

Space Resource Mining: Excuse me, that's my asteroid.

by

Aletta Maria Magdalena Kruger

u15223729

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Under the supervision of:

Prof. Dr. Stephan Hobe

Declaration of originality

Full names of student: Aletta Maria Magdalena Kruger

Student number: u15223729

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Acknowledgements

First and foremost, I would like to give all the glory to God Almighty who has seen me through all the ups and downs of my studies. I love you. Always.

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With Gratitude,

Aletta Maria Magdalena Kruger

Abstract

Space resource mining is slowly, but surely, becoming a reality, and with this reality come certain legal issues, such as: the legality of space resource mining; property rights over outer space mined ore; and conflicts between investors interested in the exploitation of the same asteroid or parcel of extra-terrestrial land. This research seeks to examine these legal issues.

The findings of this study indicate that space resource mining is not prohibited by the Outer Space Treaty *per se*; it is possible that states can appropriate outer space natural resources provided that that does not include any permanent claims of appropriation over the area where the natural resources are being mined and it does not prevent other states from doing the same. The Outer Space Treaty and the Moon Agreement, which are the guiding treaties of international space law, lack specific rules the regulation of the mining of space resources.

This research study recommends that a new legal regime should be drafted to govern space resource mining to ensure a safe and orderly development of this activity. Furthermore, an efficient dispute settlement mechanism must be established within the context of the legal regime governing space resource mining, to resolve disputes arising in the course of space resource mining.

List of Acronyms

DSB	Dispute Settlement Body
ICJ	International Court of Justice
IISL	International Institute of Space Law
ISA	International Space Authority
NASA	National Aeronautics and Space Administration
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNCOPOUS	United Nations Committee on the Peaceful Uses of Outer Space
SDSB	Space Dispute Settlement Body
UNGA	United Nations General Assembly
US	United States
VCLT	Vienna Convention on the Law of Treaties
WTO	World Trade Organisation

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Chapter 1: Introduction

1.1 Background to study

Future exploration for metals, minerals, and resources will inevitably involve outer space.¹ However, space mining may give rise to certain legal issues, because the current international legal framework is insufficient to regulate this emerging industry.² Legal issues include, but are not limited to, the legality of space resource mining, property rights in outer space and conflict over outer space resources, and these issues should be addressed beforehand to ensure legal certainty and the methodical exploitation of these natural resources.³

For centuries, civilisation has relied heavily on the utilization of the natural resources of Earth to satisfy the continued development of technology and the ever-growing human population.⁴ The focus of this exploitation is particularly on minerals and fossil fuels, which are elements that are non-renewable.⁵ The United Nations (UN) estimates that the current world population is 7.7 billion and is expected to increase by 2 billion people in the next 30 years, which puts the world population at a staggering 9.7 billion by 2050.⁶ As a result, the exhaustion of non-renewable metals, minerals, and

¹ ; G Leterre 'Providing a legal framework for sustainable space mining activities' unpublished Master's thesis, Universite Du Luxembourg, 2017 1; GM Goh *Dispute Settlement in International Space Law* (2007) 157-158; <https://www.mining.com/astronomers-identify-12-asteroids-close-enough-for-mining-29724/> (accessed 5 May 2021); <https://www.generalkinematics.com/blog/mining-in-space/> (accessed 5 May 2021); <https://www.forbes.com/sites/cognitiveworld/2019/05/13/the-race-to-mine-space/?sh=8b922611a700> (accessed 13 May 2021); KA Baca 'Property Rights in Outer Space' (1993) 58 *Journal of Air Law and Commerce* 1045; L Gradoni 'What on Earth is Happening to Space Law?' (2018) *European Journal of International Law* 1; ME Wachowicz et al 'Space Mining Challenges: Expertise of Polish Entities and International Perspective on Future Exploration Missions' in J Sasiadek (ed) *Aerospace Robotics III* (2019) 161; RJ Lee *Law and Regulation of Commercial Mining of Minerals in Outer Space* (2012) 22; W Giraldo, W & JI Tobon 'Extraterrestrial minerals and future frontiers in mineral exploration' (2013) *Dyna* 83; RS Jakhu et al *Space mining and its regulation* (2017) 113

² F Tronchetti *The Exploration of Natural Resources of the Moon and Other Celestial Bodies: A Proposal for a Legal Regime* (2009) 2; Goh (n 1) 158; Jakhu et al (n 1) 113-114; Leterre (n 1) 1;

³ Goh (n 1) 158; Jakhu et al (n 1) 113-114; Tronchetti (n 2) 158.

⁴ <https://www.generalkinematics.com/blog/mining-in-space/> (accessed 5 May 2021); Lee (n 1) 21; Wachowicz et al (n 1) 161.

⁵ n 4 above.

⁶ <https://www.un.org/en/global-issues/population#:~:text=The%20world's%20population%20is%20expected,nearly%2011%20billion%20around%202100> (accessed 14 August 2021).

resources on Earth is a problem looming in the near future.⁷ Consequently, finding alternative mining strategies to supply similar mineral resources for the growing global need is of paramount importance for the continued survival and development of humanity.⁸

One of these promising alternatives is mining the sky.⁹ Not only would space mining help with the growing global needs, but it would also lessen some of the environmental damage caused by traditional mining on Earth.¹⁰

More recently private entities have looked at space, more specifically the Moon and asteroids, as the final frontier to make a profit.¹¹

Planets, moons, asteroids, and comets exist in abundance and contain large quantities of resources that are rare or non-existent on Earth.¹² Even so, the first step in researching alternative mineral deposits in space is looking at celestial bodies closest to Earth.¹³ These bodies are identified as the Moon, Venus, Mars, asteroids, and comets.¹⁴ However, Venus is not ideal for mining projects owing to its extremely fluctuating temperatures and pressures prevailing on the surface.¹⁵ Therefore, the focus will fall on the other bodies mentioned above. Even so, there are still major

⁷ Baca (n 1) 1044; <https://www.generalkinematics.com/blog/mining-in-space/> (accessed 5 May 2021); <https://www.mining.com/astronomers-identify-12-asteroids-close-enough-for-mining-29724/> (accessed 5 May 2021); Lee (n 1) 1; Wachowicz *et al* (n 1) 161,165.

⁸ Giraldo & Tobon (n 1) 83; <https://www.generalkinematics.com/blog/mining-in-spacexdfccccc/> (accessed 5 May 2021); Lee (n 1) 21.

⁹ Giraldo & Tobon (n 1) 83; <https://www.forbes.com/sites/cognitiveworld/2019/05/13/the-race-to-mine-space/?sh=8b922611a700> (accessed 13 May 2021).

¹⁰ Baca (n 1) 1042; <https://www.bbvaopenmind.com/en/science/physics/asteroid-mining-a-new-space-race/> (accessed 13 May 2021); P Morris 'Space Mining, Space Law, and Why No State can Boldly go forth Alone' unpublished Master's thesis, University of Amsterdam, 2018 9; Wachowicz *et al* (n 1) 165.

¹¹ Baca (n 1) 1042-1044; Goh (n 1) 157-158; JL Zell 'Putting on the Moon: Creating an International Authority to Regulate Mining Rights in Outer Space' (2006) 15 *Minnesota Journal of International Law* 490; Morris (n 10) 7; Leterre (n 1) 2; S Hobe 'The Impact of New Developments on International Space Law (New Actors, Commercialisation, Privatisation, Increase in the Number of Space-Faring Nations)' (2010) 15 *Uniform Law Review* 881.

¹² A Brehm 'Private Property in Outer Space: Establishing a Foundation for Future Exploration' (2015) 33 *Wisconsin International Law Journal* 354; Baca (n 1) 1042-1043; C Foster 'Excuse me, you're mining my asteroid: Space property rights and U.S. Space Resource Exploration and Utilization Act of 2015' (2016) *University of Illinois Journal of Law, Technology & Policy* 408-409; Giraldo & Tobon (n 1) 83; <https://space-agency.public.lu/en/space-resources/ressources-in-space.html> (accessed 14 August 2021); <https://www.mining.com/astronomers-identify-12-asteroids-close-enough-for-mining-29724/> (accessed 5 May 2021); <https://www.generalkinematics.com/blog/mining-in-space/> (accessed 5 May 2021); Leterre (n 1) 2; Tronchetti (n 2) 1; Zell (n 11) 490.

¹³ Giraldo & Tobon (n 1) 83.

¹⁴ n 13 above.

¹⁵ n 13 above, 83-84.

challenges which should be faced before space mining can take off.¹⁶ Some of these challenges involve mining in low gravity environments, such as asteroids or the moon.¹⁷ This means that mining engineers will have to work out a way to anchor, drill into and recover material from an uncooperative body.¹⁸ There is also the challenge that the mining robot will have nothing to anchor itself to because of the fact that the rocks and dust of rubble pile asteroids are held together by their own microgravity.¹⁹ Studies suggest that granular material can behave as a solid, a liquid or a gas in this environment.²⁰ This behaviour will be particularly important for asteroids that are rubble-piles, as spacecraft trying to land or drill into these could easily destabilise regolith causing granular flow or avalanches.²¹ With these challenges, it should also be kept in mind that asteroids move at various high speeds.²² Gravity also makes the transporting of materials needed for a mining operation hugely expensive.²³ Power to operate mining equipment is also a challenge.²⁴ The International Space Station generates up to 120 kilowatts of electricity from 35 000 square feet of solar arrays. Drills would need similar sized power plants.²⁵ The exploration and exploitation of these resources present great technical difficulties but owing to current technological advances and the high prices of minerals and energy, this exploitation is becoming closer to being economically and technically feasible.²⁶

¹⁶ Giraldo & Tobon (n 1) 84; <https://space-agency.public.lu/en/space-resources/ressources-in-space.html> (accessed 14 August 2021); <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021); <https://www.sciencedaily.com/releases/2017/09/170919092612.htm> (accessed 5 May 2021); <https://www.theguardian.com/business/2016/feb/06/asteroid-mining-space-minerals-legal-issues> (accessed 13 May 2021).

¹⁷ <https://www.nature.com/news/let-s-mine-asteroids-for-science-and-profit-1.10733> (accessed 5 May 2021); <https://www.mining.com/web/the-golden-asteroid-that-could-make-everyone-on-earth-a-billionaire/> (accessed 10 May 2021); <https://www.bloomberg.com/opinion/articles/2020-12-21/space-mining-on-asteroids-is-never-going-to-happen> (accessed 11 May 2021); <https://www.bbvaopenmind.com/en/science/physics/asteroid-mining-a-new-space-race/> (accessed 13 May 2021); Wachowicz et al (n 1) 163.

¹⁸ n 17 above.

¹⁹ n 17 above.

²⁰ <https://www.sciencedaily.com/releases/2017/09/170919092612.htm> (accessed 5 May 2021).

²¹ n 20 above.

²² <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021).

²³ <https://www.bloomberg.com/opinion/articles/2020-12-21/space-mining-on-asteroids-is-never-going-to-happen> (accessed 11 May 2021).

²⁴ n 23 above.

²⁵ n 23 above.

²⁶ Giraldo & Tobon (n 1) 86.

Nevertheless, the Moon is an easy target for potential mining because of its accessibility and proximity to Earth.²⁷ In addition to this, analysis of the Moon has indicated that it is rich in important and useful elements, such as water ice,²⁸ oxygen,²⁹ helium-3,³⁰ potassium, phosphorus, thorium, aluminium, iron, silicon, hydrogen, chromium, manganese and other rare earth elements.³¹

These elements in themselves have valuable applications. Firstly, water ice can be used as a rocket propellant or life-support materials for astronauts.³² Secondly, oxygen is found in the ground as oxides, which is bound by other minerals, but which could most likely be separated and converted into breathable air.³³ Finally, Helium-3 can generate nuclear power through a process called nuclear fusion which does not produce toxic waste.³⁴ Thus, Helium-3 has the potential to replace fossil fuels and other substances as the primary source of energy on Earth.³⁵ Moreover, it has been established that 25 tonnes of Helium-3 can provide all the power that the United States (US) needs in a year.³⁶ It can thus be concluded that Helium-3 is by far the most valuable resource contained on the Moon.³⁷

In comparison, other valuable elements, such as magnesium, aluminium, titanium, iron, chromium and trace elements of lithium, cobalt, nickel, copper, zinc, niobium, molybdenum, lanthanum, europium, tungsten, and gold, are commonly found in

²⁷ Giraldo & Tobon (n 1) 84; Tronchetti (n 2) 1-3.

²⁸ <https://space-agency.public.lu/en/space-resources/ressources-in-space.html> (accessed 14 August 2021); https://www.orbitalmatters.com/resources_near_earth_life_support/ (accessed 14 August 2021); Tronchetti (n 2) 5-6.

²⁹ https://www.orbitalmatters.com/resources_near_earth_life_support/ (accessed 14 August 2021).

³⁰ Giraldo & Tobon (n 1) 84; Tronchetti (n 2) 5-6.

³¹ D Sivoletta *Space Mining and Manufacturing: Off-World Resources and Revolutionary Engineering Techniques* (2019) 34; Giraldo & Tobon (n 1) 84; <https://www.mining.com/web/the-golden-asteroid-that-could-make-everyone-on-earth-a-billionaire/> (accessed 6 May 2021); <https://www.mining.com/the-global-race-to-mine-outer-space/> (accessed 10 May 2021); Tronchetti (n 2) 5-6;

³² <https://www.mining.com/web/the-golden-asteroid-that-could-make-everyone-on-earth-a-billionaire/> (accessed 6 May 2021); <https://www.forbes.com/sites/cognitiveworld/2019/05/13/the-race-to-mine-space/?sh=8b922611a700> (accessed 13 May 2021); Tronchetti (n 2) 5.

³³ <https://space-agency.public.lu/en/space-resources/ressources-in-space.html> (accessed 4 August 2021).

³⁴ <https://www.mining.com/web/the-golden-asteroid-that-could-make-everyone-on-earth-a-billionaire/> (accessed 6 May 2021); S Hobe 'The Basic Legal Order for Commercial Space Activities' (2010) 3 *Indian Journal of International Economic Law* vii; Tronchetti (n 2) 6; Wachowicz *et al* (n 1) 162.

³⁵ n 34 above.

³⁶ Giraldo & Tobon (n 1) 84; Tronchetti (n 2) 6.

³⁷ Giraldo & Tobon (n 1) 84; Leterre (n 1) 2; Tronchetti (n 2) 6.

meteorites from Mars.³⁸ As a result, the possibility exists that these materials may be concentrated enough in some places to be mined.³⁹ In spite of this, the fluctuation of surface heat and the distance of Mars to Earth limits the opportunity for exploration for now.⁴⁰

Similar to the abovementioned celestial bodies, asteroids can be considered as a source of minerals, especially, iron, nickel, iridium, palladium, platinum, gold, and magnesium.⁴¹ Similarly to Mars and the Moon, asteroids are also rich in water, which will support space travel endeavours and make such travel more affordable.⁴² Asteroids are, furthermore, very rich in platinum group elements, like platinum, palladium, ruthenium, rhodium, osmium, and iridium.⁴³ In the 2012 Planetary Resources, an asteroid mining company estimated that a small 30-meter long asteroid might contain between \$25-\$50 billion worth of platinum.⁴⁴ Another source establish that platinum sells for around US\$50 000 per kilogram and that an asteroid of about 200 metres that is rich in platinum could have a value of \$30 billion.⁴⁵ Considering this, these metals have high market prices that enhance the possibility of economically profitable extraction in the near future.⁴⁶

In addition to this, according to National Aeronautics and Space Administration (NASA), the current estimated asteroid count is over 1 million.⁴⁷ Most of these

³⁸ Giraldo & Tobon (n 1) 84.

³⁹ n 38 above.

⁴⁰ n 38 above, 84-85.

⁴¹ <https://www.generalkinematics.com/blog/mining-in-space/> (accessed 10 May 2021); Sivoletta (n 31) 38-39.

⁴² <https://www.generalkinematics.com/blog/mining-in-space/> (accessed 10 May 2021); <https://www.bbvaopenmind.com/en/science/physics/asteroid-mining-a-new-space-race/> (accessed 13 May 2021); <https://www.forbes.com/sites/cognitiveworld/2019/05/13/the-race-to-mine-space/?sh=8b922611a700> (accessed 13 May 2021); <https://www.peacepalacelibrary.nl/2015/12/space-mining-and-u-s-space-law/> (accessed 16 May 2021); Sivoletta (n 31) 38-39.

⁴³ Brehm (n 12) 354; Giraldo & Tobon (n 1) 86.

⁴⁴ <https://www.reuters.com/article/us-space-asteroid-mining/tech-billionaires-bankroll-gold-rush-to-mine-asteroids-idUSBRE83N06U20120424> (accessed 14 August 2021); <https://www.mining.com/web/the-golden-asteroid-that-could-make-everyone-on-earth-a-billionaire/> (accessed 10 May 2021); <https://www.peacepalacelibrary.nl/2015/12/space-mining-and-u-s-space-law/> (accessed 16 May 2021).

⁴⁵ Brehm (n 12) 354; <https://www.nature.com/news/let-s-mine-asteroids-for-science-and-profit-1.10733> (accessed 6 May 2021); <https://www.peacepalacelibrary.nl/2015/12/space-mining-and-u-s-space-law/> (accessed 16 May 2021).

⁴⁶ Giraldo & Tobon (n 1) 86.

⁴⁷ <https://solarsystem.nasa.gov/asteroids-comets-and-meteors/asteroids/in-depth/> (accessed 14 August 2021).

asteroids can be found in the Main Asteroid Belt, orbiting the sun between Mars and Jupiter.⁴⁸ In particular, the Main Asteroid Belt holds between 1.1 and 1.9 million asteroids larger than 1 kilometre in diameter,⁴⁹ where asteroids usually range in size from 530 kilometres to fewer than 10 meters in diameter.⁵⁰ Apart from this, there are more than 800 out of 10 000 Near-Earth Asteroids which orbit close to Earth and are over 1 kilometre in diameter.⁵¹ Over a 1000 of these asteroids are, furthermore, classified as potential threats to Earth.⁵² Even so, these could possibly be a good place to start mining, because that could potentially bring back resources that are a scarcity on Earth and in the process lessen the threat of asteroids crashing into Earth.

As has been seen above, celestial bodies closest to our planet have plenty of opportunity for mineral exploration, the utilization of new materials and alternative clean energy.⁵³ Moreover, these celestial bodies are a backup of materials that are depleted or very rare on Earth.⁵⁴ Exploration and exploitation are getting closer to being economically and technically feasible.⁵⁵

There is a growing need for an appropriate legal regime for organizing this exploration.⁵⁶ The reasons are that space mining could not be initiated owing to the absence of specific rules that establish how space mining has to take place and the rights and obligations of the parties involved.⁵⁷ As a result, investors and operators interested in space mining will refrain from investing money and time to advancing technology for exploitative activities in space.⁵⁸ Thus, a sound legal regime to manage and regulate the exploitation of natural resources of celestial bodies will stimulate the participation of States and private investors and operators, which will contribute to its

⁴⁸ <https://solarsystem.nasa.gov/asteroids-comets-and-meteors/asteroids/in-depth/> (accessed 14 August 2021); <https://www.bbvaopenmind.com/en/science/physics/asteroid-mining-a-new-space-race/> (accessed 13 May 2021).

⁴⁹ n 48 above.

⁵⁰ n 48 above.

⁵¹ n 48 above.

⁵² n 48 above.

⁵³ Giraldo & Tobon (n 1) 86.

⁵⁴ Baca (n 1) 1042-1044; Brehm (n 12) 354; Giraldo & Tobon (n 1) 86.

⁵⁵ Giraldo & Tobon (n 1) 86.

⁵⁶ Baca (n 1) 1045-1046; F Xu *et al* 'A Re-Examination of Fundamental Principles of International Space Law at the Dawn of Space Mining' (2020) 44 *Journal of Space Law* 1; Leterre (n 1) 3; Tronchetti (n 2) 2-3.

⁵⁷ Leterre (n 1) 3; Tronchetti (n 2) 2-3.

⁵⁸ Tronchetti (n 2) 3.

safe and orderly development.⁵⁹ In addition, mining rights, ownership, regulations and global accords are key elements that need to be determined now in order to avert future conflict.⁶⁰

There are already five international treaties that form the basis for future space mining operations, but these instruments are still lacking.⁶¹ In addition, this international framework is complemented by non-binding resolutions of the United Nations General Assembly (UNGA), several bilateral or regional treaties, State practice and norms of customary international law.⁶² The international treaties include the following:

- Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies of 1967 (Outer Space Treaty);⁶³
- Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched in Outer Space of 1968 (Rescue Agreement);⁶⁴
- Convention on International Liability for Damages Caused by Space Objects of 1972 (Liability Convention);⁶⁵
- Convention on Registration of Objects Launched into Outer Space of 1975 (Registration Convention);⁶⁶and
- Agreement Governing the Activities of States on the Moon and Other Celestial Bodies of 1979 (Moon Agreement).⁶⁷

⁵⁹ Goh (n 1) 157-158; Tronchetti (n 2) 3.

⁶⁰ <https://www.forbes.com/sites/cognitiveworld/2019/05/13/the-race-to-mine-space/?sh=8b922611a700> (accessed 13 May 2021).

⁶¹ Goh (n 1) 158; Hobe (n 11) 874-875; Jakhu *et al* (n 1) 6; Leterre (n 1) 5.

⁶² Leterre (n 1) 6.

⁶³ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (adopted on 19 December 1966, entered into force on 10 October 1967).

⁶⁴ Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (adopted on 19 December 1967, entered into force on 3 December 1968).

⁶⁵ Convention on International Liability for Damage Caused by Space Objects (adopted on 29 November 1971, entered into force on 1 September 1972).

⁶⁶ Convention on Registration of Objects Launched into Outer Space (adopted on 12 November 1974, entered into force on 15 September 1976).

⁶⁷ Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (adopted on 5 December 1979, entered into force on 11 July 1984).

In spite of the above, there are no specific rules addressed in these Treaties about the mining of space resources.⁶⁸ Nonetheless, this study will focus primarily on the Outer Space Treaty, which is the fundamental law governing space activities⁶⁹, and the Moon Agreement, which is also built upon the principles laid down in the Outer Space Treaty.⁷⁰

When it became apparent that space resource utilization is no longer a distant dream but a reality that is fast approaching, the question emerged as to whether this activity complies with the core principles set out in the Outer Space Treaty.⁷¹ The short answer is that the Outer Space Treaty does not prohibit space resource mining *per se*.⁷² Space resource mining can possibly fall under Article 1 paragraph 2 of the Outer Space Treaty which establishes the freedom of the use of outer space.⁷³ This freedom of use is limited by Article 1 paragraph 1 of the Outer Space Treaty which determines that such use must be for the benefit of all mankind.⁷⁴ Furthermore, Article IV and IX provide that the freedom of use must also be in compliance with provisions concerning military uses and environmental considerations.⁷⁵

The Moon Agreement is considered to be a failure by many owing to the low State ratification number.⁷⁶ Even so, the Moon Agreement is an important development in international space law because it introduces new rules and elements which should have practical impacts on future missions in space.⁷⁷ Article 11 of the Moon Agreement

⁶⁸ FG Von der Dunk 'Private Property Rights and the Public Interest in Exploration of Outer Space' (2018) *University of Nebraska College of Law* 2; IISL Directorate of Studies, Background Paper:

'Does international space law either permit or prohibit the taking of resources in outer space and on celestial bodies, and how is this relevant for national actors? What is the context, and what are the contours and limits of this permission or prohibition?' (2016) 41; Tronchetti (n 2) 3; Xu *et al* (n 56) 1.

⁶⁹ Goh (n 1) 158; IISL DoS Study on Space Resource Mining (n 68) 41; Leterre (n 1) 6; Louise de Gouyon Matignon "Public International Space Law" (2019) *Space Legal Issues*.

⁷⁰ IISL DoS Study on Space Resource Mining (n 68) 41.

⁷¹ Leterre (n 1) 6.

⁷² IISL DoS Study on Space Resource Mining (n 68) 41.

⁷³ IISL DoS Study on Space Resource Mining (n 68) 41; Leterre (n 1) 9.

⁷⁴ HR Hertzfeld & FG Von der Dunk 'Brining Space Law into the Commercial World: Property Rights without Sovereignty' (2005) 6 *Chicago Journal of International Law* 96; IISL DoS Study on Space Resource Mining (n 68) 41.

⁷⁵ IISL DoS Study on Space Resource Mining (n 68) 41.

⁷⁶ A Geldenhuys 'The Legal Status of the Concept of Common Heritage in the Exploitation of Resources on the Moon and Other Celestial Bodies: Is Now the Time for a Legal Regime?' unpublished Master's thesis, University of Pretoria, 2015 31; Gradoni (n 1) 1; Hobe (n 34) ix; Tronchetti (n 2) 39; V Blanchette-Séguin 'Reaching for the Moon: Mining in Outer Space' (2017) 49 *International Law and Politics* 962.

⁷⁷ Tronchetti (n 2) 40.

refers to space mining activities, and it will, thus, be considered in more detail. Article 11 paragraph 3 of the Moon Agreement prohibits the taking of resources *in situ* on celestial bodies, including the Moon, until the international community sets a regime for the exploration of outer space.⁷⁸ Considering that no international space law has rules regarding space mining, an effort should be made to adhere to the plea of the Moon Agreement to establish an international regime for space mining.⁷⁹

Therefore, it is credible that space mining is not prohibited under the existing international space law and, as a result, needs a legal regime that regulates space mining.⁸⁰

Consequently, the question arises, that, once planets, asteroid or comets are mined, mined ore can be owned by the certain company, state or party that initiated or invested in that space mining activity. In the event that companies, states or private operators can acquire property rights over the resources of celestial bodies, which logically includes the right of use, trade and commercialisation, that will, firstly, create a clear and safe legal framework for those who invest in the exploration of space resources and, secondly, it will make the exploration of these resources a profitable business.⁸¹ There are no specific rules in the existing space law regime that address whether or not natural resources of celestial bodies can be owned.⁸² Article II of the Outer Space Treaty forbids the national appropriation of any part of outer space, which means that outer space can never be colonised by states.⁸³ On the other hand, the same concept does not necessarily apply to property rights concerning the natural resources of celestial bodies once they have been mined.⁸⁴ So, it can be argued that once immovable property (land) is transformed into movable property (mined ore) it

⁷⁸ Blanchette-Séguin (n 76) 962; IISL DoS Study on Space Resource Mining (n 68) 41; Moon Agreement, Article 11(5); N Harn 'Commercial Mining of Celestial Bodies: A Legal Roadmap' (2015) 27 *Georgetown International Environmental Law Review* 644; Yun, Z 'Multilateral Regime for Space Resource Exploration and Utilization' (2020) 17 *Indonesian Journal of International Law* 330-331.

