January 2012

# A Proposed Legal Framework On The Extraction And Consumption Of Outer Space Resources

Melissa M. Gordon

# A PROPOSED LEGAL FRAMEWORK ON THE EXTRACTION AND CONSUMPTION OF OUTER SPACE RESOURCES

by

Melissa M. Gordon
Bachelor of Science, Florida Institute of Technology, 2004

A Thesis
Submitted to the Graduate Faculty

of the

University of North Dakota

in partial fulfillment of the requirements

for the degree of

Master of Science

Grand Forks, North Dakota
May
2012

"You own the stars?"
"Yes."
"But I've already seen a king who…."
"The Kings do not own, they 'rule' over. It is a very different matter."
- Antoine de Saint-Exupery (1943)

This thesis, submitted by Melissa M. Gordon in partial fulfillment of the requirements for the Degree of Master of Science from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

Dr. Santhosh Seelan

Joseph J. Vacek, J.D.

Dr. David Whalen

This thesis is being submitted by the appointed advisory committee as having met all of the requirements of the Graduate School at the University of North Dakota and is hereby approved.

Dr. Wayne Swisher,
Dean of the Graduate School

5-2-12
Date

PERMISSION

| | |
|---|---|
| Title | A Proposed Legal Framework on the Extraction and Consumption of Outer Space Resources |
| Department | Space Studies |
| Degree | Master of Science |

In presenting this thesis in partial fulfillment of the requirements for a graduate degree from the University of North Dakota, I agree that the library of this University shall make it freely available for inspection. I further agree that permission for extensive copying for scholarly purposes may be granted by the professor who supervised my thesis work or, in his absence, by the Chairperson of the department or the dean of the Graduate School. It is understood that any copying or publication or other use of this thesis or part thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to the University of North Dakota in any scholarly use which may be made of any material in my thesis.

Signature Melissa M. Gordon

Date April 24, 2012

TABLE OF CONTENTS

LIST OF FIGURES

Figures Page

ACKNOWLEDGEMENTS

I would like to take the opportunity to express my sincere appreciation to husband, Lindsey Gordon, who provided continuous encouragement and support throughout my years of study at the University. Lindsey has driven me towards excellence in times of uncertainty and has always been my strong hold. We make a terrific team and I thank him dearly for the love he has bestowed upon me.

To my family members, I thank each of you for the understanding and patience you've provided during my time of research. I know this journey seemed long and I am truly grateful for your support.

To God, my savior, I am genuinely grateful for the courage and wisdom you have given me. This thesis would not have occurred without the serenity of knowing this was in your plan.

To my committee members, thank you for challenging me to reach my academic goals and providing me with many ideas and viewpoints, and to my colleagues for inspiring me to contribute to our industry.

# ABSTRACT

The future of space exploration endeavors depends highly on the utilization of in-situ resources. Large scale exploration road maps take advantage of local resources to reduce mission costs and enable the growth of revolutionary self-sufficient technologies to prolong mission duration and reach beyond current destinations. The major space treaties included limited provisions on space resource utilization in terms of excavation and consumption. A natural resource can be extracted from its place of origin with limited restriction on the quantity and method of use.

To address the risk of ecological damage, resource appropriation, and impending disputes, claims, and decrees regarding resource utilization, a comprehensive analysis is performed on the legal doctrines governing activities in outer space, the environmental protocol of Antarctica, the principles of the high seas, and a case study on resource appropriation. An analysis of the aforementioned doctrines concludes: 1) the need to provide an international authority with the power to act when claims and disputes of international cooperation and consultations fail and 2) the need to establish a protocol on environmental protection to the Outer Space Treaty to ensure peaceful and orderly development of our celestial bodies during scientific and commercial activities involving resource utilization.

# PART ONE

# INTRODUCTION

Extra-terrestrial exploration is inevitable. As the human race grows, as technology grows, potential shortages of useful minerals will inspire scientists to seek alternatives for sustaining the human race and our technological demands. Outer space provides an array of valuable resources and thus is seen as the next frontier for creating wealth and sustaining technological demands. To meet demands, nations will rely on the utilization of outer space in-situ resources to provide efficient, reusable and reliable sustenance. The primary goals of space exploration are scientific, security, and economic interests. The idea is not to merely explore our planetary system but to use accessible space for the benefit of humankind.[1] Utilizing space resources for scientific or technological development will advance and validate capabilities to a point where those capabilities are available for implementation on future space missions or in technological developments here on Earth.

Much like the pilgrims of the 1600's, packing only enough supplies for the trip across the Atlantic, they relied on the possibility of using local resources in the Americas to sustain their colony. Imagine what would have become of those explorers if they were unable to harness the local resources upon their arrival. Fast forward a half of millennia,

[1] 44th Robert H. Goddard Memorial Symposium, "John Marburger Keynote Address," http://www.nss.org/resources/library/spacepolicy/marburger1.pdf (accessed October 15, 2011).

the human race is venturing to Moon, Mars and asteroids. Mankind is continuously looking for ways to improve longevity of life. If the improvements can be created from the use of available resources, then mankind will find a way to incorporate them into our way of life. The quandary is mankind generally focuses on making newer and better capabilities, but rarely focuses on the effects, whether to the environment or to resource quantity, until a detrimental event occurs or the discovery of potential shortages in the supply of a resource is announced. Even then, mankind usually finds another method or another available resource to replace the capability. For instance, hybrid cars have been developed as an alternative to gasoline powered vehicles. Although the purpose is to reduce the consumption rate of oil, a valuable natural resource, the magnets used in the hybrid car's motor and generator contain rare elements, which by their name do not exist in high quantities. The secret to the magnet's intense field are the three pounds of alloy made with rare earth elements.[2] Now scientists are researching other methods to compensate for the potential shortages of rare earth elements used not only in hybrid cars but also in electronics, like iPod ear buds, we use daily. The solution to resource usage is finding alternative methods, such as resource rationing, to prevent resource depletion and potential ecological damage. The concern with over usage of resources is a problem not only on Earth but on celestial bodies. On Earth we can mitigate these problems through established environmental protection agencies and legal systems to handle disputes when cooperation and consultation amongst private, government or non-government agencies fail. In space, these mitigation agencies and systems are not established.

[2] Devin Powell, "Sparing the rare earths," *Science News* Vol. 180, no. 5 (2011): 18-21.

The space law principles that have been governing outer space activities for over 45 years do not address the present state of space activities, in which both private and States Parties are interested in extracting and consuming the natural resources of celestial bodies for both scientific and commercial purposes. The major space treaties contain inadequate provisions on the limitations of outer space resource utilization. A State Party to the space treaties can extract an outer space resource from its place of origin with limited restriction on the quantity and method of use. For many readers, the limitless use of outer space resources may not raise a brow. The average person is not concerned with activities that occur in space, much less the utilization of space resources, until those activities or usages affect their daily lives here on Earth. If potential shortages of certain rare Earth elements are arising then the hopes of finding the same element or a replacement becomes inevitable. Nations will turn to space resources if they can no longer find a solution here on Earth. Not all have a complete understanding of the untold riches that lie within the surfaces of our planetary bodies. This dissertation will bring to light the worldly use of outer space resources, such as Helium-3, europium, tantalum, and water, and why conservation of these resources is warranted.

In order to ensure peaceful and orderly development of our planetary bodies a new environmental protocol will be developed through the study of current legal doctrines to manage, regulate, and facilitate balanced resource extraction. Such a protocol will establish environmental protection, resource rationing and create an environmental committee to facilitate and exchange information about environmental issues. Ecological damage, resource appropriation and impeding disputes/claims from resource utilization

are among the few items that will be encountered as we venture beyond Earth without proper legal doctrines governing the way.

## PART TWO

## RESOURCE INITIATIVES

Visions of exploring beyond Earth's boundaries were thought of as early as the 2nd Century. A True Story, written by Lucian of Samosata (circa 120-180 CE), is a science fiction work depicting voyages to the Moon and Venus, extraterrestrial life and interplanetary war.[3] In the 1800s, Konstantin Tsilokovsky envisioned flight outside the earthly globe and "the need to move farther away from earth and become an independent planet – a satellite of the sun and a brother of the earth."[4] In 1903 he published "The Exploration of Cosmic Space by Means of Reaction Devices" where he calculated the horizontal speed required to leave Earth's atmosphere and enter space by means of a rocket.[5] "Show me life bigger than the Earth" a common theme behind the visions of ancient and current space explorers. Before the twenty-first century the competition for exploration of the Moon and beyond was between two world powers, the Soviet Union and the United States. Now with the growth and stature of other nations, such as India, China and Japan, the return to the Moon has become a realistic prospect for many nations.

---

[3] Overview of Lucian of Samosata, "A True Story by Lucian of Samosata," Barnes & Nobles website, http://www.barnesandnoble.com/w/a-true-story-by-lucian-of-samosata-lucian-of-samosata/1104697779 (accessed April 15, 2012). Online version of *A True Story* is available from http://ebooks.adelaide.edu.au/l/lucian/true/ (accessed April 15, 2012).

[4] Walter A. McDougall, …*the Heavens and the Earth* (New York: Basic Books, Inc., 1984), 21.

[5] Ibid.

As already indicated the future of deep-space missions depends highly on taking advantage of local resources to enable the capability of self-sufficiency and sustained human presence in space. As stated *supra*, on the Moon lies a vast abundance of natural resources. Some scientists believe natural resources of the Moon and other celestial bodies will produce better results due to quality and quantity.[6] The Moon is rich in silicon, iron, oxygen, aluminum, hydrogen, helium and other minerals. Figure 1 visually illustrates the weighted percent of elements found in a typical soil sample taken from the lunar surface.[7] These minerals and volatiles can be used for manufacturing propellants used in robotic and human vehicles, water production for life support systems, fabrication of structures, production for a new energy source, and much more. Getting to space is not cheap. Nations have been witnesses to the exploration budget and have seen the budgetary shortfalls. Discovering and proving ways to survive and sustain long duration missions by utilizing in situ resources reduces mission cost by eliminating large amounts of mass consumed in life support systems, food, propellant, and waste disposal. Taking advantage of local resources will enable growth of revolutionary self-sufficient technologies that will prolong mission duration and reach beyond current LEO destinations.

Before In-situ Resource Utilization (ISRU) can be implemented it's essential for nations to invest in resource mapping and site surveying to determine resource location and quantity availability. In 2008 India launched this effort with their Chandrayyan-1 spacecraft. The mission objectives were to prepare a three-dimensional atlas of the near

[6] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies* (Netherlands: Martinus Nijhoff Publishers, 2009), 2.
[7] edited by G.H. Heiken, D. T. Vaniman, and B.M. French, The lunar source book: a user's guide to the moon (Cambridge University Press, 1991), CD-ROM, produced by Lunar and Planetary Institute.

and far side of the Moon and conduct chemical and mineralogical mapping of the lunar surface to show elemental distribution.[8] One of the many payloads on-board the

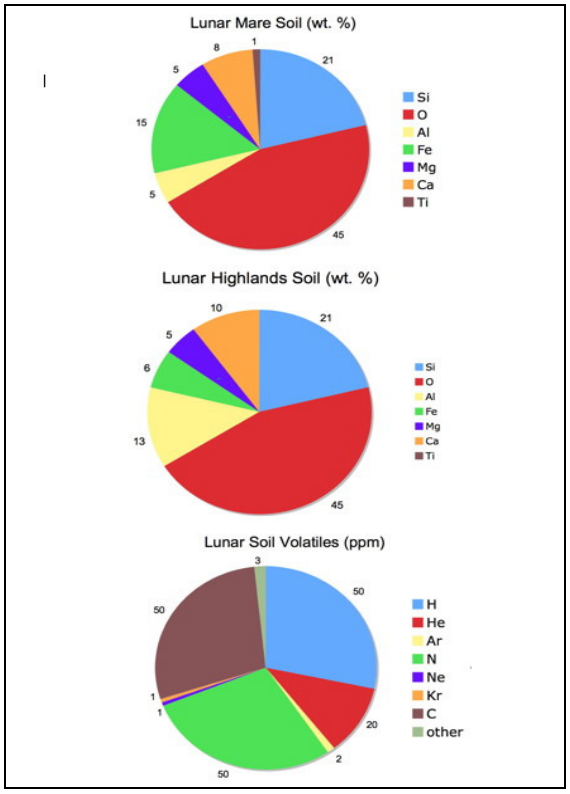


**Figure 1.** Weighted % of elements found in the lunar soil.
CREDIT: Dr. Paul Spudis- www.spudislunarresources.com/

spacecraft was the imaging X-ray spectrometer. This payload's primary objective was to determine the presence and abundance of elements on the lunar surface. Results from the payload showed detection of strong x-ray signals of Silicon, Magnesium, Aluminum, Calcium and Iron. Another onboard instrument was NASA's Moon Mineralogy Mapper ($M^3$) which characterized and mapped the mineral and chemical elements on the Moon using a push broom imaging spectrometer.[9] The instrument collected and combined

[8] Chandrayaan-1 scientific objectives, "India's First Scientific Mission to the Moon," ISRO website, http://www.isro.gov.in/Chandrayaan/htmls/objective_scientific.htm (accessed February 20, 2012).
[9] NASA's Moon Mineralogy Mapper, "Instrumentation," NASA's JPL website, http://m3.jpl.nasa.gov/ (accessed February 20, 2012).

spectral coverage in 446-3000 nm, spatial resolution in 70-140 m/pixel, and spectral resolution in 10-40 nm to create topographical images showing reflectance of the lunar surface.[10] Trace amounts of water-ice were detected at the lunar poles and on certain craters located near the north and south poles. Figure 2 illustrates the detected water-ice found near a crater. Figure 3 is a mineral map derived from the spectral signatures. The image illustrates iron-rich lava flows shown in green, purple and blue and mineral plagioclase shown in the pink and red regions.

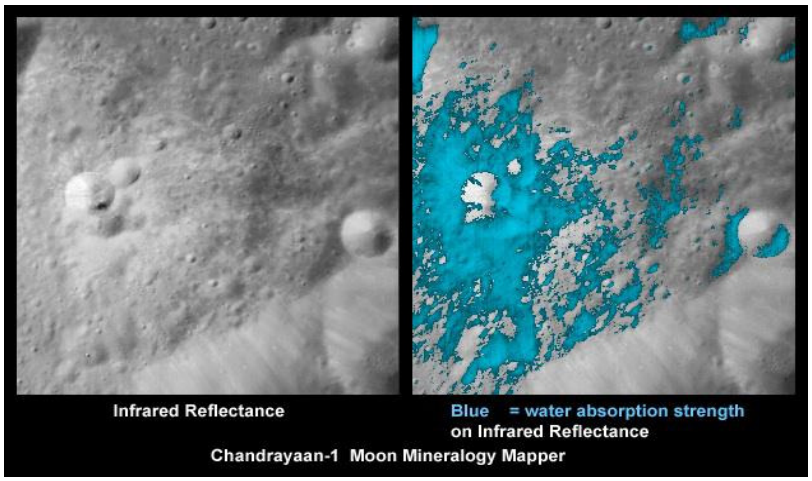


**Figure 2**. Chandrayaan-1 Moon Mineralogy Mapper. Image on the left shows brightness at shorter infrared wavelengths. On the right, the water-rich minerals (light blue) are shown around a crater. Both water- and hydroxyl-rich materials were found to be associated with material ejected from the crater. CREDIT: ISRO/NASA/JPL-Caltech/USGS/Brown Univ.

