

HUMAN SPACEFLIGHT SYMPOSIUM (B3)
Poster Session (P)

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MARS GREENHOUSE MODULE TEST-BED FOR ANALOGUE RESEARCH AND POST-DISASTER
MANAGEMENT

Abstract

Human life in extreme environments, including space, is highly dependent on technology, namely Environmental Control and Life-Support Systems (ECLSS), whose main functions include atmosphere revitalization, water recycling, and food production. They can be achieved with a fully regenerative closed loop or with a partially open loop dependent on resupply and /or local resources (In-Situ Resources Utilization). Technologies for ECLSS can be physico-chemically or biologically based but realistically, a combination of both is needed, not only for higher redundancy, but also because these technologies are complementary. Food production can only be achieved with the inclusion of a greenhouse module in the regenerative ECLSS and physico-chemical LSS are needed to achieve a higher control and reliability of the overall system which will be capable of supporting human life in extreme environment areas, not naturally suitable for living either on Earth or in space. This paper presents the concept of an analog self-deployable greenhouse module test-bed (GMT) with integrated elemental functions (such as water distribution and thermal control) addressing the complexity and requirements of such a foldable structure for partially automated air revitalization or food production. Such a system will be required for long-duration missions and first settlements on the Moon and Mars and could also provide beneficial food production in remote and extreme environment areas on Earth or in areas damaged by natural disasters or wars. A similar concept could also be used for underwater habitat. Issues to be addressed include the integration of the life-supporting systems into an easy to deploy, portable module with the necessary strength, stiffness and stability. The GMT will be designed such that fabrication can be demonstrated and deployment tests can be executed at one of the permanent analogue sites, such as the Mars Desert Research Station or the Flashline Mars Arctic Research Station for longer operation trials.