10/8/2009

A Legal Regime for the Mining of Helium-3 on the Moon: U.S. Policy Options

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This article draws upon and develops material in an earlier study by Richard B. Bilder, Eugene N. Cameron, Gerald L. Kulcinski and Harrison H. Schmitt on *Legal Regimes for the Mining of Helium-3 from the Moon* (February 1989), prepared under the auspices of the Wisconsin Center for Space Automation and Robotics (WCSAR) for the National Aeronautics and Space Administration (NASA) (WCSAR-TR-AR3-8901-1) (hereafter "Wisconsin NASA Study"), available online at http://ft.neep.wisc.edu/pdf/wcsar8901-1.pdf. I have also drawn considerably for my discussion of technical aspects of lunar He-3 mining and the potential for He-3 fusion energy on Harrison H. Schmitt, *Return to the Moon: Exploration, Enterprise and Energy in the Human Settlement of Space* (Copernicus Books-Praxis Publ. Ltd. 2006) (hereafter "Schmitt, *Return to the Moon*").

I wish to express my appreciation for helpful comments to Professor Gerald L. Kulcinski, Grainger Professor of Nuclear Engineering and Director of the Fusion Technology Institute at the University of Wisconsin-Madison; Professor John F. Santarius, Associate Director of the Fusion Technology Institute at the University of Wisconsin-Madison; Dr. (and former Senator) Harrison H. Schmitt, who conducted geological studies on the Moon as a member of the crew of the 1972 Apollo 17 lunar landing mission; and Professor Bernard Oxman of the University of Miami Law School. However, their generous assistance should not be regarded as necessarily indicating their agreement with my legal analysis or policy suggestions.

During the past several years, the United States and three of the world's other leading space powers – Russia, China, and India – have each announced their intent to establish a base on the Moon, in part with the purpose – or, in the case of the United States, at least exploratory goal – of seeking to mine and bring to Earth Helium-3 (He-3), an isotope of helium rarely found naturally on Earth but believed to be present in large amounts as a component of the lunar soil.[1] The potential value of He-3 is that it is

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[1] On January 14, 2004, President George W. Bush committed the United States to a long-term human and robotic program to explore the solar system, starting with a return to the Moon by 2020. See, e.g., "President Bush Announces New Vision for Space Exploration Program," January 14, 2004, http://www.whitehouse.gov/news/releases/2004/01/20040114-1.html; D.E. Sawyer and R.W. Stevenson, "Bush Backs Goal of Flight to the Moon to Establish Base," *N.Y. Times*, Jan. 15, 2004, p.1. "Bush unveils vision for moon and beyond" (Jan. 15, 2004), http://www.cnn.com/2004/TECH/space/01/14/bushspace/index.html. In December 2006, NASA announced more detailed plans for a U.S. return to the Moon by 2020 and the establishment of a permanent lunar base by as early as 2024. See, e.g., Warren E. Leary, "NASA Plans Permanent Base on the Moon for Exploration," *N.Y. Times*, Dec. 5, 2006, at p.9, and Marc Kaufman, "NASA Plans Lunar Outpost," http://www.washingtonpost.com/wp-dyn/content/article/2006/12/04/AR2. In May, 2007, NASA released *The Global Exploration Strategy: The Framework for Coordination*, a document developed by fourteen national space agencies, including NASA, presenting a vision and plan for international collaboration in space exploration, including exploration of the Moon (available at http://www.nasa.gov/pdf/178109main_ges_framework.pdf), The Global Exploration Strategy notes, *inter alia*, that: "Finally, the Moon's known abundance of Helium-3 could prove valuable if fusion reactors ever become feasible in the future" (at p.11) and includes among its list of goals for future lunar missions the study of lunar helium-3 for "fusion reactors on Earth" to "reduce Earth's reliance on fossil fuels." According to Mark Williams, "Mining the Moon," [MIT] *Technology Review*, Aug. 23, 2007, "While the U.S. Space Agency has neither announced nor denied any desire to mine helium-3, it has nevertheless placed advocates of mining helium-3 in influential positions," http://www.technologyreview.com/Energy/19296/. On June 18, 2009, NASA launched its Lunar Reconnaissance Orbiter to conduct investigations to prepare and support future human exploration to the Moon. See http://lro.gsfcanusa.gov; Jeffrey Kluger, "U.S. Shoots for the Moon, This Time to Stay," http://www.time.com/time/health/article/0,85999,1905344.00.html. However, on the possible impact of budgetary limitations on NASA's proposed lunar programs, see, e.g., Dennis Overbye, "NASA Panel Grapples With Cost of Space Plans", *N.Y. Times*, Aug. 13, 2009, at p.A17; Kenneth Chang, "Behind Moon Travel Goal, Big Talk and Little Money", *id*., Aug. 25, 2009, at p.D2; Robert S. Boyd, "NASA can't pay for Moon Effort", *Wisconsin State Journal*, Sept. 4, 2009, at p.A12.

On Russia, see, e.g., "Russia to launch industrial mining of helium-3 on Moon in 2020," March 17, 2006, http://English.pravda.ra/science/tech/17-03-2006/77404-moon-0, stating that

> "According to an official statement released in January, the mining of helium-3 on the Moon will be the main purpose of the Russian Space exploration program. 'We are planning to set up a permanent station on the Moon by 2015. The industrial mining of helium-3, a rare isotope, is expected to begin on the Moon in 2020' said Nikolai Sevastyanov, head of the Rocket and Space Corporation *Energia*."

See also "Russia Plans mine on the Moon by 2020," Agence France press, Jan. 26, 2006, http://www.spacedaily.com/reports/Russia_Plans_Mine_on_the_M.

On China, see, e.g., Melinda Liu and Mary Carmichael, "To Reach for the Moon: China's lunar program is about more than national pride. Try this: a limitless supply of clean, safe energy," *Newsweek*,

theoretically an ideal fuel for thermonuclear fusion power reactors, which could serve as a virtually limitless source of safe and non-polluting energy.[2] For example, it is estimated that 40 tons of liquefied He-3 brought from the Moon to the Earth – about the

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Feb. 12, 2007, http://www.msnbc.msn.com/id/16960411/site/newsweek/print/i/disp.; "China's New Moon Mission Blasts Off – Is Mining Helium 3 the Ultimate Goal?," (Oct. 25, 2007), http://www.dailygalaxy.com.my-webing/2007/10/china-newmoon; "Cosmo chemist and geochemist Organg Ziyuan from the Chinese Academy of Sciences who is now in charge of the Chinese Lunar Exploration program has already stated on many occasions that one of the many goals of the program would be the mining of helium-3" from which "each year three space shuttle missions could bring enough fuel for all human beings across the world", http://www.chinadaily.com.cn.cndy/2006-07/content_649325.htm; "China tools up for Asian space race," http://www.spacedaily.com/reports/China_tools_up_for_Asian_space.

On India, see, e.g., Somini Segupta, "India, Launching Orbiter, Plans to Seek Uranium [sic] on the Moon," *N.Y. Times*, Oct. 22, 2008, at p.A8; "Helium-3 sparks interest in moon," (23 Oct. 2008), http://timesofindia.indiatimes.com/HealthSci/Helium3_sparks_inter; "India: Moon Mission, Quest for Helium 3," Oct. 22, 2008, http://intellibriefs.blogspot.com/2008/10/india-moon-mission-quest.

And, see, generally, e.g., Adrein Bloomfield, "Russia sees moonplot in NASA Plans," 13 Aug. 2007, http://www.telegraph.co.uk/news/main.jhtml?xml=/news/2007/05/0, reporting that many countries, including the U.S., Russia, Germany, India and China are taking the possibility of mining lunar He-3 "very seriously"; Mark Williams, "Mining the Moon," [MIT] *Technology Review*, Aug. 23, 2007, http://www.technology_review.com/Energy/19296/; Jeffrey Kluger, "40 years later, It's Moon Race 2.0," *Time*, Nov. 13, 2008, www.time.com/time/magazine/article/0.9171.1858878.00.htm; John Lasker, "Race to the Moon for Nuclear Fuel," Dec. 15, 2006, http://www.wired.com/science/space/news/2006/12/72216.

Japan is also planning a manned mission to the Moon by 2020 and a manned lunar base by 2030. See, e.g., Michio Kaku, "The New Race for the Moon," *Wall St. J.*, June 23, 2009, p.A13. More broadly, for a description of recent activities of member states of the UN Committee on the Peaceful Uses of Outer Space (COPUOS) relating to the Moon, see Note by the UN Secretariat for the COPUOS Legal Committee for its Forty-Eighth Session, Vienna, 23 March-3 April 2009 on "Activities being carried out or to be carried out on the Moon …," UNGA A/AC.105/C.2/L.271/Add. 1, 22 Oct. 2008.

[2] See L.J. Wittenberg, J.F. Santarius and G.L. Kulcinski, "Lunar Source of He-3 for commercial fusion power," 10 *Fusion* Technology 167 (1986), and discussions in Wisconsin NASA Study and Schmitt, *Return to the Moon*, note * *supra*. And see generally, e.g., Harrison H. Schmitt, "Mining the Moon," *Popular Mechanics* (Oct. 2004), http://www.popularmechanics.com/science/air_space/1283056.html; Julie Wakefield, "Researchers and Space Enthusiasts see helium-3 as the perfect fuel source," 30 June, 2000, http://www.space.com/science_astronomy/helium3_000630.html; Mark Williams, "Mining the Moon," [MIT] *Technology Review*, Aug. 23, 2007, http://www.technologyreview.com/Energy/19296/; Lawrence E. Joseph, "Who Will Mine the Moon?," *N.Y. Times* (Op. Ed.), Jan. 19, 1995, p.A19 (in which he asks "Will the Moon become the Persian Gulf of the 21st Century?"); ABC Online, "Moon Gas may solve Earth's energy crisis," Nov. 26, 2004, http://www.abc.net.au/newsitems/200411/S1252715.htm; Timothy Freeman, "A New Pathway to the Stars," *N.Y. Times* (Op. Ed.), Dec. 21, 2003, http://www.nytimes.com/2003/12/21/opinion/a-new-pathway-to-the-stars.html; "Moon's Helium-3 Could Power Earth," http://www.space.com/scienceastronomy/helium3_000630.html; Gary Cramer, "There's Helium-3 in Them There Moon Hills!" http://www.direct.ca/trinity/helium3.htm.

In *Moon*, a recently released (June 12, 2009) science fiction movie, directed by Duncan Jones and starring Sam Rockwell, the protagonist is an astronaut sent to the Moon on contract with a private Japanese company to mine Helium-3 to be used in terrestrial fusion energy reactors which are, so the movie posits, then supplying 70% of the world's energy. See http://www.sonypictures.com/classics/moon/, http://www.imdb.com/title/tt1182345. And see also "Is Moon's sci-fi vision of helium 3 mining based on reality?" *Scientific American*, "60-Second Science Blog," June 12, 2009, http://www.scientificamerican.com/blog/60_second_science.

amount that would comfortably fit in the cargo bays of two of the existing U.S. space shuttles – would provide sufficient fuel for He-3 based fusion reactors to meet the full electrical needs of the United States – or a quarter of the entire world's electrical needs – for an entire year.[3]

While the technological and economic feasibility of fusion-based nuclear energy – and particularly fusion reactors utilizing He-3 as fuel – is still uncertain and contested, and its commercial realization at best decades away, the implications of such a development could be far-reaching and profound. Fusion energy could significantly reduce the world's heavy dependence on fossil fuels, with their accompanying problems of environmental pollution, the emission of greenhouse gases, and global warming – not to mention their rising price and role in recurrent geopolitical and economic tensions. Fusion energy could also provide a safer alternative to many countries' growing reliance on energy from nuclear fission reactors, with their dangers of nuclear accidents and terrorism, weapons proliferation, and radioactive waste disposal. And, in contrast to the threat of depletion of terrestrial fossil fuels, it is estimated that there is sufficient He-3 present on the Moon to meet humanity's rapidly growing energy needs for many centuries to come. Thus, it is not surprising that, despite the problematic future of He-3-based fusion energy, the United States and other major powers are beginning to position themselves so as to ensure their future access to lunar He-3 resources.

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[3] Estimate given to author by Professor Gerald Kulcinski, Director of the Fusion Technology Institute, University of Wisconsin-Madison, *supra* note *. Compare Schmitt, *Return to the Moon*, *supra*, note *, at p.5: "One metric tonne (2200 lbs.) of helium-3 fused with deuterium … has enough energy to supply a city of 10 million, or one sixth of the population of the United Kingdom, with a year's worth of electricity, or over 10 gigawatts of power for that year." For earlier estimates see, e.g., Wisconsin NASA Study, note * *supra*, p.32; G.L. Kulcinski and H.H. Schmitt, "The moon: an abundant source of clean and safe fusion fuel for the 21st century, 11th International Scientific Forum on Fueling the 21st Century," October 1987, Moscow, USSR (1987); The Artemis Project, "Lunar Helium as an Energy Source in a Nutshell," http://www.asi.org/adb/02/09/hee3-intro.html.

However, this growing interest in lunar He-3 poses its own problems. As yet, there is no international consensus on whether, or how, any nation or private entity can exploit or acquire title to lunar resources. The UN-developed 1967 Outer Space Treaty[4] does not specifically address this question. While a related UN-sponsored 1979 Moon Agreement[5] (frequently referred to as "the Moon Treaty") purports to lay the groundwork for the eventual establishment of a regime for the exploitation of lunar resources, that agreement has thus far been ratified by only a very few countries – not including the U.S. and none of which are currently leading space powers. Absent an agreed international legal framework, attempts by the United States or any other nation or private entity to acquire and bring to Earth significant quantities of He-3 could give rise to controversy and conflict. Indeed, without the security of an established legal regime, nations or private entities might well be reluctant to commit the very substantial money, effort and resources necessary to mine, process and transport back to Earth the amounts of lunar He-3 sufficient to support the broad-scale terrestrial development of He-3-based fusion energy.

Consequently, it seems timely to revisit the question of the legal regime potentially applicable to exploiting He-3 and other lunar resources.[6] This article will

[4] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies. Done at Washington, London and Moscow on January 27, 1967, entered into force October 10, 1967, 18 U.S.T. 2410, T.I.A.S. No. 6347, 610 U.N.T.S. 205, 6 I.L.M. 386 (1967) (hereafter "Outer Space Treaty").

[5] Agreement on the Activities of States on the Moon and Other Celestial Bodies, G.A. Res. 34/68, 5 Dec. 1979, U.N. GAOR, 34th Sess. Supp. No. 46, U.N. Doc. A/34/664 (1979), entered into force 11 July 1984, 1363 U.N.T.S. 3, 18 *ILM* 1434 (1984) (hereafter "Moon Agreement"). While the Agreement is referred to by the U.N. and will be referred to in this article as "the Moon Agreement", it is more commonly referred to in the relevant literature as "the Moon Treaty".

[6] The Moon Agreement, and the question of the legal regime applicable to the exploitation of lunar resources, has spawned a surprisingly extensive literature, particularly in the early 1980's following the

Moon Agreement's completion by the U.N. Committee on the Peaceful Uses of Outer Space (COPUOS) and its submission for consideration by the U.S. and other states.

