



## **Characterization of the breccia deposits in downtown L'Aquila (Central Italy) through multichannel analysis of surface waves**

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On April 6th 2009 an Mw 6.3 earthquake hit the historical city of L'Aquila (Central Italy) causing about 300 casualties, more than 39000 homeless and strong damage in the city and in the surrounding villages. L'Aquila downtown suffered Mercalli-Cancani-Sieberg (MCS; Sieberg 1930) intensity > VIII. Heavy damage and collapses were concentrated in the unreinforced masonry buildings including historical churches.

Starting from June 2009, the Italian Civil Defense Department promoted a microzoning study of the epicentral area, aimed at identifying, at a detailed scale, areas where local seismic amplification could occur due to the characteristics of surface geology.

L'Aquila is founded on a terrace that slopes down moving in the southwest direction, and raises about 50 meters above the Aterno river bed. The terrace is formed by alluvial Quaternary breccias consisting of limestone clasts in a marly matrix. In the northern part of the city the terrace is in contact with outcropping limestone, while moving toward south, breccias are over imposed to lacustrine sediments formed mainly of silty and sandy layers and minor gravel beds. As found by boreholes, the thickness of the breccias formation ranges from tenths of meters at north to just few meters at south. The uppermost weathered part of breccias outcrops at south and is indicated as "limi rossi". The presence of breccias and "limi rossi" in the northern and southern part of the city respectively, is well identified by collected geotechnical data. Shear wave velocity ( $V_s$ ) are quite high in the northern sector and can reach values of about 1000 m/s, whereas in the southernmost part the  $V_s$  of "limi rossi" drops down to 300-400 m/s. The microzoning studies at L'Aquila evidenced the presence of low-frequency (about 0.6 Hz) amplification diffused in the historical center with high amplification factors in the southern area of the city were "limi rossi" outcrops.

We here present the results of multichannel surface waves analysis (MASW) based on active and passive sources. Active methods consist of 1D linear arrays of 4.5 Hz-vertical geophones using a minigun as source. Passive methods consist of 2D arrays of seismic three-component sensors. In order to investigate the low-frequency amplification, the geometry of 2D arrays was accordingly designed, using 16 seismic stations with maximum aperture of 1 km that recorded many hours of ambient seismic noise. We deployed three 2D arrays, one in the northern part and two in the southern part of the city. The 1D linear array was dedicated to characterize the shallower part of "limi rossi".

With the aim to derive the shear wave velocity profiles, the apparent phase velocity estimated through arrays technique has been inverted through a neighborhood algorithm.