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Dwyka-age diamondiferous eskers in the Lichtenburg/Ventersdorp diamond fields, North West Province, South Africa.

Mike C.J. d

e Wit

University of Pretoria/Tsodilo Resources Ltd.

Abstract

North-south orientated sinuous 'runs', that occur almost entirely on a flat erosional surface of the dolomites of the Malmani Subgroup (Transvaal Supergroup) in Lichtenburg-Ventersdorp area (North West Province), are composed of diamond-bearing gravels. The unconformity, at some 1,500 m elevation, cuts across the dolomite sequence and formed prior the deposition of the Pretoria Group sediments representing a time gap of at least 80 Myr. It is characterised by siliceous breccias (palaeo-karst infill) and conglomerates (reworked breccias) of the Rooihoogte Formation that have since been exhumed. Glacial pavements and remnants of thin Lower Karoo sediments are also found on this pre-Pretoria/per-Karoo surface. East to west this dolomite plain measures 150 km, and north-south it is on average 40 km wide. Diamonds were discovered in these gravel 'runs' in 1926 and they have been mined ever since, having produced some 10 million carats of diamonds. The gravels, that make up these 'runs' and sinkholes directly or indirectly linked to these runs, are very poorly-sorted and are best described as diamictites. The 'runs' form positives ridges that meander across the dolomite surface and have a very flat gradient, with sections flowing 'uphill'. The 'runs' are up to 30 km long and between 80 to 300 m wide, and have always been regarded as post-Gondwana drainage features of unknown age linked to southward flowing river systems. From new field evidence, geomorphological studies, diamond inclusion and zircon dating, and clay analysis it is clear that these coarse-grained 'runs' represent eskers that are associated with last glacial episode of the Dwyka continental ice sheet that are preserved on this ancient poly-phase erosion surface. The bedrock facies of these upland facies consist of locally derived bedrock breccia, shattered bedrock and glaci-tectonised bedrock breccia. The bedrock breccias commonly grade upwards into the diamictites. The diamictites are very poorly sorted, massive or graded matrix- and clast-supported units, and the reworked glacial debris are present as horizontally or gently dipping crudely bedded units. The diamictite has also been found in cavities created by the karstification of the dolomite surface, whereas the eskers are the infillings of ice-walled stream channels and record deposition in subglacial drainage networks. There are two agate populations in the gravels and both are linked to the Pretoria Group: an abraded population, found in most runs, is associated with the Hekpoort volcanic units; and an unabraded population, only found in the Lichtenburg area, is linked to

local Bushy Bend-type volcanism. Crustal zircon ages from the Lichtenburg area are Mesoproterozoic and older but mantle zircons from a large pothole suggest that Cambrian-age kimberlites exist locally. This is supported by ages of two clino-pyroxene diamond inclusions and surface texture analysis of diamonds from a substantial diamond parcel. The geological model for the Lichtenburg and Ventersdorp diamond fields is therefore that the diamonds were derived from 500 Ma kimberlite(s) which intruded into the poly-phase erosional dolomite surface and were subsequently reworked and incorporated into the eskers of the waning Dwyka glaciation.