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Preliminary Results from the iMUSH Active Source Seismic Experiment

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iMUSH (imaging Magma Under Saint Helens) is a US NSF sponsored multi-disciplinary investigation of Mount Saint Helens (MSH), currently the most active volcano in the Cascades arc in the northwestern United States. The project consists of active and passive seismic experiments, extensive magnetotelluric sounding, and geological/geochemical studies involving scientists at 7 institutions in the U.S. and Europe. The long-term goal of the seismic project is to combine analysis of the active source data with that of data from the 70 element broadband seismograph operating from summer 2014 until 2016. Combining seismic and MT analyses with other data, we hope to image the MSH volcanic plumbing system from the surface to the subducting Juan de Fuca slab. Here we describe preliminary results of the iMUSH active source seismic experiment, conducted in July and August 2014.

The active source experiment consisted of twenty-three 454 or 908 kg weight shots recorded by $\sim$3500 seismographs deployed at $\sim$6,000 locations. Of these instruments, $\sim$900 Nodal Seismic instruments were deployed continuously for two weeks in an areal array within 10 km of the MSH summit. 2,500 PASSCAL Texan instruments were deployed twice for five days in 3 areal arrays and 2 dense orthogonal linear arrays that extended from MSH to distances $>$ 80 km. Overall the data quality from the shots is excellent. The seismograph arrays also recorded dozens of micro-earthquakes beneath the MSH summit and along the MSH seismic zone, and numerous other local and regional earthquakes. In addition, at least one low frequency event beneath MSH was recorded during the experiment.

At this point we have begun various types of analysis of the data set: We have determined an average 1D Vp structure from stacking short-term/long-term average ratios, we have determined the 2-D Vp structure from ray-trace inversions along the two orthogonal profiles (in the NW-SE and NE-SW directions), and we have made low-fold CMP stacks of the profile data. The 1-D average model was made from the modulus of short-term average/long term average ratios of all traces from all shots, with traces sorted into offset bins and summed. In addition to strong *Pg* and *Sg* phases, the STA/LTA stack clearly shows *PmP*, *PmS*, and *SmS*. The 2-D ray-trace inversions have identified a -15% *dlnVp* anomaly at 4-10 km depth bsl beneath the MSH summit. We identify this anomaly as the feeder magma chamber to the shallowest (1-3 km depth) magma chamber previously imaged by local earthquake tomography (Waite and Moran, 2009, *Journal of Volcanology and Geothermal Research, 182, 113-209*). Pre- and post-critical *PmP* phases image the Moho, at depths varying from 35-40 km, directly beneath the MSH plateau and to the east beneath the Cascadia backarc.