

Lunar domes in the Apennine region near crater Huxley: Morphometry and mode of formation. M. Wirths¹ and R. Lena² - Geologic Lunar Research (GLR) Group. ¹km 67 Camino Observatorio, Baja California, Mexico; mwirths@starband.net; ²Via 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 two low domes located in the Apennine region near the crater Huxley and just south of the Apennine bench formation, termed Huxley 1 and 2 (Fig.1 and Table 1).

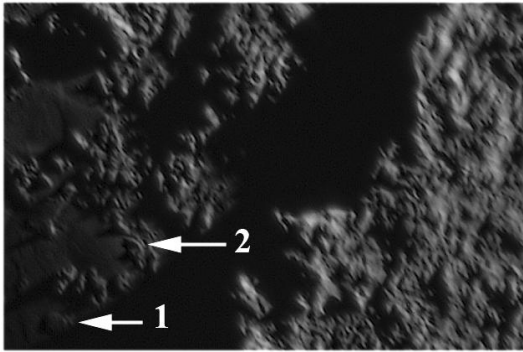


Fig. 1. Telescopic image acquired on June 27, 2012, at 03:58 UT with a 450 mm aperture Starmaster driven Dobsonian (M. Wirths).

General description and spectral properties: The oldest lavas in this region are probably those of the lighter albedo plains units inside the main Imbrium ring, called the Apennine Bench Formation [4]. More recent lava flows in the Imbrium basin were of different composition, much darker, and covered most of the Apennine Bench lavas. The lavas of the examined mare domes are characterized by moderate TiO_2 content (Table 2).

dome	long.	lat.	slope	D [km]	h [m]	V [km ³]
Hux1	-04.42°	20.28°	0.64°	7.5 x 9.6	50	1.9
Hux2	-03.68°	21.26°	0.37°	31.5 x 22.5	85	31.5

Table 1: Morphometric properties of the Huxley domes in the Apennine region.

dome	R_{750}	R_{415}/R_{750}	R_{950}/R_{750}
Hux1	0.1035	0.5919	1.0534
Hux2	0.0994	0.5897	1.0638

Table 2: Albedo at 750 nm and the spectral ratios R_{415}/R_{750} and R_{950}/R_{750} of the examined lunar domes.

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 Hux1 and

Hux2 were determined to 50 ± 5 m and 85 ± 10 m, resulting in flank slopes of 0.64° and 0.37° respectively (Fig. 4). Assuming a parabolic shape the estimated edifice volumes correspond to about 1.9 and 31.5 km³ for the domes Hux1 and Hux2.

In the LOLA DEM, the elevation difference between the western summit of Hux1 and the surrounding mare soil corresponds to about 50 m, which is in good agreement with our image-based photoclinometry and shape from shading (Table 1). We also estimated the height of Hux1 based on shadow length measurements in the oblique illumination view shown in Fig. 1, where a value of 48 ± 5 m was computed.

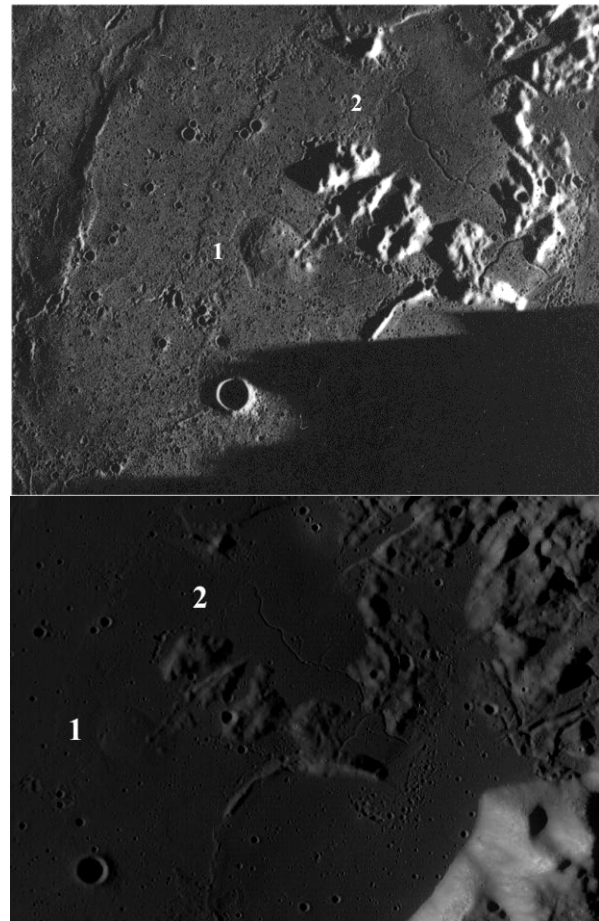


Fig. 2. Top: Section of the Apollo imagery AS17 M 1829. Bottom: Section of LROC WAC image 117515109 ME (NASA/GSFC/Arizona State University). Two examined domes (Hux1 and Hux2) are apparent. Two promineces are located on the surface of Hux1. A sinuous rille and some linear rilles due to tensional stress, probably formed by dikes intrusion, are detectable on the large surface of the dome Hux2.

Furthermore, according to the GLD100 data [5], the derived height of Hux2 corresponds to about 85 m, as shown in the cross section of the dome shown in Fig. 3.

