Inorganic Carbon Limitation and Diversification of Hydrogenotrophic Methanogens in the Samail Ophiolite, Oman

ELIZABETH M. FONES[1], DANIEL R. COLMAN[1], EMILY A. KRAUS[2], ALEXIS S. TEMPLETON[3], JOHN R. SPEAR[2], AND ERIC S. BOYD[1]

[1]Department of Microbiology and Immunology, Montana State University, Bozeman, MT 59717

[2]Department of Civil and Environmental Engineering, Colorado School of Mines, Golden, CO 80401

[3]Department of Geological Sciences, University of Colorado, Boulder, CO 80309

Serpentinization can generate fluids that are enriched in H_2 and depleted in inorganic carbon. Two metagenome assembled genomes (MAGs) affiliated with *Methanobacterium* were recovered from subsurface fracture fluids of the Samail Ophiolite, Oman. One MAG (Type I) was abundant in circumneutral waters (, while the other (Type II) was abundant in hydrogen rich, hyperalkaline waters. The Type I MAG couples H_2 oxidation to CO_2 reduction and methanogenesis. Surprisingly, the Type II MAG, which are derived from Type I lineage, lack two key H_2 oxidizing [NiFe]-hydrogenases (Frh and Mvh) and these functions appear to be replaced by formate dehydrogenases. This indicates the Type II *Methanobacterium* drives methanogenesis with formate and suggests that the availability of oxidants supplants that of reductants in shaping methanogen evolution in highly serpentinized waters. Single amplified genomes (SAGs) reveal ongoing strain-level diversification of the Type II MAGs, including at several loci of putative physiological and ecological importance. Results are discussed in relation to ongoing Methanobacterium evolution in response to inorganic carbon limitation.