

Space Exploitation - Digging in a Legal Vacuum?

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Abstract

History has shown over time that the discovery of new natural resources has always led to a new era of scientific development. With the advent of space exploitation, beyond space exploration, humanity has taken the search for new means of resource extraction one step further into a new era. Asteroids, comets and other celestial bodies, rich in natural resources, are ready to be exploited. The technological capacity for this venture has already been reached. The only question that now remains is who will be the first human (or robot?) to bring back metals to Earth, or which entity will be the first to use water and volatiles from space to build up space bases?

While watching ROSETTA, Europe was woken up to its next challenge to explore the comet Churyumov-Gerasimenko. Already in 2013, the world listened closely as President Obama announced that an asteroid would be retrieved and exploited by the U.S. by 2025. Announcements like these are expected to be put into action by the leading space faring nations and space industries. Technology might be ready for space exploitation, but is society, too? In the long-standing tradition of discovering new natural resources, these discoveries have frequently been followed by long-lasting conflicts. Article 2 of the Outer Space Treaty forbids any claim of national appropriation. Furthermore, Article 11 para 5 of the Moon Agreement states that an international allotment regime is to be established prior to the exploitation of the Moon. This paper elaborates on the idea of providing mining rights with regard to national legislation. In particular, it refers to the Austrian Mineral Exploitation Act which, inter alia, provides for mining rights (on Earth) without claims of appropriation of the mined land.

1 Introduction

Space mining – a real issue?

After the scientific community had discovered that rocky planets, comets and asteroids are composed of valuable natural resources, people started to think about how to exploit these resources. In the early 70s, when the Club of Rome¹ announced its study “The limits to Growth,” with particular

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¹ For further information see <http://www.clubofrome.org/?p=375> (last accessed 10 September 2014).

consideration as to the limits of natural resources on the Earth, the search for new natural resources in space became a serious undertaking.

In the early 90s technology was ready to send space probes to near Earth objects. Most of them were merely designed to orbit natural space objects and take pictures or collect dust. A few probes were designed to land on an asteroid, but only a limited number of probes succeeded. Examples of NASA asteroid exploration projects are: Galileo, NEAR, Deepspace 1, Stardust, Genesis, Hayabusa, Dawn. Europe has its very own success comet mission Rosetta, which successfully landed on Churyumov-Gerasimenko in 2014.²

The In-situ Resource Utilisation Element (ISRU) established at the NASA Marshall Spaceflight centre works on the exploitation of O₂, H₂O, N₂, HE to be used in space for human life support systems and future manned space flight missions to the Moon and to Mars.³

Private initiatives such as Planetary Resources have the ambitious goal to deliver space resources for space missions.⁴

President Obama announced in 2013 his plans to catch an asteroid from the Asteroid belt by 2025.⁵ The asteroid would then be brought to the Moon where it is going to be mined. This project, to be carried out by NASA, can be the initial step towards turning commercial space mining into a serious, real-life issue.

2 Commercial Space Mining And Economic Considerations

A large number of celestial bodies are of high interest to scientific research. For commercial space mining, only a few celestial bodies are noteworthy, in particular those which show the following parameters: One of these parameters is the composition of the celestial body. A good study and estimation of the composition of metals, minerals and other matter is on top of the list of information needed.⁶ The spin rate and microgravity is also a critical indicator for a safe landing on the body.⁷ Human presence in space during a mining mission is also a critical issue and cost driver. However, one of the main cost drivers is propulsion, which thus makes the distance of a celestial body a significant criterion.

² See http://www.esa.int/Our_Activities/Space_Science/Rosetta/Europe_s_comet_chaser (last accessed 10 September 2014).

³ See <http://isru.msfc.nasa.gov/index.html> (last accessed 10 September 2014).

⁴ See <http://www.planetaryresources.com/mission/> (last accessed 10 September 2014).

