

**WATER-BEARING MINERALS IN THE MARTIAN SOIL
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The infrared and near-infrared spectra, results of Viking heating GCMS experiments and the interpretations of martian soil chemical composition show that a few percent of bound water may be incorporated in the soil, probably in hydrated salts. The purpose of this work is to examine the thermodynamic stability of probable water-bearing minerals as a function of latitude, season, and depth by comparing the fields of hydrate stability with the martian atmospheric water - surface temperature conditions plotted on a P_{H_2O} -T diagram.

The present work is based on the results of Viking MAWD experiment (1). The estimated values of maximum and mean surface temperatures as function of latitude and L_S by (2) also have been taken into account. The mean annual values for surface temperatures and atmospheric water vapor were also used. The stability of mineral hydrates at four distinct depths of the martian soil have been studied. The stability of hydrates in the surface level (level 1) is assumed to be dependent on diurnal surface temperature variations from mean to maximum values and seasonal changes of atmospheric water content. Hydrates which are stable near the maximum surface temperatures may, supposedly, exist in the soil, because the rate of dehydration-hydration reactions increases with the increase of temperature. At lower temperatures (in winter or at night) dessicated minerals may exist as metastable phases. Mean diurnal temperatures and seasonal water vapor variations were used to consider the hydrate stability on level 2 (about 20-30 cm from the surface). For level 3, where seasonal temperature variations decline (3-12 m from the surface), we used the mean annual values for surface temperature and atmospheric water vapor content. At the roof of ice-bearing rock (level 4, 0-400 m from the surface) the P_{H_2O} -T conditions are determined by water vapor-ice equilibrium.

The stability of Mg, Ca, Fe sulphates, Mg, Ca, Fe chlorides, Mg, Ca, Na, K carbonates, Mg, Ca nitrates, goethite, hemathite and water ice have been analyzed as a function of latitude, season, and depth (i.e., Figs. 1 and 2). The results predict seasonal changes of hydrate stability predominately on high and middle latitudes in both hemispheres. The asymmetric zonality of mineral hydrate distribution in the martian soil (predicted early (3)) is plausible. During the winter in high and middle latitudes of each hemisphere high hydrates may be stable, while during the summer in these regions more dessicated minerals may be stable. Conditions in southern tropics and subtropics are favorable for the existence of highly dessicated minerals. The total bound water content in the soil may increase from the southern tropics toward the polar regions. With depth increasing, maximum soil temperatures decrease down to level 3, which provides the stability of more hydrated minerals. The depth zonality is most vivid in the equatorial region where the roof of ice-bearing rocks may be found at a depth of 300-400 m from the surface. In the polar regions the depth zonality of hydrates is improbable. Proceedings from the predicted depth zonality may suggest that in the areas of current erosion more hydrated salts should be exposed on the surface. In this case erosional areas can be found using the IR-mapping.

Absence of any latitudinal zonality by interpretation of telescopic near-infrared spectra may be due to intensive aeolian transportation of dust. The periodic crystallization of salts on the surface of rock fragments may result in salt weathering and duricrust formation. The bound water in hydrates may be a fairly substantial reservoir of planetary water.

References

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- (2) Kieffer H.H. et al (1977), *J. Geophys. Res.* 4249.
- (3) Suleimenov O.M. et al Abs LPSC 17, 845-846.

