



Space and Mining: An Odd Couple? ...Or a Match Made in Heaven?

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PTMSS

Montréal, May 11, 2015

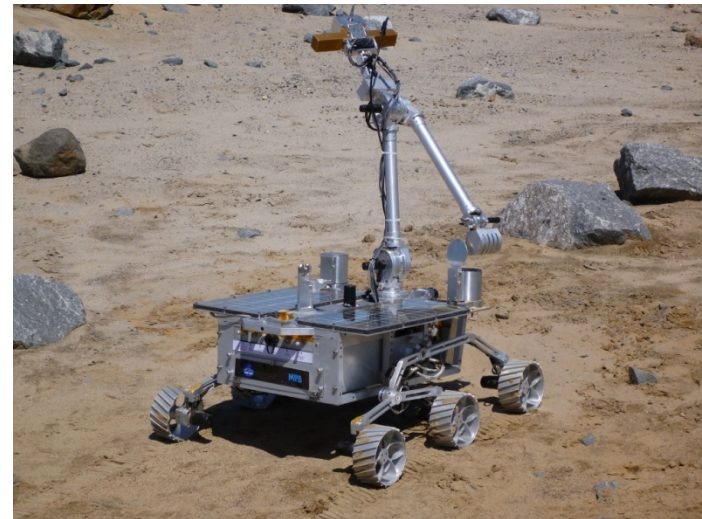
Seemingly Worlds Apart

Mining

- Profit-Oriented
- Designed to Survive Abuse
- Mass Produced
- Operate for 1000's Hours

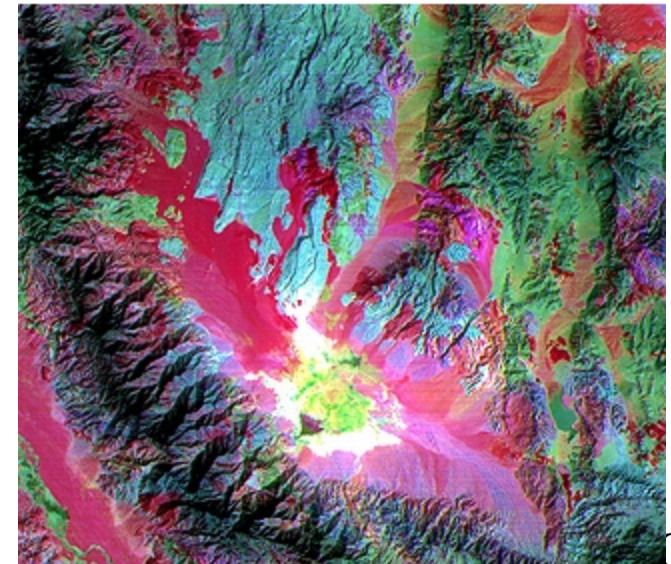
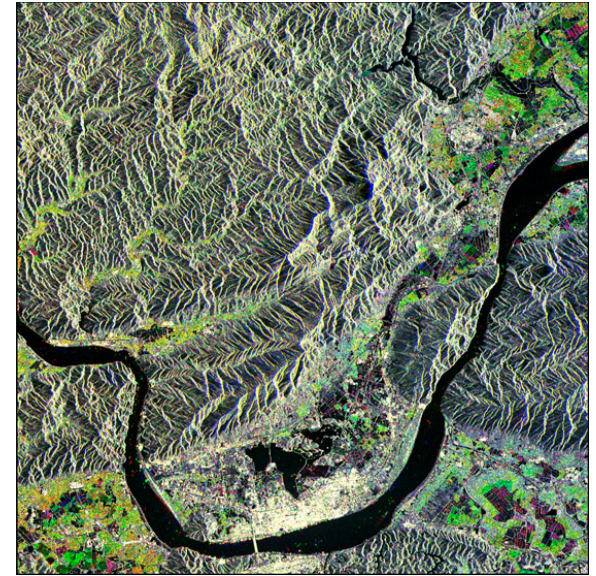
Space

