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THE LUNAR CATACLYSM HYPOTHESIS AND IMPLICATIONS FOR THE ENTIRE SOLAR SYSTEM

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New data (this paper), integrated with that from a decade-long campaign to test the lunar cataclysm hypothesis (*e.g.*, Cohen *et al.* 2000; Kring and Cohen 2002; Strom *et al.* 2005; Puchtel *et al.* 2008), continue to support an intense period of bombardment several hundred million years after solar system formation. The geological, geochemical, and isotopic data imply: (i) that basin-forming impacts occurred on the Moon ~3.9-4.0 Ga; (ii) impacts also occurred on Mars at that time and on asteroids ~3.6-4.1, implying the lunar cataclysm is an inner solar system cataclysm. Geochemical fingerprints (iii) point to asteroids as the main source of debris hitting the Moon, while geological fingerprints (iv) independently point to the main asteroid belt as the source of projectiles hitting the Moon, Mercury, and Mars, and also (v) indicate the asteroid belt was sampled in a size-independent manner. This suggests (vi) that resonances swept through the asteroid belt, which implies that (vii) Jupiter's orbit moved. Thus, analyses of the Moon are (viii) revealing details about the accretion and orbital evolution of planets in both the inner and outer solar system. If the entire lunar basin-forming epoch occurred in a narrow interval of time, then that implies most of the ancient cratered planetary surfaces among the terrestrial planets were produced at the same time and that many geological events previously believed to have occurred over the first 500 to 600 Ma after accretion may have, instead, occurred within a narrow 200 Ma interval of time around 4 Ga. The highest science priority for lunar exploration is to test the impact cataclysm hypothesis further with impact melt samples returned to Earth from the South Pole-Aitken Basin and other pre-Nectarian basins.