

Cornucopia Mission: Going For the Low Hanging Fruit

By Robert L. Frantz and Michael Buet

KSI space philosophy suggests a pragmatic worldview using a wide-angle lens to observe the entire universe and its implications for humans on Earth. From our observations, we arrive at theories and one theory promoted by KSI suggests that Space can provide an abundance of wealth for the benefit of all humankind, as well as the answer to our over-population problems. Research clearly establishes that this wealth and the building blocks of a brand new Space civilization can be found on asteroids, moons, and planets in the form of valuable resources for Earth such as platinum, gold, and diamonds. Based upon hard data gathered from meteorites, which are the remains of asteroids that managed to reach Earth's surface, experts estimate that asteroid regolith composition should match or exceed the Moon's regolith contents in silicon, aluminum, calcium, iron, and magnesium oxides. According to their estimations, a 1 km diameter asteroid should contain more gold and platinum-group metals (PGMs) than have ever been mined on Earth.

The next question is: How do we operationalize this theory into reality? Moreover, we must also consider the vast implications associated with mankind's expansion into Space: The Earth population is currently increasing at a frightening geometric rate – world population as of September 6, 2013 at 10:30 am Eastern Time was 7,168,395,698¹ and counting, slated to top the 10 billion mark perhaps as early as 2025, but certainly by 2050. By all experts' accounts, we will have exceeded the Earth's fresh water and food production capabilities within that period, with unavoidable results: Wars, famine, and pandemic diseases.

This could cause the rapid, abrupt demise of our entire Western civilization, which in turn would wipe out all the accumulated scientific treasure-trove from which we now benefit. The current occupant of Newton's Chair at Cambridge, Stephen Hawking said: "I don't think the human race will survive the next thousand years, unless we spread into space. There are too many accidents that can befall life on a single planet. But I'm an optimist. We will reach out to the stars."² But our time is running out – We MUST open Space for mankind to expand into now, or suffer the consequences: In just a few years, if we don't act now, we could possibly lose the ability even to launch rockets to Space.

However, there is hope: We have the technology right now to go out and start the Space Gold Rush. Just like the '49ers, we can now go out there and harvest the endless riches of Space. We can use space-based resources to build space structures in space, designed only for space use, free of the exacting and very costly engineering requirements of rocket launches from deep within the Earth's gravity well. We can extract all we need to survive in space from the Moon, the asteroids, and Mars and we can do it right now, before it is too late. We have everything we need today to go out

¹ www.prb.org.

² http://refspace.com/quotes/Stephen_Hawking.

and harvest the endless supply of raw materials needed to build gigantic space habitats, which would have the capability of providing idyllic living conditions for millions of people, located at the multiple Lagrange points around the Earth and the solar system. All this will require a steady supply of large amounts of raw regolith.

There are three companies now actively pursuing realistic asteroid mining. One is Planetary Resources, whose objective appears to be to go survey first, then corral asteroids and move them to Moon orbit for further exploitation, using “tomorrow’s” technologies. They also appear to have an underlying goal of claiming asteroid ownership rights by simply landing their numerous inexpensive observation/survey cube-sats on as many NEAs as possible. We believe that this goal will receive serious international scrutiny and opposition in view of both the existing international treaty on space exploration and simple common sense.

The second company is Deep Space Industries, with similar plans to Planetary Resources to survey, then re-route and exploit entire asteroids in cis-lunar orbit or at Lagrange points, again using “tomorrow’s” technologies. However, neither has published their plan on how they plan to return the materials to Earth for processing.

Both these companies plan to re-route entire asteroids towards Earth into cis-lunar orbits or Lagrange points, and then send astronauts out there, something that has not been done in 50 years, and keep them there for extended periods of time. This will be exposing them fully to deadly cosmic radiation and solar flares.

Many experts also question the wisdom of aiming entire asteroids, however small, in the general direction of Earth.... We have witnessed just how much damage even a very small one can cause at Chelyabinsk – and that one did not even reach the ground.

The third company, started by the authors of this paper, is Kepler Energy & Space Engineering (KESE),³ which proposes a simpler, more direct and more cost-effective approach using current space-proven hardware and technology. KESE can start to launch the Cornucopia Mission now. Its mantra is “keep it simple”. KESE will be in a position to provide both PR and DSI companies with fully shielded spacecraft and space habitats that can be moved to cis-lunar orbit for their projects when they are ready to send their astronauts to cis-lunar orbit.

Over and beyond the very significant long-term payoffs to Investors implied in all the above asteroid and Moon/Mars mining and the enormous benefits to Earth in general, KESE aims to provide mankind with the only possible escape valve from the incoming overpopulation and resulting wars, famine, and pestilence, which would signify the end of Western civilization as we know it today. The KESE business model also includes a very significant immediate ROI component from the start of the hardware build on Earth all the way through the entire mission by offering and inviting the Internet public at large

³ www.kesellc.com.

to participate in this (literally) out-of-this-world project first-hand via exclusive mission access deals with service providers.

