

# LIVE LONG AND PROSPER: THE NEED FOR A NEW MULTILATERAL AGREEMENT GOVERNING ASTEROID MINING

*James McSweeney\**

## I. INTRODUCTION

“Space, the final frontier. . . . [T]o boldly go where no man has gone before.”<sup>1</sup> These words, the opening narration to the television show *Star Trek*, were heard by thousands of eager space enthusiasts when the original installment of the show aired from 1966 to 1969, coinciding with the end of the Space Race between the United States and the Soviet Union.<sup>2</sup> But space does not only appeal to those who watched *Star Trek*. For thousands of years, from ancient civilizations to the present, Earth’s relation to the vastness of space has fascinated humanity.<sup>3</sup> Space has and will continue to leave man wondering what lies beyond: Heaven,<sup>4</sup> the gods,<sup>5</sup> or extraterrestrial life?<sup>6</sup>

---

\* J.D. Candidate, May 2020, University of Louisville Brandeis School of Law; B.A., University of Kentucky, 2017. I would like to thank my fiancée, Mary Frances Miller, and my parents, Kathi and Gene, for their unwavering support, even after constantly listening to space facts for over a year. “Many years ago the great British explorer George Mallory, who was to die on Mount Everest, was asked why did he want to climb it. He said, ‘Because it is there.’ Well, space is there, and we’re going to climb it, and the moon and the planets are there, and new hopes for knowledge and peace are there.” – John F. Kennedy (Sept. 12, 1962).

<sup>1</sup> *Star Trek* (Desilu Productions 1966–1969).

<sup>2</sup> *Id.*; see *The Space Race*, HISTORY (Feb. 22, 2010), <https://www.history.com/topics/cold-war/space-race>.

<sup>3</sup> See generally E.C. KRUPP, ECHOES OF THE ANCIENT SKIES: THE ASTRONOMY OF LOST CIVILIZATIONS (2003); FRANCIS GODWIN, THE MAN IN THE MOONE (1638) (detailing a man’s campaign to fly to the moon—using migrating geese—and his discovery of an extraterrestrial civilization.).

<sup>4</sup> *Luke* 24:51 (King James) (“And it came to pass, while he blessed them, he was parted from them, and carried up into heaven.”).

<sup>5</sup> See generally K.S. CHARAK, SURYA THE SUN GOD (2007) (discussing the role of the Sun and Surya, the Hindu god of the Sun, according to the Puranas, ancient Hindu religious texts that detail the history of the universe.); STEPHEN QUIRKE, THE CULT OF RA: SUN-WORSHIP IN ANCIENT EGYPT (Thames & Hudson 2001) (describing the sources for the creation of Ra—the Egyptian god of the sun, order, kings, power, and the sky—and Ra’s impact on creation and the physical world, and the worshipping of Ra).

<sup>6</sup> See EDWARD REGIS JR., EXTRATERRESTRIALS: SCIENCE AND ALIEN INTELLIGENCE ix (Cambridge Univ. Press 1987) (“If we should one day find out that intelligent aliens do exist, what will the discovery mean? Will it irretrievably alter our view of ourselves, or will human life go on pretty much as it had before?”); Don Lincoln, Opinion, *Does Alien Life Exist?*, CNN (Jan. 4, 2018), <https://www.cnn.com/2018/01/04/opinions/alien-life-opinion-lincoln/index.html>.

As the scientific landscape surrounding space travel constantly evolves and privatizes, leading to the possibility of commercial asteroid mining ventures, a new multilateral agreement is necessary. The most recent treaty governing space travel and asteroid mining was ratified nearly forty years ago.<sup>7</sup> That agreement—coined the Moon Agreement—followed the language of the Outer Space Treaty, stating in Article XI that “[t]he moon is not subject to national appropriation by a claim of sovereignty, by means of use or occupation, or by any other means.”<sup>8</sup> In conjunction with Article I, Article XI also applies to “other celestial bodies within the solar system”, which includes asteroids.<sup>9</sup>

This note will demonstrate the need for a new multilateral agreement that allows countries to claim asteroids—or at least less than the whole of an asteroid—for mining purposes while still maintaining the goals set forth by prior treaties and agreements. In Part II, this note will examine previous treaties signed by the member states of the United Nations. Second, it will discuss legislation passed by Congress that encourages private entities, such as SpaceX and Planetary Resources, to invest and experiment in space travel and, eventually, in asteroid mining. Part III will analyze the feasibility of using asteroid mining to rectify the depletion of Earth’s natural resources, and how a multilateral agreement would serve as a more effective means to govern asteroid mining. Finally, this note will offer potential provisions to a new multilateral agreement permitting nations to conduct asteroid mining.

## II. BACKGROUND

On July 20, 1969, the United States stunned the world by completing the Apollo 11 mission—the first manned mission to the moon.<sup>10</sup> “That’s one small step for a man, one giant leap for mankind.”<sup>11</sup> Neil Armstrong and Buzz Aldrin were the first men on the Moon—thus concluding the Space Race—and Apollo 11 becoming the first of six successful manned Moon landings

---

<sup>7</sup> G.A. Res. 34/68, annex, Agreement Governing the Activities of States on the Moon and Other Celestial Bodies Annex, UN Doc. A/RES/34/68 (1979), <http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/moon-agreement.html> [hereinafter Moon Agreement].

<sup>8</sup> *Id.*

<sup>9</sup> *See id.*

<sup>10</sup> *July 20, 1969: One Giant Leap for Mankind*, NASA (July 20, 2019), [https://www.nasa.gov/mission\\_pages/apollo/apollo11.html](https://www.nasa.gov/mission_pages/apollo/apollo11.html).

<sup>11</sup> *Id.*

by the United States.<sup>12</sup> From the time before the Apollo 11 landing to the planned NASA missions Lucy<sup>13</sup> and Psyche,<sup>14</sup> humanity has continuously made steps towards a greater understanding of space.<sup>15</sup> With that understanding, sovereign nations created international regulations and treaties, which designated the inability to claim celestial bodies and the liabilities associated with space travel.<sup>16</sup>

### *A. The Outer Space Treaty*

The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, more commonly known as the “Outer Space Treaty,”<sup>17</sup> is a United Nations treaty ratified in 1967.<sup>18</sup> The treaty was ratified by numerous member states, such as the United States, the former Soviet Union, and the United Kingdom. The Outer Space Treaty came into effect on October 10, 1967.<sup>19</sup> As of April 2020, the Outer Space Treaty has been ratified by 119 member states, in addition to 23 signatures from other member states.<sup>20</sup>

The purpose of the treaty was to promote “the use [of] outer space only for peaceful purposes.”<sup>21</sup> The intent behind “peaceful purposes” is demonstrated in several key articles, such as Article I (“benefit and . . .

<sup>12</sup> *Id.*; *The Space Race*, *supra* note 2.

<sup>13</sup> See *Lucy*, NASA SCIENCE: SOLAR SYSTEM EXPLORATION (last visited July 8, 2020), <https://solarsystem.nasa.gov/missions/lucy/in-depth/>.

<sup>14</sup> See *Psyche*, NASA SCIENCE: SOLAR SYSTEM EXPLORATION (last visited July 8, 2020), <https://solarsystem.nasa.gov/missions/psyche/in-depth/>.

<sup>15</sup> See, e.g., Adam G. Riess et al., *Type Ia Supernova Discoveries At z > 1 From the Hubble Space Telescope: Evidence for Past Deceleration and Constraints on Dark Energy Evolution*, 607 *ASTROPHYSICAL J.* 665 (2004); Laura Ferrarese et al., *The Extragalactic Distance Scale Key Project. IV. The Discovery of Cepheids and a New Distance to M100 Using the Hubble Space Telescope*, 464 *ASTROPHYSICAL J.* 568 (1996).

<sup>16</sup> See Moon Agreement, *supra* note 7; Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205 [hereinafter Outer Space Treaty]; Convention on International Liability for Damage Caused by Space Objects, Mar. 29, 1972, 24 U.S.T. 2389, 961 U.N.T.S. 187 [hereinafter Liability Convention].

<sup>17</sup> *Outer Space Treaty*, ENCYCLOPAEDIA BRITANNICA, <https://www.britannica.com/event/Outer-Space-Treaty#accordion-article-history> [hereinafter ENCYCLOPAEDIA BRITANNICA] (last visited July 11, 2020).

<sup>18</sup> *Id.*

<sup>19</sup> *Id.*

<sup>20</sup> Status of International Agreements Relating to Activities in Outer Space as at 1 January 2019, U.N. Doc. A/AC.105/C.2/2019/CRP.3 (2019) [hereinafter Status of International Agreements].

<sup>21</sup> ENCYCLOPAEDIA BRITANNICA, *supra* note 17.

interests of all countries”),<sup>22</sup> Article II (“not subject to national appropriation”),<sup>23</sup> Article IV (no nuclear armaments in Earth’s orbit),<sup>24</sup> Article IX (“guided by the principle of cooperation and mutual assistance”),<sup>25</sup> and Article X (other member-states are “afforded . . . opportunit[ies] to observe the [launching] of space objects”),<sup>26</sup> but this note will only focus on Articles II (national appropriation) and VI (international responsibility and liability)<sup>27</sup> of the treaty.

Article II, the most important article for this note’s purpose, declares that “[o]uter space, including the Moon and other celestial bodies, is not subject to national appropriation by claims of sovereignty, by means of use or occupation, or by any other means.”<sup>28</sup> This means that under the current treaty no country can lay claim to any asteroid, or the materials within it.

