Episodic eclogitic diamond genesis at Jwaneng diamond mine, Botswana

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The diamondiferous Jwaneng kimberlite cluster (~240 Ma) is located on the NW rim of the Archaean Kaapvaal Craton in central Botswana. Previous studies report eclogitic diamond formation in the late Archean (2.9 Ga) and in the Middle Proterozoic (1.5 Ga) involving different mantle and sedimentary components [1;2;3]. Here we report newly acquired Sm-Nd ages of individual eclogitic pyrope-almandine and omphacite inclusions along with their major element data and nitrogen data from the diamond hosts to re-examine Jwaneng's diamond formation ages.

The Sm-Nd isotope analyses were performed via TIMS using $10^{13}\Omega$ resistors [4]. An initial suite of three pyrope-almandine and 14 omphacite inclusions yield $^{143}Nd/^{144}Nd$ from 0.51102±7 to 0.5155±5. $^{147}Sm/^{144}Nd$ vary from 0.024 to 0.469. Major element data defines two inclusion populations: (1) seven omphacites with high Mg#, high Cr# and one pyrope-almandine with low-Ca define an isochron age of 1.93±0.16 Ga with ε_{Ndi}= +3.5; (2) seven omphacites with low Mg#, low Cr# and two pyrope-almandines with low-Ca define an isochron age of 0.82±0.06 Ga with ε_{Ndi}= +3.7. Nitrogen contents of corresponding diamond host growth zones in Group (1) are ≤ 50 at.ppm whereas Group (2) range between 50 to 700 at.ppm with N-aggregation > 70 %B.

Additional data used to define "co-genetic" inclusion suites include Sr-isotopes and trace elements of the inclusions and carbon isotopes of the diamond hosts. Re-Os data of coexisting sulphide inclusions from the same silicate-bearing diamonds further validates the ages and indicates more periods of diamond formation at Jwaneng than previously assumed. The integrated data indicate the possibility of an extensive Paleoproterozoic diamond-forming event in southern Africa.

[1] Richardson et al. 1999, Proc 7th IKC Vol.2, 709-713
[2] Richardson et al. 2004, Lithos 77, 143-154
[3] Thomassot et al. 2009, EPSL 282, 70-90
[4] Koornneef et al. 2014, ACA 819, 49-55