Distribution of Raman biosignatures in salt nodules from the hyperarid core of the Atacama Desert

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Even in one of the driest places on Earth, the Atacama Desert, life has found adaptive strategies to decreasing amounts of water: from refuges inside or below rocks as endoliths or hypoliths to inside salts in hygroscopic niches [1]. In the hyperarid core though, one of the last refuges for life are inside salt crusts using deliquescence as a water source or in the subsurface waiting for transitory episodes of increased moisture [2]. These adaptive strategies might also apply to a putative Martian life which endured a transition from a water rich past to the very harsh surface conditions of the present and giving us clues on where to best look for traces of life on the Red Planet. Salt crusts and salt nodules are particularly interesting targets in this regard because they reside on or very near the surface and are thus easily accessible to future robotic missions. In the Atacama, salt nodules have been shown to host photosynthetic organisms containing easily identifiable pigments by Raman spectroscopy such as carotenoids or scytonemin. Mostly composed of halite, they are associated with polygonated soils, but their formation processes are still not fully understood. Salt nodules occur in varying morphologies which can control micro-environmental conditions and possibly microbial colonization (habitation of “micro-niches”). One of the most damaging factors for life and its remains, both in the Atacama and on Mars, is solar radiation. To investigate the distribution of potential Raman signatures in micro-niches we mapped/reconstructed the sampling areas using photogrammetry techniques and plotted the dose received according to the nodules’ orientation. We then analysed salt nodules sections using Raman mapping to infer any relations between the amount of light received and the presence of detectable signal. Raman instruments are indeed part of the next two rover missions to Mars: ESA/Roscosmos’s ExoMars2020 and NASA’s Mars2020. To support and interpret future spectroscopic data correctly, a better understanding of potential habitable environments and putative biosignatures, using analogue environments such as the Atacama Desert, is of paramount importance.

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