

PRELIMINARY RESULTS FROM AN INTEGRATED SHALLOW GEOPHYSICAL INVESTIGATION IN THE NORTH-EASTERN SECTION OF THE MALTA ISLAND

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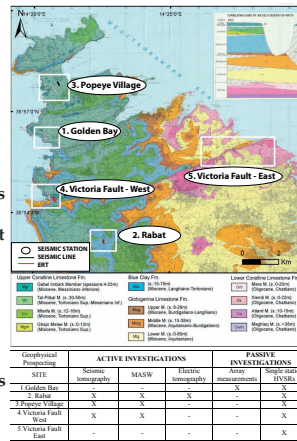
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INTRODUCTION

In the framework of the project "SIMIT" and under an agreement between INGV and DPC of the Regione Siciliana, seismic hazard estimates were performed, resulting in the distribution of the expected PGA values which do not include the contribution of the site geology. In order to take the subsoil response into account in the hazard assessment of the Maltese islands, on November 2014 we performed several geophysical investigations including seismic and electrical 2D-tomography, MASW profiles, 2D arrays and single-station measurements using ambient noise.

Previous studies performed in Malta by several authors have pointed out that even rock-sites can show site amplification as the effect of cliff-edge and unstable boulder collapse (Panzeria et al. 2012; Galea et al., 2014) as well as to the strong impedance contrast between the Blue Clay and the Globigerina Limestone Fm buried under tens of meters of the Upper Coralline Limestone Fm (Vella et al., 2013). This latter is responsible for an amplitude peak between 1 and 2 Hz.

We decided to focus the attention on the problem of amplification at sites where the Upper Coralline Limestone outcrops, finally selecting the following sites: 1. Golden Bay; 2. Rabat; 3. Popeye Village; 4. Victoria Fault - West; 5. Victoria Fault - East.

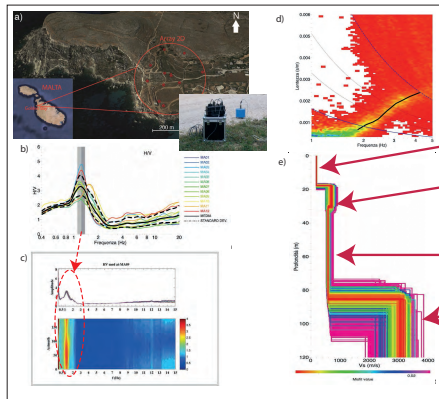


PASSIVE SEISMIC INVESTIGATIONS

SITE 1) GOLDEN BAY

HVSRs AMPLITUDE 4 PEAKS AT 1.2 Hz CAUSED BY THE IMPEDANCE CONTRAST BETWEEN GLOBIGERINA LIMESTONE AND BLUE CLAY FM

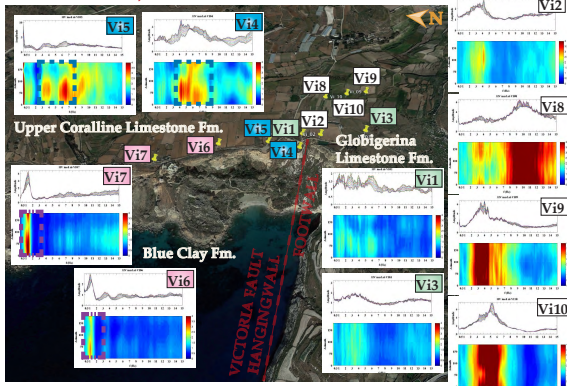
This peak is isotropic, the two horizontal component of ground motion NS and EW showing the same amplitude levels. Conversely, at frequency higher than 4 Hz, stations located closer to the cliff show a slight broadband directional amplification effect with a variable direction.



