EVIDENCE FOR YOUNG VOLCANISM ON MERCURY FROM MESSENGER'S THIRD FLYBY. Louise M. Prockter[1], Carolyn M. Ernst[1], Brett W. Denevi[2], Clark R. Chapman[3], Sean C. Solomon[4], David T. Blewett[1], James W. Head III[5], Gabriele Cremonese[6], Simone Marchi[7], Matteo Massironi[7], William J. Merline[3]. [1]Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20723, USA. Email: Louise.Prockter@jhuapl.edu. [2]Arizona State University, Tempe, AZ 85251, USA. [3]Southwest Research Institute, Boulder, CO 80302, USA. [4]Carnegie Institution of Washington, Washington, DC 20015, USA. [5]Brown University, Providence, RI 02906 USA. [6]INAF Astronomical Observatory of Padova, Italy, [7]University of Padova, Padova, Italy.

The MESSENGER spacecraft completed its third and final flyby of Mercury on 29 September 2009 and is now en route to orbit insertion on 18 March 2011 [1]. During the approach to that flyby, imaging filled in a further 6% of the Mercury global map. The MESSENGER spacecraft has now imaged ~91% of Mercury's surface; including Mariner 10 data, ~98% of the planet has now been imaged by spacecraft.

The new MESSENGER images reveal a multi-ring impact basin located at 27.4º N, 57.6º E, measuring 290 km in diameter (Fig. 1). In terms of size and morphology, the basin closely resembles the 265-km-diameter Raditladi double-ring basin that was imaged during MESSENGER's first Mercury flyby [2, 3] (inset, Fig. 1). The newly viewed basin has a well-defined inner peak ring approximately 130 km in diameter and slightly elongated in the N-S direction, and a partial third ring to the south and southwest (*a* in Fig. 1). Most of the rim and central peak ring appear relatively crisp and undegraded. The newly imaged basin is unusual in several respects: (1) it has comparatively young smooth plains within its central peak ring; (2) these plains show evidence of flow; (3) the smooth plains are deformed by extensional troughs; and (4) just outside the basin is the largest candidate explosive volcanic feature yet identified on Mercury.

Color images of this basin reveal that the smooth plains within the peak ring have distinctive color properties (*b* in Fig. 1), implying that the fill was emplaced in a separate event unrelated to the basin-forming impact. It is thus likely that the material is volcanic material rather than solidified impact melt. The smooth plains material appears to have overtopped and obscured the southern portion of the basin's peak ring (*c* in Fig. 1), providing further evidence that they are volcanic in origin. These characteristics are in contrast to those of the smooth plains material within Raditladi's peak ring, which lacks color differences from material in the outer parts of the basin and features indicative of flow.

Crater age-dating results [2] suggest that crater densities at Raditladi are an order of magnitude less than those at Caloris, implying that the Raditladi basin may have formed as recently as 1 Ga. There is no appreciable difference in age between Raditladi's interior smooth plains and its basin ejecta. Crater density measurements on the newly imaged basin suggest that it is slightly older than Raditladi, but the plains within the central ring are appreciably younger than the annulus of plains between the central ring and the principal basin rim [4], providing further evidence that the interior plains are volcanic. For a particular crater production function [5, 6], the age of the innermost plains may be less than a billion years. Some of the smooth plains in Raditladi and in the newly imaged basin may be the youngest volcanic plains yet identified on Mercury.

Within the central smooth plains is a set of mostly circumferential troughs (*d* in Fig. 1). Extensional faulting is generally confined to impact basins on Mercury, with one exception to date [7]. Prior to the discovery of the new basin, only three impact basins – Caloris, Rembrandt and Raditladi – were known to contain extensional troughs or graben, and of these, the Raditladi structures are unusual in that they are confined to the center of the basin within the peak ring, rather than being distributed toward the basin margin. The pattern of graben in the new basin is most similar to the pattern in Raditladi. A particular origin mechanism for the Raditladi troughs has not yet been demonstrated. That the troughs in the newly viewed basin are confined to the central volcanic plains suggests that the volcanism and deformation may have been related.

Volcanic activity also appears to have occurred to the northeast of the new basin (*e* in Fig. 1), where a high-reflectance region of diffuse material over 200 km in extent surrounds a ~30-km-diameter, scalloped rimless depression. Similar scalloped depressions have been identified elsewhere on Mercury, notably just inside the rim of the Caloris basin [8]. These features have been interpreted as sites of explosive volcanic activity [9] where bright material is thought to have been emplaced ballistically around a central source vent. The newly imaged bright region is unusual in that it is at least twice as large as any of the previously identified candidates for volcanic vents.

References: [1] S. C. Solomon et al. (2007) *SSR,* 131, 3. [2] R. G. Strom et al. (2008) *Science,* 321, 79. [3] L. M. Prockter et al., (2009) *LPSC,* 40, abstract 1758. [4] C. R. Chapman C. R. et al. (2009) *GSA Abstracts, 41*, 197-5. [5] S. Marchi et al. (2009) *Astron. J.*, 137, 4936. [6] M. Massironi et al. (2009), *GRL*, 36, L211204. [7] T. R. Watters et al., *LPS, 41,* this volume. [8] Murchie S. L. et al. (2008) *Science*, 321, 73. [9] J. W. Head et al. (2009) *EPSL,* 285, 227.