China is also very active in the research and analysis of lunar resources. In 2007, China launched the first spacecraft in the series of their lunar mission program, Chang'e-1. Change'e-1 mission objectives were aimed at mapping the chemical composition and abundance of various elements on the lunar surface as part of an evaluation to determine

[10] NASA's Moon Mineralogy Mapper, "$M^3$ Overview and Working with $M^3$ Data," NASA's JPL Website, http://moonmineralogymapper.jpl.nasa.gov/pubs/Isaacson_M3_Workshop_Final.pdf (accessed December 5, 2011).

potential useful resources on the Moon.[11] One resource of interest was helium-3. A multi-channel microwave radiometer was developed to gather information about the brightness temperature of the Moon. The brightness temperature data when combined with the chemical composition data would be used to obtain the thickness measurement of lunar regolith layers providing an estimate on resource amounts, such as helium-3.[12]

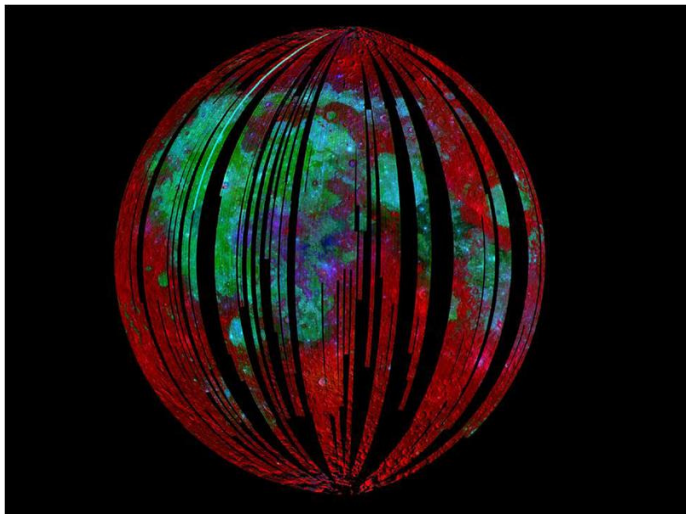

**Figure 3.** NASA's Moon Mineralogy Mapper from Chandrayyan-1 mission. Illustrates the various materials found on the near side of the Moon. CREDIT: ISRO/NASA/JPL-Caltech/Brown Univ./USGS.

Figure 4 illustrates the success Chang'e-1 achieved in mapping and outlining the distribution of key elements on the Moon. China has launched its second lunar spacecraft, Chang'e-2, with the objective of returning high resolution images to aid in the selection of a future landing site for the Chang'e-3 lander and rover mission scheduled in 2017. Chang'e-3 primary mission is to land a rover on the Moon and return to Earth with

[11] Sun Huixian, et al., "Scientific objectives and payloads of Chang'E-1 lunar satellite," *J. Earth Syst. Sci* 114, no. 6 (December 2005): 789-794, http://www.ias.ac.in/jessci/dec2005/ilc-25.pdf (accessed January 7, 2012).

[12] Ouyang Ziyuan, et al., "Chang'E-1 Lunar Mission: An Overview and Primary Science Results," *Chin. J. Space Sci.* 30 no.5 (2010): 392-403, http://www.cjss.ac.cn/qikan/manage/wenzhang/2010-05-02.pdf (accessed January 7, 2012).

lunar soil samples for scientific research.[13] As already indicated, many nations have plans to participate in further exploration of the Moon; among these are the United States, Russia, Europe, China, Japan, India, Germany, and South Korea. The rising topic of discussion among nations is commercialization of outer space.

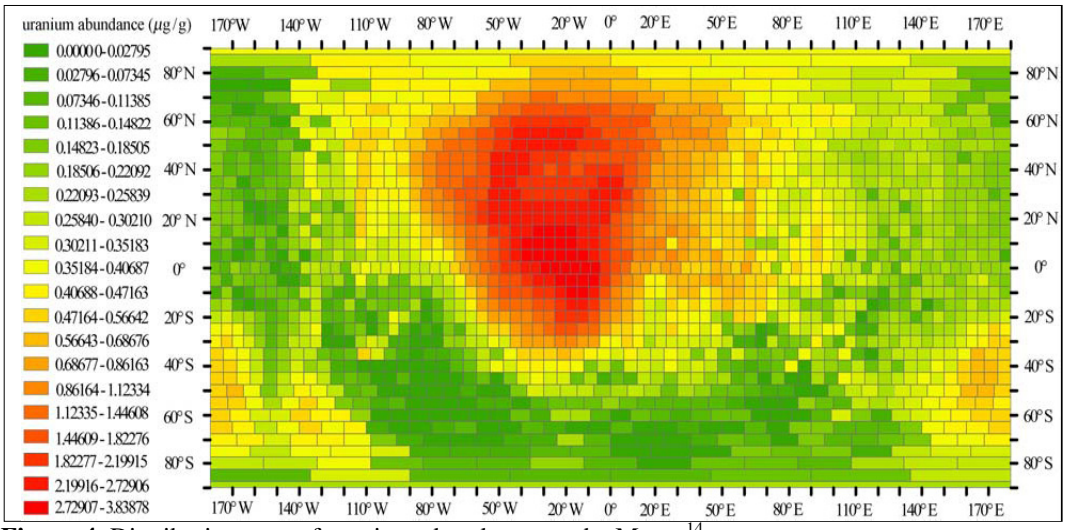

**Figure 4.** Distribution map of uranium abundance on the Moon.[14]

The assumption behind commercializing outer space resources is that it will lead to economic and financial benefits on the Moon and back on Earth. Recent publications, by Tronchetti[15] and Schmitt[16], address in detail the commercial benefit on the extraction, exploitation, and consumption of Helium-3, a rare commodity on Earth but abundant on the Moon. Helium-3 originates in the Sun and is implanted onto the lunar regolith by exposure to the solar wind.[17] Helium-3 when fused with materials like deuterium can be used as a fuel in fusion reactors. It has the potential to replace fossil fuels and be the

[13] NASA Lunar Science Institute, "Chang'e-2 finishes main mission," http://lunarscience.nasa.gov/articles/change-2-finishes-main-mission/ (accessed January 7, 2012).
[14] Ouyang Ziyuan, et al., "Chang'E-1 Lunar Mission: An Overview and Primary Science Results," 392-403.
[15] See Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies, 211*
[16] See Harrison H. Schmidt, *Return to the Moon* (New York, NY: Praxis Publishing, 2006).
[17] edited by G.H. Heiken, D. T. Vaniman, and B.M. French, The lunar source book: a user's guide to the moon, 686

primary source of energy on Earth. Schmitt[18] depicts the energy savings and value of helium-3:

> Detailed analyses of lunar soil samples and other evidence indicate that helium-3 concentrations are probably between 20 and 30 parts per billion in undisturbed, titanium-rich soils….the value of helium-3 relative to the probably energy equivalent value of coal in 2010-2020-estimated conservatively at $2.50 per million BTU – will be almost $40,000 per ounce! At $40,000 per ounce, 100 kilograms of helium-3 would be worth about $140 million. One hundred kilograms constitutes enough fuel to power 1000-megawatt electric plant for a year when fused with deuterium…..A plant of that capacity will fill the needs of a city about the size of Dallas for about one year.

There are other essential minerals on the lunar surface that would serve in sustaining human presence in space. An oxide mineral known as ilmenite ($FeTiO_3$) is an important constituent of lunar rock. This mineral can be found in the lunar mare basalts and can provide $TiO_2$, Fe and O through chemical reduction. $TiO_2$ can be used as a refractory, the Fe for materials fabrication and the O for life support and rocket propellants.[19] Other notable minerals found on the lunar surface that may be used for production purposes are aluminum, iron, and hydrogen. Outer space in general is abundant in resources. According to John S. Lewis the per capita income in using asteroidal iron and steel would generate wealth in the neighborhood of $7 Billion per person.[20] Add this to the gold, silver, and uranium deposits found in the asteroid belt; that number could reach as high as $100 Billion per person.[21] The idea of creating wealth by opening new and previously unforeseen markets with outer space resources is thriving in the minds of both the private and government industry. In the United States, NASA recently published a series of

---

[18] Harrison H. Schmitt, *Return to the Moon*, 44

[19] edited by G.H. Heiken, D. T. Vaniman, and B.M. French, The lunar source book: a user's guide to the moon, 209

[20] Virgiliu Pop, *Who owns the Moon? Extraterrestrial Aspects of Land and Mineral Resources Ownership* (Space Regulations Library Vol. 4: Springer, 2008), 24

[21] Ibid.

Human Exploration Destination Maps revealing new technological developments and demonstrations with ISRU capabilities.[22] Technology demonstrations include water extraction from the Moon's surface for use in habitats, vehicle systems, and waste removal. Another example is regolith manipulation and solidification schemes for shield protection against cosmic radiation. Another is food augmentation through an integrated environmental control and life support system. Many of the proposed technologies lead the path toward improving living conditions in space. Furthermore, the road maps have identified devices that will mine and drill into planetary surfaces in order to extract minerals for further characterization to determine their usefulness in creating infrastructure, utility/functionality, comfort, and safety.

Future missions have been outlined in NASA's budget, such as the precursor mission xPRM Lunar Lander scheduled to deploy in 2016.[23] Its primary mission is to demonstrate the extraction of water and other materials from the lunar surface to prove the production of propellants is achievable through the use of lunar resources. As mentioned above, China in 2017 will be extracting lunar material for their scientific research. So much of space exploration hinges on the ability to propel vessels, explorers and their cargo in the most cost effective and efficient way. Propellant resources on Earth are limited and expensive given the shear weight of the system being launched. Resources on the Moon can be extracted and refined to provide the sufficient sustenance and propellant for explorers to reach beyond the Moon. John Marburger, former

[22] NASA Space Technology Roadmap, "TA-07 Human Exploration Destination Systems," NASA website, http://www.nasa.gov/offices/oct/home/roadmaps/index.html (accessed October 15, 2011).
[23] NASA Exploration Enterprise Workshop, "FY 2011 Exploration Precursor Robotic Missions (xPRM) Point of Departure Plans, NASA website, http://www.nasa.gov/pdf/457443main_EEWS_ExplorationsPrecursorRoboticMissions.pdf (accessed October 15, 2011).

presidential scientist advisor, who headed the Office of Science and Technology Policy, is well-known for the speech he gave at the 2006 Goddard Memorial Symposium, "[t]he greatest value of the Moon lies neither in science nor in exploration, but in its material."[24] It is well recognized in the space industry that extracting elements from the lunar surface and processing them into "fuel or massive components of space apparatus", as stated by Marburger, has a tremendous cost advantage over objects launched from Earth.

ISRU may begin as a State operated activity in order prove and verify the capabilities work, but in the end the use of ISRU will become a commercial activity where private industries will want to exploit the resources to make a profit in outer space and back on Earth. With the growth of nation's exploration potentials, the need to establish a framework on environmental protection becomes evident. The moon and other planetary bodies have an abundance of resources to avail one of, but "Who owns the rights to those resources?" and "What laws are in place to regulate the consumption and extraction of those resources?" If commercialization is allowed, and resource extraction can begin on the lunar surface, asteroids or other planetary bodies without a legal framework to guide their methods and consumption, then the planetary bodies that once looked so promising will become devoid.

Resource monitoring and availability is the key in accomplishing the advancement of the quality of life on Earth and in reaching the goal of sustaining human presence in outer space. The failure to protect the environment from extraction and consumption of space resources will lead to terrestrial disruption, depletion of non-

[24] 44th Robert H. Goddard Memorial Symposium, "John Marburger Keynote Address," http://www.nss.org/resources/library/spacepolicy/marburger1.pdf (accessed October 15, 2011).

replenishing resources, a first come and first serve mentality toward the use of resources, and a risk to international peace and political fairness amongst all. If exploring beyond LEO is truly the objective then the management of resource extraction and consumption is necessary.

# PART THREE

# METHODOLOGY

## 3.1 Introduction

In the paragraphs to follow, a comprehensive analysis is performed on the Outer Space Treaty (OST), the Moon Agreement (MA), the Protocol on Environmental Protection to the Antarctic Treaty, principles of the high seas, the structure of the International Court of Justice, and a case study on resource appropriation. The analysis of these doctrines will identify the legal provisions governing resource extraction and consumption and to discover which elements of these doctrines can be used in developing an environmental protocol to manage, regulate, and facilitate balanced resource extraction in outer space. Through judicious analysis the following statements make a claim on the existing issues discovered in the space law system of which this thesis will convey and contend in detail:

1. The provisions of the OST and MA provide limited safeguarding on the extraction and consumption of outer space resources.
2. From a Private and State prospective, planetary bodies, such as the Moon, are seen as a source of profit from the potentially valuable minerals; therefore they are targets for resource utilization.

3. There is a need to develop an environmental protocol that will protect terrestrial disruption, potential depletion of non-replenishing resources, ownership and control (first come, first serve) of extracted resources, and will safeguard international peace and political fairness among all.

Before diving into the laws that govern the use and exploration of outer space there are a couple of terms that need defining. The privatization and commercialization of space have been used interchangeably through many space policy publications. In the case of defining privatization and commercialization one may have to look to the context around the ideology and background imbue on it. For the purposes of this paper the definitions described by von der Dunk[25] will apply:

> "private" refers to the legal classification of an actor undertaking a space activity as oppose to "public" which comprises governments, governmental agencies, and intergovernmental organizations, and "commercial" refers to the main driving factor behind, and overarching objective of, such an activity and hence, is to contrasted to such other objectives as military or scientific purposes.

Also, for the intent of this paper the terms "use" and "ownership", as they apply to extraterrestrial declarations on space resources, need further clarification. The term "use" applies to the common property of all who can enjoy it, whereas, the term "ownership" applies to appropriation of common property by claim of sovereignty. Use does not mean own unless there is a clear act of total possession or complete depletion. Total consumption of a resource must never occur as it would mean ownership and would be counter Articles II and IX of the OST.[26] There are arguments in favor of the right to exploit a resource without having to claim ownership. These arguments come from the

[25] Frans G. von der Dunk, "The Moon Agreement and the Prospect of Commercial Exploitation of Lunar Resources," *Annals of Air and Space Law* Vol. XXXII (2007): 93.
[26] Virgiliu Pop, *Who owns the Moon? Extraterrestrial Aspects of Land and Mineral Resources Ownership*, 138

lack of provisions on a resource once the resource has been extracted from its place of origin. In order to claim ownership of a resource, there must be a legal right to use, possess and give away said property. Since the space treaties do not provide a legal right to own extracted resources then the legality of whether exploitation means ownership cannot be disputed without the creation of a third definition not yet provided by space doctrines. Many of the legal doctrines contain vague content and do not outline the specifics behind their terminology. A closer look at the doctrines will unveil that most of the provisions are very general in nature and undefined terms result in broad interpretations of States Parties.