A major source of debate is whether the Outer Space Treaty binds private corporations from claiming celestial bodies as well.<sup>29</sup> In 2015, Congress passed the U.S. Commercial Space Launch Competitiveness Act, which allows corporations and private entities to utilize asteroids and other space resources, but without laying claim to the land on which the resources sit.<sup>30</sup> While this law makes resource hunting legal for U.S. citizens, some experts, such as Professor Frans von der Dunk and Professor Fabio Tronchetti, argue that this could violate the Outer Space Treaty.<sup>31</sup>

Article VI of the Outer Space Treaty states that each member state will be internationally liable for any space-related national activities, including actions “carried on by governmental agencies or by non-governmental entities . . . .”<sup>32</sup> However, to be held liable for the non-governmental entity, that member state must authorize and supervise the actions of the entity.<sup>33</sup> A

---

<sup>22</sup> Outer Space Treaty, *supra* note 16.

<sup>23</sup> *Id.*

<sup>24</sup> *Id.*

<sup>25</sup> *Id.*

<sup>26</sup> *Id.*

<sup>27</sup> *Id.*

<sup>28</sup> *Id.*

<sup>29</sup> Elizabeth Howell, *Who Owns the Moon? Space Law & Outer Space Treaties*, SPACE.COM (Oct. 27, 2017), <https://www.space.com/33440-space-law.html>.

<sup>30</sup> *Id.*; see also U.S. Commercial Space Launch Competitiveness Act, Pub. L. No. 114-90, § 402, 129 Stat. 704, 721 (2015) (codified at 51 U.S.C. §§ 10101–51303).

<sup>31</sup> James Rathz, *Law Provides New Regulatory Framework for Space Commerce*, REG. REV. (Dec. 31, 2015), <https://www.theregreview.org/2015/12/31/rathz-space-commerce-regulation/>.

<sup>32</sup> Outer Space Treaty, *supra* note 16.

<sup>33</sup> *Id.*

potential vulnerability of this Article is that, since non-governmental entities may not be bound to the Outer Space Treaty, a member state may be able to authorize, supervise, and be held liable for the actions of a non-governmental actor, thus agreeing to the actor mining asteroids for minerals on behalf of the member state while still not technically violating the Treaty.

However, as will immediately be discussed, the Outer Space Treaty is not the only binding agreement to space-faring nations. These other international agreements, as well as certain U.S. legislation, further highlight the need for a new multilateral agreement.

### *B. The Moon Agreement*

In 1979, following the enactment of the Outer Space Treaty, the United Nations General Assembly passed the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies,<sup>34</sup> which is also known as the “Moon Agreement.”<sup>35</sup> This agreement attempted to elaborate upon the usage and property rights regarding the Moon and other celestial bodies.<sup>36</sup>

To explain those rights, Article VIII of the agreement provides, “. . . State Parties may, in particular: (a) Land their space objects on the moon and launch them from the moon; [and] (b) Place their personnel, space vehicles, equipment, facilities, stations and installations anywhere on or below the surface of the moon.”<sup>37</sup>

However, while member states of the United Nations may freely explore space and the moon, Article XI provides, “The moon and its natural resources are the common heritage of mankind . . . .”<sup>38</sup> Furthermore, “The moon is not subject to national appropriation by any claim of sovereignty, by means of use or occupation, or by any other means.”<sup>39</sup> Similar to the Outer Space Treaty, the Moon Agreement likewise states, “The provisions of this Agreement relating to the moon shall also apply to other celestial bodies within the solar system . . . .”<sup>40</sup> Furthermore, also similar to the Outer Space Treaty, the Moon Agreement contains a provision that requires member

---

<sup>34</sup> Moon Agreement, *supra* note 7.

<sup>35</sup> *Id.*

<sup>36</sup> Howell, *supra* note 29.

<sup>37</sup> Moon Agreement, *supra* note 7.

<sup>38</sup> *Id.*

<sup>39</sup> *Id.*

<sup>40</sup> Compare Moon Agreement, *supra* note 7, with Outer Space Treaty, *supra* note 16.

states to be held internationally responsible for the activities on the moon, and on other celestial bodies, for any acts carried out by governmental agencies or non-governmental entities.<sup>41</sup>

While the additional provisions and details in the Moon Agreement may appear as a more appealing document, the agreement failed to garner any support from the major space-faring countries, which practically renders the agreement useless.<sup>42</sup> As of January 2019, only eighteen countries have ratified the Moon Agreement.<sup>43</sup> Not included in that list are the United States, the United Kingdom, Russia, and China.<sup>44</sup> With so little support, especially from the major space-faring countries, the Moon Agreement “is not considered a binding element of international space law.”<sup>45</sup>

### C. The ASTEROIDS Act

On July 10, 2014, the American Space Technology for Exploring Resource Opportunities in Deep Space Act, also known as the ASTEROIDS Act, was introduced in the United States House of Representatives.<sup>46</sup> Following its introduction in the House, the bill was referred to the House Committee on Science, Space, and Technology.<sup>47</sup> The ASTEROIDS Act was proposed to “facilitate the commercial exploration and utilization of asteroid resources to meet national needs.”<sup>48</sup> Additionally, the bill sought to “discourage government barriers to the development of economically viable, safe, and stable industries for the exploration and utilization of asteroid resources in outer space in manners consistent with the existing international

<sup>41</sup> Compare Moon Agreement, *supra* note 7, with Outer Space Treaty, *supra* note 16.

<sup>42</sup> David Johnson, Comment, *Limits on the Giant Leap for Mankind: Legal Ambiguities of Extraterrestrial Resource Extraction*, 26 AM. U. INT’L L. REV. 1477, 1481 (2011) (“While many claim the Moon Treaty’s use of the common heritage of mankind principle prohibits the exploitation of extraterrestrial resources, that document’s limited acceptance by spacefaring nations renders it practically useless.”).

<sup>43</sup> Status of International Agreements, *supra* note 20. The Moon Agreement parties include Armenia, Australia, Austria, Belgium, Chile, Kazakhstan, Kuwait, Lebanon, Mexico, Morocco, Netherlands, Pakistan, Peru, The Philippines, Saudi Arabia, Turkey, Uruguay, and Venezuela. *Id.*

<sup>44</sup> *See id.*

<sup>45</sup> Johnson, *supra* note 42, at 1487.

<sup>46</sup> American Space Technology for Exploring Resource Opportunities in Deep Space Act, H.R. 5063, 113th Cong. (2014).

<sup>47</sup> *Id.*

<sup>48</sup> *Id.*

obligations of the United States.”<sup>49</sup>

Representative Bill Posey (R-FL), the sponsor of the bill, explained that “[o]ur knowledge of asteroids – their number, location, and composition – has been increasing at a tremendous rate, and space technology has advanced to the point where the private sector is now able to begin such expeditions.”<sup>50</sup> Posey continued by saying, “Our legislation will promote private exploration and protect commercial rights as these endeavors move forward.”<sup>51</sup>

As of July 15, 2014, the bill was further referred to the Subcommittee on Space and no further action has been taken on it.<sup>52</sup> Although no action was taken on the ASTEROIDS Act, it was eventually used in a larger bill: the U.S. Commercial Space Launch Competitiveness Act.<sup>53</sup>

#### *D. The U.S. Commercial Space Launch Competitiveness Act*

Less than a year after the introduction of the ASTEROIDS Act, the U.S. Commercial Space Launch Competitiveness Act was introduced to the House of Representatives.<sup>54</sup> Unlike the single section of the ASTEROIDS Act, the Commercial Space Launch Act was comprised of twenty-two sections<sup>55</sup> and utilized language from a previous bill, The Space Resource Exploration and Utilization Act of 2015.<sup>56</sup> Similar to the ASTEROIDS Act, the Space Resource Exploration and Utilization Act called for the President of the United States to “facilitate” and to “promote the right of U.S. citizens to engage in commercial exploration for and commercial recovery of space resources.”<sup>57</sup>

On November 25, 2015, the U.S. Commercial Space Launch

<sup>49</sup> *Id.*

<sup>50</sup> Matthew Shaer, *The Asteroid Miner's Guide to the Galaxy*, FOREIGN POLICY (Apr. 28, 2016), <https://foreignpolicy.com/2016/04/28/the-asteroid-miners-guide-to-the-galaxy-space-race-mining-asteroids-planetary-research-deep-space-industries/>.

<sup>51</sup> *Id.*

<sup>52</sup> American Space Technology for Exploring Resource Opportunities in Deep Space Act, H.R. 5063, 113th Cong. (2014).

<sup>53</sup> Shaer, *supra* note 50.

<sup>54</sup> U.S. Commercial Space Launch Competitiveness Act, H.R. 2262, 114th Cong. (2015).

<sup>55</sup> Compare H.R. 2262, with American Space Technology for Exploring Resource Opportunities in Deep Space Act, H.R. 5063, 113th Cong. (2014).

<sup>56</sup> Compare H.R. 2262 § 402–3, with Space Resource Exploration and Utilization Act of 2015, H.R. 1508, 114th Cong. (2015).

<sup>57</sup> Compare H.R. 5063 § 2, with H.R. 1508 § 2.

