

## **Structural style of Cyberjaya and Putrajaya, Selangor**

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**Abstract:** Rock cores from Putrajaya consists of various materials including calc-silicate hornfels, granite, carbonaceous schist and quartz-mica schist. Sheared materials were common and difficult to trace. In order to appreciate the geology of this area, especially the structural geology, outcrops in the adjacent areas were assessed. The Cyberjaya and Putrajaya areas have experienced several phases of deformation.

**Abstrak:** Batuan teras yang diperoleh dari Putrajaya terdiri daripada pelbagai jenis batuan termasuk hornfels kalkasilika, granit, syis berkarbon dan syis mika-kuarza. Batuan tericah lazim ditemui dan teras gerudinya sukar untuk dikesan. Untuk memahami geologi kawasan ini dengan lebih mendalam terutamanya geologi struktur, singkapan-singkapan di kawasan berdekatan telah ditinjau. Kawasan Cyberjaya dan Putrajaya telah mengalami beberapa kali canggaan.

### **INTRODUCTION**

Cyberjaya and Putrajaya are being rapidly developed into flagship zones and cyber cities. Numerous outcrops were exposed as a result of widespread major earthworks and road works. As developments were rapid, some of the geological features were exposed and subsequently back-filled with some of the features remaining unrecorded. The main objective of this paper is to provide a general description on the geological structures.

At major road cuts in the vicinity of Cyberjaya and Putrajaya (Figure 1) some outcrops were exposed displaying interesting structural elements. The rocks in Putrajaya were generally similar to Kajang Schist and the rocks in Cyberjaya were generally similar to Kenny Hill formation. Several reverse faults were observed at a few locations with strikes ranging from southwest to south-southwest (SW-SSW). Deformations were complex with recumbent folds and refolded folds within the Kajang Schist. Asymmetrical chevron to circular folds occurred in thinly bedded meta-siltstones, probably of the Kenny Hill formation.

### **PREVIOUS WORKS**

Structures in the Kenny Hill rocks generally strike north-south and dip commonly less than 30° (Stauffer, 1973). This folding has been superimposed on an earlier deformation of the Lower Paleozoic at approximately right angles to the strike of the superimposed fold (Gobbett, 1964). Tectonic transport in general was westward direction in Bukit Pantai – Damansara (Tjia, 1979) and in Bangi – Salak area (Zaiton Harun, 1981).

In the vicinity of Selangor-Negeri Sembilan border, at Kampung Sungai Buah, Zaiton Harun and Tjia (1984) found that Kenny Hill-like rocks were deformed into large, asymmetrical overturned folds with axial planes striking between north and northeast, dipping moderately to gently

to the east. Low angle reverse faults were also important modes of deformation. The tectonic transports were towards west and also superposed on this direction thrust towards southeast.

The superposed thrusts were interpreted as being products of westward thrust while the southeasterly directed thrust was considered as localized backward thrusting.

### **FIELD OBSERVATIONS**

#### **Locality A, adjacent to Western Transport Terminal (WTT)**

A tight isoclinal recumbent fold can be clearly observed from a junction of road B15 towards WTT (Figure 2). The rocks consist of meta-quartzite, meta-rhyolite and schist. The meta-rhyolite were consists of porphyroblastic feldspar measuring a few millimeters in length gives a spotted appearance with lineations aligned to the original bedding. The differences in lithology provide a clear view on the recumbent fold. This recumbent fold collapsed towards west which indicates tectonic transport to the west.

Two reverse faults were observed at 138°/40° and 202°/70° indicating tectonic transport was towards northeast and southeast, respectively. At least one reverse fault (138°/40°) cuts the recumbent fold indicating that the reverse fault is younger. The relative age of these reverse faults was not readily determined. The schist general strikes north-south to northeast-southwest and has with various dips.

