

Mining Outer Space

Overcoming Legal Barriers to a Well-Promising Future

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Abstract

Iced water, Helium-3 or Oxygen are only some of the valuable minerals that are harvestable in outer space. They are ideal to effectively resolve issues arising from the depletion of terrestrial natural resources combined to the augmentation of Earth's population and its subsequent needs. Numerous initiatives are undertaken by both public and private entities for such exploitation in outer space. Equally important are the barriers imposed by space law: outer space "in the Interest of Mankind", "Freedom of its Use and Exploration", the "Non-appropriation principle" and the demand for an "Equitable Sharing", are the cardinal provisions of space law and the key blockage to the realization of space mining activities. The purpose of this paper is twofold: first, it proposes potential ways to interpret the above principles, as elucidated by current policies and commercial initiatives, in order to conceptualize a legal framework for space mining. Second, it suggests a possible regulatory regime so that space mining activities can take place in accordance with the already existing space law principles. One question that will be proposed to be taken into account is whether the legal regimes governing the resources of the Deep Seabed and the Antarctic regions are applicable. Are such analogies acceptable? To what extent are they useful in the quest for a set of effective legal provisions to govern outer space exploitation? These are only few of the burning queries that are currently being discussed and still awaiting to be answered. Could outer space "colonization" be the answer? Approach ambitious, but likely effective. Hence, what should prevail: the barriers imposed by a solid but outdated legal framework, or the terrestrial dire need for sustainability and exploitation of alternative resources such as those that outer space promises to provide?

I. Introduction

The paper focuses on the need to create a new legal regime regulating property rights on parts of outer space, such as the natural resources of the celestial bodies. The concept of the paper is constructed on the fact that the current provisions of space law are proven to be inadequate to effectively regulate the

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issue, while space mining is not far from becoming reality. The topic is of specific significance especially after the integration to the national U.S. law of an Act¹ that allows the appropriation of natural resources of the celestial bodies by the extracting entities. Such regulation raised concerns as to whether or not it contradicts the provisions of international space law. However, such analysis does not fall within the ambit of the present paper that seeks to locate the loopholes of international space law concerning the issue of space mining and to emphasize the need to create a new and specialized legal framework to govern such matters.

I.1. The Issues That Need to Be Addressed

Just a few months ago, JAXA launched an asteroid-hunting spacecraft named Hayabusa2 which has as its mission to reach an asteroid, mine it and bring sample material back to the Earth.² Similarly, almost a year ago, an event of historical significance for the entire humanity took place in outer space. After almost eleven years of traveling in outer space, a spacecraft named “Rosetta” rendezvoused with a comet. Its probe, named “Philae”, landed on the comet.³ This event is highly promising for the future of human presence in outer space. Such a presence inevitably raises a myriad of questions regarding commercial exploitation of outer space. Such commercial activities, including space mining, are indeed of critical importance for humanity as reflects a level of technological capabilities that will enable exploitation of space resources. These technological achievements, combined with the Earth’s need for additional mineral resources, make the need for a legal framework for space mining activities a burning issue.

Commercial human activity in outer space tends to be developing intensively.⁴ At the same time, the depletion of the existing terrestrial mineral natural resources makes the need to mine for new ones imperative. Present efforts of mining in areas not covered by national jurisdictions, such as the deep seabed and the Polar Regions, aim to respond to this pressing need.⁵ Space mining can be classified in this category too; however, its very special characteristics make it subject to the need for a particular legal treatment that is currently non-existent. The lack of specific international and space law rules that

1 An Act to facilitate a pro-growth environment for the developing commercial space industry by encouraging private sector investment and creating more stable and predictable regulatory conditions, and for other purposes, 114th Congress, 1st Sess, Senate (10 November 2015).

2 Jaxa’s website.

3 “Touchdown! Rosetta’s Philae probe lands on comet” at www.esa.int.

4 Ricky J. Lee. *Law and Regulation of commercial Mining of Minerals in Outer space* (2012, Springer Dordrecht, Heidelberg, London, New York) at 7.

