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APOLLO 16 (DESCARTES) LANDING SITE ROAD LOG

by

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and D. P. Elston

April 1972

This report is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards and nomenclature.

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1. Geologic map of the Apollo 16 (Descartes) region, by D. P. Elston, E. L. Boudette, and J. P. Schafer. 1 sheet, scale 1:100,000.

2. Geologic map of the Apollo 16 (Descartes) landing site area, by D. P. Elston, E. L. Boudette, and J. P. Schafer. 1 sheet, scale 1:25,000.

3. Engineering geology of the Apollo 16 (Descartes) traverse area, by E. L. Boudette, J. P. Schafer, and D. P. Elston. 1 sheet, scale 1:12,500.

4. Apollo 16 (Descartes) landing site road log, by E. L. Boudette, J. P. Schafer, and D. P. Elston. 17 p.

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APOLLO 16 (DESCARTES) LANDING SITE ROAD LOG [1/] [2/]

by

E. L. Boudette, J. P. Schafer, and D. P. Elston

EVA I

0.0 KM Leave ALSEP area on azimuth 280°; distance to Station 1 is 1.4 km.

Drive over undulating terrain of irregular unit of the Cayley Formation with degraded craters up to about 50 m across.

0.3 Cross northeast-trending filigree (possible layering) shown by low, sinuous escarpment.

0.8 Area of Station 2, North Rim of Spook (degraded crater)

Convex escarpment about 5 m high facing southeast, which may require slight detour to north. Boulders ~5 m

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[1/] This road log is intended for use with the following materials:

(a) U. S. Geological Survey, 1972, Apollo 16 (Descartes) Surface Data Package (1:12,500 and 1:25,000-scale maps): [unpublished].

(b) Boudette, E. L., Schafer, J. P., and Elston, D. P., 1972, Engineering geology of the Apollo 16 (Descartes) traverse area (1:12,500-scale): U.S. Geol. Survey Open File Map, April 1972.

(c) Elston, D. P., Boudette, E. L., and Schafer, J. P., 1972, Geologic map of the Apollo 16 (Descartes) landing site area (1:25,000-scale): U.S. Geol. Survey Open File Map, April 1972.

[2/] Station tasks and procedures are not given. See other sources such as cuff check lists and traverse planning kits.

across appear to northwest in direction of Buster and possibly athwart path. Layering (bench and step topography) or colluvial features may be present in Spook.

0.9 Leave area of Station 2 on azimuth ~270°

Small (~30 m), sharp secondary craters about 100 m ahead and to the southwest. Buster Crater is within a block field ~150 m to northwest. A convex escarpment trending to northeast, east of Halfway Crater, may provide a bedrock sampling target.

1.3 West of Halfway Crater

Major escarpment and crease with up to 20 m of relief lies athwart traverse and may require detour to the south. Traverse here is over undulating, cratered, locally block-covered terrain. Largest blocks are associated with 30-40 m secondary craters.

1.5 Station 1 (east rim of Flag)

Plum Crater is to southwest on edge of Flag's rim and continuous ejecta blanket, about 40 m across at this point. Boulders in the area are probably a mixed suite contributed from North Ray and South Ray Craters, and perhaps local sources. Layering and colluvial features are possible in Flag Crater. Ray material (light albedo) from South Ray is abundant east and west of Flag. Return by same route to Station 2, then to Station 3 which is 50 m west of LM site.

2.9 Station 3

Regolith here appears to be darker, representing different underlying unit than in areas of Flag and Spook craters. Area is comparatively free from South Ray contribution that was seen to west. An albedo contrast appears to mark the contact.

EVA II

0.0 KM Leave LM Site on azimuth ~173°; distance to Station 4 is 4.4 km

Route south to Survey Ridge is over rolling irregular terrain. Pronounced ray material is nearly absent over the route, which has low albedo. The northern two-thirds of this traverse leg is lightly cratered; the southern third is among several 20-40 m craters both sharp and degraded. Mounds that occur northeast of Phantom Crater may be volcanic constructional features. Filigree, shown by albedo stripes on the crest of Survey Ridge, is interpreted to be primary layering in volcanic rocks. Outcrops may be found in areas where the filigree is well-developed.

The immediate approach to Survey Ridge is over a bright patch of regolith believed to be strewn by a block swarm from South Ray. Abundant relatively small blocks, and possibly an ejecta mantle, occur near the crest of the ridge.

1.3 Traverse crest of Survey Ridge on azimuth 227°

Blocks of varied lithologic types may occur along the ridge crest which is mantled by light regolith. Northeast-trending convex scarps facing southeast bound the ridge. The slope of Stone Mountain to the south appears to be held up by two major stratigraphic units comprised of probable lava flows. The major units are recognized on the basis of topographic benches, albedo, and surface morphology. The

lower unit is light medium gray with a relatively smooth surface, and the upper unit is dark medium gray and rougher appearing. The best development of filigree occurs to the southeast of Stone Mountain, associated with lobate scarps. This filigree may reflect primary layering.

