# **Automatic Computation of Schlumberger Apparent Resistivity Curves**

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#### **ABSTRACT**

Geophysical prospecting by the apparent resistivity method involves the measurement of apparent resisitvity between two potential electrodes as a function of the separation of two collinear current electrodes. From the early days of the application of the resistivity sounding method, an important tool in the interpretation of the data has been the comparison of the apparent resistivity curves obtained from the field observations with apparent resistivity curves computed for assumed models of the layered earth consisting of two or three horizontal, homogeneous, and isotropic layers of given thickness and resistivity. Theoretical curves for models of more than two or three layers are approximated using published nomograms.

A modified version of the Koefoed (1979) program for the computation of the sample values of the apparent resistivity and current electrode spacing alongwith resistivity transform in a Schlumberger configuration, using the linear filter method by Gosh (1971) is presented. This program has been written in Turbo BASIC language and is based on the sampling interval of the fourth of a decade. By the twofold application of the filter, the sampling values of the apparent resistivity are computed at intervals of an eighth of a decade. In this trial and error method, the entire apparent resistivity curve of a model layered structure is calculated for comparison with the measured curve.

## INTRODUCTION

The apparent resistivity  $\int_{0}^{\infty} a(r)$  for Schlumberger VES sounding in a horizontally layered earth is obtained as follows:

$$\int a(r) = r^2 \int_0^\infty T(\lambda) J_1(\lambda r) \lambda d\lambda \dots (1)$$

where r is half the current electrode spacing and  $J_1(\lambda r)$  is a Bassel function of order 1.  $T(\lambda)$  is known as the resistivity transform and is easily obtained for an arbitrary number of layers having different resistivities and thicknesses by means of recurrence formulas.

The linear filter method developed by Gosh (1971) permits the right hand side of equation (1) to be calculated using a set of fixed co-efficients taking advantage of the fact that  $T(\lambda)$  in equation (1) is an algebraic expression involving no more complicated functions than the exponential.

In this algorithm, a point filter is used to calculate the apparent resistivity. The maximum error of calculation is less than 0.5% and in most practical cases it is much less. Unfortunately, numerical problems can arise if very large resistivity contrasts (of the order of  $10^3$  -  $10^4$  or larger) occur in two successive layers and the resistivity of the lower layer is the larger one. However, this problem is unlikely to arise in connection with the resistivities usually encountered in nature.

The electrical resistivity soundings are interpreted by matching them with a set of model resitivity curves. Each model curve corresponds with a system of subsurface layers of varying thickness and electrical resistivity. In practice, interpretation of resistivity soundings is invariably subjected to the principle of equivalence: any resistivity sounding can be matched with several slightly deviating model curves, representing different subsurface resistivity stratifications (Kunetz, 1966). Therefore, selection of a matching layer model should be subjected to constraints based on available geological information (Zohdy et al, 1974). Most useful in this respect are geophysical well logs, particularly the electric resistivity logs (Scot Keys and Mac Cary, 1971). Information may also be derived from lithologic logs, geologic maps, and data on subsurface water levels and electrical conductivities.

## PROGRAM LISTING

This program computes apparent resistivity model curves and first asks for information concerning the layer model: the number of layers, their resistivities and their thicknesses. The parameters of the layers should be presented to the computer in the following sequence: first the top layer, and then going down step by step.

The program then asks for information concerning the output you want: the abscissa of first point of output and the number of samples of the output (at intervals of an eighth of a decade). The values of the apparent resistivity at these sample points are then printed out.

