Preliminary observations of Rustaveli basin, Mercury

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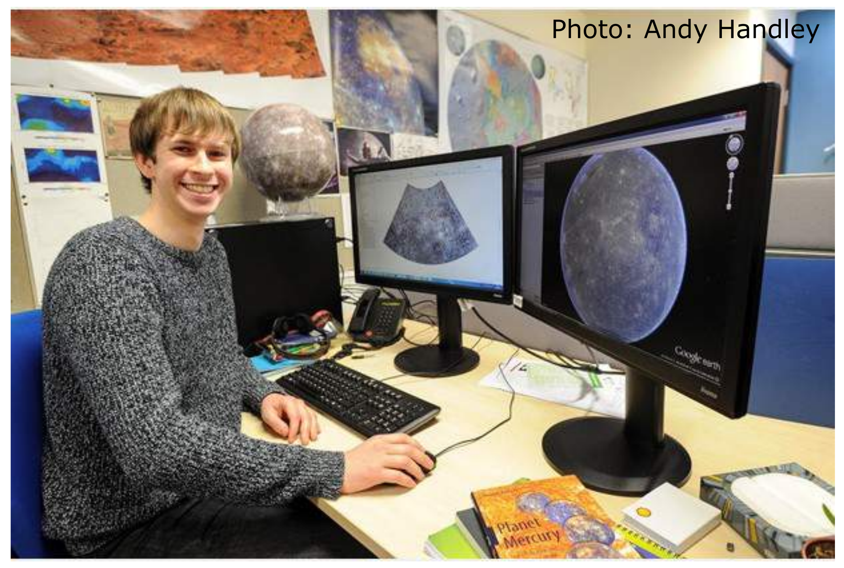

Introduction

The morphology and infill of several large basins on Mercury, such as Rachmaninoff and Raditladi (**Fig. 1** and e.g. [1,2]), have been studied in detail. This work aims to provide a similar analysis of Rustaveli basin. Rustaveli (**Fig. 2**) is a ~200 km diameter peak-ring basin on Mercury. It is an important feature in the NE of the Hokusai (H-5) quadrangle, of which we are currently producing a ~1:2M scale geological map (#2067) [3].

