Hydrogeochemical setting of the Northern Athabasca Oil Sands area

J.J. GIBSON[1,2*], Y. YI[1,2], S.J. BIRKS[1,2], M.C. MONCUR[1], J.W. FENNELL[3], K.TATTRIE[1]

[1]Integrated Water Management, Alberta Innovates-Technology Futures, Victoria & Calgary, Canada, john.gibson@albertainnovates.ca (*presenting author)

[2]University of Victoria, Victoria, Canada, jjgibson@uvic.ca.

[3]Worley Parsons, Calgary, Canada, jon.fennell@worleyparsons.com.

Introduction

The oil sands of Northern Alberta represents an important oil reserve for Canada and the world. These vast hydrocarbon deposits have been exposed to the surface via long-term erosion by the Athabasca River and its tributaries. This geological evolution has led to a complex hydrogeological system, which features numerous pathways connecting the surface and subsurface hydrologic systems. Here, we present a study based on data and information collected from several river sampling campaigns along the main channel of the Athabasca River, including geochemical and isotopic signatures in formation water, that shed light on the natural hydrogeological setting of the Northern Athabaca Oil Sands Area.

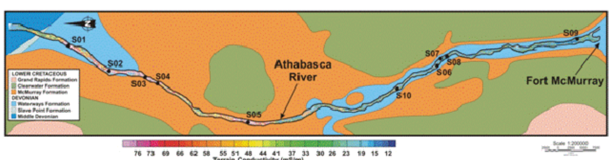

Figure 1: Terrain electrical conductivity of a 125-km reach of the Athabasca River from Fort McMurray to the Firebag River overlain on a map of bedrock geology. Zones of elevated terrain conductivities indicate potential connections between surface water and groundwater, and these areas were targeted for groundwater sampling for a full suite of geochemical and isotopic analyses to characterize and trace the origin and evolution of groundwater discharging to the river.

Results and Discussion

Electrical conductivity surveys reveal large areas with elevated conductivity, reflecting both variation in geologic substrate (e.g. evaporites), as well as variable salinity of inflowing waters in seeps and an array of groundwater springs. The geochemical and isotopic composition of these groundwater inflows are similar to those found in the McMurray Formation and Devonian Formation waters. The distribution of the seep geochemistry and some of the bulk river chemistry are related to changes in geology along the reach of the Athabasca River studied. The results of this investigation provide insight into the geochemical and isotopic evolution of riverine water quality, specifically the significant influence of natural groundwater sources of salinity and organics to the Athabasca River.

Assessing the health effects of atmospheric particulate matter

RETO GIERÉ[1]

[1] Universität Freiburg, Geowissenschaften, 79104 Freiburg, Germany (giere@uni-freiburg.de)

Atmospheric particulate matter (PM) is ubiquitous in the atmosphere and is generated in various environments through natural processes and human activity. Individual particles display a wide range of physical, chemical, structural and surface properties, which depend on source, chemical reactions, and transport under variable atmospheric conditions [1]. Several epidemiological and toxicological investigations have linked airborne PM with adverse effects on human health, both acute and chronic. Effects associated with PM exposure include chronic obstructive pulmonary disease (COPD), exacerbation of asthma, fibrosis, slower lung development in children, and lung cancer, but also an increase in cardiovascular diseases [2]. The inhaled fine particles ($PM_{2.5}$) can migrate to the alveoli in the deep lung, where they remain for long periods of time and interact with lung fluid and tissue. The deepest part of the lungs, thus, acts a special type of active sampler for atmospheric dust. The finest PM fraction may translocate to epithelial and interstitial sites and possibly to extrapulmonary organs. Inhaled coarse particles, on the other hand, are retained in the upper part of the respiratory tract, but there is increasing evidence that coarse particles may also produce adverse health effects [3].

Within the lung, the inhaled PM interacts with lung fluid and tissue, stimulating various types of biological and biochemical responses (e.g., immune defense reactions, inflammation, cytokine release). These reactions to external stimuli are still poorly investigated, and their relationship with, and dependence on, specific PM properties are largely unknown. To improve our knowledge on the health effects of PM, a close collaboration between diverse scientific disciplines is crucial. Moreover, it is essential to characterize single particles in detail in order to perform meaningful experiments designed to improve our currently poor knowledge on the interaction between atmospheric PM and the respiratory tract.

This presentation will discuss various approaches to assessing the health impacts of PM. It will describe experimental results obtained from *in-vitro* stimulation of lung cells with diverse types of PM, which have been found to be present in ambient air (magnetite, black toner dust, various metal sulfates, and tire-wear particles). This presentation will also report results from investigations on lung tissue samples and brochoalveolar lavage (BAL) fluids.

[1] Gieré & Querol (2010) *Elements* **6**, 215-222. [2] Pope et al. (2009) *New Engl J Med* **360**, 376-386. [3] Brunekreef & Frosberg (2005) *Eur Resp J* **26**, 309-318.