

PLANETARY PROTECTION AS AN ENABLER IN THE EXPLORATION OF THE SOLAR SYSTEM.

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Introduction: Planetary protection is the discipline of preventing “harmful contamination” of extraterrestrial solar system bodies by terrestrial biology, and of similarly preventing uncontrolled release of returned extraterrestrial material into the Earth’s biosphere. Since the earliest days of the “Space Race”, scientists have considered that, for certain targets in the solar system, particularly those held as being; “of significant interest relative to the process of chemical evolution and/or the origin of life in the solar system”, or for which “scientific opinion provides a significant chance of contamination which could jeopardize a future biological experiment”, precautions need to be taken to avoid confusing a terrestrial biosignature for an extra-terrestrial one. An international consensus policy of how this should be achieved has been managed by the Committee on Space Research (COSPAR) since the early 1960s.

To date, only three solar system bodies have been identified as warranting such a high level of planetary protection concern; Mars, Europa and Enceladus. Planetary protection implementation for robotic explorers at Mars has focused on limiting the introduction and release of viable organisms into the martian environment to avoid such harmful contamination at the 99.99% probability level (per mission). For the other targets, landers have not been yet launched to them, and it has been sufficient to manage the contamination problem by avoiding impact of fly-by spacecraft.

Initially, when little is known about the habitability of a target body to support viable terrestrial biology (or its own extraterrestrial biology), the protection levels need to be the most conservative. But as knowledge of the target is increased, the potential exists to modify requirements without threatening the overall goal of avoiding harmful contamination of the target before the “period of biological exploration” is completed.

This paper will address what planetary protection will look like in the middle of the 21st century. By this time, it is anticipated that the first human crews will have visited (and returned samples from) the surface of Mars, but to only limited locations on the surface. Similarly, robotic explorers may have visited the surfaces of Europa and Enceladus in search for evidence of life there. So maybe planetary protection in this era is about lateral and vertical constraints on terrestrial biological contamination as the “period of biological exploration” (when the desire is for exploration of the

target body to be able to proceed unencumbered by terrestrial biological contamination) continues.

To maintain such a level of contamination avoidance during crewed exploration will however need a revision to the current planetary protection paradigm for Mars; the implementation will need to not only take account of the number of organisms introduced into the martian environment, but also what happens to them on their release. The technology increments and knowledge gaps that need to be addressed in the intervening period will be discussed. Additionally, topics relevant in this time frame to the return of extraterrestrial samples (and the spacecraft and crews that collected them) to the home planet will be addressed.

References:

- [1] Race, M.S, J.E.Johnson, J.A. Spry, B. Siegel, and C.A. Conley, (Editors), (2016) Planetary Protection Knowledge Gaps for Human Extraterrestrial Missions -Workshop Report, <<https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20160012793.pdf>>