

# PAH characterization of reworked bitumen contributions to the lower Athabasca River

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The lower Athabasca River valley in northeastern Alberta, famous for oil sands mining, but it was also the site of one of the largest Ice Age floods that occurred in North America. During deglaciation, a large proglacial lake (Lake Agassiz) drained catastrophically through the Athabasca River valley. This catastrophic flood eroded deeply into the bitumen-bearing Clearwater and McMurray Formations, transporting and then depositing bitumen in what is now the Peace-Athabasca Delta. The modern-day erosion of these flood deposits is thought to represent an important source of polycyclic aromatic hydrocarbons (PAHs) to the Athabasca River. This erosion occurs primarily at “Big Bend” a large, 18 m high and 3900 m wide cut bank being actively eroded by the Athabasca River.

Here, we present the results of a study to estimate the importance of Big Bend to the PAH budget for the lower Athabasca River. We examined the composition and the concentration of PAHs in five exposures at the Big Bend site and compared these data to (i) other sources of PAHs (the McMurray Formation, forest fire ash, and pet coke) and (ii) water quality PAH data collected by the Governments of Canada and Alberta as part of regional environmental monitoring programs. We estimate Big Bend contributes ~8.4 tons of PAHs and 750 kt of sediment to the lower Athabasca river each year. This represents ~50% sediment budget of the lower Athabasca River. PAHs from Big Bend are characterized by a unique compositional profile that differs from the McMurray Formation, forest fire ash, and pet coke. Water samples were then compared to these PAH sources. Water samples were more similar to the raw bitumen and Big Bend during months of high river discharge, but matched better with forest fire ash and pet coke during low flow periods. These results suggest the natural bank erosion by the Athabasca River during periods of high discharge plays an important role in supplying PAHs to the lower Athabasca River and the downstream Peace Athabasca Delta. This study has revealed that the erosion of reworked bitumen at Big Bend is a major source of PAHs input to the lower Athabasca River region.

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