GRUPPO NAZIONALE DI GEOFISICA DELLA TERRA SOLIDA
Trieste, 17-19 Novembre 2015

Studio delle Proprietà Geotecniche e del Comportamento Dinamico dell'Alta Valle del Crati nell'Area Urbana di Cosenza

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PON Ricerca e Competitività 2007-2013 | Ministero dello Sviluppo Economico | Ministero dell'Istruzione dell'Università e della Ricerca | UNIONE EUROPEA Fondo europeo di sviluppo regionale

Istituto Nazionale di Geofisica e Vulcanologia

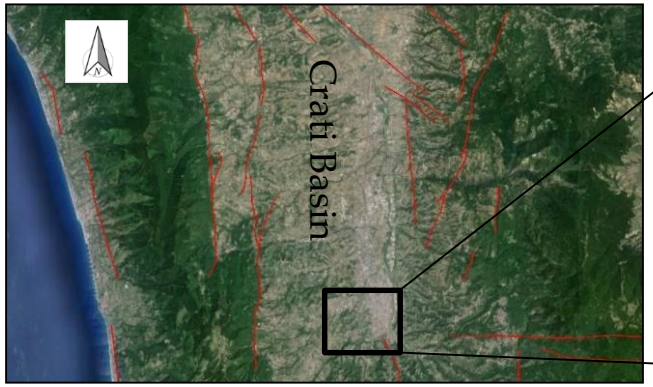
Progetto Pon – *MASSIMO* (*M*onitoraggio in *A*rea *S*ismica di *SI*stemi *MO*numentali)

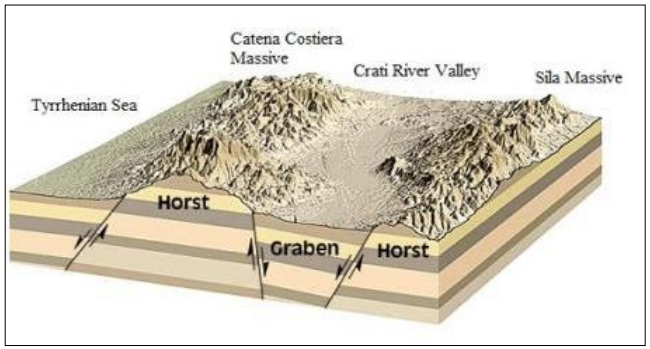
The *MASSIMO* project has the purpose to study and monitor the response of different types of constructions to seismic stress by different approaches

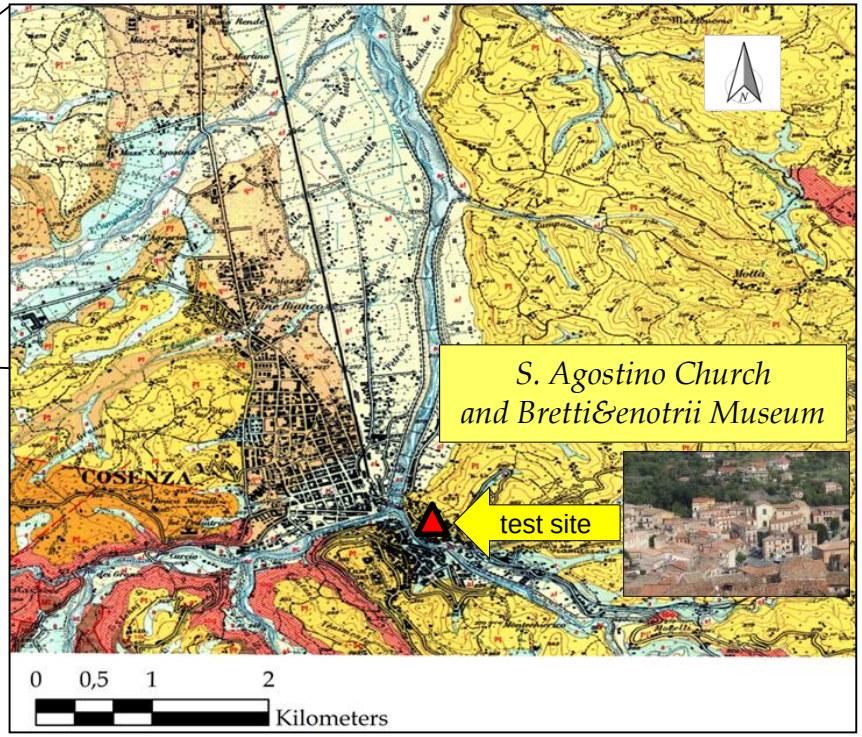
- Analysis of the seismogenetic sources;
- The surface geology, the topographic characteristics, the elastic properties of soils in relation to the monument architectural and static preservation;
- Monitoring and early warning products by using remotely sensed data (SAR and optical data);
- Earth monitoring products through aeromagnetic surveys;
- Monuments surveying (screening) with proximal remote sensing instruments (laser scanner, thermal camera, sclerometer, georadar, sonic instruments, flat jack testing)

