

Did the Manicouagan Impact Cause a Biotic Turnover 215.5 Million Years Ago? Constraints from Airfall and Detrital Zircon U-Pb LA-ICP-MS Geochronology.

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The ~100 km, ~225 Ma (1) Manicouagan impact structure, while smaller than Chicxulub, could have still caused severe biotic disruptions. One biotic event potentially related to Manicouagan is the Adamanian-Reveultian (A-R) continental biotic turnover (2) in the Chinle Fm, dated by previous detrital zircon CA-ID-TIMS geochronology from sandstones as between 213 and 218 Ma (3). We explored the temporal relationship between the A-R boundary and Manicouagan by sampling a series of sandstones and mudstones bracketing the biotic transition at Devil's Playground, Petrified Forest National Park, spanning 20 m below a CA-ID-TIMS date of 213.870±0.078 Ma (3), performing LA-ICP-MS analysis on the extracted zircons. This provided tests of two hypotheses: 1) The LA-ICP-MS data from mudstones are of airfall origin and accurately represent depositional ages; and 2) The A-R zircon ages are consistent with Manicouagan. With additional constraints from accumulation rates of 34m to 25m / Myr based on the nearby CPCP-1 1A core and outcrop (4), we found that: 1) all samples have mixtures of different aged grains near the depositional age plus much older grains; 2) given any reasonable interpretation of accumulation rates, all dates (except one with extreme Pb loss) are several million years too old, showing all age populations, including from mudstones, to be mixtures of a variety of ages and cannot be from pure airfall, falsifying hypothesis 1; 3) age constraints from mudstone zircon age peaks are consistent with Manicouagan but incompatible with the accumulation rates and will need CA-ID-TIMS for further testing of hypothesis 2; 4) mudstones appear to have had an additional source of >2 Gyr grains than the fluvial sandstones which were sourced from SE and S highlands (5). If statistically significant, this suggests mudstones have an added dust source from Archean terranes to the NE consistent with having both airfall and eolian zircon sources corroborating a modified hypothesis 1. Mudstones may be a better target for depositional ages than the sandstones.