# On the application of freshwater diatoms from marine sediments as a proxy for monsoons.

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## Introdution:

Asia has the largest river network due to abundant monsoon precipitation and large annual runoff (Tamura *et al.* 2016). The input of freshwater from the monsoon precipitation brings specific markers, such as freshwater diatoms and specific diatom ecological assemblages that are preserved in marine sediments. Being thus we will use freshwater diatoms as a proxy to identify the monsoon signal in the Japan Sea (Fig.1), which records the monsoons patterns.

## Location:

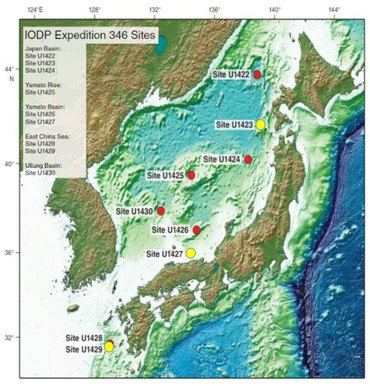



Fig. 1 - Core location for Exp.346.

Freshwater diatoms (Fig.9) are easily identifiable and have been used in the Pacific Ocean to reconstruct environmental conditions (Lopes et al. 2006) and flooding episodes (Lopes and Mix, 2009).

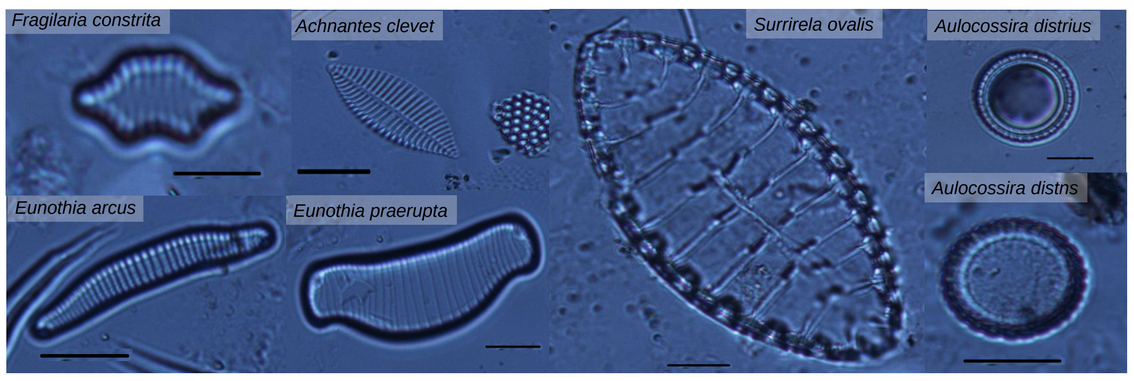



Fig. 9 – Freshwater diatoms, Scale length 10 µm

## Sample Preparation

The method used for this study was the following:

- Weight a known volume of sample (about 1g), dry over night at 40ºC and weight again.

Fig. 2 - Preparation for weighing

- Promote clay dispersion by adding a 0.33% of sodium phosphate and let the sample rest for about 12h.
- Attack organic matter with 25ml 30% $H_2O_2$.
- Attack carbonate with 25ml 10% HCl.

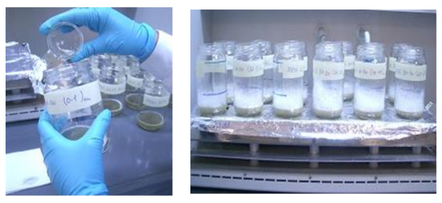


Fig.3 Organic matter attack

- To remove the clay fraction, add distilled water, let the sample rest for 8h and decant the remnant. Repeat this process until no clay remains in suspension.

Fig. 4 – Remove the clay fraction.

## Slide Preparation

For slide preparation, a known volume of the solution resultant of the preparation procedures is poured in the ‘‘Battarbee circular evaporation tray” (Battarbee, 1973).

