Hogan Lovells

Innovations in Space:

Space mining

Scot Anderson, Julia La Manna, Randy Segal, and Steven Kaufman

Scot Anderson
Partner | Denver and Washington, D.C.
+1 303 454 2452 (Denver)
+1 202 637 5600 (Washington, D.C.)
scot.anderson@hoganlovells.com.

Julia La Manna
Associate | Denver
+1 303 454 2406
julia.lamanna@hoganlovells.com

Randy Segal
Partner | Northern Virginia, Silicon Valley, and Washington, D.C.
+1 703 610 6237
randy.segal@hoganlovells.com

Steve Kaufman
Partner | Washington, D.C.
+1 202 637 5736
steven.kaufman@hoganlovells.com

A Series on Innovation and Space

During this next installment of the Innovations in Space series, our team provides an overview of space mining and the extraction of natural resources in outer space. Space mining and the exploration of natural resources in outer space present at least two value propositions. First, the availability of resources will be critical to supporting the continued exploration of outer space and potential colonization of other planets. Natural resources (including water) will be valuable, if not essential, to these long-term and sustainable efforts. Second, there are significant resources that can be mined for use and commercial ventures back on Earth. As additional innovative technologies are developed, the feasibility of space mining becomes increasingly possible (if not probable) to achieve both of these value propositions. These technologies are hyper-connecting the world (and the Moon and the planets) and offering new ways to interact.

In the arena of space mining, developments are bringing many legal, regulatory, and contractual challenges and considerations that need to be kept in mind to support the successful launch of a new business. Along with innovative business models and technologies (some fully or partially still on the drawing board), often come new hurdles, paradigms, and new approaches to partnering and capital raising.

New technologies bring with them many new considerations, many of them quite fundamental. Innovative and disruptive technologies change and improve how we see and interface with the world. They bring great benefits and often a paradigm shift in how the industry develops and the benefits it can deliver. But these innovations also raise new issues of space sustainability, the setting not only of national standards but also global expectations, coordination and cooperation, and the recognition of new risks and safeguards to put into place when technologies are deployed in outer space.

To the moon and beyond

In *Across the Airless Wilds*, Earl Swift describes the development of the lunar rover and its use in the later Apollo missions. Swift notes that the astronauts on the last lunar mission in 1972, Gene Cernan and Jack Schmitt, traveled five miles from their lunar module:

> No other explorer has been in circumstances so remote, or so extreme in their hazards. No expedition had before, or since, pushed adventure farther or further. Cernan and Schmitt were out at the edge of the edge of man's travels as a species. By comparison, Roald Amundsen's trek to the South Pole was a run to the corner grocery.[1]

While that expedition was almost 50 years ago, there is a renewed interest to return to the moon. The next visitors plan to stay for a while, establishing a permanent base sustained, in part, by the development of resources on the moon. Ice exists on the moon, which can be processed to provide the basic needs for human habitation – air, water, and fuel. Melting this ice can be used for water, and further broken down to produce oxygen for habitats and hydrogen for fuel. Once those basic needs are met, other existing raw materials from the moon can be used for manufacturing and development, providing a solid foundation and opportunity to expand over time. Looking forward, the moon also has large quantities of helium-3 which can be used for future fusion power projects.

But the extraction of resources in outer space will not stop at the moon. Mars also has ice and perhaps even subsurface liquid water, which colonists could use in conjunction with mining to support a planetary base. Near-Earth asteroids could also be the source of useful metals and materials, with websites such as asterank.com already providing an "estimate [of] the costs and rewards of mining asteroids."[2] We may be some time away from economically developing minerals on asteroids, but on 20 October 2020, the Origins, Spectral Interpretation, Resource Identification and Security-Regolith Explorer (OSIRIS-REx) landed on the asteroid known as 101955 Bennu with a goal of collecting a physical sample.[3] Following the successful completion of this task, OSIRIS-Rex is expected to return to Earth in 2023 with about 60 grams of material. This long distance prospecting expedition is a start toward gathering resources from asteroids.

Human-kind will only become more active on the moon, Mars, and deeper space where the asteroids orbit. The teams pursuing these areas of exploration and development will include private companies such as SpaceX, Blue Origin, iSpace, and Moon Express, inevitably leading to questions like "Can we do that?", or "Is it OK that we did that?"

