The Effects and Distribution of Moisture in Gas Shale Reservoir Systems

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The moisture content is an important component within the gas shale reservoir system as the amount and distribution of water can have adverse effects on the volume of sorbed and free gas, relative permeability/diffusivity and solution gas may be a measurable contributor to total gas in place. The variation in the effects of moisture content depends on the mineralogy, maturity, kerogen type, and pore size distribution. To understand these variations a suite of organic-rich shales from northeastern British Columbia have been analysed. Analysis includes organic geochemistry, mineralogy, methane sorption capacity, water adsorption isotherms and surface area analysis.

Devonian, Jurassic and Cretaceous shales from northeastern British Columbia have moisture contents ranging from 0.5 to 15% and methane capacities between 0.1 to 3.5 cc/g at 6 MPa. Maturity ranges from immature to overmature and TOC contents range from 0.5 to 17 wt%. When moisture content of a shale is varied, a trend of decreasing methane capacity with increasing moisture content is observed. However, when comparing a suite of moisture-equilibrated shales, there is no correlation between moisture content and the methane sorption capacity. Shales can have both high and low sorption capacities with high moisture content. Some general trends are observed; the Cretaceous and Devonian shales show methane capacity increases with moisture content while the opposite trend is found for the Jurassic shale. These differences are due to the variation of the amount and distribution of the water within the different shales. Water isotherms identify the range of pore sizes that contain hydrophilic sorption sites. Hydrophilic sorption sites are concentrated within the micro- and mesoporosity as a positive trend occurs between the moisture content and micro- and mesoporous surface area. The pore size distribution, in turn, is controlled by mineralogy, maturity, kerogen type and mineralogy. For example, the mineralogy affects the moisture content with clay-rich shale sorbing more water than quartz-rich shales.

Identifying the controls and distribution of inherent moisture in gas shale reservoir systems provides an understanding of water sensitivity and aids the overall evaluation of the reservoir with respect to one of the controlling factors of sorbed methane capacities.