

HIDDEN VALLEY 2017

An Anglo-Malaysian Expedition to the
Gunung Mulu National Park, Sarawak



REPORT

on the findings of

THE HIDDEN VALLEY 2017 EXPEDITION

to the

GUNUNG MULU NATIONAL PARK SARAWAK

During April 2017

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Approach passage to Api Centre | photo Jeff Wade

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Abstract

Mulu Caves 2017 was the 24th Anglo-Sarawak Expedition to Gunung Mulu National Park and operated in the field between the dates 28th March - 6th May 2017. The expedition had three main parts:

- 1: A ten strong team to the Hidden Valley on Gunung Api, led by Dave Nixon, between 31st March -20th April.
- 2: A smaller sized team based at Mulu Park headquarters re-establishing the top entrance to Creedence and investigating leads from the 2014 expedition.
Led by Mark Brown.
- 3: Another headquarters based team concentrating on the prospects in the southern peninsular of the Gunung Api massif. Led by Les Williams.
- 4: A small team climbing leads off Sarawak chamber. Led by Andy Eavis.
- 5: Overall support for a National Geographic photography and reporting team in various locations around the National Park.

The Hidden Valley team included a total of eight members from the UK and France, supported by local personnel, two permanent base camp assistants and a number of porters from the vicinity of Mulu National Park. The expedition was further assisted by the National Park Management and staff.

Exploration

The expedition relocated and used only the Conviction Cave entrance to the Wonder Cave system, high on the north cliff face of the Hidden Valley. The team explored and mapped significant cave development representing a major continuation heading north towards the Melinau Gorge. In total 12.5km of new cave was surveyed making the Wonder Cave system 19km in length.

Science

Paleomagnetic sampling took place in various places on this trip as well as mineral specimens from some of the oldest and highest cave passages in Mulu yet to be studied.

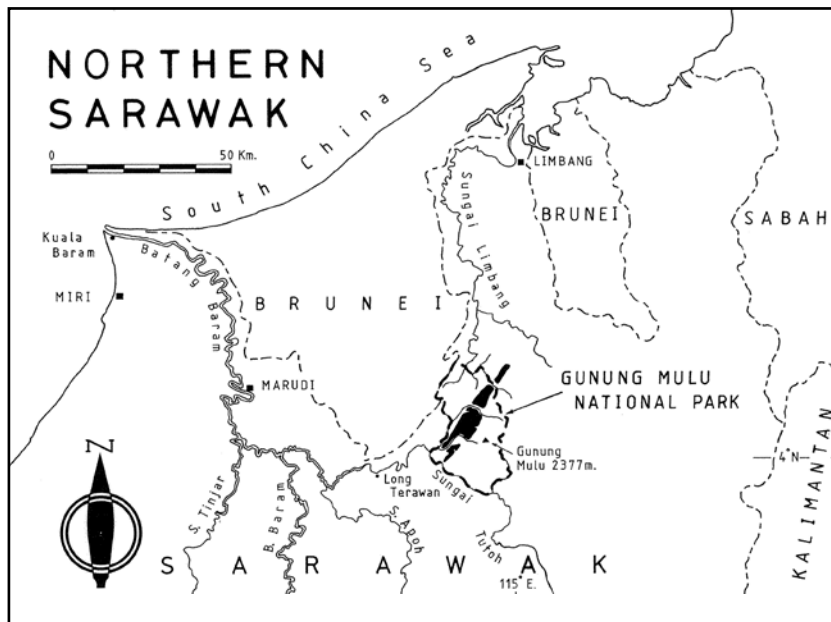
Introduction

Location

The Gunung Mulu National Park is situated in north-eastern Sarawak, with its northern boundary forming part of the border with Brunei, (Figs. 1 & 2). It was officially constituted in 1974 and opened to visitors in 1985. Lying 4° N. of the equator it now covers an area of 813.9km².

The Park is dominated by the sandstone mass of Gunung Mulu, which rises to 2377m. To the west of Mulu, and on its flank, lies a band of Melinau limestone, which forms the lesser peaks of Gunung Api and Gunung Benarat. The lower slopes are covered in dense tropical rainforest, which rises to meet the montane forest of Mulu's upper slopes.

Both the G. Mulu National Park and the adjacent G. Buda National Park have recently been extended.



Mulu has a rich mixture of plant and wildlife and in the limestones beneath the forest canopy lie some of the world's most impressive caves. The biodiversity of the Park and the significance of its karst landscape were given international recognition in 2000, when it was declared a World Heritage Site.

History of exploration in Mulu

A comprehensive account of the exploration of the Mulu caves is set out in reports dating back to the first RGS expedition and for the sake of brevity will not be repeated in full here. In summary, exploration commenced during the 1978 Royal Geographical Society expedition to Mulu and has continued since then with groups of UK cavers visiting the Park and working in partnership with the Forest Department and National Park employees to explore and study Mulu's underground landscape.

Exploration and survey work have established Mulu as one of the pre-eminent speleological sites in the world. Although precise definitions of 'the largest' or 'the biggest' cave passages and chambers remain open to debate, the Park contains one of the world's largest natural underground voids, Sarawak Chamber. It also holds what is arguably the world's largest cave passage (Deer Cave), the largest cave by volume and 8th longest cave in the world (Clearwater), and what is currently believed to be the 8th largest chamber (Api Chamber, in Whiterock Cave).

The early expeditions to the Park (1978, 1980, 1984) made rapid and significant discoveries with over 140km of passage explored and surveyed. Although the pace of exploration has slowed somewhat, new caves and additional passages continue to be discovered in the Park.

Figure 3 (next page) demonstrates the contrast of exploration extents between the 1984 expedition and 2012.

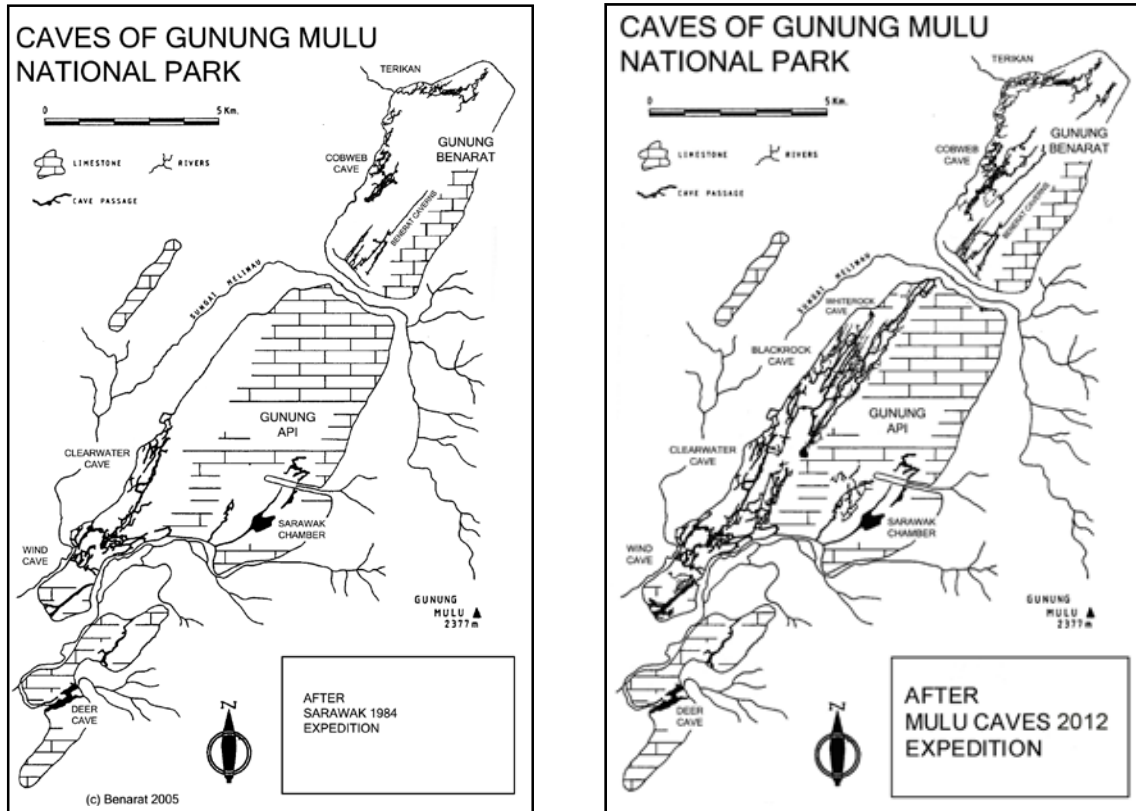


Figure 3: Contrasting exploration extents from 1984 and 2012

By the end of 2015, Mulu National Park had seen 23 major expeditions, bringing the total of surveyed cave in the G. Mulu National Park to 403km. In addition, the adjacent Gunung Buda National Park contains a further 74km of cave.

History of exploration in the Hidden Valley

Comprehensive accounts of all the exploration in the Hidden Valley can be accessed by means of the Mulu Caves reports from the years quoted below and are referred to on numerous occasions in this report.

The first expedition to the Hidden Valley also happened to be the first expedition to Mulu, 39 years ago. It was an honour therefore to have one of the original members of the 1978 trip on this the 6th British visit to the remotest part of the Gunung Mulu National Park.

Given the lack of infrastructure in place at Mulu all those years ago it makes the achievements of the first party here even more remarkable. Especially when you consider some of the easily accessible and vast open underground areas yet untouched by man, lying in slightly more hospitable parts of Mulu.

Without venturing into the western end of the Hidden Valley the 1978 team mapped nearly 5km of Wonder Cave before another team returned to the area 15 years later to prospect for further possibilities.

The 1993 trip was again a lightweight reconnaissance expedition to establish the merits of a return trip. Exciting developments in Clearwater delayed an immediate return, but when eventually it occurred hard won gains were the reward for the 1996 team in the discovery of major cave development deeper into the western end of the valley. The Cloud/Bridge/Cobra Cave system then proved that other large areas of Mulu contained extensive and mature development as well as the caves on the western margins i.e. Clearwater Cave.

The 1996 return to Wonder Cave resulted in a minor extension at the northerly end of the cave but was overshadowed by the fall and subsequent rescue from within the cave, which fortunately didn't end up as a serious incident. This was to be the end of exploration in Wonder Cave for another 19 years.

Interest in the area was reinvigorated in 2014 when a tiny black dot in the greenery was observed from helicopter mounted GoPro footage. A year later it was reached on foot and discovered to be the entrance to Conviction Cave, a major high level discovery.

Hidden Valley 2017 – Preface

Dave Nixon

The scene was set, the challenge laid down and the remotest part of the Gunung Mulu National Park was to be pitted against a well prepared and equipped British/ Malaysian led expedition.

During the 2015 reconnaissance expedition a small cave entrance was entered on the north face of the hidden valley ~200m above the river level. The newly discovered Conviction Cave consequently connected to Wonder Cave, first discovered in 1978, and a new route was pioneered north into totally uncharted territory deep in the central and eastern side of Gunung Api. The vast unknown nature of this part of the mountain made the return expedition prospectus a very attractive read.



General view of the Hidden Valley and south eastern faces of Gunung Api.

Plans were made to base this expedition around the findings and framework of the previous one, which was challenging but favourable in comparison to some of the expeditions in the past to this area. Mobilisation of food, equipment and manpower was to be by means of helicopter shuttles from Mulu airport to the Hidden Valley. Base camp was again to be the spacious and comfortable entrance to Prediction Cave, while the underground camp was to be set up 400m from the current northerly limit of exploration.

The team consisted of ten hand picked, suitable skilled and experienced members. This included three from the initial Conviction Cave exploration team, three Mulu newcomers, two that just couldn't resist temptation plus two local and very patient base camp assistants. By way of completion and to top it all off the overall leader based back in Mulu Park Headquarters was a member of the very first expedition to the Hidden Valley 39 years previous.



Sea freight equipment ready for dispatch, 3 month prior to expedition departure | Rob Eavis

Logistically, visits to the Hidden Valley require much more preparation than many other parts of the National Park due to its remote nature, this trip was no exception to that rule. Facilitating all the requirements to maintain what turned out to be a total of 190 man days of cave exploration took some considerable thought and execution. The support of the Forestry Commission, Mulu National Park Authority and the local community cannot go without mention in relation to direct assistance, safety/rescue planning and communications. Much of this being as a direct result of action points and lessons learnt from the previous expedition. None of this time reflected itself in the amount of cave explored but in the same instance none of that time was regarded as unproductive, quite the opposite.

Access and Egress

Dave Nixon

In comparison to the 2015 expedition in the Hidden Valley, the objectives, and consequently the amount of equipment, dictated directly what our access to the Prediction Cave base camp was going to entail. Given that there was close to 1000kgs of equipment, careful thought had to go into the best ways to facilitate this. Thereafter it was going to be pretty much a carbon copy of the previous expedition in terms of access to the base camp and Conviction Cave entrance.

There was little doubt that the only realistic method of efficiently transporting the majority of the team and equipment to the Hidden Valley was going to be by means of an airlift using a helicopter. Fortunately the helipad was still serviceable thanks to a prior visit in the year by a team to clear the existing landing area further. In addition the route down from the col to Prediction Cave was also modified to eliminate the necessity to cross the river twice by means of sticking to the cliff base on the south side of the valley all the way. Without doubt a fantastic improvement.

An added incentive in using a helicopter mobilization and consequential helipad clearing was that in the event of a rescue this method of access/egress would have been a proven and viable option at the very start of the expedition. This was a necessity in terms of rescue planning which is covered later.

It's no mean feat to arrange and execute a helicopter mobilization without any major difficulties along the way. As it turned out, we managed to make it a massive success to the credit of all involved. It has to be stressed that achievement outweighed failure by the tiniest of fractions.

The plan was to purchase most of the food and consumables in Miri, as normal then along with the sea freighted gear from the UK move it up river to Mulu on longboats. Most team members and excess gear could go up to Mulu on the commercial flight. Once most of the team and equipment were in Mulu time was taken to carefully prepare all the gear into manageable loads, weighed up, marked and segregated into prioritized batches. All this time a team of porters was on standby, in case the dreaded plan B had to be deployed.

Meanwhile a six-man team, Cafferty and Nixon and four porters Steve Jack, Tegong Tua, Sudin Kunya and Boniface Thomas had a very early alarm call followed by a very long ramble. Walking in to Prediction Cave base camp from Mulu park headquarters travelling with as little equipment as they needed. The main objective of this team was to reach the Hidden Valley that day and subsequently make final checks to the helipad and establish communications back to the team in Miri in preparation for the forthcoming helicopter departure.

With 12 months of planning behind us, the helicopter hired and paid for, all manpower /equipment now in place and communications established the date was set. It was with some considerable nervousness when daybreak came on 2nd April and all eyes turned to the weather conditions. How lucky were we feeling? The previous morning was perfect and this lessened the odds even more.