The Outer Space Treaty

The law of space is, fundamentally, international law. The bedrock of space law today is a treaty: The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (Outer Space Treaty). The Outer Space Treaty was ratified in 1967, and over 100 countries are parties, including most space-faring nations. Article I of the Outer Space Treaty provides, "[t]he exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries … Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies."[2] Significantly, the Outer Space Treaty prohibits the appropriation of any celestial body by any nation. All activities in outer space are conducted under the authorization

1. Swift, Earl, *Across the Airless Wilds: The Lunar Rover and the Triumph of the Final Moon Landings*, 6 July 2021.
2. Asterank, Asteroid database and mining rankings, accessed 19 August 2021.
3. National Aeronautics and Space Administration, OSIRIS-REx, accessed 20 August 2021.
4. United Nations Office for Outer Space Affairs, Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, signed 27 January 1967.

and supervision of a nation state, even activities conducted by private parties and other non-governmental entities.

The provisions in the Outer Space Treaty prohibiting national appropriation and stating that the exploration and use of outer space "shall be carried out for the benefit and in the interests of all countries"[5] are interpreted by some to prohibit or restrict the development of space resources. Read as a whole, however, it is clear that the Outer Space Treaty allows both governments and private parties to develop minerals in outer space. The prohibition on national appropriation does not prohibit the exercise of private rights over extracted resources, or the ownership of extracted resources by governmental or private parties. Indeed, the Outer Space Treaty anticipates the development of extracted resources. The treaty includes the phrase "exploration and use" twice in its terms, with the word "use" demonstrating that the drafters expressly considered and authorized the development and deployment of space resources. The United States State Department has consistently maintained that the Outer Space Treaty allows for commercial extraction and ownership of resources, with the view that the treaty's non-appropriation principle applies to space resources only when such resources are "in place." This prohibition does not extend to governmental or private ownership of resources once they are removed from the celestial body.

In 1979, the United Nations developed a document entitled "Agreement Governing the Activities of States on the Moon and Other Celestial Bodies," commonly called the "Moon Agreement." While the Moon Agreement has only been signed by 20 countries, and none of them space-faring nations, it does have one provision potentially relevant to the development of natural resources in outer space. The Moon Agreement states that celestial bodies and their resources are "the common heritage of mankind"[6] a phrase also used in the United Nations Convention on the Law of the Sea where the deep sea is characterized as the common heritage of mankind. This "common heritage" concept has been used to justify a value-sharing approach among nations for the development of minerals from the deep sea. Given that the Moon Agreement is not widely accepted, and that the Outer Space Treaty does not include this "common heritage" phrase, the received view is that the development of resources in outer space need not be subject to a similar, monetary-sharing arrangement.

Progress in the United States

Some countries, including the United States, have enacted legislation to codify the interpretation of the Outer Space Treaty authorizing the development of space resources.

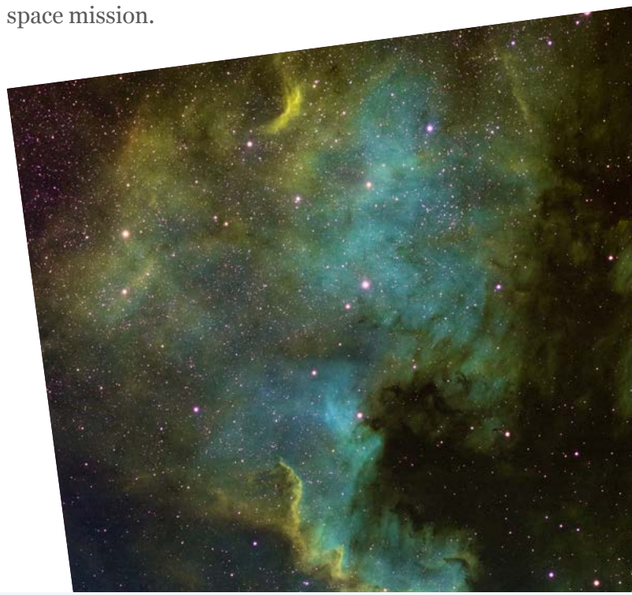
For starters, the United States enacted the Commercial Space Launch Competitiveness Act in 2015. Title IV of that Act, entitled "Space Resource Exploration and Utilization Act," creates private property rights over resources extracted from space. It directs the president to: (1) facilitate the commercial exploration for and commercial recovery of space resources by United States citizens; (2) discourage government barriers to the development of such industries, in a manner consistent with United States international obligations; and (3) promote the right of United States citizens to engage in such industries free from harmful interference. As noted above, anyone acting in outer space does so under the supervision and responsibility of a government. Accordingly, under the Act, "[a] United States citizen engaged in commercial recovery of an asteroid resource or a space resource under this chapter shall be entitled to any asteroid resource or space resource obtained, including to possess, own, transport, use, and sell the asteroid resource or space resource obtained in accordance with applicable law, including the international obligations of the United States." The statute also states that "[i]t is the sense of Congress that by the enactment of this Act, the United States[7] does not thereby assert sovereignty or sovereign or exclusive rights or jurisdiction over, or the ownership of, any celestial body."[8]

