Development of Self-Sustaining Mars Colonies Utilizing the North Polar Cap and the Martian Atmosphere

Dr. James Powell
Plus Ultra Technologies, Inc.

A revolutionary new concept for the early establishment of robust, self-sustaining Martian colonies is proposed. The colonies, which would be located on the North Polar Cap of Mars, would utilize the readily available water ice and the Martian atmosphere to produce all of the propellants, fuel, air, water, plastics, food, and other supplies needed to sustain the colony. The colonists would live in thermally insulated large, comfortable habitats under the surface of the icecap, where they would be fully shielded from cosmic rays. The habitats and supplies would be produced by a compact, lightweight robotic unit termed ALPH (Atomic Liberation of Propellant and Habitat), which would land 2 years before the colonists arrived. Using a compact, lightweight nuclear reactor/steam turbine power source and small process units (e.g., H2O electrolyzer, H2 and O2 liquefiers, methanator, plastic polymerizer, food producer, etc.) ALPH would stockpile many hundreds of tons of supplies, plus insulated habitats, to be in place and ready for use when the colonists landed. With the stockpiled supplies, the colonists would construct and operate rovers and flyers, to extensively explore the surface of Mars, using the North Polar Cap as the base of operations. In terms of the benefits to the Martian Exploration and Development of Space (HEDS), the ALPH concept greatly reduces the amount of Earth supplied material needed to colonize and explore Mars and enables the establishment of large permanent colonies on Mars. It also greatly reduces the associated human and mission risks, as compared to previous proposals, and vastly increases the capability for colonization and exploration, not only of the surrounding Martian surface, but also the ice cap itself. The North Polar Cap is at the center of the vast ancient ocean that appears to have covered much of the Martian Northern Hemisphere. Small, self-heated ALPH-like units would travel deep (1 km or greater depth) inside the ice cap, collecting data on its internal structure, the composition of and properties of the ancient Martian atmosphere, and possible evidence of ancient life forms (microfossils, traces of DNA, etc.) that were deposited there either by wind transport or as remnants of an ancient ocean. Finally, propellant and supplies for Mars to Earth return journeys could be transported with relatively low DV requirements to Mars orbit, and from there, to be stockpiled back in Earth orbit. Such a supply route would enable faster and much lower cost journeys between Earth and Mars.

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