M110 GALIMOS

Monitoring the interaction between oceanographic elements and sedimentary seabed structures at the Galician margin.

Vigo (Spain) – Cádiz (Spain)

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During the second week of our GALIMOS cruise, we continued consequently with our scientific program by analyzing the obtained data sets and applying the results to the ongoing daily program. Main target of investigation was the region around the shelf edge – uppermost continental slope. Two prominent morphological ledges at 400-500 m water depth extend over the whole study area here. A geological origin of these terraces, i.e. relation to the underlying rock formation, can be excluded. Our basic hypothesis focused, thus, on a possible mechanistic linkage between horizontal boundaries in the internal structure of the water-column and the characteristics of the seabed.

To overcome this target, we investigated the water column itself with a number of lateral profiles as well as time series (stationary measurement at selected stations) through the shipboard 18 kHz Parasound and the 75 kHz ADCP systems. The obtained data demonstrate how sharply confined water layer on the one hand and wide clouds occur regularly at distinct water depths off the shelf edge/uppermost slope. These elements show a direct relationship to the day/night cycle, rising to the surface during sunset and diving back to greater water depth when daylight returns (“Dial Vertical Migration”), underlining their biological background. However, wave-like vertical movements, which run along the lower boundary of these elements with frequencies of minutes to hours, suggest that these interfaces act as media for travelling “internal waves”. We expect that the frequently appearing wave trains transport a high amount of energy to the seabed in the respective depth where the ledges are placed.

We collected valuable information about the density and type of the particles in the layers and clouds with a particle camera (ParCa) and a rosetta water sampler (18 bottle with 10 l volume each). Intention was to understand which sort of material is responsible for the obtained acoustic 18 kHz signals. In addition, we run numerous lateral and temporal profiles, partly repeatedly. This great data set allows for a detailed analysis of prevailing wave lengths, the driving wave systems behind, and the energy levels with the potential to affect the seabed.

In a next step, we looked directly at the conditions of the seafloor in the ledges’ region. We drove the ROV (*Remotely Operating Vehicle*) three times upslope across the individual ledges. Finding was that the geostrophic, generally northward directed bottom current interacts intensely with the seabed, leading to certain deposition of sediments only in lee-side (north facing) locations. Areas exposed to this current show, in contrast, submarine slided material and *in-situ* formation of early-diagenetic crusts.

A sediment-core transect, taken inside a slope channel ("gully"), demonstrated that downslope gravity-driven processes play a certain but probably not significant role in transporting sands from the outer shelf down into the deep ocean. A group of bottom-trawling fisher boats accompanied our activities at the shelf edge every day. Though officially registered as single trawlers, these boats come in pairs pulling massive iron chains over the ledges' seafloor to collect the fish, and leave massive traces in the seabed sediments as we could observe during our ROV dives.

The wind conditions turned to northerly directions during this week leading to southeasterly rolling wave and swell systems – exactly what we hoped would happen. This change led to a certain upwelling regime, in contrast to the conditions during the first week of our research cruise. We recovered the lander which we had deployed on the center of the mid-shelf mudbelt on September 21, five days later.

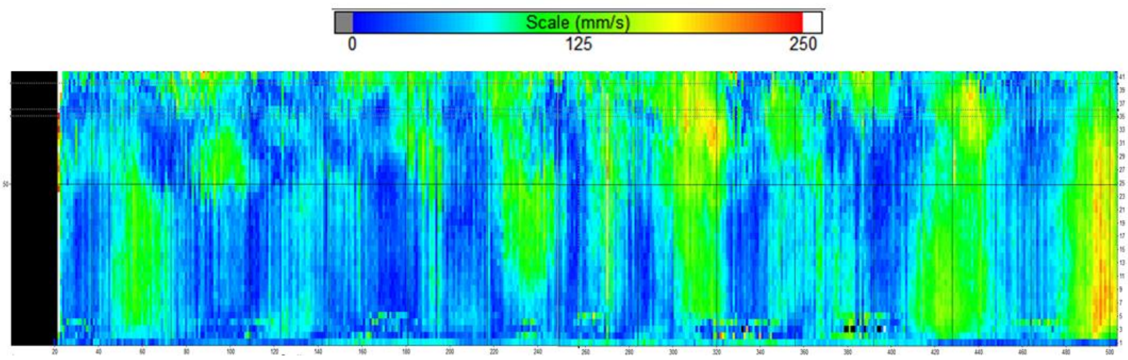

Figure: 5-day time series of bottom current intensity at the second lander station.

The recovery maneuver turn out, however, to be more difficult than expected; we had analyzed all boats' movements in the region (400 boats with a 5-minutes time resolution over one full year) prior to its deployment to be able to select a location where fishery activities could be fully excluded. Nevertheless during the night before our recovery action, a fisher boat ("Hermano Suage") cross exactly our lander's position, switching illegally off its Automatic Identification System for half an hour. Our recovery action lasted finally for 20 hours. Fortunately, we had equipped the lander with two independent recovery systems, with position-sending units (releaser), and we had an ROV on board. After having determined the exact position of the lander (slided by 95 m from its original location), we found the frame nearly intact on the seafloor. Using a self-constructed weight-hook mechanism and the manipulator of the ROV under poorest visibility on the seafloor we were able to bring the lander back to the deck, thanks to the great technical skills of the ROV team and of the crew of METEOR – plus a great bite of fortune. The suffered damage was comparably limited (one current meter lost, the frame heavily bent, all buoys destroyed).

The devices fixed on the lander have, nevertheless, recorded a scientifically outstanding data series. A first tentative analysis shows how tidal cycles, wind intensities, internal wave trains, and bottom-near suspension interplay with each other. We have, thus, fully achieved our main target on the shelf.

During the remaining two days, we finished our lateral profiling on the shelf, measured several additional stationary time series with Parasound and the CTD/rosetta water sampler, and sampled sediments along two further transects in slope gullies. A ROV dive at the location of the first lander deployment (in mid-shelf position off the Douro river mouth) to obtain a measure of the seabed sand ripple dimensions as an additional indicator for bottom flow intensities during the storm which has affected this region during the preceding week.

We have worked on 42 stations in total during this expedition (CTD/rosetta water sampler 58 deployments, Rumohr corer 24, particle camera 8, grab sampler 11, gravity corer 7, ROV 6, Lander mooring 2). It was an exciting experience to collaborate with colleagues of nine different nationalities, with a wide range of scientific expertise, allowing for a maximum of data collection during these two weeks. I would like to express my great gratitude to my scientific team at this point. Also, the crew of RV METEOR with its outstanding cooperativeness has significantly contributed to the success of this cruise. I thank captain and crew cordially for their support.

Till Hanebuth – *Chief Scientist;* September 30, 2014, after arrival in the port of Cadiz.