Distribution of bacteria and associated minerals in the gill chamber of the vent shrimp *Rimicaris exoculata* and related biogeochemical processes

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The shrimp *Rimicaris exoculata* dominates the megafauna of some mid-Atlantic Ridge hydrothermal vent fields. This species harbors a rich bacterial epibiosis inside its gill chamber. At the Rainbow vent field, the epibionts are associated with iron oxide deposits. Investigation of both bacteria and minerals by scanning electron microscopy (SEM) and X-ray microanalysis (EDX) shows the occurrence of three distinct compartments in the gill chamber: (1) the lower pre-branchial chamber, housing bacteria, but devoid of minerals, (2) the "true" branchial chamber that contains the gills and remains free of both bacteria and minerals, and (3) the upper pre-branchial chamber housing the main ectosymbiotic bacterial community and associated mineral deposits. According to our chemical and temperature data, abiotic iron oxidation appears to be kinetically inhibited in the environment of the shrimps and this would explain the lack of iron oxide deposits in the first two areas. We propose that, in the third area, iron oxidation is microbially promoted. The discrepancy between the spatial distribution of bacteria and minerals suggests that different bacterial metabolisms are involved in the two compartments. A possible explanation lies in the modification of physico-chemical conditions downstream of the gills, that would reduce the oxygen content and favor the development of bacterial iron-oxidizers in this Fe^{II}–rich environment. A potential role of such iron-oxidizing symbionts in the shrimp diet is suggested. This would be unusual for hydrothermal ecosystems, where most previously described symbioses rely on sulphide or methane as an energy source.

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