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THE CAVES OF GUNUNG SEWU, JAVA

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ABSTRACT

Gunung Sewu is an area of spectacular limestone cone karst in southern Java. Hundreds of cave entrances are known to exist, and many of them were explored for the first time in 1982. Eight caves have more than a kilometre of mapped passage, and sixteen reach depths of over 100 metres. Most of the cave streams drain to a single resurgence, and some of the caves provide valuable water resources.

THE GUNUNG SEWU KARST

Gunung Sewu lies adjacent to the south coast of central Java (Fig. 1). The limestone hills have an area of over 1000 km^2 and rise to altitudes of around 500 m, though most of the area is at under 300 m. The name "Gunung Sewu" translates as "Thousand Hills" and derives from the small limestone cones which dominate the landscape. Immediately to the north lies the Wonosari Plateau; the city of Yogyakarta is 30 km away and not far beyond is the active volcano of Gunung Merapi (Fig. 2).

Located just south of the equator, Gunung Sewu has a warm climate, shielded from extremes by breezes from the Indian Ocean. Average temperatures are indicated by that of the water in the caves (27°C) and there is remarkably little variation from this, day or night. Rainfall is mainly in the months of November to May, and averages around 2000 mm per year. The dry season varies from three to seven months, and may be completely dry; August 1982 had cloudless skies throughout. Though the climate may be ideal for caving, the dry season creates undue hardship for the local population.

Over a quarter of a million people live within the karst. Small villages are scattered throughout the area, and practically everyone is occupied by farming. Good volcanic clay soils in the valley floors are intensively cultivated while terracing on the thin soils of the limestone hills provides further land of poorer quality. The critical restriction on economic development is the total lack of surface water or readily available ground-water throughout the dry season, and consequently the population of Sewu are among the poorest in Java. They are however, hard-working and extremely friendly people. The whole area is easily accessible by a dense network of very rough roads almost completely devoid of traffic. A robust vehicle is essential but few places are more than a kilometre from a driveable track. Finding cave entrances is no problem, as any local person knows the way to the nearest luwang (sinkhole).

GEOLOGY

Massive reef limestones of Miocene age support the karst features which distinguish Gunung Sewu. They have a total thickness of at least 650 m, and through most of the area dip very gently towards the coast, though they are structurally more complex along their northern margin. They are underlain by various volcanics and clastics, and are only overlain by clays mainly of weathered volcanic ash origin which floor the valleys within the karst. Towards the north and northeast the reef limestones show a transition into chalky, bedded, lagoonal limestones whose largest outcrop is on the Wonosari Plateau (Fig. 2). This boundary is complex and interdigitated but is a major hydrological feature with considerable influence on the pattern of cave development within Gunung Sewu. The chalky limestones of the Wonosari Plateau are basically non-cavernous, though isolated small cave passages are known; surface streams from the Plateau sink where they meet the reef limestones.

In detail, the Gunung Sewu limestones show a considerable range of lithology. Compact, fine-grained, cream coloured calcilutites dominate, but autobreccia structures are common. Some breccias are spectacular, with crystal-lined vugs. Beds of chalky limestone occur sporadically through the main limestone, but increase in proportion towards the northern facies boundary where they are

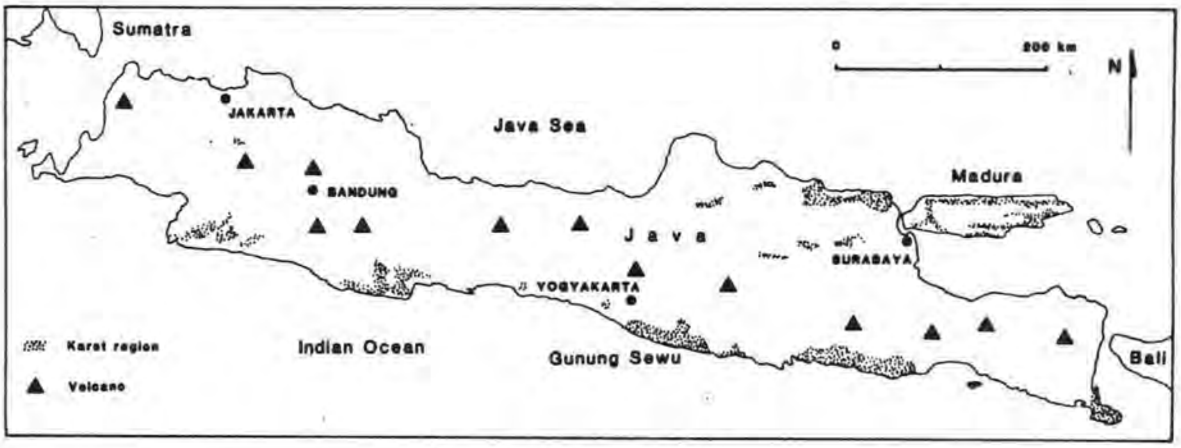


Figure 1 Karst areas of Java

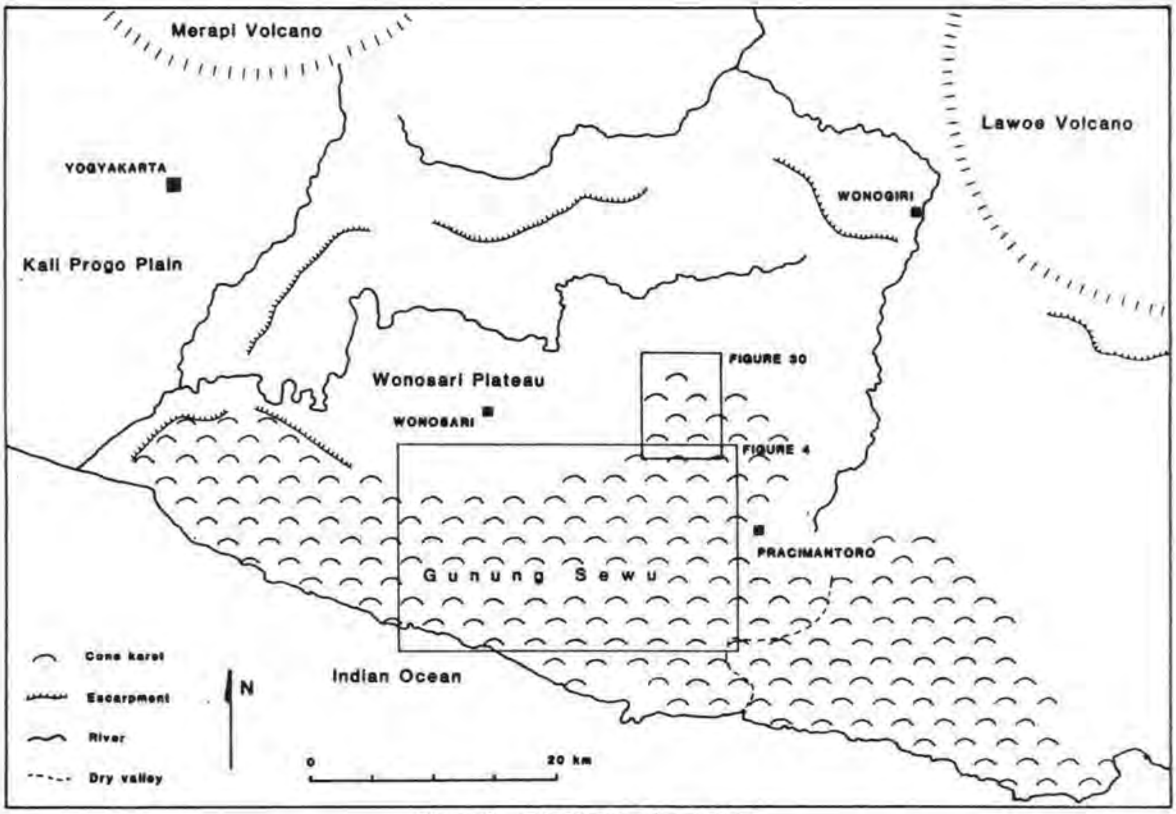


Figure 2 The Gunung Sewu area

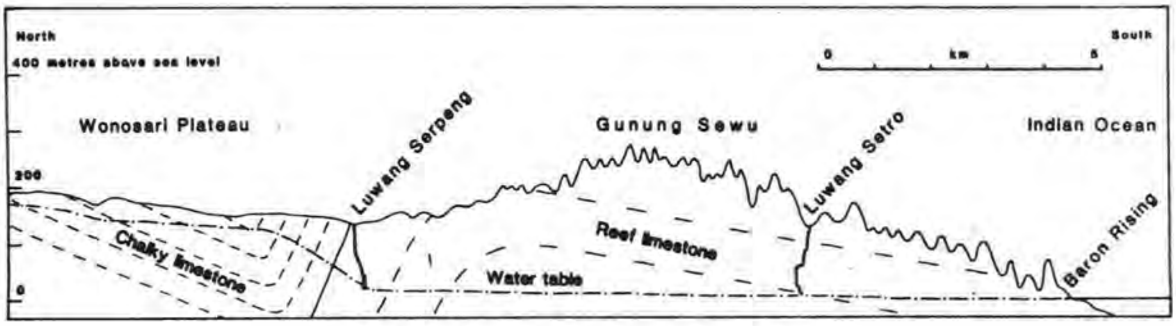


Figure 3 Cross section through Gunung Sewu

commonly very thinly bedded. Elsewhere, a crude and massive bedding may be recognisable, but many outcrops have an almost structureless appearance. Biohermal structures, with reef masses and forereef breccia slopes are identifiable in some places. A distinctive feature of the Gunung Sewu limestones is its content of isolated, lenticular or irregular, masses of volcanic ash. Individual ash pockets may be from centimetres to tens of metres across, and it would appear that they may be dense enough in some of the eastern areas to cause perching within the karst aquifer; the clay matrix of some of the limestone breccias may also contribute to this effect. In most areas, the base of the limestone is not seen and in Central Sewu it would appear to be well below sea-level.

SURFACE KARST

Gunung Sewu is an extremely well developed cone karst (Lehmann, 1936). The landscape is entirely dominated by the conical limestone hills. There are probably 10,000 of them, all of remarkably consistent size, the mean being around 200 m in diameter and 50 m high. The lack of forest cover means that the cones are clearly visible and they stretch to the horizons in almost monotonous uniformity. The dominant shape is a hemisphere, though some are more sinusoidal, others are purer cones with uniform slopes and only rounded tops, while a few are more irregular. Terraces, cliffs, overhangs and notches occur irregularly and appear to have no more than local significance. The soil cover is thin and patchy and there is negligible scree; bare rock and various karren forms constitute most of the slope surfaces. Artificial terracing is almost ubiquitous, preserving narrow soil strips between steps of bare rock or hand-built rubble walls. The cones are not simply related to geological structure and are certainly not simple, exhumed reef-knolls. The only geological influence is the development of flatter, more rounded cones in the chalkier limestones of the facies transition zone towards the Wonosari Plateau.

Between the cones, valleys are floored with clay which may be 10 m deep. In some cases there is only a low rocky col between adjacent cones, but linear, terraced, clay-floored depressions, integrated into dendritic dry valley systems, are much more common. Some of these systems feed to the coast or sinkholes along the edge of the Wonosari Plateau; others terminate in closed basins within the cone karst, and these may or may not have conspicuous open sinkholes. Artificially dammed lakes, known as telagas, are formed on the thicker clay floors. Without the ubiquitous terracing, surface run-off would cause major soil erosion in these valleys. The proportion of conical hill to valley floor does vary, though through most of Gunung Sewu the limestone hills occupy two to three times the are of the clay-floored valleys. In some of the higher central parts, the valleys are reduced to narrow winding strips between the cones, while in parts of northeast Sewu and close to the coast the cones are only isolated hills in wider alluvial tracts.

A feature of Gunung Sewu is the general concordance of cone summit altitudes, rising from each flank towards the central east-west crest line (Fig. 3). Even the finer details of this "summit surface" match closely to the geological structure, and suggest the possibility of development of the cones by dissection of an anticlinal stratimorph. The integration of the valley systems indicates the importance of early fluvial erosion, but the precise origin of the cones is open to debate, contributions to which were not among the objectives of the 1982 field work. Nevertheless, the Gunung Sewu cone karst remains a remarkably impressive product of limestone erosion.

CAVE EXPLORATION

Cave entrances abound in Gunung Sewu. Fossil caves, commonly with profuse stalagmites, open into the sides of the conical hills, but far more important are the sinkholes sited on the edges of the valley floors between the cones. From almost any point in Sewu it is possible to just walk downhill and arrive at a sinkhole within a kilometre or so. Most entrances descend steeply or vertically, and many have been modified by local people who have built stone walls, behind which floodwaters drop sediment, building up flat fields right to the lip of the entrance drop. A few entrances have been blocked, but sinkholes are still a major component of the Sewu karst.

Villagers have explored some caves in search of dry-season water supplies. Most horizontal entrance have been explored, though commonly only as far as the first water and they appear always to have stopped at deep water.

1. Cone karst with an alluviated valley floor in northern Gunung Sewu (Waltham)

2. Dam around the Puleireng sinkhole on the edge of the renovated telaga (Waltham)

3. Andy Eavis and Sudiyono rig the entrance drop of Luwang Jalak Bromo (Waltham)

Vertical drops have foiled them through lack of equipment, though they have managed some spectacular climbs and have used bamboo ladders for drops of up to about 10 metres where water was visible below. The dominance of shaft entrances has reduced the overall impact of these explorations.

Of early foreign visitors to the area, Danes was the most significant. His enthusiasm was considerable and his writings (1915) describe many of the cave entrances, but he nowhere explored far beyond daylight. Since then, Balazs (1968) and many others, including British, karst geomorphologists have visited Gunung Sewu, but they either ignored or did not notice the caves. Indonesian cavers, from the Specavina national group, together with various foreign guests have visited a handful of the Sewu caves, but have done little systematic exploration.

In summer 1982, after a brief reconnaissance in 1981, the authors of this paper explored many of the caves as part of a groundwater exploration project (see below). The project identified 250 entrances, explored 170 of them and surveyed 62 of the caves with a combined surveyed length of nearly 28 kilometres. Details of this work appear in an unpublished report (Waltham et al, 1981), copies of which are held in the BCRA and RGS libraries. Only the major caves are described in this paper, though brief notes on all known sites are in the Gunung Sewu Luwang Register as an appendix.

In 1982, a group of Belgian cavers from the Verbond van Vlaamse Speleologen en Alpinisten, led by Denis Wellens, also visited Sewu on a filming project. They made the first exploration and survey of Luwang Grubug.

THE CAVES AND CAVE HYDROLOGY

The caves of Gunung Sewu fall into a number of reasonably definable groups. One group comprises the fossil stalagmite caves within individual cone hills; these are common, but are unlikely to be of any considerable length, and due to their low water resource potential were almost totally ignored by the 1982 project.

A major group of caves lies along the northern margin of Sewu where it borders the Wonosari Plateau. Surface rivers from the Plateau sink where they meet the outcrop of the cavernous Sewu limestones, and there is also a considerable underground water input due to southward leakage from the Wonosari Plateau aquifer. The result is a suite of active river caves which in the wet season must be nearly all impassable or flooded to the roof, and in the dry season still contain some sizeable flows. Great lengths of explorable stream passages do not exist because nearly all the known caves descend rapidly to a flooded zone between 10 and 30 m above sea level. Dye tracing of the two major river sinks has proved a connection over more than 15 km, right beneath the Gunung Sewu ridge, to the Baron resurgence on the coast. It is likely that all of the caves in this group drain to Baron (Fig. 4). The flow at the Baron ranges between about 6 and 30 cumecs, and it appears to account for the drainage of a very large proportion of Gunung Sewu. The resurgence is on the beach, and behind the boulders of the entrance collapse only 100 m of river passage is explorable up to a deep sump. The curved line of the major underground link on Fig. 4 is based on the assumption that the major zone of cave conduits controls the position of a conspicuous groundwater trough recognisable on a contoured water table map. Details of this map, its compilation and its implications, are in the main report (Waltham et al, 1981) and will also appear in a future publication by the same authors.

In contrast to the large cave passages associated with the major sinks of the northern margin, the central area of Sewu is characterised by steeply descending shaft systems. They are located in the valleys and depressions between the conical hills and mostly have quite small catchment areas. In the dry season the entrances are all dry, but some do progressively pick up water at increased depths; in the wet season they are important active drains and some back up water to the surface. Most have little horizontal extent before terminating in either static pools, active sumps or clay chokes formed of the vast amounts of inwashed surface sediment. Only a few reach sub-horizontal conduits, and these rapidly sump. Only one shaft cave, Buhputih, has been dye tested, again to the Baron resurgence (Fig. 4). It is likely that most drain direct to Baron, or alternatively northwards into the marginal groundwater trough and then to Baron; those further to the southeast probably drain to other coastal springs all of which are much smaller than Baron.

The fourth, and rather less well defined, group of caves comprises a number of more generally horizontal systems in the north and east of Gunung Sewu.

There is some spacial overlap with vertical shaft systems which also occur within this area. The larger number of horizontal caves is at least partly due to the geology, in that ash beds within the limestone increase in number to the east and must reduce the vertical permeability of the aquifer. Dye tests have defined the hydrology of the area (Fig. 4). The underground Kali (River) Bribin is an anomalously large, major conduit at high level within the cone karst. It must have a large catchment, and three cave streams have been dye-traced to it (Fig. 4). Downstream it has been traced through Ngreneng, into the marginal groundwater trough and thence to Baron. The edge of the Baron catchment has been partly defined by the dye trace from the Sodong (Mudal) cave to the Pracimantoro spring on a low level plain across a facies boundary comparable to that onto the Wonosari Plateau. There is no accessible cave at Pracimantoro itself.

The following descriptions of the caves are intentionally very short. They define just the character of the caves, and the surveys provide the details. All the smaller caves are only referred to in the appendix register. Conventional notation is used on the cave surveys, except for three additional items added to evaluate the water resources which were the original purpose of the surveys. These are:

1) Figures beside water-flow arrows refer to dry season flows in litres/second
2) Figures in square boxes refer to the depth in metres below the entrance
3) Figures in rounded boxes refer to pool capacities in cubic metres.

STREAM CAVES OF THE NORTHERN MARGIN

GUA SEMULUH

Length 1250 m Depth 52 m Grade 5 survey (Fig. 5).

A large, seasonally dry, level passage extends from the northern entrances to the main entrance just at the start of a canal which is heavily used for water supply. Beyond the canal, the large passage continues with gours and stalagmites and then continues unsurveyed to a partial mud blockage. An entrance in the next depression to the south drops into a large unexplored passage which may be the continuation and may connect with the upstream inlet in Gua Bribin. From the gour passage, the Semuluh water drains down a smaller, younger canyon to a terminal sump.

LUWANG CEBLOK

Length 600 m Depth 92 m Grade 5 survey (Fig. 6).

Two 25 m entrance pitches drops into a roomy passage leading to a third pitch. This gives access to two large sloping boulder chambers separated by a spectacularly low duck. The lower chamber ends in a wide and deep terminal lake which has a waterfall dropping straight into it from an inaccessible roof passage. The cave is quite short, but very varied and extremely pleasant; it may in the future be used for water abstraction from either the entrance or terminal pool.

GUA SUCI

Length 260 m Outline survey (Fig. 7).

The Kali Suci river sink is one of the most impressive in Sewu, but it does not live up to its promise. A powerful stream flows in a passage 5 to 10 m high and wide, which connects through to two large collapse windows, but not 100 m from daylight the third segment of cave ends in a deep sump pool overlooked by massive stalagmite.

The sump is however very short, and connects to the half kilometre long Gua Buri Omah. This cave has a short tributary canyon draining into about 400 m of large gently graded river passage which sumps at both ends. Downstream it drains to Luwang Grubug, at almost the same level.

LUWANG GRUBUG

Length 2290 m Depth 161 m Outline survey (Fig. 7).

Grubug is the finest cave yet found in Sewu. It was originally explored, in 1982, by Denis Wellens and his Belgian colleagues, who are publishing their own description and survey. The outline survey in Fig. 7 is a compilation of the writers' own low grade surveys with the downstream passage simplified from the Belgians' survey.

The Grubug entrance is a dramatic 64 m free hanging pitch into the centre of a chamber crossed by the underground Suci river. The narrow surface opening creates magnificent visual effects when sunbeams, filtered through overhanging trees, and picked out by a thin mist, strike the floor of the chamber and slowly

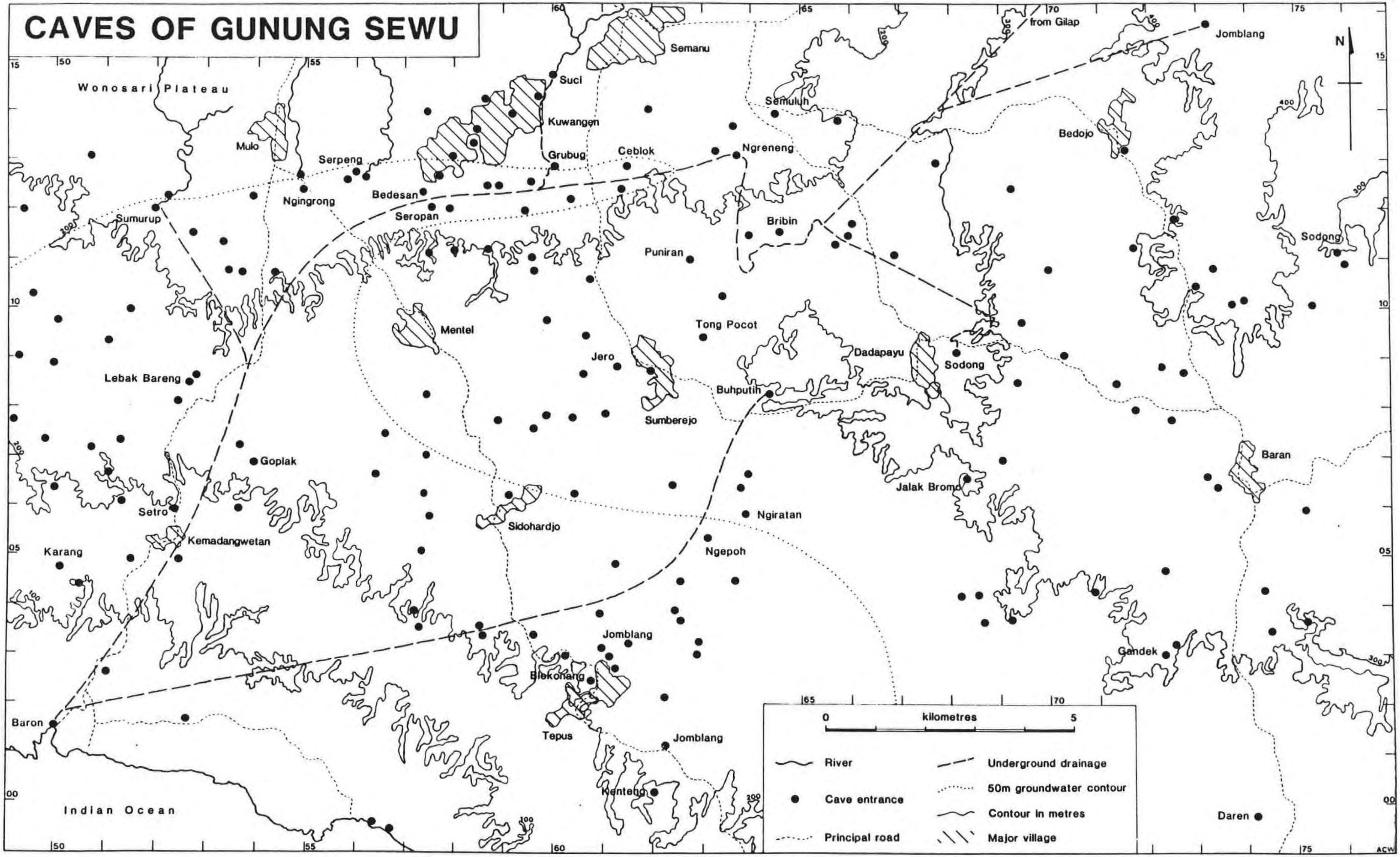
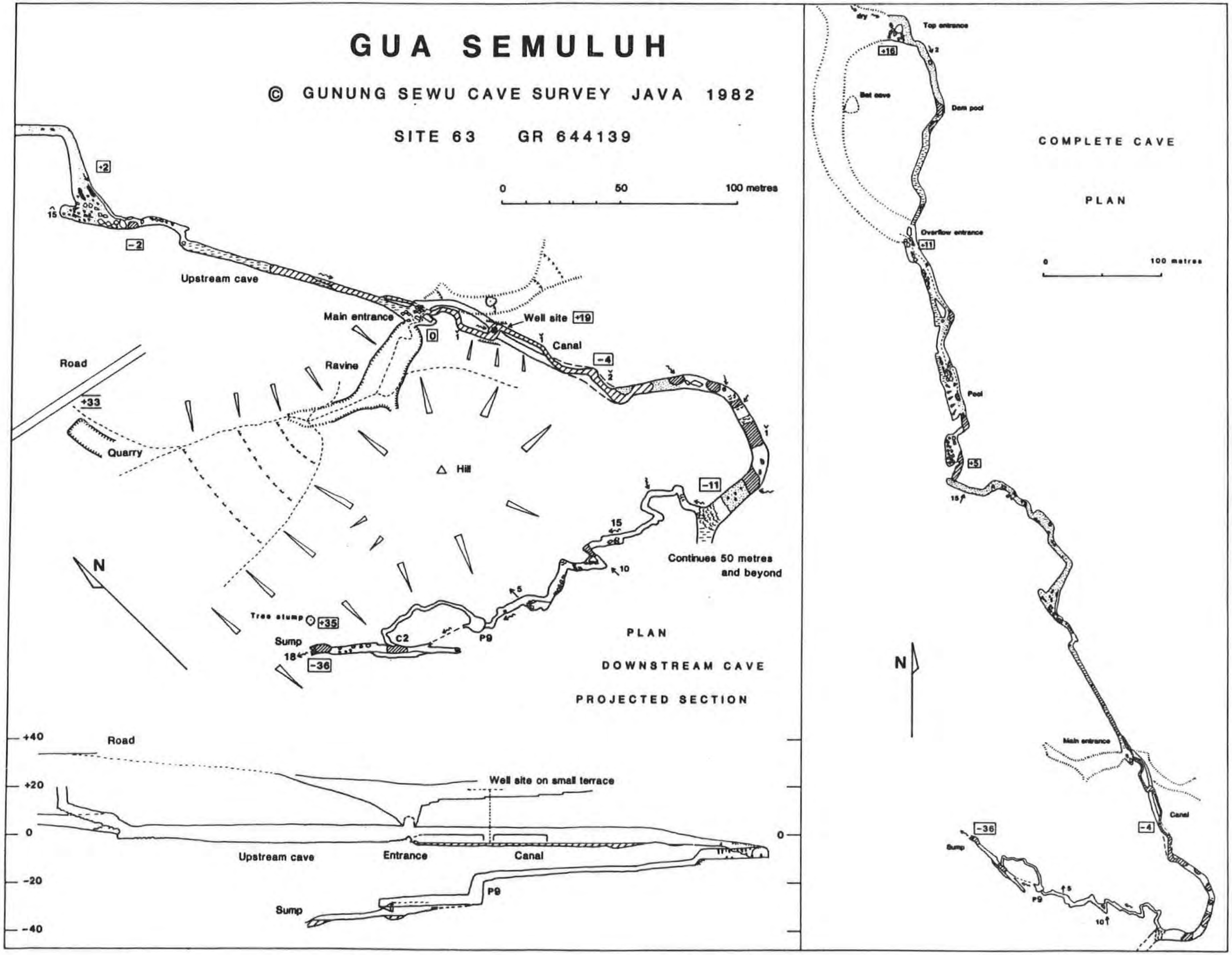

