

Shan Plateau Expedition 2012/2013

Final Report

Summary

The Shan Plateau Expedition in December 2012 and January 2013 was a six person three week caving expedition spent based in Ywangan Township in the Southern Shan State of Myanmar (Burma). The expedition followed on from three previous expeditions to the Shan region in 2010, 2011 and 2012. The Shan Plateau Expedition 2013 was a six-person three-week caving expedition to the Ywangan Township area in the Southern Shan State of Myanmar (Burma).

The 2013 expedition was highly successful, more than doubling the length of the longest known cave in Myanmar (Kyauk Khaung – ‘Stone Cave’) from 2.3 km to 4.8 km. A major drafting lead (Heart of Darkness; see attached survey) was left ongoing at the base of a > 30 m pitch, where the final pushing/derigging team ran out of rope dangling above open passage. The surveyed depth range of Kyauk Khaung was 92 m in 2011/12, and is now 148 m. The lowest and highest surveyed points of Kyauk Khaung are both ongoing leads. Heart of Darkness is heading towards a major depression near the village of Linwe (see Figure 1). The 2013 expedition found two major resurgences, and a large strongly drafting sink within the Linwe depression, each locally more than 10 m in diameter. This opens the possibility of a major cave system extending from Kyauk Khaung to the Linwe Depression (~3.5 km in a straight line), with the Khauk Khaung water most likely resurging 4.5 or 7.5 km from where it sinks, with > 300m of elevation change (Fig. 2). Two extremely large well decorated passages (> 50 m wide; > 25 m high) were found near Kyauk Khaung, at a higher level, suggesting multi-level development.

The 2013 expedition therefore started to bear the fruit of the 2010, 2011 and 2012 expeditions, and has established the world-class caving potential of the Ywangan area. The 2013 expedition collected, and preserved, samples of the first cave-adapted fish reported from Myanmar. Scientific links have been established between the Universities of Mandalay, Oxford, and Kunming to provide a detailed analysis these new species of cave-adapted fish.

Caving in Myanmar requires both national and local permissions and careful liaison with the local authorities and in some cases monks and monasteries. As in previous years our national permissions were obtained in advanced by Phyo Wai Yar Zar and local permissions were negotiated by our guide Yan Naing. In Ywangan, access was typically straightforward, although we were subject to a night time curfew and had to return to the town before dark. We strengthened relations with our national and local contacts in Ywangan. We have been told that we can stay in the village by the main cave entrance next year, which will increase the length of trips to the far reaches of the cave

Note that the compilers of this report and the members of the expedition agree that any or all of this report may be copied for the purposes of private research.

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Expedition Members

Peter Talling

Ben Wright

Tim Guilford

Lui Hong

Fleur Loveridge

Lou Maurice

If you would like further information regarding this expedition then please contact the Expedition Leader, Peter Talling on Peter.Talling@noc.ac.uk

With Thanks

Myanmar is not always a straightforward place to travel and this expedition would not have been possible without the ongoing help and assistance from Mr Phyo Wai Yar Zar, Managing Director of All Asia Exclusive and vice chair of the Myanmar Tourism Promotion Board. We are also indebted to our driver Dan Oo who always made sure we got there regardless of the state of the roads, and our new guide Daniel Htwe.

We were also fortunate to receive financial support from the Mount Everest and Ghar Parau Foundations. Visiting Myanmar is not a cheap activity and we are therefore extremely grateful for this contribution. We hope that the caving potential of Myanmar is now beginning to be unlocked, with ongoing underground leads within a 4.8 km long cave, and adjacent large entrances found ready for next year. As always, the local people in and around Ywangan were incredibly friendly.

Introduction

Background

This was the fourth Myanmar Shan Plateau Expedition, following on from the successful reconnaissance trips carried out in 2010, 2010/11 and 2011/12. This in itself had been facilitated by early preparatory work by Joerg Dreybrodt, which had made key contacts and used these to carry out a short expedition to Southern Myanmar.

This year the expedition was focused entirely on the area around Ywangan Township. This area, in the north western corner of the Southern Shan State (Figure 1) had originally been identified by the team as having karstic potential during early geological research prior to the 2010 expedition. However, it was not until the expedition in 2010/11 passed through the area en route to Lashio that people hopped enthusiastically from the back of the moving truck, and found very well developed karst. The majority of the 2011/12 expedition was based in Ywangan, and found 2.3 km of passage beyond an impressive river sink in Kyauk Khaung ('Stone Cave'). This made Kyauk Khaung the longest (and briefly deepest) cave in Myanmar. Extending and deepening Kyauk Khaung was a major objective for the 2012/13 expedition, which also aimed to explore for further entrances within the surrounding area.

Permissions

Permissions for the 2012/13 expedition were obtained at the national level via Mr Phyo Wai Yar Zar, Managing Director of All Asia Exclusive and vice chair of the Myanmar Tourism Promotion Board. Mr Phyo was able to arrange for special permission for the expedition to stay in Ywangan Township, something not normally afforded to foreigners who are required to stay in licenced hotels only. We later discovered that tourist cycles tours do sometimes stay in Ywangan, but with the proviso of passing through and staying for one night only, rather than the facility to base an expedition in the area as we required. Without such special permissions it is clearly impossible to carry out expeditions in these areas and we are grateful to the authorities for facilitating this. Locally, the Immigration department in Ywangan granted permissions day to day with respect to the destinations we wished to visit. The length of Kyauk Khang now means that future trips will really need to be based in local villages nearer to the cave entrance, to avoid the 45 minute drive each way from Ywangan itself. Mr Phyo believes that it will be possible to stay in the local villages next year, and this will be key. A true 4 wheel drive vehicle may also be needed to access some of the new areas in an efficient manner, although we hope this will not mean losing our old driver Dan Oo.

a)



b)



Figure 1 Location of the Shan States; a) Location of the states in Myanmar; b) Area of the Shan States

Travel & Accommodation Logistics

All six expedition members entered Myanmar at Yangon airport having travelled from Britain via Bangkok or directly from China. Internal flights were then taken to Heho, the regional airport which serves the nearby tourist sites around Inle Lake. At Heho the expedition team was met by its guide, **U Thet Nyo Htue**, its driver, **Dan Oo**, and the Mazda pickup truck which was to be our expedition vehicle.

The preceding Air Bagan plane that landed at Heho on Christmas Day overshot the runway and crashed, killing two passengers and a further person on the ground. From what we saw of the

remains of the plane, it was surprising that anyone survived. Talling had originally planned to book this earlier flight for the expedition team, but left the booking to Mr Phyoe's team, who booked the subsequent flight.

Table 1 Expedition Time Line

Date From	Date To	Comments
24 th Dec 2012	25 th Dec 2012	Flight from Heathrow to Yangon via Guagzhou in China. Liu Hong flies in from Kunming. Team meet in Yangon.
25 th Dec 2012		Travel to Heho; preceding plane crashed at Heho airport killing 3 people.
26 th Dec 2012	10 th Jan 2013	Caving in Ywangan Township area
11 th Jan 2013		Travel to Yangon via Heho; night in Ywangan
12 th Jan 2013	13 th Jan 2013	Flights back from Yangon to Heathrow and Kunming.

