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How Old is Cone Crater at the Apollo 14 Landing Site?

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The Lunar Reconnaissance Orbiter (LRO) Narrow Angle Cameras (NAC) provides new opportunities to investigate crater size-frequency distributions (CSFDs) on individual geological units at key lunar impact craters. We performed new CSFD measurements for the Copernican-aged Cone crater at the Apollo 14 landing site because it is an anchor point for the lunar cratering chronology at young ages [1-4].

Cone crater (340 m diameter) is located about 1100 m NE of the Apollo 14 landing site on a 90 m high ridge of the Fra Mauro Formation, and exhibits a sharp rim [e.g., 5,6,7]. Samples from Cone crater were collected from four stations (Dg, C1, C2, C′) during the Apollo 14 mission [7]. Exposure ages of those samples were used to date the formation of Cone crater. Although there is a considerable range of exposure ages (∼12 Ma [8] to ∼661 Ma [9]), several studies of Cone crater samples indicate an age of ∼25-26 Ma [e.g., 2,10,11].

On the basis of our CSFD measurements we determined an absolute model age (AMA) for Cone crater of ∼39 Ma, which is in the range of model ages derived by previous CSFD measurements that vary between ∼24 Ma [12] and ∼73 Ma [13]. However, we found a wide spread of model ages ranging from ∼16 to ∼82 Ma for individual areas on the crater ejecta blanket. Like [13], we find that the CSFD measurements on LROC images yield older AMAs than previous CSFDs [e.g., 12]. However, our results are closer to the older CSFDs than to those of [13] and are just within the error bars of [14]. Our derived N(1) = 3.26 x 10−5 km−2 is almost identical to the N(1) = 3.36 x 10−5 km−2 of [15]. Comparing the CSFD results to exposure ages of the returned samples we find somewhat older ages. However, at least two of our count areas produce AMAs that are within the error bars of the exposure ages [e.g., 10]. Six other areas show ages that are within two standard deviations to the exposure ages [e.g., 10]. For two count areas that were directly sampled, we obtained ages that are 10 and 23 Ma older than the exposure ages [e.g., 10].

We find that CSFD measurements performed on the ejecta blanket of Cone crater yield AMAs that agree well with the exposure ages, considering the relatively small count areas and the hummocky nature of the ejecta blanket. However, the AMAs are generally older than the exposure ages, which may be due to the small count area sizes [16], a possibly higher recent impact rate [17], some unidentified secondary craters [13], poor calibration of the production function, or inaccurate exposure ages.

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