

PRELIMINARY OVERVIEW ON THE KARST AREAS OF KALAW (MYANMAR)

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Southeast Asia hosts some of the most relevant karst areas in the world, many of which are in the Indochina Peninsula. Due to the severe restrictions of the government, the karst areas of Myanmar (former Burma) are actually those less explored and studied.

In 2005, in collaboration with the Universities of Bologna (Italy) and Yangon (Myanmar), the association La Venta organized a first expedition to Shan State (NE Myanmar) in order to carry out a preliminary investigation on the karst areas. Unfortunately, the present political situation does not allow further investigation in what is probably one of the most interesting karsts of Indochina.

The investigated area lies within a radius of ~70 km around the town of Kalaw and represents the most western branch of a large plateau made of Permian limestone and dolomite, which extends across a great part of central and southern Shan State. The landscape is characterized by a series of rounded ridges, N-S oriented, which share different basins flowing southward.

The area shows many of the typical geomorphic features of tropical countries. In the carbonate areas the relief displays abrupt ridges, conical hills and large closed depressions. Cockpits and blind valleys mainly occur on limestone, whereas, on weathered dolomites we find hills and cone-karst. The same landscape occurs on the Mesozoic carbonate conglomerates.

During the period of field investigation 27 caves were surveyed. Due to the wide extension of carbonate rocks, most of the investigation should be considered as a preliminary survey, aimed at identifying the most interesting areas. Major caves were accurately surveyed, collecting a total length of about 4 km of cave topographies along with zoological sampling and preliminary geological and hydrogeological studies.

1. Introduction

The Indochina Peninsula hosts some of the most relevant karst areas in the world. Due to severe restrictions by the government, the karst areas of Myanmar (formerly Burma) are actually the least explored and studied.

In 2004, the La Venta Association undertook a reconnaissance expedition in Shan State (NE Myanmar) in order to get a preliminary insight of the karst areas. This mission allowed us to pinpoint many interesting areas but finally we decided to focus our researches on the zone south of the town of Taunggyi. The second expedition was carried out in February 2005 (De Vivo et al., 2006). The team, composed of 13 cavers from La Venta and 6 researchers from Yangon University, focused its effort on the area close to Kalaw and on a wide karst area located to the west of the village of Pinlaung, about 70 km to the south (De Vivo and Piccini, 2006). Due to the wide extension of carbonate rocks, most of the investigation should be considered as a preliminary survey, aimed at identifying the most interesting

areas for further and more detailed research in future years. Major caves were accurately surveyed, collecting a total length of about 4 km of cave topographies. Photo and video documentation were also carried out, along with a zoological sampling and preliminary geological and hydrogeological studies.

2. Geological and Geomorphologic Overview

The investigated area lies within a radius of about 70 km around the town of Kalaw and represents the most westerly part of a large plateau made of Permian limestone and dolomite. The landscape is characterized by a series of rounded ridges, N-S oriented, which separate different basins flowing southward, the widest of which is the Paung Laung River. The ridges are made up mainly of carbonate rocks where a well-developed karst landscape occurs.

In the area, two different karst units exist. The most important is part of a thick series of dolomites and limestones of Permian-Triassic age (“Plateau Limestone”)

(Thura et al., 2002). This carbonate unit is covered by Mesozoic "Red Beds", which are made of shales, mudstones and sandstone (Brown and Sondhi, 1933). The second karst unit consists of thick Cretaceous conglomerate sequences, which lay unevenly on shaly Mesozoic sequences. Fluvial environment conglomerates are made of well-rounded polygenic elements, mainly from Permo-Triassic carbonates and some red siltstone pebbles, held in a reddish calcareous matrix and inter-bedded with sandstone. On the old geological map, these are known as the "Kalaw Red Beds" and dip at approximately 40 degrees eastward.

The area is characterized by N-S tectonic lineaments, either compressive or extensive. Roughly, the "Limestone Plateau" ridges correspond to anticlines, whereas conglomerates match to wide curvature synclines. W of Pinlaung, the carbonate outcrops consist of parallel ridges due to E-facing thrusts.