5 David E. Marko, A Kinder, “Gentler Moon Treaty: A Critical Review of the Current Moon Treaty and a Proposed Alternative” (1992) 8 J. NAT. RES. & ENVT’L. L. 293 at 310-313.

would govern the aforementioned activities constitutes the rationale behind this paper.

Space mining activities are being developed by major private entities and investment plans are scheduled to take place in the very near future. However, their realization presupposes a clear relevant regulatory framework, which does not currently exist. It is for this reason that all these investment plans remain theoretical. Legal issues such as the “non-appropriation” and “free exploration” provisions of space law arise and inhibit the undertaking of respective private investments, letting the uncertainty of law grow.⁶ Accordingly, there is an increasing need for the creation of a set of specific space law rules that will regulate the issue, taking into account the technological possibilities, the commercial risks, and current needs of our society. Space law treaties that govern outer space activities were created in an era when space mining was not foreseen.⁷

As a result, space law is an inadequate legal framework to address space mining activities. It is thus impossible for private entities to realize their commercial aspirations in space without the creation of new rules intended to serve the specific needs of these initiatives. Under the current space law, the exploration and exploitation of outer space is supposed to be conducted “in the interest of all States”.⁸ Similarly, no ownership rights can be acquired on celestial bodies.⁹

1.2. Factual and Legal Background

The resources that can be collected through space mining activities are mainly water, oxygen, titanium and iron, all being of great importance for human activities both on Earth and in outer space.¹⁰

An important number of space mining plans have already been developed. Mined materials from outer space, in particular from asteroids and near-Earth objects, will be sent to Earth and used as resources for human activities. In

6 Fred Kosmo, “The Commercialization of Space: A Regulatory Scheme that Promotes Commercial Ventures and International Responsibility” (1987-1988) 61 S. Cal L. Rev. 1055 at 1057.

7 Eilene Galloway, “Maintaining International Space Cooperation for Peaceful Uses” (2004) 30 J. Space L. 311 at 314.

8 John Adolph, “The Recent Boom in Private Space Development and the Necessity of an International Framework Embracing Private Property Rights to Encourage Investment” (2006) 40 International Law 961 at 963; Bin Cheng, “The Commercial Development of Space: The Need for New Treaties” (1991) 19 J. SP. L. at 17.

9 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer space, including the Moon and Other Celestial Bodies, 1967 (hereinafter “OST”), article I.

10 Ezra J. Reinstein, “Owing Outer space” (1999-2000) 20 Mw. J. Int’l L. & Bus. 59 at 60 and, Jonathan R. Tate, “Near Earth Objects – A Threat and an Opportunity” (2003) 38 Physics Edu. at 218.

addition, the placement of asteroids in orbits near the Moon and the Earth has been deemed feasible and potentially beneficial, since in such a way the materials found therein will be automatically used by the Earth and the Moon.¹¹ The first category of activities of space mining (*i.e.*, sending resources on Earth to be used as resources for human activities) includes two methods of exploitation: either minerals will be extracted and processed in outer space and then brought to Earth for terrestrial use; or, minerals will be extracted from the celestial bodies and brought to Earth in order to be processed and further used there.¹²

To date, several mining plans have been developed by major companies such as Planetary Resources Inc., Deep Space industries Inc., and Kepler Energy and Space Engineering LLC (KESE).

- *Planetary Resources, Inc.*: The main concept followed by the company is the use of water extracted from asteroids to make water depots.¹³ The latter will be used to refuel rockets after the conversion of water to liquid oxygen and hydrogen. It is estimated that in such a way the current cost of fueling satellites and spacecraft will be significantly reduced. The activities will be funded by the National Aeronautics and Space Administration (hereinafter NASA), with which the company has already signed a non-reimbursable Space Act Agreement, and by other investors.¹⁴
- *Deep Space industries Inc.*: Planning to launch the 70-lb DragonFiles spacecraft to asteroids for the collection of samples in 2016, the main investment plan of this company is to transform raw asteroid material into complex metal parts using a technology called MicroGravity Foundry. The material will be further used for satellite fueling. Another activity in which Deep Space Industry intends to be involved in is harvesting Asteroids for building materials useful for the construction and restoration of satellites and solar power stations that will produce carbon-free energy for Earth consumption.¹⁵
- *Kepler Energy and Space Engineering LLC*:¹⁶ This company is designing CORNUCOPIA, an automated asteroid mining system aiming to extract Near-Earth-Asteroids' regolith. The purpose is to return the minerals to

11 This refers to a natural process, during which the asteroid gradually breaks apart and material falls on either Moon or Earth where they are being collected.

