C3$="N" THEN 4250
4230 DISP "NEW Y-MIN AND Y-MAX:" @ INPUT M1,M2
4240 PRINT "Y- PLOT LIMITS:";M1,M2
4250 DISP "Y-AXIS MAJ &MIN TICS:" @ INPUT D4,D2
4260 S2=S1+Dx3/2 @ G9=S2+(N-1)*D
4270 PRINT "X-MAX=";G9;" X-MIN=";S2 @ PRINT "X-RANGE=";G9-S2
4280 DISP "CHANGE X-LIMITS?(Y/N)" @ INPUT C3$
4290 IF C3$="N" THEN 4320
4300 DISP "NEW X-MIN AND X-MAX:" @ INPUT S2,G9
4310 PRINT "X- PLOT LIMITS:";S2,G9
4320 DISP "X-AXIS MAJ &MIN TICS:" @ INPUT D3,D1
4330 PRINT "XMTCS=";D3;" XMNTCS S=";D1 @ PRINT "YMTCS=";D4;" YMTCS=";D2
4340 DISP "OVERLAP PLOTS?(Y/N)" @ INPUT V2$
4350 IF V2$="N" THEN GCLEAR
4360 H9=(M2-M1)*.05 @ G9=G9-S2
4370 H1=M1+H9 @ G1=.05+H9-S2
4380 H2=M2-H9 @ G2=.88+H9-S2
4390 G9=S2+G9 & SCALE S2,G9,M1,M2
4400 PRINT "XXXXXXXXXXXXXXXXXXXXXXXXXX XXX"
4410 PRINT "
4420 DISP "TITLE OF Y-AXIS" @ INPUT L1$
4430 DISP "TITLE OF X-AXIS" @ INPUT L2$
4440 PRINT ";L1$
4450 XASSIS M1,D1,S2,G9
4460 YASSIS S2,D2,M1,M2
4470 ! LABEL X-AXIS
4480 LDIR 90
4490 FOR X=S2+D3 TO G9-D3 STEP D3
4500 MOVE X,H1 & LABEL VAL$(X)
4510 NEXT X
4520 ! LABEL Y-AXIS
4530 LDIR 0
4540 PRINT "NEW X-MIN AND X-MAX:" @ INPUT S2,G9
4550 PRINT "X-PLOT LIMITS:";S2,G9
4560 NEXT Y
4570 PENUM & MOVE S2,W(I)
4580 S2=S2+(15-1)*D/2
4590 FOR I=2 TO N
4600 U(I)=U(I-1)*D
4610 DRAW X,W(J)
4620 NEXT J
4630 COPY U1*="PSEUDO-RE
4640 PRINT L2$
4650 CLEAR
4660 RETURN
4670 ! SUBPROGRAM MAXMIN
4680 M1=W(I) & M2=W(I)
4690 FOR I=2 TO N
4700 IF UdXMl THEN M1=W(I)
4710 IF W(I) M2 THEN M2=W(I)
4720 NEXT I
4730 RETURN
4740 ! SUBPROGRAM STOP
4750 PRINT " "
4760 CLEAR @ DISP "ALL DONE!!!"
4770 STOP
4780 ! SUBPROGRAM TRANSFER
4790 IF W2=1 THEN U1$="PSEUDO-RE
4800 IF W2=2 THEN U1$="PSEUDO-CH
4810 IF W2=3 THEN U1$="PSEUDO-M.
4820 IF W2=4 THEN U1$="PSEUDO-PH
4830 FOR J=1 TO N
4840 FOR I=1 TO M
4850 IF W2=1 THEN Z(I,J)=R(I,J)
4860 IF W2=2 THEN Z(I,J)=F(I,J)
4870 IF W2=3 THEN Z(I,J)=M(I,J)
4880 IF W2=4 THEN Z(I,J)=P(I,J)
4890 NEXT I
4900 NEXT J
4910 RETURN
Appendix 2: Examples of program operation

KEY (1) OPERATION MODE
EXAMPLE

THIS SUBPROGRAM ALLOWS DATA INPUT FROM TAPE OR KEYBOARD
OPERATE KEY? (Y/N):

Y

INPUT FROM TAPE (T) OR KEYBOARD (K):

K

AREA NAME?:

BAID AL JIMALAH

LINE NAME?

