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Hydrological Properties of Rocks within Accretionary Prism; an Example from the Shimanto Belt, SW Japan

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Fluid flow processes within accretionary prisms have attracted much attention recently in regard with its role on the earthquake initiation processes within a shallow part of the plate subduction zones. Previous geological studies of accretionary prisms have argued that shear zones such as mélange zone, decollements and other thrusts may act as a main fluid conduit within prisms. However, studies of the hydrological properties of rocks such as porosity and permeability have been limited in the toe region of the prisms and the fluid transport properties for whole structural range of the prisms have not been fully understood. In this study, we measured porosity and permeability of rocks from the Shimanto belt in Kochi prefecture, SW Japan, which is one of the most well studied accretionary complexes. Porosity was estimated from the volume of water replaced the pore space of a sample immersed in water inside a vacuum chamber. Permeability measurements were made at high confining pressures to 200MPa at room temperature using a gas-medium tri-axial apparatus. Beside the measurements of the hydrological properties, measurement of the anisotropy of magnetic susceptibility of the Shimanto rocks has been made to evaluate strain and deformation within the accretionary prism.

The porosity of the Shimanto rocks is mostly under 5% and it seems there is no systematic variation of the porosity in relation to the major structures or the sedimentary ages of the Shimanto belt. Sample of Miocene age the Ocean Drilling Program (ODP) core show much higher porosity of about 30% than the same age samples from the Shimanto belt [1]. This remarkable difference of the porosity may be explained with porosity-depth relationship as a result of compaction of the Shimanto belt due to burial to the depth of approximately more than 5km.

Permeability of the massive rocks is about 10^{-15} m^2 under low effective pressures and lowers than 10^{-19} m^2 at high pressures. On the other hand, permeability of fractured rock is about 10^{-17} m^2 at the lowest. Although shear zones such as melange and decollements have been suggested as a main fluid conduit in accretionary prisms, presented study showed relatively impermeable nature of mélange rocks. On the other hand, permeability of the fractured rocks was measured to be relatively high, suggesting these fractures as an important conduit for fluid transport processes within accretionary prisms.

Reference

[1] Taylor, E. and Fisher, A., 1993, *Proceedings of the Ocean Drilling Program, Scientific Results,* **131**, 235-245 (1993)