- Service or Science-Oriented
- Mass-optimized
- One of a Kind
- Low Duty Cycle



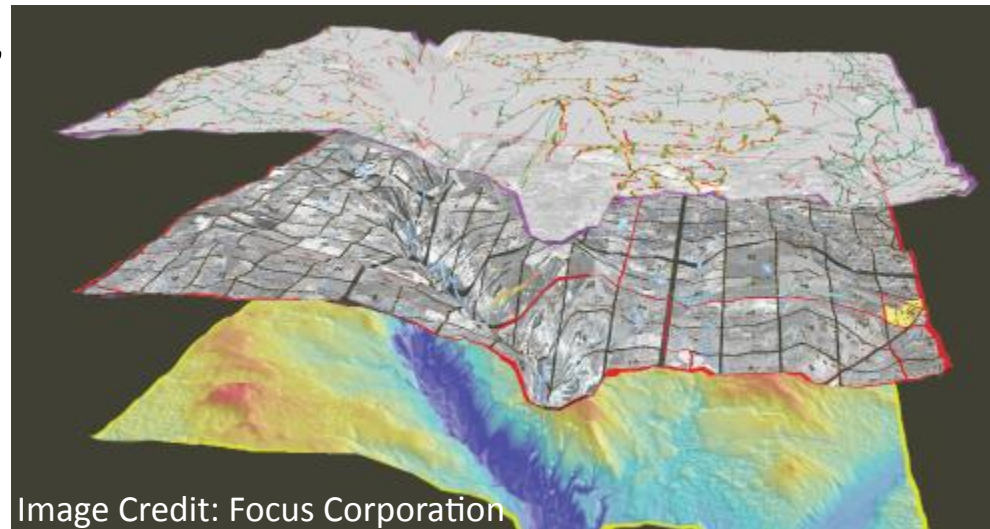
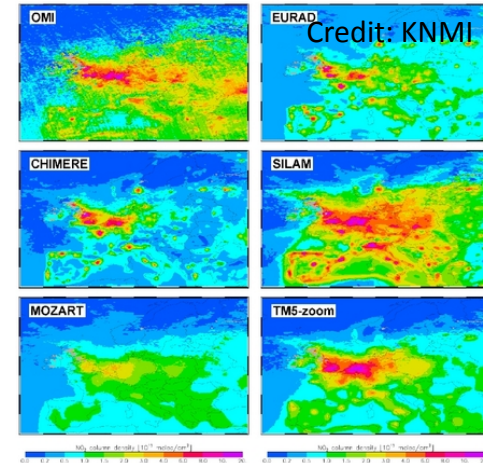
How Space Benefits Mining

- Earth Observation
 - Environmental Monitoring:
 - Satellite Imagery to Map Contaminated Sites
 - Hyperspectral Imaging of Mine Tailings



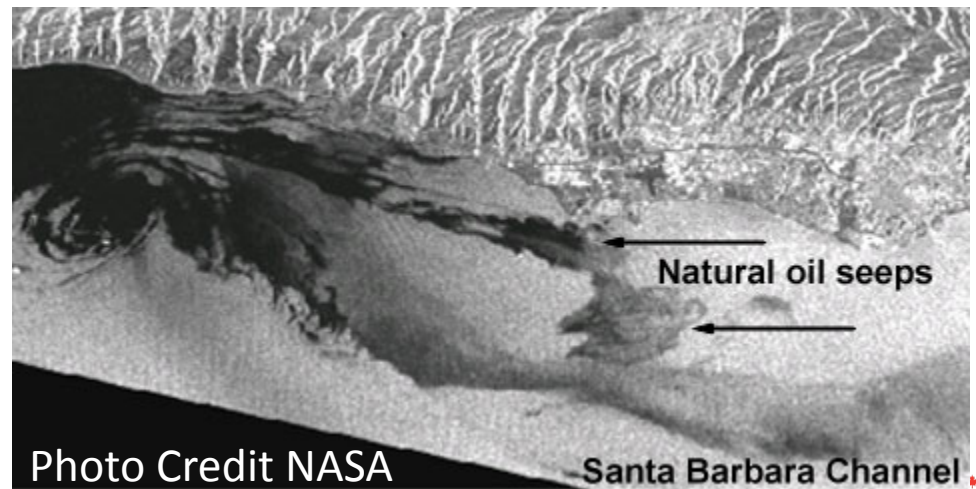
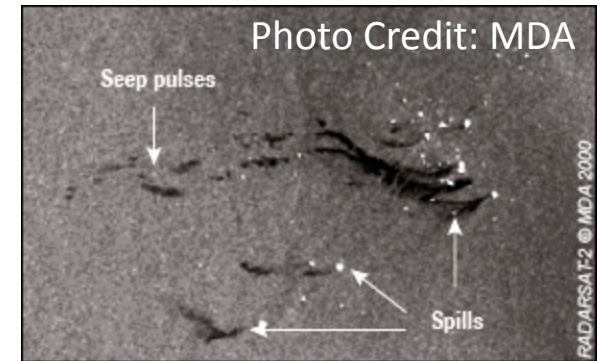
How Space Benefits Mining

