Hadean crustal relics and evidence for lifetime of early crust

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The Nuvvuagittuq supracustal belt (Québec) and the Acasta gneiss complex (NWT), Canada represent some of the oldest crustal remnants on Earth and are thus outstanding archives for inferring the early history of the continental crust. There are, however, controversies about how existing data should be interpreted in terms of geochronology and time scales. In this study, Sm-Nd isotope data, combined with U-Pb dating and Lu-Hf isotope data, were examined.

We analyzed thirteen samples, previously dated by U-Pb, zircon and Lu_Hf geochronology from the Acasta gneiss complex for high-precision ^{146,147}Sm-^{142,143}Nd-systematics. The ^{147}Sm-^{143}Nd data yield an alignment corresponding to an age of 3371 Ma age. Ten out of the thirteen samples show negative ^{142}Nd anomalies with an average deficit of -9.6±5 ppm.

We show that, unlike previous claims, the ^{146}Sm-^{142}Nd systematics are susceptible to resetting. Furthermore, when combined with the corresponding ^{147}Sm-^{143}Nd and ^{176}Lu-^{176}Hf data for the same samples, these data provide a fairly accurate picture of the evolution of Nuvvuagittuq and Acasta rocks. To examine quantitatively the effect of thermal resetting, we designed a new model whereby isotopes undergo exchange in a closed system at whole rock lengthscale. The Nuvvuagittuq mafic rocks were only partially reset, implying that direct dating of these rocks is not possible. In contrast, the degree of resetting was more extreme in Acasta, which yields rather constant ^{142}Nd anomalies, while the ^{147}Sm-^{143}Nd system records a younger age of ~3400 Ma. In both cases, the existence of negative ^{142}Nd anomalies can be attributed to Hadean crustal extraction between 4500 and 4300 Ma. The lifetime of this crust was investigated using time-dependent box models, including recycling into the mantle, and is shown to persist over 0.5-1 Gyr. In addition, the existence of positive ^{142}Nd anomalies in younger rocks was found to depend strongly on this parameter, and on the mantle stirring time.

Diffusive heavy metal fluxes in bottom river sediments

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Suspended particles are scavengers of contaminants in streams. When they become deposited on the river bed they can act as efficient traps. Early diagenetic processes in bottom sediments are known to induce diffusive fluxes towards the overlying water in lakes and seas for some elements and downwards for others [*e.g.*, 1, 2].

We applied to a river one of the methodologies commonly used for non turbulent water bodies, i.e., porewater *peepers*. The Lot River (in SW France) was selected because of its history of long-term metallic contamination and the consequent concern about the possible re-entering in the river dissolved flux of previously trapped heavy metals. The benthic pore water samplers (with a 10 mm vertical resolution) were installed manually by a SCUBA diver at a depth of ca. 2 m in a slow channel of the river.

The interstitial water redox potential, pH, dissolved sulfate and phospahe all decrease with depth, contrary to Fe and Mn which increase with depth. All of this is coherent with diagenesis.

For Cd and Zn we observe a peak in dissolved concentration 1 to 3 cm below the sediment-water interface, this implies a double flux, one towards the river and the other towards the sediments. This last component is in favor of removal of Cd and Zn from the river flux to the ocean, but in turns it might cause some concern for groundwater supply in local well fields in alluvial aquifers. These observations are explained in terms of geochemical processes.

[1] Gaillard *et al*. (1986) *Mar. Chem* **18**, 233-247. [2] Gaillard *et al*. (1987) *Chem Geol* **63**, 73-74.

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