

THE COMMERCIAL EXPLOITATION OF OUTER SPACE AND CELESTIAL BODIES – A FUNCTIONAL SOLUTION TO THE NATURAL RESOURCE CHALLENGE

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Most proposals on the exploitation of natural resources in outer space are based on the assumption that space resources correspond to physical phenomena, the legal regime of which should vary depending on the environment from which they originate. Mineral reserves on celestial bodies are considered appropriable while in contrast the orbit-frequency spectrum should remain unencumbered by exclusive rights. It is argued here that such a physical distinction between outer space and celestial body resources is untenable both in law and in practice. The article therefore suggests a more comprehensive approach to regulating space resources, based on a functional interpretation of the space law regime. This approach is based on the fact that the category of natural resources is principally defined by its potential as a source of economic value after transformation by human activity. It should thus be governed by a uniform regime determined by the basic principle of free and undisturbed use of outer space by all States. The criterion of scarcity implicit in this principle is sufficiently flexible to efficiently regulate the exploitation of the wide array of natural resources in outer space, as is illustrated by the regime of the geostationary orbit.

INTRODUCTION

The current space law treaties do not conclusively determine the exploitation of natural resources and the issue is subject to much controversy among legal scholars. Most proposals on the exploitation of natural resources in outer space are based on the assumption that space resources correspond to physical phenomena, the legal regime of which should vary depending on the environment from which they originate.¹ Mineral reserves on celestial bodies are generally considered appropriable while in contrast most authors contend that the orbit-frequency resource should remain unencumbered by exclusive rights.

The above approach to space resources presupposes that it is both possible and necessary to distinguish between the appropriation of natural resources of celestial bodies and other space resources. To determine the tenability of this assumption, the article shall ascertain (1) whether it is possible to define the notion ‘celestial body’ (section I); (2) whether the non-appropriation principle can be deemed applicable to natural resources (section II); (3) what should be understood by the notion ‘natural resources’ in the context of outer space and what legal principles guide the exploitation of these resources (section III).

It shall be argued in this article that the presuppositions underlying a selective application of the non-appropriation principle to space resources are untenable, unwarranted and insufficient in light of the main goal of the space law regime to spur the free and undisturbed use of outer space by all States.

I. DEFINING CELESTIAL BODIES

I.I. Relevance for the legal regime of natural resources

In the years preceding the finalisation of the 1967 Treaty on principles governing the activities of States in the exploration and use of outer space, including the Moon and other celestial bodies (hereinafter: ‘Outer Space Treaty’ or OST), the need to define the notion ‘celestial body’ was raised frequently.² Whatever matter such definition would comprise, it was argued that celestial bodies were physically markedly different from their largely void surroundings and should therefore be subject to a separate legal regime. The main space law resolutions in force at the time did not undermine this contention as they referred to ‘outer space and celestial bodies’ when defining the scope of their provisions, thus leaving open the possibility of installing two separate legal

regimes, determined by the physical characteristics of their subject matter.³

The legally binding Outer Space Treaty left the conceptual quandary unsolved as it neglected to define any of its operative notions for fear of rendering its provisions obsolete in the light of unforeseeable scientific and technological advances. Nevertheless, scholarly effort to accurately delineate the various physical components of outer space dwindled significantly after the OST came into force. This was likely due to the decision of the drafters to substitute all references to ‘outer space and celestial bodies’ with the formula ‘outer space, including the Moon and other celestial bodies’.⁴ The inclusive reach of the notion ‘outer space’ understandably reduced the need to define its component parts, as any provision on ‘outer space’ was *ipso facto* also applicable to the celestial bodies contained therein.⁵

It follows that most space law provisions are indiscriminately applicable to both the material and immaterial components of outer space. Nevertheless, some provisions of the Outer Space Treaty still distinguish between outer space and celestial bodies, such as Article IV OST on the military uses of outer space, as does the entire 1979 Agreement governing the activities of States on the Moon and other celestial bodies (hereinafter: ‘Moon Agreement’ or MA). The need to define what exactly constitutes a ‘celestial body’ is therefore still raised by contemporary scholars⁶ when discussing the limits of the peaceful uses of outer space⁷ or when determining the scope of the Moon Agreement.⁸ Importantly, the MA is the only convention that contains specific provisions on natural resources in space. It is thus often considered vital to define the celestial body concept in order to define the legal regime governing the exploitation of these resources.⁹ The following sections will determine whether it is indeed possible, necessary and advisable to give an accurate definition of the celestial body notion in this context.

I.II. A priori definition

The outer space environment hosts innumerable variations of matter in widely varying physical configurations, ranging from infinitesimal particles of dust and gaseous substances to vast land masses with solid surfaces that make up the stars and planets. It is difficult to sustain that this entire range of physical manifestations should be classified as celestial bodies from a legal point of view. Some scholars have therefore

advanced a number of more or less arbitrary *a priori* criteria to legally define a subcategory thereof as celestial bodies.

First, it has been argued that the celestial body concept should comprise only certain astronomical categories, such as stars, planets and their satellites. Expanding it to comets, meteoroids and micrometeoroids would broaden the notion to inordinate extents.¹⁰ A scientific delimitation appears untenable for defining a legal concept, however, as law is only interested in regulating the activities of man. Indeed, it is commonly acknowledged that the meaning of the legal notion 'celestial body' should not necessarily correspond to that of its scientific equivalent.¹¹ It therefore stands to reason that the notion can also not be defined by reference to the scientific *subcategories* that make up the concept, as this would merely defer the problem. Furthermore, scientific taxonomy itself is susceptible to constant revision. The reclassification by the International Astronomical Union of Pluto as a Trans-Neptunian dwarf planet rather than as a full-fledged planet is the most recent example of such scientific whimsicality.¹² As the primary aim of formulating definitions is to enhance legal security, little would be gained by defining the celestial body concept with reference to related notions that are themselves amenable to constant change. Finally, little agreement exists among legal scholars as to which scientific categories should be retained for defining celestial bodies. A scientifically inspired interpretation of the notion thus appears untenable.

Most authors therefore dispense with the method of astronomical classification and immediately focus on the physical properties of the material phenomenon at hand, relying solely on such qualities as the body's size or mass to determine its legal status. As such, FASAN argues that celestial bodies are all material objects that can be transported *in toto* through outer space.¹³ A similar criterion was retained by the Working Group III of the International Institute of Space Law on the legal status of celestial bodies, which defined these bodies as all '*natural objects in outer space, including their eventual gaseous corona, which cannot be artificially moved from their natural orbits*'.¹⁴ The transportation criterion, however, disregards the potential of future technological developments that may well allow for the displacement of objects of such magnitude as to completely deprive the category of celestial bodies of any content.¹⁵ The inclusion of gaseous coronas in the definition of the Working Group III has also been denounced for running counter to common sense,¹⁶ as these phenomena rather resemble parts of outer space *sensu stricto*.¹⁷

Indeed, what little agreement exists as to the interpretation of the notion 'celestial body' is typically derived from the normal meaning of a *body* as being an individualized form of matter that distinguishes itself from the surrounding environment through its mass and structure.¹⁸ Criteria for further delimiting the notion cannot rest on any sound legal, technological or scientific basis and are therefore unwarranted. However, it appears that even a general definition of celestial bodies as denoting all objects in space that distinguish themselves through their material manifestation, is undercut by the Moon Agreement, which provides that '*[f]or the purposes of this Agreement reference to the Moon [and other celestial bodies within the solar system, other than the Earth,] shall include orbits around or other trajectories to or around it*' (Article 1 (2) *jo.* (1) MA).¹⁹

The integral applicability of the legal regime of celestial bodies to the orbits around them appears irreconcilable with the generally accepted classification of orbits around the Earth

as intrinsic parts of outer space *sensu stricto*, as was stressed time and again by the community of States in their denunciation of the 1976 Bogotá Declaration (see *infra*).²⁰ The fact that the Moon Agreement expressly excludes the Earth from the class of celestial bodies to which it is applicable (Article 1 (1) MA, see *supra*) does not change this finding, for the physical characteristics that determine the manifestation of orbits around Earth are no different from those that make up the trajectories around the Moon and other celestial bodies. Moreover, it has correctly been stated with respect to the geostationary satellite orbit (hereinafter: GSO) that orbits are not so much physical phenomena as they are fictions that exist only by virtue of the path created by artificial space objects navigating through void space.²¹ It follows that, depending on the applicable rules, orbits should be considered parts of outer space *sensu stricto* or as intrinsic components of celestial bodies, while their reliance on artificial Earth satellites should in theory subject them to the legal regime of space objects.²² It follows that an *a priori* classification of physical phenomena in outer space cannot be sustained for defining the scope of applicability of potentially diverging legal regimes.

