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Understanding Permeability

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ABSTRACT

Permeability is a fundamental concept in geoscience. Every geologist and engineer uses permeability as a basic measure of reservoir rock quality or to quantitatively determine fluid production rates from wells. Confusion sometimes arises, however, since the term is often used with a lack of understanding and precision leading to miscommunication.

The Darcy equation clarifies the meaning of permeability, but does not explain it. To gain additional insight into the meaning of permeability, we can address the issue of how the pore geometry of rocks influences permeability. Electrical currents and fluid flow in rocks is governed by the same volumetric and geometric aspects of pore geometry. The difference between the flow of fluids and electric currents is the way each interacts with pore surfaces. Interaction of fluids with pore surfaces can be very strong and is propagated throughout the fluid by viscous forces. In contrast, interaction of electric currents with pore surfaces is localized to within a few angstroms of the surface and does not affect conduction in the remainder of the pore water. Using this information, permeability can be expressed as the product of volumetric (porosity), geometric (electrical efficiency) and surface interaction terms. Separating the variables which determine permeability in this way permits the investigation of each independently of the others. Using this approach results in a relationship between electrical conductivity and permeability.