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Curves 10 DIM R(10), D(9), H(9), T(35) 20 F = EXP(LOG (10)/8) 20 F = EXP(LOG (10)/8) 21 F = EXP(LOG (10)/8) 22 F = EXP(LOG (10)/8) 23 INPUT GIVE NUMBER OF LAYERS = ",19 240 IS = 19 - 1 240 IS = 19 - 1 240 INPUT R(1) 250 FOR 1 = 1 TO 19 250 FOR 1 = 1 TO 19 250 INPUT R(1) 250 PRINT "GIVE DEPTHS" 250 INPUT R(1) 250 PRINT "GIVE DEPTHS" 250 INPUT H(1) 250 FOR 1 = 1 TO 18 251 D(1) = H(1) 253 FOR 1 = 1 TO 18 254 D(1 + 1) = H(1 + 1) - H(1) 255 NEXT 1 250 D(1) = H(1) 255 NEXT 1 250 PRINT "LAYER RESISTIVITY DEPTH" 250 FOR 1 = 1 TO 18 250 FOR 1 = 1 TO		5	REM Schlumberger Apparent Resistivity Model	540 STOP			
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100   NEXT     630   A2 = (A.1-I/A.1)/(A.1 + I/A.1)     110   PRINT "GIVE DEPTHS"   640   B = (B + A2*R(I))/(1 + A2*B/R(I))     130   FOR I = 1 TO I8   650   NEXT K     660   RETURN   660   RETURN     151   FOR I = 1 TO I8   70   END     153   FOR I = 1 TO I8   70   END     154   D(I + I) = H(I + I) - H(I)   TEST EXAMPLE     155   NEXT I   670   END   END     156   PRINT "LAYER RESISTIVITY DEPTH"   180   FOR I = 1 TO I8   GIVE NUMBER OF LAYERS = 3     190   PRINT TAB (2);I;TAB(10);R(I);TAB(30);H(I)   7   50     120   NEXT I   7   7   7     120   PRINT TAB (2);I9; TAB (15);R(I9)   7   350     120   PRINT "GIVE FIRST ABSCISSA = ";XI   7   100     120   PRINT "MUMBER OF SAMPLES = ",N   7   100     120   PRINT "NUMBER OF SAMPLES = ",N   7   100     130   PRINT "NO RAMDA T(I)   GIVE NUMBER OF SAMPLES = ? 30     130   PRINT "NO RAMDA T(I)   GIVE NUMBER OF SAMPLES = ? 30     130   PRINT "NO RAMDA T(I)   GIVE NUMBER OF SAMPLES = ? 30     130   PRINT "NO L2   AR   A   A   A   A     140   GOSUB 550   Resistivity Transform   Functions     150   PRINT "Schlumberger VES Curve"   3 2.88E-03   50     150   PRINT "Schlumberger VES Curve"   3 2.88E-03   50     150   PRINT "NO L2   AR   4 3.84E-03   50     150   FOR M = 1 TO N   5 5.12E-03   50     150   FOR M = 1 TO N   5 5.12E-03   50     150   GOSUB 550   6 6.83E-03   50     150   FOR M = 1 TO N   5 5.12E-03   50     150   FOR M = 1 TO N   5 5.12E-03   50     150   FOR M = 1 TO N   5 5.12E-03   50     150   FOR M = 1 TO N   5 5.12E-03   50     150   FOR M = 1 TO N   5 5.12E-03   50     150   FOR M = 1 TO N   5 5.12E-03   50     150   FOR M = 1 TO N   5 5.12E-03   50     150   FOR M = 1 TO N   5 5.12E-03   50     150   FOR M = 1 TO N   5 5.12E-03   50     150   FOR M = 1 TO N   5 5.12E-03   50     150   FOR M = 1 TO N   5 5.12E-03   50     150   FOR M = 1 TO N   5 5.12E-03   50     150   FOR M = 1 TO N   5 5.12E-03   50     150   FOR M = 1 TO N   5 5.12E-03   50     150   FOR M = 1 TO N   5 5.12E-03   50     150   FOR M = 1 TO N   5 5.12E-03   50     150   FOR M = 1 TO N   5							
110 PRINT "GIVE DEPTHS"   640 B = (B + A2*R(I))/(1 + A2*B/R(I))     120 FOR I = 1 TO I8   650 NEXT K     140 INPUT H(I)   152 D(I) = H(I)     153 FOR I = 1 TO I8   670 END					•		
130 FOR I = 1 TO I8				•	, ,	/=\ \	
140   NPUT   H(I)   153   NEXT   1   152   D(I) = H(I)   153   FOR I = I TO I8   155   NEXT   1   160   PRINT "LAYER RESISTIVITY DEPTH"   160   PRINT "LAYER RESISTIVITY DEPTH"   160   PRINT "LAYER RESISTIVITY DEPTH"   160   PRINT TAB (2);I;TAB(10);R(I);TAB(30);H(I)   210   NEXT   2   250				1,77			
