VOLCANIC SHIELDS ON MERCURY IDENTIFIED AT LAST? J. Wright[1], D. A. Rothery[1], M. R. Balme[1] and S. J. Conway[2], [1]School of Physical Sciences, The Open University, Milton Keynes, MK7 6AA, UK (jack.wright@open.ac.uk), [2]LPG Nantes – UMR CNRS 6112, Université de Nantes, France.

Introduction: Small (<50 km) basaltic shield volcanoes are known on Earth [1], the Moon [2], Mars [3] and Venus [4], but have not hitherto been positively identified on Mercury. A candidate on Mercury suggested by Head et al. on the basis of MESSENGER flyby imagery [5] was subsequently shown not to be a constructional edifice but to be a compound volcanic vent that had acted as a source only for explosive volcanic eruptions [6]. Here we introduce a good candidate for a small basaltic shield on Mercury, and a somewhat less convincing second candidate. Both are less than 10 km in diameter, and are situated towards the edges of lava-flooded impact basins, where one might expect to find volcanic structures.

First Candidate: 123°02’14” E, 34°07’40” S.

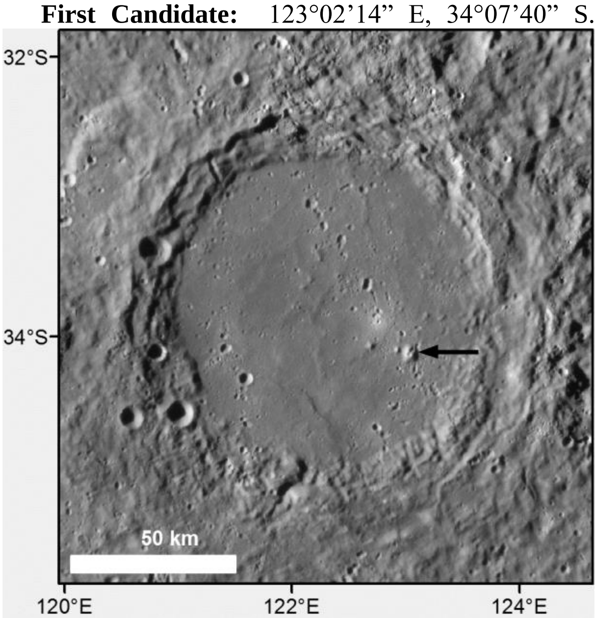

Fig. 1. *The unnamed impact basin hosting the first candidate volcanic edifice (black arrow).*

Locality. This candidate volcanic edifice is situated within a ~120 km impact crater (Fig. 1). Craters of this size on Mercury typically contain central peaks or peak- rings [7], however any peak elements originally present appear to have been buried by smooth plains material. The candidate edifice is situated inside the basin, close to the edge. It is the largest positive relief feature within the basin.

Physical characteristics. This positive relief feature has a circular outline in map view (Fig. 2). It is ~6 km in diameter. From shadow length measurements, we estimate it to be ~600 m high, corresponding to an average slope of ~20°. The feature has a bowl-shaped depression centred on its summit. This depression has a shallower appearance than similarly sized impact craters in the region. The northern flank of the feature has a separate depression running from the peak to the base. Available NAC imagery does not reveal how this depression relates to the summit depression.

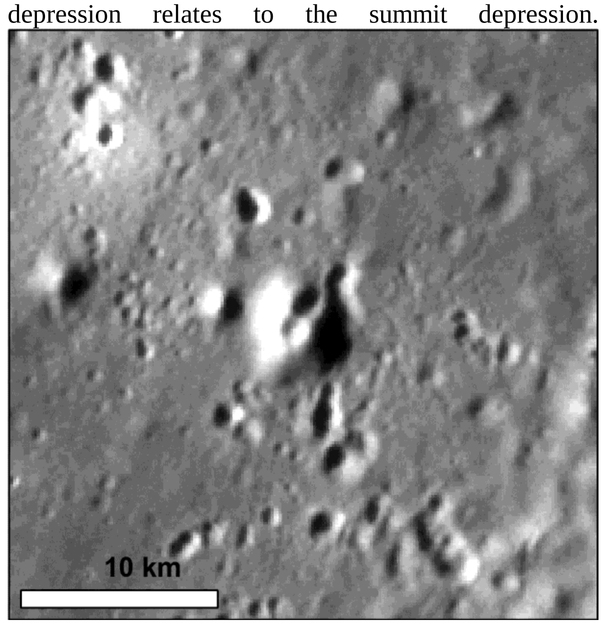

Fig. 2. *The first candidate volcanic edifice seen in NAC image EN1015774526M (~136 mpp).*

Spectral characteristics. The interior of the impact basin is predominantly low reflectance blue plains with some low reflectance material (LRM) [8]. However, the positive relief feature appears as a relatively red spot (Fig. 3), like those associated with sites of explosive volcanism elsewhere on Mercury [5]. Furthermore, small impacts onto the surrounding smooth plains exhume blue material, indicating a deeper source for the red material associated with the positive relief feature.

