

# **First Steps Towards the Lunar Ark Concept –Saving Life on Earth from a Future Catastrophe**

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In 2013, thanks to NASA LROC imagery, several hundred pits were discovered on the lunar surface. These lunar pits are hypothesized to be remnant lava tubes. Considering the Moon is geologically inactive, these lava tubes could be an excellent shelter as they are likely to have remained pristine for 3-4 billion years. Lunar lava tubes are excellent locations that are sheltered from radiation, temperature swings, and small meteorite impacts. In-contrast Earth is a dynamic planet, with molten core, active volcanoes and moving tectonic plates. Earth is undergoing significant changes resulting in loss of whole ecosystems, extinction of many thousands of species, and endangering a critical food chain that could threaten human survival. Our human presence further destabilizes the situation. Our civilization and our technology are very fragile to natural disturbances that can knock it down and cause a total collapse.

Earlier we proposed steps to develop a Lunar Ark that would protect 6.7 million species of plants, animals and fungi. However it is a long term endeavor that would 30 years to advance. One of the practical first-steps to safeguarding life on Earth using the Lunar Ark could be to safeguard plant species and crops that are critical to the food-chain. This was the premise in the development of the Svalbard Seed Vault in Norway. However Svalbard is vulnerable to accelerating climate change. Rising sea waters had partially inundated the facility in 2017. Furthermore we have identified at least seven other Earthly catastrophes that can disable the Svalbard seed vault. To truly avoid earthly catastrophes, a seed-vault facility needs to be constructed and operated off-Earth. Lunar lava-tubes are the ideal candidates, for the reasons described above. In addition, the lava tubes maintain a constant temperature of -25 C which is only slightly lower than Svalbard seed vault temperature of -18 C.

Our studies show that the Svalbard Seed Vault can be replicated inside lunar lava tubes and help secure more than 1 million samples of seeds of critical plants and crops. This facility could be developed with present day technology and rolled out with 5-8 years. The seed samples would take up 100 tons of mass and is estimated to require 17 launches of the Falcon Heavy, including structures to transport seed containers into the lava tube, with a moon lander carrying nearly 7 tons of seeds each. We envision the seeds would be packaged into large containers comparable in dimension to large CubeSats or small-satellites. These seed containers would contain a built-in centrifuge that would simulate Earth gravity for the seeds inside. The modules would be transported down a lunar lava tube and stored. The modules would be pressurized and would obtain power using laser-power beaming from the surface. Laser power beams would supply power to multiple seed storage containers networked in the lunar lava tubes. In addition, the lasers will also provide communications and status report on the integrity of the seed containers. We further analyze the logistics of seed collection, transport to the Moon and placement of the seed containers inside a suitable lunar lava tube.