Global biogeochemical cycle of silicon: New model

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Silicon, as the second abundant element in soil and earth's crust, is geochemically important both in inorganic and organic regimes. Silicate weathering due to tectonic uplifting is great associated with long-term CO_2 consumption and consequently climate change. Rough estimations of global primary production show that Si accounts for ~1.5% molar mass of terrestrial primary production while ~4.5% of marine primary production is contributed by Si. Furthermore, the coupling of Si cycle with other major nutrient cycles of C, N, P, and S can be used as forcings to investigate the role of Si in fields of earth, biology, and ecology sciences.

Thus, a model of the global biogeochemical cycle of Si was developed to explore the incorporation of all these geochemical and biological processes and to quantify the changes of each geochemical reservoirs and fluxes under perturbations. Three domains, terrestrial, coastal ocean, and Open Ocean are established. Terrestrial domain deals with processes occurring on land and freshwater environments, including mineral weathering and other geochemical processes, primary production of land biota (Si:C ratio taken as 0.02, compared to 0.15 for that of marine diatoms), as well as that of freshwater diatom. Open ocean domain contributes ~80% of all marine primary production. Coastal ocean domain is the linkage between those two domains; distinct water chemistry changes and subsequent biological transformations makes it a critical place of global changes.

Sensitivity tests of temperature-dependent perturbations, e.g. weathering and primary production are put forward as of an evaluation of the model's robustness on a timescale of 10000 yrs.

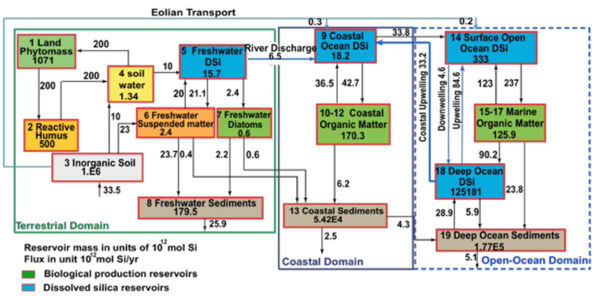

Figure 1: A simplified model of biogeochemical cycle of Si.

Cultivation practices affect heavy metal migration between soil and *Vicia faba*

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Introduction

Pot-test experiments were conducted to study the influences of mulching and fertilizing on the migration of heavy metals from soil to *vicia faba* (broad bean). Semi-transparent film was used to mulch soil. Swine manure compost was mixed with soil at a rate of 50 mg kg^{-1} as fertilizer. Broad bean was grown for several months until fruits were formed. Soils and bean parts were sampled to analyze and fractionate heavy metals.

Results and Discussions

Mulching promoted an obvious growth of broad bean [1]. Fertilizing decreased soil pH and increased SOM content [2]. Mulching reduced the exchangeable metal fractions by 5% to 52%. Fertilizing, in contrast, increased the exchangeable fractions of most of the metals except Fe and Pb by 20% to 295%. While the two cultivations increased obviously metal concentrations in bean laminas as compared to unmulched and unfertilized controls, the levels of most of the metals except Pb decreased in bean fruits.

Calculated bioconcentration factors (BCF) and transfer factors (TF) indicate that the cultivations had little influences on the metal enrichments in roots, but promoted their migration from roots to laminas [3]. In particular, mulching greatly promoted the absorption and translocation of Fe, while fertilizing enhanced the bean fruit uptake of Pb [4, 5].

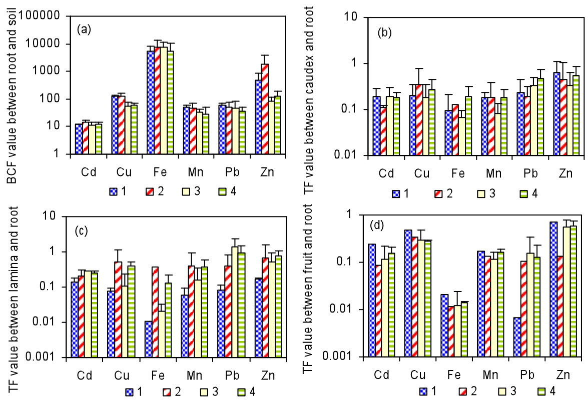

Figure 1: Influence of cultivation practices on BCF and TF of metals *1: no mulching and no fertilizing (control); 2: mulching only; 3: fertilizing only; 4: joint mulching and fertilizing.

[1] Ehlken Kirchner (2002) *Journal of Environmental Radioactivity* **58**, 97–112. [2] Bulluck *et al*. (2002) *Appl. Soil Ecol*. **19**, 147–160. [3] Liaoyan (2003) 197–206. [4] Queirolo *et al*. (2000) *Sci. Total Environ*. **255**, 75–84. [5] Tommasini *et al*. (2000) *Appl. Geochem*. **15**, 891–900.