

# **New value of displacement of Bok Bak fault and its implication on the Chuping limestone formation of Kedah and Perlis, Malaysia**

SYED SHEIKH ALMASHOOR

Jabatan Geologi  
Universiti Kebangsaan Malaysia  
43600 UKM Bangi

**Abstract:** A recent discovery and definition of the extension of 82 kilometres of Bok Bak fault in north Kedah and Perlis makes way for a plausible interpretation of the amount of displacement of the fault. Based on the disposition of two pairs of correlatable rock-units which exhibit similarities in orientation, lithology and microfossil contents on opposite sides of the fault, the displacement is inferred to be about ten kilometres sinistrally. This interpretation has been carried out in an objective manner and therefore its outcome should prevail over earlier ones which are speculative in nature. Apparently the fault displaced Bukit Kepelu, Bukit Mulong and Bukit Kodiang in north Kedah from Bukit Chuping in central Perlis, and these hills are hereby thought to have been once a continuous rock unit of the Chuping limestone formation.

**Abstrak:** Penemuan baru dan penentuan unjuran sesar Bok Bak sepanjang 82 km di utara Kedah dan Perlis telah memungkinkan tafsiran mengenai nilai anjakan sesar dilakukan. Berdasarkan kedudukan dua pasang unit batuan yang serupa dari segi orientasi, litologi, dan kandungan mikrofosil di kedua-dua belah satah sesar, nilai anjakan ditafsirkan ke kiri sebanyak 10 kilometer. Tafsiran ini telah dilakukan secara objektif. Oleh itu nilai baru ini mengatasi nilai-nilai anjakan yang dicadangkan sebelum ini yang lebih bersifat spekulatif. Nampaknya sesar ini telah memisahkan Bukit Mulong dan Bukit Kodiang di utara Kedah dengan Bukit Chuping di tengah Perlis. Bukit-bukit ini dipercayai satu ketika dahulu pernah berselantaran sebagai unit formasi batu kapur Chuping.

## **INTRODUCTION**

Bok Bak fault was named by Burton (1965) who mapped a prominent 30½ kilometre long sinistral-slip fault in the 330° direction running across his assigned map area in Baling, south Kedah. In addition, Rozita (1992) and Teoh (1992) has observed fault markings of Bok Bak fault at the western margin of Bukit Perak granite massif, central Kedah. Their observations substantiate the generally accepted inference of the extension of Bok Bak fault for 32½ kilometres northwest of the Baling area up to the west margin of Bukit Perak (Lai, 1987; Tjia, 1989). Burton's (1965) postulation that the fault extended more than 400 kilometres into north Kedah and Perlis, initially northwestward in an arcuate manner, then straight northwards into south Thailand, had remained unsubstantiated for three decades.

## **PREVIOUS INTERPRETATIONS**

The amount of displacement of Bok Bak fault has been subjected to four different interpretations. Three of the interpretations made were related to areas where the exact location of the fault was still

under speculation or its presence was unsubstantiated by field evidence. A fourth interpretation (see Burley and Jamaluddin, 1989) is confined over a defined and an adjacently-inferred sections of the fault in south Kedah. Burton (1965) based his interpretation on the apparent amount of displacement between the Semanggol rocks of Padang Terap area in north Kedah, and that of the Kulim-Baling area in south Kedah, and suggested a sinistral displacement of between 51½ and 58 km. Ibrahim Abdullah *et al.* (1989) notice a shortcoming in Burton's interpretation as the Semanggol rocks in the two areas cannot be matched because they strike in almost orthogonal directions. To cater for the disparity in the strike directions, Ibrahim Abdullah *et al.* (1989) took a simplistic approach by speculating that the Semanggol Formation in the Kulim-Baling area had been rotated by granite intrusion. After undoing the rotation and matching the Semanggol rocks on the basis of lithofacies equivalence, they concluded a 25 km left-lateral displacement.

Burley and Jamaluddin (1990) notice a similarity in strike and dip ("steepness") of the granite boundaries in south Kedah on opposing

sides of the Bok Bak fault, and based on this feature they inferred a sinistral displacement of 30 km. Raj (1982) used Landsat imageries to delineate the probable southward extension of Bok Bak fault up to southwest Kelantan; then by restoring the continuity of the Main Range granite in southwest Kelantan and the Lower Paleozoic strata in Central Perak, he concluded a 20 km left-lateral displacement.

