

Bringing the Science to Climber and Coach

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Training4Climbing.com

International Rock Climbing Researchers Association
3rd Congress program – August 7, 2016

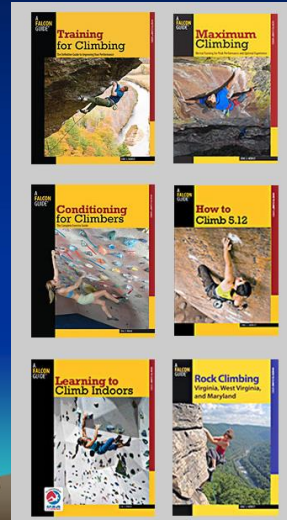
Presenter Biography

- Began climbing in 1977 (age 13), but also involved in baseball, gymnastics, and X-Country.
- Lead first 5.12a/7a+ in 1981 (age 17), and established some of the first 5.13a/7c+ in the Eastern US mid 80s.
- Wrote first articles on training for climbing in 1987 for *Rock & Ice* and in 1988 for *Climbing* magazines. Since then, has written 100+ articles for a wide range of national and international health, fitness, and climbing publications.



Presenter Biography (cont.)

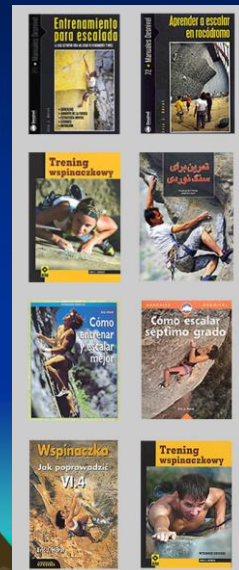
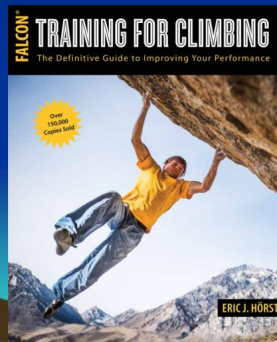
- 1st book, *Flash Training*, published in 1994.
- *How to Climb 5.12* in 1997.
- *Training for Climbing* in 2001; with 2nd Edition in 2008. 150,000+ copies sold.
- *Conditioning for Climbers* (exercise book) published in 2007.
- *Maximum Climbing* (mental training & climbing mastery) in 2010.



Presenter Biography (cont.)

- Many foreign translations—global book sales of 300,000+.
- Coached & consulted with 100s of climbers from around the world, some who have stood on podiums.

Training for Climbing
3rd edition
 Coming August 2016!

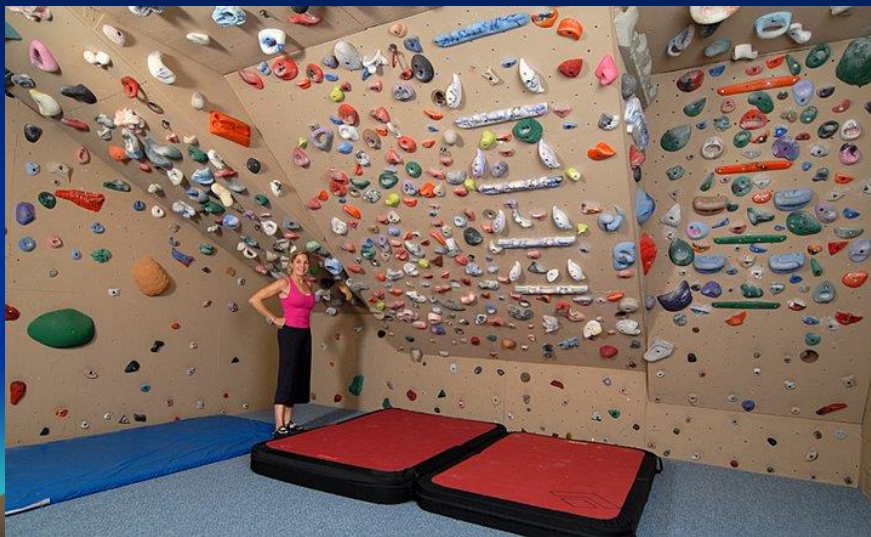


Presenter Biography (cont.)

