



SEVENTH FRAMEWORK PROGRAMME

Area 6.4.1.2. Cross-cutting research activities relevant to GEO

ENV.2008.4.1.2.1. Monitoring and observing oxygen depletion throughout the different Earth system components

Deliverable 7.1

***“Set-up and implementation of in situ observatories for monitoring oxygen depletion and associated parameters in land-locked water bodies (Swiss Lakes, Koljö Fjord, Loch Etive, Ionian Sea lagoon) and data collection into the HYPOX web portal”*; Month 24**

Editor: Henrik Stahl, SAMS

Project acronym: *HYPOX*

Project full title: *In situ monitoring of oxygen depletion in hypoxic ecosystems of coastal and open seas, and land-locked water bodies*

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5. The GMM Benthic Observatory (Katakolo Bay, Greece)

Involved partners: UPAT, Greece (lead partner) and INGV, Italy

5.1 Background and observatory outline

The GMM (Gas Monitoring Module) benthic observatory was used for monitoring O₂ in a thermogenic gas seep area in Katakolo Bay, Greece. Detailed repetitive oceanographic surveys have been carried out by the UPAT with the collaboration of INGV for the study of spatial (horizontal and vertical) distribution of O₂, CH₄ and H₂S in the Aetoliko lagoon, Amvrakikos gulf and Katakolo bay. The data incorporated results from the deployment of MEDUSA in Amvrakikos gulf between 16-17 September 2010 and in Katakolo bay 19 -21 September. Based on all these data, Katakolo proved to be the best site for short-term-monitoring and studying the effect of gas seepage on O₂ reduction (i.e. O₂ variation in a gas plume near-field), since intense gas seepage and oxygen concentration reductions had been identified. The selection of the monitoring site was based on all available data regarding the gas flux measurements, gas composition and origin, oceanographic parameters of seawater and geotechnical properties of the seafloor. The monitoring site is located inside the harbor of Katakolo in an area which is more or less unaffected by the vessel traffic. The site is located within a thermogenic gas seepage area where active faults are intersected (Fig.1). Moreover very close to the monitoring site, a weather station has been operating for the last two years and is still active.

