Peru 2001 – 2002

Expedition Report

PUMACOCHA 2001

EDITED BY

ROB HARPER, BVM&S, MRCVS, FRGS

CONTENTS

THE TEAM

BACK ROW:
Les, Nick, Mark, Ian, Matt & Rob

FRONT ROW:
Juan

INTRODUCTION

In June 2001 six cavers from Britain, Canada and Peru undertook a short reconnaissance expedition to the Yauyos District of southern Peru where there is a large area of karst with numerous cave entrances.
As far as could be ascertained by a review of the available references none of this area had been examined in detail. Both the geology and topography suggested that there was considerable potential for both deep and long cave development.
The primary target of this expedition was the large open shaft taking the waters flowing out of Lake Pumacocha which had originally been noted by Les Oldham a British geologist and caver living and working in Peru. Subsequently Nick Hawkes had descended the first part of the entrance shaft and discovered that the cave continued beyond the daylight zone.
After a few initial promoting sessions by Nick amongst cavers in his home region, (the Mendip Hills in the UK), news of a exciting new caving prospect deep in Peru slowly became public knowledge among the local caving community. In early 2001 Rob Harper took the bait and contacted Nick with a view to a reconnaissance trip. After emailing around their acquaintances an experienced technical caving team was put together.

===//===

PERSONNEL

NAME	NATIONALITY	DOMICILE	CLUB
Rob Harper	British	UK	B.E.C.
Mark Hassell	Australian	Canada	None
Nick Hawkes	British	Peru	B.E.C.
Ian McKenzie	Canadian	Canada	A.S.S.
Matt Tuck	British/Canadian	Canada	B.E.C.
Juan Castro	Peruvian	Peru	None
(Les Oldham	British	Peru	None)

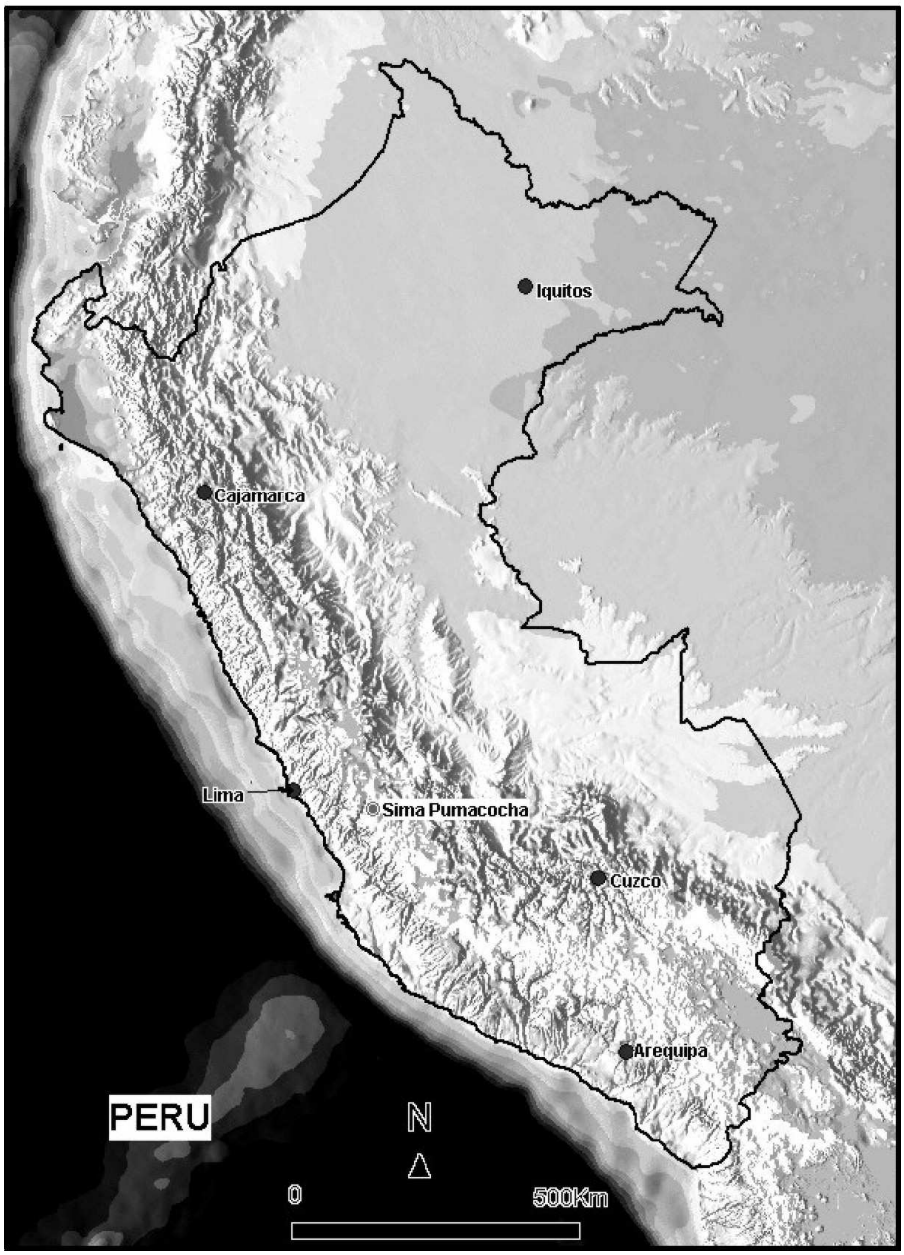
NOTE 1……..B.E.C. = Bristol Exploration Club
A.S.S. = Alberta Speleological Society

NOTE 2……..Due to personal circumstances Les was unable to take a part in the active exploration of the cave.

