Combined Th/U, Pa/U and Ra/Th dating of fossil reef corals

J.C. OBERT[1,2*], D. SCHOLZ[1], J. LIPPOLD[3], T. FELIS[4], K.P. JOCHUM[2], M.O. ANDREAE[2,5]

[1]Institute of Geosciences, Johannes Gutenberg University, Mainz, Germany
[2]Biogeochemistry and Climate Chemistry Departments, Max Planck Institute for Chemistry, Mainz, Germany
[3]Institute for Geological Sciences, University of Bern, Switzerland
[4]MARUM – Center for Marine Environmental Sciences, University of Bremen, Bremen, Germany
[5]Geology and Geophysics Department, King Saud University, Riyadh, Saudi Arabia
*Correspondence: johobert@students.uni-mainz.de

Post-depositional open-system behaviour in fossil reef corals is a major problem for accurate absolute dating. The commonly used ^{230}Th/U-system [e.g., 1] can be disturbed by post-depositional diagenetic alteration, which results in wrong ^{230}Th/U-ages. Since fossil reef corals are important palaeoenvironmental archives, precise absolute dating is essential for sea-level and climate reconstructions.

We have developed a method for combined preparation and analysis of fossil reef corals by the ^{230}Th/U-, ^{231}Pa/U- and ^{226}Ra/^{230}Th-methods. Inconsistencies between ages determined by the different methods identify diagenetically altered corals. Concordia diagrams reveal additional information about the alteration processes. (^{226}Ra/^{230}Th) and (^{226}Ra/U) ratios provide information about the last 10 to ~50 ka of the coral's diagenetic history.

Here we present new data of the combined application of the three isotope systems to fossil Last Interglacial corals from the Gulf of Aqaba, northern Red Sea. Previous studies have shown that these corals were subject to substantial open-system behaviour [2]. The process that was proposed to explain the (^{234}U/^{238}U) and (^{230}Th/^{238}U) ratios of these corals is U gain with subsequent U loss after a certain amount of time. The amount of lost U is assumed to be proporational to the amount of U previously gained. The application of our combined approach should enable us to validate/reject this model and possibly further constrain the timing of U addition and loss, respectively. In this context, we compare our data with quantitative modelling of various diagenetic scenarios.

[1] Obert, Scholz, Felis, Brocas, Jochum and Andreae (2016) *Geochim. Cosmochim. Acta*, **178**: 20-40

[2] Scholz, Mangini and Felis (2004) *Earth Planet. Sci. Lett.*, **218**: 163–178