

Permeability Anisotropy and Resistivity Anisotropy of Mudrocks

Amy Adams, MIT

ABSTRACT

Laboratory experiments show that the permeability anisotropy (ratio of horizontal to vertical permeability) increases with burial and decreasing porosity (Fig. 1). A similar trend is noted for the resistivity anisotropy, equal to the ratio of the horizontal to vertical resistivity. Laboratory experiments reveal that the conductivity anisotropy, equal to the inverse of the resistivity anisotropy, is directly proportional to the permeability anisotropy. This proportionality applies across the full porosity range for a variety of uniform mudrocks measured (Fig. 2).

We use numerical models to show that 1) the permeability anisotropy of uniform mudrocks can significantly increase the permeability anisotropy of layered mudrock systems, and 2) that the proportionality observed between the resistivity anisotropy and permeability anisotropy in uniform mudrocks does not extend to layered mudrocks. This follows because the permeability can vary by orders of magnitude between layers, while the formation factor (pore fluid normalized resistivity) varies only slightly (factor of 2).

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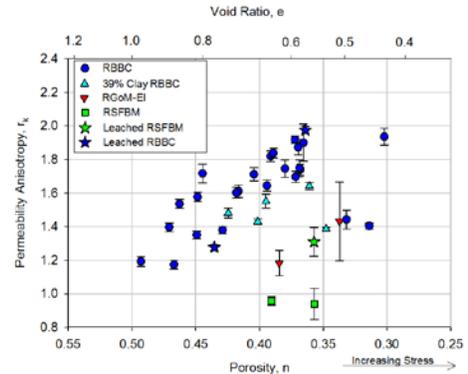


Fig. 1: Permeability anisotropy of various resedimented mudrocks as a function of porosity. Permeability anisotropy initially increases with decreasing porosity for most mudrocks. With increasing compression, horizontal flow paths become cut off, decreasing horizontal permeability and permeability anisotropy. This trend is especially evident for RBBC (dark blue circles).

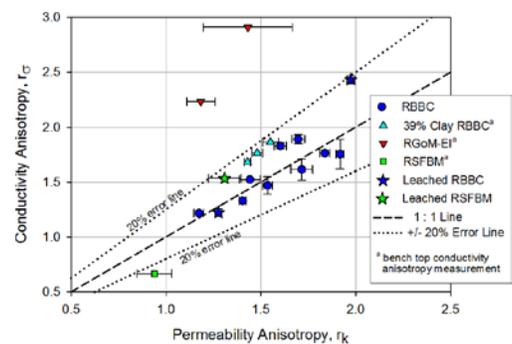


Fig. 2: Cross plot of conductivity anisotropy (inverse of resistivity anisotropy) vs. permeability anisotropy for 6 mudrocks studied. The conductivity anisotropy can be used to predict the permeability anisotropy within +/- 20%. Both anisotropy values are limited to a range of 1-3.