Not only did it have to be good in the Hidden Valley but also in Miri 97km away, and at Mulu airport, not to mention all pretty much at the same time. Although misty prior to sunrise this soon evaporated and the call was made from the helipad that it was flyable, the conditions in civilization were better still and a great sigh of relief came rising out of the whole Mulu Caves project team. The plan A was quite literally poised to fly.

The weather held up well and was now the least of our concerns as the helicopter was heard in the distance and then flew past the Hidden Valley landing site at considerable height. The aircraft went right out of the eastern end of the valley to turn round and then repeated the pass overhead and at speed. Now out of the western end of the valley and back again for a third pass.



AS 355 on the Hidden Valley helipad | Rob Eavis

Accompanying the pilot Captain Hafiz, and as much priority equipment as a AS355 twin squirrel can carry, was Colin Boothroyd, who's knowledge of the area and in particular the location of the helipad was essential information for the flight. Even with this, the moments became more and more apprehensive, both on board and on the ground, as the helicopter conducted a fifth, sixth and then lower & slower seventh pass over the helipad. Eventually the courage and skillful abilities of the pilot, approaching from the western end of the valley delicately managed to weave his way through the gaps in the trees and touched down on what he described as the tightest landing he'd ever done. What a relief.

The main concern was the tail rotor, which was dangerously close to one particular tree. Once the safe position of the nose of aircraft was marked on the ground with timber beams we then had some guidance as to where to bring in the front of the fuselage without having to land a helicopter whilst looking over your shoulder at the same time. Not something you are probably taught during routine flying lessons.

Camping and Logistics

Luke Cafferty

Due to the success of the 2015 Hidden Valley expedition using the Prediction Cave entrance as their base camp it was decided that the 2017 expedition would also use Prediction Cave camp as our base camp. We were promised the perfect camp by the members of the 2015 expedition, and they really didn't lie; in a hostile place such as the Hidden Valley, Prediction Camp really is a little piece of paradise!

As described in the 2015 report the Prediction Cave camp is the ideal camp. Over 100m wide and under the drip line of the high cliffs, which keeps the camp area very dry, even during a major storm we only had a light mist around the camp. The 2015 team had already established that the camp had a constant water supply in the form of some drippers falling from the cliffs above, one issue that was found in 2015 was that it proved a bit of inconvenience scrambling up to the base of the cliff and trying to carry the full bags of water back down to camp area so with some forward thinking, we landed in the Hidden Valley with some tarpaulin, a length of hose and a tap. The tarpaulin was strung up underneath the drippers and this fed into a 120l plastic dustbin, which had the hose syphoning water down to the camp area. With the simple addition of a tap fitted on the end, water on demand made life much easier by providing a constant, immediate and controllable water supply.

This year the team consisted of eight cavers and two locals residing at the Prediction Camp but even with ten people, there was more than enough room for everyone to have their own space. With increased numbers the camp was enlarged from the previous stay, it even comprised of two bathrooms. Our two local porters were brilliant, they worked wonders to turn the camp into a 5 star resort with plenty of seating space some temporary tables for cooking and food storage and we even had a draining board for washed pots. All in all we were short of nothing.

The route down to the river was re-established again and just as the previous expedition had taken advantage of the great bathing facilities we also used the river to wash both clothing and ourselves. A log bridge was built across the river to provide safe crossing for the trail up to Conviction Cave although regular repairs were required following heavy rain.



Cooking at Prediction Cave basecamp | Rob Eavis

Wonder Cave system

(Gua Ajaib)

Hidden Valley

Gunung Api, Mulu National Park, Sarawak, Malaysia.

Surveyed ~ April 2017 :

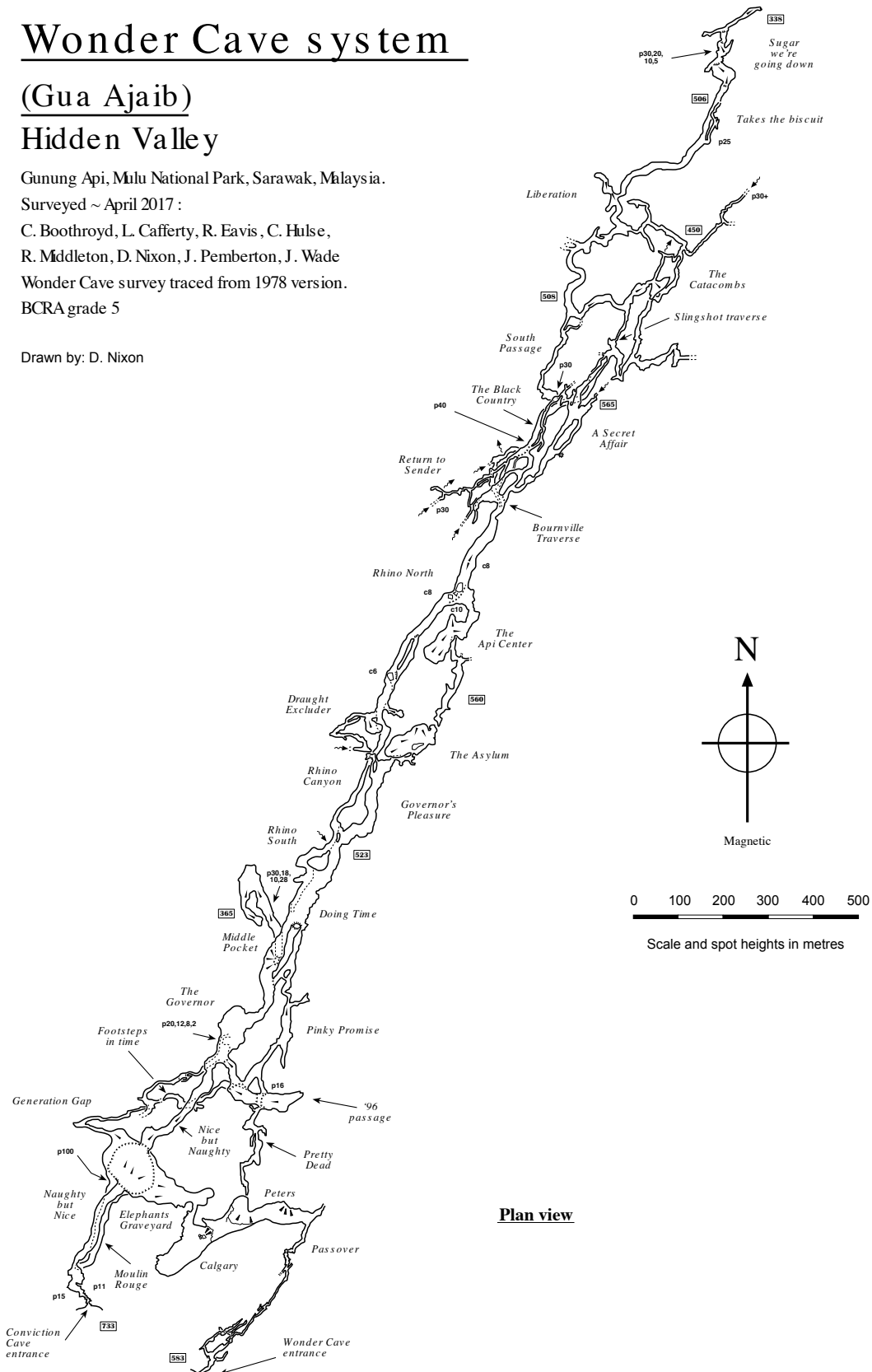
C. Boothroyd, L. Cafferty, R. Eavis, C. Hulse,

R. Middleton, D. Nixon, J. Pemberton, J. Wade

Wonder Cave survey traced from 1978 version.

BCRA grade 5

Drawn by: D. Nixon



Wonder Cave system post expedition survey - plan view.

Exploration

Climbs around The Governor

Rob Middleton

Two obvious climbs in The Governor chamber were explored towards the end of the trip. The first (climbed by RM) involved a sketchy traverse along a rock bridge past the governor himself, then a couple of bolts and a small free climb up into the 2m diameter passage, which sadly went only 15m before re-emerging in the roof of The Governor chamber.

The second (Climbed by JW) was a flowstone ramp on the east side of the cave just before The Governor. This was climbed with some bolts and aid to continuing ascending passage which petered out after 20m with no ways on.

Climb above the end of Pinky Promise

A window was spotted above the exit to Pinky Promise with potential above. This was climbed by RM up overhanging rock for 20m until calcite was reached at the fringe of the window. A few sketchy moves on bolts in rotten calcite followed before the window was entered properly. Sadly it proved to be little more than a ledge, and the climb continued above entirely on flow. No visible way on was seen at the top, though not all the passage could be seen. This was left rigged as a poor future lead if in the area.

Pinky Promise

Dave Nixon

The route into the cave since 2015 had been well trodden through The Governor chamber and on northwards in the large Doing Time passage. This was the initial route for the 2017 trip until a bypass provided a much easier way into the northerly section of the cave.

The Pinky Promise extensions can be entered from the south by means of a moderately easy free climb, which commences immediately before the very last 3m climb down into The Governor chamber. This area can be extremely wet on occasions as the small inlet responds dramatically to rainfall on the surface.

A 20m climb up eroded flowstone leads to a large passage heading off south, liberally coated in slippery mud. It continues to ascend and gradually levels out after 80m at a point where a junction is met with an obvious passage heading off east higher up on the bedding plane, the route to Pinky Promise. Ahead the way on is an easy boulder covered walking passage, ascending gradually all the time, 20m wide and 10m high with a small inlet 30m beyond the junction. It continues for 150m until a large void is met and the floor drops away dramatically. This is the Elephants Graveyard in Wonder Cave and in more detail the opposing passage to Naughty but Nice which can be seen across the void heading south back towards the entrance to Conviction Cave. The pitch wasn't descended and the passage was christened Nice but Naughty.

Back at the junction, a scramble up a mud bank, best protected with a rope, gives access to Pinky Promise, a superb series of large passages well decorated and connected to various other parts of the system.

Initially progress can be made on an impressive flowstone floor to the point where the floor drops away into a deep open pit beneath. Just prior to this a passage darts off north soon to encounter another passage entering at a Y junction from the south. This southerly passage continues and ascends for 50m until a second entry point to the deep open pit also falls away in the floor. A rock bridge exists on the west side, which permits access to a passage heading south on the other side of the void, Footsteps in Time.

Back at the Y junction the passage is wider and lower and requires a short section of crawling to access the continuation which now heads north parallel with Doing Time. A large lead on the east ascends the bedding into a breakdown chamber with no way on. At this point the way on is down and into a smaller sized passage with partial sediment infill and more short low sections to another smaller Y junction. The passage to the west goes for 50m to a window looking down into the Governors Chamber. Ahead the passage dimensions increase and more flowstone and gour pools are met as the route descends gradually to a muddy section. A 10m slippery climb up through a hole on the east side of the passage (rope left rigged) leads up into a chamber, which was first found during the 2015 expedition. This closes the loop back to the phreatic passage above Rhino south and provides a much easier route to the magnificent underground Rhino campsite.



Jeff Wade at the start of Pinky Promise | Rob Eavis.

Pretty Dead

Rob Middleton

From the Y junction in Pinky Promise, or alternatively a window up on the right of the Pinky Promise (as you are heading north towards White Rhino), a slope over mud and calcite

leads to a large drop ahead which is the junction of the pitch dropped down to Footsteps in Time and a rock bridge leading to a passage on the right above the hole heading south. A good-sized phreatic passage leads south in attractive passage to a crossroads with a low crawl to the right and a stooping passage to the left.

Right can be followed a short distance past some straws and small stalactites to a muddy choke. Left is also short-lived but well decorated.

Following the main passage continues on through a series of chambers with some interesting rock walls to a tight climb through popcorn into a chamber/aven. At the far end a calcited climb was pushed for approximately 8m until it appeared to end. A small trickle of water was coming from the top down the calcite.



Figure 15 – Approach passage to Pretty Dead | Jeff Wade.

Footsteps in Time

Rob Middleton

During the discovery of “Pinky Promise” two windows were located looking down onto a huge ramped passage below. Normally this would be a really exciting lead, however a tiny note in the 1996 Hidden Valley report, suggesting a previous discovery in this area via a climb up from below, meant that motivation was low. The second and lower of the two windows was descended, but all too quickly two sets of footsteps were located and it became apparent this was in fact the passage first entered by climbing from the ‘78 Chamber’ in 1996.

However the description was poor and the passage had not been surveyed, so we remedied this to tie it into the modern survey line, also hoping that they might have missed something. The passage consists of a 250m+ long large ascending boulder strewn ramp passage some 30m wide and 30m high, which connects back into the 78 Chamber

at the base via a 35m pitch, and ends in a boulder choke at the top. The pitch from Pinky Promise comes in about 2/3 up the slope, and was noted in '96 but not climbed into. (Interestingly this would have allowed access for that expedition to 6km of cave with almost no kit needed had they been able to climb the pitch). Also surveyed was a sizeable side passage 1/3 way up the ramp, which had also previously been entered and explored though again not surveyed. This finished in a collapse/mud choke directly above Nick Jones's pitch in known cave and included a couple of poor climbing leads in the roof.

Total survey metrage in this area was counted in our expedition tally. Below is the relevant note from the 1996 report appendix for reference.

"Towards the end of the expedition Mick Nunwick, Mark Wright and Tim Allen managed to climb the aven (at the end of Wonder Cave, now called the 78 Chamber) via a circuitous route and gained access to continuing passage. The 15m by 10m passage rose steeply for 200m before ending at an impenetrable choke. Half way back to the climb a side passage was found near a small roof inlet. This also choked but a steep ramp near the choke was left unclimbed."

It is believed that we entered through the roof inlet mentioned above.

The Middle Pocket

Rob Middleton

The large pit in the centre of the Middle Pocket traverse was a tempting open lead left by the 2015 exploration. It was initially descended by RM and CH on 11/04/17, who dropped a 67m pitch to a big loose ramp. This was followed down, still on rope, for 35m to a final scramble down to a short flat area at the base of the ramp and the head of a 50m pitch. Unfortunately, no more rope was available so a return was required. During the exit RM had a quick look upslope from the pitch. This was harrowingly loose, and the climber stopped after 20m at a 5m climb up stacked boulders. It looks poor and heads in the direction of known cave, but is technically a lead.

On 12/04/17 RM, RE and JP returned and descended the following 50 m pitch landing on another boulder slope. Down led back under Middle Pocket itself to a blind pit 10m deep. But up led to a col, and then a descent to the north in 15m wide and 50m high rift passage to a large breakdown chamber. Despite extensive searching, no way on could be found amongst boulders in the floor. However an ascending 6m diameter passage was followed south, climbing gradually up flow stone until the calcite steepened. Two 20m pitches were climbed with minimal gear, however another climb approximately 35m would be required to access two windows into passage above. This is a good lead but requires a vast amount of rigging gear to access.

