

Transport and Frictional Properties of a serpentinite bearing fault along Gokasho-Arashima Tectonic Line and its possible high velocity slipweakening

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Gokasho-Arashima Tectonic Line is a serpentinite bearing fault zone in Mie Prefecture, central Japan, which is thought to be the eastward extension of the Kurosegawa tectonic zone. At the studied Matsuo outcrop, the contact fault between a large serpentinite body and Cretaceous fore-arc basin sediments can be seen. The fault zone at Matsuo outcrop consists of a zone of fractured sedimentary rocks and cataclasites of Matsuo Group origin (> 30 m in width), a 50 mm thick clayey fault gouge, a 0.6-0.9 m thick foliated gouge, and brecciated serpentinites (> 250 m). Permeability has been measured with an intravessel deformation-fluid-flow apparatus in Kyoto on rock samples taken from each structural division described above. Measurements were done under confining pressure of 5 MPa up to 120 MPa, roughly corresponding to 0.3 - 7.5 km in depth. The fault zone is characterized by an impermeable to moderately permeable fault core (10-18 m²), and a permeable damage zone (10-16 m²). Frictional properties were investigated on clayey fault gouge samples taken from the fault outcrop, mainly consisting of smectite group clay minerals, using the Biaxial Friction Machine in Kyoto Univ. Results show that, in the range of 15-45 MPa normal stress and velocity of 0.0014-14 microns/sec, the fault gouge has a strong velocity strengthening behavior and the frictional coefficient is approximately 0.32 for dry runs and 0.13 for wet runs

Based on the experimentally determined physical properties, the possible effect of thermal pressurization in this fault zone was evaluated using a numerical analysis based on Lachenbruch (1980). Initial parameters were chosen from measured data at an effective pressure corresponding to 3 km in depth and analyses were done for different widths of deformation-zone. In all cases thermal pressurization caused slipweakening with characteristic weakening distance of a few meters. Permeability of fault gouge is not very low, so that thermal pressurization is not very effective for the present serpentinite-bearing fault zone.

Keywords: Gokasho-Arashima Tectonic Line; permeability; porosity; friction; thermal pressurization;

References

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