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What's mine is yours.

– Asteroid mining in outer space and the principle that exploration and use of Outer Space shall be carried out for the benefit and in the interest of all countries and shall be the province of all mankind.

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Contents

Abstract

Mining in outer space has in recent years emerged as a real possibility. Private companies are at the forefront of developing new technology to achieve the exploitation of resources in outer space. The legal conditions are still a barrier because of that the large space treaties do not expressly prohibit or allows such a venture. The problem surrounding this type of mining has materialized even more when the United States in November of 2015 adopted a new law which entitles US citizens (both natural and legal) rights to own, posses, transport and sell space- and asteroid resources.

This essay has thus tried asteroid mining under this new US law in relation to The Outer Space Treaty to which the US is bound, mainly on the basis of its first two articles. This treaty represents the cornerstone of international space law and its principles are decisive when assessing a space activities legality. The main principles tried in this essay on asteroid mining are the principles of use of space in the benefit of and interest of all countries, the non-appropriation of space and that outer space is the province of all mankind. In order to answer whether the new US law is contrary to these principles, I have interpreted what the principles mean by treaty interpretation but also by making allegories to other similar areas such as mining on the deep seabed on the Antarctic as well as the prolonged use of outer space through satellite operations in the geostationary orbit with the help of the works of distinguished commentators. Based on these interpretations, I conclude that the new legislation is not in itself a breach of America's international agreements but the application of said legislation may cause problems. My conclusion is that the purpose of mining will affect the legality of the venture. A mining operation whose purpose is consistent with the benefit principle will be judged on a milder basis regarding if its action is an appropriation of Outer Space.

Sammanfattning

Gruvdrift i yttre rymden har under de senaste åren vuxit fram som en reell möjlighet. Privata företag ligger i bräschen med att utveckla ny teknik för att uppnå utnyttjandet av resurser i yttre rymden. De rättsliga förutsättningarna är fortfarande ett hinder för sådana aktiviteter då de stora rymdfördragen inte uttryckligen förbjuder eller tillåter det. Problemet kring denna typ av gruvdrift har aktualiserats än mer då USA i november 2015 antog en ny lag där de berättigar amerikanska medborgare (både fysiska och juridiska) rätt till att äga, inneha, transportera och sälja rymd- och asteroidresurser.

Denna uppsats har därmed prövat gruvdrift på asteroider under denna nya amerikanska lagstiftning i förhållande till Rymdfördraget, till vilken USA har förbundit sig, främst utifrån dess två första artiklar. Detta fördrag utgör grunden för den internationella rymdrätten och dess principer är avgörande vid bedömningen av en rymdverksamhets laglighet. Principerna som huvudsakligen testas i denna uppsats i förhållande till om asteroidgruvdrift är tillåtet är: principerna om fri användning av rymden till nytta och intresse för alla länder, förbudet mot beslag av yttre rymden och att ”outer space is the province of all mankind”. För att svara på om den nya amerikanska lagen strider mot dessa principer, har jag tolkat vad principerna innebär. Detta har jag gjort genom fördragstolkning men även genom allegorier till andra liknande områden, så som gruvdrift på djuphavsbotten och på Antarktis samt långvarigt användande av yttre rymden genom placerandet av satelliter i den geostationära omloppsbanan med hjälp av stöd i doktrin. Baserat på dessa tolkningar drar jag slutsatsen att den nya lagstiftningen i sig inte är i strid med USA: s förpliktelser under Rymdfördraget, men tillämpningen av denna lagstiftning kan orsaka problem. Min slutsats är att syftet med gruvdrift kommer att påverka dess lagenlighet. En gruvdrift vars syfte är förenligt med principen om att vara till nytta för alla länder kommer att bedömas på en mildare basis sett till om verksamheten är otillåtet beslagtagande av yttre rymden.

Abbreviations

COPUOS	Committee on the Peaceful Uses of Outer Space
ICJ	International Court of Justice
IISL	International Institute of Space Law
OST	Outer Space Treaty
UNCLOS	United Nations Convention on the Law of the Sea

1 Introduction

1.1 The problem

In recent years, the prospect of asteroid mining has become feasible. In November of 2015 the President of the United States of America Barack Obama signed a new act, "US. Commercial Space Launch Competitiveness Act" whose section 402 contains an amendment to an earlier space act which reads:

"A United States citizen engaged in commercial recovery of an asteroid resource or a space resource under this chapter shall be entitled to any asteroid resource or space resource obtained, including to possess, own, transport, use, and sell the asteroid resource or space resource obtained in accordance with applicable law, including the international obligations of the United States."[1]

This spurs on the development of the Space industry and gives potential investors a higher degree of clarity in the legal standings of such ventures. However there is some controversy to this section of the Act whether it actually complies with the international obligations to which the United States is a part of, in essence the Outer Space Treaty[2]. The signing of the act has gathered attention both from media, the international community and commercial interest. The legal issues of conducting mining on celestial bodies are however in need of clarity to secure the lawful use of outer space since the US view of what restrictions their international obligations imposes on asteroid mining may differ from the view of the international community.

[1] U.S. Commercial Space Launch Competitiveness Act sec **51302**

[2] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies (the "Outer Space Treaty"), 610 U.N.T.S. (entered into force 10 October 1967).

1.2 The purpose of the essay

The purpose of this essay is to assess the compliance of commercial asteroid mining under the new US Space Act Title IV with articles I and II of the Outer Space Treaty.

