Preliminary findings from geological mapping of the Hokusai (H-5) quadrangle of Mercury

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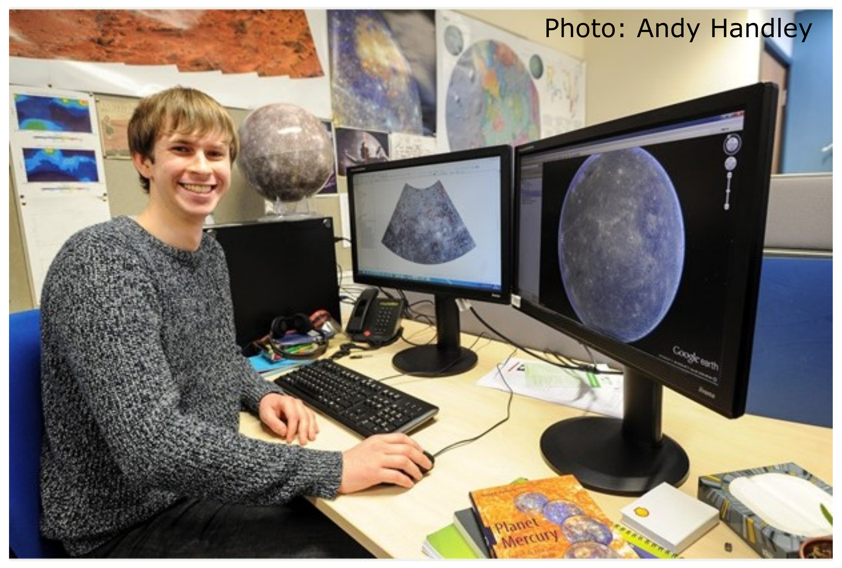


The Map

New ~1:3M scale quadrangle geological maps of Mercury are being produced [1]. Using data from NASA's MESSENGER spacecraft, we are making a geological map of Hokusai quadrangle, for which there is no existing Mariner 10 map. Linework is drawn at 1:400k scale using ArcGIS. Craters >20 km will be assigned degradation classes according to the schemes in [1] and [2] to determine the morphostratigraphy of the region.

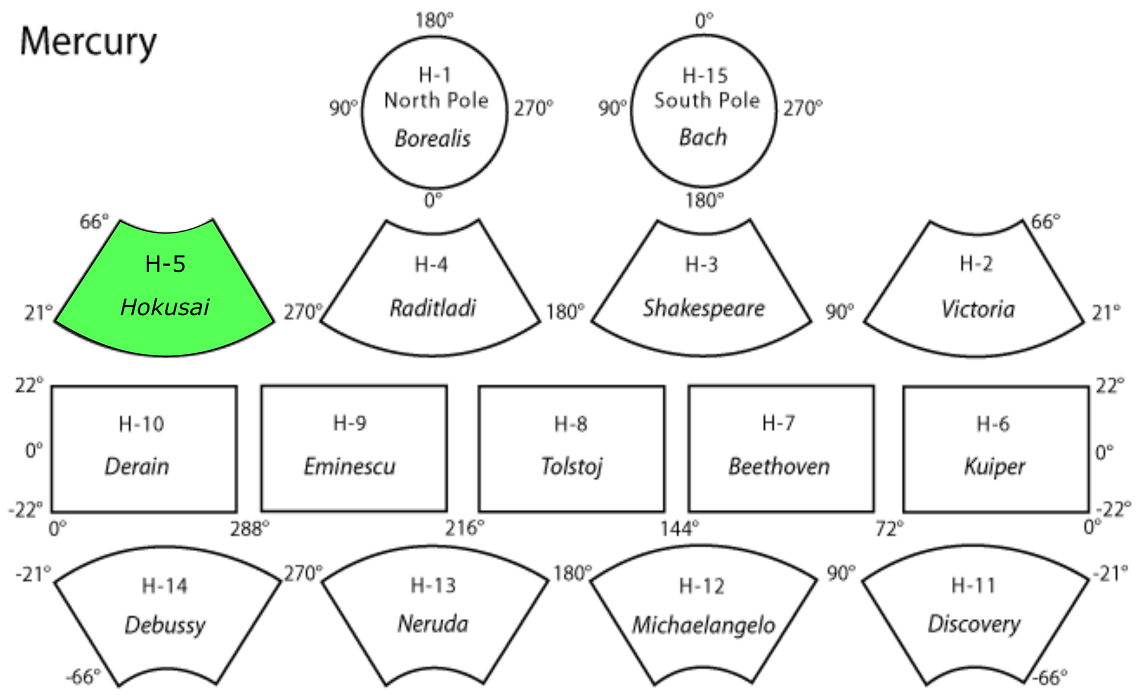


Fig. 1: Mapping quadrangles of Mercury. New geological maps of H-2, H-3 and H-4 are complete. H-6 is underway [1].

