World Record 221m Dive at Boesmansgat, South Africa

I departed HKG on Saturday the 29th May for JNB, arriving Sunday morning after a good sleep on the aircraft. I had over the past two weeks sent dive gear to JNB with pilot friends, this equipment had been stored at the crew hotel. The people I rented the car from picked up this stored gear and then met me at the airport with the gear and car. It was a 300km drive to Badgat where I was staying for the next few days.

On arrival, about 11am, I got myself settled in and then set up the dive gear. I planned a dive that afternoon to start the warm-up process for bigger dives to come. It took some time to get organised but I was in the water by 1520 for a 58 minute dive with a max depth of 24m. It was the first time I had dived the Mk15.5 rebreather using the drysuit so I wanted to make sure I was comfortable, everything worked and so on. All was largely in order with just some minor adjustments required.

The next day, Monday I did another dive, this time a 66m dive for 145minutes. I was pleased with how it all went but was a bit wet in one area. I was not sure why. I filled my drysuit with water and found a small hole that needed repairing. I think I may have made the hole when I was trying to squeeze through a doorway. I got through but maybe nicked the drysuit at the same time. That evening the hole was patched and I hoped the problem was solved. A test dive the next day would prove the fix (or not).

By now Don Shirley and I were well into the pumping of gases and gathering of equipment ready for the 1000km drive WSW to the next dive destination, Boesmansgat (Bushman's Cave), on the edge of the Kalahari Desert (S27º 55' 19" E023º 38' 33"). We needed about 15x12lt tanks, all pumped with various gas mixtures, plus the extensive collection of associated dive equipment, camping equipment and so on. It was a major task getting it all together and I must compliment Don for management skills in getting it all together. I was really just labour to do as directed. We also needed 5 large helium and oxygen tanks for extra gas, argon supplies for our drysuit inflation, the haskel pump, a compressor, etc etc.

Tuesday morning I was in the water by 0920 for a 120 minute 105m dive. The suit was fine and dry. (A dry dive is a happy dive!) These dives were also for me to get comfortable with the new Hammerhead electronics I had fitted to the Mk15.5, replacing the old analogue system. I had accumulated 8 dives using the system prior to coming to South Africa, but none since I had filled the handset with oil. This was done to make the unit more tolerant to great depths. On these proving dives in South Africa, the unit worked fine

but the depth reading was now 30% in error. At 105m it read 77m for example. I did not see this as a serious problem as my prime task for the HH unit was to control the rebreather, but it did mean I could not use the decompression calculating capabilities of the HH due to the false depth readings. My two VR3's (dive computers) were always the prime tool for that task anyway.

The next day I planned a short dive to test my skills at operating an underwater scooter (DPV), as Don and I planned some scooter exploration later. I had never used one so I wanted to become familiar with its operation on a simple, shallow dive before a more serious one.

Once out of the water on this last dive it was full swing into packing for the drive ahead. This took us hours with some changes of plans as we struggled to fit all the gear into my rental car and Don's truck and a trailer. We were to meet up with BigB (Reef Divers) in Pretoria, where I was to return my rental car, more gear was to be collected and BigB's truck was also to be loaded. Don had to go into JNB to get some bits and pieces, so BigB, a couple of his employees, and I all set to and repacked the vehicles. We just managed to fit all the gear in. We then stayed overnight before heading off the next morning, at 6am. Sipo, one of Don's employees was accompanying us, BigB was also joining us so there was now four in the team.

