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Imaging of Mt. Vesuvius' s quiescent stage using velocity and attenuation tomography.

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The 3-D total S and P attenuation images of Mt. Vesuvius were obtained in two frequency bands with the Coda Normalization (CN) method, that has been demonstrated to be independent of site and almost insensitive to radiation pattern. The images in the highest frequency band (centered at 18Hz) have been compared with those obtained through the application of the so called "slope decay" method, yielding practically the same results. Interestingly, the independence of CN of site transfer function makes this approach particularly suitable for the application to volcanic areas, where site effects may severely affect the spectrum of the radiation emitted by the VT earthquakes. We solved the tomographic problem by applying a multi-resolution method, which enhances the resolution in the volume cells crossed by a high number of rays. The high ray-sampling is localized essentially under the central part of the cone till to a depth of 4-5 km. In this zone we have thus an S-wave attenuation image with a resolution of 300 meters, comparable with that of the velocity tomography. Laterally to this high-resolution zone, resolution becomes lower due to the station density, which is not comparable with the cell dimension. We crossed the information obtained from both the velocity and the attenuation tomography. We isolated the volumes showing laterally or in depth strong velocity contrasts. A zone located exactly under the cone shows an inverse correspondence between velocity and $Q_S^{-1}$and a correlation with the high $\frac{V_P}{V_S}$ contrast, which may be associated with the presence of fractured medium permeated by fluids. Our interpretation excludes the presence of a shallow patch of magma, in agreement with previous interpretation of the velocity tomography. This results are also corroborated by geochemical studies, that recognized the location of an hot aquifer under the cone located just in the same position. The observed atten-

uation increasing toward East and North direction may be explained by the presence of the old caldera rocks (Mt. Somma), surrounding the central structure of Mt. Vesuvius in the North and East quadrants. In agreement with the interpretation reported in several velocity tomography studies, the low attenuation zone is interpreted as related to the residual part of solidified lava from the last eruption. An high contrast in both S-wave velocity, and Q_S^{-1} is spatially coincident with the zone of maximum seismic energy release. The observed strong contrast may be generated by a highly fractured area (presence of VT earthquakes) at the border between the limestone basement and volcanic rocks over imposed. In the same area the low P and S attenuation and the high $\frac{V_P^{-1}}{V_S^{-1}}$ may by associated to the presence of fluids filling the cracks, confirming the involvement of the fluids in the generation of larger events. We exclude the presence of large gas reservoirs, due to the similar pattern of Q_P^{-1} and Q_S^{-1} for all the analyzed frequencies. The results obtained are intriguing, as they add new information about the volcano quiescent stage at a small scale.