CAVES OF GUNUNG SEWU
Wonosari Plateau
Mulo
Serpeng
Nglngrong
Sumurup
Bedesan
Seropan
Suci
Kuwangen
Grubug
Semanu
Ceblok
Ngreneng
Semuluh
Bribin
Puniran
Bedojo
Jomblang
from Gilap
Sodong
Mentel
Tong Pocot
Jero
Dadapayu
Sodong
Buhputih
Sumberejo
Lebak Bareng
Goplak
Setro
Kemadangwetan
Karang
Sidohardjo
Ngiratan
Ngepoh
Jalak Bromo
Baran
Jomblang
Blekonang
Tepus
Jomblang
Kenteng
Gandek
Baron
Indian Ocean
Daren
N
kilometres
0
5
River
Cave entrance
Principal road
Underground drainage
50m groundwater contour
Contour in metres
Major village
ACW

Figure 4


GUA SEMULUH
© GUNUNG SEWU CAVE SURVEY JAVA 1982
SITE 63 GR 644139
0
50
100 metres
+2
-2
15
Upstream cave
Main entrance
0
Well site
+19
Canal
-4
Road
Ravine
+33
Quarry
Hill
-11
15
10
5
Continues 50 metres and beyond
N
Tree stump
+35
Sump
18
-36
C2
P9
PLAN
DOWNSTREAM CAVE
PROJECTED SECTION
+40
+20
0
-20
-40
Road
Well site on small terrace
Upstream cave
Entrance
Canal
P9
Sump
dry
Top entrance
+16
2
Bat cave
Dam pool
COMPLETE CAVE
PLAN
Overflow entrance
+11
0
100 metres
Pool
+5
15
N
Main entrance
Canal
-4
-36
Sump
P9
5
10
Figure 5

move across it during the day. Three passages radiate from the chamber. A wide, dry, high level tunnel leads to the large Jomblang entrance, the easiest way in with a broken 40 m pitch. Upstream to the north is over half a kilometre of wading or swimming in a wide passage. The downstream canyon has over half a cubic metre per second of white water in an extremely sporting passage. Cascades, rapids, pools and waterfalls alternate as far as a terminal sump, from where the water has been dye-tested to the Baron resurgence.

LUWANG SEROPAN
Length 650 m Depth 65 m Grade 5 survey (Fig. 8).
A broken entrance shaft and a short canyon passage lead directly to a length of river passage. This is mostly 8 m wide and almost level, characterised by deep pools and low ducks as far as sumps both up and downstram. The source of the water is unknown, and downstream it flows into the Bedesan cave.

LUWANG BEDESAN
Length 1025 m Depth 104 m Grade 5 survey (Fig. 10).
A narrow, meandering canyon passage descends a series of pitches and climbs, to junction with a large stream passage. Upstream this is wide and almost level to a sump at about the same level as the continuation in the Seropan cave. Downstream there is a magnificent flight of large gours and cascades as far as a deep, depressing and very muddy terminal sump pool, before which there are several tributary passages. The terraced gour pools make this cave one of the more spectacular and exciting yet found in the Sewu area.

LUWANG SERPENG 2
Length 220 m Depth 96 m Grade 5 survey (Fig. 12).
Serpeng 2 has the smallest entrance of a trio of holes near the Serpeng village. A 47 m shaft drops into a large dry passage which is unexplored upslope. Downstream a series of small climbs and pitches lead down a large canyon to the edge of a large and impressive terminal lake which is a potential target for a future abstraction borehole. A short distance east of the entrance lies the enormous crater-like Serpeng 1 pothole with a sloping, crumbling 60 m pitch to a short passage and sump. Adjacent to this, a deep blind valley ends at the massive entrance of Gua Serpeng which sumps hardly out of daylight.

GUA MULO AND GUA NGINGRONG
Lengths 170 and 380 m Depth 74 m Grade 5 survey (Fig. 9).
The Mulo caves are in two parts. Valleys from the north end at Gua Mulo which has a low, wide, level passage through to an exit into a large blind depression, partly ringed by rocky cliffs, indicative of some collapse in its origin. Another valley system enters it from the south, and in its east wall is the tall arch entrance to Gua Ngingrong. The large and impressive passage leads to a series of pitches each into a deep pool, and then into a large chaotic chamber and a terminal sump complex - a spectacular piece of cave but again one which does not live up to the scale of its entrance.

GUA SUMURUP
Length 1435 m Depth 58 m Grade 5 survey (Fig. 11).
With its entrance in the dry gorge just beyond the sumped river sink of the Kali Tegoan, Gua Sumurup surprisingly and unfortunately does not lead back into the underground river. Its impressive entrance passage leads to a 24 m pitch into a deep lake, beyond which lies a spacious chamber. But the further passages are just roomy level tunnels with abundant mud from their annual complete flooding, and they all end in murky sumps. The main river sink has been dye-tested to the Baron resurgence.

POTHOLES OF THE CENTRAL AREA

LUWANG BLEKONANG
Depth 134 m Grade 5 survey (Fig. 15).
A succession of dry shafts provide a steep descent in an ever diminishing passage to a depth of 134 m. Beyond that point a narrow rift continues.

LUWANG BUHPUTIH
Length 850 m Depth 200 m Grade 5 survey (Fig. 14).
A series of climbs, rope pitches and rifts drops into a large dry canyon which continues to the head of a pitch. From that point the cave spirals down

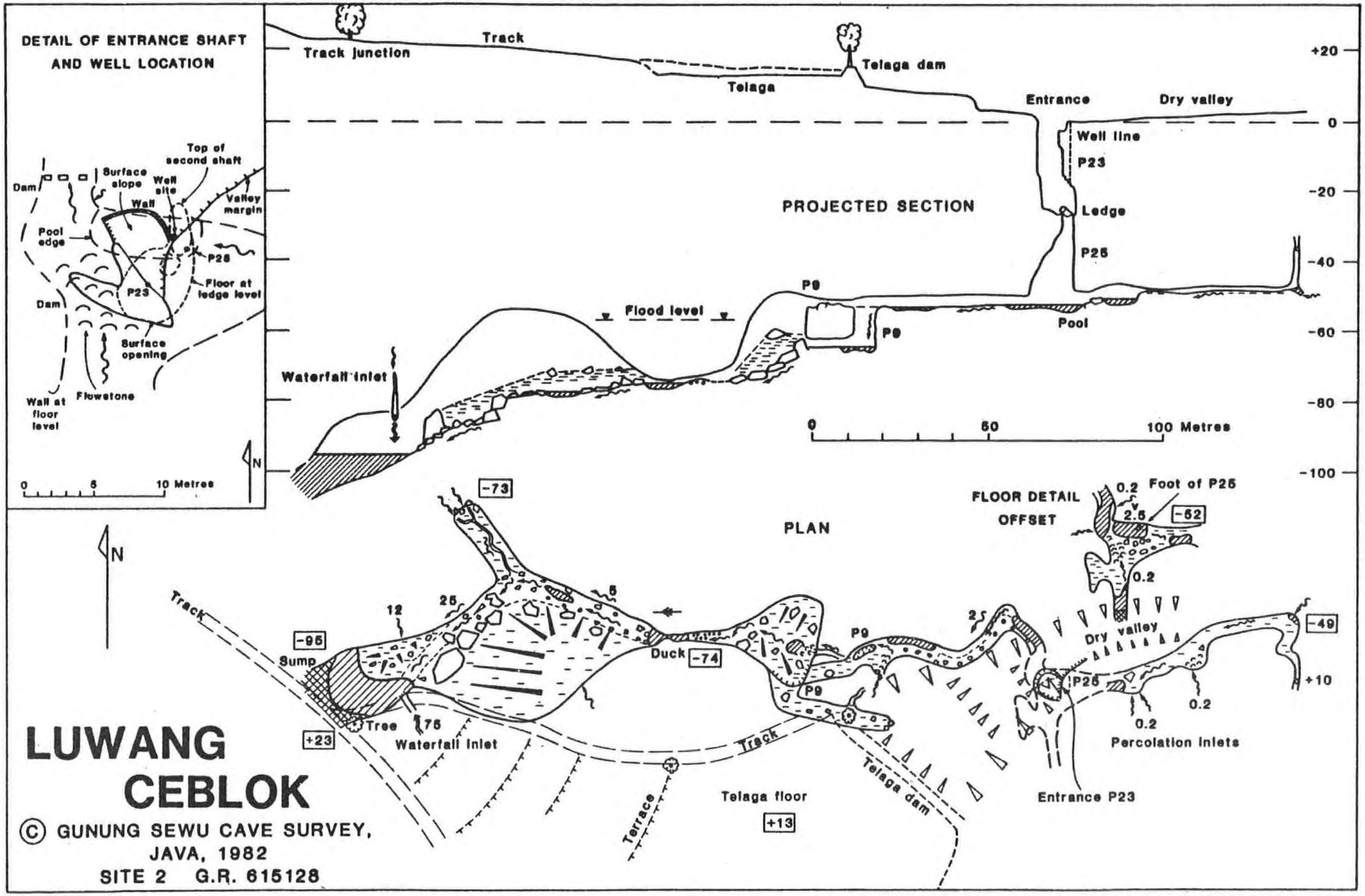
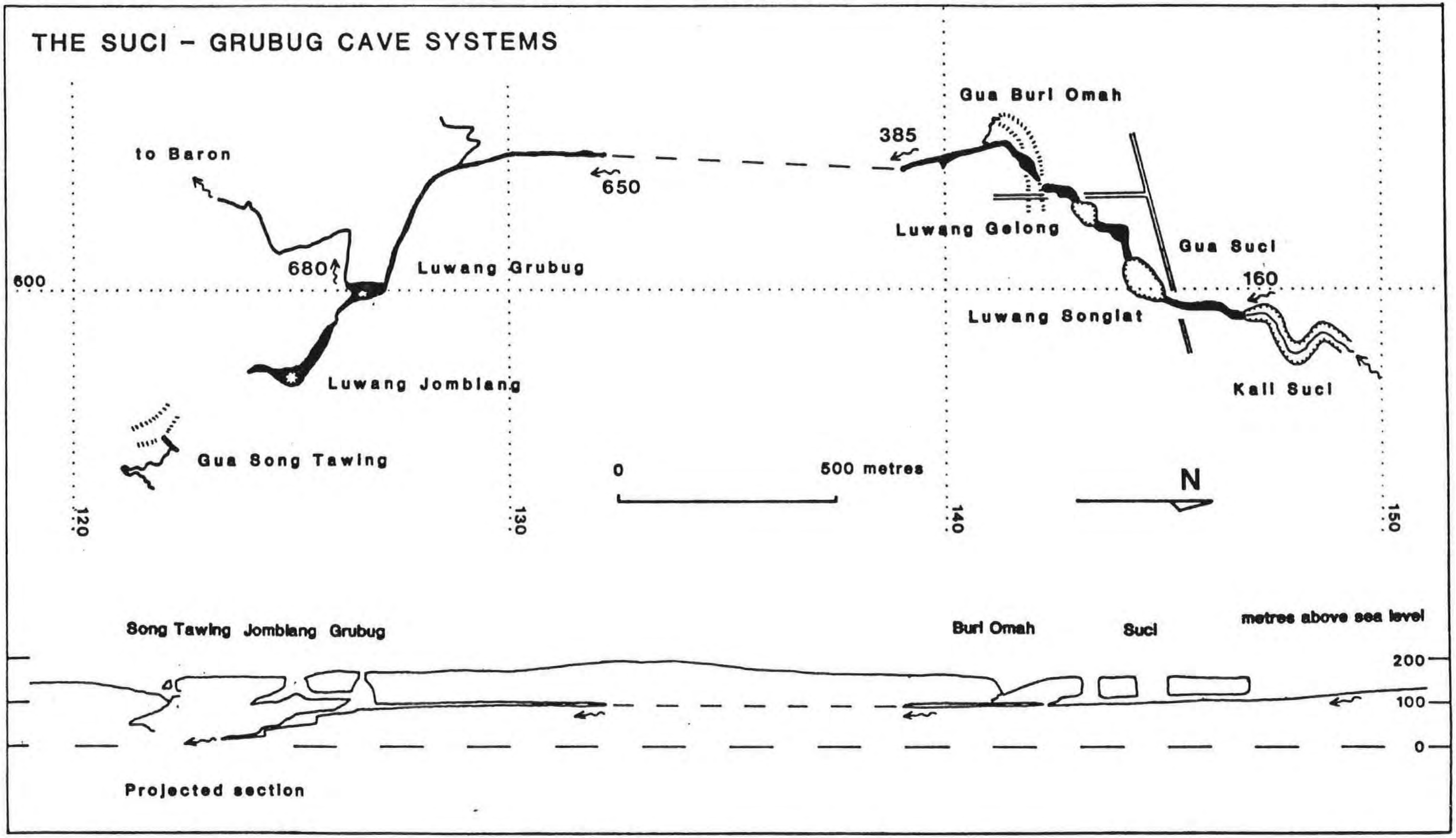

DETAIL OF ENTRANCE SHAFT AND WELL LOCATION
Dam
Surface slope
Well site
Wall
Top of second shaft
Valley margin
Pool edge
P25
Floor at ledge level
P23
Dam
Surface opening
Flowstone
Wall at floor level
0 5 10 Metres
N
Track junction
Track
Telaga
Telaga dam
Entrance
Dry valley
Well line
P23
Ledge
P25
PROJECTED SECTION
P9
Flood level
P9
Pool
Waterfall inlet
+20
0
-20
-40
-60
-80
-100
0 50 100 Metres
PLAN
N
-73
FLOOR DETAIL OFFSET
0.2
Foot of P25
2.5
-52
0.2
12
25
5
2
P9
Dry valley
-49
Track
-95
Sump
Duck
-74
P9
P25
+10
0.2
0.2
Percolation inlets
+23
Tree
75
Waterfall inlet
Track
Telaga dam
Terrace
Telaga floor
+13
Entrance P23
LUWANG CEBLOK
© GUNUNG SEWU CAVE SURVEY, JAVA, 1982
SITE 2 G.R. 615128

Figure 6



THE SUCI - GRUBUG CAVE SYSTEMS
to Baron
680
Luwang Grubug
650
385
Gua Buri Omah
Luwang Gelong
Gua Suci
160
Luwang Songlat
Kali Suci
Luwang Jomblang
Gua Song Tawing
0
500 metres
N
600
120
130
140
150
Song Tawing Jomblang Grubug
Buri Omah
Suci
metres above sea level
200
100
0
Projected section

Figure 7

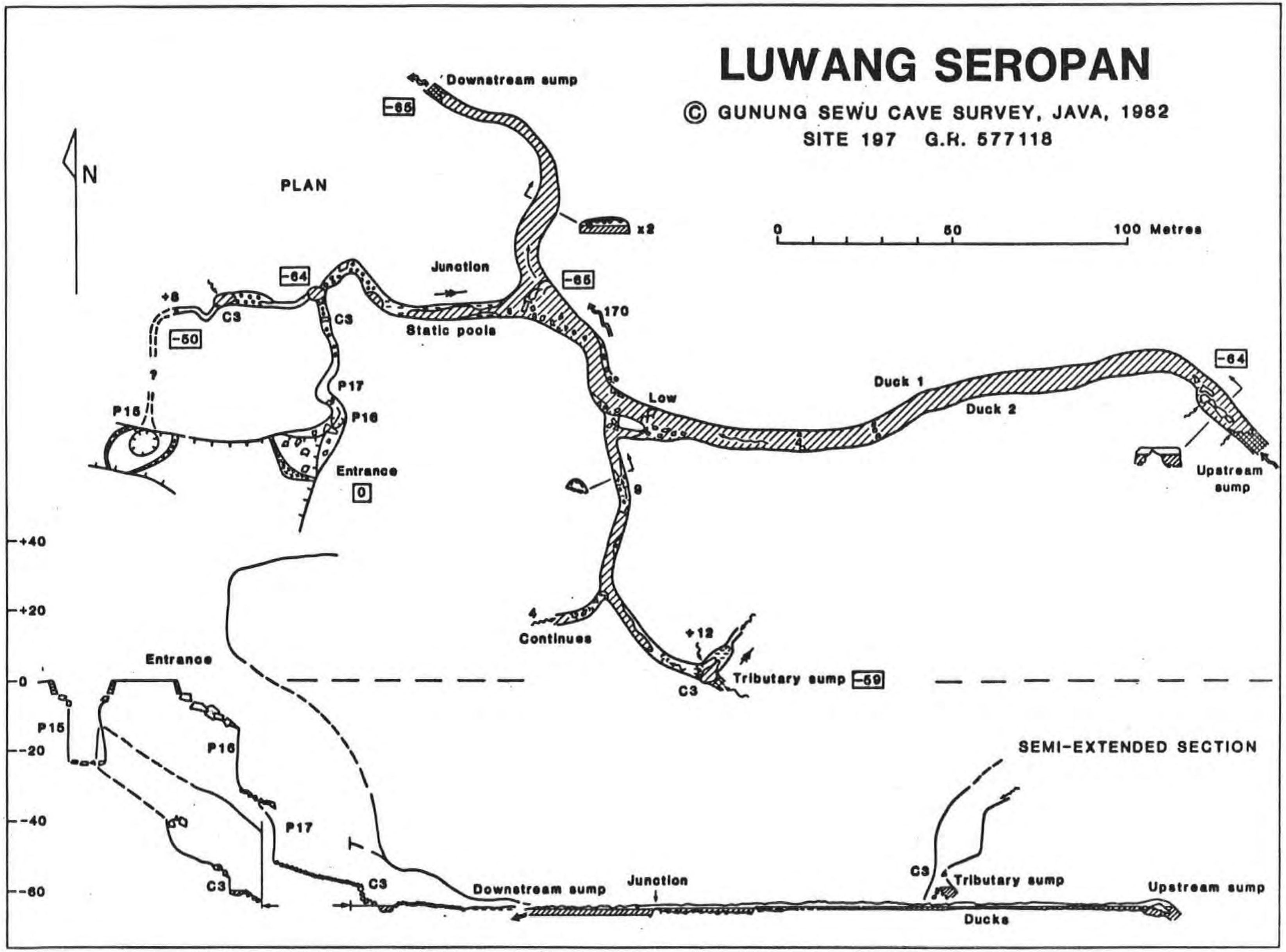

LUWANG SEROPAN
© GUNUNG SEWU CAVE SURVEY, JAVA, 1982
SITE 197 G.R. 577118
N
PLAN
0
50
100 Metres
Downstream sump
-66
x2
Junction
-64
+8
C3
-50
?
P15
P17
P16
Entrance
0
Static pools
-66
170
Low
Duck 1
Duck 2
-64
Upstream sump
9
4
Continues
+12
C3
Tributary sump
-59
+40
+20
0
-20
-40
-60
Entrance
P15
P16
P17
C3
C3
Downstream sump
Junction
C3
Tributary sump
Upstream sump
Ducks
SEMI-EXTENDED SECTION

