Determination of the deformation conditions of the shear zone using fault rocks: an example for the Asuke Shear Zone

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The Asuke Shear Zone (ASZ) transects the Inagawa Granodiorite in the Ryoke Belt, and it extends NE–SW for ˜14 km and is several tens to hundreds of meters wide around Asuke Town, Aichi Prefecture. Cataclasites constitute entirely the ASZ, whereas pseudotachylytes and mylonites are also observed in the central segment of about 4.5 km along the ASZ (Sakamaki et al., 2006). The ASZ is considered to be deformed in cataclastic-plastic transition regime of granitic crust (Sakamaki et al., 2006). Kinematic indicators and stretching lineations in the mylonites indicate a sinistral–normal shear. In this presentation, I will summarize (1) the paleostress orientations during the formation of mylonite using slip data of the shear zone and healed miocrocracks in quartz grains in the protolith granite, and (2) those just after the formation of pseudotachylyte using microstructure of calcite infilling amygdales. I will also summarize the deformation conditions of the ASZ using microstructures of recrystallized quartz grains and those of calcite grains.

In the high strain area such as the central part of the shear zone, it is believed that the mylonitic lineation defined by the stretching lineation is parallel to the displacement direction of the shear zone (Simpson, 1986). Assuming that the Wallace-Bott hypothesis that the displacement direction is parallel to the direction of the shear stress acting on the slip surface, the combination of the mylonitic foliation and lineation of mylonite which can judge the shear sense can be used for paleostress analysis as well as fault slip data. The mylonites strike NE–SW to ENE–WSW and dip 50–70° to the N, and mylonitic lineations plunge 40-50° to the NW. As a result of the Hough-transform-based inversion method (Yamaji et al., 2006), the optimum estimated σ_1 axis trends 183° and plunges 63°, whereas the σ_3 axis trends 310° and plunges 14°. The stress ratio is 0.56. Kanai and Takagi (2016) reported the Z-maximum quartz *c*-axis LPO patterns from the mylonitized pseudotachylyte that was used for the paleostress analysis this time, and the deformation temperature was estimated of 300-400 °C. Moreover, differential stress is estimated to have been 110–130 MPa based on the recrystallized grain size.

Paleostress orientation analysis using calcite *e*-twins in the amygdales of the pseudotachylytes has been carried out (Kanai and Takagi, 2016). The optimal estimated σ_1 axis trends 228° and plunges 55°, whereas the σ_3 axis trends 320° and plunges 1°. The stress ratio is 0.78. The deformation temperature and differential stress estimated by the morphology of the *e*-twins (Burkhard, 1993) and the twinning ratio (Yamaji, 2015) give 150-200 °C and 40-80 MPa, respectively. The misfit angle of the stress tensor estimated from the mylonite and the calcite *e*-twin is 23.1°. Although deformation temperature, differential stress and deformation scale are different in recrystallized quartz in mylonite and calcite amygdales in pseudotachylyte, the principal stress axes orientation estimated from mylonite and calcite are similar. The timing of mylonitization and calcite twinning is about 70 and 50 Ma, respectively, on the basis of the deformation temperature of mylonites, cooling curve of the Inagawa Granodiorite (Yamasaki, 2013) and fission-track zircon age of pseudotachylyte (Murakami et al., 2006). The ASZ is considered to have been activated under the single paleostress filed that involves the orientation of NW-SE subhorizontal $\sigma 3$ axis and $\sigma 1$ axis plunging 60° S˜SSW during 70-50 Ma.

References

Burkhard, M., 1993, *Jour. Struct. Geol.*, **15**, 351-368.
Kanai, T. and Takagi, H., 2016, *Jour. Struct. Geol.*, **85**, 154-167.

Murakami, M., Kosler, J., Takagi, H. and Tagami, T., 2006, *Tectonophysics*, **424**, 99-107.
Sakamaki, H., Shimada, K. and Takagi, H., 2006, *Jour. Geol. Soc. Japan.*, **112**, 519-530.
Yamaji, A., 2015, *Jour. Struct. Geol.*, **72**, 83-95.
Yamaji, A., Otsubo, M. and Sato, K., 2006, *Jour. Struct. Geol.*, **28**, 980-990.
Yamasaki, T., 2013, *Jour. Geol. Soc. Japan.*, **119**, 421-431.

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