ALPO Feature: The Moon
Domes in the Hortensius Region

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Introduction

The crater Hortensius resides in the very rich Hortensius-Milichius-Tobias Mayer dome field of the Moon. Many observers have studied the dome field near crater Hortensius. North of Hortensius is a group of six domes called the "Schlumberger Domes" by Jim Phillips, former ALPO Lunar Dome Survey Recorder (1). This group is easily observed at a solar altitude of 4 to 5 degrees, and at least five of the domes show a summit craterlet (2). A sketch map of the region drawn by W.L. Rae in 1964 (Figure 1) shows the six domes to the north of Hortensius plus four more domes to the south. These latter four domes are the subject of this report. In Rae's drawing there are no details of the position or type of these domes. These four domes also appear in the *Geologic Atlas of the Moon* (3), but are not listed in the ALPO dome catalog.

Recently, this group of four domes has been observed by the GLR group. Observation of these domes requires very low solar altitude for maximum detail. In addition, a fifth feature has been observed in the area and is reported here.

Geology

The present domes are in the region of Oceanus Procellarum, just south of the outer wall of the Imbrium Basin . As it is not within a formal basin, we must first examine the likelihood of volcanic activity occurring here. Examination of this region with spacecraft reveals that this geographic area is of intermediate elevation and has an intermediate Bouguer gravity anomaly (4). While lava flows rarely occur in areas of great lunar height or low gravity anomalies, they frequently occur in the present context. Examination of the broader region, extending south from the wall of Imbrium through the Copernicus region, also reveals a wide variety of other volcanic products. So there are domes (especially those north of Hortensius, as well as those east and north of Milichius), the presence of extensive sheet (trap) lava flows, *mare ridges*, and sinuous rilles. From this material, it is clear that this region has been the source of volcanic activity, and is expected to have volcanic geology.

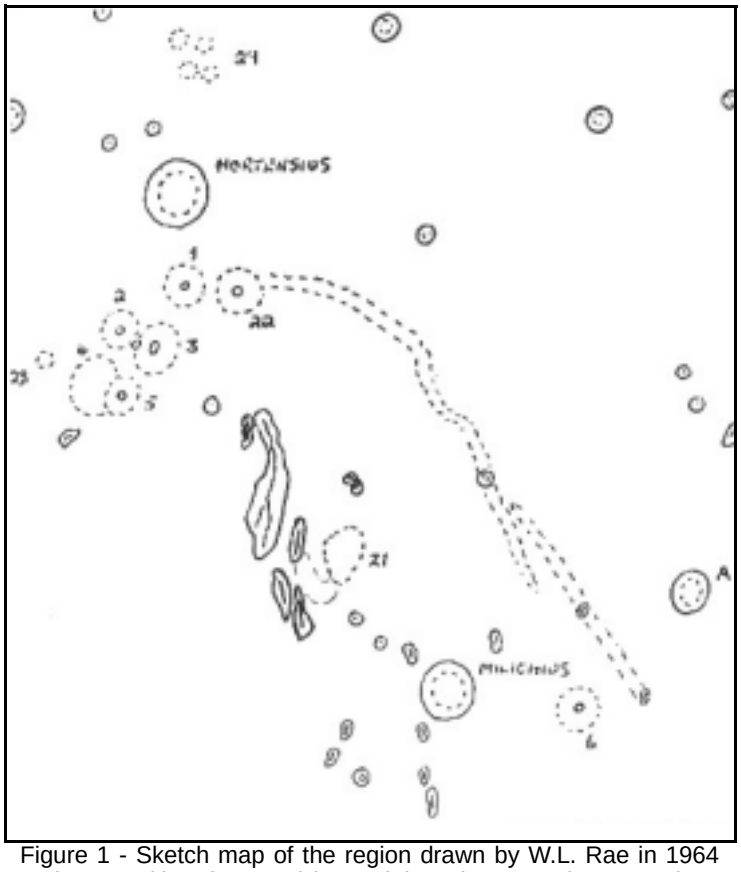

Figure 1 - Sketch map of the region drawn by W.L. Rae in 1964 and reported in reference (1). South is at the top and IAU east is at the left

The geologic history of the region began with the Imbrium impact 3.85 billion years ago. This impact created a multi-ring basin, with the outer ring occurring just north of the Copernicus area (though the Copernicus impact did not occur until much later). It also created deep fractures in the lunar crust.

