No. 2012

Development of High-Speed Ion Exchange Reaction Field Using Swelling Phenomenon in Clay Interlayer - For Practicable Separation Method of Rare Earth Elements from Deep-Sea Mud -

Yu Tachibana[a] and Masanobu Nogami[b]

[a]Department of Nuclear System Safety Engineering, Graduate School of Engineering, Nagaoka University of Technology
[b]Department of Electric and Electronic Engineering, Kindai University

Summary

In recent years, it has become clear that the pelitic sediments around Minamitorishima contain highly concentrated rare-earth elements (REEs). The pelitic sediments are called rare-earth rich mud and it may be a very attractive marine mineral resource for Japan, which is one of countries with few natural resources. However, we still have the following questions which should be solved.

Question (1): The distribution of rare-earth rich mud on the deep seabed is not clear.
Question (2): The technologies collecting and lifting the rare-earth rich mud from the deep seabed at a depth of 4,000 to 6,000 m have not been developed.
Question (3): It is difficult to predict the range of adverse environmental impacts caused by marine resource development.

We have challenged the development of basic technology to elute immediately REEs from the rare-earth rich mud after collecting and lifting the rare-earth rich mud from the deep seabed. This technology is based on the high-speed ion exchange reaction of REEs on the rare-earth rich mud using ozone and suitable cations and it contributes actively to solutions in Question (3). Therefore, the adsorption-desorption behavior of REEs on tricalcium phosphate which is a main constituent of mud has been examined in order to clear the elution promoting effect achieved by the combination of ozone and cation in this study.

The effect of ozone on tricalcium phosphate was examined in an aqueous solution. As a result, it was found that tricalcium phosphate can exist stably in a solid state. In addition, as a result of examining the influence of adding ozone into an aqueous solution containing REEs, it was found that ozone converts rare earth metals and divalent REEs into trivalent REEs. Moreover, the cation exchange reactions between REEs on the mud and alkaline earth metal ions in an aqueous solution were confirmed. This phenomenon indicates that the acetic acid complex of REEs can exist very stably in an aqueous solution, further improving the elution of REEs from tricalcium phosphate.

Based on the above results, the separation of REEs from simulated rare earth rich mud was carried out using the combinational method of ozone and calcium chloride. Predictably, the improvement in elution rate of REEs was clearly confirmed.