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ADG Insights

The development of natural resources in outer space

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As the world's population grows along with the demand for the planet's limited resources, governments and private enterprises are setting their sights on outer space.

In asteroids and on the moon, there is an abundance of water, base metals, and precious metals. Once the stuff of science fiction, people are now actively working to develop the technology to extract and utilize these resources. These efforts will almost certainly be led by companies in the aerospace, defense, and government services (ADG) industry sector.

Although there is a growing consensus among spacefaring nations that commercial space mining is consistent with international law, companies and their investment partners will likely require some additional legal clarity before undertaking a space mining venture. Specifically, they will likely want to address the same key legal risks that are considered before a terrestrial mining venture. These include:

- Security of tenure: Can the mining company secure the legal right to explore for and develop the mineral properties?
- Fiscal regime: What economic burdens, such as taxes, royalties, and export duties will apply to the mining venture?
- Bankability: Does the legal and commercial regime applicable to the mining venture allow investors to finance the project?
- Enforceability: Are the agreements, licenses, concessions, and legal commitments enforceable, and is the project relatively safe from expropriation or naturalization?

Below, we examine the promise of space mining and the challenges presented by the current state of space mining law.

Space resources basics

Asteroids are the 4.6 billion-year-old remains of the formation of our solar system.[1] They range in size from less than 33 feet to about 329 miles in diameter.[2] Most have odd, non-spherical shapes causing them to rotate irregularly as they orbit the sun.[3]

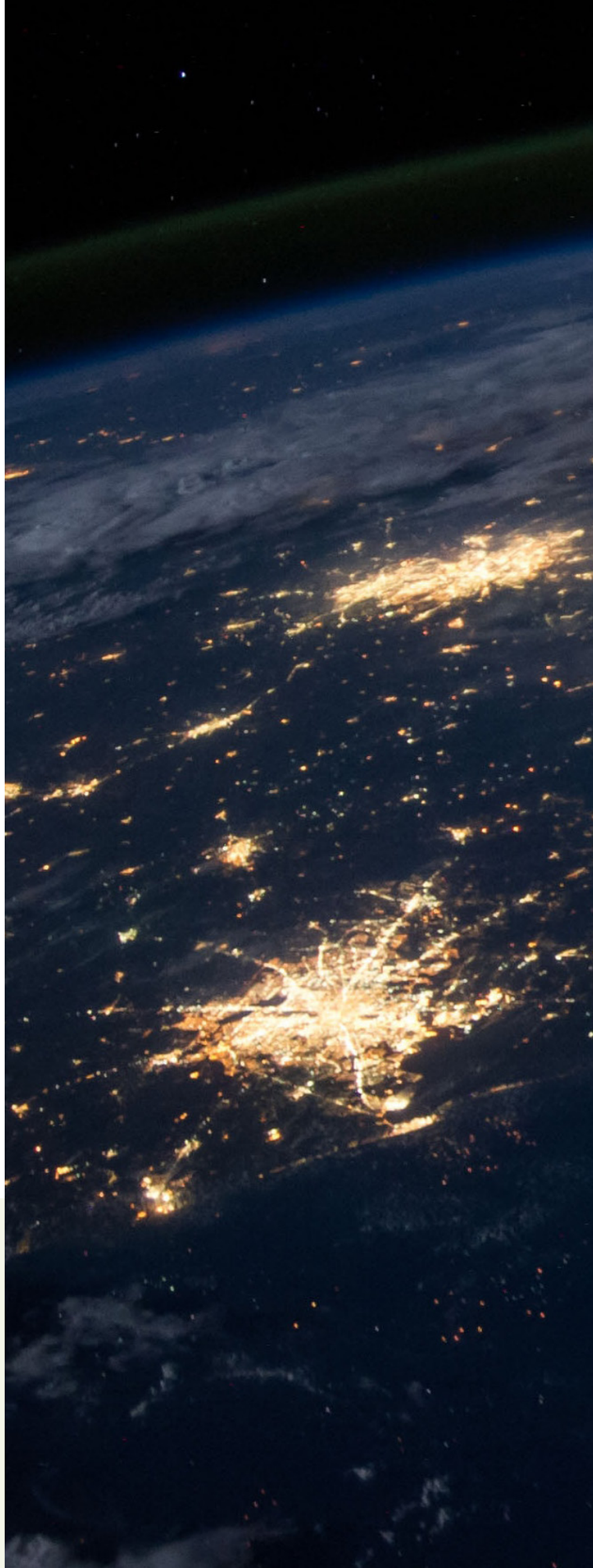
Most asteroids orbit in the main asteroid belt between Mars and Jupiter.[4] This belt contains millions of asteroids,[5] but is so far away that it would be very difficult with existing technology to utilize their resources. Fortunately, "near-Earth asteroids" (NEAs) orbit closer to Earth.[6] NEAs are defined as having an orbital distance from Earth of 1.3 astronomical units (au) (equivalent to about 120 million miles) or less.[7] To date, scientists have documented over 20,000 NEAs and discover more every year.[8]

