Effect of sedimentary processes on deep-water ecosystems in the Whittard canyon

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The Whittard canyon

During this MSc thesis, a study will be performed regarding the physical or sedimentary processes driving the physical shape of the habitats containing cold-water coral and deep-water oyster communities, on the flanks of the upper reaches of the Whittard canyon.

This dendritic canyon system is located in the Bay of Biscay on the Irish continental margin, 314.8 km South of Ireland, in water depths between 200 and 2000 m (Van Rooij et al., 2010a). It consists of 4 main branches of more than 100 km long and is the most northern of approximately 35 canyons incised in the Bay of Biscay (Huvenne et al., 2009).

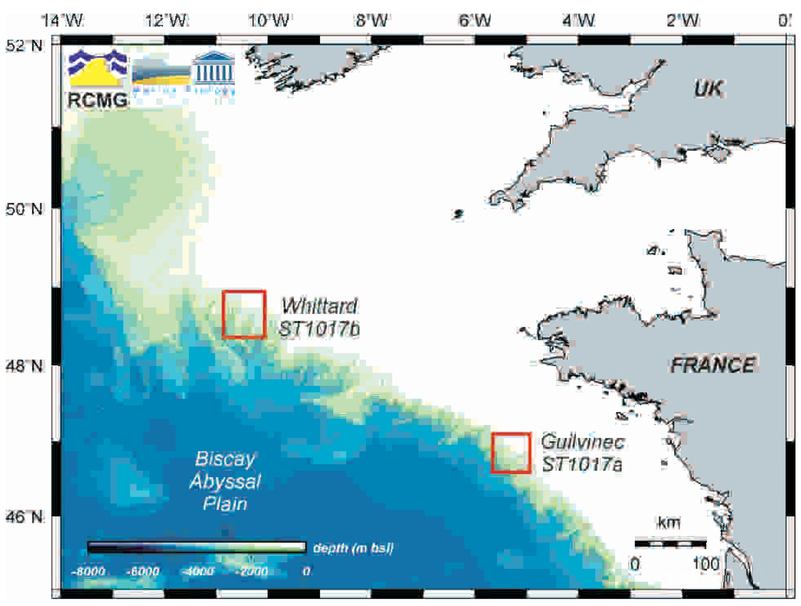

Fig. 1: Location of the Whittard canyon system, located on the Celtic-Armorican margin in the northern Bay of Biscay, as a part of the R/V Belgica St1017 expedition (June 2010).

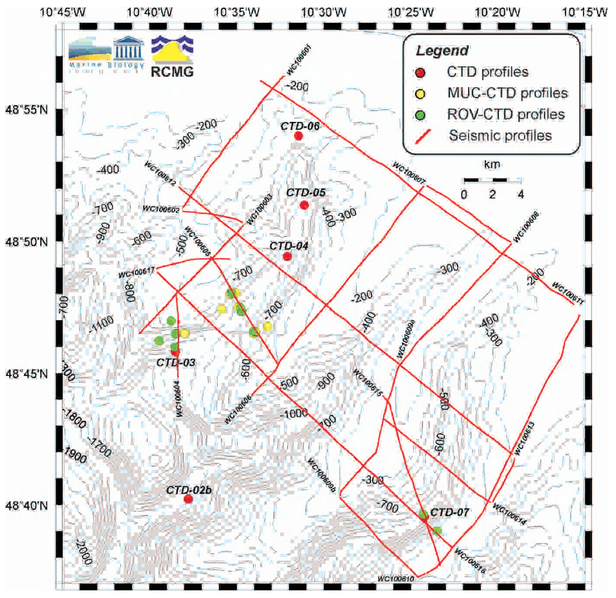

Fig. 2: Location of the high-resolution single channel seismic profiles, CTD and the ROV dive positions, on a basemap of the Whittard canyon area provided by the Geological Survey of Ireland (GSI), acquired within the framework of the Irish National Seabed Survey (INSS).