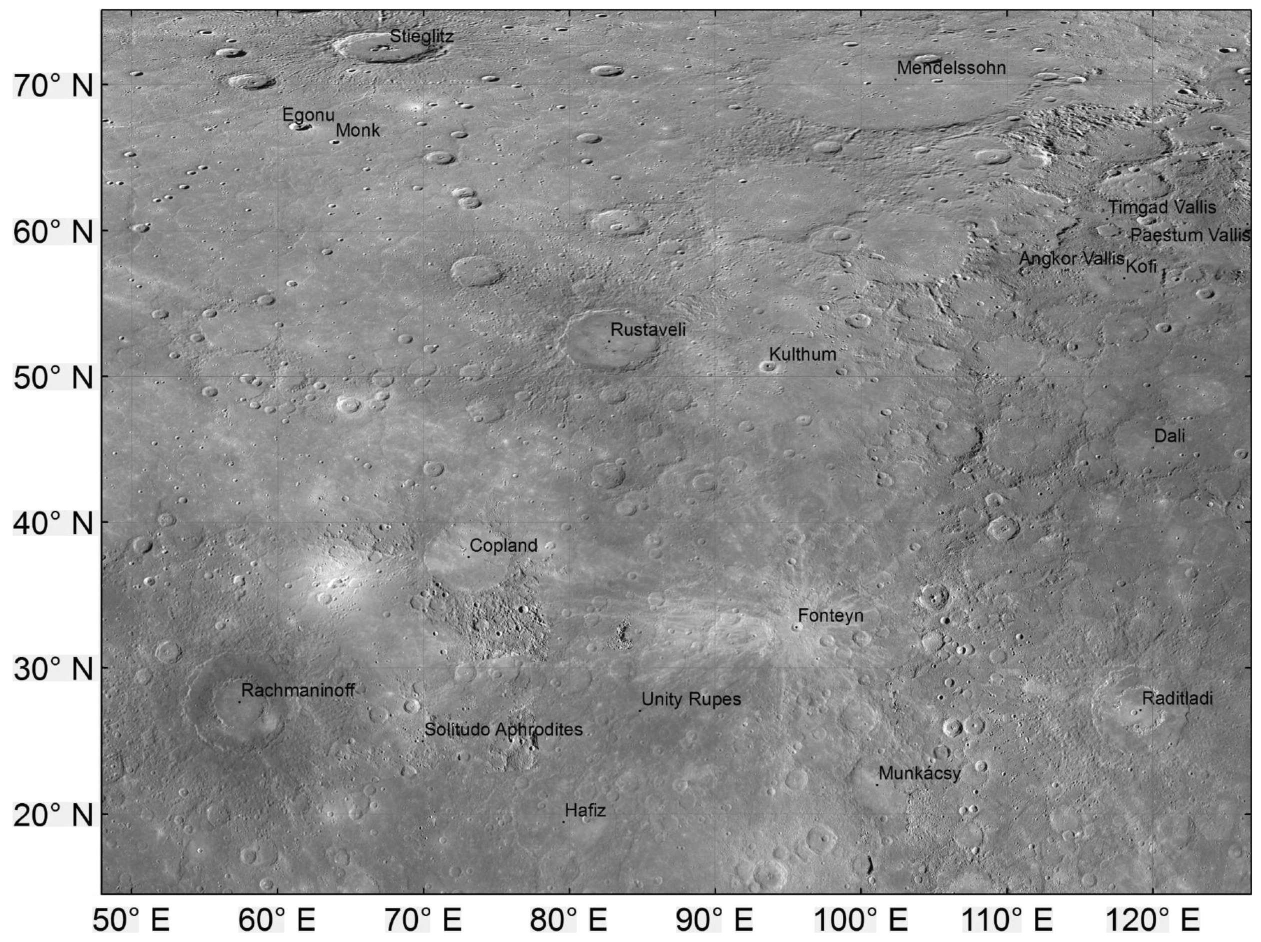

Fig. 1: The global context of Rustaveli. This image is cropped from the global mosaic of Mercury in a cylindrical projection (MDIS9). (Image mosaic credit: MESSENGER Team NASA/ Johns Hopkins University Applied Physics Laboratory/ Carnegie Institution of Washington.

General Observations

Age: Rustaveli is one of the youngest basins on Mercury of its size. Geological evidence for this interpretation includes its widespread and undegraded ejecta blanket, its sharp crater rim and terraces, and the low density of craters superposed on it (**Fig. 2**). These observations suggest a probable Mansurian age for the impact.

Infill: The floor of Rustaveli is covered by a smooth infill. It appears to have a crater density similar to or less than typical Northern Plains. **To test this, we counted the craters on the infill and ejecta. We compare the results of these counts as N(4) values where N(4) is the number of craters superposed on a geological unit with diameter greater than 4 km per million km^2. This allows the comparison of crater counts without reference to a crater model production function.**

Peak-ring: Rustaveli's peak-ring is flooded by smooth infill that largely buries its peak-ring. Such a depth of flooding suggests that the infill seen today is the result of post-impact volcanism rather than impact melt. The peak-ring is also off-centre and elongated E-W. An oblique impact trajectory may explain this irregularity.

Polygonality: The western portion of Rustaveli's crater rim can be closely approximated by straight lines. On Earth, polygonality in small craters is attributed to slumping along joints in the target material. How such a large polygonal crater could form in this way is unknown.

