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Space Resources and Emerging Export Control Compliance Issues

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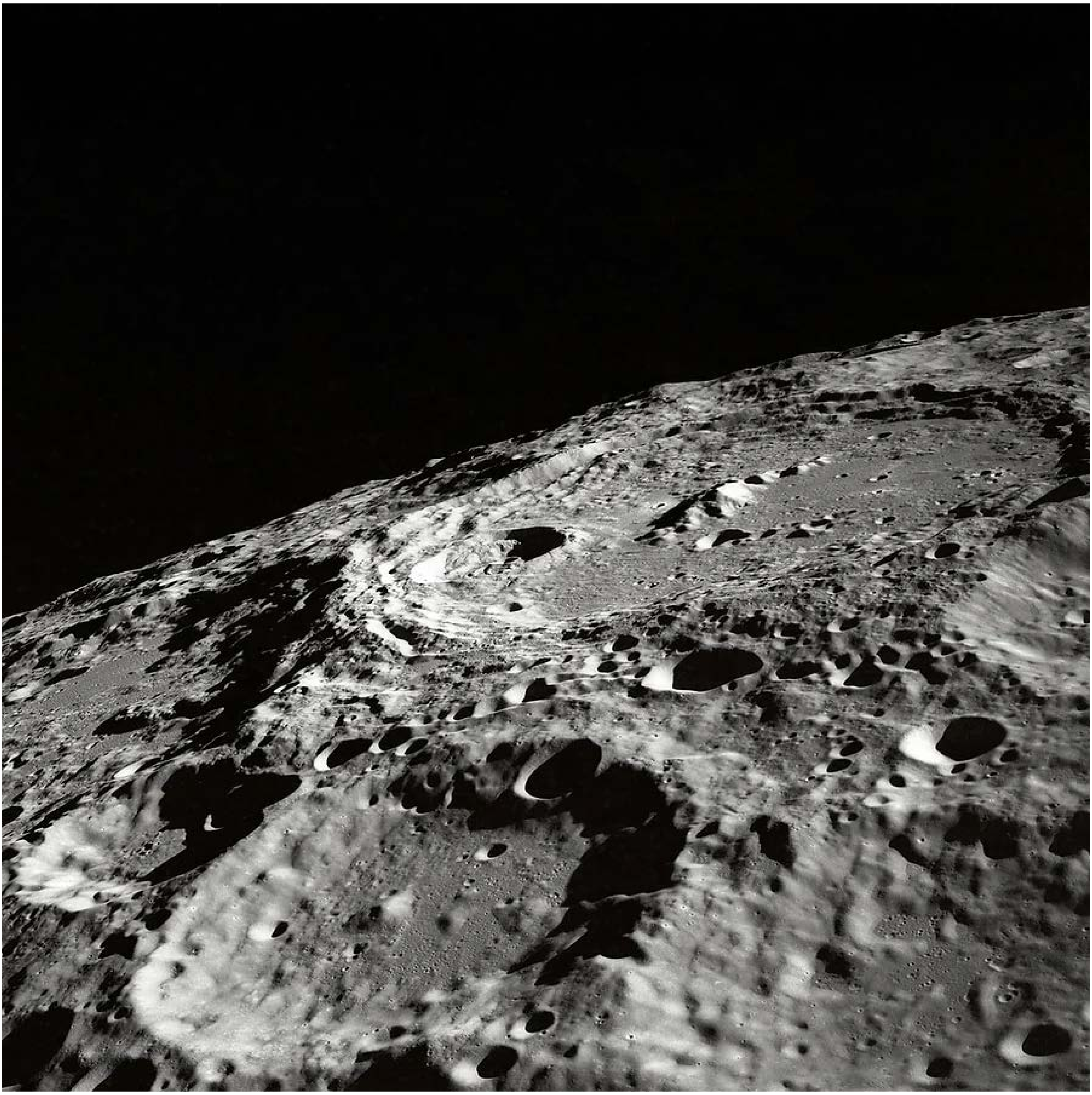
In 2022, many countries and private actors plan to launch spacecraft to the Moon. The US will launch its NASA Artemis 1 mission (including the maiden flight of its Space Launch System (SLS), an uncrewed Orion capsule and ten CubeSats) to the Moon no earlier than March[i]; and US startups will begin commercial lunar lander and rover missions under NASA's Commercial Lunar Payload Services (CLPS) program (including one mission by Astrobotic Technology and two by Intuitive Machines)[ii]. Russia will return to the lunar surface with its revived Roscosmos Luna 25 mission (part of a long series of Luna-Glob missions conducted in the early space race). India's ISRO plans to make another attempt to land its third Chandrayaan mission on the lunar surface in 2022. South Korea's KARA will launch the Korea Pathfinder Lunar Orbiter (KPLO) mission to the Moon, and Japan's JAXA will launch its Smart Lander for Investigating Moon (SLIM) lunar lander mission.[iii] This is just the start of a larger number of planned lunar missions and a growing presence of government and private actors operating in the lunar environment in this decade and onward.



This growing interest in the Moon by government space actors (US, China, Luxembourg, and other major actors), startups and other stakeholders is fueling a new race to develop capabilities to land, to operate, and to put in place a sustainable infrastructure on the Moon using local materials, through in-situ resource utilization (ISRU). Like with the International Space Station (ISS), and other large joint space initiatives, this new paradigm will require these stakeholders to develop common rules of the road to remain in line with existing space law, maintain cooperation, and create the right framework conditions for the companies developing these new capabilities. Those framework conditions will include remaining compliant with overarching export control regimes of countries.

