A Survey about the dome Posidonius 1

by Raffaello Lena and Jim Phillips

Posidonius is a floor-fractured crater (FFC), originated as a result of magmatic intrusion. The occurrence of small-scale graben in an arcuate pattern that follows the crest of a local topographic high in Posidonius, suggesting formation by uplift from a magmatic intrusion associated with FFC formation, has been recently described by French et al. (2015).

Using LROC GLD100 dataset French et al. (2015) identify a domical feature, located near the western rim of Posidonius. If an igneous intrusion occurred near the western rim of Posidonius, as proposed by French et al. (2015), a slightly elevated terrain should be detected as an up-bowing of the soil, which would be visible in terrestrial telescopic images taken under oblique solar illumination. The presence of small-scale graben detectable only on NAC imagery (Fig.1) are the demonstration of the "traces" of the laccolith-forming intrusion of pressurized magma between rock layers of the lunar crust.

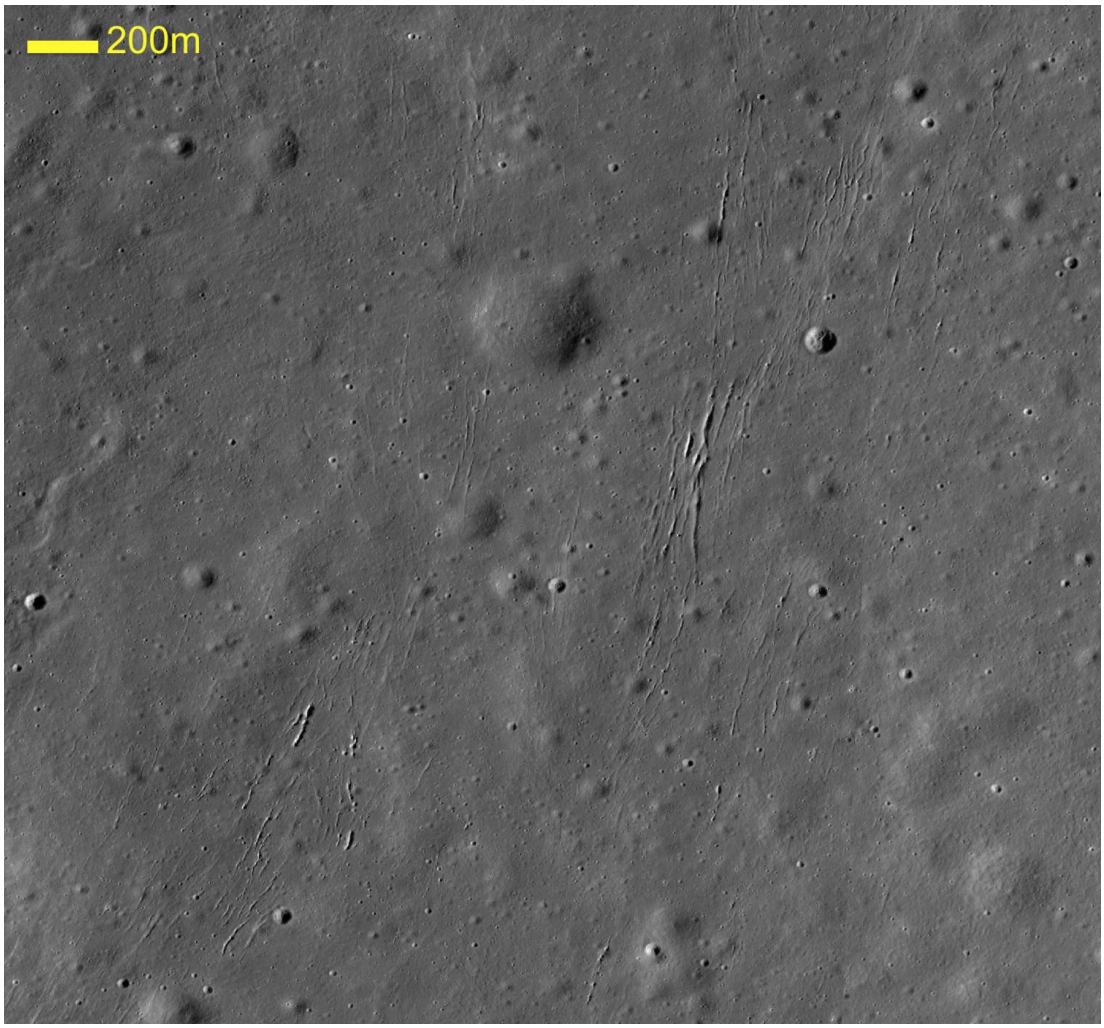