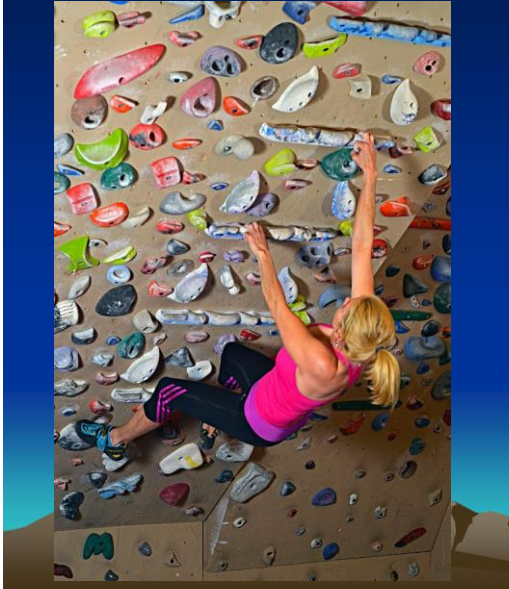
- Launched TrainingForClimbing.com in May 2000...the Internet's original climber training site.
- Research Paper Published: *Behavior Analysis and Sport Climbing*, Journal of Behavioral Health and Medicine, 2010, with Dr. Fleming.
- Training products design consultant with NICROS, since 1994.
- Still climbing 5.13 at age 52....but my kids warm up on my projects!



Welcome to My Home (Gym)!



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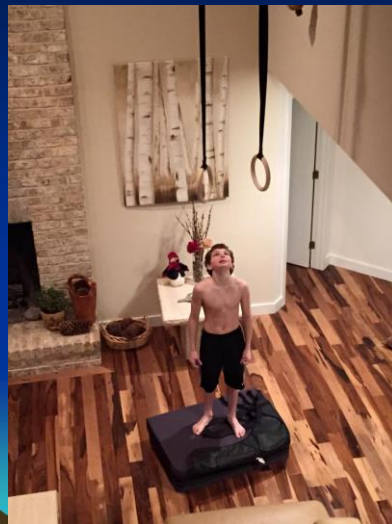
Welcome to My Home (Gym)!



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Welcome to My Home (Gym)!



What I've Learned from You!



- I've been consuming research papers since ~1991.
- For every climbing-related study, I typically read 5+ papers from unrelated activities.

What I've Learned from You!

- Assimilating a vast array of information has enabled me to synthesize/develop novel approaches (many unpublished in my books) to training for climbing.
- My journey is a never-ending series of “aha!” moments (when I briefly think I've figured things out), followed by humbling moments of realization...that I've only grasp the tip of the iceberg.
- Ultimately, for each question answered...I'm faced with 10 new questions.
- Climbing research is occasionally conflicting...a sign of the complex and multi-faceted nature of climbing.

What I've Learned from You! (cont.)

- **Research has confirm things that I've surmised intuitively.**
 - Elite climbers demonstrate a more even distribution of body mass between limbs, as well as more lateral movement , thus often displacing COM before each hand movement (Zampagni 2011).
 - 3 sets of characteristics (each having 8 selected variables) explained climbers' overall performance (Max OS & Max RP): 38% Physiological, 33% coordination & technical, and 25% mental/tactical (Magiera 2013).
 - Elite climbers have a greater “climbing time to exhaustion” (Paolo 2014).
 - Climbing time to exhaustion is significantly associated with on-sight climbing level (Espana-Romero 2009).
 - Elite climbers possess greater grip strength & MVC/BM (Fryer 2014).
 - Boulder climbers have a higher MVC (12%) and RFD (38%) than lead climbers (Maurizio 2014)

What I've Learned from You! (cont.)

- **Research often surprises with findings that are counter-intuitive, especially to the non-researcher.**

- Faster recovery between climbs with Active vs. Passive recovery (Watts 2000; Draper 2006)
- Forearm blood flow occlusion begins at as little as 15% of MVC....with complete occlusion ~50% MVC. (Köstermeyere 2000)
- Anthropometric and flexibility account for only 0.3% and 1.8% of the total variance in performance, respectively (Mermier 2000).
- Isometric endurance at a % MVC is relatively "fixed". For example, climbers and non-climbers have a similar hang-time to failure at 40% MVC (Grant 2003). Boulder and lead climbers have not-significant difference in hang-time to failure at 60% (Balas 2016).

What I've Learned from You! (cont.)

