Visualization of a high-strain shear zone based on a field survey for minor faults: A case study of southern Kyushu, Japan

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Owing to a nationwide GNSS network installed since mid-1990s, several high-strain shear zones defined as concentrated regions of strain rates have been recognized in Japanese Islands (Sagiya et al., 2000, PAGEOPH). The high-strain shear zone with a sinistral strike-slip was identified also in southern Kyushu (Nishimura and Hashimoto, 2006, Tectonophysics; Wallace et al., 2009, Geology). There have had large earthquakes in this area such as the 1997 Northwestern Kagoshima Earthquake (Faculty of Science, Kagoshima Univ., 1997, Report of CCEP), however, any seismogenic faults associated with these earthquakes or active faults with strike-slip tectonic landforms had not been previously recognized at the surface.

In this study, we focused on existing minor faults to clarify a geological evidence of the shear zone suggested by geodetic studies. Basement rocks in the study area are mostly composed of sandstone and mudstone of the Shimanto accretionary complex, and are with a minor exposure of the Miocene Shibi-san Granodiorite (Yoneda and Iwamatsu, 1987, J. Geol. Soc. Japan). Mesoscale fault zones with clayey gouge and cataclasite are rare in the study area. Instead, minor faults cutting bedding planes and deformation structures subparallel to the bedding (such as mélange fabric), suggesting the formation clearly after the accretion of the Shimanto accretionary complex, are commonly observed. Slip directions can be examined from striations along the minor faults. Striations are also often identified along joints in the massive sandstone. Based on orientation data of these striations, we applied stress tensor inversion techniques (Yamaji, 2000, J. Struct. Geol.; Yamaji and Sato, 2012, Comp. Geosci.) to elucidate stress states. Our field survey in northwestern Kagoshima ($22 \times 16 \text{ km}$) revealed an occurrence of the E-W trending zone of ~2 km wide showing a stress state consistent with the sinistral high-strain shear zone (NE-SW compression and NW-SE extension). This zone largely overlaps the aftershock distribution of the 1997 Northwestern Kagoshima Earthquake. This study can contribute to one of helpful approaches to examine potential future activities of faults (or shear zones) without clear tectonic landforms.

This study was funded by METI, Japan as part of its R&D program supporting development of technology for geological disposal of HLW.

Keywords: high-strain shear zone, stress tensor inversion, minor faults, southern Kyushu