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Biogeochemical cycle of silicon in tropical and subtropical regions

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Silicon (Si) is one of the important elements on the earth's surface. The Biogeochemical cycling of Si links and influences the processes of weathering, leaching, plant uptake, and transformation. To better understand the biogeochemical cycle of Si in soil, rock, plant, and water, some studies were done in the critical zone, located tropical and subtropical regions.

Runoff outputs constitute the dominant mechanism of Si depletion in tropical soils. However, the combined effects of dissolved Si (DSi) retention by highly weathered soil and the Si uptake by vegetation attenuate desilication rates in these ecosystems. Tropical soils exhibit limited quantities of weatherable minerals, resulting in soil solution with low concentrations of DSi. Consequently, the primary sources of available Si are atmospheric dust inputs from distant sources and biogenic silica originating from plants. Irrigation, the application of Si fertilizers, crop harvesting, and corresponding Si exports significantly impact soil Si cycling within agroecosystems. Therefore, soil Si cycling in tropical regions is different from that in other climatic zones.

High Si uptake by plant significantly increased the weathering rate. Desilification and resilification coexisted in the subtropical and tropical regions during soil formation. Plant growth was very important to Si cycling, not only increased the primary mineral weathering, but also redistributed Si in the soil profile and enriched Si in the surface soil. Different plants represented soil desilification or resilification according to its ability in cycling Si. Phytolith in the surface horizon of the young soils derived from granite contributed little to stream Si output in the subtropical area, which is much different from tropical soils in which phytolith is a main source of Si in runoff.

Several perspectives are proposed, including the exploration of the processes, fluxes, rates, related factors, and mechanisms associated with Si cycling in tropical and subtropical regions. These comprehensive studies can significantly enhance the understanding of pedogenesis and soil evolution and provide valuable insights for guiding the sustainable management of tropical and subtropical soils.

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