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Fission-track dating of zircons in pseudotachylytes from a brittle-ductile shear zone and an active fault in Japan, and from a large-scale landslide in Langtang, Nepal

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Pseudotachylyte is a product of frictional melting along faults and landslides, and of meteorite impact. Precise dating of pseudotachylyte gives significant information of the timing of such natural pulse of flash melting processes. We have been doing researches of absolute dating of major faults in Japan using fission-track (FT) dating of zircon grains from an active fault (Nojima Fault: Murakami and Tagami, 2004) and a brittle-ductile shear zone (Asuke Shear Zone: Murakami et al., 2006) in central Japan, and from a large-scale landslide (Tsergo-Ri Landslide) in Langtang, Nepal (Takagi et al., 2007). Reviewing these papers, we introduce the usefulness of zircon FT dating for pseudotachylytes.

Pseudotacylyte from the Nojima fault

Nojima fault, located in Awaji Island, Japan, was reactivated during the 1995 Kobe earthquake (M7.2). Otsuki et al. (2003) excavated pseudotachylyte layers in the Nojima fault, in which the detail of physical process during seismic slip was recorded. Zircons from 2-10 mm thick pseudotachylyte layers collected at the Hirabayashi trench of the fault and analyzed them by FT method. The measured ages of the layers (56 Ma) were significantly younger than those of surrounding rocks (74 Ma). This age is quite concordant with the K-Ar ages of mica clay minerals from fault gouges along the major active faults in SW Japan such as the Median Tectonic Line, Atotsugawa Fault and Atera Fault (Takagi et al., 2005). This means that the initiation of these active faults go back to Paleocene time after wide intrusions of Late Cretaceous granitoid in the Inner Zone of SW Japan.

Pseudotacylyte from the Asuke Shear Zone

Asuke Shear Zone is located in Ryoke granitic terrane in central Japan. Sakamaki et al. (2006) described the occurrence of pseudotachylyte layers and associated ultramylonite and cataclasite that are generated in cataclastic-plastic seismogenic zone. The analyzed pseudotachylyte has microlites and amygdules indicating clear melt-quench textures. Zircon grains are separated from a 10 cm thick pseudotachylyte layer. The ages of the PT layer are 53 Ma, significantly younger than those of surrounding granitic rocks (74 Ma).

Pseudotacylyte from the Tsergo Ri landslide from Langtang, Nepal

Eighty six zircon grains are separated from an injection pipe of glassy and vesicular pseudotachlyte about 10 cm in diameter surrounded by crushed sillimanite gneiss of the Higher Himalayan Sequence. The pseudotachylyte has natural glass (Masch et al., 1985) and large vesicules. Most of the zircon grains analysed have no spontaneous tracks since the age of this sample is very young and analyzed area (grain size) is very small. The zero-track grains had been correctly etched and were included in the age calculation. The age of the pseudotachylyte pipe is 51 Ka, lying between two subpeaks (70 and 20 Ka) of the Würm glacial period.

Usefulness of zircon FT dating for pseudotachylyte

The behavior of zircon FT annealing is well known at high temperature and short time events, such as the frictional heating on shear zones. FTs in zircon were totally annealed at the temperature-time conditions of approximate 910˚C for 4 sec (Murakami et al., 2006b). The FT length distribution provides additional information for quantitative reconstruction of thermal history within the respective partial annealing zones of studied accessory minerals. The alteration of zircon grains is also negligible. From our experience on pseudotachylytes from three different geotectonic occurrence, the zircon FT dating of pseudotachylyte is fairly reliable method for determination of the age of ancient movement along a fault and a landslide.

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