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The 1800–1100 Ma tectonic evolution of Australia

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Abstract

This paper presents a plate tectonic model for the evolution of the Australian continent between ca. 1800 and 1100 Ma. Between ca. 1800 and 1600 Ma episodic orogenesis occurred along the southern margin of the continent above a north-dipping subduction system. During this interval multiple orogenic events occurred. The West Australian Craton collided with the North Australian Craton (ca. 1790–1770 Ma), the Archaean nucleus of the Gawler Craton amalgamated with the North Australian Craton (ca. 1740–1690 Ma), and numerous smaller terranes accreted along the western Gawler Craton and the southern Arunta Inlier (ca. 1690–1640 Ma). The pattern of accretion suggests southward migration of the plate margin, which occurred due to a combination of slab rollback and back stepping of a subduction system behind the accreted continental blocks. Coeval with subduction a series of continental back-arc basins formed in the interior of the North Australian Craton and parts of the South Australian Craton, which were attached to the North Australian Craton prior to 1500 Ma. Extension of the North Australian Craton led to the opening of an oceanic basin along the eastern margin of the continent at ca. 1660 Ma. Continuing divergence was accommodated by oceanic spreading whereas the continental basins thermally subsided resulting in the development of sag-phase basins throughout the North Australian Craton. This oceanic basin was subsequently consumed during convergence, which ultimately led to development of a ca. 1600–1500 Ma orogenic belt along the eastern margin of Proterozoic Australia. Between ca. 1470 and 1100 Ma, the South Australian Craton, consisting of the Curnamona Province and the Gawler Craton rifted from the North Australian Craton and was re-attached in its present configuration during episodic ca. 1330–1100 Ma orogenesis, which is preserved in the Albany-Fraser Belt and the Musgrave Block.

Keywords: Australia; Proterozoic; Tectonics; Back-arc; Subduction; Accretion; Collision; Reconstruction

1. Introduction

Tectonic interpretations in Precambrian terranes are fraught with uncertainty due to the relative scarcity of exposure, data density and the tendency for primary geological information to be obscured during later tectonism. Nevertheless, the volume of data in a number of Australian Precambrian provinces has grown considerably and there is a growing body of evidence to support the operation of plate margin processes in many of these provinces. For example, arc-related magmatism has been documented in the Arunta Inlier, Georgetown Inlier, and along the western edge of the Gawler Craton (Champion, 1991; Zhao, 1994; Zhao and McCulloch, 1995; Teasdale, 1997; Ferris et al., 2002), and medium- to high-pressure metamorphic belts occur in the Rudall Complex (Smithies and Bagas, 1997; Bagas, 2004), Arunta Inlier (Norman and Clarke, 1990) and Musgrave Block (Clarke et al., 1995). This has prompted a number of recent models for the evolution of Proterozoic Australia that involve processes analogous to modern plate tectonics (e.g., Myers et al., 1996; Krapez, 1999; Scott et al., 2000; Dawson et al., 2002; Giles et al., 2002, 2004).