http://openmap.rm.ingv.it/ponmassimo

Geological Setting of the Study Area



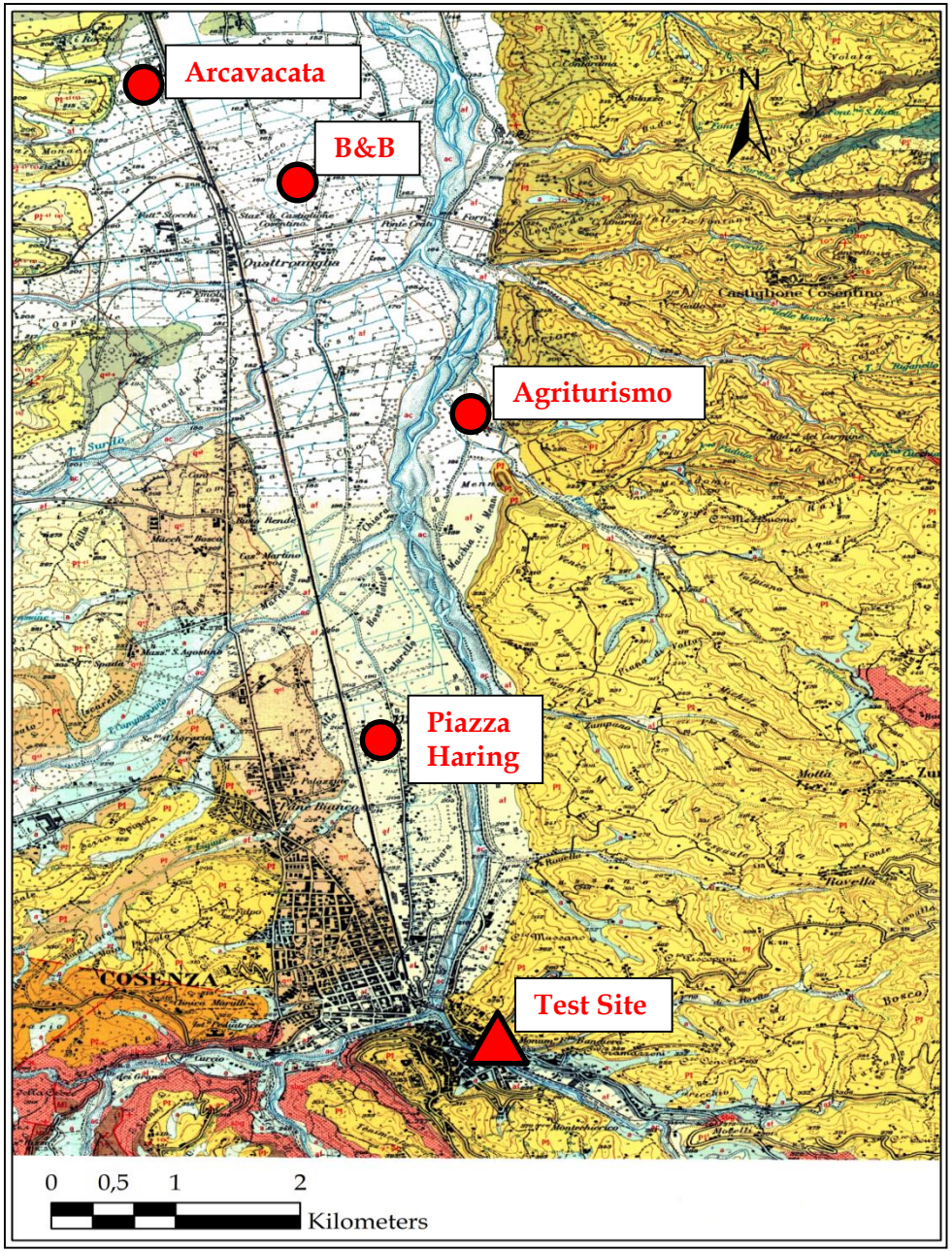


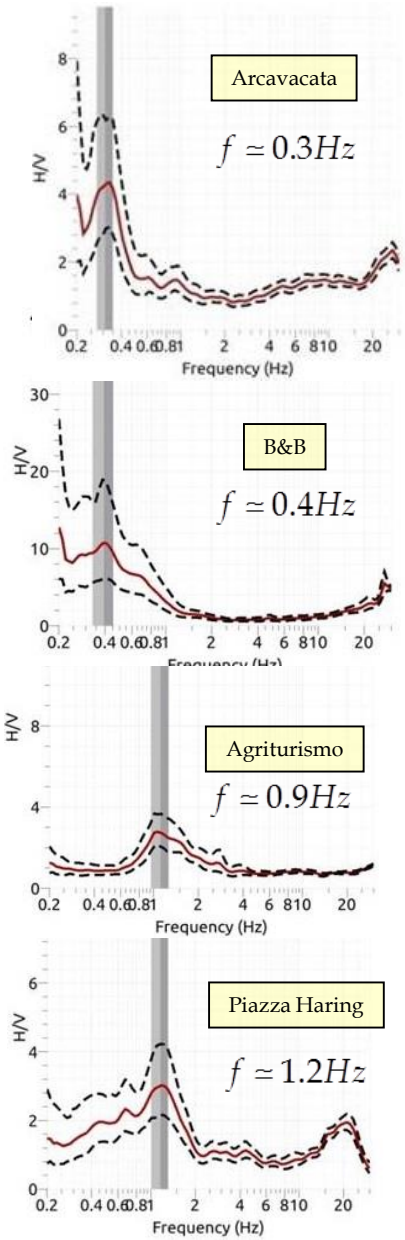


CASSA DEL MEZZOGIORNO (1958-1962)
Carta geologica della Calabria, scala 1:25.000

Geological evolution of the Crati Basin:

- Metamorphic Bedrock
- Marine sediments on metamorphic bedrock
- Tectonics
- Fluvial erosion