I.III. A functional definition

The above section has argued the untenability of scientific, astronomical and purely physical criteria as a means of distinguishing between the myriad components of outer space as subjects of separate legal regimes. This does not imply, however, that the entire realm of outer space, including the Moon and other celestial bodies, should be guided by a uniform set of rules and principles. The difficulties encountered in defining the celestial body concept merely serve to show that the legal regime applicable thereto cannot be delineated by virtue of a prior definition of its subject matter. Conversely, it stands to reason that such prior definition is unwarranted if one chooses to delineate the material scope of space law provisions on the basis of their respective content, *i.e.* if one takes a functional approach to defining the component parts of the outer space sphere, depending on the applicable provision. For example, Article XII OST provides that '*[a]ll stations, installations, equipment and space vehicles on the Moon and other celestial bodies shall be open to representatives of other States Parties to the Treaty on a basis of reciprocity*'. It is clear that this provision can only apply to land masses in space that allow for the settlement of such bases as are contemplated by the provision. Therefore, if a natural object in space is sufficiently large and solid to sustain a base, it should be considered a celestial body for the purpose of this provision.²³ If it does not meet these requirements, the question of whether or not the object at issue constitutes a celestial body becomes irrelevant, as the provision cannot be deemed applicable. Similar considerations determine the applicable scope of other provisions, such as Article 8 (2) MA, which explicitly allows States Parties to the Agreement to land their space objects on celestial bodies.

The functional approach avoids the need for a prior classification of material phenomena in space and has therefore been suggested by a number of authors in order to escape the definitional dilemma of celestial bodies.²⁴ This is not to say that the approach is completely devoid of any consideration for the physical characteristics of these phenomena, however, for the activities that can be undertaken on celestial bodies are often defined by virtue of their physical composition. This renders it at times rather difficult to distinguish between a functional approach and one that relies

on a physical delimitation between celestial bodies and other parts of outer space. For example, GÁL considers celestial bodies to be all astronomical objects that are sufficiently large to allow for manned *c.q.* unmanned landing and which cannot be deviated from their orbit,²⁵ while COCCA argues that celestial bodies should at least be amenable to occupation.²⁶ As opposed to these definitions, however, the functional approach does not primarily depend on the physical qualities of the various components of outer space to rigidly determine the applicable regime, but rather allows for a more flexible regulation of human activities in space, in keeping with the characteristics of the specific spatial phenomenon with which it is concerned.

A functional approach is thus more in line with the central goal of the space treaties, which is to encourage the exploration and use of outer space, including the Moon and other celestial bodies.²⁷ The very titles of the Outer Space Treaty and the Moon Agreement already clarify that the principal aim of these treaties is to regulate the *activities* of States in outer space and on celestial bodies, rather than to determine the *legal status* of these extraterrestrial phenomena as such. There is thus little reason to apply a uniform definition of celestial bodies to a wide range of human activities that by their aim are geared toward different phenomena in space. It follows that, if two provisions are both by their wording applicable to celestial bodies only, their practical scope can nevertheless comprise two separate subcategories of material objects, should this be warranted by the concrete activity regulated by the provisions at issue. For example, it is clear that the celestial bodies referred to in Article XII OST should be capable of supporting a space station or other installation of human fabrication, thus rendering the provision only applicable to natural objects in space of a rather large magnitude with a stable composition and a solid surface. On the other hand, the nature of the activity of installing a weapon of mass destruction on celestial bodies as prohibited by Article IV OST allows extending the coverage of the provision to a much wider category of material objects in space than Article XII. Limiting its coverage to merely those celestial bodies that are suitable for landing and erecting space stations as envisaged by other provisions would render it vulnerable to circumvention and thus rather ill-suited for regulating the activity at hand.

Conversely, provisions of the Outer Space Treaty that are applicable not only to celestial bodies, but also to the outer space surrounding them and in which they are included, do not depend on any delimitation of the term 'celestial body' in order to determine their material scope, given the encompassing nature of the phrase 'outer space, including the Moon and other celestial bodies'. Most provisions of the OST for their operability thus do not rely on a definition of what constitutes a celestial body, regardless of whether this should be a functional definition or one formulated *in abstracto*, provided these provisions are also *applied indiscriminately* to all phenomena in outer space for the activities they regulate.

This point should be well understood. For various reasons explicated above, it has been argued that the functional approach is the only means of interpreting the scope of the current space law provisions by which can be arrived at a workable legal regime for the various components of outer space. As this approach is defined by the practical implications of the activity regulated by a given provision, it presupposes that provisions that do not by their wording or by their activity discriminate between outer space *sensu stricto*

and celestial bodies are also applied indiscriminately to these phenomena in practice. For example, as Article I, para. 1, OST refers to 'outer space, including the Moon and other celestial bodies' when proclaiming that activities therein shall be carried out for the benefit of all countries, the practical application of this provision does not pose any problems *only* if it is indeed applied indiscriminately to both outer space *sensu stricto* and to the celestial bodies contained therein. If, hypothetically speaking, a practice were to arise that for some reason would limit the application of this provision to celestial bodies alone, however, the only way of arriving at a workable regime in this respect would be by defining these bodies *in abstracto*, for the scope of the provision cannot be deduced from the nature of the activity concerned. Regardless of whether such practice could be justified by arguing the emergence of a norm of customary international law or through the conclusion of a new treaty, the discriminative application of a norm regulating the activity of States governed by Article I, para. 1, OST would not be practicable as it has been argued that an *a priori* definition of physical components of outer space is untenable.

The above interpretation of Article I OST so far remains firm within the realm of legal hypotheses. The problems illustrated by the example, however, are by no means illusory. This becomes clear when one looks at the current interpretation of the principle of non-appropriation as codified in Article II OST. It is telling, in this respect, that the need to define the notion 'celestial body' is typically raised when determining the applicability of this principle.

II. IMPLICATIONS FOR THE APPLICATION OF THE NON-APPROPRIATION PRINCIPLE

II.1. Indiscriminate application of the principle

Article II OST states that '*[o]uter 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*'. This provision is repeated *verbatim* in Article 11 (2) of the Moon Agreement, albeit understandably limited to the Moon and other celestial bodies.

The exact meaning of Article II OST has been subject to many controversies, particularly as regards the interpretation of the notion 'national appropriation'.²⁸ The material scope of the non-appropriation principle as applying to both outer space *sensu stricto* and celestial bodies, however, appears sufficiently clear to withstand scrutiny and has indeed never been challenged explicitly. Nevertheless, the need to define the notion 'celestial body' is most often raised with specific reference to the need to clarify the scope of application of the principle of non-appropriation.²⁹ The apparent logic behind this argumentation presupposes that by limiting the notion 'celestial body' to a subcategory of material phenomena in outer space, the corporeal objects that escape this classification should be amenable to appropriation, for they are too insignificant to constitute celestial bodies, yet at the same time cannot be assimilated with outer space *sensu stricto* because of their material manifestation. As such, it has been argued that '*[p]ursuant to the non-appropriation principle of Article II of the OST, celestial bodies cannot be appropriated. In practice, should (some) asteroids and comets be considered celestial bodies, they would fall under this prohibition; per a contrario, if they are not celestial bodies, they may become the object of [...] property rights*'.³⁰ Similarly, the abovementioned proposals that define the category of celestial bodies by reference to their capability of being captured and

transported as a whole, clearly presuppose that natural objects that can *de facto* be appropriated should also *de iure* escape the application of the non-appropriation principle. In other words, underlying the need for defining celestial bodies is the contention or implied supposition that there is a third category of phenomena in space, solely defined by its physical characteristics, that eludes the general prohibition of Article II OST.³¹

