

NOTES

Commercial Mining of Celestial Bodies: A Legal Roadmap

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ABSTRACT

Humanity is outgrowing the current body of space law. Commercial entities have steadily increased their presence in space and now they want in on a lucrative new field—mining. There is a growing need for raw materials sourced outside of Earth's gravity. Millions of dollars have already been invested to lay the groundwork for such an operation, but outdated laws stand in the way. Part I of this note introduces the benefits and timeliness of commercial mining in outer space. Part II surveys the current legal landscape and analyzes ambiguous provisions pertaining to commercial mining ventures. Finally, Part III proposes that it is time to revisit the Moon Agreement, particularly Article II(5), which calls for the establishment of an international governing regime.

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I. INTRODUCTION

Environmentalism and space are two words not commonly associated with each other.¹ Oceans, rivers, forests, and smog—these are the images that pop into mind when many people think of environmentalism, and yet it is the image of Earth rising over the Moon's horizon² that gave birth to the environmental movement.³ Robert Poole argues that the photo, taken during the 1968 Apollo 8 mission,⁴ the so-called Earthrise photo, “marked the tipping point, the moment when the sense of the space age flipped from what it meant for space to what it means for Earth.”⁵ People literally saw the blue marbled planet rising over the horizon of a desolate lunar surface. Symbolically, people saw the rarity of life in the universe, the fragility of the planet, and the urgent need to protect its resources.

An unlikely partnership between astronomy and the earth sciences has since developed. Moira McGuinness of the U.S. Environmental Protection Agency explains that “satellite imaging and data collection play a large role in helping inform scientists in environmental protection and human health.”⁶ NASA's Earth Observing System, for example, uses a coordinated series of polar-orbiting and low inclination satellites to conduct long term observations of the land surface, biosphere, solid Earth, atmosphere, and oceans.⁷ Scientists have used this information for disaster reduction, integrated water resource management, ocean and marine resource monitoring and management, weather and air quality monitoring, and biodiversity conservation.⁸

Space has not only given us tools to better manage our planetary resources, but it has also introduced everyday items such as memory foam,⁹ cordless tools,¹⁰

1. See, e.g., Moira McGuinness, *Science Wednesday: Earthrise—The Picture That Inspired the Environmental Movement*, OUR PLANET, OUR HOME (July 1, 2009), <http://blog.epa.gov/blog/2009/07/science-wednesday-earthrise/> (“I’ve never been terribly interested in space exploration . . . I’ve been tempted to think on occasion, ‘What a waste of money. We have so many problems on Earth to solve.’”).

2. See *Earthrise—Apollo 8, Image #: 68-HC-870*, GREAT IMAGES IN NASA, <http://grin.hq.nasa.gov/ABSTR/ACTS/GPN-2001-000009.html> (last visited Oct. 3, 2015).

3. See also John Noble Wilford, *On Hand for Space History, as Superpowers Spar*, N.Y. TIMES (July 13, 2009), http://www.nytimes.com/2009/07/14/science/space/14mission.html?pagewanted=all&_r=0 (“[T]he picture was the spiritual nascence of the environmental movement.”).

4. McGuinness, *supra* note 1.

5. ROBERT POOLE, *EARTHRISE: HOW MAN FIRST SAW THE EARTH* 8 (2010).

6. McGuinness, *supra* note 1.

7. *NASA's Earth Observing System Project Science Office*, NASA'S EARTH OBSERVING SYSTEM, <http://eospsoc.sfc.nasa.gov> (last visited Sept. 2, 2015).

8. See *Global Earth Observation System of Systems (GEOSS)*, UNITED STATES ENVTL. PROT. AGENCY (May 9, 2007), <http://www.epa.gov/eos/basic.html>.

9. *Forty-Year-Old Foam Springs Back With New Benefits*, NASA SPINOFF, https://spinoff.nasa.gov/Spinoff2005/ch_6.html (last visited Sept. 2, 2015).

10. *Spinoff from a Moon Tool*, NASA SPINOFF, https://spinoff.nasa.gov/spinoff2001/johnson_mill.html (last visited Sept. 2, 2015).

UV-blocking sunglasses,¹¹ and water filters¹² into our daily lives. The exploitation of space has generated all this and more in less than five decades. The speed at which technology has advanced is a testament to the benefits of our spirit of exploration. But our growth is constrained by limited resources—everything we do requires raw materials and we are using these materials at an increasing frequency. To satisfy our energy needs, we depend heavily on oil, coal, natural gas, and nuclear fission.¹³ This is problematic because many planetary resources are practically nonrenewable¹⁴ as the natural processes through which they form take millions of years to complete.¹⁵

