

# $\delta^{44}\text{Ca}$ -Temperature Calibration on Fossil and Cultured *G. Sacculifer*: A new Proxy for the Reconstruction of Palaeo Sea Surface Temperature (SST) Fluctuations

Thomas F. Nagler<sup>1</sup> & Anton Eisenhauer (aeisenhauer@geomar.de)<sup>2</sup>

<sup>1</sup> Universität Bern, Isotopengeologie, Erlachstr. 9a, CH-3004 Bern, Switzerland

<sup>2</sup> GEOMAR, Wischhofstr. 1-3, D-24148 Kiel, Germany

SST is an important factor for the reconstruction of global climate change because at the ocean-atmosphere interface SST influences physical parameters like ocean-atmosphere gas exchange and global precipitation patterns. Application of stable oxygen isotopes ( $\delta^{18}\text{O}$ ) and chemical SST-proxies (Sr/Ca, Mg/Ca, alkenones, etc.) for glacial/interglacial reconstructions of SST change is limited by uncertainties introduced by various factors, e.g. salinity, dissolution, continental ice volume and post-depositional chemical alteration. We here report on direct  $\delta^{44}\text{Ca}$ -temperature calibrations ( $\delta^{44}\text{Ca} = ({}^{44}\text{Ca}/{}^{40}\text{Ca}_{\text{sample}} / {}^{44}\text{Ca}/{}^{40}\text{Ca}_{\text{normal}} - 1) \times 1000$ ) on calcite foraminifera demonstrating the high potential of Ca-isotopes as new SST-proxy. Biogenic Ca-precipitation is a kinetic process in which  ${}^{40}\text{Ca}$  precipitates more rapidly than  ${}^{44}\text{Ca}$ . In order to avoid species dependent isotope fractionation we focused our investigations on a single foraminifera species (*Globigerinoides sacculifer*) which is known to inhabit shallow euphotic waters in tropical and subtropical oceans.

Ca-isotope determinations involved the use of a  ${}^{43}\text{Ca}$ - ${}^{48}\text{Ca}$  double spike. Procedural blanks are less than 1 ng. Ca isotopic compositions were measured on a single cup AVCO mass-spectrometer. Ca isotopic fractionation was calculated

based on an exponential fractionation law. Application of this new method to *Globigerinoides sacculifer* of an equatorial east Atlantic sediment core indicates that the SST difference between Holocene and Last Glacial Maximum (LGM) amounts to  $3.1 \pm 0.7$  C.

We analysed cultured *Globigerinoides sacculifer* that grew in sea water kept at temperatures of 19.5, 26.5 and 29.5°C, to serve as absolute temperature calibration. It was found that the temperature range of about 10 C corresponds to a total  $\delta^{44}\text{Ca}$ -variation of about 2.5 with a  $\delta^{44}\text{Ca}$ -change of  $0.24 \pm 0.02$  per 1°C defined by the weighted linear regression (95% confidence level).

The difference between mean Holocene and mean LGM  $\delta^{44}\text{Ca}$  in the analysed drill core is about  $0.74 \pm 0.18$ . Because of the use of one species only any vital effects can be ruled out to have influenced our  $\delta^{44}\text{Ca}$  record. In addition, variations of the initial seawater  $\delta^{44}\text{Ca}$ -ratio can be neglected for Holocene/LGM variations because this time interval is short when compared to the Ca-residence time in the ocean. Thus we interpret  $\delta^{44}\text{Ca}$ -variations in the core as to reflect glacial/interglacial SST variations corresponding to about  $3.1 \pm 0.7$  C according to our  $\delta^{44}\text{Ca}$ -temperature calibration.