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HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)
Going Beyond the Earth-Moon System: Human Missions to Mars, Libration Points, and NEO's (4)

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AN INCREMENTAL SERIES OF HUMAN EXPLORATION MISSIONS FROM EARTH ORBIT TO THE MOONS OF MARS

Abstract

The Stepping Stones plan for human space exploration is a proposed series of incrementally more challenging exploration missions beginning with the ETF-1 Orion reentry test in 2014 and building incrementally towards the international goal of landing on Mars. Each mission must develop technologies and demonstrate capabilities which enable subsequent missions. At each step along the way astronauts will address key science objectives relating to the formation of the solar system and the origins of life. The Stepping Stones sequence proceeds incrementally from Earth-orbit tests to month-long missions to explore the lunar farside from the Earth-Moon L2 point. These demonstrate the capability of Orion to operate beyond the Van Allen belts and to reenter at the velocities needed for deep space missions. Teleoperation of rovers on the lunar surface from the L2 point enables exploration and sample return from the South Pole-Aitken basin – one of the oldest and deepest craters in the solar system. Next, a set of progressively more challenging Plymouth Rock missions to asteroids in the 2020s will develop the capabilities needed to operate in deep space for 6-9 months, and then durations of a year or more. These missions will return samples of primordial material dating back to the formation of planets, and also help us understand the threat posed by possible asteroid impacts. In the mid 2030's astronauts can take advantage of a rare opportunity to more easily visit the moons of Mars, when the lowest delta-V orbital opportunity is likely to coincide with the phase in the solar activity cycle that provides the most protection from harmful galactic cosmic rays. Using the capabilities for teleoperation from orbit developed during the lunar missions, and the ability to travel long distances through deep space and operate around small bodies developed during the asteroid missions, astronauts can remotely explore Mars from one of its moons. We have analyzed both Deimos and Phobos and conclude that Deimos is a superior location for an early Mars orbiting mission. Certain locations on Deimos have continuous sunlight for many months as well as continuous visibility to Mars. The "Red Rocks" mission to Deimos in 2033 would prepare the way for an eventual human landing on the red planet.