MERCURY'S H11 DISCOVERY QUADRANGLE: MAPPING PROGRESS UPDATE. A. J. Blance[1], D. A. Rothery[1], M. R. Balme[1], J. Wright[2] and V.A. Galluzzi[3]. [1]The Open University, School of Physical Sciences, [2]European Space Agency, ESAC, [3]INAF, Institute for Space Astrophysics and Planetology (IAPS).

Introduction: Here we present progress on the mapping of Mercury's H11 Discovery quadrangle (0–90°W, 22.5–65°S), part of a series of maps aiming to cover Mercury globally at 1:3M scale [1-8], ready for BepiColombo's arrival at the planet. Maps will provide scientific context for discoveries made by the mission, and will aid in targeting sites of interest.

Methods: We are mapping H11 using MESSENGER data, digitising features on ArcGIS. The map is in a Lambert Conformable Conic projection, as is standard for the mid-latitude quadrangles. The primary data product used for mapping is a 166 m/pixel monochrome basemap, along with high and low incidence angle variants [9], a colour mosaic [10], and a global DEM [11]. Individual MESSENGER MDIS frames are used to look at features of interest when they provide higher resolution or different illumination conditions. The mapped area will extend 5° beyond the boundary of the H11 quadrangle. After initial mapping is complete, a reconciliation process will occur with the surrounding quadrangle mappers to ensure consistency across the quadrangle boundary.

Map Units: So far we have mapped all crater rims, the contacts of crater infills, and currently are mapping ejecta deposits around craters.

Crater rims. The rim crests of craters over 5km in diameter are digitised as a linear feature, mapped into three subclasses: rims of 5-20km diameter craters, rims of >20km diameter craters, and buried/subdued crater rims. On the smaller end of this crater size range, craters that are noncircular or significantly subdued are not mapped, as these are likely secondary craters, or are so degraded that they can be considered part of the underlying terrain. Secondary crater chains will be mapped as a separate surface feature.

Crater infills. For craters >20km in diameter, the crater interior fills are mapped as a unit. These fill materials are divided into smooth or hummocky subclasses.

Crater ejecta. Ejecta and rim materials are mapped together as a unit for craters >20km in diameter. These units are assigned subclasses according to their host crater's degradation state. Degradation level is determined by assessing the preservation of the crater's structure and materials: fresher, less degraded craters have extensive preservation of the crater's rim crest and ejecta deposits, a morphological sharpness to the rim and crater materials, and crater rays for the very freshest craters. Two major systems have previously been used to classify crater degradation on Mercury [1,12,13], a 3 and a 5-class system, so we are using both systems concurrently. The final map of H11 will therefore have two forms, corresponding to the two systems of crater degradation classification.

Intercrater plains. A major geological terrain found across Mercury, but particularly dominant in the southern hemisphere. Crater density shows that intercrater plains are the oldest terrain type on Mercury [13,14,15], a gently rolling terrain almost saturated with secondary craters, heavily modified by repeated impact events [14].

Smooth plains. Like intercrater plains, smooth plains are a major geological terrain on Mercury. They are however characteristically less heavily cratered, level to gently sloped, and younger [16]. Smooth plains are often found within large impact basins, and can exhibit sharp boundaries with surrounding materials.

Structural features. Mercury exhibits a variety of structural features, including wrinkle ridges and lobate scarps, which will be digitised in H11 as linear features. These structures are interpreted to be the surface expressions of thrust faults [17].

Surface features. In addition to the major geological units and linear features, there are also a variety of surficial units that will be mapped in H11, represented on the map with a partially transparent symbology. These include faculae, which are high albedo red colour anomalies found in enhanced colour images of Mercury, frequently located around pits. These features are suggested to be pyroclastic deposits, with central pits interpreted as vents [18]. Fields of hollows will also be mapped; shallow cavities usually found within crater interiors, they likely form via a volatile loss process [19]. Crater rays and catenae in H11 will also be digitised.

Overview of H11: The H11 quadrangle is heavily cratered, containing craters and impact basins that span the size and age range for impact structures on Mercury. A variety of terrain types are found within H11, but crater materials and intercrater plains constitute most of the quadrangle. There is also a minor component of smooth plains materials, found mostly within the interiors of large craters. In addition to the terrain types frequently found elsewhere on Mercury, H11 hosts the less common chaotic terrain, the largest, and potentially sole example of its kind on Mercury.

Notable Features in H11:

Chaotic Terrain. The chaotic terrain consists of fields of knobs, pits, and linear grooves (Fig 1). Craters in the area are drastically altered with unusual crater rim degradation. The severity of this ranges from furrowing in crater walls, to dissection of rim structures by radial grooves, to almost complete destruction of crater structures. The chaotic terrain in H11 is found at the antipode to the Caloris impact basin, with previous studies [20] suggesting the Caloris impact event may have formed the terrain. Seismic shaking and ejecta deposition at the impact's antipode could have caused extensive alteration and resurfacing. This mechanism has also been proposed for chaotic terrains on the Moon [20]. Alternatively, Rodriguez et al. [21] suggested the terrain may have been formed by later volatile loss. We aim to test these two hypotheses, so have focused on dating the terrain relative to the Caloris impact event. Our crater counts of the terrain and the Caloris crater rim (thought to best represent the age of impact) produce ages indistinguishable from each other. Work is ongoing in investigating the terrain's morphology, with an emphasis on comparison to chaotic terrains on other planetary bodies. For mapping the terrain within H11, there are two main options. One option is to map the terrain as its own major geological unit, digitising a contact between the terrain and the surrounding area (possibly a gradational contact), and adding a class to the mapped units. This option was used in previous mapping efforts of the area, where the terrain was termed "hilly and lineated material" in the Mariner 10 era map [22]. Alternatively, if the original geological units of the terrain are discernable despite the chaotic alteration, the area could be mapped as these precursor units, with a partially transparent overlay showing the extent of chaotic alteration. This approach is similar to how surface features are mapped within H11.

