

KUNENE REGION

NAMIBIA 2015

KAOKOLAND SPELEOLOGICAL EXPEDITION REPORT



Main Passage in Omungongo (MT)

COMPILED BY MARK TRINGHAM WITH CONTRIBUTIONS FROM ALL CAVERS WHO TOOK PART

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GENERAL NOTES

All locations are reported using WGS84 geodetic system with degrees and decimal degrees. Data from earlier exploration by others used the Namibian Schwarzeck system (Bessel 1841 ellipsoid) which matches published geographical maps. Schwarzeck data was converted to WGS84 using web based conversion software to make it possible to use Google Earth satellite imagery and GPS instruments. All map figures have north at the top.

Photos contained in this report are credited to the photographer using their initials and remain copyright of the individual concerned.

All cave exploration was performed using good quality dust masks and with oxygen or carbon dioxide meters and any other visitors are strongly recommended to follow the same precautions. Lethally low oxygen levels were found at one site. No participants caught histoplasmosis (a fungal lung infection transmitted in bat guano) but that is not proof positive for absence of it in this region.



Surface terrain near Camp Aussicht & the Ochre Mine (DA)

1. SUMMARY

A team of 5 UK and 2 French speleologists visited Kaokoland in Kunene Region Northern Namibia for an 18 day expedition during September 2015. Planning for the expedition through the earlier part of 2015 comprised literature research, correspondence with earlier cave explorers and study of geological maps and publications. The expedition received an invitation and in-country support from IRDNC – Integrated Rural Development and Nature Conservation, an NGO who wanted any caves evaluated for potential tourism resource and conservation.

The expedition used 2 camp locations, one at Opuwo and one at Camp Aussicht. These locations were used to access cave objectives identified either from Google Earth or from local information. Many cave objectives were found to be too short to be of interest (<10m) or blind dolines, however 7 new caves of moderate length were found and evaluated. The longest and most impressive of these was Ondimba ja Omungongo (Cave of Omungongo) which was found to be 358m surveyed length and 59m deep. Two further new caves found were each nearly 100m long and the remaining 4 caves were each around 25m long.



Main Passage in Omungongo (MT)

The caves are formed in Neoproterozoic (PreCambrian) dolomite and limestone of the Otavi Group and located on faults or other fractures. The caves are likely to be of hypogenic origin with no obvious relation to present day surface drainage or topography. The caves explored contain morphologies consistent with



Fault aligned passage and mummified steenbok antelope in Mundumithe (MT)

this mode of origin. Many of the caves start with vertical pitches between 10m and 25m deep, followed by inclined passages and chambers leading down to sediment chokes.

The caves explored contain significant bat populations and the original expedition objective of recording species present had to be deferred until a future year after sufficient permits for collection are obtained. Ondimba ja Omungongo in particular had a large bat population with metres deep banks of dried bat guano in many parts. Other fauna of interest included 5 small mummified antelope found in Ondimba ja Mundumithe, probably Steenbok, which had become trapped after jumping or falling into the 3m deep entrance pitch. In another cave Ondimba ja Okavau the expedition found the skeleton of an Oryx which had been the subject of local folklore from several decades ago when a local hunter was said to have chased it with his dogs and in trying to escape the unfortunate animal had jumped into the 22m deep entrance shaft and been lost, the hunter returning empty handed. This cave also has an unusual tree root system down the entire entrance shaft.



The 22m deep entrance pitch at Okavau with tree roots and oryx horns at the bottom (MT)

All the new caves explored and numerous other sites had entrance locations shown to the expedition by local villagers. The entrances are mostly quite small and require local knowledge to find. The team was also directed to a few previously explored sites recorded in the 1990s by Namibian and South African cavers but only 2 of these were explored, the massive Orumana Sinkhole which contains 2 large chambers one of which is cathedral sized and Blister Pot which is less interesting. Because IRDNC and local villagers were previously unaware exactly what type of features the expedition team was keen to explore, extra time was required and fewer entrance locations visited than if this was not the case. Therefore in subsequent years any further expedition is likely to be able to make quicker progress with prior identification of cave sites in advance of expedition arrival in the field. It can be expected that many more hypogenic caves of similar character will be found in this region where Otavi Group dolomite and limestone formations occur.

2. INTRODUCTION

2.1 OBJECTIVES

The principal objective of the expedition was to locate and explore new caves in karst areas between the towns of Opuwo and Sesfontein in NW Namibia (Fig. 1). Caves in this part of Namibia have not received much attention from either local or international explorers since teams from Namibia and South Africa were there around 1990 to 1994. During 2014 local conservancies had asked IRDNC to determine what caves are present in the area, have them explored and determine what environmental or tourism value

they might have and what protection measures would be appropriate. IRDNC in turn approached GSS who have members who are part-time South African residents, bat experts and have worked in other areas of Namibia previously. GSS communicated with these previous explorers from Namibian National Museum and S. African clubs and determined the details of what previous cave exploration had been done. Also a literature search was done and a systematic study made using Google Earth to try and locate any new cave entrances.

The previous work in the 1990s indicated mostly vertical shaft entrances present up to around 120m deep located in hilly limestone and dolomite karst terrain, but the caves described had little horizontal development. Elsewhere in Namibia caves up to 5km length such as Dragons Breath and Arnheim caves have been found in the same geological formations and it was hoped that similar horizontal cave development might be found here also.

Initial plans included biological objectives with identification of bat species and determination of their habitats. Also if any discovered caves reached the water-table then there was considered a high chance that specialised aquatic fauna might be found, as has been the case elsewhere in Namibia, with for example unique blind cat-fish species discovered. However during the expedition planning it became clear that the necessary permitting for collection of biological material would not be available in time. Therefore this initial plan was deferred until a future visit and instead the expedition planned to locate and photograph any noteworthy bat or other biological sites.

A further objective was to determine the speleogenesis in this presently very arid area and determine the relationship between the caves, paleo-climate and local geology. The geology is of particular interest in that a thick >500m Precambrian carbonate sequence accumulated 750 to 610 Million Years ago prior to evolution of any hard-bodied organisms such as corals or shell-fish. The carbonate deposition instead was dependant on algal and bacterial mats to secure the calcareous sediment. Also any water resources found would be of particular interest to the local population.

The specific areas to be investigated were decided upon in collaboration between the expedition cavers and IRDNC after enough information had been gathered to indicate that further exploration for caves in the area was worthwhile. This was done using camps at Opuwo and Camp Aussicht near the village of Otjimatemba.

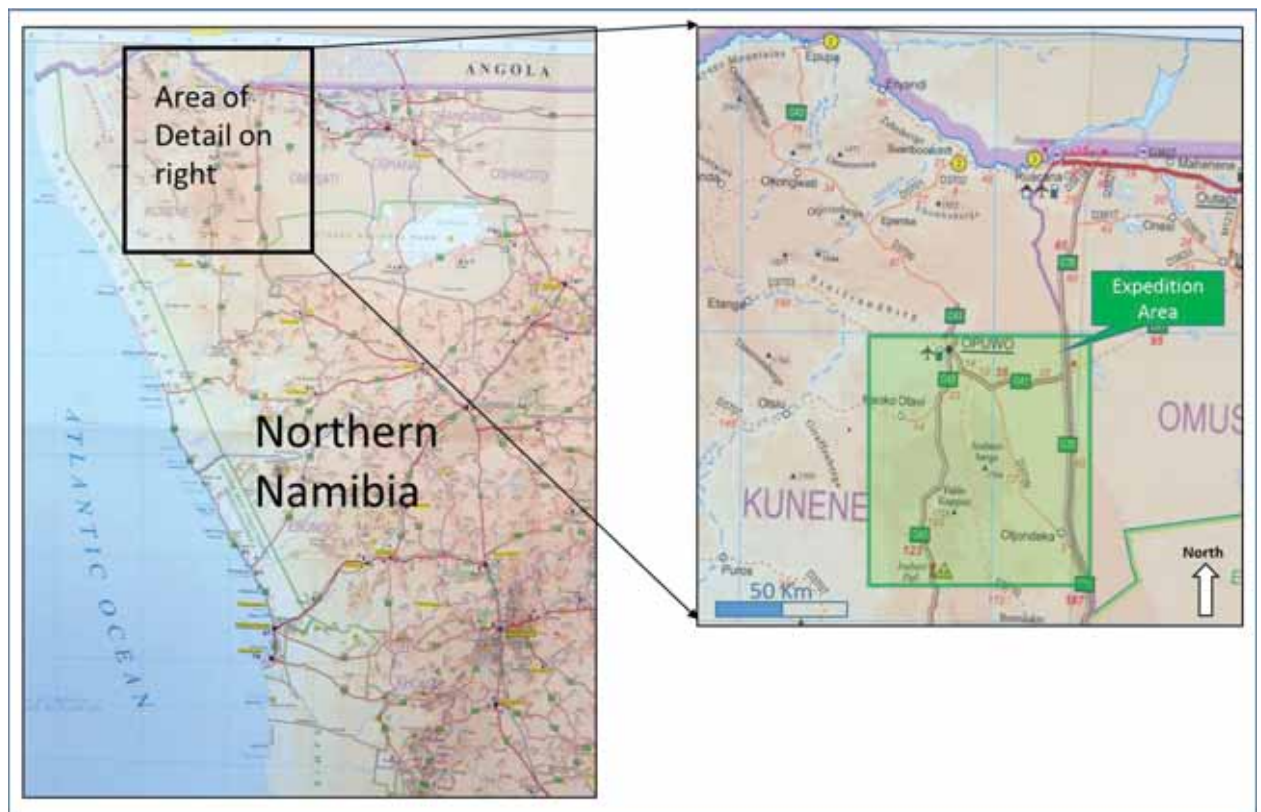


Figure 1 Location map of the expedition area

2.2 THE TEAM

7 speleologists were invited to attend by IRDNC under the leadership of Mark Tringham with a core of GSS members and others from the UK clubs Hades and BEC and the French club GSV as shown below. This mixed team was formed based on previous expedition experience together in India, Ethiopia and Greece as well as caving in the UK. Comprehensive in-country support was provided by IRDNC under the management of Basilia Shivute and leadership in the field by Roger Collinson. This ranged from transport, food and camping logistics to local liaison. Dave Kangombe, Titus Rungondo and Katipo Nguna have local liaison responsibilities for IRDNC with certain conservancies and they therefore led the liaison requirements.

CAVERS



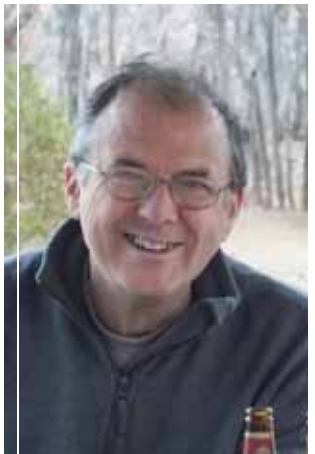
Mark Tringham
Gloucester Speleological
Society (GSS)



Henry Dawson
Bristol Exploration
Club



Dave Appleing
GSS



Robin Weare
Hades Caving Club



Joe Duxbury
GSS



Antoine Aigueperse
Groupe Speleologique
Vulcain (GSV)



Patricia (Patou) Gentil
GSV

NAMIBIAN SUPPORT



Roger Collinson



Rosalia Andreas



William Collinson



Dave Kangombe



Titus Rungondo



Katipo Nguna



Diana Tumbukee



Stein Katupa



Kagwana Ambambi



Jendery Tganeb



Duncan Gilchrist



Agnes Samases

2.3 TRAVEL TO KUNENE REGION

The UK Cavers departed on the 5th September 2015 on a flight from London and met up with the French expedition members at Johannesburg International Airport on the morning of the 6th. The second leg of the journey was a 2+ hour flight from there to Windhoek airport. The flights were uneventful and on arrival the cavers received a warm welcome from IRDNC staff who had come to meet us with three 4x4 vehicles already laden with camping equipment for onward transportation to Kunene Region. The journey was split over 2 days with around 2 hours for the 125 km journey to Okahandja, north of Windhoek, for an evening meal and overnight stay at Guesthouse Sylvanette. The evening meal and drinks after proved an enjoyable opportunity for all to introduce themselves and discuss the expedition plans.

The drive from Okahandja to Opuwo was a further 650 km via Outjo and Kamanjab and took around 10 hours including a few rest stops. The route passed several game farms and wild areas where the group had their first sightings of giraffes, warthogs, zebras and various antelopes.

In Opuwo tents had already been put up by an advance party of IRDNC staff at the Kunene Village Rest Camp on the outskirts of the town behind The Scents of Namibia perfume factory. Therefore camp was quickly established ready for 4 nights stay. The group found it to be a tidy site with a basic shower block with hot water and a covered cooking area with electricity and lighting.



Figure 2 The route from Windhoek Airport to Opuwo

2.4 GENERAL INTRODUCTION TO THE AREA

Namibia is an arid country with a population of 2.1ml spread over 825,615km². The expedition was based in the northern part of Namibia near the border with Angola, which is the least developed part of the country. The scenery in the area visited is a hilly scrub and with an amazing variety of trees adapted to the arid environment. Average annual rainfall in the area south of Opuwo is around 250 to 300mm and the average annual temperature is around 22 deg C. Because of the predominantly hot sunny climate annual evaporation rates average over 3000mm. Natural ground water springs occur in the dolomite and limestone karst areas, in some places providing a year round water supply. Many solar powered water pumps also extract water from government drilled wells for human and livestock use.

The main 'C' roads between principal towns have a tarmac surface, while 'D' roads predominately have well-graded gravel surfaces. Smaller mostly unmapped and uncategorized tracks lead to many small villages. The main gravel roads are fine for 2 wheel drive vehicles with good ground clearance, but a 4x4 is essential on the minor tracks to access the villages and hills or to go off-road. The expedition did a lot of travelling on minor tracks and off-road to reach the sites of interest for exploration as easily as possible.

Much of Namibia is divided into conservancies and these form distinct areas where responsibility for the protection of the natural environment has been given over to the local population. Each conservancy has a board and chairperson appointed who control the use of natural resources, any hunting or other use of land in the areas concerned. This speleological expedition took place over several conservancies and IRDNC liaised with all of these to inform about the expedition activities and obtain guidance and support.

Two main groups of people inhabit the area, each with their own language. These are the Herero who are generally more settled and the Himba who are semi-nomadic herders who move where the rains fall to take advantage of the best grazing. Each tribe has distinctive clothing and hair styles, the Herero ladies wear large billowing Victorian style dresses and bi-cornered hats, said to originate from German settler days. In contrast the Himba ladies are famous for their short goat skin skirts, bare breasts and very ornamental clay piped braided hair and head dresses. Both tribe's livelihoods are based on intensive cattle and goat grazing and this commonly has resulted in reductions in wildlife and significant long term desertification of the area, particularly around the villages and water supplies. Once the grass is eaten, the ground surface forms a hard surface that is difficult for grass seeds to germinate in and consequently the area is very arid and dusty.



Herero and Himba ladies in traditional dress (MT).

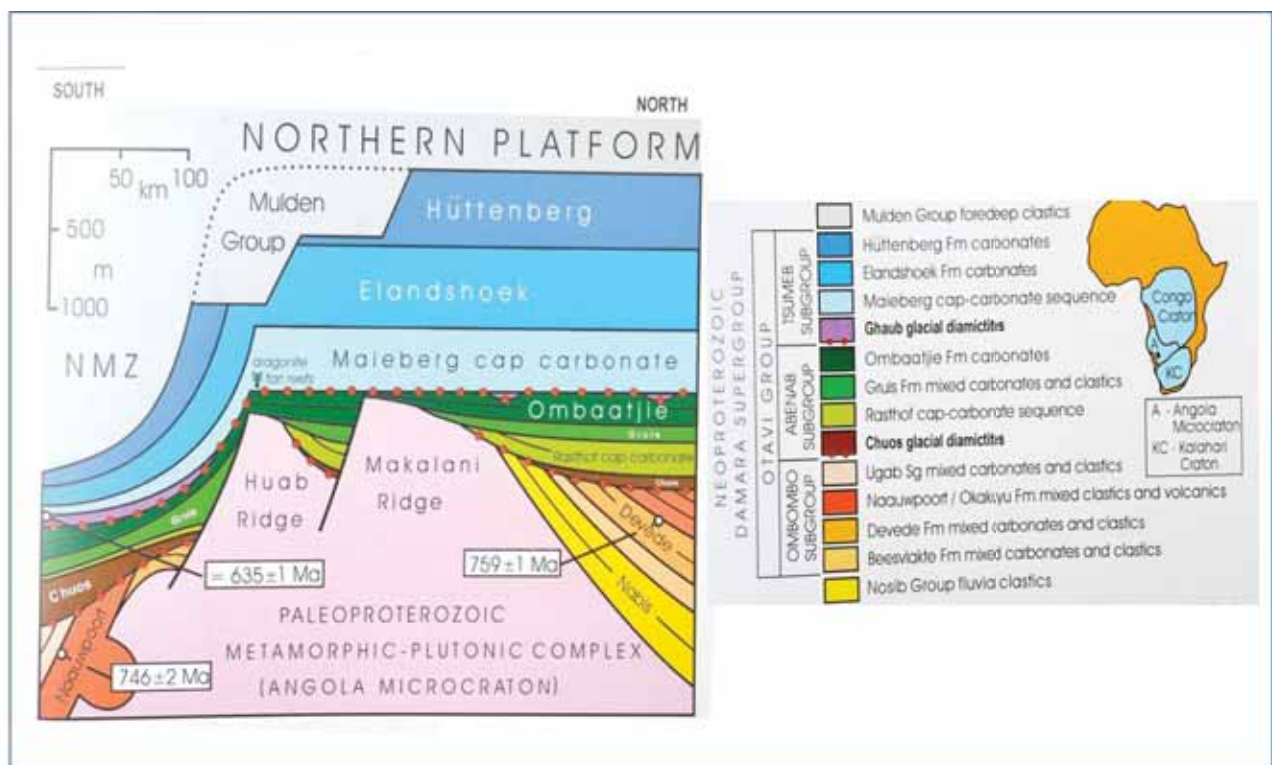
Accommodation for many visitors is at camp sites, some of which have water and basic toilet and shower facilities. Electric power is available at a few of these, but a generator or inverter from the vehicle is recommended for caving expedition electronic equipment. This expedition used 3 sites during 12 days in the field, 2 of which had electricity supplied while the 3rd one at Camp Aussicht did not. At Camp Aussicht

pillar-like forms and sedimentary features include more regularly layered algal laminites, sedimentary breccias and current bedded deposits.



