Press Releases

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JAMSTEC
The University of Tokyo
Chiba Institute of Technology

Dense Field of Ferromanganese Nodules Found in Japanese Exclusive Economic Zone around Minamitorishima Island

- Clue to comprehensive understanding of genesis of oxide mineral resources -

Overview

A research group led by the Japan Agency for Marine-Earth Science and Technology (JAMSTEC: Asahiko Taira, President), The university of Tokyo (Makoto Gonokami, President) and Chiba Institute of Technology (Kazuhito Komiya, President) found a dense field of ferromanganese nodules[*1] (figure 1) at a depth of 5,500 m- 5,800 m on seafloor from southern to eastern part of the Japanese Exclusive Economic Zone (EEZ) around Minamitorishima Island (figure 2) during research cruises in May-June 2010 and April 2016. It is the largest scale ever identified in the zone, while a smaller scale of distribution with cobalt-rich ferromanganese crusts[*2] has already been known to exist on the slope of seamounts.

It is also noted that a multi-narrow beam echo sounder system played a significant role in detecting these ferromanganese nodules in the area. After the cruise in 2010, a high-intensity reflection by the system confirmed existence of ferromanganese nodules during dives by a submersible by *Shinkai 6500*, followed by identification of the expanse of dense fields of the ferromanganese nodules (Figure 3) in 2016. It demonstrated that the multi-narrow beam echo sounder system is an effective and less costly method in grasping the distribution of ferromanganese nodules.

Moreover, it became clear that 1) chemical composition of these ferromanganese nodules in Minamitorishima is common with that of ferromanganese crusts, containing metals of economic interest such as cobalt, nickel, copper and molybdenum and 2) the area of distribution of the ferromanganese nodules overlaps extensively with that of REY-rich mud[*3]. While the genesis of ferromanganese nodules, ferromanganese crusts and REY-rich mud has been usually discussed separately, it suggests that ferromanganese nodules could be a clue to understand them in a comprehensive manner. Collected samples will be further analyzed to elucidate genesis of these three types of oxide mineral resources around Japan.

The above results were published in *Geochemical Journal* issued by the Geochemical Society of Japan on August 26, 2016 (JST).

Title: Geology and geochemistry of ferromanganese nodules in the Japanese Exclusive Economic Zone around Minamitorishima Island
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Title: Acoustic characterization of pelagic sediments using sub-bottom profiler data: Implications for the distribution of REY-rich mud in the Minamitorishima EEZ, western Pacific

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*1 Ferromanganese (Fe-Mn) nodules
Ferromanganese nodules are formed by ion exchange reactions that precipitate ore components from seawater or pore water of sediments.

*2 Ferromanganese (Fe-Mn) crusts
Similar to manganese nodules, they're metallic layers of iron and manganese hydroxide on the flanks of submarine volcanoes. Reflecting its significant value as mineral resources containing rich cobalt sources, they are often referred to as cobalt-rich crusts.

*3 REY-rich mud
REY-rich mud is pelagic sediment containing high concentrations of rare earth elements and yttrium (REY). It is mainly composed of fish debris such as fish bone and tooth, iron oxide and manganese oxide.