It is necessary to briefly mention the history behind the foundation of these legal doctrines. The Antarctic Treaty System, the Outer Space Treaty and Moon Agreement were written post World War II between the times of 1959 and 1979. The avoidance of conflict (a priori) became the central theme in the post-bellum international law.[27] The United Nations Charter was in charge of removing any threats to the peace. "Areas that would have normally been considered *terra nullius* (Moon, deep seabed) or where conflicting claims could have grown into full-fledge wars (Antarctica) became, over the years, objects of international treaties."[28] Statements within the preambles of the OST, Antarctic Treaty, and MA explicitly call attention to maintaining international peace so as to send a clear message to the international community to conduct scientific and exploration needs in a peaceful manner. The preamble of the Antarctic Treaty recognizes "it is in the interest of all mankind that Antarctica shall continue forever to be used

[27] Virgiliu Pop, *Who owns the Moon? Extraterrestrial Aspects of Land and Mineral Resources Ownership*, 60
[28] Ibid.

exclusively for peaceful purpose and shall not become the scene or object of international discord" [29] and the MA declares the desire "to prevent the Moon from becoming an area of international conflict."[30] Maintaining international peace drove the warrant of free access to all areas and removed the technical difficulties that would be encountered in establishing title and delineating boundaries.[31] The notion of instituting free access to all areas of space became the driver behind the non-appropriation principle[32] and as a result of the principle an object or territory in outer space is not subject to private ownership or transaction but it is open to all. Tronchetti provides a detailed view on how the term *res communis omnium* was supported by legal institutions and the problems faced in characterizing the legal status of outer space.[33] The declarations proclaimed in the preambles of the OST and MA make clear the desire to keep outer space and the celestial bodies from becoming a place of international conflict. The concern is determining how to avoid international conflict while allowing States Parties the right to derive potential benefits from utilizing the natural resources found on the Moon and other celestial bodies. Given the rise in private ventures into outer space along with support for commercial spaceflight industry, a set of provisions that will protect the space environment and its resources should be clearly delineated.

The question has often been raised whether there is a need to amend the provisions of the OST to permit space-faring nations and private operators rights to

[29] See Preamble to the Antarctic Treaty, available at the following website: http://www.antarctica.ac.uk/about_antarctica/geopolitical/treaty/update_1959.php
[30] See Preamble to the Moon Agreement, available at the following website: http://www.unoosa.org/oosa/SpaceLaw/gares/html/gares_34_0068.html
[31] Ibid.
[32] See Article II of the Outer Space Treaty, available at the following website: http://www.unoosa.org/oosa/SpaceLaw/outerspt.html
[33] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies*, 12-14

perform exploitation of extraterrestrial resources. There is a commercial advantage for using outer space resources in terms of exploitation.[34] Tronchetti argues exploitation will contribute to the betterment of living conditions on Earth.[35] Tronchetti also argues the industrial, financial, and political interests that would result from such exploitation activities. These interests would require a new legal framework to preserve the validity of the current space law regime while establishing provisions to govern the exploitation of natural resources.[36] The International Institute of Space Law even identified current international space legislation does not include detailed provisions with regard to the exploitation of natural resources of outer space, the Moon or other celestial bodies and provided their view that a specific legal regime for exploitation of space resources should be elaborated through the United Nations for the purposes of clarity and legal certainty in the near future.[37] The argument of this paper is that before one can establish provisions to govern exploitation activities there must first be provisions on environmental protection that includes balanced resource extraction and consumption. As each of the doctrines mentioned above are analyzed, it will become evident that there is a breakdown in the current space law framework for governing extraction and consumption of space resources and there is a need to manage these resources before exploitation and consumption begin.

[34] Definition of exploitation is use or utilize, especially for profit. Applying that definition in terms of outer space means extracting a mineral from the surface, gaining ownership of it and utilizing it to make a profit either in space or back on Earth.
[35] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies*, 287
[36] Ibid., 288.
[37] International Institute of Space Law, "Statement of the Board of Directors of the International Institute of Space Law," (2009), IISL website, http://www.iislweb.org/docs/Statement%20BoD.pdf (accessed on January 30, 2011).

## 3.2 Outer Space Treaty

In space law, the most recognized legal document governing the exploration and use of outer space is the OST.[38] It is made up of seventeen articles broadly addressing the subject of sovereignty, exploration, use, militarization, liability, and conflict in outer space and on celestial bodies. The treaty is the most widely accepted among all of the outer space treaties. The notion that activities in space should remain in full harmony and adhere to certain international obligations led to the creation of the OST which entered into force in 1967. The realization of the warranted need came from the excitement of the Sputnik flight and the awareness that international cooperation was essential if uncontrolled activities and chaotic developments in space were to be avoided. The treaties underlying principles are as follows:

1. Exploration and 'use' of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interest of all countries

2. Outer space shall be free for exploration and use by all states on a basis of equality

3. Outer space shall not be subject to appropriation by claim of sovereignty, by means of occupation, or by any other means

[38] Treaty was adopted by the UN General Assembly on December 19, 1966, opened for signature on January 27, 1967, and entered into force on October 10, 1967. The Treaty has 101 Parties and has been ratified and signed by all current space-faring nations.

4. Activities in exploration and use of outer space must be carried out in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security

5. No nuclear weapons or any other kinds of weapons of mass destruction shall be placed in orbit around Earth

6. Consultations may take place in the event of dangerous activities in space

For principles describing the international responsibility for the protection of the environmental and management of outer space resources a review of a few OST Articles (I, II, VI, and IX) should prove instructive.

*Article I*

Article I addresses three basic rights: the right of free access, the right of free exploration and the right of free use. Article I declares that:

> 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. Outer space, including the moon and other celestial bodies, shall 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, and there shall be free access to all areas of celestial bodies. There shall be freedom of scientific investigation in outer space, including the moon and other celestial bodies, and States shall facilitate and encourage international cooperation in such investigation.

In the first sentence "Province of all mankind" prescribes that the exploration and use of outer space must be carried out for the benefit and interest of all countries, irrespective to their degree of economic or scientific development. This sentence represents an obligation to developed States to ensure any activities, whether exploring the land or

using space resources, be performed in a manner that benefits all countries, regardless of their status quo in being a space-faring nation. Developing countries are protected through the idea of space exploration and use being conducted "for the benefit" and "in the interest" of all mankind.[39] The Article testifies that though all nations have a common stake in resources found off Earth only a few are in a position to make use of them.[40] This principle takes into account not only the needs and rights of the States directly involved in space activities but also those of all mankind.[41] Some scholars interpret the concept as just a moral obligation without imposing any legal obligation to those developing countries that may never use or explore outer space.[42] To what extent is a State Party obligated to share the benefits of their space activities? It should be noted that developing States played an important role during the drafting of this treaty. The insertion of "irrespective of their degree and scientific development" was the result of a Brazil representative.[43] Though the intent to of taking into account all needs and rights of States is clear what is unclear are the details of how a developing State or even a space-faring State would receive the benefits prescribed by another State. For example, what if a state extracted helium-3 from the Moon's surface and exploited the mineral back on Earth to provide a renewed energy source for electrical power production. Would the country that extracted and exploited helium-3 be obligated to share the enormous profit it collected? Or did the country meet its obligation of the treaty by providing the benefit of a renewed energy source to all States? According to the article all countries are to

[39] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies*, 63
[40] David M. Livingston, "Ethics and Off-Earth Commerce," in *Space Politics and Policy: An Evolutionary Perspective*, ed. Eligar Sadeh (Netherlands: Kluwer Academics, 2002), 235.
[41] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies*, 21
[42] Ibid., 24.
[43] Ibid., 21.

receive the benefit, but there is a possibility for only one country to receive the profit. Who or what manages the States Parties that would exploit and consume outer space resources without due regard to resource rationing and turn an unmanaged and ungoverned frontier into a profit.

Article I (2) affirms the Moon and celestial bodies shall be "free for exploration and use by all States"; the term 'use' causes great controversy over the types of activities that can be performed in space. The term 'explore' refers to the research and scientific activities performed within the space environment. It is the term 'use' that is general and open to interpretation. Use can be defined as a scientific or commercial activity. While there are no disputes over the former, there is a great difference of opinion concerning the latter. Some States Parties to the treaty, such as France, view the term 'use' as equivalent to 'exploitation.'[44] Replace the term 'use' with 'exploit' in Article 1 (2) and it can be interpreted that all states have the right to exploit the land in space without discrimination of any kind but on the basis of equality and in accordance with international law. The thought of allowing exploitation on these terms brings to mind a TV series known as Firefly.[45] Firefly illustrates one person's idea of what would happen if we colonized another solar system. One entity controls all aspects of outer space. The vision is technology will advance but under the same political, moral and ethical problems as we have today. The main character is a smuggler who looks for honest labor but cannot, do to equality of all man. There is a shortage of food and medical supplies. The series portrays the outcome of what would happen when one State is given the right to mine and

[44] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies*, 22 states that France declared it was important for all States, no only those engaged in space exploration, to know what the term 'use' implied. In their view the term 'use' was equivalent to the term 'exploitation.'
[45] *Firefly,* created by Joss Whedon (California: Twentieth Century Fox Television, 2002), DVD.

exploit but only on the basis of equality. The concept implies all States would have the right to mine. How does one equally share the freedom to explore and 'use' outer space amongst all State Parties? The paragraph goes on to say "there should be free access to all areas of celestial bodies." What if two State Parties want to 'use' or 'exploit' the same area? How do you resolve that conflict?

Article 1 (3) provides freedom of scientific investigation on all celestial bodies. It's interesting this last paragraph exists. If 'explore' refers to freedom of research and scientific activities as stated above, then technically this last paragraph is already covered by the second paragraph of the article. Why would the right of freedom for scientific investigation need to be re-stated, unless the purpose of the second paragraph is really to allow activities, like exploitation resulting in a need to establish the right of freedom for scientific investigation? However, the additional paragraph may be to re-establish the intent behind the types of space activities allowed. Regardless, the terms are vague and clarification is needed.

In summary, Article I sets the right of free access to explore, use and perform scientific investigations on any area of a celestial body. However, the article fails to provide clear specifics on the term 'use' and if the term encompasses exploitation, the sharing of areas prone to activity, management of products derived from those activities, limitations on the amounts of product extracted or consumed, and the creation of an authority in charge with the power to resolve conflict when it arises. There is also no environmental protocol on monitoring these activities to discern if an activity will cause harm to a State or another State's activity, the environment of a celestial body, or to personnel residing on the Moon.

*Article II*

Like Article I, Article II embodies an essential principle of space law by defining the legal status of outer space and a basis for all manned activities in the realm of space located approximately 100 km above sea level. Article II states the non-appropriation principle of outer space and celestial bodies. The viewpoint on non-appropriation began back in 1960. From 1960 to 1966, the Association of the Bar of the city of New York, the Institute of International Law, and the International Institute of Space Law had either recommended or drafted a statement that stated "Celestial bodies…shall not be subject to national appropriation by any person, organization, or State on Earth."[46] Article II reads, "Outer 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." The Article reinstates the *res communis omnium* character, that is, outer space is free access open to all and cannot be owned by anyone, not even a State. The term *res communis omnium* is derived from the Roman law and applies to areas such as air and light.[47] Virgiliu Pop argues the OST has conferred outer space with the character of "*res communis* – placed by nature at the equal disposal of all men and non-appropriable by individual States or private persons."[48] The drafters of the Article make it clear that a terrestrial claim in outer space is not allowed. The general consensus among the drafters of the Treaty was to preserve the peaceful nature of the space environmental and ensure all mankind had free access, exploration and use, without discrimination of any kind.

---

[46] Virgiliu Pop, *Who owns the Moon? Extraterrestrial Aspects of Land and Mineral Resources Ownership*, 64

[47] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies*, 11

[48] Virgiliu Pop, *Who owns the Moon? Extraterrestrial Aspects of Land and Mineral Resources Ownership,* quotes David S. Myers, 65.

It is necessary to discuss if appropriation by claim of sovereignty refers to land (property on the surface) or to the extraterrestrial material under the surfaces. In view of the drafters of the Treaty, the idea of movable extracted resources was not thought of and so it's really not out of character that the OST does not directly address the appropriation of extracted resources. Pop argues certain viewpoints that could be implied since appropriation of extraterrestrial materials is not directly stated. One viewpoint stated by Pop is the OST prohibits appropriation of extraterrestrial material because the OST does not distinguish between celestial bodies and their resources and instead enounces only one legal regime prohibiting national appropriation.[49] On the same viewpoint another scholar argues that if the exploration and use of outer space is to be in the interest and benefit of all mankind and not for the benefit of a single State, then any resource extracted has to be used exclusively in the interest and benefit of all mankind. However, it would be difficult to extract material away from a particular State because that State would argue their use of such material coincides with the interest of mankind.[50] The second viewpoint Pop argues is the OST allows appropriation on limited quantities of extraterrestrial material because such quantities are required in scientific experiments, operation needs of local outposts, and in scientific testing back on Earth.[51] The later example has already been seen by the Apollo missions when astronauts brought back regolith and rock samples for scientific analysis. These examples would fall under the freedom of scientific investigation provided by the Article I of OST. The third viewpoint Pop argues is the OST allows appropriation merely because Article II doesn't specifically

[49] Ibid., 135.
[50] Ibid., 136.
[51] Ibid., 137.

state non-appropriation of materials thereon. The seizure of materials merely lies within the freedom of exploration and use of outer space as stated by Article I of the OST.

One scholar argues enterprise rights falls into the category of the right to explore and exploit outer space resources without having to claim ownership over the land thereof.[52] On the same viewpoint Pop[53] quotes a scholar, who found it appropriate to cite the play *Rudens* by Titus Maccius Plautus:

> [W]hen the slave says: - the sea is certainly common to all persons – the fisherman agrees; but when the slave adds: - then what is found in the common sea is common property – he rightly objects, saying: - But what my net and hooks have taken, is absolutely my own.

The common theme behind each of these viewpoints is that outer space resources will be extracted and used in some form or fashion. The right of who owns those resources is still debatable. Until the OST can be updated to address clarity and legal certainty of the term 'use' then the right of using outer space resources for exploitation or scientific investigation is valid option open to all States.

