IRON-BEARING MINERALS AS A TRACE NUTRIENT SOURCE FOR SNOW ALGAE COMMUNITIES AND IMPLICATIONS FOR MINERAL BIOSIGNATURE FORMATION. Z. R. Harrold[1], E. M. Hausrath[1], A. E. Murray, O. Tschauner[1], A. H. Garcia[1], A. Lanzirotti[4], M. A. Marcus[5], M. Newville[4], C. L. Bartlett[1] and J. Raymond[3], [1]Department of Geoscience, UNLV, 4505 S. Maryland Parkway, Las Vegas, NV 89154-4010 Elisabeth.Hausrath@unlv.edu, [2]Desert Research Institute 2215 Raggio Parkway Reno, NV 89512, [3]University of Nevada, Las Vegas, School of Life Sciences, 4505 S. Maryland Pkwy., Las Vegas, NV 89154, [4]Center for Advanced Radiation Sources, The University of Chicago, Chicago, IL, USA, [5]Lawrence Berkeley National Lab, Advanced Light Source, Berkeley, CA, USA

Introduction: Snow and ice environments on Earth harbor diverse life forms from all three domains: bacteria, archaea, and eukaryotes [e.g. *1, 2, 3*]. Icy planets and moons including Mars, Enceladus and Europa are therefore of particular interest in the search for past and present life beyond Earth. In order to select, detect and interpret astrobiological mission targets on icy worlds, it is vital to understand how microbial communities survive in and impact cold environments.

Snow surface communities of algae and bacteria "bloom" during seasonal snowmelt [*2*]. Microbial inhabitants of these icy environments face numerous challenges including nutrient limitations. While algae provide a primary production pathway within the microbial community, their growth is partially reliant on acquiring sufficient micronutrients [*5-7*]. Iron in particular, plays a key role in numerous cell functions including photosynthesis and respiration [e.g. *4*]. Iron deficiencies can result in impaired algal cell division, chlorosis and overall low population densities [e.g. *4*].

Iron, however, is sparingly soluble in circumneutral aqueous environments, such as snow and ice. Aeolian dust and detritus provide the most abundant source of iron in snow. Direct alga-mineral contact in snow is suggested to play a role in micronutrient acquisition [e.g. *8, 9*]. Some algae in iron-deficient oligotrophic marine environments acquire iron through a symbiotic relationship with bacteria [*10*]. The bioavailability of mineral-bound Fe to snow algae communities, and whether these biota-mineral interactions can produce persistent mineralogical biosignatures remains unknown.

We investigate snow algae-microbe-mineral interactions via field and laboratory based studies. Special focus is given to investigating (1) the ability of a xenic, snow algae culture to utilize Fe-bearing minerals as an iron source, (2) the effect of these snow algae-prokaryote consortia on mineral dissolution and (3) the potential for mineralogical biosignature formation.

Fe-minerals as an Fe source for snow algae: Growth experiments of xenic *Chloromonas brevispina* cultures incubated with Fe-minerals suggest naturally occurring, Fe-bearing forsterite ($Mg_{1.8}Fe_{0.2}SiO_4$) can support snow algae growth. Parallel geochemical data indicate forsterite dissolution rates in the biotic systems exceed dissolution in abiotic controls.

Algae and prokaryote growth dynamics in xenic cultures subjected to Fe-replete and Fe-limiting conditions are also investigated. Growth rates in Fe-replete and forsterite bearing cultures are higher than that of Fe-limiting cultures. A steady-state prokaryote to algae ratio during exponential and stationary phase algae growth, alludes to algae-prokaryote partnerships.

Mineralogical biosignature formation: Synchrotron μXRF, μXRD and μXANES analyses of snow algae communities indicate the presence of cell-associated, Fe-bearing mineral phases. Field samples exhibit direct associations between cryophilic microbial biomass and Fe(II) and Fe(III)-bearing minerals. Fe(II) minerals directly associated with snow algae cell surfaces may support algal cell trace nutrient requirements. Distributed Fe(III)-precipitates within a snow algae biofilm and Fe(III)-coatings on snow algal cells suggest biologically mediated Fe-oxide precipitation. A nano-crystal sized Fe-mineral was also identified with biomass from Fe-limited, xenic *C. brevispina* cultures grown in the presence of Fe-bearing forsterite. These snow algae-mineral associations provide evidence for the possible formation of mineralogical biosignatures in snow and ice environments.

Ongoing work is required to determine the mechanism of snow algae Fe acquisition from Fe-bearing minerals, and their influence on system mineralogy and mineralogical biosignature formation.

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