A Comparison of Plug-Derived, Probe-Derived and Crushed-Rock Permeability in Low-Permeable Shales: Examples from the Duvernay Shale, Alberta (Canada)

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Abstract

We compare different methods for determination of gas permeability in low-permeability Canadian shales. Furthermore, we analyze and discuss the effects of different controlling factors including porosity, TOC content, mineralogy, pore-fluid content and effective stress on permeability.

For the samples analyzed under similar pore-fluid content, probe-derived permeabilities ($3.8\cdot10^{-4}$ - $2.7\cdot10^{-2}$ mD) were consistently higher than pulse-decay-derived ($8.4\cdot10^{-5}$ - $7.6\cdot10^{-4}$ mD) and crushed-rock ($3.7\cdot10^{-7}$ - $5.9\cdot10^{-6}$ mD) permeabilities. Corrected probe-derived permeabilities for Overburden (NOB) pressure ($1.5\cdot10^{-5}$ - $5.6\cdot10^{-4}$ mD) were, however, comparable with the pulse-decay-derived and crushed-rock permeabilities. Crushed-rock permeabilities measured on cleaned samples ($3.8\cdot10^{-5}$ - $1.1\cdot10^{-3}$ mD) were up to more than two orders of magnitude higher than those measured on uncleaned samples ($4.3\cdot10^{-7}$ - $5.9\cdot10^{-6}$ mD). The gas permeability values measured for plugs and crushed-rock increased significantly with increasing porosity (2.5-6.6 %), ranging between $3.7\cdot10^{-7}$ and $1.1\cdot10^{-3}$ mD. For the samples analyzed, the dominant pore throat diameters for gas (He, N_2) transport could be well estimated from porosity and permeability data using Winland-style correlations.

Reference Cited

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