# Research Progress Report – November 25, 2012

Wilfrid Laurier University & University of Waterloo Researchers

**Project Title*: Sediment Core Sampling to Assess Contaminant Deposition to the Slave River Delta Over Time***

**Background:** This project is part of the Slave River & Delta Partnership's (SRDP) activity funded by the NWT Cumulative Impact Monitoring Program (CIMP) 2011-2012

**Project Goals:** This project, which was identified as a priority by the SRDP, addresses community concerns that contaminants may be increasing in the Slave River. We analyzed contaminants in a sediment core from frequently-flooded Lake SD2 in the Slave Delta to: **1)** Determine baseline concentrations of contaminants of concern (PAHs, metals) before oil sands development began; **2)** Assess if the levels of the contaminants that are in hydrocarbons from oil and gas have changed since development of Alberta's oil sands.

When long-term records of measurements of river water are not available, sediments deposited by floods into lakes of the Slave Delta provide one of the best and only sources of information to track changes in water-quality of the Slave River over time.

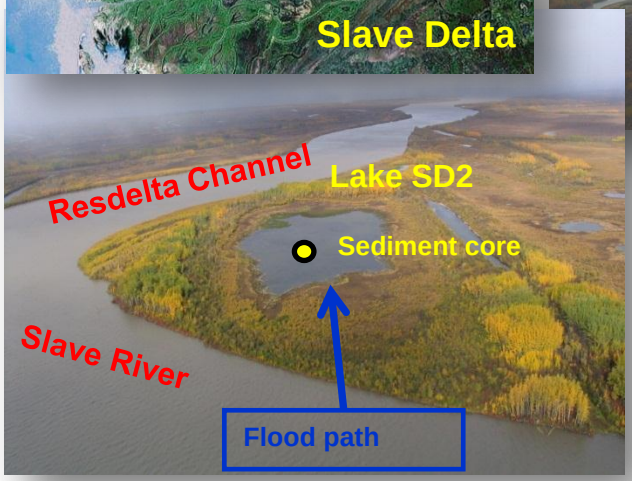
**This Report :** Provides an update of our activities, results & conclusions so far**.**

**Progress to Date:** Sediment cores were collected on September 14, 2011.

- All samples have been analyzed for organic contaminants (PAHs) and metals.
- Data have been analyzed for PAHs (results & conclusions are reported here).

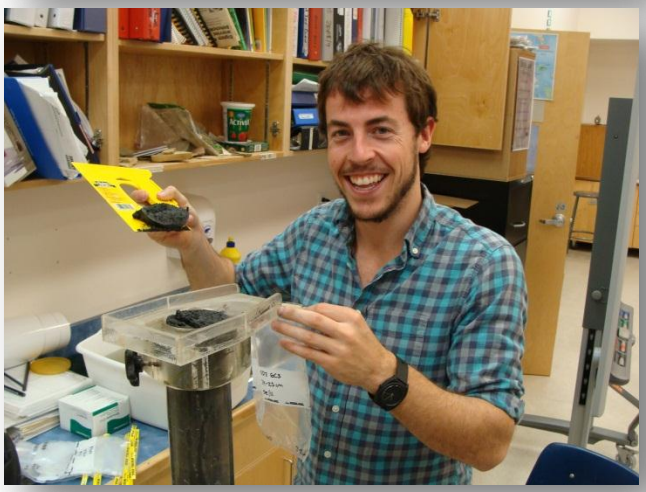
PAHs are contaminants of concern, because some PAH compounds that occur in oil sands are associated with human health disorders, and toxic effects & deformities in fish.





