

Legal Regulation of Commercial Exploitation of Outer Space Resources and China's Countermeasures

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How to cite this paper: Wang, C., & Wang, J. Y. (2024). Legal Regulation of Commercial Exploitation of Outer Space Resources and China's Countermeasures. *Beijing Law Review*, 15, 1040-1064.
<https://doi.org/10.4236/blr.2024.153063>

Received: June 20, 2024

Accepted: July 30, 2024

Published: August 2, 2024

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Abstract

With the increasing commercial exploitation of outer space resources, countries have strengthened legal regulations in this field. As one of the major countries in space exploration and commercialization, the United States has accumulated rich experience in legal regulations for the commercial exploitation of outer space resources. This paper conducts an in-depth study on the legal regulations for the commercial exploitation of outer space resources recently issued by international organizations and the United States, including their legislative backgrounds, main legal frameworks, and implementation effects. It also analyzes the current situation of China's legal regulations on the commercial exploitation of outer space resources. The paper proposes ways to optimize and improve China's legal regulations. Through comparative research, this paper aims to provide useful insights for the legal regulation of the commercial exploitation of outer space resources in China, promoting the rapid, efficient, sustainable, and orderly development of China's commercial exploitation of outer space resources.

Keywords

Commercial Exploitation of Outer Space Resources, International Legal Regulation, Outer Space Treaty, Optimizing and Upgrading Path

1. Introduction

In the field of international legal regulations, issues such as ownership, use rights, development rights, international cooperation, and benefit sharing related to outer space resources, as well as the legal status of space activity entities, space intellectual property protection, space commercial transportation services,

and space resources, need to be improved and developed urgently. This article examines the latest legal regulations in this field represented by Western countries such as the United States, aiming to explore ways to optimize and enhance China's legal regulations for the commercial exploitation of outer space resources. Through in-depth research on the legal regulations of international and American laws regarding the commercial exploitation of outer space resources, this article denies and avoids the parts that violate international law and seek personal gain, and draws on its feasible parts to provide inspiration for China. Combining with China's actual situation, the article proposes optimization and enhancement paths, including position and attitude, domestic laws and regulations recommendations, international cooperation and exchange, and the development and enhancement of hard power, with the aim of providing useful references for China's legal regulations construction for the commercial exploitation of outer space resources and promoting China's outer space resource development undertakings to a new height. More comprehensive, specific, and feasible legal regulatory measures should be formulated.

2. Domestic and Foreign Scholars' Research on Legal Issues Related to Space Resources

With the development of human space technology capabilities, the trend of commercialization and privatization of space resource activities has gradually emerged. However, the current international space law lacks specific rules for governing space resource activities, and even the basic principles widely recognized by the international community for all outer space activities, their interpretation and legal effects applicable to space resource activities are also highly controversial. Existing international treaties on outer space law have obvious limitations in terms of their era. As international exploration and utilization activities of outer space resources continue to develop, foreign scholars have conducted in-depth research on the legal issues associated with space resource activities. Domestic academic research on space resource activities started relatively late, but with the steady growth of China's space capabilities, Chinese scholars have captured the realistic trends of commercialization and privatization of space resource activities and begun to sort out related legal issues. Domestic research on space resource governance mainly focuses on the following aspects: 1) The legal status and rights attribution of space resources; 2) The international legal basis for commercialized and privatized space resource activities; 3) The construction of an international system for space resource governance and China's response.

2.1. Domestic Academic Research on Legal Issues Related to Space Resource Activities

2.1.1. Legal Attributes of Outer Space Resources

Many studies emphasize that the legal attribute of outer space resources is the common heritage of mankind, and their legal attributes urgently need to be clar-

ified. Xu Xiangmin and Wang Yan (2007) argue that the current principles, rules, and systems related to the utilization and environmental protection of outer space resources confirm that outer space resources are shared by all mankind, which all countries can freely survey, utilize, and develop them. Liao Minwen (2018) argues that the moon and other celestial bodies differ from other intangible natural resources in outer space that cannot be touched, whether in original place or moved, and their rights and interests bring socioeconomic value that is the common property of all mankind.

Scholars have different opinions on whether the legal attribute of outer space resources is a common property or a *res nullius*. Li Shouping (2017) argues that the attribute of outer space resources should be the common property of mankind and points out that there is a direct correlation between the attribute of outer space resources as common property and their attribute as the common heritage of mankind. Some scholars believe that the legal attribute of outer space resources is a *res nullius*. Yan Yongliang (2019) advocates that “small space objects floating in outer space with unstable orbits” should be defined as “movable *res nullius*”, allowing countries to freely retrieve such space minerals.

2.1.2. The Legality of Space Resource Development

Against the backdrop of the increasing commercialization and privatization of space resource activities, Chinese scholars have begun to verify whether there is international legal support for non-governmental private entities to carry out commercial space resource activities, focusing mainly on the interpretation of Article II of the Outer Space Treaty, which prohibits appropriation. Under traditional international space law, the subjects of space activities are states and intergovernmental international organizations. The commercial utilization of outer space attracts private entities to join space activities, leading to a diversified development trend in the subjects of space resource activities. Professor Li Shouping (2013) believes that one of the urgent legal issues to be resolved is whether non-governmental private entities are qualified subjects of space resource activities. Scholar Yan Yongliang (2019) combines the statements of various countries during the negotiations of the Outer Space Treaty and the inherent logical relationship between the principle of non-appropriation and Articles I, VI, and IX of the Treaty, refuting the view that the principle of non-appropriation should be interpreted literally as restricting only states and not private entities from occupying space resources.

2.1.3. Rights Attributes of Outer Space Resources

Some scholars advocate the theory of no right to outer space resources. Ling Yan (2006) believes that countries should prohibit private possession of the moon and other celestial bodies in domestic law. Luo Yangdie (2021) argues that the right to utilize satellite orbit resources is a limited usage right rather than ownership, and the right holder can obtain the usage right through succession.

Some scholars advocate the theory of possession rights over outer space re-

sources. Jia Hailong (2010) argues that ownership of outer space resources is possible and that the international community should establish a legal system of outer space property rights to provide a favorable legal environment for their development.

Some scholars advocate the theory of priority development rights over outer space resources. Duan (2024) argues that states, other non-state entities authorized by states, and natural persons can obtain rights separated from ownership of outer space resources through “priority development,” including mining rights and distribution rights.