See, particularly, Wisconsin NASA Study, Chpts. V, VII and VIII and Schmitt, *Return to the Moon*, Chpt. 12, note * *supra*; and *The Moon Treaty*: Hearings before the Subcommittee on Science, Technology, and Space of the committee on Commerce and Transportation, U.S. Senate, 96th Cong., 2d Session (July 29 and 31, 1980), Serial No. 96-115 (hereafter referred to as "1980 Senate Hearings"), with three accompanying Committee Prints containing the text of the Agreement and three studies requested for the use of the Senate Committee: Part 1 – an analytical study by Eilene Galloway of the background, history of negotiations, comparison with other international documents, and issues raised by the Moon Agreement; Part 3 – an Office of Technology Assessment study of technologies and possibilities for the exploitation of extraterrestrial resources and an analysis of issues, constraints and possible congressional actions regarding the Moon Agreement; and Part 4 – a Congressional Research Service study review of the technological, foreign policy and legal issues which may arise in connection with examination of the Moon Agreement (hereafter "1980 Senate Committee studies"); M.J. Peterson, *International Regimes for the Final Frontier* (State Univ. of N.Y. Press, 2005), Chpt. 7; Virgiliu Pop, *Who Owns the Moon: Extraterrestral Aspects of Land and Mineral Resources Ownership* (Springer 2009); Glen H. Reynolds and Robert P. Merges, *Outer Space: Problems of Law and Policy* (Westview Press, 2nd ed. 1997), pp. 105-166 (collecting articles, with comments); K. Baslar, *The Concept of the Common Heritage of Mankind in International Law* (Martinus Nijhoff 1998, Chpt. 5; C. O. Christol, *The Modern International Law of Outer Space* (Pergamon Press, 1982), at pp. 225-31; International Law Association, Sixtieth Report (Montreal, 1982), *Report of the Space Law Committee*, on "The Conflicts in the Interpretation of the Leading Principles of the Moon Treaty of 1979" (Professor D. Goedhuis), pp. 12, 419-530.

Among the many relevant articles, see, e.g., Nathan C. Goldman, "The Moon Treaty: Reflections on the Proposed Moon Treaty, Space and the Future" in J.E. Katy (Ed.), *People in Space* (1985), pp. 140-49; S.M. Williams, "International Law before and after the Moon Agreement," 7 *International Relations*, 1168-93 (1981); S.M. Williams, "The Law of Outer Space and Natural Resources," 36 *Intl. & Comp. L.Q.* 142 (1987); Dula, "Free Enterprise and the Proposed Moon Treaty," 2 *Houston J. Intl. L.* 3 (1979); Blaser, "The Common Heritage in Its Infinite Variety: Space Law and the Moon in the 1990's," 5 *J. of Space Law and Technology* 79 (1990); C. Joyner, "Legal Implications of the Concept of the Common Heritage of Mankind," 35 *Intl. and Comp. L.Q.* 190 (1986); Cheng, "The Moon Treaty," 33 *Current Legal Problems* 213 (1980); M.E. Davis and R.J. Lee, "Twenty Years After: The Moon Agreement and Its Legal Controversies," 1999 *Australian Intl. L.J.* 9; C. Christol, "The Common Heritage of Mankind Provision in the 1979 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies," 14 *Intl. Lawyer* 429 (1980); E. Galloway, "Issues in Implementing the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies," *Proceedings of the Twenty-Third Colloquium on the Law of Outer Space* 19 (1980); Walsh, "Controversial Issues Under Article XI of the Moon Treaty," 5 *Annals of Air and Space Law* 489 (1981); Goedhuis, "Some Recent Trends in the Interpretation and the Implementation of the Rules of International Space Law," 19 *Colum. J. Transnatl. L.* 213 (1981); Webber, "Extraterrestrial Law on the Final Frontier: A Regime to Govern the Development of Celestial Body Resources," 71 *Georgetown L.J.* 1426 (1983); K.N. Rao, "Common Heritage of Mankind and the Moon Treaty," 21 *Indian J. of Intl. L.* 275 (1981); Zullo, "The Need to Clarify the Status of Property Rights in International Space Law," 90 *Georgetown L.J.* 2413 (2002); N. Tannenwald, "Law Versus Power on the High Frontier: The Case for a Rule-Based Regime for Outer Space," 29 *Yale J. Intl. L.* 363 (2004); Danilenko, "The Concept of the Common Heritage of Mankind in International Law," 13 *Annals of Air and Space Law* 247 (1988); Note: "Exploring the Last Frontiers for Mineral Resources: Comparison of International Law Regimes for the Seabed, Outer Space and Antarctica," 23 *Vand. J. Transnatl. L.* 819 (1990); Note: "A Reasonable Approach to Resource Development in Outer Space," 12 *Loyola L.A. Intl. & Comp. L.J.* 615 (1990); Dula, "A Kinder, Gentler Moon Treaty: A Critical Review of the Current Moon Treaty and Proposed Alternative," 33 *Indian J. Intl. L.* 1 (1993); Hoffstadt, "Moving the Heavens: Lunar Mining and the Common Heritage of Mankind in the Moon Treaty," 42 *U.C.L.A. L. Rev.* 575 (1994); Rana, "The Common Heritage of Mankind on the Final Frontier," 26 *Rutgers L. Rev.* 225 (1994); Goedhuis, "Conflicts in the Interpretation of the Leading Principles of the Moon Treaty of 5 December 1979," 28 *Neth. Intl. L. Rev.* 14 (1981); Lyall, "On the Moon," 26 *J. of Space L.* 129 (1998); Jasentuliyana, "The United Nations Space Treaties and the Common Heritage Principle," 2(4) *Space Policy* 296 (1986); Walsh,

briefly discuss: (1) the technical and economic prospects for the development of He-3-based fusion energy; (2) the present legal situation concerning the exploitation of lunar resources such as He-3; and (3) some possible policy options for the U.S. regarding the establishment of an international legal regime capable of facilitating the development of He-3-based fusion energy.

I. The Prospects for He-3-Based Fusion Energy[7]

Helium-3 is a component of the "solar wind" of gas and charged particles continuously emitted by the sun into the solar system in the course of its thermonuclear fusion processes.[8] During more than four billion years in which the solar wind has impacted the Moon, significant amounts of He-3, as well as particles of other ionized components of the solar wind, have become embedded in the Moon's regolith – the loose

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"Controversial Issues Under Article XI of the Moon Treaty," 5 *Annals of Air & Space Law* 489 (1981); Doyle, "Legal and Policy Implications of Treating Resources as the Common Heritage of Mankind," *Proceedings of the 29th Colloquium on the Law of Outer Space* (1986) at pp. 31-37.

[7] See particularly, L.J. Wittenberg, J.F. Santarius and G.L. Kulcinski (1986) "Lunar Source of He-3 for commercial fusion power," 10 *Fusion Technology* 167 (1986); L.J. Wittenberg, E.N. Cameron, G.L. Kulcinski, S.H. Ott, J.F. Santarius, G.I. Sviatoslovsky and H.E. Thompson, "A Review of Helium-3 Resources and Acquisition for Use as a Fusion Fuel," 21 *Fusion Technology* 2230 (1992), and e.g., Wisconsin NASA Study, *supra* note *, Chpts. III and IV; Schmitt, *Return to the Moon*, *supra* note *, Chpt. 5, 6 and 7; G.L. Kulcinski and H.H. Schmitt, "Fusion power from lunar resources," 21 *Fusion Technology* 2221 (1992); Artemis Project, "Lunar Helium as an Energy Source, in a Nutshell," http://www.asl.org/adb/02/09/he-3-intro.html.; J. Wakefield, "Researchers and space enthusiasts see helium-3 as the perfect fuel source," http://www.space.com/scienceastronomy/helium3_000630.html.

For a description of the University of Wisconsin Fusion Technology Institute's Wisconsin Center for Space Automation and Robotics (WCSAR) research on the development of He-3 energy and a sampling of media coverage regarding He-3, see e.g. the WCSAR website, http://fti.neep.wisc.edu/Research/he3-pubs.html., and, more generally, John Lasker, "Future in Fusion? UW team involved in controversial 'race' to harness moon's energy," [Madison, WI] *Capital Times*, Dec. 23-24, 2006, p.1, http://fti.neep.wisc.edu/gallery/pdf.ct122206.pdf.

[8] Normal helium (He-4), familiar as the gas used for balloons and blimps, has two protons and two neutrons in its nucleus. Helium-3 (He-3) is a light, non-radioactive isotope of helium which has two protons but only one neutron in its nucleus. The sun produces helium by fusing hydrogen atoms together, releasing enormous amounts of energy, but about one in every ten thousand helium atoms comes out, missing a neutron, as He-3. For brief popular descriptions, see "Helium-3," http://en.wikipedia.org.wiki/helium3; Artemis Project, "Lunar Helium as an Energy Source, in a Nutshell," http://www.asi.org/aab/02/09/he.3-intro.html, *supra* note 3.

and dusty upper layer of rocks and soil comprising much of the Moon's surface. While He-3 constitutes only a minute proportion of the lunar regolith, it is estimated that, altogether, there may be as much as one million metric tons of He-3 potentially recoverable from the Moon's surface.[9] This amount of He-3 is theoretically equivalent to ten times the energy content of all of the coal, oil and natural gas economically recoverable on Earth.[10] Since the Earth – unlike the Moon – possesses a magnetic field and atmosphere which deflect the solar wind, He-3 is rarely found naturally on Earth. The small amounts of He-3 available for research and experiment on Earth are derived principally from the decay of tritium used in thermonuclear weapons.

While interest in lunar He-3 relates to its potential use as a fuel for thermonuclear power reactors – most likely, together with deuterium (D), an isotope of hydrogen, in an He-3-D fuel cycle – the technological and economic feasibility of fusion power itself has yet to be demonstrated.[11] Unlike the engineering and material requirements for power production in the uranium and plutonium-fueled nuclear fission reactors now operating in the U.S. and a number of other countries, the production of power by thermonuclear fusion requires the containment of ionized plasmas at extremely high temperatures – a feat not easily or economically achievable with present materials and technology.

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[9] See L.J. Wittenberg, J.F. Santarius and G.L. Kulcinski, "Lunar Source of He-3 for commercial fusion power," 10 *Fusion Technology* 167 (1986); Wisconsin NASA Study, *supra* note *, p.30.

[10] L.J. Wittenberg et al., note 10, *supra*; Wisconsin NASA Study, *supra* note *, p.32.

[11] See generally, e.g., T.K. Fowler, *The Fusion Quest* (Johns Hopkins Press, 1997); Institute of Physics Report, "Fusion as an Energy Source: Challenge and Opportunities" (Sept. 2008), http://www.iop.org/activity/policy/publications/file_31695.pdf. For more popular introductions to nuclear fusion, see "Nuclear Fusion," http://en.wikipedia.org/wiki/Nuclear_fusion; "How Nuclear Fusion Reactors Work," http://science.howstuffworks.com/fusion-reactor.htm.

For expressions of skepticism concerning the practicality of nuclear fusion, see, e.g., "Nuclear Fusion: Its impossible. And what's more, It's improbable," *The Economist*, July 20, 2002, p.69; Editorial: "Nuclear fusion must be worth the gamble," *New Scientist*, 7 June 2006; Institute of Physics Report, *supra*, Sec. 7, "Six Challenges for Fusion."

Nevertheless, the enormous potential of fusion energy continues to spur persistent and intensive efforts to overcome these obstacles. One of the most significant of these is the recent establishment, by a consortium of the European Union (through EURATOM), the U.S., the Russian Federation, the People's Republic of China, Japan, the Republic of Korea and India – of ITER, a large-scale international experimental research project designed to explore the scientific and engineering feasibility of magnetic containment fusion power production.[12] The program will be located at Cadarache, France and is expected to cost over U.S. $12 billion and to continue for 30 years.[13]

For a number of reasons, including the present limited availability of He-3 and the very high temperatures required to achieve an He-3-D fusion reaction, most current research – including the ITER experimental program – and any first generation fusion power reactors will likely be based upon a fuel cycle involving the fusion of deuterium (D) and tritium (T), two isotopes of hydrogen available on Earth and capable of fusing at considerably lower temperatures than required for an He-3-D-based fusion reaction.[14]

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[12] ITER is the acronym for International Thermonuclear Experimental Reactor (and also means "the way" in Latin). For a description of its history and mission, see the ITER website at http://www.iter.org/a/home/htm. The ITER agreement was signed on November 21, 2006. See, e.g., "World Briefing: France: Countries Agree to Pursue Fusion Energy," *N.Y. Times*, Nov. 22, 2006, p.A5. For U.S. Congressional authorization of U.S. participation in ITER, see P.L. 109-58, sec. 972c.

[13] *Ibid.*

Another different major experimental approach, attempting to utilize lasers to achieve nuclear fusion and produce energy, is the National Ignition Facility (NIF), located at Livermore, California. See, e.g., William J. Brood, "In Hot Pursuit of Fusion (or Folly): In a $3.5 billion colossus of light and mirrors, scientists dream of kindling the power of the stars," *N.Y. Times* (*Science Times*), May 26, 2009, at D1; "The National Ignition Facility: On target, finally," *The Economist*, May 30, 2009, at p.81. For an expression of doubts regarding the likelihood of success of the NIF, see, e.g., Editorial, "The Hoped for Laser Miracles," *N.Y. Times*, May 29, 2007, at A22.

[14] See, e.g., Wisconsin NASA Study, *supra* note *, at pp. 13-17; Schmitt, *Return to the Moon*, *supra* note *, at pp. 40-42, 64-65, and, generally, the references in note 11, *supra*.

In a deuterium-tritium fuel cycle, the nucleus of deuterium, a stable isotope of hydrogen (an element whose nucleus contains only one proton and no neutrons) containing one proton and one neutron, comes together in a fusion reaction with the nucleus of tritium, a radioactive isotope of hydrogen containing one proton and two neutrons, to create a helium nucleus consisting of two protons and two

However, if and when technically achievable, an He-3-D fuel cycle would theoretically offer very significant advantages as compared with the D-T fuel cycle. This would be chiefly because, unlike a D-T fusion reaction which results in considerable neutron radiation, an He-3-D fusion reaction would produce little radioactivity as well as a substantially higher proportion of directly usable energy.[15] More specifically, the comparative advantages of an He-3-D fuel cycle over a D-T fuel cycle would include: (1) increased electrical conversion efficiency; (2) reduced radiation damage to containment vessels, obviating the need for frequent expensive replacement; (3) reduced radioactive waste, with consequent reduced costs of protection and disposal; (4) increased levels of safety in the event of accident; and (5) potentially lower costs of electricity production.[16] In particular, since an He-3-D fusion reaction, unlike a D-T reaction, would produce few neutrons, it could not be readily employed to produce plutonium or other weapons-grade fissile materials and would consequently significantly reduce risks

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neutrons, releasing a high energy neutron. The technical description of the reaction is D + T → n (14.07 MeV) + HE-4 (3.52 MeV), the energy released being 17.6 MeV (million electron volts).