For several reasons the above argumentation must be categorically refuted. First, the contention that micrometeoroids and other small corporeal particles in outer space should constitute an intermediate category of phenomena in space amenable to appropriation is in flat contradiction with the comprehensive reach of the term 'outer space, including the Moon and other celestial bodies' as used expressly in Article II OST. Whatever natural objects the category of celestial bodies might encompass, it is clear that any material phenomenon eluding this classification should be subsumed under the overarching category of outer space (*sensu lato*).³² Second, whatever meaning is attributed to the phrase 'outer space, including the Moon and other celestial bodies' in Article II OST, this interpretation should also be extended to other provisions in the Outer Space Treaty that have a similarly defined scope. Altering the meaning of Article II OST by re-interpreting its material scope thus appears an overly broad and unwarranted measure likely to produce unintentional external effects, as it would exclude an entire range of material phenomena from space law entirely. Finally, even if it could in theory be argued that the non-appropriation principle does not apply to all components of outer space, it is practically impossible to define a subcategory of cosmic matter that is amenable to appropriation, for various reasons stated above: no scientific, technological or physical criteria can accurately define the contours of such a category, nor can they be deduced from the wording of the provision itself or from the activity regulated by it. It follows that however Article II OST should be interpreted, the provision must be applied indiscriminately to all physical components of outer space.

The Moon Agreement, for the States that have become party to it, obviously does not alter this assessment. To be sure, Article 11 (2) MA limits the application of the non-appropriation principle to celestial bodies alone, yet this is simply because the general aim of the agreement is to regulate only the activities of States undertaken on these bodies. Moreover, the lack of any clear definition of what constitutes a celestial body according to the Moon Agreement and the safety net provided by Article II OST implies that even those cosmic elements that are not subject to Article 11 (2) MA remain non-appropriable pursuant to the OST. The preamble of the Moon Agreement further clarifies that the agreement was mainly intended to further refine and develop the principles of the Outer Space Treaty with respect to celestial bodies and should thus be read in conjunction with the latter instrument.³³ The largely repetitive nature of the Moon Agreement is even often cited as one of its main deficiencies.³⁴ This suggests that the scope and wording of Article 11 (2) MA should not affect the interpretation of the non-appropriation principle in the OST.

The above merely wishes to clearly establish the inclusive reach of Article II OST as a uniform provision applying to both celestial bodies and outer space *sensu stricto*, irrespective of the meaning to be attributed to either component.³⁵ By no means is it implied that the non-appropriation principle should

also prohibit property rights on natural resources of outer space, including those of the Moon and other celestial bodies. It *does* imply, however, that whatever the outcome of the discussion on the applicability of Article II OST on natural resources, it should be the same for the resources of both celestial bodies and outer space *sensu stricto*, for these categories of resources can only be defined by reference to the physical environment in which they are found.

II.II. Appropriation of natural resources

A great deal has been written about the applicability of Article II OST to natural resources and scholars appear deeply divided over the subject. Some authors categorically deny the right of States to appropriate any form of space resources, as the general and encompassing wording of Article II OST does not allow differentiating between outer space, including celestial bodies, and the natural resources thereof.³⁶ A second school of authors renders the applicability of the non-appropriation principle dependent on the type of resources concerned. One such author is PRITZSCHE, who, in a detailed study on the legal status of natural resources in outer space, argues that both the resources of outer space *sensu stricto*, such as orbits, and the mineral reserves in place on celestial bodies should be considered non-appropriable, while a third category of so-called *eigenständige Ressourcen*, such as solar energy and natural resources removed from celestial bodies, cannot be considered subject to Article II OST.³⁷

Such categorization is difficult to sustain, however. As far as the separate classification of solar energy is concerned, it has already been argued that there are no legal grounds for devising *ad hoc* categories of physical phenomena that inexplicably elude application of certain key provisions of space law. Moreover, it is obvious that solar energy originates from the Sun and should thus in principle be covered by the same legal regime as other natural resources removed from celestial bodies. The argument according to which natural resources no longer in place on celestial bodies should be appropriable is widely shared among legal scholars. This is confirmed by Article 11 (3) MA, which expressly limits the applicability of the non-appropriation principle with regard to celestial bodies to natural resources 'in place'. At the same time, however, most authors, as well as the international community in general, vehemently oppose any type of durable and exclusive rights vested in natural resources that do not originate from celestial bodies, such as orbital positions and sections of the radio-frequency spectrum.³⁸ As such, the property claims of the equatorial countries in the 1976 Bogotá Declaration to the natural resources of the sections of the geostationary satellite orbit 'above their territories' were nearly unanimously condemned as a violation of Article II OST.³⁹ Similar outcries were heard upon the registration and subsequent leasing of several orbital slots by Tonga in the 1990s.⁴⁰ Such a dichotomy between natural resources of celestial bodies and other space resources cannot be sustained in light of the indiscriminate phrasing of Article II OST and the untenability of defining the respective physical environments from which these resources originate.

It has merely been argued so far that the non-appropriation principle cannot distinguish in its application between natural resources of celestial bodies and other space resources. This is not to say, however, that all space resources should be considered non-appropriable. Rather, it supports the view that Article II OST simply does not apply to any type of natural resource in outer space. Most authors agree that the

prohibition of national appropriation only relates to the establishment of titles with regard to territorial areas of outer space and celestial bodies.⁴¹ The main purpose of the non-appropriation principle is to avoid territorial conflicts in outer space so as to guarantee the free exploration and use thereof in accordance with Article I OST. Article II OST neither mentions nor excludes the natural resources originating in the space environment and should thus be considered inapplicable thereto.⁴² This was confirmed by the discussions on the Moon Agreement, in spite of and partially even due to the opposition to this convention. Article 11 (3) MA clearly states that natural resources of the Moon and other celestial bodies can be appropriated once removed from their place. As it was argued that the Moon Agreement should be interpreted in line with the Outer Space Treaty and Article II OST does not distinguish between the natural resources originating from celestial bodies and other space resources, one must conclude that no resources in outer space are *in se* non-appropriable. The debate on whether or not the Moon Agreement installed a moratorium on the exploitation of natural resources only confirms this view. Article 11 (5) provides that '*States Parties to this Agreement hereby undertake to establish an international regime [...] to govern the exploitation of the natural resources of the Moon as such exploitation is about to become feasible*'. Ample evidence suggests that this provision does not imply that the exploitation of natural resources on celestial bodies can only be initiated after said international regime is established.⁴³ This activity should thus be considered lawful under the Moon Agreement, even though the international regime of Article 11 (5) MA has yet to be erected.⁴⁴ Moreover, the moratorium issue underscores that the appropriation of space resources was not considered prohibited by the Outer Space Treaty either. As a moratorium entails the temporary prohibition of a previously allowed activity, the mere fact that the issue was raised during the negotiations on the Moon Agreement presupposes by definition that Article II OST was deemed inapplicable to natural resources in space.⁴⁵ In this respect, the vehement opposition to the MA due to the allegedly implied moratorium only confirms that space resources should be subject to appropriation pursuant to the OST. It follows that there is no legal ground for *a priori* barring the appropriation of the orbit-frequency spectrum and other natural resources of outer space *sensu stricto*.

