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Some comments on the emplacement level of the Kemahang granite, Kelantan.

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Abstract: The Kemahang granite is suggested to be a high level emplacement considering MacDonald's (1967) data and new evidence from the Sungai Kusial area. The fabric of the granite on the western side of the body is interpreted to be due to major faulting or crush zone which developed after emplacement and solidification. The high level emplacement suggestion conforms well with the geology of north Kelantan.

INTRODUCTION

The Kemahang granite of MacDonald (1967) is a granitic mass of batholithic dimension in north-west Kelantan close to the Thai border (Fig. 1). The body is in contact with the Taku Schists on all sides except the west where it is in contact with Permo-Triassic sediments which also include metamorphics such as slates, phyllites, marble and metavolcanics.

The granite was mapped by the Geological Survey of Malaysia and reported in MacDonald (1967) which is to date the only major study of the granite. Hutchison (1973a, b) made some interpretations regarding the nature of the granite. A specimen of the Kemahang granite was dated radiometrically by Bignell and Snelling (1977). It is the aim of this note to discuss the nature of the granite.

FEATURES OF THE GRANITE

MacDonald (1967) reported that the granite contains 'a number of different varieties of granitic rocks, the predominant type is medium- to coarse-grained, grey in colour, with large feldspar phenocrysts, abundant biotite, marked lineation of feldspar phenocrysts at a number of localities and has undergone intense shearing in the west' and 'the shearing in general increases towards the west'. He said that the contact of the granite with the Taku Schists is 'irregular, and granitic apophyses within the schists are common, often as narrow close veins parallel to the foliation forming lit-par-lit injection gneisses'. He wrote that the sheared rocks are often gneissic or even schistose and microscopically revealed cataclastic textures such as mortar structure, deformed and bent feldspars, shattered quartz, strained polarization and even mylonitization.

PREVIOUS INTERPRETATIONS

From the writings of MacDonald (1967) it can be gathered that he interpreted the granite to be an intrusive magmatic body and the shearing was suggested to be the 'result of adjustments within the granite during solidification and associated tectonic movements which took place during and after emplacement and solidification'. The level of emplacement was not mentioned by him.