150 NEXT   1							
152 D(1) = H(1) 153 FOR I = 1 TO I8 154 D(I + I) = H(I + I) - H(I) 155 NEXT I 160 PRINT "LAYER RESISTIVITY DEPTH" 180 FOR I = 1 TO I8 190 PRINT TAB (2);I;TAB(10);R(I);TAB(30);H(I) 210 NEXT I 220 PRINT TAB (2);I;TAB(15);R(I9) 240 INPUT "GIVE FIRST ABSCISSA = ";X1 250 PRINT "FIRST ABSCISSA = ";X1 250 PRINT "NUMBER OF SAMPLES = ";N 300 PRINT "NUMBER OF SAMPLES = ";N 300 PRINT "NUMBER OF SAMPLES = ";N 330 PRINT "NO RAMDA T(I)" 340 Y = X1/822.8 350 FOR J = 1 TO 34 360 GOSUB 550 370 T(I) = B 380 Y = Y *F 385 PRINT TAB (2);J; TAB (10); Y; TAB(35); T(J) 385 PRINT TAB (2);J; TAB (10); Y; TAB(35); T(J) 390 PRINT "NO L/2 AR 400 FOR M = 1 TO N 500 PRINT "NO L/2 AR 401 GOSUB 550 60 GOS				660 RETUI	RN		
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154   D(  + 1) = H(  + 1) - H(  1)		153	FOR $I = 1$ TO $I8$				
155 NEXT					TEST EXAMPLE		
160 PRINT "LAYER RESISTIVITY DEPTH"   180 FOR I = 1 TO 18   190 PRINT TAB (2);I,TAB(10);R(I);TAB(30);H(I)   210 NEXT I   220 PRINT TAB(2);I9; TAB(15);R(I9)   7350   735							
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260 PRINT "FIRST ABSCISSA =";X1 280 INPUT "GIVE NUMBER OF SAMPLES =";N 300 PRINT "NUMBER OF SAMPLES =";N 330 PRINT "RESISTIVITY TRANSFORM FUNCTION" 335 PRINT "NO RAMDA T(J) " 340 Y = X1/822.8 350 FOR J = 1 TO 34 360 GOSUB 550 370 T(J) = B 380 Y = Y *F 385 PRINT TAB (2);J; TAB (10); Y; TAB(35); T(J) 390 PRINT "Schlumberger VES Curve" 392 PRINT "Schlumberger VES Curve" 392 PRINT "NO L/2 AR 40 GOSUB 550 400 FOR M = 1 TO N 410 GOSUB 550 6 6 6.83E-03 50 420 T(35) = B 7 9.11E-03 50 430 Y = Y * F 48 0.012 50 440 S = 42*T(1)-103*T(3)+144*T(5)-211*T(7)+ 303*T(9)-574*T(11) 10 0.021 50 440 S = S+1184*T(13)-3162*T(15)+10219*T(17)- 24514*T(19) 450 S = S+1184*T(13)-3162*T(15)+10219*T(17)- 24514*T(19) 460 S = S+1184*T(13)+346*T(33)+38*T(35))/10000 15 0.091 50 480 FOR J = 1 to 34 490 T(J) = T(J + 1) 510 AO = Y/28.8207792 19 0.288 50 520 PRINT TAB(2);M; TAB(20);AO;TAB(47);S 20 0.384 50.072							
280 INPUT "GIVE NUMBER OF SAMPLES =";N				? 100		*	
300 PRINT "NUMBER OF SAMPLES = ";N 301 PRINT "RESISTIVITY TRANSFORM FUNCTION"  102 FUNCTION"  303 PRINT "NO RAMDA T(J) " 304 Y = X1/822.8  305 FOR J = 1 TO 34  306 GOSUB 550  307 T(J) = B  308 PRINT TAB (2);J; TAB (10); Y; TAB(35); T(J)  309 NEXT J  309 PRINT "NO L/2 AR  400 FOR M = 1 TO N  400 FOR M = 1 TO N  401 FOR M = 1 TO N  402 T(35) = B  403 Y = Y*F  404 S = 42*T(1)-103*T(3) + 144*T(5)-211*T(7) +  307 S = (S-106*T(31) + 93*T(33)-38*T(35))/10000  407 FOR M = 1 to 34  408 FOR J = 1 to 34  409 T(J) = T(J)  409 T(J) = T(J)  400 FOR M = 1 TO N  401 GOSUB 550  402 T(35) = B  403 T(35) = B  404 S = 42*T(1)-103*T(3) + 144*T(5)-211*T(7) +  450 S = S + 1184*T(13)-3162*T(15) + 10219*T(17)-  24514*T(19)  460 S = S + 18192*T(21) + 6486*T(23) + 1739*T(25)  470 T(J) = T(J)  470 T(J) = T(J + 1)  470 T(J) = T(J)  470 T(J				GIVE DEP	THS		