⁷⁹ Geldenhuys (n 76) 31; IISL DoS Study on Space Resource Mining (n 68) 42; Yun (n 78) 330-331.

⁸⁰ IISL DoS Study on Space Resource Mining (n 68) 41; Leterre (n 1) 3.

⁸¹ Goh (n1) 158; Tronchetti (n 2) 194.

⁸² n 81 above.

⁸³ Blanchette-Séguin (n 76) 961; Hertzfeld & Von der Dunk (n 74) 81; IISL DoS Study on Space Resource Mining (n 68) 26; P De Man *Exclusive Use in an Inclusive Environment: The Meaning of the Non-Appropriation Principle for Space Resource Exploitation* (2016) 305.

⁸⁴ Tronchetti (n 2) 196.

becomes feasible to acquire property rights.⁸⁵ Notwithstanding this, it is still bound by the principles established in both the Outer Space Treaty and the Moon Agreement.⁸⁶

According to unilateral initiatives, like the US and Luxembourg, “space resources are capable of being appropriated in conformity with international law.”⁸⁷ Even so, a few domestic bills recognising that space resources can be owned do not make such appropriations internationally lawful.⁸⁸ Nevertheless, these domestic bills recognise property rights within their respective territories even when they do not protect state sovereignty in outer space.⁸⁹ So it could be argued that the legal status of outer space is similar to that of the High Seas and, if mining asteroids is like fishing in the High Seas, then to acquire property rights over space resources would not need sovereign mediation, as it does in the traditional way.⁹⁰

An argument can also be made that, if space mining is not prohibited under the existing international space law, then owning the ore after mining a celestial body should not be prohibited either.⁹¹ Even so, this does not provide the legal certainty called for.

As a result, for space mining to be successful it needs not only a legal regime that governs space mining activities⁹² but one which also resolves issues relating to property rights over mined ore.

Owing to all of this, how will potential conflicts between companies and investors interested in the exploitation of the same asteroid or parcel of extra-terrestrial land be governed?

The ambiguity left by the Outer Space Treaty regarding the permissibility of space resource utilization has already led to countries, such as the US and Luxembourg, adopting their own national legal framework in order to offer investors the legal certainty that they require to further develop their activities.⁹³ Conflict arising out of

⁸⁵ n 84 above.

⁸⁶ n 84 above.

⁸⁷ Grandoni (n 1) 1-2; The Exploration and Use of Space Resources Act 2017, Article 1.

⁸⁸ Grandoni (n 1) 2.

⁸⁹ n 88 above, 1-2.

⁹⁰ Blanchette-Séguin (n 76) 966; Grandoni (n 1) 1-2; Von der Dunk (n 68) 5; V Pop (2009) *Who owns the Moon? Extraterrestrial Aspects of Land and Mineral Resources Ownership* Springer 139.

⁹¹ Harn (n 78) 644; Leterre (n 1) 3; Tronchetti (n 2) 194-195; Yun (n 78) 333.

⁹² Goh (n 1) 157-158; Tronchetti (n 2) 236.

⁹³ Leterre (n 1) 3; Xu *et al* (n 56) 1.

space resource mining in these states would easily be solved because of their unilateral initiative to establish domestic bills that govern space mining within their territory. The issue arises when companies from different states with different domestic laws about space mining become involved.⁹⁴

A reliable solution for potential conflicts about exploitation of the same asteroid or parcel of extra-terrestrial land is to establish a dispute settlement mechanism within a legal regime that governs space resource mining.⁹⁵ It is, therefore, crucial that a global framework is agreed upon that enables transparency, fairness, and collaboration - one that unites us in a better future for all of humanity and not just a selected few.⁹⁶

1.2 Critical Research Questions

The research questions are:

1. Is space mining a possibility under the existing international space treaties?
2. Can an entity be given property rights over mined ore?
3. How is it determined that an asteroid is worth mining?
4. How will potential conflicts between investors interested in the exploitation of the same asteroid or parcel of extra-terrestrial land be governed?

1.3 Research Aims

The aim of this study is to illustrate that space mining activities, including property rights over mined ore, are not illegal nor prohibited under the existing international space law. Moreover, there is a growing need for a legal regime that governs this issue to ensure legal certainty and its safe and orderly development. Furthermore, the main aim of this study is to determine how conflicts over profitable asteroids or parcels of extra-terrestrial land can possibly be addressed.

⁹⁴ H Sutherland 'The Stakes Are Out of This World: How to Fix the Space Act of 2015' (2021) 22 *Vermont Journal of Environmental Law* 128.

⁹⁵ See Chapter 5.

⁹⁶ <https://www.forbes.com/sites/cognitiveworld/2019/05/13/the-race-to-mine-space/?sh=8b922611a700> (accessed 13 May 2021).

1.4 Chapter Breakdown

The aims of the research study and the research questions will be addressed in the following chapters.

In Chapter 2, the Outer Space Treaty and the Moon Agreement will be considered in detail to see whether space resource mining is prohibited or if it is a possibility under these treaties.

Chapter 3 will look at the crucial issue of property rights in outer space, specifically whether natural resources of celestial bodies can be owned after these resources are mined and, thus, be used, traded and commercialised on Earth.

Chapter 4 will determine how asteroids are evaluated and assessed to be worth mining.

Chapter 5 will deal with certain aspects of a proposed legal regime that can possibly govern space resource mining, along with a dispute settlement mechanism to deal with potential conflicts between investors interested in the exploitation of the same asteroid or parcel of extra-terrestrial land.

In Chapter 6 a conclusion will be drawn from the preceding chapters.

1.5 Limitations in Scope

Space resource mining is still in its infancy.⁹⁷ Therefore, technology and legislation are not yet where they should be for space resource mining to take off.⁹⁸ There is no space mining legal regime in place at present, so it is still a possibility that space mining can be made illegal, which, in turn, will resolve all the issues that this study tries to address.

Little written work has been done on some of the issues addressed in this study, because it is not yet a problem, since space mining is not yet fully in effect.

⁹⁷ <https://www.scientificamerican.com/article/new-law-paves-the-way-for-asteroid-mining-but-will-it-work/> (accessed 6 May 2021).

⁹⁸ Giraldo & Tobon (n 1) 84; <https://space-agency.public.lu/en/space-resources/ressources-in-space.html> (accessed 14 August 2021); <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021); <https://www.sciencedaily.com/releases/2017/09/170919092612.htm> (accessed 5 May 2021); <https://www.theguardian.com/business/2016/feb/06/asteroid-mining-space-minerals-legal-issues> (accessed 13 May 2021).

The space mining market is already valued at a figure up to trillions of dollars, while not a single drill has left Earth for that purpose.⁹⁹

This study will look only at the legal aspects and legal issues which could possibly arise out of space resource mining.

1.6 Conclusion

This study will illustrate that space mining activities, as well as property rights over mined ore, are neither illegal nor prohibited under the existing international space law. Moreover, there is a growing need for a legal regime that governs these issues to ensure legal certainty and its safe and orderly development. Flowing from this, there are only a certain number of asteroids or parcels of extra-terrestrial land that will be worth the risk of mining or profitable to mine. Thus, this study will also illustrate how possible conflicts over profitable asteroids or parcels of extra-terrestrial land can possibly be addressed.

⁹⁹ <https://www.mining.com/the-global-race-to-mine-outer-space/> (accessed 10 May 2021); Leterre (n 1) 2.

Chapter 2: The Lawfulness of Commercialised Space Resource Mining under the existing Space Treaties

2.1 Synopsis

This chapter contains an overview of the Outer Space Treaty and the Moon Agreement, interpreted according to Articles 31-33 of the Vienna Convention on the Law of Treaties (VCLT). In doing this, the chapter will discover whether or not space resource mining is a possibility under the existing international space law.

2.2 Introduction

Space activities are not the same as they were in the initial years of the space age.¹⁰⁰ They are currently affected by commercialisation and privatisation.¹⁰¹ But the question about whether it is possible to mine space resources under the existing space legal regime remains.

There are no specific rules addressed in any international space treaty about space resources mining.¹⁰² Consequently, this chapter will discuss some crucial articles of both the Outer Space Treaty and the Moon Agreement through the perspective of the VCLT to see whether space resource mining is a possibility.

2.4 The Outer Space Treaty

The Outer Space Treaty is the first international space convention to be adopted and it is seen as the 'constitution' of human activities in outer space and on celestial bodies.¹⁰³ The reason for this is that it contains all the basic principles of human activity in the terrestrial lunar system and the interplanetary space system of the Sun.¹⁰⁴ Furthermore, it is the most widely ratified space treaty, with a ratification number of 111 countries.¹⁰⁵ In other words, the principles of the Outer Space Treaty

¹⁰⁰ IISL DoS Study on Space Resource Mining (n 68) 2.

¹⁰¹ <https://www.mining.com/the-global-race-to-mine-outer-space/> (accessed 10 May 2021); IISL DoS Study on Space Resource Mining (n 68) 2; Xu et al (n 56) 5.

¹⁰² IISL DoS Study on Space Resource Mining (n 68) 41; Tronchetti (n 2) 3; Xu et al (n 56) 1.

¹⁰³ Brehm (n 12) 357; IISL DoS Study on Space Resource Mining (n 68) 3-4, 25; Leterre (n 1) 6; S Hobe et al *Cologne Commentary on Space Law – Outer Space Treaty* (2017) 187; Tronchetti (n 2) 18-19; Von der Dunk (n 68) 2.

¹⁰⁴ n 103 above.

¹⁰⁵ <https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/status/index.html> (accessed 24 August 2021); IISL DoS Study on Space Resource Mining (n 68) at 3-4, 25.

have received wide support and acceptance across the globe.¹⁰⁶ All the space-faring countries are parties to this treaty.¹⁰⁷ The Outer Space Treaty is, thus, the cornerstone of the legal regime.¹⁰⁸ Moreover, it is believed partly to reflect customary international law which binds both state and non-state parties to the treaty.¹⁰⁹

2.4.1 Article I & II of the Outer Space Treaty

Article I establishes fundamental principles of international space law, namely that all states have the right to access, use and explore outer space including the Moon and other celestial bodies on a non-discriminatory basis.¹¹⁰

Article I reads as follows:

The exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries [...] and shall be the province of all mankind. Outer space [...] shall be free for exploration and use by all States without discrimination of any kind on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies. There shall be freedom of scientific investigation in outer space, [...] and States shall facilitate and encourage international co-operation in such investigation.¹¹¹

The 'freedom of use and exploration' is ensured for all states through Article I.¹¹² Thus, this right, guaranteed by Article I, is for both states and their citizens.¹¹³ In other words, both governmental and private activities in outer space are allowed.¹¹⁴

¹⁰⁶ IISL DoS Study on Space Resource Mining (n 68) 3-4; Tronchetti (n 2) 19.

¹⁰⁷ Tronchetti (n 2) 19.

¹⁰⁸ Gradoni (n 1) 2; Xu *et al* (n 56) 5.

¹⁰⁹ Articles of the Outer Space Treaty that is considered to reflect customary international law is: Article II; Article III; Article IV; Article V; Article VI; Article VII; Article IX; IISL DoS Study on Space Resource Mining (n 68) at 3-4, 25; S Hobe 'Adequacy of the Current Legal and Regulatory Framework Relating to the Extraction and Appropriation of Natural Resources in Outer Space' (2007) 32 *Annals of Air and Space Law* 116;

¹¹⁰ Hobe (n 34) vii-viii; IISL DoS Study on Space Resource Mining (n 68) 25; Lee (n 1) 154; Xu *et al* (n 56) 8.

¹¹¹ Outer Space Treaty, Article I.

¹¹² Hobe (n 109) 116; IISL DoS Study on Space Resource Mining (n 68) 25; Xu *et al* (n 56) 8.

¹¹³ IISL DoS Study on Space Resource Mining (n 68) 25.

¹¹⁴ Goh (n 1) 158; Hobe (n 109) 120; IISL DoS Study on Space Resource Mining (n 68) 25; Outer Space Treaty, Article VI & XIII.

The right to access, explore, and use outer space entails certain obligations.¹¹⁵ The obligations that hinder the use and exploration of outer space are, firstly, that the ‘exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries [...] and shall be the province of all mankind.’¹¹⁶ Secondly, outer space is free to be accessed by all states on a non-discriminatory basis.¹¹⁷ Thirdly, the freedom of use and exploration is fundamentally underpinned by Article II.¹¹⁸

Article II establishes the ‘non-appropriation-principle,’ which forbids the national appropriation of any part of outer space.¹¹⁹ In essence, Article II is prohibitive.¹²⁰ In other words, this article places an obligation on states to refrain from acting in a certain way or from embarking on a particular action.¹²¹ The drafters of the Outer Space Treaty, in the 1960s, did not allow space to be colonised.¹²²

The freedom to use outer space is based on the non-existence of territorial sovereignty of any state in outer space.¹²³ If no state ‘owns’ outer space or any part of it, then no state is expected to ask permission or require authorisation to use and explore outer space.¹²⁴ Hence all states can use and explore outer space freely.¹²⁵

¹¹⁵ Hobe (n 109) 120; IISL DoS Study on Space Resource Mining (n 68) 25; Morris (n 10) 25.

¹¹⁶ cf Baca (n 1) 1063-1064; Hertzfeld & Von der Dunk (n 74) 96; Hobe (n 34) viii; Hobe (n 109) 120; IISL DoS Study on Space Resource Mining (n 68) 30; Leterre (n 1) 13; Outer Space Treaty, Article 1 para 1 & 3.

¹¹⁷ Baca (n 1) 1065; Hobe (n 109) 120; IISL DoS Study on Space Resource Mining (n 68) 25; Morris (n 10) 25.

¹¹⁸ Blanchette-Séguin (n 76) 961; Hobe (n 109) 120; Von der Dunk (n 68) 3.

¹¹⁹ Brehm (n 12) 358; De Man (n 83) 305; Hertzfeld & Von der Dunk (n 74) 81; Hobe (n 34) xi; Hobe (n 109) 120; IISL DoS Study on Space Resource Mining (n 68) 26; JG Wrench ‘Non-Appropriation, No Problem: The Outer Space Treaty is Ready for Asteroid Mining’ (2019) 51 *Case Western Reserve Journal of International Law* 438-439; Xu *et al* (n 56) 18.

¹²⁰ n 119 above.

¹²¹ Baca (n 1) 1065; Blanchette-Séguin (n 76) 961; IISL DoS Study on Space Resource Mining (n 68) 26.

¹²² IISL DoS Study on Space Resource Mining (n 68) 26; Leterre (n 1) 9 -10.

¹²³ IISL DoS Study on Space Resource Mining (n 68) 30; Outer Space Treaty, Article II; Von der Dunk (n 68) 3.

¹²⁴ n 123 above.

¹²⁵ n 123 above.

The principle of 'free use' can also be found in the Law of the Sea.¹²⁶ The High Seas are also free from the territorial sovereignty of states and so every state has the right to enjoy the 'freedom of the High Seas' as it is provided for in the United Nations Convention on the Law of the Sea (UNCLOS).¹²⁷ According to the Law of the Sea, 'commercial uses,' like fishing in the High Seas, are included in the principle of 'free use.'¹²⁸ On the other hand, the Outer Space Treaty does not give a detailed explanation of what rights are contained in the 'freedom of use', unlike the UNCLOS.¹²⁹ In other words, the freedoms of use in outer space are not defined in the Outer Space Treaty.¹³⁰ As a result, the possibility exists that no particular uses are identified in Article I of the Outer Space Treaty because of the constantly and rapidly developing technology.¹³¹ Therefore, if particular uses had been identified that would have limited the freedoms and led to a variety of uses not envisioned at the time of the drafting the Outer Space Treaty.¹³² However, 'exploration' means an activity for scientific investigation and discovery.¹³³ It is questionable as to whether the term 'use' denotes the use for exploration purposes only or whether it includes commercial uses of outer space.¹³⁴ Finally, the 1969 VCTL enshrines the rules of treaty interpretation.

2.4.2 Interpreting Article I in accordance with the VCLT

Since the Outer Space Treaty is an international treaty governed by public international law, it should be understood in accordance with the rules enshrined in Article 31-33 of the VCLT.¹³⁵

¹²⁶ Blanchette-Séguin (n 76) 966-967; Gradoni (n 1) 2; IISL DoS Study on Space Resource Mining (n 68) 30; Von der Dunk (n 68) 5.

¹²⁷ Blanchette-Séguin (n 76) 966-967; Gradoni (n 1) 2; IISL DoS Study on Space Resource Mining (n 68) 30; Pop (n 90) 139; UNCLOS, Article 87 & 89; Von der Dunk (n 68) 5; Xu et al (n 56) 8.

¹²⁸ n 127 above.

¹²⁹ Hobe (n 109) 116; IISL DoS Study on Space Resource Mining (n 68) 30; United Nations Convention on the Law of the Sea (done 10 December 1982, entered into force 16 November 1994).

¹³⁰ Hobe (n 109) 116; IISL DoS Study on Space Resource Mining (n 68) 30.

¹³¹ Hobe (n 109) 116; IISL DoS Study on Space Resource Mining (n 68) 30; Leterre (n 1) 9-10; Wrench (n 119) 438.

¹³² n 132 above.

¹³³ Hobe (n 109) 117.

¹³⁴ n 132 above.

¹³⁵ Article 31 and 32 of the VCLT apply to the Outer Space Treaty because these Articles has customary international law status; IISL DoS Study on Space Resource Mining (n 68) 26; Leterre (n 1) 10.

According to Article 31, a treaty must firstly be interpreted in good faith in accordance with the ordinary 'meaning to be given to the terms of the treaty in their context and in light of its object and purpose.'¹³⁶ Therefore, the interpretation of the word 'use' must be consistent with the other provisions of the Outer Space Treaty.¹³⁷

The term 'use' in the Outer Space Treaty is not defined.¹³⁸ It was also not discussed during the negotiations of the Treaty, which cancels out the 'supplementary means of interpretation' in accordance with Article 32 of the 1969 VCLT.¹³⁹ Even so, it is understandable that the term 'use' was not debated, because, when the Outer Space Treaty was drafted, it was impossible to predict the advances in technology and all the possible opportunities to use space.¹⁴⁰

The term 'use' appears to not have a common ordinary meaning.¹⁴¹ Gorove points out that 'exploration' and 'use' cannot have the same meaning since the terms would be redundant in the context of Article I.¹⁴² According to Hobe, the term 'use' entails both economic and non-economic activities and includes activities the goal of which is to make economic profit.¹⁴³ Furthermore, Hobe believes that 'use' has a meaning wider than 'exploration,' because what can be seen from Article I paragraph 2 of the Outer Space Treaty is that the phrase 'exploration and use' is employed rather than only the word 'exploitation' only.¹⁴⁴ In that case, using resources and consuming them as the space mining industry intends to do, would be included in the freedom of use of outer space.¹⁴⁵ However, these different perspectives will not help to create an outcome.¹⁴⁶

Furthermore, interpretation requires that the context of the treaty must be taken into consideration.¹⁴⁷ Therefore, when interpreting the Outer Space Treaty, it must be

¹³⁶ Hobe (n 109) 117; Vienna Convention on the Law of Treaties (done May 23, 1969, entered into force January 27, 1980) Article 31; Xu *et al* (n 56) 10.

¹³⁷ IISL DoS Study on Space Resource Mining (n 68) 41; Leterre (n 1) 11.

¹³⁸ Hobe (n 109) 116; IISL DoS Study on Space Resource Mining (n 68) 41; Leterre (n 1) 7.

¹³⁹ IISL DoS Study on Space Resource Mining (n 68) 41; Leterre (n 1) 7.

¹⁴⁰ Tronchetti (n 2) 223

¹⁴¹ IISL DoS Study on Space Resource Mining (n 68) 31; Leterre (n 1) 11.

¹⁴² Leterre (n 1) 11; S Gorove 'Freedom of Exploration and Use in the Outer Space Treaty: A Textual Analysis and Interpretation' (2020) 1 *Denver Journal of International Law & Policy* 98.

¹⁴³ Hobe *et al* (n 103) 35; Leterre (n 1) 11; Xu *et al* (n 56) 11.

¹⁴⁴ Hobe (n 109) 117; Leterre (n 1) 11; Xu *et al* (n 56) 11.

¹⁴⁵ Leterre (n 1) 11; Xu *et al* (n 56) 11.

¹⁴⁶ IISL DoS Study on Space Resource Mining (n 68) 31.

¹⁴⁷ VCLT, Article 31.

consistent with all the other provisions in the treaty.¹⁴⁸ This means that the rights and obligations of Article I of the Outer Space Treaty must be read and understood in harmony with the other articles of the treaty.¹⁴⁹

This interpretation of the term ‘use’ in Article I is further confirmed by subsequent state practice that establishes the agreement of the parties regarding its interpretation.¹⁵⁰ In other words, subsequent state practice focusses on the current consensus of the parties in understanding the treaty.¹⁵¹ Therefore, looking at activities taking place in outer space can provide a good indication of subsequent state practice.¹⁵² Indeed, large numbers of satellites have been launched into orbit for different purposes as well as the fact that samples of things in outer space have been gathered and used to perform scientific experiments.¹⁵³ The commercial or non-commercial use of satellite positions in orbit and the use of frequencies are recognised by the international community as being part of the ‘free use’ principle.¹⁵⁴ Ricky Lee argues that companies are already making a profit from limited space resources by launching satellites into orbits with only a certain number of slots available. In other words, he argues that ‘the idea that the commercial use of space resources is prohibited by the Outer Space Treaty... is quite simply absurd.’¹⁵⁵ Likewise, Article VI of the Outer Space Treaty includes private commercial activities in outer space by establishing the responsibility of States for national activities in outer space ‘whether such activities are carried out

¹⁴⁸ Leterre (n 1) 11.

¹⁴⁹ IISL DoS Study on Space Resource Mining (n 68) 28; Leterre (n 1) 11; O Dörr & K Schmalenbach (2018) *Vienna Convention on the Law of Treaties: A commentary* Springer 582.

¹⁵⁰ Dörr (n 149) 592-593; J Dugard et al (2018) *Dugard’s International law: A South African Perspective* Juta 623; Leterre (n 1) 12; MN Shaw (2017) *International law* Cambridge University Press 707; VCLT, Article 31(3).

¹⁵¹ Dörr (n 149) 561, 593; Leterre (n 1) 12.

¹⁵² Leterre (n 1) 12.

¹⁵³ Hobe (n 109) 118; Leterre (n 1) 12; Scientific investigation is a use that is allowed under the Outer Space Treaty, Article I; Tronchetti (n 2) 223; Von der Dunk (n 68) 5.

¹⁵⁴ De Man (n 83) 323; Erlank ‘Finding Property in New Places – Property in Cyber and Outer Space’ (2015) 18 *Potchefstroom Electronic Law Journal* 1766; IISL DoS Study on Space Resource Mining (n 68) 31; Leterre (n 1) 12; Von der Dunk (n 68) 5.

¹⁵⁵ Erlank (n 154) 1766; <https://www.peacepalacelibrary.nl/2015/12/space-mining-and-u-s-space-law/> (accessed 16 May 2021); <https://www.wsj.com/articles/BL-LB-52649> (accessed 4 May 2021); <https://stories.avvo.com/nakedlaw/bizarre/far-out-laws-your-asteroid-mining-rights.html> (accessed 4 May 2021); <http://opiniojuris.org/2015/11/25/international-law-does-not-prohibit-commercial-asteroid-mining-nor-should-it/> (accessed 5 May 2020); <https://www.scientificamerican.com/article/new-law-paves-the-way-for-asteroid-mining-but-will-it-work/> (accessed 6 May 2021); <https://theconversation.com/who-owns-space-us-asteroid-mining-act-is-dangerous-and-potentially-illegal-51073> (accessed 16 May 2021); Leterre (n 1) 12.

by governmental agencies or by non-governmental entities.¹⁵⁶ Consequently, ‘using outer space’ has advanced to mean not only use outer space for explorative and scientific purposes but also for commercial ones.¹⁵⁷ However, certain limits are put in place.

2.4.3 Use for the Benefit and in the Interest of All Countries

Article I, paragraph 1 of the Outer Space Treaty restrains the ‘freedom of use’ principle, by providing that the use of outer space ‘shall be carried out for the benefit and in the interest of all countries.’¹⁵⁸ There are, however, various opinions as to what this phrase means. Specifically, some scholars argue that only harmful uses which cause direct and immediate damage to other states are excluded, while other scholars claim that the ‘benefits’ of the use should be divided, because only that would satisfy the phrase ‘in the interest of all countries.’¹⁵⁹ In accordance with the general rules of treaty interpretation according to the VCLT, this phrase ‘in the interest of all countries’ can possibly be interpreted as concluding that ‘states should pay due regard to the interests of other countries, and avoid harmful interference and respect environmental concerns, as provided in Article IX of the Outer Space Treaty.’¹⁶⁰

A question that emerges from this context, according to the International Institute of Space Law, is whether and to what extent the use of non-renewable and limited resources will be permitted,¹⁶¹ since the exhaustion of space resources will not honour Article IX of the Outer Space Treaty, which protects the environment, promotes sustainability and the principle of ‘due regard of the ... interests of all other State Parties to the Treaty.’¹⁶²

When assessing the ‘interests of all countries’ to what extent natural resources (such as minerals and water) are renewable should be taken into account.¹⁶³ The freedom

¹⁵⁶ Brehm (n 12) 358; Hobe (n 109) 120; IISL DoS Study on Space Resource Mining (n 68) 31; Leterre (n 1) 9, Outer Space Treaty, Article VI; 12; Von der Dunk (n 68) 4.

