ORANGE MATERIAL IN THE SULPICIUS GALLUS FORMATION AT THE SOUTHWESTERN EDGE OF MARE SERENITATIS; B. K. Lucchitta, U. S. Geol. Survey, Flagstaff, Az., 86001, and H. H. Schmitt, NASA-Johnson Space Center, Houston, Tx., 77058.

Orange material was observed and photographed in the dark mantle of the Sulpicius Gallus Formation on the southwestern rim of the Serenitatis basin (1). The association of orange and dark material is of special interest as the two materials were observed and sampled by the Apollo 17 crew on the rim of Shorty crater in the valley of Taurus-Littrow.

The Sulpicius Gallus Formation was defined by Carr (2), who considered it to be of Eratosthenian or Imbrian age. Its surface characteristics and albedo (3) are very similar to those of the dark mantle in the Taurus-Littrow area (4): The Sulpicius Gallus Formation generally is smooth and appears relatively uncratered; it seems to drape over the underlying landscape, covering mountains, low hills, and older mare; it tends to presently exist as thick deposits in topographic lows and to leave hilltops exposed as bright areas; and it is embayed by younger mare (5). Dark material also appears to occur beneath younger mare near the edge of the Serenitatis basin, where a young crater ejects dark material, and larger young craters have a dark layer on their inside walls. The dark material seems to be relatively unconsolidated; it moves downslope readily, and craters within it are rapidly degraded to create a smooth surface of apparently young age. The Sulpicius Gallus area differs spectrally from other dark mantle areas in appearing reddish in earth-based color images (6), whereas many other very dark areas on the Moon appear bluish using instrumental determinations (7).

The Apollo 17 original photographic film and visual observations show that the orange material occurs only within dark material on older mare and highlands, it is absent on unmantled, younger mare. The orange material is found predominantly as halos, patches, or rays around fresh, bowl-shaped craters ranging from less than 50 m to about 250 m in diameter. Craters of similar size, shape and freshness with white halos, mixed halos, or without halos are also common. White-halo craters tend to occur near topographic highs, and orange-halo craters near lows, however, all orange-halo craters are located in patches of dark material. Locally orange material is found on the rims and the walls of more subdued, older craters that have been degraded to deep or shallow inverted cones. Orange and red material also

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occurs as prominent streaks parallel to white and brown streaks aligned downslope on the steep walls of a kidney-shaped depression and a graben with darkly mantled rims. Three layers were recognized in these rim mantles as sources of the streaks: in descending order, an orange-brown layer near the surface (probably regolith), an orange layer, and a red layer. The red material also is present as discrete subsurface masses resembling dikes where it has been exposed by younger impact craters.

The orange material locally underlain by red material probably occurs in the subsurface to a depth of about 50 m, either as continuous layers on an undulating surface, or as discrete pockets embedded in dark material. Excavation by impact formed the orange halos. It seems most likely that the orange and red materials are of volcanic origin, perhaps the product of fire fountains (8), and that they are equivalent in age or younger than the older mare lavas.

Even though the general characteristics of the Sulpicius Gallus dark mantle are similar to those of the dark mantle in the Taurus-Littrow area, and a similar origin is suggested, the high abundance of orange material visible from lunar orbit is distinctive to the Sulpicius Gallus Formation.

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