Fossil pillar structures in algal stromatolites (MT)

The warm periods of carbonate deposition were sharply interrupted by at least two widespread glacial periods when iron-rich diamictites were deposited. These are the Ghaub and Chuos Formations which are conglomerate drop-stones characteristic of sedimentation in submarine glacial environments. In other far-flung places such as Canada and South America similar-aged glacial deposits also occur, leading to the theory that a 'snow-ball earth' was established over much of the globe during these glacial episodes.



The Damara Orogen is a metamorphosed fold and thrust belt formed over a former sedimentary basin where micro-plates of the Angolan and S. African Cratons collided during late Neoproterozoic times. The Northern Platform was deformed during the same Orogenic period with mostly North-South trending fold axes and thrust faults which strongly influenced the present-day topography and geological outcrop patterns. The Opuwo to Sesfontein carbonate outcrops and karst areas are bounded to the west by a belt of metamorphic schists with a zone of thrust faults separating the 2 regions (Fig. 3). To the east the carbonate outcrops are flanked by the Etosha Pan where the Otavi Group carbonate rocks mostly occur

at depth beneath a younger cover sequence. Southwards the karst area continues with a sweeping curve to the south-east and east around the south side of the Etosha Pan. Northwards intermittent carbonate outcrops occur in the region north of Opuwo where another change in tectonic trend occurs with fold axes and thrust faults swinging to the north-west and west.

Modern geological and hydro-geological maps and book publications are available for Namibia and copies of some were obtained on loan during Q1 2015 from the Geological Society of London library. These include publications on the groundwater hydrology by A. E. van Wyk et al (2001)², Christelis & Struckmeier³ showing springs and inferred karst underground drainage directions (Fig. 5).

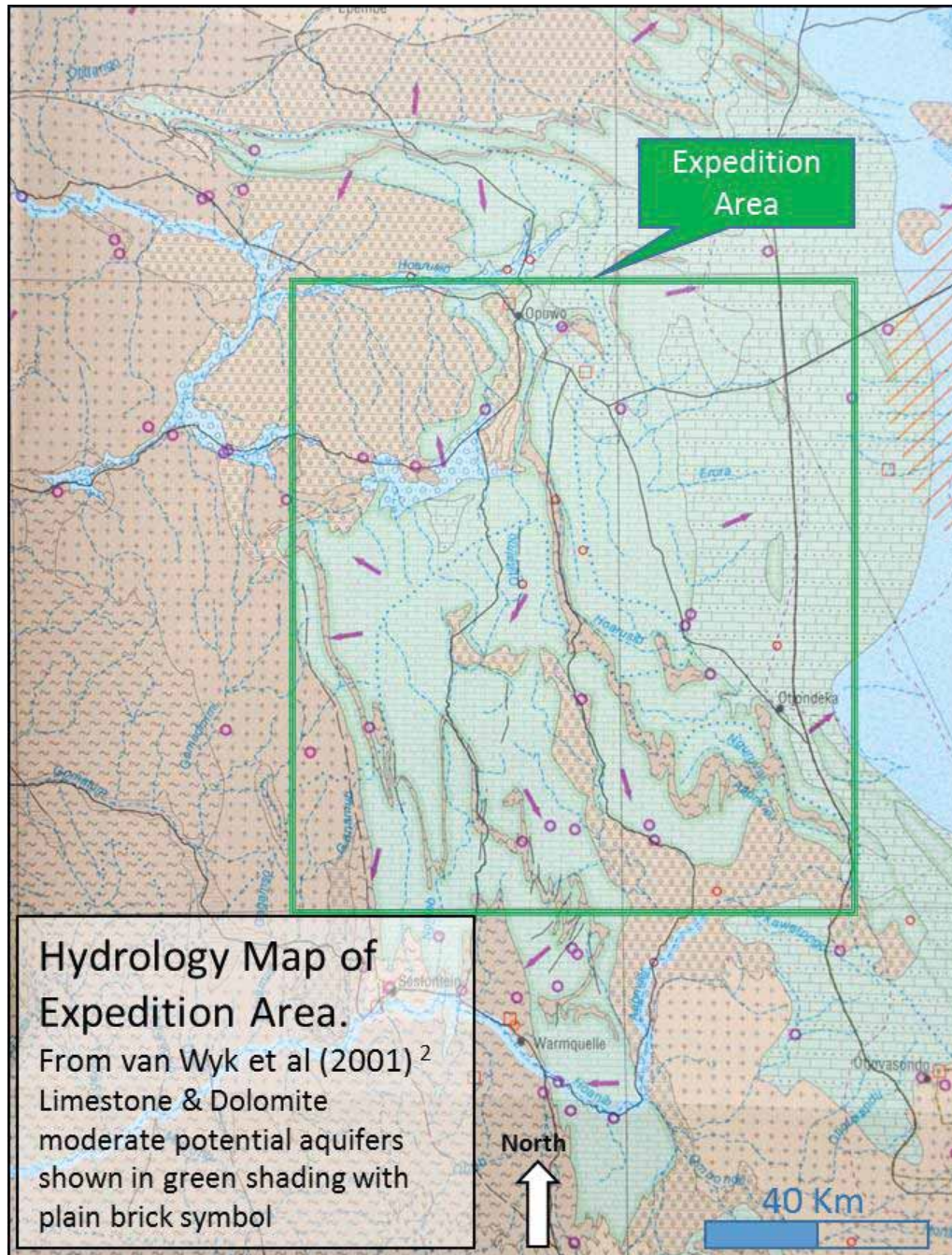


Figure 5 Hydrology Map

² A.E. van Wyk, H. Strub, W.F. Struckmeier (Eds.) "Hydrological Map of Namibia 1:1000 000" Publ. Dept. Water Affairs and Geol. Survey / Windhoek 2001.

³ "Groundwater In Namibia an Explanation to the Hydrological Map" G. Christelis & W. Struckmeier (Eds.) Dec 2011.

The geology observed in and around the explored caves is described in Section 3 under each of the cave descriptions and the main cave locations are posted onto the geological map Figure 6 below.

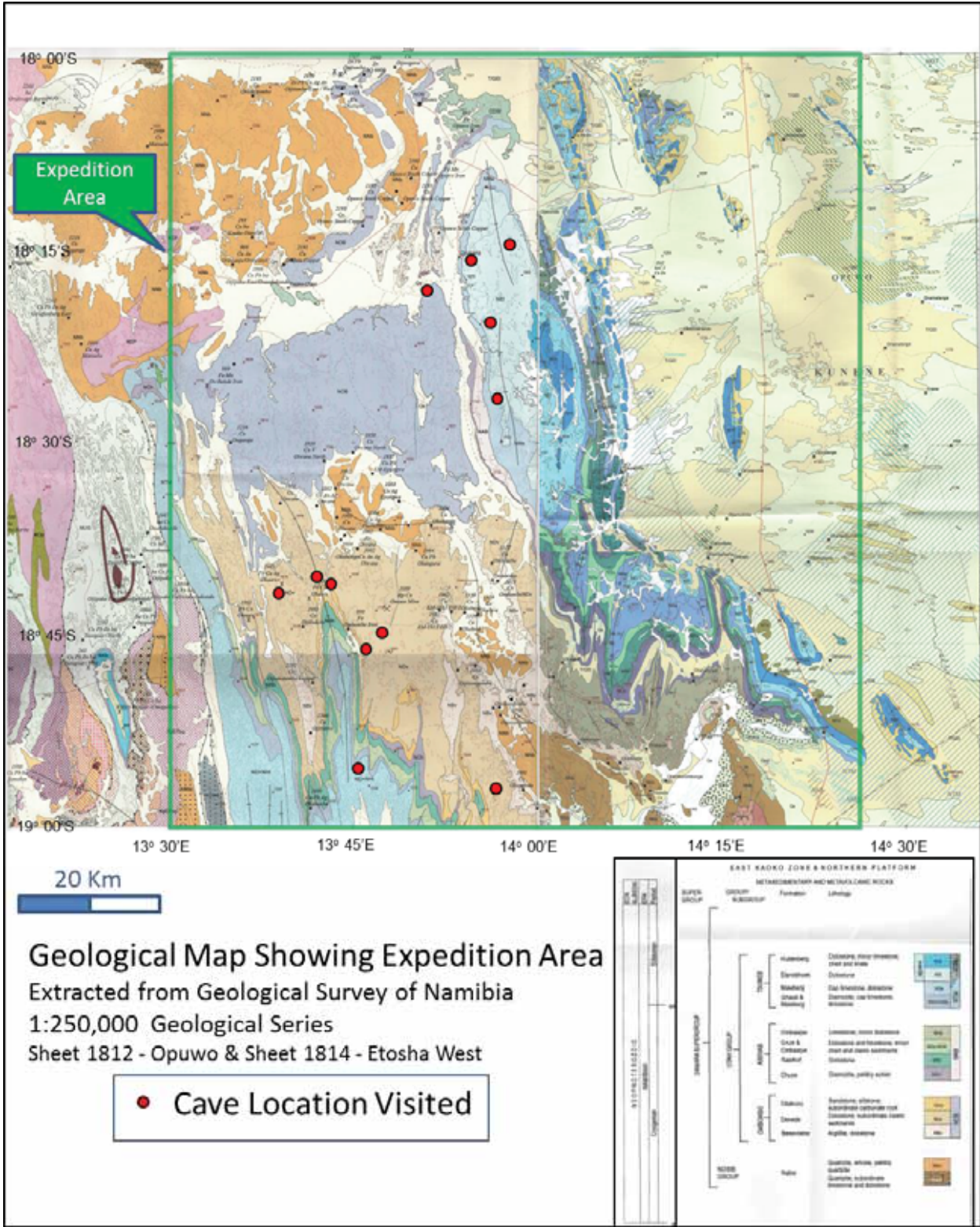


Figure 6 Geological map of expedition area showing cave locations visited

2.6 PREVIOUS CAVE EXPLORATION

The South-West Africa Karst Research Organisation (SWAKNO) explored in this region briefly in 1990. They used aerial photos and located 4 vertical caves mostly with large deep entrance shafts. The

description of the exploration and survey results was published by J.E.J. Martini et al. (1990)⁴. Further exploration by the same group in 1994/5 found some other similar cave sites up to 120m deep. The main results from these further visits and study of the speleogenesis were published in *Karstologia* in 1996⁵ & 1999⁶. All these caves are also listed in the Namibian Cave Registry: <http://www.namibweb.com/cavesreg.htm>. Useful email advice was received during this expedition planning from Eugene Marais a biologist from the Namibian National Museum who was involved in all these explorations, along with advice from S. African cavers active in Namibia. All entrance coordinates from the earlier work were provided in confidence for conservation reasons by E. Marais and having this information largely avoided the risk of inadvertent re-exploration of known sites. Additionally this expedition had email and telephone contact with a local missionary and guide Philippe Zilliox who although not a caver has particular interest and local knowledge on some cave entrance locations.

There is evidence that Orumana Sinkhole (Section 3.1.2) had been explored before 1990 because SWAKNO⁴ reported finding some “very dubious home-made ... ladders”, the rusted remains of which were still there when visiting Orumana Sinkhole during this expedition. It was suggested these had been left by the S. African army.

3. AREAS EXPLORED

3.1 ORUMANA AREA

3.1.1 Overview

4 days exploration was conducted while based at Opuwo as described in the expedition diary (Section 4). The tracks followed off-road in the Orumana area are as shown on Figure 6 below. Orumana Sinkhole was approached from the NE and although previously visited by SWAKNO it was evaluated and photographed for IRDNC. Nearby to Orumana Sinkhole another site was visited which has a vegetation anomaly visible on Google Earth (Feature 5), that was thought possibly related to ground water or cave entrances. However this turned out negative with anomalous tree cover only, probably related to earlier habitation. Figure 6 also shows the route taken around Blister Pot to evaluate Google Earth Feature 8 and try to locate ‘Irish’s lost hole’ reported by SWAKNO, but both proved negative in terms of speleological interest. Also the route south is shown via Okavare Village, from where the knowledgeable Head Man was collected to act as guide to Ondimba ja Omundu and the mini-karst pavement area around Algal Arch. The following day the same guide took the expedition to Wow Gdoo Abyss in the mistaken belief that a new site was available in that area, but then time was still available to travel on to Ondimba ja Omungongo and start the exploration there and this proved to be the best cave discovery of the expedition (Fig. 7).

4. Martini, J.E.J, Marais, J.C.E, and Irish, J., (1990) *Kaokoveld Karst, Namibia, The 1990 SWAKNO Kaokoveld Speleological Expedition*. Bull. S. African Speleological Association, Vol. 31, p.25-41.

⁵ J.E.J. Martini et J.C.E. Marais (1996) *Grottes hydrothermales dans le Nord-Ouest de la Namibie*. *Karstologia* No. 28-2, p. 13-18.

6. J.E.J. Martini, J.C.E. Marais, et J. Irish, (1999) *Contribution à l'étude du karst et des grottes du Kaokoland (Namibie)*, *Karstologia* No. 34-2, p. 1-8.

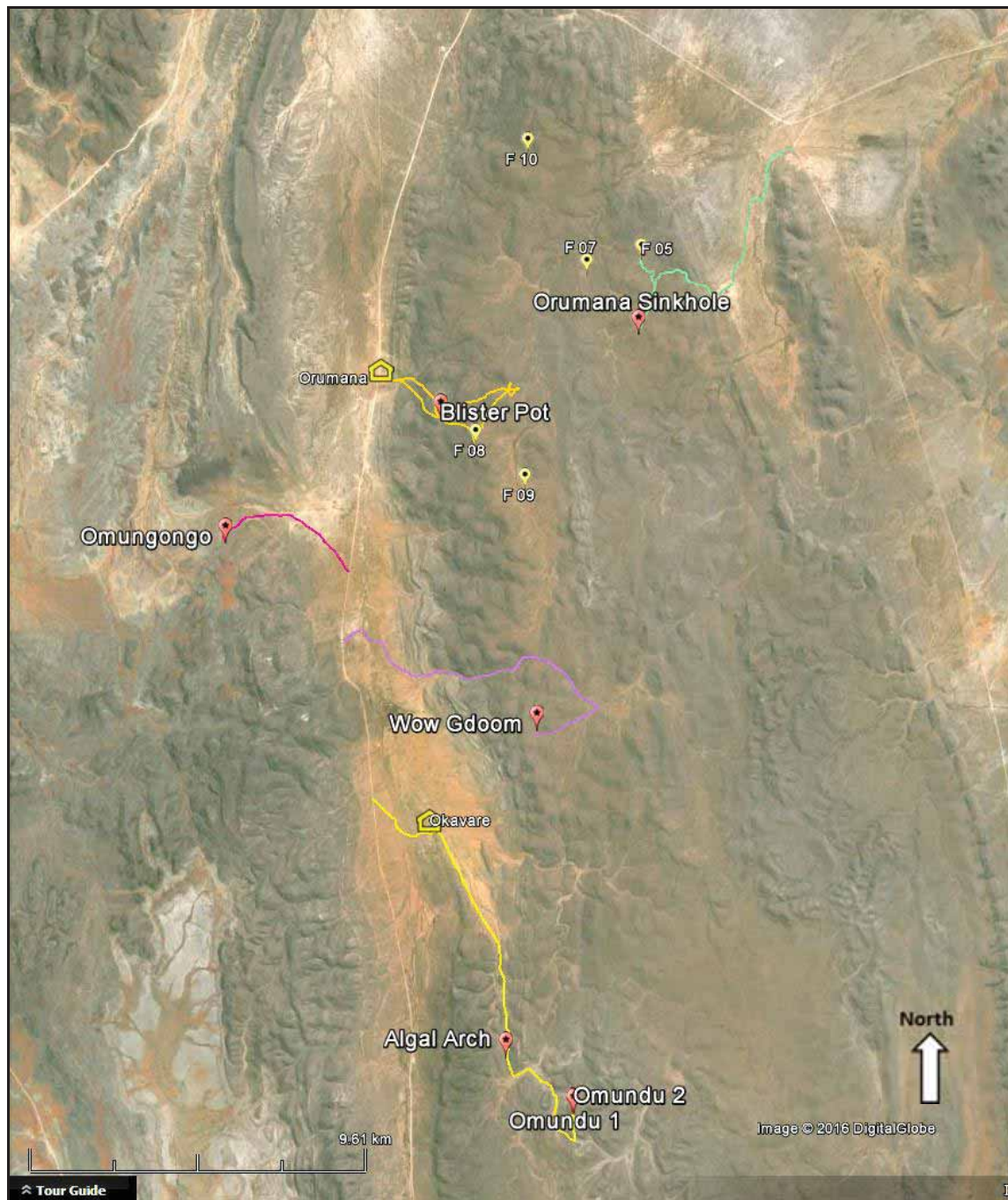


Figure 7 Overview map from Google Earth showing tracks around Orumana & Okavare villages

3.1.2 Orumana Sinkhole

The cave is accessible by 4WD from the NE near the road head at Otjerunda Village taking about one hour followed by 15 minutes on foot, with the route as shown below.



Figure 8 The location and route taken to Orumana Sinkhole

The cave was explored with 2 teams using both Entrance 1 (E1) and 2 (E2). Entrance E1 is easier to negotiate because the top 14m or so of the descent is a free-climbable slope rather than vertical. E1 is much larger than the other entrances as illustrated on the SWAKNO map below (Fig. 9). Geological observations show that E1 & E3 are aligned along a prominent fault. The cave is developed in well-bedded limestones and dolomitic limestones, which on the surface show intense karst solutional weathering. The cave bears no relation to any surface drainage or topography and was considered by the SWAKNO explorers to be at least partly of hypogenic origin and this seems the most likely mode of origin.

