Behavior of Uranium and Thorium during the Earth's core formation

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The first 100 Myr of Earth's history was marked by accretion and core formation. While most Earth's core formation models are based on the behaviour of siderophile elements, lithophile elements are likely to give additional constrains on the accretional history of the Earth and segregation of its core. Here we investigate the molten metal/silicate liquid partitioning of U and Th. While U and Th are two refractory lithophile elements, the existing geochemical models show some discrepancies on both concentrations and ratio of U and Th in the Bulk Silicate Earth (BSE) compared to chondrites, as well as large uncertainties.

By adding our new metal-silicate partition experiments of U and Th to the all existing data, we developed global models of U and Th partitioning between the mantle and core throughout the Earth's accretion. The calculated concentrations in the BSE for U and Th are in agreement with previous studies (U_{BSE} = 11.4±0.5 ppb and Th_{BSE} = 43.2±1.7 ppb), while the content of the Earth's core for both elements are negligible. When compared to geochemical estimates, the calculated (Th/U) of the BSE offers some insights on the building blocks of Earth, supporting EL chondrites over EH as reduced starting material. We found also that U and Th depend differently on the oxygen content of the metallic phase, with Th being more sensitive than U to this parameter. To reproduce the (Th/U) of the BSE, the oxygen content of the Earth's core must be lower than 4 wt%, providing a strong constraint on the maximum of the core in oxygen.