IAS POSTGRADUATE GRANT SCHEME

Scientific report by Sara Benetti

It is widely acknowledged that climate change and resulting sea level oscillations affect in some way the sedimentary processes operating along continental margins. The aim of my PhD project (Deep sea sedimentation and climatic change) is to further investigate of the role of climatic processes in controlling deep-sea sedimentation.

While the first part of my project was focused on analyzing the sedimentation patterns along the western North Atlantic margin at a large scale, the second part of the project involves a more detailed investigation of deposition by turbidity currents in the deep sea. For this purpose, I decided to study suites of cores from several basins or abyssal plains along the Canadian and US Atlantic margin. As many of these cores are stored at Bedford Institute of Oceanography –BIO- (Dartmouth, NS, Canada), I spent the period May to October 2003 working there under the supervision of David Piper (Geological Survey of Canada – Atlantic).

The IAS grant contributed in part to the cost of the flight to Canada (£767.30) and living expenses (around £3000 for rent and daily allowance) for the four months I was in Canada.

During this period I was able to select sets of cores from Baffin Bay, Orphan Basin, Newfoundland Basin and Sohm Abyssal Plain on the basis mainly of their state of preservation and their potential for "telling a story".

Thanks to the available material, the second part of my PhD project evolved into three distinct subtopics:

- Study of turbidite deposition in abyssal plains at different latitudes, focusing on the timing, rates and styles (using mainly cores);
- Study of the deposition by turbidity currents in Orphan Basin (using cores and seismic data);
- Study of turbidite deposition from the North Atlantic Mid-Ocean Channel (NAMOC) (using mainly cores).

The aim of first subtopic is to clarify the connections between timing, rates and styles of deposition and sea level fluctuations and different modes of turbidity current initiation and delivery off different environments (i.e. cold ice margin, warm ice margin and temperate low stand rivers).

The second and third subtopics can give important insights on the processes operating in Orphan Basin and at the NAMOC outlet in the Sohm Abyssal Plain, which are areas still relatively unknown and with limited data availability.

In order to study turbidite deposition in the cores, I rely mainly on facies interpretation. There are several tools that can help in this exercise, such as magnetic susceptibility, shear strength, spectrophotometric data, and x-radiographs. When possible, all these data were collected or acquired during my time at BIO. Once turbidites had been identified, I carried out grain size analyses with a Coulter LS230 analyser, which measures particle size distribution using the principle of laser diffraction. This instrument is very time-efficient, as it can perform an analysis every 10-15 minutes, requires a very small amount of sediment (from a few 100 mg for very fine samples to 1 or 2 grams for sand-sized samples) and covers a wide range of grain sizes in one analysis (0.4 to 2000μm, clay to sand).

Descriptions and grains size analyses provide information on the styles of turbidite deposition, however, in order to evaluate the timing and rates of deposition, I needed to assess the chronology of the cores. Keeping in mind the available amount of time and analysis costs, I tried to choose cores that already had an established chronology. When needed and possible, I am getting additional ^{14}C dates, otherwise I am using markers, such as carbonate content and volcanic ash layers, to correlate my cores with other cores, whose chronology has already been established. Samples for ^{14}C dates and XRD analyses have also been collected during my time at BIO.

While at BIO, I also participated to Hudson cruise 2003-033 (15 June – 6 July 2003), which consisted mainly in the investigation by seismic and coring of the Scotian and Newfoundland margins. During the cruise several new cores were collected in Orphan Basin and three of them will be included in the study of the deposition by turbidity currents in the basin.

Core 03033-24, collected just beyond a levee crest in the southern part of the basin, and core 03033-025, collected on a terrace on the flank of Orphan Knoll, 37 m above the turbidite plain, will be especially useful in establishing the turbidity current pathways and may allow the distinction of flows originating from debris flows and those generated by processes involving meltwater. Core 03033-028, collected in the flat lower fan at the basin outlet, will tell how often turbidity currents escaped the basin, thus giving information on intensity and frequency of turbidity currents.

Overall, my time at BIO was very useful for my PhD studies and I think I got a lot out of it, including my participation to the cruise that was not planned when I left for Canada. The possibility to work directly on the cores (instead of just having the samples sent over to UK) allowed me to interpret the processes represented by the different facies, to know exactly how certain analyses are carried out and, when possible, to participate to the whole process of core investigation, from the choice of coring site to the splitting, description and collection of data. Moreover, I think the cores I am studying have a great potential for providing information on the mechanisms of turbidity current generation and on the deposition by turbidity currents in the deep sea.