Stability of water on Mars.

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Abstract

In order to try to quantify some of the factors determining the evaporation rate of water on Mars, we have been measuring evaporation rates under simulated martian conditions in a large planetary environmental chamber. All of our experiments have been performed at 5.25 Torr (7 mb) total pressure, but we have varied the temperature of the water surface, atmosphere and walls of the chamber (the walls we assume to be somewhat analogous to surrounding surfaces on Mars). We have also monitored the partial pressure of water vapor in the atmosphere to investigate its effect on evaporation rate. Most importantly, we have attempted to model the effect of advection - physical removal of the water vapor by wind or other forms of atmospheric motion - by (1) placing a bag of dry ice in the chamber and (2) by installing a copper cold finger with circulating methanol/dry ice slurry next to the sample and pumping as necessary to maintain 5.25 Torr. As might be expected, the situation is complicated and not readily described theoretically, but several conclusions seem to be emerging. Evaporation rates under nonadvective conditions are 1.2 mm/h and decrease only by about 30% as water vapor builds up in the atmosphere to as much as 40 vol %. Wall temperature and water surface temperature do not appear to affect evaporation rates significantly, but a 20 C increase in atmospheric temperature causes a 40% increase in evaporation rate. The evaporation rate increases by a factor of two in the presence of advection and under advective conditions is not affected significantly by changes in water, air, or wall temperature, or water vapor pressure. These results suggest that atmospheric motion may be the dominant factor in determining water evaporation on Mars.