P.227

GEOLOGY OF THE REGION OF THE DESCARTES (APOLLO 16) SITE

D. P. Elston, E. L. Boudette, J. P. Schafer, and W. R. Muehlberger
U. S. Geological Survey, 601 East Cedar Avenue, Flagstaff, Arizona 86001; and C. A. Hodges and D. J. Milton, U. S. Geological Survey, 345 Middlefield Road, Menlo Park, California 94025

The Apollo 16 landing site, known as the Descartes site (9°00'01"S; 15°30'59"E), was selected to sample and study the geology of probable volcanic constructional units of the lunar highlands, units which have yet to be directly studied.

The landing site area is at the west edge of the Kant Plateau, which is topographically the highest region on the near side of the moon, and which is believed to consist mainly of volcanics. Rocks of the Cayley Formation and of the Descartes highlands (a distinctive unit of the Kant Plateau) can be sampled within short traverse distances of the landing site.

The Cayley Formation is the plains-forming unit of the highlands. It is characterized by mostly smooth to undulating terrain and probably is composed of rocks derived from fluid lavas and/or pyroclastic debris. The Cayley fills old crater floors and topographic lows in the highlands. At places well away from the Descartes region, the Cayley appears to be overlapped by the latest mare volcanic materials.

Materials of the Descartes highlands form hilly and mountainous regions which stand topographically above the Cayley. However, Descartes materials at places appear to be intergradational and thus contemporaneous with the Cayley, and are interpreted to represent a more viscous phase of volcanism. Samples of the plains- and mountain-forming units will contribute essential information on the difference between mare and highland volcanism, and on the chemical and thermal evolution of the moon.

Detailed geologic mapping was carried out using second-generation film positives of Apollo 14 convergent 80 mm and 500 mm photographs analyzed in an analytic stereoplotter; the photogeologic observations were recorded on a planimetric base by means of a coordinograph. Fine details not recorded on conventional photographic prints became available for structural and stratigraphic analysis.

Geology of the landing site region.--The main mountain and hill areas are divided into two units. Areas characterized by irregular hills and plateaus and linear troughs are mapped as hilly, furrowed Descartes materials. Areas characterized by smooth convex domes and linear troughs are mapped as domical

Geology of the region of the Descartes site

D. P. Elston

P-228

Descartes materials.

The plains of Cayley materials are mostly gently undulating, except for craters. One particularly smooth area has been mapped separately as smooth Cayley. Also mapped separately is a large area of irregular Cayley that includes several diverse types of topography not easily separable, and at places includes low, irregularly lobate hills. Apollo 16 is to land on irregular Cayley.

A transitional unit of undulating to low-hilly topography separates plains from hills and mountains in many places. This unit has been previously included in Cayley, but we prefer to call it a facies of Descartes materials, because its geologic features are commonly continuous into adjacent hill and mountain areas. Even so, the boundary between Cayley and Descartes is crossed by numerous structural lineaments and locally by apparent outcrop traces of stratiform rock bodies.

Outcrop traces of rock strata are recognized in a few places on the moderate-resolution 80 mm photographs on which the regional map is based.

Lineaments believed to be the traces of fractures and faults in the bedrock occur abundantly in all map units except the smoothest Cayley material, and locally constitute as many as four intersecting sets. The mapped density and orientations of the lineaments indicate multiple deformations. Some lineaments follow the bottoms or sides of the conspicuous linear troughs of the hill and mountain areas, supporting an interpretation that the troughs are of fault origin. Some such lineaments extend out of the troughs, which indicates that the lineaments are bedrock and not slump features. Zones of fine parallel lineation occur at a few places. They locally transect apparent lines of stratification, and may be zones of foliation or shearing.

Numerous subcircular to elongate depressions, rimless or with rims notably lower than those of impact craters of comparable form, occur throughout the region, except in pre-Imbrian materials. These depressions are gradational in size and form into the linear troughs of the uplands, and are believed to be mostly of endogenetic (volcano-tectonic) origin.

Impact craters of Imbrian(?) to late Copernican age are scattered throughout the region. On both Cayley and Descartes materials, craters of sizes above the limits of resolution (about 50 m on the 80 mm model and 10 m on the 500 mm model), are of frequencies notably below saturation or steady-state levels. This indicates either a relatively recent age of formation of the rocks compared to those of previous Apollo landing areas, or an anomalously low impact frequency. However, two "island" areas of older landscape, bearing severely degraded craters (or ring structures) of inferred pre-Imbrian age, project through the cover of younger materials about 20-25 km southwest and northwest of the landing site. One of these areas appears to be saturated with craters of sizes far above the limit of resolution. The apparent overlap

P. 229

relations suggest that pre-Imbrian materials may occur at a moderate depth beneath the landing site.

Geology of the traverse area.--The landing site and most of the traverse length lie within the unit of irregular Cayley materials. Traverse plans presently call for the examination and sampling of domical Descartes materials on Stone Mountain to the south during EVA 2, and on Smoky Mountains to the north during EVA 3.

A layered series of rocks that may include both Cayley and Descartes materials is exposed in the walls of North Ray crater. Strata in the crater locally appear highly deformed, as well as cut by a prominent N-S fault. Structural and stratigraphic relations between Cayley and Descartes materials may be exposed in the crater. A possible overturned flap of material derived from within the crater occurs on the western rim of the crater.

Sets of fine irregular lineaments are identifiable at many places in both the Cayley and Descartes materials. At some places, some of the mapped lines may have been produced by downslope movement of regolith. However, in most places the relationship of the lines to topography indicates that they represent the outcrop traces of sequences of finely stratified rocks that lie very close to, if not at, the surface. Actual bedrock outcrops perhaps occur only on cliffs such as those within North Ray crater. However, regolith in the other areas of inferred stratification cannot be more than a few meters (perhaps locally less than one meter) thick, so that the stratification pattern has not been destroyed by movement of regolith.

Several craters other than North Ray in and near the traverse area reveal that a layered series of rocks makes up the unit mapped as irregular Cayley. The layers visible on the photographs appear to range in thickness from about 10 to 40 m. At least four distinct layers are exposed in North Ray crater, two layers in Baby Ray crater, and three layers in South Ray crater. Stratification also has been recognized in parts of the walls of several older craters of comparable size. Only a most tentative correlation of strata between craters can be made at this time. Planned surface geologic and geophysical investigations will provide data that could lead to a reasonably accurate understanding of the stratigraphic and structural relations in the landing site area.