### Contention-Mining

#### Even with the costs of mining, the economic benefits outweigh-  Private companies are key to jumpstart asteroid mining that will in turn initiate a space economy that spills over to tech innovation, planetary defense, and climate change.

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[Jack, "Space, the Final Frontier of Enterprise: Incentivizing Asteroid Mining Under a Revised International Framework, 40 Mich. J. Int'l L. 189, 2018, <https://repository.law.umich.edu/mjil/vol40/iss1/5>, accessed 6-24-21]

A casual Internet search for asteroid mining is likely to turn up **sky-high dollar value estimates of asteroids**. From Neil deGrasse Tyson saying that asteroid mining will make the first trillionaire,12 to a Goldman Sachs note stating that a single asteroid could contain **$25–$50 billion** worth of platinum relative to a $2.6 billion cost of an asteroid-grabbing spacecraft,13 to reports that NASA is sending a probe to an asteroid worth **$10,000 quadrillion**, the profit element of this enterprise is not lost on observers.14 However, these estimates depend on the extraction of metals like platinum, their return to Earth, and sale at the current market price, which, as the aforementioned Goldman Sachs note concedes, would “crater the global price of platinum . . . .”15

Instead of attempting to mine metals, the initial step in asteroid mining proposed by Planetary Resources, the most prominent asteroid mining company in existence today, is to **mine asteroids for water**.16 By making propellant available in space, asteroid mining “increases the payload capacity of rockets, enables the creation of a space highway with fuel depots located at various points of need throughout the Solar System, and allows spacecraft to **travel much farther**.”17 In other words, the business of asteroid mining, at least in its infancy, is not about harvesting valuable metals and returning them to Earth,18 but rather about **providing raw materials** to enable the **growth of the space economy**.

The impetus to provide in-space materials to the space economy is a matter of physics. Launching an object into space is expensive: SpaceX’s Falcon 9—with the capacity to carry just over 50,000 pounds of payload into low Earth orbit19—costs an estimated $36.7 million to launch and uses between $200,000 and $300,000 in fuel each trip.20 If asteroid mining companies were able to provide some of the **propellant in space**, that would **not only reduce fuel costs**, but would **reduce the overall launch weight**, **freeing up more space for payload**.21

In sum, should asteroid mining companies be able to provide fuel in space, it could **dramatically reduce the costs** of transporting rockets and cargo into space—both into **low Earth orbit** and to **more distant targets**, like Mars. Having this infrastructure in place could also **reduce the long-term costs** of the asteroid mining business itself, given that the business model involves launching objects into space. While a 2012 study estimated the total cost of an asteroid retrieval mission at $2.6 billion,22 a substantial reduction in launch costs would result in meaningful savings.23 This model of asteroid mining as a provider of in-space resources, then, can facilitate the growth of the space economy: future forays into space would have their costs greatly reduced by a “space highway with fuel depots.”24

B. Public and Private Actors in the Asteroid Mining Space

Both private companies and the space agencies of sovereign governments bear mentioning in a full discussion of asteroid mining. The role of the private sector in space has expanded substantially in the past decade, leading some commentators to suggest that the private sector has eclipsed the public sector in this arena.25 The asteroid mining industry, as detailed above, both depends upon and tends to facilitate this development. Sovereign space agencies, by contrast, conduct a waning share of activity in space and increasingly operate by way of public-private partnerships as an investor in the space economy.26 This marks an important shift from the factual backdrop of the original OST in that private, independent companies are increasingly taking the wheel.

As explored above, the asteroid mining business facilitates the **growth of the space economy** by reducing launch costs. However, the future of asteroid mining as a **lucrative industry** also depends upon the existence and growth of a **robust space economy**. The **symbiotic relationships** that could develop between private companies deserves emphasis. The viability of asteroid mining depends on a space economy to which asteroid mining companies can **sell fuel and metals**: the lack of a current market in asteroid resources should **resolve itself** “when the space population hits critical mass, demanding infrastructure.”27 For spaceflight companies,28 a crucial component to reduce costs is access to propellant in space.29

Sovereign governments continue to play a significant, albeit declining, role in the space economy. NASA’s share of the national budget decreased from 4.4% in 1966 to 0.5% in 2014.30 Its current strategy centers on partnership with the private space economy: “NASA helps mitigate financial risk, while the private sector conducts research and innovation more efficiently than NASA can . . . .”31 Similarly Luxembourg, which lacks its own space agency,32 opened a 200 million Euro fund in 2016 to bring asteroid mining companies to the country.33 Planetary Resources has availed itself of opportunities offered by both NASA and Luxembourg, performing contract work with the former and securing funding from the latter.34