[15] See, e.g., J.F. Santarius, "Overview Poster on D-He-3 Fusion: Physics, Engineering and Applications," Fusion Technology Institute, University of Wisconsin, WCSAR website http://fti.neep.wisc.edu/proj?hm+he3es; G.. Kulcinski, "Using Lunar Helium-3 to generate Nuclear Power without the Production of Nuclear Waste," presented at the 20th International Space Development Conference, Albuquerque, New Mexico, May 24-28, 2001; Schmitt, "Return to the Moon," note * *supra*, pp. 43-47, 65-67; Wikipedia, "Helium 3," *supra* note 8, and Arternis Project, "Lunar Helium-3 as an Energy Source in a Nutshell," http://www.asi.org/adb/02/09/he3-intro.html (*supra* note 8).

In a helium-3-deuterium fuel cycle, the helium-3 nucleus, consisting of two protons and one neutron captures the extra neutron of deuterium in a fusion reaction to create normal helium-4 and emit a proton. Since the product weighs less than the initial components, the missing mass is converted to energy. The technical description of the reaction is D + He-3 → p (14.68 MeV) + He-4 (3.67 MeV). One kilogram of He-3 burned in a fusion reactor with 0.67 kilograms of deuterium will theoretically produce about 19 megawatt years of energy output.

In a helium-3-helium-3 fusion reaction, two helium-3 nuclei, each consisting of two protons and one neutron, would fuse to produce one helium-4 nucleus, consisting of two protons and two neutrons and two high energy protons. The technical description of the reaction is He-3 + He-3 → 2p + He-4 (12.86 MeV). However, while such a "third generation" fuel cycle would theoretically produce no neutrons and thus no radioactivity whatsoever, it would require such high temperatures as to be presently impractical.

[16] See, e.g., J.F. Santarius, WCSAR poster, *supra* note 15; Wisconsin NASA Study, *supra* note *, pp. 17-22; Schmitt, *Return to the Moon*, *supra* note *, especially pp. 43-47.

of nuclear proliferation.[17] Consequently, interest in the eventual development of He-3 fueled thermonuclear energy is likely to continue.

How would lunar He-3 be extracted and transported to Earth?[18] Since the solar wind components are weakly bound to the lunar regolith, it should be relatively easy to extract them utilizing reasonable extensions of existing technology. Thus, under one proposed scenario, once a lunar base is established, robotic lunar mining vehicles fitted with solar heat collectors would: (1) traverse appropriate areas of the Moon's surface – probably, in particular, the lunar maria or "seas" – scooping up the loose upper layer of the lunar regolith and sizing it into small particles; (2) utilize solar energy to process and heat the collected regolith to the temperatures necessary to release, separate and collect in a gaseous state the He-3, as well as certain other solar-wind elements embedded in the regolith particles; (3) discharge the spent regolith back to the lunar surface; and (4) return with the collected He-3 and other gaseous byproducts to the lunar base. The collected He-3 gas could then be liquified in the lunar cold and transported to Earth, perhaps in unmanned remotely-operated shuttles. Importantly, such a mining operation could result in the collection not only of He-3 but also, as byproducts of the collection process, significant amounts of hydrogen, oxygen, nitrogen, carbon dioxide and water, all potentially very useful – indeed, perhaps indispensable – for the establishment and maintenance of a lunar base or further outer space activities such as expeditions to Mars

[17] See J.F. Santarius, G.L. Kulcinski, L.A. El-Guebaly, "A Passively Proliferation-Proof Fusion Power Plant," 44 *Fusion Science and Technology* 289 (Sept. 2003).

[18] See, e.g., Wisconsin NASA Study, *supra* note *, pp. 26-30; Schmitt, *Return to the Moon*, *supra* note *, pp. 111-124.

or other planets.[19] Since He-3 is believed to comprise only a small proportion of the lunar regolith, it will probably be necessary to process large amounts of lunar regolith in order to obtain the quantities of He-3 necessary to sustain a large-scale terrestrial He-3 based power program. However, since the regolith will be discharged back to the Moon's surface immediately after processing, the extraction of He-3 and other solar wind components from the lunar soil seems in itself unlikely to have a significant detrimental impact on the lunar environment or landscape.[20]

Whether the production of lunar He-3-based fusion power will prove commercially viable remains a complex and disputed question. The commercial success of such a development will clearly depend, among other things, on the parallel and integrated achievement, not only of economically efficient He-3 fueled fusion power reactors, but also of a sustainable lunar mining enterprise capable of economically extracting and returning to Earth an assured supply of He-3 to fuel such reactors; neither of these will be worth doing without the other. However, the development of He-3-based fusion need not start from scratch but will likely build on the substantial research and investment already committed to the development of fusion power more generally in ITER and other already ongoing projects. Moreover, the development of lunar He-3 mining can similarly build on -- and indeed form an additional rationale for -- the already

[19] See, R.J. Bula, L.J. Wittenberg, T.W. Tibbits and G.L. Kulcinski, "Potential of Derived Lunar Volatiles for Life Support," in *The Second Conference on Lunar Bases and Space Activities of the 21st Century* (1988), at pp. 547-550, and e.g., Wisconsin NASA Study, *supra* note *, pp. 30-31; Schmitt, *Return to the Moon*, *supra* note *, pp. 5 and, generally, Chpt. 7.

[20] See E.N. Cameron, W.D. Carrier III, G.L. Kulcinski, and H.H. Schmitt, "Net Environmental Aspects of Helium-3 Mining, Phase I: Effect on the Moon," WCSAR (Wisconsin Center for Space Automation and Robotics) – TR-AR3-9012-1 (Oct. 1989, rev. Dec. 1990); G.L. Kulcinski, E.N. Cameron, W.D. Carrier III, and H.H. Schmitt, "Environmental Aspects of Lunar Helium-3 Mining," WCSAR-TR-AR3-9201-5 (Jan. 1992), (prepared for Space 92, The Third International Conference on Engineering, Construction and Operations in Space, 31 May-4 June 1992, Denver, CO).

existing commitment of various space powers to the establishment of lunar bases; as indicated, lunar mining activities may be worth developing not only to extract He-3 from the lunar regolith, but also to obtain a variety of other byproducts highly useful for the support of lunar bases.

Finally, the economic viability of He-3-based fusion power will, of course, depend on its eventual cost of production in comparison to the cost of production of alternative sources of energy such as fossil fuel or other conventional sources of energy, energy produced by nuclear fission reactors, or D-T or otherwise-based fusion energy – all figures difficult to accurately predict at this time. Proponents of He-3-based fusion energy argue that, even taking into consideration the substantial costs involved – costs of developing and operating He-3-based fusion power reactors; establishing, equipping and maintaining an adequate lunar base and He-3 mining operation; and transporting He-3 back to Earth – He-3-based fusion power will eventually be more than competitive with the cost of other types of fossil fuel, fission or fusion energy, and indeed will provide more than sufficient incentive for the potential participation of both government and private capital and enterprise in such an endeavor.[21] But other commentators are more

[21] See, in particular, the detailed discussion of He-3 fusion economics in Schmitt, *Return to the Moon, supra* note *, Chpts. 5, 6, 7 and 8; G.L. Kulcinski, G.A. Emmert, H. Attaya, J.F. Santarius, M.E. Savan, I.N. Sviatoslavsky and L.J. Wittenberg, "Commercial Potential of D-He-3 Fusion Reactors," Proc. 12th Symp. Fusion Engr., Monterey, CA, 1 EEE-87 Ch.2, 567-2, p.772 (1987). Schmitt predicts that He-3 gas could be returned to Earth for under $1 billion per metric ton. Kulcinski adds that, if He-3 was sold for $4 billion per metric ton, He-3 energy would still be a good energy value equivalent of the value of oil at $28 per barrel. (Between May 2008 and May 2009, the price of crude oil ranged from about $147 to $30 per barrel. As of early October, 2009 it was approximately $70 per barrel.) For a report on the problematic future of oil as a world energy source, see, e.g., *Foreign Policy* (Sept/Oct 2009), special issue on "Oil: The Long Goodbye", accessible at http://www.foreignpolicy.com/node/47222.

Apart from its potential use as a fuel for fusion reactors, He-3 has important uses for, *inter alia*, scientific and medical research (e.g. magnetic resonance imaging), neutron detection (e.g. in connection with Department of Homeland Security responsibilities) and cryogenics. According to the University of Wisconsin Fusion Technology Institute, the limited amount of He-3 now available is priced at more than $5000 per gram, which is equivalent to $5 million per kilogram or $5 billion per metric tonne. Of course, this price could be expected to decrease if supplies of lunar He-3 became available.

skeptical, doubting both the technical feasibility of such a complex and challenging development and the likelihood of He-3 based fusion power ever competing successfully with more traditional Earth-based energy systems.[22] Suffice it to say that, as noted, the major space powers currently consider the potential of He-3-based fusion energy sufficiently promising as to warrant their serious interest and to furnish at least an additional rationale for their commitment to programs to establish national stations on the Moon.

II. The Current Legal Situation Regarding Lunar Mining

The most salient place to look for international rules governing the mining of He-3 or other lunar resources is the growing body of "space law" – and, in particular, the UN-developed 1967 Outer Space Treaty and 1979 Moon Agreement. However, while each of these sets out general principles relevant to the exploitation of lunar mining, neither provides a more detailed legal regime for the conduct of such activities.

The 1967 Outer Space Treaty,[23] which as of August 2009 was legally binding on 100 nations, including all of the principal space powers,[24] establishes a broad framework

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[22] See, e.g., testimony of Dr. Timothy D. Swindle in Hearings of the Subcommittee on Space and Aeronautics of House Committee on Science and Technology on "Lunar Science and Resources: Future Options," April 2, 2004, reprinted in http://www.spaceref.com/news/viewsr.html?pid+12414 and *id.* = 12418; Frank Close, "Fear over Factoids," http://physicsworld.com/cws/article/print/30679 (Aug. 3, 2007); "Moon's 'Abundant' Resources Largely an Unknown Quantity," *Science* Magazine, March 12, 2004; discussion in Wikipedia, "Helium-3," http://en.wikipedia.org/wiki/Helium-3; J. Lasker, "Race to the Moon for Nuclear Fuel," *Wired* (Dec. 15, 2006) reporting that Jim Benson, founder of the space contractor Space Development, said that mining the moon for helium-3 doesn't pass the "net energy test" since it would require more energy to retrieve helium-3 and bring it back to Earth than it would yield. But, on the "net energy test" question, see Wittenberg, *et al.* (1992), note 7, *supra*, at p.2244, arguing otherwise.

[23] See note 4, *supra*.

[24] North Korea, which acceded in March, 2009, became the 100th party to the treaty. As of August 2009, the Outer Space Treaty had also been signed by 27 additional states. See http://www.oosa.unvienna.org/oosa/spacelaw/outerspt.html; United Nation's treaties and principles on outer space and related General Assembly resolutions' status of international agreements relating to activities in

for the exploration and use of outer space, including the Moon and other celestial bodies and is widely regarded as the "charter" of international space law. As relevant to possible lunar mining activities, the Treaty provides that the States Parties may "use" the Moon for peaceful purposes, presumably including not only scientific but other activities as well, but that they have a general obligation to share the benefits of such use with all countries (Art. I). The Treaty expressly prohibits any national appropriation by claim of sovereignty, by means of use or occupation, or by any other means over specific territory on the Moon (Art. II), and forbids any barring of "free access" to any area of the Moon or any discriminatory exclusion of any state from the opportunity to explore or make use of the Moon (Art. I). However it recognizes that States Parties may establish stations and other installations on the Moon (Art. XII), that a state establishing such stations or conducting such activities has the right to exercise jurisdiction over such installations and its own personnel (Art. VIII), and that such activities may be carried out by nongovernmental entities (Art. VI) or through international organizations or joint enterprises (Art. XIII). Notably, while the Outer Space Treaty would seem to bar the assertion of exclusive national or other territorial claims to particular lunar mining sites, the treaty appears permissive in allowing a party to the Treaty to make "use" of lunar resources, subject to certain general environmental, notification, inspection and other constraints. [25] Moreover, nothing in the Treaty appears to preclude the possibility of the conduct of lunar mining activities by States Parties, intergovernmental organizations or private enterprises, or the ownership by such entities of resources removed from the

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outer space as at 1 January 2009, Addendum, UN Ref. Sales No. E08.I.10.ST/SPACE/11/REV2/Add2E (Aug. 2009).

[25] See, e.g., Schmitt, *Return to the Moon*, pp. 282-86.

Moon – although the Treaty provides, in some unspecified sense and to some unclear extent, that any such "use" of lunar resources should inure to the benefit and in the interests of all countries.

As its name indicates, the 1979 Moon Agreement,[26] which was developed within the UN Committee on the Peaceful Uses of Outer Space (COPUOS)[27] and entered into force in 1984, was intended to supplement the Outer Space Treaty by dealing more specifically with potential human activities on the Moon and other celestial bodies within the solar system, other than Earth. As of January 2009, it has been ratified by only thirteen countries – Australia, Austria, Belgium, Chile, Kazakhstan, Lebanon, Mexico, Morocco, The Netherlands, Pakistan, Peru, Philippines, and Uruguay – none of which are presently engaged in significant space activities.[28] However, while the Moon Agreement presently has few parties and is, in any case, not legally binding on either the U.S. or any other current or likely major "space power", it is nevertheless likely to form at least the

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[26] See note 5, *supra*.

[27] The UN Committee on the Peaceful Uses of Outer Space (COPUOS), originally consisting of 18 nations members, has now grown to 53 nations members. See http://www.oosa.unvienna.org.oosa/copuos/copuos.html.

For extensive discussions of the negotiation of the Moon Agreement in COPUOS, see 1980 Senate Hearings, *supra* note * and particularly the testimony and written statement and submitted answers to Committee questions by Roberts B. Owens, Legal Adviser, U.S. Department of State, at pp. 3-27 of the Hearings and S. Neil Hosenball, Chairman, U.S. Delegation to COPUOS and General Counsel of NASA at pp. 46-67 of the Hearings; the accompanying 1980 Senate Committee Studies, Part I by Mrs. Eileen Galloway; M.J. Peterson, *International Regimes for the Final Frontier* (State Univ. of N.Y. Press, 2008), Chpt. 7; Judge H. Tuerk, "The Negotiation of the Moon Agreement," International Institute of Space Law (IISL) and European Centre for Space Law (ECSL) Space Law Symposium 2009 on "30th Anniversary of the 'Moon Agreement': Retrospects and Prospects," Vienna, 23 March 2009, at www.oosa.unvienna.org/pdf/pres/psc2009/sympoo.pdf. And see, generally, discussion in many of references in note 6, *supra*.

[28] As of January 2009, in addition to the 13 states parties to the Moon Agreement, four other states had signed but not yet ratified the Agreement: France, Guatemala, India and Romania. See United Nations Office for Outer Space Affairs, "Status of International Agreements relating to activities in outer space as of January 2009," note 22, *supra*, accessible at http://www.unoosa.org.oosa.SpaceLaw/moon.html and http://www.unoosa.org/pdf/publications/ST_SPACE_11_Rev2_Add1E.pdf.

background for any possible future discussions concerning the development of a lunar mining regime. Consequently, it is worth describing in some detail.

