**AGE RELATIONS OF THE REMBRANDT BASIN AND SCARP SYSTEM, MERCURY.** Sabrina Ferrari[1,2] (sabrina.ferrari@studenti.unipd.it), Matteo Massironi[1,2], Simone Marchi[3], Paul K. Byrne[4], Christian Klimczak[4], Gabriele Cremonese[2]. [1]Department of Geosciences, University of Padua, Padua, Italy; [2]Astronomical Observatory of Padua, INAF, Padua, Italy; [3]NASA Lunar Science Institute Center for Lunar Origin and Evolution, Southwest Research Institute, Boulder, CO 80302, USA; [4]Department of Terrestrial Magnetism, Carnegie Institution of Washington, Washington DC, 20015, USA.

**Introduction:** The 715-km-diameter Rembrandt basin is the largest well-preserved impact feature of the southern hemisphere of Mercury [1] (Fig. 1), and was imaged for the first time during the second flyby of the MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) mission [2]. Much of the basin interior is covered by smooth, high-reflectance plains interpreted to be of volcanic origin [1,3] that host sets of contractional and extensional tectonic structures. This pattern resembles the arrangement of structures observed within the Caloris basin [4–6], with individual sets of radial and concentric landforms most likely due to multiple episodes of deformation [1,7,8]. Notably, Rembrandt basin and its smooth plains are cross-cut by a 1,000-km-long reverse fault system [1,9] that trends ~E–W, bending toward the north within the basin. The individual faults of this system accommodated crustal shortening that resulted from global contraction as Mercury's interior cooled [1]. The current shape of the reverse fault system may have been influenced by the formation of the Rembrandt basin [10].

As the Rembrandt basin area was affected by many commonly found processes that modified the surface of Mercury (i.e., basin formation and impact gardening, global and basin-related tectonics, and volcanic resurfacing), it is well suited for understanding the sequence and duration of such processes. The emplacement of the interior smooth plains predates both the basin-related tectonism and the final development of the giant scarp, which is suggestive of either short-lived volcanic activity immediately after basin formation or a later volcanic phase set against prolonged tectonic activity.

In order to quantify the duration of volcanic and tectonic activity in and around Rembrandt basin, we determined the crater count-derived ages of the involved terrains by means of the Model Production Function (MPF) chronology of Mercury [11,12], which is rely on the knowledge of the impactors flux on the planet.

**Crater chronology:** By determining the Size-Frequency Distribution (SFD) of superposed impact craters on the Rembrandt basin rim using MESSENGER fly-by data, Watters et al. [1] estimated that Rembrandt and Caloris basins have a similar relative age. On the basis of age determination via MPF method [11-13], our analysis on the basin-realted material (hummocky terrains and proximal ejecta) confirms the formation of the Rembrandt basin at 3.8±0.1 Ga, during the end of the Late-Heavy Bombardment. We also constrained the emplacement of the interior smooth plains between 3.7±0.1 and 3.5±0.1 Ga, applying a distinction between the primary population and the smaller craters to that occurred after the resurfacing of the basin floor (Fig. 2). These ages place the oldest smooth layer formation during or soon after the impact event, and so we cannot definitively determine from our crater counts whether those plains are impact melt or volcanic material; conversely, the youngest smooth covers result temporally unrelated to the basin formation, and can be attributed to volcanism.

We detected the same chronological relationship for the terrain bordering the basin at the foot-wall of the giant scarp (Outer Plains, Fig. 1) where the primary crater population of the older layer predates the basin formation at least of 100 Myr, while the younger unit revealed by smaller craters is temporally similar to the interior smooth plains of Rembrandt basin.

**Conclusions:** The MPF crater chronology allowed us to constrain the Rembrandt basin formation to the early Calorian period and a widespread resurfacing to up until 3.5 Ga ago. The volcanic activity affected both the basin and its sorroundings, but ended prior to some basin-related and regional faulting. If the giant scarp formed before the Rembrandt basin formation [10], the regional tectonic activity along this structure might have lasted for more than 300 Ma.

**References:** [1] Watters T. R. et al. (2009) *Science*, *324*, 618. [2] Solomon S. C. et al. (2008) *Science*, *321*, 59. [3] Denevi B. W. et al. (2009) *Science*, *324*, 613. [4] Murchie et al. (2008) *Science*, *321*, 73. [5] Watters T. R. et al. (2009) *EPSL*, *285*, 309. [6] Byrne P. K. et al. (2012) *LPS*, *43*, abstract 1722. [7] Watters T. R. et al. (2005) *Geology*, *33*, 669. [8] Byrne P. K. et al. (2013) *LPS*, *44*, this mtg. [9] Byrne P. K. et al. (2012) *LPS*, *43*, abstract 2118. [10] Ferrari S. et al. (2012) *EPSC*, *7*, abstract 2012-874. [11] Marchi S. et al. (2009) *The Astron. Jour.*, *137*, 4936. [12] Massironi M. et al. (2009) *Geophys. Res. Lett.*, *36*, L21204. [13] Marchi S. et al. (2011) *Plaet. Space Sci.*, *59*, 1968.