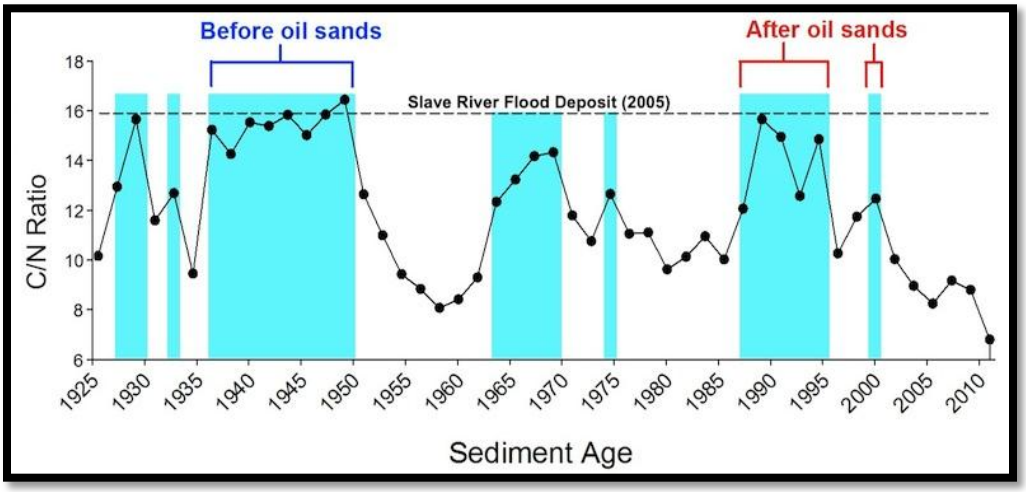

**Lake SD2** was chosen for the study because 1) it is frequently flooded from the Slave River, and 2) previous research developed knowledge of the lake's flood history.

- Knowing this makes it possible to assess changes in contaminants carried by the Slave River to the Slave Delta.

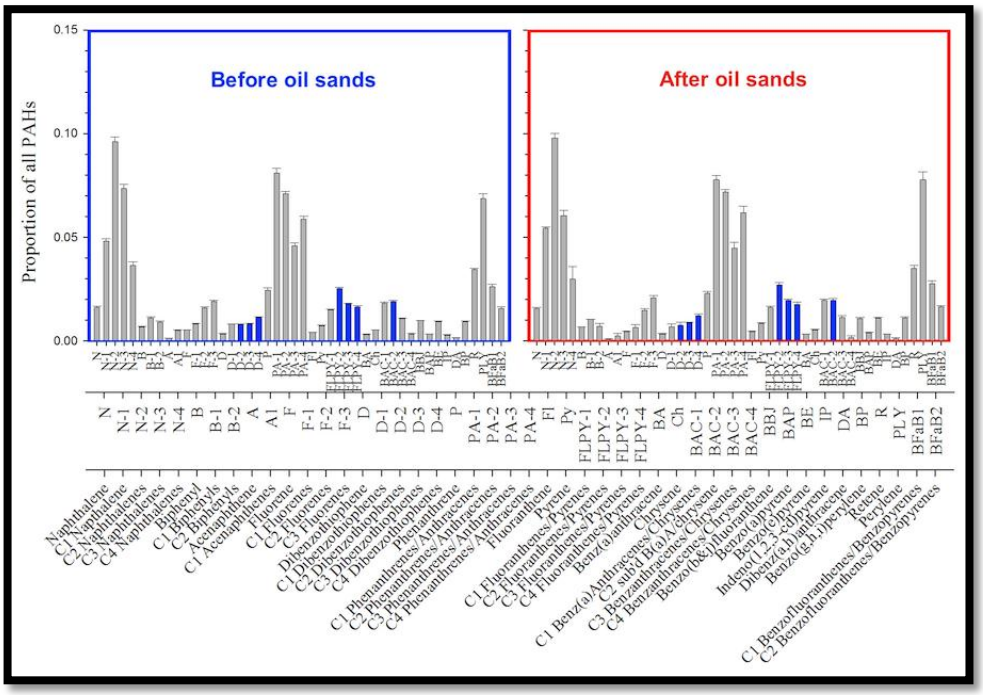



- A 48-cm long sediment core was collected from Lake SD2 using a corer fitted with a plexiglass tube. We worked with Gaby Lafferty out in the delta to complete this project.
- The sediment core was cut into 1-cm thick slices (~2 years each). We did this work at the Deninu School, which provided opportunity to engage with the students.
- The sediment core spans the past 90 years (back to about the year 1925).

