

Agreement INGV-DPC 2007-2009

Project S4: ITALIAN STRONG MOTION DATA BASE

*Responsibles: Francesca Pacor, INGV Milano – Pavia
and Roberto Paolucci, Politecnico Milano*

<http://esse4.mi.ingv.it>

Appendix B

Activities following the April 6, 2009, L'Aquila earthquake

June 2010

edited by:

UR6 - Giuseppe Lanzo, Sapienza University of Rome

Seismic characterization of the RAN stations located in the near-fault area of the L'Aquila earthquake

The mainshock on 6 april 2009 was recorded by 56 digital strong motion RAN stations at distances within 280 km from the epicenter. Of particular interest are the stations located in the epicentral area. The high-quality strong motion data produced makes the L'Aquila earthquake the best-recorded normal fault event world-wide and the best-recorded earthquake in Italy in a near-fault area. Ground motion recordings from these stations represent therefore a valuable set of data because they provide new information regarding ground shaking and site effects in a near-fault region.

The majority of near-fault stations belong to an array which was installed across the upper Aterno valley in 2001 by the DPC. This array is formed by six stations, namely *Colle Grilli* (AQG), *Fiume Aterno* (AQA), *CentroValle* (AQV), *Il Moro* (AQM), *Ferriera* (AQF) and *Monte Pettino* (AQP). However, three of these stations (AQM, AQF and AQP) did not trigger or malfunctioned during the mainshock. Another station which recorded the mainshock and many aftershocks is located in downtown L'Aquila (AquilPark, AQK). The location of these strong-motion stations is shown in Figure 1.



Figure 1. General view of the Aterno valley and bordering mountains showing the location of the RAN strong-motion stations (AQG, AQA, AQV, AQM, AQF, AQP); in the rear the station AQK in downtown L'Aquila (vertical scale exaggerated 2x)

A subsoil classification of the above mentioned stations was first carried out mainly based on the geological information available and is described in Di Capua et al. (2009). A geological map (scale 1:100.000) of L'Aquila and the eastern Aterno valley is shown in Figure 2, together with the locations of the strong-motions stations.

