



A generalized Archie's law for n-phases

Paul Glover

Université Laval, Département de géologie et de génie géologique, Québec, Canada (paglover@ggl.ulaval.ca, +1 (418) 656 7339)

Archie's Law has been the standard method for relating the conductivity of a clean reservoir rock to its porosity and the conductivity of the fluid saturating its pores for over 60 years. Initially an empirical relationship for a narrow range of rocks and porosities, it has found wide application and has more recently been verified by more analytical methods as well as extended for use when the surface conduction is significant such as at low salinities and in clay-bearing lithofacies. However, Archie's law remains applicable only when the matrix remains non-conducting. A modified version which allowed a conductive matrix was published in 2000. Here we present a generalized form of Archie's law for any number of phases. Examination of the general law shows it to be formally the same as the traditional Archie's law and modified Archie's law for 1 and 2 conducting phases, respectively. The generalized law has also been examined in detail for three phases and semi-quantitatively for four phases. Unfortunately, the law in its most general form is very difficult to prove experimentally. Instead we have carried out numerical modeling in three dimensions to demonstrate that it behaves well for a system consisting of four interacting conducting phases.