¹⁵⁷ Hobe (n 34) ix; IISL DoS Study on Space Resource Mining (n 68) 31; Leterre (n 1) 7,9,12; Tronchetti (n 2) 223; Von der Dunk (n 68) 5; Xu *et al* (n 56) 14.

¹⁵⁸ Hertzfeld & Von der Dunk (n 74) 96; IISL DoS Study on Space Resource Mining (n 68) 31; Tronchetti (n 2) 223.

¹⁵⁹ IISL DoS Study on Space Resource Mining (n 68) 31; Tronchetti (n 2) 223.

¹⁶⁰ IISL DoS Study on Space Resource Mining (n 68) 31.

¹⁶¹ n 160 above.

¹⁶² IISL DoS Study on Space Resource Mining (n 68) 31; Outer Space Treaty, Article IX.

¹⁶³ n 162 above.

of fishing on the High Seas under the Law of the Sea is subject to special protection when the species is endangered.¹⁶⁴ In other words, fish stock can be exhausted but generally fish stock is seen as renewable.¹⁶⁵

On the other hand, it is difficult to answer whether celestial resources are ‘exhaustible’ or ‘not renewable.’¹⁶⁶ In view of this, astronomers estimate that the universe is infinite which means that the asteroid population could not be ‘exhaustible.’¹⁶⁷ However, it is essential to consider that the number of asteroids that are near and accessible from Earth is, in fact, ‘exhaustible’ and limited.¹⁶⁸

Space resource mining, when interpreted logically, will not be opposed to Article II of the Outer Space Treaty, which prohibits appropriation by use or occupation.¹⁶⁹ Even so, the activities of use should be carried out in accordance with the principle of cooperation and Article XI of the Outer Space Treaty.¹⁷⁰

2.4.4 Province of all mankind

The phrase in Article 1, that ‘the exploration and use of outer space [...] shall be the province of all mankind’ presents complicated questions with regard to the legal evaluation of space resource mining.¹⁷¹

‘[T]he province of all mankind’ is a term used in the Outer Space Treaty that is not explained, while the ‘common heritage of mankind’ is a term used in the Moon Agreement to express the perspective of what the future legal regime governing the exploitation of natural resources in outer space will be about.¹⁷² The concept ‘common heritage of mankind’ has ceased to be relevant in relation to space resources, owing to the low number of states that have ratified the Moon Agreement, none of which is a major space-faring state.¹⁷³

¹⁶⁴ n 162 above.

¹⁶⁵ n 162 above.

¹⁶⁶ n 162 above.

¹⁶⁷ n 162 above.

¹⁶⁸ n 162 above.

¹⁶⁹ Hertzfeld & Von der Dunk (n 74) 81; IISL DoS Study on Space Resource Mining (n 68) 31; Outer Space Treaty, Article IX.

¹⁷⁰ n 169 above.

¹⁷¹ IISL DoS Study on Space Resource Mining (n 68) 32; Outer Space Treaty, Article 1 para 1.

¹⁷² Hertzfeld & Von der Dunk (n 74) 96; IISL DoS Study on Space Resource Mining (n 68) 32-33; Morris (n 10) 16;

¹⁷³ Hertzfeld & Von der Dunk (n 74) 96-97; IISL DoS Study on Space Resource Mining (n 68) 33.

Thus, by interpreting the Outer Space Treaty in a systematic and teleological way with regards to the concept of ‘province of all mankind,’ the use of space resources should not benefit only one country with its nationals, but should also take into account the needs and interests of other states.¹⁷⁴ Considering the treaty and Article I, it is seen that the language used emphasizes the community aspects of space activities.¹⁷⁵ In other words, the final goal of the provision referring to ‘the province of all mankind’ is that all states benefit from space activities.¹⁷⁶ On the other hand, if countries and their nationals are not allowed to use space resources, how will they enjoy the exploration and use freedoms in outer space?¹⁷⁷ It can be concluded that some sharing of the benefits of space resources exploration and use is necessary.¹⁷⁸ However, the manner in which this would be done remains unresolved.¹⁷⁹ Even so, in this regard international cooperation may play a role as addressed in several provisions of the Outer Space Treaty.¹⁸⁰ Furthermore, an agreed-upon interpretation of the provisions of the treaty through state practice could develop and define the obligations of states in this situation.¹⁸¹

2.4.5 Conclusion

Considering the Outer Space Treaty as a whole, the use of space resources is not explicitly prohibited as long as the other rights and obligations in the treaty are met.¹⁸² Furthermore, the treaty guarantees the freedom of exploration and use if certain conditions are met to ensure that space activities, including exploitation endeavours, will serve all of humankind.¹⁸³ The conditions that should be met are the following: ‘for the benefit and in the interests of all countries’; ‘without discrimination of any kind’; ‘in accordance with international law’; with ‘free access to all areas of celestial bodies’; ‘guided by the principle of cooperation and mutual assistance’; ‘with due regard to the corresponding interests of all other state Parties to the Treaty’; and to ‘avoid harmful

¹⁷⁴ Hobe (n 109) 123; IISL DoS Study on Space Resource Mining (n 68) 33.

¹⁷⁵ IISL DoS Study on Space Resource Mining (n 68) 33.

¹⁷⁶ Hobe (n 109) 117; IISL DoS Study on Space Resource Mining (n 68) 33.

¹⁷⁷ IISL DoS Study on Space Resource Mining (n 68) 33.

¹⁷⁸ Hertzfeld & Von der Dunk (n 74) 96-97; IISL DoS Study on Space Resource Mining (n 68) 33.

¹⁷⁹ n 178 above.

¹⁸⁰ IISL DoS Study on Space Resource Mining (n 68) 33.

¹⁸¹ n 180 above.

¹⁸² IISL DoS Study on Space Resource Mining (n 68) 34; Leterre (n 1) 13.

¹⁸³ IISL DoS Study on Space Resource Mining (n 68) 34.

contamination'.¹⁸⁴ These conditions should be met by states before the 'right to use space resources' can be implemented.¹⁸⁵

2.5 The Moon Agreement

No detailed solutions for possible conflicts that may arise from the exploration of the Moon and celestial bodies exists in the Outer Space Treaty.¹⁸⁶ A more detailed document dealing with this kind of problem became necessary and this led to the construction of the Moon Agreement.¹⁸⁷

The Moon Agreement builds and expands on the principles laid down in the Outer Space Treaty.¹⁸⁸ In other words, this treaty does not compromise the established principles governing activities in outer space.¹⁸⁹

Similar to the Outer Space Treaty, the Moon Agreement prohibits all forms of national appropriation by any means and builds on this by including claims over the surface, sub-surface and natural resources of the moon.¹⁹⁰ The provisions of the Moon Agreement are applicable to the moon and other celestial bodies in the solar system, excluding Earth and celestial bodies that are regulated by specific legal norms.¹⁹¹

Moreover, the Moon Agreement has set down a very basic functional framework under which the exploration and use of outer space could be carried out.¹⁹² This framework includes requirements for each state party with regards to activities involving exploration and the use of the moon or other celestial bodies¹⁹³ as well as conditions to be followed when state parties undertake missions of exploration and use.¹⁹⁴ Furthermore, Article 11 paragraph 3 of the Moon Agreement prohibits the

¹⁸⁴ IISL DoS Study on Space Resource Mining (n 68) 34; Leterre (n 1) 13.

¹⁸⁵ n 184 above.

¹⁸⁶ Tronchetti (n 2) 38.

¹⁸⁷ n 186 above.

¹⁸⁸ Brehm (n 12) 358; Von der Dunk (n 68) 6.

¹⁸⁹ Brehm (n 12) 358; R Sankaran & N Raju 'A Framework to Address Burgeoning Commercial Complexities in Space Mining' (2017) 66(1) *German Journal of Air and Space Law* 76.

¹⁹⁰ Moon Agreement, Article 11; Sankaran & Raju (n 189) 76.

¹⁹¹ n 190 above.

¹⁹² n 190 above.

¹⁹³ Moon Agreement, Article 5; Sankaran & Raju (n 189) 76.

¹⁹⁴ Moon Agreement, Article 8; Sankaran & Raju (n 189) 76.

taking of resources *in situ* from celestial bodies, including the Moon, until the international community sets a regime for the exploration of outer space.¹⁹⁵

There are 18 state parties and four signatories to the Moon Agreement.¹⁹⁶ From the low ratification number, the Agreement may be considered to be a failure, especially when comparing it with the degree of acceptance of the other space treaties and the fact that no space-faring nations are parties to the Agreement.¹⁹⁷ Moreover, the legally binding value of the Moon Agreement is nowhere near the same as that of the Outer Space Treaty.¹⁹⁸ This leads to the fact that the Moon Agreement may need to be amended in order for it to be acceptable to states.¹⁹⁹ Even so, the Moon Agreement is to be considered as an important development in international space law, because it flows from, and elaborates on, concepts declared in the Outer Space Treaty, and it introduces new rules which should have an impact on future missions.²⁰⁰

Hence, considering the low state ratification number and the limited legally binding value of the Moon Agreement, it serves no purpose when dealing with the question of space mining is a possibility. Even so, much can be learned from the Moon Agreement, including the fact that the agreement attempts to form the circumstances under which the free exploration or use of the Moon, in accordance with the Outer Space treaty, may be administered. Furthermore, the Moon Agreement shows the requirements of the creation of 'an international regime ... to govern the exploitation of the natural resources of the moon.'²⁰¹ Consequently, no detailed discussion of the Moon Agreement will be laid out in this study.²⁰²

The Moon Agreement is considered to be a failure because of its low ratification numbers, as this seriously influences the legal binding value of this agreement. Even

¹⁹⁵ Brehm (n 12) 358; IISL DoS Study on Space Resource Mining (n 68) 41.

¹⁹⁶ Geldenhuys (n 76) 31;

<https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/status/index.html> (accessed 24 August 2021).

¹⁹⁷ Geldenhuys (n 76) 31; Tronchetti (n 2) 39-40.

¹⁹⁸ Geldenhuys (n 76) 31; Tronchetti (n 2) 40.

¹⁹⁹ Tronchetti (n 2) 40.

²⁰⁰ n 199 above.

²⁰¹ Moon Agreement, Article 11(5); Tronchetti (n 2) 41-42.

²⁰² For a detailed discussion of the Moon Agreement see Tronchetti (n 2) 38-61; IISL DoS Study on Space Resource Mining (n 68) 35-39; Sankaran & Raju (n 189) 76-79.

so, one thing that can be taken away from the Moon Agreement is that there is no international space law that has rules regarding space mining, and so an effort should be made to adhere to the plea of the Moon Agreement to establish an international regime for space mining.²⁰³

2.6 Results and conclusions

Under the existing space law regime, space resource mining raises different legal issues that need to be addressed sufficiently to ensure legal certainty and methodical exploitation of these natural resources.²⁰⁴ In spite of existing international space treaties, there are no specific rules that address such a use of outer space, nor is there a specific legal order for space resource mining.²⁰⁵ Even so, the interpretation of the Outer Space Treaty indicates that space resource mining is not prohibited *per se*.²⁰⁶ This activity could possibly fall under Article 1 paragraph 2 that establish the freedom of use of outer space.²⁰⁷ Even so, this freedom of use is limited by Article 1 paragraph 1 that establish that the freedom of use must be for the benefit of all humankind.²⁰⁸ Furthermore, Article IV and IX provide that the freedom of use must also be in compliance with provisions concerning military uses and environmental considerations.²⁰⁹ Consequently, the freedom of use of outer space must be in line with the conditions laid down in the Outer Space Treaty.²¹⁰

Considering the Outer Space Treaty and the Moon Agreement, space resource mining is not prohibited, but it should adhere to the conditions laid down in the Outer Space Treaty, which should be converted into an appropriate international space regime.²¹¹

²⁰³ Geldenhuys (n 76) 31; Hobe (n 34) vix; IISL DoS Study on Space Resource Mining (n 68) 42.

²⁰⁴ IISL DoS Study on Space Resource Mining (n 68) 41; Jakhu et al (n 1) 113-114; Tronchetti (n 2) 2.

²⁰⁵ IISL DoS Study on Space Resource Mining (n 68) 41; Tronchetti (n 2) 3.

²⁰⁶ IISL DoS Study on Space Resource Mining (n 68) 41.

²⁰⁷ IISL DoS Study on Space Resource Mining (n 68) 41; Outer Space Treaty, Article 1 para 2.

²⁰⁸ IISL DoS Study on Space Resource Mining (n 68) 41; Outer Space Treaty, Article 1 para 1.

²⁰⁹ IISL DoS Study on Space Resource Mining (n 68) 41; Outer Space Treaty, Article IV & IX.

²¹⁰ IISL DoS Study on Space Resource Mining (n 68) 41.

²¹¹ n 210 above, 42.

Taking into account that no international space law has rules regarding space mining, an effort should be made to adhere to the plea of the Moon Agreement to establish an international regime for space mining.²¹²

Therefore, it is clear that space mining is not prohibited under the existing international space law and, as a result, there is a need for a legal regime that regulates space mining.²¹³

²¹² n 210 above, 42.

²¹³ n 210 above, 41.

Chapter 3: Property rights in Outer space

3.1 Synopsis

This Chapter will examine whether it is possible to acquire public or private property rights in outer space, which is composed of the Moon, other celestial bodies and outer space resources.²¹⁴ Both the provisions of the Outer Space Treaty and the Moon Agreement will be considered here.

3.2 Introduction

Now that it was established in the previous chapter that space resource mining is not prohibited by the current space legal regime, the following question needs to be discussed in detail: Can public or private property rights be acquired over anything in outer space?²¹⁵

The existence of property rights in outer space has become an issue for discussion within the space law community.²¹⁶ Firstly, states are interested in exploration and the exploitation of the Moon and other celestial bodies. Secondly, private investments in projects that aim to mine natural resources of celestial bodies in outer space are growing rapidly.²¹⁷

Space is, therefore, becoming more commercialised, which leads to questions regarding exploration and the use of outer space and whether one, under the existing space law regime, can have public or private property rights over the Moon and other celestial bodies or their natural resources.²¹⁸ These questions have no clear-cut answers under the existing space law regime.²¹⁹ Different arguments have been presented in an effort to answer these questions. On the one hand, scholars, like Baca, suggest that the same security that people enjoy on Earth should be

²¹⁴ Tronchetti (n 2) 195.

²¹⁵ Goh (n 1) 158; <https://www.theguardian.com/business/2016/feb/06/asteroid-mining-space-minerals-legal-issues> (accessed 13 May 2021); <https://www.washingtonpost.com/news/wonk/wp/2018/06/13/how-much-is-a-moon-rock-really-worth/?noredirect=on> (accessed 13 May 2021); Tronchetti (n 2) 195.

²¹⁶ Brehm (n 12) 355.

²¹⁷ Brehm (n 12) 354; Foster (n 12) 408; <https://store.hbr.org/product/the-commercial-space-age-is-here/H066NH> (accessed 25 May 2021); Tronchetti (n 2) 193; Wrench (n 119) 438; Xu *et al* (n 56) 5.

²¹⁸ Brehm (n 12) 35; Goh (n 1) 158; Tronchetti (n 2) 194.

²¹⁹ Brehm (n 12) 35; Goh (n 1) 158; <https://www.washingtonpost.com/news/wonk/wp/2018/06/13/how-much-is-a-moon-rock-really-worth/?noredirect=on> (accessed 13 May 2021); Tronchetti (n 2) 194.

enjoyed in space, which will lead to the stimulation of participation and involvement of space-faring states and private investors in the exploitation of space resources.²²⁰ On the other hand, scholars argue that it is impossible for any kind of property rights to exist in space.²²¹

However, when property rights can be acquired over outer space resources, with the right to use, trade and commercialise these resources, this will contribute to a clear and safe legal framework which will establish legal certainty for investors and make them aware that their interests are secured and protected.²²² In other words, this will make clear that exploiting space resources can indeed become a potential profitable business.²²³

As a result, the problem of property rights in space needs greater clarity by proposing a system allowing subjects to obtain widely accepted property rights over extra-terrestrial natural resources.²²⁴

The possibility of exercising property rights over outer space resources unavoidably raises concerns of compatibility with the Outer Space Treaty.²²⁵ Article II of the Outer Space Treaty established that outer space, including the moon and other celestial bodies, “is not subject to national appropriation by claim of sovereignty”, which prevent states and private parties from appropriating any part of outer space.²²⁶ Therefore, in 1969 when Neil Armstrong and Buzz Aldrin hoisted the flag of the US on the moon, it was a purely symbolic gesture.²²⁷ No country can own the moon or any other part of space.²²⁸

²²⁰ Baca (n 1) 1059-1060; Tronchetti (n 2) 194.

²²¹ Pop (n 90) 136-137; Tronchetti (n 2) 194.

²²² n 221 above.

²²³ n 221 above.

²²⁴ Brehm (n 12) 355; Hobe (n 109) 121-122; <https://store.hbr.org/product/the-commercial-space-age-is-here/H066NH> (accessed 25 May 2021); Tronchetti (n 2) 195.

²²⁵ Tronchetti (n 2) 195.

²²⁶ De Man (n 83) 305; Erlank (n 154) 1765; Hertzfeld & Von der Dunk (n 74) 81; <https://www.theguardian.com/business/2016/feb/06/asteroid-mining-space-minerals-legal-issues> (accessed 13 May 2021); Outer Space Treaty, Article II; Pop (n 90) 136; Tronchetti (n 2) 195; V Pop 'Appropriation in outer space: the relation between land ownership and sovereignty on the celestial bodies' (2000) 16 *Space Policy* 276.

²²⁷ cf Baca (n 1) 1054-1055; Sivoilella (n 31) 2; Tronchetti (n 2) 195.

²²⁸ Erlank (n 154) 1765; <https://www.theguardian.com/business/2016/feb/06/asteroid-mining-space-minerals-legal-issues> (accessed 13 May 2021); Outer Space Treaty, Article II; Pop (n 90) 136; Tronchetti (n 2) 195; Von der Dunk (n 68) 3.

Even so, the purpose of this chapter is to analyse and clarify whether or not property rights can be obtained over natural resources of outer space under the existing space law regime.²²⁹

Both the provisions of the Outer Space Treaty and the Moon Agreement will be considered. Even so, it should be kept in mind that the Moon Agreement has little ratification by States and, therefore, cannot serve as a standard for the whole international community.²³⁰ Notwithstanding this, the Moon Agreement builds on the 'non-appropriation' principle in the Outer Space Treaty and lays down provisions dealing with property rights over the Moon and the exploitation of its natural resources, which makes the Agreement relevant for this chapter.²³¹

3.3 Movable and immovable property rights in outer space

Generally, there are two types of property rights, immovable property rights and movable property rights.²³² On the one hand, immovable property is "property that cannot be moved or an object so firmly attached to land that it is regarded as part of the land."²³³ Hence, immovable property rights are property rights applying to land.²³⁴ When comparing this with outer space, immovable property rights are property rights pertaining to the surface, the subsurface and any part of celestial bodies, which include the Moon.²³⁵ On the other hand, movable property is defined as "property that can be moved or displaced...and as anything that is not so attached to land as to be regarded as a part of it as determined by local law."²³⁶ When comparing this with outer space, movable property rights are the rights which can be obtained by mining extra-terrestrial natural resources, removing these resources from their original position and so making them movable property.²³⁷

Furthermore, it can easily be argued that property rights cannot be obtained over the Moon or any other celestial body, but the same does not necessarily apply to property

²²⁹ Tronchetti (n 2) 195.

²³⁰ Hobe (n 109) 116; Pop (n 226) 275; Tronchetti (n 2) 195.

²³¹ Tronchetti (n 2) 195.

²³² Erlank (n 154) 1761; Tronchetti (n 2) 196.

²³³ Tronchetti (n 2) 196.

²³⁴ n 233 above.

²³⁵ n 233 above.

²³⁶ n 233 above.

²³⁷ n 233 above.

rights concerning natural resources of celestial bodies once these resources have been mined by a public or private entity.²³⁸ Tronchetti supports a large number of scholars that argue that, if immovable property is transformed into movable property, then that property becomes liable for property rights.²³⁹ However, property rights over extracted natural space resources can be acquired only in accordance with principles established in the Outer Space Treaty and, where relevant, the Moon Agreement.²⁴⁰ Furthermore, the purpose of the extraction of the natural space resources is crucial in determining the possibility of property rights over such resources.²⁴¹ The extraction of extra-terrestrial resources for scientific reasons is allowed under the Outer Space Treaty,²⁴² while the same does not necessarily apply to the extraction of extra-terrestrial resources for non-scientific purposes.²⁴³

Moreover, it is of crucial importance to be aware of two types of property rights existing in outer space; the first is concerned with the Moon and other celestial bodies, while the second is concerned with the natural resources of these celestial bodies.²⁴⁴ The key to a legal basis on which the commercialisation of space resources may be allowed and developed is in the understanding of the two types of property rights existing in outer space.²⁴⁵

3.4 Immovable property rights in outer space

Nowadays, investing in a piece of land on the Moon or the surface of any other celestial body has become increasingly popular.²⁴⁶ Individuals and companies behind this scheme are claiming ownership over the Moon and other celestial bodies, and, in return, promising their customers the acquisition of proprietary titles and rights over the acquired extra-terrestrial land.²⁴⁷ This issue raises some fundamental questions, such as, can immovable property rights be acquired over extra-terrestrial bodies in accordance with existing space law provisions?²⁴⁸ Is selling immovable property on

²³⁸ Outer Space Treaty, Article II; Tronchetti (n 2) 196.

²³⁹ Tronchetti (n 2) 196.

²⁴⁰ n 239 above.

²⁴¹ n 239 above.

²⁴² Leterre (n 1) 7; Outer Space Treaty, Article 1 para 3;

²⁴³ Tronchetti (n 2) 196.

²⁴⁴ n 243 above, 197.

²⁴⁵ n 243 above, 197.

²⁴⁶ Hertzfeld & Von der Dunk (n 74) 82; Hobe (n 109) 116; Pop (n 90) 10-11; Tronchetti (n 2) 197.

²⁴⁷ Hertzfeld & Von der Dunk (n 74) 82; Tronchetti (n 2) 197.

²⁴⁸ Tronchetti (n 2) 198.

the Moon or other celestial bodies legal or are these companies committing fraud with regard to their customers?²⁴⁹

The starting point is Article II of the Outer Space Treaty which states that “outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.”²⁵⁰ The meaning of Article II is clear; outer space is a *res communis omnium*, meaning that space is free to be explored and used by all states, without the possibility of its being appropriated.²⁵¹ Space is not a *res nullius*²⁵² and any extension of state sovereignty in space is forbidden in accordance with Article II of the Outer Space Treaty.²⁵³ In other words, the article prohibits territorial claims over anything in outer space.²⁵⁴

Owing to this, it can be affirmed that property rights in outer space are prohibited because of the restrictions on state sovereignty in outer space.²⁵⁵ Even private property rights are prohibited because, if states cannot appropriate extra-terrestrial land, neither can their nationals.²⁵⁶

Sovereignty and property are not only independent notions, but they belong to different branches of law.²⁵⁷ Sovereignty forms part of political and public law, while property forms part of civil and private law.²⁵⁸ In the context of the outer space legal regime, sovereignty and property are interlinked.²⁵⁹ The fact that sovereignty is prohibited in

²⁴⁹ For an example of a company selling land on the Moon see: <https://lunarembassy.com/> (accessed 14 August 2021); Tronchetti (n 2) 198; Von der Dunk (n 68) 3.

²⁵⁰ Baca (n 1) 1065; Brehm (n 12) 356, 359; De Man (n 83) 305; Erlank (n 154) 1765; Hertzfeld & Von der Dunk (n 74) 81; Outer Space Treaty, Article II; Tronchetti (n 2) 198; Von der Dunk (n 68) 3; Wrench (n 119) 439.

²⁵¹ Brehm (n 12) 356; De Man (n 83) 305; Hobe (n 109) 119; Leterre (n 1) 1; Tronchetti (n 2) 198; Wrench (n 119) 439; Xu *et al* (n 56) 8.

²⁵² Hobe (n 109) 119; PHJ Thomas *et al* *Historiese Grondslae van die Suid-Afrikaanse Privaatreg* (2000) 193-194;

²⁵³ Brehm (n 12) 359; De Man (n 83) 305; Erlank (n 154) 1765; Hertzfeld & Von der Dunk (n 74) 81; Leterre (n 1) 1-2; Tronchetti (n 2) 198; Von der Dunk (n 68) 3.

²⁵⁴ n 253 above.

²⁵⁵ Brehm (n 12) 361; Erlank (n 154) 1765; Morris (n 10) 16; Pop (n 226) 278; Tronchetti (n 2) 198; Von der Dunk (n 68) 3; Wrench (n 119) 439.

²⁵⁶ Baca (n 1) 1052; cf Brehm (n 12) 359; Erlank (n 154) 1765; Pop (n 90) 2, 278.

²⁵⁷ De Man (n 83) 319; Pop (n 226) 275; Tronchetti (n 2) 198.

²⁵⁸ n 258 above.

²⁵⁹ De Man (n 83) 319; Tronchetti (n 2) 198.

outer space, automatically bans the possibility of acquiring titles of private or public property in outer space.²⁶⁰ Three arguments can be given in support of this exclusion.

Firstly, outer space is a *res communis omnium*. Outer space cannot, thus, be appropriated regardless of whether the subject involved is public or private. Immovable property rights are not allowed within the solar system.²⁶¹ Consequently, no one would ever be allowed to own outer space or any part thereof.²⁶² Just because 'property' is not mentioned in Article II of the Outer Space Treaty does not mean that it is not prohibited within Article II.²⁶³

Secondly, state jurisdiction is a requirement for the acquisition of immovable property rights.²⁶⁴ In order for property rights to exist, there should be a superior authority, like a state, to enforce them.²⁶⁵ However, in outer space sovereignty is prohibited,²⁶⁶ and so private property rights over the surface or sub-surface of the Moon or other celestial bodies are not possible.²⁶⁷

Thirdly, some provisions of the Outer Space Treaty forbid claims of private property rights over the Moon or any other celestial body.²⁶⁸ Article II forbids national appropriation of outer space.²⁶⁹ Looking further, private entities, in accordance with Article VI of the Outer Space Treaty, are allowed to conduct space activities with the authorisation of the state of nationality.²⁷⁰ Therefore, when a state is prohibited from doing something, it cannot give its nationals or other entities the authorisation to take part in the prohibited activity because the state lacks the authority to do so.²⁷¹ Furthermore, if it so happens that a state protects the territorial acquisitions of its

²⁶⁰ De Man (n 83) 319; Morris (n 10) 16; Pop (n 226) 278; Tronchetti (n 2) 199.