2.2. Foreign Academic Research on Legal Issues Related to Space Resource Activities

Foreign academic research on legal issues associated with space resource activities started earlier and has also launched intense discussions on whether the commercialization and privatization of space resource activities have an international legal basis. Drawing on legal sources such as international treaties, space soft law, international customs, and relevant domestic law provisions, combined with international developments in space resource activities, foreign scholars have deeply explored the limitations or tacit recognition of existing international legal norms on commercialized and privatized space resource activities. The broad provisions of international treaty texts have led to different interpretations among foreign scholars, focusing on analyzing where the boundary of restrictions on space resource activities lies under the principle of non-appropriation, whether the principle of the common heritage of mankind applies to governing space resource activities, the model of distribution of space resource property rights, and the construction of future international systems. Regarding the limitations of the principle of non-appropriation on the commercialization and privatization of space resource activities, unlike domestic scholars who almost unanimously believe that non-governmental private entities are also subject to the principle of non-appropriation, foreign scholars have some differences on this issue. Scholar Stephen Gorove (1969) made a restrictive interpretation of the applicable subjects of the principle of non-appropriation based on the literal meaning of Article II of the Outer Space Treaty as early as 1969, arguing that this principle does not apply to non-governmental private entities. Although such a view was uncommon at the time, it has been re-adopted today with the rapid development of space technology and the increasing feasibility of the commercialization and privatization of space resources. Scholar Brandon C. Gruner (2004) emphasizes that the interpretation of the principle of non-appropriation has deviated from the original intention of formulating the Outer Space Treaty. Scholar Abigail Pershing (2019) systematically reviewed the changes in the interpretation of the principle of non-appropriation over the past five decades from the perspectives of national practice, legislation, and academic views. She concluded that the scope and objects of application of the principle of non-appropriation have gradually narrowed from the initial broad interpretation

path. National practice has even formed a new international custom, namely, that the principle of non-appropriation does not apply to space resources extracted or removed from celestial bodies.

In analyzing the feasibility of applying the principle of the common heritage of mankind to governing space resource activities, foreign scholars focus on exploring the dynamic development process of the principle of the common heritage of mankind in international law and comparing and drawing on the practical experience of applying this principle to the governance of natural resources in other global commons such as the international seabed area, the Antarctic region, and the Arctic region. There have been many controversies surrounding the principle of the common heritage of mankind since its inception. First, there is no consensus on the basic concept and constituent elements of the common heritage of mankind. Scholar **Christopher C. Joyner (1986)** points out that the common heritage of mankind is neither a *res nullius* nor a common property, and neither all mankind nor any country can claim ownership or sovereignty over it. All subjects only enjoy reasonable usage rights over the common heritage of mankind under certain circumstances.

2.3. Analysis of Scholars' Viewpoints

Domestic and Foreign Academic Research on Legal Issues Related to Space Resources

Both domestic and foreign academic circles have realized that the existing international legal framework for space resource governance is outdated and cannot effectively respond to the legal challenges brought about by the recent developments in the commercialization and privatization of space activities. Domestic and foreign literature have different focuses in this research. Domestic literature explores the legal status of space resources and other urgent legal issues in the process of the commercialization and privatization of outer space at a more macro level, proposes suggestions for improving the international framework for space resource governance, and contributes valuable opinions for China's response. Foreign literature, guided by practical issues and realistic needs, analyzes in more detail and depth the legal basis for space resource property rights and proposes suggestions to safeguard and incentivize non-governmental private entities to participate in space resource activities.

However, regarding the legal attribute of outer space resources, the academia and politics broadly agree and support the theory of the common heritage of mankind. Nevertheless, further discussion is needed on whether outer space resources belong to the common heritage of mankind. The term "common heritage of mankind" ultimately boils down to the phrase "common heritage". The concept of "heritage" originated and is widely used in the field of civil and commercial law. It may be appropriate to analyze "the common heritage of mankind" in the context of "shared heritage" in civil and commercial law. In the field of civil and commercial law, under the theory of absolute succession, there are two interpretations of shared heritage: one is the Roman law doctrine, which

advocates that shared heritage is jointly owned by shares, and the other is the Germanic law doctrine, which advocates that shared heritage is jointly owned by the entire group. The Roman law doctrine of “joint ownership by shares” can be traced back to the Twelve Tables of Roman Law: “Debts and obligations shall be legally divided and attributed to the co-heirs.” In other words, under the Roman law doctrine, shared heritage is ultimately recognized as the individual rights and obligations, unrelated to the rights and obligations of the group, and individuals have the right to divide and dispose of their share in the shared heritage (Fang, 2022). As for the Germanic law doctrine of “joint ownership,” this interpretation essentially states that in a family group, the death of one family member does not affect the rights and obligations of the entire family group, meaning that the deceased’s heritage belongs to the family group, which is a comprehensive entity constructed by all family members.

Based on this, the “common heritage of mankind” faces two urgent issues that require argumentation: Who left the “common heritage,” and should it be jointly owned by shares or jointly owned? Regarding who left the heritage of outer space resources, this cannot be scientifically and rationally examined academically. Regarding joint ownership by shares and joint ownership, although the term “common” is used in “the common heritage of mankind,” from the exploration and utilization of outer space resources, even if the principle of the common heritage of mankind is acknowledged and the prohibition of appropriation is advocated, views such as “priority” and “first occupancy” still emerge regarding the rights attributes of outer space resources, which are actually similar to the idea of “joint ownership by shares.” Therefore, it is difficult to define how outer space resources can be jointly owned. In summary, while the claim of the common heritage of mankind expresses the world’s aspirations for the exploration and utilization of outer space resources, it is difficult to provide a fair answer to related questions, and this claim is also difficult to gain a firm foothold in the academic circle in the long run.

Regarding the content related to the rights attributes of outer space resources, countries with strong space exploration capabilities, such as the United States, often advocate the theory of possession and promote “first occupancy.” Outer space resources are concentrated by capable countries, while countries that are still in the stage of space technology development find it difficult to “get a piece of the pie” in the fierce international competition. This is bound to cause conflicts between the two international forces.

Further discussion is needed on the relevant legal issues of outer space resources.