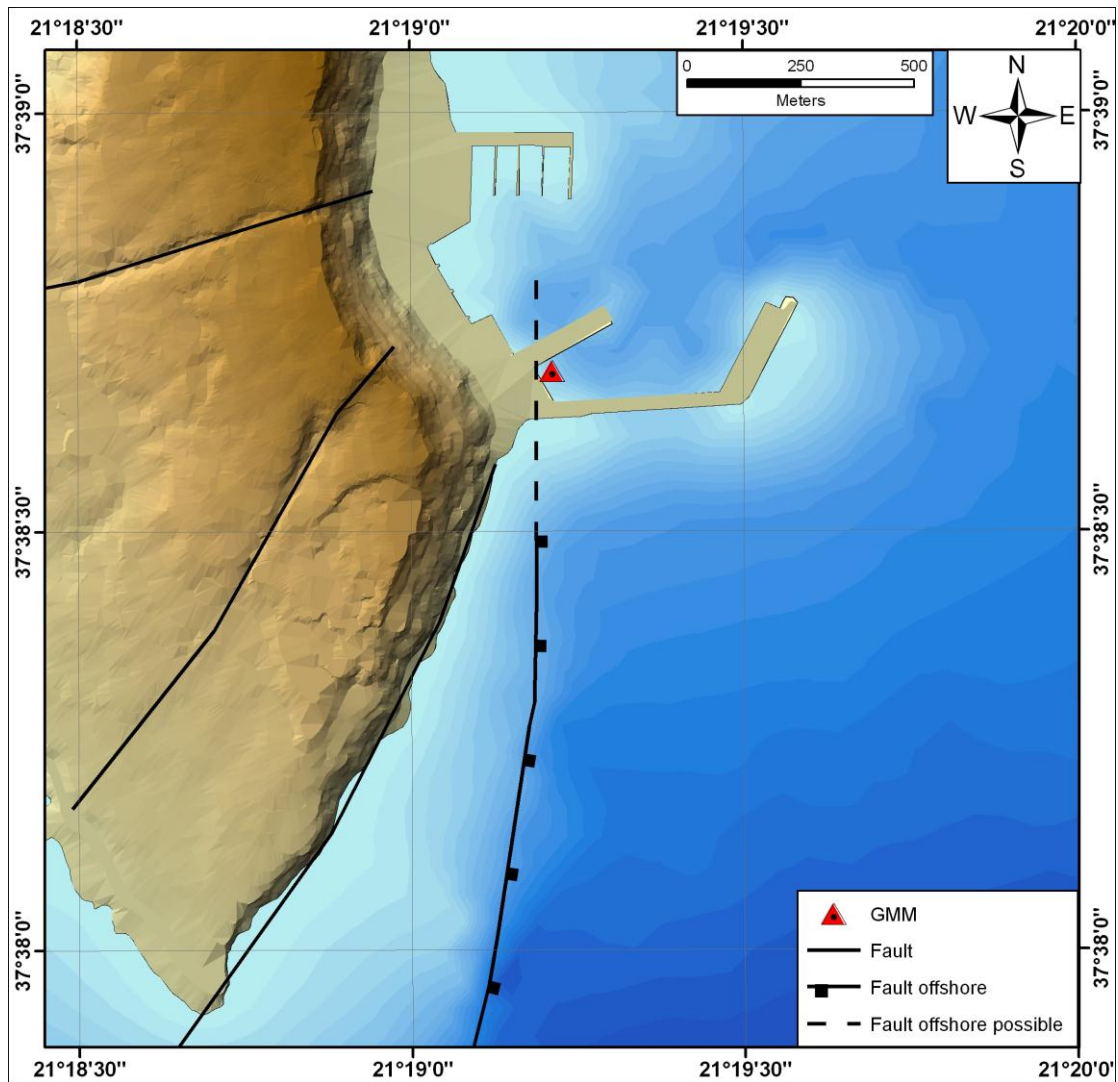


Fig. 1:Map showing the Katakolo harbour and the GMM monitoring site.

Katakolo bay has attracted the interest of scientists due to the vast seepage occurring in the harbour and can be considered as a unique natural laboratory to study O_2 versus gas seepage by a long term monitoring. Offshore bubbling plumes are widespread throughout the harbour docks. The bubbles issuing from cracks in the seabed are of the order of 10 - 20 cm in diameter. The seepage is considered as thermogenic methane (*Etioppe et al., 2006*). Extensive bacterial mats (*Beggiatoa sp.*) have been found on the seafloor at these seep sites. Furthermore, onshore seeps have penetrated and damaged the docks around the harbour.

For the long-term monitoring in Katakolo bay the Gas Monitoring Module (GMM), developed in a previous EU project (ASSEM), was used (Fig. 2). The GMM is based on a multiparametric approach in which the detection of gases (O_2 , CH_4 , H_2S) is associated with that of key physicochemical factors, i.e. temperature, pressure and conductivity. Gas detection is based on the use of oxygen, methane and hydrogen sulphide sensors commercially available. All sensors have a unique time reference and are controlled by a dedicated data-acquisition system (*Marinero et al., 2006*).



Fig. 2: The GMM benthic observatory on board the research vessel (Barbantonis) in Katakolo Bay.

5.2 The GMM Benthic Observatory configuration

During the deployment the GMM was configured with the following payload (Fig. 3):

- two semiconductor METHane (CH₄) Sensors (METS; Franatech GmbH, Luneburg, Germany)
- an oxygen sensor
- a turbidimeter
- an H₂S electrode microsensor (ATM GmbH, Rostock, Germany)
- a CTD SBE-37-SI Microcat (Sea Bird) for measurements of conductivity (C), temperature (T) and depth (D, or pressure, P) and
- a current meter
- an electronic vessel
- a battery vessel

