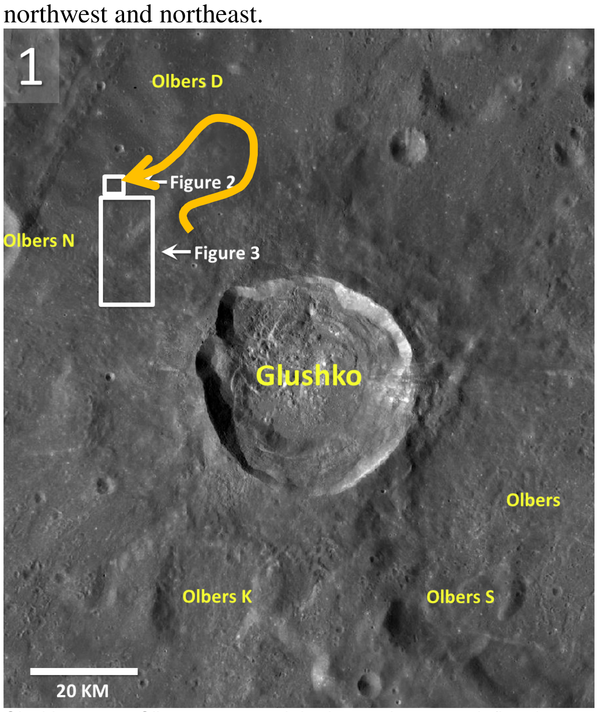
IMPACT MELTS AT GLUSHKO CRATER – LROC REVELATIONS. T.A. Giguere[1,2] B.R. Hawke[1], C.A. Peterson[1], S.J. Lawrence[3], J.D. Stopar[3], and the LROC Science Team. [1]Hawaii Institute of Geophysics and Planetology, University of Hawaii, Honolulu, HI 96822, [2]Intergraph Corporation, P.O. Box 75330, Kapolei, HI 96707, [3]School of Earth and Space Exploration, Arizona State University, Tempe, AZ 85281.

Introduction: Fresh lunar craters and some older large craters have deposits of lava-like material in and around the crater. Initially thought to be volcanic because of their flow-like morphology, these deposits are now known to have originated by high shock pressures and related melting of materials at the impact site [e.g., 1, 2]. Impact melts are associated with craters of virtually all sizes, from the largest (basins) to the very small (< 1 km) [3]. Lunar impact melt deposits are observed as thin veneers, flows, and ponds (*Figures 1, 2, 3*).

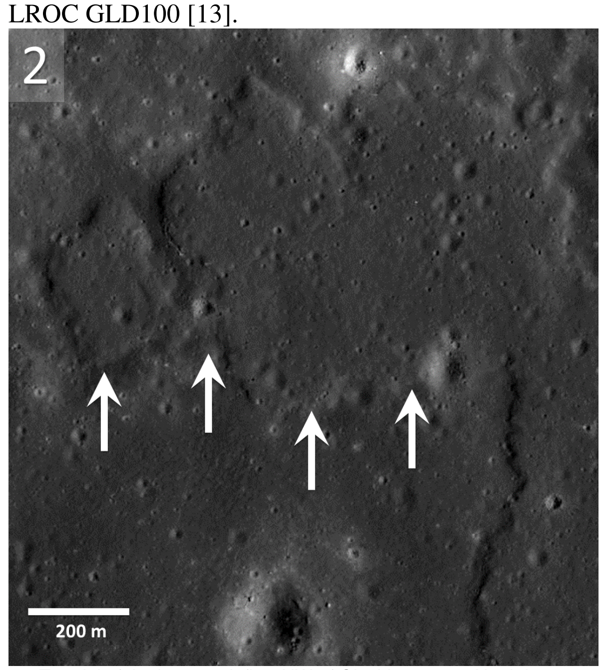
The focus of this study is the melt-rich lunar crater Glushko (*Figure 1*), formerly Olbers A, located west of Oceanus Procellarum and WNW of Grimaldi at 8.1° N 77.7° W. Glushko crater is located in the highlands just outside of the inner facies (map unit Iohi) of the Orientale Hevelius formation. The crater impacted into the northwest rim of Olbers crater and is classified as Copernican in age [4]. At 43 km in diameter, Glushko possesses a relatively high albedo due to the highlands material excavated during impact, and has a prominent ray system that extends in all directions across the nearby surface. Some rays extend nearly 800 km to the east and northeast over Oceanus Procellarum. The crater floor is complex with several small central peaks, significant wall failure which adds hummocky material to the floor, and prominent wall slumps to the northwest and northeast.



Glushko crater, Olbers crater, and the largest impact melt flow (orange line). Figures 2 and 3 are shown as white boxes. North is up.

Many fresh lunar craters and their associated impact melts have been studied previously [e.g., 3, 5-8], but Glushko has not been examined in detail because of limitations in resolution of available data. This study leverages the high spatial resolution of images from the Lunar Reconnaissance Orbiter Cameras (LROC) to study the origin and modes of occurrence of the exterior impact melts of Glushko crater.

