Forum: Committee on the Peaceful Uses of Outer Space (COPUOS)
Issue: Discussing Methods of Resource Extraction from Extraterrestrial Bodies
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Introduction

Space is the unlimited expanse in which everything is located. Recently, scientists have found the potential in utilising the resources from extraterrestrial bodies such as the Moon, asteroids and Mars. These resources play a vital role in promoting sustainable space mining as well as helping with industrial processes on Earth.

Due to the abundance of water ice, regolith and other valuable resources, extraterrestrial bodies such as the Moon, asteroids and Mars have been target sites for space mining. Organisations such as NASA have launched programs such as Artemis to further explore the surface of the moon, continuing Neil Armstrong's legacy, and countries, such as the UAE, have launched their own space exploration missions. As resources on earth are scarce but human wants and needs are unlimited, space mining allows us to harness and collect resources such as helium-3 and other Rare Earth Elements (REEs), which can aid in sustainable energy production. Other necessities such as oxygen, drinking water, and fuel can be supplied by these extraterrestrial bodies, reducing astronaut's reliance on the Earth's supplies. Furthermore, space mining shifts the resource extraction from Earth to space, protecting the Earth's environment and reducing harmful effects caused by improper extraction.

Aside from environmental benefits, space mining can contribute to economic growth, creating job opportunities and paving the way for technological advancements. As countries and firms continue to innovate, there will be better technology on the market, allowing for progress and constant improvement.

However, the extraction of resources from space does not come without issues. As there is no clear ownership of space, there may be a lack of agreement on how resources should be

shared, leading to geopolitical tension and conflict. Moreover, another pressing issue arising from space mining is the potential space debris as a result of it.

Considering the many factors presented above, space mining has proven itself to be a useful tool for sustainable development on Earth. However, legislative frameworks will be needed in order to ensure that space is used in a responsible and efficient manner.

Definition of Key Terms

1. **Extraterrestrial:** Other life forms from planets that we do not associate home with, potentially from other solar systems or galaxies.
2. **Volatiles:** the group of chemical elements and chemical compounds that can be readily vaporized. On planet Earth, this would refer to the volatile components of magma.
3. **Asteroid Mining:** The process of extracting valuable minerals and materials, such as metals or water, from asteroids. These materials can serve industrial purposes or support space missions.
4. **In Situ Resource Utilization (ISRU):** The use of local resources at mission destinations instead of utilising all resources from Earth only, increasing efficiency and enhancing human capabilities
5. **Regolith:** A region of loose, heterogenous rock and dust that sits on top of a layer of bedrock. On planet Earth, this would refer to soil
6. **Rare Earth Elements (REEs):** Consists of the fifteen lanthanides on the periodic table plus scandium and yttrium. These are critical to high-tech industries, including electronics, renewable energy, and aerospace. REEs are believed to be present in significant quantities in certain asteroids.
7. **Lagrange Points:** Positions in space where objects tend to stay put. Lagrange Points such as L4 and L5 are potential hubs for space mining and resource extraction.
8. **MOU:** A memorandum of understanding, or MOU, is a nonbinding agreement that states each party's intentions to take action, conduct a business transaction, or form a new partnership. This type of agreement may also be referred to as a letter of intent (LOI) or memorandum of agreement (MOA).
9. **Exobiology:** The study of life in outer space, including the potential for extraterrestrial organisms and the conditions necessary for their existence.

Background Information

Extraction Processes

To extract these resources, astronauts identify celestial bodies through telescopes, robotic probes and spectroscopy. When a site is located, autonomous and lightweight mining equipment is transported there to be used for extraction. Astronauts utilise methods such as surface collection, subsurface drilling and asteroid mining to extract valuable resources. This includes materials such as water ice, metals and REEs. After extraction, these resources are to be heated, magnetically separated or electrolysed, refining the materials, and turning them into water, metals and gases that can be used or consumed by humans.

