

The origin and characteristics of notches in the limestone hills in Peninsular Malaysia

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Massive limestone hills occurring in the tropics usually take the form of steep sided hills known as the tower karst. In the Kinta Valley, the tower karst is regarded as the mature type consisting of isolated small to large mogote hills rising above an alluvial plain which is largely underlain by the Kinta Valley Limestone. The mogote hills are largely found at the eastern to north-eastern part of the Kinta Valley for an area measuring 30 km long and 5 km wide. A number of mogote hills (Kanthan area) also occur in the north-western part of the Valley. The mogote hills in the Kinta Valley is observed to continue vertically downwards till the platform levels of the buried karst which underlie most parts of the Kinta Valley underlain by the limestone.

Notches are horizontal solution grooves of varying depths common found cutting into the foot of the mogote hills coinciding with or above the local swamp levels. Typically the Kinta Valley notches are the multiple level type. The tallest recognizable notch is about 14 m from the present alluvial plain level or about 23 m from the platform level of the subsurface or buried karst. From the 23 m to the 13.5 m level above the major platform level, the notches are the horizontally grooved or scalloped type with the height of the scalloped grooves ranging from a few cm to 50 cm. Below the 13.5 m level to the level of the present ground

surface (and swamp level or about 7 m above the platform level) the notches are the multiple level horizontal roof type. The deepest horizontal roof notch is determined to be 7 m cutting horizontally into the foot of the mogote hill of Gunung Rapat. The vertical height of this deep notch is 2 m.

It is believed that no marine processes had played any role in the formation of these notches. The notches were formed as the result of the freshwater groundwater or swamp cut and the shape and horizontal depth of the notches were related to the conditions and the recession of the levels of the groundwater or swamp water levels.

It is believed that the notches were dissolved into or etched on the vertical to subvertical surface of the mogote hill which were platformed as the result of an earlier transgressive solution phase. After the main platform of the buried karst were formed, the platform surface were subjected to periods of dryer climatic conditions. The precipitation was sufficient to allow mainly vertical solution resulting in the formation of rounded pinnacles and dolines under some alluvial/ soil cover. These resulted in the reworking and the formation of the tin-bearing old alluvium. During about Late or Middle Pleistocene and coinciding with the eustatic rise in the sea level in the Sundaland region, a wetter condition existed. The formation of the Transitional Unit part of the alluvium took place during this time. The Transitional Unit Alluvium is composed of massive non-bedded "granite wash" indicating sporadic mass flow transport and sedimentation. It is believed that the granite wash was quickly eroded during periods of seasonal flood which deposited the Transitional Unit Alluvium en masse in part as colluvial deposits. The Transitional Unit is thickest near the siliceous highlands and become thinner at the lower parts of the valley. However, it is believed that at the Gunung Rapat area the deposition of the Transitional Unit reached a level of at least 23.5 m above the present ground level. The Transitional Unit at that time had covered up the foot of the vertical and subvertical mogote hills such as Gunung Rapat.

This level of deposition was temporary as this was above the stable base erosional level prevalent at that time. The coming of the more wet condition resulting from further rise in the eustatic sea level, the Transitional Unit Alluvium become saturated. The groundwater level had probably reached a level of 23.5 m above the present ground level and had started etching into side of the mogote hill. Meanwhile, the temporary depositional surface was denuded as the result of erosion and formation of river system in the Kinta Valley. The result of such solution and etching had caused the formation of the horizontal scalloped notches from 23.5 m to the 13.5 m level. Below this level, the climate must have become very wet and swampy condition was formed around the mogote hills. The solution now is believed to be faster and the vertical denudation rates had become slower. The resultant solution consist of the flat roof notches which were found at between the 13.5 m to the 7 m (or 4.5 m to -2 m relative to the present ground level) above the major platform level. This period of notching under swamp condition is believed to mark the onset of the Holocene.