Another factor that needs further consideration is when the use of space resources results in ownership of those resources. If a State has the freedom of scientific investigation, as stated by Article I, but any attempt to claim ownership of a part is forbidden by Article II, then at what point does freedom of scientific investigation turn into ownership of parts? Say a State Party collects lunar regolith to build a shield over a lunar outpost to protect its inhabitants from the effects of radiation exposure. Most scientists are aware of the need to protect astronauts from the extreme radiation

[52] Ibid., 138.
[53] Ibid., 139.

environment on the lunar surface.[54] One way to reduce the amount of exposure is to dig beneath the lunar surface and build an outpost covered in lunar regolith. Studies show about 1-2 meters of regolith is needed for effective shielding.[55] Although there is a lot of lunar regolith available on the lunar surface, the 1-2 meters utilized by a State is no longer available to any other State, thus proving resource ownership. Another example is using a space resource for local needs. If a State is to be successful in sustaining human presence on the Moon then it needs a life support system. A life support system provides astronauts with food, water and air. Water, like food, is a heavy element on a spacecraft payload. Finding ways to eliminate large amounts of mass is essential in reducing mission costs. The Lunar Crater Observation and Sensing Satellite (LCROSS)[56] and $M^3$ missions confirm the presence of water ice on the lunar surface. In order for the water ice to be used in a life support system for food, drinking, and hygiene purposes, the metallic minerals contained within the water ice would need to be removed. Once the water ice is altered and consumed within a life support system, then technically only one State has access to the resource unless the outpost bears the same international operations of the International Space Station. Depending on the amount of water ice available, what system is in place to ensure the resource is divided fairly among all States? What system is in place to manage the rate of quantity consumed versus quantity remaining? What about protecting the scientific data that is locked away in the micro and macro mineral-logical level of the Moon?

---

[54] The Moon's surface is exposed to cosmic rays and solar flares. The radiation doses received from these events are extreme and hard to stop even with shielding.

[55] Jared Bell, *et. al*, "Radiation Shielding for a Lunar Base: Conceptual Design Report," LSU website: http://cmie.lsu.edu/NASA/Teams/Radiation%20Shielding%20for%20a%20Lunar%20Base/Fall/Report_Design.pdf (accessed January 20, 2012).

[56] NASA LCROSS, "Lunar Crater Observation and Sensing Satellite," NASA website, http://www.nasa.gov/mission_pages/LCROSS/news/lunar-water-metal.html (accessed January 20, 2012).

It should be clarified that this principle also covers sovereignty claims to the space surrounding a celestial body. Like in most contracts when terms are vague and open to broad interpretations someone finds a way out. Variations of sovereignty can already be seen in space activities like remote sensing, telecommunications, and permanent constructions of settlements. A satellite occupies a set orbit space for an extended period of time. During the period of contract no other satellite can have that space, so technically the company or organization of that satellite claims control over the said space for a period of time which results in a form of sovereignty. Most of mankind looks for loopholes in laws governing the activities they wish to partake in and thereby the natural tendencies of mankind justifies the need to establish clear and distinct guidelines.

*Article IX*

It has already been established in the paragraph above the OST does not adequately provide provisions on the extraction and consumption of outer space resources. This non-establishment of guidelines directly hinders the ability to protect the environment housing those resources. There is no reason why States Parties using and exploring outer space cannot establish a set of guidelines that adopt an environmental protocol aimed at achieving global responsibility for the activities performed in outer space. Most space activities have been about national prestige, not planetary responsibility.[57] Space debris is one of the greatest hazards facing human activities in outer space. Technical studies and analyses on legal and policy implications to determine

[57] Howard A. Baker, *Space Debris: Legal and Policy Implications* (Netherlands: Martinus Nijhoff Publishers, 1989), 75.

a better international regime for recognizing and regulating space debris started before 1989.[58] Today the States Parties to the OST still remain unresponsive on providing environmental guidelines for space activities. Pitfalls experienced from not updating the space treaty, as it pertains to space debris, prove that by not establishing a clear framework for environmental protection of space resources we are heading for similar challenges. Establishing legal rules for environmental protection will increase State's understanding on the nature of ecological systems and promote awareness to environmental impact. Lunar and celestial economic development is the future for space exploration. The conception of man as a steward tending to the environment is essential in protecting the environment on a universal scale for future generations.[59] Activities in outer space have been conducted by men for over 50 years now. Planetary relationships, such as the Earth-Moon system, are essential to the existence of life on Earth. Can man afford to ignore the Earthly history lessons in resource preservation and the safe keeping of the environment? The one Article of the OST that addresses some limitations on space activities for the safeguarding of the environment is Article IX. This article will be examined in detail, Article IX states:

> In the exploration and use of outer space, including the moon and other celestial bodies, States Parties to the Treaty shall be guided by the principle of cooperation and mutual assistance and shall conduct all their activities in outer space, including the moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty. States Parties to the Treaty shall pursue studies of outer space, including the moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose. If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space,

[58]Ibid., 1.
[59]Ibid., 86.

> including the moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the moon and other celestial bodies, may request consultation concerning the activity or experiment.

The history of this Article is worth mentioning because the activities occurring in space during the time of its creation played an influential role on the drafters of this treaty. The question of harming the outer space environment through space activities began after the launch of Sputnik I.[60] A question was put forward on whether "early exploration attempts or ill-considered experiments might result in biological, chemical or radiological contamination of lunar or planetary surfaces such as to complicate or render impossible further studies of scientific importance."[61] Two committees were formed to protect the newly founded space environment from harmful experiments, first the Committee on Contamination by Extraterrestrial Exploration (CETEX), disbanded in 1959, and then the Committee on Space Research (COSPAR).[62] According to Baker's assessment, the two committees were only concerned with the effects of contamination and environmental interference as it would pertain to damaging other scientific activities. As such the committees gave no consideration on whether scientific space research and experiments would pose as a hazard to the outer space environment.[63] Baker perceives the committee's approach as a "sci-lab" viewpoint:

[60] Ibid., 87.
[61] Ibid.
[62] Ibid.
[63] Ibid., 88.

> the view that the value of outer space, including the moon and other celestial bodies, is limited to its use as a laboratory for scientific activity and that any proposed space activity will be assessed as potentially harmful to the outer space environment if and only if it threatens the future use of outer space for scientific purposes. [64]

This "sci-lab" viewpoint made its way into the wording of Article IX. The viewpoint can be seen in Article IX (1) and (3), "States Parties……shall conduct all their activities in outer space….with due regard to the corresponding interests of all other States Parties…", and "If a State Party….has reason to believe that an activity or experiment…..would cause potentially harmful interference with activities of another State Party….it should undertake appropriate international consultation…" The provisions within these two sentences are directed towards activities performed by the States and their potential to harm other States Parties research activities. Neither sentence provides restrictions on space activities that could cause potential harm to the space environment. It was not until seven months before the treaty was open for signatures that US President Lyndon B. Johnson proposed the treaty be updated to include a principle about avoiding harmful contamination while performing activities in space.[65] Both the US and USSR submitted draft proposals on Article IX including provisions about avoiding harmful contamination of the celestial bodies. The fact both draft proposals included a common principle of avoidance of contamination and the declaration made by President Johnson to include such a provision are the reasons why Article IX now includes provisions about avoiding harmful contamination of celestial bodies. Article IX (2) and (4) state, "State Parties…shall pursue studies of outer space, including the moon and other celestial bodies, and conduct exploration of them so as to

[64] Ibid., 89.
[65] Ibid., 93.

avoid their harmful contamination and also adverse changes in the environment of Earth…" and "A State Party which has reason to believe that an activity of experiment……would cause potentially harmful interference with activities…including the moon and other celestial bodies, may request consultation concerning the activity or experiment."

Though this one article contains many provisions on performing scientific activities in space it is imperative to disclose what it does not say about the management of outer space resources. There are many benefits that come from using outer space, to name a few, remote sensing, satellite television, wireless communications, and unmanned exploration missions. It is the side effects from these activities like pollution and foreign object debris that have an adverse impact on the space environment. The term "so as to avoid" harmful contamination in the second sentence of the article really offers no direct protection for the environment. No activity is banned, only avoided, thereby allowing for harmful contamination by default. The sentence provides no preventative measures on how to avoid producing contamination, no clear definition on what would constitutes as contamination, nor does it provide a course of action for cleaning up contamination that may result from an activity. Looking further into Article IX (2), the adjective used to describe contamination differs on location: "Harmful contamination" to be avoided on celestial bodies, while "adverse changes" are to be avoided on Earth resulting from the introduction of extraterrestrial matter.[66] By using a different expression for Earth's location would imply harmful contamination may be permitted to enter Earth. Adverse changes may not necessarily constitute harmful contamination; such an example is

[66] Ibid., 94.

provided by Baker: "The importation to Earth of an extraterrestrial organism, which results from harmful contamination, would be permissible as long as adverse changes of Earth's environment do not occur."[67] So, the importation of an extraterrestrial organism that releases a virus and affects certain humans would be permissible because it did not adversely change the Earth's environment (e.g., evaporation of a continental water supply). The allowance of certain activities without proper environmental guidelines leaves open the door to certain ill-fated damages that may not be reversed. What is missing from this article is a committee in charge of performing environmental impact assessments of activities before allowing them to proceed.

The article does not mandate, it implies, the need to have "due regard" to other parties partaking in activities in outer space. The movement of dust, mining, or release of hazardous materials may affect the activities of other State Parties. For example, if a State Party builds a large Radio telescope on the far side of the Moon to avoid electromagnetic interference created on Earth, how do they stop other State Parties from building on the near side and contaminating the RF spectrum? The consensus to perform an activity is not required before proceeding. Now, the Japanese delegation had suggested an amendment to include more detailed regulation of 'contamination' but it was rejected.[68] During the drafting of OST the intent was not to establish too rigid procedures which might hinder future research or limit their space activities.[69] An establishment of environmental principles would have prohibited or limited such activities, especially if those activities harmed the celestial body and its surrounding space environment.

[67] Ibid.
[68] Ibid., 97.
[69] Ibid.

However, it is evident during the drafting of the OST the rules governing environmental protection were based on laws of man and not laws of nature as interpreted by scientists.[70]

Article IX (3) and (4) provide general provisions about consulting with other States Parties should there be a "reason to believe" an activity or experiment would cause potentially harmful interference with activities of another State Party or with activities in the peaceful exploration and use of outer space. Article IX (4) provides no obligation for the State undertaking the activity to agree to the request for consultation, it simply states a State Party "may request" consultation. The procedures on how to begin consultation or an authority to overhear said arguments and provide a resolution is not provided by this article or by OST. If a State Party is at fault for pursing a potentially harmful activity – which is based on the premise of sufficient knowledge, then what appropriate measures would be taken? According to this article and the OST there is no obligation for a State to oblige with the resolution of the consultation. States could apply to dispute a resolution under international law; however, there are no procedures in place to invoke Earth-bound resolution of outer space disputes. Below is an example of a dispute based on the drive shown by commercial entities to reach space for exploitation. If a State Party decides to strip mine He-3 on the lunar surface creating a gigantic electrostatic dust cloud which settles on another State Parties optical telescope, how do the two State Parties facilitate their differences? What if their difference cannot be worked out? What authority is in charge to hear and resolve their conflict? Currently, such an international authority does not exist. Now, if an environmental committee had been established by the OST then the

[70] Ibid., 95.

two State Parties would have been aware of the activity and an impact assessment would have been performed before allowing such an activity to take place. The goal of this paper is to provide recommendations on the principles of such a committee.[71] Later, the need to establish an international authority will be discussed as well as the work that has already been done by the space community to create such an authority.

## 3.3 Moon Agreement

The Moon Agreement governs the activities of States on the Moon and other celestial bodies. The Preamble of the agreement recognizes that the Moon and other celestial bodies have important roles in the exploration of outer space.[72] The desire of the agreement is to prevent the Moon from becoming an area of international conflict while promoting further progress in the development and use of the Moon and other celestial bodies. The MA was created to provide additional detailed provisions for man's activities on celestial bodies.[73] The agreement elaborates on environmental protection and bears in mind the benefits which may be derived from the exploitation of the natural resources. Awareness on what types of activities could be performed on the Moon and other celestial bodies became known in the course of the successful Moon landings performed by the United States from 1969 to 1972. Unlike the general provisions in the OST used to account for exploration and use of celestial bodies, the MA speaks to the awareness of a State's willingness to perform activities such as exploitation and the need to define and develop provisions relating to the exploration and use of outer space resources. The

[71] See Part Six Recommendations for A Protocol on Environmental Protection to the Outer Space Treaty
[72] The Agreement titled, "Agreement Governing the Activities of States on the Moon and other Celestial Bodies" was approved by the UN General Assembly on December 5, 1979, and opened for signature on December 19, 1979, and entered into force on July 11, 1984.
[73] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies,* 38

drafting of the MA began in 1970 and continued for the next eight years as State Parties deliberated on the wording.[74] On December 18, 1979 the agreement had received approval and was open for signatures, and on July 11, 1984 the agreement entered into force. Surprisingly, after many years of deliberating only a hand full of States ratified the agreement.[75] As of 2011 only thirteen States have ratified the agreement, with an additional four States being signatories to it. The agreement has not been ratified by any nation which engages in self-launched manned exploration missions or has plans to do so. The following space-faring nations have not signed the agreement: the United States, United Kingdom, Russia, Europe, China, and Japan. France and India signed but did not ratify the agreement. This level of acceptance makes the binding force of the MA unsuccessful. While the agreement may not be binding to all State Party's, it does introduce new elements on exploitation which will have a practical impact on space activities performed on the Moon or other celestial bodies. Though the MA is deemed unsuccessful there are some legal scholars analyzing its provisions for the purpose of developing a new legal regime which allows private operators to exploit the natural resources found on the Moon and other celestial bodies for commercial purposes.[76] Even though the MA is not binding to the current space-faring nations it is still an in-force agreement and an important doctrine of space law. Articles 6, 7, 11 and 15 will be

[74] Ibid.

[75] The Moon Agreement required ratification by five States before it would enter into force. The ratifications were Chile, the Philippines, Uruguay, the Netherlands, and Austria. Following the ratification eight additional States ratified the agreement, Belgium (2004), Lebanon (2006), Mexico (1991), Pakistan (1986), Peru (2005), Kazakhstan (2001), Morocco (1993), and Australia (1986). The MA has not been ratified by any major space power.

[76] See Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies* and Harrison H. Schmidt, *Return to the Moon*.

analyzed for the content relating to safeguarding on extraction and consumption of outer space resources.[77]

*Article 6*

Much of the MA is an elaboration from the OST so certain articles will contain similar wording. Only the new rules and elements will be analyzed within the Articles stated above. Article 6 declares:

1. There shall be freedom of scientific investigation on the moon by all States Parties without discrimination of any kind, on the basis of equality and in accordance with international law.
2. In carrying out scientific investigations and in furtherance of the provisions of this Agreement, the States Parties shall have the right to collect on and remove from the moon samples of its mineral and other substances. Such samples shall remain at the disposal of those States Parties which caused them to be collected and may be used by them for scientific purposes. States Parties shall have regard to the desirability of making a portion of such samples available to other interested States Parties and the international scientific community for scientific investigation. States Parties may in the course of scientific investigations also use mineral and other substances of the moon in quantities appropriate for the support of their missions.
3. States Parties agree on the desirability of exchanging scientific and other personnel on expeditions to or installations on the moon to the greatest extent feasible and practicable.