E1 was firstly rigged with rope belay to a large tree, then descended 6 m to a rebelay onto a small tree and then another 5m to a ledge. This was followed by a 4m traverse to the left using a sling over a nose of rock and 1 bolt inserted. The descent continued nearly vertical for 5 m and then a final bolt belay was inserted for the 12 m vertical pitch to the bottom. E2 was rigged using a rock and small tree at the top with a 3m descent to another tree which was used as a rebelay point. From here another 2m descent was made to the level of a natural bridge across and a bolt was used as a deviation from where a free-hanging drop of around 45m was made to the bottom.



Orumana Entrances 1 & 2 (DA & RW)

The cave has a breath-taking cathedral sized main chamber approximately 40m high, 55m wide and 80m long. A second smaller chamber leads off through a squeeze and up to the foot of the shaft going up to E3. E2 provides a 'sky hole' with a direct descent into the lower part of the main chamber and has two balconies off part-way down which are out of reach from the abseil. At floor level two other tiny chambers can be accessed through a flat-out crawl at the lowest point of the main chamber in an eastward direction. These are only a few metres wide and a dust mask is recommended for protection.



Orumana Sinkhole showing the bottom of Entrance 1 with figure in grey half way down (MT) the rebelay point on Entrance 2 pitch (PG) the main chamber (DA) Entrance 2 pitch with figure in red near the top (MT) and the prolific stalactite and stalagmite formations (DA & HD)

The SWAKNO map was checked visually and seems in general to provide a good realisation of the cave apart from slight misplacement of E2 relative to the cave below and under-estimation of the balcony sizes

below E2. Probably in the future it would be worthwhile making a modern laser-based survey to improve the accuracy considering the speleological significance of the cave.

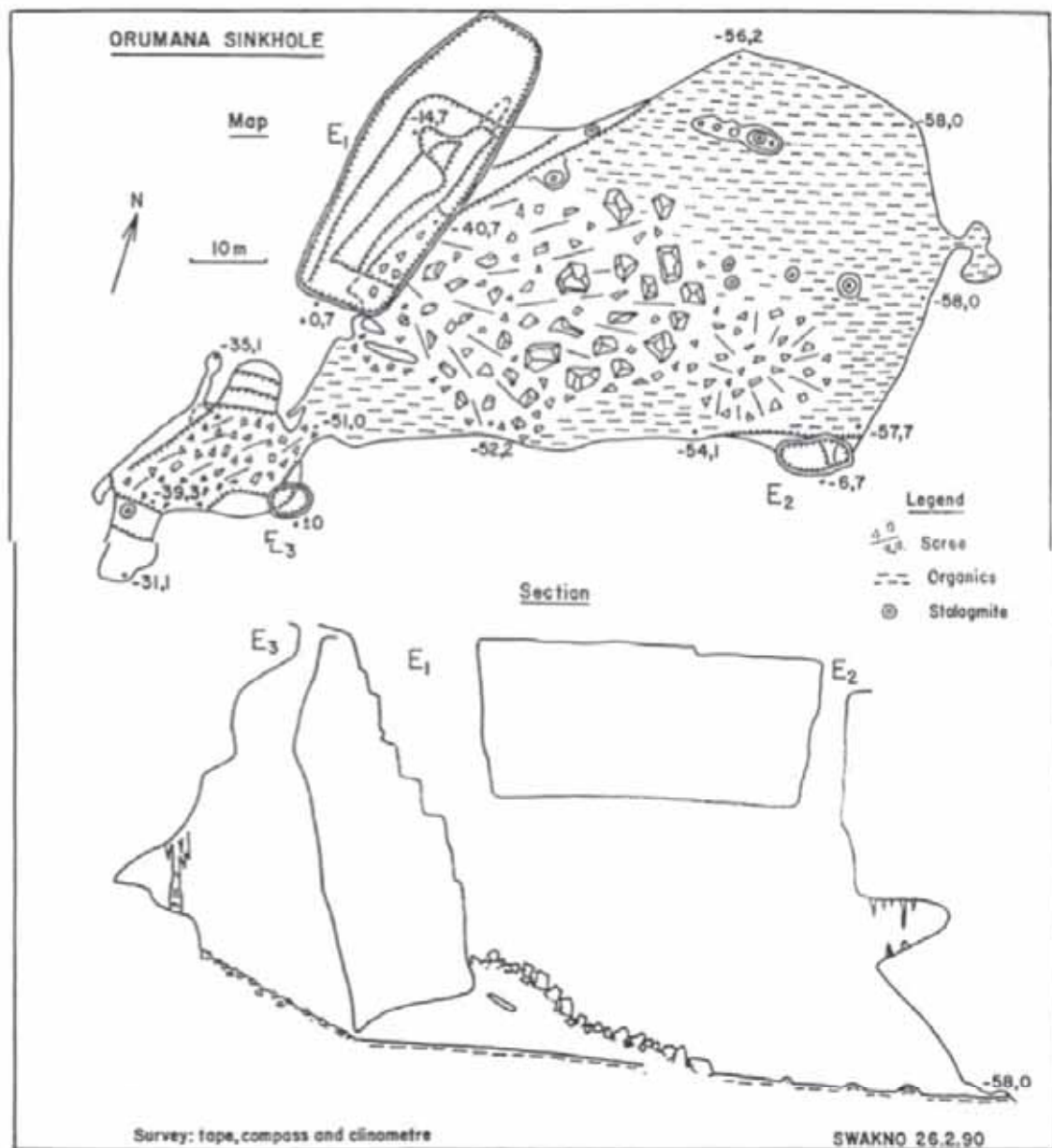


Figure 9 The SWAKNO survey of Orumana Sinkhole

The floor of the chamber is covered with boulders in the upper part and has dry dusty soil further down. As can be seen in the photos the cave is spectacular due to its size and shape and there are numerous impressive stalactites adorning the walls and one large cluster of club-like stalagmites and some smaller ones on the floor. The main chamber is well-lit naturally during day-time from E1 and E2, however the more minor chamber and side branches near E3 are quite dark and require lighting. Remains left by previous visitors include some rusty wire ladders discarded below E1, old flares and some rusty belay points.

There are copious animal remains on the floor including a lot of bird bones, cow, millipedes, a mummified lizard, a snake skeleton and evidence for the passage of probable baboon or hyrax polishing the rock surfaces in places. Living fauna includes a lot of birds nesting in the roof of the main chamber and bats in the darker areas below E3. Mapane bees are also abundant in the Main Chamber and on the surface nearby. These are annoying tiny stingless bees that buzz around your head and try to fly in your eyes, ears and nose. During the visit they seemed to become more aggressive as time went by in the cave and on the surface nearby.

3.1.3 Ondimba ja Omungongo

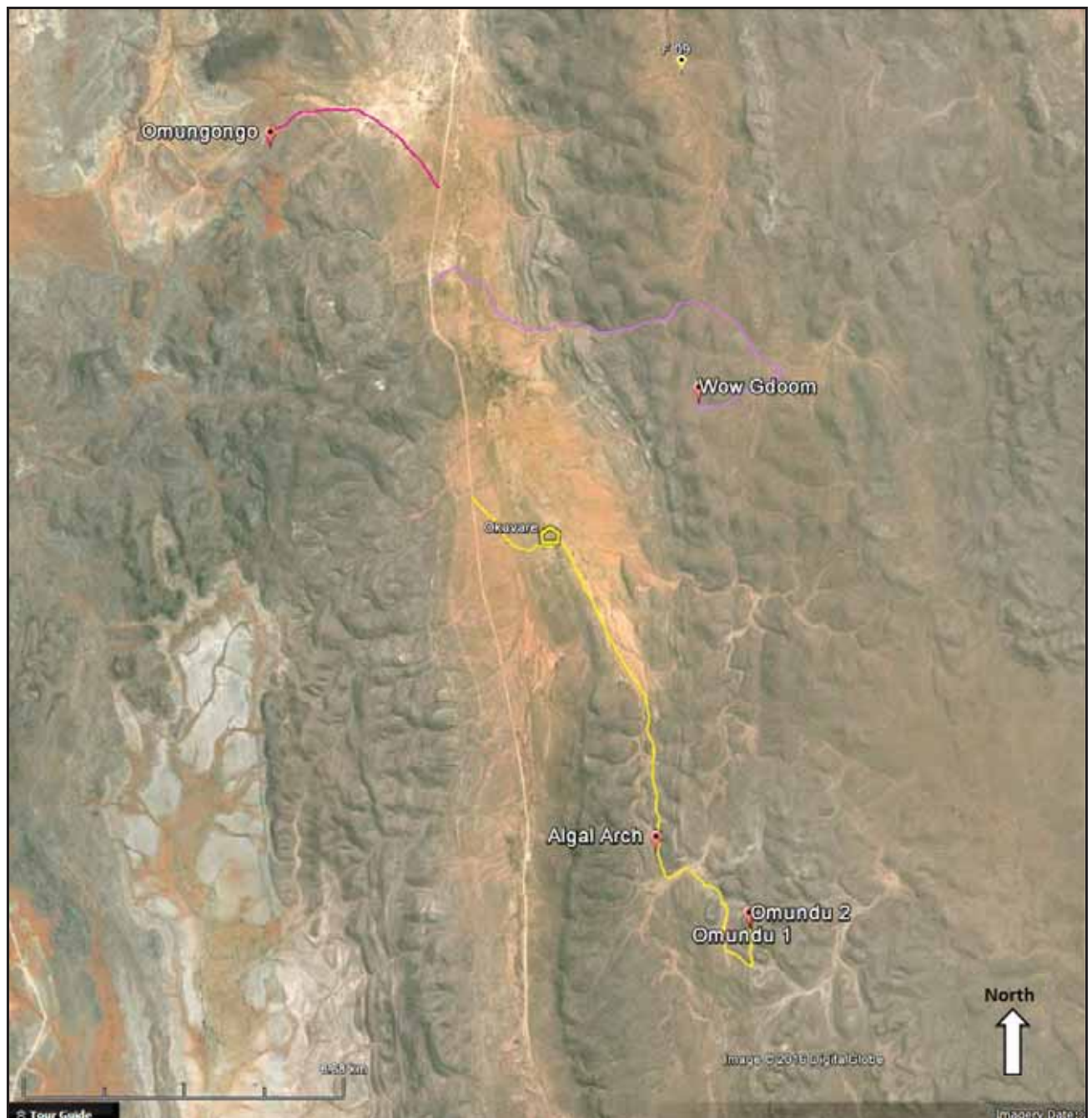


Figure 10 Google Earth Map showing tracks taken to caves in the Okavare area

This cave is approached along dirt tracks from the east, followed by a 100m walk slightly uphill over the last part. The entrance to Omungongo comprises an 'L' shaped inclined rift entrance shaft 22m deep with a lot of sharp boulders and awkward edges to negotiate near the top. The pitch was rigged using a large boulder and bolt inserted on one side and with a deviation on the other side around another boulder and 2 further deviations are required further down. Near the bottom the shaft opens out into a majestic large downward sloping main passage, In general this is more than 5m high and 10m wide, with a bouldery floor mostly covered in thick layers of dry bat guano. After 100m length the main passage abruptly ends at a small pool of water, however 20m and 40m before a complex 3 dimensional maze side series leads off on the left, as shown on the survey plan and elevation Figures 11 &12. The cave has 358m surveyed length and is easily the longest discovered during the expedition and also the deepest at -59m, just exceeding Orumanas deepest point.



As

Omungongo entrance, 22m pitch and main passage with abundant roof cupolas and dolomite rock with large chert nodules (MT) and below, the water pool at the bottom (DA)

can be seen on the photos here and in the Section 1 (Summary), the cave is very scenic with the large winding main passage, numerous dome like chambers, giant banks of guano and unusual geology with the cave formed in a cherty dolomite. The chert is in the form of dark coloured nodules which range in size from a few cm diameter up to around 1m and these protrude from the walls of the passages due to their relative insolubility compared to the dolomite. The form of the the main passage and side series, with numerous roof cupolas and blind upwards pointing passages and the lack of relationship to surface topography or drainage are all indicators for a hypogenic origin for this cave.



The cave contains a large number of bats and judging from the guano thickness these have been in residence for a long time. The bats have some preferred roosts near the water pool at the bottom of the main passage and at the extreme up and downward ends of the side series. No significant issue occurs

with air quality, however good dust mask protection is essential due to disturbance of the dried guano when moving through the cave.

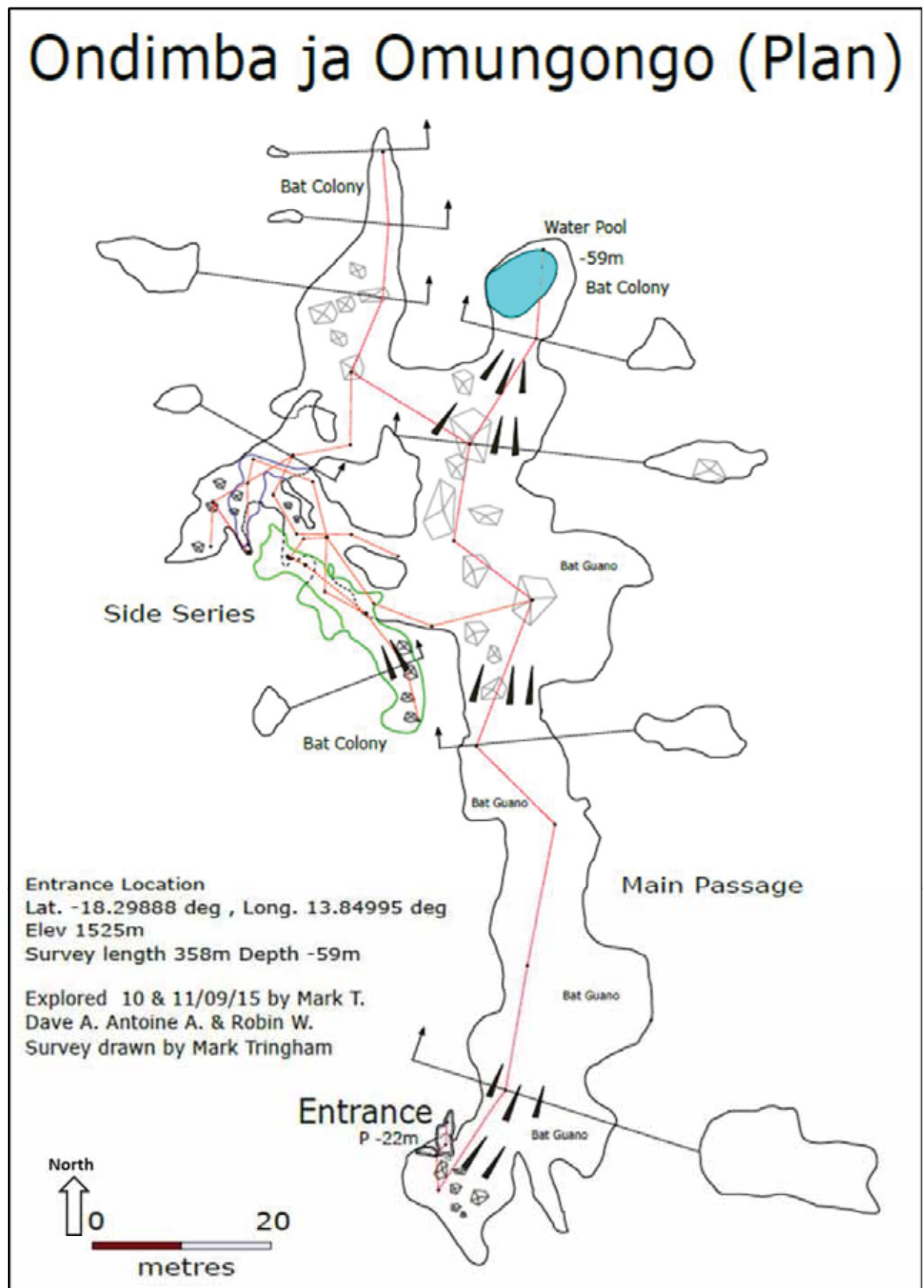


Figure 11 Survey plan of Ondimba ja Omungongo

Ondimba ja Omungongo (Elevation)

Entrance Location

Lat. -18.29888 deg , Long. 13.84995 deg

Elev 1525m

Survey length 358m Depth -59m

Explored 10 & 11/09/15 by Mark T. Dave A. Antoine A. & Robin W.