Figure 8

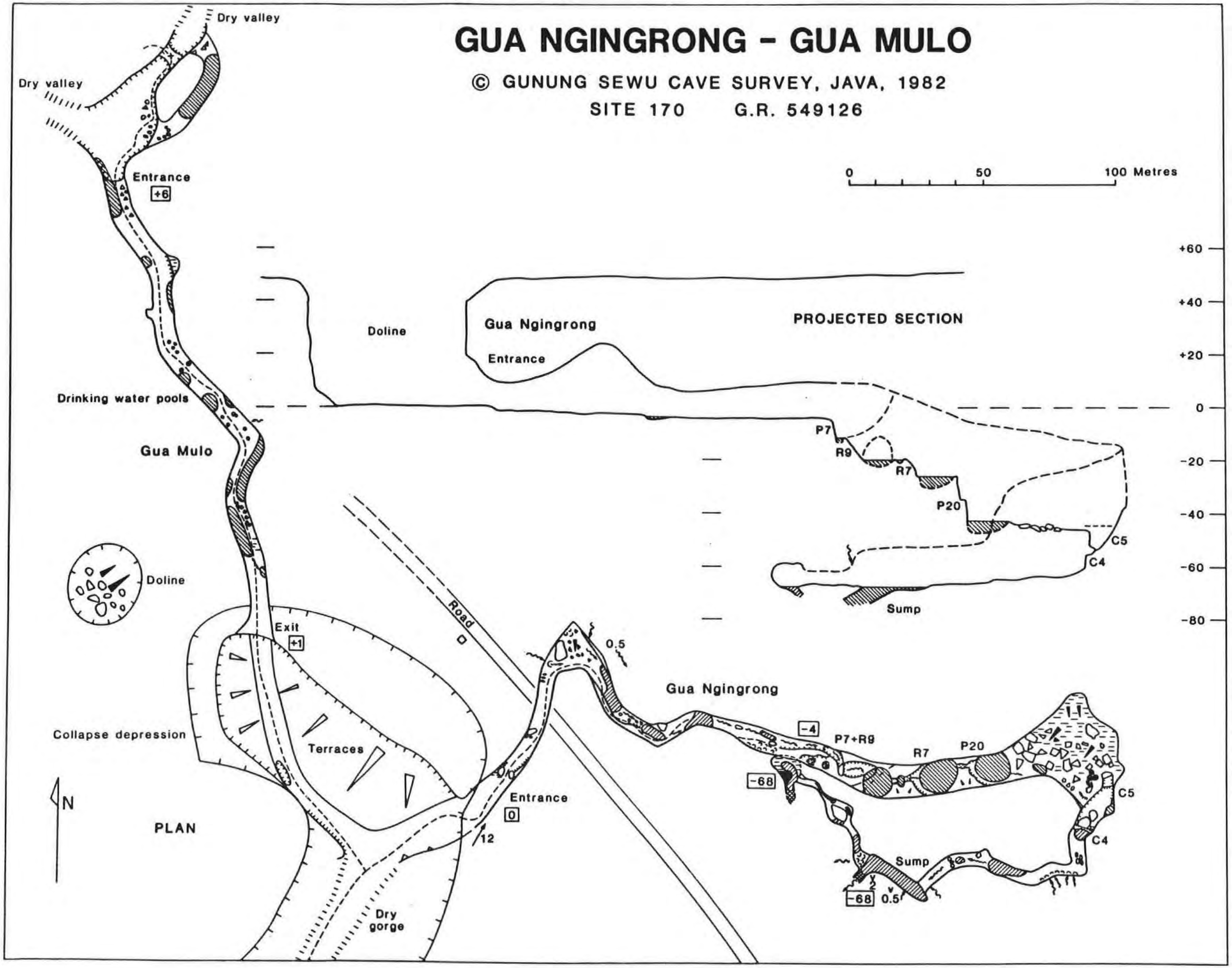
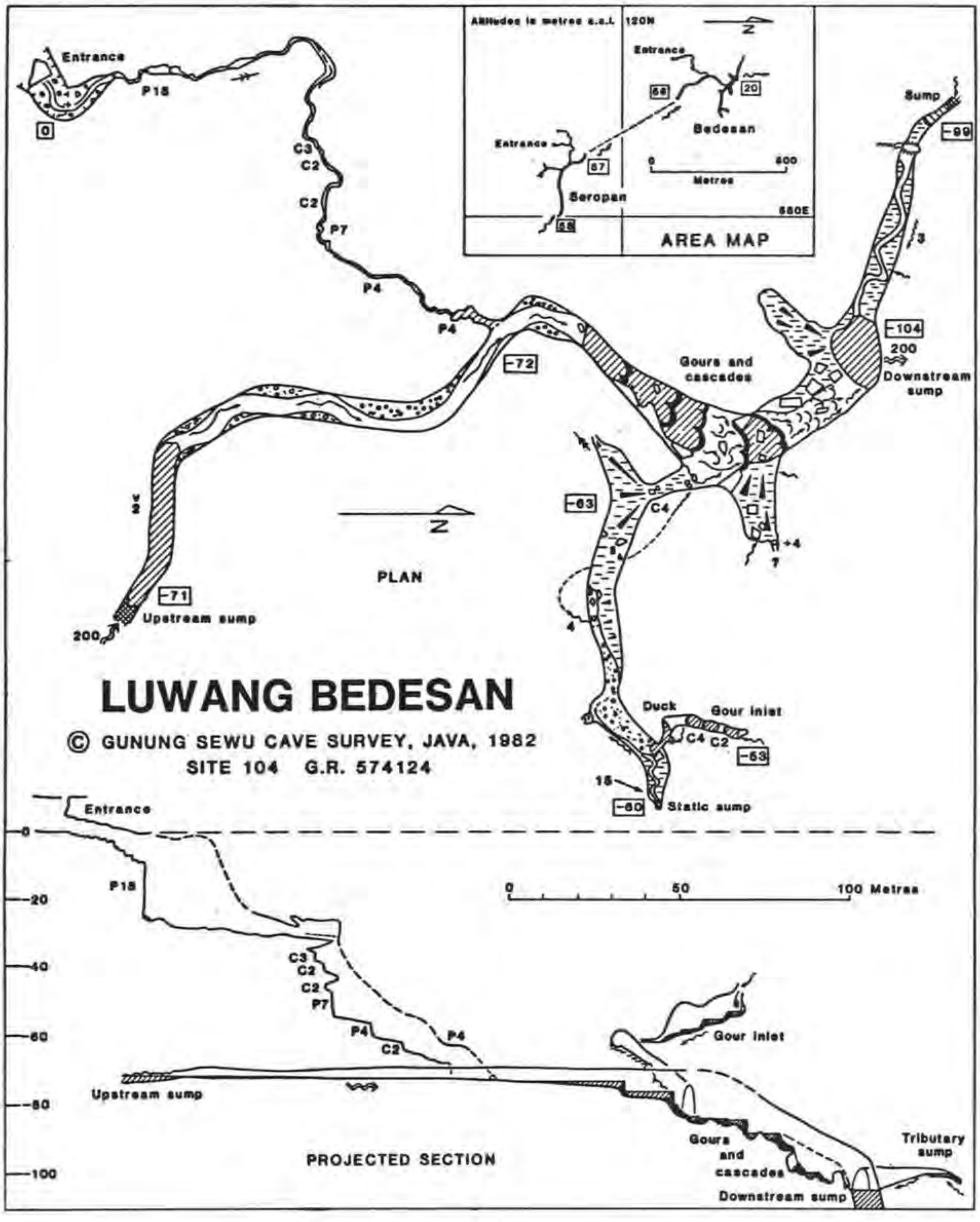
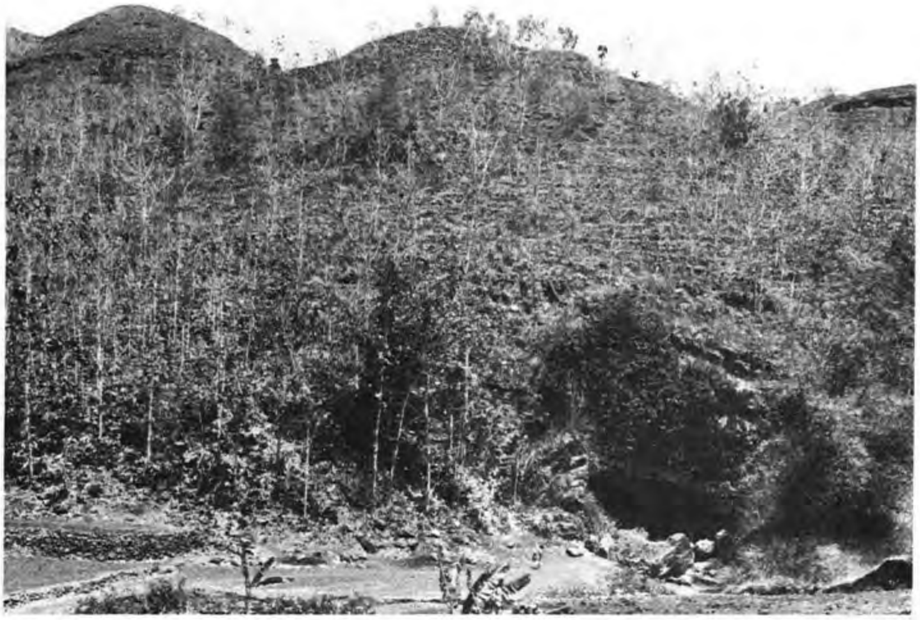

GUA NGINGRONG - GUA MULO
© GUNUNG SEWU CAVE SURVEY, JAVA, 1982
SITE 170 G.R. 549126
0
50
100 Metres
Dry valley
Dry valley
Entrance
+6
Drinking water pools
Gua Mulo
Doline
Exit
+1
Collapse depression
Terraces
N
PLAN
Road
Entrance
0
12
Dry gorge
0.5
Gua Ngingrong
-4
P7+R9
R7
P20
-68
C5
C4
Sump
-68
0.5
Doline
Gua Ngingrong
Entrance
PROJECTED SECTION
P7
R9
R7
P20
C5
C4
Sump
+60
+40
+20
0
-20
-40
-60
-80

Figure 9



LUWANG BEDESAN
© GUNUNG SEWU CAVE SURVEY, JAVA, 1982
SITE 104 G.R. 574124
Entrance
P15
0
C3
C2
C2
P7
P4
P4
-72
-71
Upstream sump
200
PLAN
N
Gours and cascades
-63
C4
+4
7
4
15
Duck
Gour inlet
C4
C2
-53
-60
Static sump
Sump
-99
3
-104
200
Downstream sump
AREA MAP
120N
Entrance
Bedesan
20
Seropan
0
Metres
0
-20
-40
-60
-80
-100
0
50
100 Metres
Upstream sump
PROJECTED SECTION
Gours and cascades
Downstream sump
Tributary sump
Gour inlet

Figure 10



4. A water carrier walks to the entrance of Gua Sodong (Waltham)

5. The fossil passage in Luwang Grubug, looking out to the Jomblang entrance (Eavis)

6. The river passage in Gua Bribin (Waltham)

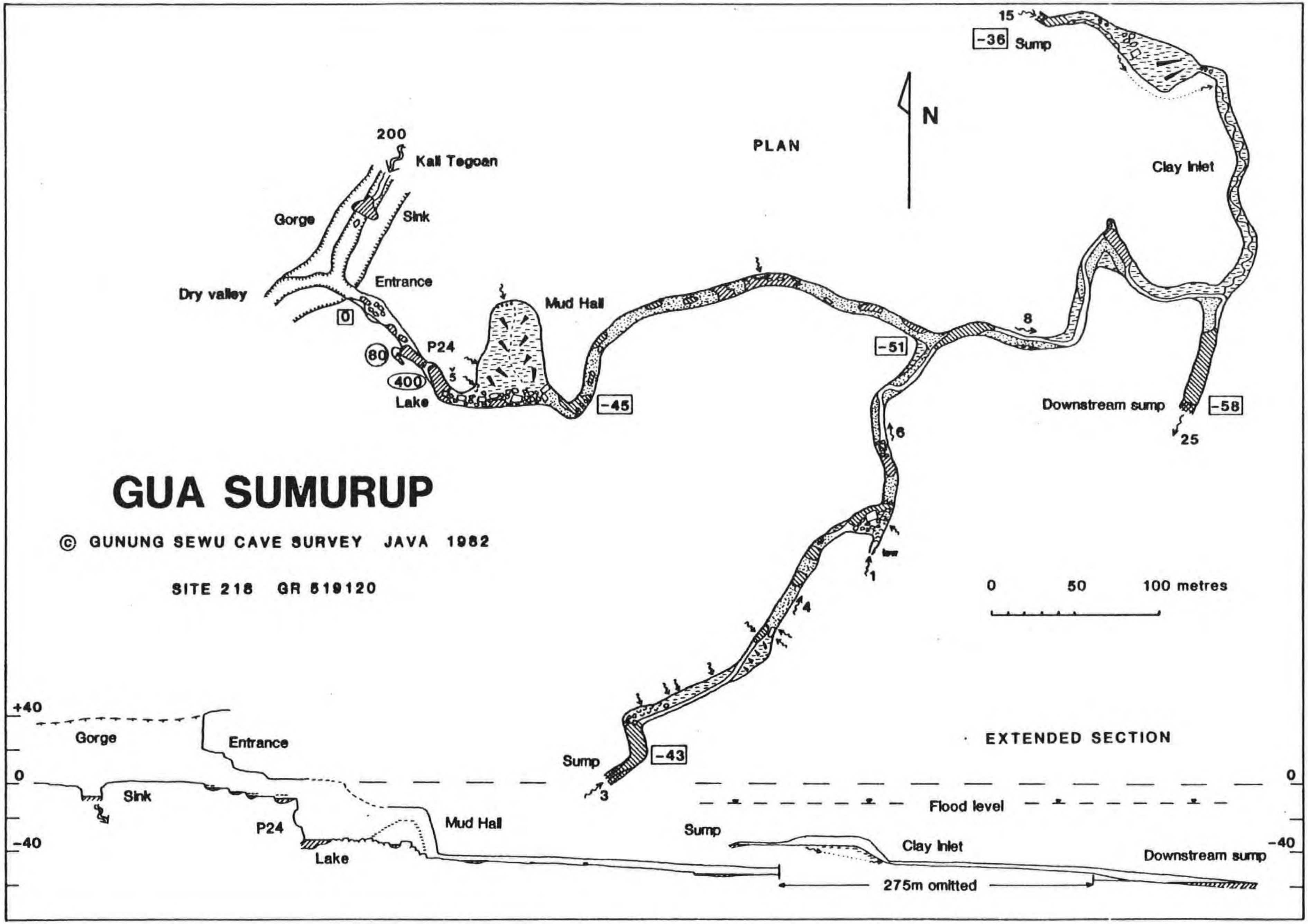

GUA SUMURUP
© GUNUNG SEWU CAVE SURVEY JAVA 1982
SITE 218 GR 519120
PLAN
N
200
Kali Tegoan
Gorge
Sink
Dry valley
Entrance
0
80
P24
400
5
Lake
Mud Hall
-45
-51
8
6
1
4
-43
Sump
3
-36
Sump
15
Clay Inlet
Downstream sump
-58
25
0
50
100 metres
EXTENDED SECTION
+40
0
-40
Gorge
Entrance
Sink
P24
Lake
Mud Hall
Sump
Flood level
Clay Inlet
Downstream sump
275m omitted

Figure 11

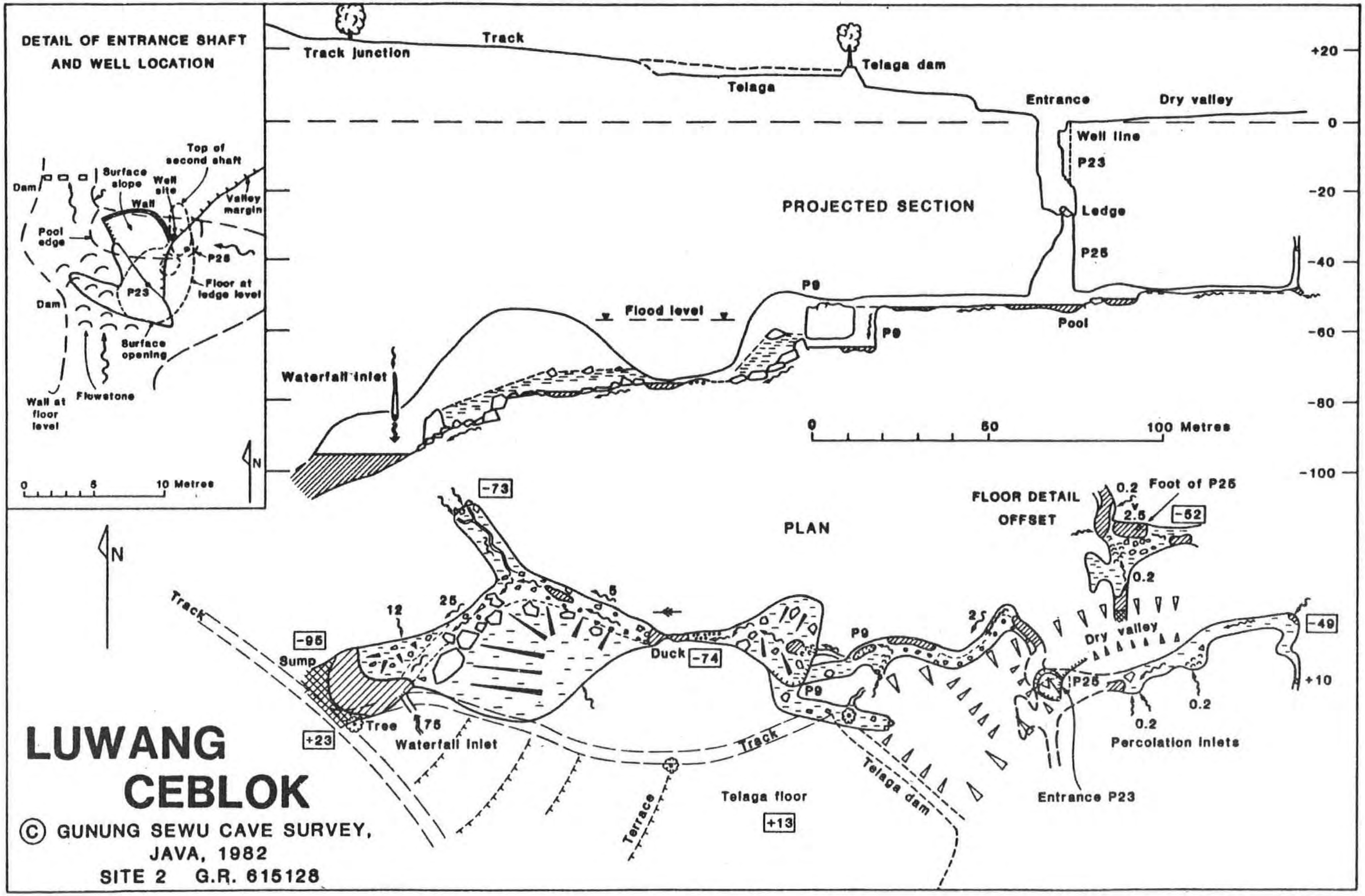

DETAIL OF ENTRANCE SHAFT
AND WELL LOCATION
Top of second shaft
Surface slope
Well site
Wall
Valley margin
Dam
Pool edge
P25
Floor at ledge level
P23
Surface opening
Flowstone
Wall at floor level
0
5
10 Metres
N
Track junction
Track
Telaga
Telaga dam
Entrance
Dry valley
Well line
P23
Ledge
P25
PROJECTED SECTION
P9
Flood level
Pool
Waterfall inlet
+20
0
-20
-40
-60
-80
-100
0
50
100 Metres
PLAN
FLOOR DETAIL
OFFSET
Foot of P25
0.2
2.5
-52
-73
-95
Sump
+23
Tree
75
Waterfall inlet
12
25
5
Duck
-74
P9
2
Dry valley
P25
-49
+10
0.2
Percolation inlets
Entrance P23
Track
Telaga dam
Telaga floor
+13
Terrace
LUWANG
CEBLOK
© GUNUNG SEWU CAVE SURVEY,
JAVA, 1982
SITE 2 G.R. 615128

Figure 6

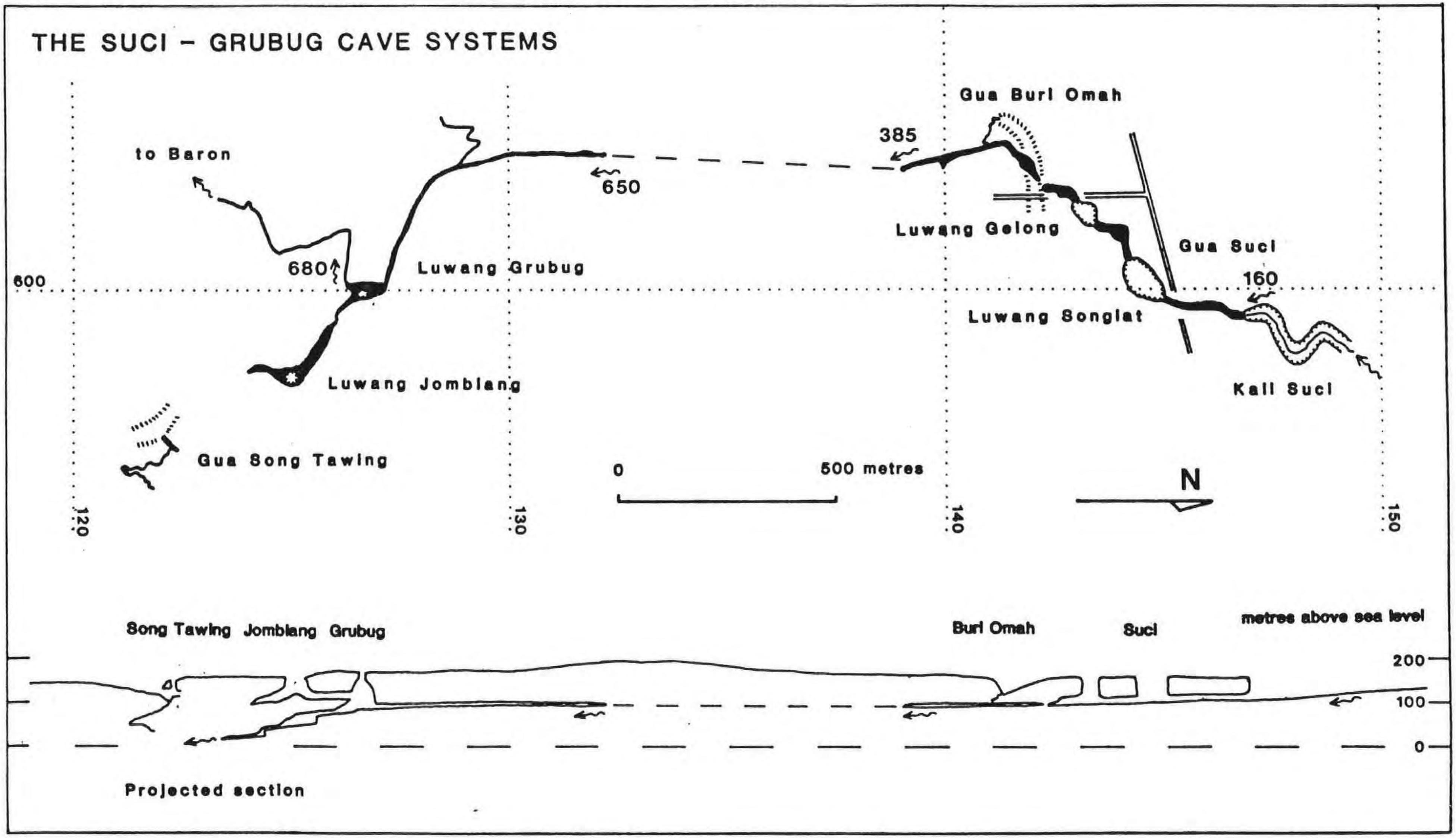

THE SUCI - GRUBUG CAVE SYSTEMS
to Baron
680
Luwang Grubug
650
385
Gua Buri Omah
Luwang Gelong
Gua Suci
160
Luwang Songlat
Kali Suci
Luwang Jomblang
Gua Song Tawing
600
120
130
140
150
0
500 metres
N
Song Tawing
Jomblang
Grubug
Buri Omah
Suci
metres above sea level
200
100
0
Projected section

