

## FINAL REPORT PROGRAM LEFE

Program LEFE/ CYBER	Project Title ICCAR (Impact of Climate Change in the Arctic on benthic foraminifera)	Years 2018-2020
PI: BONNIN Jérôme, <a href="mailto:jerome.bonnin@u-bordeaux.fr">jerome.bonnin@u-bordeaux.fr</a> , EPOC UMR5805 Participating Laboratories : EPOC, KOPRI (South Korea)	Contribution to <i>ANR GREENEDGE</i> Other funding sources : REBECCA (LEFE – CYBER: REBECCA)	
<p><i>Context</i></p> <p>Observations of the fast warming and the associated reduction in sea ice in the Arctic motivate the urgent need to improve our understanding of the ecosystem functioning in such fragile environments to better predict near future environmental changes and their consequences. In this perspective, the ICCAR project aims at investigating the distribution of benthic foraminifera in various arctic settings (water depth, temperature and water mass, productivity, sea-ice, fjords).</p> <p><i>Objectives / scientific questions</i></p> <p>To achieve this, the ICCAR project is articulated around two major objectives:</p> <ol style="list-style-type: none"> <li>1) Deepen our knowledge on the distribution of living benthic foraminifera in key areas (Barents, Baffin, Chukchi) of the arctic realm and investigate their adaptation to recent climate change in the Arctic seas.</li> <li>2) Evaluate the potential of benthic foraminifera as a bio-indicator of sea ice extent in the Arctic seas.</li> </ol> <p><i>Main results</i></p> <p>Relative abundances of major benthic foraminifera species and their vertical distribution in the sediment at the end of the summer period in the Barents Sea and the Baffin Bay (Fig. 1 and 2, respectively) show clear differences between the 2 regions and between different zones within those regions.</p> <p>In the Barents Sea (Fig. 1), benthic foraminifera assemblages show relatively clear trend between the deep stations of the continental slope largely influenced by the Atlantic waters (NwAC) and those from the shelf partly bathed and influenced by arctic waters (ESC) and the position of the polar front. On the continental slope, surficial infauna <i>C. wuellerstorfi</i> and <i>O. tenerus</i> are dominant at water depth exceeding 1800m and 2500m water depth, respectively. Agglutinated species appear dominant on the slope where hydrodynamic conditions are instable and where food availability is limited. On the shelf, the organic flux is relatively low at this period, the major phytoplanktonic bloom taking place earlier in the summer, and deep infaunal taxa <i>M. barleeanus</i> with ecological preference on more refractory organic matter is dominant. Near the polar front, primary productivity is higher and the total standing stock of living benthic foraminifera is high particularly at St. 11 and opportunistic species <i>C. neoteretis</i> and <i>L. arenulata</i> are abundant. The deep infauna <i>N. labradorica</i> is clearly observed below the maximum oxygen penetration depth only north of the polar front as the result of high organic matter flux associated with the front.</p> <p>In the Baffin Bay (Fig. 2), benthic foraminifera assemblages are highly dominated by agglutinated species while they represented less than half of the assemblages in the Barents Sea. The only calcareous species are <i>M. barleeanus</i> and <i>N. labradorica</i>. The first one is mostly found in the Baffin Bay while the latter one is only found in the North Water Polynia and the Nares Strait where primary productivity, related to the seasonal sea ice cover, is much higher. Living <i>M. barleeanus</i> observed at St. 204 showed clear signs of incomplete calcification or dissolution probably due to high CO<sub>2</sub> solubility in Baffin Bay waters. Those studies hence show the essential role of primary productivity, dependant on both water masses and sea ice, for benthic foraminifera populations.</p>		

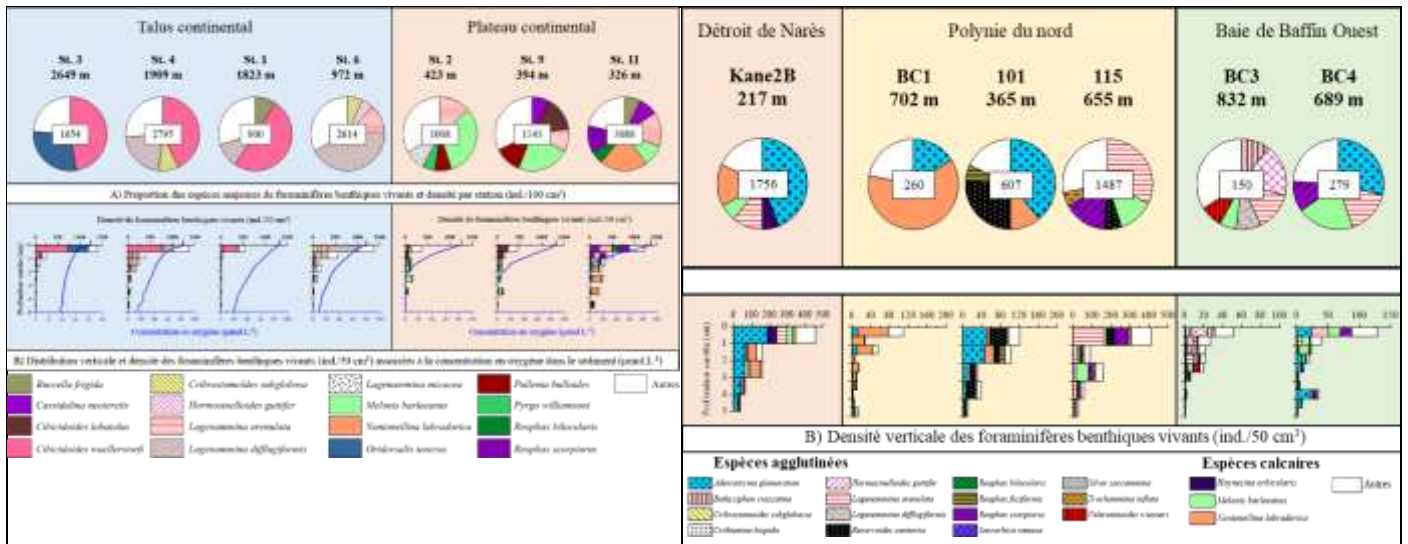


Figure 1. Relative abundances of major benthic foraminifera species and their vertical distribution in the sediment at the end of the summer period in the Barents Sea