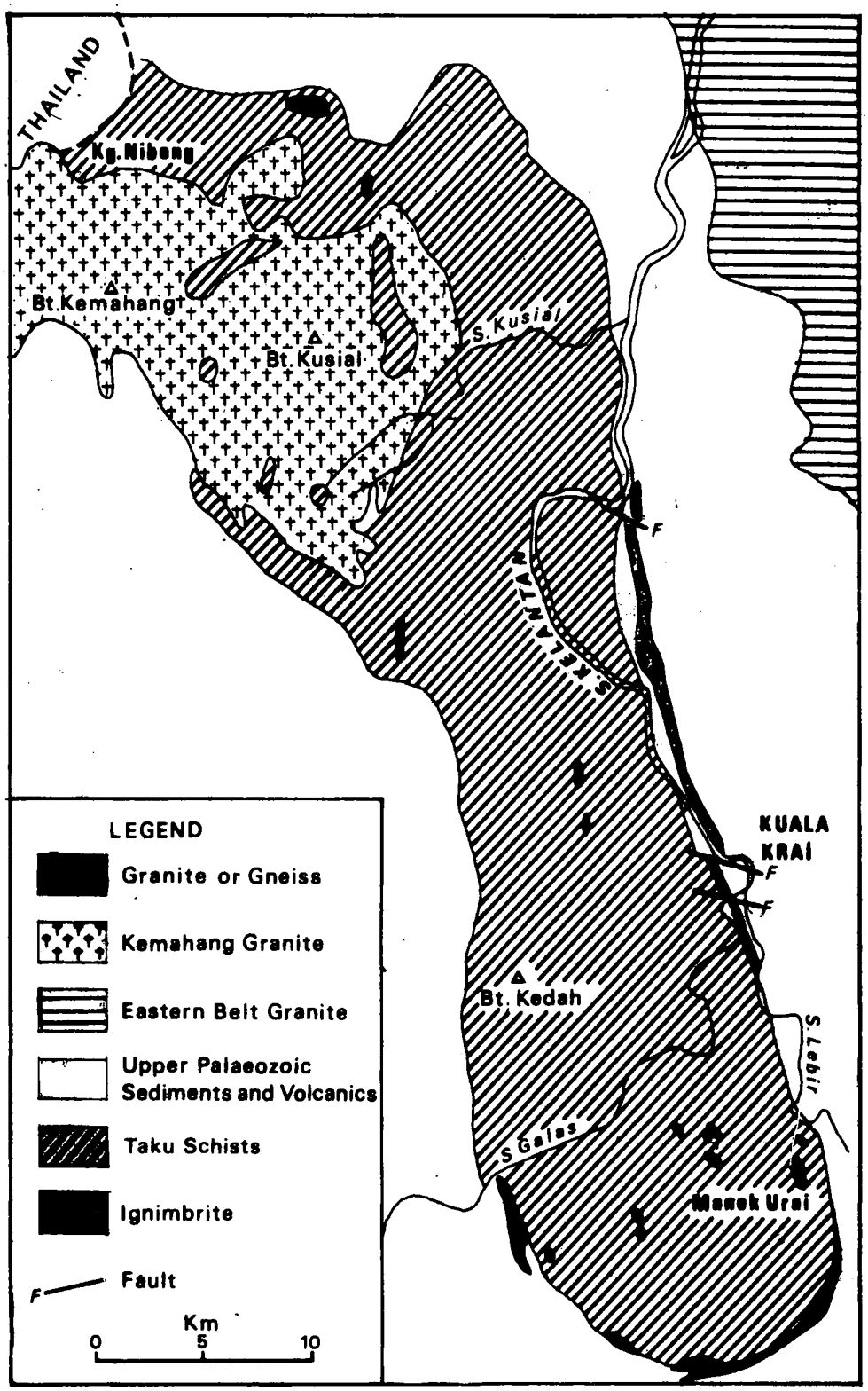

Fig. 1. Location map showing Kemahang granite and Taku Schists.

However, Hutchison (1973a) interpreted the granite described to 'have many features of the catazone' and in the same paper features of catazonal granites given are, for example, complete conformity of the plutons with the country rocks which are characteristically almandine-amphibolite facies rocks commonly showing migmatization, possession of gneissic foliation and the granites cause no contact metamorphism since the emplacement is synkinematic. He (1973b) said that the Kemahang granite is 'an extensive parautochthonous granite body' 'formed in part of foliated granite gneiss and in part of cataclastic granite' and 'contains a number of schist relics, often quite large, which have survived anatexis'.

EVIDENCE AGAINST CATAZONAL LEVEL OF EMPLACEMENT

The granite fabric is used by Hutchison (1973a, b) to support a catazonal level of emplacement and the granite is interpreted to be formed by anatexis, presumably of Taku Schists rocks, and emplaced in situ or a short distance from the site of anatexis. From the descriptions and some field observations I find it difficult to agree wholly with what has been interpreted.

Conformity with country rocks

The Kemahang granite has very few features of the catazonal type. The contact of the Kemahang granite with the Taku Schists as described by MacDonald (1967) is clearly intrusive. This evidence would be against the catazonal interpretation. However, Hutchison (1973a) who noted this feature, said that the Kemahang granite is best considered to be transitional between the mesozone and catazone.

Grade of metamorphism of country rocks

There is also no evidence that the country rocks of the Kemahang granite have been metamorphosed to the almandine-amphibolite facies or show migmatization. Exposures are in fact relatively scarce in that part of the Taku Schists terrain. But, in the better exposed Taku Schists terrain further south, almandine-amphibolite facies rocks are present. However, such rocks are rare and in fact most of the terrain appears to be underlain by garnet zone or lower grade rocks (MacDonald, 1967; Lim & Khoo, 1976). Migmatization is exceedingly rare, if present at all. The so-called autochthonous granite gneisses from Sungai Anali and Manek Urai are quartzo-feldspathic gneisses. Those from the Manek Urai area including Sungai Anali are low grade metamorphics containing abundant cataclastic relics and are sandwiched between garnet and chlorite grade rocks. These gneisses are not catazonal granites or autochthonous granites as interpreted by Hutchison (1973b). There is no evidence to support the catazonal granite interpretation from the country rocks.

