INVESTIGATION OF HYDRAULIC CONTINUITY IN SHALY SANDSTONE USING GEOPHYSICAL WELL LOGS

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Hydraulic continuity is the key concept of petroleum hydrogeology, which studies the effects of groundwater flow on the subsurface distribution of petroleum hydrocarbons. With interconnected pore space being the primary requirement, continuous permeability profiles could facilitate the evaluation of the potential for hydraulic communication. As continuous and readily available records of physical parameters of the fluid-filled rock formation, geophysical well logs should lend themselves well to such investigations.

A series of conventional numerical algorithms for shaly sandstone lithology were applied to two suites of commonly recorded well logs over a continuous 700 m long section of Upper Cretaceous age from South-Eastern Alberta. Spread-sheet computations were conducted with logs digitized over one-metre intervals and a number of core porosity and permeability measurements averaged over the corresponding intervals.

Excessive clay mineralogy in shales did not invalidate the analytical algorithms. All seven core-calibrated, log-derived porosity profiles compared well with each other over the full range of calculated magnitudes of 3 to 27%, and also with porosities measured on core samples from adjacent townships. However, more detailed comparative data sets are necessary for the reliable evaluation of accuracy. Two unrelated methods of determination were used to generate closely related, continuous permeability profiles with calculated values ranging from $10^{-2}$ to $10^3$ md. The method based on the free fluid index was favoured over the one relying on statistical calibration with limited core porosity and core permeability, because the more direct approach of calculation allows for fewer uncertainties and recurring errors. The accuracy of the permeability profiles could also not be evaluated unambiguously due to an insufficient number of core values for comparison.

In conclusion, porosity and permeability profiles derived from geophysical well logs may contribute in relative, and possibly in absolute, terms to investigations of hydraulic continuity either directly or as input parameters for mathematical models.