Figure 1: Detail of small scale graben on the crater floor of Posidonius and in the region of the examined dome termed Posidonius 1. Note the lines of pits which have developed along the larger graben.

An analysis of the shallow domical structure, first proposed by French et al. (2015), has been published in a report by Lena and Fitzgerald (2021). The dome, located at 28.26° E and 32.02° N, is termed as Posidonius 1 (Pos1).
In this second report we include a compilation of terrestrial telescopic images collected during our survey of this region.

Ground-based observations: The domical object is clearly detectable with low solar illumination angle demonstrating that Posidonius must be imaged close to the terminator (Figs. 2-7). It displays a curved edge showing that the centre of the structure is slightly higher than the edges.

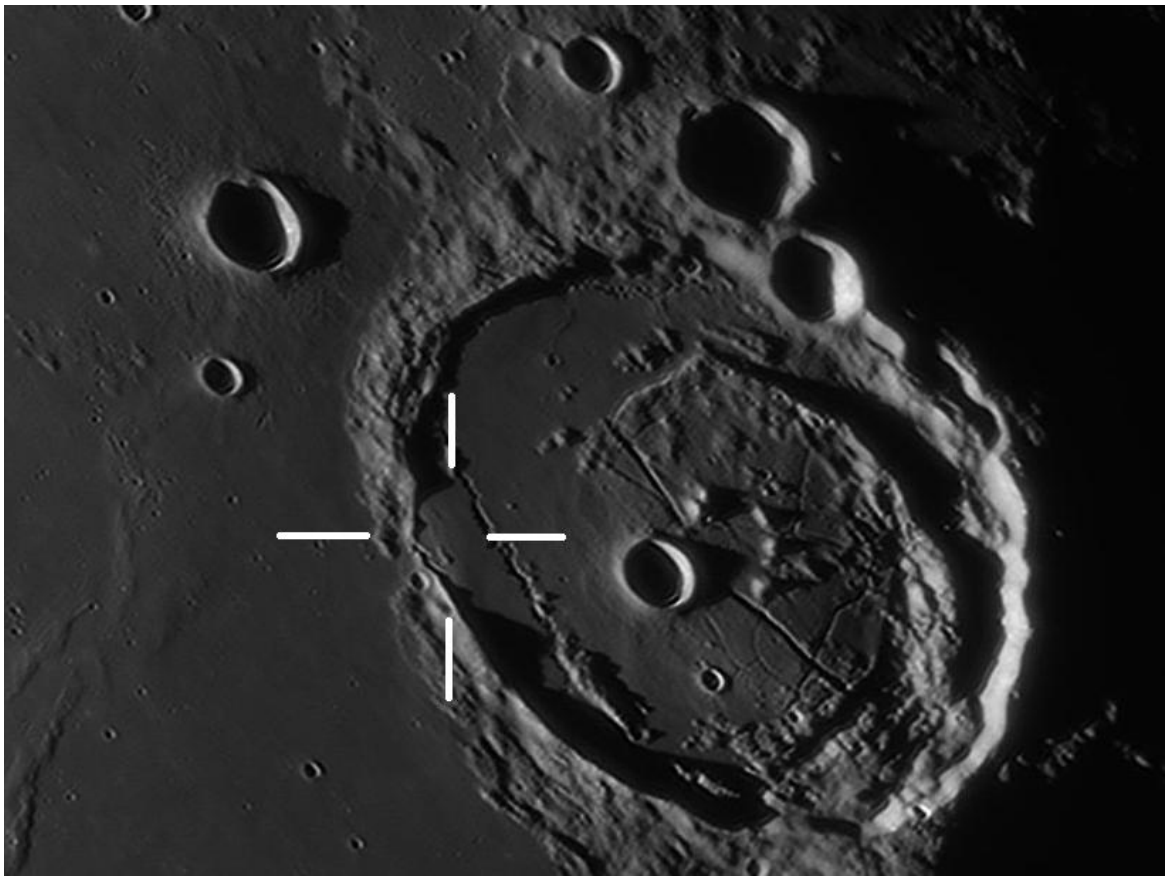

Figure 2: Telescopic image made on October 10, 2017 at 04:02 UT by Teodorescu using a 355 mm Newtonian telescope. The dome Posidonius 1 (Pos1), is marked with white lines.