For several reasons it cannot be argued that the specific wording of Article 11 MA limits the legitimacy of appropriating natural resources to those that physically originate from celestial bodies, such as mineral reserves found in the lunar regolith. First, it has been shown that the lawfulness of appropriating natural resources of celestial bodies does not depend on Article 11 MA but is immediately implied by Article II OST, the general wording of which does not legally or practically allow for a rigid distinction between the physical environments of space resources. Second, the qualification by the Moon Agreement of the natural resources of celestial bodies as the 'common heritage of mankind' (hereinafter: CHM) cannot justify a separate treatment of these resources as regards the applicability of the non-appropriation principle. Article 11 (1) MA clearly states that '*[t]he Moon and its natural resources*' are the common heritage of mankind. Thus, whatever meaning is to be attributed to the disputed CHM concept, it must determine the legal status of both the celestial bodies and of their natural resources. As it is universally agreed that the Moon and other

celestial bodies as such cannot be appropriated, the implications of the CHM qualification cannot comprise the amenability to appropriation.⁴⁶ Third, the specification in Article 11 (3) MA that the non-appropriation principle applies only to natural resources 'in place' on the Moon should not be interpreted as limiting the scope of the provision to material resources found on or underneath the surface of celestial bodies. The criterion merely serves to confirm that claims on natural resources of celestial bodies are illegitimate when not directly linked with their actual exploitation, as this would be tantamount to establishing sovereign claims over areas of these bodies; the very exploitation of these resources renders them subject to appropriation. The 'in place' criterion is thus less an indication of the physical location of natural resources on celestial bodies than it is a specification rendering the establishment of property rights on these resources conditional on their exploitation (see further *infra*). Furthermore, CHRISTOL has convincingly argued that the provisions of the Moon Agreement do not solely apply to natural resources materially 'in place' on or beneath the surface of celestial bodies, as the latter concept also comprises immaterial components given the inclusion of orbits and other trajectories in space in Article 1 (2) MA (see *supra*).⁴⁷

It cannot be argued that international practice has given rise to a norm of customary international law altering the interpretation of the non-appropriation principle so as to exempt only natural resources of celestial bodies from the prohibition to vest property rights in outer space. Despite the ambitious plans of major spacefaring nations in this direction, no actual large-scale commercial exploitation of celestial body resources has taken place so far. Conversely, the orbit-frequency spectrum is being used intensively on a daily basis; orbital positions and radio frequencies have been and continue to be leased and auctioned in various countries. If anything, international practice thus appears to support the emergence of a customary norm that affirms the tradable nature of the orbit-frequency spectrum, rather than that of mineral reserves on celestial bodies.

Finally, the selective application of Article II OST so as to exclude only the natural resources of celestial bodies cannot be attributed to a particular interpretation of the notion 'national appropriation' contained in this provision. The exploitation of the orbit-frequency spectrum essentially amounts to the temporary use of a non-depletable spatial resource that does not significantly deteriorate after intensive use. Exploiting natural resources of celestial bodies, on the other hand, more often than not takes the form of an irreversible destruction through consumption of a depletable mineral reserve. Were the notion 'national appropriation' in Articles II OST and 11 (2) MA to apply to natural resources, it would therefore appear more likely to prohibit the exploitation of celestial body resources than it would the everyday uses of the orbit-frequency spectrum that have so strenuously come under attack in recent years.⁴⁸

What has been established so far is that the non-appropriation principle is not applicable to any type of natural resource in space. The question still remains whether the exploitation of these resources is in fact an allowable use of outer space. Article I, para. 2, OST broadly proclaims that '*[o]uter space, including the Moon and other celestial bodies, shall be free for exploration and use by all States*'. While the exact interpretation of the notion 'use' in this provision is disputed, most authors agree that it includes the commercial exploitation of natural resources.⁴⁹ Main arguments in favour

of this interpretation are the permissive and enabling nature of the Outer Space Treaty in general and the open phrasing of Article I, para. 2, OST.⁵⁰ Legislative history also supports a broad reading of the notion 'use' in this provision, as it was preceded by a reference to 'exploration and *exploitation*' in UNGA Resolution 1348.⁵¹ In any event, Article I OST does not expressly prohibit the commercial exploitation of natural resources. It should thus be considered permissible pursuant to the general rules of interpretation, subject to restrictions found in other provisions of space law.⁵²

As we have seen, such restrictions do not immediately flow from Article II OST. This is not to say that all natural resources in space should be appropriable in all circumstances. It is merely argued that the exploitation of natural resources is an allowable use of outer space and celestial bodies, the appropriation of which is not prohibited *per se*. The legal regime of natural resources in space (section III) is ultimately determined by a proper understanding of the space resource concept (III.I) and of the space law principles that can be usefully applied thereto (III.II).

III. THE LEGAL REGIME OF NATURAL RESOURCES

III.I. A functional definition

The notion 'natural resource' does not have a clearly defined meaning in international law. The Outer Space Treaty does not expressly address the issue and the only international space law instruments that contain explicit provisions on natural resources fail to define it in any way. Article 11 of the Moon Agreement is largely limited to declaring natural resources of celestial bodies the common heritage of mankind (*supra*), while the other reference in international space law, Article 44 (2) of the Constitution of the International Telecommunication Union (hereinafter: ITU), merely obliges its Member States to '*bear in mind that radio frequencies and any associated orbits, including the geostationary-satellite orbit, are limited natural resources*'.

The unqualified reference to the general notion 'natural resources' in two instruments regulating physically different environments appears to confirm that the notion's meaning transcends categorisation and that there is no legal ground for distinguishing between the resources of celestial bodies and other space resources.⁵³ The above provisions also clarify that any legal definition of natural resources should not be limited to tangible resources alone. Definitions suggested in literature that focus on the material characteristics of space resources should thus be dismissed, for they would exclude orbital positions and radio frequencies, in manifest contradiction to the clear language of Article 44 (2) ITU Constitution.⁵⁴ Most authors therefore advance a broad definition of space resources, comprising both tangible and intangible resources.⁵⁵ For example, PRITZSCHE interprets the notion as referring to '*alle materiellen oder immateriellen Teile, Bestandteile und körperlich oder räumlich abgrenzbaren Erscheinungen des Weltraums einschließlich der Himmelskörper [...], die Gegenstände wirtschaftlicher Nutzung sind oder sein können*'.⁵⁶ Equally comprehensive is the definition advanced by WILL, who extends the notion to cover every material and immaterial object and phenomenon in outer space, including orbits, points, solar rays and radio frequencies.⁵⁷

Pursuant to these definitions, any component particle of outer space can theoretically be considered a natural resource.⁵⁸ As such an all-encompassing interpretation would derive the qualification of 'natural resource' of any practical relevance, however, the notion should be further

circumscribed. Most authors do so by requiring that a particular phenomenon in space produce an economic value upon transformation through human use in order to be considered a space resource.⁵⁹ A similar criterion is used to delineate the natural resource concept in international law in general.⁶⁰ This also corresponds to the definition of natural resources in Black's Law Dictionary, the relevant entry of which refers to '*any material from nature having potential economic value*'.⁶¹

It follows that the category of natural resources in space is defined by virtue of its susceptibility to exploitation, rather than by certain predefined physical characteristics. This is in line with the functional definition of the celestial body concept suggested earlier. As any phenomenon in outer space can theoretically be considered a natural resource, every single particle can in principle be categorised both as a component of a celestial body *c.q.* outer space *sensu stricto* and as a natural resource, depending on the particular context. A physical conception of natural resources would thus render impracticable any application of Article II OST, as it has been established that this provision does not apply to natural resources. Furthermore, Article II OST also prohibits the national appropriation of outer space 'by means of use'. Rendering this provision applicable to phenomena that exist only by virtue of their amenability to a certain use would be nonsensical and would disproportionately limit the legitimacy of human activities in outer space. Indeed, the principal use of outer space consists of artificial satellites being placed in orbit around Earth. This activity has been characterised as a use of a limited natural resource by the ITU Constitution. The application of Article II OST to natural resources would thus render unlawful the principal activity undertaken by States since the dawn of the space age. This can barely have been the intention of the drafters of the OST, in particular as this activity was already commonplace at the time of the negotiations.⁶²

Natural resources are defined by their use. It follows that the legal regime of these resources flows directly from the general principles of the Outer Space Treaty on the exploration and use of outer space. The main tenets of this legal regime will be discussed in the next section.

III.II. Proposal for a flexible legal regime on space resources

Thus far we have argued that it is untenable both in law and in practice to rigidly distinguish between various types of natural resources in space based solely on the physical environment in which they occur, as the applicable law does not distinguish on this basis either. This is not to say that all space resources should be governed by the exact same legal regime. Rather than resorting to an artificially bifurcated application of the non-appropriation principle, however, the legal basis for a flexible differentiation between space resources can be found in other criteria implicit in the main principles governing the exploration and use of outer space.