The area shows many of the typical geomorphic features of tropical countries. Topography is controlled mainly by lithology: where clastic rocks outcrop, the landscape consists of rounded hills, with a thick cover of soil, conversely, in the carbonate areas the relief displays abrupt ridges, conical hills and large closed depressions. Cockpits and blind valleys mainly occur on limestone; on weathered dolomites we find hills and cone-karst probably due to a more rapid evolution of the landscape. The same landscape occurs on the conglomerates; in this case the formation of cockpits, instead of cones, depends moreover on the morpho-structural setting, with the formation of the former in the low-gradient areas and the development of the latter in the high relief.

3. Description of Studied Areas and Caves

Our investigation tours took place from the village of Kalaw. Due to the number of caves indicated by local people

we were obliged to get only a quick look at most of the karst areas of this region. The areas with the most speleological potential are the mountains formed in the Plateau Limestone belonging to the long N-S strip running W of Kalaw (Fig. 1). During the 2005 expedition our efforts were concentrated mainly in some of the areas close to Kalaw and close to the village of Pinlaung, about 80 km further south, which are here described in more detail.

3.1. The conglomerate karst in the neighborhood of Kalaw

Just to the west of Kalaw, wide outliers of "Red Beds" conglomerate occur. In the topographically favored areas, we find several closed basins, up to 2-3 km² wide, where water flows along blind valleys that feed stream sinks. Minor

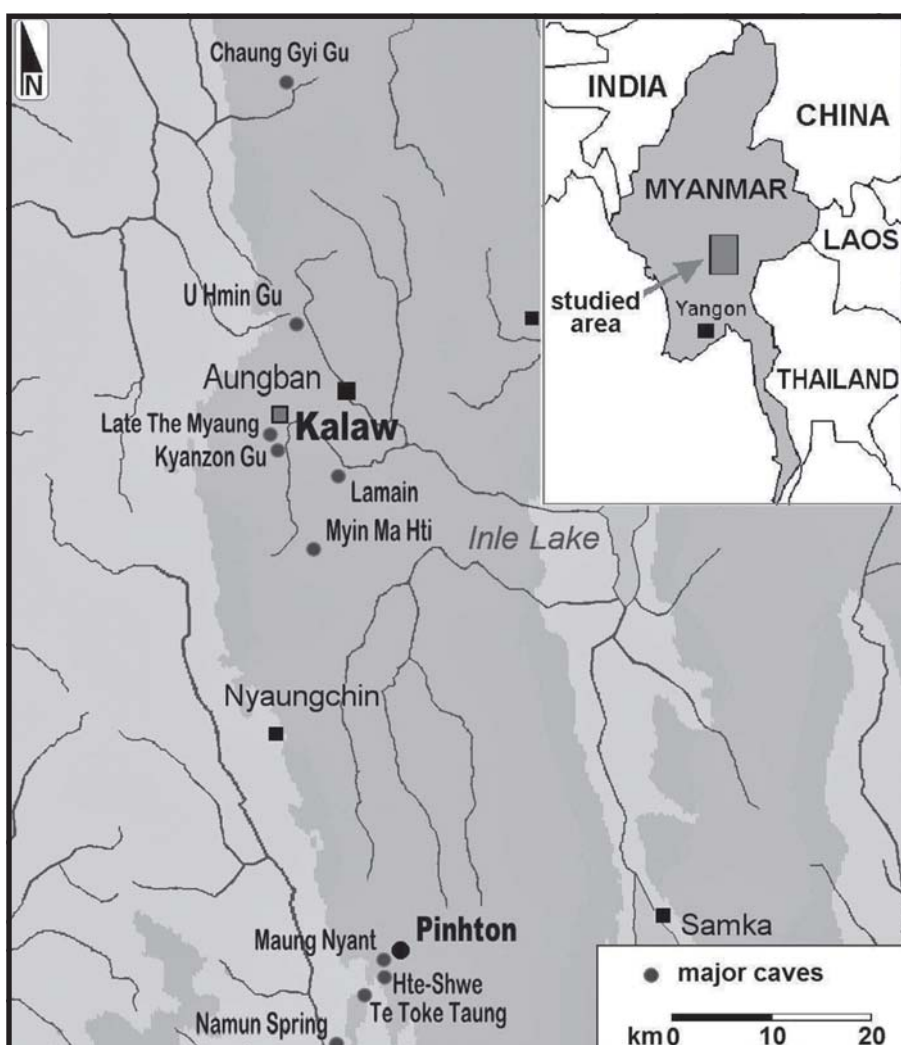


Figure 1: Sketch map of the investigated area with the location of major caves.

depressions have variable shapes, ranging from the usual star-like plan of cockpits to the circular plan of dolines. Along the watersheds, we find bare rocks shaped as isolated blocks, pinnacles and rounded karren. The coarse nature of the conglomerates does not allow the development of dissolution sculptures, but the number, and extent, of caves demonstrate that this rock is particularly soluble.