²⁶¹ Brehm (n 12) 361; Leterre (n 1) 1-2; Morris (n 10) 16; Outer Space Treaty, Article II; Pop (n 226) 278; Tronchetti (n 2) 199.

²⁶² n 261 above.

²⁶³ Hertzfeld & Von der Dunk (n 74) 81; Leterre (n 1) 1-2; Tronchetti (n 2) 200.

²⁶⁴ Brehm (n 12) 359; Morris (n 10) 16; Pop (n 226) 278; Tronchetti (n 2) 200.

²⁶⁵ Tronchetti (n 2) 200.

²⁶⁶ Brehm (n 12) 359; Morris (n 10) 16; Outer Space Treaty, Article II; Pop (n 226) 278.

²⁶⁷ Brehm (n 12) 359; Morris (n 10) 16; Pop (n 226) 278; Tronchetti (n 2) 200.

²⁶⁸ Leterre (n 1) 1-2; Morris (n 10) 16; Outer Space Treaty, Article II & VI; Pop (n 226) 278; Tronchetti (n 2) 200;

²⁶⁹ Brehm (n 12) 358; Erlank (n 154) 1765; Hertzfeld & Von der Dunk (n 74) 81.

²⁷⁰ Brehm (n 12) 358; Outer Space Treaty, Article VI; Tronchetti (n 2) 200.

²⁷¹ cf Baca (n 1) 1065-1066; Morris (n 10) 16; Pop (n 226) 278; Tronchetti (n 2) 200.

nationals in outer space, that state would violate Article II of the Outer Space Treaty because it would constitute national appropriation by ‘any other means.’²⁷²

Article II of the Outer Space Treaty also uses the term ‘nationals’ which is not defined in the article, but does not necessarily mean that it excludes private individuals.²⁷³ The meaning of the word ‘nationals’ has to be found in other provisions in the Treaty.²⁷⁴ Article VI includes ‘non-governmental entities’ in the scope of the term, while Article IX uses the word ‘national’ mainly indicating non-governmental entities.²⁷⁵ Owing to this, any reading of ‘national appropriation’ in the Outer Space Treaty also includes private appropriation.²⁷⁶

The Moon Agreement honours the Outer Space Treaty and, in more detail, prohibits private appropriation of outer space and any part thereof.²⁷⁷ On the one hand, Article 11(2) restates Article II of the Outer Space Treaty.²⁷⁸ On the other hand, Article 11(3) states that any part of the Moon, along with natural resources of the Moon or any other celestial body, will not become property of any public or private entity.²⁷⁹ Article 11(3) also adds that the placement of personnel, stations or any installations on the surface of the Moon will not create any right of ownership.²⁸⁰ The Moon Agreement explicitly prohibits the creation of property rights on extra-terrestrial land, while the Outer Space Treaty does not.²⁸¹ However, this does not mean that, because the Outer Space Treaty does not explicitly prohibit the right to immovable property in outer space, it condones it.²⁸²

Consequently, outer space, or any part thereof, is not able to be appropriated by anyone, private or public.²⁸³ Therefore, it is unlawful to claim immovable property

²⁷² Outer Space Treaty, Article II; Tronchetti (n 2) 200.

²⁷³ n 272 above.

²⁷⁴ n 272 above.

²⁷⁵ Hobe (n 109) 124; Outer Space Treaty, Article VI & IX; Tronchetti (n 2) 200-201.

²⁷⁶ Hobe (n 109) 124; Tronchetti (n 2) 201.

²⁷⁷ Morris (n 10) 16; Pop (n 226) 278; Tronchetti (n 2) 201.

²⁷⁸ Hobe (n 34) ix; Hobe (n 109) 124.

²⁷⁹ Hobe (n 34) x; Hobe (n 109) 124; Moon Agreement, Article 11; Tronchetti (n 2) 201.

²⁸⁰ n 279 above.

²⁸¹ Hobe (n 109) 124; Morris (n 10) 16; Pop (n 226) 278; Tronchetti (n 2) 201.

²⁸² n 281 above.

²⁸³ n 281 above.

rights, whether as a private or public entity, with regards to the Moon or any other celestial bodies.²⁸⁴ Such unlawful claims have to be repudiated.²⁸⁵

However, the non-appropriation principle or the impossibility of acquiring immovable property rights in and over anything in outer space has no influence over other provisions of both the Outer Space Treaty and the Moon Agreement that give states a restricted collection of property rights.²⁸⁶ For example, Article VIII of the Outer Space Treaty states that ‘the State Party to the Treaty on whose registry an object launched into outer space is carried, has jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body.’ In other words, objects can be sent into outer space and the owner of that object does not lose ownership over it.²⁸⁷ Therefore, objects can be landed or built on a celestial body and their presence in outer space does not affect their ownership.²⁸⁸ However, the state that registered that space object has jurisdiction over a limited set of property rights that are applicable to the space facility and all personnel.²⁸⁹ This notion is repeated in Article 12 of the Moon Agreement.²⁹⁰ Article 12 confirms that ownership over space vehicles, equipment, facilities, stations and installations is not lost because of their presence on the Moon or other celestial bodies.²⁹¹ Even so, the placement of facilities, stations, installations, equipment, space vehicles or personnel on or below the Moon or other celestial bodies will not create proprietorship over the surface or subsurface of the Moon or any other celestial body.²⁹²

The increasing number of individuals claiming ownership over the Moon or other celestial bodies could to some extent interfere with states and private ventures that want to exploit natural resources on the Moon and other celestial bodies.²⁹³ Even so,

²⁸⁴ n 281 above.

²⁸⁵ Tronchetti (n 2) 201.

²⁸⁶ Baca (n 1) 1066-1067; Erlank (n 154) 1766; Hertzfeld & Von der Dunk (n 74) 82; Tronchetti (n 2) 201.

²⁸⁷ Baca (n 1) 1067; Brehm (n 12) 358, 361; Erlank (n 154) 1766; Hertzfeld & Von der Dunk (n 74) 81; Tronchetti (n 2) 201-202.

²⁸⁸ Tronchetti (n 2) 202.

²⁸⁹ Baca (n 1) 1067; Outer Space Treaty, Article VI; Tronchetti (n 2) 202.

²⁹⁰ Moon Agreement, Article 12; Tronchetti (n 2) 202.

²⁹¹ n 290 above.

²⁹² Hertzfeld & Von der Dunk (n 74) 83; Tronchetti (n 2) 202.

²⁹³ Tronchetti (n 2) 202.

individuals claiming ownership over extra-terrestrial land can be refused by relying on the arguments presented above.

3.5 Property rights over natural resources in outer space

Outer space is full of inexhaustible natural resources.²⁹⁴ For example, one-kilometre sized asteroids could most likely provide a billion tons of iron, 200 million tons of nickel, 10 million tons of cobalt, and 20 000 tons of platinum metals, while the Moon has resources like iron, aluminium and Helium-3.²⁹⁵ Over the years, the possibility of mining the natural resources of outer space has become a focus for states and private ventures.²⁹⁶ Companies are being erected for the sole purpose of mining the Moon and other celestial bodies for monetary gain.²⁹⁷

However, the question arises as to whether space resource mining is compatible with the law or even a feasible legal option under the existing space legal regime?²⁹⁸ Furthermore, does the extraction and appropriation of extra-terrestrial resources fall within the parameters of the 'non-appropriation' principle of the Outer Space Treaty?²⁹⁹ Moreover, when a single state mines a celestial body does it fall within the parameters of the principle requiring the exploration and use of outer space to be carried out for the benefit and in the interest of all states?³⁰⁰

The short answer to these questions is that the extraction and use of the mineral resources of any extra-terrestrial land is permissible as long as it complies with the fundamental principles of the space law regime.³⁰¹ This answer is, of course, general and vague, which brings about the need for creating a new set of rules that specifically address issues of space resource mining.³⁰²

There is the Outer Space Treaty, which does not contain any reference to the use of space resources.³⁰³ Then there is the Moon Agreement, which established rules to

²⁹⁴ Tronchetti (n 2) 211.

²⁹⁵ Baca (n 1) 1042; Brehm (n 12) 354; <https://www.thenewatlantis.com/publications/property-rights-in-space> (accessed 24 August 2021); Tronchetti (n 2) 211.

²⁹⁶ Tronchetti (n 2) 211.

²⁹⁷ n 296 above.

²⁹⁸ Pop (n 90) 136; Tronchetti (n 2) 213.

²⁹⁹ Pop (n 90) 136; Tronchetti (n 2) 211.

³⁰⁰ Tronchetti (n 2) 213.

³⁰¹ n 300 above.

³⁰² n 300 above.

³⁰³ n 300 above, 219.

govern the exploration of extra-terrestrial resources, but this treaty is only relevant and applicable to states that are parties to the treaty, which is few.³⁰⁴ This gives rise to uncertainty between legal scholars on the interpretation of the rules concerning extra-terrestrial resources.³⁰⁵ A greatly contested question is whether the ‘non-appropriation’ principle established in Article II of the Outer Space Treaty includes outer space resources or not.³⁰⁶ Appropriation of natural resources of celestial bodies is not illegal as long as such appropriation is carried out in accordance with all the principles laid down in the Outer Space Treaty.³⁰⁷

An analysis of some of the Outer Space Treaty provisions is in order to establish whether the appropriation of natural resources in outer space is obliquely forbidden.³⁰⁸

Outer space is accessible to all for exploration and use, but it cannot be appropriated by anyone.³⁰⁹ Therefore, it is possible that states can appropriate outer space natural resources provided that such appropriation does not include any permanent claims of appropriation over the area where the natural resources are being mined, and it does not prevent other states from doing the same.³¹⁰ This point of view is parallel to that of the Law of the Sea.³¹¹ The High Seas are considered *res communis*³¹² and this does not prevent any nation from fishing in that area, but requires that a nation does not exclude other nations from doing the same.³¹³ However, any exploration and exploitative activities in outer space should be accomplished in accordance with the other principles laid down in the Outer Space Treaty. Therefore, the exploration and use of outer space should also be for the benefit and in the interests of all states, as well as in terms of the ‘province of all mankind’.³¹⁴ These general principles should be

³⁰⁴ n 300 above, 219.

³⁰⁵ Pop (n 90) 136; Tronchetti (n 2) 219.

³⁰⁶ Hobe (n 109) 123; Pop (n 90) 136; Tronchetti (n 2) 219.

³⁰⁷ Hobe (n 109) 123; Tronchetti (n 2) 220.

³⁰⁸ Tronchetti (n 2) 220.

³⁰⁹ Erlank (n 154) 1765; Outer Space Treaty, Article I & II; Tronchetti (n 2) 220.

³¹⁰ Baca (n 1) 1066; cf Outer Space Treaty, Article IX; Hertzfeld & Von der Dunk (n 74) 83; Pop (n 90) 138; Tronchetti (n 2) 221.

³¹¹ UNCLOS, Part VII; Tronchetti (n 2) 221.

³¹² An area or territory that is not subject to legal title of any state;

<http://systemandlaw.weebly.com/res-nullius-and-res-communis.html> (accessed August 2021); Pop (n 90) 138; Xu *et al* (n 56) 8.

³¹³ Pop (n 90) 139; Tronchetti (n 2) 221; UNCLOS, Article 87; Xu *et al* (n 56) 8.

³¹⁴ Tronchetti (n 2) 221-222.

taken into account when dealing with the possibility of appropriation and the use of outer space resources under the Outer Space Treaty.³¹⁵

When the term 'use' in the Outer Space Treaty is analysed, it could also possibly be used to support the legality of the exploration and use of outer space natural resources.³¹⁶ To 'use' means to employ, to make use of something for certain purposes or to enjoy the right to employ, occupy or exercise a property.³¹⁷ Therefore, states and private entities are allowed to employ or make use of outer space or its resources.³¹⁸ Even so, questions arise such as how broadly the term 'use' can be interpreted? What is the meaning of the use of the space environment? Does the term 'use' include commercial use?³¹⁹ As discussed in Chapter 2.4.2 above, the term 'use' in Article I paragraph of the Outer Space Treaty has to be understood also to include 'commercial use.'³²⁰ Thus, 'use' is a synonym of exploitation.³²¹

If such a broad interpretation of the term 'use' is accepted and includes the term 'exploration', then it is fair to look at the issue of the extraction and exploitation of space resources.³²² So the right to use space resources should be included in the right to use outer space in accordance with Article I paragraph 1 of the Outer Space Treaty.³²³ 'To use outer space' would logically imply to mine and utilize the natural resources contained within space.³²⁴ To erect a building on extra-terrestrial land without the opportunity of mining and extracting resources *in situ* is unimaginable.³²⁵

No reference to the use space resources for either scientific or non-scientific purposes can be found in the Outer Space Treaty.³²⁶ The Treaty establishes only the freedom of scientific investigation of outer space.³²⁷ Even so, state practice makes it possible to collect and analyse outer space resources for scientific purposes under the Outer

³¹⁵ n 314 above.

³¹⁶ Tronchetti (n 2) 222.

³¹⁷ Baca (n 1) 1066; Tronchetti (n 2) 222.

³¹⁸ Baca (n 1) 1066; Leterre (n 1) 1-2; Pop (n 90) 139; Trochetti (n 2) 222.

³¹⁹ n 318 above.

³²⁰ Leterre (n 1) 9; Tronchetti (n 2) 223.

³²¹ n 320 above.

³²² Hobe (n 109) 118; Tronchetti (n 2) 223.

³²³ n 322 above.

³²⁴ Tronchetti (n 2) 224.

³²⁵ n 324 above.

³²⁶ n 324 above.

³²⁷ Leterre (n 1) 7; Outer Space Treaty, Article 1 para 3; Pop (n 90) 138-139.

Space Treaty.³²⁸ Thus, it can be agreed that states can use outer space resources for scientific purposes, because no objections were raised by the international community when samples of the Moon were brought back from both the US Apollo 11 missions and the Soviet Luna space probes in 1970.³²⁹

Furthermore, it may be argued that the same rules stated above should apply to the use of outer space resources for non-scientific purposes.³³⁰ However, these should take place only in accordance with Articles I, III and IX of the Outer Space Treaty.³³¹ The principles laid down in these articles require states to carry out exploration and the use of outer space for the benefit and in the interests of all countries, to carry on their space activities in accordance with international law, and to avoid potentially harmful interference with the activities of other states.³³² However, these are general principles. What is needed is a detailed set of legal rules governing the use of outer space resources for non-scientific purposes.³³³ This will result in legal certainty that will protect the investments of investors and avoid conflict and claims.³³⁴

The Moon Agreement will also be looked at, because, unlike the Outer Space Treaty, it contains provisions concerning the use of extra-terrestrial resources for both scientific and non-scientific purposes.³³⁵ The Moon Agreement cannot be overlooked simply because it received limited ratification from states because, during the Moon Agreement negotiations, consensus was reached on the possibility of the exploitation of outer space resources.³³⁶ Therefore, it is justified to analyse the Moon Agreement because of the growing interest of states in mining the Moon and other celestial bodies.³³⁷

The Moon Agreement builds on Article I paragraph 3 of the Outer Space Treaty that laid down the freedom of scientific exploration.³³⁸ It contains provisions dealing with

³²⁸ Leterre (n 1) 7; Pop (n 90) 138-139; Tronchetti (n 2) 224.

³²⁹ Leterre (n 1) 7-8; Pop (n 90) 135-136, 138-139; Tronchetti (n 2) 224.

³³⁰ Pop (n 90) 139; Tronchetti (n 2) 224;

³³¹ Tronchetti (n 2) 224.

³³² n 331 above.

³³³ n 331 above.

³³⁴ n 331 above, 225.

³³⁵ Tronchetti (n 2) 225; Xu *et al* (n 56) 8.

³³⁶ Tronchetti (n 2) 225.

³³⁷ n 336 above, 225.

³³⁸ n 336 above, 225.

the exploration, use and exploitation of the natural resources of the Moon and other celestial bodies for scientific purposes.³³⁹ These provisions provide elements that are useful to apply when carrying out scientific activities on extra-terrestrial land, even when they are not very detailed.³⁴⁰

Article 6 establishes the freedom of scientific investigation for states by giving states the right to collect and remove samples of any substance from extra-terrestrial land, which shall remain at the disposal of the state that collected the substance for scientific purposes.³⁴¹ This scientific investigation stretches further than only the state that collected the samples. A segment of the removed samples should also be available to other interested state parties, as well as the international community for scientific investigation.³⁴² State parties are also entitled to use suitable amounts of substances of the Moon or other celestial bodies for the support of their mission.³⁴³

Article 6 confirms not only the right to mine and use outer space resources for scientific reasons, but also to anticipate a permanent manned station on the surface of the Moon and most likely the use of the mined resources to support the station.³⁴⁴ When Article 6 is compared with the Outer Space Treaty, it progresses the promotion of exploration and study of outer space resources.³⁴⁵

In both Articles 8 and 9 of the Moon Agreement the possibility of manned and unmanned stations on the Moon is established.³⁴⁶

In accordance with Article 8 state parties may land their space objects on the Moon and place their personnel, space vehicles, equipment, facilities, stations and installations anywhere on or below the surface of the Moon.³⁴⁷ Furthermore, if they do not interfere with the activities of other state parties, the above mentioned elements may be moved over or below the surface of the Moon or other celestial bodies.³⁴⁸

³³⁹ n 336 above, 225; Xu *et al* (n 56) 9.

³⁴⁰ Tronchetti (n 2) 225.

³⁴¹ Moon Agreement, Article 6; Pop (n 90) 143; Tronchetti (n 2) 225; Xu *et al* (n 56) 8.

³⁴² n 341 above.

³⁴³ Tronchetti (n 2) 226.

³⁴⁴ n 343 above.

³⁴⁵ n 343 above.

³⁴⁶ n 343 above.

³⁴⁷ Moon Agreement, Article 8; Tronchetti (n 2) 226.

³⁴⁸ n 347 above.

Article 9 states that state parties may build manned or unmanned stations on the Moon or other celestial bodies.³⁴⁹ However, these should comply with three limitations, namely: a state party shall use only that area that is required for the need of the station; a state party shall inform the Secretary-General of the UN immediately of the location and purposes of that station; and stations have to be installed so that they do not limit the free access to all areas of the Moon.³⁵⁰

These abovementioned provisions should be read in conjunction with Article 11(3) of the Moon Agreement.³⁵¹ Article 11(3) states that “the placement of personnel, space vehicles, equipment, facilities, stations and installations on or below the surface of the Moon...shall not create a right of ownership over the surface or subsurface of the Moon or any areas thereof”.³⁵² Consequently, the Moon and other celestial bodies cannot be appropriated.³⁵³ Hence, parties to the Moon Agreement may perform scientific activities on the Moon, may collect and remove samples over or below the surface of the Moon for scientific purposes, may place personnel and establish permanent stations on the Moon’s surface or subsurface, without gaining property rights over any part of the Moon, whether there is a station or other facility installed or not.³⁵⁴ It could be argued that states acquire rights over extracted materials similarly to those of an owner, even when Article 6 avoids terms like ownership or property.³⁵⁵

As mentioned above, Article 11(2) of the Moon Agreement restates the non-appropriation nature of extra-terrestrial land that is also found in the Outer Space Treaty.³⁵⁶ It can, thus, be established that property rights on the Moon and other celestial bodies are prohibited explicitly for both states and private entities.³⁵⁷ Article 11(3) establish that no minerals or other resources in place may be owned by any state or private entity, but it is not prohibited to use such minerals and resources,

³⁴⁹ Moon Agreement, Article 9; Von der Dunk (n 68) 6.

³⁵⁰ Tronchetti (n 2) 226.

³⁵¹ n 350 above.

³⁵² Baca (n 1) 1069; Brehm (n 12) 358-359; Moon Agreement, Article 11; Pop (n 90) 146; Tronchetti (n 2) 226.

³⁵³ Pop (n 90) 145-146; Tronchetti (n 2) 226;

³⁵⁴ Pop (n 90) 145; Tronchetti (n 2) 226-227.

³⁵⁵ Moon Agreement, Article 6; Tronchetti (n 2) 227.

³⁵⁶ Baca (n 1) 1069; Hobe (n 34) ix; Pop (n 90) 146.

³⁵⁷ Baca (n 1) 1069; Tronchetti (n 2) 227-228.

although that is subject to regulations that must to date still be established by the international regime.³⁵⁸

It should be kept in mind that, according to the Moon Agreement, outer space is the 'Common Heritage of Mankind', which makes the natural resources of outer space the 'common property' of all humankind.³⁵⁹ This means that the whole of humankind is empowered to exploit outer space resources via an international regime and enjoy the benefits resulting from that exploitation.³⁶⁰ This international regime, in accordance with Article 11(5) of the Moon Agreement, is supposed to be drawn up as soon as the exploitation of outer space natural resources is about to become feasible.³⁶¹

Owing to this, property rights over celestial bodies and their resources is prohibited, while the exploitation of these resources for non-scientific purposes may take place under an international regime acting in the best interests of humankind which is yet to be drawn up.³⁶² At first glance the Moon Agreement seems clear, but major questions are still not answered by this Agreement, questions such as: 1. When outer space natural resources are removed from their original position to what extent will it be possible to acquire ownership over these resources? 2. Is it forbidden to mine natural resources from outer space before such an international regime is established?³⁶³ 3. Is the exploitation of outer space resources suspended in this pre-regime phase?³⁶⁴

With regards to the first question, legal scholars argue it both ways.³⁶⁵

On the one hand, the majority of legal scholars argue that, when resources from celestial bodies have been removed from their initial position, whoever extracted those resources becomes the owner.³⁶⁶ In 1979, the US Secretary of State, Cyrus Vance, explained that 'this "non-appropriation" principle applies to the natural resources of

³⁵⁸ Baca (n 1) 1069; Blanchette-Séguin (n 76) 963; Hobe (n 109) 124; Moon Agreement, Article 11; Pop (n 90) 146; Tronchetti (n 2) 228.

³⁵⁹ Tronchetti (n 2) 228; Von der Dunk (n 68) 6-7.

³⁶⁰ Pop (n 90) 146; Tronchetti (n 2) 228; Von der Dunk (n 68) 6-7.

³⁶¹ Baca (n 1) 1069; Harn (n 78) 644; Pop (n 90) 146; Tronchetti (n 2) 228; Von der Dunk (n 68) 6.

³⁶² Baca (n 1) 1069; Tronchetti (n 2) 228.

³⁶³ Pop (n 90) 146.

³⁶⁴ n 363 above.

³⁶⁵ Tronchetti (n 2) 228.

³⁶⁶ n 365 above, 229.

celestial bodies only when such resources are “in place.”³⁶⁷ The prohibition on national appropriation does not, however, limit ‘ownership to be exercised by States or private entities over those natural resources which have been removed from their “place” on or below the surface of the moon or other celestial bodies.’³⁶⁸ So nobody can claim ownership over the surface or subsurface or natural resources in place, but one can claim property rights over resources that have been removed from their initial position.³⁶⁹

On the other hand, some legal scholars argue that the phrase ‘in place’ does not limit the non-appropriation principle and that, simply because resources are removed from their original spot, it does not make such resources appropriable.³⁷⁰ These scholars also lean on Article 11(5) of the Moon Agreement because it constitutes a limit to the possibility of appropriating resources once they are removed, because Article 11(5) contains a commitment from the international community to draw up an international legal regime governing the exploitation of these resources.³⁷¹

However, if the preparatory work of the Moon Agreement is analysed, the term ‘in place’ was used for the purpose of allowing the creation of ownership over resources that have been removed from their original site.³⁷² Initially there was negative reaction to this term, but, even so, it was accepted by all the delegations and inserted in the Moon Agreement.³⁷³ Owing to all of this, the concept supporting the legality of the acquirement of property rights over resources that are no longer in their original location should be supported.³⁷⁴

With regards to the second and third question, it is widely believed that the Moon Agreement does not enforce a suspension on the exploration of outer space resources

³⁶⁷ <https://2009-2017.state.gov/s/l/releases/remarks/264963.htm> (accessed 1 July 2021); Pop (n 90) 146.

³⁶⁸ <https://2009-2017.state.gov/s/l/releases/remarks/264963.htm> (accessed 1 July 2021).

³⁶⁹ Hobe (n 109) 124; Tronchetti (n 2) 229.

³⁷⁰ Tronchetti (n 2) 229; Xu *et al* (n 56) 19.

³⁷¹ Harn (n 78) 644; Tronchetti (n 2) 229.

³⁷² Hobe (n 34) x; see the US position in the UNGA, Verbatim Record of the two hundred and third meeting UN Doc A/AC.105/PV.203 22 at https://www.unoosa.org/pdf/transcripts/copuos/AC105_PV203E.pdf (accessed 2 September 2021); Tronchetti (n 2) 229; Xu *et al* (n 56) 19.

³⁷³ n 382 above.