1.3 Questions

- Is the "US. Commercial Space Launch Competitiveness Act" Title IV in compliance with articles I and II of the Outer Space Treaty?

- What legal status and meaning have articles I and II of the Outer Space Treaty?

- Is commercial asteroid mining permitted under the legal regime of the Outer Space Treaty?

1.4 Delimitations

There are many interesting questions in the field of Space Law but due to limitations of time and space this essay will focus on the newly enacted American space act regarding commercial space activities. The part of the act that is of importance to asteroid mining is Title IV, which is the one I am going to examine. I will assess this act's compliance with binding international space law. The emphasis of this essay is placed on the principles regarding use contra appropriation of celestial bodies found in the outer space treaty.

1.5 Method and perspective

The methodology used in this essay is an interpretive one with much use of the method of interpretation found in "The Vienna Convention on the Law of Treaties" articles 31-33. By interpreting the legal documents governing

the field of space law and supporting my arguments with work published by legal scholars I try to resolve an issue of what the actual law is and what the Outer Space Treaty regulates regarding commercial space mining. I have also made allegories to mining on the deep seabed, mining on Antarctica and the use of satellites in the geostationary orbit. These examples are valuable since they show examples of how the international community have handled matters of mining in extreme areas as well as prolonged commercial use of outer space.

My perspective is one of how international commons should be managed in relations to commercial enterprise.

1.6 Research standing

Since issues related to mining in outer space are gaining more and more attention, the academic publications are increasing[3]. Asteroid mining and its regulation are at the forefront of space law research with a general inclination amongst commentators considering the activity legal, but with many practical difficulties to resolve.
The leading author on space mining issues is Doctor Fabio Tronchetti[4] but Doctor Ricky J. Lee is also noteworthy whit his "*Law and Regulation of Commercial Mining of Minerals in Outer Space"*[5].

[3] See for example Kelly M. Zullo, 'The Need To Clarify The Status Of Property Rights In International Space Law' (2002) 90 Georgetown Law Journal ;
Henry R. Hertzfeld and Frans G. von der Dunk, 'Bringing Space Law Into The Commercial World: Property Rights Without Sovereignty' (2005) 6 Chicago Journal of International Law ;
René Lefeber, 'Relaunching The Moon Agreement' (2016) 41 Air & Space Law.
[4] See for example Tronchetti, Fabio, 'Title IV – Space Resource Exploration and Utilization of the US Commercial Space Launch Competitiveness Act: A Legal and Political Assessment'. Air & Space Law 41, no. 2 (2016): pp. 143–156.
[5] Lee, Ricky J., Law and Regulation of Commercial Mining of Minerals in Outer Space [E-book], Springer Netherlands, 2012.

1.7 Sources of information

With the UN space treaties as primary sources, I have furthered my research with a number of publications by distinguished commentators. I have used books such as *"Handbook of Space Law"*[6] and articles as "*Aspects of the International Legal Regime concerning Privatization and Commercialization"*[7]. The articles are from journals with serious editorial processes but I note that Georgetown Journal solicits articles[8], which might affect the author's bias. However, Oduntan has expressed similar views in other circumstances[9] making it unlikely that he wrote an article to fit with Georgetown Journal's desired view of the new Space Act. I have also used other international treaties as well as documents originating from the UN.

1.8 Disposition

I begin this essay by introducing the purpose of this essay and in which way I have operated to achieve my result. In chapter two, I briefly describe the development of space law and an overview of the legal body of this field. I deepen the presentation of the legal body in chapter three, where I examine Space law applicable to asteroid mining and exemplify purposes of asteroid mining put forward by two American space enterprises. In chapter four, I discuss other legal issues similar to asteroid mining to further my arguments. In chapter five, I draw conclusions from my research. I reach the conclusion that space mining that leaves the resources in outer space is more likely to gain acceptance under the provisions of the Outer Space Treaty than space mining that brings back resources to earth for resale.

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[6] Dunk, Frans G. von der & Tronchetti, Fabio (red.), Handbook of space law, 2016.
[7] Oduntan, Gbenga, 'Aspects of the International Legal Regime concerning Privatization and Commercialization'. Georgetown Journal of International Affairs 17, no. 1 (Spring2016): pp. 79-90.
[8] http://journal.georgetown.edu/about-us/editorial-process/ last assessed 18 May 2016.
[9] http://www.espi.or.at/images/stories/dokumente/Presentations_2016/Space_Mining/GBENGA_ODUNTAN.pdf pp. 24, 29–34; presentation held at the Space mining seminar held by the European Space Policy Institute on 13th April 2016.

2 The development of Space Law

Nowadays it is difficult to distinguish science from science fiction. As technology develops, the final frontier gets closer and closer. Since the start of the Space Age, considered to begin with the launch of the Soviet satellite Sputnik in 1957[10], much have been achieved. Manned missions to outer space, the moon landings and the establishment of the International Space Station (ISS) are amongst these achievements.

The field of International Space law has its origins around the time of Sputnik. Since the US and the USSR both had great space ambitions the need for international agreements became evident.[11] Space law was developed in the UN, by the first temporary and latter permanent UN Subcommittee called "The Committee on the Peaceful Uses of Outer Space (COPUOS)"[12] which made it a new field of International Public Law. Therefore, its legal sources are in conformity with the ones found in the International Court of Justice's statue art 38 1a-d[13]. For international space law the sources are therefore treaties, customary international law, general principles of law and the teachings of highly skilled commentators.

