

LUNAR PROPERTY AND MINING RIGHTS

An Interactive Qualifying Project Report:

submitted to the Faculty

of the

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the

Degree of Bachelor of Science

by

Joseph Miller

and

David Coit

Date: 26 May 2008

Professor John M. Wilkes, Advisor

Introduction

A second space race is upon us. Major countries such as the United States, Russia, China and Japan, among others, are all involved in making plans to visit or revisit the moon by 2025. Serious colonization could begin within three decades in an attempt to harvest the moon for valuable resources. Space-faring nations also want to begin learning how to build and supply bases as part of carrying out interplanetary missions.

During the first Space Race of the 1960s, the United States and Russia competed to be the first country to have a man walk on the moon. America won when, on July 20, 1969, Neil Armstrong first walked on the surface of the moon during the Apollo 11 mission. This race was momentous not only for the fact that humans had finally reached out and achieved success in a key facet of space travel, but also for the fact that space was now a new frontier of Earth. As such, treaties written during the time of the Space Race which were designed to designate space as a peaceful environment for all mankind to research and explore cooperatively.

The most widely recognized of these treaties is the Outer Space Treaty (OST), ratified by the United Nations in January 1967. Many of the main articles of the OST are designed to ensure peace and cooperation in space, declaring all weapons of mass-destruction banned from space, and citing the rescue of foreign astronauts as mandatory, should the need arise. The OST also prohibits any country from claiming property as its own in any part of space. This severely affects the countries involved during this second race as they want to mine and set up lunar bases. Investment in colonies will require rights pertaining to property ownership and mining rights.

Most people's perception is that the moon is a desert in which one region is much like

another and nothing particularly valuable is there. In reality, the polar and equatorial regions are very different and a potential energy resource is present. One of the legacies of the first moon race is samples of various lunar regions which challenge this undifferentiated “desert” image. Hence, we will be making a natural resource case for the moon, stressing the implications of the presence of Helium-3 (He-3). In so doing, we will be setting the stage for describing the institutional structure which will govern the development of the moon and shape later space law.

Our aim in this paper is to explain the specifics of the OST, and analyze its implications in terms of how it applies to the world today. The shortcomings have become clearer given the passage of time and there have been changes of countries' policies and political structure since the original treaty was written. In addition, analogous laws and other historical analogies will be developed into a useful legal discourse, providing a clearer understanding of the way we think the situation should be interpreted. From this perspective, which anticipates the emergence of competition for lunar resources, it should be clear why we think change in the legal framework defined by treaty is called for. In the end we will propose specific changes designed to secure public and private investments, legitimate state interests, and international peace.

Overview

1) Why Are we Concerned?

The entire discussion of whether or not the laws of space need to change is moot if it is not discussed in the context of why humans should go into space in the first place. In our view, there are legitimate national aspirations and interests to be furthered and protected that will drive space activity even more now than in the past. What has changed since the last manned missions to the moon? We know much more about what is there and conditions on Earth have changed politically, economically and technologically. Is there economic value in returning, or is space only of scientific interest? It is likely that the long term economic value will outweigh the scientific value, but initially it may not look that way. Specifically pertaining to the laws, what is different about this Second Space Race that would require the radical revision of the laws that will be proposed in this report? The potential for economic incentive, and rivalry, is so much greater that reviewing the rules of the game on the basis of principles, before the institutional arrangements are set in a way that would clearly favor one space faring nation over another, seems prudent as well as appropriate.

Some space agencies would like to use the moon as a stepping stone for missions to the other planets of the solar system. The United States in general and NASA in particular is inclined toward this view. Current NASA policy is to focus on the moon as a test bed for Mars missions. Other space agencies tend to be more interested in the moon for its own sake or as a resource repository. Some space agencies just do not want to be left out of the movement into space, so for them participation in building space stations and lunar bases are equally interesting.

The moon should be of greater interest as there is a wide consensus that it can be used as a refueling station, providing liquid oxygen for spacecraft leaving Earth for outer solar system destinations. It is also clear that a lunar base would be a place where one could help test the effects of prolonged exposure to a low-gravity (but not micro-gravity) environment on humans and machinery. Thus it can be a proving ground that is helpful in refining methods for the colonization of other planets. However, this argument can be pushed too far, as Mars is very different from the Moon and in many ways would be easier to inhabit given that it is closer to Earth's gravity and has an atmosphere as well as water. What Mars lacks is a clear economic motivation for occupation, so the Moon, which is closer and economically more interesting, will certainly be developed first, despite the greater difficulty of living and working there.

So, there is important research that will be done on the moon, but the moon is not purely a research bed. There are many economic avenues that one can pursue on the moon. Once a group has landed on the moon, mining for ferrous metals is a simple task that can yield important results. There is also an isotope of great value on the moon; He-3 (Science Daily, 1998). This isotope of Helium could, and will very probably, power the Earth for centuries once the fusion technology to use it is available. He-3 will be able to fuel fusion reactors which are expected to be developed within the next 40 years. Fusion reactors are much more powerful than the current generation of fission reactors and have been considered as the next step in energy evolution for a long time.

With all of these new opportunities coming to light it is easy to see why many countries are excited to see mankind return to the Moon to build a base, and why others are afraid to be left out. China in particular has been very forthcoming about its plans to begin construction of a

moon base as soon as possible (Elliott).

The original space property treaties were written to defuse the emerging and potentially very expensive space race that was part of the USA-Soviet Union cold war. The goal was to reduce the range of potential areas of conflict and, in particular, protect the United States and Russia from each other by preventing them from putting nuclear weapons in space and on the moon. The ability to claim portions of the moon as their own, as a spoil of the Cold War, would have led to the militarization of space and possible armed conflict on the Moon. Have the times changed enough that a new treaty needs to be written, which allows entrepreneurs and international political and economic competition to drive the development of the Moon, within a legal framework, or is the original Outer Space Treaty still wise policy? This is the central question of the current report, and we view it as arising in the context of a new space race, this time one with long term economic advantage rather than geo-politics and military strategy driving it.

China has the most ambitious and aggressive plan to reach the moon by 2010 (Elliott), though most observers do not expect a crew to land until around 2018. Either way, the general view is that the Chinese will be on the ground -before the USA returns. As of now, the United States has set a goal of returning for the first time in 2020, with 2 missions a year for the next decade envisioned at present. The lack of funding increases for NASA is making even that benchmark year as the goal for the first lunar landing look unreasonable, especially given that the ISS (International Space Station) is not yet completed and is still consuming resources. With the United States' planned launches being so far off, many are not aware of the fast pace that China is setting for the Second Space Race. If action is not taken soon it will be too late to review or

change the laws that apply to property and mining on the moon. In our view, that would be unfortunate, especially for those that would like to see the moon developed by the private sector, based on multinational entrepreneurial ventures, rather than by competing national space agencies. Investment by private sector capitalists is discouraged by the current legal regime even more than the actions of states, but the current rules also hamper the actions of states intent on developing the moon as part of a search for resources.

2) Valuable Regions

Examining the value of what is at stake is a good place to begin thinking about the question of lunar propriety and mining rights. Viewing the Moon in a telescope gives one the opinion that the Moon is a desolate sphere, containing just rocks, dust and craters. This view of the Moon generally begs the question of why there is a necessity for property rights when all of the property appears to be the same? On Earth there is fertile soil and there is depleted soil; there are waterways, coastlines and landlocked regions; there are mountains, crevices and open plains while the Moon appears to be simply a huge desert with craters interspersed randomly. This common view of the Moon, however, is wrong. There are many areas on the Moon which are essential to a successful initial colonization of Earth's satellite. Both the poles and the equator hold incredible strategic and economic value and need to be considered with extra care when talking about how to divide up the surface.

There is some water on the Moon (Science Daily, 1998). Most of this water is stored in the form of ice located below the regolith, in craters and concentrated at the poles. The highest concentration of hydrogen, one of the two atoms necessary to create water, is certainly at the poles, and some of it is probably in the form of water. Most of the water is contained within the dark, permanently shaded craters that litter the Polar Regions. Hydrogen might be as much as 1% of the gas trapped in the lunar regolith on a more broadly distributed basis, but again should be somewhat more concentrated at the poles. It is believed that the southern pole contains approximately four times the amount of lunar ice (Blewett, T.D. et al) as the North Pole as a result of more of the South Pole staying in shadow than the north, but further research is needed

to test this theory. NASA intends to fire a probe within the next few years to raise a plume of material from a promising site and test the theories about what is under the surface by analyzing what materials are raised as part of the impact plume.

If there is water on the Moon, and it can be easily extracted, it will provide first generation colonists with an important stepping stone. Water is heavy, weighing in at 1000kg/m^3 at standard atmospheric conditions, and shipping it to the Moon would be a very costly endeavor. Harvesting the ice and hydrogen at the poles would surely prove to be a much less expensive initial development tactic, enabling those at the base, and some later colonists to live off the land until hydrogen can be imported in bulk and combined with the abundant local oxygen source to produce water (and rocket fuel) on site.

Some researchers consider the presence of lunar ice as being of secondary importance to that of power sources available to a moon base at this location (Spudis).

At the equator, the moon's rotation results in 14 Earth days of light followed by 14 Earth days of darkness. The lunar regions hold mountains which are almost constantly exposed to sunlight, though it is not as intense, essentially being in the dark about 1 Earth day of the 28 Earth day cycle. Further, not all the mountains in the region would be in the dark at the same time, so near continuous solar power is possible on the small scale sufficient for an initial colony. A system of lasers could be constructed on the polar mountains which, when powered by solar panels, would beam power directly into a lunar colony. Because of the near constant sunlight on those regions, there would never be a shortage of power for a base or colony.

