Controls on sources and mechanisms of flow and transport in seasonally cold and wetland-dominated catchments

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Abstract

Bitumen mining and upgrading in Alberta Oil Sands Region (AOSR) of Canada, releases toxic pollutants into the atmosphere, which are deposited on land and transported by water bodies [1, 2]. Knowledge of source areas, timing of runoff generation, and pollutant speciation and pathways in impacted watersheds is therefore crucial to understand potential impacts on the aquatic ecosystems [3]. For seasonally cold climates and catchments drained and dominated by peatlands, this task is difficult, and as such, the systems are not well understood. In this work, we examine high-frequency hydrometric, water chemistry and isotope tracer data from the AOSR. We aim to provide an understanding of streamflow generation and water quality change drivers in five diverse rivers that drain into the Athabasca River. The results reveal consistent seasonal responses in water quality both within and among watersheds, with little variation in the magnitude of concentrations. PHREEQC modeling results suggest hydrologic flushing of weathering products in the watersheds during freshet. We propose a new conceptual framework to explain water and chemical constituent storage and release in these watersheds. This presentation highlights the importance of this integrated approach, spanning diverse watersheds and multiple geochemical and isotopic measurements. Our findings serve as valuable input for the study and management of water resources in similarly impacted environments.

[1] Wasiuta *et al.* (2019) *Environ. Sci. Technol.* **53**, 12856–12864 [2] Kelly *et al*. (2009) *PNAS* **107**, 16178–16183. [3] McEachern, Prepas & Chanasyk (2006) *J. Hydrol.* **323**, 303–324.