Addendum 2: Correlations of VPM-B(2), RGBM, and GF Gradients and Tensions

Compartment Gradients and Tensions are Tracked Stop-by-Stop for 3 Alternative Ascents from a 120 min dive to 200 ft on Trimix 18/45

•This addendum tracks and compares gradients for ascents from 1 dive only: 120min at 200ft on 18/45. Alternative ascent tables for this dive are shown on page 49. VPM-B was at conservatism level (2), GAP RGBM and GF were at nominal conservatisms.

•Page 4 of the original slides notes that "TATs are closely related to comparative surfacing gradients." TATs were therefore used as convenient 1-point summaries of correlations of VPM-B to GAP RGBM and GF schedules.

•A more detailed comparison of compartment gradients and tensions requires analysis of many more data points for each ascent. Essentially, the TAT data summarized by the two red-colored points on the two plots on page 22 have been expanded into 12 plots each, with 16 points per plot, shown on pages 55 and 57.

•Correlation plots for times at each stop and stair-step profiles are shown in the lower right-hand charts on pages 18 and 19 for VPM-B(2) vs. RGBM, and on page 20, and 21 for VPM-B(2) vs. GF.

Organization

•**Original Slides VPM-B vs GAP RGBM and GF Slides (pages 1-38)**
VPM-Bv3.2_vs_GAP_RGBM_and_GF_200ft_3mix1845_Dives.pdf

•**Addendum 1 HSE RGBM vs. GAP RGBM (pages 39-46)**
HSE_vs_GAP_RGBM_200ft_3mix1845_Dives.pdf

•**Addendum 2 (pages 47-57)**
TandG_VPMB_vs_GAP_RGBM_and_GF_200ft_3mix1845.pdf

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Notations and Conventions

Gradients and Tensions were calculated as functions of time from ascent schedules generated by V-Planner and GAP decompression models.

Profiles

- The ascent schedules calculated by V-Planner and GAP software, shown on page 49, were used to calculate compartment tensions and gradients in a custom Mathematica program.
- If you really want details, then review all of the modeling assumptions (such as compartment half-times, partial pressure of H_2O, etc.) in the open source code of the obsolete Mathematica VPM program at my website: http://www.decompression.org/maiken/VPM/multigas_vpm.htm

Plots

- Both compartment tensions (T) and gradients (G) are considered, even though the information is redundant. Although tensions are conventional, gradients are more closely related to physical and physiological processes.
- Compartments are labeled according to Buhlmann's ZHL-16 Nitrogen half-times. Conventionally, Helium half-times are scaled by the ratio of the two gas's diffusivities. This is physically inconsistent with the idea that compartments represent time-scales for perfusion. Just another deco model inconsistency!