South Rhino Canyon

Rob Eavis

This passage can be looked down into from various places along Doing Time, and although it was not entered in 2015 it was presumed correctly to be a northwards continuation of the Rhino Canyon vadose passage. Named as 'Downstream Rhino Canyon', it was not

until more of the system had been explored in 2017 that it was realised that the water in this primarily vadose canyon actually flowed towards the north, making this section actually upstream from the White Rhino Camp.

From the Rhino Canyon entry point near camp, the canyon southwards is initially fortified by a section of large, dark boulders under heavy showers from impenetrable cracks in the roof above. Weaving through the boulders breaks out into a fine passage with a mud floor and some calcite formations.

Wide initially, the passage soon becomes 15m tall and 5m wide, similar to the canyon to the north. After 100m the passage becomes floored with loose boulder slopes which continue up and down for another 90m until a final slope up joins the Doing Time passage.

25m before the connection, two small holes in the floor take different routes down through the boulders to a vantage point looking down a long calcite ramp into a continuing passage. A return with rope leads down into a chamber 20m in diameter with a solid mud floor and distinct mud tide line all around. The only way on here is back to the south along a 5m x 5m passage which after 80m connects back into the main passage explored earlier through an obscure hole between boulders. This oxbow passage is the furthest south that the vadose component of the Rhino Canyon has been seen, seemingly rising up phreatically from the floor of the muddy chamber and joining into the phreatic that has come down from the Doing Time development.

Near this obscure hole a loose climb up the west wall accesses two passage at roof level. The larger of the two heads directly west for 40m, climbing steeply at the end before closing up in a calcited ramp. The left hand passage is a one metre diameter tube which connects back into the canyon after 35m.

The Asylum

Jon Pemberton

From the top of the short climb marking the end of the 2015 expeditions survey of the 'Governor's Pleasure' a short stooping passage leads to a crawl up a slope which enters the boulder choke proper. A flat out crawl through boulders (dug in 2015) leads to a 5m climb down into a well decorated passage containing some superb crystals. A small, draughting muddy tube heads east for 20m up a ramp but is too tight to continue.

The passage continues for 50m northeast to a choke of boulders. At the end of the chamber a 3m climb up leads to a tight angled squeeze up between bedrock. 'The Letterbox' then opens up into the side of a large boulder lined phreatic passage some 10m in diameter. After an awkward exit from 'The Letterbox' the passage continues southeast to enter 'The Asylum' a boulder lined chamber 150m long and 80m wide containing two large stalagmites opposite the entrance.

At its southern end a slope up over boulders soon flattens at the base of an 80m high aven; a passage looks to continue from the top. The northern end of The Asylum terminates in a 50m high calcite ramp completely choked at the top. A few routes down through

boulders at the northeast end all terminate in boulders and calcite. A route south can be taken from here which loops back around to the passage containing 'The Letterbox'.



Letterbox squeeze through into The Asylum | Rob Eavis.

Draught Excluder

Dave Nixon

One of the leads remaining from the 2015 expedition lay in the Rhino Canyon north. A mere 10 minutes from camp on the west side lay an obvious and relatively easy aid climb up to a hole in the shoulder of the passage.

An easy approach from the floor leads to a 15m pitch up through a well decorated stoop straight into a 20m diameter chamber with three ways off.

High up at the top of the chamber is what appears to be an obvious large passage. Further aid climbing gained access to this via a 40m steepening climb. The way on from the top is not as it appears from the floor and soon becomes a minor mud and boulder floored passage which closes down after 20m. A second, far less attractive climb on the east side above the entry point into the chamber can be seen from the main route. This was not tackled.

The route was de rigged and attention was turned to the other lead off the chamber at lower level. This option was far smaller but considerably more attractive due to the powerful draught emitting from the stooping height continuation. A well decorated passage can be followed for 80m to the head of a 16m pitch down. Here a small stream flows from an upslope continuation to sink downslope amongst boulders and mud. A muddy route can be followed down for 35m beyond the sink to a sediment choke.

Upstream a sharp corner is followed by a pool into a narrow canyon. Just prior to the pool a climb on the north side was found to be blind.

Awkward caving continues in the floor of the canyon for 50m until the base of a 15m pitch is reached. This enables access to the top of the incision and consequently a route into a high spacious rift running east-west. To the east the water and draught originate from a 35m aven above a plunge pool with a small passage visible going off at the head of the unclimbed pitch. In the opposite direction the large rift heads off at a similar elevation but without the inlets. This also remains unexplored.

North Rhino Canyon

Dave Nixon

Turning round in 2015 from such a promising lead at the northern end of Conviction / Wonder Cave was hard, really hard. It only dawned on us just how exposed and vulnerable we were as we returned this year with greater manpower, knowledge and equipment. So, returning to the final survey station in the Rhino Canyon, fully tooled and backed up, was a satisfying feeling.

An awkward 6m climb up out of the canyon at a boulder collapse enables access to the continuation of the major route north which initially hides well a short oxbow high up on the east side of the passage. The main route ahead however is at floor level and after a short breakdown zone soon develops into a magnificent 20m high by 6m wide trench winding off effortlessly into the distance.

Following 200m of easy going a boulder breakdown area is reached on a corner where prospects become even more encouraging as a huge passage joins from the east. This development runs down from the Api Centre and joins the main conduit heading towards the Melinau Gorge.

Climbing down boulders for 8m to the base of the trench it's then possible to crawl for a very short distance beneath massive wedged blocks in the trench to regain the enlarged way on. Passing superb chicaned mud banks this then enters a truly spectacular section of cave now 35m high by 12m wide. Roped assistance is required up an 8m collapse but this then leads to yet more easy going with the occasional breakdown area to clamber over.

High in the roof after 250m the phreatic component of the development (A Secret Affair) can be seen to continue north in commanding fashion, while the low level way on soon degenerates into a narrow muddy canyon. The only possibility of continuing is by means of a very muddy climb bridging the canyon and onto the incredibly slippery Bournville Traverse. This is where first earshot is possible of the large inlets entering from the south (Return to Sender) and the source of the dark brown sediment deposit and also permits access to the Black Country and the remainder of the northerly section of the system.



North Rhino Canyon close to the offset for the Api Centre | Jeff Wade

The Api Centre

Jeff Wade

The entrance passage to The Api Centre is a south easterly passage branching off from Rhino North on a distinctive corner with a large boulder breakdown. Here the canyon enlarges at a high level above this breakdown and is first seen from the main route through Rhino North where a large boulder is climbed up on to. The main way to the rest of the cave is to climb down the other side, but by keeping at the same level this large boulder breakdown can be traversed above, leading to a vertical shuffle up a narrow on the left wall, 3m high and handline useful, which is then followed by another climb up unstable boulders on the left, 6m high. This is generally worth climbing by the first person and then being rigged as a pitch to the right in a more stable area, 10m pitch. From this point, the start of The Api Centre passages can be accessed by walking.

The entrance passage up to The Api Centre chamber is some 8m wide by 6m high fossil gallery, with light cave walls and a distinctive orange passage roof gently scalloped. This roof can be seen regularly throughout the main north heading passages of the cave. Light coloured mud cracked floors are also present in places. After some 100m the floor of the passage starts to ramp up and boulders can be seen long into the distance. This is the start of The Api Centre chamber.

The Api Centre chamber boulder ramp keeps a constant incline of around 30 degrees all the way to the back some 100m away. Throughout the width of the chamber keeps to around 40m wide. The roof however from the beginning of the chamber steeply shoots up to nearly 100m high at the back of the chamber, which explains the significant echo of a large void when initially entering the chamber. No passages were found at the back of the chamber, but there is potentially something at the top of the chamber albeit difficult to see from the floor and too large an effort to explore.

Back at the start of The Api Centre chamber a passage to the north quickly blocks after some 20m and is most likely a high level passage that can be seen to the right of The Api Centre entrance passage in the Rhino North, with only several tens of meters between the two.

On the opposite wall in The Api Centre chamber an unobvious stooping passage between the boulder rubble and a shelf in the roof give access to a passage descending south east initially, which then turns after 30m to then follow in parallel the south west line of the Rhino North canyon. This passage of approximately 5m wide and 4m high is highly decorated in places with some nice flow stone formations. This passage is typically formed on an angled bed between two rock types that traverse the passage leading to a slanted roof across the passage cross section, whereby up dip is to the east and down dip to the west. Due to the forces on the roof several large boulders have peeled off landing onto a flat mud floor below. Strangely this floor mud is undisturbed, but flecks of mud on the ceiling can be seen up to some 6m away caused by this action leading to an atypical passage decoration. The passage ends in a calcite blockage, but it is clear that it would have originally linked to The Asylum only a few meters away.

A Secret Affair

Dave Nixon

The march north was always top priority during the planning and active part of the expedition, however as is often the case it was a matter also of having to think on our feet about the speleogenesis of what we were exploring almost as we were exploring it. Fortunately we were able to employ some very useful software which, enabled us to instantly access and interpret all the data we were gathering in the field at the end of each day.

This illustrated with little doubt that we were not only going to have to consider what was going on at floor level but also, and more importantly as it turns out what was happening high up in the phreatic roof tube not normally a consideration in the strike related passages on the western flanks of Gunung Api.

A temporary route up from the base of the vadose canyon led via a 40m bolt route passing loose blocks to permit access to the phreatic roof tube. Heading north a long traverse, protected by ropes in places gives access to a high level junction. The obvious way on lies in the opposite side of the deep canyon, however tackling this proved unnecessary.

By following the roof tube adjacent to the canyon it soon leads to a small chamber above the trench with an easy rock bridge permitting access to the north side. This chamber contains a very large distinctive black stalagmite. Heading south from this chamber an easy aid climb up a gulley on the west wall gives access to a large higher level tube. A muddy inlet comes in from the roof on the east side, this wasn't entered. Ahead the large passage continues for 80m until it closes down with a narrow rift in the wall being the only way on. This can be descended with the aid of a rope for 8m and allows access to a small but very well decorated terminal chamber.



Northward facing scalloping at the start of the high level Secret Affair series | Rob Eavis.

Returning to the rock bridge chamber an easy scramble up a slope leads into the opposing large tube heading north. Easy walking soon leads to a large junction, to the right the passage descends with fine examples of scalloping and again soon leads to another smaller junction. A short section of stooping soon gives way to larger passage dimensions and the opposite side of the deep trench considered an objective at the very first high level junction.

Retracing now to the small junction progress can be made in a low wide passage with crystalline floor. Before long a small but very distinctive chamber is entered. This has a perfectly smooth, flat, water eroded roof.



Flat roofed chamber in Secret Affair | Rob Eavis

Beyond, the passage changes character and becomes larger with much flowstone and an oxbow on the east and a way down opposite. The oxbow contains a chute at the start which is clearly a wet weather inlet. Ascent and descent of this lead and the route down was never undertaken.

Ahead easy walking soon leads into a long high breakdown chamber 40m high with massive blocks strewn in the floor.

At its widest point the well decorated mud floored oxbow reenters. In the same area another passage enters and cuts through the large breakdown chamber. Two pitches down (12m) lead to a dry water course and a route underneath the large boulder floor to connect to another passage detailed later in this description.

A bolt climb of 11m into the narrow inlet passage leads up a flood inlet passage which was only partially explored for 80m due to a large flooding event during the solo pushing trip.

Continuing north in the breakdown chamber a scramble over and up massive collapsed blocks leads to the obvious way on. Well decorated with some fine gypsum flowers in places, the route gradually diminishes into a terminal stal and flowstone blockage after 120m.



Large breakdown chamber with route down in the floor back to the Black Country | Rob Eavis.

Returning all the way to the large junction north of the black stalagmite is where the description continues.

Sweeping northwest amongst some mature formations the route soon descends over large collapsed blocks. After 85m the edge of a pitch down is met. Just prior to the drop off a small tube cuts underneath the north wall and access to yet another route heading north is entered. At this point a perfect take off was rigged to permit a 40m free hanging pitch dropping straight into the 'Black Country' immediately north of the stream sink.

Skirting the pitch head a 2m diameter tube gradually rises and can be followed for 100m passing a blind route on the east side, to the top of a 40m pitch down. This was subsequently connected to the chamber at the end of the 'South Passage' which runs off the junction at the start of Liberation.

A short bolted traverse led to a continuation of the passage across the top of the pitch. This passage contains a deeply incised vadose trench which originates from the passage to the east at the junction shortly after the traverse. Ahead at this junction is a small crystal filled phreatic passage which runs immediately to another junction both routes being blocked. The wet weather route to the east can be followed through pools in a wide muddy passage to the floor level of the large breakdown chamber. A subsequent connection was made through this blockage to close the loop.

Return to Sender

Cat Hulse

From the top of the 40m pitch into Secret Affair, and up the short rope above it, the main Black Country passage can be seen below. On the south side of the opening above the short pitch a flake can be clambered around and then traversed using 10m of rope to a crawling passage heading to the left approximately half way across. The crawl ends in a mud choke after approximately 30m of belly crawling, but continuing across the traverse leads to Return to Sender. It can be accessed by another 10m rope traverse to the top of a 20m pitch with a large swing to the left to land on a large boulder in the passage below. Via a series of short climbs, one of which benefits from a few slings, a junction is reached.

The obvious passage continues straight ahead over boulders for a few metres but ends in a boulder choke with a rumbling watery sound, but a route through could not be found. A climb of 2m on the right of the passage leads on.

The phreatic passage is followed from the climb to a traverse to a chocolate-broccoli ledge, where the waterfall at the start of the Black Country can just about be glimpsed below. The traverse uses an 8m rope to reach a muddy passage the other side, and following this soon opens into a junction with a small oxbow to the right and a dead end to the left, after which another passage to the left is passed.

The left passage continues a few metres to end in a sump pool to the left and a low crawl to the right that becomes too tight. Directly onwards following the draught leads to a letterbox emitting a howling gale. Through this is a gunbarrel-black chamber with a waterfall. A climb up beside the waterfall leads into more rift-like passage until another similar waterfall aven is reached. This was pushed approximately 30m upwards in a wet corkscrew climb that would be highly dangerous in wet conditions and would certainly benefit from protection. Phreatic tubes can be followed west from here but ended in too-tight constrictions & sumps. A strong draught emits from the waterfall aven but is thought to be water driven.

The Black Country

Jeff Wade

The Black Country starts at the Bourneville Traverse and finishes at the T-junction between The Catacombs and the Slingshot Traverse (main way on to South Passage and Liberation) and makes a clear change in the nature of the cave. It is clear that flooding has occurred bringing in a lot of mud and sediment and it is also the first place that equipment gets significantly dirty in the cave. This should be seen as a warning as during heavy rain silent dry passages become 3-4m deep lakes several hundred meters long, interlinked by noisy rivers in canyon type passages. However, before and after the Black Country, areas can be found to sit out a flood.

