Understanding the Heterogenic Magnetic Properties of Serpentinized Peridotites: Indication of Serpentinization Processes?

*Xiangyu Zhao[1], Masakazu Fujii[1,4], Hirokuni Oda[2], Xiang Zhao[3], Rei Kanemaru[4]

1. National Institute of Polar Research, Japan, 2. Geological Survey of Japan, AIST (National Institute of Advanced Industrial Science and Technology), 3. Research School of Earth Sciences, Australian National University, 4. Department of Polar Science, School of Multidisciplinary Science, The Graduate University for Advanced Studies (SOKENDAI)

Serpentinization of peridotites is widespread on the seafloor with slow-spreading environments. It has been extensively investigated as the process significantly changes the physical properties of the oceanic lithosphere. As serpentinization processes are often associated with production of magnetite, magnetic properties can provide valuable insights for better understanding the processes. Magnetic susceptibility and saturation magnetization have been used as indicators of the degree of serpentinization. Nevertheless, the quantitative relationship between the magnetite abundance and degree of serpentinization remains poorly constrained. For example, though nonlinear relationship is often observed for natural serpentinized peridotite, it varies from site to site with great scatters (e.g., Oufi et al., 2002; Fujii et al., 2016). Furthermore, laboratory experiments by Malvoisin et al. (2012) shows that magnetite abundance grows linearly as serpentinization advances, which is different from the trend observed from natural samples. To better understand the relationship between magnetic properties and serpentinization processes, we performed comprehensive magnetic studies on serpentinized peridotites with a variety of serpentinization degree that were collected from the Yokoniwa Rise in the Central Indian Ridge. As with previous studies, these samples show a wide range of variability in magnetic properties. By relating the magnetite abundance with the density of bulk sample, we show that the quantitative relationship between magnetite abundance and serpentinization degree may sensitively depend on the reaction pathway of serpentinization. Moreover, we found that the domain states of magnetite, which affects the oceanic magnetic anomaly, also varies in a wide range, even for samples with similar serpentinization degrees, indicating that a definitive correlation between the domain state and serpentinization degree may not exist. Microscopic magnetic mapping and scanning electron microscopy imaging are exploited to understand the driving factor(s) that might determine domain states. In summary, we suggest that the quantitative relationship between the abundance of magnetite and serpentinization degree is likely dependent on the degree and pathway of serpentinization. But the domain state of magnetic minerals in the serpentinized peridotites is probably independent of serpentinization degree.

Keywords: serpentinization of seafloor, rock magnetism, microscopic mapping

