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Intrinsic quality factor, source dimensions and attenuation site effects from the inversion of rise time data of microearthquakes recorded in 2002 at Mt. Etna

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The intrinsic quality factor Qp of the compressional body waves is considered one of the geophysical parameters better correlated with the physical state of the rocks. This is because, as shown in laboratory studies (Kampfmann and Berckemer, 1985; Sato and Sacks, 1989) a type-Arrhenius exponential law relates Qp with the temperature T and the pressure P of the rocks. In volcanic areas, low Qp values are usually associated to high temperature rocks (e.g. Sanders et al; 1995; de Lorenzo et al., 2001). Starting from the above considerations, in the frame of an European project aimed to investigate the movement of fluid masses inside the Mount Etna, a research line has been dedicated to the reconstruction of Qp images of the volcano with different techniques. To this end, in this work we present the results of a first study aimed to obtain a first estimate of the average intrinsic Qp at Mt. Etna by using the classic rise time method (Gladwin and Stacey, 1974). About three-hundred microearthquakes preceeding and accompanying the 2002-2003 Mt. Etna flank eruption have been considered in this study. On the high-quality velocity seismograms, measurements of the first half cycle of the wave, the so-called rise time, have been carried out. By using a classical time domain technique, these data have been inverted to infer an estimate of the intrinsic quality factor Qp of P wave, and the source rise time of the events, which represents a rough estimate of the duration of the rupture process. For each event Qp varies from a minimum of 6 to a maximum of 571, with an average value of 67 and a standard deviation of 22. A residual correlation among Qp and the source rise time has been inferred, which is a clear indication of the need of performing a future three-dimensional tomographic Qp study in the area. A first attempt to quantify the effect of

residual attenuation at each recording site has been performed. This allowed us to estimate generally negative Delta_Q station residuals with the exception of two stations. Stress drops, inferred from source rise time and magnitude duration data, varies from a minimum of 0.5 MPa to a maximum of about 100 MPa. A strong variability of stress drop is also inferred but the present trade-off among Qp and source rise time impedes us to evaluate if a departure from self-similarity occurs for the studied events.

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