Lunar maria display differences in morphology and composition that appear to be complex functions of geography, rate of effusion of mare basalts, modes of emplacement, time of formation, and other parameters. Some surface features reflect variations in these parameters, and hence provide clues to the geologic histories of the maria. To interpret the styles of volcanism and modes of mare emplacement, certain surface features are being systematically mapped in selected regions of the Moon; for example, the sequence and modes of emplacement of mare deposits have been interpreted for the Orientale Basin (1). The ~370 km-diameter Smythii Basin is similar to Orientale in that both basins are only partly filled with mare deposits and afford the opportunity to interpret the early stages of basin fill. The Smythii Basin, however, is older and more degraded than Orientale, and appears to have a more complex geologic history, particularly in regard to volcanic processes. With the exception of Lunar Orbiter I photography for the northern part of the basin, Smythii is imaged with rather high sun-angle photographs that make its study difficult. Nonetheless, because of the diversity of features, Smythii has been included in several topical (2,3,4,5,6) and stratigraphic studies (7,8,9). However, in none of these or other investigations have the individual surface features for the basin as a whole been analyzed. In this report, we show the distribution of features associated with Smythii and discuss their significance in the volcanic history of the basin.

Features that were identified, mapped, and measured include dorsa, ring craters, "ghost" craters, domes (with and without summit craters), rimless pits, crater chains, arcuate and linear rilles, and scarps. An attempt was also made to define the distribution of a low albedo unit ("dark mantling"), although its identification is difficult in many parts of the basin. Several styles of volcanism are represented in the Smythii Basin. Earliest recognizable volcanism appears to be associated with the modification of many large (25 to 50 km) impact craters to form floor-fractured craters, in which magmatic intrusions elevated and deformed the floors (4). This episode was accompanied by more general fracturing of both the basin floor and the associated deposits within the basin, forming extensive networks of linear and arcuate rilles (grabens). These extensional tectonic processes may have been in response to intrusion of magma into the basin floor. This period was followed by the extrusion of mare basalts. Although the vents for the basalts are not obvious, several of the larger craters in the basin are filled with mare units. Some of these craters are not connected with the mare units outside the crater, indicating local extrusion. The others may have been sources for the Mare Smythii lavas. Conceivably, if basaltic magmas rose through highland-type lithologies, they may have become "mixed," which might account for the high Al:Si ratio previously noted for Mare Smythii (8).

The frequency of dorsa is highest in the north and northeast parts of the basin, an area also considered to have the thickest mare deposits (6). It is
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suggested that the mare lavas flowed generally from the southeast and west toward the northeast and accumulated in the lowest parts of the basin, with the dorsa representing compression associated with both adjustments of the partly solidified lava and with post-emplacement processes. The lack of clearly defined flow fronts, sinuous rilles, and other "plains-type" (1) basalt features suggest high rates of effusion of flood type eruptions. Irregular, hummocky mare terrain on the western margin of the Mare Smythii may represent areas where the highly fluid lavas drained away, leaving discontinuous crusts of solidified lava.

The distribution of dark mantling deposits appears to be associated with irregular pits, crater chains, domes, and linear and arcuate rilles of "raised-rim" morphology. These features are suggested to be volcanic vents for dark mantle deposits, considered in the Smythii Basin to be pyroclastics. The formation of dark mantling deposits appears to be the youngest episode of major volcanism in the Smythii Basin.

References:

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