Resources Found on Extraterrestrial Bodies and Their Uses

On the Moon, resources like water ice can be turned into hydrogen and oxygen for rocket fuel or can be converted into water that is safe to drink. Asteroids contain not only precious metals such as gold and platinum, but also organic compounds that are crucial for life support systems. Similarly, metallic asteroids contain metals like nickel, cobalt and iron, which are important for manufacturing and construction. Mars contains significant amounts of CO2 and water ice, which can be used to produce breathable oxygen, methane fuel and agricultural supplies through ISRU techniques.

Dangers of Space Mining

Space mining can result in significant amounts of debris, which can potentially damage or disrupt satellites. In addition to that, the increased traffic in outer space can result in more frequent collisions, further contributing to the issue of space debris. Additionally, the fact that no nation has ownership over space can lead to disagreements on how to split resources.

Current Situation

Missions

Currently, aside from exploratory missions, there have been no large-scale operations to extract resources. NASA has tested their robot, OSIRIS-REx on asteroid Bennu and JAXA has

tested Hayabusa2 on asteroid Ryugu. There have been missions such as Artemis (mentioned below), with the sole purpose of research and exploration.

Artemis

On November 16th, 2022, NASA launched their first Artemis mission, Artemis I. NASA's aim was to land the first woman, first person of color, and first international partner astronaut on the Moon during this mission, and to explore the surface of the moon, assess its suitability for resource extraction while protecting space heritage and minimising space debris in the process.

Emirates Mars Mission

The Emirates Mars Mission (The Hope Probe), was launched on 20th July 2020, with an aim of capturing a complete image of the Martian atmosphere. Through this mission, the United Emirates Space Agency hopes to understand the reasons behind phenomenon such as the loss of oxygen and hydrogen from Mars' atmosphere.

Tianwen-1

Tianwen-1 was a Chinese space exploration mission that was launched on July 23rd 2020. Its aim was to explore the internal structure of Mars, as well as the presence of water. Tianwen-1 was the second mission that recorded audio on Mars' surface, and the first mission to land safely on its initial attempt.

Legal frameworks

Outer Space Treaty

The Outer Space Treaty, formally known 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, is an international agreement established in 1967. It lays the foundation for the peaceful exploration and use of outer space with principles outlined to govern activities in outer space. It ensures that states are liable for their actions in space, prohibits nuclear weapons and sovereignty over space.

Artemis Accords

The Artemis Accords are a set of principles designed to enhance and reinforce the peaceful exploration of space. Written by NASA, it aims to promote transparency and

interoperability, protect space heritage, and provide emergency assistance as well as clean up space debris. Currently, the Artemis Accords has a total of 50 signatories.

Major Parties Involved and Their Views

United States of America

The United States has passed laws outlining and regulating how private and governmental asteroid miners could be legalised in the future, and space law related to asteroid mining is likely to be an active area in the next 10 years or more.

National Aeronautics and Space Administration (NASA)

The National Aeronautics and Space Administration of the United States, or NASA, is considered to be the most advanced organization in regards to space exploration to date. NASA plays a large role in primarily space exploration, however as of recently, potential extraction of resources from extraterrestrial bodies, largely in its commitment to In-Situ Resource Utilization (ISRU). This focuses on harnessing materials found on the Moon, Mars, and asteroids to support future human exploration and lessen reliance on raw resources from Earth.

NASA has had a few projects aimed at understanding the geology and resource potential of these celestial bodies. An example could be the Mars Oxygen In-Situ Resource Utilization Experiment, also known as (MOXIE). This groundbreaking experiment produced oxygen via solid oxide electrolysis of carbon dioxide in the Martian atmosphere, and was the first instance of ISRU being done on a different planet. As this was the first ISRU experiment ever done on a planet other than Earth, it was conducted on a small scale.

