Open marine benthic ecosystems

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La composition des faunes de foraminifères benthiques des écosystèmes marins ouverts est toujours mal comprise. Un faisceau d'observations suggère que le flux de matière organique vers le fond marin, la quantité mais aussi la composition des particules, serait le facteur déterminant pour la composition des faunes. L'oxygénation des eaux de fond semble nettement moins importante. Nos études sur la marge Est-Atlantique et dans l'Océan Indien montrent clairement que la majorité des espèces carbonatées ont des exigences nutritives plus élevées que celles des espèces agglutinées. Il n'y a pas de différence évidente entre ces deux groupes concernant leur tolérance à l'hypoxie, par contre les milioles y sont particulièrement sensibles. Dans les canyons sous-marins de la marge Est-Atlantique, les faunes de foraminifères indiquent que ces écosystèmes sont des hotspots de reminéralisation de matière organique. A cause des événements sédimentaires fréquents, la colonisation de l'écosystème reste souvent imparfaite.

1. Eastern Atlantic marginal environments: impact of food quantity and quality on benthic ecosystems

Ample evidence from experimental as well as field studies suggests that bottom water oxygenation is much less important than thought previously. It appears that the organic flux to the seafloor is the principal control of faunal density, biodiversity, species composition and microhabitats. Not only the quantity, but also the quality of the organic compounds is important.

The study of the living foraminiferal faunas of four W-E transects off the Portuguese margin [7] reveals a clear bathymetrical species succession, which coincides with an offshore decrease of phytopigment concentrations. Calcareous taxa are progressively replaced by agglutinated taxa, suggesting that they have higher trophic requirements. The microhabitats of the calcareous taxa comply very well to the TROX-model. However, at some stations, large amounts of epifaunal species are found deep in the sediment. We ascribe these anomalous distributions to macrofaunal bioturbation. It appears that calcareous taxa are better capable to migrate back to the sediment-water interface than agglutinated taxa.

At 900 and 1150 m deep stations off the Walvis Bay upwelling area [5] the relative poverty of the foraminiferal faunas contrasts with the high surface water productivity. This is explained by strong bottom currents, which appear to transport most labile organic matter to deeper sites and nourish bottom nepheloid layers.

2. The Indian Ocean OMZ: faunal adaptations to low oxygen concentrations

The study of a ten station transect from the Murray Ridge provides a detailed picture of the foraminiferal successions from the core of the Oxygen Minimum Zone (OMZ; 885m) down to 3000 m water depth [2]. Very low oxygen concentrations in the core of the OMZ are responsible for the low biodiversity there. The abundance of agglutinated taxa at all stations shows that, contrarily to earlier speculations, they are just as resistant to low oxygen concentrations as calcareous taxa. Miliolid taxa, however, occur only below the OMZ, underlining their sensitivity to hypoxia. Multivariate analyses emphasize three distinct assemblages, characterizing the heart of the OMZ, the lower OMZ, and the ecosystems below the OMZ.

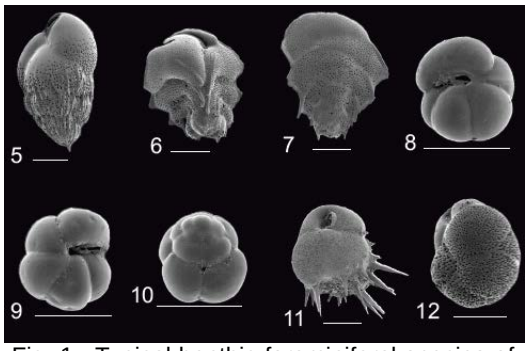

Fig. 1 : Typical benthic foraminiferal species of the Indian Ocean Oxygen Minimum Zone.

Submarine canyons: biogeochemical hotspots

Benthic ecosystems in the axis of the active Capbreton Canyon are impacted by repeated turbidite deposits [1]. Ecosystem colonization remainq in an early state, with high density, low diversity and strong dominance. Comparison of living and dead faunas reveals that the dominant *Bolivina subaenariensis* has a turnover time of 1.5 to 2 years, surprisingly long for such an opportunistic taxon.

In the less active Whittard canyon, upper canyon station display much higher foraminiferal densities than open slope stations, testifying of high quality organic matter focusing towards the canyon [3. At a lower canyon station, an opportunistic fauna in an early state of ecosystem colonization shows that also in Whittard canyon, gravity deposits may hamper the development of equilibrium faunas.

In the inactive Cap Ferret canyon, differences between canyon and slope faunas are less striking [4]. However, the higher faunal density and diversity, and the presence of deep infaunal species, suggest that the canyon axis is a privileged area for organic matter demineralization.

4. Biogeography of deep-sea benthic foraminifera

In their review of the biogeography of deep-sea foraminifera, Gooday & Jorissen [6] show that deep-sea species are often cosmopolitan. Conversely, continental slope species have more geographically limited ranges, and show a large morphological variability. This is thought to reflect the greater heterogeneity of continental slopes.

Collaborations

R. Donavaro, A. Pusceddu (Ancona University) B. Deflandre, A. Grémare, P. Anschutz, T. Mulder, S. Schmidt (Bordeaux I University), C. Waelbroeck (LSCE), H. De Stigter, G.J. Reichart (NIOZ).

Associated publications

[1] Bolliet, T., Jorissen, F.J., Schmidt, S, **Howa, H.**, 2014. Benthic foraminifera from Capbreton Canyon revisited. *Deep-Sea Research II*, in press.

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[4] Duros P., Fontanier, C., **Metzger, E.**, **Cesbron, F.**, Deflandre, B., Schmidt, S., Buscail, R., **Jorissen F.J.**, 2013. Live (stained) benthic foraminifera from the Cap-Ferret Canyon (Bay of Biscay, NE Atlantic). *Deep-Sea Research* I, 74, 98-114.

[5] Fontanier, C., **Metzger, E.**, Waelbroeck, C., Jouffreau, M., LeFloch N., **Jorissen, F.J.**, Etcheber, H., Bichon, S., Chabaud, G., Grémare, A., Deflandre, B., 2013. Live (stained) benthic foraminifera off Walvis Bay, Namibia *Journal of Foraminiferal Research,* 4, 55-71.

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