## A 100-year record of surface water temperature based on oxygen isotope ratios across bivalve mollusk shells, *Arctica islandica* (North Sea)

Bernd R. Schöne<sup>1</sup>, Antuané D. Freyre Castro<sup>1</sup>, Thomas Pohlmann<sup>2</sup>, Jens Fiebig<sup>1</sup>, Ingrid Kröncke<sup>3</sup>, Wolfgang Dreyer<sup>4</sup> & Wolfgang Oschmann<sup>1</sup>

1 Institute for Geology and Paleontology, INCREMENTS Research Group, JW Goethe University, Frankfurt / Main, Germany

www.increments.de

- 2 Institute for Marine Sciences IFM, Hamburg Univ., Troplowitzstr. 7, 22529 Hamburg, Germany
- 3 Senckenberg Institute, Marine Research Division, Schleusenstr. 39a, 26382 Wilhelmshaven, Germany
  - 4 Zoological Museum, C. Albrechts University Kiel, Hegewischstr. 3, 24105 Kiel, Germany

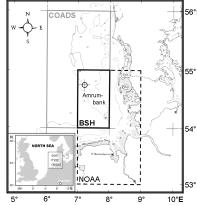
objective

Demonstrating the use of  $\square$ <sup>18</sup>O ratios of long-lived bivalve mollusk shells, *A.islandica*, for century-long reconstructions of surface water temperatures.

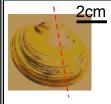
Sea surface temperature (SST) measurements are rare and limited in distribution, especially in the boreal and temperate marine settings. In addition, no proxy records are avalaible for these latitudes.

Here, we present a century-long SST chronology based on  $\delta$  <sup>18</sup>O ratios of the bivalve mollusk *A.islandica*.

Currently, our record covers the period of 1884-1983 and compares well with observational datasets such as COADS (Comprehensive Ocean-Atmosphere Data Set) or BSH (Bundesamt für Seeschifffahrt und Hydrographie) and modeled data NOAA (NOAA/NESDIS Extended Reconstructed).



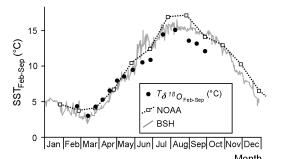
Map showing the sampling locality. The shell lived at 25m depth (Amrumbank). Spatial coverage of observational (COADS & BSH) and modeled (NOAA) SST data is indicated by boxes.



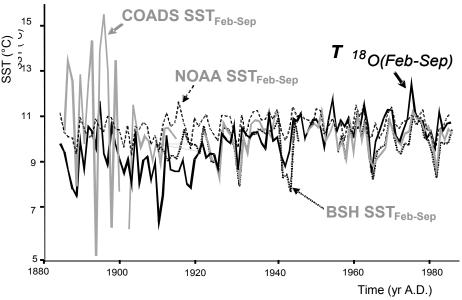
The bivalve mollusk *A. islandica* is one of the longest-lived (>375 years) animals. It occurs in boreal and temperate regions of the North Atlantic Ocean. The studied shell was 122 years old when collected alive. *A. islandica* regularly (daily, annually) accretes aragonite to its shell allowing for high-precision calendar dating of each shell portion.

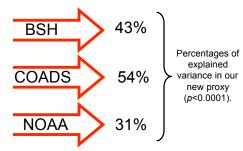
Milling technique [resolution up to  $65\mu m \sim 1-3$  days of growth]. Samples (20 to  $80\mu g$ ) were processed in a Finnigan Mass Spectrometer 253. Standard deviation is better than 0.06‰. The Grossman and Ku equation enabled us to calculate temperatures from these values.

Annual growth increment



Intra-annual \_18O-derived temperature record. Overall good agreement between measured (NOAA, BSH) and oxygen isotopederived temperatures (black). Daily growth pattens of the shell enabled precise calendar dating of the isotope record.





Comparison between observational (COADS, BSH), modeled (NOAA) and our new weighted proxy SST ( $T_{D18O(Feb-Sep)}$ ). The general trend is the same among all datasets and show a high degree of running similarity. Prior to the late 1940s the temporal resolution of observational data was much lower than in recent times resulting in large fluctuations of the COADS record.

## summary

Temperatures reconstructed from  $\,\delta^{\,18}{\rm O}$  values of the shell aragonite closely matches SST

Intra-annual growth record enabled precise calendar dating of each shell portion and each isotope sample.

## conclusion

A. islandica can be used as a proxy for long-term, high-resolution reconstructions of SST prior to instrumental measurements.



Emmy Noethe Program



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