Modelling the biogeochemical cycle of silicon in soils: Application to a temperate forest ecosystem

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We investigated the biogeochemical cycling of silicon (Si) in an acidic brown soil covered by a coniferous forest (Douglas fir). Based on published and original data, we constructed a conceptual model and used a modified version of the reactive transport code MIN3P for model testing and quantification purposes. The model was first calibrated and further validated with respect to biomass data and Si-concentrations in capillary solutions, which were collected monthly over several years by means of suction-cup lysimeters placed at different soil depths.

The model was calibrated quite accurately (limited to a ten percent concentration error). Mass balance calculations indicate that an average of 60% of the biogeochemical cycle of Si was controlled by biological processes (i.e. Si-uptake and dissolution of phytoliths). Sensitivity analyses suggest that no more than 55% of the Si-cycle is controlled by weathering of primary silicates. Such a large contribution of biological turnover to Si-cycling may be explained by the combined effects of a relatively large Si-content in the litter fall (i.e. specifically in the needles) and high biomass productivity of the coniferous species considered. In addition to potential implications for the global Si cycle, this investigation raises several fundamental questions concerning the nature of Si-uptake mechanisms and physiological use of Si by trees in natural systems.

Ultramafic xenoliths suites from Patagonia extra back-arc, Argentine: Evidences of lithospheric mantle metasomatized by OIB-like melts and subduction related fluids

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Mantle ultramafic xenoliths from Patagonia, Argentine, related to Andes extra back arc tectonic setting, represented by Prahuaniyeu (41°20’09.4”S, 67°54’08.1”W) and Chenque volcanoes (43°38’39.3”S, 68°56’22”W), are the focus of this studies. Prahuaniyeu is sited in the Northern of Somun Curá Plateau and corresponds to pyroclastic events that host the xenoliths in ash cones and small lavas flow. Chenque is located further South of the Somun Curá Plateau, and corresponds to lava flows and Oligocene alkaline basalts that host the ultramafic xenoliths. Prahuaniyeu ultramafic xenoliths are classified as spinel-lherzolites, harzburgites and spinel-websterites, while Chenque xenoliths are spinel-lherzolites, phlogopite-harzburgite, phlogopite-lherzolite and websterites. Xenoliths textures of both volcanos are porfiroclastic and type-I protogranular. Phlogopite in the Chenque xenoliths indicates a hydrated lithospheric mantle underneath that region. Trace elements analyses in both xenolith sets show that the litospheric mantle in the studied areas is depleted compared to primitive mantle, but with LREE enrichment compared to HREE. Spidergram shows that Prahuaniyeu xenoliths (Ce_N/Yb_N=16,14-26,87) are enriched in calchophile elements (W, Pb, Sn, Sb) and in LILE (Ba e Sr). The HFSE (Th, Zr, Hf and Y) are depleted, though Nb and Ta are enriched. Chenque xenoliths (Ce_N/Yb_N = 0,39-15,02) are also enriched in the same calchoplhile elements, but they exhibit Ba depletion and Th extreme depletion. Batch melting modeling for both ultramafic xenoliths suggest they are product of more than 50% of primitive mantle partial melting, which indicates that these lithopheric mantle may be very ancient or several time processed. High Nb/Hf ratios for both xenolith sets suggest metasomatic processes through carbonatitic or OIB-like melt percolation. However, high Pb/Ce ratios suggest that liquids associated to subduction events also played an important role in the metasomatic processes.