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Separation of Qi and Qs from passive data at Mt. Vesuvius: a reappraisal of seismic attenuation

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Seismic attenuation in the area of Mt. Vesuvius is reappraised by studying more than 400 S-coda envelopes of small local VT earthquakes recorded at Mt. Vesuvius from 1996 to 2002 at the 3-D stations of OVO and BKE. The purpose is to obtain a stable separate estimate of intrinsic and scattering quality factors for shear waves. A preliminary estimate of the same quantities was already obtained by Bianco et al. (1998). We investigate in the present paper 4 frequency bands, centred respectively at fc=3,6,12 and 18Hz with a bandwidth of 0.6fc. Then, we stack the normalized (at 11s lapse time) filtered coda envelopes obtaining a single stacked trace for each component and station. Stacked envelopes are fit to the multiple scattering model of Zeng in the hypothesis of constant velocity half space. Results show that the scattering attenuation (proportional to $Q_s^{-1}$the inverse scattering-quality factor) is much stronger than the intrinsic dissipation (proportional to Q_i^{-1}) and that Q_s^{-1}decreases with frequency. Intrinsic attenuation is much less frequency-dependent. We also fit the data with the diffusion model in the assumption of half-space, finding the same values for the estimates of $Q_s^{-1}$and Q_i^{-1}obtained using the multiple scattering model. We assume this evidence as an indirect indication of the presence of diffusive processes in the shallow crust underlying Mt. Vesuvius. In order to test the consequences of the half space assumption we fit the stacked coda envelopes at BKE to the diffusion equation solved with the boundary condition of a diffusive layer over a homogeneous half space. We test both a fully absorbing and a reflecting boundary condition, setting the half space at a depth of 2 km below the sea level, representing the carbonate basement at Mt. Vesuvius. Results show that the diffusivity, D, estimated in the assumption of reflecting boundary condition is greater than that estimated in the assumption of uniform half space, whereas the diffusivity estimated with the absorbing boundary condition is close to the estimate done in the assumption of half space. OVO station shows re-

sults different from those obtained at BKE for the frequency bands centered at 12 and 18Hz. In these two bands, scattering attenuation is comparable to the intrinsic dissipation, and is much smaller than that measured at BKE. A comparison with the results from Bianco et al. (1998) indicates that for another group of 5 stations located on Mt. Vesuvius, the coda envelopes behave like BKE. OVO is consequently the unique anomaly among a set of 5 stations. We interpret this anomaly as due to an effect of strong lateral heterogeneity which modifies the redistribution of the seismic energy into the coda at OVO. A comparison of the results obtained using passive data (the present data set) and the active data obtained in the same area during TOMOVES experiment by Wegler (2004) shows that the diffusivity estimated with shot data during TOMOVES is smaller of a factor greater than 4. This discrepancy is interpreted as due to different earth volumes sampled by the coda waves in the two cases.