EGU2020-5924
https://doi.org/10.5194/egusphere-egu2020-5924
EGU General Assembly 2020

Paleogene Polar Plankton and export productivity changes between the Eocene and Oligocene

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Aiming to support the prediction of future climate developments, this project investigates the role on geological timescale of the ocean plankton in reducing atmospheric carbon concentration by exporting carbon to the deep-sea. While it is well-known that the transition from the Eocene to the Oligocene brought significant climate changes and, in connection, also a change of the oceans' carbon export production, the important role of phytoplankton and the links to changing ocean circulation are still poorly understood, as is, similarly, the impact on those changes on the diversity of the plankton contributing to the carbon pump. Investigating the nature of this interaction will provide significant insight into the functions of the oceans as climate regulators.

To address those question, we are generating diversity and absolute abundance data for diatoms and radiolarians, biogeographic data for radiolarians, as well as oxygen and carbon isotope data on planktic and benthic foraminifera, and on the fine fraction (<45µm, i. e. coccoliths), as well as other proxies to estimate surface and deep ocean temperatures and export productivity. These will be generated as paired data from individual samples in various deep-sea drilling sites in and around the Southern Ocean (as it is the focal point of the climatic/oceanographic changes at that period). These data will then be compiled and confronted to an ocean circulation model.

Here we will present our results so far (oxygen and carbon isotope on the bulk fine fraction, as well as radiolarian and diatom diversity estimates), based on two main localities from the antarctic (ODP Site 689B from the Weddell Sea) and the subantarctic (ODP Site 1090B on the southern flank of the Agulhas ridge) South Atlantic. A comparison with a newly generated, database-driven diversity analysis of the same groups in the same region, using the Neptune (NSB) database, will also be shown. While the exhaustive taxonomical compilation made on these two sites for the diatoms records three times more species than what was recorded in the literature for the Southern Ocean biome, it still shows an evolutionary turnover at the Eocene-Oligocene, just as the classic, NSB-driven analysis does. The fine fraction oxygen isotope at both sites 689B and 1090B show a pattern similar to that recorded in planktonic foraminifera in neighbour sites, indicating a significant drop in SST close to the Eocene-Oligocene boundary, while the fine fraction carbon isotope signal in the antarctic site shows a subsequent decrease indicating changes in exported productivity 2Myr after the global cooling.

How to cite: Rodrigues de Faria, G., Lazarus, D., Struck, U., Asatryan, G., Renaudie, J., and Ozen, V.: Paleogene Polar Plankton and export productivity changes between the Eocene and Oligocene, EGU General Assembly 2020, Online, 4–8 May 2020, EGU2020-5924, https://doi.org/10.5194/egusphere-egu2020-5924, 2020