Survey drawn by Mark Tringham

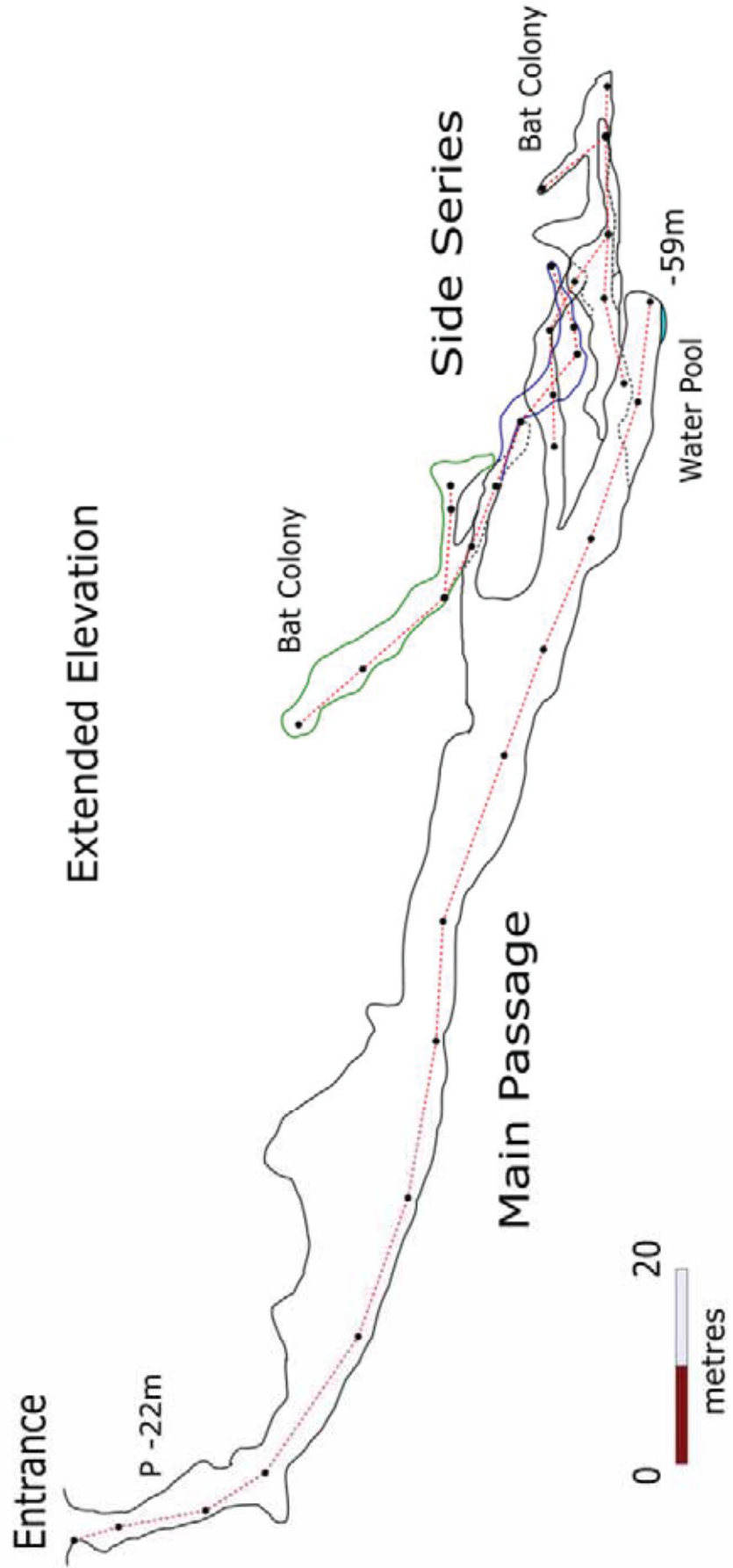


Figure 12 Survey elevation of Ondimba ja Omungongo

3.1.4 Ondimba ja Omundu 1

The 2 Omundu caves are located around 11 km south and around 45 minutes drive SSE from Okavare Village. The caves are named after the Omundu trees nearby, one of which was used to fix the rope to for descending Omundu 1. The first explored was Omundu 1 and as shown on the survey Figure 13 this comprises a 1m diameter circular entrance leading directly into an inclined rift cave 13m deep and with a narrower portion about half way down. At the bottom the cave ends at a mud choke.



Entrance to Omundu 1 (MT)

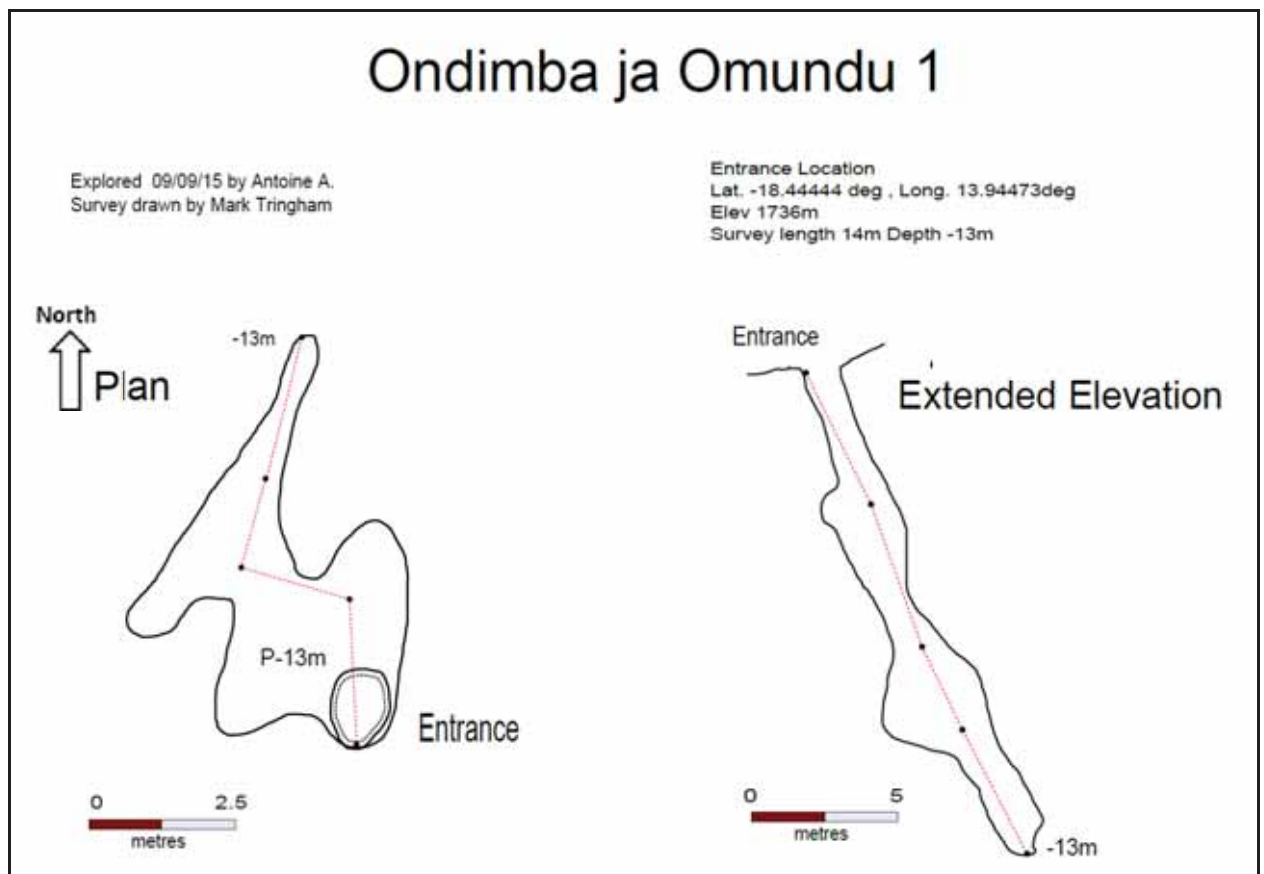


Figure 13 Survey plan and elevation of Ondimba ja Omundu 1

3.1.5 Ondimba ja Omundu 2

The second Ondimba ja Omundu 2 is larger and slightly more interesting with again a small circular entrance and then two pitches separated by a ledge (Fig.14) with a lot of dried baboon manure present on it. The entrance pitch has very polished rock due to the baboon movement in and out. At the head of the second pitch there is some calcite flowstone and small stalactites. Below the second pitch the rift shaped passage quickly narrows and slopes down to a mud choke. A few bats were seen in this part of the cave.



Entrance to Omundu 2 (JD)

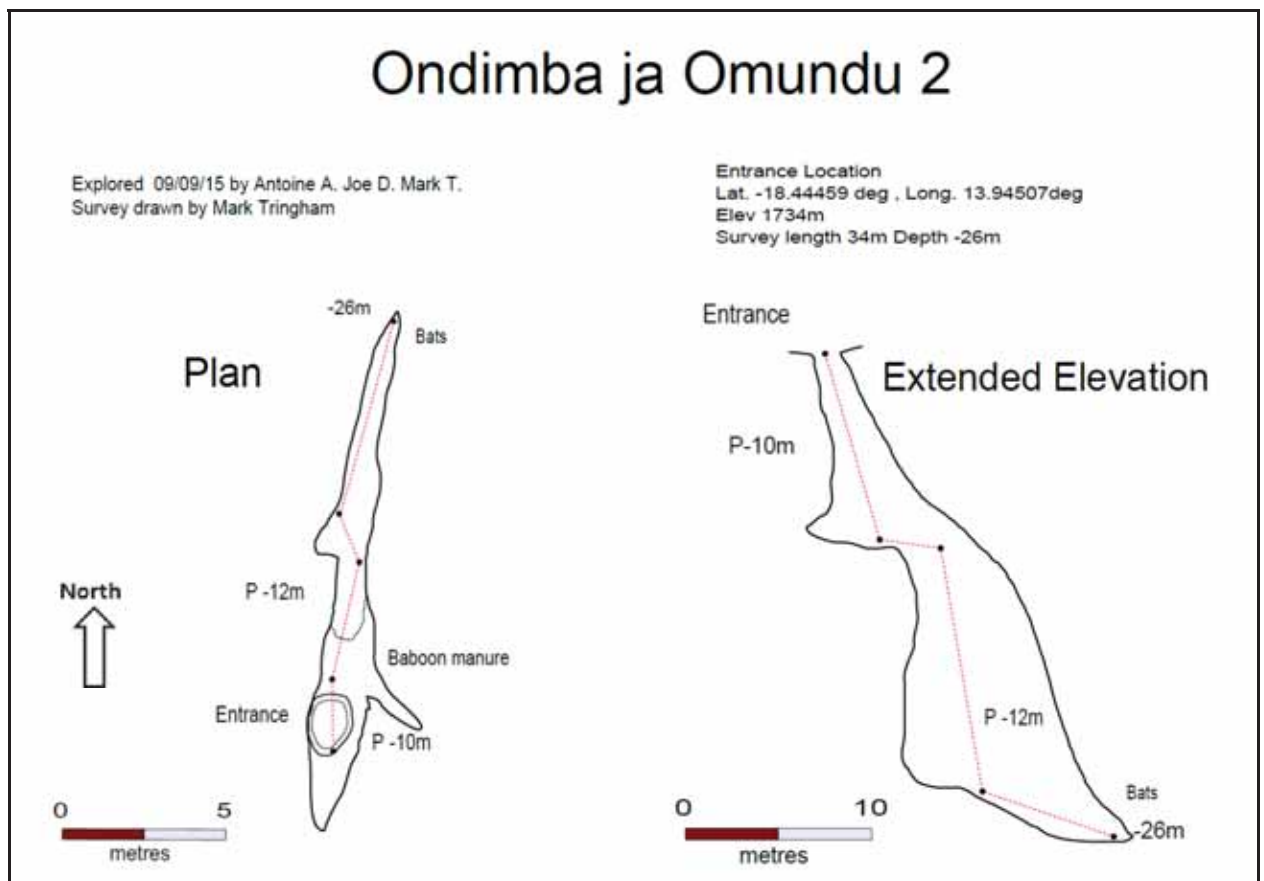


Figure 14 Survey plan and elevation of Ondimba ja Omundu 2

3.2 CAMP AUSSICHT AREA

3.2.1 Overview

During the second part of the expedition Camp Aussicht was used as a base and with the advice from the owner Marius and other guidance several sites investigated. In addition some Google Earth features were investigated. All the off-road tracks taken and the sites investigated are shown below on Figure 15. In purple is the route taken to check out some Google Earth Features 1, 2 & 22, but these all were found to be insignificant in terms of speleological interest. Ondimaba ja Okavau, Uahana and Okuapa resulted in cave discoveries which were surveyed and these are shown in Sections 3.2.2 to 3.2.4. The long loop route west of camp Aussicht shown in yellow was a reconnoitre mostly of the accessible lower ground occupied by dolomite rocks of the Devede Formation, but this only resulted in 1 small find called Ondimba ja Donald, however this was too small to warrant a detailed investigation and also had elevated levels of CO₂ impeding access. Batpipe likewise had high CO₂ and in this case a vertical entrance shaft was looked into but lowering a gas meter down showed that any descent would likely be fatal. The track in green on Figure 14 shows the route to Okarumba Village from where guides were collected from and where elephant watching at a watering hole was done as described in the Diary Section 4. The ochre mine is close to the main road and was explored and photographed, again as described in the Diary for 15th September.

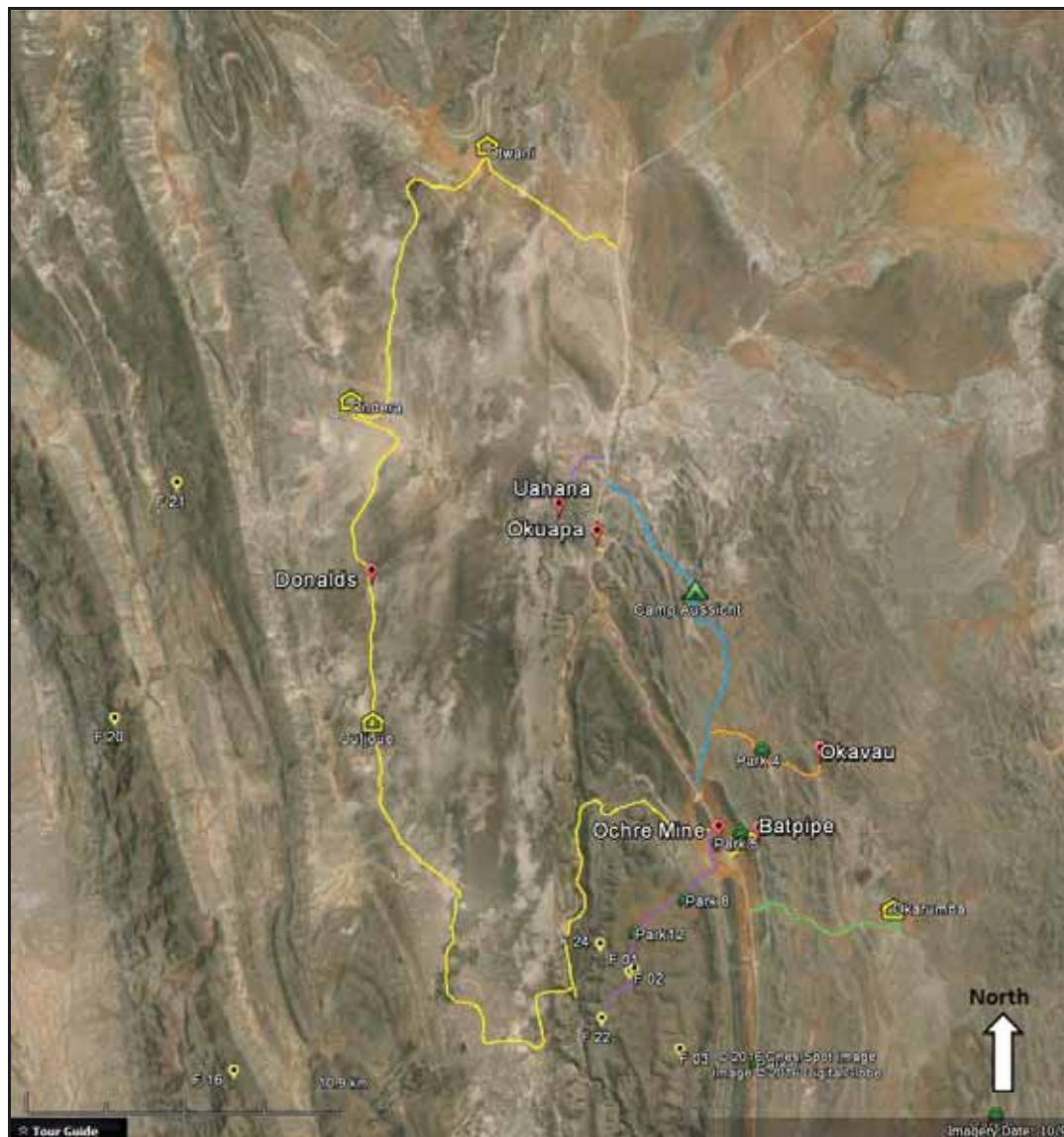


Figure 15 Google Earth Map showing tracks taken to caves in the Camp Aussicht area

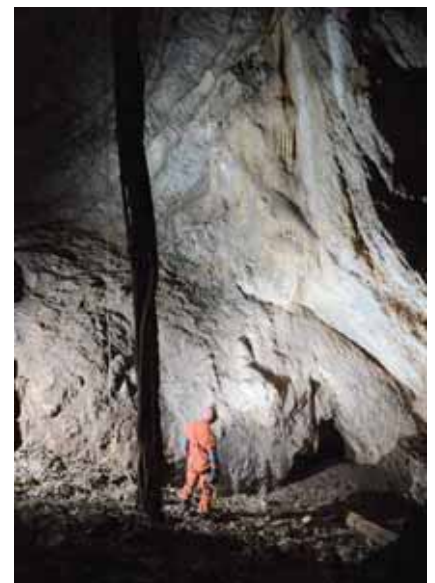
3.2.2 Ondimba ja Okavau

Access to Ondimba ja Okavau is shown in orange on Figure 15 and comprised 2km off-road driving followed by 2.5km on foot over easy terrain up a broad gently sloping valley. The cave has an entrance shaft 3m x 5m wide at the top which narrows to 2m x 2m a few metres down. A hard to access small inlet passage occurs on the south side of the shaft around 5m down with a lot of loose rocks present. The shaft then bells out at 8m depth into a wide dome shaped chamber with a boulder and dried mud floor at a final depth of 23m, as shown on the survey Figure 16 below and on the photos. While the cave is not long, the bell shaped chamber is quite spectacular in size and shape with large ficus tree roots spiralling all the way down from the surface and going into the floor. On one side attractive calcite flowstone occurs high up in the chamber wall.

The expedition found the skeleton of an Oryx which had been the subject of local folklore from several decades ago when a local hunter was said to have chased it with his dogs and in trying to escape the unfortunate animal had jumped into the 22m deep entrance shaft and been lost along with some dogs, the hunter returning empty handed. In addition many other animal bones were found on ledges and partly buried in the floor including steenbok (?) porcupine and smaller rodents.



Okavau entrance (DA) & oryx skeleton at foot of entrance shaft (MT)



Okavau entrance shaft, with tree roots and chamber at bottom. Note fault breccia visible in middle picture and calcite flowstone in right hand picture.