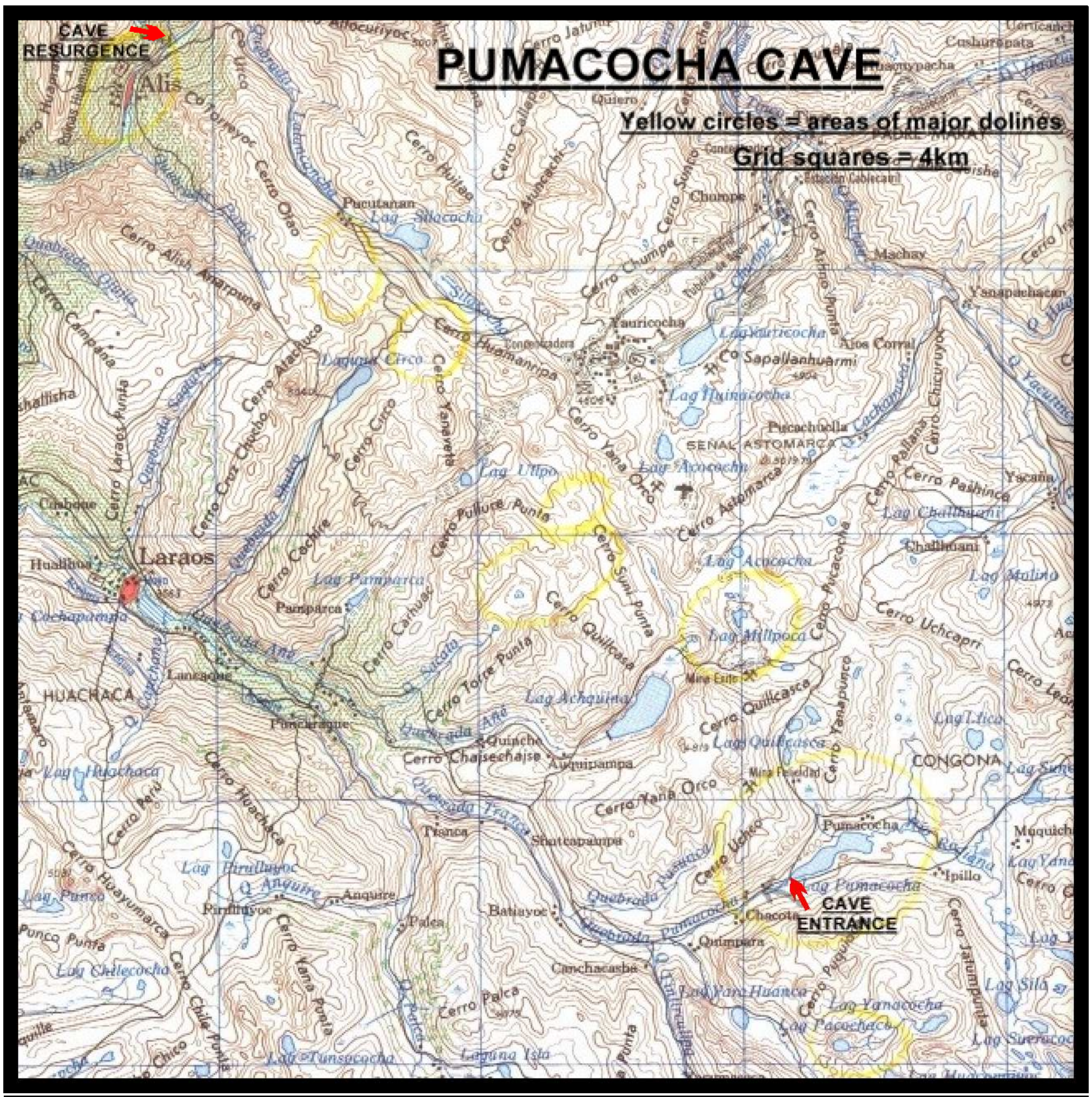
===//===

LOCATION & TOPOGRAPHY

SATELITE PHOTOGRAPH INDICATING CAVE LOCATION



TOPOGRAPHICAL MAP OF THE CAVE AND IMMEDIATE AREA



===//===

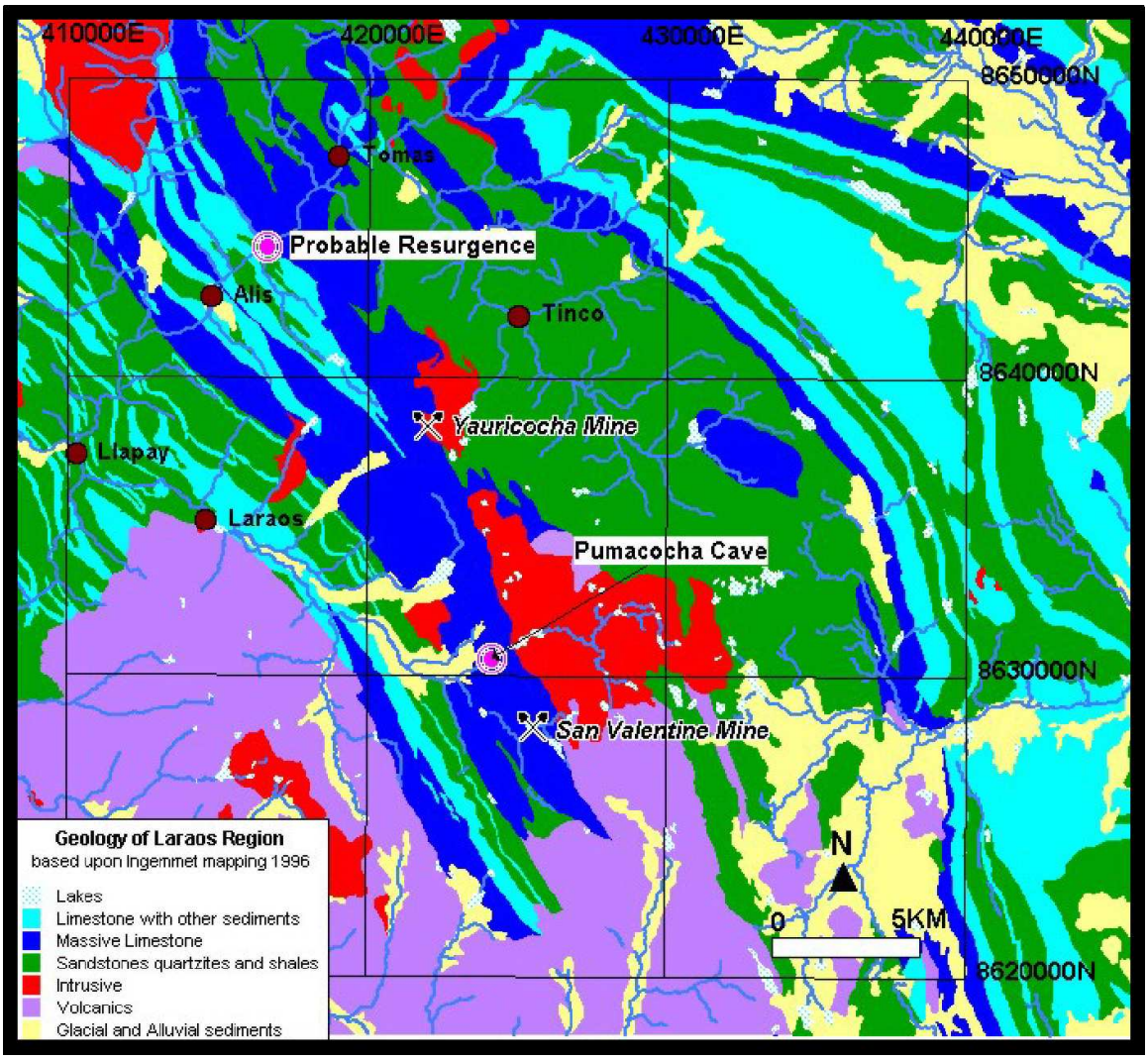
GEOLOGY/GEOGRAPHY

The cave is located within the 100,000 scale Yauyos mapsheet number 25-L which was published in 1996 by the Instituto Geologico Minero y Metallurgico (INGEMMET). The entire mapsheet covers a half degree quadrangle, which equates to just over 3000km^2. Les Oldham has mapped several areas within the mapsheet including the area directly over the Pumacocha cave while exploring for base and precious metals. During the course of his mapping Les first recognised the potential for major cave development in this area.

Geological controls are the primary elements that dictate a cave's location and form. Caves form in limestone, and the best caves are developed in massive limestone with little or no interbedded silts, shales or other non-carbonate dominated lithological horizons. Within Peru, the best limestone for cave development is the Upper Cretaceous Jumasha Formation. The Jumasha limestones comprise a massive thickly bedded sequence of limestones and minor dolomites. Within the Yauyos mapsheet approximately 700km^2 of Jumasha limestones outcrop, making the area highly attractive for cave exploration and karstic studies. In the region of study this lithological unit has been estimated at approximately 400m thickness (Megard et al., 1996). Directly overlying the Jumasha Formation is another limestone unit known as the Celendin Formation that was also deposited in the Upper Cretaceous and has also been estimated as having a thickness of 400m. The Celendin Limestones are not as favorable for cave development due to common interbedded layers of gypsum, red-brown shales and some sandstone. Nevertheless caves can and do occur in this formation. Below the Jumasha limestone lie two further Cretaceous limestone bearing formations, namely the Pariatambo and Chulec formations. Together these form an estimated 330m of potential cave bearing stratigraphy. Jurassic age limestone also occur to the northeast of the principal area of study yet still within the Yauyos mapsheet. These are the Lower Jurassic Condorsinga unit of approximately 1000m thickness and the middle Jurassic Chaucha Formation of an estimated 300m thickness. In total therefore the region has over 2400m of limestone stratigraphy that has subsequently been thrusted and folded during a sequence of orogenic events. The deformation is likely to be closely associated to a period of intrusive activity during the Paleogene and Neogene epochs, which has left the limestones commonly tightly folded, and in many areas standing near vertical. During this period of deformation it is likely that many of the predominantly limestone hosted mineral deposits for which this area is famous for were formed. The principal mineral deposits of the region all have strong magmatic associations suggesting direct association with the Cenozoic intrusive activity.

Geology at Pumacocha

The Pumacocha cave system lies between two active mining camps. To the south is the San Valentin polymetallic carbonate replacement orebody and to the north lies the larger mineral district of Yauricocha where many of the small lead/zinc/silver orebodies appear to occupy karstic or solution-collapse cavities.



The cave is located within the Jumasha Limestone adjacent to the contact with a large Miocene granodiorite intrusive. The entrance to the cave is situated in limestones very close to the contact with granodiorite, and along a regional northwest trending high angle reverse/thrust fault. The presence of considerable cherty horizons which were located underground suggest that the mapped cave to date lies close to the lower contact with the underlying Lower Cretaceous Pariatambo Formation.

All limestones where the cave sinks are vertically bedded and this clearly explains the extreme vertical nature of the cave development.

