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Mud volcano monitoring and seismic events along the North Anatolian Fault (Sea of Marmara)

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The Sea of Marmara, a pull-apart basin formed along the northern strand of the North Anatolian Fault (NAF) system, is considered a seismic gap, that will be filled in the next decades by a large magnitude ($M > 7$) earthquake, close to the Istanbul Metropolitan area (12 million inhabitants). For this reason, several marine geological and geophysical studies have been carried out in this region, starting from the destructive 1999 Mw 7.4 Izmit earthquake, to gather information relative to seismogenic potential of major fault strands. Together with these studies, in the frame of EC projects (i.e. MarmESONET and Marsite, among others), an intensive program of long-term monitoring of seismogenic faults was carried out using seafloor observatories deployed during several expeditions led by Italian, French and Turkish groups. These expeditions included MARM2013, on board of the R/V Urania, of the Italian CNR, when four ocean bottom seismometers (OBS) were deployed in the central part of the Sea of Marmara, at depths between 550 and 1000 m. One of the main aims of the experiment was to assess the long-term seismic activity along an active segment of the NAF, which connects the central and the western basins (depocenters), where the principal deformation zone appears relatively narrow and almost purely strike-slip. The present study shows the results of processing and analysis of continuous data records from these OBS stations during 50 days.

We were able to detect seismic signal produced by an active mud volcano located close to the NAF trace, from about 3 to 6 km of distance from the OBS stations. Additionally, we captured the May 24, 2014, Mw 6.9 strike-slip earthquake occurred in the northern Aegean Sea between Greece and Turkey, which caused serious damage on the Turkish island of Imbros and the cities of Edirne and Çanakkale, as well as on the Greek island of Lemnos. The earthquake nucleated on the westward continuation of the NAF system in the NE Aegean Sea, and was felt in Bulgaria and southern Romania. Several aftershocks followed the main shock, the strongest measuring 5.3 of magnitude. To verify the effects of this external forcing on the activity of the submarine mud volcano in Marmara, we calculated the root-mean-square (RMS) and standard deviation (STD) on three-minute waveform segments in a period from 2014.04.11 to 2014.05.31 in the 10-25 Hz frequency band. In addition, we also calculated auto- and cross-correlation of seismic ambient noise in the same time-period and frequency range to assess the variations of waveform coherency prior to the earthquake. Preliminary results show periodic changes of RMS and STD amplitudes, which may result from the effects of tides, but no short- or long-term precursory signs of the earthquake detected by our approach.