# Current action in special mix diving

R.W. Bill Hamilton
Hamilton Research, Ltd.
Tarrytown, NY 10591
rwh@rwhamilton.com



## Some issues

- Reverse dive profiles
- Surface oxygen
- Deep stops
- In-water treatment
- OEA and sex

## Some terms

- OEA is Oxygen Enriched Air
  - Some call it nitrox, but that really means less $O_2$ than air
- Partial Pressure is the fraction times the total pressure
  - A good unit is Atmospheres, atm
  - But not ATA, since that means "atmospheres absolute"

Units of Pressure

- 1 msw ≡ 1/10 bar; 1 fsw = 1/33 atm (exc USN)
  So 3.2568 fsw = 1 msw (not 3.2808)

## Technical diving is a mature sport

- Requires special techniques, mixes, training, decompression, equipment
  - In UK the word has been used to refer to rebreather diving.
- Community practice is widespread and fairly uniform, worldwide.
- But there are still no accepted standards.

## Reverse dive profiles

- It has always been a rule to do deep dives first. (dives or multi-level stops)
- The Smithsonian Institute wanted to know how important this was so held a workshop.
- There were some anecdotes, but not much real data showing problems.
- Conclusion: One can do reverse profiles, but within certain limits.

## Reverse dive profiles, continued

- Intuitively it makes sense to work up toward the surface in multi-level dives.
- Most deco calculations and dive computers allow ascents in any order.
- Edmonds and colleagues have done animal experiments that show less DCS when done in normal order. (recent article in UHM)
- My position: The criteria are limited enough that I would not expect problems.

## Surface oxygen

- What benefit is breathing $O_2$ at the surface?
- Consider the uses:
  - Awaiting treatment
  - Prior to a flight
  - During a surface interval

## Awaiting treatment

- We all know to go on oxygen ASAP when DCS is suspected. (More on treatment later)
- Many cases clear up without recompression.
- But the rules are to go to a chamber anyway. (if practical)

## Prior to flying

- It works well for reducing time before flying.
- How does one know how to account precisely?
  - Some dive computers allow this.
  - Decompression programs can also.
- Can be used on an ad hoc basis to increase conservatism.

## $O_2$ during the surface interval between dives

- Studied formally by Vann at Duke.
- Same considerations.
- Rules of thumb might be available from DAN

## Does $O_2$ in diving affect treatment

- Oxygen exposure during technical diving will not normally prejudice a treatment
- Oxygen exposure management is part of treatment.
- When OEA first started this was a concern; Dr. Peter Bennett made the statement that "nitrox" divers could not be treated. Wrong!

## Deep stops

- A practical observation by ichthyologist Richard Pyle. . .
- Pyle found when he stopped to drain swim bladders he felt better. (Feeling better is a real factor in decompression)
- Pyle developed an algorithm for inserting the stops.
- But you have to pay for these.

## Deep stops, DCS effects

- Deep bounce dives tend to cause fatigue, malaise, etc., maybe neurological DCS more than limb bends
- Deep stop advocates say deep stops reduce these effects. Probably true. (this is DCS)

## Deep stops, gradient factors

- Eric Baker developed a more formal and more mathematical algorithm for doing deep stops.
- These put first stop deep enough to reduce need for close approaches to M-values.
- Gradient factors are an arbitrary method, but they greatly smooth the ascent profile.
- Again, one has to pay this back with slightly longer times.

## Deep stops, paying it back

- These stops, as mentioned, cause more time to be required at the end.
- How can we get credit for the deep stops without having to pay back the time????

## Deep stops, George Irvine's approach

- George is an outspoken proponent of the WKPP (Woodville Karst Plains Project) which explores the aquifers of North Florida.
- These are the originators of the DIR (Doing It Right) philosophy. This is about operations.
- Derived from this is GUE (Global Underwater Explorers, gue.com) of Jarrod Jablonski.
- JJ and George will be in Stockholm Nov 25 for a tech diving workshop.

## Deep stops, more from George

- George slows down ascent early, with a more or less specific pattern.
- Then shortens some mid-range stops a bit. He felt it.
- Proceeds normally thereafter, but **totally skips** the last shallow stop (3 msw/10 fsw).
- He gets away with this!

## Deep stops, "bubble models"

- Several computational algorithms or "models" do this sort of thing in a more formal way.
- Yount's VPM (Varying Permeability Model) deals with surface tension, surfactants, and other forces operating on bubbles.
- Strives to maintain no more than a tolerable level of bubbles.
- Leads to deeper stops, and can do this without having to pay back.
- But can be quite conservative.

## Deep stops, RGBM

- Closely derived from VPM is Bruce Wienke's Reduced Gradient Bubble Model.
- Even more complicated math than VPM.
- Leads to similar type profiles, deep stops that don't have to be paid back, and fast ascents.
- Wienke claims extensive experience, but this is not readily available.
- Lots of opinions on this. I am reserving judgment.

## Computational algorithms

- There are a number of these: Abyss, Voyager, Pro-Planner, GAP, and now Nautilus.
- Nautilus has many features, including a hybrid profile using VPM and the Hamilton-Kenyon constraints.
- Looks good, but experience is limited.

## In-water recompression

- First, DCS is a fact of life.
- "Treatment" should be part of every dive plan.
- Don't do serious diving without oxygen available.
- If you can't easily get to a chamber, consider IWR
- Prompt treatment gives better results.

## In-water recompression, planning

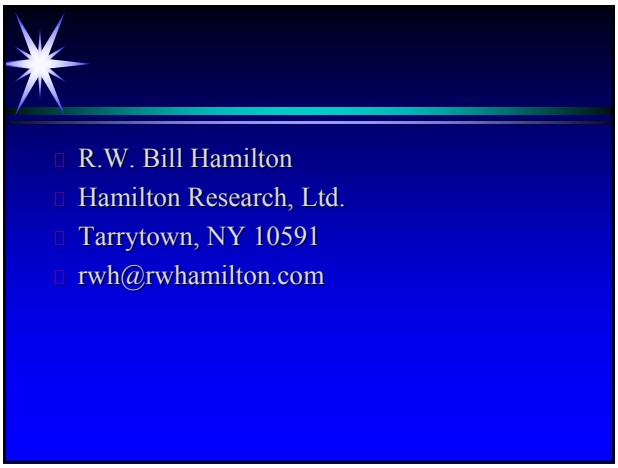
- IWR is not a trivial exercise.
- Requires, at a minimum:
  - Surface and in-water support
  - Oxygen (don't try this with air)
  - Full Face Mask
  - Thermal protection
  - Ascent control (1 fsw/min)
  - Hydration
  - Most of all, you need to know what you are doing!

## In-water recompression, resources

- UHMS has a workshop on it.
- Dr. Pyle has done several good articles.
- Edmonds' book has Australian method, important because there is experience.
- Catch 22: When you really need it you may not want to do it.

## OEA and sex

- In a recent report in *Undercurrent* a couple began diving with OEA, and had sex one day during their noon break.
- This brings to mind earlier reports about urchin divers who could have a family life after switching from air to OEA. (1992 workshop at DEMA)
- It is real.
- These air dives resulted in sub-clinical DCS, the tiredness and malaise mentioned earlier.
- Proper decompression fixes it.


R.W. Bill Hamilton
Hamilton Research, Ltd.
Tarrytown, NY 10591
rwh@rwhamilton.com