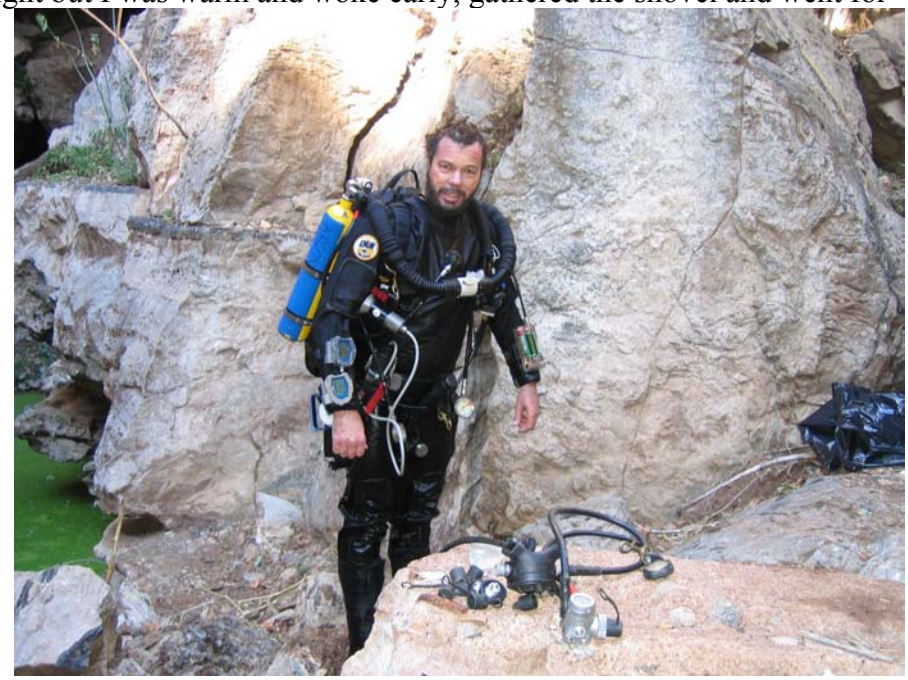
We arrived at the campsite at 3pm on the Friday. It was located at the edge of a large, rock sided, 70m deep hole. At the bottom of the hole was a 10m x 15m puddle with a big rock in the middle of it. The water was covered by green duckweed. This was the entrance to the world's largest known underground body of water. To get down to the water was quite a climb, and we had 15 tanks, 4 rebreathers, one set of double tanks, tools, suits etc etc to transport. Quite an undertaking! We decided it was best to set up camp first, then start on the mammoth task of lugging the gear down to the hole. The compressor, Haskell and large gas bottles would stay at the top. By dark the camp was set up. We each had a tent, and most importantly, foam mattresses to sleep on. It was a cold place. Down to about zero

each night and up to about 10-12degC during the day. I slept well that night, and by 7am the next morning we had all had breakfast and started the packhorse routine. Great care had to be taken carrying the heavy gear down the steep rocky climb, so we helped each other as needed. We all poked fun at Don as he was the official photographer for the event (self proclaimed), so ensured all events were recorded both in video and still form. He would call out to us to do it again after just negotiating a particularly difficult bit, he didn't get it recorded quite as he wanted or some such excuse. Obviously we ignored him. It was all good fun but hard work. In the end we were amazed at how quickly the equipment was transported down to the cave entrance. It was all done by late morning.

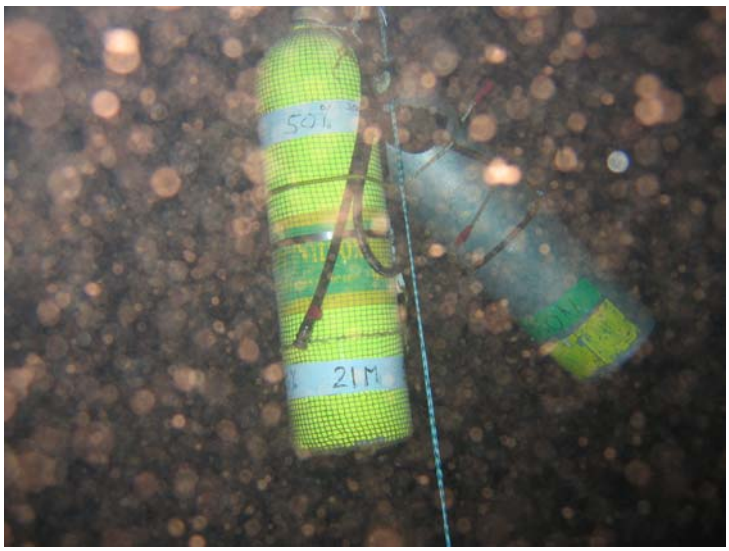
After lunch we prepared for our first dive. We aimed to get familiar with the entrance and determine what the status was as regards lines in the cave. We needed to setup 10 bailout tanks for my deep dive, and had no idea if there were lines that we could use or not. We decided we would just keep life simple and place our own line to hold the tanks. As it turned out, old lines used by Nuno Gomes when he did his record open circuit dive were in good condition, but loops to attach my bailout tanks to were at the wrong depths so it was a good decision. Thus on the first dive Don and I tied off the line and ran it down to 60m. 2xO2 tanks were hung at 6m, 2x50% at 21m, 1x35/15 at 35m and 1x17/40 at 50m. BigB did his own warm-up dive and helped with the shallower tanks. While on this dive we discovered the old Sheck Exeley line clearly labelled and running off the main vertical line at a depth of 20 odd metres. He dived the cave in 1994.

