Imperial College Caving Club
Bougoumez 2001

Team Members

Colm Carroll (leader)
Ed Austin
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Hugh Penney
Tim Wright

Summary

This report describes the 2001 expedition by Imperial College Caving Club to the High Atlas Mountains of Morocco. Led by chemistry PhD student, Colm Carroll, the five member team spent 15 days on the side of Jbel Ghat, exploring and mapping the caves of the area.

Despite surveying a large number of shafts, the lack of major cave development was somewhat disappointing. However, the expedition was a great success in terms of making local contacts for the future (including a geology professor in Beni Mellal who was interested in our work) and gaining experience of the sort of terrain and conditions in the High Atlas.

We would like to thank the all those that helped us for their support with this expedition, and we hope to continue work in Morocco.

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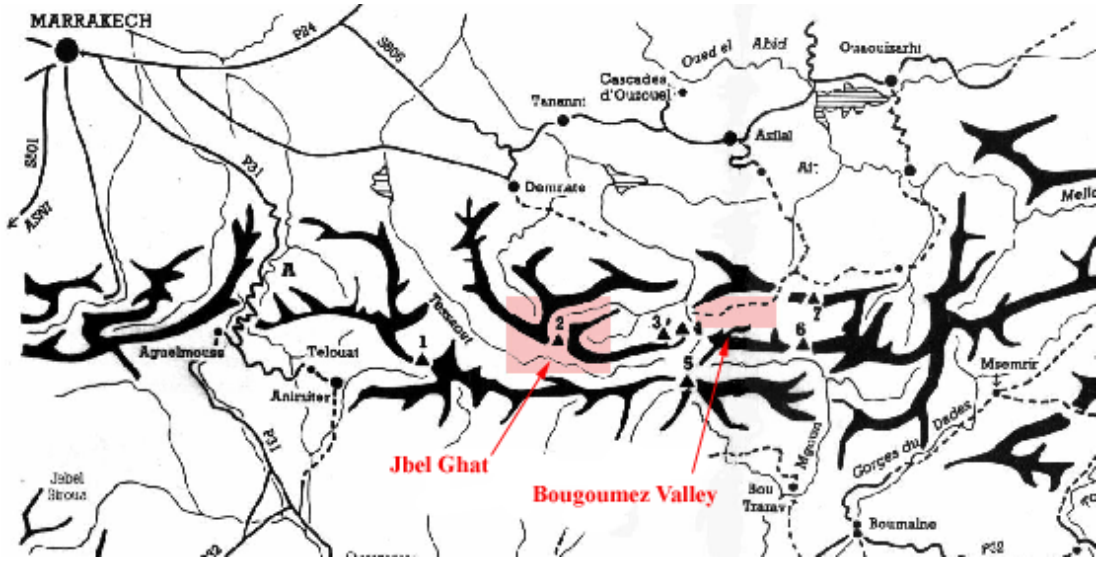
1 Introduction

The aim of the expedition was to follow up on the 1999 reconnaissance of the High Atlas in Morocco. The specific area chosen was Jebel Ghat, in the central part of the High Atlas near the well-known mountain of Mgoun and about 6 hours drive east of Marrakech.

The Jebel Ghat plateau was chosen because a French expedition which went there in 1982 reported that further prospecting would be worthwhile; even though they had only reached about 100m depth, they found a lot of rifty entrances and the potential if a cave 'goes' is considerable. The summit of Jebel Ghat is over 3800m and the zones we looked at (following the French division of the mountain) were at about 2800-3200m.



Map of central High Atlas Mountains

Local logistical problems were overcome by close contact with Muhammad Achahri, a guide with whom the 1999 team stayed. He provided transport from Marrakech as well as organising supplies, mules and a cook. Hassan, the cook, also performed the role of guarding the camp during the day and talking in Berber to the many shepherds on the mountain for us. Using local people in this way was a good solution to the otherwise considerable logistical problems of exploring this area.

2 Approach to Jbel Ghat

Colm and Hasan leading the Mules on the walk-in.

With a limited amount of time in the field, the important factor was to get to the destination and set-up camp as quickly as possible, giving a reasonable period to explore the area of interest. In the end, of the 3 weeks we had in Morocco, 15 days were on the mountain exploring the area.

2.1 London to Marrakech

Direct flights from Heathrow to Marrakech were booked with British Airways, these proved to be a very convenient way of getting to the entrance of the Atlas Mountains. With the exception of food and cooking utensils all the necessary personal and caving equipment for the expedition was taken out to Morocco as personal luggage. Spread amongst five people it was possible to carry sufficient hardware for the possible exploration of large vertical and horizontal cave systems.

2.2 Marrakech to Abachkou

After a couple of days in Marrakech to acclimatise to the Moroccan way of life we travelled to Abachkou to start the expedition proper. Just before we left, Ed and Colm went on a mission to buy a tarpaulin to protect us from the sun. After traipsing around the Souk for at least three hours, we finally got one made to measure for more than twice the proper price!

Transport into the mountains had been arranged from London through Mohammed Achahri and went very smoothly. The region we were visiting was quite well developed and the journey from Marrakech to the Bougoumez Valley was six hours on hardtop roads. Nevertheless the final section of the trip from our Gite in the Bougoumez valley to Jbel Ghat could only be achieved on four wheel drive vehicle or mules. There is a good network of trucks between villages, particularly on market days and if necessary transport of equipment could be achieved this way.

2.3 Abachkou to Jbel Ghat

From Abachkou at the foot of the Jbel Ghat massif, the equipment and food for the next three days was carried by just four mules. The walk up to our base camp was done over two days. The first 3 hours were spent walking up large rocky river-beds past many Berber villages the seemed stuck in medieval times. We eventually reached a point next to a large source where we could camp for the night. The following day dawned bright and clear, but trouble was ahead. While most of the team and the mules continued towards the head of a valley, Tim and Jan were forced to remain near the source with a bad bout of sickness. The route continued up a steep path, which became even more narrow and loose as it reached the high-level valley where we were intending to camp. This terrain proved very difficult for the mules and equipment had to be unloaded and carried over the worst parts. Eventually, an exhausted team reached the camp after 6 hours.

2.4 Jbel Ghat Base Camp

Camp was set up at the head of a high-level valley between Jebel Awltoum and Jebel Ghat at about 2800m above sea level. This place was chosen as, despite being 1-2 hours from the caving areas, it was the only place where we could be guaranteed water. The valley was hot, dry, dusty and sometimes extremely windy, but quickly became home to the expedition.

2.4.1 Water

Water was the greatest cause for concern on our approach to the mountain. The last major water source we passed on the route to Jbel Ghat was in the valley, 3 hours walk from Abachkou. There were no settlements after that point, until we reached the head of the river valley approximately 700 metres below camp, at the village of Azib Igouzane.

On our arrival on Jbel Ghat, we were shown a small spring by a shepherd decided to set-up camp nearby. The presence of a number of shepherds and numerous livestock on the mountain showed there to be a sufficient supply of water for us. We treated all our water with iodine droplets, much to the disdain of our Berber neighbours. During our time on the mountain, we found just three additional springs over the whole area; of which the little trickle by which we camped was by far the largest!

Hugh treating our water with iodine.

2.4.2 Food

Our expert chef, Hassan, at work.

The eating arrangements were more than adequately organised by Mohammed Achahri and our chef, Hassan. All food and supplies were purchased beforehand, which meant we were completely self sufficient on the mountain for the full 15 days we were there. Hassan, supplied a mess tent and all the utensils for cooking and eating. He also proved to be a dab-hand at preparing excellent meals, which we were all thankful for after a long day in the field.

2.4.3 Neighbours

When making the arrangements for the expedition from the comfort of London, we thought the Jbel Ghat region would be too isolated for anyone else to be living there. However, as soon as we turned the corner in to the valley between Jebel Awltoum and Jebel Ghat we were greeted by a Berber shepherd with a large flock of goats and sheep. Over the course of the fifteen days, we met many other shepherds, and had to do battle with their beasts each morning to fill our water bottles. All the shepherds knew what we were doing within minutes, and were able to help us out on occasion. It was when the wind was strong and the temperature extra low that we realised how tough these mountain-dwellers are. Surviving on mostly bread, with only a blanket to keep them warm, they tend their flock on the mountain each year until the first snows of winter.

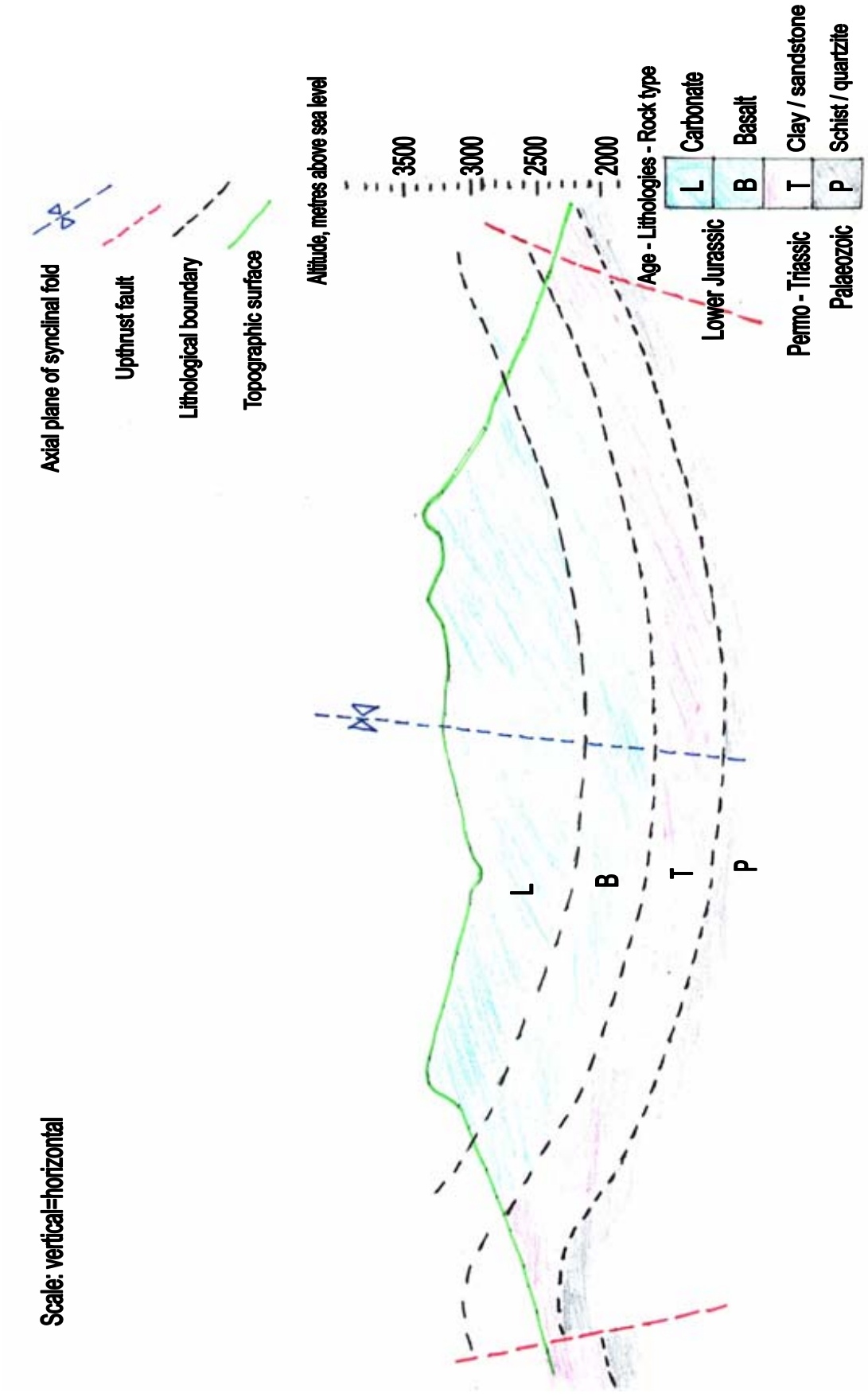
3 Geology of Jbel Ghat, Central High Atlas

Situated in the western part of the central High Atlas of Morocco (M'goun massif area), Jbel Ghat is typical of the geological structure of the Mesozoic cover. The large syncline structure of the mountain is clearly seen from the map topography where the 'horseshoe' shape ridge encircles the plateau. The bordering steep up-thrust faults to the north-west and south-east are also typical of regional geology. The described structure can be observed in the provided cross-section. Fold deformation of the Jbel Ghat sequence is quite unpronounced and the bedding dips at a maximum of 25° at the tips of both fold limbs. The trace of the syncline axis is orientated NE – SW and the axis dips approximately 5° to towards the north – east.

The carbonate rocks investigated for caves are Lower Jurassic in age, in particular belonging to the middle to upper Lias (see stratigraphic column). This formation is up to 1000 metres thick and dominates the area's geology and is similar to equivalent formations like that of the Todra canyon. It overlies a distinctive basalt formation, probably also of Lower Jurassic age. The Lower Jurassic is underlain by variable Permo-Triassic clastic rocks, which is generally exposed at lower altitudes or where faults have placed them higher against younger rocks. The basement under the Mesozoic sequence is an old Palaeozoic metamorphic terrain of the Varsican deformation and is exposed in few localities across the region.

The gentle dip of the bedding does not favour vertical cave development whereas the altitude difference between the plateau (3500m) and the carbonate base of the mountain (2000m) indicates a possible cave network of 1500m depth. However only cave-like superficial openings were found, mostly 10 – 50m surface shafts similar to large grikes, and there was no clear indication of horizontal cave development in the upper 400 metres of the carbonate formation. Many of the shafts have developed as fissures along continuous (sub) vertical faults, the cavities often elongate in shape along fault strike (generally WNW – ESE). This feature was particularly clear in zone N and the south east side of zone B. Many large shake-holes were observed but the plateau is also incised by canyon, indicating substantial underground and surface drainage. It is also important to note that many shafts and shakeholes were plugged or filled with sometimes snow, ice, rock debris and mostly a hard silty soil. Often standing water was observed on such plugs and small drainage holes were found confirming underground percolation. Such soil plugs offer promising but difficult digs especially when such surfaces sounded 'hollow'. In conclusion for further prospecting for a master network, a small entrance allowing no material in would be useful.