330 PRINT "RESISTIVITY TRANSFORM FUNCTION"  535 PRINT "NO RAMDA T(J)"  340 Y = X1/822.8  350 FOR J = 1 TO 34  360 GOSUB 550  77 T(J) = B  380 Y = Y *F  385 PRINT TAB (2); J; TAB (10); Y; TAB(35); T(J)  390 NEXT J  392 PRINT "Schlumberger VES Curve"  395 PRINT "NO L/2 AR  40 FOR M = 1 TO N  40 FOR M = 1 TO N  410 GOSUB 550  420 T(35) = B  430 Y = Y *F  440 S = 42*T(1)-103*T(3) + 144*T(5)-211*T(7) + 9  20 0.016  330*T(9)-574*T(11)  450 S = S + 1184*T(13)-3162*T(15) + 10219*T(17)-  24514*T(19)  460 FOR J = 1 to 34  460 FOR J = 1 to 34  470 S = (S-106*T(31) + 93*T(33) - 38*T(35))/10000  480 FOR J = 1 to 34  490 T(J) = T(J + 1)  510 AOO = Y/28.8207792  520 PRINT TAB (2);M; TAB(20);AO;TAB(47);S  520 PRINT TAB (2);M; TAB(20);AO;TAB(47);S  520 PRINT TAB ABSCISSA = ? 1 FIRST ABSCISA = ? 1 FIRST ABSCIS APPLE		280	INPUT "GIVE NUMBER OF SAMPLES = ";N	? 1			
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FUNCTION"  335 PRINT "NO RAMDA T(J)"  340 Y = X1/822.8  350 FOR J = 1 TO 34  360 GOSUB 550  370 T(J) = B  380 Y = Y *F  385 PRINT TAB (2); TAB (10); Y; TAB(35); T(J)  390 NEXT J  392 PRINT "Schlumberger VES Curve"  395 PRINT "NO L/2 AR  400 GOSUB 550  400 FOR M = 1 TO N  400 FOR M = 1 TO N  400 GOSUB 550  400 FOR M = 1 TO N  500 L/2 AR  400 FOR M = 1 TO N  500 L/2 AR  400 FOR M = 1 TO N  500 L/2 AR  400 FOR M = 1 TO N  500 L/2 AR  400 FOR M = 1 TO N  500 L/2 AR  500 L/2 BR  70 9.11E-03  50  400 FOR M = 1 TO N  500 L/2 SO  400 FOR M = 1 TO N  500 L/2 SO  400 FOR M = 1 TO N  500 L/2 SO  400 FOR M = 1 TO N  500 L/2 SO  400 FOR M = 1 TO N  500 NEXT J  500 L/2 SO  400 FOR M = 1 TO N  500 L/2 SO  500 L/		330	PRINT "RESISTIVITY TRANSFORM	GIVE FIRS	TABSCISSA = ?1		
335 PRINT "NO RAMDA T(J)"  340 Y = X1/822.8  550 FOR J = 1 TO 34  360 GOSUB 550  370 T(J) = B  385 PRINT TAB (2);J; TAB (10); Y; TAB(35); T(J)  385 PRINT TAB (2);J; TAB (10); Y; TAB(35); T(J)  387 PRINT "Schlumberger VES Curve"  388 PRINT "NO L/2 AR  40 FOR M = 1 TO N  400 FOR M = 1 TO N  400 FOR M = 1 TO N  401 GOSUB 550  402 T (35) = B  403 Y = Y*F  404 S = 42*T(1)-103*T(3) + 144*T(5)-211*T(7) +  3030*T(9)-574*T(11)  405 S = S + 1184*T(13)-3162*T(15) + 10219*T(17)-  245 14*T(19)  460 S = S + 18192*T(21) + 6486*T(23) + 1739*T(25)  470 FOR M = 1 to 34  480 FOR J = 1 to 34  490 T(J) = T(J) + 10  590 NEXT J  590 PRINT "NO L/2 AR  40 GOSUB 550  50 G 6 G.83E-03  50 G 6 G.83E-03  50 G 6 G.83E-03  50 G 7 9.11E-03  50 G 8 G.83E-03  50			FUNCTION"				
340 Y = X1/822.8  350 FOR J = 1 TO 34  360 GOSUB 550  Resistivity Transform Functions 77 (J) = B  380 Y = Y *F  385 PRINT TAB (2); J; TAB (10); Y; TAB(35); T(J)  392 PRINT "Schlumberger VES Curve"  305 FOR M = 1 TO N  40 FOR M = 1 TO N  400 FOR M = 1 TO N  400 GOSUB 550  420 T(35) = B  430 Y = Y *F  800 NEXT J  300 NEXT J  440 FOR M = 1 TO N  450 S = S + 1184*T(13)-3162*T(15) + 10219*T(17)-  24514*T(19)  450 S = S + 18192*T(21) + 6486*T(23) + 1739*T(25)  470 FOR M; J = 1 to 34  470 S = (S-106*T(31) + 93*T(33)-38*T(35))/10000  480 FOR J = 1 to 34  470 S = (S-106*T(31) + 93*T(33)-38*T(35))/10000  150 NEXT J  160 NEXT J  170 0.288  50 0.384  50 0.384  50 0.384  50 0.384  50 0.384  50 0.384  50 0.384  50 0.384		335	PRINT "NO RAMDA T(J) "				
350 FOR J = 1 TO 34 360 GOSUB 550			• • • • • • • • • • • • • • • • • • • •			50	
