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Interrelations between Intermediate-Depth Earthquakes and Fluid Flow in subducting Oceanic Plates

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Hydrous fluid escape from the downgoing slab is widely believed to be the trigger that induces partial melting in the overlying mantle wedge, thereby producing the magmas erupted in arc volcanoes. Arc magmatism has a distinct chemical signature due to the addition of elements carried by initially hydrous slab-derived fluids. What is yet to be established are the mechanisms which are responsible for hydrous fluid flow from sources within the slab into the overlying wedge, and furthermore whether and how this fluid flow is linked to possible reactivation of normal faults and intermediate-depth earthquakes (70-300km). Two main but rival hypotheses have been proposed to explain intraslab seismicity; one, currently more in favor, suggests that high fluid pressures lead to dehydration embrittlement that triggers earthquakes, the other suggests that melt shear instabilities trigger seismic slip and may thereby produce permeabilities. Until now, testing these hypotheses has been restricted to theoretical investigations, lab experiments, and interpretations of seismic data. Unlike these more indirect approaches, we are able to directly investigate former slab rocks that experienced an earthquake during their burial in a subduction zone. We present so far unique field evidence indicating that intermediate-depth earthquakes produce frictional melts in subducting slabs and that the seismic failure was subsequently followed, not preceded, by infiltration of external fluid. We describe pseudotachylytes (quenched frictional melts) in eclogites from a fossil subduction slab in Zambia. Shortly after pseudotachylyte formation an external hydrous fluid infiltrated the rocks. Subsequent fluid flow leads to continuous vein formation during ongoing burial. The passing fluids mobilize those trace elements from the eclogites, which are characteristic of a ‘hydrous slab component’ in arc magmas. Since the fluids released by dehydrating slabs are believed to be the primary trigger for arc magmatism, we propose that intermediate-depth earth-

quakes have the potential to produce fluid-pathways within and out of the slab.