

HYPOTHETICAL TIME SEQUENCE OF THE MORPHOLOGICAL CHANGES IN GLOBAL AND LOCAL LEVELS OF THE DARK DUNE SPOTS IN POLAR REGION OF MARS.

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Introduction: Our interpretation on the formation process of dark dune spots (**DDS**) has been developed according to the newest data of the *Mars Global Surveyor* (*MGS*), and *Mars Express* (*MEX*). The spot formations occur mainly in craters of the Southern Polar region [1] between -60° to -82° latitudes [2]. We formed a model where not only the materials of the *dark dunes* (**DD**), the CO_2 and H_2O frost components, covering the DD by white snow/ice during the Martian winter, but various states of Martian Surface Organisms (**MSO**) components (CBC like formation [3]) and a special component were involved [4]. This latter is a film of adsorbed water [5] on the surface of soil grains.

Materials: On dark dunes characteristic, growing splotches, called *dark dune spots* appear at the end of the winter or in early spring [1]. Recently, Christensen et al. [6] interpreted the appearance and temporal development of some kinds of spots by CO_2 defrosting and outburst, but these are not dark dune spots. We worked out an interpretation exclusively for the DDSs [2]. In a detailed sequence of interactions of soil components we show that development and characteristic features of these spots involve many kinds of material (Fig. 1).

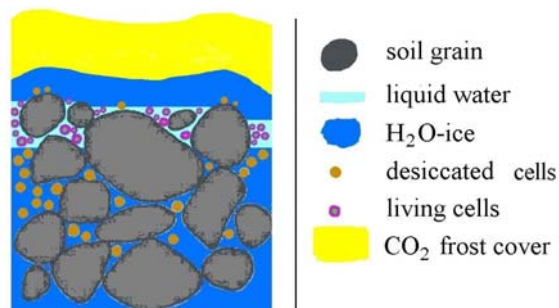


Fig. 1 The materials of the dark dune (**DD**) fields are fine-grained, dark blue, low-albedo, sand-sized, eolian sediments, mainly of dense basaltic fragments.

On Fig. 2. and Fig. 3. we show that DDSs appear when the spotting process advances and holes are produced in the frost layer. Our time sequence of DDS transformations was interpreted as a phenomenon resulting from interaction of soil material participants, of frosted cover of CO_2 , soil grains, water ice, water adsorbed layer, and possible formations of Martian Surface Organisms.

