Fault age determination using full-pattern-fitting K-Ar illite dating method: an example from the Yeongwol thrust system, Okcheon Belt, Korea

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Illites in fault gouges preserved two illite-polytypes in terms of detrital ($2M_1$) and authigenic ($1M_d$/$1M$) origins, and can be used to determine an absolute age of brittle deformations such as faulting. This is based on the end-member mixing model reflecting proportions of the above mentioned two illite-polytypes. In this study, we applied this method for detailed interpretation of the brittle deformations of the Yeongwol thrust system in the northeastern Okcheon Belt, Korea.

Six representative fault gouge samples were collected from the Yeongwol area. All samples were separated into four size fractions (< 0.1 μm, 0.1–0.4 μm, 0.4–1.0 μm and 1.0–2.0 μm) using a high-speed centrifuge in $NaHCO_3$ (pH 10) solutions. Illite-polytype quantifications were performed using the full-pattern-fitting method using the WILDFIRE© program based on X-ray powder diffractions of each size fraction. We have conducted the K-Ar age dating for these size fractionized samples, and the relative proportions of the $2M_1$ illites in all of the size fractions of each sample were plotted against their K-Ar ages as a function of $\exp(\lambda t) - 1$. The interception ages at 0% $2M_1$ illite content represent the pure authigenic ($1M_d$/$1M$) illite ages, indicating the latest brittle deformation age that can be obtained by this method.

The results from the Yeongwol thrust system of the northeastern Okcheon Belt demonstrated the lower intercepts of ca. 82.0, 66.1, 62.9, 20.4, 18.9 and 18.2 Ma for the NAT-1, PF-1, PE1T-2, MTB, MS-2 and BRF-1 samples, respectively. This is indicative of two brittle deformation events in the study area during the Late Cretaceous to Early Paleocene and the Early Miocene, clearly indicating the reactivation of earlier formed faults during successive orogeny.