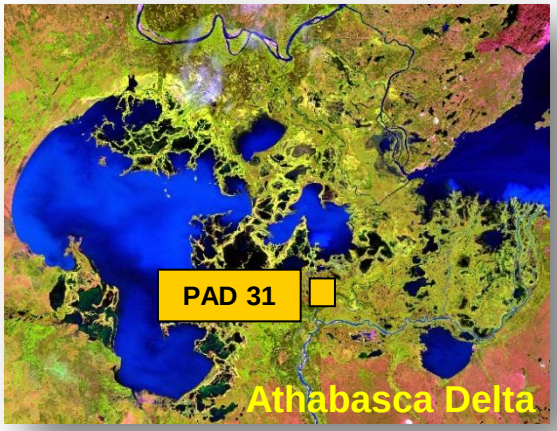
# Results (1)

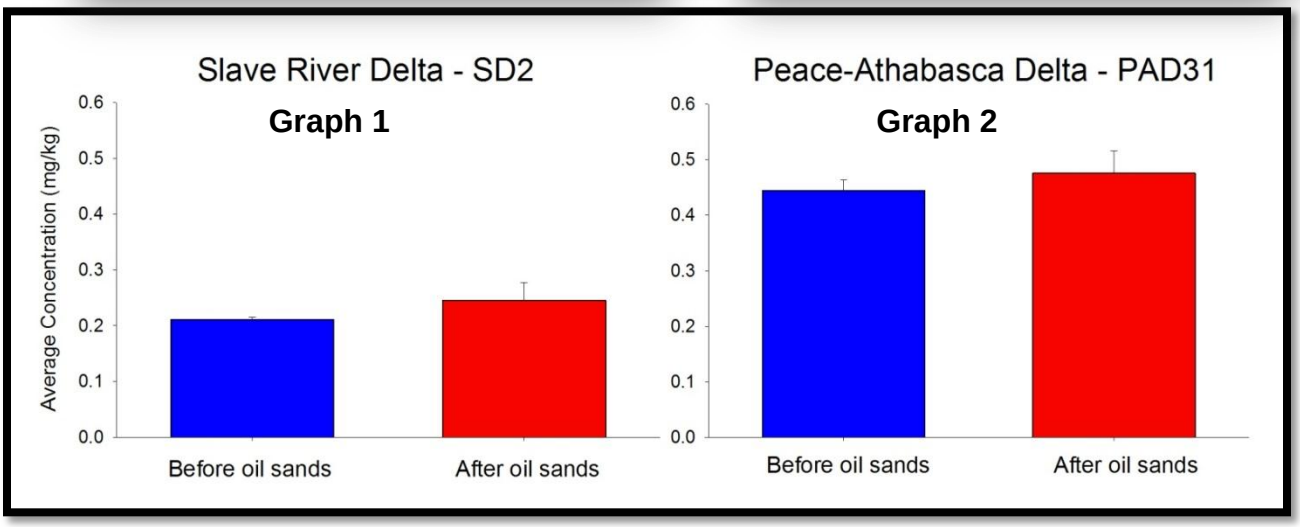



- In the above graph, the black dots show changes over time in the carbon-to-nitrogen (C/N) ratio in the sediment core from Lake SD2. The C/N ratio was used to determine periods when floodwaters entered the lake (= high values comparable to the 2005 flood deposit; shaded in blue) and periods without flooding (lower values; not shaded).
- There were two main periods with evidence of heavy flooding. We compared these two periods -- one **before (1936-51)** and one **after (1987-1994, 2000)** oil sands development began in 1967-- to assess if contaminants transported by the Slave River have changed since development of Alberta's oil sands.
- When we compared these two time periods, we found that the ***composition of PAHs*** (= the types and relative amounts of the 47 compounds) in flood-deposited sediments at Lake SD2 ***has not changed since development of Alberta's oil sands*** (see the graph below ). This means that organic contaminants characteristic of oil sands have not increased in sediments carried by the Slave River between the 1940s and the 1990s.



