Influence of water–rock interactions on the strength of outer-rise faults

*Ken-ichi Hirauchi[1]

1. Department of Geosciences, Faculty of Science, Shizuoka University

Knowledge of the amount of water stored in oceanic plates is important for understanding subduction zone water budgets (e.g., Hatakeyama et al., 2017, *Sci. Rep.*). Beneath the outer rise, the incoming oceanic plate bends down into the trench, resulting in the formation of extensional normal faults (i.e., outer-rise faults). Seismic reflection studies have shown that these normal faults penetrate into the upper mantle and act as a permeable fluid pathway. How deep outer-rise faults can develop primarily depends on the depth extent of strain localization within the oceanic lithosphere. Infiltration of seawater into outer-rise faults may promote the growth of mechanically weak hydrous phases such as talc and serpentines, perhaps leading to further strain localization. In order to understand effects of water–rock interactions on the strength of the upper mantle, I have conducted high-pressure deformation experiments on simulated peridotite fault gouges in the presence of hydrothermal water (Hirauchi et al., 2016, *Nat. Commun.*). I found that at a temperature of 500°C and a confining pressure of 1 GPa, the development of talc-bearing, localized shear zones leads to an order-of-magnitude reduction in strength. This finding indicates that water–rock interactions along outer-rise faults play a role in deepening the fault depth and increasing water budgets in the oceanic upper mantle.

Keywords: outer-rise faults, fault strength, hydrous minerals