Over the next few hundred million years, lava was created by radioactive heating of country rock in the upper mantle (5). These low-density melts oozed into the impact-created faults and flowed out into the basin. They were not confined to the basin, but poured through the low points in the basin walls and also tracked up faults created by smaller impacts nearby. It is tempting to suggest that the present volcanic structures formed from lavas that crossed the basin wall. However, domes from satellite vents rarely form this far from the main vent (see

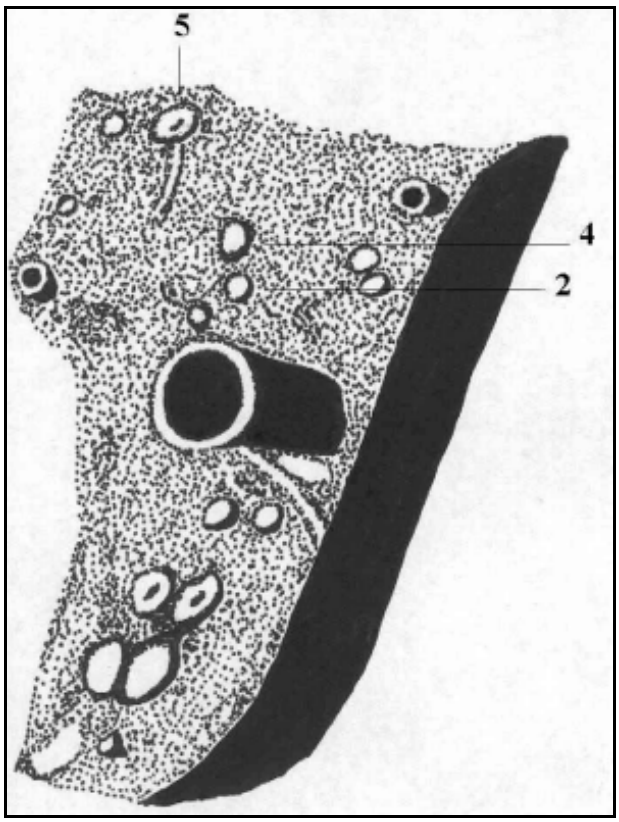

Figure 2 - Sketch map by Raffaello Lena. South is at the top and IAU east is at the left.

examples in reference 6). Further, while so-called "rootless cones" may occur at some distance from the vent, these are usually much smaller (7). Thus, the present volcanic products probably formed from lava tracking up faults just outside the basin proper.

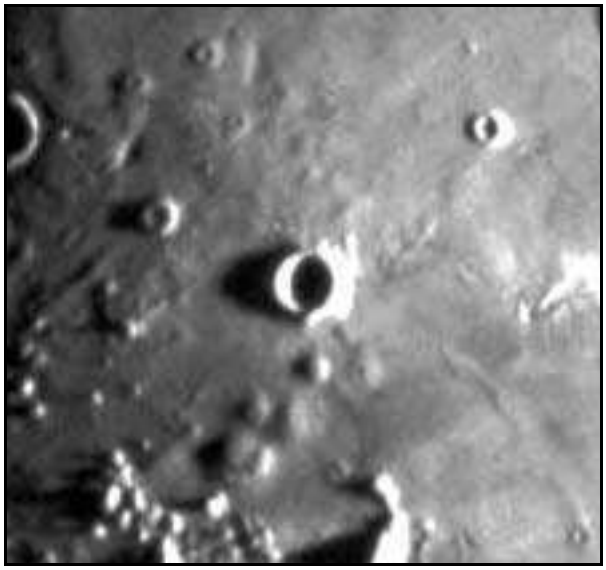

Figure 3 - Image by Morio Higashida. South is at the top and IAU east is at the left.

Eventually, the sheet flows gave way to lavas that were of higher viscosity. These formed small volcanoes, which on the Moon are called domes. The present domes are examples of these late lava flows.

At about this time, volcanism ceased in this region of the Moon. At a later time, this section was struck by the impact that produced the Copernicus crater (1 billion years of age). Although the ejecta from this impact covered all of the volcanic materials in this region, in some places one can still see the patterns of the darker *mare* lavas beneath. These lava fields can be seen both around the present domes and around the domes just north of Hortensius, suggesting that the objects under consideration are indeed volcanic domes.

Figure 4 - *The Photographic Lunar Atlas*, G. Kuiper. South is at the top and IAU east is at the left.

Observations

On August 28, 2001 at 22:00 UT (Colongitude 29.9°, solar altitude over Hortensius 2.12°) Raffaello Lena observed several domes-like features located to the south of the crater Hortensius (Figure 2). This observation was carried out under excellent seeing conditions (I Antoniadi Scale) using a 100mm f/15 refractor.

