A Globally Consistent Cenozoic Plate Tectonic Model for Southeast Asia: Insights From Regional Tectonostratigraphy and Implications for Future Exploration

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ABSTRACT

Almost four decades after Warren B. Hamilton's 1979 synthesis on "Tectonics of the Indonesian Region", a plethora of competing ideas and models have been published for the Cenozoic evolution of the Indo-Pacific region. However, drilling campaigns during the past ten years have proven there is still much to learn in terms of regional understanding. Substantial complexity in the number, timing, and inter-relationship between various regional tectonic events contributes significantly to the challenges of de-risking frontier plays. A long-term project was undertaken to evaluate the existing published regional tectonic models and test them against the available public-domain stratigraphic, geochronological, and geophysical data. This provided the basis for, and underpins, a revised plate model that honors both the global-scale plate circuit constraints alongside the higher-resolution detail of the observed regional and local tectonic events. The timing and context of these regional events are the most important factors when assessing the creation, evolution, and potential destruction of hydrocarbon play types in the prospective basins of the region. Examination of data examples from multiple locations around the South China Sea margins allow resolution of the most likely timing for events such as rift to drift transition, spreading ridge jump, cessation of spreading, and later collisions. By taking a broader view of relative plate motions, it is possible to assess which of the driving mechanisms of either escape tectonics, slab pull, or slab roll-back was most important during this region's evolution. In eastern Indonesia, key events include the collision of the Australian continental promontory with the Eurasian margin and the interaction of exotic terranes with northern New Guinea. By reconciling data examples from basins around Sulawesi, the Banda Arc, and West Papua, a consistent plate model can be constructed. This is used to gain insight into the effect of Cenozoic tectonism on the prospectivity of local Mesozoic and Cenozoic petroleum systems. Plate models are powerful tools to aid prediction of play prospectivity in areas with little data. With greater resolution now built into a consistent model, future assessment of burial history, maturation of source rocks, timing of trap formation, and the relationship between the hinterland provenance and potential reservoir quality in the region's frontier basins can be supported.