

EVIDENCE OF THE MIRANDOLA ANTICLINE USING HVSR MEASUREMENTS

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The southwestern portion of the Municipality of Mirandola area (Province of Modena, Emilia-Romagna region, Italy) is interested by a buried structural high known as "Mirandola Anticline" (Burrato et al. 2003). In correspondence of this structure the continental and marine superficial deposits of Po Plain are particularly thin.

104 passive seismic measurements (single station microtremor) were performed over the entire municipal area for the seismic microzonation study of Mirandola (september 2011 – february 2012).

The comparison of HVSR (horizontal to vertical spectral ratio) curves (Castellaro et al. 2005) with the detailed geological sections made by Geological, Seismic and Soil Survey of Regione Emilia-Romagna for the recent researches relating to potential geothermal reservoirs in the Mirandola subsoil (Martelli e Molinari 2008), shows an excellent correlation between the stratigraphic architecture of superficial units and the results of the passive seismic measurements (peak frequency and amplitude).

In the area of the structural high culmination, where Quaternary Continental deposits are thinned (80-90 meters only) and laid directly over Pliocene units, a very high impedance contrast, connected by an abrupt velocity increase, is detected: HVSR peaks are steep with frequencies > 1 Hz and very high amplitude (>3) (i.e. R075 and R085).

Where a very thin layer of Quaternary Marine deposits (only 20-30 meters) is interposed between thinned Quaternary Continental deposits and Pliocene units, a high impedance contrast connected by two very close velocity increases is detected: HVSR peaks are wide with frequencies ~1 Hz and high amplitude (~3) (i.e. R062, R065 and R086).

The fundamental frequency (f0) map, required by the DGR 1051/2011 of Regione Emilia-Romagna for the first level seismic microzonation, was then enhanced to highlight the results of HVSR measurements related with the structural high: in addition to the required f0 values for each single measuring point, a colour-shaded grid, related to HVSR peaks amplitude, has been added in background. This thematization, created with Inverse Distance Weighting (IDW) interpolation provided by the desktop GIS Mapinfo Professional, allows us to highlight how the HVSR measurements show with great precision the architecture of the more superficial stratigraphic units, in particular where they are thinned, due to the presence of the Mirandola Anticline.