The cardinal principle on the use of outer space is codified in Article I, para. 2, OST.⁶³ As mentioned above, this provision pronounces outer space, including the Moon and other celestial bodies, to 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*'. Article II OST is typically interpreted as a corollary provision to this guiding principle, guaranteeing the free use of outer space by prohibiting territorial claims in space.⁶⁴ The ancillary nature of this provision thus further supports a narrow interpretation of

its scope so as to exclude natural resources. The principle of equality between all States codified in Article I, para. 2, OST is elaborated upon in Article IX OST, which stresses that ‘[i]n the exploration and use of outer space, including the Moon and other celestial bodies, States Parties to the Treaty [...] shall conduct all their activities [...] with due regard to the corresponding interests of all other States Parties to the Treaty’. To this effect, Article IX OST instructs all States to avoid ‘harmful interference’ with the activities of other States in the peaceful exploration and use of outer space.

The principles contained in Articles I and IX OST are the main provisions guiding the various uses of outer space in general and thereby also delineate the main tenets of the legal regime of space resources.⁶⁵ These tenets largely correspond to the principles guiding the use of shared natural resources in international law in general.⁶⁶ The vague nature of these provisions notwithstanding, it is possible to infer from their wording some very concrete criteria that allow us to flexibly differentiate between various types of natural resources in outer space, obviating any need to resort to a discriminative application of Article II OST.

The main goal of the Outer Space Treaty is to guarantee the undisturbed exploration and use by all States of outer space, including the Moon and other celestial bodies, as the province of mankind. The amenability of natural resources to be freely used by one State without impinging on the equal rights of other States to engage in like activities first and foremost depends on the general availability of the natural resource at hand. This availability is determined both by the physical characteristics of the specific space resource and the strategic value it has for the international community of States. These two criteria constitute the concrete application for the exploitation of natural resources of the OST principle of free use of outer space on the basis of equality with due regard to the corresponding interests of all States. In other words, the legal regime of the exploitation of natural resources of outer space, including the Moon and other celestial bodies, is determined by the *scarcity* of the particular resource, regardless of its astronomical origin.⁶⁷ Whether a space resource should be considered scarce depends on a wide variety of factors that should be carefully assessed in each case, which may vary in time and can depend on the particular use envisaged. As such, regard should be had of the physical abundance of the resource, its location and accessibility, the availability of alternative resources for the specific use concerned, whether or not the resource is of particular interest to more than one State and whether it is depleted by human exploitation.⁶⁸ Again a parallel can be drawn with the criteria that determine the use of shared natural resources in general international law.⁶⁹

The physical characteristics of phenomena in space thus once more infiltrate the natural resource discussion. The particular context in which this occurs, however, is manifestly different from the one previously considered. Rather than rigidly determining the legal status of their physical manifestation, the present consideration of the scarcity of natural resources aims to regulate their concrete exploitation. This allows for a more flexible, dynamic and above all legally correct approach to the regulation of the wide array of space resources so as to contribute to the efficient use of outer space.

The practical application of this approach may well necessitate rendering certain space resources non-appropriable, provided they are in limited supply and have a high strategic value for a large variety of States. This is where

the exploitation of the orbit-frequency spectrum enters the discussion. As already mentioned, Article 44 (2) ITU Constitution qualifies radio frequencies and any associated orbits as limited natural resources. This qualification was first introduced with respect to the geostationary satellite orbit in 1971.⁷⁰ The prevalent system in force at the time for allocating radio frequencies was an *a posteriori* method solely concerned with protecting registered satellites from harmful interference by later users. Due to the intensive use of the GSO by industrialized nations, the developing countries feared that such a ‘first-come, first-served’ system would effectively render all economically valuable slots occupied by the time they could access space. The ITU therefore set off on a series of administrative radio conferences in the 1970s and 1980s to revise its allocation methodology so as to mitigate the concerns of the developing countries regarding the consumptive exploitation of the GSO by a mere few industrialized spacefaring nations.⁷¹

The outcome of these revisions was the introduction of an *a priori* allotment plan that in principle granted all ITU Member States a future possibility to operate geostationary satellites in the so-called planned fixed satellite service (hereinafter: FSS) bands.⁷² To this effect, each administration was granted at least one allotment, comprising a nominal orbital position and a bandwidth of 800 MHz.⁷³ Further, it was specified in current Article 44 (2) ITU Constitution that all countries should be guaranteed equitable access to the orbit-frequency spectrum, ‘taking into account the special needs of the developing countries and the geographical situation of particular countries’. Finally, it had already been stressed in 1971 that registration by a prior user ‘should not provide any permanent priority’ over later users and that registrants should take all practicable measures to help non-registrants exploit space systems.⁷⁴

The above changes appear to have been inspired by the need to avoid permanent quasi-property rights being vested in a space resource by a select number of countries. Rather than constituting a selective application of the non-appropriation principle, however, the specific rules installed by the ITU instruments more likely are the concrete implementation of a legal regime of space resources determined by the criterion of scarcity. In other words, the orbit-frequency spectrum has been subjected to a specific legal regime, not because it is considered a limited *natural resource of outer space sensu stricto*, but because it is a *limited* natural resource. To be sure, the exact limits of this resource cannot be determined with any accuracy due to rapidly changing needs and technologies.⁷⁵ Nevertheless, the intensive use of the GSO renders the fear for saturation thereof more palpable than the depletion of mineral reserves on celestial bodies, the exploitation of which is still pending and largely speculative. It is therefore not surprising that the concrete implementation of the criterion of scarcity first occurred with respect to the GSO, despite the specific calls for the elaboration of an international regime for the exploitation of the natural resources of celestial bodies in the MA. Conversely, it is clear that the perceived scarcity of a particular mineral reserve with great strategic value, located on an easily accessible celestial body, would spur significant legal efforts in order to guarantee its preservation, notwithstanding the express permissibility of its exploitation and appropriation in the MA.

Article 44 (2) ITU Constitution qualifies *any* orbit associated with the use of the radio-frequency spectrum as a limited natural resource. It follows that a purported *a priori*

applicability of the non-appropriation principle to these resources should affect all orbits around Earth that are used for telecommunication purposes, regardless of the particular service for which they are used. The ITU regime is much more flexible and discriminative than such a rigid application of Article II OST could allow for, however. First, the *a priori* allotment plan devised to appease the developing countries applies only to the expansion bands of the frequency spectrum used for fixed satellite services. This covers only a mere one percent of the total spectrum allocated to space services.⁷⁶ The remaining bands are still governed by the first-come, first-served principle. Moreover, the ITU rules on radio communications do not apply to the military uses of radio frequencies, as Article 48 (1) ITU Constitution provides that Member States retain their entire freedom with regard to military radio installations.⁷⁷ Thus, it is clear that different rules are in force for different uses of the radio-frequency spectrum and associated orbits. Second, the *a priori* allotment plan distinguishes between the GSO and other orbits. We have seen that it is physically impossible, however, to accurately delineate the GSO, as an orbit is not as much a physical phenomenon as it is a legal fiction created by the path of an artificial Earth satellite. It follows that there are as many GSOs as there are geostationary satellites. Moreover, no single satellite describes a perfect GSO and frequent corrections are needed to compensate the constant oscillations of the satellite. As the GSO is thus a phenomenon that can only be identified by virtue of the use made of it by an artificial satellite, there are no physical grounds for distinguishing between the GSO and other orbits. The sole reason why specific rules regarding the GSO can and should be introduced is because its intensive use for telecommunication purposes has rendered it considerably more scarce than other orbits, such as the low and medium Earth orbits (LEO/MEO). The odds of developing countries pressing for an *a priori* regime with respect to the latter orbits depend on the likelihood that such orbits and the associated spectrum would approach scarcity.⁷⁸

The specificities of the ITU legal regime on radio communications thus reveal that it is not governed by the non-appropriation principle but rather by a flexible application of Articles I and IX OST to the exploitation of natural resources, as guided by the functional criterion of scarcity. The inapplicability of Article II OST does not imply that the entire orbit-frequency spectrum should be considered appropriable. The relative scarcity of the GSO in combination with the strategic value of FSS services may very well warrant a specific regime shielding them from national appropriation. However, the free use of outer space by all States is not served by declaring all orbits and services non-appropriable, physically limited though they may be, if their strategic value is limited as well. For example, satellites used for direct broadcasting services typically require only orbital slots that cover the territory of the State receiving the signals. The competition over the orbit-spectrum resource for these services will thus be limited to a specific geographic region, hence arguably allowing for more intrusive rights than when considering fixed satellite services.⁷⁹ The reference to 'the geographical situation of particular countries' in Article 44 (2) ITU Constitution could be interpreted in this sense as a criterion concretizing the strategic value of the orbit-frequency resource (see *supra*).

