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Previously unsuspected dietary habits of hydrothermal vent fauna: the bactivorous shrimp Rimicaris hybisae can be carnivorous or even cannibalistic

Emma Versteegh (1), Cindy Van Dover (2), and Max Coleman (1)

(1) NASA Jet Propulsion Laboratory, California Institute of Technology, Pasadena, United States (emma.versteegh@jpl.nasa.gov, +1 818 354 3259), (2) Duke Marine Lab, Duke University, Beaufort NC, USA

Most hydrothermal vents support productive communities, with chemosynthetic bacteria at the base of the food web. They form a potentially important link in global geochemical cycles. However, few data yet exist on their significance in ocean biogeochemistry and related ecological processes. We present results on the structure of part of the food web around hydrothermal vents of the Mid-Cayman Rise (MCR), revealing previously unknown life-history traits of the alvinocarid shrimp species Rimicaris hybisae. We also demonstrate that stable carbon isotope ratios (δ13C values) are an excellent tracer of trophic positions in these ecosystems, in spite of recent findings arguing otherwise.

Two hydrothermal vent fields have been described at the ultra-slow spreading ridge of the MCR. These include the world's deepest hydrothermal vents (Piccard field $\sim$4985 m), which support a food web, which includes bactivorous shrimp and carnivorous anemones. The nearby Von Damm vent field ($\sim$2300 m) supports a more complex food web, with more primary producers, and probably some influx of photosynthetically produced carbon.

Rimicaris hybisae is abundant at both known MCR vent fields and shows a high degree of spatial variability in population structure and reproductive features. In previous work it has been considered bactivorous. Large variations in tissue δ13C values remained largely unexplained, and it has been argued that δ13C values are not a good food web tracer in hydrothermal vent ecosystems.

We observed that shrimp tended to be either in dense aggregations on active chimneys or more sparsely distributed, peripheral shrimp in ambient or near-ambient temperatures. With the hypothesis that varying δ13C values show real differences in food sources between individuals and that shrimp in different locales might have different diets, we collected shrimp from both environments at the Von Damm site during E/V Nautilus (NA034, August 2013) and examined their gut contents.

Stomach contents of all shrimp from dense aggregations at the Von Damm field (n=18) consisted of white, amorphous material that resembled bacteria. Sparsely distributed peripheral shrimp ($\sim$1 m from dense aggregations) had stomachs filled with fragments of crustacean exoskeleton (5/13), a mixture of bacteria-like material and crustacean exoskeleton (3/13), or bacteria-like material only (5/13).

We then analyzed the δ13C, δ15N and δ34S compositions of the shrimp gut contents. We show that R. hybisae switches its diet from exclusively chemosynthetic bacteria to crustacea during its life history. This is reflected in dramatically lower δ13C values of shrimp tissues, and slightly elevated δ15N values. To further support our findings, measurements of δ34S values on the same individuals and their gut contents are ongoing.

Our contribution to disentangling the food web around the MCR hydrothermal vents fields helps quantify their carbon budget and determine their role in ocean carbon cycling.