ness shows older features. From another point of view, this distinction represents the time scale of the equilibration of the small crater population.

This clear separation of processes and ages causes the "roughness units" on hectometer-scale and kilometer-scale roughness maps to be different: boundaries outlining units of different roughness on kilometer-scale and hectometer-scale roughness maps often do not coincide. This situation differs significantly from Mars, where, despite a very wide diversity of scale-dependence of roughness for different terrains, the unit boundaries were the same over 4 octaves (factor of 16) of scales, and the color composite of three roughness maps separated by 2 octaves made a nice synoptic overview of martian geomorphologic diversity (Kreslavsky and Head, 2000). On the Moon combining hectometer-scale and kilometer-scale roughness in a single composite does not produce easily interpretable maps. In the rest of the paper we consider scales separately: first, hectometer-scale roughness maps (Figs. 2 and 3) in Section 4 and then kilometer-scale roughness (Figs. 1, 4, and 5) in Section 5.

4. Hectometer-scale roughness

4.1. Craters

Both the roughest and the smoothest terrains on the Moon are associated with large, young impact craters. While the typical variations of roughness over maria and highlands are within the 0.7–1.3 interval, the roughness of the youngest craters and their vicinities varies over a much wider interval, 0.4–5. This observation is well in line with conclusions from Section 3: large young craters are the only resolved features young enough so that the accumulated regolith layer is thin, and regolith gardening processes have not brought the roughness values to equilibrium.

The most prominent, unusually smooth crater-associated terrain is a large sheet of impact melt just outside the Copernican-age crater Rutherfurd (60.9°S 12.1°W, Fig. 8). The median roughness for the smooth area is 0.6, its smoothest part is 0.4. A similar but smaller melt sheet occurs just to the north of Copernican-age crater Glushko (8.4°N 77.6°W, former Olbers A). A few very smooth pixels are associated with large melt pools on the southeastern outer wall of Tycho and just to the north of King.

With these exceptions, all other parts of the youngest craters are rough. Because the maps in Figs. 2 and 3 are stretched to show minor variations of roughness over maria and highlands, the rough young craters there are saturated white. Fig. 9 shows local maps for the largest ($D > 70$ km) Copernican-age craters; the grayscale is stretched to show crater details; the stretch is the same for all maps. Here, following Wilhelms (1987) and McEwen et al. (1997), we consider craters with prominent bright rays as Copernican; this is not consistent with the redefinition of the Copernican period by Stöffler and Ryder (2001).

It is seen that there are significant variations of roughness both within the craters and between them. It is interesting that the inner walls, where they are resolved in the map, are smoother than the other parts of the craters (see the southern walls of Rutherfurd in Fig. 8, the northern walls of Tycho and southern walls of Hayn in Fig. 9). Unlike the smooth melt sheets outside the craters, the melt pools on the crater floors are rough.

Craters in Fig. 9 are arranged according to their general decrease in roughness. Among the largest ($D > 70$ km) Copernican-age craters, the median roughness calculated over the whole crater is the highest for Tycho and Jackson, 3.4; it decreases to 2.3 for Copernicus and further decreases to 1.9 for Stevinus and Vavilov.

Fig. 8. Crater Rutherfurd ($D \approx 47$ km) in the lower right part of the image and impact melt sheets outside the crater. Portion of LROC WAC mosaics centered at 60°S 13.5°W, local equirectangular projection, north at the top. Insert shows the hectometer-scale roughness (115 m baseline) for the same area; brighter shades denote rougher surface. This map was created in local equirectangular projection with 16 pixels per degree sampling, R_{pix} = 1.9 km.