

## HYPOX PROJECT

### CRUISE REPORT

## MEDUSA SURVEY IN THE CRIMEA SHELF (BLACK SEA) 19-22 April 2010

G. Marinaro<sup>1</sup>, N. Lo Bue<sup>1</sup>, F. Furlan<sup>2</sup>

<sup>1</sup>INGV – Sezione Roma2, <sup>2</sup>Tecnomare spa

The objective of the MEDUSA surveys in Black Sea was to perform an instrumental and visual exploration, including oxygen, methane and CTD measurements, in selected hypoxic-anoxic areas and in correspondence with gas seeps on the Crimea Shelf.

MEDUSA team embarked on MARIA S. MERIAN on April 19<sup>th</sup> in Port Eregli.

During the survey MEDUSA transmitted in real-time to its Surface Control Unit all data collected by the scientific payload (see Table 1), acquired at 1 Hz sampling rate.

A Posidonia transponder was added to MEDUSA in order to provide a precise positioning at sea.

**Table 1**

DESCRIPTION	MODEL-MANUFACTURER	RANGE	RESOLUT.	RESPONSE TIME
CH4 sensor (1)	K-METS - Franatech	0.01-10 $\mu$ M	2 nM	~ 2 min
CH4 sensor (2)	HydroC - CONTROS	0.1-100 $\mu$ M	10 nM	~2 min
O2 sensor	Optode 3830 - AANDERAA	0-500 $\mu$ M	<1 $\mu$ M	< 25 s
TV camera + light	Multi SeaCam 1060 – DEEPSEA POWER&LIGHT			
CTD	SBE-19plus	0-9 S/m -5;35 °C 7000 dbar	0.00007 S/m 0.0001 °C 0.002% f.s.	
Turbidimeter	Wet labs ECO-NTU, controlled by CTD	0.0024-5 $m^{-1}$		

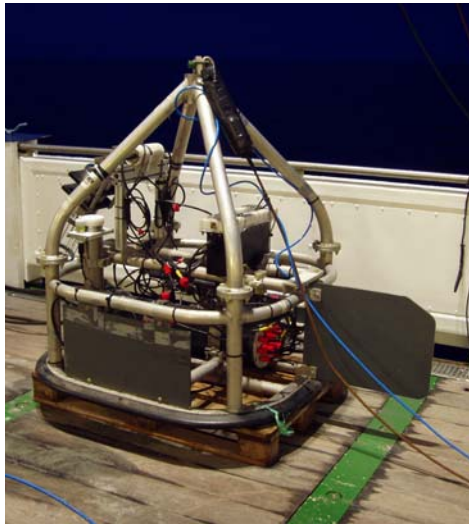


Fig.1. MEDUSA system

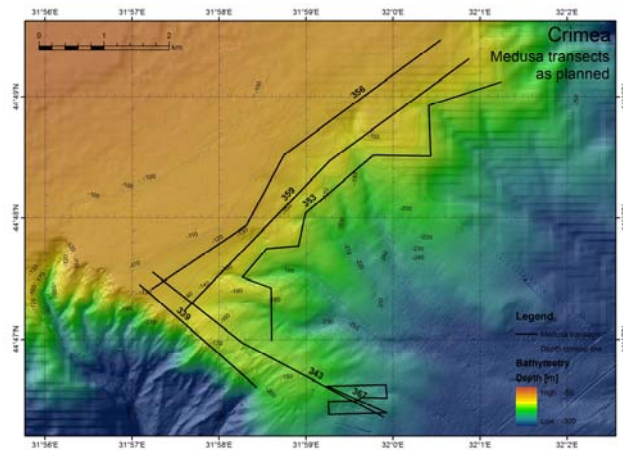


Fig.2. Map of the six transects surveyed by MEDUSA

MEDUSA (fig.1) was completely assembled on 19<sup>th</sup> April and the surface control unit was installed in the ship hangar. The surveys started on April 20<sup>th</sup>. Before each Medusa dive, CTD casts were performed in order to provide a water column reference and water samples were collected to perform analytical analysis of oxygen (Winkler Titration) to be compared with the Optode measurements.

In total 6 transects were carried out, which included data recording along vertical profiles (cast) and horizontal survey (towing).

### **Transect 1 (station 339)**

The first transect was performed along the more western shelf edge, perpendicularly to the bathymetric profile. It started at 10.25 UTC at 44° 46,609'N 31° 58, 372'E (MEDUSA GPS) at about 215 m of depth and it ended at 13.39 UTC at 44° 47,555'N 31° 56, 908'E (MEDUSA GPS) at about 115 m. The seafloor appears with smooth and rippled structures alternate with sudden cracks and large carbonates outcrops.