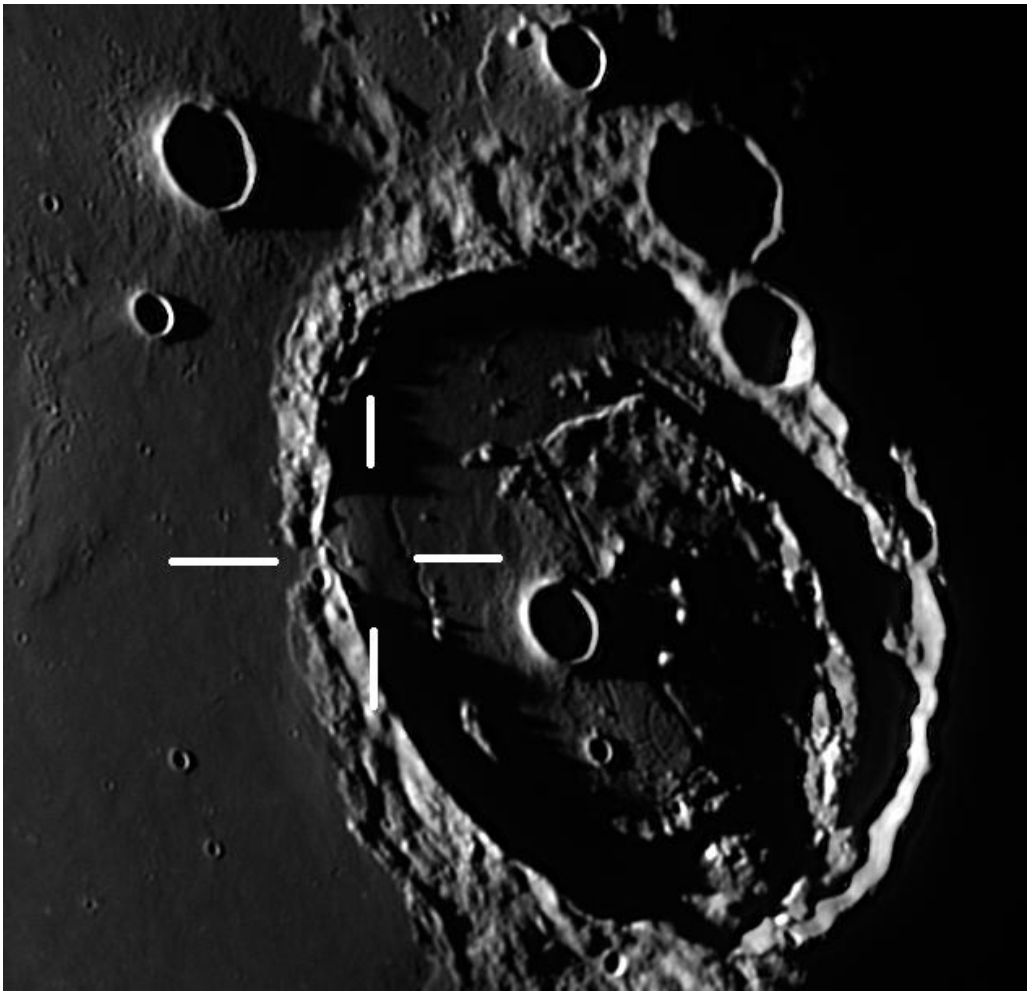

Figure 3: Telescopic image made on September 19, 2019 at 02:11 UT by Viladrich using a C14. The examined dome, Posidonius 1, is marked with white lines.

