Candidate constructional volcanic edifices on Mercury

Conference or Workshop Item

CANDIDATE CONSTRUCTIONAL VOLCANIC EDIFICES ON MERCURY.

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]CNRS, Laboratoire de Planétologie et Géodynamic, Université de Nantes, France.

Introduction: Studies using MESSENGER data suggest that Mercury's crust is predominantly a product of effusive volcanism [1,2] that occurred in the first billion years following the planet's formation [3,4]. Despite this planet-wide effusive volcanism, no constructional volcanic edifices, characterized by a topographic rise, have hitherto been robustly identified on Mercury [5,6], whereas constructional volcanoes are common on other planetary bodies in the solar system with volcanic histories [e.g. 7].

Here, we describe two candidate constructional volcanic edifices we have found on Mercury and discuss how these edifices may have formed [8].

Candidate volcanic edifice #1 (CV1): CV1 is a topographic prominence 6.1 km across and ~530 m high in Heaney crater (Fig. 1). It has flank slopes of ~10° and a summit depression 1.7 km across that is shallower than impact craters of similar size. CV1 is surrounded by smooth plains that cover the floor of Heaney. No kipukas or wrinkle ridges indicative of a former peak-ring, which otherwise might explain CV1, are observed within Heaney. CV1 is coincident with a red color anomaly consistent with others elsewhere on Mercury that are interpreted as pyroclastic deposits [9].

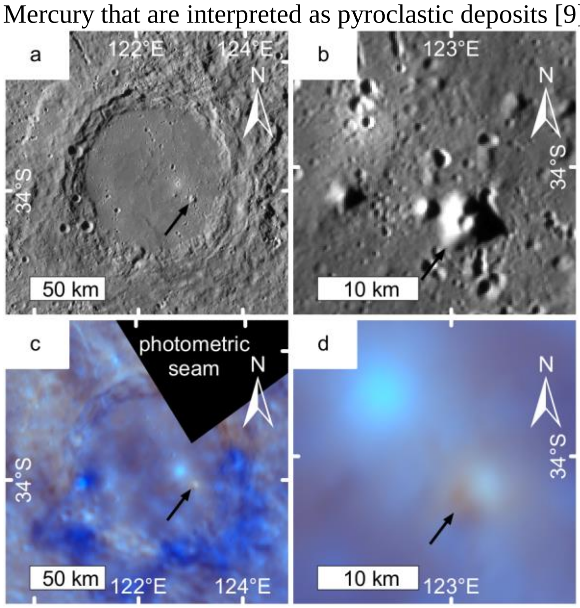

Fig. 1. *CV1 indicated by black arrow in all panes.* ***(a)*** *Heaney crater.* ***(b)*** *Detail of CV1. Two smaller knobs to the west may also be volcanic. A fresh impact crater lies ~10 km NW of CV1.* ***(c)*** *Enhanced color view of Heaney. Low-reflectance material is exhumed in the southern rim and ejecta. CV1 is coincident with a red color anomaly.* ***(d)*** *Detail of CV1 red color anomaly. The blue anomaly to the NW is due to fresh ejecta from the young impact crater in (b).*

We suggest that CV1 formed towards the end of small-volume, post-impact effusive volcanism that occurred within Heaney. As the effusion rate dropped, flows shortened and stacked to form an edifice. A terminal explosive eruption, facilitated by volatiles derived from subsurface low-reflectance material [10], may have created the red color anomaly.

Candidate volcanic edifice #2 (CV2):

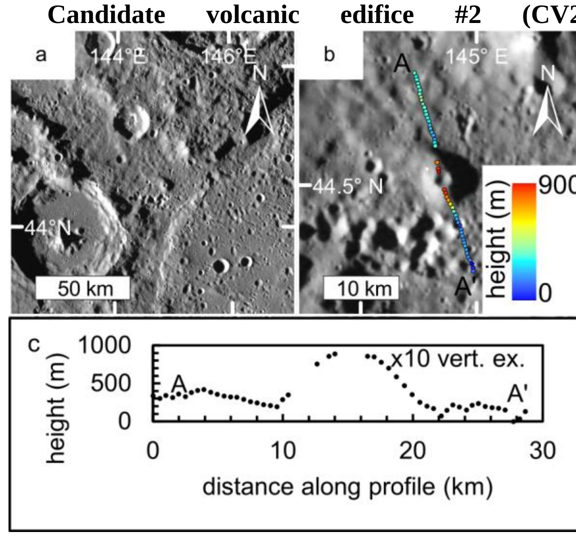

Fig. 2. ***(a)*** *Setting of CV2 in NW of Caloris rim.* ***(b)*** *Detail of CV2 and locations of elevation data. A and A' mark the ends of the topographic profile shown in (c).* ***(c)*** *Topographic profile of CV2.*

CV2 resembles CV1. It is 12.1 km across, ~700 m high and has an average flank slope of 7–8° (from Mercury Laser Altimeter (MLA) [11] data). It also has a shallow summit depression but lacks a red color anomaly similar to that of CV1. CV2 may have formed as the eruptions that formed Caloris Planitia waned.

References: [1] Denevi B. W. et al. (2013) *J. Geophys. Res. Planets, 118*, 891–907. [2] Whitten J. L. et al. (2014) *Icarus, 241*, 97–113. [3] Byrne P. K. et al. (2016) *Geophys. Res. Lett., 43*, 7408–7416. [4] Marchi S. et al. (2013) *Nature, 499*, 59–61. [5] Head J. W. et al. (2008) *Science, 321*, 69–72. [6] Rothery D. A. et al. (2014) *Earth Planet. Sci. Lett., 385*, 59–67. [7] Sigurdsson H. et al. (2000) *Encyclopedia of volcanoes.* [8] Wright J. et al. (in rev.) *J. Geophys. Res. Planets.* [9] Thomas et al. (2014) *J. Geophys. Res. Planets, 119*, 2239–2254. [10] Weider S. Z. et al. (2016) *Geophys. Res. Lett., 43*, (3653–3661). [11] Cavanaugh J. F. et al. (2007) *Space Sci, Rev., 131*, 451–479.