Many of the provisions of the Moon Agreement in substance echo already binding provisions of the Outer Space Treaty. However, as related to the question of lunar mining, the most relevant and controversial provision of the Agreement is Article 11, which purports to establish a framework for the eventual establishment of an international regime to govern the exploitation of the Moon's natural resources. Article 11 provides:

> 1. The Moon and its natural resources are the common heritage of mankind, which finds its expression in the provisions of this Agreement and in particular in paragraph 5 of this article.
>
> 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, 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.
>
> 4. States Parties have the right to exploration and use of the Moon without discrimination of any kind, on a basis of equality and in accordance with international law and the terms of this Agreement.
>
> 5. States Parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the Moon as such exploitation is about to become feasible. This provision shall be implemented in accordance with article 18 of this Agreement.
>
> 6. In order to facilitate the establishment of the international regime referred to in paragraph 5 of this article, States Parties shall inform the Secretary-General of the United Nations as well as the public and the international scientific community, to the greatest extent feasible and practicable, of any natural resources they may discover on the Moon.

> 7. The main purposes of the international regime to be established shall include:
> (a) The orderly and safe development of the natural resources of the Moon;
> (b) The rational management of those resources;
> (c) The expansion of opportunities in the use of those resources;
> (d) An equitable sharing by all States Parties in the benefits derived from those resources, whereby the interests and needs of the developing countries, as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the Moon, shall be given special consideration.
>
> 8. All the activities with respect to the natural resources of the Moon shall be carried out in a manner compatible with the purposes specified in paragraph 7 of this article and the provisions of article 6, paragraph 2, of this Agreement.

Article 6(2) of the Agreement, referred to in Article 11(8), provides:

> In carrying out scientific investigations and in furtherance of the provisions of this Agreement, the States Parties shall have the right to collect on and remove from the Moon samples of its minerals and other substances. Such samples shall remain at the disposal of those States Parties which caused them to be collected and may be used by them for scientific purposes. States Parties shall have regard to the desirability of making a portion of such samples available to other interested States Parties and the international scientific community for scientific investigation. States Parties may in the course of scientific investigations also use mineral and other substances of the Moon in quantities appropriate for the support of their missions.

Other provisions of the Agreement provide, *inter alia*, that, in the exploration and use of the Moon, the States Parties shall pay due regard to the interests of present and future generations as well as to the need to promote higher standards of living and conditions of economic and social progress and development (Art. 4); shall take measures to prevent the disruption of the existing balance of the Moon's environment (Art. 7); may pursue their activities on the Moon anywhere on or below its surface (Art. 8); may establish manned or unmanned stations on the Moon (Art. 9); and shall retain jurisdiction and control over their personnel, vehicles, equipment, facilities, stations and installations on the Moon (Art. 12(c)). Article 16 of the Agreement provides that an international organization whose membership is comprised of a majority of States Parties may conduct

activities under the Agreement if it declares its acceptance of the Agreement's obligations. Article 17 permits any state party to propose amendments to the Agreement, which shall enter into force for any State Party accepting the amendments upon their acceptance by a majority of States Parties and thereafter for each other Party on its acceptance. Article 18 provides that the UN Secretary General shall, at the request of one-third of the States Parties to the Agreement and with the concurrence of the majority of the States Parties, convene a conference of the States Parties to review the Agreement, which conference shall also consider the question of the implementation of the provisions of Article 11, paragraph 5, on the basis of the principle referred to in paragraph 1 of that article and taking into account in particular any relevant technological developments.

It is relevant that the negotiations in COPUOS for the Moon Agreement, and the debate in the U.S. over its acceptance, took place in the context of concurrent negotiations in New York at the Third UN Law of the Sea Conference (UNCLOS-3) concerning the character of the seabed mining regime to be established by what eventually was reported out by the Conference as the 1982 UN Law of the Sea Convention (LOSC).[29] The UNCLOS-3 negotiations ultimately resulted in the approval by the Conference of a highly controversial seabed mining regime – supported by the large bloc of developing countries but strongly opposed by the U.S. and certain other developed countries – permitting the mining of seabed mineral resources only under the aegis of an international authority effectively dominated by developing countries, and

[29] U.N. Convention on the Law of the Sea, U.N. Doc. A/CONF.62/122, 21 I.L.M. 1245 (1982). As of May 4, 2009, 158 countries were parties to the LOSC. See UN Division of Ocean Affairs and Law of the Sea, "Chronological lists of ratifications [to the Convention] as of 04 May 2009," http://www.un.org/Depts/los/reference_files/chronological_lists_of_r.

imposing significant limitations on the role of private enterprise.[30] As is well known, in 1982 the Reagan administration refused to either sign or ratify the LOSC, primarily on the grounds that the proposed international seabed regime would both hamper the development of seabed mineral resources and be antithetical to free enterprise principles strongly held by the U.S.[31] Indeed, despite the UN General Assembly's subsequent adoption in 1994 of an Implementation Agreement effectively nullifying the provisions of Part XI to which the U.S. and some other countries objected,[32] the U.S. has to date still not ratified the LOSC.[33]

In view of this history, it is not surprising that the Moon Agreement, since its conclusion in 1979, has also encountered substantial opposition in the U.S. as well as some other countries. The phrases "common heritage of mankind" and "international regime" in Article 11 of the Agreement inevitably evoked similar phrases figuring prominently in the UNCLOS-3 negotiations and the LOSC, and raised the spectre that the

[30] The Deep Seabed regime is set forth in Part XI, Arts. 133-85 and Annexes III and IV of the Convention. For discussion, see generally, e.g. Oxman, Caron and Buderi (Eds.), *Law of the Sea: United States Policy Dilemma* (1983); Oxman, "The High Seas and the International Seabed Area," 10 *Mich. J. Intl. L.* 526 (1989); and summary of the seabed regime of the 1982 Convention and the U.S. objections to it in American Law Institute, *The Restatement of the Law (Third), The Foreign Relations Law of the United States* (1986), Sec. 523, Reporter's Notes 2, 3 and 4.

[31] See statements by President Reagan and Ambassador Malone on July 9 and August 12, 1982, respectively, 18 Weekly Comp. of Pres. Doc. 887 (1982), U.S. Dept. of State, *Current Policy* No. 416 (1982); The Law of the Sea Convention, White House Office of Policy Information, Issue Update No. 10 (April 15, 1983), at 8; and, generally, references in note 30, *supra*.

[32] Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982, signed July 29, 1994 and endorsed as an annex to a resolution of the U.N. General Assembly (U.N.G.A. Res. 48/263, A/48/950 (1994)), (adopted with 121 states in favor, none opposed, and seven abstentions). For a contemporary discussion see, e.g., "Law of the Sea Forum: The 1994 Agreement on Implementation of the Seabed Provisions of the Convention on the Law of the Sea," 88 *AJIL* 696-714 (1994), and particularly Oxman, "The 1994 Agreement and the Convention," 88 *AJIL 687 (1994).*

[33] President Clinton transmitted the Convention and Implementation Agreement to the Senate for its advice and consent to ratification in 1994. See Senate Treaty Doc. No. 103-39 (Oct. 7, 1994). However, the Senate has not yet acted with regard to the Convention. But see as to current prospects for ratification, note 54, *infra*.

type of lunar mining regime contemplated by Article 11 would simply mirror the restrictive seabed regime ultimately embodied in Part XI of the LOSC. Thus, in 1980 Congressional hearings on the Moon Agreement,[34] a succession of industry and other representatives strongly opposed U.S. participation in the Moon Agreement, arguing that: (1) it would create a moratorium on commercial exploitation of lunar resources pending the conclusion of a more comprehensive agreement for regulating resource activities, which might be long delayed or never occur; (2) Article 11 in any case purported to establish guiding principles for the eventual negotiation of such a successor agreement that were very likely to be contrary to free market principles and the commercial development of outer space by private enterprise; and (3) the Agreement would give other countries – and particularly developing nations – political control over the permissibility, timing and direction of expanding commercial uses of outer space.[35] Responding to these concerns, and consistent with its position on the LOSC, the Reagan administration withdrew the Moon Agreement from consideration by the Senate and, while never explicitly rejecting it, refused to either sign or ratify the Agreement. Subsequent U.S. administrations have also shown little interest in the Agreement and, as previously noted, most other countries, including all of the other "space powers", have to date likewise refrained from accepting it.

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[34] See 1980 Senate Hearings, note 6, *supra*.

[35] Statements at the 1980 Senate Hearings in opposition to ratification of the Agreement were made, *inter alia*, by the L-5 Society, the American Astronautical Society, the Aerospace Industries Association, National Association of Manufacturers, and United Technologies, Inc. See, particularly, the testimony and statement of Leigh Ratiner, Counsel for the L-5 Society, 1980 Senate Hearings, *supra* note 6, pp. 105-132; and testimony and statement of Marie A. Dubs, Chairman, American Mining Congress Committee on Undersea Mineral Resources and Vice President, Kenecott Development Corporation, 1980 Senate Hearings, *supra*, note 6, pp. 133-45. The politics of rejection of the Agreement are well-described in N.C. Goldman, "The Moon Treaty: Reflections on the Proposed Moon Treaty, Space Law and the Future" in J.E. Katz (Ed.), *People in Space* (Transaction, 1985), at pp. 140-49 and Baslar, *supra* note 6, Chpt. Five.

Debate as to whether the U.S. should join the Moon Agreement and as to the Agreement's potential implications for the development of lunar resources has centered on several issues.[36] One question concerns the effect of the provision in Article 11(1) that "the Moon and its natural resources are the common heritage of mankind".[37] As indicated, opponents of U.S. participation in the Agreement suggest that, as a result of the UNCLOS-3 negotiations and Part XI of the LOSC, the phrase "common heritage of mankind" can be argued to have now taken on the fixed meaning in international law that such "common heritage" resources are not subject to direct national or private exploitation but can only be legally developed and appropriated under the aegis and supervision of an international organization or authority controlled by a majority of nations – in effect, by the bloc of developing nations, which are the most numerous. In their view, the phrase reflects a particular economic and political philosophy which would likely limit the role

[36] For detailed discussions of the various issues and arguments *pro* and *con*, ratification of the Moon Agreement see, e.g., 1980 Senate Hearings, *supra* note *, and in particular, the testimony of Roberts B. Owens, Legal Adviser of the U.S. Department of State, in 1980 Senate Hearings at pp. 2-17; Peterson, *International Regimes for the Final Frontier*, *supra* note 6; Baslar, *The Concept of the Common Heritage of Mankind in International Law*, *supra* note 6; Reynolds and Merges, *Outer Space: Problems of Law and Policy*, *supra* note 6; and, generally, the other references cited in note 6, *supra*.

For detailed expressions of the U.S. administration's views in support of the Agreement in 1979 and 1980, see in particular the testimony, submitted statements and answers to submitted questions by Robert Owens, Legal Adviser to the State Department and S. Neil Hosenball, Chairman, U.S. delegation to COPUOS and NASA General Counsel in 1980 Senate Hearing, note * *supra*, at pp. 2 *et seq.* and 46 *et seq.*, respectively. See also Secretary of State Vance's November 28, 1979 response to a joint letter from Senator's Church and Javits of the Senate Foreign Relations Committee (enclosing a statement by Ambassador Petree, U.S. Deputy Representative to the UN Security Council) and Assistant Secretary of State J. Brian Atwood's January 2, 1980 reply to an enquiry by Senator Stone, excerpted in part in M. Nash, "Contemporary Practice of the United States," 74 *AJIL* 421 (1980); and, more generally, references in note 6, *supra*.

[37] See, generally, references in note 6, *supra*, and, in particular, Baslar, "The Concept of the Common Heritage,"*supra* note 6; Rana, "The Common Heritage of Mankind and the Final Frontier," 26 *Rutgers L.J.* 26 (1995); G.M. Danilenko, "The Concept of the 'Common Heritage of Mankind' in International Law," XIII *Annex of Air and Space Law* 247 (1998); Virgiliu Pop, *Who Owns the Moon*, *supra* note 6, Chpt. 7; Hoffstadt, "Moving the Heavens," *supra* note 6; Rao, "Common Heritage of Mankind and the Moon Treaty,"*supra* note 6; Jasentuliyana, "The United Nations Space Treaties and the Common Heritage Principal,"*supra* note 6; Christol, "The Common Heritage of Mankind Provision in [the Moon Agreement]", *supra* note 6; and Joyner, "Legal Implications of the Concept of the Common Heritage of Mankind," *supra* note 6.

of the U.S. and bar or at least constrain any significant role for U.S. or other private enterprise in the exploitation of lunar resources.

Proponents of U.S. acceptance of the Agreement, on the other hand, deny that the "common heritage" concept has taken on any such fixed meaning in international law. They maintain, instead, that the "common heritage" concept, at least as accepted by the U.S. and most developed states, reflects simply a broad international consensus that certain very general equitable principles should be considered as applying to such common areas or resources – in particular, that areas regarded as part of the "common heritage" should not be subject to exclusive national or private appropriation, that there should be some sharing among all nations of the benefits of such "common heritage" resources, and that there should be particular concern for the protection of the environment in areas regarded as the "common heritage". In support of their position, they argue that the UN General Assembly, by its approval of the 1994 Implementation Agreement, effectively amending Part XI of the LOSC so as to remove many of the strict constraints that Part previously imposed on national or private exploitation of seabed minerals, has now clearly rejected any ideological or highly restrictive interpretation of the "common heritage" concept. They maintain, further, that the Moon Agreement does not expressly define the term "common heritage" and that the negotiating history of the Moon Agreement demonstrates that the countries participating in COPUOS intended the "common heritage" principle to have its own meaning in the Moon Agreement, separate and distinct from whatever meaning it may have in the LOSC; they contend that this interpretation, insisted upon by the Soviet Union in particular, is reflected both in the final clause of Article 11(1), which emphasizes that the "common heritage" concept "finds

its expression in this Agreement" (rather than in any other agreement) and, in particular, in Article 11(5), which expressly contemplates a separate negotiation to establish a resource regime of a very general and unspecified character. Consequently, in this view, the parties are free, if and when they eventually negotiate a resource regime under Article 11(5) and 18, to devise a lunar mining regime of whatever nature they wish – which can be completely different from the LOSC seabed regime as originally contemplated in Part XI of the LOSC – subject only to the very broad criteria set forth in Article 11(7). Moreover, they point out that it is clear that, in any such further negotiation under Articles 11(5) and 18, any State Party which disagrees with the type of regime negotiated can refuse to agree to it and not be legally bound.