Although different asteroid types are made up of different component elements, some contain significant amounts of platinum group materials and other valuable metals.[9] For context, it has been estimated that the value of a single platinum-bearing asteroid could be between US$25 and US$50 billion.[10] These metals are highly useful and valuable, both on Earth and in space.[11] As a result of Earth's gravity, much of our planet's supply of these metals is found near Earth's core, making the relatively smaller amounts that are more readily accessible in the crust layer even more valuable.[12] By contrast, on asteroids, the lower relative gravity makes these metals easier to access.[13]

The moon also holds significant amounts of ice in craters located at the moon's south pole.[14] Scientists estimate that within about 40 of these craters there are 1.3 trillion pounds or 600 million metric tons of water-ice.[15] Lunar ice can be converted to water and rocket fuel and the estimated deposits could be transformed into enough rocket fuel "to launch one space shuttle per day for 2,200 years."[16] This makes the moon a very attractive option to house a space re-fueling station, and indeed, there are multiple proposals to this effect.

The nascent space mining industry is quickly becoming a viable reality. Many estimate that extracting and utilizing water in space, the first step to creating a space mining economy, could be achieved within a decade.[17] However, there remains significant legal uncertainty about how mining the moon and asteroids can and should proceed under existing international and domestic law.

In addition to the technical and financial challenges, considerable regulatory uncertainty surrounds the space mining industry. The central unsettled questions are whether international law permits private ownership of space resources and relatedly, what, if any, international benefit-sharing the law requires. There are also certain regulatory gaps; for example, the absence of a dispute resolution framework. Still, it may be possible to move forward with the development of resources in outer space under existing laws and treaties. The remainder of this article describes the legal uncertainty surrounding the space mining industry and discusses what that uncertainty may mean for space mining entities.



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8. "Discovery Statistics," Center for Near Earth Object Studies, CALIFORNIA INSTITUTE OF TECHNOLOGY, https://cneos.jpl.nasa.gov/stats/totals.html, (last visited Nov. 5, 2019). Detailed information about asteroids can be found at www.asterank.com.
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14. Andrea Thompson, 'Significant Amount' of Water Found on Moon, SPACE.COM (Nov. 13, 2009), https://www.space.com/7530-significant-amount-water-moon.html.
15. "NASA Radar Finds Ice Deposits at Moon's North Pole," NASA, https://www.nasa.gov/mission_pages/Mini-RF/multimedia/feature_ice_like_deposits.html (last visited Nov. 5, 2019).
16. Paul Rincon, Ice deposits found at Moon's pole, BBC NEWS (Mar. 2, 2010), http://news.bbc.co.uk/2/hi/science/nature/8544635.stm (paraphrasing comments made by Dr. Paul Spudis of the Lunar and Planetary Institute in Houston, Texas, at the 41st Lunar and Planetary Science Conference).
17. Mike Wall, Asteroid Mining May Be a Reality by 2025, SPACE.COM (Aug. 11, 2015), https://www.space.com/30213-asteroid-mining-planetary-resources-2025.html.

Space mining law

Outer Space 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 (the Outer Space Treaty) is the foundational text of international space law.[18] It entered into force in 1967 and has been signed and ratified by over one hundred nations, including the United States. While it deals in large part with preventing any one nation from gaining a military advantage in space, it also has significant consequences for commercial mining activity.

