I was rather tired so slept quite well for most of the flight, arriving in JNB at 7am local time ready for the 3hr drive to the dive site. The car was waiting for me so off I went. I arrived at Komati Springs at about 10:45 after a small detour to get some food supplies for my stay.

It was Saturday and quite busy at the dive shop. Don Shirley, the owner was running a trimix course for 3 or 4 people and with various other people milling around getting gas he was flat out. I was most grateful that he still took an interest in me when he was able and sorted out what I wanted that day etc.

My plan was not to do any big dives, just down to 70m to place some bailout tanks ready for deeper dives later in the week. Another diver, Lo, was looking for a buddy so I was happy for him to come with me. He was a very pleasant, older man (57) who it seemed was quite experienced. He also would be diving an Inspiration rebreather. He was not familiar with this level in the cave so I said I would show him part of it. We agreed to leave the 70m level to ascend at 30min runtime and off we went.

Lo dropped a 50% Oxygen 12lt tank for my later dives at 16m just inside the entrance of the cave. I dropped a 50% at 21m in the shaft. I then dropped an air tank at 68m in the shaft. With just one bailout tank each plus our rebreathers we were now free to have a look around. We swam along the tunnel at 68m for about 4min and then I placed a jump left down a side tunnel. We went down there until the total dive time so far was 23min. I signalled to turn the dive. (It would take 7 min to get to where we could start the ascent.) Lo was reluctant to turn around (having too much fun I guess) but turned anyway and led us out.

I slept well that night.

Sunday Don was still busy with his students but filled the tanks I required for the days activities of placing more bailout tanks. It was a hassle getting enough tanks and regulators, especially as I had a couple of problems with mine and Don did not have the spares to solve the problems. I arranged for the spares to be picked up in JNB by my driver before he brought the computers to me. That worked out quite well as it turned out. The gases were eventually mixed. Quite a complicated process as these tanks were for depth and needed to have various helium and O2 percentages in them. I had a 12lt 13/60 (13% O2, 60% helium, the rest is nitrogen) that was to be placed at the bottom of the shaft (105m) and a 9/70 that I was to place at 120m. I also needed a 7/68 that I would use as bailout for the placement dive. The other tanks already in place would be further bailout if needed. This took some time to get sorted. Also I had to find sufficient regulators with the correct hoses and pressure gauges as I did not have enough. It was frustrating but all was organised in the end.

Lo wanted to come again on this dive too. 120m is a serious depth and I tend to prefer to dive solo, but as he is a capable diver agreed he could come. We planned that he would follow me

10 minutes after I left and we would meet at the bottom of the shaft (105m) as I returned from placing the tank at 120m.

Eventually, in the afternoon I got in the water. The dive went as planned, I placed the tanks where required, and met Lo at the bottom of the shaft as I was returning from 120m. I actually had to wait about a minute for him, but as I could see him coming did so. It was quite funny really. My deco obligation was steadily increasing as I waited, so when he arrived I just wanted to start the ascent. On his arrival I sort of said g'day, lets go. Of course he wanted to look around, which was not part of the plan so up we went. Sorry Lo…..

The next day I sort of had a rest day. I did do a (minor?) dive to 70m to place another tank and reposition another into a better area. It was not a long dive, about 80 minutes.

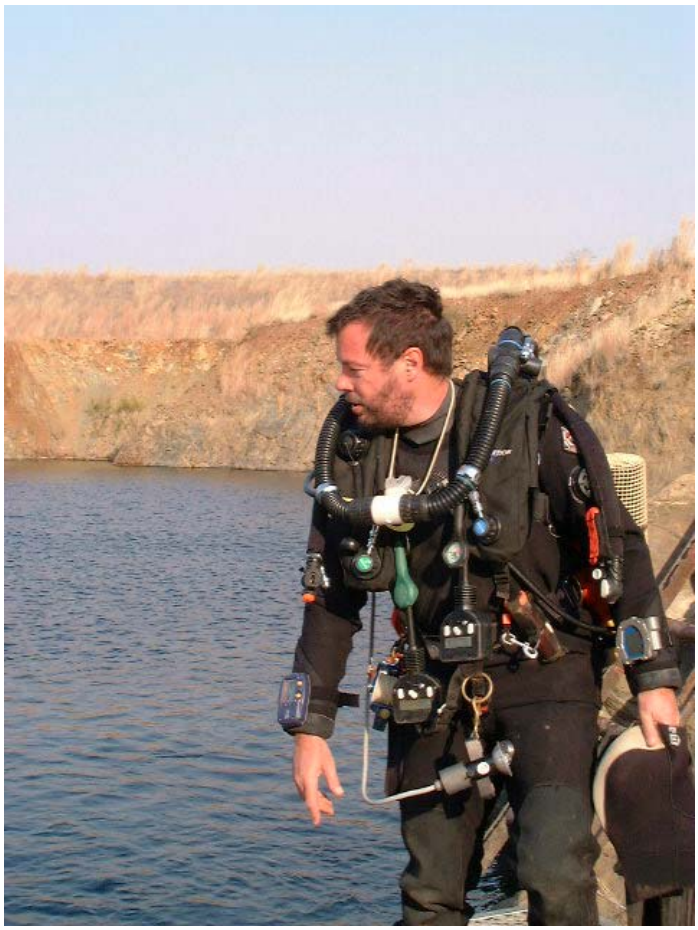
On Tuesday all was ready for the big push. I was in the water by 0930, feeling good and on my way. I had my rebreather plus two bailout tanks in case the rebreather failed. I also had a small tank for argon that I used to inflate my drysuit. Argon is a dense gas which helps one stay warm. The two tanks were bottom mix, one a 6% O2/73% He mix, the other a 9/73 mix. These mixtures were hypoxic near the surface, not breathable until about 30m depth. They were designed to be suitable mixes from 180m to 120m really, the 6/73 for the extreme depths. I had to remove one tank to get through a narrow doorway 7 minutes into the dive at 16m just before the top of the shaft that drops vertically to 104m. Once over the shaft I emptied my buoyancy vest of all air and exhaled completely to get descending quickly. Once on the descent, as the depth increased my actual rate of descent increased. I could then inhale and inject argon into my suit to counteract the increasing pressure (that causes suit squeeze which is rather painful or worse.) On the descent I have to keep a careful eye on the O2 level in my rebreather to ensure with the increasing depth it does not get too high. (See the PPO2 explanation later.) The regular injection of the diluent, a 6/73 mix, keeps the O2 level down enough usually.

