Ascents from 100 ft (30.5m) Dives on Air

Comparison of V-Planner VPM-B to Buhlmann Tables, and GAP RGBM + GF Tables

•This compilation demonstrates that at 100 ft, VPM-B decompressions are comparable to Bühlmann's sea level tables. RGBM and GF tables are increasingly more conservative compared to VPM-B, with increasing dive times.

Organization

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Notations and Conventions

•ALL CONLUSIONS and GENERALIZATIONS PERTAIN ONLY to the SPECIFIC DEPTHS, GAS MIXTURES, and PROGRAM SETTINGS CONSIDERED in this DOCUMENT

Profiles

•12 profiles of 100 ft on air back gas, with bottom time ranging from 10-120 min are modeled, with deco using air and O_2.
•Total of 72 VPM-B models = 12-profiles x 3-conservatisms x 2 deco gas combinations (air, air + O_2).
•Correlations of RGBM and GF to 72 VPM-B models = 12-profiles x 3 different conservatism settings x 2 deco gas combinations (pages).
•All ascents at 33 ft/min. No breaks included from O_2 Exposure. All descents on back gas at 100 ft/min.

Plots

•Gas mixtures denoted as percents in braces: {%O_2, %He, %N_2}
    •air is then: {21,0,79}
•Three types of plots are shown that correlate VPM-B to Bühlmann, RGBM and GF:
    •Bühlmann, RGBM, and GF vs. VPM Total Ascent Times (pages: 7, 12, 13, 17, 22, 23, 27, 32, 33)
    •Overlaid stair-step profiles (pages: 8, 10, 18, 20, 28, 30)
    •RGBM, and GF Stop-times vs. VPM-B stop-times (pages: 9, 11, 19, 21, 29, 31)
•Diagonal lines in plots are *NOT* fitted correlations –they are just indications of 1:1 correlation to guide your eyes.
    •Points that lie above the lines denote longer GF and RGBM times, while points below the lines indicate longer VPM-B times.
•I use Imperial American units and conventions. cf == cubic feet (volume).1 cf = 28.23 liters. In the USA, tank capacities are discussed in terms of the volume of gas that is contained at the maximum rated pressure. psi == pounds per square inch (pressure).

V-Planner and GAP Software Settings

•Ascents calculated by GAP RGBM v2.1.3 (Aug, 2003 Edition) and V-Planner (VPM-B) v3.22.
•VPM conservatisms are denoted: Nominal as VPM-B (N), Level 2 as VPM-B (2), and Level 4 as VPM-B (4).
•RGBM and GF run at nominal GAP conservatisms. VPM-B run at nominal (N), (2), and (4) conservatisms.

Discussion of Correlation Plots for VPM-B to Buhlmann, RGBM and GF Total Ascent Times (TATs)

VPM-B TATs Correlate Linearly to Bühlmann and RGBM –though Not to GF

General Notes

•All data include time to 1st stop at ascent rate of 33 ft/min.

•TATs are closely related to comparative surfacing gradients for Bühlmann, VPM-B, RGBM, and GF because all three ascent methods employ similar stage depths. Therefore, roughly speaking, a longer TAT implies a more conservative schedule.

Bühlmann vs. VPM-B (pages 7, 17, and 27)

•Each of the 3 sections (with increasing VPM conservatism levels) begins with comparison of TATs for VPM-B and Bühlmann 100ft air decompression tables. These comparisons benchmark VPM-B as more conservative than Buhlmann sea level tables.

RGBM vs. VPM-B (pages 12, 22, and 32)

•VPM-B(2) is nearly 1:1 correlated with RGBM. Considering that VPM-B(2) is even more conservative than Bühlmann's 108 ft tables (page 17), RGBM is clearly very conservative at 100 ft.

GF vs. VPM-B (pages 13, 23, and 33)

•VPM-B is not linearly correlated to GF. With increasing conservatism levels, VPM-B tables can be generated that have longer TATs than GF.

•THIS PROPOSITION IS BEING IMPLICITLY TESTED BY V-PLANNER: Bühlmann doesn't credit for deep stops –so inclusion of deep stops in GF-modifications of algorithms based on Bühlmann a/b s *may* lead to too much conservatism. VPM-B credits deep stops. Therefore, VPM-B TATs are shorter than GF TATs.

Discussion of Correlation Plots of VPM-B to RGBM and GF Stop Times

General Notes

•The plots on pages 9, 11, 19, 21, 29, and 31 directly compare stop time vs. stop time for two different deco methods.They avoid the offsets that occur on the conventional stair-step depth vs. run-time plots of the same data, which are shown on pages 8, 10, 18, 20, 28, and 30.

•Data points are plots of the (x,y) pair: (VPM-B stop time, RGBM/GF stop time) for each decompression stop. Individual stop depths are not indicated, but generally, the longest stops correspond to the shallowest stops for each gas mixture. For O_2 deco, the 20 and 10 ft stops are shown as green-colored points. Stops on back gas are shown as black-colored points. For the deepest stops, more than one point will often plot on top of another point.

RGBM vs. VPM-B (pages 9, 19, 29)

•VPM-B(N) stops on air are shallower and much shorter than RGBM. Stops on O_2 are comparable to RGBM. VPM-B(N) is more aggressive than RGBM (page 9).

•VPM-B(2) initial (deepest) stops on air are shallower and shorter than RGBM. Stops on O_2 are the similar to RGBM (page 19).

•VPM-B(4) air stops are very similar to RGBM, but VPM-B stops on O_2 are longer than RGBM (page 29). VPM-B(4) is increasingly more conservative than RGBM with increasing bottom times (page 29).

GF vs. VPM-B (pages 11, 21, 31)

•VPM-B(N) and (2) are increasingly more aggressive than GF for increasing bottom times (pages 11, and 21).

•VPM-B(4) is 1:1 correlated to GF for dives longer than 70 min. For 20-60 min VPM is more conservative than GF(page 31).

Discussion of Plots of VPM-B Stop Times vs. Bottom Times

See pages 14-15, 24-25, 34-35

•TATs and groups of stop times (e.g. times at 10+20 ft) are linearly correlated to dive times. This translates to simple rules that relate stop times to bottom times. We can use these relationships to specify analytically-based procedures for VPM-B deco-on-the-fly.

•CAUTION: remember that the rules derived from these slides are special cases that only relate to 100 ft dives on air.

SECTION 1

Ascents from Dives at 100 ft for 10 -120 min
12 on Air with Air Deco
12 on Air with Air+O_2 Deco

VPM-B Conservatism Setting (N)

10 VPM-B air deco TATs are compared to Bühlmann page 7
24 VPM-B profiles compared to RGBM and GF (pps. 8-13)
24 VPM-B ascents with Air and Air+O_2 deco are summarized (pps. 14-15)

Benchmark:
Correlation of TATs for Air Decompression Dives

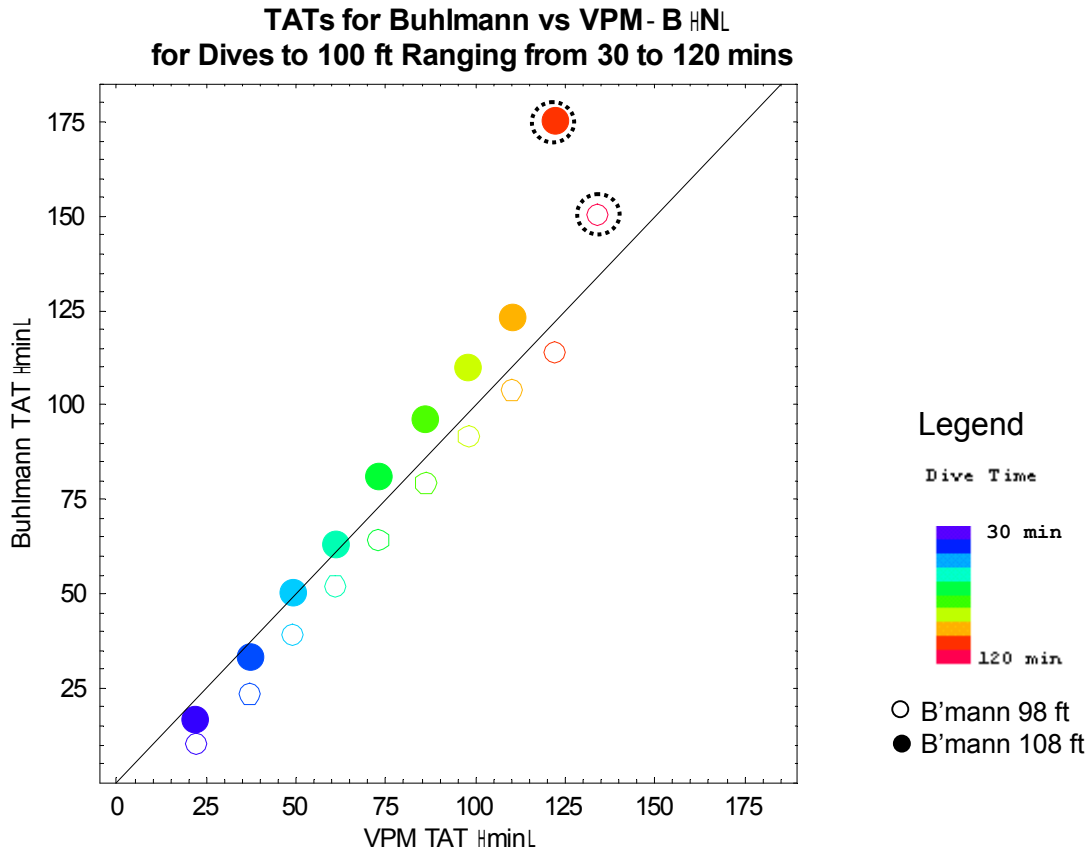
Bühlmann at 98 ft (30 m) and 108 ft (33m) vs. VPM-B(N) 100 ft

Conclusions:

1) 100 ft VPM-B(N) correlates linearly to Bühlmann's 1984 Sea-level Tables.

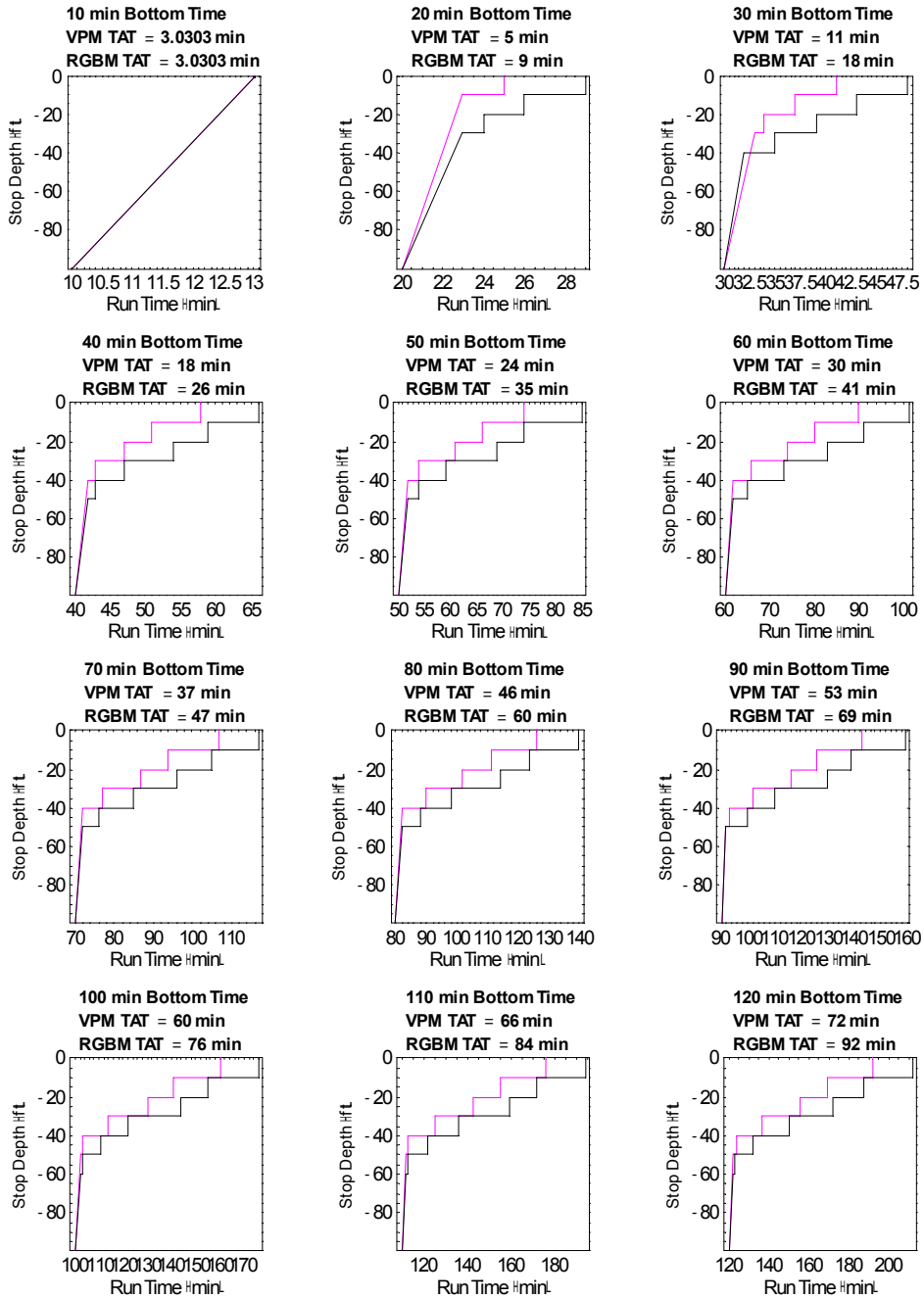
2) 100 ft VPM-B(N) tables have longer TATs than 98 ft Bühlmann.

