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Subduction dynamics, tectonics, and dynamic topography in the Banda-Java subduction zone

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At the far end of the Tethyan realm, the Indo-Australian plate subducts in the Java and Banda trenches. Across the trench, a checkerboard-like distribution of continental and oceanic units sets the geodynamic stage since the Australian continent docked into the subduction zone a few Myr ago: to the East, the Australian continent now subducts and collides with the mostly oceanic Wallacea while to the West, the Indian oceanic plate subducts underneath continental Sundaland. We hypothesize that this fast and transient geodynamic regime explains many observations that characterize the region over the last few Myr: slab rollback and formation of the Banda arc, subsidence of the Weber superdeep seafloor to more than 7000 m, back-arc thrusting in Flores, dynamic subsidence in Sundaland and Sahul, and controversial slab tearing underneath Timor. We set out to model subduction dynamics accounting for the complex assemblage of plates in a real-Earth perspective, using the fast thermo-mechanical code LaMEM that allows dealing with complex setups. Our results predict the winding of the subduction zone around Papua, ultimately retreating into the Banda embayment, thereby causing the extreme dynamic subsidence of the Banda seafloor. Geometrical consistency imposes coeval slab tearing underneath Timor while the slab rolls back. The formation of the Flores backthrust quickly follows Australian collision with Wallacea and propagates westward in continental Sundaland. Shortening rates quickly drop tenfold while entering Sundaland, in Java, in agreement with kinematic and structural observations. In the geologically near future, the back-arc thrust is predicted to reverse the subduction polarity, Wallacea being on the brink to subduct southward underneath Australia. Last, transient mantle flow expectedly causes dynamic subsidence in Sahul and Sundaland, thereby profoundly remodeling the physiography of the entire region.