**MODEL FOR FORMATION OF SPIDER PATTERNS IN THE CRYPTIC REGION.** G. Portyankina and W.J. Markiewicz, Max Planck Institut für Aeronomie, Max-Planck-str., 2, Katlenburg-Lindau, 37191, Germany

**Introduction:** The cryptic region is one of the most dominant albedo features in data from Thermal Emission Spectrometer (TES) onboard of the Mars Global Surveyor (MGS). It is situated between latitudes 73°S and 81°S and longitudes 175°W and 225°W. Its main characteristic is that it remains cold well after it attains an albedo similar to the Martian soil. This low albedo is in contradiction with the low temperature that is close to that of $CO_2$ ice. One possibility to resolve this paradox is to assume that a large fraction of the solar flux passes through a surface layer of $CO_2$ ice and is absorbed by the dust underneath it. This is possible if the ice is slab $CO_2$ ice. Within this cryptic region Mars Orbiter Camera also onboard of MGS has taken images of radially converging dendritic patterns example of which is shown in Figure 1.

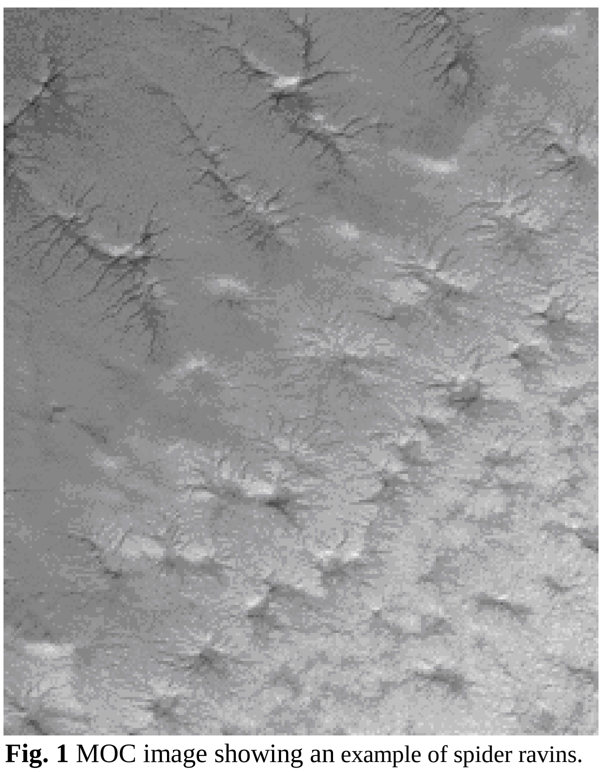

**Fig. 1** MOC image showing an example of spider ravins.

These spiders are unique patterns of South Polar Regions. They have never been seen before neither in other regions on Mars nor on other Solar System bodies. A descriptive model for formation of such a patterns was proposed by [1]. The winter condensation of $CO_2$ includes atmospheric dust in roughly its average atmospheric mass fraction. The $CO_2$ slab ice is virtually transparent to solar radiation with 72% of solar energy reaching the bottom of a 1 metre thick layer [2]. Dust will modify the depth of penetration of sun light but can not influence the basic aspects of the model as long as the solar penetration is greater than the thermal flux attenuation length [1]. Dust grains embedded in the $CO_2$ slab will absorb solar radiation on a time scale of less than one second [3] and form individual gas pockets around themselves. The grains will rest in a gas layer, continue to sublime the ice underneath it, and "sink" downwards. Net result should be clean $CO_2$ ice with dust accumulating at the bottom. The transparent layer of the slab $CO_2$ ice will have low temperature and the underlying dust low albedo - the situation observed in the cryptic region. With increasing solar radiation flux during spring, the temperature of dust in and under the ice will increase raising the sublimation rate of $CO_2$ ice. The gas formed during sublimation at the bottom of the slab layer cannot diffuse through the $CO_2$ deposit and localized escape pathways should develop. Those of them large enough to carry adequate warm gas from the sub-layer to remain open will grow into vertical columnar vents. Mixture of fine dust grains and $CO_2$ gas can be ejected through them and redistributed according to wind direction to form patterns of spiders. In this model these patterns represent channels formed by sub-slab channelized flow of the sublimation gas towards the vents.

