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Solving the Martian meteorite age paradox with a widespread Uranium-rich reservoir on Mars

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Documenting major geochemical reservoirs on planetary bodies is a necessary prerequisite to understanding planetary evolution. Here we present Pb isotopic evidence for a pervasive Martian reservoir that evolved with a long-term 238U/204Pb (μ) value at least 2.4 times higher greater than those inferred from studies of all other Martian meteorites except 4.428 Ga clasts in NWA7533. Any significant mixing with this and an unradiogenic reservoir produces trends with steep slopes in Pb isotopic diagrams. The steep trend seen here can be used erroneously to define a crystallization age for Chassigny of 4.531$\pm$30 Ga (2σ), which is in conflict with all other isotopic systems that yield a widely accepted age of 1.39 Ga. Similar, steep trends have also been observed in the Shergottites and have been used to calculate a >4 Ga age and have also been attributed to terrestrial contamination. Our new Chassigny data however, argue that this mixing occurred on Mars and this radiogenic component is present in virtually every Martian meteorite. The presence of this radiogenic reservoir on Mars resolves the paradox between Pb isotopic data and all other radiogenic isotopic systems in Martian meteorites. Importantly, Chassigny and the Shergottites are likely derived from the northern hemisphere of Mars, while NWA 7533 originated from the Southern hemisphere, implying that the U-rich reservoir, which most likely represents some form of crust, must be widespread. The significant age difference between SNC meteorites and NWA 7533 also supports the preservation of this crust throughout Martian history.