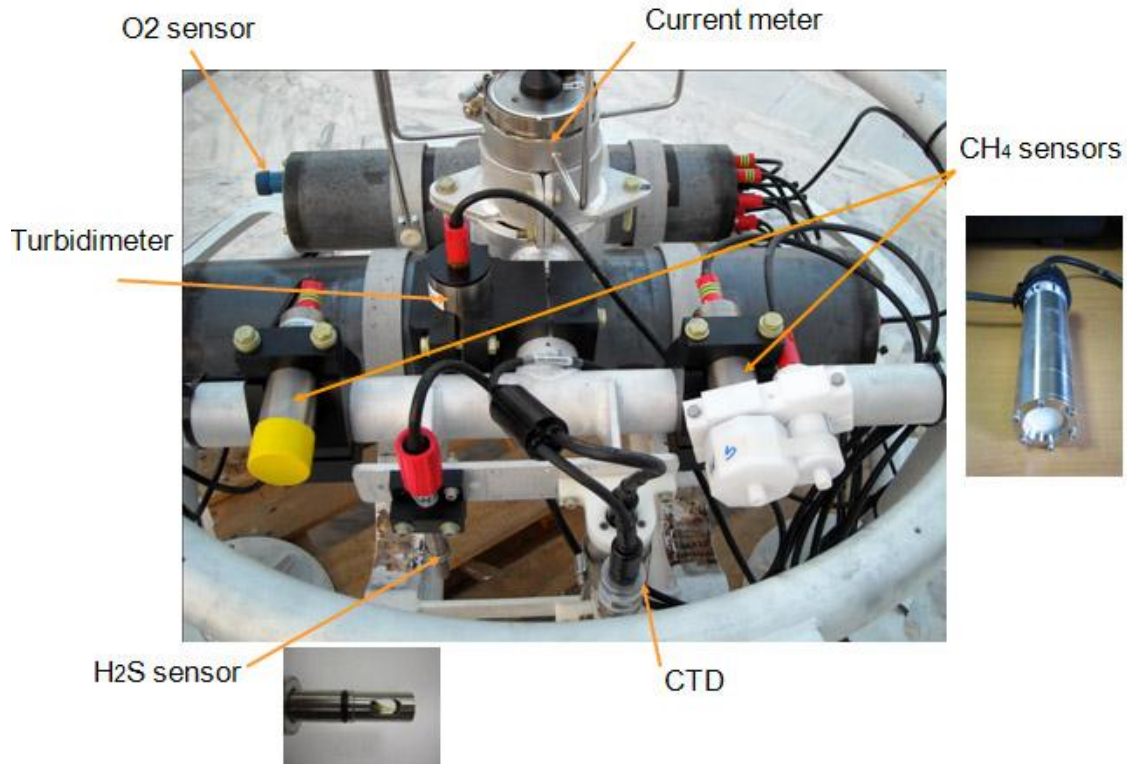


Fig. 3: The GMM Benthic Observatory sensor package.

5.2 Preliminary data from the GMM Benthic Observatory

The preliminary GMM data analysis has shown a good correlation between the measurements of two methane sensors with no shift in sensors signals (Fig. 6). The preliminary results also show eight main methane peaks associated with oxygen drops. The preliminary results also show a series of main periods of O₂ depletion, apparently related to enhanced seepage. All data are under careful quality-check and analysis.

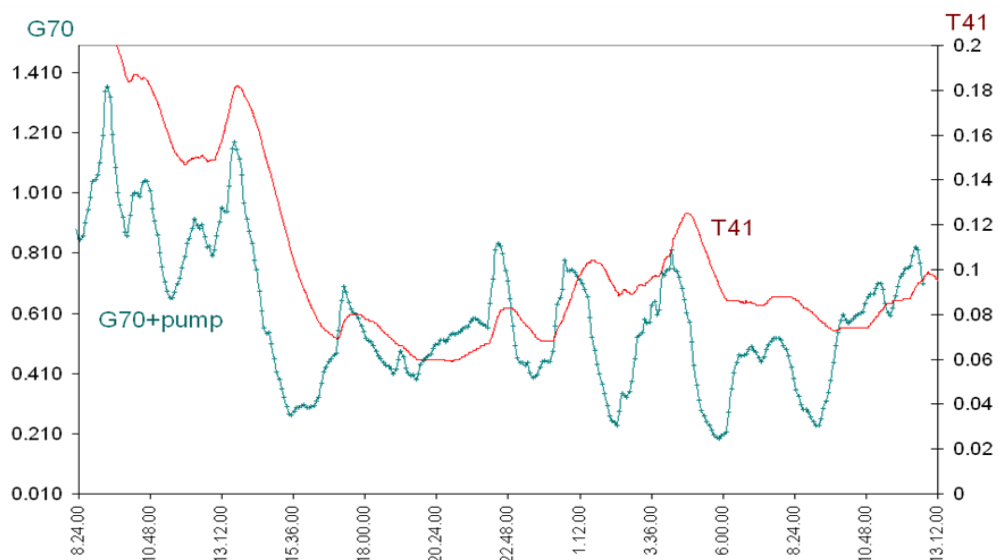


Fig. 6: Data set showing the good correlation of two methane sensors measurements.