

Mega-Impacts on Mars: Implications for the Late Heavy Bombardment in the Inner Solar System, and the Early Evolution of the Earth and Mars

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There are about 30 very large impact basins on Mars, > 1000 km in diameter, most of which are revealed by their topographic and/or crustal thickness signatures. Crater retention ages and model absolute ages suggest these all formed in a relatively short time (100-200 million years?), perhaps during a “Late Heavy Bombardment” (LHB) caused by the evolution of the orbits of the giant planets. This so-called “Nice Model” of planetary formation may explain the LHB on the Moon at about 3.9 billion years ago and would have produced a similar bombardment throughout the inner solar system. The formation of 30 very large impact basins would have had catastrophic environmental consequences for Mars, which were further complicated by the demise of the global magnetic field at about the same time. If there are no very large basins on Mars older than the 30 we see and the LHB really lasted everywhere only a short time, there may have been a relatively longer time (~400 million years?) during which Mars and the Earth suffered no major impact trauma and during which conditions on both worlds may have been far more habitable than during the LHB. However, if the formation of the Mars crustal dichotomy was due to an even larger giant impact that predated the very large basins, all record of this earlier and possibly more clement time on Mars may have been erased. Ages of the smaller but still very large basins can be used to approximately date the giant impact (if it occurred). Even the very large basins appear to have reset the crater retention ages of the entire crust of Mars and may have by themselves erased any record of an earlier time.