

MINING TECHNOLOGY ON PHOBOS & DEIMOS. Ashish H. Mistry¹ and Sanjaykumar J. Vasadia^{2, 13-b}
 Deep Nagar Society, At: Po: Bardoli -394 601, Dist: Surat, State: Gujarat, Country: India. E-mail:
 ashu_aerospace@yahoo.co.in , ²c/o Hansaben Raj Dada Ni Khadki , Adas, Ta & Dist: Anand , State: Gujarat,
 Country: India. E-mail: sanjayj200@yahoo.com

Introduction: Resource utilization would play an important role in the establishment and support of a permanently Manned Base on any Planet, Scientific Knowledge & Future Exploration Preparation. Phobos and Deimos are the two satellites of Mars. Both are believed to be captured asteroids. We can consider them Asteroids of large size. Phobos is a dark body that appears to be composed of carbonaceous surface materials. It is similar to the C-type asteroids. Phobos' density is too low to be pure rock, however, and it is known to have significant porosity. These results led to the suggestion that Phobos might contain a substantial reservoir of ice. Phobos is covered with a layer of fine-grained regolith at least 100 metres thick; it is believed to have been created by impacts from other bodies.



Figure 1: Strip-mining equipment extracts raw materials from Moons of Mars. In the foreground, a mining cart transports the materials to a processing plant.

The possibility of mining Phobos & Deimos or their natural resources has been suggested for two reasons: (1) extracted minerals might be returned to Earth or Mars or (2) materials could be used to build space stations or used as fuel for exploration. Returning pieces to Earth will be expensive but beneficial. If returned to Mars, it is more likely that Phobos & Deimos mining would be used to support space exploration, i.e., space stations or even a Mars base. The most useful material for these applications would likely be water, extracted. Water would be used to make hydrogen and oxygen rocket propellants, and water and oxygen would be useful for life support in space habitats. Spacecraft would have to carry food and supplies for the mining crew and the equipment for the mine. Newly developed spacecraft should make landing on

Phobos & Deimos possible.

The machinery will likely be solar powered, to reduce the need for fuel that would have to be hauled to the Phobos & Deimos by spacecraft. The equipment will also have to be lightweight to transport it to the moons of Mars. Using robotic equipment to limit the personnel needed to carry out the mining project. This would reduce the amount of supplies, like food, required for a manned mission. Miners on moons of Mars would use techniques similar to those used on Earth. The most likely method would be to scrape desired material off and tunnel into veins of specific substances. Scraping, or strip mining, will pull out valuable ore that will float off the moons. Because much of the ore will fly off, a large canopy might be used to collect it. Phobos & Deimos have nearly no gravity, so the mining equipment, and the astronaut-miners who operate it, will have to use grapples to anchor themselves to the ground. However, the lack of gravity is an advantage in moving mined material around without having to use much power. Once a load of material is ready to be sent to either Earth or a space colony, rocket fuel for a ferrying spacecraft could be produced by breaking down water from the asteroid into hydrogen and oxygen. Thus Mining of Mars Moon Resources plays an important role in Future Mining Missions & Utilizations of resources of Mars & on other planets.

References:

- [1] Muff, T., Johnson, L., King, R., Duke, M.B., A Prototype Bucket Wheel Excavator for the Moon, Mars and Phobos, Proceedings of STAIF-2004. [2] JS Lewis, *Mining the Sky: Untold Riches from the Asteroids, Comets, and Planets*, Addison-Wesley, Reading, MA. 274 pp. (1996) [3] Amos, J.; *Martian Moon 'Could be Key Test'* [4] Hindustan Copper limited (Mines) [5] www.nasa.gov, www.howstuffworks.com, www.space.com.