- Earth Observation
 - Environmental Monitoring:
 - Measurement of Green House Gas
 - Cumulative environmental effects of oilsands development: landscape disturbance mapping, air pollutants, water color mapping



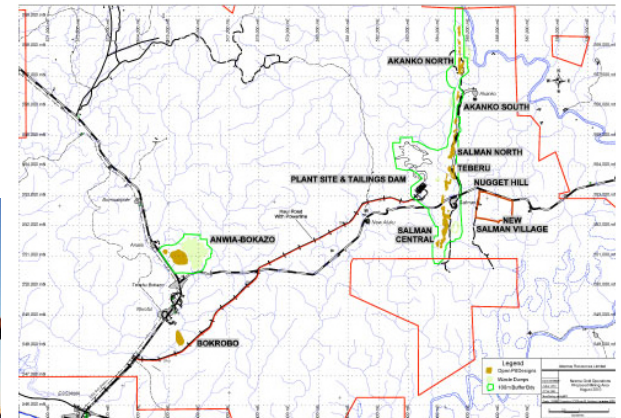
How Space Benefits Mining

- Earth Observation
 - Resource Mapping:
 - RADARSAT-1 and -2 for oil seeps detection (a way to identify energy reserves underneath the ocean floor).



How Space Benefits Mining

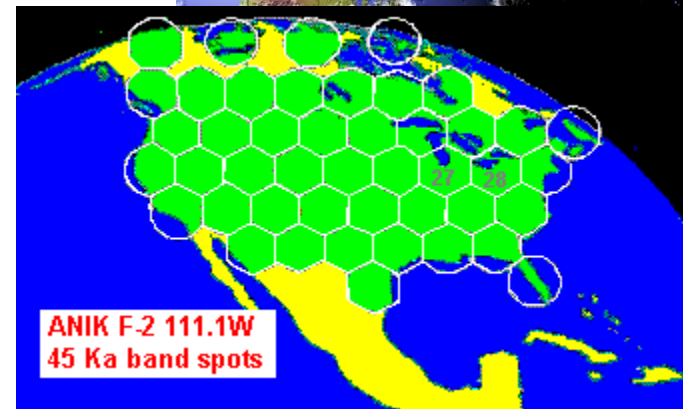
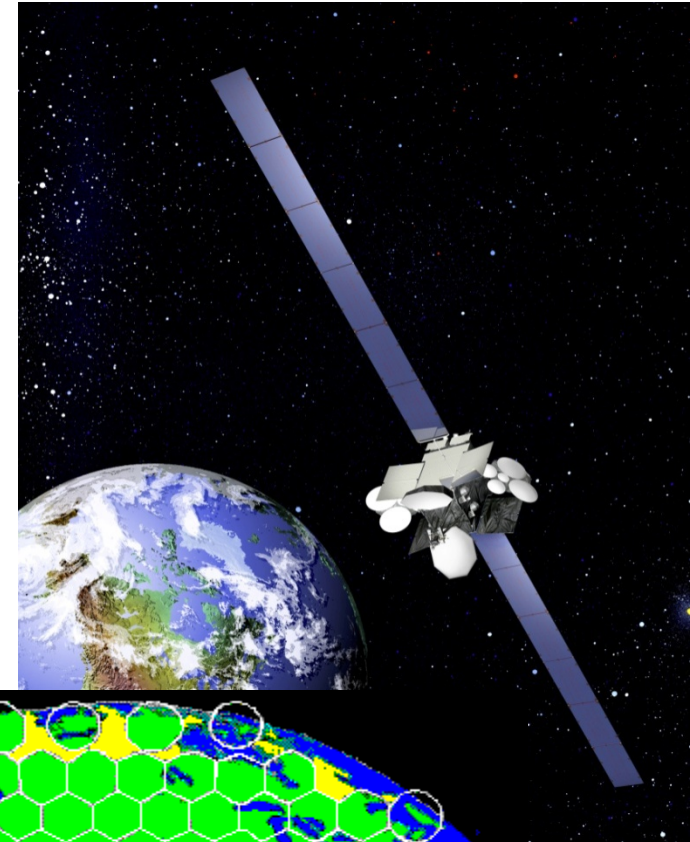
- Navigation
 - traffic, truck, train, and transit fleet management and control systems (positioning, satellite communications);
 - traveler information, navigation, and route guidance systems (positioning);





