

Redox substrates and autotrophic pathways of *Endoriftia persephone*, the gammaproteobacterial endosymbiont of vestimentiferan tubeworm *Riftia pachyptila*

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Vestimentiferan tube worm *Riftia pachyptila* lives at deep-sea hydrothermal vents, which have a high degree of temporal heterogeneity in habitat chemistry. Their growth is dependent on a sulfur-oxidizing endosymbiotic gammaproteobacterium, *Endoriftia persephone*, that lives in the trophosome organ. *E. persephone* may be able to use two carbon fixation pathways, the Calvin Benson Basham cycle (CBB) and the reductive citric acid cycle (rCAC). In addition, they may also be able to use multiple electron donors (H₂ and reduced sulfur compounds including H₂S) and multiple electron acceptors (oxygen and nitrate). To clarify the carbon fixation pathways and redox substrates, and to infer whether these capabilities are environmentally induced, *R. pachyptila* were collected at hydrothermal vent sites in the East Pacific in November 2014 and October 2016 with the HOV ALVIN. The worms were incubated at sea in high pressure vessels under conditions designed to induce the relevant activities (high versus low sulfide; presence and absence of hydrogen gas; presence and absence of nitrate and oxygen). Freshly harvested symbionts were incubated in the presence of different redox substrates (H₂, H₂S, O₂, nitrate) to determine which one(s) stimulated carbon fixation rates. Pathways were verified via stable isotope analyses and enzyme assays (RubisCO for CBB; ATP dependent citrate lyase for rCAC; hydrogenase for H₂ use; nitrate reductase for nitrate utilization). Clarifying the capabilities of the symbionts to adjust to hydrothermal vent heterogeneity will in turn clarify the factors influencing the distribution of this ecosystem-structuring symbiosis.