

Chemistry of Low Degree Hydrous Partial Melt at High Pressures

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Geophysical evidence hints towards the possibility that silicate melt may reside on top of the 410 km seismic discontinuity in some regions of the mantle. Based on the difference in the water storage capacity of upper mantle (dominantly olivine) and transition zone minerals (primarily wadsleyite), it has been suggested that if there is any melting at the top of the transition zone, it is likely to be hydrous melt. This hydrous melt phase might be able to reconcile the differences between geochemists view of stratified mantle (based on trace element differences in MORB and OIB) as opposed to geophysicsts view of whole mantle convection (based on seismic tomography of slabs).

However, fundamental questions remain unanswered: what is the composition of low degree hydrous partial melts at these conditions? Is this melt neutrally buoyant? Is the melt layer at the top of 410 km discontinuity, geophysically detectable?

In this study, we are determining the compositions of low degree hydrous partial melts that would be in equilibrium with the mineral assemblage at the base of the upper mantle. Initial experiments employ an estimated melt composition in the system CaO-MgO-Al₂O₃-SiO₂-H₂O, which was sandwiched between layers of peridotite (CAMS). By examining the shift in the composition of melt and mineral phases as the melt tries to equilibrate with the solid phases, the melt composition can be iteratively modified until the melt composition remains unchanged. Experiments are performed at 14 GPa and 1450 °C i.e, conditions pertinent to the top of the transition zone. The effect of iron on the melting relations is also being explored.

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Abs. No. **263**

Meeting: **DMG 2008**

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date: **2008-05-30**

Req. presentation: **Poster**

Req. session: **S04**