1.7 Leave Survey Ridge on azimuth ~168°

The traverse from the ridge for a distance of about 1.4 km is over a lightly cratered terrain characterized by patches of high albedo dispersed over a regolith of low background albedo. These patches are probably produced by the same process which affected the ridge crest, therefore blocks from South Ray are probably abundant. The latter one-third of this traverse leg in the direction of the major morphologic boundary at the base of Stone Mountain is over rather dark regolith. Some large blocks are associated with small 25-35 m craters. The approach to Stone Mountain is over a transitional unit (Idd_0) between rocks of the Cayley Formation (Ici) and materials of the Descartes Mountains. Albedo contrasts and low scarps or subtle topographic breaks may be apparent on the ground which define the contact. Filigree occurs ahead and to the southeast, with possible associated outcrops.

2.7 Turn right to azimuth 191°

Route is between two rather fresh, probable secondary craters; blocks are resolvable within or on their rims.

The regolith appears dark. A convex escarpment or change in albedo of regolith about 70 m south of the southern crater indicates a possible change in subsurface materials. South of the contact, filigree is common. The following hypotheses to explain the origin of filigree seen on the photographs need to be evaluated:

1. An optical or photographic phenomenon.
2. Colluvial (regolith) flow patterns.
3. Relief resulting from near-surface layered bedrock forming benches draped by regolith. Outcrops should occur locally.
4. Some combination of the above.

3.1 Station 6 bypass; turn left to azimuth 161°

Slope on Stone Mountain increases up to about 10° near the contact between Idd_0 and Idd_1, where regolith becomes darker and is sparsely cratered. The thickest regolith may occur at the base of the mountain, related to mass wastage on the slopes above. A relatively rapid destruction of small craters by colluvial transport may occur here.

3.5 Station 5 bypass; turn right to azimuth 176°

Traverse is along the base of the upper and most prominent Stone Mountain bench held up by unit Idd_2. A distinct albedo contrast between the principal units may be visible on the ground here. Outcrops may occur on the steep pitch. A view west into Stubby occurs at end of traverse leg.

3.9 200 m west of Cinco Craters; turn left to azimuth 132°

The slopes increases to ~12°-15° where trafficability may become fairly difficult. The surface becomes smoother after ~200 m, although crater density, block density, and block size increase. Regolith thickness may decrease upward on slope. The filigree here may or may not compare to that on lower slopes.

4.4 Station 4 (Cinco Craters d and e); depart on azimuth ~331°

A west to north panorama of Descartes landing site area may be seen from here. This area provides the only opportunity to see simultaneously into several craters in the southern part of the landing area. The walls of South Ray, Baby Ray, Stubby, and Wreck are of particular interest. Large scale geomorphic features of Smoky Mountain can be observed from here also. Boulders about 10-20 m across, probably from South Ray, occur about 50 m to south on the rim of Cinco e. Cinco d and e craters appear to penetrate the regolith, believed to be thin, and should provide an opportunity to sample locally derived Descartes materials.

The return to Station 5 is scheduled to cross terrain east of Cinco a, b, and c. The appearance of filigree, blocks, and albedo contrasts may be enhanced in different sun angle, and regolith thickness may be easier to estimate.

5.2 Station 5; depart on azimuth 341°

Observations made near Station 5 on bypass traverse

leg may be helpful in explaining the prominent step and bench topography here. Station 5 appears to be just above the base of a regional sub-unit of the Descartes (Idd_2). The lithologic contrasts between the sub-units of the Descartes materials (Idd_2 and Idd_1), as well as with the Cayley Formation at the base of Stone Mountain, may be distinctive and thus reflected in the regolith.

Retrace traverse bypass leg to Station 6.

5.6 Station 6; depart on azimuth ~239°

Station 6 is near the contact between Idd_1 and the transitional unit, Idd_0. The route to Station 7 approaches the rim of Stubby Crater over sparsely cratered terrain with irregular ejecta from South Ray and regolith strewn by block swarm debris. An increase in block density and block size toward Station 7 is probable. A convex escarpment believed to be a lava flow front (the contact between Idd_1 and Idd_0) is crossed about halfway between Stations 6 and 7. The escarpment is probably mantled by regolith, but it may be possible to sampled bedrock float along it. Filigree (layering?) may be traced off the flank of Stone Mountain into the east part of Stubby.