The longest cave explored is the Late The Myaung Saint (Dead Tortoise Valley Sink), located about 1 km west of Kalaw (Fig. 2), which represents the present-day sink for the Late The valley. The first part consists of a wide and irregular room affected by rock collapse. Going downwards we can reach an active tubular passage, only a couple of meters wide, which is directed towards the N following a fracture. A meandering route, with several pools, characterizes the middle part of the cave. In the final section, large rooms and active passages lead to the terminal sump.

The Late The Myaung Gu (Gu = cave) is located just a few tens of meters above the valley floor. This cave is probably an old swallow-hole. The entrance initially slopes steeply downwards and then levels out before becoming totally choked at the bottom. The cave is used by the ethnic Tibetan community as the site of a religious shrine.

Another interesting cave is the Kyanzon Gu, situated close to the Say Wingabar monastery to the south of the town and consists of two narrow passages that lead to a room with rock fall detritus. The cave follows a main fracture along

vadose meanders and epiphreatic passages, with deposits of sand and mud. In the final section, the cave becomes moderately active; here the cave shows parallel fissures and conduits, with sand deposits.

3.2. Areas north of Kalaw

To the north of Kalaw, Permian carbonate rocks outcrop widely, but do not show intense karst features, due to the smooth topography and to the occurrence of thick red soils cover. In some places, limestone residual hills characterize the landscape; in the largest of these, some caves occur, mainly due to lateral infiltration of water.

A typical example is the U Hmin Gu (Fig. 3) that is found in an isolated hillock, formed in the Plateau Limestone, and is of great archaeological and religious importance with hundreds of ancient Buddha images dating back to possibly the 14th-16th century. The cave has two entrances that open onto the first chamber where most of the images are to be found. A side branch leads to the second part of the cave that consists of a maze of tunnels and rooms of different sizes. In the furthest part, a pit of 15 m leads to a lower level characterized by a muddy floor, which ends with high passages.

Further to the north we find Chaung Gyi Gu (Big River Cave). The entrance is large and a terrace of gours spans the passage inside. The passage is around 6 m wide and 10 m high with a highly sculpted floor and continues to a shaft on the right-hand side. Straight ahead the passage becomes

