Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.12362

Metasomatic Fluids in Diamonds and the Destruction of the North China Craton

REED BENJAMIN MERSHON[1,2], ODED NAVON[2], YAAKOV WEISS[2] AND JEFFREY W HARRIS[3]

[1]University of Hawaiʻi at Mānoa
[2]Hebrew University of Jerusalem
[3]University of Glasgow
Presenting Author: reed.mershon@gmail.com

Metasomatic processes control diamond formation and influence the evolution of the continental lithosphere. Fibrous diamonds trap and preserve such melts in microinclusions during their growth, thus providing an opportunity to study and characterize pristine mantle metasomatic agents.

A suite of fourteen diamonds from Pulandian Pipe 50 kimberlite (North China Craton) was analyzed for nitrogen concentration and aggregation and volatile content using FTIR, and for the microinclusion compositions by EPMA (major elements) and LA-ICP-MS (trace elements). The diamonds carry between 357-1063 ppm nitrogen in both A-centers and B-centers with 9-37 % B. On a total-nitrogen vs. % B-centers plot, all diamonds fall along a single isotherm (assuming a similar residence time), suggesting their formation in a singular event and origin from the same depth in the lithosphere. In comparison to most fibrous diamonds that carry mostly A-centers, the Pulandian diamonds resided longer or formed deeper in the lithospheric mantle. Twelve diamonds bear high-Mg carbonatitic microinclusions compositions, rich in Mg, Ca, Fe, K, and CO_2. Two contain a saline composition, with one rich in Cl, K, and Na, and another rich in Cl, K, Ba, and Sr. The high-Mg carbonatitic high-density fluid (HDF) is indicative of a carbonated peridotitic source, whereas the saline HDF suggests an association with subducted oceanic crust. The incompatible trace elements exhibit a “planed” pattern without distinct fractionation for the high-Mg carbonatitic composition and a “ribbed” pattern with significant enrichment in Ba, Th, LREEs and depletion in alkalis and Nb for the saline ones.

Our findings join earlier observations on the coexistence of saline and high-Mg carbonatitic mantle fluids. The “planed” trace element signatures resemble that of the Pulandian kimberlites, whereas the “ribbed” signature implies a subducted origin bearing similarity to later erupted alkali basalts; a mixing model suggests that small addition of saline HDF to the basaltic source could produce the alkali basalt signatures. If the large addition of such H_2O- and CO_2-rich near-solidus melts to the lithospheric mantle at depth occurred in the North China Craton, it may have produced a high volume of carbonate-rich hydrous veins that weakened the cratonic roots sufficiently to begin decratonization.