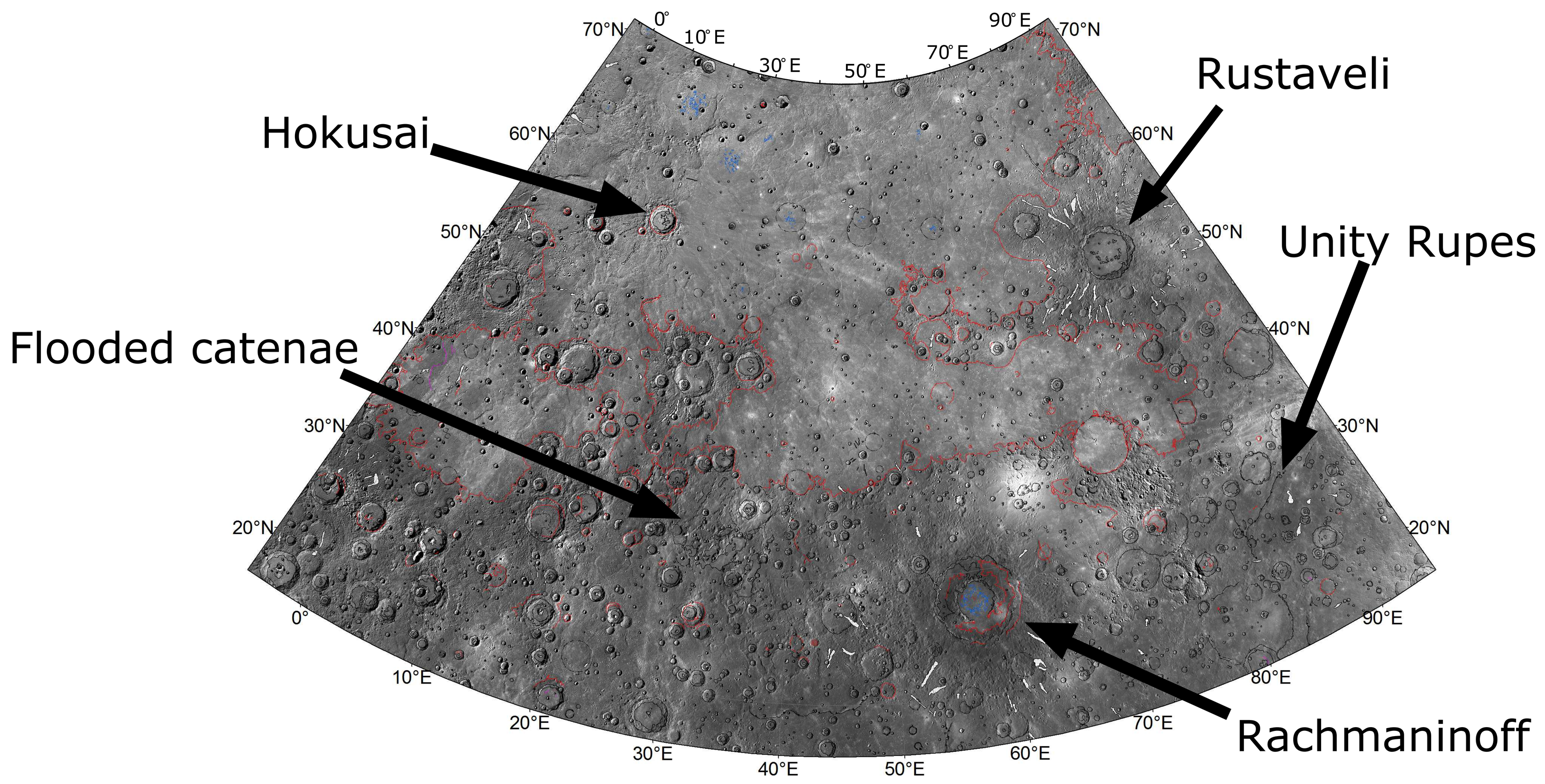


Fig. 2: Preliminary linework of the Hokusai quadrangle.