Heading north from The Bourneville Traverse this gives access to a high rift, some 4m wide at the bottom and over 30m high. After some 50m the passage enlarges to the left where a stream inlet runs in from fissures within the walls. Soon after this point the ceiling dives down to form an arched roof tube, and at floor level large dark mud banks are either side

of a narrow water channel. However, by this point the water from the stream inlet has already sunk into the floor. A large vertical mud bank is met, and a scramble up the side is needed to continue with the main way on. The water here sinks somewhere in the floor before this bank, and after heavy rain water levels can significantly back up due to this mud blockage creating a pool over 4m deep.

Once up the mud bank, the passage enlarges again and high above is A Secret Affair at roof level (P40 if dropping into The Black Country). Climbing down on to slippery boulders and a short scramble up the other side leads to the top of a ledged passage where the way on is down with the small canyon in the middle. Once again the ceiling comes down and a dark phreatic tube 15m wide by 5m high is passed, with dried gours pools at floor level. The passage then descends further on to slippery boulders, the roof rises up once more and loses its oval shape and then turns gently to the right. At this point in flood, water is issued on this corner from below, which flows along all the following section until it sinks just before the T-junction at The Catacombs and the Slingshot Traverse, where it then most likely flows into The Catacombs.

From this corner the passage is mainly boulder scrambling, but after 50m a clear channel or potential water course is clear, which offers easier walking in dry conditions in a 10m wide by 15m high passage. After 100m this stream channel breaks into large boulders which are bypassed by a step up on to ledge to the left. Walking across several large boulders and a short slope within a chamber marks the T-junction between The Catacombs, which is accessed by a low wide crawl to the right (south east), and the Slingshot Traverse to the left. Before this point a small tube on the left occasionally draughts and emits noise from the sound of air under pressure, which is once again a sign of the active nature in this part of the system.

Catacombs

Cat Hulse

From the T Junction at the end of the Black Country, the Catacombs begins with a low & wide rubbly crawl heading south from which rumbly water noise can be heard issuing. This soon leads to a wide boulder-strewn passage, passing a sump pool to the right and then taking a sharp U-turn to the north. It continues in a stompy and boulder-hoppy manner to meet another large & heavily calcited passage from the right.

This passage to the right headed up a mud slope past some stalagmites bearing a startling resemblance to Anthony Gormley figurines before a 25m limestone ramp to the lip of a pool. A 10m tit-deep wade leads to more fluted limestone ramps into a large aven/chamber with a large (>10m high) boulder/flake. The far side of the chamber is a blank wall with an unascended climb (approx. 8m) on the right side.

The main passage continues, dark and muddy, and it is joined by water from under the floor and from the right hand walls as you are heading north. The water is followed downstream, rising and sinking in the floor until it rises before a large inlet to the left. This connects to the liberation series.

To the right (downstream) deep pools with large mudbanks soon lead to a large mudbank

blocking the way. From the top of here 3 options can be seen: a muddy slope up and to the left, a deep canyon cut into the mud below which likely goes in the same direction as the previous and a passage to the right just above the level of the top of the mudbank.

The mud directly ahead & to the left can be scaled to lead to a slippery traverse which also connects to the Liberation series. The muddy canyon below can be slid down then followed for approx. 25m before a miserable gurgling duck/sump, but following the same direction as the passage that can be seen from above (the muddy traverse that connects with liberation).

The smaller (stooping height) phreatic passage to the right taking a draught continues to another muddy meander where a mud ramp to the left can be traversed to the continuation of the passage. This continues heading sharply upwards and the character changes to a walking-sized vadose canyon as you pass a small inlet to the right which takes the draught and emits a rumbling sound. The passage directly ahead continues sharply upwards and the limit of exploration is a steep mud slope which became too vertical with insufficient depth of mud to form decent holds so attempts to scale were unsuccessful. There is also no decent rock to bolt into it's all mud. A solid wall can be seen directly ahead but the wall to the right at the top of the climb can't be visualised from the bottom so it could be a lead for a determined mud-climber. There is no draught. The rumbling inlet to the right can be climbed to a tight spiky near-vertical passage that was pushed for some distance before it became too tight.



Mud covered walls of the flood prone Catacombs | Jeff Wade.

South Passage

Colin Boothroyd

A short distance westerly from SlingShot traverse the Liberation Passage runs into a T Junction with enticing passages to the north and the south.

The South Passage follows a 210 bearing and soon reduces from a large section size of 6m x 6m to a passage of 2m x 3m. The passage floor is made up of mud covered pebbles kindly mixed with sharp limestone stones. Small passages in the east wall either interconnect and terminate or connect back to the Liberation Passage. The pebbles (5cm -10cm diameter) are clearly imbricated and indicate that the water flow is from south to north.

The South Passage drops to crawling and there are some shallow pools that keep the passage entertaining. A low level traverse around a final pool is rewarded with a significant enlargement that quickly opens out into a chamber of measuring 20 x 40 metres and 25 metres high. Across the inclined floor of the chamber is a 2 metre rising step that can be easily negotiated.

A pitch from one of the higher level Secret Affair passages drops down a very steeply inclined wall into the most southerly limit of the chamber.

At the lowest point within the chamber there are a pair of small passages that become blocked with boulders and mud after a few metres.

Liberation

Luke Cafferty

The Black Country eventually runs north and downwards to a distinctive T-junction with an inaccessible rumbling sound beneath the boulder floor. The roomiest way is to the east, but this soon lowers to a flat out crawl and access to the Catacombs series of passages described earlier.

To the west is an ascending slope to a small dry chamber with a small, uninspiring looking rift at the far end. This rift, Slingshot Traverse, takes a good draught and is passable but requires rigging. Beyond the traverse a stooping passage enlarges into a low chamber with two passages leading off. East from the chamber, past an unexplored route in the floor, leads to a slightly larger chamber with just one way on, a steep but easily climbable slope down to the east. Soon water can be seen emerging in the floor and flowing away at a junction into a small classic phreatic tube. The water here has an unknown origin but a large joint developed chamber 30m x 30m with water entering from an unseen source in the roof 50+m above. A flowing stream runs from the chamber into a small descending passage upto 2m x 3m in size, with several small inlets joining the passage en route. After approx. 100m a second stream passage, roughly the same dimensions, is met and both streams flow into a deep pool at a Y junction. This second stream passage is part of the Catacombs connection to the Liberation series.

Back at the junction after the Sling Shot Traverse, left leads to an awkward low, wide passage with sharp mud formations strewn on the floor. This passage soon enlarges and

starts climbing up dip with the draught and after 80m comes to a large junction; left leads to South Passage and right leads to the magnificent Liberation passage. The Liberation series starts with a small scramble up into an old phreatic passage with a calcited mud trench in the floor, at this point all the scallop marks on the walls and floor indicate rapid water flow northwards. This 8m x 3m passage meanders superbly in this fashion for a short way until its character changes into a high vadose canyon, 3m x 20m, with the phreatic component staying at roof height. This is a particularly stunning section of cave, complimented a short way along by a spectacular 9m long straw hanging free down the centre of the trench (see appendix 1, page 60). Here on the west wall are two unentered passages, roughly 30m up.



Beginning of Liberation facing north | Jeff Wade

Ahead the main way continues in fine style to a spacious junction with a possible roof passage 50m above. Right at the junction is a descending passage which leads down to a connection back to the Catacomb series. Northwards continues with the canyon gaining more height and the depth of the trench being 40+m in some places. An obvious high route on the west was climbed into and found to be blind, and shortly after yet another long straw hangs in the passage which starts to narrow and after a further 200m a calcited scramble is met.

A small inlet of water comes in on the east wall but an easy 5m pitch up brings you to the top of the collapse, where a short traverse on the opposite wall keeps you out of the water until a 5m down pitch brings you back into the canyon. After 50m a calcited boulder collapse is passed by climbing up a boulder on the right hand side and squeezing between the obvious gap between the boulders. Shortly after the collapse is a series of climbs down into the Dry Cascades. An easy 5m free climb down and a traverse around a deep pool brings you to the another easy 3m free climb, and then a 22m pitch down leads to a pool of water and the pitch head into the start of Sugar We're Going Down.

Takes the Biscuit

Colin Boothroyd

At the start of the climbs and pitches that together make up Sugar We're Going Down there is an inlet coming in from high up on the eastern wall. The inlet can be seen flowing over a large section of vertical and inclined flowstone. The flowstone wall (approximately 20 metres) can be climbed, to the right of the inlet water, with the aid of approximately 6 bolts to a small stance adjacent to stalactites.

A traverse to the left of the stance, around the stalactites and over the inlet stream leads to a further fluted flowstone ramp. This can be delicately ascended for 15 metres to a small window through a calcite blockage giving access to a small passage heading north. The inlet water emerges from a small hole at the top of the flowstone and has not been fully examined.

The small northerly trending passage passes over holes in the floor to the canyon below. At one point a short climb down a hole leads to a passage that passes over the canyon and leads to a further collection of small roof passages. All the leads close down. There is minimal evidence of draught. The impression from the various large roof pockets is that rising phreatic water has tried to find a high level northerly route in this zone but has failed to penetrate the rock and hasn't provided a route north.

During the exploration period there was clearly a downpour on the surface resulting in the inlet waterfall becoming a major cascade. The 20 metre pitch was left rigged as the original explorers were eager to escape from the deluge and head towards drier, safer passages.

Approximately 100 metres south of the initial Takes the Biscuit climb, along Liberation, the large roof tube of the main Liberation passage is clearly visible trending north. This passage was not climbed into. The total height to be climbed looks to be 30 – 40 metres. It is unknown whether this roof tube is also encountered in the Takes the Biscuit passages.

Sugar we're going down

Jon Pemberton

A fine 40m dry cascade pitch drops to a large chamber 60m high containing a large boulder slope at its NE side. This can be ascended for 30m to chokes in calcite. Following the left wall north for 40m, a 3m deep trench must be crossed to reach the continuation, at which point a ramp on the west can be ascended for 50m to a choke. Continuing east the passage changes completely from mud floor to clean washed, emerging on a balcony overlooking three separate shafts in the floor, all ~10m in diameter. Only the middle shaft was descended which linked up with certainly the 1st and possibly the 3rd shaft further down. From the pitch head a 40m aven stretches upwards which would be a very remote bolt climbing prospect.

The middle shaft descends 55m through a vertical phreatic series to a large muddy passage. This continues to descend over and through boulders (climb 5m) and changes its course completely and heads north again following a stream. This continues over a very loose boulder pile with an inlet entering from the roof to a steeply descending mud and boulder choke in the floor.

Back at the prominent change of direction, a short climb up behind a large slab leads to a series of short muddy pitches down, 8m, 10m and 4m, with some nasty pitch heads and awkward take off points. This eventually breaks out in a large rift passage 30m high containing a stream at floor level with lots of inlets emerging from above. The passage ends at an 8m climb down in a rift to a static sump pool. Above this a 40m high aven represents another remote bolting project and concludes the cave's northerly limit. This is believed to be the remotest place yet reached by man in the Mulu National Park.



The Hidden Valley team at Rhino Camp | Jeff Wade

*Left to Right standing:
Luke Cafferty, Rob Eavis, Rob Middleton, Jon Pemberton, Dave Nixon, Cat Hulse*

*Front sitting:
Colin Boothroyd, Jeff Wade*



The superb Rhino Camp | Jeff Wade

Underground Camp

Jon Pemberton

The White Rhino camp explored on the 2015 expedition proved to be a vital discovery in aiding the 2017 expedition and its further explorations into the system. The sandy floor surrounding 'The White Rhinoceros' was more than enough to sleep 8 comfortably. We each flattened out a space for our thermorests and had enough space beside our pits to house our bags and gear. Most people used cotton/silk liners for sleeping in with a couple of people using light weight sleeping bags.

Water wasn't an issue as an inlet from high in the connecting chamber was utilised to catch water in an Ortlieb bucket from where a small diameter pipe syphoned it down to camp giving us water on tap.

Next to this a large slab acted as a great kitchen top to house three stoves. We also had room for all of our underground food mainly consisting of noodles, tinned food, dehydrated meals for our breakfast and evening meals and the regular sweet snacks for on the go food.

Above this we hung a washing line which spanned the width of camp for everyone to hang wet gear from and generally get things off the floor.

Everyone used their spare headlamps in camp and only used 10 candles towards the end of the underground exploration. Camp was successfully demobilised leaving nothing behind only a few pits in the sandy floor from where we had slept.

Power generation

Rob Eavis

The helicopter mobilisation allowed for the delivery of two petrol generators that would be used to charge the power-hungry drills, lights and gadgetry the team would be using every day. One generator was left at the helipad as a backup for both our primary unit at Prediction Cave and also in case the solar panels did not provide enough for the radio repeater. This backup was not used.



Generator and recharging facilities at base camp | Dave Nixon

The main power source was a four stroke petrol powered 1kw 'suitcase' type generator. This proved to be reliable, quiet and virtually impossible to run out of fuel. It was at base camp all the time and used mostly on the rest days between each of the underground camp trips, and was able to supply all the power we needed with only 20 litres of fuel used for the whole expedition. A relay unit was used to protect against low voltage and unplanned shutdowns. There were no issues with any of the equipment, including the laptops and the ability to recharge as many lithium iron batteries as we could connect at one time.

Inside the cave a 30Ah USB power bank was used each evening to charge the survey phones, but also cameras, DistoX2s and iPods. This was invaluable, especially for the power-hungry Samsung Note 4's that were used for the surveying. It should be noted that this power bank took in excess of 10h to fully charge in between trips.

Medical Report

Dr. Catherine Hulse

Introduction

After 2015's somewhat exciting rescue (see HV 2015 report), it was decided to enlist a Doctor for this expedition so they ended up with me. I remained with the Hidden Valley team while a representative from each of the Creedence and Connection teams was selected to take responsibility for the medical kits, and all members who attended the pre-expedition meeting received basic medical training. The teams based at HQ also had access to the clinic there if required. The closest hospital is based in Miri, a 5 minute drive then 30 minute plane journey from park HQ.

Pre-expedition preparation

All expedition members were invited to training at the pre-expedition meeting where the basics in giving emergency drugs, the contents of the first aid kits, and the indications and contraindications for the items carried was covered.

Most of the medications in the previous kits was expired and was therefore replaced prior to this year's expedition. I also used this as an excuse to update some of what was carried, and a more comprehensive medical kit was put together for the Hidden Valley team due to the remoteness of the location and lack of access to other supplies for the full 3 weeks, and the fact that I was there and able to use it. Most of this returned to the UK with me as most of it originated from my personal kit.

Casualty evacuation plans

It was planned to use the helicopter to drop kit to Hidden Valley in order to test it and the helipad cut in case of a casualty evacuation from the Hidden Valley. Evacuation from HQ would be by 4x4 to the local clinic or 4x4 then plane to Miri if required. Theoretically a helicopter could transfer from Hidden Valley direct to Miri if it were required.

