Lunar domes in the Wollaston region: Morphometry and mode of formation. M. Wirths[1] and R. Lena[2] - Geologic Lunar Research (GLR) Group. [1]km 67 Camino Observatorio, Baja California, Mexico; mwirths@starband.net; [2] Via Cartesio 144, sc. D, 00137 Rome, Italy; r.lena@sanita.it

Introduction: Recent studies about lunar domes are based on the evaluation of their spectrophotometric and morphometric properties, rheologic parameters, and their classification based on the spectral properties and three dimensional shapes of the volcanic edifices [1-3]. In this contribution we provide an analysis of three low domes located to the north of Aristarchus region near crater Wollaston, termed W1-3 (Fig.1 and Table 1). The lavas of the examined mare domes are characterized by low R_{415}/R_{750} (reddish lavas) indicating a low TiO_2 content (Table 3).

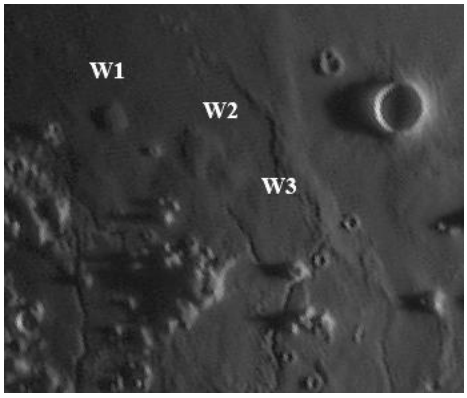

Fig. 1. Telescopic image acquired on July 9, 2014, at 03:34 UT with a 450 mm aperture Starmaster driven Dobsonian (M. Wirths). Rectified view of the telescopic CCD image.

Morphometric dome properties: Based on the telescopic CCD image (Fig. 1) we obtained a DEM of the examined domes by applying the combined photoclinometry and shape from shading method (sfs) described in [1-3]. The heights of the domes W1-3 were determined to 53, 55 and 40 m, resulting in flank slopes of 1.0°, 0.64° and 0.54°, respectively (Fig. 2 and 3). Assuming a parabolic shape the estimated edifice volumes correspond to about 1.1, 3.2 and 1.2 km^3 for three examined domes W1-W3. We also estimated the height of W1 based on shadow length measurements in the oblique illumination view shown in Fig. 1, where a value of 50 m was computed according to lunar topographic orthophotomap LTO 39A1.

Dome	long. [°]	lat. [°]	D [km]	h [m]	slope [°]	V [km³]
W1	-49.25	30.60	6.0	53	1.00	1.1
W2	-48.57	30.35	10.4	55	0.64	3.2
W3	-48.30	30.27	8.4	40	0.54	1.2

Table 1: Morphometric properties of the examined domes in the Wollaston region.

GLD100 dataset: Scholten et al. present a nearly global lunar DEM with a grid size of 100 m, the so-called GLD100 [4]. This DEM has been constructed based on photogrammetric analysis of LROC WAC image pairs. ACT-REACT Quick Map tool was used to access to the GLD100 dataset, allowing to obtain the cross-sectional profiles and the corresponding 3D view (Fig. 4), in agreement with the results obtained with photoclinometry and sfs applied to telescopic image.

According to the classification scheme for lunar domes introduced in [1, 3], and based on a principal component analysis (PCA), the domes W2 and W3 belong to class C_1. On the contrary, W1 belongs to class E_2.

Dome	viscosity [Pa s]	E [m^3 s^{-1}]	T [years]	U [m s^{-1}]	W [m]	L [km]
W1	$1.4x10^4$	122	0.30	$5.2x10^{-4}$	9	32
W2	$6.5x10^3$	340	0.30	$2.5x10^{-3}$	4	22
W3	$2.4x10^3$	320	0.16	$5.5x10^{-3}$	3.5	16

Table 2: Modeling results for the viscosity, effusion rate (E), effusion time (T) and magma rise speed (U), dike width (W), dike length (L).

Dome	R_{415}	R_{750}	R_{415}/R_{750}	R_{950}/R_{750}
W1	0.0635	0.1086	0.5851	1.0335
W2	0.0676	0.1162	0.5822	1.0186
W3	0.0675	0.1161	0.5814	1.0104

Table 3: Spectral data of the examined domes.

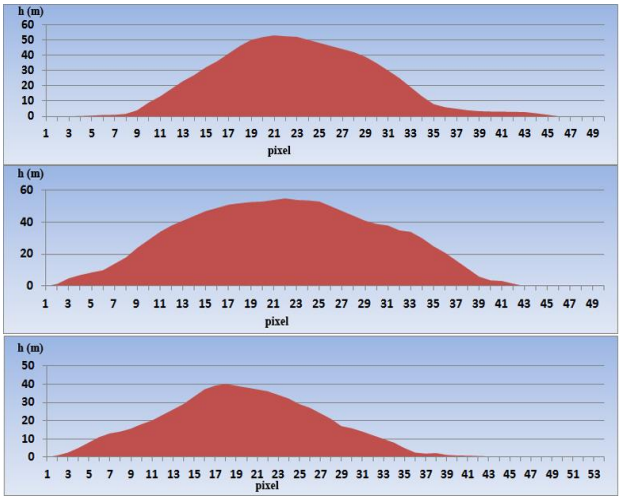

Fig. 2. Cross-sectional profile in east-west direction derived from the telescopic image for the domes W1(top), W2 (middle) and W3 (bottom). The vertical axis is 10 times exaggerated.