A CCD image of the region was obtained by Morio Higashida (Figure 3) using a Newton 20 cms f/8, on August 13 2001 at 19:04 UT (solar altitude over Hortensius of 3.06° and Colongitude 205.04°). The image details domes 1-4. *The Photographic Lunar Atlas* also reveals these five features (Fig. 4). This image was taken on August 30, 1956; 11:51 UT (solar altitude over Hortensius of 5.95° and Colongitude of 201.84°). The four domes are also seen in the geologic map of the Copernicus quadrangle (Figure 5). Domes 1-4 appear to be hemispherical, having a gentle slope, but are lacking in other surface features. Dome 5 has a more complex structure (best appreciated in Figure 4).

Table 1: Locations and Diameters of Domes 1 - 4

Feature	Longitude	Latitude	Diameter
1	-27.92	+5.60	5.0 Km
2	-28.10	+5.67	5.5 km
3	-27.87	+5.32	5.0 Km
4 (*)	-28.08	+5.37	5.0 km
5 (complex structure)	-27.72	+4.93	6.5 Km
(*) Head and Gifford reported a dome at -28.00 ° +5.50°			

Using available images, we were able both to measure the diameter of domes 1-4 and to document their position (Table 1). These 4 unlisted domes may be classified according to the Westfall classification scheme as DW/2a/5f/0 (9). The domes appear to require a solar altitude of 1.2° to 3.0 ° in order to be seen well. We were not able to evaluate the height of these domes.

Conclusion

This paper further clarifies the location and type of four domes to the south of Hortensius. A fifth feature (feature 5) is also identified, but further imagery is needed to confirm its real nature.

References

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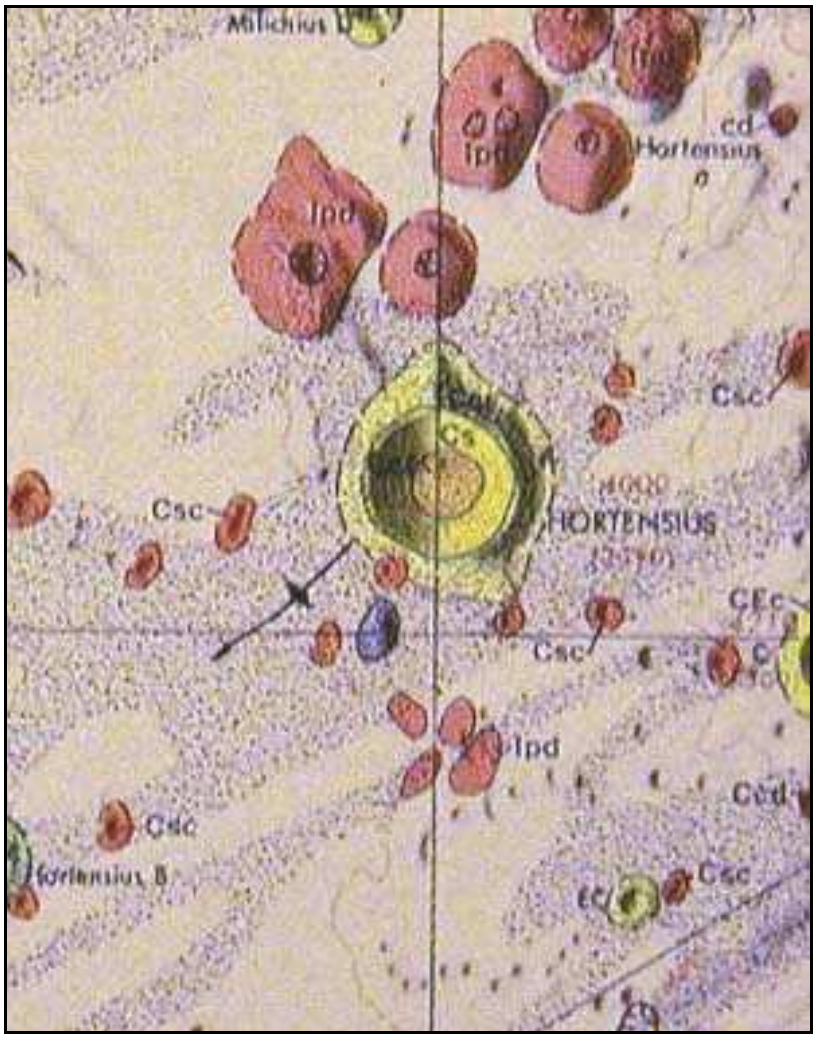

Figure 5 - The Hortensius region. In contrast to the other images of this article, north is at the top and IAU east is at the right. From ref. 3; U.S. Geologic Survey.