Modelling transfer of elements from the continent to the ocean at the large watershed scale in a tropical environment

C. ROELANDT,[1] Y. GODDERIS[1] M.-P. BONNET[1]
AND F. SEYLER[1]

[1]LMTG, CNRS-IRD, Observatoire Midi-Pyrénées, Toulouse, France, (godderis@lmtg.obs-mip.fr)

Continental weathering of silicate rocks has been recognized as a major driver of climatic changes at the geological timescale. New evidences and preliminary modelling works [1] show that the impact of continental weathering on the geochemical cycles and climate might be non negligible at shorter time scales, from 10^2 to 10^4 years, with for instance an increase in total continental weathering by 12% from the LGM towards the present day [2].

Continental weathering at large scale (10^6 km^2) is generally described through parametric laws (see for instance [3]), linking weathering rates to mean annual air temperature and continental runoff. These laws are masking numerous other parameters, implicitly included, such as the role of vegetation and physical erosion. These laws generally overestimate weathering rates in tropical area, because of high local temperature and runoff. It was indeed stressed by Edmond *et al*. and others [4] that chemical weathering in tropical environment might be extremely low due to the development of thick soils undergoing weak physical erosion.

A coupled model of biospheric and weathering processes has been developped to estimate the transfer of elements to the ocean originating from tropical watersheds. The BERNI model is the result of the coupling of LPJ – dynamic global vegetation model [5] with the WITCH model [6] that estimates dissolution/precipitation of minerals in the soil environment from kinetic laboratory laws.

Here we present results obtained for the Orinoco watershed. Output of the coupled model includes major ion concentrations that are compared to available data, and CO_2 consumption through weathering for a tropical environment. We emphasize the need for the development of mechanistic numerical models of weathering processes working at the continental scale.

References

[1] Aumont *et al*. (2001) *GBC* **15**, 393-405.
[2] Burton K.W. *et al.* (2006) EGU General Assem., Vienna
[3] Dessert C. *et al*. (2003) *Chem. Geol.***202**, 257-273.
[4] Edmond *et al*. (1995) *GCA* **59**, 3301-3325; Millot *et al*. (2002), *EPSL* **196**, 83-98.
[5] Sitch S. *et al*. (2003) *Global Change Biology* **9**, 161-185.
[6] Goddéris *et al*. (2006) *GCA* **70**, 1228-1147.

Microbial leaching of iron from magnetite under aerobic and anaerobic environments

YUL ROH[1], JONGMIN OH[1], YONGJAE SUH[2,] AND
HEE DONG JANG[2]

[1]Chonnam National University, Gwangju, South Korea (rohy@chonnam.ac.kr)
[2]Korea Institute of Geoscience and Mineral Resources, Daejeon, South Korea

It is in its infancy to use bacteria as a novel biotechnology for leaching precious and heavy metals from raw materials. The objective of this study was to investigate biogeochemical processes of iron leaching from magnetite reduction by iron-reducing bacteria isolated from intertidal flat sediments, southwestern part of Korea. Microbial leaching experiments were performed using both Aldrich magnetite and magnetite ore, in well-defined media with and without bacteria under aerobic and anaerobic environments. Water soluble Fe production was determined by Inductively Coupled Plasma Spectroscopy (ICP) analysis of bioleached samples in comparison to uninoculated controls, and the resulting precipitated solids were characterized by X-ray diffraction (XRD) and scanning electron microscopy (SEM).

The pH typically decreased from 7.3 to 5.5 during 4-week incubations. The Eh of the initial medium decreased from ~ 40 mV to -550 mV under anaerobic environments upon incubation with the metal reducing microorganisms. Measured pH and Eh are consistent with the thermodynamic stability of ferrous iron formation. The decrease in pH is due to glucose fermentation producing organic acids and CO_2. The extent of iron leaching from magnetite in the aerobic conditions (Fe = 107 ppm) was higher than that in the anaerobic environments (Fe = 94 ppm). In the anaerobic conditions, Fe(III) in the magnetite was also reduced to Fe(II), but no secondary mineral phases were observed. Amorphous iron oxides formed in the medium under aerobic conditions where there was sufficient supply of oxygen from the atmosphere. This study suggests that the reduction processes involve dissolution-precipitation mechanisms as opposed to solid state conversion of magnetite to amorphous iron oxides. The ability of bacteria to leach soluble iron and precipitate amorphous iron oxides from crystalline magnetite could have significant implications for biogeochemical processes in sediments where Fe(III) in magnetite plays an important role in the largest pool of electron acceptor as well as the tool as a novel biotechnology for leaching precious and heavy metals from raw materials.