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LEVERAGING GEOLOGICAL SURVEY DATA FOR SUSTAINABLE LUNAR EXPLORATION: THE FUTURE OF IN-SITU RESOURCE UTILIZATION

Abstract

In-Situ Resource Utilization (ISRU) on the lunar surface is a vital component of future lunar exploration, offering a long-term solution of maintaining human presence and our scientific activities. ISRU refers to the use of local resources, reducing the need for expensive re-supplies from Earth. Geological survey data from previous lunar missions, such as NASA's Apollo program, the Lunar Reconnaissance Orbiter (LRO), and more recent missions like the indigenously developed, Chandrayaan-3 mission, have been critical in locating important resource reserves on the moon. These data provide key insights into the composition, distribution, and accessibility of lunar minerals, with precise exploration of resource-rich locations for future ISRU efforts in a sustainable manner. Studies based on such data have highlighted the potential of extracting water from permanently shadowed craters at the lunar poles, as well as the feasibility of mining lunar rocks for oxygen and metals. This comes with its own set of challenges of limited knowledge that we have of dark side of lunar surface, the harsh polar environment, etc. This paper leverages on the existing available geological survey record that has been collected by various previous lunar missions. An analysis of all the metadata of various publicly available data was conducted, with identification of potential resource sites, and potential technologies to extract it. It aims to provide a roadmap for ISRU application for reduced space mission cost and making the whole operation sustainable for the future settlement or manned space stations and making ISRU an indispensable tool in the arsenals of future space explorers