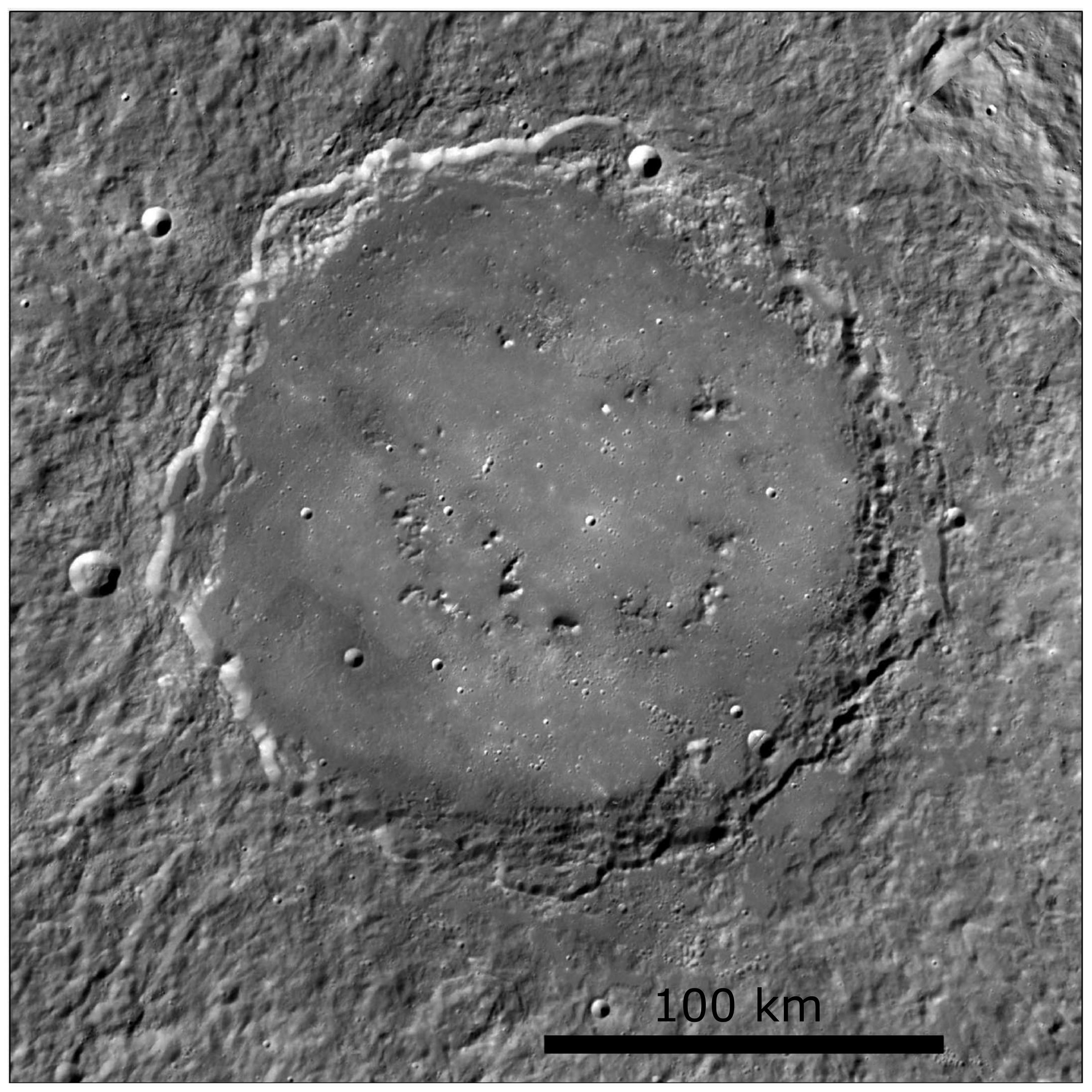

Fig. 2: Sinusoidal projection of Hokusai basemap centred of Rustaveli

Rustaveli Crater Counts

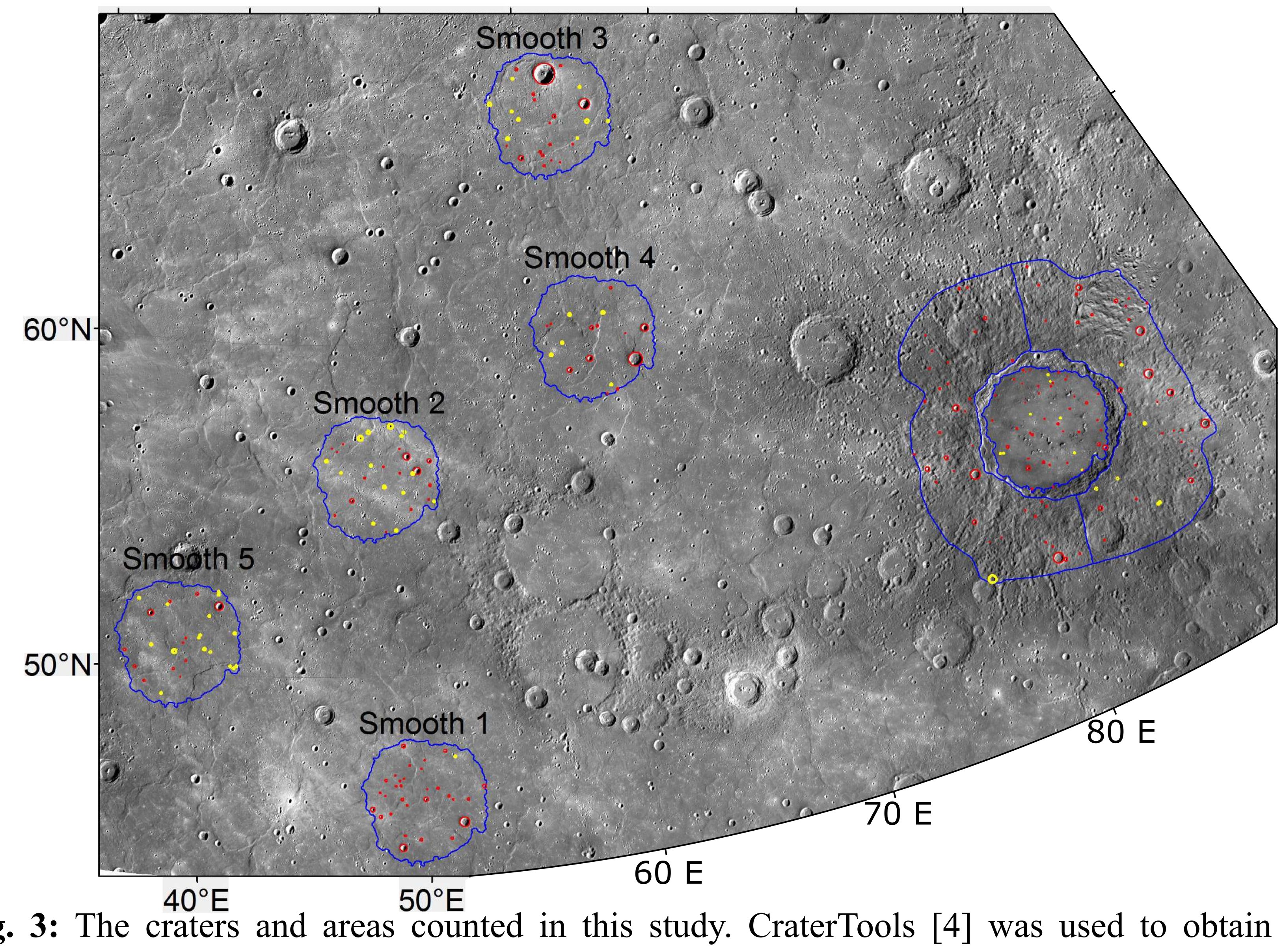

Fig. 3: The craters and areas counted in this study. CraterTools [4] was used to obtain data. A conservative approach was used: only craters indisputably superposing Rustaveli's thick ejecta blanket were counted. Furthermore, care was taken to avoid counting obvious secondary craters. NAC images were used in conjunction with the basemap when counting craters.

