Geophysical Research Abstracts,
Vol. 10, EGU2008-A-04760, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-04760
EGU General Assembly 2008

Temporal variations of chemical weathering fluxes in boreal rivers under permafrost conditions. Example of the Nizhnaya Tunguska watershed (Central Siberia).

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Boreal regions will be very sensitive to global warming which should induce an important reduction of the permafrost area, and also probably a significant modification of the hydrological regime of these high latitude regions. In permafrost areas the hydrological characteristics of rivers are indeed very specific with the occurrence of three highly contrasted periods: a very low water period from October to May, a spring flood in May/June, and a relatively high water period in summer, from June to the end of September [1]. However, previous geochemical studies interested in boreal systems do not take these temporal variations into account.

In this work, we propose to characterize the temporal variability of dissolved chemical fluxes carried by boreal rivers under permafrost conditions. For this purpose, two rivers draining the South of the basaltic plateau of Putorana in Central Siberia (Kochechumo and Nizhnaya Tunguska) were sampled along the year and an extended spatial sampling of the watershed was carried out during the summer. The dissolved load of these water samples were analysed for major and trace element concentrations as well as for strontium and uranium isotopic compositions.

On the basis of element concentration variations, three periods can be marked out, matching the three hydrological periods. Variations of concentration ratios as well as variations of Sr isotope ratios show however that annual concentration pattern cannot be explained solely by dilution processes but have to involve the contribution of different sources. Thus, the significant increase of aluminium and iron concentrations when the spring flood discharge occurs is certainly linked to the presence of colloidal substances, most likely originating from upper soil horizons during the period of snow melting.

Temporal variations of (^{234}U/^{238}U) activity ratios are also observed in the dissolved load of the two rivers, with higher values in winter ($>$2) than in spring and summer (from 1.2 to 1.5). We propose that in winter, when all surface waters are frozen, the only contribution to the riverine water flux would come from deep underground reservoirs having high rock/water ratios and long periods of interaction thus producing high uranium activity ratios [2]. In summer, the contribution of surface waters, flowing over the permafrost in the active layer (suprapermafrost flow), would be predominant and thus constitute the main chemical flux carried by these rivers.

Overall, permafrost regions represent very specific hydrogeochemical systems compared to tropical and temperate systems with two different fluxes over the year : a deep water flux in winter and a predominant surface water flux in spring and summer.

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