- **Research is clarifying the physiology of climbing, discovering some of the performance-limiting constraints and discriminating factors among climbers.**

- Vascular conductance (forearms) is higher in climbers vs. non-climbers (Ferguson 1997; Thompson 2014).
- Non-specific VO₂ is not correlated to climbing performance, whereas upper-body peak VO₂ is strongly associated with on-sight ability (Michailov 2015).
- Climbers who engage in some non-specific aerobic training recovery more quickly between ascents as evidenced by faster HR normalization between climbs (Schöffl 2006; Balas 2014).
- Elite climbers deoxygenate (and re-oxygenate) forearm flexor muscles faster than non-elites and demonstrate a greater Force-Time Interval (Fryer 2014).
- Aerobic and anaerobic alactic are the two primary energy systems contributing ~43% and ~37%, respectively. Anaerobic lactic contributes ~20% on average. (Bertuzzi 2007)

What I've Learned from You! (cont.)

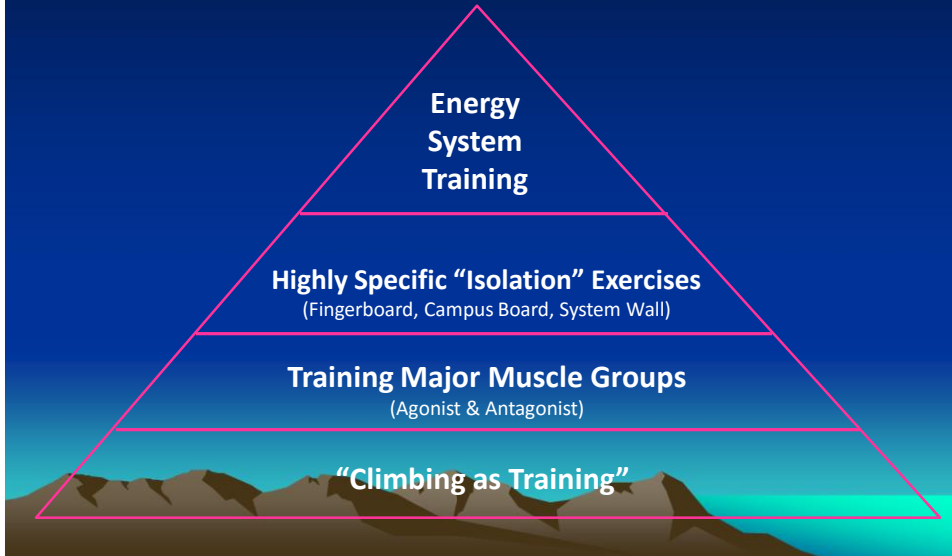
- Research has begun to provide useful insight into effective training methods.
 - Eva Lopez-Rivera (2012) insights into fingerboard training; specifically the effectiveness of “max weight” vs. “minimum edge” training.
 - High correlation between finger strength gains and improvements in local endurance (Lopez-Rivera 2012)
 - Detraining in 10-14 days without training...sharp loss of strength in 4 weeks of no training (Lopez-Rivera 2012)

What I've Learned from You! (cont.)

- German volume training works.... (ha ha!)



Hierarchy of Training Specificity



"Energy System Training"

"Energy systems" refer to the metabolic pathways that produce ATP for muscular contractions. Three energy systems function to replenish ATP in muscle:

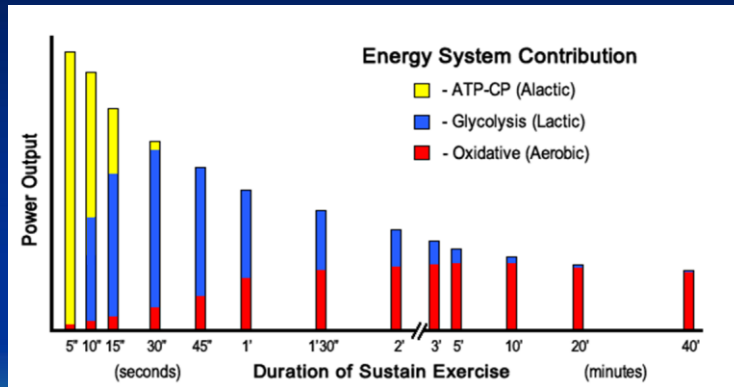
1. **Phosphagen** (anaerobic alactic)
2. **Glycolytic** (anaerobic lactic)
3. **Mitochondrial respiration** (aerobic).

All three contribute to ATP production at any given moment, however, just one or two tend to dominate depending on the duration and power requirements of an exercise or activity.