In relevant part, the Outer Space Treaty provides, "the 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 . . . and shall be the province of all mankind. 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."[19]

Speaking directly to ownership of celestial bodies, the Treaty continues, "[o]uter space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means."[20]

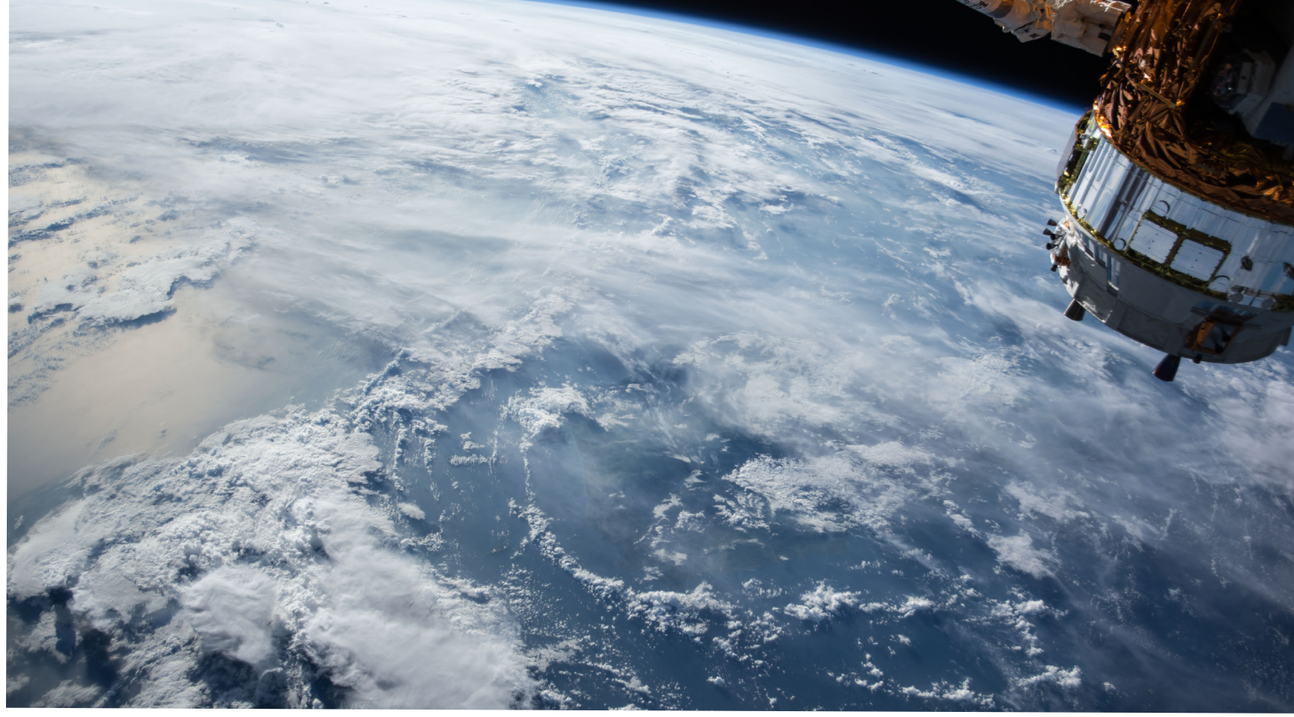
While the Treaty makes clear that there is a right of free access to celestial bodies for all nations, it prohibits ownership of the bodies themselves. It also qualifies that space activities by private entities must be authorized and supervised by the appropriate nation. However, the Treaty does not deal clearly with whether space resource extraction is a lawful enterprise under its terms.

The Treaty's statement that the exploration and use of space "shall be carried out for the benefit and in the interests of all countries" is subject to multiple interpretations. While some have argued that this clause mandates an international profit-sharing mechanism, the United States and others have taken the position that it merely reiterates the right of free access articulated in Article I.[21]

Whether the prohibition on national appropriation extends to a grant of private rights over extracted resources is similarly contested. Specifically, there is some disagreement regarding whether private entities can own resources extracted from the celestial body without any nation owning the body itself. The Treaty includes the phrase "exploration and use" twice in its terms. The word "use" seems to indicate that leveraging space resources was within the contemplation of the drafters, and thus, not prohibited.[22] Still, it is unclear how rights would be distributed where national appropriation is prohibited. The diplomatic history of the Treaty indicates that perhaps this point was left ambiguous deliberately in order to gain support across nations.[23]

