PART B

AITKEN CRATER AND ITS ENVIRONS

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The crater Aitken is among the most significant features photographed during the Apollo 17 mission. This was the first Apollo mission to fly over Aitken, located at latitude 17° S, longitude 173° E, in as yet undivided highlands. The crater is approximately 150 km in diameter and, based on shadow measurements, approximately 5 km deep.

Aitken is one of few fresh-looking and therefore relatively young craters on the lunar far side; its rim deposits are clearly superposed on older, unnamed features. The crater is characterized by (1) a slightly high albedo, continuous ejecta blanket that extends outward to approximately one crater diameter; (2) flow patterns and dunes extending beyond the continuous ejecta blanket to approximately two crater diameters; (3) sharp secondary-crater chains that also extend outward to two crater diameters; (4) irregularly terraced crater walls having very few flat surfaces; (5) dark mare-like fill with some light-colored swirls; and (6) a cluster of craters 6 km in diameter with interior domical structures and "high lava marks" on their walls.

Before the Apollo 17 mission, Aitken Crater was photographed by the Lunar Orbiter II and Zond 8 spacecraft. However, the Apollo 17 coverage added numerous details, as summarized in the following description of the general setting of the crater and its features.

CRATER SURROUNDINGS

Aitken Crater is in a rugged and densely pitted area of the lunar far-side highlands. As shown in figure 32-6, the continuous ejecta blanket that extends 100 to 150 km from the rim crest is somewhat brighter than the surroundings. In this zone, thick debris mantles and subdues preexisting topography.

Chains and clusters of craters that are most probably secondary to Aitken Crater are best portrayed in the low-Sun-angle photography of Zond 8; one crater chain measures approximately 300 km in length (fig. 32-7). Numerous craters in the vicinity of Aitken are filled with light plains materials. Some of these craters are younger than Aitken, indicating that the plains materials are not Aitken ejecta but may be locally derived. Intercrater light plains in the same region, however, are more densely pitted and are overlain by craters secondary to Aitken and by fine ejecta. These observations suggest multiple sources for the light plains units in the lunar highlands.

Flow scarps probably related to the deposition of the ejecta blanket of Aitken Crater occur beyond the continuous rim deposits. These small-scale structures are best studied in high-resolution Apollo 17 panoramic camera photographs. Two examples in the region north-northeast of the crater are shown in figure 32-8.

Scarps in both areas display lobate fronts and appear to cross the terrain with complete disregard of preexisting topography. The scarps are reminiscent of the flow scarps in the area of the crater Mandel'shtam (ref. 32-15). Similar but not identical scarps were also observed around King Crater (refs. 32-16 and 32-17), where they show definite relationships to the preexisting terrain—accelerating downslope and decelerating upslope (ref. 32-16). No such relationship is clear in the case of the flow scarps near Aitken Crater.

CRATER INTERIOR

Although generally circular, the rim crest of Aitken Crater is crenulate and marked by a few straight segments. There is an affinity toward northeast-southwest and northwest-southeast linear trends.

The wall of Aitken Crater is irregular. There is one steep scarp in the northeastern part and only one discontinuous terrace that extends to approximately one-fifth of the crater depth, and the rest of the wall is made up of domical and irregular blocks (fig. 32-9).

