THE CASE FOR A ROBOTIC IN-SITU LIFE DETECTION MISSION TO EXPLORE POTENTIAL HABITATS ON MARS. Dirk Schulze-Makuch, Astrobiology Group, ZAA, Technical University Berlin, Hardenbergstr. 36, D-10623 Berlin, Germany, schulze-makuch@tu-berlin.de

In-Situ vs Sample Return Mission: There are several critical advantages for the launch of an *in-situ* robotic life detection mission rather than a sample return mission before human missions are launched to Mars, which might occur as early as the 2030s. These are: (1) once a sample is in a container, the environment changes and different results may be obtained, especially with highly sensitive samples, a lesson learned from the Viking mission [1,2]. A sample put in a box during long-term transport from Earth to Mars would further exacerbate the problem; (2) a sample return mission might have serious planetary protection consequences by potentially exposing Earth and its inhabitants to indigenous Martian life. A sample retrieving facility does not yet exist and even a sample analysis and biohazard test plan still needs to be developed for the arrival of extraterrestrial samples [3]; (3) the technology is now ready for a life detection mission to Mars. There does not exist any single method for unambiguously detecting either past or present life, but it can be done if multiple complimentary novel approaches are used [4]

Mission Priorities: The proposed *in-situ* life detection mission should be focused on exploring potential habitats/microhabitats near the surface of Mars. Examples of potential targets are:

(1) Recurrent Slope Lineae (RSL). Several types of RSL seem to exist and some of these are likely caused by surface water brines [5] Laboratory experiments showed that some microbes could possible thrive in such environments [6].

(2) Salt deposits such as existing in the Southern Highlands of Mars. In the most hyperarid regions of Earth microbes live within salt rocks (e.g., halite) using the hygroscopic properties of salts to have access to water from the atmosphere [7].

(3) Analog work in the hyperarid Atacama Desert showed that transient microbial habitats exist, particularly after access to water such as a rare precipitation event [8]. No rain falls on Mars today, but liquid water could be present near the surface in form of fog [9], near-surface groundwater, ice microbursts [10], and possibly from mineral dehydration reactions[8].

(4) Caves, particularly deep-reaching lava tube caves or ice caves are natural windows to the subsurface and might provide a possible habitat for putative Martian life [11].

Searching for Martian Life: The recent confirmation of organic compounds and methane on Mars [12,13] raised again the possibility of indigenous life being present on the Red Planet. Mars is a terrestrial planet and has been exposed to environmental conditions similar to Earth in the past [14], and is the most Earth-like planet in our Solar System. Life on Mars, if it exists, may have even shared a common origin with life on Earth [15]. Nevertheless, given the different types of stresses on today´s Mars, microbes might have evolved novel adaptations to the harsh Martian environment. Martian life might switch between dormant and vegetative stages of life as response to environmental conditions on time scales much larger than observed on Earth [16] or might make use of hydrogen peroxide´s (or perchlorates`) antifreeze and hygroscopic properties [17]. In its natural history Mars exhibited dramatic environmental shifts [18] and thus any surviving near-surface life would have to adapt to those shifts by natural selection. The power of natural selection and the adaptability of life is displayed in many awe-inspiring ways in the biota of Earth. It seems likely that putative Martian life would share many similarities with Earth life, but is expected to also utilize some different building blocks and processes of life that evolved to answer the challenging environmental conditions that do not exist on Earth.

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