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Small scale shallow attenuation structure at Mt. Vesuvius, Italy

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We present a high resolution 3-D model of S-wave attenuation (Q_s^{-1}) for the volcanic structure of Mt. Vesuvius. Data from 332 VT earthquakes located close to the crater axis in a depth range between 1 and 4km (b.s.l.) recorded at 5 3-C seismic stations were used for the inversion. We obtained the estimate of Q_s^{-1} for each source-station pair using a single-station method based on the normalization of the S-wave spectrum for the coda spectrum at 12s lapse time. This is a modification of the well known coda-normalization method to estimate the average Q_s^{-1} for a given area. We adopt a parabolic ray-tracing in the high resolution 3-D velocity model using almost the same data set; then we solve a linear inversion scheme using the L-squared norm with positive constraints in 900m-side cubic blocks, obtaining the estimate of $Q_s^{-1}$for each block. Robustness and stability of the results are tested changing in turn the input data set and the inversion technique. Resolution is tested with both checkerboard and spike tests. A further test is carried out comparing the coda-normalization method with the ordinary spectral decay method, which furnishes comparable results.Results show that attenuation structure resembles the velocity structure, well reproducing the interface between the carbonates and the overlying volcanic rocks which form the volcano. Analysis is well resolved till to a depth of 4-5 km. Higher Q contrast is found for the block overlying the carbonate basement and close to the crater axis, almost coincident with a positive P-wave velocity contrast located in the same volume and previously interpreted as the residual high density body related to to the last eruptions of Mt. Vesuvius. We interpret this high-Q zone as the upper part of carbonate basement in which most of the high energy seismicity take place. The low-Q values found at shallow depth are interpreted as due to the high heterogeneity due to the mixing of lava layers and pyroclastic materials extruded during the last eruptions.