

Introduction: Lobate scarps on Mercury are generally accepted as being surface expressions of thrust faulting. This is taken as evidence of lithospheric contraction on a global scale, reflecting either global cooling, leading to thermal contraction and internal phase changes [1], [2], [3], [4]; or tidal despinning, leading to collapse of an equatorial bulge [5], [6]; or a combination of both [7], [8]. It has been further suggested that the orientations of lobate scarps could reflect a pattern of mantle convection [9].

Here we describe compressional tectonics localized along the interface between basin-fill and the inner walls of >200 km diameter impact basins. These are considerably larger than the ghost craters with deformed rims that have been the focus of other studies [10], [11], [12]. We draw attention to several examples of outward-directed thrust faults following the inside of basin rims, mostly unremarked although identified as basins in a global survey of >300 km basins by Fassett et al. [13]. In some cases the thrust scarp lies close inside the original basin rim, whereas in other cases the rim has been overthrust.

This poster: Figure 1 is a map showing identifiable rims of basins where we have identified outward-directed, rim-tracing thrust faults. Figure 2 is a global map of 'certain' and 'probable' >300 km basins according to Fassett et al. [13]. Figure 3 is a simplistic model showing how crustal contraction could cause thrust faulting at the lower boundary of basin-fill. Figures 4-9 illustrate some examples of basins with tectonized edges, discussed individually in their captions. We note the spectral terrain type according to the terminology of Denevi et al. [14].

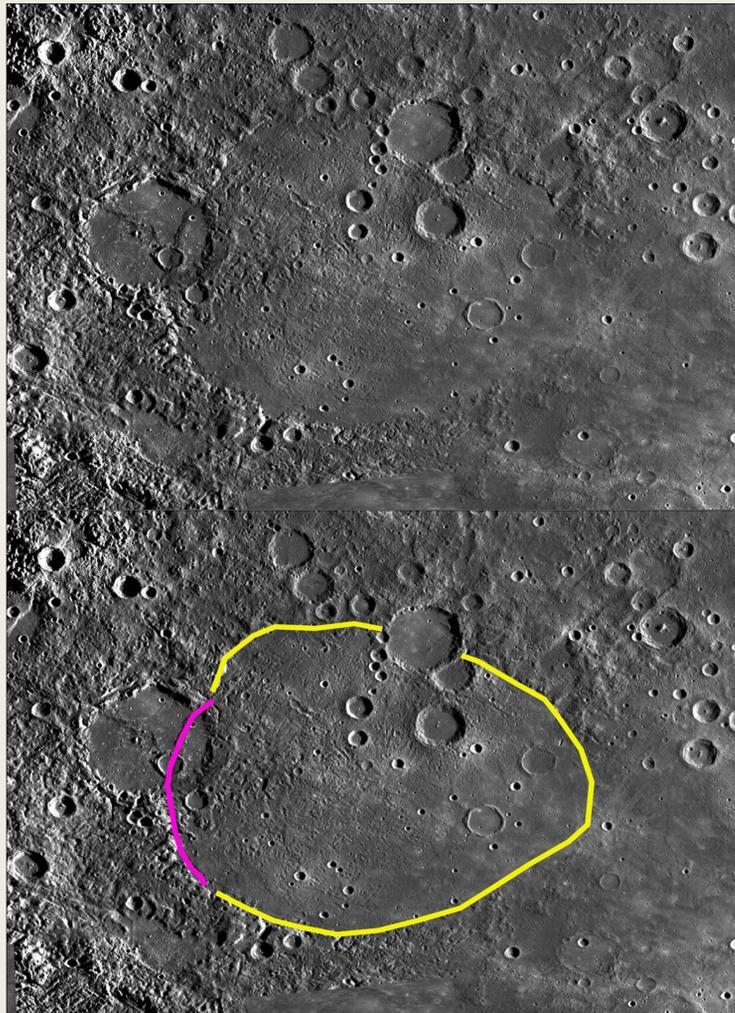


Fig 4 MDIS8 mosaic view of basin b37, 430 km diameter, listed by Fassett et al. [13] as a 'definite' basin. Top: unannotated, Bottom: yellow line trace of original rim, pink line thrust scarp developed close to the line of the original rim.