ACKNOWLEDGEMENTS

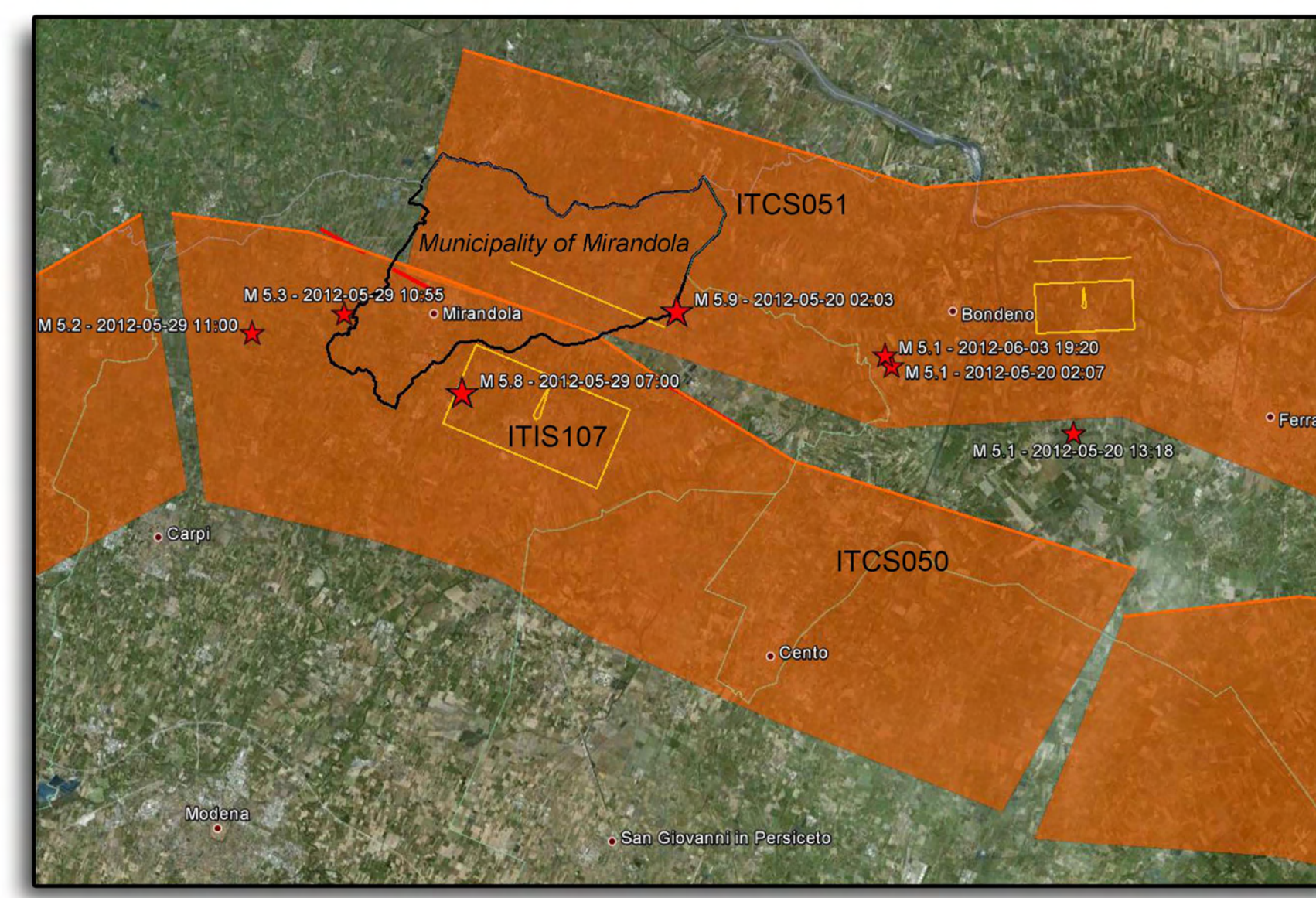
We are grateful to Luca Martelli (Geological, Seismic and Soil Survey of Regione Emilia Romagna) for his valuable and helpful suggestions.

IMPEDANCE CONTRAST

- HVSR peaks amplitude ≥ 3.5 Very high impedance contrast
- HVSR peaks amplitude = 3 High impedance contrast
- HVSR peaks amplitude = 2.5 Medium impedance contrast
- HVSR peaks amplitude = 2 Low impedance contrast
- HVSR peaks amplitude < 2 Very low impedance contrast

PUNCTUAL AND LINEAR OBJECTS

- 0.95 HVSR measuring points with f0 values
- f0 > 1Hz area limit
- oil wells
- traces of cross sections