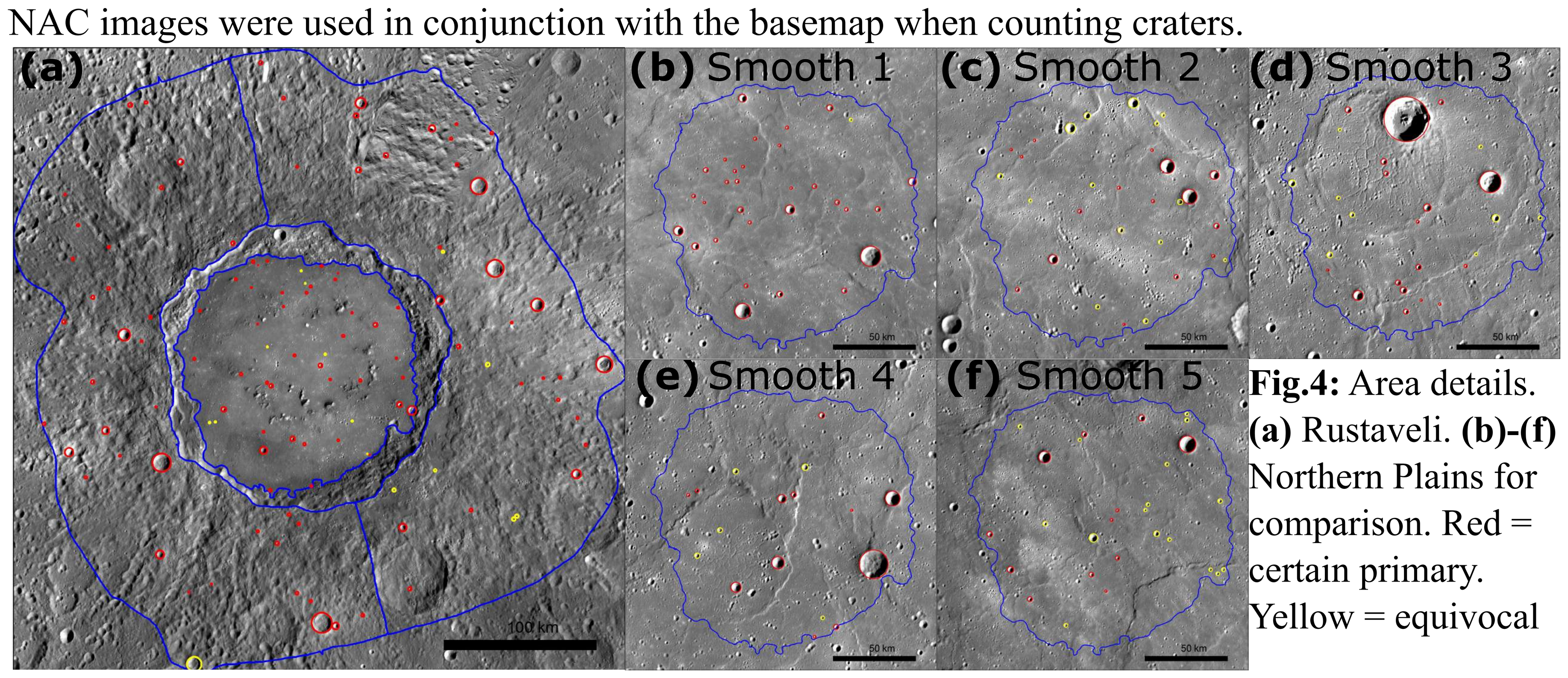

Fig.4: Area details. **(a)** Rustaveli. **(b)-(f)** Northern Plains for comparison. Red = certain primary. Yellow = equivocal

Count Unit	N(4)	Craters D ≥ 4 km	Count Area (km^2)	Source
Rustaveli ejecta	172.0 ± 41.7	17	9.9 x 10^4	
Rustaveli infill	100.2 ± 70.8	2	2.0 x 10^4	
Smooth 1	344.0 ± 130.0	7	2.0 x 10^4	
Smooth 2	307.7 ± 125.6	6	1.9 x 10^4	
Smooth 3	290.0 ± 130.1	5	1.7 x 10^4	
Smooth 4	264.8 ± 118.4	5	1.9 x 10^4	
Smooth 5	149.2 ± 86.1	3	2.0 x 10^4	
All Smooth units	270.8 ± 53.1	26	9.6 x 10^4	
Moderate density Northern Plains	273		4.1 x 10^6	[5]
Low density Northern Plains	170		4.1 x 10^6	[5]
Rustaveli affected plains	130			[5]

Table 1: The results from our crater counts with additional values from the literature for comparison.

Results and Discussion

We compare the N(4) for Rustaveli's infill and for randomly chosen areas on the surrounding smooth plains. Rustaveli's infill is significantly less cratered than the Northern Plains. Our N(4) value for Rustaveli's ejecta is of the same order as the value reported by [5] for the plains affected by Rustaveli. The difference may arise from uncertainty in our count due to our small areas. We cannot conclude that Rustaveli's infill is significantly younger than its ejecta. A younger age for the infill would support its origin by post-impact volcanism. At the N(2) level, it may be possible to distinguish the ejecta and infill, however most craters <10 km are likely to be secondaries so care must be taken when making these counts.

References: [1] Prockter L. M. et al. (2010) *Science, 329*, 668-671. [2] Blair D. M. et al. (2013) *JGR: Planets, 118*, 47-58. [3] Wright J. et al. (2016) LPS XLXII, Abstract #2067. [4] Kneissl T. et al. (2011) *PSS, 59*, 1243-1254. [5] Ostrach L. R. et al. (2014) *Icarus, 250*, 602-622. [6] Strom R. G. et al. (2008) *Science, 321*, 79-81.