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TI: Deep Upper Mantle Melting Detected with ScS Reverberations near Subduction Zones

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AB: Observations of a low-velocity layer atop the mantle transition zone are often interpreted as a layer of partial melt trapped within the deep upper mantle. Multiple ScS reverberations are sensitive to radial changes in impedance within the mantle and have been used to investigate the extent and thickness of these low-velocity layers. Revenaugh and Sipkin (1994) first reported evidence for a layer of dense, silicate melt resting atop the 410-km discontinuity beneath eastern China and the Sea of Japan. A recent study with a larger dataset has confirmed the presence of this low-velocity layer and examines its geographic extent on the arc-side of the subducting Pacific and Philippine slabs. Laterally extensive and geographically coherent observations have also been made using ScS reverberations in the southwest Pacific, beneath the Coral and Tasman Seas. In both of these regions, the thickness of the proposed melt layer is on the order of ~~50-70 km, an estimate that is at odds with predictions by dynamic and petrologic models. We propose that the layer is produced by water-induced melting initiated in the upper mantle (~~350 km depth) with a resulting melt that is negatively buoyant and percolates down to the 410-km discontinuity. If this melt has a zero-degree dihedral angle, then complete grain boundary wetting may preserve the signature of the melt, even for very low melt fractions. Excess water may be introduced into the region via storage in dense hydrous magnesium silicates and nominally anhydrous minerals within subducting slabs. ScS reverberations have also been used to detect a low-velocity layer atop the 410-km discontinuity on the oceanward side of the subducting slab at the western margin of the Pacific plate. Without the slab to transport excess water into this region, we suggest the combined effect of low

water content with increased temperature induces melting in this situation. Revenaugh, J. and Sipkin, S. A., 1994. Seismic evidence for silicate melt atop the 410-km mantle discontinuity. Nature (London). 369, 474-476.

DE: 3619 Magma genesis and partial melting (1037)
DE: 7203 Body waves
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DE: 8124 Earth's interior: composition and state (1212, 7207, 7208, 8105)
SC: Mineral and Rock Physics [MR]
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