After the dive we climbed back up to the camp and enjoyed a good meal cooked by BigB. Tomorrow the plan was that I would place the tanks at 80m

and 120m (running the line down as I descended) while Don and BigB would have a dive together. It was a cold night but I was warm and woke early, gathered the shovel and went for my constitutional!! It was windy and we had to rig a shelter around the cooking table so that some of the heat from the gas rings would actually heat the water and food. BigB did a clever job of solving that problem. Anything that was placed carelessly would blow away and red sand tended to cover everything.



Originally we had planned on diving the day we arrived, but that was impossible due to arriving too late, and the time it took to set up camp and transport to the cave entrance the gear. We thus had lost a day effectively. I needed a rest day before the deep dive, and a rest day after the dive as well. Don also elected (wisely) to have a rest day after my big dive as well. He was to be the deep support diver and the plan was he would meet me at 120m as I ascended. Thus the plan for the next few days was that I would place the deep cylinders and then have a rest day, Don and BigB would go for a dive together on the scooters on my rest day, I would do the big dive on the Tuesday, and we would all have a rest day on the Wednesday.



On Sunday I was in the water by 10:20 and quite quickly ran the line to 80m and hung 1x17/40, then continued down to 120m and hung 1x12/55. I was out of the water after a dive of 162 minutes. Tomorrow was my day off from diving. Ben, the last of the three support divers also arrived on Sunday afternoon. He was to be my shallow support diver and was the only open circuit diver in the team. I was diving the Mk15.5 and Don and BigB were on Inspirations.

On the Monday BigB and Don went for there dive and had some fun on the scooters. We had

encountered a problem with the compressor the previous evening that could have been a problem for dives later in the week. It was annoying for BigB as he had had the motor serviced prior to this trip. When the compressor was started it ran for 5 minutes and then seized. The pumping of gas on the day could be achieved with some innovative lateral thinking by Don using the haskel, but we needed to get the compressor sorted out for later. BigB rang an employee, Darby who was tasked with finding a new motor and bringing it to us.

To back track! When we had first arrived and set up camp, the inevitable forgotten items started to be determined. Nothing important!! Just things like matches, salt, pepper, an A Clamp adapter that was required to fill my Mk15.5 spheres and so on. It was quite amusing. As each item was discovered, a SMS message would be sent to Ben saying buy this, pick up that and so on. In the end, he must have received 10 or more SMS messages from us. Anyway, when he turned up he had all the gear, plus lots more besides. Luxury things like battery powered fluro lights, computer gadgets and so on. He was an excellent addition to the team. So, when Ben arrived on the Sunday it was like Christmas.

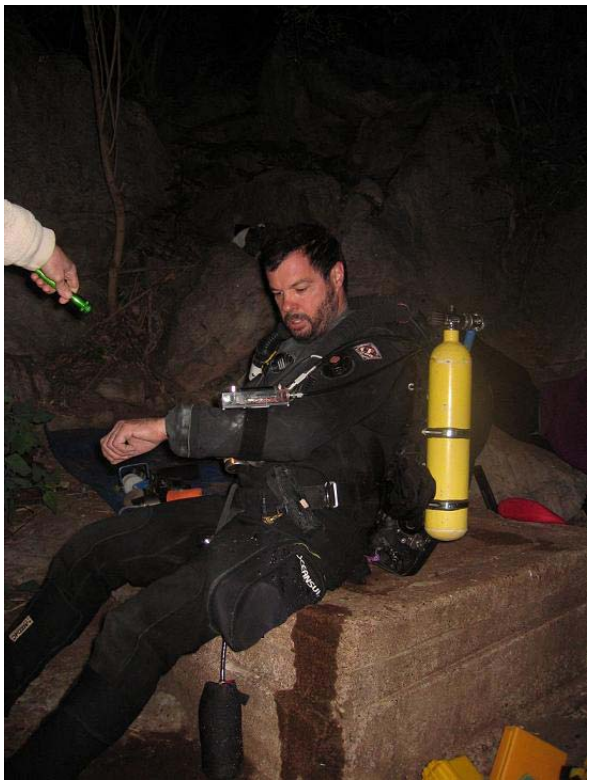
Monday I assisted Don and BigB get ready for their dive, and also Ben who was getting into the

water for the first time. I also liaised with Darby via mobile phone as we sorted out the new motor for the compressor. He did an excellent job of choosing the right motor, and for a bargain price as well. Darby arrived about 3 o'clock in the afternoon and he and BigB had the new motor installed fairly quickly. The mounting holes on the new motor did not match the holes on the mounting plate so some very innovative work was done to get the motor in place. It is amazing what you can do with tie wraps!!

