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The impact of Mediterranean Outflow Water on the Pliocene North Atlantic

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The opening and closing of ocean gateways play an important role amongst climate forcing mechanisms: along with paleogeography, surface and deep-water circulation are altered, and hence global heat transport. An important component of North Atlantic circulation patterns is the warm and saline Mediterranean Outflow Water (MOW) that enters the North Atlantic via the Gibraltar Strait. Its onset, that is strongly related to the opening of the Gibraltar Strait during the Late Miocene and Early Pliocene (c. 5.2 Ma), and early history are poorly constrained and its impact on oceanography and climate since the Pliocene are largely unexplored. The herein presented project, funded by the Austrian Science Fund FWF, is part of the research goals of Expedition 339 of the Integrated Ocean Drilling Program (IODP) that explores the environmental significance of the MOW and its role in global climate as a component of North Atlantic circulation since the Pliocene.
The project focuses on the reconstruction of the Pliocene history of MOW based on an approach that integrates micropaleontology and geochemistry: quantitative analysis of benthic foraminiferal assemblages is used for the reconstruction of MOW velocity and intensity; δ18O and Mg/Ca from planktic and benthic foraminiferal shells are evaluated for changes in water-temperature and salinity; δ13C, TOC, S and $CaCO_3$ are applied as proxies for productivity and bottom-water ventilation.
Although the ultimate goal will be a MOW-record for the entire Pliocene, special emphasis will be put on two topics:
(1) Paleoceanographic changes related to the opening of the Gibraltar Strait and the onset of MOW during Late Miocene – Early Pliocene. While the opening of the Gibraltar Strait is well-constrained to 5.23 Ma, the onset and early history of MOW remains poorly understood. The new proxy records will help to evaluate the impact of the new water source on the local Early Pliocene paleoenvironment.
(2) Evaluation of variability in MOW intensity and its potential relation to the Middle Pliocene Thermal Optimum (MPTO) and Late Pliocene climate deterioration. The Early-Middle Pliocene world with its warm-house climate and elevated CO_2-levels is often referred to as a potential analogue to future climate change. However, the underlying mechanisms of the MPTO as well as the subsequent climate cooling are strongly debated. A strong focus of the project will thus lie on the variability of MOW intensity, the impact of these changes on North Atlantic circulation patterns and the potential impact on MPTO and the Late Pliocene climate transition.