Competitiveness Act was signed into law by President Barack Obama.<sup>58</sup> The passage of this law resulted in bipartisan praise.<sup>59</sup> Congressman Derek Kilmer (D-WA) supported the law because it would cause the commercial space industry to flourish and place the United States “at the head of [the] growing, global industry.”<sup>60</sup> Congressman Bill Posey (R-FL), the sponsor of the ASTEROIDS Act<sup>61</sup> and the original Space Resource Exploration and Utilization Act of 2015,<sup>62</sup> commended the law, stating, “This bipartisan, bicameral legislation is a landmark for American leadership in space exploration. Recognizing basic legal protections in space will help pave the way for future commercial space endeavors.”<sup>63</sup> Finally, Senators Marco Rubio (R-FL) and Patty Murray (D-WA) applauded the law as an “important step forward” in the creation of new jobs.<sup>64</sup>

Although the Space Resource Exploration and Utilization section of the law was embraced by potential commercial miners, many critics to the Act argue that it “could lead to violations of international space law.”<sup>65</sup> Those concerns stem from interpretations of the Outer Space Treaty and whether private entities have the international authority to extract resources from asteroids.<sup>66</sup> The law says that “a U.S. citizen engaged in commercial recovery of an asteroid resource or space resource shall be entitled to any asteroid resource or space resource obtained.”<sup>67</sup> However, to bypass the prohibition of national claims of sovereignty in the Outer Space Treaty, the U.S. Commercial Space Launch Competitiveness Act contains a clause that declares “the United States does not, by enactment of this Act, assert sovereignty or sovereign or exclusive rights or jurisdictions over, or

---

<sup>58</sup> See U.S. Commercial Space Launch Competitiveness Act, Pub. L. No. 114-90, 129 Stat. 704 (2015) (codified at 51 U.S.C. §§ 10101–51303).

<sup>59</sup> See *President Obama Signs Bill Recognizing Asteroid Resource Property Rights into Law*, PLANETARY RESOURCES (Nov. 25, 2015), <https://www.planetaryresources.com/2015/11/president-obama-signs-bill-recognizing-asteroid-resource-property-rights-into-law/>.

<sup>60</sup> *Id.*

<sup>61</sup> See H.R. 5063.

<sup>62</sup> See H.R. 1508.

<sup>63</sup> *President Obama Signs Bill Recognizing Asteroid Resource Property Rights into Law*, *supra* note 59.

<sup>64</sup> *Id.*

<sup>65</sup> *U.S. Space-Mining Law Seen Leading to Possible Treaty Violations*, CBC NEWS (Nov. 26, 2015), <https://www.cbc.ca/news/technology/space-mining-us-treaty-1.3339104>.

<sup>66</sup> See generally *id.*

<sup>67</sup> U.S. Commercial Space Launch Competitiveness Act, Pub. L. No. 114-90, § 402 129 Stat. 704, 721 (2015) (codified at 51 U.S.C. § 51303).



ownership of, any celestial body.”<sup>68</sup> This leaves commercial asteroid mining in limbo as to three main questions: (1) whether the Outer Space Treaty prohibits private entities from mining; (2) if mining requires a claim of sovereignty to an asteroid; and (3) if unilaterally allowing private entities to mine would have international repercussions.<sup>69</sup>

### *E. Private Corporations Expanding into Space*

As discussed above, political debate regarding the Outer Space Treaty’s applicability to private corporations is unknown. However, that has not slowed the progress of some entities. Currently there are four main companies that are focused on space-faring operations: Bradford Space,<sup>70</sup> Consensus Space,<sup>71</sup> SpaceX,<sup>72</sup> and Virgin Galactic.<sup>73</sup>

Deep Space Industries (DSI) was founded in 2013 as a rival company to Planetary Resources.<sup>74</sup> Its original plan was to create unmanned spacecraft, known as “Fireflies,” which would assess the minerals stored within asteroids.<sup>75</sup> Next, samples of prospective asteroids would be returned to Earth for further test using spacecraft known as “Dragonflies,”<sup>76</sup> and ultimately, “Harvestors” would conduct the physical asteroid mining.<sup>77</sup> DSI planned to begin launching the DragonFly spacecraft in 2016, with the expeditions expected to take two to four years.<sup>78</sup> DSI also has patent-pending technology, known as the MicroGravity Foundry, which converts raw extraterrestrial materials into complex metal components.<sup>79</sup> However, DSI has currently set aside the prospect of asteroid mining until “it can be reliably certain that the cost of traveling to [asteroids] won’t bankrupt the business.”<sup>80</sup>

<sup>68</sup> *Id.* § 403.

<sup>69</sup> See *U.S. Space-Mining Law Seen Leading to Possible Treaty Violations*, *supra* note 65.

<sup>70</sup> BRADFORD SPACE, <https://www.bradford-space.com/index.php> (last visited Apr. 18, 2020).

<sup>71</sup> CONSENSYS SPACE, <https://www.consensus.space/> (last visited Apr. 18, 2020).

<sup>72</sup> SPACE X, <https://www.spacex.com> (last visited July 8, 2020).

<sup>73</sup> VIRGIN GALACTIC, <https://www.virgingalactic.com> (last visited July 8, 2020).

<sup>74</sup> Rod Pyle, *Deep Space Industries: A New Asteroid-Mining Company Is Born*, SPACE.COM (Jan. 28, 2013), <https://www.space.com/19462-asteroid-mining-deep-space-industries-birth.html>.

<sup>75</sup> *Id.*

<sup>76</sup> *Id.*

<sup>77</sup> *Id.*

<sup>78</sup> Deborah Byrd, *Deep Space Industries Joins the Asteroid Gold Rush*, EARTHSKY (Jan. 22, 2013), <https://earthsky.org/space/deep-space-industries-to-build-fleet-of-asteroid-mining-spacecraft>.

<sup>79</sup> *Id.*

<sup>80</sup> Andrew Zaleski, *How the Space Mining Industry Came Down to Earth*, FORTUNE (Nov. 24,

Ultimately, DSI was acquired by Bradford Space, which was announced January 1, 2019.<sup>81</sup> With this acquisition, Bradford Space now has “a presence in the United States to help sell ECAPS systems and other technologies, as well as ‘a great engineering and production team’ and customer base.”<sup>82</sup> ECAPS is a Swedish company, which was also acquired by Bradford Space, that “developed high-performance non-toxic satellite propulsion systems.” Moving forward, DSI will change as it is rebranded to Bradford Space, Inc., but it’s new objectives are still related to space-faring operations.<sup>83</sup> DSI’s new goal is to continue work “on a satellite bus called Xplorer that is intended for use on missions beyond Earth[’s] orbit.”<sup>84</sup> But, that does not mean that asteroid mining will never be in the cards. Ian Fichtenbaum, the director of Bradford Space, said, “For commercial asteroid mining, we are not people who sneer at its prospects . . . . We believe it has a real future and want to see if DSI’s Comet and Xplorer as well as Bradford’s existing activities can play a part of that future. [But] for now[,] we are taking things step by step.”<sup>85</sup>

Planetary Resources, originally known as ARKYD Astronautics, was founded in 2009, but began work towards asteroid mining in 2012.<sup>86</sup> Planetary Resources was the first major corporation to devote attention towards asteroid mining.<sup>87</sup> The company “boasts investors including movie director James Cameron and Google cofounder Larry Page.”<sup>88</sup> At the start of 2018, Planetary Resources launched a miniature satellite of its own design with the goal of detecting water beneath an asteroid’s surface.<sup>89</sup> However, the company fell into financial trouble, resulting in employee cutbacks by over 80% and Luxembourg selling its 10% stake in the company.<sup>90</sup>

Like DSI, Planetary Resources was also acquired, with ConsenSys Space stepping in to revitalize.<sup>91</sup> While not fully explaining how the acquisition of

2018), <http://fortune.com/2018/11/24/asteroid-mining-space-planetary-resources/>.

<sup>81</sup> Jeff Foust, *Deep Space Industries Acquired by Bradford Space*, SPACENEWS (Jan. 2, 2019), <https://spaceneews.com/deep-space-industries-acquired-by-bradford-space/>.

<sup>82</sup> *Id.*

<sup>83</sup> *Id.*

<sup>84</sup> *Id.*

<sup>85</sup> *Id.*

<sup>86</sup> *Timeline*, PLANETARY RESOURCES, <https://www.planetaryresources.com/company/timeline/> (last visited Dec. 13, 2018).

<sup>87</sup> See generally Pyle, *supra* note 74.

<sup>88</sup> Zaleski, *supra* note 80.

<sup>89</sup> *Id.*

<sup>90</sup> *Id.*

<sup>91</sup> *ConsenSys Acquires Planetary Resources*, PLANETARY RESOURCES (Oct. 31, 2018),

Planetary Resources will fit with the overall operations at ConsenSys, Joe Lubin, the founder of ConsenSys, said at the press release, “Bringing deep space capabilities into the ConsenSys ecosystem reflects our belief in the potential . . . to help humanity craft new societal rule systems through automated trust and guaranteed execution. And it reflects our belief in democratizing and decentralizing space endeavors to unite our species and unlock untapped human potential.”<sup>92</sup> Since this acquisition, ConsenSys has continued on their path towards “building collaboration platforms to diversify, democratize, and decentralize space endeavors.”<sup>93</sup> That work has culminated in “an open source citizen-led space sustainability system,” known as TruSat.<sup>94</sup>

Instead of focusing on asteroid mining, Elon Musk, SpaceX’s founder, is determined to enable people to live on other planets.<sup>95</sup> While SpaceX is not known for operations centered around asteroid mining, the company’s technological advances in cost-effective space shuttle technology make it a notable entity for space travel.<sup>96</sup> SpaceX retrieves and reuses previously launched rockets, with the intent to use them for multiple future launches.<sup>97</sup> This multiple-use strategy drastically cuts the overall price tag for shuttle launches.<sup>98</sup>

Finally, Virgin Galactic was founded by Sir Richard Branson in 2004 as an extension of his Virgin Group and sister companies.<sup>99</sup> Like SpaceX, Virgin Galactic’s main vision is not focused asteroid mining.<sup>100</sup> Instead, Sir Branson and Virgin Galactic aim to launch passenger flights in a suborbital path.<sup>101</sup>

---

<https://www.planetaryresources.com/2018/10/consensys-acquires-planetary-resources/>.

