A Survey of Impact Craters in the Inner Solar System: Perspectives from Earth

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The Earth shares a similar history of bombardment by asteroids and comets with other planets in the inner Solar System. Nevertheless, there are significant differences in the number, size, distribution, and degree of preservation of impact craters on Earth versus those on the other planets. Most craters in the Solar System are now widely accepted to be of impact origin. Twentieth-century studies of craters on Earth have documented impact-related structures such as overturned rim strata, hummocky ejecta, shattercones, shocked quartz grains, and diagnostic minerals such as coesite and stishovite that form in intensely overpressured environments. Unfortunately, there are <200 well-preserved impact craters on the Earth, owing to erosion and destruction from tectonic activity. To fully understand crater size-morphology relationships as well as the history of bombardment in the inner Solar System, it is necessary to observe the crater population on relatively airless bodies such as the Moon and Mercury which preserve a nearly complete record of bombardment. In contrast to the Earth, which has few ancient terranes preserved, >90% of the Moon's surface is older than 3 billion years (Ga). The Moon has several large impact basins older than 3.8 Ga, the result of intense bombardment from large asteroids. Although the Earth is lacking in large craters and impact basins, it is estimated that before 3.8 Ga the Earth had >22,000 craters greater than 20 km in diameter, ~40 basins at 1,000 km across, and may have had some basins up to 5,000 km across. Each of the other planets in the inner solar system—Mercury, Venus, and Mars—feature different crater populations as a result of proximity to the Asteroid Belt, atmospheric attenuation and destruction of small impactors (Venus), or in the case of Mars, crater modification from eolian, periglacial, fluvial, and igneous processes