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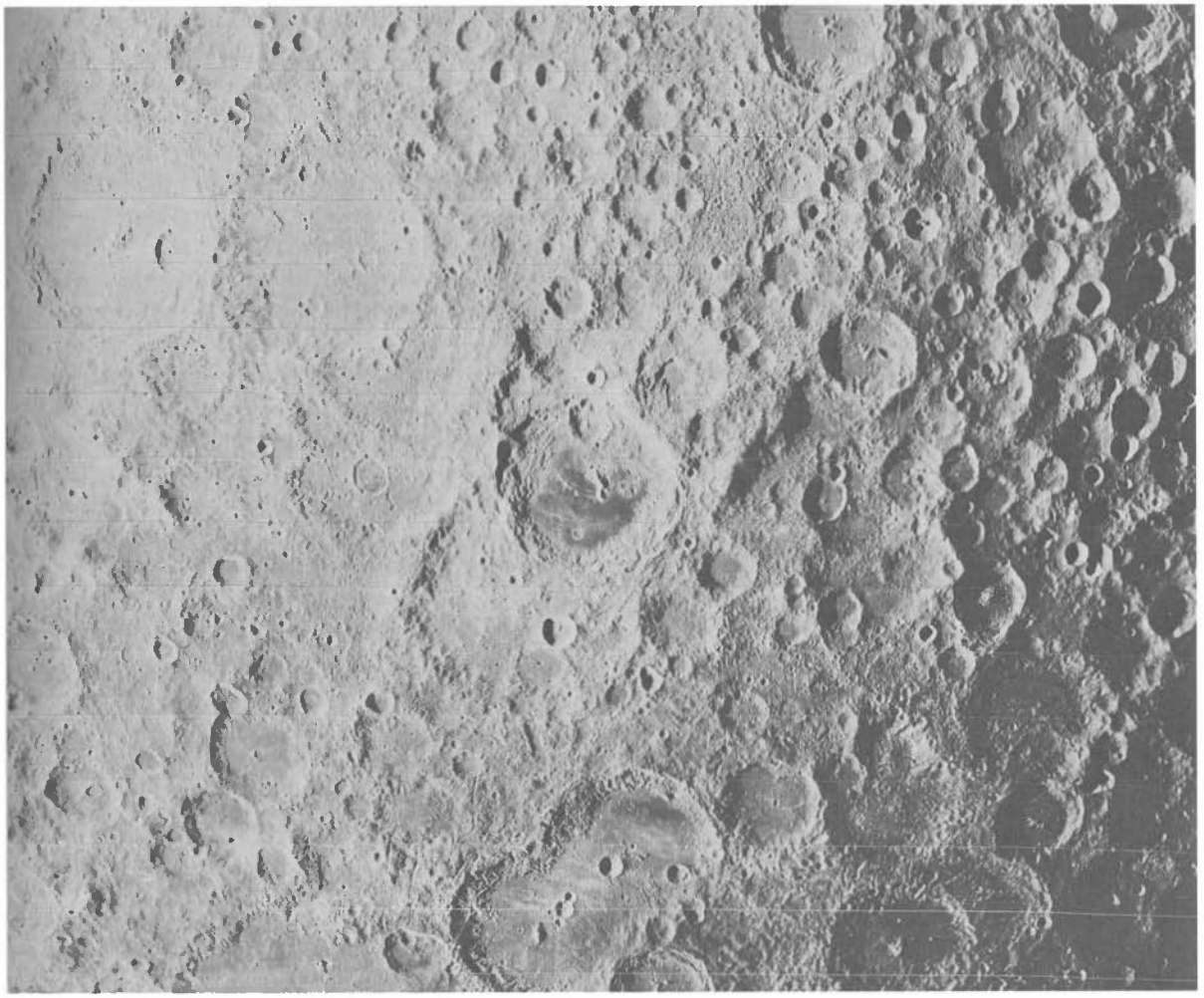

FIGURE 32-6.—Part of Lunar Orbiter II frame 33-M centered on the crater Aitken (lat. 17° S, long. 173° E). Relative high albedo rim deposits of Aitken extend outward to one crater diameter. Icarus Crater with its large central peak is in the upper right corner; west of it is Daedalus Crater. Northwest of Aitken is the pair of old subdued craters, Heaviside (right) and Keeler (left). Due south of Aitken Crater is the crater Van de Graaff, on the northeastern rim of Mare Ingenii.

By comparison with other large craters (e.g., Copernicus), only very few flat areas (the so-called "pools") are observed on the wall terraces.

The jumbled appearance of the crater wall may be ascribed to post-Aitken events, particularly those events that formed the 30-km-diameter crater on the northern wall and the 12-km-diameter crater on the northern rim of Aitken Crater (fig. 32-9). These probable impact craters may have caused massive slumping and downslope movement along the wall of Aitken. The effects of this slumping are obvious in (1) widening of the crater in places and the crenulations along the eastern and western parts of the wall; (2) the presence of a large and relatively flat unit that is interpreted as a landslide next to the steep scarp on the northeastern part of the wall; (3) the apparent lack of flat pools and sharp terraces, in spite of the relative freshness of other features of the crater; and (4) complete destruction of the northern part of the wall by the superposition of the unnamed 30-km-diameter crater.