The cave is formed in steeply dipping dolomite of the Devede formation and is located on a fault with a 2m thick breccia zone present along the fault. The form of the cave with a relatively large chamber below

a narrow entrance shaft and the lack of relationship to any surface topography or drainage indicates a likely hypogenic origin for this cave.

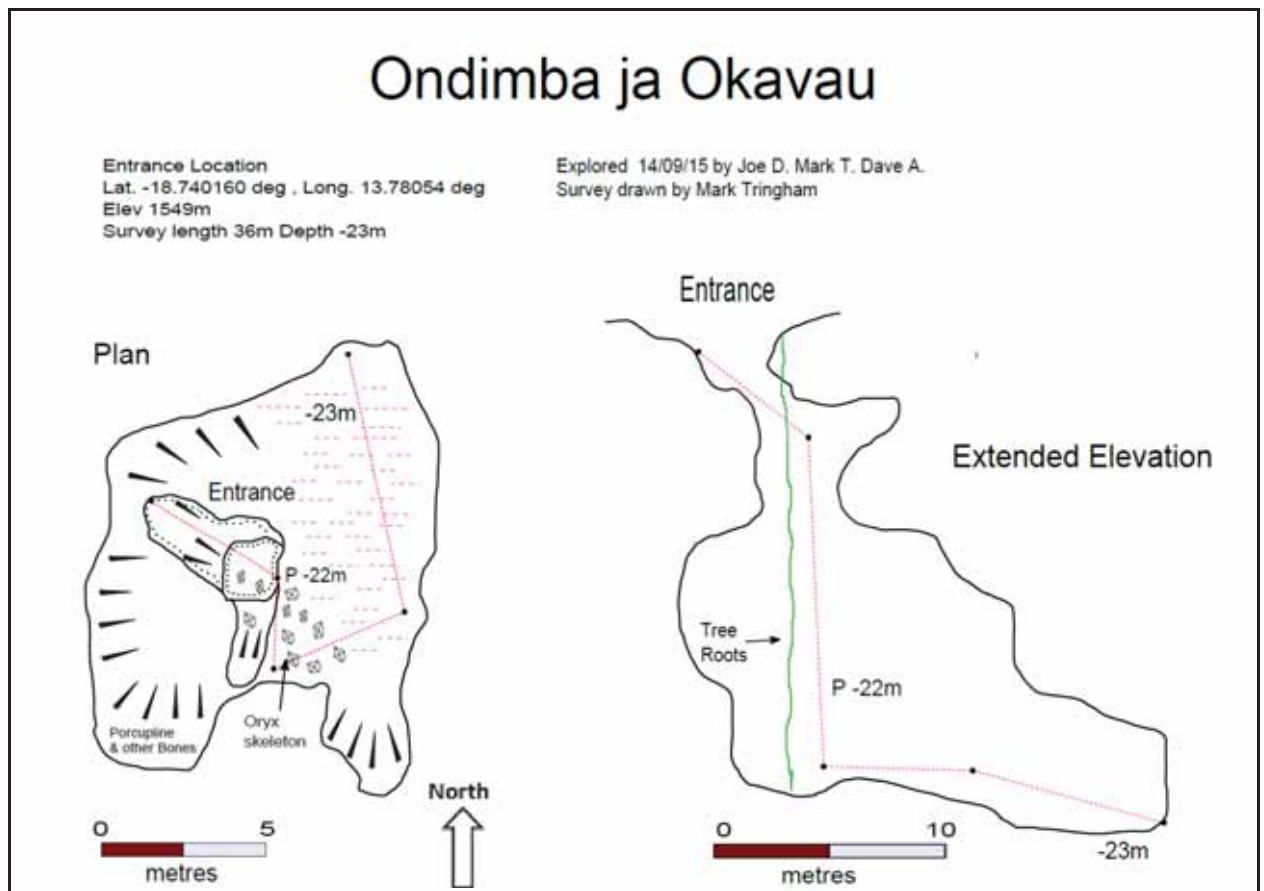


Figure 16 Survey plan and elevation of Ondimba ja Okavau

3.2.3 Ondimba ja Uahana

This cave is located around 3km from the main road and approached from the north up a moderately steep valley. It has a moderate sized entrance going in and down at the foot of a small bluff of cherty limestone. The cave comprises an entrance chamber with some flowstone calcite formations and a lower chamber and these are linked by a 6m deep inclined pitch. The lower chamber in part runs back under the entrance and also descends to a boulder and mud choke in the opposite direction at a final depth of -8m as shown on the survey Figure 17 below.



Uahana entrance and 6m pitch descent (PG)

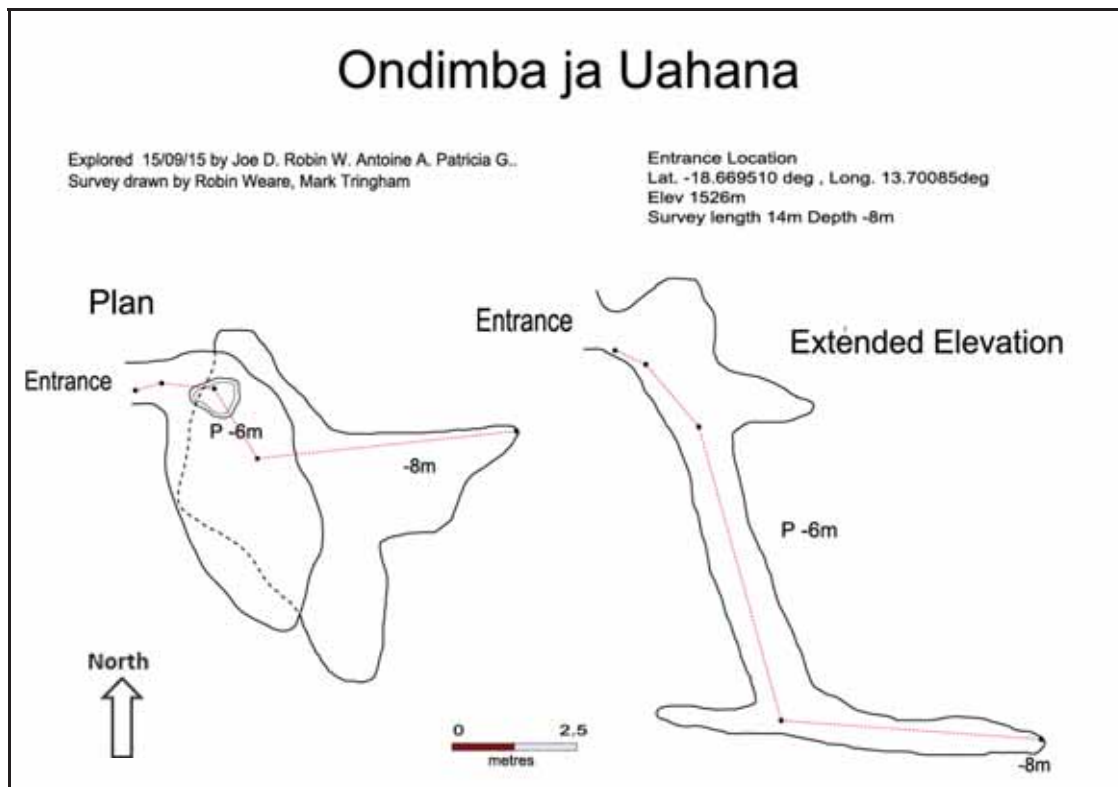


Figure 17 Survey plan and elevation of Ondimba ja Uahana

3.2.4 Ondimba ja Okuapa

This cave is located only 300m off the main road WNW of Camp Aussicht (Fig. 15) across a river-bed and 6m up the valley side. It has a small slot-like entrance which leads into a wide sloping chamber which has some nice calcite formations including a fine column and a boulder floor. At the lower end the chamber narrows down into a small passage which has a bat roost and which finally ends at a silty choke as shown on the survey below.



Okuapa entrance and decorated boulder chamber (RW & PG)

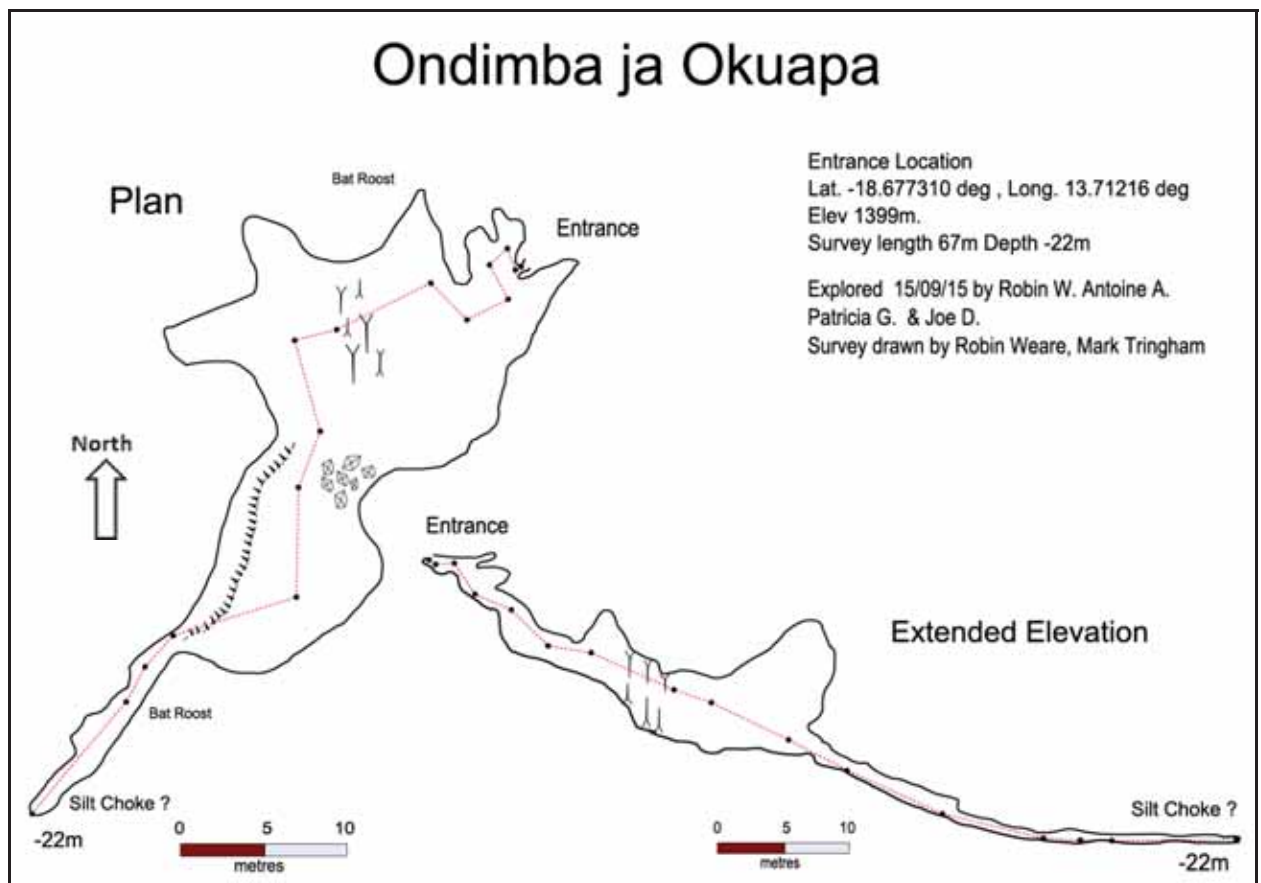


Figure 18 Survey plan and elevation of Ondimba ja Okuapa

3.3 OTJIMATEMBA AREA

3.3.1 Overview

Several off-road tracks and hikes were taken in the area around Otjimateмба and Joubert Pass (Fig. 19) in the search for new cave sites using local guides and features spotted on Google Earth. These resulted in the discovery of one significant Cave called Ondimba ja Mundumitthe and other sites of only minor speleological interest. Mundumitthe is described in Section 3.3.2 below. The other sites include Omutungi which was found to be very small and comprised a 15m deep pot with rifts off at the bottom too small to enter, not surveyed. The excursion shown in orange to the SE of Otjimateмба resulted in only very minor holes and one rock shelter being found. The trip shown in light green comprised a long hike on foot to evaluate Google Earth Features 28 & 29 and this is described in detail in the Expedition Diary Section 4 (12th September), but resulted in a few caves found each only a few metres long and 1 large doline. The track shown in red on Figure 19 comprised an attempt to locate an entrance known to local guides, but which could not be found, despite a lengthy search.

3.3.2 Ondimba ja Mundumitthe

Mundumitthe is approached from the E and NE along a vehicle track next to power lines and then on foot for 1 km easy walk over undulating ground between 2 branches of the same valley. The entrance is a 1m diameter hole located on the flank of the valley and 6m higher than the valley floor. It has a 2.5m slightly overhanging drop which requires a rope hand line or small ladder to negotiate. Below the entrance a descending passage passes a boulder pile and then quickly becomes bigger with descending chambers up to 9m wide and 10m high with a lot of calcite formations and a few bats. Two mummified steenbok remains were seen here, one in the middle of the passage near the boulder pile and another in an alcove under the left wall of the chamber, as shown on the survey Figure 20. Below the 2nd chamber there is a short squeeze ringed with calcite formations and down over boulders into another well decorated 3rd chamber. Two more small antelope mummies were found here, one on each side of the chamber. The 3rd chamber has 2 ways off, with a steeply ascending aven ahead and a smaller twisting passage going down over boulders, first to the right and then left under the aven. This twisting passage continues a for a further 15m through tight squeezes and short climbs between small chambers, until finally a silt choke is

reached at a distance of 91m and depth of -28m below the entrance. The lower part of the cave had a moderate number of bats present at the time of the visits.



Figure 19 Google Earth Map showing tracks taken in the Otjimatemba area

Two mummified steenbok remains were seen here, one in the middle of the passage near the boulder pile and another in an alcove under the left wall of the chamber, as shown on the survey Figure 20. Below the 2nd chamber there is a short squeeze ringed with calcite formations and down over boulders into another well decorated 3rd chamber. Two more small antelope mummies were found here, one on each side of the chamber. The 3rd chamber has 2 ways off, with a steeply ascending aven ahead and a smaller twisting passage going down over boulders, first to the right and then left under the aven. This twisting passage continues a for a further 15m through tight squeezes and short climbs between small chambers, until finally a silt choke is reached at a distance of 91m and depth of -28m below the entrance. The lower part of the cave had a moderate number of bats present at the time of the visits.



Mundumithe Entrance, Entrance Passage & First Chamber (MT)



Second and Third Chamber and calcite squeeze between with abundant speleothems (MT)

No air quality problems were detected despite the restricted size of the cave in the lower part. The cave is formed in Maieberg Formation dolomite and is aligned along a fault running northwards parallel to the axis of a tightly folded syncline seen on the surface and evident on the Google Earth picture Figure 19.

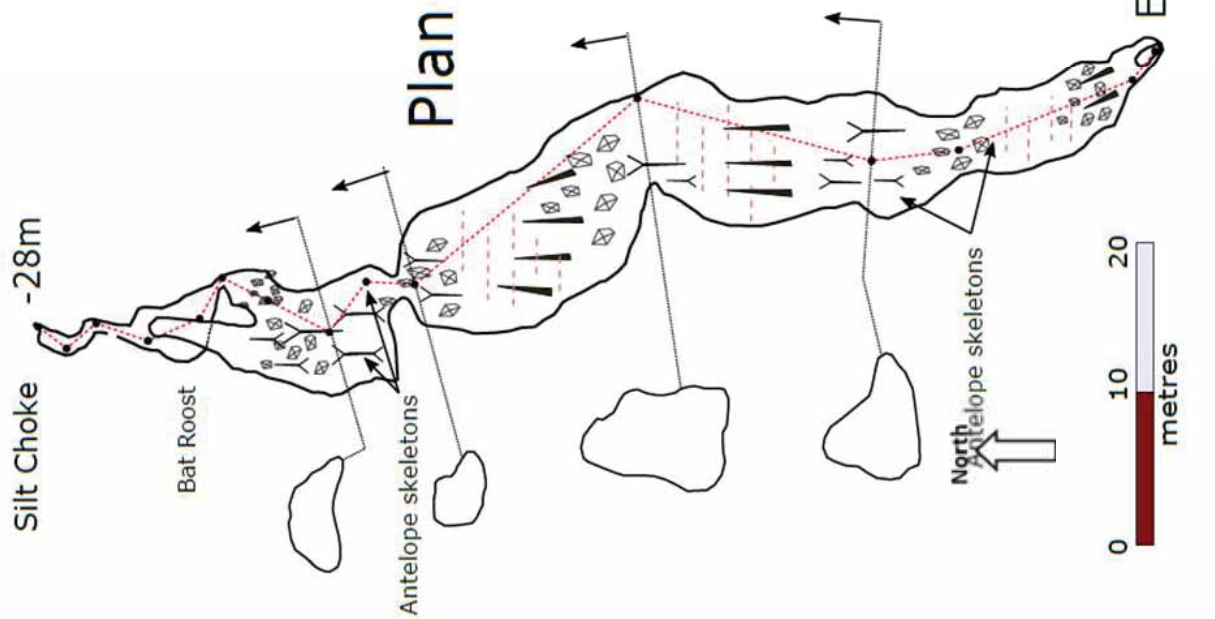
Ondimba ja Mundumithe

Entrance Location

Lat. -18.914070 deg , Long. 13.75034 deg
Elev 1353m

Survey length 91m Depth -28m

Explored 12&13/09/15 by Joe D. Mark T. Patricia G.
Survey drawn by Henry Dawson, Mark Tringham



Extended Elevation

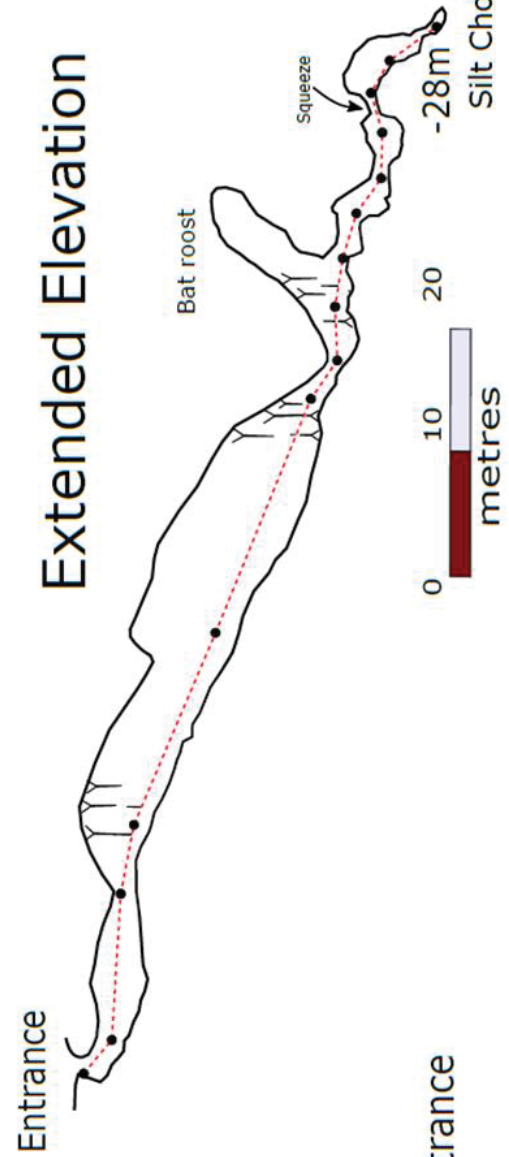


Figure 20 Survey of Ondimba ja Mundumithe

4. EXPEDITION DIARY

FRIDAY 4TH SEPTEMBER

Antoine and Patou were the first to leave home in Lyon and travelled by TGV to Paris, where they discovered how to carry their 30kg bags in the subway!