Each of these situations clearly demonstrates the importance of the Polar Regions, especially the South Pole. If any nation or company gains control over, or is given priority

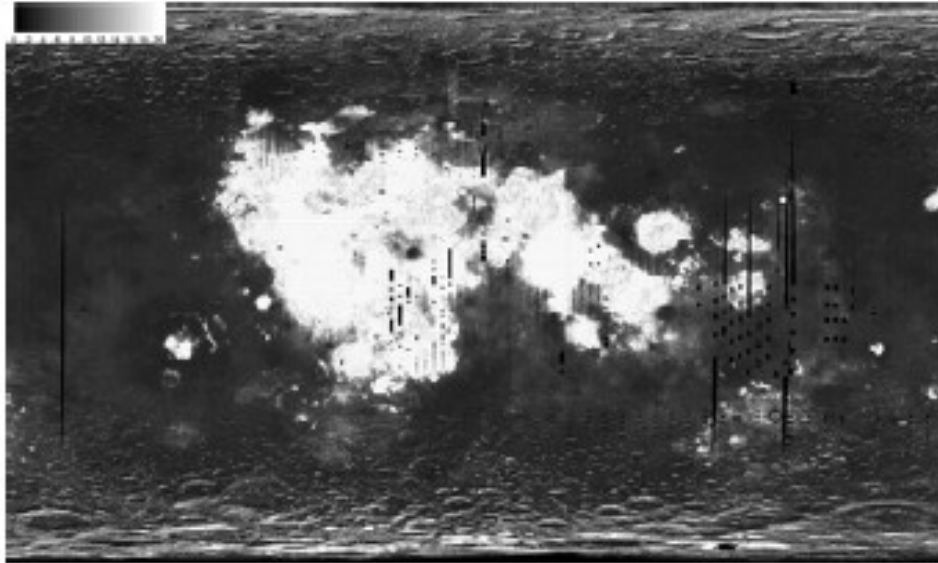
access to, polar resources other later colonists' attempts to get established on the moon would be greatly hindered by their inability to harvest lunar ice, hydrogen, or get a good location for solar collectors (Klinkman). Even the need to purchase these resources from a competing vendor that does not need to pay premium prices, but rather just the actual cost of production, could be a serious disadvantage in running a profitable venture.

The Polar Regions in particular need to be considered a commons region which colonists from all countries will need to be able to access and probably will need to be given permission to pass through as well. But, life support resources held in common still need to be developed through investment and can't be allowed to be overexploited either. The mountain solar unit locations will need to be regulated to prevent later groups from blocking the solar feed to an earlier set of panels or the situation will start to resemble competition between trees in a forest. Life support power will need to have priority over production unit power. Power is a basic need for the survival of both animals and plants on the moon, and is also needed to operate machinery. It is most accessible in the polar regions of the moon, so food production may well be concentrated at the poles though the consumers of the food and their related machinery may be operating elsewhere on the moon.

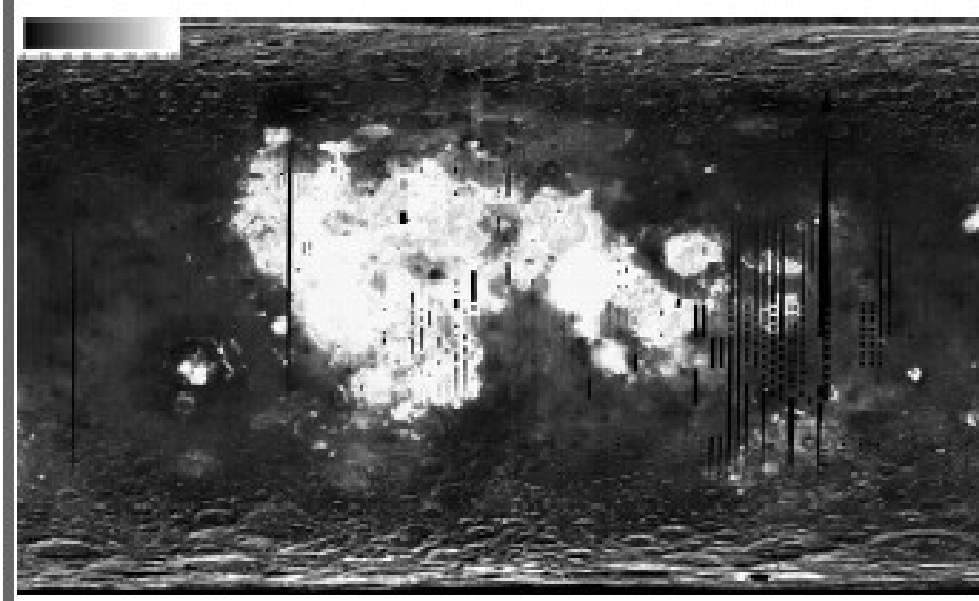
The other critical region for prospectors is likely to be the equator of the Moon. Using superimposed graphs of ilmenite (FeTiO_3) and surface maturity, a team of scientists has shown that the heaviest concentrations of $^{\text{He-3}}$ will be on the equator (Blewett, T.D., et al). The scientists used the background knowledge that ilmenite is the best host for $^{\text{He-3}}$ when compared to other lunar regolith minerals to begin their research. $^{\text{He-3}}$ is also known to be implanted in a surface as a result of solar winds, and so it can be shown that the more mature and exposed to solar winds a

surface is the higher $^{\text{He-3}}$ content that it will contain. The following images are the results of the team's satellite and calculations of the lunar surface.

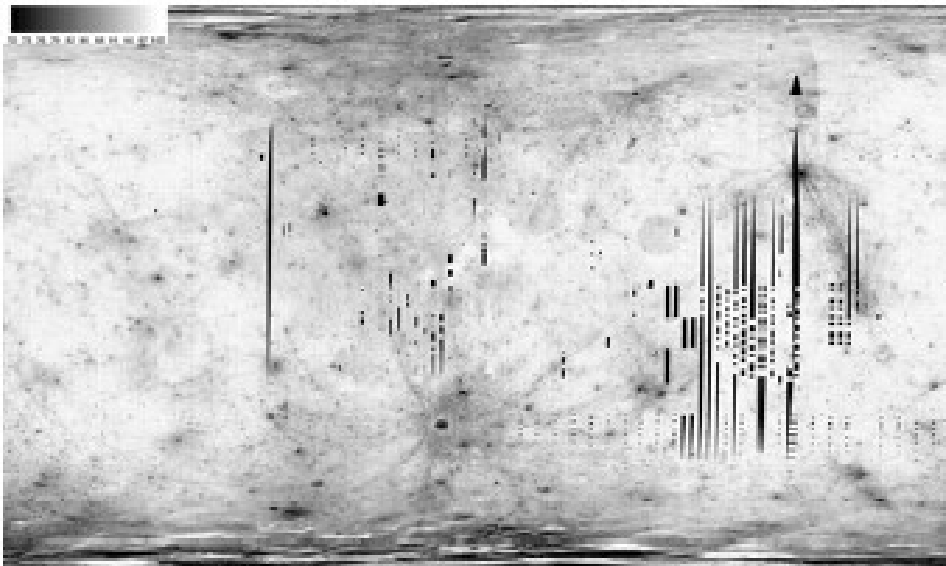
This first image shows the relative concentrations of TiO_2 on the lunar surface.



A second image graphs out the surface exposure of the lunar surface as a function of the intensity over the Iron Oxide content.



Finally, the superposition of the first and second images and application of a function developed by Lawrence A. Taylor is shown in this third image.



(All images from Blewett, T.D., et al)

The images clearly indicate a concentration of ${}^{\text{He-3}}$ the moon around the equator. Any expedition to the moon motivated by economic yield from He-3 mining, as opposed to oxygen mining, must make the important choice of whether to first focus on prospecting the ${}^{\text{He-3}}$ or setting up as close to the water and power as possible. Indeed, cooperation or trade between two specialized installations may be necessary when and if He-3 mining begins.

It is also possible that the He-3 mining units will be rovers and that raises the question of how to power them during the 14 Earth day long “night” unless they can move rapidly enough around the equator to stay constantly in the light. Alternatively, one could operate in any given location half the time if the crews could readily travel back and forth to the poles for a break or move to units entering 2 week period of sunlight as the ones they were operating enter a 2 week period of darkness.

Once again, important political considerations must be taken into account when deciding what rights and advantages accrue to the first national and corporate bases to set up shop so that establishing later bases (and the later development of international mining colonies) remains possible. The question of how to allocate mining rights and whether full property rights over land are necessary to justify and protect the necessary infrastructure investments does arise and will be addressed further on.

3) Processing the Surface

Backpedaling a bit to the comparison of the lunar surface to land which is more familiar, one becomes aware that there is value in different types of surface. On Earth there are streets, farmlands, plains, and so on. On the Moon, however, there is mostly just a very fine dust and some rocks. Steps can be taken to alter the terrain on the moon to suit the needs of researchers, miners, producers and resident colonists. There are four main surface types: raw sediment, microwaved surfaces, glassed regions and finally a foiled region (Klinkman).