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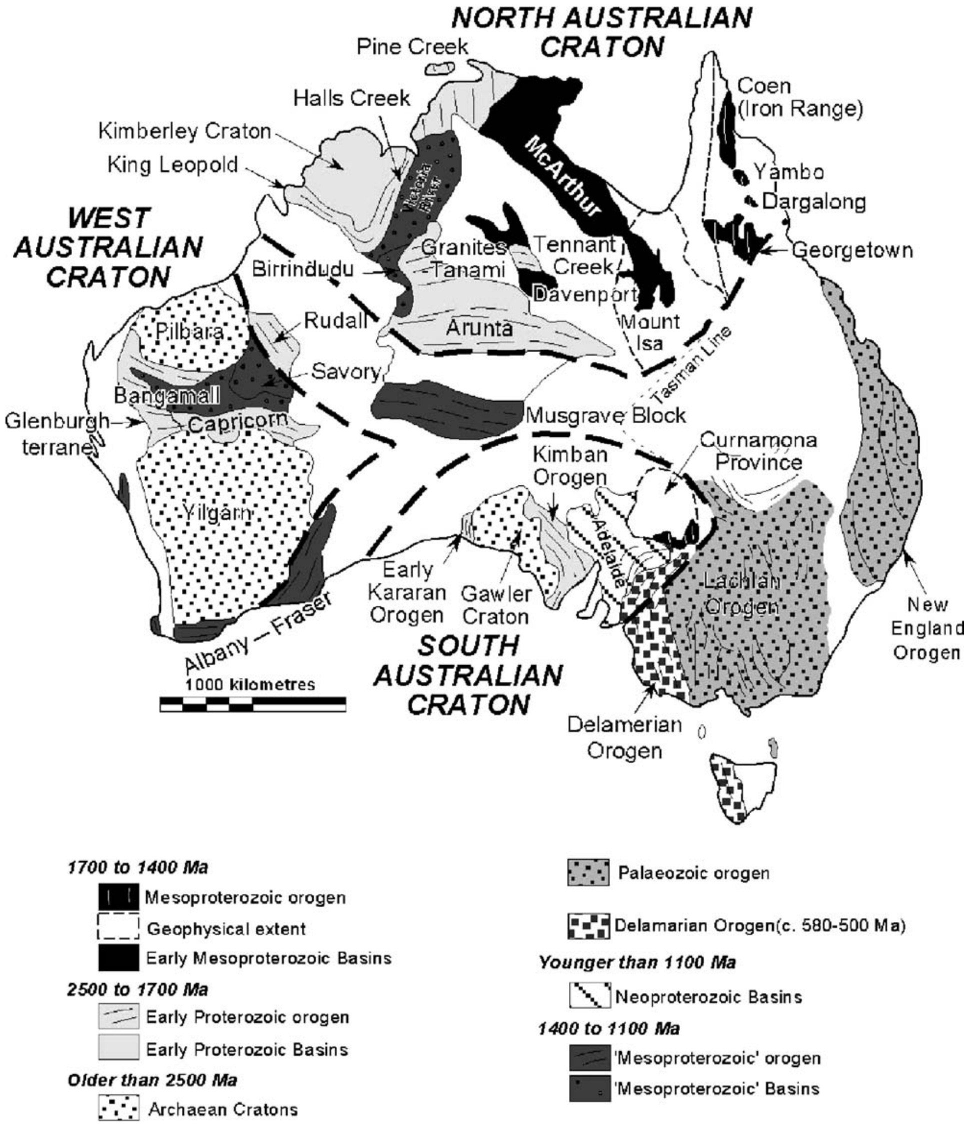

Fig. 1. Tectonic element map of the Australian continent showing the age of major terranes within the North Australian Craton, South Australian Craton, and West Australian Craton. Map adapted after Myers et al. (1996) and Foster and Gray (2000).

Myers et al. (1996) suggested that the North Australian Craton, the South Australian Craton, and the West Australian Craton (Fig. 1a) evolved independently before their amalgamation during ca. 1330–1100 Ma orogenesis. Krapez (1999) and Dawson et al. (2002) proposed a plate tectonic model involving indentor tectonics, in which the current architecture of major lithospheric structures has remained essentially the same since the Middle Palaeoproterozoic (Fig. 2b). Scott et al. (2000) and Giles et al. (2002) suggested that plate margin processes might in part control basin evolution in the interior of the continent. In contrast to Myers et al. (1996), a number of researchers have pointed out that the terranes and cratons that make up the Australian continent may have interacted prior to ca. 1330 Ma orogenesis (Laing, 1996; Li, 2000; Raetz et al., 2002; Wingate and Evans, 2003; Giles et al., 2004). For example, the Curnamona Province (Fig. 1), which is interpreted to be part of the South Australian Craton, has sedimentological, geochronological and structural data that suggests it was connected to the North Australian Craton during the late Palaeo- to early Mesoproterozoic (Laing, 1996; Giles et al., 2004). Palaeomagnetic data also suggests that large oceans did not separate the South Australian