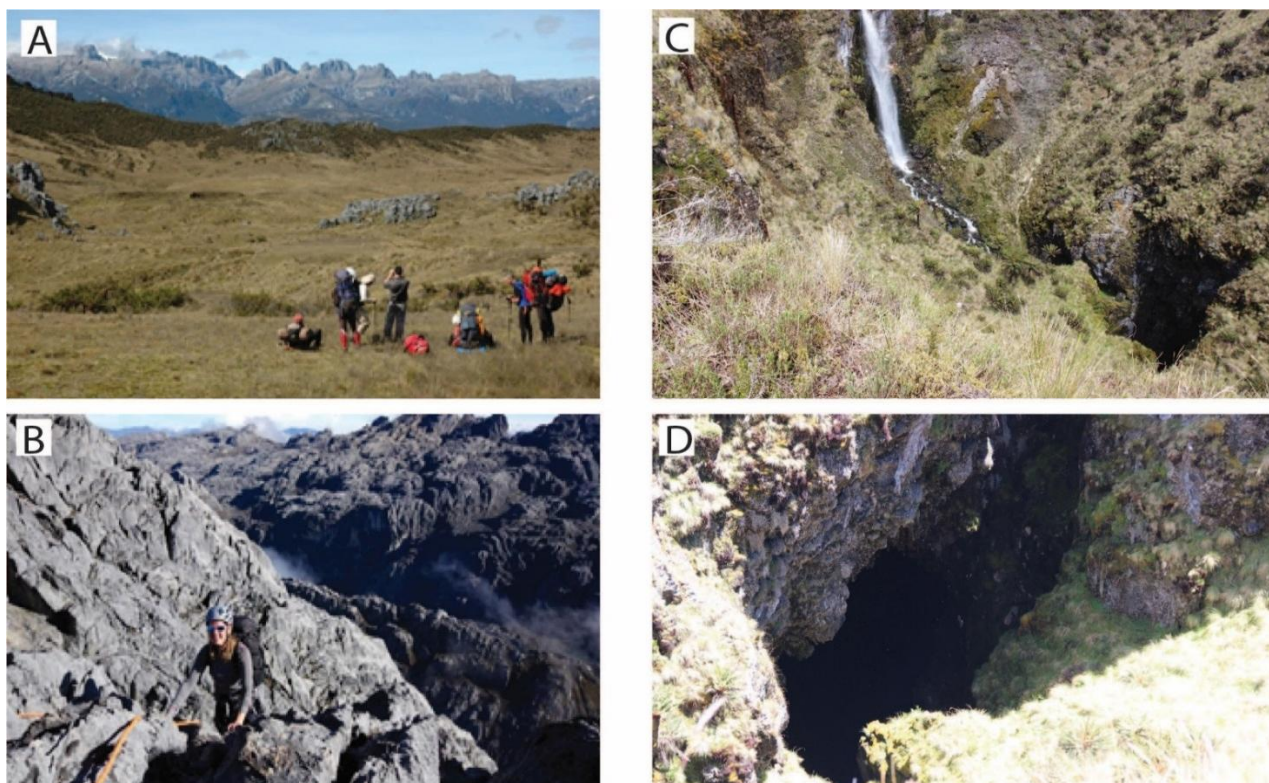


# The Gates of Hell Expedition

## Overview

This ambitious expedition will explore arguably the last great mountain range on Earth yet to be visited by cavers. Our goal is to explore the high limestone plateau on the approach to Puncak Jaya (Carstensch Pyramid, 4884 m), the highest mountain in Oceania, located in Indonesian Papua. This highly karstic limestone plateau extends for around 70 miles on either side of Puncak Jaya at an elevation of between 3,500 to 4,800 meters (Figs. 1 and 2). The expected limestone vertical range exceeds that of the world's current deepest cave, giving immense potential for significant cave formation.

