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Tertiary tectonic evolution of the NW Sabah continental margin

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The NW Sabah continental margin can be sub-divided into 6 tectono-stratigraphic provinces on the basis of differences in structural styles and sedimentation histories: (1) Rajang Group Fold–Thrust Belt, (2) Inboard Belt, (3) Baram Delta, (4) Outboard Belt, (5) NW Sabah Trough and (6) NW Sabah Platform.

The Tertiary sedimentary sequence was deposited during two main phases of basin development:

(1) A pre-early Middle Miocene phase of generally deep-marine clastic sedimentation.
(2) A post-early Middle Miocene phase of clastic shelf/slope deposition, which prograded northwestward over the underlying sediment wedge and is separated from the latter by a major regional unconformity.

Evidence for Palaeogene subduction of South China Sea oceanic crust beneath NW Sabah is incomplete. The subduction hypothesis (Hamilton, 1979) is based on the following main elements:

(1) The Rajang Group Fold–Thrust Belt of turbidites and associated ophiolites, interpreted to represent an accretionary prism.
(2) The sub-linear NW Sabah Trough, interpreted to represent the sea-bed expression of a subduction trench.

A major missing element in this hypothesis is a volcanic arc of the correct age.

Factors suggesting a trench orientation which is non-conformable with the NW Sabah Trough are :

(1) The Baram Delta Toe Thrust Zone which shows features that strongly suggest present-day activity as a result of gravitational tectonics. This zone had previously been thought related to subduction, but is now ascribed to delta tectonics.
(2) Sudden termination of both the NW Sabah Trough and the West Baram Delta against the Luconia Block, whereas the Rajang Group Fold–Thrust Belt extends southward into Sarawak. The Trough becomes less well expressed towards the Palawan area.
(3) Extensive NNE-SSW oriented left-lateral wrench tectonics of the Inboard Belt.
(4) Extensive offshore protrusion of the Rajang Group Fold–Thrust Belt (thrust-sheet complex, Hinz, 1989) along the axial plane of the sharp inflection of the structural strike of the Rajang Group Fold–Thrust Belt (NNE oriented 'NW Borneo Trend' to ESE oriented 'Sulu Trend').

The geodynamic interpretation of the observed relationships is that of a Palaeogene subduction system broadly parallel to the structural strike of the Rajang Group Fold-Thrust Belt. The NW Sabah Trough represents the downfaulted southeastern margin of the NW Sabah Platform, overlain to the southeast by the Baram Delta Toe Thrust and the Rajang Group thrust sheet complex. The inboard Belt wrench tectonics trend parallel to the postulated trench (cf. the Semangko fault of the Sumatra subduction system) as a result of oblique subduction. Counter-clockwise rotation of Borneo from Eocene to Middle Mocene resulted in increasingly oblique subduction. The Baram Delta sediment prism masks the Palaeogene trench, which becomes inactive further south.

The following four-stage model for the tectonic evolution of the NW Sabah shelf is proposed:

(1) Late Eocene to early Middle Miocene oblique subduction of South China Sea oceanic crust beneath NW Sabah with deposition and subsequent imbrication of deep-marine sediments into an accretionary prism.

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(2) Collision of the South China Sea attenuated continental crust with Sabah, and cessation of ocean-floor spreading in the early Middle Miocene, led to regional uplift and erosion of the accretionary prism, resulting the Deep Regional Uncoformity. This was followed by northwest-ward progradation of clastic sediments over the Inboard Belt from Middle Miocene to early Late Miocene.

(3) Resumption of convergent forces between Borneo and the NW Sabah Platform in Middle late Miocene was accompanied by major tectonic activities. The Inboard belt was subjected to strong compressional deformation associated with major N-S wrench zones, resulting in the Shallow Regional Unconformity. Two new depocentres were formed seaward of the Inboard Belt: the Baram Delta and the Outboard Belt.

(4) From Late Miocene to Recent, a thick prograding clastic wedge built out towards the northwest in both depocentres, whilst the Inboard Belt was continuously eroded. A Late Pliocene phase of locally developed deformation affected the Inboard Belt, Outboard Belt and Baram Delta.