1983/37. Computer calculation and modelling of Schlumberger configuration resistivity sounding.

J.W. Hudspeth

Abstract

The data reduction program reduces Schlumberger configuration field data to apparent resistivities which are stored in a file. The modelling program displays at the user's screen, on the same log-log graph, both the observed and modelled apparent resistivities. The graph may be printed.

INTRODUCTION

The relevant programs are written in FORTRAN and run interactively through .CSS's on the Tasmania Department of Mines Perkin-Elmer 8/32 mini-computer. The modelling program uses "Resiso" as written by D.E. Leaman with the computational part of the program retained intact, but the input/output parts altered in order to facilitate interactive running with graph display. The programs are preliminary versions designed to provide Schlumberger configuration calculation and modelling to users, who will suggest modifications to be made to the final version.

DATA REDUCTION

To run the data reduction program type "SCHCALC X.Y", where X.Y is the name you give to the file which will contain the reduced data. The screen will respond with:

"THIS IS A SCHLUMBERGER ARRAY PROGRAM. IF YOUR ARRAY IS NOT SCHLUMBERGER, THEN YOU HAVE THE WRONG PROGRAM"

Enter name and number of probe (80 characters maximum), then enter title/number *etc.* or probe and this will be written as the first line of your file, followed by the line:

"SCHLUMBERGER ARRAY"

and the screen will then respond with:

"DO YOU WISH TO ENTER FURTHER INFORMATION? e.g. DATE, LOCATION, COMMENT"

If you do not enter 'N' or 'Y', the screen prompt will be:

"ANSWER N OR Y"

If your reply is 'Y' for yes the response is:

"ENTER A LINE OF INFO., 80 CHARS MAX."

and you should then enter up to 80 characters of information. The screen will continue to request a line (80 characters) of header information while you continue to respond with 'Y' to "DO YOU WISH TO ENTER FURTHER INFORMATION?" In response to 'N', the screen will ask for field data, beginning with:

"ENTER HALF POTENTIAL ELECTRODE SPACING"

Following your entering this reading, the response will be:

"ENTER HALF CURRENT ELECTRODE SPACING, RESISTANCE.
TYPE 0.0,0.0 TO QUIT."

Enter the appropriate values separated by a comma. The screen response will then be to display the calculated apparent resistivity and the half current electrode spacing, followed by:

"CHANGE POTENTIAL SPACING?"

A reply of 'Y' will require that a new half potential electrode spacing be entered when requested. A reply of 'N' will require that new half current potential spacing and corresponding resistance values be entered when requested. It is not necessary that the half current electrode spacing values be in ascending order.

Invalid characters punched in response to a prompt will result in repeat of the prompt and the correct value may then be punched in. In the case of punching in an incorrect but acceptable (to the program) value, the set of values should be completed (that is, a calculated apparent resistivity and half current electrode spacing should be made to appear on the screen). The correct set of values should then be punched in and the offending resistivity/spacing pair (they will be on the same line in the written file) deleted through 'EDIT' after completion of the SCHCALC program.

MODELLING

In order to model the date written to file X.Y, type:

"RESMOD X.Y"

The screen response will be:

"ENTER NUMBER OF LAYERS"

You should then enter the number of layers (an integer) which you require for this model. If you enter an integer greater than 6 the screen will type:

"ARE YOU SURE YOU WANT THIS MANY LAYERS"

Entering 'Y' will take you to the next data request and entering 'N' will allow you to enter a different number of layers when requested. Following the number of layers being entered, the screen will type:

"RHO 1"

and you should enter the resistivity of the model's uppermost layer (a real number). The next prompt is:

"RHO 2 D 1"

and you should enter, separated by a comma, the resistivity of the second layer and the depth to the top of the second layer (both real numbers). The screen will continue to request the resistivity and depth to the top of successive model layers until there are as many layers as you have specified. The depths are in metres and the resistivities in ohm metres.

The program will then calculate a set of apparent resistivity versus half current electrode spacing values and these will be displayed on the screen. If you wish to examine these values you should stop the screen scrolling after the last value.

Following this a log-log (base 10) plot of the observed and modelled apparent resistivity versus half current electrode spacing will be displayed on the screen. Observed values are denoted by "x", calculated values by "+" and points representing coincidence of observed and calculated values by "*". The graph is self-scaling and scaled on the observed data. Calculated points not falling within the area of the graph are not plotted. The resistivities and depths of up to the first eight layers of the model are plotted to the left. The last line of the screen will read:

"PRINT GRAPH?"

A 'Y' response will print the graph on the lineprinter, otherwise type 'N'. The next screen prompt is:

"TRY NEW MODEL?"

An 'N' response will terminate the program. A 'Y' response will set up a new model and graph, beginning with:

"ENTER NUMBER OF LAYERS"

A response other than 'N' or 'Y' to either of the questions will result in the prompt:

"ANSWER N OR Y"

The entry of an illegal character in response to a data request will result in a repetition of the data request. Supplying only one number in response to the "RHO D" data request will result in a wait for the second number, without any reminder.

