Archean melt inclusions in zircon from quartzite and granitic orthogneiss from South Africa: Magma compositions and probable sources of protoliths

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Abstract: Results are presented of analyses of melt inclusions in > 3.0 Ga zircon grains from three lithologies in South Africa: the Orange Grove Quartzite of the Witwatersrand Supergroup, quartzite of the Beit Bridge Group and the S-type Singelele orthogneiss, the latter both of the Central Zone of the Limpopo Belt. In each case, the presence of melt inclusions indicates that the zircon is magmatic in origin. No melt inclusions occur in metamorphic overgrowths in some grains. Melt inclusions in detrital zircon grains from the two quartzite units indicate that both tonalitic-trondhjemitic and granitic magmas were being emplaced in the source areas at about 3.2 Ga. Granitic magmatism at that time is among the earliest recognized in southern Africa. Inclusions in zircon grains from the Singelele orthogneiss are compositionally similar to the host rock, showing that they are a magmatic phase rather than a xenocrystic phase.

Key-words: zircon, Archean quartzite, melt inclusion, tonalitic-trondhjemitic magma, South Africa.

Introduction

Melt inclusions in zircon provide direct information about the composition and crystallization features of the magma from which zircon was crystallizing, and the U-Pb systematics of the same zircon often indicates when that crystallization took place. As such, zircon and its melt inclusions provide powerful clues to the magmatic origin of the rocks in which magmatic zircon is found. This was demonstrated for the first time in Archean enderbitic and charnockitic orthogneisses from the Anabar and Aldan Shields of Siberia (Chupin et al., 1992; 1993; 1994). In the study presented here, melt inclusions (Chupin & Chupin, 1995; Chupin et al., 1997) were studied in detrital grains of zircon from two units of quartzite from South Africa: the greenschist-facies Orange Grove Quartzite (OGQ), the basal unit of the gold- and uranium-bearing Witwatersrand Supergroup, and the granulite-facies Beit Bridge Group (BBG) of the Central Zone of the Limpopo Belt near Messina (Fig. 1). In addition, to compare the composition of melt inclusions in zircon with the composition of the originally igneous rock containing it, similar inclusions were studied from the S-type, granulite-facies garnet-bearing Singelele granitic