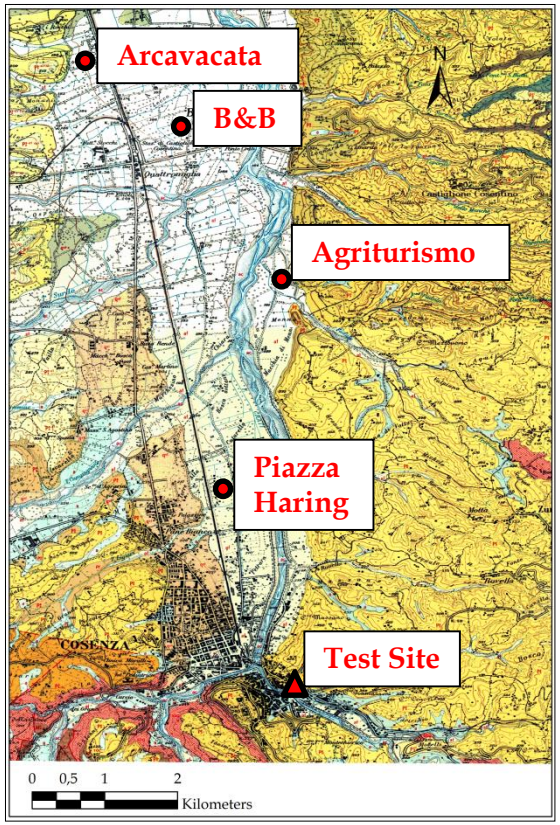
HV

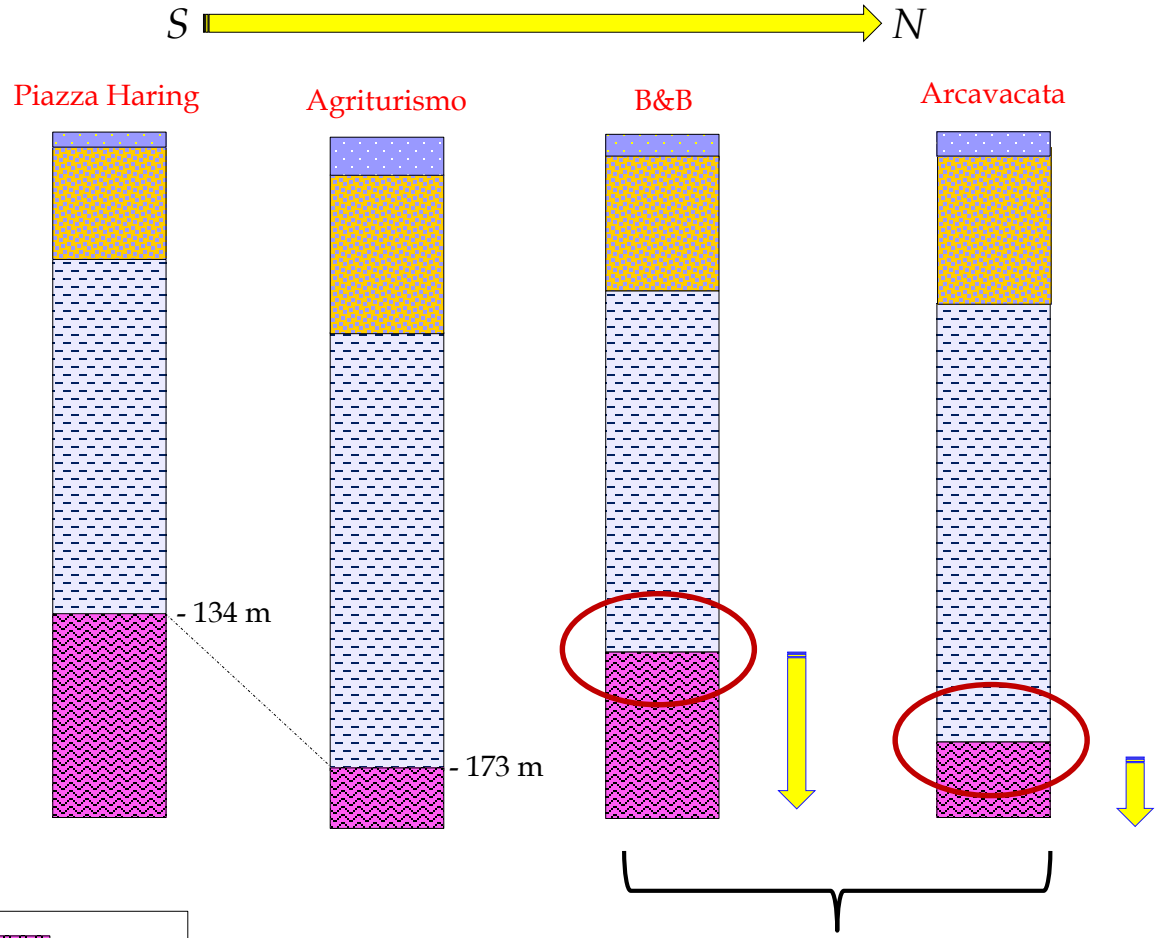
Crati Basin

$$f = \frac{\langle V_S \rangle}{4h}$$

All the sites were studied using seismic noise array analisis (2D-1D arrays) in order to obtain a shear-wave velocity profiles

Results from seismic noise measurements: Bedrock Deepening



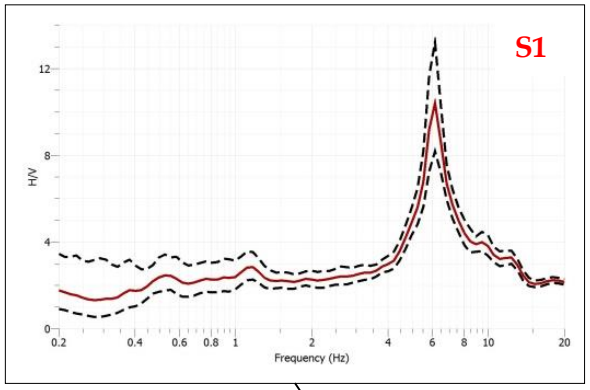


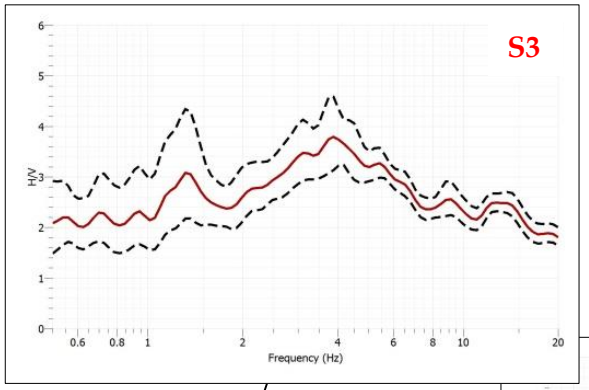
Dynamic models obtained with too small arrays to agree with HV picks at 0.4 Hz and 0.3 Hz, respectively

