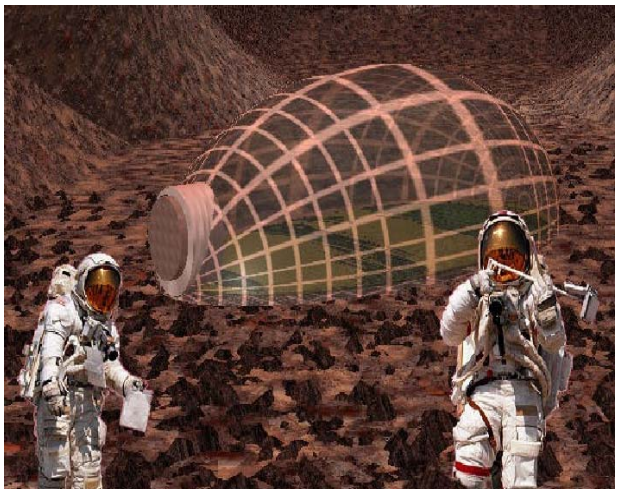
PENELOPE BOSTON, Complex Systems Research, Inc.

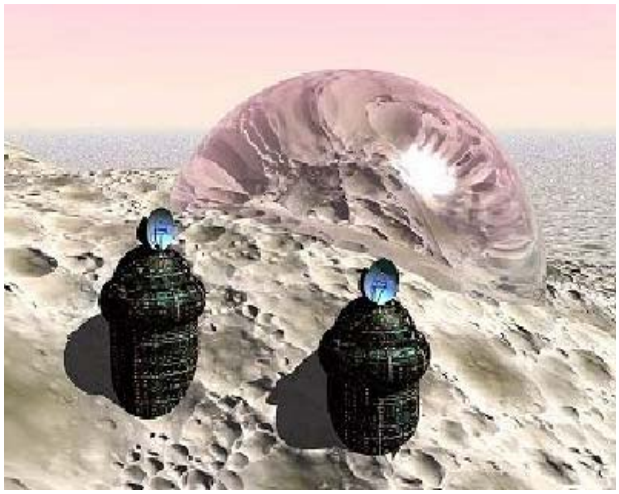
System Feasibility Demonstrations of Caves and Subsurface Constructs for Mars Habitation and Scientific Exploration

Natural subsurface cavities and subsurface constructs present the most mission effective habitat alternative for future human missions in the high-radiation environment of Mars. Additionally, lava tubes, other caves, cavities and canyon overhangs are sites of intense scientific interest. They offer easier subsurface access for direct exploration and drilling and may provide extractable minerals, gases and ices. Expanding our NIAC Phase I feasibility assessment of a subsurface Mars mission architecture for the scientific exploration and human habitation of caves and subsurface facilities, we propose a two-part viability demonstration of selected technologies combined into a functioning system. This system can be integrated into both robotic precursors and human missions.



Transparent bubble over the cave habitat below provides light. The ISRU units are busily supplying necessary volatiles to the habitat. Such direct input of photons into a habitat or plant growth facility will depend upon the successful development of radiation-shielding transparent materials.

Part I (months 1-11) involves construction of an in-cave test habitat with associated life-support and auxiliary systems for use with rodents and plants. This will culminate in an extended duration “Mouse Mission to Inner Space” in an Earth lava tube representative of those visible in recent MOC images of Mars. This will provide proof-of-concept for organism responses to system components and synergistic behavior. Additionally, it will lay the foundation for viability testing of non-human Earth organisms in situ on Mars – an indispensable precursor to human missions not currently recognized nor planned for within NASA.



Photos courtesy of R.D. Frederick

Part II (months 12-23) expands on design, engineering, and scientific lessons learned during Part I to construct a human-scale inflatable in-cave habitat with associated life-support and auxiliary systems. This will culminate in an extended duration “Speleonaut Mission to Inner Space” with a human crew (2) living and performing scientific work in a pristine biologically-sensitive Earth cave representative of possible Martian subsurface life detection sites. This proposal describes a revolutionary system comprising a merger of unique technologies that will enable future NASA missions by solving human survival and exploration problems in the hostile Martian environment.