Although NASA is not currently engaged in active mining operations, its scientific missions, such as the MOXIE mission, are of utmost importance for gathering data that could inform future resource extraction efforts, promoting more missions in the future.

Germany

Due to its large Economy, Germany's need for sustainable access to important raw materials that are becoming scarce on Earth has made it an important player in the topic of

extraterrestrial resource extraction. With the aim of building a legal framework, the Federal Association of German Industry (BDI) promotes a national space law to encourage private ownership in extraction outside of Earth. With a big aerospace sector, private firms such as OHB have begun researching space mining projects, helped by research and development programs from the German Aerospace Centre (DLR). By using its industrial ability and advanced technology to access the enormous resources found in space, Germany is positioned to play a significant role in determining the direction of space resource extraction in the future.

Luxembourg

Having a complex legal system that allows Luxembourg-based businesses ownership rights over materials they take from celestial bodies. Luxembourg has become an advocate for the pro-privatisation of extraterrestrial resource extraction worldwide. The government of Luxembourg was the first European country to establish legal certainty for acquiring minerals and other resources found on asteroids and other celestial bodies in July 2017 when it passed a significant space resources law. This law creates an ideal setting for investment and innovation in the aerospace mining industry by allowing individual firms to get these resources.

United Arab Emirates (UAE)

The United Arab Emirates (UAE)'s space program, the UAE Space Agency (UAESA) was founded in 2014. The agency has created Federal Law regulating the exploration and exploitation of non-living resources in space, giving ownership rights to firms and aligning with similar laws in the U.S. and Luxembourg.

The UAE encourages privatization in space resource extraction interestingly, viewing it as growth for its space industry. The Emirates Mission to the Asteroid Belt, which is set to launch in March 2028, is a mission that aims to explore multiple asteroids to determine if any of them have the potential to extract important materials. The UAE has been actively committed to extraterrestrial resource extraction, an example being their successful Emirates Mars Mission, which launched the "Hope Probe" to study Mars in the hope of finding resource potential.

China

China's most recent space program, Tianwen, has been launched in order to answer scientific questions regarding extraterrestrial bodies. China has already launched Tianwen-1, where they sent 6 robotic spacecraft to the Martian surface for research purposes. The second

phase of the mission, Tianwen-2, is set to launch in May 2025, with the aim of exploring asteroids.

UN Involvement, Relevant Resolutions, Treaties and Events

- Resolution on the Peaceful Uses of Outer Space, 14 December 1966 **(A/RES/21/111)**
    - Emphasizes the importance of international cooperation in the peaceful use of outer space.
- Establishment of the United Nations Committee on the Peaceful Uses of Outer Space **(COPUOS)**, 1959
    - Facilitates discussions on space law and promotes sustainable use of outer space resources.
- UN Conference on the Exploration and Peaceful Uses of Outer Space, 2010
    - Addressed challenges and opportunities related to space exploration and resource utilization.
- Partnership with UAE Space Agency, 2020
    - An MOU was signed to establish a UNOOSA project office in Abu Dhabi, promoting sustainable space activities.

Possible Solutions

Privatisation

Privatisation, also known as denationalization, is the concept of transferring ownership, and control of public sector enterprises/industries to the private sector. What this means is that industries, such as the aerospace industry, frequently solely managed by governmental organisations around the globe could become privatised, meaning that other bodies besides governments can be involved in the aerospace industry.

In some countries such as the United States, France, and Japan, the aerospace industry is in the private sector, meaning that companies such as BlueOrigin and SpaceX can exist. However, other countries such as Russia, China and India are against or have yet to allow private-sector aerospace firms.

Governmental Involvement

Being the Opposite of privatisation, some nations might better align with staying government-affiliated, prioritising space programmes like NASA (United States), ISRO (India), Roscosmos (Russian Fed.), and CNSA (PRC) over private aerospace firms. As governments experiment with resource extraction in outer space, this also pokes at the question of in-space sovereignty and possible governmental ownership of land in space.

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