<sup>92</sup> *Id.*

<sup>93</sup> *ConsenSys Space Launches TruSat System*, (Oct. 21, 2019) CONSENSYS, <https://consensys.net/blog/press-release/consensys-space-launches-trusat-system/> (last visited July 11, 2020).

<sup>94</sup> *Id.*

<sup>95</sup> *About SpaceX*, SPACEX (last visited July 8, 2020), <https://www.spacex.com/about>.

<sup>96</sup> See Brad Tuttle, *Here’s How Much It Costs for Elon Musk to Launch a SpaceX Rocket*, MONEY (Feb. 6, 2018), <https://money.com/elon-musk-falcon-heavy-rocket-launch-cost/>.

<sup>97</sup> *Id.*

<sup>98</sup> *Id.*; see also Loren Grush, *SpaceX’s Last Falcon 9 Upgrade Could Finally Make Reusable Rockets Cost-Effective*, VERGE (May 9, 2018), <https://www.theverge.com/2018/5/9/17254384/spacex-falcon-9-block-5-upgrade-rocket-reusability-savings>.

<sup>99</sup> Michelle La Vone, *Virgin Galactic, A Brief History*, SPACE SAFETY MAG. (Nov. 18, 2014), <http://www.spacesafetymagazine.com/space-disasters/virgin-galactic/virgin-galactic-brief-history>.

<sup>100</sup> Meghan Bartels, *‘Billion-Dollar View’! See Incredible Footage from Virgin Galactic’s 1st Spaceflight*, SPACE.COM (Dec. 13, 2018), <https://www.space.com/42736-virgin-galactic-spaceshoptwo-unity-flight-video.html>.

<sup>101</sup> *Id.*

On October 31, 2014, the initial testing of the company's early versions of these passenger vehicles, the SpaceShipTwo, utterly failed when the shuttle ripped apart like "paper fluttering in the wind," and killed one of the pilots.<sup>102</sup> Four years later, on December 13, 2018, a tourism spaceship was launched over the Mojave Desert in California, surpassing an altitude of fifty miles, and officially entered space.<sup>103</sup> Virgin Galactic plans to continue testing newer versions of the SpaceShipTwo, and to ultimately accomplish its goal of space tourism.<sup>104</sup>

These are only four among numerous companies involved in space travel and asteroid mining.<sup>105</sup> As technology advances and the need for extraterrestrial minerals becomes a measure of global survival, more private entities will be founded for space-faring operations and for asteroid mining.

The debate over the role of the Outer Space Treaty in commercial space travel saw a revival on April 6, 2020—the day President Donald Trump signed an executive order "encourage[ing] international support for the public and private recovery and use of resources in outer space . . . ."<sup>106</sup> In the order, President Trump asserts that "Americans should have the right to engage in commercial exploration, recovery, and use of resources in outer space, consistent with applicable law."<sup>107</sup> The goal is to "lead the return of humans to the Moon for long-term exploration and utilization, followed by human missions to Mars and other destinations."<sup>108</sup> The order also sidesteps the issue of whether the Outer Space Treaty allows for this action—simply stating that the Outer Space Treaty "also contribute[s] to uncertainty regarding the right to recover and use space resources"—but rather, it challenges the restrictions of the Moon Agreement.<sup>109</sup> President Trump

---

<sup>102</sup> Christian Davenport, *Virgin Galactic's Quest for Space*, WASH. POST (Nov. 19, 2018), [https://www.washingtonpost.com/news/business/wp/2018/11/19/feature/virgin-galactic-space-tourism/?noredirect=on&utm\\_term=.84854cfb0a87](https://www.washingtonpost.com/news/business/wp/2018/11/19/feature/virgin-galactic-space-tourism/?noredirect=on&utm_term=.84854cfb0a87).

<sup>103</sup> Associated Press, *Virgin Galactic Test Flight Soars 50 Miles High, Opening Space Tourism Era*, MARKETWATCH (Dec. 13, 2018), <https://www.marketwatch.com/story/virgin-galactic-test-flight-soars-50-miles-high-opening-space-tourism-era-2018-12-13>.

<sup>104</sup> *Id.*

<sup>105</sup> See MOON EXPRESS, <http://moonexpress.com/> (last visited Dec. 12, 2018); KLEOS SPACE, <https://kleos.space/> (last visited Dec. 12, 2018); TRANSASTRA, <http://www.transastracorp.com/> (last visited Dec. 12, 2018); ATEN ENGINEERING, <https://www.atenengineering.com> (last visited Dec. 12, 2018).

<sup>106</sup> Exec. Order No. 13,914, 85 Fed. Reg. 20,381 (Apr. 6, 2020).

<sup>107</sup> *Id.*

<sup>108</sup> *Id.*

<sup>109</sup> *Id.*

asserts that the United States “does not consider the Moon Agreement to be an effective or necessary instrument to guide nation state regarding the promotion of commercial participation in the long-term exploration, scientific discovery, and use of the Moon, Mars, or other celestial bodies.”<sup>110</sup>

### F. *The Decimation of Natural Resources*

With the Earth’s population increasing evermore,<sup>111</sup> humanity’s consumption of natural resources, such as fossil fuels, metal ores, and non-metallic minerals, has exponentially grown.<sup>112</sup> In 1970, humanity consumed 22 billion tons of biomass.<sup>113</sup> To compare, humanity consumed 70 billion tons of biomass in 2010.<sup>114</sup> This rate of increase shows a more than tripled amount of consumption of natural resources.

However, resources are finite,<sup>115</sup> and humanity’s consumption can approach Earth’s ability to renew resources. On August 2, 2017, humanity “celebrated” Earth Overshoot Day.<sup>116</sup> However, this is nothing to revel in. Earth Overshoot Day marked the point where humanity had consumed more resources at that point in the year than the Earth could have renewed during the full twelve months.<sup>117</sup> As Rachael Revesz put it, humanity would survive “on credit.”<sup>118</sup> This is one of the earliest days in the year to globally reach Earth Overshoot Day, with it occurring in November during the 1980s and in October in 1993. In 2018, the United States’ individual Overshoot Day was March 15th, and the United Kingdom’s was marked on May 8th.<sup>119</sup>

<sup>110</sup> *Id.*

<sup>111</sup> Joel E. Cohen, Human Population: The Next Half Century, 302 *SCIENCE* 1172, 1172 (“By 2050, the human population will probably be larger by 2 to 4 billion people.”).

<sup>112</sup> See Alex Kirby, *Human Consumption of Earth’s Natural Resources Has Tripled in 40 Years*, *ECOWATCH* (Jul. 25, 2016), <https://www.ecowatch.com/humans-consumption-of-earths-natural-resources-tripled-in-40-years-1943126747.html>.

<sup>113</sup> *Id.*

<sup>114</sup> *Id.*

<sup>115</sup> Jolene Creighton, *A Timeline of Death: How Long Until We Exhaust All Our Resources?*, *FUTURISM* (July 24, 2014), <https://futurism.com/how-long-do-we-have-until-we-exhaust-all-of-our-resources/>.

<sup>116</sup> Rachael Revesz, *Earth Overshoot Day: Mankind Has Already Consumed More Natural Resources Than the Planet Can Renew Throughout 2017*, *INDEPENDENT* (Aug. 2, 2017), <https://www.independent.co.uk/news/science/earth-overshoot-day-2-august-2017-year-planet-natural-resources-clean-water-soil-air-pollution-wwf-a7872086.html>.

<sup>117</sup> *Id.*

<sup>118</sup> *Id.*

<sup>119</sup> *Country Overshoot Days*, *OVERSHOOTDAY*, <https://www.overshootday.org/newsroom/country->

A NASA study in 2014 suggested that the Earth was heading towards “irreversible collapse” resulting from unsustainable resource exploitation and “increasingly unequal wealth distribution.”<sup>120</sup> Additionally, a World Wildlife Fund study in 2002 proposed that humanity would need to colonize extra Earth-sized planets by 2050 to counteract the exhaustion of natural resources on Earth.<sup>121</sup>

As discussed in more depth below, asteroids contain a multitude of elements and materials, including metals that are considered “rare Earth metals.”<sup>122</sup> On the periodic table, these elements are the lanthanides, such as lanthanum, cerium, praseodymium, and neodymium.<sup>123</sup> These metals are so “rare” because it is difficult to find the geologic deposits of the minerals, and even more difficult to extract the metals.<sup>124</sup>

Lanthanum and cerium are vital in converting petroleum into gasoline, and dysprosium and neodymium are used in the batteries for gas-electric vehicles.<sup>125</sup> Additionally, indium and tellurium are used for the production of solar panels.<sup>126</sup> One of the most notable items that uses rare Earth metals is the ubiquitous smartphone.<sup>127</sup> Smartphones use minerals like yttrium, terbium, and gadolinium.<sup>128</sup> While these materials are present on Earth in small amounts, approximately two billion people have smartphones, and that estimate is projected to increase.<sup>129</sup> Moreover, on average, smartphone users will upgrade to a new phone roughly every eleven months, which leads to the

overshoot-days/ (last visited Nov. 3, 2018).