First aid kit contents

The set up of the first aid kits was changed this year- each team was provided with a 6L basecamp daren drum and 2x3.6L emergency kits, 1 more suited to overground use and 1 more suited to underground use but both interchangeable if required with the contents being mostly the same. The emergency kits contained mainly emergency medications, painkillers, splints and dressings for immediate use. The basecamps kit contained antibiotics, spare items and non-emergency medications. In Hidden Valley the basecamp kit was kept at prediction cave with an overground emergency kit, and the underground emergency kit was taken to white rhino underground camp in wonder cave. The Creedence team also took an underground emergency kit to camp and left the rest above ground, and the connection team didn't carry theirs much at all as they returned to HQ most evenings.

Inside every kit was also enclosed a laminated crib sheet with all of the medications, and their major indications and contraindications without medical jargon suitable for any non-medic to use as a guide.

Changes to the kits from previous years were mainly an increased selection of antibiotics, more alternative painkillers (Diclofenac, Codeine) due to the difficulties in obtaining and carrying Tramadol since it became a controlled drug, and a full complement of emergency drugs which was provided in every emergency kit. Only small quantities of non-prescription medications were carried in accordance with last expedition's recommendations, with advice given to all expedition members to provide their own supplies of these to reduce waste. The exception to this was iodine & gauze which were carried in large quantities by the expedition due to the ease & cheapness of obtaining these in-country.

'Day kits' from last year were used on some trips, but not prepared for use as team members were encouraged to carry their own minor incident supplies (simple analgesia, iodine etc.)

Hygiene

Clean running water was provided at HQ. Drip collection was used at both prediction and white rhino camps in Hidden Valley and no sterilisation was used. There were no cases of gastroenteritis reported during the expedition.

Hand hygiene was maintained by running water by the kitchen at all camps, through use of a siphon pipe and tap at the Hidden Valley camps. Antibacterial soap was provided for with running water and alcohol gel for toilets.

Incidents

No major evacuations were required this expedition.

Medium incidents:

Dislocated shoulder (not first, previous shoulder injury)

Olecranon (elbow) bursitis x2

Minor incidents:

Cuts & scrapes, bruises

Finger injury

Leech bites

Sprained ankle

Tinea cruris (groin rot), Tinea pedis (foot rot)

Harness sores

Supplies Used

Gauze

Iodine

Flucloxacillin

Miconazole cream

Talcum powder

Triangular bandage

Majority of members used their own supplies.

Recommendations for future expeditions

1. A full inventory is available for all expedition medical supplies with expiry dates. It is unlikely that anything will need to be replaced for the next trip as planned for October 2017- most of the new medications are in date until well into 2018.

2. A personal medical kit list was provided for this expedition due to the reduced quantities of non-prescription items carried by the expedition. This should be disseminated again prior to future trips as most common problems are easily treatable with personal kit.

3. Pre-expedition medical training was generally thought to be beneficial. This could be provided prior even if a doctor is not available for the next trip.

4. It was noted on disposing of the expired drugs that the encapsulated medications were almost completely disintegrated. I cannot know whether this began to occur before they expired or not but due to the extent of damage in minimally expired meds I expect that it did. Care should be taken in storage of encapsulated meds not to puncture packaging to minimise the humidity they are exposed to and where possible encapsulated medications avoided. However I am not aware of any availability of Tramadol, Doxycycline or Flucloxacillin in any other form.

5. Permanent replacement of Tramadol with Codeine +/- Diclofenac may be required due to the issues raised above and the difficulties in obtaining and transporting it, in addition to the risk of cognitive side effects.

A single basecamp kit at HQ is easily sufficient even for a large team as re-supply from the local clinic is possible if required. As basecamp kits were not carried to



underground camps it may be worthwhile including frequently-used antibiotics such as flucloxacillin +/- clarithromycin (penicillin allergic) for prompt treatment of skin infections in the underground environment.

*Medical kit preparation at Park HQ
Jeff Wade*

Food

Jeff Wade

Whilst an advanced party, Moose and Luke, headed to Mulu head quarters to prepare equipment in the store, Cat, Rob M, Jeff and Mark Brown, with the help of Veno completed the task of buying the food over a period of two days. The food for both the Hidden Valley and the expeditions based at the national park head quarters was bought at the same time. This was collected in separate shopping trollies for each part of the expedition, paid for separately, and then more importantly boxed (with the help of the friendly shop staff) and labelled to prevent mixing of the expedition food - much of which for the Hidden Valley team would remain in its boxes from the supermarket right through to its arrival at base camp in the Prediction cave entrance.

The calculation of the quantities of food was made significantly easier with the help of a spreadsheet used on previous expeditions to Mulu, originated by Mark Brown. In the spreadsheet the quantities are automatically propagated based on the number of man-days in the field. However, a few additional items to the standard list were also required and these have been noted at the bottom of this table.

In general, these figures for the purchasing of food in advance were perfect, as by the end of expedition in the Hidden Valley around 2 days' worth of additional food remained at the base camp, which for a team of 8 people is not a huge amount; and if for unknown reasons we were in need of the extra it was there. Very little food was brought into the

valley during the expedition, but, during the weekly shift changeover of porters, some fresh vegetables were brought in and were certainly appreciated, as the general diet, particularly underground, did lack vegetables, and fruit was only in dried form.

Surface Food

Whilst on surface we were treated to having a camp cook, Steve, who put together all the surface food. Generally this consisted on noodles for breakfast with the occasional egg, and then for evening meals it tended to be rice, a vegetable dish, meat or fish from cans, and nearly always the small dried salted fish, which we all grew to like with time, albeit these were not part of our shopping list. For lunch this tended to be similar to the evening meals, but was often more than not a hap hazard affair as people were often in different places during surface days. To reduce any hunger between meals and to stock pile the energy before the next trip underground crackers with jam or chocolate spread were provided.

Underground Food

The main breakfast meal was noodles as per on surface. Lunch was a variety of raisins, peanuts, chocolate, crackers, cheese, biscuits and cake. Then for evening meals, it was either noodles with some type of canned fish normally, or a dehydrated meal that made a nice change to noodles all the time whilst underground. Similarly when underground camp was dissembled very little reminded food wise, but at the same time no one went hungry.

From a cooker perspective we probably used around 2-3 of the long gas cylinders each day at underground camp for the team of 8 persons.

Lessons Learned

This time the fruit cake made locally for underground was much better sealed than in previous years. It can be said that for the first two weeks of having it all the cake was in good condition, however for the final week some of them started to go off and sadly had to be thrown away. Therefore in the future it would be much better to have maybe a bit less cake and concentrate on eating it sooner. Also, a denser type of cake could be better as it would not let the air into it so readily.

Of all the tin food we bought several group members found the curried chicken hard work, as the well boiled bones within were effectively edible too. I think this threw a few people who aren't used to that, so maybe not so good for the future.

A long time was spent searching for an alternative to Tang, which could not be found anywhere. In the end a combination of dissolving vitamin flavoured tablets and powdered ginger and honey drink offered an alternative to caffeinated drinks, along with Milo. However, it would be good to find a flavouring that could be easily dissolved into a water bottle for day drinks.

Not really a food item but it was noticed that rolls of tape were somewhat lacking especially after boxing up the helicopter loads using respective colours, yellow, blue

and red, depending on which load drop. Probably more tape is needed in the future if a similar approach is used.

Food Shopping List

Below are the items bought in the initial shop in Miri for the team.

Item	Quantity	Manday estimate	x180 mandays
No. Of mandays used for initial shop			180
<u>Daily snacks/lunches/C5 brews</u>			
Chocolate bars various	175g bars	0,5	90
Peanuts	88g pkts	0,23	40
	112g pkts	0,33	60
Raisins 42g packets	pkts	0,4	72
Cheese kraft blocks	250g	0,12	20
	500g	0,04	8
Biscuits 66g	small pkt	0,3	54
Crackers (800g tin)	big tin	0,05	9
Jams jars mixed flavours	jar 450g	0,05	9
Peanut butter	jar 600g	0,02	4
Nutella	750g jar	0,06	8
Nutella	small jar	0,02	4
Tea BOH	bags	3	540
Coffee	3 in 1 sachets		200

Item	Quantity	Manday estimate	x180 mandays
Coffee	200g jar and refill		1
MILO tins	1.5kg tins	0,01	2
Milk powder 500g pkts	500g bags	0,02	3
Sugar	kg	0,02	3
Fruit cake (ordered in advance)300g slabs	cake	0,3	50
Dried fruit 150g pkts	pkts		6
Man/day estimation for UG camp meals			180
Underground camps			
Instant Noodles 75g pkt veggie or meaty	pkt	2	450
Muesli	kg	0,02	3
Pasta shape and straight	kg		3
tuna/sardines/mackerel 200gm tin	tin	0,5	90
curry	bigger tins	0,08	15
Soup chicken/mush/veg 60g	pkt		30
Candles			30
Lighters			20
RICE	5kg bag		6
eggs for chopper	various		100
fresh meat/veg - Veno			Unknown
Other			
Ketchup/Sweet chilli sauce	475g bottle		6
Washing powder	pack		1
Scour pads/sponges			6
Wash up liquid			1
scrub brushes			2
Buckets (check invent)			1
Detol soap			10

Item	Quantity	Manday estimate	x180 mandays
Gas cylinders			50
Toilet roll			40
Big freezer bags and wraps			50
Hand sanitiser	100ml bottles		2
Bin bags			50
Ziplock bags	6x8" 150cm		100
Grip seal bags	10x10"		100
Spirits	750mL		8
Nail Varnish (bright pink or red - Not too opaque)			10
String for Nail Varnish	20m		1
Tupperware boxes	small		8
Trenching tool	small		1
Mugs Bowls cutlery			8
Log Book			2
Mixed Nails	kg		1
Cord 2/3mm dia	20m		2
Drum 25L for water collection on surface			1
Tie Wraps			100
Duck Tape			4
Parcel Tape			4
Carry Mat for equipment protection			1
Spoons			12
Mugs			10
12v car battery 70-80Ah			1
Fuel and containers			2

Equipment

Rob Middleton

The Hidden Valley 2017 expedition prioritized lightweight and safety for its equipment choices. Lightweight equipment was necessary as everything needed to go in by Helicopter, and out by porter, and following Colin Boothroyd's dramatic rescue in 2015, it became apparent that with such a complicated and remote system, safety must also be a high priority. With this in mind a Sked stretcher was taken to base camp, and a collection of hauling gear was taken to the head of the 100m pitch. This pitch was also double rigged, both to speed up access, and to allow for a spare hauling rope if needed in a rescue. All expedition members were also advised to carry Petzl Microtraxion hauling devices 'just in case'. Thankfully none of this equipment was required but it is very much better to be looking at it than for it.

By Mulu standards, the further reaches of Wonder Cave are fairly equipment heavy. Over 500m of rope was required just to reach the majority of the leads, with many of the known leads also requiring significant tackle to attack. For this reason it was decided to take 1500m of rope. This was a combination of 500m of rope from the Mulu Caves Project store (mainly 9mm Beal), and 1km of 9mm Spanset rope kindly donated to the expedition by Spanset Ltd. It should be noted this rope both handled well and wore well, and can be highly recommended for vertical caving.

Zinc plated 8mm throughbolts were used primarily for anchors, with Fischer being preferred as their bolts are both fairly cheap, and tested and rated to reasonable strengths (+6kn in all configurations), though some other brands were used as leftovers from the store. One such leftover did pull out during normal operation, which somewhat shocked the operative involved, though this may have been as a result of inexperienced user error rather than the type of bolt specifically. Petzl 8mm alloy hangers were used as standard, while a number of stainless hangers and bolts were acquired by the expedition should any fixed rigging be needed. These were generally not used as it was felt by the end of the trip that, considering the remoteness of the far reaches of Wonder Cave, a return was unlikely within the duration where fixed rigging could be trusted.

A combination of karabiners, maillons and slings were used by the expedition, primarily Petzl and Lyon, with Mark Wright Training Ltd. again very kindly offering the expedition preferential rates on equipment purchases for any extras needed.

Makita 18v SDS drills were the preferred choice, with new 5mah batteries proving a wise if costly investment particularly for bolt climbing with 40+ bolts a battery possible. Petzl Tam Tam bolting hammers were used as standard.

2 team members took aid climbing equipment, consisting of etriers, gri gris for belay, a couple of sky hooks and some quickdraws and skinny slings. One member used a dynamic rope for climbing, although this soon became fix rigged and so most climbing was done using static rope (not to be recommended.)

Most members opted for Scurion headtorches as their main lighting, with the long duration batteries ensuring only 2 were needed for a 4 day camp. One member used a Petzl Ultra Wide (on its 3rd expedition to Mulu), which also performed well, but required many

more batteries for an underground camp, while another used 2 Fenix HP12 head torches which succeeded in blinding everyone, and proved a successful caving light running off 18650 Batteries. Many changes were needed, however the batteries were small and the system proved versatile, though somewhat lacking in terms of spot power. Back up and camp lights were from a variety of brands, with Petzl and Fenix being popular, and a number of member choose to carry a AA based spare in case the Lithium Ion batteries of Scurion, Ultra, 18650 etc. were to be removed at security in the airport. With new security protocols this is a very real risk for caving expeditions, though this time all members survived unscathed.

Walking boots, FiveTen Canyoneers and classic wellington boots were all used by members, with pretty much everyone being happy with their choice, except for Luke whose cheap Karrimor boots literally fell apart while he was half way through a 5 day camp. FiveTen also kindly offered preferential rates to the expedition. They can be recommended for their exceptionally grippy rubber and support, however their durability in jungle environments is questionable, both in terms of the fabric upper which holes easily, and in terms of the glue used which becomes less effective in the heat. Running repairs with seam sealant were sufficient to allow continued use throughout the trip.

Clothing was typically either Ronhills or Lycra with full body but lightweight covering recommended both to keep jungle nasties at bay and to avoid too many scratches underground, which easily become infected. A one-season sleeping bag was recommended for underground camp with liners alone proving just a little chilly.

Cooking was done on Kovea Spider stoves, which were both reliable and powerful, and had adapters fitted to work with local gas canisters, as the typical European screw thread types are not available in Malaysia. MSR pan sets were used, which were good, though the pan handle failed on more than one occasion nearly scalding one member of the team cooking in his Y-fronts. This should be replaced with a more sturdy example for future trips.

It was a very well planned and successful expedition gear-wise, with a big thanks to our sponsors Spanset, Mark Wright Training Ltd. and FiveTen.



The outcome of an enormous amount of planning - all equipment and personnel on location. | Rob Eavis

During the 2015 trip the communications in or out of the Hidden Valley were very poor, be it via the satellite phone or radio. The teams often had to rely on notes left with porters to convey messages. This position was strained severely during the rescue evacuation, with numerous hard trips made to the col to send radio messages back to Park HQ. In 2017 significant changes were made to ensure no repeat of this restraint.

Satellite phone

The previous satellite phone used the Iridium system, which has only occasional satellites flying over the small window of sky the Hidden Valley offers. This was always going to challenge phone calls, but also most SMS messages were either not able to be sent or lost in transit.