While sovereign governments do hold some of the purse strings relevant to asteroid mining companies and the space economy as a whole, private companies are **increasingly displacing national space agencies**.35 A private space economy that is **increasingly independent from sovereign governments** tends to undermine the factual framework upon which the original OST relied.36 Specifically, Article VI assigns responsibility for nongovernmental entities to national governments, the implicit assumption likely being that private entities would be acting at the behest of a sovereign.37 This concern is increasingly unsubstantiated in an environment in which private, independent companies are ascendant.38

C. Global Benefits of Asteroid Mining

Asteroid mining has the potential to **facilitate space travel**, an outcome the OST holds to be in the interest of **humanity as a whole**.39 The potential of asteroid mining to **reduce the cost of spaceflight**, moreover, could **facilitate the growth of the space economy**. Asteroid mining thus aligns with another stated purposes of the OST in the sense that an expanded space economy could provide **substantial benefits to all mankind**.40 **First**, in seeking to face the challenges posed by space travel, the public sector space race gave rise to **numerous technological innovations**, ranging from LEDs to emergency blankets to memory foam.41 It seems likely that the private space race would result in a **similar degree of innovation**, the products of which could **benefit people across the globe**.

**Second**, a successful mission to Mars could provide benefits beyond a mere sense of interplanetary accomplishment. NASA suggests that, given the parallels between the formation and evolution of Mars and Earth, a voyage there could help “us learn more about our own planet’s history and future.”42 The scientific advancements from such a mission cannot currently be anticipated and are **difficult to predict**, but “expand[ing] the frontiers of knowledge” in this manner could well bring **benefits to all mankind**.43

**Third**, the development of asteroid mining technology could also help **advance asteroid diversion tactics**. The **development of the technology** required to conduct successful asteroid mining operations could “help us to divert any incoming asteroids.”44 This is of **great importance** since NASA recently eliminated its Asteroid Redirect Mission due to funding cuts;45 NASA’s project was hailed by some scientists as a “critical step in demonstrating we can protect our planet from a future asteroid impact . . . .”46 Asteroid mining could step in and **fill an important void**. While the probability of an Armageddon-causing impact is low, the effects of an **impact** would be **extremely severe**.47 Even **some mitigation** of this risk as a byproduct of asteroid mining would be a **benefit to humanity as a whole**.

**Finally**, reduced launch costs could facilitate measures to **combat global climate change**. One proposed solution for canceling out predicted increases in average worldwide temperature is to “prevent[] . . . about **1%** of incoming solar radiation—insolation—from reaching the Earth. This could be done by **scattering into space** from the vicinity of Earth an appropriately small fraction of total insolation.”48 Asteroid mining could facilitate such measures in that “[t]echnologies that could **greatly decrease the cost of space-launch** could make a telling difference in the practicality of all types of **spacedeployed scattering systems of scales** appropriate to insolation modulation.”49 There are certainly intermediate measures to combat climate change that ought to be taken first, but asteroid mining would **facilitate this expedited solution**. While some of the benefits of asteroid mining would doubtless accrue primarily to those nations with asteroid mining companies within their borders, the benefits noted in this section—space exploration as a **general proposition**, **technological and scientific development**, improvement of **asteroid diversion technology**, and facilitated means of **swiftly countering climate change**—would **inure substantially to the benefit of all mankind**.

#### Commercial asteroid mining is coming now – lower costs,  improving tech and energy from private sector make it viable – and the legal basis for private appropriation is already in place

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**Space exploration is back**. after decades of disappointment, a combination of better technology, falling costs and a rush of competitive energy from the private sector has put space travel **front and center**. indeed, many analysts (even some with their feet on the ground) believe that commercial developments in the space industry may be on the cusp of starting the largest resource rush in history: **mining on the Moon**, Mars and **asteroids**.

While this may sound fantastical, some baby steps toward the goal have already been taken. Last year, NASA awarded contracts to four companies to extract small amounts of lunar regolith by 2024, effectively **beginning the era of commercial space mining**. Whether this proves to be the dawn of a gigantic adjunct to mining on earth — and more immediately, a key to unlocking cost-effective space travel — will turn on the answers to a host of questions ranging from what resources can be efficiently.

