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Fluid migration in the subduction zone: a coupled fluid flow approach

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Subduction zone are the main entry point of water into earth's mantle and play an important role in the global water cycle. The progressive release of water by metamorphic dehydration induce important physical-chemical process in the subduction zone, such as hydrous melting, hydration and weakening of the mantle wedge, creation of pore fluid pressures that may weaken the subduction interface and induce earthquakes. Most previous studies on the role of fluids in subduction zones assume vertical migration or migration according to the dynamic pressure in the solid matrix without considering the pore fluid pressure effect on the deformation of the solid matrix. Here we investigate this interaction by explicitly modeling two-phase coupled poro-plastic flow during subduction. In this approach, the fluid migrates by compaction and decompaction of the solid matrix and affects the subduction dynamics through pore fluid pressure dependent frictional-plastic yield. Our preliminary results indicate that: 1) the rate of fluid migration depends strongly on the permeability and the bulk viscosity of the solid matrix, 2) fluid transfer occurs preferentially along the slab and then propagates into the mantle wedge by viscous compaction driven fluid flow, 3) fluid transport from the surface to depth is a prerequisite for producing high fluid pore pressures and associated hydration induced weakening of the subduction zone interface.