Ywangan Township

The first phase of the expedition was based in Ywangan Township (Figure 2). Although not a restricted area, we required special permission to stay here for an extended period. Local permissions were straightforward and simply required informing the local Immigration officials of our plans for each day and then returning to the town before night fall.

There are no hotels in Ywangan and the expedition stayed in the main guesthouse in the town, a small, but clean and cheerful establishment not far from the main road. Typically the guesthouse catered for those travelling the road from Mandalay to Kalaw, with the occasional addition of passing westerners on cycle tours of the region. We took three rooms in the upstairs of the guesthouse, which in the absence of other guests gave us access to a larger communal room in which we stored our equipment. The guest house did not offer catering, but the town had several excellent restaurants and plenty of noodle and samosa bars for breakfasts. Overall, the logistics in Ywangan were straightforward compared to other areas we have previously visited in Myanmar and it proved to be an excellent and friendly expedition base.

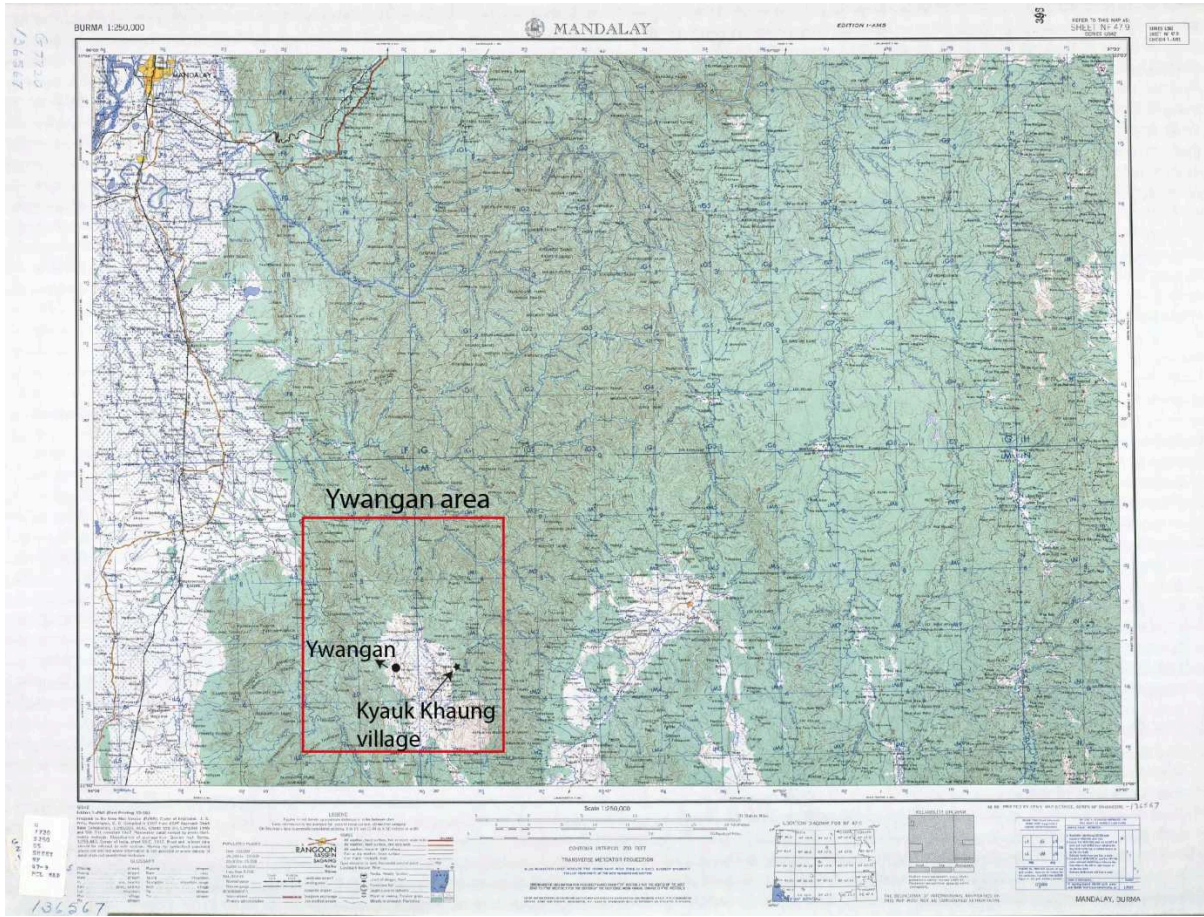


Figure 2. Showing the location of Ywangan and Kyauk Ngauk cave. Manadaly is in the top left part of the map.

