LUNAR MARE DOMES: CLASSIFICATION AND MODES OF ORIGIN. James W. Head and Ann Gifford, Department of Geological Sciences, Brown University, Providence, RI 02912

On the basis of morphology, mare domes have been subdivided into seven classes. Class 1 domes have circular to elliptical outlines (Fig. 1), range from 5.5 to 12.5 km in diameter (Fig. 2), and exhibit shallow slopes less than about 5°. All have summit pit craters (Hortensius 2; 7.1°N; 28.0°W; Vitruvius 1, Grace; 14.4°N; 35.6°E) (Fig. 3). Summit pit diameters range from 1.4 to 2.8 km and pit diameter/dome base diameter ratios range from 0.18 to 0.25, generally decreasing with increasing diameter. Class 2 features often have a slightly more irregular outline than Class 1 domes although circular-elliptical outlines are common. Their main distinction from Class 1 domes is in their more irregular cross-sectional shape, a tendency toward flat tops and steeper margins. The majority of these domes range from 6.0 to 16 km in diameter and 80% have summit pits. Pit diameter/base diameter ratios show a range similar to Class 1 domes (Tobias Mayer 1; 12.9°N, 31.3°W). Class 3 domes are generally similar to Class 1 and Class 2 features in shape and diameter but are characterized by uniformly lower topographic relief. Many of these features represent very gentle swellings of mare topography and the margins of the features tend to merge gently with surrounding mare material. Sixty percent of Class 3 domes have summit pits (Vitruvius 2, Diana; 14.6°N; 35.2°E). Class 4 structures are mare ridges and arches and are composed of ridge/arch segments that take on dome-like appearances. Class 4 domes are irregular in shape and no summit pits are observed (Eratosthenes 1; 18.1°N; 8.4°W). Class 5 features are often irregular in shape, range from 5-19 km in diameter and are closely associated with highland units. The mare material forming these features often appears draped on or around a portion of nearby highland terrain. No pit craters are observed (Eratosthenes 4; 22.3°N;4.6°). Class 6 features range from 4-7 km in diameter and appear to have greater relief than other domes in this size range. They are found in close association with highland terrain, often have a slightly higher albedo than surrounding mare, and do not exhibit pit craters. They often appear adjacent to isolated islands, or kipukas, of highland material (Manilius 2; 15.1°N; 7.6°E). Class 7 includes several regions of irregular outline and irregular dome-like topography with complex surface detail (Fig. 1). No pit craters are observed Arago 1 (6.2°N; 19.9°E) and 2 (7.6°N; 25.5°E). The vast majority of the domes in the Marius Hills fall in this class.

Class 1, 2, and 3 domes show generally similar characteristics, and are morphologically very similar to terrestrial lava shields (1). This interpretation is strengthened by morphometric similarities, presence of summit pit craters, albedo similarities, and association with mare material of known volcanic origin. The characteristics of Class 5 features suggest that they largely result from draping of mare material over pre-existing topography during lava emplacement. Class 6 features occur at the low end of the diameter range of mare domes (4-7 km) (Fig. 2) and their similarities to and association with adjacent highlands (Fig. 1) strongly suggests that many of these features originate as islands of terra material with lavas flowing

© Lunar and Planetary Institute • Provided by the NASA Astrophysics Data System

LUNAR MARE DOMES

James W. Head

around them to create a dome-like appearance, or kipuka (2). Class 4 features are not common, are distinctly different from Classes 1, 2, and 3, and are closely related to mare ridge/arch features. Their genesis (and the origin of ridge/arch systems) is uncertain, although they may be related to shallow intrusions (3) or structural warping (4). Class 7 features are uncommon outside of their extensive development in the Marius Hills. Their complexity suggests that they may represent a combination of factors related to mare emplacement, possibly including lavas of higher viscosity (5). The two major types of mare dome occurrence therefore appear to be related 1) to primary lava source areas (Class 1, 2, 3, and 7) and 2) to the interaction of lava deposits with pre-existing topography by draping or kipuka formation (Classes 5,6).

