

## Isotopic Insights into Carbon Metabolism in a Boreal Forest Hydroelectric Reservoir of the James Bay area (Canada)

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Hydroelectric reservoirs from the boreal forest release CO<sub>2</sub> at a rate of about 2g•m<sup>-2</sup>•d<sup>-1</sup> (St-Louis *et al.*, BioScience 50, pp 766-775, 2000). In the present study, its sources, and the overall carbon metabolism in such large artificial lakes, are examined, with some attention to seasonal variations, based on isotopic approaches. The study site is part of a series of eight large reservoirs of the eastern James Bay (Eastern Canada). It extends over 2835 km<sup>2</sup>. Isotopic monitoring of its CO<sub>2</sub>-emissions started in 1999, although we primarily refer here to samples collected during the year 2001. Three sets of samples were collected: i) summer surface waters at 15 stations representing various ecological zones of the reservoir, ii) summer water column profiles at three sites of increasing bathymetry, and iii) monthly samplings of inflowing and outflowing waters of the reservoir throughout the year. *In situ* measurements included water and air temperatures, pH, alkalinity, dissolved oxygen content and wind speed. Laboratory analyses included measurement of dissolved organic matter (DOM) concentrations, of C/N ratios in DOM, of <sup>13</sup>C contents of dissolved inorganic and organic carbons (DIC, DOC) as well as of the overlying air-CO<sub>2</sub>, of <sup>15</sup>N and <sup>14</sup>C contents in DOM, and of <sup>18</sup>O-content in dissolved oxygen.

$\delta^{13}\text{C}$  values in DIC vary from -9‰ to -14‰ (vs VPDB). They are lower under windy conditions and in shallow zones.  $\delta^{13}\text{C}$  values in DOC are uniform and average -27.1±0.2‰.  $\delta^{13}\text{C}$ -values of air-CO<sub>2</sub>, above the reservoir, average -10.8±0.7‰ but show a -1 to -2‰ shift under windy conditions. DOM-C/N ratios vary between 12 and 38, with a mean value of ~ 30. <sup>14</sup>C activities in DOM, at the deepest sampling station, vary between 106% (vs. modern carbon), at the water-air interface, and 110%, at a depth of 70 meters. DOM-<sup>15</sup>N analyses are in progress. Preliminary results on the seasonal distribution of DIC-<sup>13</sup>C-contents in outflowing waters indicate values within the range depicted by summer DIC-samples. However, much higher *p*CO<sub>2</sub> values are observed during the ice cover period.

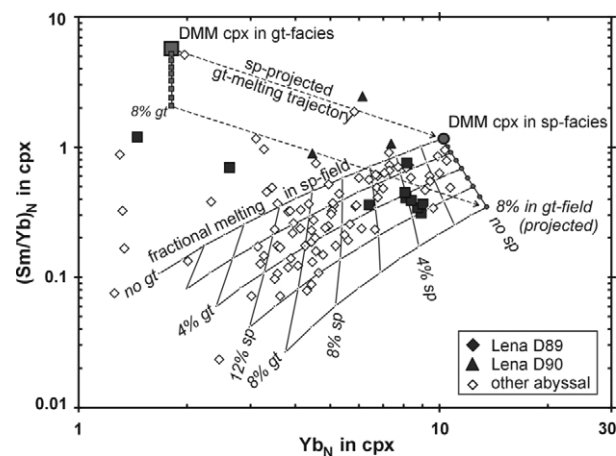
The CO<sub>2</sub> released at water-air interface seems to result essentially from DOM oxidation in the upper water column (epilimnium). This DOM derives from the decay of post-nuclear organic matter in top soils of the drainage basin. Photosynthetic activity sequesters relatively important quantities of CO<sub>2</sub> during summer sunny days, but its incidence on seasonal carbon budgets is likely modest.

## Deep melting underneath the ultraslow Lena spreading center

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Plagioclase-free abyssal spinel peridotites from the ultraslow and highly oblique-spreading Lena Trough between Greenland and Spitsbergen have mineral compositions that are very similar to normal residual abyssal peridotites, except for extremely high sodium concentrations in cpx (0.6-1.7% Na<sub>2</sub>O), thus forming a compositional transition between the continental and oceanic mantle. Most samples have fertile spinel compositions (Cr# ~0.16), associated with LREE-depleted ((La/Yb)<sub>Cl</sub> ~0.006) cpx trace element patterns, suggesting that they are residues of (near-) fractional melting. However, they have fractionated M- to HREE ratios at high HREE concentrations. Such characteristics can only be explained by an initial 4-6% fractional melting of a garnet peridotite followed by another 3-4% melting in the spinel field. This suggests on the one hand a high mantle potential temperature and on the other hand a deep cessation of melting, possibly because of a thick lithospheric cap. This is consistent with the extremely low effective spreading rate and the vicinity to a continental margin which may allow conductive cooling to reach deeper levels than commonly estimated for mid-ocean ridge conditions.



**Fig1.:** Cpx trace elements (all ion probe data) in Lena Trough and other residual abyssal peridotites. Polybaric fractional melting models suggest variable degrees of melting in stability field of garnet and spinel peridotite. For most Lena Trough cpx, more melt extraction occurred in the presence of residual garnet than under spinel-facies conditions.