Microstructure of the Modern Cold-Seep Clam *Calyptogena*: Establishing a Framework for Intraskeletal Chemical Analysis

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Marine methane seeps are globally distributed but poorly understood phenomena where sulfide- and hydrocarbonrich pore-fluids flux from the lithosphere to the hydrosphere. Benthic megafauna that typically inhabit methane seeps are supported principally by symbiotic relationships with sulfuror methane-oxidizing bacteria. Considering the trophic linkage between pore-fluid chemistry, chemosynthetic bacteria, and seep metazoan, it is likely that variation in the availability of methane, sulfide, or both will affect metazoan growth and survival, as well as the ecological dynamics in methane seep environments. Intraskeletal chemical analysis of the shells of vesicomyid clams, which depend nutritionally on endosymbiotic sulfide-oxidizing bacteria, will provide a "window" into temporal variation in sulfide and perhaps other compounds. Two species of vesicomyid clams, *Calyptogena kilmeri* and *Calyptogena pacifica*, dominate the megafauna in Monterey Bay seeps. Three layers of material comprise *Calyptogena* shells: an outermost proteinaceous periostracum, an outer homogenous (i.e., microcrystalline) carbonate layer, and an inner nacreous carbonate layer. The homogoneous layer contains thick (~1 cm), weakly apparent density bands that curve toward the outer margin of the shell at ~20º. The homogenous layer is not always preserved along the entire length of the shell, likely due to varying amounts of dissolution, which may be enhanced by the low pH conditions of methane seeps. The nacreous layer comprises very thin (~100µm) sublayers extending along the entire inner curvature of the shell. XRD analyses suggest aragonitic composition of both the nacreous and homogenous layers. In sampling for intraskeletal chemical analyses, both the homogenous and nacreous layers have advantages and disadvantages. The homogenous layer is thicker and contains more carbonate material, but is sometimes discontinuous due to dissolution. The nacreous layer is more continuous than the homogenous layer, but is a poor sampling option due to significantly less carbonate material and continuous calcification throughout the inner layer of the shell.