THE DIAMONDIFEROUS GRAVELS OF THE SOUTHWESTERN TRANSVAAL, SOUTH AFRICA.

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A detailed analysis of the alluvial diamond gravel deposits of the southwestern Transvaal has indicated that these deposits are far more complex than was previously thought. It is apparent that the gravels consist of a basal alluvial deposit overlain by a calcretized eluvial gravel, a lateritized colluvial deposit and a younger fluvial sequence (Fig. 1). The basal, Primary Older Gravels have recently been discovered to occur below hardpan calcrete in palaeodrainage channels. Where exposed, the sequence consists of up to 2m of clast-supported gravels with angular to sub-rounded clasts of quartzite, vein-quartz, amygdales, lava, banded-ironstone and shale of 1-10cm in size. The -5mm matrix fraction consists of essentially the same components, but with the addition of kimberlitic garnets and ilmenites. The gravels are variously calcretized, with hardpan calcrete usually developed at the surface. Late-stage decomposition of the hardpan calcrete has resulted in the formation of makondos, in which the eluvial gravel component has accumulated. The clasts in the eluvial deposits are composed almost exclusively of chemically resistant, siliceous lithologies.

The colluvial gravels are thin (usually less than 1m thick), aerially extensive deposits that are the result of deflation of the southwestern Transvaal landsurface. They are best developed on deeply-weathered Ventersdorp lava in which pseudokarst solution features have been etched by laterization processes.

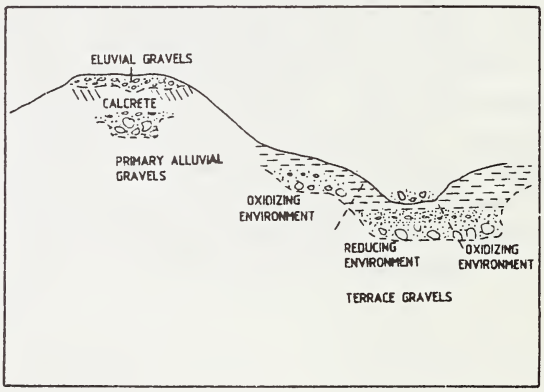

Figure 1(a):
Spatial relationships between the Eluvial and Primary Alluvial Gravels and the Terrace Gravels.

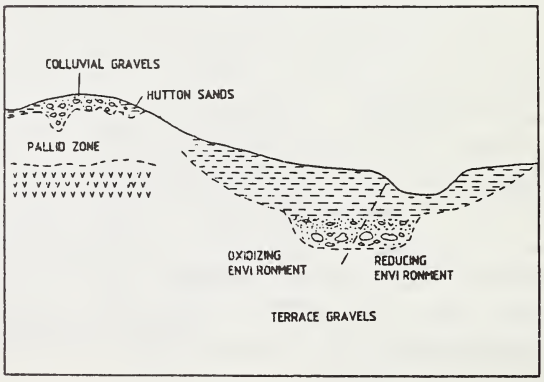

Figure 1(b):
Spatial relationships between the Colluvial and Terrace Gravels.

The younger Terrace Gravels are found everywhere along Plio-Pleistocene drainage lines at depths of 3 to 8m. The deposits consist of an approximately 5m, upward-fining, alluvial, sedimentary sequence deposited on an uneven floor of Ventersdorp lavas. The entire sequence is variably calcretized and the lower portions of the package are either oxidized or reduced, depending on the proximity of the water-table.

It is argued that there is a direct correlation between the gravel stratigraphy of the southwestern Transvaal and that which is developed along the lower Vaal River in the Barkly West district. The (A1) Primary Alluvial Gravels appear to be time correlatives of the Older Gravels (Primary Alluvial Gravels) of Barkly West; the derived older gravels find their equivalent in the colluvial and eluvial components of the southwestern Transvaal; the (A2) Terrace Gravels are most likely equivalent to the Rietput Formation; and the (A3) River Gravels equivalent to the Riverton Formation.

An investigation of the gravels indicates that the clasts have a local origin. By far the majority of the clasts consist of Ventersdorp lithologies. Other clasts can be traced to the Karoo Sequence (both Dwyka and Ecca lithologies), the Amalia, Kraaipan and Zoetlief sequences, and local dyke and vein networks.

