

A Search for Evidence of Extraterrestrial Impacts in Jack Hills Zircons

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The Late Heavy Bombardment (LHB) is an intense flux of planetary debris into the inner solar system originally hypothesized to have occurred at ~3.9 Ga. The nature of the LHB is controversial and the known record of its existence is largely restricted to lunar samples. However, the interpretive basis from which $^{40}\text{Ar}/^{39}\text{Ar}$ age spectra have been used to infer lunar LHB activity is deeply flawed and alternate sources of evidence are needed before clearer insights can be drawn. Although Earth would have experienced a ~20 times greater flux of impactors than the Moon – leading to significant crustal heating and even melting – the Hadean (pre-3.8 Ga) terrestrial rock record is virtually non-existent. Arguably the most complete record of the Hadean is found in detrital zircons from the Jack Hills, Western Australia, which semi-continuously span the period 4.38-3.8 Ga. Investigations of these grains have previously suggested the existence of a hydrosphere, continental crust, sedimentary cycling and plate boundary interactions on early Earth. We have undertaken several interrelated studies using Jack Hills zircons to address the question: do Hadean zircons preserve evidence of the LHB? To address this, we have developed a Ti-U-Th-Pb depth profiling method to obtain continuous age vs. temperature (T^{zln}) data from <4 Ga rims on >4 Ga zircons as an environmental monitor of the LHB-era. Results show anomalously high temperatures associated uniquely with LHB-era rim growth. In a companion study, geochemical characterization of <4 Ga Jack Hills zircon cores reveals a unique population at 3.84-3.91 Ga that is consistent with recrystallization during high temperature events, the likeliest source of which are LHB impacts. Thus our preliminary data may represent the first terrestrial evidence for impact-related heating during the LHB.