12 Peter G. Chamberlain, Lawrence A. Taylor, Egons R. Podnieks, Russel J. Miller, "A Review of Possible Mining Applications in Space" 51 at 53 (Arizona Uapress).

13 Lauren E. Shaw, "Asteroids, The New Western Frontier: Applying Principles of the General Mining Law of 1872 to Incentive Asteroid Mining" (2013) 78 J. Air L. & Commerce 121 at 128-129.

14 Information gathered from Planetary Resources Inc.'s website.

15 Santa Monica, "Commercial Asteroid Hunters announce plans for new Robotic Exploration Fleet" published at PRWeb website.

16 Information derived from: Kepler Energy and Space Engineering's website.

the Earth and to Low Earth Orbit (LEO) in order to “build space structural components needed for space habitats and space exploration vehicles to be built in LEO”.¹⁷ The further purpose is to de-orbit and send the habitats to deep space or to make them remain stationary at Lagrange points. KESE finds it feasible to establish permanent presence in LEO using habitats in order to provide zero-gravity and near-Earth gravity environments.

The exhaustion of terrestrial resources, the rapid growth of developing countries’ populations and the development of technological achievements reveal the significance and the possible realization of space mining activities. However, what is missing is an unambiguous regulatory framework for space mining activities.

1.2.1. Relevant Deficiencies in Space Law

The Outer Space Treaty (OST) and the Liability Convention¹⁸ recognize in their respective preambles the nature of the “exploration and use” of outer space as being “in the common interest of all mankind”, while the Moon Agreement (MOON)¹⁹ recognizes outer space as “the common heritage of all mankind”. The OST sets specific principles such as the “exploration and use” of outer space “for the benefit and in the interests of all countries” (art. I OST), the “freedom of exploration” (art. I OST), the “non-appropriation” (art. II OST) and the “cooperation and mutual assistance” (art. IX OST). At the same time, the MOON reaffirms the above principles, further elaborating and expressly prohibiting the appropriation of the Moon and the other celestial bodies “by claim of sovereignty, by means of use or occupation, or by any other means”, calling the exploration and use of outer space the “province of all mankind”.

The question that inevitably arises is whether the aforementioned provisions are relevant and compatible with space mining. Through the interpretation of the principles cited above, it becomes clear that outer space is the common property of whole mankind,²⁰ the exploration and exploitation of which can take place in a cooperative way. As a consequence, it appears that the mining activities currently under planning may not be based on solid legal grounds, in so far as space law is concerned.

17 Kepler Energy and Space Engineering website.

18 Convention on International Liability for Damage Caused by Space Objects, 1972 (hereinafter LIABC).

19 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 1979 (hereinafter MOON).

20 Harold W. Bashor, Jr, *The Moon Treaty Paradox* (2004, Xlibris Corporation) at 265; Paul Stephen Dempsey, “The Intersection of Air Law and Space Law” (2013) at 5.