Gneissic foliation

Regarding the gneissic foliation, it is clear from MacDonald's (1967) account that the Kemahang granite is formed also in part by unfoliated granitic rocks (Figs. 2, 3 & 4). It is uncertain how this feature can properly be accommodated in a catazonal interpretation. Maybe this feature can be explained by a catazone-mesozone transitional level of emplacement. Maybe emplacement a short distance from site of

Fig. 2. Kemahang granite. Medium grained granite with phenocrysts of feldspar showing flow alignment. Note euhedral shape of the feldspar phenocrysts. Location: Sg. Kusial, Kelantan.

Fig. 3. Kemahang granite. Medium grained granite with concentrations of euhedral feldspar phenocrysts. Concentrations may be formed by processes such as filtering during magmatic stage. Locality: Sg. Kusial, Kelantan.

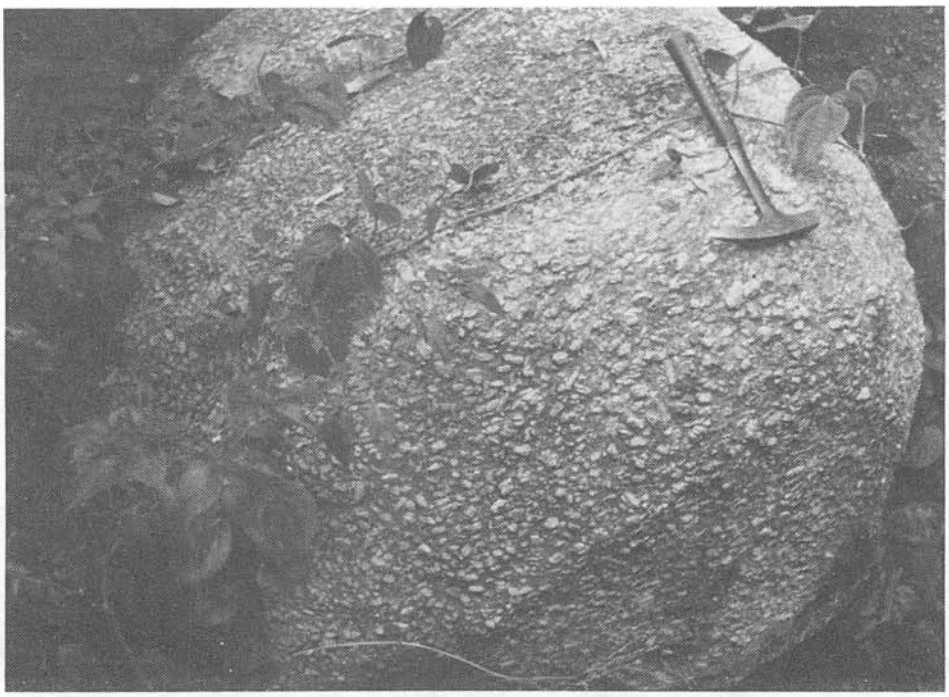

Fig. 4. Kemahang granite. Granite with abundant randomly orientated feldspar phenocrysts in medium grained matrix. Locality: Sg. Kusial, Kelantan.