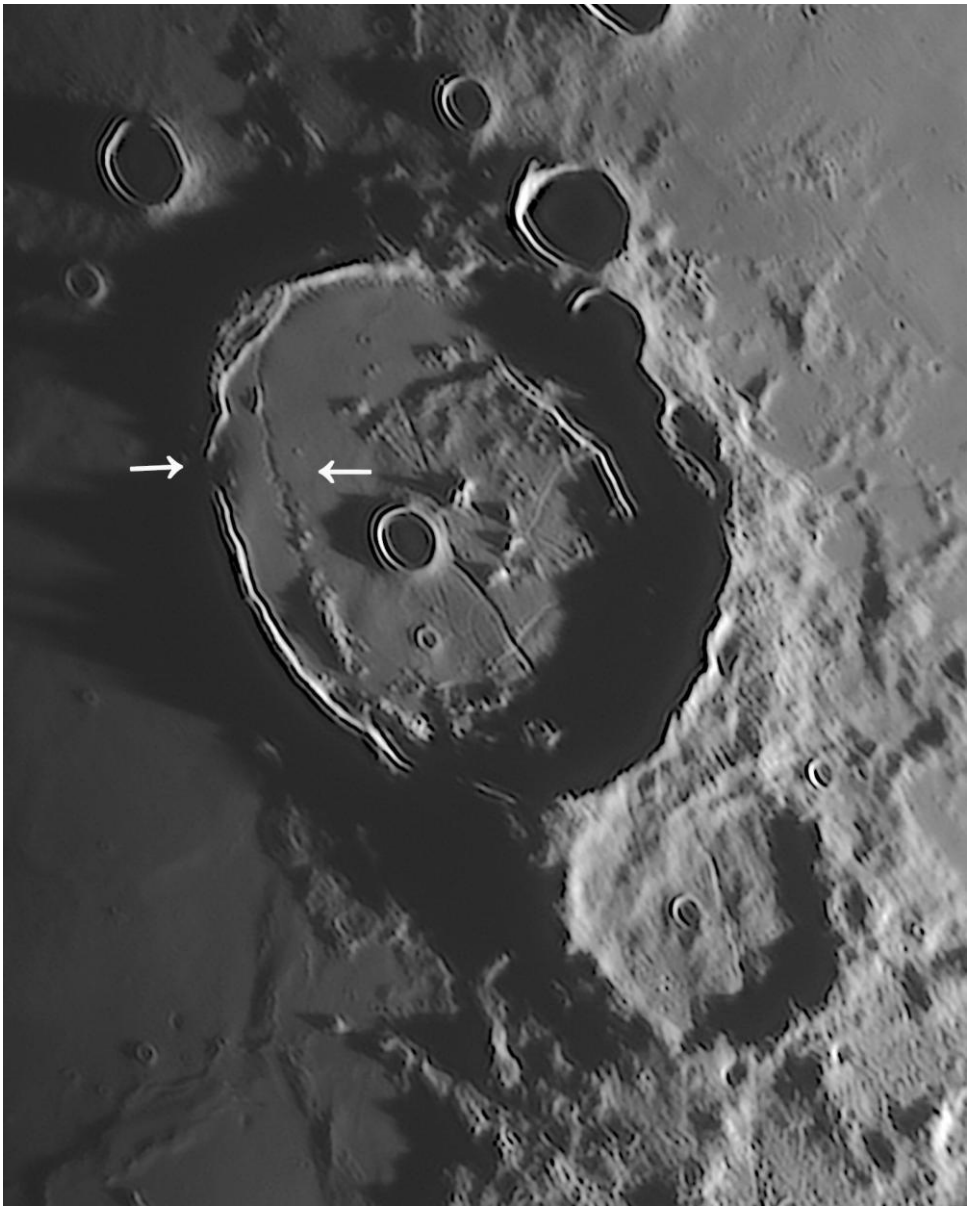

Figure 4: Telescopic image made on April 02 2017 at 01:30 UT by Schenck with a C11.

