

## Fission-track analysis in a possible creeping zone of the Atotsugawa Fault using apatite and zircon

# Ryuji Yamada[1]; Kazuo Mizoguchi[1]; Tatsuo Matsuda[1]; Kentaro Omura[1]

[1] NIED

Possibility of creeping behavior has been pointed out based on electro-optical distance measurement, GPS, and seismic prospecting in the Atotsugawa fault. NIED conducted the fault drilling to collect fault rocks in the possible creeping. Those rocks seem to have been collected from the same fracture zones found at the outcrops on the right bank in the middle reach of the Atotsugawa river. We performed apatite and zircon FT analysis on the outcrop samples to detect the thermal anomaly in the fracture zones.

[Samples] 6 fracture zones were confirmed at the outcrops with the extent of 20 m long near the portal of the Kamioka mine prospect tunnel, located on the right bank at 1.5 km upstream from the confluence of the Atotsugawa and the Takahara rivers. Deformation and alteration of the Hida metamorphic rocks was more advanced than that in the surrounding area. Each fracture zone consists of a gouge zone of 1-3 cm wide and cataclastic zones of 10-15 cm wide on its both sides. Samples for dating were collected from both a gouge and a cataclastic zones about 10 cm apart each other in each fracture; 12 samples in total. Reference samples were also collected; one from the outcrops where no fractures were observed, and another from the Miyagawa area that is believed to be locked.

[FT ages] Zircon FT ages of samples in fracture zones were 119 (5) - 148 (9) Ma whilst those of references were ca. 142 (6) Ma (1-sigma errors are given in parentheses). Although the dispersion of the zircon age in the fracture zones exceeded 2-sigma errors of each data, the ages of gouges were not necessarily younger than those in fractures. Apatite FT ages of samples in fracture zones were concordant at 2-sigma error level (44.0 (2.2) - 59.6 (5.1) Ma) except for a single gouge sample (32.1 (3.2) Ma), whilst those of references were 45.9 (2.6) - 53.7 (3.1) Ma. Although FT ages for other minerals in fracture zones were comparable with or less than those of reference samples, Quaternary ages could not be obtained. Previous works reported that zircon and apatite FT ages of the granitic rocks that intrude into the Hida metamorphic rocks were ca. 100-170 Ma and ca. 40-50 Ma, respectively (e.g., Matsuda et al., 1997). Matsuda et al. (1997) concluded that the discordance in these ages presumably reflected the regional uplift. The distribution of FT ages for both minerals in the present results are mostly concordant with that in the previous works. An exceptionally young apatite age obtained solely in the a gouge zone may have been reset totally or partially by the co-seismic frictional heat later than 32 Ma. It is not realistic that the scattered zircon ages within the 10-m order might reflect the difference in cooling of each samples. The cooling phases may have been overprinted totally or partly by secondary heating. It is hardly possible that co-seismic frictional heat was a single source for such a irregular pattern in zircon ages. The degree of secondly heating by co-seismic geothermal fluids may have varied at different parts because the permeability was heterogeneous due to joints or fissures developed unevenly in fractures. In this case, rocks may exhibit plastic behavior under the temperature condition over 250 deg. C (closure temperature of zircon FT; possibly higher for shorter-term heating), so that joints or fissures were unlikely. The secondary heating may have taken place when the co-seismic geothermal fluids migrated after the rocks begun to show brittle behavior.

[Constraints on fault dynamics] We may detect different co-seismic heat events in ancient times in fracture zones at depths corresponding to the closure temperatures of apatite and zircon FT systems. Considering the temperature/pressure conditions and the rock properties at these depths, we will discuss about the estimates of the heat generated by fault friction and those conveyed by co-seismic geothermal fluid that migrate through joints and fissures in the brittle rocks at depth.