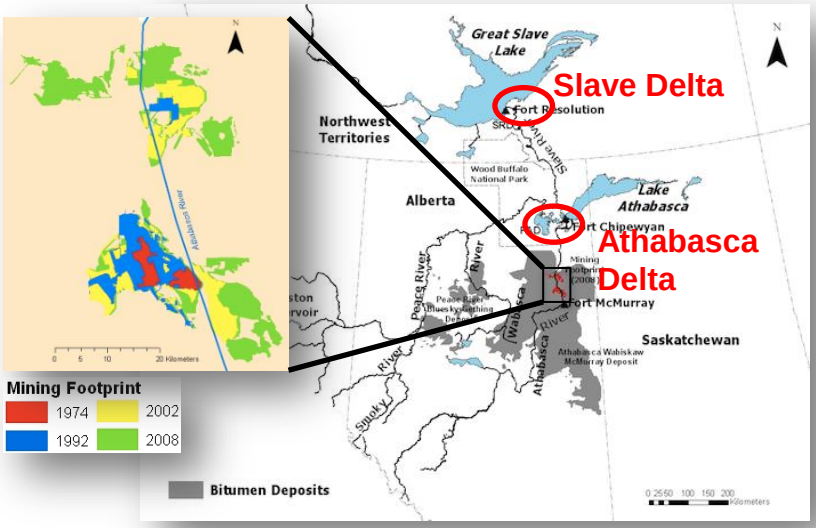
# Results (2)


- Graph 1 (left-hand) above shows that at Lake SD2 the concentration of PAHs common in bitumen and transported by rivers (as reported by Hall et al. 2012[1]) ***have not increased significantly above baseline levels that existed before oil sands development began***.
- ***This finding agrees with results from our comparable study of a frequently-flooded lake (PAD 31 or 'Johnny Cabin Pond') in the Athabasca Delta*** (Hall et al., 2012[1]), which also shows that the concentration of these PAHs have not increased in this lake since oil-sands development started (see Graph 2 above).
- Note that the concentration of these PAHs in sediments of Lake SD2 in the Slave Delta are ***less than half*** the values at the flood-prone lake in the Athabasca Delta (Johnny Cabin Pond/PAD31). This suggests that contaminants from the oil sands and carried by the Athabasca River are retained within the Athabasca Delta and Lake Athabasca, and they are diluted by 'cleaner' sediments carried by the Peace River. These features appear to produce much lower concentrations of organic contaminants carried by the Slave River compared to the Athabasca River.

*[1]Hall et al. 2012. Has Alberta oil sands development altered delivery of polycyclic aromatic compounds to the Peace-Athabasca Delta? PLOS ONE 7(9): e46089. doi:10.1371/journal.pone.0046089 (free access)*




These maps show the locations of the Slave River Delta and the Athabasca Delta, in relation to Alberta's oil sands development (grey area).

# Preliminary Conclusions

1. We measured the composition (= the relative amounts of the various compounds) and concentration of PAHs in a sediment core from flood-prone Lake SD2 in the Slave Delta, and compared values in sediments carried by Slave River floodwaters before and after development of Alberta's oil sands.
2. This comparison shows that the composition of PAHs carried by the Slave River into Lake SD2 during flood stages has not changed substantially since oil sands mining began.
3. Also, the concentration of indicator PAHs found in bitumen and transported by the Slave River has not increased in Lake SD2 above baseline values measured in sediments deposited before oil sands development began. This finding agrees with research in the Athabasca Delta (Lake PAD31), which also shows no increases at a site located closer to the oil sands development.
4. Average concentrations of the river-transported bitumen-associated PACs at Lake SD2 are less than half compared to the flood-prone lake in the Athabasca Delta (PAD31).
5. This study compared contaminant levels in sediments deposited into Lake SD2 before (1936-51) oil sands development versus after (1995-2000). The study could not determine changes in contaminant levels since 2000, a period of growth in oil sands activities, because flooding has not been extensive into SD2 during the past decade. But, frequent flooding has occurred at Lake PAD31 (Johnny Cabin Pond) since 2000, and the sediments there show no increase in PAH levels since 2000 above pre-impact values.

**Future Contributions: 1)** Analysis of metals of concern are ongoing and will be completed by June 2013. **2)** We plan to present these results and preliminary conclusions at the upcoming joint ENR-CIMP-DFO meeting on cumulative effects monitoring in the NWT (Yellowknife, January 2013).

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