Discussion of Correlation Plots

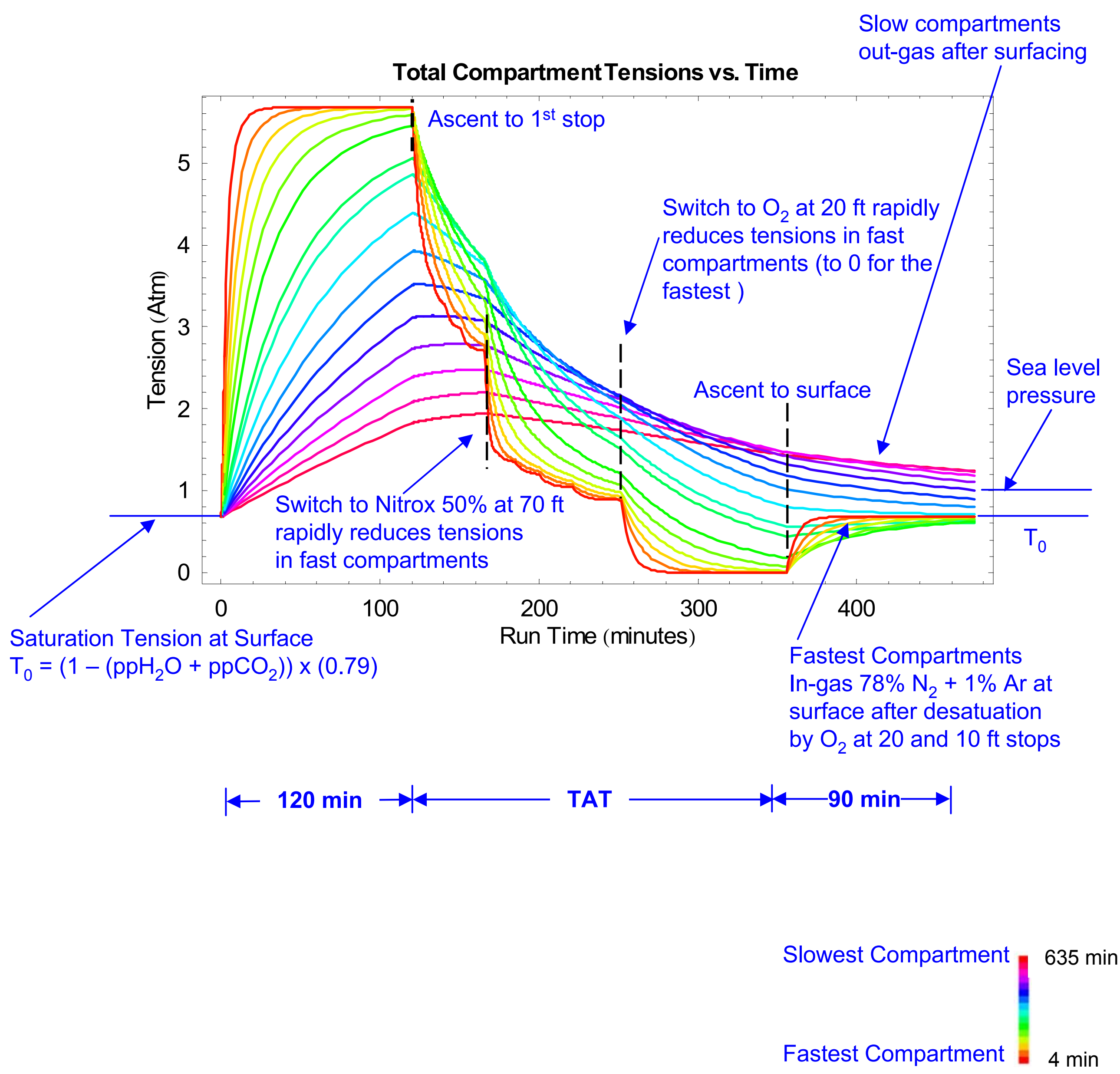
- VPM-B(2) and RGBM Ts and Gs, shown on pages 54 and 55, are much more nearly correlated than VPM-B(2) and GF Ts and Gs, shown on pages 56 and 57.
- VPM-B(2) and RGBM Gs and Ts are 1:1 correlated for compartments ranging from the slowest (635 min), to the controlling compartment (a point near plot's upper right-hand corner).
- RGBM fast compartment Gs and Ts are lower than VPM-B(2) for the deepest stops, nonetheless, RGBM Gs and Ts are greater than either VPM-B(2) and GF from 30ft up to the surface.
- Slide 5 discusses the general (ie: applies to all 200ft dives) operational factors that lead to larger surfacing gradients for RGBM compared to VPM-B(2) and GF.
- GF surfacing Gs and Ts are much less than VPM-B(2) and RGBM, but GF TATs are 138 mins longer than VPM-B(2) and RGBM (which are virtually identical at ~356 min TAT).

Ascent Schedules

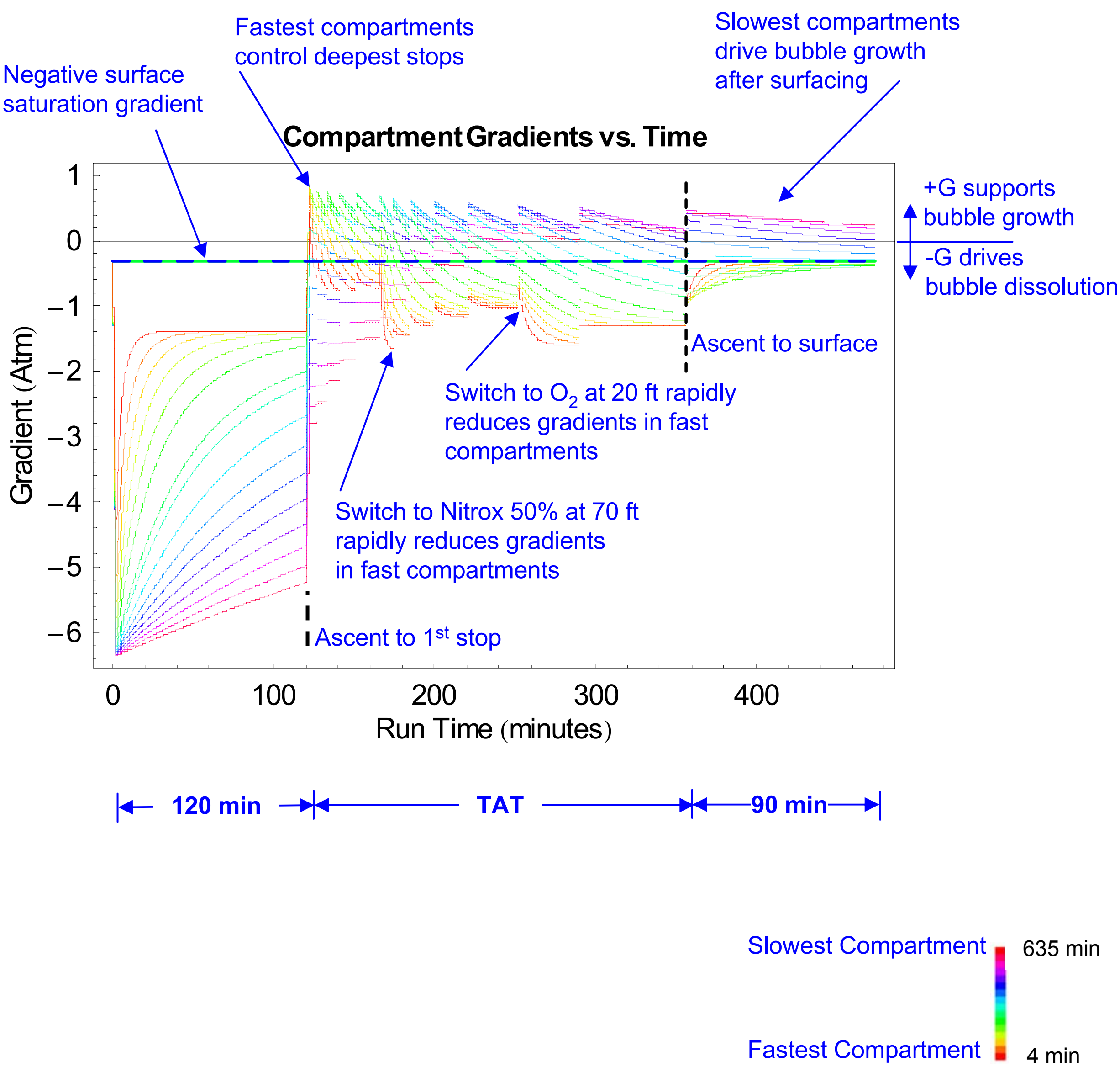
For reference, the depths, run times , and gas oxygen and nitrogen fractions are tabulated for the three alternative ascent models. Stair-step plots of the ascents are shown in the lower right-hand plots of slides 18 and 20.