3. International and Domestic Laws on the Commercial Exploitation of Outer Space Resources

3.1. Current Status of International Legal Regulations

Currently, international legal provisions regarding the commercialization of

outer space resources are mainly reflected in United Nations treaties such as the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (the Outer Space Treaty) and the Convention on International Liability for Damage Caused by Space Objects (the Liability Convention), as well as principles adopted by the General Assembly such as the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, and the Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries. These treaties, declarations, and other documents are compiled in the United Nations Office for Outer Space Affairs' "International Space Law: United Nations Treaties on Outer Space."

Overall, the United Nations treaties and related international soft law on outer space have not specifically mentioned outer space resources. Although there are different understandings among academics regarding the relationship between outer space and outer space resources, the exploration and utilization of outer space resources are generally considered as activities falling within the scope of the exploration and utilization of outer space. The basic principles of the Outer Space Treaty, such as benefiting all mankind, peaceful use, freedom of exploration, non-appropriation, and international cooperation, naturally apply to the exploration and utilization of outer space resources, especially for scientific research purposes.

In terms of the term "exploitation," it does not appear in the Outer Space Treaty, but "utilization" in a broad sense can encompass it. As for commercial exploitation, the Outer Space Treaty does not prohibit private entities from engaging in outer space activities and does not make clear provisions regarding commercial outer space activities, only requiring contracting states to authorize and continuously supervise outer space activities conducted by their private entities.

At the United Nations level, the Committee on the Peaceful Uses of Outer Space (COPUOS) is a platform dedicated to discussing outer space affairs, but it is not an international regulatory body overseeing space activities that surpasses nations. Since 2016, under the proposal of countries such as Greece and Turkey, the Legal Subcommittee of COPUOS has begun discussing legal issues related to space resources. Pursuant to General Assembly resolution 71/90, in 2017, the Subcommittee considered agenda item 14, "General exchange of views on potential legal regimes for activities related to the exploration, exploitation, and utilization of space resources," as a separate topic/item. To date, this topic has been discussed at annual sessions of the Legal Subcommittee each year. At the 60th session of the Legal Subcommittee in 2021, it was decided to establish a working group on the legal issues of space resource activities, which was renamed the Working Group on Legal Issues of Space Resource Activities at the

61st session of the Legal Subcommittee in 2022. Currently, international discussions on the legal issues of space resources are ongoing.

3.2. Domestic Laws Related to Space Resource Development

3.2.1. The United States' Commercial Space Launch Competitiveness Act of 2015

The United States took the lead in legislative practice and enacted the Commercial Space Launch Competitiveness Act of 2015. The provisions of this act generally follow the relevant legal documents adopted by the United Nations, reflecting basic principles such as the principle of non-appropriation. However, the most distinctive aspect is the United States' attitude towards private entities participating in the exploration and utilization of outer space resources. The United States clearly and firmly affirms the important position of private entities in outer space resource activities and supports private entities in conducting outer space resource activities and obtaining benefits. In the relevant documents of the United Nations, the subjects used by the United Nations for outer space resource-related activities have always been "contracting states," "states," and so on, rather than private entities. In fact, the relevant documents of the United Nations have not made clear provisions on the scope of "contracting states" or "states," and whether these subjects include citizens of each country is worthy of further discussion. However, in this U.S. public law, while the United States stated in Section 403 that it would not appropriate outer space resources, Section 51303 provides for the possessory rights of U.S. citizens over outer space resources. Here, although the subject appears to have changed on the surface, it also reflects the United States' "double standard" of ostensibly supporting the principle of non-appropriation while actually promoting private possession, which effectively violates the international acts adopted by the United Nations.

3.2.2. Luxembourg's Law on the Exploration and Use of Space Resources of 2017

Other countries, such as Luxembourg, followed suit and enacted the "Law on the Exploration and Utilization of Outer Space Resources" in 2017. This law stipulates the ownership of outer space resources and clearly states that "outer space resources can be appropriated." It also clearly defines the subject and object of outer space resources. In terms of objects, the scope of outer space resources is not clearly defined, but resources such as satellite communications and orbit positions are excluded; in terms of subjects, it clarifies that the subject of commercialization of outer space resources is the project operator who explores and utilizes outer space resources for commercial purposes, including state-owned and private companies. Furthermore, the law also stipulates procedures for granting property rights and supervision of outer space resources (Feng, 2022). Luxembourg's "Law on the Exploration and Utilization of Outer Space Resources" also clarifies the legal status of private entities. Compared to the US "Space Resource Exploration and Utilization Act of 2015", this law is more practical and operable

in its provisions related to private entities, improving the relevant procedures for authorization and supervision among private entities.

The most prominent aspect of Luxembourg's "Law on the Exploration and Utilization of Outer Space Resources" is that Luxembourg does not recognize the principle of non-appropriation, publicly defying the basic principles adopted by the United Nations. This action, for Luxembourg, can bring economic benefits by attracting international enterprises engaged in space exploration to settle in Luxembourg, thereby driving an increase in fiscal revenue and promoting economic development. Meanwhile, the law's relevant provisions for private entities are also based on Luxembourg's negative attitude towards the principle of non-appropriation.

4. Evolution of U.S. Policies and Laws Related to Commercial Exploitation of Outer Space Resources

The United States continues to establish, revise, and improve its legal regulatory system for the commercial exploitation of outer space resources, aiming to rationalize its current commercial development and future needs in this area. From an international legal perspective, with the continuous development of aerospace technology, the Outer Space Treaty has shown more regulatory deficiencies compared to the past. The United States actively provides legal supplementation for the exploitation and utilization of outer space resources by interpreting ambiguous legal norms. On the other hand, the United States seeks international recognition from both the private and intergovernmental levels, including signing the Artemis Accords (*Artemis Accords*, 2020) and utilizing the work outcomes of the Hague Working Group on Space Resources Governance. Domestically, the U.S. outer space law system primarily consists of two parts: national-level legislative documents such as the 2010 National Space Policy and the 2015 Commercial Space Launch Competitiveness Act; and presidential executive orders, which can create new federal government powers but have loose restrictions, unclear court reviews, and may conflict with laws.

