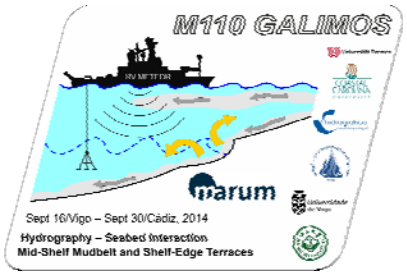
M110 GALIMOS

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

Vigo (Spain) – Cádiz (Spain)

Sept. 15 – 30, 2014

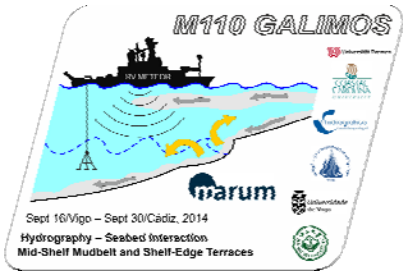


1st Weekly Report – Sept. 15th – 21st, 2014

The study area off the northwestern Iberian Peninsula, namely Galicia and the northernmost part of Portugal, is a representative example of an Atlantic continental margin with a 40 km wide continental shelf (0 – 160 m water depth) and a steep continental slope (down to 2.500 m water depth). The oceanographic and sedimentary shelf systems are generally dominated by the winter storm regime. Seasonally, the wind fields control ocean-current directions, seabed-sediment mobilization, and upwelling/downwelling conditions; and these waters serve as the second largest fishing ground in Europe. Our research project, having started in 2006 already, aims at understanding how oceanographic and sedimentary processes interact with each other along a continental margin from coast, across the shelf, down into the deep ocean. In the past years, we have concentrated on the geological system and gained deep insight into the long-term evolution and built up of depositional centers and erosion-dominated zones on centennial to millennial time-scales. A prominent example for a sediment depocenter is the mudbelt, which forms since about five thousand years in mid-shelf position (100 – 140 m water depth) all along the coast. Such mud depocenters serve as cradle of life due to their comparably calm bottom conditions, and represent the major sink of material supplied by rivers to the ocean. An example for erosional activity is found just off the shelf edge in the form of a pair of terraces at 350 – 450 m water depth. These terraces appear in association with numerous downslope-running channels ("gullies") which cut back into the shelf edge. Their origin remains obscure but data from a preceding cruise indicate that a particular layer in the ocean stratification coincides with the position of these terraces.

However, to explain the reason why these features form in the way we find them on the seabed today remains speculative as long as our interpretation is based on pure geological observations. Our current cruise targets, thus, on the linkage of the modern oceanographic system – its bottom currents, tidal currents, and its internal vertical and horizontal boundaries – with long-term sedimentary and erosional processes. Main object of interest are the mid-shelf mudbelt and the uppermost-slope terraces.

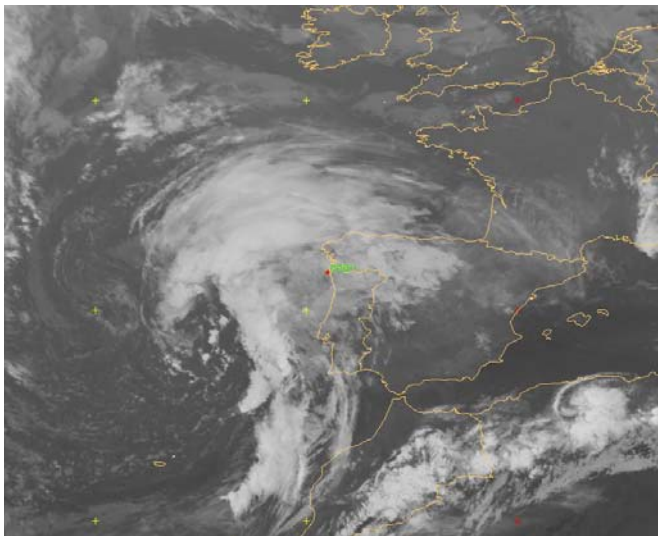
To address the objectives of the cruise, we came on board with a variety of instruments suited for measurements in the water column and below the seafloor. The shipboard acoustic devices working with 4, 18, 30, and 75 kHz frequencies provide detailed insight into the water-column structure. We collect *in-situ* data with a water-sampler containing 18 bottles released at selected water depths, a device for temperature-density profiles (CTD), and a particle camera. A remotely operating vehicle (ROV) dives just above the seafloor equipped with a variety of cameras, sensors, and material collectors. Last but not least, three types of corers are suited to take sediment samples at different seabed penetration depths. For a continuous monitoring of near-seabed processes, we have designed a so-called lander which is composed of a 2 x 2 m sized frame on which 3 current



sensors (ECM), 2 water-column velocity profiler (ADCPs), and one grain-size measuring device (LISST) are fixed.