⁵ See <http://www.reuters.com/article/2013/04/11/us-space-asteroid-idUSBRE93A00F20130411> (last accessed 10 September 2014).

⁶ See Astra – Asteroid mining, Technologies Roadmap, and applications, International Space University Space Studies 2010 Report at 7 https://isulibrary.isunet.edu/opac/doc_num.php?explnum_id=73 (last accessed 10 September 2014).

⁷ Ibid.

Natural resources that could be found on celestial bodies are Oxygen, Calcium, Silicon, Platinum, Helium 2, Titan, and other volatiles.⁸ Additionally, metals such as iron, silver, and gold could be found, albeit depending on the composition of the celestial body.⁹

A mining mission is a long-term mission with different phases ranging from phase 1: Remote sensing of the targeted object, to phase 2: fly-by missions, to phase 3: landing on the object and taking samples. The mined resources can either be used in space to build up space stations and secure human presence in space, or else on the surface of the Earth.¹⁰

3. Legal Aspects

At present, there is no law in force which explicitly refers to space mining. However, a number of treaties will apply to space mining missions. The relevant (space) treaties will be examined in the following sub-chapters.

3.1 Outer Space Treaty (OST)

3.1.1 Freedom of 'Use'¹¹ of Outer Space

Art I OST¹² enshrines the so called 'space freedoms'. Accordingly, the exploration and use of outer space shall be carried out by states without discrimination (Art I para 2). What does this mean for space mining? Since mining is a form of use of outer space, the exploitation of outer space is basically not forbidden under Art I OST.

3.1.2 Space Mining – For the Benefit and in the Interests of all Countries?

According to Art I OST the 'use' of outer space has to be carried out 'for the benefit and in the interests of all countries'. Although this clause which forms part of Article I OST has normative character, it cannot be executed. The benefit and interest of a country are not stagnating factors. Rather, interests and policies of countries tend to change frequently. For example: a number of states that lack the necessary technology to mine may be leaning against space mining right now. This view might be changed if these respective states would at some time in the future develop the capacity to mine in space as well. Therefore, it is legitimate to ask whether it is for the benefit and in the interest of all countries to wait for all states to develop the same capacity to mine, much like runners are waiting at the starting line for their starting signal. This situation should not be for the benefit and in the interest of all

⁸ See Benaroya, *Turning Dust into Gold*, Springer 2010 at 125.

⁹ See *Astra – Asteroid mining* supra fn 6 at 49ff.

¹⁰ *Ibid.* at 23ff.

¹¹ For the freedom of use of outer space in general see S.Hobe in: *CoCoSL*, Vol. 1 at 34f.

¹² *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies*, opened for signature on 27 January 1967, 610 U.N.T.S. 205 (entered into force on 10 October 1963).

countries, since it would promote a boundless race for natural resources. However, the ‘for the benefit and in the interest of all countries clause’¹³ should not be ignored either. Acting for the benefit and in the interest of all countries actually means that no single actor can recklessly exploit outer space, the Moon, and other celestial bodies. As a result, it is indispensable that the exploitation of outer space needs to be clearly regulated.

3.1.3 No claim of Appropriation

Article II OST contains two significant messages and restrictions applicable to space mining. The first half of the sentence claims that outer space, including the Moon and other celestial bodies, is not subject to national appropriation.¹⁴ The first question thus is as to whether asteroids, comets, and other objects are considered ‘celestial bodies’ under Article II OST?¹⁵ There is no legal definition of a ‘celestial body’. A look into a dictionary shows that a ‘celestial body’ is considered a natural object located outside the atmosphere of the Earth, such as the Sun, the Moon, other planets, and asteroids.¹⁶ The answer, therefore, must be ‘yes’: each natural object (no artificial objects such as satellites) outside the atmosphere of the Earth is not subject to national appropriation. However, what does the term ‘national appropriation’ actually indicate? The second half of the single sentence contained in Art II OST provides us the answer. National appropriation occurs ‘by claim of sovereignty, by means of use or occupation or by any other means.’¹⁷

The interpretation of the wording ‘by means of use or occupation or by any other means’ is mainly discussed in this context. The question inherent to the contract language is whether the exploitation and use of natural resources in outer space is generally forbidden under Article II OST.

