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The Kinta Valley karst landscape — a national heritage to be preserved

(Lanskap kars Lembah Kinta — warisan kebangsaan yang perlu dipelihara)

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Abstract: Kinta Valley karst is of aesthetic, cultural and scientific importance. Many caves were built inside caves and some caves and wangs were developed as recreational parks. Geologic features such as notches and cave deposits are considered reliable indicators of past climatic conditions. In addition, the limestone is also being exploited for economic purposes. Therefore, a policy for a balance between conservation and exploitation activities in Kinta Valley karst is proposed.

Abstrak: Kars Lembah Kinta adalah amat penting dari segi estetik, kebudayaan dan saintifik. Kuil-kuil dibina di dalam gua-gua manakala taman-taman rekreasi dibina didalam wang. Fitur-fitur seperti takik dan enapan gua dianggap indikator yang baik untuk keadaan cuaca masa lampau. Akan tetapi, batukapur ini juga sedang aktif dieksploitasi untuk tujuan ekonomi. Satu polisi untuk mewujudkan keseimbangan di antara aktiviti pemuliharaan dan eksploitasi kars Lembah Kinta dicadangkan.

KARST IN MALAYSIA

Karst in a humid tropical country like Malaysia takes the form of typical tropical limestone towers, normally protruding from alluviated plain. The best known karst landscape occurs in the Kinta Valley and northern Perlis. In south-west Kelantan the karst is less well-known but are actually more varied in their development (Paton, 1964). Offshore, the famous island karst occurs in the Langkawi islands. Karst can also be seen in Pahang, particularly in the northwest. In Selangor, above surface limestone can be seen outcropping in three locations in the Gombak area (Crowther, 1989). The occurrences of limestone karst in Sabah and Sarawak are reported by a few workers (Liechti, 1960; Cumming, 1961; Wilford, 1964; Farrant, 1995). Mulu caves are one of the most well-known caves in the region.

Karst is a terrain with distinctive hydrology and landforms arising from a combination of high rock solubility and well developed secondary porosity (Ford and Williams, 1989). The rate of karstification is always thought to be fastest where the climate is wettest. Because of this, much of the Malaysian karst are thought to be in the mature stages of karstification (Crowther, 1989; Ros Fatihah Muhammad and Yeap, 2001). Karst studies have become increasingly important in understanding of the Quaternary paleoclimate. With the advancement of absolute dating methods such as Uranium series (Schwarcz, 1980), Electron Spin Resonance (Ikeya, 1995; Yoshida *et al*, 2001) and Thermoluminecense, caves are becoming more important in karst studies.

Karst in Malaysia is attractive to the public. The importance of conserving representative karst areas for science and recreation has been recognised particularly in the case of the Gunung Mulu National Park in Sarawak. Other areas which are being valued for their importance for conservation are Gunung Senyum in Pahang (Mohd Shafeea Leman, 2001), Kinta Valley (Fig. 1) and Lenggong (Ros Fatihah Muhammad and Yeap, 2001). Of all the areas, Kinta Valley is the one facing the threat of destruction through on-going quarrying activities. Urgent steps need to be taken to highlight its heritage value.

THE KINTA VALLEY KARST

Karst in the Kinta Valley takes the form of typical tropical karst. It was renowned as the world's richest tin mines in early the 1960's and 1970's. The subsurface landform has evolved into pinnacles acting as pockets and trapping the tin-rich placers.

The uniqueness of the Kinta Valley karst lies mainly, among others, on the spectacular shape of steep-sided limestone towers which protrude from the vast alluvial plain. The formation of this tower karst is made possible by various factors, namely: the humid, wet tropical climate, accelerated karstification and its location in the floodplain of Kinta. The floodplain location of the karst ensures a constant supply of allogenic water to the karst which promotes the karstification processes. During the course of karst development, wangs or closed depressions were formed. Normally surrounded by vegetated steep walls

and sometimes filled with water to form lakes, wangs easily draw the attention of nature lovers. Within the karst, cave systems with magnificent cave deposits are numerous and accessible.

