Origin of gold and emerald mineralization in the Murchison Greenstone Belt, Kaapvaal Craton, South Africa

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The Murchison greenstone belt (MGB) represents one of a number of Archaean volcano-sedimentary successions within the Kaapvaal Craton of South Africa (Fig. 1, inset). It is situated approximatively 200 km north of the 3.5 to 3.2 Ga Barberton greenstone belt. The belts form part of the cratonwide Thabazimbi-Murchison lineament which represents a major suture along which assembly of the northern Kaapvaal Craton took place (Mc Court, 1995). Gold, antimony, arsenic, tungsten and mercury are the most frequent metals found in structuraly controlled, hydrothermal ore deposits on the central portion of the belt. In addition, volcanogenic copper-zinc massives sulphide and pegmatite-related emerald mineralization are located in the northern and southern parts of the belt, respectively.

This study presents new U-Pb isotope determinations on single zircon grains from key formations in the MGB, as well as Pb-Pb isotopic determinations of pyrites associated with gold, antimony and emerald mineralization.

Geological setting

Mafic-to-felsic volcanics and volcanoclastics sediments (La France and Weigel Formations, SACS, 1980) occupy the central portion of the belt, as well as the Au-Sb mineralized zone, the so-called Antimony Line (Fig. 1). Quartzites, conglomerates and quartz-sericite-chlorite schists (MacKop Formation) occur south of the Baderoukwe gneiss pluton in the Bawa Schist Belt (Fig. 1, SACS, 1980).

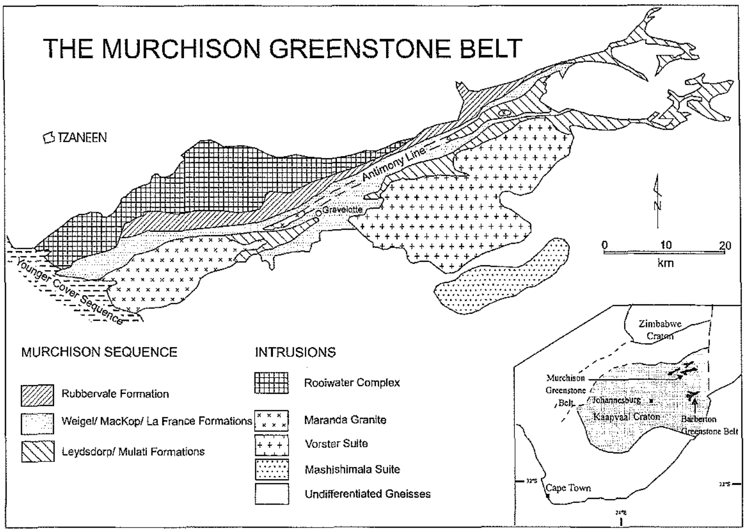

FIG. 1. Geological map of the Murchison greenstone belt.

Intensely sheared intermediate-to-felsic lavas, pyroclstic rocks, quartz-feldspar porpyries and the mineralized Copper-Zinc Line occur within the Rubbervale Formation which occurs along the northern flank of the MGB (Fig. 1).

A suite of potassic granitoid rocks (Vorster Suite) intrudes the southern margin of the MGB, but are generally poorly exposed such that no clear evidence exists to establish their mutual relationships. The granitoids range in composition for granodiorite to alkali-feldspar granite suggesting that all these units might be genetically related and could form a single batholith encompassing or underlying the MGB. Migmatites and orthogneisses of more sodic compositions (tonalite-trondhjemite-granodiorite) occur both to the north and south of the MGB. The final magmatic event in this region is represented by the post-tectonic Mashishimala granite pluton (Fig. 1).

The MGB has been interpreted as part of an exhumed island arc developed along the northern edge of the Kaapvaal protocontinent (Vearncombe, 1991; Mc Court, 1995).

Results

U-Pb and Pb-Pb studies show that the Murchison greenstone belt is substantially younger than the 3.45 to 3.23 Ga Barberton greenstone belt; it formed between 3.09 and 2.97 Ga and as such represents a discrete age of greenstone belt on the Kaapvaal Craton identified for the first time in this study. Single zircon U-Pb age determinations on the metavolcanics in the MGB yield ages of 3084 Ma and 2971 Ma, while the youngest detrital zircons in metaconglomerate from within the belt are 3076 Ma (Poujol *et al.*, 1997). The oldest granites recognized are the tonalitic-trondhjemitic gneisses along the southern margin of the MGB, dated at 3228 Ma. The Maranda batholith, which intrudes the central portion of the belt (Fig. 1) along the Antimony Line, was emplaced at 2.97 Ga, and appears to represent the plutonic equivalent of the acid intrusives rocks comprising the Rubbervale Formation, which are also 2.97 Ga old. Pyrites from the Malati Pump and Monarch East Au-Sb deposits located along the Antimony Line defined a secondary Pb-Pb isochron whose age is *c.* 2.97 Ga, essentially indistinguishable from the emplacement age of the Maranda Batholith which has intruded the Antimony Line. This structural feature, which must have been present prior to the emplacement of the 2.97 Ga felsic magmas, not only represents the locus for intrusion of the batholith, but also focussed fluids that, at least initially, appear to have been derived from the volatile saturated Maranda granite.

References

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