

27th IAA SYMPOSIUM ON HUMAN EXPLORATION OF THE SOLAR SYSTEM (A5)  
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RAPID CONSTRUCTION OF NEXT GENERATION FACILITIES ON THE MOON: A CASE STUDY  
OF THE LUNAR ARK, BIO-REPOSITORY FOR EARTH'S BIO-DIVERSITY

**Abstract**

The lunar lava tubes are theorized to be a network of nearly 100+ subsurface tunnel-like tubes formed from ancient lava flow on the Moon's surface. They can provide shelter that is impervious to cataclysmic changes that occur periodically on Earth's surface. The lunar lava tubes are expected to be a shelter from the extreme temperature variations of the Moon's surface, radiation, in addition to micro-meteorites. Earlier, our team envisioned utilizing one of the lunar lava tubes, which are nearly 80 m in cross-sectional diameter and nearly 100 m deep, as Earth's biorepository (Lunar Ark). The Ark would cryogenically store eggs, sperm, seeds, and spores from 6.7 million plants, animals, and fungi species. This paper analyzes how we can construct a subsurface Ark on the Moon using a modular-building block strategy. In developing this Lunar Ark, we envision having to build a facility that can readily expand further into the lunar lava tube as needs increase. We envision the Lunar Ark to consist of a series of cryogenically frozen cylindrical compartments (much like a train compartment) that are prepared on Earth and are finally assembled end to end on the bed of a lunar lava tube. The pre-fabricated cryo-compartments loaded with the bio-matter would arrive from Earth using a Starship-type lander. The Lunar Ark compartments will be constructed on Earth as they need to preserve the bio-matter all the way on the trip from Earth to the Moon. Further, given that the lava tubes are precious, we would take stringent measures to preserve and protect them by building a green-environmentally friendly structure that would not damage the walls and ceilings of the ancient lunar lava tubes. We first envision developing an inflatable membrane that would be expanded into the lava tubes, creating a protective shell. Next, a series of three parallel raised mono-rail systems will be built to transfer in and out heavy goods into the lava tubes. The monorails will be anchored using a regular series of support structures mounted to the base of the lava tube. Utilizing this system of construction will permit us to build and expand the Ark as needed while working to preserve the lunar lava tube features. Importantly, we look to the rapid construction and setup. Hence, the Lunar Ark becomes operational in a matter of weeks or even days with the delivery of cryogenically preserved content to the surface of the Moon.