Geophysical Research Abstracts
Vol. 12, EGU2010-8298-1, 2010
EGU General Assembly 2010

Sr/Ca ratios in cold-water corals - a 'low-resolution' temperature archive?

Andres Rüggeberg (1), Jan-Rainer Riethdorf (2), Jacek Raddatz (2), Matthias López Correa (3), Paolo Montagna (4), Wolf-Christian Dullo (2), and André Freiwald (3)

(1) Renard Centre of Marine Geology, Ghent University, Krijgslaan 281, S8, B-9000 Gent, Belgium (Andres.Ruggeberg@UGent.be), (2) IFM-GEOMAR, Leibniz-Institut für Meereswissenschaften an der Universität Kiel, Wischhofstr. 1-3, 24148 Kiel, Germany, (3) GeoZentrum Nordbayern, Friedrich-Alexander-Universität Erlangen-Nürnberg, Loewenichstr. 28, 91054 Erlangen, Germany, (4) Lamont-Doherty Earth Observatory, Geochemistry, 237 Comer 61 Route 9W - PO Box 1000, Palisades, NY, 10964-8000, US

One of the basic data to understand global change and past global changes is the measurement and the reconstruction of temperature of marine water masses. E.g. seawater temperature controls the density of seawater and in combination with salinity is the major driving force for the oceans circulation system. Geochemical investigations on cold-water corals Lophelia pertusa and Desmophyllum cristagalli indicated the potential of these organisms as high-resolution archives of environmental parameters from intermediate and deeper water masses (Adkins and Boyle 1997). Some studies tried to use cold-water corals as a high-resolution archive of temperature and salinity (Smith et al. 2000, 2002; Blamart et al. 2005; Lutringer et al. 2005). However, the fractionation of stable isotopes (delta18O and delta13C) and element ratios (Sr/Ca, Mg/Ca, U/Ca) are strongly influenced by vital effects (Shirai et al. 2005; Cohen et al. 2006), and difficult to interpret. Nevertheless, ongoing studies indicate the potential of a predominant temperature dependent fractionation of distinct isotopes and elements (e.g. Li/Ca, Montagna et al. 2008; U/Ca, Mg/Ca, delta18O, Lòpez Correa et al. 2008; delta88/86Sr, Rüggeberg et al. 2008).

Within the frame of DFG-Project TRISTAN and Paläo-TRISTAN (Du 129/37-2 and 37-3) we investigated live-collected specimens of cold-water coral L. pertusa from all along the European continental margin (Northern and mid Norwegian shelves, Skagerrak, Rockall and Porcupine Bank, Galicia Bank, Gulf of Cadiz, Mediterranean Sea). These coral samples grew in waters characterized by temperatures between 6°C and 14°C. Electron Microprobe investigations along the growth direction of individual coral polyps were applied to determine the relationship between the incorporation of distinct elements (Sr, Ca, Mg, S). Cohen et al. (2006) showed for L. pertusa from the Kosterfjord, Skagerrak, that $\sim$25% of the coral's Sr/Ca ratio is related to temperature, while 75% are influenced by the calcification rate of the organism. However, the Sr/Ca-temperature relation of our L. pertusa specimens suggest, that mean values are more reliable for temperature reconstruction along a larger temperature range than local high-resolution investigations. Additionally, our results plot on same line of Sr/Ca-temperature relationship like tropical corals indicating a similar behaviour of element incorporation during calcification.

References:

Adkins JF, Boyle EA (1997) Changing atmospheric Δ14C and the record of deep water paleoventilation ages. Paleoceanography 12:337-344

Blamart D, Rollion-Bard C, Cuif J-P, Juillet-Leclerc A, Lutringer A, Weering Tv, Henriet J-P (2005) C and O isotopes in a deep-sea coral (Lophelia pertusa) related to skeletal microstructure. In: Freiwald A, Roberts JM (eds) Cold-water Corals and Ecosystems. Springer-Verlag, Berlin Heidelberg, p 1005–1020

Cohen AL, Gaetani GA, Lundälv T, Corliss BH, George RY (2006) Compositional variability in a cold-water scleractinian, Lophelia pertusa: New insights into vital effects. Geochemistry, Geophysics, Geosystems 7:Q12004, doi:12010.11029/12006GC001354

López Correa M, Montagna P, Rüggeberg A, McCulloch M, Taviani M, Freiwald A (2008) Trace elements and stable isotopes in recent North Atlantic Lophelia pertusa along a latitudal gradient and from fossil Mediterranean sites. ASLO 2008 Summer Meeting, St. John's, Newfoundland & Labrador, Canada, 08.06.-13.06.2008, p. 47

Lutringer A, Blamart D, Frank N, Labeyrie L (2005) Paleotemperatures from deep-sea corals: scale effects.

In: Freiwald A, Roberts JM (eds) Cold-water Corals and Ecosystems. Springer-Verlag, Berlin, Heidelberg, p 1081–1096
Montagna P, López-Correa M, Rüggeberg A, McCulloch M, Rodolfo-Metalpa R, Dullo W-C, Ferrier-Pagès C, Freiwald A, Henderson G, Mazzoli C, Russo S, Silenzi S, Taviani M (2008) Coral Li/Ca in micro-structural domains as a temperature proxy. Goldschmidt Conference, Vancouver, British Columbia, Canada
Rüggeberg A, Fietzke J, Liebetrau V, Eisenhauer A, Dullo W-C, Freiwald A (2008) Stable strontium isotopes (delta88/86Sr) in cold-water corals — A new proxy for reconstruction of intermediate ocean water temperatures. Earth and Planetary Science Letters 269:569–574
Shirai K, Kusakabe M, Nakai S, Ishii T, Watanabe T, Hiyagon H, Sano Y (2005) Deep-sea coral geochemistry: Implication for the vital effect. Chemical Geology 224:212-222
Smith JE, Schwarcz HP, Risk MJ (2002) Patterns of isotopic disequilibria in azooxanhtellate coral skeletons. Hydrobiologia 471:111–115
Smith JE, Schwarcz HP, Risk MJ, McConnaughey TA, Keller N (2000) Paleotemperatures from deep-sea corals: Overcoming 'vital effects'. Palaios 15:25-32