Space mining - as a form of ‘use’ of outer space is, however, restricted by Art II OST.¹⁸ No physical or juridical person can claim national appropriation of the Moon, outer space, and other celestial bodies. Under Art II OST space mining is not generally forbidden¹⁹ as long as a state including a natural or physical person does not claim sovereignty or property rights of outer space, the Moon, and other celestial bodies. However, the crucial question still

¹³ For the benefit and in the interests of all countries clause in general see S. Hobe in: CoCoSL, Vol. 1, at 38.

¹⁴ For the principle of non-appropriation in general see S. Freeland, R. Jakhu in CoCoSL, Vol. 1 at 44ff.

¹⁵ For further information see R. Lee, Law and Regulation of Commercial Mining of Minerals in Outer Space at 187f.

¹⁶ See http://en.wikipedia.org/wiki/Astronomical_object (latest accessed 10 September 2014).

¹⁷ For further information on Art II OST see S. Hobe, B. Schmidt-Tedd, K. Schrogl, Cologne Commentary on Space Law, Vol. 1, 2009, Carl Heymanns at 44ff.

¹⁸ See also R. Lee, supra fn 15 at 165.

¹⁹ Ibid. at 197.

remains as to whether the appropriation and sale of mined resources is allowed or forbidden under the treaties?

Notably, the fact that space mining is not explicitly forbidden under Art II OST does not automatically provide for mining outer space. A look into other international treaties which deal with international territorial regimes and their uses may actually help to solve the legality of space mining.

3.2 The Convention on the Law of the Seas (UNCLOS)

Application by analogy – fishing an asteroid or mining the ‘Moon bed’?

The High Sea Convention (1959)²⁰ served as a blue print for the OST as far as the principle of non-appropriation of international territories is concerned. Article 2 of the High Sea Convention (HSC) shall be open to all nations and no state may claim sovereignty. In 1982 the UNCLOS²¹ followed the HSC. According to Art 87 UNCLOS, the freedoms of the high seas are, *inter alia*, the freedom of fishing, the freedom to lay submarine cables and pipelines, and the freedom to fly over the high seas. According to the UNCLOS these freedoms shall be exercised by all States with reasonable regard to the interests of other States comparable to the principle ‘for the benefit and in the interests of all states’. In essence, the UNCLOS explicitly allows fishing as a form of exploitation of an international territorial regime.

But can we apply the UNCLOS by analogy to space mining? In general, analogy applies if the lack of legal regulation is not planned.²² However, the Vienna Convention on the Law of Treaties does not support legal analogy. Irrespective of the discussion as to whether analogy is allowed in general under international law, one has to state that at the time of the adoption of Art II OST space mining was not seriously considered. The lack of any legal regulation of space mining would thus constitute an unintended legal loophole. But in order to apply the concept of legal analogy, a similar legal subject is needed. Perhaps by analogy of Art 87 UNCLOS we might fish asteroids – using a certain degree of imagination - under the same legal regime as fishermen fish in the sea. Nevertheless, fish constitutes a renewable natural resource, whereas outer space, the Moon and other celestial bodies do not. Fishing is totally different from mining natural resources. Thus Art 87 UNCLOS might not apply by analogy to space mining.

²⁰ Convention on the High Seas, opened for signature on 29 April 1958, 450 U.N.T.S. (entered into force on 30 September 1962).

²¹ United Nations Convention on the Law of the Sea, opened for signature on 10 December 1982 1833 U.N.T.S. 3.

²² See P. Bydlinski, *Bürgerliches Recht I Allgemeiner Teil*³, Springer, 2005 at 24f.

