UPDATED CATALOGS OF PEAK-RING BASINS AND PROTOBASINS ON MARS. David M. H. Baker, NASA Goddard Space Flight Center, Greenbelt, MD 20771, david.m.hollibaughbaker@nasa.gov.

Introduction: The morphology of peak-ring basins (exhibiting a rim crest and interior peak ring) (Fig. 1a) in the complex crater to basin transition on the Moon and Mercury have been well characterized based on data from recent missions to these planetary bodies [e.g., 1]. Although global crater catalogs have recently been produced for Mars [e.g., 2], the detailed characteristics of the crater to basin transition on Mars has not been completely re-examined since basin ring catalogs and measurements were produced over two decades ago [3]. Since that time, an abundance of Mars datasets have become available, including global topography and image mosaics. Here, previous basin catalogs [3] and the global crater catalog of Robbins *et al.* [2] are re-analyzed to provide updated catalogs of peak-ring basins (Fig. 1a) and protobasins (Fig. 1b) on Mars. These updated catalogs are important for comparisons with other planetary bodies, constraining basin formation models, and understanding the original morphology of degraded craters [e.g., 4].

Data and Methods: A catalog of craters ≥1 km on Mars from Robbins *et al.* [2] was used to systematically survey all craters >75 km on the planet (*N*=737) in a manner similar to [5,6] for the Moon and Mercury. This diameter range nearly completely covers the crater to basin transition on Mars; however, future work will survey craters down to at least 50 km. Although the crater catalog by Robbins *et al.* [2] includes morphological classifications, these did not reliably identify the various basin types considered here. Datasets used for the survey included PDS-archived MOLA gridded topography and a global THEMIS daytime IR mosaic [7]. During the survey, each crater was identified as having a rim crest in addition to a single interior ring of peaks (peak-ring basin), an interior ring of peaks plus a central peak (protobasin), a central peak only (complex crater), or no interior structure (unclassified). Where present, the peak-ring and central-peak diameters were measured, as in [5,6]. For consistency, we used image-based circle-fits to rim-crest diameters from [2]. Multi-ring basins were not fully re-examined here, although the presence of many of the concentric ring structures suggested by [3] are considered doubtful based on preliminary topographic analyses.

The Basin Catalog: A listing of the peak-ring basins and protobasins with their rim-crest, peak-ring, and/or central-peak diameters is given in Table 1. A total of 16 peak-ring basins and 8 protobasins were identified, ranging in rim-crest diameter from 101 to 446 km (peak-ring basins) and 89 to 298 km (protobasins) (Table 1, Fig. 2a). The basins cover a range of degradation states and have peak rings in various states of preservation. Eight of these basins are newly identified and not included in the catalog of [3].

In addition, 141 craters exhibited central peaks only; these complex craters ranged in rim-crest diameter from 75 to 182 km. Four basins were identified as multi-ring basins (exhibiting three or more concentric rings). The remaining 572 craters generally lacked interior structures that could reliably be identified as a central peak or peak ring. Most of these craters were heavily degraded and/or resurfaced by sedimentary deposits or volcanic materials.

Comparisons with the Moon and Mercury: Although it has a larger surface area, Mars has nearly an order of magnitude fewer peak-ring basins than Mercury (*N*=110). The Moon has a similar number of peak-ring basins at 17 in number. The lack of peak-ring basins on Mars can be attributed to the planet's much higher resurfacing and erosional rates [3].

Like Mercury, the rim-crest diameters of protobasins overlap those of peak-ring basins over a much larger range than on the Moon (Fig. 1). The ring and rim-crest diameter trends for peak-ring basins and protobasins on Mars are shown in Fig. 2a and also compared to the Moon [1,5] and Mercury [1,6] in Fig. 2b. The ring-diameter trends for Mars follow a power law that is similar to those on the Moon and Mercury. The rim-crest diameter range for protobasins and peak-ring basins on Mars is similar to Mercury, likely owing to the planets' similar gravitational accelerations. In contrast, peak-ring basins on the Moon only occur at diameters >200 km (Fig. 2b).

Conclusions and Future Work: Previous catalogs, including ring measurements, of peak-ring basins and protobasins on Mars were updated based on MOLA topography and a global THEMIS daytime image mosaic. The updated catalog (Table 1) represents an improved characterization of the crater to basin transition on Mars and provides consistency with recently updated catalogs for the Moon and Mercury.

Future work will survey smaller crater sizes in the 50 to 75 km range. More detailed geological analyses of peak rings on Mars, including structural and compositional mapping, will be important for furthering our understanding of the formation of impact basins on planetary bodies.

References: [1] Baker, D.M.H. and Head, J.W. (2013) *Planet. Space Sci.* 86, 91–116. [2] Robbins, S.J. and Hynek, B.M. (2012) *J. Geophys. Res.* 117, E05004. [3] Pike, R.J. and Spudis, P.D. (1987) *Earth Moon Planets* 39, 129–194. [4] Allen, C.C. (2015) *LPSC 46*, no. 2787. [5] Baker, D.M.H. et al. (2011) *Icarus* 214, 377–393. [6] Baker, D.M.H. et al. (2011) *Planet. Space Sci.* 59, 1932–1948. [7] Edwards, C.S., *et al.* (2011) *J. Geophys. Res.* 116, E10008.