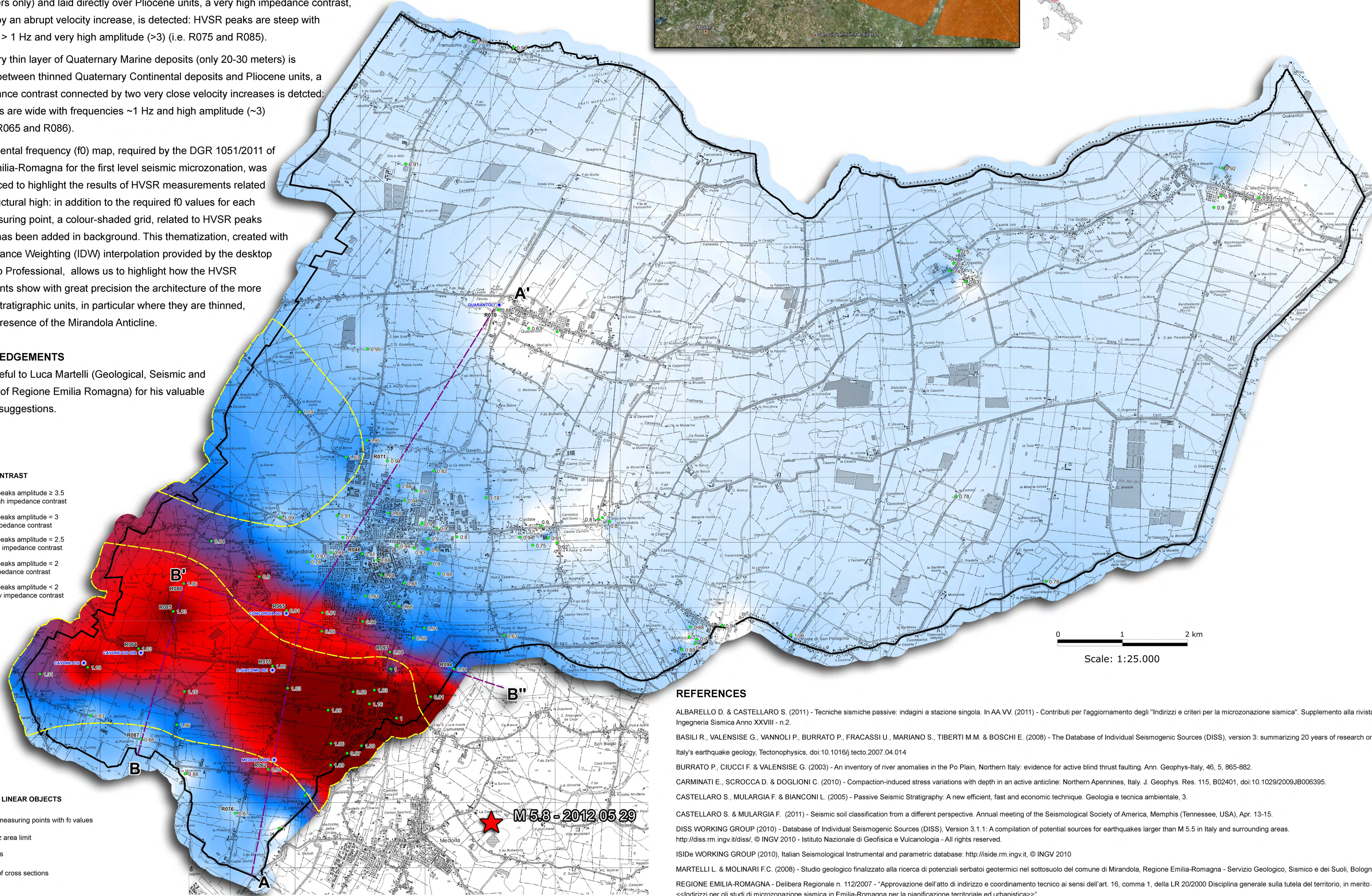


May-June 2012 seismic sequence in Emilia, Italy

Red stars: earthquakes with Magnitude greater than 5, taken from ISIDE database (ISIDE Working Group, 2010).