This year we utilised the Inmarsat satellite system, with a new iSatPhone 2. This uses geostationary satellites, meaning that if a signal can be found then it should be reliably available. Research suggested that the nearest satellite is "I-4 Asia-Pacific" which sits at 143.5°E. This puts it at a bearing of 100° from Hidden Valley at 42° above the horizon. It was hoped that this should be a good location for somewhere in Hidden Valley. Nobody realised that it would be possible to get constant, full signal whilst sat at Prediction Cave camp!

That was the hard part sorted. However, for the duration of the trip the mobile phone coverage at Mulu Park HQ was extremely intermittent, so a few SMS communications were missed.

Radios

Handheld radios from HV seem to struggle to reach anywhere useful, unless you wanted to take a quick ramble up to the col from Prediction Cave where coverage was a guarantee. In previous years a solar powered radio repeater situated on Gunung Mulu had enabled far reaching handheld radio communications around the Park. This however was sporadic due to lightning strikes occasionally taking out the equipment, this repeater has been out of action for many years now. The Hidden Valley is in a very 'dark' black hole when it comes to radio coverage.

This year a solar powered radio repeater was installed on the Hidden Valley helipad. This meant it was possible to speak directly to Park HQ from either the helipad directly or even from Prediction Cave camp using a handheld radio. This repeater was trickle charged every day by the expedition's 2x 60w foldable solar panels, previously used in Hidden Valley in 2015, and the 12v 80ah car battery was still fully charged at the end of the trip.

The link was only made possible by the use of an aerial lent to us by the National Park which was 7m long and erected in the middle of the helipad. By utilising this and a base station radio set a link was made possible via the existing radio repeater on Batu Bungan. This is the same repeater which enables radio traffic to reach camp 5 from park

headquarters. Hand held radio communications were even possible from Conviction Cave entrance via the base station and the repeater all the way to Park HQ. Beats the hell out of barking SOS messages across the Hidden Valley for 3 hours to attract attention. Trust me.



Radio repeater station and solar charger on helipad | Dave Nixon.

Photography

Jeff Wade

Due to the remote nature of the Hidden Valley and the efforts needed to transport equipment to it, all equipment was kept to an essential minimum. This also applied to the camera equipment whereby two main photographers were appointed for the expedition, Rob Eavis and Jeff Wade. However, it can be said that the majority of the other expedition members also had point and shoot cameras, which were worth taking for recording the smaller things of interest, bat skeletons and fossils, and for simply capturing the moment.

Prior to the expedition, Rob and Jeff discussed the equipment that each of them planned to take and the interchangeability of this equipment between the two. In both cases the flash guns of preference were Yongnuo YN560 IV, which are remote firing via a radio trigger mounted on the camera hot-shoe. Also, these units could be remotely changed for their power levels and the width of the flash beam, whereby each flash-gun is individually assigned a certain channel of control that can then be adjusted on the remote firer.

Both photographers used SLR cameras which accommodate lenses with a range of 10-22mm, which is well suited to general cave passage photos.

Prior to entering the Hidden Valley a large amount of silica gel had been prepared for

keeping camera equipment dry. Despite this precaution, there were a number of minor equipment failures, but nothing that hasn't been experienced by many a photographer in Mulu before; humidity will get inside cameras and may also affect flashguns and the like. Silica gel is still a must-have accessory, along with novel and creative methods of keeping camera gear operational.



*Cooking on gas!
One way to dry out
the camera.
Rob Eavis*

Most of the cave was shootable with electronic flashes, with only a few locations which would have benefited from the power of large flashbulbs - the Elephant's Graveyard, for example. However, for portability and ruggedness it was decided to use flashguns throughout. A tripod was brought into the valley but never taken into the cave, partly proving the success of the flashguns and radio trigger combination.

Several photo-specific trips were organised where appropriate, but generally photography was completed during exploration, when something significant was found or if the team stopped for a break to eat. This meant that the cameras were carried most days, as discoveries would often be derigged at the end of the day leaving only one chance to get a shot.

The cave photography itself offered quite a variety between the light and colourful ancient passages at high level, and the darker environment of the lower active collector that absorbed the light from all around. Along the way there were fine flowstone formations, straws longer than any of us have seen, colourful fossil galleries, mud liquid and dry, pitches, large chambers and a little bit of water to play in. On the only occasion that lots of water was seen, none of photographers were thinking about taking pictures!

As always from the photographers point of view none of the photos would be possible without the support and patience of the team, and our thanks goes out to them.

Surveying

Rob Eavis

This expedition built on the successful use of the Android-based TopoDroid surveying system, first used in 2015. The TopoDroid app runs on Android phones and is a direct replacement and upgrade of the well-used PocketTopo PDA-based system. Many features are the same, including direct Bluetooth connection to DistoX units and immediate drawing of the cave features onto that data, but many key improvements make it a worthwhile step change.



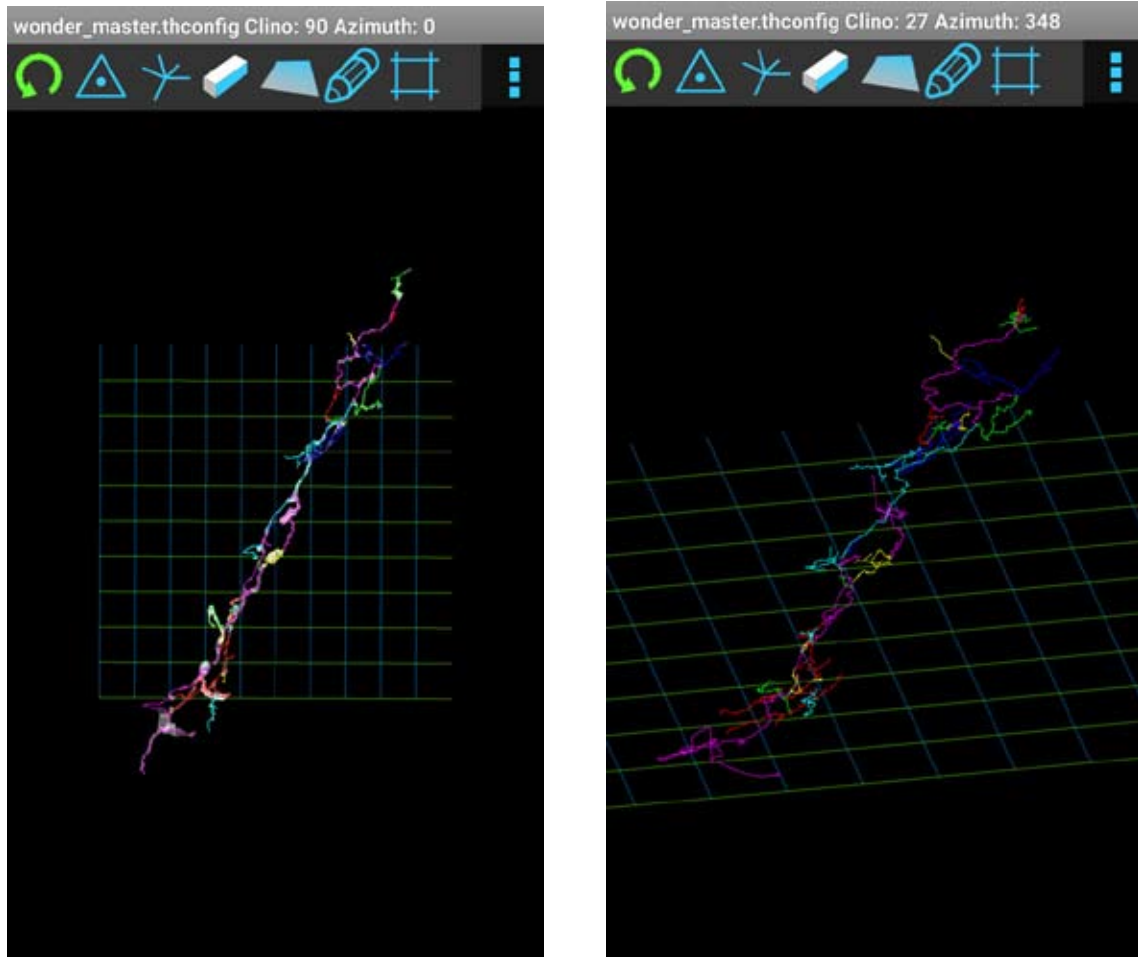
Surveying hardware, Leica distoX and Samsung Galaxy Note 4 – Dave Nixon

The hardware has improved dramatically with modern Android phones offering an extremely useful, if mmmmmmmunlikely, tool for the underground environment. They can be used as previous report and survey libraries, backup devices, surprisingly good cameras and even backup torches!

For this expedition 2x Samsung Note 4 phones were the main survey units, plus a Z6 device also for the third surveying team. Each night at underground camp the day's new survey files were wirelessly backed up onto the other devices, in case of any hardware failure.

Each day's survey was then saved as a .th file and added to a master document using the ThManager app, which allows for files to be included and equated together.

Finally, to finish off, this master could then be viewed and queried in 3D using the Cave3D app. This enabled each exploration team to be able to quickly see their position relative to all known cave, allowing them to make informed decisions about lead priorities or where to search for connections. And all of this without a laptop computer.



Cave 3d output in plan and oblique views, with each section of cave surveyed denoted by colour.

Biospeleology and geology

Dave Nixon

Cave life

Unlike nearly all other caves in Mulu national park the Conviction / Wonder Cave system is one of very few which populate virtually no species within it's known extent. The reason being that their entrance series contain extremely small passage dimensions in Mulu terms, this has the effect of preventing any type of airborne access. Consequently the much larger and typical Mulu style passages beyond the entrances are bereft of life . Furthermore it is reasonable to assume that there are no other passages that lie unknown and easily lead back out to the Hidden Valley providing an alternative to the two known restricted entrances. Therefore absolutely no guano was encountered and likewise none of the hierarchy of creatures in that particular food chain.

All the biospeleology was observed in the entrance series of both caves and amounted to a few cockroaches and very small ground based insects.

Further into Wonder Cave at various locations small bird and/or bat bones were present but these were likely to have been washed in by inlets from above. Some of the bones being heavily calcited, suggesting at relatively ancient events.

Mineralisation

During the exploration of Wonder Cave many remarkable formations were seen but perhaps the most interesting discoveries were the ones which weren't initially obvious. Research back in the UK revealed a very unexpected result when analysis was finally carried out. Black and white images were taken from a scanning electron microscope (SEM) and pictures of the geological sample surfaces obtained. Colour images of the surfaces were also taken on a simple reflected light microscope.

Analysis plots were obtained on the SEM by analysing the x-rays emitted by the mineral under electron bombardment, by a technique called energy-dispersive x-ray microanalysis (EDX for short). The EDX information was taken over various areas on the image but will only come from near the surface of the sample (maybe 1 or 2 microns) as the electrons don't penetrate very far into the surface. The output graphs plot x-ray intensity against energy and each peak will correspond to some electronic transition in a particular atom. Each peak is labeled with the appropriate elemental symbol. Peaks are roughly proportional to relative amounts but not exactly, also note that the percentage readings are in weight percent rather than atomic. The quantitative percentages (in weight percent) on the analysis are limited in their accuracy owing to the nature of the samples. It is to be noted that the amounts varied a lot from place to place on the geological sample.

Green mineralisation, location : Elephants Graveyard

This was found on the boulder floor in a large chamber and took the form of a geode type feature within a broken piece of limestone. The bright green colour attracting attention if nothing else. The SEM pictures (plate 1) show quite regular tablet or lozenge shapes about 10 microns across, which can just about be seen as light green on the light microscope photo (plate 2).

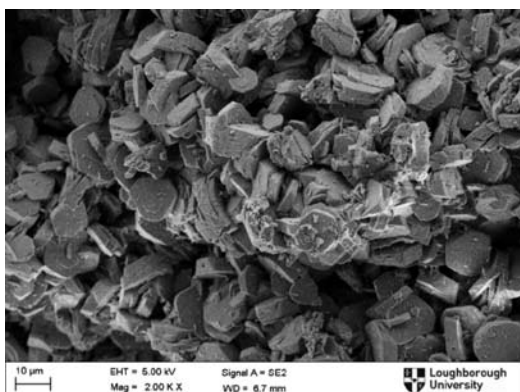


Plate 1

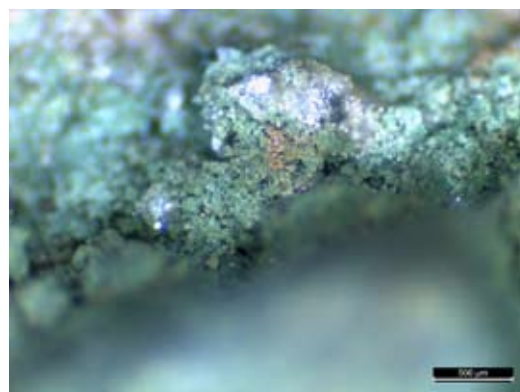


Plate 2

The EDX analysis (plate 3) shows a strong nickel signal along with a lot of Al, Ca, and oxygen and smaller amounts of C, Ti, Mg, Si, K and Fe, so it would seem to be largely a

nickel mineral of some description. The whole geological sample seemed to be a nodule of the same material throughout and was quite friable. This mineral could possibly be garnierite which is a silicate with magnesium, or limonite which is an oxide/hydroxide with iron. Obviously more research is required.

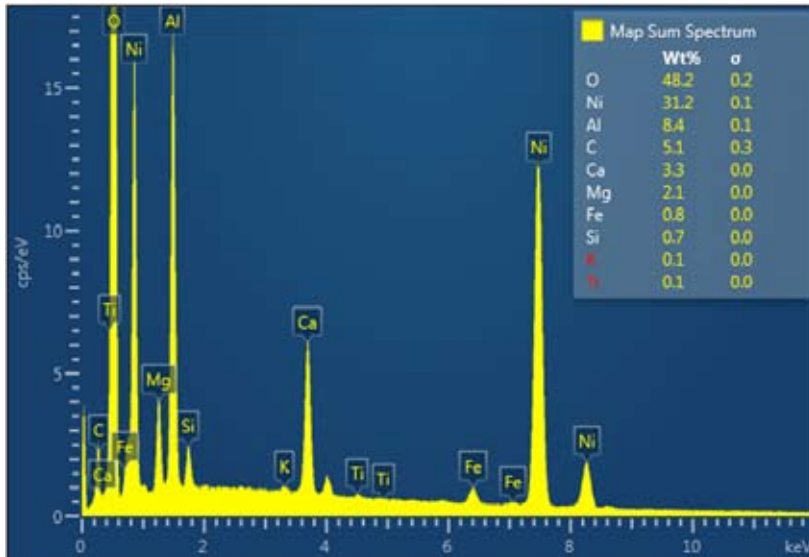


Plate 3

Yellow mineralisation, location : Generation Gap

In several localised areas a vivid yellow deposit was present mainly visible on walls and roof and predominantly on bedrock. It appears to be a thin coating to the limestone and can be seen flaking off at one site. It has a distinct visual similarity to the deposits noted in Benerat Caverns in Sid Perou’s film ‘Hollow Mountains of Mulu’ although no field work on the Benerat site is currently available.

