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Sediment thickness estimated from HVSR ambient noise measurements in the epicentral area of the April 6 2009 L'Aquila earthquake (central Italy)

Federica Durante, Francesco del Monaco, and Marco Tallini
Italy (geol.durante.federica@gmail.com)

In this paper we present the empirical relationship between the sediment thickness (z) and the resonance frequency (f0), as defined by the HVNSR method, for the Quaternary Western L'Aquila Plain (central Italy) which was struck by the Mw: 6.3 earthquake on April 6t h 2009.

The whole activities were organized as follows: i) acquisition of approximately 500 HVNSR measurements located homogenously and at high density in the studied areas; ii) a geological and geophysical database was carried out taking into account boreholes data, Vs in-hole tests (cross hole, down-hole and SDMT techniques), seismic reflection investigations and HVNSR measurements; iii) reconstruction of the f0 contour lines map by using the Natural Neighbor method; iv) comparison of sediment thickness with f0 values to estimate the empirical relationship between them which is characterized by a quite high correlation coefficient (0.73) and is comparable with others from references; v) reconstruction of the sediment thickness contour lines map by using the Natural Neighbor method. To estimate the local seismic response within the seismic microzonation activities for urban planning purposes, the sediment thickness lied upon the geological bedrock could be useful to evaluate as showed in several case studies. One of the possible approach to evaluate the sediment thickness is to determine the empirical relationship between it and its resonance frequency (f0) as defined by the HVNSR method. In fact, following this earthquake, within the scope of building reconstruction and seismic microzonation planning of L'Aquila Municipality, many boreholes, among which several ones encountered the geological bedrock, and in-hole Vs tests (DH, CH, SDMT) were carried out in the more damaged area. The large number of data, with others performed in previous time in the same area, were used to calculate the empirical relationship which was compared with others from literature.

The estimation of sediment thickness has been constrained by a great number of boreholes spread out homogeneously in area. Seismic noise measurements has been executed nearby the deep boreholes which intercepted the geological bedrock.

As a rule, known f0, the sediment thickness (z) can be evaluated from the resonance frequency (f) with the following equation:

z=a•fˆb,

where a and b are two parameters obtained from the best fitting technique in the diagram z vs. f

The best fitting coefficient of the z vs. f equation decrease because of the presence in the subsoil of strong geophysical heterogeneities of fill-basin soft sediments (Delgado et al. 2000b).The sediment thickness vs. f0 relationship, together with the f0 and sediment thickness contour lines maps, could be considered a useful tools for seismic site characterization within the scope of seismic microzonation and urban planning purposes.