THEME 4:
The Earth's Surface

Session 4:5
Physical and chemical weathering at local and global scale

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This symposium will focus on past and present physical, chemical and biological processes of weathering, from nano- to global scale. In particular we welcome field, experimental and modelling studies of weathering processes in soil, catchment areas and deltas and the coupling of climate, hydrology, vegetation, lithology, topography and weathering. New elemental and isotopic tracers of past and present weathering rates are especially welcome as well as studies of how chemical fluxes have varied through time as a function of tectonics and climate.

4.5.11

The role of plants in the terrestrial biogeochemical cycle of Si

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Thirty seven years ago, the experiments of Lovering and Angel [1] demonstrated that Si accumulated in plants may be significant enough to affect the weathering processes and soil formation. Today, the evaluation of the role of plants is crucial for modelling the global cycle of Si [2].

The productivity of Si as a function of terrestrial ecosystems is still not well established because published studies on biomass and litterfall including Si data are scarce. The most productive ecosystem is represented by tropical rain forests with an average productivity of 20 t/ha/yr of dry matter. In the amazonian rain forest, Lucas et al. [3] showed that each year, 41 kg/ha/yr of plant-derived Si are injected into soil. The cultivation of Si-rich plants, such as rice or sugarcane, can lead to even more important values. Over 100kg/ha of silica can be recycled each year by sugarcane [4]

Most of the Si in the plants forms opal-A particles called phytoliths. The role of phytoliths and soil silicates as a source of dissolved Si in soil solutions can be estimated using a steady-state approach of the biogeochemical cycle of Si. If the production of phytoliths injected in soil is higher than their dissolution rates, a sink of biogenic silica can be created.

The statement that plants increase the chemical weathering rates by a factor of 2 to 8 has been demonstrated in several watershed studies. Several mechanisms can explain the role of plants in increasing weathering rates: 1) the increase of acidity around roots and below the litter favors the hydrolysis of silicates and the liberation of chemical elements in soils ; 2) the release of silicon from the decomposing organic matter is more rapid than the chemical alteration of soil and parent rock minerals. In order to determine if the dissolved silica has a biogenic (phytoliths) or non-biogenic (soil minerals) origin, new tracers such as the Ge/Si ratios are required.

References

[1] Lovering T.S. and Engel C. (1967) *U.S. Geol. Paper* **594B**, 1-16.

[2] Conley D.J. (2002) *GBC* **16**, 68/1-68/8.

[3] Lucas et al. (1993) *Science* **260**, 521-523.

[4] Berthelsen et al. (1999) *Proc. Aust. Soc. Sugar Cane Tech.* **21**, 92-100.