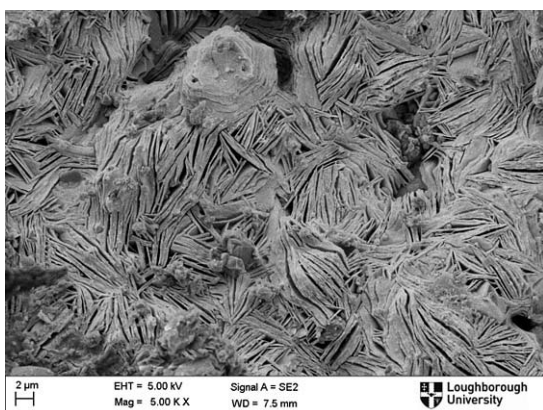


Plate 4

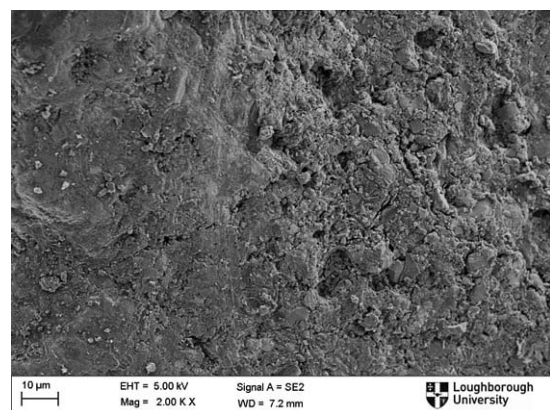


Plate 5

Looking at the SEM pictures nothing particularly structured is visible, at best a powdery type of deposit on the surface with a particle size up to 2 microns or so (plate 5). The image displayed in ‘plate 4’ looks a lot more interesting but this is believed to be the underlying limestone. The light microscope picture (plate 6) shows the colour well, however the particles are a bit small to visualise.

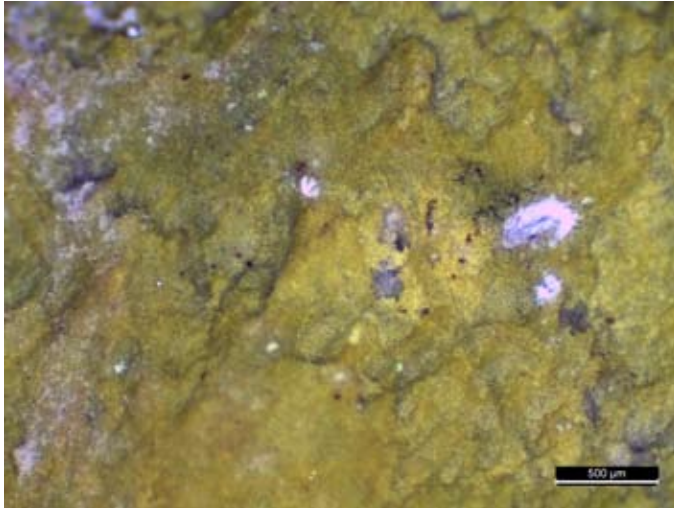


Plate 6

The analysis however (plate 7) shows a very strong uranium peak along with a lot of calcium, oxygen and vanadium (V) and smaller amounts of Al, Mg, Si, P, K and Fe. The calcium is no doubt coming from the limestone but it seems clear that the yellow coating is a very rich uranium mineral. It's difficult to be sure what mineral it is-pitchblende (uranium oxide) is the commonest one but there are plenty of others of which carnotite contains vanadium, autunite has calcium and phosphorous and a mineral called gummite is a sort of amorphous mass of lots of different ones. This later contender certainly has the appearance of the geological deposits seen in Wonder Cave.

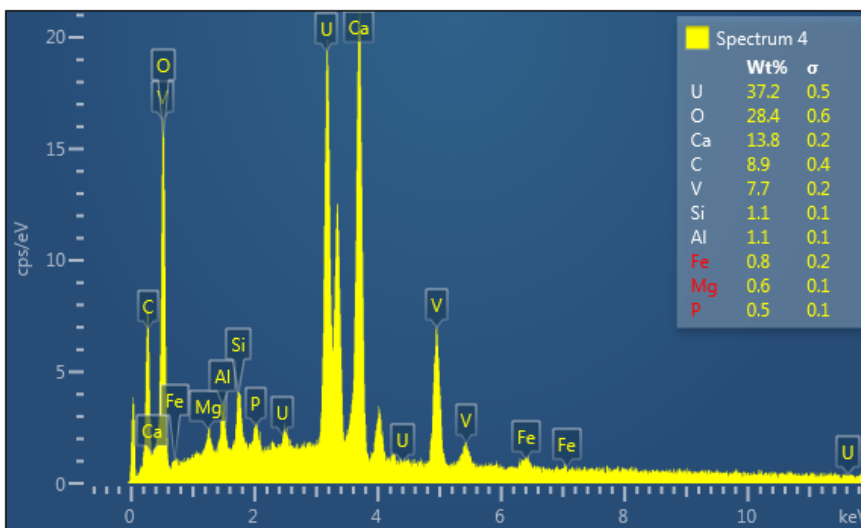


Plate 7

Uranium minerals/compounds are mainly pretty soluble, which supports any leaching hypothesis. Whether this has leached out of the rock and deposited itself as a result of an evaporation process or alternatively leached out of sediment once occupying the passage remains to be understood. There is however no evidence of sediments having filled these passages totally, which would have to be the case given the location of some of the deposits.

Neither geological samples registered very highly on a radiation meter during the initial analysis.



Typical style of deposition of Yellow mineralisation in Wonder Cave | Rob Eavis

Needle Crystallisation, location : Rhino Canyon

At the beginning of the vadose trench named the Rhino Canyon on high on the shoulder of the passage a very localised area of needle shaped crystals was found. No more than



2mm thick but sometimes up to 100mm long they appear to be growing out of a section of detached wall lying on a thin mud floor. These are thought to be selenite (calcium sulphate) being white or translucent and having very little rigidity. No further research was done at the time.

Needle mineralisation deposits in Rhino Canyon | Rob Eavis

Expedition Rescue Logistics

Andy Eavis

After the problems of the 2015 Hidden Valley trip (Colin Boothroyd accident), it was realised that unnecessary risks had been taken and many people learnt a lot about expedition rescue logistics. In retrospect, in 2015, we were extremely lucky to get Colin out satisfactorily, and I suppose you could say Colin was also very lucky!!

We had previously thought that self-rescue with a team of 8-10 people was a real consideration on a caving expedition. However, recent events on other expeditions around the world have shown that if it is "deep cave", you need many more people and of course, the best possible surface evacuation situation. Applying what was learnt from 2015, there were a large team of cavers in the park covering the whole expedition, so if there had been a major problem nearly 30 cavers were able to assist, plus a number of trained, local people who had performed so well in 2015. This gave as good a situation as possible for underground rescue.

As far as the evacuation on the surface was concerned, it was realised that with the remote nature of Hidden Valley, helicopters were the only viable way of getting a casualty out in a reasonable timescale and relatively comfortably, so a Heli-pad and helicopter logistics were essential.

The only way to be certain that a helicopter could be used in the event of an emergency was to make a Heli-pad and use it for the initial supply. This was expensive, but with the late edition of a National Geographic photography team to the expedition they contributed handsomely to the helicopter costs to enable their aerial photography, so the finances were made possible.

Initially, it was difficult to find an appropriate helicopter but a private organisation in Miri - Layang Layang had a number of charter aircraft and were prepared to do the flying. They are of course based in an oil town and generally serviced the offshore industry and the pilots had never, or very rarely ever landed in a small forest clearing. However, Layang Layang agreed to do the flying and the heli-pad that had been made at the end of the 2015 expedition was enlarged and tidied for this trip. The pilot, Hafiz Suhaili, took more than six passes over the heli-pad on his first landing before he was prepared to make the descent. The heli-pad was then tidied further. It was notable that on the first supply trip he took much longer for the shuttles from base camp than he did on the later trips.

Everybody on the trip was insured for rescue so the costs of a helicopter would have been covered. A suitable credit card number had been lodged with the helicopter company so in the event of an accident there would have been little delay. Other cavers would have been picked up from camps around the park and taken to the scene of the incident.

To sum up. If there had been an underground rescue, we could have got a large number of experienced cavers into the cave and we could have evacuated a casualty to medical services very quickly, coordinated by excellent communications - both by satellite phone and the back-up of a Mulu VHF park radio with a substantial booster station.

A possible model of logistics for very remote places.

Hidden Valley 2017 – Conclusions

Dave Nixon

Technically it was a failure, the ambitious objective of traversing through the entire mountain didn't pay off. But as failures go it was about as successful as you could get. The time taken in team selection and planning was the key to the entire trip, indeed once all the equipment and team were safely in the Hidden Valley it was almost a given that we would succeed in one form or another. However, as we learned last time it only takes a moment to lose control of a situation and your weaknesses are exposed. The combination of a younger team mixed with older experience paid off here, as across the board the approach was always with caution in mind. Equipment and communications in particular backed this up immensely but credit where credit is due and that credit must go to all the team for being so diligent with the exploration they executed.

Typically when you meticulously plan for medical emergencies and rescues the facilities go unused; I would add that given the experience of both environments I know which one I would choose again.

Communications were reassuringly good, or was it that they were particularly bad on the previous trip? The technology used for powering and recharging the park radio system ought to be a must should anyone ever return to this, or any other remote area in the park.

From the point of view of further exploration in the Hidden Valley, I would consider a return to Wonder Cave a poor use of resources, given the leads remaining after this year's trip. The logistics involved with putting a team to the end of Wonder Cave is too complex and expensive, and besides, the knowledge gained this trip indicates that this may not be the best line of approach.

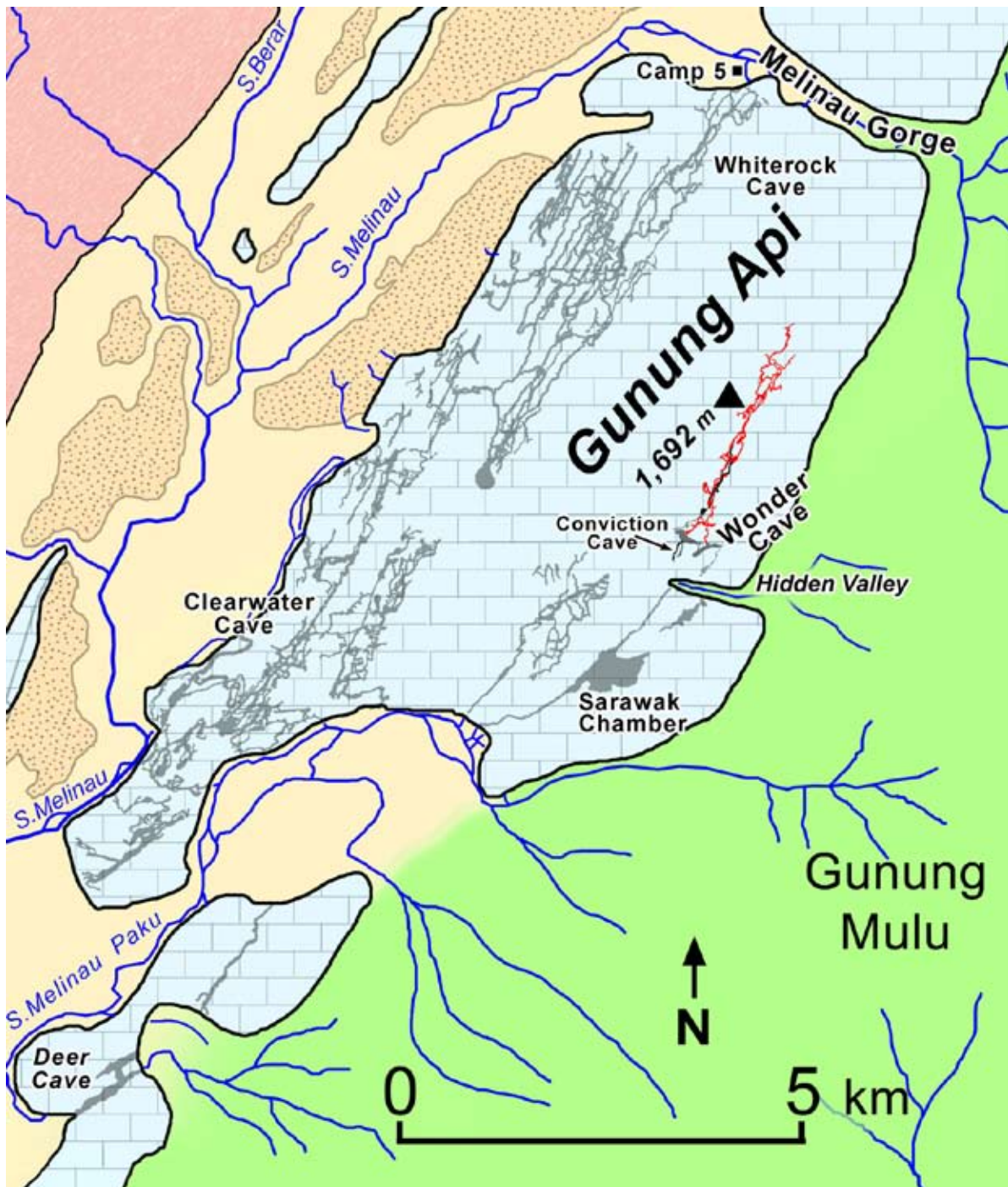
One of the striking discoveries of this trip was the unquestionable fact that the water which formed the passages associated with Wonder Cave, ran off the Mulu formation and sank in the Hidden Valley. Clearly water also flowed off the same formation and went south towards the Melinau Paku via Prediction Cave as one obvious example. Back in Wonder Cave, from this sink feature it then created the routes we explored by flowing north towards the Melinau gorge leaving clear evidence of this in the form of cobble deposition and scallop marks in the passages throughout the system. The Melinau Gorge or even the Medalam were the other end of the hydraulic gradient for these ancient flowing rivers. Indeed the modern percolation water which is invading the older passages is still flowing north and represents a sizeable amount of water in flood conditions.

With all this knowledge, and the survey figures now combined with the existing Gunnung Api data, it strongly suggests that we ought to be turning our attention to the south eastern part of the Melinau Gorge for some answers to the questions this trip has thrown up.

