Delineating sources of bitumen-derived acid extractable organics in the Athabasca oil sands region

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Naphthenic acids (NAs) found naturally in bitumen that become concentrated in oil sands process-affected waters (OSPW) pose a threat to aquatic ecosystems by seepage from tailings ponds. Previous research combined high resolution Orbitrap mass spectrometry with intramolecular carbon isotope analysis ($\delta^{13}C_{pyr}$) to characterise and quantify the acid extractable organics (AEOs) fraction containing NAs in groundwater near a major oil sands tailings pond [1]. Here, we build upon this work through further development and application of these techniques at a different study site. As observed previously, OSPW was characterised by an elevated $\delta^{13}C_{pyr}$ value and high proportions of O_2 and O_2S species classes, and $\delta^{13}C_{pyr}$ values in groundwater reflected mixing between OSPW and non-bitumen containing AEOs. To distinguish between different sources of bitumen-derived AEOs (i.e., natural versus mining-related), several additional geochemical and isotopic parameters were employed; the ratio of even over odd O_x species classes and sulphur isotope analysis ($\delta^{34}S$) of AEOs. While the potential for $\delta^{34}S$ to distinguish sources thus far appears limited, higher ratios of even over odd O_x species classes in bitumen-rich McMurray Formation groundwater compared to OSPW indicates a possible new tool to discriminate between different bitumen-derived AEOs in the Athabasca oil sands region.

[1] Ahad *et al*. (2013) *Env. Sci. Technol*. **47**, 5023–5030.