Beyond the Calvin cycle: Alternative pathways for autotrophic CO_2 fixation at deep-sea hydrothermal vents

Michael Hügler[*]*, Stefan M. Sievert, and Johannes F. Imhoff*

Autotrophic microorganisms form the basis of the food web at hydrothermal vents. These organisms – either free-living or as symbionts in invertebrates – are responsible for the fixation of inorganic carbon and thus mediate the transfer of energy from the geothermal source to higher trophic levels. Despite their importance for the ecosystems, we are currently only beginning to understand these microbial communities and their metabolic capacities. Since many free-living and symbiontic gamma-proteobacteria from hydrothermal vent sites use the Calvin cycle for carbon fixation, it was believed that CO_2 is mainly fixed via this pathway in these ecosystems. However during the last three years this view has changed. Epsilon-proteobacteria have been identified as a major, if not dominant component of the microbial community at deep-sea hydrothermal vents. We could show that they use the reductive tricarboxylic acid (TCA) cycle for carbon fixation. In addition, this pathway is also used by some Archaea and by members of the *Aquificales*. The later are important community members at high-temperature environments at vents and elsewhere. Even some symbiotic bacteria fix CO_2 via the reductive TCA cycle, e.g. the endosymbiont of the tubeworm *Riftia pachyptila*. Within the autotrophic archaeal community at vents interesting modifications of the known carbon fixation pathways and even a novel CO_2 fixation pathway have been discovered. Thus, autotrophic carbon fixation through alternative CO_2 fixation pathways might be more widespread and more significant than previously thought. Especially the reductive TCA cycle plays a crucial role.

**Presenting Author: Leibniz Institute of Marine Sciences, IFM-GEOMAR, Kiel, Germany*