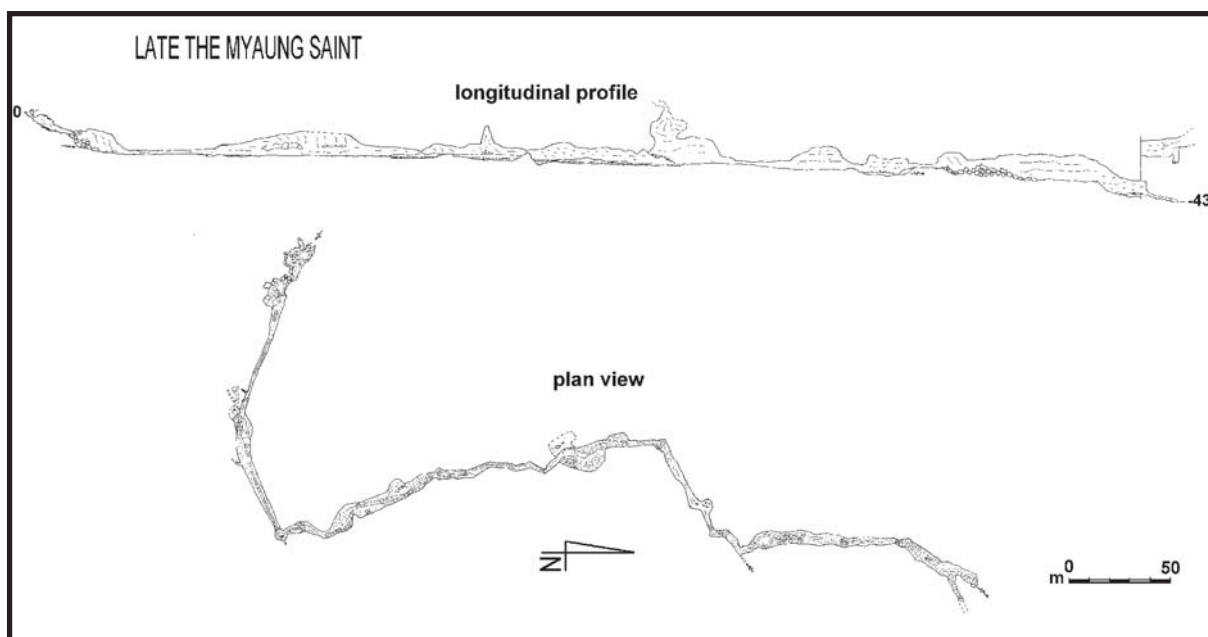


Figure 2: Longitudinal profile and plan view of Late The Myaung Saint Cave (survey: E.G. La Venta, 2005).

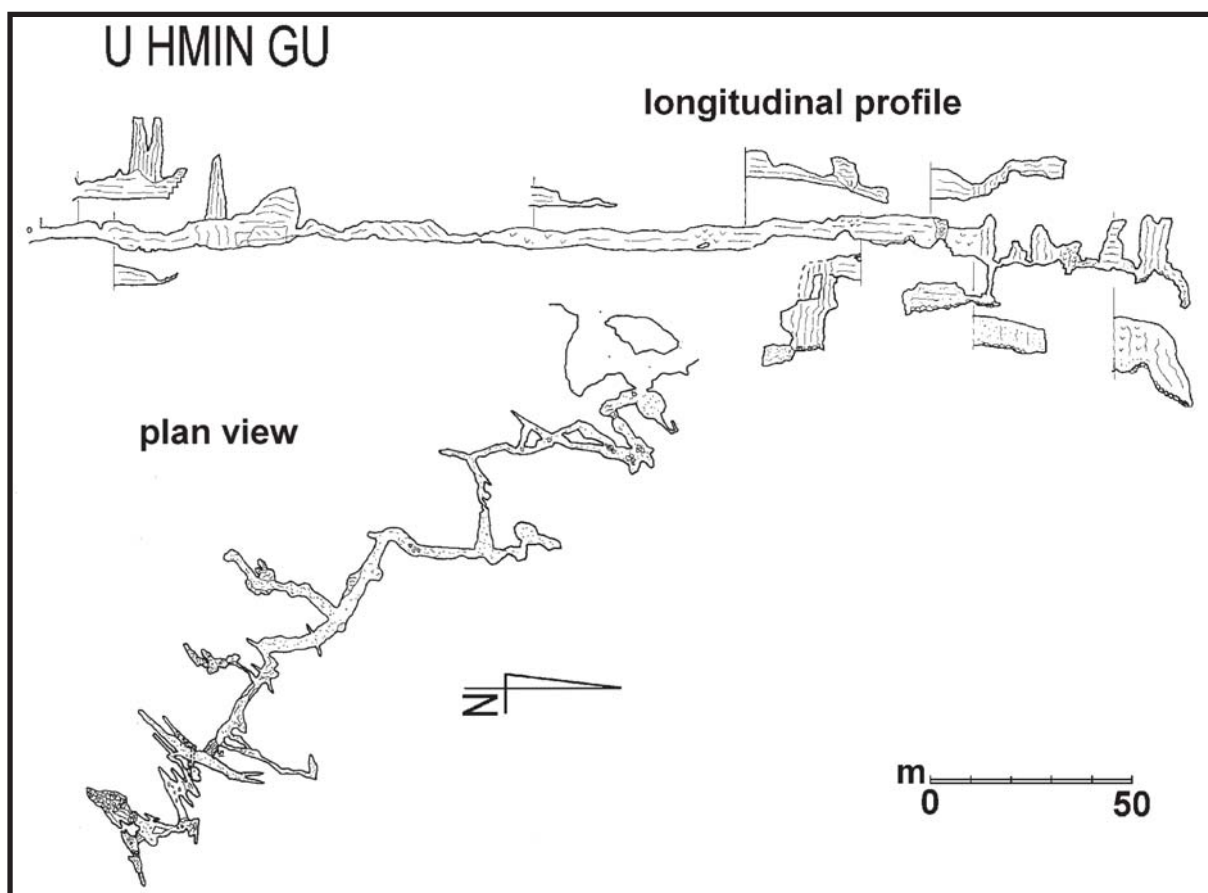


Figure 3: Longitudinal profile and plan view of U Hmin Gu cave (survey: E.G. La Venta, 2005).

narrow and meandering before ending after about 80 meters.