A second related question is whether the provisions of the Moon Agreement establish a moratorium on the conduct of resource activities by states or by private enterprises, or preclude states or private enterprises from acquiring property rights in extracted lunar resources, pending the establishment of any international regime negotiated under Article 11(5).[38] As indicated, opponents of U.S. acceptance of the Moon Agreement contend that the "common heritage" principle stated in Article 11(1) of the Agreement, having taken on a fixed meaning associated with Part XI of the LOSC, effectively mandates such a moratorium and precludes states or private enterprises from acquiring such right. But supporters of U.S. participation in the Agreement maintain that there is nothing in Article 11 or other provisions of the Moon Agreement that suggests any such limitation on states or private enterprises in this respect, except as they might in the future expressly agree to such a moratorium in the context of negotiating the

[38] See, generally, discussions in references in note 6, *supra*.

international regime contemplated by Article 11(5) or otherwise.[39] Moreover, they argue that Article 11(3) expressly provides that it is only natural resources "in place" that are not subject to potential property or ownership rights; that it is clear from the negotiating history that the phrase "in place" was specifically proposed by the U.S., and accepted by the other nations present, as a recognition that the Agreement did not imply any moratorium on the removal and ownership of lunar resources; and that Article 6(2)'s provision of a right to collect and remove mineral and other samples for scientific investigation cannot reasonably be interpreted as having the negative implication that lunar resources cannot be removed for other purposes.

A third question is whether the Agreement in any other respect precludes private enterprise from a role in the eventual exploitation of lunar resources.[40] Opponents of U.S. ratification insist that the Agreement's "common heritage" and other provisions – and, in particular, its threat of the possible imposition of an international regime similar to that which would have been established under Part XI of the LOSC, will discourage and in practice preclude the likelihood of private investment or participation in the development of lunar or other outer space resources. Proponents of U.S. acceptance argue that, to the contrary, the negotiating history supports the view that the U.S. was successful in preserving such private enterprise rights; that nothing in Article 11 requires

[39] See, e.g., the testimony of State Department Legal Adviser Roberts Owens at the 1980 Senate Hearings, *supra* note 6, that:

> "Again Mr. Chairman, during the negotiation of this treaty, the United States took the position virtually from the outset that there should be no moratorium on the exploitation of these resources pending the establishment of the regime. That statement was repeatedly made by the representatives of the United States. Others acquiesced in that proposition. I think that virtually all the lawyers who have looked at the treaty and its negotiating history agree that during the interim, before the conference takes place in order to attempt to establish the regime, there will be no moratorium on the exploitation of these resources" (at p.7, and see also pp. 15-17).

[40] See, generally, discussions in references in note 6, *supra*.

that any international regime eventually negotiated be of a nature which precludes such a role for private enterprise; and that Articles 11(3) and 14 in particular expressly contemplate such a role for nongovernmental entities or natural persons.[41] They note further that, while Article 11(7)(d) establishes as one criteria of such a regime an "equitable sharing by all States Parties in the benefits derived from these resources," the term "equitable sharing" is not defined; in the opinion of most commentators, "equitable" in this context cannot be considered to mean "equal"; and Article 11(7)(d) expressly states that, in such sharing, "the efforts of those countries which have contributed either directly or indirectly to the exploration of the Moon shall be given special consideration". Thus, while there appears to be an obligation to provide some share of any benefits derived from the exploitation of lunar resources such as He-3 to the international community, there is no definition of what the "benefits" to be shared are, and no specific obligation as to how much must be shared, with whom, or in what form.

What, then, is the effect of the Moon Agreement on the law applicable to the exploitation of lunar resources – and, in particular, the mining and exploitation of He-3? As indicated, the Agreement is not in itself legally binding on the U.S., nor indeed on most major "space powers" or other states, since they are not Parties. Moreover, the Agreement should perhaps be given little weight as evidence of developing customary law since, in contrast to other "space law" agreements which have achieved very wide

[41] For the U.S. administration's position in 1979 and 1980, see references in note 36 *supra*. And see, among a number of other commentators, e.g., Goldman, "The Moon Treaty," *supra* note 6, contending that the Moon Agreement is neither a threat to the free enterprise system nor rules out exploitation of lunar resources by private companies, and Dula, "Free Enterprise and the Proposed Moon Treaty," *supra* note 6.

ratification, it has over a considerable period gained few adherents, none of which are significant space powers.

But this conclusion may be too cavalier. First, as indicated, the Moon Agreement arguably constitutes a reinforcement, spelling out, or agreed interpretation by the space powers and many other concerned states participating in the COPUOS negotiations of a number of principles and obligations contained or implicit in the Outer Space Treaty – and thus already legally binding on them as parties to that treaty. Second, the Agreement reflects a long and careful process of negotiation and accommodation in COPUOS between the states primarily concerned with outer space and lunar activities as to the most sensible and viable rules for the conduct and rational regulation of activities on the Moon. In particular, its non-controversial provisions – such as those regarding the establishment of stations, conduct of scientific research, concern for environmental protection, obligations of noninterference, notice and consultation, and so forth – can be argued to evidence, at least as to these matters, an emerging body of customary lunar law. Thus, the Moon Agreement will almost certainly play some role and have to be taken into account in any further discussions concerning the development of a lunar mining regime.

The effect of Article 11 on lunar resource exploitation or mining is, of course, more problematic. The Agreement's prohibition on exclusive national or private claims to portions of the surface or subsurface of the Moon, and perhaps to resources in place, simply reaffirms similar previously existing prohibitions already binding on the U.S. and other states under the Outer Space Treaty. However, apart from any highly contested interpretation of the "common heritage" provision in Article 11(1) as in itself implying a moratorium on lunar mining until some kind of Part XI LOSC-type international regime

is established, there would appear to be nothing in Article 11 or any other part of the Agreement which would prohibit States or private enterprises from mining and acquiring ownership of He-3 or other lunar resources pending the possible establishment of any international regime; indeed, as indicated there is substantial support in the language of the Agreement and its negotiating history for the legitimacy of such activities.[42] During the 1980 Congressional hearings in the U.S. on the Agreement, the then Legal Adviser of the U.S. State Department, Roberts Owen, concluded in testifying on this point, "pending a Moon Conference in 15 or 30 years – and whether or not the United States becomes a party to the Moon Treaty – American companies will have a continuing legal right to

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[42] See, generally, discussion in references in note 6 and 36, *supra*. In his written statement to the Senate Foreign Relations Committee in the 1980 Senate Hearings, note 6, *supra*, S. Neil Hosenball, Chairman of the U.S. delegation to COPUOS and NASA General Counsel, summarized the U.S. position regarding interpretation of the Agreement as follows:

> ... The uncontradicted statements made by the United States (on the public United Nations record of negotiations), the defeat of specific proposals by other delegations, the reference to agreed understandings in the Committee Report and the General Assembly Resolution adopting the Treaty in my view conclusively establish as a matter of treaty interpretation that
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> (1) A state may remove and exploit natural resources from the Moon and other celestial bodies. This conclusion is in part based on the uncontradicted statement of the U.S. Representative, April 19, 1973. The phrase "in place" appears in Article 11, paragraph 3, and was as indicated proposed by the United States.
>
> "One or two particular points should be made concerning these matters as they are reflected in Working Paper 15 which the United States delegation introduced on April 17. As is apparent from the text, this working paper excludes the concept of a pre-regime moratorium. References to the words 'in place' in the first sentence of that paragraph and to paragraph 7 of Article X make this clear. More particularly, the words 'in place' in the first sentence of paragraph 2 are intended to indicate that the prohibition against assertion of property rights would not apply to natural resources once reduced to possession through exploitation either in the pre-regime period or, subject to the rules and procedures that a regime would constitute, following the establishment of the regime. Also with regard to the last sentence of paragraph 2 of Article X, the 'without prejudice' clause would apply to exploitation whether by a State, government entity, non-governmental enterprise or international organization."
>
> (2) There is no moratorium in the Treaty on exploitation of natural resources either pre-regime or if a state chooses not to become a party to the Treaty establishing such a regime. Proposals for such a moratorium were submitted for the record by India, Italy and other delegations. No such provisions appear anywhere in the Treaty and the United States through numerous statements in the record said it would not accept a moratorium.
>
> ....
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> (4) The United States can carry out exploitation of the natural resources of the Moon or other celestial bodies through the use of public or private entities ... (at p.59).

exploit the Moon's resources."[43] This conclusion has generally been supported by leading experts – for example, in the deliberations and report of the Space Law Committee of the International Law Association at its 1982 Montreal meeting[44] and in much of the relevant literature[45] – and, notably, by the current parties to the Moon

[43] See 1980 Senate Hearings, *supra* note 6, at p.6.

And see, more broadly, Legal Adviser Owens' testimony in the Hearings that:

> "In discussing the development of U.S. policy on the exploitation matter, I wish to stress that the United States constantly maintained several themes, which I would like to set forth and illustrate through references to the negotiating history of the Treaty.
>
> First, the United States was willing to accept the concept that the natural resources of celestrial bodies were the common heritage of mankind. Indeed, it was the United States which first proposed the phrase in the course of active negotiations. However, the U.S. view was—and is—that this concept embodies no substantive rules or a pre-determined form of legal regime, and the United States has consistently resisted efforts to give the phrase content which would be adverse to U.S. interests. In our view the phrase can acquire substantive meaning only by reference to the specific context in which it is employed.
>
> Secondly, the United States has consistently rejected any suggestion that the Moon Treaty should impose a moratorium on unilaterial exploitation of nonterrestrial natural resources pending the establishment of an international regime; indeed, we have insisted that even after such a regime is established, the right of unilaterial exploitation will continue to be available to those States which do not choose to participate in such a regime.
>
> Third, the United States has been aware of the vital role that American free enterprise can play in outer space, and the U.S. positions were designed to promote this role, both by ensuring that nothing in the Treaty would circumscribe this potential and by inserting into the Treaty certain rights which would be important to commercial exploitation by private or public entities."
>
> .... (at p.12)

[44] See International Law Association, *Report of the Sixtieth Conference* held at Montreal, August 29, 1982 to September 4, 1982 (1983), report of the Committee on Space Law on "The Conflicts in the Interpretation of the Leading Principles of the Moon Treaty of 1979" by Professor Dr. D. Goedhuis, with Commentary on various questions put to the Committee and Chairman's Postscript (at pp. 479 et seq. of the ILA *Report*).

The Sixtieth Conference, in its Resolution No. 10, 1982, expressly noted that it:

> "3. *Is of the opinion* that under the terms of the Agreement of the Moon Treaty [sic] there is no moratorium on the exploitation of the natural resources of the moon, prior to the establishment of the international regime as provided for in Article XII(3) of this Agreement." (at p.12 of the ILA *Report*)

And see discussion by S.M. Williams, a member of the ILA Space Committee, in "The Law of Outer Space and Natural Resources," 36 *Intl. & Comp. L.Q.* 142 (1987).

[45] See, generally, references in note 6, *supra*. And see, e.g., Pop, *Who Owns the Moon*, *supra* note 6, who, after surveying the literature, concludes that most of the commentators consider that Article 11 of the Moon Agreement does not establish any temporary prohibition on the appropriation or exploitation of lunar resources pending the establishment of some lunar resource regime (at pp. 146-7).

Agreement in a Joint Statement submitted to the most recent 2009 meeting of the legal subcommittee of COPUOS.[46]

In sum, while the Outer Space Treaty – perhaps as supplemented by the Moon Agreement – establishes a useful framework for many prospective activities on the Moon and clearly prohibits the staking of exclusive national or private claims to particular areas of the lunar surface, neither the Treaty nor the Agreement appears to preclude the mining and acquisition of property in lunar He-3 by national, international or private enterprises, subject to certain broad "common heritage" obligations, such as an obligation to share to some unclear extent the benefits or proceeds of such activities. However, whatever the merits of this conclusion, it will clearly remain open to at least vigorous political as well as legal challenge – particularly by developing or other states currently unable to participate in lunar mining or other activities. Moreover, the Outer Space Treaty and Moon Agreement – as well as international law more generally – leave many other significant questions concerning the potential exploitation of He-3 or other lunar resources unresolved. Consequently, if the U.S. or other "space powers" who intend to establish stations on the Moon plan to proceed with the mining and exploitation of lunar He-3 in connection with their potential development of an He-3-based fusion power program, they will be doing so under conditions of substantial legal and political – not to mention technological and economic – uncertainty. The question, then, is whether the U.S. should do something to remedy this situation – and, if so, what?

[46] See the Joint Statement on the benefits of adherence to the Agreement Governing the Activities of State on the Moon or other Celestial Bodies by States parties to the Agreement, submitted to the Legal Subcommittee of COPUOS, UNFA Doc. A/AC.105/C.2/L.272, 3 April 2008 (ANNEX), para. 7(e), noting that the Moon Agreement "does not propose a closed and complete mechanism" and "does not preclude any modality of exploitation, by public or private entities, or prohibit the commercialization of such resources, provided that such exploitation is compatible with the principle of the common heritage of mankind."

III. Should the U.S. Seek International Agreement on a Lunar Resource Regime?

As indicated, there does not at present appear to be any legal barrier to the U.S. engaging in lunar mining, subject to the very general limitations imposed by the Outer Space Treaty and broader international law. Moreover, as a practical matter, no other nation is likely in the near future to attempt or be in a position to prevent the U.S. from establishing a lunar base and conducting such activities on the Moon as it wishes. Consequently, the U.S. could presumably proceed to develop an He-3-based fusion energy program on the assumption that it could mine and bring to Earth lunar He-3 without any need for seeking further international agreement expressly recognizing its right to do so. Under this approach, the U.S. could develop an appropriate legal regime of its own, consistent with its own needs and principles, rather than having to reach compromises with other countries. There is precedent for unilateral U.S. action of this kind in U.S. Congressional enactment of the 1980 Deep Seabed Hard Minerals Act which, following U.S. rejection of the 1982 LOSC, continues to govern the commercial recovery of deep seabed minerals by U.S. companies.[47]

However, even if the U.S. could "go it alone" in this way, there are reasons why it may not wish to do so. First, neither the U.S. government nor American private enterprise is likely to be willing to risk the very substantial investment and long-term effort necessarily involved in seeking to develop He-3-based fusion energy without some assurance that – assuming the very difficult technical and engineering obstacles to developing efficient fusion reactors and establishing permanent moon bases can be

[47] Pub. L. No. 96-283, 94 Stat. 553 (1980), 30 U.S.C. § 1401 *et seq.*. See, e.g., ALI Restatement of the Law Third, *The Foreign Relations Law of the United States* (1987), sec. 523, Reporters' Note 5 ("United States Deep Seabed Mineral Resources Act"), Vol. 2, pp. 96 *et seq.*

overcome – the requisite supply of lunar He-3 can continue to be obtained without encountering significant legal or political difficulties. Whatever may be the most legally persuasive interpretation of existing international law, the unilateral appropriation of lunar resources by the U.S. – especially of a potentially uniquely valuable resource such as He-3 – may be challenged by other nations or people on Earth. This, certainly, was international experience in the 1960's when developing nations vigorously protested what they then saw as the prospect that a few technologically-advanced countries and their private enterprises might alone appropriate what was at the time assumed to be the mineral riches of the deep seabed – a perception which ultimately led to the enunciation of the "common heritage" doctrine, the convening of UNCLOS-3, and the adoption of Part XI of the 1982 LOSC.[48] Only a broadly accepted international agreement is likely to offer the prospect of continuing legal and political predictability and stability that would seem essential if a long-term He-3-based fusion energy program is to be undertaken and sustained.[49]

Second, while the Outer Space Treaty and present international law do not expressly bar the unilateral appropriation of lunar resources, they nevertheless do impose an obligation on nations to cooperate in their activities in outer space and to avoid

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[48] See references at notes 30 and 31, *supra*.

