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The entrance of the Izmit Gulf : a key site for monitoring gas emissions and seismicity in the Sea of Marmara

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The Sea of Marmara has been widely recognized as a seismic gap that will be probably filled in the next decades by a large (M >=7) earthquake along the North Anatolian Fault (NAF) system. Accordingly, new research activities started in the last years, and the possibility of installing seafloor observatories, considered.
Only long-term observatories allow continuous observation of large numbers of parameters. This capability is crucial for observing natural processes that are either very episodic, or statistically require long time series to be detected. Among these phenomena, gas seepage at the seabed, occurring in various locations in the Sea of Marmara (Geli et al., 2008) may be sensitive to seismicity, providing possible precursor signals.
Several lines of evidence suggest that the Gulf of Izmit, in the eastern Sea of Marmara, is a key area for monitoring the activity of the NAF through seismometers and gas sensors, because:
1) it is an area characterized by a “focusing” of the NAF principal deformation zone into a single strike-slip fault, along which the dextral strike-slip rate averaged over geological times (10 mm/y) has been measured (Polonia et al., 2004);
2) it is close to the western end of the surface rupture associated with the 1999 Izmit earthquake; thus, it is a probable area where the next earthquake will nucleate;
3) it is characterized by gas and fluids emission related to the fault activity, as documented by acoustic images of the water-column and direct observations carried out using ROVs (Gasperini et al., 2009). The methane and hydrogen sulphide escape is also confirmed by the presence of “black patches” at the seafloor observed during MarNaut cruise. Seafloor multi-parameters monitoring in this area is therefore essential to unravel relationships between geochemical, physical and geophysical parameters and the mechanical behaviour of faults; the information could then be used for seismic risk assessments and to define early-warning strategies;
4) gas emissions are not continuous and relatively weak. Most of the gas remains trapped and accumulate in the sediments. This is a perfect condition for monitoring gas outputs related to seismicity. In fact, if the gas emission would be continuous and vigorous, it would have an intrinsic variability (flux pulsations) which would be impossible to be detected by sensors during emissions eventually triggered by an earthquake;
5) it is a relatively easily accessible area, due to the moderate water depth (200 m) and its vicinity (5 km) to the coastline.
An Italian seafloor observatory, the SN-4 of the GEOSTAR class, has already been deployed in the Gulf of Izmit, as part of a pilot experiment in the frame of ESONET (European Seafloor Observatory Network), in September 2009 (Gasperini et al., 2009). The SN-4 observatory, equipped with seismometer, CTD, current meter, and methane sensors, will provide the first set of continuous data from the site.

References

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