Perhaps we should shift our gaze. Perhaps we should expand our resource base by extracting not only from the rock we call home, but also from the multitude of rocks flying above us.¹⁶ Extracting resources from celestial bodies has the benefit of filling a growing demand for raw materials sourced outside of Earth's gravity, a demand created both by the cost of escaping Earth's gravity and an increase in infrastructure in space. The Moon and Near Earth Asteroids ("NEAs") are attractive sources of raw materials because of the technical and financial rewards of mining them.¹⁷ The Moon and NEAs both contain a wealth of resources that can satisfy our growing needs.¹⁸ For example, unlike Earth, the Moon is rich in Helium-3, an isotope that may provide safer nuclear energy in fusion reactors because of its nonradioactive properties.¹⁹ NEAs are comprised of metals, rocks, dust, ice, and tar dating back to the solar system's formation four-and-a-half billion years ago.²⁰ Even tiny asteroids contain high-demand metals that may be worth millions of dollars.²¹

The possibility of lunar and asteroid mining is not just a fantasy. Several private investment groups have been increasingly interested in commercial

11. *Ultraviolet-Blocking Lenses Protect, Enhance Vision*, NASA SPINOFF, https://spinoff.nasa.gov/Spinoff2010/hm_3.html (last visited Sept. 2, 2015).

12. *Water Treatment Systems Make a Big Splash*, NASA SPINOFF, https://spinoff.nasa.gov/Spinoff2004/er_1.html (last visited Sept. 2, 2015).

13. RICKY J. LEE, *CREATING A PRACTICAL LEGAL FRAMEWORK FOR THE COMMERCIAL EXPLOITATION OF MINERAL RESOURCES IN OUTER SPACE* 42 (2009).

14. *See id.* at 52.

15. *Id.*

16. *But see* Jeb Butler, Note, *Unearthly Microbes and the Laws Designed to Resist Them*, 41 GA. L. REV. 1355, 1366 (2007) (arguing that we should not extract resources from celestial bodies because the same environmental preservation principle that we apply on Earth should also apply in space).

17. *See* Benjamin David Landry, *A Tragedy of the Anticommons: the Economic Inefficiencies of Space Law*, 38 BROOK. J. OF INT'L L. 523, 525-26 (2013).

18. *Id.*

19. *Helium-3 Mining on the Lunar Surface*, EUROPEAN SPACE AGENCY, http://www.esa.int/Our_Activities/Preparing_for_the_Future/Space_for_Earth/Energy/Helium-3_mining_on_the_lunar_surface (last visited June 12, 2014).

20. William Steigerwald, *New NASA Mission to Help Us Learn How to Mine Asteroids*, NAT'L AERONAUTICS & SPACE ADMIN., <http://www.nasa.gov/content/goddard/new-nasa-mission-to-help-us-learn-how-to-mine-asteroids/#.U5os7CiP7bw> (last visited Aug. 8, 2013).

21. *Id.*

mining ventures. Planetary Resources, Inc., financed by Google executives and operated by former NASA officials, is working on building orbital gas stations to breathe life into aging satellites.²² These stations will pump fuel processed from water found on NEAs.²³ In December 2013, Moon Express, Inc., a privately funded commercial space company dedicated to developing and mining lunar resources, unveiled its MX-1 lunar lander.²⁴ The MX-lunar lander is a groundbreaking robotic space vehicle capable of delivering commercial payloads to the Moon at a fraction of the cost of conventional approaches.²⁵ With developments like these, the stars are aligning for commercial mining of celestial bodies to blast off.

The final star to align is the modernization of the international space law regime. There are several gaps in commercial space activity that must be filled before commercial mining of celestial bodies can become a reality. Mining on Earth is already an admittedly risky endeavor, and celestial mining is exponentially riskier. Aside from practical safety and operational risks, the gaps in space law create a variety of legal risks. Filling the legal gaps will provide commercial mining operators with a greater degree of certainty about their rights and obligations under international space law and boost investor confidence.

Different legal issues and gaps are implicated in the different phases of a space mining operation. A space mining operation is comprised of seven phases—planning, exploration, launch, transit, extraction, return, and exploitation.²⁶ The planning phase involves mineralogical and technical feasibility analyses of mining the target celestial body.²⁷ With the use of remote sensing technology, the exploration phase involves the use of a spacecraft to analyze mineralogical samples and assess the viability of various deposits.²⁸ The launch phase refers to the segment of the operation from conception to final launch.²⁹ The transit phase begins after the final launch and ends when the mining craft arrives at the target.³⁰ The extraction phase lasts from the landing of the mining craft on the target to the full recovery of all mined ores.³¹ The return phase involves the return to Earth of processed or unprocessed mined ores.³² Finally, the exploitation phase commences when the mined ores are sold for profit in their processed, unprocessed,

22. Andy Pasztor, *What Happened to that Crazy Asteroid Mining Plan?*, WALL ST. J. (May 7, 2014), <http://www.wsj.com/articles/SB10001424052702303417104579544072639525550>.

23. *Id.*

24. *Moon Express Unveils Breakthrough “MX-1” Commercial Lunar Lander*, MOON EXPRESS (Dec. 5, 2013), <http://www.moonexpress.com/#news>.

25. *Id.*

26. LEE, *supra* note 13, at 19-21.

27. *Id.* at 19.

28. *Id.*

29. *Id.*

30. *Id.* at 20.

31. *Id.*

32. *Id.* at 20-21.

or utilized form.³³ While significant legal issues are implicated in each phase, the exploration, extraction, return, and exploitation phases pose legal issues unique to commercial ventures.