### AMOUNT OF DISPLACEMENT FROM THE NORTH KEDAH AND PERLIS SECTION

Recently, an additional extension of 82 km of Bok Bak fault northwest of Bukit Perak, was substantiated when Almashoor (1995) delineated and defined a 58 km segment of the fault zone in north Kedah and Perlis. The fault runs in the 320° direction and its zone is estimated 800 metres wide. Fault markings seen near Jitra and Pokok Sena (in Kedah) imply a left-lateral movement. The location of this segment of Bok Bak fault discrepant with that speculated by Burton (1965).

An earlier report by Abdul Majid Sahat (1987) had placed an additional extension of 70 km to the southeast of the Baling area. Therefore, from the Sungai Siput area to the Perlis/Thailand boundary the confirmed length of Bok Bak fault now stands at 215 km, and is thus established as a major fault in Peninsular Malaysia (Almashoor, 1995).

The segment of Bok Bak fault defined by Almashoor (1995) enables one to make a reliable and perhaps accurate interpretation on the amount of displacement of Bok Bak fault. The interpretation is made from the presence of two pairs of correlatable rock-units on opposite sides of the fault. One pair of matchable unit are Bukit Rawa and Bukit Tunjang (Fig. 1). These hills are sandstone beds of the argillo-arenaceous Upper Devonian-Permian Kubang Pasu Formation (Jones, 1978). These two hills are located adjacent to the Bok Bak fault zone 10 km apart from each other. Their topography, particularly that closest to the fault zone, shows the drag effect caused by the left-lateral movements of the fault. The similarities in lithology, (strike-)ridge orientation and size/thickness of Bukit Rawa and Bukit Tunjang suggest that they could possibly have, at one time, been a continuous sandstone bed/hill, but are now separated from each other by about 10 kilometres by the Bok Bak fault.

The second pair of correlatable rock units are between the group of Chuping limestone hills in Perlis and the group limestone hills near Kodiang in Kedah. Both groups of hills (or mogotes) are aligned in nearly N-S directed zones that are located

ten kilometres apart on opposite sides of Bok Bak fault. It thus appears that the two groups of mogotes could have been the same unit once, but had been offset by the fault over a similar distance of about ten kilometres.

Agewise, the two groups of hills are quite similar, and therefore may be grouped into the Chuping limestone (see also Kamal Roslan, 1989). The Chuping limestone mogotes of central Perlis were thought to be of Permian age (Jones 1978, pp. 104 and 106) but are now extended into upper Middle Triassic or lower Upper Triassic (Ladinian or Carnian) based on the discovery of Triassic microfossils in Bukit Chuping (Fontaine *et al.*, 1988). Bukit Chuping is, incidentally, located adjacent to the Bok Bak fault.