3) 100 ft VPM-B(N) tables are comparable to 108 ft Bühlmann for dives 60 min or less.



Extra conservatism is typical of *last* schedules in Buhlmann tables, which often show large increase in TAT for incremental increase in bottom time. I exclude these data in discussing correlations

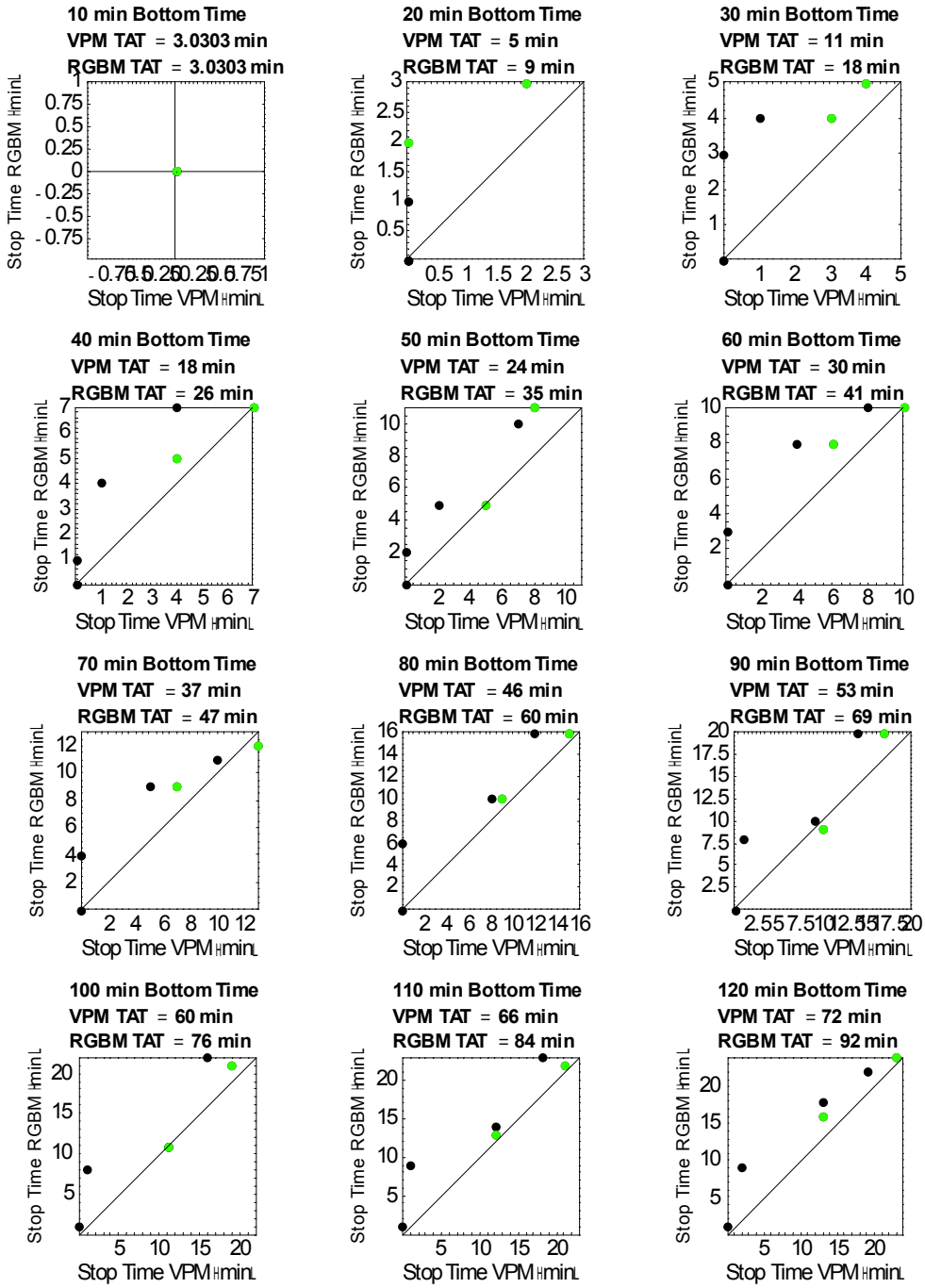
Comparison of RGBM and VPM-B (NL) Ascents for Array of 100 ft Dives on Back Gas {O_2, He, N_2} = {21, 0, 79} Deco on {21, 0, 79}, and {100, 0, 0}



LEGEND
Dive Profiles

VPM-B
RGBM

Correlation of RGBM to VPM-B (NL) Stop Times for Array of 100 ft Dives on Back Gas {O_2, He, N_2} = {21, 0, 79} Deco on {21, 0, 79}, and {100, 0, 0}



LEGEND
Deco Gases
O_2, He, N_2
100, 0, 0
21, 0, 79

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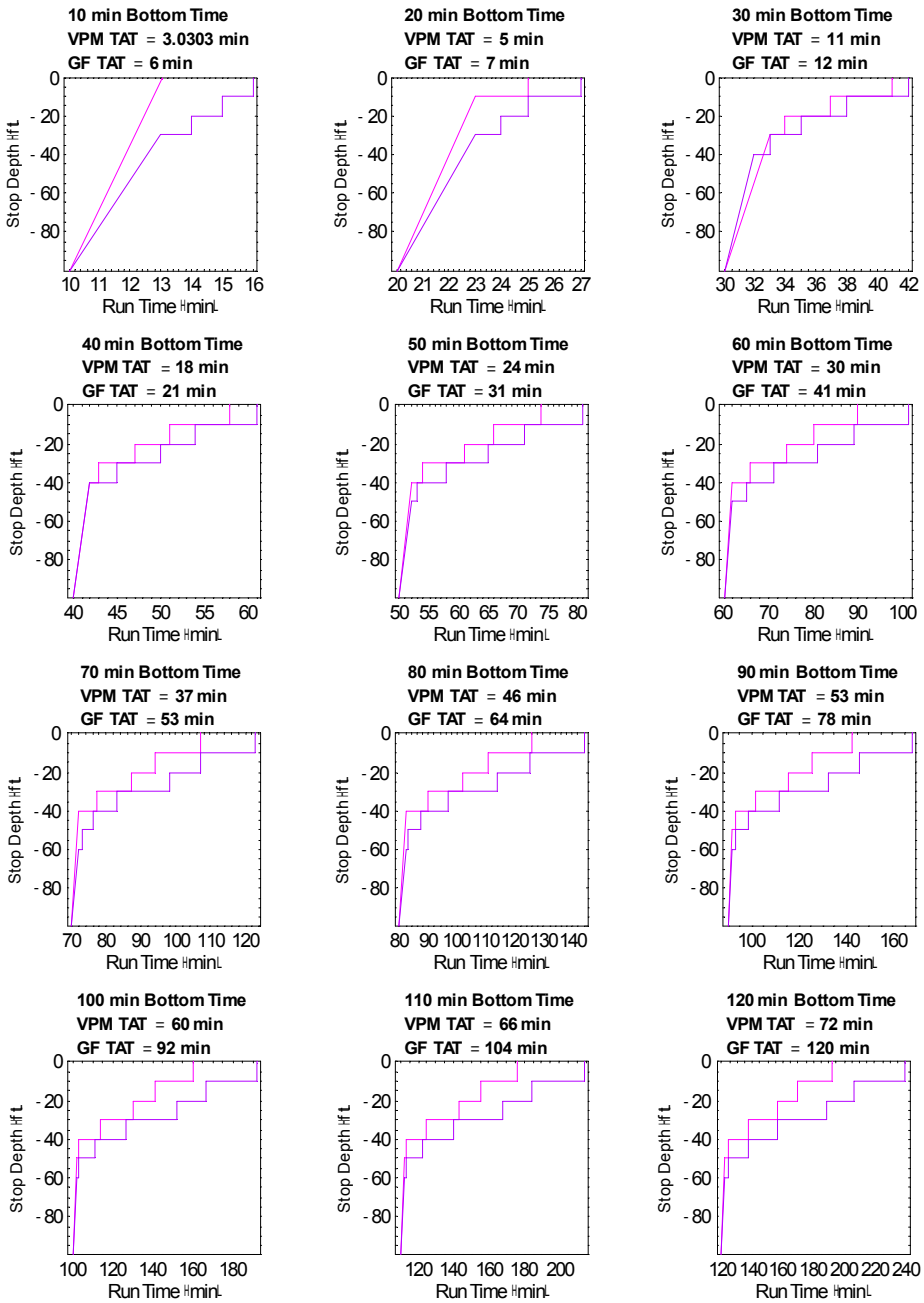
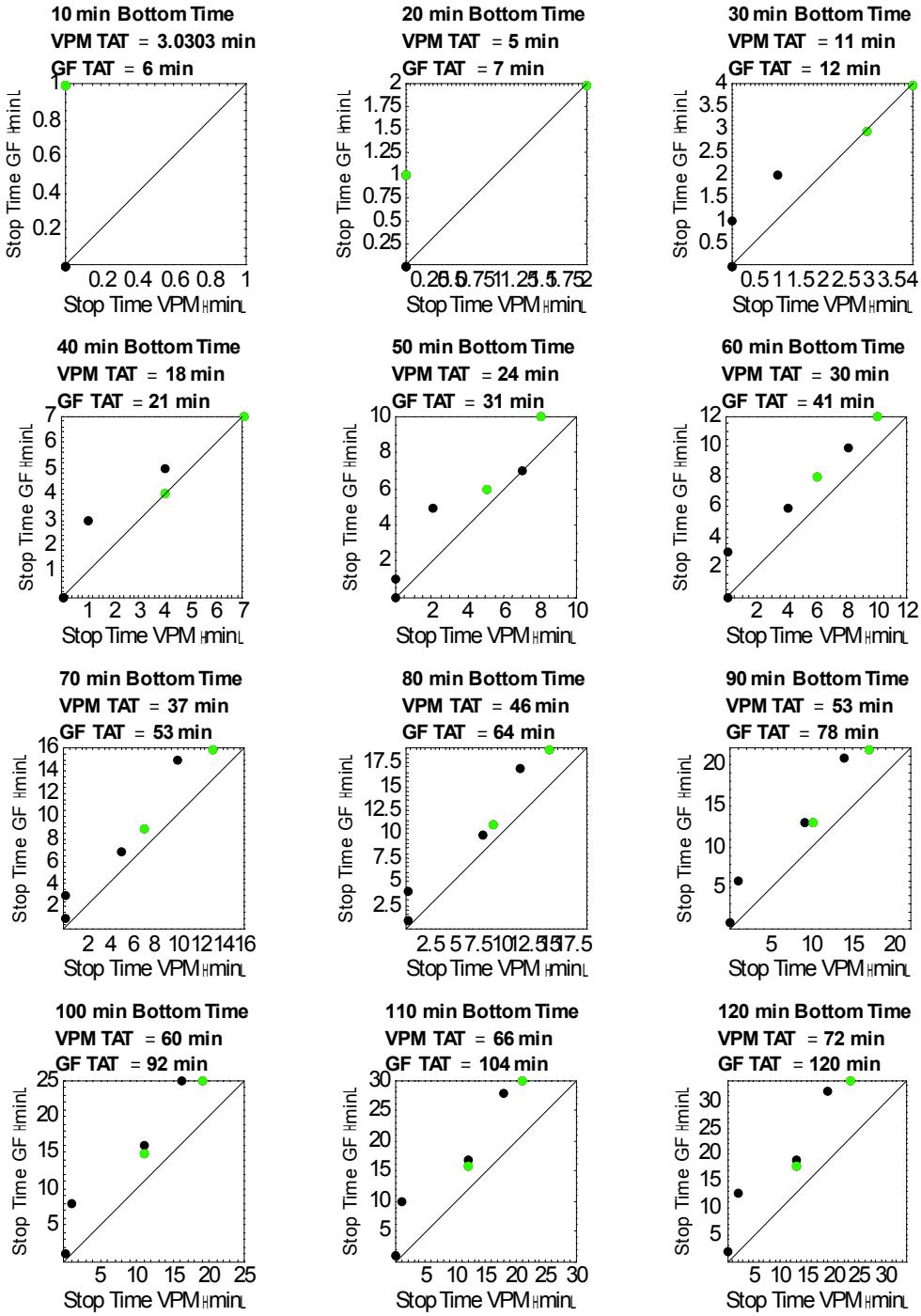
Comparison of GF and VPM-B (NL) Ascents for Array of 100 ft Dives on Back Gas {O_2, He, N_2} = {21, 0, 79} Deco on {21, 0, 79}, and {100, 0, 0}



