Thermal-Mechanical Effects of Low-Temperature Plasticity (the Peierls Mechan ism) on the Deformation of a Viscoelastic Shear Zone

Masanori Kameyama [1], David A. Yuen [2], Shun-Ichiro Karato [2]

[1] FRPSD, JAMSTEC, [2] Univ. Minnesota

We numerically studied the thermal-mechanical effects of low-temperature plasticity, which is called the Peierls mechanism and has a strong dependence on the stress, on the formation of shear zones. We found that the Peierls mechanism inhibits the development of thermal instability in shear zones given that the spatially-averaged strain rate is constant. The Peierls mechanism enhances deformation at a significantly lower stress, reduces the amount of dissipative heating, and thus stabilizes the shear zone. For dry olivine rheology, the deformation by the Peierls mechanism is significant for temperatures between around 800K and 1000K. This finding suggests that the Peierls mechanism may be crucial to the thermal-mechanical behavior in the shallow portion of slabs.