Ruthenium isotope constraints on the timing of volatile element accretion

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The present-day isotope composition of Ru in the Earth's mantle was predominantly established by the materials added to the Earth as a late veneer after core formation had ceased. If the late veneer consisted of volatile-rich carbonaceous chondrites, as suggested by some heterogeneous accretion models, it could account for the Earth's budget of volatile elements. This view, however, cannot be reconciled with recently reported Ru isotopic data for primitive meteorites and post-Archean mantle samples, showing that carbonaceous chondrites cannot be the late veneer materials [1]. The major implication from this result is that the Earth must have accreted volatile-rich materials during earlier stages of accretion or, alternatively, the materials of the late veneer did not supply substantial amounts of HSE. Hence, investigating Ru isotope signatures in the putative remnants of pre-late veneer mantle is key to place further constraints on the timing of volatile element accretion. Such primordial signatures were most likely preserved only in the early Archean mantle before it was overprinted by the late veneer. Initial results obtained for samples from the Bushveld Complex (2.06 Ga) and the Abitibi greenstone belt (2.7 Ga) indicate that the terrestrial Ru isotopic composition seems to be homogeneous since Neoarchean times. To further asses the Ru isotopic composition of the early Earth's mantle we are currently investigating early Archean chromitites and komatiites from South Africa, Australia and Greenland.

[1] Fischer-Gödde and Kleine (2017) *Nature* **541**, 525-527.