3.3. Areas west of Kalaw

A few kilometers west of Kalaw is an area which shares a similar morphology to that of the area to the west of Pinlaung (see below). In fact it is the northerly continuation of that same dissected ridge with steep slopes that are densely forested and highly karstified. Although time restraints prevented any concentrated efforts in this area two large caves were found. Near the village of Lebyin is a large resurgence cave, Yang-Nyaung Gu. Even in the dry season the issue from this cave is big enough to irrigate a very large cultivation area. The spring itself was not penetrated very far but a huge upper entrance is said to go back down to the water beyond any blockage. Twinn Li (Bad Smell Cave in the local Palaung language) is another large spring situated near the village of Pinmon, a little further south. It was dry when visited and a large passage (10 m x 7 m) was followed for about 200 meters and the way on is wide open. There is however great potential in both these caves and in other caves nearby.

3.4. Areas south of Kalaw

Towards the south, the limestone ranges display a karst landscape with several promising areas. In all this area we did only a rapid investigation of the most accessible caves.

Lamain Cave is located to the east of the road to Pinlaung, and is a huge open pit that landed in a large daylight chamber with a further pit of around 20 meters. On the rim of the second pit, a wood platform is used to lift the guano from the bottom of the cave. This pit opens into a large chamber hosting a bat colony. From the chamber, two different passages proceed; the first, ascending, contains calcite deposits while the second is accessible through a lateral pit.

Myin Ma Hti Cave is used for religious purposes and is filled with many Buddha images. It is located about 6 km SE of Kalaw. It consists of a karst tunnel, which acted as a phreatic tube in the past, joining some large subterranean rooms. In places, side cavities and short branches may be found. The second part of the cave consists of a wide chamber with different levels. Man has heavily modified the cave and

the floor is artificial, and thus it is not easy to recognize its natural morphological features.

3.5. Area SW of Pinlaung (Namun Karst System)

Seventy km to the south of Kalaw and 10 km to the W of Pinlaung village, a broad limestone ridge runs N-S. In the middle part, the ridge is 6-7 km wide and is bounded to the west by the Paung Laung River. Steep slopes, rock walls, and sharp watersheds dividing closed basins characterize the landscape. On the east side, some blind valleys feed stream sinks. In short, it is a typical situation of contact karst, where some rivers, with the upper basin made of impermeable rocks, are forced to cross a carbonate ridge through underground passageways, direct to the Paung Laung valley. The whole karst area is characterized by closed depressions and cockpits, which imply a high development of endokarst. This area belongs to a wide carbonate plateau that is probably divided into different hydro-geological

systems flowing towards the SW. The largest among them is located just west of the village of Pinhton and is fed by a basin of about 30 km² that converges on a huge swallow hole, along a first narrow carbonate ridge located close to the village of Pinhton (Fig. 4).

The stream, which has here a discharge of about 1 m³/s in the dry season, passes through a large karst tunnel 270 m long, named Hte Shwe Cave, flowing out in a nearby valley, developed again on the impermeable Cretaceous rocks (Fig. 5). The entrance consists of a large portal, about 40 m high, which continues with a canyon occupied by a lake about 80 m long and closed by a big flowstone. An upper gallery, which enlarges in a room rich with stalactites and gours filled with pisolites, again reaches the stream after a path of about 50 m. After a small descent between large rock blocks, one reaches the exit of the cave. The last chamber, about 40 m long and 20 m high, presents large terraced deposits of sands and gravels, probably formed during the rainy season and eroded in the dry one.

After a path of 5 km southward, the river ends at a second huge swallow hole named Te Toke Taung Cave. The entrance is a portal about 40 m high where the water falls into a large shaft, about 50 m deep. The waterfall jumps into the bottom of the shaft, occupying the whole section of a canyon that continues towards the north.