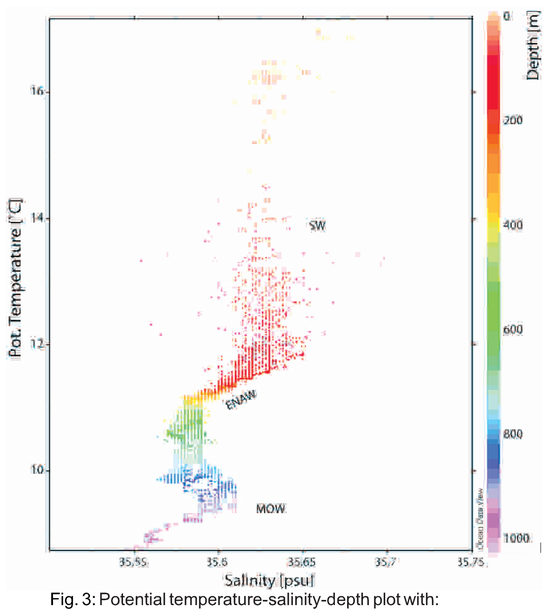

Fig. 3: Potential temperature-salinity-depth plot with:

SW = Surface Water (0–100 m)
ENAW = Eastern North Atlantic Water (100–750 m)
MOW = Mediterranean Outflow Water (below 750 m)
The maximal coral occurrence is at 850 m depth, around a sigma-theta of 27.45 kg/m³

Methods

This multidisciplinary study will use high-resolution single channel seismic profiling, multibeam bathymetry (RSS James Cook), high-resolution sidescan sonar (TOBI), CTD profiling (including turbidity), as well as ROV GENESIS observations.

Canyons and cold-water coral ecosystems

Canyons are subjected to several sedimentary processes and therefore material is resuspended or transported from the highly productive shallow shelves to the deep sea environments. These processes include the capture of along-slope sediment transport, resuspension by internal waves and tides, down-slope sediment transport, dense shelf water cascading and turbidity currents. They may result in either canyon flushing or focussed deposition of sediments and organic matter. Canyons are therefore complex environments that can harbour a significantly increased biodiversity and biomass compared to the open slope (Huvenne et al., 2011). Because of the many processes incising the shelf, the upper reaches of a canyon are always V-shaped with steep flanks, while the lower reaches are broad and U-shaped.

Cold-water corals (mainly *Lophelia pertusa*) occur in waters with specific characteristics (4 to 12 °C and a density envelope of 27.35–27.65 kgm^{-3}) and areas where food supply is high due to processes like internal waves. They can form structural habitats like patches, reefs or carbonate mounds, but they can also occur on steep canyon walls. On these cliffs, they are protected from strong downslope currents and deep-sea trawling by overhanging harder strata. The same is true for the deep-water oysters (Van Rooij et al., 2010b).