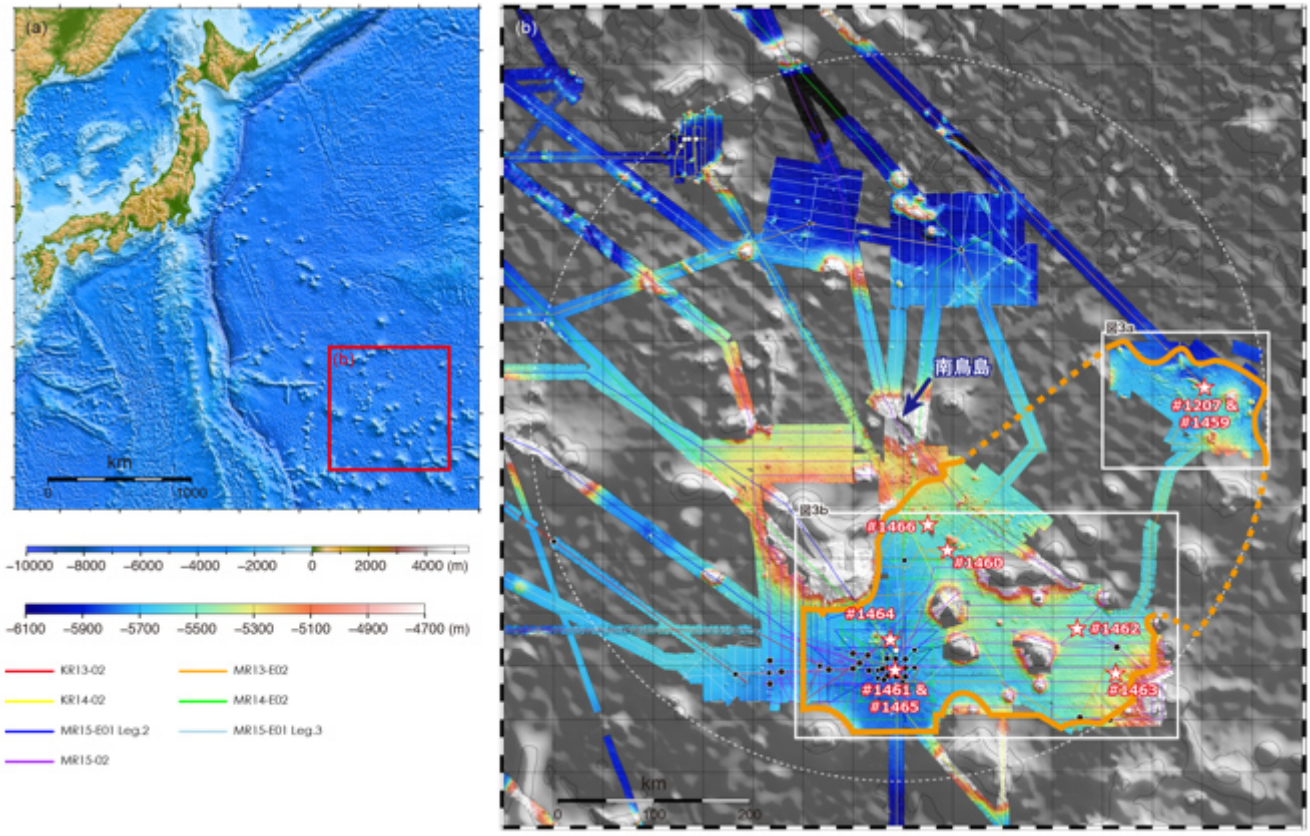

Figure 1. a) Location of Minamitorishima Island. b) Seafloor topography around Minamitorishima Island in the Japanese EEZ.
The stars show sites where research by *Shinkai 6500* was carried out (dives in 2016 are shown in 4-digit numbers, while the dive 1207 was done in 2010.)
The orange outlined area indicates areas where Fe-Mn nodules were discovered in 2010 and 2016. The EEZ is indicated in the white dotted line.

Figure 2. A dense field of Fe-Mn nodules covering seabed.
(The photo was taken in 2016.)