360 GOSUB 550       Resistivity       Transform       Functions         370 T(J) = B       No.       RAMDA       T (J)         380 Y = Y *F       T       T       T         385 PRINT TAB (2):J; TAB (10); Y; TAB(35); T(J)       1       1.62E-03       50         390 NEXT J       2       2.16E-03       50         392 PRINT "Schlumberger VES Curve"       3       2.88E-03       50         395 PRINT "NO       L/2       AR       4       3.84E-03       50         400 FOR M = 1 TO N       5       5.12E-03       50         410 GOSUB 550       6       6.83E-03       50         420 T(35) = B       7       9.11E-03       50         440 Y = Y* F       8       0.012       50         440 Y = Y* F       8       0.012       50         440 Y = Y* F       9       0.016       50         330*T(9)-574*T(11)       10       0.021       50         450 S = S + 1184*T(13)-3162*T(15) + 10219*T(17)-       11       0.028       50         24514*T(19)       12       0.038       50         460 S = S + 18192*T(21) + 6486*T(23) + 1739*T(25)       13       0.051       50         470 S = (S-106*T(31) + 93*T(33)-38*T(3				I CIVIDLE (	or order Elect = 50		
370 T(J) = B 380 Y = Y *F 385 PRINT TAB (2); J; TAB (10); Y; TAB(35); T(J) 390 NEXT J 2 2.16E-03 390 NEXT J 392 PRINT "Schlumberger VES Curve" 3 2.88E-03 395 PRINT "NO L/2 AR 4 3.84E-03 400 FOR M = 1 TO N 5 5.12E-03 400 GOSUB 550 400 T(35) = B 7 9.11E-03 50 420 T(35) = B 7 9.11E-03 50 440 S = 42*T(1)-103*T(3) + 144*T(5)-211*T(7) + 9 303*T(9)-574*T(11) 10 0.021 50 450 S = S + 1184*T(13)-3162*T(15) + 10219*T(17)- 11 24514*T(19) 460 S = S + 18192*T(21) + 6486*T(23) + 1739*T(25) 470 S = (S-106*T(31) + 93*T(33)-38*T(35))/10000 15 0.091 480 FOR J = 1 to 34 490 T(J) = T(J + 1) 17 0.162 50 170 NEXT M 18 0.216 50 170 S = (S-106*T(31) + 93*T(35); AO;TAB(47); S 170 NEXT M 18 0.216 50 50 O.384 50 50 50 50 50 60 60 60 60 60 60 60 60 60 60 60 60 60				Dacieticity	Tronsform	Emations	
380 Y = Y *F  385 PRINT TAB (2);J; TAB (10); Y; TAB(35); T(J)  390 NEXT J  2 2.16E-03  390 NEXT J  392 PRINT "Schlumberger VES Curve"  3 2.88E-03  395 PRINT "NO L/2 AR  4 3.84E-03  50  400 FOR M = 1 TO N  5 5.12E-03  50  410 GOSUB 550  6 6.83E-03  50  420 T(35) = B  7 9.11E-03  50  430 Y = Y * F  8 0.012  50  440 S = 42*T(1)-103*T(3) + 144*T(5)-211*T(7) + 9  30*T(9)-574*T(11)  450 S = S + 1184*T(13)-3162*T(15) + 10219*T(17)- 11  24514*T(19)  460 S = S + 18192*T(21) + 6486*T(23) + 1739*T(25)  +79*T(27) + 200*T(29)  470 S = (S-106*T(31) + 93*T(33)-38*T(35))/10000  480 FOR J = 1 to 34  490 T(J) = T(J + 1)  50  71 1.62  72 2.16E-03  50  6 32.88E-03  50  6 6.83E-03  50  70 9.11E-03  50  9.11E-03  9.028  50  9.028  5				•			
385 PRINT TAB (2); TAB (10); Y; TAB(35); T(J) 1 1.62E-03 50 390 NEXT J 2 2.16E-03 50 392 PRINT "Schlumberger VES Curve" 3 2.88E-03 50 395 PRINT "NO L/2 AR 4 3.84E-03 50 400 FOR M = 1 TO N 5 5.12E-03 50 410 GOSUB 550 6 6.83E-03 50 420 T(35) = B 7 9.11E-03 50 430 Y = Y*F 8 0.012 50 440 S = 42*T(1)-103*T(3) + 144*T(5)-211*T(7) + 9 0.016 50 330*T(9)-574*T(11) 10 0.021 50 450 S = S + 1184*T(13)-3162*T(15) + 10219*T(17)- 11 0.028 50 24514*T(19) 12 0.038 50 460 S = S + 18192*T(21) + 6486*T(23) + 1739*T(25) 13 0.051 50 470 S = (S-106*T(31) + 93*T(33)-38*T(35))/10000 15 0.091 50 480 FOR J = 1 to 34 16 0.012 50 490 T(J) = T(J + 1) 17 0.162 50 500 NEXT J 18 0.216 50 500 NEXT J 18 0.216 50 500 O.384 50.072				140.	RAMDA	1 (3)	
