

Silicon isotope fractionation during the formation of amorphous (alumino)silicate phases

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Weathering of silicate minerals and the resulting formation of clay minerals are key processes at the Earth's surface, which regulate for instance the ocean pH, atmospheric carbon dioxide (CO₂) budget, soil development and associated nutrient transfer. One key element in the diverse weathering processes is silicon (Si), which enters the biogeochemical cycle as dissolved silicic acid (Si(OH)₄ or DSi). In the critical zone, however, Si is frequently precipitated as short range ordered hydroxylaluminosilicate (HAS) phases, such as imogolite or allophane. The precise formation paths and the environmental controls on HAS formation, as well as their impact on Si isotope fractionation are not yet well constrained, and needs further investigation. For this purpose, a series of laboratory experiments will be performed at different pH and temperature conditions in order to resolve the reaction kinetics and mechanisms and conditions underlying the formation of amorphous silica and HAS phases. Besides the traditional oxygen (O) and hydrogen (H) isotope analysis, Si isotope fractionation between reactive fluid and solid phases is studied at high temporal resolution using the three-isotope method, which is a unique proxy to trace the direction and the progress of low-temperature water mineral/rock interactions. Understanding the behaviour of Si isotope fractionation under these different environmental conditions will provide further insights to mechanisms of HAS formation.