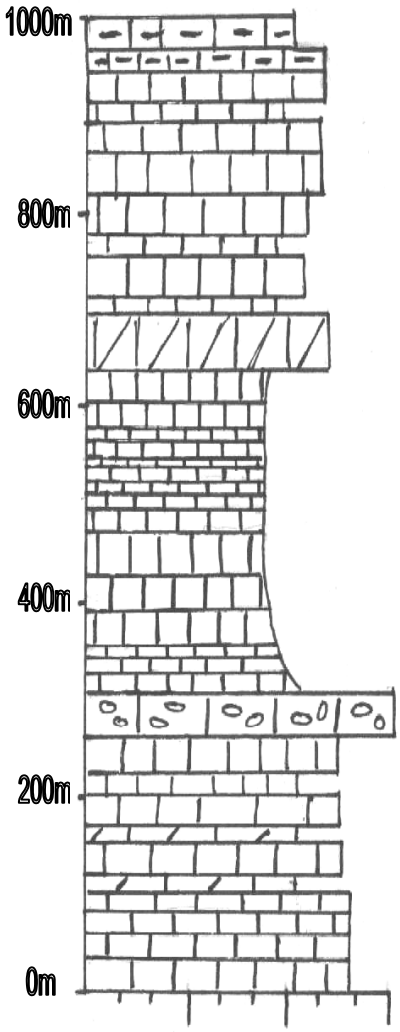
3.1 Geological Cross Section of Jbel Ghat 300-120˚



3.2 Geological Timescale for Jbel Ghat, Mgoun Massif, Central High Atlas

Age (Myears)	System	Series	Event	Rock	Significance
3		Pliocene			Rapid Uprisal
5		Rest of Miocene	Inversion During Atlas Orogeny		
16	Tertiary	L. Miocene			Compression
30		Oligocene			Extensional Tectonics
135	Jurassic		Atlas Gulf Froms	Carbonate	Subsidence, Block, Faulting, and Volcanism
205		Liassic (213-188)	Pangea Breaks Up	Basalt	
250	Triassic			Variable Clastics	Formation of Comntinental Basins
290	Permian				Formation of Basement to Mesozoic Cover
355	Carboniferous		Varsican Orogeny	Metamorphics Created	

3.3 Stratigraphic Column of Jbel Ghat Formation (Lower Jurassic Carbonates)



Carbonate shales

Cm to dm muddy limestone interbedded with massive grain limestone

Grey massive to dm alternating muddy and grain limestone

Grey and red metre bedded limestone and dolomite

Grey and black dm to mm bedded muddy limestone

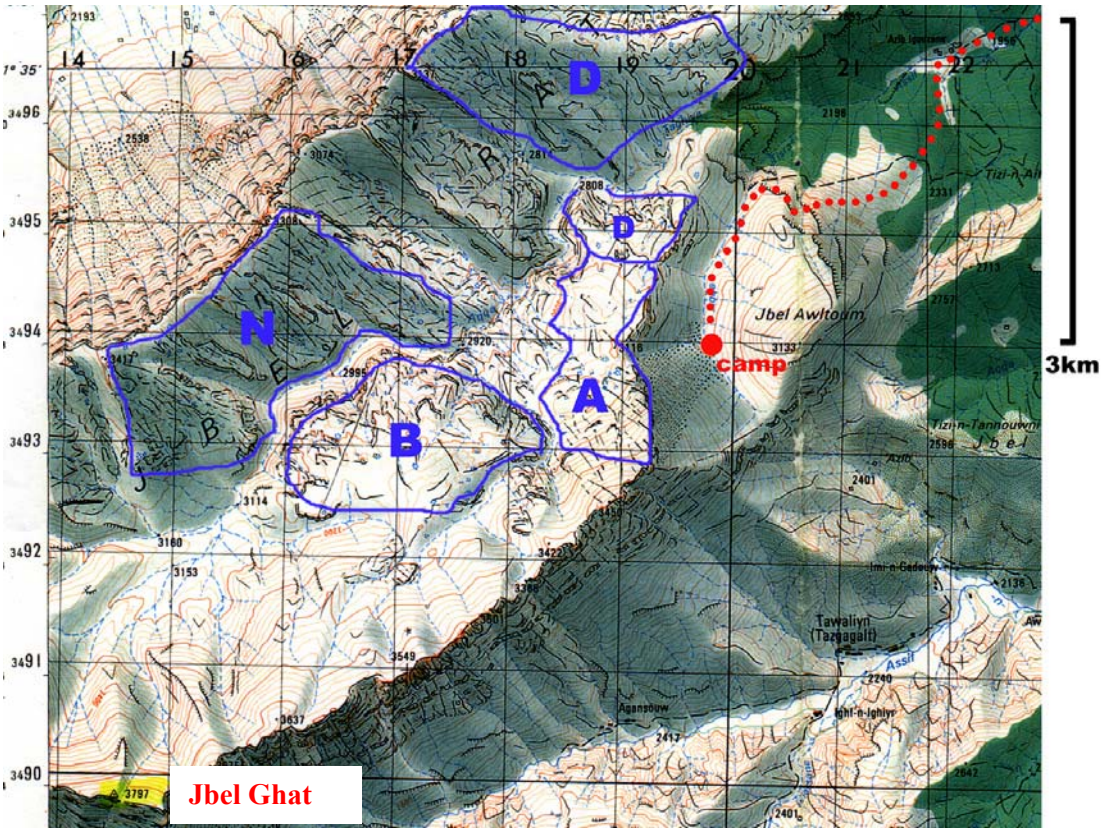
Red carbonate pebble conglomerate

Grey and white massive to cm bedded variable limestone with some dolomite

4 Prospecting and Cave Exploration

The Ghat Plateau

Within two days of establishing a base camp, daily exploration trips ascending the 400m to the Ghat plateau were taking place. The plateau had been divided into various areas by the French team in 1982, it was decided to keep these divisions for consistency. During the first few days, the expedition team concentrated on areas A and B (see map below); an area in which the French expedition had found several deep shafts. Once we had gained a feel for the terrain and discovered the most efficient routes through the undulating plateau, we shifted our focus to area N. This was the area where the French discovered the most interesting caves.



Map of Jbel Ghat Plateau

4.1 Area A

Area A was the first place explored within a couple of days of our arrival. The terrain consists of loose scree, and not much exposed rock. The French had spent a lot of time examining this area, so we only had a brief exploration. A few minor shafts were apparent with a maximum depth of 30m. The floor of these shafts was a mix of the loose rock from the surface, and dark earth. It was quickly decided to concentrate on other areas on the plateau.

4.2 Area B

Area B is adjacent to area A and only takes slightly longer to get to. The terrain consists of large expanses of exposed rock cut by deep canyons. The going is made very difficult by the endless climbing and descending; this type of ground also makes prospecting a trying activity as the ground has to be covered in great detail. The team spent several days criss-crossing this part of the plateau. We managed to locate a number of caves that the French had explored 19 years earlier.

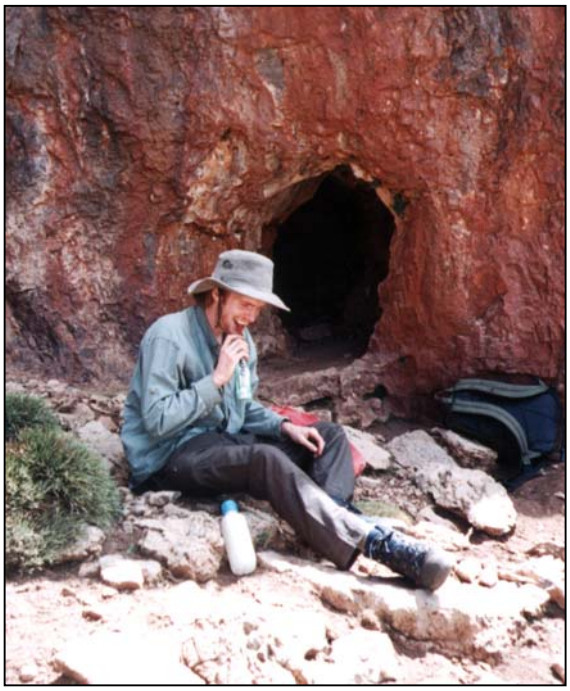
The most interesting caves discovered in this area were sheep and sheep 2, so called as one of the caves had a live sheep on a ledge half-way down when we first located them. These caves were bottomed by Ed and Colm to yield a muddy floor with a large snow-plug. Both caves followed the, by now familiar, theme of a long, narrow shaft cutting deeply into the rock. In these cases it was possible to free climb the first 35m before the rope was needed

The only other cave of note in this region is Ifri Ahmen - 'Water Cave'. We were led to this cave by one of the local Berber shepherds. He led a team of Hugh, Jan and Tim on a speedy walk into the heart of the rocky region to this cave with a small spring emanating from a crack at the base of the wall. Although the cave had no potential to it, hopes were raised that this spring would allow for a camp in the centre of the Ghat massif, saving three hours a day of walk in, however it was soon realised that the capacity of the spring would not maintain any sort of camp.

Typical Area B Cave

4.3 Area N

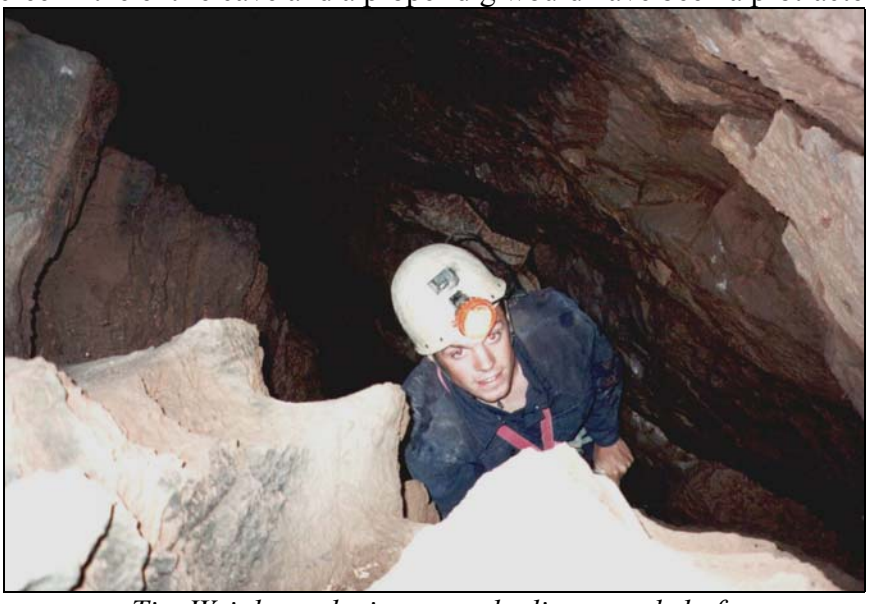
The Vulcain expedition of 1982 didn't have much time to explore area N, but they were sufficiently impressed to suggest it has the most potential of the area. The majority of our time on the Ghat plateau was spent exploring the caves of area N. At first it took over two hours to reach this distant section, but we soon discovered an easy route down a gentle slope, just north of the col above the camp. This route reduced the time taken to approximately one hour each way and allowed for much more prospecting to be done.



Ed Austin eating pepperami outside one of the small, short holes that litter the Ghat plateau.

Area N proved to be easier to explore than B as it consists mainly of a reasonably flat slope, with quite a lot of pavement. The area contains dozens of shafts, most of which end at flat, earth floors. As with area B, area N has many short phreatic holes in the limestone massif which close down after a few metres.

After several days of progressive surveying, no ongoing cave passage was discovered. Despite having the best potential, and an enormous number of unexplored holes, area N proved to be not much more interesting than areas A and B. In all, we surveyed 29 shafts in area N, all following the similar pattern. Only one cave displayed something different. This cave consisted of a sloping shaft entering the hillside at a sharp angle. The cave turned a couple of corners, still sloping on loose scree, before ending in a choke. This was the first example of a cave where there seemed to be digging potential. Unfortunately, in this case, there was a large amount of scree in the entire cave and a proper dig would have been a protracted affair.



Tim Wright exploring a newly discovered shaft.

5 Expedition Diary

Thursday 30th August 2001 London to Marrakech
Left South Kensington around midday for the journey to Heathrow. Uneventful British Airways flight to Marrakech *via* Casablanca. Grand taxi to our hotel in the Medina. Food and mint tea in Djemaa el Fna.

Friday 31st August Marrakech
Ed and Colm go in search of a tarpaulin/sun screen in the souk. After hours of being shown carpets, blankets, and curtains, they eventually get a tailor made light cotton sheet for far too much money. In the meantime, Tim goes in search of carbide. A wild goose chase all around central Marrakech inevitably leads back to the souk where we get 5 kilos worth.

Saturday 1st September Marrakech to Tabant
Landrover arrives in the morning, it's quickly packed and we head to the airport where Jan's flight has just arrived. Lazy Jan hires himself a porter, so negotiate a 5Dh fee, then underway to the Bougoumez valley. The mountain road was being completed remade, with many new bridges being built to survive the spring snowmelt. Delicious lamb tagine for dinner, after which Tim charges the satphone battery.

Sunday 2nd September Tabant to Igouzane Valley
Drive to nearby souk in the morning to stock up on supplies for the camp. We're introduced to our chef, Hassan, then we drive along valley to Abachkou. Our mules soon join us, and are quickly packed before heading off towards Jbel Ghat. We leave the road straight away, and are soon passing through the medieval style villages. The path gives way to a rough wadi, so we decide to stop for the night. Another exquisite tagine, then sleep under the stars.

Monday 3rd September Igouzane Valley to Awltoum Valley
Continue up the valley under a harsh sun. Tim suffering from sunstroke and diarrohea, so he and Jan decide to rest for the day. The rest of us start up the steep hill to the Awltoum valley. The path is quite worn, needing repaid in some cases, and we even had to unload the mules once, but all is well, and we keep going. Soon turn the corner into the valley. Find the spring, and camp nearby. Very windy night.

Tuesday 4th September Awltoum Valley
Wake early due to wind. No-one slept well. Hassan's tent collapsed three times in the night. Colm goes down to collect Tim and Jan. After returning, Colm and Ed climb up to the col between the Awltoum and the Ghat valleys.

Wednesday 5th September
Colm and Ed visit area B in the morning. Manage to locate B3, one of the Vulcain caves. View area N, and then back to B where Sheep and Sheep 2 caves are found.

Thursday 6th September
Hugh, Tim and Jan head to recce area N while Ed and Colm check out some of the shallow shafts in area D. The shafts in D prove small and disappointing. In the evening, we set up our shit-pit, far enough away from camp that we can't see it, but close enough to get to in an emergency!

Friday 7th September
Windy night again, so wake quite late. Tim and Jan explore area B, Colm, Hugh and Ed stay on camp duties – mostly doing battle with the sheep and goats for drinking water. Hugh experiments with our outback oven and bakes a cake.

Saturday 8th September
Hassan disappears early to visit the souk – we think he's missing Berber company.
Jan goes to prospect in area N, while Hugh, Ed and Colm go to the bottom of the Ghat valley to look at the wadi. The wadi is a deep gorge, but contains nothing of much interest. We stumble across a Berber camp. Walled hut, with prayer mat and not much else

Sunday 9th September
Ed and Colm go back to area B to explore and survey sheep. There are large snow plugs at the bottom.