#### **Locality B, Utility Tunnel Cut south of Jambatan Putra**

The excavation for construction of a utility tunnel exposed an outcrop, measuring about 4 meters high, 20 meters wide and 30 meters long. The rocks consist of schist and phyllite similar to the Kajang Schist. The rocks strike south-southwest and dip moderately at 60°. A reverse fault

striking at  $205^\circ$  with drag folds indicating tectonic transport towards east-southeast (Figure 3). However this reverse fault was superimposed by a lateral fault. This reverse fault was also cut by other oblique left lateral strike slip fault at  $100^\circ/70^\circ$  indicating the oblique lateral fault was youngest.

**Locality C, south Cyberjaya**

The outcrop is located at the end of a partially completed road (Fig 4). A striking asymmetrical chevron to circular, open to tight fold with its axis at  $003^\circ/25^\circ$  consists of thinly bedded, low grade metasediments (?Kenny Hill formation) terminated on the east by a fault ( $210^\circ/85^\circ$ ). The type of fault is not readily determined. However on the hanging wall smaller folds show slight drag towards the east. A few quartz veins ( $208^\circ/70^\circ$ ) transect the chevron folds showing pinch-and-swell effect and are also folded in places that could possibly mark progressive deformation.

However, the west wing of the fold strikes  $240^\circ/15^\circ$  and the east wing strikes  $240^\circ/50^\circ$  which indicates compression was from north-south direction prior to east-west compression. This strike is different from the structure in the northern Selangor region as compiled by Stauffer (1973) as having north-south axis.

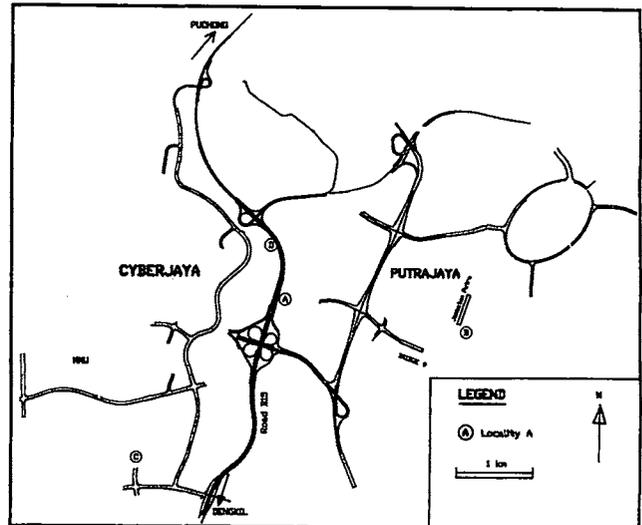


Figure 1. Road map of Cyberjaya and Putrajaya showing locality A to D.

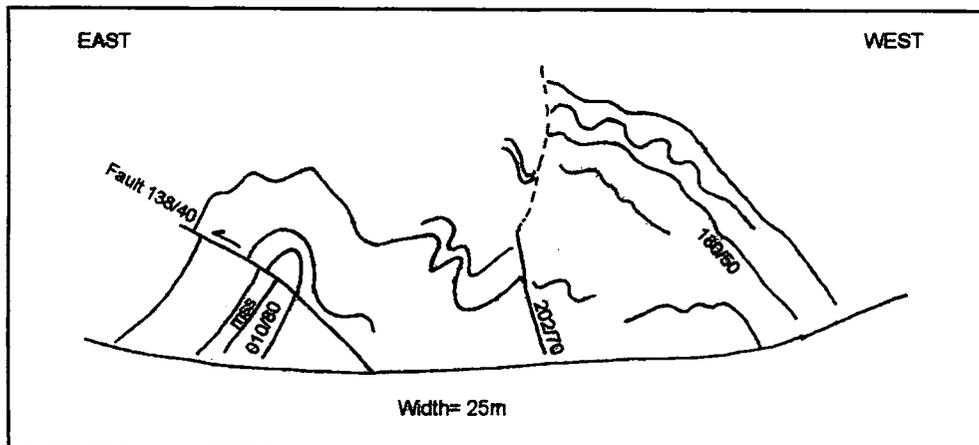


Figure 2. Locality A: Adjacent to WTT showing recumbent fold cut by a reverse fault.

