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Seismic velocity variations at Mt. Etna during the 2002-2003 eruption measured using the Coda Wave Interferometry technique

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The Coda Wave Interferometry (CWI) technique can discriminate between source displacement, scattering movement and velocity variations. Here we use the CWI technique for the detection of changes in seismic velocity using doublets (i.e. pairs of highly similar waveforms recorded at the same station at different times). Doublets shares a similar travel path, therefore for identical co-located sources, whose origin times are different, the observed difference in waveforms is related to a change in the medium. In a strongly scattering environment such as a volcano, the seismic coda, composed of multiply scattered waves, 'samples' the medium more effectively than the direct (ballistic) arrivals, allowing a detection accuracy in velocity changes of the order of 10-4. We apply the CWI technique to seismic data recorded by a temporary broadband deployment during the 2002-2003 eruption of Etna Volcano, Italy. Our catalog spans the October, 31st, 2002 - February 2003 time interval. The 2002-2003 eruption was characterized by two distinct lava flows created by different fissure systems, characterized by distinct lava chemical composition. The two different flows interested the North-East Rift and the southern flank of the volcano. The seismic stations used are located on the southern flank, close to a secondary vent. All the recorded seismicity has a shallow hypocentral location and small source-receiver distance (P to S onset shorter than 1 s). Using the CWI technique, abrupt changes in velocity can be detected with errors smaller than one percent and over different temporal window lengths, from days to minutes. Those changes, which are recorded during the eruption, can be associated with changes in eruptive phase (from lava fountains to strombolian activity), observing positive changes in velocity during the explosive phase and the

opening of new vents and negative changes associated with lower activity levels. The variations are likely related to changes in the pressurization of the system.