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Numerical modeling of volatiles in Earth's mantle

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The transport and storage of water in the mantle significantly affects various material properties of mantle rocks and thus water plays a key role in a variety of geodynamical processes (tectonics, magmatism etc.) Geological and seismological observations suggest different inflow mechanisms of water via the subducting slab like slab bending, thermal cracking and serpentinization (Faccenda et al., 2009; Korenaga, 2017).
Most of the previous numerical models do not take different dip angles of the subduction slab and subduction velocities into account, while nature provides two different types of subduction regimes i.e. shallow and deep subduction (Li et al., 2011). To which extent both parameters influence the inflow and outflow of water in the mantle still remains unclear. For the investigation of the inflow and outflow of fluids e.g. water in the mantle, we use high resolution 2D finite element simulations, which allow us to resolve subducted sediments and crustal layers. For this purpose the finite element code MVEP2 (Kaus, 2010), is tested against benchmark results (van Keken et al., 2008). In a first step we reproduced the analytical cornerflow model (Batchelor, 1967) used in the benchmark of van Keken et al.(2008) as well as the steady state temperature field.
Further steps consist of successively increasing model complexity, such as the incorporation of hydrogen diffusion, water transport and dehydration reactions. Systematic simulations are performed to assess the influence of different model parameters on various target parameters such as dehydration depth, volcanic line position etc., the ultimate goal being the derivation of scaling laws for water transport in the mantle.

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