

## A sedimentological study at Bukit Belah, Batu Pahat, Johor

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**Abstract:** A sedimentological study was carried out at Bukit Belah, Batu Pahat, Johor which was interpreted by previous workers as part of the Bukit Payong Formation. The study area consists of three main sedimentary facies, namely conglomerate facies, sandstone facies and siltstone facies. In general, the sandstone is thickly-bedded and relatively more dominant than the conglomerates. At some localities, the sandstone is interbedded with siltstone and mudstone. Based on petrographic study, the Bukit Belah sandstone can be classified as lithic arenites, quartz arenites, arkose wacke and quartzose wacke sandstone. Several sedimentary structures were identified in the study area such as parallel lamination, cross lamination and graded bedding. The rock sequence shows a fining upward sequence and together with the presence of some sedimentary structures, it is interpreted that the sediments were deposited in a braided river system.

**Abstrak:** Kajian sedimentologi telah dijalankan di kawasan Bukit Belah, Batu Pahat, Johor yang ditafsirkan oleh pengkaji terdahulu sebagai sebahagian daripada Formasi Bukit Payong. Kawasan kajian terdiri daripada tiga fasies utama iaitu fasies konglomerat, fasies batu pasir dan fasies batu lodak. Konglomerat kebanyakannya terdiri daripada jenis sokongan matrik dan masif. Batu pasir umumnya wujud dalam lapisan tebal dan lebih dominan berbanding konglomerat. Di beberapa lokaliti, batu pasir ini wujud sebagai selang lapis bersama batu lodak dan lumpur. Berdasarkan analisis petrografi, batu pasir Bukit Belah boleh dikelaskan kepada arenit litik, arenit kuarza, wak kuarza dan wak arkos. Beberapa struktur sedimen juga dapat dikenal pasti seperti laminasi selari, laminasi silang dan penggederan. Batuan sedimen ini menunjukkan jujukan menghalus ke atas dan kehadiran struktur sedimen dapat ditafsir sekitaran pengendapan merupakan sekitaran sungai berburai.

### INTRODUCTION

Sedimentary rocks exposed at Bukit Belah (Fig. 1) and its surrounding area has been interpreted as part of the Bukit Payong Formation (Tan, 1988, Syahrul Salehudin; 2000). Several studies on various geological aspects were carried out by previous workers. Burton (1973) interpreted the rock sequence as molasse deposits of Upper Triassic age. In a detailed sedimentological study by Noor Bakri Endut (1981), the Bukit Belah rock sequence was divided into three main facies with eleven subfacies. Noor Bakri Endut (1981) also estimated the thickness of the rock sequence as approximately 2,000 m which can be divided into three main sections namely lower, middle and upper section. Tan (1988) proposed the Bukit Belah Formation to include the rock sequences at Bukit Belah, Bukit Payong, Bukit Inas and Bukit Bindu. The study area was mapped by Md. Shahid Ayub (1978) and based on aerial photographs and topographic maps studies, several geologic aspects of the area were discussed by Juhari Mat Akhir *et al.* (1985). The age of the study area was suggested as Lower Cretaceous (Uyop Said & Syahrul Salehudin, 2001). In general, the rock sequence at Bukit Belah consists of conglomerates, sandstone, siltstone and mudstone.

### MATERIAL AND METHOD

Several samples were collected from six localities including one locality at Bukit Payong for petrographic study. However, the rock sequence at only four localities is discussed in this paper. Five rock sections from six localities were measured (Fig. 2). In an attempt to interpret the environment of deposition of the rock sequence, a detailed study was carried out on the measured rock sections.

### RESULT AND DISCUSSION

#### Lithology And Petrography

Based on the field observation, three main lithologies were identified at Bukit Belah namely conglomerates, sandstone and siltstone. Sandstone is the most dominant lithology, followed by siltstone and conglomerates. The results of the present petrographic study is shown in Table 1.