³⁷⁴ Tronchetti (n 2) 229-230.

while awaiting the establishment of an international regime.³⁷⁵ During the negotiations of the Moon Agreement, Hosenball, the representative of the US, declared that “the draft agreement ... places no moratorium upon the exploitation of the natural resources on celestial bodies, pending the establishment of an international regime”.³⁷⁶ This statement from Hosenball did not receive any objections from Kolossov, the representee of the Soviet Union at UNCOPOUS.³⁷⁷

Consequently, by interpreting the Moon Agreement provisions, the legality of the acquisition of property rights over resources that are no longer in their original location is supported, as well as the fact that resources can be exploited in the pre-regime era, since there is no suspension on space resource mining.³⁷⁸ Upholding this contradicts the whole purpose of the Moon Agreement, because, if states and private entities are allowed to have ownership over mined resources and it is legal to mine such resources before there is an established international regime, then, without a doubt, the Moon Agreement and the ‘Common Heritage of Mankind’ principle incorporated in this treaty is insignificant.³⁷⁹

Continuing with this argument, every state has the right to mine the Moon or any other celestial body on its own, so there is no reason for rules governing space mining activities and, even if such rules are drawn up, states that are already performing extraction missions will have difficulty accepting such rules.³⁸⁰ Furthermore, this also makes the statement ‘the exploration and use of outer space...shall be carried out for the benefit and in the interests of all countries’³⁸¹ murky, because, when a state is entitled to gain ownership over mined ore, how will that state share with and benefit all of humankind?³⁸²

³⁷⁵ Pop (n 90) 146; Tronchetti (n 2) 230; UN Doc (n 372) 22.

³⁷⁶ n 375 above.

³⁷⁷ UN Doc (n 372) 43-45.

³⁷⁸ Hobe (n 109) 124; Pop (n 90) 146; Tronchetti (n 2) 230.

³⁷⁹ n 378 above.

³⁸⁰ Tronchetti (n 2) 230-231.

³⁸¹ Outer Space Treaty, Article I.

³⁸² Tronchetti (n 2) 231.

The Moon Agreement, as well as its interpretation creates uncertainty and confusion.³⁸³ Thus, it is necessary to draw up legal rules aimed at making space resource mining possible and compatible with the existing principles of space law.³⁸⁴

3.5 Conclusion

Even prior to the existence of the Moon Agreement, it was considered to be a right to use and exploit natural resources of outer space for non-scientific purposes before the setting up of an international regime.³⁸⁵ However, for the parties to the Moon Agreement the use and exploitation of these resources could take place only when they are carried out in accordance with Article 4 and 7 which require that the mining and use of any celestial body is done in a way that pays attention to the interests of present and future generations and without disrupting the environment of outer space.³⁸⁶

Furthermore, states understood that the right to mine and use space resources existed before the Moon Agreement, which means that such states considered the right to mine and use outer space resources to be legally enforceable under the Outer Space Treaty.³⁸⁷ If this argument is accepted, then it should be kept in mind that the use of outer space resources is not prohibited under the terms of the Outer Space Treaty.³⁸⁸

Finally, it can be concluded that there is a need for a set of comprehensive legal rules that ensure the legal compliance of the future use and exploitation of outer space in compliance with Article I, II, III and VI of the Outer Space Treaty.³⁸⁹

³⁸³ n 382 above.

³⁸⁴ n 382 above.

³⁸⁵ n 382 above.

³⁸⁶ n 382 above.

³⁸⁷ n 382 above.

³⁸⁸ n 382 above.

³⁸⁹ n 382 above.

Chapter 4: Not enough Mine-worthy Near-Earth Asteroids for Everyone

4.1 Synopsis

This chapter contains an overview of factors that make an asteroid or other celestial body worth the risk of attempting to mine it for monetary gain.

4.2 Introduction

Several private space companies are competing with regard to claiming the trillions of pounds worth of rare metals and substances thought to exist in asteroids.³⁹⁰ Firstly, Blue Origin has won NASA funding to study techniques for turning lunar ice into the hydrogen and oxygen needed to sustain a permanent settlement on the moon and refuel rocket ships.³⁹¹ Secondly, Planetary Resources came out of the shadows in 2012 with backing from high-profile billionaires and high hopes of creating a trillion-dollar industry, but its financial support dried up over the course of six years.³⁹² Finally, Deep Space Industries also had bold plans to extract resources from space.³⁹³ Furthermore, this company has been developing strategies for reducing the cost of space exploration including researching a water-propulsion system.³⁹⁴

Since then, numerous start-ups all over the world have decided to follow these examples and invest themselves in planning the mining of the Moon and asteroids.³⁹⁵ Firstly, China is in the race of space resource mining, and it has control over major natural resource companies.³⁹⁶ Secondly, The US has NASA which focusses on space

³⁹⁰ Baca (n 1) 1042-1044; Brehm (n 12) 354; Foster (n 12) 409; Goh (n 1) 158; <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021); <https://www.mining.com/astronomers-identify-12-asteroids-close-enough-for-mining-29724/> (accessed 5 May 2021); Leterre (n 1) 2; Morris (n 10) 7; Wrench (n 119) 438; Xu et al (n 56) 5; Zell (n 11) 490.

³⁹¹ <https://www.mining.com/web/the-golden-asteroid-that-could-make-everyone-on-earth-a-billionaire/> (accessed 10 May 2021).

³⁹² Brehm (n 12) 354; <https://www.mining.com/web/the-golden-asteroid-that-could-make-everyone-on-earth-a-billionaire/> (accessed 10 May 2021); Leterre (n 1) 2-3; Von der Dunk (n 68) 2.

³⁹³ Brehm (n 12) 354; <https://www.bloomberg.com/opinion/articles/2020-12-21/space-mining-on-asteroids-is-never-going-to-happen> (accessed 11 May 2021); Leterre (n 1) 2-3; Von der Dunk (n 68) 2.

³⁹⁴ <https://www.azomining.com/Article.aspx?ArticleID=1480> (accessed 20 June 2021).

³⁹⁵ Brehm (n 12) 355; Leterre (n 1) 3.

³⁹⁶ <https://www.mining.com/web/the-golden-asteroid-that-could-make-everyone-on-earth-a-billionaire/> (accessed 10 May 2021).

exploration and which could be a major help for space exploitation.³⁹⁷ Finally, there is the European Space Agency that teamed up with the Ariane Group, which is preparing for a mission to the moon in 2025 with natural resources in mind.³⁹⁸ Additionally, Luxembourg, in Europe, has registered 10 space mining companies since 2016. Furthermore, there is also a race to acquire the water in space which can be used for energy purposes like rocket fuel and fuel cells between the US, Russia, China and India.³⁹⁹

However, before these companies spend their trillions there must first be the likelihood that suitable asteroids or other celestial bodies exist for their companies' purposes,⁴⁰⁰ asteroids that have commercially profitable material and not only a high concentration of a resource.⁴⁰¹

Even though there are, according to NASA, currently more than 1 million asteroids, it still does not make it commercially viable to mine any one of these million asteroids.⁴⁰² Therefore, what will make an asteroid the perfect one to mine?⁴⁰³ And how many of these perfect asteroids are currently known to man?⁴⁰⁴

4.3 Resources in outer space and the likelihood of mining them in the near future

Recently, private entities have looked at space, and more specifically the Moon and asteroids, as the final frontier for making a profit.⁴⁰⁵

³⁹⁷ n 396 above.

³⁹⁸ n 396 above.

³⁹⁹ <https://www.mining.com/the-global-race-to-mine-outer-space/> (accessed 10 May 2021); Von der Dunk (n 68) 2.

⁴⁰⁰ <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021); Leterre (n 1) 2.

⁴⁰¹ Giraldo & Tobon (n 1) 86; M Elvis 'How Many Ore-Bearing Asteroids?' (2014) 91 *Planetary and Space Science* 1.

⁴⁰² <https://solarsystem.nasa.gov/asteroids-comets-and-meteors/asteroids/in-depth/> (accessed 5 May 2021).

⁴⁰³ <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021).

⁴⁰⁴ n 403 above.

⁴⁰⁵ Baca (n 1) 1042-1044; Goh (n 1) 158; Hobe (n 11) 881; <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021); <https://www.mining.com/astronomers-identify-12-asteroids-close-enough-for-mining-29724/> (accessed 5 May 2021); Leterre (n 1) 1-2; Morris (n 10) 7.

Planets, moons, asteroids, and comets exist in abundance and contain large quantities of resources that are rare or non-existent on Earth.⁴⁰⁶ However, the first step in researching alternative mineral deposits in space is to look at the celestial bodies closest to Earth.⁴⁰⁷ These bodies are identified as the Moon, Venus, Mars, asteroids, and comets.⁴⁰⁸ However, Venus is not ideal for mining projects owing to its extremely fluctuating temperatures and pressures prevailing on the surface.⁴⁰⁹ Therefore, the focus will fall on the other bodies mentioned.

In spite of this, there are still major challenges and these should be faced before space mining can take off.⁴¹⁰ There are problems such as:

- Environmental constraints, like low gravity, dust, vacuum, temperature gradient, radiation, have a great influence on the effectiveness of devices, mining methods and mission operational difficulties;⁴¹¹
- Remote operation and automatization processes are necessary;⁴¹²
- Lack of geo-technical engineering data for processing sites;⁴¹³
- Engineering properties of the lunar regolith, such as trafficability, particle shapes, particle size distribution, slope stability, bulk density, compressibility, diffusivity, etc.;⁴¹⁴ and

⁴⁰⁶ Baca (n 1) 1042-1043; Giraldo & Tobon (n 1) 83; <https://space-agency.public.lu/en/space-resources/ressources-in-space.html> (accessed 14 August 2021); <https://www.mining.com/astromers-identify-12-asteroids-close-enough-for-mining-29724/> (accessed 5 May 2021); <https://www.generalkinematics.com/blog/mining-in-space/> (accessed 5 May 2021); Tronchetti (n 2) 1; Zell (n 11) 490.

⁴⁰⁷ Giraldo & Tobon (n 1) 83.

⁴⁰⁸ n 407 above.

⁴⁰⁹ n 407 above, 83-84.

⁴¹⁰ Giraldo & Tobon (n 1) 84; <https://space-agency.public.lu/en/space-resources/ressources-in-space.html> (accessed 14 August 2021); <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021); <https://www.sciencedaily.com/releases/2017/09/170919092612.htm> (accessed 5 May 2021); <https://www.theguardian.com/business/2016/feb/06/asteroid-mining-space-minerals-legal-issues> (accessed 13 May 2021).

⁴¹¹ <https://www.nature.com/news/let-s-mine-asteroids-for-science-and-profit-1.10733> (accessed 5 May 2021); <https://www.mining.com/web/the-golden-asteroid-that-could-make-everyone-on-earth-a-billionaire/> (accessed 10 May 2021); <https://www.bloomberg.com/opinion/articles/2020-12-21/space-mining-on-asteroids-is-never-going-to-happen> (accessed 11 May 2021); <https://www.bbvaopenmind.com/en/science/physics/asteroid-mining-a-new-space-race/> (accessed 13 May 2021); Wachowicz *et al* (n 1) 163.

⁴¹² Wachowicz *et al* (n 1) 163.

⁴¹³ <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021); Wachowicz *et al* (n 1) 163.

⁴¹⁴ <https://www.sciencedaily.com/releases/2017/09/170919092612.htm> (accessed 5 May 2021); Wachowicz *et al* (n 1) 163-164.

- Mission preparation; power to operate;⁴¹⁵ specific device building; site preparation; mining; waste disposal; transporting back to Earth, etc.⁴¹⁶

Therefore, the exploration and exploitation of these resources' present great technical difficulties but, owing to current technological advances and the high prices of minerals and energy, this exploitation is getting closer to being economically and technically feasible.⁴¹⁷

Nevertheless, the Moon is an easy target for potential mining because of its accessibility and proximity to Earth.⁴¹⁸ In addition to this, an analysis of the Moon has indicated that it is rich in important and useful elements, such as water ice,⁴¹⁹ oxygen,⁴²⁰ helium-3,⁴²¹ potassium, phosphorus, thorium, aluminium, iron, silicon, hydrogen, chromium, manganese and other rare earth elements.⁴²²

These elements in themselves have valuable applications. Firstly, water ice can be used as a rocket propellant or life-support materials for astronauts.⁴²³ Secondly, oxygen is found in the ground as oxides, which is bound by other minerals, but could most likely be separated and converted into breathable air.⁴²⁴ Lastly, Helium-3 can generate nuclear power through a process called nuclear fusion which does not produce toxic waste.⁴²⁵ Therefore, Helium-3 has the potential to replace fossil fuels and other substances as the primary source of energy on Earth.⁴²⁶ Moreover, it has been established that 25 tonnes of Helium-3 can provide all the power that the US

⁴¹⁵ <https://www.bloomberg.com/opinion/articles/2020-12-21/space-mining-on-asteroids-is-never-going-to-happen> (accessed 11 May 2021).

⁴¹⁶ Wachowicz *et al* (n 1) 164.

⁴¹⁷ Giraldo & Tobon (n 1) 86.

⁴¹⁸ Giraldo & Tobon (n 1) 84; Tronchetti (n 2) 1-3.

⁴¹⁹ <https://space-agency.public.lu/en/space-resources/ressources-in-space.html> (accessed 14 August 2021); https://www.orbitalmatters.com/resources_near_earth_life_support/; Tronchetti (n 2) 5-6.

⁴²⁰ https://www.orbitalmatters.com/resources_near_earth_life_support/ (accessed 14 August 2021).

⁴²¹ Giraldo & Tobon (n 1) 84; Tronchetti (n 2) 5-6; Zell (n 11) 490.

⁴²² Giraldo & Tobon (n 1) 84; <https://www.mining.com/web/the-golden-asteroid-that-could-make-everyone-on-earth-a-billionaire/> (accessed 6 May 2021); <https://www.mining.com/the-global-race-to-mine-outer-space/> (accessed 10 May 2021); Sivolella (n 31) 34; Tronchetti (n 2) 5-6; Zell (n 11) 490.

⁴²³ <https://www.mining.com/web/the-golden-asteroid-that-could-make-everyone-on-earth-a-billionaire/> (accessed 6 May 2021); <https://www.forbes.com/sites/cognitiveworld/2019/05/13/the-race-to-mine-space/?sh=8b922611a700> (accessed 13 May 2021); Tronchetti (n 2) 5.

⁴²⁴ <https://space-agency.public.lu/en/space-resources/ressources-in-space.html> (accessed 14 August 2021).

⁴²⁵ Hobe (n 34) vii; <https://www.mining.com/web/the-golden-asteroid-that-could-make-everyone-on-earth-a-billionaire/> (accessed 6 May 2021); Tronchetti (n 2) 6.

⁴²⁶ n 425 above.

needs in a year.⁴²⁷ Thus, Helium-3 is by far the most valuable resource found on the Moon.⁴²⁸

In comparison, other valuable elements, such as magnesium, aluminium, titanium, iron, chromium and trace elements of lithium, cobalt, nickel, copper, zinc, niobium, molybdenum, lanthanum, europium, tungsten, and gold, are commonly found in meteorites from Mars.⁴²⁹ As a result, the possibility exists that these materials may be concentrated enough in some places on Mars to be mined.⁴³⁰ In spite of this, the distance between Earth and Mars limits the opportunity for exploration for now.⁴³¹

Similarly to the abovementioned celestial bodies, asteroids can be considered as a source of minerals, especially, iron, nickel, iridium, palladium, platinum, gold, and magnesium.⁴³² Similarly to Mars and the Moon, asteroids are also rich in water, which would support space travel endeavours and make it more affordable.⁴³³ Asteroids are, furthermore, very rich in platinum group elements, like platinum, palladium, ruthenium, rhodium, osmium, and iridium.⁴³⁴ In 2012 Planetary Resources, an asteroid mining company, estimated that a small 30-meter long asteroid might contain between \$25-\$50 billion worth of platinum.⁴³⁵ Another source establish that platinum sells for around US\$50 000 per kilogram and that an asteroid of about 200 meters that is rich in platinum would have a value of \$30 billion.⁴³⁶ Considering these facts, these metals

⁴²⁷ Giraldo & Tobon (n 1) 84; Tronchetti (n 2) 6.

⁴²⁸ n 427 above.

⁴²⁹ Giraldo & Tobon (n 1) 84.

⁴³⁰ n 429 above.

⁴³¹ n 429 above, 84-85.

⁴³² <https://www.generalkinematics.com/blog/mining-in-space/> (accessed 10 May 2021); Sivoletta (n 31) 38-39.

⁴³³ <https://www.generalkinematics.com/blog/mining-in-space/> (accessed 10 May 2021); <https://www.bbvaopenmind.com/en/science/physics/asteroid-mining-a-new-space-race/> (accessed 13 May 2021); <https://www.forbes.com/sites/cognitiveworld/2019/05/13/the-race-to-mine-space/?sh=8b922611a700> (accessed 13 May 2021);

<https://www.peacepalacelibrary.nl/2015/12/space-mining-and-u-s-space-law/> (accessed 16 May 2021); Sivoletta (n 31) 38-39.

⁴³⁴ Brehm (n 12) 354; Giraldo & Tobon (n 1) 86; Zell (n 11) 490.

⁴³⁵ <https://www.reuters.com/article/us-space-asteroid-mining/tech-billionaires-bankroll-gold-rush-to-mine-asteroids-idUSBRE83N06U20120424> (accessed 14 August 2021); <https://www.mining.com/web/the-golden-asteroid-that-could-make-everyone-on-earth-a-billionaire/> (accessed 10 May 2021); <https://www.peacepalacelibrary.nl/2015/12/space-mining-and-u-s-space-law/> (accessed 16 May 2021).

⁴³⁶ Brehm (n 12) 354; <https://www.nature.com/news/let-s-mine-asteroids-for-science-and-profit-1.10733> (accessed 6 May 2021); <https://www.peacepalacelibrary.nl/2015/12/space-mining-and-u-s-space-law/> (accessed 16 May 2021).

have high market prices that enhance the possibility of economically profitable extraction in the near future.⁴³⁷

In addition to this, according to NASA, the current estimated asteroid count is far over 1 million.⁴³⁸ Most of these asteroids can be found in the Main Asteroid Belt, orbiting the sun between Mars and Jupiter, which holds between 1.1 and 1.9 million asteroids larger than 1 kilometre in diameter, where asteroids usually range in size from 530 kilometres to less than 10 meters in diameter.⁴³⁹ However, it can logically be established that none of these asteroids would be commercially viable to mine yet, because of the distance between the Earth and the Main Asteroid Belt.⁴⁴⁰

At the same time, many asteroids lie outside of the Main Asteroid Belt.⁴⁴¹

There are also asteroids that come close to Earth and are called Near-Earth Asteroids or Near-Earth Objects.⁴⁴² The main focus of this chapter will fall on the Near-Earth Asteroids, which have been established to be between 16 000 – 17 000 according to NASA⁴⁴³ and 20 000 Near-Earth Asteroids larger than 100 meters in diameter and another 10 million asteroids larger than 20 meters in diameter, according to Professor Martin Elvis.⁴⁴⁴ Additionally, more than 800 of these asteroids are over 1 kilometre in diameter.⁴⁴⁵ Furthermore, over a 1000 of these asteroids are classified as being

⁴³⁷ Giraldo & Tobon (n 1) 86.

⁴³⁸ <https://solarsystem.nasa.gov/asteroids-comets-and-meteors/asteroids/in-depth/> (accessed 14 August 2021).

⁴³⁹ <https://solarsystem.nasa.gov/asteroids-comets-and-meteors/asteroids/in-depth/> (assessed 5 May 2021); <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021); <https://www.space.com/51-asteroids-formation-discovery-and-exploration.html> (accessed 5 May 2021); <https://www.bbvaopenmind.com/en/science/physics/asteroid-mining-a-new-space-race/> (accessed 13 May 2021).

⁴⁴⁰ Elvis (n 401) 1; <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021); <https://www.azomining.com/Article.aspx?ArticleID=1480> (accessed 20 June 2021).

⁴⁴¹ <https://www.space.com/51-asteroids-formation-discovery-and-exploration.html> (accessed 5 May 2021); <https://solarsystem.nasa.gov/asteroids-comets-and-meteors/asteroids/in-depth/> (accessed 5 May 2021).

⁴⁴² n 441 above.

⁴⁴³ <https://solarsystem.nasa.gov/asteroids-comets-and-meteors/asteroids/in-depth/> (accessed 5 May 2021); <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021); P Calla *et al* 'Asteroid mining with small spacecraft and its economic feasibility' (2019) *Cornell University* 2.

⁴⁴⁴ Elvis (n 401) 1; <https://www.azomining.com/Article.aspx?ArticleID=1480> (accessed 20 June 2021).

⁴⁴⁵ <https://solarsystem.nasa.gov/asteroids-comets-and-meteors/asteroids/in-depth/> (assessed 5 May 2021).

potential threats to Earth, through NASA's minor planet survey.⁴⁴⁶ Even so, it could possibly be a good place to start mining, because it could potentially bring back resources that are scarce on Earth and, in the process, lessen the threat of asteroids crashing into Earth.

As has been seen above, celestial bodies closest to our planet have plenty of opportunity for mineral exploration, the utilization of new materials and alternative clean energy.⁴⁴⁷ Furthermore, these celestial bodies provide a backup for materials that are depleted or very rare on Earth.⁴⁴⁸ Moreover, the exploration and exploitation is getting closer to being economically and technically feasible.⁴⁴⁹

4.5 Asteroids

4.5.1 Classifications of Asteroids

There are a few different classifications of asteroids, which will be looked at to find which asteroids can be mined for monetary gain.⁴⁵⁰ Asteroids fall into three general classes based on composition.

The C-type or carbonaceous asteroids are most common.⁴⁵¹ They are dark in colour and carbon rich. Therefore, these asteroids contain a large amount of water that could

⁴⁴⁶ <https://solarsystem.nasa.gov/asteroids-comets-and-meteors/asteroids/in-depth/> (assessed 5 May 2021); <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021).

⁴⁴⁷ Calla *et al* (n 443) 1; Giraldo & Tobon (n 1) 86.

⁴⁴⁸ Baca (n 1) 1042-1044; Giraldo & Tobon (n 1) 86.

⁴⁴⁹ Giraldo & Tobon (n 1) 86.

⁴⁵⁰ <https://www.generalkinematics.com/blog/mining-in-space/> (accessed 14 August 2021) <https://www.space.com/51-asteroids-formation-discovery-and-exploration.html> (accessed 5 May 2021); <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021); <https://www.nature.com/news/let-s-mine-asteroids-for-science-and-profit-1.10733> (accessed 5 May 2021); <https://www.azomining.com/Article.aspx?ArticleID=1480> (accessed 20 June 2021); <https://www.sciencedaily.com/releases/2017/09/170919092612.htm> (accessed 5 May 2021); <https://solarsystem.nasa.gov/asteroids-comets-and-meteors/asteroids/in-depth/> (accessed 5 May 2021).

⁴⁵¹ Foster (n 12) 409; <https://www.generalkinematics.com/blog/mining-in-space/> (accessed 14 August 2021) <https://www.space.com/51-asteroids-formation-discovery-and-exploration.html> (accessed 5 May 2021); <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021); <https://www.nature.com/news/let-s-mine-asteroids-for-science-and-profit-1.10733> (accessed 5 May 2021); <https://www.azomining.com/Article.aspx?ArticleID=1480> (accessed 20 June 2021); <https://www.sciencedaily.com/releases/2017/09/170919092612.htm> (accessed 5 May 2021); <https://solarsystem.nasa.gov/asteroids-comets-and-meteors/asteroids/in-depth/> (accessed 5 May 2021).

be important for human consumption in space or it could be used to create rocket fuel for many different types of vehicles and satellites in space.⁴⁵²

The S-type or siliceous asteroids are stonier in composition.⁴⁵³ These asteroids have significant amounts of iron, nickel, cobalt and smaller amounts of gold, platinum and rhodium.⁴⁵⁴ Moreover, efficient extraction of the S-type asteroids could prove most fruitful by bringing platinum and gold back to Earth and selling it in traditional metal markets.⁴⁵⁵

The M-type or metallic asteroids contain the most precious metals.⁴⁵⁶ These asteroids are rare in comparison to the other type asteroids. Moreover, their composition is made up of pure metals, such as platinum, nickel and iron.⁴⁵⁷

Furthermore, the classifications of asteroids is important, because mining techniques will have to be tailored to specific types of asteroids.⁴⁵⁸ Furthermore, different equipment will be sent to mine an iron-nickel asteroid from mining on a carbonaceous asteroid.⁴⁵⁹ Therefore, it should be determined which asteroid holds what materials, because different vehicles would need to be sent to obtain different metals and sending the wrong vehicle could be financially devastating.⁴⁶⁰ Hence, mining companies will need to know what the best asteroids are to mine and where they

⁴⁵² Foster (n 12) 409.

⁴⁵³ Foster (n 12) 409; <https://www.generalkinematics.com/blog/mining-in-space/> (accessed 14 August 2021); <https://www.space.com/51-asteroids-formation-discovery-and-exploration.html> (accessed 5 May 2021); <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021); <https://www.nature.com/news/let-s-mine-asteroids-for-science-and-profit-1.10733> (accessed 5 May 2021); <https://solarsystem.nasa.gov/asteroids-comets-and-meteors/asteroids/in-depth/> (accessed 5 May 2021); <https://www.sciencedaily.com/releases/2017/09/170919092612.htm> (accessed 5 May 2021); <https://www.azomining.com/Article.aspx?ArticleID=1480> (accessed 20 June 2021).

⁴⁵⁴ n 453 above.

⁴⁵⁵ n 453 above.

⁴⁵⁶ Foster (n 12) 410.

⁴⁵⁷ n 456 above.

⁴⁵⁸ Giraldo & Tobon (n 1) 86; <https://phys.org/news/2017-10-asteroid-years-industry-expert.html> (accessed 6 May 2021); <https://www.generalkinematics.com/blog/mining-in-space/> (accessed 14 August 2021).

⁴⁵⁹ n 458 above.

⁴⁶⁰ n 458 above.

are.⁴⁶¹ In addition, it will be necessary to know as much as possible about the characteristics of these objects.⁴⁶²

Furthermore, mining companies will be interested in the M-type asteroids, also known as the metallic asteroid.⁴⁶³ However, not all asteroids are M-type asteroids. Therefore, to narrow them down further 16 000 – 20 000 asteroids require satellite observations with a telescope and spectrographic instrument.⁴⁶⁴ Moreover, the composition of asteroids is studied through the analysis of the light that reflects from the asteroids surface or by examining fragments of meteorites that have landed on Earth.⁴⁶⁵ However, these techniques have their limitations.⁴⁶⁶ Furthermore, with a spectrograph the composition of the surface of an asteroid can be determined according to wavelengths.⁴⁶⁷ For example, a reddish asteroid may appear to contain iron and nickel on the surface.⁴⁶⁸ In spite of this, a spectrograph can view only the surface of the asteroid, not the inside. Therefore, the surface can be modified by things like collisions with other objects or even radiation, which ultimately does not give an accurate result of what lies inside an asteroid.⁴⁶⁹ Consequently, *in situ* measurements are still required to complement the data and establish a clear candidate for exploration.⁴⁷⁰

4.5.2 Mine-worthy Near-Earth Asteroids

In choosing an asteroid it must be sufficiently large and have a high concentration of valuable and widely used minerals.⁴⁷¹ Furthermore, the speed at which the asteroid

⁴⁶¹ n 458 above.

