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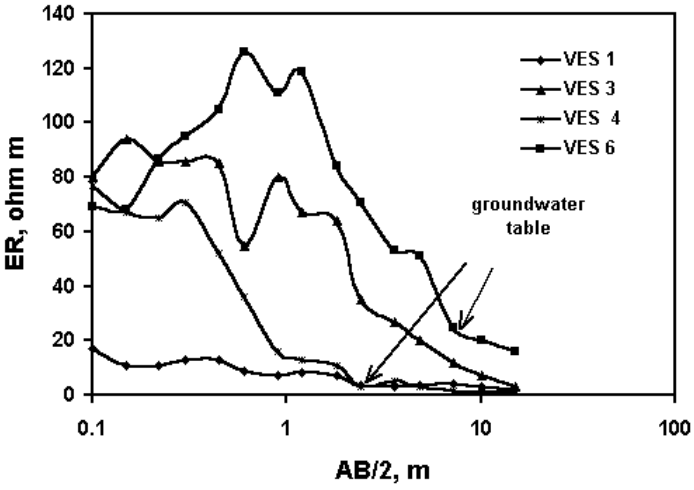
Vertical Electrical Sounding to detect groundwater levels in arid areas

Water and salt content distributions within the soil profile are the main properties causing considerable variations in electrical resistivity. Since the evaporation in the arid areas (Astrakhan', Russia) is about five times higher than the precipitation, the water content and salt distributions are determined mainly by the saline groundwater.



The soil profile is divided into a top unsaturated layer with high resistivity and a bottom layer saturated by saline groundwater with low resistivity. Considering large differences in electrical resistivity between the unsaturated and saturated zones, the VES method was applied to detect the saline groundwater level. The approximate location of the groundwater table was estimated by a visual inspection of the VES curve. The AB/2 value with the sharp change to the low resistivity (3-20 ohm m) was selected from each VES profile and multiplied by an empirical coefficient (0.32 for the investigated soils). These coefficients vary from 0.28 to 0.34 for other soil types (Barker, 1989). For example, for VES 6 the AB/2 with such sharp change is 7.2 m and the groundwater table is estimated as 7.2x0.32=2.3 m. In some cases (VES 3) it was difficult to visually determinate where the VES curve has a sharp change in electrical resistivity. Nevertheless, with the computer interpretation of the VES data we could determine the changes more accurately. The results of the computer interpretation of the VES data were compared with the real groundwater tables measured in bore-holes and the relative errors of the VES estimation varied from 3 to 11% as shown in Table.

Case number	Groundwater table		Relative estimation error
	Real (bore hole)	Estimated (VES)	
	m		%
1	2.19	2.37	7
2	1.15	1.29	11
3	2.47	2.55	3
4	2.38	2.25	5
5	1.60	1.53	5
6	1.17	1.34	8
7	1.32	1.22	8
8	1.38	1.24	10
Mean			8

Reference: Barker, R.D. 1989. Depth of investigation of collinear symmetrical four-electrode arrays. Geophysics. 54:1031-1037.

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2002-2012