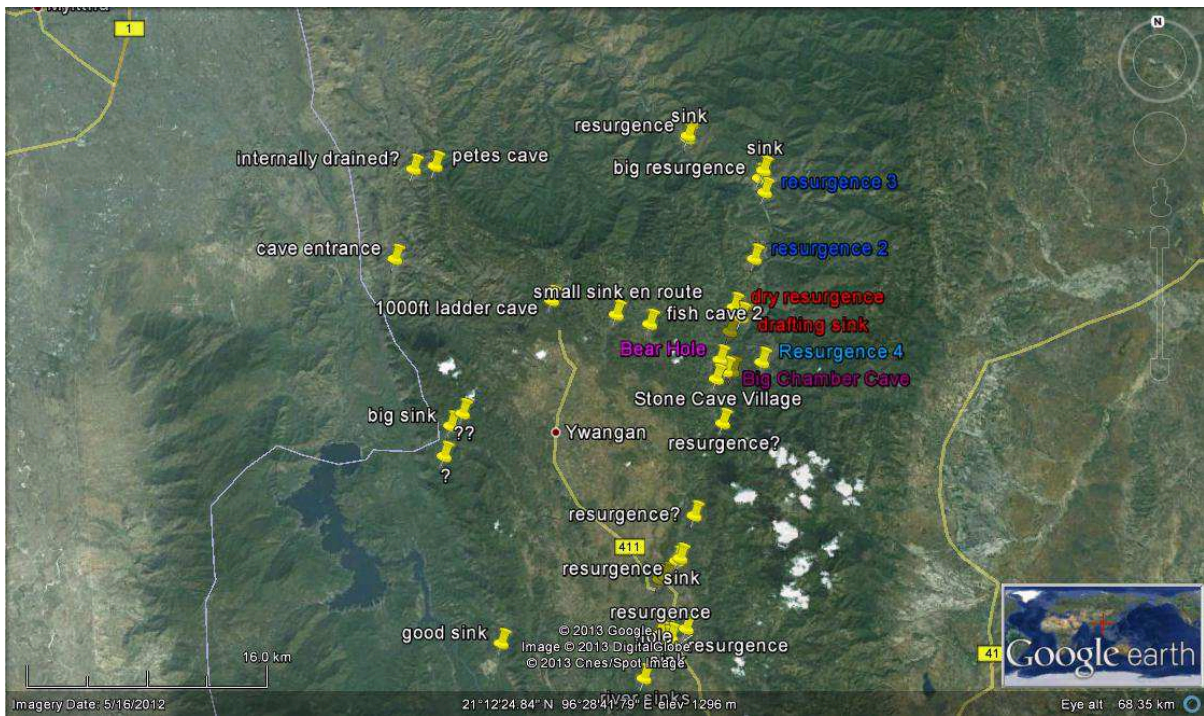


Figure 3 Locations of Main Caves Identified and/or Explored near Ywangan

Equipment

Over the three Shan Plateau expeditions we have now built up a supply of rope and rigging gear in Myanmar to allow exploration of small more vertical caves. In Ywangan we encountered more shafts than we have previously in the Hopong Region and the Northern Shan State. However, these were typically less than 40m in depth and were all blocked at the base. Nonetheless, given the relief in this area, and the proximity of the edge of the Shan Plateau to the west and the north, it is possible that more vertical development may be encountered in the future. We have now stored ~300m of rope with our guide in Ywangan, some of which was later used by the following Dreyboldt expedition further south.

Most exploration in Ywangan was carried out in one cave, Kyauk Khaung. Here most progress was horizontal, although an increasing number of pitches and climbs up in the downstream area did require the use of single rope technique. In addition we regularly used tapes for handlines on smaller climbs. Given the large built up of mud in some areas from the wet season floods, we also discovered that bamboo stakes or stemples provided excellent tools for scaling steep mud banks.

Surveying

All caves were surveyed to BCRA Grade 5 and the entrances logged using GPS. Surveying was by a mixture of traditional (hand held compass and clinometer in combination with a tape measure) methods and digital techniques. The latter used a “Disto” which allows laser measurement of distances, which particular useful in the larger passages discovered in Kyauk Khaung.



Figure 4. Surveying in Stalagmite Slalom in Stone cave

Cave of the Ywangan Township Area



Figure 5: View of valley and stream that sinks (to the left of photo) in Kyauk Khaung (Stone Cave)

Kyauk Khaung (Stone Cave)

Co-ordinates: E 096°33'09.4''; N 21°11'28.2'' (WGS 84). Length: 4,790 m. Depth: 149 m. [longest cave yet found in Myanmar; and second deepest]

The entrance to Kyauk Khaung is a large arch in a limestone cliff into which the Sin Lea (Elephant Whirlpool Creek) flows. It is accessed from the village of Kyauk Ngauk (Stone Bird), being 25-40 minutes walk down the closed valley from the village.

Text in Italics denotes passage explored previously in 2011/12. Please also see the main survey for a full map of the cave.

River and Entrance:

The river almost immediately flows down a short waterfall and progress is best made by clambering along and down the large mudbanks on the right hand side of the passage as you look down stream. The main river (below) passes around several bends before sumping after approximately 200m. Just before the sump it is possible to climb up to an eyehole, but no way on could be found.



Figure 6: (left) Entrance and (right) river passage close to the entrance of Kyauk Khaung

Catwalk: About 100m back from the sump a large highlevel passages, The Catwalk, goes off on the right. Despite being approximately 12m above the streamway The Catwalk, contains large amounts of fresh mud and large flood debris from the monsoon. In this mud, feline paw prints are numerous. Lou Maurice was lucky enough to see a Civit in 2012/13, which rapidly moved out of sight down the passage as mud bogged down the caver's wellies. The roof of the Catwalk soon rises up into a very large hading rift. About 100m further on, it is possible to climb up a mudbank to the right and enter Over 18 Series.

Continuing along The Catwalk, the passage becomes lower, crawling in places, but always drafting. After a further 150m a brief flat out section leads immediately to a junction. Right leads to a large chamber from which the stream may be heard but not accessed. It is likely that the far side of the chamber connects through to the area around Enlightenment, but this was not pursued due to a dangerous slope of mud and boulders. Back at the junction, straight on soon leads to a balcony overlooking the main stream, which flows from left to right.



Figure 7: Formations with Oo-la-la



Figure 8: Ooo-la-la looking towards the way to Independence Day

The cat-flap extensions:

A short distance along the catwalk shortly before the handline climb, it is possible to climb up (3-4 m) with difficulty on the right (facing in). A high step up behind and boulder and further scrambling up steep boulders leads to the top of the main rift. It is then possible to duck under the roof into a second medium sized chamber, and then follow a tortuous upward route between boulders – as first seen by Talling in 2011/12. There is a route at the same level along the top of the rift heading towards Ooo-la-la. Returning to the initial chamber, this route was extended upwards through an even more tortuous series of boulder, climbs and a small lateral narrow crawl for a considerable distance. The route is locally highly polished and is used by animals (cat sized or smaller from where polish seen between boulders). It was left at an upward tubular squeeze, and a 30 cm window into an adjacent large chamber, on the last day of the 2012/13 expedition. It is likely that further exploration will find a way on. The end of the passage is now the highest point in the cave, over 50 m above the entrance, and most likely leads to a second entrance used by animals in the vicinity of the path down from the nearby village.

Right Downstream & Enlightenment

From the end of the Catwalk, a climb down reaches a chamber with the river. The main stream is of noticeably smaller volume and soon splits again at a diffluence. To the right the water sinks into a choke of flood debris. However, shortly back from this it is possible to ascend a large mudbank via The Slayer's Staircase (a line of bamboo stakes) and enter Enlightenment. This huge chamber is effectively a steeply ascending boulder pile, some 60m wide and with 100m vertical range. The boulders can be very loose in places and care must be taken.

Stalagmite Slalom:

At the top of Enlightenment the boulders, almost, but not entirely fill to the roof. Here it is possible to crawl between the resulting gap. A wide but low passage extends for over 150m, often in close proximity to stalagmites and stalagtites, make this difficult and stressful. Towards the end of the explored passage the elevation starts to dip down steeply, until the limit of exploration. The cave is likely to continue here, but has not been pushed to a conclusion. It is very likely to continue downwards through loose boulders to the southern end of Edge of Enlightenment.



Figure 9: Tense survey team in Stalagmite Slalom.

The east side of Enlightenment is likely to connect back to the large chamber accessed from The Catwalk. However, as time and the difficult terrain did not allow inspection of all of the wall in Enlightenment this has not been physically verified.

To the west side of Enlightenment it is possible to rig an assisted climb down to connect to the area above the flood debris choke and then enter a small tube. This leads to an undescended 6m pitch.

Left Downstream – The Great Leap Forward

Back at the diffuence at the end of the Catwalk, the left hand fork of the streamway leads under a low arch to continuing stream passage. This does not last for long, however, as the stream then sinks, and a 3m climb down leads into a dry continuation. 10m further on it is possible to enter an oxbow heading back upstream where a pit allows the last sighting of the streamway.

