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Late Jurassic–Cenozoic reconstructions of the Indonesian region and the Indian Ocean

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ABSTRACT

The heterogeneous Sundaland region was assembled by closure of Tethyan oceans and addition of continental fragments. Its Mesozoic and Cenozoic history is illustrated by a new plate tectonic reconstruction. A continental block (Luconia–Dangerous Grounds) rifted from east Asia was added to eastern Sundaland north of Borneo in the Cretaceous. Continental blocks that originated in western Australia from the Late Jurassic are now in Borneo, Java and Sulawesi. West Burma was not rifted from western Australia in the Jurassic. The Banda (SW Borneo) and Argo (East Java–West Sulawesi) blocks separated from western Australia and collided with the SE Asian margin between 110 and 90 Ma, and at 90 Ma the Woyla intra-oceanic arc collided with the Sumatra margin. Subduction beneath Sundaland terminated at this time. A marked change in deep mantle structure at about 110°E reflects different subduction histories north of India and Australia since 90 Ma. India and Australia were separated by a transform boundary that was leaky from 90 to 75 Ma and slightly convergent from 75 to 55 Ma. From 80 Ma, India moved rapidly north with north-directed subduction within Tethys and at the Asian margin. It collided with an intra-oceanic arc at about 55 Ma, west of Sumatra, and continued north to collide with Asia in the Eocene. Between 90 and 45 Ma Australia remained close to Antarctica and there was no significant subduction beneath Sumatra and Java. During this interval Sundaland was largely surrounded by inactive margins with some strike-slip deformation and extension, except for subduction beneath Sumba–West Sulawesi between 63 and 50 Ma. At 45 Ma Australia began to move north; subduction resumed beneath Indonesia and has continued to the present. There was never an active or recently active ridge subducted in the Late Cretaceous or Cenozoic beneath Sumatra and Java. The slab subducted between Sumatra and east Indonesia in the Cenozoic was Cretaceous or older, except at the very western end of the Sunda Arc where Cenozoic lithosphere has been subducted in the last 20 million years. Cenozoic deformation of the region was influenced by the deep structure of Australian fragments added to the Sundaland core, the shape of the Australian margin formed during Jurassic rifting, and the age of now-subducted ocean lithosphere within the Australian margin.

Contents

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1. Introduction

This paper updates and extends previous attempts (Hall, 1996, 2002) at reconstructing the SE Asian and West Pacific regions (Fig. 1). The principal features of these Cenozoic models have since been tested using information not used in constructing them (e.g. Hall and Spakman, 2002; Miller et al., 2006; Richards et al., 2007). The Cenozoic model has been slightly modified but the major changes are the reconstruction of the growth of SE Asia during the Cretaceous which mainly involved modelling the rifting of fragments from the Australian margins, interpreting a spreading history for the Ceno-Tethys, and tracing the subduction history of this oceanic crust

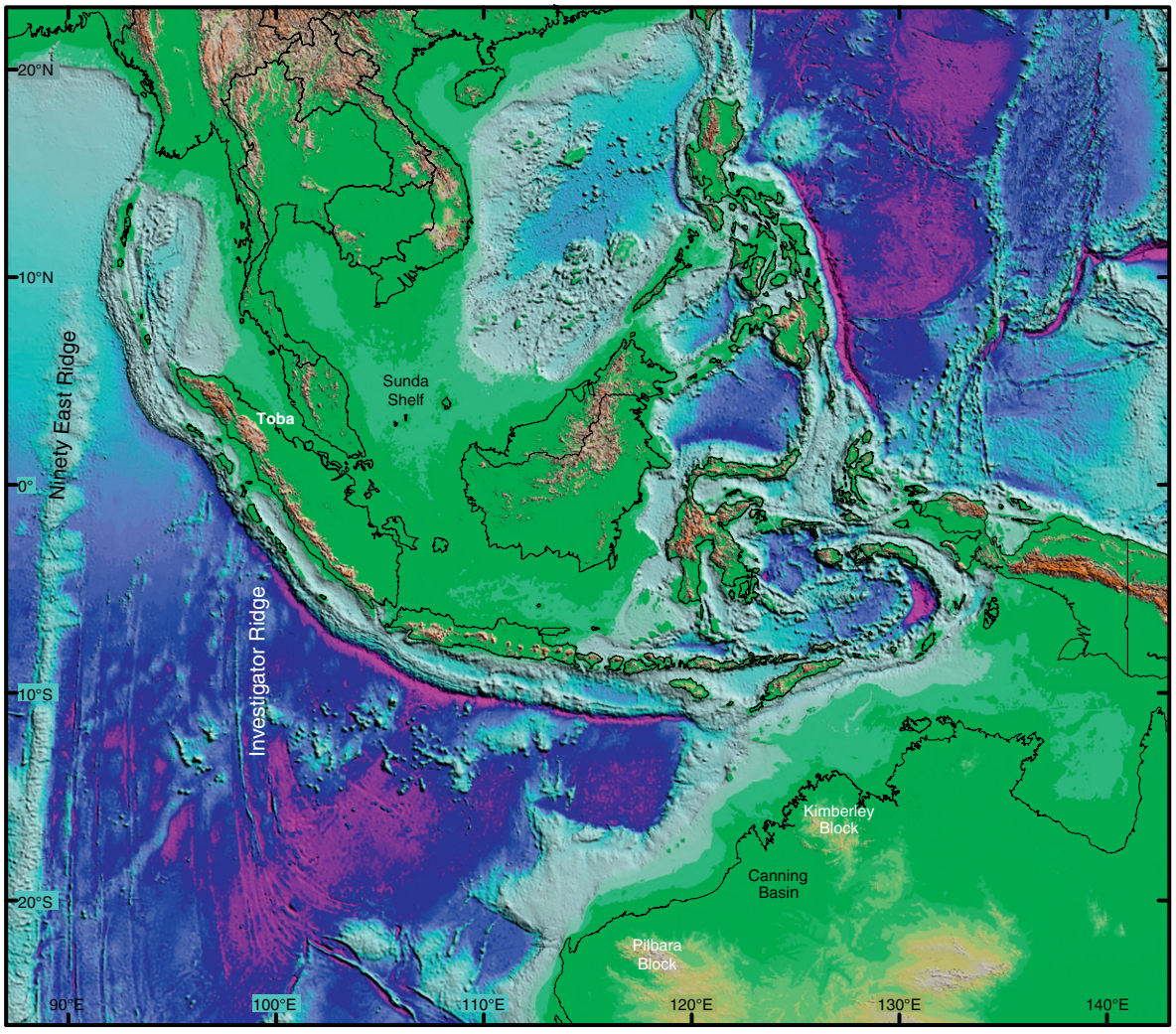

Fig. 1. DEM of the region including SE Asia, the Western Pacific, eastern Indian Ocean and Australia from satellite gravity-derived bathymetry combined with SRTM topography (Sandwell and Smith, 2009). The main geographical and tectonic features of the region are identified on Figs. 2, 3 and 4.