

ANNUAL REAPPEARANCE OF BIOGENIC DARK DUNE SPOTS ON SOUTHERN POLAR REGION OF MARS. A. Horváth (1,2), T. Gánti (3), Sz. Bérczi (4), A. Gesztesi (1), E. Szathmáry (3,5)

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ABSTRACT

As we observed in the investigation [1, 2, 3] of the Dark Dune Spots (DDSs) their formation pattern exhibits a seasonal/annual morphological dynamics (Fig. 1). Comparison of the late winter and spring images of 1999 and 2001 years revealed the annual reappearances of the DDSs on the same positions and places (in similar „constellations”) [2]. We show examples of this reappearance in intracrater regions (Fig. 2). However, on some places, the returning of DDSs happens with various dynamics [4]. The fact that DDSs partly reappear in the same configuration (and position) and partly do it in a changed dynamics proves that a biological process determines the reappearance of the DDSs. This observation also supports our DDS-MSO hypothesis which suggests that the DDS appearance process is a biogenic one instead of an exclusively geological/physical defrosting one.

CONDITIONS OF THE ANNUAL DDS-PROCESS

Physical parameters of energetics

Two groups of physical parameters and the conditions they formed were considered during the annual transformational sequence of the DDS-MSO system in our studies.

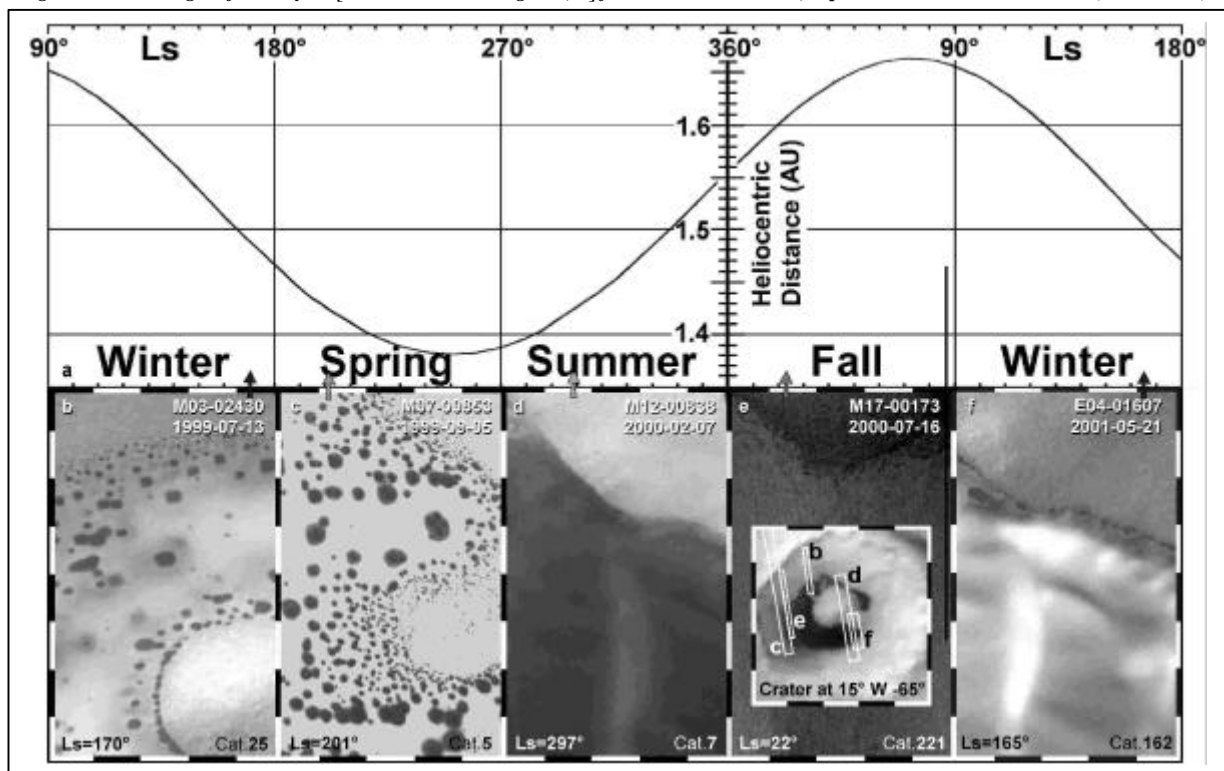
One group was the energetics which were determined mainly by the orbital elements and rotational axis tilt of the planet Mars. The tilt angle 23,5 degrees, similarly to Earth, causes the seasons on Mars, which results in sinusoidal changes in the incident sunlight onto the surface. However, the large eccentricity of the Mars' orbit superposes a great thermal modification on this seasonal effect.

The heliocentric distance of the planet alternates between 1.38 and 1.67 astronomical units (AU) and the result of this changes is the hotter late-winter and spring on the southern hemisphere, because the smallest heliocentric distance is reached late spring. This group of parameters determines the energetic input into the materials of the system of DDS-MSO to be studied (Fig. 1).

Materials of the interactions

The other group of the parameters refers to the four acting materials in the DDS-MSO system. The double sinusoidal combination changes of the energetic input conditions should be fitted with the observed DDS variations and interpreted with the four material components: the dark dune soil, the frost, the water and the MSOs.