The rules of the road are still in development when it comes to how governments and industry treat the space domain. Existing international space law provides a baseline in ensuring that space is used for peaceful purposes; but as technological capabilities advance, gaps have emerged in areas that once appeared self-evident, such as with utilization and commercialization of space resources. Luxembourg and the US have taken steps to fill in such gaps with their own national laws addressing space resources, and these examples add to debates in multilateral forums such as the UN COPUOS; however, the road to a consensus in COPUOS is very long.

While governments and other stakeholders painstakingly work toward developing a collective understanding in the use of space resources and how they fit within the existing international and national space regulatory frameworks, some common rules of the road in export control already attach to activities and products in the space domain, and they may become even more applicable as the lunar dust settles. As stakeholders work toward developing an infrastructure on the Moon and build their knowledge of how to utilize local resources in the harsh lunar environment, their activities will still conform to applicable export control regimes.

Suppose a startup wanted to obtain a sample of lunar material to develop a technical capability. On Earth, one way to obtain lunar resources (albeit temporarily) is by asking NASA for a lunar sample. NASA must comply with the requirements in the US ITAR and EAR export control regime, and its export process is outlined in its Export Control Program Operations Manual[iv]; this manual also provides guidance on when exceptions for fundamental research and public domain goods apply. In the case of obtaining lunar samples, a request must be made to NASA's Lunar Sample Curator who will determine whether a unilateral action can be taken or an outside scientific review by the Allocation Analysis Review Board (AARB) is required. If the request is approved, samples under 10 grams are sent internationally by US diplomatic pouch mail to the US embassy nearest the requestor's location, while quantities above 10 grams are hand-carried by the investigator or their representative.[v] That sample must also be returned to the Curator by hand or through mail services outlined in NASA's website after use. So far, this makes sense since the Apollo missions brought back only 382 kg of samples between 1969 and 1972, and there isn't much to go around.

Perhaps an alternative method to obtain a sample of lunar material to develop a technical capability might be by using meteorites which land on Earth. It should be noted that while some meteorites have landed on Earth from asteroid impacts on the Moon and Mars, finding a lunar meteorite is extremely unlikely; yes, small quantities can be purchased for scientific and education purposes[vi] – but in this context, let's just consider all meteorites by analogy. The ownership of meteorites is possible in some common-law countries, including the US and Canada; collectors in those parts can thank an ancient principle of Roman law that was applied in England and Wales for many centuries, known as the *Ad Coelum Doctrine*. In quick summary, this property law principle states that property holders have rights to not only to the plot of land itself, but also the air above and the ground below, including minerals. So, if a meteorite lands on private property in the US, the owner of that property may claim ownership. Moreover, in the US if a meteorite falls on public land, the Bureau of Land Management (BLM) within the US Department of the Interior outlines the rules regarding casually collecting meteorites located on public lands; specifying that the total mass of meteorites collected be less than 4.5 kg per year and not sold commercially[vii]. The BLM also outlines two other situations where meteorites can be solicited, i.e. by scientific and educational institutions for research purposes, and by commercial companies which are issued a land use permit and aim to sell the meteorites commercially. However, many countries have not adopted this "finders-keepers" approach, and meteorites there might have to be forfeited to the public institutions with or without compensation.

In this hypothetical, the easiest way for a startup to obtain a sample of lunar material to develop a technical capability is by using lunar regolith simulant. Lunar regolith simulant is a terrestrial material synthesized to approximate the chemical composition, and mechanical or engineering properties of real lunar regolith. Initial simulants JSC-1 and MLS-1 approximate the chemical composition, minerology, particle size distribution, and engineering properties of different areas on the lunar surface; i.e. JSC-1 approximates the properties of lunar mare soil and contains a high percentage of glass-rich basaltic ash, while MLS-1 is derived from a high-titanium basalt hornfels which approximates the chemical composition of Apollo 11 soil[viii]. Today, regolith simulant can be sourced from private companies like Exolith and The Martian Garden; and it is exported much like other commodities within the World Customs Organization's "Harmonized Commodity and Coding System". For instance, the HS-code/CN-number for Mojave Mars Simulant (MMS) is listed as 2505 1050, since it is most similar to "sand" in the "Harmonized Tariff Schedule" (HTS-code).[ix] Under the TARIC system, 2505 10 is described as: "*Natural sands of all kinds, whether or not coloured, other than metal bearing sands of Chapter 26: - Silica sands and quartz sands*". Other simulants will also be classified based on their composition and similarity to items referenced in the HS-code.

Whichever the approach that is taken by the startup, the technology that it develops will likely be subject to restrictions if it tries to export it to another country. As we move beyond 2022, and lunar missions ramp up in pace, we are likely to see the creation of new technologies, processes, and types of products developed specifically for the lunar environment or using lunar materials to create a sustainable lunar infrastructure. Buildings, structures, landing platforms, hardware, solar panels, and even food grown on the Moon are possible through ISRU, and that research provides a deeper understanding of the nature of dust on our own health and in the durability of hardware and equipment in the lunar environment. As cooperation among governments lunar activities increase and technologies further develop, it seems likely that some of the products that are generated on the lunar surface will be treated more as commodities in some form and will become more commonplace for export control compliance purposes.

[i] Source: NASA Artemis

[ii] Source: NASA CLPS

[iii] Source: NASA Space Science Data Coordinated Archive

[iv] Source: NASA Export Control Program Operations Manual

[v] Source: NASA Sample Requests For Research

[vi] Source: Meteorites For Sale

[vii] Source: US Department of the Interior: Bureau of Land Management

[viii] Source: JSC-1: A New Lunar Soil Simulant

[ix] Source: The Martian Garden