SPACE EXPLORATION SYMPOSIUM (A3)
Mars Exploration – Part 2 (3B)

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THE MICHIGAN MARS ENVIRONMENTAL CHAMBER: DETERMINING THE ENVIRONMENTAL CONDITIONS AT WHICH LIQUID BRINES FORM ON MARS

Abstract

The Michigan Mars Environmental Chamber (MMEC) will test the hypothesis that salts present in the Martian soil at concentrations of about 1 wt% can deliquesce and form microscopic brine pockets that can be concentrated into larger pockets or layers by freeze-thaw cycles. This is relevant to exobiology because these brine pockets have the potential to be habitable. The MMEC principally consists of a thermal vacuum system with a chilled mirror hygrometer and a microwave soil moisture sensor.

Thermodynamical evidence for the existence of liquid saline water in areas disturbed by the Phoenix Lander was first shown by Renno et al. 2009. Independent experimental evidence was subsequently given by Zorzano et al. 2009, showing that sodium perchlorate (found in significant quantities by the Phoenix Lander) grows by deliquescence while absorbing water vapor at Phoenix environmental conditions.

The MMEC has been designed to simulate the environmental conditions at the Mars Phoenix landing site during diurnal and seasonal temperature cycles. The system consists of a vacuum chamber with six internal thermal plates. The plates are arranged to form a cubic thermal cavity, that can be cryogenically cooled by liquid nitrogen. Additional thermal control is attained through the use of resistive patch heaters, which are fixed on the thermal plates. The vacuum chamber inlet is connected to a carbon dioxide dry gas stream, which can be throttled to control the chamber's humidity. The vacuum chamber outlet passes through a chilled mirror hygrometer to measure the chamber humidity before the air exits the vacuum pump.