One of the first things that Neil Armstrong noted when first stepping off the Lunar Lander in 1969 was the surface of the moon. He made note of how fine the sediment of the surface was. The sediment, called regolith, is obviously the most prominent surface type currently on the moon, though there are outcroppings of rock and crater ridges. To mine for ferrous metals in the powder found on or near the surface one needs only to run a magnet along the surface and collect what sticks (Klinkman).

The major hazard in working with the surface dust is that it is very dangerous to breath, can clog machinery and sticks to people in space suits. If there is any disturbance to the surface, such as a space craft landing, the particles of dust can be accelerated to incredible speeds and blown to the far reaches of the Moon. The blast of a liftoff may even drive some of the dust far enough to circle the moon before settling down again on the surface, due to the lack of air resistance and relatively modest pull of gravity. These fine particles can get into machinery and damage critical parts, disabling the machinery. The best way to remedy the problem of these

flying particulates would be to pave the surface.

The second type of lunar surface is a microwaved surface. Essentially this is akin to paving a road on Earth, but instead of using pavement a high intensity beam of energy is swept over the surface causing the top layers to fuse together. This creates a strong layer which is capable of supporting most of the machines that will be needed for mining on the Moon. This surface would also minimize the number of raw particles that would be blown about, protecting machinery. The microwaved surface can also be 'peeled up' to allow access to the raw regolith sediment beneath and so that it is not doing permanent damage to the Moon. The peeled surface can probably be used as construction material for future lunar settlements (Klinkman).

If the high energy beam used to microwave the surface is left over an area for a much longer period it will fuse the layers at a much deeper level. This creates a 'glassed' surface. Excellent for landing pads, this dense a hard silicon layer would go deep into the surface. It can support the much larger weights of spacecrafts while also serving as a thin and solid form of radiation shielding. A layer of normal regolith about 10 meters thick would be required to protect the human inhabitants of the bases, and there is still debate about whether plants will need a similar level of protection. Lunar bases are likely to be underground or buried unless a dense building material made out of regolith can be produced locally.

Unfortunately, glassing a surface to this depth and density prevents the harvesting of anything valuable that could be extracted from the regolith and so should not be done more than is necessary, or should be done only after valuable gasses and metals are extracted.

Finally, just as on Earth, there can be a type of farm set up on the Moon. Attempting to gather hydrogen to make water outside of the few concentrated deposits at the lunar poles would

be a near futile process without the creation of a foiled surface. Only about one percent of the gases extracted from raw regolith would be hydrogen that has been deposited by solar wind. The majority of extracted gases would be oxygen from the oxide rocks and He-3 from the solar wind. Once all of the existing hydrogen is mined one can accelerate the collection of more hydrogen by covering a large region with a surface layer of iron rock particles- possibly in the form of a foil. This means that the creation of Iron Hydride, FeH_x , will become a priority of increasing importance as other sources of hydrogen are exhausted.(Klinkman). Hydrogen can be isolated and combined with the abundant Oxygen in the lunar regolith to make water. Unlike Earth farms, however, this foiled region must remain completely undisturbed for approximately 20 years to convert the iron into worthwhile amounts of Iron Hydride through exposure to the solar wind. Should the region be disturbed by other activity in any way the gathered FeH_x , or at least the hydrogen, could be entirely lost into space.

Just as in the original colonization of Earth territories, there is great strategic value in certain areas on the moon. The poles, the south pole in particular, are the best hope for lunar ice and most of the hydrogen already on the moon currently is concentrated there. The poles also contain the mountains necessary to deliver constant power to the lunar bases. The equator, meanwhile, contains all the signs of a strong He-3 presence which is a tempting target for commercial mining for export by colonists in the near future. Once land rights are established, a colony group must determine the best way to make use of the land they control, or to which they have access. Certain areas must be glassed to allow for landing pads and underground bases, while other areas must be designated to be foiled to farm for hydrogen. Some must be microwaved to protect the machinery and the rest will be dangerous sediment that also holds the

key to all of the profits available to pay for developing the Moon. All of these elements combine to produce a tricky land use game that must be considered by any group who wishes to govern the activities of these lunar colonists. None of these considerations take into account the scientific aspect of the moon which a significant number of scientists believe can provide humanity with a window into the history of the solar system- if it is not disturbed by commercial activity before it is studied in depth.

4) The Current Regulatory Regime and Treaties

Now that the Moon has been established as a location of great economic and scientific interest, the pertinent laws governing the access to its' resources must be examined. The first major treaty dealing with Space Law was the "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies", better known as the Outer Space Treaty. It was ratified in 1967, two and a half years before the first moon walk by the United States (Unoosa.org 2 Apr. 2008).

During the early days of the Cold War, the U.S. and allied nations sought to create a peaceful environment in outer space, submitting other drafts to the U.N. for approval. The Soviet Union, however, began testing its Sputnik satellite program at this time, and also undertook the military testing of intercontinental ballistic missiles. The Soviets quickly discarded the draft proposals of the Western countries for fear that it would place restrictions on their activities in this field. During the course of the next decade, the U.N. received many draft proposals from other parties seeking to allow nations to explore outer space freely and still demilitarize space. (Rusek) The fact that in 1967 the US was encouraging limits to the claims it could make on the eve of success in the Moon Race led to a mutual interest in cooling the friction by the two superpowers, as they feared the cost of a contested effort to develop the moon. This led to the widely ratified OST.

Inspired by the Law of the Sea, the OST has many provisions designed to ensure cooperation and peace between space faring nations, and to provide for the safety of the astronauts. Many of the articles of the OST are prohibitive, aimed at keeping weapons out of

space and blocking nations from claiming territory in space or on other planets. Other articles deal with recovery of lost astronauts and space vehicles, requiring member nations to assist in any way possible should the need arise.

The moon, as a likely mining colony and other economic destination for space-capable nations, must have explicit land laws set in place for there to be international order. Currently, the OST has some rules that provide some guidelines; but, one is probably misguided and unenforceable and others are likely to be too vague or, as some clauses are, simply lacking in substance. The laws pertinent to lunar land and mining rights in the OST are the controversial ones that are problematic and each have their respective problems.

Article II of the OST states:

“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.”

This article explicitly denies any party to the treaty the permission to stake claims to land as, historically, colonists have in the past. Planting a flag, emblem or any other symbol of your country is meaningless in terms of securing lunar property rights, and in 1967, this is how the US wanted it. The article also states that use or occupation is not treated as legitimate claims of ownership. They would have been treated as such under prevailing Civil Law.

The primary problem with this article is that its language tends to be designed to appease communist or socialist countries that view land and capital ownership as a matter to be handled on the nation-state level, as opposed to recognizing private ownership and enterprise, as legitimate. The article does not explicitly forbid an independent party, for example- a multi-

national corporation, from claiming ownership of a tract of land but it makes the nation-state the responsible actor while denying it the right to claim territory. As will be later discussed in types of land law, a company representing a communist nation cannot legitimately claim land in the name of a nation to develop it under charter from a nation. This is because the nation does not own the land in the first place and probably cannot delegate authority that it does not have, as Britain did to the East India Company, but that is a matter in the gray area.

Articles VI and VIII outline the role a country plays in governing its spacecraft, personal or possible infrastructural space bases. Article VI states:

“States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty. When activities are carried on in outer space, including the moon and other celestial bodies, by an international organization, responsibility for compliance with this Treaty shall be borne both by the international organization and by the States Parties to the Treaty participating in such organization.”

This Article basically asserts that every nation is responsible for what they, or any

company incorporated under that nation's law, do in space. The international community may hold the nation or nations liable for any law infringements whether the violating party is a national or multinational effort or business pursuit.

Similarly, Article VIII states:

“A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body. Ownership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to the Earth.”

In other words, if a spacecraft is launched from Country A, and is registered as such, then it is under Country A's control the entire time it is on a mission. Country A has jurisdiction for the cargo and passengers on board, as well as the veto power over the objectives of their mission, if it happens to be a non-governmental entity going into space. The second sentence of the article ensures that if Country A has ownership of items on the vehicle, they will retain possession of them throughout the flight and return of the vehicle. Should the spacecraft land somewhere other than Country A, the items in question still belong to Country A and no other country may claim possession. This ensures that a country does not feel extra pressure to force the vehicle to return to the origin if extenuating circumstances arise. This also protects the crew and cargo of the

mission in case they land in a country dissatisfied with the imposition of preserving them and caring for the injured. Lastly, and most obviously, this clause provides a set of laws for crews to obey, enabling the maintenance of order in space.

Another major article from the OST is Article XII, which deals with station sharing between nations.

“All stations, installations, equipment and space vehicles on the Moon and other celestial bodies shall be open to representatives of other States Parties to the Treaty on a basis of reciprocity.”

This article declares that, should any bases be constructed on the moon, they will be accessible to all nations whom have signatures on the treaty. This goes beyond a simple requirement to assist an astronaut in distress or at risk. Once again, moves were made by the original writers of the treaty to promote cooperation and unity, as opposed to competition that could lead to conflict (especially armed conflict) between space-faring nations. The article does go on to state that any foreign nations to use an installation must give advance notice to allow for preparations to be made for their arrival, but nothing provides for an outright denial of fair use.

Other articles deal exclusively with the demilitarization of space. Most prominent among these articles is Article IV, stating:

“States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner. The Moon and other celestial bodies

shall be used by all States Parties to the Treaty exclusively for peaceful purposes.”