How Space Benefits Mining

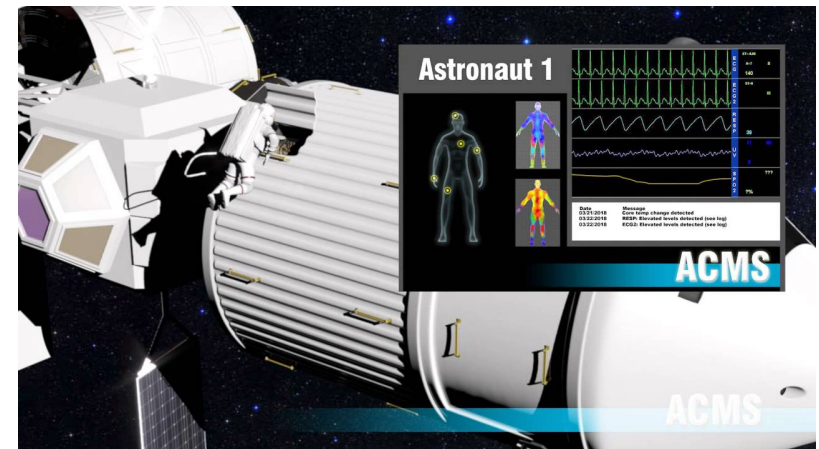
- Satellite Communications
 - Access to communications networks to remote communities.
 - Delivery of vital public services to ensure universal access to all Canadians





How Space Benefits Mining

- Satellite Communications
 - Telehealth/Telemedicine for Astronauts and Remote Communities



Spin-Offs from Space Into Mining

- Autonomous Vehicle Navigation
 - Terrain-Based Localisation
 - Navigation in Natural Terrain
 - Autonomous Vehicle Control
 - MacDonald Dettwiler & Associates



Photo Credit: Atlas Copco



Spin-Offs Into Mining

- Laser-Based Terrain Sensing
 - 360 Degree Scan
 - 200m – 3km Range
 - Robust to Lighting Conditions
 - Compact, Rugged
- Neptec Design Group

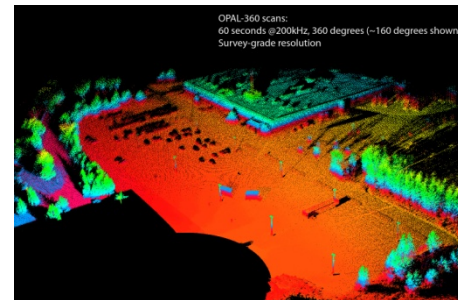


Photo Credit: Neptec

Spin-Ins from Mining

- Planetary Drilling
 - Diamond-bit Coring
 - Adapted for Space Environment
 - Dry Drilling
 - Deltion Innovations Ltd.



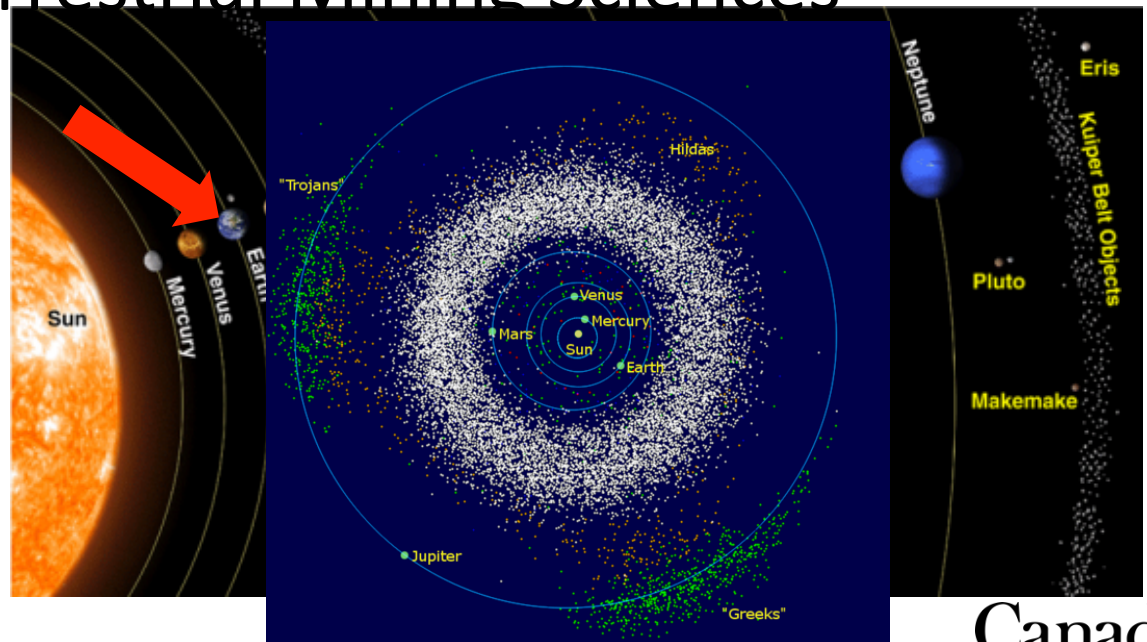
Spin-In & Off: ATV Market

- Planetary Rovers
 - Simple Suspension Design
 - All-electric Drive
 - High Payload to Mass
- Ontario Drive & Gear



