GENOMIC CAPACITY FOR ARSENIC BASED METABOLISMS IN GLOBAL OXYGEN MINIMUM ZONES. Jaclynk K. Saunders[1] and Gabrielle Rocap[2]. [1]University of Washington, School of Oceanography (jaclynk@uw.edu), [2]University of Washington, School of Oceanography (rocap@uw.edu).

Introduction: Prior to the oxygenation of the atmosphere by photosynthetic Cyanobacteria about 2.4 billion years ago, the early Earth was characterized by a reducing atmosphere and anoxic ocean. The anoxic ocean persisted throughout most of the Precambrian, thus preventing the rise of the electrochemically lucrative aerobic respiration. Early microorganisms utilized other elements with high electrochemical potentials in order to obtain energy. One such element used for bioenergetic gains by early microorganisms was arsenic, with arsenic based metabolisms still in existence today [1]. It has been hypothesized that microorganisms had the capacity to metabolize arsenic as long as 3.4 billion years ago, with recent fossil evidence indicating an active microbial arsenic cycle in 2.72 billion year old fossilized stromatolites [2]. It is likely that arsenic based metabolisms were of even greater significance on early Earth as active volcanism and geothermal activity would have maintained high concentrations of arsenic in the environment and the redox potential of arsenic would be extremely beneficial in the reducing atmosphere and anoxic ocean [3].

More representatives of anaerobic arsenite oxidizers, both chemoautotrophic and photosynthetic, are required to better constrain the origin and potential significance of arsenotrophy on early Earth. Oremland *et al.* (2009) [4] suggests that this limited taxonomic representation of chemolithotrophic arsenite oxidizers may result from the predominant use of classical microbiological techniques, which are biased towards copiotrophic organisms, as opposed to high throughput molecular techniques. In order to better understand the evolution and environmental impact of arsenotrophy, both past and present, we have utilized high throughput metagenomic sequencing and bioinformatics techniques to identify additional environmental representatives of arsenic metabolism linked genes.

Marine Oxygen Minimum Zones (OMZs) are regions of naturally occurring low oxygen concentrations which span about 1% of global ocean volume [5]. The East Tropical North Pacific (ETNP) OMZ is a modern proxy of ancient reducing oceans which prevailed during the Precambrian era, with persistent oxygen concentrations below 3 nmol kg^{-1} [6]. In the absence of oxygen, nitrate is the next best electron acceptor for respiration, and therefore many microbes in OMZs make a living off of reducing nitrate to N_2 [6] resulting in 30-50% of global nitrogen loss occurring in OMZs [5]. The anoxic waters of OMZs support rare metabolisms including anammox, sulfate reduction, and methanogenesis, among others [5].

Within the anoxic waters of the East Tropical North Pacific (ETNP) OMZ, the components of autotrophic arsenite oxidation – arsenite and nitrate – are available. While arsenic concentrations are lower today than in the early ocean, arsenic is still quite abundant in seawater at 1-3 µg/L [7] and is abiotically reduced to arsenite in oxygen deficient waters [8]. Nitrate concentrations through the oxygen deficient waters of the ETNP range from about 20-40 uM nitrate.

An oceanographic research cruise through the ETNP OMZ was conducted in 2012. At a station located in the central region of the OMZ, metagenomics samples of the microbial community were obtained at 10 depths spanning the oxygen depleted region. A *de novo* assembly of microbial genomes captured in this dataset indicates genetic signs of arsenotrophy [9]. Phylogenetically informed taxonomic identification of short-reads has been performed which provides information about the diversity of the arsenic-related genes as well as an estimate of relative abundance of these genes in the microbial community sampled [10].

The capacity for arsenic-based metabolisms in the ETNP OMZ not only indicates an additional strategy for microbial energetics, but may also be associated with denitrification processes common in these regions as some autotrophic arsenite oxidizers have the capacity to reduce nitrate to N_2 [11]. The application of genomics techniques to this OMZ system provides insight into the expanse of arsenic-based metabolisms in present-day environments as well as the potential significance of arsenic based metabolisms in ancient oceans.

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