As every fan of science fiction knows, the resources of the solar system appear **virtually unlimite**d compared to those on Earth. There are whole other planets, dozens of moons, thousands of massive asteroids and millions of small ones that doubtless contain humungous quantities of materials that are scarce and very valuable (back on Earth). Visionaries including Jeff Bezos imagine heavy industry moving to space and Earth becoming a residential area. However, as entrepreneurs look to harness the riches beyond the atmosphere, access to space resources remains tangled in the realities of economics and governance.

Start with the fact that space belongs to no country, complicating traditional methods of resource allocation, property rights and trade. With limited demand for materials in space itself and the need for huge amounts of energy to return materials to Earth, creating a viable industry will turn on major advances in technology, finance and business models.

That said, there’s no grass growing under potential pioneers’ feet. Potential economic, scientific and even security benefits underlie an emerging geopolitical competition to pursue space mining. The United States is rapidly emerging as a front-runner, in part due to its ambitious Artemis Program to lead a multinational consortium back to the Moon. But it is also a leader in **creating a legal infrastructure for mineral exploitation**. The United States has adopted the world’s first space resources law, recognizing the property rights of private companies and individuals to materials gathered in space.

However, the United States is hardly alone. Luxembourg and the United Arab Emirates (you read those right) are racing to codify space-resources laws of their own, hoping to attract investment to their entrepot nations with business-friendly legal frameworks. China reportedly views space-resource development as a national priority, part of a strategy to challenge U.S. economic and security primacy in space. Meanwhile, Russia, Japan, India and the European Space Agency all harbor space-mining ambitions of their own. Governing these emerging interests is an outdated treaty framework from the Cold War. Sooner rather than later, we’ll need new agreements to facilitate private investment and ensure international cooperation.

What’s Out There

Back up for a moment. For the record, space is already being heavily exploited, because space resources include non-material assets such as orbital locations and abundant sunlight that enable satellites to provide services to Earth. Indeed, satellite-based telecommunications and global positioning systems have become indispensable infrastructure underpinning the modern economy. Mining space for materials, of course, is another matter.

In the past several decades, planetary science has confirmed what has long been suspected: celestial bodies are potential sources for dozens of natural materials that, in the right time and place, are **incredibly valuable**. Of these, water may be the most attractive in the near-term, because — with assistance from solar energy or nuclear fission — H2O can be split into hydrogen and oxygen to make **rocket propellant**, facilitating in-space refueling. So-called “**rare earth” metals** are also **potential targets** of asteroid miners intending to service Earth markets. Consisting of 17 elements, including lanthanum, neodymium, and yttrium, these critical materials (most of which are today mined in China at great environmental cost) **are required for electronic**s. **And they loom as bottlenecks in making the transition from fossil fuels to renewables backed up by battery storage.**

#### Asteroid mining solves rare earth metal depletion – prevents tech stagnation and unsustainable resource extraction

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As electronics continue to become increasingly more important in everyday life, so is the ability to **produce electronic components**. With the supply of minerals on Earth having a finite size, some are worried that Earth will soon run out of critical resources such as **platinum and lithium**. What are asteroids, what are they composed of, and could they be the key to providing humanity with a near-infinite source of minerals?

What minerals are commonly needed for electronics?

Since the introduction of the first commercial circuits, electronics have become incredibly advanced with silicon dies having billions of active components, resistors the size of dust specks, and capacitors that can hold obscene amounts of charge for their size. However, many of these components rely on minerals that most will never have heard of for them to be able to work. Basic components such as resistors and capacitors use common materials including iron, carbon, and aluminium, but components such as LEDs, silicon dies, and thin-film displays use lanthanum, cerium, neodymium, and europium. While many of these minerals **fall under the “rare-earth” category**, that does not necessarily mean that they are rare; but many are.

Why are these minerals running out?

Minerals that are rare by nature are uncommon in the crust, and mass industrialisation is quickly using up remaining reserves of these minerals. However, it is important to understand what reserve means and how reserves are calculated. Let’s take Uranium as an example to understand this concept better; as things currently stand, there are 80 years of Uranium reserves left. Now, this does not mean that all the uranium will be used up globally in 80 years, this means that at the current price of Uranium, proven sources will continue to supply Uranium at a profitable rate for 80 years. When all reserves are used up, the price for that mineral increases, and this makes areas that used to be unprofitable more profitable, thus generating new reserves.