SATURDAY 5TH SEPTEMBER

Antoine and Patou stayed overnight at a friend's house in Paris and departed at 06h30 and travelled to Charles de Gaulle airport for their flight via Dubai to Johannesburg with a wait of three hours between flights. Meanwhile in the UK the British members of the expedition made their way by train and bus to London Heathrow Airport, where they met up and distributed some of the heavier kit between themselves before checking in together for the overnight flight to Johannesburg.

SUNDAY 6TH SEPTEMBER

Antoine and Patou arrived in Johannesburg at 6hr to a very cold airport and they were joined on-time at 10h15 by the British contingent. Mark tried to buy whisky in the duty free shop, but he was told that it is forbidden to take whisky into Namibia, only wine is allowed!

After two separate flights to Windhoek departing just a few minutes apart the whole team was reunited at Windhoek and was met by the IRDNC staff, Roger, William, Agnes the cook, Dave K. and Titus who were to work as guides and drivers. The group left the airport at 16h and arrived for an overnight stop at the Sylvanette Guesthouse in Okahandja. This country hotel was comfortable and provided us all separate rooms and a good evening meal. There is no liquor licence at the hotel so a shop was visited in town to buy beer, which was very welcome after the long journey from Europe! Roger, Mark and Titus made some welcoming after-dinner speeches outlining the initial plans for the expedition.

MONDAY 7TH SEPTEMBER

The group was awake at 7h and set off on the long drive to Opuwo at 8h30. There was a stop after two hours at Otjiwarongo for refuelling and at 11h20 for lunch at Outjo. The group left at 13h30 and then stopped at another petrol station in Kamanjab, where Henry was accosted by a local man trying to sell him a nut with his name on it. The shopkeeper came out and announced they were thieves and we should stay away from them. There were two Himba women in the shop with their distinctive dress and hair. Joe asked how could Himba women be distinguished? He then turned around to see two ladies in goat-skin skirts, clay-braided hair, and bare breasts and so he didn't need to ask for any more clarification!

The convoy arrived at the IRDNC 'Kunene Village Rest Camp' in Opuwo at 18h. The camp site is on the edge of the town next to the 'Scents of Namibia' perfume processing plant. There was no grass anywhere, but it did have basic hot showers and western style toilets. The team was delighted to find that tents had already been put up by the IRDNC staff and that there was a tent each. The team assembled for a meeting and Mark made proposals for targets and teams for the following day. The first objective would be to visit **Orumana Sinkhole**, which was already explored by SWAKNO in the 1990's with the exception of two high level balcony passages identified on their survey. The objective would be to check out these unexplored parts by entering with two teams one each into Entrances 1 & 2, make a photographic record and evaluate the cave for IRDNC. The group prepared the necessary vertical rigging equipment ready for the morning.

TUESDAY 8TH SEPTEMBER

The group departed at 8h30 for **Orumana Sinkhole** after all were ready, with one car going to the Ministry of Tourism and Environment office to pick up Kagwana. We picked up 2 local guides in Otjerunda village who guided us to the end of the rough vehicle track and then for the 15 minute walk further uphill to the cave entrances.

TEAM 1: Entrance 2 was rigged by Antoine, sporting an unusual pink leotard, Robin and Patou and this comprised a 50 m vertical shaft. The first rope was fixed to a tree above the shaft and went down around 5 m to near a natural bridge across. Then a new rope was fixed to the roots of a second tree and

a bolt belay was also put in. A deviation was put in further down followed by a massive free-hang through the roof of the chamber and around 40 m down to the floor. The two balconies identified by the SWAKNO survey were looked into while descending, but were about 6 m too far out of reach to access. It could be seen that they are separate balconies and slope upwards until choked by boulders.

TEAM 2: Henry, Dave A., Joe and Mark went down the bigger and easier Entrance 1, free climbing down on ledges to a large tree. Dave rigged from this with the first rope, then descended 6 m to a small tree, using it as a rebelay and then a further drop of 5 m to a ledge. There was then a traverse of 4 m to the left, using a sling over a nose of rock and a bolt was installed. This was followed by a descent of 5 m to a final bolt, and then a 12 m free-hang to the bottom. Old very rusty wire ladder remains were seen belayed to the ledge, which pre-date the SWAKNO expedition.

The main chamber has two tiny chambers off accessed by a dusty flat out crawl at the very bottom, which Henry explored. The group found various animal bones and other remains in the floor of the main chamber, including a snake with skin, a cow's skull, bird and bat skeletons and antelope and paw foot prints..

Both teams explored all the cave, made both movie and still photography. Henry calibrated 2 DistoX survey instruments ready for work in future days. Henry and Mark followed Antoine out of Entrance 2, to complete the first recorded 'exchange' trip and Robin and Patou did another exchange out of Entrance 1. Everyone thought the cave was very spectacular and sporting with such a massive main chamber, abundant speleothems and interesting geology. However, nobody liked the very irritating mapani bees which seemed to get more and more persistent the longer the group stayed in the cave.

The team went to the cars for lunch at 15h30 and then visited Google Earth Feature 5, which just turned out to be an anomalous concentration of green acacia trees, but no cave feature at all. The guides said there is only one other cave in this area, but it is only 4 m long. However the guide also informed that in the wet season a large stream flows off the mountain and sinks before reaching the village, indicating it may flow into a cave. The team went back to the camp at 18h and ate an excellent dinner prepared under the direction of Agnes.

WEDNESDAY 9TH SEPTEMBER

The team had a later start after slow preparations. The group separated into 2 groups with Mark, Joe and Antoine going to find some potential cave entrances a long way south of Orumana village with a guide, and Patou, Dave A., Henry, and Robin going to to investigate the potential for caves at Google Earth Feature 26 and surrounding carbonate canyons.

TEAM 1: Antoine, Mark, and Joe were with Titus and were joined by Stein from IRDNC and the local village chief acting as guide to locate two cave entrances. After a long bumpy drive and 20 minutes of walking, they were asked to wait while the guide took a further 20 minutes solo to finally locate the entrances. Both entrances were small circular holes located on a featureless scrubby wooded hillside. The first was called **Ondimba ja Omundu 1** and was explored by Antoine using a tree to fix the rope. This cave has a pitch of 13 m and is blind. The second cave, **Ondimba ja Omundu 2** was also rigged by Antoine and then Joe and Mark followed in. It has 2 pitches with a ledge between. The cave finished after about 26 m surveyed length and 24 m depth at a rift which is too tight with no further ways on. There were a few bats seen inside. In both caves there were a lot of polished rock surfaces and medium-size dried animal dung and Joe suggested the likely explanation was that baboons come to sleep inside these caves as a secure and warm location out of the easy reach of leopards or other predators. The team completed the exploration and surveying of both caves and then on the drive back an interesting limestone pavement area was spotted along the dirt road back to the village and the team stopped there to check it out. Several holes were found but only one was of any significant length, around 10m which Antoine explored and sketched.



Limestone pavement south of Okavare with algal stromatolites and small caves (MT)

TEAM 2: On the way to the carbonate canyons the second team visited some springs near Otjondeka Village which had scenic tourism potential but no caves.



One of the springs and Herero lady in irrigated field nearby (DA)



Figure 21 Google Earth map showing tracks and springs visited in the Otjondeka area

The team also visited a camp site which again would be suitable for tourists to stay which is part of Roger's plans for the area. They eventually reached their destination and set off after lunch, from the end of an easily driveable track. One group comprising Dave, Roger, William and Robin split off after passing two excellent looking gorges, while Henry, Patou, Kagwana and Rosalia headed on to find Google Earth Feature 26.



Panorama of Carbonate Canyons area looking West (DA)
& photo in the Canyon (RW)



Figure 22 Google Earth Map showing tracks taken in the Carbonate Canyons S. of Otjondeka

The GPS compass was out of calibration and after a while Henry noticed that the device had taken the group down a parallel valley requiring them to climb a short hill to relocate Feature 26. Kagwana and Rosalia headed back to join the other group as they didn't have much water while Henry and Patou headed up the hill to Feature 26. Feature 26 was a dry, steep-sided gorge with the waypoint being located at the very top where it flattened out into a shallow streambed. This gorge continued down to join up with one of the two gorges Robin and Dave were looking at.

Patou and Henry then took a direct path back to the cars avoiding the valley bottoms as they have a lot more vegetation and this was difficult to push past and very scratchy. There were two types of bushes to watch out for in particular, the first has long thick spines and the second has short hooks. The long spines are very tough and can puncture skin and even car tyres very easily. The short hooks are a terrible nuisance as they catch your skin and clothes as you push past. Patou and Henry ended up covered in scratches and punctures!

Meanwhile, Dave and Robin headed up the northerly gorge towards Feature 26. The valley bottom was quite a rocky scramble in places with a lot of vegetation. The gorge was quite deep to start with and was followed until the side walls lowered and the gorge became shallow, but this was still a fair way from feature 26. A solution tube (0.3m diameter) was encountered in the right wall near the top but no other cave entrances were evident. On the return back down the gorge, Dave climbed a steeply bedded outcrop to check for holes and another rock face to check out a possible dark void/shadow, but both areas were negative. Returning to the lower track they met with Roger, Dave K, Kagwana and Rosalia and initially headed back towards the vehicles but then turned off to explore a north easterly gorge with one of the local shepherds. This steep sided gorge held no cave development other than a small animal shelter on the right wall created by solutional erosion between large boulders. Where the valley began to shallow the shepherd led the two out to the left of the gorge to a hand pump (proving that underground water flow/aquifer exists) for a drink of fresh water and to meet up with the rest of the group.

This group returned to the campsite at Opuwo via an expensive (by local standards) liquor store and enjoyed some lovely music on the way home. A superb dinner was cooked by Agnes as usual.

TUESDAY 10TH SEPTEMBER

Breakfast included fresh doughnuts made by Agnes which were extremely good!

TEAM 1 : One group comprising Antoine, Henry, Joe and Patou went to Orumana village to find **Blister Pot** and the lost 'Irish Hole' reported by SWAKNO, and also try to check out **Google Earth Features 8 and 9**. After receiving local advice they started the walk at 10h. Titus initially joined in but after 30 minutes and 150 m elevation gain and realising that it was planned to walk 12 km, he went back down again for a less strenuous day!.

At 11h the group reached **Blister Pot** which is a steep-sided open sink hole. Henry free-climbed down into it and found it to be blind as reported by SWAKNO, with no significant underground continuations. They continued on and at 12h30 were at the waypoint that Mark had estimated for the lost Irish Hole. After a lunch break of doughnuts they started to look for the reported cave dividing up to search as much ground as possible and in the process losing Joe. The group stopped searching at 14h30 without finding any cave entrances and regrouped with Joe who had come back to the tree where kit bags had been left. Next the group walked on towards Google Earth Feature 8 arriving at that location at 16h but disappointingly found nothing, no big hole, no big stone, no big tree, nothing to which the Google shadow feature could be matched!



Figure 23 Google Earth Map showing tracks taken in the Orumana area

The team decided next to return to the Orumana shop and the walk finished at 17h30, passing the school playground and meeting up with Titus again near the bar. They debriefed Titus and some local men about the caves and their locations. Titus informed that he met one man who indicated there were two other caves in the area of Orumana Sinkhole. The team returned back by 18h30 to the camp at Opuwo.

TEAM 2: The arrangement was that the team comprising Mark, Dave A., & Robin accompanied by Dave K., Roger, William, Kagwana & Stein would travel in two cars and rendezvous at the Orumana Village 'Shopping Centre' along with Team 1. However after two police vehicles passed at high speed on the dirt road, heavy dust obscured visibility for the first of the vehicles and the shop was missed completely as they sped on past. The team travelled on for around 20 km before realising and turning around. The benefit was that ostriches, steenbok and springbok were seen as well as huge baobab trees. They returned and met up back much later than planned. Meanwhile Mark, Kagwana and others travelled in pursuit thinking that Roger was thinking of a rendezvous at Okavare where the same guide was expected to assist like the previous day. Finding the others not there the guide was collected and they returned to the shop for a long patient wait while the 'wild-life' tour group completed their unscheduled excursion and returned a little sheepishly to the original planned meeting point around one and a half hours late.

The plan for Team 2 was to be shown a large entrance and one smaller cave entrance by the guide. A detailed discussion was held to determine if the large entrance was a new one or one already explored by SWAKNO. The conclusion was that it was likely a new one, so the group took a winding dirt track steeply uphill in places for around an hour and then walked a further 20 minutes to a very impressive sink-hole entrance. However towards the end of the track it became clear that the team were getting closer and closer to what proved to be **Wow Gdoo Abyss**, a 120 m pothole already explored by SWAKNO. The site was enticing with deep holes in a huge sinkhole doline formed along a major fault. The group took photographs from above and inside the sinkhole and checked out some 'through bolt' belays at the pitch-head which appeared to be of more modern design than the reported exploration date in 1994. The conclusion being that another team had likely visited this site more recently.



The entrance to Wow Gdoo Abyss (DM & MT)

The group drove down the hill again and just had time to visit a second site called **Ondimba ja Omungongo** and this proved to be the most significant new cave explored during the expedition. It comprised a narrow vertical entrance rift which was belayed with one bolt and a sling over a rock pillar. It descended around 25 m using two deviations and one rebelay before opening out into an impressive large gently descending passage about 15 m wide and 10 m high. There was less than an hour remaining available due to time lost earlier in the day and the need to make the return road journey mostly in daylight, so Dave and Robin went quickly down the large passage for approximately 100 metres to reach a small pool at the bottom of the cave after which the passage closed off. The dried mud around the pool showed signs that it has been bigger in the past. There were 20 or 30 bats roosting nearby. Several large side passages were seen on the left side but there was no time to explore them. Robin became very short of breath at this point but the gas meter showed normal levels of oxygen. He decided it was safest not to trust the meter and retreated quickly back out of the cave, arriving on the surface “white as a sheet and looking as though he had seen a pterodactyl” as William later described it. Dave, who was not been so far down, also felt short of breath. Whilst Robin and Dave had been exploring Mark descended and solo surveyed the entrance pitch and about one third of the main route down to the pool without feeling any ill-effects related to air quality. The group all then left the cave intending to return the next day to continue the exploration. They returned to the car as the sun was setting and in time for the drive back to Opuwo.

During the evening, Robin tested the oxygen meter and the carbon dioxide meter used by Team 1 by putting a plastic shopping bag over his head and breathing into it, providing great entertainment to all those around the dinner table. It was determined that both meters were working normally and the conclusion therefore was that trying to breathe hard through a dust mask during exertion in a steep or vertical cave can create oxygen deficiency and it is better to slow down and rest as required to get your breath back, providing of course that no pterodactyls are around!



Robin testing the gas meter (MT)

FRIDAY 11TH SEPTEMBER

Again the expedition split into two groups:

TEAM 1: Mark, Antoine, Dave A. and Robin returned to the previous days **Ondimba ja Omungongo**. They descended quickly after Dave had adjusted the rigging to change the final rebelay to a simpler and safer deviation. Then Antoine and Robin set off using the gas monitors to explore the rest of the cave and confirmed that the air was OK with oxygen level remaining at 20.9% throughout. The carbon dioxide level was also normal except that it increased when Antoine disturbed some guano-rich sediments while sliding down a slope, perhaps consistent with the circumstances when Robin and Dave felt short of breath the previous day.

The complex of passages to the left of the main passage was explored and consisted of several chambers and side passages going off in two places and was heavily populated by bats. At least a hundred came out of one bat roost alone after being disturbed.

While the exploration continued, Dave and Mark surveyed the remainder of the main passage and the first side passage, then Antoine replaced Dave to continue surveying, while Dave took photographs helped by Robin. Robin left the cave after being photographed ascending the entrance pitch. Dave then stayed behind for an hour with Antoine to assist Mark with further photography in the impressive main passage and got some good results. All the exploration, surveying and photography was then complete and the team exited the entrance pitch and de-rigged. Because the expedition was transferring camp location Team 1 then spent the next 3 hours driving, much of it off-road, to Camp Aussicht, arriving there about 18h, just before dark.

