

EVIDENCE FOR WATER BY MARS ODYSSEY IS COMPATIBLE WITH A BIOGENIC DDS-FORMATION PROCESS. *T. Gánti (1), A. Horváth (2,3), Sz. Bérczi (4), A. Gesztesi (3), E. Szathmáry (1,5)*

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Abstract: The neutron measurements of the Mars Odyssey spacecraft provided evidence for some form of water in the upper layer of the surface of the Southern Polar Region of Mars. This is compatible with the prediction of a presumably existing supply of water in our model of DDS formation, where the MSOs (Mars Surface Organisms) are covered by seasonal water ice. Hypothetical MSOs are thought to melt the ice above them, which initiates the characteristic morphogenesis of DDSs [1, 2 and 3]. Concomitant melting of water frost in the uppermost layer of the soil may contribute to the observed traces of liquid water.

Evidence for water by the Mars Odyssey on the South Pole: MGS MOLA data indicated that the southern fresh frost cover is 0.1–1 meter thick [4]. (These are average values, from which significant deviations may occur locally.) However, the frost cover surely consists of three components: frozen carbon dioxide, carbon dioxide clathrate and water ice [5, 6]. Unfortunately, till today we do not have any data about the depth of these layers.

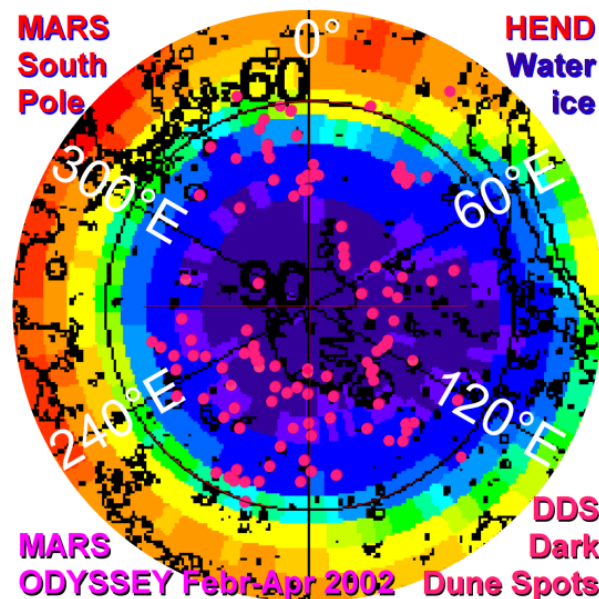


Fig. 1. Evidence for water by the High-Energy Neutron Detector (HEND) of the Mars Odyssey spacecraft from February to April of 2002 in the South Polar Region of Mars (in the summer), and the sites of dark dune spots (red circles).

Data provided by the Gamma Ray Sensor on the Mars Odyssey spacecraft by the American Neutron Spectrometer (NS) and the Russian High Energy Neutron Detector (HEND) indicated deficits of high-energy neutrons in southern highlands of Mars. (These deficits indicate that hydrogen is concentrated in the subsurface.)

Model calculations suggested that the best possible fit to

the data was a water-ice rich layer with at least tens of centimeters in thickness. In this case the subsurface material has a water ice concentration of 60% by volume [7, 8 and 9].

This prevalence of water ranges from the South Pole up to 60°S, surprisingly coinciding with the region of the DDSs (Fig. 1). From this data we may deduce that water in some form is relatively abundant in this region of the DDSs.

DDS formation process: Dark Dune Spots (DDSs) and their clusters (Fig. 2) are interesting objects with seasonal frost cover transformational dynamics. They were observed on the Mars Orbiter Camera (MOC) narrow angle images of the Mars Global Surveyor (MGS) spacecraft [10] from the year 1998 to 2002.

The frost cover appears during autumn and gradually thickens in winter until formation of DDSs transforms this layer, beginning in late winter. On surfaces other than the dark dunes the frost disappears during spring, but on the latter the frost persists until late spring or even early summer [11].

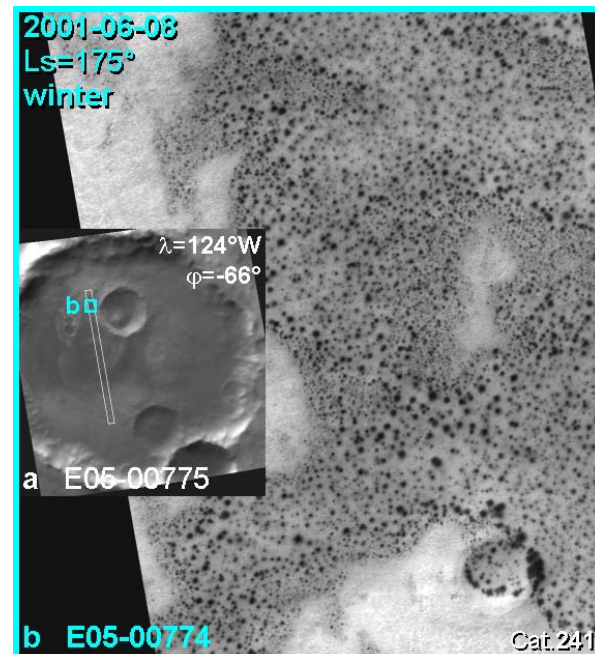


Fig. 2. Example for the characteristic features of a dark dune spot (DDS) field (b) in the crater Chamberlin (a). Sun in the figures illuminates from upper left, north is up.

In the earlier detailed analyses of several thousand dark dune spots on the Southern Polar Region of Mars from MGS MOC images we could determine the shape, the pattern and the seasonal/annual dynamics of these spots [2, 3, 12, 13].