LEGEND
Dive Profiles

VPM-B
GF

Correlation of GF to VPM-B (N) Stop Times for Array of 100 ft Dives on Back Gas {O_2, He, N_2} = {21, 0, 79} Deco on {21, 0, 79}, and {100, 0, 0}

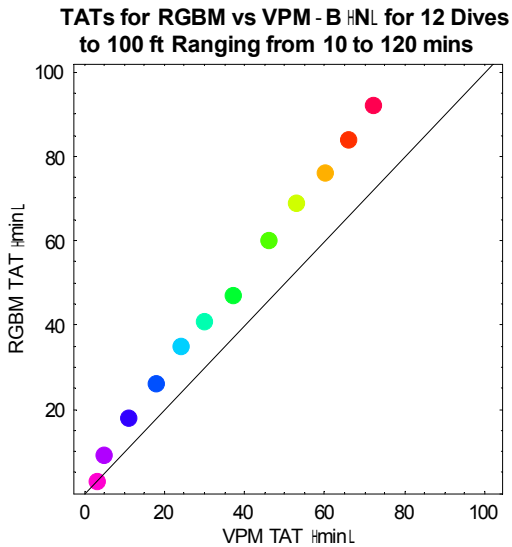


LEGEND
Deco Gases
O_2, He, N_2
100, 0, 0

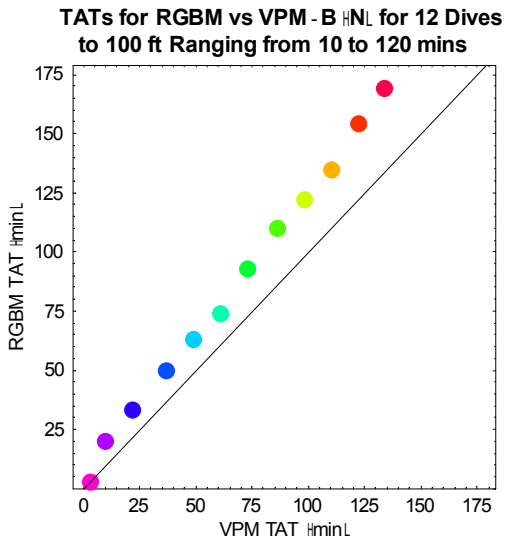
21, 0, 79

Correlation of RGBM and VPM-B(N) TATs for 100 ft Dives

Air+O_2 Deco



Air Deco



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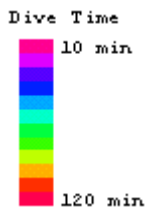
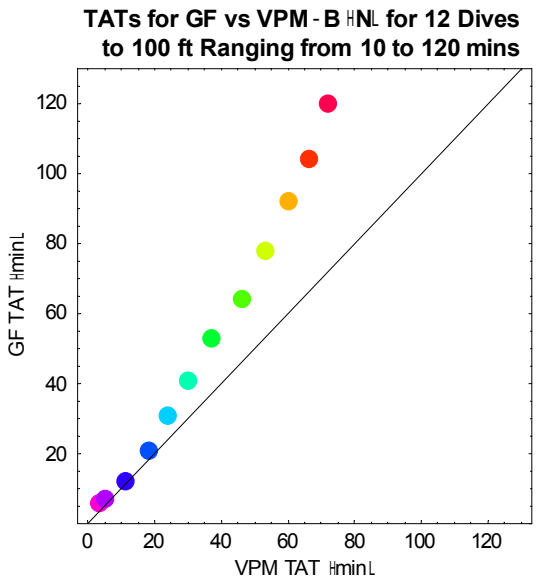
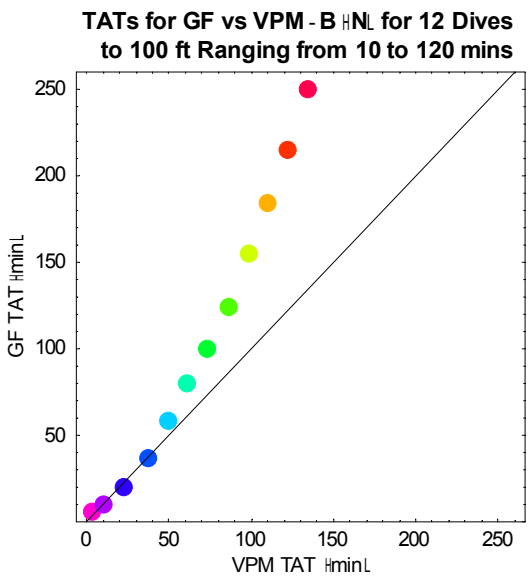


Correlation of GF and VPM-B(N) TATs for 100ft Dives

Air+O_2 Deco



Air Deco



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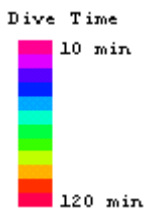

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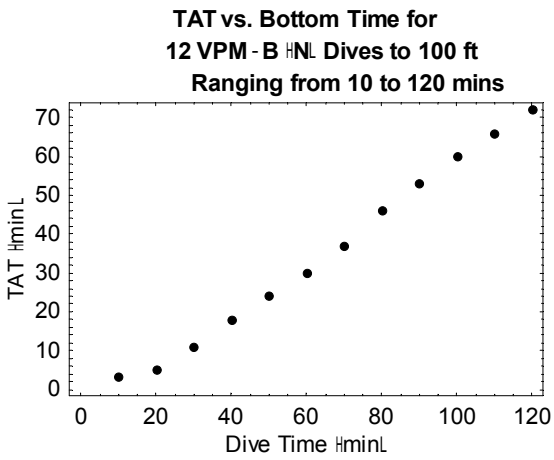
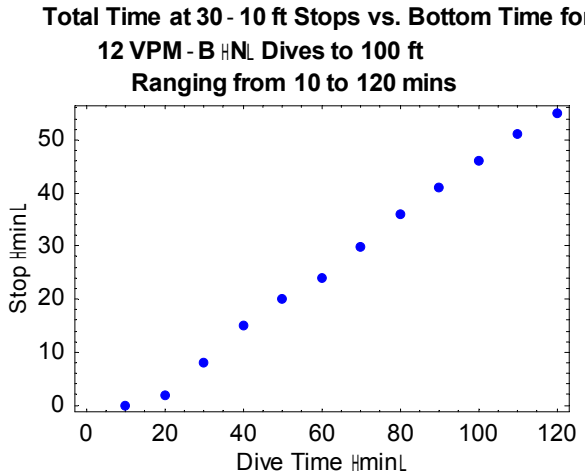
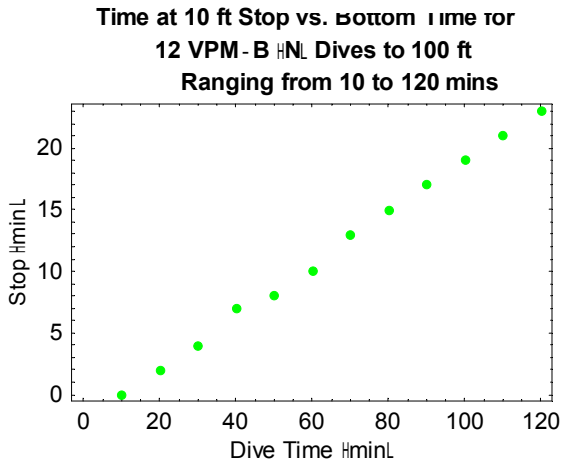
Limited Distribution

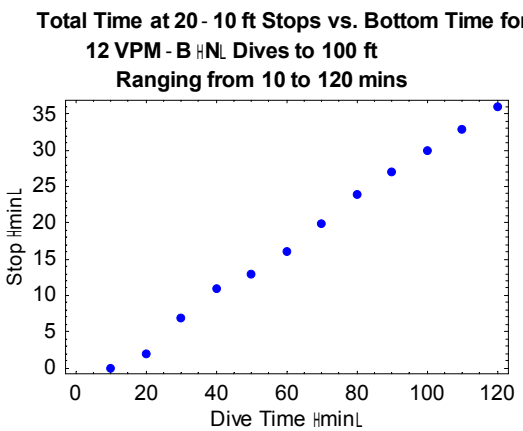
Stop Times vs. Bottom Times VPM-B Conservatism (N)

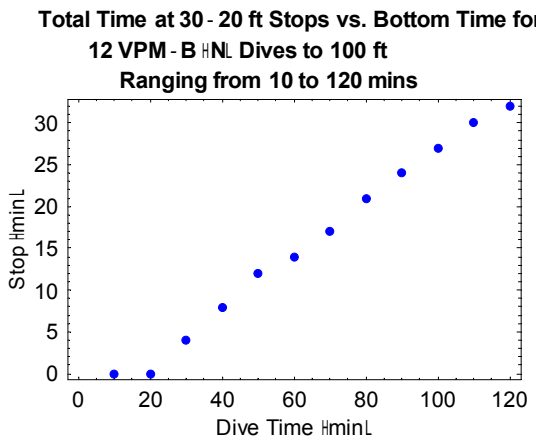
Air+O_2 Deco





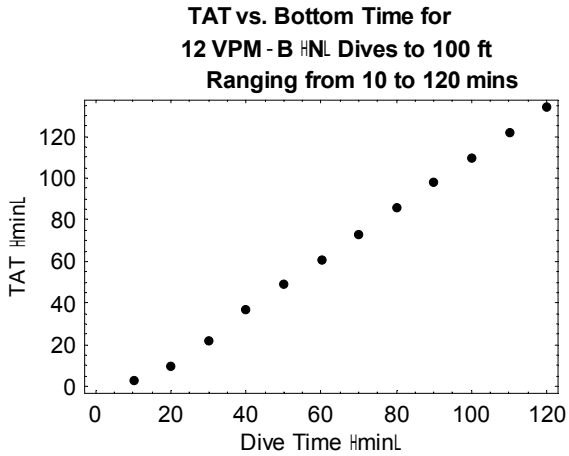


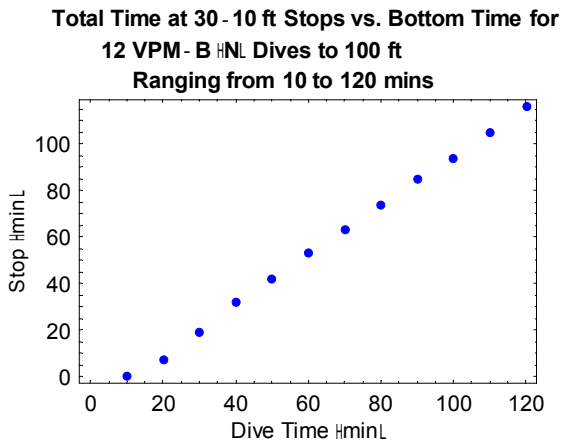


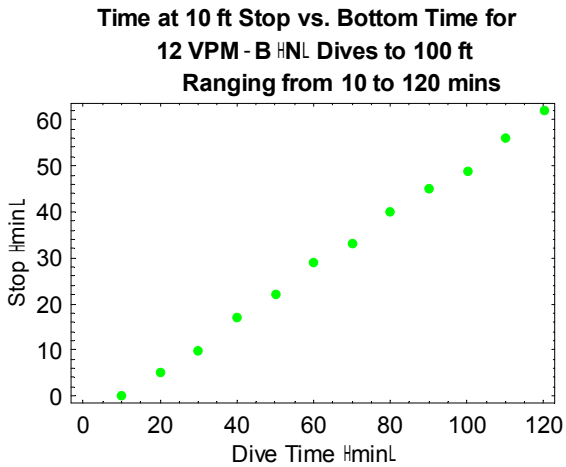


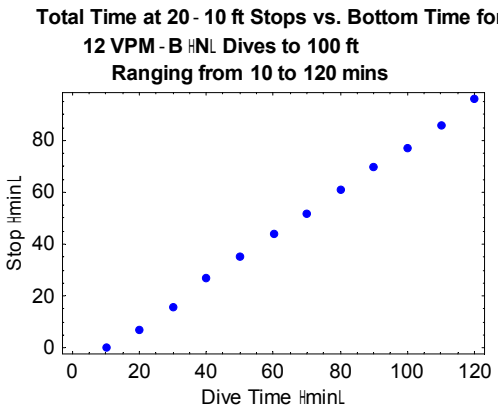
Stop Times vs. Bottom Times VPM-B Conservatism (N)