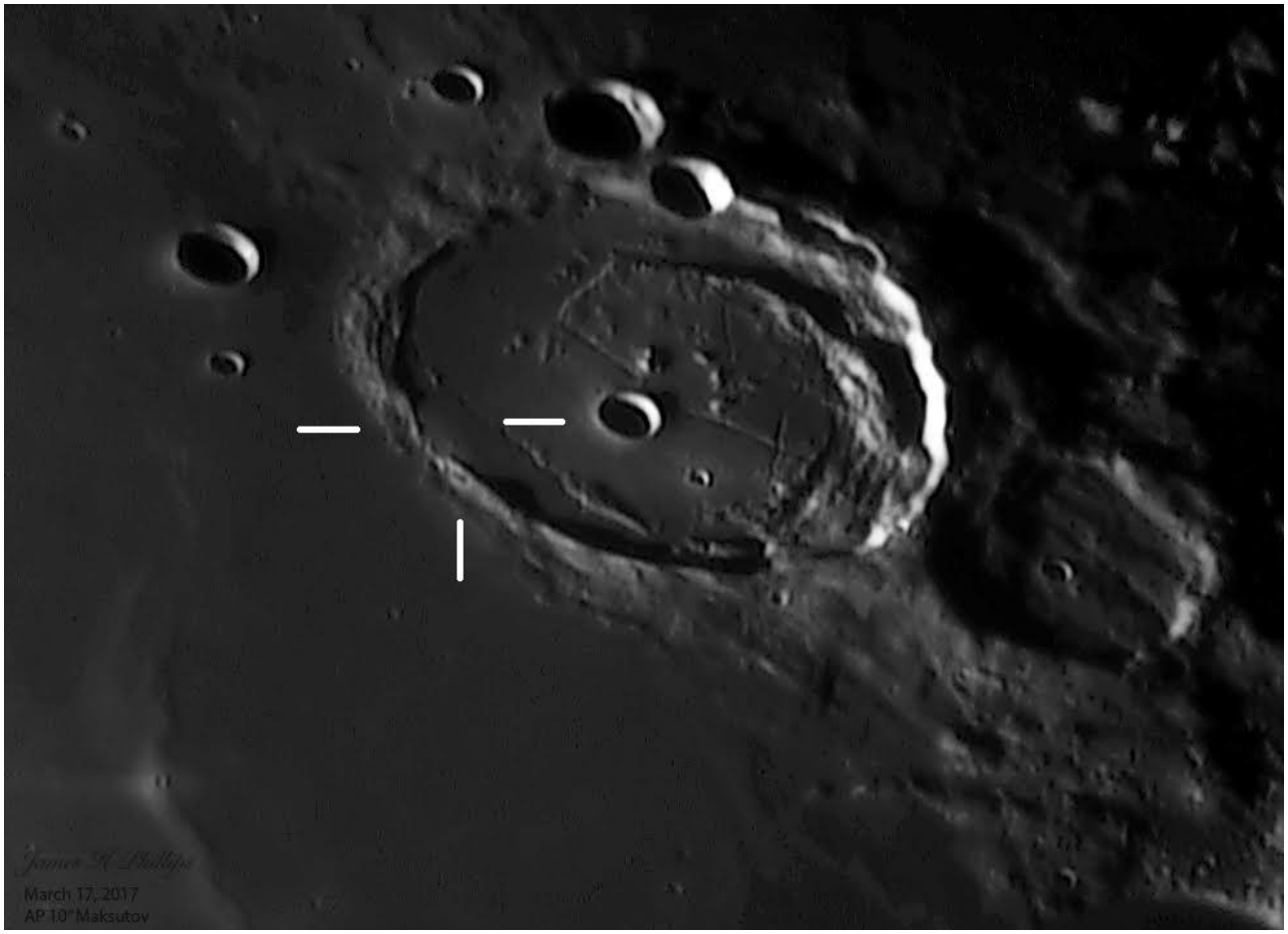

Figure 5: Telescopic image made on March 17, 2017 by Phillips with an AP 10" Maksutov.