Monday 10th September
Jan, Tim and Hassan go to zone N for caving! Hassan eventually finds up what us crazy types are up to. Hugh, Ed and Colm cook bread rolls on the oven. Hugh not feeling very well, so decides to descend to the valley tomorrow.

Tuesday 11th September
Colm and Ed go to look at zone B and find many small alcoves. Tim and Jan accompany Hugh on the first bit of his descent to the valley

Wednesday 12th September
Jan, Tim and Colm go to zone N for shaft-bashing. N3 is rediscovered quite quickly, and then many other shafts. Find one horizontal cave curling into the hillside, but it ends in a boulder choke quite quickly. Find another load of shafts, including one defended by a scorpion – Scorpion Cave. Colm checks out a different route back to camp via the end of the valley, but it isn't any quicker.

Thursday 13th September
Jan, Ed, and Colm go to area N, Tim tends his blisters. Many shafts are explored, but all end in mud or snow floors with no continuation.

Friday 14th September
Jan, Ed and Colm return to zone N. Many more shafts are bottomed, again no continuation. We get caught in a bed electrical storm, lightening hitting all around. We abandon our SRT kits and huddle under rock shelters.

Saturday 15th September
All to zone N for more shaft bashing. On return to camp, find that Hugh has arrived back from Bougoumez. He only made it as far as Azilal, but is looking much better. He brings news of the World Trade Centre attacks. We're all quite shocked. We phone home, and end up reassuring everyone that on top of a mountain in Morocco is a safer place to be than central London.

Sunday 16th September
Windy night, so noone sleeps too well. Hugh, Tim and Ed go to explore the wadi at the bottom of the Ghat valley, while Jan and I set off up Jbel Awltoum to admire the view.

Monday 17th September **Awltoum Valley - Tabant**
Jan and Hugh go to zone N to pick up the kit and finish prospecting, Tim and Ed go on photo trip to zone A, and Colm walks to the summit of Ghat, following the easy ridge. Perfect weather, not a breath of wind. Bit of a party that night, with a fire. Just after dark Hassan hears the muleteers arriving, a very welcome event.

Tuesday 18th September **Tabant - Marrakech**
Up early, tents down and pack the mules. Make good progress down the valley to Abachkou. Arrive just after midday. Quick phone-call to Muhammed for the landy, and then into a café for Fanta and Coke. Mules set off to Tabant straight away, and a couple of hours later, the landy turns up, and we're on our way, arriving at the same time as the mules. Delicious chicken cous cous for dinner, then a well deserved sleep in Muhammed's gite.

Wednesday 19th September to Saturday 22nd September
Landrover transfer back to Marrakech. We've arranged to stay at the Grand Hotel Tazi through Muhammed, Comfortable beds, swimming pool and beer. Peruse the souks, eat in Djemaa el Fna, and generally relax until our flight leaves on Saturday.

6 Logistics

Transport Logistics have already been discussed, the remaining logistical information is given below.

6.1 Moroccan Contacts

- Mohamed Achahri (Official mountian guide and gite owner)
- Mohammed Tijani (Geology Professor, Beni Mellal)
- Mohammed Afani (Student, member of Beni Mellal Caving Club)
- British Embassy (Casablanca)

Our main contact in Morocco was Mohamed Achahri, an experienced mountain guide living in the Bougoumez Valley, in the heart of the Central High Atlas. He had all the knowledge and contacts necessary to set us up with transporting our equipment and providing food. His agent, Francoise Pearson, was based in France (French and English speaking), we finalised timing and transport arrangements through her. During the expedition, a satellite telephone was used to communicate with Mohamed Achahri, to finalise the descent plans. The British Embassy in Rabat were kept informed of our expedition in case of any accidents.

6.2 Other Contacts

- Hamish Brown (Atlas Mountains guide, based in Scotland)

Hamish Brown has been travelling in the Atlas Mountains for many years and is quite a well known figure in the area. He was able to provide large scale maps of the area we were exploring when all other sources proved fruitless.

6.3 Sources of information

- Pengelly Library
- The Map Shop
- Westminster Speleological Group Library

The Pengelly Library is based in London and is an archive of UK and foreign expedition reports, specifically for caving. This provided us with the report on the 1982 expedition by a French group to Jbel Rhat. The WSG library contains a copy of the rare ‘Inventaire Speleologique du Maroc’ which didn’t mention any know caves in our area, . We also borrowed some maps from the WSG.

6.4 Medical Report

Apart from the usual stomach bugs, there were no real medical problems on the expedition. A number of people suffered from diarrhoea at the beginning of the trip, with the resulting dehydration necessitating an unplanned camp on the walk in, but these soon resolved themselves. All water used was treated with tincture of iodine for which we got much derision from our Berber neighbours, but, as we shared our water supply with their many hundred goats, it was definitely needed. Blisters were a problem for some, with Spenco blister kits much used, but all in all, it was quite a healthy environment for an expedition.
It should be noted that caving in Morocco is a very small sport, and in the case of an

underground accident, help would be needed from abroad. We were completely self sufficient for handling the medical side of on accident, and had arranged for cave rescue to fly in from France if they were needed.

6.5 Financial Report

Due to the generosity of the sponsorship bodies listed below, the cost of the trip worked out to be quite reasonable. Our two major expenses were transport and our chef and food. The transport was shared between the flights out and back (British Airways), and the hire of a landrover and mules to carry our kit to the base camp. The provision of a chef seemed a luxury before we left, but we quickly realised that Hassan's expertise was much needed. Expertly prepared tagine was the perfect antidote to a long, tiring day in the field. With strong winds and rain surprisingly frequent, the large Berber tent became a useful sheltered communal area, something the French expedition of 1982 lacked, with morale suffering as a result.

Insurance was provided by the British Cave Research Association. Most of the expedition equipment was provided by Imperial College Caving Club and Imperial College Exploration Board with a few extras bought by the expedition team.

6.6 Sponsorship

Hugh and Hassan using the expedition Satphone.

We are grateful for the following for providing financial sponsorship for the expedition:

- Imperial College Exploration Board
- Royal College of Science Association
- University of London Convocation
- Albert Reckitt Trust
- Royal Society of St. George
- Ghar Parau Foundation

And the following companies and people:

- Hamish Brown for helping us with maps and logistics
- Unilever for the Pepperami – a true life saver
- Jeremy Milton of 3rd Planet Connections for the loan of a satellite telephone
- STOIC for the loan of a video camera
- Dr. Peter Dorward of Imperial College Health Centre for advice on medical supplies.

6.7 Weather

September was chosen as the best time to hold the expedition as the intense sun of the summer had lost some of it's strength, but winter had not yet set in. However, the exposed Jbel Awltoum valley where we had our base camp suffered from regular buffeting by the high winds of the Atlas. One the first night of our camp, Hassan's cooking tent blew down on three occasions – no one slept very well. After the first night, the tents were pegged down firmly, and no such problems arose. We also experienced quite a large amount of rain, mostly in brief showers. Once, while prospecting in zone N, a violent electrical storm crossed the Ghat plateau. There isn't much shelter on the plateau, and caves often act as conduits for lightening, so everyone was terrified for the twenty minutes that the storm lasted.

Whilst the weather was variable, morale didn't suffer as a result. However, the French expedition of 1982 mentioned that the weather took it's toll on their expedition. As they didn't have a storage tent, their kit was exposed to the wind and often took off down the valley in the middle of the night.

Temperatures on the plateau were not high enough to prevent exploration. Indeed, the combination of altitude and the time of year ensured that the daily temperatures were quite pleasant. The night-time temperatures did drop quite low on occasion and a warm sleeping bag was required.

7 Future Work

Whilst we have no current plans to revisit the Ghat Plateau, the potential cave hidden beneath the surface demands further investigation. A winter recce to identify blowing holes in snow cover to mark out true cave entrances would narrow down sites of interest. However this would be a very demanding trip with winter climbing and skiing skills required.

8 References

Prospection au Jbel Ghat, Echo des Vulcains (Speleogroupe Vulcain, Lyon , France) 1982.

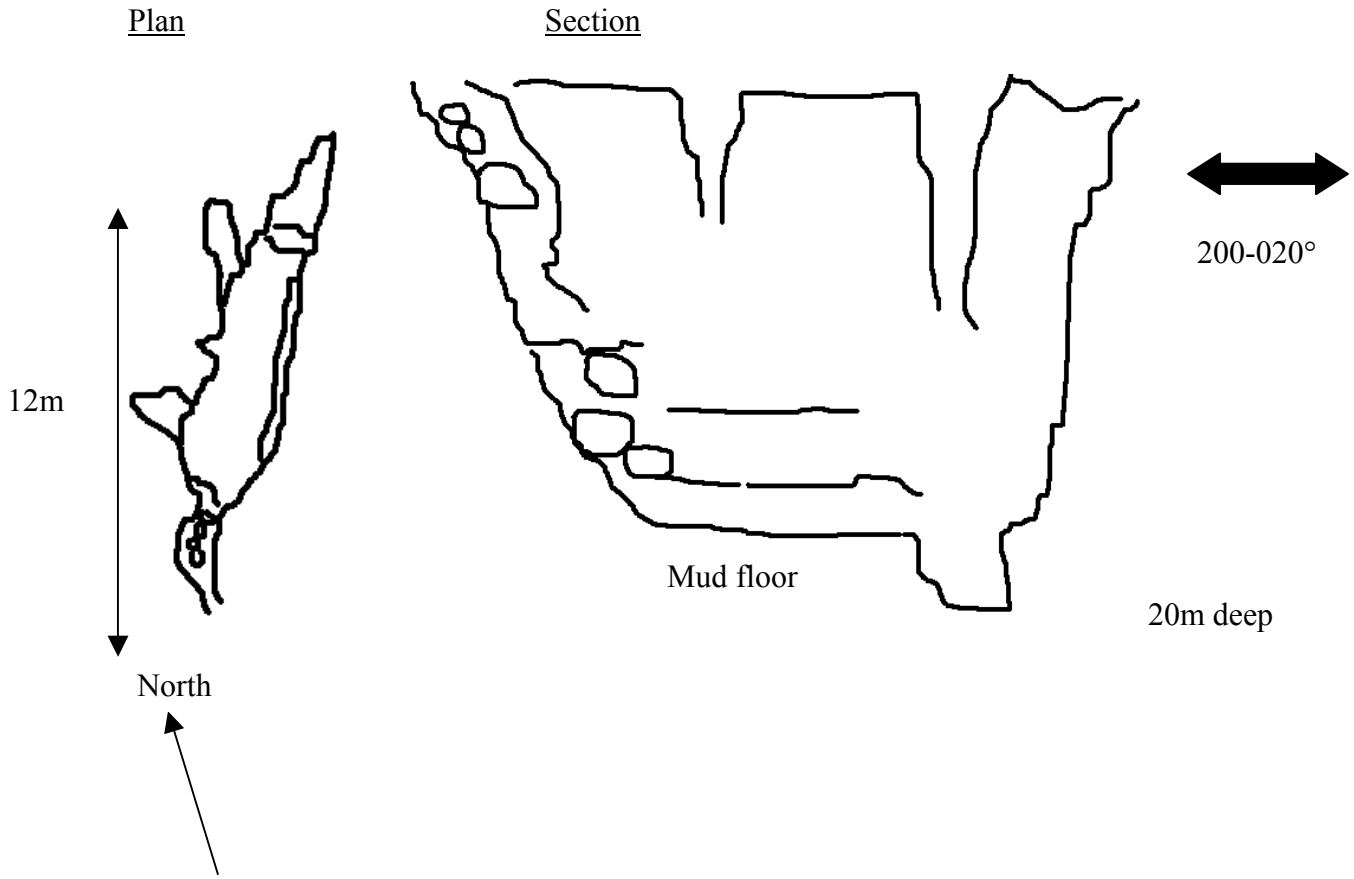
Structure and post-Palaeozoic evolution of the central High Atlas, Jacobshagen et al (Institut fur Geologie, Freie Universitat Berlin) 1989?

9 List of Jebel Ghat Caves

CAVE NAME	UTM CO-ORD (E 29 R0, N)	SURVEY	NOTES
N4 – E1	716344, 3494423	Y	Fault
N4 – E2	716432, 3494402	Y	Fault
N4 – E3	716793, 3494353	Y	-
N4 – E4	716782, 3494321	Y	-
N4 – J1	716255, 3494513	Y	-
N4 – J10	716516, 3494346	N	Small grike
N4 – J2	716309, 3494203	N	Small grike in valley
N4 – J3	717132, 3494444	N	1m wide rift into scarp
N4 – J4	717044, 3494521	N	Open rift along valley
N4 – J56	716914, 3494594	Y	Cave on valley edge
N4 – J7	717040, 3494412	N	Shakehole
N4 – J8	716822, 3494104	Y	-
N4- J9	716722, 3494243	Y	-
NT1	716071, 3494354	N	Awkward grike
NT2	716156, 3494414	N	Boulder covered grike
N2	716342, 3494103	Y	Relocated GV cave
N3	716225, 3494336	Y	Relocated GV cave
N4 – J11	715800, 3494900	Y	-
N3 – H1	716045, 3494429	Y	-
N3 – J1	715355, 3494343	N	Rift
N3 – J2	715602, 3494501	N	Large shakehole, unstable
N3 – J3	715903, 3494339	Y	-
N4 – C1	716451, 3494507	Y	In pavement
N4 – E5	716782, 3494291	Y	-
N4 – C2	716451, 3494512	Y	-
N4 – C3	716780, 3494335	Y	A lot of narrow rift
N4 – C4	716780, 3494335	Y	-
N4 – C5	716793, 3494353	Y	-
N3 SPRING	715890, 3494278	N	Water supply, unreliable
RO1	717075, 3493227	N	Very big grike
RO2	717251, 3493132	N	Marked by GV?
SO1	718358, 3493043	N	50m shaft runs e-w
SHEEP	717236, 3492167	Y	-
SHEEP2	717278, 3492228	Y	-
IFRI AHMEN	717218, 3493149	Y	Water supply, unreliable
2HOLES	717831, 3492826	Y	-
B3	717276, 3492824	Y	Relocated GV cave
A – ET1	719200, 3494650	Y	-
A – FH	719175, 3494600	Y	-
A – ET2	719100, 3494500	Y	-
A – ET3	719035, 3494410	Y	-

