Small smooth units ('young' lavas?) abutting lobate scarps on Mercury

Conference or Workshop Item

SMALL SMOOTH UNITS ('YOUNG' LAVAS?) ABUTTING LOBATE SCARPS ON MERCURY. C.C. Malliband[1], D.A. Rothery[1], M.R. Balme[1], and S.J. Conway[2], [1]The Open University, Milton Keynes, UK (chris.malliband@open.ac.uk), [2]CNRS, LPG, Université de Nantes, France

Overview: Elaborating the history of magmatism and tectonism at the surface of Mercury is vital to fully understand the planet's geological history. Current thinking has linked the end of large scale magmatism to global cooling and contraction. In the process of mapping the Derain (H-10) quadrangle of Mercury we have found small (<15000 km^2) patches of smooth plains units, often abutting against contractional tectonic features. This suggests some magmatism was not solely limited to impact basin interiors after the onset of global contraction.

Background: Magmatically derived units on Mercury are typically classified principally on the basis of their geomorphology [1,2]. Younger units are generally smooth and relatively uncratered, whereas more ancient units are more heavily cratered and textured. Lobate scarps and wrinkle ridges are widely recognized to be surface expressions of contraction faults linked to Mercury's global contraction [3].

Mercury has many large areas of smooth plains, thought to have been emplaced at around 3.7–3.9 Ga [2]. A contractional stress regime makes it hard for eruption pathways to remain open, inhibiting prolonged large-scale eruptions. Current thinking suggests large scale effusive volcanism ceased at around 3.5 Ga [4] at the start of global contraction. Previously the only younger smooth units identified have been restricted to medium-small impact basins [5] and impact melt [2]. This work is the first to document units outside impact basins that clearly postdate global contraction.

Examples found: We have found multiple examples of ponding at lobate scarps, and these examples outcrop with a small number of styles. The clearest examples are those that show deep ponding, evidenced by very smooth topography with little or no trace of the underlying landscape, directly abutting against a lobate scarp and superposing terrain with a notably more cratered texture. This is illustrated in Figure 1 which shows the example at Calypso Rupes. This is the most common type we have so far identified. Other examples do not show such deep magma flooding but show subdued, 'ghost-craters', indicating a thinner layer of lava (10-100s m vs many 100s m of flooding). Other examples show 'humpbacks' of cratered areas of higher topography caused by lobate scarps with smoother plains occurring on either side. Very few topography-forming processes occur on Mercury and elevated ridges are almost all fault controlled, suggesting these units formed after the onset of global contraction. The ponding examples found are geographically widespread and do not show any clear pattern of distribution. All are small in area (<15 000 km^2).

Other small scale smooth patches were noted by [1], but were not studied in detail. Our mapping has identified more than 5 examples of isolated smooth patches, remote from any identified fault features. We are studying these to complement studies of smooth patches abutting faulting.

Emplacement: We aim to examine how emplacement of these smooth patches occurred. As ponding examples are found abutting against fault scarps, it is possible that faults may have provided pathways for magma movement. It is also possible that temporary stress relief after fault movement allowed reactivation of existing magma pathways

References: [1] Whitten J. L. et. al. 2014 Icarus 241, 97–113 [2] Denevi B. W. et al. 2013. JGR-Planets. 118, 891–907. [3] Byrne P. K. et. al. 2014. Nature Geosci. 7, 301–307 [4] Byrne P. K. et. al. 2016. GRL, 2016GL069412 [5] Wright J. et. al. 2017. 48th LPSC, #2239

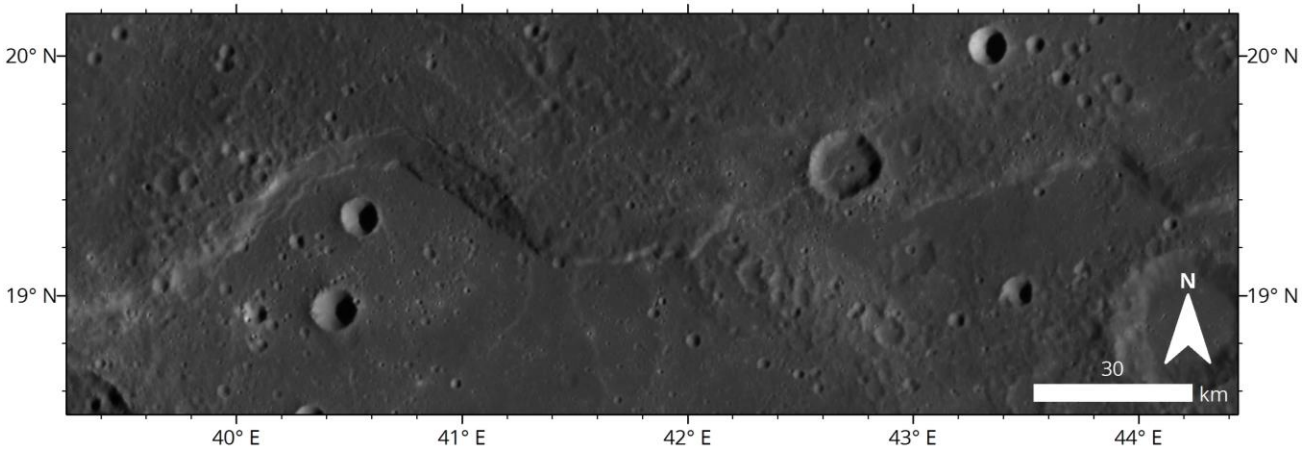

Fig 1: Calypso Rupes. Note the more heavily cratered surface on the hanging wall (north) and smooth plains abutting against the scarp.