<sup>120</sup> Nafeez Ahmed, *NASA-Funded Study: Industrial Civilisation Headed For ‘Irreversible Collapse’?*, GUARDIAN (Mar. 14, 2014), <https://www.theguardian.com/environment/earth-insight/2014/mar/14/nasa-civilisation-irreversible-collapse-study-scientists>.

<sup>121</sup> Mark Townsend & Jason Burke, *Earth ‘Will Expire By 2050,’* GUARDIAN (Jul. 7, 2002), <https://www.theguardian.com/uk/2002/jul/07/research.waste>.

<sup>122</sup> Alison Morris, Note, *Intergalactic Property Law: A New Regime for a New Age*, 19 VAND. J. ENT. & TECH. L. 1085, 1091 (2017).

<sup>123</sup> Stephen Shaw, *Asteroid Mining*, ASTRONOMY SOURCE (Aug. 21, 2012), <http://www.astronomysource.com/tag/rare-earth-metals-from-asteroids/>.

<sup>124</sup> Morris, *supra* note 122, at 1085.

<sup>125</sup> David Ferris, *5 Years After Crisis, U.S. Remains Dependent on China’s Rare Earth Elements*, E&ENews.NET (Jan. 12, 2015), <https://www.eenews.net/stories/1060011478>.

<sup>126</sup> *Id.*

<sup>127</sup> Bianca Nogrady, *There’s Gold, Platinum and Other Valuable Materials in Every Phone – The Hard Part Is Getting It Out*, BBC (Oct. 18, 2016), <http://www.bbc.com/future/story/20161017-your-old-phone-is-full-of-precious-metals>.

<sup>128</sup> *Id.*

<sup>129</sup> *Id.*

devices being thrown away or stored elsewhere.<sup>130</sup> While the phrase “reduce, reuse, recycle” may be taught to children,<sup>131</sup> only 10% of all smartphones are recycled, so a minimal amount of those rare earth metals are recovered and reused.<sup>132</sup>

Ultimately, these rare Earth metals are estimated to be exhausted within the next twenty years.<sup>133</sup> This means that the ability to create new smartphones, solar panels, car batteries, and other devices could cease sometime within that period.<sup>134</sup> If these materials were recycled and reused, then these rare Earth metals may be prolonged, but these minerals will not last forever.<sup>135</sup> Asteroid mining is a probable solution to the depletion of, among other minerals, the rare earth metals.<sup>136</sup>

### III. ANALYSIS

As just discussed, Earth’s natural resources are dwindling at an unprecedented level.<sup>137</sup> To combat the ever-increasing need for natural resources, asteroids must be used as a supplemental source, which requires the drafting of a new multilateral agreement between the major space-faring nations.

#### *A. Minerals Contained in Asteroids and How to Use Them to Reduce Resource Deficiencies on Earth*

When the public thinks of asteroids, the common conception is that all asteroids are simple masses of space rock. This notion is technically correct, but it falls short in considering the minerals they contain.<sup>138</sup> Asteroids are categorized in one of three compositional classes: carbonaceous (C-type),

---

<sup>130</sup> *Id.*

<sup>131</sup> See *Reduce, Reuse, Recycle*, NAT’L INST. OF ENVTL. HEALTH SCI., <https://kids.niehs.nih.gov/topics/reduce/index.htm> (last visited July 11, 2020).

<sup>132</sup> Nogrady, *supra* note 127.

<sup>133</sup> Julian Turner, *Mined Into Extinction: Is The World Running Out of Critical Minerals?*, MINING TECH. (Apr. 9, 2017), <https://www.mining-technology.com/features/featuremined-into-extinction-is-the-world-running-out-of-critical-minerals-5776166/>.

<sup>134</sup> See *id.*

<sup>135</sup> See *id.*

<sup>136</sup> Morris, *supra* note 122.

<sup>137</sup> See *supra* Part II.F.

<sup>138</sup> See Charles Q. Choi, *Asteroids: Fun Facts and Information About Asteroids*, SPACE.COM (Sept. 20, 2017), <https://www.space.com/51-asteroids-formation-discovery-and-exploration.html>.

siliceous (S-type), and metallic (M-type).<sup>139</sup> C-type asteroids are the most common, and they usually are comprised of clay and silicate rocks.<sup>140</sup> Similarly, S-type asteroids have silicate rocks as well as nickel-iron.<sup>141</sup> Finally, as the name suggests, M-type asteroids contain deposits of nickel-iron.<sup>142</sup>

However, these are not the only resources present in asteroids.<sup>143</sup> Valuable resources such as iridium, osmium, palladium, platinum, rhenium, rhodium, and various other rare metals are present with the nickel and iron in M-type and S-type asteroids.<sup>144</sup> Additionally, “C-[type] asteroids are thought to be rich in water, carbon dioxide, carbon monoxide, ammonia, methane, and other ‘volatile’ substances,” which, among other uses, could be utilized during long-distance space missions, reducing the need for, and high cost of, launching these materials into space.<sup>145</sup>

When discussing the passage of the U.S. Commercial Space Launch Competitiveness Act, Congressman Lamar Smith, the Chairman of the House Committee on Science, Space, and Technology at the time, stated that “[t]he natural resources of our Solar System have great potential to facilitate and support our human endeavors, both in outer space and on Earth.”<sup>146</sup> Congressman Bill Posey agreed by saying, “[a]steroids and other objects in space are excellent potential sources of rare minerals and other resources that can be used to manufacture a wide range of products here on Earth and to support future space exploration missions.”<sup>147</sup>

As Congressman Foley hinted towards, multiple theories and uses are present for utilizing the new materials extracted from asteroids.<sup>148</sup> One of the foundational theories justifying asteroid mining is to bring the minerals back

---

<sup>139</sup> *Id.*

<sup>140</sup> *Id.*

<sup>141</sup> *Id.*

<sup>142</sup> *Id.*

<sup>143</sup> See Samuel Roth, Note, *Developing a Law of Asteroids: Constants, Variables, and Alternatives*, 54 COLUM. J. TRANSNAT'L L. 827, 831 (2016).

<sup>144</sup> See *id.*

<sup>145</sup> *Id.* at 832–33 (“[T]he traditional figure [for launching objects into space] is \$10,000 per pound, although developments in recent years have reduced the price to \$2,000 or \$3,000 per pound, and SpaceX . . . claims its spacecraft will further reduce the price to \$1,000 per pound.”).

<sup>146</sup> *President Obama Signs Bill Recognizing Asteroid Resource Property Rights into Law*, *supra* note 59.

<sup>147</sup> *Id.*

<sup>148</sup> See *id.*



to Earth and use them to replace the depleted resources.<sup>149</sup> This practice would allow the mining industry “to send refined materials, rare metals and even free, clean energy to Earth.”<sup>150</sup> Platinum group metals are prevalent in everyday items, ranging from carbon monoxide detectors to jewelry and catalytic converters.<sup>151</sup> “Today, the major sources of platinum group metals are South Africa and Russia. A single 500-meter platinum-rich asteroid contains more platinum than has been mined in the history of humanity.”<sup>152</sup> With Earth-based mines of platinum estimated to be depleted by approximately 2030, it is necessary, now more than ever, to seek an alternate source for these materials.<sup>153</sup> But platinum is not the only mineral that will expire soon. Indium, which is used for touchscreens and solar panels, and tantalum, which is used for cell phones, are estimated to expire by 2024 and 2058, respectively.<sup>154</sup>

Another theory is to use the resources as a basis for developing a “self-sustaining, space-based industry.”<sup>155</sup> Currently, it costs NASA \$10,000 to launch a single pound of material into Earth’s orbit.<sup>156</sup> As previously stated, C-type asteroids may contain essential resources like water, carbon dioxide, and ammonia.<sup>157</sup> If space explorers do not wish to continually return to Earth, water is necessary to keep a space colony alive.<sup>158</sup> Not only is the adult human body approximately sixty percent water,<sup>159</sup> and not only are adult humans

<sup>149</sup> Roth, *supra* note 143, at 864–65.

<sup>150</sup> Steven Siceloff, *Study: Asteroids Provide Sustainable Resources*, NASA (June 13, 2013), [https://www.nasa.gov/mission\\_pages/asteroids/news/asteroidmining.html](https://www.nasa.gov/mission_pages/asteroids/news/asteroidmining.html).

<sup>151</sup> See *PGM Applications*, INT’L PLATINUM GROUP METALS ASS’N, <https://ipa-news.com/index/pgm-applications/> (last visited July 11, 2020).

<sup>152</sup> *Planetary Resources’ Letter to Members of Congress Regarding H.R. 5063 – The ASTEROIDS Act*, PLANETARY RESOURCES (Sept. 10, 2014), <https://www.planetaryresources.com/2014/09/planetary-resources-letter-members-congress-regarding-h-r-5063-asteroids-act/> [hereinafter *Planetary Resources’ Letter to Members of Congress*].

<sup>153</sup> See Rachel Nuwer, *What Is the World’s Scarcest Material?*, BBC (Mar. 18, 2014), <http://www.bbc.com/future/story/20140314-the-worlds-scarcest-material>.

<sup>154</sup> *Global Resources Stock Check*, BBC, <http://www.bbc.com/future/story/20120618-global-resources-stock-check> (last visited July 11, 2020).

<sup>155</sup> Siceloff, *supra* note 150.

<sup>156</sup> Brooke Boen, *Advanced Space Transportation Program: Paving the Highway to Space*, NASA: MARSHALL SPACE FLIGHT CTR., <https://www.nasa.gov/centers/marshall/news/background/facts/astp.html> (last visited July 11, 2020).

<sup>157</sup> See Roth, *supra* note 143 at 868–69.

