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One Person’s Trash is Another’s Treasure; Extracting Additional Information on Fluid Rock interaction from Disturbed Isotopic Systems

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Crustal fluids can be tracked using traditionally dismissed discordant uranium (U)-lead (Pb) data, offering a novel tool for understanding mineralization processes. This study confronts traditional limitations in geochronology posed by Pb-loss in zircon, which has typically led to the dismissal of discordant U-Pb data, which is data where the isotope systems do not yield similar apparent ages. By reinterpreting these data as critical indicators of past geological processes, such as mineralization and hydrothermal activity, we challenge the conventional perception that views Pb-loss as an analytical hindrance. Employing a comprehensive geochronological database from Geoscience Australia and state geological surveys, our research utilizes Bayesian modelling through Monte Carlo simulations to investigate radiogenic-Pb mobility in the Arunta region of Central Australia. Our findings reveal significant Pb-loss events that correspond to major tectonothermal episodes in the region's history. Specifically, we resolve Pb-loss events at approximately 850 Ma, likely corresponding to the opening of the Centralian Superbasin; 550 Ma, an age associated with the Petermann Orogeny; 475 Ma, potentially linked to the extensional Larapinta Event; and 320 Ma, which corresponds to the Alice Springs Orogeny. These insights underscore the utility of discordant U-Pb data for reconstructing detailed geological histories and promote the use of these data as a valuable tool for understanding fluid mobility in the crust, mapping fluid pathways, and pinpointing potential sites of mineralization within complex geological terrains.