A further 10m downstream another climb down (~4m) lands in a chamber. The only way out is via a small U-tube which leads to the foot of a climb up to a second chamber. From here further ascent is required, via a very steep mud slope into which steps were cut. As the gradient reduces the climb enters a passage full of boulders, with another climb up and a pitch down.

Much of this section could not be accessed in 2012/13, as the low passages had become blocked by cobbles carried in by floods.

Upstream – The Road to Mandalay

From the balcony the upstream passages continues for approximately 150m to a junction with an inlet. In these 150m, some of the flow sinks behind a stal boss. At the junction, an inlet comes in from the right. To the left, the main streamway continues unexplored through deep water, but is at this point only 50m from the downstream sump.

The inlet passage, The Road to Mandalay, continues for over 500m to the south west. For the first 150m the “inlet” is actually dry, but then water is finally met cascading down a rocky section before sliding into a rift on the left (true right). Above the climb the stream continues in fine style, past calcite formations and flowstone. Several times the water sinks and reappears. After a short constricted section, walking passage resumes.

The passage soon became mainly blocked by boulders running in from above, and is notable for the abundance of gently waving leeches on the walls. Ben Wright stripped off and swam along a pool in the stream at a low level, but there was no obvious way on. A disappointing conclusion.

Over 18 Series

Back in The Catwalk, Over 18 Series is entered by scrambling up a mudbank. To the right, this may connect back to the high hading rift encountered earlier in the Catwalk, although this was not explored. To the left a large beautifully decorated chamber is entered. This leads, on the left, into a wide passage with numerous stal columns and a mud floor. After around 100m a very large junction, Ooo La La, is reached. To the left leads via a smaller section of passage, to the impressive Independence Day. This large passage-chamber contains an untouched mud floor and many columns, other calcite formations, and some idyllic crystal pools. There is no major route out of Independence Day, but a small descending muddy slope was not explored.

Right at Ooo La La leads over large house sized boulders to another beautifully decorated chamber. Climbing down at the eastern end of this chamber, enters a smaller muddy passage, Off the Page..

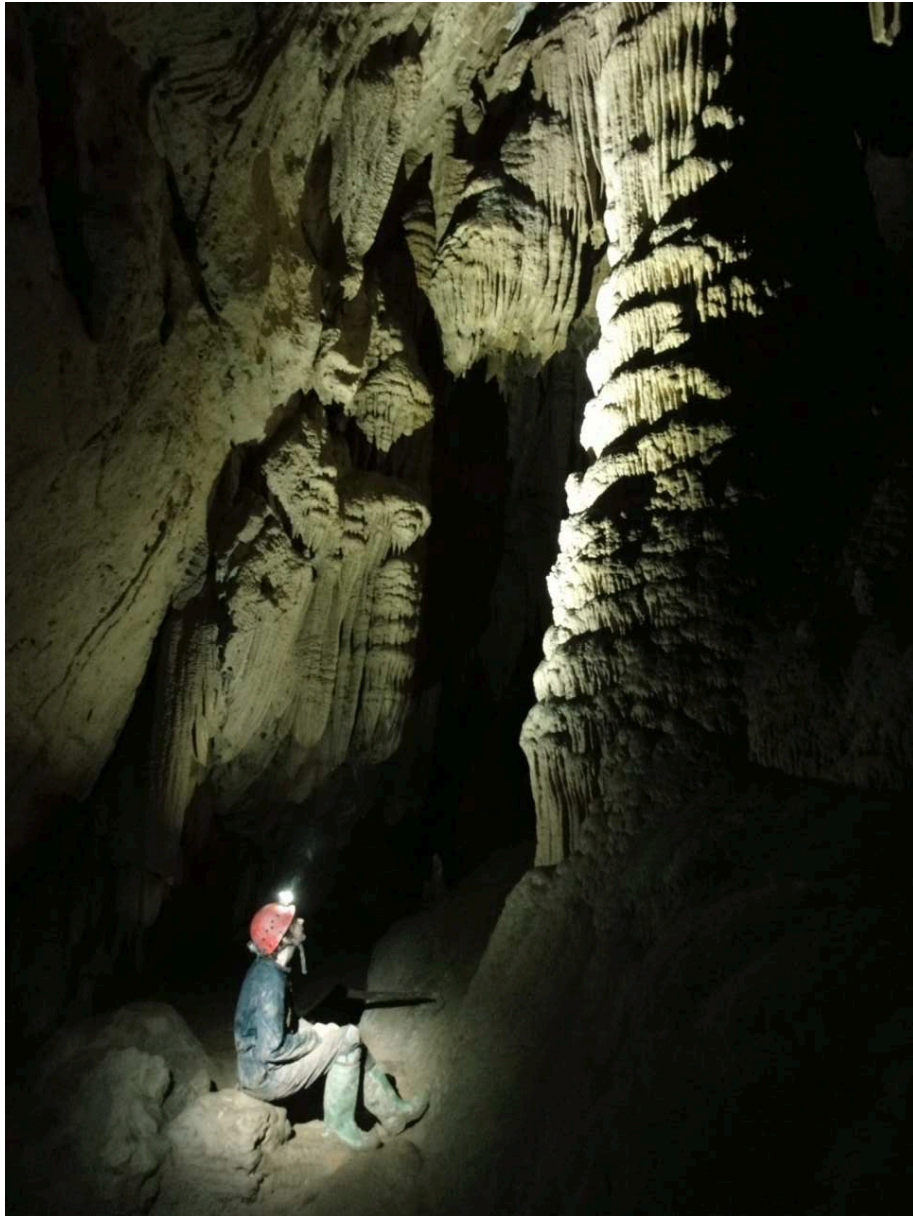


Figure 10: In Independence Day

This is clearly a major flood overflow route and is extremely muddy, with numerous pools of water. These pools were seen to drain during the course of the 2012/2013 expedition as the monsoon water evaporated. About 400m along the passage a high aven enters from the left. Shortly after this some water drains down a small passage to the left which leads to a short undescended pitch.

After another 400m, shortly after passing a small drain on the right, a major cross passage is encountered. To the right this is choked with mud almost immediately, while to the left it continues for around 100m to a steeply ascending boulder choke. Interestingly the choke soon rises above the muddy flood line, but no safe way through could be seen.

A further 200m down Off The Page the passage splits. The main way on is to the left up a mudbank, but it is also possible to continue in crawling passage straight ahead (The Cat

Latrine). This eventually reconnects to the main route via a climb up.

Taking the main route, this soon emerges into a much larger area containing a major junction.

