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# Tectonics of the South China Sea Region

The tectonics of the South China Sea (SCS) region influence the petroleum systems of each of the seven surrounding nations, all producers, as well as form a touchstone of sorts in understanding the geology of all of Southeast Asia. Yet many of the broad issues in its geology remain controversial, due in part to the complexity of the geology, but also to conflicting paleomagnetic data, spotty geochronology, few constraints from ocean spreading, and confidential treatment of data by Asian nations. Even the opening history of the SCS, which forms the single largest piece of ocean crust internal to the Southeast Asian region, is still open to revision. Nevertheless, analysis of regional geological data geographically registered with a comprehensive gravity and magnetic database, in a GIS, has proved helpful in predicting some poorly understood aspects of the geological relationships of the region.

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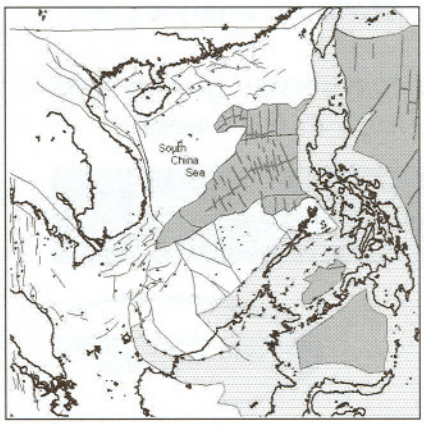

*ArcView generated GIS*

Unraveling the pre-Tertiary tectonic history has largely been an academic endeavor based on onshore data. The continental crust of Southeast Asia was constructed in the pre-Tertiary, with the assembly of terrains around the Kontum massif, overprint of several phases of Indosinian orogeny, its accretion onto China, and the construction of one or more Andean-type orogens on the eastern flank in China, Vietnam, the Sunda craton, and in Borneo. The current SCS continental crust lay to the east and north of these granitic belts and appears to be largely composed of the forearc of the Andean-style orogens, including any exotic terranes that may have collided with the arcs. Any assessment of the petroleum potential should, therefore, take account of the possibility of unforeseen source rock systems and unique maturation histories.

The Tertiary of Southeast Asia is a story the interactions of several smaller "plate-like systems" trapped between Eurasia, Indo-Australia, and the Pacific. Within Indochina, the unifying concept of "escape tectonics" has become the overriding theme of Tertiary deformation. Sea floor spreading in the SCS during the Oligo-Miocene is often linked to the Red River fault system, the major boundary between Indochina and China and a pivotal element in the escape tectonic approach. The linkage has been viewed several ways, but by using plate kinematic principles the situation is best viewed in terms of the breakdown of an unstable ridge-transform-transform triple junction and migration of the SCS spreading center to the south.

All of the sedimentary basins along the South China and Vietnam coast are intimately linked to the evolution of the spreading system, as are their petroleum potentials. The Pearl➢

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River Mouth Basin and Beibuwan form a nearly purely extensional arm of the triple junction and were de-activated at the point of sea floor spreading. The 15-km deep Song Hong basin appears to be a hyperextended detachment basin localized at the unstable triple junction during the process of its breakdown. Basins along the Vietnam coast are part of a continental borderland and should have petroleum systems akin to other strike slip systems of the world, provided a source rock exists and the maturation history proves favorable in relative to trap creation.

The southern margin of the SCS is dominated by the geology of consumption of the proto-SCS, the collision of the SCS terranes with Borneo, and thick overlap assemblages in the Baram and Rajang deltas. Very little exploration has taken place in the central SCS for a variety of reasons, but interest remains high, especially in shallower water. Because of its geological history, perhaps the single most important risk factor will be the thermal history in that the heat flow has varied widely with time. Because the ridge has migrated with time, no single heat flow history can characterize the whole of the SCS, but the general pattern will be from low during the forearc history to high in stretched crust to very high in areas directly affected by successful sea floor spreading. ■

### Biographical Sketch

JAMES W. GRANATH received BS and MS degrees in geology from the University of Illinois at Urbana-Champaign and a PhD in structural geology from Monash University in Australia. Since 1976 he has taught at SUNY Stony Brook and spent 18 years in Conoco in research, international exploration, and new ventures. In 1999 he opened a consulting practice focused on structural geology and tectonics as applied to exploration problems. He is a member of AAPG, AGU, GSA, HGS, GITA, and SEAPEX and is a certified petroleum geologist (#5512). Jim's expertise lies in structural analysis, regional synthesis, and prospect and play evaluation. Recent projects have focused on the thrust belts of Europe and the Andes and GIS applications to Southeast Asian tectonics and the petroleum basins of Mexico. He can be contacted through granath@attglobal.net.