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Deep oceanic circulation in subpolar North Atlantic over the last 60 ka : a synthesis of multi-proxy approach based on Marion Dufresne cores

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Different cruises on board the R. V. Marion Dufresne allowed to take cores along the paths of the main overflow waters in sub-polar North Atlantic. The cores studied for glacial period are characterized by deposition rates ranging from 8 to 24 cm/ka and those studied for the Holocene period have sedimentation rates between about 90 and 15 cm/ka.

Multi-proxy approach was conducted each time with the magnetic properties as the common studied parameters, used as bottom-current tracer. These properties were coupled, depending on the cores, with oxygen and carbon isotopes of planktonic and benthic foraminifera, sortable silt, IRD counting. The rationale for the study of magnetic properties is linked to the path of the overflow waters over the sills between Greenland and Iceland and between Iceland-Faeroe and Scotland after they form in the Nordic seas. These sills are rich in magnetic particles deposited from the volcanic-rich surrounding areas and they are then more or less efficiently transported in sub-polar North Atlantic by the overflow waters depending on the intensity of the later.

During the last glacial period, all the CALYPSO cores distributed from the Norwegian sea to the Bermuda Rise exhibit the same pattern of variations in magnetic concentration. The age models are based on correlation between planktonic delta18O of a core nearby Greenland and delta18O in Greenland ice (Voelker et al., 1998) and confirmed by a perfect fit between the continuous earth magnetic field intensity profile retrieved from sediments and from ice via cosmogenic isotopes. It shows that every minimum in magnetic concentration, also characterized by high IRD content, fresh surface waters, fine mean grain size in the sortable silt range, coincides with cold periods in Greenland. A synthetic “contourite drift deposit” curve has been constructed and illustrate continuously the variations in the intensity of the overflow waters during glacial time. They mimic in phase and in relative amplitude the air temperature variations over Greenland. These results indicate that Norwegian sea was participating to the overflow water formation all over the glacial period and that the deep ocean was undergoing fast changes.

During the Holocene, sedimentary sequences taken using the Casq corer of the R.V. Marion Dufresne (P.I.C.A.S.S.O and AMOCINT cruises) allowed very high time resolution study with age models based on multiple (up to 35) radiocarbon dating. Three magnetic records (concentration), together with sortable silt, form locations distributed along the Gardar drift indicate variations in the intensity of the Iceland-Scotland overflow water which can be interpreted, depending on the investigated time interval within the Holocene period, as progressive emplacement of the water mass after deglaciation, progressive shut down (and change in depth) during the abrupt cold early Holocene event and as changes in the main path of the overflow waters.

A synthesis of this multi-years project will be presented.