VPM-B(2)			RGBM(N)			GF(N)		
ft	min	fO2 / fN2	ft	min	fO_2 / fN_2	ft	min	fO2 / fN2
0.	0.	0.21 / 0.79	0.	0.	0.21 / 0.79	0.	0.	0.21 / 0.79
100.	1.	0.18 / 0.37	100.	1.	0.18 / 0.37	100.	1.	0.18 / 0.37
200.	2.	0.18 / 0.37	200.	2.	0.18 / 0.37	200.	2.	0.18 / 0.37
200.	120	0.18 / 0.37	200.	120	0.18 / 0.37	200.	120	0.18 / 0.37
167.	121	0.18 / 0.37	167.	121	0.18 / 0.37	167.	121	0.18 / 0.37
134.	122	0.18 / 0.37	134.	122	0.18 / 0.37	134.	122	0.18 / 0.37
120	127	0.18 / 0.37	130	126	0.18 / 0.37	130	126	0.18 / 0.37
110	133	0.18 / 0.37	120	132	0.18 / 0.37	120	133	0.18 / 0.37
100	141	0.18 / 0.37	110	140	0.18 / 0.37	110	142	0.18 / 0.37
90	151	0.18 / 0.37	100	147	0.18 / 0.37	100	155	0.18 / 0.37
80	166	0.18 / 0.37	90	162	0.18 / 0.37	90	170	0.18 / 0.37
70	174	0.5 / 0.5	80	178	0.18 / 0.37	80	193	0.18 / 0.37
60	185	0.5 / 0.5	70	186	0.5 / 0.5	70	204	0.5 / 0.5
50	200	0.5 / 0.5	60	197	0.5 / 0.5	60	219	0.5 / 0.5
40	221	0.5 / 0.5	50	213	0.5 / 0.5	50	241	0.5 / 0.5
30	252	0.5 / 0.5	40	232	0.5 / 0.5	40	272	0.5 / 0.5
20	290	1. / 0.	30	263	0.5 / 0.5	30	322	0.5 / 0.5
10	356	1. / 0.	20	298	1. / 0.	20	380	1. / 0.
			10	355	1. / 0.	10	493	1. / 0.
0.	474.	0.21 / 0.79	0.	473.	0.21 / 0.79	0.	611.	0.21 / 0.79

