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 earthquake and tsunami that occurred 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. Palaeo-age grids 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 Java and Sumatra sections of the overriding margin. Periods of compression correlate with trench-normal velocity components of both the over-riding core and margin directed towards the trench.

Subduction of major bathymetric features such as the Wharton Ridge and Roo Rise enhance strain rates in an already compressional regime. Extension in the over-riding plate is also influenced by trench-normal plate velocities, occurring when motion in both the core and the margin is directed away from the trench, or when there is 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. The observed relationships between upper plate stress regime and tectonic factors such as plate motion, and subduction geometry will enable better differentiation between basin formation due to subsidence without lithospheric thinning or due to rifting e.g. Sunda Basin and Java Sea basins. Reconstructed slab window locations may aid in understanding magmatic and volcanic episodes that influence thermal maturation of hydrocarbons in Sumatran and Javanese basins.