APOLLO 17 GEOLOGIC MAPS: WHAT WE KNEW THEN. B. K. Lucchitta, U. S. Geological Survey, 2255 N. Gemini Drive, Flagstaff, AZ 86001. blucchitta@usgs.gov.

Introduction: Two geologic maps were published for the Apollo 17 landing site (1:250,000 [1], 1:50,000 [2]). The maps reflected our understanding of the geology of the Moon at the time, but also benefited from the results of earlier Apollo missions [3] and from the Metric and Panoramic Camera photographs. The main objectives of the mission were to better understand the structural setting of the site, and to learn about the compostion and age of the highlands and the valley floor, which included materials of exceptionally low albedo and of a very bright patch.

Pre-mission observations and interpretations: *Highlands.* The Apollo 17 site lies within a graben radial to the Serenitatis impact basin and is bordered by high massifs (Fig, 1), likely composed mostly of Serenitatis ejecta. The massifs were thought to have been uplifted after the impact event, perhaps some of it so late that a sharp knick point with the valley floor is still preserved [4]. The massifs are bordered by rounded domes of the “sculptured hills” and by more subdued hills on the valley floor. All these highland materials were interpreted to be ejecta composed of breccia [3]; an origin as intrusive or extrusive volcanic domes was considered less likely [1,4].

The plains of the valley floor were interpreted either as a veneer of ejecta on underlying lava, or as fluidized ejecta filling the entire deep trough.

Dark Mantle. Material of exceptionally low albedo on the valley floor was considered to be a young mantle of possible pyroclastic origin [1,2]. It apparently draped over and subdued young craters, and crater counts suggested an age possibly as young as the crater Tycho [5]. However, young mare of the Serenitatis basin locally embayed the dark mantle [6], inserting ambiguity into the age assignment.

Fresh bright material at the base of the South Massif was thought to be an avalanche derived from the massif, dislodged by a seismic event or impact from secondary craters [4]

A sharp young scarp, facing east and interpreted to be a fault [2], transgresses the valley floor in a northerly direction and enters the massif to the north as a single scarp.

Craters on the valley floor were assigned Eratosthenian and Copernican ages [1,2]. A fresh-looking crater cluster south-east of the landing site was tentatively attributed to be from Tycho.

Post mission observations and interpretations: *Samples from the massifs* were collected from large blocks that rolled down the slopes, suggesting consolidated source rocks. The sculptured hills, by contrast, yielded small samples grabbed off the surface, confirming more friable rocks and thus explaining the more dissected aspect. All highland samples were breccia with radiometric ages of 3.9 to 4 b.y. [7], corroborating that impact basins are ancient.

