

N(50) Crater Retention Ages for an Expanded Inventory of Lunar Basins: Evidence for an Early Heavy Bombardment and a Late Heavy Bombardment?

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LOLA topography and LOLA-derived crustal thickness data provide evidence for a population of impact basins on the Moon that is likely a factor 2 larger than the classical lists based on photogeology. Frey (2012) determined N(50) crater retention ages (CRAs) for 83 candidate basins > 300 km in diameter by counting LOLA-identified craters superimposed over the whole area of the basins. For some basins identified in topography or model crustal thickness it is not possible to unambiguously identify the crater rim as is traditionally done. Also, Quasi-Circular Depressions (QCDs) > 50 km in diameter are recognizable in the mare-filled centers of many basins. Even though these are not apparent in image data, they likely represent buried impact craters superimposed on the basin floor prior to mare infilling and so should be counted in determining the age of the basin. Including these as well as the entire area of the basins improves the statistics, though the error bars are still large when using only craters > 50 km in diameter. The distribution of N(50) CRAs had two distinct peaks which did not depend on whether the basins were named (based on photogeology) or recognized first in topography or crustal thickness data. It also did not depend on basin diameters (both larger and smaller basins made up both peaks) and both peaks persisted even when weaker candidates were excluded. Burgess (2012, unpublished data) redid the counts for 85 basins but improved on the earlier effort by adjusting the counting area where basins overlap. The two peak distribution of N(50) ages was confirmed, with a younger peak at N(50) ~ 40-50 and an older peak at N(50) ~ 80-90 (craters > 50 km diameter per million square km). We suggest this could represent two distinct populations of impactors on the Moon: one producing an Early Heavy Bombardment (EHB) that predates Nectaris and the second responsible for the more widely recognized Late Heavy Bombardment (LHB).