As I approached the bottom of the shaft I would usually start injecting gas into my buoyancy vest (BC) to slow the rate of descent. I did this only minimally to keep the descent rate high to the end. (Later I worked out my average descent rate was 22m/minute, peaking at 30 at one stage.) Once on the bottom I immediately headed along the shaft, injecting gas into my

suit and BC to get my buoyancy and comfort levels right. I had a 3 minute swim at this level before turning left down a 35deg angle tunnel. Since leaving the surface I had been following a permanent guide line of course. Once heading down the incline the depth increased rapidly. Every breath would require extra diluent being injected into the breathing loop to counter the compression as it increased. I would also have to inject argon into my suit quite often as well to counter the suit squeeze. I passed the tank I had left at 120m previously quite quickly and very soon was at the end of the line left from my previous dive a few weeks earlier. That ended at 152m depth. As I approached this point I got the reel ready to tie on and continue down. That did not take long and I was soon on my way again. I passed a minor restriction at 160m and then it was clear down at the same angle. Reeling out, checking depth, watching the time and injecting gas into the suit kept me busy, and as you can imagine I was in a high state of concentration. As I approached 182m I started looking ahead for a place to tie off the line. The plan before I started the dive was to turn around when the first of the following happened…

1. Reach 182m
2. Time into the dive hit 30 minutes
3. Dive computer predicted time to reach the surface reached 350 minutes
4. I felt lonely and wanted out

As it happened I was much earlier than I thought I would be. I hit 182m at the 21 minute point…I had really been motoring. It took me a minute to tie off the line, cut it off the reel and then I started the ascent. Predicted time to the surface was 330 minutes. I had laid 85m of new line.



My ascent rate could not be like my descent, it had to be regulated to about 10m/minute for decompression reasons. I had calculated before the dive that my first deco stop would be at 120m, it was actually at 128m for 2 minutes. At those sort of depths the deco obligation is still increasing so it was a long two minutes. The next stop was at a very convenient 105m for 2 minutes. That meant I could swim along the 3 minute horizontal swim to the bottom of the shaft while on the deco. I reached the bottom of the shaft just before my safety diver (Don Shirley) arrived to check I was ok. At the bottom of the shaft I had planned to use a bit of the bailout tank left there to flush out my loop. This tank had a 13/60 mix. The reduced He (at the shallower depths) would have reduced my total deco time by a few minutes. As it turned out the special fitting would not clip into my rebreather as it should so I had to ditch that idea. Very strange and it will need looking at when the tank is brought to the surface. Just then my diluent in the rebreather tank ran out. This is not as bad as it sounds but certainly got my attention. The extreme depth meant I used more than expected. On the ascent, with care it is not a problem. As one ascends the gas in

the loop expands so some has to be vented anyway (the opposite of the descent). I just had to be careful not to vent too much. The rebreather tank also supplied the gas for my BC. That problem was solved by hooking my BC into one of the bailout tanks I was carrying. I continued the ascent, stopping as my computers told me to. At 55m I hooked into the air tank left there and flushed the entire He out of the rebreather loop. That gave me a bit of narcosis (expected) as the non narcotic He was replaced with the air (nitrogen at depth gives one narcosis). Removing the He as soon as possible was another way of reducing the deco obligation. At this point I had been diving for 54 minutes and had according to my computers 327 minutes to go. I was now stopping every 3m or so for about 2 minutes. At 35m I did another flush this time using a 35% O2 mix. The stops were now 4 minutes each and increasing. By 21m it was12 minutes, by 14m 18 minutes, 12m, 27 min, 9m 37 min, (now out of the cave). At 6m I flushed the rebreather with pure O2 and stayed at that level for 61 minutes. As the O2 was metabolised I would inject a bit more in to keep the breathing volume at a lung full. The last stop was at 3m for 130 minutes. While on pure O2 one has to have a five minute air break to reduce the chance of a O2 convulsion (like an epileptic fit) about every 30 minutes. The 6m and 3m stops were done in open water on a deco frame. Total time of the dive was 404 minutes.