Table 5.3 Energy Systems

Energy System	Energy Source	Duration of Steady-State Exercise	Power Output
Anaerobic Alactic	ATP-CP	1–12 seconds	Very high
Anaerobic Lactic	Muscle Glycogen	12 seconds–about 2 minutes	High
Aerobic	Fatty Acids, Glycogen, Lactate	2 minutes–about 2 hours	Low to Moderate

Energy System Contribution (conceptual)



- I suspect this conceptual model over-estimates glycolytic contribution (and underestimates aerobic), especially in the forearms of climbers.

“Energy System Training”

Two approaches used by many climbers & coaches:

1. Since climbing draws on all three energy systems...why not train all three systems in a single workout?
 - Power training (anaerobic alactic) on the campus board
 - Strength and strength-endurance training (anaerobic lactic) on the hangboard
 - Strength-endurance & power-endurance training (anaerobic lactic) via bouldering 4x4s
 - More campus training! (anaerobic alactic)
 - A few near-maximal laps on a roped route (anaerobic lactic & aerobic)
2. Or, since failure on difficult rock climbs always seems to result from “pumping out”...do as many pump-producing exercises and climbs as possible...and not leave the gym until the “pump lust” is satiated.

“Energy System Training”

I do NOT endorse the two aforementioned approaches!

Hörst philosophy on energy system training:

- Effective energy system training should target a single system (to avoid possible “interference” of signaling/gene expression?)...especially during early and middle phases of a training cycle.
- Dedicate an entire workout—and ideally a 2- to 4-week training phase—to targeting a single energy system. (Other energy systems may be trained once or twice per week, as a separate workout, for maintenance.)
- Well-trained climbers can do up to three split two-a-day workouts per week, given at least 4 hours rest between sessions. Two approaches:
 - AM session: Aerobic endurance (local & general), PM session: strength/power (alactic).
 - AM session: Strength/Power (alactic), PM session: Power/strength-endurance (lactic).
- Programming workouts for all 3 energy systems is tricky...and the “art” of training program design. More “elite” needs a more nuanced program.

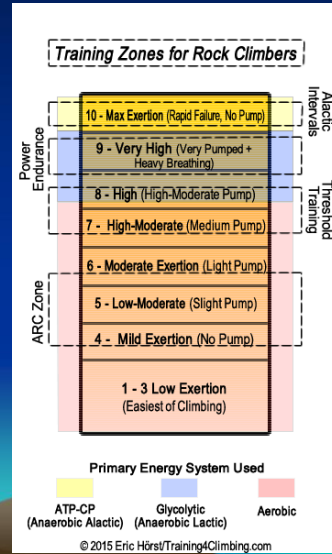
Energy System Training

- What are possible objective measures for each energy system? What protocols and tools can a coach use?
- See chart below for basic subjective assessment:

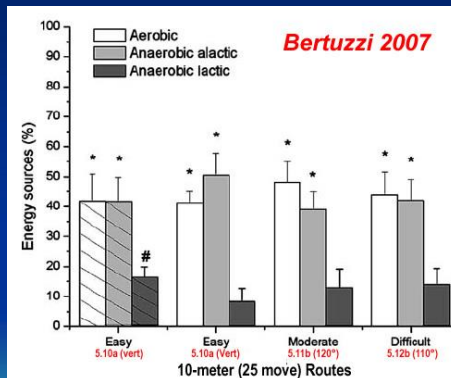
Which Quadrant Is Your Climbing Strength and Weakness?	
<p>Anaerobic Power</p> <ul style="list-style-type: none"> • Short, severe boulders lasting <15 seconds • Big campus movements & lunges • Powerful pulls off small holds • Catching small holds on deadpoints & lunges 	<p>Aerobic Power</p> <ul style="list-style-type: none"> • Able to recover at brief, marginal mid-climb rests • Fast recovery between strenuous, pumpy exercises • Fast recovery between boulders (as in competition, when rest is limited to 4 minutes) • Recover quickly between redpoint attempts
<p>Anaerobic Capacity</p> <ul style="list-style-type: none"> • Sustained, difficult boulders lasting 15 seconds – 2 minutes • Roped climbing through long, pumpy sequences • Holding isometric contractions (like hangs) for up to 2 minutes 	<p>Aerobic Capacity</p> <ul style="list-style-type: none"> • Climb much of the day at a relatively high level • All-day stamina on multipitch and wall routes • Able to train twice per day with a few hours rest in between