However, there is another aspect to resources that need to be considered; **environmental damage**. A good example to demonstrate this is Lithium. While Lithium is rather abundant in the crust, it is spread very wide, making most crust uneconomical to mine. If all cars on earth went electric, the proven reserves of Lithium would run out in 3 years. Of course, new reserves would be made available, and this would extend the ability to use Lithium in industrial practices. However, mining Lithium has a massive environmental impact and sees vast amounts of land destroyed and made toxic due to by-products in the extraction process. The same applies to many rare minerals; many tons of earth is needed to get even the smallest quantity.

What are asteroids, and what are they made of?

Asteroids are small cosmic bodies that orbit a star and can range in size, density, and composition. One of the largest asteroids in the Solar System, Vesta, has a diameter approximately 330 miles, while some of the smallest can be just two meters across. Asteroids mostly consist of rock as well as minerals, but their exact composition greatly varies. For example, M-type asteroids are those that mostly consist of nickel-iron, while C-type asteroids consist of clay and silicate rocks. Other minerals that are often found in asteroids include gold, cobalt, palladium, platinum, and osmium.

Could asteroid mining be the key to ensuring limitless supplies?

While asteroids themselves may contain trace amounts of rare minerals, their size and lack of an ecosystem **would allow for a mining operation to destroy an entire asteroid with no repercussions.** Asteroids are also plentiful in the Solar System, and would most likely **provide humanities resource needs for millions of years.** For perspective, the total weight of the asteroid belt is only 3% that of the moon, but that is still 2.39×1021 kilograms. Even then, that is only the asteroid belt and does not consider stray asteroids that orbit the sun, planets, and rings around Saturn / Jupiter.

#### Asteroid mining offsets terrestrial growth that ruins the environment and enables solar power satellites – both solve climate change

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The mission is essential, Joyce declares, to save Earth from its **major problems**. First of all, the fictional billionaire wheels in a fictional Nobel economist to demonstrate the actual truth that the entire global economy is sitting on a **mountain of debt**. It has to keep growing or it will **implode**, so we might as well take the majority of the **industrial growth off-world where it can’t do any more harm to the biosphere.**

Secondly, there’s the **climate change fix**. Suarez sees asteroid mining as the only way we’re going to build **solar power satellites.** Which, as you probably know, is a form of uninterrupted solar power collection that is theoretically more effective, inch for inch, than any solar panels on Earth at high noon, but operating 24/7. (In space, basically, **it’s always double high noon).**

The power collected is beamed back to large receptors on Earth with large, low-power microwaves, which researchers think will be harmless enough to let humans and animals pass through the beam. A space solar power array like the one China is said to be working on could reliably supply 2,000 gigawatts — or **over 1,000 times more power than the largest solar farm currently in existence.**

“We're looking at a 20-year window to **completely replace human civilization's power infrastructure,**” Suarez told me, citing the report of the Intergovernmental Panel on Climate Change on the coming catastrophe. Solar satellite technology “has existed since the 1970s. What we were missing is **millions of tons of construction materials** in orbit. **Asteroid mining can place it there.”**

The Earth-centric early 21st century can’t really wrap its brain around this, but the idea is not to bring all that building material and precious metals down into our gravity well. Far better to create a whole new commodities exchange in space. You mine the useful stuff of asteroids both near to Earth and far, thousands of them taking less energy to reach than the moon. That’s something else we’re still grasping, how relatively easy it is to ship stuff in zero-G environments.

### On Debris

#### 1. Nonunique nation satellites are launching as well. Warrant doesn’t have enough strength. 2200 satellites already 60 new starlink satellites will not exacerbate the problem. Furthermore we can restrict star link program or thinks like that. Satellite already in orbit

#### Coordinate launches once in orbit it will be fine.

#### 2. Robots solve

**Gao, 21** -- Reporter at Reuters

[Liangping, and Ryan Woo, "China launches robot prototype capable of catching space debris with net," Reuters, 4-27-21, https://www.reuters.com/lifestyle/science/china-launches-robot-prototype-capable-catching-space-debris-with-net-2021-04-27/, accessed 6-25-21]