The language is very straightforward. Military surveillance is not restricted, but weapons of mass destruction that threaten Earth are strictly forbidden from entering orbit or being installed in space, including the Moon. The second sentence continues to enunciate the point that all of space exploration and utilization is to be viewed as part of the furthering of mankind’s expansion into space peacefully and in a way that everyone benefits. However, it’s also important to note that this language does not require nations to be incapable of defending their interests in space. Conventional and/or newer, non-mass-destructive technologies and means of force may be deployed so the risk of armed conflict in space is still a possibility. So, while no one can lawfully be an aggressor, everyone may have an implicit right to develop defense mechanisms ensuring their safety and protecting their investments.

Other treaties were written dealing with the laws of space, the most prominent of which would be the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, better known as the Moon Treaty. The Moon Treaty was finished in December of 1979 and covered many of the same topics as the OST, but using different wording and thus having some subtle differences, making it more controversial than the OST. One of the key statements of the treaty is Article 11, Section 3 which lays out the terms for lunar property claims. It states:

“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. The placement of

personnel, space vehicles, equipment, facilities, stations and installations on or below the surface of the Moon, including structures connected with its surface or subsurface, shall not create a right of ownership over the surface or the subsurface of the Moon or any areas thereof.”

The difference in this treaty lies in the key words “international intergovernmental or non-governmental organization.” Contrary to the OST, the MT disallows any actor, whether national or private, to claim land on the celestial body. The MT closes the opportunity that the OST provided for implicitly allowing the independent development of the lunar surface by corporations.

In addition to the complete halt to property prospects, the MT goes further in its laws to state in Article 11.7(d) that:

“The main purposes of the international regime to be established shall include: ... d) An equitable sharing by all States Parties in the benefits derived from [lunar] resources, whereby the interests and needs of the developing countries, as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the moon, shall be given special consideration.”

This Article claims that the rewards reaped by the space-faring nations, whom achieve lunar development, should be shared by all the “developing countries” or any nation involved in some way. For one, this nebulous text does not provide a clear-cut line to draw between who should receive the benefits and who shouldn’t. For that matter, it is unclear how an independent

party, whom does not own the land, would go about sharing the wealth, much less have motivation to extract resources or provide services if they will not receive profits based on their efforts. Space travel is expensive, so it would be illogical for a business to participate if it must give up profits in advance. This Article heavily favors smaller nations who do not have space capabilities because it assures them, whether deserved or not, the benefits of another country's investments and progress. (Wasser, et al.)

Especially given the limiting rules engaged by the MT, States Parties to the Treaty may feel the treaty no longer suits their interests or intentions for space. For this reason, both the OST and the MT contain an exit article (OST Article XVI, MT Article 20).

“Any State Party may give notice of its withdrawal from the Agreement one year after its entry into force by written notification to the Secretary-General of the United Nations. Such withdrawal shall take effect one year from the date of receipt of this notification.”

Any subscribing nation may give a one year warning of its departure from these treaties. Many of the main and potential players in the current Space Race, including Russia, China, and the United States have not signed nor ratified the Moon Treaty; and so, it is mostly considered a dead act. (Wilkes) However, it is still cited as important and many smaller countries refer to it when the issue of space rights and laws arise. Only nine countries fully ratified the MT; so this provides a clue to the original intentions of the mostly non-space-faring nations whom signed the original OST. They wanted to keep open the possibility of corporate activity on the Moon as a possible vehicle for future colonization. (UNOOSA)

Precedents in History

Before looking into the future, one should reflect back to the opening of other new territories. It is a very sensible thing to look to the past in order to make reasonable decisions about how to stimulate orderly, peaceful development in the future. Land rushes in particular are shining examples of what can happen when there is no established law in a newly opened region. A glaring example is that of the New World when it was first discovered by European nations in the late 15th century, but examples continue right up to the 19th century in North America.

One of the most prominent rushes in recent United States history is that of the Oklahoma Land Run of 1889. This period of a few weeks saw thousands of settlers staking claims in the newly acquired Oklahoma territories with little or no supervision. This experience contains many lessons pertinent to the issue of property rights on the Moon. Also not to be overshadowed are the initial settlers of the New World and the conflicts that arose, particularly those between the representatives of Protestants and Catholic nations.

When, in 1492, Columbus sailed the ocean blue on behalf of Spain and stumbled upon South America en route to the Orient, he opened up a whole new continent to the European world to explore, colonize, and exploit. After Columbus landed in Portugal after his return trip and told the Portuguese king of what he found, the king quickly laid claim to Columbus' findings. Once King Ferdinand and Queen Isabella of Spain became aware of Portugal's new claim they sent messengers to Pope Alexander VI asking for a block on a complete claim by Portugal. Pope Alexander VI agreed and signed the Papal Bull Inter Caetera on May 4, 1493 (Inter Caetera).

This Bull, which is in essence a law as laid down by a Pope, “draws a line of demarcation one hundred leagues west of any of the Azores or Cape Verde Islands, and assigns to Castile the exclusive right to acquire territorial possessions and to trade in all lands west of that line,” (Inter Caetera). While this Bull clearly favored Spain over Portugal in its distribution of land, it was still a law laid down by the Pope. Both Spain and Portugal were Catholic nations and respected the Pope and as such each respected the Inter Caetera as written. Their efforts in the New World then were not focused against one another as much as toward converting or enslaving the native population (ultimately replacing it with African slave labor). It was considered more important to establish permanent footholds rather than battling the other power for control of prime locations. In the end, Brazil was Portuguese and the rest were under Spanish influence.

Once more nations began landing along the New World, however, problems arose. When the British, French and Dutch arrived over the next hundred years wars began to break out. These new settlers were not all Catholic and so did not see the Inter Caetera as something which should be respected or even tolerated. Open privateering occurred between the entrepreneurs with British letters of Mark allowing them to raid the Spanish Treasure Fleets on behalf of the British Crown, which shared in the spoils by condoning piracy. Many were killed over in disputed islands and tracts of land. A Spanish force killed all the helpless survivors of a French fleet that was driven ashore in a storm on the coast of North America to prevent a French claim in the New World. The new nations were not in the Americas exclusively as soldiers of God. Despite the Pope’s directives, they were there to compete for territorial control, profit, and expansion.

This conflict brings to light the importance of differences in the backgrounds of countries

involved in the UN's decision making process. The OST was pushed forward by the United States in an effort to assure the Russians that the States would not claim vast territories upon reaching the moon. The wording of the OST, however, limits Socialist nations more than Capitalist nations from expanding their influence beyond the Earth (Wilkes). Companies that stake claims in space cannot be representatives of Socialist nations as their claim would implicitly be owned by the State, violating Article II of the OST. This loophole does not absolutely preclude actions by private organizations chartered by Capitalist nations.

As has been stated before, one is in a grey area, as it is not clear that a nation can charter an organization to claim property rights the nation can't legally claim. Something less permanent and absolute, like mining rights for a specified period, may be possible. As the non Catholic nations in the 16th century disregarded the Pope's law, so can Capitalist nations refuse to sign the new Moon Treaty and work their way around the features of the OST that complicate private enterprise and begin operations. Unless a newer agreement is reached that establishes an authority that can charter, permit, and control operations in space by state and private enterprises, this will happen anyway. The signatories will withdraw from the Treaty if threatened by sanctions that would leave no framework in place to control potential conflict and would be worse than letting the OST be "reinterpreted," in order to allow private actors to operate on behalf of the States that responsible for their actions under OST rules. China in particular must make some important decisions before it begins the first launches involved in setting up a Moon Base. A more recent historical event explains some further details in this Second Space Race.

Twelve O'Clock, high noon on April 22nd 1889 saw the first legal settlers of the Oklahoma Territory recently assimilated by the United States in the Indian Appropriations Bill in

March that same year. The first trains to the prime locations, namely the Oklahoma City and Guthrie train stations, were so overfilled with people that some were hanging off of the roofs of the rail cars to gain some space. When the first cars arrived at the Guthrie station they were already emptied of people as everyone had jumped off the still moving cars to get a head start (Howard).

The intensity with which the city of Guthrie was built is remarkable. Before noon on that fateful day, naught existed but open plains, a water tower and a small train station. By midnight an entire city plan had been created which would be able to house the ten thousand settlers who first arrived. Many thousands of these settlers had brought their own tents and camping supplies and so the first night saw an enormous campsite with each settler carefully guarding his claim from those around him.

The morning of the next day, however began to bring some reality testing about the landscape. A thick red dust was the prominent feature of the area. Coupled with very sparse external water and few food supplies, many settlers were quick to return to their hometowns and ignore the Oklahoma territory. The hardier homesteaders remained and began the process of constructing the town they had laid out previously. The city of Guthrie went on to become the temporary capital of Oklahoma and is currently a thriving city (Howard).



Taken April 24th 1889



Taken May 10 1893

(Pictures from Benjamin)

The question can be raised as to why Guthrie and the Oklahoma train stations were such attractive targets for these first rushes. The answer was simple; there were water towers and rail lines. One of the most principal rules of prime property choice was put into effect: “location, location, location.” The available water was critical to those who needed to focus on getting shelter set up before wells were dug and irrigation lines created. The rail lines could support trade as soon as one had something to export as well as the quick import of goods and more settlers. As we all know in retrospect, Oklahoma territory mining and drilling rights would be what mattered for the economy, as the area was oil rich, but the early settlers had to focus on life support, grass grazing rights and water for plants animals and people.

The Moon presents a similar situation in that just about all of the hydrogen and lunar ice is divided between the poles. Just as Guthrie and the Oklahoma stations were important footholds to control when beginning to settle, the poles will be vital locations for the first generation of lunar colonists.

