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Space Resources, the Enabler of the Earth-Moon Econosphere (5)

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LIVING AND WORKING SPACE: LUNAR ICE AND THE LIFE SUPPORT SPACE RESOURCES ECONOMY

Abstract

Supporting life in space is a challenge, even after 50 years of experience. While the human spaceflight community has mastered the art of supporting life for long duration missions in Low Earth Orbit (LEO), these missions still depend on consumable supplies from earth such as water, food, air, and energy needed to make a habitable environment. Technology has advanced significantly since the human spaceflight community has begun launching humans into space. As such, we've developed ways to recycle air and water with approximately 42 % and 90 % loop closure, respectively, on the International Space Station (ISS). That being said, resources via our "life tether" to earth are essential to ensuring human explorers can live and work in space indefinitely. Supply interruptions because of launch availability, cost, and system reliability are still significant challenges that our human spaceflight program struggles with. In-situ space resources will be needed for future deep-space human-rated spaceflight to ensure we can continue to provide the elements from our delicate biosphere on Earth that enable people to live and work off Earth. If we start living and working in space, economic grounding of this valuable resource will be required to determine if industry can provide water as a commodity for life support. This paper examines lunar ice applications for life support systems in space, drawing on technical, geologic, economic, and policy analyses. The end product of this paper takes the form of an economic analysis for a life support system architecture in which life support commodities are provided on the free market as a space resource for future explorers. The analysis will provide insight into whether an economy can be formed around the buy, sell, and trade of water for life support.