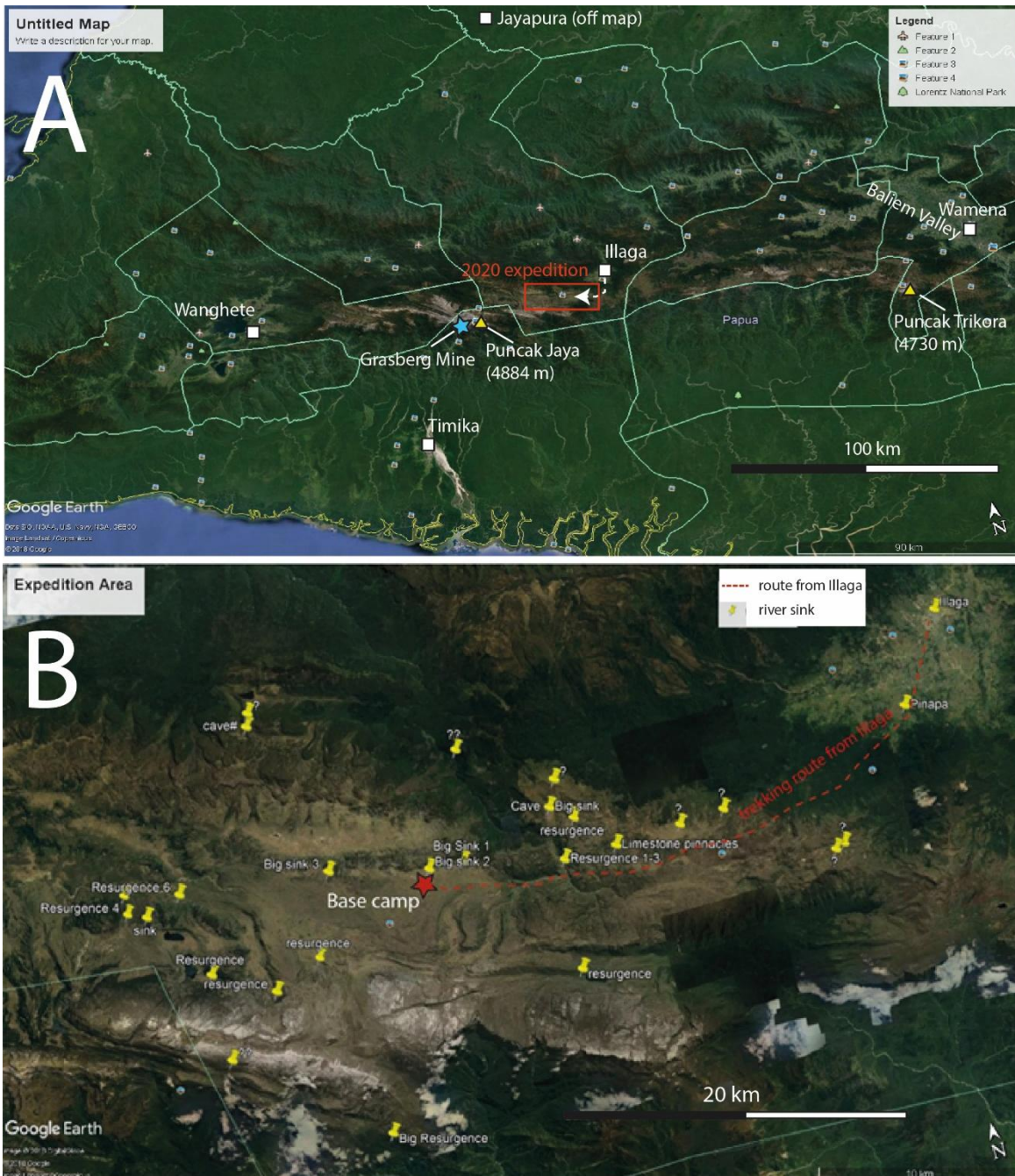
Climbing expeditions to Puncak Jaya have reported seeing large cave entrances into which major rivers flow, including "The Gates of Hell" (Fig. 1). Discussions with climbing expedition leaders and their local contacts confirm that these caves have thus far not been entered and remain unexplored. The fact that the terrain is open grassland or bare rocks means that identification of cave entrances is far more straightforward than in the dense jungle, which covers much of Papua and nearby islands like New Britain. Indeed, satellite imagery has identified many other rivers sinking into the underworld (Fig. 3), as well as subsequent resurgences, but there have been no attempts yet to enter and explore these caves. However, the extreme remoteness, high altitude, changeable weather, heavy rainfall and serious mountain conditions will be major challenges to solving this last great problem for speleologists.