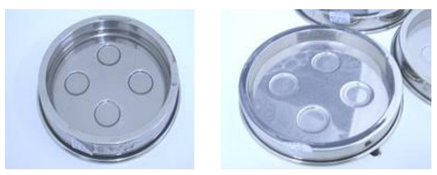
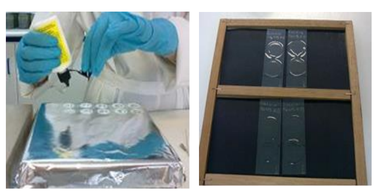


Fig.5- Battarbee circular evaporation tray



When the tray is dry, samples are mounted in a resin with refractive index (RI) 1.7.

Fig.6 –Sample mounting

## Taxonomic Identification

For the taxonomic study of diatom species, we have identified a minimum of 300 individuals. According to Fatela and Taborda (2002) (Fig.8) as this number represents satisfactory statistical reliability in a large number of paleoceanographic studies.

Because diatom valves can be broken or corroded before sampling or during cleaning, samples with more than half a valve are considered.

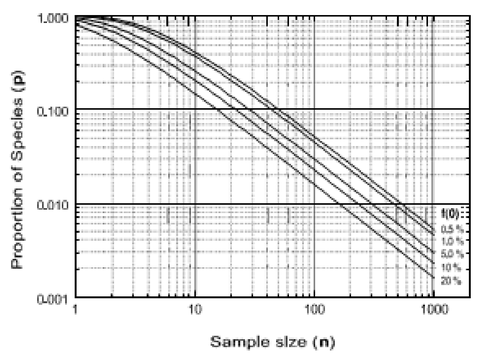



Fig. 8. Counts (n), from a random sample, needed to detect a species occurring with a proportion (p) in the assemblage, and the probability of failure to detect its presence (f(0)) (modifed from Dennison and Hay, 1967) (Fatela and Taborda, 2002).

