
Porosimetry Measurement of Shale Fabric and its Relationship to Illite/Smectite Diagenesis

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Abstract: The extent of illite/smectite (I/S) reactions is linked with quantitative measurements of shale fabric in a suite of samples from a lower Frio Formation well. Greater illitization of the I/S clays is found in laminated shales that possess a larger pore surface area/pore volume (SA/V) of $3.21 \times 10^6 \text{ cm}^{-1}$ than the adjacent massive shale lithofacies with a SA/V of $1.97 \times 10^6 \text{ cm}^{-1}$. Mean pore diameter in both shale lithologies is 0.0145 micrometers, though in the laminated shale distributions are skewed towards more smaller-sized pores. While no direct permeability measurements were made, estimates of permeability that are based on simple physical models using SA/V suggest that lower permeabilities are associated with laminated shales. The trend of greater illitization at higher SA/V values is contrary to expectations that reaction extent is enhanced by greater permeabilities, such as created by silt laminations in shale. The limitations of estimated permeabilities emphasize that porosimetry measurements of shale fabric are useful for estimating the access of material to all reaction sites, and do not just describe the effect of a few large pores that dominate permeability. Greater reaction extent in the laminated shales is associated with the accessibility of fluids to more pore space than in the massive shales.

Key Words: Illite/Smectite • Shale fabric • Mercury porosimetry

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