9.1 Cave Surveys for Area A:

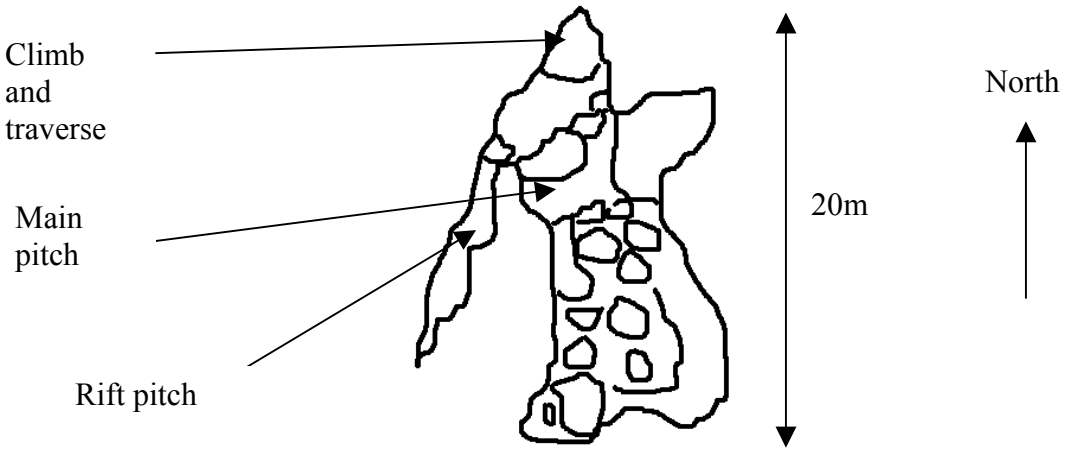
9.1.1 A – ET1



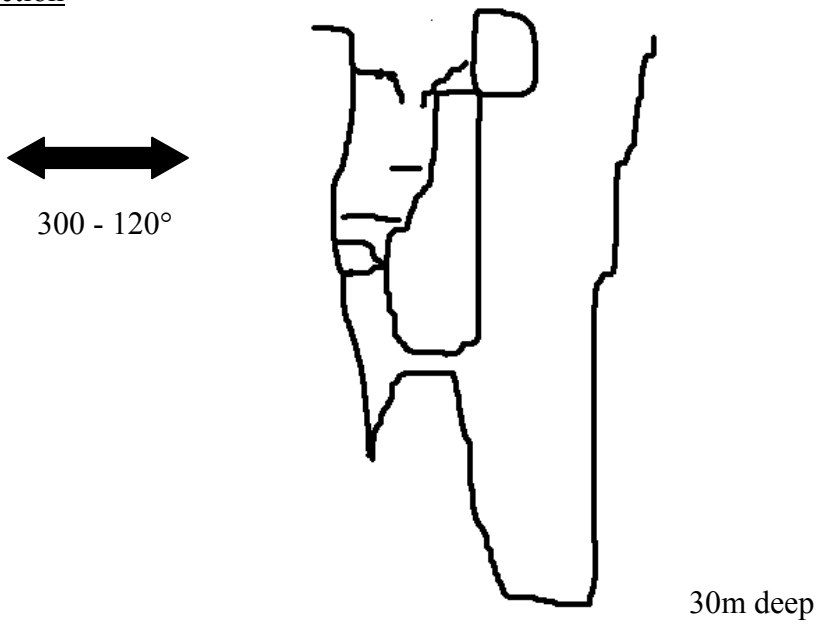
9.1.2 A – FH (flyhole)

9.1.3 A – ET2

Plan

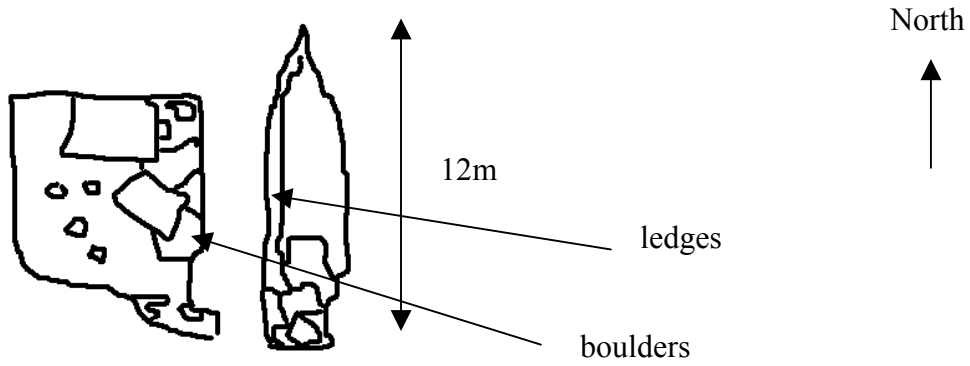


Section

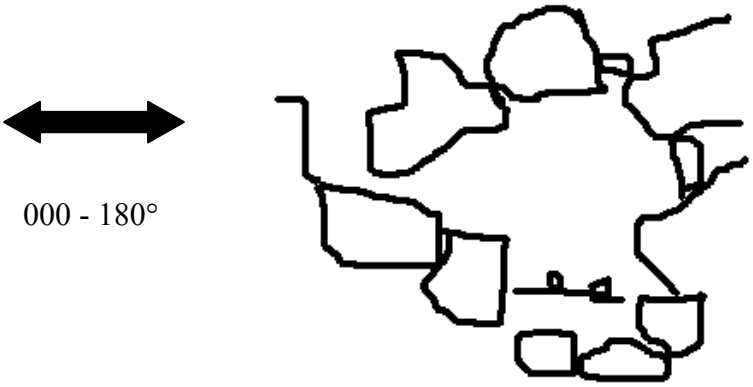


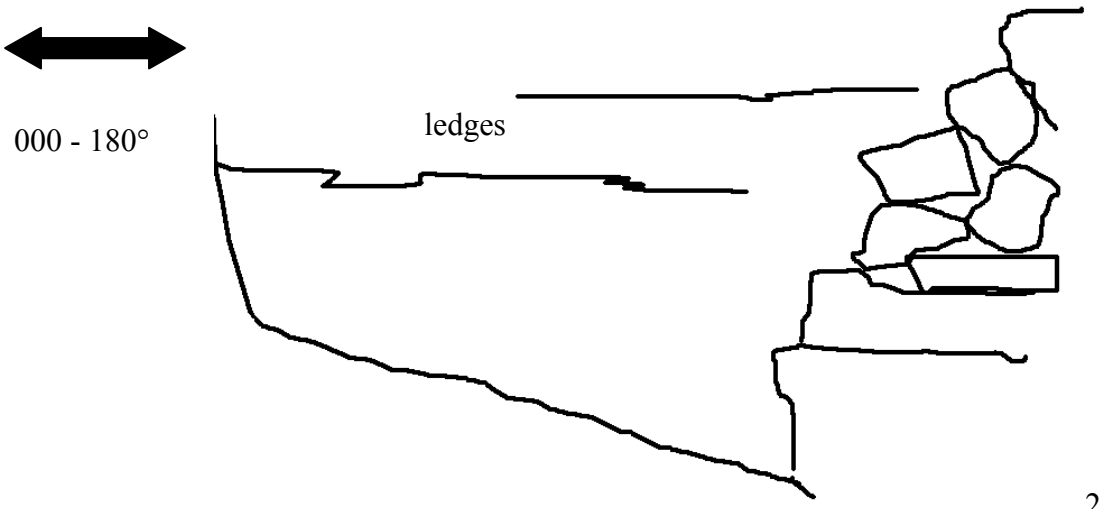
9.1.4 A – ET3

Plan



Sections

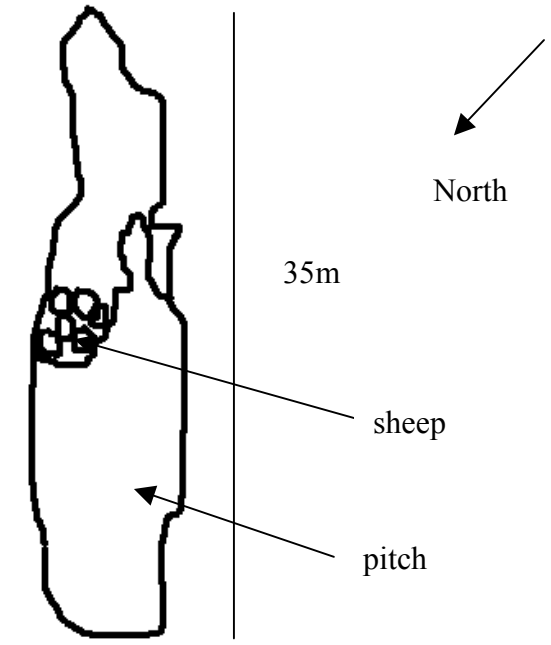




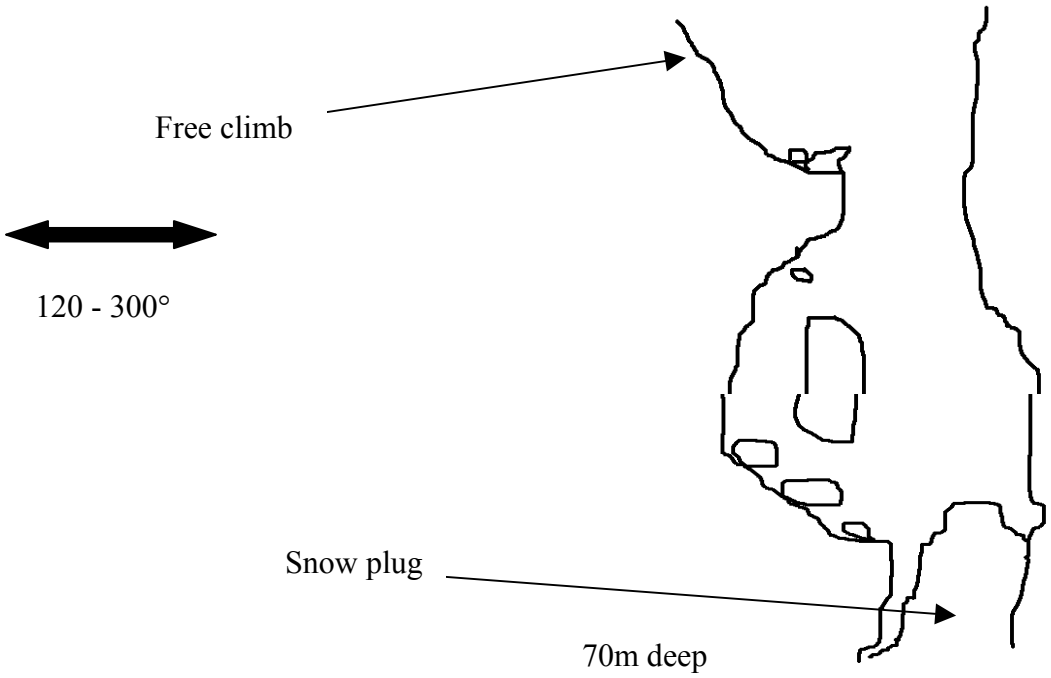
9.2 CAVE SURVEYS for AREA B:

9.2.1 SHEEP

Plan at –20m

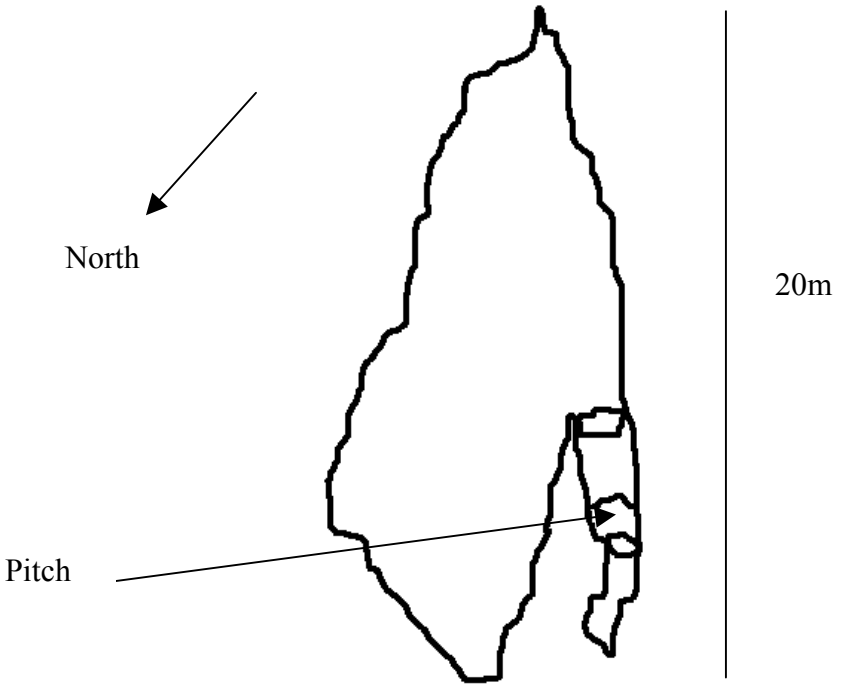


Section

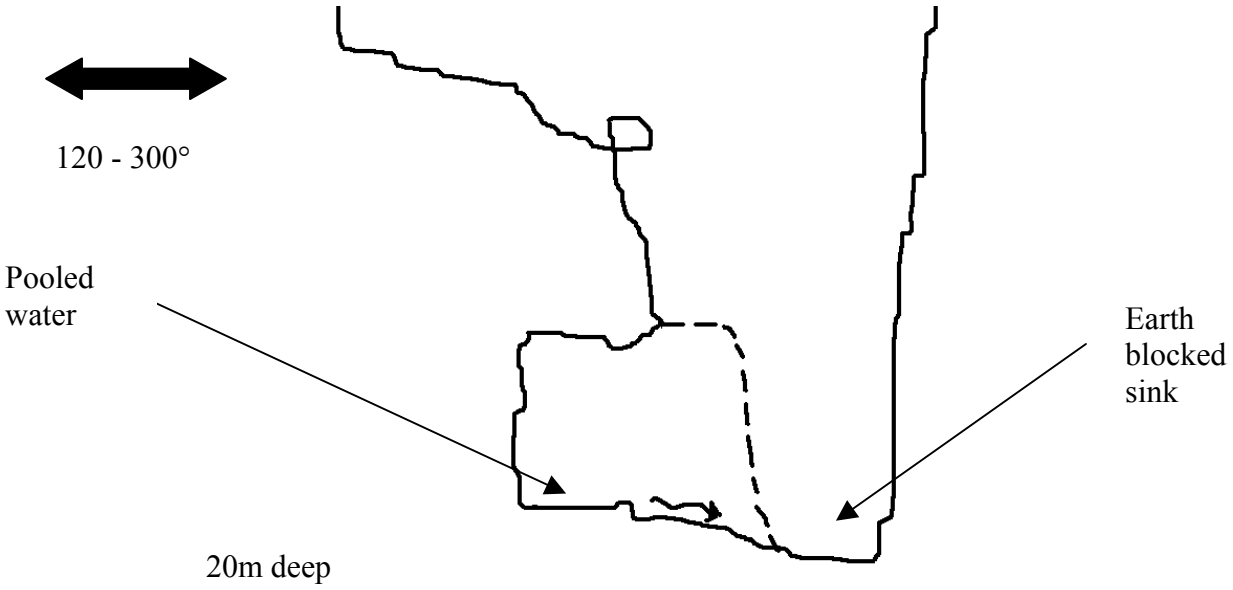


9.2.2 SHEEP 2

Plan

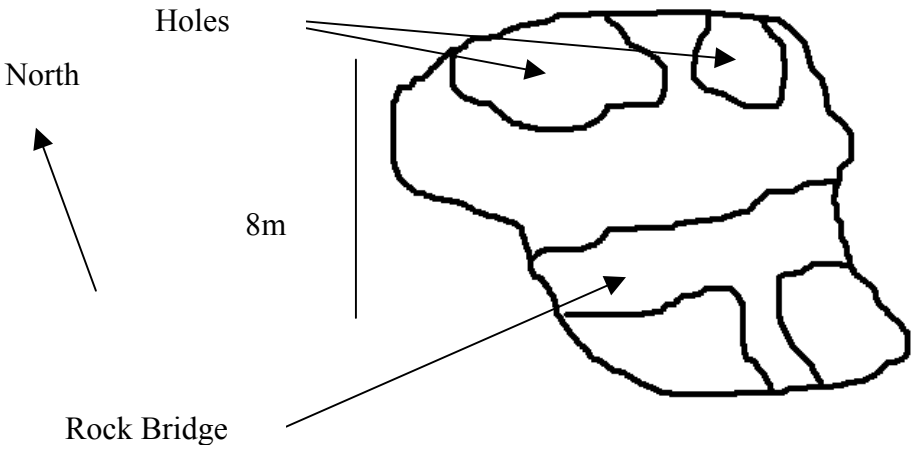


Section of Pitch

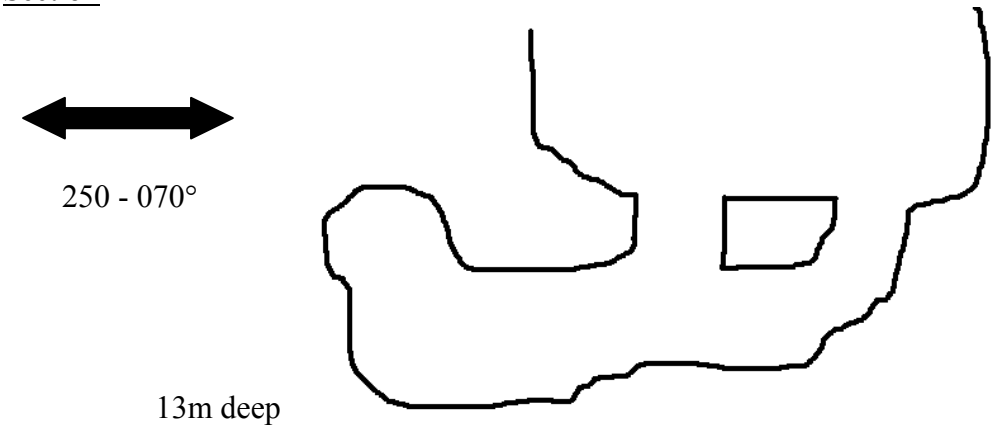


9.2.3 2 HOLES CAVE

Plan

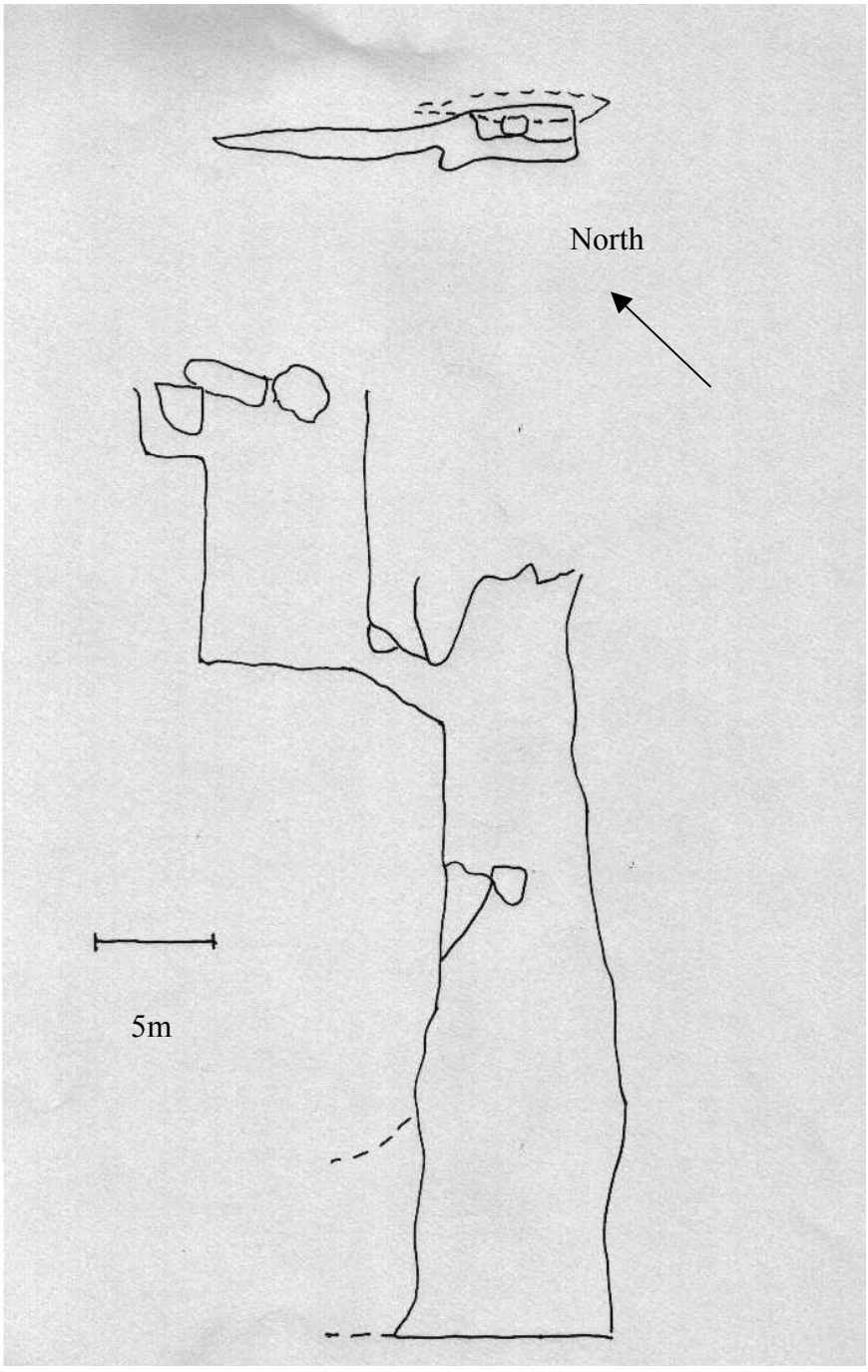


Section



9.2.4 IFRI AHMEN (Water cave) – Cave of the green jedi

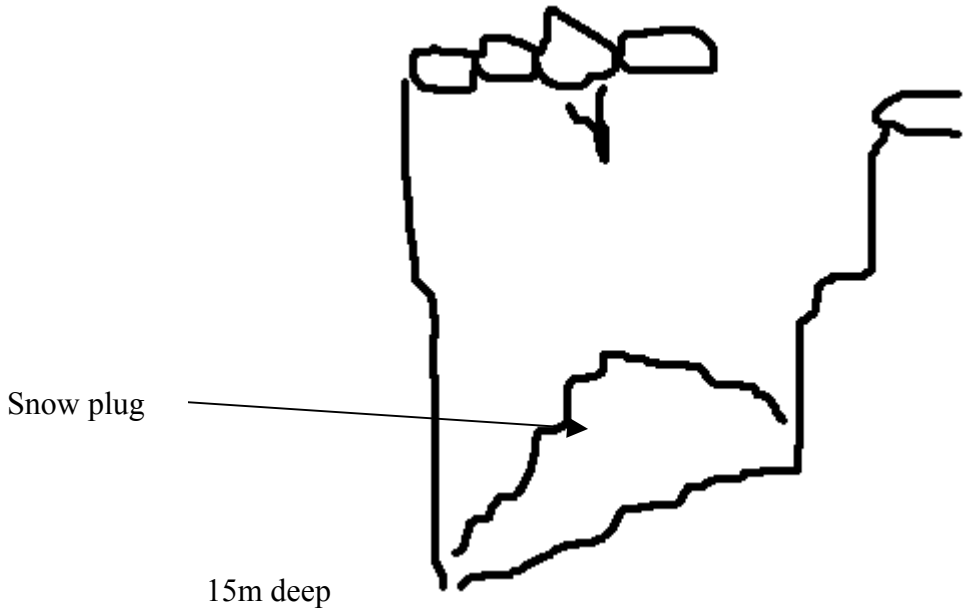
Plan and Section



9.2.5 B3 (groupe vulcain)

Relocated cave, original survey GV 1981

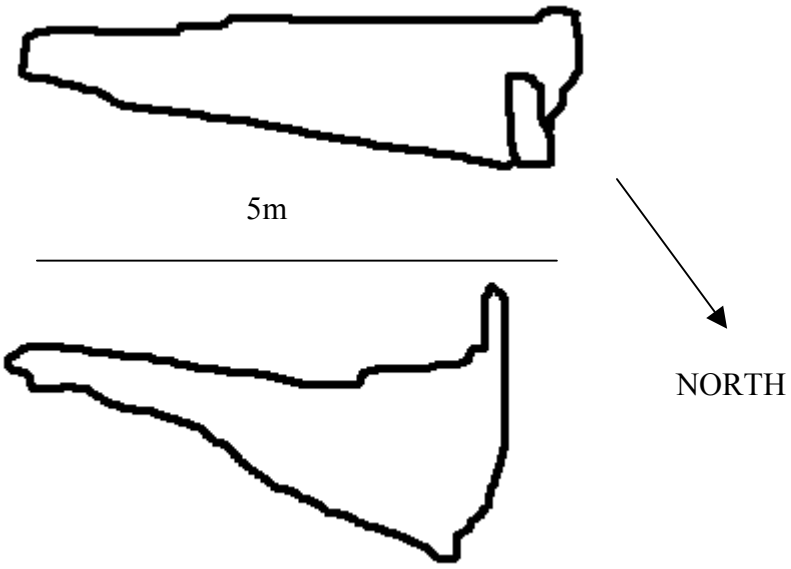
Section



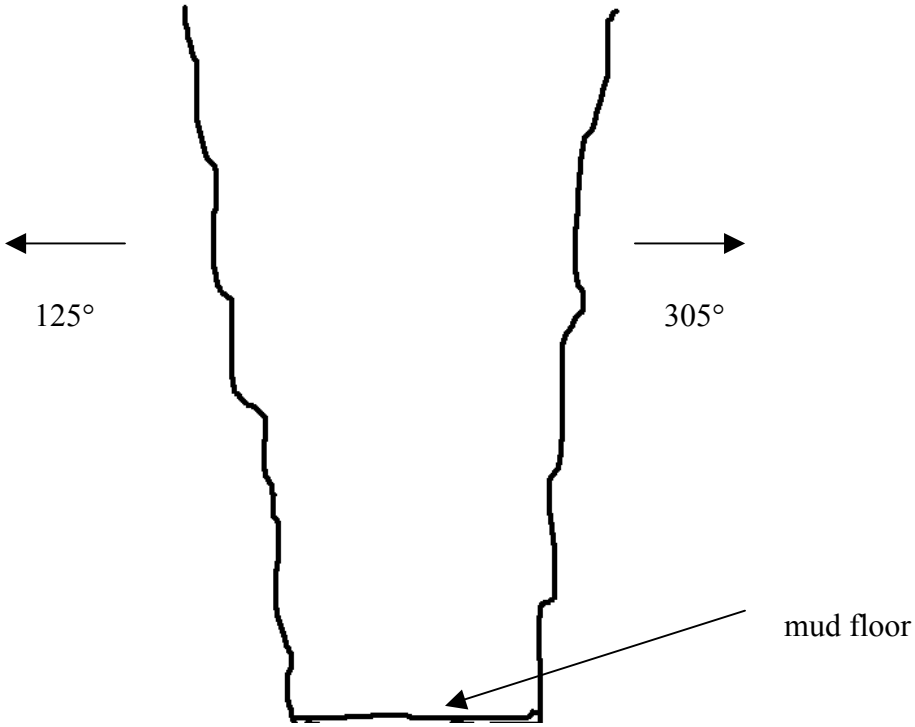
9.3 Cave Surveys for Area N

9.3.1 N4 – C1

Plans (top; bottom)



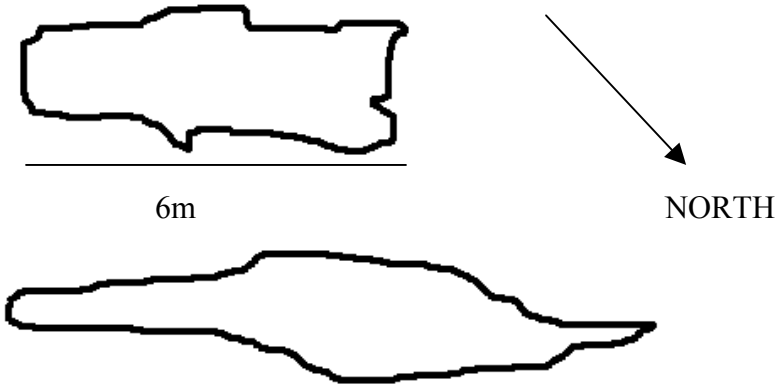
Section



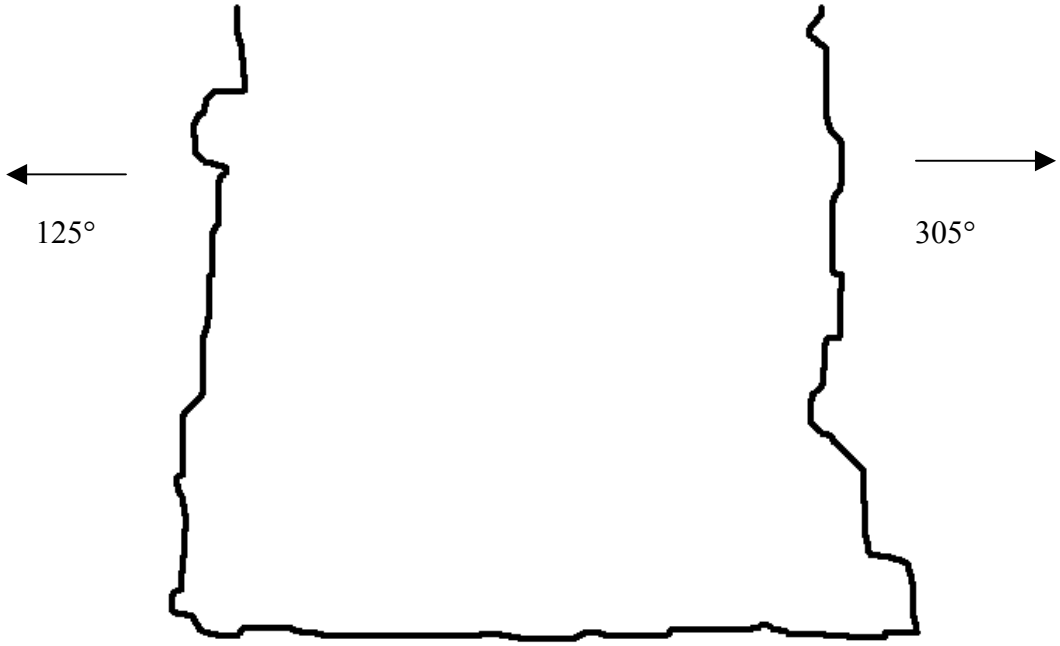
14.5m deep

9.3.2 N4 – C2

Plans (top; bottom)