This note will argue that several key ambiguities in the current body of space law are stunting the growth of the commercial space mining industry, and those ambiguities are best resolved by establishing an international regime to govern celestial mining activities. Part II provides a thorough assessment of how the current legal landscape applies to commercial activities in space. Part II also analyzes the ambiguities inherent in the principles of non-appropriation, for the benefit of all, and province of mankind while suggesting interpretations of these principles. Part III proposes that the international community revisit the Moon Agreement, amend it in such a way that will garner more international support, and bring force to Article 11(5), which provides for the establishment of an international governing regime. Finally, Part IV concludes with a summary of this note's main points.

II. THE CURRENT LEGAL LANDSCAPE

Five multilateral treaties and five United Nations General Assembly (“UNGA”) declarations make up the body of space law today. Subsection A reviews the historical context within which this body of law developed. Subsection B includes a brief introduction of the treaties and declarations relevant to commercial mining. Subsection C contains an explanation of the extent the legal instruments apply to private and nongovernmental entities. The note then analyzes key ambiguous provisions with respect to commercial space activity and offers an interpretation of the provisions as applied to commercial mining in Subsection D.

A. HISTORICAL BACKGROUND

The environment in which space law developed helps to contextualize the discussion on the inadequacies of today's space law landscape with respect to commercial space activities. Born and raised in the Cold War era, the space industry was shaped by the interests of a state-centric international system.³⁴ Nongovernmental and multinational private actors had yet to enter the global stage and, as such, the various international legal instruments that sprouted to keep up with the budding space industry did not adequately account for the commercial interests that are so prevalent today.³⁵ Essential treaty terms were left

33. *Id.* at 21.

34. Rebekah Davis Reed, *Ad Astra Per Aspera: Shaping A Liability Regime for the Future of Space Tourism*, 46 HOUS. L. REV. 585, 590-92 (2009).

35. *Id.*

vague and ambiguous in international legal instruments for two reasons.³⁶ First, the United States and the Union of Soviet Socialist Republics, which were the only spacefaring states at the time and thus the voices that mattered the most, simply could not agree on many matters at a detailed level.³⁷ Second, a treaty containing general principles rather than a comprehensive code was better suited to adapt to rapidly evolving space technologies and applications.³⁸

B. BRIEF INTRODUCTION OF THE LEGAL INSTRUMENTS

1. Principles Declaration

The Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space (the “Principles Declaration”) was unanimously adopted by the UNGA on December 13, 1963.³⁹ This was the first UNGA declaration to articulate most of the fundamental principles of space law today, and all nine of its provisions were later repeated in the Outer Space Treaty.⁴⁰ Many regard the nine principles found in the Principles Declaration as customary international law.⁴¹

2. 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” or “OST”) was adopted by the UNGA on December 19, 1966 and went into force on October 10, 1967.⁴² As of January 1, 2015, 103 states have ratified it, including all states involved in space activities,⁴³ and an additional twenty-five have signed the OST.⁴⁴

The OST is widely regarded as the foundation of modern international space law on which subsequent treaties elaborate or expand,⁴⁵ and some argue that

36. See RICKY J. LEE, *LAW AND REGULATION OF COMMERCIAL MINING OF MINERALS IN OUTER SPACE* 101 (2012).

37. See *id.*

38. See *id.* The review clauses in the Registration Convention Art. X and the Moon Agreement Art. 18 make it possible for the international community to revise legal provisions in response to technological and political changes.

39. Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, G.A. Res. 1962 (XII), U.N. Doc. A/RES/18/1962 (Dec. 13, 1963).

40. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, *opened for signature* Jan. 27, 1967, 610 U.N.T.S. 205 [hereinafter *Outer Space Treaty*].

41. LEE, *supra* note 13, at 230.

42. *Outer Space Treaty*, *supra* note 40.

43. LEE, *supra* note 13, at 191.

44. See UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS, *Status of International Agreements relating to activities in outer space as at 1 January 2015*, A/AC.105/C.2/2015/CRP.8 (2015), http://www.unoosa.org/pdf/limited/c2/AC105_C2_2015_CRP08E.pdf [hereinafter *Status of International Agreement*].

45. Vladimír Kopal, *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, UNITED NATIONS, OFFICE OF LEGAL AFFAIRS, <http://legal.un.org/avl/ha/tos/tos.html> (“Introductory Note” tab) (last visited Sept. 9, 2015).

many of its provisions have crystallized into customary international law.⁴⁶ These provisions include freedom of use (Art. I), non-appropriation (Art. II), applicability of international law (Art. III), state responsibility (Art. VI), liability for damage caused by space objects (Art. VII), and the retention of jurisdiction and control by states over space objects (Art. VIII).⁴⁷

3. Rescue Agreement

The Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (the “Rescue Agreement”) was adopted by the UNGA on December 19, 1967 and entered into force on December 3, 1968.⁴⁸ The Rescue Agreement elaborates on elements of Articles V and VIII of the OST.⁴⁹ Some argue that some of its provisions may be regarded as customary international law because of: (1) the widespread compliance by non-party states, and (2) the humanitarian nature of the provisions, which parallel customary international maritime law.⁵⁰

