Identification of oxide layer structures of ferromanganese nodules in the Minamitorishima EEZ using X-ray CT

*Ryo Shimomura[1], Kentaro Nakamura[1], Shiki Machida[2,3], Kazutaka Yasukawa[1,2], Koichiro Fujinaga[2,1], Yasuhiro Kato[1,2,3]

1. Department of Systems Innovation, School of Engeneering, The University of Tokyo, 2. ORCeNG, Chiba Institute of Technology, 3. JAMSTEC

In recent years, it has been discovered that ferromanganese nodules are densely distributed from the south to the east of the Japanese Exclusive Economic Zone (EEZ) around Minamitorishima [1]. Ferromanganese nodules in the Minamitorishima EEZ contain Co at the maximum of 0.65% and Ni at the maximum of 0.8% [2] and thus, expected as a future resource for the critical metals. To focus on the promising areas for the future development of the nodules, it is necessary to elucidate their origin. The internal structure of ferromanganese nodules is one of the most important keys to understanding the origin and growth history of the nodules.

In this study, we conducted X-ray CT analysis of the nodules from the Minamitorishima EEZ to nondestructively identify the internal structures of the nodules. As a result of the analysis, it was defined that the oxide layers of the nodules can be classified into 5 layers on the basis of the difference in X-ray absorption rate. We also found that the X-ray absorption rate corresponds to both the growth texture and chemical composition of the oxide layers. Moreover, several peaks were observed in the histograms of the total oxide layer thickness, and these peaks corresponded to number of oxide layers. This suggests that formations of ferromanganese nodules occur intensively during certain periods when each oxide layer starts growing.

References
[1] JAMSTEC (2016) press release, August 26, 2016.
[2] Machida et al. (2016) Geochemical Journal, 50, 539–555.

Keywords: ferromanganese nodules, X-ray CT analysis, Minamitorishima EEZ