The conglomerates are badly weathered and occupy the southern part of the study area. Based on the observation of hand specimens, the conglomerates collected from

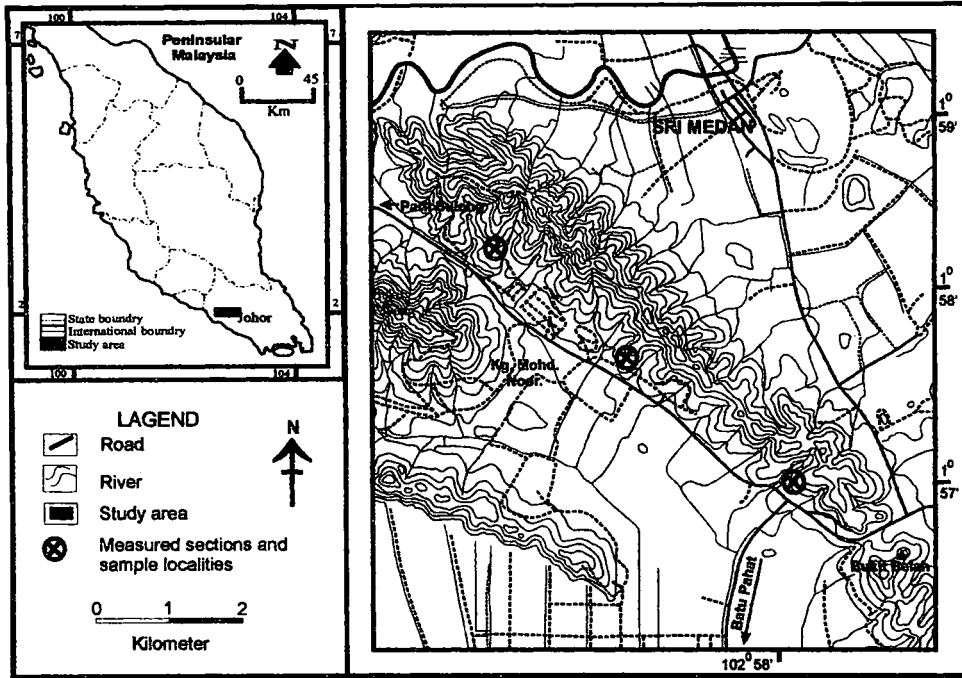


Figure 1. Location map of the study area.