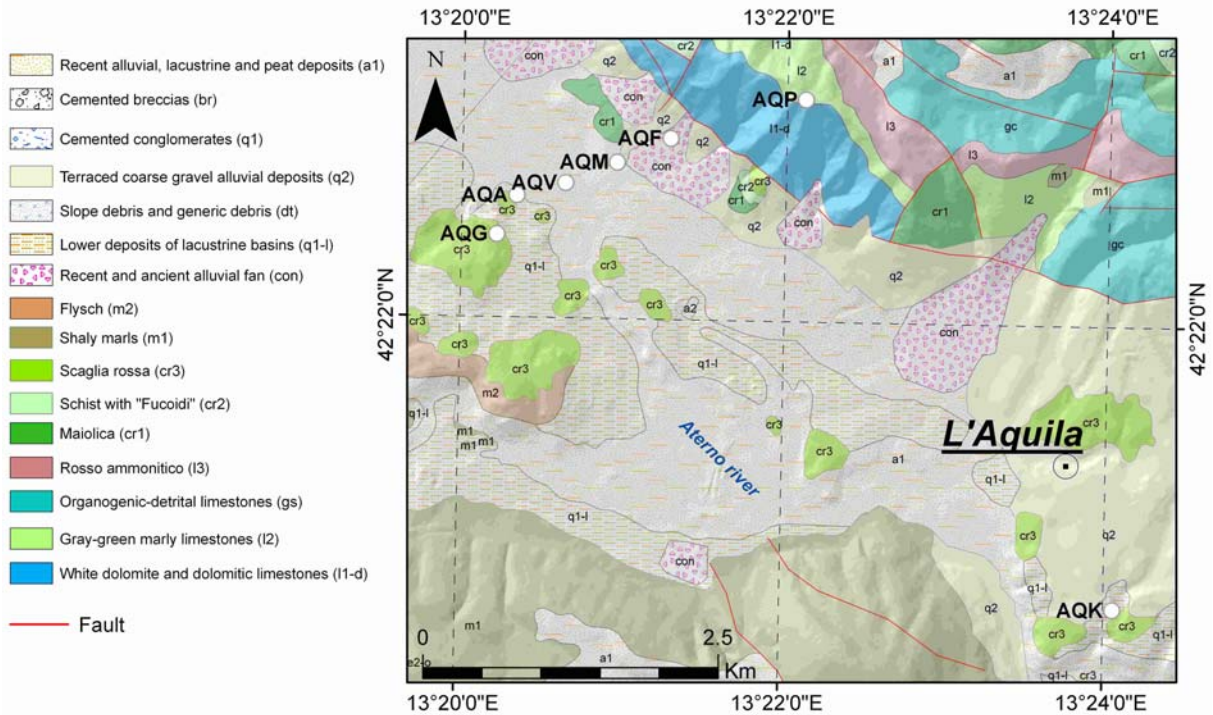


Figure 2. Geologic map of the Aterno valley in correspondence of L'Aquila (Geologic Map of Italy, scale 1:100.000, Sheet 139 "L'Aquila")

However, it was soon recognized that the major shortcoming of the accelerometric dataset was a lack of good information on site conditions. To properly use this significant set of strong motion records it is desirable to identify the site conditions at the stations. A major effort was therefore undertaken by this research unit to improve the characterization of subsoil conditions at these sites. Boring logs and down-hole tests were carried out at AQQ, AQA and AQC (for AQV a cross-hole test was already available). Further, an additional borehole was drilled approximately between AQA and AQV. The results of these tests are presented hereafter in terms of stratigraphic and V_S - V_P profiles.

AQG

The AQG station is located at the hilltop of Colle Grilli, which is a calcareous highly fractured ridge having height of 50 m and width at the base of 300 m. A borehole was drilled adjacent to the recording station to a depth of 40 m. Boring log and V_S and V_P profiles are presented in Figure 3. Along the whole profile pervasively tectonized calcirudite, locally in sandy/silty matrix, has been found. The V_{S30} for this site is 685 m/s, making it a stiff site (B) in the Italian code and EC8 classification system.

AQA

The AQA station is located in proximity of the right bank of the Aterno river. The geology of the area indicates that the station is located on the Holocene deposits, at the southern edge of the alluvium valley (Figure 4). A 30m-depth borehole was drilled by the Department of Civil Protection on the left bank of the river (the right bank was not accessible), approximately in front of the station. Soil profile consists of 6 m of calcareous gravels in sandy/silty matrix with layers of silty/clayey soils overlying talus debris constituted by angular gravels to 30 m depth. The down-hole was carried out by this RU (Figure 4). The V_{S30} for this site is 552 m/s, making it also a stiff site (B) in the Italian code and EC8 classification system.

