ANNUAL CHANGE OF MARTIAN DDS-SEEPAGES.

Horváth, A. (1, 2, 3), Kereszturi, Á. (1, 5), Bérczi, Sz. (1, 4), Sik, A. (1, 5), Pócs, T. (1, 6), Gesztesi, A. (3), Gánti, T. (1), Szathmáry, E. (1,7)

(1) Collegium Budapest (Institute for Advanced Study), 2 Szentháromság, H-1014 Budapest, (esa@colbud.hu);
(2) Konkoly Observatory, H-1525 Budapest Pf. 67; (3) Budapest Planetarium of Society for Dissemination of Scientific Knowledge, H-1476 Budapest Pf. 47, (planet@mail.datanet.hu); (4) Eötvös University, Dept. G. Physics, Cosmic Mat. Sp. Res. Gr. H-1117 Budapest, Pázmány 1/a.; (5) Eötvös University, Dept. of Physical Geography, H-1117 Budapest, Pázmány 1/c;
(6) Eszterházy Károly College, Dept. of Botany, H-3301 Eger Pf 43, (colura@ektf.hu);
(7) Eötvös University, Dept. of Plant Taxonomy and Ecology, H-1117 Budapest, Pázmány 1/c; Hungary.

Introduction: The signs of surface water found by MGS (on MOC images [1]), Mars Odyssey (neutron data [2]) and Mars Express (spectral data, [3]) play important role in understanding surface processes – especially probable life forms – on Mars. There are signs of recent liquid water on Mars like the *gullies* formed probably during high obliquity [1, 4, 5] and dark *slope streaks* which could be formed by gravitational mass movements or water seepage [6, 7, 8].

We discovered and analysed a possible third group of phenomena presumably produced by liquid water on the surface, called *DDS-seepage*. These are originated at dark dune spots (***DDS***). (Dark dune spots appear in the defrosting surface in late winter–early spring in the polar regions of Mars [9, 10]).

Most of the DDS-seepages can be found at the steep slopes of the dark dunes in craters and the intercrater areas and we could study not only great number of these seepages [11, 12] but also could observe their changes from one Martian year to the other.

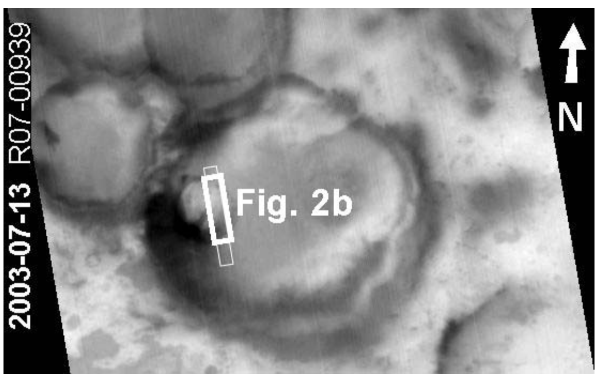

***Fig. 1** The crater where we studied the dunefield and DDS-seepages. The frame refer the belt of* Fig. 2b *(MGS MOC image)*

Data and methods: The DDSs and the DDS-seepage structures were identified visually on images from the MGS MOC and measured manually with *Surfer* software, the topographic data were from MGS MOLA measurements. The maximal error of the morphometric results is 30%.

The surface studied is about 41 square kilometers where there we found 750 dark dune spots and 440 DDS-seepage formations**.**

We analyzed a crater (coordinates: 150.8°W, 69.2°S and diameter ca. 70 km, ***Fig. 1***) based on two images of the same region in spring, but with one martian year difference (E07-00808 and R07-00938; ***Fig. 2***), almost in the same phase of the seasonal cycle of the DDS-phenomenon.

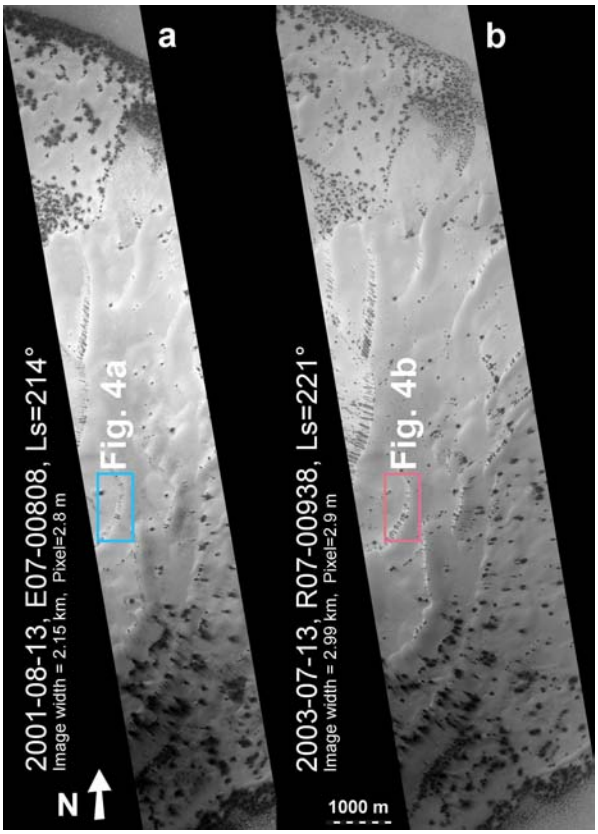

***Fig. 2** MGS images of the same locality from 2001 and 2003 with DDS-seepages on the slopes. Enlarged view of the frames with more details about the seepage-flows are given in* Fig. 4

Morphological charateristics and annual change of DDS-seepages:. The dark and grey streaks from these DDS's suggest that the frosted layer has been partly or totally defrosted (***Fig. 3a, b, 4a, b***).