390 NEXT J  392 PRINT "Schlumberger VES Curve"  3 2.88E-03  305 PRINT "NO L/2 AR  4 3.84E-03  50  400 FOR M = 1 TO N  5 5.12E-03  50  410 GOSUB 550  420 T(35) = B  7 9.11E-03  50  430 Y = Y* F  8 0.012  50  440 S = 42*T(1)-103*T(3) + 144*T(5)-211*T(7) + 9  300*T(9)-574*T(11)  450 S = S + 1184*T(13)-3162*T(15) + 10219*T(17)- 11  24514*T(19)  460 S = S + 18192*T(21) + 6486*T(23) + 1739*T(25)  +79*T(27) + 200*T(29)  470 S = (S-106*T(31) + 93*T(33)-38*T(35))/10000  480 FOR J = 1 to 34  490 T(J) = T(J + 1)  500 NEXT J  510 AO = Y/28.8207792  512 2.16E-03  50  2.88E-03  50  6 6.83E-03  50  6 6.83E-03  50  9.11E-03  50  9.01E  9 0.016  50  0.021  50  0.021  50  0.038  50  0.051  50  0.091  50  400 T(J) = T(J + 1)  17 0.162  50  50  50  50  50  50  50  50  50  5				4	4 (05 00	50	
392 PRINT "Schlumberger VES Curve" 3 2.88E-03 50 395 PRINT "NO L/2 AR 4 3.84E-03 50 400 FOR M = 1 TO N 5 5.12E-03 50 410 GOSUB 550 6 6 6.83E-03 50 420 T(35) = B 7 9.11E-03 50 430 Y = Y* F 8 0.012 50 440 S = 42*T(1)-103*T(3) + 144*T(5)-211*T(7) + 9 0.016 50 330*T(9)-574*T(11) 10 0.021 50 450 S = S + 1184*T(13)-3162*T(15) + 10219*T(17)- 11 0.028 50 450 S = S + 18192*T(21) + 6486*T(23) + 1739*T(25) 13 0.051 50 470 S = (S-106*T(31) + 93*T(33)-38*T(35))/10000 15 0.091 50 480 FOR J = 1 to 34 16 0.012 50 490 T(J) = T(J + 1) 17 0.162 50 500 NEXT J 18 0.216 50 500 PRINT TAB(2);M; TAB(20);AO;TAB(47);S 20 0.384 50.072		200	NEVT 1	1			
395 PRINT "NO L/2 AR 4 3.84E-03 50 400 FOR M = 1 TO N 5 5.12E-03 50 410 GOSUB 550 6 6.83E-03 50 420 T(35) = B 7 9.11E-03 50 430 Y = Y* F 8 0.012 50 440 S = 42*T(1)-103*T(3) + 144*T(5)-211*T(7) + 9 0.016 50 330*T(9)-574*T(11) 10 0.021 50 450 S = S + 1184*T(13)-3162*T(15) + 10219*T(17)- 11 0.028 50 24514*T(19) 12 0.038 50 460 S = S + 18192*T(21) + 6486*T(23) + 1739*T(25) 13 0.051 50 +79*T(27) + 200*T(29) 14 0.038 50 470 S = (S-106*T(31) + 93*T(33)-38*T(35))/10000 15 0.091 50 480 FOR J = 1 to 34 16 0.012 50 490 T(J) = T(J + 1) 17 0.162 50 500 NEXT J 18 0.216 50 50 PRINT TAB(2);M; TAB(20);AO;TAB(47);S 20 0.384 50.072				2			
400 FOR M = 1 TO N  410 GOSUB 550  420 T(35) = B  430 Y = Y*F  440 S = 42*T(1)-103*T(3) + 144*T(5)-211*T(7) + 9  330*T(9)-574*T(11)  450 S = S + 1184*T(13)-3162*T(15) + 10219*T(17)- 24514*T(19)  460 S = S + 18192*T(21) + 6486*T(23) + 1739*T(25)  +79*T(27) + 200*T(29)  470 S = (S-106*T(31) + 93*T(33)-38*T(35))/10000  480 FOR J = 1 to 34  490 T(J) = T(J + 1)  50  512E-03  50  6 6.83E-03  50  9.11E-03  50  9.012  50  9.016  50  9.021  50  9.021  9.028  9.038  9.0012  9.028  9.0016  9.0016  9.0016  9.0021  9.0028  9.0038  9.0021  9.0038  9.0051  9.0058  9.0051  9.0058  9.0051  9.0058  9.				3			
410 GOSUB 550 420 T(35) = B 430 Y = Y*F 440 S = 42*T(1)-103*T(3) + 144*T(5)-211*T(7) + 9 450 S = S + 1184*T(13)-3162*T(15) + 10219*T(17)- 24514*T(19) 10 0.028 50 460 S = S + 18192*T(21) + 6486*T(23) + 1739*T(25) 12 0.038 50 470 S = (S-106*T(31) + 93*T(33)-38*T(35))/10000 15 480 FOR J = 1 to 34 490 T(J) = T(J + 1) 500 17 18 19 19 19 18 19 19 19 19 19 19 19 19 19 19 19 19 19				4	3.84E-03	50	