⁴⁶² n 458 above.

⁴⁶³ n 458 above.

⁴⁶⁴ Giraldo & Tobon (n 1) 86; <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021).

⁴⁶⁵ Calla *et al* (n 443) 2; <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021);

<https://www.sciencedaily.com/releases/2017/09/170919092612.htm> (accessed 5 May 2021);

⁴⁶⁶ n 465 above.

⁴⁶⁷ n 465 above.

⁴⁶⁸ n 465 above.

⁴⁶⁹ n 465 above.

⁴⁷⁰ Calla *et al* (n 443) 2.

⁴⁷¹ <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021).

moves should also be considered along with how far out it is orbiting and how long a probe will take to get to the specific asteroid.⁴⁷²

The view of Professor Martin Elvis, at the Harvard-Smithsonian Centre for Astrophysics, is that an asteroid must have a market value of \$1 billion for it to be worth mining.⁴⁷³ In order to satisfy this requirement an asteroid must be more than 1 km in diameter, contain more than 10 parts per million of platinum and have a velocity relative to the speed of the Earth, which is 4.5 kilometres per second.⁴⁷⁴ How many asteroids satisfy this requirement?

Moreover, Elvis basis his theory on the number of meteorites that have fallen to Earth.⁴⁷⁵ For example, approximately 4% of meteorites that have fallen to Earth are metallic, which, according to his theory, means that only 4% of Near-Earth Asteroids are also metallic.⁴⁷⁶ Therefore, accepting this theory of Elvis means that only 10 Near-Earth Asteroids are theoretically economically viable and practically feasible to mine.⁴⁷⁷ However, the Elvis theory has its limitations.⁴⁷⁸ Some of these limitations are that meteorites “lack part of the story”, which means that delicate components of ancient material contained within asteroids may be lost during atmospheric entry.⁴⁷⁹

Furthermore, researchers from the Scottish University of Strathclyde in Glasgow found 12 asteroids that, according to them, are worth mining, because they fall within the category of “Easily Retrievable Objects”.⁴⁸⁰

Consequently, there are approximately between 10 – 12 Near-Earth Asteroids which are viable for mining for commercial purposes. Even so, it is a small number for the number of companies that are popping up to mine outer space resources.

⁴⁷² n 471 above.

⁴⁷³ Elvis (n 401) 1; <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021).

⁴⁷⁴ n 473 above.

⁴⁷⁵ n 473 above.

⁴⁷⁶ n 473 above.

⁴⁷⁷ n 473 above.

⁴⁷⁸ Elvis (n 401) 1; <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021);

<https://www.sciencedaily.com/releases/2017/09/170919092612.htm> (accessed 5 May 2021).

⁴⁷⁹ <https://www.sciencedaily.com/releases/2017/09/170919092612.htm> (accessed 5 May 2021).

⁴⁸⁰ <https://www.mining.com/astronomers-identify-12-asteroids-close-enough-for-mining-29724/> (accessed 5 May 2021).

Furthermore, space resource mining is still in its developing stage.⁴⁸¹ Eventually, companies will mine further from Earth which will increase the number of mine-worthy asteroids. However, how will conflict be handled between these space mining companies with only approximately 12 Near-Earth Asteroids worth mining?⁴⁸²

4.7 Conclusion

As has been seen in the previous Chapters,⁴⁸³ there is concern over the legal certainty and complications of this growing industry.⁴⁸⁴

Even so, there are also many technical challenges to overcome.⁴⁸⁵ For example, a challenge will be to collect samples from the surface of the asteroid for a detailed chemical analysis.⁴⁸⁶ This will be no small feat because some asteroids move faster than others and the most feasible asteroid to mine could be orbiting far out, which would also take longer for a probe to get to the said asteroid which could lead to a bigger chance of the probe malfunctioning or some other problems that will minimise the chances of the probe's safe return to Earth.⁴⁸⁷ Another challenge will be to land a mining craft on the targeted asteroid surface and extract the resources *in situ*.⁴⁸⁸ It is also important to know which asteroids hold which resources, and, for preparing for the practical side of a mining mission, such as landing and extraction of material.⁴⁸⁹

However, not all asteroids are profitable. Thus, for an asteroid to be commercially viable it must be more than 1km in diameter, contain more than 10 parts per million of platinum and have a velocity relative to the speed of the Earth of less than 4.5 kilometres per second.⁴⁹⁰

⁴⁸¹ <https://www.scientificamerican.com/article/new-law-paves-the-way-for-asteroid-mining-but-will-it-work/> (accessed 6 May 2021).

⁴⁸² See Chapter 5.

⁴⁸³ See Chapter 2 & 3.

⁴⁸⁴ <https://www.mining.com/astronomers-identify-12-asteroids-close-enough-for-mining-29724/> (accessed 5 May 2021).

⁴⁸⁵ n 484 above.

⁴⁸⁶ <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021).

⁴⁸⁷ n 486 above.

⁴⁸⁸ n 486 above.

⁴⁸⁹ <https://www.sciencedaily.com/releases/2017/09/170919092612.htm> (accessed 5 May 2021).

⁴⁹⁰ Elvis (n 401) 1; <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021).

Consequently, the number of Near-Earth Asteroids that fulfil these requirements is approximately between 10 – 12 asteroids.⁴⁹¹ It should be kept in mind that the data available is limited and that these results are by no means definitive. Even so, it is a small number for the number of companies that are popping up to mine outer space resources. Outer space mining is still in its infancy.⁴⁹² Eventually, companies will mine further from Earth which will make the number of mine-worthy asteroids greater. However, in the meantime, how will conflict be handled between these space mining companies with only approximately 12 Near-Earth Asteroids worth mining?⁴⁹³

⁴⁹¹ Elvis (n 401) 1; <https://theconversation.com/mining-asteroids-could-unlock-untold-wealth-heres-how-to-get-started-95675> (accessed 5 May 2021); <https://www.mining.com/astronomers-identify-12-asteroids-close-enough-for-mining-29724/> (accessed 5 May 2021).

⁴⁹² <https://www.scientificamerican.com/article/new-law-paves-the-way-for-asteroid-mining-but-will-it-work/> (accessed 6 May 2021).

⁴⁹³ See Chapter 5.

Chapter 5: New Legal Regime and Dispute Settlement Mechanism

5.1 Synopsis

This Chapter contains suggested elements for a dedicated legal regime to govern the commercial exploitation of outer space resources, along with a dispute settlement mechanism within the context of the legal regime governing the commercial exploitation of outer space resources to settle any conflict that may arise in the course of space resource mining.

5.2 Introduction

Not long-ago space resource mining was considered to be only a science-fiction dream, but nowadays the situation is changing quickly.⁴⁹⁴ Governments, space agencies and the private sector's interest in, and financial commitments to, space activities have surged in recent years, in particular space activities related to the Moon and Near-Earth Asteroids.⁴⁹⁵ Thanks to this, the day on which space resource mining will start is approaching quickly.⁴⁹⁶

Furthermore, uncertainty is expected as space resource mining is still in its infancy.⁴⁹⁷ Most space resource mining companies are looking at asteroids and putting up telescopes to try to figure out what is worth doing and where.⁴⁹⁸ The asteroid mining market is already valued at up to trillions of dollars, but a single drill from Earth has yet to make it to space.⁴⁹⁹

⁴⁹⁴ Foster (n 12) 408; Goh (n 1) 157-158; Tronchetti (n 2) 233.

⁴⁹⁵ Brehm (n 12) 354-355; Foster (n 12) 408; Goh (n 1) 157-158; <https://www.mining.com/the-global-race-to-mine-outer-space/> (accessed 10 May 2021); L De Gouyon Matignon 'The Lawfulness of Space Mining Activities' (2019) *Space Legal Issues* 89; Tronchetti (n 2) 233; Wrench (n 119) 438; Xu *et al* (n 56) 5.

⁴⁹⁶ De Gouyon Matignon (n 495) 89; Tronchetti (n 2) 233; Xu *et al* (n 56) 1.

⁴⁹⁷ Foster (n 12) 410; <https://www.scientificamerican.com/article/new-law-paves-the-way-for-asteroid-mining-but-will-it-work/> (accessed 6 May 2021); M Feinman 'Mining the Final Frontier: Keeping Earth's Asteroid Mining Ventures from Becoming the Next Golf Rush' (2014) 14 *Pittsburgh Journal of Technology Law and Policy* 221.

⁴⁹⁸ n 497 above.

⁴⁹⁹ <https://www.mining.com/the-global-race-to-mine-outer-space/> (accessed 10 May 2021).

How space mining will ultimately work is yet to be determined, but, even so, the first steps in making space resource mining a reality is by giving investors legal certainty.⁵⁰⁰ Space mining raises legal issues mainly related to the compatibility of such use with the existing space law principles and the need for ensuring its orderly and safe development.⁵⁰¹

Some of the analyses conducted so far need to be recapped. Firstly, the use of the resources of celestial bodies for scientific investigation is allowed.⁵⁰² Secondly, outer space is a *res communis omnium*, thus nations and their citizens are entitled to use outer space resources as long as their activities do not involve any claim over areas in outer space or prevent other nations and their citizens from doing the same.⁵⁰³ Finally, everyone has to comply with the principle that the exploration and use of outer space will be carried out for the benefit and in the interest of all humankind.⁵⁰⁴

It is on this abovementioned basis that legal problems relative to the use of outer space resources for commercial purposes are to be solved.⁵⁰⁵ The question arises as to whether the current principles and rules of space law are adequate to ensure the peaceful and orderly development of space resources mining.⁵⁰⁶ This question is answered when one looks at nations, such as the US and Luxembourg, that have enacted national legislation allowing private companies to exploit and own celestial resources.⁵⁰⁷ To go further, is there even a need for a specific legal regime dealing with space resource mining? David Gump, chief executive officer of Deep Space Industries, does not think so and wants space resource mining to go forward like deep

⁵⁰⁰ Brehm (n 12) 354-355; E Jonckheere 'The Privatization of Outer Space and the Consequences for Space Law' unpublished Master's thesis, Ghent University 2017 99; <https://www.mining.com/the-global-race-to-mine-outer-space/> (accessed 10 May 2021); see Chapter 2 & 3; T Cheney 'There's No Rush: Developing a Legal Framework for Space Resource Activities' (2019) 43 *Journal of Space Law* 136;

⁵⁰¹ Goh (n 1) 158; Tronchetti (n 2) 234.

⁵⁰² Leterre (n 1) 8-9; See Chapter 2.4.1, 2.4.2 & Chapter 3.5.

⁵⁰³ De Gouyon Matignon (n 495) 89; Outer Space Treaty, Article IX; See Chapter 3.4; Xu *et al* (n 56) 8.

⁵⁰⁴ Outer Space Treaty, Article I para 1; See Chapter 3.

⁵⁰⁵ Tronchetti (n 2) 235.

⁵⁰⁶ n 505 above.

⁵⁰⁷ De Gouyon Matignon (n 495) 89-90.

sea mining – without a global treaty.⁵⁰⁸ In spite of this, the analysis of this study suggests a specific legal regime needs to be established for space resource mining.⁵⁰⁹

The Outer Space Treaty has its limitations. Firstly, the Outer Space Treaty contains only general principles.⁵¹⁰ It is fine to lay down general principles for the development of a new type of activity, but general principles lack the required precision to solve specific problems that will most likely arise when this new activity enters a more advanced phase,⁵¹¹ for example, when conflict arises between different companies over mining the same asteroid or parcel of extra-terrestrial land on the Moon. Secondly, the term ‘used’ is not defined in the Outer Space Treaty, along with how exploration and the use of outer space should take place in practical terms.⁵¹² This is a cause of confusion and legal uncertainty about the content and applicability of these general principles among legal scholars and space investors.⁵¹³

Should space resource mining be based only on these limited principles of the Outer Space Treaty?⁵¹⁴ Space resource mining raises several specific legal issues, such as the right of mining extra-terrestrial sites or property rights over extracted materials and these may not be properly addressed or solved by simply relying on the existing space law principles.⁵¹⁵ Therefore, the existing space law needs to add and extend rules that address all foreseeable scenarios and legal issues that may emerge in all phases of space resource mining.⁵¹⁶

Furthermore, only a new legal regime will be able to regulate the safe and orderly development of space resource mining.⁵¹⁷ A set of rules indicating under which conditions space mining may be carried out and what the rights and obligations would be of the subjects involved in such activities will lead to such activities being performed

⁵⁰⁸ <https://www.mining.com/asteroid-miner-will-handle-treaty-issues-by-taking-a-page-from-the-deep-sea-miners-82448/> (accessed 5 May 2020).

⁵⁰⁹ Brehm (n 12) 355; De Gouyon Matignon (n 495) 105; See Chapter 2 & 3.

⁵¹⁰ Leterre (n 1) 6.

⁵¹¹ Tronchetti (n 2) 235.

⁵¹² n 511 above, 236.

⁵¹³ n 511 above, 236.

⁵¹⁴ n 511 above, 236.

⁵¹⁵ Goh (n 1) 158; Tronchetti (n 2) 236.

⁵¹⁶ Tronchetti (n 2) 236.

⁵¹⁷ Feinman (n 497) 220; PB Larsen ‘Asteriod Legal Regime: Time for a Change?’ (2014) 39 *Journal of Space Law* 135; S Coffey ‘Establishing a legal Framework for Property rights to Natural Resources in Outer Space’ (2009) 41 *Case Western Reserve Journal of International Law* 133; Sutherland (n 94) 125; Tronchetti (n 2) 236.

in an organised and peaceful manner.⁵¹⁸ Even so, these rules must be clear and unambiguous, as this will give private investors certainty and predictability regarding the advantages and disadvantages of their space resource mining mission.⁵¹⁹

Having no rules to govern space mining activities could lead to no-one investing because there will be no framework that protects and secures the proper financial and technical investments.⁵²⁰ Some private operators might argue that a set of legal rules to govern space resource mining is unnecessary and could lead to more expense and delay and even prevent mining activities.⁵²¹ In contrast, a legal regime for space resource mining could reduce the inherent risk of such activities.⁵²² Without a set of legal rules to govern space resource mining, such an activity could not be safely organised.⁵²³ For example, who will be entitled to mine the resources of a parcel of extra-terrestrial land? For what time period? Who will have property rights over the mined ore? How will it be possible to maintain and administer the non-appropriative nature of outer space?⁵²⁴ These questions will increase tension between subjects involved in space resource mining, and these could lead to the possibility of conflict among them if these questions remain unanswered.⁵²⁵ The only way to avoid this is by establishing a legal regime that manages the commercial use of space resources.⁵²⁶ Additionally, a legal regime should be established to protect the interests of the private companies that consider such a regime useful.⁵²⁷

Scholars, like Baca, argue that the law should not anticipate technological advances, meaning that a set of space resource mining rules should not be established because of the lack of technology allowing for the exploitation of outer space resources to take

⁵¹⁸ Sutherland (n 94) 125; Tronchetti (n 2) 236.

⁵¹⁹ Cheney (n 500) 136; Goh (n 1) 158; Jonckheere (n 500) 99; Sutherland (n 94) 125; Tronchetti (n 2) 236.

⁵²⁰ Tronchetti (n 1) 237.

⁵²¹ n 520 above.

⁵²² n 520 above.

⁵²³ n 520 above.

⁵²⁴ n 520 above.

⁵²⁵ Cheney (n 500) 136; Tronchetti (n 1) 237.

⁵²⁶ Tronchetti (n 1) 237.

⁵²⁷ n 526 above, 237-238.

place.⁵²⁸ In line with this argument, law for a specific activity should be formulated only after the development of the specific technology.⁵²⁹

Even so, in this case, according to Tronchetti, the law must anticipate technological developments, which means that space resource mining has not yet begun because of the absence of specific rules making clear how the mining of extra-terrestrial resources should work.⁵³⁰ This includes how it should be organised, what rights and obligations parties have and whether or not property rights can be gained over extracted materials.⁵³¹ Moreover, without such rules there is legal uncertainty among nations and private entities interested in investing money and/or developing technology to carry out space resource mining.⁵³² The need for a legal regime that establishes what is allowed and what prohibited when utilising an extra-terrestrial site is becoming more urgent.⁵³³ The presence of such a legal regime will promote legal certainty among nations and private entities and stimulate them to devote their resources to the utilisation of the natural materials of outer space.⁵³⁴

5.3 Underlying principles required for a new space regime

It is expected that the mining of outer space resources will contribute a large number of benefits⁵³⁵ to enhance living conditions on Earth.⁵³⁶

The legal regime aimed at regulating space resource mining must benefit all of humankind, not only because of the number of benefits that can be gained from utilising space resources, but also because the new regime must be in line with the Outer Space Treaty.⁵³⁷ Article I is crucial for drafting a new legal regime, because it states that the use of outer space must be carried out for the benefit of, and in the

⁵²⁸ See Baca (n 1); Tronchetti (n 2) 238.

⁵²⁹ Cheney (n 500) 138; Tronchetti (n 2) 238.

⁵³⁰ n 529 above.

⁵³¹ Tronchetti (n 2) 238.

⁵³² Goh (n 1) 158; Tronchetti (n 2) 238.

⁵³³ Tronchetti (n 2) 238.

⁵³⁴ Goh (n 1) 158; Tronchetti (n 2) 238.

⁵³⁵ See Chapter 1 for the detailed analysis of the benefits coming from space resource mining.

⁵³⁶ Tronchetti (n 2) 238-239.

⁵³⁷ Sutherland (n 94) 125; Tronchetti (n 2) 239.

interests of, all of humankind.⁵³⁸ Therefore, rules and solutions that can benefit all of humankind need to be developed for space resource mining.⁵³⁹

In contrast, a realistic approach must be followed when developing a legal regime to govern space resource mining, which means that such a legal regime should not require the mandatory sharing of benefits and technology. Furthermore, historically it can be seen that these types of mandatory requirements are not accepted by states.⁵⁴⁰ Therefore, the legal regime should focus on the essential elements required to ensure success and realisation of outer space exploitation instead.⁵⁴¹ However, the only way outer space exploitation will become a successful reality is when the interests of space-faring states and private operators are protected and when the legal regime offers a possibility that operators can make a return on the investment that they make in space resource mining.⁵⁴² Without their financial support and technical expertise, these activities will never take place.⁵⁴³

Moreover, the Outer Space Treaty has a general principle that establishes the international responsibility of states for the space activities of their nationals,⁵⁴⁴ but, even so, this new legal regime should also refer directly to private operators and create rights and duties for them to be involved in the utilisation of space resources.⁵⁴⁵ Therefore, when a private operator has been granted a licence to mine space resources, he/she then also has a duty to comply with them.⁵⁴⁶ Hence, when the private operator fails to comply with this duty, his/her licence may be revoked or the private operator may be fined.⁵⁴⁷ Additionally, the general principle will still be fully applicable under the proposed legal regime.⁵⁴⁸

⁵³⁸ Jonckheere (n 500) 98-99; Tronchetti (n 2) 239;

⁵³⁹ Jonckheere (n 500) 98-99; for a possible way to benefit all of mankind through space resource mining see Sutherland (n 94) 125-127; Tronchetti (n 2) 239.

⁵⁴⁰ See 1982 Law of the Sea Convention, Part XI requiring the mandatory sharing of the benefits derived from the Area, along with the Moon Agreement, Article 11(7); Tronchetti (n 2) 239.

⁵⁴¹ Tronchetti (n 2) 239.

⁵⁴² Goh (n 1) 158; Hertzfeld & Von der Dunk (n 74) 81; Tronchetti (n 2) 239.

⁵⁴³ Tronchetti (n 2) 239.

⁵⁴⁴ Outer Space Treaty, Article VI.

⁵⁴⁵ Goh (n 1) 158; Jonckheere (n 500) 98-99; Tronchetti (n 2) 240.

⁵⁴⁶ n 545 above.

⁵⁴⁷ n 545 above.

⁵⁴⁸ n 545 above.

Consequently, a new legal regime governing the exploitation of outer space resources would most likely be successful if a balance can be reached, on the one hand, between the existing space law principles, such as the use of space for the benefit of all and the non-appropriative nature of the space environment, and, on the other hand, creating encouragements to stimulate the participation of private operators in outer space exploitation.⁵⁴⁹

5.4 Treaty vs UNGA Resolution

During the initial years of the space age, the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) which had been set up by the UNGA successfully came up with five international conventions.⁵⁵⁰ The five international conventions are: the Outer Space Treaty; the Rescue Agreement; the Liability Convention; the Registration Convention; and the Moon Agreement. Beyond these five space treaties, no new treaty has come into existence up to the present.⁵⁵¹ Furthermore, up to the present date no draft text or treaty is on the agenda of the UNCOPUOS.⁵⁵² No amendment to any of the space treaties has been made so far, even when procedural rules have been put in place per treaty.⁵⁵³

These have rather been replaced by an abundance of non-binding UNGA Resolutions.⁵⁵⁴ Even so, the non-binding status of these Resolutions does not prevent states from abiding by them voluntarily.⁵⁵⁵ It is doubtful whether UNGA Resolutions qualify as state practice, as they are mainly recommendary in character and not legally binding.⁵⁵⁶ However, these Resolutions remain significant because they can contribute

⁵⁴⁹ Feinman (n 497) 220; Goh (n 1) 158; Jonckheere (n 500) 98-99; Tronchetti (n 2) 240.

⁵⁵⁰ Baca (n 1) 1062; Hobe et al (n 103) 171; IISL DoS Study on Space Resource Mining (n 68) 1; Leterre (n 1) 5; R Venkata Rao et al (2017) *Recent Developments in Space Law: Opportunities & Challenges* Springer vii.

⁵⁵¹ Hobe et al (n 103) 172; IISL DoS Study on Space Resource Mining (n 68) 1-2; Venkata Rao et al (n 550) vii, 1.

⁵⁵² IISL DoS Study on Space Resource Mining (n 68) 2.

⁵⁵³ n 553 above.

⁵⁵⁴ Hobe (n 11) 875; Hobe et al (n 103) 172; Leterre (n 1) 6; Venkata Rao et al (n 550) vii, 1.

⁵⁵⁵ IISL DoS Study on Space Resource Mining (n 68) 7; Larsen (n 517) 3012.

⁵⁵⁶ *S v Petane* 1988(3) SA 51 (C) 2; Advisory opinion of the ICJ in *the Legality of the Threat Of Nuclear Weapons case*, 1996 ICJ Reports 233, 236, 238-239, 242, 253, 255.

to the interpretation of existing treaties and the development of existing legal concepts.⁵⁵⁷

For example, the Outer Space Treaty is not clearly defined and, thus, has to be interpreted.⁵⁵⁸ These UNGA Resolutions support the reinterpretation of the general terms in above mentioned treaties.⁵⁵⁹ In other words, by the formulation and adoption of legally non-binding documents, the meaning of treaties is clarified.⁵⁶⁰ Therefore, even if these non-binding documents do not evolve into customary international law status, they may contribute to the interpretation of existing treaties and the development of existing legal concepts.⁵⁶¹

5.5 Legal nature of the legal regime required

The set of rules to govern the exploitation of outer space should rather take the form of an international treaty that will be open for acceptance and ratification by states.⁵⁶² However, it is well known that some space-faring nations, like the US, do not want to enter into negotiations for a new space treaty. Even so, such a treaty seems to be the only solution to ensure enforceability and to force states to respect the rules while utilising outer space.⁵⁶³ Therefore, a UNGA Resolution is not suitable, because it will most likely miss the degree of precision which is required to ensure the safe and orderly development of space resource mining.⁵⁶⁴ Its legal value is not as strong as that of an international agreement would be.⁵⁶⁵ A UNGA Resolution also does not hold a state responsible when it commits a wrongful international action.⁵⁶⁶

Furthermore, the treaty should both have both general rules and specific rules that govern the powers and functions of the entities created through the treaty.⁵⁶⁷ Having

⁵⁵⁷ IISL DoS Study on Space Resource Mining (n 68) 7-8; Larsen (n 517) 3012; Feinman (n 497) 221; Hobe (n 34) viii; Advisory opinion of the ICJ in *the Legality of the Threat Of Nuclear Weapons case*, 1996 ICJ Reports 255.

⁵⁵⁸ IISL DoS Study on Space Resource Mining (n 68) 8.

⁵⁵⁹ n 558 above.

⁵⁶⁰ n 558 above.

⁵⁶¹ n 558 above.

⁵⁶² Geldenhuys (n 76) 35; Tronchetti (n 2) 242.

⁵⁶³ Tronchetti (n 2) 242.

⁵⁶⁴ Geldenhuys (n 76) 35; Larsen (n 517) 301; Tronchetti (n 2) 243.

⁵⁶⁵ Larsen (n 517) 301; Tronchetti (n 2) 243.

⁵⁶⁶ Tronchetti (n 2) 242-243.

