



Neukum Crater in Noachis Terra, Mars: Absolute Model Ages and Stratigraphy

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We geologically mapped the Neukum crater in Noachis Terra, Mars, using a variety of data sets (e.g., HRSC, CTX, MOC, HiRISE, THEMIS, CRISM, and MOLA), and identified 21 geomorphologic units. Several plains units on the crater floor show distinct morphologies (smooth, rough, hummocky, furrowed), albedo, surface roughness, and thermal inertia, and are large enough to be dated with crater size-frequency distribution (CSFD) measurements. Like other craters in the vicinity, Neukum crater hosts pits on its floor, showing fine-scale layering, likely related to the deposition of a regional unit that filled these craters. The wide distribution of pits indicates that the degradational process that created them must have been active at regional scale. Thus, Neukum crater can serve as a case study for processes that shaped significant portions of Noachis Terra. We used CTX images to perform CSFD measurements of seven mapped geologic units to study their stratigraphy and absolute model ages (AMAs). In some cases it was challenging to obtain robust CSFDs, particularly for the hummocky units, when surface roughness and crater sizes were similar. These crater sizes, however, were not used for the fitting of the production function, and thus, do not affect the derived AMAs. Our CSFD measurements suggest that Neukum crater is at least 3.5-3.7 Ga old, as indicated by our age for unit Nr, which represents the crater rim and the older age of unit Nfh2, which is exposed on the crater floor. Neukum crater might even be older and certainly is a Noachian crater. While the crater itself is old, most of our map units exhibit significantly younger ages, indicating modification of the crater. At least three units show evidence for resurfacing, i.e. units Hfh2, Hfs, and Nhpu2. The youngest AMA of 66 Ma was derived for the floor of the northeastern pit within Neukum crater. This map unit Nhpu2 also exhibits additional AMAs of 450 Ma and 2.2 Ga. Similar ages (within the error bars) to the 450 Ma AMA have been found for units Hfr1 (460 Ma) and Hfs (570 Ma). Within their error bars, units Hfh1 and Hfr2 also show overlapping ages of 340 Ma and 300 Ma, respectively. Taking into account the error bars, the oldest ages of units Nhpu2 (2.2 Ga) and Hfs (1.8 Ga) are also similar to each other. Thus, several geologic units associated with Neukum crater might share similar modification histories, implying that the responsible processes affected large areas within the crater and possibly even outside the crater. In fact, our geologic study indicates that aeolian processes might have substantially modified the crater and its floor until the recent past. Thus, our AMAs are consistent with our morphologic observations of deflation of many of our map units. Evidence for accumulation of material only exists in a few places in form of transverse and longitudinal dunes.