AN INSIGHT INTO THE COMPARISONS OF SPACE COLONIZATION OF HEAVENLY BODIES OF THE INNER SOLAR SYSTEM

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Abstract— Space Colonization has long been termed as a secondary permanent habitat for humans in other nearby planetary bodies to exploit the vast untapped resources in the solar system and beyond as our beautiful planet has been increasingly getting resource scarce. There is also another reason for colonization of other planets and moons, Long have scientists debated about a catastrophic event resulting in the destruction of the earth and the extermination of the human species. This event dubbed "The Armageddon" is the event in which a gigantic asteroid or comet about more than 400 kms in diameter collides with the earth and causes widespread devastation and annihilation of both earth and its living species. Space colonization has been stressed as a noteworthy attempt to ensure continuation of the human species in the event of the above mentioned catastrophe, even though the probability of an asteroid hitting the earth is estimated to be about 1 in 768000 chances. This paper will compare Space Colonization of Mars with the Space Colonization of Ceres and give an insight as to which is more feasible, economically viable and supports more human sustenance .Unique Proposals given by Space agencies to support human life in hostile environments was taken into account, due to the fact that using existing technologies is more economical than going for yet to be established techniques. Our Proposals have also been included in this paper with a brief explanation.

I. INTRODUCTION

Our Planet Earth is increasingly becoming polluted and scarce of resources mostly due to human intervention and increasing globalization. After a certain period of time, there will be a chronic shortage of resources and prominent life essentials such as water. Hence to combat this, we have to look at the outer space to mine resources and also to tap its vast land for a colony.

With the advent of the first satellite, Sputnik in the 1950's and the Human Landing on moon in 1967, Mankind has always been interested to set up bases in other planets and planetary bodies especially for research and also to search for extraterrestrial life, although the efforts have always been deterred by unavoidable issues such as hostile extraterrestrial environments and lack of essential gases such as oxygen and methane traces. To combat these issues, there have been several proposals for setting up bases in the Moon, Mars, Venus and a Few Asteroids. Apart from the usual choices, the moons of the Gas Giants, The Kuiper belt and The Oort Cloud have also been marked as potential colonization sites.

A major concern is that despite several proposals, few have actually got past the drawing board, as technological and finance issues still plaque many space enthusiasts . Hence the most sought out locations to be first Colonized are the Moon, Mars and a few Asteroids. To sum it up, Earth's Moon is very close by for mobility and is very easily accessible for colonization. However Moon's Surface is full of ridges and plains and has little to no rocky surface. Every now and then small Meteors and Meteoroids impact the surface thus riddling the entire moon's surface with lots of craters. Hence Bases cannot be set in such uneven surfaces. There is no Atmosphere in moon; the atmospheric pressure is also low. Hence Colonization of moon is still being debated.

After this the next ideal target will be mars with its thin layered atmosphere and similar surface conditions like of earth. Mars is also the most favorable planet for human life after earth when it comes to life sustenance. Its atmosphere is however comprised of 95% of carbon-dioxide, traces of nitrogen, noble gases and very few traces of oxygen which is not very ideal.

The colonization of Asteroids has also been looked at as NASA recently estimated that the asteroid belt is estimated to have natural resources worth 6000 trillion dollars in today's terms.

The largest of all the asteroids, Ceres is a major potential permanent settlement as it is full of precious metals and can fuel a future space trade route and become a solar system hub for space transport and mining. Presence of water ice has been discovered in Ceres which can be used there for permanent Settlement. Ceres however is prone to meteoroids impact and cosmic radiation which is a big issue and needs to be tackled.

Hence a comparative study of both planetary bodies will be a step in understanding the need for human colonization and can be a valuable contribution to studies undertaken specifically for this purpose.

II. EXISTING PROPOSALS FOR LIFE SUPPORT SYSTEMS

For any human missions to space, the most prominent question and speculation will be as to how will

astronauts be able to survive the hostile conditions of outer space . Long have the Soviets debated this issue and after repeated extensive study and research have come up with a interesting solution termed as CELSS.