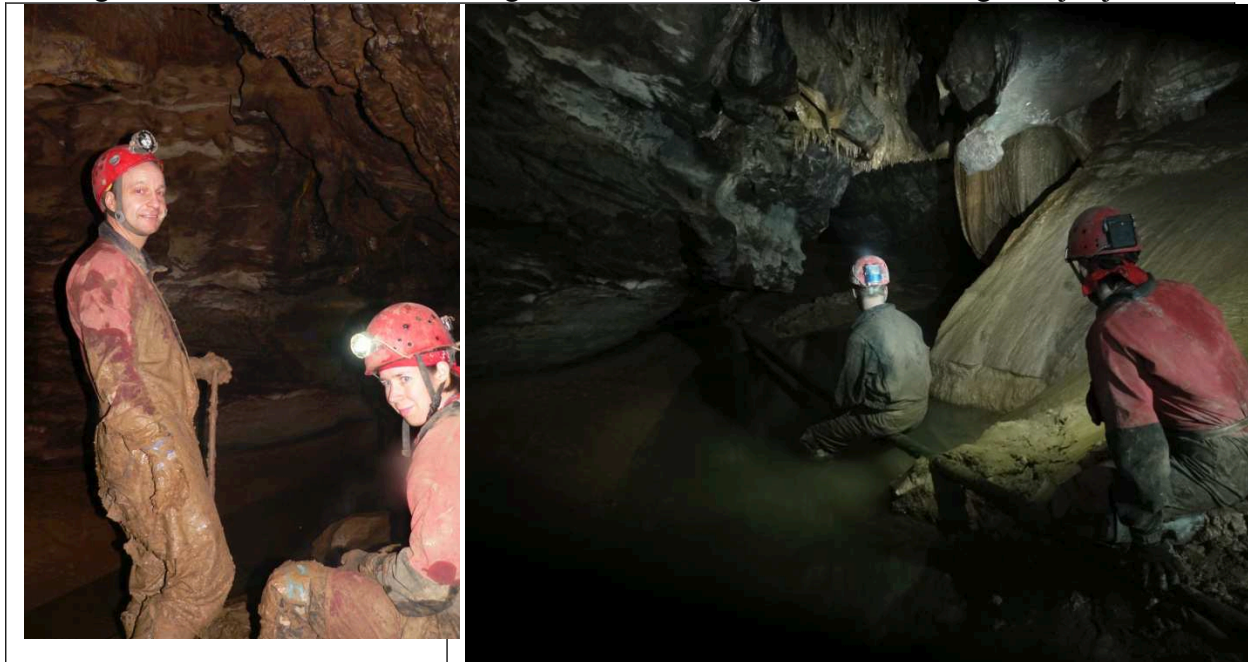


Figure 11: (left) Pete and Fleur after a muddy crawl in Out of the Page. (right) Stemple of Doom (aka Liquid limit) pool in Out of the Page.

New Upstream - Infinity and the Edge of Enlightenment:

Turning left the upstream passage can be followed for several hundred metres. However it soon degenerates. Instead progress is made by ascending a mud bank on the immediate left as one exits Off the Page. From here a large and well decorated chamber – Infinity – is entered. An 8m climb down from the right hand side of Infinity allows the upstream passage to be re-enters. This leads to over 1km of passages, but unfortunately includes much crawling. There are occasional glimpses via boulder chokes of potentially larger passages in the area above, but these cannot be entered. This area – known as the Edge of Enlightenment – is heading straight for Enlightenment, but at a substantially lower level. Ultimately it ends in a choke.



Figure 12. Liu Hong approaching Infinity.



Figure 13. Lou in the Edge of Enlightenment

New Downstream – Absolute Truth and The Heart of Darkness:

Turning right at the end of Off the Page leads in the downstream direction to the northern extend of the cave. The passage is large with a (dry) stream trench between mudbanks. The trench may be followed down into a smaller muddy passage, down several climbs to a short pitch. This leads on through a muddy crawl to a further undescended pitch.

Back in the main passage it is possible to ascend the mudbanks on the left to enter a large chamber called Absolute Truth. At the top (north west) end of this chamber are some large calcite formations. At the north east end of the chamber it is possible to climb down over boulders and gain access to a high rift passage – The Heart of Darkness.

The rift is entered by abseiling down a mudslope before a shorted bolt-climbed pitch is ascended to regain the same level. From here the rift continues 2 to 3m wide and up to 20+m vertical range. Progress is generally made at the mid level where many boulders are wedged. After ascending the pitch the next 15m of progress is gained via a protected traverse which ends in a pitch down shortly followed by a further pitch up. A short section of unhindered progress is then followed by a more significant drop, estimated to be in excess of 30m and the current limit of exploration.

