Goldschmidt 2000
September 3rd–8th, 2000
Oxford, UK.

Journal of Conference Abstracts
Volume 5(2), 420

River Geochemistry and Chemical Weathering of Shields: From Subarctics to Tropics

Jerome Gaillardet (gaillardet@ipgp.jussieu.fr)[1], **Romain Millot**, **Bernard Dupre** & **Claude Allègre**

[1] Laboratoire de Geochimie-Cosmochimie, Institut de Physique du Globe, T 24-14, 3 etage, 75252 PARIS, France

Shields are the flattest and oldest part of the continents and are mainly constituted of silicates. Because they occur at different latitudes, under different climates, they are submitted to contrasted conditions of weathering and erosion. They also have contrasted geological histories. So far, the geochemistry of the Canadian shield rivers have been poorly documented. We have analysed a series a rivers draining the Slave province North to Yellowknife and a series of rivers draining the Quebec Province, in the region of Lac St. Jean.

Main features of the Canadian rivers of this study

Geologically, the Slave Province is dominated by granitic rocks, while the Quebec Province is rather constituted of anorthosites and charnockites. Another contrasted parameter is the available water: with runoff values close to 120mm, the Slave Province is much dryer than the Quebec Province (500mm). As a consequence, the Quebec catchments are forested (boreal forest), while the Slave Province rivers drain the tundra. Rivers are black (organic rich) in the Quebec province and white in the Slave region. In both regions, soils are thin and glacial remains, glacial meals and sands are abundant. All these rivers are characterised by very low suspended sediments concentrations.

Analysis and results

We have analysed the dissolved phase for major, trace, carbon and Sr isotopes. The sands and glacial clays have also been measured. As observed in other parts of the world, a strong decoupling exist between the most interrelated soluble elements (Na, Ca, K, Mg, Sr, Ba) and elements of low solubility such as Al, Fe, REE, Th, whose concentrations are highly correlated with Dissolved Organic Carbon. Ultrafiltration experiments confirms that the presence of these elements at high levels in the dissolved phase is due to their complexation by organic molecules. In Quebec Province, metal complexation is 10 times lower than in the Slave Province, as a result of the lower biological productivity.

Sr isotopes and elemental ratios

While the rivers of the Slave province have very radiogenic Sr isotopic ratios (up to 0.751), the rivers of the Quebec craton are nonradiogenic (0.712) even if, in terms of Ca/Na, Mg/Na or Sr/Na ratios, they are typical silicate draining rivers. The Sr isotopic composition of the water is consistent with the Sr isotopic ratio of the sands and other glacial materials, suggesting that no major Sr isotopes fractionation in such a weathering regime occur.

Weathering fluxes

Using the major elements, once corrected from atmospheric inputs and except Silica, which is likely to be consumed by organisms in lakes, we have calculated " weathering cationic rates " for each of the rivers analysed here. It is found that the weathering rates (expressed in $t/Km^2/yr$) of the Quebec Province are two-time those of the Slave Province. When compared to the weathering rates of other shield provinces submitted to a tropical climate, it is shown that the rates found for the Canadian shield are among the lowest on Earth. A positive effect of temperature is observed with a slight increase of cationic weathering rates with temperature. This increase remarkably mimics an Arrhenius type law. However, the activation energy that can be deduced from the correlation between the log. of the cationic weathering rate and temperature is lower than that classically admitted, for example by the C cycle model of Berner. In other words, weathering rates of silicates inferred from shield areas increase slower than predicted theoretically. Many factors can counteract the effects of temperature, in particular, soil development, organic matter than may explain the discrepancy between measured and predicted rates of weathering.