MICROORGANISMS AND ORGANIC CARBON DISTRIBUTION IN THE HYPER-ARID MARS-LIKE SOILS AND THEIR CORRELATION WITH THE OXIDANT ACTIVITY. J. E. Valdivia-Silva*[,1,2], F. Karouia[1,3] and C. P. McKay[1], [1]NASA Ames Research Center, Space Sciences & Astrobiology Division, Moffett Field, CA 94035, USA, [2]Biomedical Research Institute, Universidad Nacional Autónoma de Mexico, México D.F. 04510, [3]University of California San Francisco, Department of Pharmaceutical Chemistry, San Francisco, CA 94143, *(Corresponding author: jvaldivias@iibiomedicas.unam.mx)

Introduction: Mars-like environments on Earth provide an important tool to lead to a better understanding of the geological, geochemical, and microbiological processes that occur or could have occurred on the Red Planet. The analogs on Earth are geographic and chemically diverse, and they also illustrate preservation mechanisms that could guide the search for fossil and structural remnants of microbial life, which could be extrapolated to Mars.

The area known as Pampas de la Joya, located in the Atacama region in southern Peru between 15 °S and 17 °S, has been the focus of astrobiological interest owing to it exhibits hyper-arid soils with very low levels of organic carbon –even lower than those presented in Chilean region as well as the presence of a high oxidant activity under both of thermal or decomposition rate experiments [1, 2, 3]. A comparison between the type of microorganisms present in these soils and an analysis of the relationship between the biomass and levels of organic carbon could give us better answers about which are the limiting factors for life in areas with minimal amount of available water. For example, the apparent heterogeneity of the microbial spatial distribution within the hyper-arid core of the Atacama, ranging from near sterility to 10^7 CFU/g, prompted us to further investigate the relationship with organic carbon and possible explanations of this high variability in these soils.

In this work, we present the results of a multi-component investigation involving microbiological and geochemical analysis of soil samples collected in the hyper-arid soils from Pampa de la Joya, and along a latitudinal moisture gradient to the Pacific cost (form 0.5 mm to 120 mm/y rainfall) in order to evaluate: 1) the biomass distribution in the core of the hyper-arid region, 2) types of microorganisms, 3) their relationship with the organic carbon distribution, and finally 4) their relationship with the oxidizing processes which could be limiting the growth of microorganisms.

Results and remarks: Mars-like soil samples from the hyper-arid Peruvian region within the Pampas de La Joya were analyzed for total and labile organic carbon (TOC & LOC), phospholipid fatty acids analysis (PLFA), real time quantitative polymerase chain reaction (RTq-PCR), DAPI-fluorescent microscopy, and culturable bacteria. TOC content showed levels as similar as the labile pool of carbon corroborating the absence of recalcitrant carbon in these soils. The range of LOC was from 2 to 60 µg/g of soil. PLFA analysis indicated a maximum of 2.3 x 10^5 cell equivalents/g. Culturing of soil extracts on R2A and TSA media yielded 1.1 x 10^2–3.7 x 10^3 CFU/g. Real time quantitative polymerase chain reaction (RT-qPCR) showed between 1.0 x 10^2 and 8 x 10^3 cells/g; and DAPI fluorescent staining method indicated bacteria counts up to 5 x 10^4 cells/g. Arid and semiarid samples showed values between 10^7 and 10^{11} cells/g with all of methods used. Interestingly, the concentration of microorganisms in these soils did not show any correlation with the organic carbon content; however, presented a significant dependence on changes in the oxidant activity present in these soil samples evaluated as the capacity of decomposition of sodium formate (Figure 1).

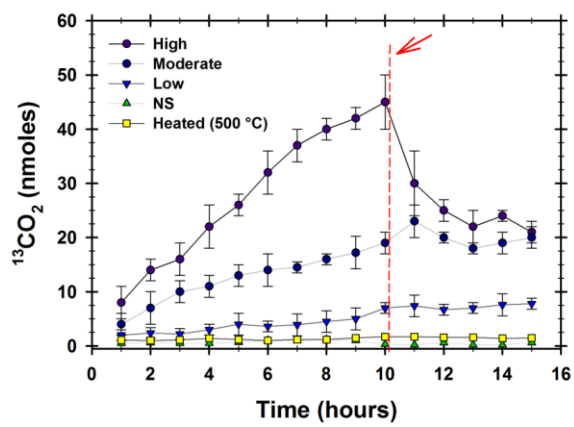

Figure 1: The decomposition of sodium formate in this soils showed a interesting high, moderate and low activity depending of type of soil. Interestingly, the high oxidant activity had a significant correlation with the lowest microorganisms concentration instead of organic carbon.

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