**Figure 1.** (A & B) Views of the beautiful and remote Puncak Jaya (Carstensch Pyramid) mountain range in Papua, comprising limestone that extends for over 70 miles, with potential for the world's deepest cave systems. (C & D) The Gates of Hell cave into which a major river sinks, which is located in the depression in the foreground of part A (all photos courtesy of Dr. Werner Weiglein).

## Aims

We aim to be the first explorers of the cave systems that must exist beneath the limestone plateau surrounding Puncak Jaya. We will focus on the western side of the plateau that lies between the peak of Puncak Jaya and the village of Ilaga (Fig. 2). This area lies on the established route followed by climbers from Ilaga to Puncak Jaya, which thus reduces risks associated with access and logistics. We will partner with Dr. Werner Weiglein, who has made this trek over 20 times and has strong links with local villagers.



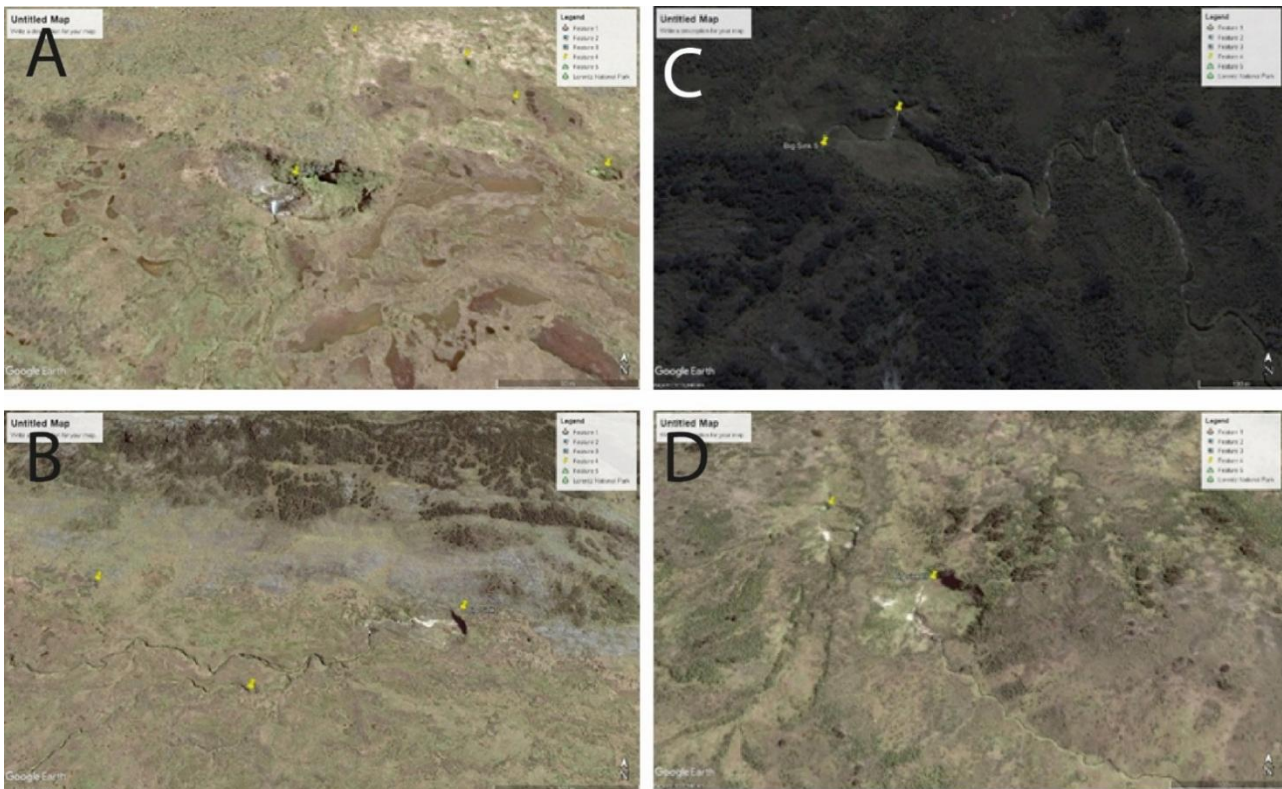
**Figure 2.** (A) Overview map of areas of interest, major towns, and peaks in Indonesian Papua. (B) Map showing the expedition area that is located ~25-30 km east of Ilaga, with major river sinks and resurgences marked. Our main base camp will be located near the Gates of Hell cave (red star). The route from Ilaga, used previously by Dr Weiglein's climbing expeditions, is the red dotted line.