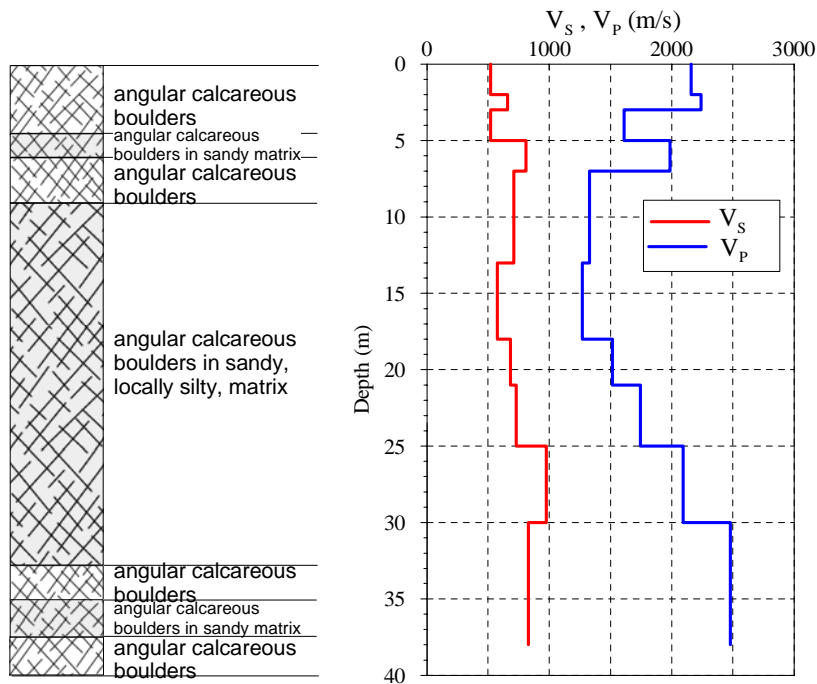


Figure 3. Stratigraphic, V_S and V_P profiles at AQQ station.

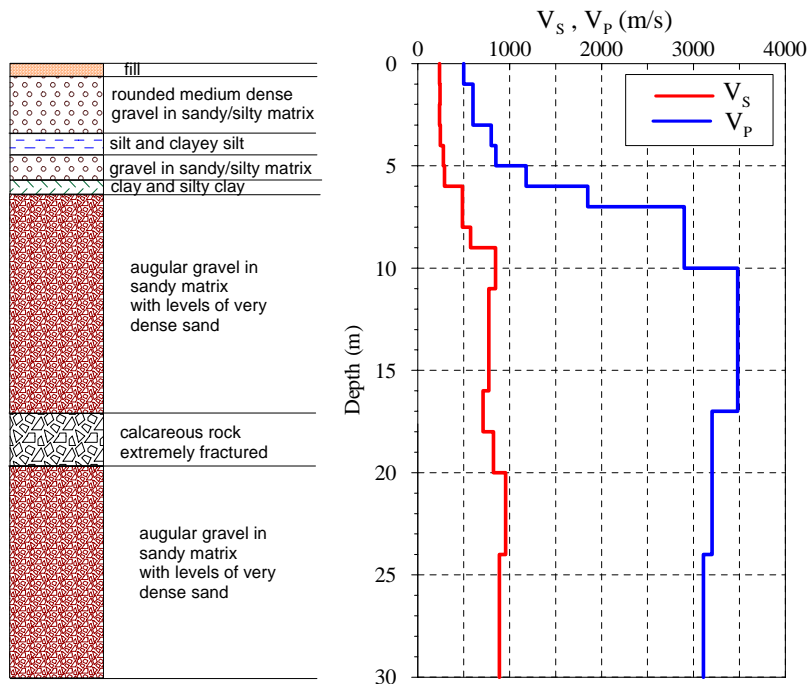


Figure 4. Stratigraphic, V_S and V_P profiles at AQA station.

AQK

The AQK station is located in downtown L'Aquila, in proximity of the entrance of the tunnel connecting the Bus Station with downtown L'Aquila. The geology of the area indicated that the station is located on cemented breccias (locally known as "megabreccia") overlying lacustrine sediments resting on limestones. A 50 m-depth borehole was drilled 200 meter

apart from the station AQQ by the Department of Civil Protection. The soil profile consists essentially of dense gravel in sandy/silty matrix with calcareous boulders (“megabreccia”) to a depth of 36 m underlain by stiff silt layer with frequent levels of sand (Fig. 5). The down-hole was carried out by this RU (Figure 5). The V_{S30} for this site is 717 m/s, making it a stiff site (B) in the Italian code and EC8 classification system.

