BYRGIUS A CRATER IMPACT MELTS – AN LROC PERSPECTIVE. B. R. Hawke[1], T. A. Giguere[1,2], V. Bray[3], S. Lawrence[4], L. Tornabene[3], B. W. Denevi[4], W. B. Garry[5], L.R. Gaddis[6], L. Kestay[6], M. Robinson[4] and the LROC Science Team, [1]Hawaii Institute of Geophysics and Planetology, University of Hawaii, Honolulu, HI 96822 (hawke@higp.hawaii.edu), [2]Intergraph Corporation, P.O. Box 75330, Kapolei, HI 96707, [3]University of Arizona, Sonett Space Science, 1541 E. University Blvd, Tucson, AZ 85721, [4]School of Earth and Space Exploration, Arizona State University, Tempe, AZ 85281, [5]Center for Earth and Planetary Studies, National Air and Space Museum, Washington, D.C. 20560, [6]U.S. Geological Survey, Astrogeology Science Center, 2255 N. Gemini Drive, Flagstaff, AZ 86001.

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]. Lunar impact melt deposits are observed as thin veneers, flows, and ponds (*Figures A, B, C*).

The focus of this study is the melt-rich lunar crater Byrgius A, located west of Mare Humorum at 24.5° S 63.7° W. This crater is located in the highlands and is very fresh. Recent age estimates put the Byrgius A impact at 48 Ma [3]. At 19 km in diameter, Byrgius A is slightly above the simple-to-complex crater transition. The crater is bowl-shaped, but does have floor deposits and some floor mounds or hummocks. Minor wall failure has occurred on the west wall, but no true scallops exist. Byrgius A impacted into the rim crest of the 87 km pre-existing crater Byrgius. As a result, the east and west rim crests of Byrgius A are low, and the north to north-northwest and south rims are high.

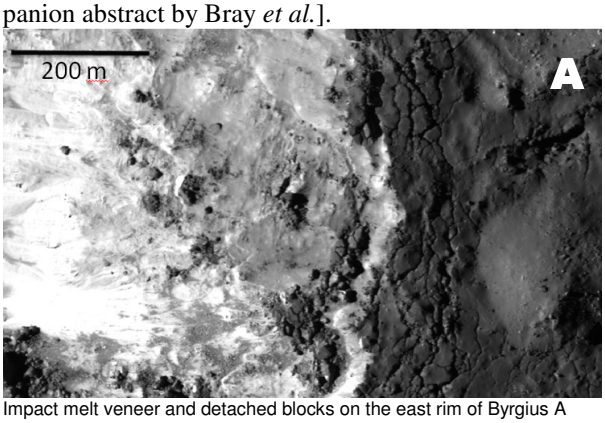
Many fresh lunar craters and their associated impact melts have been studied previously [e.g., 4-7], but Byrgius A has not been examined in detail because of limitations in resolution of available data. This study leverages the high spatial resolution (~0.5 to 1 m/pixel) of images from the Lunar Reconnaissance Orbiter Cameras (LROC; 8-11) to study the origin and modes of occurrence of impact melts of Byrgius A.

Data: High resolution LROC Narrow Angle Camera (NAC) image pairs (M102573276, M107293947, M109658189, M112014030) of the study area were mosaicked. Solar incidence angles ranged from 23 to 74 degrees, and resolution ranged from 0.5 to 0.9 meters/pixel, with a processed mosaic resolution of 0.7 meters/pixel.

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 [4, 5]. 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, mpact melts at Byrgius A exhibit all of these modes of occurrence.

Exterior Melt Deposits.

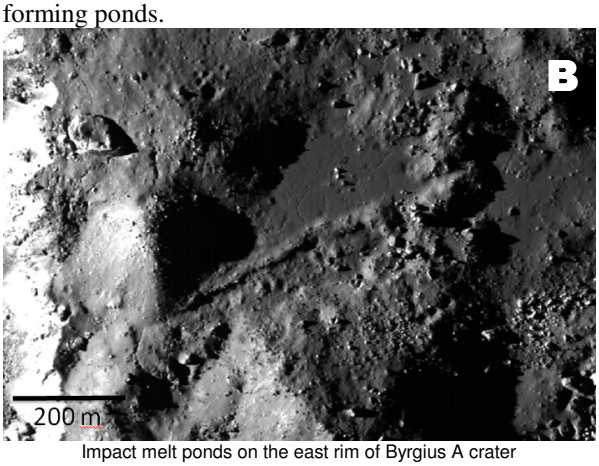
Veneer. Melt veneer, draped on the crater rim during the impact, was identified in all available NAC images for Byrgius A. The distribution extends continuously from the north-northwest around the eastern side to the south-southwest rim. No rim coverage is available to the west, but the fact that flows and veneer are observed beyond the western rim crest suggests that melt veneer will be observed there also when new images are available. Melt veneer is most abundant on the northeast to the east side of the crater rim. 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 *(Figure A),* occurring sometimes as individual blocks and other times as clusters of blocks. Nearby small impacts or seismic activity may have dislodged the blocks. Veneers are now recognized on the inner walls, slumps, terraces as well as draped on the central uplifts of larger craters [see companion abstract by Bray *et al.*].



