TABLE 1. Summary of Observed Morphology of Areas Associated With Ray Material in Copernicus Region

Area	Radial* Distance, km	On Ray?	On Secondaries?	Size and Morphology of Secondary	V Structured in Spot?	Closest Uprange/Downrange Secondary, km
E5†	47					
E3	97	Yes	Yes	Heavily mantled, ~3.5 km diameter	Yes	~2
E4	122	Yes	Yes	Mantled, ~3.0 km diameter	Yes	~2
R2	185	Yes	Yes	Mantled, ~0.5 km diameter	Yes	~3 (Large, 2.5 × 5.5 km)
R5	325	Yes	Yes	Mantled, ~0.7 km diameter	Yes	~5
M1	331	No	No	···	No	~135
R7	361	Yes	Yes	Fresh, ~2.7 km	Yes	~1
R6	426	Yes	No	??	No	~21
CM	221	No	No	···	No	~27

*Distance is measured from the center of Copernicus. Crater radius along the heading of the ray element investigated here is 44 km.

†Located on Rim of Copernicus: continuous ejecta blanket.

mare soils is the strength of the mafic absorption bands. Weakening of soil pyroxene bands with surface exposure is the normal process of soil maturation and is associated with the development of soil agglutinates [*Adams and McCord*, 1973]. Freshly exposed mare basalt, such as fragmental debris at craters, is not only brighter than mature mare soils but also always exhibits stronger absorption bands.

Ejecta 5 (E5). This area is within 10 km of the northern rim of Copernicus. It is located on a very hummocky unit that could contain a component of impact melt in the overturned flap [*Howard and Wilshire*, 1975]. This spot is located about 10 km to the east of the line between the E3–R2–R5 ray system and the center of Copernicus. It is well within the band of high radar backscatter which characterizes both the floor of Copernicus and a bright region of the ejecta blanket extending 15 to 20 km beyond the rim. The reflectance spectrum for E5 exhibits the weakest absorption bands for any area associated with Copernicus. The band center near 0.91 μm nevertheless is characteristic of the highland low-calcium pyroxene feldspathic composition observed in the crater interior.

Ejecta 3 (E3). The morphology of this area is dominated by the extensive covering of ejecta from Copernicus that blankets this area. Except to the east, it is at about this radial distance from Copernicus that the continuous ejecta blanket fragments into discontinuous deposits. At this E3 locality, however, the ejecta blanket is apparently still continuous. In addition, the spot is located on a heavily mantled crater chain (that nevertheless still has prominent V structures) which extends northward to join the R2–R5 ray. At E3 the subdued secondaries in this chain are about 3–5 km diameter. The radar backscatter characteristics of this area are diffusely bright, with no prominent features. E3 is located just at the edge of the bright ejecta region of Copernicus which extends somewhat farther from the crater at this point than at any other location around the crater. The spectrum of E3 exhibits a more prominent absorption band than E5. The band center occurs at a longer wavelength, near 0.96 μm, indicating an average pryoxene composition that also includes a somewhat more calcium-rich component. This mafic component is more likely to be a 2-pyroxene mixture where the band shift is the combined result of a low-calcium orthopyroxene and a clinopyroxene [*Singer*, 1981]. Models for mixing systematics are discussed in detail in section 4.

TABLE 2. Measured Properties of Areas Associated With Ray Material in Copernicus Region

Area	Visible Albedo P&W	Band Center, μm	Band Strength, %	Radar Backscatter Character
E5	13.8	0.91	2	High
E3	12.7	0.96	5½	Medium high
E4	12.1	0.96	4½	Medium high
R2	10.5	0.965	5½	Diffuse medium
R5	10.5	0.975	8	Diffuse medium
M1	9.3	1.00	10	Low
R7	9.9	0.99	11½	High
R6	10.5	0.995	12½	High
CM	9.9	1.01	24	High

Ejecta 4 (E4). This area, located just south of the Carpathian mountains, borders on a large secondary crater cluster, the largest crater of which is about 3 km in diameter. All the secondaries have a mantled appearance, and they all possess V structures. To the north and west (within 10 km), comparable size and larger secondaries are fresher looking (some possess well-preserved rims) and have V structures up to 12 km in length. Secondaries exist within 2 km of E4 in the uprange direction. Area E4 and the general region north to the Carpathian mountains are moderately high in radar backscatter, but only about half the echo strength of the continuous ejecta blanket to the south. Several of the larger secondaries are apparent on the radar image, but there is no localized feature at or close to the E4 spot. One of the locally radar-bright areas is the 6-km diameter crater located 10 km to the west. The spectral characteristics of E4 are similar to those for E3, implying a similar low and high-calcium pyroxene mixture, although the absorption band appears slightly weaker.

Ray 2 (R2). This area is located 60 km north of the Carpathian mountains in Mare Imbrium on the main ray system that extends from area E3 to area R7. Northward, from the Carpathian mountains the ray can be readily distinguished on the mare by its higher albedo. Area R2 is just north (within 5