4. Liability Convention

The Convention on International Liability for Damage Caused by Space Objects (the “Liability Convention”) was adopted by the UNGA on November 29, 1971 and entered into force on September 1, 1972.⁵¹ The Liability Convention elaborates on Article VII of the OST.⁵² In addition to providing procedures for the settlement of claims for damages, it also provides that a launching state shall be: (1) strictly liable for damage caused by its space objects on the surface of the Earth or to aircrafts, and (2) liable for damage due to its fault in outer space.⁵³

46. BIN CHENG, *United Nations Resolutions on Outer Space: ‘Instant’ International Customary Law?*, in *STUDIES IN INTERNATIONAL SPACE LAW* 126 (1997) (factors that support this view include the large number of states that have ratified; support given by states not party to the OST to UNGA resolutions reiterating the contents of these provisions; the *opinio juris* of states given in speeches made during debates in intergovernmental organizations; and repetition of provisions in subsequent instruments); LEE, *supra* note 13, at 191.

47. *Id.* at 229-39.

48. *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space*, UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS, <http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introrescueagreement.html> (last visited Sept. 11, 2015).

49. *Id.*

50. LEE, *supra* note 13, at 219.

51. *Convention on International Liability for Damage Caused by Space Objects*, UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS, <http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introliability-convention.html> (last visited Sept. 11, 2015).

52. *Id.*

53. *Id.*

5. Registration Convention

The Convention on Registration of Objects Launched into Outer Space (the "Registration Convention") was adopted by the UNGA on November 12, 1974 and entered into force on September 15, 1976.⁵⁴

6. Moon Agreement

The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the "Moon Agreement") was adopted by the UNGA on December 5, 1979 and entered into force in July 1984.⁵⁵ The international community has not widely accepted the Moon Agreement—only sixteen states have ratified it and only four have signed it as of January 1, 2015.⁵⁶

C. APPLICABILITY TO PRIVATE AND NONGOVERNMENTAL ENTITIES

A common concern underlying all sources of international law is the binding effect of the law on the parties involved. The concern is particularly pronounced in the relatively uncharted territory of space law. Unlike domestic law, international law operates in a system comprised of sovereign states that are bound only by the international laws to which they have consented to be bound⁵⁷ or by customary norms of international law.⁵⁸ This remains true in the international space industry where the treaties and declarations that make up the body of space law have been entered into by states or intergovernmental organizations comprised of states. Yet in the modern age of space exploration, a state-centric legal structure quickly becomes problematic as the space industry becomes increasingly dominated by private and nongovernmental actors.⁵⁹

Some scholars have argued that although the space treaties and declarations only directly bind states and intergovernmental organizations, private and nongovernmental entities engaged in space activities are also bound by them indirectly

54. *Convention on Registration of Objects Launched into Outer Space*, UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS, <http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introregistration-convention.html> (last visited Sept. 11, 2015).

55. *Agreement Governing the Activities of States on the Moon and other Celestial Bodies*, UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS, <http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/intromoon-agreement.html> (last visited September 10, 2015).

56. *Status of International Agreement*, *supra* note 44, at 5-10.

57. Pursuant to Article 26 of the Vienna Convention on the Law of Treaties, states can express consent to be bound by a given legal instrument by ratifying the instrument, after which point the state will be legally obligated to adhere in good faith to the rights and obligations arising from the instrument. Vienna Convention on the Law of Treaties art. 33, *opened for signature* May 23, 1969, 1155 U.N.T.S. 331 [hereinafter Vienna Convention]. Under Article 18, states that have signed, but not ratified, are obligated only to refrain from acts that would defeat the object and purpose of the treaty. *Id.*

58. See LEE, *supra* note 13, at 208.

59. See Meredith Blasingame, *Nurturing the United States Commercial Space Industry in an International World: Conflicting State, Federal, and International Law*, 80 Miss. L. J. 741, 742-44 (2010).

vis-à-vis the “appropriate state” that is responsible for supervising them pursuant to Article VI of the OST.⁶⁰ Article VI states that “States Parties to the Treaty shall bear international responsibility for national activities in outer space” and “[t]he activities of nongovernmental entities in outer space . . . shall require authorization and continuing supervision by the appropriate State Party to the Treaty.”⁶¹ When the Principles Declaration was being negotiated, the U.S. delegate proposed that “A state or international organization from whose territory or with whose assistance or permission a space vehicle is launched bears international responsibility for the launching, and is internationally liable for personal injury, loss of life or property damage caused by such vehicle on the Earth or in air space.”⁶² While there has been debate as to the precise meaning of the phrase “appropriate state,” many leaders in the field agree that it is best defined as the state in the best position to assert direct and immediate jurisdiction over the nongovernmental entity in question, whether that be the territorial state or the state of nationality.⁶³