The Kinta Valley karst represents of the final stages of karstification. It also acts as nature's vault preserving/ safeguarding the records of the history of the paleoclimate, archeology and culture (Ros Fatihah Muhammad and Yeap, 2001). Besides being aesthetically appreciated, caves which are located at the foot of some limestone hills have drawn the attraction of Buddhist and Hindu worshippers.

In this paper, Gunung Rapat is chosen as an example of an important heritage site that need to be preserved.

CHARACTERISTICS OF KINTA VALLEY KARST

Geology

Geologically, the Kinta Valley is underlain by the Kinta Limestone which has been dated Devonian to Permian (Suntharalingam, 1968). The limestone includes several relatively thin argillaceous beds, and exceed 3000 m in stratigraphic thickness (Ingham and Bradford, 1960). Much of the limestone is found beneath the general surface where it underlies the tin ore bearing alluvium for which the Kinta Valley was once famous. The Kinta Valley Schist occurs mainly below the Kinta Limestone though parts are found to interbed with the former (Ingham and Bradford, 1960).

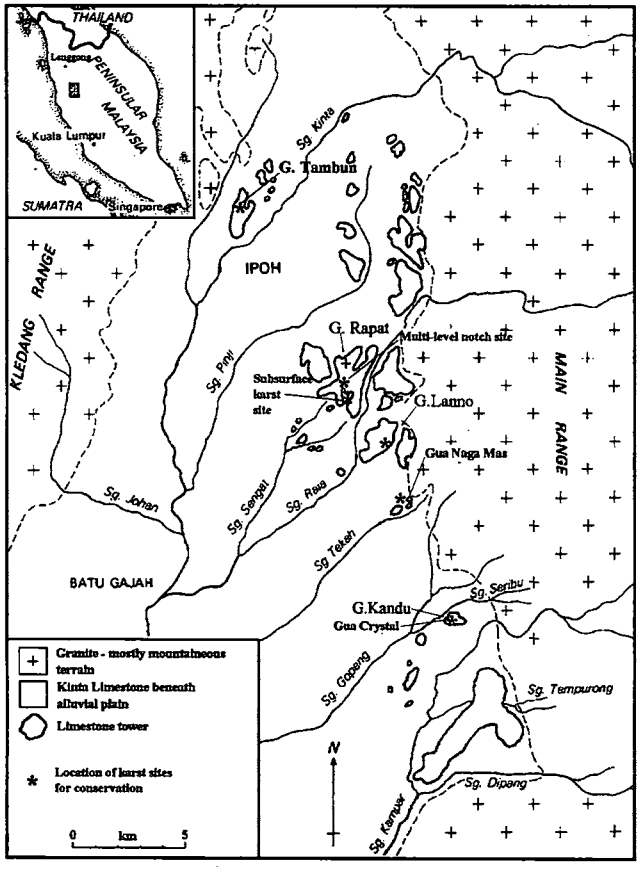


Figure 1. Kinta Valley Karst and some of the sites proposed for conservation (after Ros Fatihah Muhammad and Yeap, 2001).

The limestone and schist were probably folded and metamorphosed during or near the end of the Permian. After the folding and metamorphism, these Paleozoic rocks (limestone and schists) were intruded by the Kledang and Main Range Granites during the very Late Triassic. Some Jurassic igneous events have been detected as well. After the folding and intrusive events the limestone slowly became emergent. Calculated rates of emergence is estimated at 0.1 mm per annum (Krahenbuhl, 1991). The Padang Rengas limestone is interpreted to be the northern most extension of the Kinta Valley Limestone and its surface expression formed of Gunung Pondok.

Social-cultural significance

Certain features in karst areas which are easily accessible to the public such as wangs and caves are always an attraction as a result of their natural beauty and scenic landscape. A few wangs were turned into recreation parks and landscaped into gardens. These parks became ideal spots for city folks to unwind over the weekends and holidays.