420 T(35) = B  430 Y = Y* F  440 S = 42*T(1)-103*T(3) + 144*T(5)-211*T(7) + 9  330*T(9)-574*T(11)				5	5.12E-03	50	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$				6	6.83E-03	50	
440 S = 42*T(1)-103*T(3) + 144*T(5)-211*T(7) + 9 0.016 50 330*T(9)-574*T(11) 10 0.021 50 450 S = S + 1184*T(13)-3162*T(15) + 10219*T(17)- 11 0.028 50 24514*T(19) 12 0.038 50 460 S = S + 18192*T(21) + 6486*T(23) + 1739*T(25) 13 0.051 50 + 79*T(27) + 200*T(29) 14 0.668 50 470 S = (S-106*T(31) + 93*T(33)-38*T(35))/10000 15 0.091 50 480 FOR J = 1 to 34 16 0.012 50 490 T(J) = T(J + 1) 17 0.162 50 50 NEXT J 18 0.216 50 50 50 50 PRINT TAB(2);M; TAB(20);AO;TAB(47);S 20 0.384 50.072				7	9.11E-03	50	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$				8	0.012	50	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		440	S = 42*T(1)-103*T(3) + 144*T(5)-211*T(7) +	9			
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24514*T(19)  460 S = S + 18192*T(21) + 6486*T(23) + 1739*T(25)  +79*T(27) + 200*T(29)  470 S = (S-106*T(31) + 93*T(33)-38*T(35))/10000  480 FOR J = 1 to 34  490 T(J) = T(J + 1)  500 NEXT J  500 NEXT J  510 AO = Y/28.8207792  520 PRINT TAB(2);M; TAB(20);AO;TAB(47);S  510 NEXT M  12  0.038  50  0.051  50  0.068  50  15  0.091  50  50  50  50  50  50  50  50  50  5							
460 S = S + 18192*T(21) + 6486*T(23) + 1739*T(25)  +79*T(27) + 200*T(29)  470 S = (S-106*T(31) + 93*T(33)-38*T(35))/10000  480 FOR J = 1 to 34  490 T(J) = T(J + 1)  500  NEXT J  510 AO = Y/28.8207792  520 PRINT TAB(2);M; TAB(20);AO;TAB(47);S  13  0.051  50  0.053  50  0.091  50  0.091  50  50  50  50  50  50  50  50  50  5							
+79*T(27) +200*T(29) 470 S = (S-106*T(31) +93*T(33)-38*T(35))/10000 15 0.001 50 480 FOR J = 1 to 34 16 0.012 50 490 T(J) = T(J + 1) 17 0.162 50 NEXT J 18 0.216 50 510 AO = Y/28.8207792 19 0.288 50 520 PRINT TAB(2);M; TAB(20);AO;TAB(47);S 20 0.384 50.072							
470 S = (S-106*T(31) + 93*T(33)-38*T(35))/10000       15       0.091       50         480 FOR J = 1 to 34       16       0.012       50         490 T(J) = T(J + 1)       17       0.162       50         500 NEXT J       18       0.216       50         510 AO = Y/28.8207792       19       0.288       50         520 PRINT TAB(2);M; TAB(20);AO;TAB(47);S       20       0.384       50.072			+79*T(27) + 200*T(20)				
480 FOR J = 1 to 34 490 T(J) = T(J + 1) 500 NEXT J 510 AO = Y/28.8207792 520 PRINT TAB(2);M; TAB(20);AO;TAB(47);S 510 AO = Y/28.8207792 520 NEXT M 530 NEXT M		<i>47</i> 0					
490 T(J) = T(J + 1)       17       0.162       50         500 NEXT J       18       0.216       50         510 AO = Y/28.8207792       19       0.288       50         520 PRINT TAB(2);M; TAB(20);AO;TAB(47);S       20       0.384       50.072							
500 NEXT J 18 0.216 50 510 AO = Y/28.8207792 19 0.288 50 520 PRINT TAB(2);M; TAB(20);AO;TAB(47);S 20 0.384 50.072							
510 AO = Y/28.8207792 19 0.288 50 520 PRINT TAB(2);M; TAB(20);AO;TAB(47);S 20 0.384 50.072					0.162	50	
510 AO = Y/28.8207792 19 0.288 50 520 PRINT TAB(2);M; TAB(20);AO;TAB(47);S 20 0.384 50.072				18	0.216	50	
520 PRINT TAB(2);M; TAB(20);AO;TAB(47);S 20 0.384 50.072				19	0.288	50	
520 NEVEL		520	PRINT TAB(2);M; TAB(20);AO;TAB(47);S	20	0.384		
		530	NEXT M	21	0.512		