The Moon Treaty

The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the Moon Treaty) addresses resource extraction from the moon, and likely also applies to asteroids.[24] As noted above, the Outer Space Treaty declares that the moon and other celestial bodies in the solar system, as well as their natural resources, are the "province of all mankind."[25] The Moon Treaty goes further, characterizing the bodies and their resources as being the "common heritage of all mankind,"[26] a phrase that some interpret to create a common interest in moon resources. The Moon Treaty has been signed by fewer than 20 countries and was not signed by the United



States or other space-faring nations.[27] Some regard it as obsolete.[28] In the event that there is a renewed international interest in the core provisions of the Moon Treaty, that treaty could present a significant barrier to private space mining.

U.S. Commercial Space Launch Competitiveness Act

In 2015 Congress passed the U.S. Commercial Space Launch Competitiveness Act. The Act is the consolidated outcome of four bills that expand existing regulation of commercial space activity.[29] Most important, for space mining purposes, is Title IV, which establishes a basis for ownership of extracted space resources.

Title IV, the "Space Resource Exploration and Utilization Act," creates private property rights over resources extracted from space.[30] It directs the President to (1) facilitate the commercial exploration for and commercial recovery of space resources by U.S. citizens; (2) discourage government barriers to the development of such industries in a manner consistent with U.S. international obligations; and (3) promote the right of U.S. citizens to engage in such industries free from harmful interference.[31]

The Act then establishes that "[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."[32] It does not make clear how exactly a citizen should go about claiming rights to space resources. The use of the word "obtained" seems to indicate a framework akin to the rule of capture, but this is not specified in the law itself.

18. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter "Outer Space Treaty"].
19. Outer Space Treaty, Art. I (emphasis added).
20. Outer Space Treaty, Art. II (emphasis added).
21. See Mike Gold, Testimony of Mike Gold Before the Subcommittee on Space, Science, and Competitiveness of the Committee on Science, Space, and Technology United States Senate, at 7 (May 23, 2017), available at https://www.hsdl.org/?view&did=807259.
22. See Joanne Gabrynowicz, Testimony of Joanne Irene Gabrynowicz Before the Subcommittee on Space of the Committee on Science, Space, and Technology United States House of Representatives, at 7 (Sept. 10, 2014), available at http://joannegabrynowicz.com/wp-content/uploads/2013/11/Gabrynowicz-Final-Testimony-H.R.-5063.pdf.
23. See Samuel Roth, Developing a Law of Asteroids: Constants, Variables, and Alternatives, 54 COLUM. J. TRANSNAT'L L. 827, 841–42 (2016).
24. Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, Dec. 18, 1979, 1363 U.N.T.S. 3 [hereinafter "Moon Treaty"]; see also id. at 842.
25. Outer Space Treaty, Art. I.
26. Moon Treaty, Art. 11 § 1.
27. See Roth, Developing a Law of Asteroids, supra note 23, at 844.
28. See id.
29. U.S. Commercial Space Launch Competitiveness Act, Pub. L. No. 114-90, 129 Stat. 704 (2015) [hereinafter "Space Launch Act"]. For a complete analysis of the Act, see Michael Dodge, The U.S. Commercial Space Launch Competitiveness Act of 2015: Moving U.S. Space Activities Forward, 29 NO. 3 AIR & SPACE LAW. 4 (2016).
30. Space Launch Act §§ 402-403, now codified at 51 U.S.C. §§ 51301–51303 (2015). Notably, the Act also clarifies that "[i]t is the sense of Congress that by the enactment of this Act, the United States does not thereby assert sovereignty or sovereign or exclusive rights or jurisdiction over, or the ownership of, any celestial body." Space Launch Act § 403.
31. 51 U.S.C. § 51302(a).
32. 51 U.S.C. § 51303 (emphasis added).

