Introduction: The objectives of the Apollo 17 mission were to understand the structural setting of the site on the rim of the Serenitatis basin (F1) and the composition and age of the highlands. Also of interest was the valley floor, which appeared overlain by exceptionally dark and bright materials (F2). To this end, two geological maps at scales 1:250,000 [1] and 1:50,000 [2] were prepared. They reflected our understanding of the geology of the Moon at the time. Map [2] shown to the right.

Premission: Highlands. The Apollo 17 site lies within a graben radial to the Serenitatis impact basin and is bordered by high “massifs” (F1,2) thought to have been uplifted after the impact event [4]. The massifs are bordered by rounded domes of the “sculptured hills”, both interpreted to be ejecta composed of breccia [3]. The plains on the valley floor (F2) were considered to be either a veneer of ejecta on underlying lava, or ejecta filling the entire trough. A “dark mantle” of exceptionally low albedo was thought to be young and of possible pyroclastic origin [1,2] because it apparently draped over and subdued young craters (F3,4). Also, crater counts suggested an age possibly as young as the crater Tycho [5] (F9,9). However, young mare of the Serenitatis basin locally embeds the dark mantle [6], inserting ambiguity into the age assignment. Fresh “bright material” at the base of the South Massif (F2) likely was an avalanche derived from the massif. A fresh-looking “crater cluster” southeast of the landing site (F2) was tentatively determined to be secondary from Tycho.

Postmission: Samples from the massifs (F2) were collected from large blocks suggesting consolidated source rocks. The sculptured hills yielded small samples grabbed off the surface, suggesting more friable rocks and explaining the dissected aspect. All highland samples were breccia with ages of 3.9 to 4 b.y. [7], corroborating that impact basins are ancient.

The valley floor (F2), littered with basalt blocks ejected from craters, confirmed that the plains were underlain by mare basalt, around 3.7 b.y. old [9] and about 1400 m thick [8], and overlain by unconsolidated regolith [8].

The dark mantle was not found. However, at the rim of the fresh crater Shorty (F7) the astronauts stumbled across orange and black glass beads [4]. Similar orange and black material ejected from small craters was observed from orbit in a dark mantle on the southwest side of the Serenitatis basin [10] (F6). The orange glass and underlying lava had similar ages of 3.7 b.y. [11]. Apparently a layer of orange and dark glass lies directly on top of the lava floor and was gardened into the regolith [12], giving it its low albedo. The most likely origin is from fire fountains [13]. The previous error in age assignment comes from the rapid degradation of young craters in the dark soil, giving an erroneously young age [14] (F4,5).

The light-mantle (F2) was indeed an avalanche dislodged from the South Massif. A study of rays and secondary craters from Tycho [15] (F8) strongly suggested that the crater cluster on the valley floor and a cluster on top of the South Massif were from Tycho, explaining both the avalanche and its ray-like aspect. Dating the event gave an age of 50-100 m.y. for the Tycho impact [15].

Conclusion: The geologic maps prepared for the Apollo 17 landing site are among the very few extra-terrestrial maps that were checked in the field. Overall, the premission geologic interpretations were correct but were refined by establishing compositions and ages for the sampled rocks. It was confirmed that most geologic processes on the Moon are ancient. A major error was the age assignment of the dark mantle, but it led to the realization that degradation rates of small craters (100-200 m) are highly sensitive to the strength of the target material.

References from abstract #1573: