

# Ultramafic Rocks in High-Strain Zones of the Southern Mawson Escarpment, Prince Charles Mountains (East Antarctica): Evidence for Major Crustal Shear Zones of the Palaeoarchaean Age?

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**Abstract** - In the southern Mawson Escarpment, southern Prince Charles Mountains (Antarctica), lenses and blocks of compositionally highly diverse ultramafic and relatively rare mafic rocks are mostly confined to generally east–west trending high-strain shear zones. These rocks consist of amphibole (actinolite, tremolite, anthophyllite or, rarely hornblende), sporadically orthopyroxene, olivine and rarely clinopyroxene. Secondary talc, serpentine, epidote, phlogopite, carbonate, chlorite, and titanite are developed sporadically. Less sheared rocks include amphibole orthopyroxenite and amphibole dunite. The geochemical features of the ultramafic rocks point to a strong influence of accumulation processes. Sm–Nd whole rock and mineral separate data point to an origin from a highly heterogeneous Archaean mantle which comprises at least a highly depleted and an enriched component. The latter may represent a metasomatically reworked depleted reservoir. The LILE enrichment probably occurred already in the early Archaean. U–Pb zircon SHRIMP dating of zircon from a syn-tectonic leucocratic quartz-feldspar vein associated with the ultramafics in a high-strain shear zone yields ages of  $2539 \pm 61$  Ma (lower intercept) and  $3333 \pm 60$  Ma (upper intercept). The ca. 3.3 Ga date is interpreted as a close estimate of the age of syn-tectonic vein formation and thus also the formation of the high-strain shear zone while the ca. 2.5 Ga date probably reflects a (tectono-)thermal overprint. The occurrence of lenses and blocks of ultramafic and subordinate mafic rocks of highly variable lithological, geochemical and Sm–Nd isotope composition in high-strain shear zones of the southern Mawson Escarpment is interpreted as a tectonic melange indicative of major deep-reaching crustal shear processes in Palaeoarchaean times.

## INTRODUCTION

Mafic and ultramafic rocks are geologically significant constituents in the southern Prince Charles Mountains (sPCM; Fig. 1 a, b). Previous workers (*c.f.*, Mikhalsky et al., 2001 and references therein) mainly investigated mafic to ultramafic rocks found as dykes in the southern part of the sPCM (southern Mawson Escarpment, Mts. Rymill, Stinear and Ruker). Blocks and lenses of ultramafic rocks as reported from the Mawson Escarpment, Mts Ruker and McCauley and Lawrence Hills in the southern PCM and also from the Radok Lake area and the Nilsson Rocks in the northern Prince Charles Mountains (Fig. 1; Mikhalsky et al., 2001 and references therein; Corvino & Henjes-Kunst, 2007; Mikhalsky et al. 2007) have not been studied in detail. Both types of occurrences of ultramafic to mafic rocks are especially abundant in the southern Mawson Escarpment which constitutes the eastern part of the sPCM (Fig. 1 b). The sPCM are mainly built up by the Archaean to Neoproterozoic Ruker Province (Phillips et al., 2006), termed Ruker Terrane by other authors (Tingey, 1991, Kamenev, 1993, Mikhalsky et al., 2006a) (Fig. 1). In this area, prominent magmatic and tectonothermal events were dated at ca. 3370–3390 Ma, 3180–3160 Ma

and ca. 2790–2770 Ma (Boger et al., 2006, Mikhalsky et al., 2006b). So far, a ca. 2650 Ma age for a post-tectonic pegmatite puts the lower age limit for tectonic activities in the southern Mawson Escarpment (Boger et al., 2006).

The southern Mawson Escarpment is mostly built up by medium-grade metamorphic rocks: hornblende–biotite orthogneisses, granite-gneisses and plagiogneisses (the Mawson Orthogneiss) and metasedimentary rocks (pelitic and calcareous metasediments and quartzites etc. of the Menzies Series) with a few relics of granulite facies assemblages. The central and northern Mawson Escarpment was distinguished as a separate Palaeoproterozoic Lambert Terrane by Mikhalsky et al. (2006a). A prominent crustal formation episode in this terrane was dated at ca. 2.5 – 2.4 Ga (Mikhalsky et al. 2006a; Corvino & Henjes-Kunst 2007 and references therein).

In this paper we present geological, geochemical and isotopic data on ultramafic and spatially associated mafic rocks occurring as blocks and lenses mainly within high-strain shear zones in the southern Mawson Escarpment. Sampling was carried out during the Prince Charles Mountains Expedition of Germany and Australia (PCMEGA) in 2002/2003. The aim of this study is to reveal the compositional features of the