The river probably resurges at the Namun Spring. Here, just above the upper spring, two small entrances open at the foot of the steep edge of the karst, along the Paung Laung River. From the lower entrance it is possible to reach the first part of a large gallery completely occupied by a lake. The opposite shore of the lake is not visible. Some hundreds of meters downstream, the water rises up diffusely among the blocks of a large rock fall.

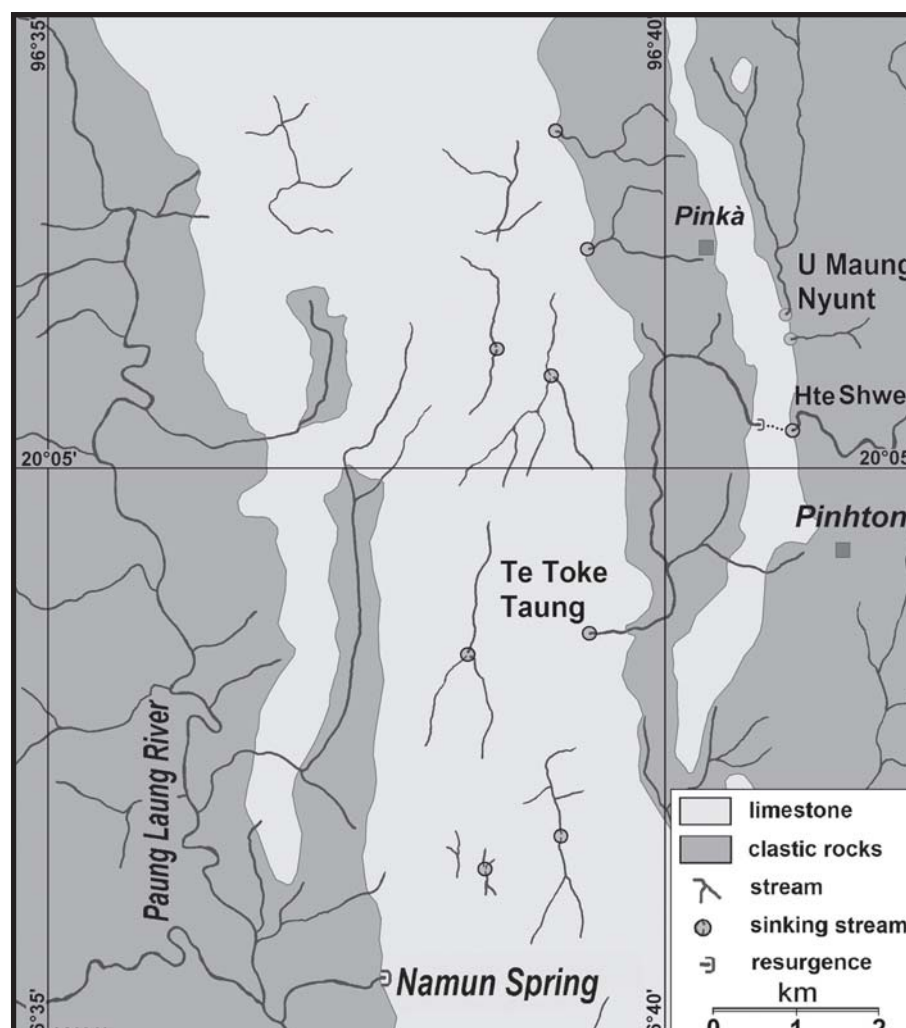


Figure 4: Sketch hydrogeological map of Namun Karst System.