The floor of Aitken Crater displays several unique features. It is filled with dark mare-like material, which, in the southwestern quadrant, is marked by

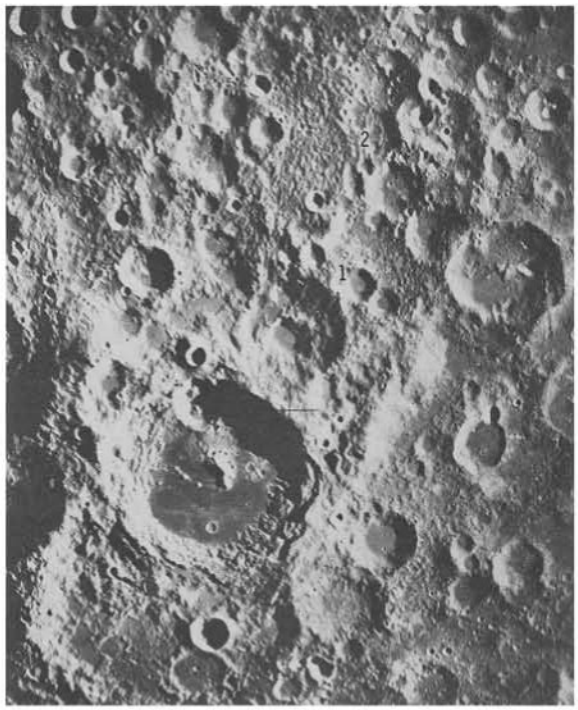

FIGURE 32-7.—Zond 8 photograph of Aitken Crater (150 km in diameter) and its surroundings. A major chain of secondary craters extends toward the north. Smaller chains are in the north-northwest sector. Secondary-crater clusters randomly surround the crater. Light plains material fills the floors of smaller surrounding craters in contrast to the darker mare-like fill in the floor of Aitken. Note the sharpness of the crater rim crest. Area of figure 32-8(a) is indicated by "1"; area of figure 32-8(b) is indicated by "2".

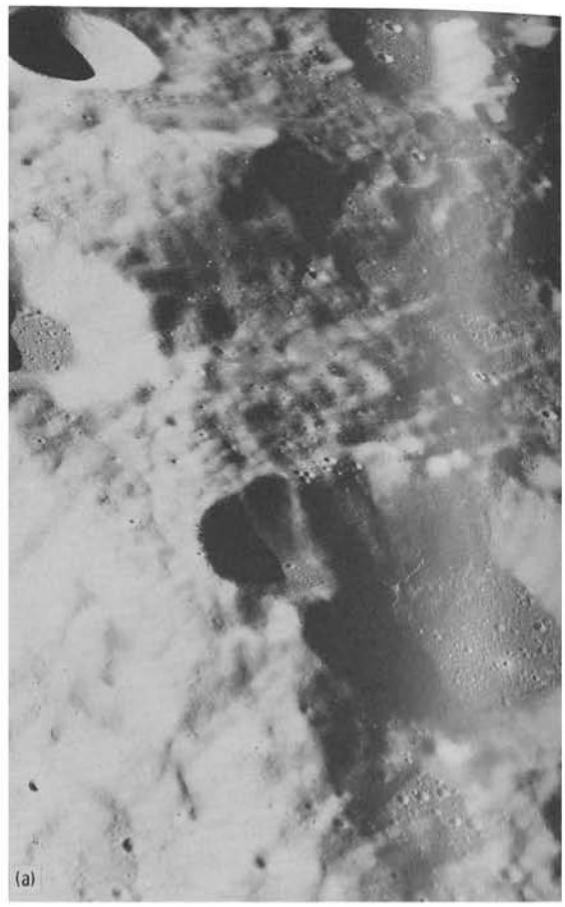

FIGURE 32-8.—Flow scarps and other flow structures north-northeast of the crater Aitken as seen in Apollo 17 panoramic camera photographs. The flow direction is from west (left) to east (right). Both areas appear to be part of a discontinuous system. (a) Part of Apollo 17 panoramic camera frame AS17-1914

light-colored swirls (fig. 32-10). These swirls are at the northern edge of the Ingenii belt of light-colored markings (ref. 32-18).

The central peak of the crater consists of two segments. The larger and topographically higher segment to the east trends generally north-south, and the smaller and topographically lower portion is represented by a row of discontinuous hills (fig. 32-9). This arrangement of the central peak complex suggests an incipient ring. Smaller probable impact craters such as Tycho and Aristarchus display a clustered central feature; larger craters such as Schrödinger display a complete ring structure. Aitken Crater appears to display characteristics that lie between these two types.