Tuesday was the big day and we decided on an early start so that if there were problems there would be plenty of daylight in which to try and solve them. As the dive plan called for about 420 minutes total time that meant an early start. So we decided to rise at 4am and try for me to be in the water by 5-30am. It was getting light about 7am. We had a team briefing after dinner (again ably cooked by BigB) and covered all the aspects and timing of the dive. I wanted Don to meet me at 120m 29 minutes into the dive, BigB to meet me at 60m 45 minutes into the dive, and Ben to meet me at 21m 75 minutes into the dive. We discussed how various situations would be dealt with, and how and when food and drinks would be delivered to me.

After the briefing I ran through the plan and what would happen when in my mind. I programmed my dive computers and the hammerhead (HH), wrote up my slate with the planned dive and the bailout plan, then went to bed. One minor?? concern I had with the early start was getting my bowel movement timing sorted out. To want to go during a very long dive was going to be a problem. As it turned out, I woke at 2am and went for a wander with the shovel, went for another wander when I got up at 4am, and went for yet another wander just before I got into my drysuit at 5-30am. I was ok for the rest of the day!! The pee valve of course deals with the other aspect of waste removal.

My dive planning had all been done on Z-planner. An old programme but easy to use and quick to do what ifs with, varying gases etc. I did four runs. Dive as planned using 60% conservative factor and the same using 80% conservative factor. Then a bailout at max depth using the same conservative factors. The actual dive I planned to be a computer dive using the two VR3's I have. These I set on 20% conservative factor. As it turned out, the 80% Z-planner dives were closer to the VR3 regulated actual dive than the 60% plan. Elevation was 1400m and the gases were as previously described. I had air in the on-board diluent sphere that I was not planning to use as all diluent would come from off board tanks. I would start the dive carrying two 12lt tanks containing my bottom mix, 5/79. The other part of the plan was the depth I was to go to. I had told the team 200m was the planned depth, but my dive planning was all based on 220m. At the time, depending on how I felt etc would determine the final depth. Maybe strange but I felt that took the pressure off and I could do what I was comfortable to do at the time. I also planned a conservative rate of descent that put me at 220m at 16 minutes into the dive. The planned ascent rate would be initially 15m/minute to the first stop at 138m. The VR3 gives 2-minute deep stops so 2 minute Pyle stops were used in the Z-planner plans. On the ascent, as I reached each bailout tank I would plug into that tank and do a flush. I would also clip it on, and remove the deepest gas I was currently carrying so that I always had two bailout tanks of good gas for the depth with me.



Once we had climbed down to the cave entrance the suiting up began. We all got ready at the same time, with BigB being tasked with a final check on the spare rebreather we had (an Inspiration) as well. There was a minor hiccup with that unit, but it was resolved eventually. Do was to enter the water first and from about 15m video my initial descent passed him and into the depths. He would then surface to await the timing to start his own descent to meet me at 120m. Darby was busy taking photos and video from the surface, so the event was well recorded.

It might be worth noting my setup with the rebreather. I had one 3lt tank mounted on the left side of the unit, which supplied air to my wing. On the right side I had another 3lt tank that supplied argon to my suit. As mentioned, the on board diluent was air and I did not intend to use it. Obviously the other sphere had O2. Both spheres are 3lt also, and can be pumped to 200 bar.

I started my descent at 06:09. As I passed Don I had to clear my mask. To have to do that at serious depth would use large amounts of gas so I used the opportunity at 15m to reduce the gas in the counter lung to reduce buoyancy and increase my rate of descent. I had no air in my wing so was soon descending like a tired brick.