BEIJING, April 27 (Reuters) - A Chinese space mining start-up launched into low Earth orbit on Tuesday a robot prototype that can **scoop up debris** left behind by other spacecraft with a big net. The NEO-01, which will also peer into deep space to observe small celestial bodies, was launched on the government's Long March 6 rocket along with a handful of satellites, state-run Xinhua news agency reported. The 30kg robot developed by Shenzhen-based Origin Space will pave the way for future technologies capable of **mining on asteroids**, according to the company. Since the establishment of the world's first asteroid mining company Planetary Resources in 2009, more than a dozen firms across the world have entered the fledging sector, including 3D Systems (DDD.N) of the United States and Japan's Astroscale. Unlike Astroscale's technology, which uses magnets to gather up space junk, NEO-01 will use a net to capture debris and then burn it with its electric propulsion system, according to a report on the company's website. Thousands of satellites have been launched globally. As they outlive their use, many end up as junk, posing danger to other operating satellites. Origin Space plans to launch dozens of space telescopes and more spacecraft to achieve the first **commercial mining of asteroids** by 2045, said the company's founder Su Meng in an interview with domestic media on April 6. Xinhua reported on Saturday that China was stepping up efforts to land a probe on a near-Earth asteroid to collect samples, and also expediting a plan to build a defence system against near-Earth asteroids.

#### 3. Normal means would have safeguards- those solve

**Fladeland, 19** -- Fellow at the Outer Space Institute

[Logan, Aaron C. Boley, Michael Byers, Meteoroid Stream Formation Due to the Extraction of Space Resources from Asteroids, Conference paper for the 1st International Orbital Debris Conference, December 2019, <https://arxiv.org/abs/1911.12840>, accessed 6-25-21]

Fortunately, it may be possible to establish simple measures that could mitigate some of these concerns, particularly the formation of debris streams with non-trivial mass fluxes. Examples include **establishing an international body** with the authority to grant **mining permits**, much like the International Seabed Authority established under the 1982 United Nations Convention on the Law of the Sea. In any scenario, safety and sustainability **requirements** should be part of the licensing regime. Some of these requirements could **limit mining rates** or require a company to produce a risk-to-Earth assessment plan. Some asteroids could even be **deemed untouchable** for safety or scientific reasons. As space law is redefined in the NewSpace era, it must be fully informed by the astrophysical context.

### On Rocket fuel emissions

ATAG. Org https://www.atag.org/facts-figures.html#:~:text=The%20global%20aviation%20industry%20produces,carbon%20dioxide%20(CO2)%20emissions.&text=Aviation%20is%20responsible%20for%2012,to%2074%25%20from%20road%20transport.

The global aviation industry produces **around 2.1% of all human-induced carbon dioxide (CO2) emissions**.

#### Water mining on moon and asteroids and improving tech solves. Establishing moon base reduces launch cost and rocket propellant’s damage on ozone.

Carter 19

(Senior journalist at Forbes. Experienced in science, tech and astronomy and space exploration. Editor of WhenIsTheNextEclipse.com) <https://www.forbes.com/sites/jamiecartereurope/2019/11/01/can-we-really-use-the-moons-billion-year-old-water-to-make-rocket-fuel-and-open-up-the-cosmos/?sh=4693974d4658>

