Some puzzling questions about the Cretaceous–Cenozoic geology of west Borneo and the South China Sea

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Puzzling features of Borneo geology remain, in spite of the steady advance in detailed knowledge from the efforts of the Geological Survey, Universities, and oil companies. Perhaps a re-examination of some of these can lead the way to a better understanding of the geology, or suggest areas where more work could be fruitful.

The features discussed are:

a) The first order boundary of the Lupar Line. Is this a suture? If so what kind? Has there been strike slip movement along it, and if so, in what sense? How could this be further investigated?

b) Australian-Indonesian mapping in West Kalimantan along the strike continuation of the Lupar Line shows Cretaceous rocks to the north (supposedly on oceanic crust) adjacent to Cretaceous shelf sedimentary rocks on continental crust. What is the nature of this contact?

c) The Serabang Formation in extreme west Sarawak shows similarities to the Lupar Formation and Lubok Antu Melange, but appears to be somewhat older. Is it a fragment of an earlier subduction zone, and, if so, did this extend north to the Natuna Islands?

d) In West Sarawak, the Kayan Sandstone in the Kayan and Penrissen Synclines is believed to be Upper Cretaceous to Paleogene on palynological evidence, although it seems identical lithologically and structurally to the Plateau Sandstone, which is upper Eocene or younger. On the southeast, the Kayan Sandstone overlies Cretaceous Pedawan Formation, apparently conformably, but on the northwest it mainly overlies the Cretaceous Serabang Formation, which is in an entirely different facies. What happens beneath the Kayan Syncline?

e) The Rajang Group is one of the most remarkable, thickest, and problematical piles of turbidites known. There seems to be nothing comparable in Southeast Asia. what was its source? West Borneo, the Sunda Shelf, continental Asia, or a foundered mountainous landmass in the area of the present China Sea Basin?
Was it deposited where it now is, relative to West Borneo, or has it moved a long way?
How deeply was it buried and by what?
How can we visualize the sedimentary regime to explain the younging along strike into Sabah?

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f) Are the remarkable strike changes shown by the Rajang Group (e.g. of 90° between the Rajang and Baram headwaters) due to oroclinal bending, and if so, when did this occur?

g) Remarkably, while intensive sedimentation and tectonism was going on in Sabah, at Melinau from late Eocene to early Miocene foraminiferal-algal limestone was accumulating in a shallow sea with only slight interruption. Similarly, in West Sarawak, during the Cretaceous to Miocene, steady stable-shelf marine sedimentation giving way to continental sand deposition, took place only 100 km or so from the deep-water trough where many thousands of metres of turbidites were accumulating, and were being folded and accreted, and where the Lubok Antu Melange was being created.

Probably geologists working in this area on subsurface and outcrop data will have already thrown light on some of these problems in studies yet unpublished. For future progress, reconstruction of **paleogeography** and **sedimentary history** are important. Information on the **probable depth of burial** of the Cretaceous-Paleogene rocks, from **vitrinite reflection** and other studies, could give an indication of the amount of sedimentary cover that has been removed from them by erosion. More geophysical data are needed - such as deep seismic over the shelf, and **gravity surveys** over the Lupar and Serabang Lines, and their offshore extensions. **Paleomagnetic studies** have already given some information about possible rotation of parts of Borneo, and if applied to the Paleogene rocks of the "accretionary prism" may give an indication of the amount of oroclinal bending; the Melinau Limestone at Mulu and Batu Gading could yield significant results.