To most people, caves are mysterious places with wondrous objects such as stalactites, stalagmites and whirlpools. Sometimes the hand of nature had carved these formations into shapes and object-like bodies which are regarded as sacred to the Buddhist and Hindu worshippers. As a result, temples were often built in caves and statues of Buddha and Hindu Deities were placed in them and their surroundings. The combination of recreational and spiritual pursuits act to draw visitors from all walks of life to these areas.

Caves also contain irreplaceable records of archeological importance. The ancient hematite rock drawing in the Tambun area is an example. Though not many archeologic materials have been discovered in Kinta Valley, the first almost complete skeleton of a prehistoric man dated 11,000 years was unearthed from the cave floor in Lenggong, just north of Kinta Valley (Zuraina Majid, 1994).

EXPLOITATION OF KINTA VALLEY KARST

Exploitation

Limestone is quarried for cement, aggregates, dimension stones and iron in Kinta Valley. In Malaysia, limestone for the cement manufacturing industries alone has produced 13.5 million tonnes of cement valued at RM81.8 million in 2001. This does not include other limestone based industries such as dimension stone and aggregates. There are currently 60 quarries in Perak, with 42 of them concentrated in the Kinta Valley and its vicinity.

Gunung Rapat is an example of an area that is being exploited in the vicinity of areas that are becoming increasingly important in the scientific and aesthetic sense.

Sustainable Use

There are a few areas, especially caves and wangs that are being developed as temples and recreation parks. Temples are mostly found in the Gunung Rapat area. The most famous being the Sam Poh Tong and Kek Look Tong temples in Gunung Rapat, and the temple Perak Tong cave in Gunung Tunggal. Gunung Tempurung has been developed as a recreation park by a company, Heritage Acres Sdn. Bhd., since 1990.

Recreational parks have also been built in wangs in Gunung Rapat and Gunung Lang.

THE KARST CHARACTERISTICS OF GUNUNG RAPAT

Gunung Rapat is the most famous limestone hill in the Kinta Valley. Its close proximity to Ipoh town and its spectacular shape of an advanced stage of a tower karst with attractive features are appealing to many visitors. Some characteristics that made Gunung Rapat important are:

The limestone tower

Geomorphologically, Gunung Rapat show cockpit type topography – with many peaks and a number of collapsed, dry and water-filled wangs. The highest peak is 318 m high and has basal area of 4.6 km^2. In plan view it is highly irregular in shape with many appendages sticking out of the whole hill like an amoeba. The steep-sided wall, sometimes almost vertical of the hills rise from the flat alluvial plain give a spectacular view to this hill.

Caves

Caves are numerous in this hill. The most important types are the foothill or notch caves commonly located at the base of the hills. These caves are very accessible and house various temples of Buddha and Hindu believers. The famous temples found in Gunung Rapat are the Sam Poh Tong (Fig. 2) and Kek Look Tong. Five levels of caving measured in this hill are located at about 184.9 m, 138.4 m, 102.4 m, 87.7 m and 80 m above mean sea level. These levels are thought to be records of base level lowering.

Notches

Gunung Rapat is located in an alluvial plain and frequent flooding of the plain give rise to swampy condition at the base of the hill. Ponds are scattered around the foothill and inside wangs. Lateral dissolution by pond water on the walls of the hills produced notches. Therefore, notches where preserved are the reliable records of previous base level. In Gunung Rapat, the best developed multi-level notches were observed, locality is found in a wang on the western part of Gunung Rapat which preserved a record of the past climatic conditions for the last 135,000 years (Fig. 3).

Pinnacles

In some areas, where mining operations have stripped off the alluvial cover, it has been observed that the original limestone platforms have been reduced to pinnacle topography by sub-surface solution. Elsewhere, mining activities of rich iron-bearing alluvium have exposed hitherto hidden important sub-surface morphology such as the planation of buried limestone at about 9 m below the floodplain level (Fig. 4) which can be seen in an open wang at the western part of the hill. The once-buried limestone forms a platform with an almost horizontal surface and, when it was subjected to downward dissolution, it formed pinnacles. Therefore, limestone platform and the pinnacles are important in understanding karst evolution.