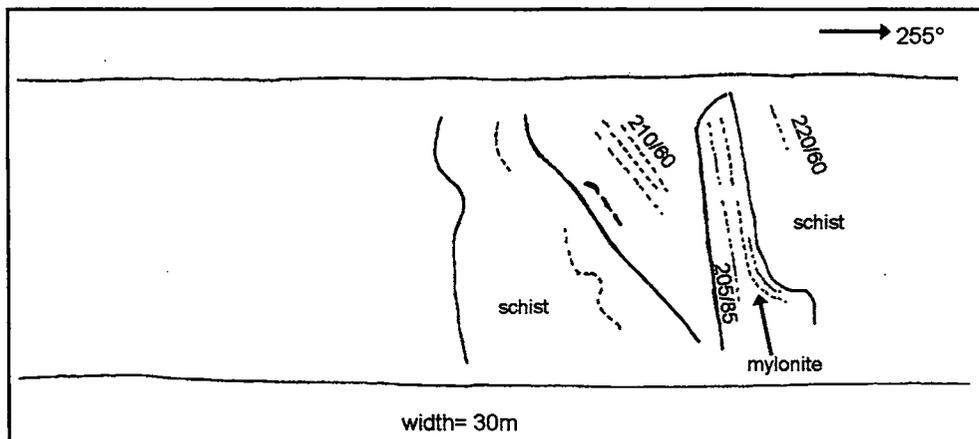


Figure 3. Locality B showing mylonite zone and drag fold.

**Locality D, 1 km north of Locality A**

This outcrop is located at the western side of a newly completed road (Figure 5). The length of this outcrop is in excess of 100 m and approximately 8 m high. The rocks consist of dark grey schist, brownish yellow meta-sandstone and meta-rhyolite (similar to locality A). The foliation of the schist predominantly strikes and dips at 170°/40° and may not follow the lithological boundaries. A fault at 170°/30° lies just above this unit. The sense of shear was not readily determined as the fault plane was perpendicular to the outcrop. One mylonitic zone about 10 cm wide was observed striking at 140°/25°. The folds immediately above this fault (hanging wall) recumbent towards the ESE indicate a reverse fault.

The meta-sandstone and meta-rhyolite demonstrate a more complex structure and refolded fold are common (Figure 6). The earlier fold was recumbent with its limbs

lying sub-horizontally and the fold axis trending 258°/00°, showing tectonic transport to the NNW. The later recumbent fold trends 025°/15°, showing tectonic transport to the ESE. Some quartz veins strike 140°/55°, 112°/70°, 130°/70° and sub-vertical veins strike 112° and 172° are observed.

**DISCUSSION AND CONCLUSIONS**

Discussion and conclusions that can be drawn from the field observations are as follows:

**Kajang Schist**

The rocks in the Putrajaya and Cyberjaya area had experienced at least three phases of deformations. The earliest recorded deformation in the Kajang Schist was the compression from the north-south with tectonic transport

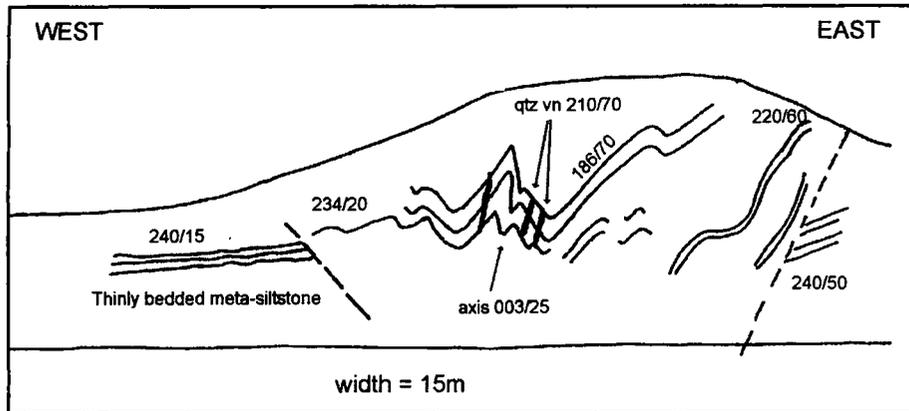


Figure 4. Locality C showing chevron fold with minor drag fold.