We can discuss the applicability of national rules concerning sea bed mining by analogy to space mining.²³ Furthermore, we can also discuss certain rules extracted from the Wellington Convention on the Regulation of Antarctic Mineral Resource Activities (note that this document is not in force yet).²⁴

3.3. The Moon Agreement

The Moon Agreement²⁵ adopted in 1979, which forms part of the ‘big five’ space treaties, specifies the ‘use’ of outer space. The Moon Agreement applies to other celestial bodies in the solar system as well (Art 1).²⁶ This agreement is the only document which explicitly refers to space mining. Art 11 paragraph 2 repeats the wording of Art II OST, namely that the Moon is not subject to national appropriation by any claim of sovereignty through usage or occupation, or by any other means. Later in Paragraph 5 it is laid down that “*state parties to the agreement undertake to establish an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the Moon as such exploitation is about to become feasible.*” This statement is crucial. The legal way of recalling Art II OST previously to this provision makes it clear that under the same conditions as already laid down in the OST, the exploitation of natural resources in space is basically allowed! Hence, it is allowed to exploit natural resources in space, with the caveat that *it must be governed* when the exploitation is about to become feasible.²⁷ Art 11 of the Moon Agreement, subsequently adopted as law, further develops Art II of the OST.

According to paragraph 7 of Art 11 of the Moon Agreement, the main purposes of the international regime to be established shall include

²³ See also the interview with Professor Frans Von der Dunk, Science Daily on 26.4.2014 <http://www.sciencedaily.com/releases/2012/04/120426134927.htm> (last accessed 10 September 2014).

²⁴ Wellington Convention on the Regulation of Antarctic Mineral Resource Activities, opened for signature on 2 June 1988 (not in force).

²⁵ Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, opened for signature on 18 December 1979, 1363 U.N.T.S. (entered into force on 11 July 1984).

²⁶ For the Moon Agreement in general see S.Hobe, R. Jakhu, S. Freeland, F. Tronchetti, P. Stubbe in: S. Hobe, B. Schmidt-Tedd, K. Schrogl, Cologne Commentary on Space Law, Vol. 2, 2013 at 325 ff.

²⁷ For further information in general on Art 11 para 5 see S.Hobe, R. Jakhu, S. Freeland, F. Tronchetti, P. Stubbe in: CoCoSL, Vol. 2, supra fn 27 at 396 f.

- (a) *The orderly and safe development of the natural resources of the Moon;*
- (b) *The rational management of those resources*
- (c) *The expansion of opportunities in the use of those resources*
- (d) *An equitable sharing by all States Parties in the benefits derived from those resources, whereby the interests and needs of the developing countries, as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the Moon, shall be given special consideration.*²⁸

Interestingly, only 15 states have ratified the Moon Agreement as of today. The reason why most states refrained from signing the agreement is that they feel constrained by the agreement itself. States are afraid of the principle enshrined in Art 11, namely that the Moon and its resources are of 'common heritage of mankind'.²⁹

However, this argument is not consistent, since only the Moon Agreement explicitly allows space mining, whereas the OST does not.

The old Latin sentence by Hugo Grotius is still valid: *ubi societas ibi ius* which means, where society exists, law will be part of it. But what if the international community remains paralyzed and does not ratify the Moon Agreement? States may start digging into an international legal vacuum; most likely, they would be doing so according to their own rules, set up in their own national interest, for their own purposes. Obviously the main space faring nations believe that they will be the first space 'digging' nations. But what if they are not? What, if private companies come in first?

3.4. The Astronauts and Rescue Agreement

The question remains whether humans who are working *in situ* in space are considered astronauts according to the Astronaut and Rescue Agreement.³⁰ This issue would clearly go beyond the scope of this paper, but it still needs to be raised in order to present a complete picture of this topic.