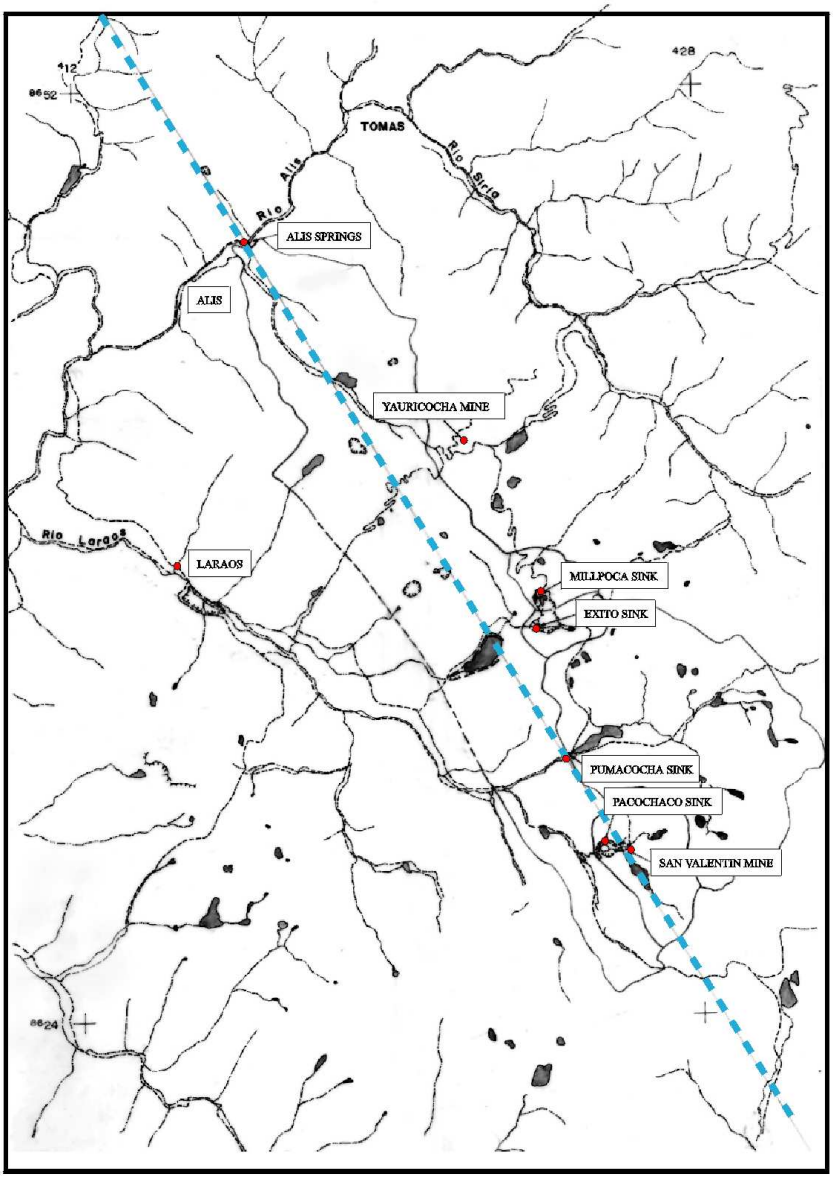
THE VALLEY WALL ABOVE THE CAVE ENTRANCE
SHOWING THE VERTICAL BEDDING

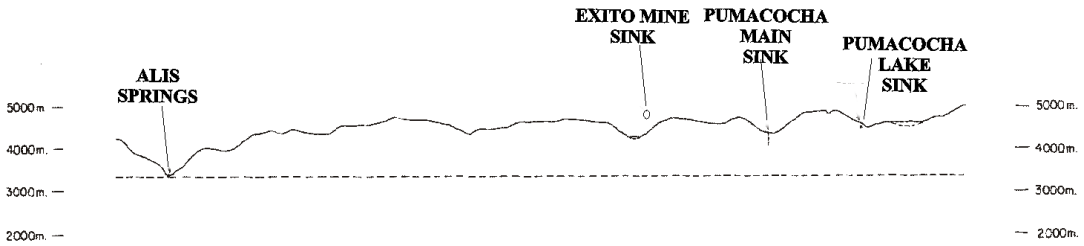
Geomorphologic controls.

Previous speleological expeditions to the Andes have commented on the lack of deep and well-developed caves and have attributed this in part to an effect of the excessive altitude (Imperial College, 1975). The argument proposed is that rainwater falling at such altitudes is less acidic since less CO_2 has been absorbed during the decent. As to whether this argument is valid or not is not here disputed, although the contribution of acidic waters is clearly a pre-requisite for large-scale cave development. The headwaters of Laguna Pumacocha rose over 30sq km of granodiorite bedrock and extensive glacial deposits. Poor drainage over the granodiorite has resulted in the development of peat bogs which themselves produce acid waters due to the decomposition of organic matter which produces CO_2 and therefore carbonic acid. Furthermore the oxidation of numerous pyretic sulphide veins within the granodiorite will also have contributed to the low pH of waters entering Laguna Pumacocha and subsequently Sima Pumacocha.

===//===

DIAGRAMMATIC SECTION FROM PUMACOCHA TO THE PRESUMED RESURGENCE AT ALIS SPRINGS



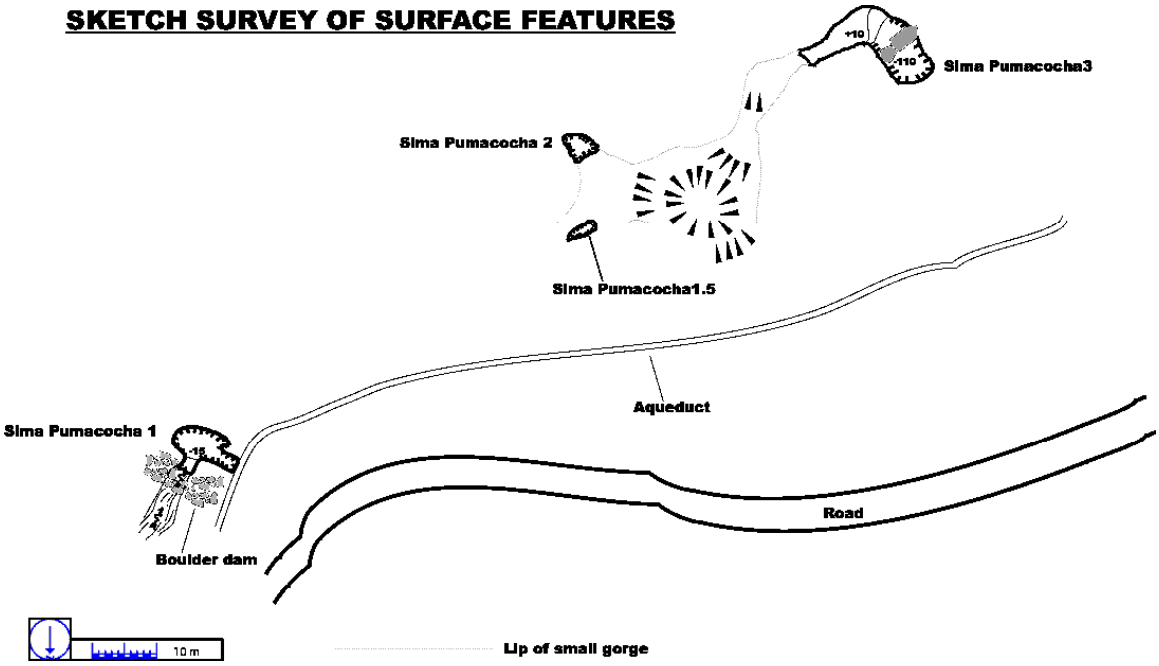


CAVE EXPLORATION & CAVE DESCRIPTION

On arrival in the area we examined the main sink and adjacent entrances which appeared to be part of a single cave complex. In the absence of a local name, we designated the system as Sima Pumacocha, (SP), and the active entrance as SP1. Two other dry entrances were noted in the small gorge downstream of the main river sink, (SP2 and SP3). Later yet another small entrance was found between SP1 and SP2 which was then called SP1.5.
Due to the large volume of water flowing into SP1 as well as a large quantity of dumped explosives in the main entrance it was decided to start by exploring SP2 and SP3.

A VIEW OF THE RIVER LOOKING TOWARDS THE ENTRANCE

NB:- All left/right descriptions below are “true”, i.e. from the point of view of someone facing downstream.



Sima Pumacocha 1

Location:-E424208 N8630500 – local datum PSAD1956

The first pitch was descended to a ledge at about –15m but not pursued further for the reasons outlined above.

MARK ASCENDS THE FIRST PITCH OF SP1
NOTE: ROLLS OF EXPLOSIVE ON LEDGES!

