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# Pb isotopic evidence for U exchange with the core?

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The temporal terrestrial lead isotope record requires a systematic decrease of time-integrated <Th/U> ratios in the sources of juvenile crustal and mantle derived volcanics and sulfide ores, starting from distinctly superchondritic Th/U ≥ 4.2 in Early-Archean samples, and decreasing to roughly chondritic Th/U values around 3.9 in Proterozoic and younger samples. This effect is independent and different from the so-called "2nd lead paradox" discussed in the literature. I have therefore called it the "third lead paradox" [1]. If Earth has remained an overall closed system since accretion time, it must have temporarily harbored a complementary, hidden subchondritic-Th/U reservoir for about 1 to 2 Ga, which subsequently somehow "disappeared". I suggest the Earth's core may be this reservoir. Experimental evidence shows that during accretion, significant amounts of uranium may have entered the core [2-4]. This resulted in an initially superchondritic Th/U ratio in the bulk silicate Earth (BSE). For example, sequestration of 3.5 ppb U in the core [3] raises Th/U of BSE from 3.9 to 4.24. Although this does not dramatically affect the terrestrial heat budget, it does explain the observed systematic shift in terrestrial Th/U ratios, if this uranium was subsequently released from the core and transferred into the convecting mantle. This release may have been caused by secular cooling of the core. Early sequestration U into the core, and its subsequent release into the mantle, also potentially resolves the "first Pb paradox," which calls for either a very young Earth of T = 4.43 Ga with a constant U/Pb ratio or a "classical" 4.57 Ga old Earth with a dramatic 35% increase in U/Pb ratio 3.7 Ga ago [5]. A 4.50 Ga old silicate Earth with a much more modest increase in U/Pb of 7% about 3 Ga ago, due to U release from the core, resolves this first Pb paradox equally well.

[1] Hofmann, A.W., Goldschmidt Abs. 2019, 1377.

[2] Wohlers, A. & Wood, B.J. GCA 205, 226 (2017).

[3] Chidester, B.A. et al. GCA 199, 1-12 (2017).

[4] Blanchard, I. et al., Geochem. Perspectives. Lett. 5, 1-5 (2017)

[5] Stacey and Kramers, EPSL 26, 207-221 (1975)