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Geochemical evaluation of co-seismic fluid-rock interaction and frictional melting in fault zones

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In this paper, we report recent progress on geochemical method for evaluating co-seismic fluid-rock interactions and frictional melting in fault zones on the basis of change in trace element and isotope compositions of fault rocks. Analyses of rocks from Taiwan Chelungpu fault and faults in accretionary complexes of Emi and Shimanto show clear evidence for co-seismic fluid-rock interaction at high temperatures (>350 deg. C). For the Shimanto samples from the Kure region, which are considered to represent rocks of ancient spray fault at 2.5-5.5 km depth, the signals of fluid-rock interactions overlap with highly elevated incompatible element concentrations, indicating that the high-temperature fluid-rock interactions were followed by frictional melting. These results demonstrate that co-seismic fluid-rock interactions widely occur within seismic faults and trace element and isotope compositions of fault rocks are useful indicators of fluid-rock interactions as well as frictional melting. For better understanding of the co-seismic fluid-rock interactions using this method, experimental determination of solid-fluid distribution coefficients for key elements such as Li, Rb, Cs and Sr and kinetic parameters at temperatures over 350 deg. C are required.

Keywords: fault rocks, geochemistry, earthquake, fluid-rock interactions, trace elements, isotopes