

Resource Potential of Fine-grained Source Rocks, Wattenberg Gas Field, Denver Basin, Colorado

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The Wattenberg Gas Field, in northeastern Colorado, has produced more than 2 TCF and 100 MMBO from the Lower Cretaceous (Albian) J Sandstone and Upper Cretaceous (Turonian) Codell Sandstone. Approximately 700 feet of organic-rich, fine-grained, source rocks occur stratigraphically below, within and above these main reservoirs. In ascending order, these "shales" include the Skull Creek Shale, Mowry Shale, Graneros Shale, Greenhorn Formation, Niobrara Formation, and Sharon Springs Member of the Pierre Shale. The shales are marine, have relatively high total organic carbon content (2-10% TOC and predominantly type II kerogen). Thermal maturity ($> 0.8 R_o$), gas saturation, anomalously high pressure gradients and EURs are related to the Wattenberg "hot spot".

Based on an integration of 2000 feet of core from several wells, historical production data and wire line logs from 7000 wells, as well as fall-off injection tests, microseismic analysis of hydraulic fractures, and production tests in several new wells, 700 feet of potential "gas shales" were reduced to two intervals, the Niobrara and Greenhorn formations. Although open fractures are rare, these rocks have high calcium carbonate content and are "fracable". Unfortunately, the two most organic-rich and gas-saturated shales, the Sharon Springs Member of the Pierre Shale and the Graneros Shale, have a high clay content and could not be effectively fracture stimulated. They probably form the top and bottom seals for this resource play.