Unlike the OST, Article 6 (2) of the MA allows States Parties to collect and remove samples of minerals and other substances from a celestial body. The article goes on to declare that States Parties shall have "regard" in making a portion of such samples available to other interested States Parties and the international scientific community. In actuality, States Parties could decline to allocate portions of the collected samples as the article does not stipulate States Parties "shall share" such portions. This sentence

[77] For broad analysis of the Moon Agreement see: I.H. Ph. Diederiks-Verschoor & V. Kopal, *An Introduction to Space Law*, (Netherlands: Kluwer Law International, 2008), 48.

essential allows a State Party to the Treaty to remove a natural resource from a celestial body with no obligation to share the resource. Furthermore, Article 6 (2) affirms States Parties, in the course of scientific investigations, are allowed to take "quantities appropriate" for the support of their mission(s). Some legal scholars feel the "quantitative assessment [should be] at the sole appreciation of the States conducting the mission" and the "use of in-situ resources is determinable by the mission definition or mission profile, defining its purposes and objectives."[78] If the latter is true then this Article does not provide any limitation on the amount of material a State Party can remove. A States Parties could deem the excessive removal of a mineral is required to successfully complete their mission profile. Recall the OST has not established an international authority to govern the extraction or consumption of space resources and since major space-faring nations have not signed the MA, then there is no reprimand or power of authority to act if a State Party chooses not to share a resource or takes too much of a resource leaving little behind for the next Party.

Regardless of the efforts put forth by a State Party or what the mission profile prescribes, a State Party should not be able to remove infinite amounts of extraterrestrial resources. Clear cutting timber in the U.S. and the resulting dust bowl are two prime examples of environmental disasters that resulted from unchecked limits on resource usage. The entrepreneurial spirit unleashed in the minds of the lumbermen, following the California gold rush, led to a new industrial era in forest exploitation which left behind

[78] Virgiliu Pop, *Who owns the Moon? Extraterrestrial Aspects of Land and Mineral Resources Ownership*, 145

waste and land destruction, leading to timber depletion and deforestation.[79] In 1850, the first lumber business opened and by 1930 deforestation could be seen on the Pacific coast.[80] In 1940, Oregon's Forest Conservation Act became law and mandated operators "to leave reserve trees of commercial species deemed adequate under normal conditions to maintain continuous forest growth and/or provide satisfactory restocking to ensure future forest growth."[81] This idea of resource rationing has not been implemented in the OST or MA.

On April 14, 1935, known as Black Sunday, massive dust storms occurred across a 97 million acre section that extended to Colorado, New Mexico, Kansas, Texas and Oklahoma.[82] The cause of the 1930s Dust Bowl was largely due to the severity of the climate, the type of soil, and excessive cultivation of land that was intended for grazing.[83] Farmers continuously cultivated the land without allowing proper topsoil regeneration time. Consider the perfect storm; no trees existed to block the wind, with the only root system holding the dirt together gone and no rain, the slightest breath of wind altered the face of that area for years. The Dust Bowl is an example of what happens when resource extraction goes unchecked. The U.S. Government responded by implementing a program to conserve soil and restore ecological balance, the program Soil Conversation Service was formed in 1935 later renamed to the Natural Resource Conservation Service (NRCS). Again this idea of resource conservation has not been implemented in the MA or OST.

---

[79] Richard A. Rajala, *Clearcutting the Pacific Rain Forest: Production, Science, and Regulation*, (Vancouver, British Columbia: UBS Press, 1998), xviii.
[80] Ibid., xix.
[81] Ibid., 169.
[82] R. Douglas Hurt, *The Dust Bowl: an agricultural and social history*, (Chicago: Nelson-Hall Inc. Publishers, 1981), 2.
[83] Ibid., 17.

If an abundant resource goes unchecked it will soon become scarce and may cause erratic environmental damages. The ambiguity of the term 'quantities appropriate' in Article 6 (2) provides no discrete limitation on the amount of material a State Party may remove. With no regulation on set quantities for resource removal the Moon will become a dwelling for unethical harvesting of space resources. The design, development and performance of space exploration activities are derived from documented lessons learned on previous missions to ensure those types of problems are not recreated. This methodology should be applied to the exploration of extraterrestrial materials so the environmental disasters that occurred through the commercial activities performed on Earth do not occur in space.

*Article 7*

Article 7 of the MA makes a recognizable improvement, in comparison to Article IX of the OST, on the environmental obligations to be held by States Parties when conducting activities on the Moon and other celestial bodies. Article 7 (1) reads:

> 1. In exploring and using the moon, States Parties shall take measures to prevent the disruption of the existing balance of its environment whether by introducing adverse changes in that environment, by its harmful contamination through the introduction of extra-environmental matter or otherwise. States Parties shall also take measures to avoid harmfully affecting the environment of the earth through the introduction of extraterrestrial matter or otherwise.

This article takes measures to avoid harmfully affecting the celestial bodies existing environment and the environment of Earth through the introduction of extraterrestrial matter. The MA moves away from the sci-lab perception and provides a scientific

classification of "disruption", based on ecological principles.[84] The definition brings awareness to the value of the Moon's environment and a need to protect that environment not only for the safety of mankind on the Moon but the protection of the Earth-Moon relationship and the safety of mankind on Earth. The Moon's environment is inert and bringing in hazardous material could potential damage the environment. A committee assigned to reviewing and approving activities performed by State Parties would bring attention to any activity that could cause potential harm, thereby reducing damages to the environment and protecting it for future scientific explorations. Though the article does amplify the environmental obligation it still contains vagueness of terms. The term 'harmful contamination' is not specific on the types of activities that should be restricted in order to prevent contamination. The article does not provide particular measures should a State bring in harmful contamination nor a consultative procedure to discuss what steps are needed to clean up or minimize further damage.[85] It should also be noted that "the period within which the environmental protection measures have to be taken is not mentioned explicitly" nor the awareness to other State Parties should the damage affect more than one State's activity, "as dangerous material may cross frontiers."[86]

Article 7 (2) advises States Parties to notify the Secretary General of the United Nations of the measures being adopted by Article 7 (1) and to notify him in advance of all placements of radioactive materials on the Moon and the purpose for such placement. While the MA allows radioactive materials on the Moon; the OST in Article IV prohibits the placement of nuclear weapons or weapons of mass destruction in space or on a

[84] Howard A. Baker, *Space Debris: Legal and Policy Implications,* 100
[85] I.H. Ph. Diederiks-Verschoor & V. Kopal, *An Introduction to Space Law*, 125
[86] Ibid.

celestial body. It may be argued a radio-active material could be deemed as a weapon of mass destruction depending on its use and function in a space activity. A chunk of uranium or the use of helium-3 when combined with other elements can produce a weapon of mass destruction. The vagueness of terms within Article 7 doesn't specify specific restrictions in terms of radioactive materials. While advance notice is necessary for placement of radioactive materials the effect of this advance notice is weakened, since it need only be given "to the maximum extent feasible."[87] The mere idea of bringing in radioactive materials on the Moon without a period within which to notify the Security General or a procedure that requires particulars about the purpose of such placements could lead to misuse of the elements. It is important to recall the space-faring nations, such as U.S., China and Russia, have not signed this agreement and are not held to the terms of the agreement. If radioactive materials are not deemed as weapons of mass destruction then either one of these parties could bring in radioactive material and use it for their own purposes, as long as they abide by the rules set forth in the OST.

*Article 11*

One of the main reasons State Parties, like U.S. and Russia, did not sign the MA was due to the term 'common heritage for all mankind' found in Article 11 (1) as opposed to 'province for all mankind' found in Article I (1) of the OST.[88] The term 'common heritage' implies benefit sharing of the natural resources found on the Moon to all States, regardless of their direct or indirect efforts, whereas, the province of all

[87] Howard A. Baker, *Space Debris: Legal and Policy Implications*, 100

[88] See Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies*, 40; I.H. Ph. Diederiks-Verschoor & V. Kopal, *An Introduction to Space Law*, 52; Frans G. von der Dunk, "The Moon and the Prospect of Commercial Exploitation of Lunar Resources," *Annals of Air and Space Law* Vol. XXXII (2007): 101

mankind concept allows State Parties to freely explore and use outer space without an obligation to share the benefits derived from their space activities. The MA proclaims both concepts, the province of all mankind concept in Article 4 (1), and the common heritage for all mankind concept in Article 11 (1). By the use of both terms the MA conveys that while exploration and use fall under the province of all mankind concept, Article 4 (1), the exploitation of natural resources falls under the common heritage of mankind concept, Article 11 (1).[89] The common heritage of mankind presumes any exploitative activities – especially commercial – require the consent of all States.[90] States would only be allowed to undertake commercial activities as long as an international regime (caretaker) would see to it that all States, especially developing countries, would benefit from those activities.[91] If the space-faring nations signed the agreement then they would be required to share the benefits derived from their exploitative activities.

On Earth developing countries have the option to barter minerals that are abundant in their land; they have some negotiation rights. On the Moon most developing countries will never be able to partake in the exploitation activities that developed countries are previed too. Article 11 (5) establishes an international regime to govern the exploitation of outer space resources when such exploitation is about to become feasible. According to legal scholars the establishment of the MA was due to the apparently imminent possibility to exploit and use the nature resources of the Moon and other celestial bodies in a commercial manner.[92] States Parties may not want an international authority

[89] Frans G. von der Dunk, "The Moon and the Prospect of Commercial Exploitation of Lunar Resources," 103
[90] Frans G. von der Dunk, "The Moon and the Prospect of Commercial Exploitation of Lunar Resources," 98
[91] Ibid.
[92] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies*, 45

governing their mining or exploitation activities because it would mean they would be obligated to report on their findings, share the benefit of their findings with all, and it would be less probable for them to make a profit.

The MA provisions do provide a step forward in the ruling of natural resources on the Moon and other celestial bodies; however, the interpretation of said provisions still causes great controversy on whether the MA allows extracted materials from the Moon's subsurface to be owned and exploited by State Parties. As stated above in Article 6 (2) the MA explicitly allows the removal of samples from the Moon. Virgiliu Pop quotes Peter Haanappel's, "the MA remains silent on the question of ownership of such samples removed from the Moon, concluding once removed [the sample] becomes the property of the collecting State, which is under the obligation to use it in accordance with the terms of Article VI (2) [in the OST]."[93] Pop declares the MA provides no specific definition of the term scientific research and how that would differ from commercial usage.[94] According to David R. Criswell there is a "blurring of scientific usage in the 'lunar sample research' meaning and in the industrial meaning, as scientific usage might comprise the use of extraterrestrial materials to develop new commercial processes."[95] Furthermore, Carl Christol's belief, which coincides with the argument of this paper, is the extent and nature of using natural resources for scientific research will become "far-ranging [and] will allow for very substantial uses of natural resources."[96]

Another debatable consideration can be found in Article 11 (3) which declares:

[93] Virgiliu Pop, *Who owns the Moon? Extraterrestrial Aspects of Land and Mineral Resources Ownership*, 144
[94] Ibid.
[95] Ibid.
[96] Ibid.

3. "Neither the surface nor the subsurface of the moon, nor any part thereof or natural resources in place shall become property of any State, international intergovernmental or non-governmental organization, national organization or non-governmental entity or of any natural person……"

If the phrase "or natural resource in place" were removed from the paragraph above then the basic principle of prohibiting a claim of sovereignty on the surface or subsurface of the Moon or any part thereof has already been instituted by the OST in Article II. The addition of the reference causes concern over the true meaning behind the paragraph. The main point of the paragraph focuses on the natural resources of the Moon and placement of said resources. Fabio Tronchetti considers "the terminology natural resources in place" was inserted to indicate that the prohibition against assertion of property rights would not apply to natural resources once removed from their original position through exploitation.[97] In layman's terms, once a mineral has been extracted from its place of origin (i.e. mining), then ownership can be claimed and exploitation of that mineral can be carried out by any State. His thought was in agreement with the U.S. official position on the provision as expressed by Delegate Hosenball in 1979, "there is no limit upon the rights of State Parties of those natural resources found on celestial bodies as are appropriate for the support of their mission and that this may well promote the commercial or practical exploitation of the natural resources on a celestial body."[98] If no limit is placed on the amount of extraterrestrial resources removed and an agreement exists that the wording of the article promotes exploitation activities, then the environmental damages that have been described above will likely occur on the celestial bodies. The Moon is inert and its resources are finite and non-replenishing. Allowing

[97] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies*, 51.
[98] Virgiliu Pop, *Who owns the Moon? Extraterrestrial Aspects of Land and Mineral Resources Ownership*, 151

exploitation without a system in place to manage resource extraction and consumption will lead to terrestrial disruption of the existing balance causing some areas to undergo a change that is permanent.

The MA does declare to establish an international regime when exploitation becomes feasible. The provisions of the international regime can be found in Article 11, (5-8). Based on the arguments within this paper and those proclaimed by legal scholars the feasibility of exploitation arrived, and thereby the need to establish an international regime is apparent. The problem with the creation of such a regime is that none of the space-faring nations will be liable to the provisions of this agreement, so how successful would such a regime be in managing exploitation, extraction or consumption of outer space resources? It has been argued that though a moratorium clause is present in the MA such resources have already been vested in mankind and the establishment of such a regime will not force those owners to give up the said resources.[99] Another opinion is since space-faring nations have not signed this agreement then exploitation of such extracted materials may happen prior to the establishment of such a regime.[100] The original basis for this article was that all State Parties, including the major space-faring nations, would be Party to this agreement so that the international regime would be designed to serve the interests and of all, regardless of whose exploitation it would concern.[101] Now, it would seem this paragraph is void and the establishment of such an international regime needs to be done outside this agreement. There are other in-work space dispute authorities that will be discussed later in this paper. It should be noted, a

[99] Ibid., 146.
[100] Ibid.
[101] Frans G. von der Dunk, *The Moon and the Prospect of Commercial Exploitation of Lunar Resources*, 110

State Party is most likely to start exploitation of such resources as soon as economically feasible. Recall certain rare elements, like Helium-3, exist on celestial bodies and allowing such elements to fall into a State Party's hand without an environmental protocol to set principles for the usage and amounts could create costly legal challenges and affect a nation's security or economy. To mitigate and even prevent these issues an environmental protocol and an international regime must be established.

