EPSC Abstracts
Vol. 7 EPSC2012-749 2012
European Planetary Science Congress 2012

Structures near Olympia Undae, North Pole of Mars.

M. Sánchez-Bayton*[1], E. Tréguier[2], M. Herraiz[1,3], P. Martin[2]

[1]Department of Geophysics and Meteorology, Faculty of Physical Sciences, UCM; Madrid, Spain, [2]European Space Astronomy Center, Villanueva de la Cañada, Spain, [3] Institute of Geosciences (UCM-CSIC).
*mbayton@esac.esa.int

1. Introduction

The boreal polar cap of Mars, (Fig.1) consisting of various layers of dust and ice (topped by the seasonal cap), presents a maximum extent of ~1300km and reaches a maximum thickness of ~3km. Olympia Undae is a dune sea encountered close to the polar cap, where gypsum deposits have recently been detected [1, 3, 4]. This study focuses on structures encountered in the southern part of Olympia Undae (area bordering Scandia Cavi).

The type of dunes encountered in this geological unit seems to be closely related with the density of dunes: transverse dunes in high density areas, barchans in low density areas [1]. Around the polar cap, winds generally blow towards the West, due to the deviation of katabatic winds by the Coriolis force [2], but in the external part of the dune field they tend to invert themselves and blow towards the East (jet wind) [8]. The characteristics of dunes and winds, the spatial distribution of gypsum deposits [1] and the encountered structures can cast light over the building process and the evolution of Olympia Undae area and its neighbouring unit Scandia Cavi (Fig.3).

New data suggest the occurrence of recent (less than 100 My) volcanic resurfacing in the Northern circumpolar area [5]. The area analyzed in this study is a region with young volcanoes and geologic edifices of possible volcanic structure with a very irregular spatial distribution: very scarce in the interior zone of Olympia Undae and abundant in its border with Scandia Cavi (Fig.2).

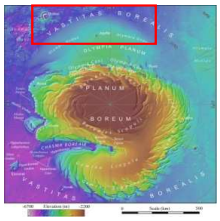


Figure 1: General map of the North Pole. Red square is Fig 2 area.

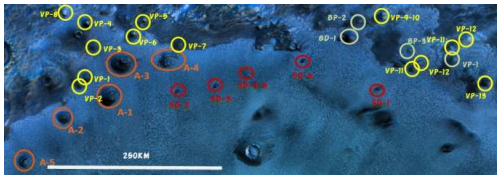


Figure 2: Detail of the area with the location of the structures listed in Table 1: Red, orange and beige circles: domes. Yellow circles: cratered structures (MOLA background).

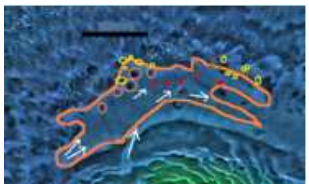


Figure 3: Gypsum distribution. Deposits are located inside the region bounded by the orange line [6] Predominant-winds in the area of study. Directions are marked by white arrows.

2. Identification of structures.

We tried to perform a classification of the encountered structures, based on their morphology. This is a complicate task due to the small size of the structures and the presence of covering layers of sediments, dust and ice.

1. **Cratered structures**. Two main types can be distinguished: **impact craters** and cratered cones. The latter has been named: **possible volcanoes, Vp**.
2. **Domes**. They can be divided into three groups, listed below.

Split Domes, SD: They present an asymmetric structure, a surrounding depression, latitudinal alignment and orientation according with the predominant winds [3] Their area ranges from 14 to 120 km^2. All of them are located in Olympia Undae.

Irregular Domes, A: Big domes with irregular structure and moon-shaped summit. Their area ranges

from 120 to 500 km^2. As the Split Domes they present a depression and are placed in Olympia Undae.

Big Domes, B: They do not present a depression and are located in the Olimpia Undae- Scandia Cavi border zone. Their area ranges from 10 to 180 km^2

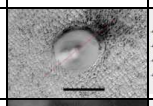
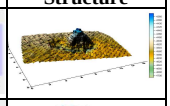
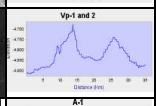
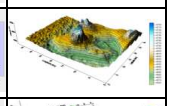
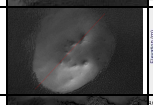
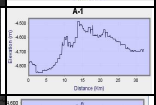
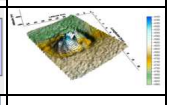
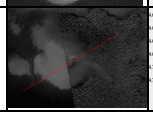
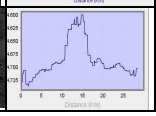
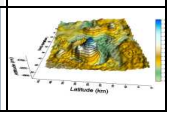
	HRSC Image	Topographic profile	Contour Structure
SD3			
Vp1 And Vp2			
A-1			
BP-1			

Table 1. Examples of encountered structures

3. Results

The encountered structures (some of them were already studied in [5, 7]) are listed in Tables 3 and 4 along with their main morphological characteristics. Their closeness and strong similarities point to a common origin, possibly volcanic. As can be observed in Fig.4, this similarity is very clear for the SD structures. Nevertheless the consideration of a different origin, such as pingos or mud domes, can not be discarded.