Halfway through this marathon some hot soup was sent down. Lovely! It is in a squeezy drink bottle. To drink it I go off the rebreather onto open circuit O2 in a tank that is on the station (or the air tank if an air break is due). I take a breath, then take the regulator out of my mouth, suck out some soup, then before removing the soup bottle from my mouth I have to blow in some air to counteract the suction. (If not the ambient water will be sucked in with the soup that is then watery and cold.) Then, finally the regulator is put back in your mouth so you can breathe again. Repeat that process a few times and that is how you have hot soup under water.

The other potentially serious but funny (in retrospect) event of the dive was that my pee valve blocked up. Ladies may not want to read this bit!! On long dives one needs to pee. Let's face it. Being immersed in 17degC water for nearly 7 hours one needs to go! So, I decided I needed to go at some stage on one of the shallower deco stops. Problem…no flow. The body was willing but the pressure would not reduce. Oh, I forgot to explain how it works. I wear a catheter condom. I attach a tube to the end of the condom which in turn is connected to a pee valve in my drysuit. When I want to go I just let it flow. Technology does the rest. Anyway, this time, no flow. I assumed the tube was kinked so decided I would wait until I was in a position where I could put a lot more argon into my suit, feel around and try and solve the problem. Well, no such luck. I could not solve the problem. This was getting serious. The

pressure in my bladder was very uncomfortable and I was stuck under water for some hours yet. I tried to go a number of times. Finally I felt some give. All this urinary pressure had built to the point the condom started to peel off. Now this condom is glued on so that is no mean feat. It just about turned a certain part of my anatomy inside out. The relief when it finally came was warm (for a short time) and sweet (sort of). Of course I was now peeing into my not so dry drysuit. I had to go twice more over the next few hours. Later inspection of my anatomy…well, I will not go into that. It turned out the pee valve had blocked. I can tell you, I will be checking that in future before a long dive.

So, what of the dive? A world record for the deepest solo cave dive on a rebreather; also the deepest cave dive (solo or otherwise) on a rebreather.

I then had a rest day to let some of the nitrogen in my body dissipate. Don Shirley could not resist the temptation to accompany me on the next dive to the end of the line I had just laid. We needed to rethink the bailout gases among other things because there were now to be two of us. Below is an email I have written to the manufacturer of my dive computers (the VR3) about the next dive. It gives an account of the events, including a brief summary of the dive described above.

VR3 = name of the dive computer
PPO2 = partial pressure of oxygen
Scrubber = unit that holds chemical that scrubs CO2 from the breathing gas mix.
Dalton's Law = A gas is made up of various constituents. Air (from a diving point of view is .21 O2, .79 N2. Thus the total at the surface of the unit of air is 1.0. At the surface the ambient pressure is 1 atmosphere. At 10m, the ambient pressure is 2 atm. That is 1atm of air plus 1 atm of water. At 20m it is 3 atm, 1 atm of air and 2 atm of water…and so on. 180m depth is thus 19atm. Now, if you are breathing air, the mix proportions remain the same, but the pressure you are breathing equals the depth in atm. Thus at 20m, (3atm), the partial pressure of the gas constituents you are breathing would be, O2…3 x .21 = .63 N2…3 x .79 = 2.37. Add .63 + 2.37 = 3atm. Thus, in this example, the partial pressure of O2 (if air was being breathed) would be 0.63. One can only breathe O2 up to a partial pressure of about 1.6 (when diving) before the risk of convulsion becomes too high. At the low end, depending on the exertion level a partial lower than .20 is not safe either. At 180m I was breathing a mix that was just 6% O2 to keep the partial pressure within safe limits. Obviously, breathing a 6% O2 mix at the surface would result in one falling over quite quickly. So that gas could not be breathed all the way to the surface. Hence me changing gases as I got shallower. So my 6/73 mix at 180m gave me a partial pressure of 1.14. At 30m it would only be .24, so that was about as shallow as I could go with that gas.

I have been using the VR3 for a couple of years now, and am impressed with it in general. I recently purchased a second one so I had two for some of the dives I am doing.

In the last week I have been in South Africa at Komati Springs doing some deep cave dives. The aim was to extend the line into the deepest section of the cave. They were all to be solo dives. I would be using my Inspiration rebreather. The first two dives were to position bailout gas. I placed the following (all 12lt tanks)…

1. *9/70 122m*
2. *13/60 104m*
3. *16/44 68m*
4. *Air 55m*
5. *35% 35m (two tanks)*
6. *50% 21m (two tanks)*
7. *50% 15m (Cave entrance)*
8. *O2 and Air at a deco station*

Most of the above tanks had whips so that I could plug them into the rebreather if required. Not all though, as I did not have enough suitable whips. The positioning and quantities were to suit the anatomy of the cave. My original planning was just one tank placed in the positions indicated above, but with no tank at 68m, but I decided to place the extra tanks to cover a two diver team for later. I planned to carry two 12lt bailout bottom gas tanks, one 6/73 and the other 7/70. The Inspiration diluent was 6/73. This diluent tank also supplied my wing gas.

