Short cruise report
MS MERIAN Cruise MSM02/1

Lisbon (Portugal) – Thorshavn (Faroes)
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Introduction and Objectives of Cruise MSM02/1

Cruise MSM02/1 is the third occurrence of the Ovide hydrological section that was performed in 2002 and 2004, as part of the CLIVAR programme under the name of A25. A Greenland-Portugal section was previously performed in 1997 under the leadership of S. Bacon (NOCS), slightly south of the Ovide path. The Ovide route crosses Reykjanes Ridge 300 miles north of Charlie-Gibbs Fracture Zone and runs through the West European Basin without having to sample on top of the complex Mid-Atlantic Ridge.

The objective of this repeated hydrological section is to monitor the variability of water mass properties and main current transports in the basin, complementing the international observation array relevant for climate studies. The western part of the Ovide section is redundant with AR7E (called also A1) which was done on the odd years and will allow a better analysis of the interannual variability.

The hydrological section includes a hundred surface-bottom stations from coast to coast, collecting profiles of temperature, salinity, oxygen and currents. From the 28 bottles closed at various depth at each stations, samples of sea water are used for salinity and oxygen calibration, and for measurements of biogeochemical components, including tracers, isotopes, nutrients and carbon.

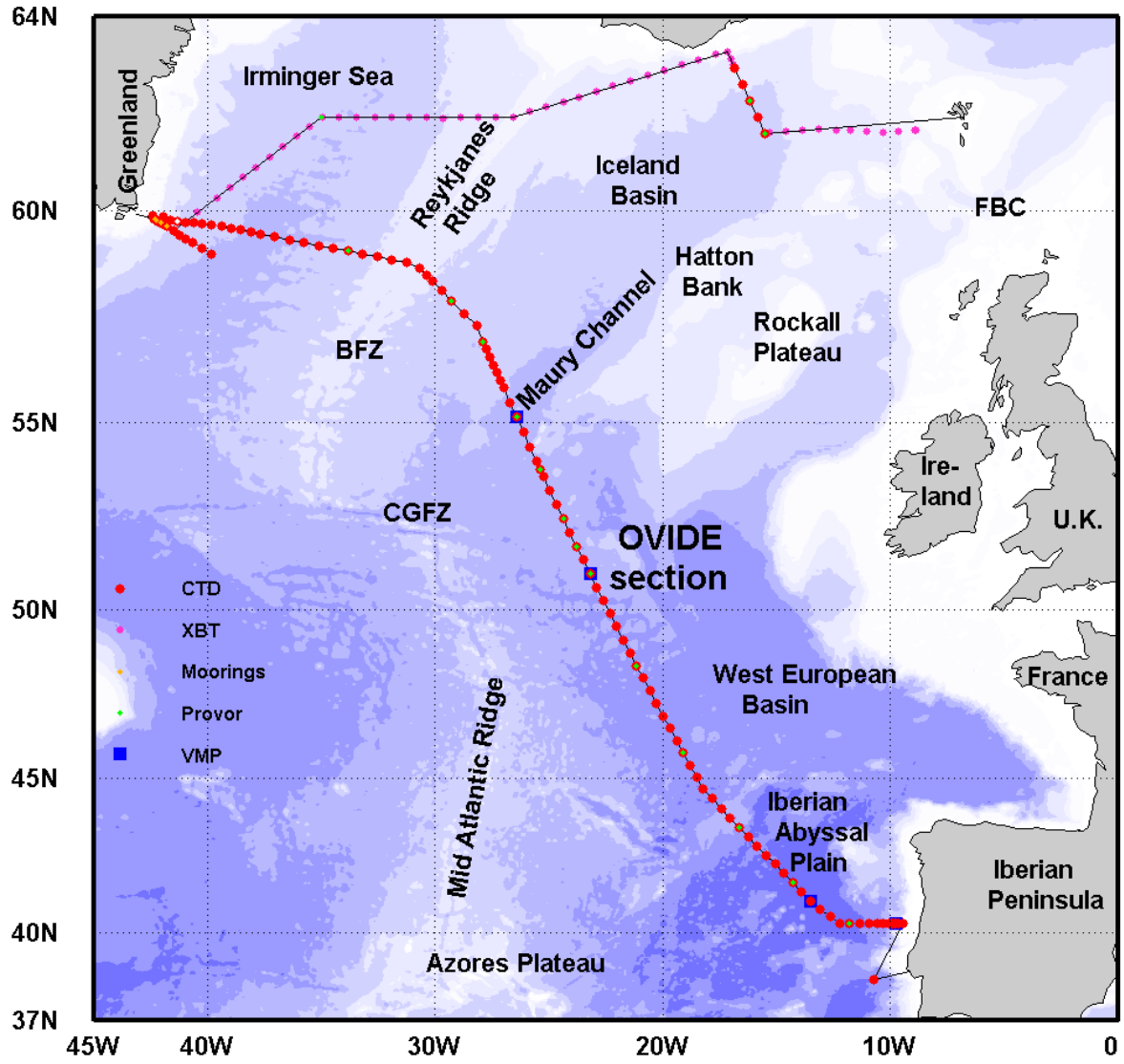
From the thermal wind equations, geostrophic transports are deduced from temperature and salinity. Then, direct current observations, preferentially those measured by the ship ADCP, are used to constrain the velocity at the chosen reference level. This is particularly important in the Irminger Sea, where bottom currents are very energetic. This way, the contribution in heat and fresh water of the major currents crossed (mostly perpendicularly) by the Ovide line can be estimated. From north to south, the major currents are the East Greenland/Irminger Current (about 20 Sv southward, 1 Sv = 10^6 m^3s^{-1}), the Deep Western Boundary Current (about 10 Sv southward), the Irminger Current (about 10 Sv northward), and the North Atlantic Current (about 20 Sv northward). Between 1997 and 2004, we already observed a significative variability of these transports (about 30%).