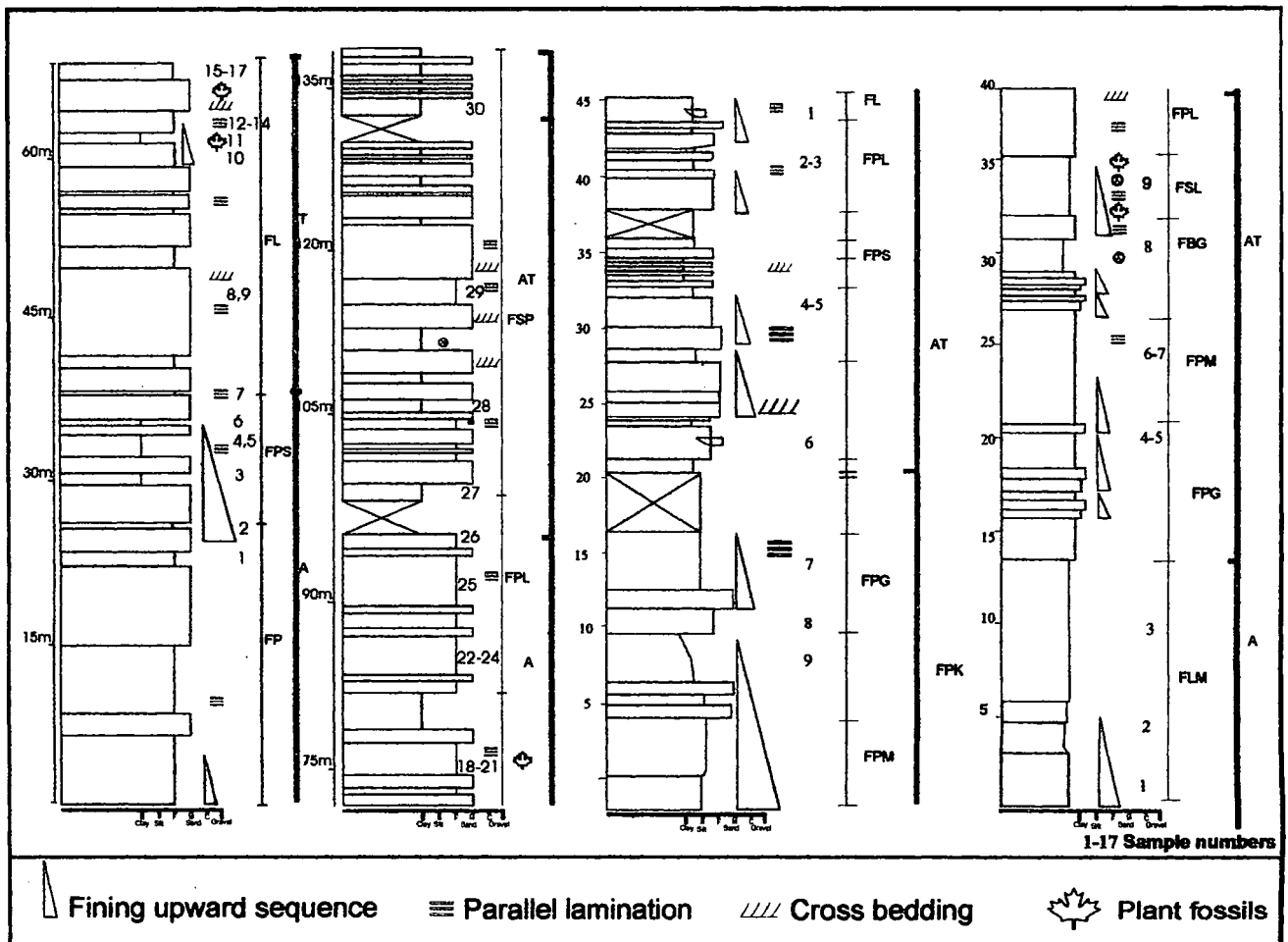


Figure 2. Lithologic log at Bukit Belah (AT-Abandoned channel, A-Channel, T-Levee, FPM-Medium sandstone facies, FP-sandstone facies, FPS-interbedded sandstone facies, FSP-sandy siltstone facies, FPL-laminated sandstone facies, FL-Massive siltstone facies, FPG-graded sandstone facies, and FSL-laminated siltstone facies).

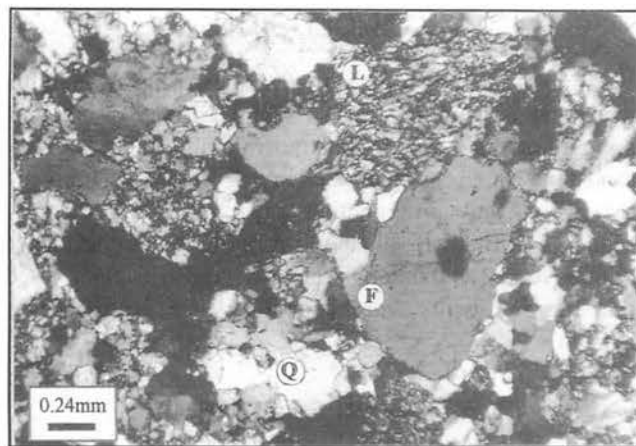


Figure 3. Photomicrograph of conglomerates from locality 7, Bukit Payong (Q-quartz, F-feldspar and L-rock fragment; cross nicol).

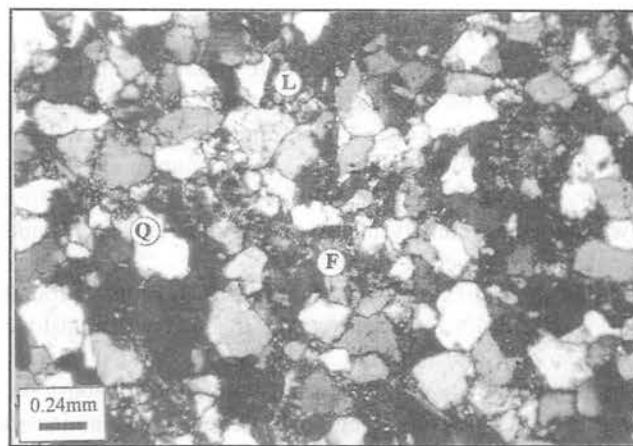


Figure 4. Photomicrograph of lithic arenites (Q-quartz, F-feldspar and L-rock fragment; cross nicol).