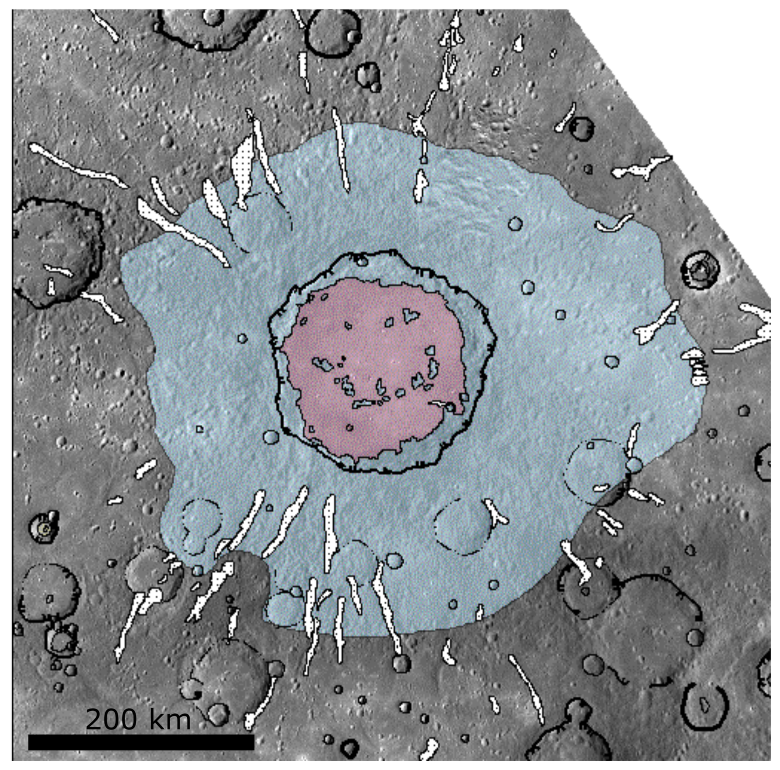
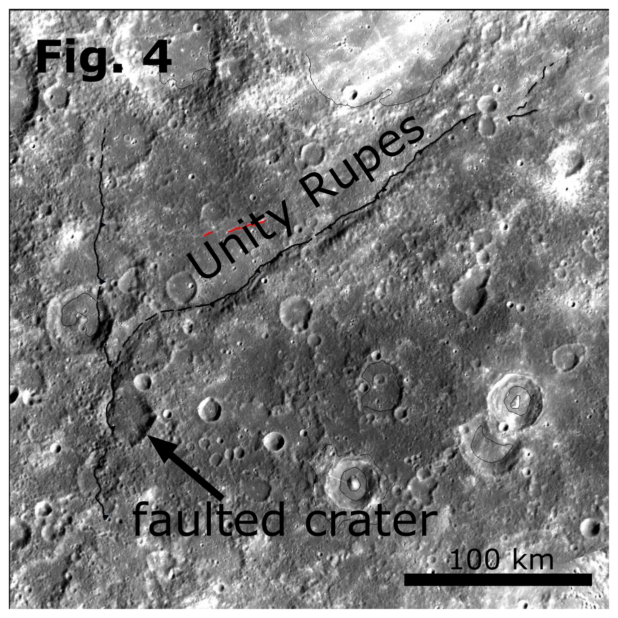


Fig. 3: The Rustaveli impact crater is described in another poster (#2063) by us [3].

