Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20380

# Metamorphic fluid production, fluid pressures, and resultant slip behaviors at deep slow slip conditions during prograde subduction

**CAILEY B CONDIT**[1], MELODIE E FRENCH[2], WILLIAM F HOOVER[1], PETER C LINDQUIST[1], VICTOR E GUEVARA[3], ADAM F HOLT[4] AND EMILY H. G. COOPERDOCK[5]

[1]University of Washington
[2]Rice University
[3]Amherst College
[4]University of Miami
[5]Brown University

Presenting Author: ccondit@uw.edu

Prograde dehydration reactions are the major source of aqueous fluids within subduction zones below the seismogenic zone. These fluids influence subduction slip behaviors, facilitate metasomatic reactions, and eventually lead to flux melting in the mantle wedge at subarc depths. Because these fluid producing reactions are sensitive to temperature (and pressure), the thermal structure of a given subduction zone exerts a first order control on the locus and magnitude of fluid production, and by extension the resultant deformational and geodynamic consequences. Here, we first show results from coupled geodynamic and thermodynamic models of prograde metamorphic fluid production from a range of typical subduction zone lithologies. We demonstrate a spatial correlation between substantial dehydration, particularly of MORBs, and deep slow slip phenomena (Episodic Tremor and Slip; ETS) in warm subduction zones between depths of 25-65 km (~0.8-2.0 GPa). Colder subduction zones do not produce significant fluids over this depth range and lack observed ETS events, suggesting the location of ETS is influenced by prograde dehydration reactions and, in turn, thermal structure. We combine these modeling results with observations from the exhumed rock record to examine the consequences of metamorphic fluid production at ETS depths: microstructural and structural analysis of quartz crack-seal veins from the Arosa Zone, Switzerland (0.9 GPa and 350°C) document ~lithostatic pore fluid pressures where our models predict ample devolatilization from subducting oceanic lithosphere. These veins record cycles of elevated pore fluid pressures and triple oxygen isotopes on vein quartz corroborate our modeling results, indicating silica precipitating fluids were sourced from metamorphic dehydration of subducting oceanic lithosphere. Lastly, we will show recent microstructural observations from a chemically reacting and phyllosilicate rich mélange zone from Pimu/Santa Catalina Island, CA that records evidence of fluid-mediated slip partitioning between talc- and chlorite-rich rocks within a warm paleo-subduction zone at ~1.0 GPa and ~500-550°C. We postulate that this slip partitioning is due to cyclic pore fluid pressure fluctuations activating frictional deformation capable of hosting slow slip strain rates. Together, these results demonstrate the intimate relationship between subduction thermal structure, metamorphic devolatilization, and slip behaviors.