Formation Compartmentalization Using Isotopic Fingerprints of Mudgases and Multilog Quantification

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ABSTRACT

Carbon isotope values and composition of hydrocarbon gases extracted from drilling muds while drilling, when plotted against depth show numerous inflections and variations, suggesting intraformational compartmentalization of the gas.

Identifying the presence and effectiveness of absolute/relative permeability barriers, and hereafter the formation compartments has an increasing impact in terms of production and exploration optimization.

For this case study the geochemical data from several isotopic depth profiles (located in the Foothills and Lloydminster region of Western Canada) were integrated with mineralogical profiles derived from gamma-ray, sonic, density and neutron porosity logs. The wireline data have been used to derive mineral fractions and porosity.

Potential permeability barriers or baffles such as shale rich bands or highly cemented horizons are shown. Integrated with the geochemical data, the result is that the isotopic composition of light hydrocarbons seems to respond to the physical properties of the rocks, mainly to the porosity and permeability contrasts.

This preliminary analysis of compartmentalization based on isotopic depth profiles leads to the hypothesis that different isotopic signature may characterize separate flow units potentially separated by permeability barriers. The composite diagrams showing the compositional profiles together with data that result from isotope ratio mass spectrometry will help in predicting shale distribution and/or the occurrence of highly cemented intervals within reservoir sections or intra formational.