The Meridional Overturning Circulation reflects the equilibrium between the warm and salty waters flowing poleward near surface and the cold and relatively fresh water flowing equatorward near the bottom. Measured across Ovide, it is mainly the balance between the North Atlantic Current and the Deep Western Boundary Current. The simple sketch is however complicated by the export into the Labrador Sea and around the Subpolar Gyre of part of the highly variable East Greenland Current. This is why an array of four currentmeter moorings and one ADCP lander was deployed on the East Greenland slope and shelf in 2004, for two year.
While temperature and salinity are often the basic parameters to identify water masses, it is useful to use tracers like CFCs to determine when they were ventilated. Oxygen is also a good indicator near the sources, but not conservative. Combining oxygen with nutrients gives useful information on the biological activity and on the remineralization processes. CFCs and nutrients are analysed by the Roscoff team led by Pascal Morin (LCM).

The measurements and analyses of pH, alkalinity and pCO_2 are performed by a Fiz Perez and Aida Rios from Vigo (IIMV) at every Ovide cruise. In 2006, it was officially part of the CARBO-OCEAN

international program, and the objective is to better quantify the role of the North Atlantic in the storage and transport of anthropogenic carbon accumulated in the atmosphere.

In 2006, samples were taken to measure isotopes of oxygen (18) and carbon (13) after the cruise. Oxygen isotopes are very useful to determine the proportion of fresh water from different origin (rain/snow, runoff, sea ice).



Cruise Narrative

MERIAN left the port of Lisbon on May 23 at 10 pm, after some repair works on the engines. Six containers were embarked, including 3 laboratories. May 24 is dedicated to tests of the different systems around 2 CTD stations. We learn to work together. A few days will be needed to determine procedures necessary to smooth the operations. During the CTD descent, the EM120 is used to listen to the rosette pinger, helping in the bottom approach. The signal is sometimes good, sometime noisy. All the stations were performed down to 5 to 15m from the bottom, as confirmed by the signal of a contacter. The Posidonia system was also used at all stations to get the 3D position of the rosette under the water.

During the 120 stations of this cruise, 2740 seawater bottles were sampled for measuring the different biogeochemical quantities delaied above. In addition to the 100 stations required for the Ovide section,

15 stations are localized along the mooring array line south east of Greenland, and 5 south of Iceland, where Iceland-Scotland Overflow Water can be found near its main source (the Faeroe Bank Channel). For all stations, LADCP data were successfully collected to determine the current profiles.
The ship ADCP, a RDI 75kHz, ran nicely from the beginning to the end of the cruise. The data until station 18 are unfortunately noisy due to interferences with the DoLog at 78kHz. The problem was found and then solved after 6 days.

Several technical issues mainly due to the ship youth will delay the work by a few days. An accident was deplored. However, tenacity and competence of the crew was determinant in the achievement of this cruise. The only unperformed work was the mooring deployment planned on the shelf at 63°N for our German colleagues. Reasons were both difficult sea-ice conditions and a broken pod. The thermosalinograph data may also be difficult to use, due to intermittent pump problems. Despite this, the Spanish GASPAR system, used to measure surface pCO_2 along the route, could provide relatively good data.

The situation near Greenland was quite unusual. After a decade of sea-ice retreat at this latitude, a large pack of multiyear ice drifted through Fram Strait at the beginning of the year (seen by satellite images) and was found a few month later along the south-east coast of Greenland. Recovering the four moorings turned out to be a patience game, followed by an intensive day of work, when easterlies finally pushed the ice against the coast for a few hours. All four moorings were recovered, with a 90% data return. First estimates of the current near Greenland indicate an unusually weak East Greenland Current when we were on site.

During the cruise, several instruments were tested: an autonomous CTD performed 2 profiles, a brand new Vertical Micro Profiler performed 3 profiles, including one at more than 5-km depth. The VMP was lost at the fourth profile east of Reykjanes Ridge, and different elements let us think that it stayed stuck at the bottom, despite several safeties to release the lest. A specific report was written.

Along the Ovide section and on our way to the Faeroe Islands, 16 profiling floats (PROVOR) were deployed in the frame of the ARGO program. They are programmed to drift at 1000m depth and collect temperature and salinity profiles from 2000m and surface every 10 days. They should be active for about 4 years. The passage near the Central Irminger Sea mooring was also the occasion to deploy a Spray glider from the European MERSEA project in order to complement the mooring measurements. The glider was recovered by the Discovery 2 months later. Finally, on our way back, 48 Expendable BathyThermographs (XBT) were launched. All the data collected by the PROVOR, the glider, the XBT and a vertically subsampled CTD dataset have been sent to the Coriolis Regional Data Center [http://www.coriolis.eu.org/] in real time.

We came back on June 28 at the Faeroes, right for the final ASOF meeting.