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The river geochemical toolbox : application to the Mackenzie River Basin, Canada.

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The Mackenzie river Basin is one of the largest arctic river. It drains the mountains of the Mackenzie and Rocky Mountains, the cretaceous lowlands and the Canadian shield. Except for this region, bedrocks in the Mackenzie river basin are essentially recycled sedimentary material. Glacial deposits are widespread.

We have conducted a number of chemical and isotopic studies on the same samples including major and trace elements, DOC, Sr, Pb, B, Li, S and O isotopes, in both the dissolved and solid phases transported by the river. We will try to review and combine the different informations deduced from the different tracers and see how they complement.

This systematic has lead to the following conclusions :

- Chemical denudation in the Mackenzie River basin is relatively high despite the very low temperatures.
- A clear control of chemical denudation rate by rock type is observed
- Carbonates are the dominant lithology to be weathered, but a significant part of carbonate weathering is not due to carbonic acid, but is rather due to sulphuric acid, derived from the oxydative weathering of pyrite.
- Chemical weathering in the Mackenzie river basin is not a sink of CO_3, but

rather a source, at least on transient timescales, because of the involvement of sulphuric acid.

- Silicate chemical weathering is proceeding faster in the lowlands compared to the mountains and controls the isotopic composition of B and Li.
- Two main reasons seem to explain the higher chemical denudation rates in the plains: the presence of organic matter that complexes aluminium and the contribution of shallow aquifers in witch the residence time of water is higher and allows for more weathering.
- A correlation between pyrite oxidation and physical erosion shows that the production of fresh surfaces is the limiting step for the weathering of shale minerals.
- Two regimes of chemical weathering are co-existing: a silicate weathering-dominated regime occurring in shallow groundwater of high water residence time and a pyrite and carbonate-dominated regimes occurring at the surface and controlled by physical denudation, thus surface area availability.