ecohydrology research group

Seminar Series presents

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"Hydroecology of the Peace-Athabasca Delta: Patterns in Late Water Quality, Productivity, and Pollution"

November 8th, 2012 at 3:30pm

EIT, room 3142

Everyone welcome

Coffee provided

WATERLOO SCIENCE | EARTH AND ENVIRONMENTAL SCIENCES

Abstract

Repeated measurements over three years (2003-05) were made on a series of Peace-Athabasca Delta lakes along a hydrological gradient. This allowed the role of river flooding to be characterized on limnological conditions of lakes and to identify the patterns and timescales of limnological change after flooding. River floodwaters were found to elevate lake water concentrations of suspended sediment, total phosphorus, SO4 and dissolved Si, and reduce concentrations of total Kjeldahl nitrogen (TKN), dissolved organic carbon (DOC) and most ions. In the absence of flooding for years to decades, evaporative concentration leads to an increase in most nutrients (TKN, inorganic N, and dissolved P), DOC and ions. Contrary to a prevailing paradigm, these results suggest that regular flooding is not required to maintain high nutrient concentrations in perched basin lakes of the PAD. Patterns of primary production as measured by standing crop of phytoplankton and macrophyte communities also do not support the prevailing paradigm that flooding is required to maintain high productivity in perched basin lakes of the PAD. Instead the aquatic macrophyte communities (which dominate in perched basin lakes) were found to be primarily light limited. River connectivity and flooding of PAD lakes was seen to lower underwater light availability and the standing crop of submergent macrophyte communities. Macrophyte species diversity was also positively related to underwater light availability.

To determine the role of the Athabasca River and atmospheric transport as vectors for the deposition of polycyclic aromatic compounds *(*PACs) and heavy metals in the PAD, sediment cores were collected from three PAD lakes (PAD 18, 23 & 31). Lake sediment cores were ^{210}Pb dated and analysed for 52 alkylated and non-alkylated PACs as well as for heavy metals. One of the three lakes (PAD 18) is elevated well above the floodplain and serves to record atmospheric deposition and within basin sources. PAC deposition was found to be dominated by PACs of pyrogenic rather than bitumen origin. The atmospheric deposition of several heavy metals (Pb, As, Sb, Hg) was found to have increased during the mid-20th century at PAD 18. Subsequently the deposition of these metals have declined due to pollution control measures on metal smelters and coal burning facilities and the phasing-out of leaded gasoline in latter half of the 20th century. Both Pb and Hg deposition remain ~10% and 60% above pre-1900 levels respectively, while As and Sb appear to have returned to pre-1900 levels. The composition of PACs differs between sediments deposited during not flood-prone and flood-prone periods in PAD lakes. Seven PACs were identified that are preferentially deposited during flood-prone periods. We have termed these seven PACs as river-transported indicator PACs. These same PACs account for 51% of the total PACs found in oil-sands sediment. The PAD 31 sediment record shows > 200 years of depositional history and has been flood prone both before and since the onset of Athabasca oil sands development. Neither the proportion nor concentration of the river-transported indicator PACs was seen to increase in sediments deposited post-1982 compared to pre-1940s sediments. Our findings suggest that natural erosion of exposed bitumen along the banks of the Athabasca River and its tributaries is the main process delivering PACs to the Athabasca Delta.