Worth mentioning is also the fact that the MOON already provides for a regulatory regime that could serve the needs of space mining. However, the MOON has been so far ratified by only sixteen States. Article 11 of the MOON provides for rules for both the outer space natural resources and property rights on them. Specifically, it describes the celestial bodies' resources as "common heritage of mankind"; it revises the "non-appropriation" principle already stated in OST and prohibits ownership rights on the extracted materials as well as on parts of the surface whereon installations for the purposes of mining are constructed. It also expressly mentions that governmental or private entities cannot acquire property rights on the selected material. Even if we suppose that this Agreement poses a potential basis for space mining, the question that still arises is twofold: how will private entities be able to sell the extracted minerals without prior property rights on them; and, further, how possible is it for companies to actually invest money for such purposes without the necessary certainty of law. The MOON was created in an era when space mining was not foreseen to happen in the near future as it is now. Consequently the need for regulation is still urgent. Besides, the same agreement poses the need for further regulation mentioning in art. 11 para 4 that should exploitation of mineral resources begin, we need to further regulate the issue.²¹ The problem seems not to be that serious concerning minerals that will remain in outer space for further use there though, since they will not be removed from outer space. However, the market tendency leads us to assume that the main purpose of space mining activities is the use of the resources for terrestrial purposes.

1.2.2. The Need to Regulate

A new balanced legal regime is required in order to delimit the scope of the previously mentioned provisions and to harmonize them with the interests of private entities seeking ways to exploit celestial bodies, such as asteroids. At the same time, the above-described legal *vacuum* cannot be covered by analogies deriving from general public international law. Neither the Law of the Sea, nor the law covering any other terrestrial areas regarded as "common heritage of mankind" and being under no State jurisdiction can effectively be used in this regard.²² The Law of the Sea, and especially the provisions covering the Deep Seabed, would be the most appropriate source for space law

21 "States Parties to this Agreement hereby undertake to establish an international regime, including appropriate procedures, to govern the exploitation of the natural resources of the Moon as such exploitation is about to become feasible".

22 Bin Cheng, *Studies in International Space Law* (1997) Clarendon Press, Oxford at 81. Gabriella Catalano Sgrosso, *International Space Law* (2011, LoGisma) Italy at 48, 49; P.P.C. Haanappel, *The Law and Policy of Air Space and Outer space, a comparative approach* (2003, Kluwer Law International) The Netherlands at 61; Ruwantis I. R. Abeyratne, *Frontiers of Aerospace Law* (2002, Ashgate) U.K. at 14.

analogies;²³ nevertheless, this prospect seems undesirable for the majority of space law scholars.²⁴

Thus, the need for a new specific legal regime is obvious. This regime will either borrow basic elements from general international law and adapt them to space law or further elaborate on the existing provisions of space law, the *lex specialis*, in an effort to achieve a set of legal rules able to govern mining activities in outer space and foster their development.

II. The Main Dimensions of the Issue

II.1. The Current Uncertainty of Law

In the first place, the analysis needed has to be regarded as twofold; firstly, the principle of non-appropriation has to be examined in conjunction with the inevitable need for property rights to be imposed on the mined parts of the celestial bodies together with the effort to conceptualize exploration of outer space as free and the cooperation inevitably linked to such a concept. The balance between these considerations has to be undertaken under the umbrella of mining exploitation.²⁵

1. The “non-appropriation” and “freedom of exploration” problem

As discussed above, outer space (and consequently the celestial bodies, including asteroids and their natural resources) is not subject to appropriation under the provisions of space law.²⁶ Nevertheless, taking into account the nature of mining activities, it is impossible to extract minerals from celestial bodies without acquiring property rights on them. The extraction of minerals leads to the removal of a part of the celestial body, meaning that the same part cannot be used or accessed by other entities, although the OST provides for the free “exploration and use” of outer space by all States.²⁷ This issue has to be addressed on the grounds of the obvious controversy it contains and a theoretical legal approach on the basis of which it has to be attempted to balance space law provisions with the current commercial and economic

23 S Freeland & R Jakhu ‘Article II’ in S Hobe, B Schmidt-Tedd & KW Schrogl (eds) Cologne commentary on space law (2009) at 60.

24 Francis Lyall, Paul B. Larsen *Space Law, A Treatise* (2009, Ashgate) USA at 64; S. Freeland, R. Jakhu at 50. Ram Jakhu and Maria Buzdugan, “Development of the natural resources of the moon and other celestial bodies: economic and legal aspects” (2008) 6 *Astropolitics* 201 at 230.

25 The nature of mining exploitation consists of the extraction of a part of the celestial body, which inevitably leads to the separation of that part from it.