The Guthrie Land Rush was successful and peaceful and as such holds lessons for future

development scenarios where key resource locations are concentrated in a few locations.

William Willard Howard, an observer of the land rush during those fateful first few days brings up the note that alcohol was strictly forbidden from Oklahoma during this land rush. In an article he wrote for Harper's Weekly, Howard states "Had whiskey been plentiful in Guthrie the disputed lots might have been watered in blood, for every man went armed with some sort of deadly weapon. If there could be a more striking temperance lesson than this, I certainly should like to see it." (Howard) This raises a striking comparison with the current Space Race.

According to the OST, weapons of mass destruction are prohibited from entering space.

Whiskey mixed with weapons, according to Howard, would have made the land rush much more belligerent than it turned out to be. If WMDs were used to back up property claims, the bright promise of the Second Space Race could turn very dark very quickly. The militarization of space could result in populations on Earth being held hostage to gain political advantages in space.

One of the most important lessons to take away from the Oklahoma experience is that the Land Rush occurred with just about no rules whatsoever beyond how and where stakes were to be claimed. The only strictly enforced rule was that there was to be no alcohol present. However, there was a political entity with legal jurisdiction and the army and federal marshals were present to keep order. The 12:00pm start time was violated numerous times, most noticeably by the marshals who were charged with protecting the land from 'Sooners,' or people who left too soon to claim property. Upon arriving at the appropriate time, the settlers were dismayed to find that some of the most desirable claims already had been occupied for quite some time by these marshals. Howard makes note of this situation and comments that the only reason the settlers did not get violent was due to their assumption that the government would step

in and remove or punish the marshals who had abused their power. It was later found out that many of these marshals had even bribed their way into service specifically to get the prime locations.

This unfortunate precedent suggests that someone will need to watch the watchers when it comes to policing the Moon and the Lunar Colonists. If a group gets illegitimate control on the South Pole or the police force (if any) it begins to claim other critical areas there will be a rapid increase in tension. Then violence could easily erupt out of political and economic rivalries fueling the space race. However, should there be no way to obtain legal mining rights, then illegal mining will occur which would create an even more unstable standoff than untrustworthy authorities, who can be held to account later.

Learning from the past and looking at precedents is a very useful tactic used in current policy making processes. Historical analogy can be taken too far but is a good way to start. By examining the Oklahoma Land Rush, to overnight creation of Guthrie City in particular, one can see analogies in the Second Space Race and the 1889 land rush. By enacting a prohibition rule during the rush, the government kept the claimers as peaceful as possible. A de-weaponization law in space would serve the same goal. Similarly, there are key areas which will be settled first and special measures must be undertaken to allow all parties a fair opportunity to claim them or gain access to them. If one of the competing groups has a way to gain illegitimate access and monopolizes a key resource, conflict will occur in or out of space institutions established by the UN and World Court.

Existing Methods of Property Law

History has provided examples of how to, or how not to, go about land claims. A proposal to lunar land claims, are property rights in general. These rights can be broken down into two major categories: common and civil law. These two form the basis of how Earthlings have come to deal with property matters and scarce resource distribution in a relatively peaceful manner. In both cases there needs to be an authority to adjudicate claims, but the legal framework increases the chances of equitable and just outcomes.

American Property Laws are founded on Common Law, which has its origin in the Lord-Vassal relations of feudal Europe. Under common law, the power of the government lies in the common people. All immovable substance is in the inalienable possession of the rightful owner of the land on which it is found. Given that the property is acquired legitimately, the property exclusively belongs to one individual or party, as opposed to ownership based on equity or conditional usage. The primary problem with this law is that the property is considered to be owned by a government and then legitimately bestowed in return for services or money (Fisher, Pond). Since the Moon cannot be claimed by governmental bodies, the application of American property laws would violate Article II of the OST.

The other type of law, civil law, could be considered a better model for the initial land laws of the Moon. Civil property law distinguishes land rights on an individual level, and the rights are justified through the use of the land. This utilitarian law excludes land claims based on national sovereignty, so it is therefore fully compatible with the OST (Brittanica). What this implies is that private industry, under this system of law, may legitimately have claim over lunar

territory on the basis that they will be mining (appropriating) and using (directly or via trade) these natural resources. In fact, the efforts to create a sustainable, long-term colony on the Moon are in harmony with the peaceful philosophies of the OST, but states must be able to authorize private corporations which can obtain use rights for this to work.

On that note, a sustainable lunar base must support itself financially. The removal of cumbersome overhead and delivery costs is decisive in making a base feasible; so, the use of local resources will be a priority. By increasing the efficiency of local extraction, conversion and use a base or colony is reducing its dependence on supplies from Earth. Heavy use of local materials will be the key to a self-sustaining and economically feasible colony as well as the source of operating cost reductions for the associated trade system.

As stated before, there is ice and hydrogen on the Moon. Water plays an essential role in the maintenance of life everywhere; the presence of water will play a critical role in where a nation will initially choose to set up camp. Later water can be produced from harvested or imported hydrogen and local oxygen. With the preexisting water residing at either of the poles of the Moon and with the He-3 mostly residing in areas closer to the equator, this creates a dilemma if land claims on a first come first served basis rather than in terms of who is best positioned to safely exploit the resources based on prior infrastructure investment. Would initial missions to set up on the Moon focus on the poles first, or would economic pressures drive them to other areas where it is harder to operate but with better long term economic promise? Will periodic access to polar resources by roving gas gatherers who travel a circuit and return to a polar base be enough? Will several fixed communities emerge, two at the poles growing food and the others near the equator doing the He-3 mining? One could see a trade system developing on the

moon itself due to a division of labor between life support and production units. Other models are also possible, and much will depend on how the mining equipment is manned and powered. In a solar economy the equator is a challenging production site and fixed mining units have to be able to store energy or move fast enough to stay in the light to stay in production. Nuclear powered, or space based solar satellite powered operations could function in the dark, but these would be far more suitable for mining than agricultural production.

Perhaps semi-robotic mining units could be operated from polar bases or even by people located on Earth, but even without people present legal conflicts can arise. However the technology and division of labor develop, there is likely to be a mix of claims; a successful colony must have operating units in various parts of the moon gathering what is needed in locations where the necessary resources are concentrated. There are likely to be several colonies both competing in a given economic niche and cooperating with other interdependent specialized units. Just as ships from many countries meet in the great ocean fisheries and return to their home ports to resupply and off load the catch, so the gas miners will roam and mingle and compete yet offer mutual assistance.

The problem is that on the moon there will be no territorial waters and Coast Guards to claim jurisdiction and enforce the regulations, and protect the fish farmers and the gatherers of wild fish from one another and to control rates of extraction. Jurisdiction of legal codes are outlawed by the OST, so what will be put in its place to preserve law and order and coordinate the economic activity in this new world? Land values will vary initially and change radically after they are exploited the first time. Even those areas likely to recover (as more gas is carried to the moon by the solar wind) raise legal issues as the rate of recovery will be determined by

their latitude, how they are left and how often they are disturbed. Bases that are dependent on tourism, science, gas mining, mineral extraction and agriculture will treat the lunar surface differently. There is really no way to even out the mix of land values for each space faring nation. They will have different goals, policies and economic strategies. However, a sustainable base on any part of the Moon will require access to energy and water or the products produced by access to water in the form of food. For this reason, past water laws should be reexamined to find out how competing nations can each have access to water on the Moon, as well as other precious life support resources. Then, once the water question is addressed, since it will come up first, it may offer some insights into how to handle the distribution of other finite and valuable resources.

An appropriate water law to consider is called “Prior Appropriation,” or priority through appropriation. This law is practiced mostly in the Western United States. In a first-come-first-serve fashion, prior appropriation grants “senior appropriation” rights, priority claim, to the first party to use a water source. Afterwards, those who need to use the source of water may be granted “junior appropriation” rights; a secondary right to access. The law further entails that the water and its source do not belong to any single entity, but to all users. (Castle) Due to the scarcity of water in western states of the U.S., many counties utilize their own subtly different versions of this water law, taking into account what type of water source they are dealing with, what the demand is, and so on.

In the case of the Moon, if this law were implemented, the first colonists would have the senior privileges over the polar caps regolith ice and hydrogen deposits. Later settlers would also have a right to mine or receive water from the poles; but, will not be able claim the same demand/needs as the first ones. If the first to arrive set up on the Moon and claim the poles this

also creates business opportunities for others who would claim the more energy rich equatorial zones.

The spirit of this seems contradictory to the OST's emphasis on equal sharing; but, in practice, one is talking about life support, not valuable resources to be sent to Earth for trade. Hence, equal sharing will have to give way to the needs of those already present. One can't send more people than can be supported by available supplies, so those coming later probably will have to make their own water and at some point will get no share of the original natural supply.

Another water law worth mentioning is the "Riparian" Water Law. Based off of common law, the riparian fundamentally grants all properties on or adjacent to a watershed or other water source rights to that water, exclusively. Those without direct contact to the source do not have a right of claim on the water, and therefore cannot use it. The problems with this law are that, since there can be multiple claims to the water; many alternative uses besides direct human consumption are subject to question. (Water Enc.) Selling cattle or food grown by irrigation is legitimate so long as ones draw does not prevent others downstream from doing the same. Using the water to manufacture textiles, paper or transport slaughterhouse wastes and polluting the water in the process imposes a downstream cost without actually reducing the flow. When one party profits at the expense of another water access and use can create strife between the parties with equal claim over the water. Again, for the Moon, this implies many problems for states or private industries that will be dependent on these few sources of water.