Wang

During the karstification process of the limestone outcrop, areas that are located in the intersection of several fracture systems were always dissolved faster and developed into wangs or closed depression. Wangs are always filled with tin-rich alluvium and where they were formerly mined, ex-mining ponds were left behind. The appearance of wangs is always as a flat plain surrounded by either almost vertical bare wall due to natural collapse or by steep wall with lush vegetation (Fig. 5). A wang in Kek Look Tong cave has been developed into a recreational park (Fig. 6).

POLICY AND STRATEGIES FOR SUSTAINABLE UTILIZATION

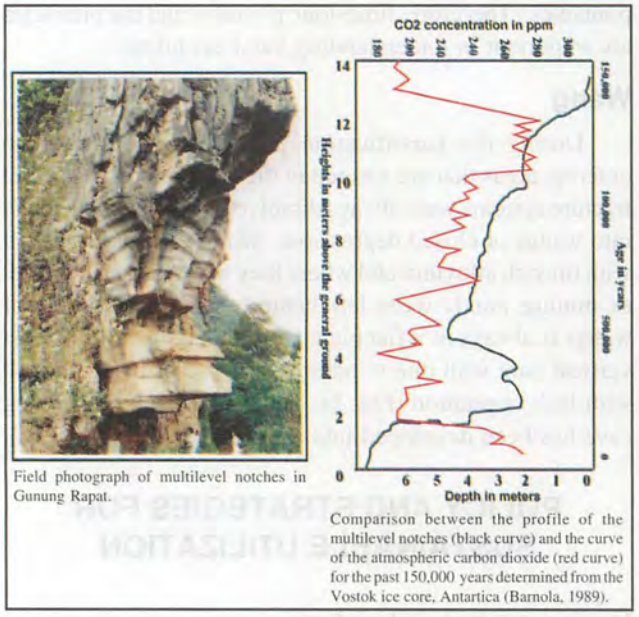
Issues on current policy

There are some conservation efforts carried out on scattered areas in the Kinta Valley Karst. Most areas which are being conserved are areas of religious importance. These areas often occur in the vicinity of quarries and mines and, because religious issues are sensitive, much areas are often not disturbed by the quarry operators. A quarry in the Simpang Pulai area has stopped operating for safety reasons because of its location which is very close to the main road.

The basis of the current conservation is obviously merely for religious reason and to a certain degree, safety purposes. However, conservation of the Kinta Valley Karst should transcend these two reasons. The biggest threat to the natural heritage resources in the Kinta Valley Karst are from quarrying and mining activities. The areas that are being exploited are always located areas of scientific, aesthetic and cultural importance.

As for the Ipoh limestone hills, though quarrying of the limestone is a major contribution to the economy of the

Figure 2. A cave that has been developed into a cave in Gunung Rapat.



Field photograph of multilevel notches in Gunung Rapat.

Comparison between the profile of the multilevel notches (black curve) and the curve of the atmospheric carbon dioxide (red curve) for the past 150,000 years determined from the Vostok ice core, Antartica (Barnola, 1989).

Figure 3. Correlation between the formation of multi-level notches with the past record of atmospheric carbon dioxide.

Figure 4. Limestone platform seen in a wang on the western part of Gunung Rapat. This platform has been reduced to pinnacles and is often filled with water. Note that a limestone aggregate factory is operating nearby.

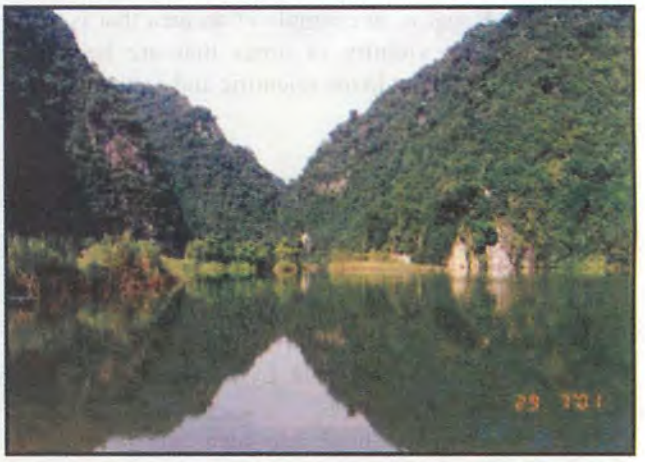


Figure 5. A water-filled wang at the northern part of Gunung Tempurung. Photograph is courtesy of Dr. Yeap Ee Beng.