4.1. U.S. Attitude towards International Regulations on Outer Space Resource Development

4.1.1. U.S. Interpretation of the Outer Space Treaty

While the United States recognizes the basic principles of the Outer Space Treaty, it sometimes adopts practices contrary to these principles in actual operations. According to Article 1 of the Outer Space Treaty (*Article 1 of the Outer Space Treaty*, 1967), "The exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind", including the exploration and utilization of outer space resources, including the exploitation of natural resources, which should also benefit all countries. This principle of common

interest is essentially designed to provide equal opportunities for all countries, including non-spacefaring nations and developing countries, to participate in space exploration and utilization and protect their realized interests (Hobe, 1992).

However, there are challenges in practice regarding whether the prohibited subjects under this article include non-governmental entities or any other natural persons. Currently, the U.S. government strongly supports private enterprises in exploring resource development on the Moon and other celestial bodies and is incorporating these resources into private property through legislation, related documents, and policies. This approach may spark controversy in the international community regarding the interpretation and application of the Outer Space Treaty.

The U.S. understanding of the Outer Space Treaty mainly revolves around the non-sovereignty of outer space, freedom of exploration and utilization, prohibition of militarization, and protection of the Earth's environment. However, in actual operations, the United States may flexibly interpret or adopt different approaches to certain principles of the Outer Space Treaty based on its own interests and needs.

4.1.2. U.S. Negative Attitude towards the Moon Agreement

In the 1970s and 1980s, the United Nations attempted to regulate or resolve the issue of ownership of outer space resources through the Moon Agreement (hereinafter referred to as the Agreement). However, some major spacefaring countries, including the United States, did not widely accept the concept of "the common heritage of mankind." Under opposition from domestic interest groups, the U.S. government changed its position on the Outer Space Treaty and did not ratify the Agreement. Due to the setback of the Moon Agreement, there are gaps and controversies in the development of outer space resources in today's world.

4.2. Impact of the U.S. Commercial Space Launch Competitiveness Act of 2015 on the Development of Space Resources

In recent years, the U.S. government has tightened its encouragement of private companies to develop outer space resources through domestic legislation and the domestic aerospace industry, posing a challenge to the existing space law system and having a significant impact on the future situation of outer space resource development.

4.2.1. U.S. Commercial Space Legislation

The United States has continuously improved its legal requirements for commercial development in outer space. The 1958 Aerospace Act, the 1984 Commercial Space Launch Act, the 1984 Commercial Remote Sensing Act, and the 1998 Commercial Space Act were incorporated into Title 51 of the U.S. Code in 2010.

This title establishes a comprehensive legal regulatory system for private research and development, launch, and operation of spacecraft and satellites. In recent years, the United States has reduced regulatory barriers and gradually lowered entry thresholds and liability limits for commercial space development through legislation (Wu, 2021).

The U.S. Exploration Policy Committee established in June 2004 called for non-governmental forces, such as relying more on private enterprises, to engage in space activities and outer space resource development and investment. Additionally, NASA developed a commercial cargo program in 2005 to seek companies capable of regularly launching cargo to the International Space Station. After soliciting proposals, NASA awarded contracts to Orbital ATK and SpaceX in 2008. With significant financial and resource support from the government, private enterprises in the United States emerged to develop outer space resources for commercial investment, such as the multi-investor-established Planetary Resources, Inc.

The 2010 National Space Policy issued by the U.S. government established commercial space development as one of its fundamental principles, explicitly recognizing the access, utilization, and exploration of outer space by all countries for peaceful purposes (The White House, 2010). Obama placed great emphasis on strengthening cooperation with the private sector and significantly increasing funding. During his tenure, NASA began to adopt a more liberal and non-interventionist approach to gradually develop close cooperation with the private sector, including procuring spacecraft and services. This undoubtedly represents a new business model where NASA requests certain types of services from the commercial space industry and then awards contracts to one or more companies to execute.

4.2.2. Basic Content and Inconsistencies with the Outer Space Treaty of the Commercial Space Launch Competitiveness Act of 2015

Based on early technological accumulation and development needs, the United States took the lead in legislative practice by enacting the Commercial Space Launch Competitiveness Act of 2015. As part of the Commercial Space Launch Competitiveness Act, this law marks a legislative milestone in the field of commercialization of outer space resources in the United States. The law clearly defines relevant concepts involved in the commercialization of outer space resources. Firstly, it defines the scope of “outer space resources” as “a space resource found on or within a single asteroid”¹, while space resources refer to “abiotic resources *in situ* in outer space, including water and minerals” (U.S. Commercial Space Launch Competitiveness Act, 2015). Secondly, it clarifies the concept of “U.S. citizen,” including natural and legal persons, thereby establishing the legal status of private entities in the commercialization of outer space resources (Nie, 2018). At the same time, the law also stipulates the responsibilities of the federal government to actively promote the commercial exploitation of

¹The term “asteroid resource” means a space resource found on or within a single asteroid.

outer space resources and refrain from setting administrative barriers or taking any illegal interference.

Moreover, the law stipulates that “U.S. citizens engaged in the commercial recovery of asteroid resources or certain space resources shall be granted rights to any asteroid resources or space resources they obtain, including the rights to possess, own, transport, use, and sell such asteroid resources or space resources”. This means that both states and non-governmental private entities can claim ownership through possession, use, transportation, and disposal. This law legally establishes the statutory status of private entities in the commercial exploitation of outer space resources, granting them property ownership rights over outer space resources.

The United States basically follows the relevant legal documents adopted by the United Nations in the provisions, reflecting the basic principles such as the principle of non-appropriation, and complies with Article 2 of the Outer Space Treaty, which stipulates that no State may appropriate outer space, including the Moon and other celestial bodies, by claim of sovereignty, use or occupation, or by any other means. However, it stipulates the right of American citizens to possess outer space resources, replacing the “state subject” with the “private subject”, implanting private development into the legal category, and directly granting private entities property rights to outer space resources. Private companies such as Boeing and SpaceX work closely with NASA and receive inseparable support at the funding and technical levels. Thus, the US government directly profits for the country in the name of “private enterprises”. The law reflects the United States’ ostensible support for the principle of non-appropriation, but in fact promotes the “dualism” of private possession, which actually violates the international law passed by the United Nations. On April 6, 2020, the United States issued an Executive Order Encouraging International Support for Access to and Utilization of Space Resources, further clarifying that American citizens should have the right to commercially explore, acquire, and utilize outer space resources in accordance with applicable laws. This also proves that the United States does not regard the outer space domain as a global common (public land).

