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Geologic mapping and distribution of impact melt pools of the lunar crater Tycho

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We will present a new, detailed geological map of the lunar crater Tycho, as well as a map of all melt pools within our study area. Tycho crater is $\sim$ 83 km in diameter and is located in the southern highlands on the nearside of the Moon. The distribution of melt pools and the new topographical analysis show evidence for an oblique impact from the southwest [1,2]. Our melt pool map also indicates that pre-existing topography affected the spatial distribution of melt pools [3].Crater size-frequency distribution (CSFD) model ages show discrepancies between absolute model ages of the ejecta blanket and the melt pools [4,5]. The apparent absolute model ages measured for melt pools at Tycho crater are younger than the ages of the ejecta blanket.

The geological map shows that Tycho is a typical complex crater with a central peak, terraced crater walls and a continuous ejecta blanket [6]. The emplacement of melt pools has two major controlling factors: (1) the direction of the impact and (2) the pre-existing topography. Impact melt pools at Tycho are mostly located outside of the crater rim and are more or less evenly distributed around the crater, with the exception of the zone of avoidance related to the impactor path from the SW [1,2]. With increasing distance from the crater center, the melt pools tend to get smaller in size and less frequent. Melt pools with larger overall surface areas are clustered in the ENE and ESE of Tycho crater, likely influenced by preexisting topography. Oblique impacts often show, the most extensive melt deposits in the inferred downrange direction. Therefore, the distribution of the impact melt pools around Tycho is consistent with an oblique impact from the southwest.

Absolute model ages derived from CSFD measurements of different melt pools give ages between 14.1 $\pm$ 1.4 Ma (Ncum(D $\geq$ 1 km) = 1.18 x 10-5) and 56.9 $\pm$ 5.1 Ma (Ncum(D $\geq$ 1 km) = 4.77 x 10-5), whereas our model age for the ejecta blanket is 73.5 $\pm$ 0.89 Ma (Ncum(D $\geq$ 1 km) = 6.16 x 10-5) [e.g.,4,5], thus being significantly older. The absolute model age for the crater floor is 25.7 $\pm$ 5.3 Ma (Ncum(D $\geq$ 1 km) = 2.15 x 10-5). However, the impact melt pools and ejecta blanket should have formed at about the same time [e.g., 7]. One interpretation of the different model ages of melt pools and the ejecta blanket is, that they have different target properties, i.e. the melt could be less porous and stronger [4,5], hence forming smaller craters for a given projectile size and impact velocity. Such an effect would result in younger ages of the melt pools compared to the ejecta blanket. Self-secondary cratering might also cause differences in CSFDs [8,9,10].

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