Journal of Asian Earth Sciences 66 (2013) 1–33

Contents lists available at SciVerse ScienceDirect

Journal of Asian Earth Sciences

journal homepage: www.elsevier.com/locate/jseaes

Review

Gondwana dispersion and Asian accretion: Tectonic and palaeogeographic evolution of eastern Tethys

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ARTICLE INFO

Article history:
Received 8 September 2012
Received in revised form 12 December 2012
Accepted 13 December 2012
Available online 2 January 2013

Keywords:
Gondwana
Asia
Terranes
Suture zones
Tethys
Tectonics
Palaeogeography

ABSTRACT

Present-day Asia comprises a heterogeneous collage of continental blocks, derived from the Indian–west Australian margin of eastern Gondwana, and subduction related volcanic arcs assembled by the closure of multiple Tethyan and back-arc ocean basins now represented by suture zones containing ophiolites, accretionary complexes and remnants of ocean island arcs. The Phanerozoic evolution of the region is the result of more than 400 million years of continental dispersion from Gondwana and plate tectonic convergence, collision and accretion. This involved successive dispersion of continental blocks, the northwards translation of these, and their amalgamation and accretion to form present-day Asia. Separation and northwards migration of the various continental terranes/blocks from Gondwana occurred in three phases linked with the successive opening and closure of three intervening Tethyan oceans, the Palaeo-Tethys (Devonian–Triassic), Meso-Tethys (late Early Permian–Late Cretaceous) and Ceno-Tethys (Late Triassic–Late Cretaceous). The first group of continental blocks dispersed from Gondwana in the Devonian, opening the Palaeo-Tethys behind them, and included the North China, Tarim, South China and Indochina blocks (including West Sumatra and West Burma). Remnants of the main Palaeo-Tethys ocean are now preserved within the Longmu Co-Shuanghu, Changning–Menglian, Chiang Mai/Inthanon and Bentong–Raub Suture Zones. During northwards subduction of the Palaeo-Tethys, the Sukhothai Arc was constructed on the margin of South China–Indochina and separated from those terranes by a short-lived back-arc basin now represented by the Jinghong, Nan–Uttaradit and Sra Kaeo Sutures. Concurrently, a second continental sliver or collage of blocks (Cimmerian continent) rifted and separated from northern Gondwana and the Meso-Tethys opened in the late Early Permian between these separating blocks and Gondwana. The eastern Cimmerian continent, including the South Qiangtang block and Sibumasu Terrane (including the Baoshan and Tengchong blocks of Yunnan) collided with the Sukhothai Arc and South China/Indochina in the Triassic, closing the Palaeo-Tethys. A third collage of continental blocks, including the Lhasa block, South West Borneo and East Java–West Sulawesi (now identified as the missing "Banda" and "Argoland" blocks) separated from NW Australia in the Late Triassic–Late Jurassic by opening of the Ceno-Tethys and accreted to SE Sundaland by subduction of the Meso-Tethys in the Cretaceous.

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http://dx.doi.org/10.1016/j.jseaes.2012.12.020

1. Introduction

Present day East and Southeast Asia is located at the zone of convergence between the Asian, India–Australia, and Philippine Sea-Pacific Plates (Fig. 1) and is the result of more than 400 million years of continental dispersion from Gondwana and plate tectonic convergence, collision and accretion. Long-term subduction and related tectonic processes have produced multiple volcanic arcs, island arc chains and marginal basins in the region. Most of the various continental pieces that now make up Asia were derived from the southern hemisphere supercontinent Gondwana (Metcalfe, 1988) and travelled north to progressively collide and coalesce prior to the current ongoing collision with the northwards moving Australian continent (Metcalfe, 1990, 1996a,b, 2011a,b). Several hundred millions of years of convergence in the Asian region, including long-term subduction–accretion, arc-continent collisions, and continent–continent collisions have resulted in multiple orogenic and mountain building events, major plutonism (e.g. tin-bearing granite belt of Southeast Asia), uplift and basin development. During the separation of the various continental terranes from Gondwana, their northwards migration and collision, three intervening Tethyan oceans, the Palaeo-Tethys (Devonian–Triassic), Meso-Tethys (late Early Permian–Late Cretaceous) and Ceno-Tethys (Late Triassic–Late Cretaceous), were opened and subsequently destroyed (Metcalfe, 1994, 1996a,b, 1998). Remnants of these ancient oceans are preserved in the various narrow suture zones and fold-thrust belts bounding the continental blocks, including ophiolitic rocks, volcanic arcs, and accretionary complexes with melange and deep sea sediments often forming discrete packages or disrupted elements of Ocean Plate Stratigraphy (OPS), see Wakita and Metcalfe (2005). The continental collisions that ultimately led to the formation of Asia began in the Palaeozoic and continue at the present day. In the Southeast Asian region continental collisions and accretion occurred in two distinct phases, one in the Late Paleozoic–Early Mesozoic and one in the Late Mesozoic and Cenozoic. The earlier phase brought together pieces