<sup>158</sup> Kevin Bonsor, *How Asteroid Mining Will Work*, HOWSTUFFWORKS.COM (Nov. 10, 2000), <https://science.howstuffworks.com/asteroid-mining1.htm>.

<sup>159</sup> *The Water in You*, U.S. GEOLOGY SURV., <https://water.usgs.gov/edu/propertyyou.html> (last visited July 11, 2020).

recommended to consume two to three liters of water per day,<sup>160</sup> but the “[w]ater could also be broken down into hydrogen and oxygen to form rocket engine propellant.”<sup>161</sup> The water would be broken down through electrolysis, and “[o]ne 75-meter water-bearing asteroid has enough hydrogen and oxygen to have launched all 135 Space Shuttle missions.”<sup>162</sup> Additionally, the metal ores from M-type and S-type asteroids could be used to build and modify spacecraft and structures for an interplanetary colony.<sup>163</sup> With each pound of material recovered in space, it will lower the final cost of launching more space expeditions.<sup>164</sup>

After considering just two of the potential ways for utilizing asteroid-based minerals, the main question left is: Are there enough resources for everyone?

### *B. There Are Sufficient Resources in Space to Accommodate All Countries and Private Entities*

While the most prevalent goal of the Outer Space Treaty was to prevent nuclear armaments from being launched into Earth’s orbit,<sup>165</sup> another principle was to allow space to be “for the benefit . . . of all countries.”<sup>166</sup> This attitude of “shared benefits” could assert that countries would be able to permissibly mine asteroids in the future, but only if those countries had an equal opportunity to access the resources.

As of mid-2020, over 23,000 near-Earth objects, including comets and asteroids, have been identified.<sup>167</sup> In addition, NASA has identified 974,837 asteroids.<sup>168</sup> This number has grown exponentially since January of 1999 due to the increase in technology,<sup>169</sup> and the future number of identified asteroids

---

<sup>160</sup> *Id.*

<sup>161</sup> Bonser, *supra* note 158.

<sup>162</sup> *Planetary Resources’ Letter to Members of Congress*, *supra* note 152.

<sup>163</sup> Bonser, *supra* note 158.

<sup>164</sup> Boen, *supra* note 156.

<sup>165</sup> See Outer Space Treaty, *supra* note 16.

<sup>166</sup> *Id.*

<sup>167</sup> INT’L ASTRONOMICAL UNION MINOR PLANET CTR., <https://minorplanetcenter.net/> (last visited Dec. 11, 2018).

<sup>168</sup> *Asteroids: Overview*, NAT’L AERONAUTICS & SPACE ADMIN., <https://solarsystem.nasa.gov/asteroids-comets-and-meteors/overview/> (follow “asteroids”) (last visited July 11, 2020).

<sup>169</sup> Meghan Bartels, *Record-Breaking 2,000 New Asteroids Approached Earth in 2017 and Astronomers Expect to Spot Even More in 2018*, NEWSWEEK (Jan. 3, 2018), <https://www.newsweek.com/record-breaking-2000-new-asteroids-approached-earth-2017-and-astronomers-769236>.

may grow with increased space travel and technology. With 197 countries in the world,<sup>170</sup> this would provide each country with approximately 4,000 asteroids, if all identified asteroids were evenly distributed. Furthermore, “[o]ne NASA report estimates that the mineral wealth of the asteroids in the asteroid belt might exceed \$100 billion for each of the six billion people on Earth.”<sup>171</sup>

One hundred billion dollars is more than enough for a single person to live with no financial limitations; it would rival the \$156 billion net worth of Amazon founder Jeff Bezos, the richest person in the world.<sup>172</sup> However, those observed asteroids and the potential \$600 quintillion of resources inside of them are only within our solar system. This still leaves potentially a near-infinite number of asteroids outside the solar system.<sup>173</sup>

### *C. A Multilateral Agreement is Currently More Effective than a United Nations Treaty*

There are two primary methods for creating a uniform set of rules pertaining to a specific topic among multiple nations: (1) a multilateral agreement between the interested parties; or (2) a United Nations treaty for all countries in the UN. Both methods have benefits and costs to their creation, but in this situation, a multilateral agreement would be the most effective.<sup>174</sup>

A multilateral agreement is an “accord between three or more . . . national

<sup>170</sup> *How Many Countries Are There in the World in 2018*, WORLD POPULATION REV., <http://worldpopulationreview.com/countries/how-many-countries-are-there/> (last visited July 11, 2020).

<sup>171</sup> Kevin Bonsor, *Valuable Asteroid Resources*, HOWSTUFFWORKS (Nov. 10, 2000), <https://science.howstuffworks.com/asteroid-mining1.htm>.

<sup>172</sup> Andy Kiersz, *Jeff Bezos Is the Richest Person Alive – Here’s How He Makes and Spends His Billions*, BUS. INSIDER (Aug. 27, 2018), <https://www.businessinsider.com/jeff-bezos-net-worth-life-spending-2018-8>.

<sup>173</sup> The current estimation is that the observable universe is approximately 92 billion light-years in diameter, with asteroids littered throughout. Chris Baraniuk, *It Took Centuries, but We Now Know the Size of the Universe*, BBC: EARTH (Jun. 13, 2016), <http://www.bbc.com/earth/story/20160610-it-took-centuries-but-we-now-know-the-size-of-the-universe>. Even with the observable universe expanding, some theories of what lies beyond the observable universe suggest the possibility of even more available asteroids to mine. *See generally 5 Theories & Predictions On What Lies Outside the Observable Universe*, YOUTUBE (Feb. 4, 2017), <https://www.youtube.com/watch?v=XmhEBiIGPUg>.

<sup>174</sup> This author does not suggest that a U.N. treaty would *never* be a more effective option than a multilateral agreement. Rather, the current circumstances and interests in space-faring operations and asteroid mining offers an incentive towards multilateral agreements.

governments.”<sup>175</sup> An example of a multilateral agreement is the North American Free Trade Agreement (NAFTA).<sup>176</sup> If countries were to make a multilateral agreement regarding asteroid mining, then only the interested parties would be required to join the agreement and be bound to it.

On the other hand, a U.N. treaty is an “international agreement concluded between two or more states in written form and governed by international law.”<sup>177</sup> If a U.N. treaty was required for asteroid mining, it would require the signing and ratification by the interested parties.<sup>178</sup> However, this would also mean that—in addition to the negotiations between countries who are able to mine asteroids in the near future—the treaty process would include the opinions and critiques of countries who will not have the ability to routinely enter space for many years.

There are four main drawbacks to using a U.N. treaty, and these disadvantages can be rectified by using a multilateral agreement. They are: (1) the limited effectiveness if the countries in the U.N. Security Council are not involved, (2) the limited jurisdiction of the International Court of Justice to rectify legal disputes, (3) the nonexistence of overarching punishment systems for violations, and (4) the difficulty in negotiating with larger groups.

The United Nations Security Council is a culmination of fifteen countries that convene to maintain international peace and security.<sup>179</sup> The Security Council is comprised of five permanent members—China, France, Russia, the United Kingdom, and the United States—and ten elected member-states to serve for two-year terms.<sup>180</sup> With some of the most influential countries in the world as permanent members to the Security Council, if these countries were not interested in joining a treaty, then it would be extremely difficult for the treaty to remain viable. This is exactly what happened to the Moon

---

<sup>175</sup> *Multilateral Agreement*, BUSINESSDICTIONARY, <http://www.businessdictionary.com/definition/multilateral-agreement.html>; see also *Multilateral*, BLACK'S LAW DICTIONARY (10th ed. 2014) (“Involving more than two parties.”).

<sup>176</sup> *North American Free Trade Agreement (NAFTA)*, OFF. U.S. TRADE REP. <https://ustr.gov/trade-agreements/free-trade-agreements/north-american-free-trade-agreement-nafta> (last visited Dec. 18, 2019).

<sup>177</sup> *Treaty*, BLACK'S LAW DICTIONARY (10th ed. 2014).

<sup>178</sup> See U.N. Charter art. 102.

<sup>179</sup> *What is the Security Council?*, U.N. SECURITY COUNCIL, <https://www.un.org/securitycouncil/content/what-security-council> (last visited July 11, 2020).

<sup>180</sup> *Current Members*, U.N. SECURITY COUNCIL, <https://www.un.org/securitycouncil/content/current-members> (last visited July 11, 2020).

Agreement in 1979.<sup>181</sup>

As previously discussed, the Moon Agreement only garnered eighteen ratifying countries and four additional signatory countries.<sup>182</sup> None of the countries on the Security Council were ratifying countries nor signatories of the Moon Agreement.<sup>183</sup> Since there was no support by major countries, the Moon Agreement held no weight in the eyes of the space-faring community and is considered non-binding international law.<sup>184</sup> If any of the permanent members of the Security Council were displeased with language or provisions in a proposed U.N. treaty, then those countries may not ratify the treaty, and no progress would have been made from the Moon Agreement.

Instead, a multilateral agreement would allow only the countries who are interested and currently more capable of mining asteroids to draft the language and provisions of the agreement. As a practical matter, such an agreement would be easier to negotiate. Countries would be less inclined to completely refuse to sign an agreement if that country had more ability to negotiate during the drafting. With less countries sitting at the table for this agreement, each country will be able to assert their interests more firmly.

