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NICO EXPEDITION leg 1 (2,8): Netherlands Initiative Changing Oceans

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The NICO expedition on the Dutch research vessel Pelagia tries to evaluate human induced changes in the North Atlantic and is a collaboration between multiple Dutch universities and research centers. The participating scientists originate from various research fields and are interested in the distribution of birds, marine organisms, plastic particles and their relation to increasing anthropogenic pressure and global warming. On leg 1 of the cruise (15.-27. December 2017) the Pelagia sailed from Texel through the Channel, the Gulf of Biscay, along the Iberian Peninsula to Las Palmas on Gran Canaria.

Aim of this study:

The main purpose of leg 1 was to investigate the climatic changes of the recent centuries to millennia that are archived in the calcite shells of microorganisms called foraminifera with a relatively novel geochemical tool called clumped isotopes and to tune this temperature proxy by retrieving foraminifera out of the seawater column.



Cruise track of 64PE428 with the 6 stations (red dots)

Instrumental setup for $\Delta 47$ analysis

4 full stations along a North-South transect on Leg-1:

Water column CTD profile

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Multinet casts in upper 800 m to catch living forams in their actual well constrained dwelling depths

Multicores: foraminifera ending up in top sediment layer, comparison to multinets

Piston cores: benthic and planktonic foraminifera in deeper sediments as paleoclimate archive

Clumped isotope ($\Delta 47$) analysis in our laboratory, check if $\Delta 47$ -T estimates match in-situ T of multinet samples, $\Delta 47$ signal of top cores (seasonal vs annual or pristine vs diagenetic alteration)?

 $\Delta 47$ analysis on piston cores to



Sampling strategy





Carbonate clumped isotope thermomety is a measure of solely Tdependent abundance of the 13C18O16O molecule of CO2 gas released during phosphoric acid digestion of carbonates at 70 C in Kiel IV carbonate device. The fully automated Kiel IV hosts up to 46 carbonate samples/standards (~100 µg per replicate) and is connected to a 253Plus isotope ratio mass spectrometer (both instruments from Thermo Scientific) that records the intensities of CO2 masses 44 to 49. The clumped isotope composition of carbonates is displayed as $\Delta 47$ with the measured ratios relative to the stochastic theoretical ratios:



reconstruct paleo-climate (T, $\delta^{1*}O_{sw}$)





Outlook and broader goal:

We will apply carbonate clumped isotope thermometry for the first time on foraminifera caught in specific water depths of which the water composition and temperature is known covering the North Atlantic. The NICO cruise samples (of leg 1, 2 and 8) will enable us to better understand the $\Delta 47$ signatures of foraminifera and to what extend the temperature signal is preserved in the sediment record. This is crucial to constrain past climatic variations precisely enough to make also better predictions on future climate scenarios.‰

Accompanied analysis of the oxygen isotope composition of the foraminifera tests enable the determination of the ∂^{18} O of the seawater from published relationships.



Research vessel Pelagia (picture copied from NIOZ webpage)

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