Investigating spatial variability of bottom current intensity in a bathyal environment: a combined ROV & AUV perspective

Matossian Alice Ofélia[1], White Martin[2], Vandorpe Thomas[3], Langedock Kobus[3], Fourie Fred[3] and Van Rooij David[4]

[1] Department of Geology, UGent
E-mail: alice.matossian@ugent.be
[2] University of Galway, University Road, Galway H91 TK33, Ireland
[3] VLIZ, Jacobsenstraat 1, Oostende, Belgium
[4] UGent, Krijgslaan 281, Gent, Belgium

The Belgica Mound Drift[1] is a small-scale contourite drift (50 km²; 500 – 800 m water depth) located in the Porcupine Seabight. The drift is enclosed by cold-water coral (CWC) mounds and was formed under the influence of the Quaternary glacial-interglacial cycles. The present-day area is affected by alongslope contour currents which are enhanced by trapped baroclinic diurnal tidal motions, strengthened at a similar water depth as the study area[2]. Additionally, there is a local topographic intensification and steering of the bottom currents in the immediate surroundings of the CWC mounds[1]. Strong bottom currents up to 50 cm/s have been measured over the drift with moorings deployed over a period of days to 6 months. In particular, bi-directional (E-NE and W-SW) diurnal K1 tidal flows are visible.

In order to better understand the spatial variations of the bottom currents over the drift, the bedforms and the seafloor texture have been studied using both the VLIZ ROV (remotely operated vehicle equipped with a Blueview scanning sonar and HD-cameras) and AUV (autonomous underwater vehicle equipped with a Side Scan Sonar, camera and Sub-Bottom Profiler). While the AUV-data offered a plurikilometric overview of the north of the drift, the ROV-data provided a close-up view of the seafloor, enabling the identification of the smaller-scale ripples.

Several features have been observed on the seafloor with the ROV, including small-scale (centimetric height and pluridecimetric wavelength) straight to sinuous ripples, linguoïd ripples, washed-out ripples characterized by a rougher seafloor texture, as well as large-scale (pluridecimetric height and up to 50 m in wavelength) sediment waves. All features have a NW-SE elongation. The sediment waves were observed within the moats while only small-scale ripples were visible on the crest of the drift. The Side Scan Sonar data confirmed the observation of these large-scale features and allowed to visualize their extent as being up to a kilometer long.

The alignment of the bedforms reveals the main flow directions under which they were formed, while the type of bedforms and the seafloor texture can help in defining the flow velocity. The inferred velocity flows range from 10 cm/s for straight to sinuous ripples, 40 cm/s for linguoïd ripples[3], 75 cm/s for washed-out ripples[4] to up to 120 cm/s for sediment waves[5]. According to the ROV data, the flow directions were estimated to be towards the SW on the western side of the drift, while being towards the NE on the eastern side. This is consistent with the mooring data, which indicates these two flow directions have been recorded over short-term diurnal tidal period.

The bottom currents are stronger in the drift moats, in the direct vicinity of the CWC mounds, and weaker on the crest, where no sediment waves have been observed. At a closer scale, the spatial variability of the bottom current velocities is demonstrated by the spatial distribution of the bedforms that varies over a few meters. This could be related to the local topography, such as the CWC mounds and the sediment waves locally impacting the bottom flows.

The potential flows under which the sediment waves form are stronger than the measured velocity flows. The superimposed sinuous to linguoïd ripples are most likely created during tidal flows whereas the washed-out ripples and sediment waves form during - not yet recorded - peak flow events, impacting more the moats. The drift and its moats are thus still being influenced by a strong hydrodynamic regime.

Therefore, the ROV and AUV are complementary tools allowing to define the spatial influence of bottom currents on the sediment dynamic evolution of an area.

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