The second drawback to a U.N. treaty is the minimal ability for the International Court of Justice (ICJ) to resolve legal disputes. The ICJ is the judicial arm of the United Nations and is used to resolve any legal disputes in accordance with international law.<sup>185</sup> However, the ICJ is only able to hear “contentious” cases between member-states of the United Nations, or any other entity, by consent.<sup>186</sup> A major limitation is that “[t]his means that a tremendous number of disputes involving individuals, corporations, parts of states, NGOs, self-determination groups, and even UN bodies are beyond the purview of the [ICJ].”<sup>187</sup> Even then,

the ICJ only has jurisdiction based on consent, not compulsory jurisdiction. Thus, if there is a dispute between two states, and one of the states has not consented to World Court jurisdiction by treaty, by specific agreement once

---

<sup>181</sup> See *supra* Part II.B.

<sup>182</sup> Status of International Agreements, *supra* note 20.

<sup>183</sup> *Id.*

<sup>184</sup> Johnson, *supra* note 42, at 1487.

<sup>185</sup> *The Court*, INT’L CT. OF JUST., <https://www.icj-cij.org/en/court> (last visited July 11, 2020).

<sup>186</sup> *How the Court Works*, INT’L CT. OF JUST., <https://www.icj-cij.org/en/how-the-court-works> (last visited July 11, 2020).

<sup>187</sup> Eric Sinrod, *The Limitations of the International Court of Justice*, FINDLAW (Sept. 23, 2014), <https://blogs.findlaw.com/technologist/2014/09/the-limitations-of-the-international-court-of-justice.html>.

the dispute has arisen, or by some other declaration, the ICJ cannot hear the case.<sup>188</sup>

A multilateral agreement may be preferential in this aspect because the agreement may specifically state which laws may be used when determining legal disputes, and the agreement may also allow for the parties to bring their cases in specified “domestic courts within states, or certain regional or specialty courts.”<sup>189</sup>

Third, a substantial drawback is the inability to enforce punishment against countries who violate the treaty. If a case was to proceed to the ICJ, and a decision was reached, the judgement is only binding upon the parties in the case.<sup>190</sup> The ability to be bound is located in the Charter of the United Nations, which every nation must agree to before joining the U.N.<sup>191</sup> However, if a party fails to perform the obligations required by the ICJ’s judgment, then “the opposing party *may* have recourse to the Security Council, which *may*, if it deems necessary, make recommendations or decide upon measures to be taken to give effect to the judgment.”<sup>192</sup> This means that a country could theoretically lose a case in front of the ICJ, with no ability to appeal,<sup>193</sup> and may suffer no punishments for refusing to comply with the ICJ’s decree.

A multilateral agreement may flourish in this aspect because it may explicitly certify that any legal disputes are binding to all members when litigating the same issue, similar to the concept of collateral estoppel. Additionally, provisions inside of the agreement may already specify the punishment or procedures for violations of the agreements. These provisions could limit the internal debates about legal issues, providing equal and fair judgments using the same law for all disputes, and would limit the ability for countries to avoid punishment for violations. Another added benefit to a multilateral agreement when drafting punishments for violating the terms is

---

<sup>188</sup> *Id.*

<sup>189</sup> *Id.*

<sup>190</sup> U.N. Charter art. 94.

<sup>191</sup> *Id.*

<sup>192</sup> *Id.* (emphasis added).

<sup>193</sup> *Frequently Asked Questions*, INT’L CT. OF JUST., <https://www.icj-cij.org/en/frequently-asked-questions> (last visited Dec. 29, 2018) (explaining that the ICJ’s judgments “are final and without appeal”).

commercial certainty. Corporations, as generally viewed, are risk averse.<sup>194</sup> Being risk averse means that when faced with multiple options, corporate investors will typically prefer the option that denotes the lowest measure of risk.<sup>195</sup> With the potential of violating parties not being punished under a U.N. treaty, corporate investors might be unlikely to become involved in space-faring operations, or, at the very least, have corporate decisions become increasingly lengthy.<sup>196</sup> As corporate decision-making becomes ever-more lengthy, the overall growth rate of corporations focused on space-faring operations will suffer.<sup>197</sup> With a multilateral agreement, and an anticipation of punishment for violations, some of the worries of corporate investors would be alleviated by a multilateral agreement.

Finally, a U.N. treaty would have a higher possibility to fail or not be drafted at all, as a result of the increased number of countries involved in the negotiations. The number of parties involved in negotiations and decision-making has been shown to relate to the length and overall effectiveness of the discussions.<sup>198</sup> With the smaller group of more interested countries involved in a multilateral agreement, it is faster, less tedious, and more appealing for the parties involved to create clearer and more concrete solutions to potential dilemmas.<sup>199</sup> In addition, the parties involved with a multilateral agreement would have a definite and defined interest in the finalized version of the agreement, as opposed to a large-scale assembly with numerous countries having little to no interest in space-faring operations.<sup>200</sup>

---

<sup>194</sup> *Corporate Risk Aversion Stifling Growth*, PRNEWswire.COM (Oct. 13, 2014), <https://www.prnewswire.com/news-releases/corporate-risk-aversion-stifling-growth-278991481.html>.

<sup>195</sup> James Chen, *Risk Averse*, INVESTOPEdia.COM (Jan. 31, 2018), <https://www.investopedia.com/terms/r/riskaverse.asp>.

<sup>196</sup> See generally *Corporate Risk Aversion Stifling Growth*, *supra* note 194.

<sup>197</sup> *Id.*

<sup>198</sup> See generally *The Size of Team Impacts Negotiations*, KARRASS.COM (Nov. 29, 2012), <https://www.karrass.com/en/blog/the-size-of-team-impacts-negotiation/>.

<sup>199</sup> See *id.*; *14.3 Problem Solving and Decision Making in Groups*, U. OF MINN., <https://open.lib.umn.edu/communication/chapter/14-3-problem-solving-and-decision-making-in-groups/> (last visited July 11, 2020).

<sup>200</sup> See generally *14.3 Problem Solving and Decision Making in Groups*, *supra* note 199. However, this is not to state that a single party should create the agreement unilaterally. While negotiations and decisions are more difficult to craft with a larger number of disinterested parties, studies have shown that the final decisions are more effective. See Jim Whitehurst, *Decisions Are More Effective When More People Are Involved from the Start*, HARV. BUS. REV. (Mar. 15, 2016), <https://hbr.org/2016/03/decisions-are-more-effective-when-more-people-are-involved-from-the-start>. Ultimately, the parties seeking to be involved in the multilateral agreement should attempt to strike the correct balance between too few members making quick but ineffective decisions, and too many members making more efficient

Considering these negatives associated with a U.N. treaty, a multilateral agreement appears to be the preferential method for outlining the rules and regulations of asteroid mining during the interim. Additionally, with private corporations making strides towards commercial asteroid mining,<sup>201</sup> the depletion of natural resources on Earth,<sup>202</sup> and the abundance of resources present in asteroids,<sup>203</sup> a new multilateral agreement between countries is becoming more imperative.

#### IV. RESOLUTION

To avoid a future “wild west” gold rush to mine asteroids for minerals, and to limit any further ambiguity surrounding the rights and authorities in the Outer Space Treaty and Moon Agreement,<sup>204</sup> a multilateral agreement must be created. However, this agreement should be limited to countries that have the ability and resources to routinely enter space and conduct mining operations. These countries would include China,<sup>205</sup> the European Union,<sup>206</sup> India,<sup>207</sup> Japan,<sup>208</sup> Russia,<sup>209</sup> South Korea,<sup>210</sup> the United Kingdom,<sup>211</sup> and the United States.<sup>212</sup>

This prospective agreement would help pave the way to future agreements between the major space-faring countries and would hopefully be considered when drafting a more universal agreement or treaty for all countries. While multilateral agreements and U.N. treaties may contain a multitude of provisions concerning rights, forfeitures, liabilities, and other important aspects, this prospective agreement should contain several crucial

decisions at the cost of lengthy and potentially more unstable constraints.

<sup>201</sup> See *supra* Part II.E.

<sup>202</sup> See *supra* Part II.F.

<sup>203</sup> See *supra* Part III.B.

<sup>204</sup> See generally Exec. Order No. 13,914, 85 Fed. Reg. 20,381 (Apr. 6, 2020).

<sup>205</sup> See CHINA NAT'L SPACE ADMIN., <http://www.cnsa.gov.cn/n6443408/index.html> (last visited July 11, 2020).

<sup>206</sup> See EUR. SPACE AGENCY, <https://m.esa.int/ESA> (last visited July 11, 2020).

<sup>207</sup> See DEP'T OF SPACE, INDIAN SPACE RESEARCH ORG., <https://www.isro.gov.in/> (last visited July 11, 2020).

<sup>208</sup> See JAPAN AEROSPACE EXPLORATION AGENCY, <http://global.jaxa.jp/> (last visited July 11, 2020).

<sup>209</sup> See ROSCOSMOS, <http://en.roscosmos.ru/> (last visited July 11, 2020).

<sup>210</sup> See KOREA AEROSPACE RESEARCH INST., <https://www.kari.re.kr/eng.do> (last visited July 11, 2020).

<sup>211</sup> See U.K. SPACE AGENCY, <https://www.gov.uk/government/organisations/uk-space-agency> (last visited July 11, 2020).

<sup>212</sup> See NASA, <https://www.nasa.gov/> (last visited July 11, 2020).



provisions.

First, the ability to mine less than a full asteroid without claiming the asteroid for one's country. As previously discussed, the Outer Space Treaty, which was ratified by all countries anticipated to join this agreement,<sup>213</sup> prohibits the national appropriation of asteroids.<sup>214</sup> If the countries attempted to claim asteroids as the property of their dominion, then these actions would violate the Outer Space Treaty. By allowing countries to circumvent the Outer Space Treaty by mining without claiming property rights to the entire asteroid, then it would incentivize countries to join the multilateral agreement and be bound by its other provisions. However, this agreement must also explicitly distinguish that the omission of complete property rights to the asteroid does not void a country's claim for the minerals that lie within the asteroid. If this distinction is not made, then this agreement would be all for naught—countries would mine the resources, but then have no ownership rights to the minerals that were extracted.