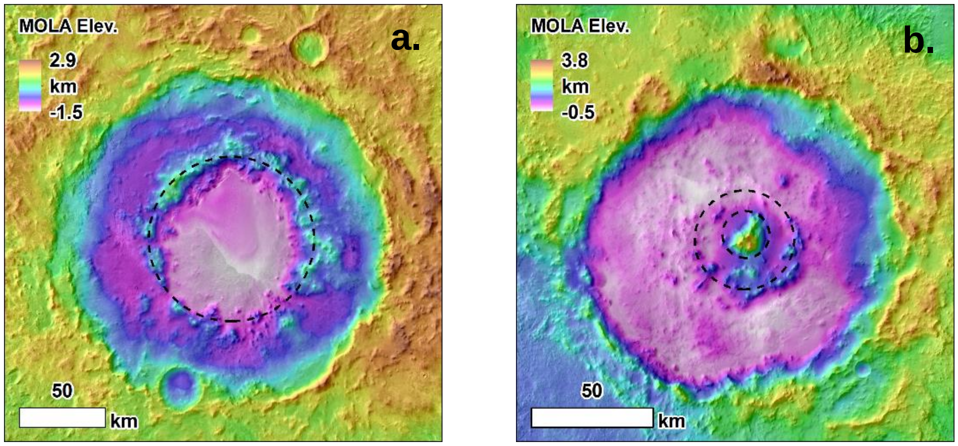

Figure 1. Examples of a peak-ring basin (a, Lowell) and protobasin (b, Liu Hsin) on Mars, showing circle-fits to their peak rings and/or central peaks. MOLA gridded topography overlain on a THEMIS IR mosaic.

Table 1. Updated basin catalogs for Mars

Name	Lat.	Lon.	D_r	D_{pr}	D_{cp}
Peak-Ring Basins					
Schiaparelli	-2.51	16.80	446	239	--
Schroeter	-1.90	55.99	292	142	--
Galle	-50.65	-30.88	223	102	--
Kepler	-46.75	141.16	222	120	--
Secchi	-57.85	101.97	217	115	--
Kaiser	-46.16	19.11	202	98	--
Lowell	-51.95	-81.37	199	96	--
Phillips	-66.33	-44.79	185	104	--
Unnamed	-39.34	76.83	180	90	--
Molesworth	-27.49	149.21	175	80	--
Proctor	-47.57	29.69	167	81	--
Becquerel	21.89	-7.94	165	72	--
Ptolemaeus	-45.89	-157.73	165	76	--
Dejnev	-25.14	-164.64	152	68	--
Unnamed	-9.07	150.51	103	33	--
Mie	48.12	139.69	101	30	--
Protobasins					
Herschel	-14.48	129.89	298	148	40
Lyot	50.46	29.31	220	106	33
Gale	-5.37	137.81	154	87	18
Bakhuysen	-22.97	15.76	153	57	29
Holden	-26.04	-34.02	153	58	21
Liu Hsin	-53.20	-171.51	135	41	19
Barnard	-61.08	61.55	121	50	12
Bjerknes	-43.06	171.48	89	34	14

D_r: rim-crest diameter (km); D_{pr}=peak-ring diameter (km); D_{cp}: central-peak diameter (km).

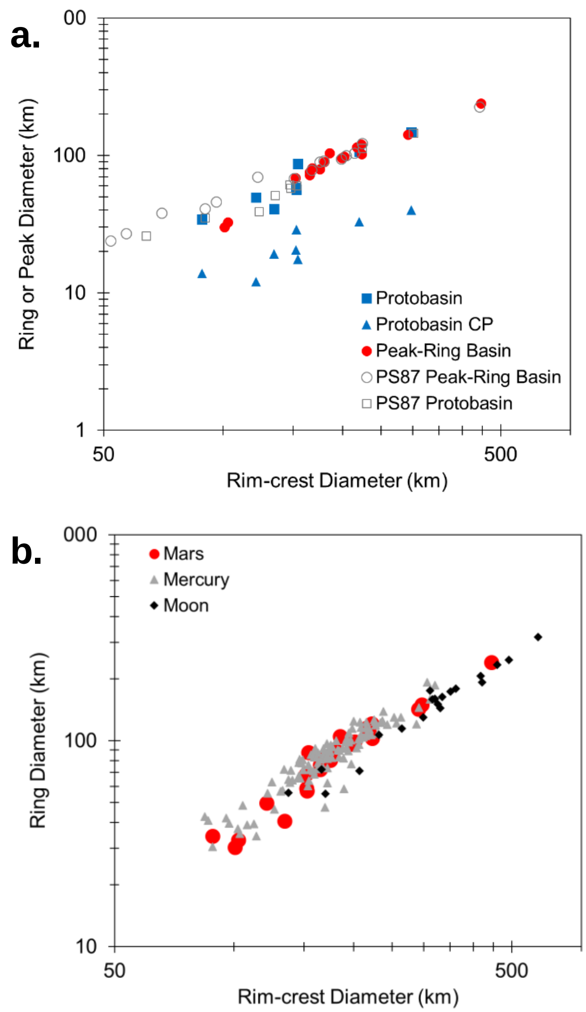

Figure 2. Peak-ring and/or central-peak diameters versus rim-crest diameters for peak-ring basins and protobasins on Mars only (a) and Mars compared with the Moon and Mercury (b) [5,6]. Data from Pike and Spudis [3] (PS87) are shown in (a) for comparison.