Pre-Witwatersrand and Witwatersrand Conglomerates in South Africa: A Mineralogical Comparison and Bearings on the Genesis of Gold-Uranium Placers

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Abstract

Pyritic quartz-pebble conglomerates from pre-Witwatersrand as well as from lower and upper Witwatersrand sediments show far reaching similarities in their ore mineralogy. The erratic and low gold and uranium contents of the investigated pre-Witwatersrand conglomerates, to a large extent, is explained by the inefficiency of the operating sedimentary reworking processes. The detrital chromites of all studied conglomerates have an identical chemical composition which points to an origin from the same provenance areas. “Fly-speck” carbon aggregates have been detected for the first time in many of the pre-Witwatersrand conglomerates indicating the possible presence of advanced, hitherto unknown lifeforms in the late Archaean. The observed extreme scarcity of uraninite in pre-Witwatersrand conglomerates may be due to recent uranium removal in the investigated weathered samples. From this study it is apparent that the Archaean pyritic conglomerates are primitive forerunners of the Witwatersrand gold-uranium placers.

1 Introduction

The Kaapvaal Craton of South Africa (Fig. 1) constitutes the most important gold province on earth, in that more than half of the world’s total gold production originates from this craton. The gold mainly is contained in pyritic quartz-pebble conglomerates within early Precambrian sedimentary sequences. These placer deposits are also uraniferous and contain about 10% of today’s proven world uranium reserves so that 98% of South Africa’s gold and practically all its uranium production originate from conglomerates of the 2500 to 2800 m.y. old Proterozoic Witwatersrand Supergroup (Fig. 2).

A great number of sedimentological, geological, and mineralogical studies have led to the general acceptance of the “modified placer theory” as a metallogenetic concept of ore formation in the sediments of the Witwatersrand Supergroup (Liebenberg 1955; Ramdohr 1955; Brock and Pretorius 1964; Pretorius 1975; and others). The concept envisages that subsequent to their sedimentation some of the heavy minerals, notably the sulphides as well as some of the gold and the uranium phases, were reconstituted and thereby lost their detrital features as a result of low-grade metamorphism.
On the Kaapvaal Craton pyritic quartz-pebble conglomerates are also found (1) in the approximately 3250 m.y. old Moodies Group of the Swaziland Supergroup in the Barberton Mountain Land, (2) in the Uitkyk Formation of the Pietersburg greenstone belt in the northern Transvaal, and (3) in the 2900 to 3200 m.y. old Pongola Supergroup of the south-eastern Transvaal and of Zululand (Figs. 1 and 2). Based on the geological setting, the Uitkyk Formation has been correlated with the Moodies Group (Grobler 1972; Brandl 1979; Muff and Saager 1979). However, a radiometric age is not yet available on the Uitkyk Formation and the stratigraphic position of this unit must be regarded with some reservation.

The Archaean quartz-pebble conglomerates, only in a few places, are known to be pyritic and to carry erratic gold and uranium values. Thus, these conglomerates so far are of insignificant economic importance. This may be the reason why little information has been published about the distribution, geology, and mineralogy of auriferous and uraniferous pre-Witwatersrand placer occurrences.