HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)
Human Mars Exploration (2)

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MARS AS THE NEXT DESTINATION FOR HUMAN SPACE EXPLORATION

Abstract

The human exploration of space is carried through for the key reasons of scientific discovery, resource extraction, and eventually commercial servicing. As the space industry evolves, it has become more apparent that our need for space exploration goes beyond robotic point design missions. Mars, as a major contender for the focus and effort of space colonization, offers many benefits to the overall spacecraft and mission design, allowing near-term missions which employ high technology readiness level designs. These benefits include trajectories with manageable Earth-Mars time durations; an atmosphere that can support propellant production from the Carbon-rich atmosphere and aero-assist Mars orbit injection; and natural resources such as minerals, ore and water speculated to exist within the layered geology of the Martian planet. Mars as a planet can provide the bare minimum level of mission support that current technology can reach within the next decade; chemical propulsion can be used to take spacecraft to Mars within six months, resulting in 1.5 year round trip mission durations. The major problem with employing a chemical propulsion system is the high fuel fraction required to support it. Utilizing Martian indigenous carbon with terrestrial hydrogen to produce methane and oxygen bi-propellant, the amount of propellant required to travel from Earth-to-Mars is vastly reduced, allowing the Earth departure vehicle to be successfully launched by any modern heavy-lift launch vehicle. The propellant production can also be used to fuel ground rovers for geological exploration. Current life support technology is able support these in-space demands, while being able to support humans on Martian soil by the oxygen and water byproducts from propellant production. Not only can the air be mined for geological resources, but so can the regolith. Materials such as clays, sulfites and ore are present to support Martian construction. Geothermal heat sources can sustain nuclear generators to provide energy sources for on-ground missions. By providing a test-bed that can support near term extended missions, Mars also piques ample scientific curiosity. The geology of Mars offers scientific background to better understand the formation of the Earth, the history of the solar system, and the origin of life. Initial missions, as shown, are able to employ relatively high TRL technologies, while future mission can utilize the repeatability of multiple missions as a platform to experiment and advance technology.