MARS: DETECTION OF REGOLITH H_2O SOURCES FROM SPACE; Zent, A. P., F. P. Fanale and S. E. Postawko, Planetary Geosciences Division, Hawaii Institute of Geophysics, University of Hawaii, Honolulu, Hi. 96822

The distribution of volatiles in the Martian atmosphere and on the Martian surface may be mapped via a variety of techniques. Unfortunately, detecting and mapping volatiles in the Martian subsurface, the most significant volatile reservoir on the planet, must proceed largely by indirect methods. H_2O in the Martian regolith is unstable with respect to the polar cold traps at all latitudes $\leq\pm40°$. Thus, if any H_2O deposits do exist at low latitudes, they are constantly losing H_2O molecules to the atmosphere at a rate that depends upon a large number of properties. The loss of H_2O molecules from a regolith source to the atmosphere, which supports only a very low ambient H_2O abundance (controlled by polar temperatures), may produce a detectable and characteristic signature in spatially resolved H_2O column abundance measurements.

To test the possibility of using column abundance measurements to detect local H_2O deposits, we have constructed a simple model of diffusive escape from buried ice into an atmosphere with a simple wind field. Seven parameters currently describe the system. We calculate their relative importance in establishing the contrast between the escaping H_2O and the ambient atmospheric H_2O abundance as an aid to future search strategies. A numerical time marching model calculates the H_2O flux out of the surface at twenty-five evenly spaced instances throughout the year (1). The contrast calculation selects the *maximum* annual flux. The local thermal regime is not specifically examined. However, the steepness of the vapor pressure curve is sufficient to prevent detection of H_2O deposits at the coldest times of the year. The vapor pressure curve is also such that the case for buried brine detection is implicitly tested. The maximum annual flux is assumed to escape into an atmosphere of ambient column abundance A_c, a constant wind speed V, and to emerge uniformly across a source of dimension S_s in the direction of the wind flow (Fig. 1). No precipitation is allowed, and divergence is set to zero. Thus, the model should predict the maximum augmentation of the ambient column abundance. At the downwind perimeter of the source, the augmented column abundance is compared to the ambient column abundance and the contrast (in %) is calculated. Implicit is the assumption that the atmospheric H_2O mapper has arbitrarily good resolution.

In order to characterize the detectability of plausible regolith H_2O systems, and to test the relative significance of the variables in Table I on a statistical basis, we performed approximately 120 contrast calculations. For each calculation, the seven input parameters were chosen by random number from the full ranges indicated in Table I. A running calculation of the correlation between each variable and the logarithm of the contrast of the H_2O in the atmosphere was maintained. We terminated the series of calculations when all correlation coefficients stablized. Correlation coefficients are given in Table II, and are of course dependent on the full ranges specified in Table I. We believe that the ranges we have selected represent a reasonable approximation of the limits of plausibility for potentially detectable deposits. The correlation coefficients should be regarded as no more than a measure of the relative importance of each variable in establishing the contrast of the H_2O "plume". Our tentative conclusions may be summarized as follows.

1). Typical contrast between the H_2O plume and the ambient H_2O is on the order of 10^{-2} to 10^{-3} %. (i.e. invisible). The prospects for detection of low latitude H_2O deposits via atmospheric H_2O mapping are very poor.

2). A few very special configurations *are* detectable (at the 20% contrast level). However, several properties must be simultaneously optimized to permit detection. Future searches, if any, should focus on times and places of low wind velocity and ambient column abundance. Porous overburden is important, but radiometric porosity estimates assume the absence of significant volatile reservoirs in the diurnal skin depth.

3). Of the variables we tested, the most critical properties seem to be the porosity of the overburden and the ambient column abundance. In Figure 2 the 20% contrast line is plotted as a function of these two variables. Note that the ice is very shallow.

4). The lack of detection of low latitude regolith H_2O sources can only be used to argue against the existence of a limited set of configurations.

REFERENCES
1. Zent, A. P., and Fanale, F. P., (1986). J. Geophys. Res., Vol. 91, D439 - D445.

TABLE I

Variable Full Ranges	
Variable	Full Range
Latitude	$-40° \le L \le +40°$
Pore Size	$0\ \mu m \le P_s \le 100\ \mu m$
Porosity	$0\% \le f \le 100\%$
Depth	$0m \le Z \le 10m$
Column Abundace	0 pr $\mu m \le A_c \le 50$ pr μm
Wind Velocity	$0\ m/s \le V \le 50\ m/s$
Source Size	$0\ km \le S_s \le 50\ km$

TABLE II

Correlation Coefficients	
Variable	Correlation Coefficient
Latitude	-0.0996
Pore Size	0.1482
Porosity	0.4584
Depth	-0.2628
Column Abundace	-0.3460
Wind Velocity	-0.2913
Source Size	0.2405

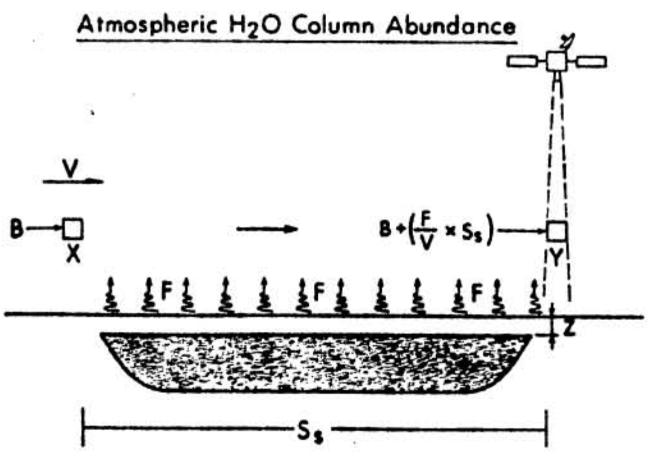

Fig. 1 - Cartoon of H_2O contrast calculation. B is the ambient column abundance; V is wind velocity; F is the escape flux; Z is the depth of the ice; S_s is the source size. The total contrast is calculated at Y.