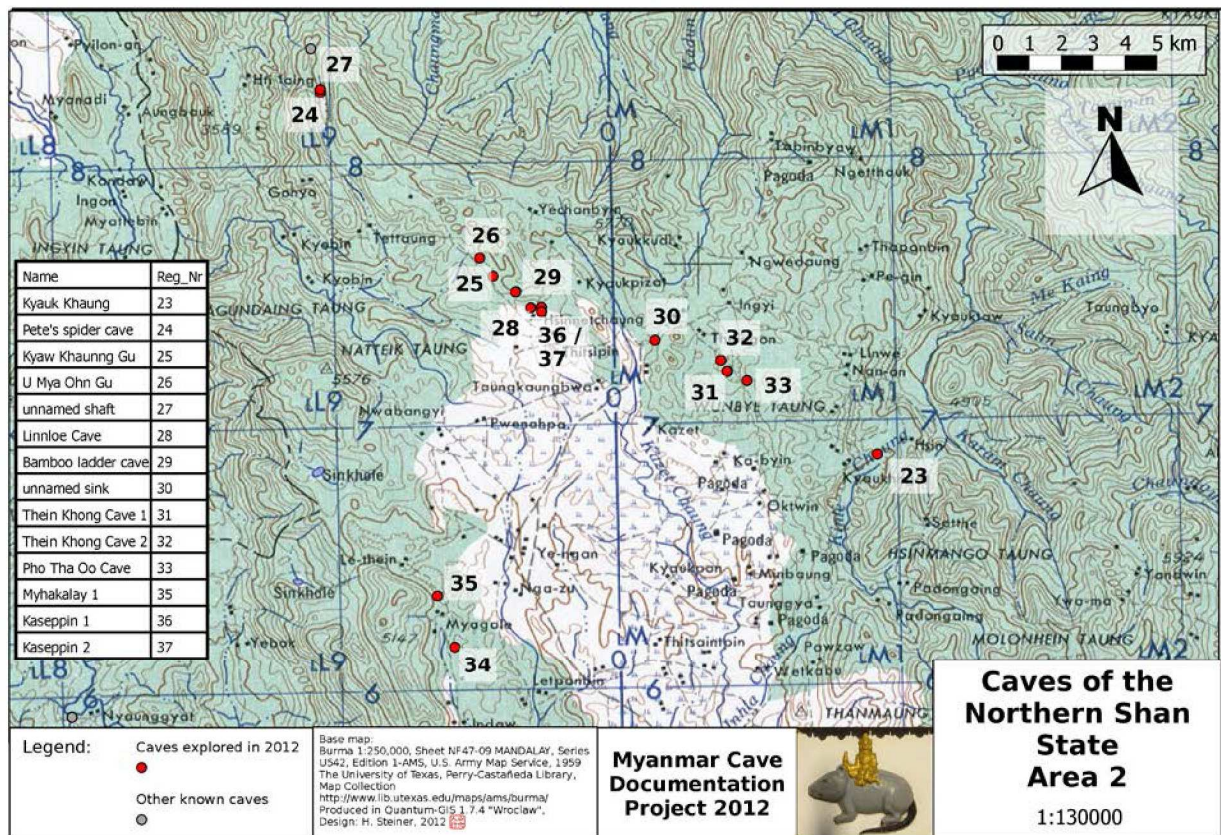


Figure 14 Caves around Ywangan Township

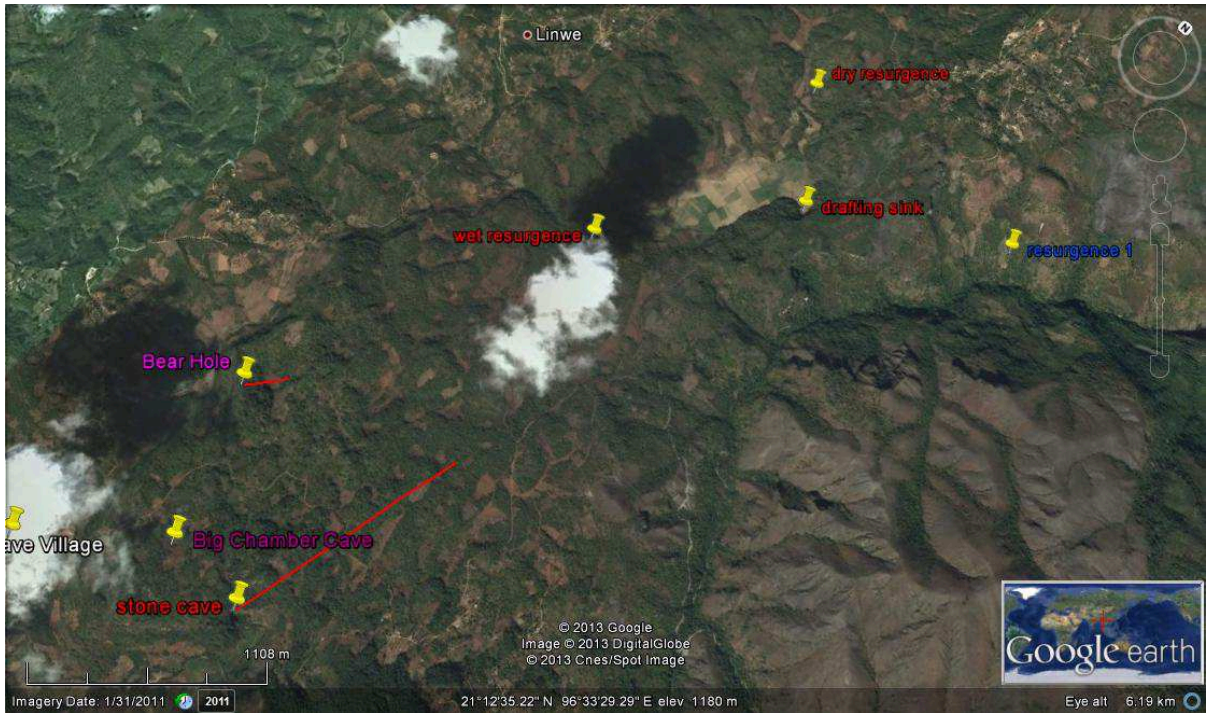


Figure 15. Google map showing Stone Cave
Map also shows village where we parked, Bear Hole and the large cave entrance we were shown on the last day ('Big Chamber Cave' or Chaung Myaung Cave). The 'wet resurgence' is Linwe Depression Cave 1, 'dry resurgence' is Linwe Depression Cave 2, and 'drafting sink' is Linwe Depression cave 3.

Other Caves Explored in 2012/2013

Bear Hole

Length 413m. Location: UTM 0245269; 2346026; entrance elevation 1198m

Visted by the 2013 expedition of the Myanmar Cave Documentation Project (UK team). A series of exceptionally large chambers entered via a small hole in a cliff near Kyauk Ngauk (Stone Bird) village. It is not yet confirmed that there is no further way one as all the walls have yet to be surveyed. Air in

Unnamed Cave

No surveyed. ~15 m long; UTM 0245093; 2345993; entrance elevation 1282m

A short passage leads almost immediately to a choke. The cave is entered via a hole in the bottom of the same Cliff which contains Bear Hole.

Chaung Myaung Cave and Hole

No surveyed. UTM 0245582; 2345277; entrance elevation 1307m

The 2012/3 expedition was shown this cave on the last day of the expedition. Two small holes in a field lead to a steep slope which will need gear to descent. Locals report the cave to be very large and to contain a lake. From climbing a short distance down the entrance (which will need a ~30m rope) – this seems to be the case...it is big, but no obvious draft. Located in large surface collapse doline above the end of Road to Mandalay within Stone Cave

Linwe Depression Cave 1 (large wet resurgence)

Not surveyed. UTM 0246019; 2347791; entrance elevation 1173m

A resurgence cave in the south west corner of the larged closed depression near to the village of Linwe. The lake at the entrance to the cave was crossed but the flow found to come from a sump. However, a further entrance at higher level allowed the sump to be bypassed. A well decorated passage lead via several climbs to the river upstream of the sump. Open and ongoing.



Figure 16: Linwe Depression Cave 1 – the wet resurgence (left) and bypass passage with remarkably long thin column (right).

Linwe Depression Cave 2 (large dry resurgence)

Not surveyed. UTM 0246393; 2349315; entrance elevation 1136m

A dry cave that is either a fossil resurgence or active in the monsoon, located at the northern end of the Linwe depression. The large entrance leads to a very large passage that appears to continue for some distance (100's m). However there is no air movement within the cave. Local describe how the passage is big enough to 'drive a car down'.



Figure 17 Entrance to the large dry resurgence in Linwe Depression.

Linwe Depression Cave 3 (drafting sink)

Not surveyed. UTM 0246788; 2348666; entrance elevation 1122m

cave is located at the northern end of the Eastern edge of the large closed depression near Linwe. To enter the cave one must scramble down over boulders. Although dry when visited, the polished nature of the rocks suggest that a substantial amount of water flows here in the wet season. After a short distance an undescended pitch was reached. The cave drafts strongly and is a good prospect for future exploration.



Figure 18. The limit of exploration in the main sink in Linwe Depression. This passage has a very strong draft.

Linwe Depression Pool

Not surveyed.

Locals claimed that this pool was the resurgence for ►Kyauk Khaung. However, this was clearly not the case as the pool appeared to be static (at least in the dry season).