Luxembourg Law on the Exploration and Use of Space Resources

The only other nation besides the United States to provide a private legal right to resources extracted from celestial bodies is Luxembourg. Similar to its strategy in satellite communications in the 1980s, Luxembourg is establishing an attractive regulatory and economic environment for space resource mining.[33]

Luxembourg announced its Space Resources initiative in 2016, stating that its goal was to create a "legal and regulatory framework confirming certainty about the future ownership of minerals extracted in space from Near Earth Objects such as asteroids."[34] Luxembourg also pledged to support space resource extraction companies by funding grants, purchasing equity, and reimbursing costs for research and development.[35]

Similar to the U.S. Commercial Space Launch Competitiveness Act, the Luxembourg Law on the Exploration and Use of Space Resources provides that space resources are subject to private ownership.[36] It also sets out a comprehensive, though not overly arduous, regulatory structure for space mining.

Making sense of space mining law

Space law is international law. Article III of the Outer Space Treaty states that State Parties shall conduct activities in outer space "in accordance with international law."[37] At present, the relationship between traditional international law and space law remains unsettled. Professor Pierfrancesco Breccia argues, for example, that "most international standards, related to the specific use of parts of the external world that are different from space, as the law of the sea, air or the rules related to Antarctica are, by their nature, inapplicable in this new field."[38] There is some uncertainty, then, about just how activities in space are to be conducted "in accordance with international law."

The Hague International Space Resources Governance Working Group (Working Group)[39] seeks to address this uncertainty for resources development in outer space. The goal of the Working Group is to "assess, on a global scale, the need for a regulatory framework for space resource activities and to prepare the basis for such regulatory framework."[40] The Working Group prepared a draft set of "Building Blocks" for a regulatory framework for the development of resources in space, and circulated that draft for comment on September 17, 2017.[41] The objective of the Building Blocks is to "create an enabling environment for space resource activities that takes into account all interests and benefits all countries and humankind."[42] Toward this end, the Working Group rests the Building Blocks on international law, including the notion that the development of space resources should be exclusively for peaceful purposes, and for the benefit and in the interests of all countries and humankind irrespective of their degree of economic and scientific development.[43] The key concepts in the Building Blocks include: (i) international responsibility for space resource activities and jurisdiction over space products; (ii) access to space resources; (iii) utilization of space resources; (iv) due regard for interests of all countries and humankind; (v) avoidance of harmful impacts resulting from space resource activities; (vi) sharing of benefits arising out of the utilization of space resources; and (vii) settlement of disputes.[44]

The concept of the common heritage of mankind has substantial impact for the development of resources on the moon and in outer space. As previously noted, the Moon Treaty describes the moon as "the common heritage of mankind," and it may well be this concept that has chilled a wider acceptance of the Agreement.[45] Describing the moon as the "common heritage of mankind" brings the development of resources on the moon in parallel with the UN Convention on the Law of the Sea (UNCLOS), which includes the same concept for the deep seabed.[46] Industrialized nations, in both instances, are concerned that their citizens will not recoup the benefits of the substantial investment necessary to develop resources on either the moon or the deep seabed.[47] UNCLOS requires a joint venture arrangement with the International Seabed Authority and the payment of something like a royalty.[48] And, as with celestial bodies under the Outer Space Treaty, a State cannot claim sovereign right or "appropriate" the deep seabed "or its resources,"[49] though this does not preclude resource exploitation.

The joint venture and royalty-like requirements under UNCLOS explain why some of the literature on resources development in outer space is keen to make it clear that the Outer Space Treaty does not describe space as the common heritage of mankind.[50] The Outer Space Treaty refers to outer space as "the province of all mankind," but not as its "common heritage."[51] Thus, the countries who are parties to the Outer Space Treaty, but not the Moon Treaty, have not adopted the view that outer space should be treated in a manner analogous to the deep seabed. Still, some commentators use the phrase "the common heritage of mankind" when talking about outer space, which is problematic.[52]

