

Permeability Anisotropy in Boston Blue Clay

ABSTRACT

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Permeability is the most important mudrock property affecting reservoir fluid flow. During consolidation, stress-induced platy particle realignment in a uniform mudrock can impose significant permeability anisotropy, defined as the ratio of the horizontal to vertical permeability. Changing conductivity anisotropy, equal to the inverse of the resistivity anisotropy, may be a good measure of changing fabric and permeability anisotropy. We measure the anisotropy of three uniform, resedimented mudrocks: pure Boston Blue Clay (RBBC), Boston Blue Clay admixed with Min-u-Sil, and higher plasticity Gulf of Mexico Eugene Island Block 330 Mudrock (RGOM-EI). In RBBC, a low plasticity glacio-marine illitic clay, the permeability anisotropy increases from 1.2 to 1.85 as the porosity decreases from 0.5 to 0.37 and the permeability decreases by over an order of magnitude. Increasing the silt content increases the permeability while decreasing the permeability anisotropy. Permeability and conductivity anisotropy relate surprisingly well in both magnitude, trend and scatter for RBBC-Min-u-Sil mixtures. Finally, RGOM-EI material exhibits a higher permeability and conductivity anisotropy than RBBC, in the range of 2.2 to 3.0 at a stress of 10 MPa with permeabilities an order of magnitude lower at comparable porosities. The study of resedimented specimen behavior offers insight to the factors controlling permeability anisotropy evolution and hence subsurface transport problems.

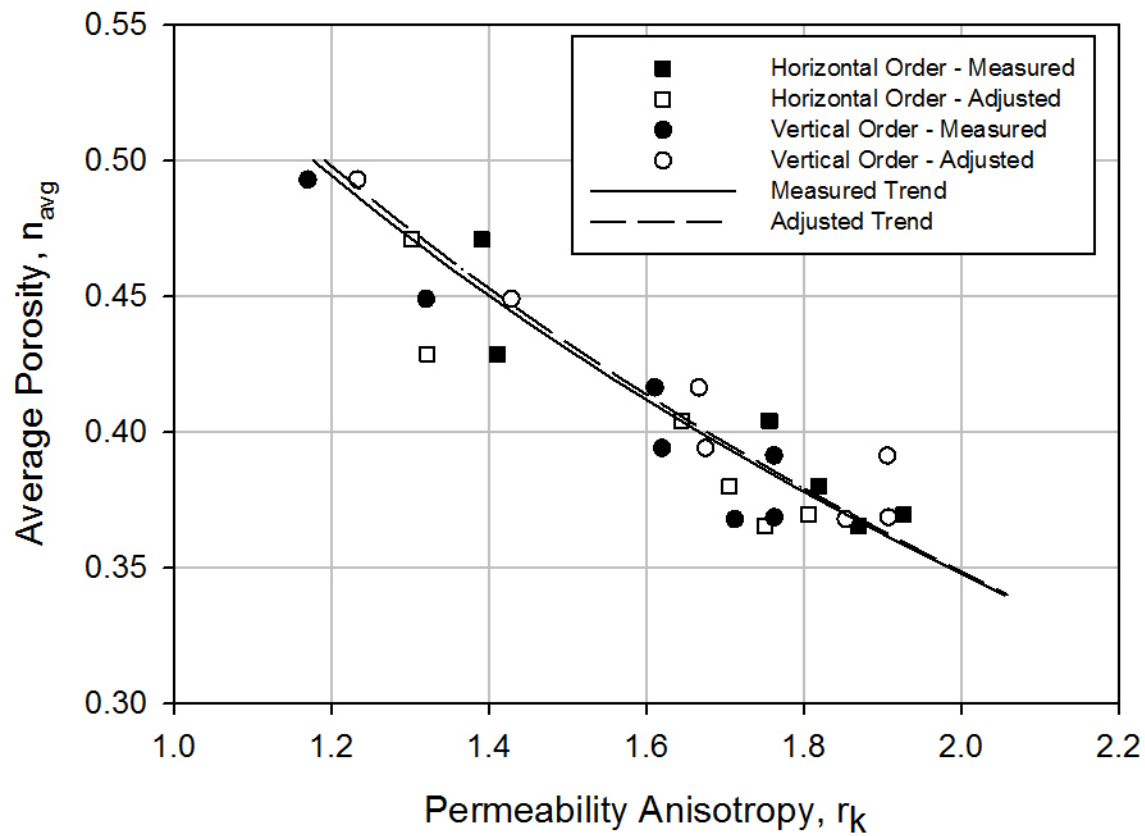


Figure 1: Measured RBBC permeability anisotropy behaviour with stress. Markers represent individual specimen measurements - solid markers indicate measured values, and open markers are measurements adjusted for measured test sequence bias. Trend lines computed using vertical and horizontal permeability vs. porosity measurements for the global dataset.