26 Fabio Tronchetti, *Fundamentals of Space Law* (2013, Springer) International Space University (e-book) at 8.

27 Dr. Sandeepa Bhat B., *Space Law in the Era of Commercialization* (2010, Eastern Book Company Lucknow) at 61; Dr. Sandeepa Bhat B., *Space Law in the Era of Commercialization* (2010, Eastern Book Company Lucknow) India at 60.

policy framework. Consequently, the new a new framework has to investigate whether the extracted minerals continue to belong to the whole mankind or become property of the extractor. In addition, the “non-appropriation” principle has been supported to qualify as *ius cogens*.²⁸ Thus, the prohibition of property rights on a given extracted material seems to be strict. Consequently, the way in which the “non-appropriation” principle can be balanced with the need to extract and make a profit therefrom has to be kept in mind.

2. The cooperation and mutual assistance issue

Following the same rationale, no cooperation is possible when it comes to mining investment issues. Private entities, which are going to be the main actors in the field of space mining, will definitely act on the strict ground of closed investment initiatives, rendering the cooperation principle imposed by space law ineffective. This anomaly cannot be resolved under the current legal regime. The cooperation problem is a very important one, taking into account that art. IX of the OST provides for the cooperation of the states concerning space activities. The same article also poses the due regard principle concerning such activities, which means that space activities have to be enacted in such a way that imposes no interference with the rights of others. But in the case of space mining, the extracted mining material will be used only by the entity that extracted it. This will prevent other States and private entities from using the same material; as a result, the due regard principle either cannot be applied in our case, or has to be harmonized in a new regulatory framework taking into account the nature of space mining. Consequently, this issue has to be considered in light of the creation of a specific legal system coordinating private entities’ interests with the major provisions of the *lex specialis* (i.e. space law). In this regard, environmental issues can also form part of this analysis, since the principles of due regard and due diligence – directly associated with operations such as mining – can only be fully examined in the context of cooperation and international consultations.²⁹

II.2. Certainty of Law: Towards a New Regulatory Framework

A second approach of the issue can be based on the assumptions derived from the first one in order to craft a potential regulatory regime that could govern space mining activities. On the one hand, the instruments of general international law as well as international jurisprudence can be used to show that an analogous framework applicable in space mining activities cannot be satisfactory. On the other hand, a totally new legal framework can be proposed based

28 R. D. Crane, “Soviet Attitude Towards International Space Law” (1962) 56 AJIL 685 at 697; Ram Jakhu and Maria Buzdugan at 227.

29 Carl Q. Christol, “International Liability for Damage Caused by Space Objects” (1980) 74 AM. J. INT’L. L. 346 at 359.

solely on the needs of the mining market and on the ultimate goal of private initiatives.

1. The international law instruments

One more part of the analysis of the issue has to be elaborated on the provisions set by the United Nations Convention of the Law of the Sea (UNCLOS)³⁰ for mining the Deep Seabed. The Deep Seabed, also known as the “Area”, can be compared to outer space and characterized as “common heritage of the mankind”.³¹ The UNCLOS provides for the establishment of a body, the “Authority” that regulates and controls investment plans concerning the mining in the Deep Seabed.³² Should a similar body should be created for space mining activities, and what would be its functions, given the political tone of space activities? How realistic and feasible is the creation of an analogous legal regime regarding space mining operations? In order to answer this question, coherent legal regimes, like the one governing the Polar Regions, can serve as an example. Another problem that has to be addressed on the basis of the Law of the Sea has to do with the “non-appropriation” principle, as analyzed above. In case we admit that the extraction of minerals cannot lead to appropriation rights on the extracted minerals, the case turns to be similar to fishing activities on the High Seas. And thus, the question that arises is how possible would it be to apply rules analogous to the ones governing the High Seas activities, given that the asteroid resources are non-recoverable.

