The thermal structure and formation process of faults in Akehama area of the Northern Shimanto Belt, western Shikoku, Japan

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The Shimanto Belt is composed mainly of accretionary complexes, which is formed due to the subduction of the oceanic plate (Taira et al., 1980). In the eastern Kyushu and central to eastern part of Shikoku, melange zones and accompanying strong deformation zones, such as brittle faults with pseudotachylyte are documented (e.g., Taira et al., 1988, Mukoyoshi et al., 2006). These brittle deformation zones are considered to record the long-term and short-term deformation processes in subduction zone. Such a fault analysis and a thermal structure analysis are mainly carried out in the above areas, and seldom in western Shikoku. Oohashi and Kanagawa (2014) reported a distribution of brittle fault zones and mélange zones, regional geologic structure, and paleothermal structure of the Shimanto belt along the western coastline of Shikoku Island. Here we report the results of deformation mapping, paleostress analysis, and vitrinite reflectance measurement on and around the brittle fault zones developed in Akehama area of the Northern Shimanto Belt.

In the study area, the fault zones are developed in coherent unit comprised of sandstone, mudstone and alternations of sandstone/mudstone. The fault zones typically has a cataclasite zone of a few to tens of cm and fracture zone of a few tens to hundred of cm in width. On the other hand, soft-sediment deformations are rarely found. These faults strike east–west and dip to north, and the average rake angle of the striations are 32 °from west. Kinematic indicators such as composite planar fabrics or slickenside topography show dextral sense of shear with reverse-slip component. Using the fault-slip data obtained in the area, we conducted a stress tensor inversion to estimate paleostress directions. The result indicates NW–SE direction for the maximum principal stress, $\sigma 1$, and NE–SW direction for the minimum principal stress, $\sigma 3$. $\sigma 1$ axes gently to moderately plunge whereas $\sigma 3$ axes generally shows subhorizontal. Although those faults has reverse-slip component, the vitrinite reflectance does not show significant difference across the fault zones ($\Delta Rm = 0.18\%$ in maximum). The absence of thermal gap across the thrust fault suggests that the faulting proceeded prior to the formation of thermal structure, which may be conducted during subduction. We thus conclude that the fault zones were developed at the relatively early stage of the subduction (frontal to middle part of the accretionary prism). Our results suggest that the oblique-slip fault (non-andersonian fault) was formed during the early to middle stage of the subduction. This finding might become important when we look at ongoing subduction process through ocean drilling programs.

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Keywords: Subduction zone, Northern Shimanto Belt, Vitrinite reflectance, Paleostress analysis, Oblique-slip faults