Figure 7

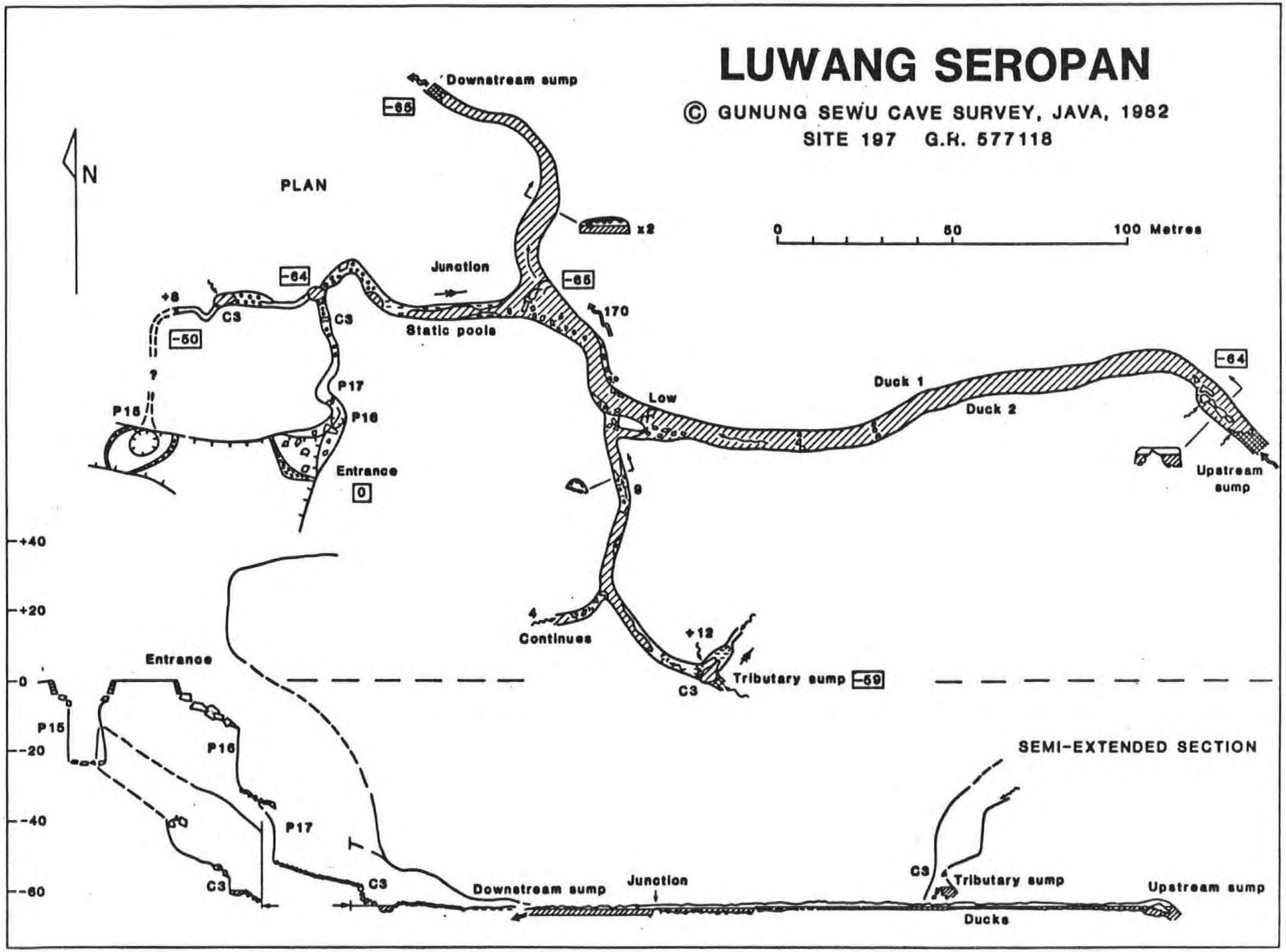
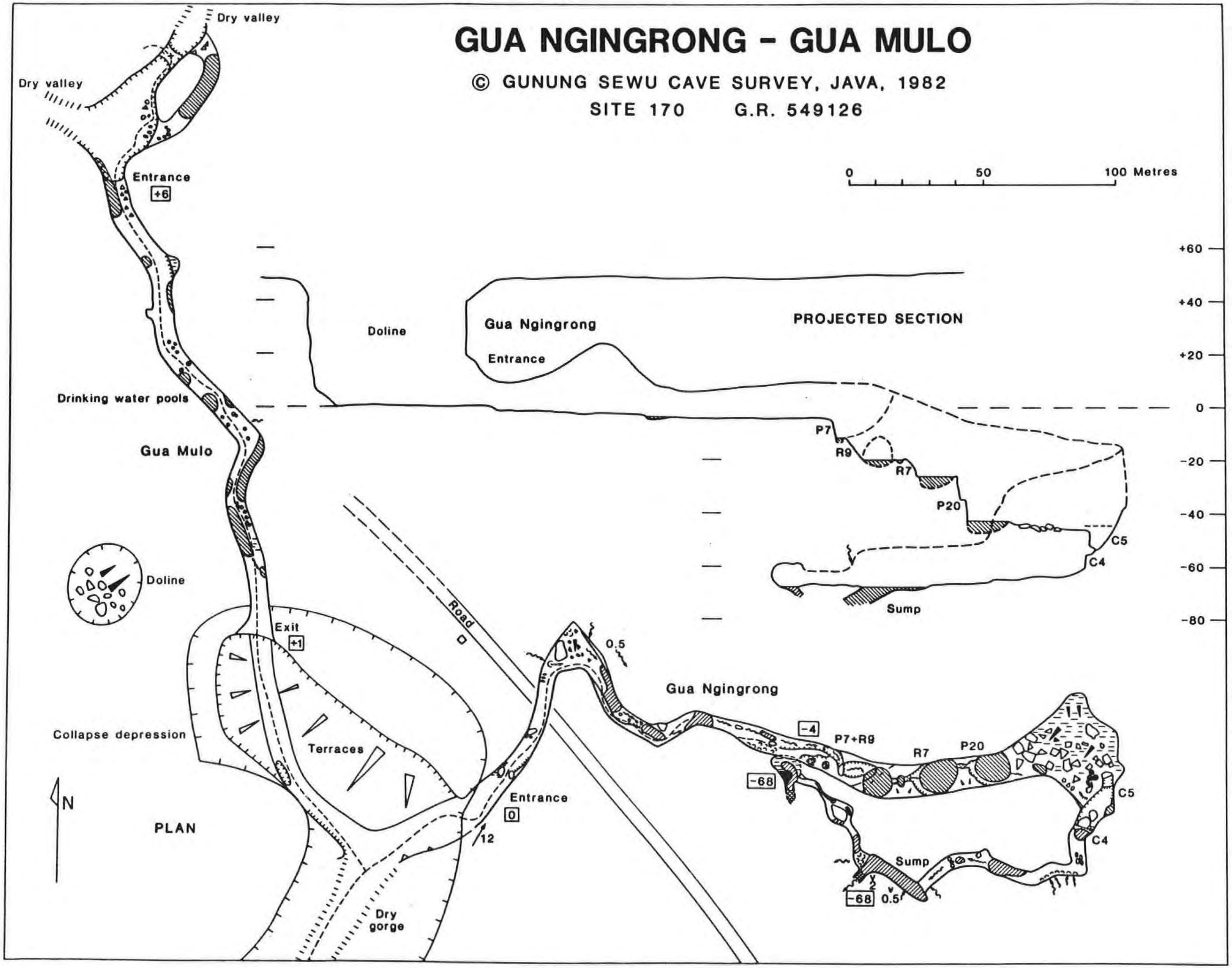

LUWANG SEROPAN
© GUNUNG SEWU CAVE SURVEY, JAVA, 1982
SITE 197 G.R. 577118
N
PLAN
0
50
100 Metres
Downstream sump
-66
x2
Junction
-66
170
-64
+8
C3
C3
-50
Static pools
?
P17
P15
P16
Entrance
0
Low
Duck 1
Duck 2
-64
Upstream sump
9
4
Continues
+12
C3
Tributary sump
-59
+40
+20
0
-20
-40
-60
Entrance
P15
P16
P17
C3
C3
Downstream sump
Junction
SEMI-EXTENDED SECTION
C3
Tributary sump
Upstream sump
Ducks

Figure 8



GUA NGINGRONG - GUA MULO
© GUNUNG SEWU CAVE SURVEY, JAVA, 1982
SITE 170 G.R. 549126
0
50
100 Metres
PROJECTED SECTION
Doline
Gua Ngingrong
Entrance
+60
+40
+20
0
-20
-40
-60
-80
P7
R9
R7
P20
C5
C4
Sump
Dry valley
Dry valley
Entrance
+6
Drinking water pools
Gua Mulo
Doline
Exit
+1
Collapse depression
Terraces
N
PLAN
Road
0.5
Gua Ngingrong
-4
P7+R9
R7
P20
-68
C5
C4
Sump
-68
0.5
Entrance
0
12
Dry
gorge

Figure 9

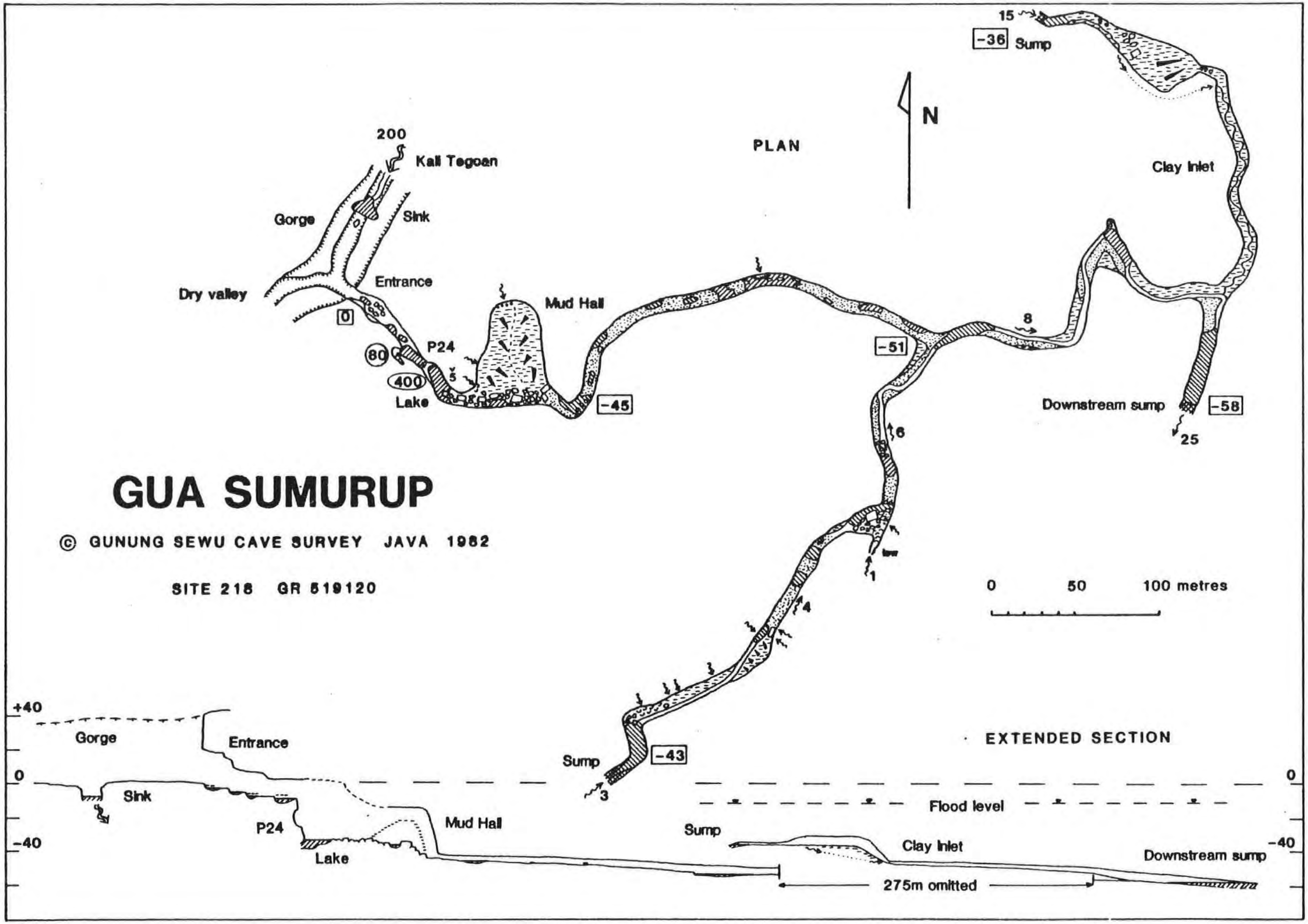

GUA SUMURUP
© GUNUNG SEWU CAVE SURVEY JAVA 1982
SITE 218 GR 519120
PLAN
N
200
Kali Tegoan
Gorge
Sink
Dry valley
Entrance
0
80
400
P24
5
Lake
Mud Hall
-45
-51
8
6
1
4
-43
Sump
3
15
-36
Sump
Clay Inlet
Downstream sump
-58
25
0
50
100 metres
EXTENDED SECTION
+40
0
-40
Gorge
Entrance
Sink
P24
Lake
Mud Hall
Sump
Flood level
Clay Inlet
Downstream sump
275m omitted

Figure 11

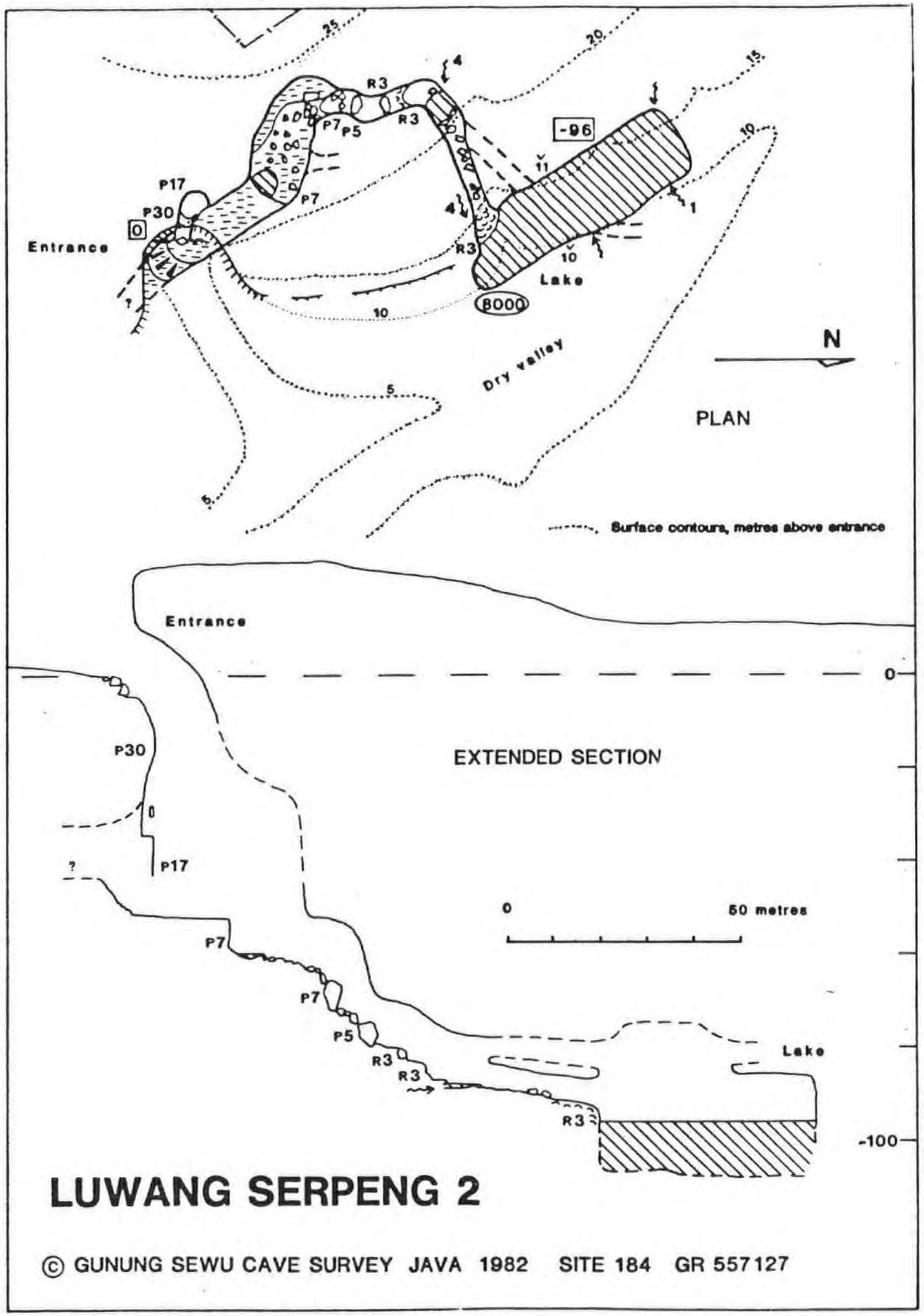


Figure 12

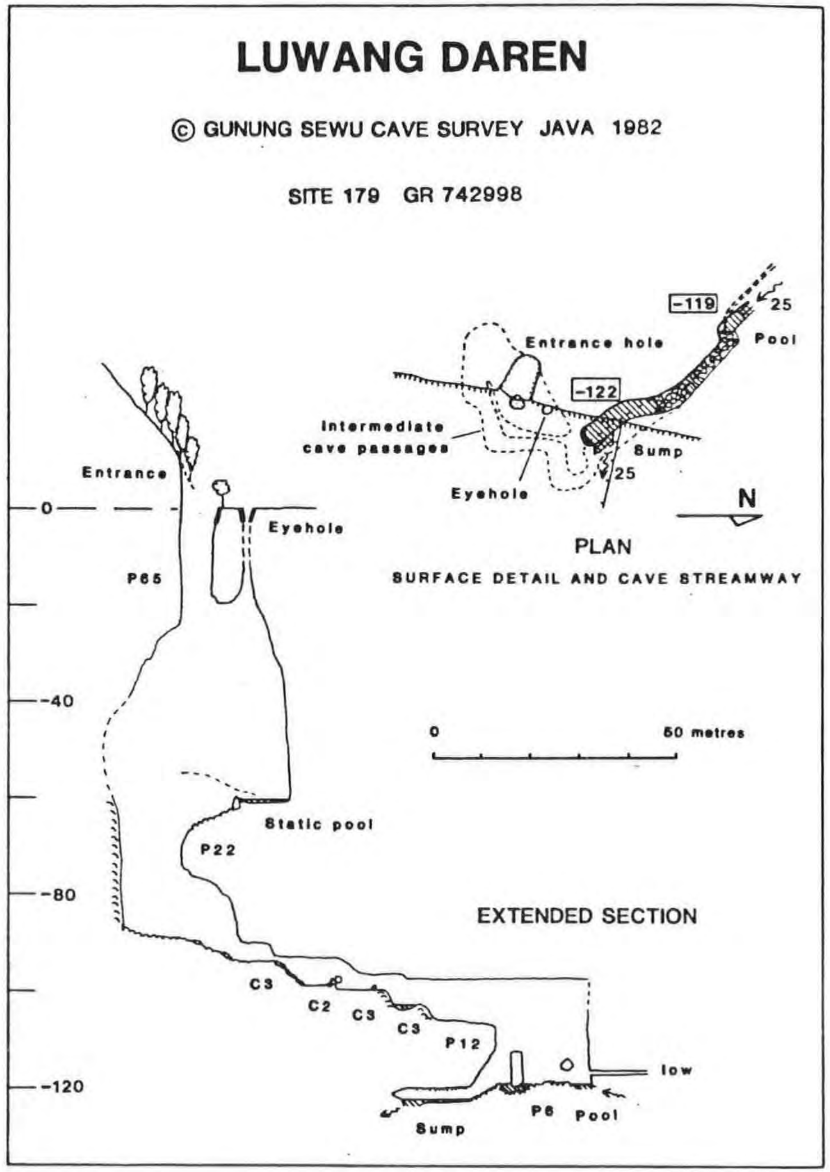


Figure 13

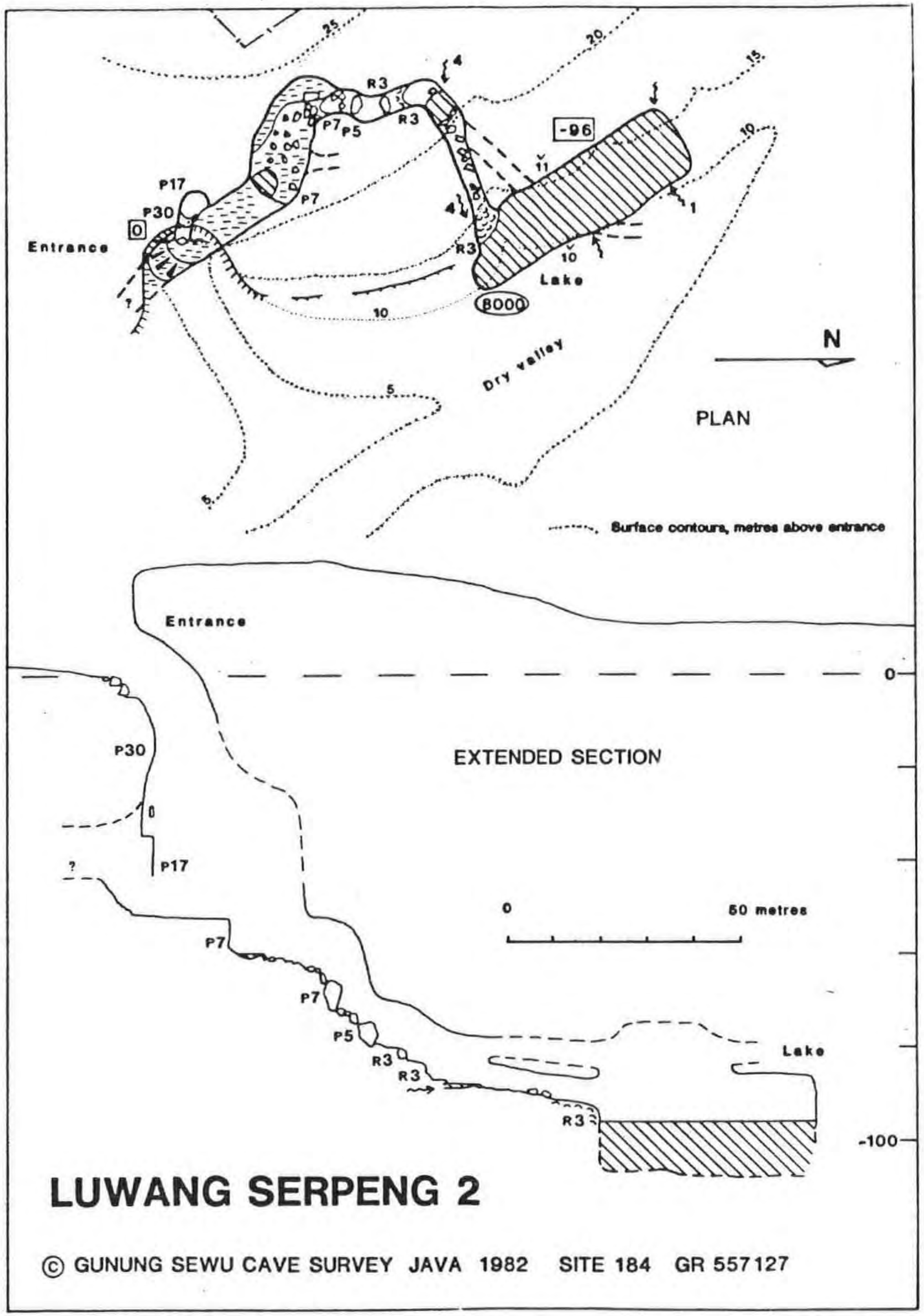


Figure 12

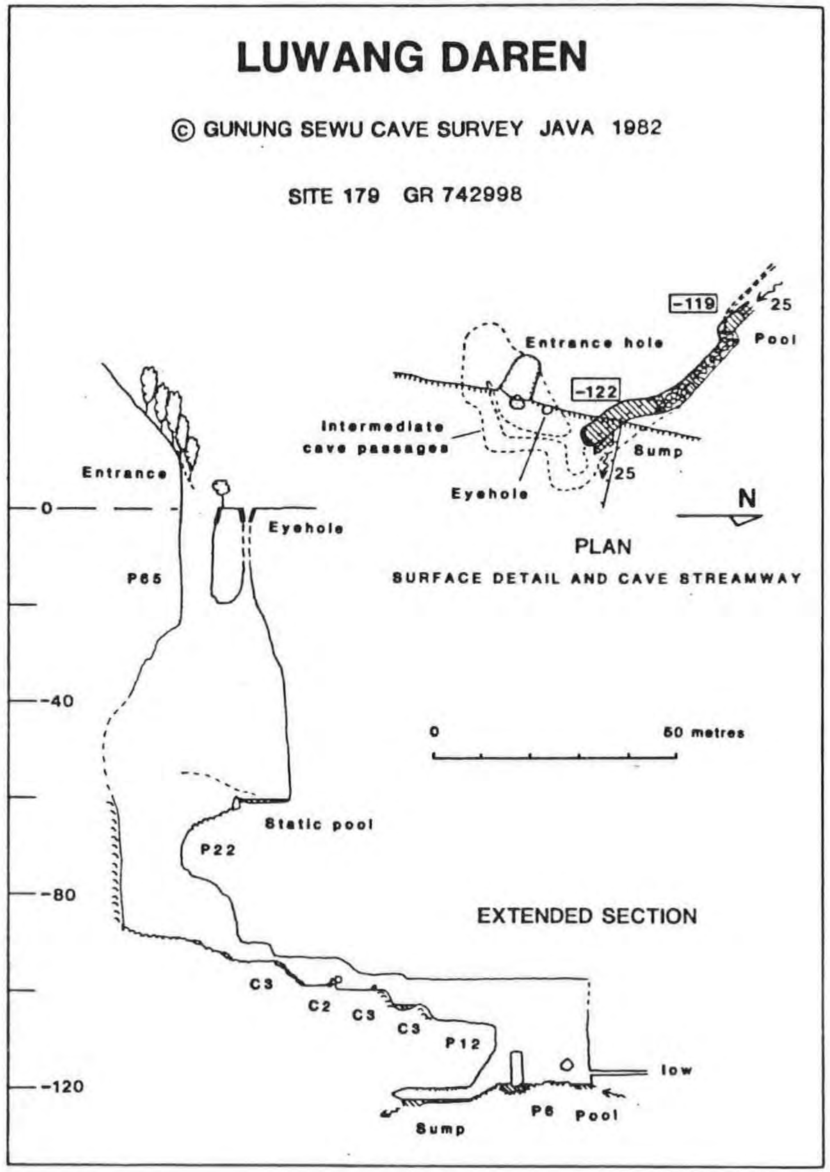


Figure 13

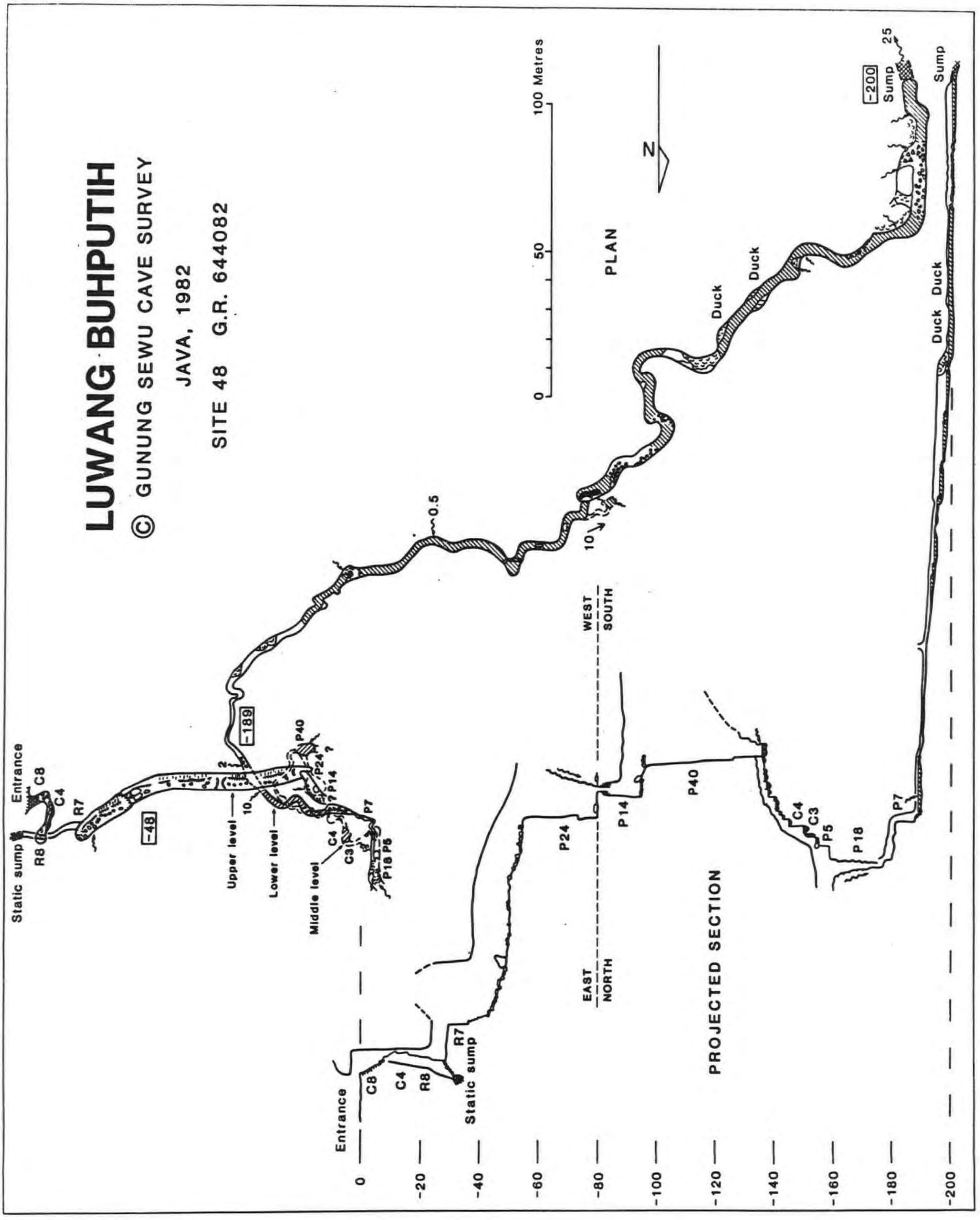

LUWANG BUHPUTIH
© GUNUNG SEWU CAVE SURVEY
JAVA, 1982
SITE 48 G.R. 644082
0
50
100 Metres
N
PLAN
Static sump
Entrance
R8
C8
C4
R7
-48
Upper level
Lower level
Middle level
10
2
-189
P40
P24
P14
?
C4
C3
P7
P18 P5
0.5
10
Duck
Duck
-200
Sump
25
Sump
Duck
Duck
PROJECTED SECTION
EAST
NORTH
WEST
SOUTH
Entrance
C8
C4
R8
R7
Static sump
P24
P14
P40
C4
C3
P5
P18
P7
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200