TEAM 2: Joe, Henry, Patou, William and Roger planned to visit Google Feature 28 which was 30 km SSE of the new location at Camp Aussicht and around 12 km SE of Otjimatamba. After some administrative delays in Opuwo the team arrived at Camp Aussicht at 11h30. They met the owner Marius Steiner who provided up-to-date information about the access roads around there. Robbie's Pass was said to be navigable but difficult 4x4 driving. A new road was under construction through the Joubert Pass and temporarily closed south of Otjimatamba. Team 2 initially took the road diversion from near Otjimatamba towards Sesfontein and after 5 km took a right hand turn down a track next to some electricity poles. This came to a fork and a right turn (left lead to a village) and after about another 5 km found a point suitable for the walk towards Feature 28. Because the walk was approximately 5 km there was insufficient time remaining, they instead chose to continue with the drive further down the track to see where it went, and met a Himba woman with a donkey. She was given a carton of apple juice but due to religious beliefs asked for verification that it did not contain any alcohol! Further on they met a man called James who spoke 3 languages and seemed to know everybody Roger knew! James discussed meeting another friend who knew of a cave near his farm which would be worth exploring in the future.

Team 2 returned to Otjimatamba and met some other locals to try and get guides to cave entrances for the following day and were told of two men who would be in the village by 09h the following day with their cows who knew of two other caves. Titus also arranged to meet one of the village chiefs at that time so an appointment was also set up for that.



The main road near Otjimatamba and Marius Steiner giving travel advice to the team at Camp Aussicht (PG)

SATURDAY 12TH SEPTEMBER

TEAM 1: After some misunderstandings three teams were formed. Team 1 comprising Mark, Dave A., Robin and Dave K., set off to find the vehicle waypoint marked by Henry the previous day and then take the long hike to evaluate Google Earth **Features 29, 28** and **30**. Fortunately Dave K. was able to drive about a further 1 km by vehicle off-track in the direction they needed to go, saving them some extra walking. The Google Earth Features seemed fairly convincing cave entrances which the Team wanted to evaluate early on after reaching the Camp Aussicht region. The days hike turned out to be about 15 km long with quite a lot of up and down in rough terrain using cattle and zebra paths where possible. The initial route led along the valley floor and then up the side with a height gain of about 150 m onto a dissected plateau where the nearest objective Feature 29 was located.

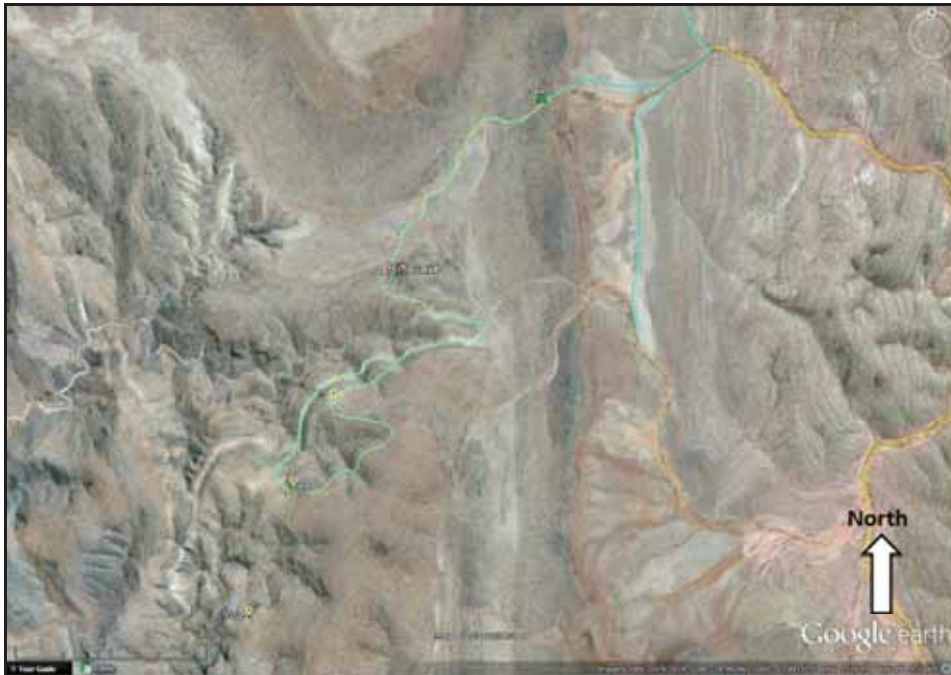


Figure 24 Google Earth Map showing tracks taken to locate **Features 29 & 28**

While passing up the valley side an outcrop of heavily karstified limestone was found with around 5 minor cave entrances, which were investigated, including Rift cave labelled on Figure 23 above. The longest of these was a 2 m high and 15 m long through cave with a small side branch which Robin crawled into. The side branch closed down after about 5 m. This cave had very polished surfaces indicative of animal use even though not many droppings were evident. Leopards were thought to be a more likely culprit than hyrax or baboon which leave a lot of droppings. The other small caves found comprised short vertical potholes and a rift and their locations were recorded.

After about 2 hours walking **Feature 29** was finally reached and it comprised a circular vertically-sided doline about 15 m diameter and 10 m deep, but disappointingly had no obvious way on. A few clefts were visible on one side and near the bottom which needed to be investigated close-up and so a rope was belayed to a tree and Mark kitted up and went down to check them out. He found no way on in either, but was startled to find a large owl perched under an overhang near the bottom. The bird was clearly agitated by the unexpected visitor and eventually flew off.

Looking across a side valley from Feature 29 alluring cave entrances were visible about 1 km away which formed the next objective. The team was faced with a decision of whether to go steeply down and up again across a side valley or stay up and contour round the head of the valley. The latter was decided upon, but while fairly flat the distance involved turned out to be around 2 ½ km, followed by a precipitous scramble down an escarpment to reach the cave entrances. On the way around a single large male zebra was seen quite close by followed by an impressively large herd of about 40 more zebras, which were clearly unused to human disturbance in such a remote location.



Blind collapse doline Feature 29, small rift breccia caves at Feature 28, area of limestone karst (DA) and overlook of F28 (MT)

Mark and Dave A. went down to investigate the objective **Feature 28**, while Robin and Dave K. contoured on further round and then descended a spur from which a view back at the escarpment cliff line was possible. Three cave entrances were found in total, each comprising around 1 to 2 m wide

and 5 to 10 m long rifts formed in dolomite fault breccias. Each cave had abundant signs of animal use with likely hyrax droppings present. Dave A. found the largest of these caves had a 2 m wide side branch going in to the left down around a corner. But it had a very unstable looking loose breccia roof above too risky to enter and investigate. The **Feature 28** cave entrance locations were recorded by GPS and Dave and Mark re-joined the others to determine the forward plan. The team determined that **Feature 30** was still around 2 km further walk away and that there was insufficient time available to reach it and return again. With heavy packs, oppressive afternoon heat and steep zebra paths to negotiate the team trudged back to the car disappointed by the negative exploration results.

TEAM 2 comprising Antoine, Patou, and Henry set off to meet the villagers at Otjimatemba concerning two of the cave entrances discussed the previous day and after a breakneck journey finally caught up with Titus. Later they zoomed off with a local guide called 'Doctor' to try and catch up with Mark, Dave A. and Robin to see if a reorganisation of people was possible, but were too late and drove on instead to meet James Vapirikavi Herunga at his cattle station. He welcomed spending time with the team and enjoyed speaking about many things other than goats! His huts were surrounded by kid goats which were adorable as they bleated and nosed around.

James took the team to meet Kaupataneua Tjahongue, who lived near a water pump further down the same valley. Kaupataneua was knowledgeable about the area and guided the team in the 4x4 and then on foot to investigate the **Red Mountain Cave**. After walking around 3 ½ km one possible cave was reached but this turned out to be only a tiny hole in the rocky outcrop. Another cave entrance was visible high up in the hill on the right shortly after starting the walk, but the locals assured the team that it definitely did not 'go'. Eventually the objective cave was reached only to find it was only a shallow rock shelter barely even in shadow!



Figure 25 Google Earth Map showing tracks taken in the area near Red Mountain Rock Shelter



Red Mountain Rock Shelter (PG), 'Tiny Hole' and limestone karst at 'Rocky Pockets' (HD)

The team returned to the car and after driving around 5km back branched off south to do some further exploration. William was driving and eventually refused to allow this hire car to be taken any further, after driving over so many spiky bushes. The team walked 2 km to a feature which was found to comprise numerous rocky outcrops in a valley where water gathered in pockets (Fig. 25). None of these were more than a few metres long and therefore not worth surveying. So, disappointedly they returned with

more tricky off-road driving to take James, Kaupataneua and Doctor home. Afterwards it proved difficult in the dark to find the right track for return to Camp Aussicht using a GPS with batteries nearly run out.

TEAM 3 comprised Joe with Titus, Roger and Duncan and 2 local guides who went to find 2 cave entrances known west of Joubert Pass. The first cave was called **Ondimba ja Mundumithe**, which was explored solo by Joe for about 100m from a small entrance with a 3 m drop into a medium-sized chambers and passageways with several forlorn looking mummified steenbok remains, plenty of formations and a few bats.. A squeeze was reached where the cave likely continued further but this was left for another day with a full team.

Team 3 then went on to **Ondimba ja Omutungi** which is named after the twisted, red-barked tree over the entrance. The entrance comprised a free-climbable straight pitch about 15 m deep onto a dirt floor with bones and narrow rifts at both ends and avens upwards, but all too small to enter. The team then went to check on access routes towards **Google Earth Features 2 & 3** for the following day, getting as close as 3 and 4 km respectively using different tracks. Then they went to Okarumba Village, where there was a well with a solar-powered water pump supplying livestock, which was also used by wild elephants. At 17h30 everyone watched avidly when a large herd of elephants came to drink, jostling fantastically as they did so. The team then returned to Camp Aussicht.



Omutungi entrance and elephant herd at Okarumba (JD)

SUNDAY 13TH SEPTEMBER

TEAM 1 comprising Joe, Mark, Patou and William went to **Ondimba ja Mundumithe** to complete the exploration Joe had started the previous day, survey and take photos of the cave. On the way the team stopped outside the bar in Otjimatamba to pick up two local guides, Doctor and one another. The team took about 45 minutes to walk to the entrance and arrived at the cave at 12h. A short rope hand-line was belayed to a tree to help safely descend the 3 m entrance pitch. Joe, Mark and Patou then surveyed the major part of the cave which Joe had explored solo the previous day and continued surveying and exploring another 15 m or so until the cave ended at a tiny sediment-filled tube at the bottom. Dust masks were worn and the gas meter carried showed no problems of air quality throughout. The team returned back to the surface for a short break and then helped William get kitted up to go in to film the cave and for Mark and William to take still pictures. Because Ondimba ja Mundumithe was the first cave of this expedition not requiring SRT rope access and training, William was able to experience visiting a 'wild' cave for first time. Particular points of interest in this cave were 4 steenbok mummified skeletons found, the well-decorated large chambers present and the interesting fractured dolomite geology. After the photography was completed the team derigged the entrance climb and walked back towards the car. William had obviously been overcome by his underground experience, because he lagged behind on the walk to do some surface photography, took a wrong turning and became separated. After he was missed by the rest of the team one guide went off in search and took about 20 minutes to find him and return safely. All were back at the car by about 15h30 for a late lunch snack and rendezvous with Roger and Titus.



The large spring described (JD)

Roger then took Team 1 to a possible future tourist lodge location 3 km west of Otjimatamba. The route initially followed a valley where the Joubert Pass reconstruction staff camp was located and then followed a surface stream flowing westwards to a sink. After descending a steep escarpment a large and beautiful spring and pool were visited with flowing water, green trees, tuneful birds, baboons and fine views of the mountains around. Of particular interest were massive tufa deposits adorning the 40 m high cliff above the spring. The team then retraced their route via Otjimatamba and went to search for elephants again at Okarumba Village and meet up with the other team. One bull elephant was

seen this time rather than the extended family which Joe had seen the previous day. The team was back at Camp Aussicht around 20h after some uncertainty on route finding in the dark on the twisty track leading from the main road.

TEAM 2 comprising Antoine, Robin, Dave A. and Henry left for what was supposed to be an 'easy day' to investigate **Google Earth Features 1, 2 and 22** (Fig. 26). Their guide and driver Duncan who had newly arrived with an awesome 4x4, took them up a track via a hunting station and then cross-country to try and cut down on the walking required to reach the objectives. Some extreme 4x4 driving was done across very rough ground and through thick thorn bushes until a point where it became impassable. The team then went on foot to locate Features 1 and 2. At **Feature 1** a rock face was found with a 2 m deep hole going in, but no cave was found at all at **Feature 2**. The team then dumped their bags and trekked about 2 km SW to reach the escarpment edge near **Feature 22**. They checked the small cliffs and two ravines in the steep slope beneath the escarpment, but no features of speleological interest were found. The view was magnificent and made for some lovely photos. The rock seen was dolomite with some red coloured sandstone, which seemed to have poor potential for cave formation.



Figure 26 Google Earth Map showing tracks taken in the area S. of Camp Aussicht

After Team 2 returned to the car they found Duncan fixing the second of two punctures sustained on the rough drive over. He had a camp fire going and prepared coffee, tea and some delicious home-made sausages, all of which cheered the group up after a disappointing day as far as caves were concerned.

As soon as the car had set off on the return journey it got a further two punctures! Duncan showed the team how to help with the repairs and the tyres were closely examined and many thorns pulled out. Many thorns had penetrated where the tread met the soft side walls and one tyre was permanently ruined where a stone had cut the side wall. After driving further 'Lo and Behold' another puncture occurred. Dave A. and Antoine were riding on the back at this time, ready to jump off and move stones when required and they raised the alert about it. The others, now well practiced, spilled out of the vehicle fetching stones to chock the wheels, undo wheel nuts and jack the car up. The 'ATS Team' (All Terrain Services) had the job done in less than 15 minutes, glue and all - what great teamwork!

Team 2 then rushed off to Okarumba Village to join Team 1 for elephant watching, while Duncan did most of the work replacing the 6th puncture of the day! On the way back to camp Duncan produced cold beer from his magic 4x4 to great elation all round! Everyone was filthy and tired, mostly from replacing tyres,

but were very happy to find another of Agnes's great dinners waiting and enjoy some more cold beers before bed.

MONDAY 14TH SEPTEMBER

TEAM 1. The initial plan devised the previous evening was for Team 1 comprising Henry, Robin, Antoine and Patou to leave early and explore a cave known by Titus about a 2 hour drive near Sesfontein. However after some further thought by Mark overnight and repeat reading of the SWAKNO report, he showed that the cave was almost certainly Warmquelle Pot, already known and explored by SWAKNO. Therefore the team instead decided to go to the next conservancy around 10 to 15 km west and NW from Camp Aussicht to reconnoitre and ask people there if they knew any caves to explore. A large tour around was made and one cave named Ondimba ja Donald was located.



Ondimba ja Donald (PG)

Figure 27 Google Earth Map showing Tracks Taken West of Camp Aussicht

TEAM 2 with Joe, Dave A., Mark, Roger and William made a rendezvous with three local guides part-way along the track from Camp Aussicht towards the main road to take them to **Ondimba ja Okavau**. The entrance and a story about this cave had been told to them by Marius at Camp Aussicht. The story was that the cave comprised an entrance shaft into which an oryx had leapt to its death and been lost while being pursued by a hunter and his dogs many years ago. The hunter had his reputation damaged for returning empty-handed after the chase, while his dogs had apparently followed the oryx down the shaft! The route to the cave comprised around 45 minutes of tricky off-road driving followed by a 30 minute walk. After arrival at the entrance it was realised unfortunately that the ropes had been forgotten. Responsibility for this omission was kept as 'we' plural, however Joe did receive some serious teasing about this. Dave stoically volunteered to return to camp with Dave K. to redeem the situation and after about 2 hours they returned with the necessary ropes and the entrance pitch was rigged with a belay to a large ficus tree which overhung the shaft. While they were away most of the pitch head had already been 'gardened' to remove all loose stones, but while descending Dave decided to kick away one further rock

from part way down the shaft. Unfortunately after descending about a further 8 m he found that a serious cut in the rope had occurred from the falling rock and after a few expletives made a mid-rope changeover and ascended again to replace the rope with a spare.

The cave was found to comprise a 22 m pitch belling out into an impressive dome-shaped chamber, but with no way on. The team felt like characters from 'Jack and the Beanstalk' because the ficus tree had tap-roots extending in a twist all the way from the surface down into the floor of the chamber. Mark surveyed and made a Gopro movie while descending in and also took some still photos at the bottom.

Of particular interest was that a disarticulated oryx skeleton and its distinctive horns was found on the chamber floor below the foot of the shaft, tying in with the legendary story told to us by Marius. While no recognizable dog skeletons were found to support that part of the story, a porcupine and a small deer skeleton, perhaps another steenbok, were found on a ledge to one side.

Air quality was found to be normal for the most part in the cave, but Dave detected low oxygen with a reading of 16.8% within the half metre nearest the floor at the bottom of the cave.

After de-rigging Okavau Team 2 returned to the vehicle and just had time to visit another cave entrance called Batpipe Hole. This is a narrow vertical pot with bats seen whirling below and a few stones were dropped down to help determine a likely depth of about 8 m, but the potential descent of this was left for another day due to lack of time.

The team drove the guides back to Okurumba Village and on the way saw around 8 elephants going towards the village watering hole. On the way back after rounding a corner in the track another elephant herd was encountered close by! One large angry elephant immediately gave chase to the vehicle and our driver Dave K. showed quick presence of mind and accelerated away quickly and outpaced the angry beast and finally shook it off after a minute or two. The team then returned to camp.

TUESDAY 15TH SEPTEMBER

TEAM 1 formed by Henry, Mark and Dave A. set off with driver Dave K. to explore two cave entrances known about by the local from Okurumba Village who was the younger of the guides from the previous day.

First however the team visited a **Himba ochre mine** located between Camp Aussicht and Otjimatemba which was said to be a religious site. Himba women mix the ochre with animal fat and aromatic perfume and spread it over their skin as a natural sunblock. Himba women claiming to be 70 years old appear to be about 40 due to the restorative properties of this skin treatment. 2 workings were seen along this escarpment, with handsome white-barked trees above. The more significant mine of the two descended



The Ochre Mine (MT) and the 'Cap Carbonate' with its distinctive white barked trees (DA). Ochre in use at Himba villages near Epupa (MT)



about 8 m down a moderately inclined shaft with steel car parts scattered about at the bottom for use as improvised hand-digging tools. The slightest contact with the sides of this hole turned skin and clothing a deep red colour. The rock seems to be a weathered glacial till diamictite with red ochreous claystone containing weathered boulders and the 'Cap Carbonate' limestone around 15m above.

