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Connecting oceanic palaeo-age grids with Sunda trench kinematics, slab window formation and overriding plate deformation since the Cretaceous

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The 26 December 2004 tsunami was caused by a large earthquake which occurred on the Sumatra fore-arc, NW of Nias. This event, and a history of large magnitude earthquakes adjacent Sumatra, inspired a study of factors that affect strain on the over-riding Sundaland margin. Today, the subduction of the Wharton Ridge appears to impose large shear tractions on the Sumatran fore-arc. In addition, the tectonic history of the Sundaland margin has been affected by changes in the rate and direction of plate motion, age of the subducting slab, slab dip angle, and slab window formation. Along the northern Tethys margin the time-dependence of these parameters is difficult to constrain as the majority of Tethys ocean crust is now subducted. We present a tectonic framework for the evolution of the Sundaland margin since the Late Cretaceous based on reconstructed oceanic palaeo-age grids.We establish the age-area distribution and geometry of subducted ocean crust based on preserved ocean crust west and northwest of Australia, geological data, and the rules of plate tectonics. Palaeo-age grids, including the location of the subducting Wharton spreading ridge, combined with time-dependent plate motion vectors enabled a novel approach to the reconstruction of slab window geometry through time.We have also computed palaeo slab age and dip, as well as relative and absolute plate vectors along this active margin to provide improved boundary conditions for understanding the geological record of tectonic deformation of the overriding margin. Our absolute plate motions are based on a recent model of African/Indian absolute plate motions in a moving hotspot reference frame. By combining plate kinematics with time-dependent slab properties we establish a relationship with periods of tectonic deformation on the overriding plate. Periods of compression correlate with trench-normal velocity components of both the over-riding

core and margin showing that motion was directed towards the trench. Subduction of major bathymetric features such as the Wharton Ridge enhance strain rates in an already compressional regime. Extension in the over-riding plate is also influenced by trench-normal plate velocities, with motion in both the core and the margin directed away from the trench or faster trenchward motion of the margin compared with the core. Extension appears to be enhanced by the presence of an underlying slab window until ca. 35 Ma. Sdrolias and Müller (2006) found back-arc rifting occurred when trench-normal velocities of the over-riding plate were directed away from the trench, and slab age $>$55 million years and intermediate slab dip $>30^{\circ}$. Our reconstructions show that periods of observed rifting at the Sunda-Java trench to 80 Ma only occur when these conditions are met.