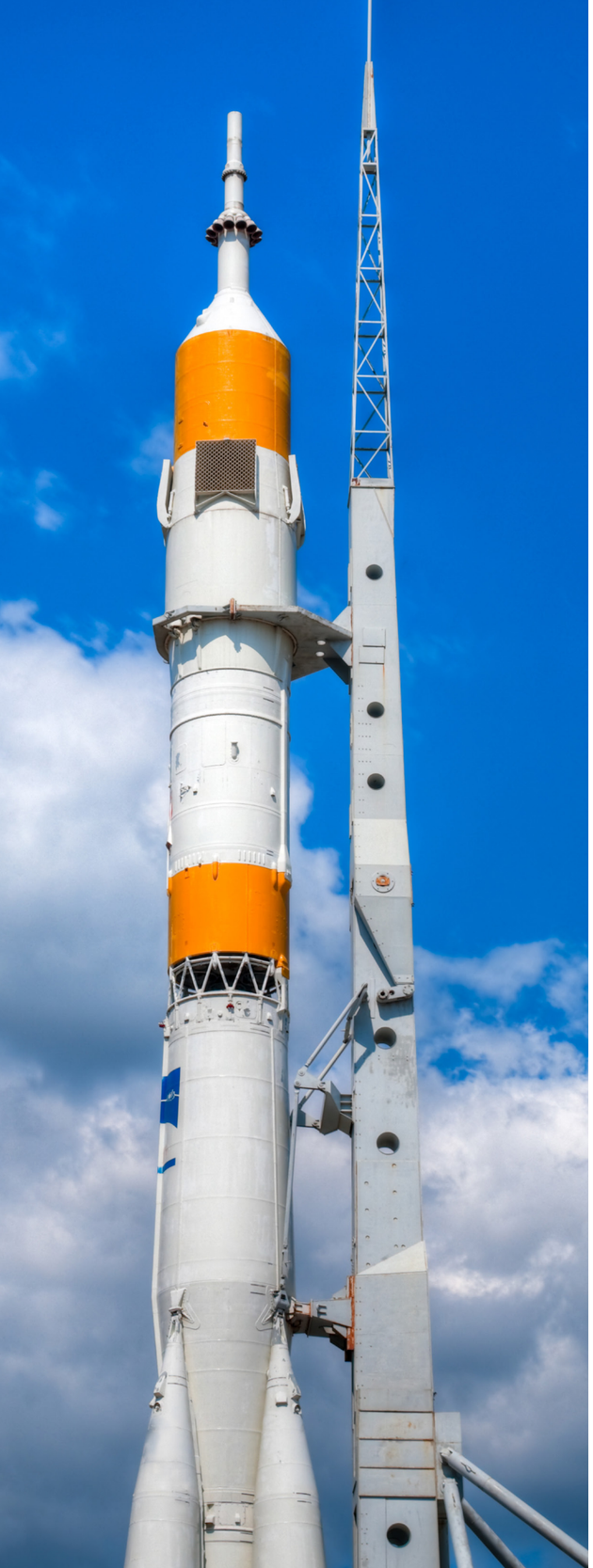
Countries like the United States and Luxembourg clearly see space resources as a "common property right,"[53] and not the common heritage of mankind. Under the common property approach, resources developed from an asteroid can be owned as private property, with no obligation to share those resources or revenue from those resources with every other country on the planet. Similarly, the Working Group Building Blocks stop short of advocating for global revenue sharing.[54] Instead, the Building Blocks require benefit-sharing in the form of technology and information, and contemplate the establishment of an international fund.[55] Given this growing consensus and the low number of signatories to the Moon Treaty, it seems unlikely that outer space will become characterized as the common heritage of mankind in any clear or unequivocal manner.

Considerations for space miners

The terrestrial mining industry is a global industry, and mining companies routinely develop mining projects in areas where the law is underdeveloped or uncertain. Looking at the key decision points for an international mining project illuminates the legal and commercial structures necessary to allow resource development to advance in space.

A mining project has an economic structure that is different from most industries. A mine requires enormous front end capital investment to secure mining rights, permits, financing and then the investment in building processing facilities, infrastructure, and moving earth to bring ore to