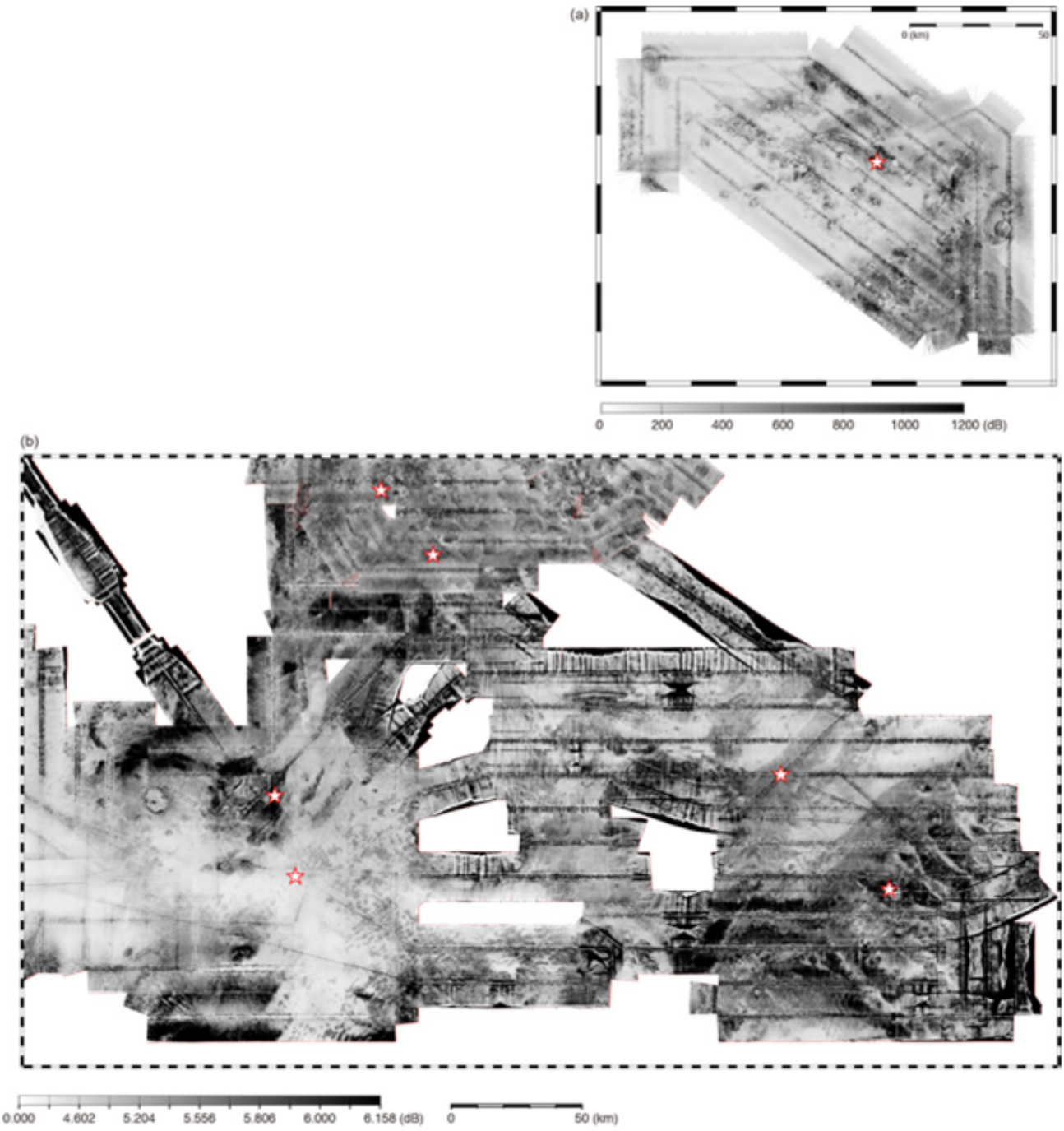

Figure 3. Distribution of acoustic reflectivity of seafloor: a) eastern part and b) southern and southeastern part of the Japanese EEZ around Minamitorishima Island. The red stars indicate dive sites in 2010 and 2016.