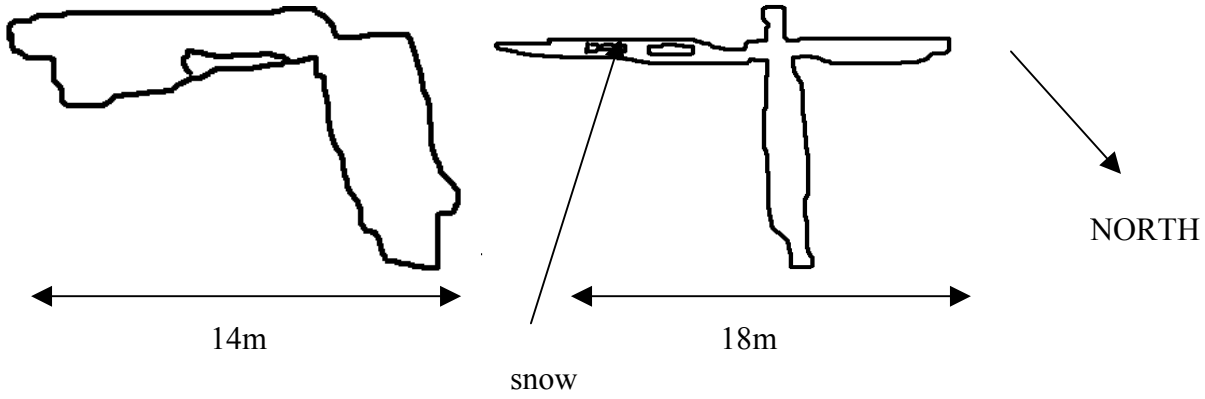
Section



12.7m deep

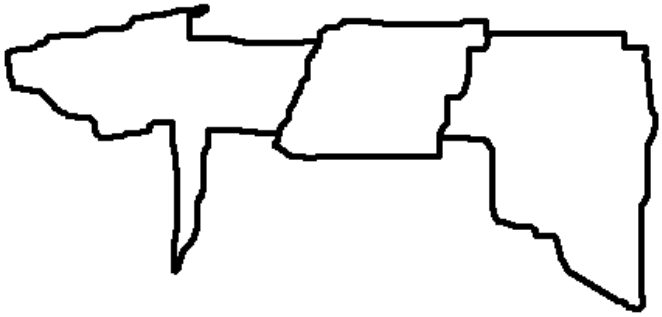
9.3.3 N4 – C3

Plans (top; bottom)



9.3.4 N4 – E1

Plan (top)



14 m

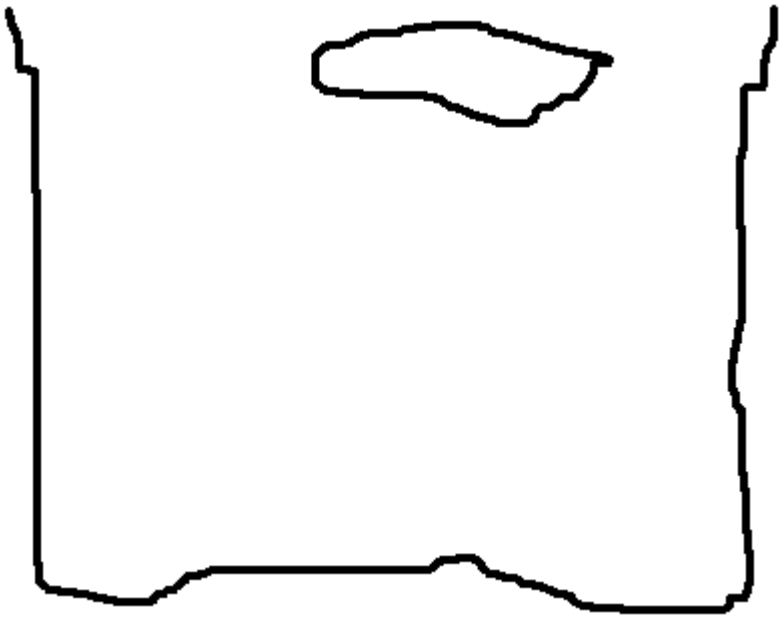
Plan (bottom)

NORTH

120°

300°

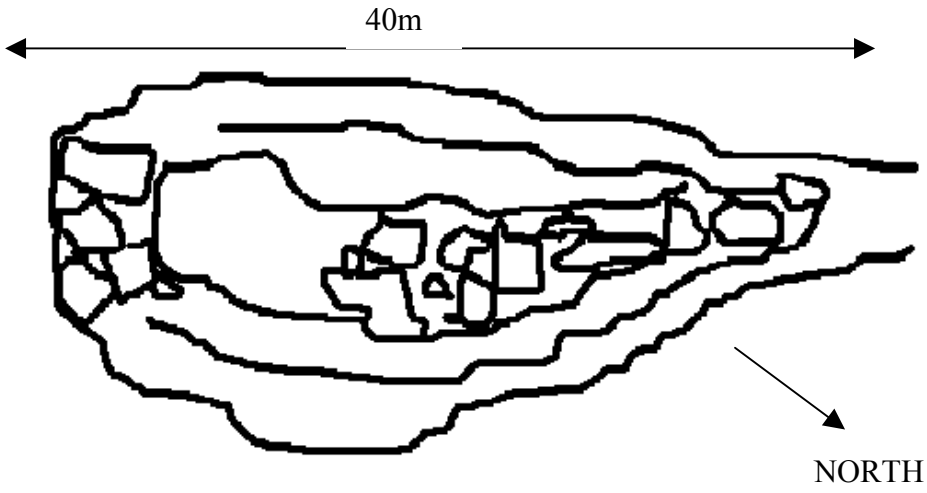
Section



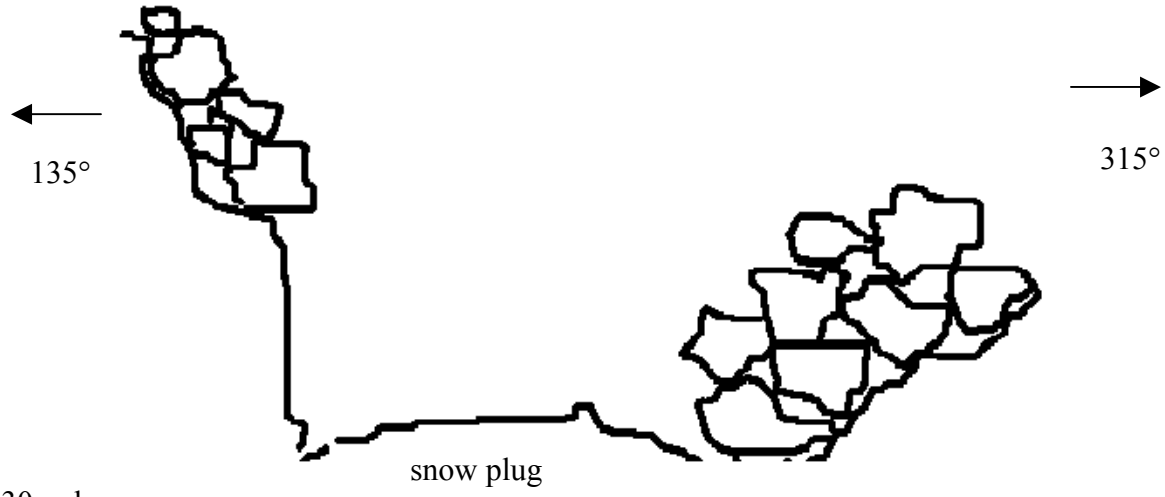
26.5m deep

9.3.5 N4 – E2

Plan



Sections

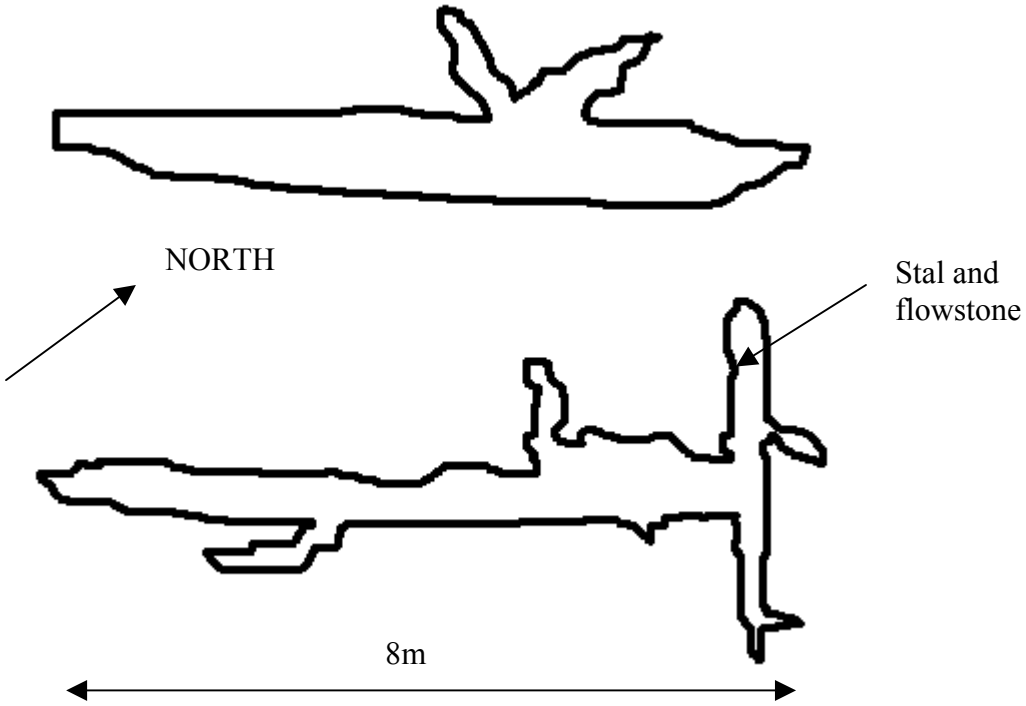


30m deep

30m deep

9.3.6 N4 – E3

Plan (top; bottom)



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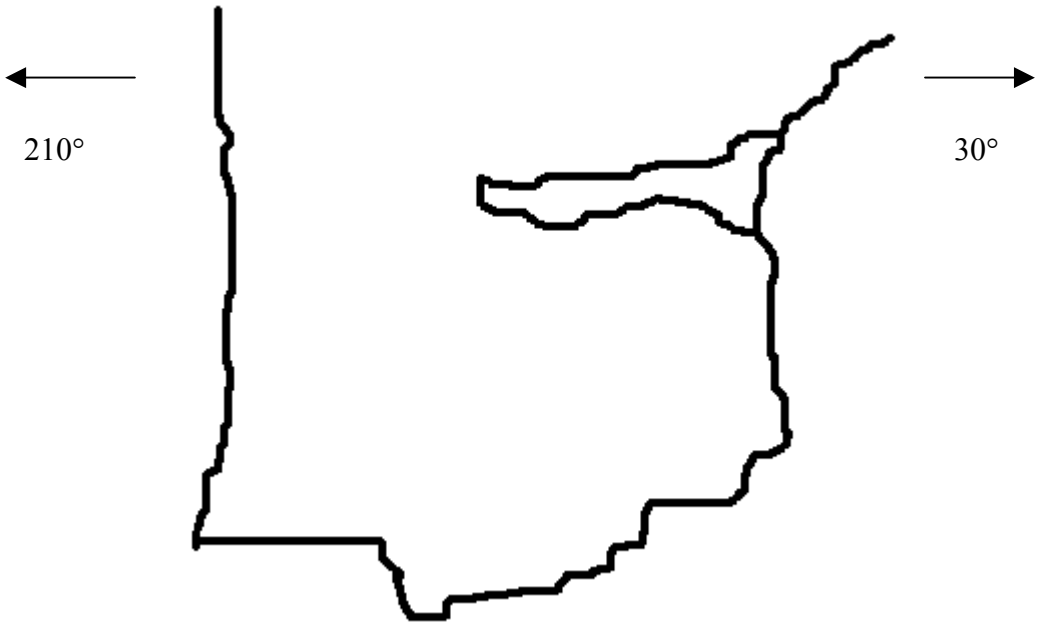
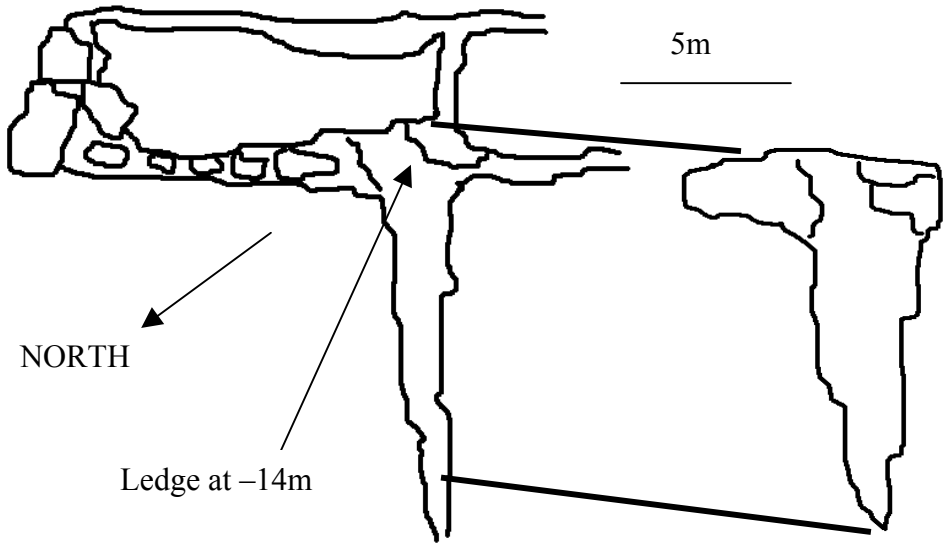