Environment

Geology and Geomorphology

The Permian and Triassic carbonate sequences of Eastern Myanmar are extensive and large tracts of the Shan Plateau are comprised of these sediments (Figure 5). Although the main lithology throughout is limestone, this is often dolomitic rather than calcitic. The stratigraphy and ages of these deposits were uncertain for some time, with the major carbonate units variously referred to as the Plateau Limestone¹, or the Shan Dolomite Group², in older publications. More recently, a revised stratigraphic assessment has been made³ which divides the carbonates into two main units:

1. The Thitsipin Limestone Formation, named for a type section at Thitsipin village near the township of Ywangan in the Southern Shan State. The Formation comprises five main lithofacies:
 - a. Poorly bedded conglomerate
 - b. Laminated calcareous shale and other fined grained carbonate sediments
 - c. Massive fined grained calcareous sediments
 - d. Thick bedded calcareous sandstone with some calcareous mud
 - e. Massive or poorly bedded cherty wackestone (matrix supported calcareous grains within carbonate mud)

Some sections of the formation are partially dolomitised and comprise fine grained dolomite.

2. The Thitsipine Limestone Formation then passes transitionally upwards into the Nwabangyi Dolomite Formation
 - a. Calcareous conglomerate and sandstone with some carbonate mud.
 - b. Poorly bedded dolomitic wackestone
 - c. Thin bedded dolomitic and bioclastic wackestone
 - d. Thinly laminated turbiditic dolomitic mudstone

The formation often suffers from shattered and brecciation.

¹ Geological Map of the Socialist Republic of the Union of Burma, Prepared under the auspices of the earth science research division, research policy direction board, Government of the Socialist Republic of the Union of Myanmar, 1:1,000,000 March 1977.

² Bender, F. (1983) *Geology of Burma*, Gerbruder Borntraeger, Berlin.

³ Oo, T., Hlaing, T. & Htay, N. (2002) The Permian of Myanmar, *Journal of Asian Earth Sciences*, 20, 683-689.

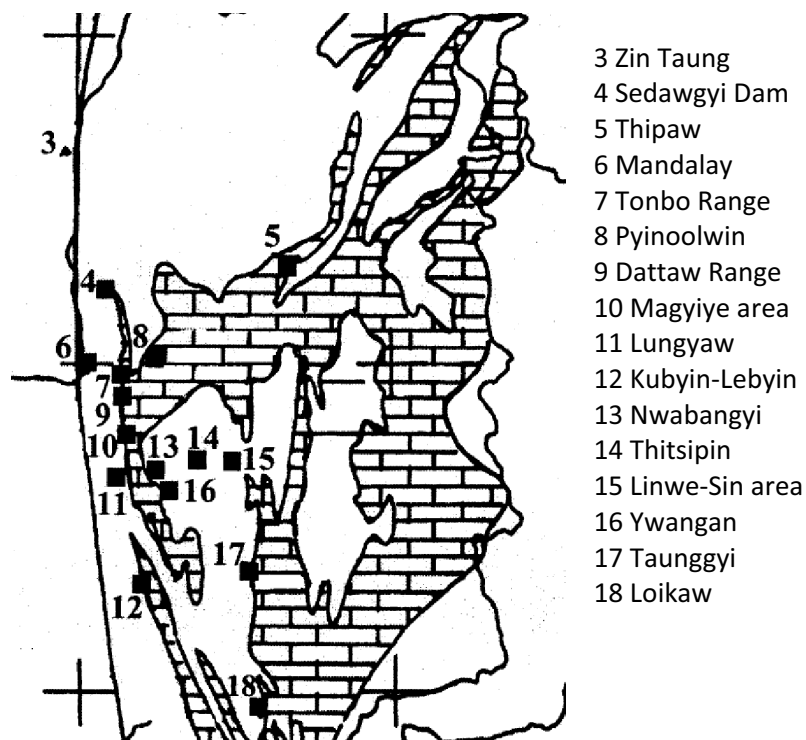
The overlying Triassic limestones tends to be more crystalline and less sandy than the underlying Devonian strata. The younger limestones also contain a greater proportion of calcium carbonate, up to 98% ⁴.

The sequence of carbonate rocks is thought to be of considerable thickness, with estimates in the range of 5000ft (approximately 1650m) in the Northern Shan State¹ and up to 1000m in the Southern Shan State ⁵.

The presence of these abundant carbonate beds has a major impact on the scenery in the Shan States, leading to “dramatic scarp and ridge scenery and with spectacular karstic features”³. The carbonates that form the Shan Plateau also form a natural geographic break between the elevated and cooler plateau states and the hotter lowlands to the east.

As well as the Permian and Triassic calcareous sediments, less extensive limestones have been deposited at other geological times included the Ordovician, the Jurassic and the Cretaceous-Tertiary. The Jurassic limestones are known to be cave developing and are seen in the caves in Kalaw and the surrounding area.

Figure 19 Extent of the Permian and Triassic Carbonates in Eastern Myanmar



⁴ Chibber, H. L. (1934) *Geology of Burma*, MacMillan and Co Limited, London.

⁵ Robertson Research International Ltd (1997) *Burma, South East Asia Geological Map Series, 1:2,000,000*, with explanatory notes, June 1997.

Observations from Ywangan

The main cave explored during the expedition, Kyauk Khaung, sinks in the Thitsipin limestone. It is not known where the water from the cave resurges, although a closed basin of Quaternary sediments some 5km to the north is one possibility. On the basis of the cave passages explored in Kyauk Khaung the Thitsipin limestone is suitable for well developed karst systems and will be a focus for future expeditions.

From geological maps, the water which feeds Kyauk Khaung appears to rise at a faulted boundary with the older Chaung Magyi Group, a Pre-Cambrian unit comprises sandstones, mudstones, dolomites and green limestones. On first inspection this does not appear to be a highly developed karst formation, but will required future investigation.

The majority of the other caves explored around Ywangan appear to be within the Ordovician Doktoye Limestone Formation and are not so well developed. The exception to this are the entrance near Myhakalay which are believed to be in the Jurassic limestones.

Hydrology and Hydrogeology

Ywangan is situated near a seasonal lake. This is reported to fill up following the rainy season but with a slight lag. We interpreted this feature to be similar to the Irish term “turlough” also representing a karstic seasonal lake. However, it is possible that there are superficial quaternary sediments in the fertile basin around Ywangan which complicate the local hydrogeology.

Apart from the aforementioned lake there are few surface water features around Ywangan. As the road from Kalaw to Ywangan ascends the plateau there are some small streambeds which the road crosses. However, we have not traced these nor found resurgences. In a number of small caves we encountered a shallow local water table and it is these caves which appear to be important for the local cave adapted fish species. These areas, due to their shallow water table, do not appear to have extensive large cave passage development, although it is clear that the underlying rocks are karstic.

