Challenges of Life Support/Medical Support for Human Missions (8)
Challenges of Life Support/Medical Support for Human Missions (2) (2)

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CROSS CONTAMINATION CHALLENGES IN HUMAN EXPLORATION OF PLANETARY BODIES

Abstract

As human exploration missions to Mars are on the horizon, microbial cross-contamination remains a key issue to address. These issues can be approached today using advances in molecular metagenomics methods, which include rapid and sensitive sequencing platforms for characterizing microbial populations. Combined with analog missions, these methods provide powerful tools for assessing the challenges associated with planetary exploration. Here, we designed a protocol to monitor forward and backward contamination events and progression in an 11-days Mars analog mission in the hyper arid Ramon crater in Israel. Forward contamination soil samples were collected daily from three sites – two sites in close proximity to the habitat and one isolated site. Backward contamination was determined in samples from nitrile gloves of six analog astronauts (AA), before and after extravehicular activities (EVAs). Temperature, relative humidity and soil composition data were also collected for all sites. Environmental DNA samples were extracted in the main habitat and 16S (bacterial) and 18S (eukaryotic, fungal) rRNA gene amplicons were sequenced and analyzed to study microbial population diversity and composition. Shannon diversity index analysis and Principal Coordinates analysis (PCoA) of rRNA genes indicated that differences in the diversity and population composition were significant in sites closer to the habitat when compared to a reference site. These samples also demonstrated the introduction of human-associated taxa to the environment. Backward contamination consisted of bacterial taxa found on the AA gloves upon return from EVA and were also detected in soil, altogether 44 genera, indicating backward contamination events. To our knowledge, this is the first protocol to utilize advanced molecular technologies to investigate forward and backward contamination in a Mars analog mission.