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Unusually High Prevalence of Type IIa Diamonds from Crater of Diamonds, Arkansas, USA and Possible Deep Mantle Origins

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Diamonds were discovered in 1906 near Murfreesboro, Arkansas, USA. Initial attempts at large scale mining were unsuccessful, with the deposit changing hands to the State of Arkansas and becoming a tourist fee dig operation called Crater of Diamonds State Park. Arkansas diamonds are related to the volcanics of the Prairie Creek Diatreme consisting of magmatic lamproite, pyroclastic lamproite, and maar epiclasts rather than the more typical kimberlitic volcanics associated with most other primary diamond deposits. The Crater of Diamonds deposit is also unique in that it is hosted *off-craton*, a similarity it shares with the other major lamproitic diamond deposit at Argyle. While some large diamonds have been found, including the largest American diamond, the Uncle Sam Diamond at 40.23 ct, most are very small and their concentration too low for the deposit to be economical. In 2024, park visitors arduosly recovered 736 diamonds, with an average weight of merely 0.14 ct.

The most unusual aspect of the deposit is the unusually high prevalence of Type IIa (nitrogen-poor) diamonds. In 2024, two of the authors were able to analyse 1,115 diamonds at the Crater of Diamonds Park by infrared spectroscopy and found 7.8% to be Type IIa. In contrast, only about 1.3% of diamonds globally are Type IIa. Globally, Type IIa diamonds are more prevalent in larger diamonds with about 40-50% of diamonds above 10-20 ct being Type IIa. At Crater of Diamonds the prevalence of Type IIa diamonds reaches 58.3% above only 1 ct. The marked Type IIa contingent may reflect a population of sublithospheric diamonds, which would be consistent with both their low nitrogen and the irregular and strongly resorbed shapes. Importantly, Raman analysis identified the mineral breyite as an inclusion in one Type IIa diamond acquired at Crater of Diamonds, strongly suggesting a sublithospheric origin. This presentation will outline the findings of testing on 1,115 Arkansas diamonds, furthering our understanding of the unique geological story of the Crater of Diamonds deposit.