LEGEND

- sands
- alluvial deposits
- bedrock
- sands and clays

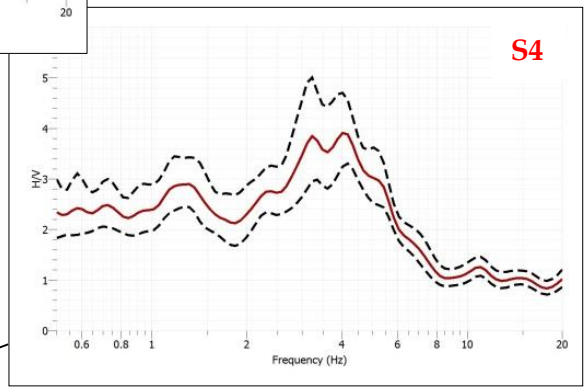
HV Test Site Area

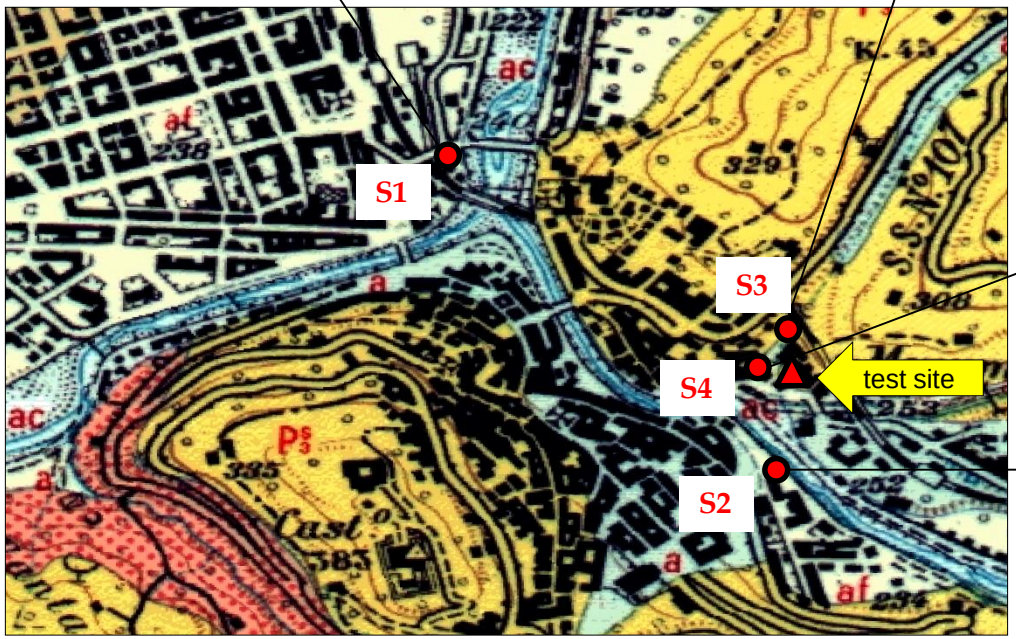


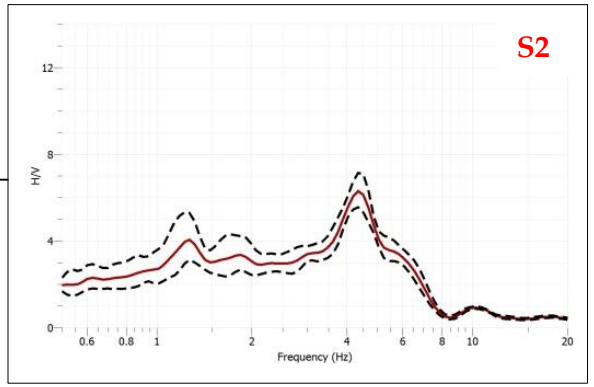


High variability in resonance frequency

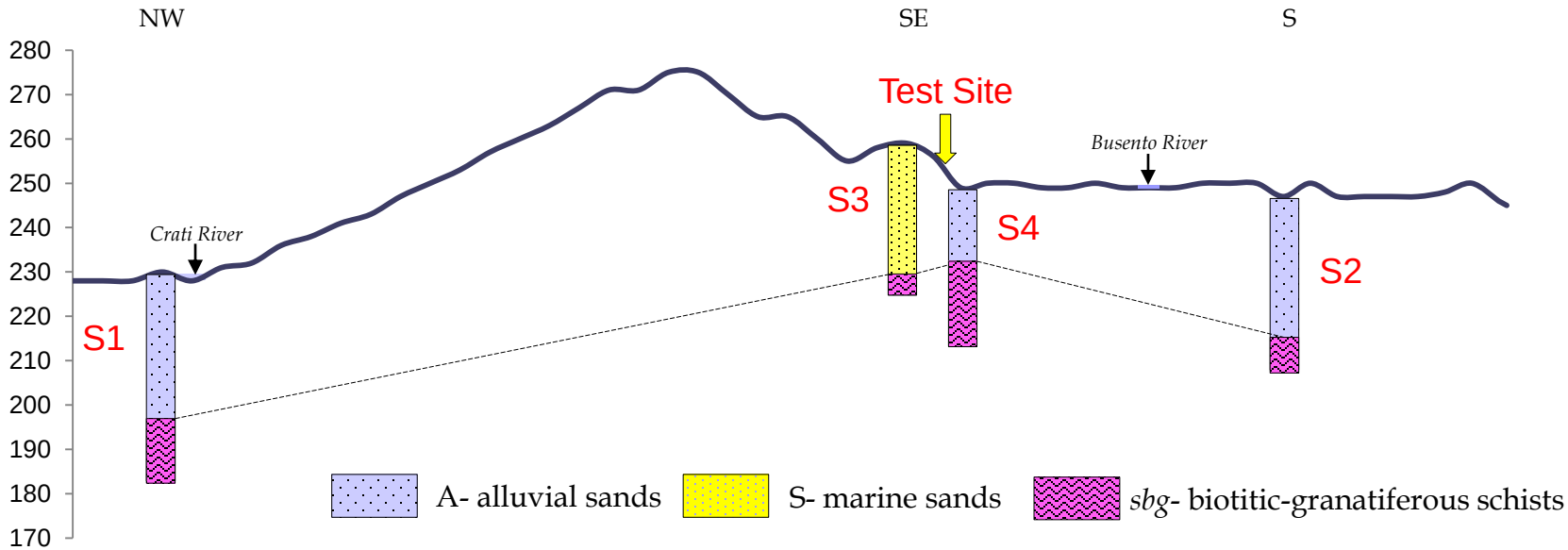
Borehole site selection

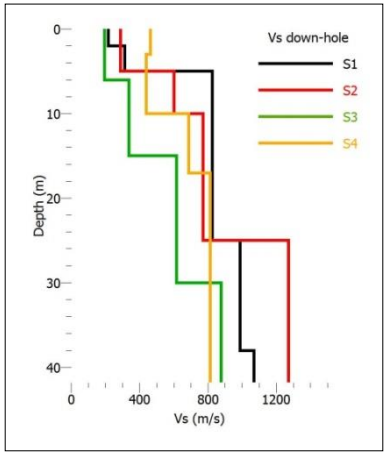


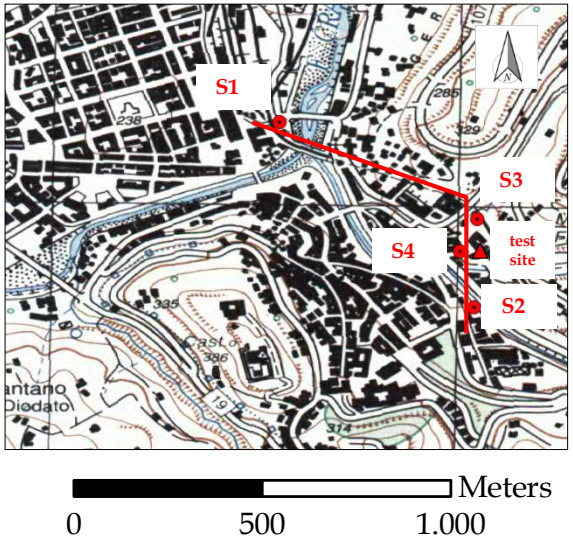




Geological Model of the Test Site Area



