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MARS SAMPLE RETURN BACKWARD CONTAMINATION - PLANETARY PROTECTION
RECOMMENDATIONS AND DESIGN GUIDELINES

Abstract

Potential Martian life is one of the key scientific issues supporting the development and implementation of a MSR mission. While the perspective of discovering forms of extra-terrestrial life is promising, it also leads to carefully considering the impact of bringing back alien entities to Earth with the risk of inadvertently releasing them in the biosphere. In its 2009 report Assessment of Planetary Protection Requirements for Mars Sample Return Missions the NRC-SSB acknowledges that even if probabilities of large-scale pathogenic or ecological effects are considered to be very low, they are also considered not to be nil. The report recommended that: "NASA should continue to maintain a strong and conservative program of planetary protection for Mars sample return. That is, samples returned from Mars by spacecraft should be contained and treated as though potentially hazardous until proven otherwise. No uncontained Martian materials, including spacecraft surfaces that have been exposed to the Martian environment,

should be returned to Earth unless sterilized.” Without any knowledge of potential Martian organisms, it is hardly possible to predict how these could behave and evolve in the terrestrial environment and thus, what the consequences of their release would be, if any. As this potential threat cannot be evaluated properly and confidently, a cautious approach has to be applied. Under contract for the ESA, the European Science Foundation set up an international interdisciplinary group of experts to “Recommend the level of assurance for the exclusion of an unintended release of a potential Mars life form into the Earth’s biosphere for a Mars Sample Return mission”. The starting point was a guideline expressed in the late 90’s specifying that: ‘the probability that a single unsterilised particle of 0.2 micron diameter or greater is released into the Earth environment shall be less than 10^{-6} ’. After considering the relevance of the approach adopted by this guideline, the Group reconsidered the two parameters it was based upon: the size and the probability of a release. The size parameter was reviewed in the light of the latest developments in microbiology, in particular considering that some free living microorganisms have been isolated after filtration through 0.1µm filters. Great attention has been paid to viruses and Gene Transfer Agents (GTAs). The maximum recommended probability of a release has been discussed and reconsidered using well defined benchmarks currently used by regulators and policy making bodies worldwide in the field of risk tolerability.