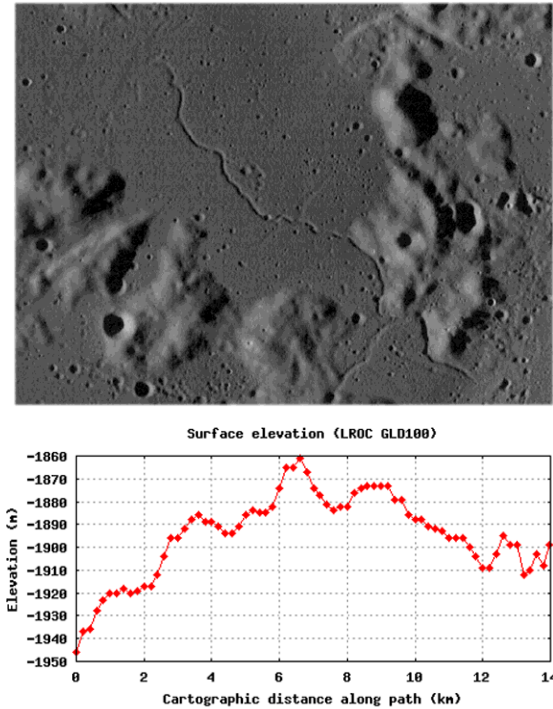


Fig. 3. Top: Enlarged image of the preceding WAC image showing the rilles in the surface of Hux2. Bottom: Cross-sectional profile in east-west direction derived with the ACT-REACT Quick Map tool of Hux 2 dome. The computed elevation corresponds to about 85 m according with the sfs measurements.

dome	h_l [km]	d [km]	p_0 [MPa]
Hux1	0.1	0.4	2.9
Hux2	1.1	2.2	17.2

Table 3: Modelling results for the minimum basaltic layer thickness h_l , intrusion depth d , and maximum magma pressure p_0 .

Hux 1, of elongated shape (circularity < 0.8), has two small prominences, likely floor ridges which were embayed by the dome, as indicated by their alignment with ridges to the north (Fig. 2). Moreover, its surface is inclined from the northwest toward the southeast direction. The dome Hux2, of elongated shape, is associated with some short linear and curvilinear rilles and has a sinuous rille on its surface, the latter clearly indicating an effusion of lava (Figs. 2 and 3). According to the dike intrusion mechanisms described in [6-7], linear rilles were probably formed by the stress fields associated with dikes that ascended to shallow depths below the surface. Although the sinuous rille crossing the surface of Hux2 indicates flowing of low viscosity lava, it is presumably not an outflow channel of Hux2, as its end points are both located on the elevation level of

the surrounding mare surface; the rille traverses the complete dome surface and does not start on the dome summit. Hence, the sinuous rille was probably formed prior to Hux2, during a different phase of volcanism. Furthermore, the flat appearance of Hux2 suggests that the rising lavas did not build up a dome through a series of flows, but that it was more likely formed by a subsurface intrusion, likely in a way similar to a terrestrial laccolith.

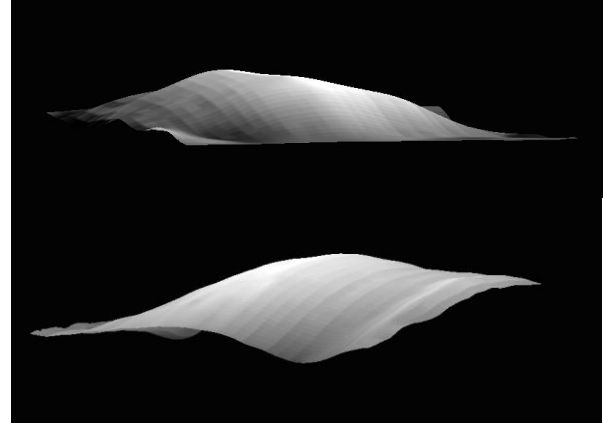


Fig. 4. DEMs of Hux 1 (top, view from southwestern direction) and Hux 2 (bottom, view from northwestern direction). The vertical axis is 20 times exaggerated.

Modelling properties: Both two domes show the characteristic non-circularity of the outlines of the candidate intrusive domes [8]. Under the assumption of an intrusive origin, we estimated the corresponding geophysical parameters, especially the intrusion depth and the magma pressure (Table 3). We obtained for Hux 2 a minimum thickness of the uppermost mare basalt layer of $h_l = 1.1$ km, an intrusion depth of $d = 2.2$ km and a maximum magma pressure of $p_0 = 17.2$ MPa. For Hux1, the magma intruded to shallow depth of 0.4 and the magma pressure p_0 was inferred to 2.9 MPa.

Conclusion: Two low domes located in the Apennine region are examined based on our image, the LOLA DEM and GLD100 data. The heights derived amount to 50 and 85 m respectively. According with the results of the laccolith modelling, the candidate intrusive dome Hux2 belongs to class In1, while Hux1 is a typical representative of class In2 as defined in [8].

References: [1] Lena et al. (2007) *Planet. Space Sci.* 55, 1201-1217; [2] Wöhler et al. (2006) *Icarus* 183, 237-264; [3] Wöhler & Lena (2009) *Icarus* 204, 381-398; [4] Wilhelms (1987) USGS Prof. Paper 1348; [5] Scolten et al. (2012) *J. Geophys. Res.* 117 (E00H17), doi:10.1029/2011JE003926; [6] Wilson and Head (1996) *LPSC XXVII*; [7] Wilson and Head (2002) *J. Geophys. Res.* 107 (E8); [8] Lena et al. (2012), *Lunar domes: Properties and Formation Processes*. Springer Praxis Books, to appear.