The large river which enters Kyauk Khaung is known to come from a resurgence although we did not have time to visit this. However, on the whole we saw very few resurgences and none of any size. We do not know where the water from Kyauk Khaung is seen again and this question remains a key one for future expeditions.

The internal drainage within Kyauk Khaung also remains of interest. The main stream, and its inlet in the Road to Mandalay, shows great propensity to split and sink or partially sink on its route downstream. Thus the volume of water at the downstream limit is significantly smaller than that at the cave entrance.



Figure 20. The seasonal lake at Ywangan

Weather

Contrary to previous experience we saw colder and wetter weather in Myanmar this year due to the passage of a significant front through the area at the start of the expedition. It rained for around three days and nights near the beginning of our time at Ywangan. This saw only little influence on the water levels in Kyauk Khaung, although it did have a large impact on the weather the local roads were passable. When the weather conditions were overcast and rainy it was also cooler than on previous visits. Later in the expedition, conditions did become warmer, but only during the day with cooler conditions continued to be experienced at night.

Presentation to the Ywangan Township Hospital

Following their outstanding help last year, when Peter Talling crushed a toe and lost the bone out of the bottom, we presented a Ventouse (suction device for delivering babies) to Ywangan Hospital. The midwives obviously knew exactly how to assemble the Ventouse.



Figure 21. Presenting the Ventouse at Ywangan Hospital

Appendix A: Ywangan Cave Database

Area	Name	Alternative Name	Date	UTM Easting	UTM Northing	Elevation	length m	Comments	Exploration
Ywangan	Pete's spider cave		26/12/2011	0227962	2358084	1239		small cave following bedding, after two climbs chokes with mud large arch entrance leads to smaller passage and two pitches down to mud choked	dead
Ywangan	Kyaw Khaunng Gu	first day cave	26/12/2011	0233489	2351635	1434	69	chamber large arch entrance totally choked with calcite	dead
Ywangan	U Mya Ohn Gu		26/12/2011	0233062	2352275	1403		narrow shaft for 3m, can see to mud floor	dead
Ywangan		Grovel down valley from Pete's spider cave	26/12/2011	0227967	2358195	1241		large arch entrance to handline climb to very large chamber with 3% CO2. Continues to further climb down	dead
Ywangan	Linnloe Cave	Bat Cave	27/12/2011	0234691	2350523	1373		Two shafts that interconnect via elaborate bamboo ladders	ongoing
Ywangan	Bamboo ladder cave	1000ft cave	27/12/2011	0234214	2351081	1562		Sink on route to fish caves	dead
Ywangan			28/12/2011	0238747	2349337	1379		Mendip esq grovel to sump	dead
Ywangan	Thein Khong Cave 1	Fish cave 1	28/12/2011	0241081	2348214	1348		Climb down to small stream which sumps	dead
Ywangan	Thein Khong Cave 2	Fish cave 2	28/12/2011	0240884	2348598	1361		shaft of four potches	dead
Ywangan	Pho Tha Oo Cave		28/12/2011	0241719	2347885	1353			dead

Ywangan	Kyauk Khaung	Stone Cave	29/12/2011	0245912	2345267	1200	2355	BIG river sink cave	ongoing
Ywangan	Myhakalay 2	Fish(es) Cave 3	30/12/2011	0232032	2338782	1078		Tim et al. found many fishes	dead
Ywangan	Myhakalay 1	Pete's Pool Plunge Cave	30/12/2011	0231496	2340576	1127		Pete rearranged toes with rock	ongoing
Ywangan	Kaseppin 1	Kaseppin 1	31/12/2011	0235048	2350533	1233		rift in doline, close to Kaseppin 2	ongoing
Ywangan	Kaseppin 2	Kaseppin 2	31/12/2011	0235051	2350375	1257		Rubbish fill series of very large chambers, not all	dead
Ywangan	Bear Hole		01/01/2013	0245269	2346026	1198	413	walls checked	ongoing?
Ywangan	No name		01/01/2013	0245093	2345993	1282		Short passage which chokes	dead
Ywangan	Linwe Depression Pool		07/01/2013	0246213	2348077	1242		static pool	
Ywangan	Linwe Depression 1		07/01/2013	0246019	2347791	1173		resurgence in Linwe depression	no passage
Ywangan	Linwe Depression 2		07/01/2013	0246393	2349315	1136		resurgence cave sumps, but entrance above leads to bypass	ongoing
Ywangan	Linwe Depression 3		07/01/2013	0246788	2348666	1122		dry resurgence cave; large passage	
Ywangan	Chaung Myaung Cave and Hole		10/01/2013	0245582	2345277	1307		ongoing but no draught	ongoing
								dry sink; climb down over boulders to reach pitch;	
								draughts	ongoing
								Small hole leads to big chamber with lake	ongoing

Appendix B: Surveys

Appendix C: Expedition Log

Date	Who	What
22/12/12	PF, FL, TG, LM, BW	leave Heathrow
23/12/12	PF, FL, TG, LM, BW	Arrive and overnight in Guangzhou
24/12/12	All	Arrive and overnight in Yangon
25/12/12	All	Travel to Heho, and on to Ywangan
26/12/12	All	Stone Cave – TG/LM/BW off the page; PT/LH/FL Ooo la la
27/12/12	All	Stone Cave – FL/PT/LH off the page; TG/LM/BW Over 18
28/12/12	All	Myhakalay – all to fish caves;
29/12/12	All	Stone Cave – TG/LM/BW off the page (stemple of doom); FL, PT, LH enlightenment RH.
30/12/12	All	All – off the page, new upstream; absolute truth, cat latrine
31/12/12	All,	Stone Cave – FL/PT/CH Downstream new leads; TG/LM/BW upstream new leads
01/01/13	All	Bear Hole and nearby cave
02/01/13	All	Stone Cave – FL/PT/BW – downstream (voltarol assist); TG/LM, LH – upstream new passage
03/01/13	All	Stone Cave – FL/PT/BW Downstream – poo traverse; TG/LM/LH new upstream passage
04/01/12	All	Myhakalay – TG/LM/FL/BW to fish cave; PT/LH to pete’s plunge and toe cave
05/01/13	All	Stone cave – FL/TG/LM – Downstream Heart of darkness; PT/LH/BW Road to Manadalay
06/01/13	Various	Myhakalay – TG/LM/FL to fish cave; Bear Hole survey – PT/LH/BW
07/01/13	All,	Linwe Depression. Successful prospecting to find sink and two major resurgences

Date	Who	What
08/01/13	All	Rest day – walking from Ywangan and survey drawing
09/01/13	All	Stone Cave – TG/LH/LM/FL photography; PT/BW Heart of Darkness
10/01/13	All	Stone Cave – PT/FL to Cat Flap; TG/LH/LM/BW photos; PT/BW/FL shown large entrance near village
11/01/12	All	Leave heho and travel to overnight in Yangon
12/01/12	All	Leave Yangon for Kunming/Guangzhou
13/01/12	All	Arrive Heathrow