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The Orange and Riet River alluvial diamond deposits in the vicinity of Douglas, Northern Cape Province: geology, evaluation, and exploitation of unique South African large diamond producing deposits

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Middle Orange River (MOR) alluvial deposits between Hopetown – Douglas and Douglas – Prieska, and the Riet River downstream of Ritchie, represent three unique sinks or repositories of high quality gem diamonds. These exceptional populations of gem diamonds include regular stones larger than 100 carats, and less common stones larger than 200 carats. The most common large stones are white (D colour) Type-II, and yellow diamonds; rare smaller coloured stones such as pinks also occur.

The MOR alluvial diamond deposits comprise extensive remnant terraces (Miocene – Present) which are preserved at successive elevations (120 m – 0m) above the modern Orange River on the left and right banks.. The Riet River system is younger with the highest terrace at 25 m above current river. These deposits are products of massive paleoriver systems draining the diamondiferous kimberlites in the southern African hinterland during periods of strong weathering and erosion caused by uplift and excessively wet climatic periods.

The remnant terraces generally comprise coarse basal gravels overlain by upward fining interbedded gravel layers and sand lenses. Sedimentological features are consistent with a system of braided channels depositing coarse gravel bars during peak flow and finer sediments during reduced flow in an incised meander system. Diamond entrapment and concentration is usually, but not always, correlated with coarse bar features, river gradient, floor rock features, structural controls (eg. dykes), banded iron formation clasts, and other subtle geological controls. In section from top to bottom the deposits generally comprise surface deflation Rooikoppie deposits, a protective hard calcrete layer with enclosed clasts and diamonds, sand lenses and sandy-gravel middlings, and coarse basal gravels.

Hopetown – Douglas MOR deposits comprise very low grade (0.07 – 0.3 carats per hundred tonnes (cpht)) deposits with a simple diamond population characterised by Type-II diamonds (generally larger than in the Douglas – Prieska leg), and yellow stones. These diamonds are associated with Karoo lava clasts and zeolites. A predominantly Lesotho provenance is indicated.

Douglas – Prieska MOR deposits have higher grades (0.35 – 1.5 cpht) and a mixed diamond population with stones up to 300 carats. The diamond population comprises multiple sources including Type-II stones of likely Lesotho origin, stones typical of the Kimberley pipes including well preserved (octahedral) fancy yellow diamonds larger than 100 carats (yellow stones typically make up about 30% of this population), gemstones with brown overtones which could have been derived from Finsch/Postmasburg kimberlite clusters north of the MOR, and Type-II and yellow diamonds with a probable provenance from the Modder/Riet rivers which tap the Koffiefontein cluster.

Riet River deposits in the vicinity of Schutsekama also have higher grades of 0.35 – 1.5 cpht. The diamond population comprises multiple sources including Type-II stones of likely Lesotho origin, a Kimberley contribution as above, and significant input from the Koffiefontein/ Jagersfontein clusters.

Exploitation of the MOR deposits requires excellent knowledge of the regional, local, macro/micro geology, and metallurgy. No two terrace remnants are the same, distinct subtleties exist which impact grades, diamond populations, processing, and financial returns. These variations impact selection of deposits which may yield economic returns. Successful exploitation is correlated with carefully managed selective mining rather than expansive high volume scenarios. In the future lower cost mining methods, improved screening and classifying, and replacement of Rotary-pans and DMS modules by high volume mineral sorters and X-ray machines, will dictate successful exploitation of the exceptional gem diamond populations from these gravel deposits.