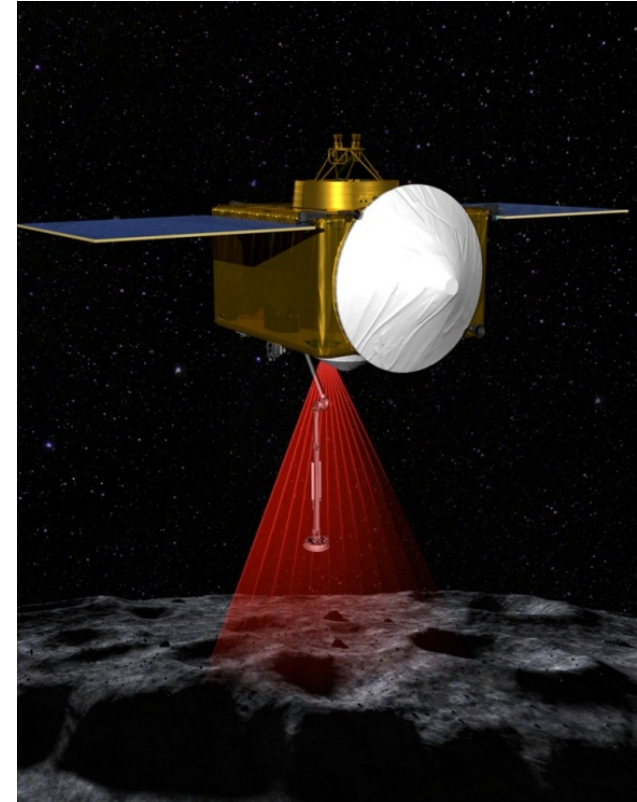
The Match Made in Heaven

- Exploitation of Resources in Space
 - Resources Extraction (Minerals, Volatiles)
 - In-Situ Resource Utilization vs Earth Return
- Planetary & Terrestrial Mining Sciences Symposium



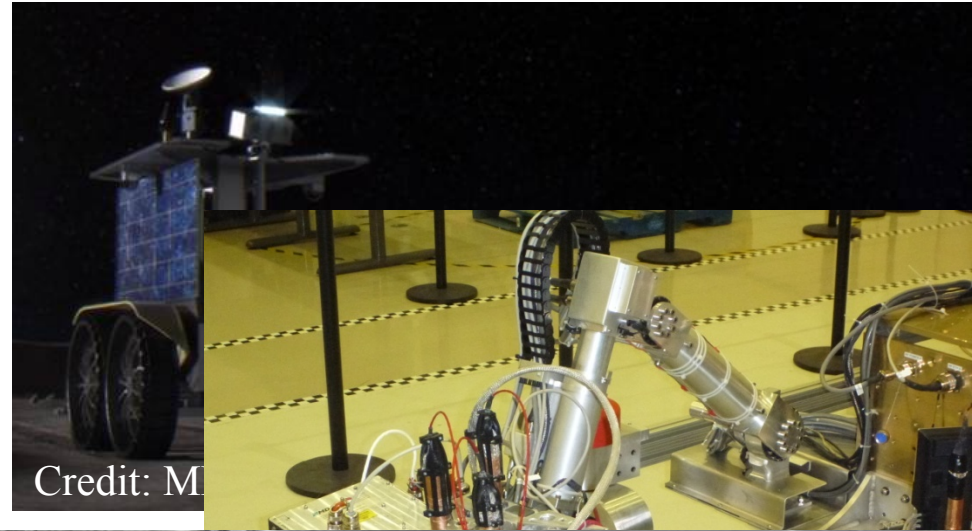
Resource Extraction in Space

- Osiris-Rex Laser Altimeter
 - Asteroid Sample Return Mission
 - Canadian Instrument Will Map Surface
 - Returned Samples Will Help Understand Nature and Composition of Asteroids



Resource Extraction in Space

- Concept Studies for Lunar ISRU Mission
- Prototypes for Planetary Missions (e.g. Coring Drill)
- Analogue Missions Conducted





Seemingly Worlds Apart?

- Only Time will Tell



Image Credit: Artur Zima