Cave Diving Death Trap

With the increasing attention being paid to the exploration of cave diving sites across Northern Australia, a new type of hazard has been unwittingly revealed. Paul Hosie (WASG) our regular cave dive writer and Ken Smith (CEGSA) explain a recent 'near death' trap experience.

By Paul Hosie and Ken Smith.

Sounds a bit dramatic doesn't it ?! Images of trapdoors and deep pits into which the hapless victim falls spring to mind. Well, not quite 'hap-less' in this case, as a matter of fact Paul Hosie is very 'hap-py' to be here to tell you his story so that you don't become the cave diving victim he very nearly was.

With the increasing attention being paid to the exploration of cave diving sites across Northern Australia, a new type of hazard has been revealed. That is not to say it is unheard of, on the

contrary, Parker Turner, a highly experienced cave diver died in Indian Springs in 1991 under similar circumstances to what happened to Paul Hosie in Waterfall Cave (KNI-19) near Kununurra, Western Australia on Thursday 16 June 2005.

Setting the Stage

On Tuesday 14 June, ASF cave divers Paul Boler, Ken Smith and Paul Hosie set up their rebreathers and all stage tanks required for a series of push dives planned beyond the Crystal Waterfall. The waterfall was flowing at a steady pace, a result of cyclonic rain having fallen on the Ningbing Ranges during March. The plan for Wednesday's dive was to drop a stage bottle at the bottom of the First Escalator Room as well as a pinger (see footnote) and stage bottle at the line's current end, some 600m beyond the waterfall.

The dive on Wednesday went according to plan, the stage bottles were dropped, a pinger was placed at the end of the line and the dive was recorded on video. The water in the cave was very clear although the slight flow was carrying some particles reducing visibility to about 10-15m. Exhaust air disturbed some of the silt from the roof and walls during the dive but the visibility was only marginally reduced during the exit. However, this was not the case when Paul Boler dived the following morning.

On Thursday morning the gear was prepared for a big push on the end of the cave as the passage was still continuing in a large horizontal tunnel at -27m depth. To go further and push the end of the cave, the plan was now to use closed circuit rebreathers to continue exploration. Paul Boler dived and when he returned he had not had a good dive. The visibility was inexplicably only 1 to 2m throughout the cave, much worse than the previous day. In spite of the bad conditions Paul Boler pushed the end of the cave a further 30m into a silted up terminal chamber before turning the dive. Paul Hosie dived next with the aim



Ken is one of Australia's most experienced cave divers. He started cave diving more than 30 years ago and is still very active with CEGSA today.



Paul Hoise shortly after finding a new cave diving site. Happiest man alive because he's marrying Kym (and WoofyDog) this Easter.

of verifying the end chamber as well as retrieving the pinger and stage bottles. Paul Hosie commenced his dive with the Inspiration rebreather and a single 100cuft of nitrox 40 for bailout. In the cave was a single 100cuft of nitrox between the first and second Elevator Rooms as well as a 100cuft bottle of nitrox, a pinger and a reel near the end of the 550m penetration.

Altered States

Paul Hosie relates: "I began the dive, which was essentially a repeat of the previous day's, in utter disbelief. The visibility had changed overnight from relatively clear to absolutely atrocious - a phenomenon I hadn't witnessed before. As I approached the bottom of the Second Escalator Room, the visibility reduced to zero and the passage seemed a bit lower and narrower as I slid down and through the cave's deepest point at -30m. Because the visibility was so poor, the entire dive was simply a line following exercise and it was with great relief I reached the Pinger and stage tank. A brief look at the terminal chamber showed that the way on was well blocked with the flow coming from a silted up low flattener. We would now have to wait for a good wet season to flush clear the way on upstream.'

"The return trip was an equally unenjoyable experience, this time with an additional 100cuft cylinder, pinger and a reel attached. The only places the visibility was greater than 2m was under the flat rock roof sections of passage above the silt mounds. As I approached the -30m dip and zero visibility point, the line that was previously attached to a single tie off rock at the deepest point had now disappeared beneath sand. The line wouldn't pull up out of the sand — it held firmly. The buried line was a little unsettling, but in zero viz all I could do was feel my way forward to try and get through. By feeling the The sound of the second back the passage and I was left in what could colloquially be referred to as a 'shithouse situation' ! All I could think was: 'DIG', although I admit I was having some intellectual difficulty 'digging' the situation at the time !!"