4.2.3. Impact of the 2015 Commercial Space Launch Competitiveness Act on Domestic Legislation in Other Countries

The domestic legislation of the United States provides strong guarantees for the active participation of non-governmental private entities in the commercial exploration and utilization of natural resources in outer space, and at the same time, by interpreting the Outer Space Treaty, it has torn the first rift in the commercial exploitation of resources in outer space, triggering the desire of other countries to do the same.

Luxembourg followed suit, enacting the Law on the Exploration and Use of Space Resources in 2017. This law stipulates the ownership of outer space resources and explicitly states that “outer space resources can be appropriated.” It

clearly defines the subjects of outer space resource commercialization as project operators exploring and utilizing outer space resources for commercial purposes, including state-owned and private companies, blatantly violating Article 2 of the Outer Space Treaty, which prohibits appropriation. In 2021, the Japanese Senate passed the Promotion Act for Commercial Activities Related to the Exploration and Development of Cosmic Resources, also establishing a national licensing system for the mining of outer space resources. While it does not violate the existing international law of “joint development” and grants equal status to private entities from all countries in the commercial development of outer space mineral resources, the practice of freely “appropriating” disowned resources essentially constitutes harm to the interests of other less developed space faring nations and developing countries, creating a situation of “unequal development” among countries.

4.3. U.S. International Strategy for Outer Space Resource Development

4.3.1. Top-Down Reshaping of Outer Space Rules—The Artemis Accords and the Sustainable Lunar Development Working Group

The Artemis Accords (*Principles for a Safe, Peaceful, and Prosperous Future, 2020*) are agreements signed by NASA with the space agencies of Australia, Canada, Italy, Japan, Luxembourg, the United Arab Emirates, and the United Kingdom regarding the exploration of the Moon. Signed on October 13, 2020, the number of signatory countries has expanded to 35 as of December 15, 2023. According to the accords, these countries will participate in the U.S.’s new lunar mission, Artemis, which also outlines future behavior in exploring the Moon, Mars, comets, asteroids, and other domains.

The Artemis Accords emphatically state that the exploitation and utilization of space resources can and will be conducted under the auspices of the Outer Space Treaty, with particular emphasis on Articles 2, 6, and 11 (“*Presentation 2, in WSF/2020 Presentations on Exploration, 2020*”). While signatory countries have stated that the exploitation of space resources does not constitute national appropriation under Article 2 of the Outer Space Treaty and have pledged to notify the UN Secretary-General, the public, and the international scientific community in accordance with UN regulations, the agreement’s provision for establishing a safety zone around lunar bases to prevent interference and disruption from non-signatory countries is essentially an act of appropriation, violating the principle of non-appropriation.

The list of signatory countries is also intriguing. While purporting to “enable all nations to share the resources of the Moon,” major spacefaring nations such as Russia, Germany, and China have not signed the accords. Instead, a large number of small countries without even current space capabilities appear on the list, further confirming that the United States is using the guise of lunar exploration to rally allies and gain moral legitimacy. This may create conditions for the United States to “encircle” territories in outer space under the guise of “regulat-

ing” small countries.

Article 10 of the Artemis Accords regarding outer space resources is vague and avoids crucial issues, focusing more on the spirit and values of the signatory countries. Rather than being a guideline for the development of outer space resources, it is more akin to a consensus reached by the United States and its “like-minded” countries, dividing camps in outer space and attempting to bypass the United Nations, using this U.S.-led agreement to falsely represent “international law” and exclude non-signatory countries from the normal utilization of outer space resources. Such actions undoubtedly infringe on the interests of countries worldwide and contribute to the fragmentation of international law.

In 2019, the Moon Village Association established a neutral forum for multi-stakeholders to discuss lunar exploration: the Global Expert Group on Sustainable Lunar Activities, aimed at addressing sustainable lunar exploration, reducing risks for future lunar missions, and enhancing global cooperation in lunar exploration and settlement. Similarly, the United States remains at the forefront in promoting projects and agendas that align with its interests, interpreting existing international law differently to suit their needs in lunar activities.

On May 30, 2023, the U.S. Department of State released the Space Diplomacy Strategic Framework (hereinafter referred to as the Framework) ([FACT SHEET: U.S. Novel Space Activities Authorization and Supervision Framework, 2023](#)), the first dedicated space diplomacy strategy document issued by the United States. It aims to achieve its space policy goals and consolidate its leadership position in the global space sector by integrating and optimizing U.S. diplomatic resources and capabilities in the space domain. The Framework focuses on core objectives, including promoting U.S. space policy through diplomacy, explicitly putting forward the guiding principle of “walking on two legs.” In addition to mobilizing forces from various departments of the State Department, national institutions, allies, and partners, it also attaches importance to non-governmental entities such as academic research institutions, the private sector, non-governmental organizations, and civil society. The United States attempts to reshape existing rules on the one hand, diluting the Outer Space Treaty through unilateral interpretations of intergovernmental soft law and non-governmental documents while creating new rules in emerging fields. On the other hand, the United States is taking the lead in creating new rules in areas such as lunar and deep-space exploration, space situational awareness, and space traffic coordination, which have low development and attention from countries worldwide and lack legal regulations.

The U.S. Department of State’s proposal to “promote and update the international order for rule-based outer space activities” essentially aims to reshape the international rules system for outer space. The Framework also introduces the concept of “commercial space diplomacy,” continuously expanding commercial space diplomacy to promote the promotion of the U.S. aerospace industry and strengthen its current leadership position, including in the field of outer space

commerce.

At the third meeting of the Biden-Harris Administration's National Space Council in December 2023, Vice President Harris announced the U.S. Framework for Authorizing and Overseeing New Space Activities (abbreviated as the Framework), aimed at promoting innovation and further enhancing the U.S.'s leadership position in the security, safety, and long-term sustainability of outer space activities. Currently, without additional legislation, the U.S. government guides the space activities of non-governmental organizations and private companies by expanding and improving the content of the Outer Space Treaty and utilizing existing internal processes within the Department of Commerce (DOC) and Department of Transportation (DOT).

4.3.2. Bottom-Up Civilian Promotion—The Hague International Working Group on the Governance of Space Resources

The Hague International Working Group on the Governance of Space Resources (hereinafter referred to as the Working Group) was established in 2015 to discuss the international legal certainty surrounding space resource development activities, mainly focusing on space mining. This group is primarily composed of high-level research institutions such as universities and think tanks from various continents. In September 2017, they formed the “Draft Text for an International Framework on Space Resource Activities,” reflecting the group's thinking on establishing international rules for space resource development and providing some guidance for world space resource extraction (Wang et al., 2017).

