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Mg/Ca and isotopic high resolution record of deep-sea hydrothermal barnacles

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Barnacles are crustaceans adapted to a sessile existence and cemented to a substrate by a protein complex. Most of the known species inhabit shallow marine environment, less than 2% of the species are found at depths between 100 and 2500 m. The shell of barnacles has a great adaptive significance, the shell of some barnacle species have been already investigated for microstructure. In this study we investigated the shell microstructure as well as the Mg/Ca and stable isotope distribution of barnacles found at a depth of around 2500m at a black smoker from the Manus Spreading centre, north-east of Papua New Guinea.
The shell consists of three substructures: an outer layer with pores and aragonite crystals, a massive interior mass and an inner layer with pores. The shell shows grown lines and the outer layer exhibits longitudinal striation from base to apex. The pores have a medium size of 0.8 microns. The size of the calcitic microcrystals are in the range of 0.2 to 0.5 microns, beside, larger aragonite crystals, with size of c. 10 microns are present. The massive interior mass has a compact structure, no pores or channels could be observed.
Oxygen stable isotope data of barnacle shell were performed from the centre to the border of the calcitic shells, along profiles. Within one shell, the isotope values show variations of max. 0.6 ‰The calculated temperatures from the stable isotope data consistently indicate that the barnacles populate sites with low temperature values, up to a few °C. The calculated temperatures from the isotope data are also in agreement with the reported habitat from the North Fiji and Lau Basins, where temperatures of max. 6°C were measured at sites populated by barnacles. Both calculated and measured temperatures of a few degrees indicate that at the sites where barnacles live, hydrothermal fluid input is present, as ambient temperature is around 1.5°C. Electron-microbeam analyses were done along the interior layer of the shell. The shell consists of a low-Mg calcite. The magnesium content varies between 0.1 and 0.85 wt.%.