In practice, states have fulfilled their obligations as the “appropriate state” by enacting domestic laws and granting regulatory authority to domestic governmental agencies.⁶⁴ The United States, for example, enacted the Commercial Space Launch Act in 1984 to regulate the private space transportation industry.⁶⁵ Designating the Department of Transportation as the regulating agency, the Act also promulgated various regulations relating to licensing, liability insurance requirements, private access to government facilities, and government indemnification.⁶⁶

D. AMBIGUOUS PROVISIONS

1. Non-Appropriation

Of all the ambiguous provisions in international space law, the settlement of the ambiguities surrounding the principle of non-appropriation will have the most significant impact on the future of commercial space mining. Without the ability to claim some type of exclusive property right in the surface of, subsurface of, and minerals to be extracted from celestial bodies, commercial ventures will not have enough security in their investment to make it worthwhile to pursue expensive mining operations.⁶⁷ The objective of commercial mining operations

60. See Joanne Irene Gabrynowicz, *One Half Century and Counting: The Evolution of U.S. National Space Law and the Three Long-Term Emerging Issues*, 4 HARV. L. & POL'Y REV. 405, 422 (2010).

61. Outer Space Treaty, *supra* note 40, at art. VI.

62. LEE, *supra* note 36, at 134.

63. *Id.* at 134, n.177.

64. See Gabrynowicz, *supra* note 60, at 422.

65. Blasingame, *supra* note 59, at 744-45.

66. Bonnie E. Fought, Comment, *Legal Aspects of the Commercialization of Space Transportation Systems*, 3 HIGH TECH L.J. 99, 110-11 (1988).

67. Sarah Coffey, Note, *Establishing a Legal Framework for Property Rights to Natural Resources in Outer Space*, 41 CASE W. RES. J. INT'L L. 119, 140-41 (2009).

is to make a profit from the exploitation of space resources and for-profit exploitation requires some form of ownership in the goods to be exploited. Unlike the lunar soil samples that were collected to further scientific research during the U.S. Apollo missions,⁶⁸ which were and continue to be legal,⁶⁹ the ores that would be collected during commercial missions would ultimately be used for private commercial purposes, rather than public scientific gains.

Therein lies the problem. Resource extraction feels like appropriation because physical matter is being removed from the source and placed in the possession of certain individuals. Until recently, resource extraction from celestial bodies did not conflict with the principle of non-appropriation because it was used for scientific research that ultimately benefited humanity as a whole by directly advancing scientific knowledge.⁷⁰ The lunar surface, for example, was damaged to some degree by the removal of soil samples, but humanity benefited equally from the damage. While some may argue that the commercial exploitation of celestial resources also benefits humanity as a whole by virtue of the products and services that it may yield,⁷¹ those benefits are tangential to the primary commercial benefits enjoyed by private entities.⁷² In the commercial context, humanity at large will not benefit equally from damage to the mined celestial body.

Article II of the OST states "outer 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."⁷³ Article 11 of the Moon Agreement states:

2. The Moon is not subject to national appropriation by any claim of sovereignty, by means of use or occupation, or by any other means.

3. Neither the surface nor the subsurface of the Moon, nor any part thereof or natural resources in place, shall become property of any State, international intergovernmental or nongovernmental organization, national organization or nongovernmental entity or of any natural person. The placement of personnel, space vehicles, equipment, facilities, stations and installations on or below the surface of the Moon, including structures connected with its surface or subsurface, shall not create a right of ownership over the surface or the subsurface of the Moon or any areas thereof. The foregoing provisions are without prejudice to the international regime referred to in paragraph 5 of this article . . .

5. States Parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the exploitation of

68. See Ellen B. Heim, Note, *Exploring the Last Frontiers for Mineral Resources: A Comparison of International Law Regarding the Deep Seabed, Outer Space and Antarctica* 23 VAND. J. TRANSNAT'L L. 819, 830-01 (1990) (describing the various chemical compounds discovered from analysis of the Apollo lunar soil samples).

69. Outer Space Treaty, *supra* note 40, at art. 1 ("There shall be freedom of scientific investigation in outer space, including the Moon and other celestial bodies . . .").

70. *Id.*

71. LEE, *supra* note 36, 160-62.

72. *Id.*

73. Outer Space Treaty, *supra* note 40, at art. II.

the natural resources of the Moon as such exploitation is about to become feasible.⁷⁴

Acknowledging the lack of widespread acceptance of the Moon Agreement and thus the uncertainty as to the force of its provisions, this note first discusses the more firmly established prohibition against national appropriation in Article II of the OST and repeated in Article 11(2) of the Moon Agreement. The note then discusses Article 11(3) and 11(5).