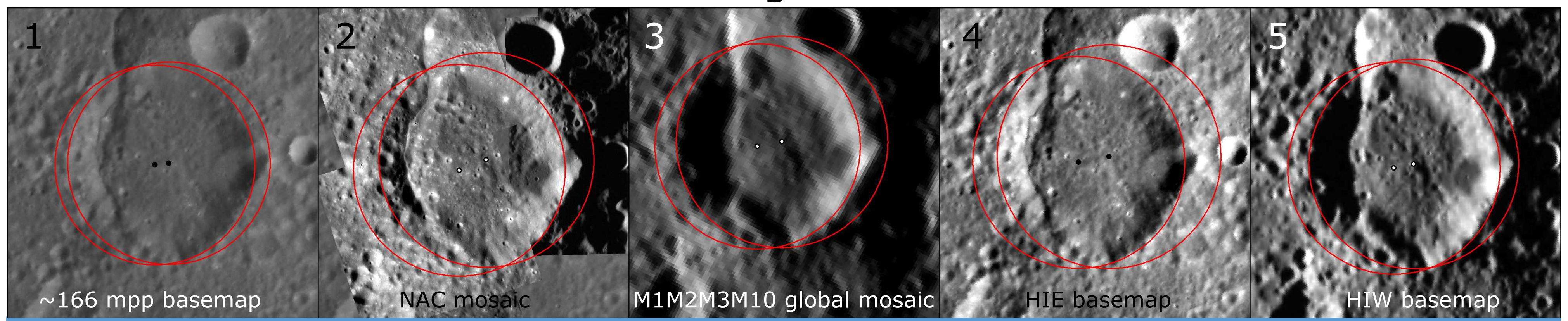
Unity Rupes Fault Kinematics



Unity Rupes is the most prominent lobate scarp in the Hokusai quadrangle. It appears to be a right-lateral sidewall ramp at the northernmost extent of a 2000 km fault system including Blossom Rupes to the south [4]. A faulted crater toward the southern tip of Unity Rupes has been used to determine the fault kinematics.

Fig. 4: Unity Rupes showing the location of the faulted crater used for kinematic analysis. Below, Fig. 5:

Fig. 5



Attempt	Footwall diameter (km)	Hangingwall diameter (km)	Slip trend (degrees)	Δx (km)
1	32.5	32.1	259	2.3
2	34.5	34.0	247	4.7
3	34.0	33.0	255	4.0
4	36.0	34.0	259	5.0
5	33.7	34.1	257	3.3

Fig. 5: Five attempts at fitting circles to the faulted crater (according to the method in [5]) and the table of results. Different background images were used in each attempt. Each image is 50 km across. In each attempt, this part of Unity Rupes is interpreted as a thrust fault with its footwall in the west and its hangingwall in the east. Circles were fitted using CraterTools [6]. The crater diameter should not change significantly across the fault. Slip trend is the bearing of the hangingwall circle centre from the footwall circle centre. Δx is the horizontal component of motion on Unity Rupes measured as the distance between the two circle centres in each attempt.

Results and Discussion

slip trend = 255±5° Δx = 3.9±1.1 km

The chief source of error is in the fitting of circles to the crater rim. The faulted crater is highly degraded, and its rim has been mostly obliterated by subsequent impacts. Unfortunately, this is the best available crater for studying the kinematics of Unity Rupes with this method. However, the average of Δx is consistent with measurements of other faulted craters as reported by [5].

Plains Units on Mercury

Globally, two major plains units can be identified on Mercury: intercrater plains (ICP) (**Fig. 6a**) and smooth plains (SP) (**Fig. 6b**). Mariner 10 mappers also recognised a third unit - intermediate plains (IP). However, MESSENGER researchers [7] have advised that IP should be remapped as either ICP or SP. Modern global geological maps of Mercury, therefore, do not contain IP [2]. However, quadrangle mappers have retained the IP unit [1]. Here, we discuss the merits of mapping intermediate plains.