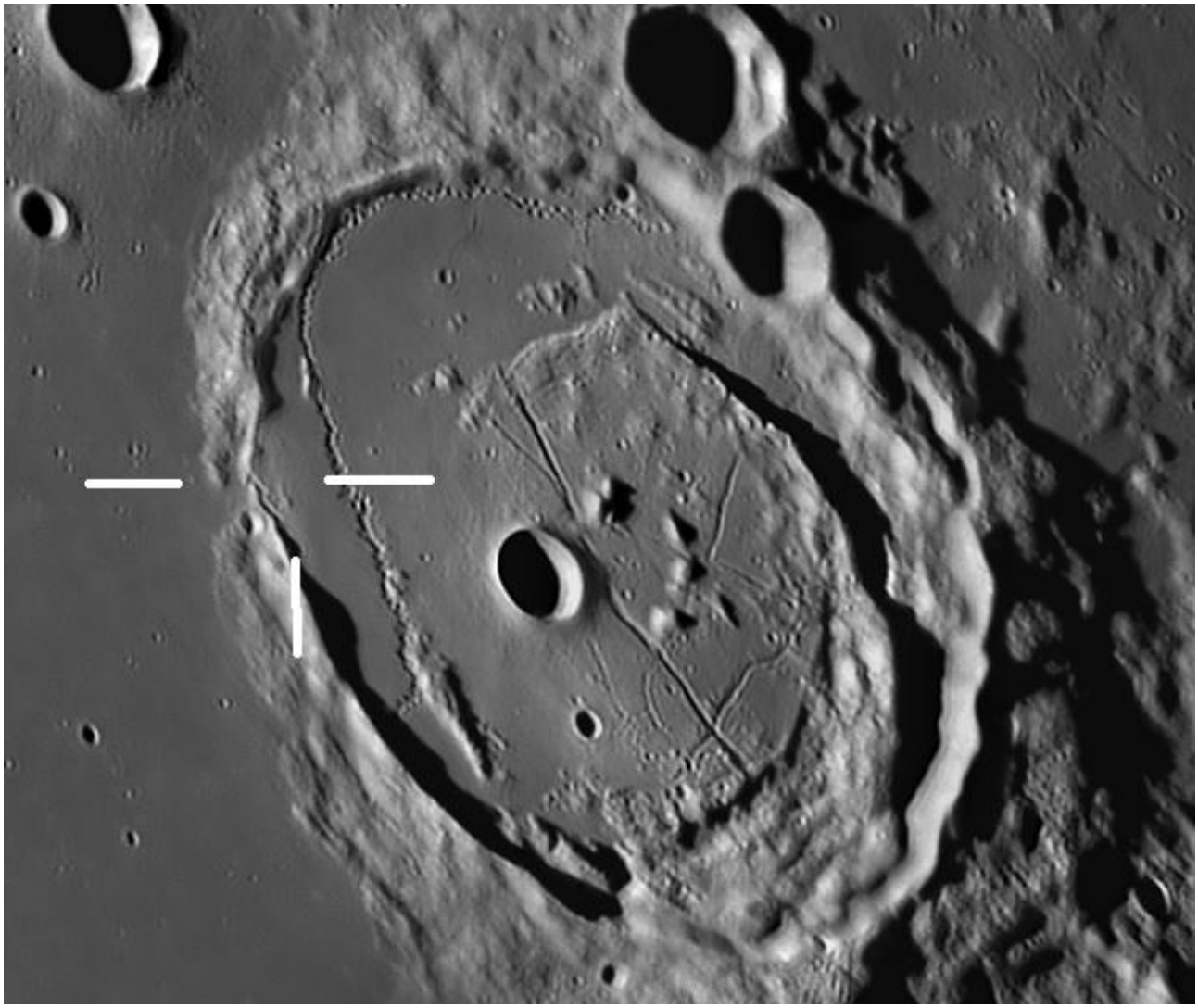

Figure 6: Telescopic image made on October 18, 2019 at 00:21 UT by Zannelli using a DK 20" telescope with aperture of 508 mm.