⁵⁶⁷ An example of an international agreement that have both general and specific provisions is the 1944 Chicago Convention on the International Civil Aviation; Tronchetti (n 2) 243.

both general and specific rules in one agreement will ensure the safe and orderly development of space mining, as well as the equal sharing of the benefits deriving therefrom.⁵⁶⁸ Moreover, it will make participants aware of their rights and obligations when mining space resources which will also contribute to certainty among private operators and financiers. Notwithstanding this, general and specific rules should be placed into one agreement because if they were to be placed into separate agreements problems could arise.⁵⁶⁹ Firstly, some states could decide to ratify only one of the two agreements, which would lead to uncertainty among participants regarding the legal framework applicable to space resource mining.⁵⁷⁰ Furthermore, states that ratify both agreements will then apply a stricter set of rules than others.⁵⁷¹ Secondly, it would not ensure the safe and orderly development of space resource mining, which will lead to the original purpose which is to set up binding rules to govern and regulate space resource mining being lost.⁵⁷²

This study proposes that an international treaty on space resource mining is the best instrument for providing for the legal regime required.⁵⁷³ This treaty should be flexible and have provisions that allow for review, that could be used to adapt provisions of the treaty to the emerging needs and requests of the states involved in space resource mining.⁵⁷⁴

Moreover, the agreement should have a precondition for becoming a party to the agreement of having ratified the Outer Space Treaty, the Liability Convention and the Registration Convention, because the provisions of these treaties are directly relevant and applicable to space resource mining.⁵⁷⁵ Hence, the acceptance of these treaties by states involved in space resource mining activities, combined with their acceptance of the new terms set forth in the agreement that contains specific rules to regulate

⁵⁶⁸ Tronchetti (n 2) 243.

⁵⁶⁹ n 568 above.

⁵⁷⁰ n 568 above.

⁵⁷¹ n 568 above.

⁵⁷² n 568 above, 243-244.

⁵⁷³ n 568 above, 244.

⁵⁷⁴ n 568 above, 244.

⁵⁷⁵ Goh (n 1) 158; Tronchetti (n 2) 244.

such exploitation, will add to build a uniform and comprehensible legal framework applicable to the commercial use of the resources of outer space.⁵⁷⁶

5.6 Purpose and main principles of the proposed Treaty

The purpose of the proposed treaty is to facilitate, encourage, manage and control space resource mining activities.⁵⁷⁷

Inspiration can be drawn from other international administrative bodies already in place, such as the International Seabed Authority created under UNCLOS.⁵⁷⁸ Therefore, under the proposed legal regime, an international organisation, namely the International Space Authority (ISA), should be established with the mandate to organise and direct these activities.⁵⁷⁹

Firstly, a licence should be obtained by a private or public entity or person to be able to mine extra-terrestrial materials.⁵⁸⁰ The requirements to obtain a licence should be to submit an exploitation working plan to the ISA.⁵⁸¹

The ISA should grant the licence only when the submitted plan provides sufficient guarantees that the mining mission would be carried out in accordance with the existing space law principles, as well as those of the legal regime to be established.⁵⁸² Furthermore, the licence should establish the terms and conditions by which the space mining activity must be carried out, such as: the duration of the activities; the location; the right of the licensee; third parties' rights; the licensee's obtaining of property rights over extracted materials, etc.⁵⁸³ Moreover, the licence should indicate how the exploitation working plan submitted by the licensee would benefit all states in accordance with Article I of the Outer Space Treaty.⁵⁸⁴ This will balance the licensee's interests with the public global interests.⁵⁸⁵

⁵⁷⁶ n 575 above.

⁵⁷⁷ n 575 above.

⁵⁷⁸ A Lewis, A 'A Bundle of Sticks in Zero G: Non-State Actor Mining Rights for Celestial Bodies' (2019) 25 *Southwestern Journal of International Law* 411; Coffey (n 517) 134; Zell (n 11) 500-501.

⁵⁷⁹ Coffey (n 517) 133; Harn (n 78) 644; Larsen (n 517) 321; Sutherland (n 94) 125; Tronchetti (n 2) 244; Yun (n 78) 333.

⁵⁸⁰ Larsen (n 517) 320; Lewis (n 580) 411; Sutherland (n 94) 128; Tronchetti (n 2) 245.

⁵⁸¹ Coffey (n 517) 134; Tronchetti (n 2) 245; Yun (n 78) 336; Zell (n 11) 511.

⁵⁸² Coffey (n 517) 134; Tronchetti (n 2) 245; Lettere (n 1) 65; Zell (n 11) 511.

⁵⁸³ Lewis (n 578) 411; Tronchetti (n 2) 245; Yun (n 78) 336; Zell (n 11) 511.

⁵⁸⁴ Tronchetti (n 2) 245; Outer Space Treaty, Article I.

⁵⁸⁵ Tronchetti (n 2) 245.

However, the license could be revoked when the licensee breaches the terms and conditions of the licence.⁵⁸⁶ Furthermore, when the timeframe of the licence that gave the licensee the right to mine a certain area has expired, that same area then becomes available to other miners.⁵⁸⁷

5.7 The institutional part of the Treaty

5.7.1 The ISA

An organisation that can represent all states, as well as provide a licence to carry out space resource mining, should be established.⁵⁸⁸

5.7.2 ISA Characteristics

The ISA would be the international organisation that organises and controls the mining of natural materials in outer space.⁵⁸⁹ In addition, the purpose of the ISA would be to ensure the peaceful, orderly, safe and fair development of space resource mining, as well as promoting cooperation in exploitation.⁵⁹⁰

Furthermore, the ISA will have the mandate to authorise people to mine certain areas or celestial bodies for commercial purposes. This will lead to the ISA also having the duty to control the mining missions that are being carried out in accordance with space law principles.⁵⁹¹

However, it is not possible to foresee all the possible situations and circumstances that may arise in the course of space resource mining, so there must be an option to extend and modify the legal regime and the ISA.⁵⁹² Therefore, with time and new issues arising, the ISA can expand and start operating through organs such as an Assembly, a Council, a Technical and Legal Committee and Special Sub-Committees.⁵⁹³ For now, having only an ISA, without organs, would be the best choice to reduce costs until the time comes when space resource mining is a reality.⁵⁹⁴

⁵⁸⁶ n 585 above.

⁵⁸⁷ Tronchetti (n 2) 245; Zell (n 11) 511-512.

⁵⁸⁸ Tronchetti (n 2) 246.

⁵⁸⁹ Coffey (n 517) 133; Tronchetti (n 2) 246; Yun (n 78) 333.

⁵⁹⁰ n 589 above.

⁵⁹¹ n 589 above.

⁵⁹² Tronchetti (n 2) 247.

⁵⁹³ Coffey (n 517) 134; 509; Lettere (n 1) 62; To view a detailed discussion of the mandates, purposes and functions of a possible Assembly, Council, Technical and Legal Committee and Special Sub-Committees see Tronchetti (n 2) 247- 254; Zell (n 11) 501.

⁵⁹⁴ Lettere (n 1) 68-69.

Furthermore, to make effective changes, all states who are signatories to this legal regime should assemble at a revision conference.⁵⁹⁵

Additionally, the ISA would hold and represent the interests of all parties to the Treaty with regards to the mining and exploiting of space resources.⁵⁹⁶ Moreover, all the ISA decisions would be in line with the principle that all states should benefit from space resource mining.⁵⁹⁷ Even so, the states that have the technology to utilise outer space resources and use that technology to actually mine space material must also be taken into particular consideration.⁵⁹⁸ Hence, weight and importance will be given to a developed state by the ISA, which should be proportional to its impact in the mining missions.⁵⁹⁹

Furthermore, the ISA should protect the interests and needs of private operators and investors obligated by and operating in conformity to the legal regime.⁶⁰⁰ These private operators and investors are fundamental to the success of space resource mining.⁶⁰¹ Therefore, during work and meetings of the ISA the respective national state must take care of the interests and requests of such private operators.⁶⁰²

5.7.3 Financing the ISA

Financing the ISA would guarantee the functioning and stability of the legal regime aimed at governing space resource mining.⁶⁰³ For instance, the ISA could be funded with a baseline budget financed by the state parties to the legal regime.⁶⁰⁴ Specifically, this budget should be used to provide the ISA with the funds needed to exercise its power and functions permanently.⁶⁰⁵ Similarly, another source of income could possibly be provided by the fee a licensee would pay to the ISA in order to be allowed to utilise space resources.⁶⁰⁶ Moreover, the duration of the licence will determine the

⁵⁹⁵ Tronchetti (n 2) 247.

⁵⁹⁶ Coffey (n 517) 133; Tronchetti (n 2) 247; Yun (n 78) 334.

⁵⁹⁷ Tronchetti (n 2) 247.

⁵⁹⁸ Tronchetti (n 2) 247; Yun (n 78) 335.

⁵⁹⁹ Coffey (n 517) 133; Tronchetti (n 2) 247.

⁶⁰⁰ Coffey (n 517) 133; Tronchetti (n 2) 335.

⁶⁰¹ Tronchetti (n 2) 334-335.

⁶⁰² n 601 above, 334.

⁶⁰³ n 601 above, 253.

⁶⁰⁴ Tronchetti (n 2) 253; Yun (n 78) 335.

⁶⁰⁵ Tronchetti (n 2) 253.

⁶⁰⁶ Coffey (n 517) 135-136; Tronchetti (n 2) 253; Zell (n 11) 510.

fees.⁶⁰⁷ For example, there will possibly be an initial fee payable to the ISA and additionally fees every five years, if the duration of the licence is that long.⁶⁰⁸ Furthermore, as things progress with space resource mining, the funds gathered by the licences could eventually reimburse states that have contributed to the baseline budget of the ISA or they could be used for the benefit and in the interests of all humankind.⁶⁰⁹

In addition, the ISA could make use of virtual and telecom technologies related to work or meetings to help reduce the operational costs.⁶¹⁰ Furthermore, this will eliminate costs, like accommodation and flight tickets, that come with traditional meetings.⁶¹¹ Moreover, this will reduce the financial contribution that parties have to provide to the baseline budget of the ISA, along with the amount of bureaucracy required to make the ISA functional.⁶¹² Consequently, the ISA could give the mandate to the Secretariat of the UNCOPUOS or the Secretariat of the UN to organise these virtual meetings.⁶¹³

Indeed, trying to make the ISA more of a virtual authority than a traditional one, should sound attractive to many states.⁶¹⁴ In addition, this would mean that the ISA would have no permanent location and would become operational only when it is needed.⁶¹⁵ Nevertheless, this does not mean that the traditional way of organising meetings should be excluded.⁶¹⁶

5.8 The mining of space resources: applicable rules and licencing procedure

Obviously, certain requirements and procedures should be followed before a subject or entity should be allowed to utilise space resources.⁶¹⁷

⁶⁰⁷ Zell (n 11) 510.

⁶⁰⁸ Tronchetti (n 2) 253.

⁶⁰⁹ For another way to benefit all of mankind through space resource mining see Sutherland (n 94) 125-127; Tronchetti (n 2) 253.

⁶¹⁰ Coffey (n 517) 136; Lettere (n 1) 68; Tronchetti (n 2) 253.

⁶¹¹ Tronchetti (n 2) 253.

⁶¹² n 611 above, 253-254.

⁶¹³ Lettere (n 1) 69; Tronchetti (n 2) 254.

⁶¹⁴ Lettere (n 1) 68; Tronchetti (n 2) 254.

⁶¹⁵ Tronchetti (n 2) 254.

⁶¹⁶ n 615 above.

⁶¹⁷ n 615 above.

Firstly, exploration of an extra-terrestrial location will take place to provide fundamental information regarding the nature of that location, along with the presence of valuable resources in that area.⁶¹⁸

Secondly, after the exploration, the potential licensee would begin with the process leading to the obtainment of a licence to be able to carry out space resource mining.⁶¹⁹

5.8.1. The exploration of celestial bodies or other space surfaces: general considerations.

As seen in Chapter 4, the first step for a subject to be able to exploit outer space resources is by the exploration of areas of celestial bodies.⁶²⁰ Through exploration the subject can gather information and data regarding the physical characteristics of a location, the nature and composition of the soil, and the presence of valuable resources.⁶²¹ After discovering a possible valuable or profitable asteroid or extra-terrestrial area, the subject would start the procedure leading to the obtaining of a licence to mine the valuable or profitable resources.⁶²²

5.8.2 Legal aspects of the exploration phase

According to Article I paragraph 2 of the Outer Space Treaty, everybody has the right to explore outer space freely, which includes the Moon and other celestial bodies.⁶²³ Therefore, the proposed legal framework of the space resource mining would not require an authorisation for exploring outer space such as the legal regime governing the activities on the high seas, which requires obtaining a licence or authorisation to carry out the exploration of a certain part of the 'Area'.⁶²⁴

Furthermore, states have the freedom of scientific investigation in outer space and they should encourage international cooperation in such an investigation.⁶²⁵ In Article 6 and 9 of the Moon Agreement this concept is elaborated upon, by providing that state parties throughout their scientific investigation of the surface or subsurface of

⁶¹⁸ Tronchetti (n 2) 254; Zell (n 11) 514-515.

⁶¹⁹ Lewis (n 578) 411; Tronchetti (n 2) 254.

⁶²⁰ Tronchetti (n 2) 254.

⁶²¹ Tronchetti (n 2) 254-255; Zell (n 11) 514-515.

⁶²² Lewis (n 580) 411; Tronchetti (n 2) 255.

⁶²³ Outer Space Treaty, Article I para 2.

⁶²⁴ Coffey (n 517) 134-135; Tronchetti (n 2) 255; UNCLOS, Annex III, Article 2-3; Zell (n 11) 502.

⁶²⁵ Leterre (n 1) 7; Outer Space Treaty, Article I para 3

extra-terrestrial land may collect and remove samples of materials and may establish manned or unmanned stations on the Moon.⁶²⁶

In retrospect, states have made use of their right to explore outer space without receiving specific permission to do so and other state parties to the Outer Space Treaty has never raised any complaint regarding their legality.⁶²⁷ Consequently, states do not need approval or permission to explore any part of outer space.⁶²⁸

This abovementioned principle, in accordance with Article VI of the Outer Space Treaty, also applies to private operators.⁶²⁹ Article VI entitles private operators to carry out activities or missions in outer space as long as their activities are under the authorisation and supervision of their national states to ensure that these private operators comply with the provisions of the Outer Space Treaty.⁶³⁰

Furthermore, the Outer Space Treaty provides the right to explore any part of outer space, but that does not mean that the subject exploring outer space can receive property rights over the resources that he/she has located during his explorative activities.⁶³¹ In accordance with the proposed legal regime, the only way to be legally entitled to remove extra-terrestrial resources and to exploit them for commercial purposes would be to get a licence provided by the ISA.⁶³² However, an ISA licence is provided on the basis of the quality and feasibility of the proposed exploration plan and not on the basis of prior exploration activities. Thus, the successful exploration of an extra-terrestrial site would not be a priority for obtaining a licence from the ISA.⁶³³

Nonetheless, an explorer that has been previously licenced for a specific location may have advantages over other subjects interested in utilising that specific area because the previously licenced explorer would know the exact location, extent and characteristics of the material contained in the area.⁶³⁴ Therefore, it would enhance

⁶²⁶ Moon Agreement, Article 6 & 9; Tronchetti (n 2) 255.

⁶²⁷ Tronchetti (n 2) 256.

⁶²⁸ Tronchetti (n 2) 256; Zell (n 11) 502.

⁶²⁹ n 628 above.

⁶³⁰ Outer Space Treaty, Article VI.

⁶³¹ Lewis (n 578) 411; Tronchetti (n 2) 256; Zell (n 11) 502.

⁶³² n 633 above.

⁶³³ Tronchetti (n 2) 256; Coffey (n 517) 134.

⁶³⁴ n 633 above.

his exploitation plan, which would lead to its being more likely to be accepted.⁶³⁵ Furthermore, the licence will be granted on a 'first-come, first-served' basis.⁶³⁶ In other words, the ISA would have a predetermined period of time to decide whether the licence should be allowed or not.⁶³⁷ Therefore, whenever a subject presented an appropriate exploitation plan, the subject would have a good chance of receiving a licence to mine that extra-terrestrial site.⁶³⁸

The proposed legal regime's application procedure for submitting the exploitative working plan, the reviewing of the plan and the concession of the licence will not be discussed in this study.⁶³⁹

5.9 The liability regime applicable to the mining of extra-terrestrial material

Although the purpose of the proposed legal regime is to allow the orderly and safe development of space resource mining, accidents will also arise.⁶⁴⁰ Consequently, the proposed legal regime would also need an adequate set of rules dealing with liability problems. This set of liability rules would most likely be based on the 1972 Liability Convention by enlarging the scope of the Convention to cover liability cases that can stem from space resource mining as well, such as the liability for damage caused to the space environment.⁶⁴¹ This study will not cover liability problems, but it should be kept in mind that a legal regime governing space resource mining will need a liability section.⁶⁴²

5.10 A proposed dispute settlement mechanism

5.10.1 A general introduction to the need for a dispute settlement mechanism.

It is logical to expect disputes to arise in the course of space resource mining, even if there is a well-rounded legal regime.⁶⁴³ On that account, an efficient dispute settlement

⁶³⁵ n 633 above.

⁶³⁶ Coffey (n 517) 134; Tronchetti (n 2) 256; Zell (n 11) 503.

⁶³⁷ Tronchetti (n 2) 257; Zell (n 11) 503.

⁶³⁸ Coffey (n 517) 134; Tronchetti (n 2) 257.

⁶³⁹ For further information on a possible application procedure for the legal regime that govern space resource mining see Tronchetti (n 2) 257-263.

⁶⁴⁰ Tronchetti (n 2) 263.

⁶⁴¹ n 640 above, 263-264.

⁶⁴² For a detailed discussion of enlarging the scope of the Liability Convention see Tronchetti (n 2) 264-269.

⁶⁴³ Tronchetti (n 2) 269.

mechanism must be established within the context of the legal regime governing space resource mining.⁶⁴⁴

Furthermore, having a dispute settlement mechanism will give the legal regime effect because the rules can then be enforced. In addition, international space law does not have any compulsory dispute settlement, so space resource mining needs a way to address future disputes.⁶⁴⁵ Moreover, the purpose of the space treaties was to set out general principles that will apply to future space activities and those states that are signatories would rely on traditional non-legal means to settle conflicts.⁶⁴⁶ In other words, the Outer Space Treaty, the Rescue Agreement, the Registration Convention and the Moon Agreement does not contain any special provisions for the settlement of conflicts.⁶⁴⁷ Instead, the Liability Convention established a system for claiming compensation for damages caused by a space object.⁶⁴⁸

Furthermore, Article III of the Outer Space Treaty establishes that “State Parties to the Treaty, shall carry on activities in the exploration of Outer Space [...] in accordance with international law including the Charter of the UN in the interest of maintaining international peace and security and promoting international cooperation and understanding.”⁶⁴⁹ Therefore, Article III makes international law applicable to space activities.⁶⁵⁰ Furthermore, general international law rules is relevant to disputes arising from space activities.⁶⁵¹ Additionally, Article XI and XIII of the Outer Space Treaty refer to consultations and the resolution of practical questions.⁶⁵² These articles create the means to avoid conflict, not a way to settle disputes. Consequently, it can be established that the Outer Space Treaty does not have any procedure for solving conflict related to outer space problems.⁶⁵³

⁶⁴⁴ Goh (n 1) 340; Tronchetti (n 2) 269.

⁶⁴⁵ E Bohinc ‘International Space Law: Legal Aspects of Exploiting Outer Space’ unpublished diploma thesis, *Evropska Pravna Fakulteta v Novi Gorici*, 2013 33; Goh (n 1) 158, 340; Tronchetti (n 2) 269.

⁶⁴⁶ Tronchetti (n 2) 270.

⁶⁴⁷ n 646 above, 270.

⁶⁴⁸ n 646 above, 270.

⁶⁴⁹ Coffey (n 517) 146; Goh (n 1) 158, 340; Outer Space Treaty, Article III; Tronchetti (n 2) 270;

⁶⁵⁰ Coffey (n 517) 146; Goh (n 1) 158; Tronchetti (n 2) 270.

⁶⁵¹ n 650 above.

⁶⁵² Outer Space Treaty, Article XI & XIII; Tronchetti (n 2) 270; Von der Dunk (n 68) 4.

⁶⁵³ Tronchetti (n 2) 270.

Owing to all of this, the UN Charter must be discussed.

Firstly, Article 1(1) of the UN Charter establishes that an objective of the UN is “to bring about peaceful means, and in conformity with the principles of justice and international law, adjustment or settlement of international disputes or situations which might lead to a breach of the peace.”⁶⁵⁴

Secondly, Article 2(3) states that “all Members shall settle their international disputed by peaceful means in such a manner that international peace and security, and justice, are not endangered.”⁶⁵⁵

Finally, Chapter Seven of the UN Charter provides the most relevant provisions which are devoted to the settlement of disputes.⁶⁵⁶ In fact, when it is possible that a dispute can jeopardise international peace and security, Article 33 establishes that the parties to such a dispute shall seek its solution through “negotiation, enquiry, mediation, conciliation, arbitration, judicial settlement, resort to regional agencies or arrangements, or other peaceful means of their own choice.”⁶⁵⁷ Therefore, conflict between parties can possibly be peacefully settled through decree by the main juridical organ of the UN, namely the International Court of Justice (ICJ).⁶⁵⁸ As a result, state parties to the UN Charter are bound by the decisions of the ICJ according to Article 94.⁶⁵⁹ Notwithstanding this, Article 94 is restricted by the optional nature of the jurisdiction of the ICJ, which “comprises all cases which the Parties refer to it and all matters specially provided for in the Charter of the UN or in treaties and conventions in force”.⁶⁶⁰ In other words, state parties can declare mandatory jurisdiction, but even so only a small group of states has made a declaration in this respect.⁶⁶¹ Hence, the ICJ’s relevance is limited with regard to the settlement of disputes arising from space missions.⁶⁶²

⁶⁵⁴ UN Charter, Article 1(1).

⁶⁵⁵ UN Charter, Article 2(3).

⁶⁵⁶ Goh (n 1) 341; Tronchetti (n 2) 270; UN Charter, Chapter 7.

⁶⁵⁷ Coffey (n 517) 146; Goh (n 1) 158, 341; UN Charter, Chapter 7, Article XXXIII.

⁶⁵⁸ Coffey (n 517) 146; Tronchetti (n 2) 271.

⁶⁵⁹ Coffey (n 517) 146; Tronchetti (n 2) 271; UN Charter, Article 94.

⁶⁶⁰ International Court of Justice, Article 36; <https://www.icj-cij.org/en/statute>; Tronchetti (n 2) 271.

⁶⁶¹ n 660 above.

⁶⁶² Tronchetti (n 2) 271; Yun (n 78) 336.

Consequently, the general applicability of the rules of international law to settle disputes is not detailed enough to ensure the proper enforcement of the proposed legal regime governing space resource mining.⁶⁶³

Not only should there be specific rules regulating space resource mining, but there should also be a specific dispute settlement mechanism to ensure the success and proper functioning of the proposed legal regime.⁶⁶⁴ In addition, this will provide a level of durability, which will ensure that conflicts will be settled and the rule of law will be enforced.⁶⁶⁵ In this way, this mechanism will be a mandatory tool to avoid the disintegration of the possible law governing space resource mining.⁶⁶⁶

Next, we will look at the dispute settlement mechanism operating within the context of the World Trade Organisation (WTO)⁶⁶⁷ for the purpose of setting up a mechanism to settle disputes arising in the course of space resource mining.⁶⁶⁸ The dispute settlement mechanism of the WTO is effective and has received worldwide acceptance and appreciation.⁶⁶⁹ Its operation has also been successful so far.⁶⁷⁰

5.10.2 The general aspects of the WTO dispute settlement mechanism.

The WTO dispute settlement mechanisms work so well because of the dedication of the WTO members to following the procedure of the WTO dispute settlement system and to respect the judgements instead of taking unilateral action when a dispute

⁶⁶³ Tronchetti (n 2) 271.

⁶⁶⁴ n 663 above.

⁶⁶⁵ n 663 above.

⁶⁶⁶ n 663 above.

⁶⁶⁷ The WTO is an international organization which deals with trading rules between states of global or near-global level. The WTO was created in January 1995. The purpose of the WTO is to help trade to flow as freely as possible because of its positive effects on economic development and well-being. The WTO system replaced the General Agreement on Tariff and Trades (GATT) which has been regulating the international economy since 1948. For the text of the WTO Agreement see: https://www.wto.org/english/docs_e/legal_e/04-wto.pdf.

⁶⁶⁸ Another model on which the dispute settlement mechanism for space mining can possibly be based is the Seabed Dispute Chamber, which is a court within the International Tribunal of the Law of the Sea or the International Environmental Law Dispute Settlement Mechanisms, see Goh (n 1) 340.

⁶⁶⁹ Tronchetti (n 2) 271-272.

⁶⁷⁰ n 670 above, 272.

arises.⁶⁷¹ The rules are clearly defined and there are flexible timetables for settling a case.⁶⁷²

Furthermore, there is a panel of experts who make the first ruling, which is later approved or rejected by the WTO members operating through the Dispute Settlement Body (DSB).⁶⁷³ In addition, there is an option for the parties to a dispute to appeal the decision of the DSB.⁶⁷⁴ Moreover, the purpose of the WTO dispute settlement system is to settle conflicts by concentrating on consultations and not to permit judgement.⁶⁷⁵

Moreover, the WTO agreements are all about the well-organized management of international trade, so that it is devoid of obstacles or discrimination.⁶⁷⁶ Therefore, if a member of the WTO believes that another member has obstructed trade or considers that an action taken by the other member is in violation of the WTO agreements or if such member fails to meet his/her responsibilities, the aggrieved member can file a violation complaint and trigger the dispute settlement procedure.⁶⁷⁷

Apart from this, it is an effective system, because of the deadlines applicable to the different stages of the dispute settlement procedure.⁶⁷⁸ The system sets strict time limits for when a case should be settled, and this is crucial for the correct functioning of the WTO.⁶⁷⁹ When a case runs its full course, it can take up to 12 - 15 months if a case is appealed.⁶⁸⁰ However, this time period can be accelerated if a case is critical, because the time periods are flexible.⁶⁸¹

⁶⁷¹ https://www.wto.org/english/thewto_e/whatis_e/tif_e/disp1_e.htm (accessed 16 August 2021); Tronchetti (n 2) 272; X Philippe 'The dispute resolution mechanism of the World Trade Organisation five years after its implementation' (1999) 3 *African Journals Online* 70.

⁶⁷² Tronchetti (n 2) 272.

⁶⁷³ Tronchetti (n 2) 272; WTO Agreement, Annex 2, Article 2; Philippe (n 671) 70.

⁶⁷⁴ n 673 above.

⁶⁷⁵ n 673 above.

