Pleistocene climate variability – marine perspective

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Les reconstructions paleoclimatiques constituent un unique moyen pour explorer l'amplitude de la variabilité et les forçages naturels de notre climat. De telles études permettent de mieux comprendre les interactions existantes entre les différentes composante de notre climat : circulation atmosphérique et océanique et aussi les mécanismes de rétroactions qui peuvent amplifier les signaux. Au sein d'EPEBI nous sommes plusieurs chercheurs à travailler sur les changements paleo-environnementaux au cour du Pléistocène.

1. High resolution study of the last deglaciation (LD) and the Last Glacial Maximum (LGM) off the 'Manche' palaeoriver

We are studying benthic foraminiferal assemblages and foraminiferal stable isotopes in core MD99-2328 (Fig. 1) over the LD and the LGM. The very high sedimentation rate covering these periods (~2m/ka) allows a precise paleoceanographic reconstruction of the area (contourites, origin of water masses, e.g., GNAIW, MOW) with respect to our knowledge on NH ice-sheets deglaciation (particularly the British–Irish Ice Sheet - BIS), influencing sediment deposits via the 'Manche' palaeoriver. We are aiming to measure trace elements on foraminifer shells (e.g., Mg/Ca, Mn/Ca) to reconstruct properties of intermediate water masses (e.g., T, O; Projet Nouvelle Equipe).

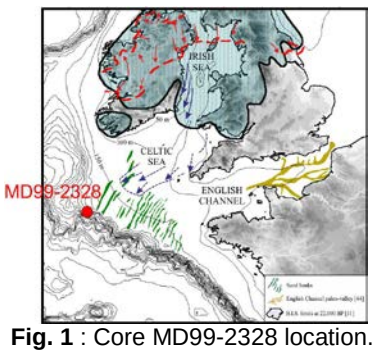

Fig. 1 : Core MD99-2328 location.

2. Marine benthic ecosystems at the Nile River prodelta over the past 20ka

We are studying benthic foraminiferal assemblages and stable isotopes in a sediment core located in the SE Levantine region over the last 20 ka. Benthic assemblages show three distinct faunal groups (Fig. 2). 1) The glacial period is characterized by eutrophic fauna because of the low sea level and the proximity to the continent. 2) The sapropel period characterized by low oxygen tolerant species. 3) The Holocene period characterized by more mesotrophic benthic taxa. During the Younger Dryas (YD) and Heinrich event (HS1) the eutrophic species *H. balthica* and *B. spathulata* increased in relative abundances whereas the other 'glacial' species decreased. Project MADHO (MISTRALS PaleoMEX 2012-2015).

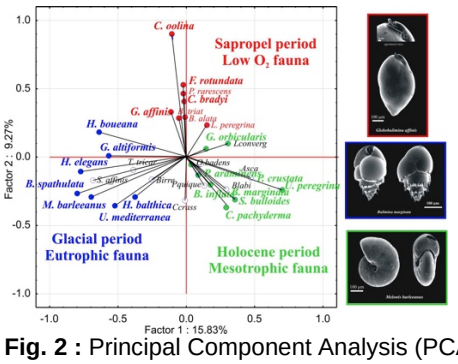

Fig. 2 : Principal Component Analysis (PCA) of the main benthic species (>5% of fauna).

3. ENSO variability over the past 250ka

This project focuses on reconstructions of the El Nino Southern Oscillation (ENSO) over the past 250 ka. Seasonally resolved records are derived from fossil giant clam shells (*Tridacna*) collected in different areas of the Indo-Pacific Ocean: Papua New Guinea (for the past 60 ka) and South Sulawesi (for the past 250 ka). Tectonically uplifted reefs are found at these locations. Initial results obtained in Papua New Guinea suggest that ENSO activity of the late 20th century is very rare in the fossil record. If confirmed, this result would imply that we may already have modified ENSO variability. More recently, we have focused on a new location in Indonesia were samples collected will provide information on ENSO activity during previous interglacial periods (similar warm periods as the Holocene). These projects have been funded by the ANR ELPASO (2012-2015), the Project Region Nouvelle Equipe and recently obtained funding via the INSU-LEFE-IMAGO program.

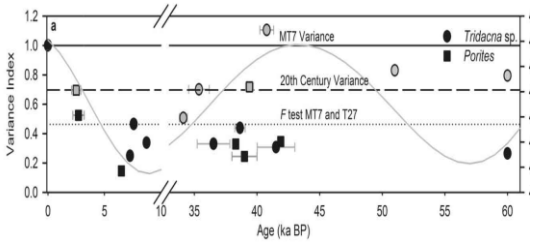

Fig. 3 : ENSO variance for modern (black line), 20th century (dotted line), Holocene (bars) and Glacial (bleu bars) conditions.

4. Pleistocene reef history

Evidence from field studies indicate that there was a period of massif reef expansion around 800-400 ka. This period corresponds to the Mid-Pleistocene Transition. We are investigating a potential link between global climate change and reef expansion via modification of the carbon cycle. We want to test if the timing of the latitudinal expansion of reefs coincides with observed changes in the Carbon cycle.

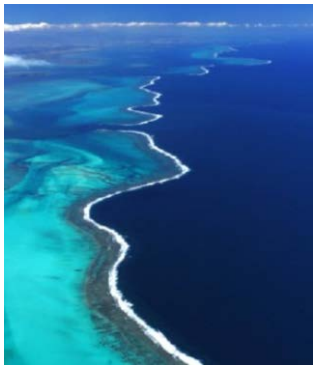

Fig. 4 : Aerial photo of the modern New Caledonia Reef system, results from bore-hole suggest this reef system expanded around 400 ka BP.

We are studying a sediment core in a turbidite deposit system offshore New Caledonia. This specific depositional setting lead to the preservation of coral fragments and other reef/plateforme dwelling species. Observation combined to XRF measurements are used to trace the history of New Caledonia Barrier Reef over the past 1.2 Ma. This project is funded by NERC (PhD studentship A. Foan) and include collaborations with IFREMER (XRF analyses).

Collaborations

G.J. de Lange (Utrecht University), S. Toucanne (IFREMER), E. Michel (LSCE), P. Braconnot (ELPASO group), K. Pedoja (Uni. Caen), L. Husson (Uni. Grenoble), A. Imran (Univ. Makassar), S. Jorry (Ifremer), Pierre Caillou (IPGParis), Aurore Boréale (Ifremer)

Associated publications

1 - Welsh, K., **M. Elliot**, A. W. Tudhope, B. Ayling, J. Chappell, 2011. Giant bivalves (*Tridacna gigas*) accurate recorders of ENSO variability. Earth and Planet. Sc. Lett., 307, 3-4, 266-270.

2 - **Elliot, M.**, K. Welsh, R. Driscoll, 2013. Giant clam recorders of ENSO variability. PAGES news, Vol 21, No 2.

3 - Pedoja et al., 2014. Staircase construction of Quaternary and Upper Cenozoic sequences of strandlines caused by sea level oscillations and tectonic uplift. Earth Science Reviews, 132, 13-38.