Complex structural evolution at the heel of SE Asia: The interplay between plate tectonics, structure, paleogeography and basin evolution between Sumatra and Myanmar

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SE Asia is the most geologically complex region on Earth due to the three-way convergence of the Indo-Australian, Eurasian and Pacific plates. Unravelling its tectonic and structural history via high resolution plate tectonic modeling is the best way to start to understand this complexity and explore basins predictively. By integrating geological information from outcrop and basins with regional structural framework interpretation and paleogeography, the model can be further calibrated and refined.

The Geognostics Earth Model (GEM) is a high resolution 4D view of global geology constructed from the bottom-up by interpreting basement terranes and major structures, then spatially reconstructing them back in time by undoing deformation patterns and basin evolution. GEM is particularly detailed in SE Asia; the result of years of collaboration with our clients exploring the region. The model includes a high-resolution analysis of major plate movement (including the Pacific), as well as more than 200 separately moving microplates. Key features of the model include:

- Progressive rotational extrusion of Sundaland, then Indochina, driven by the collision of Greater India, opening the main petroleum basins in the Gulf of Thailand and South China Sea in the Late Eocene – Early Miocene.
- Kinematically complex, Eocene-Miocene back-arc extension, transtension, then transpression along the southern (Sunda) margin of SE Asia, driven by the combined effects of Indian Ocean plate dynamics and rotational extrusion.
- A shift in Pacific plate dynamics in the Mid Miocene triggered a major regional readjustment in SE Asia, with East to West convergence causing widespread terrane collision in Eastern Indonesia, the Phillipines and Sabah, as well as basin inversion throughout the region.
- Consistency with regional biostratigraphic zones, including paleo-latitude and connections between continental blocks at different times (e.g. Indian fish in Myanmar).

The North Sumatra and Andaman Sea basins lie offshore between Sumatra and Myanmar at the 'heel' of SE Asia. This is an historically poorly understood region, despite exploration having commenced in the late 19th century and having produced in excess of 5.5Bboe. Our work shows an intriguing relationship between regional tectonics, paleogeography, structure and basin evolution. We identify at least nine regional basin phases from Early Eocene to Recent which illustrate this relationship:

Basin Phase 1 (48-40Ma):	Deformation + metamorphism of economic basement during early collision of India
Basin Phase 2 (40-37.5Ma):	Uplift + exhumation of basement, possible intramontane or early rift basins
Basin Phase 3 (37.5-31Ma):	Main syn-rift phase (key basin-forming event), with complex dextral strike-slip component

Basin Phase 4 (31-29Ma):	Basin inversion due to onset of rapid rotational extrusion of [Indochina + Sundaland]
Basin Phase 5 (29-26Ma):	Tectonic quiescence, onset of rapid thermal sag, ongoing rotation
Basin Phase 6 (26-23Ma):	Dextral transpression drives main basin inversion phase due to ongoing rotation
Basin Phase 7 (23-21Ma):	Dextral transtension due to onset of opening of Andaman Sea as West Burma couples with India, thermal sag
Basin Phase 8 (21-17Ma):	Tectonic quiescence, thermal sag
Basin Phase 9 (17-12Ma):	Tectonic quiescence, thermal sag, carbonate buildups
Basin Phase 10 (12-5.5Ma):	Dextral transtension, thermal sag
Basin Phase 9 (5.5-0Ma):	Barisan Orogeny, foreland fold-thrust belt to south, thermal sag + loading

We will show a high-resolution plate tectonic animation that illustrates the tectonic context for each basin phase and discuss basin-scale structural evolution through time using seismic examples.