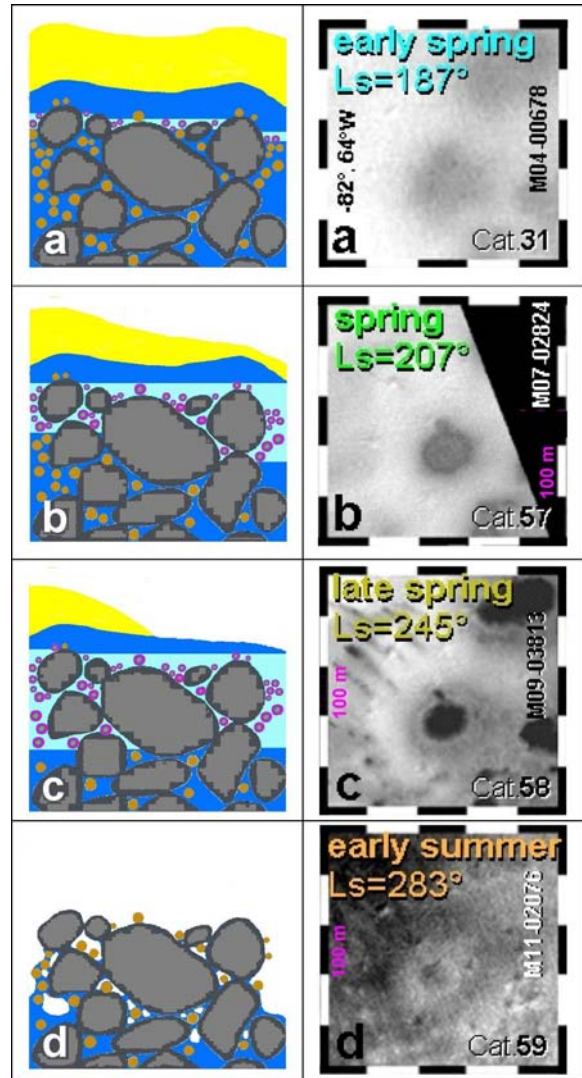


Fig. 2. and **Fig. 3.** The pair of the columnar figures shows the counterparts of the local (material textures) and global (MGS MOC images) arranged in transformation sequence of the DDS phenomenon phases. **Fig. 3.** column contains different seasonal phases of a DDS from the same locality at the "Inca City" region. The detailed explanations about the interactions of the soil particles and the corresponding surface changes on DDS are shown on the next page in a columnar figure caption.

<p>Fig. 2a. shows that the soil grains of the dark dune are covered with H₂O and CO₂ frost (dark blue and lemon light yellow). The adsorbed water is wetting the surface of the grains below the frost cover, however, a thin layer of melted water appears. In the deeper layers the H₂O ice (dark blue) is not melted. Some MSO-s are living (violet-green), however, most of them are in dry form (dark yellow).</p>	<p>Fig. 3a. Growing individual DDSs: the main steps.</p> <p>Solar phase: early spring at the Southern Polar region. ($L_s=187^\circ$). The following stages were observed at the same locality of the "Inca City" region. At this first stage fuzzy gray coloring on the white frosted field appears. Later dark dune spots begin to develop. They start to form from the bottom of the ice cover.</p>
<p>Fig. 2b. shows that the frost has partly evaporated. Large amounts of grain are covered with adsorbed water which originates from melting of the H₂O ice between the soil grains.</p>	<p>Fig. 3b.</p> <p>Solar phase: middle spring ($L_s=207^\circ$). The dark dune central structure begins to appear, with inner "umbra" and outer "penumbra".</p>
<p>Fig. 2c. shows that the frost has partly evaporated and the yet existing H₂O ice layer [7] covers the soil grains and shields the bottom layers. Most of the MSO-s is living between the grains, where larger amount of liquid water exists. Dark blue color shows permanently frozen H₂O ice.</p>	<p>Fig. 3c. Solar phase: late spring ($L_s=245^\circ$). At this stage we can observe the gradual darkening of the inner "umbra" and the increasing size of the outer "penumbra". Ellipsoidal DDSs extend in slope direction. Occasionally flow elements appear (tail) in the direction of the slope.</p>
<p>Fig. 2d. shows the almost final desiccated state. Adsorbed water layers exist only in the deeper holes and cavities. Dry and frozen dark soil grains are exposed as dark surface of the dune. Dark blue shows permanently frozen H₂O ice at the bottom of the section.</p>	<p>Fig. 3d. Solar phase: early summer ($L_s=283^\circ$). With the disappearance of the frost on surface of dark dunes a lighter spot remnant appears; it seems to preserve the "imprint" of place of the spot, where the DDS originally appeared (it was called "phantom" or "ghost" DDS).</p>

Conclusions: In our earlier paper we showed that the formation of DDS begins from the bottom of the frost layer, at the frost/soil boundary [2]. Parallel description of our interpretation of DDS-formation used several agents. These agents act together in a revival-desiccation cycle of the MSOs, alternately changing according to the seasonal periods. Upper soil layers get water vapor from the wintertime condensation of the atmospheric H₂O.

During defrosting this precipitated water ice component is producing partly fluid water, partly adsorbed water on the surface of soil grains, in the uppermost layer of the dune subsurface. This amount of water is the source of the life activity of the putative MSOs in our model. This amount of water may contribute to the production of other observed traces of liquid water associated with the DDSs [8].

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