[11 August 1983]

APPENDIX 1

Example of interactive resistivity calculation and modelling

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*SCHCALC MELT01.RES
-
-
-THIS IS A SCHLUMBERGER ARRAY PROGRAM
-IF YOUR ARRAY IS NOT SCHLUMBERGER, THEN YOU HAVE THE WRONG PROGRAM.
-
-
-ENTER NAME AND NUMBER OF TRAVERSE (80 CHARACTERS MAXIMUM)
->MELTON MOWBRAY NO.1
-DO YOU WISH TO ENTER FURTHER INFORMATION?
-(E.G. DATE, LOCATION, COMMENT)
->Y
-ENTER A LINE OF INFO., 80 CHARS MAX.
->14TH. JULY 1983
- DO YOU WISH TO ENTER FUTHER INFORMATION?
-(E.G. DATE, LOCATION, COMMENT)
->Y
-ENTER A LINE OF INFO., 80 CHARS MAX.
->CENTRED ON BOREHOLE BEHIND PUB
-DO YOU WISH TO ENTER FURTHER INFORMATION?
-(E.G. DATE, LOCATION, COMMENT)
->Y
-ENTER A LINE OF INFO., 80 CHARS MAX.
->PROBE LINE BEARING 335 TRUE
-DO YOU WISH TO ENTER FURTHER INFORMATION?
-(E.G. DATE, LOCATION, COMMENT)
->N
-ENTER
-       HALF POTENTIAL ELECTRODE SPACING
->0.5
-ENTER
-       HALF CURRENT ELECTRODE SPACING, RESISTANCE
-TYPE 0.0,0.0 TO QUIT
->2.5,2.84
-   56.          2.5000
-CHANGE POTENTIAL SPACING?
->N
-ENTER
-       HALF CURRENT ELECTRODE SPACING, RESISTANCE
-TYPE 0.0,0.0 TO QUIT
->5.0,0.74
-   58.          5.0000
-CHANGE POTENTIAL SPACING?
->N
-ENTER
-       HALF CURRENT ELECTRODE SPACING, RESISTANCE
-TYPE 0.0,0.0 TO QUIT
->10.0,0.15
-    47.        10.0000
-CHANGE POTENTIAL SPACING?
->N
-ENTER
-       HALF CURRENT ELECTRODE SPACING, RESISTANCE
```

