A re-assessment of the evidence that the S.E. Asian Shear Basins resulted from the India-Tibet Collision

Charles S. Hutchison, Department of Geology, University of Malaya, Kuala Lumpur.

The indentation experiments of Tappoiner et al. (1982) provide strong support for a working hypothesis that the "back arc" shear basins (Red River; Gulf of Bacbo; Tonle-Sap, Mekong; Malay) resulted from the indentation of India into Eurasia. The alternative hypothesis that they resulted from E-W compression and that the Indian collision may be irrelevant has been presented to this meeting last year by B.G.M. Wood.

The timing of the closure of the Tethys by collision of India with the Lhasa-Gandise Block of S. Tibet along the Indus-Zangbo-Yarlung Suture may now be constrained by isotope date (Wang, 1984). The first and second cycles of the Linzizong volcanics of the Gandise arc are predominantly ardesites of subduction-related calc-alkaline affinity. Cycle I gave a Rb:Sr age of 97.5 Ma (Cenomanian). Cycle III is of rhyolite, welded tuff and trachy-dacite interbedded with continental strata. K:Ar dates are 60 Ma (Plaeocene). The chemistry of Cycle III indicates a continental crustal origin. Therefore the Tethys was closed after the Cenomanian and soon before the Palaeocene.

However, there is evidence that S.E. Asia began its rifting history before the Palaeocene: (1) the tholeiitic basaltic dykes of the east coast province of Peninsular Malaysia have been dated at Kuantan by Haile et al. (1983) as 104 ± 10 Ma (Albian) and (2) the basins of the Pearl River Mouth and Beibu Gulf were already beginning to receive their sedimentary fill in Cretaceous times (Li, 1984). Such rifting and subsidence could not have resulted from the Indian collision.

In China, this spectacular period of rifting and basin development is referred to as the "Yenshanian Earth movements". Its effects were felt throughout the whole continental crustal part of S.E. Asia. The rifting was accompanied by a high heat flux from the mantle, resulting in high geothermal gradients which even today have not waned below 40° C km^{-1}

Many of the Chinese basins are floored by Late Cretaceous (Late Yenshanian) granites, of S-type, formed by partial melting of the continental crust, and dated at 80-130 Ma. They have been responsible for the greatest part of the mineral wealth of China. These granites cannot be regarded as "basement" to the basins, which in many cases began their formation before the granites were emplaced. They are therefore an integral part of the rifting and subsidence process. Several wells in the S. China Sea region have drilled into such Late Yenshanian granites, and locally they occur in Peninsular Malaysia and on S. China Sea islands.

It therefore appears that S.E. Asia, extending from the Sunda Shelf into China, was a province of spectacular rifting associated with anomalously high heat flow resulting in crustally derived granites and subsidence, before the collision of India with Tibet.

The major NW-SE shears may have resulted from the collision, but it appears they were superimposed on an already rifting high heat flow province.

The indentation model of India predicts that (1) South China should have moved eastwards (supported by palaeomagnetic data); (2) that Indo-China and the Malay Peninsula should have rotated clockwise and remained at the same latitude (this is proved for Indochina, but data on Peninsular Malaysia contradict the prediction); (3) that the Lhasa Block should have moved northwards ahead of India (proved by the palaeomagnetic data).

The palaeomagnetic data on Peninsular Malaysia and Borneo (Haile and Briden, 1982) suggest a strong anti-clockwise rotation between the Late Cretaceous and the Early Miocene, but no movement since Miocene times. These observations contradict the indentation model.

Continuing rifting along the NW-SE shears has given Late Cenozoic alkaline basalts especially along the Tonle Sap-Mekong basin and in several Chinese basins and at Kuantan on the edge of the Penyu Basin. Such alkaline basalts are to be expected and they must occur within and along the margins of the Malay and Natura Basins (for example on the margin of the Tenggol Arch) but none has been documented in the literature. Hopefully the petroleum industry can document such volcanism without endangering their proprietary information.

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