Physico-chemical and mineralogical transformations of fluid fine tailings (FFT) associated with the Alberta oil sands end pit lakes

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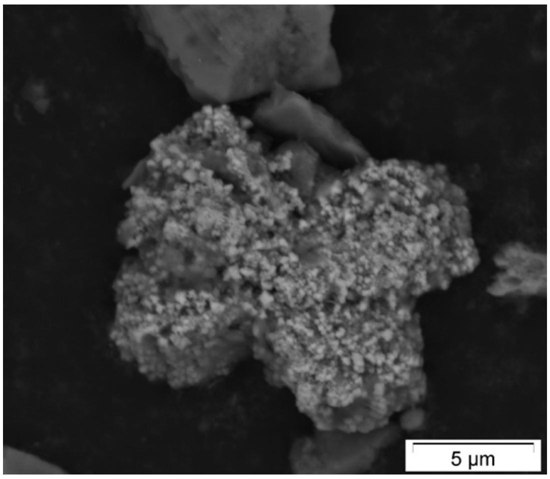
Traditional methods used to extract bitumen involve caustic hot water digestion and flotation, which produce a fine tailing slurry consisting of water, sand, fines residual bitumen and naphtha products [1]. The current practice is to store the tailings in large settling basin to allow the solids to settle out by gravity forming a denser unconsolidated mass termed fluid fine tailings (FFT). To date little information exists on the biogeochemical nature of the newly processed FFT product prior to deposition and the evolution of the material during long term storage in settling basins.

Discussion and Results

During the development of the material significant changes in pore water geochemistry and the associated *in situ* development of AVS are observed, giving rise to the depostion of proto-iron sulfides (Fig. 1). The chemical evolution of porewater and head water was tracked over a period of 6 months. The significance of changes observed will be discussed in terms of the biotic versus physico-chemical processes.



[1] Chalaturnyk et al. (2002) *Petroleum Science and Techonolgy,* **20,** 1025-1046

Highly oxidized species in TSR-altered oils

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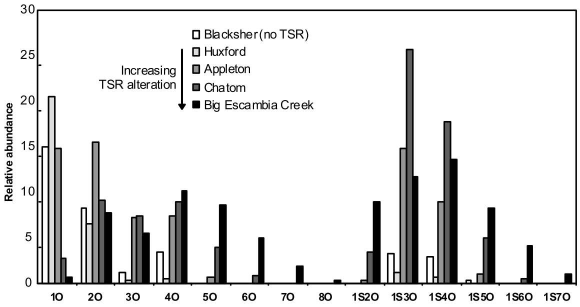
Thermochemical sulfate reduction (TSR) involves a complex series of redox reaction that occur typically in hot (>120°C) carbonate reservoirs whereby petroleum is oxidized by sulfate forming H_2S, CO_2, and a sulfur-rich insoluble solid. It is well documented that oils altered by TSR are enriched in organosulfur species, primarily thiophenic, that form as a consequence of the primary sulfate reduction reaction and back reactions with produced H_2S or other low valance state sulfur species. In contrast, enrichment in partially oxidized hydrocarbons has not been reported in TSR-altered oils, which typically have low Total Acid Numbers (TAN < 0.2).

Oils from onshore Alabama were analyzed by negative ion electrospray ionization Fourier transform ion cyclotron resonance mass spectrometry (NESI-FTICR-MS). The suite includes oils at varying extent of TSR-alteration as well as oils of equivalent thermal maturity that have not subjected to TSR-alteration. Although the total amount of oxygen species is low in all samples, their relative distribution varies in a systematic manner. With increasing extent of TSR, 1O and 2O species, which dominate unaltered oils, are replaced with species containing additional oxygen atoms. Hydrocarbons and organosulfur species with 5 to 8 oxygen atoms are detected only in the most TSR-altered oils.



The distributions of the Ox and SOx species appears to accurately reflects the extent of TSR and are particularly useful in deciphering the geohistory of reservoirs where H_2S and light hydrocarbons have migrated in from off-structure.