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Stable strontium ($\delta^{88/86}$Sr) and U-Th isotope record of cold-water corals from the Gulf of Cadiz – potential proxy for the reconstruction of intermediate water temperatures and Mediterranean outflow intensity

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The use of azooxanthellate cold-water corals as potential archives for intermediate water mass properties and climate variability was recently tested (e.g., Smith et al. 2000, Lutringer et al. 2005, Montagna et al. 2005, Cohen et al. 2006). During the RV-M.S.Merian-1/3 cruise (spring 2006) a small reef structure (2 x 1 m) in 1325 m depth on top of the Captain Arutyunov Mud Volcano (MV), predominantly build-up by *Lophelia pertusa,* was sampled with a video-guided grab. Living solitary corals (*Flabellum sp., Dendrophyllium sp.*) were found up to 30 cm above the sediment on a dead *Lophelia pertusa* colony. A mud volcano related xenolithic block (0.5 x 0.5 m, in the sediment directly underneath), could be identified as the hard substrate base, necessary for the initial reef growth and rare on this MV-site.

Potentially recorded environmental influences on these archives are time intervals of marine methane emanation (surface-near gas-hydrate occurrence), the mud volcano activity itself (tectonically active region) and significant water mass changes by varying depth of the Mediterranean Outflow Water (MOW) due to climate changes.

In a first step we applied the stable strontium isotope method ($\delta^{88/86}$Sr) after Fietzke and Eisenhauer (2006), assuming a temperature dependent strontium isotope fractionation during calcium carbonate precipitation. The temperatures determined for the living solitary corals are ranging from 9 to 11.5 ˚C (typical error: $\pm$ 1˚C). For comparison, the sampling station related CTD profile documents a recent bottom water temperature of 8.96 ˚C and a range from 10 to 10.5 ˚C for the lower MOW, which is

actually positioned between 1075 and 1188 m depth. First U-Th age data imply slow growth rates of 0.13 to 0.25 mm/year for these corals, therefore the prepared sub-samples of approx. 5mm growth interval integrate up to 40 years of oceanographic changes.

However, the temperature correlation implies the stable strontium approach, which was originally deduced from reef building corals, as suitable for solitary species as well.

For the fossil *Lophelia pertusa* colony the actual $\delta^{88/86}$Sr data set indicates a range from 7.5 to 13.3 ˚C with an U-Th age distribution over the last 10 ka. Multi ion counting – inductively coupled plasma – mass spectrometer (MIC-ICP-MS) measurements of U-Th on 5 to 90 mg sub-samples identified remnants of early *Lophelia pertusa* colonisation phases on the xenolithic substrates. The calculated ages of 9.92 $\pm$ 0.12 ka, 5.86 $\pm$ 0.09 ka, 5.56 $\pm$ 0.11 ka, 5.43 $\pm$ 0.11 ka, 2.84 $\pm$ 0.07 ka and 1.96 $\pm$ 0.05 ka are closely correlating with the water depth specific record of increasing lower Mediterranean Outflow published by Schönfeld and Zahn (2000). The position of the colony remnants on the substrate even implies a movement of the major block around 5.5 ka, e.g. due to mud volcano activity or erosion.

The major part of the recovered colony is grown between 690 to 200 years BP. Combined with the lack of living *Lophelia pertusa* and the actual position of the lower MOW, approximately 140 to 250 m above the sampling site, a record of the mean lower MOW position is implied by this archive.

The stable strontium isotope ratio $\delta^{88/86}$Sr of biogenic carbonates may serve as a new paleo-temperature proxy for reef-building and solitary deep-sea corals and thus introduce new perspectives in paleoceanography, such as changes in intermediate and deep-sea temperature and ocean circulation.

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