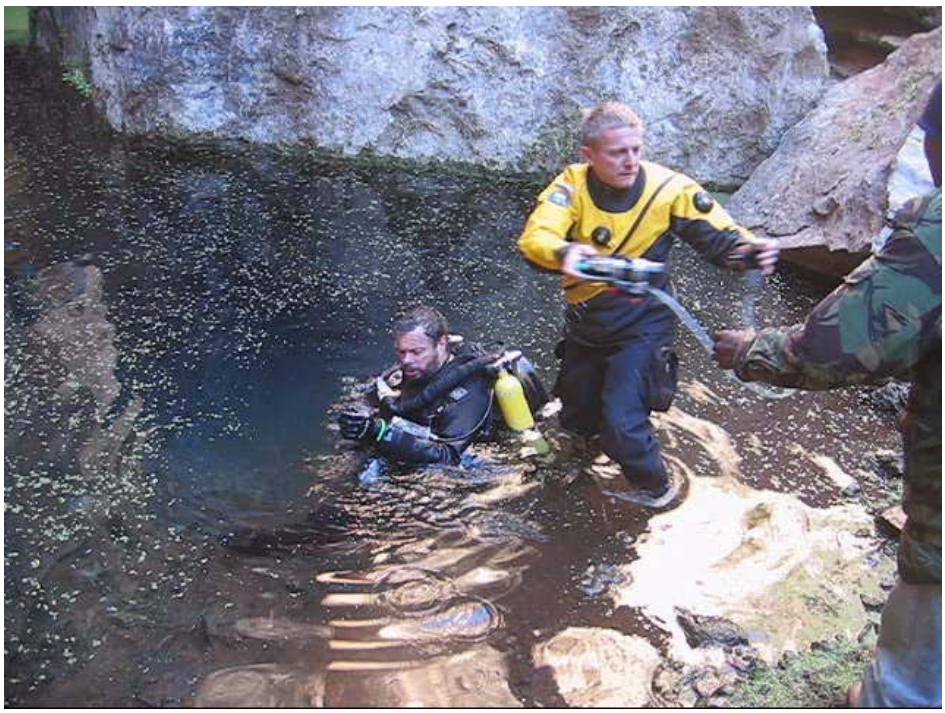
Once on the line after negotiating the entrance the rate of descent, as mentioned, increased rapidly. I was very aware of a line running off the main line at 55m and did not want to descend onto that going down like a stone, so I was careful to ensure that was cleared safely. The ADV in the Mk15.5 made it easy for me to keep the diluent coming into the counterlung as the depth increased and the gas compressed. The low (5/79) O2 level of the mix also ensured that the PPO2 level did not get higher than 1.3 on the descent as well, even when dropping at 30m/minute. I had started the dive with a PPO2 of 0.4 set for the entrance. Once in the cave and on my way down I initially increased the PPO2 demanded to 1.0. Very easy and quick to do on the HH! When it became obvious the PPO2 level would not be an issue I increased again the demanded PPO2 to 1.3.

No gas was going into my wing but an occasional burst of Argon was needed into the drysuit to stop suit squeeze. I kept this to the minimum to ensure a high rate of descent. Passing the last bailout tank at 120m one could not help but think about the calculations as to the bailout gas required from the bottom up to this tank. But that was fleeting as I was actually enjoying the descent. Passing 150m I wondered again how the HH would stand up to the depths. I had not had it deeper than 121m before. The oil filled handset should be ok. What about the pod in the Mk15.5 itself? I was confident that the Mk15.5 would be ok. If the HH components failed then I could run the

Mk15.5 manually. The secondary just used the power generated by the individual O2 cells themselves, which was a marvellously safe but simple fallback position.

The next thing to think about was when to start injecting gas into the wing to arrest my descent? Too early and the descent rate would be reduced at the wrong time. Too late and I would overshoot my max depth. Yet another reason for the 200-220m max depth plan! At 185m I start injecting air into the wing. At 200m my rate of descent seemed hardly to have slowed at all. After 30seconds of injection there seemed to be no effect. I could feel that the wing was inflated to quite a degree, and still inflating so I decided it was now time to start injecting some argon into the suit as well. It all came together and the descent stopped at 213m as indicated by my two VR3's. The HH showed 150m, which was in error, as I knew it, would be. The other thing I notice, and it was marked, was how my field of vision had tunnelled significantly. This started to onset at about 200m and was very noticeable at 213m. My END was only about 45m so I suspect it was the start of minor HPNS symptoms.