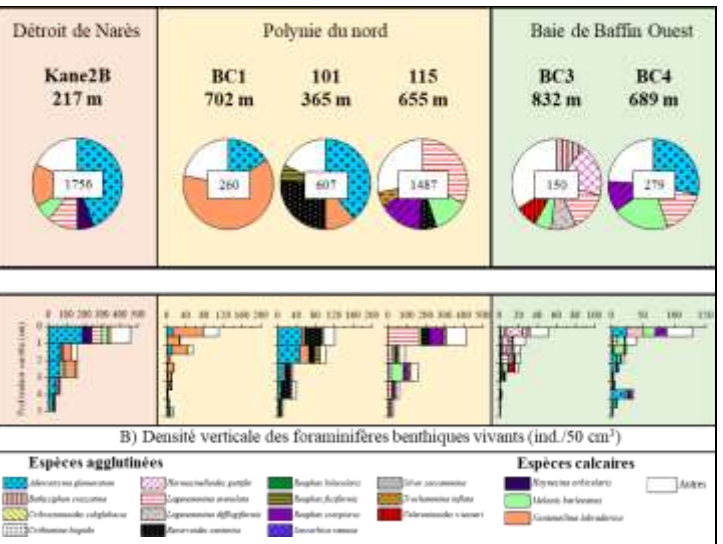


Figure 2. Relative abundances of major benthic foraminifera species and their vertical distribution in the sediment at the end of the summer period in the Baffin Bay

### Future of the project :

Research on living and dead benthic foraminifera conducted during the ICCAR project will be extended in remote arctic environments 1) in the Greenland Sea as part of the MOCOSED17 campaign (SHOM, UB) and 2) in the framework of the REFUGE-ARCTIC project (PPR "Océan et climat" ; Défi 2: Intensifier les recherches dans des océans polaires en pleine mutation et aux enjeux géostratégiques majeurs) and associated oceanographic campaign onboard the NGCC Amundsen during the summer 2023 in the Lincoln Sea and north of the Nares Strait.

The objectives of those projects are to better evaluate the physical, chemical and biological processes associated to sea-ice in those arctic regions and provide some keys to understand past, present and future climatic variations in this rapidly changing arctic environment. Sediment cores collected will allow a better characterisation of the structure of the living benthic community in those regions where the response of the benthic fauna to environmental parameters such as sea-ice and primary productivity in polynyas or near ice shelves and glaciers is still poorly known. This study will also help to better constrain past environmental reconstructions of climate change on long sediment cores based on fossil assemblages combined with sedimentological, micropaleontological, elemental, isotopic, molecular proxies.

### Publications

- Racine, C., Bonnin, J., Nam, S.-I., Giraudeau, J., Biguenet, M., Dessandier, P.A., Kim, J.-H. 2018. Distribution of living benthic foraminifera in the western arctic: influence of sea-ice. *Arktos* 4:28, [doi.org/10.1007/s41063-018-0062-y](https://doi.org/10.1007/s41063-018-0062-y)
- Bonnin, J., Racine, C., Giraudeau, J., Dessandier, P.A., Zaragosi, S. Living benthic foraminifera in the Barents Sea: control of primary productivity and Atlantic water. *To be submitted to Frontiers in Marine Science*.
- Racine, C., Bonnin, J., Giraudeau, J., Massé, G. Response of living benthic foraminifera to varying sea-ice conditions in the Bay of Baffin. *To be submitted to Marine Micropaleontology*.

### Communications

- Bonnin, J., Racine, C., Giraudeau, J., Dessandier, P.A. Response of benthic foraminifera in the Barents and Chukchi Sea. Hanyang University, ERICA campus, **Corée du Sud**. Avril 2019.
- Racine, C., Bonnin, J., Giraudeau, J., Zaragosi, S., Garlan, T., 2018. Distribution of living benthic foraminifera in the western Barents Sea. **FORAMS 2018 conference, Edimbourg**, Ecosse, 17-23 Juin 2018.
- Racine, C., Bonnin, J., Giraudeau, J. Foraminifères benthiques vivants en Mer de Chukchi, Mer de Barents et Baie de Baffin, résultats préliminaires. JEST, EPOC, Avril 2018.
- Racine, C., Bonnin, J., Giraudeau, J., Massé, G. 2017. Modern distribution of benthic foraminifera in the Baffin Bay. **Arctic Change conference, Québec**, Canada, 11-15 Decembre 2017.

### Thèse

Calypso RACINE. Doctorat, Université de Bordeaux. Foraminifères benthiques arctiques bio-indicateurs écologiques des changements climatiques récents. (Encadrement 50% avec ADT, Co-encadrement J. Giraudeau, DR, CNRS, 50%). Thèse soutenue le 28/01/2019.

