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REY-rich mud: An overview from scientific and engineering perspectives

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The potential of deep-sea “REY-rich mud” in the Pacific Ocean as a novel source for rare-earth elements and yttrium (REY) was reported in 2011 [1]. The mud has multiple advantages as a mineral resource: enormous resource potential, very low contents of radioactive elements, ease of leaching/refining, etc. Subsequently, we discovered the REY-rich mud containing >5,000 ppm total REY at shallow depth (2 to 4 meters) below the seafloor in the Japanese exclusive economic zone (EEZ) around Minamitorishima Island that is located ~1,900 km southeast of Tokyo [2].

Since the discovery of the “extremely REY-rich mud”, we have conducted a variety of investigations from both scientific and engineering perspectives, towards the development of the new and highly promising REY resource in the near future. We successfully visualized the spatial distribution of REY-rich mud in the Minamitorishima EEZ recently [3]. We also demonstrated that the REY-rich mud contains a huge amount of Sc as well as REY, whose demand in energy and environmental fields will significantly grow over the next few decades [4]. In addition, together with a number of Japanese private-sector companies, we are addressing the technical challenges for developing the deep-sea REY-rich mud deposit, including lifting of the mud from deep-sea floor of >5,000 m water depth, and efficient beneficiation techniques of minerals hosting REY [3], which are critical for the economic feasibility of the resource development.

Here we report a general overview of our latest researches to quantify the resource potential of REY-rich mud in the Minamitorishima EEZ, together with a realistic framework of the development system for the REY-rich mud deposit.

[1] Kato, Y. et al. (2011) *Nat. Geosci.* **4**, 535–539.

[2] Iijima, K. et al. (2016) *Geochem. J.* **50**, 557–573.

[3] Takaya, Y. et al. (2018) *Sci. Rep.* **8**, 5763.

[4] Yasukawa, K. et al. (2018) *Ore Geol. Rev.* **102**, 260–267.