How both reactive bedrock accessory minerals and vegetation affect the behaviour of REE, U and Th during silicate weathering : Mule Hole watershed, South India

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REE, U and Th are often found as major elements in the same accessory minerals and secondary phases, both at whole rock and regolith scale. The importance of these phases on biogeochemical budgets is often ignored because of their relatively low abundance of ≤2% by volume. The mobilization, redistribution and fractionation of REE, U and Th during weathering processes have been investigated in the heterogeneous parent gneiss and soils of the Mule Hole small experimental watershed, South India.

The REE-U-Th mineralogy has been studied by coupling SEM-EDX, EPMA and LA-ICPMS analyses. The elemental concentrations have been measured by ICPMS in rocks, regolith, plants and water reservoirs (rainfall, throughfall, overland flow water, pore water, groundwater, stream water). Leaching experiments have been carried out on both fresh gneiss and soil samples to ascertain the kinetics of the elemental sources.

For REE-U-Th, monazite, allanite, baestnesite, xenotime are major bearing minerals and apatite and titanite are minor phases. Low temperature hydrothermal processes have a strong influence on the replacement of monazite and allanite in the fresh rock. Monazite and xenotime, identified in the stream sediments, are more resistant to weathering. Allanite, baesnesite, apatite and titanite are completely broken down in the early stages of weathering. Brockite and thorite have been were identified as secondary weathering phases of monazite. The initial mineralogical distribution in bed rock has a significant incidence of the REE, Th and U mobility at the watershed scale.

Hydrological model-based approach permits to estimate the elemental fluxes cycled through the vegetation and regolith of REE, U and Th. Vegetation has a significant effect on the tranfer of easily available REE in soils.