## Results:

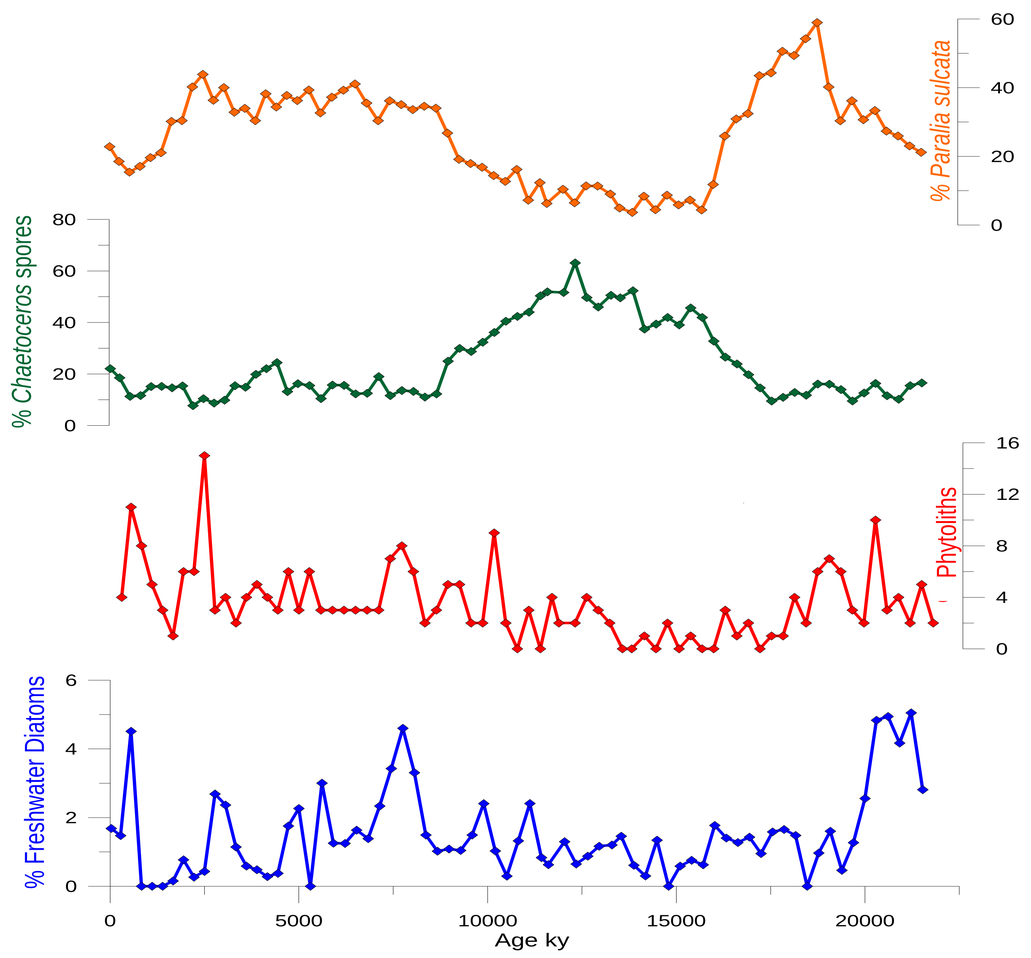



Fig. 10 – Percentage of freshwater diatoms, phytoliths, *Chaetoceros* spores and *Paralia sulcata*. Age models based on preliminary data report from Exp.346 IODP.

In Figure 10 we can observe environmental changes over time. In the first 9000ky the species *Paralia sulcata* presents higher values than the *Chaetoceros* genus, having also 2 peaks of freshwater diatoms and phytoliths. Since *Paralia sulcata* is a specie characteristic of coastal environments, it appears with higher abundance during periods of upwelling (Abrantes, 1991).

Between 9000ky and 16000ky there seems to occur a change of environment with the decrease of the species *Paralia sulcata* and the increase of the genus *Chaetoceros*. The *Chaetoceros* are indicators of oceanic productivity (Lopes et al., 2006) reacting with the increase of nutrients in the ocean. This nutrient input can occur with the increase of river discharges, also shown by the diatom peak of fresh water and phytoliths around 9000ky. According to Lu *et al*., (2006) the spatial distribution of phytoliths is closely related to climatic factors such as temperature, precipitation and growing season.

Around 16000ky we can observe a new change of environment marked by the decrease of *Chaetoceros* and the increase of *Paralia sulcata*. This may indicate an increase in the coastal upwelling process and a decrease in river discharges. At 20000 ky new phytoliths and freshwater diatom peak with a percentage decrease of *Paralia sulcata*.

References:
IODP (Exp346) 2013. Expedition 346 Scientists, 2013. *Asian Monsoon: onset and evolution of millennial-scale variability of Asian monsoon and its possible relation with Himalaya and Tibetan Plateau uplift*. IODP Prel. Rept., 346. oi:10.2204/iodp.pr.346.2013; Lopes, C., Mix, A. C., and Abrantes, F. A., 2006. *Diatoms in northeast Pacific surface sediments as paleoceanographic proxies*. Marine Micropaleontology, 60, 45-65.; Lopes C. and Mix A.C., (2009). *Pleistocene megafloods in the northeast Pacific*. Geology 37, 79-82; F. Abrantes (1991). Increased upwelling off Portugal during the last glaciation: diatom evidence. Marine Micropaleontology, 17, pp. 285–310.;H.Y. Lu, N.Q. Wu, X.D. Yang, H. Jiang, K.B. Liu, T.S. Liu, (2006). Phytoliths as quantitative indicators for the reconstruction of past environmental conditions in China I: phytolith-based transfer functions. Quat. Sci. Rev., 25, pp. 945–959.; McQuoid M. R. and Nordberg K., (2002). The Diatom *Paralia sulcata* as on environmental indicator species in Coastal Sediments. Estuarine, Coastal and Shelf Science, 56; F. Fatela and R. Taborda (2002). *Confidence limits of species proportions in microfossil assemblages.* Marine Micropaleontology 45, 169-174