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Physical and Chemical Characteristics of Nine Diamond Parcels from the Central African Republic – Is Source Discrimination Possible?

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As part of the Kimberley Process Certification Scheme (KPCS), an on-going process involves the building of a database of the physical and chemical properties of rough diamonds from the African continent. This will be used for identifying the provenance of such diamonds, to halt the flow of, specifically, conflict diamonds. Conflict diamonds originate from countries that have known affiliation with rebels who use the diamonds as a source of income. The Mintek-SADPMR Provenance laboratory, via the KPCS, is actively involved in provenance studies of rough diamonds to ultimately identify conflict diamonds, and received 105 diamonds from the Central African Republic (CAR) for analyses and addition to the database.

The diamonds investigated were representative of the two diamond producing areas of the CAR and placed into nine separate parcels, labelled A1 to A9. The two areas were referred to as the "east" and "west". The aim of the investigation was to identify the physical (morphological) and chemical characteristics of the nine parcels and to tentatively place them into two groups – each representing the producing areas. Morphological observations were made by optical stereomicroscopy. Chemical data were collected by Fourier transform infrared spectrometry (FTIR) and laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS).

Forty-four percent of the entire population was white in colour. Sixty percent exhibited surface features as sand particles, radiation spots, frosting and graphite. The dominant form was dodecahedron, as shown in 63% of the diamonds. Twenty one surface features specific to the dodecahedron, octahedron and general shape were identified. Of the nine parcels, parcel A8 contained the lightest diamonds, with masses at and below 0.2 carats. Parcel A9 held the heaviest diamond from the entire parcel – 3.7 carats.

Fourier transform IR was used to identify the concentration of nitrogen, the diamond sub-type and the nitrogen aggregation state, in each diamond. Diamonds that contain nitrogen are called Type I whereas those that contain no measureable nitrogen are referred to as Type II. One diamond in parcel A9 was found to not contain nitrogen. Fourier transform IR identified subtypes in the diamond spectra as Type IaA and IaB. It was shown that the overwhelming majority of diamonds were a combination of subtypes as Type IaAB. Fourier transform IR also revealed that all diamonds contain nitrogen in all three aggregation states.

Laser ablation ICP-MS was utilized for determining 26 trace elements in each diamond. From this, the statistical viability of the data was determined. The data obtained compare well with previously analysed diamonds from Bria in CAR, for the majority of elements. Additionally, the data show that parcels A1, A3, A5, A6 and A9 are least enriched in trace elements. These parcels also correspond best with those from Bria in terms of their chemical trends.

Discrimination of the parcel from CAR with some parcels from the Democratic Republic of the Congo (DRC) shows a good distinction between diamonds from these countries. Diamonds from DRC are less enriched in trace elements that those from CAR.

Based on the concentration of N, the aggregation state of N and trace element enrichment of the diamonds, the parcels have been tentatively grouped as A1, A3, A5, A6 and A9 (Group 1), and A2, A4, A7 and A8 (Group 2). Additionally, comparing these diamonds to those from Bria, places parcels in Group 1 as originating from the eastern diamond producing area of CAR. In order to produce a statistically sound database, however, larger numbers of diamonds need to be analysed from any one area.