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Lobate Ejecta Deposits at Mercury's South Pole (H15)

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During geological mapping of H15, we have discovered unrecorded lobate ejecta deposits. One example, at Nairne crater (c4; 70.36° S, 1.65° E), exhibits two distinct lobes that propagate into the floor of a pre-existing, more degraded (c1) crater. The lobes exhibit steep fronts and are thicker and rougher than typical ballistically emplaced ejecta. Nairne exhibits asymmetrical terracing and ejecta deposition, an off-centre bright blue central peak, and bright red impact ejecta. We identify what we interpret as perched impact melt occupying topographic lows on top of the larger of the two lobes. Lobate ejecta deposits are relatively rare on Mercury; Xiao & Komatsu compiled a database of only 7 craters with ejecta flows globally [1], and Blance et al. [2] found more. However, timing of emplacement has remained ambiguous.

We mapped using a MESSENGER MDIS monochrome basemap (166 mpp) and individual monochrome NAC images at higher resolutions. We used 665mpp enhanced color mosaic and DEM to distinguish units by colour and to assist in the mapping of topographic features. We mapped the following units: crater wall material, central peak material, crater floor material (smooth/hummocky), and three types of ejecta material. Continuous proximal ejecta exhibits higher relief and rougher texture than the flat, low-lying discontinuous distal ejecta; both are spectrally red. Lastly, ponded impact melt is characterised by very smooth localised deposits and is spectrally blue.

We used shadow-height measurements to calculate a lobe height of 56.7 ± 0.6 km and an ejecta mobility of 2.3 ± 0.06 . These were calculated to integrate Nairne with the database published by Xiao and Komatsu [1], wherein the morphological and geometrical parameters of their 7 candidates are listed.

Key factors affecting the formation of ejecta flows on Mercury include the slope of the underlying terrain, high surface temperature and volatiles. Two emplacement scenarios are being considered: a mass-wasting event producing an ejecta flow similar to that at Tsiolkovskiy crater on the Moon, or a fluidised ejecta flow. We are also considering the influence of an oblique impact in forming lobate ejecta deposits.

Previously there has been no evidence to demonstrate whether ejecta flows on Mercury formed during or after the impact event that formed the crater. Our interpretation of ponded ejecta melt on the larger of the two lobes provides the first evidence that the ejecta flows occurred early in the impact process. The impact melt on the lobe and that of the crater floor share a similar blue colour, indicative of a similar composition and may reflect synchronous formation.

References:

- [1] Z. Xiao and G. Komatsu (2013) *Planet. & Space Sci.* 82-83, 62-78.
- [2] A. J. Blance et al. (2022) MExAG Ann. Meeting.

