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Late, bouyant melting at the upper mantle-transition zone boundary

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One of the most important interfaces in the Earth is that between the relatively dry upper mantle and the relatively wet transition zone. In this work we use abi initio modelling to examine the transition of wet wadsleyite into olivine after upwelling. We find that the presence of water produces substantive melting which should be widespread across the globe if not always seismically visibile. Using seismic measurements of the properties of the 410 discontinuity and related low velocity zones we predict that the mantle transition zone needs to be relatively dry (<0.3 wt%) on average with wet patches up to (>0.6 wt%). This leads to a transition with substantial width on top of which sits low velocity zones produced by water, decoupled from local temperature effects and unable to act as local filters of elements between different mantle rock sources. The produced fluid is predicted to be bouyant and percolating. This leads to substantial water loss from the transition zone to the upper mantle which should eliminate the difference in water contents between them. We predict, however, that hydrous melting across this boundary is very recent and thus there has no been enough time for transition zone water to substantially infiltrate the upper mantle though this will change in the future.