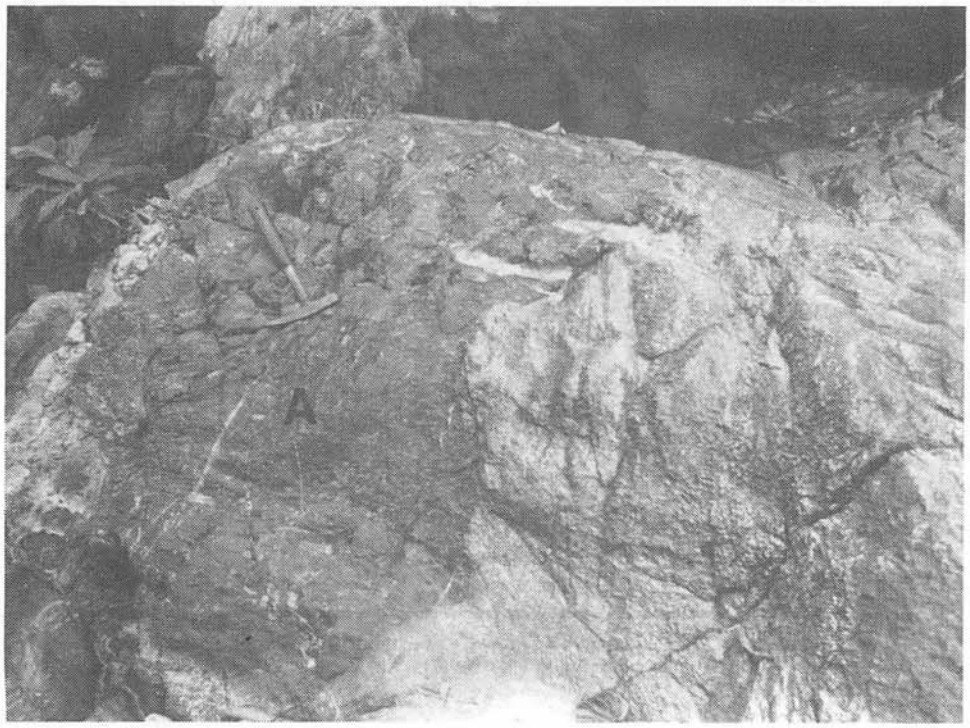

Fig. 5. Kemahang granite containing a large xenolith of amphibolite (A). Locality: Contact of Kemahang granite with Taku Schists, Sg. Kusial, Kelantan.