## 3.4 Law of the Sea Convention

The two common terrestrial examples used to provide guidance for the establishment of provisions on non-sovereign areas are the ocean and Antarctica. The ocean has long been proclaimed to be free to all States, except the area along a nation's coastline. In the 1940s States began to claim vested interest in discovering ways to utilize the seas resources near their coastline. As technology developed, the pursuit of resource exploration moved beyond the coastline region and into the deep sea. When the value of worth on sea resources, like oil, metals and fish set in, States began to find ways to exploit the available resources in order to turn a profit. As a result, new issues relating to the non-sovereign nature of the sea, its resources, and the environment began to form which led the community of States to establish the 1982 United Nations Convention on the Law of the Sea (UNCLOS).[102] Though the establishment for the convention started in 1982 the agreement did not entered into force until 1994. Article 136 of the Convention declares the area, defined as the seabed and ocean floor and subsoil thereof, and resources as common heritage of mankind. The common heritage concept described

[102] See *United Nations Convention on the Law of the Sea (UNCLOS)*, Vol. 1833, I-31363, November 16, 1994

by Article 136 is the same terminology used in the Moon Agreement (MA). Recall the MA has not been signed by the major space-faring nations. The UNCLOS took nearly twelve years to enter into force. This was largely due to the impossibility of reaching an agreement between the developed and developing States on how to interpret the benefit sharing of exploited resources.[103] The major debates were over Article 140 and 144.[104] The authority set forth by the convention would be responsible for ensuring equitable sharing of financial and economic benefits that were derived from activities within a given area. Any new technology developments or scientific knowledge obtained by activities performed within an area would also be given to the authority so it could promote and encourage the transfer of such knowledge to developing states for the purpose of benefiting all Parties. Developed States are more likely to partake in exploration activities leading to the development of new technologies compared to a developing State that doesn't have the resources or financial ability to invest in technology improvements. It seems the favor is in the developing State. In most cases a developed State is not willing to transfer an advanced technology whether it's to a developing State or developed State. It could be argued that the transfer of technology to another developed State poses security risks. The idea of equally sharing resources and technology is not a favored choice. This position has been stated in the debates on the common heritage concept within the MA.

The United States did not sign the draft convention of the UNCLOS that was opened for signature in 1982. According to Tronchetti, "the U.S. considered the legal

[103] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies,* 104 and associated footnote.
[104] Ibid., 105.

regime proposed in Part XI to be detrimental to its political and economic interests and an obstacle to the development of seabed resources."[105] The U.S. had already begun exploitation of oil in the Gulf of Mexico prior to the establishment of this convention and did not agree with the provisions stated in Article 140 and 144. The Convention seemed to lack protection for those developed States that had already begun exploitation and made substantial investments in sea bed mining prior to 1982.[106] Two years earlier the U.S. Congress enacted the Deep Seabed Hard Mineral Resource Act on June 28, 1980. The U.S. proclaimed the exploitation of sea resources was needed in order to maintain a supply of minerals in case industrial needs exceeded the domestic sources of supply. The act encourages exploitation of sea resources and provides licenses to those citizens wishing to partake in exploitation activities. This is a classic example of events driving policy, as exploitation activities started many years before the international draft convention on the law of the sea.

As stated above the UNCLOS entered into force in 1994; however, to this date the U.S. has not ratified the convention. This state of affairs describes a great example of a sovereign area establishing a convention which opens the door to global exploitation; however one major State player, the U.S., who is involved in such exploitive activities, chooses not to sign it. This same state of affairs can be projected in outer space exploration and exploitation. The MA does establish provisions on exploitation; however, the common heritage concept is once again shown to be unfavorable to many developed State Parties and as a result they have chosen not to sign the agreement. Developed

[105] Ibid., 107.
[106] Ibid. Note the same mentality could be said for exploitation of outer space resources. States Parties who begin exploitation activities before an international agreement governing those activities is in force and signed by all, will be reluctant and most likely not sign any postmortem documentation.

States that have the means to exploit in space could do so freely and may create their own exploitation act that suits their interests, as we've seen with the UNCLOS. Before such an act is established it is necessary to create an environmental protocol that is attractive to all State Parties so that resource consumption and environmental protection can be the fore focus before exploitation activities occur.

## 3.5 Antarctic Treaty

The exploration history on the continent of Antarctica is an interesting one. The first claim of land ownership on Antarctica was made by the United Kingdom in 1908.[107] Soon following were the claims of land ownership by six other States (New Zealand, France, Norway, Australia, Argentina and Chile) between the years of 1924 and 1940. Even before the first official land claim was announced, explorers from other countries, the U.S., Soviet and Belgium, had been navigating the land as far back as 1818.[108] While the seven States mentioned above do have territorial claims in the area, the remaining three do not own and have not recognized a claim to the area. Figure 5 below illustrates the territorial claims by the seven States broken down by degree sectors. It is interesting to note that some claims, like Argentina and the United Kingdom, are overlapping.

Even though these claims exist it is important to note they are not recognized by other States. In order to formally make a territorial acquisition certain pre-conditional terms must be met. Under international law, sovereignty can be acquired when real and effective possessions take place; a formal declaration of claim by itself is not sufficient

[107] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies,* 133
[108] Ibid.

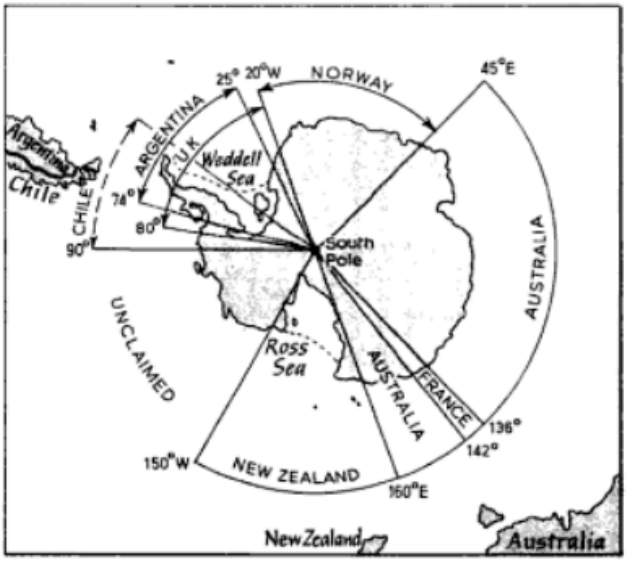


**Figure 5:** Territorial claims in Antarctica.[109]

to consummate the process of sovereign appropriation.[110] A State must occupy the land and then submit to international law the claim to acquire sovereignty. The land must be unoccupied and international law must approve of the manner and the means of a State's occupation.[111] To summarize, acquiring sovereignty is a legal condition acquired by a State through a legal process.[112] The assessment of each State's claims is complex and the acts or circumstances deemed to be sufficient to claim ownership vary with each case. A comprehensive analysis for each claim clearly shows an argument for and against the legality of each claim.[113] For the sake of international cooperation and timing of events, such as the recent ending of the Second World War and the International Geophysical Year (IGY) of 1957-1958, the seven claimant States and five non-claimant States agreed to put off the disputes over sovereignty on the continent, at least for the duration of the

[109] Barbara Mitchell, *et al*, "Antarctica: a special case?" *New Scientist* Vol. 73, no. 1034 (1977): 64.
[110] Christopher C. Joyner, *Antarctica and the law of the sea*, (Netherlands: Martinus Nijhoff Publishers, 1992), 42.
[111] Ibid.
[112] Ibid.
[113] For a detail analysis on each State's claim see Christopher C. Joyner, *Antarctica and the law of the sea*, Chapter 2 on Sovereignty in Antarctica, 44-55

Antarctic Treaty. The disputes were neutralized by means of Article IV in the Antarctic Treaty which declares that nothing contained within the Treaty shall be interpreted as a renunciation of or to previous claims of territorial sovereignty or prejudicing the voice of diplomatic convictions on the matter or assessment of new claims or enlargement of an existing claim while the Treaty is in force. The provisions contained in Article IV assure the sovereignty claim made by each of the seven States' is preserved. To this day Article IV has proven to be demonstratively effective in suspending sovereignty disputes and stabilizing the Treaty regime.

Exploitation activities in Antarctica can be traced back to the 1860s. Antarctic whaling became popular when man discovered oil could be derived from the thick coating, known as fat or blubber, of a whale. When the first Antarctic land station opened in 1904 the activity grew and within three years the Antarctic whaling produced more oil than the rest of the world's whaling activities put together.[114] The increase in whaling activity without strict controls led to depopulation in several whale species, such as the blue whale. A total of 282,903 blue whales were caught between 1925 and 1963. Like many other areas of terrestrial exploitation, the history of Antarctic whaling is a "repeated story of discovery, overexploitation and collapse."[115]

As land exploration activities increased in Antarctica others States became more aware of Antarctica's value. Soon States began to establish research facilities and, as mentioned above, States began to lay certain claim to specific territories. Agreed to collaborations eventually led those twelve States to participate in extensive research

[114] National Research Council Polar Research Board, *Antarctic Treaty System: An Assessment*, (Washington DC: National Academy Press, 1986), 28
[115] Ibid., 29.

programs and together they established several scientific research stations across the continent. In an effort to support scientific research the twelve states participated in several consultation meetings; each meeting leading up to the development of today's Antarctic Treaty. The international Antarctic Treaty was signed on December 1, 1959, and entered into force on June 23, 1961.[116] The treaty has been in force for over fifty years and continues to be a major bench mark in international law. Today there are five different treaties governing the activities in Antarctica. The Antarctic Treaty regime is seen as one of the most successful regimes in international law as it has made possible the ability to transform a once disputed terrain into "a natural reserve, devoted to peace and science."[117]

The Antarctic Treaty in part served as a model for the development of the OST. Similar principles found in the OST can be traced back to the Antarctic Treaty; principles such as the utilization of the Moon and other celestial bodies for peaceful purposes, the prohibitions of placing objects carrying nuclear weapons in orbit around Earth, the freedom of scientific research and the promotion of international cooperation.[118] The Antarctic Treaty, like the OST, serves as a foundation, allowing for principles that were regarded as general to be further developed. The solution of specific problems, like mineral exploitation and environment controls required a separate formulation and needed specific legal attention to guide their development path.

[116] The Antarctic Treaty opened for signature December 1, 1959 and entered into force on June 23, 1961, 12 UST 794, TIAS No. 4780, 402 UNTS 71.
[117] See Article 2 in the Protocol on Environmental Protection to the Antarctic Treaty
[118] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies,* 139

The Antarctic Treaty, like the OST, contains no provisions on mineral exploitation. The absence of such activity is not surprising because prior to the creation of either doctrine the idea of mineral exploitation may have been thought of, but due to the harsh environment of both places the technology required to perform such activities had not been developed. During the creation of the Antarctic Treaty mineral exploration was not financially viable due to the lack of mining technology and insufficient geological data to show prime areas suitable for mining activities. It was not until the 1970s when the first discussions on utilizing Antarctica's mineral resources were conducted. The Consultative States set forth and adopted the following recommendation during their Seventh Consultative Meeting, "Recognizing that mineral exploration is likely to raise problems of an environmental nature and that the Consultative Parties should assume responsibility for the protection of the environment and the wise use of resources."[119] A few years following, the Consultative States took a decision to establish a moratorium on any activities relating to the exploitation of mineral resources until an international legal regime was established that would adequately regulate mining activities and provide proper provisions to protect the Antarctic environment and ecological systems dependent on it.[120] The Eleventh Consultative Meeting held in Buenos Aires in 1981 established the main principles from which such a regime should be derived.[121] Consultative meetings were held and conducted by the Consultative States.

[119] See "Recommendation VII-6, Antarctic Resources – Effects of Mineral Exploration," *Antarctic Treaty Report of Seventh Consultative Meeting*, Wellington, Publication No. 440 (1972): 22, http://www.ats.aq/documents/ATCM7/fr/ATCM7_fr001_e.pdf (accessed February 28, 2012).
[120] National Research Council Polar Research Board, *Antarctic Treaty System: An Assessment*, (Washington DC: National Academy Press, 1986), 43
[121] See "Recommendation XI-I, Antarctic Mineral Resources," *Antarctic Treaty Report of Eleventh Consultative Meeting*, Buenos Aires, (1981): 19, http://www.ats.aq/documents/ATCM11/fr/ATCM11_fr001_e.pdf (accessed February 28, 2012).

To qualify as a Consultative State, a State had to be one of the original twelve signatures to the Antarctic Treaty or conducted substantial research in the Antarctic region. By default, only industrialized States were members of the Consultative Party. Any decision making, including the creation of new legal doctrines, on Antarctica were to be conducted by the Consultative Party. When the establishment of a new mineral resource regime began, developing countries raised a flag and started asking the Consultative States to take into consideration their interests and to share with them the benefits to be derived from those resources. When the Consultative States said no, the developing countries brought the issue to the United Nations.[122] The United Nations then declared the utilization of Antarctica belonged to the international community and therefore a new international regime should be created to reflect that approach.[123]

In an attempt to satisfy all new parties involved the United Nations, Consultative States and developing countries worked through the complexity of the topic and began negotiations. Negotiations took until 1988 to adopt the Convention on the Regulation of Antarctica Mineral Resource Activities (CRAMRA). Surprisingly, the Convention allowed exploitation of Antarctica's resources but only to the agreed measures set forth by the Convention's principles. One principle excluded mineral exploitation activities in certain regions of Antarctica, such as the deep seabed and declared no mineral resource activity was allowed to take place until it was evaluated based upon assessment of its possible impact to the Antarctic environment.[124] Further, the Convention established institutions: an Antarctic Resource Commission, an Advisory Committee and a

[122] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies,*145
[123] Ibid.
[124] See text of Convention on Regulation of Antarctic Mineral Resource Activities, Article 4, 389, http://www.state.gov/documents/organization/15282.pdf (accessed on February 29, 2012).

Regulatory Committee. Each committee would be given an allotment of time to assess and give recommendations with regard to mineral exploration in a given area. After further evaluation of CRAMRA's principles it was clear the text of CRAMRA provided way more detailed regulations on mineral exploration than any current outer space treaty.

The adoption of the CRAMRA was headed for success until 1989. Two State Parties, Australia and France, withdrew their support after environmental groups began to speak out on the potential environmental damages that would result once exploitation in Antarctica was allowed. Since the Convention required ratification by sixteen States in order to enter into force and with the withdrawal of two major State players the fate of CRAMRA soon ended. Australia and France declared the development of mineral resources within Antarctica would be detrimental to its environment. Further pressure came from non-governmental organizations that wished to ban mining in Antarctica and declare it a World Park. [125] France and Australia began working negotiations for a convention to preserve and protect Antarctica's environment while a delegation from Chile proposed to strengthen the functions and powers of the Antarctic Treaty Consultative Meetings. [126] After years of negotiations the States Parties finally reached a decision and adopted the Protocol on Environmental Protection to the Antarctic Treaty in 1998.[127]

Key provisions within the Protocol are found in Article II, III and VII. Article II commits the Parties to a comprehensive protection of the Antarctic environment and

[125] Kees Bastmeijer, *The Antarctic Environmental Protocol and its Domestic Legal Implementation*, (Netherlands: Kluwer Law International, 2003), 46.
[126] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies,* 156
[127] *The Protocol on Environmental Protection to the Antarctic Treaty* was signed on October 4, 1991 and came into force in January 14, 1998, once ratified by all 27 (now 28) Antarctic Treaty Consultative Parties (ATCPs)

designates Antarctica as a natural reserve, devoted to peace and science.[128] Article III assures activities in Antarctica are planned and conducted based on prior assessments of, and informed judgments about, their possible impacts to the Antarctic environment and dependent and associated ecosystems.[129] The same Article includes a list of judgments that shall be taken into account when assessing the activities impact to the environment. An overview includes: 1) scope of activity, including duration and intensity; 2) cumulative impact of the activity; 3) assessment if the activity will detrimentally affect any other activity in the Antarctic Treaty area; 4) whether technology and procedures are available to provide environmentally safe operations; 5) an existing capacity to monitor key environmental parameters and provide early warning of adverse effects of the activity and 6) an existing capacity to respond promptly and effectively to accidents, particularly those with potential environmental effects.[130] Lastly, and probably the most important principle is contained in Article VII which prohibits any activity relating to mineral resources, other than scientific research.[131] This Protocol bans all commercial mineral resource activity and prohibits exploitation and mining of Antarctica's mineral resources unless for scientific research. The one difference between the latter sentence in this Article and the OST is the Protocol establishes a committee to assess and agree to any activity relating to mineral resources. Neither the OST nor the MA have established such a committee. Mining in Antarctica, unlike outer space, is a controlled option even if a State declares it's for scientific research.

