NORTH ATLANTIC PALEO-PRODUCTIVITY CHANGES DURING MARINE ISOTOPE STAGES (MIS) 10 TO 16 COCCOLITHOPHORE SR/CA EVIDENCE

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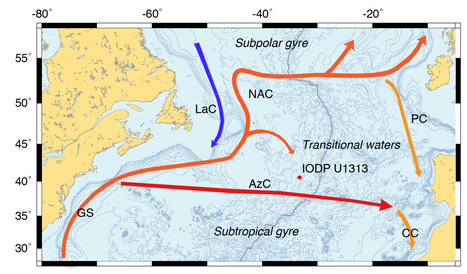
PhD Aims and reasoning

>> To characterize **paleoproductivity** variability at mid-Atlantic ocean and in the Iberian margin during the Late Pleistocene - Marine Isotopic Stage (MIS) 16 to 10 (676 to 355 ka ago) - straddling the Mid-Brunhes event.

Why study coccolithophore **paleoproductivity**?
Marine primary productivity is a contributor to the decrease of pCO_2 during glacial periods. Coccolithophores are linked to the carbon cycle in two ways: by synthetizing organic matter (biological pump) an by building their calcite coccoliths (carbonate pump). The understanding of coccolithophores' role, as a phytoplankton functional group and their productivity variability, is important for their integration into climatic models and can ultimately lead to a better understanding of Earth' biogeochemical cycles.



>> To study the **impacts** of abrupt climatic change events such as **Heinrich-type events**; the North Atlantic Current (**NAC**) and **frontal system** evolution; and the different modes of the Atlantic Meridional Overturning Circulation (**AMOC**) on coccolithophores productivity..

Why in the **North Atlantic**?
The North Atlantic is the primary deep ventilator of the oceans playing a key role in the thermohaline circulation through the Atlantic Meridional Overturning Circulation (AMOC) whose strength is affected by regional or global climatic changes

Methods

Sample collected and suspended in 2% ammonia → Passed through a 20µm sieve to recover only the smaller fraction → **Sample cleaning:** 1) **MNX** reagent 2) 2% **ammonia** 3) Water rinsing → **Acid** addition to dissolve coccoliths → **Sr/Ca analysis in ICP-AES** → Subtraction of temperature effect >> final residual is the **paleoproductivity** signal

Stoll and Ziveri [2002] and *Stoll et al.* [2002]

