Preliminary observations from data recorded by OBS in the Ionian Sea (Italy) during the SEISMOFAULTS experiment

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The Ionian Sea area is a known site of seismic hazard. Several historical high-magnitude earthquakes occurred in the area (e.g., 1193, M=6.6; 1693, M=7.4; 1908, M=7.2) [Boschi et al., 1997], whose tectonic sources and generation mechanism are still debated. Due to the lack of a seafloor seismic network the detection and location of marine earthquakes are often elusive. The SEISMOFAULTS experiment [http://www.seismofaults.it/] was performed between 2017 May and 2018 May to increase knowledge on the seismicity in the western Ionian Sea. Seven broad-band Ocean Bottom Seismometers and Hydrophones (OBS/H; Figures 1a and 1b) were deployed during the experiment and recovered at the end of the experiment. The extension of the network was ~150 x 100 km^2 with a ~30 km station interspacing. The OBS/H are broadband instruments built at the INGV OBS Lab Gibilmanna.

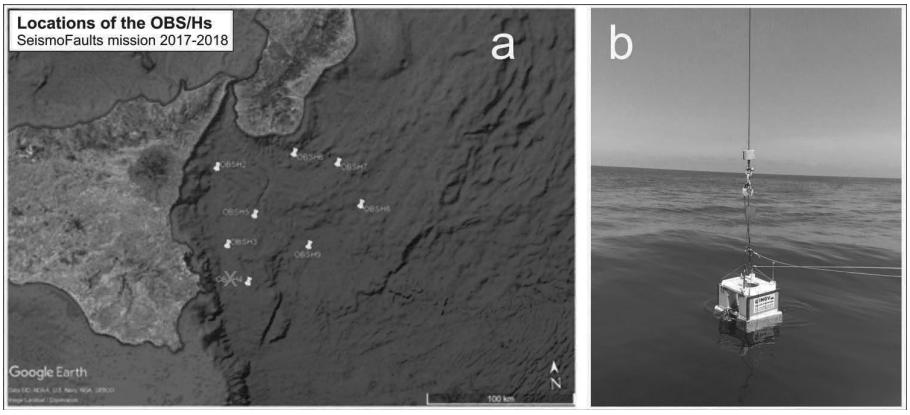

Figure 1 (a) Map of Ocean Bottom Seismometers and Hydrophones (OBS/H) deployed during the SEISMOFAULTS experiment. (b) Example of OBS/H during the deployment.

About 549 Gb (data and metadata) were recorded. The data formats available are: Güralp Compressed Format (GCF) and Seismic Analysis Code (SAC). Data were organized in a simple filesystem archive. The first step was the estimation on ship of the time digitizer clocks drift, after the OBS/Hs were recovered at the end of the experiment. Estimated time drifts for the whole mission period were < 0.5 s for all OBS/Hs. A linear correction of the time drift was applied to the data.
Quality analysis showed a high recording rate and good quality of the data (Figures 2a and 2b).

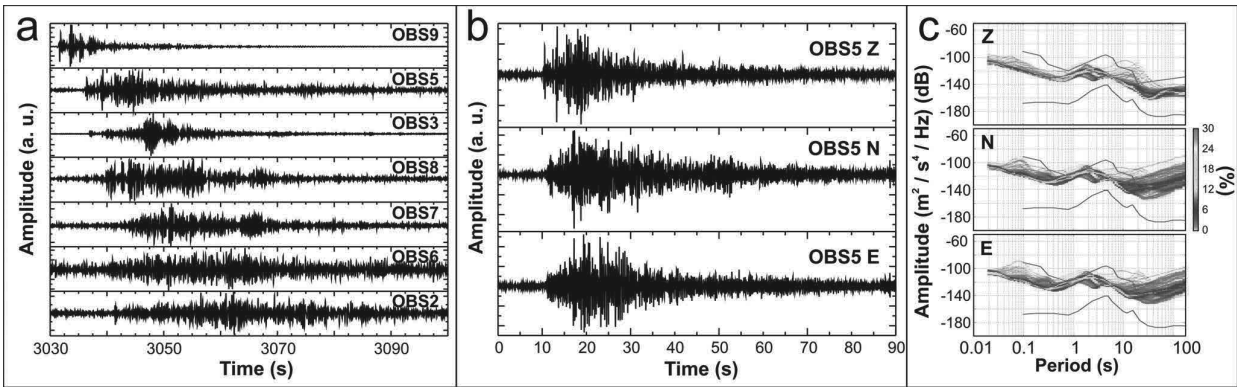

Figure 2 (a) Waveforms of a local event (2017, July 19, M=2.4) recorded on all OBSs (z-component); (b) waveform of the previous local event recorded on the three components of OBS5; (c) probability density function calculate in summer (2017, July 11-17) for the three components of OBS5.

Probability density functions were constructed for the seismic data recorded during one week in different seasons (Figure 2c). In general, the spectral curves are within the Peterson [1993] model limits, except for the expected high noise on the horizontal components at low frequency. We found that the OBS/H recorded seismic data from events at different epicentral distance ranges (i.e. local, regional and teleseismic). During the experiment about 2400 local events were recorded by the INGV land networks ($0.4 \leq M_L \leq 3.9$).

These events include earthquakes from Etna, northern Sicily, southern Tyrrhenian and western Ionian Seas. Identification of P-wave and S-wave arrivals was performed on a subset of 43 earthquakes that occurred in the western Ionian Sea. Travel times from OBS/H and land stations were integrated to locate these events. We used the Hypoellipse code [Lahr, 1989], by considering simultaneously six different 1D velocity models and taking into account the topographic height of the seismic stations, as well as the negative values of OBS/H stations (zero is the sea level). Statistical analysis shows that the addition of OBS/H data significantly improves the estimate of hypocentre location. A comparison of the locations performed with land seismic network only, with the ones that combined land and marine stations, shows a difference in the azimuthal GAP that can go up to about 150°. A sensitive reduction of horizontal and vertical errors (up to 9 km and 12.5 km, respectively) is also observed.

Thanks to the use of OBS/Hs we could obtain detailed locations of earthquakes in the offshore area of Ionian Sea. A well constrained hypocentral distribution is crucial to better define the tectonic structures that are able to generate such destructive earthquakes as the ones that occurred in historical and recent times in this area.

References

Boschi E., Guidoboni E., Ferrari G., Valensise G. and Gasperini P., (1997). *Catalogue of the strong earthquakes in Italy from 461 BC to 1990.* ING&SGA, Bologna, 973 pp.

http://www.seismofaults.it/

Lahr J.C., (1989). *HYPOELLIPSE/version 2.0: a computer program for determining local earthquake hypocentral parameters, magnitude, and first motion pattern.* Open-File Report - U. S. Geological Survey, 95, 89–116.

Peterson J., (1993). *Observation and Modeling of Seismic Background Noise.* US Geological Survey Open File Report. US Geological Survey: Albuquerque, NM, USA, pp. 93–322.