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Introduction: The sustained dryness and high radiation conditions at Mars surface today impose significant challenges to possible biology. However, during times of high obliquity, surface and subsurface conditions would have been more amenable to microbial life if it was present. If that were the case, a record of extant or recent life may be preserved in near subsurface water ice. Further, subsurface water ice is a fundamental unexplored record of Mars that may shed light on near-surfaces processes that have influenced both surface and atmospheric conditions on regional to planetary scales over orbital cycles. We propose an astrobiology mission concept that aims for due diligence in the search for extant life on Mars and the context for which it might exist [1].

Importantly, available technologies support both access to subsurface ice and science payload elements for evaluating it as a possible abode for extant life. Since human exploration of Mars is expected within the next 20 years, it is time critical that the search for signatures of life occur within the next decade, before the surface is contaminated by the human microbiome, and sufficiently early enough to allow time for follow up missions should they be necessary. Ultimately, in situ robotic access to pristine subsurface ice would enable evaluation of its indigenous biological potential, support in situ resource utilization, and help define the science payloads for human exploration missions to Mars.

Drilling: Drilling requires knowledge of accessible ice at scales relevant to sampling (less than or equal to 1 m resolution) before drilling. Doing so, mitigates the risk of dry holes. Accessible-ice mapping might be accomplished by remote and/or in situ prospecting. Alternatively, the risk can be mitigated by targeting high latitude landing sites that are more likely to have near surface ice, like that encountered by the Phoenix lander. Further, robotic drilling is required in order to avoid inadvertent and high contamination risk to science imposed by a direct human presence [2]. An auger-type drill, such as the one on the ESA's 2020 ExoMars rover, would provide sample "bites" for science measurements.

Since the subsurface ice is expected to melt during drilling, the operation will create a "spacecraft-induced Special Region," which means the drill would need to meet planetary protection category IVc mission requirements. The science objective to search for life signatures in samples in situ would heighten the mission classification to category IVb. However, a high bioburden level (for alive, dead, spores, and degraded cells) and biomolecular contamination control will be required to maintain the science integrity.

Measurements would also be needed to confirm the distribution and nature (massive ice, ice cement, or mineral hydration) of subsurface water in drilled material. Doing so will help corroborate remote and in situ prospecting observations but also support modeling that may extend science insights into climatic and geohydrologic processes that influence habitability.

Science Requirements: The highest priority science goal would be to search for signs of extant or recent life, not to the exclusion of cryogenically, well-preserved ancient life (older than the last high obliquity). Since all measurements have to cope with noise and biosignature interpretations rely on assumptions, all detected biosignatures have a certain level of ambiguity. A positive detection of a sole possible-biosignature will not be enough to support a conclusion about life's presence. Thus a science strategy utilizing multiple and independent measurement types for context and biosignature interpretations is required to attempt to overcome these issues.

Other objectives would be to test for an Earth-like biochemistry, since its results could heavily sway future exploration, and to characterize the subsurface ice habitability potential or ecology. The latter would address general water qualities (oxidants, organic and inorganic solutes, pH, Eh and D/H ratios), bioavailable elements (CHNOPS, metals) and perhaps radioactive isotopic dating of materials and processes.

Samples for in situ measurements must target the most likely depth that was wet during high obliquity and has preserved life signatures since. This will likely be location dependent, but within the top 2 m [3-5].

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