We studied the transformational process according to a hypothesis which describes the observations on dark dune

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spots morphology, the patterns of DDSs, the formation and transformation of DDSs by using the following components: the *Dark Dune fields' material* and its *frost cover*, the putative *Martian Surface Organisms* (MSOs) and their supply of *water* (embedded in the hypothetically porous dark dune soil).

Individual DDSs exhibit a characteristic spot structure with an inner dark region, transitional gray peripheral ring and the frost cover surrounding the structure (Fig. 3a) [1, 2, 3 and 13]. On slopes the spots are elongated downwards: they occur in ellipsoidal or fan-shaped forms and sometimes streams flow out from these spots (Fig. 3b) [1, 2, 3 and 13]. We also observed that DDSs are shallow crater-like holes in the frosted layer and that the DDS formation process is triggered from the bottom of the frost (Fig. 3c,d) [3, 12]. We also observed seasonal and annual variation and recurrence of DDS patterns, too (Fig. 4a-d and 4e,f) [3, 12]. The shape, location, development and other features of the DDSs prompted us to suggest that some fluid phase must be invoked in their explanation, which under the given circumstances cannot be anything else but liquid water.

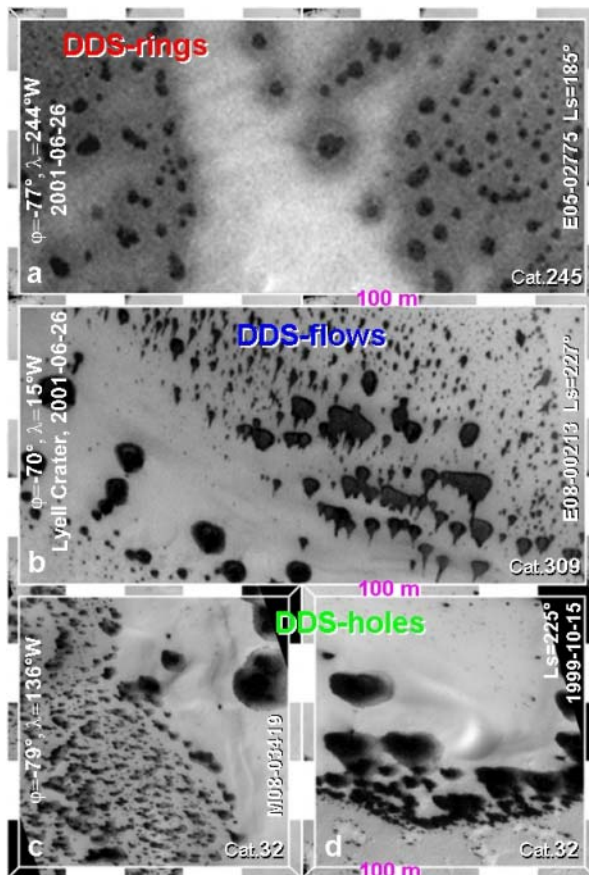


Fig. 3 Dark dune spot (DDS) characteristic features: inner ring structures (a), fan and flow-shaped forms (b), shallow holes-form (c). Sun in all figures illuminates from upper left north is up.

Biological interpretation of DDS-formation by four agents: We interpret the sequence of DDS formation as an accelerated process of sublimation combined with melting of water and some kind of biological activity of putative Mars Surface Organisms (MSOs) acting on, or in, the material of the dark dunes [1, 2, 3, 12 and 13].

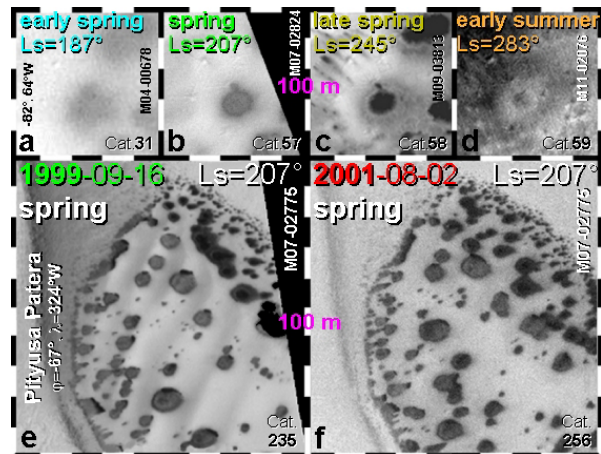


Fig. 4 Dark dune spots seasonal (a-d) and annual (e, f) dynamics. Sun in all figures illuminates from upper left north is up.

We sketched the following life cycle of MSOs: in winter the first rays of sunlight activate the MSOs, they start to warm up and melt the H₂O ice around them, while above them sublimation of CO₂ on the top of the frost is accelerated. Later MSOs begin to grow and reproduce themselves in the water melted by them. Complete defrosting of the water ice cover stops shielding the MSOs and water immediately evaporates, too, on this unprotected region, hence the life conditions of MSOs cease and they desiccate.

All these events happen in the upper layer of the dark dune soil. In our model we suggest that the four components act together in a life-desiccation cycle, alternately following each other seasonally and annually. Therefore, despite the adverse conditions, the hypothetical Martian Surface Organisms could dwell below the surface ice, in the upper water-rich layers of the dark dune field. Melting of water ice in the uppermost layer of the dune subsurface, triggered by the life activity of MSOs above, may contribute to the observed traces of liquid water associated with the DDSs.

Conclusions: Neutron measurements of Mars Odyssey (HEND, NS) observed the presence of water ice, which was abundant in the upper 2-meter thick layer of the Southern Polar Region between 90°S--60°S latitudes [7, 8 and 9]. This observation is compatible with prediction for the existence of seasonally melting water on the basis of the MSO hypothesis, and that the DDS phenomenon is evidence for present-day life on Mars.

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