

## Synchrotron X-ray perspective on formation mechanism of REY-rich mud in the eastern South Pacific

TERUHIKO KASHIWABARA<sup>1</sup>, RYUICHI TODA<sup>2</sup>,  
KENTARO NAKAMURA<sup>2</sup>, KAZUTAKA YASUKAWA<sup>2</sup>,  
KOICHIRO FUJINAGA<sup>2</sup>, TATSUO NOZAKI<sup>1</sup>,  
YOSHIO TAKAHASHI<sup>2</sup>, KATSUHIKO SUZUKI<sup>1</sup> AND  
YASUHIRO KATO<sup>2</sup>

<sup>1</sup>Japan Agency for Marine-Earth Science and Technology  
(JAMSTEC), teruhiko-kashiwa@jamstec.go.jp

<sup>2</sup>The University of Tokyo

The REY-rich mud is the deep-sea sediments containing greater amount of rare-earth elements and yttrium (REY) than normal pelagic sediments [1]. They have received much attention as potential new resources of REY because their  $\Sigma$  REY contents are even higher than the ion-absorption-type deposits on land. However, geochemistry responsible for such a huge accumulation of REY into the deep-sea sediments is still ambiguous. The present study aims to provide better understanding of the formation mechanism of the REY-rich mud based on the molecular-scale insights obtained by synchrotron X-ray analyses.

We performed speciation of several elements including REY, Fe, and P in the sediments collected from the eastern South Pacific during several DSDP expeditions. They are an ideal suite of samples to track the transition from hydrothermal sediments to the REY-rich mud along the spreading of the EPR. Our XAFS and  $\mu$ -XRF analyses for REY revealed that the host phase of REY is apatite, in spite of the presence of abundant hydrothermal Fe-Mn oxyhydroxides [2]. On the other hand, the behavior of P seems to be strongly controlled by hydrothermal Fe (oxyhydr)oxides, and apatite occurs as main P species coincident with the absence of  $\text{CaCO}_3$  below CCD based on (i) XANES analyses of Fe and P and (ii) MAR (mass accumulation rate) correlations. Previous model for the formation of the REY-rich mud suggested the relationship with the mid-ocean ridge hydrothermal activity producing Fe-oxyhydroxide particulates and biogenous activity entraining carbonate/silica materials [1]. Our findings indicate that the geochemistry of apatite should also be considered as another factor. In addition, potential roles of carbonate dissolution below CCD and preconcentration of P on hydrothermal Fe-oxyhydroxide precipitates are implied for the formation of apatite in the REY-rich mud in the eastern South Pacific.

[1] Kato et al. (2011), *Nat.Geosci.* **4**, 535-539. [2] Kashiwabara et al. (2014), *Chem. Lett.* **43**, 199-200.