Space colonization has to incorporate sophisticated and advanced technologies such as human support systems to sustain human life in hostile environments. The Soviets proposed a sustenance life support system for human colonization dubbed as "Controlled Ecological Life

Support System or CELSS. The CELSS has a life support system consisting of a human enabled environments comprising of living rooms. Synthesized Plants in lab conditions and photosynthesis produce oxygen which supports human life and in turn carbon dioxide which is expelled from human lungs is used to support plants and photosynthesis. This reversible process ensures the success of the life support systems. Further research into the CELSS proposal has resulted in variant and inspired theories like Biohome, Biosat, Biosphere, Human Life Support and Sustenance System etc. These theories have not yet been tested but have been proven to be capable of supporting human life in space and can be used in future space colonization expeditions.

III. THEROTICAL INSIGHT INTO THE SPACE COLONIZATION OF MARS AND PROPOSAL

Mars is a fairly large planet with a diameter of about 6780 km. Its surface is similar to earth will presence of plains, very tall mountains , ridges and also deserts . Its atmospheric pressure and density is comparable to earth due to a very lower mass. This also means that it has a weak magnetosphere. A solar day in Mars is about 24 hours, 40 minutes which is similar to earths 23 hrs, 59 minutes. Mars also features poles like earth and its orbit has a lower eccentricity similar to earth. Presence of extraterrestrial microorganisms which has been proved to live below the traces of water ice in mars has encouraged space enthusiasts about the probability of human survival despite hostilities.

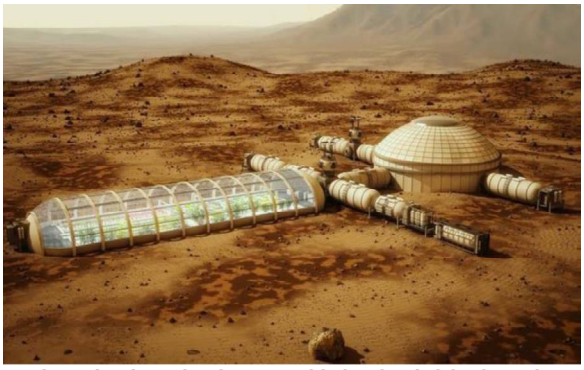


FIG 1 – AN ARTISTIC IMPRESSION OF A COLONY ON MARS (SOURCE – GOOGLE IMAGES)

IV. CONSTRUCTION AND WORKING

PROPOSAL - We propose a permanent settlement on mars to incorporate design of underground cities and utilities. This underground settlement is for the purpose of shielding human life from cosmic radiation. This is because unlike earth , the magnetic field of mars is comparatively weaker and its atmosphere , being relatively weak does not possess an ozone layer , thus filtering of ultraviolet radiations and cosmic rays is absent thus freely allowing the cosmic radiations to hit the ground . This underground settlement proposal is also strengthened by the fact that average surface temperature on mars is colder than the coldest regions of antartica i.e about 216 k, thus the underground settlement which will be set up in human favorable conditions will shield people from the bitter cold. Also impact craters caused by meteors and meteoroids are also a cause of concern, despite the probability of hitting them is low. The underground base will be completely set up of lots of living chambers and labs for human settlement. The bases can be sustained using CELSS system or biosphere system with presence of plantations all around the facility which will help in increasing oxygen content . Also traces of oxygen present in the atmosphere can be sucked into the facility which is then stored in tanks and then transported into tubes containing perforated holes which is so small that it can just let the oxygen molecule in and stop the larger nitrogen molecules which is then expelled out back into the atmosphere.

TERRAFORMING – An unique proposal by many prominent space agencies to actually change the entire environment and modify it to a near earth conditions like increasing the content of oxygen in the atmosphere from a mere 0.5% to 18 % by certain chemical processes on a huge scale. Although this proposal is impressive, it is neither economically viable nor feasible and deliberating changes can cause other geological risks unknown to mankind.

