

Applications of FTICRMS towards evaluating source charge contributions in severely biodegraded oils; examples from the Alberta Oil Sands and the Liaohe basin, NE China

Thomas B. Oldenburg, Melisa Brown, Haiping Huang, Jennifer Adams, Barry Bennett, Norka Marcano, and Steve Larter
Geoscience, University of Calgary, Calgary, AB, Canada.

Development of computerized GCMS technologies in the 1970's resulted in the practical biomarker technologies and the source rock facies and maturity molecular concepts that we still use today. Also in the 1970's another analytical development was taking place, namely Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FT-ICR-MS) by Marshal and Comisarow at the University of British Columbia. Four decades later FTICRMS has evolved into a commercially available front line tool capable of analyzing thousands of components in a petroleum mixture at once. We have been focusing on its applications to petroleum systems characterization of difficult settings where conventional analytical methods struggle. These new technology developments in high resolution mass spectrometry allow us now to investigate high molecular weight polar components of petroleum which are more resistant to biodegradation in situations where most of the standard geochemical typing proxies fail due to strong alteration of those components by microbial degradation.

Geochemical assessment of severely degraded oils is currently not easily achieved as the most common markers are often destroyed by the degradation process. Our petroleomics research program is currently developing a suite of facies and maturity markers for severely biodegraded oils based on high molecular weight polar compounds. In this study, we will present the first FTICRMS results of the analysis of a specially selected sample suite of oils from the Alberta oilsands deposits and the Liaohe basin in N.E. China selected from different locations and chosen to be representative of the main charge elements in the basins. The samples were selected based on geological settings, GCMS studies of resistant components and highly biodegradation resistant stable isotope proxy assessments (Adams et al., 2010; Marcano et al., 2010; Huang et al., 2003, 2004; Oldenburg et al., 2004, 2006, 2007). Using a Bruker 12T FTICRMS we show that high molecular weight mixed nitrogen and sulphur compounds readily discriminate the major source charge components in the Alberta basin. We also contrast the source related NS, NSx dominated distributions of the marine source rock sourced Albertan heavy oils with the very different nitrogen dominated components of oils selected from the Liaohe basin which are charged by lacustrine source rocks. We conclude that FTICRMS will likely revolutionize the petroleum geochemistry of heavy oil petroleum systems.