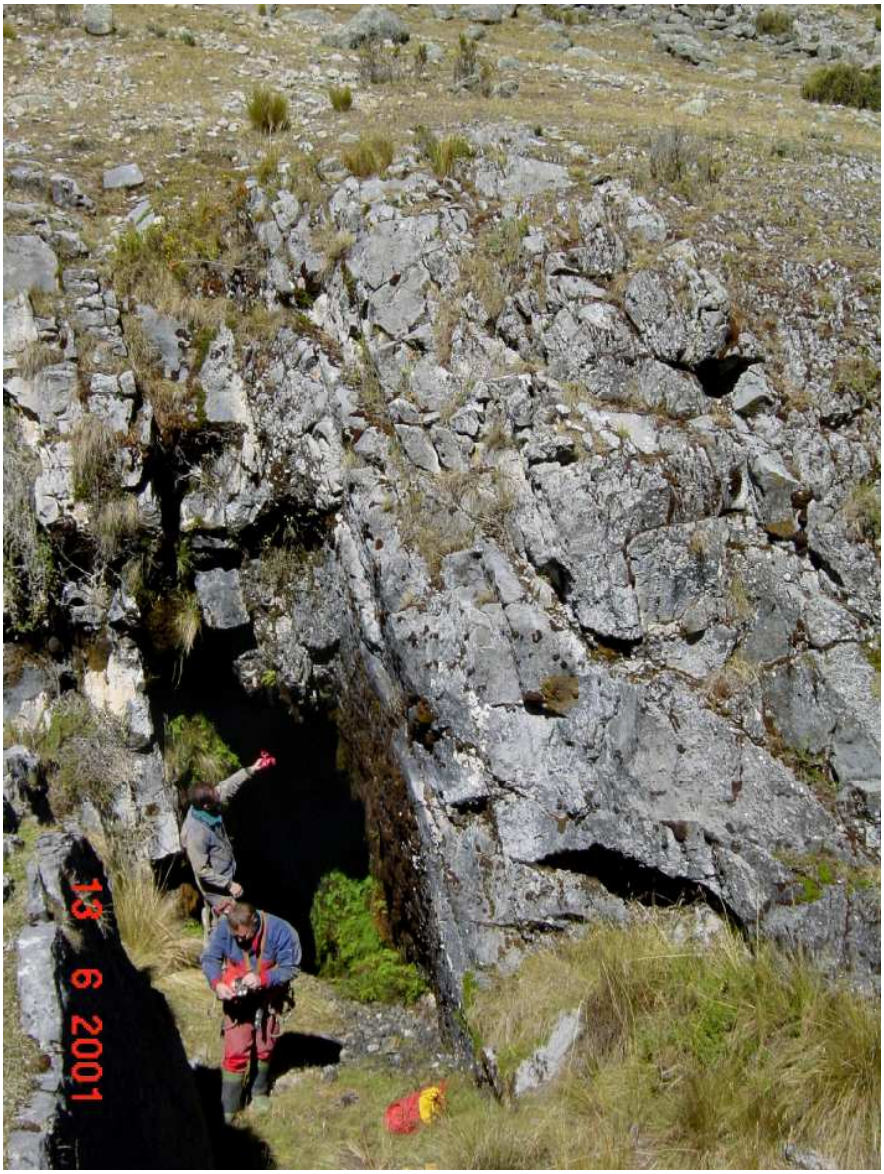
Sima Pumacocha 1.5

Two small passages leading left from the entrance chamber in SP2 were followed to a stage where a connection could be confirmed with an entrance in a small depression about four metres from the entrance of SP2.

Sima Pumacocha 2

Location:-E424208 N8630500 – local datum PSAD1956

A strongly draughting entrance about 30m down valley from SP1 in the left wall of a small gorge.



IAN ASSESSES THE DRAUGHT WHILE ROB KITS UP AT THE ENTRANCE OF SP2

First a steeply descending rift passage led after 11m to an 8m pitch, (40m rope to natural belay at entrance), to the floor of a chamber. From here two side passages on the left were pushed back to the surface at SP1.5. However the main way forward was a rift passage with two short, (c3m), freeclimbs to the head of a 31m pitch, (40m rope, natural belay to boulder, deviation, 2 spits, 1 deflection and 1 natural thread belay). This pitch ended at a large ledge/small chamber where a large aven could be seen entering on the far side at about five metres height that was not investigated.
From the floor of the ledge/chamber the next pitch, ("Ammonite Shaft" - 113m, 1 natural belay, 1 natural rebelay, 6 spits, 2 deviations), dropped down a large, (c 20m x8m), rift to land on another ledge, "Blitzkrieg Bridge", so called because of the periodic rain of small stones from above.
To the left at the base of "Ammonite Shaft" a short horizontal rift passage at "Blitzkrieg Bridge" was followed for c 50-60m to an, as yet, undescended pot which will probably just come into the roof of "Huanca Gorge" - see below.
The next pitch, ("Cages on Highway Nine"), was a free hanging 20m, (2 spits), pitch immediately to the right of the landing point at the bottom of "Ammonite Shaft". This pitch ended at the head of a very large, (c 10 x 15m), passage, ("The Huanca Gorge"), which descended steeply via a series of ramps and short drops passing an intriguing cruciform calcite decoration en route to a boulder blockage after c75m. A short section of crawling and a two metre handline pitch was followed to regain the main passage now smaller in dimension, (c 3x3m), still sloping at the same average angle which steepened to become a broken 40m pitch to a very high narrow, (c 1m), vertical rift with a small inlet stream. Downstream was blocked by a boulder fall after a few metres but a 2m climb gained a more spacious higher level. Then a short steeply descending passage, (handline), led to a ledge about six to seven metres above a large active streamway, ("The Shining Path" – c 4m x 15m), which is almost certainly the water sinking at SP1.
On the left hand side immediately below the boulder ruckle was a window into a parallel stream passage sloping down to the head of a pitch. This was not descended but from the noise almost certainly links back above the Shining path streamway.
From the ledge above the streamway a short abseil, (3m from natural belay), allowed access to a sloping ledge on the left of the passage about 3m above the river. Upstream the water came down a pitch of unknown height and flowed off down a series of steep cascades. The ledge was traversed to gain a short high-level oxbow on the left. Approximately ten metres of passage with two short, (c2m), free-climbable drops led to a small resurgence and pool followed immediately by a 25m wet pitch, (2spits, 2 rebelays), where several small streams entered and at the foot of the pitch the main streamway was regained at a large pool.
At the far side of the pool a steep and powerful cascade of about eight metres ended at a large pitch of unknown depth. This cascade was avoided by a sloping abseil on the left side to a large ledge, ("The X-files Ledge"), but the force of water precluded further progress at this level without a significant amount of upward artificial climbing. However it was found to be possible to cross the cascade at the lip of the pitch and from this point a three to four metre free-climb of the right wall gained good natural belays. Abseiling from these belays to further natural belays it was found to be possible to descend the pitch avoiding the water. A spit was placed, the pitch was descended for 30-40m to the end of the rope.