Methods: LROC WAC and high resolution NAC images were utilized in this investigation [9-12]. The high resolution (0.5 -1 m/pixel) provided by the NAC images was critical for the study of the smallest impact melt features. Topographic data were provided by the LROC GLD100 [13].



Termini of the large melt flow NW of Glushko crater. North is up.

Results and Discussion: Melt deposits form during and soon after impact, occur in a variety of forms, and may be emplaced both in and outside the crater generally <1 crater radii from the rim crest [5, 6]. Hard rock veneers are thin layers of melt material draped over terrain. Cracks related to downslope tension often occur in veneer deposits along crater rims. Melt flows occur when large amounts of melted material are deposited on the rim then travel downslope into or away from the crater. Ponds of melt form when veneer runoff and flows accumulate in low lying catchments within or outside the crater. As discussed below, impact melts at Glushko exhibit all of these modes of occurrence.

Melt Modes of Occurrence.

Veneer. Melt veneer, draped on the crater rim during the impact, was identified in all available NAC images for Glushko. Extensive veneer extends continuously from the southwest around the western side to the northeast rim. The melt veneer is most abundant on the northwest and north rim crest. Minor amounts may be found in the east-northeast and around to the south side. Veneer is found in moderate amounts on the south to south-southwest rim crest.

Cracks in the veneer concentric to the crater rim are observed; these may be created by downslope tension after emplacement. Mass wasting of fragmented rim veneer is observed at some locations, occurring sometimes as individual blocks and other times as clusters of blocks. Nearby small impacts or seismic activity may have dislodged the blocks.

Melt Ponds. The terrain surrounding Glushko sports a significant number of melt ponds. Over 100 ponds were identified ranging in size from <100 m to over 7 km in diameter. The largest and most substantial impact melt ponds are located on the north and northwest rim of the crater as would be expected since the largest abundance of veneer is located in the same area. The source of the pond melt was most likely the ubiquitous molten veneer that draped over the entire area, and subsequently drained into nearby topographic lows forming ponds. The largest pond is located 19 km NNE of the crater. Cooling or contraction cracks appear on the surfaces of most of the larger ponds and serve to confirm identification. There are melt ponds identified in areas where the evidence for melt veneer is weak, such as on the east and northeast rim. Since visual evidence for veneer appears to degrade more quickly than for ponds, this may indicate that Glushko may be older than classified. As a comparison, the melt veneer at Byrgius A exhibits a younger surface [14].

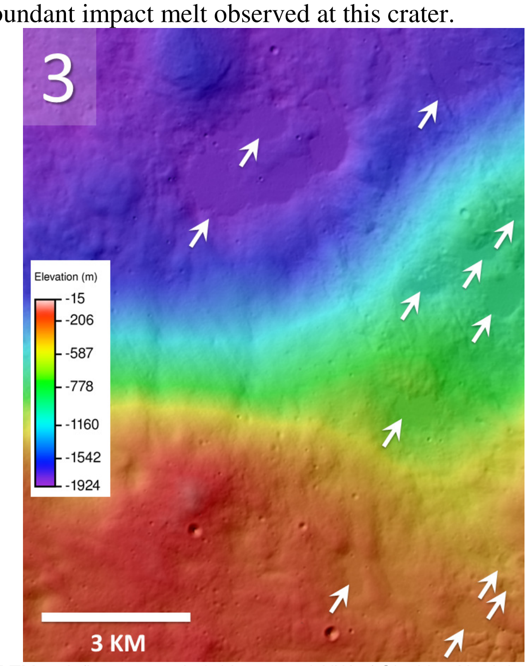
Flows. With the exception of a few minor flows to the southeast (< 5 km length) the largest flows are to the north and northwest. The flows to the north, although small, exhibit some interesting morphology. A 1.5 km long flow, 4 km from the rim, has a deeply incised channel and runs perpendicular to the impact ejecta vector. A second flow(s), 1.8 km long and 13 km from the rim, has the appearance of a braided set of flows, with some overlapping each other.

The largest flow is located to the northwest, see the orange trace of the flow in Figure 1. Impact melt material arriving on the terrain less than a crater radii, collected into a large pond approximately 20 km from the crater rim and flowed northwest until it encountered a topographic obstruction. The flow continued counterclockwise around the obstruction and reached its maximum distance from the crater of 35 km (1.6 radii). Flowing roughly southwest, the flow terminated (*Figure 2*) at a distance of 31 km from the crater. The total length of the flow is nearly 47 km with a drop in elevation from beginning to end of ~236 m.

The flow termini in figure 2 exhibits an elevated flow margin with digitate lobes of ~5 m in height with respect to the preexisting surface. White arrows point to the southern margin of this flow.

Figure 3 is a digital terrain model of an area to the northwest which includes a portion of the obstruction that caused the large deviation of the melt flow. White arrows identify the many melt ponds in this area.

Interpretation. The impact melts to the northwest can be traced to have come from two directions; the first melts were delivered directly during the impact event, and the second melts were delivered by flowing around elevated topography. Crater rim heights have been shown to affect exterior melt direction and volume. Measured rim heights for Glushko show a low in the SSW and in the NNW, which corresponds to the abundant impact melt observed at this crater.



DTM melt flows & ponds (white arrows) NW of Glushko. North is up.

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