"I backed off a bit until I had room under my elbows to start scooping the sand out to the sides and behind me (fortunately, it's about 2m wide at this point). I did this for a while (the VR3 download later showed it was 10 minutes) and could feel that I had in fact made a small hole in the sand ahead of me. I squeezed and struggled to worm my way through that hole but the box on my back was never going to allow it. My breathing rate was elevated from the workload and I started feeling a bit frantic. I decided to back up and take a break, gather my thoughts in the water back into the cave where it was spacious and I could at least read my displays. The rebreather displays (PO2) and the VR3 (decompression obligation) showed that everything was OK, the rebreather was working perfectly. I was glad I had several bailout decompression scenarios on my survey slate pages, but they were of no use to me where I was. I had to get through this blockage but I was having difficulty seeing how that was possible. The fear was certainly increasing. I had a knot in my stomach and thought about crapping myself to provide relief but felt that maintaining control was more important."

"It was at this point I realised that the situation was pretty desperate and with the arrival of this realisation, logical thought departed, leaving my mind in a susceptible state. As I hung onto the line, taking a few moments to relax, it felt as if I was an impartial observer of myself. I observed my brain trying to make sense of the patterns in the silt swirling in front of my facemask. Realisation struck hard that my mind was about to take a time out. I was about to lose consciousness and if that happened. I wouldn't be waking up again. This is the closest I have been to death, I believe I was only seconds away from blacking out. Instinctively, all I could think of was that I had to regain some logical thought process, so I began counting from one to ten. Thousand One, Thousand Two, Thousand Three, Thousand Four . . . I think I got to about 6 or 7 before my brain jumped back into first gear and enabled me to analyse the situation."

A Fresh Outlook

"My first realisation was that I was never going to get through the hole I was digging with the rebreather on my back or the tanks on my side. I had to remove the rebreather and breathe from one of my bailout bottles to get my body through the hole, then I would have to drag the gear through and put it all back on in order to complete my long decompression obligation. I had removed and remounted the Inspiration before in -40m at the end of Weebubbie



Can I come Cave Diving too please Daddy? (WoofyDog is Paul's adopted daughter).



so I knew I could do that. I also had to connect the tanks to each other in a daisy chain so I could get them through the gap as well. So, I had a plan and because I had the skills and experience to know I could do this, it provided me with some much needed confidence for the task ahead."

"It took me a few minutes to disconnect everything, remove the rebreather and sort everything to where I needed it. When I shut off the rebreather mouthpiece and took my first breath from the open circuit regulator, I got a lung full of small rocks and grit (Note To Self #1 - mesh over mouthpiece not such a bad idea after all !!). After hacking and spluttering for another minute or two, to clear my airways, I braced myself and headed back down into the muck for the second attempt at digging through. It proved to be a further ten minutes of scooping/digging before I could pull myself through the small hole | had created. | pulled the two cylinders up and then reached back in to pull the rebreather through. Because of its bulk, I had to apply some force to pull the unit through the small hole and I ended up damaging a handset but we didn't find this out until we got to Kija Blue sinkhole the following week."

Ningbing Pinging.



Dave Woods on Ningbing Karst Pavement.

"On the 'out' side of the hole, I was flushed with relief but my concern now turned to the whereabouts of the line as a line entanglement now would really be annoying ! I felt all around but the line was buried under the sand. I knew it had run down the left hand side of the passage at this point so I kept over to the right wall to avoid it. I put the rebreather back on and shortly after breathing from it again it started alarming out. I had no idea what the problem was as it was still zero visibility — I could not read the displays held against my face mask. Running through the possibilities I realised that I hadn't turned the O2 back on and when I did, the problem resolved immediately (Note To Self #2 — LED Head Up Display (HUD) critical for cave diving with a CCR)."

"My next problem was depth -1 had virtually no idea because zero visibility means you can't read a dive computer placed against your face mask. All I could tell was whether the first numeral of the depth was a 1 or a 2. This was quite concerning because I knew I had at least an hour of decompression to do and at least one microbubble stop was required by the VR3 algorithm at about 24m. I ascended very slowly by feeling my way up the cave wall and was able to read the computer again at -18m after which I referred to my bailout decompression tables and completed the most conservative schedule I had listed. I did approx 90minutes of decompression and this gave me ample time to reflect on, and rationalise my near death experience. I felt fortunate to have survived and realised I had an obligation to make sure others were made aware of this hazard. By the time



I was ready to ascend the last few metres and swim back along the -3m passage to the canals and the surface, I was quite calm."

"Upon surfacing, I was amused to find out that Ken & Paul B thought I was pushing the end of the cave and laying line rather than having a major crisis. When I related my misfortune, Ken at once realised what had caused the sand blockage. The following is Ken's account of his experience and how this had happened."

A Different Perspective

Ken Smith's recollects the events in KNI19 on Thursday 16 June 2005.