Discussions in COPUOS eventually lead to the first space treaty "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies" called the Outer Space Treaty (OST) [14]. The OST, was drafted and ratified during the cold war and during this time it was unthinkable for private enterprises to

[10] Nyman Metcalf, Katrin, Activities in space - appropriation or use*?* (1999) pp. 47–48.
[11] Dunk, Frans G. von der & Tronchetti, Fabio, Handbook of Space law, pp. 2–3.
[12] Ibid. pp. 10–11.
[13] Statute of the International Court of Justice, (entered into force 24 October 1945), Article 38.
[14] Nyman Metcalf, Katrin, Activities in space - appropriation or use*?* p. 128.

operate in space, both due to technological barriers as well as political (in US.S.R there were no private enterprise)[15]. Therefore, the OST gives little direction in the legality of private enterprise in outer space. Subsequent three UN treaties laid the legal framework for the issues of liability[16], registering[17], and rescue of space objects and astronauts[18] but none on the fact of space mining. That is until the drafting of the Moon treaty, which addresses this question in a forward-looking way by stating that when such activities are feasible an international regime regulating these issues should be drafted[19]. The problem with this treaty is its low number of ratifications and its lack of spacefaring nations[20].
With resource exploitation in space now drawing closer the need for clarity on these issues is even larger.

COPUOS continues to have a central role in the development of space law, even though the drafting of treaties have reached a standstill. The committee consists of two sub-committees, the technical and the legal one. It has 77 members and they hold annual sessions where issues of space are discussed and reports to the General Assembly are drafted.[21] So far they have not produced much clarity regarding space-mining issues but on its 2016 session the committee agreed on making utilization of space resources an item on the agenda for next year's session[22].

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[15] Lee, Ricky J., Law and Regulation of Commercial Mining of Minerals in Outer Space pp. 95–96.
[16] Convention on the international liability for damage caused by space objects (the "Liability Convention"), 961 U.N.T.S. (entered into force 1 September 1972).
[17]Convention on registration of objects launched into outer space (the "Registration Convention), 1023 U.N.T.S. (entered into force 15 September 1976).

[18] Agreement on the rescue of astronauts, the return of astronauts and the return of objects launched into outer space (the "Rescue Agreement"), 672 U.N.T.S (entered into force 3 December 1968).
[19] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (the "Moon Treaty), 1363 U.N.T.S. (entered into force 11 July 1984) Article 11.
[20] Status of International Agreements relating to activities in outer space as at 1 January 2016 A/AC.105/C.2/2016/CRP.3.
[21] http://www.unoosa.org/oosa/en/members/index.html ; http://www.unoosa.org/oosa/en/ourwork/copuos/index.html (last assed 21 May 2016).
[22] Committee on the Peaceful Uses of Outer Space, Legal Subcommittee, Fifty-fifth session, Vienna, 4-15 April 2016, Draft report, XVI paragraph 20.

The five space treaties were drafted in the form of a framework, which needs national regulation to fulfil their purpose[2324]. The US has a brooding Space Industry with companies such as Deep Space Industries[25] and Planetary Resources[26]. Their need for regulation and clarity in property issues have somewhat been met at the end of last year.

On the 25th of November in 2015, President Barack Obama signed an act that grants American citizens property rights over extracted space resources. Questions remain whether the progressive passage of the act, Title IV, complies with the OST of whom the US is a State Party. The Act can have difficulties concerning the principles regarding use and appropriation of outer space found in articles I and II of the OST, which are articles that governs the field of International Space Law.

[23] Nyman Metcalf, Katrin, Activities in space - appropriation or use*?* p. 21.
[24] "Schematic overview of national regulatory frameworks for space activities" Uses of Outer Space, Legal Subcommittee, Fifty-third session Vienna, 24 March-4 April 201 4 Item 8 of the provisional agenda*.
[25] https://deepspaceindustries.com/.
[26] http://www.planetaryresources.com/.

3 Asteroid mining in outer space

3.1 The legal framework

As mentioned in the chapter above, the field of space law consist of five well-known international treaties, called the space treaties, as well as UN resolutions, called the space principles, and substantial amounts of national regulations and bi-party treaties[27]. I am going to focus on the Outer Space Treaty since its articles can be interpreted in relation to space mining. The Moon Treaty, as previously mentioned, is not binding on the US and is not perceived to represent customary international law[28]. To be more precise the OST has 104 ratifications, including all space faring nations, while the Moon treaty only has 16 ratifications none of them from space faring countries[29]. I am going to compare this framework of the OST with the new American act.

3.1.1 US. Commercial Space Launch Competitiveness Act

Chapter IV of the new Space Act regarding resource extraction, also called "Space Resource Exploration and Utilization Act of 2015", has caused a lot of stir internationally[30]. In its section 402 it proposes an amendment to an earlier space act. In this amendment, section 51301 defines space and asteroid resources and section 51302 entitles American citizens (companies

[27] Dunk, Frans G. von der & Tronchetti, Fabio, Handbook of Space law pp. 106–108.
[28] See for example Ibid. p 788.
[29] Status of International Agreements relating to activities in outer space as at 1 January 2016 A/AC.105/C.2/2016/CRP.3.
[30] See for example https://www.theguardian.com/science/2015/nov/13/congress-claims-space-resource-rights-for-americans-to-exploit-new-frontier.

included) the right to sell, use, posses, transport and own such resources. This right shall however be exercised under national and international law.[31] The act also includes a disclaimer of extraterrestrial sovereignty in section 51303. With this section the American lawmakers wanted to assure the international community that they aren't intending to nationally appropriate outer space.[32]

The International Institute of Space Law (IISL), which is a non-governmental organization that gathers experts in the field of Space Law from many countries[33], stated a position paper on the new American space act. The paper stated that the interpretation made by America in Title IV is one of different possible interpretations of the Outer Space Treaty[34]. However it notes that the validity of this new passage is dependent on the reception of other countries[35]. In the COPUOS session of 2016 these questions were partly discussed under the agenda items "general exchange of views" and "Status and application of the five United Nations treaties on outer space"[36].

