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Thorium and uranium power plate tectonics, but not the geodynamo

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We report a new tight constraint on the amount of heat producing elements uranium (U) and thorium (Th) in the Earth's core. Radioactive decay of potassium, thorium, and uranium power the Earth's engine, with variations in ^{232}Th/^{238}U recording planetary differentiation, atmospheric oxidation, and biologically mediated processes. We report and assess several thousand ^{232}Th/^{238}U (κ) and time-integrated Pb isotopic (κ_{Pb}) values in the Earth, core, and silicate Earth. Complementary bulk silicate Earth domains (i.e., continental crust $\kappa_{Pb}^{CC} = 3.94^{+0.20}_{-0.11}$ and modern mantle $\kappa_{Pb}^{MM} = 3.87^{+0.15}_{-0.07}$, respectively) tightly bracket the solar system initial $\kappa_{Pb}^{SS} = 3.890 \pm 0.015$. These findings reveal the bulk silicate Earth's κ_{Pb}^{BSE} is $3.90^{+0.13}_{-0.07}$ (or Th/U = 3.76 for the mass ratio), which resolves a long-standing debate regarding the Earth's Th/U value. Negligible Th/U fractionation accompanied accretion, core formation, and crust–mantle differentiation. Trivial amounts of these elements were added to the core and do not power the geodynamo. Our best estimate on U concentration in the core is 0.24 ppb by weight, and taking into account the uncertainty, the upper limit is 4.7 ppb at 95% confidence level. This translates to less than 1 TW of radiogenic power generated by the decay of U and Th in the core at present.