6.0 Station 7 (BB Crater); depart on azimuth ~302°

BB Crater (about 50 m across with a block about 5 m across on the east rim) probably penetrates the regolith and into Descartes materials. The underlying Cayley

Formation also may be exposed. Blocks in the area could thus represent locally derived Descartes and Cayley materials, as well as Cayley from South Ray. Filigree occurs on the east wall of Stubby, and overlap relations between Idd_0 and Ici may be observable on the wall and floor. Alternative interpretations of the origin of the filigree are:

1. Photographic artifact or optical effect.
2. Colluvium lobes.
3. Regolith-mantled lava flows, and locally exposed bedrock.

Station 7 provides (with Station 14) the best opportunity to describe the morphology of the irregular, rimless or low-rimmed craters in order to evaluate their genesis:

1. Endogenetic (volcano-tectonic collapse structures).
2. Exogenetic (impact craters).
3. Some combination of processes.

The route to Station 8, along the north rim of Stubby, probably will be over a block-strewn cratered area across which trafficability is likely to become increasingly difficult. Blocks are probably mostly from South Ray Crater. Denser ray material will be encountered at the end of the traverse leg near Station 8. The mapped contact between Cayley Formation and Descartes materials is crossed about 0.3 km from Station 7. A morphologic break and associated albedo contrast may occur at the contact.

6.5 Station 8 (north rim of Stubby); depart on azimuth 008°

Station 8 is the closest approach to South Ray Crater and is located upon a probably continuous patch of blocky ejecta derived from South Ray Crater. A convex northeast-trending escarpment mapped northeast of the station may project as far as the station. Secondary craters from South Ray and Baby Ray ejecta may be identified in the area. Northeast-trending creases occur about 200 m northwest of the station. One of these probably will be crossed on the traverse leg to Station 9. The appearance of wall morphology, filigree, and the major contact in Stubby seen near Station 7 may be enhanced by different sun angle.

The first half of the traverse leg to Station 9 is over terrain similar to that at Station 8, probably with difficult trafficability. The northeast-trending crease separates the light ejecta (or disturbed terrain) from dark regolith, the latter with probably improved trafficability.

6.9 Station 9; depart on azimuth 001°

Station 9 is in dark regolith. A sharp albedo contrast where cratering density is less may be apparent on the ground. The return to the LM site from Station 9 is over lightly to moderately cratered terrain, locally strewn by South Ray, Baby Ray, and possibly North Ray blocky ejecta.

7.7 Turn to azimuth 040°

This traverse leg skirts inside the west rim of a

gentle, rimless circular depression, and is parallel to irregular, faint ray material to the northwest.

8.0 Turn to azimuth 018°

Turn is made around eastern side of a degraded crater, ~40 m across, between SP and Sunset Craters. After crossing a gentle basin, the southwest end of a northeast-trending, rather prominent ray from South Ray is encountered about 0.6 km beyond the turn. About 175 m north of the ray, the conspicuous bright-haloed WC Crater is blocky, and the trafficability locally may be difficult. The return to LM is via the east side of Double Spot Craters.

9.5 LM, end of EVA II

EVA III

0.0 KM Leave LM; azimuth 030°

After leaving the smooth, sparsely cratered area at the LM site, this leg of traverse climbs a long irregular slope more than 40 m high, passing through a gentle swale. A mound about 250-300 m across with a summit crater occurs about 150 m west of the north part of the leg; this may be a small volcanic constructional feature with an associated volcanic crater; alternatively, the crater may be an impact feature unrelated to the mound. A low escarpment associated with an albedo change from relatively dark at the LM site to relatively light occurs at the north end of the leg. The change in albedo may mark the boundary between layered units in the Cayley Formation (Ici).

0.8 Turn to azimuth ~356°

At the beginning of the traverse leg, the depression just to west contains some filigree (possible layering). The north half of the leg follows the irregular outer slope of the east rim of Palmetto Crater. Very few blocks large enough to be visible on the photos appear around Palmetto, but many smaller ones may be present. This east rim area also appears to be crossed by thin and discontinuous ray material from South Ray Crater. On the rim of Palmetto, the north end of the leg crosses a north-facing escarpment believed to be a layering bench. It then passes along the

east slope of another mound with a summit crater (End Crater; Station 17). This part of the traverse should provide a good view of the flank of Smoky Mountain, where filigree occurs on its relatively smooth steep slope. This filigree is interpreted to have the same origin as that on Stone Mountain, reflecting primary layering in lava flows.

2.2 Turn to azimuth ~002°

The first half of this traverse leg is along generally north trending low ridges. Filigree along sides of ridges may be outcrop traces of bedrock, more or less covered by regolith, and may provide float samples of the bedrock. Increasing amounts of North Ray ejecta may appear along this leg, although no rays or blocks are visible on photographs.