500E

TYPE OF SURVEY, TIME DOMAIN (T) OR FREQ. DOMAIN (F)?

F

STATION LOCATION WILL BE -VE FOR S&W AND +VE FOR N&E
FIRST STATION LOCATION ON N=1 DIPOLE?:

-100

STATION ORDER DECREASE (D) OR INCREASE (I)?:

I

NO. OF DIPOLES ALONG PROFILE?

4

DIPOLE LENGTH?:

50

NO. OF IP LEVELS (N=)?:

4

FREQUENCY DOMAIN IP SURVEY
AREA: BAID AL JIMALAH
LINE: 500E FIRST STATION: -25
NO. OF DIPOLES = 4 N= 4
DIPOLE LENGTH: 50

INPUT DATA REDUCED? (Y/N):

N

ONE FREQUENCY USED? (Y/N):

Y

--INPUT DATA--
INPUT PSEUDO (P) OR WINDOW (W)?

P

DIPOLE NO.: 1
DIPOLE NO= 1 STATION= -25
N= VP CR PFE RPS
FOR LEVEL N= 1
INPUT VP, CR, PFE, RPS

32, 2.36, 2.3, -0.8
2 32.0 2.4 2.3 -.8

FOR LEVEL N= 3
INPUT VP, CR, PFE, RPS

17, 2.43, 2.6, -0.8
3 17.0 2.4 2.6 -.8

FOR LEVEL N= 4
INPUT VP, CR, PFE, RPS

10.9, 2.57, 1.2, -0.5
10.9 2.6 1.2 -0.5

DIPOLE NO.: 2
DIPOLE NO= 2 STATION= 25
N= VP CR PFE RPS
FOR LEVEL N= 1
INPUT VP, CR, PFE, RPS

141, 2.37, 1.9, -1.1
1 141.0 2.4 1.9 -1.1

FOR LEVEL N= 2
INPUT VP, CR, PFE, RPS

63, 2.43, 2.3, -1.2
2 63.0 2.4 2.3 -1.2

FOR LEVEL N= 3
INPUT VP, CR, PFE, RPS

37, 2.56, 1.6, -0.6
3 37.0 2.6 1.6 -0.6

FOR LEVEL N= 4
INPUT VP, CR, PFE, RPS

18, 2.23, 1.8, -0.2
4 18.0 2.2 1.8 -0.2

DIPOLE NO.: 3
DIPOLE NO= 3 STATION= 75
N= VP CR PFE RPS
FOR LEVEL N= 1
INPUT VP, CR, PFE, RPS

85, 2.43, 1.8, -0.8
1 85.0 2.4 1.8 -0.8

FOR LEVEL N= 2
INPUT VP, CR, PFE, RPS

37, 2.57, 1.2, -2
2 37.0 2.6 1.2 -2

FOR LEVEL N= 3
INPUT VP, CR, PFE, RPS

15.7, 2.24, 1.1, -2
3 15.7 2.2 1.1 -2

FOR LEVEL N= 4
INPUT VP, CR, PFE, RPS

19.8, 2.61, 8, -3
4 19.8 2.6 8 -3
Appendix 2.—Examples of program operations—Continued