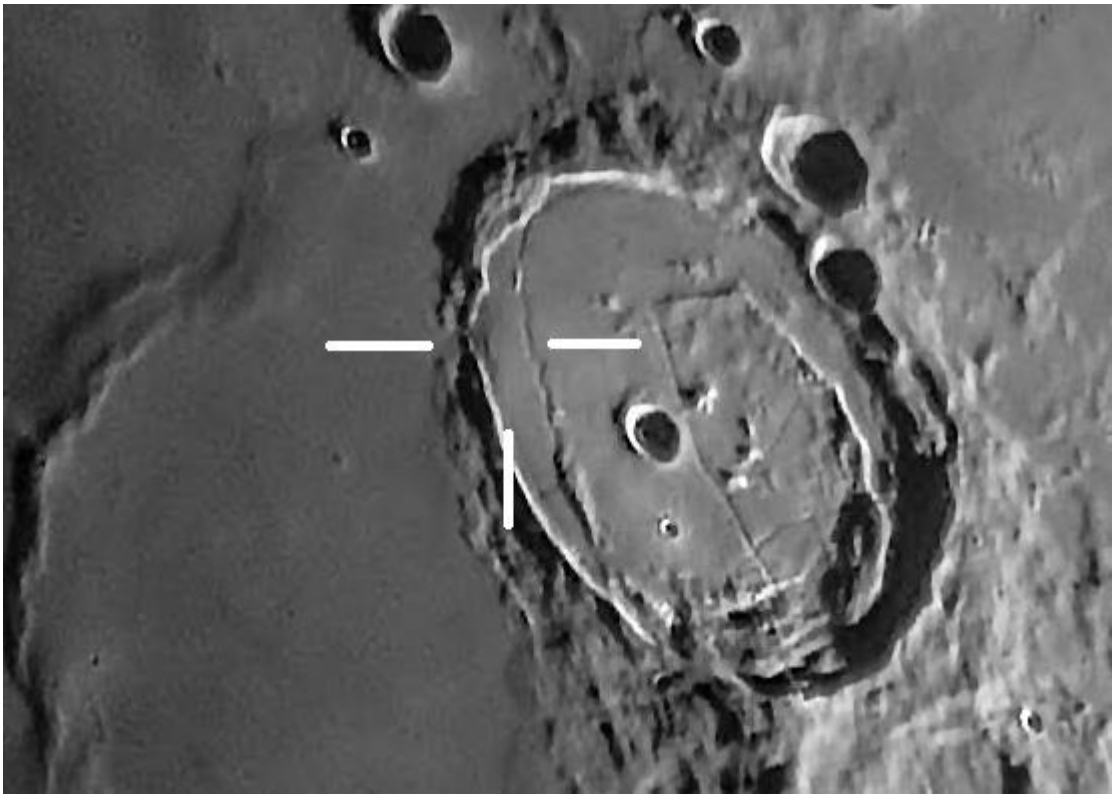

Figure 7: Telescopic image made on June 8, 2019, at 20:29 UT by Heinen using a Celestron 9,25".

Morphometric properties: The elevation of the shallow domical structure measured on the terrestrial image of Fig. 2 is determined to 74 ± 10 m (Fig. 8), its diameter amounts to 8.0 x 11.2km, resulting in an average flank slope of 0.8° ± 0.08°. In the LOLA DEM, the elevation difference between the centre of Pos1 and the surrounding surface corresponds to 65 ± 10 m (Fig. 7), which is in good agreement with the terrestrial image-based photoclinometry and shape from shading analysis (Fig. 8).
It has an elongated shape with circularity (minor axis/major axis) of 0.72.