2. The proposal of a totally new legal regime

One could argue that the proposal of completely new legal provisions inspired by the actual plans and aims of entities involved in the planning of space mining activities is the only solution. Provisions emerging from rules that govern the commercial use of Earth orbits can be taken into account. In addition, recent national attempts to regulate in this field, such as the proposed US Asteroids’ Act³³ and the recently passed *H.R. 2262 U.S. Commercial Space launch Competitiveness Act*³⁴ have to be examined as inspiring examples to be imitated or

30 United Nations Convention on the Law of the Sea of 10 December 1982 (hereinafter “UNCLOS”).

31 Article 136.

32 Jeremy L. Zell, “Putting a Mine on the Moon: Creating an International Authority to Regulate Mining Rights in Outer space” (2006) 15 *Minnesota Journal of International Law* 489 at 504 and, Sarah Coffey, “Establishing a Legal Framework for Property Rights to Natural Resources in Outer space” (2009) 41 *Case W. Res. J. Int’l L.* 119 at 129.

33 American Space Technology for Exploring Resource Opportunities in Deep Space (ASTEROIDS) Act of 2014.

34 An Act to facilitate a pro-growth environment for the developing commercial space industry by encouraging private sector investment and creating more stable and predictable regulatory conditions, and for other purposes, 114th Congress, 1st Sess, Senate (10 November 2015).

to avoided given their direct practical implications on the space industry. Despite the fact that a new legal regime can be oriented by the need to counterbalance actual interests of the States and private entities with the interests of mankind as a whole, this balancing attempt cannot take place at the expense of the protections provided under existing space law. Such limitations can emanate from the liability system already existing in space law, thus preventing arbitrariness. Therefore, mining activities will obtain a legally substantial incarnation among the commercial space activities, without evading from the existing limits of the *lex spatialis*. Current investment plans of private entities with respective activities can also be taken into account, in order for the better harmonization between the current market needs and international *ius cogens* to take place.

The idea behind the new regulatory framework would possibly be the division of some of the outer space resources (i.e. a number of asteroid resources) and via regulation distributing their use according to the needs of each country for a certain period of time so that relevant investment plans can take place, taking into account the need of the developing countries to have access to the sources and their economic and technological capabilities to this respect. In such a way all the above presented space law principles (mainly the free exploration on a basis of equality and the cooperation principle) can be combined and applied under a new regulatory regime that will both serve the needs of our society and the demands of space law.

The conclusions of such regime are expected to reinforce the initial proposition regarding the unsuitability of legal analogies concerning space mining. Space mining investments can only reach their full potential through the legal certainty created by a new, specialized legal regime.

III. Interdisciplinarity of the Issue

The issue in question has to be approached from a multidisciplinary angle. First, it entails deep philosophical roots. This is due to human nature, which is inextricably connected to the inherent will to always break the limits and embark in endless pursuits for human needs. This endless pursuit, on the one hand, is motivated by the fear of depleting terrestrial natural resources and not being able to survive. On the other hand, however, it leads to the fear of legal uncertainty which is a preventive factor to the above-described human wills. These two opposing factors can come to a harmonious relationship only through the instruments of law through which legal certainty can be induced.

The human fear of uncertainty is also shared by commercial entities which require a stable environment for their investments to thrive. Considering the already existing mining plans of commercial entities, legal uncertainty poses a factor that enhances risk. Indeed, risks are an essential component of the way the market works. However, the legal uncertainty is something more than the usual risk of potentially losing some money. A defective legal regime threatens the future of such initiatives. This is especially true if we take into account the

trillions of dollars that space mining activities are expected to generate.³⁵ Consequently, the necessity of a precise and solid legal regime governing space mining activities, which will grant the respective entities the possibility to foresee the impact of their investments, is pressing.

Furthermore, we should never forget the nature of the space activities *per se*, which are surrounded by political motives, forces and powers. As the world of space law is literally being created by policy, the saying “the big fish eats the little ones” seems to perfectly fit our case. Assuming that no precise regulatory regime exists to pose such limits, then chaos will preponderate and space mining activities will always be guided by the power of the most capable nations and private entities. Thus, rules and limits are required. For all the above reasons, the sole solution to the uncertainty is the creation of normative certainty which would leave no room to arbitrariness.

