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^{187}Re- ^{187}Os Nuclear Geochronometry: Dating Peridotitic Diamond Sulphide Inclusions

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Nuclear geochronometry [1-2] is a new dating method which combines principles of geochronology with nuclear astrophysics. It is embedded in other scientific fields like cosmochemistry, cosmology and nuclear theory, which pose tight constraints for nuclear geochronometry. It is based upon identified Re/Os element ratios $\approx$ 1, interpreted as the nuclear production ratio, and ultra-subchondritic initial ^{187}Os/^{188}Os ratios within terrestrial rocks, suggesting that Earth's core still contains element ratios and isotopic signatures of at least two rapid (r) neutron-capture process [3] events. The 13.78 Ga old component, represented by the isotopic signature of a komatiitic basalt [5085 BasKom] [4] from the Barberton Greenstone Belt (Onverwacht Group, South Africa), is assigned to the Earth's inner core. The other isotopic signatures identified so far within pyroxenites / komatiites are assigned to its outer core due to at least one gravitational collapse of the old component, commencing $\approx$ 3.48 Ga [2] and resulting in one or more additional r-process event(s). Here I show that ^{187}Re-^{187}Os nuclear geochronometry can also be successfully applied for dating peridotitic diamond sulphide inclusions by means of two-point-isochrones (TPI), using a so-called nuclear geochronometer always as the second data point in a TPI diagram. It turns out that the method may have a huge potential to constrain the chemical evolution of the SCLM. For example, TPI ages for Ellendale (Australia) peridotitic diamond sulphide inclusions EL50, EL23, EL54-1, EL54-3, EL55-1 and EL65 reported in the literature [5] reveal at least two main fractionation events. The age cluster between 1.4 Ga and 1.5 Ga is consistent with a previously reported isochrone age [5]. The event $\approx$ 2.3 $\pm$ 0.3 Ga overlaps the Great Oxidation Event (GOE) between 2.22 Ga and 2.46 Ga. While the $\approx$ 1.4 Ga to 1.5 Ga events lead to fractionation of the ^{187}Re/^{188}Os ratios towards values typical for mantle peridotite, the latter caused only minor disturbance of the ^{187}Re/^{188}Os nuclear production ratio assigned to the outer core. It cannot be excluded that a major change in oxygen/sulfur fugacitiy across the core – mantle boundary (CMB), coincident with the GOE, is responsible for the ^{187}Re/^{188}Os fractionation of the EL50 sample. Because of its minor degree of fractionation, EL50 can still be used as a so-called fractionated chronometer for dating those Ellendale peridotitic diamond sulphide inclusions, which do not show open system behaviour. Whether the $\approx$ 1.4 Ga to 1.5 Ga fractionation events are due to an even more pronounced change in oxygen and/or sulfur fugacities across the CMB, within the mantle or, alternatively/additionally, reworking of the mantle because of mantle convection and/or subduction of oceanic crust, remains an open question. This question will be addressed in future studies.

[1] Roller (2014), *GSA Abstr. with Programs*, **46**, 323. [2] Roller (2014), *Abstract S51B-4444*, Fall Meeting, AGU 2014. [3] Burbidge *et al.* (1957) *Revs. Mod. Phys.* **29**, 547 – 650. [4] Birck *et al.* (1994), *EPSL* **124**, 139 – 148. [5] Smit et al. (2010) *GCA* **74**, 3292 - 3306.