The KESE business model is based upon a thorough academic feasibility study vetted by renowned Space engineering authorities and academics, which clearly demonstrates that existing space-proven technologies are available right now for successfully flying to and from asteroids, using a very simple, very basic mining technique for the extraction of asteroid regolith. The ore will be brought back to LEO as a fine regolith powder contained in four relatively small return vehicles (RV), capable of carrying only ~10 tons/each, which would be incapable of causing any harm to Earth even in the worst case: If proper re-entry angle for LEO insertion is not achieved, the RV will either bounce off harmlessly into space or its thin outer casing will immediately disintegrate against the upper layers of the atmosphere and the fine asteroid powder within the disintegrating cylinder will just volatilize into a large puff of smoke.

Once the four separate return vehicles are in LEO, exploitation of the valuable resources that all asteroids possess can start inside the shield of Earth's magnetic field (the inner Van Allen belt), which protects astronauts from deadly cosmic radiation and solar flares. Performing all manned space operations in LEO, only 250 miles from Earth support, will be much easier and a lot safer than performing the same tasks in deep-space 240,000 miles (400,000 km) from Earth, fully exposed to deadly cosmic radiation and dangerous solar flares.

An example of what valuables can be extracted from asteroid regolith is platinum, a scarce resource on Earth, but plentiful on such bodies as asteroids and moons. Platinum, on the U.S. market, sells for about \$55,000 an ounce. It has been demonstrated by detailed meteorite studies that ~10% (or more...) of asteroid regolith can consist of platinum group metals (PGMs). Each ton of regolith returned to an orbiting workstation could produce up to 3 or 4 kg of platinum and gold. Over and beyond that, we now can use regolith powder directly "as-is" to 3D-print our shielding "bricks" in LEO, as was shown by experiments conducted at Washington State University.⁴

With the current paradigm shift towards the commercialization of space, NASA and conventional aerospace corporation engineers and scientists are now shifting from government-sponsored jobs to civilian jobs. New actors are also involved, such as very wealthy entrepreneurs who are using DBAs, MBAs, and CPAs to crunch out business plans that have demonstrated to their satisfaction the staggering potential for asteroid and moon mining to achieve fabulous returns on investment despite the high launch expenses and risks. Actually, when all else is computed in, these do not significantly differ from Earth-based long-term investment costs and risks, with significantly higher potential returns.

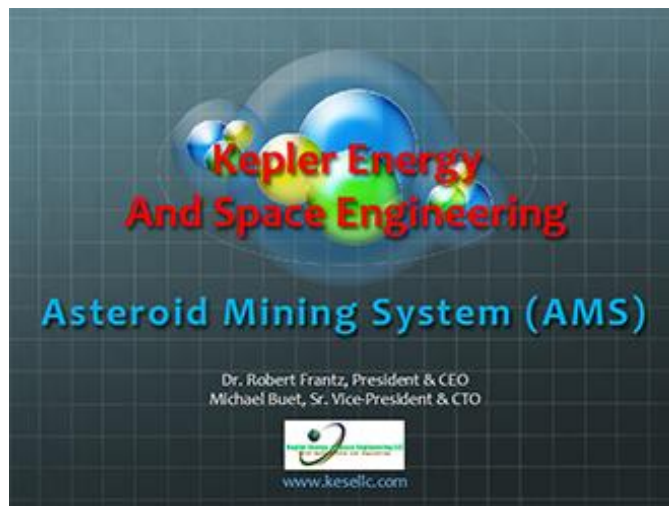
⁴ <http://www.space.com/18694-moon-dirt-3d-printing-lunar-base.html>.

Besides the academic feasibility study, KESE has produced a comprehensive business and marketing plan. A scaled prototype model of the Cornucopia Automated Mining System and of a complete model made from the KESE radiation-protection outer-shield elements of space habitats and spacecraft are being developed using a 3D printer.

Initial funding of \$1M is being sought by KESE to complete its planned-for proof of concept feasibility study by top scientists and experts, which will provide all Cornucopia Mission investors with the due diligence for funding the entire Project.⁵

Space is truly our “Final Frontier.” It can become our reality of tomorrow, for our children, and for our children’s children. Once started, this new Space civilization will not need to rely on Earth-based resources: On the contrary, it will be designed to be self-sufficient from the start, as well as providing Earth with a much-needed outlet for its population and it will supply all its own basic materials as well as returning as much of it as is needed down to the Earth’s surface. It can also start providing the world with as much free solar and H₃ fusion energy as it needs.

The few individuals savvy enough to invest early in this new Gold Rush will greatly benefit from a relatively low level of investment.



⁵ Available now to qualified Investors. Write to bob@kesellc.com or Michael@kesellc.com for information.



KESE's Keys to Success!