It's worth noting that the Working Group's activities were supported by the US-based Deep Space Industries (now acquired by Bradford Space) (Bradford Space, n.d.) and the Secure World Foundation. It was mainly pushed by private US companies, including Deep Space Industries and Planetary Resources, with the Dutch government as the spokesperson (chair of the Working Group) and the Institute of Air and Space Law at Leiden University in the Netherlands serving as the secretariat (responsible for drafting provisions and convening meetings).

The Secure World Foundation, also known as the US Secure World Foundation, was originally a privately founded family foundation established in 2002. Its key personnel include high-level US government staff such as researchers from the Aerospace Institute and former foreign policy advisors to the US Strategic Command. Bradford has operating companies and comprehensive support facilities in New York, Luxembourg, and the Netherlands, and has been closely cooperating with multiple national space agencies for many years, especially the European Space Agency, NASA, the Netherlands Space Agency, and the Luxembourg Space Agency. This shows that the Working Group is essentially a non-official organization supported by private US entities, representing the US government's position and interests. Its aim is to provide international support for US commercial space resource development from the bottom up and use academia to occupy a high ground internationally and facilitate legal theories, fur-

ther promoting the improvement of relevant US domestic legislation.

Although the Working Group adopted Chinese scholars' views on "priority rights," "search and/or acquisition," and "international recognition required for obtaining space resources," China has faced difficulties in making suggestions and modifications. The Hague International Working Group on the Governance of Space Resources is actually a semi-official international rule-making platform that reflects the strategic interests of US deep-space exploration, aligning with the interests of countries that are part of the Moon Agreement (such as the Netherlands).

5. China's Stance and Measures for Promoting Commercial Development of Space Resources

In the context of great power competition, space resources, as the "common heritage of mankind" yet to be fully allocated, have sparked competition led by the US. Despite shared interests, China should maintain its own voice, follow the principles of the Outer Space Treaty and the human community, consider the realities of many developing countries, adhere to humanitarianism, efficiently explore and utilize space resources, and avoid associating with exclusive groups like Artemis. Meanwhile, China should actively strengthen international cooperation, conduct frank and in-depth exchanges on commercial space resource development, resolve differences among countries regarding the legal status of space resources, and prevent countries like the US from arbitrarily carving up space resources based on the "first possession theory." Finally, China should reflect on its relevant policies and advance legislation when the time is ripe.

5.1. Great Power Competition as the Backdrop for Space Resource Exploration and Utilization

With various international forces entering outer space, space resource exploration and utilization activities have entered an era of great power competition. China currently faces attempts by the U.S. to rally its allies to maintain its leading position in international rule-making for outer space. On the other hand, with the technological progress of late-developing countries represented by China, there is an urgent need to improve existing international rules or establish new ones to provide international legal and discourse system support for their space mission implementation and expansion of space-related international interests.

The U.S. possesses powerful space technology and has a significant number of satellites in outer space. Its space resource exploration and utilization activities have reached a mature stage compared to other countries. As China's aerospace technology continues to develop, with the completion of the Beidou Satellite Navigation System and the comprehensive rollout of space station construction, China's aerospace industry is increasingly occupying an important position internationally, challenging the U.S.'s "dominant" international status. In recent years, the U.S. has repeatedly created the "China threat theory" in an attempt to confuse international attitudes and hinder China's aerospace and space resource

activities. China has clearly stated that such rhetoric is an attempt by the U.S. to justify its military buildup seeking space hegemony. The U.S. publicly identifies outer space as a battlefield, strives to build space forces and compete for space command, and heavily invests in developing space weapons, making the US the biggest threat to space security.

Under the continuous threat from other countries, China should grasp international discourse power to avoid falling into foreign discourse system and being in a passive and suppressed position in the exploration and utilization of outer space resources. We should recognize the threats and suppression posed by international forces led by the United States to China's space industry amid the great power game. We must firmly oppose the formation of cliques in outer space resource activities and resolutely resist the suppression of foreign forces on China's space industry. Meanwhile, in the context of the great power game, we should fully recognize China's status as a major aviation power, have full confidence in China's exploration and utilization of outer space resources, grasp international discourse power, and build a Chinese platform for international outer space resource activities.

5.2. China's Existing Position on the Exploration and Utilization of Outer Space Resources

China is one of the contracting parties to the Outer Space Treaty and actively fulfills its obligations under the treaty, committed to maintaining peace and security in outer space. In the 2006 white paper "China's Aerospace," the phrase "rational development and utilization of space resources" was included under the principle of "adhering to comprehensive, coordinated, and sustainable development." Similarly, in the 2011 and 2016 white papers on China's Aerospace, the same phrase was mentioned under the principle of peace. In the 2021 white paper, "actively participating in international discussions and mechanism construction in areas such as space resource development and utilization" was highlighted as a key aspect of future cooperation. China has also extensively participated in international conferences centered around the United Nations, such as the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS). In a 2017 statement, China expressed its firm commitment to following the relevant principles set by the United Nations, upholding the important legal status of international law in the exploration and utilization of outer space resources, actively promoting the construction of international mechanisms for benefit sharing and international coordination among countries, resolutely safeguarding the peaceful development of outer space resource exploration and utilization, and broadly seeking consensus on the basis of the United Nations to establish international governance institutions and mechanisms for outer space. When it comes to the international regulation of the commercial utilization and exploitation of outer space resources, China mainly follows the principles and provisions of international space law.

China affirms the relevant norms adopted by the United Nations, including

“peaceful use,” “non-appropriation,” and “seeking benefits and interests for all countries.” It firmly upholds the important platform status of the United Nations in international activities related to outer space resources and actively participates in the exploration and utilization of these resources, working with countries around the world to build institutional mechanisms for international coordination and cooperation.