3.5. Celestial bodies retrieval missions and the Liability (LIAB) and Registration Convention (REG)

The crucial question is whether a redirected celestial body such as an asteroid may cause potential harm to humans or properties on the surface of the Earth. It further leads to the question as to which entity might be held liable in case of damage on the surface of the Earth or in outer space caused by an artificially retrieved celestial body. The OST has not foreseen the possibility

²⁸ For further information in general on Art 11 para 7 see S.Hobe, R. Jakhu, S. Freeland, F. Tronchetti, P. Stubbe in: CoCoSL, Vol. 2, supra fn 27 at 397 f.

²⁹ For further information see R. Lee, supra fn 15 at 260f.

³⁰ Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, opened for signature on 22 April 1968, 672 U.N.T.S. (entered into force on 3 December 1968).

of the movement or the redirection of celestial bodies by humans. According to Art VI OST, activities carried out in outer space shall be authorised and continuously supervised. However, according to Art VII OST, states may be held liable in case of damage caused by objects launched into outer space or beyond. Moreover, man-made space objects shall be registered (Art VIII OST). The crucial question, therefore, is whether a captured asteroid that is redirected by new promising technologies shall be considered a man-made space object.

A retrieved celestial body may be brought from its original trajectory to another trajectory where it can constitute a harm for other (artificial) 'space objects'. In the view of the author, the process of transforming a natural space object through retrieval (which is a man-made process) has to conform to the appropriate space treaties.³¹ However, the space treaties do only apply to (artificial) space objects. Transforming and retrieving natural space objects and altering their properties (e.g. changing their trajectories) cannot be without consequences. Thus these transformed natural space objects necessarily have to be considered 'space objects' under the space treaties. If that comes true, states must not contaminate space according to Art IX OST and Art 7 Moon Agreement. Furthermore, states must provide post-mission space debris concepts and are not allowed to dispose stones and volatiles in critical orbits. Moreover, under Art VIII OST states would for instance retain jurisdiction and control of a retrieved asteroid.

The REG by definition only applies to space objects that are launched into Earth orbit or beyond (Art II). Is a retrieved asteroid from the Asteroid belt '*launched*' into Earth orbit? To answer this question, one may compare this situation with the launch of small satellites from the International Space Station in Outer Space where the obligation to register might necessarily apply to satellites launched from outer space into Earth orbit.³²

3.6. The Austrian Mining Act – as a role model for future space mining acts?

According to the previously mentioned principle *ubi societas ibi ius*, the need for national legislation to govern the exploitation of natural resources in space with respect to the general principles of international law and space law is evident. The international community needs to find a legal regime that does not infringe the principle of non-appropriation enshrined in Art II OST. The Austrian Mining Act³³ differentiates between three mining categories.

³¹ See also Ernst Fasan, *Large Space Structures and Celestial Bodies*, 1984, Coll. L. Outer Space at 243.

³² See A. Rinner, *A new Approach towards Outer Space ,Democratisation'?* Diploma Thesis, University of Graz, 2013.

³³ Austrian Federal Law Gazette Bundesgesetz über mineralische Rohstoffe (Mineralrohstoffgesetz - MinroG (StF: BGBl. I Nr. 38/1999).

1. National resources: state property (Paragraph 4)
2. Private resources: the owner of the property is the owner of the resources (Paragraph 5)
3. “Property-free” minerals and mining rights: apply to resources that generally neither belong to a state nor to a private property. Only the holder of a licence is entitled to mine and use/sell the resources (Paragraph 3)

According to Paragraph 3 of the Austrian Mining Act (AMA) resources and minerals which are “property-free” in general and thus need to be authorised are, inter alia, Iron, Titan, Gold, Silver, Platin etc. If the state or a private entity wants to mine these property-free minerals, one has to apply for a licence (Paragraph 21 AMA).

