Numerical experiments of shear deformation with frictional heating

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We develop a thermal-mechanical model for describing the deformation expected in the mantle wedge. We consider shear deformation of a two-dimensional region composed of a Maxwell viscoelastic material under a constant velocity at the boundary. Viscosity of the material depends on temperature. We included a stiff inclusion as a model of an asperity along the plate boundary. Our preliminary result shows that a zone of localized deformation develops around the stiff inclusion. In the zone of localized deformation, a significant amount of heat is generated by viscous dissipation, and temperature in the zone increases by several hundred degrees. Our result suggests that heating by viscous dissipation may play an important role in the formation of decollements around subducted seamounts.

We develop a thermal-mechanical model for describing the shear deformation expected to occur in the mantle wedge. We consider shear deformation of a two-dimensional rectangular region composed of a Maxwell viscoelastic material under a constant velocity at the boundary. Viscosity of the material is assumed to depend only on temperature for simplicity. In order to model an asperity or a weak region along the plate boundary, we included a small inclusion whose viscosity differs from that of the surrounding material. We carried out time-marching simulations and monitored the evolution of temperature and strain around the inclusion. Our preliminary result shows that the deformation localizes in a narrow region when a sufficient amount of heat is generated by viscous dissipation. In the zone of localized deformation, temperature increases by several hundred degrees owing to strong dissipative heating. We found that the zone of localized deformation develops in the region where the largest amount of heat is generated at the initial stage of the evolution. The zone of localized deformation develops along the plate boundary when the inclusion is weaker than the surrounding material, while it develops away from the plate boundary when the inclusion is stiffer than the surrounding material. Our result suggests that heating by viscous dissipation may play an important role in the formation of decollements around subducted seamounts.