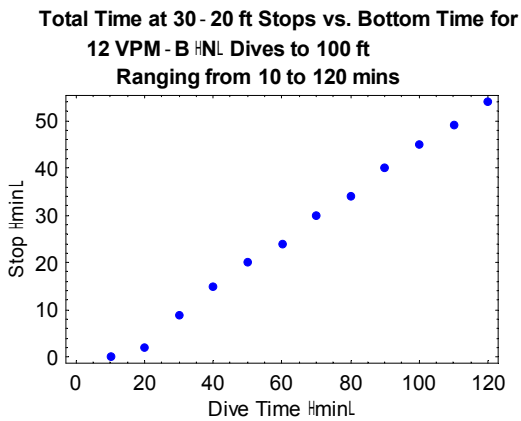
Air Deco











SECTION 2

Ascents from Dives at 100 ft for 10 -120 min
12 on Air with Air Deco
12 on Air with Air+O_2 Deco

VPM-B Conservatism Setting (2)

10 VPM-B air deco TATs are compared to Bühlmann page 17
24 VPM-B profiles compared to RGBM and GF (pps. 18-23)
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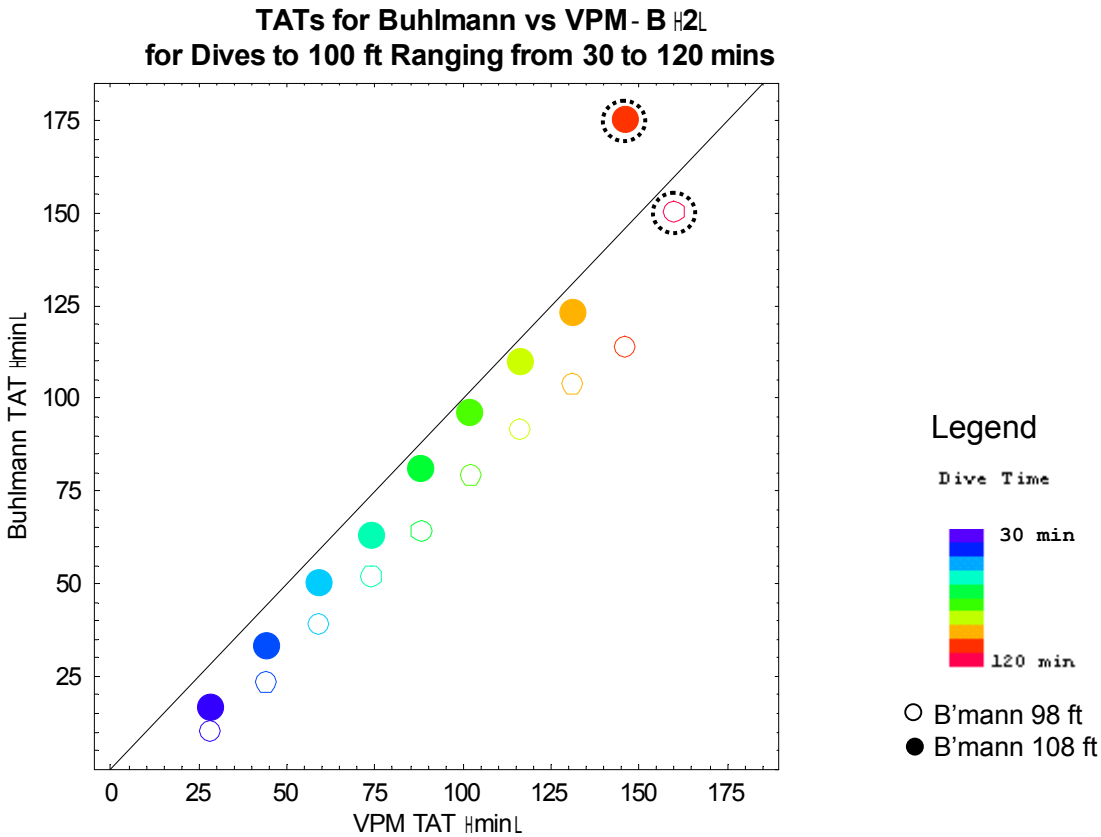
Benchmark:
Correlation of TATs for Air Decompression Dives

Bühlmann at 98 ft (30 m) and 108 ft (33m) vs. VPM-B(2) 100 ft

Conclusions:

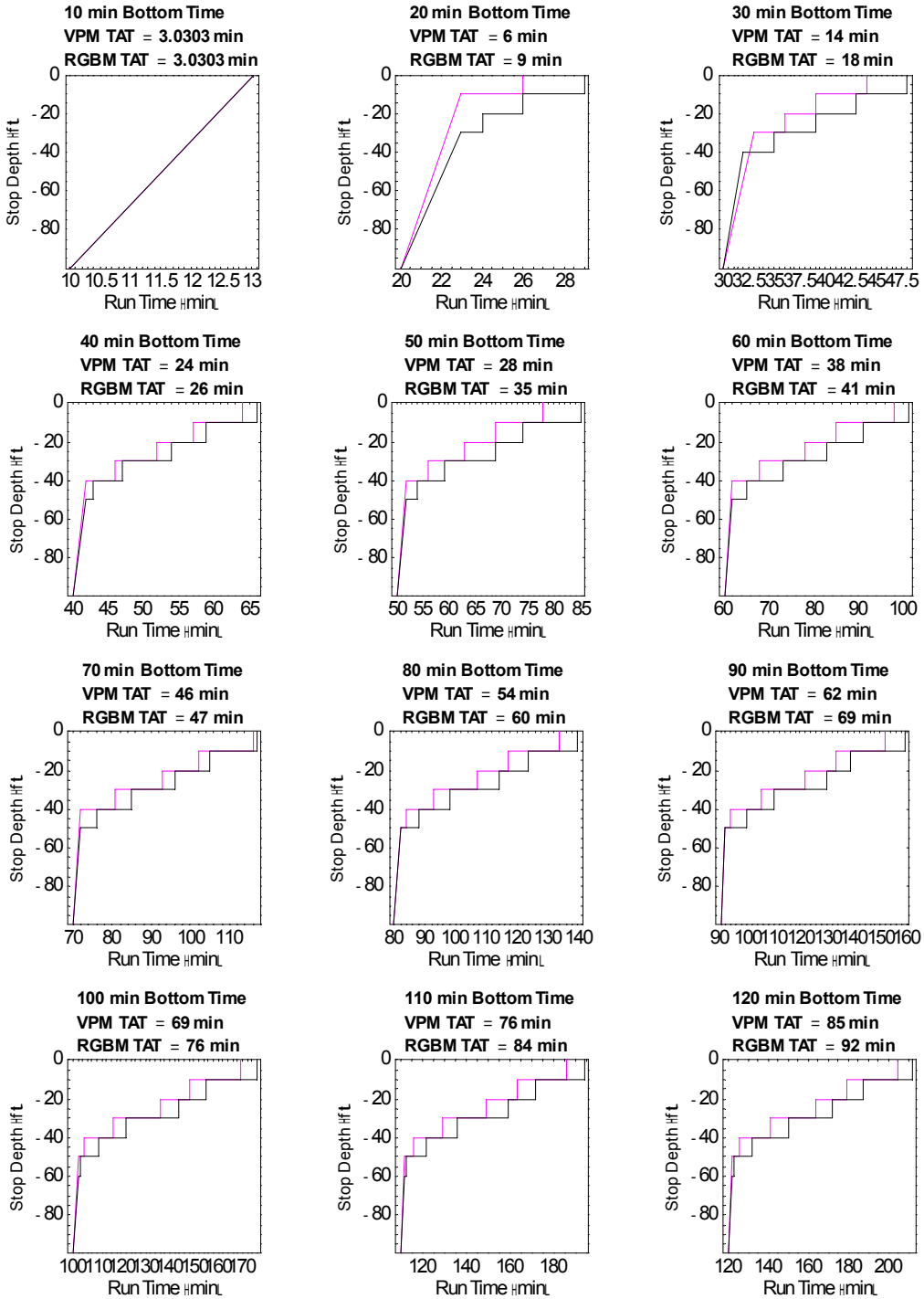
1) 100 ft VPM-B(2) correlates linearly to Bühlmann's 1984 Sea-level Tables.

2) 100 ft VPM-B(2) tables have longer TATs than both 108 and 98 ft Bühlmann.



Extra conservatism is typical of *last* schedules in Buhlmann tables, which often show large increase in TAT for incremental increase in bottom time. I exclude these data in discussing correlations

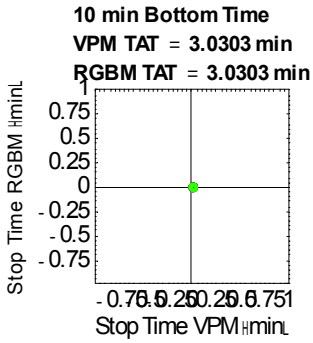
Comparison of RGBM and VPM-B (2) Ascents for Array of 100 ft Dives on Back Gas (21, 0, 79) Deco on (21, 0, 79), and (100, 0, 0)

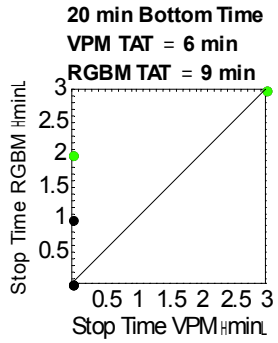


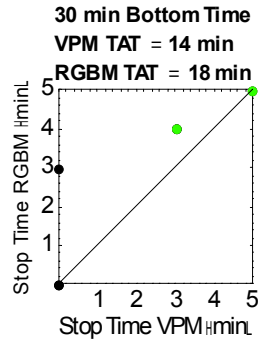
LEGEND
Dive Profiles

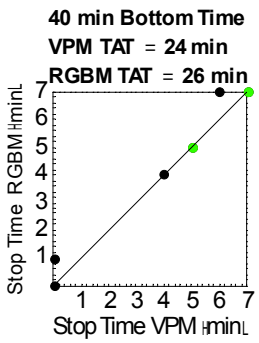
VPM-B
RGBM

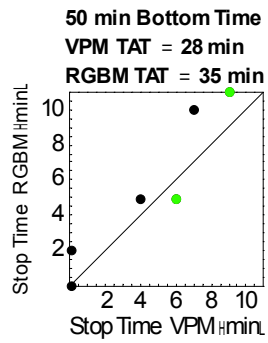
Correlation of RGBM to VPM-B (2) Stop Times for Array of 100 ft Dives on Back Gas (O_2, He, N_2) = (21, 0, 79) Deco on (21, 0, 79), and (100, 0, 0)