Figure 6. A wang near the Kek Look Tong cave that has been landscaped into a garden. Photograph is courtesy of Dr. Yeap Ee Beng.

state of Perak, the importance of preserving some of the hills is indicated in the Draft Structure Plan (Amendment) of Ipoh City Council 1998-2020. In this draft, it is stated that limestone hills have been recognised as a natural potential as heritage resource, certain species habitat, and also the presence of caves which can be exploited as tourism and research centre.

Proposals to preserve the limestone hills include:

a) Limestone hills with heritage value and special characteristics such as Gunung Kanthan, Gunung Rapat, Gunung Datok, Gunung Tambun, Gunung Lano, Gunung Terendum, Gunung Panjang and Gunung Lang need to be preserved and gazetted as protected areas under the National Park Act 1980 and Wildlife Protection Act 1972.

b) Only suitable development and activities are permitted in the areas that are being gazetted for preservation. Proposals for specific development in limestone areas are:

- Federal Recreational Park: Gunung Rapat
- Cave and Geology Research Park: Gunung Kanthan and Gunung Datuk
- Natural Species Research Park: Gunung Tambun, Gunung Lanno and Gunung Terendum,
- Archeological and Historical Park: Gunung Panjang
- City Park: Gunung Lang

The location of limestone hills in the structure plan map is shown in Figure 7.

In addition to that, any development located close to the limestone areas has to follow guidelines for limestone hills slopes and safety zone provided by the Department of Minerals and Geoscience.

According to this plan, it is obvious that the City Council has acknowledged the importance of these limestone hills especially for recreational and educational purposes. However, numerous quarry lease locations exist in the very same hills that are planned for preservation. Quarry lease locations in the Kramat Pulai area consists of G. Rapat, G. Terendum, G. Lanno and other smaller hills are shown in Figure 8. The critical issue here is there seems to be non-uniformity between landuse plan of different authorities. However, this assumption is only based on limited access to the landuse plan data. This does not include plan from other local authority such as the Ipoh City Council.

STRATEGIES FOR SUSTAINABLE UTILIZATION

In the situation where there is a need to conserve and exploit at the same time at a specific heritage resource, it is important to have a policy that balances conservation and exploitation. With this policy, it is hoped that any effort to exploit certain areas in the heritage resources must be accompanied by a well-planned management plan.

The policy, planning and guidelines pertaining to development must be formulated based on the principle of deriving benefits from natural heritage resources (scientific, aesthetic and cultural).

Before implementing any policy to conserve, an assessment must be made to rank the value of the specific heritage resource. Here, the writers have proposed an assessment scheme that evaluate (adapted by Ibrahim Komoo, 2003) the heritage value of Gunung Rapat which is part of Kinta Valley Karst. Values used to rank the heritage significance of Gunung Rapat (Table 1). The distribution of areas being exploited and the divisions of the value given is shown in Figure 9 and Figure 10, respectively.

Gunung Rapat is an example where ranking of it as a heritage site was carried out based on studies of some of its karst features and their scientific importance in Gunung Rapat so far.

A proposed policy for a balanced conservation and exploitation must meet certain criteria. Below are some suggestions on how to develop such areas:

Sustainable utilization of Kinta Valley Karst

A sustainable exploitation method can be implemented in the Kinta Valley Karst. An alternative to surface quarrying and mining is subsurface/underground exploitation. Implementation of such a policy will preserve the heritage resources from destruction through blasting of the limestone hills. However, it is crucial to first identify heritage sources within the exploited areas that need to be preserved. Ibrahim Komoo and Hamzah Mohamad (1993) proposed the application of geological knowledge to the development of ecotourism activities. Geological characterization of new and existing tourism destinations should be carried out and recommendations to utilise the heritage in a sustainable manner should be made.