The north half of this leg crosses a degraded crater with filigree on its walls, perhaps reflecting a thin light-colored layer. The traverse then climbs onto the ray-covered, blocky, continuous ejecta mantle of North Ray Crater, of uncertain but probably difficult trafficability.

4.7 Turn to azimuth 304°

This leg is well within the blocky ejecta mantle around North Ray Crater, and almost certainly difficult to cross. However, the orientation of the leg may permit travel between radial concentrations of blocks. Single blocks or ray-like groups of different lithologies may provide opportunities to sample various strata exposed in North Ray Crater.

5.2 Stations 11 and 12; rim of North Ray Crater

The strata exposed in the walls of North Ray may be correlatable with ejecta lithologies on the basis of albedo. Faults, and possibly exposures of dark dike material, may appear in the east and south walls and floor of the crater. An overturned flap of ejecta is inferred on west rim of crater from photographic study. The southeast rim is probably the best point for a closeup view of the slope of Smoky Mountain where filigree, creases, possible bedrock-controlled benches, and the major morphlogic boundary between Descartes Mountain materials and rocks of Cayley Formation occur.

The east and west walls of North Ray are presently interpreted to be stratigraphically equivalent on the basis of a thick, light-hued unit near the bottom which has been traced discontinuously around the crater wall. An alternative interpretation is that the east and west walls are not equivalent, but disjunctively dislocated along a north-south vertical fault.

The conspicuous large block just north of Station 12 may have originated in dark (dike?) material in the south wall and floor of North Ray.

5.4 Leave Station 12; depart on azimuth 130°

Descend a slope of blocky ejecta of North Ray Crater, initially returning along the previous northwest-bound leg.

6.1 Station 13; depart on azimuth ~122°

This station is just off the mapped limit of continuous North Ray ejecta in an area of scattered blocky ejecta and numerous small craters. The Descartes/Cayley contact occurs about 200 m to the east, slightly upslope.

About midway to Station 14 the traverse crosses several filigree lines, and then the Descartes/Cayley contact. An indication of the contact may be seen in a topographic break, or in a change in the character of the regolith. The traverse then climbs the ridge on the southwest side of Ravine Crater, which may be somewhat blocky.

6.9 Station 14, Cat Crater; depart on azimuth ~183°

This station is on domical material of the Descartes Mountains, which may be compared with material of Stone Mountain seen on EVA II. The station provides a close view of the near part of the slope of Smoky Mountain, as well as an over view into Ravine Crater, a rimless or low-rimmed depression that perhaps is the product of endogenetic collapse rather than impact. The ridges on the southeast and southwest sides of Ravine Crater appear to be structurally controlled. Observations of the interior of the crater and its peripheral ridges may provide information on its origin. Creases perhaps underlain by fractures in bedrock are locally abundant. Cat Crater, 50 m across, exposes material of the southwest ridge. The station also should provide a good

view downslope across the Descartes/Cayley contact onto the Cayley lowland.

The traverse leg to Station 15 descends from the ridge and crosses the contact onto the Cayley Formation. It then proceeds southward across moderately cratered terrain, probably containing decreasing amounts of North Ray ejecta, and with only a thin overlay of ray material from South Ray Crater. Numerous north-south filigree lines may be bedrock controlled.

8.2 Station 15, Dogleg Crater; depart on azimuth 251°

This 50 m fresh crater samples the Cayley Formation in a moderately cratered area with many creases (fractures) and filigree lines (layering in bedrock?). The following traverse leg intersects filigree lines and small scarps at nearly right angles; creases are of various orientations. This area is moderately cratered, and covered by disturbed regolith or thin overlay of ray material from South Ray Crater.

8.9 Cross outbound track

9.2 Station 16, Dot Crater; depart on azimuth 152°

This is a fresh 50 m crater with a bright and probably blocky ejecta ring, located on a low mound. Filigree lines extending north-south occur a short distance to the north. The mound could be a subtle volcanic constructional feature,

overlying a degraded ejecta blanket from Palmetto Crater. The next traverse leg passes along the northeast side of a degraded, saucer-like, 250 m depression, which also occurs on the degraded rim of Palmetto.

9.7 Station 17, End Crater; depart on azimuths 176° and 210°, returning to the LM Site via the outbound track

This sharp-rimmed, conical 60 m crater is on the summit of a smooth mound 250-300 m wide. It was passed on the east during the northbound traverse. The origin of the mound and the crater--whether they constitute a related volcanic cone and crater, or whether the crater is of impact origin and not related to the mound--is of great interest. If the mound is not of volcanic origin, it probably is part of a modified as well as degraded rim of Palmetto. This Station 17 also permits observation of the degraded rim, walls, and central mound of Palmetto Crater. The appearance of features observed on the northbound traverse may be enhanced by the different sun angles on the southbound traverse.

11.9 LM; end of EVA III