Geophysical Research Abstracts
Vol. 20, EGU2018-12621-1, 2018
EGU General Assembly 2018

Reconstruction of Glacial-Interglacial Temperature and Export Production Gradients over the Polar and Subantarctic Front in the Southern Indian Ocean

Lena M. Thöle (1), Alfredo Martínez-García (2), Eri Amsler (1), Julia Gottschalk (1), Alexandra Auderset (2), Jörg Lippold (3), Alain Mazaud (4), Elisabeth Michel (4), and Samuel L. Jaccard (1)

(1) University of Bern, Institute of Geological Sciences and Oeschger Centre for Climate Change Research, Switzerland (lena.thoele@geo.unibe.ch), (2) Max Planck Institute for Chemistry, Climate Geochemistry Department, Mainz, Germany, (3) Institute of Earth Sciences, University of Heidelberg, Heidelberg, Germany, (4) Laboratoire des Sciences du Climat et de l'Environnement (LSCE), Gif-sur-Yvette, France

Over glacial-interglacial cycles, the Southern Ocean exerts a major leverage on atmospheric CO_2 concentrations and thus Earth's climate. The Antarctic Circumpolar Current (ACC) plays a crucial role in the global heat and nutrient distribution, Antarctic sea ice dynamics, and the upwelling of CO_2- and nutrient-rich subsurface waters. As micronutrients and light are limiting primary production in this area, nutrients that are brought up to the surface are not completely consumed, engendering a degree of inefficiency in the biological pump thereby allowing for CO_2 to escape to the atmosphere. Due to its dynamical association with the Westerlies, a strengthening and/or northward shift of the ACC during glacial periods has been hypothesized. However, paleoceanographic reconstructions are not unambiguous and changes in ACC dynamics on glacial/interglacial timescales are still under debate. Linked to the ACC are several fronts, the main ones being the Subantarctic Front (SAF) to the north and the Polar Front (PF) to the south, where the ACC flow is strongest. These fronts are characterized by the subsurface occurrence of Subantarctic Mode Water (SAMW) in the north and a strong gradient towards very cold but fresh Antarctic Surface Waters in the south, respectively. Along with these strong temperature gradients, these fronts mark distinct nutrient regimes modulating biogeochemical processes and export production.

In order to better constrain the impact of frontal movements on export production patterns and ultimately CO_2 sequestration, we reconstructed sea surface temperatures (GDGT-based TEX_{86}) and ^{230}Th-normalized export production (opal) fluxes for two cores located in today's polar and subantarctic zones, respectively. These data allow us to calculate changes in the temperature and export production gradients since the penultimate glacial period, documenting shifts in the position of the fronts and associated nutrient and temperature characteristics. This will help to better understand past changes in export production and the ACC, providing a more complete picture of Southern Ocean dynamics and its relevance for CO_2 sequestration over glacial-interglacial cycles.