Constraints on outer core compositional stratification and core-mantle reaction from outer core wavespeed profiles

G. HELFFRICH

Earth Sciences, University of Bristol, Wills Memorial Building, Queen's Road, Bristol BS8 1RJ, UK (george@gly.bris.ac.uk)

Light elements in the nearly pure iron core of the Earth are required in order to match the material properties of the outer and inner core [1,2]. Recent seismological models [3.4] of outer core structure suggest that the outermost outer core could contain velocity gradients that deviate from homogeneous self compression, signalling thermal or chemical changes. Using a thermodynamic megallurgically-based model of core liquids, I show that in the Fe-O-S system, light element stratification with 1.3-2.2 wt% sulfur enrichment coupled with 0.3-1.0 wt% oxygen depletion, yields feasible wavespeed profiles and is a structurally stable density profile in the outer core. In contrast, stratification by superadiabatic thermal gradients or reactive chemical transport of oxygen between the mantle and the core [5,6] is incompatible with the seismic information. Consequently, if present, anomalous seismic velocity structure in the outer core records the gradual growth of the inner core if sulfur and oxygen are the dominant liquid alloy components.

[1] Stevenson (1981) *Science,* **214**, 611-619. [2] Poirier (1994) *PEPI* **85**, 319-337. [3] Tanaka (2007) *EPSL* **259**, 486-499. [4] Kennett *et al.* (1995) *GJI* **126**, 108-124. [5] Rubie *et al.* (2004) *Nature* **429**, 58-61. [6] Asahara *et al.* (2007) *EPSL* **257**, 435-449.

Dissolved carbon in large boreal catchment basins and hydroelectric reservoirs: Isotopic clues

JEAN-FRANCOIS HÉLIE*, ÉRIC ROSA, ANNIE LALONDE AND CLAUDE HILLAIRE-MARCEL

GEOTOP – Université du Québec à Montréal, C.P. 8888 succursale Centre-ville, Montréal (QC) Canada, H3C 3P8 (*correspondence: helie.jean-francois@uqam.ca)

Carbon sources and cycling in boreal environments are currently the focus of a growing number of investigations in Eastern Canada, mainly because of the importance of hydropower and its potential in this region. Here, we investigate dissolved inorganic and organic carbon fluxes and sources in 5 impounded (La Grande 3400 m^3/s, Eastmain, St. Lawrence 12 100 m^3/s, Ottawa 1950 m^3/s and Nelson 2370 m^3/s) as well as 2 pristine (Great Whales 680 m^3/s and Koksoak) river systems. These major rivers were sampled monthly at their outlet for at least one year. The St. Lawrence River has been under investigation since June of 1997 on a bi-weekly basis. Also, synoptic surveys were undertaken in August 2008 on the La Grande and Great Whales Rivers. At each visit, water temperature, pH, Gran alkalinity and specific conductivity were measured. Samples were also collected for the analysis of i) major ions concentrations; ii) $\delta^{13}C$ of dissolved inorganic and organic carbon as well as particulate organic carbon (respectively DIC, DOC and POC); iii) $\delta^{18}O$ and $\delta^{2}H$ of the water molecule; and iv) radio-isotopes (Uranium series and Strontium - not discussed here). In all the sampled river systems, POC concentrations were at least an order of magnitude smaller than the dissolved forms. As a result, the dissolved forms will be the focus of this investigation. Rivers draining carbonates (St. Lawrence and Nelson Rivers) present higher DIC concentrations and higher ^{13}C-contents in dissolved inorganic carbon (DIC), in response to the dissolution of soil carbonates. DOC/DIC ratios above 2.4 are observed in rivers draining silicates; their lower ^{13}C-DIC content directly reflects the organic matter oxidation in soils. However, the DIC isotopic composition of impounded rivers draining silicates reflects both the organic oxidation origin of DIC and CO_2 degassing along the reservoir. The striking feature of this boreal data set is the homogeneity of the isotopic composition of DOC (-27.4±0.2‰ vs V-PDB). Moreover, C:N ratios and ^{14}C activity ($A^{14}C$) of bulk dissolved organic matter (MOD) measured in the La Grande River reveal that this DOC is relatively fresh and young ($A^{14}C$ higher than 100% MC).