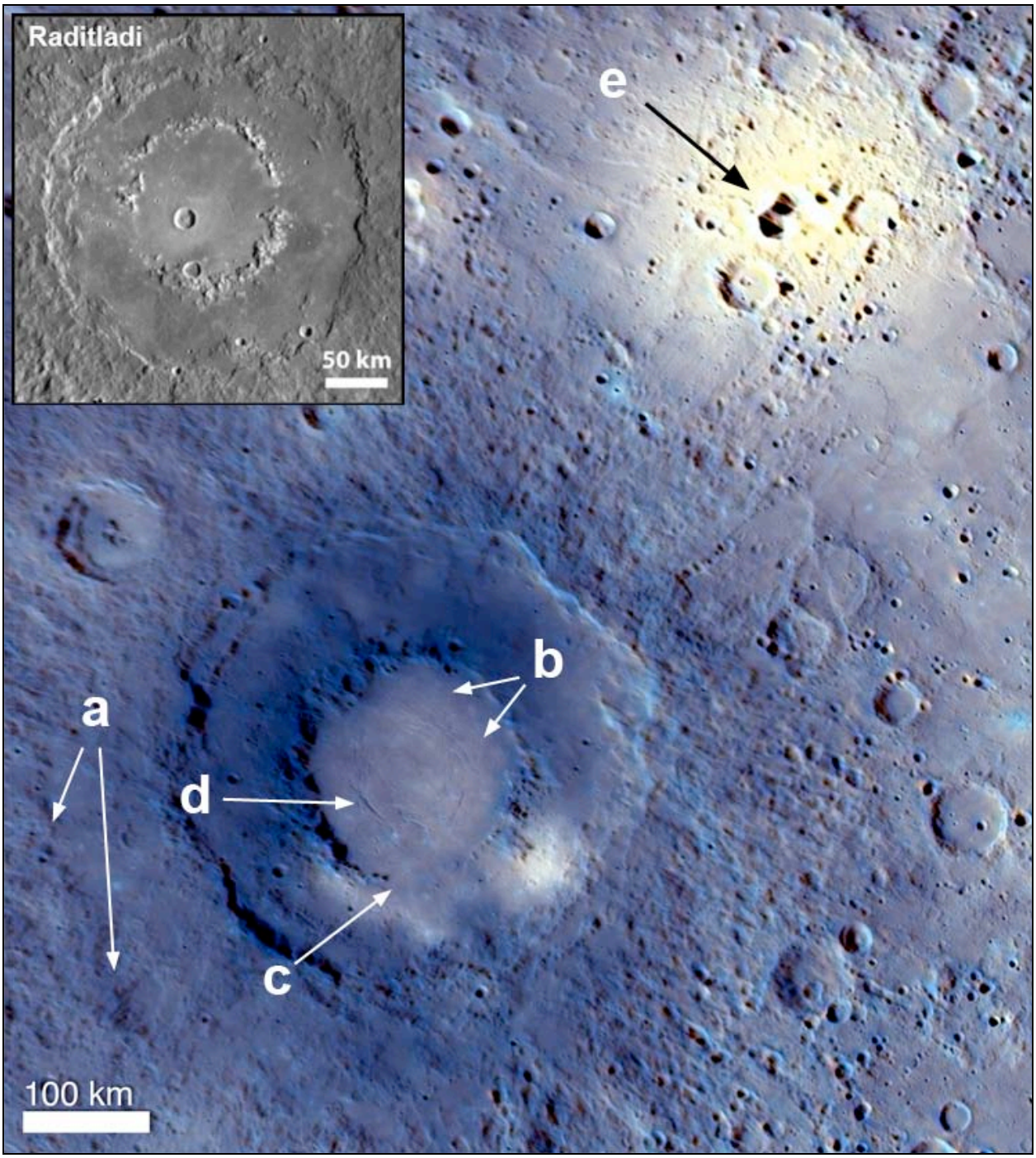

Figure 1. Enhanced-color view (second and first principal component and 430-nm/1000-nm ratio in red, green, and blue, respectively) of the newly imaged basin and surrounding terrain observed during MESSENGER's third flyby of Mercury. Lower-resolution wide-angle camera observations (5 km/pixel) were merged with the higher-resolution narrow-angle camera mosaic (430 m/pixel) to display color variations with geologic terrain. A partial third ring is visible to the southwest of the basin (*a*). The inner ring contains smooth plains material (*b*) that apparently flowed over the top of the central ring to the south (*c*). The inner smooth plains are tectonically disrupted by subcircular troughs (*d*), which appear analogous to those within the similar-sized Mercury basin Raditladi (inset, top left). To the northeast of the basin lies a scalloped depression (*e*) surrounded by bright diffuse material, thought to result from an explosive volcanic event. Equirectangular projection centered at 27°N, 57°E.