[128] See Article II, Protocol on Environmental Protection to the Antarctic Treaty
[129] See Article, III 2 (c), Protocol on Environmental Protection to the Antarctic Treaty
[130] See Article, III 2 (c, d, e), Protocol on Environmental Protection to the Antarctic Treaty
[131] See Article, VII, Protocol on Environmental Protection to the Antarctic Treaty

The regulations set out in the Environmental Protocol are mandatory and legally binding on all of the signatory Parties. Never before had Nations agreed to such a comprehensive and stringent set of rules to protect the environment of a whole continent. It's interesting to note that it took a total of 28 years from the first discussions in 1970 on mineral exploitation activities within Antarctica to 1998 when a resolution was reached. If the same calculations were applied to the OST from the date the treaty was adopted, then in 1995 there should have been an agreement on mineral exploitation activities in outer space. Unfortunately, such an agreement has not been reached. As mentioned in the previous chapter's outer space mining activities are winding up and though Antarctica's terrestrial environment is different than the extraterrestrial environmental in outer space, there is still a need to protect and preserve the outer space environment. The environmental protection and preserve model found within Antarctica's Environmental Protocol and the six annexes contained within it will be the basis for developing a protocol on environmental protection to the OST found in Part Six.

## 3.6 Case Study on Prior Appropriation

The "State of Wyoming vs. State of Colorado" is a terrestrial non-international case ruling on prior appropriation of water rights.[132] The ruling on prior appropriation in this case is an analogy to the commercial utilization of extraterrestrial mineral rights for the benefit of a State Party as opposed to an equitable apportionment of the mineral between States on the basis of equitable rights. The state of Wyoming brought forward a claim against the state of Colorado for its attempt to divert the Laramie River. Both States

[132] Supreme Court of the United States, "*State of Wyoming vs. State of Colorado et al.*," 259 U.S. 419, June 5, 1992.

have adopted the doctrine of prior appropriation[133] on water rights. The Laramie River flows through both States; each State has equivalent jurisdiction to the river, so the laws of state sovereignty and interstate stream were argued. The diversion of the Laramie River as Colorado had intended would upset the water rights of Wyoming. In accordance with the prior appropriation rights, the first person to use a quantity of water from a source for a beneficial use has the right to continue using that source as long as it's for the same intended purpose. Subsequent users can use the remaining water for their own beneficial purposes provided that they do not impinge on the rights of previous users.

Prior appropriation is based on "first in time, first in right" principle. The rights of a prior appropriator are especially active in the time of water deficiency. The intent of Colorado's diversion system on the Laramie River would take water outside the watershed where it would have been impossible to return it to the stream, thus going against the vested rights of other prior appropriation states. The impact would have left thousands in Wyoming without irrigation means to water their acres. In addition, the short in water flow would be injurious to sister States. The court ruled on equity over the prior appropriation doctrine as the means to divide the flow of the Laramie River between two states in an equitable manner. The court ruled in favor of Wyoming on a prior appropriation date and therefore denied Colorado's attempt on the division of the Laramie River.

This case is an example of an "I" mentality where one State wishes to divert a resource flow for the benefit of their needs without due regard to the cause and effect

[133] Prior appropriation on water rights is common in the Western U.S. States. Each water right has a yearly quantity and appropriation date. The first user with the earliest appropriation date uses their full allocation allowing the user with the next earliest date to use their allocation and so on.

impacts it would have on other States. Wyoming and Colorado have equivalent jurisdiction to the same resource. Luckily, for Wyoming and Colorado, a system was in place to assess resource usage and its effect to other States and their environment. In the terrestrial example, the capacity of the shared source is examined first before the allotted amounts are dispersed. Such a system does not exist in outer space. All State Parties to the OST have equivalent jurisdiction to space resources, yet unlike the terrestrial example, there is no established court authority to settle a dispute if one State wishes to use a resource for their own benefit which in turn causes an inequitable act to other State Parties. The over usage of one mineral would eventually lead to depletion and could potentially cause harm to the environment, depended ecosystems or another State Party. The intent to establish a system for the management of outer space resources would be to preserve the resources and protect the environment. Though Article I (1) of the OST declares equitable rights to the exploration and use of outer space to all States irrespective of their degree of economic or scientific development, it provides no guidance on the details of how a developing State or even a space-faring State would receive the benefits prescribed by another State. Commercial or scientific uses of minerals without an oversight committee assessing its impact to the environment and proper consumption would leave State Parties to consume outer space resources without due regard to resource rationing and turn an unmanaged and ungoverned frontier into an environmental disaster. The ending result would leave both the private and government worlds without a potential return of investment, whether that return be to benefit science or commercial endeavors.

# PART FOUR

# RESULTS AND DISCUSSION

The current legal doctrines, the Outer Space Treaty and the Moon Agreement, governing outer space activities include limited provisions on space resource utilization in terms of excavation and consumption. A natural resource can be extracted from its place of origin with limited restriction on the quantity and method of use. Part 2 provides a summary of the resources found on the Moon. Recall that the Moon is rich in aluminum, iron, silicon, oxygen, hydrogen, chromium, water and other minerals. Each of these minerals can be used in the development of revolutionary self-sufficient technologies to prolong mission duration in space. These minerals and volatiles can be manufactured in-space to be used in many of the following areas: propellant systems on robotic and human vehicles, water production for life support systems, fabrication of structures, and production for a new energy source. The goal for significant technology development is to sustain human presence on the surface of the Moon through affordable measures; those measures will be achieved through utilizing in situ resources thus reducing mission costs by removing large amounts of mass from each mission destination.

The most valuable resources contained on the Moon are water and Helium-3. Water will have an enormous impact in terms of usage in propellant and life-support operations for a crewed mission. Utilizing water ice on the Moon removes a significant

amount of space and weight a typical launch vehicle would carry. Water is the fundamental building block to food and hygiene and will be essential for carrying out long duration manned missions. Robotic exploration missions to the Moon have proven water ice exists at the lunar poles and in certain craters located near the north and south poles. However, not so clear is how much water ice exists and how much water ice would be required to sustain one or multiple life support systems on the Moon. Depending on international collaboration amongst certain State Parties multiple life support systems may be required. Depending on its abundance in quantity this resource may be a high value target. Helium-3 is also another high value target for consumption. Scientific research reveals Helium-3 when fused with other minerals, such as deuterium, has the potential to be used as a fuel in fusion reactors. Scientists believe it has the potential to replace fossil fuels and be a primary source of energy on Earth. Since Helium-3 is rare on Earth but abundant on the Moon this mineral also becomes a high value target.

The possibilities to explore and use outer space for commercial and scientific research purposes have raised several legal questions regarding if and to what extent ownership over outer space resources is contained and allowed under the existing space law regime. Part three provided a comprehensive analysis on articles within the existing space law regime that pertained to the acquisition of ownership rights over space resources. The analysis concludes mineral resource ownership in terms of total consumption or extraction is a realistic possibility to both private and public participants. Private participants show the distinct possibility of participation in resource exploitation as oppose to public participants showing participation in resources consumption, leading to ownership, for scientific and technology developments. Regardless, of whether the

participant is public or private utilizing space resources leads to extraction and consumption of minerals that are finite and non-replenishing.

The ruling on whether the current space law regime allows for exploitation of space resources is debatable. Review of the analysis performed on the OST in Part 3 concludes space resources can be used for the benefit and interest of all mankind. The justification on the act to seize materials merely lies within the text of Article 1, the freedom of exploration and use of outer space by all States. How the resources are used is not clear cut as analysis shows the term 'use' can be defined as a scientific or commercial activity. Some State Parties to the treaty view 'use' as equivalent to 'exploitation.' Until the OST can be updated to address clarity and legal certainty of the term 'use' then the right of using outer space resources for exploitation or scientific investigation is a valid option open to all States. Review of the analysis performed on the MA in Part 3 holds a slightly different weight as the major space-faring nations have not signed the treaty. Though the MA has not been signed and ratified by the majority of State Parties it is still an in-force agreement and thus applicable to space activities performed by those States that have signed it. In review of the treaty's provisions the MA concludes, like the OST, that the exploration and use of the Moon and other celestial bodies shall be for the benefit and interest of all mankind. The MA provisions do provide a step forward in the ruling of natural resources on the Moon and other celestial bodies; however, the interpretation of said provisions still causes great controversy on whether the MA allows extracted materials from the Moon's subsurface to be owned and exploited by State Parties. From the perspective of resource management it can be argued the provisions in the MA due more harm than good. Recall Article 6 of the MA

established the consent to remove samples from the Moon to further scientific investigation and put emphasis on making portions of those samples available to other interested State Parties. However, the article does not force States to share those samples it merely insists State Parties shall have "regard" to sharing. This allows a State Party to choose whether it shares a resource. Recall certain minerals on the Moon may be limited in quantity available so one healthy heaping could remove all of an available resource. Article 6 goes on to affirm State Parties may take 'quantities appropriate' for the support of their missions. Since there is no definition on the term 'quantities appropriate' it can be assumed a State may take however much of a resource they deem appropriate.

Too often throughout history the phrase "the ends will justify the means" has been used as an excuse to pursue first and think about the consequences later. How devastating have the consequences been, whether intended or unintended? Thomas Gangale in *Boldly Own What No One has Before* pronounces, "We are invited to dismantle a legal structure that has existed for forty years….and erect what in its place?[134] The time of mining and exploiting outer space resources is amongst us and the legal doctrines governing our activities in space do not provide the necessary provisions to protect the outer space environment and manage the excavation and consumption of outer space resources. As new mining technologies arise, both private, commercial and government industries will be interested in the new investments to be won. As President Kennedy stated, "Whether it will become a force for good or ill depends on man, and only if the United States occupies a position of pre-eminence can we help decide whether this new

[134] Thomas Gangale, *The Development of Outer Space: Sovereignty and Property Rights in International Space Law,* (Santa Barbara, California: ABC-CLIO, 2009), xii.

ocean will be a sea of peace or a new terrifying theater of war."[135] Similarly, only we "the international community" can decide whether exploitation and excavation will be a sea of peace or a terrifying theater of war.

[135] President J.F. Kennedy, "Address at Rice University in Houston, Texas on the Nation's space effort," 12 September 1962, Rice University website. http://www.jfklibrary.org/Asset-Viewer/Archives/JFKWHA-127-002.aspx (accessed 10 March 2012).

# PART FIVE

# CONCLUSION

History confirms that once a subject has hands on a valuable resource, there seems to be a general rule that they are entitled to use them according to their purpose and needs. The clear cutting timber, dust bowl and Antarctic whaling events are all examples of what happens when resource usage goes unchecked. The OST and MA are broad in their interpretation of resource usage. No limits to the amount of resource removal have been placed upon the rights of State Parties. Regardless of the efforts put forth by a State Party or what the mission definition prescribes, a State Party should not be able to remove infinite amounts of extraterrestrial resources. The OST and MA also do not provide an environmental committee to assert environmental damages or protect the environment from damages caused during resource extraction and consumption. Furthermore, if all State Parties have the right to use space resources, as deemed by the OST and MA, then what statues are in place to ensure the resources are divided fairly among all States? What about the sharing of areas prone to activity or the establishment of an institute that has been declared the authority in charge with the power to resolve conflict when it arises? Recall certain rare elements, like Helium-3, exist on the Moon and allowing such elements to fall into a State Party's hand without an environmental protocol to set principles for the usage and amount could create costly legal challenges

and affect a nation's security or economy. To mitigate and even prevent these issues an environmental protocol and an international regime must be established.

There exists great confusion in terminology relating to space activities, and it is imperative that steps be taken soon in order to arrive at a more standardize use of terms and expression that are associated with the current space activities. Everything ultimately depends on the political will of the states concerned. By not addressing the aforementioned activities of extraction and consumption, State Parties will act first and think about the consequences after. A quote provided by a commissioned officer in the US Air Force provides insight on how State Parties will perform without a new legal framework to ensure proper consumption and extraction of outer space nature resources:

> Every State has the same sovereign right as the United States to fully utilize space for its own socioeconomic development and pursue of its own self interests. If every state pursues the same U.S. path of unilateral action and opposition of legal regimes prohibiting or limiting their access or use of space, then ultimately conflict in space will happen and that conflict is likely to have large detrimental effects on the use of space by all States.[136]

Nations are already establishing a legal regime on the purposes of providing licenses to exploit resources.[137]

A Convention on Environmental Protection for Outer Space needs to be employed as well as a committee of specialist that understand the celestial terrain and can mitigate the risks of extraterrestrial disruption and associated ecosystems. Also, an international authority is needed when consultations amongst State Parties fail. As more State Parties become involved in extraction and consumption of mineral resources a court of

[136] Brian Weeden, "Space Weaponization: Aye or Nay?," Arms Control Association Web site, http://www.armscontrol.org/act/2008_11/Book_review (accessed 10 March 2012).
[137] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and other Celestial Bodies,* 302

international law needs to be established to allow States to make claims, settle disputes and provide final rulings on resource utilization. Such an authority has been set up with similar non-sovereign areas, such as the high seas and Antarctica. Why would outer space, a place of abundant resources, be treated any different?

In conclusion, in order to ensure peaceful and orderly development of our planetary bodies while preserving their environment this researcher recommends two notions: 1) Put into force the Final Draft of the Settlement of Space Law Disputes written in 1998 to serve as a mechanism for resolving disputes and enforcing them, and 2) Create a Protocol on Environmental Protection to the Outer Space Treaty utilizing the methods and provisions set forth by the 1998 Protocol on Environmental Protection to the Antarctic Treaty. The details on both of these notions are outlined in the following section.

