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A Fresh Look at the Geobiology & Sedimentary Environments of the Hypersaline Great Salt Lake, USA

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1 Introduction

The Great Salt Lake (GSL) is the defining hydrological feature of the Great Basin, North America's largest desert -- and it is the largest waterbody in the western USA. Despite the early (Eardley, 1938) recognition of "bioherms," algal layers, and mats covering hundreds of square km of lake area, these features have not been the focus of intensive documentation. The prevailing notion is that the GSL is lifeless. Despite interest from industries mining the salt and harvesting the brine shrimp for aquaculture, relatively little is known about the lake geochemistry, microbial diversity, metabolic activity, and mineralogy, and how these relate with processes of biosedimentation and fossil preservation.

Research on the GSL is underway to: 1) identify the taxa present in various lake environments using 16S/18S small sub-unit (SSU) rRNA genes; 2) relate patterns of microbial diversity to environmental conditions in the lake and environs (e.g., pH, DO); 3) relate organism assemblages to specific facies and microbially-influenced sedimentary structures (MISS) in the modern environment (e.g., mats, laminated crusts, tufas, hot springs); and 4) eventually interpret ancient MISS preserved in archived sediment cores from the GSL's ancestral Lake Bonneville. An initial goal is to assess the composition, architecture, and preservation of modern GSL microbial communities using genomic (DNA sequencing) and microscopic techniques (SEM, EDAX).

2 Initial Study Results

A pilot study has commenced a microbiological census of the modern GSL (Beer et al, 2010). Examination of various sedimentary facies in the modern GSL (Fig. 1) confirms

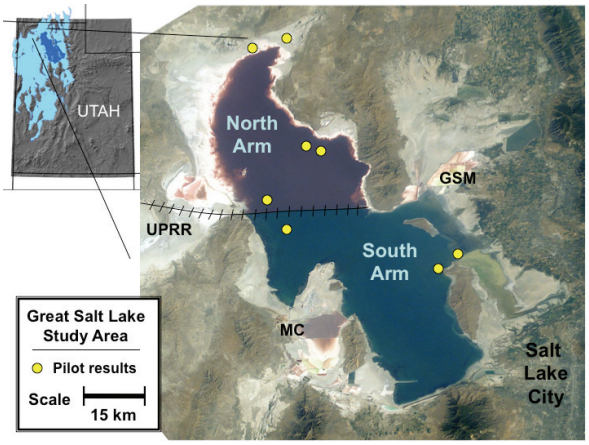

Fig. 1. GSL sample locales NASA-EOS 08-19-2003. UPRR– Union Pacific Railroad. Extractive Mineral Industries: GSM– Great Salt Lake Minerals; MC– US Magnesium.

that microbial communities are found in mats, crusts, tufas, oolites, carbonate hardgrounds, stromatolites, open water, and benthos. Traditional cultivation and isolation approaches on samples from the lake and surrounding features yielded some Archaea, Bacteria, microalgae and cyanobacteria. Preliminary phylogenetic analysis of 16S data from samples analyzed demonstrate the diversity of GSL microbiota (Beer et al. 2010). Crenarchaeota are present in the photic part of the water column in the South Arm, but they are not at depth in the anoxic brine wedge. Examination of a laminated mat specimen using microscopy and phylogenetic 16S SSU rRNA gene analysis confirmed that the microbial community varies by layer sampled.

It is essential to thoroughly document and describe GSL microbial diversity and associated organo-sediments; the GSL is a major avian habitat and stopover in the inter-hemispheric flyway, and provides food for millions of migrating birds, some of which are endangered. The GSL

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faces significant development pressure: local extractive industries plan to enhance production and salt mining by removing thousands of liters of water from the GSL, which will lower the current shoreline by several meters. Pipeline ruptures in 2010 created an unprecedented pollution disaster in the GSL. Such environmental pressures underscore a critical need to assess the geobiology, before the GSL becomes an uninhabitable terminal lake system.

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