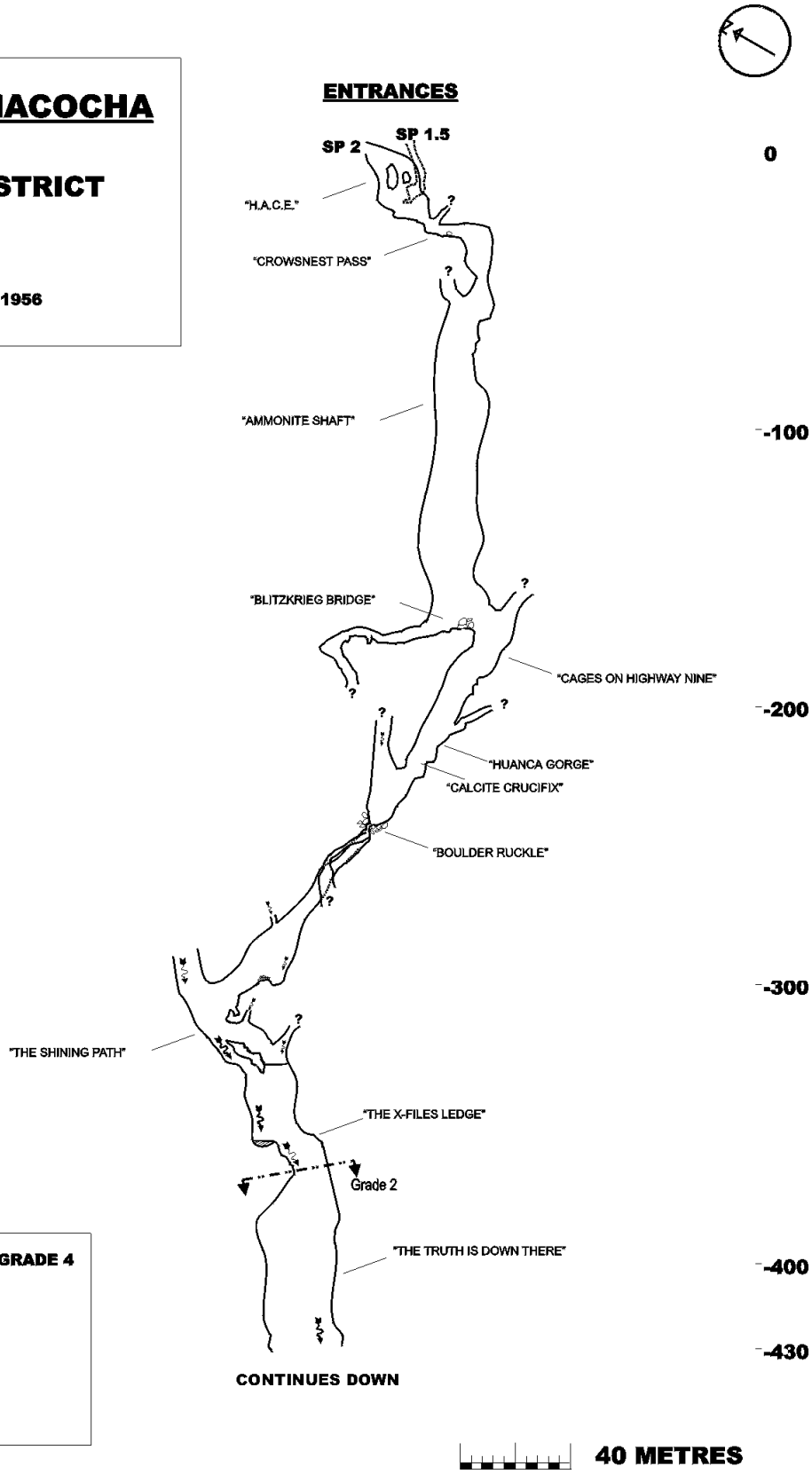
ROB SURVEYING WITH MATT JUST ABOVE THE “X-FILES” LEDGE

At this point the caver was once again coming under the main water flow. This and the fact that there was no floor in sight for at least another 15-20m prompted the decision to return rather than tie on the separate short length of rope in the tackle sac.

SIMA PUMACOCHA

LARAOS
YAUYOS DISTRICT
PERU

E424208
N8630500
Local datum - PSAD 1956
Altitude = 4400m



SURVEYED TO BCRA GRADE 4
JUNE 2001
by
Rob Harper (BEC)
Mark Hassell
Nick Hawkes (BEC)
Ian McKenzie (ASS)
MattTuck (BEC)

Sima Pumacocha 3

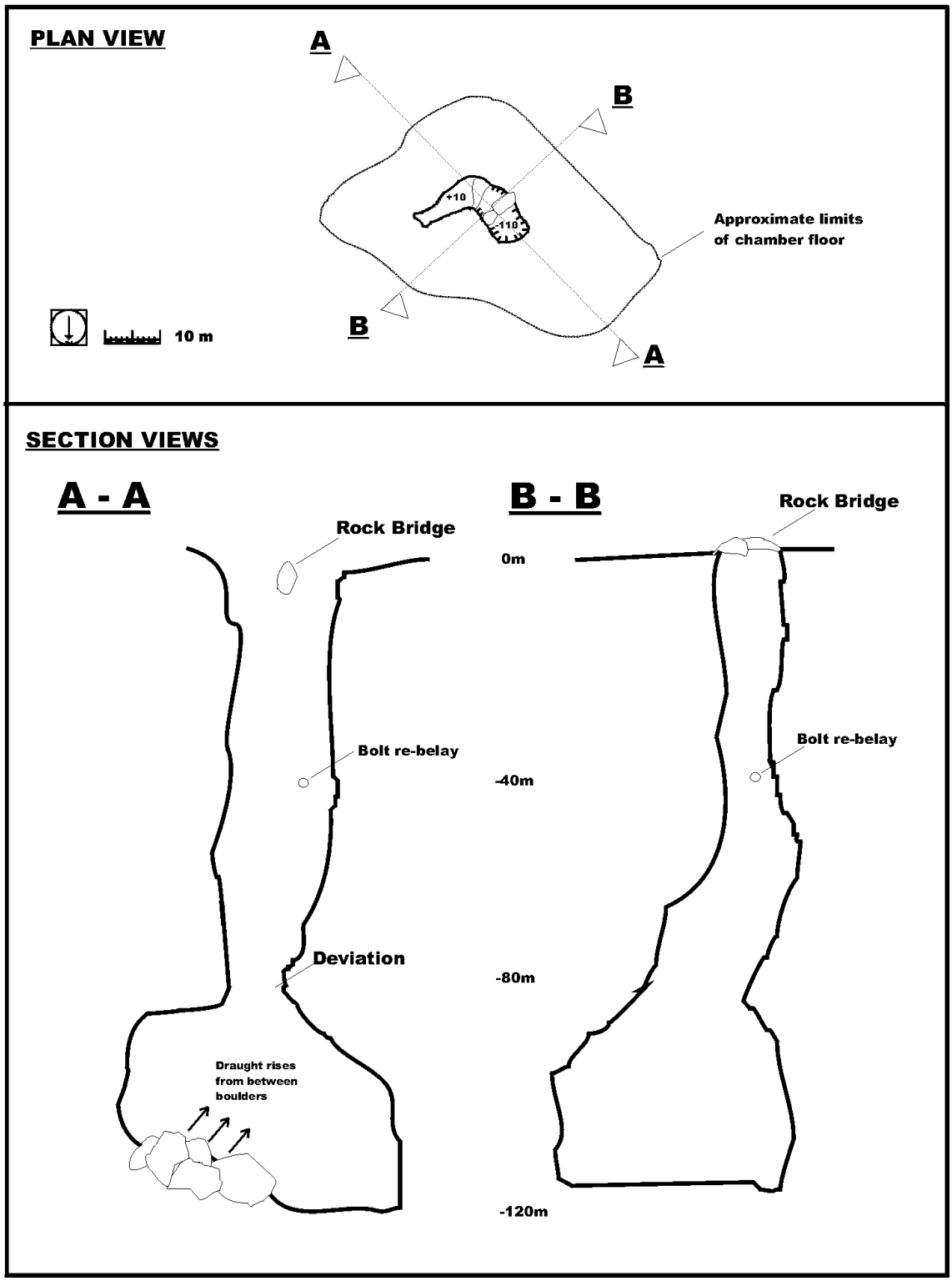
Location:-E424107 N8630438 – local datum PSAD1956

Following the gorge downstream from SP2 across a large depression allows access to a small vadose trench ending in a large, (c 20x5m), open rift aligned in a North/South direction with a noticeable outward draught. From the lip of this rift a daylight pitch, (c 120m), ends in a large, (c 20 x 50m), chamber floored with boulders through which the draught rises.

MATT
ATTEMPTS TO PLUMB
THE DEPTH OF SP3

MARK
NEARING
THE TOP OF SP3

SIMA PUMACOCHA 3 (Grade 1 survey)



===//===

SURVEY NOTES

1. For the Grade 4 sections of the survey all measurements were taken using either a 30 or 25m fibron tape read to the nearest centimetre, a Suunto Compass and a Suunto clinometer, both read to approximately half a degree. The resulting data was recorded immediately.
2. For the Grade 2 sections of the survey distances were estimated from rope lengths and angles assumed because of the vertical nature of the passage. This data was recorded immediately after exiting the cave.
3. The raw data was processed on a laptop computer within 24 hours using "COMPASS" software to produce a centre-line and a computer generated passage outline. This was then imported into CorelDraw and the final survey drawn.
4. GPS readings were taken with a handheld Garmin 12 GPS receiver using local datum PSAD1956.

===//===

EQUIPMENT

The vertical and steep sections of the cave were traversed using SRT, (Single Rope Techniques), and "Alpine Style" rigging, (rebelays as needed to avoid rope/rock contact), was used as far as possible. The principal rope used was a 9mm static rope from Sterling Ropes. Initially this was a comfortable rope to use for both abseil and ascent. However despite careful rigging the abrasion resistance of this rope was not good. There were problems with slipping of the sheath over the core that might have been avoided by washing the rope before use. Also after only a short period of use flattened sections of rope were discovered. Although these sections were probably as strong as the more conventional rounded rope they caused a marked change in the friction characteristics for descenders, (both racks and Petzl Stops), and gave rise to some worrying moments.
Wherever possible natural features or rockclimbing protection devices - such as nuts and "friends" - were used as belays. When this was not possible either pitons or self-drilling 13mm rock anchors, (Petzl), were inserted using a hand held driver.
The members of the team provided their own personal equipment for rope work. Everyone used a "Frog" system.

===//==

TRAVEL & ACCOMODATION

All team members assembled in Lima and then traveled to the area of the cave by road.

