Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.10017

Mesoproterozoic diamond formation in the root of the Sask craton: A link to the MacKenzie large igneous event?

SARAH EM MILNE[1], SUZETTE TIMMERMAN[1], GEORGE READ[2], D. GRAHAM PEARSON[1], ANETTA BANAS[1] AND THOMAS STACHEL[1]

[1]University of Alberta
[2]Star Diamond Corporation
Presenting Author: saraheli@ualberta.ca

Most diamonds come from Archean lithospheric mantle that underpins the Archean nuclei of cratons. However, several studies have indicated the importance of Proterozoic mantle and/or Proterozoic diamond formation in creating economic diamond deposits. The recent discovery that the depletion and stabilisation of the diamond-bearing lithospheric mantle root beneath the Sask craton (Canada) occurred in the Palaeoproterozoic, with dominant Re-Os ages of peridotitic mantle xenoliths between 2.4 and 1.7 Ga, [1], despite Archean crustal basement ages of 3.3-2.1 Ga [2], raises immediate questions about the age of the diamonds in the Fort à la Corne (FALC) kimberlite field. In this context, it is particularly important to understand when and under what conditions diamonds formed underneath such an unusual craton, and what role, if any, the Palaeoproterozoic Trans Hudson Orogen (THO: 1.9 to 1.7 Ga, [2]) played in diamond genesis.

The diamonds recovered from the FALC field are dominantly of lherzolitic paragenesis. Hence, in this study, we analysed Sm-Nd isotope systematics of 11 individual silicate inclusions from (n=11) lherzolitic diamonds from the Star kimberlite, part of the FALC field. Garnet inclusions (n=8) have similar concentrations of Sm (1.3-1.8 ppm) and Nd (1.9-2.6 ppm) and thus limited variation in Sm/Nd ratios. Clinopyroxenes (n=3) also show a narrow range in Sr (126-134 ppm), Sm (1.4-1.5 ppm) and Nd concentrations (7.0-8.1 ppm), as well as in $^{87}Sr/^{86}Sr$ ratios (0.704656-0.704713), indicating a homogenised/equilibrated lherzolitic substrate. A regression of the garnet and clinopyroxene inclusions defines a singular Sm-Nd isochron with an age of ~1300 Ma.

This diamond formation event clearly occurred well after the THO event and is within error of the 1267 ± 2 Ma MacKenzie plume event in Northern Canada [3]. The 'rule' that diamonds are only associated with cratons containing Archean lithospheric mantle needs to be re-evaluated. Large magmatic events not only resorb diamonds but can also play a role in diamond formation.

[1] Czas et al. (2020) *Lithos* 356-357, 105301. [2] Rayner et al. (2005) *Can J Earth Sci* 42, 635-657. [3] LeCheminant et al. (1989) *EPSL* 96, 38-48.