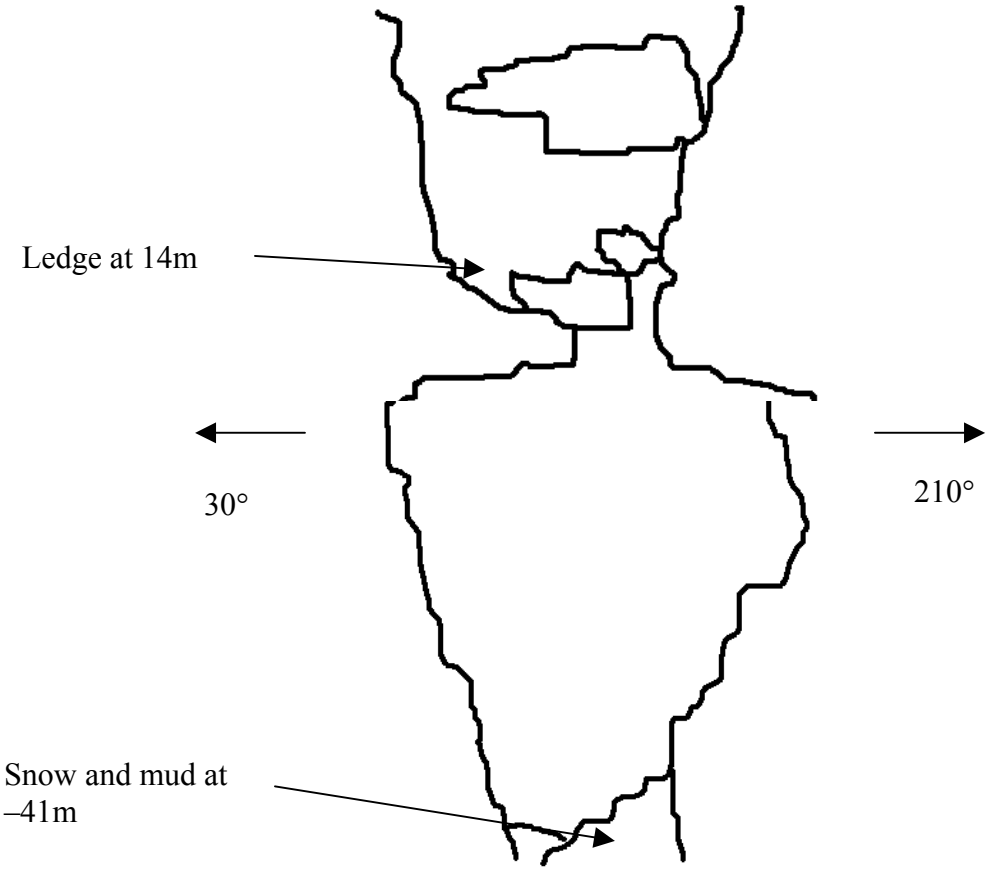
20m deep

9.3.7 N4 – E4

Plans top bottom (at –14m)



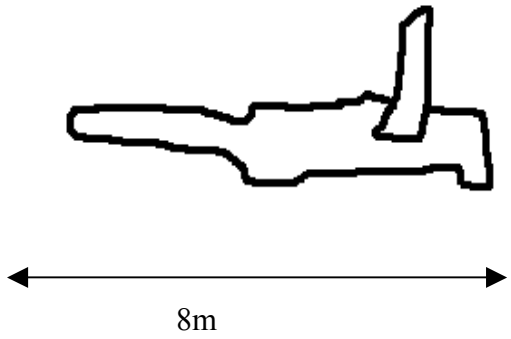
Section



9.3.8 N4 – C5

(same area as E3)

Plan



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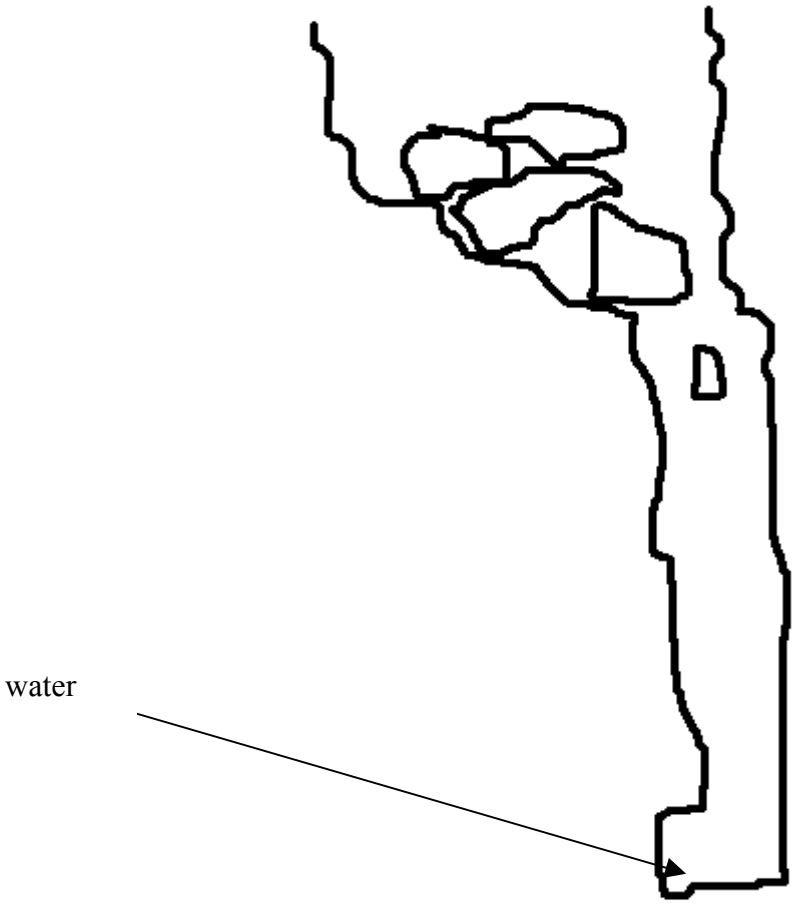
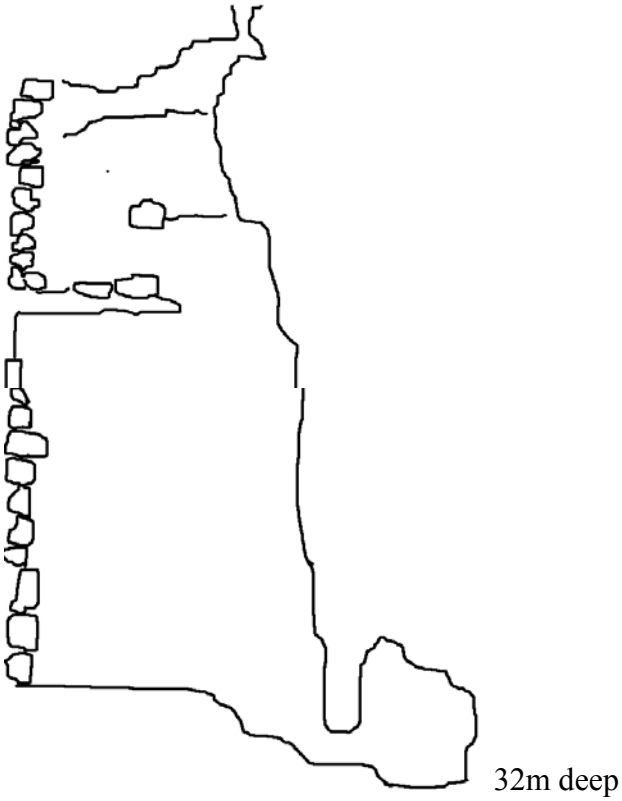


28m deep

9.3.9 N4 – E6

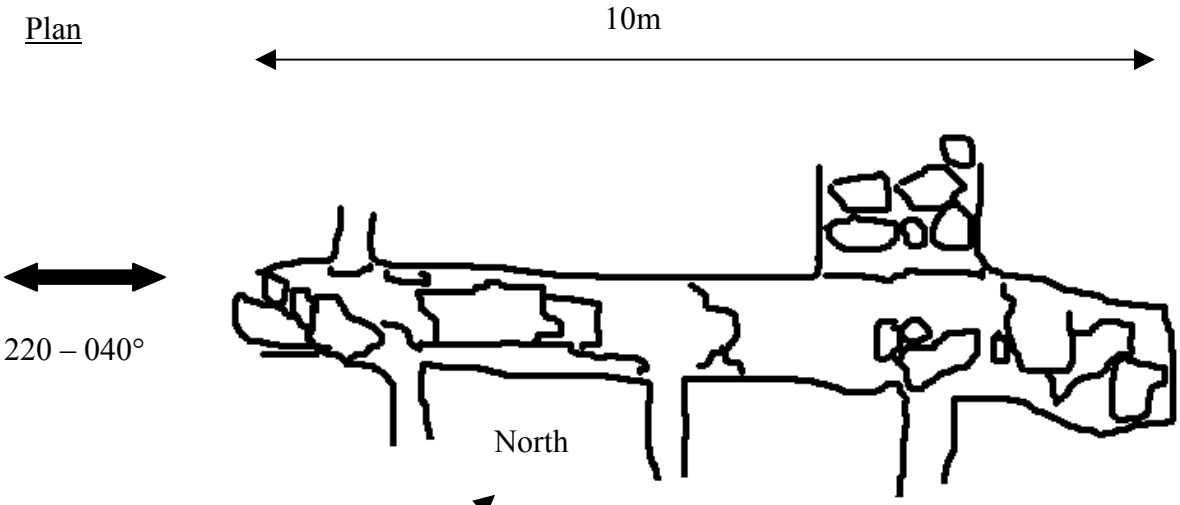
Section



9.3.10 N4 – E5

South of E4

Plan



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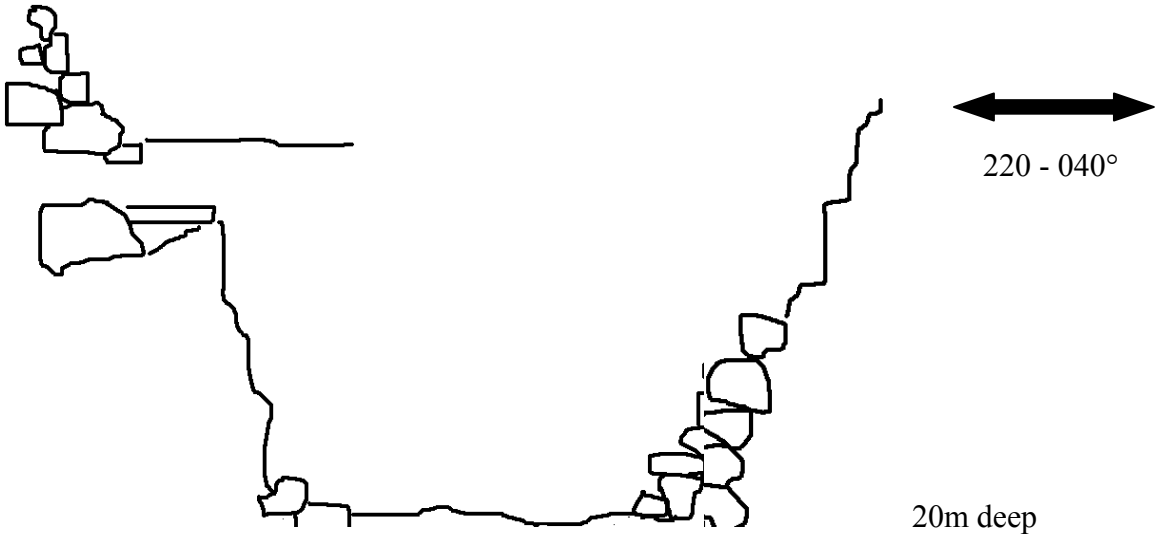
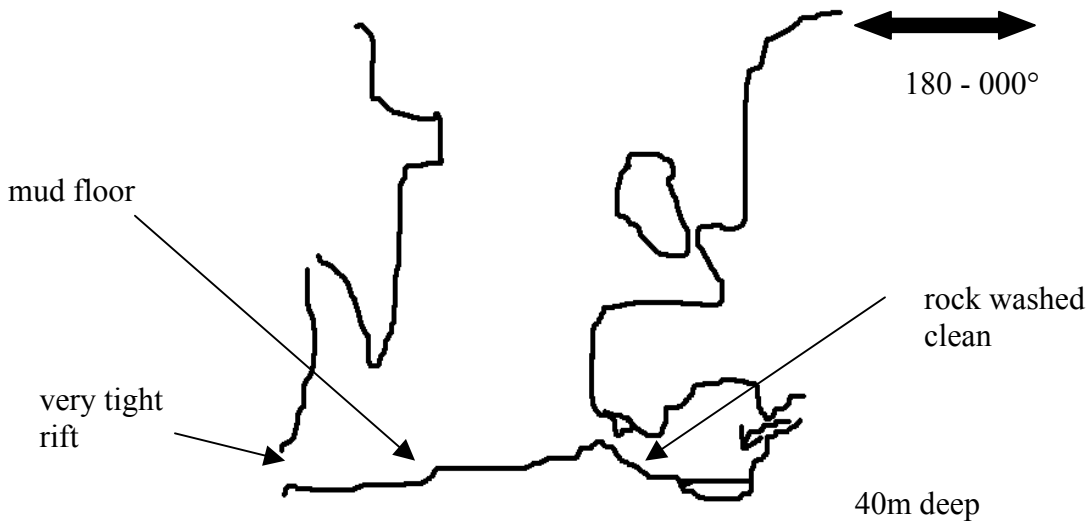
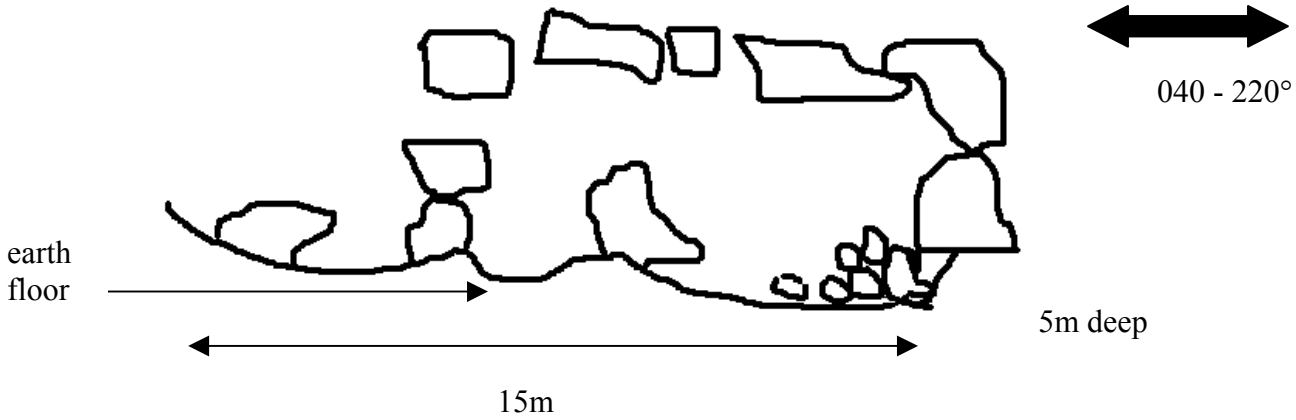


