How is particulate organic carbon transported in the submarine canyon connected to the Congo River?

Sophie Hage*[1], Megan Baker[2], Sanem Acikalin[3], Nathalie Babonneau[4], François Baudin[5], Bernard Dennielou[4], Robert Hilton[6], Christophe Rabouille[7], Ricardo Silva Jacinto[4], Guillaume Soulet[4], and Peter Talling[8]

[1]Univ Brest, Ifremer, CNRS, Geo Ocean – Univ Brest, Ifremer, CNRS, Geo Ocean – France

[2]Department of Geography, Durham University – Royaume-Uni

[3]School of Natural and Environmental Sciences, Newcastle University – Royaume-Uni

[4]Geo-Ocean, UMR6538, Univ Brest, Ifremer, CNRS – UMR6538 – France

[5]Institut des Sciences de la Terre de Paris – Institut National des Sciences de l'Univers, Sorbonne Universite, Centre National de la Recherche Scientifique, ISTeP - UMR 7193, Laboratoire Biominéralisations et Environnements Sédimentaires – France

[6]Department of Earth Sciences, University of Oxford – Royaume-Uni

[7]LSCE, UMR 8212, Université Paris-Saclay – UMR 8212 (CEA – France

[8]Departments of Geography and Earth Sciences, Durham University – Royaume-Uni

Résumé

The role of the land to ocean aquatic continuum in the carbon cycle is increasingly being considered in global carbon budgets. Among systems that connect land to the ocean, the Congo Submarine Canyon is of particular interest since the canyon head starts within the Congo River estuary, which delivers about 7% of the total organic carbon (OC) from the world's rivers. However, particulate transport mechanisms operating in the Congo Canyon, and submarine canyons more globally, remain poorly constrained. This is due to the difficulty in observing and capturing particles in canyons during transit.

To understand how OC is transported in the Congo Canyon, and whether this transport is efficient, we use data from a mooring that was deployed 30 m above the canyon floor at 2.2 km water depth for 4 months. The mooring included an acoustic Doppler current profiler (ADCP) to image transport in the water column; and an Anderson sediment trap to capture the transported sediment and OC. A 1.2-m thick succession was recovered from the trap in which total organic carbon (TOC), carbon stable isotope (δ13C), radiocarbon and Rock-Eval measurements were performed at 1-cm intervals.

We found that particulate transport in the canyon is dominated by two processes. First, tides induce a continuous current (speeds up to 20 cm/s) that mixes water and sediment through the entire water column, with a net transport direction that points upslope. Trapped particles associated with tidal currents show little variations in grain size (mean D50 = 7 μm) and TOC (mean = 4 %). Second, 8 downslope turbidity currents were measured, that were up to 40 m thick, 4 m/s in speed, and 3 days long. Trapped particles associated with turbidity currents show coarser grains (D90 = up to 90 μm) and lower TOC concentrations (mean = 2%) compared to tidal sediments. δ13C, radiocarbon and Rock-Eval measurements indicate that transported OC in the canyon has a similar composition to OC found in the Congo

*Intervenant

River and distal lobe. Therefore, despite intense mixing due to tidal currents and flushing due to turbidity currents, the transport of OC in the canyon is efficient.

Mots-Clés: organic carbon, submarine canyon, turbidity current, tidal current