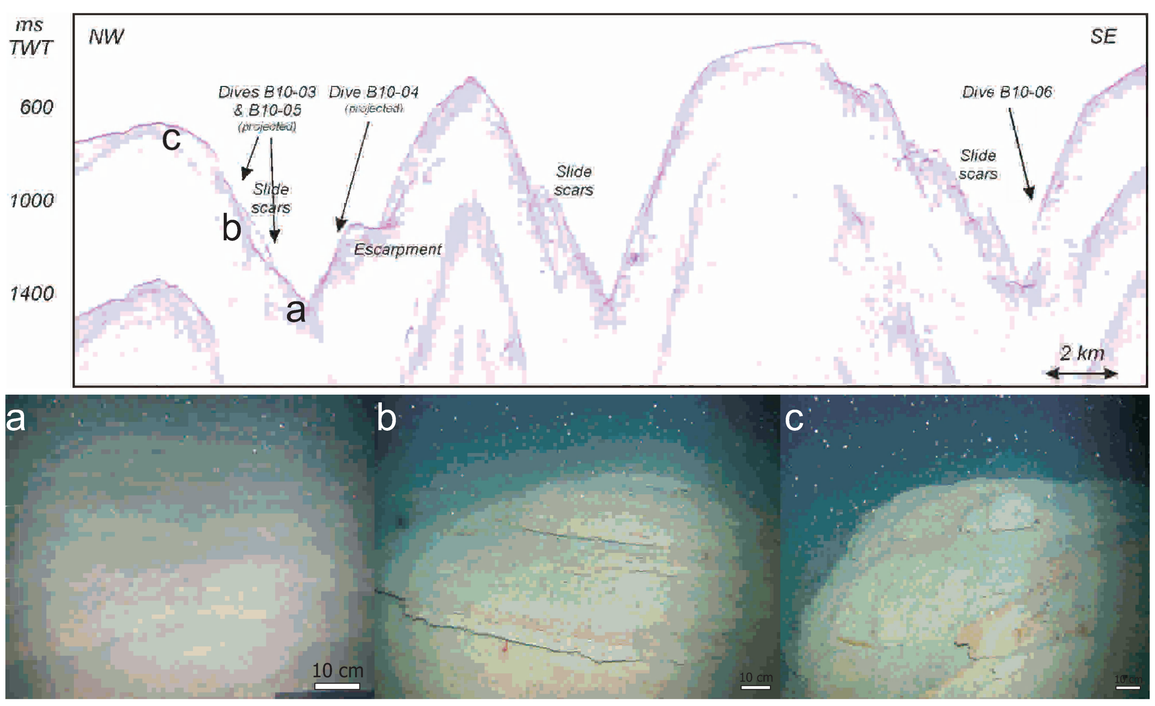

Fig. 4: ROV images of

a) The canyon floor with ripples and dunes
b) The "middle" canyon flank with outcropping harder banks
c) The "upper" canyon flank with cliffs and boulders
The canyon is therefore characterized by active sedimentary processes like erosion, transport and deposition

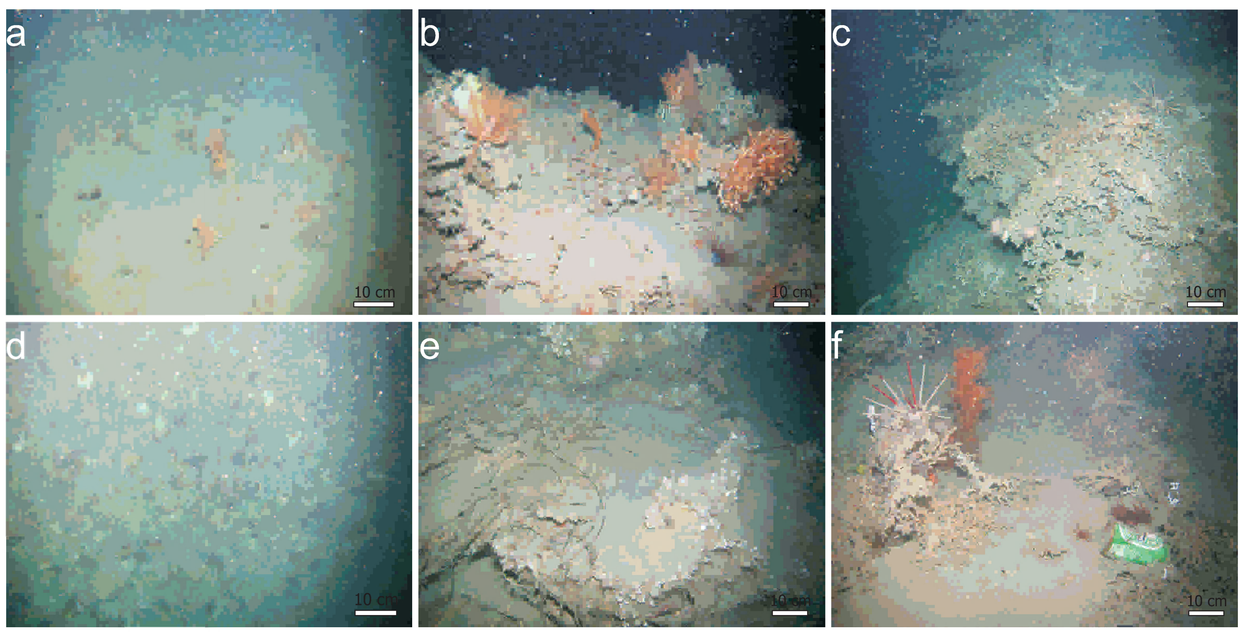

Fig. 5: ROV images of

a) Mostly solitary, dead cold water coral rubble with occasional living cold water corals, soft corals and sponges on top
b) A "graveyard" with a small sedimentary layer on the dead corals and occasional living cold water corals, soft corals and sponges on top
c) Sporadic cold water corals associated with cliffs, where they can create large reef blocks at the edge of the cliff with rubble at its foot
d) Vertical wall covered by deep-water oysters (Van Rooij et al., 2010b)
e) Anthropogenic impact, in this case fishing lines
f) Anthropogenic impact, in this case litter

References

[1] Huvenne (2009), James Cook Cruise 35, 35 pp.
[2] Huvenne (2011), PLoS ONE, 6, 1-9.
[3] Van Rooij et al. (2010a), RCMG internal publication, 39 pp.
[4] Van Rooij et al. (2010b), Deep-Sea Research I, 1-12.

Summary

During this MSc thesis, the geological processes driving the deep-sea ecosystems on the flanks of the Whittard canyon will be studied in an integrated way (including anthropogenic impact).

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