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Earth's Pb paradoxes resolved

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Earth's two Pb paradoxes have been discussed, but not adequately resolved, in hundreds of publications since Patterson first defined the Pb-Pb isochron for the Solar System in 1956 (Patterson, 1956). In this contribution, the resolution of the Pb paradoxes is based on the identification of a new, not previously identified, third Pb paradox (Tessalina and McNaughton, 2025). We use compilations of existing Pb isotope data on modern oceanic basalts to explore the implications of the new paradox on the composition of Earth's major modern reservoirs. The resolution of Earth's Pb paradoxes will generate a reappraisal of the Pb isotope geochemistry of all terrestrial materials. The third paradox not only provides the key to resolving all Pb paradoxes, but has major implications for: (i) U-Pb isotope system behaviour; (ii) mantle and crust evolution through time, (iii) mantle-crust tectonics, from Archean to modern, (iv) incompatible element behaviour at mantle conditions, and (v) modern mantle Pb reservoirs including the difference between shallow and deep mantle Pb.

References:

Patterson, 1956. Age of meteorites and the Earth. Geochem. Cosmochim. Acta, 10, 230-237.

Tessalina and McNaughton, 2025. Resolving Earth's Pb paradoxes (in review)