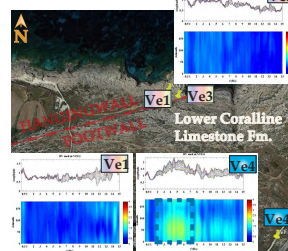
F-k ANALYSIS
Vs velocity profile:
 Weathered limestones of the Upper Coralline Fm (Vs=200 m/s; h=18m)

Unweathered limestones of the Upper Coralline Fm. (Vs=700 m/s; H=15m)
 Blue Clay Fm (Vs=600 m/s h=55m)
 Globigerina Limestone bedrock (Vs=3000 m/s)

SITES 4 and 5) VICTORIA FAULT

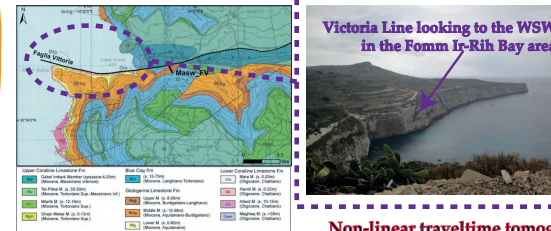


Stations on the fault footwall do not show directional amplification. Stations at about 1.5 km far from the fault hanging wall show only the stratigraphic peak. Stations installed on the fault hanging wall show a maximum amplification along NE-SW direction with amplitudes up to a factor of 4 in the band 3-8 Hz.



ACTIVE SEISMIC AND ELECTRICAL INVESTIGATIONS

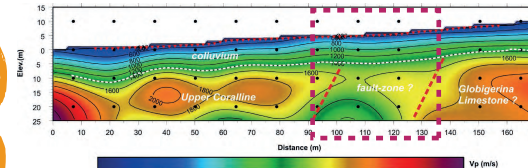
SITE 4) VICTORIA FAULT



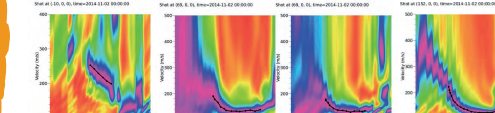
The most part of the sedimentary sequence outcropping in the Malta Island (from Lower Coralline Fm. to Upper Coralline Fm.) is exposed along the cliff and the overlying uplifted block.

Non-linear travelttime tomography and surface waves analysis across the Victoria Fault - West our results reveal a low-Vp region that suggests a shallow fault zone

We used 72 geophones (4.5 Hz) and 2880 hand-picked first-arrival traveltimes from 40 selected common shot gathers. The readings were input to a non-linear tomographic code. top provide high-resolution Vp images of the shallow subsurface



The tomogram shows between 90 m and 130 m a low-Vp region that may be related to a shallow fault zone. The latter should displace the Upper Coralline Fm. (hanging wall) and the Globigerina Limestone Fm. (footwall). Further analyses are required to prove the recent activity of this fault strand.

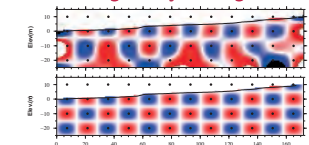


SITE 2) RABAT



Electrical resistivity tomography (ERT; Wenner-alpha array) close to Rabat suggests that the thickness of the Blue Clay Fm. in this site is about 45-50 m. This result is in accordance with results from passive seismic analyses.

Preliminary checkerboard tests indicate resolution depth down to about 15 m, due to a good ray coverage.



Lower values of Vs are retrieved by multi-channel surface waves analysis in the southern portion of the profile, confirming results obtained by refraction tomography.

CONCLUSIONS

- ◆ WE PROVIDE A SUBSOIL CHARACTERIZATION OF SOME SITES WHICH REPRESENT A TYPICAL SITUATION WHERE THE OUTCROPPING FRACTURED LIMESTONES OF THE UPPER CORALLINE FM. OVERLIE THE PLASTIC BLUE CLAY FM.
- ◆ MICRO-TREMOR ANALYSES REVEALED A TYPICAL PEAK IN THE H/V CURVES IN THE 1-2 Hz RANGE, MOST PROBABLY RELATED TO THE INTERFACE BETWEEN THE TWO FORMATIONS.
- ◆ DIRECTIONAL ANALYSES CLOSE TO SOME IMPORTANT FAULT ZONES REVEALED THE PRESENCE OF A RECURRENT NE-SW PEAK THAT NEEDS TO BE THOROUGHLY STUDIED.
- ◆ SHALLOW GEOPHYSICAL INVESTIGATION OF THE VICTORIA LINE CLOSE TO THE FOMM IR-RIH BAY REVEALED A SHALLOW FAULT ZONE, HOWEVER FURTHER STUDIES ARE NEEDED TO ASSESS THE POSSIBLE RECENT ACTIVITY OF THIS COMPLEX FAULT SYSTEM AT THIS SITE.