Evolution of hydraulic and frictional properties of incoming hemipelagic sediments during diagenetic reactions

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Deployments of seismic and geodetic observation networks had revealed the activity of slow earthquakes along the subduction plate boundaries, which are characterized as intermediate fault slip rate between earthquake (~1m/s) and stable sliding along the plate boundary (~1 nm/s). Diagenesis of subducting sediments has stimulated interest in their relationship to regular and slow seismicity in the subduction zone. We report experimental results on the effect of diagenetic reactions to hydraulic and frictional properties of incoming hemipelagic sediments. Hemipelagic sediments taken from KS-15-3 Shinseimaru cruise are used as the starting sample. Friction experiments and permeability measurements were carried out with a confining pressure of 150 MPa and a pore pressure of 58 MPa and temperatures ranging RT–230 degC. When the sample is sheared immediately after reaching the experimental condition, all experimental data at the temperature below 150 degC showed a velocity-strengthening behavior. On the other hand, at the temperature of 230 degC, the frictional behavior is no longer stable, but stick-slip behavior was observed during the experiments. We also measured a time-dependent permeability evolution of hemipelagic sediments to assess how diagenetic reactions consolidate the sediments. Permeability decreased about an order magnitude due to the mechanical compaction from the effective pressure of 3 MPa to 92 MPa, and decrease additional an order magnitude of permeability is observed during the hot-pressing of the sample at the pressure and the temperature of 92 MPa and 100 degC, respectively. Those experimental observations suggest that thermally activated compactions, possibly pressure solution creep, could contribute key role for understanding the physical property of subducting sediments.

Keywords: subduction zone, frictional property