Numerous flow scarps are clearly visible in the dark mare floor, particularly in the eastern and southwestern parts (fig. 32-10). In two places, the flow scarps are related to smaller craters in the floor (figs. 32-10 and 32-11). These craters range in size from 4 to 7 km. The interiors of three in one cluster are occupied by equal-size, perfectly domical structures (fig. 32-12). The domical structures are very unusual in appearance and somewhat resemble those reported in the Mons Rümker area (ref. 32-19). The three craters in the eastern part of the floor, as well as an isolated one in the southwestern floor of Aitken, are breached; the breaches lead to flow scarps in the floor fill, suggesting that the craters are related to the fill. They may have been the source of the mare

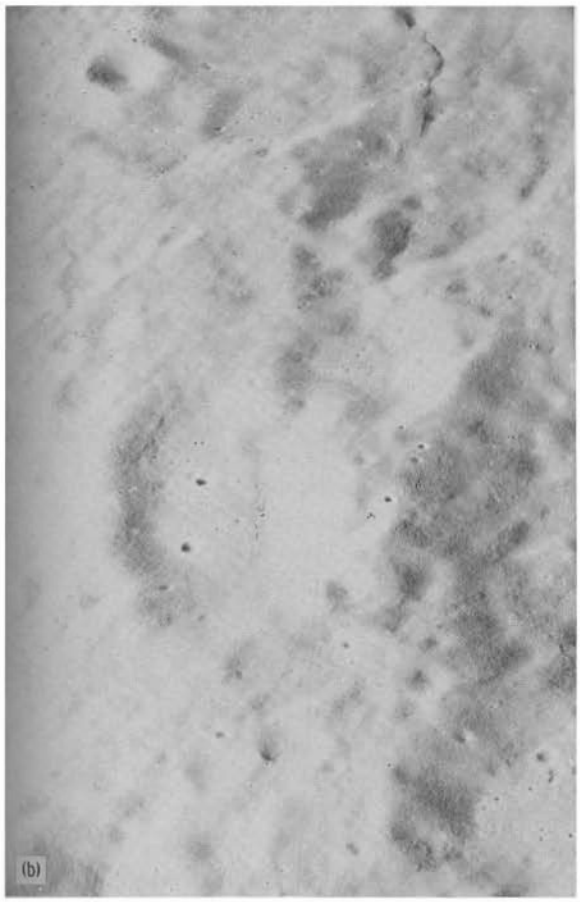

FIGURE 32-8.–Concluded. (b) Part of Apollo 17 panoramic camera frame AS17-1676.

material, or at least part of it. The domical structures in their interiors may represent the last stages of volcanic eruption. These structures were described by the Apollo 17 command module pilot as resembling the dacite domes in northern California and Oregon (sec. 28). Late stages of eruption commonly produce more viscous materials represented by domical structures (ref. 32-20).

Some of the craters described previously as well as a crater in the southern part of the floor (fig. 32-13) show a ringed interior that is interpreted as a high lava mark (i.e., a preserved strand line of an earlier higher level of lava within the craters than exists today). The lava level may have receded because of drainage back into the source chamber or because of loss of volatiles or loss in volume as a result of crystallization (or both). Similar lava marks were observed in Palus Putredinis during the Apollo 15 mission (ref. 32-21) and in Mare Nubium during the Apollo 16 mission (ref. 32-15).

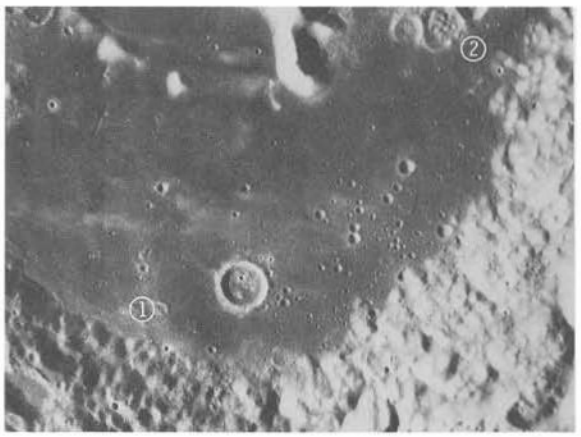

FIGURE 32-10.–Apollo 17 Hasselblad frame AS17-150-22962 showing the southern part of the floor of Aitken Crater. Note the light-colored markings in the dark mare floor, also the flow scarps in the southwestern and eastern portions. The scarp and/or ridge in the southwestern corner leads to a partially flooded crater (1), and one ridge or flow structure in the eastern part of the wall leads to a breach in an unusual crater (2). See also figure 32-11.