Interpretation. Since this positive relief feature is situated within an impact structure, the first hypothesis might be that it is a peak element with a superposing impact crater. However, this hypothesis cannot account for the prominence of this positive relief feature and the burial of the rest of the implied peak-ring.

Instead, we propose the following sequence of events to explain the current appearance of the positive relief feature and its host impact basin. 1) The host impact basin formed. The degradation state of this basin (C2, [9]) suggests a Mansurian age for this impact.

2) After formation, the basin is infilled by effusive volcanism. The burial of the expected peak elements is the major indication of post-impact volcanism. 3) Towards the end of this period of effusive volcanism, the positive relief feature is built as a late-stage volcanic edifice. During, and continuing after, edifice formation, small primary and secondary impacts occur throughout the region, causing the impact craters on the smooth plains and the northern flank of the edifice. 4) Before the extinction of the volcano, there is a final stage during which at least one explosive eruption occurred, creating the red spot (pyroclastic deposit).

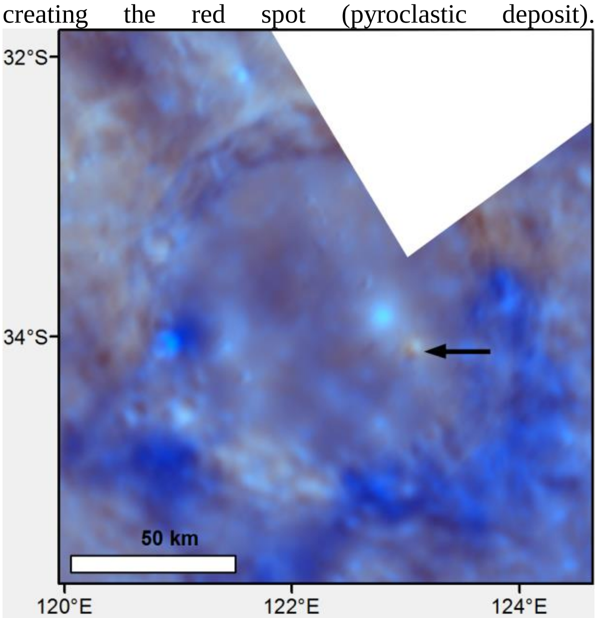

Fig. 3. *Enhanced colour mosaic of the host impact basin. The black arrow indicates the red spot associated with the candidate volcanic edifice. To the north-west, bright crater ejecta is seen. In the south, there is extensive LRM. The top-right of this figure has been masked out due to a seam in the colour mosaic.*

Second Candidate: 144°51'24" E, 44°30'49" N.

Locality. The second candidate volcanic edifice is located in the north-west of the Caloris basin near the outermost edge of the interior plains material.

Characteristics. This feature physically resembles the first candidate volcanic edifice (Fig. 4). It is ~8 km in diameter. The bowl shaped summit depression again has an apparently shallower profile than similarly sized impact craters nearby. However, unlike the first candidate, this one is not associated with a red spot or any colour distinct from the surrounding terrain.

Interpretation: The interpretation of this feature is more equivocal than the first candidate. It is possible that this positive relief feature is a Caloris rim element or ejecta block with a superposing impact crater. This candidate lacks the corroborating evidence of the first candidate. It is not located within smooth plains and does not have an associated red spot. We consider the interpretation of this feature as a volcanic edifice to be a plausible alternative based upon its resemblance to our more convincing first candidate. Furthermore, the location of the second candidate at the edge of the Caloris basin, where there is abundant evidence for volcanic activity elsewhere [10], provides some credibility to this hypothesis.

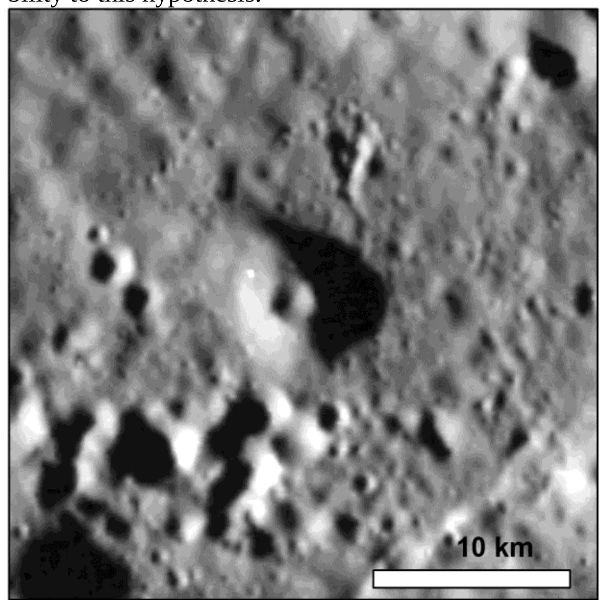

Fig. 4. *A close-up of the second candidate volcanic edifice seen in the 166 mpp monochrome basemap.*

Future Work: Now that some candidate small volcanic shields have been identified in Calorian and younger basins, more might be able to be found by looking in similar settings. Unfortunately, high-resolution MESSENGER data are too sparse to be able to study these features properly, however they may prove to be interesting science targets for the upcoming BepiColombo mission to Mercury [11].

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