X-ray fluorescent analysis of black mottles in loam

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Introduction

Loam is one of soil type which contains equal amount of sand, silt and clay. In the loam at Hiruzen highland, Okayama Pref. black mottles are found at near the contact plane with Daisen volcanic ash layers. Mottles, concretions or nodules are of much interest in the weathering process of rocks. Elemental distributions among black mottles and surrounding matrices were measured through the microbeam X-ray fluorescent equipment in BL4A branch to obtain the information to clarify the mechanism of weathering process and the concentration of metal elements.

Experiment

Specimens were prepared to thin section and were observed by optical microscope. Source beam was monochromatized to 14.5 keV and converged to 4.5 × 7.0 μm^2 by KB mirror in the qualitative spot analyses and two-dimensional imaging of fluorescent X-Ray. XANES spectra of Fe and Mn were measured using 200 × 200 μm^2 beam cut by horizontal and vertical slits. Imagings were carried out with the step size: 14 × 10 $\mu\mu^2$, νυμber of steps: 36 × 50 and dwell time: 5-7 seconds. Experimental valuables for XANES spectra of Fe and Mn are follows; ΔE = 50 pulse, number of steps = 121 for Fe and 90 pulse, 101 for Mn respectively. Pyrite, fayalite, hematite and goethite were used as references of Fe and MnO, Mn_2O_3, MnO_2 for Mn references.

Results and discussion

Qualitative spot analyses revealed that both mottle and matrices contained large amount of Fe and Mn. Minor to trace K, Ti, Cr, Ni, Cu, Zn, Ga, Pb, and Rb were detected besides in them under the 300 seconds' exposure. Imaging of Mn (Fig.1) shows black spots are richer in Mn content than matrix, and each content of Fe and other trace metal elements such as Cr, Ni, Cu, Zn and Pb has positive correlation with Mn distribution. This suggests Mn or Fe was condensed by effect of oxidation or reduction including the geomicrobiological process. XANES spectrum of Fe shows chemical state of Fe is ferric in both mottles and matrices, but for Mn the state in mottles is clearly more oxidized than in matrices (Fig.2).

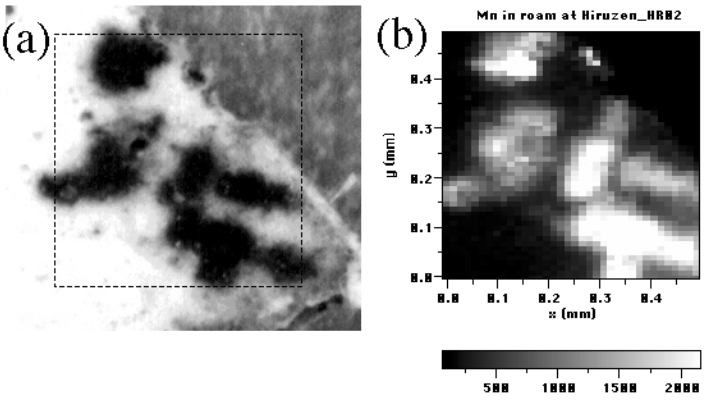

Fig.1 (a) Microphotograph and (b) image map of Mn showing 0.5 × 0.5 mm^2 region of black mottles in Hiruzen loam.

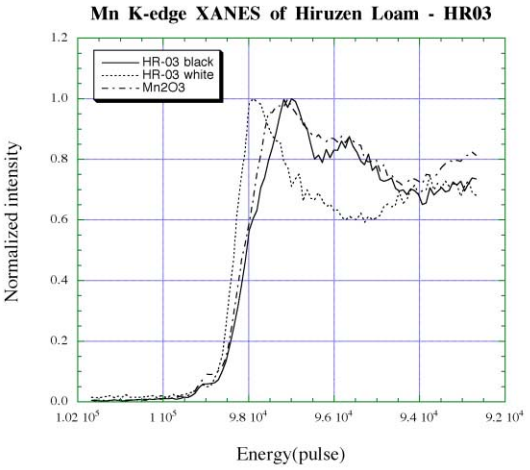

Fig.2 Mn-K XANES of black mottle, white matrix and Mn_2O_3.

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