Investigation of the Souring of Bakken Oil Reservoirs

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The Bakken Formation is rapidly emerging as an important source of oil in the Williston Basin (see Figure 1). The Formation typically consists of three members, with the upper and lower members made up of shale and the middle member composed of dolomitic siltstone and sandstone. Total organic carbon within the shales may be as high as 40%, with estimates of total hydrocarbon generation across the entire Bakken Formation ranging from 200 to 400 billion barrels. Crude oil quality from the area is generally characterized as light (31 to 45 degrees API) and sweet, exhibiting low concentrations of hydrogen sulfide (H_2S). It is the naturally sweet nature of the crude oil coupled with an increasing concern that the Bakken may become soured through current oil field practices that formulate the hypotheses of this research.

Oil field reservoir souring is defined as occurring when increasing concentrations of H_2S are observed in production fluids. Souring is toxic to life, corrosive to equipment, and damaging to the reservoir. This is a relatively well-known problem in the contemporary oil industry; however, the identification of the source of H_2S is site-specific and will require vigorous analyses.

The three general causes of souring are mechanical (fracturing and intrusion into another formation), thermochemical (e.g., mineral dissolution), biogenic (sulfur-reducing bacteria activity) or combinations thereof. In all cases, the causes of excessive H_2S production in previously nonsour environments are primarily anthropogenic and originate through the disruption of ancient equilibrium where the system is forced to "seek" a new thermodynamically stable point. Over the course of this project, several wells where H_2S production occurs will be evaluated in an effort to determine the causes of souring based on field data, sample analysis, laboratory experiments, and numerical modeling. This paper will present an outline of the research goals, a current understanding of the Bakken, and initial findings through the time of the workshop.

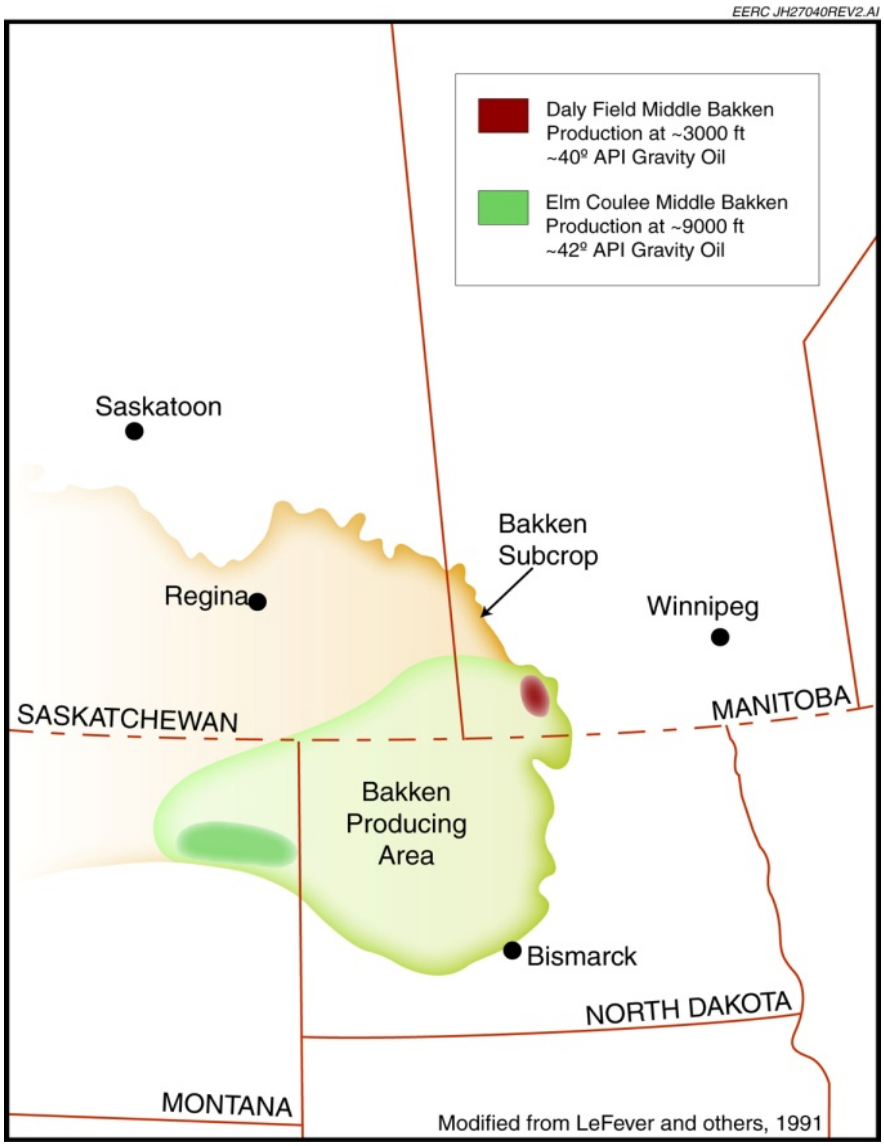

Figure 1. Bakken Formation oil production area in the Williston Basin.