The location of these structures inside dunes or close to them invites to consider the relationship between their shape and the predominant winds in the area. SD-type structures seem to be oriented according to the winds (Fig.5) but Vp and irregular and big domes do not follow wind directions in such a clear way.
The presence of gypsum deposits [9] in the area raises additional questions due to theirpossible relationship with both aqueous and volcanic processes. This will be analyzed in a future study.

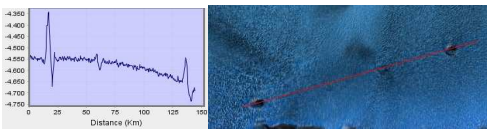


Figure 4. Topographic Profile crossing structures SD-3, 4 and 5

Name	Lat-Lon	Width (km)	Length (km)	Height (m)	
				Max	Min
SD-1	170,09ºE-80,05ºN	13,23	10,8	-4502	-4681
SD-2	197,95ºE-79,70ºN	6,93	6,99	-4477	-4636
SD-3	193,09ºE-79,88ºN	5,75	5,26	-4348	-4684
SD-4	188,95ºE-79,84ºN	4,75	4,28	-4500	-4597
SD-5	189,16ºE-79,78ºN	3,1	4,38	-4498	-4613
SD-6	181,98ºE-79,54ºN	5,65	7,29	-4527	-4740
A-1	205,87ºE-79,3ºN	29,68	27,55	-4482	-4801
A-2	212ºE-79,25ºN	20,24	20,24	-4422	-4943
A-3	202,99ºE-78,71ºN	30,2	30,2	-4560	-4872
A-4	197,79ºE-78,92ºN	33,7	24,26	-4658	-4859
A-5	219,83ºE-79,13ºN	7,66	20	-4518	-4804
BD-1	176,9ºE-79ºN	19	23	-4640	-4928
BD-2	175,4ºE-78,56ºN	20	30	-4770	-4928
BD-3	171,6ºE-79,25ºN	6,4	7	-4719	-4800
BD-4	170,5ºE-79,5	6,5	12,3	-4711	-4777
BD-5	164ºE-79ºN	10,2	32,9	-4600	-4778

Name	Lat-Lon	Width (km) Crater-Total	Length (km) Crater-Total	Height (m)	
				Max	Min
Vp-1	207,12ºE-78,69ºN	3,9-12,86	4,1-13	-4719	-4925
Vp-2	208,24ºE-78,75ºN	3,56-17,33	3,10-15	-4738	-4896
Vp-3	204,82E-78,10ºN	2,95-10,8	2,85-10,5	-4771	-4897
Vp-4	204,39ºE-77,53ºN	32,43-16	3,62-14	-4771	-4897
Vp-5	200,41ºE-78,15ºN	1 1,27 1,4 9,71	1,1 2,15 1,4 7,97	-4381	-4825
Vp-6	198,75ºE-77,93ºN	6,78	8,4	-4487	-4792
Vp-7	195,94ºE-78,73N	3,67	3,73	-4702	-4842
Vp-8	205,98ºE-77,12ºN	1-2-16	1,06-2,23	-4673	-4965
Vp-9	173ºE-78,4ºN	2,1-4,7	2,7-5,42	-4680	-4884
Vp-10	175,1ºE-78,4ºN	6,19	6,35	-4581	-4886
Vp-11	168,5ºE-79,5ºN	9,7	11,7	-4713	-4824
Vp-12	168,18ºE-79,37ºN	1,62-6,7	1,66-10,62	-4680	-4800
Vp-13	159,5ºE-79,35ºN	6,5-11,7	7,7-13,5	-4632	-4782
Vp-14	164,9ºE-78,8ºN	2-8-8,85	2,41-12	-4690	-4774
Vp-15	163,3ºE-78,5ºN	4 – 2; 14,5	4.4-2.41; 34	-4625	-4770

Tables 3 & 4 **Location and characteristics of large (A) and small (SD) domes and big (BD) domes and cratered edifices (Vp). encountered in the study area**

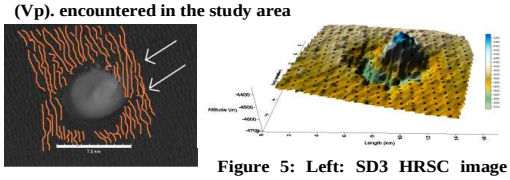


Figure 5: Left: SD3 HRSC image where the shape of the dunes and the direction of wind are drawn. Right: 3D image which shows the wind direction with respect to SD3.

References

[1] Tamaka & Hayward (2008), JGR vol 114. [2] Spiga and Forget, (2009), LPSC [3] Fishbaugh et al. (2007), JGR .112. [4] Masse et al. (2012), EPSL. [5] Neukum & van Gasselt (2006), EPSC, p.621. [6].Howard (2000), Icarus, vol.1. [7]Garvin et al. (2000), Icarus, vol 144. [8] Cantor et al. (2010), Icarus , vol 208. [9] Langevin et al (2005), Science, vol 307