I did the solo dive as planned to 148m where the line ended, tied on and extended the line to 182m. I laid 85m of new line. The VR3's worked perfectly. My plan was to turn the dive if one of the following occurred…

1. *Run time of 30 minutes*
2. *Reached 182m*
3. *Time to Surface prediction was 350 minutes*
4. *I wanted to get out.*

I programmed the VR3's with all the gases, most turned off as they would only be used for bailout. 6/73, 13/60, Air and O2 were "on". The run time was 404 minutes. I reached the 182m point at a run time of 21 minutes (I was motoring!!) At the turn the predicted time to surface was 340 minutes.

The next day was a rest day. Don Shirley, licensee of IANTD Africa could not resist the dive with all that gas in place so decided to come on the next dive. He wanted to just get to the end of the line to "see the country". We discussed carefully the bailout gas situation and were happy we had sufficient with a couple of additions. We would take in a 72% O2 for the entrance of the cave and move the 50% 7 minutes swim into the cave at 16m. Also Don would carry an extra 9/70 and drop it at 120m with the other tank. We would both carry two bottom gas bailout tanks.

On the day all went to plan on entry and descent. I moved the tank from the entrance 7 minutes into the cave. We were about a minute behind my runtimes of the previous dive, understandable with the tank positioning etc. I had an annoying mask leak that needed to be fixed enroute. Clearing one's mask at serious depths eats the diluent. I was watching my on board diluent supply carefully. On the previous dive I had used it all by 182m; just injecting into the loop and wing as the depth increased did that. I planned to plug in the left side bailout gas when down to 50 bar. Ascent would not mean I used much or in actual fact, any.

In the event I decided during the descent at 105m to plug the left bailout whip into my wing gas supply thus keeping all the remaining onboard gas for diluent.

At 181m there was a muffled thump, and at the same time my Inspiration electronics started to play up. The left (master) handset went dead and the right started flashing on and off rapidly. Now that got my attention I can tell you! I flashed Don with my light, did not wait for a response and immediately turned. I started the ascent, swimming up the 35deg angled tunnel and at the same time deciding what to do. I managed to get the left handset going again by turning it off and on and the right one stopped flashing. That solved the problem of having to go either OC or semi-closed. Semi-closed with the limited onboard diluent would have meant unplugging the wing and plugging the bailout into the Inspiration diluent supply. Even though I now had electronics back I could hear a constant funny electrical sound, sort of like a distant sonar, that did not sound good. It seemed to be coming from behind my head, was quite faint but very distinctive and not normal. I had the feeling my electronics were being fried and would only be available for a limited time.

On inspection of my gear later I discovered that the audio alarm unit had imploded, causing all the problems. Later discussion with AP Valves revealed they are pressure tested to 160m. I guess we were operating the Inspirations well outside their design parameter depths!!

The first deco stop was at 126m which was very convenient as the 120m tanks (placed slightly deeper than 120m for convenience) were within reach. We each clipped one on as by this time Don had caught me up. The next deep stop was at 105m. While there both handsets started flashing on and off rapidly, O2 injection ceased and there was no longer any PO2 indication. That was it, time for semi-closed operation. I showed Don the flashing handsets which elicited a response that sounded remarkably course!! and he then signalled semi-closed operation. I had started that already and couldn't agree more with the suggestion. Once I got my brain in gear I started to think through the ramifications of the situation. I had semi-closed operation for about the next 3 hours until I could get to 6m and flush out all the diluent and run the unit as an O2 rebreather. I had 50 bar of on board diluent so would need to plug in a bailout gas to have sufficient to reach the next staged tank at 68m. That took 14 minutes with deco stops but amazingly the 50 bar lasted…just. At 68m I dumped the deeper of my bailout gases, picked up the 16/44 tank, plugged in the whip and sort of breathed easier. I did not switch the VR3's as just 10m further up was the air. There I dumped the other of my deeper gases and picked up the air. I did a full flush onto air and immediately noticed the narcosis effect. (Mild only.) Now I had the time to switch the VR3's. Remember, I am operating semi-closed, and that requires one hand to manually inject the flushing diluent every 4 breaths. Programming the VR3, namely turning on a gas, selecting it and confirming the selection all takes time, and requires two hands in effect. I managed to change one VR3 reasonably efficiently on the second attempt between breathing operation requirements. Almost through making the changes a gas injection was required. By the time I got back to the VR3 it had given up waiting for me and I had to start again. On the second attempt, as mentioned, I completed the task. The other VR3 gave me more trouble. It took three attempts, in between gas injections to get it done. I figured I had to prioritise to the breathing, as if I went unconscious it would not matter what the VR3's said. As I continued up I had 5 stops between 55m and 35m over the next 17 minutes. I turned on the next gas, 35%, while on the ascent to where it was waiting at 35m. It was busy, what with wanting fresh gas so often and all, but I was in the swing of it now. Don had been left behind on his Abyss Explorer stops way back at 85m and was some 10m or more below me now. At 35m I dumped the 16/44 tank and picked up a 35% tank, plugged it in, flushed and switched the VR3's. Not so bad having eliminated one of the steps by turning on the 35% gas earlier.