After collecting the guide the team drove on to the first cave objective, turning off the main road near Otjimatemba and down a long track to the NE. The search for the cave entrance commenced over the flank of a gentle hill and after walking about for around 30 minutes the guide asked us to wait while he searched separately trying to find it for a further hour. The whole team eventually joined in the search again forming a search line, and walking about for another hour, but it was to no avail, no entrance could be found!

After a lunch break Team 1 moved on to the next objective, **Batpipe Hole**, the entrance of which had been located the previous day about 15 minutes walk from the car. After arrival at the cave Henry set to work with great enthusiasm setting up an anchor and putting on his SRT gear whilst Dave A. prepared the gas detector. This was lowered into the hole about 7 m and the alarm went off. It came out flashing and beeping and the lowest oxygen level was found it to be 11.8%! The team agreed the wisdom of checking oxygen levels before descent and discussed the potential fatal consequences with our guides. The team trudged back to the car for a cold beer from the cooler to drown their sorrows, but 'salt was rubbed into the wound' a little because the beer cans were found to be covered with smelly blood from meat storage the previous day. But a cold beer after caving on expedition is a special treat, so the team just had to avoid breathing in as they drank the beer.

Following these two disappointing exploration results the team decided to visit the diopside mine at Camp Aussicht. Dave A. had luckily brought a chisel action bit for his Hilti drill, so whilst he took photos of the many bats, Henry and Mark set to work mining some semi-precious green diopside and other bright green and blue copper minerals embedded in the walls. This kept geologist Mark happy for ages with an almost child-like delight as he enthusiastically ferreted about with the drill and then a bolting hammer.

Before dinner the team sat with Marius and discussed the oryx skeleton at Ondimba ja Okavau and had a beer whilst perusing his stock of crystals and polished semi-precious stones for sale.



Camp Aussicht Diopside Mine entrance (RW), pit props, Henry working with the Hilti drill and resident bats (DA)



TEAM 2. Joe, Robin, Antoine and Patou formed Team 2 and they collected a guide who took them to a cave called **Ondimba ja Uahana**, after the guide's first name. The entrance was in a cliff face, leading directly to a 6 m pitch down. There was also a short upper level, but this was only short. Antoine put in two bolts and rigged a rope for the descent. There were some blind cross rifts at the bottom, occupied by

bats. Robin surveyed the cave while Titus was given his first descent and re-ascent of a cave using SRT equipment.

From there the team took Uahana back to his house and then met another guide Titus was looking for and he took the team to another cave in the middle of a rocky area the far side of the dry Okuapa River bed from the road. A slot entrance between rocks led into a wide sloping chamber. Robin surveyed the cave while Antoine and Patou took some photos. They took the guide back home and then also visited one of the Himba ochre mines before returning to camp.

WEDNESDAY 16TH SEPTEMBER

The caving was now complete and it was time to move on to R&R ! A relaxing start to the day was made with team photos and watching the sun rise from the observation tower on the hill above Camp Aussicht before driving back to Opuwo so that our guides could attend an IRDNC work function.

On arrival at Opuwo a message was received informing that the group were in fact not going to camp at the Kunene Village Rest Camp again, but instead would be camping at the more luxurious Opuwo Country Lodge, where there was a swimming pool, bar and restaurant available. This campsite is on the top of a hill overlooking the town, with superb panoramas in all directions and away from the all-pervasive dust. The camp is offset 1 km from the lodge and has water, electricity and western-style shower blocks. At the Lodge rounds of cold beer, dips in the swimming pool, catching up on emails and relaxing were what made up a lovely afternoon!

THURSDAY 17TH SEPTEMBER

After saying goodbye to Duncan the whole team had a tourist day trip to Epupa Falls on the Kunene River NW from Opuwo and also visited two Himba villages. The drive to Epupa Falls was about 180 km and took about 3 hours at a steady pace along gravel roads. Over a rugged and twisting section near to Epupa the journey seemed more like a stage in a rally event with the road here having a loose surface and frequent roller coaster-like dips for many stream-bed crossings. Henry was driving one of the cars and described it as being like driving on marbles! The car slid all over the place leading to more than a few anguished expletives from Mark who was sat in the back holding onto the door handle so hard his knuckles turned white.

Three beautiful Himba girls were given a lift in Katipo's car on the way to Epupa and because he was in charge of their Conservancy, a visit to their village was arranged after seeing the Falls. Epupa Falls were very impressive and all were surprised to see such a big river in such an arid country, especially during the dry season. After a 5 km drive along a dirt road upstream for nature watching, the group came back to a lodge overlooking the falls, where an excellent lunch had been pre-booked for us by IRDNC.



Epupa Falls (MT)

The first Himba village was visited and comprised a settlement with neat mud and stick huts shaped like earth ovens and with little hearths just inside the entrance. In exchange for some food brought just for the occasion and a little cash the group was given a guided tour of the village and a charming dancing and singing performance. Using Katipo as an interpreter Mark and Henry were able to have an interesting two-way conversation inside the home of one of the senior village ladies. The village had goats as a primary farm resource but also arts and crafts for sale some of which were purchased as gifts for friends and relatives.



Himba village hut, singers (MT) and craft sales (RW)



The group made a shorter stop at a second Himba village where lots of cattle were penned in the centre between the huts with an awful lot of dung around. This village had some Himba men and boys around and the boys had a ruffle of cloth like an apron and hair either shaved or formed into one or two stiff pony tails sitting away from the surface of their heads.

After return to Opuwo the group met up for dinner with IRDNC staff and with UK Lottery and WWF funding representatives including Albie, Coreen, Cath, Danika, Basilia (our main coordinator from IRDNC), Linak, Urban and Russell and for Mark to give them a presentation on the preliminary findings from the expedition.

The word about the expedition seemed to be spreading and the description and pictures/films shown by Mark caught the imagination of our IRDNC hosts. There was positive sentiment for another trip being considered in the light of the moderate success enjoyed this time.

FRIDAY 18TH SEPTEMBER

Most of the morning was spent packing and then the team was taken for a tour of the IRDNC project 'Scents of Namibia' factory, situated next to the Kunene Village Rest Camp. The group were shown the method of collection and extraction of essential oils from various leaves and seeds including the most important product 'Namibian Myrrh' which is produced from the gum of a dwarf tree. This was followed by a visit to the grog shop in town, and some supermarket shopping.



Namibian myrrh tree *Commiphora Wildii* (MT)

Eventually the group left Opuwo and drove in a loose convoy to Etosha National Park, entering by the Galton Gate not long before it was due to close for the day and continued through the park to arrive at Olifantsrus Camp just before dark. The camp has a watering-hole with a hide above, reached by an elevated walkway, from which the group were able to watch a wide variety of wildlife through the evening, including elephants with

young, rhinos, zebras, wildebeest, oryx and desert fox.

SATURDAY 19TH SEPTEMBER

The group made an early start and drove through Etosha, stopping at several watering-holes along the way. At the first watering-hole lions were seen. There were elephants at the next watering-hole and a lot of springbok seen along the way, together with wildebeest, hartebeest, zebra, and oryx. The group stopped at Okaukujo Lodge for a very impressive buffet lunch and saw more elephants close up at the watering-hole there. Henry, Patou and Antoine then left for Windhoek and flights home while the rest of

the group continued on with more impressive wildlife watching to Halali Lodge, taking a route close to the vast expanse of the Etosha salt pan.

SUNDAY 20TH SEPTEMBER

The remaining part of the group continued on with their drive to Namutoni Lodge, located on the eastern edge of Etosha Park, stopping again at many watering-holes to view wildlife, including elephant, giraffe, zebras, kudu, impala, bustards, and a large group of lions resting under a tree. After setting up camp at Namutoni they drove round Fischer's Pan, being rewarded by the sight of a cheetah resting in the shade of a tree, right by the road.

MONDAY 21ST SEPTEMBER

During the night, some elephants got through the perimeter fence of the lodge, and one had been crashing about in the bushes close to the camp site. It was still there in the morning very close by. The group packed up and left on the long drive to Windhoek, stopping for lunch in Otjiwarongo and then arrived in Windhoek in the rush hour – exactly what they had hoped to avoid! Here they firstly said fond goodbyes to Agnes and then moved to hotels for the night with Dave A., Joe, and Mark staying in the Casa Africana, while Robin and William stayed in another one nearby. In the evening William organised a meal at 'Joe's Beerhouse', where everyone enjoyed excellent food and beer in a characterful and bustling restaurant and bar.

TUESDAY 22ND SEPTEMBER

Most of the group spent a few hours in the morning sightseeing round Windhoek at the Alte Fest, Christ Church Cathedral and the Independence Museum, while Mark visited the Geological Survey Museum, library and map sales office where he bought 1:250,000 series geological maps of the expedition area. Dave K. took the team to the airport, where they met William again, who was waiting for his different flight to Cape Town. There were no problems with the extra baggage, and flights via Johannesburg back to London were uneventful.

WEDNESDAY 23RD SEPTEMBER

The flight into Heathrow arrived on time, and everyone made their separate ways home.

5. ACKNOWLEDGEMENTS

The 2015 Kaokoland expedition is indebted to IRDNC for providing major support on transport, camping and food as well as local liaison and guiding without which this trip and its achievements would not have been possible.

Additionally the team gratefully acknowledges receipt of a financial grant from the Ghar Parau Foundation which went towards flight costs from the UK to Namibia for the British participants.

This expedition was conceived by Roger Collinson and Sandie Sowler who helped start things off particularly in relation to the investigation of Orumana Sinkhole.

Loan of important gas detection safety equipment was kindly provided by John Hine and Groupe Speleologique Vulcain (GSV).

Mary Wilde on behalf of the British Caving Library and Josiane Lips of GSV provided copies of some key publications prior to the expedition.

Generous advice on previous work and exploration opportunities was received from E. Marais, P Zilliox, S. Craven, S. Sowler and R. Ellis and it is hoped that open communication and co-operation can continue in the future among these fellow cavers so that further successful expeditions can take place.

6. CONCLUSIONS

6.1 RESULTS ACHIEVED

During the 8 days spent in the field 7 significant caves were explored and surveyed totalling 618m surveyed length and 183m total depth. As shown on the Table below Ondimba ja Omungongo was the longest and deepest of these and it also contained the largest and most scenic passages. Most caves started with vertical pitches requiring ropes or ladders and then had downward sloping passages below. These results can be considered a moderate success for a new team starting in this region and forms a significant contribution to the understanding of karst and caves in this interesting part of Namibia.

New Caves Found by the 2015 Kaokoland Expedition to Kunene Province, Namibia						
Date	Name	Entrance Location			Surveyed Length m	Max. Depth m
		Lat.	Long.	Elevation		
09/09/2015	Ondimba ja Omundu 1	-18.444440	13.94473	1736	19	-18
09/09/2015	Ondimba ja Omundu 2	-18.444590	13.94507	1734	34	-26
10/09/2015	Ondimba ja Omungongo	-18.298880	13.84995	1525	358	-59
12/09/2015	Ondimba ja Mundumithe	-18.914070	13.75034	1353	91	-28
14/09/2015	Ondimba ja Okavau	-18.740160	13.78054	1549	36	-23
15/09/2015	Ondimba ja Uahana	-18.669510	13.70085	1526	13	-7
15/09/2015	Ondimba ja Okuapa	-18.677310	13.71216	1399	67	-22
	Total				618	-183

Figure 28 Table listing new caves found by the expedition

6.2 SPELEOGENESIS

Two types of cave-bearing karst developments were found in the expedition area. The first type, which is less significant, comprises areas of limestone with small 'immature' caves and limestone pavements, such as south of Okavare and SE of Otjimatemba as described in Section 4 (9th & 12th September). In these areas surface dissolution of limestone is easily seen with pitting and karren along with small mostly rift-shaped caves. Probably the prevailing arid climate, lack of surface streams and high evaporation have prevented more mature karstification in these modest sized limestone outcrops.

The second type of karst comprises dolomite and limestone areas with scattered and sparse significant caves which are likely of hypogenic or mixed epigenic and hypogenic origin, as described by SWAKNO⁷ and deduced by this expedition from the morphologies described below:

- 1) None of the entrances to the more significant surveyed caves show any evidence of connection to present or likely ancient surface water courses and there is little or no evidence for seasonal vadose stream flow inside or epigenic flow indicators such as scallops or fluting.
- 2) The entrances occur at a variety of unpredictable geographical locations on the flanks of valleys and hillsides in either limestones or dolomites ranging at the oldest from the Devede Formation up to the Elandshoek Formation at the youngest (Figs. 3 & 4) without any obvious preferential speleogenic horizons.
- 3) Many of the caves have formed on geological faults and the entrances are mostly quite small compared to the caves passages below.
- 4) Within the caves indicators of rising thermal fluids include dome shaped chambers with only small exits upwards, numerous roof cupolas such as in Omungongo and blind ascending dome shaped passages and avens, such as in Mundumithe and Omungongo. Cupolas or Alveoles as SWAKNO termed them are typical of either condensation corrosion by thermal fluids such as sulphuric vapours or liquid thermal/density convection processes or generally confined phreatic conditions⁸.
- 5) A 3D maze complex is present in the lower part of Omungongo with morphology unrelated to any possible epigenic pattern .
- 6) Roof half tubes are present in Mundumithe near the entrance.

⁷ J.E.J. Martini et J.C.E. Marais (1996) "*Grottes hydrothermales dans le Nord-Ouest de la Namibie*". Karstologia No. 28-2, p. 13-18.

⁸ Alexander Klimchouk (2009) "*Morphogenesis of hypogenic caves*". Geomorphology No.106. P.100-117

6.3 FURTHER POTENTIAL

Based on this short expedition and earlier SWAKNO work it can be surmised that with guidance from local conservancies and others and geological study further similar caves are likely to be found over the entire area of carbonate outcrop on the Northern Platform geological province (Figs. 3 & 29), both north and south of this 2015 expedition area. To merit mounting another expedition a reasonable number of entrances need to be known about in advance mostly from local knowledge but also from satellite imagery. Google Earth features investigated this time were generally a disappointment in terms of speleological significance, which is a surprise since SWAKNO had used aerial photos to locate the more major caves they found. Learnings from this expedition can be applied to future remote sensing investigations. It should be noted that the major N-S limestone outcrop centred on Robbies Pass around 25 km WNW of Camp Aussicht and areas north of Opuwo were not visited due to lack of time available. Features of speleological interest are said to exist there and also unvisited Google Earth objectives remain.

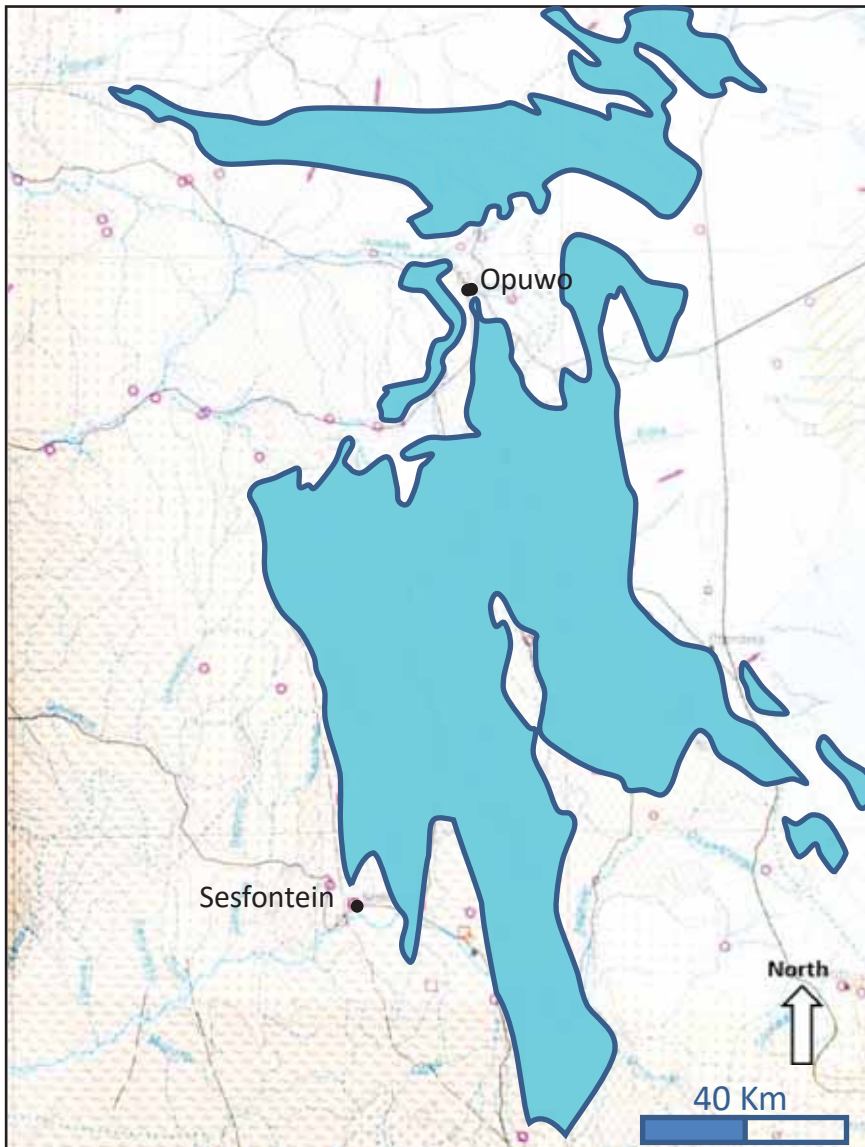


Figure 29 Areas of speleological potential around Opuwo & Sesfontein based on published hydrological map from van Wyk et al (2001) ²