Accommodation was generously provided free of charge by Don Jesus Arias at his Llapay hydroelectric station located approximately 15km down valley from the cave. This was at an altitude of only 3000m as opposed to the 4375m at the cave entrance which greatly facilitated altitude acclimatization. The excellent free food, clean beds,

warm showers, daily room cleaning and access to electrical power were also much appreciated. By common consensus, this was the most comfortable expedition in which any of the team members had participated.

===//==

MEDICAL REPORT

All members of the expedition suffered to a greater or lesser extent from mild Acute Mountain Sickness caused by low oxygen levels due to the high altitude of the cave entrance. Fortunately the clinical signs were restricted to breathlessness and feelings of faintness on exertion, nausea and headaches. Those suffering from headaches were easily able to control them with simple non-steroidal anti-inflammatory drugs, (aspirin and ibuprofen), and within four to five days everyone had acclimatized well. This was helped greatly by being able to sleep at a much lower altitude. Oxygen and appropriate medications for treating the more serious forms of AMS, (pulmonary and cerebral oedema), were included in the medical kit but were not required.

Because of the increased water loss through panting particular care was taken to avoid dehydration including the establishment of depots of water and electrolyte solutions within the cave.

Apart from the above and a slightly infected small wound on a digit, which responded rapidly to topical medication, there were no medical problems

===//===

REFERENCES

(a) Geological references

Megard, F., Caldas, J., Paredes, J.& De La Cruz, N., 1996, Geologia de Los Cuadrangulos de Tarma, La Oroya y Yauyos. INGEMMET, Boletin 69, Lima, Peru.

(b) Speleological references

No direct references to cave exploration at or near Pumacocha could be found. Below is a list of general caving references relating to Peru.

Bowser, R.J. et al., 1973, *"Imperial College Expedition to the Karst of Peru."*
Cave Science: Journal of British Speleological Association. No.52.

Di Mauricio, T., 1979, *"Pedizione Peleo-Alpinistica in Peru"*
Speleologia 2, 28-29

Gilbert, A., 1989, *Le Karst de Cochapata irma Grande.* Spelunca 36 p11-17.

Hartmann, H. *"Eine Hohle in der Kultstatte Kenko bei Cuzco (Peru)"*

Imperial College, 1984. *"Imperial College Expedition report"*

Maire, R., 1986 *Une classique de la cordillere des Andes: La Sima de Milpo (-402m), Perou*
Spelunca 5 (23) 28-31

Martinez, A. Romero, D., Romero, M., et C.Ribera, 1983, *"El carst del nord del peru expedicions HIRCA-76 I MILLPU-77"* Speleon, 26-27, p147-180.

Martinez, D., 1977, *"Expedition Speleologique "cordillera Peruvienne" Rapport de expedicion"*
Bibliotheque de la F.F.S.14p.

Masriera, A., 1973, *"Nota sobre la Expedicion Espeleologica esanola a las regiones karsticas del Peru"*
Espeleole.G 18 979-981.

Morales Arnao (Cesar), 1970, *"Primera expedicion cientifica de espeleologia. Caverna de Huagapo(Tarma)"* Revista Peruana Andina Glaciologia, Lima V.8 p173.

Orville, M. 1977, *"Recherches Speleologiques au Perou"*
Spelunca 3, p98-102.

Ribera,C. & Belles X., *"Perou"* Dept Biologia Animal, Universitat de Barcelona.

Romero, D., 1979, *"MILLPU"*. Espeleoleg, 28, 539-541.

Rossell, G., 1965, *"Cavernas, Grutas y cuevas del Peru"* Lima, 54pp.

Sammartino, Y., 1982, *"Perou 82 - Expedition en Foret Amazonienne D 'Altitude"*
Club Bagnolais d'investigations souterraines.

Sammartino, Y., 1984 *"Perou 82"* Spelunca 14.

Sammartino, Y., 1987, *"Expeditions au Perou 1802-1986"* Fed Fr Speleol.

Sammartino, Y., Staccioli, G., & Klien, J.D., 1981, *"Perou 79, expedition du groupe Speleo Bagnols Marcoule."* Bagnols/Ceze -Rapport d'expedition,183p.

Ullastre martorell, J., 1973, *"Aportacion al conocimiento geoespeleologico de algunas regiones karsticas del peru."* Peleon, 20, p167-224.

Wilson, J.M. et al., 1982, *"Peru 82, Southampton University Exploration Society Peru Expedition"*
Southampton University.

1987, "Perou". Spelunca 28, 10-11.

Unknown
1977, "Espeleologia a HIRCA -76"
Muntanya 86, (690) p339-347.

===//===

ACKNOWLEDGEMENTS

The team would like to express their thanks to the hospitality shown towards them by the people of Laraos, the workers and management of the San Valentin Mine and above all the extreme generosity of the mine and hydro-electric station owner, Don Jesus Arias, who most generously provided both food and secure lodging for us during our stay. In addition we wish to thank Jeny the cook and the all the security personnel at the hydro-electric station for making our stay so enjoyable.

Our thanks must also go to Sterling ropes for providing a generous discount on five hundred metres of rope.

===//===

CONCLUSION

The speleological potential of this area is immense - as shown by the results of just one small reconnaissance expedition. At –430m Sima Pumacocha is the deepest limestone cave and the second deepest natural underground cavity yet explored in South America and, so far, has shown no sign of ending. The presumed resurgence is approximately 16km distant from the entrance and almost 1000m lower in altitude thus there is great potential for a very extensive cave system. There is also the exciting possibility that some of the shafts noted by expedition members near the Yauricocha mine may be higher entrances to Sima Pumacocha. If a connection exists then Sima Pumacocha could be one of the deepest known caves in the world.

===//===

ADDENDUM FOR 2002

CONTENTS

INTRODUCTION

In September of 2002 the original team members and some additional cavers returned to Sima Pumacocha to continue exploration from the end point reached in 2001 and to check for the possibility of other cave systems in the area. For a part of the expedition the team was supplemented by Peruvian cavers from the CEESPE who did not participate in the underground work to any significant extent but did do some very valuable reconnaissance work.

PERSONNEL

NAME	NATIONALITY	DOMICILE	CLUB
James Alvardo	Peruvian	Peru	C.E.E.S.P.E.
Carlos Bermudez	Peruvian	Peru	C.E.E.S.P.E.
Dany Bradshaw	British	UK	B.E.C
Bob Cork	British	UK	B.E.C
Rob Harper	British	UK	B.E.C.
Mark Hassell	Australian	Canada	A.S.S.
Nick Hawkes	British	Peru	B.E.C.
Tony Jarratt	British	UK	B.E.C
Peter MacNab	British	UK	B.E.C
Ian McKenzie	Canadian	Canada	A.S.S.
Samuel Mansiel	Peruvian	Peru	C.E.E.S.P.E.
Rolando Miranda	Peruvian	Peru	C.E.E.S.P.E.
Matt Tuck	British/Canadian	Canada	B.E.C.
Juan Castro	Peruvian	Peru	None
(Les Oldham	British	Peru	None)

NOTE 1……..B.E.C. = Bristol Exploration Club
A.S.S. = Alberta Speleological Society
C.E.E.S.P.E. = Centro de Exploraciones Subterraneas del Peru

NOTE 2……..Due to personal circumstances Les was unable to take a part in the active exploration of the cave.

CAVE EXPLORATION & CAVE DESCRIPTION

Sima Pumacocha 2

Location:- as above

The cave was partially re-bolted and rigged to the previous limit over two trips. From the limit of 2001 a series of re-belays, (spits), along the right wall allowed a dry hang to a window into a parallel shaft at approximately –20m. A short 3 to 4m traverse, (spits), across a narrow ledge and around the head of another shaft led to a vertical dry slightly muddy rift, (c 3x 10m), which was descended to regain the stream after a descent of approximately 75m, thus avoiding the wet pitch, ("Cascadas de Don Jesus"). As the direct landing point was wet a traverse line was rigged along the right hand wall to gain a gravelly beach where the water sank.

"X-Files"

From here a steeply sloping rift passage approximately 6 x?20m, ("The Horizontal Bit"), floored with massive boulders could be followed for about 60m where a small inlet stream entered on the left.