Notes on Reading Tension Plots

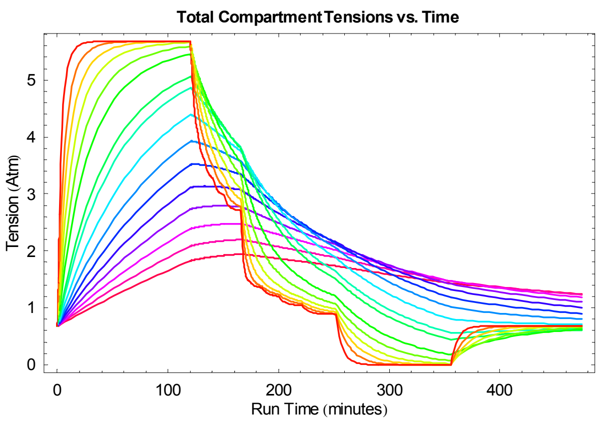


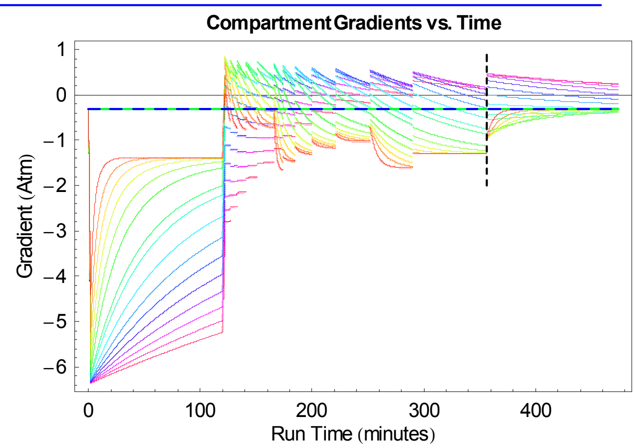
Notes on Reading Gradient Plots



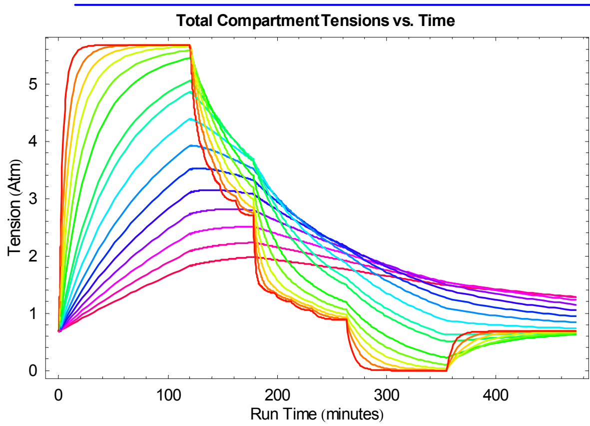
Plots of Tensions and Gradients vs. Run Time

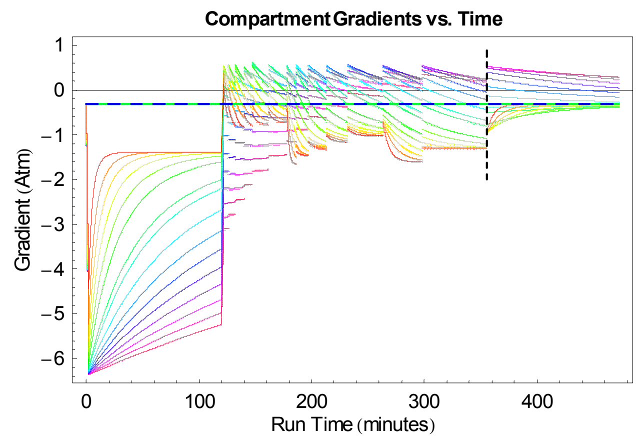
VPM-B (2)



