The response of microorganisms to climate and anthropogenic induced geochemical changes in oil sands tailings ponds and natural ecosystems surrounding Fort McMurray Alberta, Canada

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The Alberta oil sands (AOS) are one of Canada's most economically important natural resources. Assessing and remediating potential detrimental environmental impacts from oil sand extraction requires new and innovative geoscientific knowledge aimed at understanding the correlation between ecological and geochemical responses to contaminant effects. Two experiments are being run to quantify the spatio-temporal context of contaminant ecology.

Thecamoebian (testate amoebae) assemblages were analyzed in samples collected in 2007 and 2008 from the Suncor Energy Inc. Constructed Wetlands Test Facility, Fort McMurray, Alberta. They demonstrate a strong relationship to varying levels of oil sands process-affected water/materials (OSPW/M). Wetlands highly impacted by OSPW/M contain low diversity assemblages. Less impacted sites contained more diverse assemblages. Thecamoebian assemblages responded quickly to a deliberate reduction in the rate of OSPW/M input, with an increase in species diversity. At sites with little change in water quality the thecamoebian assemblages were comparable to the previous year. The results suggest that thecamoebian assemblages are sensitive to OSPW/M and hence are useful environmental proxies capable of gauging the impact of oil sands materials in reclaimed areas and for biomonitoring of the success of aquatic reclamation initiatives. This study established the correlation of thecamoebians to oil sands geochemical data.

To extend the applicability of thecamoebians as biomonitors of potential AOS industrial contamination, the Geological Survey of Canada's Coal and Oil Resources Environmental Sustainability Project (CORES) aims to determine both reliable methods for discriminating anthropogenic from natural contaminant sources, and what ecological impacts in the natural areas surrounding AOS operations can be attributed to contaminants emanating from oil sands operations. The initial calibration of thecamoebians against OPSW/M contamination has been enhanced with samples collected from 50 natural lakes across the AOS region. Multivariate statistical analysis of the thecamoebian and geochemical/nutrient data reveals that thecamoebians are not only powerful

biomonitors of OPSW/M, but also of water quality in natural lakes. The combined contamination-uncontaminated gradient of thecamoebian assemblage versus lake ecology and nutrient data is now established as a comprehensive calibrated training set for use as a predictor of high-resolution (1-10 year) paleoecological changes across the region over the timeframe of AOS operations.

Multi-proxy analysis of lake sediment cores is underway. These archives have revealed changes in the thecamoebian assemblage and the grain size record in response to climate and anthropogenic impact. The established micropaleontological record will be associated with the geochemical and nutrient record to help recognize the response of these proxies to climate and human induced environmental changes.

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