Direct evidence for the nature and timing of sub-arc mantle metasomatism

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Subduction delivers sediment and hydrated oceanic lithosphere into the convecting mantle. Some of these materials are involved in magma generation and returned to the surface as arc volcanism. The remainder continues into the deeper mantle contributing to long-term heterogeneity that may be later sampled by mantle plumes. In order to understand the global cycling of volatiles in subduction zones it is essential to understand the physical and chemical processes of fluid release and melting. Unique upper mantle samples from Batan Island (Philippines) have incompatible trace element and radiogenic isotope characteristics typical of their host lavas. Here we show that they also preserve extreme U-Th-Ra disequilibria. These do not result from either host magma contamination, steady-state diffusion in the mantle or subsequent crustal level processes. Rather, they provide the first direct evidence that such signatures in arc lavas originate in the mantle and that contributions from both wet sediment melts (between 8 kyr and 10's kyr ago) and aqueous fluids ($\ll 8$ kyr) were separately delivered from the slab. The samples also us to estimate the amounts of water (≥ 625 ppm) that may be returned to the asthenosphere, perhaps to be stored at the seismic transition zone.

Life as the catalyst of mineral weathering in acidic forest ecosystem

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In our temperate regions, forests ecosystems developed on acidic soils are characterized by a low nutrient-content and an absence of fertilization. In this context, the life (plant, fungi, bacteria) is strongly dependent on the nutrients input coming from soil mineral weathering and atmospheric deposits. However, what do we know about the relative contribution of biotic and abiotic reactions on the mineral weathering process? What is the stability of soil mineral in time? Are there mineral weathering hot spots into the soil? Who are the actors involved in mineral weathering? Our present knowledge highlights that mineral dissolution is increased in the upper soil horizons where life is intense and the organic matter mineralised. Preliminary analyses also show that a large proportion of fine-size minerals evolves during the seasons in relation with the environmental conditions. Notably, the soil under the influence of the tree root systems (ie rhizosphere) appears as an important mineral weathering hot spot due to intense biological activities (root and associated microbes), which take place in. Despite its small size (ca. 1% of soil), it contributes up to half of the weathering flux. Recent results showed an enrichment of efficient mineral weathering bacteria in the rhizosphere, suggesting a functional complementation between the trees and their associated microbes. Future challenges will be to identify the abiotic and biotic parameters impacting weathering reactions, and to develop models integrating life. Multidisciplinary approaches combining isotopic and genetic tools as well as biogeochemistry and ecology are needed.