Our specific objectives are as follows:

- Exploring caves associated with three identified river sinks (Fig. 3), including the major cave entrance known locally as “The Gates of Hell” (Fig. 1);
- Identifying sites for future (perhaps much deeper) cave exploration;
- Detailed mapping of cave passages explored; and
- Building relationships to help establish a long-term project on the plateau, hence enabling sustainable speleological or other scientific research and exploration.

## Identified River Sinks

The area we seek to explore contains an unusually large number of major river sinks and resurgences on satellite images (Fig. 3). We will focus initially on three major river sinks that lie almost on the trekking route from Ilaga. These disappearing rivers most likely feed a large resurgence that is situated 400 meters lower in altitude and which is 12 km away from the entrances in a gorge closer to Ilaga (Resurgences 1-3 in Fig 2). Dr. Werner Weiglein confirms that there is a big river resurges at this location, as it is next to their camp on day two of the climbers’ trekking route to Puncak Jaya. We will visit this resurgence, together with a series of large holes on satellite images further to the west. Finally, we will visit a series of large river sinks and resurgences located up to 20 km to the east and south of our base camp (Fig. 2). If they have significant caves, we will then set up satellite camps. We thus plan on at least 18 days in the field around our base camp. It rains most days and water levels in the caves will be a major factor. Temperatures often fall below zero.



**Figure 3.** Satellite images of major river sinks within the expedition area, located to the east of Ilaga (Figure 2b). Panel A shows the ‘Gates of Hell’ cave entrance, which is also shown in Fig. 1.

## Logistics

**Access and Permissions:** Permits are a key challenge. We are partnering with local expert Dr. Werner Weiglein (of Weiglein Expeditions) to reduce risks associated with permissions. Dr. Weiglein has already successfully guided over 20 rock climbing trips to Puncak Jaya from Ilaga. Importantly, this includes several recent trips, so he is familiar with the current situation around Ilaga. Dr. Weiglein

[www.gatesofhellexpedition.org](http://www.gatesofhellexpedition.org)

has developed necessary links with local tribal chiefs in Ilaga as well as the Indonesian authorities. In addition to arranging permissions, Dr. Weiglein will assist us with procurement of local guides for the route to the plateau, together with porters and camp staff.

The journey towards Puncak Jaya will begin in each of the home countries for the respective expedition members. We will meet in Bali or Jakarta and then take an internal flight to Timika before using a chartered Cessna flight to reach Ilaga. We will need to finalise permissions in Timika and Ilaga, as well as procure provisions, local guides and porters in Ilaga. It is therefore expected that this initial preparatory phase, including travel, will take approximately five or six days. We will spend two to three further days walking to our base camp on the plateau, around 20 km west of Ilaga. Given the 1,000 meters of ascent and the initially demanding terrain through the rainforest, expedition members will be carrying only essential supplies on the trek. Heavy caving equipment, which will include personal gear, ropes, metal rigging gear, bolting equipment, drills and charging technologies, will be taken to the campsite via helicopter.

We will make a base camp in an area convenient for exploration near to the identified river sinks. However, we recognise that the results of initial explorations and surface reconnaissance over a wider area may result in a need for moving the main camp or satellite camps being set up.

**Surface Work:** Not all expedition members will be underground at all times. This will permit us to carry out significant surface exploration and provide essential safety cover for those underground.