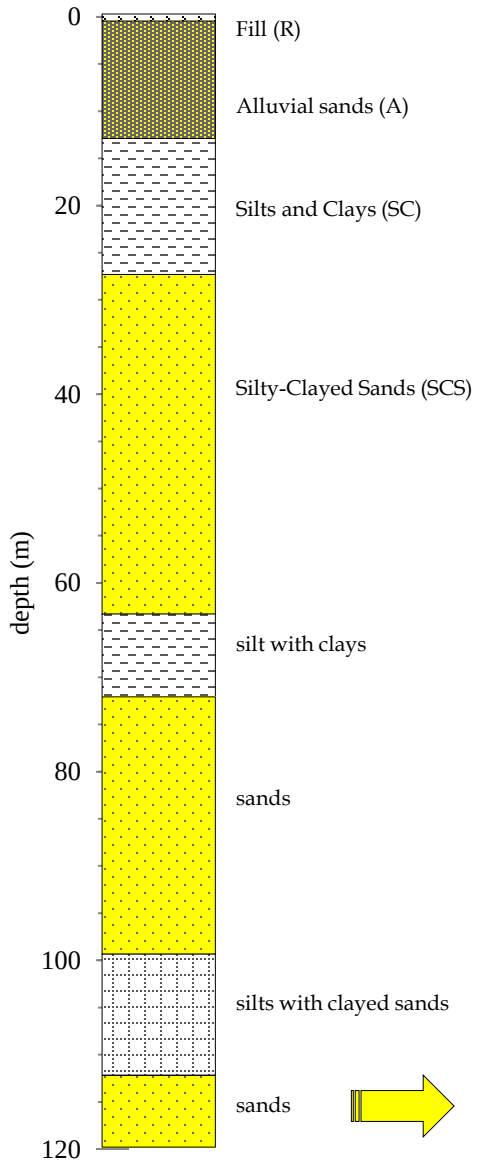


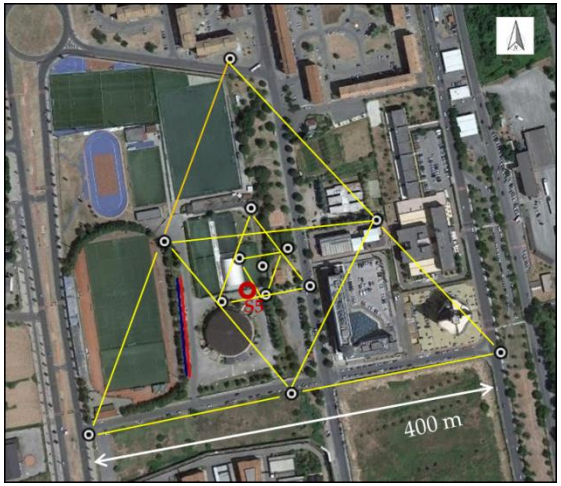


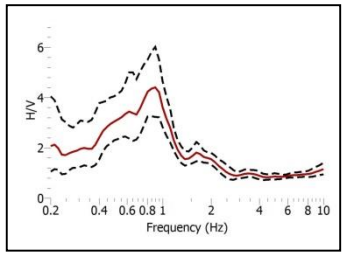
Down-hole Test

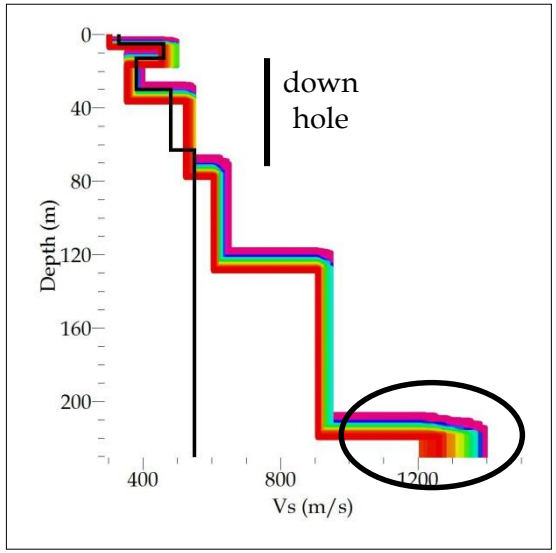
High variability in bedrock velocities

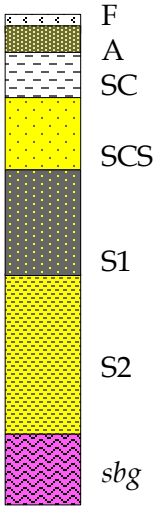
Site S5







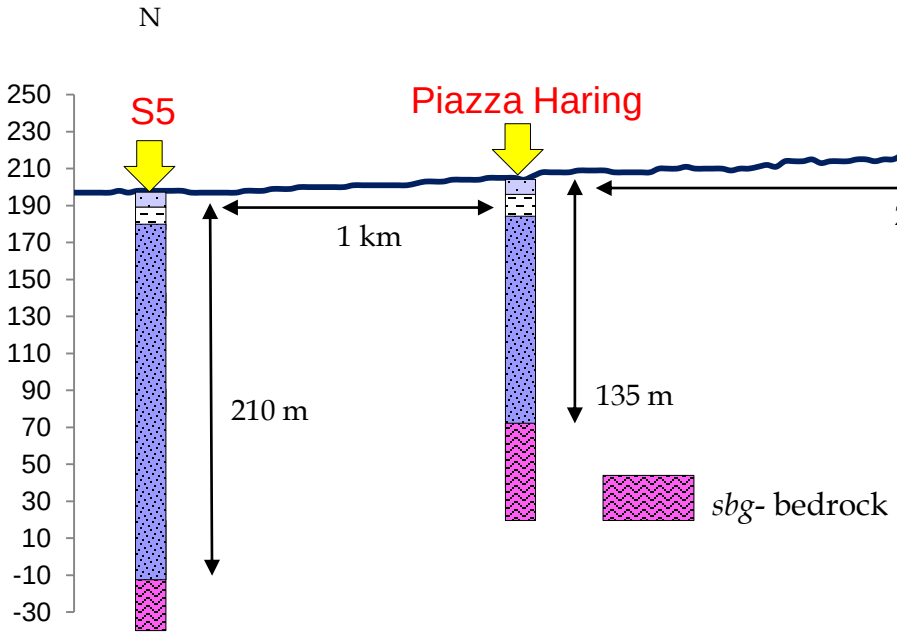


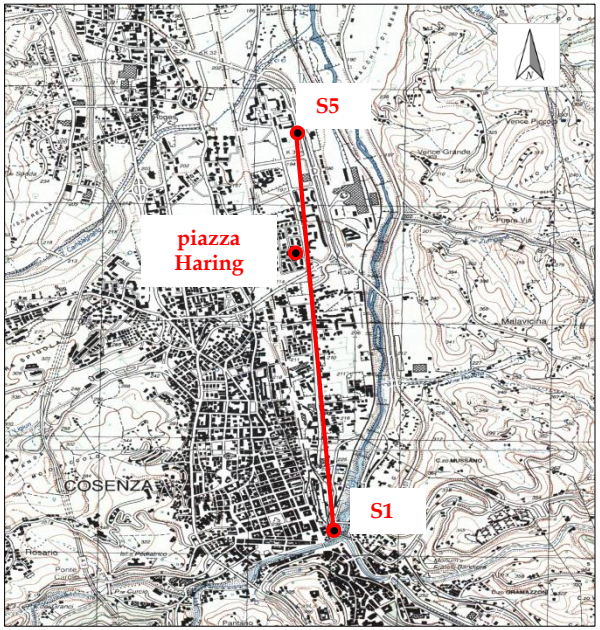


Inversion Problem

Finding the position of the bedrock