The inapplicability of Article II OST also largely renders void the discussions on how to qualify the rights States can

exercise with respect to the orbit-frequency spectrum. Manifest are the objections to the current use of the GSO as purportedly constituting a form of *de facto* appropriation.⁸⁰ These objections cannot hold, however, if one accepts that the GSO is a natural resource and in this respect is not subject to the non-appropriation principle.⁸¹ *A contrario*, it might be argued that, as no distinction can be made between outer space *sensu stricto* as a territory and as a natural resource, Article II OST should be deemed applicable to the GSO as an intrinsic part of outer space.⁸² However, this would fail to appreciate the full implication of the functional approach to both the definition of space resources and of outer space. The GSO is defined solely by the trajectory of an artificial satellite, which represents a particular use of outer space as a natural resource. As an orbit is thus not a physical phenomenon and its component positions are not fixed at a certain point in outer space, it cannot be equated with the territory of outer space *sensu stricto* and therefore escapes application of Article II OST.

Conversely, it follows that orbital positions allotted to a certain administration must be used by that administration in order to be subjected to the regime of natural resources and elude the non-appropriation principle. The placing of a satellite in orbit around Earth can in this respect be seen as an act similar to that of removing a natural resource from its place in the (sub)soil of a celestial body as contemplated by the Moon Agreement. This ties in with the interpretation given to the 'in place' criterion in Article 11 (3) MA as not solely applying to tangible resources (see *supra*). Allocating a void part of outer space to a State that has no means or intention of using it is tantamount to a territorial claim to an area of outer space and thus explicitly prohibited by Article II OST. In this light, the measures taken by the ITU to combat the so-called 'paper satellite' problem spurred by the actions of Tonga are not merely a matter of good administration, they are necessary to ensure that the legal regime of the orbit-frequency spectrum is in line with the OST.⁸³ To be sure, the instruments of the ITU are international conventions through which the States Parties may deviate from previously committed engagements, such as the OST.⁸⁴ However, the practice of allotting positions and frequencies to States not in a position of using them might very well run counter to the instruments of the ITU as well, for it negates the qualification of the orbit-frequency spectrum in Article 44 (2) ITU Constitution as a '*limited natural resource, [to] be used rationally, efficiently and economically*'.⁸⁵

CONCLUDING REMARKS

The article has argued that the different components of the outer space environment can only be defined from a legal point of view with reference to the activities that are allowed in or upon them. It is commonly agreed that the exploitation of natural resources is a legitimate activity that is not expressly regulated by the provisions of the Outer Space Treaty. It follows that whatever provisions are applicable to natural resources in space, they cannot discriminate between different types of resources unless such distinction is implied by the specific activity regulated by a given provision. The Moon Agreement does not affect this finding.

The criterion of scarcity implicit in Articles I and IX OST allows for a flexible regulation of the wide variety of space resources, taking into account their physical abundance and strategic value for the international community of States. In this light, a selective application of Article II OST to the orbit-

frequency spectrum is untenable, unwarranted and insufficient for a workable regulation of space resources. First, the phrasing of this provision and the nature of the activity do not allow for a discriminative application to different types of space resources. Further, the rigidity of a distinction between the appropriation of celestial body resources and the orbit-frequency resource is inapt for an efficient exploitation of the entire array of resources in outer space. Finally, the application of the non-appropriation principle to space resources cannot guarantee the free and undisturbed use of outer space by all States. Rendering orbital slots non-appropriable as such does not contribute to the accessibility of the GSO for non-spacefaring nations. Further, practice has shown that categorising the GSO as non-appropriable has not kept States from leasing their allotments and launching satellites into slots pre-registered by other administrations. Conversely, mineral reserves on celestial bodies are commonly regarded as appropriable yet it is clear that such legal designation has little value without the actual act of exploitation. Moreover, the legal regime of these resources is not definitively settled by deciding on the inapplicability of the non-appropriation principle, as it is clear that a scarce mineral reserve with great strategic value should not be susceptible to appropriation by a single State.

The above complexities do not arise when one accepts that natural resources hinge upon their amenability to exploitation for arising as a separate category subject to regulation by space law. The criterion of scarcity is sufficiently versatile to guarantee the efficient management of the wide array of space resources while fully respecting the main principles of space law and furthering the main goal of free and undisturbed use of outer space, including the Moon and other celestial bodies, by all States without discrimination.

¹ The term 'phenomenon' is used here to indiscriminately indicate all material and immaterial components of outer space, subject to further qualification.

² See the reports of the Working Group III of the International Institute of Space Law (hereinafter: IISL) on the legal status of celestial bodies, published in the 1962-1966 IISL Proceedings of the colloquium on the law of outer space (hereinafter: 'IISL Proceedings').

³ See the Declaration of legal principles governing the activities of States in the exploration and use of outer space in UNGA Res. 1962 (XVIII) of 13 December 1963; UNGA Res. 1721 (XVI) of 20 December 1961 on international co-operation in the peaceful uses of outer space.

⁴ On the significance of this substitution, see B. CHENG, "Introducing a new term to space law: 'Outer void space'", 11 *Korean Journal of Air & Space Law* 1999, 321-324.

⁵ The 1967 report of the Working Group III reveals a consensus that the OST severely diminishes the need to come up with a definition of what constitutes a celestial body.

⁶ See, for example, V. POP, *Who owns the Moon?*, Berlin, Springer, 2009, 47-58.

⁷ B. CHENG, "Properly speaking, only celestial bodies have been reserved for use exclusively for peaceful (non-military) purposes, but not outer void space", in M.N. SCHMITT (ed.), *International law across the spectrum of conflict*, Newport, Naval War College, 2000, 80.

⁸ See, for example, R. OOSTERLINCK, "Tangible and intangible property in outer space", 39 *IISL Proceedings* 1996, 276.

⁹ I.H.PH. DIEDERIKS-VERSCHOOR, "The legal status of artificial space objects", 24 *IISL Proceedings* 1981, 93; K.U.

PRITZSCHE, *Natürliche Ressourcen im Weltraum – das Recht ihrer wirtschaftlichen Nutzung*, Frankfurt am Main, Peter Lang, 1989, 89-91; A. GÓRBIEL, "Twenty years of the international space law development in the United Nations", 50 *Nordic Journal of International Law* 1981, nr. 16.

¹⁰ G.P. ZHUKOV, "The problem of the definition of outer space", 10 *IISL Proceedings* 1967, 273; G. GÁL, *Space law*, Leiden, Sijthoff, 1969, 186-187.

¹¹ E. VASSILIEVSKAIA, "Les problèmes juridiques de la mise en valeur de la Lune et des planètes", in A. PIRADOV (ed.), *Le droit international de l'espace*, Moscow, Editions du Progrès, 1976, 148.

¹² IAU General Assembly Resolutions B5 and B6 of 24 August 2006, available at http://www.iau.org/static/resolutions/Resolution_GA26-5-6.pdf (accessed 4 August 2010). See also L.I. TENNEN, "Legal implications of the IAU Resolutions on planet definition: Some preliminary observations", 49 *IISL Proceedings* 2006, 526-529.

¹³ E. FASAN, *Weltraumrecht*, Mainz, Krausskopf, 1965, 113.

¹⁴ See Art. 1 of the Draft Resolution of the Working Group III, 1965 IISL Proceedings, 352.

¹⁵ See the comments of HALEY and SZTUCKI in the discussions of the Working Group III in the 1965-1966 IISL Proceedings; R. FROHN, *Internationalisierung von Himmelskörpern*, Berlin, Verlag, 1969, 69; M.G. MARCOFF, *Traité de droit international public de l'espace*, Fribourg, Editions Universitaires de Fribourg Suisse, 1973, 242.

¹⁶ See the comments of SZTUCKI, *supra* note 15.