Figure 14

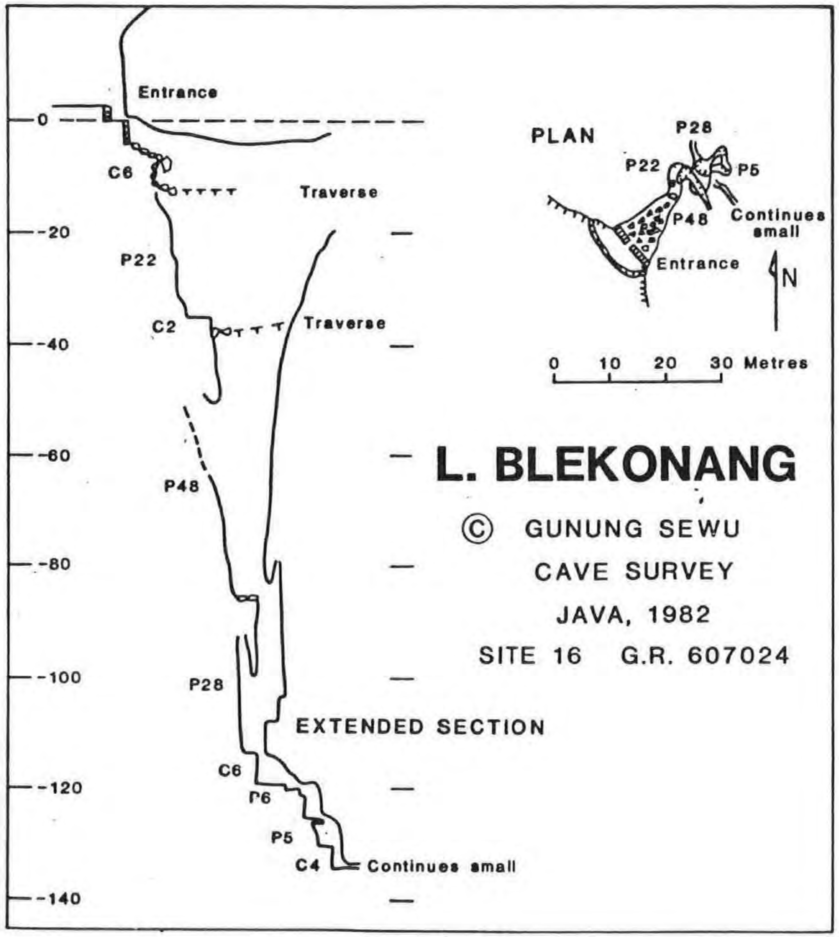


Figure 15

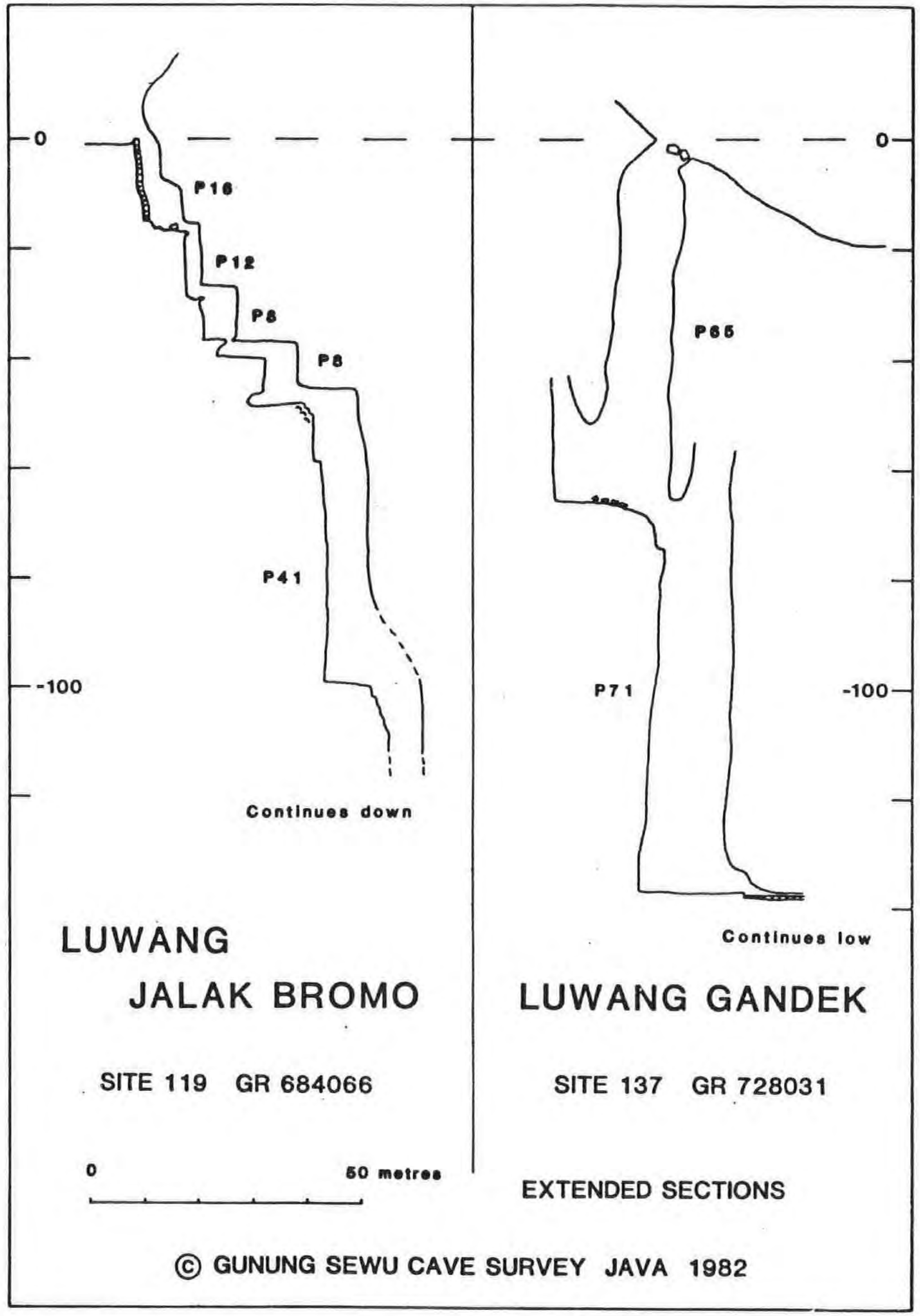


Figure 16

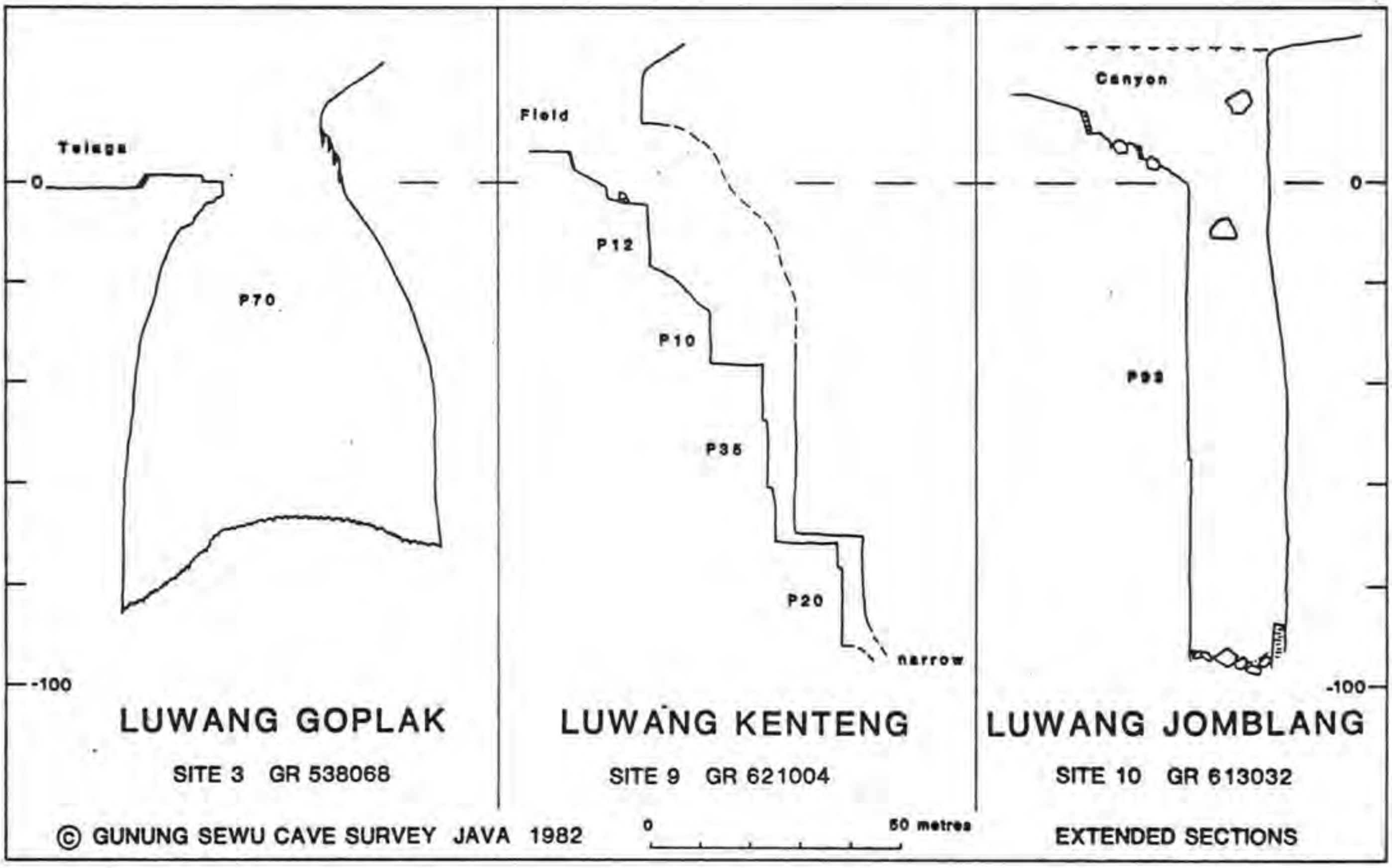


Figure 17

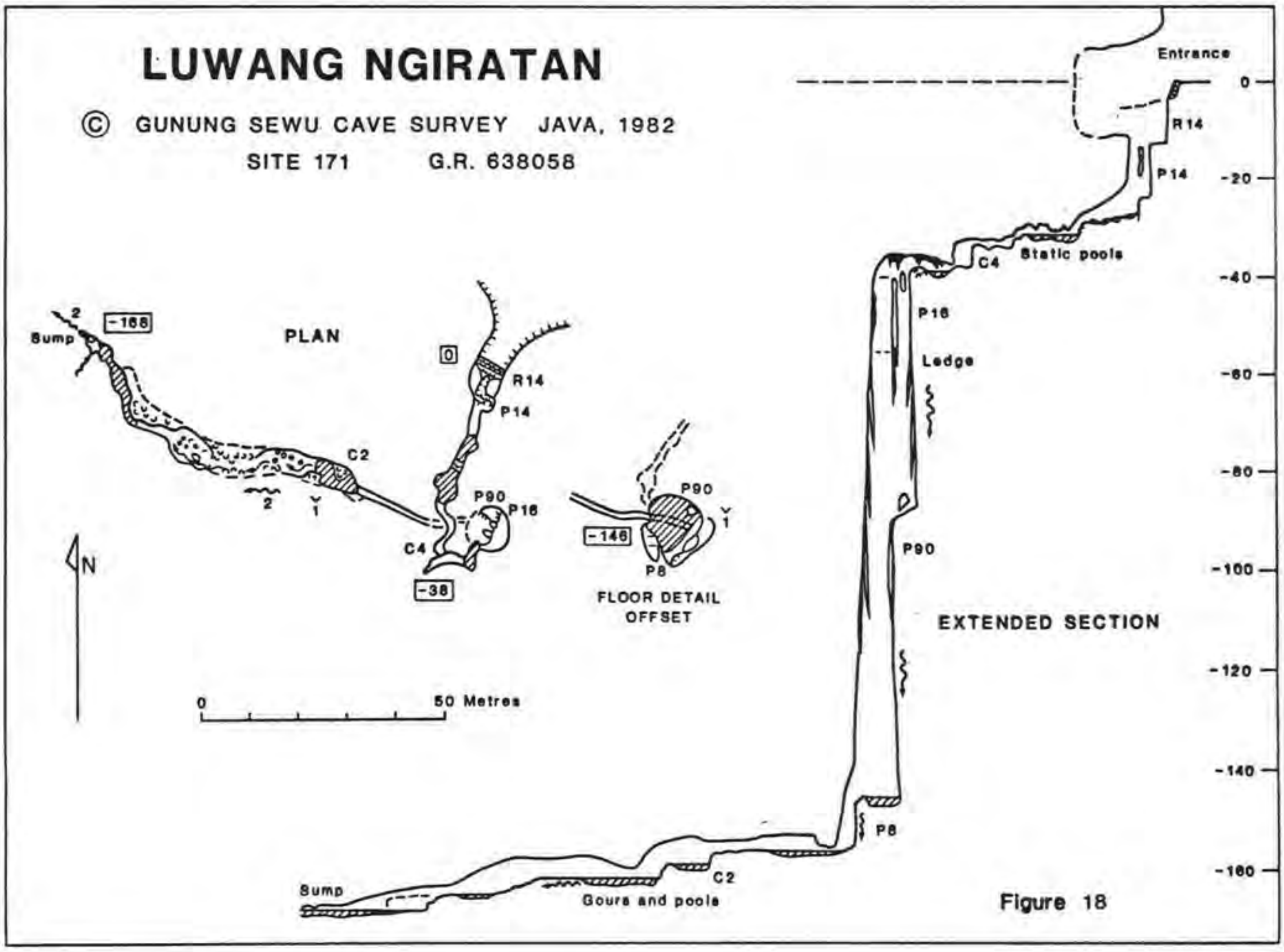


Figure 18

beneath itself for more than 130 m. A trio of spacious shafts leads to a small streamway which contains a fine succession of gour pools, steepening into climbs and pitches and two deeper shafts. Various inlets combine to give a substantial flow down the gently graded lower streamway, which has extensive flowstone deposits and a series of long pools some of which have minimal airspace, before the terminal sump. Buhputih is the deepest cave yet explored in Sewu, and its fine shafts and lower streamway combine to make it an excellent system. There is the possibility of upstream extension from the foot of the main shafts.

LUWANG DAREN
Length 240 m Depth 122 m Grade 3 survey (Fig. 13).
An impressive free-hanging 65 m entrance pitch is followed by another pitch in the same shaft, and then a passage broken by short climbs which spirals round beneath the entrance chamber. This ends at a drop overlooking a noisy streamway, and two alternative descents lead to upstream and downstream sections neither of which can be followed far.

LUWANG GANDEK
Depth 138 m Grade 3 survey (Fig. 16).
Two fine shafts each about 70 m deep drop to a very low bedding plane passage which continues half full of water.

LUWANG GOPLAK
Depth 85 m Grade 3 survey (Fig. 17).
An impressively large opening has completely overhanging walls in a superb bell shaft with a minimum drop of 70 m. This lands on a sloping boulder floor and there is no way on.

LUWANG JALAK BROMO
Depth 105 m Grade 3 survey (Fig. 16).
A spiralling succession of short pitches leads to a much larger shaft over 40 m deep, from the foot of which a climb descends to the edge of a further undescended dry shaft of unknown depth.

LUWANG JERO
Depth 151 m Grade 3 survey (Fig. 20).
A fine descent of 78 m in a large entrance shaft leads to a short dry descending passage ending at a second pitch. This immediately bells out into a free hanging drop down the centre of a chamber, the floor of which slopes down boulders at one end to a terminal sump pool.

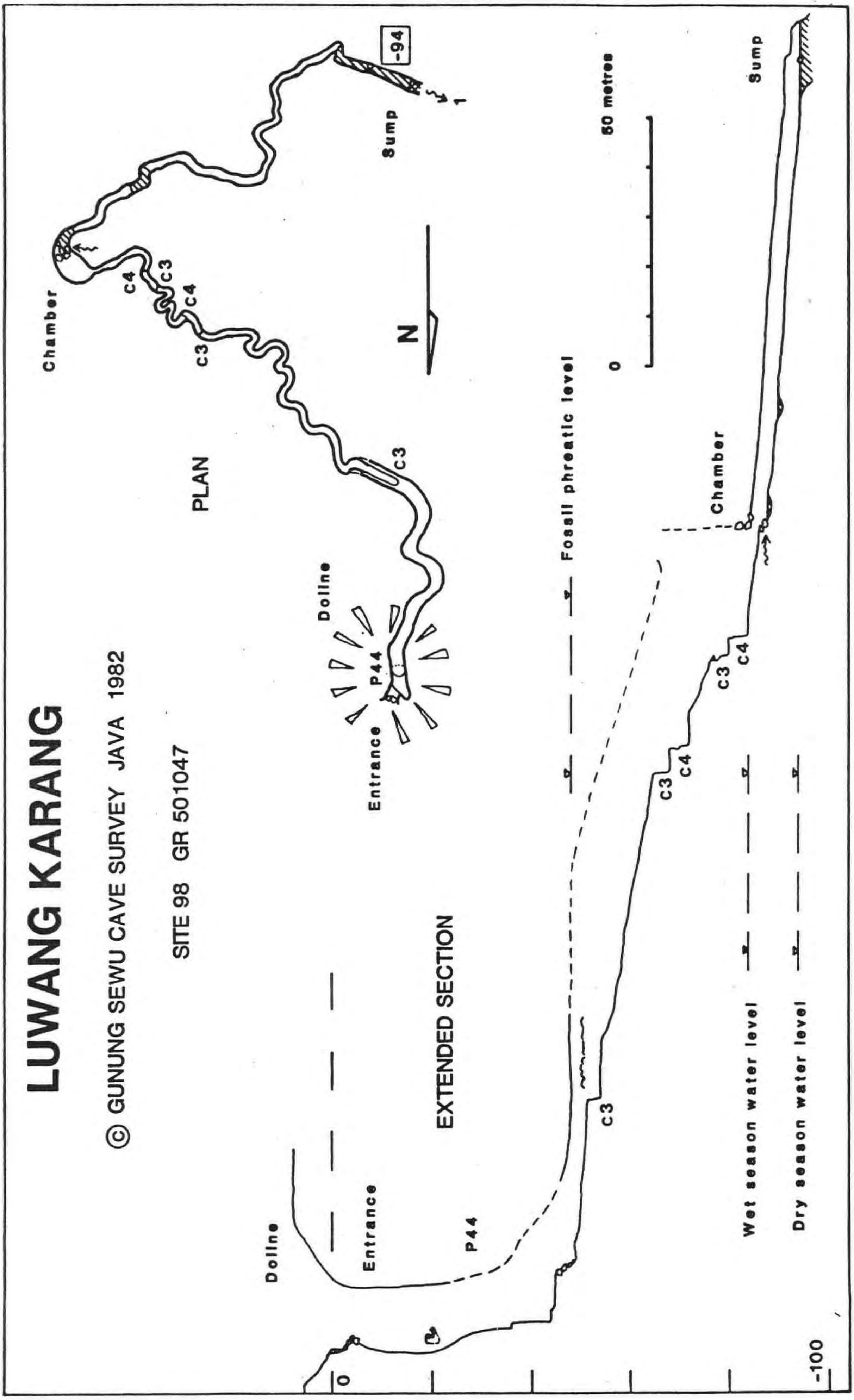
LUWANG JOMBLANG (10)
Depth 95 m Grade 3 survey (Fig. 17).
A single cylindrical shaft drops via a 93 m pitch to an impassable floor of mud and boulders.

LUWANG JOMBLANG (175)
Depth 106 m Grade 3 survey (Fig. 23).
A spectacular 77 m entrance shaft has a single outlet which rapidly diminishes in size. This has another pitch and a small canyon which continues to the top of an undescended drop of 20 m; this enters a large chamber which appears to continue as a sizeable passage.

LUWANG KARANG
Length 325 m Depth 94 m Grade 3 survey (Fig. 19).
An entrance pitch of 44 m drops to the head of a meandering canyon with a phreatic roof tube in its first section. Short climbs break the steady descent to where mud shows the level of annual flooding, 10 m above the normal sump level.

LUWANG KENTENG
Depth 72 m Grade 3 survey (Fig. 17).
A steeply descending dry canyon has a series of pitches followed down 72 m to the lip of an undescended 20 m pitch beyond which the passage appears to continue as a narrow rift.

GUA LEBAK BARENG
Length 470 m Depth 166 m Grade 5 survey (Fig. 22).



LUWANG KARANG
© GUNUNG SEWU CAVE SURVEY JAVA 1982
SITE 98 GR 501047
PLAN
Dolline
Entrance
P44
C3
C4
Chamber
Sump
-94
N
0
50 metres
EXTENDED SECTION
Fossil phreatic level
Wet season water level
Dry season water level
0
-100

Figure 19

A large and inviting entrance yields an easy walking passage which barely descends. This ends at the top of a spectacular shaft system which drops 140 m with unbroken vertical walls. At its foot is a deep pool under a showerbath, and an outlet streamway which, though pleasant and decorated, ends prematurely in a deep clear sump pool. Even though of no great length, Lebak Bareng provides some exciting vertical caving.

LUWANG NGEPOH
Depth 182 m Grade 3 survey (Fig. 21).
An unassuming entrance climb and a low, wide, boulder-strewn chamber lead to the top of a fine, dry, broken, shaft over 60 m deep. At its foot a small opening reveals the blackness of another shaft, the best part of 100 m deep, which is characterised by a rain of dripping water. The 67 m pitch ends on what appears to be a floor but is in fact a number of very large, loose slabs of dubious stability. From the foot of the next pitch a few metres of canyon ends at an undesended 20 m pitch where there appears to be a way on below. It is likely that, with very little effort, Ngepoh could become the deepest cave in Sewu.