- Use KIS=Keep It Simple
- Go for Low Hanging Fruit
- Use Current Space-proven Technology and Hardware
- Provide Quickest Return On Investment to Investors



LOW HANGING FRUITS: AVAILABLE NOW

- Over 2,000 known Near Earth Objects within possible reach from Earth with our Automatic Asteroid Mining System
- Over 10,000 already mapped by JPL



Known Potentially Hazardous Asteroids Near Earth

The graph shows the cumulative number of known Potentially Hazardous Asteroids (PHAs) near Earth from 1998 to 2012. The x-axis represents the year, and the y-axis represents the number of PHAs. The data shows a steady increase over time, reaching approximately 10,000 by 2012. An inset graph shows a similar trend for the number of PHAs within 0.1 AU of Earth.



Use Current Technology and Hardware

- Simple "no-frills" with multiple Fail-Safe/Four Independent Return Vehicles
- Use current Commercial Launch Capability
- Use current proven Navigation and flight control hrdwr (DAWN/HYABUSA)
- Use simplest possible Mining Technique
- Use well-tested NASA Recovery System
- Easy PGMs/Metallics/Minerals Processing once back on Earth and/or in LEO



The slide includes three images: a satellite in orbit, a rocket launch, and a recovery system labeled HEART (High Earth Return Vehicle).

Keep It Simple! Keep it SAFE!!

- **Advantages of KESE over NASA, Planetary Resources and Deep Space Industries Projects:**
 - ✓ They Require Unproven, Underdeveloped Asteroid Capture & Moving Technology
 - ✓ Aiming an entire Asteroid in the Direction of Earth is a Risky Proposition...
 - ✓ All these Projects Expose Humans to Deadly Deep Space Cosmic Radiation Outside the Van Allen Belts. Equivalent to stepping INSIDE a nuclear reactor.
- KESE will be Ready to Provide Radiation-safe Support vehicles for Other Manned Projects Located Outside the Van Allen Belt/Cis-Lunar Orbits (~239,000 MILES FROM EARTH) for a Fee

All AMS Manned Operations are in LEO (~250 Miles), inside the FIRST Van Allen Belt, close to Earth

— Low Earth Orbit (LEO)
— Indicates the extent of Van Allen radiation belts
— 30.6% of distance to the Moon

EARTH – MOON DISTANCE: 238,900 MILES

Keep It Simple! Keep it SAFE!!


All AMS Manned Operations are in LEO (~250 Miles/400km), inside the FIRST Van Allen Belt, close to the Safety of Earth

2ND VAN ALLEN BELT


CIS-LUNAR ORBIT

Fast Return On Investment

- ◆ Faster than other upgrades with High Returns: **Why?**
- ✓ Use almost exclusively Space-proven Technologies and existing flight-proven hardware systems: Can build and launch NOW
- ✓ Straight-forward Flight Plan:
 - + Go there as fast as possible,
 - + Harvest ~40 tons of payloads as fast as possible
 - + Return payloads to LEO as fast as possible

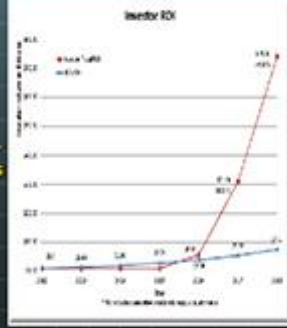


Gold at the End of the Rainbow?



Asteroid Regolith: Why needed?


- Regolith provides effective radiation and micro-meteorite shielding material for deep-space exploration space ships built in LEO.
- Asteroid Regolith contain estimated 10% or more PGM: On-board spectral and x-ray analysis can identify mineral rich asteroids
- A 1 km radius asteroid is estimated to contain more gold and PGMs than have ever been mined out of Earth since the beginning of time.





What Can we Do with Asteroid Regolith in LEO?

- Use the Asteroid Regolith "AS-IS" with a 3D Printer to manufacture Interlocking Cosmic Radiation Shield "Bricks" to manufacture the outer-shell for Space Habitats and Manned Deep-Space Spacecrafts
- Asteroid Regolith contain estimated 10% or more PGM: Extract PGMs and Metallics in LEO to use in manufacturing parts and components for the Space Habitats and Spacecrafts
- Finance LEO Operations by sending PGMs for ROI on Earth as needed



CURRENT PGM COMPONENTS MARKET VALUE (as of 8/20/2013)

Precious Group Metals Value (8/20/13)	Price/kg
RHODIUM (Rh)	\$38,259
PALLADIUM (Pd)	\$25,173
SILVER (Ag)	\$836
RHENIUM (Re)	\$11,250
OSMIUM (Os)	\$12,000
IRIDIUM (Ir)	\$25,720
PLATINUM (Pt)	\$50,765
GOLD (Au)	\$44,801



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Editors' Postscript: Space activity made an historic transition over the past fifteen years – from totally government programs to private industry. The change has profound, and permanent, positive impacts for the evolution of Space exploration, development, and human Space settlements. Asteroid mining has jumped to the top of the high-return-on-investment Space enterprises. The combined skills of Dr. Robert Frantz and Michael Buet have taken them from philosophy and theory to this specific proposal for capturing the known resources of asteroids for Earth needs. *Bob Krone and Gordon Arthur.*