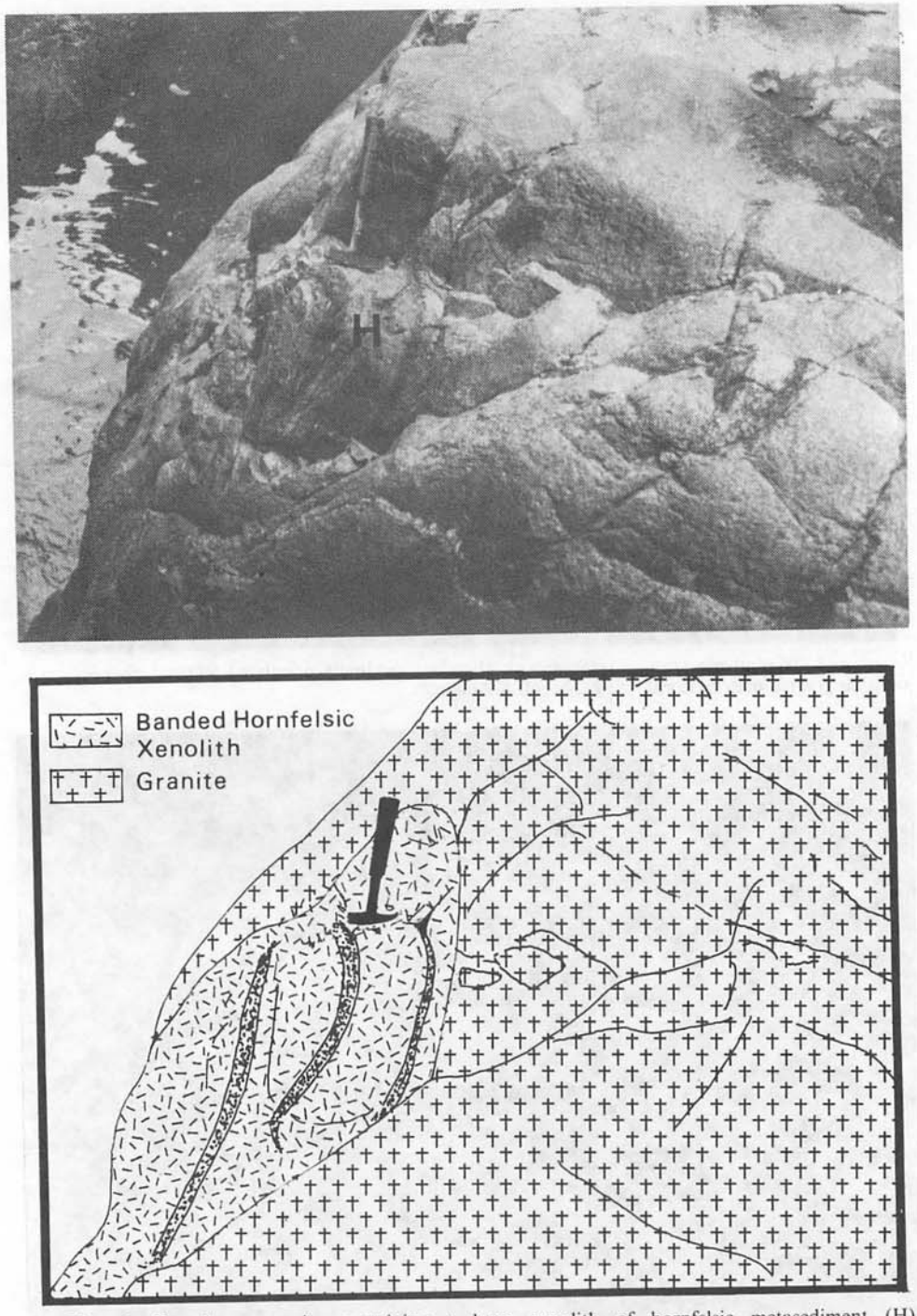

Fig. 6. Kemahang granite containing a large xenolith of hornfelsic metasediment (H). Locality: Contact of Kemahang granite with Taku Schists, Sg. Kusial, Kelantan (Sketch drawn from photograph above).

anatexis (or parautochthonous) could have given rise to this feature. I am uncertain but this problem will not arise if the granite is not interpreted to be catazonal. The gneissic foliation need to be re-examined.

The petrography of the gneissic and sheared rocks on the western side of the Kemahang granite are evidently formed after solidification or after the granite have cooled down sufficiently. The petrographic features are not features of synkinematic granites of catazonal emplacement. Strained crystals and mylonitic groundmass cannot remain so without recrystallization under the high temperature conditions of the catazonal granite interpretation.

The textures also do not support MacDonald's (1967) suggestion that they were formed during solidification of the granite. Recrystallization would have obliterated the mentioned textures had shearing occurred when the granite was not solidified. It is true that internal adjustments of the granite during solidification can produce non-cataclastic gneissic granites such as the outer rim of the Ardara granite in Donegal (Pitcher and Berger, 1972, Chapter 8). Evidently the textures of the sheared rocks from Kemahang granite formed after solidification or after the rocks have cooled significantly.

Contact metamorphism

The lack of contact metamorphism caused by the Kemahang granite as stated by Hutchison (1973a) is also not true. There is contact metamorphism. At the contact of the Kemahang granite with the Taku Schists in Sungai Kusial (Fig. 1), contact metamorphosed rocks can be seen. These rocks are hornfelsic and sometimes contact permeated with development of quartzo-feldspathic minerals. Large inclusions in Figs. 5 and 6 are most probably xenoliths, the hornfels from pelitic Taku Schists and the amphibolite from common amphibolite bands in the Taku Schists. There is no reason to believe that the xenoliths interpreted here are relics which have survived anatexis. The presence of contact metamorphism indicated that the Kemahang granite is not synkinematic.

PRESENT INTERPRETATION

Features such as discordance to country rocks and the presence of contact metamorphism suggest that the Kemahang granite is a high level emplacement. The sheared rocks on the western side of the body probably indicate the presence of major faulting or crush zone which developed after emplacement and solidification of the granite.