LUWANG NGIRATAN
Length 325 m Depth 168 m Grade 5 survey (Fig. 18).
A broken entrance drop is followed by a tortuous and constricted passage to the head of a 106 m shaft. This is a magnificent vertical feature, draped in stalactites and floored by a deep pool. The continuing passage features stalagmites, flowstone, gours and pools but unfortunately ends in a sump after little further descent.

LUWANG PUNIRAN
Depth 100 m Grade 3 survey (Fig. 23).
A staircase of five pitches floors a steeply descending canyon. A further climb ends at the lip of an undescended 20 m pitch into a pool which appears that it may be a sump.

LUWANG SETRO
Length 250 m Depth 140 m Grade 3 survey (Fig. 24).
A large high canyon passage has a series of short drops followed by two deeper pitches and a final staircase into a terminal sump pool.

LUWANG TONG POCOT
Length 900 m Depth 142 m Grade 5 survey (Fig. 25).
The roomy entrance shaft soon narrows into a fossil rift, so that the only way on is in a small youthful overflow passage. This has a succession of nine short drops, interspersed with an interesting swim and a pair of thought-provoking squeezes, before opening out into a horizontal gallery. This contains a series of long pools, and has plenty of length though unfortunately a general shortage of standing height. A pair of waterfalls provide interest near to the halfway point to the terminal sump. The combination of shafts and stream cave make Tong Pocot a fine system, but the restricted passage sizes make it more memorable for its sporting challenge than for its grandeur.

CAVES OF THE NORTHEASTERN AREAS

GUA BRIBIN
Length 3900 m Depth 33 m Grade 5 survey (Fig. 26).
An uninspiring entrance passage, blackened by the soot from paraffin torches, ends at a T-junction with a major river gallery. The cave river is dammed by a substantial masonry structure with overflow channels, and large pumps feed a pipeline to a water distribution scheme for the surrounding villages. Upstream of the dam, the cave is occupied by a lake one kilometre long, most of which is deep and so requires a monumental amount of swimming. Beyond the lake a short section of river passage ends in an upstream sump which has been proved to drain a wide catchment area towards the east. A large dry tributary passage has been followed for 500 m in a northerly direction; it continues unexplored and may relate to the fossil passage in Gua Semuluh.

Downstream of the dam lies a kilometre of gently descending and very fine river cave. Foaming rapids and deep, smooth, fast-moving water alternate with canals and lakes, bordered by a variety of shingle beaches and rocky terraces. The mostly black walls are broken by just patches of white stalactites and

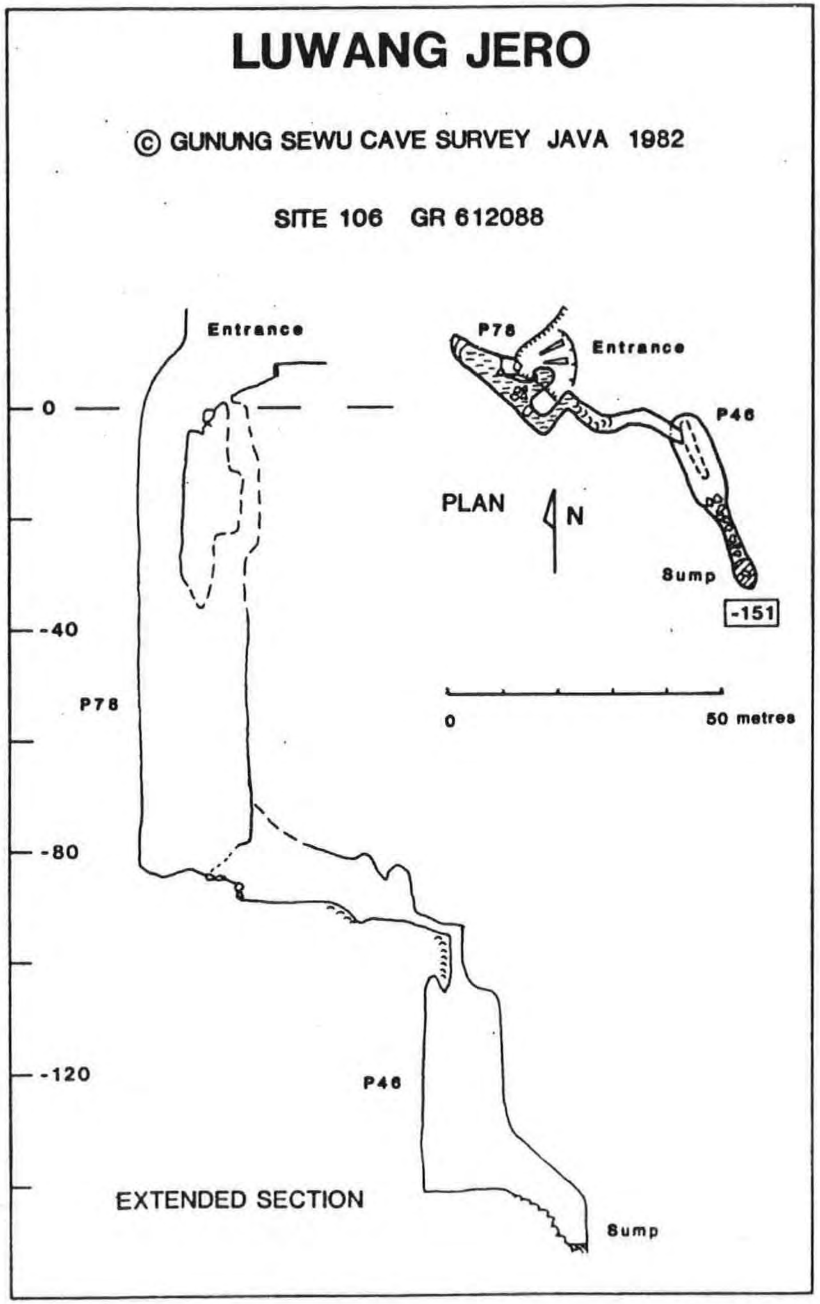


Figure 20

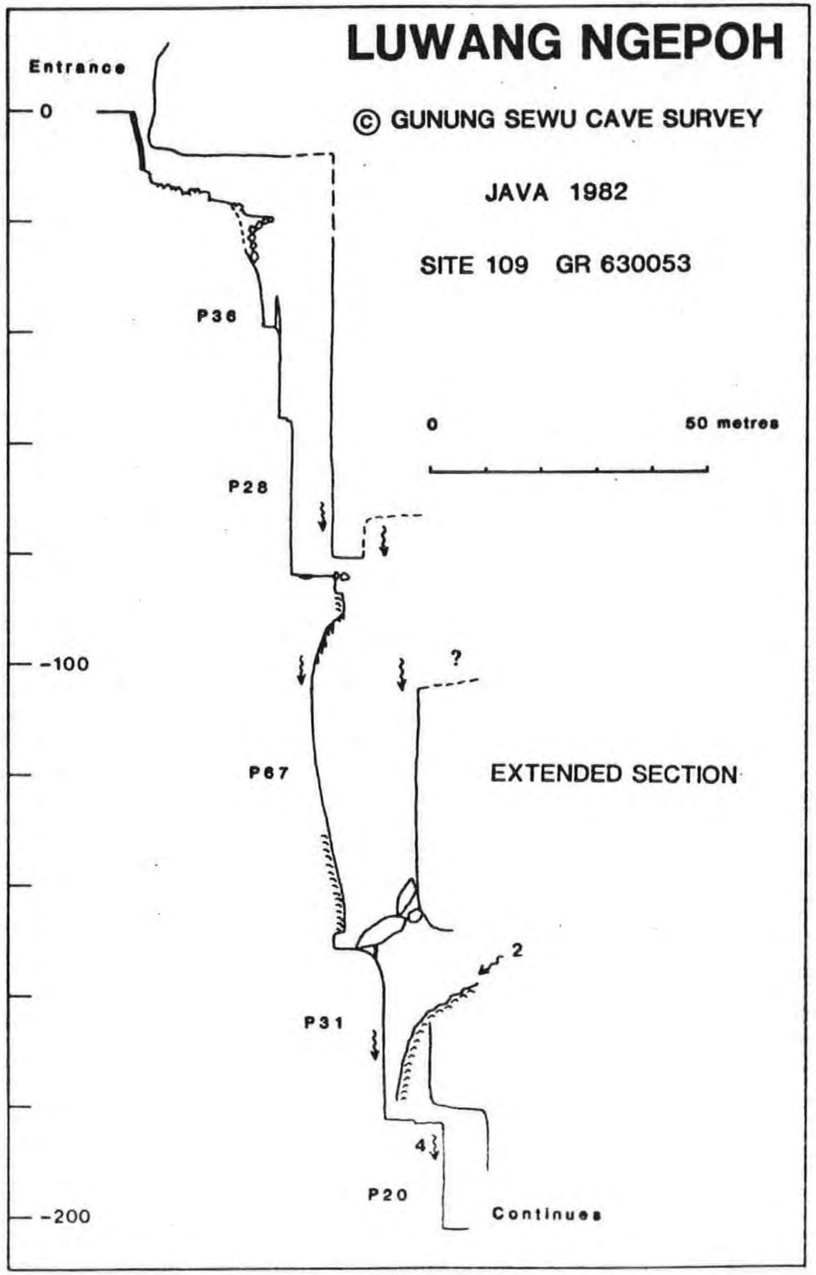


Figure 21

7. Main stream passage in Gua Sodong at Mudal (Eavis)

8. Waterfall inlet in Luwang Ceblok (Waltham)

9. The 63 metre shaft in Gua Lebak Bareng (Eavis)

10. Upper passage in Gua Ngingrong (Waltham)

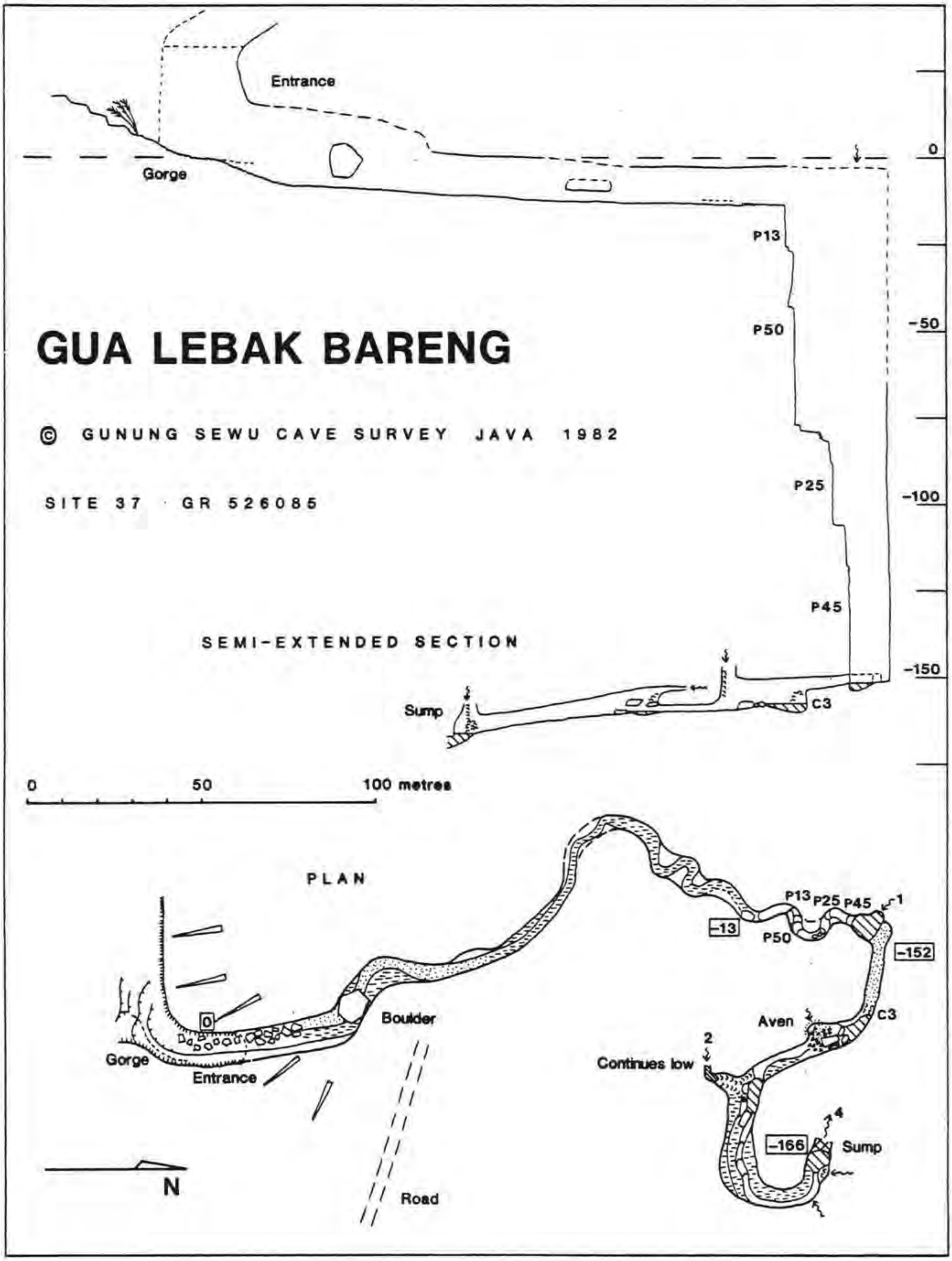

GUA LEBAK BARENG
© GUNUNG SEWU CAVE SURVEY JAVA 1982
SITE 37 GR 526085
SEMI-EXTENDED SECTION
Entrance
Gorge
P13
P50
P25
P45
Sump
C3
0
-50
-100
-150
0 50 100 metres
PLAN
Boulder
Entrance
Gorge
Road
N
-13
-152
-166
P13 P25 P45
P50
Aven
C3
Continues low
Sump
1
2
4

Figure 22

flowstones. A single muddy inlet passage is not completely explored but probably connects to Luwang Sindon. Below the inlet junction a final fast sluice takes the river into its terminal lake over 300 m long, much of which is deep enough to require swimming. Beyond the sump the water is next seen in the flooded rift of the Gua Ngreneng collapse, where the main conduit is frustratingly inaccessible; and from there it has been dye-traced to the Baron resurgence. The Bribin is a fine piece of river cave well worth a visit; life jackets are essential for its exploration together with some float rope for the downstream section.

GUA GILAP
Length 1090 m Depth 71 m Grade 5 survey (Fig. 27).

A large collapse doline has a massive, arched entrance in one wall. A thin path snakes down a long boulder slope well into the darkness zone, right down to the cave stream. The path is heavily used by villagers who depend on the cave stream for their sole dry season water supply. Two failed pump schemes remain in the cave, though better engineering should one day lift the water at least to the daylight area and save the villagers scrambling into the darkness. Downstream the cave sumps in the boulders of the collapse, though a higher level route leads to an undescended pitch which may provide the way on.

Upstream the passage is open and shortly leads to a large chamber with a floor of mud and collapse debris but a roof still intact. Beyond this, the streamway continues as a splendid keyhole gallery with a meandering canyon cut in the floor of a tube over 5 m in diameter. The water flows through an endless succession of gour pools floored with crunchy, crystalline calcite, and most of the keyhole ledges are decorated with white stalagmites. The upstream sump is created where the roof plunges into a pool ponded behind a gour-covered zone of collapse debris. Upstream of its chamber, the Gilap cave is one of the best decorated in Sewu and provides easy and most enjoyable caving.

GUA SODONG (Dadapayu)
Length 2075 m Depth 90 m Grade 5 survey (Fig. 28).

The almost level entrance passage is normally dry as far as a pool 200 m from daylight. This is heavily used by villagers for both washing and abstraction; their journeys in and out using paraffin torches have left black soot over all the walls, and too often a thick stinking fog hangs in the cave. It is a uniquely unpleasant cave environment, which should soon be eliminated by a new well from the roadside to permit direct abstraction from the cave pool.

The cave beyond the pool was explored through a 3.5 m sump, which can be free-dived with care, though it disappears late in the dry season as the pool level drops. Beyond the sump, the pool continues with long and very low ducks when the level is high. The pool ends at a gravel bank after which the passage continues 5 m high and wide. It keeps this size to the end of the cave, but for the great majority of its length it has a narrow, meandering, vadose canyon cut up to 5 m deep in its floor. The canyon is mostly a metre wide, so not difficult, and its interminable twists and turns are relieved by a few deep pools, some cascades and a couple of handline pitches. The canyon is only developed in some sections as it was cut by waterfall retreat in the original stepped profile of the cave; where the canyon is missing, the cave is spacious and quite well decorated. The terminal sump comes as rather a disappointment; the promise of further lengths of gently graded passage is provided by the dye trace to the Bribin cave sump also at high level.

GUA SODONG (Mudal)
Length 4290 m Depth 46 m Grade 5 survey (Fig. 29).

A fine dendritic stream cave system with three major branches, Sodong is the longest known cave in Sewu. Its entrance is normally crowded with villagers who use the water from an inlet just inside. The main flow leaves the passage and is thought to go via Luwang Sapen to the Northern Tributary. Heavily polluted overflow fills pools in the passage beyond, and these constitute a very serious health hazard. Once the pools are traversed the cave becomes progressively more pleasant, as a high tunnel provides easy walking broken by two short handline pitches and long canals, with one area of decorated chambers.

The Main Stream Passage is mostly a high canyon, with a sizeable stream along its whole length of nearly two kilometres. The water emerges from the top sump, flows through a succession of pools, small cascades and waist-deep canals, and eventually feeds into the terminal sump from where it has been dye traced to the Pracimantoro spring two kilometres away and on almost the same level.

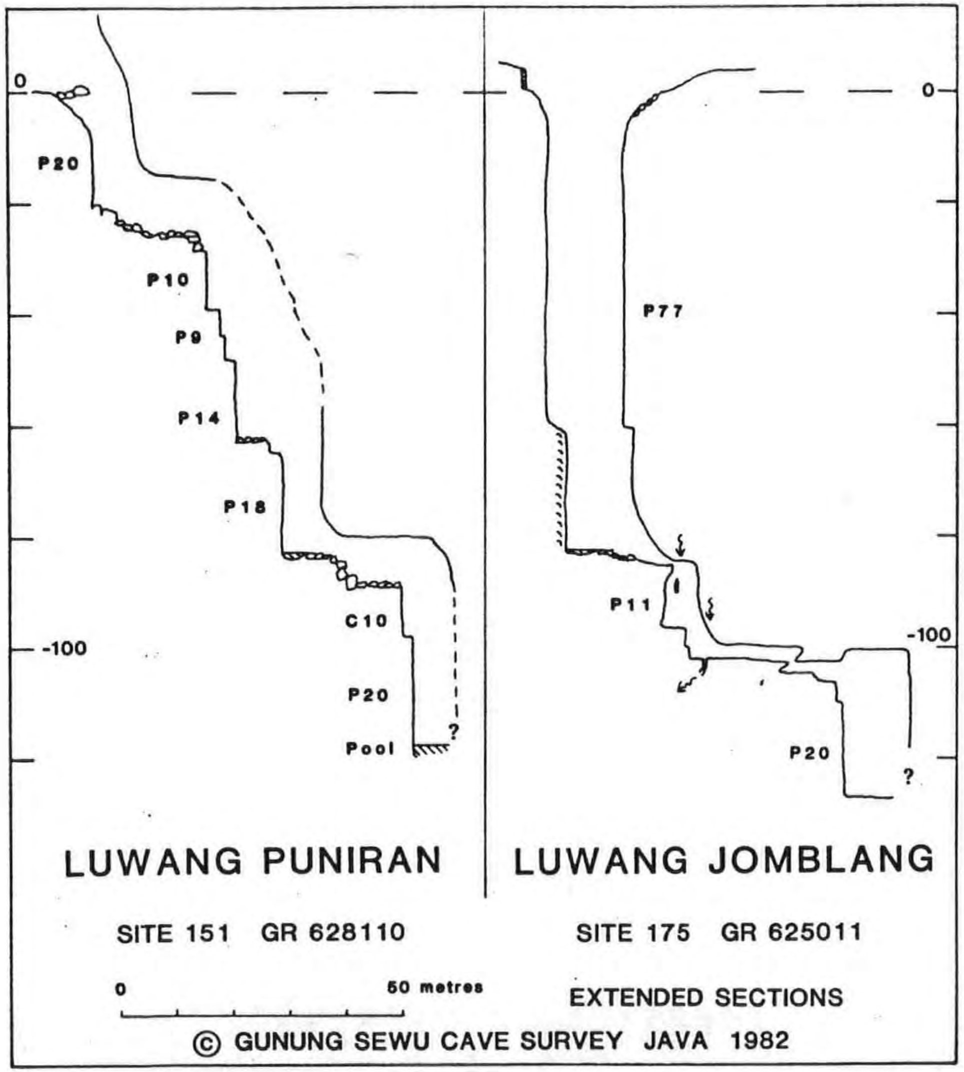


Figure 23

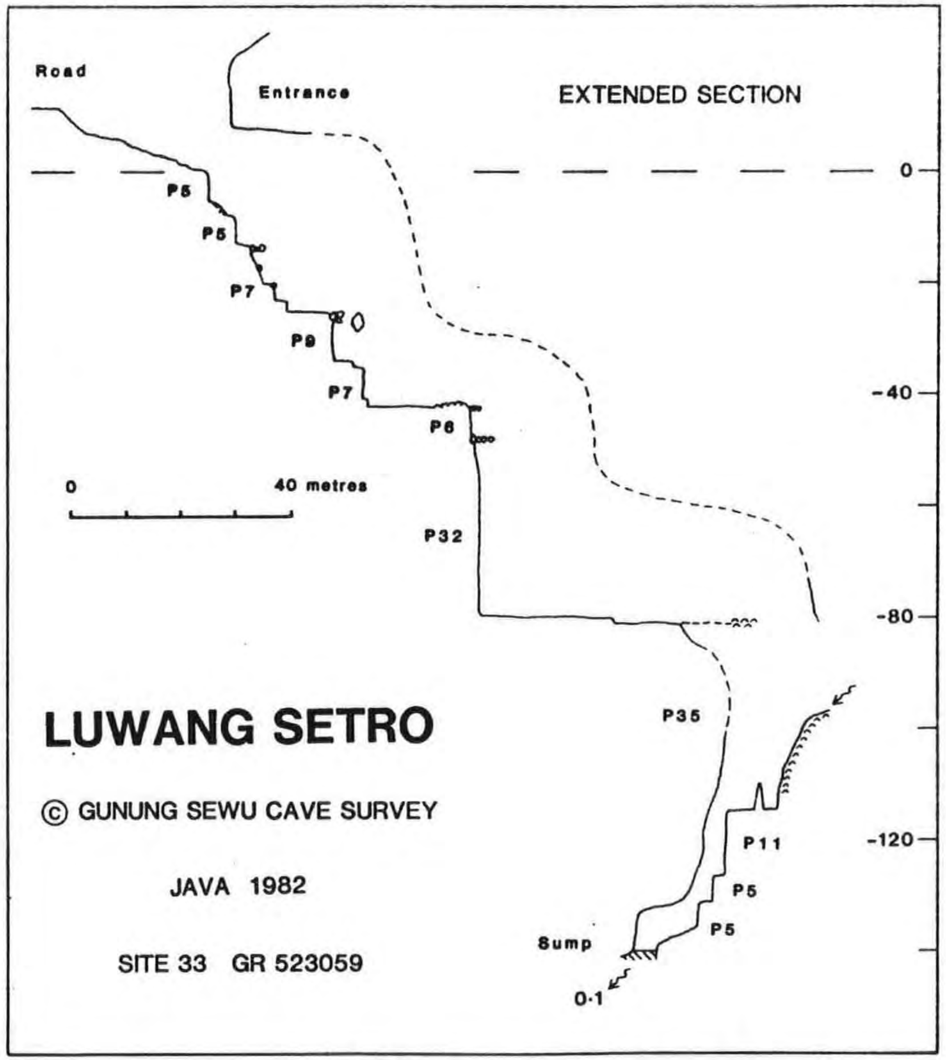


Figure 24

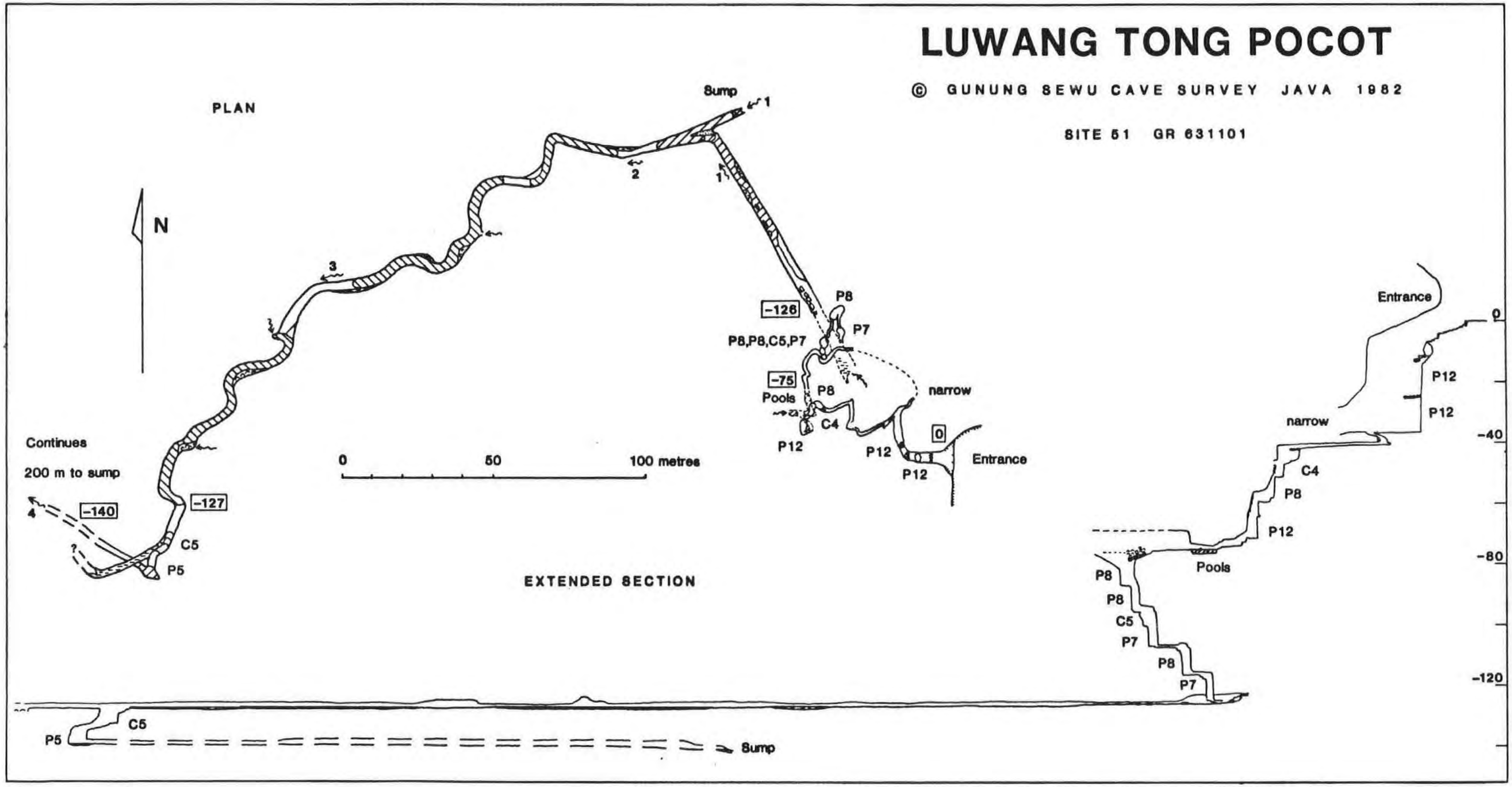

LUWANG TONG POCOT
© GUNUNG SEWU CAVE SURVEY JAVA 1982
SITE 51 GR 631101
PLAN
N
Sump
1
2
3
4
-126
P8
P7
P8,P8,C5,P7
-75
Pools
P8
C4
P12
narrow
0
Entrance
Continues
200 m to sump
-140
-127
C5
P5
0
50
100 metres
EXTENDED SECTION
Entrance
P12
narrow
C4
P12
Pools
P7
P8
0
-40
-80
-120
Sump