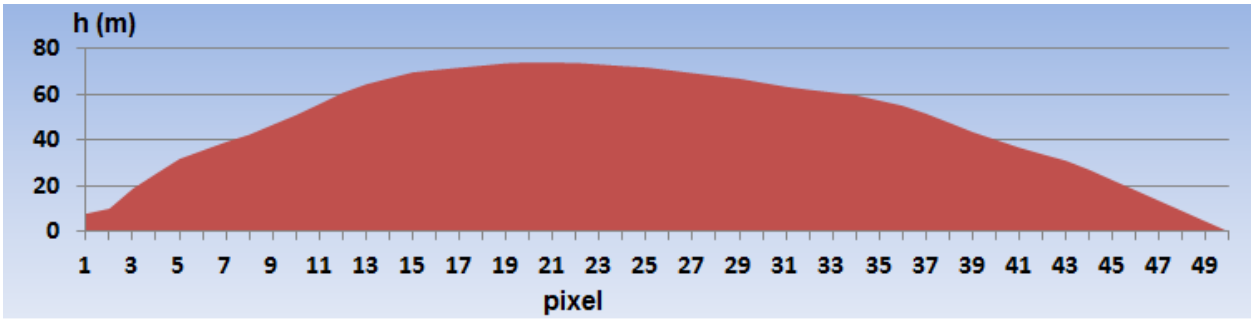

Figure 8: Cross-sectional profile of the shallow domical structure described in the text, obtained using the combined photoclinometry and shape from shading method (Lena et al. 2013), on the image shown in Fig. 2 and regarding the central region of the feature excluding the hills located on the summit. The vertical axis is 40 times exaggerated.

Discussion: The up-bowing of the soil, detected in the telescopic images, confirms the assumption reported by French et al. (2015) that an igneous intrusion occurred in this region. Pos 1 belongs to class In2 of intrusive domes (see Fig. 9).

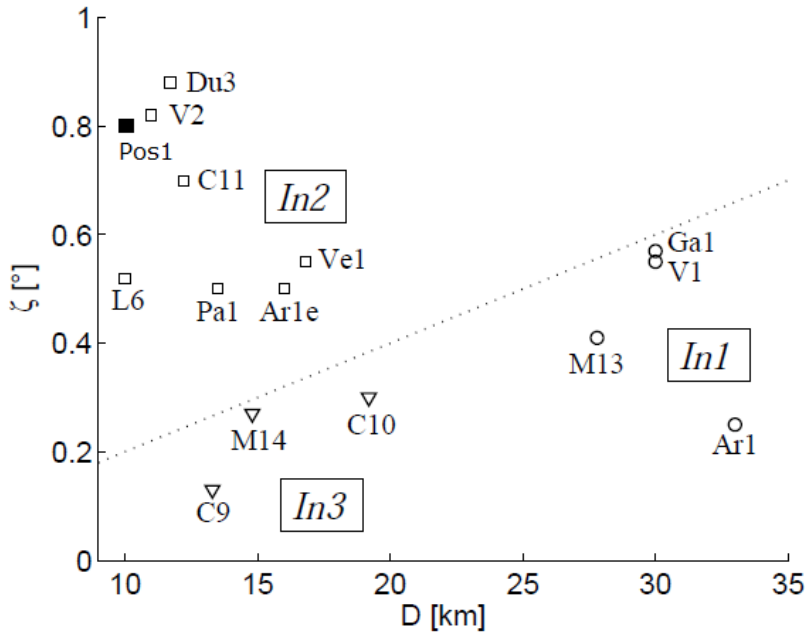

Figure 9: Diameter vs. flank slope diagram illustrating the three established morphometric classes of lunar intrusive domes. Circles, squares, and triangles denote the domes of the classes In1, In2, and In3, respectively. In black square is shown the recognized Posidonius 1 (Pos 1).

Our data based on measurements carried out using LOLA DEM, photoclinometry and shape from shading analysis identify that the dome Pos1 is related to a magmatic body rising near the surface, with a low intrusion depth of 0.36km as inferred using the laccolith model by Kerr and Pollard (1988). The laccolith model yields an uppermost basaltic layer thicknesses of 205m, in accordance with the data of French et al. (2015) that report, in their work, a maximum local mare unit thickness of 190m for the small graben groups in Posidonius.

References

[1] French, R. A., Bina, C. R, Robinson, M. S., Watters, T. R. Small-scale lunar graben: distribution, dimensions, and formation processes. Icarus 252 (2015) 95–106. https://doi.org/10.1016/j.icarus.2014.12.031

[2] Lena, R. and Fitzgerald, B., (2021). Volcanism in Posidonius: magmatic intrusions and the dome Posidonius 1. BAA LS circular, 9-19.

[3] Lena, R., Wöhler, C., Phillips, J., Chiocchetta, M.T., 2013. Lunar domes: Properties and Formation Processes, Springer Praxis Books.

[4] Wöhler, C., Lena, R., Lunar intrusive domes: Morphometric analysis and laccolith modelling, Icarus, 204, Issue 2, 2009, 381-398. https://doi.org/10.1016/j.icarus.2009.07.031.