

A Record of 2.5 and 1.1 Billion Year Old Crust in the Lawrence Hills, Antarctic Southern Prince Charles Mountains

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Received 7 December 2006; accepted in revised form 31 May 2007

Abstract - We report single zircon U-Pb and whole-rock Sm-Nd ages, along with geochemical data, for various leucocratic gneiss, amphibolite and quartzite samples collected from the Lawrence Hills in the Southern Prince Charles Mountains of Antarctica. Our data reveal the existence of two distinct crustal components that were generated at around 2.5 and 1.1 billions of years ago. Early Palaeoproterozoic leucocratic gneiss is dated at 2475 Ma (U-Pb zircon) and occurs interlayered with gneisses that have Sm-Nd crustal residence ages of 2.9-2.4 Ga. These data suggest the addition of new crustal materials near the Archaean-Proterozoic transition or partial recycling of a slightly older 2.9-2.8 Ga component. The c. 2.5 Ga ages are similar to those for orthogneiss in the adjoining North Mawson Escarpment. They also reflect a major tectonic episode that affected both the Vestfold Hills and Napier Complex, but are not yet widely documented in the greater Prince Charles Mountains (except in the detrital zircon record). The Early Palaeoproterozoic crustal component is juxtaposed to the north by a sequence of gneisses that have bimodal volcanic compositions and, based on their Nd systematics, were formed no earlier than the Mesoproterozoic. Zircons from a leucocratic version of these gneisses give a grouped U-Pb age of c. 1080 Ma that represents crystallisation of the igneous precursor and corresponds with a pulse of Grenville-age magmatism that is evident throughout the central belt of the Prince Charles Mountains. We suggest that reworked fragments of a Late Mesoproterozoic magmatic suite are responsible for the prominent and dispersed high magnetic anomalies in the vicinity of the Lawrence Hills rather than Archaean or Palaeoproterozoic crust.

INTRODUCTION

The Lawrence Hills, or 'Dalton Hills' (informal name), form a minor group of little studied rock exposures located near the northernmost end of the Mawson Escarpment at latitude 72°30' S and longitude 68°43' E in the Southern Prince Charles Mountains (PCM; Figs. 1 & 2). Reconnaissance fieldwork in these hills was first undertaken by Australian workers during the 1972-73 austral summer Australian National Antarctic Research Expeditions (ANARE) and the results were reported by Tingey et al. (1981). Additional short visits were made by German and Russian workers during the 2002-03 Prince Charles Mountains Expedition of Germany and Australia (PCMEGA).

According to Tingey et al. (1981) the Lawrence Hills are composed of pink coloured, strongly foliated leucocratic gneiss and subordinate mafic horizons. Two generations of leucocratic pegmatite intrusions have been reported; an early set consisting of conformable lenses and isoclinally folded material, and a younger set of irregular veins that cut across the main foliation. The leucocratic gneiss records an Early Neoproterozoic whole-rock Rb-Sr age of 941

±94 Ma, along with a low initial ⁸⁷Sr/⁸⁶Sr ratio of 0.7038 and Sr model age (T_U) of 963 Ma (Tingey, 1991). Zircons from a pegmatite vein have yielded a U-Pb date of 495 ±18 Ma which is interpreted as the intrusion age (Mikhalsky et al., 2006b). There is little other available information for the Lawrence Hills, although the prospect that they record evidence of both c. 1000 Ma ('Grenvillian') and c. 500 Ma ('Pan-African') events is important.

Fitzsimons (2000) identified three Grenville-age provinces in the East Antarctic Shield, each thought to reflect separate collisional belts, and proposed that they were most likely amalgamated during Pan-African orogenesis. This view opposed earlier models of a continuous Grenville-age Circum East Antarctic Orogen (e.g. Unrug, 1992, 1997; Yoshida, 1995), with the implication that East Antarctica was not a continental-scale landmass until Gondwana assembly at c. 500 Ma. At least two Grenville-age provinces occur in the PCM, known as the Beaver and Fisher Belts (Kamenev et al. 1993; see below), and these are compatible in age with the 990-900 Ma (Rayner) and 1330-1030 Ma (Wilkes & Maud) provinces of Fitzsimons (2000). Sparse Rb-Sr and U-Pb age data for some isolated nunataks in the