Surface exploration will initially comprise undertaking a series of day-treks to more outlying sinks and resurgences. These include treks to features identified from satellite imagery (Figs 2 and 3). We will also speak to our local guides and porters about locations of other sites of speleological interest that they may know of. Finally, we will cover ground on foot to locate smaller cave entrances which will not show up on satellite imagery. Experience suggests that less obvious cave entrances, which are not major water conduits, can sometimes provide the most fruitful access to caves.

All cave entrances and other sites of interest will be logged using GPS and added to a GIS record of the area explored by the expedition team. This data can be supplemented by observations of, for example, geological boundaries observed in the field, or other geomorphological features, which may have an influence on cave development.

**Caving Techniques and Equipment:** For self-evident reasons, we do not have specific information about the nature of the caves we will descend. However, we do know from geological and satellite information that they have the potential to carry significant volumes of water and that they could well be entirely vertical in nature, or at least contain vertical pitches. We will use single rope technique (SRT) to safely rig around any obstacles that present themselves. SRT involves fixing static ropes to the cave walls using either natural or drilled anchors. Ropes will be rigged away from water and rock to avoid abrasion. Descent will be via friction abseiling devices, with mechanical camming devices (“jammers”) used for ascent (Fig. 4). Personal



**Figure 4.** Single Rope Technique

safety lines (known as cows' tails) will be used for horizontal progression, for example, on the approach to vertical sections, or to cross deep water. Team members have explored many deep caves in this fashion.

It is expected that the caves near Puncak Jaya will be cold. Low underground temperatures will reflect the average annual surface-air temperature and waterfalls may cause strong drafts and further wind-chill. We will therefore use warm fleece layers beneath abrasion-proof oversuits. It is essential to stay out of water in such environments and the caves will be rigged accordingly. In case this is not always possible, we will also have neoprene wetsuits available.

Underground lighting will be via LED technology. Advanced caving lights can last several days on a single battery pack. Nonetheless, we will require multiple battery packs and charging capability for both lights and drills, which will be required to place anchors to rig ropes for SRT. We will thus take a solar charging system.

**Cave Mapping:** All caves explored will be mapped using modern surveying methods. We will use laser range-finders with built-in compass and clinometer to map a "centre line" through the cave passages, with additional measurements taken to provide passage detail and cross sections. The raw data will be processed and plotted in three dimensions, with 2-D plans and elevations prepared for illustrative purposes. Combined with entrance locations and satellite imagery, we will thus determine the nature and trends of the underground development relative to surface features.



**Figure 5.** Cave mapping: laser range finding (left); note taking and range finding (right)

**Opportunities for Scientific Work:** The primary aim of the expedition is physical (geographical) exploration of new underground worlds, as formal scientific expeditions to Indonesia need far more onerous permits. However, visiting new environments for the first time offers unparalleled opportunities for scientific advancement. We will therefore make important observations that can be a catalyst for future scientific expeditions. In particular, we will make observations about:

- hydrology and hydrogeology underground;
- location of significant speleothems which can be used for dating, providing valuable insights into past climates;
- presence of cave sediments, which again can inform studies of past climates; and
- the presence of any cave life, which, due to the extreme and isolated environment, is likely to include new species to science.

In all cases, this would involve photos, sketches and written observations rather than samples, which would require permitting.

In addition, we will engage with our guides and porters to understand the role that caves have in their local culture. Typically, caves in Asia and Oceania are seen as an important local resource (for example, for bat guano, hunting flying foxes, etc.). However, we know that the caves on this plateau are not entered by the local people. At present, we do not understand the reasons for this and we may find folklore that may be associated with the caves.

## **Safety**

There are three main areas of hazards associated with the expedition. These relate to travelling and living in harsh environments, exploration of unknown caves and the local geopolitical situation.

**Overground:** We will be camping at altitude in a serious mountain environment, which is known for regular heavy rain and poor weather conditions. To mitigate against the effects of exposure, we will need to be well-equipped and have durable tents, sleeping bags and clothing. We will also need to ensure that our supplies include provisions for a high calorie diet due to our physical exertion in these conditions. Team members will need to be suitably equipped for changes in conditions and will always need to carry emergency equipment. As a team, we will make use of a satellite phone in case of any emergencies.