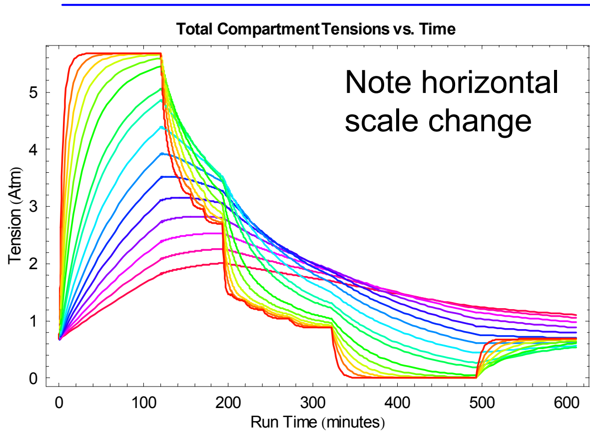


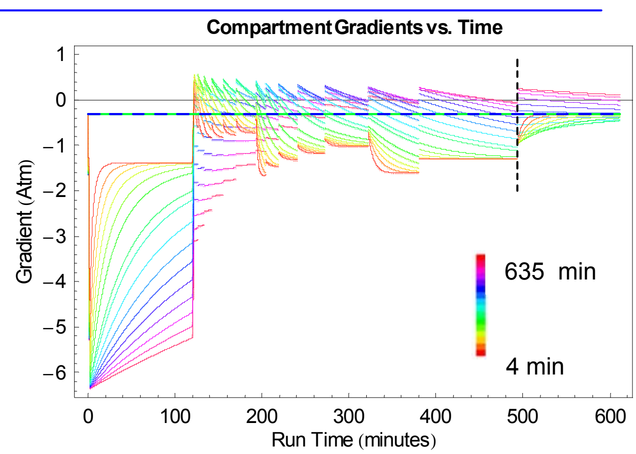
RGBM





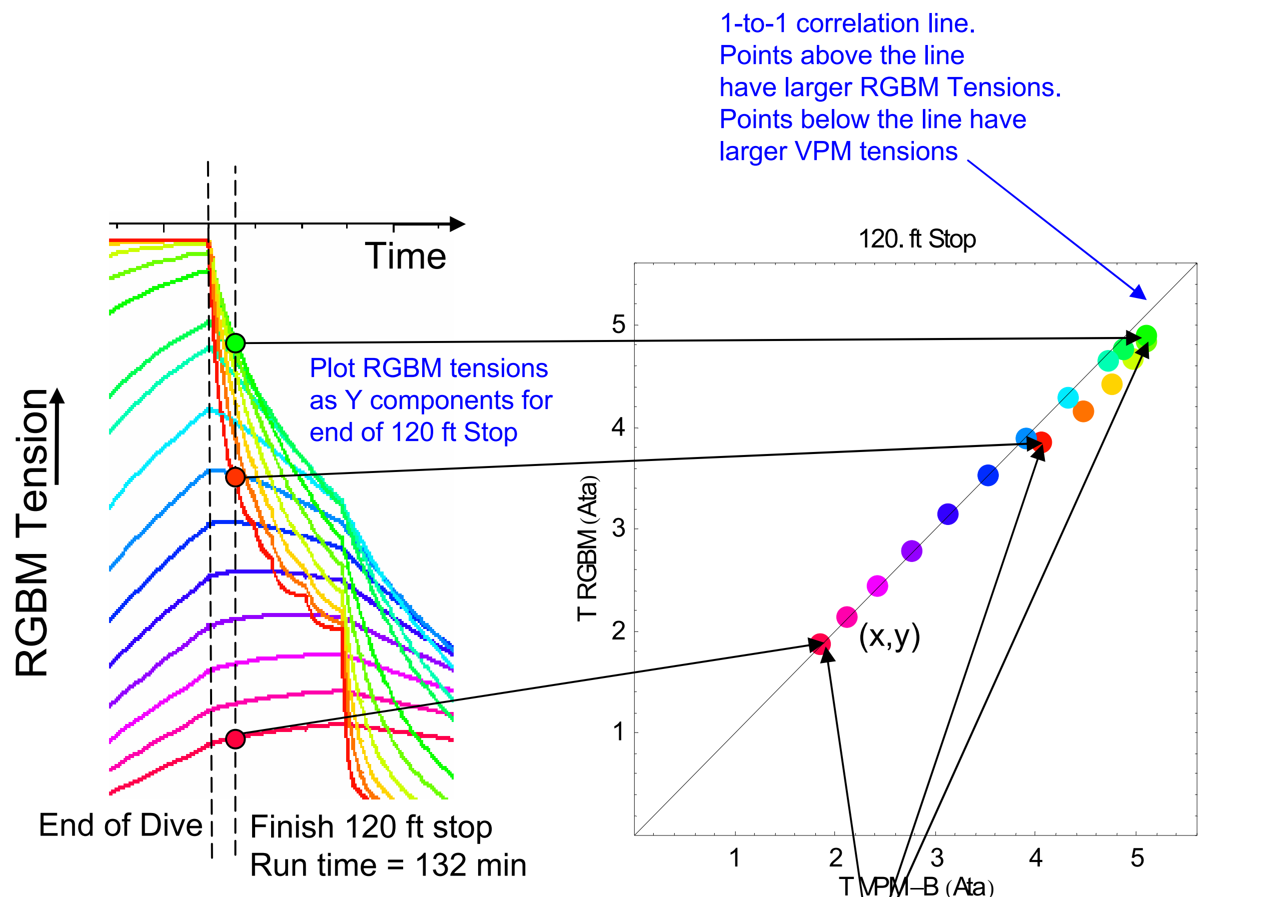
Gradient Factor





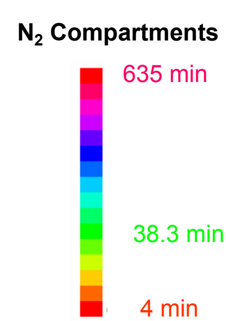
Construction of Tension and Gradient Correlation Plots

