Relationship between tellurium in the Fe-Mn oxides in the ocean and ambient seawater

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Marine ferromanganese crusts (Fe-Mn crusts) are Fe-Mn oxides widely distributed on the seafloor, and important materials for (paleo)oceanographic studies (e.g. Hein et al., 2014). Tellurium (Te) is one of the highly enriched elements in the Fe-Mn crusts by more than ten thousand times relative to that in the continental crusts (Hein et al., 2010). Variation of concentration and isotopic compositions of Te in the Fe-Mn crusts could be a potential indicator for changes in redox condition of seawater, because of two valences of Te in ocean environments (+4 and +6; Lee and Edmond, 1985). In this study, we performed the measurement for concentration and isotopic compositions of Te in the surface layer of the Fe-Mn crusts, which was in contact with ambient seawater. The results were compared with the depth profile of the dissolved oxygen in the sampling site. To investigate the relationship to ambient seawater, the Fe-Mn crusts were sampled from two seamounts located in the Northwest Pacific, which showed different dissolved oxygen profile, and analyzed for Te concentration and isotopic compositions of the surface layer.

The results show that the correlation between the Te concentration and isotopic compositions in the surface layer of the Fe-Mn crusts changes depending on water depths. With increasing depths, the Te concentration decreases more drastically at shallower water depths than at deeper water depths. Moreover, the surface samples from two seamounts show a difference in the water depths where the concentration gradient of Te in the Fe-Mn crusts changes. The changes in the concentration gradient of Te in the Fe-Mn crusts may correspond to the changes in the chemical state of Mn in conjunction with the changes in the dissolved oxygen concentration in ambient seawater. Therefore, the Te concentration in the Fe-Mn oxides potentially indicates the dissolved oxygen concentration in the marine environment. The Fe oxides and Mn oxides are observed on the surface of the Mars by recent observation of exploration vehicles (e.g. Lanza et al., 2016), and the trace elements in these oxides potentially provide the information of water environments when they are formed. In the presentation, the results of the measurement of Te in natural samples, and laboratory experiment for application to Fe-Mn oxides on Mars will be discussed.

Keywords: tellurium, Fe-Mn oxides, ocean environment, Fe-Mn crusts, stable isotope