Unless one party has a monopoly over an entire body of ice of hydrogen, all parties with facilities adjacent to the deposit would have legitimate claim to the profits received by selling water to equatorial or other lunar location communities. Further, if water is in short supply for

agriculture, (for plants and growing fish in ponds for protein), but nearly all of the water used in this way can be recycled, using hydrogen derived from lunar water to refuel rockets and truly consuming it will be controversial. Yet, without hydrogen the potentially huge and economically important LOX supply on the moon is not yet rocket fuel and nowhere near as valuable in the first fuel extraction market that will operate on the moon. What authority will be in a position to insist that hydrogen for fuel be imported, gathered from the solar wind or mined out of common regolith rather than taken from the limited but much richer polar hydrogen deposits in the form of ice? A legitimate allocation and priority system that does not yet exist and will need to be created to avoid conflict and set up a wise resource use policy.

Many Saharan nations, where water is extremely valuable and scarce, treat water as a commodity. Although the price is much higher, countries like Algeria buy and sell water rights and put emphasis on sustainable usage. Many nations in this position urge the U.N. to help instruct people on how to preserve and recycle water and push technology towards this goal by making it precious and expensive in the economic system. (Kadouri, et al) Between nations in space, however, a free market water system could cause some problems, with one nation struggling to provide adequate life support for its people and another “burning” vast quantities of hydrogen as rocket fuel. Dangling a water bottle over another nation’s head, just as OPEC nations do with oil, will be resented and wars over water and oil supplies are one part of the historical record of Earth that one doesn’t want to repeat in space.

A relief to the water pressure problems caused by rocket refueling demand could come from a technological breakthrough that would facilitate gas trading between the Earth and the Moon. Provided that space agencies do not find better, cheaper means of getting water from the

surface of the Earth into space, there is also oxygen in low-Earth orbit (LEO). Oxygen collection devices that would operate in LEO have been proposed by Demetriades and Klinkman (Demetriades 1961-62; Klinkman, et al. 20 Sept. 2007). Both inventors were influenced by the need to develop a freight system to support activities on the Moon, and thus the need to refuel spacecraft that would never land on Earth but rather shuttle between Earth orbit and Lunar orbit. Klinkman also explicitly referred to spacecraft that had consumed nearly all of their fuel reaching LEO and are en route to the Moon. Refueling capabilities would increase the mass of material landed on the moon to build a base by 250% according to Klinkman (Klinkman, et al). Demetriades was not really thinking as much about what would come to LEO from the moon, but according to Klinkman it would probably be LOX and later He-3. (Klinkman and Wilkes, 2008)

LOX is the heavy part of rocket fuel, over 85% of the total weight. Hence, having the LOX gathered in LEO or arriving from the Moon to LEO would be of immense value. Then only the light part, hydrogen, would need to be lifted from Earth. It is hard to store liquid Hydrogen for very long in space, but mixed with oxygen it becomes highly stable water and can be stored in orbit indefinitely. Oxygen can also be mixed with Nitrogen to make an acceptable rocket fuel, and Nitrogen, like Oxygen, can be gathered in LEO or from the upper Earth atmosphere which is 72% Nitrogen and only 22% Oxygen. There is no reason that some of the hydrogen lifted to orbit for use in rocket refueling could not be transported to the Moon, where it could be stored in a gaseous state for much longer. There it could be combined with locally extracted LOX to refuel space craft lifting off from the Moon or departing from lunar orbit. That would leave the relatively small and precious lunar supply of Hydrogen available for

development into a recycled water supply and allow the large supply of oxygen to be exploited for use as rocket fuel. (Klinkman and Wilkes, 2008) At any rate, a trade system could be created between orbiting satellites and lunar colonies to provide hydrogen for the moon and oxygen for LEO, and then there would be water in both areas of space where it would be precious and valuable.

Oxygen will not be available on the Moon until infrastructure investments are made. Until there are oxygen mines on the moon, picking up supplies of it in LEO en route to the moon that did not have to be lifted from Earth will be an attractive option. This economic reality should drive the development of the LEO gas gathering infrastructure until lunar derived oxygen sources start to compete with it.

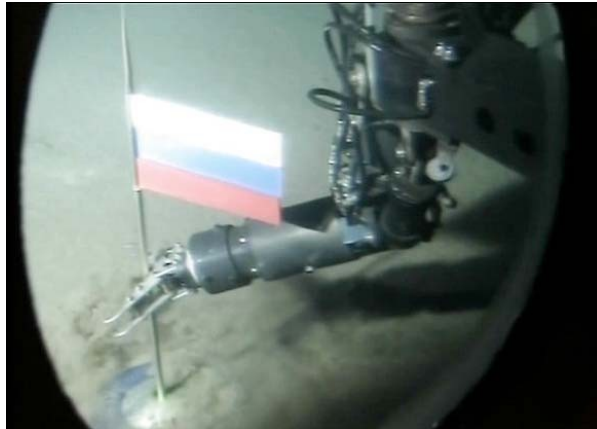
It is not clear whether hydrogen will ultimately be easier to lift from Earth, gather in LEO, or gather on the Moon, but it is relatively light, likely to be expensive in space generally and most abundant on Earth. Hence, the bulk of that used from fuel will probably come from the oceans, rivers and lakes of the Earth while the modest supply on the Moon is used for life support.

The Mining Laws of Earth

Settlers who break down the lunar surface and separate the gases, metals and glasses into what they want and do not want will be interested in reviewing the rules governing international mining rights on Earth as a starting place. It may come as a shock to them that this is a matter left to the individual nations, despite the global impact of such activity. There are no accepted or official international mining laws. In 1972, the United Nations Conference on the Human Environment met in Stockholm and laid out what are, to our knowledge, the only relevant international law governing mining rights. Principle 21 of this conference says that:

“States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.” (UNEP)

All countries have sovereign rights to their own resources. Should a country wish it, however, they may have economic contracts between other nations and companies which allow them to exploit resources in their territory. This is why certain seabeds in the world are sought after, such as the Arctic claim by Russia, which may have natural gas and oil deposits. (Pring)



In the Fall of 2007, Russia planted their flag on the bed of the Arctic Ocean to stake its claim over the area's resources. The legitimacy of this claim is much disputed.

(Picture from TheWE.cc)

Thus, there is no precedent involving how one gets the right to mine in an area where all nations have some rights, and the OST makes the moon the first place where this situation will have to be addressed where no adjacent nation can legitimately claim jurisdiction. Again, if no nation may hold title over any land on the lunar surface the principles prevailing on Earth would not apply to the lunar case unless the signatories all give a year's notice and forswear that treaty.

The question is what happens if laws that allow individual enterprises to hold property, a kind of sovereignty over their land if no state can claim jurisdiction, could be put into play? Similar economic contracts could arise if corporations can hold contracts from state owned (space) agencies which pay them to develop resources out of local lunar materials.

If at some point a country does claim territory on the Moon, by right of investment and continuous use, this law giving them rights up to the point that their activities negatively affect others would probably become applicable. Until such time the thing to watch is corporate investment based on getting contracts from nation state government agencies or large multinational companies that have the equivalent of a space agency devoted to space

transportation, involving freight and/or tourism.

In addition to Stockholm 1972, The United Nations Convention on the Law of the Sea (UNCLOS) touches a few of the more important issues raised by claims for lunar mining rights. Particularly in Part V, the Exclusive Economic Zone (EEZ), precedents for dealing with international territory and the handling of such are clearly evident. For the EEZ, there are two parties to consider: the coastal state and the other states. The EEZ is defined as the region of sea two-hundred nautical miles outside of a territorial sea adjacent to it, the territorial sea belonging to the coastal state. The two parties have different rights over the area. (UNCLOS)

“Article 56: 1. In the exclusive economic zone, the coastal State has:

a) sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, of the waters superjacent to the seabed and of the seabed and its subsoil, and with regard to other activities for the economic exploitation and exploration of the zone, such as the production of energy from the water, currents and winds;...”

(UNCLOS)

This means that the nation closest to the resources holds claim for the extraction even though it is in international territory. It is land under international law, yet available for one country’s use.

“2. In exercising its rights and performing its duties under this Convention in the exclusive economic zone, the coastal State

shall have due regard to the rights and duties of other States and shall act in a manner compatible with the provisions of this Convention...” (UNCLOS)

This essentially means that once property has been established privately or nationally, parties can still have access to the resources around their property and they must respect all other state parties in the area because of the international law. Because the Moon, no matter how loosely the text is interpreted, is not “adjacent” to any individual body exclusively, the “coastal” rights may have to be examined and implemented only once people are on living on the Moon near or on key deposits of natural resources. However, the “others” rights may be used sooner.

“Article 58: 1. In the exclusive economic zone, all States, whether coastal or land-locked, enjoy, subject to the relevant provisions of this Convention, the freedoms referred to in article 87 of navigation and overflight and of the laying of submarine cables and pipelines, and other internationally lawful uses of the sea related to these freedoms, such as those associated with the operation of ships, aircraft and submarine cables and pipelines, and compatible with the other provisions of this Convention...”