Example: Comparative Tensions at end of 120 ft stop

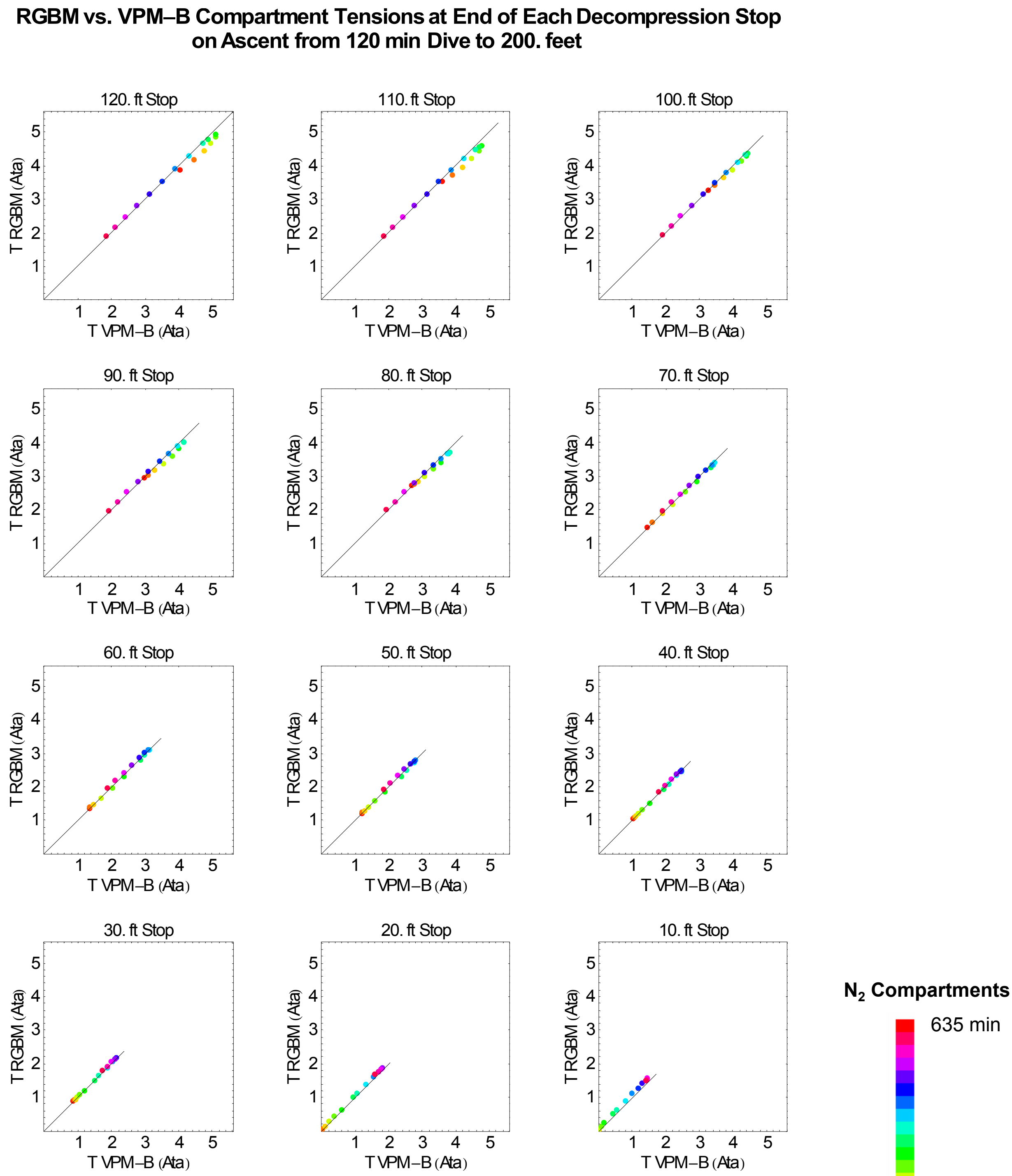


3 example points corresponding to total tensions (Ttotal=TN_2 + THe) in compartments representing 635 min, 38.3 min, and 4 min N_2 Bhulmann ZHL-16 compartments.

Plot VPM tensions, just like the RGBM illustration, as X components for end of 120 ft Stop



Stop-by-Stop Correlation Plots of RGBM vs. VPM-B(2) Tensions



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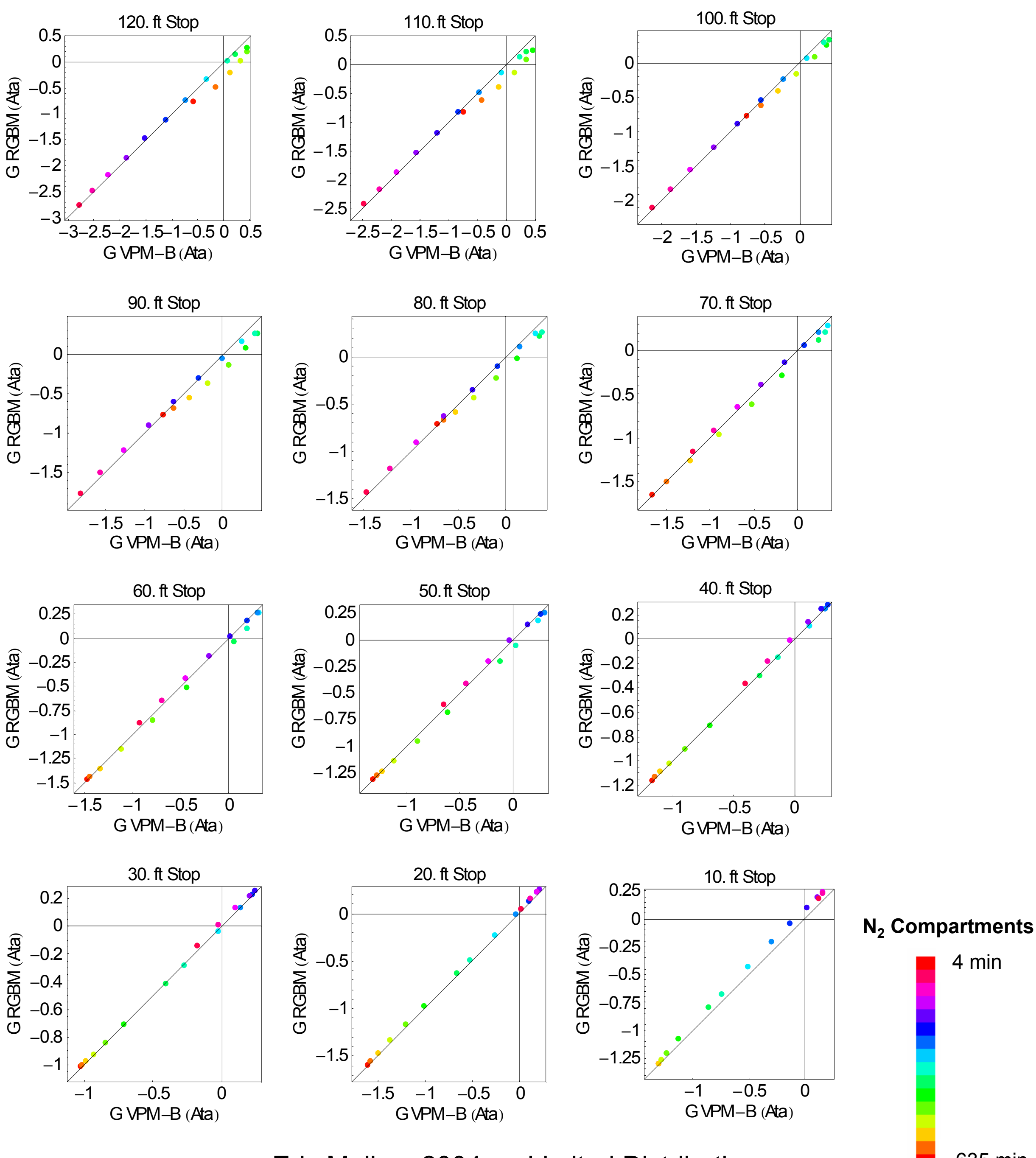
Stop-by-Stop Correlation Plots of RGBM vs. VPM-B(2) Gradients