[49] See, e.g., Statement of the Board of Directors of the International Institute of Space Law (IISL), 22 March 2009, reading in part:

> "At present, international space legislation does not include detailed provisions with regard to the exploitation of natural resources of outer space, the Moon and other celestial bodies, although it does set down a general framework for the conduct of all space activities, including those of private persons and companies, with respect to such natural resources.
> The IISL is of the opinion that a specific legal regime for the exploitation of such resources should be elaborated through the United Nations, on the basis of present international space law, for the purposes of clarity and legal certainty in the near future. The IISL will continue to play an active role in any such discussions as they develop."

http://www.iislweb.org/html/20090322_news.html.

conduct that might give rise to disputes.[50] As indicated, the U.S. is already committed to international cooperation in outer space through its participation in the Outer Space Treaty, the framework for coordination in space exploration agreed to by fourteen national space agencies, including NASA, in their 2007 "Global Exploration Strategy",[51] and other agreements in a number of specific areas – for example, the Space Station Agreement[52] – and has similarly committed itself to international cooperation in developing fusion energy through its participation in the recently concluded ITER agreement.[53] U.S. insistence on a right unilaterally to appropriate lunar He-3, without further international agreement, could be controversial and regarded as inconsistent with these precedents.

Finally, if countries other than the U.S. also engage in activities on the Moon – as now appears highly likely – it will be in the interest of each of them to have at least some understandings to provide for cooperation on common problems and keep them from

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[50] See, e.g., Outer Space Treaty, supra note 4, Art. IX; U.N. General Assembly A/RES/63/90, 18 December 2008 on "International Cooperation in the Peaceful Uses of Outer Space." It is noteworthy that the Russian Federation and India have signed a 10-year cooperation agreement to run from December 2007 for the development of a shared space vehicle for Moon exploration. See Note by the UN Secretariat for COPUOS Legal Committee for its Forty-Eighth Session, *supra* note 44, para. 15.

[51] See note 1, *supra*, and particularly "Theme 4: A Global Partnership," stating, *inter alia*, that "The shared challenges of space exploration and the common motivation to answer fundamental scientific questions encourage nations of all sizes to work together in a spirit of friendship and cooperation" (at p.12).

[52] Agreement on cooperation in the detailed design, development, operation and utilization of the permanently manned civil space station, with Annex, September 29, 1988, e.i.f. January 30, 1992; Arrangement concerning application of the space station intergovernmental agreement pending its entry into forces September 29, 1988, e.i.f. Sept. 29, 1988 and Agreement concerning cooperation on the Civil International Space Station, March 27, 2001, 1998 U.S.T. 212. See, e.g., Gorove, "The US/International Space Station Agreement of September 29, 1988, "Some Legal Highlights," 16 *J. Space L.* 1982 (1988); Stewart, "Resolution of Legal Issues Confronting the International Space Station Project: A Step Forward in the Development of Space Law," 19 *Va. J. Intl. L.* 745 (1989).

See also the October 6, 2006 Statement of U.S. National Space Policy, at http://www.ostp.gov/html/US%20National%20Space%20Policy.pdf which states, *inter alia*, that "The United States will seek to cooperate with other nations in the peaceful use of outer space to extend the benefits of space, enhance space exploration, and to protect and promote freedom around the world."

[53] See note 12, *supra*.

interfering with each other's activities. And, as the Moon Agreement anticipates, if some kind of lunar agreement is in their common interests, it will be difficult for such an agreement not to address in some way the salient and thus far unresolved issue of the exploitation of lunar resources.

Consequently, if the U.S. decides that it is serious about seeking to develop an He-3-based fusion energy program, it would seem sensible for it at some point to also seek international agreement on a lunar resource regime designed to provide the long-term legal and political stability that such a program will most likely require.

IV. Should the U.S. Try to Establish an Acceptable International Lunar Mining Regime Quite Soon, Even Before the Feasibility of Lunar Mining and He-3-Based Fusion Power Are Established and It Commits to an He-3-Based Fusion Power Program?

There are clearly arguments that, given the current uncertainty as to the feasibility of both establishing a permanent U.S. lunar base capable of carrying on He-3 mining activities and developing fusion reactors that economically warrant investment in the creation of a major He-3-based fusion power program, it would be premature for the U.S. to seek at this time to negotiate a lunar mining regime with other countries; other countries are unlikely to see a need for such negotiations at this time and, in any event, it is certainly arguable that we simply don't now know enough to do a sensible job in this respect. Indeed, it was for this reason that COPUOS, in drafting Article 11 of the Moon Agreement, expressly deferred the negotiation of such a regime to such time "as such exploitation is about to become feasible."

However, there are reasons suggesting that the U.S. should seek to reach international agreement on such a regime quite soon and even before the possibility and practicality of a permanent moon base and an He-3-based fusion power program are clearly established. First, as discussed, states and enterprises are unlikely to be willing to undertake the substantial effort and investment involved in developing lunar He-3 mining and He-3-based fusion power without the assurance of political and legal predictability and stability that only a broadly accepted international agreement can hope to provide. Given the long lead time which will be required if the U.S. wishes to achieve a viable He-3-based fusion power program in the relatively near future – perhaps within the next half-century or so – it seems sensible for it to begin to take steps to put the necessary legal infrastructure in place fairly soon.

Second, the international climate is arguably now relatively favorable to achieving international agreement on the kind of international lunar resource regime the U.S. hopes to achieve. Other major countries such as Russia, China, India, the European Union and Japan, which appear currently to have the ability to participate in the potential exploitation of lunar resources, may well now share with the U.S. an interest in a more open access regime and market-based mechanisms. The U.N. General Assembly's adoption of the 1994 Implementation Agreement nullifying the provisions of Part XI of the LOSC to which the U.S. objected clearly reflects such a broader international acceptance of a U.S.-favored more free-enterprise-oriented approach to the exploitation of deep seabed "common heritage" resources – a persuasive precedent for the similar treatment of lunar resources. Indeed, there is now growing support in the U.S. for U.S.

ratification of the LOSC and such accession currently seems increasingly likely.[54] In addition, as indicated, international cooperation among the major technologically-advanced countries in both space and fusion power development is already ongoing under the Space Station and ITER agreements and the new Obama administration appears to look favorably on cooperative multilateral rather than unilateral approaches to dealing with broadly international issues. Moreover, the recent sharp spike in oil prices and heightened international concern about global warming have reinforced the pressing need of our global economy to find ways to meet the world's growing appetite for energy while still decreasing our emission of greenhouse gases – and thus to renewed international interest in the development of alternative energy sources such as nuclear fission and fusion.

Third, for a variety of reasons, the influence and "bargaining power" of the U.S., both as a leader in space and nuclear technology, and more generally as an actor on the world stage, is arguably currently declining relative to that of China, Russia, India, the

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[54] For the State Department's Summary of continuing U.S. administration support for ratification of the LOSC, see http://www.state.gov/g/oes/ocus/opa/convention/.

On President George W. Bush's support for ratification, see Kevin D. Futch, Introductory Note to President Bush's May 15, 2007 statement on "Advancing U.S. Interests in the World's Oceans," 46 *ILM* 886 (2007). For a review by the State Department's Legal Adviser on the Bush Administration's arguments supporting ratification of the convention, see J.B. Bellinger, III, "The United States and the Law of the Sea Convention," a presentation at the University of California-Berkeley Law of the Sea Institute on November 3, 2008, at http://www.state.gov/s/1/rls/111587.htm. See also John R. Crook, "Contemporary Practice of the United States," 99 *AJIL* 495 (2005), 101 *AJIL* 650 (2007), 102 *AJIL* 168 (2008), and 103 *AJIL* 135 (2009).

On April 2, 2009, Secretary of State Clinton, at a joint session of the Antarctic Treaty Consultative Meeting and the Arctic Council, said that the United States was "committed" to ratifying the Law of the Sea Convention, http://www.google.com/hostednews/afp/article/ALeqM5gB10PzPFiju89s, and on May 11, 2009 the Department of State listed the LOSC as one of the 17 treaties on its "Treaty Priority List" on which the Administration seeks Senate advice and consent "at this time". See letter of May 11, 2009 from Richard R. Verma, Assistant Secretary, Legislative Affairs, U.S. Department of State to Senator John Kerry, Chairman of the Senate Committee on Foreign relations, http://www.globalsolutions.org/files/general/White_House_Priorities.

European Union and other countries.[55] If this is so, the ability of the U.S. to negotiate the kind of lunar resource regime it wants may well be greater now than later.

Finally, it may be easier to establish the type of lunar resource regime the U.S. would prefer while the feasibility of He-3 exploitation and fusion power – and, indeed, the possibility that we may eventually find valuable resources on Mars or elsewhere in the solar system in the course of our exploration of space – is still uncertain and speculative and before potentially concerned states have developed important stakes in particular outcomes.

V. What Kind of Lunar Mining Regime Should the U.S. Try to Obtain?

Consistent with its past positions regarding the mineral resource provisions of both the Moon Agreement and the LOSC, it may be suggested that the U.S. will presumably wish to seek a lunar resource regime having at least the following characteristics:

- Provisions permitting and facilitating the exploration and development of lunar resources by the U.S. or its private companies. The regime should permit the U.S. or its private companies to conduct, without burdensome regulation or interference, any and all of the activities reasonably necessary to prospect for, explore, mine, process and either use or transport to earth lunar resources, and in particular He-3. The regime must clearly provide

[55] See, e.g., Fareed Zakaria, *The Post-American World* (W.W. Norton: 2008) (arguing that the rise of new global powers inevitably means the relative decline of U.S. influence); National Intelligence Council, Office of Director of National Intelligence, "Global Trends 2025: A Transformed World," http://www.dri.gov/nic/NIC_2025_project.html; Scott Shane, "Global Forecast by American Intelligence Expects Al Quaeda Appeal to Falter," *N.Y. Times*, Nov. 21, 2001, at A13, reporting that the National Intelligence Council states that "Although the United States is likely to remain the single most powerful actor, the United States relative strength – even in the military realm – will decline and U.S. leverage will become more constrained"; Pamela Hess, "Intelligence Report Says Farewell to American Supremacy," *Huffington Post*, Nov. 20, 2008, http://www.huffingtonpost.com/2008/11/20/intelligence-report-says.

for the acquiring of property rights in minerals or other substances removed from the Moon's surface or subsoil, the effective operation of and control over necessary stations or facilities, jurisdiction over necessary personnel, some measure of exclusivity over areas subject to resource activities, and some measure of privacy over proprietary information. The regime should also provide or permit a national or international management structure for He-3 production, marketing, and sales that permits timely decisions, within general guidelines, on all aspects of operational management. In particular, the regime should ensure the retention by the U.S. or its private companies of reasonable proceeds or profits commensurate with the effort involved and sufficient to encourage and warrant the level of investment involved.

- A role for private enterprise. The regime should expressly allow and encourage private enterprise to play a significant role in the exploration, development, and use of lunar resources, subject to appropriate and reasonable regulation. This means that private enterprise must have assurance of security of tenure during the life of mining operations and the right to earn and retain reasonable profits. Environmental regulations should be designed and used solely to minimize the impact of mining operations on the environment, to a degree consistent with economic viability of the operations. Any permitting process should be simple, direct, and prompt.
- Consistency with international law. The regime should be consistent with existing U.S. obligations under the Outer Space Treaty, the U.N. Charter,

other international instruments and customary international law. This includes the obligations not to claim title to territory on the Moon, to respect the right of other states to conduct activities there and to conduct any activities with due respect for environmental concerns.

- Recognition of broader international community concerns. The regime should contain provisions recognizing that the international community as a whole has legitimate interests in the exploration and use of the Moon and its resources. All states should have the right to conduct activities on the Moon without discrimination. The regime should recognize that the international community is entitled to share in the benefits of lunar exploitation. However, any sharing of benefits must be consistent with the right of the states and private enterprises primarily involved and actually planning or engaged in mineral or other resource activities to a principal role in decisions relating to the conduct of such activities and to a fair profit and return for their investment and effort. The regime should also require that all states conducting activities on the Moon must meet their obligations to the broader international community and to future generations by ensuring that their activities do not cause significant environmental or other damage.
- Encouragement of international cooperation. The regime should encourage cooperation rather than competition among states conducting activities on the Moon, including openness of access and reasonable exchanges of

information, mutual assistance in situations of need, and joint activities where appropriate.

- Dispute-avoidance and settlement procedures. The regime should contain provisions for the avoidance and peaceful resolution of disputes, including obligations requiring prior notification of actions likely to affect other states and consultation if problems, difficulties, or controversies arise.
- Flexibility. The regime should include provisions permitting and facilitating its prompt revision and development as lunar activities proceed and the need for additional or different regulatory measures or arrangements becomes apparent. Again, the regime should recognize the right of states and enterprises primarily involved and actually planning or engaged in resource activities to a prominent role in decisions relating to changes in or development of the regime.

VI. How Should the U.S. Attempt to Establish an Acceptable International Lunar Resource Regime?

What steps might the U.S. take to try to achieve an acceptable lunar resource regime? Should the U.S. ratify and accede to the Moon Agreement, possibly with reservations, and then move within the Article 11 and 18 framework of that Agreement to negotiate such a regime? Should it negotiate an acceptable regime beforehand as a condition precedent to its acceptance of the Moon Agreement – perhaps in the form of a proposed agreed amendment or protocol pursuant to Article 18 of the Agreement – only then joining the Agreement with the assurance that the agreed-upon regime will be incorporated within the Moon Agreement's framework? Should it instead seek a new

amendment or protocol to the Outer Space Treaty, making clear the right of its parties to acquire and utilize lunar or other extraterrestrial resources? Or should it seek to negotiate, either on a broad or a narrow multilateral basis, an entirely new agreement, outside the framework of the present Moon Agreement or Outer Space Treaty, embodying the type of regime it considers acceptable? Finally, regardless of the way the U.S. seeks to establish a lunar mining regime assuring it of access to lunar He-3, should it also seek to establish, together with other concerned countries and perhaps interested private enterprises, a corporate international or quasi-international entity for the cooperative mining of lunar He-3, and possibly even for the terrestrial development of a global He-3-based fusion energy program?