Once the descent had stopped I was disappointed I was not at 220m and pondered starting the descent again for those last few metres. I decided it was not worth the loss of gas to do that however, but before starting the ascent I did a 360deg turn to see what I could see. Nothing as far as the light would penetrate in the crystal clear water. This was one huge area of water. The work of breathing on the Mk15.5 was just like at 6m. I could not detect a difference. The high helium content obviously helps but all the same, what a magnificent rebreather it is. The HH setpoint control



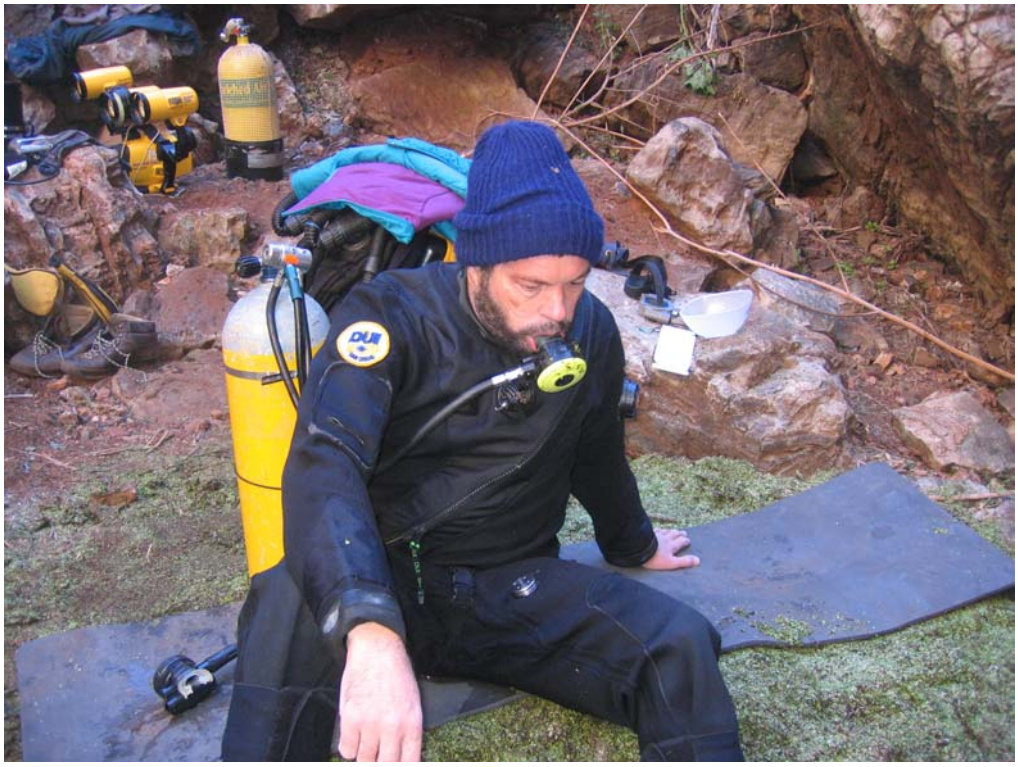
was also rock solid.

It had taken 10 minutes to get from the surface to 213m. Time was lost getting in the entrance of course, so the average rate of descent was about 25m/minute, peaking at about 30m/minute for a high percentage of the descent. As I started the ascent the VR3's said time to the surface was 400 minutes. At the planning stage I had pondered what rate of ascent to use when. I decided on 15m/minute to the first deco stop, then 10m/minute to 15m, then 5m/minute for the rest. As it turned out I averaged 11m/minute with a peak rate of 13.5m/minute. The first VR3 deep stop was at 150m for 2 minutes. That next stop was at 120m which was very convenient as that was the first flush depth and where I picked up a shallower gas bailout tank. I arrived at 121m at 24minutes into the dive, so was early and Don was not yet there. I could see his light above me descending however. I did the first diluent flush, and then clipped on the tank, unclipping it from the line it had been hanging on. The plan was that Don would take my spare cylinder, and ascend rolling up the line as well. As he wasn't there yet once my two-minute stop was complete I decided I might as well start rolling up the line myself. We met at 111m and I handed over the reel. At the next deco stop, which was at 105m for two minutes, I handed him the spare tank and told him I was happy for him to continue his ascent, leaving me behind.

Deep stops continued at 93m, 77m and 61m. The plan was to meet BigB at 45minutes into the dive at 60m. With my slower than planned ascent rate, about 8m/minute on average, I was by 60m running 3 minutes late, arriving at 48 minutes into the dive. BigB was waiting for me. At 50m I again flushed the unit, handed over my second bottom gas tank to BigB and clipped on the 50m mix. I now had a 17/40 and a 12/55 slung. After this hand off I waved BigB away and he started his ascent. Above 50m the stops increased in frequency and length quickly. At 45m for 3minutes, 42m for 5 minutes, 39m for 6 minutes, 36m for 7 minutes, 33m for 9 minutes and then 29m for 15 minutes.

