

Petroleum Potential of the Middle Proterozoic Midcontinent Rift System (MRS) in Iowa

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The Midcontinent Rift System (MRS), a billion-year-old failed rift that extends from Lake Superior to Kansas, is characterized in Iowa by a central horst, dominated by mafic volcanics and deep, clastic-filled flanking basins. These basins, which reach a maximum model depth in excess of 12,000 m, include a basal clastic stratigraphic sequence that is roughly correlative with the Oronto Group of northern Wisconsin. Unit C, the middle unit of this basal clastic sequence, is a dark shale equivalent to the Nonesuch Shale, and 586 m of this unit were penetrated by the Amoco No. 1 M.G. Eischeid well at a depth of 5,400 m. Similar dark shales also were encountered in cores from the Manson Impact Structure and although an intact sequence was not penetrated, the abundance of this lithology suggests that a relatively thick sequence of Unit C rocks originally existed at that location. The presence of thick Unit C shales in the Eischeid well, 7 km outside of the original axial rift graben, and a similar thick sequence at the Manson Structure, 25 km from the graben, implies a widespread original distribution of this unit, deposited in a waterbody at least 150 km wide and probably wending along most of the 1,450 km length of the feature.

Unit C in the Eischeid well now is over-mature and is only a marginal source rock (T_{\max} 497°–508°C, TOC avg. 0.13–0.6%, generic potential avg. 0.22 mg HC/g rock) that reached peak oil generation about 800 Ma. However, the Eischeid rocks originally lay in an area of high heat flow from the voluminous volcanic and plutonic rocks in the active rift graben. Rocks in more distal locations would not have been subjected to these high heat conditions and likely would have released their petroleum much later. The most likely place to recover MRS petroleum would be in the Keweenawan fluvioclastics that overlie Unit C and at some distance from the over-mature rock near the axis of the rift.