**Underground:** The biggest risks in exploration caving typically relate to loose rocks, rising water levels and flooding. The first of these is mitigated by a careful choice of routes and removing loose rocks in advance of descending pitches. Flooding is more challenging, especially in such a rainy environment. We will need to proceed with extreme caution, use local knowledge about likely weather patterns, obtain forecasts by satellite communications, if possible, and carefully interpret indicators of past flooding to understand the likely magnitude and frequency of any historic flooding events. We may decide to only enter caves during certain times of day or to rig ropes to higher levels in anticipation of flooding. Low temperatures will be a hazard and we will need to be equipped appropriately, including if we are trapped by flood water unexpectedly. No underground trip will proceed without a surface “callout”, meaning that an “ETO” (estimated time out) is left with a team member. At least one team member will remain on the surface at all times. It goes without saying there is no “cave rescue” in such extreme locations. We will thus train in self-rescue and our team includes very experienced members of UK and other national cave rescue teams.

**Local politics:** Indonesian Papua has a strong independence movement and this had led to violent clashes at various times in recent history. For this reason, expedition dates are chosen to avoid Indonesian Independence Day. We have also chosen to work with an experienced local expert (Dr. Weiglein) who is well connected with both the local villages in the area of Ilaga, and the Indonesian government. As well as making access more straightforward, this will be essential for our safety in the field. Working closely with the local chiefs is the best route to minimising risk.

## Personnel

We have an experienced team of international cave explorers:

**Professor Peter Talling:** Pete was a rock climber in his previous life before going over to the dark and muddy arts of caving some 20 years ago. He has been part of over 30 caving expeditions worldwide, often as leader and to new areas for cavers. They include expeditions to China (nine times), Myanmar (six times), Timor Leste, Philippines, Spain, Austria, Croatia, USA, Tasmania, New Zealand and Kyrgyzstan. They include the longest and deepest caves in Myanmar, East Timor and China. He spends far more time than is healthy looking for holes in the ground on Google Earth and regularly ruins sets of clothes by squeezing enthusiastically into what he hopes to be the next deepest cave in the world. When not exploring underground worlds, his day job is mapping and monitoring the ocean floor with new technology. He has designed and led numerous international research projects and oceanographic research cruises, and heads a major research group, spread across the Earth Sciences and Geography Departments at Durham University. He will co-lead the expedition.

**Dr Fleur Loveridge:** Fleur started caving in her late teens when at Oxford University. Her first experience of cave exploration came in South Wales in 1996, shortly followed by the first of ten expeditions to the Picos de Europa in Northern Spain. She now has over twenty years of experience of organising and participating in caving expeditions, including deep underground in Spain, Austria and Croatia (to -1.4km). She has also caved extensively in China and Myanmar and participated in expeditions to Timor Leste, USA, Australia and New Zealand. She loves the wilderness and wild places, and the remoteness and personal responsibility that comes from being deep and/or a long way underground. She has also canoed 450km down the Colville River in Alaska, passing the point furthest from a structure in the United States. Fleur is part of the "cavers list" attached to the Cave Rescue Organisation in the Yorkshire Dales. In real life, Fleur is an engineering geologist who conducts research into storage of thermal energy in the ground. She will co-lead the expedition.

**Avelina Wright:** Avelina lives for adventures. She loves travel, exploration and discovering new, exciting things, but also cherishes learning new languages and interacting with local people. She started caving 16 years ago with her University club, crawling around in very small, tight and squalidly muddy Devonian holes. Since then, she has progressed from being a south-western mud wallower to bottoming a number of serious 1000+ meter deep caves in foreign mountain ranges and camping underground for up to



a week at a time, all in the name of exploration. As a soprano, she occasionally provides the entertainment at camps underground or an impromptu concert for her fellow explorers in large subterranean chambers. At home in the Yorkshire Dales, she helps to run her local cave and mountain rescue team (the Cave Rescue Organisation) and is also a qualified Casualty Carer. Tuesdays to Fridays, you will find her in a dress or a suit, advising clients in agricultural property law in Cumbria. She has responsibility for expedition equipment.

