Cities on Volcanoes 9
November 20-25, 2016
Puerto Varas, Chile
'Understanding volcanoes and society: the key for risk mitigation'

Investigation of P-wave Scattering around Etna Volcano in frame of the TOMO-ETNA Experiment

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Physics of Volcanoes, Mt. Etna, Seismic Scattering

The TOMO-ETNA experiment, as part of the European Union project "MEDiterranean SUpersite Volcanoes (MED-SUV)" efforts with resources of the EU project "EUROFLEETS 2", and other funding agencies from Italy, Spain, and Germany, aimed to resolve the structure beneath Etna volcano and surrounding areas of Sicily in a never reached high structural resolution using active and passive seismic methods. In June 2014 air-gun shots were recorded by 168 seismic stations onshore plus 27 ocean bottom instruments offshore in the Tyrrhenian and Ionian Seas while during the passive experiment 50% of stations were running until October 2014. For resolving a volcanic structure the investigation of attenuation and scattering of seismic waves is fruitful. In contrast to existing studies that are almost exclusively based on S-wave signals emitted by local earthquakes, here recorded signals of air-gun shots, generated in the Ionian and Tyrrhenian Seas, were analyzed by applying a new methodology based on the coda energy ratio defined as the ratio between the energy of the direct P-wave and the energy in a later coda window, based on the assumption that scattering caused by heterogeneities removes energy from direct P-waves that constitutes the earliest possible arrival to any part later in the seismic wave train. As an independent proxy of the scattering strength along the ray path, we measure the peak delay time of a direct P-wave, which is well correlated with the coda energy ratio. As a result the distribution of heterogeneities around Etna is visualized as the projection of the observation in directions of incident rays at the stations. It shows increased seismic scattering in the volcano and east of it. The strong heterogeneity found supports earlier observations. The heterogeneous zone towards the east coast of Sicily is interpreted as a potential signature of the eastward sliding volcano flank.