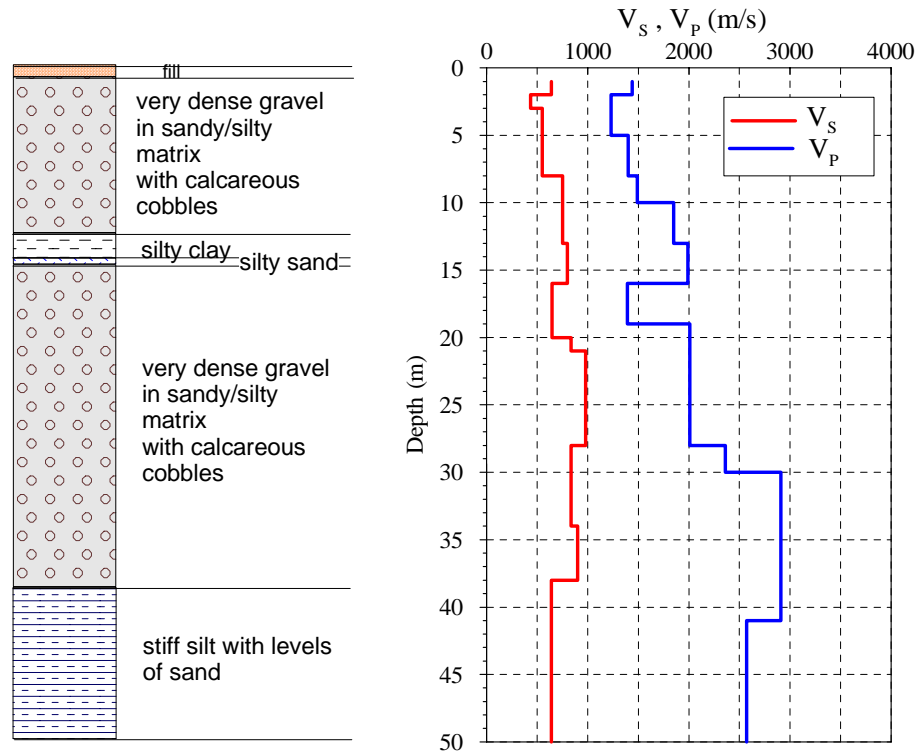


Figure 5. Stratigraphic, V_S and V_P profiles at AQQ station.

Borehole in the Aterno valley

An additional borehole was drilled in the Aterno valley at approximately 250 m from AQA station. The borehole, named AQA2, was carried out in proximity of the left bank of Aterno river. The main motivation for this drilling was to obtain information on the position of the calcareous bedrock in order to construct a reliable 2D cross-section of the Aterno valley along the transect. This information will help in modelling the 2D seismic response analysis of the cross-section of the valley with the aim of reproducing the recorded ground motion at the stations and quantify the importance of site effects in the epicentral area. The stratigraphic profile in AQA2 is illustrated in Fig. 7. A seismic dilatometer test (SDMT) is also planned at the site.



Figure 6. Location of the AQA2 borehole.

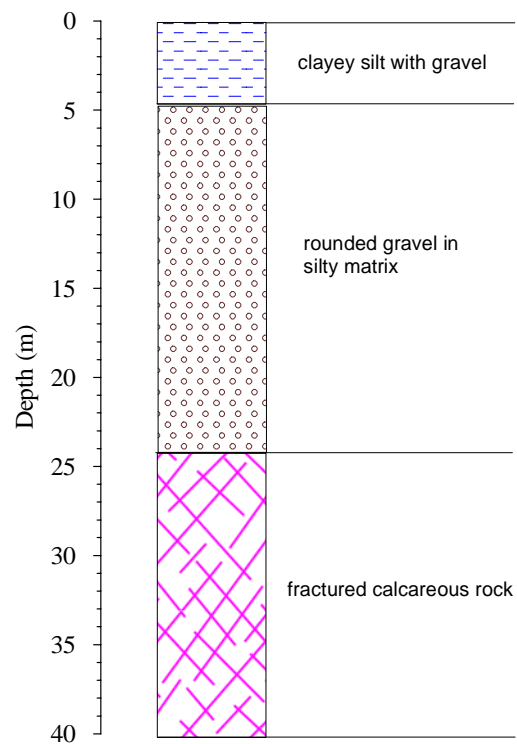


Figure 7. Stratigraphic profile at AQA2 site

References

Di Capua G., Lanzo G., Luzi L., Pacor F., Paolucci R., Peppoloni S., Scasserra G., Puglia R. (2009). Caratteristiche geologiche e classificazione di sito delle stazioni accelerometriche della RAN ubicate a L'Aquila". Progetto DPC – INGV S4: Banca dati accelerometrica (http://esse4.mi.ingv.it/images/stories/Classificazione_Sito_Stazioni_RAN_AQ.pdf).