Mollusc clumped isotope thermometry using a new approach

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We present a new approach of calibrating clumped isotope thermometry for mollusc. In our study we sampled growth bands from live mollusc specimens (*Villorita cyprinoides var. cochinensis*) collected from Cochin back water estuary in India. The growth bands represent seasonal carbonate deposition at different temperatures during a year. Simultaneous collection of water samples and co-existing carbonate allowed calculation of temperature using Epstein thermometry [1]. The temperature estimated using this approach showed seasonal range of 20° C to 42 °C.

The Δ_{47} values are derived using the method described in Ghosh *et al* 2006 [2] where heated gas equivalent together with carbonate standards (like NBS-19 and MAR J1) are analysed. The approach in producing this calibration curve varies from Henkes *et al*., 2013 [3] where bulk samples of mollusc species collected from natural marine setup across latitudes along with specimens grown under monitored conditions were analysed for Δ_{47} using carbon dioxide equilibrium scale. Our relation obtained as a function of temperature (in kelvin) is

Δ_{47}= = 0.055 x $10^6/T^2$ + 0.02 (r^2= 0.8996), which matches well with the inorganic calcite precipitation curve. We are monitoring the similar specimens at laboratory condition at different temperatures to further evaluate the thermometry equation.

[1] Kim, S.-T. & O'Neil, J.R. (1997) *Geochim. Cosmochim. Acta,* **61**, 3461-3475. [2] Ghosh *et al* (2006), *Geochim. Cosmochim. Acta* **70**(6), 1439–1456. [3] Henkes *et al* (2013), *Geochim. Cosmochim. Acta* **106** (2013) 307–325.

A first look at boron isotope based pCO_2 values from the eastern Arabian Sea for the last 22 kyr

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The Arabian Sea is an unique region with semi-annual reversal of surface water circulation between southwest (SW) and northeast (NE) monsoons. The pCO_2 in the Arabian Sea is always in excess of that in the atmosphere, and the EAS is found to serve as a significant source of carbon dioxide to the atmosphere [1]. However nothing was known up to today about the past pCO_2 variations of the EAS.

We present here for the first time pCO_2 values from the eastern Arabian Sea for the last 22 kyr. We have used planktonic foraminifera species *Globigerinoides ruber* (sensu stricto) from a sediment core AAS9/21, collected at 1807m water depth (14°30.539′N, 72°39.118′E). We have analysed boron isotopes on a MC-ICPMS at the University of Southampton, UK. pH and pCO_2 were calculated from the boron isotopic values. Results show that pCO_2 varied from ~200 to ~440ppmv during the study period. A comparison with atmospheric CO_2 data from Antarctic ice core [2] suggest that the EAS seems to have fluctuated between a source and sink of atmospheric CO_2 in the past, with significant excess (w.r.t. the atmosphere) during the deglacial. Further comparison with western Arabian Sea (WAS) pCO_2 values [3] for the similar period reveals that during most of the time the WAS pCO_2 values were much higher as a result of intense upwelling which brings CO_2-rich sub-surface waters to the surface. The large variations in pCO_2 from the EAS are probably be due to a combination of physical processes such as moderate upwelling, influx of freshwaters from rain and rivers, and winter convective mixing processes.

[1] Sarma V.V.S.S. *et al*. (1998)*Tellus*,**50B**, 179-184. [2] Monnin E. *et al*. (2004) *Earth Plan. Sci. Lett*.,**224**, 45-54. [3] Palmer M.R. *et al*. (2010) *Earth Plan. Sci. Lett*.,**295**, 49-57.

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