The moon has water. That’s great news for a future moon-base, but it’s also often talked-up as a resource for creating rocket fuel. Last week NASA announced that it would send a mobile robot, the Volatiles Investigating Polar Exploration Rover (VIPER) to the South Pole of the Moon to find the exact location and concentration of water ice in the region. “The key to living on the Moon is water—the same as here on Earth,” said Daniel Andrews, project manager of the VIPER mission and director of engineering at NASA’s Ames Research Center in Silicon Valley. “Since the confirmation of lunar water-ice ten years ago, the question now is if the Moon could really contain the amount of resources we need to live off-world.” Another theory goes that if we can use the water on the moon—which is locked-up as ice, but we’ll worry about that later—to power spacecraft, they will be able to go way, way further into the cosmos and kick-start a new era of interstellar mining. Water on the Moon would make future Mars missions more affordable and could fuel commercial enterprises linking the Earth and the Moon. “Creating space fuel depots would allow spacecraft to travel much farther and allow missions and satellites to sustain operations,” says Karen Panetta, IEEE Fellow, Dean for Graduate Education, Tufts University. “Rather than transporting water into space in heavy loads on rockets, the goal is to extract it (mine it) from the moon and asteroids.” It would also mean rockets don’t have to expend a lot of fuel just to get the fuel for their entire up into space with them. Launch costs would plummet. Wait. Water into rocket fuel? Surely you cannot fuel a rocket with water; liquid-fuel rockets use liquid oxygen and either kerosene or liquid hydrogen. Ah … oxygen and hydrogen. So what’s the science behind making rocket fuel from moon-water and asteroid-ice? How do you make rocket fuel from water? “Water—h2o—consists of hydrogen and oxygen, which can be refined into high-efficiency fuel,” says Panetta. It’s all about water electrolysis, a technique that uses an electric current (in space, from solar panels) to break down compounds and convert them into something else. In this case, hydrogen fuel. “Electrolysis is one approach that has been used in space to separate h2o to provide oxygen supplies for manned space missions, which helped alleviate the need for high-pressure oxygen storage tanks,” she says. On the International Space Station astronauts use electrolysis to split oxygen from hydrogen in water. Why don’t we already make rocket fuel from water on Earth? We could, but water is a precious commodity on Earth. It’s also not economical, and in any case, we’re talking about pretty small amounts of fuel needed by spacecraft. “Propelling an object in zero gravity doesn’t need much fuel, so water offers a viable solution in space,” says Panetta. However, water molecules are already used in many launch systems, albeit in their cryogenic liquid state to increase their density. “Couple this with solar energy for reliable power and it opens up new avenues for not just space exploration, but also for autonomous mining operations,” says Panetta. Yup—autonomous mining is what the “water into rocket fuel” debate is really all about. The image shows the distribution of surface ice at the Moon's south pole (left) and north pole (right), detected by NASA's Moon Mineralogy Mapper instrument. Blue represents the ice locations, plotted over an image of the lunar surface, where the gray scale corresponds to surface temperature (darker representing colder areas and lighter shades indicating warmer zones). The ice is concentrated at the darkest and coldest locations, in the shadows of craters. This is the first time scientists have directly observed definitive evidence of water ice on the Moon's surface. The image shows the distribution of surface ice at the Moon's south pole (left) and north pole ... [+] NASA How water-ice at the moon’s South Pole will be ‘mined’ Get ready for autonomous robots on the moon. A lot of work will be needed on developing reliable autonomous mining techniques for docking, drilling, detecting and repairing equipment. “The robots will use artificial intelligence to gather information and communicate among each other what they learn, so each robot doesn’t have to relearn everything from scratch, but rather, just upgrade their knowledge and data models,” says Panetta. How old is the water-ice at the Moon’s South Pole? A new study published in the journal Icarus suggests that while a majority of those deposits are likely billions of years old, some may be much more recent. While most of the ice deposits are in patches on the floors of large craters formed about 3.1 billion years or longer ago, the researchers also found evidence for ice in smaller and relatively young craters. It’s argued that older ice could have been sourced from water-bearing comets and asteroids hitting the moon, while newer water-ice might come from bombardment from pea-sized micrometeorites. What about mining asteroids? The technology is likely to be perfected on the moon. “Landing and taking off again from an asteroid adds another dimension of challenges,” says Panetta. However, asteroids are a much more exciting prospect. “C-type asteroids contain potentially up to 20% water by mass and will be good targets for mining (and) M-type asteroids contain structural metals like iron, nickel and cobalt which can be used to build structures in space using 3D printing,” says Panetta. It would therefore be possible to fabricate spare parts on site from mined materials, allowing robots to repair each other and drilling equipment. As natural resources become depleted on Earth, successfully mining and transporting them back could become big business. Asteroid Ryugu from an altitude of 6km, which Japanese spacecraft Hayabusa2 has been exploring since June 2018. Asteroid Ryugu from an altitude of 6km, which Japanese spacecraft Hayabusa2 has been exploring since ... [+] JAXA, UNIVERSITY OF TOKYO, KOCHI UNIVERSITY, RIKKYO UNIVERSITY, NAGOYA UNIVERSITY, CHIBA INSTITUTE OF TECHNOLOGY, MEIJI UNIVERSITY, UNIVERSITY OF AIZU, AIST. Is any of this going to happen soon? That depends on technology. “The combination of solar energy, artificial intelligence, robotics and materials science are truly responsible for enabling mining in space to become a reality,” says Panetta. “Don’t be surprised if the first successful mining operation on the moon is announced within the next five years.”