Bedrock Deepening

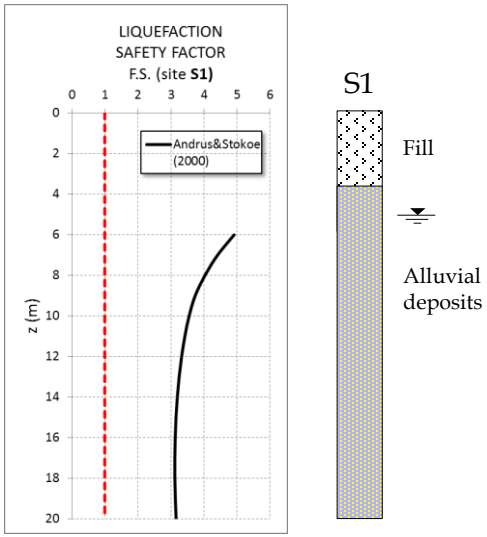


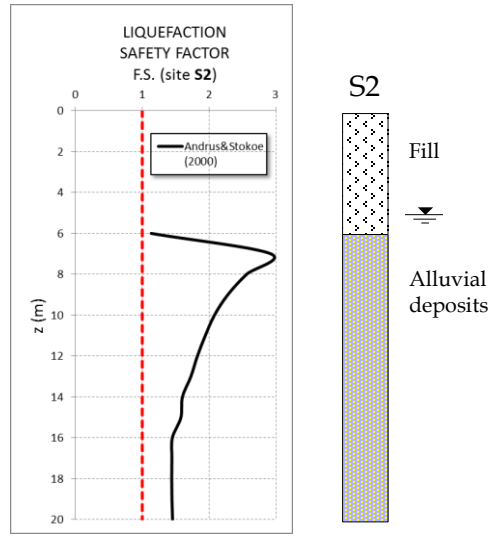


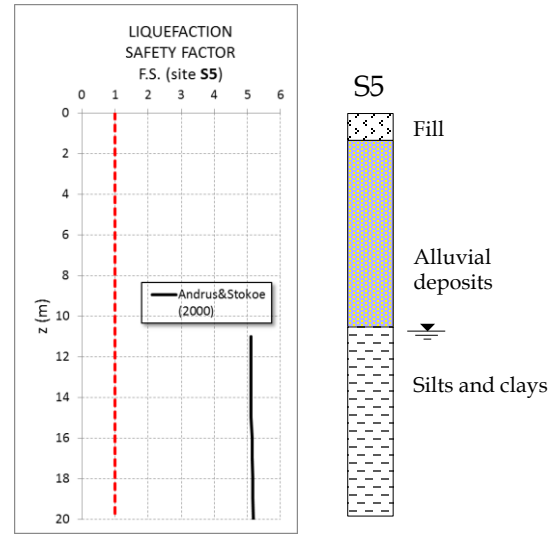
Meters

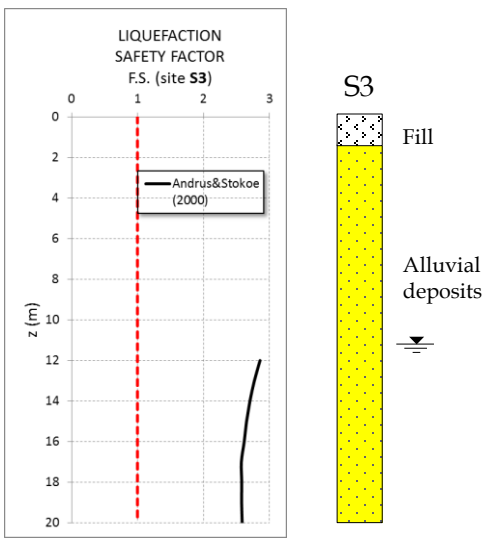
0 1.550 3.100

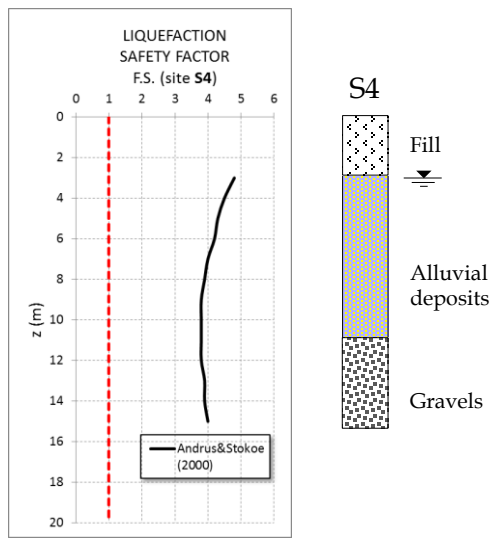
Testing Liquefaction Risk











Simplified procedure by *Andrus&Stokoee (2001)* was applied for preliminary evaluation of liquefaction risk for all the study sites:

$$F.S. = \frac{CSR}{CRR}$$

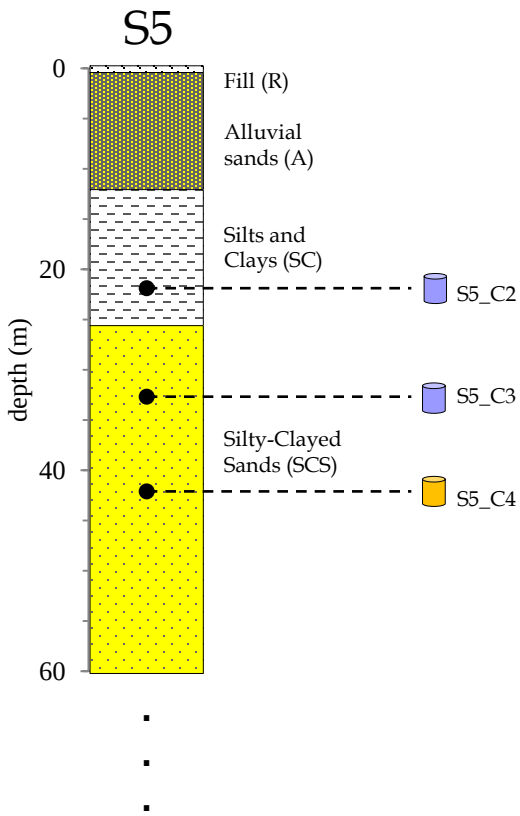
CSR: Cyclic Stress Ratio
CRR: Cyclic Resistance Ratio

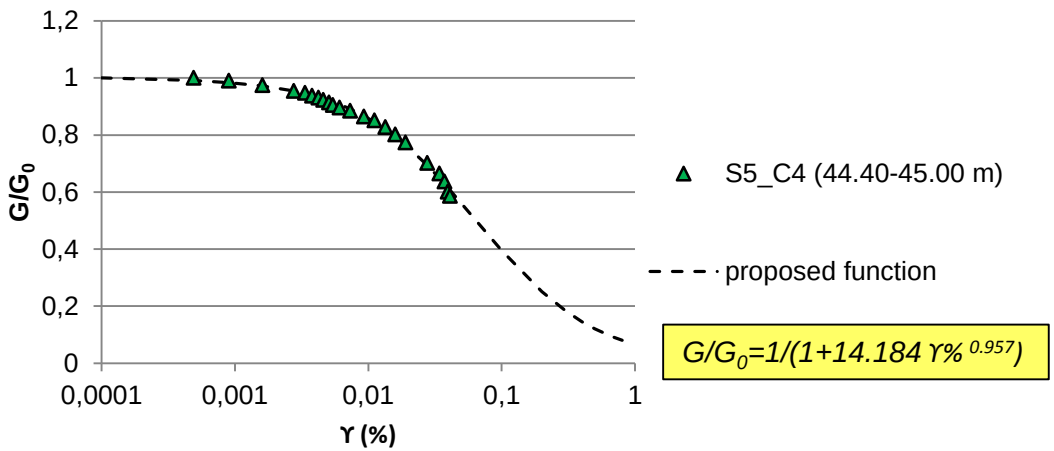
Acquifer level

Site S5: RC and TTC Tests

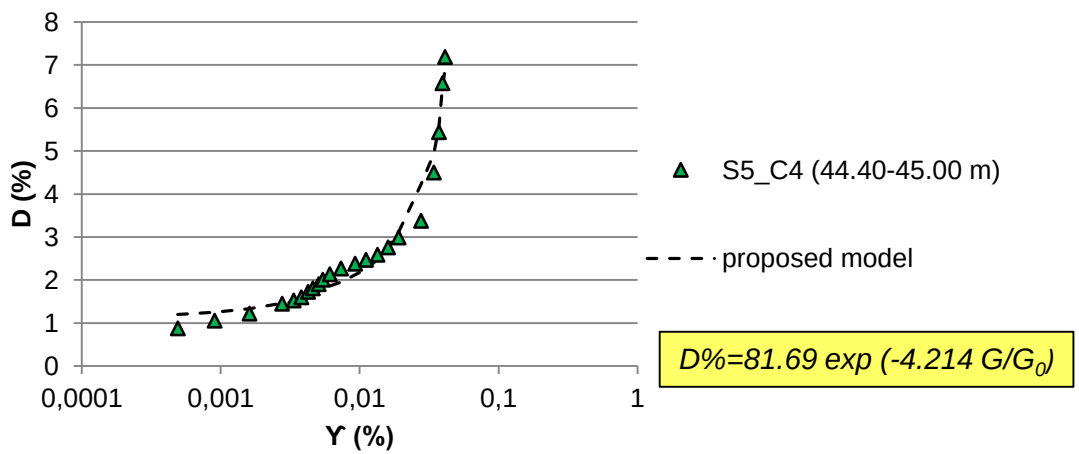
Undisturbed samples collected in borehole S5:

1. Identification of linear and volumetric thresholds
2. Decay law

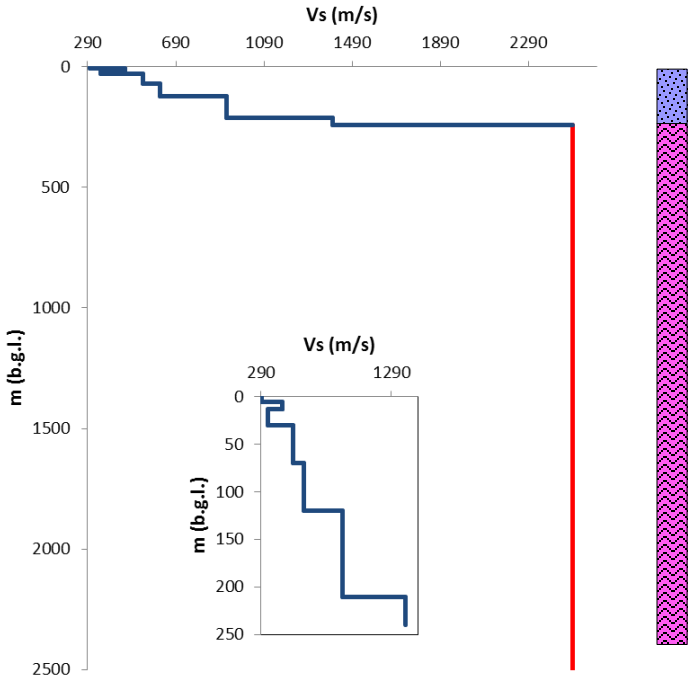




Finding a complete decay model: Ardin and Drevich (1972) in modified form after Yokota (1981)