FIGURE 32-9.–Vertical view of Aitken Crater obtained by Apollo 17 mapping camera. Note the sharp crenulations of the rim crest and the irregular nature of the crater wall. The crater in the northern part of the wall is 30 km in diameter (Apollo 17 mapping camera frame AS17-0341).

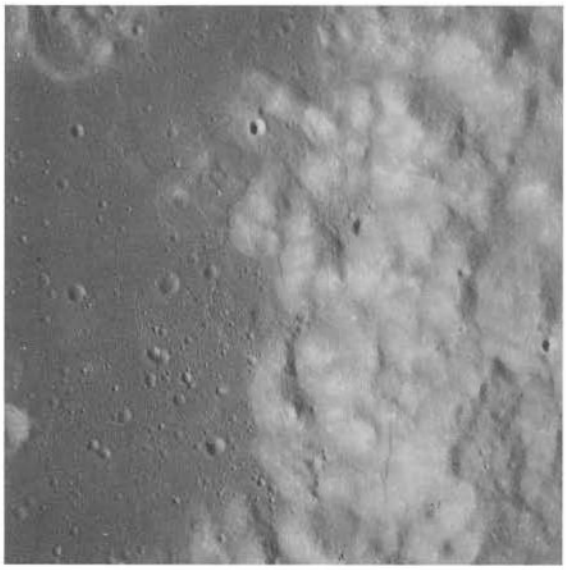

FIGURE 32-11.–Detail of the eastern part of the floor of Aitken Crater. Numerous flow scarps and ridges are displayed in the dark mare-like unit. One is clearly related to a breach in the crater in the upper left corner of the photograph. A few of the scarps appear to lap up against the lower part of the crater wall. A large and discontinuous scarp is present at a higher level on the southeastern wall of the same crater. This large scarp is probably unrelated to those in the floor (AS17-149-22796).

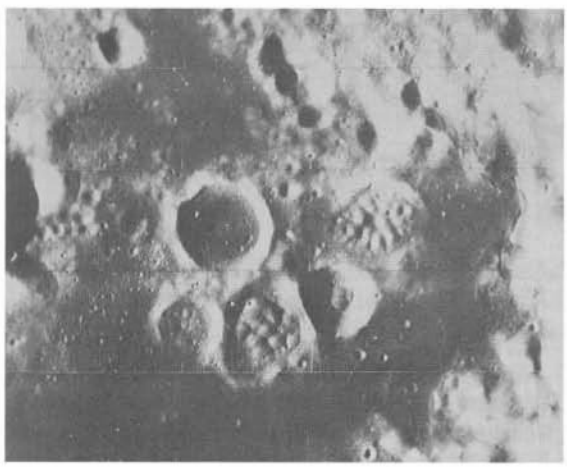

FIGURE 32-12.–A cluster of craters in the eastern part of the floor of Aitken Crater. Framelet width is 6.3 km (Lunar Orbiter II frame 33-H).

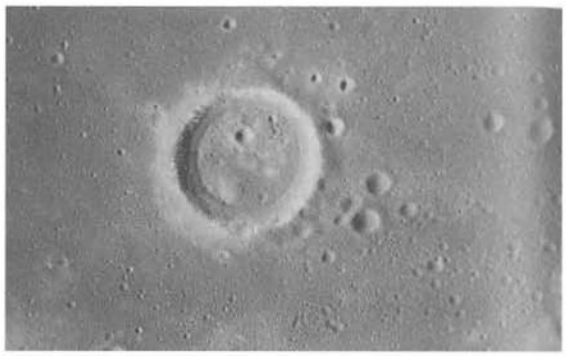

FIGURE 32-13.–Apollo 17 Hasselblad frame showing an 8-km-diameter crater in the floor of Aitken Crater that displays a high lava mark on the inner wall (AS17-149-22797).

CONCLUSIONS

Characteristics of the rim deposits and ejecta blanket of Aitken Crater indicate a probable impact origin. The freshness and lesser degradation of the rim crest may have been caused by post-Aitken events.

The dark floor fill, its flow scarps, and smaller craters with domical structures are probably volcanic in origin. The variety of landforms suggests episodic eruptions represented by the dark basalt-like floor material and finally the more viscous domical materials in the smaller craters.

This combination of impact and volcanic structures makes Aitken Crater particularly attractive for future study and analysis. In addition to the fact that it is one of very few craters on the lunar far side with a dark mare floor, the crater is young enough for its features to be well preserved. Extensive photographic coverage of Aitken Crater by the Apollo 17 crewmen will permit detailed investigation of its many interesting features.