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HUMAN EXPLORATION ZONES ON MARS

Abstract

The next great step in human exploration of the solar system is landing astronauts on the surface of Mars. This mission will be a monumental endeavor, requiring years of preparation and integration of knowledge from many disciplines. One question of great importance is: where will we choose to land? The search for future human exploration zones (EZ) on Mars is now underway. Forty-six individual EZs were proposed at the "First Landings Site/Exploration Zone Workshop for Human Missions to the Surface of Mars" (2015). These areas were originally identified based on science, in-situ resource utilization, and engineering criteria essential to the success of current mission concepts.

An EZ is a collection of science and/or resource regions of interest (ROI) within a 100 km radius of a central habitation area. These ROIs together qualify an EZ based on the science and in-situ resource utilization objectives identified in the Exploration Zone Rubric. The objectives for science include: astrobiology, atmospheric science, and geoscience. The objectives for in-situ resource utilization include: water mining, civil engineering material, food production medium, and metal/silicon mining. Each objective category has its own list of threshold and qualifying criteria which will be presented in detail.

Two candidate human EZs are presented as case studies for understanding the overall selection process. The Protonilus Mensae EZ (Gallegos and Newsom, 2015) is located in the northern hemisphere, situated on the Martian planetary dichotomy boundary (48.548E, 41.905). It is a complex, fretted landscape of mesas and valleys carved by past surface water flow. Glacial landforms in the area (i.e. lobate debris aprons and lineated valley fill) offer a potential water resource. The Mesopotamia EZ (Gallegos and Newsom, 2015) is located in the southern hemisphere on the eastern rim of the giant Hellas impact basin (94.338E, -35.36). The EZ is dominated by Hesperian lava flows, important for science objectives. Vast fluvial channels stretching tens of kilometers across and nearly a kilometer deep, like Dao Vallis, demonstrate the past flow of water through this area as well as past potential habitability. Glacial landforms (i.e. massif-draped debris aprons) offer a potential water resource. Newly acquired high-resolution satellite imagery (HiRISE) of both EZs show distinct signs of glacial processes including intricate flow textures, erosion patters, and other geomorphic landforms.

Mission concepts have been presented by NASA; it is now the responsibility of geoscientists and project engineers to determine where we will take our first steps on Mars.