

## Ce(IV) species formed during weathering processes in granite and soil strata

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### Variation of Ce(IV)/Ce(III) ratio in a soil strata [1]

Chemical-states of trace elements in natural solid materials have not been applied very much to elucidate geochemical implications compared with wide applications of abundances and isotope ratios of trace elements. This is due to high detection limits of appropriate physico-chemical methods employed for the speciation of trace elements in rocks. Fluorescence XAFS especially with multi-element semiconductor detection system conducted in BL-12C in Photon Factory is a promising tool to develop speciation studies for trace elements in rocks. We have applied fluorescence XANES for the oxidation state of Ce in natural solid materials. In this study, we report an application to soil strata, where presence of Ce(IV) was found in the depth between 0.60 and 1.50 m in the soil strata presumably due to the oxic condition in the layer compared with the shallower regions (Figure 1). The fact is consistent with the appearance of positive Ce anomaly in the REE patterns, relative abundances of REE (rare earth elements) in rocks against reference materials such as chondrite, shale, etc. The Ce(IV) ratio coupled with the REE patterns shows that more than 50% of light REE is incorporated into the soil, because we can assume that Ce(IV) has been mainly produced by water-rock interaction. There is a correlation between the abundances of Ce(IV) and Mn(IV), suggesting that the oxidation of Ce by Mn oxides is responsible for the appearance of Ce anomalies in the REE patterns.

### Oxidation states of trace elements within the boundary region of minerals

The chemical reaction producing Ce(IV) in the weathering of granitic rocks has also been examined using micro XANES technique coupled with the micro XRF system using BL-4A in Photon Factory. It was clearly indicated that Ce(IV) formed in a crack of quartz within the granitic rocks. EPMA study suggests that the mineral is secondary phosphate containing large amount of REE. These results suggest that the Ce(IV) is produced during weathering processes in the Earth's surface. Ando et al. [2] also apply the similar method to a study on the chemical-state of iron in the dislocation creep in deformed peridotites which was conducted in the program of 2000G268.

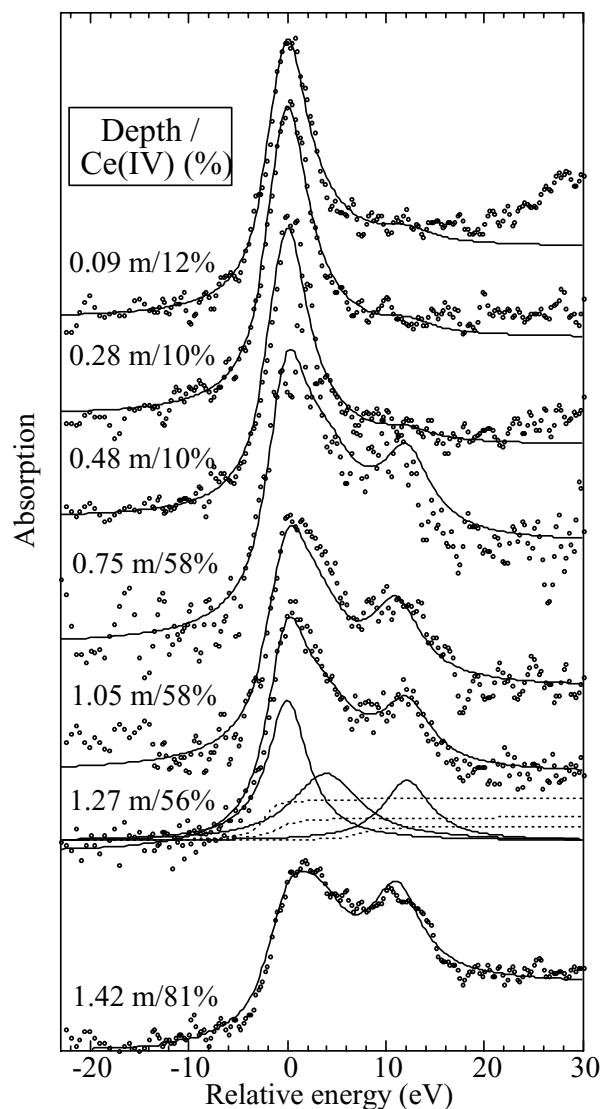


Fig. 1. Cerium L<sub>III</sub>-edge in the soil strata of an experimental paddy field in NIAES. The Ce(IV) percentage was estimated by the deconvolution by reference materials.

[1] Y. Takahashi, K. Yuita, N. Kihou, H. Shimizu, and M. Nomura, submitted to Phys. Scripta.

[2] J. Ando, Y. Shibata, Y. Okajima, K. Kanagawa, M. Furusho, and N. Tomioka, Nature, 414 (2001) 893-895.

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