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IMAGING FLUIDS AND FLUID REACTIONS IN SUBDUCTION ZONES
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Water is recycled to the Earth's interior at subduction zones, and a large portion of the subducting fluid is mobilised at depths shallower than 150 km. Seimological and magneto-telluric methods are potential tools for imaging fluid circulation when combined with petrophysical models. Measurements of the physical properties of hydrous phases allow refining fluid circulation in the mantle wedge from geophysical data.

In the cold (<700 degree C) melt-free fore-arc mantle wedge above the subducting slab, serpentinisation is caused by the release of large amounts of hydrous fluids in the cold mantle above the dehydrating subducting plate. Low seismic velocities in the wedge give a time-integrated image of extensive hydration and serpentinisation within the stability of serpentine below 700 degree C. Using elastic properties, the amount of serpentinization is calculated to reach 50-100% in hot subductions, while it is below 10% in cold subduction. This amount corresponds to a time-integrated reaction of water-rich fluids originated from the dehydrating slab with the overlying mantle wedge.

Electromagnetic profiles of the mantle wedge reveal high electrical-conductivity bodies. In hot areas of the mantle wedge (>700 degree C), water released by dehydration of the slab induces melting of the mantle under volcanic arcs, explaining the observed high conductivities. In the cold wedge (<700 degree C), high conductivities in electromagnetic profiles provide "instantaneous" images of fluid circulation.

Small fractions (ca. 1% in volume) of connective high-salinity fluids account for the highest observed conductivities. Modelling shows that low-salinity fluids (<0.1 m) released by slab dehydration can evolve towards high-salinity (>1 m) fluids during progressive serpentinisation in the wedge. These fluids can mix with arc magmas at depths to produce high-chlorine melt inclusions in arc lavas.

Electrical conductivities up to 1 $S.m^{-1}$ are observed in the hydrated wedge of the hot subductions (Ryukyu, Kyushu, Cascadia), while moderate conductivities are observed in the cold subductions (N-E Japan, Bolivia), reflecting low fluid flow in the cold wedge of the latter. This is consistent with the seismic observations of extensive shallow serpentinisation in hot subduction zones, while serpentinisation is sluggish in cold subduction zones.

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