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Ophiolites and Intra-Oceanic Island Arc Assemblages of Eastern Australia, New Caledonia and New Zealand

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1 Abstract

Throughout the Phanerozoic the eastern margin of Gondwana and related fragments such as New Caledonia and New Zealand that are now dispersed from it grew through the addition of ophiolites and associated intra-oceanic island arc assemblages. Exactly how and why this occurred remains controversial with two main competing models referred to as either ‘quantum’ or ‘accordion’ tectonics. The quantum model envisages continental growth through the additional of discrete intra-oceanic assemblages analogous to contemporary tectonic settings in Taiwan, Timor and Papua New Guinea (Aitchison and Buckman, 2012). The alternative regards eastern Australia as the type example of a different style of convergent plate margin referred to as an ‘extensional accretionary orogeny’ (Collins, 2002).

The oldest Phanerozoic ophiolites and intra-oceanic island arc assemblages are of Cambrian age and are widely reported from the Lachlan Fold Belt in the eastern Australian states of Victoria and NSW (Spaggiari et al., 2003; Greenfield et al., 2011). Similar rocks are also known from Mount Read in Tasmania (Berry and Crawford, 1988; Crawford and Berry, 1992; Mulder et al., 2016), the Weraerai terrane and its correlatives in the New England orogen further east in northeastern NSW (Aitchison et al., 1994; Aitchison and Ireland, 1995) and Queensland, the Takaka terrane in NW Nelson, New Zealand (Münker and Cooper, 1999) and the Bowers terrane in Northern Victoria Land, Antarctica (Weaver et al., 1984; Münker and Crawford, 2000; Rocchi et al., 2011; Palmeri et al., 2012).

The Late Ordovician saw the development of the intra-oceanic Macquarie island arc (Glen et al., 1998; Glen et al., 2007). This system contains important economic mineral deposits. The way in which these arc

rocks developed and were juxtaposed against a surrounding suite of Lachlan Fold Belt, eastern Australia remains the subject of investigation (see Aitchison and Buckman, 2012 for discussion). In a similar area, enigmatic rocks of the Tumut ophiolite also crop out (Graham et al., 1996; Belousova et al., 2015).

Further to the east in the New England orogeny Siluro-Devonian rocks of the Gamilaroi terrane and its along-strike correlatives near Mt Morgan in Queensland represent another intra-oceanic island arc assemblage emplaced onto the Gondwana margin in the Late Devonian (Aitchison and Flood, 1994; Offler and Murray, 2011).

The Late Carboniferous-Permian saw development of significant intra-oceanic island arc and ophiolitic complexes remnants of which crop out in New Zealand, eastern Australia, and New Caledonia. These include the Brook Street terrane (Spandler et al., 2005; McCoy-West et al., 2014) and Dun Mountain Ophiolite Belt in New Zealand (Coombs et al., 1976; Stewart et al., 2016), the Gympie terrane in southeast Queensland (Waterhouse and Sivell, 1987; Sivell and Waterhouse, 1988) and the Koh terrane in New Caledonia (Meffre et al., 1996; Ali and Aitchison, 2002).

The youngest on-land association of ophiolitic and intra-oceanic island arc rocks in the region is of Eocene age. Ultramafic rocks are well exposed in New Caledonia where they structurally overlie continental rocks of Gondwana margin affinity that, in the northeast of the island, have experienced eclogite facies metamorphism (Aitchison et al., 1995). The emplacement of these rocks was a widespread regional event with potentially correlative rocks exposed in Papua New Guinea (Parrot and Dugas, 1980) as well as Northland and East Cape in New Zealand (Whattam et al., 2005; Whattam et al., 2008).

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