

Sensitivity of the chemical weathering of the continents to environmental gradients

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Chemical weathering of the continental surfaces is a key process of the biogeochemical global cycles, including the cycles of the main cations, carbon, nutrients, isotopes. Recent field studies have emphasized the high sensitivity of the weathering systems to the ongoing anthropogenic changes (land use and climate change). These observations challenge our ability to predict how continental weathering (and hence the chemical composition of the waters flowing on the continents) will evolve in the future. There are only two methods for exploring and understanding this sensitivity to the environmental gradients such as climatic changes, variability in the vegetation cover, physical erosion intensity: the pluri-decadal monitoring of watersheds, and numerical modelling. Numerical modelling is a powerful tool, but it must be mechanisms-based if we want to catch the dynamics of the weathering system and predicts its future evolution. Here we present recent advances in the modelling of weathering reactions in the critical zone and at the watershed scale for a large variety of environments: temperate area, humid equatorial environment, tropical zone. The mathematical expressions of the dissolution/precipitation reactions are based on laboratory kinetic laws, and the hydrological parameters (soil water content, water fluxes) are calculated by offline biospheric models. The output of the models is compared first to available data from monitored watersheds. Then the sensitivity to the vegetation cover and climatic change is explored. The models suggest that the sensitivity of the weathering system (soil+saprolite) to the presence of vegetation appears to be higher in warm humid environment where intense evapotranspiration eventually limits the soil drainage. This is confirmed by climate change sensitivity tests where drainage changes overwhelm the temperature rise and thus seem to control the weathering response.

The geochemistry of the Brent impact structure, Ontario, Canada

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Thirteen impact melt samples and basal suevitic breccias from two drill cores of the 3.8 km diameter Brent impact structure have been analyzed for major and trace elements, including PGE. In selected samples, Os, Cr, W, Sr, and Pb isotope ratios were also measured. This multi-tool approach not only characterizes the projectile responsible for the formation of the structure, but also documents the distribution and nature of the meteoritic component (s) within. The Brent simple crater is an ideal case study: the target consists of mainly gneiss with minor alnoite dykes and the structure was extensively drilled beyond its lenticular melt sheet. Using a Ni-Cr correlation, the Brent structure was previously interpreted as formed by an ordinary chondrite (OC; type L or LL) [1]. Although the CI-normalized PGE concentrations of the melt rock show relatively flat patterns [2], the characteristic deviations from chondrite patterns could only be explained by fractionation of the meteoritic component. In recent years, a previously poorly constrained projectile type was characterized and proposed for the Rochechouart, Saäksjärvi, and Gardnos impact structures [3, 4]. The PGE pattern observed for Brent resembles that of IA and IIIC non-magmatic iron meteorites (NMI). The moderately siderophile element concentrations were affected by hydrothermal alteration, but the melt zone samples retain Ni/Cr ratios not only consistent with OC, but also with IA and IIIC NMI.

[1] Palme *et al.* (1981) *GCA* **45**, 2417–2424. [2] Evans N. J. *et al.* (1993) *GCA* **57**, 3737–3748. [3] Tagle *et al.* (2009) *GCA* **73**, 4891–4906. [4] Goderis *et al.* (2009) *Chem. Geol.* **258**, 145–156.