ENERGETICS OF *ACIDIANUS AMBIVALENS* DURING AEROBIC GROWTH ON SULFUR AND VARYING NUTRIENT AVAILABILITY. C. E. Hart[1] and D. Gorman-Lewis[1], [1]Department of Earth and Space Sciences, University of Washington, Seattle, WA.

Introduction: While there are several unifying traits for life on Earth, life beyond the Solar System may take different and unrecognizable forms. The need to acquire energy to overcome internal entropy production, however, is a universal characteristic of all living systems. Despite the prominent role microorganisms play in our environment and their versatility to thrive in the harshest chemical and physical environments, microbial energetics has been a largely underutilized area of research. Understanding microbial energetics and the driving force of growth can provide insight into the evolution of energetic adaptations on Earth, the ability to quantify energy budgets for microbial growth and cell maintenance, and facilitate evaluations of habitability or analogs of life elsewhere.

Microbial growth can be modeled by macrochemical equations that describe catabolic and anabolic reactions on a given substrate and not solely rely on standard states or the catabolic portion of growth [ref 1, 2 3]. This model was applied to the thermoacidophilic sulfur-oxidizer, *Acidianus ambivalens* (*A. ambivalens*), during growth on elemental sulfur to investigate energetic needs under varying nutrient availabilities. Energetics of *A. ambivalens* was calculated for optimal growth conditions, designed to enhance growth but is likely inefficient, and two different treatments of oxygen limitation.

Results: In all experiments, Gibbs energy of the overall growth reaction was primarily dissipated through the release of enthalpy. Optimal growth conditions yielded the largest cell numbers and total heat produced, as anticipated. Enthalpy and Gibbs energy, both in J/C-mol, were negatively correlated with biomass yield, the quotient of C-mol of biomass and moles of substrate consumed. Growth efficiency, in terms of joules of Gibbs energy consumed per second, increased as oxygen availability decreased.

Conclusions: When nutrients were unlimited, growth occurred inefficiently by producing a greater amount of heat and lower biomass yields. In oxygen-limited systems, growth was more efficient, which resulted in a tighter coupling of energy consumption to biomass production and lower losses of energy through heat. With continued research investigating the thermodynamics of microbial growth, further constraints can be placed on habitability and understanding the driving force of microbial growth in extreme environments.

References:

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