Rangin, C., Silver, E., von Breymann, M. T., et al., 1990
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1. GENERAL INTRODUCTION[1]

Shipboard Scientific Party[2]

Numerous models have been proposed for the opening of marginal basins in the west Pacific region. Most models are related to simple subduction processes inducing extension in the back-arc area, and the models vary depending on the force balance or the age of the subducted slab (Karig, 1971; Chase, 1978; Molnar and Atwater, 1978; Uyeda and Kanamori, 1979). In contrast, the South China Sea and the Japan Sea have been interpreted as Atlantic-type basins (Taylor and Hayes, 1983) or pull-apart basins related to transcurrent shear zones controlled by intracontinental deformation processes (Tapponnier et al., 1982; Lallemand and Jolivet, 1985).

Marginal basins in back-arc settings can also be trapped as a consequence of subduction zone flipping or jumping, following collision of the volcanic arcs bordering these basins with a continent or another island arc. They may also have been created in multiple events, such as the displaced borderlands and probable trapped basins within the Banda Sea (Silver et al., 1985).

The Sulu and Celebes seas lie immediately southeast of the South China Sea drifted continental margin, within a complex geodynamic environment marked by active arc-arc or arc-continent collision zones, subduction zones, and significant strike-slip motion along major faults (Fig. 1). The nature and origin of these small basins are important for palinspastic and kinematic reconstructions of the west Pacific region. Our focus in Leg 124 is on the age, stratigraphy, paleoceanography, and stress of the rocks within these basins. We expect these basins to represent small islands of undisturbed stratigraphic history within a complex regional tectonic setting.

BASIN AGE

The age of the west Pacific marginal basins is unknown, but various workers have considered them to be either Mesozoic (a remnant of Tethyan–Indian ocean), or Cenozoic.

The first hypothesis is supported by the presence of lower Cretaceous ophiolites onshore around these basins. Consequently, the Sulu and Celebes seas could be the source for these ultramafic-mafic rocks. If correct, this hypothesis could allow a direct comparison between oceanic crust and ophiolites. These small basins then could be considered preserved pieces of a larger Mesozoic oceanic basin that might be correlated with the Argo abyssal plain in the southeast Indian Ocean, where oceanic crust of a similar age was recently drilled (Gradstein, Ludden, et al., in press).

If Paleogene in age, these basins could be considered as trapped pieces of the Indian Ocean or Philippine Sea plates. Alternatively, they could belong to the Paleogene rifting history of the Eurasian margin. If related to the Indian Ocean or Philippine Sea Plates, these basins would reveal a completely different record. In the first case, they would document the history of accretion of exotic terranes to the Eurasian margin. If rifted from the Asian margin, they would have registered the whole Cenozoic history of this continental margin. If Neogene in age (Rangin, 1989), the Sulu Basin could document the rifting and spreading processes of small basins within a larger scale collision zone.

STRATIGRAPHY

Independently of the tectonic objectives, one of the major scientific problems considered during this leg is the sedimentation processes in oxygen-deficient basins. A study of this type of basin can provide us with information on paleoenvironments associated with potential hydrocarbon sources, as well as give us a better understanding of the relationships between stagnant basins and the global oceanic-atmospheric climate system. Specifically, Tissot (1979) has demonstrated that the long-term (last 600 m.y.) accumulation of organic matter in the oceans is directly related to sea-level changes.

The silled Sulu Sea Basin serves as a natural laboratory for studying sedimentation in an oxygen-deficient basin through a relatively long period of time. It also allows us to study the effect of sea-level changes on the expected anoxic-oxic cycles of sedimentation. Periodic lowerings of sea level during the latest Cenozoic would have been particularly well registered in this semi-isolated basin. During Tertiary time, similar temporary isolation could have resulted from local collisions of arc terranes with the drifted continental margin of China, the ages of which are quite well controlled onshore. Consequently, the impact on sedimentation in these basins by local tectonic vs. global sea-level changes could be tested.

STRESS MEASUREMENT

The driving stresses within a collision zone are not at all understood. The Celebes and Sulu basins provide excellent locations for measuring such stresses, because although they have thrust boundaries, none of the thrusts on either basin represents self-sustaining subduction. Therefore, trench pull does not appear to be the likely dominant stress. It is likely that the thrusts are driven by boundary stresses due to collision processes. At present, no stress measurements have been taken in the Sulu, Celebes, or Banda basins. In addition to determining stress orientation and magnitude in each basin, we are curious as to how well coupled the basins are. Great similarity between the basins in the orientation of maximum horizontal stress may suggest strong coupling between the basins. Great differences suggest weak coupling.

