Temperature and nutrients changes during MIS 11c and the Holocene on the Portuguese margin

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The interglacial marine isotope stage (MIS) 11c and the Holocene are often considered the most similar interglacial periods in terms of orbital parameters and greenhouse gas concentrations. In the North Atlantic some studies record rather similar conditions during these 2 periods, while others show significant differences. To contribute to this puzzle we have generated trace element ratio (Mg/Ca, Ba/Ca, Cd/Ca) and stable isotope records of 3 planktonic foraminifera species (*G. ruber* (white), *G. bulloides*, *G. inflata*), and biomarker records for Portuguese margin site MD03-2699 (39°N; 10.7°W). During the Holocene *G. ruber* (white) Mg/Ca based temperatures shows values around 19°C, i.e. 2°C higher than the mean annual alkenone SST-U_k'37. MIS 11c temperatures were slightly warmer than during the Holocene. During the early phase of both interglacials (MIS 11c: 426–412 ky; Holocene: 11-4 ky), stronger upwelling and intensification / persistence of the wintertime warm subtropical current was recorded for most of the temperature and nutrient proxies used, than during later phase (MIS 11c: 412-395 ky; Holocene: 4 ky-Present). However, the interval of high nutrient supply/ higher productivity lasted longer during MIS11c than during the Holocene.

Coupling identity and metabolic function of single cells with SIMS

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We describe an instrumental and methodology development aiming at coupling microorganism's phylogenetic identity and functions or interactions in soil, water, sediment or other ecosystems. [1] [2].

A NanoSIMS (Secondary Ion Mass Spectrometer) instrument with 50nm lateral resolution is used to obtain in one single measurement:

1) the phylogenetic identity of uncultured single cells through the visualization of oligonucleotide probe hybridization signal (similar to FISH method but replacing fluorescent oligonucleotide by an isotopically or elementally labeled probe),

2) the quantitative measurement of the metabolic activity of individual uncultivated cells by using stable isotope labeling (^{13}C, ^{15}N;…).

We introduce two newly developed modes of operation:

1) Low energy (< 100eV) reactive ion *in situ* pre-sputtering before analysis. Using the sample as an electrostactic mirror this allows to enhance the ionization yield by orders of magnitude while limiting sputtering of the sample. This is interesting for very surfacic measurements or samples of a few nanometers thickness (ex: membranes).

2) Faster isotope analysis of whole cells. In this mode the primary ion spot is enlarged up to a few µm. Each individual cell isotopic ratio is automatically chained in so-called "grain mode". The instrument's throughput is then dramatically increased, at the cost of the loss of intracellular resolution.

[1] Tianlun Li *et al*., (2007) Simultaneous analysis of microbial identity and function using NanoSIMS, *Environ. Microbiology* . [2] N. Musat *et al*., (2008) A single-cell view on the ecophysiology of anaerobic phototrophic bacteria, *PNAS*, Nov 18, 2008, **105**, no. 46.