22	0.683	51.537	21	316.227	100.133
23	0.911	54.187	22	421.696	100.073
24	1.215	59.114	23	562.341	100.035
25	1.620	66.868	24	749.894	100.005
26	2.161	77.644	25	1000.000	99.981
27	2.882	91.068	26	1333.521	99.964
28	3.843	105.940	27	1778.279	99.950
29	5.125	120.211	28	2371.373	99.940
30	6.834	131.512	29	3162.277	99.942
31	9.113	138.158	30	4216.965	99.956
32	12.153	139.859			
33	16.207	137.770			
34	21.612	133.360	-	CONCLUSIO	NS

### Schlumberger VES Curve

No	L/2	AR
1	0.999	57.698
1 2	1.333	66.956
3	1.778	76.547
4	2.371	92.534
5	3.162	111.714
6	4.216	131.935
7	5.623	150.264
8	7.498	163.106
9	10.000	167.112
10	13.335	161.053
11	17.782	147,332
12	23.713	131.256
13	31.622	117.910
14	42.169	109.375
15	56.234	104.824
16	74.989	102.550
17	100.00	101.380
18	133.352	100.762
19	177.827	100.430
20	237.137	100.240

A BASIC computer program is presented for comparison of resistivity field data with the data derived from a layer model. If the agreement between the two sets of data is unsatisfactory, then the parameters of the layer model are adjusted. The processing is iterated until a sufficient agreement between these model data and field data is obtained. A version of this method, in which the adjustment of the layer parameters is done by human judgment, has been a common practice in resisitivity sounding interpretation for many years.

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