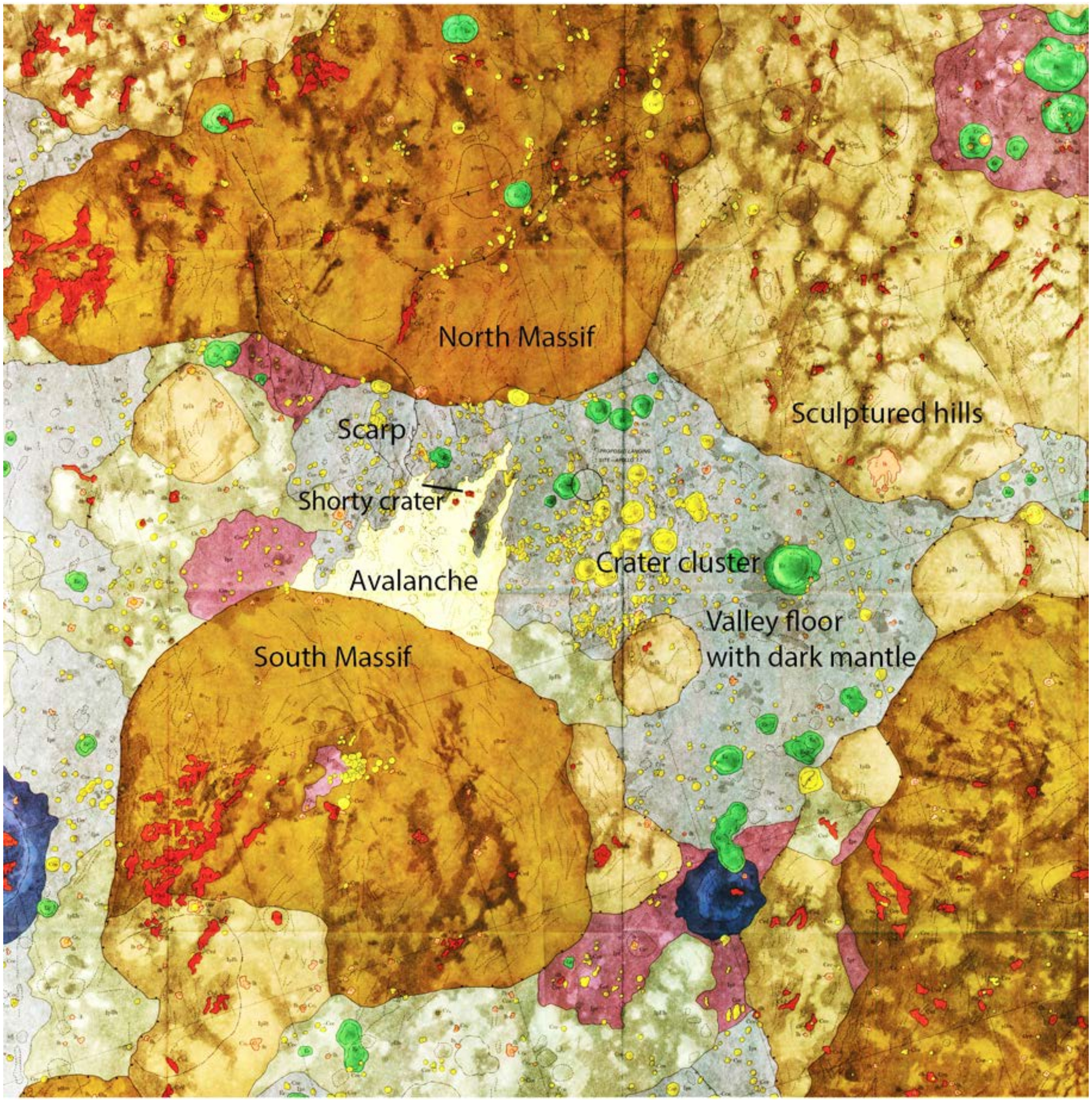
The valley floor, littered with basalt blocks ejected from craters, confirmed that the plains were underlain by mare basalt, around 3.7 b.y. old [9] and about 1400 m thick [8]. Fourteen meters of unconsolidated sediments on top were considered to be regolith [8].

The dark mantle was not found. However, at the fresh Shorty crater, the astronauts stumbled across orange and black glass beads on the crater rim [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]. The orange glass and underlying lava have similar ages of 3.7 b.y. [11]. Apparently a, perhaps intermittent, 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 mantle, giving an erroneously young age [14].

The avalanche was indeed dislodged from the South Massif. A study of rays and secondary craters from Tycho [15] stongly 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].

The sharp ridge crossing the valley floor appears to be a mare ridge with numerous splays. In the North Massif the ridge becomes a single scarp. A study of the scarp’s directions and elevations in the highlands [16] did not support a low-angle thrust; instead it suggested a high-angle fault with changing directions, perhaps following pre-existing fault patterns.

Conclusion: The geologic maps prepared for the Apollo 17 landing site are among the very few extraterrestrial 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.



Geologic map of Taurus-Littrow landing area. Modified from [2].
Dark circle in upper center of valley floor is landing site. Copernican craters: yellow. Eratosthenian craters: green. Imbrian craters: dark blue. Red splotches: dark mantle on highland material. Purple and greenish beige areas are low-lying hills.

References:
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