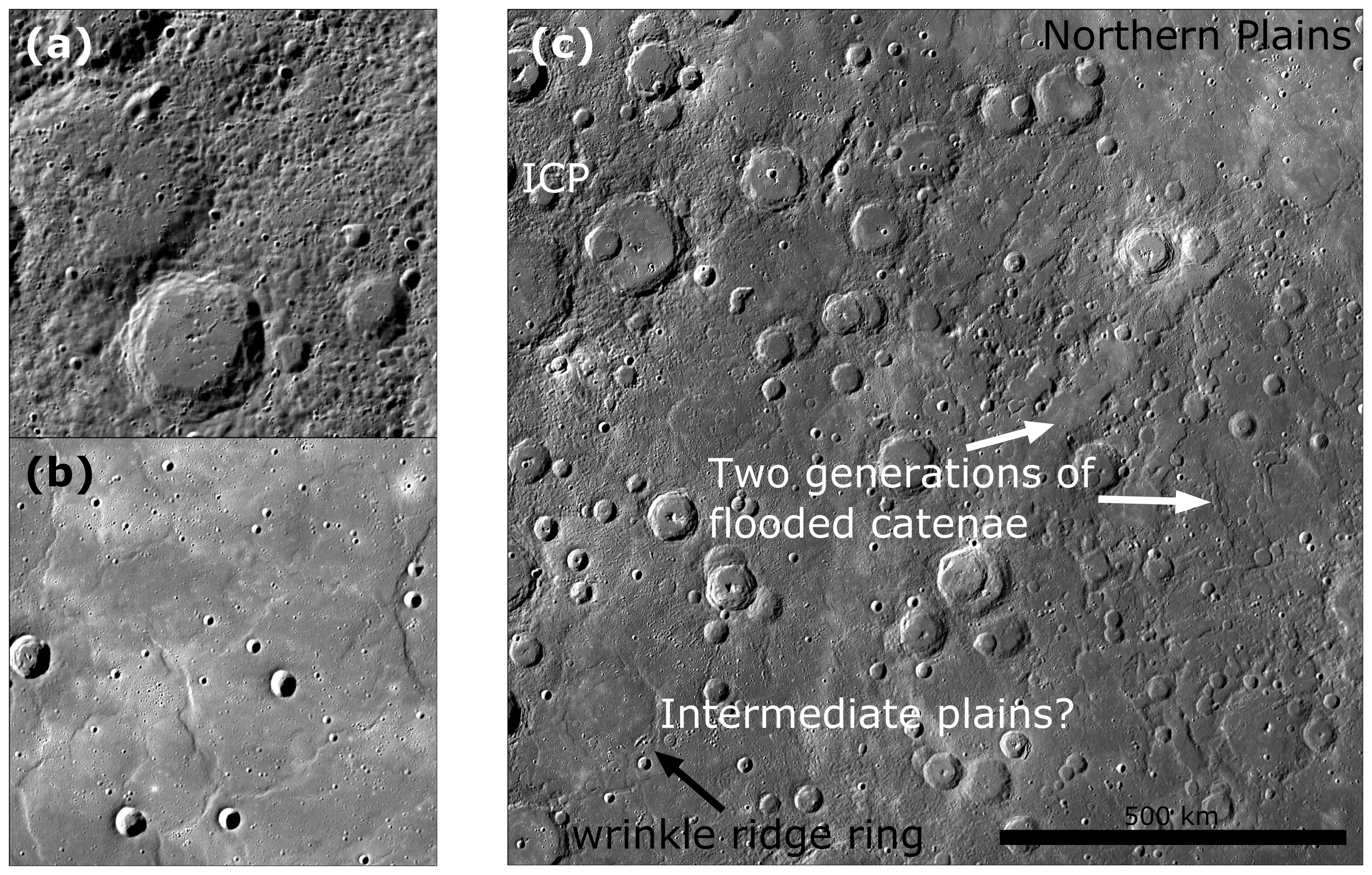


Fig. 6: **(a)** ICP and **(b)** SP. Both images 180 km across. **(c)** Regional relationship between SP in the NE, ICP in the NW and a region of possible 'intermediate plains' in the centre. The fill of the northern catenae resembles Northern Plains material but the eastern catenae have a darker fill, suggested to be possible IP.

Results and Discussion

Geological mapping of Hokusai has revealed a regionally extensive unit with traits of both ICP and SP. This IP is not as textured as ICP, and appears to lack its population of Pre-Tolstojan craters. Young, primary impacts have distributed many secondaries across the IP, making it resemble ICP. SP features (e.g. ghost craters) are prominent in IP. Crater counting has determined an age for IP between typical ICP and SP [8].

Mapping 'intermediate plains' fits with hypotheses of continuous resurfacing early in Mercury's history.

References: [1] Galluzzi V. et al. (2016) *LPS XLVII*, Abstract #2119. [2] Prockter L. M. et al. (2016) *LPS XLVII*, Abstract #1245. [3] Wright J. et al. (2016) *LPS XLVII*, Abstract #2063. [4] Massironi M. et al. (2015) *Geol. Soc., London, Special Publications*, 401, 269-290. [5] Galluzzi V. et al. (2015) *Geol. Soc., London, Special Publications, 401*, 313-325. [6] Kneissl T. et al. (2011) *PSS, 59*, 1243-1254. [7] Whitten J. L. et al. (2014) *Icarus, 241*, 97-113. [8] Galluzzi V. et al. (2015) *EGU GAC Abstracts, 17.*