**Model of cleaning $CO_2$ ice:** The modeling of spiders' formation should include mechanism of cleaning dusty $CO_2$ ice to produce an ice slab transparent for most of the solar radiation that can reach the surface of Mars through its atmosphere. As a first step we calculated the timescale for this cleansing process. We consiered two types of shapes for dust grains: spheres and cylinders with the ratio height/radius = 1/10. Dust grains receive Solar radiation amount of which depends on time of day, season and and latitude of the place inside cryptic region. All radiation received by the dust grain is assumed to go into sublimation of the ice underneath it; the grain sinks to the bottom of sublimed volume – and in such a way moves downward inside the ice. Time needed for cleaning of 1-meter thick $CO_2$ slab ice by such a process was calculated for different particle shapes and orientations. Plots in Figure 2 show distance from the top of slab to the dust grain center (grain radius is 2.5 µm) versus time (starting with the southern spring at $L_s = 150^o$) for spherical grains and differently oriented cylinders. Curves are: cylindrical dust particle tilted by $10^o$ from vertical (1), $30^o$ (2), $60^o$ (3), $90^o$ (5), and spherical dust particle (4).

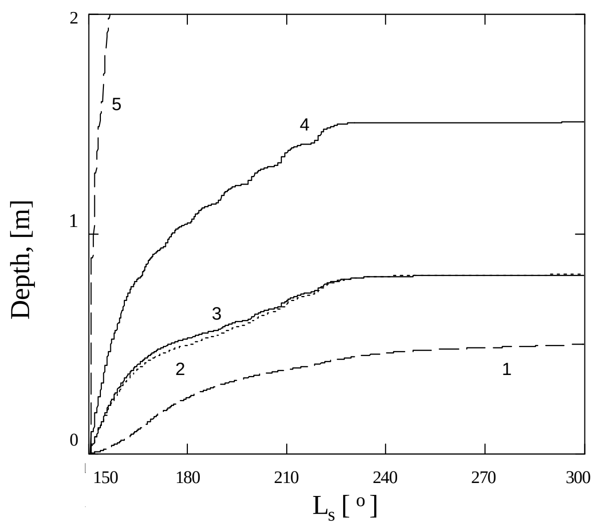


**Figure 2** Depth to wich particles sink as a function of time

As the $CO_2$ ice evaporates, the boundary atmosphere-ice will move downward as well as dust particles. The comparison of the rates of two processes is shown at Figure 3. The dashed lines show the depth of boundary atmosphere-ice, curves are shown for several values of albedo, line 1 – depth of cylindrical dust particle tilted by $10^o$ from vertical and line 2 – depth of spherical dust particle.

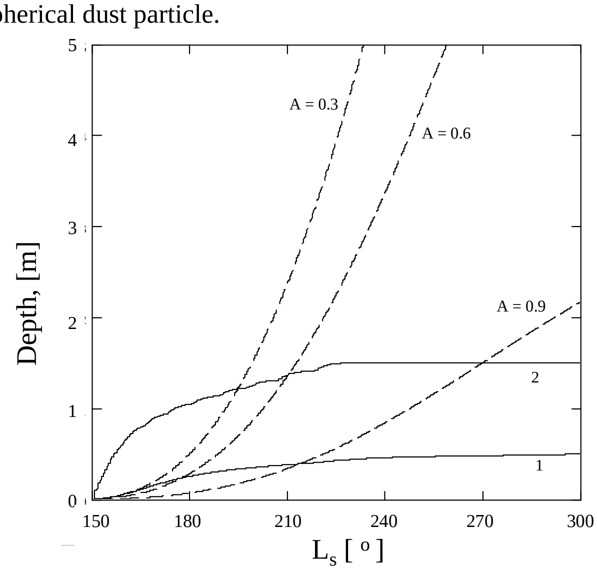


**Figure 3** The comparison of particles sinking rate and the rate of ice sublimation.

Our initial estimates of the time scales critical for the cleaning process show that this aspect of the model is feasible.

**Future work:** We plan to create a physical model for the formation of spiders including elements such as: absorption of solar flux by dust imbedded in the $CO_2$ ice, sinking of the dust particles, and build up of pressure at the bottom of the $CO_2$ slab.

**References:**

[1] Kieffer, H.H. (2000) International Conference on Mars Polar Science and Exploration, p. 93. [2] Hansen, Gary B. (1997) *JGR*, *102*, 21569-21587. [3] Kieffer, H.H. ; et al. (2000) *JGR*, *105*, 9653-9699.