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From Continental Breakup To Oceanic Lithospheric Subduction: The History Of The Central South China Sea Basin

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http://iodp.tamu.edu/scienceops/precruise/southchinasea/participants.html

In recent years, with a concerted effort in new geophysical data acquisition, processing and interpretation, as well as scientific drilling, we have analyzed the evolution history of the South China Sea (SCS) from pre-rifting Mesozoic tectonic background, continental rifting and breakup, oceanic lithospheric evolution and sedimentary records, to subduction and collision.

A special focus is on major transitional events like Mesozoic transitions from the Tethyan to Pacific regimes and from an active to a passive continental margin, and the Cenozoic rifting-to-drifting transition. The overall Mesozoic evolution of southeast China comprised almost an entire cycle of orogenic build-up, peneplanation, and later extension, all under the influence of the subducting palaeo-Pacific plate. Continental margin extension and rifting continued into the early Cenozoic, eventually triggering the Oligocene opening of the SCS.

Major unconformities, such as the breakup unconformity (BRU) and the Mid-Miocene unconformity (MMU), are examined. Complex structures and strong lateral velocity variations are revealed at the continent-ocean boundary (COB). The overall transitional deformation style from the rifting to drifting suggests a successive episode of rifting, faulting, compression, tilting, and erosion at the COB during the crustal thinning and mantle upwelling. We further present an opening model indicating discrete rifting and seafloor spreading prior to the buildup of a unified spreading center for the entire basin.

We suggest that the spreading of the SE Sulu Sea started in the Early Oligocene/Late Eocene due to the subduction of the Proto SCS, and terminated in the Middle Miocene by the obduction of the NW Sulu Sea onto the Palawan continental block.

Combined analyses of deep tow magnetic anomalies and International Ocean Discovery Program (IODP) Expedition 349 cores show that the initial seafloor spreading started around 33 Ma in the northeastern SCS, but varied slightly by 1-2 myr along the northern COB. A southward ridge jump of ~ 20 km occurred around 23.6 Ma in the East Subbasin; this timing also slightly varied along the ridge and was coeval to the onset of seafloor spreading in the Southwest Subbasin. The terminal age of seafloor spreading is ~15 Ma in the East Subbasin and ~16 Ma in the Southwest Subbasin. The full spreading rate in the East Subbasin varied largely from ~20 to ~80 km/myr, but mostly decreased with time except for the period between ~26.0 Ma and the ridge jump (~23.6 Ma), within which the rate was the fastest at ~70 km/myr on average. The primary contribution to magnetic anomalies of the SCS is found not in the top 100 m of the igneous basement.

In the central basin and neighboring regions of the SCS, first-order seismic sequence boundaries are interpreted.

A characteristic early Pleistocene strong reflector is also identified, which marks the top of extensive carbonate-rich deposition. The fossil spreading ridge and the boundary between subbasins acted as major sedimentary barriers, across which seismic facies changes sharply and cannot be easily correlated. The sharp seismic facies change along the Miocene-Pliocene boundary indicates that a dramatic regional tectonostratigraphic event occurred at about 5 Ma, coeval with other regional events. The depocenter or the area of the largest sedimentation rate switched spatially and temporally. The most active faulting and vertical uplifting are now caused most likely by the active and fastest subduction/obduction in the southern segment of the Manila Trench and the Northeast Palawan -Luzon arc collision. Timing of magmatic intrusions and seamounts constrained by seismic stratigraphy in the central basin varies and does not show temporal pulsing in their activities.