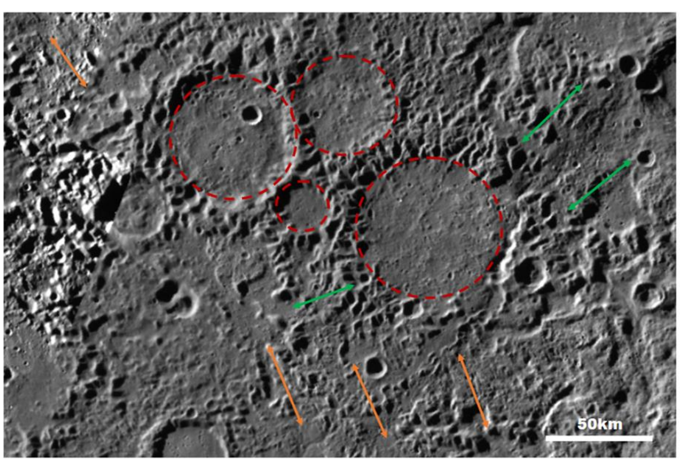

Fig 1 *An area of chaotic terrain in H11. Dissected crater rims indicated by red dashed lines. Orange and green arrows indicate linear groove populations.*

Discovery Rupes. Discovery Rupes, which gives its name to the H11 Discovery quadrangle, is one of the longest and tallest lobate scarps on Mercury [23]. It is found close to proposed pyroclastic vents, in addition to two ancient impact basins, Andal-Coleridge and b54 [24,25]. This is an excellent area for studying the interplay between ancient basins, faults, and volcanic features, where the presence of ancient basins may influence the propagation of faults [24,26] and pyroclastic pit sites may occur preferentially on impact craters and in highly fractured areas [27].

Future Work: After finishing digitisation of crater ejecta and rim materials, mapping will move on to assessing the plain material geological contacts. Intercrater and smooth plain contacts will be digitised. If distinguishable intermediate plains are present in H11, these may also be mapped as a separate unit, as has been done in other quadrangle maps [e.g. 4,5,6]. The chaotic terrain will also need to be mapped, where it will either be given its own geological unit, or will be represented as an overlay, depending on if the precursor plain materials are identifiable. Structural features and remaining surface features will be mapped, and finally reconciliation with other quadrangle maps at the boundaries of H11 will follow.

References: [1] Galluzzi V. A. et al. (2016) *J. Maps, 12*, 227-238. [2] Mancinelli P. (2016) *J. Maps, 12*, 190-202. [3] Guzzetta L. et al. (2017) *J. Maps, 13*, 227-238. [4] Wright, J. et al. (2019) *J. Maps, 15*, 509-520. [5] Pegg D. L. et al. (2021) *J. Maps, 17*, 718-729. [6] Malliband C. C. et al. (2022) *J. Maps*, 1-10. [7] Giacomini L. et al. (2022) *J. Maps*, 1-12. [8] Galluzzi V. A. (2023) 54th *LPSC.* [9] Chabot N. L. et al. (2016) *LPS XLVII*, #1256. [10] Denevi B. W. et al. (2016) *LPS XLVII*, #1264. [11] Becker K. J. et al. (2016) *LPS XLVII*, #2959. [12] McGill G. E. and King E. A. (1983) *USGS Map I-1409*. [13] Prockter L. M. et al. (2016) *47th LPSC*, #1245. [13] Murray B. C. et al. (1975) *JGR, 80*, 2508-2514. [14] Trask N. J. and Guest J. E. (1975) *JGR, 80*, 2461-2477. [15] Whitten J. L. et al. (2014) *Icarus, 241*, 97-113. [16] Spudis P. D. and Guest J. E. (1988) *Mercury*, 118-164. [17] Strom R. G. et al. (1975) *JGR, 80*, 2478-2507. [18] Head J. W. et al. (2009) *EPSL, 285*, 227-242. [19] Blewett D. T. et al. (2013) *JGR, 118*, 1013-1032. [20] Schultz P. H. and Gault D. E. (1975) *The Moon, 12*, 159-177. [21] Rodriguez J. A. P. et al. (2020) *Scientific Reports, 10*, 1-14. [22] Trask N. J . and Dzurisin D. (1984) *USGS Map I-1658*. [23] Galluzzi V. A. et al. (2021) *EGU 21, 16184*. [24] Fassett C. I. et al. (2012) *JGR, 117*, 2156-2202. [25] Orgel C. et al. (2020) *JGR, 125.* [26] Watters T. R. et al. (2001) *PSS, 49*, 1523-1530. [27] Klimczak C. et al. (2018) *Icarus, 315*, 115-123.