

Bitumen Filled Fractures in the Bakken Formation and Implications for Gas Shale Systems

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Shales are an essential element in siliciclastic petroleum systems, acting as source rock, and seal. More recently, shales have been recognized as significant, albeit low quality reservoir rocks. In the last decade, greater effort has been focused on understanding the reservoir characteristics of shales, and the Devonian Bakken Formation has garnered significant attention. The Bakken Formation is the source rock for much of the petroleum contained in the Williston Basin and the middle Bakken siltstone/carbonate is the target of renewed oil exploration efforts. Geochemical analyses of oils from the Bakken petroleum system reveal differences in oils that are attributed to Bakken facies variability, and differences in source rock maturity. The oil geochemistry has provided insight into the evolution of the Bakken petroleum system.

The Bakken shale contains sub-horizontal to vertical bitumen filled fractures and pores interpreted to have formed during petroleum generation. The fractures and pores are visible in both the upper and lower shale, and provide insight into migration of petroleum out of Bakken shale, suggesting fracture formation may have been an essential step in the migration process. The presence of large pores within the shale facies demonstrates development of significant pore systems is possible within the shale facies. Observations from the Bakken oil system may also provide insight into the development of gas shale systems. The cracking of retained petroleum to gas in shales is a significant source of gas for gas shales, and appears to be the primary reason marine shales that contain Type II, oil-prone kerogen can become gas charged systems at higher levels of thermal maturity. Assuming that bitumen filled fracture systems that developed in the upper and lower Bakken during petroleum generation and migration are the rule rather than the exception, this observation may help explain why marine, oil prone source rocks have the potential to deliver gas as gas shale systems.