We deployed 70 broadband seismometers in the summer of 2014 to image the seismic velocity structure beneath Mount St. Helens (MSH), Washington, as part of the collaborative imaging Magma Under St. Helens (iMUSH) project. Our goal is to illuminate the MSH magmatic system with active- and passive-source seismology, magnetotellurics and petrology. Details of the velocity structure, coupled with other geophysical and geologic data, can help constrain the geometry and physical state of any bodies of melt beneath the volcano. The broadband array has a diameter of ~100 km centered on MSH with an average station spacing of 10 km, and will remain deployed through summer 2016. It is augmented by dozens of permanent stations in the area. We determine P-wave arrival times using Antelope software and also incorporate permanent network picks. There were more than 400 quality local events during the first year of iMUSH broadband recording, which to date have provided over 11,000 arrival times. The iMUSH experiment included 23 active shots in 2014 that were recorded with good signal-to-noise ratios across the entire array. Direct raypaths from local earthquakes and active shots reach 15-20 km depth beneath MSH. We use the program struct3DP to iteratively invert travel times to obtain a 3-D seismic velocity model and relocate hypocenters. Travel times are computed using a 3-D eikonal-equation solver. We intend to expand our analysis to include S-wave arrivals from active shots and local events, teleseismic arrivals to help constrain lower crustal seismic velocities, and double-difference tomography methods. Our model interpretations will benefit from comparison and/or integration with other portions of the iMUSH experiment, such as active-source and ambient noise tomography, receiver functions, magnetotellurics, and petrology. The preliminary 3-D model shows low P-wave speeds along the St. Helens seismic Zone (SHZ) from 5-15km depth.

(A) Station and event geometry. Box shows area in B, line shows cross-section in C. (B) Depth slice through Vp model at 9.4 km depth, with earthquakes and recording stations. Generally lower velocities along the SHZ which goes NNW from MSH. (C) Cross-section along strike of SHZ, with earthquakes and recording stations.