DIPOLE NO.: 4
DIPOLE NO= 4 STATION= 125
N= VP CR PFE RPS
FOR LEVEL N= 1
INPUT VP, Cr, PFE, RPS
195, 2.57, .8, -.3
1 115.6 2.6 .8 -.3
FOR LEVEL N= 2
INPUT VP, Cr, PFE, RPS
32, 2.24, .8, .2
2 32.0 2.2 .8 .2
FOR LEVEL N= 3
INPUT VP, Cr, PFE, RPS
17.2, 2.62, .6, -.3
3 17.2 2.6 .6 -.3
FOR LEVEL N= 4
INPUT VP, Cr, PFE, RPS
12.2, 2.64, .6, .2
4 12.2 2.6 .6 .2
THIS ROUTINE ALLOWS STORE ANY PART OR ALL OF INPUT AND/OR OUTPUT DATA ON TAPE

OPERATE KEY? (Y/N):

Y

OUTPUT FILENAME AND NO. OF REC.?

IPDAT, 20

STORE PSEUDO(P) OR WINDOW(W) DATA?

P

---------------

DATA STORED ON FILE: IPDAT
REDUCED PSEUDOSECTION OF AREA: BAID AL JIMALAH
LINE: 500E
### Appendix 2. Examples of program operations—Continued

**KEY (3) OPERATION MODE**

**EXAMPLE**

<table>
<thead>
<tr>
<th>Example</th>
<th>Operation</th>
<th>Mode</th>
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<tbody>
<tr>
<td>THIS ROUTINE PROVIDES</td>
<td>OPERATE</td>
<td>DATA</td>
</tr>
<tr>
<td>PSEUDOSECTIONS-OR-FILTERED DATA</td>
<td>OPERATE</td>
<td>KEY? (Y/N)</td>
</tr>
<tr>
<td>OPERATE</td>
<td>PRINT PSEUDO(P) OR WINDOW(W)</td>
<td></td>
</tr>
<tr>
<td>OPERATE</td>
<td>OPERATE</td>
<td></td>
</tr>
<tr>
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<tr>
<td>OPERATE</td>
<td>OPERATE</td>
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**IP FIELD DATA**

**DIPOLE: 1**

<table>
<thead>
<tr>
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<th>VP</th>
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<th>PFE</th>
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<td>-3</td>
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**DIPOLE: 2**

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**DIPOLE: 3**

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**DIPOLE: 4**

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<td>4</td>
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<td>2.6</td>
<td>1.2</td>
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</table>
Appendix 2.—Examples of program operations—Continued

KEY (4) OPERATION MODE
EXAMPLE

THIS SUBPROGRAM ALLOWS CORRECTION OF MISTAKES IN INPUT DATA
OPERATE KEY?<Y/N>:
? Y
ANY MISTAKES <Y/N>?
? Y
MISTAKES IN PSEUDO?<Y/N>?
? Y
WHICH DIPOLE(J) AND N(I)?
? 3,2
CORRECTION OF INPUT VALUE OF DIPole 3 N = 2
WRONG VALUE:
37 2.57 1.2 -.2
ENTER NEW VALUES:
? 37,2.58,1.2,-.2
CORRECT VALUE:
37 2.58 1.2 -.2
ANY MISTAKES <Y/N>?
? N
Appendix 2.—Examples of program operations—Continued

KEY <5> OPERATION MODE
EXAMPLE

THIS ROUTINE ALLOWS REDUCTION OF PSEUDOSECTION DATA
OPERATE KEY?<Y/N>?
Y

TO PRINTOUT REDUCED IP-DATA
USE KEY <3> OPERATION MODE
----------------------------------

THIS ROUTINE PROVIDES PRINTOUTS OF PSEUDOSECTIONS OR FILTERED DATA
OPERATE KEY?<Y/N>:?
Y
PRINT PSEUDO(P) OR WINDOW(W)?
P
PSEUDO SECTION DATA
DIPOLE: 1 STATION: -25
N= RES PFE MF RPS
1 23.4 1.2 51.4 - .1
2 51.1 2.3 45.0 - .8
3 65.9 2.6 39.4 - .8
4 79.9 1.2 15.0 - .5