**Martin Holroyd:** Martin first started caving at the age of 14 and has been an active caver ever since. After caving extensively throughout the UK, he began cave diving in 1985. He has been fortunate enough to be involved in many new discoveries in the Yorkshire Dales. Notable discoveries were made in both Dale Barn Cave and Ginging Hole. Both caves are regarded as extremely difficult. Martin has overseas expedition experience in the jungles of Belize, Vietnam and Borneo, often being dropped into remote areas by helicopter. He has also caved in China, at altitudes of 5000m in Peru and in the remote subterranean systems of the Nullabor in Australia. As if that was not enough, Martin has participated in cave diving expeditions in Spain, and further diving trips in Florida and Oman. He is currently an active member of the Cave Rescue Organisation in the Yorkshire Dales, having previously served with the Swaledale Fell Rescue Team and the Upper Wharfedale Fell Rescue team. At home, Martin worked for the fire service, with specialist roles in rope rescue and water rescue. He is our expedition safety officer.



**Dr Richard Gregson:** Richard was born in France and educated at Oxford University Medical School, where he also joined Oxford University Cave Club. This led to him exploring every major cave in the UK and Ireland, as well as participating in many caving expeditions to the Picos de Europa. He was part of the team that bottomed Pozu del Xitu, at that time the first cave over 1000m deep to be explored by a British team. He also co-wrote a book about it – *Beneath the Mountains* – which became *the* classic caving expedition tome. Richard has bottomed the Gouffre Berger and been on expeditions to Borneo, USA and Indonesia. Professionally, he became a paediatric eye surgeon and worked in Nottingham for 20 years and then moved to the Cayman Islands for 3 years before retiring. Richard is our expedition medical officer.



**Thomas Starnes:** Thom was the caving secretary for the University of Plymouth Adventure & Expo Society before going on to serve a three year term as chair of the Council of Higher Education Caving Clubs (CHECC), the forum representing university caving clubs in the UK. Thom has participated in overseas expeditions to Madagascar and Oman, with a focus on biodiversity research, and to Austria as a cave explorer. Thom's bachelor's degree honours project involved mapping the species diversity of fig trees on the island of New Guinea



by combining herbarium specimens with expedition accounts and cutting-edge spatial modelling techniques. He speaks a little Bahasa Indonesia and is always keen to learn new phrases. Other than caving, his interests include natural history, spatial analysis, cartography and fell running. Thom is a Senior GIS Analyst with a nature conservation non-profit in the UK. He will develop the expedition GIS, and lead on cave mapping.

**Harriet Field:** A social scientist with an interest in culture and community, Hattie recently completed her BA in International Relations, writing her dissertation on the Israeli-Arab Bedouin community in the Negev Desert. She began caving three years ago after joining the Cambridge University Caving Club. Expeditions and fieldwork have taken her across Oman, Israel, the Indian Himalayas and Mongolia, where she spent two months investigating rural to urban migration. Having spent her early caving years in the UK, Hattie is looking forward to traveling further afield for her first caving expedition. She has a strong interest in trail running and hiking; partaking in both mountain and trail marathons, and will soon begin a career in the civil service. She will work with the expedition social media.

**Dr Andreas Klocker:** Andreas started his caving career in the Junee-Florentine in Tasmania, which is seen by most as Australia's most challenging caving area. He has since been caving and cave diving on several big expeditions in Mexico and New Zealand. In 2015, Andreas led a successful push in Sistema Huautla, the deepest cave in the Western Hemisphere, to explore beyond several sumps in Redball Canyon. This trip involved several sustained camping trips underground, daily commutes through several sumps and multiple aid climbs to work from a depth of 750 meters towards the surface. This was the start of a collaboration that led to efforts to connect Sump 9 in Sistema Huautla to its resurgence, under the banner of the 'Beyond the Sump Expeditions'. This project now pulls together an international team of cave explorers, with both caving and cave diving skills, to explore some of the most remote places found inside the Earth. If Andreas is not in a cave, he explores deep reefs off the coast of Tasmania. Occasionally you might also find him working in climate science where he studies ocean circulation. Andreas is running the expedition website and social media.

