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Internal and permeability structures of faults developed in the Shimanto accretionary prism in Kochi prefecture

Manami Kitamura[1*], Mukoyoshi Hideki[2], Takehiro Hirose[3]

[1]Hiroshima University, [2]Marine Works Japaan, [3]Kochi Institute for JAMSTEC

Hydrological properties of major faults within accretionary prisms have attracted much attention recently in regard with its role on the earthquake generation processes within a shallow part of subduction zones. However internal and permeability structures of low-angle fault zones in accretionary prism have not been fully understood yet. We thus described the occurrence of large-displacement fault zones in the Cretaceous Shimanto belt in SE Kochi prefecture, and determined their permeability structures by laboratory fluid-flow tests. Among many faults in the research area, large-displacement faults were determined from temperature gap across the fault using a Vitrinite reflectance technique.

We focused on two fault zones with inferred displacement of >2 km; one is developed in a sequence boundary between basalt and pelitic breccias, and the other is in a melange zone. These fault zones are composed of cataclasite and clay-rich gouge zones. As total thickness of the fault zones is less than a few meters, fault slip is localized into thin gouge zones with average thickness of ~3 cm. The ratio of fault thickness to displacement of the fault zone is ~10^-5, that is far low as compared with worldwide displacement-thickness scaling relationship (10^-3 to 10^-1; e.g., Shipton et al. 2006). Fluid-flow experiments at effective pressures up to 100 MPa showed that permeability of the hanging wall was relatively low (10^-18-10^-20 m^2 at effective pressures of >50 MPa), while it is higher by 1-3 orders of magnitude in the footwall and fault zones. The permeability structures imply that high pore fluid pressure could be sustained within the fault zone, which may promote the thrust movement. Furthermore, the relatively thin fault zones with respect to displacement may be due to low strength of such low-angle faults that are energetically easy to propagate in a shallow part of subduction zone without forming a wide damage zone.

Keywords: fault, accretional complex, permeability