RGBM vs. VPM–B Compartment Gradients at End of Each Decompression Stop on Ascent from 120 min Dive to 200. feet



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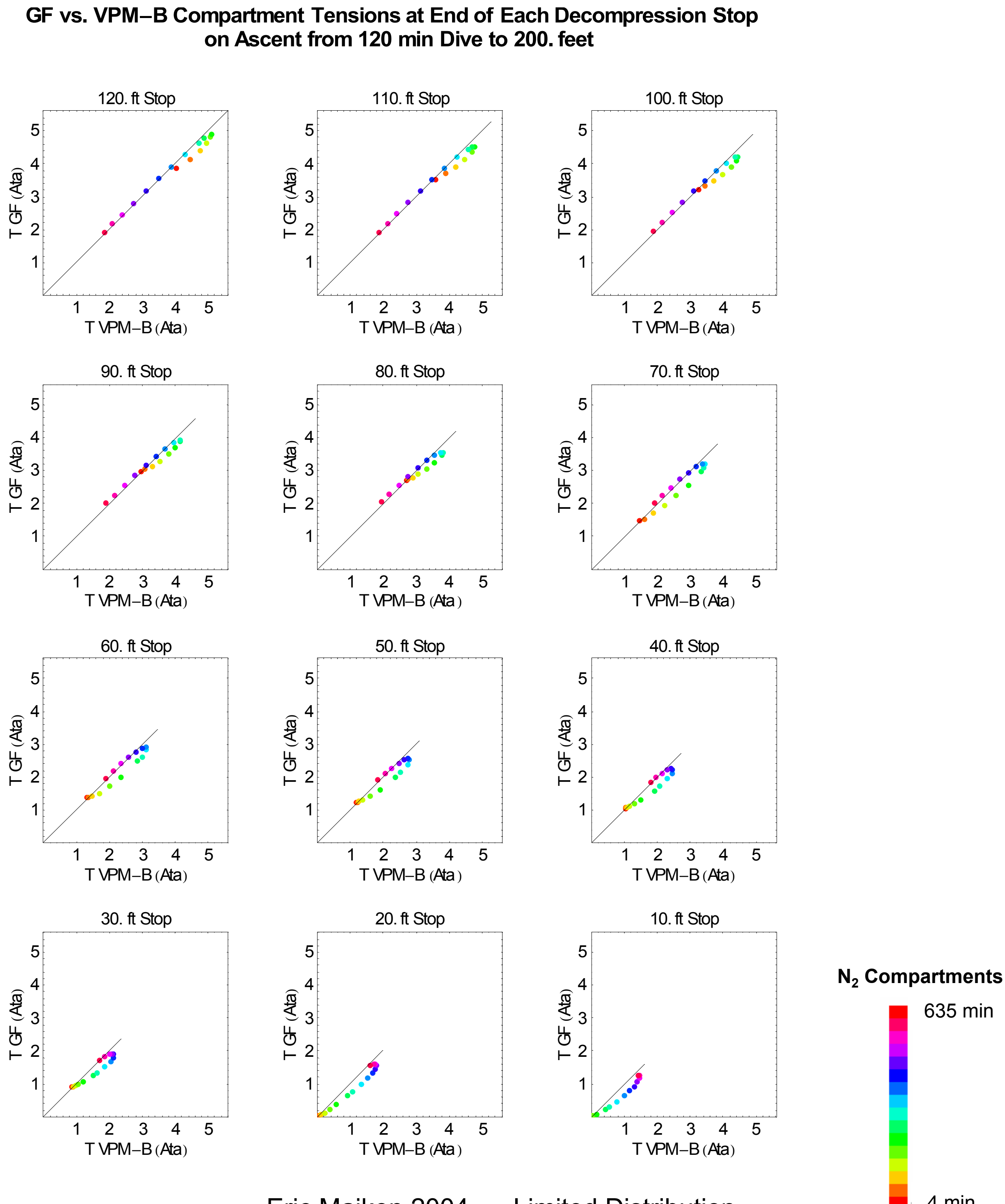
Stop-by-Stop Correlation Plots of GF vs. VPM-B(2) Tensions