**Laura Benn:** Laura started caving with the Southampton University Caving Club in 2012, becoming president before moving on to join the Council of Higher Education Caving Clubs (CHECC) committee as secretary. In her post-student years, she has participated in several overseas expeditions including exploring caves in China, Vietnam and Philippines. Outside of caving, she is also a keen rock climber and likes to get out as often as the weather allows. Her enthusiasm for



adventure led her to take a short career break and spend the last year caving and climbing around the world, from caving deep below the Dachstein plateau to ice climbing in the Canadian Rockies. Laura has a background in physics and is currently training with the Met Office to become an Operational Meteorologist. She is the expedition treasurer.

**Jeff Wade:** Jeff started caving with his University of Sheffield club, SUSS, some 16 years ago. Since then his passion for caving and in particular cave exploration has taken him far and wide, including to the bottom of the current deepest cave in the world, Vryovkina, at a depth of -2212m. He has been actively involved in supporting other cavers in their training and development through a variety of roles, the most recent as president of the Grenoble caving club, SGCAF, in France. Within Europe he has undertaken tens of expeditions across France, Switzerland, Austria, Greece and Spain. However, some of his expeditions have taken him further afield to China, Malaysia, India and Timor-Leste. He has also been an active member of Derbyshire Cave Rescue Organisation for many years, whilst living in the UK. Jeff also specialises in cave photography and was recently awarded the Giles Barker award for his contributions to this. He will be our expedition photographer.



**Gareth Davies:** Gareth first tried caving as a scout but it wasn't until his late 20's that the caving bug really set in as he became a committed cave explorer in South Wales. His first foray overseas was a tourist trip to the Gouffre Berger. Since then he has been involved in four cave diving expeditions to Castleguard in Canada, and been exploring and diving glacial moulins on the Gornergletscher (Zermatt) on four occasions. He has also been on caving expeditions to Malaysia, Tennessee, the Picos de Europa in Spain, the Dachstein in Austria and led an expedition to Colombia. He has participated in many tourist trips caving and diving in France, Sardinia, Iceland, Malaysia, Crete, Spain as well as the UK. When not involved in foreign expeditions Gareth can be found digging or diving in South Wales and is an active member of two local cave and mountain rescue teams. He is training officer for the Welsh Section of the UK Cave Diving Group. Above ground he likes to get out walking, cycling, diving, sea kayaking and white water canoeing. He will lead on expedition sponsorship.



**Chris Snell:** Chris grew up in Somerset and started caving as a boy scout. That was now well over over 30 years ago, but his enthusiasm has not waned. He has caved lots within the UK and has been on numerous trips around Europe, including some of the large classic vertical systems. Occasionally, his arm is twisted to go digging for the Devon master system! Other interests include mountaineering, canyoning, mountain biking and trekking. He also really



enjoys travelling and has fond memories of trips to Japan and the USA, whilst his mountaineering has taken him to the Alps and extensively across Scotland. He is very much looking forward to the expedition, being his first caving expedition. In his day job, Chris is an electronic engineer. This feeds into caving remarkably well as he has built numerous caving lights over many years and was the designer of the electronics of the Earthworm caving light. Chris is responsible for our electronic and technology gear.

**Ursula Collie:** Urs has over forty years of experience of caving and caving expeditions, and is half of the equipment retailer Starless River. Also a solicitor, she will be the expedition home agent.

### **Outline Schedule**

The expedition schedule is based on 5 weeks away from the UK and achieving a minimum of 18 days on the mountain cave exploring. This includes for some contingency in our travels plans since local air travel may be effected by weather conditions, and additional time could be required for arranging permits.

Day 1: Fly to Bali or Jakarta

Days 2-3: Fly via Jayapura to Timika. Obtain permissions and purchase some provisions

Day 4: Fly with Cessna from Timika to Ilaga.

Days 5-6: Arrange permits in Ilaga. Acquire additional permissions, load helicopter, start acclimatisation.

Days 7-9: Walk Ilaga to Base Camp, set up camp, continue to acclimatise.

Days 10-28: Caving and prospecting from base camp. Use of satellite camps as necessary.

Days 29-30 Walk from Base Camp to Ilaga

Days 31-32: Fly with Cessna from Ilaga to Timika

Day 33: Fly from Timika to Bali or Jakarta

Days 34-35: Return to home country.