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Rare-earth elements enrichment of Pacific seafloor sediments: the view from volcanic islands of Polynesia

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Rare-earth elements (REEs) are key metals for «green» technologies such as energy saving lamps or permanent magnets used in, e.g., wind turbines, hard disk drives, portable phone or electric or hybrid vehicles. Since several years, world demand for these metals is therefore drastically increasing. The quasi-monopolistic position of China, which produces around 95 % of global REEs production, generates risks for the industries that depend on a secure supply of REEs. In response, countries are developing and diversifying their supply sources, with new mining projects located outside China and efforts in the area of REEs recycling.
Most of these projects focus on deposits related to carbonatites and alkaline-peralkaline magmatism, which are generally enriched in light REEs (LREEs) compared to the heavy REEs (HREEs)-enriched deposits of the ion-adsorption types, located in southern China. However, a recent study revealed new valuable resources corresponding to seafloor sediments located in the south-eastern and north-central Pacific. The deep-sea mud described by these authors show a higher HREE/LREE ratio than ion-adsorption deposits, a feature which significantly increases their economic interest. The authors suggest mid-ocean ridge hydrothermal activity as an explanation to this anomalous enrichment.
However, several contributions have documented considerable REEs enrichment in basalts and peridotitic xenoliths from French Polynesia. Several arguments have been exposed in favour of a supergene origin, with a short migration, suggesting that REEs were collected from weathered basalts. The Tahaa volcanic island (Sous-le-Vent Island, Society Archipelago, French Polynesia) is the first location where such enrichment has been described. New petrographic and mineralogical investigations confirm a supergene mobilization of this abnormal occurrence. REE-bearing minerals (mainly phosphates of the rhabdophane group) are primarily located within basalt vesicles but also in crack that cross-cut the calcite filling the vesicles or the volcanic glass. They are also closely associated with Ni-Mg bearing phyllosilicates, which appear to nucleate from alteration of olivine and clinopyroxenes. Further investigations are done to evidence and confirm an anterior magmatic enrichment.
On the basis of these observations, we believe that the anomalous enrichment observed in seafloor sediments could derive from abnormally-rich provinces corresponding to aerial basaltic formations from oceanic islands primarily enriched during weathering processes (Melleton et al., 2014).

Melleton et al. (2014). Rare-earth elements enrichment of Pacific sea-floor sediments: the view from volcanic islands of Polynesia. In preparation.