Geopark

The Kinta Valley Karst is an area where natural heritage resources are found in urbanised and industrial areas. We propose that the Kinta Valley Karst be conserved and developed as a UNESCO geopark (Ibrahim Komoo, 2002). This concept offers the opportunity to recognise, protect and enhance Earth heritage sites at the global level. Kinta Valley Karst Geopark will recognise the relationship between people and geology implement policies that practise conservation with ongoing economic development. We also purpose that geological and landscape heritage resources such as, the Geological Park, Geological Monument and Protected Sites concept be incorporated in the Kinta Valley Karst. We recommend that their existing aesthetic and cultural heritage resources such as the recreation parks, temples, these archeological sites be preserved in their present state.

CONCLUDING REMARKS

The karst landscape in Kinta Valley area is of great importance in terms of scientific value. To the general public, it has became increasingly significant with cultural and aesthetical appeal. However, in the very same areas, limestone is being exploited for economic purposes. Thus, it is important to identify the crucial areas that need to be conserved. A policy that balances between conservation and exploitation activities must be implemented in these areas.

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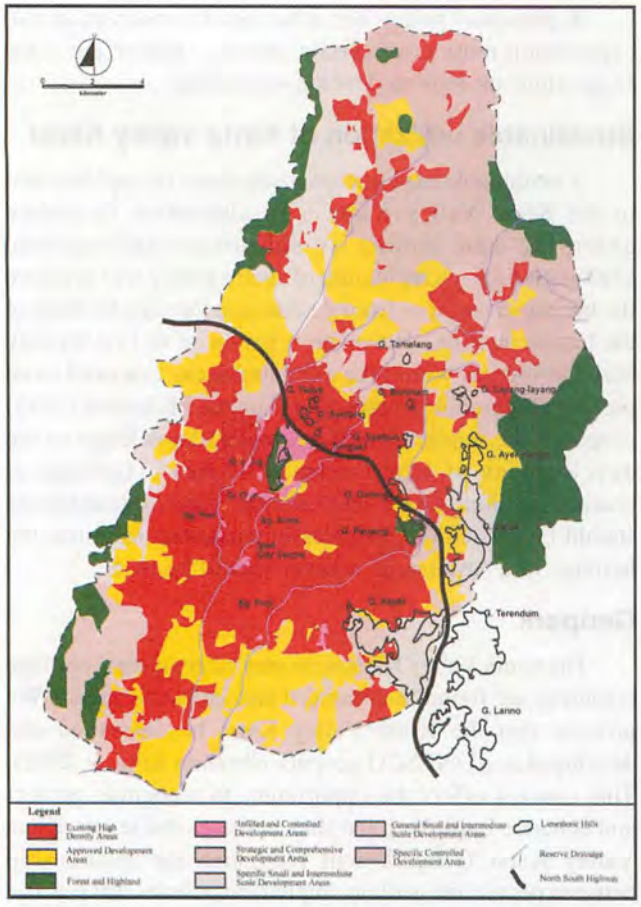

Figure 7. The location of limestone hills in the structure plan map.