3. In exercising their rights and performing their duties under this Convention in the exclusive economic zone, States shall have due regard to the rights and duties of the coastal State and shall comply with the laws and regulations adopted by the coastal State in accordance with the provisions of this

Convention and other rules of international law in so far as they are not incompatible with this Part.” (UNCLOS)

This Article is hazy in that the pipelines and cables could be construed as infrastructure. If they are infrastructure, then the boundaries of what can be built are far and wide. Similarly, entailed in Article 87 is:

“The high seas are open to all States, whether coastal or land-locked. Freedom of the high seas is exercised under the conditions laid down by this Convention and by other rules of international law. It comprises, *inter alia*, both for coastal and land-locked States:

- a) freedom of navigation;
 - b) freedom of overflight;
 - c) freedom to lay submarine cables and pipelines, subject to Part VI;
 - d) freedom to construct artificial islands and other installations permitted under international law, subject to Part VI;
 - e) freedom of fishing, subject to the conditions laid down in section 2;
 - f) freedom of scientific research, subject to Parts VI and XIII.”
- (UNCLOS)

If these two Articles were applied to the Moon, this could mean, assuming full

infrastructural development, that anyone can develop part of the Moon. If one does not assume full development, then what these two statements would mean is that everyone, while peacefully agreeing with each other, can go build up transportation facilities, extract resources, and conduct scientific experiments.

The intent of these laws is to provide a safe and secure environment for countries to operate in international waters. Laws that emulate these can be expected to appear when lunar colonies are established, unless a larger international authority takes jurisdiction as sets priorities that supersede the goals of the individual actors.

Enforceability

One of the greatest obstacles for space law is enforceability. The weaponization of space sets a dangerous precedent no matter what organization initiates it. The OST strictly forbids weapons of mass destruction from entering space; however, the use of more conventional weaponry is not even addressed and controlled, much less prohibited. To ensure the security of space activities, the United Nations or some other administrative body must have full regulatory and enforcing rights.

Chapter VII, which is Articles 39 through 51, of the U.N. Charter discusses the U.N.'s military doctrine. Specifically, Articles 39, 40, and 41 state the peacekeeping mechanism:

“Article 39: The Security Council shall determine the existence of any threat to the peace, breach of the peace, or act of aggression and shall make recommendations, or decide what measures shall be taken in accordance with Articles 41 and 42, to maintain or restore international peace and security.”

(Chapter VII)

The U.N. claims the right to respond to all international acts of violence, and has used this right in the past. The Korean War was the U.N. security forces' debut; and in the end, the border of the rep. of Korea at the 38th parallel was restored. At one point this required holding that line against an army of over a million Chinese communists who intervened in that struggle. This serves as an example of what the U.N. is capable of enforcing given the international political will to do so. The People's Republic of China was not at that time a member of the UN and the Nationalist

government on the island of Formosa was not only a member but held China's seat on the Security Council.

“Article 40: In order to prevent an aggravation of the situation, the Security Council may, before making the recommendations or deciding upon the measures provided for in Article 39, call upon the parties concerned to comply with such provisional measures as it deems necessary or desirable. Such provisional measures shall be without prejudice to the rights, claims, or position of the parties concerned. The Security Council shall duly take account of failure to comply with such provisional measures.” (Chapter VII)

Members of the U.N. are required to send forces to aid in the decision of the Security Council. In space, this could be problematic as one country may have forces in place which give it strategic advantages, or simply be the dominant force in position. This presence, even under the U.N., will create instability for rival powers, and any force emplacement has to be done carefully.

“Article 41: The Security Council may decide what measures not involving the use of armed force are to be employed to give effect to its decisions, and it may call upon the Members of the United Nations to apply such measures. These may include complete or partial interruption of economic relations and of rail, sea, air, postal, telegraphic, radio, and other means of communication, and the severance of diplomatic relations.” (Chapter VII)

The U.N. can, in principle, “shut down” a country’s transport and communications facilities until a dispute is resolved, but the Security Council rarely uses its full powers. On the Moon or in space, a lunar territory or any transportation facility between the Earth and Moon could be taken over by forces serving the U.N. if there were sufficient cause.

The U.N. must be up to the task of asserting its strength and be willing to fund the force necessary to secure the near space region; or, again, another organization may have to take over this critical role. Property conflicts aside, other issues will emerge, from such serious infringements as smuggling equipment deemed illegal by the international community to or from the Moon and space to the mundane like traffic violations (if there is gradually more activity, this will matter). If the U.N. is incapable of providing this service to the world community, then another third party will have to be created to address these issues, otherwise or else it will create an unstable environment for development until one national actor, or an alliance of them, becomes powerful enough to control near space.

In the development of the new world in the 16th and 17th centuries pirates, privateers and raiders operated in the Caribbean Sea as the European powers competed for control. First, the British were the privateers preying on the Spanish. Later, the newly created United States tried to break the British blockade with French assistance and the revolutionary war ended in rebel success when a French fleet off Yorktown, Virginia prevented the escape of a besieged British army. Even when all these nations were at peace the British navy ruled the seas to the extent of trying to enforce an end of the slave trade against the Spanish and Portuguese while half of the USA was still a slaveholding territory. During the American Civil War of the 1860’s the British

would decline to break the northern states' blockade of southern ports and the Confederacy ultimately lost the war. This ended slavery everywhere in the New World other than Brazil. Brazil finally outlawed the practice in the 1890's, a generation later.

In the 20th century Britain and the US would twice combine forces to deal with the threat of a new kind of blockade by German U boats. Clearly peace imposed by a dominant navy or naval alliance is not completely stable, but there is a form of international law when a navy is dominant enough to enforce its will. However, other nations will combine forces to resist a dominant power, as the Spanish and French tried (unsuccessfully) to do to contest British control of the Mediterranean Sea during the Napoleonic wars. The only thing worse than maritime peace imposed by an Imperial State is no rules at all, or no one able to enforce them with everyone acting out of immediate national self interest. (Wilkes)

In space, conditions are shaping up to be analogous the 16th Century in which 5 new seafaring powers (Portugal, Spain, the Netherlands, Britain and France) vied for control of the seas, and thus access to overseas territories. Thus, to avoid a long period of contest in which it is impossible for anyone to impose order, a regime needs to be put in place at the outset by a legitimate international organization and agreed to by the major space faring nations.

The decision of the US to give up the right to claim the moon on the eve of landing there first, sets a useful precedent in this regard. Its recent decisions to militarize space in order to defend its military assets in space are an unfortunate step in the wrong direction. However, the Moon is not yet a strategic site used by the military, hence there is still possible to set a precedent in the development of the moon that will foster peace and cooperation rather than colonization as an outgrowth of competitive empire building.

Possible Solution

The authors are not the first to bring to light the need to set up a new protocol that is friendly to private investment and yet demands mutually responsible action by competing space faring nations. We may be the first to say that the UN should do it and in principle has the power to do so, however unlikely it is to do so. The permanent membership of the Security Council is not far from a gathering of the space faring nations, (USA, Russia, China, France, England) and could spin off a subcommittee on space affairs that allowed Europe to vote as one member and invite Japan, India and possibly Brazil to participate.

Proposals, such as the Google X Prize and the Ansari X Prize, have noted the private investment problem, if not the legitimate rule making and enforcement issues, and a few have gone so far as to submit possible solutions to issues the authors have put forward. The most prominent and promising solution found was the Wasser Space Prize written by Alan Wasser and Douglas Jobes. These two have put together a sound solution which will grant a parcel of land to groups who can create semi-permanent colonies on the moon while still protecting national interests.

The Wasser solution centers around 600,000 square mile “claims... made by true, permanently inhabited settlements” (Wasser, et al). This establishes the point that to make a claim colonizing groups need to be present and fully functional. These colonists would no longer be earthlings on the moon but true lunar citizens. The Wasser Solution also goes on to explain that this will not be a land grab, but a peaceful and multinational effort. The point is made that the endeavor of building a lunar settlement is far too expensive and time consuming

for any one country or corporation to run alone. The process of building these colonies will take many millions of dollars of capital and be a risk too large for any one group (Wasser). Hence, they want to create a new entity that can own property and claim jurisdiction on tracts of the Moon that is not a company or a country per se, but an organized and approved collection of Earth based organizations committed to the common goal of colonizing, presumably for profit, but not necessarily for profit.

Wasser and Jobes (2008) go on to make many arguments similar to those made in this report to justify their proposal. They clearly want to force the issue of legitimizing private enterprise and corporate actors as the developers of the moon. Thus they want to see the Moon treaty set aside and the OST “tested” and re- interpreted if not replaced. We are sympathetic to the goal but a bit less enthusiastic about the means proposed. In our view the current actors are nation states and that needs to be acknowledged even as room is made for corporate actors. Otherwise states will hide behind at least some of the new corporate entities and distort the situation by creating a loophole in the protocols designed prevent open conflict between rival nations.

The goal is to enable true joint ventures in which many nations and corporations can cooperate while limiting their exposure to financial risk. For nation states it is equally important that they do not need to put their national honor on the line in ventures where the nation is not fully invested, though some of their citizens are totally committed and acting in part for the nation. Hence, the authors of this report to look favorably on the Wasser Space Prize initiative as a step in the right direction, and feel that many of the conclusions they reached are sound and some of the resulting proposals would be well worth debating, developing and possibly putting

into practice.

Conclusion

The existing property laws on Earth are not applicable to the moon under current OST treaty and those dealing with space are currently inadequate for the purposes of the development and settlement of the Moon. The OST is outdated; but, since it is difficult to get many countries to sign a new treaty, the OST will probably need to be amended and clarified as to what conduct is actually allowed by non-state actors and what responsibility the states have for the actions of the lunar corporations that they charter.

