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Deciphering the enigmatic origin of Guyana's diamonds

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Abstract

Diamonds have long been mined from alluvial terrace deposits within the rainforest of Guyana, South America. No primary kimberlite deposits have been discovered in Guyana, nor have there been previous studies on the mineralogy and origin of the diamonds. Paleoproterozoic terranes in Guyana are prospective to diamond occurrences because the most productive deposits are associated spatially with the eastern escarpment of the Paleoproterozoic Roraima Supergroup. Geographic proximity suggests that the diamonds are detrital grains eroding from the <1.98 Ga conglomerates, metamorphosed to zeolite and greenschist facies. The provenance and paragenesis of the alluvial diamonds are described using a suite of placer diamonds from different locations across the Guiana Shield. Guyanese diamonds are typically small, and those in our collection range from 0.3 to 2.7 mm in diameter; octahedral and dodecahedral, with lesser cubic and minor macle forms. The diamonds are further subdivided into those with abraded and non-abraded surfaces. Abraded diamonds show various colors in cathodoluminescence, whereas most non-abraded diamonds appear blue. In all populations, diamonds are predominantly colorless, with lesser brown to yellow and very rare white. Diamonds are predominantly Type IaAB and preserve moderate nitrogen aggregation and total nitrogen concentrations ranging from trace to ~1971 ppm. The kinetics of nitrogen aggregation indicate mantle-derived residence temperatures of 1124 ± 100 °C, assuming residence times of 1.3 and 2.6 Ga for abraded and non-abraded diamonds, respectively. The diamonds are largely sourced from the peridotitic to eclogitic lithospheric upper mantle based on both $\delta^{13}C$ values of –5.82 ± 2.45‰ (VPDB-LSVEC) and inclusion suites predominantly comprised of forsterite, enstatite, Cr-pyrope, chromite, rutile, clinopyroxene, coesite, and almandine garnet. Detrital, accessory minerals are non-kimberlitic. Detrital zircon geochronology indicates diamondiferous deposits are predominantly sourced from Paleoproterozoic rocks of 2079 ± 88 Ma.

Keywords: Diamond, Guyana, Guiana shield, Roraima supergroup