Modelling coral calcification and proxy recording

FLORIAN BÖHM[1], ISABELLE TAUBNER[12], ANTON EISENHAUER[1] AND MARKUS BLEICH[2]

[1]GEOMAR, Kiel, fboehm@geomar.de, itaubner@geomar.de, aeisenhauer@geomar.de

[2]Inst. of Physiology, Univ. Kiel, m.bleich@physiologie.uni-kiel.de

Proxy records of zooxanthellate scleractinian corals are widely used for reconstructing past climate. It is well known that coral physiology strongly influences isotope and element incorporation in coral skeletons. Proxies commonly have to be calibrated for individual coral colonies before they can be applied. For a better understanding of these so-called vital effects it is important to understand and quantify the processes that influence proxy recording in corals and coral calcification in general.

We developed a numerical model of elemental and isotopic fluxes in scleractinian corals. It is based on the two recently published coral models of Hohn and Merico (2012, 2015) [2] [3] and Nakamura et al. (2013) [4]. It is implemented as a boxmodel quantifying ionic and molecular fluxes between ambient seawater and the major coral compartments, oral and aboral epithelia, coelenteron, calcifying medium, and skeleton. It includes carbonic and boric acid chemistry and isotopes, calcium and its isotopes, and O_2. Trans-cellular and para-cellular fluxes are implemented.

The ion permeability of the oral epithelium was tuned to ^{45}Ca tracer data of Furla et al. (2000) [1] and Ussing chamber results of Tambutté et al (2012) [5]. Diffusive ion permeabilities of the aboral epithelium and the skeleton are constrained by electro-physiological data from Ussing chamber experiments on *Stylophora pistillata* colonies. The combined para- and trans-cellular model fluxes were adjusted to yield calcification rates equivalent to an annual extension on the order of 1 cm/year.

Our initial results confirm the conclusion of Hohn and Merico (2015) [3] that para-cellular fluxes through the aboral epithelium are of minor importance. Ion diffusion through the coral skeleton is also insignificant compared to the trans-cellular fluxes. Trace elements and isotopes are used to further constrain and test the model and to identify processes influencing their incorporation.

[1] Furla P., Galgani I., Durand I., Allemand D. (2000) *J. exp. Biol.* **203**, 3445-3457. [2] Hohn S., Merico A. (2012) *Biogeosciences* **9**, 4441-4454, doi: 10.5194/bg-9-4441-2012. [3] Hohn S., Merico A. (2015) *Frontiers in Earth Science 2*, **37**, doi: 10.3389/feart.2014.00037. [4] Nakamura T., Nadaoka K., Watanabe A. (2013) *Coral Reefs* **32**, 779-794, doi: 10.1007/s00338-013-1032-2. [5] Tambutté, E. et al. (2012) *Proc. Royal Soc. B*, **279**, 19-27, doi: 10.1098/rspb.2011.0733.