While the impulse to put a priority on maintaining the peace in space and encouraging international cooperation made sense at the time, it is now necessary to develop the basis for colonizing the moon and an equal emphasis needs to be placed on protecting infrastructure investments. Hence, the property and mining rights issues must be addressed and an appropriate role for corporate actors must be defined, if there is to be private investment. This is an especially important issue in the USA as NASA does not see itself as a development agency, but rather a science and R and D agency. If the USA is to participate in colonizing the moon, private enterprise and corporate actors will need to be legitimated and heavily involved in joint ventures that transfer technology from the space agency and its contractors to corporate actors. State investment in productive infrastructure is far less controversial in socialist and communist nations, such as the People's Republic of China. However, the current treaty rules make it even more difficult for a state than a corporation to lay claim to property rights on the moon.

The mining, water, and property laws of the Earth have been ignored in the OST but the experience of the past has some bearing on plans for the Moon, and should be reviewed in terms

of creating new rules and establishing a general policy. Actual laws elaborating on the protection of property will have to be written in the next decade if they are to precede the actual construction of facilities and the claiming of strategic territories de facto, by setting up a base and using local resources. Frankly, some current treaty rules may have to be set aside after reconsideration and whole new legal entities and frameworks created. It would be easier to do this on logical and rational grounds before people representing given nations start settling in territories, as then they will have interests to protect and rules will benefit one actor at the expense of others. Now it can be done as a matter of principle, at least so far as the current space faring nations are concerned.

The tendency of the current rules to favor the interests of non space faring nations who are not actors but lay claim to the benefits of space exploration will have to be changed. It would be more appropriate to preserve the rights of lunar resource access to nations and corporate actors who wish to become space faring in the future but cannot do so at present than to treat all nations as equals in terms of lunar resources. This is especially important if the moon becomes a refueling depot, or the source of LOX for refueling in space. Then space faring ventures denied access to lunar resources and facilities is pace supported by bases on the Moon would be at a severe disadvantage.

Space in general and the moon in particular is an entirely new frontier for human settlement and it is a hostile environment at that. These laws should not also be hostile to investment trade and the peaceful pursuit of legitimate public and private interests through space activity. A trade system with large implications for the energy economy of planet Earth is likely to develop between the Moon and the Earth. Rules must govern and protect this trade. These

rules must also be enforceable or else there will be as little likelihood of the peaceful development of He-3 mining on the moon as there was peaceful development of oil fields in the Middle East. Either the U.N. must take advantage of its legitimacy and develop a real space technology capability (both for the regulation and defense of trade), or a new space administration will need to be created.

History instructs us that lack of a legitimate authority that both Catholic and Protestant European nations would defer to in the first age of discovery led to continuing conflict among nations and the toleration of legalized piracy against competing powers. This went on until one of the actors could dominate the seas restore order and suppress profitable but reprehensible activities such as the slave trade. Even then combinations of rivals determined to thwart the dominant empire made it hard to preserve the fragile peace. The future world deserves better than this, and the lessons of history have led to an interesting first step in space.

The existing outer space treaty actually put preserving the peace and preventing a space technology race before economic return. However, 50 years later, a new space race is developing that is driven more by economics than politics and it is necessary to prepare for it. It is unlikely that the current treaty could hold the emerging players in line even if it made sense as an institutional framework for a period of lunar development, which it does not. It must be developed or replaced in the next ten years or the signatories will withdraw from it and there will be nothing in place to curb the tendency of economic and political rivalry to generate armed conflict.

The Cold War that produced the first space race was not in all respects a bad thing. Money that would normally have been spent on the military and in more low level conflicts such

as the Korean and Vietnamese wars instead set in motion the pursuit of wonders in space. A few heroes put their lives on the line and an army of technologists pushed the limits of what was possible. As a result the Moon was explored and the implications of what was learned there has now begun to create a new dream grounded in resources found there that are either not available on Earth or easier to get into space from the Moon than from the Earth. The space race embodied humanity's nobler dreams but it was also realized in the context of national competition using technology developed to deliver weapons of mass destruction. In a way, nuclear war, unthinkable on Earth, was being pushed out of the biosphere and up into space.

Even so, the immortal words spoken on that first moonwalk spread a feeling over the world that one may call the Moon the same as the blue sea- "our common heritage." Now, in a second space race, the philanthropic language of the original treaties may disappear as resources become scarcer and whole future economies depend on who gains access to resources from space, starting with the moon. Still, the precedent of finding a way to do this as peaceful rivalry that creates new possibilities rather than new levels of destruction stands before us.

The UN, an organization that came out of the experience on the last World War, and is charged with preserving the peace, faces a new and critical challenge. In order to avoid a war that could consume the human race, the world community must have rules that prevent such conflicts from arising. Hopefully, the UN and the OST can evolve into what is needed in the time available to forestall a new period of instability. However, if the UN is not up to the challenge of balancing the needs of non space faring nations against the claims of space faring nations, against corporate and state actors, and against the hopes and dreams of humanity then a new organization is needed. Any organization created in the future will need to be able to aid in

creation and protection of a trade system as vital as the oil distributions of the late 20th century.

Works Cited

- Benjamin, Andrews E. History of the United States Volume 5. Charles Scriber's Sons. New York, 1912.
- Blewett, D. T., et al. "Implanted He-3 Abundance Distribution on the Moon." Lunar and Planetary Sciences. 2008.
- Castle, Anne. "Water Rights Law- Prior Appropriation." Find Law. 1999. Holland and Hart, LLP. 2 Apr. 2008
<<http://library.findlaw.com/1999/Jan/1/241492.html>>.
- "Chapter VII: Actions with Respect to Threats to Peace, Breaches of Peace, and Acts of Aggression." Un.Org. United Nations. 10 May 2008. <<http://www.un.org/aboutun/charter/chapter7.htm>>.
- "Civil Law." Encyclopedia Britannica Online. Encyclopedia Britannica. 2 Apr. 2008
<<http://www.britannica.com/eb/article-28525/property-law>>.
- "Declaration of the United Nations Conference on the Human Environment." United Nations Environment Programme. June 1972. United Nations. 10 May 2008
<<http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=97&ArticleID=1503>>.
- Demetriades, Sterge T. "Preliminary Study of Propulsive Fluid Accumulator Systems." Journal of the British Interplanetary Society. 1961-62, Vol. 18
- "Dramatic Melting in Arctic Icecap." www.TheWE.cc. BBC News World Edition. 10 May 2008
<http://www.thewe.cc/weplanet/news/water/dramatic_melt_in_arctic_icecape.htm>.
- Elliott, Katie, et al. The New Space Race Initiative. 16 May 2007.
- Fisher, Howard, and Dale Pond. "Our American Common Law." Sympathetic Vibratory Physics. 2001. 7 May 2008
<<http://www.svpvriil.com/OACL.html>>.
- Howard, William Willard. "The Rush to Oklahoma." Harper's Weekly. 18 May 1889: 391-94.
- Inter Caetera. "The Papal Bulls as they Pertain to the Americas." 27 November 2007.
<<http://bullsburning.itgo.com/essays/Caetera.htm>>.
- Kadouri, Djebbar, and Nehdi. "Water Rights and Water Trade: an Islamic Perspective." The International

- Development Research Centre. IDRC. 7 May 2008. <http://www.idrc.ca/en/ev-93956-201-1-DO_TOPIC.html>.
- Klinkman, Paul, et al. "Harvesting LOX in LEO: Toward a Hunter-Gatherer Space Economy." American Institute of Aeronautics and Astronautics. 20 Sept, 2007.
- Klinkman, Paul. Personal Interview. 4 April 2008.
- Klinkman, Paul and John Wilkes. "LEO-LUNAR TRADE: Path to an Economically Sustainable Lunar Base." Advanced Technology Working Group of the National Space Society in Washington, D.C. 31 May 2008
- Pring, George W. "Mining, Environment and Development." United Nations Conference on Trade and Development. UNCTAD. 7-10. 10 May 2008
- <http://www.natural-resources.org/minerals/CD/int_law.htm>.
- "Prospecting For Helium 3 on the Moon." 2 December 1998. Science Daily. 20 April 2008.
- <<http://www.sciencedaily.com/releases/1998/12/981202080006.htm>>.
- "Rights, Riparian." Water Encyclopedia. 2007. 7 May 2008
- <<http://www.waterencyclopedia.com/Re-St/Rights-Riparian.html>>.
- Rusek, Ben. "The Outer Space Treaty At a Glance." Arms Control Association. Apr. 2008. Arms Control Association. 18 Apr. 2008 . <<http://www.armscontrol.org/factsheets/outerspace.asp>>.
- Spudis, Paul D. "Is there ice on the Moon?." 14 November 2006. National Space Society. 22 April 2008.
- <<http://www.nss.org/settlement/moon/ice.html>>.
- "United Nations Convention on the Law of the Sea." Un.Org. United Nation. 7 May 2008.
- <http://www.un.org/Depts/los/convention_agreements/texts/unclos/closindx.htm>.
- "United Nations Office for Outer Space Affairs." Unoosa.Org. United Nations. 2 Apr. 2008
- <<http://www.unoosa.org/oosa/index.html>>.
- Wasser, Alan, and Douglas Jobs. "Space Settlements, Property Rights, and International Law: Could a Lunar Settlement Claim the Real Estate It Needs to Survive?" Selected Works. 2007. The Space Settlement Institute. 2 Apr. 2008. <http://works.bepress.com/douglas_jobs/1/>.
- Wilkes, John. Personal Interview. Multiple. 23 October 2007 to 29 April 2008.