Elucidation of the Geometric Properties of the Pdu Microcompartment by Cryo-Electron Tomography

Kevin Cannon[1], Todd Yeates[2], Jessica Ochoa[3], Justin Miller[4], James Evans[5], Trevor Moser[6]

[1]UCLA [2]University of California Los Angeles, [3]California Institute of Technology, [4]UCLA, [5]Pacific Northwest National Lab, [6]Pacific Northwest National Lab

kacannon@g.ucla.edu

Approximately 20% of all bacteria contain giant supramolecular structures called bacterial microcompartments, or MCPs. MCPs are organelle-like structures that carry out various metabolic functions and are composed of a large proteinaceous shell that encapsulates enzymes and other proteins. These shells are roughly polyhedral in shape and consist of tessellating hexameric, pentameric and trimeric protein oligomers. Besides organizing an interior space inside the cell, the protein shell of an MCP plays a vital role in controlling diffusive transport of metabolic substrates and products from and to the cytosol. While some MCPs, such as carboxysomes, have been observed to have a nearly icosahedral shell, others have ambiguous geometries that have not been characterized in detail. Compared to carboxysomes, the 1,2-propanediol utilization (Pdu) microcompartment is a type of MCP that is more irregular in shape and size, with polyhedral properties that are not yet well-understood. Additionally, the hexagonally shaped protein oligomers that make up the shell of the Pdu MCP have distinct properties, with one side that is flat and one side that is dimpled. The native orientation of these shell proteins has not been confirmed in endogenous MCPs. We present ongoing efforts to use cryo-electron tomography (cryo-ET), combined with X-ray crystallographic data, to investigate these unsolved mysteries of the geometric shape of the Pdu MCP.