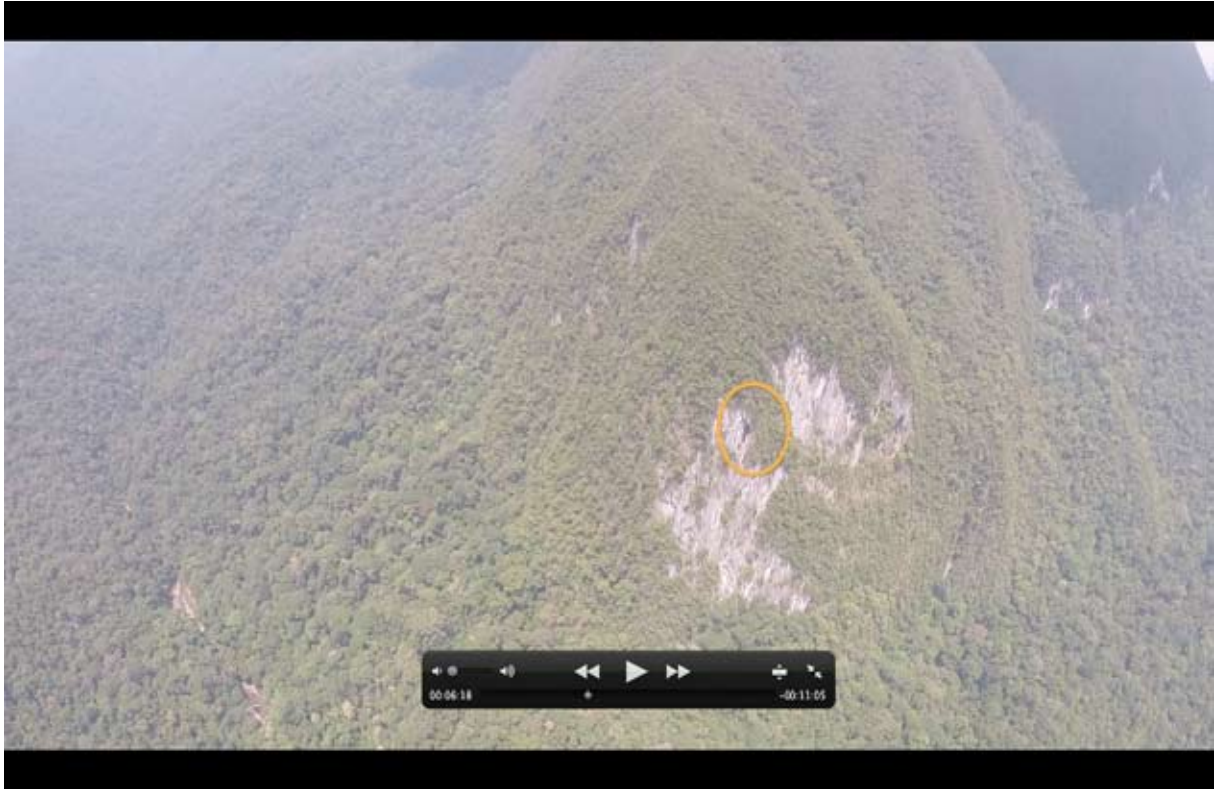
Lo and behold, we subsequently found more than enough evidence from previous visits to that particular area as well as yet more valuable video footage from the 2014 flight which led to the discovery of Conviction Cave in the beginning. There are a series of entrances in close proximity at base level on the eastern edge of the Melinau Gorge, namely Bat, Rat, Frog and Pinnacle Caves. In addition, and of great interest as per the

2000 expedition logbook.. “200m further on [from Frog Cave] is a ‘Nasib Bagus’ sized stream rising from a bouldery resurgence”. Many of these caves are also reported to have draughts emitting from them.

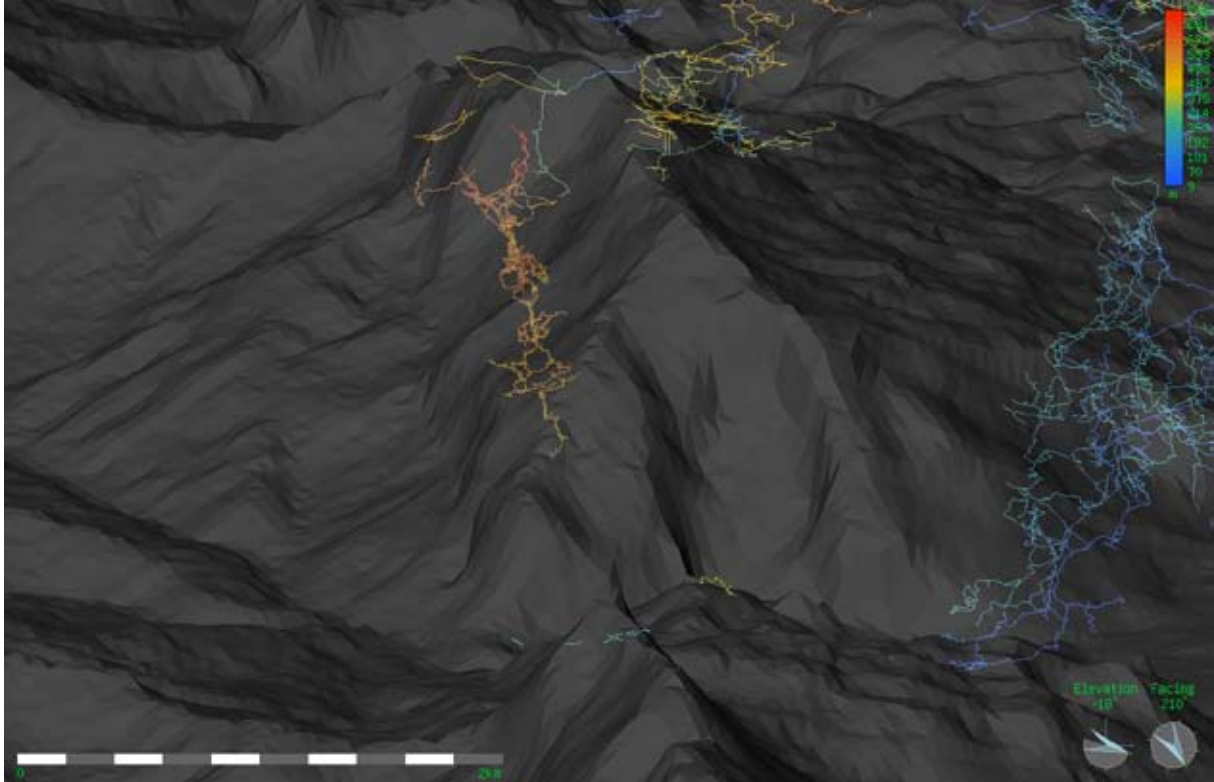
To top it all, if we now project the development we’ve surveyed in Wonder Cave, which is considerably higher than the valley floor (~200m) through to the Melinau Gorge, we find a feature of particular interest. Give or take the odd 50m this entrance, or what certainly looks like an entrance is in the direct firing line of the Wonder Cave main line in both direction and in elevation. Coincidence, or completeness?



Overview of Gunning Api, with 2015 extensions in black and 2017 in red. (map by Jerry Wooldridge)



Screenshot from helicopter mounted video camera of objective in Melinau Gorge.



Projected line of Wonder Cave system with surface topography draped over.

Appendix 1 – Straw stalactite formations.

Colin Boothroyd

The picture on the front cover of this report is of a straw hanging in the middle of Liberation passage.

This isn't any old straw - it is the world's longest known straw stalactite!

Shortly after breaking into the splendid Liberation Passage we were surprised to find the straw hanging in the middle of the passage. Astonishing though this was, the greater astonishment was to discover a second, even longer, straw in the middle of the passage a further 300 metres to the north.

On a subsequent trip careful measuring with a laser measurer gave us the two lengths. The first straw, to the south, was 9.03 metres in length, and the one to the north is the record breaking 9.13 metre long straw stalactite.

In both cases the two straws are fairly isolated (it is common to find straws to be in large clusters across passage roofs), both tips of the straws were between 2 - 2.5 metres above the passage floor and there was little other calcite development in terms of other stalactites or underlying stalagmites.

The begging question is : Why?

Why haven't they collapsed under their own weight? Why don't they have many friends? Why are they in the middle of the passage and 300 metres apart?

Subsequent discussions with speleologists that have particular interest in calcite formation development suggest that the depth of the passage within the mountain may play an important role.

Liberation Passage has over 1000 metres of pure and massive crackless limestone above the passage roof. This stands the passage apart from most known cave passages in Mulu that generally have a few hundred metres of overlying limestone. This may mean that that the drips that feed these remarkable straws are from water that has passed through a lot of limestone and taken longer than is normal to reach the roof of Liberation Passage. It is thus possible that the rate of dripping could be generally more constant than a straw that is susceptible to the typical slow and fast drip rates of traditional straws that are near the surface and respond directly to periods rainfall of rainfall on the surface.

It is also possible that the water chemistry and the crystallography could be varied as a consequence of the passage of the water through the overlying rock.

This, unfortunately, is only conjecture.

The surprise discovery was not scrutinised during the expedition. It is now waiting for detailed evaluation by an enthusiastic and determined speleothem expert.

The previously known longest straw stalactite is 9.03 metres long. We've beaten it by 100mm.

Expedition members



Back row : Catherine Hulse, Dave, Rob Middleton, Steve Jack, Dave Nixon, Colin Boothroyd.
Front row : Luke Cafferty, Jon Pemberton, Rob Eavis, Jeff Wade (photo).

Sponsorship

Tex Energy – Infinite Orbit

The Infinite Orbit is a hand crank generator suitable for providing instant power direct to a device or battery and is suitable for charging smartphones, iPhones, GPS, satphones, headtorches and individual batteries. It is promoted very much as an emergency device - the intention is not a product for fully charging other devices, but rather enabling emergency power to be generated, allowing that emergency call to be made, or an extra hour's light from a dead torch.



The unit is constructed from hard wearing aluminium, making it lightweight, robust and able to function at extreme locations. The Hidden Valley was just such a location, and an ideal place for putting the Infinite Orbit through it's paces.

Our main power supply was a 240 volt generator at the base camp and some solar panels and a car battery at the helipad that we used to keep a radio relay station alive. Notwithstanding these 'luxuries',

we were able to test the Infinite Orbit on several occasions at base camp, to determine its properties and to add charge to appliances when the generator was not functioning or was unavailable.

The Infinite Orbit is a fairly lightweight (339g) and durable device. It certainly seems well built and has a quality construction. The cranking handle doesn't 'marry' to the



generator body when packed, but its action is smooth and solid in use. The Orbit comes with a range of USB connectors to match with most modern devices, and there is a robust storage case and spare 'O' ring. The unit isn't fully waterproof and shouldn't be subjected to immersion, but its IP65 rating means it's more than splashproof and with a modicum of care will provide reliable use in most environments; we had no problems with it in the humid tropical rainforest. It's 5volt 2amp output means it isn't a fast charger, so a fairly significant amount of cranking is required to generate power.

Using the Infinite Orbit to recharge a smartphone used for surveying | photo Jeff Wade

On two occasions the performance was measured when charging an iPhone 7 that was in airplane mode:

- a) 10 mins cranking raised the charge level from 90 - 92%
- b) 90 mins cranking raised the charge level from 79% - 100%

Pros

- The unit is robust and withstood both the rugged handling and the 100% humidity levels
- It is easy to use - there are no complicated considerations
- It reliably delivered charge on all occasions

Cons

- It took a long time and energy to deliver charge
- The cranking handle does not 'marry' to the generator when packed and not in use
- There were no instructions in relation to the cranking rhythm or direction to maximise performance/cranking efficiency
- The cable outlet point is vulnerable to knocks/wear

The general feeling amongst the team is that the unit could be of value in some emergency situations. In our particular circumstances, with reliable generator charging facilities available, the Orbit was very much an emergency backup tool. But one can see its advantages, and in other situations it could be a dependable supplier of emergency power for small electrical devices and batteries.

The unit was kindly supplied by TexEnergy, www.texenergy.co.uk

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Sarawak Forestry Corporation

The Sarawak Ministry of Planning and Resource Management

The Resident, Miri Division

The Sarawak Immigration Department

The Sarawak Police Department

Gunung Mulu National Park Management & Staff

Hein Gerstner

National Geographic Society

Veno Enar and all the porters

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References

Briggs J. 1988.

'Mountains of Malaysia', Longman, Malaysia

Brook D. B. & Waltham A.C. (editors) 1978.

'Caves of Mulu', Royal Geographical Society, London.

Eavis A.J. (compiler) 1981.

'Caves of Mulu '80', Royal Geographical Society, London.

- Eavis A.J. (compiler) 1985.
'Caves of Mulu '84', British Cave Research Association. UK.
- Fogg P. (editor) 2000.
'Benarat 2000 Expedition Report', Benarat 2000
- Kirby M.J. (editor) 1989.
'Mulu Caves '88 Expedition Report', Cave Science, Volume 16, No. 2. British Cave Research Association. UK.
- Kirby M.J. (editor) 1990.
'Mulu Caves '89 Expedition Report'. Mulu Caves '88.
- Kirby M.J. (editor) 1992.
'Mulu Caves '91 Expedition Report'. Mulu Caves '89.
- Kirby M.J. (editor) 1993.
'Hidden Valley '93 Reconnaissance Expedition Report'. Hidden Valley '93.
- Kirby M.J. (editor) 1998
'The Caves of Hidden Valley', Mulu Caves '96 & '98 Expeditions Report. Mulu Caves '96 & '98
- Kirby M.J. (editor) 2008.
'Mulu Caves '07 Expedition Report'. the Mulu Caves Project.
- Kirby M.J. (editor) 2009.
'Mulu Caves '09 Expedition Report'. the Mulu Caves Project.
- Kirby M.J. (editor) 2010.
'Mulu Caves 2010 Expedition Report'. the Mulu Caves Project.
- Kirby M.J. (editor) 2011.
'Mulu Caves 2011 Expedition Report'. the Mulu Caves Project.
- Willis R.G. (editor) 2012.
'Mulu Caves 2012 Expedition Report'. the Mulu Caves Project.
- St. Lawrence H. (editor) 2014.
'Mulu Caves 2014 Expedition Report'. the Mulu Caves Project.
- Eavis R. & Nixon D. (editor) 2015.
'Mulu Caves 2015 Hidden Valley, Expedition Report'. the Mulu Caves Project.
- Meredith/Wooldridge/Lyon 1992.
'Giant Caves of Borneo', Tropical Press Sdn. Bhd., Kuala Lumpur.

- Smart P. & Willis R.G. (compilers) 1982.
'Mulu', Cave Science, Volume 9, No. 2, British Cave Research Association, UK.
- St. John S. 1862.
'Life in the Forests of the Far East', Smith Elder & Co., London. Reprinted by the Oxford University Press, 1986.
- Weight A. (editor) 1990
'Gunung Api Connection Expedition Report', Gunung Api Connection 1990
- Willis R.G. (editor) 2003.
'Benarat 2003 Expedition Report', Benarat 2003
- Willis R.G. (editor) 2005.
'Benarat 2005 Expedition Report', Benarat 2005