9.3.11 N4 – J1



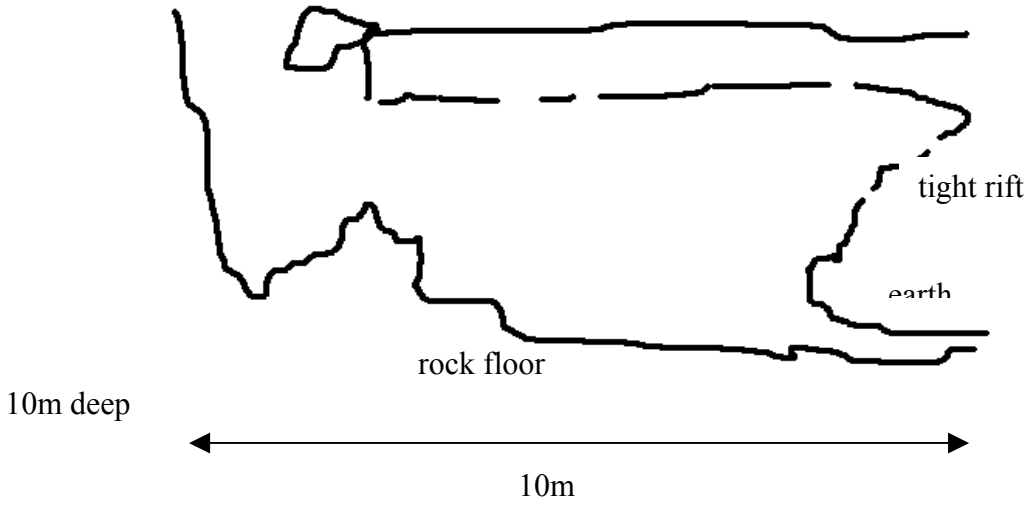
9.3.12 N4 – J8



9.3.13 N4 – J9

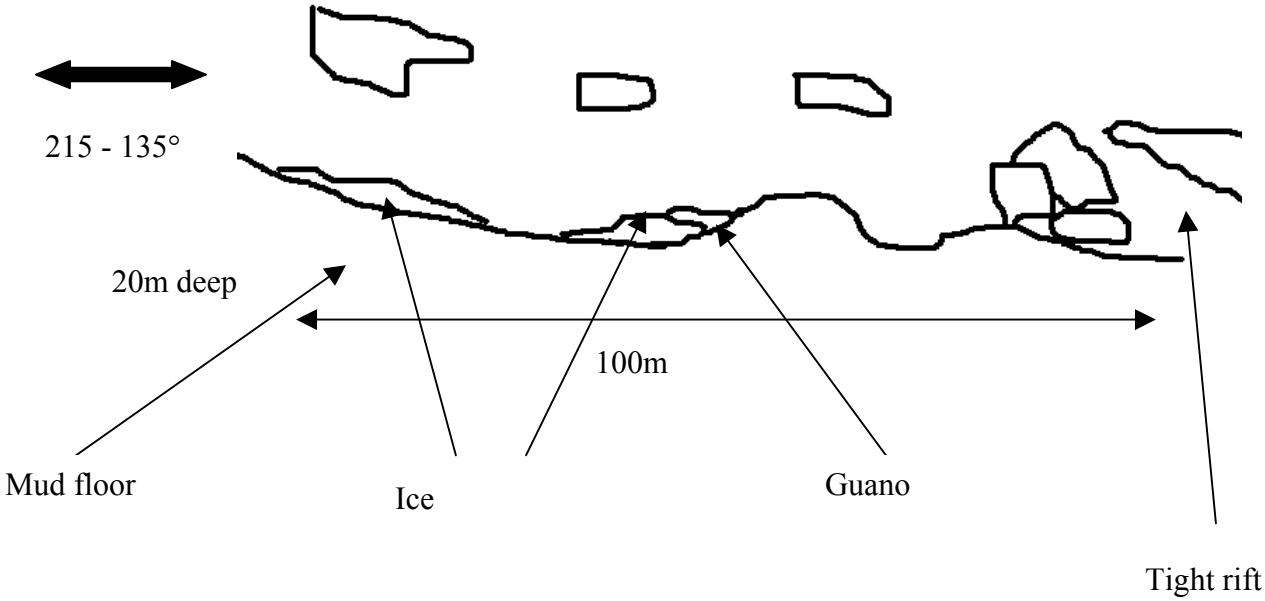
Plan

Section



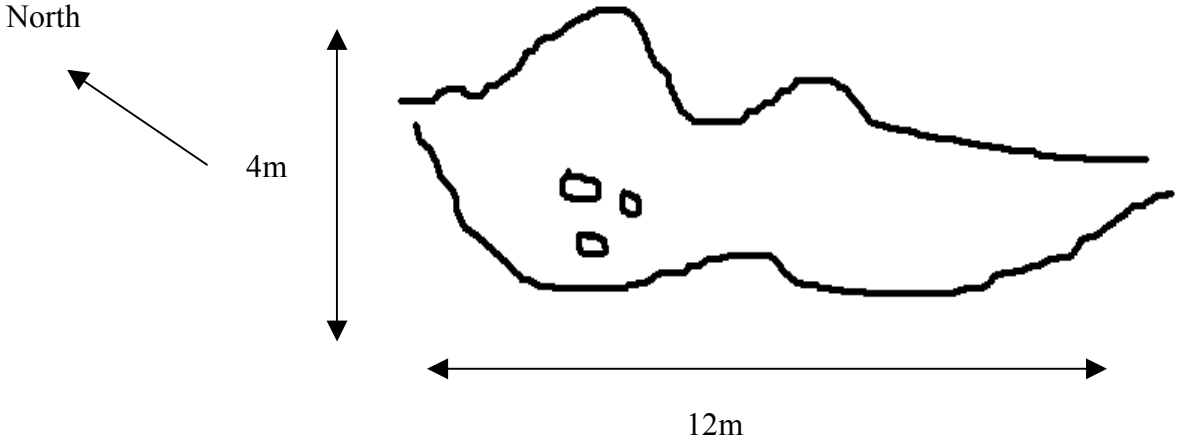
9.3.14 N4 – J11

Section



9.3.15 N3 – H1

Plan



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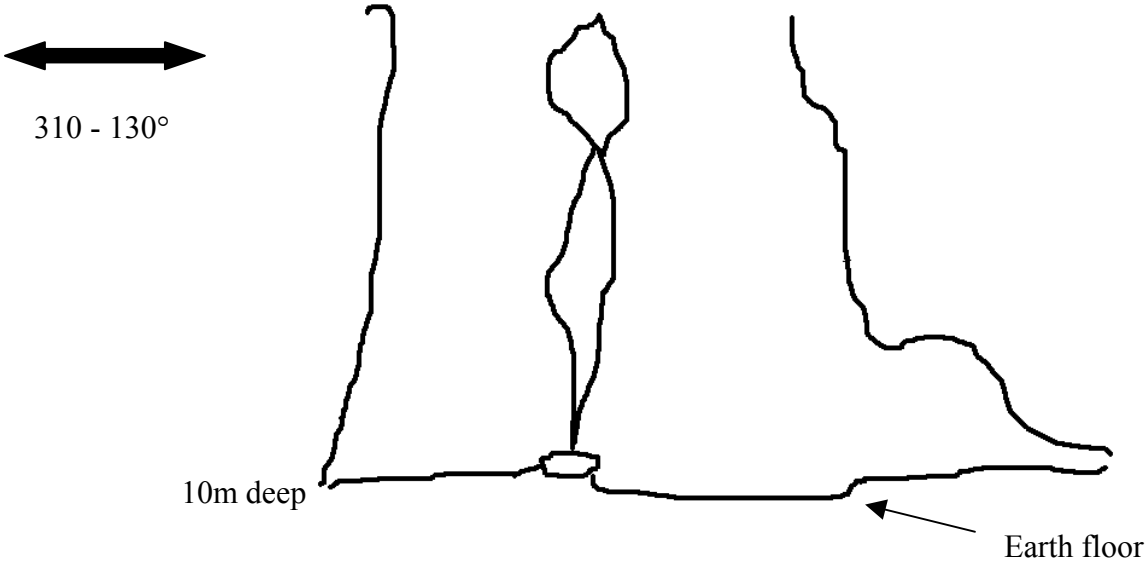
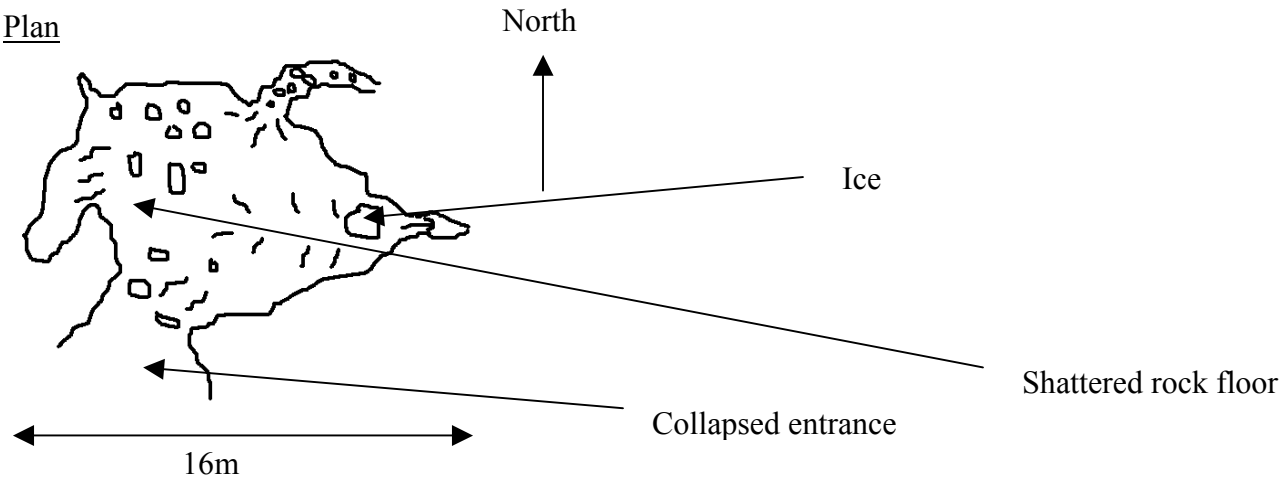


9.3.16 N3 – J3

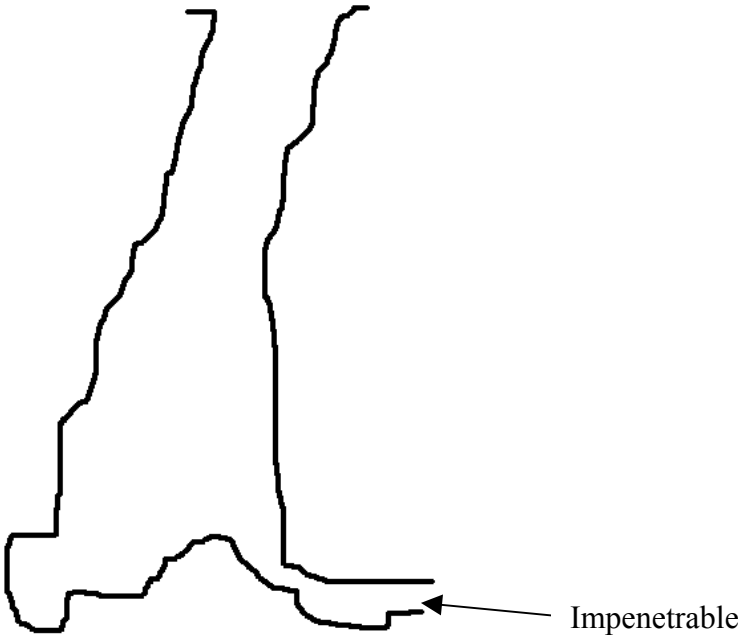
Plan



9.3.17 N2 (groupe vulcain)

Relocated cave, original survey GV 1981.

Section

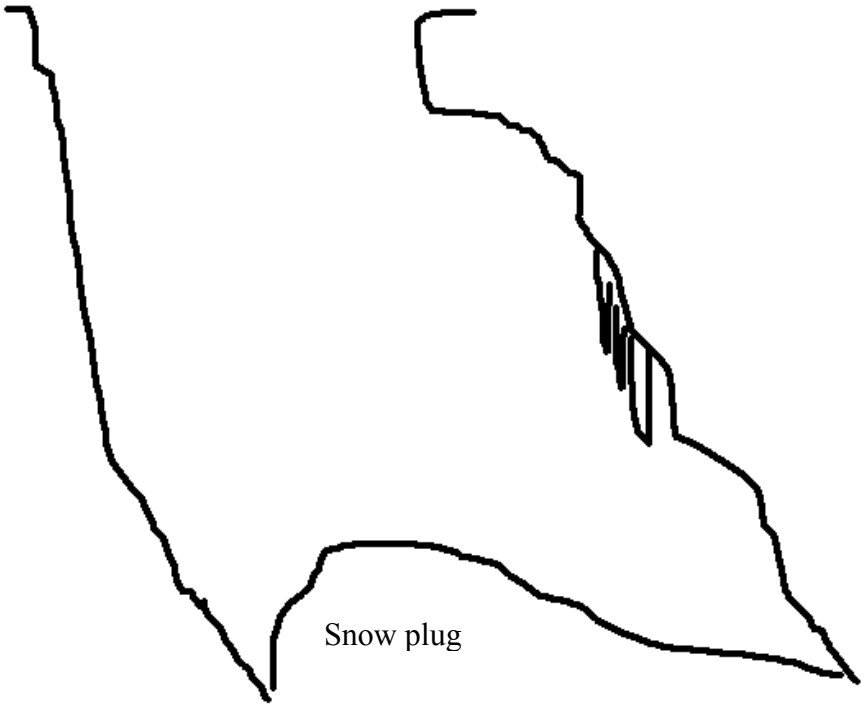


36m deep

9.3.18 N3 (groupe vulcain)

Relocated cave, original survey GV 1981.

Section



35m deep