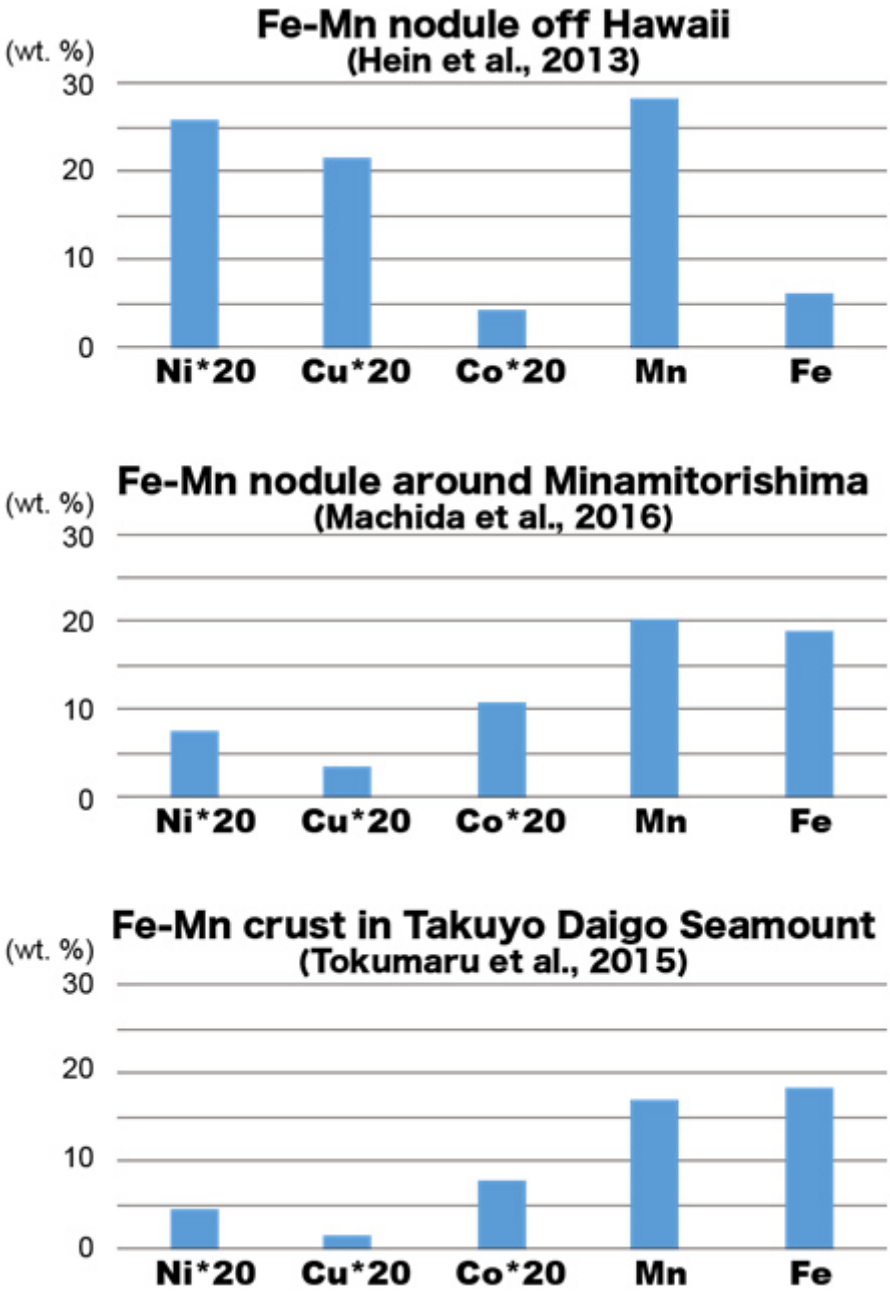

Figure 4. Comparison of compositions of Fe-Mn nodules in EEZ, Minamitorishima Island, Fe-Mn nodules in the coast off Hawaii, and Fe-Mn crust in Takuyo Daigo Seamount.
For the purpose of comparison with data of manganese (Mn) and iron (Fe), the concentrations of nickel (Ni), copper (Cu) and cobalt (Co) are multiplied their actual compositions by 20.