V. THEROTICAL INSIGHT INTO THE SPACE COLONIZATION OF CERES

The Largest Asteroid with a diameter of 950 km, Ceres is shaped like a dwarf planet and its rocky composition is quite similar to earth with an outer dusty and rocky terrain, large traces of water ice in its crust and a solid core. This makes it an ideal location for landing, setting up bases and even starts mining operations for precious natural resources which can trigger a space race between prominent nations of earth.

Our Proposal of concept of underground facilities and cities can be incorporated in Ceres also because of its high prevalence of impact craters. Ceres has no atmosphere and no magnetosphere and small meteoroids and cosmic rays directly hit its rocky

surface. Hence underground cities are more feasible for permanent human settlement.

VI. COMPARISONS BETWEEN SPACE COLONIZATION OF MARS AND CERES

Both Planetary bodies are excellent potential destinations for an extraterrestrial permanent base and both have their own advantages and disadvantages. Both cannot be preferred over the other because in the event of a future space trade being established, both can actually be excellent trading hubs in the transport of natural materials from interplanetary mining operations to earth and back.

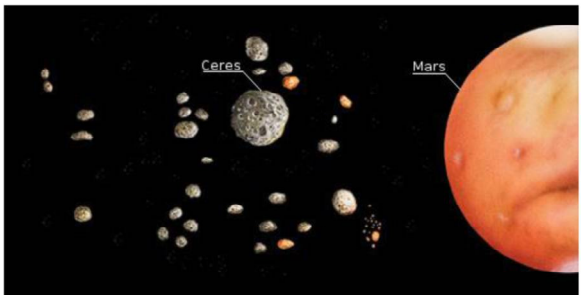


FIG 2 – A CLOSEBY COMPARISON OF MARS AND CERES

To sum it up Mars is an inner planet of a solar system. Its composition, magnetic field is all earth like. It unlike Ceres Actually has a thin atmosphere which can filter out some of the cosmic rays and it is also not in repeated danger of meteors impacting the surface unlike Ceres. Mars also has larger traces of water recently being discovered apart from the water ice found in its polar ice caps and can sustain a larger percentage of population as it has a much larger area. Although lacking in rich natural resources, mars actually can aid research about forming of life millions of years back. Also Martian years though are nearly twice that of earth years, A Martian day or Sol is about a little more than 24 hours making it easy for humans to adapt faster compared to Ceres. The similar axial tilts and poles also help in adaptation.

On the other hand, Ceres as a dwarf planet is equally important as it is located in a strategic position in the asteroid belt. Colonizing of Ceres can aid in colonization of moons of the gas giants. And unlike mars Ceres is so rich in natural resources that mining it can eliminate the shortage of resources on earth. Ceres is also important as a hub for future space trading activities between countries. The Energy required to travel to Ceres is very less, even lesser than the energy required to travel to the moon.

The notion of saving of energy can also accelerate efforts to plan a human colony in both mars and Ceres.

VII. COMPARISONS

COMPOSITION	MARS	CERES
Diameter	6780 km	950 km
Orbital Period	686 days (1.89 earth years)	1680 days (4.60 earth years)
Category	Planet (inner solar system)	Dwarf planet , Asteroid
Satellites	Two (Phobos , Deimos)	None
Eccentricity	0.093	0.075
Orbital Speed	24 km/sec	17 km/sec
Atmospheric presence	95 % Co2 with traces of O	None

CONCLUSION

Thus the above work is a minor contribution to the numerous extensive studies being undertaken in this field. Comparative study of potential sites can help in figuring out the best viable and economical and will be the first step in human colonization of extraterrestrial bodies.

Still, Human colonization cannot be undertaken now because it is not possible using existing limited technologies and solutions, neither is it economical nor is it viable . Present studies have shown that humans still have a long way to go before they can undertake long arduous interplanetary expeditions, the major drawback being hostile conditions increasing as we get further away from earth.

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