Keeping in mind all of the above, the most appropriate legal research method to be used in order to address the issues that have been exposed is the interdisciplinary legal research method.³⁶ The multidisciplinary nature of the issue could not have left space for any other approach of the issue, since *per se* investment policies of private entities can be taken into account. Many technical and scientific references can also assist to the examination of the issue in order to specify the exact legal impact of the mineral extractions. A transsystemic analysis of the issue has to also take place, since national mining regulations have to be compared and contrasted in order to set a potential basis and examples for solving the problem. The starting point, however, has to always remain be the basic primary sources of international and space law which will inevitably lead to use, at least partially, the doctrinal method. This method has to be used concerning treaty interpretation so that the legal gaps deriving directly from the currently existing legal regime can be located and examined.

From a theoretical point of view, the need for a regulatory framework also involves human rights issues. Indeed, another rationale for the need to undertake in a legally convenient and efficient way space mining, one should take into consideration human rights. The questions that should be answered are closely linked to the eventual exhaustion of terrestrial resources States – and the international community in general – have, according to international law, the obligation of States to act. This means the responsibility to take all possible measures to guarantee the existence and maintenance of – among others – any kind of resources needed for a decent living. Space mining regulation serves such obligation, preventing from the depletion of terrestrial resources and promising a sustainable long-term existence of human beings on the Earth. Hence, such a regulation will enable States to stay in accordance

35 It has been speculated by John Lewis in 1997 that a small metallic asteroid contains minerals of almost \$20 trillion USD worth. (John Lewis, *Mining the Sky: Untold Riches from the Asteroids, Comets, and Planets*, Pegasus Group Books, 1997).

36 Dawn Watkins, Mandy Burton. *Research Methods in Law* (Routledge, 2013) at 72.

even with such responsibilities are mainly found in human rights law, proving once more the interdisciplinary and transsystemic nature of the space mining regulation that is needed.

IV. Conclusions

Having discussed the most important issue encountered in the space law regime, such as the “non-appropriation” principle both from a theoretical point of view as well as their practical impacts, several conclusions can be inferred. To begin with, the appropriation of outer space cannot be based on a sole legal basis. The interpretation of this “non-appropriation” principle has to be made under the umbrella of the whole space law system and also has to take into account the current context. The need to commercialize outer space appears to be dire and demands an up to date interpretation of these provisions.

Although activities such as space mining are both feasible and beneficial for humankind, they cannot be realized under the current legal framework. Hence, the uncertainty created by the existing provisions, as analyzed above, has to be overcome by the development of a new legal regime specifically addressing the connections between space law and current commercial initiatives. This new legal framework should propose ways so that appropriation of parts of outer space (*i.e.*, minerals) becomes legally feasible. This can take place only through the reconsideration of the nature of such parts of outer space and by excluding them from the scope of the “non-appropriation” principle.

While one of the purposes of this paper was to interpret this principle, the legal regime framing such activities should be the topic of a separate research based on the findings of this analysis.

As exposed during this analysis the barrier to acquisition of property rights in outer space is such that every attempt in this respect is discouraged due to the existing absolute prohibition. However, the trend that can be witnessed in the behavior of both public and private entities reveals their strong will to engage in activities which requires this blockage to be resolved.

An example that illustrates the above can be found in the Federal Aviation Administration’s recent intention to leverage the FAA’s existing launch licensing authority to encourage private sector investments in space systems by ensuring that commercial activities can be conducted on a non-interference basis.³⁷ This reveals the strong will to find possible legal ways so that commercial activities that presuppose property rights in parts of outer space can take place in the near future.

37 Online: <<http://mobile.reuters.com/Article/idUSKBN0L715F20150203?irpc=932>>.

It is ambiguous whether either kind of interpretation of the current space law provisions could allow the acquisition of property rights on parts of outer space per se, or whether an arbitrary colonization of outer space could resolve the problem *de facto*. Regardless of the answer, the only thing that is sure is the urgent need for a new and specific legal regime governing commercial space activities such as space mining.

