The first report of the evidence for hydrothermal activity in old oceanic plate

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A petit-spot monogenic volcano erupted on flexural part of lithosphere are reported from the world ocean [1]. Many of studies about petrology, geochemistry and geochronology of petit-spot volcanos had been done to understand their origin and nature of the asthenosphere. However, there has not been any studies about hydrothermal activity because nobody has ever observed in-situ eruption of petit-spot volcanos. As petit-spot volcanic activity ubiquitously occurs in the world ocean despite its small volume, the hydrothermal activity in petit-spot volcanos must be an important process for metal flux from seafloor to ocean.

During the cruise KS-18-9 of *R/V Shinsei-maru* in August 2018, we collected some ferromanganese oxides by dredge in offshore of Fukushima prefecture where simultaneously corrected basalts show youngest eruption in previously reported petit-spot volcanoes of NW Pacific (i.e. very few alteration of glass). The metal luster and massive texture of the ferromanganese oxides are typical features of hydrothermal origin. Hence, we defined geochemical and mineralogical features of the ferromanganese oxides using (μ)XRF, ICP-MS and XRD.

Based on the ternary plot of (Ce + Y + Zr) vs. (Ni + Cu) vs. (Mn + Fe), all samples are plotted into the area of hydrothermal origin[2]. REE patterns show negative Ce anomaly and low REE content which are character of hydrothermal origin[3] besides low La/Lu ratio as low temperature hydrothermal deposits rather than high temperature (~ 350 ℃) hydrothermal deposits. The samples contain 7 Åmanganate (birnessite), quartz, plagioclase and smectite. 7 Åmanganate indicates low temperature hydrothermal activity[4] as well. As the petit-spot volcanic activity is unique heat source for hydrothermal activity at the old oceanic plate (approximately 130 Ma). Otherwise, the hydrogenetic rim of some samples which are characterized by vernadite and enrichment of Cu and Ni implies cessation of the hydrothermal activity.

This is the first report of the presence of hydrothermal activity on an old oceanic plate in NW Pacific. The hydrothermal activity possibly occurred on the foot of petit-spot knolls because hydrothermal vents and mounds, and ferromanganese samples showing sign of hydrothermal have never been found during dives of submersible *SHINKAI 6500*[5], which explore along the slope of the knoll. Petit-spot volcanoes must be more simple hydrothermal system than others because of simple heat supply from a monogenetic eruption. Hence, it is the most suitable example to understand a complete process of single hydrothermal circulation. Detailed investigations by submersible *SHINKAI 6500* are highly required to define the hydrothermal system and the metal flux from petit-spot to ocean in the future.

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