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Geochemistry of REY carriers within REY-rich muds in the Pacific Ocean

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Deep-sea sediments containing greater amount of rare-earth elements and yttrium (REY), called REY-rich muds, have received much attention as a new resource of REY because of their great economic potential exceeding the world's current reserves on land [1]. However, geochemistry responsible for such a huge accumulation of REY into the deep-sea sediments is still ambiguous. In this study, we extensively performed speciation of multiple elements including REY, Fe, and P in the REY-rich muds to clarify the carriers of REY and their associated geochemical processes during the formation of REY-rich muds.

Samples are collected from the two regions of the Pacific Ocean, the eastern South Pacific and the central North Pacific, where the significant variations in hydrothermal influences are observed. Our XAFS analyses revealed that REY is commonly hosted by apatite in the two Pacific regions. In the eastern South Pacific, a strongly hydrothermally-affected region, the formation of REY-rich mud is geographically coincident with the occurrence of apatite, which seems to be authigenically formed below CCD derived from phosphate ion adsorbed on hydrothermal Fe-Mn (oxyhydr)oxides. Although hydrothermal activity has been considered as an important marine process controlling the REY accumulation into the sediments, our results also indicate its potential role in the formation of apatite. In contrast, biogenic apatite such as fish debris seems to be important in the central North Pacific with less hydrothermal influences, as shown in the REY-rich muds in other regions [2]. A series of our findings indicate that apatite is of specific importance as the eventual host of REY for the widespread formation of the REY-rich muds, and various geochemical processes account for the origin of apatite and its accumulation of REY [3].

[1] Kato et al. (2011), *Nat.Geosci.* **4**, 535-539. [2] Yasukawa et al., (2014), *J. Asian Earth Sci.* **93**, 25-36. [3] Kashiwabara et al. (2018), *Geochim Cosmochim Acta*, **240**, 274-292.