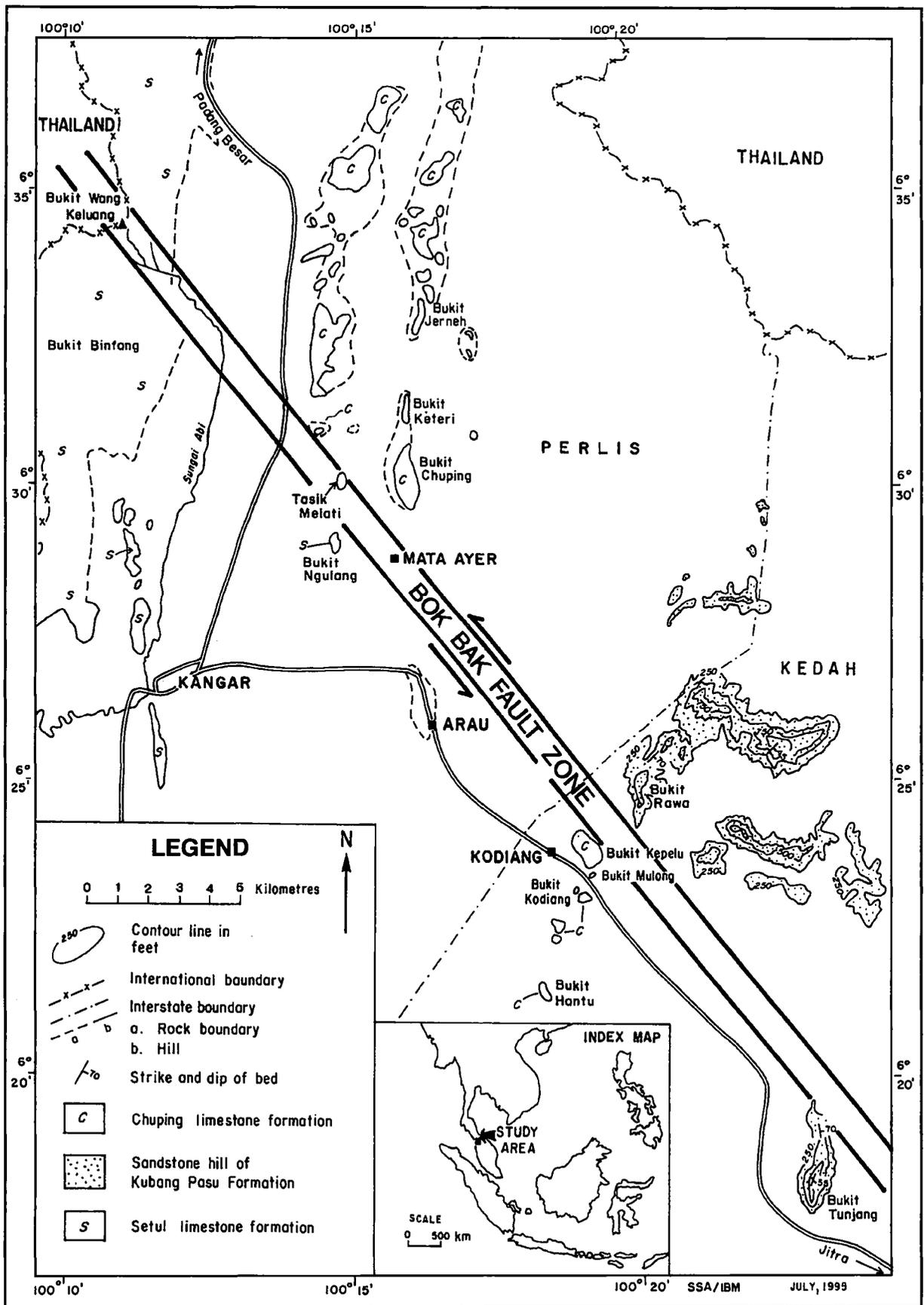
The limestone mogotes near Kodiang range in age from Late Permian (Metcalf, 1981) to early Late Triassic (Koike, 1973, 1982). Bukit Kepelu, which is located closest to the fault, contains upper Carnian-lower Norian (Upper Triassic) conodonts, whilst Bukit Mulong, the next mogote closest to the fault, possesses a lower Norian conodont element (Yii, 1979). The next hill in the sequence, Bukit Kodiang, contains late Anisian to early Carnian conodonts (Koike, 1982). Apparently, Bukit Kepelu, Bukit Mulong, Bukit Kodiang and Bukit Chuping were probably once a continuous sequence but have been offset by the Bok Bak fault by ten kilometres. Such a close linkage between the hills invalidates the formational status of Kodiang limestone as put forward by de Coe and Smit (1975).

### CONCLUSIONS

A detailed lithostratigraphic and biostratigraphic study on Bukit Kepelu-Bukit Mulong and Bukit Chuping to establish their kinship would help to confirm the amount of displacement of Bok Bak fault. However, at this moment, the lithologic and topographic correlations that are presented in this paper strongly suggest that there had been a net left-lateral displacement of 10 kilometres along the Bok Bak fault. As the amount of displacement is estimated from two pairs of what appear to be lithologically and chronologically correlatable rock-units that are located on opposite sides of the fault, the estimation should be a reliable quantification compared to previous estimates which are mainly speculative in nature.

