After the Moon

Stephen J. Mojzsis
Geoastronomy Research Group, Bayerisches Geoinstitut (BGI), Universität Bayreuth, 95440 Bayreuth, Germany. stephen.mojzsis@uni-bayreuth.de
Konkoly Observatory, Research Center for Astronomy and Earth Sciences (CSFK), 1121 Budapest, Hungary. Stephen.mojzsis@csfk.org

The inner solar system experienced bombardment from late accretion of leftover planetesimals, comets and asteroids in the first several hundred million years of the Solar System. The sources and tempo of this bombardment are debated. Radiometric dating of achondrite meteorites record differentiation and formation of crusts by ca. 3 Myr into Solar System history. Superimposed on this early history are later impact-induced U-Pb and Pb-Pb ages that wane by ca. 4.45 Gyr ago. Younger ages are confined to $^{40\text{-}39}$Ar geochronology, which is relatively susceptible to thermal resetting, and describe an age continuum from ca. 4.48 Gyr ago extending in a long tail to 3.0 Gyr ago with occasional impact events as recently as 250 Myr ago. The decline in late accretion intensity was well underway before Earth, Moon and Mars could have last experienced wholesale crustal melting as defined by the oldest zircon U-Pb ages around 4.4 Gyr ago.
Here I track the dynamical profile of late accretion flux by coupling models of giant planet migration with time-integrated ages compiled from different radiogenic systems for meteorites, and lunar, martian and terrestrial rocks. I show that if giant planet migration commenced at ca. 4.48 Gyr ago as is now widely believed (Mojzsis et al., 2019, 2022; Walton et al. *in press*), it led to an intense ~30 Myr influx of comets to the inner solar system capable of continually renewing planetary crusts until ca. 4.45 Gyr ago. This age comports with planetary Pb, Xe and Nd isotopic values extrapolated to primordial compositions which yield separation times for terrestrial silicate reservoirs. Concurrent bombardment continues to affect the inner solar system as a smooth (monotonic) decline in impactor flux. I end with a description of the dynamical basis of this late accretion scenario, its thermal consequences to the crusts of the terrestrial planets and assess the likelihood that a persistent biosphere could be established on Earth (and Mars) since ca. 130 Myr after solar system formation.