# PART SIX

# RECOMMENDATIONS

## 6.1 International Space Authority

Space and the celestial bodies, except Earth, are the few places not governed by legal authority. The OST holds States Parties accountable for resolving conflict amongst themselves through the principle of co-operation and mutual assistance. If a conflict cannot be resolved then according to the OST the State Party is to request international consultation.[138] At first glance this may seem appealing to some readers as space for centuries has been sort of a safe haven as no real international conflict has occurred. The space age has been in an explorative nature for the last several years. If conflict has risen it's been over the wording of principles.[139] Nowadays, with advancements in technology countries other than the U.S. and Russia are beginning to launch their own initiatives for space exploration. While international cooperation amongst all States Parties involved in space activities has been conveyed in the OST and MA there still lies the chance that an obligation of good faith maybe overruled by extenuating circumstances. Like in any sport, once more players are involved in the game there is a higher risk for confrontation and competiveness. The latter has already been seen in the 1960s space race between the U.S. and Russia. If both nations had reached the Moon within the same time period then

[138] See Article IX of the Outer Space Treaty

[139] Karl-Heinz Bockstiegel, "Proposed Draft Convention on the Settlement of Space Law Disputes," *Journal of Space Law* Vol. 12, no. 2 (1984):137

one could postulate the kinds of heroic events that may have occurred to resume position over a particular piece of property. Whether an activity takes place at home, work, nationally or internationally a dispute amongst parties is inevitable. As stated by Frans G. von der Dunk, "the subject of a dispute settlement is at the heart of every legal system or subsystem, whether national or international, and in principle it should not be any different for space law either."[140]

The creation of an international authority over space activities has been in discussion for quite some time. The first initiative on the creation of a settlement for resolving space disputes occurred in 1978 by the International Law Association (ILA).[141] With collaboration between the ILA and the International Institute of Space Law the first Draft Convention on the Settlement of Space Law Disputes was created in 1982 at the Sixtieth Conference of the International Law Association held in Montreal.[142] The draft convention incorporated the following basic principles: 1) States Parties should be able to choose a method for dispute resolution that's applicable to their specific case, 2) binding and non-binding settlement methods should be established, especially if a State Party does not agree to the conclusions of such non-binding methods, 3) methods for dispute resolution should be provided, 4) obligation to fulfill the decision of the tribunal and 5) draft of an annex for disputes settlement clause to be served as a model or be included into future bilateral or multilateral treaties on Space Law.[143] The draft Convention follows to some degree the dispute settlement of the Law of the Sea Convention. The

[140] Frans G. von der dunk, "Space for Dispute Settlement Mechanisms-Dispute Resolution Mechanisms for Space?," *Proceedings of the Forty-Fourth Colloquium on the Law of Outer Space* 442-452 (2001): 442
[141] Karl-Heinz Bockstiegel, "Proposed Draft Convention on the Settlement of Space Law Disputes," 137
[142] Ibid.
[143] Ibid., 139.

three methods presented in the convention for dispute resolutions were conciliation, arbitration and the International Court of Justice. The dispute parties could be sovereign States, intergovernmental organizations (i.e. NATO) or private entities. The convention considered government or non-government agencies to be under the States Parties to the treaty. Overall, the draft convention seemed to contain the necessary mechanisms to move it forward with adoption. According the proceedings a final draft was to be brought forward at the 1986 ILA Conference. [144] However, various views over the dispute mechanisms and the growth of using outer space for commercial purposes led to more changes and in 1998 at the Sixty-Eighth Conference of the ILA in Taipei the discussion of the Final Draft of the Revised Convention on the Settlement of Disputes Related to Space Activities took place.[145] The Final Draft Convention was not adopted during this conference and has yet to be adopted. It's clear a few issues relating to disputes with private entities have not been worked out; however, the ILA clearly has the expertise to put forth a successful convention and the notion of creating a new mechanism when one already exists is preposterous.

This thesis recommends the following: 1) put forth the creation of the international space settlement system created by the ILA and 2) amendment the OST to include the dispute mechanism with the power to resolve and enforce judgment when cooperation, negotiation and consultation of international disputes among States Parties fail.

[144] Ibid.
[145] Final Draft on the Settlement of Dispute Related to Space Activities, *Sixty Eighth Conference of the International Law Association*, Taipei, (1998): 239

## 6.2 Environmental Protocol to the Outer Space Treaty

The Moon is a satellite to our planet that few of us will ever visit but whose continued health we all depend on. The Earth to Moon system is vital to our very existence and is the key to understanding our universe and the history of our planet's creation. The Moon and the celestial bodies are important to science because they teach us about past, present and future being of Earth. The study and research of the celestial bodies leads to an understanding of how a planet works. Extracting and consuming resources from a planet's surface is needed to continue the pursuit of planetary science; however, such science could not continue if such resources were depleted or disruption to the environment caused an adverse change to its existing balance. It is lackadaisical to put the determining factor of whether the existing balance of the space environment has been disrupted solely on States especially since a State has no duty to consult if it believes its activity may cause disruption.[146]

The space environment is remote, hostile and uninhabited; it very much resembles the environment of Antarctica. Antarctica has adopted a protocol to enhance the protection of its environment and its dependent and associated ecosystems. States Parties to the OST should be no different in ensuring protection of the space environment. This protocol is not meant to hinder scientific exploration; it's meant to preserve the environment and its valuable resources by ensuring the first come, first serve mentality of mankind doesn't lead to terrestrial disruption, delete non-replenishing resources, and destroy international cooperation. By acknowledging that the Moon offers a unique place

[146] See Article IX of the Outer Space Treaty

for conducting scientific research, sustaining manned presence, and furthering technology development then there should be no objection to protecting this asset through the creation of an environmental protocol.

The utilization of space resources is applicable to other areas where extraction and consumption of resources under exceptional circumstances has become an issue. Therefore the basis for the creation of an environmental protocol for outer space will be similar to the principles used in the 1998 Protocol on Environmental Protection to the Antarctic Treaty. A Protocol on Environmental Protection to the Outer Space Treaty should contain the following elements:

1. The protocol would be written in such a manner that does not override, modify or amend the OST. The creation of the protocol would be a legal doctrine to supplement the OST as with other space doctrines like the Agreement on the Rescue of Astronauts, Convention on International Liability for Damage Caused by Space Objects, and Convention on Registration of Objects Launched into Outer Space.

2. The Protocol would require an environmental impact assessment of all activities before they are allowed to continue. Activities would be planned and conducted on the basis of information sufficient to allow prior assessment of, and informed judgments about, their possible impacts to the space environment and dependent and associated ecosystems. An activity would be modified, suspended or cancelled if it resulted or threatened the space environment or dependent and associated ecosystems. The following attributes would be provided and assessed:

a. The scope of the activity, including its area, duration and intensity;

b. The cumulative impacts of the activity, both by itself and in combination with other activities in the outer space area;

c. Whether the activity will detrimentally affect another activity in the outer space area;

d. Whether there exists the capacity to monitor key environmental parameters and ecosystem components so as to identify and provide early warning of any adverse effects of the activity and provide such modification of operating procedures as may be necessary;

e. Whether there exists the capacity to respond promptly and effectively to accidents, particularly those with potential environmental effects;

3. The Parties to the Protocol would co-operate in the planning and conducting of activities in the space environment. Particular co-operation would exist among those States Parties whose activities would potentially impact the activity of another State Party. Each State Party would be responsible for the following:

a. Provide appropriate assistance to other Parties in the preparation of environmental impact assessments;

b. Provide to other Parties upon request information relevant to any potential environmental risk and assistance to minimize the effects of accidents which may damage the space environment or dependent and associated ecosystems;

c. Consult with other Parties with regard to the choice of sites for prospective stations and other facilities so as to avoid the cumulative impacts caused by the excessive concentration in any location;

d. Where appropriate, undertake joint expeditions and share the use of stations and other facilities

e. Carry out such steps as may be agreed upon at Outer Space Consultative Meetings.

4. The establishment of a Committee for Environmental Protection. Each State Party would be entitled to be a member of the Committee and would appoint a representative who may be accompanied by experts and advisers in the space environment field. Observer status in the Committee would be opened to any Contracting Party to the Outer Space Treaty and Moon Agreement which is not a Party to the Protocol. The Committee may also invite such other relevant scientific, environmental and technical organizations which can contribute to its work to participate as observers at its sessions. The Committee shall represent a report on each of its sessions. The report would cover all matters considered at the session and reflect all views expressed. The report would be circulated to all States Parties to the Protocol, the observers attending the session, and would thereupon be made publicly available.

5. The Committee for Environmental Protection would be responsible for the environmental assessment of activities prior to their commencement. The assessment would fall into three categories; (a) less than a minor impact; (b) a

minor impact; or (c) more than a minor impact. The ideal is to have a representative from each Party and their associated experts and advisors in the space environment field to assess each activity and determine the path forward depending on the assessment impact outcome.

6. Waste storage, disposal and removal from the outer space environment, as well as recycling and source reduction, would be essential considerations in planning and conducting of activities in outer space. Waste would be removed to the maximum extent practicable and be returned with the country from which the activities generating the waste were organized. Past and present waste disposal sites on land and abandoned work site on celestial bodies shall be cleaned up by the generator of such waste.

7. A State Party or States Parties that undertake activities resulting in harm to the space environment, human life or another Party's equipment and/or facilities would be liable to pay the costs of response action taken by the other Parties, should they fail to take prompt and effective response action, and be liable to pay the cost of damages done to Parties involved. The timeframe and amount for such payable costs will be determined by the dispute mechanism described below.

8. The Committee for Environmental Protection would be responsible for ensuring the preservation of outer space resources by setting forth rules on the reasonable amount of mineral extraction. These rules would be in agreement with the principles for environmental protection set forth by the Protocol.

9. Disputes arising among Parties from the interpretation or application of the Protocol would, at the request of any of one of them, consult among themselves as soon as possible with a view to having the dispute resolved by negotiation, inquiry, mediation, conciliation, arbitration, judicial settlement or other peaceful means to which the parties to the dispute agree. Each Party, when signing, ratifying, accepting, approving or acceding to the Protocol, or at any time thereafter, may choose, by written declaration, one or both of the following means for the settlement of disputes concerning the interpretation or application of this Protocol when conciliation among Parties fails, (a) International Court of Justice; or (b) the Arbitral Tribunal.

    a. A Party which has not made a declaration shall be deemed to have accepted to the competence of the Arbitral Tribunal;

    b. If Parties to a dispute have not accepted the same means for the settlement dispute, the dispute may be submitted to the Arbitral Tribunal, unless the parties otherwise agree.

This thesis recommends a Protocol on Environmental Protection to the OST be established immediately and include the principles set forth above. This will lead to peaceful and orderly exploration and development of our celestial bodies.

# BIBLIOGRAPHY

## *BOOKS*


Baker, Howard A. *Space Debris: Legal and Policy Implications*. Netherlands: Martinus Nijhoff Publishers, 1989.

Bastmeijer, Kees. *The Antarctic Environmental Protocol and its Domestic Legal Implementation.* Netherlands: Kluwer Law International, 2003.

Diederiks-Verschoor, I.H. Ph. & Kopal, V. *An Introduction to Space Law*. Netherlands: Kluwer Law International, 2008.

Gangale, Thomas. *The Development of Outer Space: Sovereignty and Property Rights in International Space Law*. Santa Barbara, California: ABC-CLIO, 2009.

Hurt, Doulgas R. *The Dust Bowl: an agricultural and social history*. Chicago: Nelson-Hall Inc. Publishers, 1981.

Joyner, Christopher C. *Antarctica and the law of the sea*. Netherlands: Martinus Nijhoff Publishers, 1992.

Livingston, David M. "Ethics and Off-Earth Commerce." In *Space Politics and Policy: An Evolutionary Perspective*, ed. Eligar Sadeh, 235. Netherlands: Kluwer Academics, 2002.

National Research Council Polar Research Board. *Antarctic Treaty System: An Assessment*. Washington DC: National Academy Press, 1986.

McDougall, Walter A. …*the Heavens and the Earth*. New York: Basic Books, Inc., 1984.

Pop, Virgiliu. *Who owns the Moon? Extraterrestrial Aspects of Land and Mineral Resources Ownership.* Space Regulations Library Vol. 4: Springer, 2008.

Rajala, Richard A. *Clearcutting the Pacific Rain Forest: Production, Science, and Regulation*. Vancouver, British Columbia: UBS Press, 1998.

Schmidt, Harrison H. *Return to the Moon*. New York, NY: Praxis Publishing, 2006.

Tronchetti, Fabio. *The Exploitation of Natural Resources of the Moon and other Celestial Bodies.* Netherlands: Martinus Nijhoff Publishers, 2009.

## *ARTICLES*

Bockstiegel, Karl-Heinz. "Proposed Draft Convention on the Settlement of Space Law Disputes," *Journal of Space Law* Vol. 12, no. 2 (1984): 137.

Dunk, Fans G. von der. "The Moon Agreement and the Prospect of Commercial Exploitation of Lunar Resources." *Annals of Air and Space Law* Vol. XXXII (2007): 98-110.

Dunk, Frans G. von der. "Space for Dispute Settlement Mechanisms-Dispute Resolution Mechanisms for Space?" *Proceedings of the Forty-Fourth Colloquium on the Law of Outer Space* 442-452 (2001): 442.

Huixian, Sun, et al. "Scientific objectives and payloads of Chang'E-1 lunar satellite." *J. Earth Syst. Sci* 114, no. 6 (December 2005): 789-794. http://www.ias.ac.in/jessci/dec2005/ilc-25.pdf (accessed January 7, 2012).

Powell, Devin. "Sparing the rare earths." *Science News* Vol. 180, no. 5 (2011): 18-19.

Ziyuan, Ouyang, et al. "Chang'E-1 Lunar Mission: An Overview and Primary Science Results." *Chin. J. Space Sci.* 30, no.5 (2010): 392-403. http://www.cjss.ac.cn/qikan/manage/wenzhang/2010-05-02.pdf (accessed January 7, 2012).

## *LEGAL DOCUMENTS*

Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, London/Moscow/Washington, (1967), 610 UNTS.

Protocol on Environmental Protection to the Antarctic Treaty, (1991), 30 ILM (1991) 1445.

United Nations Convention on the Law of the Sea, (1982), 21 ILM 1245 (1982), SopS 49-50/1996.

Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, (1979), 1363 UNTS 3.

Convention on the Regulation of Antarctic Mineral Resource Activities, (1988), 27 ILM, (1988), 868.

Antarctic Treaty, (1959), 402 UNTS 71, (1961), SopS 31/1984.

## *INTERNET AND WEB BASED RESOURCES*

CD-ROM produced by Lunar and Planetary Institute, edited by G.H. Heiken, D. T. Vaniman, and B.M. French. The lunar source book: a user's guide to the moon. Cambridge University Press, 1991. Lunar and Planetary Institute website. http://www.lpi.usra.edu/lunar_sourcebook/

## *FILM*

*Firefly.* Created by Joss Whedon. California: Twentieth Century Fox Television, 2002. DVD.