Americas way of unilaterally affecting international space law was meet with critique from certain delegates of the COPUOS 2016 session[37]. They made their discontent clear, for example by the following statement:
"The view was expressed that the unilaterally enacted national legislation of a particular State that protected private property rights in resources extracted from the Moon or other celestial body represented a reversal of the

[31] U.S. Commercial Space Launch Competitiveness Title IV section 402.
[32] Ibid.
[33] http://www.iislweb.org/about.html
[34]See, International Institute of Space Law (IISL) position paper on space resource mining available at http://www.iislweb.org/html/20151220_news.html (last accessed May 16, 2016).
[35] Ibid p. 3.
[36] Committee on the Peaceful Uses of Outer Space, Legal Subcommittee, Fifty-fifth session, Vienna, 4-15 April 2016 Draft report, B, paragraph 3.
[37] Committee on the Peaceful Uses of Outer Space, Legal Subcommittee, Fifty-fifth session, Vienna, 4-15 April 2016 Draft report 'IV. Status and application of the five United Nations treaties on outer space' paragraphs 21–30.

negotiation position of that State at the time of the negotiation of the Moon Agreement in the Committee and its adoption by the General Assembly"[38].

3.1.2 The Outer Space Treaty

The OST is the cornerstone of international space law. Central articles for the purpose of this essay are article I about principles of how the use and exploration of outer space shall be conducted and article II about the non-appropriation principle. As mentioned earlier the treaty is mostly silent on matters regarding private actors in space, however commentators have interpreted the above-mentioned articles to encompass private enterprise[39]. As earlier mentioned, the IISL's position paper stated that the US act is a possible interpretation of the OST[40]. However, other scholars have opposing opinions. One example is law professor Gbenga Oduntan that finds the new act to breach international law and expresses the opinion that asteroid mining is banned by the OST for any other purposes than scientific research[41].

What is clear, is that a state party is responsible for all activities conducted in space by its nationals and shall provide licensing and supervision according to article VI of the OST. The provisions in said article are further developed in the registration[42] and liability[43] conventions, which the US has ratified. This means that the United States is responsible for not letting its nationals breach the principles of the OST.

[38] Committee on the Peaceful Uses of Outer Space, Legal Subcommittee, Fifty-fifth session, Vienna, 4-15 April 2016 Draft report 'IV. Status and application of the five United Nations treaties on outer space' paragraph 22.
[39] See for example Nyman Metcalf, Katrin pp. 282–284.
[40] See, International Institute of Space Law (IISL) position paper on space resource mining p. 3.
[41] Oduntan, Gbenga, 'Aspects of the International Legal Regime concerning Privatization and Commercialization'. Georgetown Journal of International Affairs 17, no. 1 (Spring 2016): pp. 82-83.
[42] Convention on registration of objects launched into outer space ("The Registration Convention"), 961 U.N.T.S. (entered into force 15 September 1976).
[43] Convention on International Liability for Damage Causes by Space Objects ("The liability Convention"), 1023 U.N.T.S. (entered into force 1 September 1972).

I will therefore continue by presenting interpretations of the principles found in articles I and II of the OST and contributing with my views. The method used is the one stated in articles 31-33 of the Vienna Convention on the law of Treaties (VCLT)[44].

3.1.2.1 Article I

The Outer space treaty 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**, irrespective of their degree of economic or scientific development, and shall be the **province of all mankind.***

*Outer space, including the moon and other celestial bodies, shall be **free** for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.*

There shall be freedom of scientific investigation in outer space, including the moon and other celestial bodies, and States shall facilitate and encourage international co-operation in such investigation **(**emphasis added)".

For matters of clarity I will begin by interpreting what *exploration* and *use* means, then *benefit* and *interest of all countries* and finally *province of all mankind*.

3.1.2.1.1 Exploration and Use

The freedoms of exploration and use are limited by both section 1 of article I and by article II of the OST. The activities considered as use and

[44] Vienna Convention on the Law of Treaties, UNTS 1155 (entered into force 27 January 1980). Articles 31-33.

exploration would likely be any activities conducted in outer space, and the question if they are lawful or not follows by the other articles in the OST. There is no further need to distinguish what is use and what is exploration in an asteroid mining session as both shall follow the benefit and interest provisions.[45] The rights given to American citizens by the Space Resource Exploration and Utilization Act of 2015 are definitely under the scope of use/exploration. This leads me to the interpretation of benefit and interest.

3.1.2.1.2 Benefit and interest of all countries

The meaning of the provision in article I of the OST that exploration and use shall be conducted in the benefit of and in the interest of all countries is not clear. Lee presents different views of how to interpret to what extent this provision is binding and he concludes that there is no real consensus but there is an inclination that the provision should be regarded more as a general mission statement for a space activity[46].