¹⁷ When used without further qualification, the notion 'outer space' in this article includes the Moon and other celestial bodies. The phrase 'outer space *sensu stricto*' denotes the part of outer space that does not comprise the celestial bodies. No legal content is attributed to this notion as such; it should only be read in relation/contrast to the concept 'celestial body'.

¹⁸ See E. VITT, "Begriffsdefinitionen", in K.-H. BÖCKSTIEGEL (ed.), *Handbuch des Weltraumrechts*, Cologne, Heymann, 1991, 51-54; F.G. RUSCONI, "An essay on the lawful concept of heavenly bodies", 9 *IISL Proceedings* 1966, 58; A.D. ROTH, *La prohibition de l'appropriation et les régimes d'accès aux espaces extra-terrestres*, Paris, Presses Universitaires de France, 1992, 103; P. DELVILLE, "Réflexions sur le principe de non-appropriation de l'espace extra-atmosphérique et des corps célestes", 63 *Revue Française de Droit Aérien & Spatial* 2009, 138; M. LACHS, "The international law of outer space", 113 *Recueil des Cours* 1964-III, 51; J. KISH, *The law of international spaces*, Leiden, Sijthoff, 1973, 47.

¹⁹ Art. 1 (3) MA further specifies that '[the Moon] Agreement does not apply to extraterrestrial materials which reach the surface of the Earth by natural means'. This provision does little to clarify the meaning of the term 'celestial body', however, as it is merely intended to exclude meteors and meteorites from the scope of the Moon Agreement. This does not preclude these same objects from being considered celestial bodies when still in outer space (*i.e.* meteoroids).

²⁰ Declaration of 3 December 1976 of the first meeting of equatorial countries, ITU Doc. WARC-BS (1977) 81-E.

²¹ See the submission of Belgium in reaction to the Bogotá Declaration in the UN Committee on the Peaceful Uses of Outer Space (hereinafter: UN COPUOS), referenced in S. GOROVE, "The geostationary orbit: Issues of law and policy", 73 *American Journal of International Law* 1979, 452-453.

²² See, for example, W.N. WHITE, JR., "Real property rights in outer space", 40 *IISL Proceedings* 1997, 370.

²³ E. VITT, *supra* note 18, 53.

²⁴ I. CSABAFI and S. RANI, "The law of celestial bodies", 6 *Indian Journal of International Law* 1966, 196; A.S. PIRADOV, *International space law*, Honolulu, University Press of the Pacific, 2000, 114; M.G. MARCOFF, *supra* note 15, 240; G. GÁL, *supra* note 10, 186-187; E. VITT, *supra* note 18, 51-54.

²⁵ G. GÁL, *supra* note 10, 186.

²⁶ A.A. COCCA, "Legal status of celestial bodies and economic status of celestial products", 5 *IISL Proceedings* 1962, 4.

²⁷ See Art. I, para. 2, OST and the preambles of the OST and the MA.

²⁸ In general, see S. FREELAND and R. JAKHU, "Article II", in S. HOBE, B. SCHMIDT-TEDD and K.-U. SCHROGL (eds.), *Cologne commentary on space law*, Cologne, Heymann, 2009, 44 and references.

²⁹ See, for example, I. CSABAFI and S. RANI, *supra* note 24, 213; V. POP, *supra* note 6, 47-58; E. FASAN, *supra* note 13, 112-113; G. GÁL, *supra* note 10, 201.

³⁰ V. POP, *supra* note 6, 50.

³¹ See also S.M. WILLIAMS, "Utilization of meteorites and celestial products", 12 *IISL Proceedings* 1969, 180.

³² A. GÓRBIEL, "L'étendue du terme 'le corps céleste' dans le droit international public", 34 *Revue Française de Droit Aérien & Spatial* 1980, 248; E. VASSILIEVSKAÏA, *supra* note 11, 149; A.D. ROTH, *supra* note 18, 102-103.

³³ See also C.Q. CHRISTOL, *The modern international law of outer space*, New York, Pergamon, 1982, 378.

³⁴ S.E. DOYLE, "Issues of sovereignty and private property", in M. BENKÖ (ed.), *Luft- und Weltraumrecht im 21. Jahrhundert*, Cologne, Heymann, 2001, 316-325.

³⁵ See also G. GÁL, *supra* note 10, 192.

³⁶ S. GOROVE, "Limitations on the principle of freedom of exploration and use in the Outer Space Treaty: Benefits and interests", 13 *IISL Proceedings* 1970, 74; E. BROOKS, "Control and use of planetary resources", 11 *IISL Proceedings* 1968, 342.

³⁷ K.U. PRITZSCHE, *supra* note 9, 87-96. Similar: M. WILL, *Solar power satellites und Völkerrecht*, Stuttgart, Boorberg, 2000, 142-143.

³⁸ J.C. THOMPSON, "Space for rent: The International Telecommunications Union, space law, and orbit/spectrum leasing", 62 *Journal of Air Law & Commerce* 1996, 306-308; S. CAHILL, "Give me my space: Implications for permitting national appropriation of the geostationary orbit", 19 *Wisconsin International Law Journal* 2001, 231; P.A. SALIN, "Orbites, fréquences et astéroïdes à l'heure de la commercialisation des activités spatiales", 26 *Annals of Air & Space Law* 2001, 179.

³⁹ J.C. THOMPSON, *ibid.*

⁴⁰ D. RIDDICK, "Why does Tonga own outer space?", 19 *Air & Space Law* 1994, 21.

⁴¹ C.W. JENKS, "Property in Moon samples and things left upon the Moon", 12 *IISL Proceedings* 1969, 148; B. CHENG, "Le Traité de 1967 sur l'Espace", 95 *Journal du Droit International* 1968, 568; S.M. WILLIAMS, "The law of outer space and natural resources", 36 *International & Comparative Law Quarterly* 1987, 146; D. GOEDHUIS, "Some recent trends in the interpretation and the implementation of the rules of international space law", 20 *Columbia Journal of Transnational Law* 1981, 219; S. GOROVE, "Sovereignty and

the law of outer space re-examined", 2 *Annals of Air & Space Law* 1977, 321; W.N. WHITE, JR., "Interpreting Article II of the Outer Space Treaty", 46 *IISL Proceedings* 2003, 175; S. HOBE, "Adequacy of the current framework relating to the extraction of natural resources in outer space", 32 *Annals of Air & Space Law* 2007, 126.

⁴² K.U. PRITZSCHE, "Die Nutzung natürlicher Ressourcen", in K.-H. BÖCKSTIEGEL (ed.), *supra* note 18, 567.

⁴³ See the submissions of the US to the UN COPUOS and the understanding adopted by the Committee itself in its 1979 report: C.Q. CHRISTOL, *supra* note 33, 298-303; M.L. SMITH, "The commercial exploitation of mineral resources in outer space", in T.L. ZWAAN (ed.), *Space law: Views of the future*, Deventer, Kluwer, 1988, 52.

⁴⁴ This view was confirmed by the replies received to the questionnaire submitted by GOEDHUIS to the Space Law Committee of the International Law Association in 1982: see S.M. WILLIAMS, *supra* note 41, 145-146.

⁴⁵ S. HOBE, *supra* note 41, 124-125; M.L. SMITH, *supra* note 43, 47; S. GOROVE, *supra* note 21, 449-450.

⁴⁶ Interestingly, both the Argentine and US drafts of the MA limited the CHM qualification to the natural resources of celestial bodies, excluding celestial bodies as such.

⁴⁷ C.Q. CHRISTOL, *supra* note 33, 305-308.

⁴⁸ See S. GOROVE, "Interpreting Article II of the Outer Space Treaty", 37 *Fordham Law Review* 1969, 353.

⁴⁹ E. BROOKS, *supra* note 36, 344; E.G. VASSILIEVSKAÏA, "Notions of 'exploration' and 'use' of natural resources of celestial bodies", 20 *IISL Proceedings* 1977, 476; S. HOBE, *Die rechtlichen Rahmenbedingungen der wirtschaftlichen Nutzung des Weltraums*, Berlin, Duncker und Humblot, 1992, 66; K.U. PRITZSCHE, *supra* note 42, 565; K.-H. BÖCKSTIEGEL, "Legal implications of commercial space activities", 24 *IISL Proceedings* 1981, 26; E.R.C. VAN BOGAERT, *Aspects of space law*, Deventer, Kluwer, 1986, 41.

