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Melt Redistribution by Pulsed Compaction within UltraLow Velocity Zones

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We investigates the melt distribution and resultant seismic signature within UltraLow Velocity Zones (ULVZs) forced by pulsed compaction at the mantle-ULVZ interface. Transient flow in the ambient mantle causes periodic compaction in the ULVZ matrix. For a neutrally buoyant melt, an initially uniform melt distribution is modified by the formation of a thin, decompacting, melt-rich layer near the top and a wide, melt-poor, compacting layer near the bottom. Such a structure is reflected in large reductions in S and P wave velocities near the top and smaller reductions near the bottom of the ULVZ. The magnitude of melt segregation in the decompaction layer is controlled by the viscosity of the ULVZ matrix in a nonlinear fashion. At high ULVZ viscosities, the compaction length becomes substantially larger than the dimension of thin ULVZs, leading to a reduction in the magnitude of melt segregation in the decompaction layer.