ASTROBIOLOGICAL *IN-SITU* INVESTIGATIONS AS PART OF A MARS SAMPLE RETURN MISSION. D. Schulze-Makuch[1] and A. Airo[1], [1]Center of Astronomy and Astrophysics, Technical University Berlin, Germany, email: schulze-makuch@tu-berlin.de

The Need for Including *In-Situ* Analysis: The focus of a Mars Sample Return (MSR) mission, as presently conceived, is a state-of-the-art analysis of Martian rocks, including the potential identification of fossilized Martian life. Hence, it is usually envisioned to collect sedimentary rocks that have been deposited under formerly aqueous, i.e. habitable, conditions, such as the deposits being investigated by the Curiosity rover at Gale Crater [1]. However, the most interesting collection sites for sample return are locations that are potentially habitable today or have been in the very recent past, such as sites showing putative hydrothermal activity [2], soils exhibiting Recurrent Slope Lineae [3], or areas close to lava tube caves or ice caves [4].

Irrespective of whether samples from presently or formerly habitable environments will be collected, it appears sensible to include in a MSR mission an *in-situ* component to make sure that active life is not overlooked. This is critical for two reasons. First, it would be a missed opportunity not to search for active life on Mars, considering that this would be the first time to do so since the Viking Landers in 1976 [5]. Secondly, not doing so could have serious planetary protection ramifications by bringing potentially active alien life back to Earth, which may endanger or interact with our own biosphere.

Martian life might be biochemically adapted to their environment in ways not known from Earth [6]. Even if not, if Martian organisms are at least as hardy as terrestrial desert dwellers there is reason for concern, since a recent study found soil microorganisms to be active in the driest core of the Atacama Desert after a rare rainfall event [7]. Although, no rain can fall from the Martian atmosphere today (8), liquid water near or at the surface could be present in the form of fog, nightly snow storms or ice microbursts, rising groundwater, and perhaps derive from structural water contained in minerals [7].

Proposal: Based on the above reasoning, we propose a MSR mission to include an *in-situ* analyses testing for the presence of active life, before sending the collected samples to Earth. Allegorically, such analysis could be done with a "tricorder"-type device, allowing to easily scan a sample for detecting life of any kind.

Previous studies on Martian analog environments on Earth, such as the high Canadian Arctic, have used three miniature low cost, low energy instruments to directly detect and characterize life forms in the field [9]. One of their life-detection methods employed a portable DNA sequencing device based on nanopore sequencing technology. However, despite the powerfulness of this tool on Earth, putative Martian organism might have such different biochemistry rendering this methodological approach as useless.

Thus, we are currently developing a device designed to detect the most general biosignatures, such as growth or metabolism, without needing to rely on a specific biochemistry for the analysis to work, as would be the case for sequencing technology. Sequencing would only be included for the purpose of ensuring that no forward contamination originating from Earth has occurred.

Testing samples on Mars for any signs of active life before returning them to Earth, would not only protect Earth from potentially detrimental contamination, but would also be valuable from a scientific viewpoint.

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