Erratum: Geoelectric estimation of aquifer parameters in the Southern part of Edo State, Nigeria

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Some equations in this paper were wrongly typesetted in the vol. 21 issue of the Journal of NAMP. The page of the article is therefore reproduced below as it ought to appear in page 356 (Vol. 21).

Theoretical background

The theory of mathematical expressions used for investigation of aquifer by geoelectrical surveys are much explained [20,11,21]. The Schlumberger configuration method of Vertical Electrical Sounding (VES) has been applied for obtaining the aquifer parameters. The depth of investigation in a Schlumberger sounding array varies typically between 0.25AB to 0.5AB [22].

Mathematically, electric current flow (J) in a conducting medium is governed by Ohm's law and groundwater flow in a porous medium. Darcy law, both having similar forms of equation

$$J = -\sigma \frac{dV}{dr} \quad (1)$$

$$q = -K \frac{dh}{dr} \quad (2)$$

where J = current density (ampere per unit area)
σ = electrical conductivity (Siemens/m)
V = electrical potential (volts)
r = distance (metres)
q = specific discharge (discharge per unit area)
K = hydraulic conductivity (or permeability, m/s)
H = hydraulic head (m)

The analogy between these two phenomenons is widely accepted [8, 9].

For homogeneous and isotropic formation, the electric current and groundwater flow both satisfy the Laplace equation: for electrical flow,

$$\frac{d^2V}{dr^2} + \frac{2}{r}\frac{dV}{dr} = 0 \quad (3)$$

and for groundwater flow,

$$\frac{d^2h}{dr^2} + \frac{1}{r}\frac{dh}{dr} = 0 \quad (4)$$

For a point current source, the solution of equation (3) in a semi-infinite homogeneous medium for (hemispherical earth) electrical flow can be written as:

$$V = \frac{\rho I}{2\pi}\frac{1}{r} \quad (5)$$

and for hydraulic flow a similar equation can be written as:

$$h = \frac{Q}{2\pi T} Inr \quad (6)$$

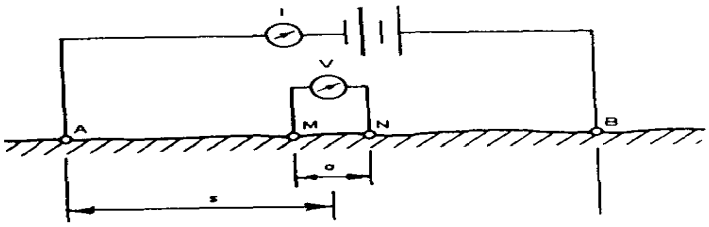
Transmissivity of an aquifer of saturated thickness b is expressed by:

$$T = kb \quad (7)$$

In general terms, since larger connected pores makes for better flow characteristics for both water and electric current it is expected that at the very least there should be some relationship between electrical and hydraulic parameters. Direct linear relationship between resistivity and hydraulic parameters (K and T) do not exist. The relationship between hydraulic conductivity, K and resistivity, ρ is controversial and various authors have reported both direct, [23] and inverse [24]. The character of the relationship (direct and inverse) depends mainly on the rock type and its porosity, while the form of the relationship (rectilinear or curve linear) is modified by relations between direction of groundwater flow, rock bedding and resistivity. In this study nevertheless an attempt is made to identify (site-specific) empirical relations in two particular aquifer types (alluvial, fissured) and then to identify more general aquifer relations. Moreover, hydrogeological properties of the aquifer in fractured aquifers generally vary rapidly.

Methodology

Four electrodes arrays are commonly used at the surface, one pair for introducing into the earth, the other pair for measurement of the potential associated with the current. The field procedure in the Schlumberger electrodes configuration (Figure 1) is to expand the current electrodes successively while the potential electrodes remain fixed.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