As an aside, while at 16m and on the 35% gas I needed to pass through a tight restriction that required me unclipping one of my side slung tanks. This was in fact the 35% one that was plugged into the Inspiration. Once through the restriction I got into a bit of a tangle. I was due to inject fresh gas into the loop so exhaled overboard. I then discovered I could not find the inject button on the counterlung. It was all twisted and goodness knows where. I calmly tried to solve the problem but to no avail. It was time to go open circuit as I was running out of breath. (I had exhaled remember!) I closed the loop mouthpiece puffing out the last of my stored breath to make sure the loop did not get water in, and then found I could not find the stage regulator. Things were getting desperate. I took an involuntary part "breath" and swallowed some water. I quite calmly then decided I was about to drown and seemed to cope with that thought without panic. That water ingestion I think did give me incentive for another minute of no air time though! Anyway…I eventually found the regulator, took some calming breaths of glorious 35% gas, sorted out the tangle and went back on the loop in semi-closed mode again. Talk about a near-death experience! To top it off, I had just swum past the 50% tank I had dropped off at the start of the dive and could have swum back a couple of metres to that and breathed off it until the mess was sorted out. As it was, I completely forgot about it as the "event" took place. Pretty stupid really! The lesson, know where the inject button is before exhaling overboard.

I stayed on the 12lt 35% gas for the next 126 minutes until the 9m stop was completed. I used about 150 bar. That was 1800lt at an average depth of 16.6m which works out at just over 5lt/minute while on semi-closed mode. I had time on my hands now so decided to see if it was worth switching to the 72% rather than the 50% I had with me. I was at the cave entrance; Don was still in the cave out of sight so I was mindful that he may need bailout gas too. I turned on the 80% I had in the VR3 and saw the advantage was not worth the switch to 72% (using 80% was close enough for what I was doing), so stuck with the 50%. I kept doing the deco in the cave entrance waiting for Don. I was just starting to get concerned when he appeared. He looked like a balloon salesman. He was festooned with 7 x 12lt tanks. I wished I had a camera. Once he had completed his 12m deco we moved slowly to the deco station and I spent the next 183 minutes on the rebreather flushed with O2 in the loop. At least I was now off semi-closed operation, having been operating semi-closed for the last 199 minutes.

From the 12m stops on I had started extending them due the lower than planned PPO2 (1.25 set in the VR3's) that I would have been experiencing while on semi-closed mode. I added 5 minutes to the 12m stop, a further 10 minutes to the 9m stop, 15 to the 6m stop and 20 to the 3m stop. I could have reduced the PPO2 in the VR3 from 1.25 to say 1.00 I guess, but it would have been just that, a guess, so opted to extend the stop times instead.

It is worth commenting on the scrubber. We were using high quality (fine) sorb and at no stage felt that we had exceeded the scrubber time available. I put in 7hrs on it, and Don 40 minutes longer than that. The fallback position was to go open circuit on O2 (and air). We had ample supplies of both at the deco station. Interestingly, Don ran his on board O2 out with 2hrs to go of his deco, so plugged in another tank to his unit. I still had 90bar of onboard O2 at the end of the dive. Don was obviously doing more O2 flushes than me!

Andre, Don's lovely wife provided competent surface support while we were on deco, even sending down mini Mars bars at one stage and offering hot soup.

Now to the point of this letter! Sorry it took so long. It is a suggestion that would really enhance the VR3 operation based on my experience.

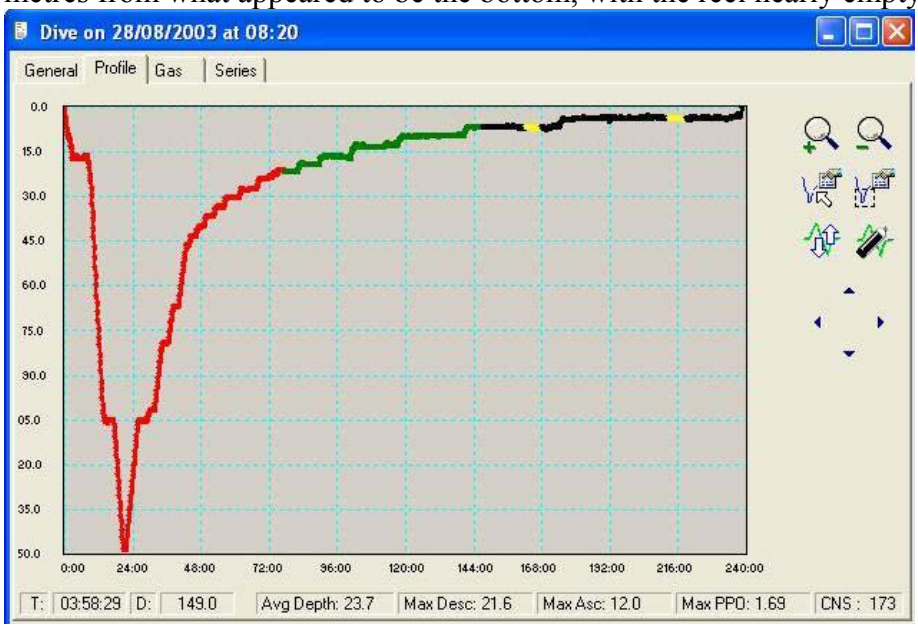
When programming the gases, instead of having the options "on" and "off", have the options of "on", "bail" and "off". Then, in the divers options menu (DVo,) you add the option to turn on, in one go, all the bailout gases that are currently set to "bail". That way you can have all sorts of gases in the unit, with the normal planned dive gases as the "on" gases. If one needs to bailout then it is very simple. Go to the DVo menu, turn the bailout gases "on" and now the normal planned dive gases AND the planned bailout gases would be on. That would just leave the other "off" gases still off. Suddenly, and very simply the VR3 now is setup for your bailout plan. This change would reduce the workload significantly when in the situation I found myself.

