Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

SSS019-10 Room: 303 Time: May 24 09:45-10:00

Thermal processes of seismogenic zones inferred from the thermochronology of fault rocks

Takahiro Tagami[1*]

[1]Div. Earth Planet. Sci., Kyoto Univ.

Quantitative assessment of heat generation and transfer along faults and associated with fault movement is of primary importance in understanding the dynamics and structural history of faulting, as well as in constraining the heat budget and thermotectonic evolution of mobile belts. Among a range of methodologies available to investigate thermal regimes around faults, thermal history analysis using radiometric dating methods is extremely useful because it reveals temporal changes of temperature in the fault zone rocks. This approach also allows us to place important constraints upon the ages of fault motions.

From methodological point of view, thermochronologic investigations of rocks from fault zones require consideration of two factors that are worth special attention [Tagami, 2005]. First, fault rocks may have been subjected to hydrothermally-pressurized conditions at some stage during fault development. Second, frictional heating along a fault is a short-term phenomenon with heating durations on the order of seconds, significantly shorter than the conventional laboratory heating having durations of ~0.1 to 10000 hours. These factors were assessed individually by specially-designed laboratory heating experiments.

Zircon fission-track (FT) analysis has extensively been conducted by our group on the Nojima fault, which was activated during the 1995 Kobe earthquake (Hyogoken-Nanbu earthquake; M7.2)[Tagami et al., 2001; Murakami et al., 2002; Murakami and Tagami, 2004; Tagami and Murakami, 2006, 2007]. Rock samples were collected from the University Group 500 m (UG-500) borehole, Geological Survey of Japan 750 m (GSJ-750) borehole, the fault trench at Hirabayashi, and nearby outcrops.

In the two boreholes that penetrate the fault at depth, zircon FTs were partially annealed in the samples nearby the fault. The age of onset of cooling from the zircon partial annealing zone (ZPAZ) was estimated by the inverse modeling of FT data using the Monte Trax program; i.e., ca. 4 Ma within ca. 3 m (in the hanging wall only) from the fault plane in the UG-500, and ca. 31-38 Ma within ca. 25 m from the fault in the GSJ-750. It is likely that the thermal overprints were caused by migration of hot fluids along the fault zone from deep crustal interior.

For the fault trench samples, zircon FTs of the 2 - 10 mm thick pseudotachylyte layer were totally annealed and subsequently cooled through ZPAZ at ca. 56 Ma, which is interpreted as the time of (final stage) of pseudotachylyte formation. It is suggested, therefore, that the present Nojima fault was formed in the Middle Quaternary by reactivating an ancient fault initiated at ca. 56 Ma at mid-crustal depth. Also conduected were (1) zircon (U-Th)/He analysis of the Nojima pseudotachylyte layer and surrounding rocks [Reiners et al., 2006] and (2) K-Ar and Ar/Ar analysis of gouge samples of Nojima fault mainly collected on outcrops [Zwingmmann et al., in prep.].

I will also present results from other areas: (1) zircon FT analysis of a boundary fault between the Okitsu melange and overriding coherent unit of the Shimanto accretionary complex, which is assigned to ancient seismogenic zone in the plate subduction zone [Sato et al., in prep.] and (2) zircon FT and U-Pb analysis of a pseudotachylite of the Asuke shear zone [Murakami et al., 2006].

References

Murakami, M. and Tagmai, T., 2004, Geophys. Res. Lett., 31, doi: 10.1029/2004GL020211.
Murakami, M. et al., 2002, Geophys. Res. Lett., 29, doi: 10.1029/2002GL015679.
Murakami M. et al., 2006. Tectonophysics, 424, 99-107.
Reiners et al., 2006, abstr. Goldschmidt Conf., Melbourne.
Tagami T., 2005, Rev. Mineral. Geochem., 58, 95-122.
Tagami T. and Murakami, M., 2006, AAPG Memoir, 85, 269-285.
Tagami, T. and Murakami, M., 2007, Tectonophysics, 443, 139-152.
Tagami T. et al., 2001, The Island Arc, 10, 457-464.

Keywords: thermochronology, fault zone, zircon, fission-track method, (U-Th)/He method