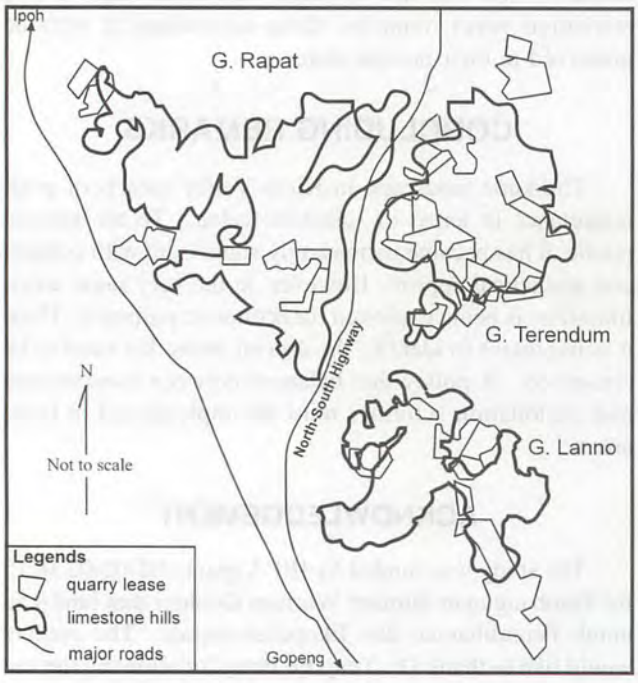

Figure 8. Quarry lease locations in Kramat Pulai area, southeast of Ipoh.

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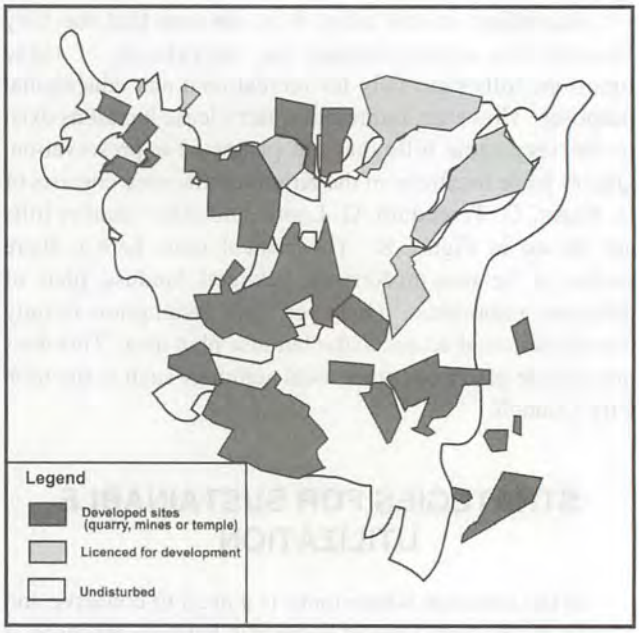

Figure 10. Locations of geological heritage sites in Gunung Rapat.

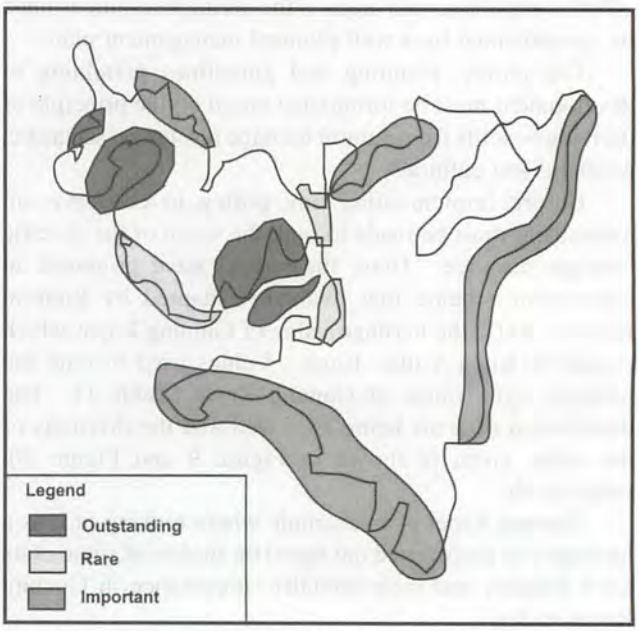

Figure 9. Distribution of areas being exploited in Gunung Rapat.

Table 1. Values used to rank the heritage significance of Gunung Rapat.

Value	Basic Description
Outstanding	Unique in terms of scientific record, special landform or features, significant occurrence or distribution or combination of any of the above criteria.
Rare	Rare in terms of scientific record, special landforms or features, significant occurrence or distribution or combination of any of the above criteria.
Important Heritage	Contains important scientific record and suitable for education and research purposes.

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