ECOLE LEMANIQUE DES SCIENCES DE LA TERRE
DES UNIVERSITES DE GENEVE ET DE LAUSANNE

Master ès Sciences in Earth sciences

Reconstruction of sea surface temperature of the Indian warm pool over the Cenozoic

Contact persons

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Context

The Cenozoic represents a key period because it records the last transition between a greenhouse and an icehouse world. Our knowledge of this long-term climate change is mainly inferred from benthic foraminifera compilation curves (Zachos et al., 2001), and only a few studies focus on reconstructing continuous SST records. Even though the sea surface is the one in direct exchange with the atmosphere. This lack is due to significant issues in the usual temperature proxies during warmer climatic states (δ18O or Mg/Ca). These classical palaeoclimatological proxies depend on the seawater chemistry (e.g., pH, salinity), which strongly fluctuate in tropical areas.
Today, the Indo-Pacific Warm Pool holds a unique place on the globe characterized by permanent sea surface temperature (SST) >28 °C and contributes to distributing heat through high convective clouds. Despite this relatively steady temperature, water salinities vary significantly due to seasonal monsoonal activity over the region. Thus, due to its central location on the global thermohaline circulation, the fluctuation of water properties (temperature and salinity) of the Indian ocean surfaces water masses play an essential role. The IPCC 5th report acknowledged the critical role of the East Equatorial Indian Ocean (EEIO) on the global climate and classified this region as one of the significant climatic "hotspots". Therefore, a call for an urgent understanding of the Indo-Pacific Warm Pool is justified on the grounds of the significance of this area for global oceanographic and climatological processes and the concerning threats to the human population living there.

Aims and Methods

This project aims to address 2 major questions:
How much do the temperatures of the Warm Pool change under global warming?
Were temperatures consistently as high in the past?
On planktic foraminifera, the traditional proxies δ18O and Mg/Ca will be coupled with clumped isotopes (Δ47). This later has the great advantage of being independent of seawater chemistry. Combining this proxy with the δ18O and Mg/Ca will allow us to decipher the salinity and temperature signals during the study interval (Modestou et al., 2020).
Because planktic foraminifera might not strictly record SST, purified fractions on coccoliths will be separated and analyzed (Tremblin et al., 2016). The coccoliths are produced by coccolithophores, single-celled phytoplankton algae that are strictly constrained to the sea surface. However, the occurrence of a relatively large vital effect precludes the classical use of the δ18O on these particles. Thus, I will also measure clumped isotopes on coccoliths purified fractions following the protocol established by (Drury & John, 2016)

References

Drury, A. J., & John, C. M. (2016). Exploring the potential of clumped isotope thermometry on coccolith-rich sediments as a sea surface temperature proxy. Geochemistry, Geophysics, Geosystems, 17(10), 4092–4104. https://doi.org/10.1002/2016GC006459
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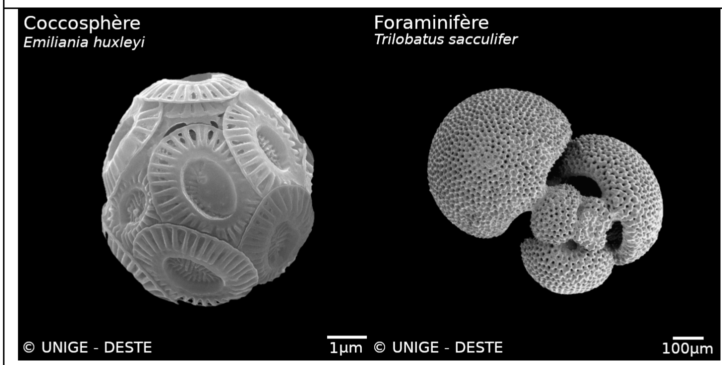

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