

# Geodigest

## News

### The Thailand cave rescue

**Tony Waltham writes** Doi Nang Non (Mountain of the Sleeping Lady) is a 1000 m high ridge of Permian limestone lying within Thailand's Chiang Rai province and almost along the border with Myanmar. It is classical tropical karst, with steep slopes of forest-covered limestone rising from the adjacent alluvial plain. Its underground drainage has thousands of sub-vertical fissures draining down to base-level stream caves that are as yet only partly explored. But the mountain is also laced with abandoned, high-level cave passages, including the 10.3 km-long system of Tham Luang Nang Non (also known just

as Tham Luang, meaning Great Cave). Its first 700 m of passage have a rudimentary tourist footpath, and its far reaches have been explored progressively by French and British cavers since the 1980s. The whole cave system has little gradient, and lies only a few metres above the level of the resurgence on the eastern side of the mountain (Fig. 7).

On 23 June 2018, a team of 12 teenage Thai footballers visited the cave with their young coach. Heading beyond the tourist section, they reached the junction with the main passage, which they followed towards the south. The passage was dry except for a few small lakes and the water dripping from stalactites, and most of it offered easy walking in grand galleries. However, the young visitors did not know that much of this passage filled with water when any significant level of flooding exceeded the capacity of the permanently active (but immature) passages at lower levels. It is because of this that the cave is closed throughout the entire wet season from July to November.

This year, the monsoon came early, with an unexpected storm that produced 15 mm of rainfall in one hour, thereby saturating the limestone and flooding the cave while the boys were underground. On their way out, they reached the main passage junction to find the way home flooded, and so retreated southwards and upstream while their own passage started to flood. Eventually they reached a chamber where they could climb a ramp to a higher level that was safe. They watched the floodwaters swirl by, and waited for the flows to reduce. It was a long wait, and they were some 2500 m from the cave entrance. The water had only needed to rise a few metres within the limestone to push flood overflows into most of the long cave passages that are nearly horizontal and were normally dry.

That same evening, many parents realized where the boys were and saw the effects of the torrential rain. At the end of the show cave path, a first section of completely flooded passage lay beyond a pool of muddy water. A team of Thai Navy SEAL divers was called to the cave. They did very well and worked their way through another kilometre of passage, with sections of flooded tunnel between dry chambers, to reach the junction with the main passage. But these were open-water divers, and they really struggled in the cramped conditions of the cave with almost zero visibility in the muddy floodwater. It was fortunate that a local ex-pat British caver, who knew the cave well, advised the Thai officials to call in specialist cave divers from Britain.

Meanwhile, sinking streams at both northern and southern ends of the mountain were dammed and diverted to reduce the flow through the cave, though stopping the entire flow was never possible in a mature karst. Cavers scoured the mountain



**Fig. 7.** Looking down from the entrance block pile into the spacious first chamber of Tham Luang (Image: *China News*.)

for another way into the cave, and although one will probably be discovered some day in the future, nothing was found in the rescue effort's panicked search. Pumps were taken in to draw water out of the cave; they drained a first pool, thereby allowing dry cavers to reach a bit further along the entrance passage to establish a dive base. But they could have almost no impact on the main cave passage (Fig. 8).

After four days, two British cave divers arrived at the cave. John Volanthen and Rick Stanton are two of the world's leading cave divers; they had spent a recent summer diving 9 km into Spain's Pozo Azul to explore the underground river beyond. They needed repeated dives to work their way up Tham Luang's main passage, diving through multiple, long, flooded sections (against strong currents in the narrower sections), swimming across underground lakes and climbing over boulders in dry chambers between the flooded sections of the cave. They even had to remove rocks in a few places that were easily passed by a crawling schoolboy but were far too narrow for a diver wearing high-capacity diving bottles. Then, on 2 July

**Fig. 8.** Thai soldiers laying pipelines from the pumps in the large entrance passage of Tham Luang. (Image: Thai Navy.)

