# Rock Varnish: Implications for Biosignatures on Mars

RICARDO MARTI-ARBONA[1], NINA L. LANZA[1], , MUNEHIRO TESHIMA[1], USHA F. LINGAPPA[2], WOODWARD W. FISCHER[2], CHRIS M.YEAGER [1*]

[1]Los Alamos National Laboratory, Los Alamos, New Mexico 87545, United States (correspondence: rm-a@lanl.gov)
[2]California Institute of Technology, Pasadena, California 91125, United States

On Earth, there is a close association between Mn deposits and the presence of Mn- and Fe-oxidizing microbes; as such, Mn can be considered a principal biosignature for Mars. The most common terrestrial Mn-rich surface material on Earth is desert varnish, a dark, shiny coating on rocks in arid locations. Microbes occupy crevices, pores and layers within rock varnish, t is probable that the concentration of Mn in many rock varnishes is mediated by microbial activity; however, the relationship between microbes and varnish remains a source of long-standing controversy. Here we report research aimed at 1) identifying and interpreting the microbial species and processes involved in the habitation and/or formation of rock varnish, and 2) identification of organic biosignatures that, in concert with trace element and mineralogy, can be used to conclusively distinguish the biogenic and abiogenic origins of terrestrial Mn-rich surfaces. Microbial communities inhabiting varnish were shaped by both location (larger contribution) and rock type. The varnish environment selects for a core group of UV- and desiccation-tolerant microorganisms, including bacterial (*Rubrobacteraceae*, *Xenococcaceae*, *Sporichthyaceae*, *Sphingomonadaceae*) and fungal (*Lecanoromycetes*, *Dothideomycetes*) taxa, across landscapes and rock types. Initial LC-MS analysis of 30 spots on the surface of a single varnished rock yielded 3,878 features and ~2,500 metabolites. Examples of metabolites linked to biological pathways that were identified on the surface of the rock include: a) glutathione disulfide, a key metabolite for desiccation resistance in fungi and bacteria, b) organic acids, which are key metal chelators and weathering agents produced by microbes, and c) a variety of amino acids.