The most relevant ambiguity in the national appropriation provision to this analysis is whether the actions of private and nongovernmental entities constitute a “national” appropriation. There are two competing perspectives. Some legal scholars interpret the ambiguity narrowly and argue that national appropriation means no more than the exercise of sovereignty,⁷⁵ which is the exclusive province of states pursuant to customary international law.⁷⁶

Ricky J. Lee concludes that Article II of the OST, and by extension Article 11(2) of the Moon Agreement, does not prohibit the assertion of title by private nationals as long as the assertion does not amount to an exercise of sovereignty by the state.⁷⁷ Lee cites the historical relationship between the British East India Company and Great Britain as an example of a scenario where a private assertion of title can practically amount to the exercise of sovereignty by a state.⁷⁸ The East India Company’s political and military power in the eighteenth century was comparable to that of small nation states at the time and, much like corporations today, their sphere of influence includes public policy issues such as labor conditions and trade.⁷⁹ This influence practically amounted to a state exercise of sovereignty because it undermined the integrity of domestic decisionmaking by way of cultural imperialism.⁸⁰

Another proponent of the narrow approach is Professor Stephen Gorove, who firmly states that the OST “in its present form appears to contain no prohibition regarding individual appropriation . . . an individual acting on his own be-

74. Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, art. 11, G.A. Res. 34/68 (Dec. 5, 1979) [hereinafter Moon Agreement].

75. See, e.g., Lawrence Riskey, *An Examination of the Need to Amend Space Law to Protect the Private Explorer in Outer Space*, 26 W. ST. U. L. REV. 47, 49 (1999), (“Article 2 of the Outer Space Treaty does not expressly prohibit the private appropriation of . . . celestial bodies.”); Glenn Reynolds & Dave Kopel, *The New Frontier: Preparing the Law for Settling on Mars*, NAT’L REV., (June 4, 2002), <http://www.nationalreview.com/kopel/kopel060402.asp> (“it is widely agreed by space-law scholars that the [OST] forbids only national sovereignty—not private property rights.”).

76. LEE, *supra* note 13, at 341. He argues that customary international law distinguishes between sovereignty (the ability to assert jurisdiction) and appropriation (the ability to obtain exclusive possession), the latter of which is capable of being asserted by both states and private nationals.

77. *Id.*

78. *Id.*

79. Stephen D. Krasner, *Think Again: Sovereignty*, FOREIGN POL’Y (Nov. 20, 2001), http://www.foreignpolicy.com/articles/2001/01/01/think_again_sovereignty.

80. *Id.*

half . . . could lawfully appropriate any part of outer space, including the Moon and other celestial bodies.”⁸¹

Other scholars disagree and argue instead that both Articles II of OST and 11(2) of the Moon Agreement do prohibit the creation of private property rights.⁸² One premise behind this broader approach is that private appropriation will defeat the object and purpose of the principle of non-appropriation, which is to preserve celestial bodies for free exploration and use on a nondiscriminatory basis and for the benefit of all mankind.⁸³

The narrow interpretation is more accurate for several reasons. The Chinese version of the OST⁸⁴ differs from the English, French, and Spanish versions by providing that national appropriation is limited to appropriations by or for the state itself.⁸⁵ This textual variation in the treatment of “national appropriation” becomes problematic in light of the presumption that terms used in a treaty have the same meaning in each authentic text.⁸⁶ Article 33(4) of the Vienna Convention on the Law of Treaties (the “Vienna Convention”) states that where there are different meanings to a provision between equally authentic texts that cannot be resolved by Article 31 or 32 of the Vienna Convention, the meaning that best reconciles the text to the object and purpose of the treaty shall be adopted unless the treaty provides or the parties agree that a particular text prevails.⁸⁷ If a narrow interpretation of national appropriation is adopted, then there is no difference between the authentic texts of the OST. However, if a broad interpretation of national appropriation is adopted, then there is a discrepancy and the various interpretive tools set forth in the Vienna Convention must be employed. The broader interpretation is more consistent with the object and purpose of the OST because of its provisions pertaining to the “benefit of all mankind” and “freedom of use and exploration.”

However, Article 31 and 32 of the Vienna Convention provide adequate interpretive solutions. Article 31 leaves the meaning ambiguous⁸⁸ and thus it is

81. Stephen Gorove, *Interpreting Article II of the Outer Space Treaty*, 37 *FORDHAM L. REV.* 349, 351 (1969).

82. *See, e.g.*, Leslie I. Tennen, *Outer Space: A Preserve for All Humankind*, 2 *HOUS. J. INT'L L.* 145, 149 (1979); Heidi Keefe, Note, *Making the Final Frontier Feasible: A Critical Look at the Current Body of Outer Space Law*, 11 *SANTA CLARA COMPUTER & HIGH TECH. L.J.* 345, 358-59 (1995); Jonathan Thomas, Note, *Privatization of Space Ventures: Proposing a Proven Regulatory Theory for Future Extraterrestrial Appropriation*, 1 *INT'L L. & MGMT. REV.* 191, 200 (2005); and Kelly M. Zullo, Note, *The Need to Clarify the Status of Property Rights in International Space Law*, 90 *GEO. L.J.* 2413, 2423 (2002).

83. *See, e.g.*, Tennen, *supra* note 82, at 149; Zullo, *supra* note 82, at 2423.

84. *See* Outer Space Treaty, *supra* note 40, at art. XVII (the Chinese, English, French, Russian, and Spanish texts are equally authentic versions).

