

Scientific Exploration and Human Utilization of Subsurface Extraterrestrial Environments: A Feasibility Assessment of Strategies, Technologies and Test Beds

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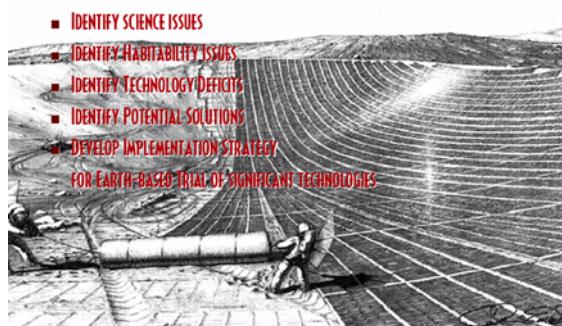
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During the next half century, humans will explore other bodies in our solar system. A major target of exobiology, geology, hydrology, and the search for volatiles will be subsurfaces of those bodies. Caves and cavities provide especially convenient access to the subsurface.

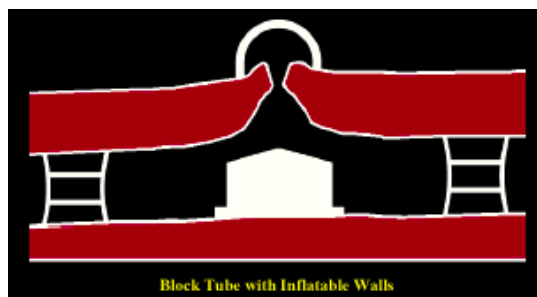
Human life support technologies and strategies may also employ caves, cavities, and lava tubes to help provide the necessities of life. Natural or constructed cavities could provide a rigid structure within which human habitations, research facilities, industrial and agricultural areas could be placed. Cavities could provide protection from ultraviolet and ionizing radiation, allow access to subsurface resources, e.g. water, minerals, and gases, and serve as pressurized structures.

Planetary subsurfaces have appeared in scientific literature and fiction, but we currently possess neither the technologies, knowledge, nor incentive to study or use them. On Earth, we use very crude methods for accessing and studying these environments. Personnel are out of communication and untrackable. Rescue is extremely hazardous. Power is a huge problem. Chemical and microbial contamination, via humans, threatens indigenous life-forms. An ethic of exploration-first irreparably damages scientific value of sites before they are studied. All these terrestrial problems will have counterparts in extraterrestrial subsurface missions. Worse, the environs are more hostile than Earth and staffed by humans in awkward pressurized suits.

As a simulation of extraterrestrial subsurface missions, we propose to develop and implement a "dress rehearsal" scenario to be tested in unexplored, scientifically valuable Earth caves. Phase I is a feasibility study of necessary technologies and current deficits. We will assess engineering and protocol solutions to problems in communication, navigation, rapid surveying, deep drilling into and within caves, use as pressure vessels for habitation, human mobility, and Planetary Protection issues. A future Phase II project would entail implementation of identified technologies in simulation of a unique mission scenario.



- Human and robotic mobility
- Communication/Navigation
- Shirtsleeve indoor environment
- Power and light
- Habitat construction
 - inflatable liners
 - air locks



PRISTINE EARTH CAVES AS MODEL SYSTEMS

- IDEAL TECHNOLOGY TEST-BED
- IDEAL DEVELOPMENT SITES FOR PLANETARY PROTECTION PROTOCOLS
- PERFECT "DRESS REHEARSAL" FOR ASTRONAUT TRAINING