History of events:

- 1 Formation of 430 km diameter impact basin
- 2 Regional emplacement of lava (low-reflectance blue plains), burying part of the basin rim in the E and largely filling the basin
- 3 Formation of a 140 km impact crater, overprinting the W rim of the basin
- 4 Flooding of the 140 km crater floor
- 5 Formation of a 30 km impact crater in the SE of the 140 km crater
- 6 More lava flooding within 140 km and 30 km craters?
- 7 Thrust faulting at the interface between basement and the fill of the 430 km basin partially overthrusts the WSW rim and cuts across the features listed in 3-6

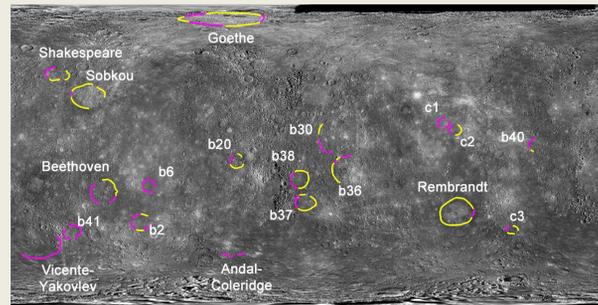


Fig 1 MDIS8 mosaic (cylindrical projection) showing basins where we recognize tectonized edges. Pink = tectonized edge. Yellow = non-tectonized edge. Names and 'b' designations are from [13], c1, c2 & c3 (280, 300 and 230 km) are newly designated here.

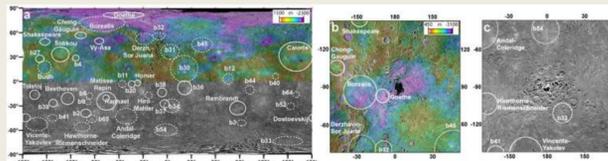


Fig 2 Certain (solid white) and probable (dashed white) impact basins on Mercury according to Fassett et al. [13]. (a) Global view, equidistant cylindrical, (b) North polar region, (c) South polar region (stereographic). MLA topography shown in the northern hemisphere.

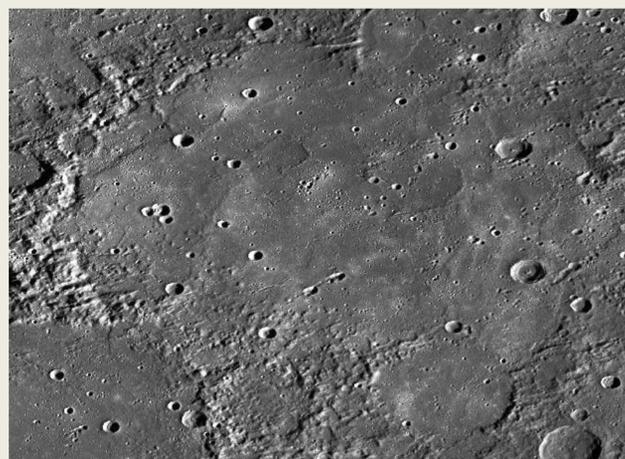


Fig 5 MDIS8 mosaic view of Shakespeare basin, 300 km diameter, listed by Fassett et al. [13] as a 'definite' basin. It resembles b37 (Figure 4) in having a lobate scarp inside its W rim, cutting a younger crater. In the SW the scarp may be partially obscured by ejecta from a younger overlapping basin, suggesting that the last tectonic episode is older than for b37. The rim is scarcely discernible between NE and SE, where it appears to have been buried by intermediate plains lava.

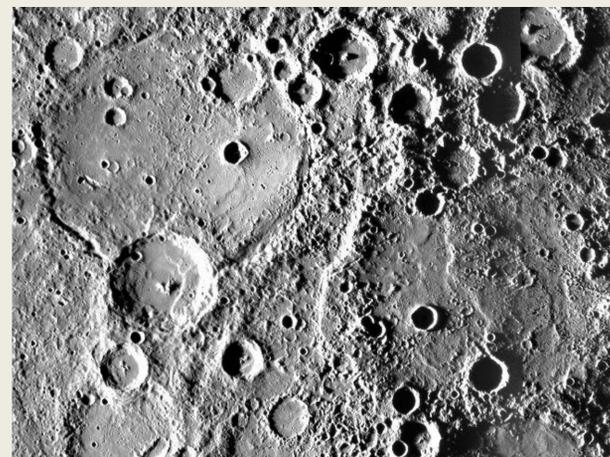


Fig 6 M1M2M3 flyby mosaic view of basins c1 (left) and c2 (right), 280 km and 300 km diameter, not listed by Fassett et al. [13] whose size cut-off was 300 km. They are buried by intermediate plains lava. The whole visible inner edge of c1 is a fault scarp, but later craters overprint this in the S and NE. c2 has a fault scarp that has over-riden its W rim.