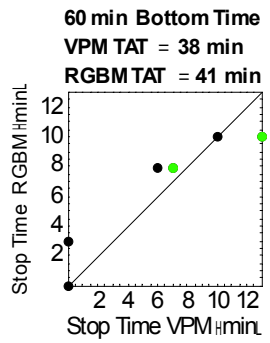


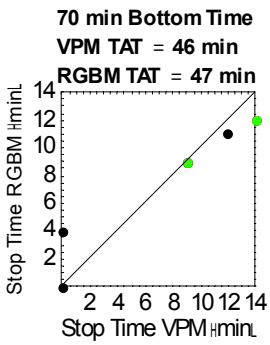


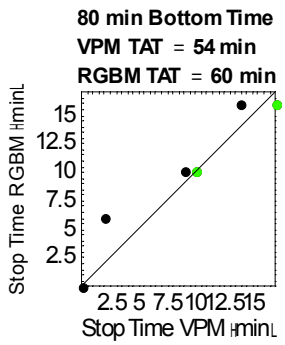


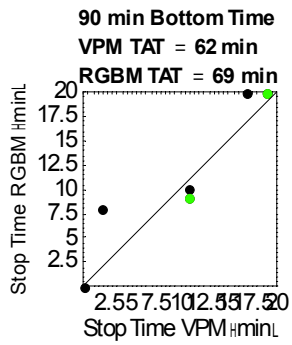


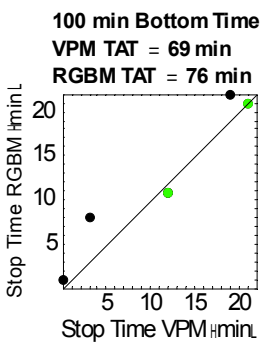


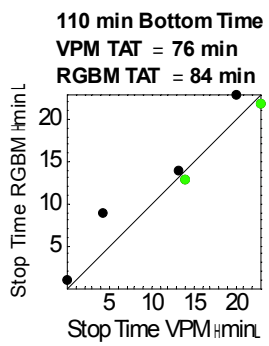


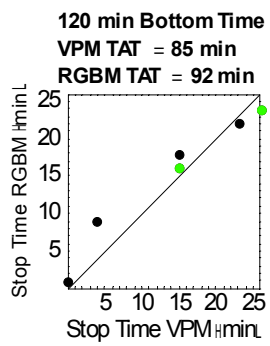








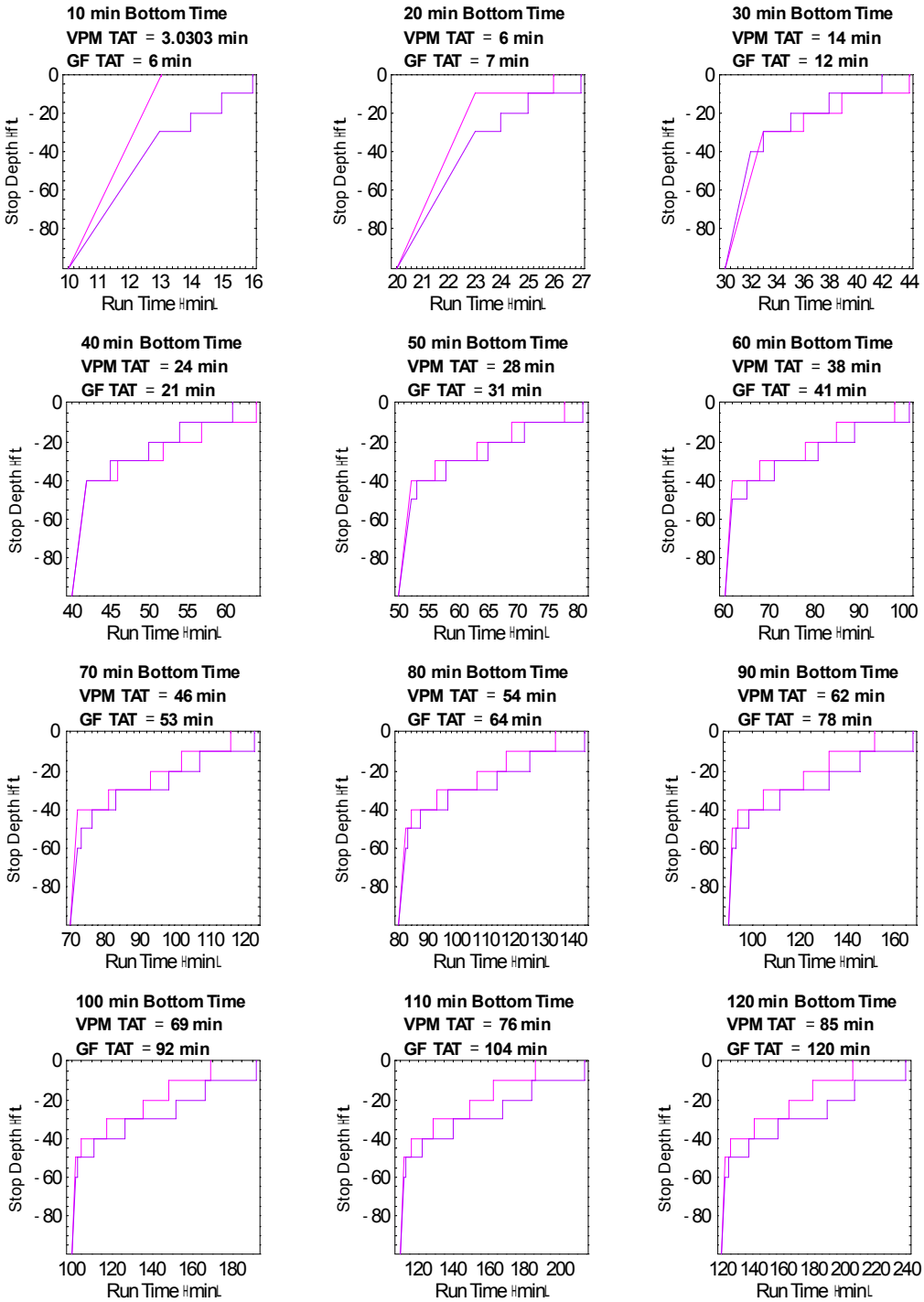




LEGEND
Deco Gases
O_2, He, N_2
100, 0, 0

21, 0, 79

Comparison of GF and VPM-B (2) Ascents for Array of 100 ft Dives on Back Gas {O_2, He, N_2} = {21, 0, 79} Deco on {21, 0, 79}, and {100, 0, 0}



LEGEND
Dive Profiles

VPM-B
GF

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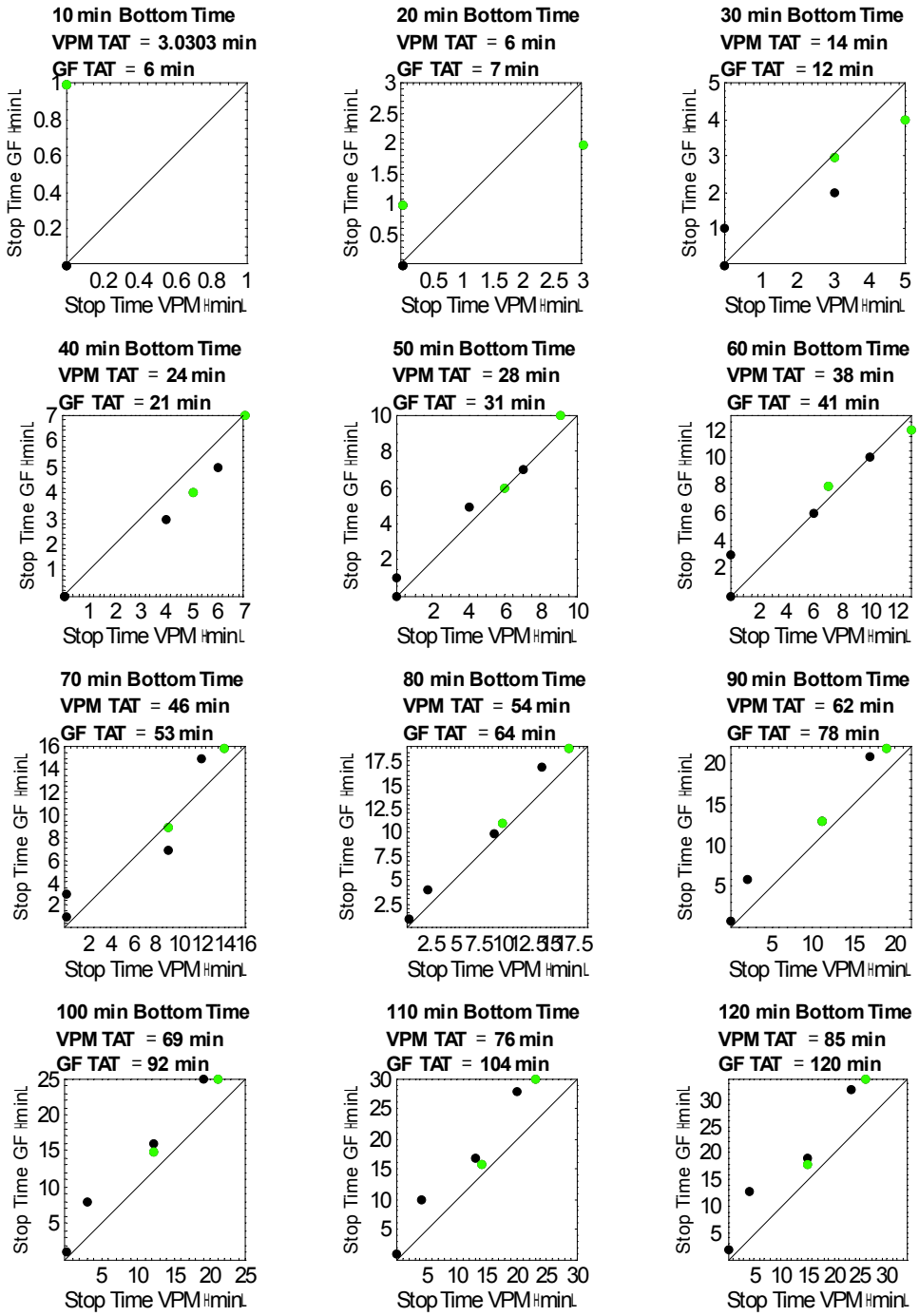
Limited Distribution

Correlation of GF to VPM-B (2) Stop Times for Array of 100 ft Dives on Back Gas {O_2, He, N_2} = {21, 0, 79} Deco on {21, 0, 79}, and {100, 0, 0}



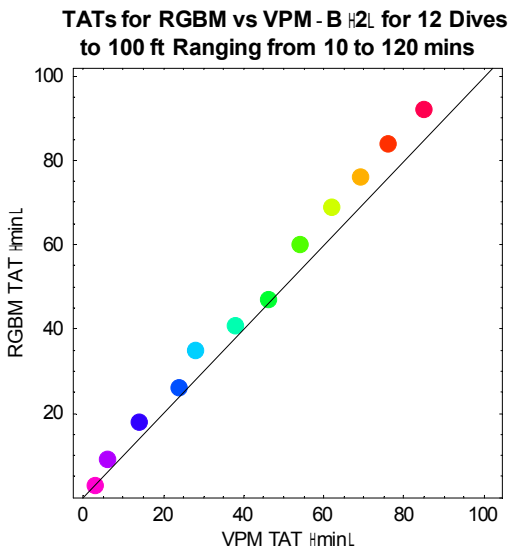
LEGEND
Deco Gases
O_2, He, N_2
100, 0, 0
21, 0, 79

