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Exploration of Near-Earth Asteroids (4)
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COMMERCIAL EXPLORATION OF M-TYPE ASTEROIDS : A REVIEW OF CHALLENGES, BENEFITS AND 21ST CENTURY TECHNOLOGIES FOR RESOURCE EXTRACTION

Abstract

Asteroid mining has been of great interest to both scientists and industrialists due to the abundant presence of precious resources and the opportunities for their commercialization. The extraction of these untapped resources have huge potential for profitability and can lead to accelerated economic development of humankind. The sample return mission of OSIRIS-REx from asteroid Bennu and the planned future missions of Mars Sample Return, VIPER have been assisting researchers to comprehend the origin of the solar system, the accessibility of resources and viability of the spacecrafts to perform resource extraction. With the increase in space exploration activities various private mining companies have assessed the profitability of asteroid mining and created good strategies for novel, crucial technology developments with the support of engineers and planetary scientists. Along with commercial aspects of space exploration which benefit socio-economic development of the community, asteroid exploration also includes identifying potential impact threats and investigate the effects of space weathering on asteroids. This paper specifically focuses on the study of M-Type asteroids and the various possibilities for its resource utilization. It is mainly targeted to M-Type asteroids due to the presence of highly utilizable minerals such as Nickel and Iron which hold high commercial value and can be utilized in the development of terrestrial infrastructure and space habitats. Despite the risks and challenges involved in mission planning and development of drilling technologies, various state of the art technologies including magnetic rakes, shaft mining, surface mining, heating process are currently in the analysis and testing phases. All the 21st century technologies for the resource extraction, utilization shall be evaluated considering the payload trade and selection studies. This paper discusses the scientific exploration techniques of the M-Type asteroids, extraction technologies, evaluation of current asteroid sample return missions, prospective of future missions for specific asteroids with current technologies and identifies its socio-economic benefits for human civilization.