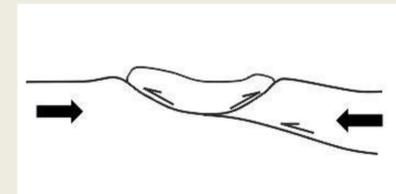


Fig 3 Sketch cross-section, not to scale, of compressional tectonics acting on a part-filled impact basin. In this example, a westward directed thrust at depth below an impact basin leads to thrusting (to the west) and back-thrusting (to the east) of basin fill. Irrespective of driving force, the scarps we see are most simply explained by this sketch model. Thrusting at the edges of low-latitude basins is most strongly developed at eastern and western rims, suggesting (admittedly from a small number of examples) tidal despinning as a driving force, whereas global contraction would lead to no such preference.

In several cases, the faulting is demonstrably considerably younger than the plains units filling the basins, and so this observation suggests despinning occurring (or continuing) well after the end of the late heavy bombardment, contrary to previous expectations [6], [8].



Fig 7 Basin b6, 320 km diameter, listed by Fassett et al. [13] as a 'probable' basin with 60% rim completeness. Left M1M2M3 mosaic, right MDIS8 mosaic. This is a rather cryptic basin, dependent on suitable illumination to reveal it. It appears to have been entirely flooded by intermediate plains lava with no surviving traces of the original basin rim. It is almost entirely surrounded by an outward-facing scarp.

WTF?*

*What's this feature?

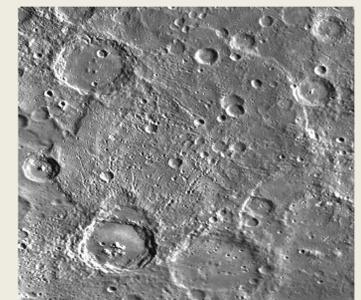
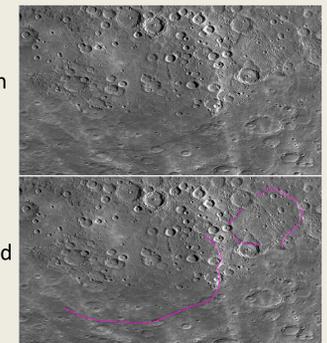


Fig 8 MDIS6 mosaic view of basin b41, 340 km diameter, listed by Fassett et al. [13] as a 'probable' basin with 20% rim completeness. This is in fact a plateau, entirely surrounded by a scarp, and is less circular than other examples. A younger 180 km peak-ring basin overprints its SE edge, and smaller craters do so in several other places. The overlapping rim of the 90 km crater at the SSW is doubled. A pair of 20 km and 30 km craters on the NNE edge appear to be cut by the bounding scarp, implying that these are older than the plateau. Is this an ancient filled basin, with its entire rim over-riden by outward directed thrusting? Did it originate as a lava plateau, and not as a basin at all?

Fig 9 MDIS8 mosaic view of Vicente-Yakovlev basin, 690 km diameter, listed by Fassett et al. [13] as a 'probable' basin. Basin b41 (Fig 8) is visible to its NE. Top: unannotated, Bottom: pink line shows rim-tracing thrust scarp. There is no doubt that Vicente-Yakovlev is a real feature, but little if any of its original rim is discernible. Dostoyevskij basin (410 km) is superimposed in the NW. Spectrally this is an area of intermediate plains.



- References:** [1] Strom R. G et al. (1975) *JGR*, 80, 2478-2507. [2] Watters T. R. et al. (1998) *Geology*, 26, 991-994. [3] Watters T. R. et al. (2004) *GRL*, 31, L04071. [4] Watters T. R. et al. (2009) *EPSL*, 285, 283-296. [5] Melosh H. J. and Dzurisin D. (1978) *Icarus*, 35, 227-236. [6] Melosh H. J. and McKinnon W. B. (1988) in Vilas F. et al. eds *Mercury*, UAP, 374-400. [7] Dzurisin D. (1978) *JGR*, 83, 4883-4906. [8] Dombard A. J. and Hauck S. A. (2008) *Icarus*, 198, 274-276. [9] King S. D. (2008) *Nature Geoscience*, 1, 229-232. [10] Klimczak C. (2012) *JGR*, 117, E00L03. [11] Freed A. M. et al. (2012) *JGR*, 117, E00L06. [12] Watters T. R. et al. (2012) *Geology*, 40, 1123-1126. [13] Fassett C. I. et al. (2012) *JGR*, 117, E00L08. [14] Denevi B. W. et al. (2009) *Science*, 234, 613-618.