

## **Application of micro-PIXE to quantitative analysis of heavy elements sorbed on minerals**

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The micro-proton-induced X-ray emission (micro-PIXE) analyzing system in JAERI is a powerful tool to investigate sorption behavior of elements onto mixtures of powder-like minerals because of the high spatial resolution of less than 1 $\mu$ m. However, the related studies in JAERI have been carried out in qualitative fashion, because quantification of minerals and the sorbed elements would be strongly influenced by mineralogical features such as shape and size of minerals and location of elements in minerals. In this study, we examined applicability of micro-PIXE analysis to quantitative evaluation of the heavy elements sorbed on minerals of uniform shape and size.

For preparation of external standards, fine powders of natural montmorillonite and synthetic apatite were contacted with solutions containing Cd, Ba, and Eu. After the contact, those minerals were washed with ethanol repeatedly. The elemental analysis by micro-PIXE was carried out for the heavy element-sorbing minerals spread on carbon plates. Three detectors for EDS with different performances in energy were employed simultaneously. The concentration of heavy element in solution was determined by ICP-AES.

Above detection limits of those heavy elements, some linear relationships were found between the following two parameters: (a) the concentration of the accumulated heavy element in the minerals, and (b) the ratio of the net counts of the peak area in EDS spectra between the heavy element and the major matrix cations in the minerals, such as Si for montmorillonite and Ca for apatite. However, the linearity differed between the detectors and varied with the concentration of the sorbed heavy elements in the minerals. These results indicate that the method using external standards is available to quantitative evaluation though its applicability may be limited.