Diogenite Highly-Siderophile-Element Systematics Do Not Provide a Direct Record of the Vestan Mantle

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Numerous meteorites are considered to represent crustal materials of planetary bodies (e.g., the Moon and Mars) and differentiated planetary pre-cursors formed >4.5 Ga (asteroids). Highly-siderophile-element (HSE; including Os, Ir, Ru, Pt, Pd, and Re) abundances and Os-isotope compositions determined for broadly basaltic magmas of these differentiated silicate bodies place important constraints on planetary evolution and are fundamental to late-accretion hypotheses **[1-5]**. However, it is a long-standing and difficult question as to why olivine-rich asteroidal mantle materials are absent among known meteorites thereby limiting our ability to provide direct measurements of mantle HSE systematics for bodies other than Earth. It has been argued that some diogenites are samples of the mantle of the asteroid 4-Vesta **[1]**, and that their HSE compositions provide a robust record of the mantle of their parent body(ies).

We conducted a study of seven diogenites that include two falls (Tatahouine and Bilanga) and five finds (Dhofar 700, NWA 5480, NWA 7284, NWA 7831, NWA 7977). Of these samples, bulk-rock powder fractions of NWA 5480 (0.079 g, 0.197 g), Dhofar 700 (0.585 g) and Tatahouine (1.0 g) were previously subject to HSE-abundance and $^{187}Os/^{188}Os$ analyses **[1,2]**. We developed new methods to quantitatively determine, for the first time, HSE-abundance and $^{187}Os/^{188}Os$ systematics for selected phases and sub-sample portions for which textural information is known. Wafers (150 μm depth) of diogenites Dhofar 700, NWA 7284, NWA 7831, and NWA 7977 were prepared for this work along with a large slice of NWA 5480 (8.6 cm × 3.6 cm). Samples were imaged via scanning electron microscopy and subjected to electron micro-probe study prior to selective analyses of HSE-abundances and Os-isotope compositions by destructive ultra-low-blank isotope dilution approaches. These new data demonstrate that diogenites do not provide a robust record of the Vestan mantle HSE characteristics but instead record a complex set of processes that include additions during impact liberation and/or near-surface impact processing prior to ejection.

[1] Day *et al.,* 2012. Nat. Geosci., 5, 614-617. **[2]** Dale *et al.,* 2012. Science, 336, 72-75. **[3]** Brandon *et al.,* 2012, GCA, 76, 206-235. **[4]** Riches et al., 2012, GCA, 353-354, 208-218. **[5]** Day *et al.,* 2016, RiMG, 81, 161-238.