So, that was that dive. To expand a bit on semi-closed operation. The rebreather normally is a closed circuit. That is, the only gas that is used is the O2 that is metabolised. As the gas is exhaled, any CO2 is scrubbed out, then the level of O2 is checked, and if not high enough more O2 is injected. This O2 level checking is done by three sensors. They feed the raw data into two independent computers. The computers determine how much O2 to inject, and then sends the signal to the injector to do the job. If the O2 level is too high or two low the computers send a signal to a noise generator that emits a load buzz. That gets your attention to check the computer readouts to see what is wrong. (A sort of last resort "Do something or die" signal.) It was this buzzer that imploded. The rebreather operates at ambient pressure. Thus great depths do not cause it to be crushed. The electronics also operate at ambient pressure as well. Quite a clever design actually. I am not sure if this buzzer operates at ambient or not. That I have yet to check. Anyway, the buzzer has a sound chamber (it seems) in it and this chamber collapsed. If it should have been at ambient then something went wrong (a blockage). Anyway, when it failed that let water into the electronic systems, so they failed. With no PPO2 readouts I had no way of determining the O2 content of my breathing mix. Obviously, if no O2 was being injected then the breathing mix would quite quickly go hypoxic and I would become unconscious. If on the other hand, the O2 level was too high then I would likely have a O2 convulsion, effectively be unconscious. Either way, it means one would drown, and not know it was happening. So, if the electronics completely fail, as happened to me, then there are two solutions. One is to go open circuit onto the bailout gas. At 180m, one 12lt tank of gas will last 6 minutes. That same tank at 6m would last me 90 minutes. So, it is best not to go open circuit unless absolutely necessary. The other option is semi-closed. When one breaths in and out only about 4-5% of the available O2 in each breath is actually used. Thus, it is not unreasonable to breathe the same gas 4 times before expelling it overboard, as long as the CO2 content is scrubbed out first. If the only problem with the rebreather is that you cannot measure the O2 content, then one can go semi-closed, still using the scrubber to get rid of the CO2. (If the loop was flooded then nothing could be done but go open circuit.) Thus, I went semi-closed. That involves breathing out all the gas into the water (overboard), then as I breathe in pushing a manual injector button to inject more diluent gas into the breathing loop. I then breathed that gas for 3 more breaths before breathing it overboard on the 4th breath and starting the process again. If I was in a high exertion situation I expelled the gas after three breaths, if stationary, relaxed and quiet on a deco stop I sometimes pushed it to five breaths. The effect is to save a huge amount of gas. As I mentioned above, I used 5lt of gas per minute (corrected for the depth) on average. If I had been open circuit it would have been 15-20lt/minute. As a final note, the O2 in the rebreather tank is not available at depth because it would cause me to convulse. Once I got to 6m, and it was safe to breath I flushed the breathing loop with pure O2, so that all that was in the loop was O2, and then I could resume using the rebreather in fully closed mode because I knew

exactly what was in the loop, so did not need any sensors. I hope that explanation is of some use??

After that dive I had the next day off. On that dive with Don at about 135m on the way down we passed another shaft with a small steel door in it recessed back into the shaft a way. We later developed a theory that that was the exit point of a shaft we had explored down to 110m some weeks earlier on a previous trip. We could not dive any deeper on that occasion because we did not have appropriate gases with us. For my last dive before heading back to HKG I decided to set up the appropriate bailout gases (most were in place from these other dives) and see where that tunnel went. Don once again would be my backup diver.