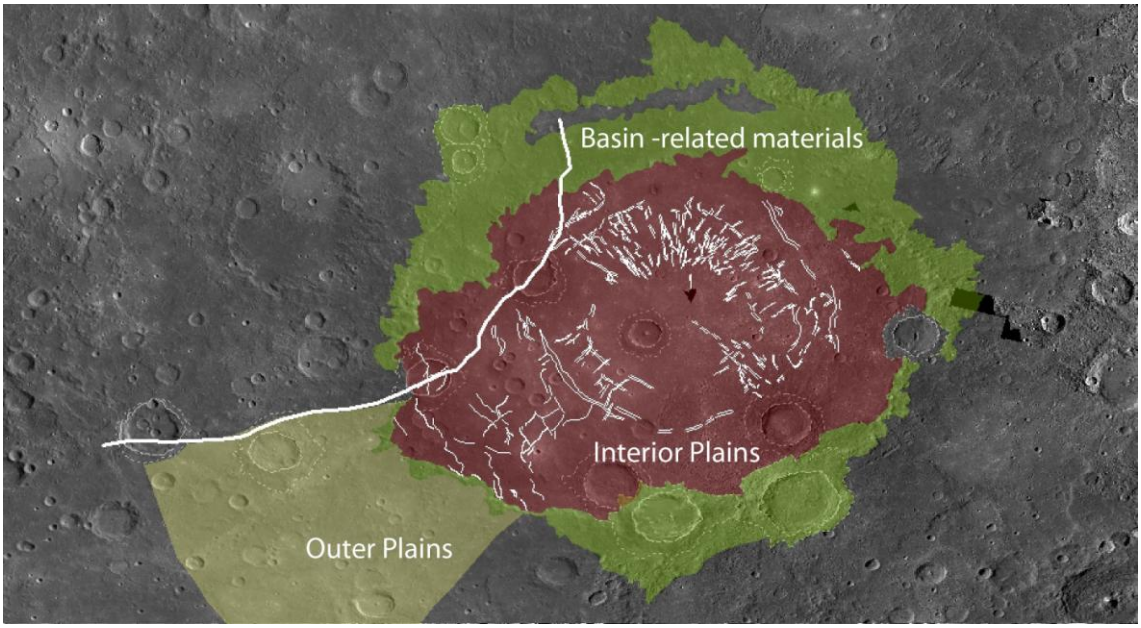


**Figure 1.** Units of the Rembrandt basin region on which crater-counts were performed displayed on the MESSENGER Mercury Dual Imaging System (MDIS) 750 nm mosaic used for the crater counts (average spatial resolution: 250 m/pixel). Major tctonic landforms are comprised of the 1,000-km-long reverse fault system (thick white line) and a widespread basin-related pattern of contractional and extensional features (thin white lines).

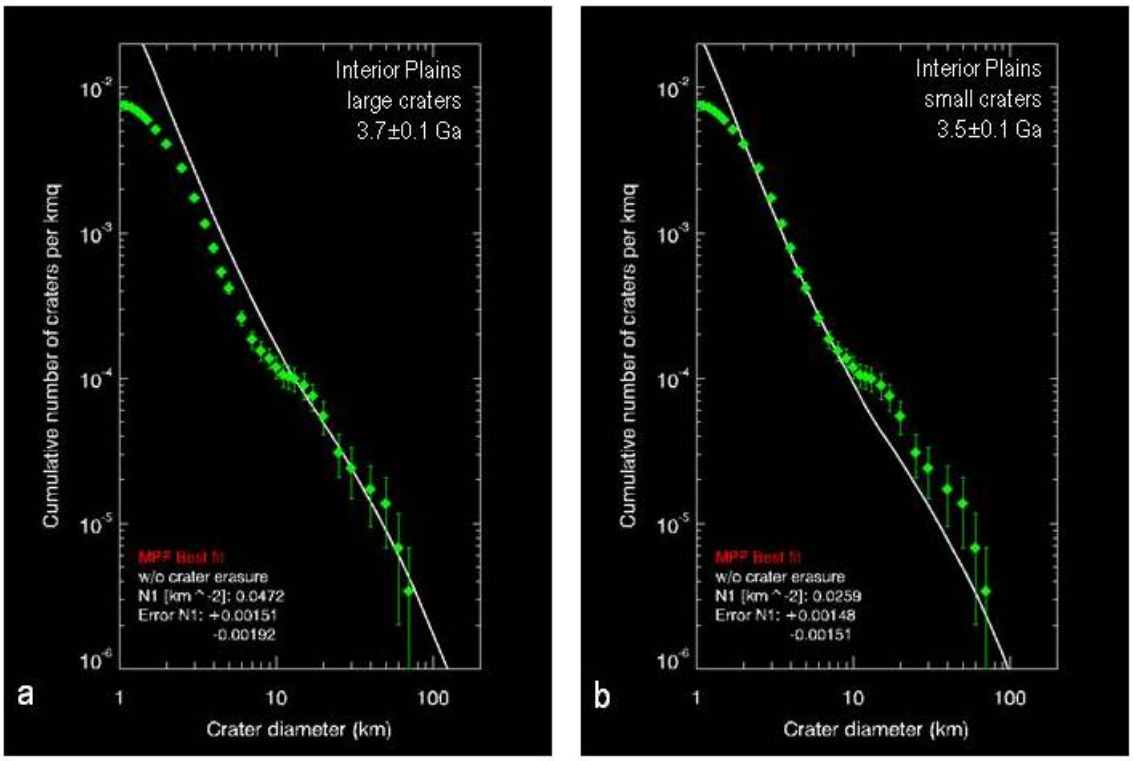


**Figure 2.** MPF minimum $\chi^2$ best fits of the cumulative crater count distributions determined for the Interior Plains. For each unit we report the age assessment for Main Belt Asteroids populations. a) Best fit of larger craters; b) Best fit of smaller craters.