⁶⁷⁶ Tronchetti (n 2) 273.

⁶⁷⁷ https://www.wto.org/english/thewto_e/whatis_e/tif_e/disp1_e.htm (accessed 16 August 2021);

Tronchetti (n 2) 273.

⁶⁷⁸ n 677 above.

⁶⁷⁹ Tronchetti (n 2) 273.

⁶⁸⁰ https://www.wto.org/english/thewto_e/whatis_e/tif_e/disp1_e.htm (accessed 16 August 2021);

Tronchetti (n 2) 273.

⁶⁸¹ n 680 above.

Furthermore, rulings are automatically adopted by the DSB, unless there is a consensus to reject the ruling.⁶⁸² As a result, this ensures that there is always a ruling made, along with the fact that the losing WTO member cannot block the adoption of the ruling.⁶⁸³

5.10.3 The procedure for the settlement of disputes

The DSB is an organ of the WTO that has the mandate to settle disputes among the members of the WTO.⁶⁸⁴ Moreover, the DSB is a section of the General Council of the WTO and consists of all WTO members.⁶⁸⁵ Additionally, the DSB has the power to establish a panel of experts to consider the case.⁶⁸⁶ The panel's decision can then be rejected or accepted by the DSB.⁶⁸⁷ Furthermore, the DSB administers the implementation of the ruling and can take action against a WTO member state if he/she has failed to obey the ruling.⁶⁸⁸

As mentioned above, the WTO dispute settlement mechanism sets out periods for each stage of the dispute settlement procedure.⁶⁸⁹ The stages of the dispute settlement procedure are as follows:

1. 60 days for consultations, mediation, and other diplomatic means of solving disputes;⁶⁹⁰
2. 45 days to set up a panel;⁶⁹¹
3. Six months for the panel to send the final report to the parties;⁶⁹²
4. Three weeks for the panel to send the final report to WTO members;⁶⁹³ and
5. 60 days for the DSB to adopt the report (if no appeal).⁶⁹⁴

⁶⁸² C VanGrasstek *The History and Future of the World Trade Organization* (2013) 230; Philippe (n 671) 74; Tronchetti (n 2) 273.

⁶⁸³ Tronchetti (n 2) 273; Philippe (n 671) 74.

⁶⁸⁴ Coffey (n 517) 135; Tronchetti (n 2) 274; WTO Agreement, Annex 2, Article 2 & 16(4);

⁶⁸⁵ Tronchetti (n 2) 274.

⁶⁸⁶ Tronchetti (n 2) 274; WTO Agreement, Annex 2, Article 2.

⁶⁸⁷ Tronchetti (n 2) 274.

⁶⁸⁸ n 689 above.

⁶⁸⁹ https://www.wto.org/english/thewto_e/whatis_e/tif_e/disp1_e.htm (accessed 16 August 2021);

Tronchetti (n 2) 274; WTO Agreement, Annex 2, Article 2.

⁶⁹⁰ Goh (n 1) 342; Philippe (n 671) 75; Tronchetti (n 2) 274; WTO Agreement, Annex 2, Article 4 & 5.

⁶⁹¹ Tronchetti (n 2) 274; WTO Agreement, Annex 2, Article 6(1).

⁶⁹² Tronchetti (n 2) 274; WTO Agreement, Annex 2, Article 12(8).

⁶⁹³ n 692 above.

⁶⁹⁴ n 692 above.

In case of an appeal, two periods would be added, namely:

6.1 60 to 90 days for the Appellate Body to submit the appeal report; and

6.2 30 days for the DSB to adopt the appeal report.⁶⁹⁵

5.10.4 First Stage

At the start, when there is a dispute between two members of the WTO, these members try to solve their dispute through consultation or other diplomatic methods.⁶⁹⁶

In addition, a member experiencing a holdup in its trade should request the member holding it up to start consultations.⁶⁹⁷ The offending member has to reply to this request within 10 days after the day of reception of the request.⁶⁹⁸ The main goal of consultations is to achieve joint satisfaction between the involved members.⁶⁹⁹

5.10.5 Second Stage

Secondly, when the 10 days has expired without a reply or the offending member refuses to enter into consultations within 30 days, or it is impossible to reach a mutually satisfactory solution within 60 days,⁷⁰⁰ the complaining member may ask the DSB directly to appoint a panel of experts.⁷⁰¹ However, this can be blocked once by either the impending member or by consensus of the DSB not to establish a panel.⁷⁰²

Furthermore, the panel of experts is there to help the DSB rule on a particular dispute, and the panel's report is not easily rejected, because of the consensus needed from the DSB to be able to reject the report.⁷⁰³ Moreover, a timetable for the procedure and deadlines for handing in written submissions is set out by the panel.⁷⁰⁴

⁶⁹⁵ n 692 above.

⁶⁹⁶ Goh (n 1) 342; https://www.wto.org/english/tratop_e/dispu_e/dispu_settlement_cbt_e/c6s1p1_e.htm (accessed 16 August 2021); Philippe (n 671) 79; Tronchetti (n 2) 274; WTO Agreement, Annex 2, Article 4.

⁶⁹⁷ Tronchetti (n 2) 274-275.

⁶⁹⁸ Tronchetti (n 2) 275; WTO Agreement, Annex 2, Article 4(3).

⁶⁹⁹ Tronchetti (n 2) 275.

⁷⁰⁰ Philippe (n 671) 80; WTO Agreement, Annex 2, Article 4(7).

⁷⁰¹ https://www.wto.org/english/tratop_e/dispu_e/dispu_settlement_cbt_e/c6s1p1_e.htm (accessed 16 August 2021); Philippe (n 671) 79-80; Tronchetti (n 2) 275; WTO Agreement, Annex 2, Article 2, 4(3), (4), (7) & 6(1).

⁷⁰² https://www.wto.org/english/tratop_e/dispu_e/dispu_settlement_cbt_e/c6s1p1_e.htm (accessed 16 August 2021); Philippe (n 671) 7; Tronchetti (n 2) 275; WTO Agreement, Annex 2, Article 6(1).

⁷⁰³ Philippe (n 671) 78; WTO Agreement, Annex 2, Article 7(1).

⁷⁰⁴ WTO Agreement, Annex 2, Article 12(3) & (5).

From here on the procedure is as follows. Each side submits its memorial to the panel before the first hearing. Next, the first hearing takes place. Then each side presents its case in an oral argument, along with other members who have an interest in the case.⁷⁰⁵ Afterwards, rebuttals are submitted and presented in oral argument. Then, the second meeting take place. If scientific or technical matters are raised, the panel may require the advice of experts.⁷⁰⁶ Then both sides have two weeks to comment on the facts and arguments that are sent to them by the panel (this does not comprise of findings and conclusions).⁷⁰⁷ Thereafter, an interim report that contains all the findings and conclusions is submitted to both sides by the panel.⁷⁰⁸ Next, both sides have one week to request a review.⁷⁰⁹ Generally, the review can last up to two weeks. Then both sides receive a final report and three weeks later that report is sent to all WTO members.⁷¹⁰ Finally, if there has been a breach of WTO rules or obligations, the panel suggests a feasible solution or says that the problem should be dealt with according to WTO principles.⁷¹¹ However, the members to the dispute are free to decide how to do this.

5.10.6 Third Stage

Thirdly, only after every WTO member has the interim report, the report may be considered for adoption by the DSB, unless the case is appealed.⁷¹² If there is not a consensus to reject the report the DSB has to adopt the report within 60 days.⁷¹³ Thus, when the report is adopted, it becomes the ruling of the DSB.⁷¹⁴

⁷⁰⁵ https://www.wto.org/english/thewto_e/whatis_e/tif_e/disp1_e.htm (accessed 14 August 2021); Philippe (n 671) 80.

⁷⁰⁶ WTO Agreement, Annex 2, Article 13.

⁷⁰⁷ Philippe (n 671) 82; Tronchetti (n 2) 277; WTO Agreement, Annex 2, Article 15(1).

⁷⁰⁸ Philippe (n 671) 82; Tronchetti (n 2) 277; WTO Agreement, Annex 2, Article 15(2).

⁷⁰⁹ Philippe (n 671) 82; Tronchetti (n 2) 277.

⁷¹⁰ Tronchetti (n 2) 277; WTO Agreement, Annex 2, Article 16(1).

⁷¹¹ Philippe (n 671) 82; Tronchetti (n 2) 277; WTO Agreement, Annex 2, Article 19.

⁷¹² Philippe (n 671) 83; Tronchetti (n 2) 277; WTO Agreement, Annex 2, Article 16(4).

⁷¹³ https://www.wto.org/english/tratop_e/dispu_e/disp_settlement_cbt_e/c6s1p1_e.htm (accessed 16 August 2021); Philippe (n 671) 83; Tronchetti (n 2) 277; WTO Agreement, Annex 2, Article 16(4).

⁷¹⁴ https://www.wto.org/english/tratop_e/dispu_e/disp_settlement_cbt_e/c6s1p1_e.htm (accessed 16 August 2021); Tronchetti (n 2) 277.

5.10.7 Appeal

Fourthly, both sides can appeal the ruling of the panel of experts.⁷¹⁵ Appeals are only based on points of law, such as legal interpretation.⁷¹⁶ Therefore, they are not for re-examining existing evidence or even examining new evidence.⁷¹⁷

Furthermore, the DSB has an Appellate Body that consists of seven permanent members.⁷¹⁸ Each appeal is heard by three randomly selected members of the Appellate Body.⁷¹⁹ The Appellate Body consist of individuals with standing in the field of law and international trade.⁷²⁰ The Appellate Body has been blocked and is now inactive for quite some time due to the non-re-election of members.

An appeal should last between 60 – 90 days.⁷²¹ Any of the panel's legal findings or conclusions can be upheld, modified or overturned by the appeal.⁷²² It is only when there is a consensus to reject the Appellate Body's report that the DSB does not have to accept the upheld, modified or overturned report of the panel.⁷²³ Otherwise, the DSB has to accept the modified report within 30 days, after circulation.⁷²⁴

5.10.8 After the DSB ruling

Finally, after the adoption of the report, indicating that a member was in the wrong, that member has to act in accordance with the recommendations contained in the report.⁷²⁵ However, if it is impossible for the member to comply with the recommendations set out immediately, that member will be provided with a 'reasonable period of time' to get the recommendations done.⁷²⁶ If that member fails to act in the reasonable time period set out, it has to negotiate a mutually accepted compensation with the complaining member.⁷²⁷ If no satisfactory compensation is

⁷¹⁵ Tronchetti (n 2) 277.

⁷¹⁶ Philippe (n 671) 83; WTO Agreement, Annex 2, Article 17(6).

⁷¹⁷ Philippe (n 671) 83; Tronchetti (n 2) 277;

⁷¹⁸ Philippe (n 671) 74; Tronchetti (n 2) 277; VanGrasstek (n 682) 240; WTO Agreement, Annex 2, Article 17(1).

⁷¹⁹ Philippe (n 671) 84; Tronchetti (n 2) 277.

⁷²⁰ Tronchetti (n 2) 277; WTO Agreement, Annex 2, Article 17(3).

⁷²¹ Philippe (n 671) 83; Tronchetti (n 2) 277; WTO Agreement, Annex 2, Article 17(5).

⁷²² Tronchetti (n 2) 277; WTO Agreement, Annex 2, Article 17(13).

⁷²³ Philippe (n 671) 78; Tronchetti (n 2) 277; WTO Agreement, Annex 2, Article 17(14).

⁷²⁴ n 723 above.

⁷²⁵ https://www.wto.org/english/tratop_e/dispu_e/disp_settlement_cbt_e/c6s1p1_e.htm (accessed 16 August 2021); WTO Agreement, Annex 2, Article 21.

⁷²⁶ WTO Agreement, Annex 2, Article 21(3); Philippe (n 671) 85.

⁷²⁷ Philippe (n 671) 85; Tronchetti (n 2) 277; WTO Agreement, Annex 2, Article 22(1).

agreed upon after 20 days, the complaining member may ask the DSB for authorisation to impose limited trade sanctions.⁷²⁸ Then the DSB has 30 days to decide, after the expiry of the 'reasonable period of time', to impose limited trade sanctions on the other member.⁷²⁹ Furthermore, the sanctions should be taken within the same sector as the dispute or if that would not be effective, the sanctions could be imposed in another sector.⁷³⁰

5.11 The dispute settlement mechanism of the proposed legal regime

The dispute settlement mechanism of the WTO is a good model for the dispute settlement mechanism of the proposed legal regime regulating space resource mining.⁷³¹ Consequently, the dispute settlement mechanism of the legal regime governing space resource mining should be able to resolve disputes arising from exploitative activities in outer space with clear rules and a flexible timetable.⁷³²

The following disputes can be settled by a dispute settlement mechanism. For example, when a state or private operator adopts a measure which is against the rules of the legal regime governing space resource mining, or when two or more states or private operators disagree on the understanding and application of certain provisions, or when a state or private operator fails to fulfil its obligations, or when the actions taken by a state or private operator prevent other states or private operators from enjoying the rights and benefits stemming from the involvement in the space resource mining legal regime, or where a state has received a licence to mine a parcel of extra-terrestrial land, but fails to obey the duty to exploit it for the benefit of all members, these will trigger the dispute settlement mechanism for the parties damaged by this behaviour.⁷³³

The dispute settlement mechanism will not be triggered when it comes to liability claims for damage caused by space resource mining activities performed on any extra-terrestrial surface.⁷³⁴ These types of disputes will have to be solved by the Liability

⁷²⁸ Philippe (n 671) 85; Tronchetti (n 2) 278; WTO Agreement, Annex 2, Article 22(6).

⁷²⁹ Philippe (n 671) 85-86; Tronchetti (n 2) 278.

⁷³⁰ Tronchetti (n 2) 278.

⁷³¹ n 730 above.

⁷³² n 730 above, 278-279.

⁷³³ n 730 above, 279.

⁷³⁴ n 730 above, 279.

Convention or other liability provisions that may most likely be inserted in the space resource mining legal regime.⁷³⁵

Furthermore, the settlement procedure should not take longer than 13 months, because the dispute settlement mechanism should be based on the idea that the prompt settlement of disputes should be essential for the proper functioning of the space resource mining legal regime.⁷³⁶

Moreover, there should be an organ with the mandate to settle disputes related to space resource mining, namely a Space Dispute Settlement Body (SDSB).⁷³⁷ Additionally, the SDSB would consist of all states that have accepted and ratified the legal regime governing space resource mining.⁷³⁸ Furthermore, the main tasks of the SDSB will be to appoint a panel of experts, accept or reject the panel's findings or the result of the appeal, and to monitor the implementation or rulings and recommendations.⁷³⁹

The procedure could most likely be structured as follows.⁷⁴⁰

Firstly, the parties to the dispute have up to 60 days to make use of consultations, mediation, or other diplomatic means to try to solve the dispute between them. However, if the parties fail to come to an agreement through consultation, mediation or other diplomatic means, the complaining party may ask the SDSB to appoint a panel of experts. Furthermore, the creation of the panel of experts can be opposed by the opposite party on one occasion. Thereafter, the complaining party can request the SDSB to appoint a panel of experts again, which can then only be refused through consensus by the whole SDSB.

Secondly, the SDSB would then have 45 days to arrange a panel of experts. Thereafter the following four phases should happen in a span of six months: The first phase is the hearing which would comprise of oral arguments from the complaining

⁷³⁵ n 730 above, 279.

⁷³⁶ n 730 above, 279.

⁷³⁷ Coffey (n 517) 136; Tronchetti (n 2) 279.

⁷³⁸ Coffey (n 517) 135-136; Tronchetti (n 2) 279.

⁷³⁹ Tronchetti (n 2) 279.

⁷⁴⁰ This procedure is in line with the WTO dispute settlement mechanism in accordance with the WTO Agreement, Annex 2 discussed above at 5.10.

party, the respondent party and any other party which might have an interest in the case. Furthermore, a memorial should be submitted before the beginning of the hearing of the oral arguments. The second phase is that of rebuttal. All the parties involved in the dispute would then have a right to submit a written rebuttal and present an oral argument. Moreover, when scientific or technical matters are raised, the panel may require the advice of experts. In the third phase the parties to the dispute will receive the interim report (consist of findings and conclusions) from the panel and would then have three weeks to ask for a review. Generally, the review could take up to two weeks. The fourth phase would be the submission of the final report to all the parties of the space resource mining legal regime. Furthermore, if the panel of experts found that there had been a breach of the legal regime, it would suggest a feasible solution in line with the legal regime that had been breached.

Thirdly, if no appeal is presented, the SDSB would have 60 days to adopt or reject the final report. Additionally, for the SDSB to be able to reject the final report, it should have the consensus to do so.

Fourthly, if an appeal is presented, the Appellate Body would have between 60 - 90 days to submit the appeal report. The Appellate Body will be established by the SDSB, and will consist of seven permanent members, who are individuals with a recognised standing in the field of international space law. Furthermore, an appeal has to be heard by only three of the seven permanent members. However, an appeal can be based only on points of law and will not re-examine existing evidence or look at new evidence. Moreover, the panel's legal findings and conclusions can be upheld, modified or overturned in the appeal.

Fifthly, the SDSB will have 30 days to adopt the appeal, unless there is consensus to reject the report.

Finally, after the adoption of the report, the party that is in the wrong should act in accordance with the recommendations contained in the report and take the necessary action. Furthermore, if the party does not comply immediately, it will be provided with a reasonable time period that is estimated by the SDSB. However, if the party still fails to comply even after the time period has lapsed, it will have to negotiate a mutually accepted compensation with the complaining party. Additionally, sanctions could be authorised by the SDSB if no satisfactory compensation is agreed upon. The

complaining party should ask the SDSB to authorise the sanctions, and then the SDSB should decide on them within 30 days of the expired reasonable time period. The sanctions should be taken in the same sector of the dispute or, if that would not be effective, the sanctions could be imposed in another sector.⁷⁴¹

Finally, in order for this dispute settlement mechanism to function properly the licence giving the mandate to the licensee to carry out the exploitation of extra-terrestrial resources should contain a clause that will force the licensee to make use of, respect and act in good faith with the mechanisms established by the legal regime governing space resource mining.

5.12 Conclusion

It should be kept in mind that not all factors required to establish a legal regime for space resource mining have been considered in this Chapter.⁷⁴² Other things that must be considered are: the exploitation of lunar resources for the benefit of all mankind; a liability section; organs of the ISA, along with their obligations and duties; the application procedure for a space resource mining licence; the submission of the exploitative working plan; what the license should contain, etc.

Additionally, the legal regime does not have to include everything that is considered in this chapter, although the legal regime proposed will promote legal certainty among nations and private entities and stimulate them to devote their resources to the utilisation of the natural materials of outer space.⁷⁴³

As the era of space resource mining comes closer, it is vital to have a legal regime, along with a dispute settlement mechanism governing this activity to ensure the safe, orderly and peaceful development of space resource mining.⁷⁴⁴

⁷⁴¹ Tronchetti (n 2) 278, 281.

⁷⁴² For more detail on other factors of a possible legal regime for space resource mining, see Tronchetti (n 2) 233-285.

⁷⁴³ Coffey (n 517) 147; Goh (n 1) 158; Tronchetti (n 2) 238.

⁷⁴⁴ Coffey (n 517) 147.

Chapter 6: Conclusion

Space resource mining may be one of the most fascinating future developments in the field of space law and space related activities.⁷⁴⁵ In addition to this, space resource mining is expected to contribute to the improvement of living conditions on Earth and with the Earth's environment.⁷⁴⁶ Moreover, the exploitation of natural resources in outer space will also contribute to industrial, financial and political interests, which will, in turn, lead to the fact that a legal regime is needed to regulate this activity.⁷⁴⁷ Consequently, a set of rules that governs and regulates how the exploitation of outer space resources may be carried out will guarantee the safe, orderly and peaceful development of space resource mining.⁷⁴⁸

Additionally, the need for a new legal regime arises from the fact that no rules regarding space resource mining exist in the current space law regime.⁷⁴⁹ The term 'exploitation' is not used in the Outer Space Treaty, and much less any reference to the possibility of mining outer space resources. However, the opposite can be said about the Moon Agreement, whose main purpose is to set out rules for mining outer space resources. Even so, the Moon Agreement lacks ratification from the space-faring nations.⁷⁵⁰ Therefore, these treaties risk the possibility that space resource mining will be disorderly, uncertain and cause tension among the private and public entities involved.⁷⁵¹ Thus, a specific legal regime is needed.⁷⁵² For this reason, this study suggests that a legal regime must be established to regulate space resource mining.⁷⁵³

Furthermore, specific attention was given to two elements.

⁷⁴⁵ Tronchetti (n 2) 287.

⁷⁴⁶ n 745 above.

⁷⁴⁷ n 745 above.

⁷⁴⁸ Coffey (n 517) 147; Tronchetti (n 2) 287; Zell (n 11) 518.

⁷⁴⁹ Feinman (n 497) 220; Tronchetti (n 2) 287; Zell (n 11) 518.

⁷⁵⁰ Tronchetti (n 2) 287.

⁷⁵¹ n 750 above.

⁷⁵² n 750 above.

⁷⁵³ See Chapter 5 for a discussion of a new legal regime.

Firstly, there is the need to preserve the validity of the existing space law principles, because the existing principles have guaranteed the peaceful and safe development of space activities in the last 50 years.⁷⁵⁴ Furthermore, space activities have grown significantly and have generally benefitted all, which is in line with the existing space law principles thanks to the acceptance and implementation of these principles by states.⁷⁵⁵ Hence, these principles should keep playing a vital role in the future space resource mining period.⁷⁵⁶

Secondly, the need to stimulate the participation of space-faring nations and private investors in space resource mining, as well as their acceptance of a legal regime through an internationally proposed agreement is of paramount importance.⁷⁵⁷ Additionally, the capital and technology to be able to mine space resources must come from states and private investors and without them space mining will never take place. Therefore, the governing rules of space resource mining must be appealing to those investors, as well as providing them with the possibility of making a profit from exploiting space resources.⁷⁵⁸

If these two factors can be balanced it will result in a successful legal regime which will stimulate a wide acceptance by states and private investors.⁷⁵⁹

The space resource mining legal regime should take the form of an international treaty.⁷⁶⁰ Many space-faring nations, like the US, have declared that they are not interested in entering into negotiations for a new space treaty. However, the establishment of a new legal instrument to govern space resource mining is clearly the most practical solution to warrant enforceability and to force states to respect it while working in outer space.⁷⁶¹

For example, a UNGA Resolution will not suffice, for, although it has significant political value, it still does not enjoy legal value compared to that of an international

⁷⁵⁴ Tronchetti (n 2) 287-288.

⁷⁵⁵ n 754 above, 288.

⁷⁵⁶ n 754 above, 288.

⁷⁵⁷ n 754 above, 287-288.

⁷⁵⁸ Leterre (n 1) 8; Tronchetti (n 2) 288.

⁷⁵⁹ Tronchetti (n 2) 288.

⁷⁶⁰ n 759 above, 289.

⁷⁶¹ n 759 above, 289.

convention.⁷⁶² Although states want a UNGA Resolution rather than a treaty, such a resolution will miss that meticulous attention to detail that is vital to ensure the safe and orderly development of space resource mining.⁷⁶³

Furthermore, the feasibility of such a proposal in terms of cost and time is a concern.⁷⁶⁴ For example, the establishment and the functioning of the ISA would possibly be an expensive task to upkeep.⁷⁶⁵ Similarly, states might possibly not be willing to accept a new set of rules that govern space resource mining or the negotiations for the new space resource mining agreement within the context of UNCOPUOS will take too long.⁷⁶⁶

In contrast to this, the cost for managing ISA could be reduced by making it a virtual organ without a permanent location, one which would become operational only in case it was needed.,⁷⁶⁷ for example, when a mining plan is submitted. Furthermore, the meetings of the ISA could be virtual and through telecommunication technologies, which will reduce the traditional costs such as flight tickets, accommodation and so forth.⁷⁶⁸ Moreover, this would help to eliminate a large amount of bureaucracy that would be required to enable the ISA to function.⁷⁶⁹

In addition, a future legal regime might sound promising to operators and investors that are interested in space resource mining, even though international treaty debates can be a problematic time-consuming process owing to the issue of attaining consensus among negotiation parties or because of the fact that some nations may not be open to a new legal regime at all.⁷⁷⁰

Furthermore, the future legal regime will allow states to gain property rights over mined ore to use for scientific or non-scientific purposes, which will be beneficial for developed states and private entities.⁷⁷¹ Developing states that do not have the

⁷⁶² Feinman (n 497) 220-221; Tronchetti (n 2) 289.

⁷⁶³ Tronchetti (n 2) 289.

⁷⁶⁴ n 763 above.

⁷⁶⁵ n 763 above.

⁷⁶⁶ n 763 above.

⁷⁶⁷ Coffey (n 517) 136; Tronchetti (n 2) 289.

⁷⁶⁸ n 767 above.

⁷⁶⁹ Larsen (n 517) 325; Tronchetti (n 2) 289.

⁷⁷⁰ Tronchetti (n 2) 290; Yun (n 78) 334.

⁷⁷¹ Coffey (n 517) 147; De Gouyon Matignon (n 495) 139; Tronchetti (n 2) 290.

financial and technical capabilities to mine space resources will also benefit from a segment of the future legal regime.⁷⁷² For example, they will benefit through subjects applying for a space resource mining licence, which will be required to include solutions to enable and stimulate international participation in the proposed mining mission.⁷⁷³ For this purpose it will be regulated by the ISA, which will help guarantee the orderly development of space mining and provide a fair opportunity for all to participate in the activity.⁷⁷⁴

Finally, the time for mining space resources has arrived; it has to be hoped that states will fully understand the importance and benefits that can be derived from exploiting natural resources of outer space along with the fact that such exploitation cannot succeed without specific legal rules.⁷⁷⁵

⁷⁷² Coffey (n 517) 147; Tronchetti (n 2) 290.

⁷⁷³ Tronchetti (n 2) 290.

⁷⁷⁴ n 773 above.

⁷⁷⁵ Feinman (n 497) 235; Larsen (n 517) 326; Tronchetti (n 2) 290; Yun (n 78) 330-331.

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