Rheologic properties: The rheologic model developed in [5], which relies on the morphometric dome properties, yelds estimates of the lava viscosity η, the

effusion rate E, and the duration T of the effusion process for a monogenetic lava dome. Using the morphometric values listed in Table 1, we obtained rheologic properties for the examined domes (Table 2).

The dome W1 is characterised by a moderate lava viscosity of 10^4 Pa s, while for W2 and W3 we have inferred lava viscosities of ~10^3 Pa s computed based on a lava density of 2800 kg m^{-3}. The domes formed over a period of time of about 0.3 years (W1 and W2) and 0.16 years (W3).

According to the model developed in [6], we estimated the magma rise speed U and the dike geometry (width W and length L). For three domes we found magma rise speeds of the order 10^{-3}-10^{-4} m s^{-1} and dike lengths of 16-32 km. The inferred dike widths amount to 9 m, 4 m and 3.5 m for W1, W2 and W3, respectively. With its rheologic properties and dike dimension, W1 is a typical representative of the rheologic group R_1 introduced in [1, 3], while the domes W2 and W3 belongs to group R_2 due to their lower lava viscosity.

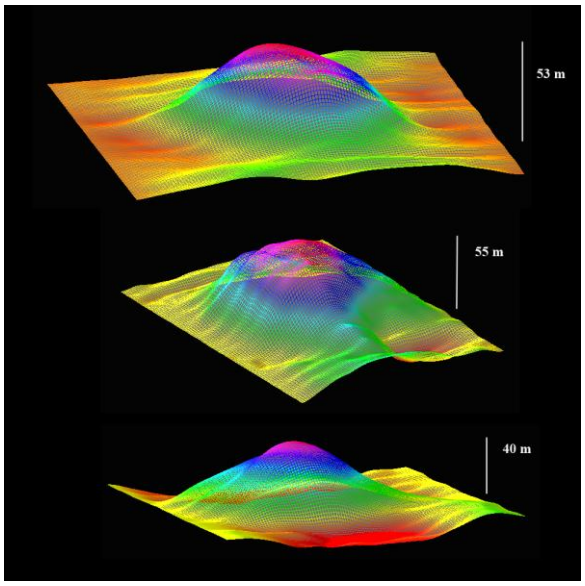

Fig. 3. 3D reconstruction based on thetelescopic CCD image for three domes W1(top), W2 (middle) and W3 (bottom).

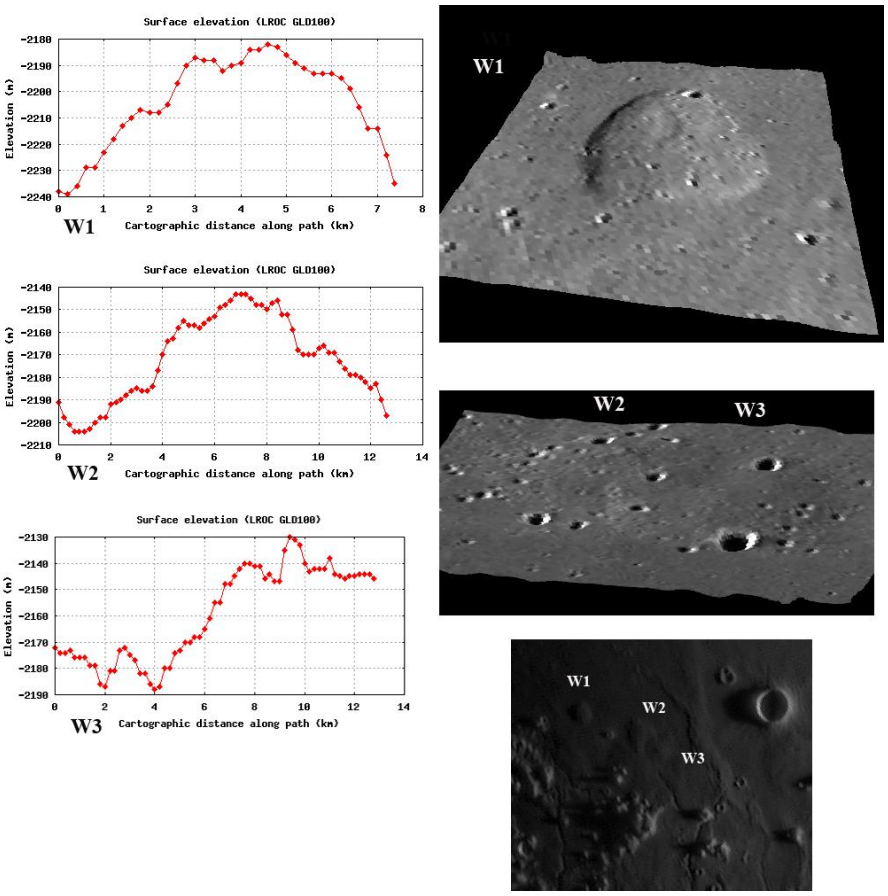

Fig. 4. 3D reconstruction and cross-sectional profile in east-west direction derived for three examined domes W1-W3 based on GLD100 dataset.

References: [1] Wöhler et al. (2006) *Icarus* 183, 237-264; [2] Wöhler & Lena (2009) *Icarus* 204, 381-398; [3] Lena et al. (2013) Lunar domes: Properties and Fomation Processes. Springer Praxis Books; [4] Scholten et al. (2012) *J. Geophys. Res.* 117 (E00H17), doi:10.1029/2011JE003926; [5] Wilson & Head (2003) *J. Geophys. Res.* 108(E2), 5012–5018; [6] Rubin (1993) *J. Geophys. Res.* 98, 15919-15935.