Eric Maiken, 2003

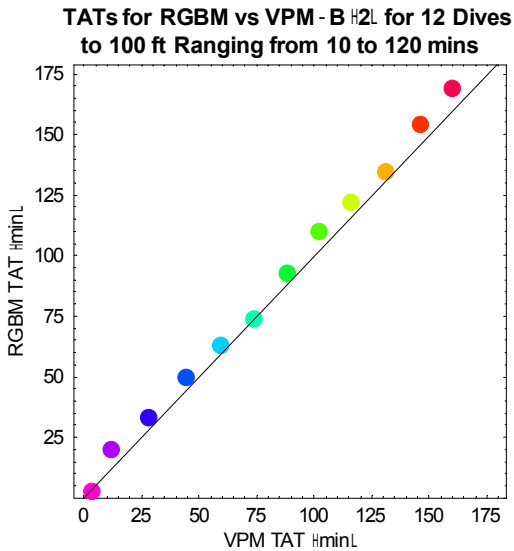
Limited Distribution

Correlation of RGBM and VPM-B(2) TATs for 100 ft Dives

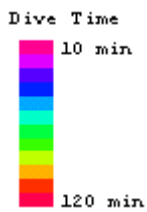
Air+O_2 Deco



Air Deco

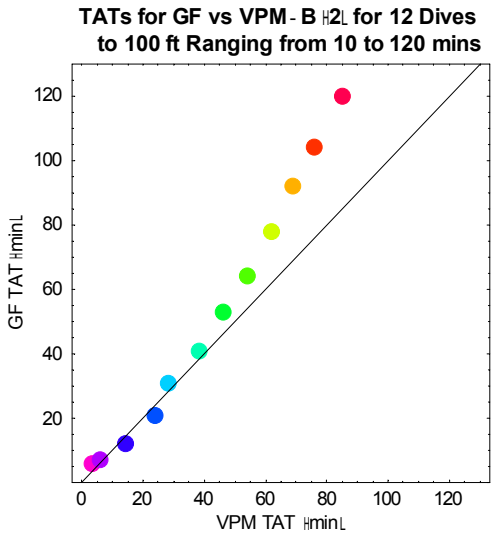


Legend

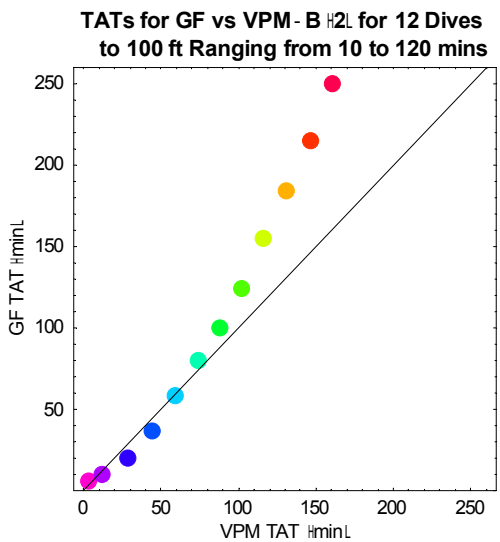


Correlation of GF and VPM-B(2) TATs for 100ft Dives

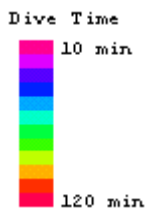
Air+O_2 Deco



Air Deco

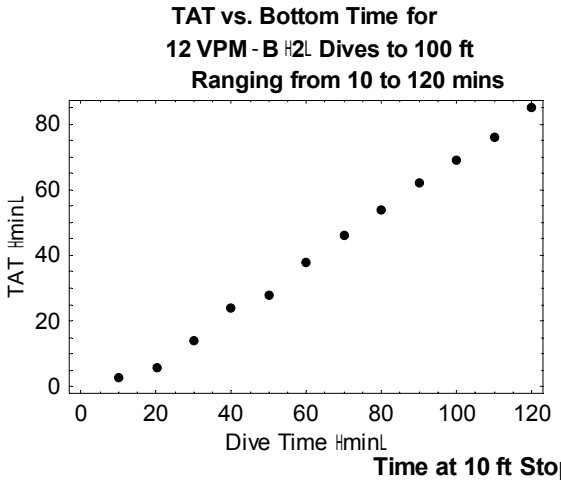


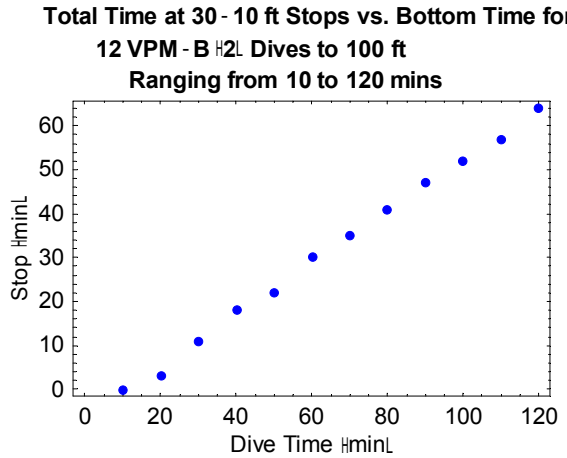
Legend

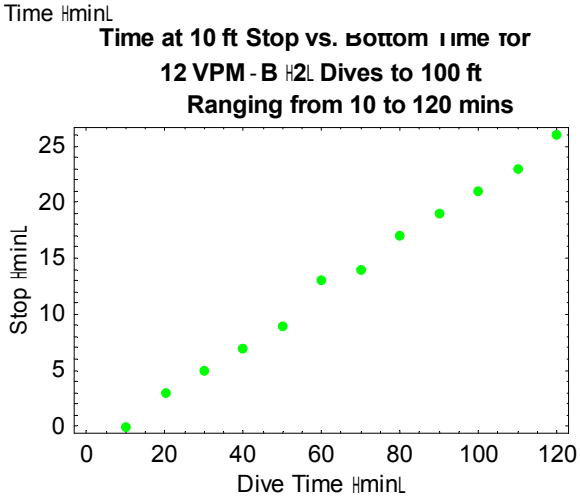


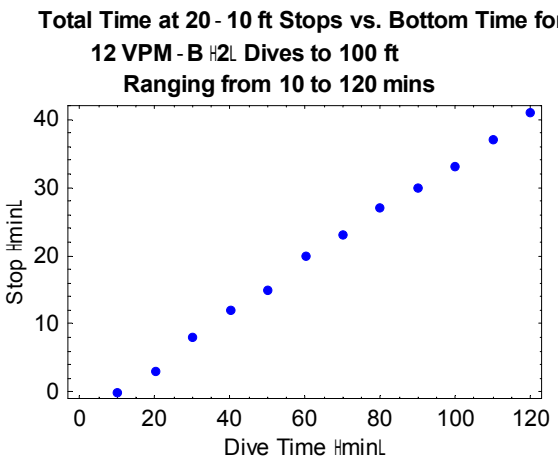
Stop Times vs. Bottom Times VPM-B Conservatism (2)

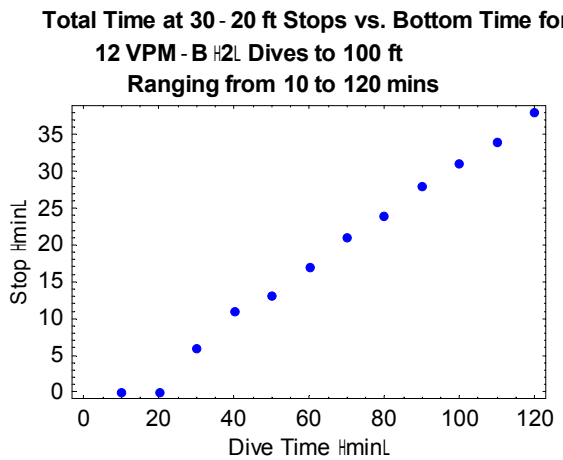
Air+O_2 Deco





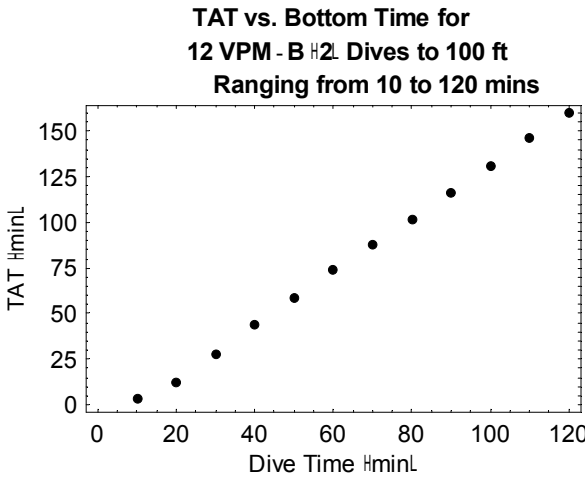


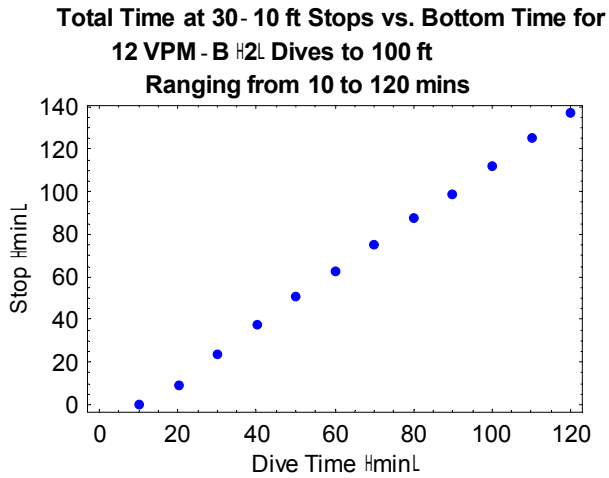


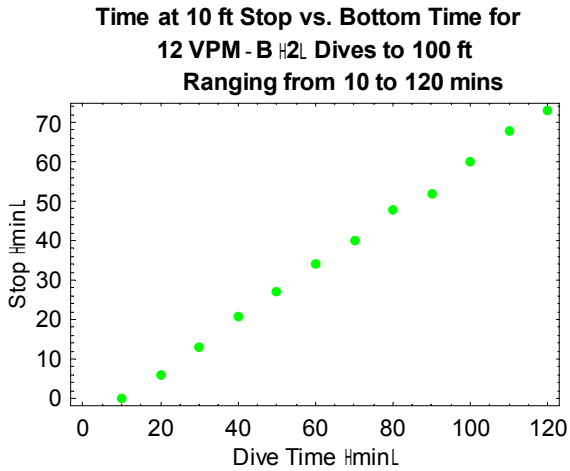


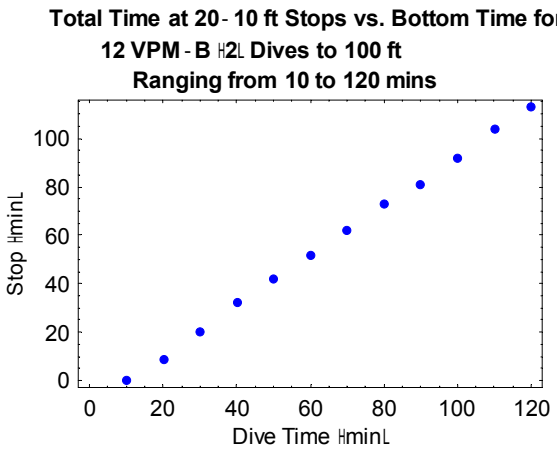
Stop Times vs. Bottom Times VPM-B Conservatism (2)

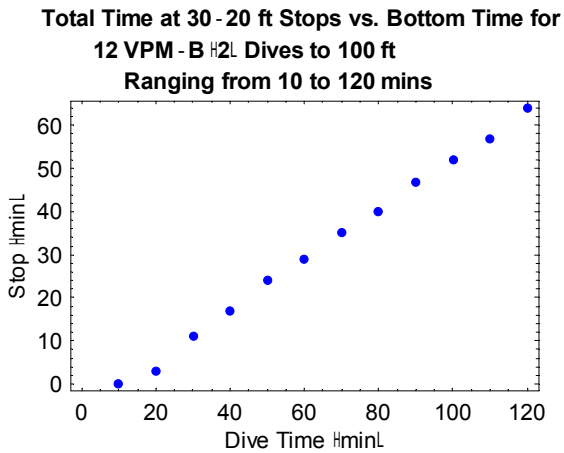
Air Deco











SECTION 3

Ascents from Dives at 100 ft for 10 -120 min
12 on Air with Air Deco
12 on Air with Air+O_2 Deco

VPM-B Conservatism Setting (4)

10 VPM-B air deco TATs are compared to Bühlmann page 27
24 VPM-B profiles compared to RGBM and GF (pps. 28-33)
24 VPM-B ascents with Air and Air+O_2 deco are summarized (pps. 34-35)

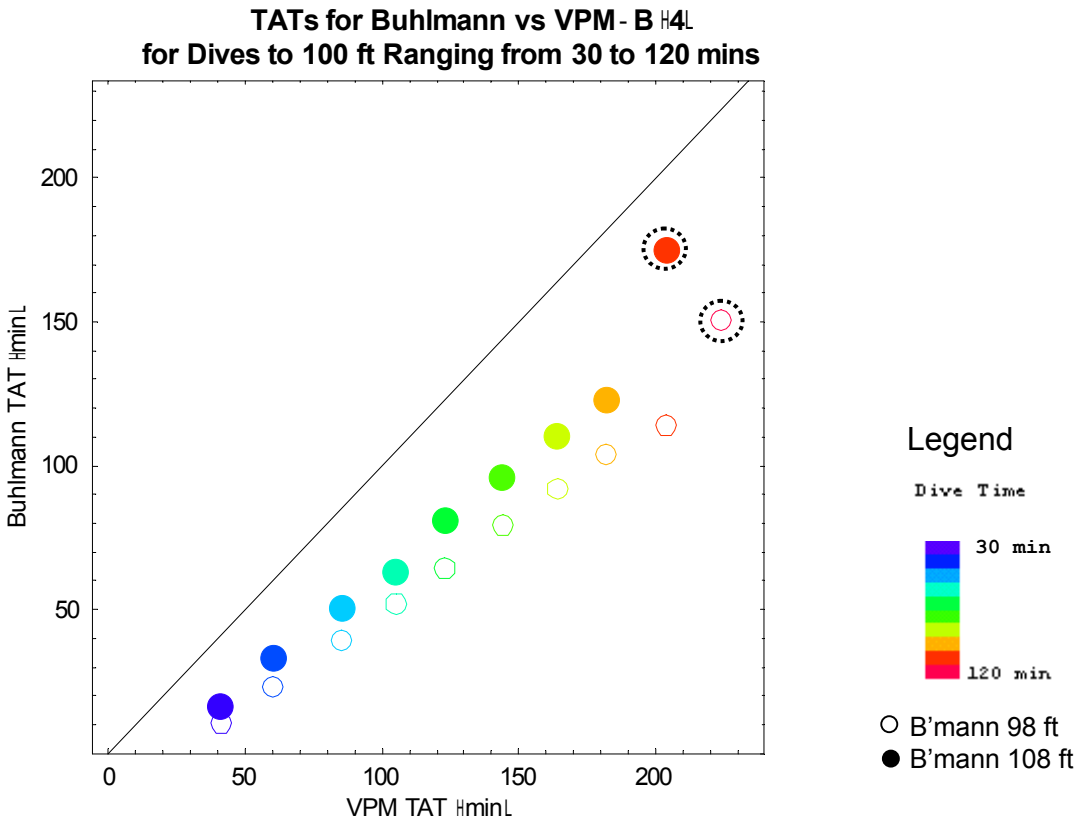
Benchmark:
Correlation of TATs for Air Decompression Dives