During the 35m stop I again did a flush, this time onto 35/15. I left the 12/55 on the line at that same depth. While on the 29m stop, Ben appeared offering Mars Bars and drinks. This was

around the 100-minute mark into the dive. He was only planning on meeting me at 21m, but he ducked down to me, shoved a drink in my hand and then retreated again. At this depth I was not able to have the drink, as I did not want to go open circuit (OC) until 6m at the earliest. It is not practical to eat and drink underwater while on the rebreather. What I do is go OC, which is like a regular scuba diver does, blowing bubbles each time he breathes out. To take a drink or bite to eat I breath in, take the drink or food, chew and swallow as necessary, then go back onto the regulator to breath again. To do so on the rebreather would be messy and cost a lot of gas. I now had a drink in my hand that I was not sure what to do with. I found a nice spot in a nook in the cave wall to stow it, and left it there, to be retrieved on a later dive. I flushed onto 50% at 21m during a 13m stop, again taking a 50% tank and leaving the 17/40. The 18m stop was 18 minutes, 15m for 25 minutes, 12m for 35 minutes, and 9m for 50 minutes before reaching 6m, 280 minutes into the dive.



At 6m I flushed the unit onto O2, having turned off the diluent to ensure there was no contamination now that I wanted pure O2 only in the loop. 84 minutes was spent at 6m, including two 5 minute air brakes to give the lungs a rest. The last stop was at 3m and was for 153 minutes where I did 5 air brakes. At 3m drinks and food was lowered to me in a string bag. Oh, and some notes on a slate. The amusing one was the crew declaring they were going into town to get hamburgers and when I finally surfaced could I carry the torch batteries up to the camp to be charged please?

I did not get seriously cold on the dive, the water being a reasonable 20degC. I did urinate plenty though and was thus thankful for the pee valve. On emerging from the water I stayed in my drysuit for a while just in case there was a problem and I needed to get back into the water to resolve it (we planned on using the Australian Method of in-water recompression if required). I also continued breathing O2 for about 20 minutes on the surface as a

precaution. After that I got into some warm clothes and waited about 2 hours before climbing up to the campsite.

The total dive time was 517 minutes and all had gone like clockwork apart from the longer dive time than planned. Gas consumption on this dive really demonstrated the advantage of using a rebreather. Total O2 consumption was 420lt from the rebreather supply, or an average of about 0.9lt/minute when air breaks are taken into account. Diluent use was about 430lt of 5/79 and 60lt for each of the diluents I flushed with on the ascent. I used about 360lt of air on the air breaks, 250lt argon for my drysuit, and 260lt air to inflate my wing. The OTU count was 720 and CNS 280%. The dive was a world record for depth (213m on the VR3's but corrected to 221m for fresh water) in a cave while using a rebreather.

The following day we pumped and mixed gas in the morning. We had to amend the mixes in the tanks I had used as my bottom mix on the previous dive from 5/79 to 14/40. This involved a bit of juggling of tanks but Don's mixing expertise made it all easy. In the afternoon we visited a dry cave nearby. It was a pleasant break. For the final day of diving Don and I planned a 40 minute scooter dive at 80m laying new line around the circumference of the cave to see if we could connect to another line that had been laid by someone else previously going in the other direction. We also planned to do some videoing of during the ascent. So the plan was for Don to leave a video camera on the line at 40m, and also for BigB to meet us at 80m on our return. BigB would video us as we rode in on the scooters. As this was our final dive, the final task was to retrieve all the tanks in

the water as we ascended. Preparations for that dive went smoothly but at a leisurely pace and we were in the water by 10:30am. We both had two 12lt tanks of bottom mix with us for bailout, but also needed to pickup another tank each on the descent. These were tanks that I had left in the water from my previous dive. Don discovered a leak from one of his first stages once we were in the water that took about 20 minutes to fix, with BigB doing the repair work for him. Once that was sorted out the descent was commenced to 80m, picking up the tanks we needed on the way down. The plan was for Don to lay the line, with me assisting. It was difficult tying off on the wall because the cave wall consisted of compacted mud that had the consistency of plasticine. It was slow going. We planned on running using the scooters for 20 minutes before turning the dive. At the planning stage we had to be careful to allow for various failures during the dive. It was obviously vital to have enough gas to cover rebreather failures and scooter failures requiring a long swim back. 13 minutes into the dive Don had a bit of a mishap. He believes his reel handle may have inadvertently touched the propeller of his scooter. This highlighted a design deficiency in the scooter itself. The nut holding on the propeller immediately loosened and the propeller instantly undid itself and disappeared into the abyss before one had a chance to even realise what was happening. There was no choice but to tie off the line, cut it and turn the dive. We placed a line arrow at the end of the line with our names and the date on it, just to record the event. Don then hooked his scooter to a clip on his harness, and latched onto me and I towed the whole "train" back to the original tie-off of the new line we had laid. The scooter had no trouble pulling us both and it all went remarkably smoothly. We cut the line so that there was a gap of about 10m between the down line and our new line, and then started the ascent. As we had been required to turn the dive early, we were already in the ascent when BigB descended to meet us. This meant he did not get to video us returning on the scooters, which was a shame.