Figure 25

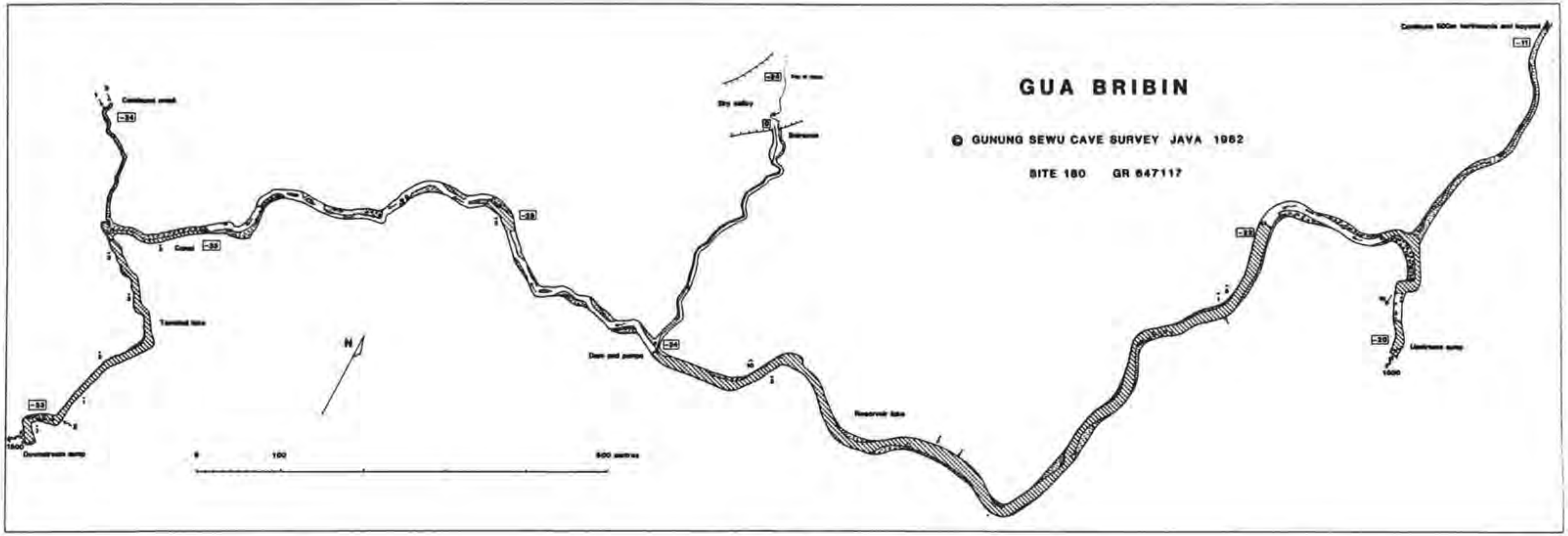

GUA BRIBIN
© GUNUNG SEWU CAVE SURVEY JAVA 1982
SITE 180 GR 647117
N

Figure 26

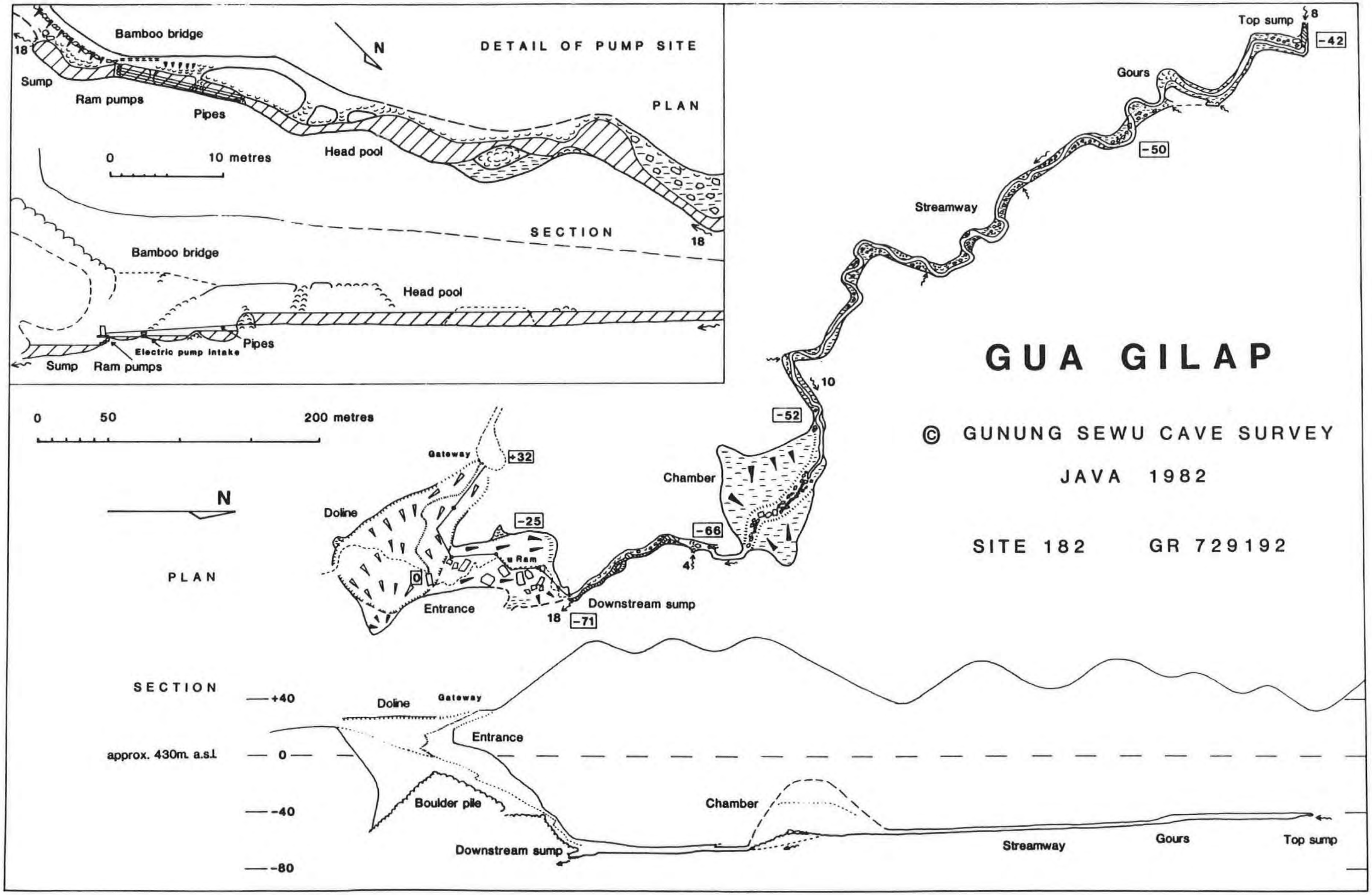

DETAIL OF PUMP SITE
PLAN
SECTION
N
Bamboo bridge
Sump
Ram pumps
Pipes
Head pool
0
10 metres
18
Electric pump intake
GUA GILAP
© GUNUNG SEWU CAVE SURVEY
JAVA 1982
SITE 182 GR 729192
Top sump
8
-42
Gours
-50
Streamway
10
-52
Chamber
-66
4
Downstream sump
-71
-25
Ram
+32
Gateway
Doline
Entrance
0
50
200 metres
PLAN
SECTION
+40
approx. 430m. a.s.l. 0
-40
-80
Boulder pile

Figure 27

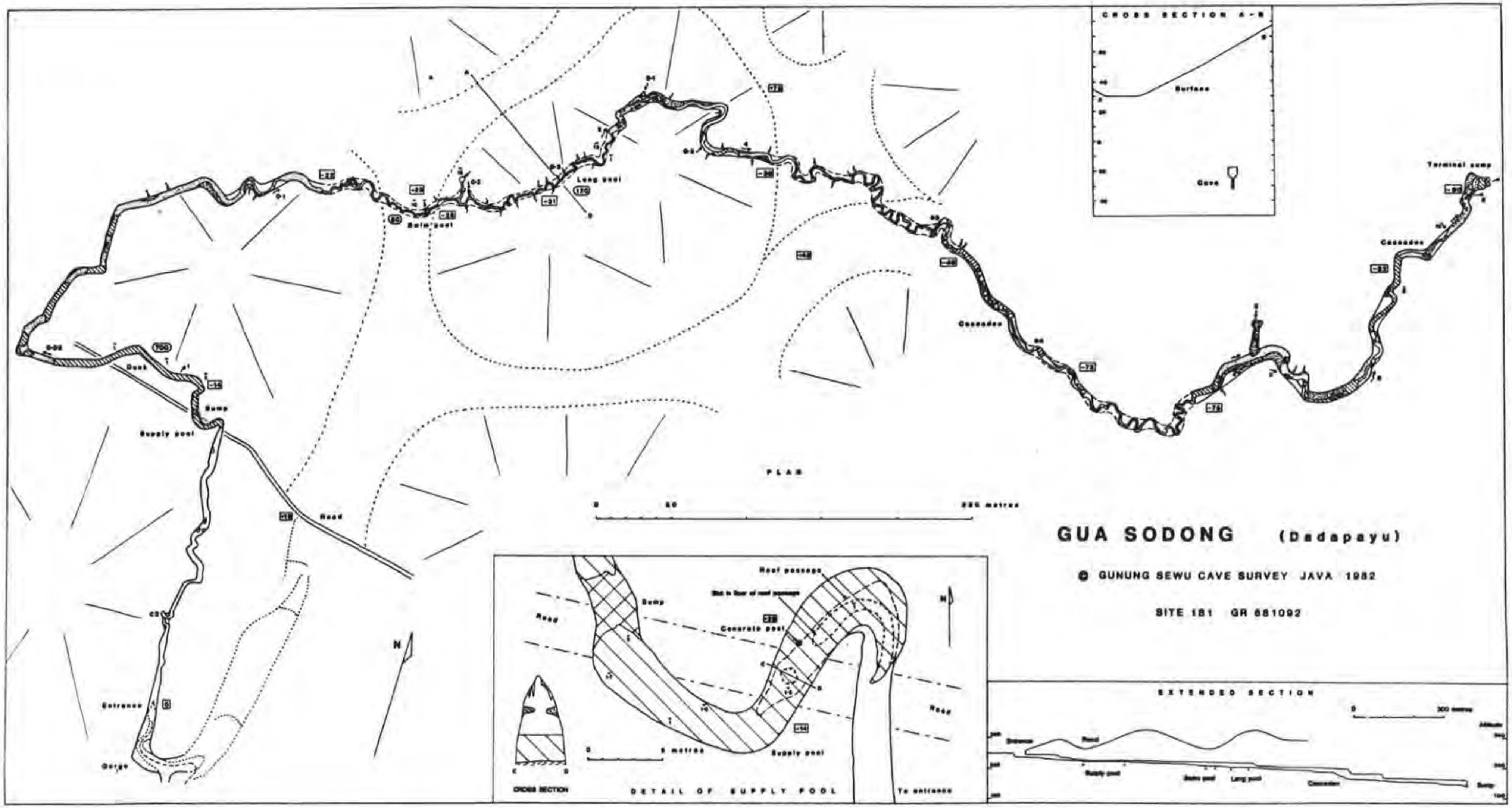
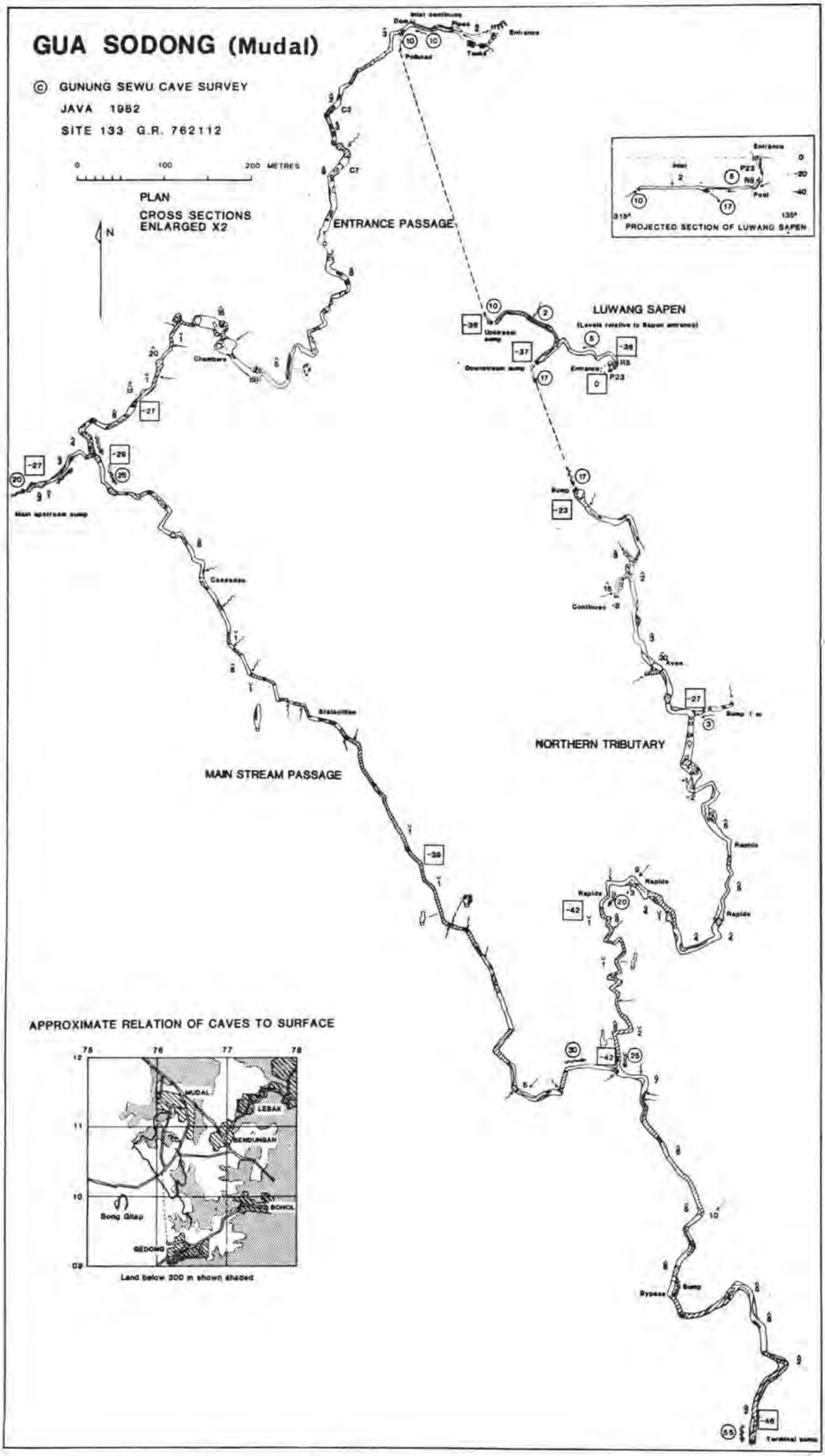

GUA SODONG (Dadapayu)
© GUNUNG SEWU CAVE SURVEY JAVA 1982
SITE 181 GR 681092
PLAN
CROSS SECTION A-B
Surface
Cave
EXTENDED SECTION
DETAIL OF SUPPLY POOL
CROSS SECTION
Terminal sump
Cascades
Long pool
Swim pool
Supply pool
Sump
Duck
Entrance
Gorge
Road
Roof passage
Concrete pool
To entrance
5 metres
N

Figure 28



GUA SODONG (Mudal)
© GUNUNG SEWU CAVE SURVEY
JAVA 1982
SITE 133 G.R. 762112
0
100
200 METRES
PLAN
CROSS SECTIONS ENLARGED X2
N
ENTRANCE PASSAGE
LUWANG SAPEN
PROJECTED SECTION OF LUWANG SAPEN
Chambers
Main upstream sump
Cascades
Stalactites
MAIN STREAM PASSAGE
NORTHERN TRIBUTARY
Rapids
Bypass
Sump
Terminal sump
APPROXIMATE RELATION OF CAVES TO SURFACE
MUDAL
LEBAK
BENDUNGAN
BOHOL
GEDONG
Song Gilap
Land below 300 m shown shaded

Figure 29

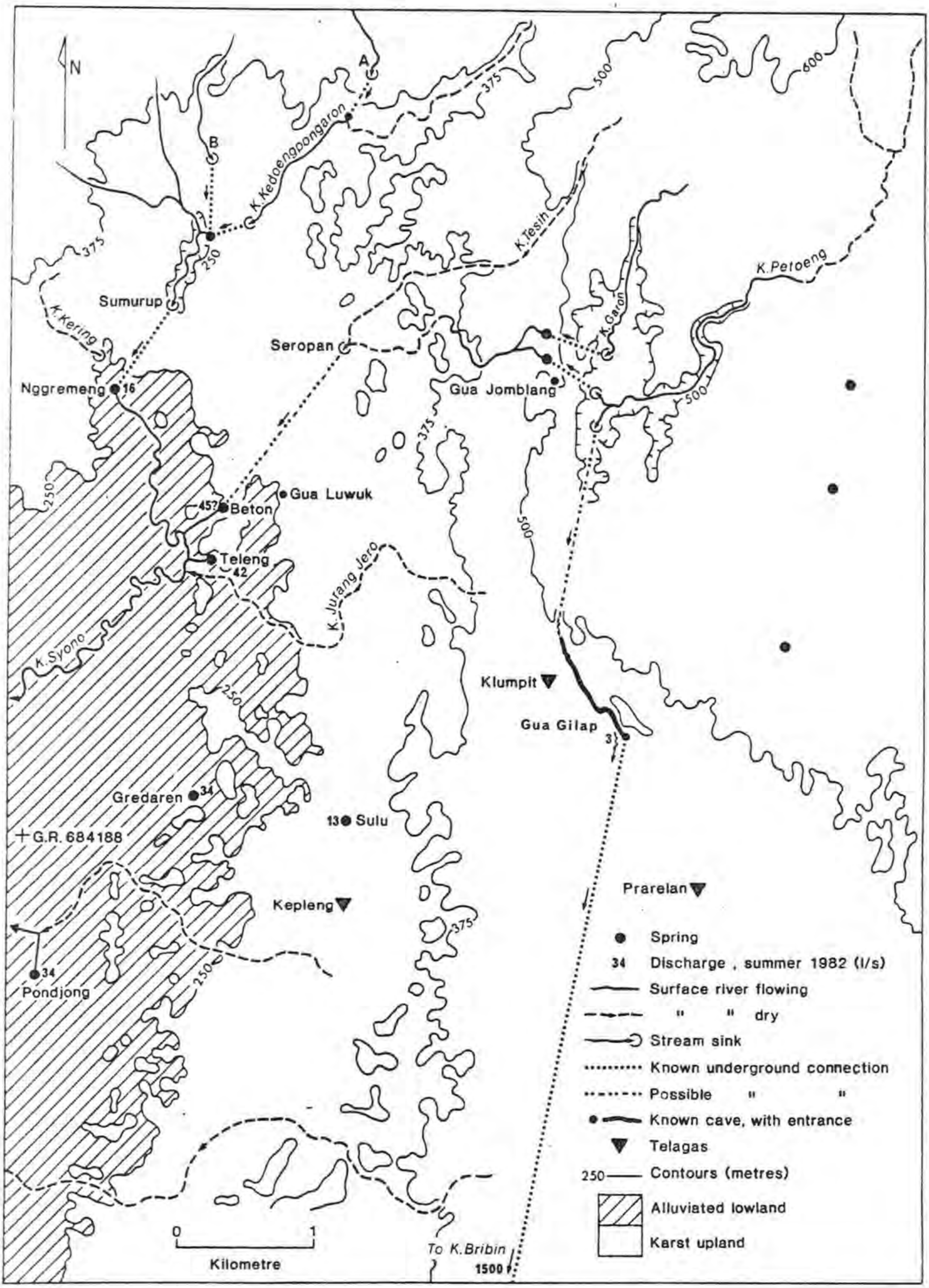


Figure 30 Northern Gunung Sewu

The Northern Tributrary is a long inlet, again a meandering canyon for almost half its length, and containing deep water. In its upper reaches its morphology becomes more complex with branches, high-level chambers and oxbows, some of which contain spectacular displays of white calcite deposits including stalactites, stalagmites, gours and cave pearls. These decorations complement the long streamways to make Sodong a very fine system different in character from most of the Sewu caves.

CAVE GEOMORPHOLOGY

In general the cave passages show little relationship to geological structure, mainly due to the rather featureless nature of the Gunung Sewu limestones. Some shafts and isolated segments of rift passage are developed on obvious joints or faults. Bedding planes control a handful of passages, notably in Sumurup, Tong Pocot and Grubug, but the interbedded volcanic ash units appear to have a regional influence (for example, in the perching of the Bribin streamway) greater than their barely visible control on individual passages.

The only major topographic influence on the caves is provided by the supply of allogenic water from the Wonosari Plateau. This accounts for the majority of the larger cave passages occurring along the northern margin of Sewu. Even with the existence of the inter-cone valley systems, catchment areas for the shaft caves in the heart of the karst are limited and most passage sections are quite small.