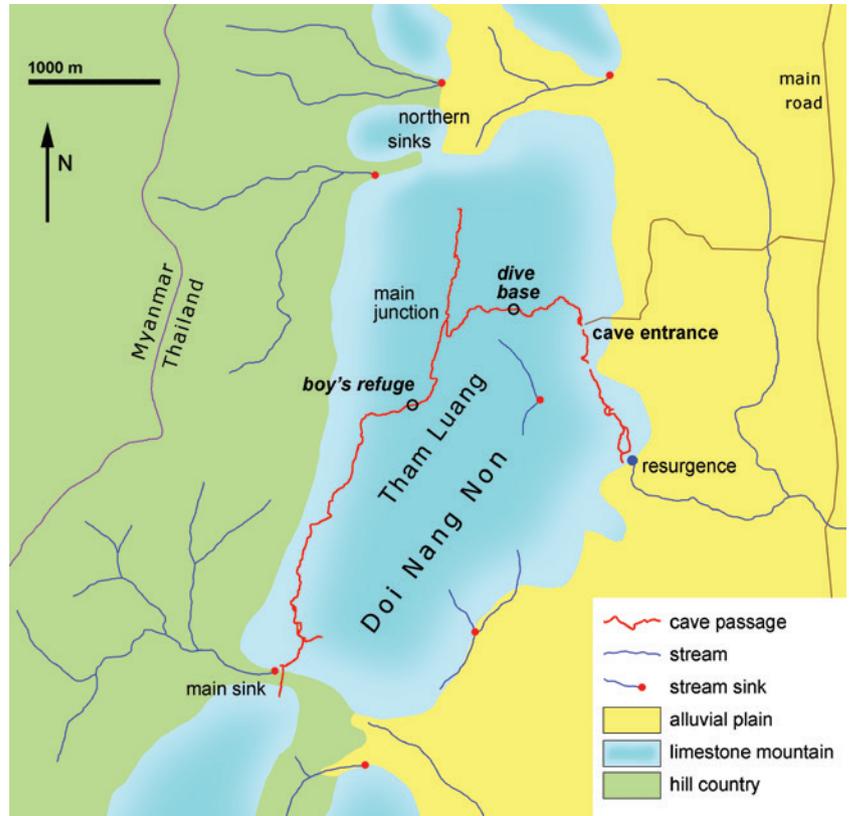


2018, they reached the boys in their dry chamber. Success was in sight. Two more English divers, Jason Mallinson (also from the Pozo Azul project) and Chris Jewell, carried in food and equipment. An Australian doctor, Richard Harris, and his cave diving partner, Craig Challen, went in to monitor the boys' condition. Four Thai SEALs went in, following the lines laid by John and Rick, and stayed with the boys (most of whom spoke no English).

The boys were in great shape, though rather hungry, and due credit goes to their coach, Ekkapol Chanthawong. He rationed their minimal food and light, so that they still had remnants of both when the divers reached them after nine days. They drank clean water dripping from stalactites, and the cave temperature of 23 °C meant they had no fear of the hypothermia that would render such an unprepared stay difficult to survive in many of the world's caves. Ekkapol kept the boys' spirits up with meditation in Buddhist style. They remained calm and composed for a full nine days; when John Volanthen first emerged from the water, they greeted him with a polite 'hello' and asked him where he had come from.

Extracting the boys was still a challenge. Waiting for the floodwaters to recede was not realistic, as the cave could stay flooded throughout the monsoon season (Fig. 9). Drilling into the cave, in the style of the Chilean mine rescue, was impractical, as cave maps are not as accurate as mine surveys in indicating where to drill. Crash-courses in SCUBA diving were not realistic, with the first underwater section being 350 m long and including some constricted sections. Rigid containers, each sealing a single boy inside, would not pass some narrow corners in the five long sections of underwater passage. The solution was to strap each boy into a flexible suit, and equip him with a full-face mask for breathing, after he had been sedated by Richard Harris to ensure no panic in the hostile and unfamiliar situation of being helpless underwater. Then each was hauled along the underwater passages by the four British divers. The water had cleared after the initial mud-laden flood, but the repeated diver-traffic was stirring up the floor sediment and the last dives were in almost zero visibility. Backup teams of Navy and civilian divers (including ex-pats from Thailand's many dive schools) relayed in hundreds of air bottles to supply the lead divers going back and forth through more than a kilometre of passages that were then underwater.

The logistics were massive, but by 10 July all the boys and their football coach were safely out of the cave, followed by the four Thai SEALs who had remained with the boys until the last was carried out. This huge success had involved nearly 100 divers from ten nations, along with hundreds of cavers and rescuers from 20 nations who, together with hundreds of Thai soldiers, diverted streams, scoured



the mountain, operated pumps and carried stretchers and equipment through the long entrance passage. Then there were the hundreds of local people who provided food and support for everyone else. Sadly, one volunteer Thai diver died when he was ferrying equipment and ran out of air while struggling in a narrow part of the underwater cave. Now there is just a lot of equipment to recover from the cave after the monsoon abates in December. After that, local tourism can benefit from the publicity, as the Tham Luang Khun Nam Nang Non Forest Park is now planned for an upgrade to a National Park.

The boys' rescue was a massive exercise that succeeded because cavers, cave divers, doctors and many others could get on with the tasks in hand; one wonders how events would have matured when fighting regulations, safety-obsessed officialdom and endless killjoys in many a part of the Western world. The boys were checked out in hospital, and, apart from a little weight loss, are all in good condition. They all revel in looking back on a remarkable experience, and none of them wants the counselling that various psychotherapists had claimed they would need; instead they plan to spend time as novice monks to honour their compatriot diver who died. They had learned something about the caves that are an exciting part of the wonderful natural world, and their future lives will probably be the better for that unplanned interlude inside the mountain.

**Fig. 9.** Simplified topography, geology and hydrology of the limestone mountain of Doi Nang Non and the cave passages of Tham Luang extending through its base. In flood conditions most of the sinks are overcome, and stream flows continue down surface channels that are normally dry. (Image: Tony Waltham)