5.3. Differences among Countries on the Legal Status of Outer Space Resources and China’s Position

Currently, due to differing international interests, there are significant disagreements among countries regarding the legal status of outer space resources, with ownership being the core issue. These differences are mainly reflected in the following aspects:

Regarding the status of outer space and its resources, some countries and scholars interpret outer space and its resources as a unified and indivisible whole, arguing that the provision in the Outer Space Treaty stating that outer space shall not be appropriated applies equally to outer space resources. However, other countries and scholars advocate for a distinction between outer space and its resources, suggesting that the status of outer space and its resources can be differentiated, and that the inappropriability of outer space does not imply the inappropriability of its resources.

Furthermore, there are disagreements among countries and academics on the rights related to *in-situ* and *ex-situ* resources. *In-situ* resources refer to those that remain in their original location in outer space, while *ex-situ* resources are those that have been extracted and removed from their original location. Some believe that both *in-situ* and *ex-situ* resources should be bound by the Outer Space Treaty and cannot be appropriated by any country. In contrast, others argue that the legal status of *ex-situ* resources may change once they are extracted and removed from outer space, allowing their ownership to be determined through domestic law or other means.

Additionally, there are varying viewpoints on the nature of outer space resources, including common, public, and private ownership. The common ownership theory posits that outer space resources are the common heritage of all mankind and should be shared and managed by all countries. The public ownership theory suggests that outer space resources should belong to an international institution or organization responsible for their management and allocation. On the other hand, the private ownership theory advocates for the ownership of outer space resources by private entities through domestic legislation. These differing viewpoints reflect the varying interests and demands of countries in resource utilization and allocation.

There are also ongoing debates regarding possession, ownership, and beneficial rights. Possession refers to the actual control and dominion over resources, ownership denotes the legal right to own the resources, and beneficial rights

pertain to the benefits derived from resource utilization. Some argue that in the development of outer space resources, countries can enjoy possession and beneficial rights, while ownership should be restricted to prevent the appropriation of outer space resources. Others contend that, subject to international law and rules, ownership of outer space resources can be granted to certain countries or entities.

Moreover, countries hold differing views on the formulation of international rules for the utilization of outer space resources. Some advocate for the establishment of international rules through cooperation that can be endorsed by a majority of countries, while others may prefer exclusive methods of developing outer space resources or maintain a cautious approach toward negotiations outside the United Nations system. Such differences can pose challenges in reaching a consensus during international rule negotiations, affecting the process of international cooperation in the development.

5.4. China's Specific Measures Based on Its Own Position

5.4.1. Adhering to the Principles of the Outer Space Treaty and Expressing a Cautious Stance

China is currently and should continue to actively participate in the formulation of rules on the utilization of outer space resources within the United Nations system, and should maintain caution in negotiations outside of other systems. Before China's hard power improves, it should adhere to the "Four Nos" principle at the official level, namely, not participating, not supporting, not accepting, and not evaluating, while encouraging academic research at the academic level. At the same time, it should carefully study the rules, always pay attention to international trends, analyze the advantages and disadvantages of existing rule negotiations for China, express a cautious stance, and wait to see how the situation develops.

5.4.2. Formulating Policies First, Then Advancing Legislation

In terms of outer space resource development, a strategy of prioritizing policies and lagging behind in legislation can be adopted. Policies are more flexible and easy to adjust in a timely manner, making them more suitable for the current unstable international situation and complex international relations compared to established laws.

In terms of policies, the current white paper's deep space exploration can promote policies such as technological innovation industries. In the future "Space Law," there can be principled statements encouraging the development of outer space resources, such as "China encourages and supports the development and utilization of outer space resources for peaceful purposes." This does not mean that China affirms the industrialization of outer space resources. On March 5, 2024, at the second meeting of the 14th National People's Congress, Premier Li Qiang of the State Council mentioned commercial aerospace in his government work report, which was the first time commercial aerospace was in-

cluded in a government work report. On February 26th, the China Aerospace Science and Technology Group released the “China Aerospace Science and Technology Corporation (CASC), 2022),” which stated that in 2024, China’s first commercial aerospace launch site will usher in its first launch mission, and multiple satellite constellations will accelerate network construction. The active guidance of national policies will help to continuously optimize China’s commercial aerospace market environment and promote the vigorous development of China’s aerospace and aviation new formats.

In terms of legal issues, it is necessary to clarify a series of content such as the legal definition, ownership, principles, procedures, and regulatory mechanisms for the exploitation and utilization of outer space resources. At the same time, it is necessary to stipulate the licensing system, responsibility system, safety standards, and environmental protection requirements for the commercial exploitation of outer space resources in accordance with the currently established international legal regulations and systems. In summary, the following positions should be upheld on the basis of complying with the basic principles of the Outer Space Treaty:

1) The inherent connection between outer space and outer space resources, as well as *in-situ* and *ex-situ* resources, cannot be severed, and a holistic approach should be taken to address related issues. If outer space and outer space resources, as well as *in-situ* and *ex-situ* resources, are treated separately, it may lead to a one-sided understanding and improper handling of the issue. For example, focusing only on outer space while ignoring outer space resources may lead to damage to the outer space environment and waste of resources; focusing only on *in-situ* resources while ignoring *ex-situ* resources may lead to unbalanced and unreasonable resource development. The interconnections and impacts between outer space and outer space resources, as well as *in-situ* and *ex-situ* resources, should be comprehensively considered to ensure that the development and utilization of outer space resources can meet human needs while protecting the integrity and sustainable development of the outer space environment.

2) There should be no conflict between the clear provision in the Outer Space Treaty that outer space resources cannot be appropriated and the development and utilization of outer space resources. The two are complementary relationships. The principle of non-appropriation aims to ensure that all countries have equal opportunities to participate in the exploration and utilization of outer space resources, preventing certain countries or entities from obtaining exclusive rights to outer space resources through improper means. The existence of this principle actually provides a legal guarantee for the peaceful, fair, and sustainable utilization of outer space resources. Under the premise of complying with the principle of non-appropriation, countries can actively carry out activities for the development and utilization of outer space resources to jointly promote the progress and development of human space exploration.

3) The principle that countries cannot appropriate outer space resources for themselves means that they cannot support private individuals under their jurisdiction to take actions that violate this obligation. Any act of exclusive possession violates the Outer Space Treaty. Actions such as those taken by the United States and Luxembourg, which grant property rights of outer space resources to private individuals and private enterprises through domestic laws, should be rejected, and more countries should be prohibited from following suit.