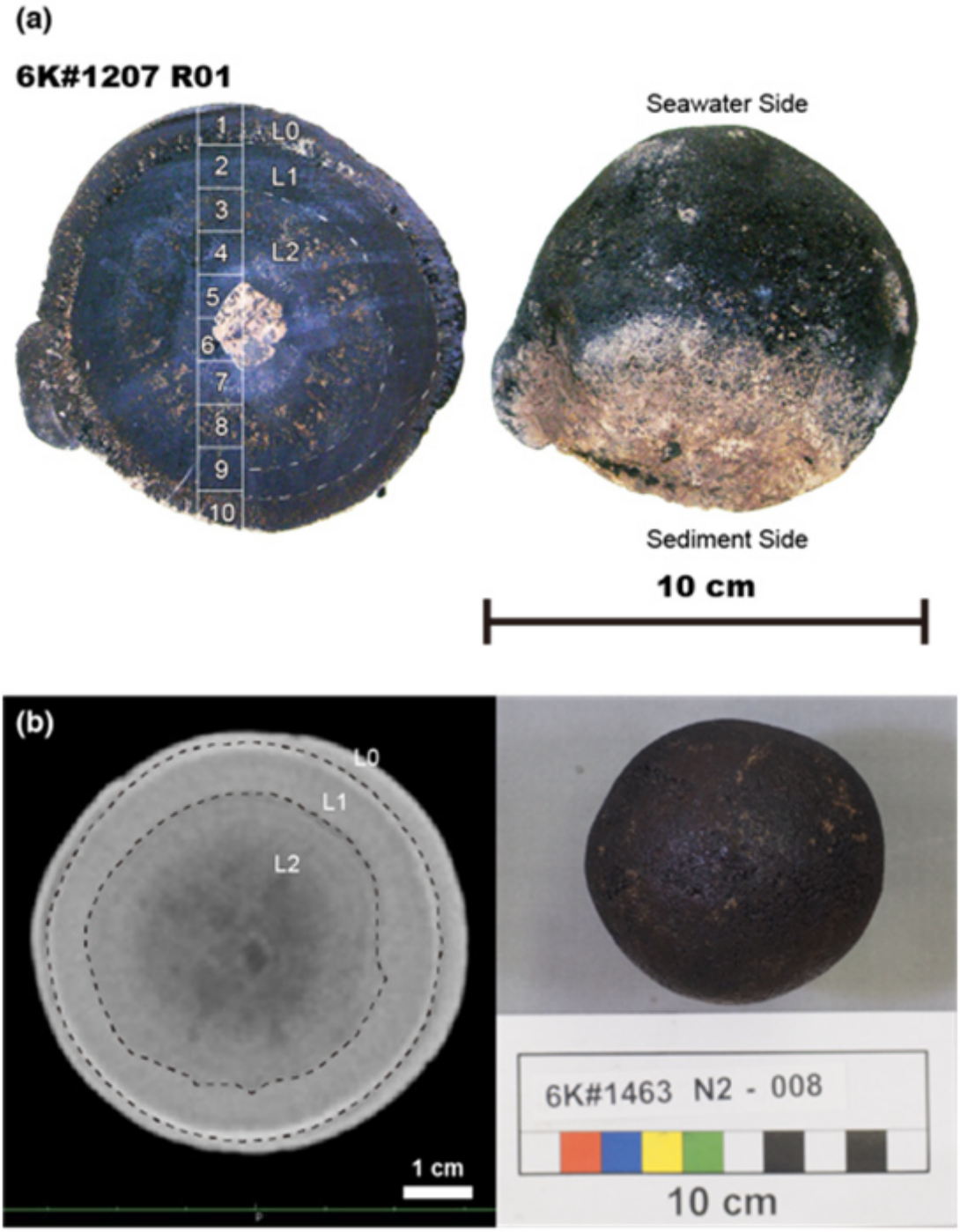

Figure 5. a) Vertical cross section of Fe-Mn nodule samples collected in 2010. (b) The left shows a cross section surface (determined by X-ray CT) of the right samples collected in 2016. L0, L1, and L2 indicate layers of different compositions in the nodules as defined by Machida et al (2016).

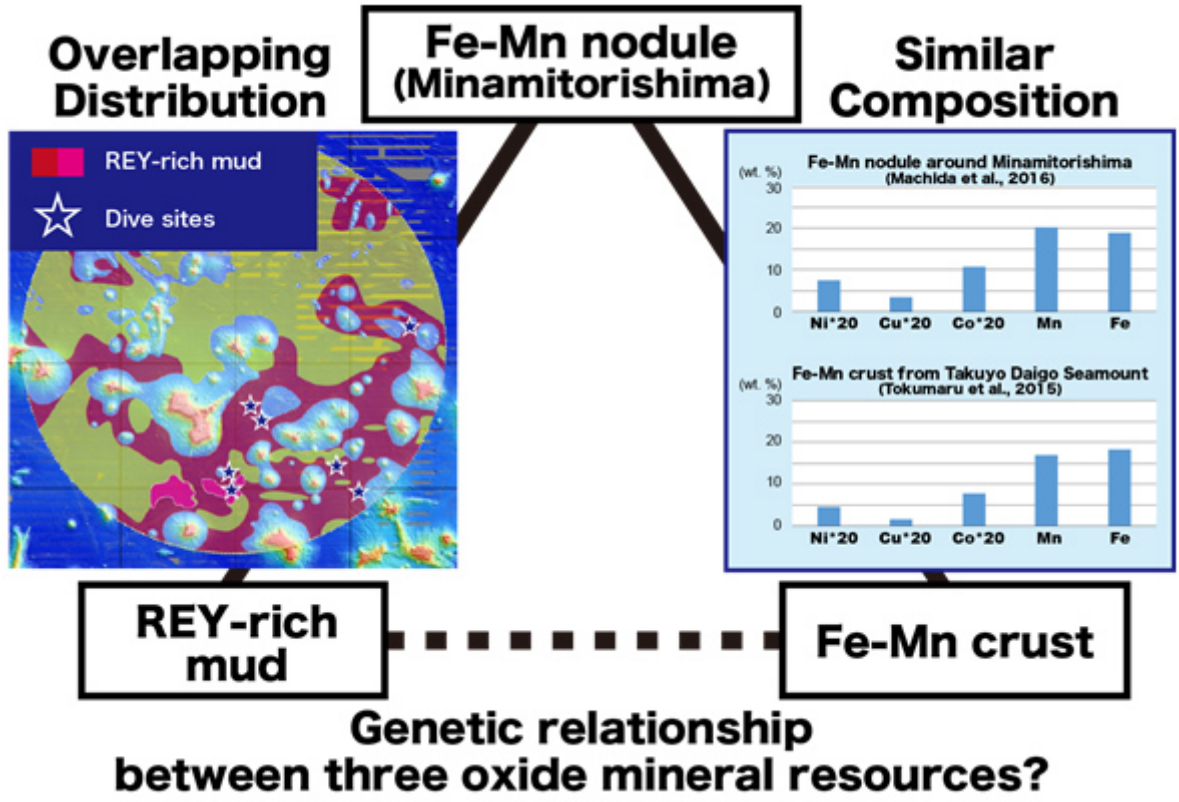

Figure 6. Illustrations of genetic relationship among three oxide mineral resources inferred from these study results.

Dense Field of Ferromanganese Nodules Found in Japanese Exclusive Economic Zone around Minamitorishima Island (Video)

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