In the colluvial and eluvial deposits, many chemically unstable clasts have been totally decomposed by post depositional processes of laterization and calcretization. As a result, these deposits consist almost entirely of siliceous clasts, such as quartz, quartzite, amygdales and agates. This assemblage is non representative of the original gravel and, therefore, cannot be used to infer a source terrane.

Diamonds are found in the alluvial, as well as the colluvial and eluvial gravels. In the latter deposits there does not appear to be any sorting of the diamonds within the gravels. In the alluvial deposits, however, the diamond acts as a heavy mineral and is, therefore, concentrated by sedimentary processes. Economic deposits of diamonds are, thus, to be found in point-bars, downstream confluences, adjacent to dykes, and wherever the hydraulic conditions were optimum for gravel deposition.

Contrary to the findings of previous studies, kimberlitic indicator minerals, such as pyrope garnets, picro-ilmentites, and chrome spinels were recovered from gravels in the southwestern Transvaal. Such indicator minerals were primarily found in the matrix of the alluvial gravels that were extensively calcretized. The eluvial gravels as well as the colluvial gravels contain few, if any, garnets. The bulk of the garnets were likely decomposed by the climatic conditions that promoted the lateritizing conditions prevalent during the African landscape cycle. Analysis of the mineral chemistry of these indicator minerals indicate that many have been derived from a diamondiferous, kimberlite source (Fig. 2).

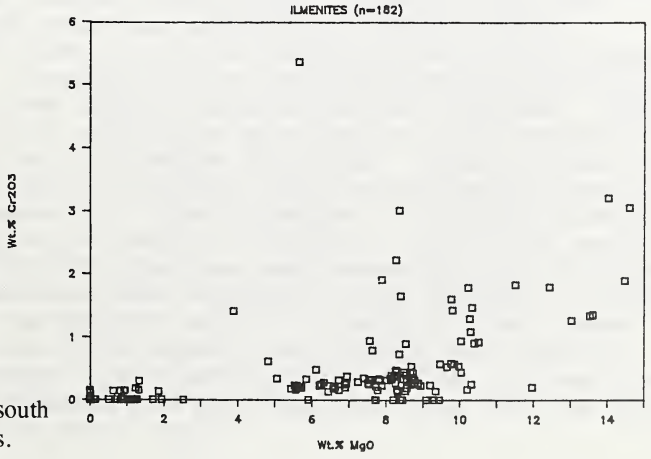

Figure 2(a):
Cr_2O_3 vs MgO plot of the south western Transvaal Ilmenites.

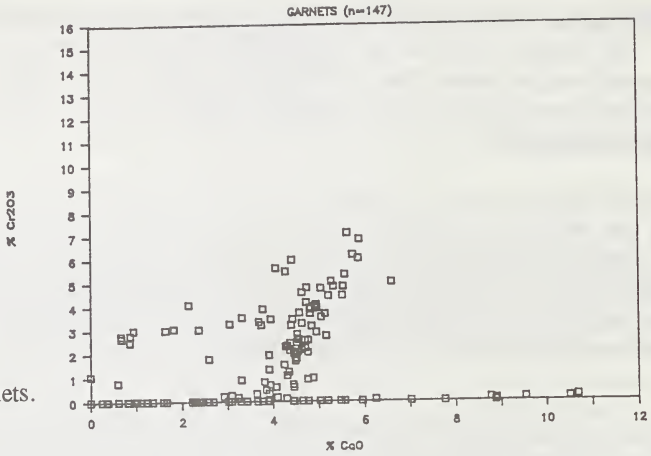

Figure 2(b):
Cr_2O_3 vs CaO plot of the southwestern Transvaal garnets.

Evolution of the southwestern Transvaal landscape can be explained within the framework of the accepted geomorphological model for southern Africa. It is envisaged that kimberlites were emplaced in the southwestern Transvaal during the late Cretaceous. Following the rifting of Gondwana, an early Tertiary drainage system developed on the ensuing African surface. As a result of the extremely long period of laterization that followed, the erosion surface was substantially lowered and a residual soil accumulated over the surface. Post African I uplift in the Miocene not only caused piracy and reversal of certain stream segments, but also resulted in the leaching of the African surface and the redistribution and concentration of the colluvial diamondiferous deposits. Subsequent Post African II uplift in the Pliocene resulted in the incision of the A2 drainage-system which reworked portions of the older colluvial gravels. Minor climatic and sea-level oscillations have, further, resulted in the cutting of the present Vaal River terraces.