Two types of terrestrial features appear analogous to lunar domes of Classes 1, 2, 3 and 7: the shields of basaltic plains and those of Iceland (1,2,6,7). Eruptions that produce the domes generally extrude lavas through a central pipe vent and flood areas surrounding the dome. This eruption style can be distinguished from flood basalt and Hawaiian shield types of deposits (6). The vent-related lunar domes are concentrated in three areas of the Moon, Marius Hills, Hortensius, and Cauchy. These areas may represent distinctive styles of lava emplacement analogous to terrestrial basaltic plains. All three areas are in relatively shallow mare basins. If the morphologic comparison to lunar domes and small terrestrial shields can be extended to other aspects of these terrestrial features (6), the lunar eruptions associated with domes should have had lower eruption rates than those typical of flood basalts, with lavas erupting through point sources to produce relatively thin flows and a series of coalescing lava shields.

References: 1) Macdonald, G. (1972) Volcanoes: Prentice Hall. 2) Head, J. (1976) Rev. Geop. Space Phys., v. 14, p. 280. 3) Strom, R. (1972) IAU Symp. 47, The Moon, p. 187. 4) Howard, K. and Muehlberger, W. (1973) NASA SP-330, Sec. 31. 5) McCauley, J. (1964) USGS Ann. Rept., p. 115. 6) Greeley, R. (1976) Proc. Lunar Sci. Conf. 7th, in press. 7) Walker, G. (1965) Lanc. Lit. Phil. Soc. Trans., 59, p. 25. 8) J. Whitford-Stark (1975) Shild Volcanoes: in Vol. Earth Moon Mars, St. Martins, N.Y., p. 66-74.

