SPACE MINERAL RESOURCE UTILIZATION. (G. Zhou[1], and A. A. Mardon[2], [1]The University of British Columbia (Department of Civil Engineering, Vancouver, British Columbia, Canada. Email: gordonz@interchange.ubc.ca), [2]Antarctic Institute of Canada (Post Office Box 1223, Station Main, Edmonton, Alberta, Canada. T5J 2M4. Email: aamardon@yahoo.ca).

Introduction: In 2004, the world's iron steel consumption exceeded 1 billion tons. [1] Spectroscopic studies suggest certain asteroids contain much needed material such as "nickel-iron metal, silicate minerals, semiconductor and platinum group metals, water, bituminous hydrocarbons, and trapped or frozen gases including carbon dioxide and ammonia." [2] Platinum metals found in asteroid have significant richer grades (up to 20 times richer) as compared to levels found on Earth. [3] As a starting point to "asteroid colonization", Near-Earth asteroids (NEA) orbiting Earth could potentially be the first locations to excavate asteroid mines. Like many space exploration missions, cost is a determining factor. Transportation alone imposes a cost of $10,000 per kilogram for the entire mission making it simply not profitable or attractive to potential investors. A potential near-instantaneous solution would be to develop an asteroid mining economy developing of a human-commercial market. It is suggested that this scenario will create the economical and technological opportunities not available today.

Missions of that caliber would require the use of native material and energy on celestial objects to support future human and robotic explorations. The process of collecting and processing usable native material is known as In-situ resource utilization (ISRU). Currently, space travelling require missions to carry life necessities such as air, food, water and habitable volume and shielding needed to sustain crew trips from Earth to interplanetary destinations. [4] ISRU is a concept to increase the efficiency of space missions by reducing the amount of material brought from Earth. This is a difficult obstacle and ISRU researchers are striving to greatly reduce expenses by proposing technologies that will enable missions to be self-sufficient. In addition, mission consumable production, surface construction, manufacturing and repair with in-situ resources and space utilities and power from space resources are technological areas that would significant advanced through advanced research in ISRU. [5] NASA currently has centers directly involved in the research of ISRU technology. The cost/benefit ratio of such a technology is still a widely debated topic amongst the academic community.

Conclusion: The horizon for this is not the current moment but resources are running out on Earth and companies and governments are looking at this. What needs to be done is a cost analysis of rare minerals that could be accessed eventually. Robotic surveys of the NEA would be the precursor to the development of in situ resources. Methods for comparing different asteroids based on trajectory and other criteria to maximize project economic feasibility needs to be further researched and explored.

References:

1. World Steel Association. (2005). *World Produces 1.05 Billion Tonnes of Steel in 2004*. Retrieved August 6, 2009, from http://www.worldsteel.org/?action=newsdetail&jaar=2005&id=120
2. 3. Sonter, M. (2006). Asteroid *Mining: Key to the Space Economy*. Retrieved on August 6, 2009 from http://www.space.com/adastra/060209_adastra_mining.html
4. 5. National Aeronautics and Space Administration. (2005). *In-Situ Resource Utilization (ISRU) Capability Roadmap Final Report*. Retrieved August 6, 2009, from http://www.lpi.usra.edu/lunar_resources/documents/ISRUFinalReportRev15_19_05%20_2_.pdf

Support of Research: This paper was supported by the Antarctic Institute of Canada.