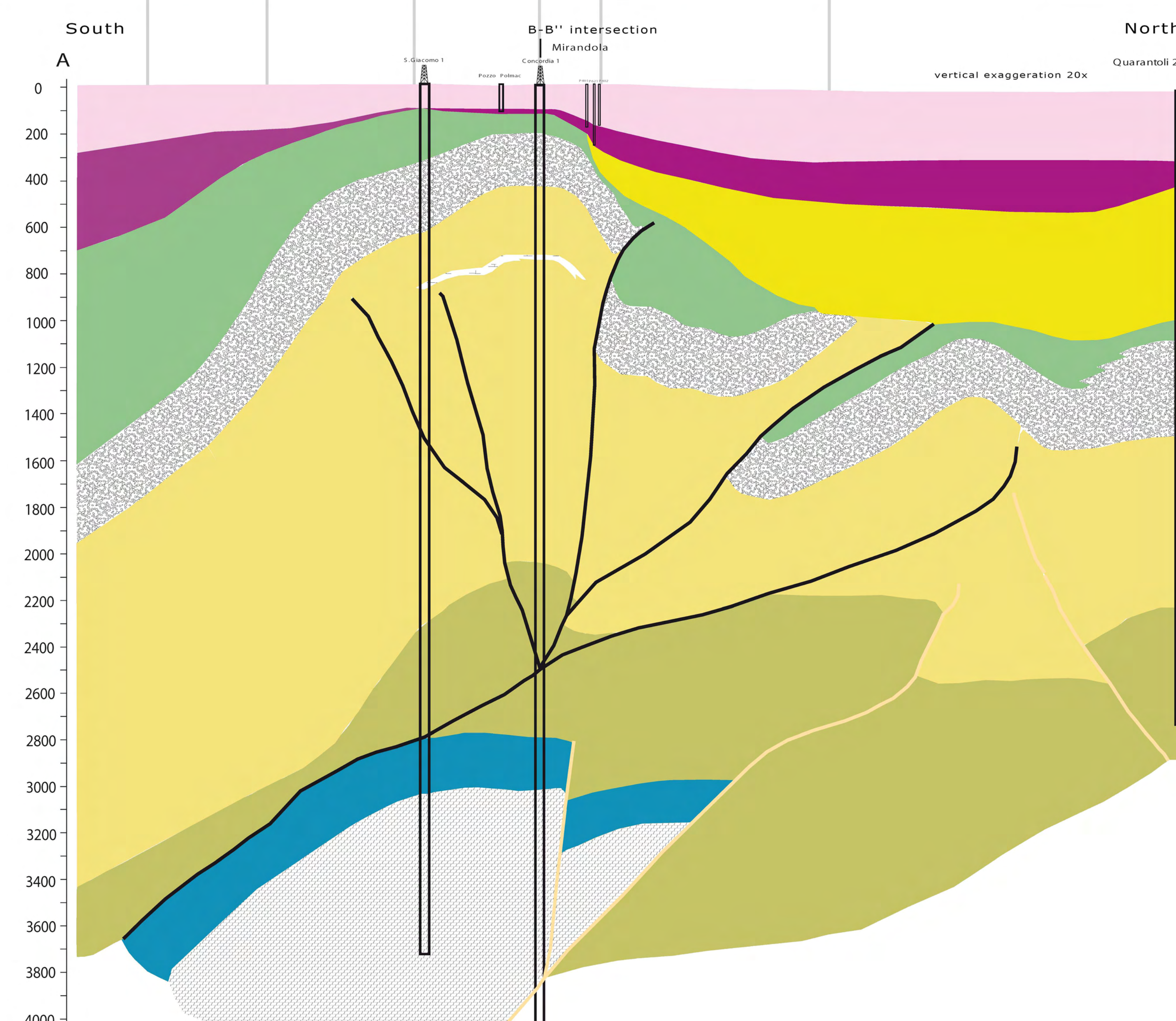
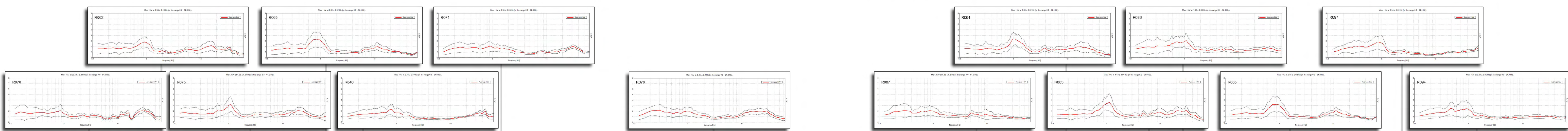
Yellow and orange polygons: individual and composite seismic sources, respectively, from DISS database (DISS Working Group, 2010, Basili et al., 2008).

ITIS107 - Mirandola
ITCS050 - Poggio Rusco-Migliarino
ITCS051 - Novi-Poggio Renatico



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Geological sections made by Geological, Seismic and Soil Survey of Regione Emilia-Romagna for the recent researches relating to potential geothermal reservoirs in the Mirandola subsoil (modified from Martelli e Molinari 2008).

Legend

- Quaternary Continental
- Quaternary Marine
- Middle Pliocene
- Santerno Clay Fm. - Lower Pliocene
- Porto Garibaldi Fm. - Lower Pliocene
- Colombari Fm. - Upper Messinian
- Gallare Maris Gr. - U.Eocene-Messinian
- Cerro Maris Fm. - L.Cretaceous -M.Eocene
- Corniglio Limestones - Lias
- Fault systems
Age: Middle-Upper Pliocene
- Fault systems
Age: Tortonian - Messinian