The early space commentator Gorove has by means of interpretation reached the conclusion that the provision of benefit and in interest of all countries is achieved by something generally beneficious in a broad sense, thus making it fairly easy to comply with[47]. Nyman means that a broader knowledge of outer space is beneficial for mankind[48] and exploration and use of space that achieves this it compliant with said provision.

My proposed interpretation by means of article 31 of VCLT of using the common meaning is that *benefit* shall in some way put all countries in a better position than they were before, since the normal meaning of benefit is to gain something. This can for example be achieved in the way that an exploration or use facilitates future exploration and use of space by others, since passing of knowledge is beneficial.

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[45] Lee, Ricky J., Law and Regulation of Commercial Mining of Minerals in Outer Space p. 164.
[46] Ibid. p. 157–159.
[47] Stephen Gorove, 'Freedom Of Exploration And Use In The Outer Space Treaty' (1971) 1 DENVER J. INT'L. L. & POL'Y, p.101.
[48] Nyman Metcalf, Katrin, Activities in space - appropriation or use*?* p. 164.

A beneficial use is therefore one that one that put States in a general better condition. For example the construction of space objects from asteroid resources would consist of a beneficial use according to my interpretation. This type of use is of a capacity building nature, lowering the thresholds for future space exploration. The sale of these objects and resources in space are therefore beneficious for the vendor, buyer, and other countries that in the future will be able to reap the fruits of these creations.

Interest of all countries is according to me even vaguer than the provision of benefit. The normal meaning of interest is involvement. By using this I interpret that the provision is meet if the space activity is performed in such a way that it doesn't hinder the involvement of other countries in a similar activity, and that it is the end goal of the activity that shall be considered which is a view shared by Nyman[49].

Ownership of space resources can be considered a use of space. Therefore it must comply with the provisions of article I of the OST.
Moon rocks harvested by the US and Soviet have previously been brought down to earth. The commentator Zullo sees the fact these States had possession over space resources as an expression of customary international law that grants ownership rights over resources harvested from outer space.[50]
However, these resources were used for scientific purposes and the US and Soviet also traded lunar samples between them for research purposes[51]. This is clearly a use of a beneficial nature.
In Russia some of these rocks have been auctioned to the public[52], but this does not in a clear way make private ownership of such resources on earth

[49] Nyman Metcalf, Katrin, Activities in space - appropriation or use*?* p. 169.
[50] Kelly M. Zullo, 'The Need To Clarify The Status Of Property Rights In International Space Law' p. 2432.
[51]Pop, Virgiliu, Who owns the moon? [E-book], (2009) p. 141.
[52] Ibid.

part of customary international law[53]. My interpretation is therefore that the ownership of asteroid resources must follow the same principles as others uses of space, and that it is the end goal that shall be assessed. The ownership and use of asteroid resources must therefore be beneficial for all countries.

3.1.2.1.3 Province of Mankind

The province of mankind principle is not very clear from the treaty text. A proposed interpretation is that the principle is similar to that of *res communis*. *Res Communis* is a legal term for the status of a territory that is for all to use without making claims of sovereignty. Therefore members of the outer space treaty should be free to use space as they like unless there are specific prohibitions or regulations. Space as a *res communis* is limited by its provisions of interest and benefit of all countries as well as the non-appropriation principle in article II.

Von der Dunk draws the line between the principle province of mankind and the principle of common heritage of mankind (CHM) by stating that while freedom of use is the legal starting point of a res communis/province of all mankind, the opposite rules under a CHM-regime where lack of regulation prescribas a ban of use.[54]

3.1.2.2 Article II

Article II of the OST reads as follows:

"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."[55]

[53] Tronchetti, Fabio, 'Title IV – Space Resource Exploration and Utilization of the US Commercial Space Launch Competitiveness Act: A Legal and Political Assessment' pp. 151–152.
[54] Dunk, Frans G. von der & Tronchetti, Fabio, Handbook of Space Law pp. 55–60
[55] Outer Space Treaty, Article II.

The space lawyer Pop presents different views of this non-appropriation principle in his book "*Who owns the moon?",* and according to him some authors mean that the principle only bans national appropriation of outer space and celestial bodies and not private appropriation. Others however make the valid argument that a country can not grant a better right to an individual in the field of international law than the one the country itself has.[56] I share this view, which is also consistent with the fact that States bear international responsibility[57] for their nationals' acts in space and they shall therefore not allow breaching of the OST's principles. This leads to the conclusion that appropriation of celestial bodies should be considered unlawful regardless if done by a State or a private entity.

What does appropriation mean under this article?
Nyman expresses the view that an appropriation in the sense of the OST is either by making a claim of sovereignty, or by using/occupying a position in space in a way that prevents anyone else from accessing it[58].
The next problem is therefore to draw a line between use and appropriation. Nyman proposes that use can stretch out over a significant period of time without being considered an appropriation as long as no claims to sovereignty or exclusivity are made. The use must also respect the provisions in article I to not infringe on the rights of others to freely use and/or explore the celestial body. Extended uses on the verge of amounting to an unlawful appropriation can be considered permissible because of its compliance with the principles of use in art I of the OST according to Nyman.[59] According to this view establishing a mining base on as an asteroid would not per se be regarded as an unlawful appropriation "by means of use or occupation, or by any other means"[60].

