Geophysical Research Abstracts
Vol. 17, EGU2015-1858, 2015
EGU General Assembly 2015

Scattering and absorption mapping of tectonic and feeding structures under the pre-eruptive Mount St. Helens volcano.

Luca De Siena (1,2), Marie Calvet (3), and Christine Thomas (2)

(1) School of Geosciences, University of Aberdeen, Seismology, Aberdeen, United Kingdom (lucadesiena@abdn.ac.uk), (2) Institut für Geophysik, University of Münster, Münster, Germany, (3) Institut de Recherche en Astrophysique et Planétologie, Université Paul Sabatier / CNRS, 14 Avenue Edouard Belin, 31400 Toulouse, France

Knowing how seismic waves lose their energy in space and frequency is both critical for understating volcanic structures and important to detect eventual changes in their seismic and volcanic activity. We measure both the peak-delay time and the coda quality factor on seismic envelopes recorded at Mount St. Helens volcano between 2000 and 2003, just before its 2004 explosive eruption. By the 2D mapping of these two frequency-dependent quantities we obtain S-wave scattering and absorption maps in the pre-eruptive phase of the volcano. We use a 2D K-means cluster analysis to highlight correlations in the frequency-dependent spatial patterns and interpret the results in terms of tectonic and feeding structures. The transition between the high-velocity and high-scattering Siletz terrane and the low-velocity and high-absorption Cascade arc crust is a persistent signature in the entire frequency range. At high frequencies, we observe strong correlation between high-scattering, high-absorption, and high P-wave heterogeneity (this last tomographically derived between depths of 0 and 10 km). In our interpretation, this correlation is a direct consequence of resonance effects, induced by the presence of melt and fluid inclusions as well as residuals of previous eruptions. The area of maximum heterogeneity is located south-south-west of the central crater: the region shows selective high absorption characteristics at 6 Hz only. If this supports the presence of a previously-inferred aseismic magma chamber intersecting the south-south-western flank of the volcano, the selectivity suggests a depth extension of the magma chamber lower than 1 km. The most important high-scattering and high-absorption signature at high frequencies remains a NNW-SSE suture crossing the volcanic cone and parallel to the St. Helens Seismic Zone. The trend confirms the persistent major role of the main direction of regional structural stress in the uprise of magma/fluid filled materials in the first few kms of the crust.