Fig. 1 Annual changes of DDS cycle [studies on MGS-images: 5, 6] follows solar insolation, depends on heliocentric distance (scale 200 m)



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Before reconstruction of the 4-actor process we shortly introduce the four material components:

The DDSs: they occur only on the dark dunes. This fact indicates that the formation of the DDSs is somehow linked with the dark dune soil, to the material of the soil itself, mainly because of its chemical composition, and probably because of other physical conditions (for example structure of the dark dune soil) [2].

The frost: it appears in autumn and persists in winter on the dark dune soil [7]. The precipitation of the frost probably depends on the physical characteristics of the soil (grain size, porosity), because the soil grains serve as crystallization seeds for the frost formation [2]. (Defrosting happens on the surface of the frost cover, so it may be independent from this characteristic.)

The water: the DDS on the slopes have ellipsoidal shape from which streams flow out and downwards according to the MOLA height measurements. The fact that stream move downward by the affect of gravity indicates a material component easily moved by gravity. This is a fluid phase [1, 2, 8], which in the pT conditions of Mars cannot be anything else but liquid water (indicated by Mars Odyssey [9, 10]).

The MSOs: the sublimation process of the frost is enhanced in the DDS regions. Because DDSs begin to form at the interface between the soil and the frost (forming a probably third boundary layer) we suggested that besides soil, water and frost a fourth component takes part in the defrosting process, which also enhances the defrosting locally. This "enhancing" components are the MSOs, the Martian Surface Organisms [1, 2, 8, 11].

4 ACTORS AND SUN: ANNUAL CHANGES OF DDS

From the above shown components and their interaction among each other on the effect of heat input from the Sun the following sequence of events can be sketched. The formation and evolution of the DDS requires multiple component interactions. The new component in our studies is the MSOs component. We suggest now a process description in the light of the life cycle of these main actors. MSOs must occupy an interface layer between the soil and the frost, or they stay in the upper layers of the soil.

During southern winter Mars approaches the Sun. Increasing heat input awakes the MSOs "sleeping" deep in soil in deep-frozen form below the frost layer. DDSs do not exist yet, because of the ice/frost cover on them. Because the frost layer' ices are transparent to light, MSOs may begin to absorb emerging sunlight and as a consequence of their warming up they begin their life cycle at the second half of the winter.

MSO's transformation from the frozen state into the living state is possible because of the appearance of the liquid water component, which is made by them. MSOs pass to a molten one, and increase the warming up in their environment. Staying in contact with both a liquid solute and the underlying soil, they become able to take up the necessary nutrients. The increasing quantity of the liquid phase causes the extension of the "living" region. This is the spring period of the MSOs (Fig. 2).

Spring the heat insulation causes that the ice cover disappears and the liquid water evaporates. The fast evaporation stops the main living conditions and the MSOs become desiccated. Evaporation is quick in the low atmospheric pressure. So disappearance of the frost and the appearance of the DDS changes the life cycle of MSOs into the desiccated and later the deep-frozen state in summer and autumn on the southern hemisphere.

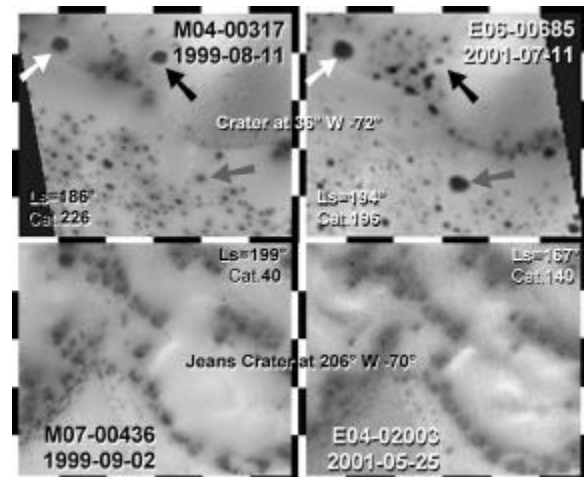


Fig.2 Annual reappearance of DDSs in the Southern Polar region of Mars. DDSs partly reappear in the same form (white arrow) and partly do it in a changed dynamics (dark arrow), proves that a biological process determines the reappearance of the DDSs (scale 200 m).

SUMMARY: COMPLEX INTERACTION

From the 4-actors process description we could see that both four material components and the sunlight are important agents in our biological interpretation of the DDS phenomena. The presence of the MSOs makes our description to be variable, suitable to fit to the multiple material components present in the atmosphere-lithosphere interface on the planet Mars. The coincidence of the changes in DDS forming actors and the sunlight cycle, the appearance of water flows, the fact that DDSs occur in dark dune soils, the shielding effect of frost cover, the fact that the spots mainly appear in the polar region, all indicates that such conditions for a special Martian life cycle as soil and water nutrients, the shielding frost (preventing lost of conditions) and the long period of sunlight (necessary for MSO revitalization) all interact in a complex system ensuring a living period for the suggested Martian Surface Organisms.

Acknowledgments: Authors thank for the use of MGS MOC images of NASA JPL and Malin Space Science Systems [6].

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