The water undersaturated transition zone

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The contrast in water storage capacity between the minerals of the Earth's transition zone and lower mantle suggests the possibility for dehydration melting at the top of the lower mantle. First-principles calculations of transition zone and lower mantle minerals combined with laboratory synthesis experiments of mantle-relevant garnets constrain the mantle water capacity across the base of the transition zone and highlight the key role of garnet in the Earth's deep water cycle.

Under Tibet, reversed polarity SS precursors indicate a boundary 70-90 km below the base of the transition zone while PP precursors have normal polarity. Zoeppritz equation modelling of the reflection and transmission coefficient for discontinuities at 660 km and 740 km depth are consistent with 2-3 vol % dehydration melting upon the breakdown of garnet to bridgmanite in this downwelling region. The results of this work revised downward the likely mantle water content in nominally anhydrous mantle minerals to <30% the mass of the surface oceans.