# Aqueous and Isotopic Geochemical Constraints on Gas and Heavy Oil Composition in the Border Plains Region, Central Alberta and Saskatchewan

Mathew C.H.M. Fay*
University of Calgary, Calgary, AB, Canada
mcfay@ucalgary.ca

and

Steve R. Larter and Barry Bennett
University of Calgary, Calgary, AB, Canada

The biodegradation of petroleum and the formation of heavy oil is a common process globally, although the specific microbial mechanisms and aqueous chemistry that control this process are inadequately understood. Oil-water contacts and reservoir temperature are known to be dominant controls of the biodegradation rate (Peters & Moldowan, 1993, Connan et al, 1997; Head et al, 2003, Larter et al, 2003), although dissolved aqueous elements must control microbial pathways and mechanistic reaction rates. The release of nutrients to microbes through mineral dissolution is considered the rate limiting control on microbial metabolism and the breakdown of hydrocarbons (Rogers & Bennett, 1997, Head et al, 2003, Roling et al, 2003). Differentiating the aqueous dissolved elements that facilitate biodegradation is complicated by the variety of geologic conditions and numerous microbial mechanisms that result in the biodegradation of hydrocarbons.

The goal for this study in the Border Plains region of Saskatchewan and Alberta between Lloydminster and Kindersley, is to study how dissolved aqueous elements accelerate or impede the biodegradation process of oil and gas. Samples of heavy oil, gas and water from Mississippian to Cretaceous formations in the Border Plains region are being analysed for bulk composition, isotopes, level of biodegradation, and trace dissolved elements. The oils in this region are believed to be genetically related to Exshaw source rocks (Obermajer et al, 2003), and the timing of regional oil charge is likely contemporaneous. The formation water samples have notably different bulk compositions and trace elements, and early results indicate a number of water types and ages. The unique appraisal of petroleum biodegradation comes from the fact that the fluid properties of the heavy oils and the compositions of the gases vary depending on the host formations water composition. Preliminary results of the study will be presented including correlations of oil and gas biodegradation, aqueous composition, and gas and water isotopes. Results of this study could be used for quick assessments of heavy oil quality and for improving models of petroleum biodegradation.

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