LUNAR UPLAND PLAINS RELATIVE AGE DETERMINATIONS AND THEIR BEARING ON THE PROVENANCE OF THE CAYLEY FORMATION

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The great abundance of feldspathic breccias and cataclastic anorthosites with a general absence of rocks of volcanic origin at the Apollo 16 site has necessitated a revision of the hypothesis of a volcanic origin for the Cayley Formation (1,2,3,4). The predominance of non-volcanic breccias at the Apollo 16 site, an observed moonwide distribution of Cayley plains (5,6) and their apparent contemporaneous age (6) have prompted the formulation of several alternate models for the evolution of the Cayley Formation.

Chao et al. (7) and Hodges et al. (8) proposed that Cayley-type plains including the Apollo 16 site are ejecta from Orientale basin. According to Eggleton and Schaber (9) these terra plains formed by the highly fluid transport of ejecta materials from many basin-forming impacts resulting in the infilling of existing depressions.

However, Oberbeck et al. (10) have shown that the mass excavated and ejected by secondary cratering events near the Apollo 16 site should be many times greater than the total mass delivered by projectiles associated with basin-forming impacts. The presence of numerous secondary crater chains (characterized by herringbone patterns) in many upland plains including the Apollo 16 site substantiate an extensive redistribution of local materials, erosion of topographic highs and subsequent mass movement of local materials into adjacent depressions.

Crater size-frequency distributions derived for two Cayley Formation sites are shown in Fig. 1. The intersection of the observed large crater production curve (11) with the empirical steady-state curve (12) yields an equilibrium crater diameter C_s which is a measure of relative age (13,14). The data indicate the Cayley Formation at the Apollo 16 site to be older ($C_s = 646 \pm 40$ m) than the Cayley Formation at the Hyginus Rille ($C_s = 407 \pm 60$ m).

Another upland plain, the Vallis Schröteri Formation, adjacent to Schröter's Valley, was similarly evaluated (Fig. 2) and its surface found to be still younger ($C_s = 372 \pm 40$ m) than the Cayley Formation at Hyginus but similar enough in age and topography perhaps to be associated in origin with the Cayley-type plains. All these surfaces are older than Mare Tranquillitatis, $C_s = 141$ m (14).

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The range in age determinations for these surfaces suggests that upland plains may have a greater age diversity than previously thought.

The indicated youth of the Cayley Formation at Hyginus might be partly due to modifications of the surface by volcanogenic materials associated with the rille system volcanotectonic complex (15). The Vallis Schröteri Formation also may be modified by dark mantling materials associated with a possible volcanic field (16,17). However, the mantling materials probably only obscure very small, degraded craters.

The evidence for diverse relative ages of Cayley-type plains, the presence of secondary cratering effects, and the appearence of mantling materials at some upland plains supports the hypothesis that these deposits are predominantly local materials derived from secondary cratering and mass movements with only a minor component of regional ejecta materials from basin-forming events.

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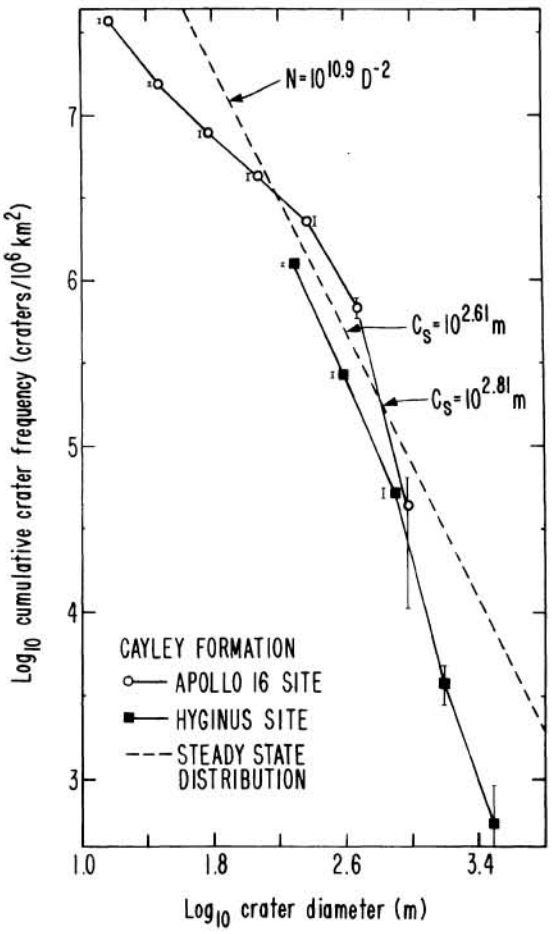

Fig. 1. Relative ages for the Cayley formation

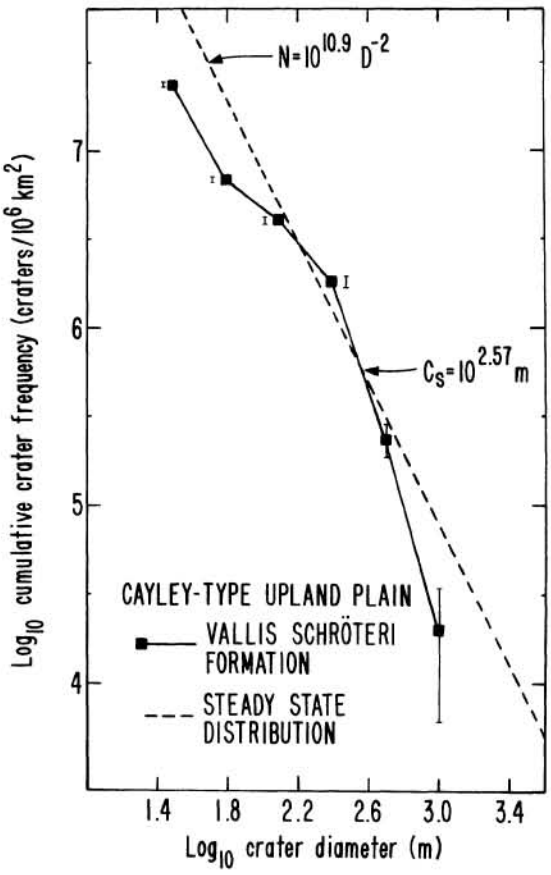

Fig. 2. Relative age of a Cayley-type upland plain