### ACKNOWLEDGEMENTS

I would like to thank Dr. Tan Teong Hing for reading the manuscript and giving valuable suggestions. Field assistance was provided by En.



**Figure 1.** The location of Bok Bak fault in North Kedah and Perlis, Malaysia. Note the ten-kilometre displacement between Bukit Chuping and Bukit Kepulu (of Chuping limestone formation) and between Bukit Rawa and Bukit Tunjang (of Kubang Pasu Formation), which are used in the interpretation of the amount of displacement of Bok Bak fault. Note also that Bukit Chuping and Bukit Ngulang are on opposite sides of the fault, and that the latter belongs to the Setul formation (Almashoor, 1995). Modified from map by Jones (1978).

Ibrahim Md Dom, who also drew Figure 1, En. Zakaria Muda and En. Tajudin Ujang. This research was supported by Universiti Kebangsaan Malaysia under grant No. 96/92 from November 1992 to November 1994.

## REFERENCES

- ABDUL MAJID SAHAT, 1987. Bukti lapangan sesar Bok-Bak di luar kawasan Baling. *Warta Geologi*, 13(4), 161-164.
- ALMASHOOR, SYED S., 1995. Located: The extension of Bok Bak fault in north Kedah and Perlis, Peninsular Malaysia. *Warta Geologi*, 21(5), 301-304.
- BURLEY, A.J. AND JAMALUDIN OTHMAN, 1990. A gravity survey of Perlis, Kedah and Penang. *Bull. Geol. Soc. Malaysia*, 26, 13-20.
- BURTON, C.K., 1965. Wrench faulting in Malaya. *Journal of Geology*, 73, 781-791.
- DE COO, J.C.M. AND SMIT, O.E., 1975. The Koding Triassic Limestone Formation in Kedah, West Malaysia. *Geologie en Minjbouw*, 54(3-4), 169-170.
- IBRAHIM ABDULLAH, AHMAD JANTAN, BASIR JASIN, ABD RAHIM SAMSUDIN AND UYOP SAID, 1989. Amount of displacement along the Bok Bak fault: Estimation by using the lithofacies equivalence. *Warta Geologi*, 15(6), 255-262.
- JONES, C.R., 1978. The geology and mineral resources of Perlis, north Kedah and the Langkawi Islands. *Geological Survey of Malaysia, District Memoir*, 17, 257p.
- KAMAL ROSLAN MOHAMED, 1989. *Stratigraphy and Sedimentology of the Triassic rocks of Peninsular Malaysia*. Ph.D. thesis. University of London (unpublished), 293p.
- KOIKE, T., 1973. Triassic conodonts from Kedah and Pahang, Malaysia. *Geology and Palaeontology of Southeast Asia*, 12, 91-113.
- KOIKE, T., 1982. Triassic conodonts biostratigraphy in Kedah, West Malaysia. *Geology and Palaeontology of Southeast Asia*, 13, 9-51.
- LAI, K.H., 1987. Photogeology of the Padang Terap-Saba Yoi-Yaha area, Malaysia-Thailand. *Geological Survey of Malaysia Annual Report for 1986*, 188-198.
- METCALFE, I., 1981. Permian and Early Triassic conodonts from northwest Malaya. *Bull. Geol. Soc. Malaysia*, 14, 119-126.
- RAJ, J.K., 1982. A reappraisal of the Bok-Bak fault zone. *Warta Geologi*, 8(2), 35-41.
- ROZITA BINTI SAID, 1992. *Geology am kawasan barat Sungai Tiang*. B.Sc. Honours thesis, Universi Kebangsaan Malaysia (unpublished), 69p.
- TEOH LAY HOCK, 1992. Geology and mineral resources of Sungai Tiang area, Kedah Darul Aman. *Geological Survey Malaysia Map Report*, 5, 93p.
- TJIA, H.D., 1989. Major faults of Peninsular Malaysia on remotely-sensed images. *Sains Malaysiana* 18, 101-114.
- YII SIEW SANG, 1979. *Conodont biostratigraphy at the Koding Limestone, Koding, Kedah, West Malaysia*. B.Sc. honours thesis, University of Malaya (unpublished), 57p.

---

Manuscript received 15 September 1995