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[2] Shipboard Scientific Party is as given in the list of participants preceding the contents.

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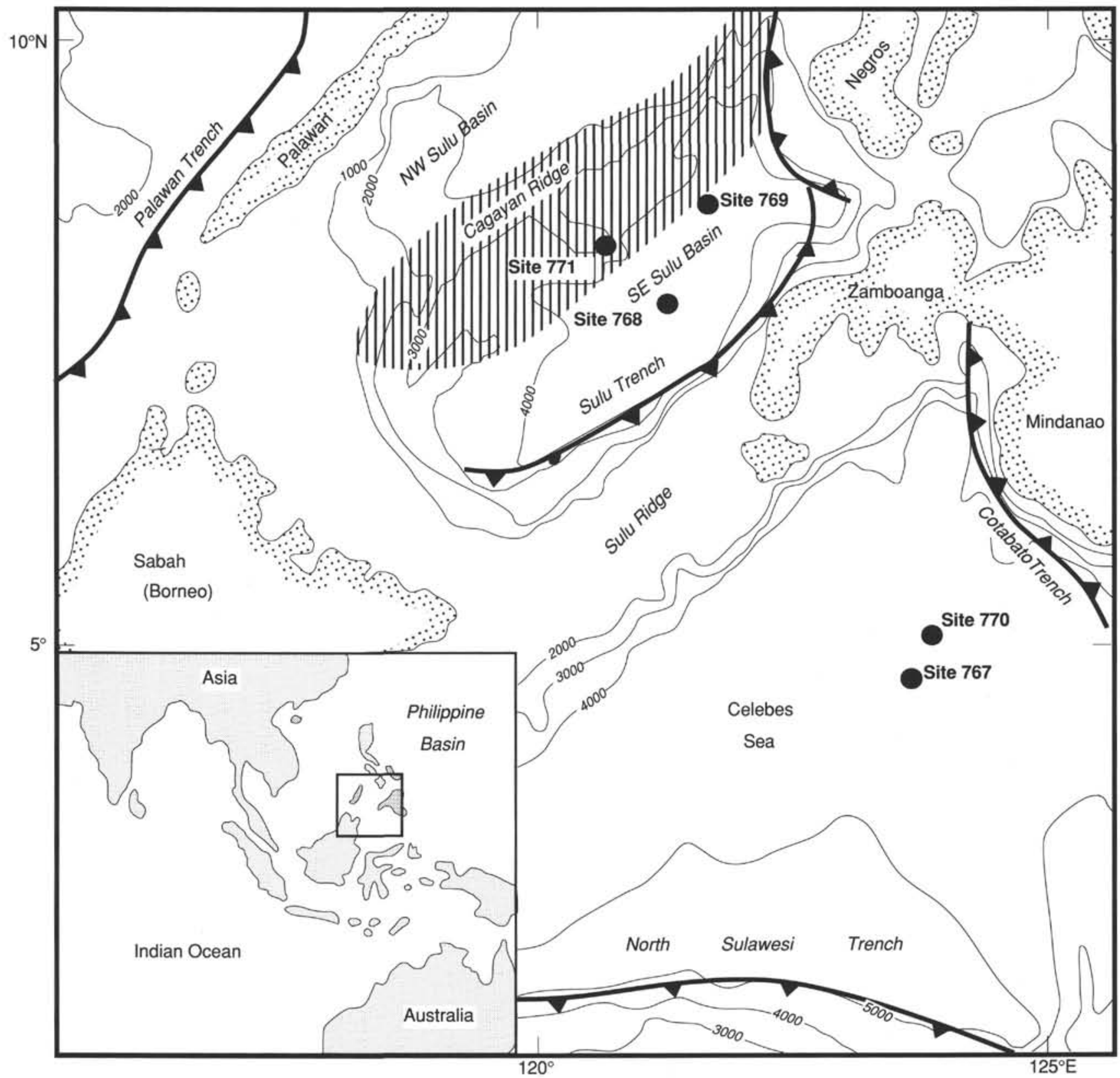

Figure 1. Geotectonic map of the Sulu and Celebes seas showing the location of the sites drilled during Leg 124. The Cagayan Ridge is shaded with vertical lines.