

LunarLAB:Concept for a Permanent Lunar Lava Tube Settlement. M.Thangavelu¹ and Julia Condon², ¹Conductor, ASTE527 Graduate Space Concepts Studio Department of Astronautical Engineering, Viterbi School of Engineering, University of Southern California, mthangav@usc.edu, ²Graduate Student, Department of Astronautical Engineering, USC

Abstract: As the new administration places more emphasis on human space exploration, it is clear that the United States is headed back to the Moon. Although quite some time has passed since humanity last touched our Moon's surface, space technology has greatly progressed across the world. Establishing a permanent presence in space is becoming increasingly important and sought after by nations across the globe, as discussed by the newly reformed National Space Council (NSC) as well as the American Space Renaissance Act (ASRA) - and what better way to do so than by establishing a permanent base on our Moon from which to spawn future galactic explorations.

A permanent Lunar Lava-Tube Astronomical Base is proposed. The base would have some surface structures, but would also have a broad subsurface component, built inside the Moon's natural structures. Lunar lava-tubes are drained conduits of underground lava-rivers; they are the perfect location for a permanent base on the moon because they can be tens, or even hundreds of meters wide with roofs ten or more meters thick. The base, and astronauts, would be protected from harsh galactic cosmic rays(GCR), extreme diurnal temperature changes, lunar dust, and micrometeorite showers. Construction would also be minimized since the tube structures are already available. The result would be fantastic – a base with both surface and subsurface structures, maximizing space and creating a beautiful aesthetic marvel.

By entering the tubes via recently discovered natural roof breaches called “skylights” and using small thrusters on spacesuits and rovers, humans can easily reach the interior of these tubes to clear out any talus piles from collapsed skylights, and erect structures. Solar powered lift systems, ladders, and extendable ramps could also be used. Certain regions also have collapsed lava tubes, providing easier access than descending directly from above. Welding, high pressure assembly, and other methods could be utilized to assemble an entry at one of the collapsed tubes. 3D printing could be used to create the majority of the structure so that construction and pre-made support material would be minimized, simplifying the process and transport of materials. The base would provide endless opportunities for commercial factories, tourism, and for scientific experiments and untold discoveries await. The training the crew would experience at This base of operations would even pave the way for future Mars (and more!) missions.

Developing a base within the lunar lava tubes would solidify the United States as a preeminent spacefaring nation. The timeline to create such a base could be as near term as 5-20 years, as the technology already exists and just needs to be implemented. Additionally, there are already prime locations that could be used, including Schrodinger's Crater (South Polar Settlement), Marius Hills (Equatorial Settlement), Aristarchus Crater (Equatorial Settlement). The architecture of the base working with the natural structure of the lava tubes would protect astronauts and provide a base of operations for future space exploration with minimal cost and effort. With teamwork and a clear project plan, the Lunar LAB can pave the way for a new era in space travel and discovery amongst the stars.

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