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PLANETARY PROTECTION AND MARTIAN ISRU

Abstract

In situ resource utilization (ISRU), the concept of "living off the land," is crucial for future space missions, especially to Mars. By utilizing Martian resources, ISRU can produce the inventory for long-term missions instead of carrying heavy resources from Earth. Multiple ideas for ISRU exist, with NASA highlighting their importance in its Design Reference Mission 5.0. Some proposed concepts include using atmospheric carbon dioxide to produce oxygen, ice beneath the surface for water or methane, or combining the produced methane and oxygen for rocket propellant.

However, human exploration beyond Earth and ISRU increases the risk of forward contamination on celestial bodies. This is especially hazardous on Mars given its significant astrobiological importance. In this regard, planetary protection policies are highly relevant in addressing the design and management of interplanetary missions to mitigate forward contamination i.e. introducing terrestrial life on other planetary bodies. Internationally, COSPAR has created legally non-binding planetary protection guidelines to aid compliance with avoiding harmful contamination of other planets stipulated by Article IX of the Outer Space Treaty. The question remains how space agencies will enforce planetary protection measures to the same standard for future Mars missions, particularly in context of the Artemis Accords which anticipates cooperative operations on celestial bodies.

This paper discusses Martian ISRU and outlines the potential limits created by implementing national and international guidelines as well as principles of customary international environmental law. In doing so, practical implications of ISRU operations are outlined, then existing binding international and national rules applicable to signatories of the Artemis Accords are analyzed for a grounded understanding of the relationship between ISRU and planetary protection. The remainder of this study will address legal

aspects of implementing planetary protection guidelines, followed by a discussion of remaining gaps to address in light of future Martian ISRU by public and private actors.