Table 1. Results from petrographic study carried on some samples from the study area.

SAMPLE	PERCENTAGE					CLASSIFICATION
	QUARTZ	FELDSPAR	ROCK FRAGMENT	MATRIX	OTHER MINERAL	
BB3/1	30 %	-	-	Clay matrix 70 %	-	Wacke arkose
BB3/2	65 %	-	-	Clay matrix 25 %	5 %	Siltstone
BB5/4a	60 %	-	-	-	Grain sized minerals	Mudstone
BB5/8a	40 %	-	-	-	Clay minerals 60 %	Sandy shale
BB5/9c	40 %	-	-	-	Clay minerals 50 % Muscovite 10 %	Sandy shale
BB6/5	90 %	5 %	-	-	Mica 5 %	Quartz arenite
BB6/6	55 %	10 %	15 %	10 %	Mica 10 %	Lithic arenite
BB6/9	65 %	-	-	Clay matrix 25 %	Mica 10 %	Wacke quartz
BP7/5	50 %	-	30 %	15 %	Mica (Muscovite) 5 %	Conglomerate

locality L4 was found to be matrix supported. From the petrographic study, this conglomerate is dominated by approximately 30% rock fragments and 15% quartz. The quartz grains are polycrystalline and monocrystalline, and generally more than 2mm in diameter. The rock fragments are of sedimentary rocks such as sandstone and siltstone (Fig. 3).

Sandstone is the most dominant lithology in the study area which comprises of fine- to coarse-grained sandstone. From petrographic study (Fig. 4), the sandstone is well-sorted with low sphericity and low roundness. It contains both monocrystalline and polycrystalline quartz. The rock fragments consist of sandstone, siltstone and mudstone.

Quartz grains make up approximately 70% of the total grains and the other 30% is of rock fragments. Therefore, this sandstone is classified as lithic arenite.

Siltstone is the second most dominant rock type at Bukit Belah which is characterised by the grains being very fine, poorly-sorted and matrix supported. Plant fragments which are black in colour were also found. Laminations are commonly observed in some of the siltstone samples examined under transmitted light microscope.

Mudstone in the study area can be classified as sandy shale consisting of a mixture of clay and silt sized particles which are poorly-sorted and unsorted in some samples. Mudstone is only exposed at a few localities.

## Sedimentary facies

The rock sequence at Bukit Belah comprises of conglomerates facies, sandstone facies and siltstone facies. The conglomerate facies is commonly found at Bukit Payong, but at Bukit Belah it is less common and highly weathered. The conglomerate facies can be divided into two subfacies, namely massive conglomerates facies and graded conglomerate facies.

As the most dominant lithofacies, sandstone is found at some localities as thick layers interbedded with mudstone or siltstone. Sandstone lithofacies can be divided into six subfacies. They are massive sandstone, graded sandstone, interbedded sandstone, conglomeratic sandstone, laminated sandstone and medium-grained sandstone.

The siltstone layers exposed at two localities are very rich in organic materials and several plant fossils were found. In general, the siltstone lithofacies can be divided into two subfacies namely massive siltstone facies and laminated siltstone facies.

## Sedimentary structures

The most common sedimentary structures found in the rock sequences are parallel and cross laminations, graded-bedding and channel structure. The parallel and cross laminations are very common in the siltstone. The graded-bedding and channel structure are found in the sandstone. These sedimentary structures can be utilised in interpreting the environment of deposition of the rock sequence.

## Depositional environment

It is interpreted that the Bukit Belah rock sequence was deposited in a braided river system which was closer to the main channel. This interpretation was based on the lithologies of the measured rock sequence which clearly shows a fining upward sequence and grain size study which was carried out on several samples. The occurrence of sedimentary structures such as parallel and cross laminations, graded-bedding and channel structure indicates that the environment of deposition is fluvial environment.

## CONCLUSION

Based on the measured rock sequence, it is found that the lower part of the Bukit Payong Formation is partly exposed at Bukit Belah. The most common lithofacies is sandstone which can be divided into six subfacies, followed by siltstone and conglomerate facies. In general, the rock sequence at Bukit Belah shows a fining upward sequence with several sedimentary structures and it is interpreted that the sediments were deposited in a braided river system.

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