

Preliminary Examination for Elucidating Resource Dependency of *d*-spacing of Biotite for Provenance Estimation of Atamadai-Type Pottery (2500-1500 BC) with XRD

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Atamadai-type pottery had been distributed in eastern Kanto region of Japan in the Middle Jomon Period (2500–1500 BC). This pottery is thought to have been made from mixture of clay as a raw material and granite fragments as a temper[1]. We focused on X-ray diffractometry (XRD) for archaeological identification of the raw material and the temper using minerals in the potteries. Previous studies indicated as follows: (1) biotite ($\text{K}(\text{Mg}, \text{Fe})_3\text{AlSi}_3\text{O}_{10}(\text{OH}, \text{F})_2$) can be a fingerprint mineral for the provenance characterization of the temper by XRD analyses of Atamada-type potteries from Hinoki site [2] and (2) 34 river sand samples around Mt. Tsukuba which were reported to possibly be useful for pottery production in the Hinoki site, abundantly contain biotite[3]. In this study, resource dependency of *d*-spacing of biotite was researched using biotite-containing rocks from various places in Japan for application to provenance estimation of the temper in the Atamadai-type potteries.

The biotite-containing rocks from Ibaraki, Aichi, Kyoto, Tottori, Okayama, Kagawa, and Nagasaki in Japan were selected in this study. The rock samples were broken by a hammer and a hand crusher, and then, finely ground with an alumina mortar and pestle. The powdered samples were analyzed by XRD using a Rigaku SmartLab diffractometer. The XRD profiles for biotite 001 were recorded in the $7.4\text{--}10.1^\circ 2\theta$ range with 2θ step of 0.01° . The counting time was set to 1.0 s for each step. The profiles were measured ten times.

The following *d*-spacing of biotite 001 in each sample was calculated from the XRD profiles: Tottori sample, 9.99 Å; Kagawa sample, 10.05 Å; Nagasaki sample, 9.94 Å; and the other samples, 10.10 Å. As for Ibaraki, Aichi, Kyoto, and Okayama samples, there were no significant differences among these *d*-spacing. This may be caused by nonlinear relation between the solid solution composition and the *d*-spacing of biotite. Therefore, elucidation of the resource dependency of *d*-spacing requires not only the *d*-spacing of biotite from different origins but also the solid solution compositions, *i.e.*, concentrations of Mg and Fe.

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