References

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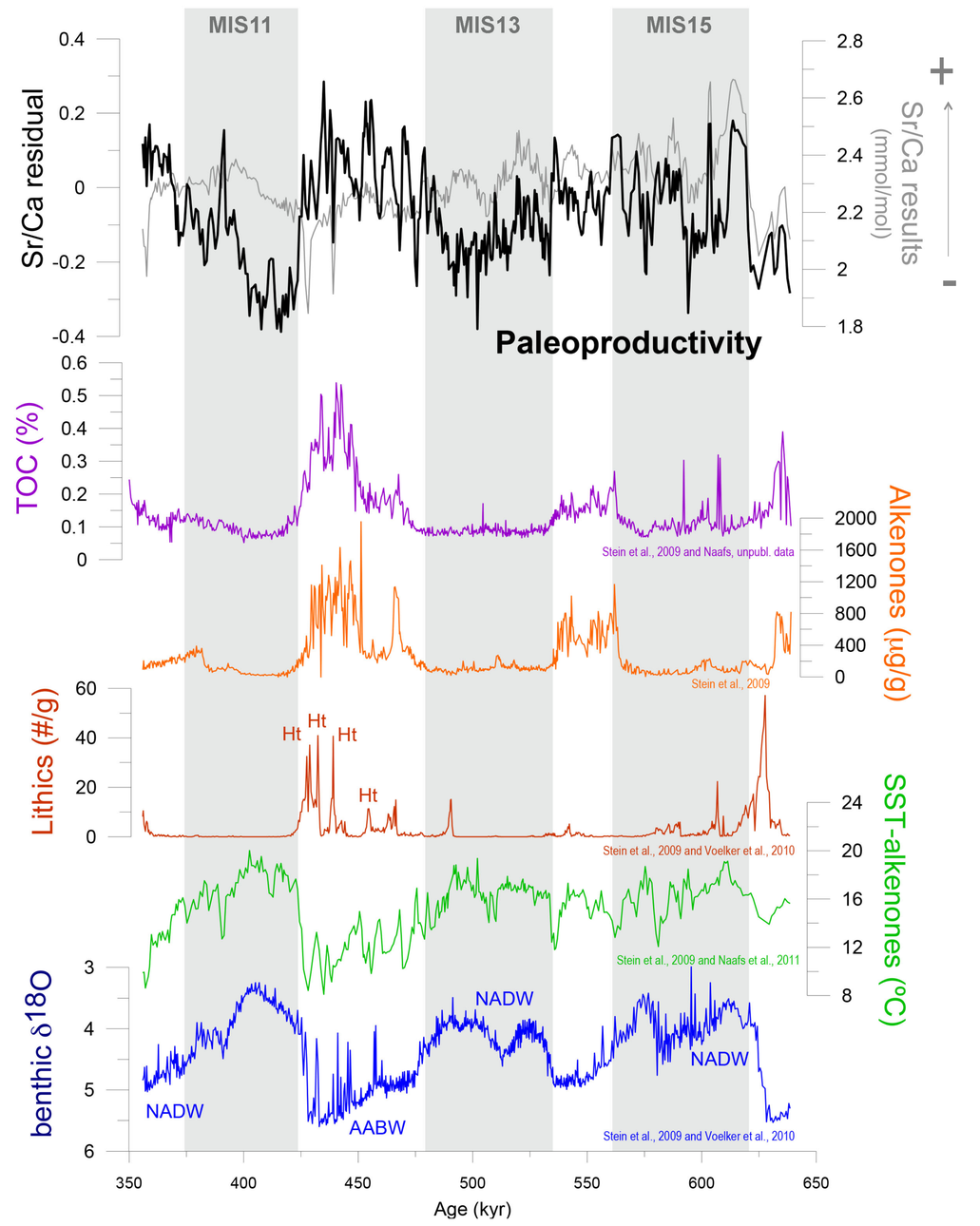
Results



Note: NADW = North Atlantic Deep Water; AABW = Antarctic Bottom Water; H = Heinrich like events (Stein et al., 2009 & Voelker et al., 2010).

High productivity period (~ 20 ka at 41ºN – grey area) might be associated to the migration of the **latitudinal high productivity band** , located today between 45º and 55º N, as proposed by *Villanueva et al.* [2001].

Causes for productivity variability in the mid-Atlantic ocean:

The variability of coccolithophores paleoproductivity reflect climate variability at **orbital** and **suborbital** scales: higher during cold periods (MIS12 and 14) than warmer periods (MIS 11 and 13) with an abrupt decrease at TV.

Glacial period
>>
Atlantic Meridional Overturning circulation is weakened and frontal system migration to southern position
>>
Constraining of air masses and much steeper T gradients
1. Stronger **wind** regime
2. Deeper mixed layer
3. Increased dust input
↑ **productivity**

Interglacial period
>>
Atlantic Meridional Overturning circulation is strong and frontal system migration to northern (actual) position
>>
Wind weakens and higher influence of oligotrophic waters
↓ **productivity**

Heinrich-like events
>>
Atlantic Meridional Overturning circulation is Weakened and frontal system migration to its southernmost position (south of 41ºN)
>>
1. Ice light blockage
2. High turbidity
3. Comm. changes
⇓ **productivity**

Further research | Spring and Summer 2014

The results are now being discussed and compared to others. Further analysis will be done regarding comparison between glacials and interglacials, water mass changes and dissolution events. The IODP Sites U1385 and U1391, in the Iberian margin, will also be analyzed during MIS 10 to 16 and MIS 11 and 12, respectively.