"When Paul Hosie Left on his push dive Paul Boler and I returned to the top of the crystal waterfall to wait for his return. This was a convenient place to wait as the water was quite shallow and we could get mostly out of the water by lying on the soft mud bank. The water temperature was 29 degrees Celsius so it was not an uncomfortable wait once we cooled down from our exertions. It was peaceful too, just the gentle splashing sound of water cascading down the crystal waterfall. Paul Boler said he was disturbed from time to time by snoring, but I didn't hear anything myself.

I had enjoyed the dive with Paul Hosie on the previous day. The cave passages had been quite clear and I had almost reached the end of the line when I had used a third of my air and had to turn back. The return dive was almost as clear with a small amount of silting in the narrower sections. The cave was clearly an active streamway. The large chambers contained dunes of fine brown sand which had covered the line in a few places. The narrower sections tended to be deeper and were scoured clean of any sand, exposing white limestone with just a few larger rocks scattered on the floor. There was no perceptible current when we were diving, but clearly the water moved quite quickly in the wet season.

The second escalator room had a particularly high and steep mound of sand from about 18 metres depth down to the rocky restriction at a depth of 30m. I didn't give this much thought during my dive but next day when Paul returned after his epic struggle I began to think about what may have happened.

During the high flow in the wet season the sand would be kept in suspension in the narrow sections of cave where the flow velocity was high. In the larger chambers the sand would tend to settle out forming the large dunes that we saw. In the second escalator room the sand slope was not in a wide chamber but in a narrow sloping tunnel. This means that the flow



would be higher in the wet season and the particle size of the sand would be larger since the finer material would be carried away. At times of high flow the water rushing up the slope would counteract the tendency of the sand to flow down into the restriction. As the water flow diminishes the sand would steadily settle out forming a uniform slope at the critical angle of repose. This sets the trap for the unwary diver.

The trouble with an underwater sand slope like this is that even a small disturbance can start a flow of sand down the slope which does not stop. The disturbed sand suspended in water forms a slurry which is denser than water. This starts to flow down hill disturbing more sand as it goes. Once started this flow will continue until the entire slope settles at a new, less steep, angle. The poor visibility that Paul Boler encountered on the first dive may have been due to the sand starting to move before his dive. It seems likely that this process continued, trapping Paul Hosie at the base of the escalator room. We don't know whether the sand movement had stopped when Paul Hosie returned or whether it was still moving. If it was still moving Paul was lucky he didn't return any later than he did.

Next day, when we returned to the crystal waterfall to remove the remaining gear, we noticed that the flow had stopped and the gour pools at the top of the waterfall had partially emptied. This seems to suggest that the sand flow had continued after Paul's escape and had completely blocked the tunnel at the base of the second escalator room. Presumably it will remain blocked until sufficient pressure builds up behind the blockage to clear it. This may not happen until the next wet season"

Conclusions / Lessons Learnt

- 1. Turbid Flow causing silt slump and cave blockage is a very real risk in Australia's top end caves. Annual wet season deluges will most likely reset these traps.
- An awareness of the hazard is required, look for signs of steeply sloped sand or silt mounds, particularly where passages are narrow or the ceiling is low.
- Avoid disturbance of silt mounds at all costs. Buoyancy control is critical and use of CCRs will minimise disruption of silt on ceilings.
- Access to decompression and PO2 information during a dive in zero visibility conditions needs to be considered. Luminous and Head Up Displays or other methods of data access should be considered.



- Fine mesh filters or nylon stockings covering open circuit bailout regulator mouthpieces should be seriously considered, particularly for CCR cave divers
- 6. Laying the line on the roof may be an advantage in restrictions where sand flows can occur. This reduces the risk of the line being completely buried.

Final Reflections

Paul Hosie found that counting was enough to restart the logical thought processes and he believes he understands how it is that many deceased cave divers have been recovered with plenty of air still in their tanks. If Paul's experience is considered relevant, life ends in confusion and brain shutdown which results in loss of consciousness and subsequent drowning.

What we are taught about taking deep breaths in order to regain composure, again if people think Paul's experience is relevant, this is probably not enough in high stress situations and cave diving instructors may wish to consider this in their training programs.

Being on a CCR was an enormous benefit as there was no additional stress of having a limited open circuit gas supply. Theoretically, Paul could have dug away for another hour or more before he would have had to start consuming his bailout supply in order to safely complete his decompression obligations. The reduction in stress due to this alone should not be underestimated. It was also noted that an LED HUD (head up display) is critical for CCR cave diving.

Safe Diving to you all. Paul Hosie, ASF-CDG Ken Smith, CDAA





FOOTNOTE

- the "Pinger" The "Pinger" mentioned in this article is a submersible radiolocation transmitter. Three pingers were used in KN119 to locate surface positions corresponding to the entrance lake, the crystal waterfall and the end of the fixed line. GPS readings were taken on the surface directly above these points to assist with mapping of the cave.