In contrast, the caves show a close relationship to the water table. They have an overall pattern of classic simplicity which relates closely to the theoretical flow of groundwater. Nearly all the vertical or steeply inclined caves are essentially vadose, while nearly all the horizontal conduits have phreatic origins. This situation existed in the past, giving the few high level, since abandonned, horizontal caves, and continues to the present where most drainage descends rapidly to a low-level water table even with such great distances to the resurgences. The dominance of this pattern perhaps reflects the poor geological influence in most of the aquifer.

The vadose shaft caves are of three types. The single shafts only occur as such because their deeper continuations are blocked by sediment or collapse; they may be either relatively cleanly sculpted cylindrical shafts such as Jomlang 10, or may be collapse-modified bell shafts such as Goplak. Of the multiple drop systems there are two types. Some were initiated on a stepped profile with a degree of geological influence, and have developed into a succession of separate shafts links by short canyons or rifts,for example at Tong Pocot and Jalak Bromo. Others started as a more irregular steeply descending route, from which deep canyons have been cut commonly developing into a stepped floor profile, as at Setro and Puniran. With the inclusion of the many shorter explored caves, the latter type probably dominates.

In various caves,stalagmite deposits and passage rerouting show evidence of past phases of development, but no widespread patterns have yet been recognised and correlation with surface changes would still be premature. Some shafts do intersect isolated segments of very old phreatic cave. Additionally, those shaft systems that lead into level conduits all show phreatic origins in their level sections; those in Lebak Bareng and Tong Pocot are good examples. In most of these cases it appears that the nearly level conduits originated just below the contemporaneous water tables, and the subsequent fall in water table levels has been relatively slight. Karang is, however, distinctive in that it has a marked phreatic level 45 m above the present sump level; its location, close to the water table trough from the northern sinks to the Baron resurgence, may indicate a relationship between the greater water table lowering and the development of the major conduits. Buhputih is a singular example of a cave with a more complex morphology. It has both a high-level vadose canyon and also a lower conduit section, but the intervening series of shafts is broken by another more gently graded section. This is probably controlled by the geology but may also relate to a past phase of phreatic development.

The caves with greater lateral extent all show evidence of phreatic initiation. This may appear as either fine keyhole passage profiles (as in both the Sodongs and Gilap), abandonned high level phreatic galleries (as in Grubug) or relatively unmodified phreatic tunnels (as in Bribin and Sumurup). Individual systems are generally not complex enough to identify long histories of development easily, but the sediment sequences, including some spectacular bone beds, in some caves appear to have a value for future research.

The relatively little incision from originally shallow phreatic caves in those systems in the heart of the cone karst, notably Bribin and Sodong (Dadapayu), suggests limited and slow water table lowering in these areas (though the picture may be locally distorted by geologically influenced perching). In contrast the caves of the northern marginal zone show much deeper incision and abandonment, notably at Grubug. This appears to relate to the more extensive development of caves in this zone fed by the Wonosari Plateau drainage, followed by more rapid and greater water table lowering in response to the increasing efficiency of the main conduits feeding directly to the Baron resurgence.

CAVE BIOLOGY

Unfortunately the Gunung Sewu caving team did not include any biologists, but the members did observe some features of the cave life which contrasted with their experience in tropical caves elsewhere. Various species of small bats occurred in most caves, and it was surprising that they penetrated to the very ends of even the longest caves. The bats had their usual generous collections of parasites, and on a number of occasions were seen to have a marked enthusiasm for swimming (or were very incompetent at taking a drink). Large colonies of bats were not found, and only the Serpeng and Grubug caves were seen to contain more than a few hundred individuals. In the entrance to Gua Serpeng, villagers use catapults to shoot the bats down from a 20 m high roof, and then take them to the local market to sell as food. There are relatively few cave swiftlets, although they are reported in large numbers from caves further southeast in Sewu.

Snakes are a normal hazard of tropical cave entrances, and a few exciting and nerve-racking encounters were experienced. Further into the caves very few snakes were seen. The nearly static pools and lakes in the seasonally active river caves of the northern marginal zone were distinguished by populations of huge black eels over a metre long and as thick as a man's arm. They had spectacular sets of teeth and a rather aggressive character, thereby rather enlivening the swims necessary to get to and from the bottoms of ropes on the pitches.

Of the smaller animals few spiders of any size were seen, but there are large numbers of the evil, black, tail-less whip scorpions which range up to the size of a man's hand. In the streams, white shrimps are common, and some caves contained large white crayfish and semi-transparent catfish. Small white crabs were common, as were normal darkly coloured frogs; some frogs in the entrance shafts exhibited amazing climbing abilities when they could progressively jump up and cling on to a vertical wall.

POTENTIAL FOR FUTURE EXPLORATION

Many incompletely explored caves are described above or appear in the appendix register. The Luwang Register also notes about 50 other known but unvisited sinkholes; Gunung Sewu provided far more than could possibly be examined within the scale of the 1982 project. Locating any of these entrances is easy because most villagers know by name the luwangs nearest to their homes. The best exploration potential probably lies in the zone of river sinks along the northern margin, where many inviting holes were left undescended because the main objective of 1982 lay in the shafts of the central area. There are also many other entrances which can easily be found by walking and asking questions in many parts of the cone karst.

The 1982 work never extended east of Pracimantoro or north of Gua Gilap. The edges of the cone karst on its northern extension contain a number of sinks and risings which appear to be linked by open cave (Fig. 30). East of Pracimantoro there is a large area of karst mostly awaiting its first visit by cavers, although Specavina members did descend the 120 m deep bell shaft of Luwang Ombo within this region; and Ombo was later explored by visiting French cavers to a depth of 230 m through 2900 m of large passages. Maps of the eastern end of the karst mark a number of sinking and rising rivers which could well repay investigation.

All cave exploration in Java is coordinated by the national body, Specavina (currently c/o Dr. R.Ko, P.O. Box 55, Bogot, Indonesia) and foreign groups should work with Specavina as closely as possible. Cooperation should not only help Specavina to develop, but foreigners will benefit immensely if they can be joined by Javanese speaking cavers. Any future expedition to Sewu would also be well advised to consult the writers' full 1982 report which is kept in the

BCRA library, and is welcome to contact any of the writers who can provide various additional data. Finally, future visitors to Gunung Sewu are reminded that the above cave descriptions are based on dry season descriptions, and most exploration is probably impossible in the wet season.

THE GUNUNG SEWU CAVE SURVEY

This was the official title of the exploration project which was carried out by the writers in 1982. The background to the Survey is of particular significance because it was one of the few instances where cavers have been contracted to explore caves specifically on an economic basis, in this case for the purpose of assessing groundwater resources.

Severe water shortages each dry season have become part of the way of life in Gunung Sewu. Not only is there inadequate water for any economically beneficial irrigation schemes, but during the dry seasons there is in many areas a complete lack of surface water, and even resources for drinking supply are desperately scarce. Traditionally, dry season supplies have come mainly from the artificially dammed telagas, most of which dry up at some time during the season, and from a number of shallow accessible caves. Better organisation of rainwater catchment from roofs, together with repairs to telaga dams, have created some improvements in the recent past. Additionally, isolated schemes to pump water from the caves have been established, for example at Bribin and Gilap, but currently none of these pump schemes is in full working order.

Since the late 1970s, Indonesia's Ministry of Public works and Britain's Overseas Development Association have jointly financed a large groundwater project centered on Yogyakarta, with Sir M. MacDonald & Partners of Cambridge as consultant engineers. Gunung Sewu lies within the area of this project. Adrian Young is the field engineer with responsibility for Sewu, and he initiated a programme of telaga improvements. He also realised that various isolated attempts to utilise the groundwater had generally not been efficient; notably a series of 13 boreholes in the limestone had mostly been dry or produced uselessly small yields. Furthermore, overall planning for the economic development of even the known sources could not proceed until the water resources of the karst aquifer were properly assessed. He wanted a team of cavers to carry out direct exploration of the sinkholes, and he therefore contacted the Royal Geographical Society, who passed his request on to the writers.

After various discussions at Cambridge, a one-man recce with Adrian Young in 1981, and some tedious "political" hassles, the project was established. The contract was simply that two two-man teams should explore and map as many sinkholes as possible in a search for useable water resources. A part-way changeover involved a fifth caver, and some overlap was invaluable to the water-tracing programme. Excellent facilities, in terms of living and transport, were provided at Wonosari, and searching for entrances was eliminated by two of the local groundwater staff, Mas Sudiyono and Mas Untung, compiling the bulk of the Luwang Register before the cavers arrived. All this combined to leave the cavers almost nothing to do except explore the caves. Adrian Young and Sudiyono in particular discovered the joys of cave exploration, but most work was done just by the teams of two experienced cavers as this was faster with so much vertical work.

The object of the exercise was to find water. Exploration of "likely" passages was the prime task. Caves with water were then surveyed to grade 5, and dry caves of any length were just surveyed to grade 3. Extensive programmes of dye tracing and water quality testing were carried out at the same time. Cave geomorphology, photography and exploration of dry caves were relegated to incidental roles.

Economically useable resources really had to be one of two types. The first were small streams or pools generally at depths of less than 30m, which could be exploited by direct access or hand dug and operated wells. The second were major streams or large lakes at depths up to about 100m, which could support abstraction schemes using boreholes and submersible pumps. The lack of finance in the rural economy of Gunung Sewu favoured the first type in the short term, but the latter have valuable long-term implications.

A number of useable resources of both types were found. In some caves, improved access or diverted cave streams could make a site viable. Some well and borehole sites were pinpointed using Bob Mackin's Molephone, where the target cave passage was only a few metres wide. Unfortunately the Molephone could not be used at the greater depths due to the shielding effect of the low resistance ash beds within the limestone, but grade 5 surveys were considered accurate enough for a borehole to hit a cave lake 10 m or more in diameter. After the first phase of explorations it was realised that the main conduits from the northern zone of river sinks to the Baron resurgence all lie at very low level, probably mostly in the phreatic zone; there was therefore little chance of gaining access to major underground rivers in explorable caves within the central part of the Sewu Karst. This did enhance the value of the anomalously high level Bribin cave river, but its descent via the Ngreneng cave into the deep watertable trough eliminated prospects of further downstream access to it. The balance of exploration effort therefore shifted, with greater importance attached to finding small perched resources within the shaft systems of the central area; many caves were therefore left unexplored where they descended to depths from which small resources could not be exploited economically.

Exploration of a karst aquifer can hardly ever be considered complete, but the 1982 programme in Gunung Sewu was considered to be well worthwhile. A large proportion of the sinkholes was explored at a cost equivalent to that of about four boreholes. Some resources with immediate potential were discovered, and five sites have been budgeted for development within 1983. Other long-term resources have been discovered, and the proper assessment of the aquifer can now permit economic planning of future water supplies throughout Sewu using a beneficial combination of telagas, small cave supplies and larger pumped schemes.

ACKNOWLEDGEMENTS

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March 1983

APPENDIX

GUNUNG SEWU LUWANG REGISTER

All known sinkholes in Gunung Sewu have been recorded in this register, in a sequence reflecting only the date of investigation. For each site, the number, name and grid reference are followed by brief details except for those caves described in the text of this paper. Surveys and further details of a number of the sites are in the main report (Waltham et al, 1981). Names are abbreviated as: G=Gua or cave; L=Luwang or sinkhole; S=Sumber or spring. After the grid reference, L=explored length, D=explored depth, P=pitch and C=climb, all in metres. The grid and all entrance locations in the central part of Sewu are marked on figure 4.

1 L Bodeh 740102 Descending passage, unvisited.
2 L Ceblok 615128 See text
3 L Goplak 538068 See text
4 G Karangwetan 515099 50m passage to narrow canyon, continues
5 L Bendo 663113 Small entrance, unvisited
6 L Karang 658114 Descending passage, unvisited
7 L Karanglampar 659114 P40, unvisited
8 L Jurangjero 668115 Shaft, unvisited
9 L Kenteng 621004 See text
10 L Jomblang 613032 See text
11 L Song Gupit 609137 P56 to choke
12 L Sumbring 612148 Climb and P60 to choke
13 L Balong U 612030 Entrance too small
14 L Balong B 612030 Entrance too small
15 L Sumberejo 612028 Entrance too small
16 L Blekonang 607024 See text
17 L Gesik 602030 Entrance too small, draughts
18 L Bentar 598078 D60, Climb and P10 to large canyon and choke
19 L Ngrapah 588078 Choked chamber
20 L Glesung 587112 D70, P25, C8 and P21 to choke
21 L Jomblang 579111 Unvisited
22 L Macanmati 574111 Unvisited
23 L Nglibeng 565067 Walled up sinkhole with draught, needs digging
24 L Kerwo 574063 D45, P10 and P20 to choke
25 L Jomblang 575057 Small shaft, choked
26 G Jurug 565074 Large passage to mud choke
27 L Karang 573051 No open cave
28 L Tabuhan 573082 L200, C4 and mud passage to P4 into sump
29 L Soroiten 543105 Narrow canyon to P20 undescended
30 L Krinjing 537108 D60, P55 to mud slope and sump
31 L Gowah 534108 D99, Pitches of 5,70,6,4 and 4 to impossible rift
32 L Tlogodadi 526081 P25 to chamber with choke and inlet passage
33 L Setro 524058 See text
34 L Katok 524049 D55, Climb to P5 and P15 to chamber with sump
35 L Jowa 514048 Canyon with P12 into chamber with sump
36 L Ngegong 509028 Blocked shaft
37 G Lebak Bareng 526085 See text
38 L Bamban 528087 Large shaft probably connects with 37
39 L Tlogolaran 509094 Blocked shaft
40 L Mbibres 512073 P8 to choked chamber
41 L Gelap 613020 D72, P60 to canyon to sump
42 L Ngoro-oro Ciut 507073 P40 on loose wall to passage and P30 undescended
43 L Bawongan 498073 L200,P20 and canyon to P20 undescended
44 G Tritis 512060 Small tourist cave, unvisited
45 L Gunung Beteng 607105 P40 continues vertically, floor unseen
46 L Puring 597107 P30 and slope to mud choke
47 L Bawahan 598097 Small shaft, choked
48 L Buhputih 644082 See text
49 L Sindon 640112 P34 and P20 into canyon and P8 undescended, may connect to Bribin
50 L Ledok 634103 P12 and P5 into canyon, too narrow to continue
51 L Tong Pocot 631101 See text
52 L Ledok 738101 Narrow shaft unvisited
53 L Cahkeri 735118 P30 unvisited
54 L Jumbleng 726035 P7 to choked chamber
55 L Gading 754036 D112, P68 to canyon and P25 to sump
56 L Sirik 746043 D48, P33 and rift to sump

57 L Sawah 725078 P5 to choked chamber
58 L Sruput 717079 D65, P40 to boulder slope and choke
59 G Blunyah 713086 Passage to P18 and large canyon to mud choke
60 G Kalen 704090 L150, Low passage to P29 and P7 into canals to choke
61 L Ombo 727116 P8 unvisited
62 L Sawah 718112 Unvisited
63 G Semuluh 644139 See text
64 L Towati 690070 Blocked sink
65 L Sumur 693037 P40 to 100m of streamway to undescended narrow pitch
66 L Jurangjero 693037 Unvisited
67 L Ngandong 687045 Shaft, unvisited
68 L Ngimbes 686045 Unvisited
69 L Kluwangan 692012 P8 to choke
70 L Glaragahumbo 693001 Slope to P30 to mud choke
71 L Sirih 680006 Two blind climbable rifts
72 L Pucang 688994 P70 to ledge at top of undescended P30
73 L Kenteng 680982 Small blind hole
74 L Gondang 682995 C7 to choked chamber
75 L Wates 417118 Descending passage, unvisited
76 L Soka 416114 Descending passage, unvisited
77 L Ngrau 411118 Shaft, unvisited
78 L Ngledok 390127 Descending passage, unvisited
79 L Ceme 387129 Cave, unvisited
80 L Bandung 397128 Unvisited
81 L Ngurik 386123 P10 unvisited
82 L Legundi 376116 P15 into doline collapse and choked chamber
83 L Soga 376108 Descending cave, unvisited
84 L Bledok 371110 Double shaft, unvisited
85 L Ngrejek 500098 D51, P28 and P12 into chamber with sumps
86 G Ngowe-owe 496104 120m passage to head of undescended P80
87 G Ngegab 492091 Canyon to P8 and choke
88 L Gondang 499089 P20 unvisited
89 L Trecep 486076 P10 unvisited
90 G Kenongo 491079 L160, D85, Passage then P20, P20 into choked chamber
91 L Bobak 487066 Unvisited
92 L Klepu 490053 Large passage to mud choke
93 L Jomblang 476057 P23 and climb to mud choke
94 L Santen 464060 Blocked sink
95 L Klumpit 440050 P15 to choke in rift
96 G Klumpit 439049 P20 to choke
97 L Banteng 432058 D75, Pitches of 30,17,7,6,4 and 9m to sump
98 L Karang 501047 See text
99 L Tlempek 505041 Shaft, unvisited
100 L Kuang 435074 Shaft too narrow to enter
101 G Jurug 583137 Descending passage, unvisited
102 G Glendu 591139 L100, Canyon descends gently to sump
103 L Kebo 580130 Low passage, unvisited
104 L Bedesan 574124 See text
105 L Gedilan 576126 Shaft, unvisited
106 L Jero 612088 See text
107 L Pendul 602078 D45, Canyon with climbs becomes too narrow
108 L Wuluh 623063 P8 and P25 into choked rift
109 L Ngepoh 630053 See text
110 L Toar 623045 C15 and canyon to undescended P20
111 L Besole 628033 P70 to boulder floor choke
112 L Puleireng 596034 D50, Shaft behind dam on telaga floor, with pitches of 30, 8 and 8m to undescended P12
113 L Mundu 628029 D62, Pitches of 10, 38 and 8m to canyon and sump
114 L Ledok 624038 Pair of sinkholes, one has P10 into complex of rifts not descended, other has P15 to choke
115 L Gebang 636045 P10 to P25 undescended with much loose rock
116 G Pengangson 662158 Two sinkholes to sumps
117 L Ngrinjing 693126 Unvisited
118 L Grigak 700108 Unvisited
119 L Jalak Bromo 684066 See text
120 L Nglampeng 595085 Unvisited
121 L Purung 628087 Unvisited
122 L Jambu 623088 Unvisited
123 L Nujo 730105 Unvisited
124 L Kalen Unvisited
125 L Jarak 735065 P30 to mud choke
126 L Gedawung 588125 Shaft, unvisited

127 L Cabe 586125 Shaft, unvisited
128 L Blerong 369142 L120, Passage to P10, chamber and duck, continues
129 unnamed 456040 L165,D51, Series of climbs in canyon to sump
130 L Tjabe 591062 Blocked sink
131 L Bandung Sumuran 492120 P40 and climbs to choke, unvisited
132 -
133 G Sodong (Mudal) 762112 See text
134 G Songgilap 755101 Large entrance and climb to choke
135 L Watugajah 727048 Small entrance, unvisited
136 L Suh Kidul 728032 P8 to choked chamber
137 L Gendek 728031 See text
138 L Jurug Watu 575036 Shaft too narrow to enter
139 L Ngirowari 578036 P40 to terminal rift
140 L Gupakwarak 528018 C10 to choke
141 L Blubug 573070 Small cave with C5 to choke
142 L Tirisan 596074 D35, Climbs to choke
143 L Mojing 603063 Climbs and P10 to mud choke
144 L Branjang 1 588032 C25 to mud choke
145 L Branjang 2 588032 D40,P20 and canyon becomes too narrow.
146 L Bete 778091 D28, P16 into two choked chambers
147 L Gadjah 778089 Small choked shaft
148 S Sodong 359129 Stream cave in doline, sumped both ways.
149 S Sungei Besar 358135 Large entrance blocked by choke
150 S Ngerenean 462023 Large resurgence on beach, no cave
151 L Puniran 628110 See text
152 unnamed 533113 Air photo feature, unvisited
153 unnamed 527115 Cave passage, unvisited
154 unnamed 539122 Air photo, unvisited
155 unnamed 607094 Air photo feature, unvisited
156 unnamed 605186 Air photo feature, unvisited
157 unnamed 610078 Air photo feature, unvisited
158 unnamed 619087 Air photo feature, unvisited
159 L Bendo 657138 P5 and climb to low bedding plane
160 L Lebuh 677130 L100 Large entrance to canyon, narrow but continues
161 L Sapen 763108 L250, P36 into small streamway, sumps both ways
162 G Kajubang 422076 Passage to blocked chamber
163 L Pringwulong 432084 P8 and P35 to terminal rift
164 L Ngampal 458056 P25 to choked rift
165 unnamed 438103 Unvisited
166 G Ngreneng 635130 Large doline with choked passes and flooded rift
167 G Toto 619139 L925 Large entrance to streamway, upstream through boulder chambers to choke, downstream to sump
168 G Kedokan 637063 Descending passage to sump, used for water supply
169 G Jomblang 733158 L354, Complex of small streamways, used for water supply, downstream continues small but promising
170 G Ngingrong (Mulo) 549126 See text
171 L Ngiratan 638058 See text
172 L Sumelap 639065 D43, P32 into streamway, continues
173 G Pozo 640075 Cave, unvisited
174 G Tritis 537072 Climb to undescended P15
175 L Jomblang 625011 See text
176 G Buri Omah 597142 See text under Gua Suci
177 L Ngelo 625037 Narrow canyon in sharp rock, continues
178 L Bohol 716018 L175, D57, P35 and climbs to passage, continues low
179 L Daren 742998 See text
180 G Bribin 647117 See text
181 G Sodong (Dadapayu) 681092 See text
182 G Gilap 729192 See text
183 L Serpeng 1 559128 D86, P60 in large shaft to passage and sump
184 L Serpeng 2 557127 See text
185 S Slili 564995 Short passage to large sump pool; springs on beach
186 S Sundak 567994 Short cave to deep sump pool; springs on beach
187 S Baron 500016 Major resurgence, 100m river cave to sump .
188 S Ngobaran 453026 Climb into large chamber with stream sumped both ways; springs on beach
189 G Song Tawing 603122 L355, D69, Large entrance with high levels, and smaller canyon through pools to undescended P7
190 L Grubug 600127 See text
191 L Kenteng 731067 Sinkhole with loose boulder floor choke.
192 L Gunung Bolong 595316 P70, unvisited
193 L Ngluweng 708042 P25, unvisited

194 L Pengangson 377075 C8, P20 and P10 to sump
195 L Glagah 377087 L150, D48, P18 to descending rift one way and P24 other way to streamway to sump
196 L Macanmati 395107 P13 to streamway to undescended P8
197 L Seropan 577118 See text
198 L Besole 378081 Rift with pitches of 5,10,12 and 12m, continues narrow
199 S Pondjong 684178 Major resurgence, no cave
200 L Jati 715133 P55 to ledge and undescended P45
201 S Pracimantoro 787097 Major resurgence, no cave
202 unnamed 753059 Unvisited
203 S Piyuyon 773946 Major resurgence on beach, cave 5m to sump
204 G Bendungan 697095 Low passage with pools to undescended P15
205 unnamed 623022 Air photo feature, unvisited
206 unnamed 350119 Unvisited
207 L Wediwutoh 637137 D35, Canyon to mud choke
208 L Jurang 634132 D20, Steep passage to sump
209 G Suci 601147 See text
210 unnamed 587142 Blocked sink
211 unnamed 574140 Choked sink
212 unnamed 576117 P8 to undescended pitch
213 unnamed 587119 Undescended P8
214 G Song Dangal 594119 L100, Large entrance to canyon to mud choke
215 unnamed 595111 P22 to mud choke
216 G Serpeng 562127 Large river sink with sump just out of daylight
217 L Banteng 522122 River distributary sink choked with mud
218 G Sumurup 519120 See text
219 unnamed 507131 Cave passage, unvisited
220 G Grengseng 536060 Short fossil stalagmite cave with small chambers
221 unnamed 510067 Unvisited
222 unnamed 499063 Unvisited
223 unnamed 458042 Unvisited
224 unnamed 445129 Air photo feature, unvisited
225 L Cikal 418134 Cave, unvisited
226 L Gondosore 412129 Cave, unvisited
227 unnamed 358152 Cave, unvisited
228 L Pongkok 585136 Unvisited
229 L Songjembul 707124 P40 and rift to undescended P12
230 G Tritis 567057 Blocked large cave entrance
231 G Brangking 536017 Short cave to sump pool
232 G Tepus 761113 Short tourist cave
233 S Wonoseri 656970 Rising, no cave
234 S Mutisari 670977 Rising, no cave
235 S Beton 698213 Rising, no cave
236 S Beton 796118 Rising, no cave
237 -
238 S Teleng 699209 Unvisited
239 S Puring 682996 Rising too narrow to enter
240 S Sambiroto 797088 Unvisited
241 S Gedaren 697190 Rising, no cave
242 S Sulu 711189 Unvisited
243 S Nggremeng 691220 Unvisited
244 S Karangmojo 473173 Unvisited
245 S Umbuldenkok 550149 Unvisited
246 S Penuh 502154 Unvisited