Bühlmann at 98 ft (30 m) and 108 ft (33m) vs. VPM-B(4) 100 ft

Conclusions:

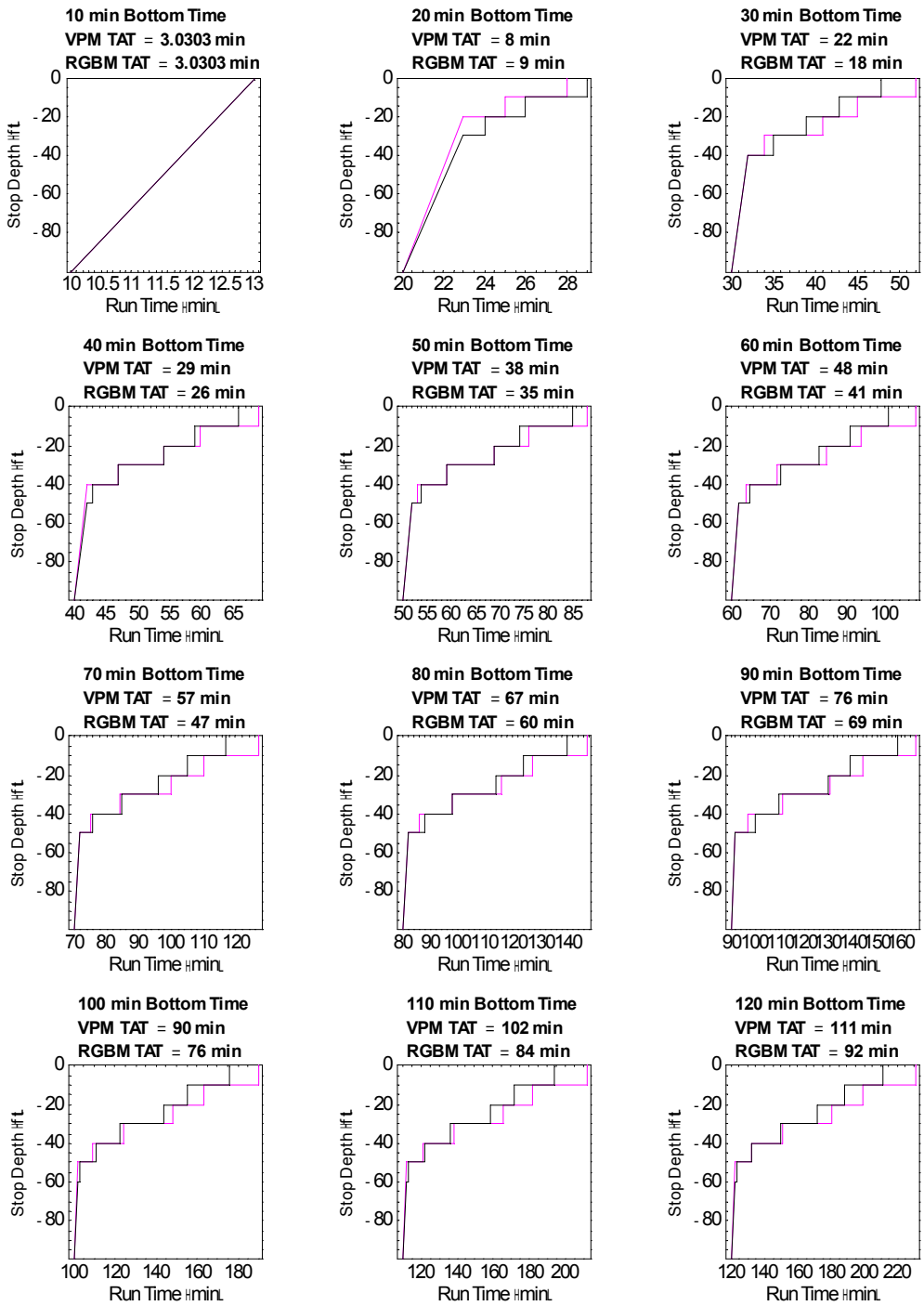
1) 100 ft VPM-B(4) correlates linearly to Bühlmann's 1984 Sea-level Tables.

2) 100 ft VPM-B(4) tables have much longer TATs than 108 and 98 ft Bühlmann.



Extra conservatism is typical of *last* schedules in Buhlmann tables, which often show large increase in TAT for incremental increase in bottom time. I exclude these data in discussing correlations

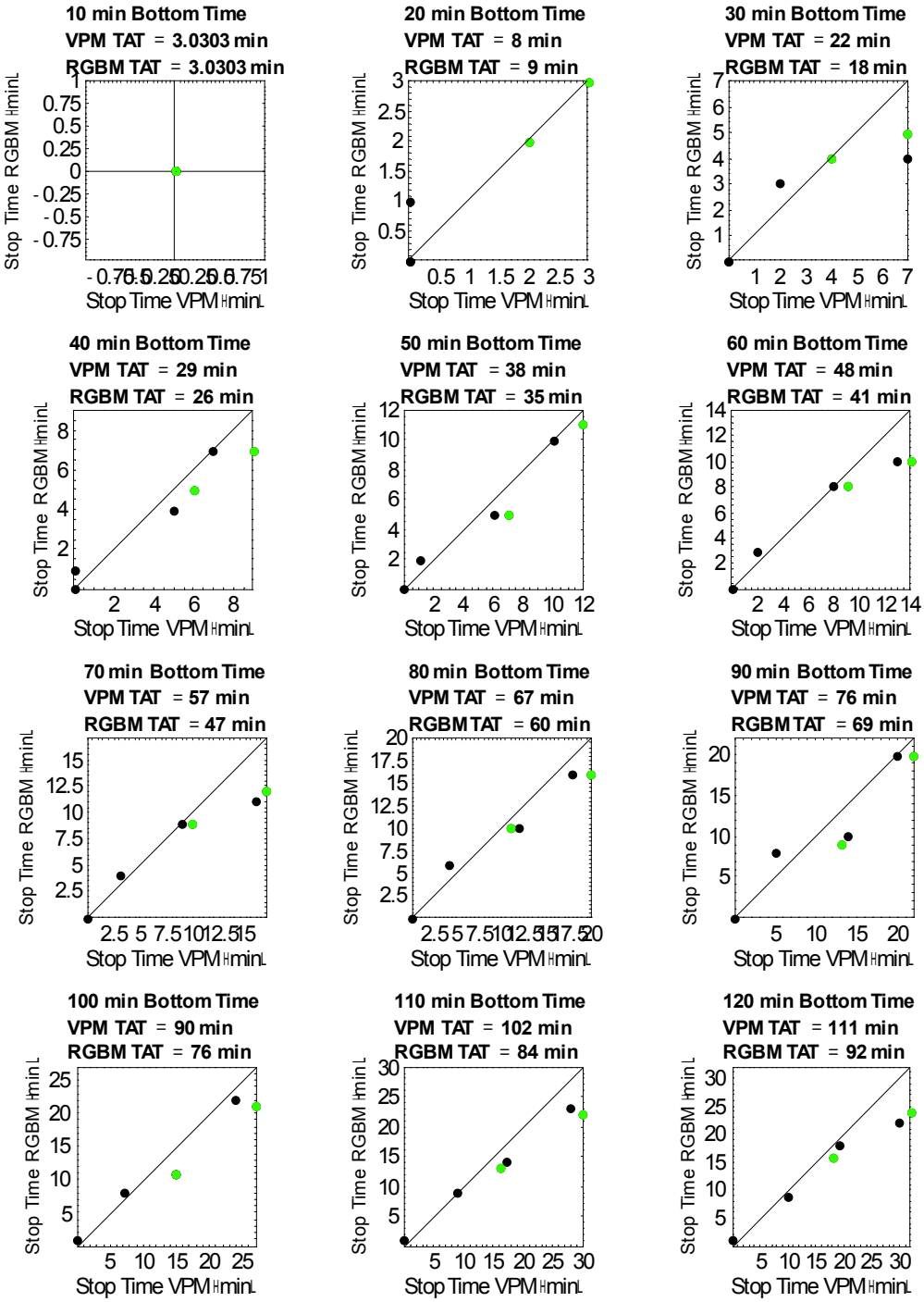
Comparison of RGBM and VPM-B (4) Ascents for Array of 100 ft Dives on Back Gas {O_2, He, N_2} = {21, 0, 79} Deco on {21, 0, 79}, and {100, 0, 0}



LEGEND
Dive Profiles

VPM-B
RGBM

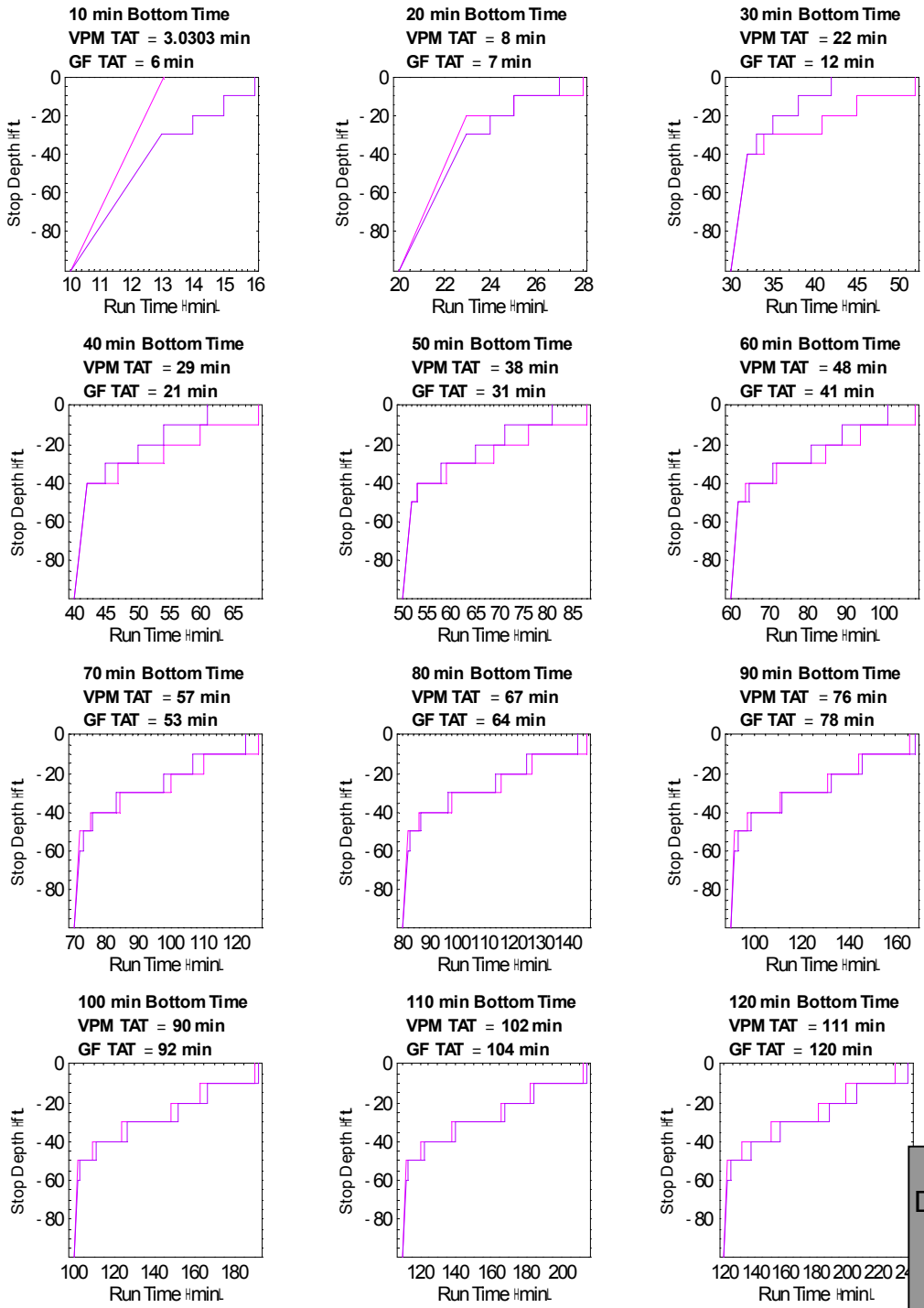
Correlation of RGBM to VPM-B (4) Stop Times for Array of 100 ft Dives on Back Gas {O_2, He, N_2} = {21, 0, 79} Deco on {21, 0, 79}, and {100, 0, 0}