Nick in "The Horizontal Bit"

Beyond this the passage divided around a boulder the smaller passage to the right could be followed for several metres to the head of another pitch in a passage approximately 6-8m wide and an unknown height. To the left a 3m drop over a boulder, (handline), allowed access to a mud floored small chamber/ledge. From this ledge the pitch, ("Pozo Jeny") was a 15m descent into a pool, ("Lago Yelina"). A traverse around this pool led to a 50m pitch, ("Rolling Thunder"), so called because of the noise emanating from below. At the foot of this the source of the sound was found to be the waters of the main stream, ("Viagra Falls"), re-entering the system from high in the roof. Another short, 15m, pitch was descended to the head of another drop, ("Pozo Britney Shakira"), which was again about 15m via a ledge and traverse to where the passage divided. To the right the stream entered a short passage and disappeared into the floor only to reappear at the foot of the first drop in the left hand passage. To the left a series of four short drops and some traversing in a 3-4m wide passage led to a deep pool at a short narrower section. After traversing across this pool the passage widened again to 3-4m and a draughting passage, ("The Road to Certain Death"), could be seen but not entered in the roof. Continuing

down the main passage led to a sump pool, ("I Juan to Go Home"), after three more short abseils.

The survey was continued to the known end of the cave.

Approaching the sump

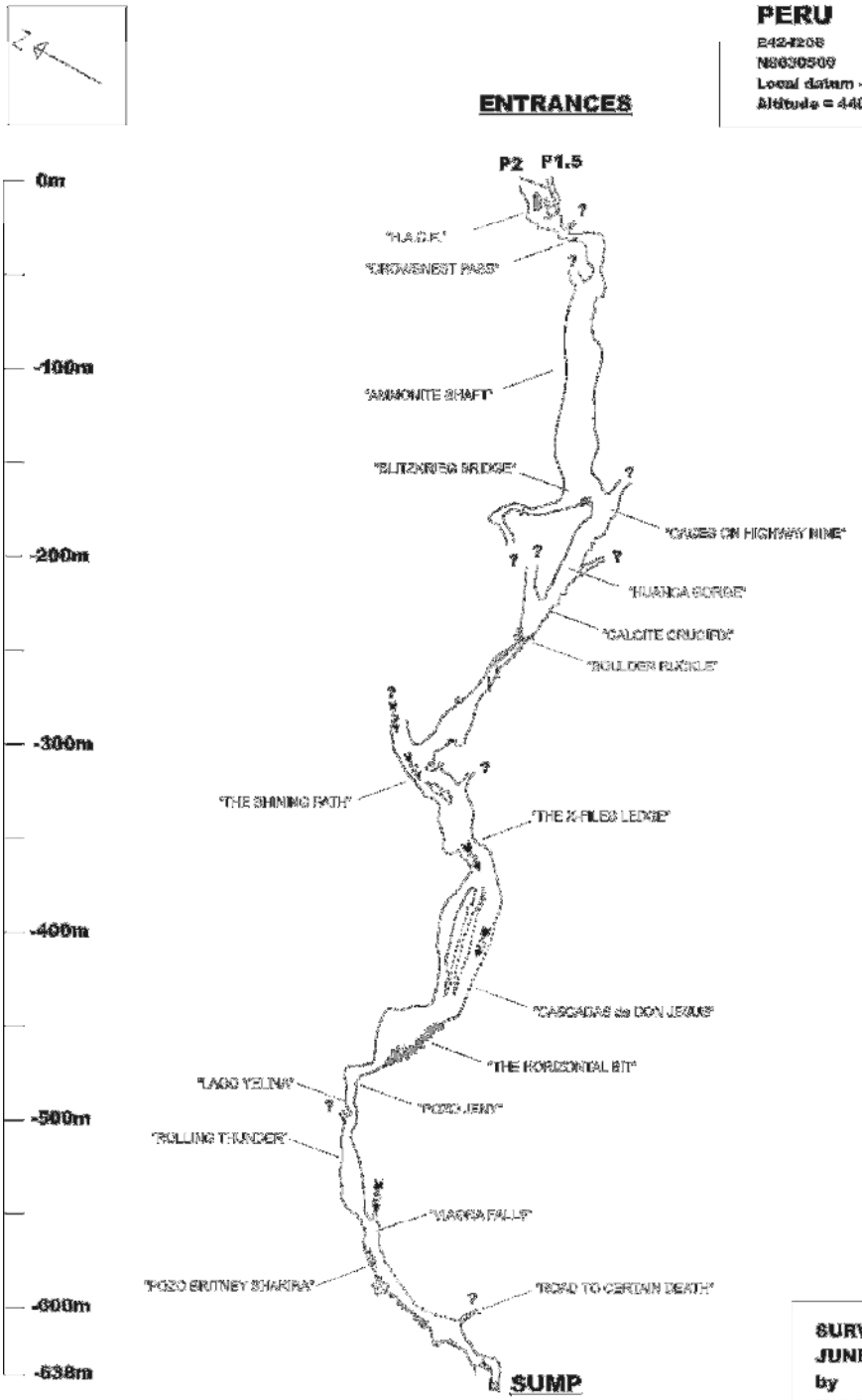
SIMA PUMACOCHA 2

LARAOS

YAUYOS DISTRICT

PERU

E42-1208
N8630509
Local datum - PSAD 1956
Altitude = 4400m



SURVEYED TO BCRA GRADE 4
JUNE 2001 & SEPTEMBER 2002
by
Rob Harper (BEC)
Mark Hassell (ASS)
Nick Hawkes (BEC)
Tony Jarratt (BEC)
Peter MacNab (BEC)
Ian McKenzie (ASS)
MattTuck (BEC)

Other sites

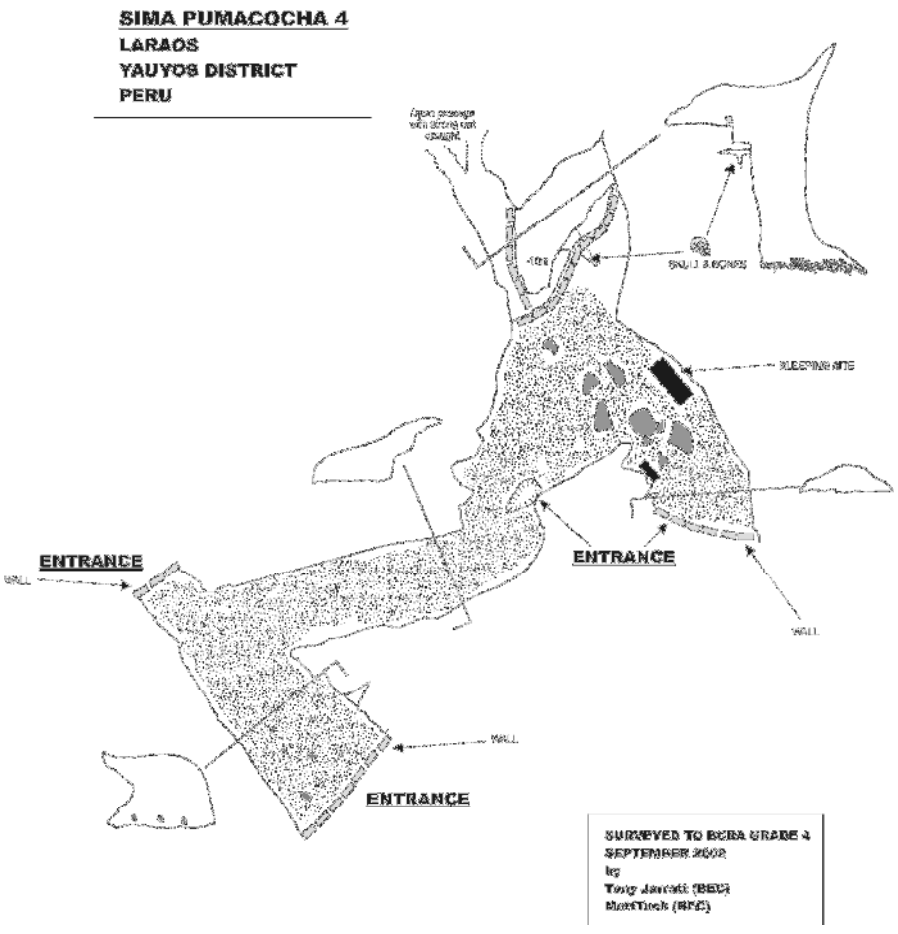
In addition to the further exploration of Sima Pumacocha the larger numbers of cavers meant that some other sites could be investigated for their speleological potential and these are detailed below.

1. Sima Pumacocha 4

Location:- Not Done

A small, (65.2m total length), but attractive system with four entrances.

This can be found by following the valley down from SP3 for approximately 200m to where a low wall and a "llamaherd" hut can be seen. The main entrance to the cave is on the right side of the valley almost directly opposite the obvious mine entrance



An upper level or roomy scalloped horizontal phreatic galleries inhabited by humming birds has a 10m walled-off pot in the floor at the bottom of which was a talus cone with many animal skulls. From here a calcite/moonmilk choke could be reached with a strong outward draught with visible open passage beyond.