⁵⁰ S.E. DOYLE, *supra* note 34, 315-316.

⁵¹ UNGA Res. 1348 (XIII) of 13 December 1958 on the question of the peaceful use of outer space. The negotiation history of the OST further confirms this reading: see S. HOBE, "Article I", in S. HOBE, B. SCHMIDT-TEDD and K.-U. SCHROGL (eds.), *supra* note 28, nr. 14.

⁵² K.-H. BÖCKSTIEGEL, "Die kommerzielle Nutzung des Weltraums", in K.-H. BÖCKSTIEGEL (ed.), *supra* note 18, 279.

⁵³ See also A.D. ROTH, *supra* note 18, 79.

⁵⁴ See, for example, the definition in R.V. DEKANOSOV, "Weltraum, Himmelskörper, ihre Ressourcen und der Begriff 'gemeinsame Erbe der Menschheit'", in INSTITUT FÜR STAAT UND RECHT DER AKADEMIE DER WISSENSCHAFTEN DER UDSSR (ed.), *Weltraum und Recht*, Moscow, 1985, 19.

⁵⁵ See the excellent dissertation on the legal regime of space resources in M.S. MCDUGAL, H.D. LASSWELL and I.A. VLASIC, *Law and public order in space*, New Haven, Yale UP, 1963, 749.

⁵⁶ K.U. PRITZSCHE, *supra* note 9, 17.

⁵⁷ M. WILL, *supra* note 37, 59-60.

⁵⁸ L. PEREK, "Outer space as natural resource", in R.-J. DUPUY (ed.), *The settlement of disputes on the new natural resources*, The Hague, Nijhoff, 1983, 222.

⁵⁹ M. MIKLÓDY, "Einige Bemerkungen zur Frage der Eigentumsrechte an Mineralschätzen der Himmelskörper", 22 *IISL Proceedings* 1979, 177, referring to a similar criterion proposed by VASSILIEVSKAÏA; A.D. ROTH, *supra* note 18, 79.

⁶⁰ See S. PAQUEROT, *Le statut des ressources vitales en droit international*, Brussels, Bruylant, 2002, 15.

⁶¹ Black's Law Dictionary, 9th ed., 2009.

⁶² R. WOLFRUM, "Einzelne Formen der Nutzung des Weltraums: Geostationäre Umlaufbahn", in K.-H. BÖCKSTIEGEL (ed.), *supra* note 18, 364.

⁶³ K.U. PRITZSCHE, *supra* note 9, 32-35.

⁶⁴ S. FREELAND and R. JAKHU, *supra* note 28, nr. 12; S. HOBE, *supra* note 41, 123; P. DELVILLE, *supra* note 18, 142.

⁶⁵ C.W. JENKS, *Space law*, London, Stevens, 1965, 275; I. CSABAFI and S. RANI, *supra* note 24, 228. Both determine the legal regime of space resources solely by virtue of the general rules on the use of space, without resorting to Art. II OST.

⁶⁶ It is not argued here that space resources should be equated with shared natural resources. However, the principles guiding the use of both resources show striking similarities: see, for example, Artt. 5 and 7 of the Convention of 21 May 1997 on the law of the non-navigational uses of international watercourses. See further J. RAINNE, "The work of the International Law Commission on shared natural resources: The pursuit of competence and relevance", 75 *Nordic Journal of International Law* 2006, 321. See also the general principles on the use of natural resources in international (environmental) law listed in R. BARNES, *Property rights and natural resources*, Oxford, Hart, 2009, 231-248; P. BIRNIE, A. BOYLE and C. REDGWELL, *International law and the environment*, Oxford, Oxford UP, 2009, 190-205.

⁶⁷ See the detailed assessment of a legal regime of space resources based on this criterion in M.S. MCDUGAL, H.D. LASSWELL and I.A. VLASIC, *supra* note 55.

⁶⁸ The exhaustible nature of space resources is frequently mentioned as a relevant consideration for determining their legal regime, without, however, fully contemplating the implications of this criterion. See, for example, C.W. JENKS, *supra* note 65, 275; E. BROOKS, *supra* note 36, 345-346; L. VIHKARI, *From manganese nodules to lunar regolith*, Rovaniemi, University of Lapland, 2002, 25; S.M. WILLIAMS, *supra* note 31, 183; R.V. DEKANOSOV, "Juridical nature and status of the resources of the Moon and other celestial bodies", 23 *IISL Proceedings* 1980, 7; M. WILL, *supra* note 37, 59; C.Q. CHRISTOL, *supra* note 33, 416-417; P.M. STERN and L.I. TENNEN, "Private enterprises and the resources of outer space", 48 *IISL Proceedings* 2005, 243; K.U. PRITZSCHE, *supra* note 9, 112 and references; P. DELVILLE, *supra* note 18, 146. The criterion is sometimes taken into account in order to determine the applicability of Art. II OST: see S. GOROVE, "Interpreting Article II of the Outer Space Treaty", 11 *IISL Proceedings* 1968, 41. However, it has already been argued that the criterion of scarcity flows from Artt. I and IX OST rather than Art. II OST.

⁶⁹ See Art. 6 of the Convention on international watercourses, *supra* note 66.

⁷⁰ Resolution 2-1 of 17 July 1971 of the World Administrative Radio Conference for Space Telecommunications, 23 *U.S.T.* 1527, 1686. See also M.A. ROTHBLATT, "ITU regulation of radio communication", 18 *Stanford Journal of International Law* 1982, 8.

⁷¹ For an overview of these evolutions, see F. LYALL and P.B. LARSEN, *Space law: A treatise*, Farnham, Ashgate, 2009, 199; J.C. THOMPSON, *supra* note 38, 290-297.

⁷² T. TJELTA, A.L. LILLEBØ and E.O. EVENSTAD, "ITU-R World Radiocommunication Conference", January 2008,

available at http://www.telenor.com/telektronikk/volumes/pdf/1.2008/Page_144-159.pdf (accessed 13 August 2010), 151.

⁷³ See Appendix 30B of the ITU Radio Regulations.

⁷⁴ Resolution 2-1, *supra* note 70.

⁷⁵ UN COPUOS study of 29 August 1977 on the physical nature and technical attributes of the geostationary orbit, UN Doc. A/AC.105/203, 1.

⁷⁶ J.C. THOMPSON, *supra* note 38, 295; R. JAKHU, "Developments in the international law of telecommunications: Strategic issues for a global telecommunication market", 83 *American Society of International Law Proceedings* 1989, 391.

⁷⁷ R. JAKHU and K. SINGH, "Space security and competition for radio frequencies and geostationary slots", 58 *Zeitschrift für Luft- und Weltraumrecht* 2009, 88.

⁷⁸ S. MOSTESHAR, "Development of the regime for the low earth orbit and the geostationary orbit", in G. LAFFERRANDERIE and D. CROWTHER (eds.), *Outlook on space law over the next 30 years*, Dordrecht, Kluwer, 1997, 88 and 102.

⁷⁹ M.L. STERN, "Communication satellites and the geostationary orbit: Reconciling equitable access with efficient use", 14 *Law & Policy in International Business* 1982, 868-870.

⁸⁰ See France's submission to the 1969 UN COPUOS session, referenced in C.Q. CHRISTOL, "The geostationary orbital position as a natural resource of the space environment", 26 *Netherlands International Law Review* 1979, 10-11. See also P.A. SALIN, *supra* note 38, 190;

⁸¹ S. GOROVE, *supra* note 21, 449.

⁸² In this sense, K.U. PRITZSCHE, *supra* note 9, 89.

⁸³ Recent ITU actions to combat paper satellites include a reduction of the time limit for bringing into use a registered satellite and a due diligence measure requiring a State to provide evidence of the seriousness of its intention to establish a satellite network.

⁸⁴ A.D. ROTH, *supra* note 18, 242.

⁸⁵ J.C. THOMPSON, *supra* note 38, 299-302; M. SMITH, "Space WARC 1985: The quest for equitable access", 3 *Boston University International Law Journal* 1985, 255.