[56] Pop, Virgiliu, Who owns the moon? pp. 63–65.
[57] Outer Space Treaty, Article VI.
[58] Nyman Metcalf, Katrin, Activities in space - appropriation or use*?* p. 165, 169.
[59] Nyman Metcalf, Katrin, Activities in space - appropriation or use*?* (1999) p. 169–170.
[60] Outer Space Treaty, Article II.

Can asteroid resources be appropriated?

One view is that since there can be no national sovereignty in outer space there cannot exist private property rights. Therefore appropriation of asteroid resources cannot be achieved, the resources should be considered part of the *res communis* even in an extracted form.

Another view is that the resources are in fact *res communis* while *in situ* (on /in the celestial body) but appropriable once extracted regardless of there not being any national sovereignty, comparable to how fish brought up from the high seas can be subject to private ownership without there being a sovereign country ruling the place.[61]

The articles I and II should be read together[62], since article I puts forwards principles that penetrates all use and exploration of space. From this I interpret that ventures of exploration and use of space which benefits/are in the interest of all countries are considered more favorably than those whose sole purpose are private profit.

Therefore, resource extraction with plans of resale on earth should be considered differently than extractions with the intention of usage in space. It is true that in a way planet earth gains resources, but it mainly benefits the vendor and the buyer. These resources could then be used any way the buyer would like, while in the situation of the resources being sold in space their use would be governed by the principles of the OST. It is hence my belief that the purpose and goals of a commercial space venture should be considered when assessing its legal status.

[61] Pop, Virgiliu, Who owns the moon? pp. 74–75.
[62] Nyman Metcalf, Katrin, Activities in space - appropriation or use*?* p. 166.

3.2 Purpose of asteroid mining

The mission of asteroid mining is harvesting valuable resources in outer space, primarily water and minerals[63]. Water can be used both in its basic form but can also be separated into hydrogen and oxygen, which are its atomic components. Oxygen can be used for air thanks etc. and hydrogen can be refined into rocket fuel. Water found on asteroids will be a key element to enable waster space exploration and by eliminating the need for space ships to return to earth for refuelling.[64] In regards to the extraction of metals such as ore, one proposed use of Deep Space Industries (DSI) and Planetary Resources is to manufacture space objects in space. This would largely reduce the cost of production compared to assembling and launching a space object from earth out to space. In the long term, resources could be brought back for earthly uses, most likely rare and expensive metals that at some point will be lacking on our planet. The amount of valuable metals located on some near earth asteroids are staggering[65] and ads an incentive to tackle the difficulties of harvesting them.
Lee divides an asteroid mining expedition into various segments, from launching until the final sale on earth[66]. I examine the segments from when the mining starts on an asteroid until the resources are used in space or brought back to earth.

3.2.1 Extraction of resources for use in space

The methods of extracting resources are still under development. The lack of gravity in outer space proposes one problem compared to traditional terrestrial mining. Planetary resources proposes a way of sucking out water from asteroids by engulfing them and then heating them up by solar energy

[63] http://www.planetaryresources.com/asteroids/#harvesting-water ; http://www.planetaryresources.com/asteroids/#mining-delivery
[64] http://www.planetaryresources.com/asteroids/market-for-h2o/
[65] http://www.space.com/19758-asteroid-worth-billions-2012-da14-flyby.html
[66] Lee, Ricky J., Law and Regulation of Commercial Mining of Minerals in Outer Space, p. 10.

to finally expulse the drained asteroid and leaving with a water filled space object.[67] The water could then be used for purposes as mentioned above.

DSI have plans to process the extracted resources into building material for 3D-printing satellites or space stations. These objects could then be sold to other parties engaged in space activities.[68]

3.2.2 Extraction of resources for returning them to earth

The extraction of minerals and metals for transport back to earth could enrich the world materially. Planetary Resources envisions this[69]. With resources not limited to what we can find here on earth, conflicts over scarce resources could be avoided. There are risks that may hinder this utopian outlook. The financial and technological efforts needed to retrieve resources, processing them and bringing them down to earth for sale require a lot of economic muscles[70]. Successful efforts could lead to the creation of large monopolies who would ultimately benefit private corporations and their investors on a much larger scale than earth as a whole. It could bring the opposite than the envisioned general enrichment of planet earth and instead just further the gaps between developed and developing countries. This could therefore consist of a breach of the benefit and interest provision of article I of the OST.

[67] http://www.planetaryresources.com/asteroids/#harvesting-water
[68] https://deepspaceindustries.com/processing/ ;
https://deepspaceindustries.com/manufacturing/
[69] http://www.planetaryresources.com/asteroids/#mining-delivery.
[70] Lee, Ricky J., Law and Regulation of Commercial Mining of Minerals in Outer Space pp. 24-25.

4 Similar issues

4.1 Breaking new ground

Since space law is a young branch of international law and much is yet on a theoretical base, to be able to assess the legality of commercial mining in space I will examine other similar issues that can give guidance on how the international community will react to such a practice. The three regulatory areas I have decided to examine are deep seabed mining, mining on Antarctica and the use of the geostationary orbit. Commentators[71] before me have used these examples to draw conclusions and I find them right to do so. In the two cases of mining regulations they have common ground with asteroid mining in the fact that they regulate the permissibility of extracting resources from a place not subject to sovereignty and which is almost inaccessible. With the case of the regulation of the use of satellites in the geostationary orbit it provides an example of a prolonged use of a position in outer space without it amounting to an unlawful appropriation, which is relatable to the occupation of an asteroid while mining it.

