Geophysical Research Abstracts
Vol. 17, EGU2015-15440-1, 2015
EGU General Assembly 2015

A cone on Mercury: Analysis of a residual central peak encircled by an explosive volcanic vent.

Alice Lucchetti (1,2), Rebecca Thomas (3), Gabriele Cremonese (2), David Rothery (3), Matteo Massironi (4,2), Cristina Re (2), Susan Conway (3), Mahesh Anand (3,5)

(1) CISAS, University of Padova, Via Venezia 15, 35131 Padova, Italy, (2) INAF-Astronomical Observatory of Padova, Vicolo dell'Osservatorio 5, 35131 Padova, Italy, (3) Dept. of Physical Sciences, The Open University, Milton Keynes, MK7 6AA, U.K., (4) Dept. of Geosciences, University of Padova, Italy, (5) Dept. of Earth Sciences, The Natural History Museum, Cromwell Road, London, SW7 5BD, U.K.

Images acquired by the MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) spacecraft since it went into orbit around Mercury in 2011 have revealed an unusual landform at -136° E, -6° N: a conical peak, encircled by a trough, and surrounded by a widespread relatively bright and red anomaly of a type interpreted elsewhere on the planet as a pyroclastic deposit. The steep-sided cone-like structure is surrounded by a 7 km-wide trench. This is in turn encircled by a topographic rise, which we interpret as the rim crest of a 43-km diameter impact crater. Spectral anomalies of this type elsewhere on the planet have been attributed to pyroclastic deposition, suggesting that explosive volcanism was involved in the formation of this landform assemblage. However, volcanism is not expected to form steep-sided edifices on Mercury, throwing the origin of the cone into doubt. We make and test the hypothesis that the cone is the intrinsic central peak of an impact crater, the rim crest of which is visible beyond the cone-encircling trough, and that the trough is a vent formed through explosive volcanism that also produced the surrounding bright, red spectral anomaly. In order to assess the viability of this hypothesis, we have investigated the probable original morphology of an impact crater of this size on Mercury by i) measuring topographic cross sections across relatively fresh craters with similar diameters, and ii) performing a hydrocode simulation of the impact. We identified three 42 - 47 km diameter impact craters where MLA tracks are available that cross the central peak structure and approximately bisect the crater. These were used as a control on crater morphology and to assess the plausibility of the results of our simulations. We simulated the formation of the impact crater using the iSALE hydrocode approximating the Hermean surface as a homogeneous layered half-space made up of a jointed 5 km basalt layer overlying an intact basalt layer. We estimated the impactor size diameter by comparing profiles obtained in a series of runs at low resolution to the topographic profile of the present topography and cross-sections of the similar-sized control craters. This analysis confirms the hypothesis that a steep-sided cone surrounded by putative pyroclastic deposits on Mercury was formed by explosive volcanic eruption from a vent encircling the residual central peak of an impact crater.