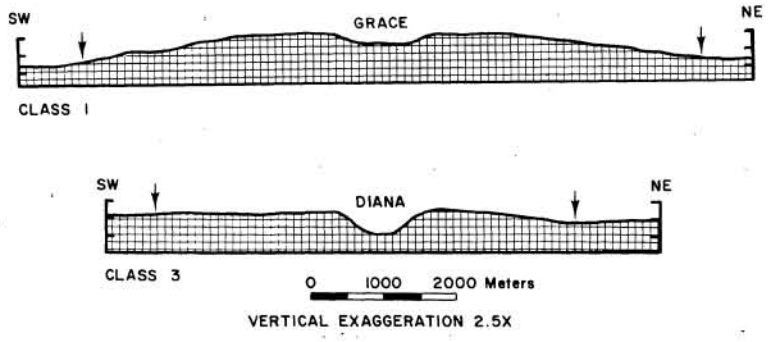


Fig. 3. Grace, Class 1
Diana, Class 3

© Lunar and Planetary Institute • Provided by the NASA Astrophysics Data System

LUNAR MARE DOMES

James W. Head

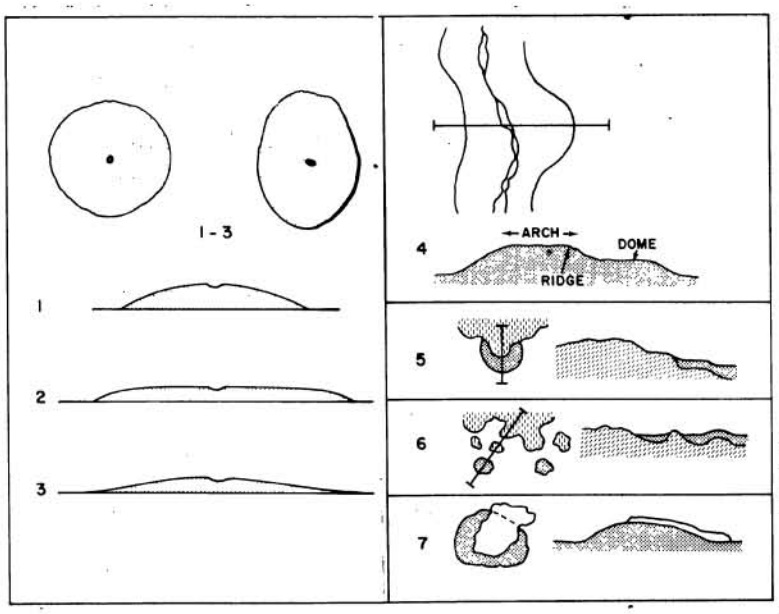


Fig. 1. Dome Types

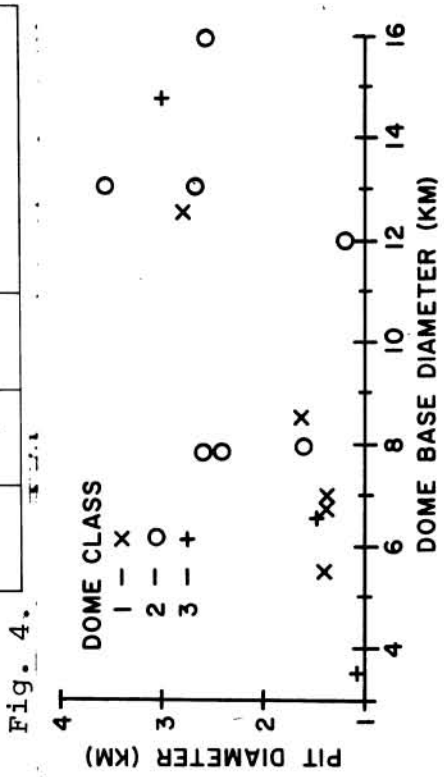


Fig. 4.

Fig. 2.

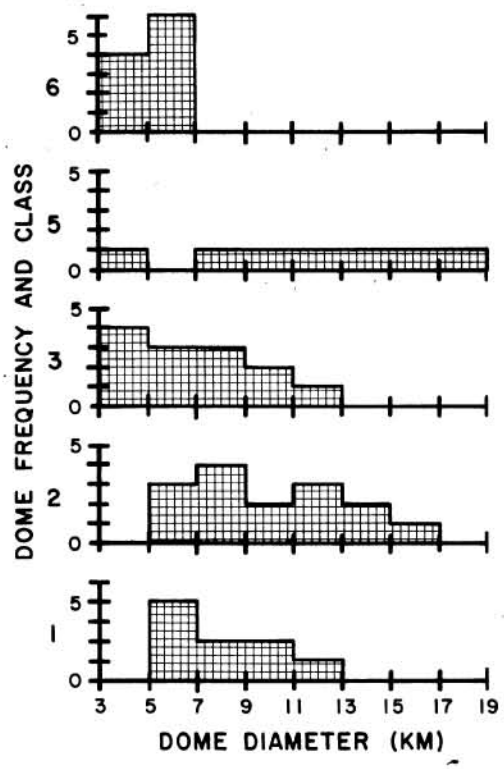
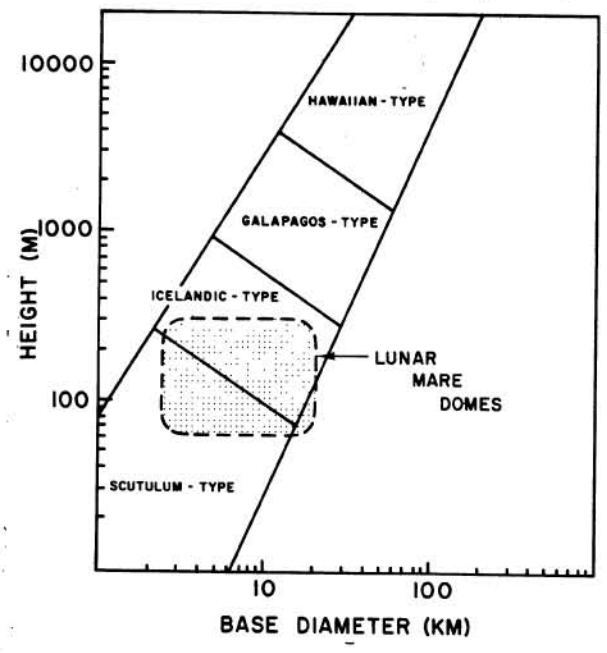


Fig. 5. Earth shields and lunar domes (after 8).



© Lunar and Planetary Institute • Provided by the NASA Astrophysics Data System