4) Any activities related to the development and utilization of outer space resources should not affect the principle of free exploration of any region of outer space by other countries. China opposes any attempt to delineate “safety zones” for exclusive use. The establishment of a “safety zone” on the Moon proposed by the United States in the Artemis Accords violates the principle of equal access and utilization of outer space resources by all countries in the world.

Currently, China can improve its licensing, management, and responsibility systems for the development of outer space resources.

With the advancement of science and technology and the evolution of national legal provisions, China can increase the types of research and production activities subject to licensing management and improve relevant procedural rules based on actual needs. Additionally, it can adjust the licensing management system for launch activities and business operations, such as establishing a licensing system for remote sensing system operations and communication satellite services, similar to U.S. legislation. Based on different methods of utilizing outer space resources, China should gradually improve the management system for outer space resources, ground facilities, and related space objects, and comprehensively manage space objects launched within China or co-launched by China abroad, as well as related data.

China should also establish and improve a system of liability for damages arising from the development of outer space resources, including rules on the subject of liability, compensation standards, and statutes of limitations for damages related to the development of outer space resources. This will clarify the principle of liability for damages arising from the development of outer space resources and the allocation of rights and responsibilities in the event of such damages (Liu, 2019). This is beneficial for maintaining the healthy and orderly development of China’s outer space resource development activities, providing legal protection for China’s legitimate rights and interests, and preparing for the formulation of comprehensive laws to some extent.

5.4.3. Encouraging Multilateral Cooperation in the Development of Outer Space Resources

With the continuous development of outer space resource exploration and utilization activities, the level of space technology in various countries has significantly improved, and human scientific undertakings have also achieved leapfrog development. Years of exploration and utilization of outer space resources have confirmed that these activities are beneficial to the future of humanity, as outer

space brings more possibilities to human beings. However, not all countries currently possess the capability for outer space resource exploration and utilization. Interstellar navigation technology and proficiency in utilizing outer space resources have become critical aspects of human outer space endeavors. Presently, only a few countries in the world possess interstellar navigation technology, and only a limited number have the ability and capital to explore, research, and master the application of outer space resources. In this context, China should recognize the significant value of outer space resource exploration and utilization activities for its future development and that of the world, and actively explore a development path for outer space resources with Chinese characteristics that aligns with the future aspirations of all humanity.

Multilateralism and international cooperation have always been China's consistent policy in the aerospace field. International cooperation is conducive to creating a favorable international environment for China and helps to better balance the interests of all parties when promoting rule negotiations in the future, seeking rules acceptable to most countries. Currently, due to differences in development needs, scientific and technological strength, and specific national conditions among various parties, there are significant controversies regarding legal issues related to the development of outer space resources, making it difficult to balance the interests of all parties. Therefore, it is challenging to establish an objective and fair international cooperation mechanism.

China looks forward to advancing the establishment of an international cooperation mechanism based on broad consensus, opposing individuals and organizations that act out of self-interest outside the United Nations framework. China opposes considerations of "first come, first served," "unilateral benefits," and predatory commercial exploitation based on selfish motives by countries. Instead, it advocates for the benefit of all humanity with a spirit of universal love, especially leading developing countries in creating equal development opportunities.

China hopes to benefit all of humanity and encourages frank and in-depth exchanges among countries on the commercial development of outer space resources. China can actively participate in international cooperation and exchanges on outer space resource extraction, establish international cooperation and exchange platforms, and jointly formulate relevant rules and standards with the international community. Additionally, China can implement cooperative projects, establish information sharing mechanisms, collaborate with partners on cooperative projects, and realize resource and data sharing as well as complementary advantages. Furthermore, China should promote international standardization cooperation, actively participate in the work of international standardization organizations, and jointly formulate international standards and norms for the commercial exploitation of outer space resources with other countries. Finally, China should strengthen international legal and policy research, deeply study international space law and related policies, and provide legal and policy support for international cooperation and exchanges.

5.4.4. Strengthening Scientific and Technological Innovation and Research and Development Capabilities

China encourages and supports the development of outer space resources for scientific research and public welfare purposes, and the future space law may include principles encouraging the development of outer space resources for peaceful purposes. Based on China's state system, it strives for the welfare of the broad masses of the people, not for private profit. On this basis, China should actively promote the exploitation of outer space resources and outer space exploration plans, enhance hard power, and enhance the right to speak in international negotiations.

China's policies should promote technological innovation industries, increase research and development investment in mining technology for outer space resources, promote technological innovation, and improve China's independent innovation capabilities in mining technology, equipment research and development, and resource utilization. Establish a sound scientific and technological innovation system, formulate specialized aerospace research institutions or university research teams, and be responsible for the technical research and development and innovation of the commercial exploitation of outer space resources. Under the premise of fully utilizing the existing aerospace technology infrastructure, integrate existing scientific research resources, research and development teams, and scientific research achievements to form an integrated research and development system of industry, university, and research. Identify key technologies that need to be broken through in the near, medium, and long term, focus on research, and focus resources on key breakthroughs around core links such as resource exploration, mining technology, resource processing and utilization, and space transportation.

5.4.5. Fostering the Commercial Aerospace Market

Meanwhile, it is essential to encourage and support the development of commercial aerospace enterprises and promote new forms of the space economy. We should facilitate the formation of a commercial aerospace industry chain, enhance the overall competitiveness of China's commercial aerospace sector, and provide strong support for the commercial exploitation of outer space resources. Given the current insufficient dynamism of Chinese enterprises, we can clarify the market positioning and development strategy, determine the role and positioning of the commercial aerospace market in the commercial exploitation of outer space resources, and identify market demands and potential growth points. It is necessary to formulate long-term and short-term development strategies for the commercial aerospace market, including technical routes, industrial layouts, international cooperation, etc. Furthermore, optimizing the policy environment involves relaxing market access and lowering the entry threshold for commercial aerospace enterprises to encourage more businesses and capital to enter the market. Additionally, providing fiscal and tax incentives, such as tax breaks and financial subsidies, can help reduce operational costs for commercial aerospace

companies. Moreover, strengthening regulation and services, establishing a sound regulatory system, and enhancing supervision and support for the commercial aerospace market are crucial to ensure fair competition and healthy market development.

In summary, China should adhere to the principles of peace, cooperation, and mutual benefit in the development and cooperation of outer space resources, enhance its own strength, and actively participate in the formulation of international rules, laying a solid foundation for future space exploration and utilization.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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