```
-TYPE 0.0,0.0 TO QUIT
->15.0,0.067
-  47.          15.0000
-CHANGE POTENTIAL SPACING?
->Y
-ENTER
-       HALF POTENTIAL ELECTRODE SPACING
->1.0
-ENTER
-       HALF CURRENT ELECTRODE SPACING, RESISTANCE
-TYPE 0.0,0.0 TO QUIT
->15.0,0.133
-  47.          15.0000
-CHANGE POTENTIAL SPACING?
->Y
-ENTER
-       HALF POTENTIAL ELECTRODE SPACING
->2..5
-ENTER
-       HALF POTENTIAL ELECTRODE SPACING
->2.5
-ENTER
-       HALF CURRENT ELECTRODE SPACING, RESISTANCE
-TYPE 0.0,0.0 TO QUIT
->15.0
->0.34
-  48.          15.0000
-CHANGE POTENTIAL SPACING?
->N
-ENTER
-       HALF CURRENT ELECTRODE SPACING, RESISTANCE
-TYPE 0.0,0.0 TO QUIT
->20.0,0.188
-  47.          20.0000
-CHANGE POTENTIAL SPACING?
->2.5
-ANSWER N OR Y
->N
-ENTER
-       HALF CURRENT ELECTRODE SPACING, RESISTANCE
-TYPE 0.0,0.0 TO QUIT
->30.0,0.070
-  40.          30.0000
-CHANGE POTENTIAL SPACING?
->N
-ENTER
-       HALF CURRENT ELECTRODE SPACING, RESISTANCE
-TYPE 0.0,0.0 TO QUIT
->40.0,0.027
-  27.          40.0000
CHANGE POTENTIAL SPACING?
->Y
-ENTER
-       HALF POTENTIAL ELECTRODE SPACING
->5.0
-ENTER
-       HALF CURRENT ELECTRODE SPACING, RESISTANCE
-TYPE 0.0,0.0 TO QUIT
->50.0,0.029
   23.          50.0000
```

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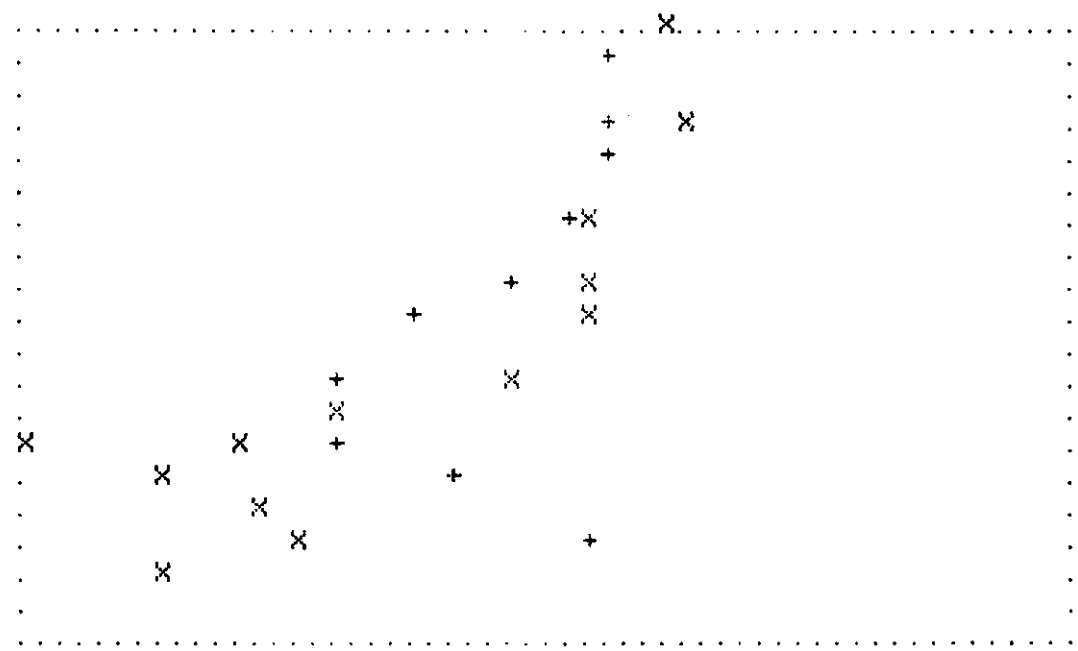
```
-CHANGE POTENTIAL SPACING?
->N
-ENTER
-       HALF CURRENT ELECTRODE SPACING, RESISTANCE
-TYPE 0.0,0.0 TO QUIT
->60.0,0.017
-   19.          60.0000
-CHANGE POTENTIAL SPACING?
->Y
-ENTER
-       HALF POTENTIAL ELECTRODE SPACING
->10.0
-ENTER
-       HALF CURRENT ELECTRODE SPACING, RESISTANCE
-TYPE 0.0,0.0 TO QUIT
->80.0,0.023
-   23.          80.0000
-CHANGE POTENTIAL SPACING?
->N
-ENTER
-       HALF CURRENT ELECTRODE SPACING, RESISTANCE
-TYPE 0.0,0.0 TO QUIT
->100.0,0.016
-    25.         100.0000
-CHANGE POTENTIAL SPACING?
->Y
-ENTER
-       HALF POTENTIAL ELECTRODE SPACING
->20.0
-ENTER
-       HALF CURRENT ELECTRODE SPACING, RESISTANCE
-TYPE 0.0,0.0 TO QUIT
->130.0,0.014
-    19.         130.0000
-CHANGE POTENTIAL SPACING?
->N
-ENTER
-       HALF CURRENT ELECTRODE SPACING, RESISTANCE
-TYPE 0.0,0.0 TO QUIT
->0.0,0.0
-JH       -END OF TASK CODE=    0     CPUTIME=0.407/0.151
-
*RESMOD MELT01.RES
- ENTER NUMBER OF LAYERS
->3
-   RHO   1
->50.0
-   RHO   2        D   1
->12.0,12.0
-   RHO   3        D   2
->200.0,20.0
-     50.5242           1.0000
-     50.5107           1.4678
-     50.4713           2.1544
-     50.3512           3.1623
-     49.9884           4.6416
-     48.9556           6.8128
-     46.3347           9.9998
-     40.9380          14.6777
-     33.1452          21.5438
```

```
-     27.0832          31.6218
-     27.7326          46.4142
-     35.5593          68.1264
-     48.1297          99.9954
-     64.2545         146.7725
-     83.5688         215.4316
-    105.2353         316.1289
-    127.6808         464.1289
-    148.8290         681.2449
-    166.7061         999.9263
-STOP
-JH       -END OF TASK CODE=    0     CPUTIME=0.182/0.079
```

```
          MODEL
 RESISTIVITY    DEPTH
        50.00
@@@@@@@@@@@@@@@   12.0
        12.00
@@@@@@@@@@@@@@@   20.0
       200.00
```



```
-PRINT GRAPH?
->Y
-TRY NEW MODEL?
->Y
-JH       -END OF TASK CODE=    0      CPUTIME=1.023/0.098
- ENTER NUMBER OF LAYERS
->
```

. . . . . AND SO ON. .