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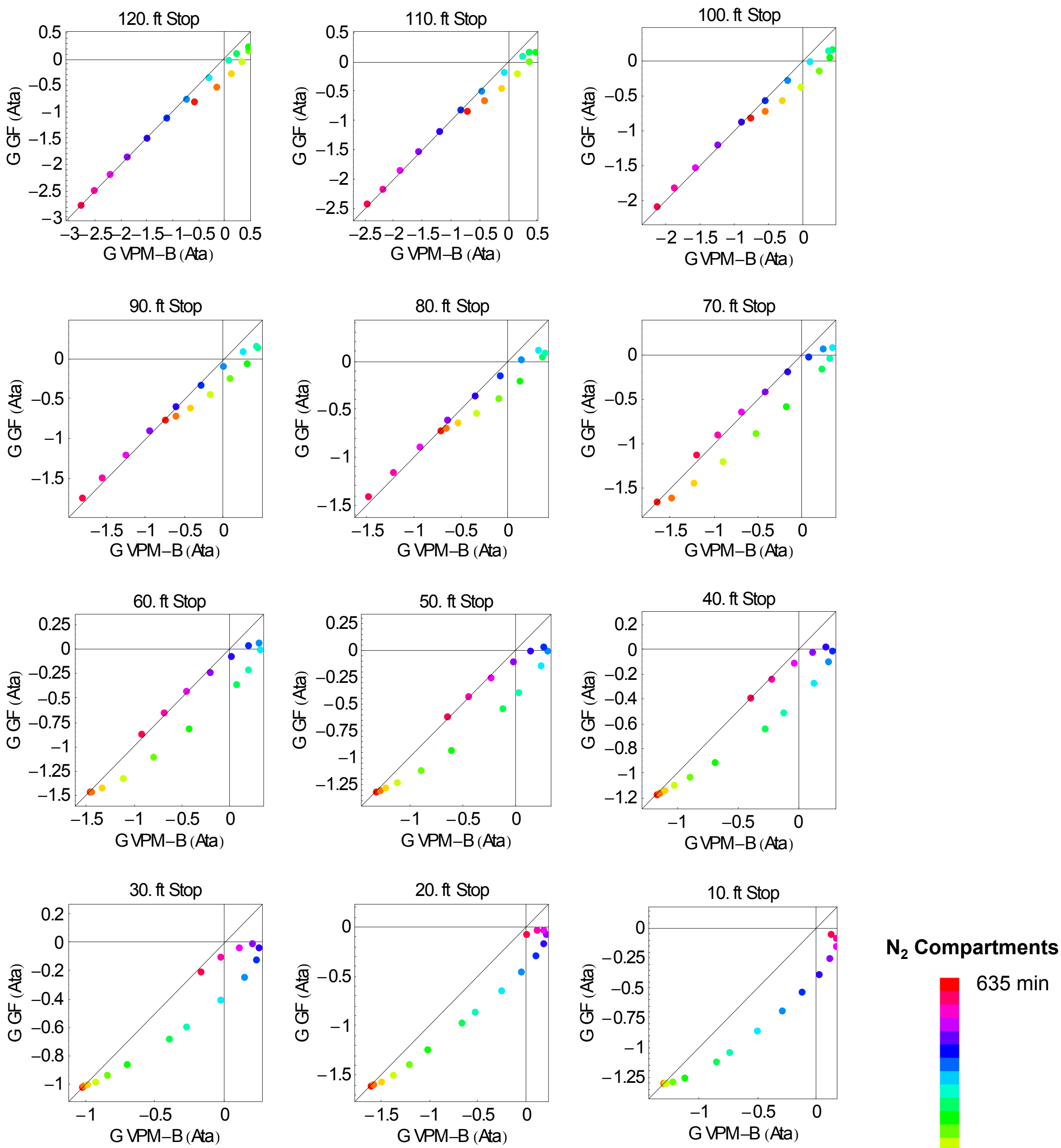
Stop-by-Stop Correlation Plots of GF vs. VPM-B(2) Gradients

GF vs. VPM–B Compartment Gradients at End of Each Decompression Stop on Ascent from 120 min Dive to 200. feet



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