85. LEE, *supra* note 13, at 337.

86. Vienna Convention, *supra* note 57.

87. *Id.*

88. “The context for the purpose of the interpretation of a treaty shall comprise, in addition to the text, including its preamble and annexes: (a) any agreement relating to the treaty which was made between all the parties in . . . conclusion of the treaty; (b) any instrument which was made by one or more parties in . . . conclusion of the treaty and accepted by other parties as an instrument related to the treaty.” *Id.* at art. 31.

appropriate under Article 32 to consult “supplementary means of interpretation, including the preparatory work of the treaty.”⁸⁹ The preparatory work of the treaty supports a narrow interpretation of the phrase. Four international legal organizations prepared draft resolutions with non-appropriation provisions broader than the one that ultimately was included in the OST.⁹⁰ The International Institute of Space Law, for example, supported a ban on private appropriation but it carefully distinguished it from national appropriation by referring to each separately in its often quoted statement: “Celestial bodies or regions on them shall not be subject to national or private appropriation, by claim of sovereignty, by means of use or occupation or by any other means.”⁹¹ The preparatory work of the treaty suggests that the broader interpretation was not included in the OST.

Regardless of how Article II of the OST is interpreted, Article 11(3) of the Moon Agreement seems to prohibit private appropriation. Still, two problems remain with respect to the application of that provision: (1) the ineffectiveness of the Moon Agreement as a whole due to the lack of widespread acceptance of it; and (2) Article 11(3)’s inconsistency with Article 11(5). Although Article 11(3) indicates the drafters of the Moon Agreement unambiguously extended the scope of non-appropriation to apply to private parties, Article 11(5) suggests the drafters also contemplated and specifically made room for the possibility of exploiting the natural resources of the Moon and presumably other celestial bodies as well.

2. OST Articles I and IX

Articles I and IX of the OST contain sibling provisions. Each state in relevant part the following:

The exploration and use of outer space . . . shall be carried out for the benefit and in the interest of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.⁹²

In the exploration and use of outer space . . . States Parties to the Treaty shall . . . conduct all their activities in outer space . . . with due regard to the corresponding interests of all other States Parties to the Treaty . . . If a State Party . . . has reason to believe that an activity or experiment planned by it or its nationals in outer space . . . would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer

89. *Id.* at art. 32.

90. WAYNE N. WHITE, REAL PROPERTY RIGHTS IN OUTER SPACE 2 (1998), http://www.space-settlement-institute.org/Articles/research_library/WayneWhite98.pdf.

91. INTERNATIONAL INSTITUTE OF SPACE LAW, DRAFT RESOLUTION CONCERNING THE LEGAL STATUS OF CELESTIAL BODIES, IN PROCEEDINGS OF THE EIGHTH COLLOQUIUM ON THE LAW OF OUTER SPACE 468 (Andrew G. Haley & Mortimer D. Schwartz eds., 1966).

92. Outer Space Treaty, *supra* note 40, at art. I.

space . . . it shall undertake appropriate international consultations before proceeding with any such activity or experiment.⁹³

There are two major ambiguities in these provisions. It is unclear whether Article I imposes specific obligations on states or whether it is merely an expression of intent to benefit all in a broad, general sense. Even if the first ambiguity could be settled definitively, there still remains the question of how exactly "benefit" should be defined. There is an inherent subjectivity to the definition of "benefit" that plagues any potential for agreement on the issue.

Four perspectives dominate the debate,⁹⁴ each premised on a different definition of "benefit." Some argue that all commercial activity is unlawful because it is by definition not for the "benefit of all," thus violating Article I.⁹⁵ Others interpret it more moderately by recognizing that commercial activity may "benefit all" if some type of community service to all states is provided in conjunction with their for-profit activities.⁹⁶ An example of such community service would be the provision of intergovernmental satellite services provided for in the Amended Convention on the International Mobile Satellite Organization of 1998.⁹⁷ Others take it a step further by arguing that commercial exploitation of space resources is lawful if the goods or services provided through such exploitation are purchased by any party, government or private consumer, on a non-discriminatory basis.⁹⁸ The sale of remote sensing services of the Earth is an example.⁹⁹ Finally, the most liberal perspective argues that commercial exploitation is lawful so long as the nature, structure, or form of the activity does not prevent any other entity from undertaking the same activity in space.¹⁰⁰

Although these ambiguities may at first glance seem impenetrable, this is not the first time the international community has dealt with similar issues. A strikingly similar debate regarding the equitable sharing of benefits arose under maritime law with respect to resources extracted from the deep seabed.¹⁰¹ Aside from prohibiting national appropriation, Article 137 of the United Nations Convention on the Law of the Sea ("UNCLOS") expressly provides that mineral resources shall be vested in mankind as a whole and the economic benefits derived from their exploitation shall be for the benefit of mankind.¹⁰² Interpretation of this provision divides into two main schools of thought. While technologi-

93. Outer Space Treaty, *supra* note 40, at art. IX.

94. See LEE, *supra* note 13, at 324.

95. *Id.*

96. *Id.* at 324-25.