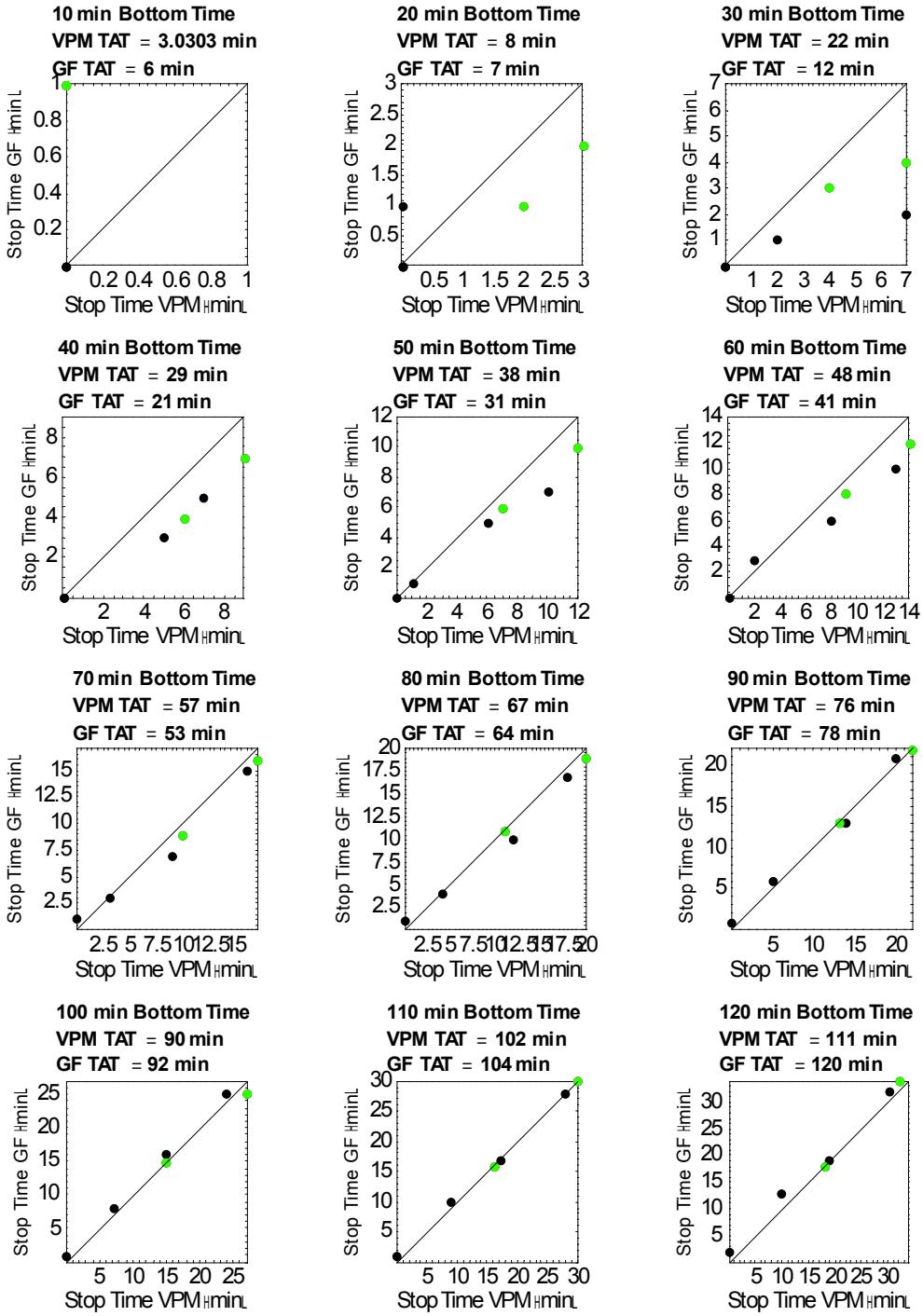
LEGEND
Deco Gases
O_2, He, N_2
100, 0, 0

21, 0, 79

Comparison of GF and VPM-B (4) Ascents for Array of 100 ft Dives on Back Gas (O2, He, N2) = (21, 0, 79) Deco on (21, 0, 79), and (100, 0, 0)



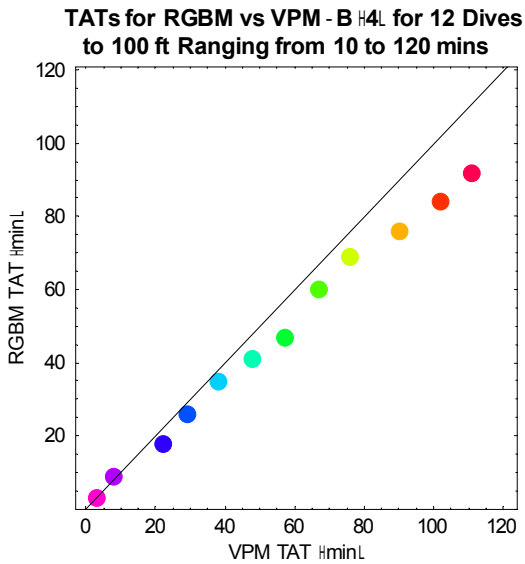
Correlation of GF to VPM-B (4) Stop Times for Array of 100 ft Dives on Back Gas {O_2, He, N_2} = {21, 0, 79} Deco on {21, 0, 79}, and {100, 0, 0}



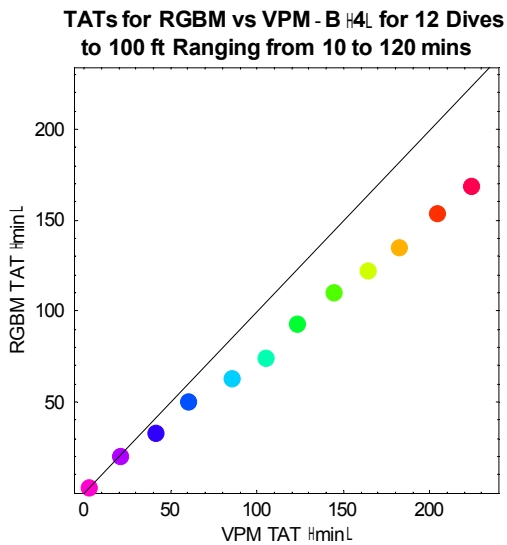
LEGEND
Deco Gases
O_2, He, N_2
100, 0, 0
21, 0, 79

Correlation of RGBM and VPM-B(4) TATs for 100 ft Dives

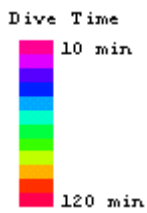
Air+O_2 Deco



Air Deco



Legend

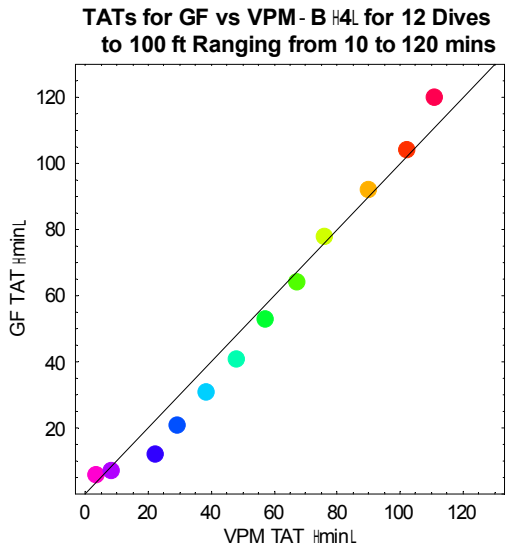


Eric Maiken, 2003

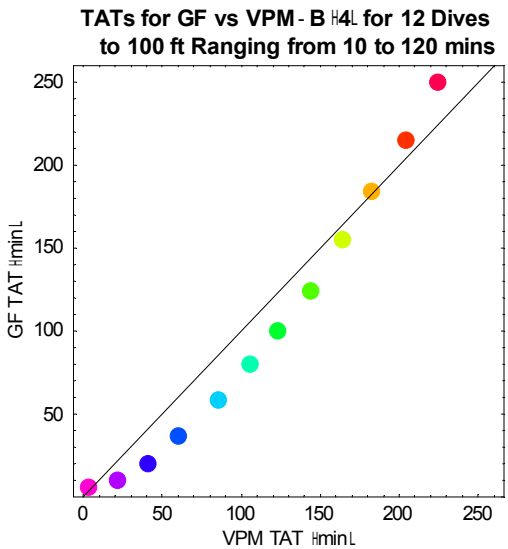
Limited Distribution

Correlation of GF and VPM-B(4) TATs for 100ft Dives

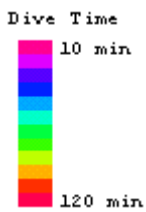
Air+O_2 Deco



Air Deco

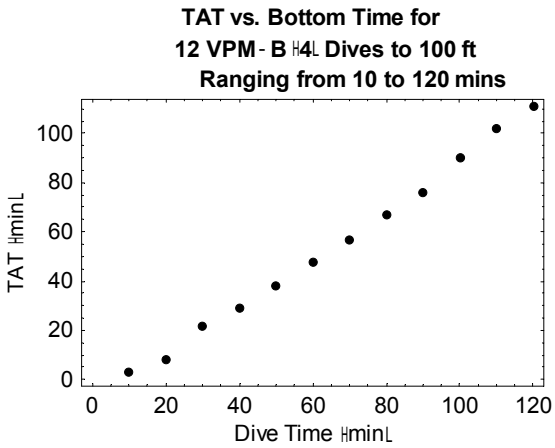


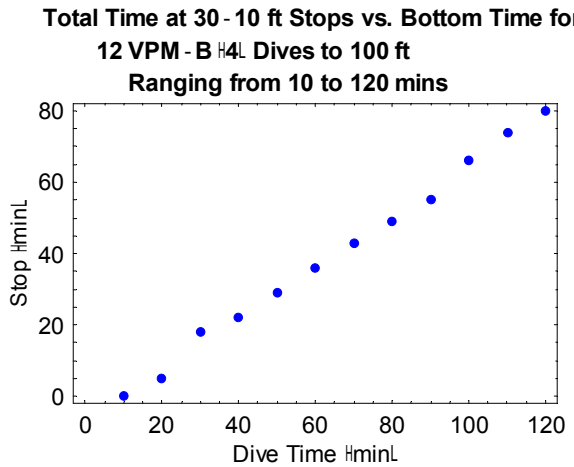
Legend

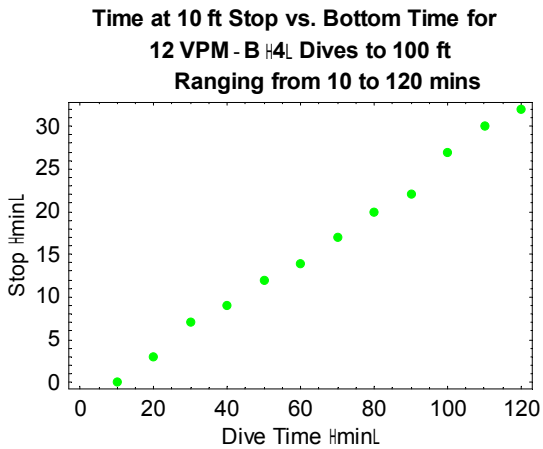


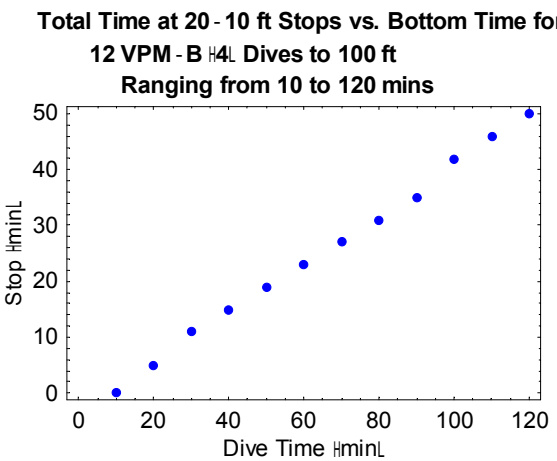
Stop Times vs. Bottom Times VPM-B Conservatism (4)

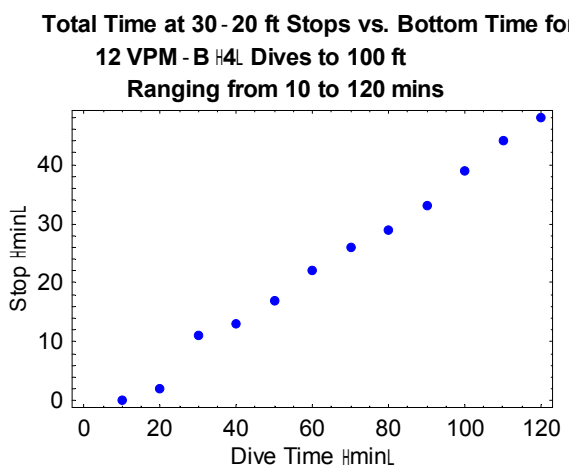
Air+O_2 Deco











Stop Times vs. Bottom Times VPM-B Conservatism (4)

Air Deco