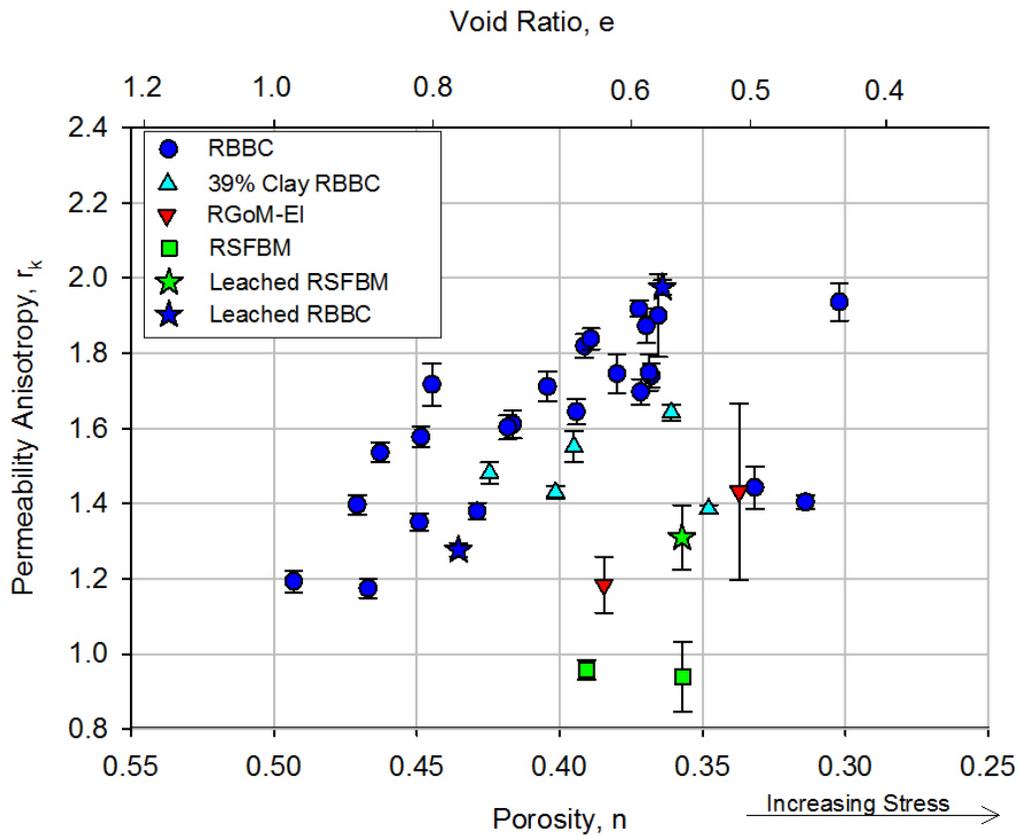


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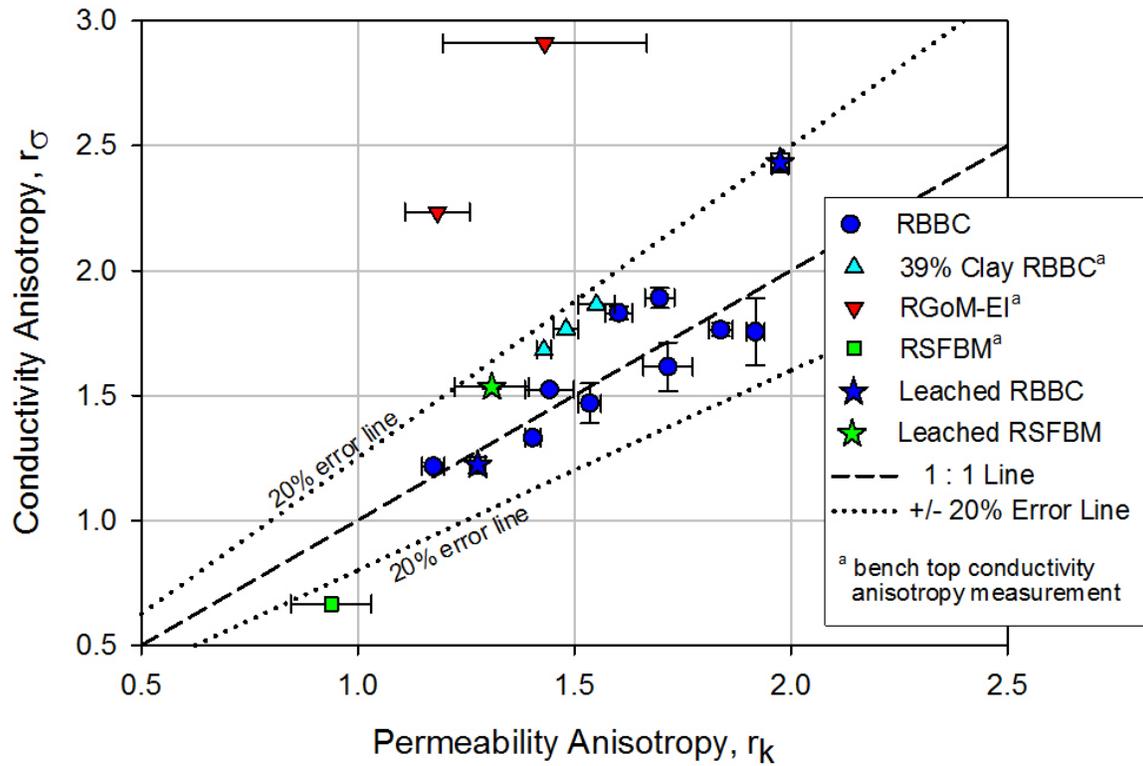


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