97. See Convention on the International Mobile Satellite Organization, Apr. 24, 1998, 28 U.S.T. 3813.

98. LEE, *supra* note 13, at 324-25.

99. See Principles Relating to Remote Sensing of the Earth from Space, Principle XII, G.A. Res. 41/65, U.N. Doc. A/RES/41/65 (Dec. 3, 1986).

100. LEE, *supra* note 13, at 325.

101. *Id.* at 28.

102. Coffey, *supra* note 67, at 129.

cally advanced, seafaring states took the position that the state that extracted the resource should acquire exclusive property rights, less developed states maintained that the economic benefits from the resources should be equally shared amongst all nations because the deep seabed is the common heritage of mankind.¹⁰³ Like commercial mining entities today, the developed states in the deep seabed debate argued that allowing nations that do not contribute to the extraction of resources to nevertheless reap its benefits would reduce the financial incentive of such operations.¹⁰⁴ To the delight of the developed nations, UNCLOS was amended in 1994 to, among other things, ensure that the management of deep seabed resources would be based on a market-oriented approach.¹⁰⁵

While the deep seabed debate resulted in a pro-mining policy that favored developed nations, a similar debate over Antarctic mining yielded drastically different results. Like the deep seabed and celestial bodies, the Antarctic region has also been designated as an area for international scientific research and environmental preservation.¹⁰⁶ However, unlike the agreements that were reached regarding deep seabed resources, the various treaties that have been entered into regarding Antarctic resources have been highly restrictive. The Protocol on Environmental Protection to the Antarctic Treaty, which entered into force in 1998, not only indefinitely prohibits all mineral resource activity not associated with scientific research, but it also provides that its terms may not be reviewed until 2048.¹⁰⁷ Some believe that this highly restrictive approach to mining in Antarctica was adopted because not enough lucrative resources have been discovered in the region to provide enough of an incentive for the international community to agree to the environmental degradation of the region.¹⁰⁸

The takeaway from the deep seabed and Antarctic examples is that the willingness of the international community to cooperate on these matters rests on a sliding scale. Environmental degradation is a certainty wherever mining occurs. Without substantial, lucrative, and readily ascertainable benefits that may be enjoyed by enough parties, there is not enough of a counterweight to overcome the serious degradation concerns. Unlike Antarctica, the Moon and NEAs contain a wealth of resources that are valuable to the human race. These resources have been discovered in such quantities that a multitude of private entities have already invested millions of dollars to position themselves at the forefront of this emerging race. Through their investments, private investors are telling the community at-large that the benefits of mining are overwhelming. Perhaps it is time for the legal community to lend an ear.

103. *Id.*

104. *Id.* at 130.

105. *See* Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982, *opened for signature* July 28, 1994, G.A. Res. 48/263.

106. Antarctic Treaty of 1959, Dec. 1, 1959, 402 U.N.T.S. 71.

107. Coffey, *supra* note 67, at 130-32.

108. *See id.*

III. PROPOSED SOLUTION

It has been nearly four decades since the failed Moon Agreement entered into force. Now is the time to revisit it. The current body of space law is punctuated with ambiguities that stunt the growth of a commercial space industry that is bursting at the seams. Although the Moon Agreement attempted to clarify some of those ambiguities with respect to commercial ventures, it practically punted most of the issues to a yet to be established international regulatory body to decide at a later date.¹⁰⁹

A logical first step would be to amend the Moon Agreement in a way that would garner more international support. Taking a lesson from history, the changes to the laws governing the commercial exploitation of space resources should be modeled after the laws governing the deep seabed. International law regards the deep seabed as a common heritage of mankind that contains a wealth of profitable natural resources. A necessary part of amending the Moon Agreement would be to give force to Article 11(5), which provides for the establishment of an international regime to govern the mining of celestial resources. This is perhaps the most important amendment because any governing body that is established would presumably have some authority over resolving any remaining ambiguities. As Professor Carl Christol explained, an intergovernmental organization charged with governing celestial mining is the most efficient and effective way to maintain open channels of communication among interested parties.¹¹⁰ Because of the relative success of the International Seabed Authority ("ISA") in regulating the exploitation of deep seabed resources, it would be prudent to use the ISA as a skeletal framework.

IV. CONCLUSION

The current body of space law is stunting the growth of the commercial space mining industry. Four of the five space treaties apply to private actors only tangentially, and the most relevant treaty to commercial mining not only lacks the requisite widespread acceptance to bring it into full force, but also has punted on several crucial issues that have at last bubbled to the surface. It is time for the international community to reconvene and amend the Moon Agreement by remodeling it after the laws governing the deep seabed. After an international governing regime is established pursuant to Article 11(5) of the Moon Agreement, there will be a centralized authority to resolve legal ambiguities relating to commercial mining ventures. We stand at the cusp of a new space race. The last star to align is the law.

109. See Moon Agreement, *supra* note 74, at art. 11.

110. Carl Christol, *An International Regime, Including Appropriate Procedures, for the Moon: Article 11, Paragraph 5 of the 1979 Moon Treaty*, in PROCEEDINGS OF TWENTY-THIRD COLLOQUIUM ON THE LAW OF OUTER SPACE 139, 146-47 (1980).