Second, the agreement should contain a provision that (1) binds liability to countries regarding private corporations' space-faring actions, and (2) ensures enforcement of the agreement upon corporations that are incorporated in said country, conducts space operations within that country, or "fly" that country's flag during operations. This provision stems from Article VII of the Outer Space Treaty<sup>215</sup> and the United Nations' Convention on International Liability for Damage Caused by Space Objects.<sup>216</sup> This provision would allow for safer mining and space travel by extending the provisions to corporations. This would also cease the questioning of whether the Outer Space Treaty applies to corporations, at least with regard to the countries that are party to the agreement. This provision would certify that corporations who are incorporated in certain countries cannot reincorporate in a non-member country to conduct space operations or to conduct operations elsewhere, solely to avoid being bound by the agreement. However, if a corporation attempts to bypass the agreement by changing the country of incorporation or intentionally avoiding conducting operations in the member-countries, then penalties should be levied against the

---

<sup>213</sup> Compare *supra* notes 206–213, with *ENCYCLOPAEDIA BRITANNICA*, *supra* note 17.

<sup>214</sup> Outer Space Treaty, *supra* note 16.

<sup>215</sup> See *id.*

<sup>216</sup> Liability Convention, *supra* note 16.

corporation. One such penalty could include a loss of ownership rights for the minerals or a percentage-based fine on the value of minerals retrieved. These penalties will ensure that countries and corporations are conducting the operations in a safe and efficient manner, while still abiding by the terms of the agreement.

Third, joint mission provisions should be adopted in the agreement. These provisions should encompass interactions between member-countries of the multilateral agreement, but it may also permit for non-agreeing parties to conduct the operations with member-countries. However, if this provision was to allow nonmember-countries to participate in space operations, the agreement should require that the nonmember-country to be bound by the multilateral agreement for the term of the operation. Conducting space activities and mining are expensive operations<sup>217</sup> and could place significant pressure on a country's economic resources. By allowing nonmember-countries to also participate or invest in space operations with member-countries, safe and fair dealings in space would be advanced, while letting the countries determine however long they wish to interact with each other. By splitting the economic cost of space travel among two or more countries, the ultimate cost of these missions can be offset by the potential payouts from asteroid mining—which would further incentivize global cooperation and safety.

Fourth, the agreement should only pertain to “near-Earth” asteroids (NEAs). As previously stated, there are over 23,000 NEAs, and more asteroids will continue to drift nearer to Earth and become NEAs.<sup>218</sup> By limiting this agreement to only NEAs, it accomplishes a two-fold task: (1) creating a definite standard on which asteroids this agreement seeks to regulate; and (2) providing for leaving asteroids in the Asteroid Belt for all countries, regardless of this agreement, to mine. By creating a definite standard, it makes it much easier for countries to know which asteroids are available for mining. However, by specifying that the asteroids orbiting in the Asteroid Belt are available to any country or corporations, the agreement

---

<sup>217</sup> Tuttle, *supra* note 96 (“SpaceX says that it costs \$62 million every time its Falcon 9 rocket is launched, while the more powerful Falcon Heavy costs an estimated \$90 million per launch.”); Sarah Kramer & Dave Mosher, *Here’s How Much Money It Actually Costs to Launch Stuff into Space*, BUS. INSIDER (Jul. 20, 2016), <https://www.businessinsider.com/spacex-rocket-cargo-price-by-weight-2016-6> (noting that the average cost estimates \$500 million per launch).

<sup>218</sup> See INT’L ASTRONOMICAL UNION MINOR PLANET CTR., *supra* note 167.

still conserves asteroids and minerals for nonmember-countries whenever they are able to routinely enter space and mine asteroids.<sup>219</sup> In addition, it would also permit countries to not be involved in the agreement, while still allowing them to conduct their own mining operations, at their own risk.

Fifth, a provision should be adopted that specifies criteria for new countries to join this agreement, even after the agreement has been solidified. That way, if a country has the potential to routinely enter space, conduct mining operations, and do so without causing an unsustainable financial burden on the country's economic resources, then they can become an official member-country to the agreement. However, new membership should also require consideration by all current member-countries, so that it reflects the overarching goals of the collective group of member-countries. This collective deliberation requirement would also protect the agreement from a potential fallout if a country wishes to join, but not all the member-countries agree on its induction.

Finally, this agreement should contain a type of "sunset" provision. A sunset provision is a provision in a contract or agreement where the agreement will dissolve after a specified period of time.<sup>220</sup> The agreement should contain such a provision because this agreement should be superseded by a more formal agreement between a larger body of nations at a later point, such as a U.N. treaty. This would permit for a future global agreement regarding asteroid mining.

A multilateral agreement that includes these six provisions would foster a safer and more productive asteroid mining industry. The space-faring nations should consider such an agreement, because just as the reality of asteroid mining is on the horizon, so are the legal ambiguities that will arise in its absence.

A crucial limitation regarding the scope of this Note is that it does not address the potential environmental effects of the increased number of space-

---

<sup>219</sup> The statistics for the number of asteroids in Part III.B only consider our solar system. INT'L ASTRONOMICAL UNION MINOR PLANET CTR., *supra* note 167. The observable universe is currently 92 billion light-years in diameter, although it continues to expand, evidenced by light from the farthest reaches finally arriving at Earth. Baraniuk, *supra* note 173. With the asteroid to space ratio in our solar system, this would calculate to theoretically 435.8 nonillion asteroids existing in our observable universe. That is  $2.29 \times 10^{24}$  times more asteroids in the observable universe than in the Asteroid Belt. While this agreement would conserve asteroids inside the Asteroid Belt, it would not impact the immensely larger quantities of asteroids present outside the solar system.

<sup>220</sup> *Sunset Law*, BLACK'S LAW DICTIONARY (10th ed. 2014).

shuttle launches. This increased launching schedule may be an additional issue that should be covered in a multilateral agreement. The ultimate environmental impact of an asteroid mining industry is discussed in James Wilkerson's Note, *Celestial Gold Mines: Mining for Natural Resources on Asteroids*.<sup>221</sup> Wilkerson warns that "[i]ncreased international space launches could mean that rockets will soon emerge as the worst offenders in terms of ozone depletion."<sup>222</sup> As such, Wilkerson suggests that the Environmental Protection Agency adopt new environmental regulations to account for such a scenario, which should consider the "possibility of reusable launch vehicles, new propellants, and hypersonic systems."<sup>223</sup> As for debris left in space after mining operations, Wilkerson envisions the potential for establishing space salvage companies.<sup>224</sup>

Although unresolved legal issues and technological restrictions may prove to be obstacles for establishing an asteroid mining industry, Captain James Tiberius Kirk of the U.S.S. Enterprise explained, "Our species can only survive if we have obstacles to overcome. . . . Without them to strengthen us, we will weaken and die."<sup>225</sup>

## V. CONCLUSION

Prior treaties regarding space have shown an initiative towards protecting the interests of all countries when it comes to asteroid mining. But, as Earth's resources continue to dwindle<sup>226</sup> in the wake of an ever-increasing population,<sup>227</sup> and resource-depleting technologies continue to expand,<sup>228</sup> the

<sup>221</sup> See James Wilkerson, Note, *Celestial Gold Mines: Mining for Natural Resources on Asteroids*, 9 U. LOUISVILLE J. ANIMAL & ENV'T'L. L. 116, 125–30 (2018). This author would also like to thank Mr. Wilkerson for his years of friendship and for the inspiration to consider this fascinating topic. Without Mr. Wilkerson's work, this Note would have never become reality.

<sup>222</sup> *Id.* at 130.

<sup>223</sup> *Id.* at 131.

<sup>224</sup> *Id.*; see also Glenn Harlan Reynolds, *Collision Course: The Need for Better Space Junk Regulations*, POPULAR MECHANICS, (Oct. 30, 2009), <http://www.popularmechanics.com/space/satellites/a12348/4326022/>

<sup>225</sup> *Star Trek: The Original Series, Metamorphosis* (Desilu Productions Nov. 10, 1967), <https://www.imdb.com/title/tt0708436/>.

<sup>226</sup> See *supra* Part II.F.

<sup>227</sup> See Cohen, *supra* note 111.

<sup>228</sup> See generally Dale Benton, *Planetary Resources Successfully Launches Space Mining Technology*, MINING GLOBAL (July 11, 2020), <https://www.miningglobal.com/technology/planetary-resources-successfully-launches-space-mining-technology>.

need for a multilateral agreement allowing countries to capitalize on the availability of resources beyond Earth is essential to humanity's survival.

As the great astronomer and cosmologist Carl Sagan once said,

Since, in the long run, every planetary civilization will be endangered by impacts from space, every surviving civilization is obliged to become spacefaring—not because of exploratory or romantic zeal, but for the most practical reason imaginable: staying alive. . . . If our long-term survival is at stake, we have a basic responsibility to our species to venture to other worlds.<sup>229</sup>

In the spirit of Sagan's quote, the type of multilateral agreement put forward in this Note would help countries fulfill this obligation.

---

<sup>229</sup> *Carl Sagan*, N.M MUSEUM SPACE HISTORY, <https://www.nmspacemuseum.org/inductee/carl-sagan/> (last visited July 11, 2020).