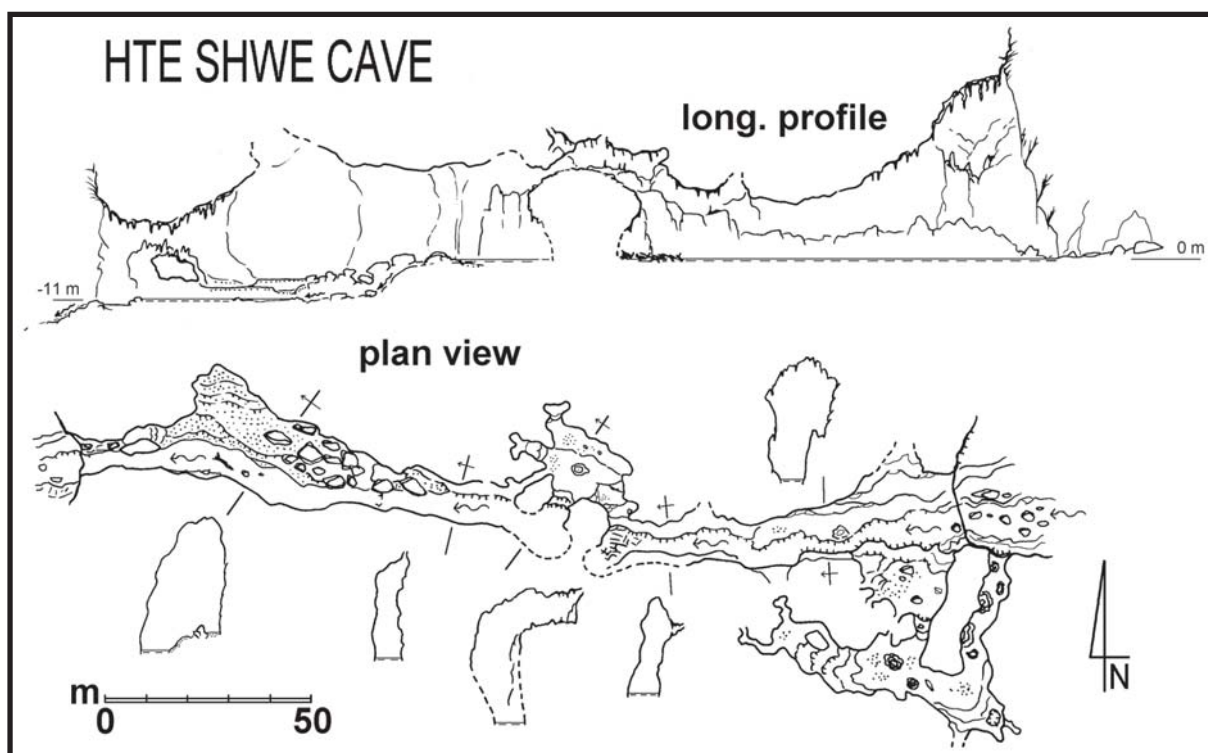


Figure 5: Longitudinal profile and plan view of Hte Shwe Cave (survey: E.G. La Venta, 2005).

The stream so originated receives other secondary tributaries. The spring collects the waters from a wide area, located N and NW, the extension of which, based upon the discharge ($3 \text{ m}^3/\text{s}$ in February 2005), could be estimated around 100-150 km^2 . If this is true, during the rainy season the flood

discharge of the spring could reach $100 \text{ m}^3/\text{s}$ or more.

One of the most promising caves of this area is the Maung Nyunt Cave, located about 4 km N of Pinhton (Fig. 6). The entrance absorbs a small creek whose water (about 120 l/s