4.2 Deep seabed mining

The prospects of deep seabed mining surfaced in the 1960's[72]. During the drafting process of UNCLOS the controversial concept of common heritage of mankind was brought in to determine the legal status of the deep seabed on the bottom of the high sea. This was a place outside of any national jurisdiction and in the convention it was called "The area"[73]. The developing countries, largely influence by the movement called "New International Economic Order" pushed for the regulation of "The area" and its resources.

[71] See the previously cited works of Tronchetti, Nyman, Pop.
[72] Dunk, Frans G. von der & Tronchetti, Fabio, Handbook of Space Law, p. 793.
[73] United Nations Convention on the Law of the Sea, Montego Bay, done 10 December 1982, entered into force 16 November, Part XI.

By setting up an international organization called "the Authority", responsible for granting permits for mining ventures and assuring that the resources extracted were distributed on a basis of equity the developing nations felt reassured that such ventures would benefit them as well. The Authority would also have a mining operation called "the enterprise" which would conduct mining on its own or in joint ventures and distribute profits to developing countries.[74]
Important to note is that the developed nations were the only actors with real possibilities to execute mining on the deep seabed[75].

The initial convention from 1982 was boycotted by some developed sea faring States with the US voicing concerns of the CHM-principle[76]. Another ten years of negotiations reformed the system of the authority by an amendment[77] to UNCLOS considering its part XI. America signed this convention but has still to ratify it[78].

4.3 Mining on Antarctica

The legal developments of Antarctica begun in the early 1900's when a number of countries made territorial claims over it. These where put on a form of hiatus by the Antarctic Treaty were claims made were neither accepted nor refuted[79]. The contracting parties have latter on entered new agreements resulting in making Antarctica a landmass for scientific exploration and not commercial exploitation. Different events influenced this development but in part environmental considerations and fear of other State Parties making profits brought the countries together to regulate what

[74]Lee, Ricky J., Law and Regulation of Commercial Mining of Minerals in Outer Space pp. 235–236
[75] Dunk, Frans G. von der & Tronchetti, Fabio, Handbook of Space Law, p. 794.
[76] Dunk, Frans G. von der & Tronchetti, Fabio, Handbook of Space Law, p. 794.
[77] Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea of,1836 U.N.T.S. (entered into force provisionally on 16 November 1994 and definitively on 28 July 1996).
[78] https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXI-6-a&chapter=21&lang=en
[79] The Antarctic Treaty, 402, U.N.T.S. (entered into force in 1961) Art IV.

was permitted and not. The result was a total ban of commercial mining on Antarctica.[80]

4.4 The Geostationary orbit

The geostationary orbit runs along the equator and in it an object rotates at nearly the same pace as earth's rotation. Therefore when an object is launched into a geostationary orbital position it will remain almost fixed at the same point relative to earth. The geostationary orbit is therefore highly valued since a satellite placed in one of its orbital slots allows great coverage of a large part of earth.
The use of this orbit, which is limited, is administered by the International Telecommunication Union (ITU) and the orbital slots are distributed by means of applications made to this organization. The slots are then awarded by the first come first served principle.[81]

The regulation and use of the geostationary orbit is a good example of how prolonged use of a location in other space doesn't count as appropriation. There are a large number of private satellites in geostationary orbit which speaks for the idea that such commercial use of outer space is tolerated under the OST. The accepted interpretation of this occupation of the orbital slot is that it is not permanent but can continue on for a very long time as long as it doesn't interfere with other satellites or hinders the access to outer space[82]. According to my opinion it can be argued that the benefit derived from satellites; such as tv-broadcasts, weather prognoses among many other uses makes an otherwise potential unlawful appropriation an accepted use under article I of the OST. This gains support from Nyman who concludes that use/exploration of outer space on the limit of being unlawful can be considered legal if in accordance with the province of mankind principle[83].

[80] Dunk, Frans G. von der & Tronchetti, Fabio, Handbook of Space Law, pp. 805–806
[81] Ibid. pp. 799–802
[82] Nyman Metcalf, Katrin, Activities in space - appropriation or use*?* pp. 224-225, 241.
[83] Ibid. pp. 394–395.

Contrary to my interpretation is the fact that this use of the geostationary orbit is administered by an international organization, and that it could be the international cooperation in combination with the beneficial effects that makes this use of space lawful. Regardless it is still clear that a beneficial aspect of a use of space helps its legal status.

5 Conclusions

The core principles of space law are found in the OST and are the ones regarding free use and exploration of other space and the principle of non-appropriation. In recent years private enterprise have begun their efforts to exploit outer space by means of asteroid mining.

This resource extraction has large economic potential. Prrivate enterprises like DSI and Planetary Resources aiming to harvest asteroids. Their business plans differs but a common goal is to extract water and metals for refinement and further use/sale. These activities are not clearly regulated. Therefore, by interpreting the outer space treaty and looking at customary international law I arrive at the following conclusions.

Title IV of the new American law "U.S. Commercial Space Launch Competitiveness Act" is a possible interpretation of articles I and II of the outer space treaty. The reception of other countries is critical because of the US's choice of unilaterally regulating this controversial issue. The purpose of the venture will likely affect its legality. I reach this conclusion by making an allegory to the acceptance of satellites orbiting the earth, while mining ventures on the deep seabed and on Antarctica have been regulatory impeded. Outer space and its celestial bodies are a sort of *res communis* but with principles limiting the use and extraction of its resources. The principle that space exploration and use shall be for the benefit of and in the interest of all countries shall be read together with other articles of the OST to offer guidance in how they should be interpreted. Therefore this article further strengthens my conclusion that uses of space that otherwise could be considered banned appropriation are allowed as long as they comply with the meaning of article I of the OST.