Following up on the Space Resource Exploration and Utilization Act, President Donald Trump issued an Executive Order in 2020 titled "Encouraging International Support for the Recovery and Use of Space Resources." This Executive Order explicitly rejected the efficacy of the Moon Agreement and directed the United States to pursue international support for the recovery and use of space resources. It also directs the Secretary of State to "seek to negotiate joint statements and bilateral and multilateral arrangements with foreign states regarding safe and sustainable operations for the public and private recovery and use of space resources."[9]

Development of international frameworks

This directive found fruition in the Artemis Accords, a series of bilateral agreements between space-faring countries. The United States has signed the Artemis Accords alongside, as of the writing of this article, the national space agencies of Australia, Brazil, Canada, Italy, Japan, Luxembourg, New Zealand, the Republic of Korea, Ukraine, the United Arab Emirates, and the United Kingdom. Under these agreements, the parties agree that space resources can be extracted and used consistent with the provisions of the Outer Space Treaty. The Artemis Accords also include other high-level provisions designed to facilitate the cooperative exploration and development of outer space.

Luxembourg has also enacted legislation designed to encourage the development of resources in space. Its space mining law, the Law of July 20, 2017 on the Exploration and Use of Space Resources[10] authorizes the Luxembourg Ministers of Economy and Space to regulate and oversee outer space resource extraction activities, creating a corporate and fiscal framework for outer space mineral development. Like the United States, Luxembourg codifies its interpretation of the Outer Space Treaty as authorizing the development of space resources. To take advantage of this structure and the Luxembourg view of the Outer Space Treaty, a company must be an entity created under Luxembourg law, or an entity created under the law of a European country that has its registered office in Luxembourg. The company must also demonstrate that it has an internal governance scheme and financial and technical arrangements to support its proposed space mining activities. Further, the management team of the company must have a good reputation and possess the knowledge, skills, and experience to pursue its space mission.



5. *Id.*

6. United Nations Office for Outer Space Affairs, *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*, signed 27 January 1967.

7. 114th United States Congress, *U.S. Commercial Space Launch Competitiveness Act of 2015*, signed 25 November 2015.

8. *Id.*

9. Executive Order 13914, *Encouraging International Support for the Recovery and Use of Space Resources*, signed 6 April 2020.

10. Luxembourg Chamber of Deputies, *Law of July 20, 2017 on the Exploration and Use of Space Resources*, signed 20 July 2017.

Not every country is enthusiastic about the implementation of the Artemis Accords. with Russia and China having been vocal about what they view as an "U.S.-centric" approach in the accords. Further, both have stated that they intend to cooperate on the development of a joint base on the Moon. The development of competing moon bases, operating under the umbrella of the Outer Space Treaty but with different legal structures, could lead to complex legal questions as the respective projects move forward. For example, many of the most robust ice reserves on the moon are located in craters at the poles. The Artemis Accords contemplate "safety zones" that would provide a designated area for lunar operations to prevent interference. But if moon resources are developed by a company operating under the authority of a country that is not a signatory to the Artemis Accords, and that company encroaches on the safety zone of an existing operator, the legal standards for space mining and the practical application of those standards on-the-ground will face an interesting test.

What the future holds

Despite these uncertainties, plans for developing space resources continue to move forward. NASA recently contracted with four companies - Lunar Outpost, Masten Space Systems, ispace Europe, and ispace Japan of Tokyo – to collect lunar regolith for the agency. The press release from NASA makes it clear that these contracts are the first step toward mining on the moon and beyond:

> Space resources will play a key role in NASA's Artemis program and future space exploration. The ability to extract and use extraterrestrial resources will ensure Artemis operations can be conducted safely and sustainably in support of establishing human lunar exploration. Moreover, in-situ resource utilization (ISRU) will play a vital role in a future human mission to Mars. Like many other operations, ISRU activities will be tested and developed on the Moon, building the required knowledge to implement new capabilities that will be necessary to overcome the challenges of a human mission to Mars.[11]

As the exploration of outer space proceeds apace, the law of outer space will evolve and transform to address new technologies and initiatives.

11. National Aeronautics and Space Administration, *NASA Selects Companies to Collect Lunar Resources for Artemis Demonstrations*, 3 December 2020.

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