

Bakken and Bakken-Like Petroleum Source Rocks, Origin and Distribution, Northern Rocky Mountains – Williston Basin

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The three-member Devonian-Mississippian Bakken-Exshaw organic-rich facies is widely distributed in the northern U.S. and southern Canadian Cordillera. Equivalent facies are also present as far south as Utah and Nevada. Paleogeographically, these rocks thin or pinch out in the west along the Devonian-Mississippian carbonate reef-mound belt of the Cordilleran shelf margin. Although these rocks reach maximum organic richness near the Devonian-Carboniferous transition, similar but somewhat less organic-rich Bakken-like beds are also present in underlying Upper Devonian and overlying Lower Carboniferous carbonate depositional cycles. At least ten cycles are identified in the underlying Duperow and Jefferson Formations, characterized by basal organic-rich Bakken-like shale or shaly carbonate, that grades upward into a stromatoporoid-coral mound or reef-bearing unit, usually overlain by evaporite or solution breccia. Lower Carboniferous cycles of the Lodgepole and Mission Canyon Formations, as many as 10-12 in number, are similar, except that carbonates are composed primarily of algal-oolith, crinoid, or mixed skeletal beds; end-cycle evaporitic units are less prevalent in the lowermost cycles.

Regionally and globally, Bakken-type highly organic-rich facies of similar age, in association with Upper Devonian reef and Lower Carboniferous carbonate mound facies, are also present in the southern U.S., the eastern U.S., and Eurasia (Domanik and Domanik-like facies of the Volga-Ural and west Siberian, and Barents Sea regions). Similar but somewhat less organic-rich facies are also known in North Africa, the Middle East, Australia, and South America. These rocks are source beds for an important percentage of the World's hydrocarbons.

Globally widespread Bakken-type deposits are believed to result from greatly increased zoo-phytoplankton productivity in the world oceans, culminating in latest Devonian with global deposition of this facies in shelf and shelf-margin regions of several continents. This marked *increase* in plankton productivity, approximately coincident with decline of Late

Devonian reef buildups, may have been a major factor in the demise of Devonian stromatoporoid-coral reef assemblages, vs. a *decrease* in plankton nutrient supply, as suggested by some researchers. The principle of *nutrient-excess* is suggested as a primary factor in this global phenomenon.

In the Williston Basin, organic-rich Bakken-like beds, intertonguing with carbonate bank units throughout the Lower

Carboniferous Lodgepole and Mission Canyon sequences, are source rocks for a significant amount of the Madison hydrocarbon resources. The three-member Bakken-Exshaw facies is present west of the Williston Basin in much of Montana, but pinches out by non-deposition near the western Montana Devonian reefal belt and on the central Montana Uplift and the Beartooth shelf.