We observed that the Optode mounted in MEDUSA provided oxygen data which were different analytical results of Winkler Titration performed on board. The offset was around +7  $\mu\text{M}$  close to the sea-bottom. Methane concentration data recorded by the METS sensor (which need a post-correction with O<sub>2</sub> data) were preliminarily corrected by the MEDUSA Optode data, and therefore they cannot be considered correct. Probably actual values are one order of magnitude lower.

In the afternoon, before the second MEDUSA dive, MPI colleagues installed on MEDUSA 4 additional types of oxygen sensors (both electrochemical and optical). All following METS data were thus corrected with the data provided by the MPI Optode.

### **Transect 2 (station 343)**

The second transect, parallel and deeper than the first one, started at 16.25 UTC at 44° 46,430'N 31° 59, 766'E at 257 m depth and ended at 20.20 UTC at 44° 47,577'N 31° 58, 293'E, at a depth of about 180 m. During this transect some small seep and bubbles were recorded by the video camera and methane sensors reached very high CH<sub>4</sub> concentrations (max value of 59  $\mu\text{M}$ ). The seafloor appeared with smooth and rippled structures and some carbonates outcrops were present. A first analysis of data from all sensors indicates an hypoxia-anoxia boundary at 175 m depth.

### **Transect 3 (station 353)**

The third transect (April 21<sup>st</sup>) started at 8.30 UTC at 44° 47,022'N 31° 58, 675'E following the isobath of 180 m along the southern part of the shelf and it ended at 15,00 UTC at 44° 47,022'N

31° 58, 675'E. Here some soft sediment spots were found, suitable for safe box corer sampling.

#### **Transect 4 (station 356)**

The fourth transect started on April 21<sup>st</sup> at 16.14 UTC at 44° 49,463'N 32° 0, 543'E, it was located at about 1 km further northward than the previous transect and it ended at 20.57 UTC at 44° 47,387'N 31° 57, 169'E following the upper isobaths of 120 m. Here the hypoxia-anoxia boundary was less evident although lower oxygen values were found in correspondence with the canyon structure located close to the slope.

#### **Transect 5 (station 359)**

On April 22<sup>nd</sup> at 6.46 UTC an intermediate transect was performed along the isobaths of 150 m in order to better verify the thermocline influence on the oxycline found in correspondence with the canyon structures. This transect started 44° 49,326'N 32° 0, 874'E and ended at 11.18 UTC at 44° 47,221'N 31° 57, 588'E.

The measurements carried out during this Medusa survey confirm that a strong water mass stratification exists highlighted by the presence of hypoxic water along the bottom shelf and of anoxic water just in correspondence with submarine canyons when depth rapidly decreases.

#### **Transect 6 (station 367)**

The last transect was located beyond the shelf edge around known active seep structures, at 220 m of depth (*Schmale et al., 2010 Journal of Marine Systems*). Initially, this dive was mainly aimed at verifying if the pattern of the oxycline is influenced by the gas seepage from the seafloor (does gas seeps influence oxygen distribution and concentration at shallow seawater?). This task should have been done by repeated vertical casts, outside and inside the seepage area, recording all oxygen and methane data from sea-surface to the seabed. Unfortunately, the limited time available did not allow to perform this activity.

The transect started on April 22<sup>st</sup> at 18,06 UTC at 44° 46,630'N 31° 59, 242'E before a short cast and carried on with an horizontal survey at a water depth of 150 m. Diving over the seep field bubbles interference was recorded by the on board fish finder (19.20 UTC), and then sensors start to record significant variations of CH<sub>4</sub> and O<sub>2</sub>. Few minutes later (20.00 UTC) Medusa was dived down to the bottom; several gas seepage structures (pockmarks, chimneys) were found and bubble trains were observed in correspondence of a ~2 m high chimney (fig.3).

As MEDUSA reached sea bottom (~240m) methane concentration started to increase, the METS sensor saturated above the calibration range (values of 2200 μM were reached) and Optodes recorded anoxic condition. Very high methane signals were permanent throughout the seepage area. At 20.33 UTC the survey ended and Medusa was recovery on board (20.47 UTC) in order to leave the survey area and to reach the harbour.

MEDUSA team disembarked on April 23<sup>st</sup>.



*Fig.3: Chimneys of seep found at station 367*