DISCUSSION

Age

Field evidence such as presence of contact metamorphism and the contact relationship indicates that the Kemahang granite is younger than the termination of metamorphism of the Taku Schists. The Middle Triassic K-Ar ages of the Taku Schists (Bignell and Snelling, 1977) can be interpreted to be the age of cooling, uplift and termination of metamorphism. If so, the age of the Kemahang granite will be post-

Middle Triassic. However, a specimen of the Kemahang granite from the western part of the body at Kampong Nibong gave a Rb-Sr whole rock age of 409 ± 12 Ma and biotite from this rock gave a K-Ar apparent age of 107 ± 3 Ma (Bignell and Snelling, 1977). They believe that the granite is emplaced during mid-Palaeozoic times and predate the Taku Schists metamorphic event. This interpretation will be in conflict with field evidence. However, the specimen dated (No. 270) is cataclastic (Bignell and Snelling, 1977) and it cannot be certain that the rock remains as a closed chemical system with respect to Rb and Sr after cataclasis. The field evidence appears to be more superior and the mid-Palaeozoic age of the granite cannot be accepted. It will be good if unsheared granites from the eastern part of the pluton are dated. However, it will be better if the pluton can be mapped in detail to ensure more meaningful interpretation of geochronological data.

Very little is known about the contact of the Kemahang granite with the Permo-Triassic country rocks. If the Kemahang granite is mid-Palaeozoic, then the contact must be an erosion surface. However, the assumption that the granite intrudes into the Permo-Triassic rocks will not be in disagreement with the interpretation that the Kemahang granite is post-Middle Triassic.

Present interpretation and regional geology

The suggestion that the Kemahang granite is a high level granite of probable post Taku Schists metamorphic event age conforms well with the geology of north Kelantan. Concordant K-Ar and Rb-Sr ages of Late Cretaceous have been obtained from granitic rocks from north Kelantan (Bignell and Snelling, 1977). The Taku Schists is also known to be intruded by high level granitic bodies. MacDonald (1967, p. 51) wrote " A muscovite-biotite schist containing andalusite has been recorded from the Sungai Siyah and a number of other localities near the contact of the Taku Schists and granite. The presence of an anti-stress mineral such as andalusite is unusual in rocks affected solely by regional metamorphism, and more likely has been formed as a result of a combination of thermal and regional metamorphism." Furthermore, MacDonald (1967) found that most of the heavy mineral concentrates 'containing andalusite are from streams flowing over, or in the vicinity of, the contact between the granite and the schists.' The development of andalusite at the contact of the Taku Schists and granites strongly supports the occurrence of contact metamorphism and the presence of high level granites. Hutchison (1973b) apparently considers the andalusite in the Taku Schists to be regional metamorphic in origin and not contact metamorphic since he made use of the mineral to deduce facies series. The low pressure intermediate facies series suggested by him may have to be reconsidered.

Another autochthonous granite gneiss body in the Taku Schists mentioned by Hutchison (1973b) does not appear to be catazonal as well. In Hutchison (1973b, p. 256) it is mentioned that 'north of Bukit Kedah, gneiss occurs in a lit-par-lit relationship with the schist'. However, MacDonald (1967, p. 49) said that 'over a small area north of Bukit Kedah gneiss has been formed by the lit-par-lit injection of granite into the schist'. There is no evidence that the granite is gneissic. There is evidence for the presence of high level granites in the Taku Schists terrain but so far catazonal or autochthonous granites have yet to be shown to occur.

The suggestion that the Kemahang granite is high level appears also to conform with more recent interpretations of the plutonic rocks of the Central Belt. In Hutchison (1973b, p. 255), it is shown that the belt from north Kelantan to Benta, Pahang, includes catazonal and mesozonal granites and much high grade metamorphics. But more recent interpretation by the same author (Hutchison, 1977, p. 189) shows that the belt, called Central Intrusive Belt, consists of epizonal granites but less high grade metamorphics. However, the Kemahang granite outcrop area is still shown as high grade metamorphics in Hutchison (1977, p. 189).

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