Approximately two metres from the head of the pot a bedding plane passage can be followed for two metres to the top of a two metre deep choked rift which contained human remains.

2. Sima Yauricocha 1

Location:-E420246 N8637850 – local datum PSAD1956

A shaft at the side of the road to the Yauricocha mine was descended to a choked floor of debris and old power cable at a depth of 20-30m. This was dug (!!) for half-a-day by several expedition members with no significant advance.

Not surveyed

3. Sima Yauricocha 2

Location:-E421511 N8638056 – local datum PSAD1956

Large open rift easily visible from the road down to the Yauricocha mine from the col. A seven metre climb enters a 10m diameter mud-floored chamber. The only passage leading off chokes after a few metres. This cave has almost certainly been mined at some stage.

Not surveyed

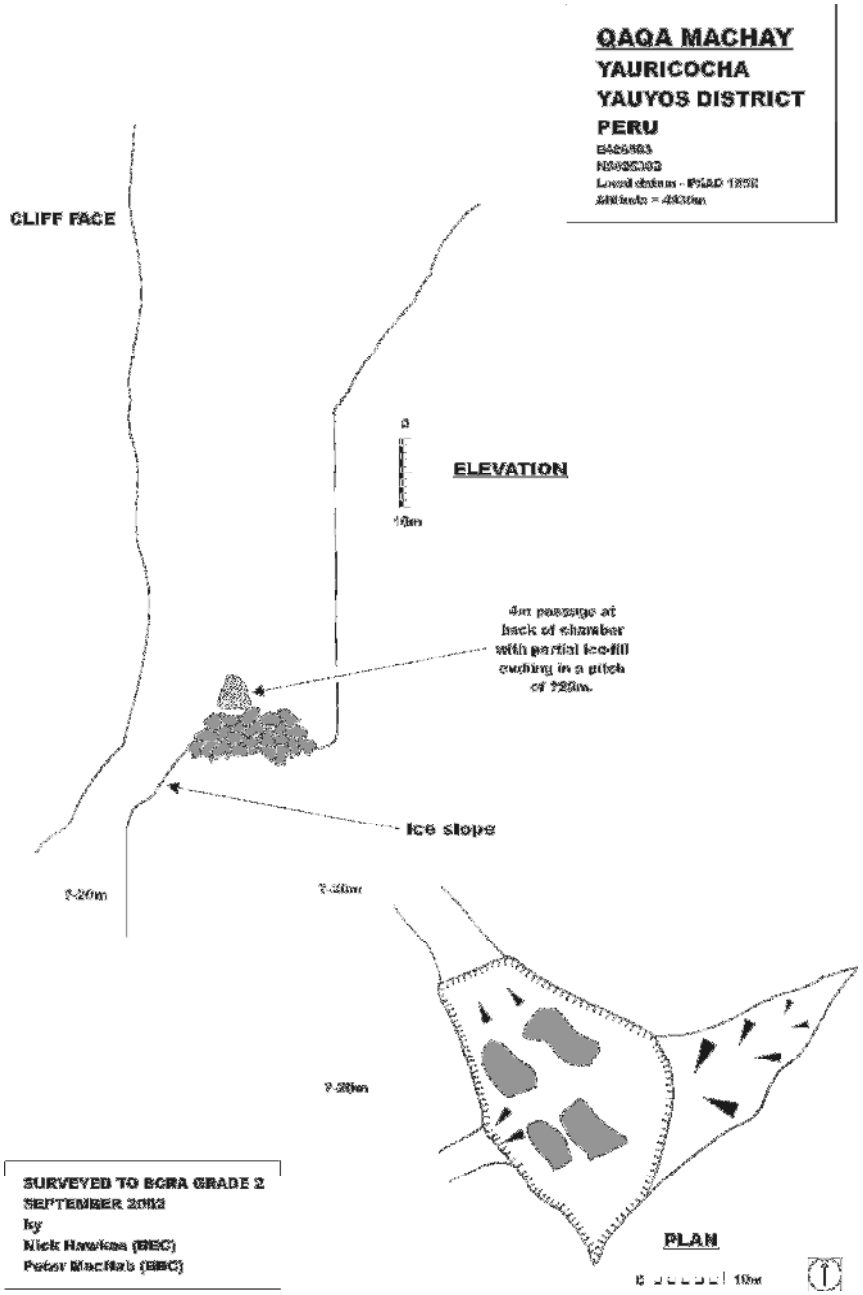
4. Qaqa Mach'ay

Location:-E426903 N8625382 – local datum PSAD1956

Nick descends the entrance of Qaqa Mach'ay

Huge open entrance, 20m x 20m, which is easily visible from the track can be reached by a lung bursting ascent over scree.
From the lip of the entrance a sloping rift can be descended for approximately 50m to a snow slope. Two passages lead off down steeply sloping ice and boulder covered slopes to further drops estimated at 20m which were not descended.

This cave may have been formed as a glacial meltwater cave since it occurs on the side of a valley where glaciers that were noted on the topographic surveys of the 1970's have since retreated.



5. Caves below Cerro Huampuna

Location:-E427637 N8624720 – local datum PSAD1956

Several entrances that had been noted in the cliff above a small lake. The lowest of these was descended to a small chamber with a canine skeleton and no passable way on at a depth of about 20m. All others were just very short oxbow systems in the cliff face.

Not surveyed

6. El Tragadero Puyo

Location:-E434536 N8641960 – local datum PSAD1956

This had been noted as a feature from the topographical map.
After parking at Chacachancha an hour's walking up a wide valley leads to a cliff face with obvious sinks and dolines at the base most, (?all), of which appear to be choked. At the head of the valley a small lake drains into an impressive entrance, approximately 18m high and 15m wide, which is the lip of a pitch into a 20m diameter shaft estimated as being at least 20m in depth. This pitch was not descended.

Not surveyed

7. Lago Milpoca drainage

Location:- Not Done

The stream that drains from this lake goes into a small doline and sinks at the limestone-granodiorite contact and is unfortunately choked. As this is an ideal situation for cave development it might be worth spending further time exploring this area for a dry entrance.

Not surveyed

8. Exito Sink

Location:- Not Done

The large, 30x30m, doline in front of the Exito Mine entrance takes a stream but is hopelessly choked with sludge and debris either from the mine or from road construction.

Not surveyed

9. Doline above resurgence.

Location:- Not Done

The large doline which can be seen on the topographic maps situated in the top of the hills above the presumed resurgence at Alis was investigated by the cavers from the CEESPE and found to be a small shaft choked at a depth of about four metres.

Not surveyed

SURVEY NOTES

Ditto 2001

EQUIPMENT

Ditto 2001

TRAVEL & ACCOMODATION

This was primarily the same as in 2001. However the larger number of participants put greater pressure on the available space and the CEESPE members stayed in a small hotel in Llapay.

The length of time spent in the cave per trip was considerably longer in 2002 than in 2001 and it became essential to have accommodation near to the cave entrance to avoid the dangers inherent in a long drive at night over poor roads by exhausted cavers. Once again thanks to the generosity of Don Jesus Arias we were allowed to use a small shepherd's, (?llamaherd's), hut very close to the entrance to Sima Pumacocha.

MEDICAL REPORT

Ditto 2001

REFERENCES

Ditto 2001

ACKNOWLEDGEMENTS

Once again the outstanding generosity of Don Jesus Arias in providing food and accommodation plus the hospitality of the people of Laraos and Llapay as well as the staff and management of the San Valentin Mine made the remarkable success of this trip possible. In particular we must thank Jeny the cook, her assistants and the security staff at the hydro-electric station for all their help at all hours of the day and night.

CONCLUSION

This expedition like its predecessor was extremely successful.

Sima Pumacocha 2 was pushed to a sump at -638m and is now easily the deepest known cave in South America and at 4375m asl is the highest known significant cave in the world. Although this sump will hamper further easy progress it appears to be a perched sump as it is considerably higher than the presumed resurgence. A possible high-level oxbow passage, which may bypass the sump, was noted by this year's explorers and will be the objective for the 2004 expedition. As the cave has been explored the length of trips has become progressively longer so any attempts at the presumed bypass will almost certainly mean underground bivouacs with their attendant logistical challenges.

Besides the exploration of Sima Pumacocha time was spent reconnoitering the area for likely entrances both for Sima Pumacocha and other cave systems. Although the shafts at high level near the Yauricocha Mine and the dolines above the presumed drainage route of the Sima Pumacocha water to its resurgence did not yield any cave passage, two other promising entrances were noted which will also be explored in 2004.

===//===

***"Job done!"* - MARK AND SNABLET AT THE SUMP**