1D-Model: Site S5



Evaluate the seismic response of the study area

Three synthetic reference earthquakes were applied to the metamorphic bedrock (*sbg*) as seismic input:

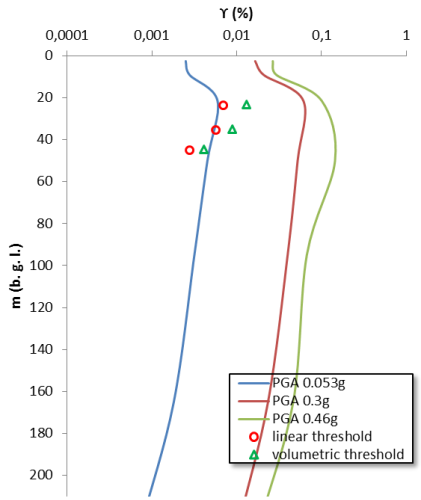
- Ms = 7.0 with epicentral distance of 5.3 km , PGA of 0.46g,
- Ms = 6.0 with epicentral distance of 0.71 km PGA of 0.31g;
- Ms = 5.0 with epicentral distance of 18 km, PGA of 0.053g.

TIBERTI M.M., et al. (Monitoraggio in Area Sismica di Sistemi Monumentali), Unità di Ricerca Analisi delle sorgenti sismogenetiche, *Rapporto tecnico sugli stati d'avanzamento intermedi* (n.3 dal 01/06/2013 al 30/11/2013.

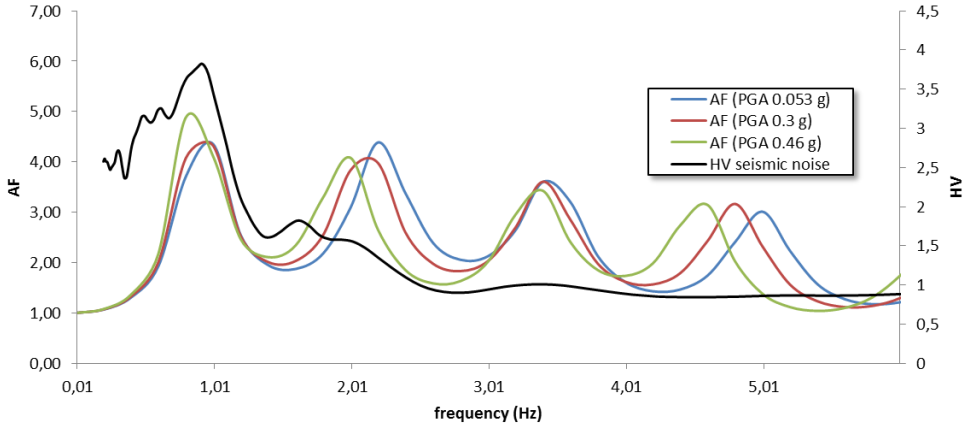
Decay law

level	group	lithology	thickness (m)	Vs (m/s)	density (kg/m^3)	Damping (%)
I	F	fill	5	300	1800	5
II	A	alluvia	8	460	1850	5
III	SC	silts and clays	17	350	1800	5
IV	SCS	silty-clayed sands	40	540	1850	1
V	S1	sands	50	620	1900	1
VI	S2	sands	90	920	1900	1
VII	*sbg*	altered bedrock	30	1400	2300	0.4
VII	*sbg*	bedrock	Half-space	2490	2400	0.4

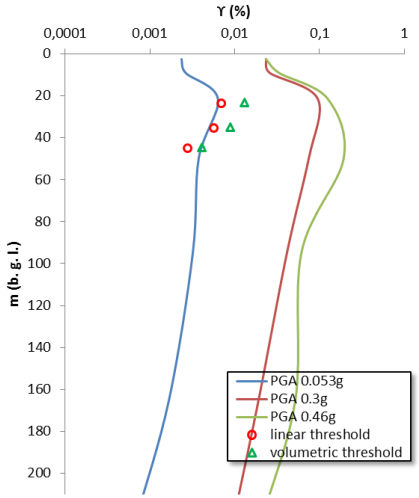
1D-Model: Results

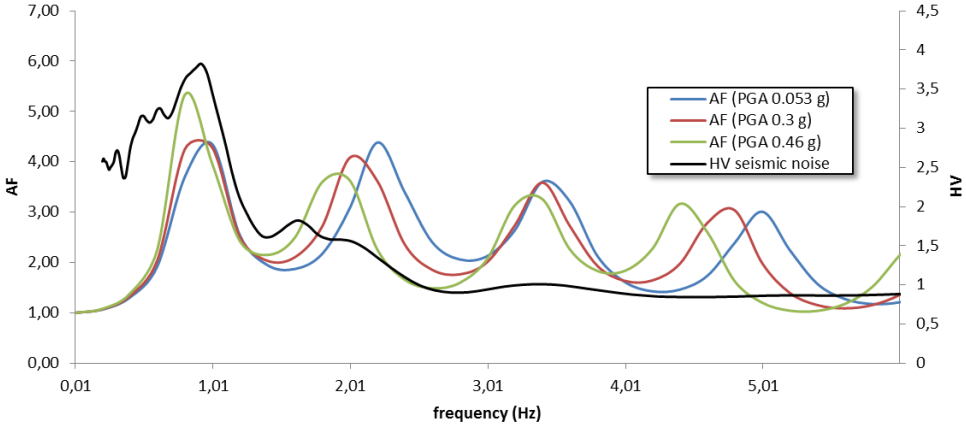


Vertical deformation profiles versus depth



Amplification functions: comparison between HV curves from seismic noise.





Conclusive Remarks

1. Geological reconstruction of the trend of the metamorphic bedrock in the High Crati Valley (seismic noise analysis, boreholes, lab Tests);

2. Testing Liquefaction Risk;

3. 1D-Model

Outlooks

Installation of permanent sensors inside the Test Site and down to the borehole depth to compare theoretical models