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Coseismic fluid-rock interactions in subduction-zone faults: Constraints from geochemical analyses of fault rocks

ISHIKAWA, Tsuyoshi[1*]

[1]JAMSTEC Kochi

In this paper, we report recent progress on geochemical method for evaluating coseismic fluid-rock interactions in subduction-zone fault zones on the basis of trace element and isotope analyses. Compositions of slip-zone rocks from the Taiwan Chelungpu fault and the Boso accretionary complex showed distinct decreases of Li, Rb and Cs and an increase of Sr, indicating coseismic fluid-rock interaction at high temperatures of >350 deg. C (Ishikawa et al., 2008; Hamada et al., 2011). In the Shimanto accretionary complex at the Kure area, the slip-zone rocks exhibited trace element characteristics consistent with coseismic high-temperature fluid-rock interactions followed by frictional melting to form pseudotachylite (Honda et al., 2011). Such geochemical anomaly induced by coseismic hydrothermal processes can be reproduced by high-velocity friction experiments at wet condition (Tanikawa et al., submitted).

Geochemical evaluation of coseismic fluid-rock interactions in fault zones is useful means not only to understand the slip mechanism (e.g. thermal pressurization) but also to constrain compositions of the fluids in the fault zones. Trace element and isotope characteristics of slip-zone rocks from the Midian Tectonic Line in Japan (Ishikawa et al., 2014) and from the Kodiak accretionary complex (Yamaguchi et al., 2014) both requires interactions with high-Li fluids, which implies that coseismic hydrothermal processes took place in the presence of fluids that had migrated from the depth.

Keywords: fluid-rock interactions, fault rocks, earthquake, geochemistry, subduction zones