DIPOLE: 2 STATION: 25
N= RES, PFE MF RPS
1 56.1 1.9 33.9 - 1.1
2 97.7 2.3 23.5 - 1.2
3 136.2 1.6 11.7 - .6
4 152.1 1.8 11.8 - .2

DIPOLE: 3 STATION: 75
N= RES, PFE MF RPS
1 33.0 1.8 54.6 - .8
2 54.1 1.2 22.2 - .2
3 66.1 1.1 16.7 - .2
4 143.0 .8 5.6 - .3

DIPOLE: 4 STATION: 125
N= RES, PFE MF RPS
1 38.5 .8 20.8 - .3
2 53.9 .8 14.9 - .2
3 61.9 .6 9.7 - .3
4 87.1 .6 6.9 - .2
Appendix 2—Examples of program operations—Continued

KEY <6> OPERATION MODE

EXAMPLE

THIS ROUTINE ALLOWS APPLICATION
OF THREE IP FILTERS
SUGG BY FRASER <1981>
WINDOW (1) FOR AVER. LEVELS (2)
FOR TOTAL AVER AND (3) FOR AVERAGE TRAPEZOID SIDES
OPERATE KEY? (Y/N)
?
APPLY MAP WINDOW? (Y/N)
?
TITLE OF DATA TO BE FILTERED
?
RESISTIVITY
FILTERED MAP RESULTS OF RESISTIVITY
AVERAGE LEVELS FILTER
-------------------------------------
AV. LEV. (1) OR ALL AV. (2) OR TRIANGLE SIDES (3):
?
1
TO RES. (1), PFE (2), MF (3) OR RPS (4)?
?
FILTERED MAP RESULTS OF PSEUDO-RESISTIVITY
AVERAGE LEVELS FILTER
-------------------------------------
STATION MAP VALUE
-25.0 55.1
25.0 86.9
75.0 80.8
125.0 77.2
APPLY MAP WINDOW? (Y/N)
?
TITLE OF DATA TO BE FILTERED
?
PFE
AV. LEV. (1) OR ALL AV. (2) OR TRIANGLE SIDES (3):
?
2
TO RES. (1), PFE (2), MF (3) OR RPS (4)?
?
FILTERED MAP RESULTS OF PSEUDO-CHR. OR PFE
TOTAL AVERAGE FILTER
-------------------------------------
STATION MAP VALUE
-25.0 1.8
25.0 1.9
75.0 1.1
125.0 1.2
Appendix 2.--Examples of program operations--Continued

KEY <7> OPERATION MODE
EXAMPLE

THIS ROUTINE ALLOWS X-Y PLOTS OF
IP OUTPUT DATA ALONG PROFILE IN
LOG OR NORM SCALE
OPERATE KEY?<Y/N>

Y
NORMAL(N) OR LOG(L) PLOT?

N
PLOT WINDOW(W) OR PSEUDO LEVEL(P)

W
-------------------------------------
PLOT OF LINE: 500E
AREA: BAID AL JIMALAH
PLOT PARAMETERS:
Y-MAX= 38 Y-MIN= 17
Y-RANGE= 21
CHANGE Y-LIMITS?<Y/N>

Y
NEW Y-MIN AND Y-MAX:

10,50
Y- PLOT LIMITS: 10 50
X-AXIS MAJ&MIN TICS:

10,2
X-MAX= 125 X-MIN=-25
X-RANGE= 150
CHANGE X-LIMITS?<Y/N>

Y
NEW X-MIN AND X-MAX:

-50,150
X-PLOT LIMITS-50 150
X-AXIS MAJ&MIN TICS:

50,10
XMJTCS= 50 XMNNTCS= 10
YMJTCS= 10 YMNTCS= 2
OVERLAP PLOTS?<Y/N>

N
XXXXXXXXXXXXXXXXXXXXXXXXXXXX

TITLE OF Y-AXIS
?
M. FACTOR
TITLE OF X-AXIS
?
METERS

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