33. See Sarah Scoles, Luxembourg's Bid to Become the Silicon Valley of Space Mining, WIRED (Jan. 10, 2017), https://www.wired.com/2017/01/luxembourg-setting-silicon-valley-space-mining/.
34. Id. (quoting the Ministry of Economy's official statement about the program).
35. Id.
36. Law on the Exploration and Use of Space Resources, Art. 1 (2017), available at https://www.loc.gov/law/foreign-news/article/luxembourg-law-on-use-of-resources-in-space-adopted/.
37. Outer Space Treaty, Art. III.
38. Pierfrancesco Breccia, "Article III of Outer Space Treaty and its Relevance in the International Space Legal Framework," Proceedings of the International Institute of Space Law (Eleven International Publishing, 2016) at 20 [hereinafter "Proceedings"].
39. The Working Group platform is a Consortium serviced by a Secretariat. The founding Consortium partner is the International Institute of Air and Space Law, Leiden Law School, Leiden University (the Netherlands). Members are major stakeholders from government, industry, universities, and research centers. The number of members to the Working Group is limited to 35. See "The Hague International Space Resources Governance Working Group," available at https://www.universiteitleiden.nl/en/law/institute-of-public-law/institute-of-air-space-law/the-hague-space-resources-governance-working-group (last visited Nov. 4, 2019).
40. Tanja Masson-Zwaam, René Lefeber, Giuseppe Reibaldi and Merinda Stewart, "The Hague Space Resources Working Group: A Progress Report," in Proceedings at 164.
41. Working Group, Draft Building Blocks for the Development of an International Framework in Space Resource Activities (2017) [hereinafter "Building Blocks"], available at https://www.universiteitleiden.nl/binaries/content/assets/rechtsgeleerdheid/instituut-voor-publiekrecht/lucht--en-ruimterecht/space-resources/revised-building-blocks-following-the-meeting-of-april-2019.pdf.
42. Building Blocks, ¶ 1.1.
43. Building Blocks, ¶¶ 4.1–4.3.
44. Building Blocks, ¶¶ 5, 7–10, 13, 19
45. Moon Treaty, Art. 11 § 1; see also Irmgard Marboe, "The End of the Concept of 'Common Heritage of Mankind': The Views of State Parties to the Moon Agreement," in Proceedings at 226.
46. UN Convention on the Law of the Sea of December 19, 1982, entered into force on November 16, 1994, UNTS 1833, 1834, 1835, Part XI [hereinafter "UNCLOS"].
47. See Marboe, supra note 45, at 236-37.
48. UNCLOS, Annex III.
49. UNCLOS, Art. 137(i).
50. See, e.g., Virgiliu Pop, "Is Outer Space Proper the 'Common Heritage of Mankind'?" in Proceedings.
51. See id. at 243-44.
52. Id.
53. See John E. Noyes, The Common Heritage of Mankind: Past, Present and Future, 40 DENV. J. INT'L L. POL'Y 447 (2011-2012).
54. Building Blocks ¶ 13.2.
55. Building Blocks ¶ 13.1.



the market. Only then does a mining company begin to generate revenue and seek a return on that investment. Resources development in space will face a similar requirement to deploy capital before it will see a return on investment.

A company looking to develop resources in outer space will consider similar legal issues that are routinely examined in international mining companies determining whether to proceed with a mining project:

Security of tenure.

A company conducting resource recovery operations in space will want to know that it will hold legal title (of some sort) to those resources. The language of the Outer Space Treaty restricting appropriation of celestial bodies creates some uncertainty as to whether a space mining company can achieve the security of tenure necessary to move forward with an investment in space mining. The U.S. Commercial Space Launch Competitiveness Act and the Luxembourg Law on the Exploration and Use of Space Resources are both designed to address that uncertainty, and provide a legal framework for securing and recognizing the right to extract resources in space. As noted above, there remains some concern that those laws may be challenged as inconsistent with the Outer Space Treaty. The adoption of laws or treaties consistent with the Working Group Building Blocks would provide greater certainty. The Building Blocks recommend a legal framework for access to space resources, which would facilitate exploration, and an international framework to assure the lawful acquisition and use of space resources.

Fiscal regime.

There is at present no mechanism to charge rentals or royalties on resources recovered in outer space. If a company uses a 3-D printer or other technology to convert raw materials into good on asteroids or in orbit around the Earth or the Moon, it can do so (so far) without incurring a governmental imposition. As the industry of resource development in outer space grows, however, governments may look for ways to tax the enterprise. If, for example, a company takes advantage of the legal frameworks established by the United States or Luxembourg, those countries could impose some severance tax or royalty payment in addition to the fees associated with forming companies under their laws. Of greater concern to a space mining company is the risk that other countries will invoke the concept that space is the "common heritage of mankind," or perhaps the language in the Outer Space Treaty that the exploration and use of outer space "shall be carried out for the benefit and in the interests of all countries." This language might be used to assert some economic interest in space resources, payable in a royalty or perhaps in kind. This concern could be addressed in part by adopting the "due regard" standard in UNCLOS, as proposed in the Working Group Building Blocks. Under that standard, a space mining company would have the freedom to conduct activities in space so long as those activities do not adversely affect the use of outer space by nationals of other states. Absent some clear resolution of this question, a space mining company will need to quantify the risk of economic burdens being imposed on its activities, and factor that risk into its project assessment.