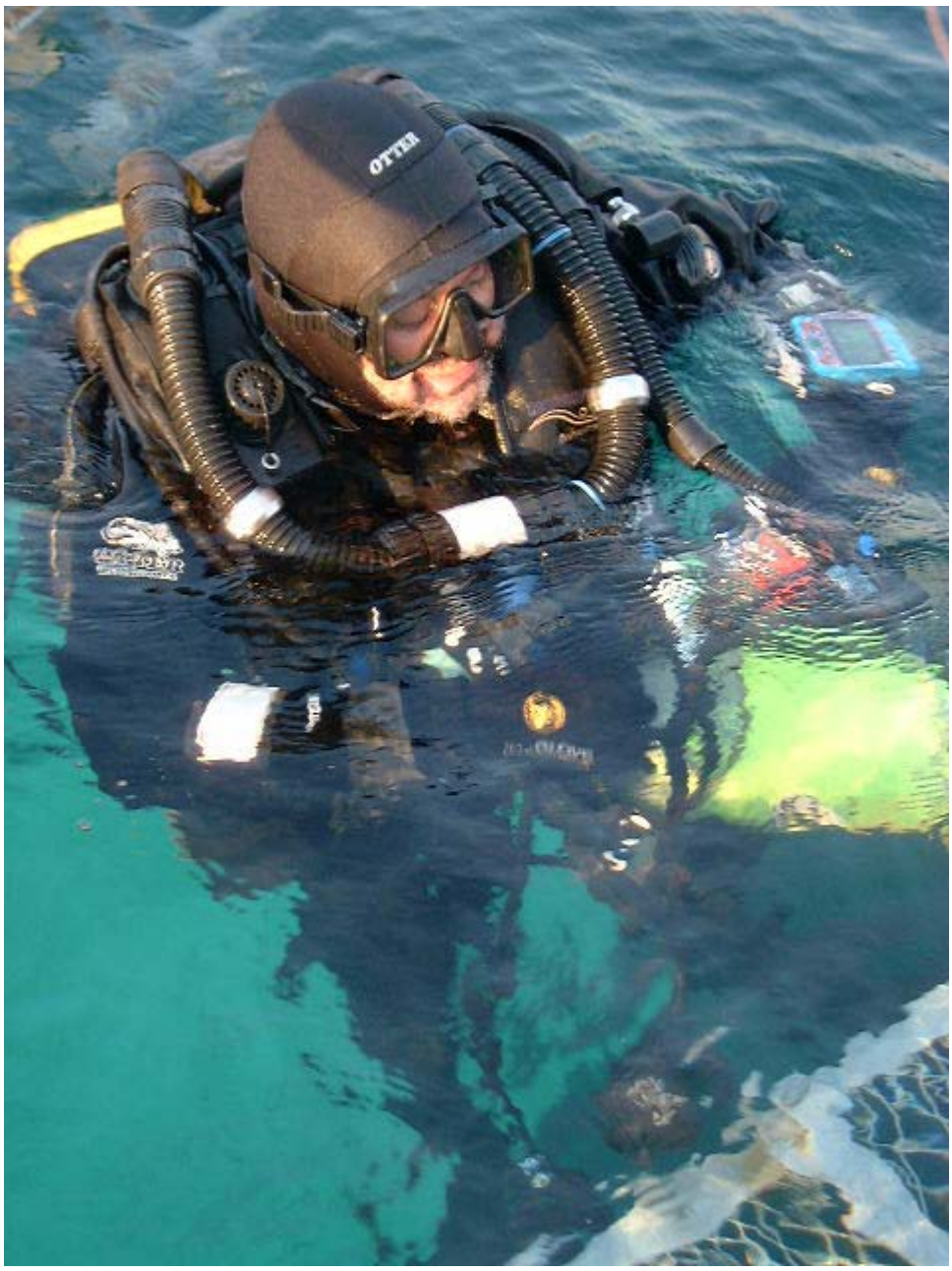
It was Saturday morning so we decided to be in the water by 6am. Well I would anyway. Don would follow 25 minutes later to meet me as I emerged at the 68m level. (The start of this other tunnel I was to explore.) I took three 12lt tanks with me plus the rebreather. I dropped one of the tanks off at the 68m level at the start of the tunnel. I had to run a line down as I went. I had two reels with me for that purpose. To get to the start point involved following a previously laid line, jumping from that line to another previously laid line. (To jump means in this context use another small reel with line on it to connect one line to the other, thus always having a continuous line to the surface. I then followed that line to where I had to jump once again to another line. Eventually I got to the point where the unexplored tunnel began. Then I tied one of my main reels to the existing line and began the descent down the fairly narrow inclined tunnel, running the guide line as I went. I reached the 110m point, where we had got to previously. There was a brick wall with small steel door in it at that point in the tunnel. The door was closed but I could get around the side of the brick wall and continue down. The tunnel got much narrower now, with some steel spikes sticking out from the walls. I had to take care around those. At about the 125-130m point the tunnel was quite narrow, just room for me but awkward. I was now moving feet first descending straight down. This was taking longer than I planned. I had planned to turn the dive at 30 minutes or 140m, whichever came first, but as I was so close to the end kept going a bit longer. A few metres from what appeared to be the bottom, with the reel nearly empty of line a tangle



developed on the reel. I did not waste time trying to sort it out at that point; I just tied on the other reel to continue down. At 139m I reached the bottom. There was another brick wall with a small closed steel door in it, and this time no way around the wall or through the door which was rusted shut. End of the road. Runtime now was 33 minutes. Time to go! I started reeling in the second line. Once that was done I had to deal with the tangle. At 140m underwater these sorts of tasks are not simple. It was not going to be easy and I really needed that reel to work so I cut the line, leaving the tangled bit on the reel, tied on the severed line again and started winding the line in as I ascended.

There were three deco stops below 68m, 120m, 100m and 81m, each stop for two minutes. At the 81m stop another tangle developed. Good grief! The reel I was using was so easy to get into trouble with!! I could see Don waiting for me at 68m. I did not muck around, just cut the line again, tied it on once more and continued up. This was all rather messy.

On reaching Don at 68m I picked up the tank I had left there, flushed my rebreather with gas from that tank (less helium in that mix which means less deco). We then started the exit. That involved retrieving the two jump reels as we went on an 11 minute swim at 68m. That took us to the shaft and the ascent could be continued. I had much more deco to do than Don of course, so he was soon above me. There were 19 deco stops in all that took a total of 326 minutes to complete. Don was out of the water 2 hours before me. During the ascent I flushed again at 35m onto a different gas mix (35% O2) and then at 6m flushed onto pure O2. As we ascended we also picked up the tanks that had been left in case of emergency bailout. I was carrying five 12lt tanks in the end and Don 6 by the time we emerged.