A. Should the U.S. Ratify and Accede to the Moon Agreement? Ratification of the Moon Agreement, under conditions which assure that a lunar resource regime acceptable to the U.S. will eventually be established under Articles 11 and 18 of the Agreement, may be the simplest way of achieving a U.S. objective of providing a stable legal and political environment in support of a massive and long-term commitment to an He-3-based fusion energy program. The arguments in favor of reconsidering the U.S. past refusal to ratify the Moon Agreement are as follows:

First, the Moon Agreement is currently the principal "game in town" – the only international instrument specifically designed to deal with issues relating to the exploration of the Moon and the use of its resources; it represents the best efforts and embodies the carefully considered compromises and pragmatic accommodations of some seven years of negotiation by the U.S. and the principal space powers and other states most concerned. As indicated, the U.S. participated fully and achieved most of its

objectives in this long-drawn out negotiation.[56] And, with the arguable exception of Article 11, the Agreement provides a broadly sensible and noncontroversial set of rules for the conduct of lunar activities already in place. Indeed, the Legal Subcommittee of COPUOS, at both its most recent 2008 and 2009 meetings, devoted considerable time to a discussion of the reasons for low participation in the Moon Agreement, the benefits of adherence to the Agreement, and the possibility of revision of the Agreement so as to encourage broader participation.[57] Given this history, the U.S. could have difficulty persuading other states of the need to embark on a completely new negotiation.

Second, whatever their merits at the time, the arguments presented in 1980 in opposition to U.S. ratification of the Agreement appear now even less persuasive. As discussed, suggestions that the Moon Agreement – and more particularly its "common heritage" language –provides a moratorium on lunar mining, precludes a role for private enterprise, or prescribes any particular type of international regime applicable to lunar resource exploitation – particularly some kind of regime dominated by developing nations – find little support in either the language of the Agreement or its negotiating history. In particular, it seems clear that, while Article 11 appears to require good faith

[56] See, generally, testimony and statements of Roberts Owens and Neil Hosenball in 1980 Senate Hearings, notes 6 and 36, *supra*.

[57] See UN General Assembly, Committee on the Peaceful Use of Outer Space, Fifty-First Session, Report of the Legal Subcommittee on its Forty-Seventh Session, held in Vienna from 31 March to 11 April 2008, A/AC.105/917, 18 April 2008, para. 42, and particularly its Annex I, Report of the Chairman of the Working Group on the Status and Application of the five United National Treaties on Outer Space, paras. 14-25; Report of the Legal Subcommittee of COPUOS on its Forty-Eighth Session, 23 March-3 April 2009, see www.unoosa.org UNGA A/AC.105/C.2/L.274 [get better cite] paras. 88-95.

See particularly the Joint Statement on the benefits of adherence to the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies by States Parties to the Agreement submitted to the Legal Subcommittee of COPUOS, UNGA Doc. A/AC.105/C.2/L.272, 3 April 2008 (ANNEX), *supra* note 44, contending that, although the Moon Agreement contains provisions that reiterate or develop the principles set out in the Outer Space Treaty, other provisions are unique to the Moon Agreement and clarify or complement principles, procedures and notions contained in other outer space treaties.

efforts to negotiate an international regime at such time as resource exploitation becomes likely, it neither mandates that the regime take any particular form – particularly one mirroring the original (pre-1994 Implementation Agreement) LOSC seabed regime – nor requires states parties to accept any regime with which they are not satisfied. Moreover, the criteria set out in Article 11(7) for any such regime appear generally consistent with U.S. objectives. Finally, as indicated, the UN General Assembly's adoption of the 1994 Implementation Agreement modifying the provisions of Part XI of the LOSC to which the U.S. objected strongly suggests that the international community – and particularly the technically advanced countries most concerned and likely to be involved in lunar exploration and development – can now be expected to be receptive to the kind of lunar resource regime the U.S. would find acceptable.

Third, while U.S. ratification of the Moon Agreement would not in itself provide for a detailed lunar resource regime acceptable to the U.S. – under Article 11 and 18 of the Agreement, only the states parties acting collectively can participate in establishing such a regime – the U.S. could – and should – condition or structure such ratification and accession in a way designed to ensure that, either before or after U.S. ratification and accession, such an acceptable resource regime will in fact be adopted by the parties to the Agreement. Some possibilities for seeking to ensure such a result are discussed below.

Fourth, to the extent that concerns as to the meaning or ideological implications of the Agreement continued to pose a political obstacle to U.S. ratification, such concerns could also be met through appropriate U.S. reservations, declarations or understandings to its ratification of the Agreement. For example, in 1982 the American Bar Association's House of Delegates approved a joint report of the ABA Sections on

International Law and on Natural Resources Law recommending U.S. ratification of the Moon Agreement which suggested that any such ratification be accompanied by declarations consistent with the following principles:

> (a) It is the position of the United States that no provision in this Agreement constrains the existing right of governmental or authorized nongovernmental entities to explore and use the resources of the Moon or other celestial body, including the right to develop and use these resources for commercial or other purposes, and no such constraint is accepted by this ratification;
>
> (b) It is the position of the United States that nothing in this Agreement in any way diminishes or alters the existing right of the United States to determine unilaterally how it shares the benefits derived from development and use by or under the authority of the United States of natural resources of the Moon or other celestial bodies;
>
> (c) Natural resources extracted or used by or under the authority of a State Party to this Agreement are subject to the exclusive control of, and shall be the property of the State Party or other authorized entity responsible for their extraction or use. In this context, it is the position of the United States that Articles XII and XV of this Agreement preserve the existing right of States Parties to retain exclusive jurisdiction and control over their facilities, stations and installations on the Moon and other celestial bodies, and that other State Parties are obligated to avoid interference with normal operations of such facilities;
>
> (d) Recognition by the United States that the Moon and its natural resources are the common heritage of all mankind is limited to recognition (i) that all States have equal rights to explore and use the Moon and its natural resources, and (ii) that no State or other entity has an exclusive right of ownership over the Moon, over any area of the surface or subsurface of the moon, or over its natural resources which have not been, or are not actually in the process of being, extracted or used by actual development activities on the Moon;
>
> (e) It is the position of the United States that no moratorium on the commercial or other exploration, development and use of the natural resources of the Moon or other celestial body is intended or required by this Agreement. The United States recognizes that, in the development and use of natural resources on the Moon, States Parties to this Agreement are obligated to act in a manner compatible with the provisions of Article VI(2) and the purposes specified in Article XI(7), and the purposes specified in Article XI(7). However, the United States reserves to itself the right and authority to determine the standards for such compatibility unless and until the United States becomes a party to a future resources regime;

> (f) Acceptance by the United States of the obligation to join in good faith negotiation for creation of a future resources regime in no way constitutes acceptance of any particular provisions or proposed provisions which may be included in an agreement creating and controlling such a regime; nor does it constitute any obligation or commitment to become a Party to such a regime regardless of the contents of any such agreement.[58]

It is true, of course, that U.S. accession to the Moon Agreement would involve risks – including those raised in the 1980 Hearings and elsewhere based on a pessimistic prediction of the likely outcome of any eventual Article 11 and 18 negotiation. Thus, U.S. accession might well encourage wider participation in the Agreement by many non-space powers and developing states – countries which might have a different ideology and approach to the exploitation of lunar resources from that of the U.S. Conceivably, if these nations constituted a majority of parties to the Agreement, they might succeed in imposing a resource regime unacceptable to the U.S. in any future Article 11 and 18 negotiations. In this event, U.S. accession to the Moon Agreement could result in embedding and legitimating a lunar resource regime embodying principles contrary to U.S. interests. Moreover, U.S. accession might in this case effectively preclude its pursuit of alternative, more hopeful strategies; while it is true that under the Agreement the U.S. is not legally obliged to agree to any eventual international regime it doesn't like, it might by that time be impractical for the U.S. to either "go it alone" or seek some other agreement.

[58] See Report, with recommendations to the House of Delegates, by the Section of International Law and Section of Natural Resources Law at the 1982 ABA Mid-year Meeting, Chicago, IL, Jan. 25-26, 1982, approved by the House of Delegates, House of Delegates Summary of Action 1966-1990\1981-85 at page 465. On the ABA position, see testimony and prepared statement of Ronald F. Stowe, Chairman of the Aerospace Law Committee of the Section on International Law, ABA in *1980 Senate Hearings*, pp. 67-85. For discussion see Christol, "The American Bar Association and the 1979 Moon Treaty: The Search for a Position," 9 *J. of Space L.* 77 (1981).

However, there are various approaches the U.S. could employ to meet such concerns. For example,

- The U.S. could indicate to the current parties to the Moon Agreement that it was prepared to ratify and accede to the Agreement, conditional on their first acting under Article 11 and 18 to adopt a lunar resource regime reflecting principles acceptable to the U.S. Conceivably, the present parties might value U.S. adherence sufficiently to adopt such a regime. However, since none of the current parties are now, or likely in the future to be, involved in lunar resource activities, they might not be best suited to fashioning the kind of resource regime the U.S. would hope to have established.
- The U.S. could negotiate an agreement with like-minded countries having a present or potential space-faring capability and concern with the effective development of lunar resources – such as Russia, China, India, the European Union and Japan – for the proposed simultaneous accession by each of them to the Moon Agreement, coupled with a joint declaration indicating their intent, immediately following their accession, to move under Article 18 to establish an acceptable resource regime meeting U.S. requirements; presumably, the combined influence of these major powers would be sufficient to ensure the adoption by all of the parties to the Agreement of such a regime.
- Perhaps preferably, the U.S. could, more broadly, negotiate with both the current parties to the Agreement, the other principal space powers, and

other interested states the specific terms of an acceptable proposed lunar resource regime, with the understanding or express agreement that, if the U.S. and other non-party states then joined the Agreement, both the old and new parties would then promptly agree to call an Article 18 conference to formally adopt this previously agreed upon lunar resource regime.

- Alternatively, while the U.S. could not propose amendment of the Moon Agreement since it is not now a party, it could, as a member of COPUOS, propose the negotiation in COPUOS – and perhaps adoption by the UN General Assembly – of a protocol or additional instrument supplementing the Moon Agreement providing for a lunar resource regime acceptable to the U.S., with the understanding that it would ratify the Agreement and Protocol or additional instrument only if the Protocol or additional instrument received sufficient acceptance, including acceptance by the other principal space powers, so as to enter into force as an agreement henceforth binding upon all parties to the Moon Agreement. This approach would, of course, be similar to that followed by the UN General Assembly in its adoption in 1994 of an Implementation Agreement effectively nullifying the provisions of Part XI of the LOSC to which the U.S. and some other states objected.[59]

As indicated, the current parties to the Agreement might be willing to agree to one of these possible arrangements in order to encourage and facilitate participation by the

[59] See note 32 *supra*.

U.S. and other space powers in the Agreement. As previously noted, discussions in recent meeting of the Legal Committee of COPUOS suggest that the parties to the Agreement, as well as other states, are actively exploring the possibility of revisions, arrangements or other accommodations which might persuade the U.S. and other countries to ratify and accede to the Agreement.[60] Once again, international experience with the analogous situation involving seabed minerals is suggestive, where a majority of states in the UN General Assembly were prepared to negotiate and adopt the 1994 Implementation Agreement modifying the mineral resource regime set out in Part XI of the LOSC in the hope of encouraging the U.S. and other important states to join the LOSC.

B. Should the U.S. Attempt to Establish an International Lunar Resource Regime Outside of the Framework of the Present Moon Agreement? While I have suggested that there are now good arguments for the U.S. – preferably, collectively with other space powers – to ratify and accede to the Moon Agreement under arrangements which would ensure that the legal regime established pursuant to Article 11 fully met U.S. requirements, the fact remains that such ratification by the U.S. may not currently be politically attainable. As was the case when the Agreement was first presented to the Senate subcommittee in 1980, influential and respected individuals and groups in the U.S. continue to strongly oppose U.S. ratification, remaining convinced that the Agreement's fundamental cast – especially, its provisions characterizing lunar resources as the "common heritage of mankind" and mandating the establishment of an "international regime" – will in practice inhibit the productive development and

[60] See note 57, *supra*.

exploitation of He-3 and other lunar resources, and, in particular, create such uncertainty for private enterprise as to effectively discourage, if not prevent, private investment and industry from playing any meaningful role in the exploitation of such resources – a role they believe essential to the successful commercial development of such resources.[61] It may be argued that, given the risks and uncertainty necessarily involved in the development of lunar He-3-based fusion energy, the enormous investment certainly

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[61] For a cogent recent statement of the arguments against U.S. ratification of the Moon Agreement, see Schmitt, *Return to the Moon*, *supra* note *, pp. 286-95. Noting the various issues raised in the 1980 Senate Hearings concerning Article 11 and other provisions of the Agreement, he states that:

> "... a one nation one vote, United Nations style organization ... seems very unlikely to be workable even though such an organization is envisioned by the 1979 Moon Agreement.... The inevitable politicization of decision-making in such organizations, and the stagnation which invariably results, argues against ... [its being suitable] for complex technical endeavors" (at p.151).
>
> .....
>
> "... the opportunities and benefits of private enterprise in developing lunar resources would disappear if the United States should ratify the Moon Agreement. If international political interference with a return to the Moon is to be avoided, the United States and other spacefaring nations should unequivocally reject this Agreement ..." (at p.292).

and concludes that:

> "The Moon Agreement, if ratified by major spacefaring nations, would create a high degree of uncertainty that is antithetical to private commercial activities on the Moon. The Agreement would, in effect, create a *de facto* moratorium on such activities. A mandated international management regime would both complicate national and private commercial efforts and give other countries political control over the permissibility, timing and management of all commercial and national resource activities on the Moon." (at p.295)

He proposes instead that:

> "In removing the Moon Agreement from the playing field, the United States and other nations could state that their policy will be to license competent entities to bring lunar resources to Earth under the general authority and constraints of the Outer Space Treaty of 1967. More proactively, these nations could state in policy and law that, under specific conditions, they will recognize a private entity, or other entity's property and mineral rights within a requested area on the Moon. ... [and goes on to suggest such conditions]." (at p.293-4)

See also testimony of Hon. H.H. Schmitt before Subcommittee on Science, Technology and Space of the Senate Committee on Commerce, Science and Transportation, Nov. 6, 2003. Dr. Schmitt currently is Chairman of Interlune-Intermars Initiative, Inc., an organization whose goal is to advance the private sector's acquisition and use of lunar resources.

See also, e.g., G. Reynolds, "Return of the Moon Treaty: The Monster L-5 Slew Lives Again," 613 *Ad Astra* 27-29 (1994) stating that the creation of an international authority "would discourage discovery if not outright prevent the development of lunar resources any time soon" (at p.28); G.H. Reynolds, "Key Objections to the Moon Treaty," http://www.nsschapters.org/hub/pdf/MoonTreatyObjections.pdf; and Baslar, *The Concept of the Common Heritage of Mankind*, *supra* note 6, pp. 161-90 (broadly discussing what he considers problems with the Moon Agreement).

It is interesting that, in the recent science-fiction movie, *Moon*, the lunar He-3 is being exploited by a private Japanese company which employs the protagonist engaged in the actual mining activities.

required, and the likely very long time horizon before any financial return can hope to be achieved, the prospect of private enterprises choosing to play a leading role in He-3 or other lunar resource development – at least without substantial government assistance – is open to question.[62] However, the 1980 Senate Hearings and subsequent lack of administration interest in the Agreement suggest that, if such opposition persists, the prospect for Senate ratification of the Agreement at any time soon may remain uncertain.