Don picked up the video camera at 40m and commenced to video anything that moved. I started picking up tanks as we slowly ascended, complying with the VR3 controlled stops. By the time I was at 9m I had 8 x 12lt tanks hooked to my rebreather harness, not to mention the scooter. BigB's decompression obligation was much less than Don and mine so once he had completed his dive he began shuttles to relieve me of my scooter and the tanks I was

carrying. Don had collected a few tanks as well and also handed these to BigB as he shuttled between the surface and us, now at 6m on deco. Total dive time was 157 minutes after 23 minutes bottom time instead of the planned 40 minutes.

That was the last dive so now began the task of packing. Don and I were not keen to do any physical work for a few hours to reduce any risk of getting bent post dive. We thus had a break and did "light duties" for a while before getting stuck into the pack up. We were breaking camp on Friday morning so could only do so much that day. We still achieved a lot before dark.

A relaxing evening was then had over a meal and we retired late for us, at 9-30pm. Usually we had been in bed by 7-30 to 8pm.

Up at 6am the next morning, breakfast and then we got stuck into the pack up proper. It was a lot of work but we were on the road by 9-30am. We stopped in a country town at Darby's parent place where they fed and watered us before we continued the journey. I arrived at my hotel in JNB about 4pm. The long shower that followed was bliss.

On Saturday, I boarded CX748 and flew back to HKG. Thanks to the crew for their assistance with my baggage.

Finally, huge thanks to Don Shirley (IANTD South Africa) for organising and making the dives possible. Also thanks to Peter (BigB) Herbst of Reef Divers for helping make it all happen as well. Thanks also go to Ben McGarry as my third support diver and Dawie Schlebysch for ably assisting above water.

RB Interface - Profile

Dive Info

Dive ID : D0000063

Version : V1.4A

Interval : 10 seconds

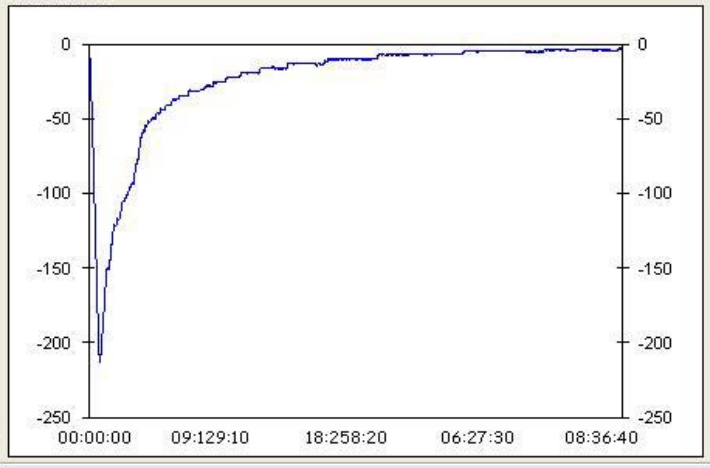
Time Down : 09/06/2004 06:09:40

Time Up : 09/06/2004 14:46:48

Max. Depth : 213.02 Meters

Duration : 517:8 minutes

Profile Plotter



Depth
Ext. Depth
PO2
Temperature
HPO2
HP Dil
PO2 - a
PO2 - b
PO2 - c
Vbattery
ebattery

Dive ID	Recordid	depth(m)	gasnumber	PO2	mark	temperature(i	extdepth(m)	vbattery	ebattery	HPDil(b)	HF
D0000063	0058	207.84									
D0000063	0059	208.22									
D0000063	0060	209.16									
D0000063	0061	210.38									
D0000063	0062	211.59									
D0000063	0063	212.72									
D0000063	0064	212.63									
D0000063	0065	211.31									
D0000063	0066	210.09									

Details | Gas | Tissue | Save | Dive List | Save Graph | Zoom | Pan < | Pan > | DAN | Feet | Meters