

VII. RESOURCE EVALUATION

PETROLEUM EXPLORATION POTENTIAL OF THE MIDCONTINENT RIFT, U.S.A.

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The 1.1 Ga Midcontinent Rift System extends more than 2,000 km, from Kansas through Lake Superior into the Lower Peninsula of Michigan. The rift itself is a horst up to 50 km wide consisting of Keweenaw volcanic rock that exhibits pronounced gravity and magnetic signatures within four geographically identifiable segments: Kansas, Nebraska, Iowa, Minnesota-Wisconsin, and Michigan.

Assessment of the potential for petroleum of Proterozoic age in rift-related marginal and overlying axial basins indicates a possible 5 billion barrel TOC (total organic carbon content) resource. However, source volume constraints curtail that estimate to 70 million barrels of oil and 420 billion cubic feet of gas. Proterozoic source rock units identified to date include the Nonesuch Formation and the Solor Church Formation, although the latter unit has been shown to be overly mature locally.

Fault-related structures along the horst vary in structural style within the various rift segments: rotated, half-graben (Kansas); over-thrust (?) and normal (Iowa); and listric (?) high-angle, reverse (Minnesota, Michigan).

Adequate volumes of reservoir rock have been identified in all rift segments. The most promising horsts are fault-related clastics of Proterozoic age or more extensive basal Paleozoic sandstone that locally occurs in marginal basins along and in sheets adjacent to the rift. Migration is assumed to have occurred under normal hydrodynamic conditions (load) with close spatial proximity between source and reservoir units. Permeability problems related to diagenesis are not anticipated.

We postulate that both structural and stratigraphic traps are likely to occur. Because probable fields are small, faults with minor displacements and small amplitude folds are considered prospective. Seals along faulted structures are assumed to be gouge-related and their effectiveness will depend upon the abundance and types of clay within individual faults. Post-rift fault displacements are generally believed insufficient to seriously affect reservoir geometries. Seals created by unconformable structures are most likely lithologic in nature, resulting from differential capillary pore pressures between units. Unconformities involving Proterozoic and possibly Paleozoic units may occur in all rift segments.

Geochemical and vitrinite reflectance studies of available oil and natural gas samples from identified accumulations in the Minnesota part of the rift yield values in the mature to immature range. The degree of preservation will vary with sedimentation, erosion, and structural factors within the specific rift segments.

Production considerations will have to include corporate infrastructure including transportation, available refineries, environmental, and geopolitical questions, as well as the price of oil and gas.

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