

Space Mining: why, what, where (and when)

M. Sonter, MSc(Hons), MAppSc, BSc, DipEd.

Principal, Asteroid Enterprises; Technical Director, Beyond Earth Resources; Brisbane, Qld.
email: mark.sonter@ber.com.au

Abstract:

Economic activities in space are now worth \$350B/yr, driven by environmental monitoring, asset tracking, surveillance, and communications. Commercialization of space tourism, space stations, and in-space manufacturing is imminent. Refuel of GEO satellites for stationkeeping is increasingly demanded.

There are plans for Moon and Mars bases, and for the mining of lunar polar craters for ice to provide an on-Moon source of rocket fuel. An expanding literature discusses the feasibility of solar power satellites, supplying electrical power from orbit, ideally constructed from asteroidal metal resources.

All of these activities are being catalyzed by the launch-cost reductions being pursued by SpaceX, from ca \$10,000 towards \$2,000/kg.

This all suggests a growing market over the next decade for commodities in orbit.

United Launch Alliance, the prime US Defence launch contractor, has called for at least 100 tonnes per annum of fuel delivered in orbit, from the Moon or Near-Earth asteroids, for its planned orbiting spacetugs, from 2023 onwards. This suggests the *total* market for fuel in orbit is probably ca \$5 Billion/yr, a figure 'in the ballpark' with specialty metal markets.

Studies by the author, and recent data from the Hayabusa and Osiris-Rex asteroid probes, demonstrate that it is now technically feasible to return resources from Near Earth Asteroids, of which there are now 20,000 known, 20% of which are intermittently more accessible than the Moon.

The application of the geological, mining, metallurgical, and management concepts and disciplines which apply in terrestrial mine project planning, and de-risking via Scoping, Pre-Feasibility, and Bankable Feasibility Studies, will drive the definition of robust asteroid resource projects.

The author has developed orebody models, and a quantification of Inferred Mineral Resource, applicable to asteroids, and has lead Conceptual and Scoping Studies to identify economic space-resources recovery projects, focussing on mining missions to selected Near Earth Asteroids.