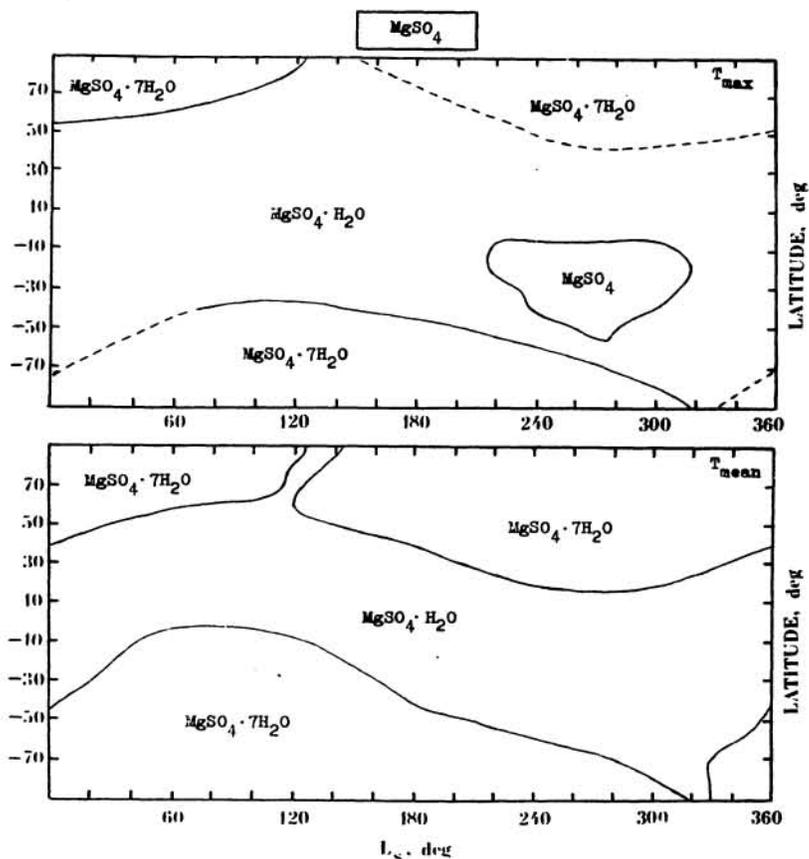


Fig. 1. Fields of magnesium sulfate stability as function of latitude and season for maximal and mean surface temperatures.

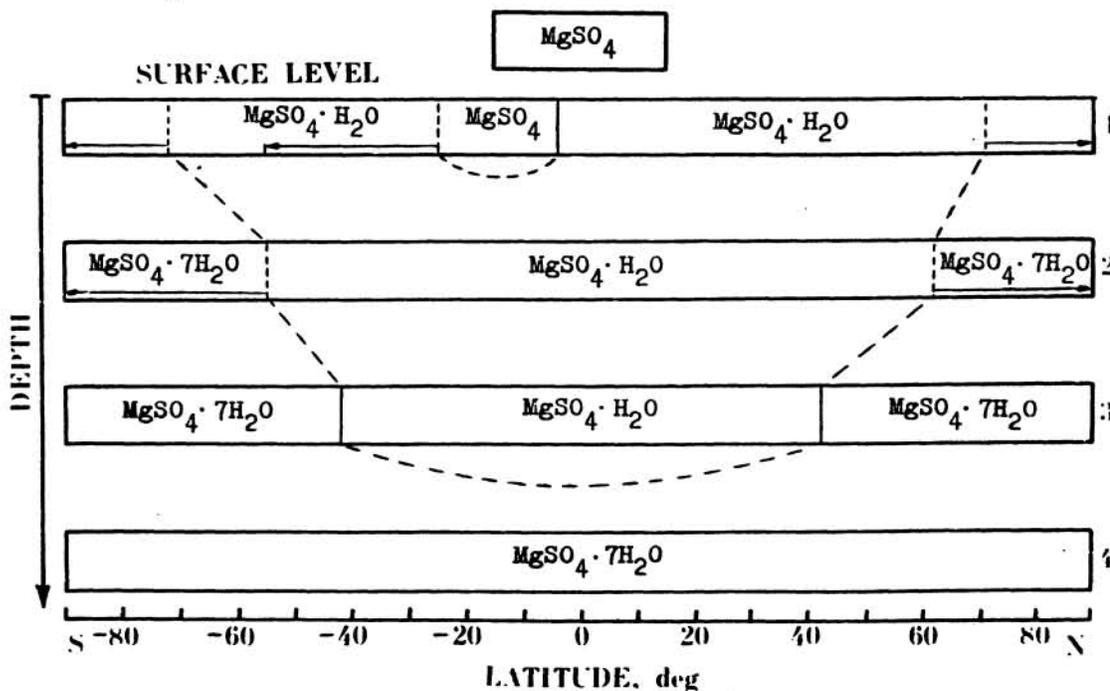


Fig. 2. Fields of magnesium sulfate stability as function of latitude and depth.