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Pan-African accretionary metamorphism in the Sperrgebiet Domain, Gariep Belt, SW Namibia

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ABSTRACT

The newly described Sperrgebiet Domain is a part of the Palaeo- to Mesoproterozoic Namaqua–Natal Province that is exposed as a basement inlier within the Pan-African Gariep Belt in SW Namibia. Clastic metasediments of the *c.* 1700 Ma Aurus Schist of the Sperrgebiet Domain exhibit Pan-African fabrics and metamorphic mineral assemblages that are not present in the low-grade metamorphic Gariep Supergroup against which it is tectonically juxtaposed. Metapelitic and semi-pelitic schists consist of phengitic white mica, chlorite, minor garnet and quartz ± biotite, and contain pseudomorphs after a prismatic aluminous mineral, likely chloritoid or staurolite. Calculated pseudosections for four mica schist samples constrain *P*–*T* conditions of around 10 kbar and 500 °C, and the late paragenesis of garnet indicates that these conditions were attained along a prograde, clockwise trajectory. These conditions and the low apparent geotherm (~14 $°C.km^{-1}$) are typical of subduction zone metamorphism, and are similar to those documented for peri-contemporaneous accretionary metamorphism in the adjacent Damara Belt to the NE. A subduction origin has also been proposed for exotic 'blueschist' blocks within the Gariep Belt; however, the absence of an accretionary metamorphic imprint in the Gariep Supergroup indicates that the Sperrgebiet Domain was decoupled from these lithologies for much of the Pan-African Orogeny. Our results are the first indication that the continental margin of the western Kalahari Craton may have been subducted during the latter stages of Pan-African convergence and Gondwana assembly.

1. Introduction

The formation of supercontinents involves the convergence and amalgamation of continents and continental fragments into one landmass (e.g. Nance et al., 2002; Meert, 2003; Li et al., 2008). This process requires the interspersed oceanic crust to be removed, such that continental orogenesis is invariably preceded by subduction. In southern Africa, the assembly of the Gondwana supercontinent occurred through the formation of various Pan-African orogenic belts that encircle the Kalahari Craton, and that mark the position of former ocean basins (Fig. 1). These orogenic belts are typically characterised by relatively high-*T*–low/medium-*P* (high apparent geotherm) metamorphic conditions (Masberg et al., 1992; Grantham et al., 1995; Groenewald et al., 1995; Goscombe et al., 2003; Goscombe et al., 2004; Engvik and Elvevold, 2004; Board et al., 2005; Ward et al., 2008), and do not readily preserve evidence of the low-*T*–high-*P* conditions and low apparent geothermal gradients that are characteristic of convergence and subduction (e.g. Ernst, 1971; Ernst, 1973). The dearth of a preserved accretionary metamorphic signal in most southern African Pan-African belts has contributed to reconstructions of the tectonic history during the assembly of this part of Gondwana still being rather speculative (e.g. de Wit et al., 2008; Gaucher et al., 2009; Frimmel et al., 2011). Such an absence could be due to it having been pervasively overprinted by subsequent collision (England and Thompson, 1984), or because the ocean basins were confined and convergence was not long-lived enough for subduction to reach high-*P* conditions, or simply that the relevant high-*P* lithologies were covered during the post-Gondwanan opening of the Atlantic Ocean, or never exhumed in the first place.

Along the west coast of southern Africa, the southward-younging Kaoko, Gariep and Saldania Belts formed during the progressive closure of the Adamastor Ocean (Fig. 1; Frimmel and Frank, 1998; Goscombe and Gray, 2007; Gray et al., 2008). Convergence and collision in all three belts was highly oblique (Gresse, 1994; Belcher and Kisters, 2003; Goscombe et al., 2003; Gray et al., 2008; Rowe et al., 2010), but the location of sutures and the polarity of subduction has not been unequivocally established because accretionary metamorphic assemblages are notably

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