My interpretation of this article is that it targets use and exploration that furthers countries and mankind's knowledge and possibilities to explore and

use outer space. Therefore, according to my analysis retrieving asteroid resources and using them to aid the further exploration of space can be considered permissible under the OST. To the effect that the Space Act from 2015 entitles US citizens the rights to conduct activities that enhances space exploration the passage is likely compliant with said treaty. However, this section does not differentiate the purposes of using space resources, which can prove to be an issue. The return of space resources for sale on earth can constitute a breach of articles II and I, since the use of these resources are not clearly in the benefit/interest of all countries according to my view. This conclusion has support in how the world community has handled the questions regarding commercial seabed mining and mining on Antarctica.

The opposition of developing countries expressed in COPUOS must be taken into account since a largely unregulated business venture in a place both infinite in its resources, but finite in its accessibility will lead to an unjust distribution of what are common resources. Asteroid mining in its extraction phase is legal under both the Space act and the provisions of articles I and I of the OST but the using phase is more dubious. Therefore, the return and sale of space/asteroid resources in outer space is probably unlawful under the OST. America's new act is therefore both compliant and non-compliant with this treaty when put to practice. I see great value of commercial enterprise in the exploration of outer space but I hope for new international regulation on the use of asteroid and space resources to ensure a just future for space law.

Bibliography

Books

Dunk, Frans G. von der & Tronchetti, Fabio (red.), *Handbook of space Law*, Edvar Elgar publishing, Cheltenham UK, 2016.

Lee, Ricky J., *Law and Regulation of Commercial Mining of Minerals in Outer Space* [E-book], Springer, Netherlands, 2012.

Nyman Metcalf, Katrin, *Activities in space - appropriation or use?* Iustus Förlag, Uppsala, 1999.

Pop, Virgiliu, *Who owns the moon*? [E-book], Springer, Netherlands, 2009.

Journals

Gorove, Stephen, 'Freedom Of Exploration And Use In The Outer Space Treaty' (1971) 1 DENVER J. INT'L. L. & POL'Y 93: pp. 93–107.

Hertzfeld R. Henry and von der Dunk G. Frans, *'Bringing Space Law Into The Commercial World: Property Rights Without Sovereignty'* (2005) 6 Chicago Journal of International Law 83 pp. 81-99.

Lefeber, René, 'Relaunching The Moon Agreement' (2016) Air & Space Law 41, no. 1: pp. 41–48.

Tronchetti, Fabio, 'Title IV – Space Resource Exploration and Utilization of the US Commercial Space Launch Competitiveness Act: A Legal and Political Assessment'. (2016) Air & Space Law 41, no. 2: pp. 143–156.

Oduntan, Gbenga, *'Aspects of the International Legal Regime concerning Privatization and Commercialization'*. Georgetown Journal of International Affairs 17, no. 1 (Spring2016): pp. 79-90.

Zullo M. Kelly, *'The Need To Clarify The Status Of Property Rights In International Space Law'* (2002) 90 Georgetown Law Journal; pp. 2414–2444.

UN documents

Committee on the Peaceful Uses of Outer Space, Legal Subcommittee, Fifty-fifth session, Vienna, 4-15 April 2016 Draft report, B. A/AC.105/C.2/L.298

Committee on the Peaceful Uses of Outer Space, Legal Subcommittee, Fifty-fifth session, Vienna, 4-15 April 2016 Draft report 'IV. Status and application of the five United Nations treaties on outer space' A/AC.105/C.2/L.298/Add.1

Status of International Agreements relating to activities in outer space as at 1 January 2016 A/AC.105/C.2/2016/CRP.3.

https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXI-6-a&chapter=21&lang=en Status of "Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982"

Electronic resources

https://deepspaceindustries.com/
https://deepspaceindustries.com/manufacturing/
https://deepspaceindustries.com/processing/ all last assessed 2016-05-25.

http://www.iislweb.org/about.html assessed 2016-05-25.

International Institute of Space Law (IISL) position paper on space resource mining available at http://www.iislweb.org/html/20151220_news.html last assessed 2016-05-25.

http://journal.georgetown.edu/about-us/editorial-process/ assessed 2016-05-25.

Oduntan,Gbenga, presentation held at the Space mining seminar held by the European Space Policy Institute on 13th April 2016. http://www.espi.or.at/images/stories/dokumente/Presentations_2016/Space_Mining/GBENGA_ODUNTAN.pdf

http://www.planetaryresources.com/
http://www.planetaryresources.com/asteroids/#harvesting-water
http://www.planetaryresources.com/asteroids/market-for-h2o/
http://www.planetaryresources.com/asteroids/#mining-delivery all last assessed 2016-05-25.

Wall, Mike, 'Earth-Buzzing Asteroid Worth $195 Billion, Space Miners Say', Space.com, http://www.space.com/19758-asteroid-worth-billions-2012-da14-flyby.html, last assessed 2016-05-25.

Yuhas, Alan 'American 'space pioneers' deserve asteroid rights, Congress says', The Guardian science, https://www.theguardian.com/science/2015/nov/13/congress-claims-space-resource-rights-for-americans-to-exploit-new-frontier, last assessed 2016-05-25.