



Widespread gas emissions in the Sea of Marmara in relation with the tectonic and sedimentary environments: Results from shipborne multibeam echosounder water column imagery (MARMESONET expedition, 2009)

Stéphanie Dupré (1), Carla Scalabrin (1), Louis Géli (1), Pierre Henry (2), Céline Grall (2), Jean-Baptiste Tary (1), Namik Çağatay (3), Caner Imren (3), and the MARMESONET Scientific Party Team

(1) IFREMER, Marine Geosciences, Plouzané, France, (2) CEREGE, Collège de France, Aix-en-Provence, France, (3) Istanbul Technical University, Turkey

Acoustic systems in marine geosciences are mainly used to explore the seabed and image sub-bottom sedimentary units. However, side-scan sonars and echosounders can detect gas emissions from the seabed into the water column. Recently, advances in technology and computer processing allow carrying out large-scale 3D surveys of the entire water column with multibeam systems, so far dedicated to seabed imagery. A shipborne multibeam survey of the water column in the Sea of Marmara was performed with the R/V Le Suroit during the MARMESONET expedition (4-25 November 2009), that is part of the ESONET (European Seas Observatory NETwork) demonstration mission MarmaraDM. Data were acquired with a Simrad EM302 multibeam echosounder (27–33 kHz, 288 beams, $1^\circ \times 2^\circ$, 2 or 5 ms pulse length) with automatic swath width control and equidistant sounding pattern over water depths varying from 300 to 1300 m. Volume backscattering coefficients were stored with <10 m depth bins along more than 2000 nm acoustic tracks. Gas bubble echoes were very well detected by the EM302 system within the water depth range of the Sea of Marmara, mostly with the central beams but also with the outer beams for the flares with strong backscatter intensity and large imprint. Geo-referenced gas flare 3D visualization is performed with Movies3D software developed for fish school echo description and biomass assessment (Trenkel et al., 2009).

The distribution of water column acoustic echoes in the Sea of Marmara reveals that free gas emissions from the seabed are more widespread than expected from previous studies using ROVs, submersibles as well as acoustic methods (Géli et al., 2008; Zitter et al., 2008). Numerous acoustic gas flares were detected in association with the North Anatolian fault system and some appear to be localized on known active fault traces. However, gas emissions also spread around the edges of the sedimentary basins (e.g. Cinarcik and Tekirdag basins) and on structural highs (e.g. Western and Central High).

References

Géli, L., Henry, P., Zitter, T., Dupré, S., Tryon, M., Çağatay, M.N., Mercier de Lépinay, B., Le Pichon, X., Sengör, A.M.C., Görür, N., Natalin, B., Uçarkus, G., Özeren, S., Volker, D., Gasperini, L. and Bourlange, S., 2008. Gas emissions and active tectonics within the submerged section of the North Anatolian Fault zone in the Sea of Marmara. *Earth and Planetary Science Letters*, 274: 34–39.

Trenkel, V.M., Berger, L., Bourguignon, S., Doray, M., Fablet, R., Massé, J., Mazauric, V., Poncelet, C., Quemener, G., Scalabrin, C. and Villalobos, H., 2009. Overview of recent progress in fisheries acoustics made by Ifremer with examples from the Bay of Biscay. *Aquatic Living Resources*, doi: 10.1051/alar/2009027.

Zitter, T.A.C., Henry, P., Aloisi, G., Delaygue, G., Çağatay, M.N., Mercier de Lepinay, B., Al-Samir, M., Fornacciari, F., Tesmer, M., Pekdeger, A., Wallmann, K. and Lericolais, G., 2008. Cold seeps along the main Marmara Fault in the Sea of Marmara (Turkey). *Deep Sea Research Part I: Oceanographic Research Papers*, 55: 552–570.