The scientific team could not be more colorful. The 19 cruise participants from Germany, Portugal, Spain, the US, the Netherlands, Belgium, China, and Estonia cover a wide range of scientific and technical expertise. This diversity in terms of specialization as well as menthality leads to great interactions in the team and the best approach in terms of the data collection strategy. Reason why we selected September as the best season was the hope to get a short-lasting storm during the cruise. Such an event would provide an analogue to the major storm events in winter time during which the oceanographic system experiences intense high-energy disturbances with measurable effects on the seabed sediments down to great water depths (even more than 2.000 m). For planning an efficient work flow and for minimizing risks concerning our instrumentation, two meterological experts (DWD) are on board who forecast wind and wave conditions with impressing precision.

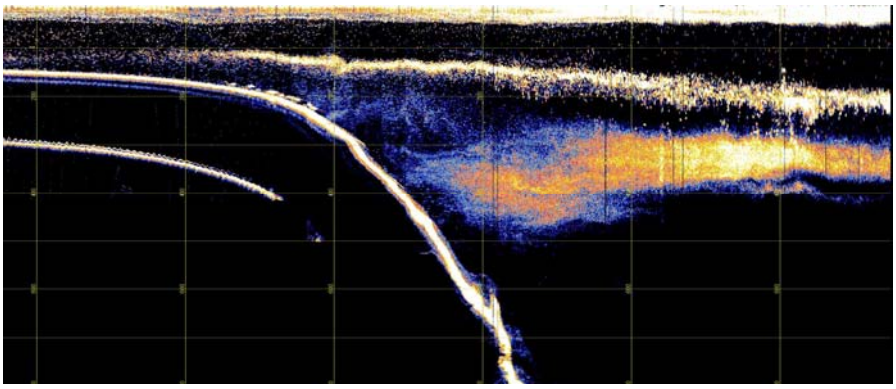
During the first week of our GALIMOS cruise, we focused on the mid-shelf region, the mudbelt. We deployed the lander already on the first day off the Douro river mouth at 50 m water depth with the intention for a 36-hour monitoring (Fig. 1). Much to our excitement (and to smaller extent a bit to our personal inconvenience during these days) a just arriving storm deep (Fig. 2) led to an unexpected 96-hour lasting time series over the increase and subsequent decrease of energy in the system. The recovery of the lander went perfectly and one day later we already deployed it for a second time off the Ría de Vigo at 125 m water depth.



In the meantime, we ran 8 profiles with the shipboard acoustic systems mainly perpendicular to the coast from 30 to 2.000 m water depths, took water and sediment samples on 20 sta-

tions, and had one dive with the ROV on the mudbelt.

Whilst the different sets of water-column data obtained on the shelf are still to be processed, the acoustic profiles across the shelf edge illustrate nicely how clouds and layers rich in either suspended sediment or billions of small organisms expand from the shelf edge over the open ocean (Fig. 3). We use these layers in order to visualize waves that migrate inside the water column and interfere strongly with the seabed and its sediments on the uppermost continental slope upon arrival.



In the second part of our cruise, we will move to the shelf edge to address the terrace subject, whilst the lander off Vigo will keep measuring. Again, a great fortune is that the wind turns to northern directions now mimicking the contrast between general summer (northerly winds) and stormy winter (southwesterly winds) conditions.

Mood and motivation in the team is great, the collaboration with the bridge and the technical crew could not be better!

Best wishes to our colleagues and families in Bremen, Lisbon, Vigo, Oostende, Conway, Tallin, Guangdong, and Woods Hole.

Till Hanebuth

Chief Scientist

Sept. 21, 2014, 42°06'N 09°25' E