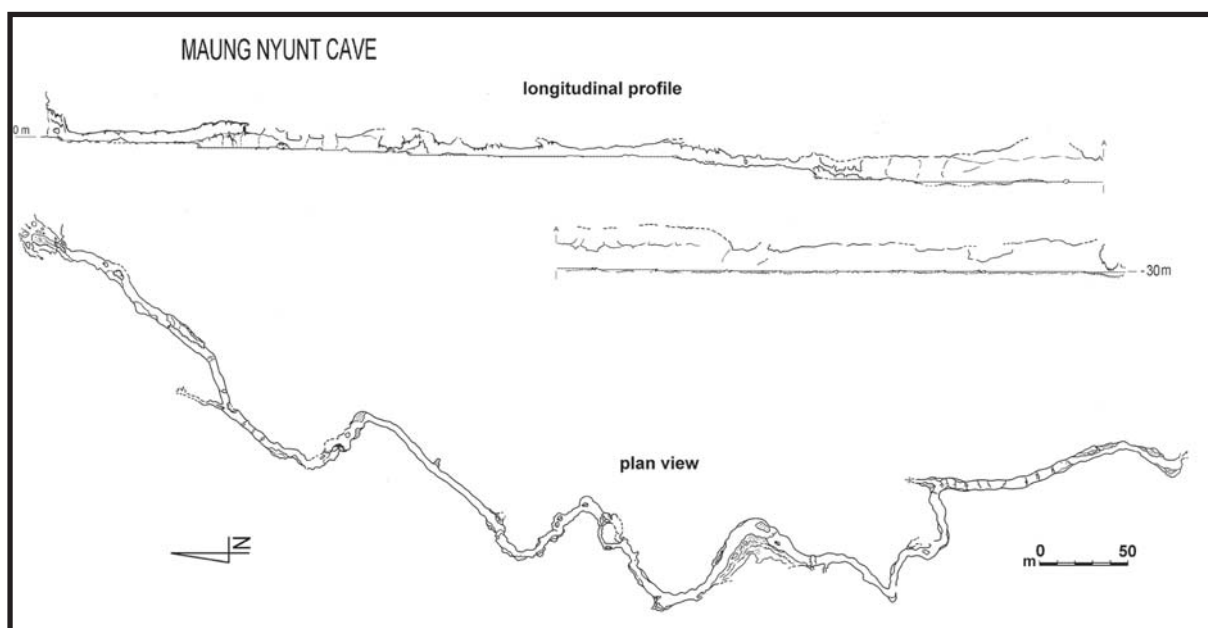


Figure 6: Longitudinal profile and plan view of Maung Nyunt Cave (survey: E.G. La Venta, 2005).

in February 2005) mostly sinks just before the entrance. Beyond the entrance, a regular shaped gallery, 4–5 m wide, goes toward the SSW for about 100 m, followed by a canyon-like tunnel, with local flowstones and stalactites. The canyon proceeds with an angular pattern for a further 150 m. After some passages with small rapids and pools, a tight fissure on the right gives access to the second part of the cave, where the canyon becomes 6–8 m wide and up to 30–35 m high. Deep pools, bounded by gours and sandy banks, form the floor. At about 800 m from the entrance, the cave receives a tributary on the left, not yet explored. Probably this is the connection point with another only partially explored cave, that is located about 500 m S of the entrance. Going downstream, the gallery continues with a regular cross-section and a series of gours and small dams of travertine form the floor. The cave continues with similar features further than the exploration limit.

3.5 Areas around Pinlaung

The village of Pinlaung lies in a plain, N-S elongated, surrounded by karst landscapes. To the west, we find some disrupted karst hills surrounding minor closed basins, whereas, to the east, a wide outcrop of dolomites displays karst towers and small depressions. In this area we have performed just a quick survey of some caves known by local people.

The most promising cave is an active stream sink, named Nanhpa (or Nant-par), which drains a closed plain 3 km NW of Pinlaung. The cave was explored for about 100 m along a canyon-like passage about 5–6 m wide and more than 15 m high. The floor is occupied by water and the airflow can be easily felt.

Name	Altitude m a.s.l.	Vertical range m	Length m
Late The Myaung Gu	1290	- 10	60
Late The Myaung Saint	1275	- 43	650
Myinn Ka Gu (2 entrances)	1507	-50 +14	100
Kyaing Sung Cave	1364	-2 +29	523
U Hmin Gu	1269	-21 +20	625
Myin Ma Hti Cave n° 1	1330	-17 +12	360
Myin Ma Hti Cave n° 2	1343	-19	116
Hte-Shwe Cave	1130	-12 + 30	270
Maung Nyunt Sinkhole	1135	- 28	> 900
Te Toke Taung Cave	870	+14, -50	100
Bat Cave	1070	- 54	180
Namun Spring Cave	370	+2	> 50

Table 1: Location and dimensions of major explored caves.

4. Conclusions

The preliminary investigation of the karst around the town of Kalaw has allowed us to gather initial information which has revealed a really promising potential for further cave exploration. Twenty caves were explored and partially surveyed for about 4 km of passages (Table 1). The major expectative concerns the region S of Kalaw, close to the village of Pinthon, where wide closed basins collect the water towards several sinks which probably belong to a unique karst system feeding the huge spring of Namun. The distance from the major stream sink and the resurgence is more than 6 km in a straight line, which leads us to suppose a complex and ramified subterranean system several tens of kilometers long.

Unfortunately the present political situation in this really “difficult” country has not allowed us to continue the exploration of this fascinating tropical karst of Southeast Asia.

Acknowledgements

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(Further information can be found at <http://www.laventa.it>).