Receiver function imaging of the complex plumbing system feeding Mount St. Helens, Washington

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Abstract

Mount St. Helens in Washington state, the most active volcano in the Cascade arc, was recently instrumented with a dense, expansive network of seismometers through the imaging Magma Under Mount St. Helens (iMUSH) Seismic Experiment, providing a unique opportunity to characterize the lithospheric structure of a magmatic system at an active volcano. With data collected from this experiment, the magmatic plumbing system feeding Mount St. Helens has been characterized by a variety of independent seismic imaging studies. These have identified an upper crustal (~4-15 km depth) low velocity zone interpreted as the primary magma reservoir containing up to an estimated 10-12% of partial melt and large lower crustal high velocity zones interpreted variably as magmatic cumulates or accreted high velocity terrane. Here, we attempt to further constrain the seismic properties of this system using receiver function-based analyses including adaptive common conversion-point (ACCP) stacking and *Ps-P* tomography. ACCP stacking reveals a three-dimensional model of seismic impedance contrasts within the crust and across the crust-mantle transition, highlighting clear variations in the amplitude of the Moho correlated with the presence of previously interpreted lower crustal cumulates as well as upper-crustal velocity contrasts associated with the shallow magma reservoir. *Ps-P* tomography reveals a three-dimensional model of V_P/V_S within the crust, highlighting strong variations in V_P/V_S related to previously interpreted upper crustal magma reservoirs while also providing relative V_P/V_S constraints in the lower crust. This ongoing work allows us to integrate constraints from the varied multi-scale seismic imaging studies of the Mount St. Helens plumbing system and validates the efficacy of receiver function based imaging in volcanic settings.