When the deco time was up, and I ascended through 1m towards the surface I felt a pain in both my shoulders. Not severe but the onset was distinct. I sat on the surface for a couple of minutes trying to assess what was happening and rapidly came to the conclusion I had a DCI hit (Decompression illness…the bends). Don was there so I told him and said I should go back down. He agreed and we briefly discussed how we would handle it. Time is off the essence in situations like this. There is an in water recompression protocol called "The Australian Method" that is well regarded and that was what we would

do. In short summary it is down to 9m on O2 for 30 minutes, ascend to 6m at 1m/12 minutes, stay at 6m for 30 minutes, ascend at the same slow rate to 3m for 30 minutes, ascend at the same rate to 2m for 30 minutes and then ascend at the slow rate to the surface. When one descends initially to the 9m it is normal for the pain to disappear. If at any stage on one of the ascents the pain reappears go back to the previous level for another 30 minutes before resuming the ascent. I had already been on O2 for 163 minutes while on deco that day (with a few 5 minute airbreaks to give the lungs a rest) so we thought going to 9m would be a bit risky. I had been on O2 for so long already going to 9m on 100% O2 would make the risk of a convulsion too high for safety. Thus we elected to start the recompression at 6m instead. I was back at 6m within 5 minutes of hitting the surface in the first place. Don then went to kit up so he could be in the water with me. The previous dive had been 358 minutes in length and now I was facing another 2 hours + in the water.

Back at 6m the pain disappeared, a good sign. Don acted as a runner for me. He brought some food, sliced apple, and drinks to keep me hydrated. I spent another 131 minutes in the water and when I emerged I had no pain…excellent. I stayed on the pontoon on the water for an hour breathing O2, then went back to the house (not far away) and lay on the bed breathing O2 still. The pain in my right arm returned at this stage. It was just a dull ache but there. During all these goings on Don and his wife had been consulting with DAN, my diving insurance people. They are top rate and told us what to do. With the return of the pain they said I should go to the chamber for recompression therapy. That involved a 3hr drive to Pretoria where the nearest chamber was. The problem was it also involved climbing from 3000ft to about 5000ft, a situation that would aggravate the bubbles causing the trouble. Don drove me in my rental car. As we climbed there was no increase in the pain at all. Very strange! We got to the military hospital at about 9pm that night. I was examined and the course of treatment determined. 6hrs in the chamber, starting at a depth of 18m on pure O2, then a staged ascent. At 18m that is a PPO2 of 2.8 on 100% O2 so there is a real chance of a convulsion. They cause no harm when not underwater, apart from maybe biting your tongue! As it was, I felt no symptoms of a pending O2 hit during the chamber session. I emerged from the chamber at about 3am Sunday morning. When at depth in the chamber the pain disappeared, but it reappeared when back at the surface, but to a lessor extent. It was determined I should have another session 2hrs long at 4pm Sunday afternoon. We slept at a friend of Don's house for what was left of the night. Once we emerged late morning I had to contact Ann and tell her the good news, and of course rearrange life as I would no longer be travelling back to HKG as planned.

For the next few hours Don's friend gave us a tour of Pretoria. He was Afrikaans so he took us to some significant sights of historical interest and gave his point of view on the Afrikaans situation and history. It was very interesting and enlightening as I knew very little about. Of course Don is English, so we had a lot of fun as well having digs at each other from a historical point of view.

Back in the chamber produced another small improvement to what was just a dull ache anyway. It lessoned at depth, but returned actually slightly worse at the surface. That caused some consternation. The chamber operator ascended quite quickly from 12m on that session and I suspect that aggravated the situation. The attending doctor determined another session was required…groan. This caused all sorts of complications as Don needed to get back home. He ended up taking my rental car and going and his friend looked after me. They were all extremely kind and helpful.

The last session was Monday morning at 8am. I was in a regular therapy session this time with 3 other people who had various medical conditions. It was also a 2hr session to 12m. The pain went again and on the surface was just an extremely dull ache. It was decided now that the residual pain was just being caused by damage that would improve with time. So we headed back to the dive site so I could pack my stuff. It was Don's wife's birthday so we had a BBQ (brai) to celebrate that night, and at 7am the next morning I drove to the airport. I am now typing this on the aircraft as I head back to HKG. As a final comment on the DCI hit, I believe it was quite minor, and largely resolved by the in-water recompression. The pain I suspect was mainly just nerve damage induced. If it had been bubble caused the pain would have got significantly worse on the drive as we climbed. What caused the hit? I doubt if that will be determined, but I can guess. The dive where I had the rebreather failure meant the PPO2's I was working to would not have been as high as my settings in the dive computers. I compensated by increasing the stop times as described earlier. Couple that with a week of very deep dives and maybe there is the hit. I had a day off between dives to give the body a rest. So, it is really difficult to determine accurately the reason. Decompression is a black art, with lots of unknowns. I was working to the latest deco algorithms and operating conservatively for the dives I was doing. I just accept what happened as part of life.

It was a fantastic week of world beating diving. It has given me much satisfaction, and it is sort of nice to be at the leading edge in the cave diving world when it comes to this sort of diving. I wonder how long the records will last?