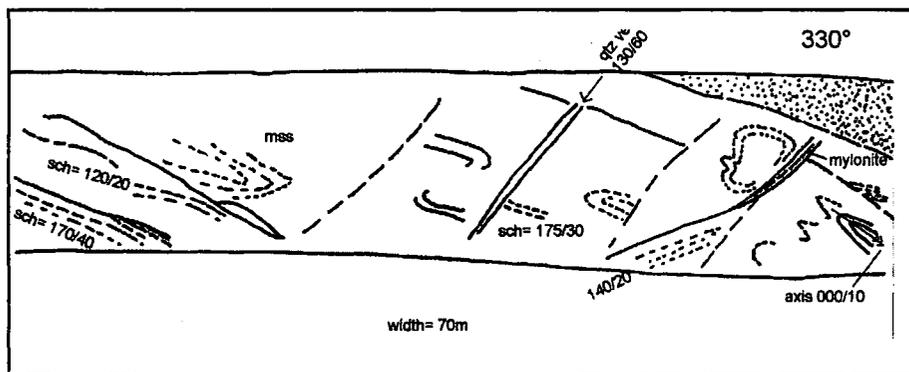


Figure 5. Locality D showing complex structures.

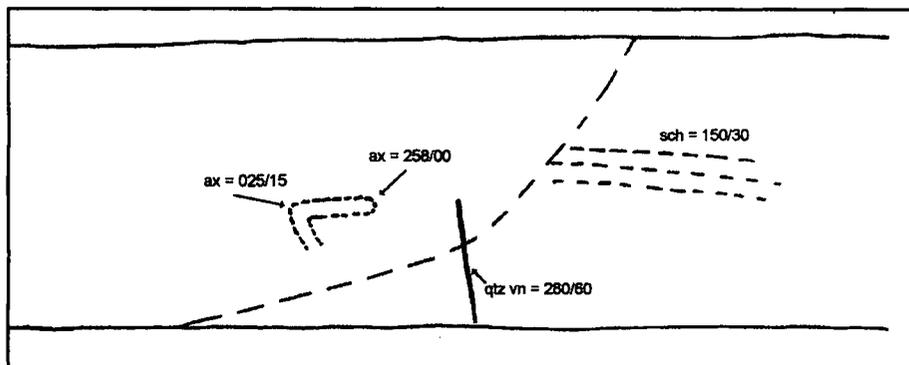


Figure 6. Locality d showing refolded fold in meta-sandstone.

to the NNW as recorded by the refolded fold. At a latter stage it was deformed into recumbent fold towards west and subsequently thrust to the ESE.

### Kenny Hill formation

In locality B, questions arise from the strikes and the lithology itself on whether it was part of the Kenny Hill formation. The strike shows a north-south compression and a later east-west compression. Some nearby Kenny Hill formation outcrops show strikes and dips of  $350^{\circ}/30^{\circ}$  and more or less have the same strike as the Kenny Hill formation in the northern Selangor and hence eliminates the possibility of localized deformation. However, their lithology that comprising of thinly bedded meta-siltstone and meta-sandstone was not reported in earlier publications. The metamorphic grades were lower than the Kajang Schist suggesting it does not belong to the Kajang Schist either. More data will be needed to determine whether the outcrop

mentioned in locality C was Kenny Hill, Kajang Schist or rock sequences yet to be identified.

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