The main characteristics of the DDS-seepages are:

- the dark streaks originate from DDS (***Fig. 3a-d, 4a, b***),
- based on MOLA data they point downslope away from DDSs (***Fig. 3a-d*** -see arrow, ***4a, b***),
- slope having angles between 18– 31 degrees (***Fig. 3a-d***),
- most streaks become narrower at the foot of the hill (***Fig. 3a, c, 4a, b***),

- at their lower end a spot indicates that the downflown material has accumulated there (***ponds***, ***Fig. 3b, d***),
- the darkness of the streaks is variable (***Fig. 3a-d, 4a, b***),
- the phenomenon ***annually appears*** on Mars (***Fig. 4***).

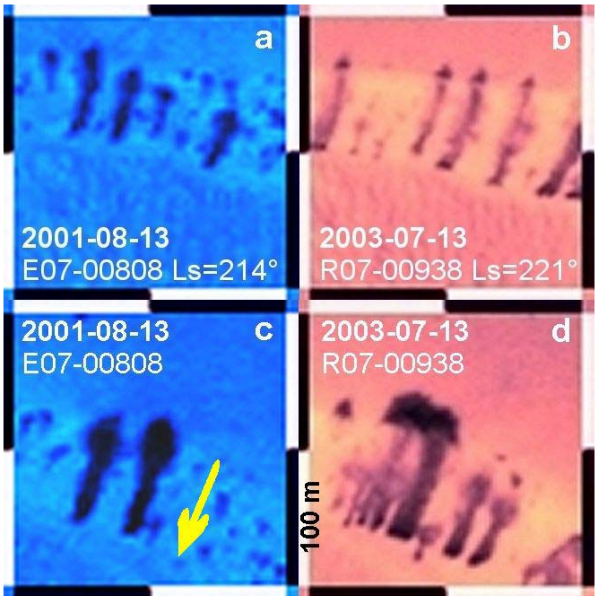

Fig. 3 Enlarged view of Fig. 4 frames where we can observe the main characteristics of the DDS-seepages. Arrow shows flow direction to all images (a-d)

Concluding model of the DDS-seepage: According to our earlier model the DDS forming defrosting process contains possible biological components [11, 12]. For these biological components (the *Martian Surface Organisms MSOs*) the defrosting process cycle begins in spring when the MSOs begin their activity and help enhance the melting of water. The molten water seepage starts flowing downwards between the ice cover and the frozen soil. First the grey color exhibits the thinner frosted layer, later the final dark color of the DDS exhibits the naked surface of the dark dunefield [13].

Summary: The morphology and annual occurence of the DDS-seepages on slopes were studied. Our results suggest the temporal presence of liquid water on polar dune surfaces bellow the CO_2 frost cover. This could be one of the few current examples of liquid water on Mars.

The water-related model of the DDS-seepage phenomena gives better interpretation of the observed slope features than the dust avalanche model [6] because of 1) the presence of ponds, and 2) the overwhelming majority of DDS-seepages narrows towards the lower end of the streak.

Our result are consonant with the water ice detected by Mars Express next to the CO_2-frost, and agree partly with the suggestions of other authors on the possible presence of liquid water on Mars today [10].

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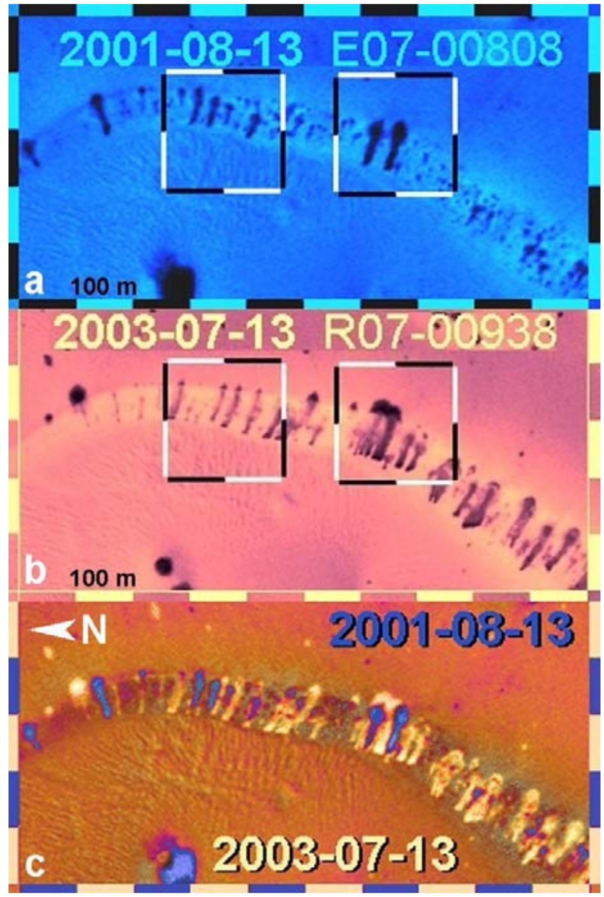

Fig. 4 Annual changes of DDS-seepages. (a) 2001-08-13, (b) 2003-07-13, (c) combination of 2001 positive and 2003 negative images

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