Consequently, if ratification of the Moon Agreement proves either undesirable or politically unachievable, the U.S. could seek to establish a lunar resource regime wholly apart from the Moon Agreement. As discussed, some precedent for this approach exists in U.S. rejection of the 1982 Law of the Sea Treaty (in particular, the Seabed Mining provisions and regime of that treaty), and the subsequent conclusion by the U.S. in 1982 and 1984 of international agreements with several other states (Belgium, France, the Federal Republic of Germany, Italy, Japan, the Netherlands and the U.K.) to resolve overlapping claims with respect to mining areas for polymetallic nodules of the deep seabed.[63] The possibilities open to the U.S. in this respect include the following:

- The U.S., as a party to the Outer Space Treaty, could propose to the other parties an amendment or protocol to that treaty that would clearly protect and provide for

[62] See, e.g., Kenneth Chang, "Grand Plans for Moon and Mars, Budget Permitting," *N.Y. Times*, July 14, 2009, at p.D2:

> "The nascent private space industry, which has yet to send anyone into orbit, does not seem likely to head to the Moon, either, with no obvious profit windfall to offset the billions of dollars in cost. 'The idea that a private investor can put together the funds to develop rockets capable of a lunar mission is extremely speculative, verging on fantasy', said John Logsdon, chairman of space history at the National Air and Space Museum."

[63] See Agreement concerning interim arrangements relating to polymetallic nodules of the deep seabed, Sept. 2, 1982, e.i.f. Sept. 2, 1982, TIAS 10562, and provisional understanding regarding deep seabed matters, with memorandum of implementation, joint record and related exchanges of notes, Aug. 3, 1984, e.i.f. Sept. 2, 1984, TIAS 11066. And see Schmitt, *Return to the Moon*, *supra* note 6, at p.294, and ALI *Restatement Foreign Relations Law*, Sec. 523, *supra* note 47.

the right of any state or private enterprise to mine, acquire property rights in, and exploit lunar or other outer space resources and to retain a reasonable share of the profits.

- The U.S. could propose to other "space powers" and other interested countries the negotiation, on a global basis, of an entirely new Moon Agreement intended to replace the present agreement, and containing different and more detailed provisions reflecting U.S. preferences. The new Agreement might incorporate and be generally consistent with the tenor and provisions of the Moon Agreement apart from its provisions regarding the establishment of an acceptable lunar resource regime. Such a negotiation could conceivably occur either within COPUOS or outside the UN framework.
- The U.S. could – taking the same approach it adopted under the 1980 Deep Seabed Hard Mineral Act with respect to the issue of deep seabed mining[64] – negotiate a lunar resource agreement only with those like-minded states actually engaged in space activities and showing interest in and a potential capacity to engage in lunar mining activities, such as Russia, China, India, the European Union and Japan. Such an agreement might not attempt to deal with lunar activities as a whole – which are already broadly covered in the Outer Space Treaty and in provisions of the Moon Agreement that may arguably be binding as customary law – but could deal only with the provision of rules relating more directly to the exploitation of lunar resources.

[64] See notes 47 and 63, *supra*.

- Finally, if objections are raised that it is premature to try to agree now on a detailed lunar resource regime, since the exploitation of such resources is unlikely for many years, the U.S. might propose that the space powers and other nations potentially involved in lunar exploration and development – and possibly other countries concerned – currently enter into at least a broad "lunar resource principles" framework agreement, expressing a firm commitment to the basic character of a regime which would be acceptable to the U.S.

However, each of these possibilities has drawbacks. Each of them bypasses and ignores the existing Moon Agreement and may on that basis alone fail to win broad international support. Moreover, the last three approaches may fail to provide the kind of broader legal and political assurance that long-term state and private investment in He-3-based fusion energy development is likely to require.

C. Should the U.S. Seek to Establish an International Organization or Enterprise for the Cooperative Development and Carrying Out of Lunar He-3 Mining – and Perhaps, More Broadly, of Terrestrial He-3-Based Fusion Energy? The U.S. could take the initiative in seeking to establish a user-based international organization or enterprise designed to cooperatively develop and manage the mining and distribution of lunar He-3 – and perhaps other lunar resources – and, perhaps, more broadly, at least certain aspects of the development, production and distribution of He-3-based fusion energy on Earth.[65]

[65] See, e.g., the proposal by H.H. Schmitt and C.C. Joyner for the establishment of INTERLUNE, a user-based international organization whose primary purpose would be to manage the initial development of commercial helium-3 fusion power on Earth and the development and operation of helium-3 production facilities on the Moon. Participation in INTERLUNE would be comprised of, (1) nations who will actively participate in creating the necessary capabilities; (2) other entities who are solely users or beneficiaries of such capabilities; and (3) investors in the enterprise as a whole. See C.C. Joyner and H.H. Schmitt, "Lunar bases and extraterrestrial law: General legal principles and a particular regime proposal" in W.W. Mandell (Ed.), *Lunar Bases and Space Activities of the 21st Century* (1985), p.741; Wisconsin NASA Study, *supra* note *, Sec. VII(D), at pp. 79-100; H.H. Schmitt, "INTERLUNE concept for helium-3 fusion development"

The organization could be comprised of, first, the principal space powers and other nations willing to actively participate in creating the necessary capabilities; second, other nations and entities who are users or beneficiaries of such capabilities; and, perhaps, third, private companies, consortia or investors interested and capable of investing and participation in the enterprise as a whole. The organization could be based on a recognition that the Moon and its resources constitute a common heritage of humankind, that the enormous potential of He-3-based fusion energy deserves to be shared by all of the Earth's nations and peoples, and that this promise might best be achieved by a cooperative rather than individualistic or confrontational approach to the development and management of such a complex, challenging, costly and potentially history-changing source of energy. The world's leading technologically advanced nations have already taken significant steps in this direction in their cooperative approach to the development and operation of the International Space Station and their formation of ITER, the cooperative project in which they are together seeking to establish the commercial practicality of fusion energy. The potential inclusion of private companies and consortia in such an organization would recognize the growing interest and important and exciting possibilities of participation by private enterprise in the commercial development of spaceflight and space resources.[66]

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in W.Z. Sadeh, S. Sture, and R.J. Miller (Eds.), *SPACE 92 – Proceedings 3d International Conference* (1992), pp. 804-813, and, generally, Schmitt, *Return to the Moon*, *supra* note *, at p.151, Chpt. 8 ("Approaches and Organizational Options for a Return," pp. 149-53).

[66] See, e.g., Commercial Space Launch Act, 49 U.S.C. § 70101(a)(1) stating that it is U.S. policy "to promote growth and entrepreneurial activity through the peaceful use of outer space." And see testimony of Hon. H.H. Schmitt before the Subcommittee on Science, Technology and Space of the Senate Committee on Commerce, Science and Transportation, Nov. 6, 2003 Commercial Space Launch Amendments Act of 2004; "Flying High: America's government has no money for its human-spaceflight plans. The private sector has plenty", *The Economist*, Sept. 12, 2009 at p.87; and, generally, H.L. van Traa-Engelman,

Such a cooperative international organization could take a variety of forms. As several commentators have suggested,[67] it might, for example, be modeled on the International Telecommunications Satellite Organization (INTELSAT), an innovative user-based intergovernmental commercial consortium which, pursuant to a U.S. initiative, was established by a number of government and operating entities, initially on an interim basis in 1964, and then by permanent agreement in 1973, to own and manage a constellation of communications satellites providing international broadcast services to all areas of the world.[68] Membership in INTELSAT was open to any state which was a member of the International Telecommunications Union (ITU); however, access to the system was available to every nation. Under the INTELSAT agreement, shares and votes in INTELSAT were reallocated periodically in proportion to each member's contribution to and use of the system; that is, substantial users, such as the U.S. which contributed more investment, had more shares and voting weight in substantive decisions of the

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Commercial Utilization of Outer Space (Martinus Nijhoff Publ., 1993), Chpt. IX ("Private Enterprise and Space Law").

[67] See, e.g., Wisconsin NASA Study, *supra*, note * at p.89; Jasentulyana (1986), note 6, *supra* at p.298; testimony of Roberts Owens in *1980 Senate Hearings*, at pp. 8, 15 and 26; Statement of Eileen Galloway, Honorary Director, International Institute of Space Law, 1980 Senate Hearings at p.173; Galloway (1980), "Issues in Implementing the [Moon Agreement]," *supra* note 6; Peterson, *International Regimes for the Final Frontier*, *supra* note 6, at p.164 (citing other references); Doyle (1986), "Legal and Policy Implications ...", *supra* note 6, at pp. 31-37; Schmitt, *Return to the Moon*, *supra* note 6, at p.289.

[68] Agreement relating to the International Telecommunications Organization (INTELSAT), with annexes, August 20, 1971, e.i.f. February 12, 1973, 23 UST 3813, TIAS 7532, 4091, 10 *ILM* 909.

And see, e.g., H.L. van Traa-Engelman, *supra* note 66, pp. 112-33; "Intelsat: Technology, Politics and the Transformation of a Regime," 29 *Intl. Org.* 655 (1975); Peterson, *International Regimes*, *supra* note 6, Chpt. 8; M.L. Smith, *International Regulation of Satellite Communications* (1990); Wikipedia description at "Intelsat", http://en.wikipedia.org.wiki.Intelsat.

A similar organization, the International Maritime Satellite Organization (INMARSAT) was established in 1979 to establish maritime satellite services, now extended to land and air mobile communications as well as maritime communications. Convention on the International Maritime Satellite Organization (INMARSAT) with Annex, Sept. 3, 1976, e.i.f. July 16, 1979, 31 U.S.T. 1, TIAS 9605. In 1999 INMARSAT was also converted into a private commercial compound under United Kingdom law. See the Inmarsat website at http://www.inmarsat.com, and see H.L. van Traa-Engelman, *supra*, at pp. 137-58.

organization. The organization's primary source of revenue was from satellite usage fees which, after deducting operating costs, was redistributed to INTELSAT members in proportion to their shares. As indicated, satellite services were available to any nation, whether or not a member of INTELSAT and all users paid the same rates; this nondiscriminatory pricing structure in effect subsidized lesser use by developing countries with heavier use by more developed nations, thus providing some sharing of the benefits of space communications technology. INTELSAT was tied to the United Nations through its recognition of the regulatory functions of the ITU.

In 2001, INTELSAT, which by that time had over 100 members, was privatized and renamed Intelsat, Ltd. It is now the world's largest provider of satellite services, operating a fleet of over 50 communication satellites and providing service to over 600 Earth stations in more than 149 countries and territories. INTELSAT offers not only a successful example of international cooperation with respect to the profitable commercial development of a common space resource but also suggests the possibility of transitioning an initially intergovernmental commercial consortium to participation or management by private enterprise.

Whatever form such a cooperative international institutional arrangement took, it would be designed and serve to provide access and influence to all nations, participants, investors, and customers in the development and use of He-3-based fusion power, alleviate conflict and discontent over which nation or nations should control lunar resources or resource-related operations on the Moon, and assure that the benefits of He-3-based fusion energy would be widely shared by all nations and peoples throughout the world. Among the more important objectives of such an organization or enterprise would

be: (1) raising the necessary capital to sustain the development of a technologically and economically viable He-3-based fusion energy system; (2) developing the necessary fusion and lunar He-3 recovery technology; (3) assuring effective continued and environmentally-sound maintenance and operation of terrestrial and lunar fusion-energy related facilities and services; (4) assuring reliable supplies of He-3 and other resources to terrestrial customers; (5) maintaining reasonable and uniform rate structures to all users; (6) assuring access to proprietary technologies, resources and profits related to a fair valuation of members participation and contribution; and (7) resolving disputes among members concerning their participation in such an enterprise.

Such an organization or enterprise might conceivably be established independently of any separate international agreement regarding a lunar mining regime; presumably, if it embraced a sufficiently broad and significant membership, including all of the leading space powers, it could in itself constitute and elaborate such a regime, although it would, of course, have to conform to the broad principles set forth in the Outer Space Treaty and those provisions of the Moon Agreement which can be considered to now reflect customary international law. Alternatively, such an organization or enterprise could be designed to supplement and be compatible with the Moon Agreement or other international agreement which might be negotiated to deal with lunar resources; indeed, Article 16 of the Moon Agreement specifically provides that an international organization whose membership is comprised of a majority of State Parties may conduct activities under the Agreement if it declares its acceptance of the Agreement's obligations. Finally, such an organization or enterprise could be established under the Moon Agreement by the parties to that Agreement as, in itself, a part of the

"international regime, including appropriate procedures, to govern the exploitation of the natural resources of the Moon" that the parties undertake to establish under Article 11(5) and 18 of that Agreement.

VII. Conclusion

The need for affordable, safe and non-polluting energy to serve the Earth's growing population is increasingly evident and urgent. The development of lunar He-3-based fusion energy, while still uncertain of achievement, offers humanity a credible prospect of meeting that need for centuries to come. Thus, it is not surprising that the U.S. and other nations proposing the eventual establishment of lunar bases have expressed interest in the possible mining and exploitation of lunar He-3.

However, neither nations nor private commercial enterprises are likely to be willing to commit resources to an He-3-based fusion energy program absent a stable and predictable legal regime governing lunar resources that provides reasonable assurance that any such effort and investment will be rewarded and can be carried on without controversy or disruption. Yet, at present, international space law fails to establish any detailed rules governing the mining, ownership and exploitation of He-3 and other lunar resources or to provide such assurance. Consequently, if the U.S. seriously contemplates the possible development of He-3-based fusion energy, it is in its national interest to take steps to establish what it would consider as an acceptable and agreed-upon international lunar resource regime – and to do so relatively soon.

There are a variety of ways, discussed above, in which the U.S. could seek to establish such an acceptable international lunar resource regime. Perhaps the simplest and most promising would be approaches involving collective accession by the U.S. and

other major "space powers" to the Moon Agreement under conditions or arrangements that assure the incorporation of an acceptable lunar resource regime within the Moon Agreement pursuant to Articles 11(5) and 18 of that Agreement. An additional initiative, well worth exploring, is the possibility of the formation by the U.S., other "space powers" and other interested nations of a user-based international organization or entity – open to all nations and perhaps private enterprises – to undertake the collective development and conduct of lunar He-3 and other resource mining activities, as well as perhaps at least some aspects of the development and management of terrestrial He-3-based fusion energy itself. Such a collective enterprise might be established on its own or perhaps incorporated within the framework of the Moon Agreement under Article 18 of that Agreement.

However problematic and seemingly remote, the question of the exploitation of He-3 and other lunar resources warrants the U.S. government's – and international lawyers' – present attention. That the U.S. and at least some other nations will eventually establish bases on the Moon – and perhaps, on Mars or other planets or their moons in our solar system – seems likely. Beginning now to think about and craft collective solutions to the issues which may well arise from such programs may not only facilitate such national activities but avoid difficulties and disputes in the future. Moreover, international cooperation in developing – and making available to all nations and people – a prospectively ideal and abundant source of affordable, safe and non-polluting energy could usher in a new and hopeful era for all humanity.