According to Paragraph 44 AMA mining-rights expire within two years if the entitled person does not make use of it. Mining rights can only be transferred with the consent of the appropriate authority (Paragraph 51ff.). The AMA also contains provisions for post-mission disposal and for policies to avoid and minimise debris for a sustainable use of natural resources. Finally under the AMA entitled persons need to pay taxes for the exploitation of natural resources (Paragraph 69ff). Different calculation methods depending on the amount of extraction apply.

4 Ideas for De Lege Ferenda and Institutional Aspects

Since no one can claim national or private appropriation in outer space under Art II OST, no national or private entity has the sovereign right to distribute mining rights in space. Overall, this calls for establishment of a supervisory agency or monitoring body by the international community.³⁴ This entity (international organisation) composed of individual member states should allocate mining rights to states which apply for such licenses. Any given state should also have the possibility to shift the obtained mining rights to private entities under its supervision. Ideally, the ITU radio communication allocation regime could serve as a role model to space mining rights allocation management.

Such body could aptly be called International Resources in Space Organisation (IRISO). The institutional procedure of an allotment regime can be the following: A potential natural object in space deemed valuable enough to be mined is detected. The target state has to notify the object at IRISO and must provide the authority with maps, composition, prospected revenues etc. After the notification the IRISO will decide upon the mining rights. If the size of the target is such that it would allow for another state to start mining operation as well, then the celestial body has to be distributed into designated

³⁴ See also R. Lee, *supra* fn 15 at 18. He proposes the establishment of an International Space Development Authority a quasi-legislative body with an administrative secretariat.

mining zones; obviously, the applying state can only receive mining rights for certain specific zones. This would help prevent a situation whereby the state which comes first can unfairly mine the entire celestial body without any limitations.

States or private companies tend to invest a huge amount of money into space technology in order to detect and deflect a targeted space object. It would be unfair - vice versa - if these efforts were not acknowledged. However, in exchange for the privilege to obtaining the right to exploit a space object, a state should not only pay taxes to IRISO, but also contribute a designated fee for the benefit and in the interests of all countries.³⁵ IRISO would establish a global fund where all taxes from space mining would be collected. This fund would be exclusively used to fund other small countries, emerging and developing countries to support space activities. IRISO would make sure that only peaceful and sustainable space activities are funded. With taxes from space mining, IRISO would develop space programmes or would directly fund national space agencies. The support of any weaponization of space would be strictly prohibited.

5 Conclusions

Space mining is not only a fascinating, but an increasingly real-life issue. Humans will venture out and do what they have done in the past, whenever they detected new territories and new resources at moments in time when no overriding regulatory regime had been in place yet: they took possession of them. Many wars have been fought - and are still being fought - over natural resources. Mankind should have learned from history, though. One accomplishment countering this dilemma has been the government of international territories, whereby Art II OST may serve as an example. However, it was not the main intention to prevent people from using and exploiting outer space when Art II OST was enacted. Thus, we can use outer space, but in the context of the benefit and in the interest of all countries (Art 1 OST). Mankind – meaning all of us - shall only go to space for peaceful purposes, and must never fight in space for natural resources. And let's not forget: we must not exclude other states from any space activities.

The OST is silent about space mining. A typical legal principle in civil and commercial laws is that no one can have more rights than he/she has obtained from its predecessor. (As has been pointed out here), neither states nor individuals can claim such special mining rights from the OST, nor by analogy.

The Moon Agreement has developed this legal question further and explicitly allows for space mining, if an international regime has been established prior to the mining activity.

³⁵ See also R. Lee, *supra* fn 15 at 18.

If the international community does not want that public or private entities start digging in a legal vacuum, thus constituting a threat to the peaceful use of outer space, the space faring nations should be proactive and agree on an international mining regime. Otherwise the international community will confront the familiar problem of space debris, mainly caused by space faring countries, and deplore the lack of international regulation as a result of narrow national (economic and financial) interests. The issue of space debris has become evident and meanwhile represents a real threat to the entire spectrum of spaceflights. According to the Moon Agreement the international community needs to act if exploitation is about to become feasible. We must take legal action right now!

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