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Thermophysical Properties of Selected Lunar Study Regions Determined from LROC and Diviner Data.

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The thermal inertia of a surface is an important property for determining temperature variations of planetary surfaces [e.g. 1, 2]. It represents the ability of a subsurface to retain heat and is defined as a combination of thermal conductivity k, density ρ and heat capacity C. Fine grained soil quickly looses heat during the lunar night, and therefore has a low thermal inertia. Rocks and exposed bedrock store more heat during the night and have higher thermal inertia values, which results in higher nighttime temperatures [2].

Using Diviner temperature data combined with subsets of the 100 m grid LROC WAC DTM (GLD100, [3]), we derived maps of thermal inertia for different study regions, such as Taurus-Littrow Valley, Aristarchus and Lichtenberg Crater. Diviner nighttime temperatures are used to estimate thermal inertia of the lunar surface. The data was binned in one hour intervals, at a minimum resolution of 32 pixels per degree. We use an expanded version of the thermal model presented by [4] to generate temperature curve look-up tables for various thermal inertia values including different local topography, layering, and time of the lunar day. For each surface facet, we compare measured and modeled temperature data in order to find the best fitting thermal inertia value. This approach is similar to martian thermal inertia derivations described by [2, 5].

Most of the area at Taurus-Littrow valley can be described by a layering subsurface model, with a very fine regolith of $\sim$ 2 cm having a low thermal inertia ($\sim$ 20 $\mathrm{Jm^{-2}K^{-1}s^{-1/2}}$ during the night) covering a more dense and conductive layer. This model is also in good agreement with a model obtained for the Apollo temperature measurements as described by [6]. The second layer on the floor of the valley has thermal inertia values $<$ 100 $\mathrm{Jm^{-2}K^{-1}s^{-1/2}}$ during the night. Due to the temperature dependence of thermal conductivity and heat capacity, the values are higher during the lunar day. The massifs surrounding the valley (Northern Massif, Sculptured Hills, and Southern Massif) and impact craters have higher thermal inertia values ($>$ 300 $\mathrm{Jm^{-2}K^{-1}s^{-1/2}}$).

Temperatures measured on the ejecta blanket of Aristarchus crater can also be explained by a layered subsurface model. Thermal inertia decreases with distance from the crater, indicating finer material with increasing distance. Close to the crater, thermal inertia of the second layer is $<$ 200 $\mathrm{Jm^{-2}K^{-1}s^{-1/2}}$, with increasing distance thermal inertia decreases to less than 100 $\mathrm{Jm^{-2}K^{-1}s^{-1/2}}$.

The floor of the impact crater is 30-35 K warmer than the ejecta blanket. High temperature anomalies are associated with the central peak, which is about 40 K warmer than ejecta blanket. Parts of the crater wall, in particular in the north-east, are up to 60 K warmer than the ejecta blanket. These areas suggest the presence of rocks and/or bedrock at or very close to the surface. This is confirmed by high-resolution NAC-images, showing boulders of different sizes in these regions.

The ejecta blanket of Lichtenberg crater also shows evidence for low thermal inertia ($<$ 100 $\mathrm{Jm^{-2}K^{-1}s^{-1/2}}$). As for Aristarchus, high temperature anomalies are associated with the crater walls. However, temperatures on the crater floor and walls are only 20 K and up to 40 K higher than the ejecta blanket, respectively. Ejecta blankets of both craters do not show evidence for large boulders or exposed bedrock.

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