Impact melt veneer and detached blocks on the east rim of Byrgius A

Melt Ponds. The largest and most substantial impact melt ponds are clustered on the east rim of the crater. A small pond also was identified to the north where a flow was impounded by a topographic rise. Nine ponds were identified on the east rim (*Figure B*), and more probably exist but are obscured by the crater

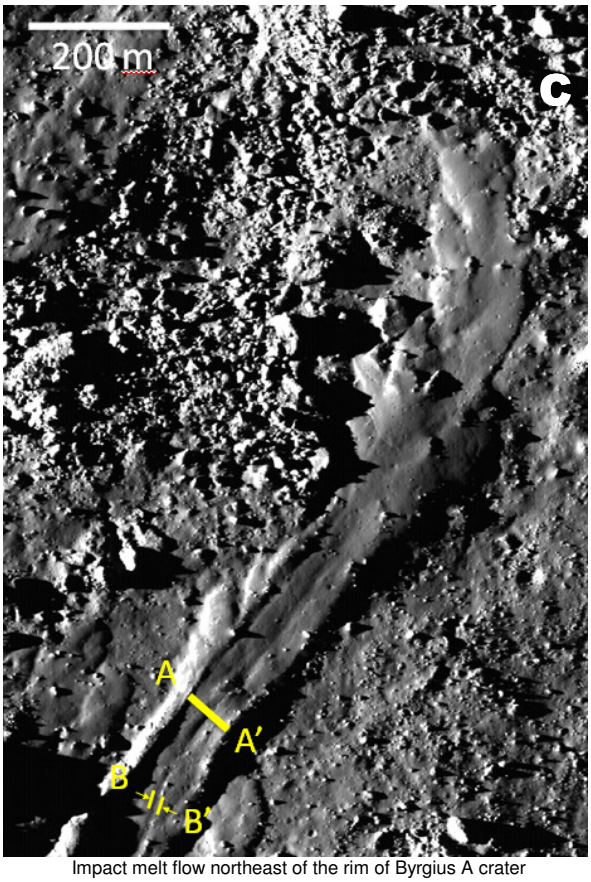
rim shadow to the east. The largest pond is closest to the rim and is 250x150 m^2 (*Figure B*). Cooling or contraction cracks appear on the surfaces of both ponds. Some debris, possibly pre-existing, is located in the pond and may give an indication of a shallow depth. The source of the pond melt was most likely the ubiquitous molten veneer that draped over the entire area, and subsequently drained into nearby topographic lows forming ponds.



Impact melt ponds on the east rim of Byrgius A crater

Flows. Most flows are located on the north through the east rim of the crater, a few flows are found to the west. More flows may be located on the east and southeast rim, but the NAC frame is shadowed so this cannot be verified. More than 20 flows were identified, with many more individual lobes.

Figure C shows a spectacular leveed flow located on the northeast rim of Byrgius A. The flow is ~3.2 km in length from the crater rim to toe. Distinctive lobes and surface flow features are seen ~1 km from the end of the flow. The flow averages 130 meters wide in this area, and both a primary channel (77 m wide) and an inner channel (8 m wide) are apparent (*Figure C profiles A-A' and B-B'*). The body of the flow is relatively debris-free but does contain an occasional block or boulder which may be cooled melt crust, but is more likely to be ejecta blocks or pre-existing debris. Blocks are more abundant along the edge of the flow. These blocks, which may have been transported by the moving material, migrated to the flow margins and are left stranded on the left and right levees as the flow level lowered when the volumic flux of melt decreased. Smaller lobes flows occur along the length of the main flow and travel for short distances. The main flow terminates in a series of digitate lobes. The flow appears to have cooled significantly by this point, forming a significant crust that halted the forward progression of the flow. However, hot melt insulated within the flow interior could, under the influence of gravity, continue to apply pressure and cause multiple breakout lobes at the flow terminus.



Impact melt flow northeast of the rim of Byrgius A crater

Interior Melt Deposits.

Little impact melt is observed on the unterraced walls of Byrgius A. Some veneer is present on the uppermost portion of the wall, just within the crater rim crest and dark blocks of veneer can be seen on the crater walls.

In contrast to the walls, the floor exhibits abundant impact melt as at other craters [6]. The eastern portion of the crater floor has a relatively flat but hummocky surface. Many floor hummocks are veneered by impact melt. The western portion of the crater floor exhibits abundant clastic debris mass wasted from the western wall. Some of this material is veneered.

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