Comprehensive geochemical analyses of feromanganese (Fe-Mn) nodule reference materials, JMn-1, Nod-P-1 and Nod-A-1

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Chemical compositions of natural samples are the most basic data, being prerequisites for understanding their formation mechanism. Investigations of the Fe-Mn nodules and crusts have been highlighted as an estimation of an economic potential for rare metal resources, as recorders of the paleo-oceanographic and –climatic history and, as the role which the global complement of the Fe-Mn crusts and nodules have played in the chemical balance in the oceans [e.g. 1]. The satandard reference materials of the Fe-Mn nodules, JMn-1(Geological Survey of Japan), Nod-P-1 and Nod-A-1(US Geological Survey), are commercially available, however, it has tended to pay little attention to their geochemical data so far in spite of lots of published data of unknown Fe-Mn oxyhydroxide samples with relatively similar matrix. Thus, there is little reliable criterion of the comprehensive geochemical compositions of these reference materials, which indicats that it is difficult to evaluate the accuracy of analytical methods and of their geochemical compositions of unknown Fe-Mn oxyhydroxide samples. Furthermore, in order to investigate temporal, geochemical and paleoceanographic evolution of the Fe-Mn crusts, they were sliced vertically into several mm-wide slabs from its outer surface to substrate rocks, and subsequent analyses of textural and compositional characteristics [e.g. 2, 3]. As a result of the slicing slab samples, a renewed analytical protocol which is suitable for the small amounts of samples (<1 g) must be required to determine the comprehensive geochemical features of their major, trace and isotopic compositions. Here, we would like to report trace element concentrations for the Fe-Mn nodule reference materials, JMn-1, Nod-P-1 and Nod-A-1 by using a quadrupole type inductively coupled plasma mass spectrometry (ICP-QMS), and to also present their Sr, Nd and Pb isotopic compositions with sequential Sr, Nd and Pb separation chemistry from the remaining aliquots of their sample solutions for trace element analyses by the ICP-QMS.

[1] Hein et al. (2013) *Ore Geol. Rev.* **51**, 1-14. [2] Hein et al. (1992) *Paleoceanography* **7**, 63-77. [3] Usui et al. (2007) *Island Arc* **16**, 420-430.