MICROBIAL MOLECULAR MARKERS AFTER A WET EVENT IN THE ATACAMA: SETTING THE TIMER OF BIOMARKERS TRANSFORMATION.

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Introduction: The hyperarid areas of the Atacama Desert in northern Chile have been investigated for decades as terrestrial analogues to study and understand the feasibility of life on Mars. Extreme and prolonged dryness favor the preservation of biological structures and molecular biosignatures, which can supply clues for habitat reconstruction and for the development of methodologies and instrumentation for life detection in planetary exploration [1, 2]. Although the Atacama is one of the driest deserts on Earth, it experiences rain falls in timescales of decades as the one occurred by the 24-26th of March 2015 over the Second Region of Chile. This event was an opportunity to study how, and to which extent, the microbial life thrives after receiving an excess of water, which otherwise is highly limited. Additionally, this Atacama "wet scenario" could be a reference point to follow up the transformation and preservation of biomarkers with time and desiccation.

Methods: From April 3-12, 2015 (7 to 12 days after the rainfall), a rover field campaign was carried out as part of the NASA LITA project [3]. To investigate the effect of the humidity gradient, we selected 4 locations, including small playas still containing a pond in their deepest parts, and performed transects to cover horizontal and vertical profiles (0-80 cm depth). Samples were analyzed in situ with a microarray immunoassay biosensor (LDChip, Life Detector Chip) [2] and then in the laboratory by geochemical, mineralogical, biochemical and metaproteomic analyses.

Results: A total of 84 samples were analyzed by ion chromatography and LDChip, 20 by XRD, and 30 from 6 selected wells by proteins and sugars extraction, quantification and metaproteomics studies.

Mineralogical and geochemical setting. XRD revealed a complex mineralogy dominated by quartz and phyllosilicates as well as gypsum in the deepest samples of some the holes. Ion chromatography showed a widespread and irregular presence of inorganic anions as sulfate, nitrate, phosphate, chloride or fluoride although with strong concentration gradients. Sulfate and nitrate dominated the deepest samples with concentrations of 20,000-30,000 ppm and 500-1,000 ppm, respectively, while the higher concentrations (40-100 ppm) of phosphate appeared in the upper and superficial samples. Similarly, small organic anions as acetate, formate, propionate were detected preferentially in the lower parts. The water content ranged from 0.17 to 4.45 % (w/w) being the wettest samples those between 10 and 20 cm deep.

A wealth of molecular and microbial markers. The LDChip immunosensor detected microbial markers in the field, particularly cyanobacteria and, after extensive assays in the laboratory, a variety of bacteria, archaea, and biopolymers (exopolysaccharides, peptides). Total proteins and sugars concentrations ranged from not detection up to 130 ppm and 38.9 ppm of proteins and sugars, respectively. Further, preliminary metaproteomic studies showed a relatively high number of peptides that can be associated to proteins and microorganisms as well as a variety of metabolic activities, among then those involved in stress resistance: heat, salt, UV radiation, or oxidative stress.

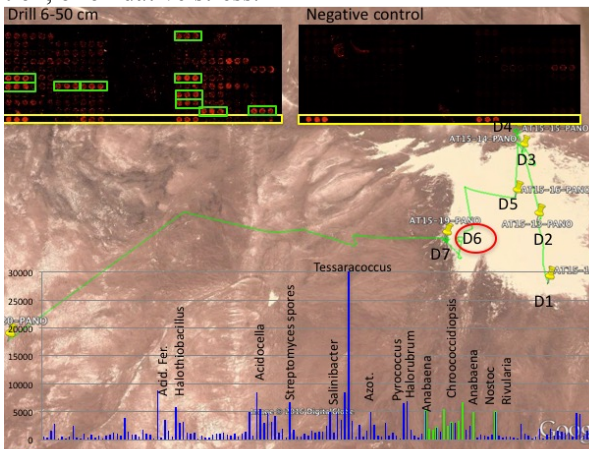

Figure 1. LDChip fluorescent images and immunogram (blue) showing immunoreactive material from diverse microbes over the map indicating one of the sampling locations and the sample analyzed (D6_50 cm deep). *Green bars*, antibodies to cyanobacteria strains.

Conclusion: By investigating the irregular distribution of the microbial communities and molecular biomarkers after flooding events would help to understand life in the Atacama and to search for target sites and molecular evidences of life in ancient lakes, ponds or river beds on Mars.

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