
A variety of remote sensing information has suggested the presence of a mare basalt lithology for the extensive unit of light plains located north of the crater Balmer on the eastern limb region of the Moon. These interpretations, based primarily on orbital geochemical and geophysical data, have led to a reexamination of the Balmer region in order to determine the origin and extent of the mare-type chemical compositions in this area. Of particular importance are: 1) Were these plains units localized by a large crater or basin, or an irregular topographic low that was later flooded (Procellarum-type)? 2) Was plains formation in this region the result of a high albedo mare fill, or mixing with surrounding highland material emplaced as ejecta? and 3) Are there any diagnostic features of this particular light plains unit that can be used to distinguish a basaltic composition for plains materials where we do not have geochemical information? Orbital geochemical data have provided evidence that in addition to the high Mg/Al plains units north of Balmer, other patches of light plains may have a substantial component of basalt (Andre et al., 1979), and it is thus possible that previous calculations of the total volume of lunar basalt may be underestimates.

Two rings of a degraded basin (here named the Balmer basin) have been identified surrounding the plains deposits in this area (Fig. 1). Wilhelms (pers. comm. 1980) also suggested the possibility of a basin in this region, while not specifying its exact location. The inner ring, 225 km in diameter, is centered at 15°S and 70°E. The rim is identified on the basis of isolated rugged mountains of pre-Nectarian terra that occur on the NE and NW rims of Balmer crater, and on the southwest rim of Kapteyn. The inner edge of the ring appears to represent a fault scarp resulting from downdropping of the inner basin, similar to the tectonic response of nearside basins to their mare fill. This downdropping has caused truncation of the northern rim of Balmer and the smaller flooded crater west of Balmer. Identification of a possible second ring of the Balmer basin is made on the basis of irregularities in the rim crests of surrounding large craters, and short segments of rugged highlands between these craters. As seen on Lunar Orbiter IV Frame 9N, the rims of La Perouse and Ansgarius appear higher and more massive where they coincide with the proposed second ring than on other parts of their rims. However, the rim segment of these two craters also coincide with the third ring of the Smythii basin as mapped by Wilhelms and El-Baz (1977). Nonetheless, additional intercrater segments of rugged terrain south of Langrenus and north of Humboldt help to define a second ring approximately 450 km in diameter (Fig. 2).

The highly degraded nature of both the inner and outer ring segments suggest a pre-Nectarian age for the Balmer basin, which is supported by the mapping of a possible Nectarian age plains unit within the second ring. According to Wilhelms and El-Baz (1977), the basin fill consists of two plains units; an older Imbrian- or Nectarian-age plains occurs predominantly between the two rings on the northern third of the basin, and a younger, Imbrian-age plains unit is present within the inner ring of the basin. Although this fill was mapped as plains material, geochemical information suggests that at least the northern part of the plains consists of either mare basalt or a basalt diluted with varying amounts of highland material.
Evidence for a basaltic composition of the Balmer light plains is present in the Apollo 15 X-ray and gamma ray data. Andre et al. (1979) noted that this unit exhibits higher Mg/Al ratios than the surrounding highlands, thus suggesting a more mafic composition. Haines et al. (1978) indicated that this area was relatively high in thorium, and Davis (1980) has shown that Fe and Ti are higher than the surrounding highlands. Based on these data, Schultz and Spudis (1979) interpreted the light plains in this region to contain a significant amount of mare material, and noted that this region corresponds to a "cluster" of dark haloed craters. Hawke and Spudis (1980) further suggested that the original basalt fill may have been KREEP-rich, and subsequently diluted with highland material ejected from several surrounding basins. Additional evidence suggesting more than a thin veneer of basalt is indicated by the +40 milligal gravity anomaly associated with the region north of Balmer (Frontispiece, Proc. Eighth Lunar Science Conference).

Orbital X-ray data and the regional setting of the Balmer plains suggest that neither unit is the result of thinly covered mare basalt fill exposed by dark haloed craters. The one dark-haloed crater in the region is located in the ejecta of the crater Petavius, on the second ring of the Balmer basin. Thus, a simple surface veneer of highland "plains" seems unlikely. Further mixing model studies with both X-ray and γ-ray data will help to constrain the possible compositions in this region. The relative age and location of the basin fill, as well as the scarp-like appearance of the inner ring and positive gravity anomaly all support a predominant basaltic composition for the central basin, and suggest a tectonic history similar to nearside multi-ring basins.

REFERENCES


Fig. 1. Lunar Orbiter IV Fr. 9M and sketch map showing Balmer region and outline of the proposed Balmer basin.

Fig. 2. Western ring structures of the Balmer basin. Arcuate segments of highlands south of Langrenus and northwest of Humboldt help to define the second ring of the basin. (Lunar Orbiter IV Fr. 184)