Bankability.

A terrestrial mining project typically requires a detailed feasibility study, describing how the mine will be designed, the applicable regulations and legal requirements, an assessment of resources and reserves, an analysis of social and environmental impacts, and an economic analysis based on the cost of mining and the likely sales price of the commodity. A feasibility study becomes "bankable" when it presents a project that is of sufficient quality to attract financing. The bankability of a space mining project will be less certain, because it may be hard to take out a mortgage on an asteroid. Crucial to bankability, however, will be the certainty of the legal and commercial regime applicable to the mining venture. As noted above, the Outer Space Treaty and the viability of the legal regimes created by the United States and Luxembourg create some uncertainty, and investors may want some further clarity around those risks before making an investment. It is likely that investments will be made in stages, as spacing mining ventures vet the technical, commercial, and legal structures necessary to move forward with a project.

Enforceability.

A mining company wants to know that its agreements are enforceable. Because mining can take place in jurisdictions with low transparency and a weak commitment to the rule of law, mining companies often rely on bilateral investment treaties or similar international norms and constructs to mitigate the risk of expropriation and nationalization. In the context of resource development in outer space, there remains a risk that someone could claim a prior right to the resources being developed, or assert a claim to some portion of the proceeds derived from resource extraction and use. A space mining venture is more likely to move forward if the mining company has some assurance that its rights will be recognized and enforced, and if the company has access to a dispute resolution mechanism that will provide for the adjudication of those rights. The Working Group includes in its Building Blocks the recommendation that such disputes be subject to arbitration under the Rules for Arbitration of Disputes Relating to Outer Space Activities. Those Rules, however, apply only when parties have agreed to such arbitration.[56] The arbitration rules would not be available to adjudicate claims from competing companies or individuals, or claims made by non-spacefaring nations under the "common heritage of mankind" construct, for example.[57] Adjudication of those claims in a single country may not be honored in other countries. It may be advisable to establish an international adjudicatory body to address those claims, similar to the International Tribunal for the Law of the Sea under UNCLOS.[58]

Existing legal frameworks provide some guidance for space mining. Based on the decision making process for earth bound mine development, it is likely that space mining companies and their investment partners will require a more sophisticated and complete legal and commercial structure before committing to a space mining venture.

56. Permanent Court of Arbitration, Optional Rules for Arbitration of Disputes Relating to Outer Space Activities, art. 1(1) (2011).
57. See generally Frans G. von der Dunk, Space for Dispute Settlement Mechanisms - Dispute Resolution Mechanisms for Space? A Few Legal Considerations, Space, Cyber, and Telecommunications Law Program Faculty Publications (2001). (http://digitalcommons.unl.edu/spacelaw/38); Maureen Williams, "Dispute Resolution Regarding Space Activities," Handbook of Space Law, ch. 19 (F. von der Dunk, ed. 2015).
58. UNCLOS, Art. 186 and Annex VI.

Conclusion

In sum, companies and governments are working to develop technologies that will enable space resource extraction, beginning with technology that will improve the ability to identify valuable and accessible asteroids. While there is some legal uncertainty surrounding the field, consensus seems to be growing among spacefaring nations that commercial resource extraction is compliant with international law. To increase domestic regulatory clarity and remain competitive with other nations, the United States should establish a mission authorization process. Otherwise, Luxembourg's new law provides a more certain legal environment for private companies than does U.S. law.

The budding space mining industry will confront a number of legal challenges that at times have an existing parallel and at others, require entirely novel solutions. Issues of interest include regulatory compliance for mining, remote sensing, and spectrum use, as well as the protection and licensing of intellectual property related to emerging technologies, to name a few. International law provides a conceptual framework for resource development in outer space, and existing treaties and proposed regulations and laws borrow heavily from the principles of international law. Still, outer space is not the sea, and an asteroid is not an island or a distant land. Over time, the law of space will evolve in its own direction, and sail away from the current metaphorical relationship with the law of the sea.

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