Energy System Training

- **Anaerobic Alactic Training:** Brief, near-maximal strength & power exercises lasting ≤ 10 seconds with work-rest ratio of 1:20 to 1:30. **Intensity of 9.5 to 10. No pump!**
- **Anaerobic Lactic Training:** Highly fatiguing strength/power-endurance exercises lasting 20" – 2'. **Intensity of 8 to 9 (out of 10). Very pumped; heavy breathing.**
- **Local Aerobic Training:** Long-duration submaximal climbing with a light to moderate pump. **Intensity of 5 to 8 (out of 10), however optimally effective training of mitochondria respiration is with "threshold training" (intensity of 7 – 8).**



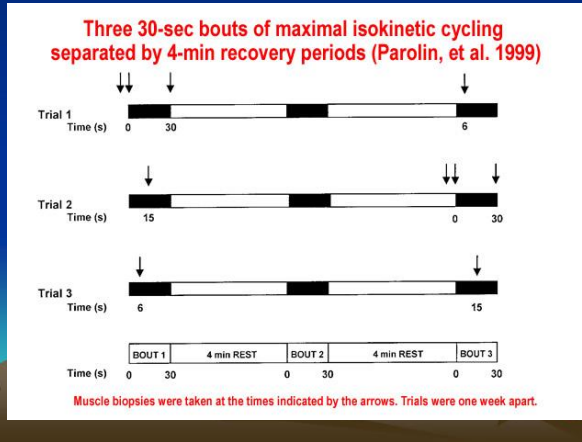
Energy System Relative Contribution



- Elite Climber average on difficult route:
 - aerobic – 42%
 - anaerobic alactic – 36%
 - anaerobic lactic – 22%
- Perhaps problems with lactate measurement (ear) and use of fast component of excess post-exercise oxygen consumption.
- Need additional studies... Determine ES contribution for short vs. long boulders, short vs. long routes, intermittent vs. steady-state climbing

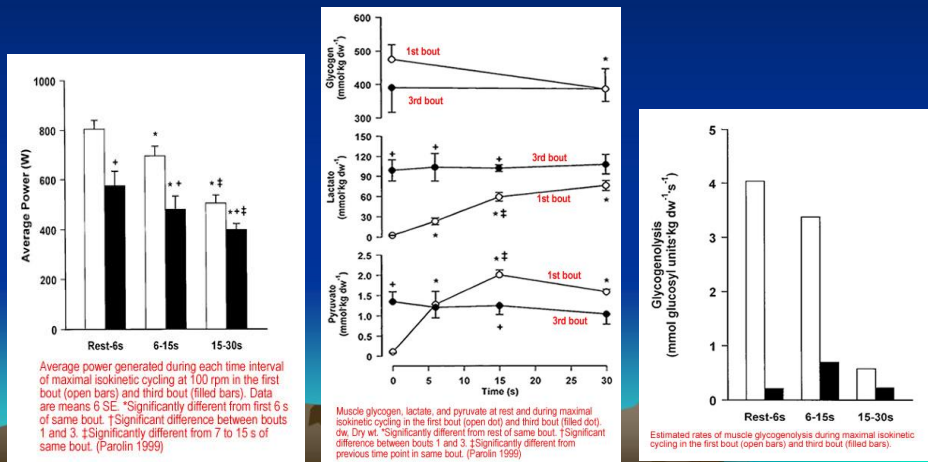
Hörst Thought Experiment...

What if we view difficult sport climbing as an *intermittent sprint sport*?



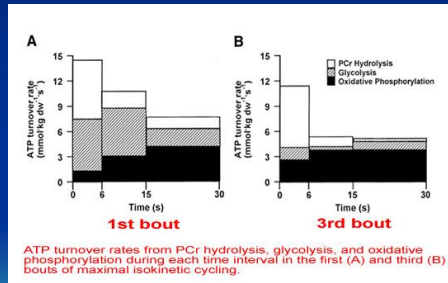
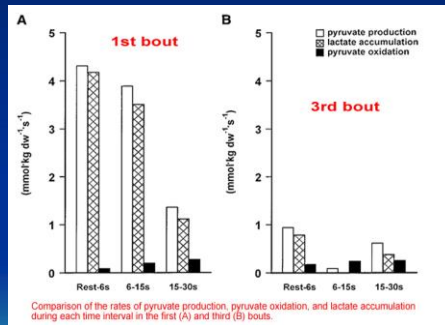
Hörst Thought Experiment...

Three 30-second bouts of maximal isokinetic cycling separated by 4-minute recovery periods (Parolin, et al. 1999).



Hörst Thought Experiment...

- Might these findings reflect the bioenergetics of sport climbing, which tends to be heterogeneous and of varying intensity?

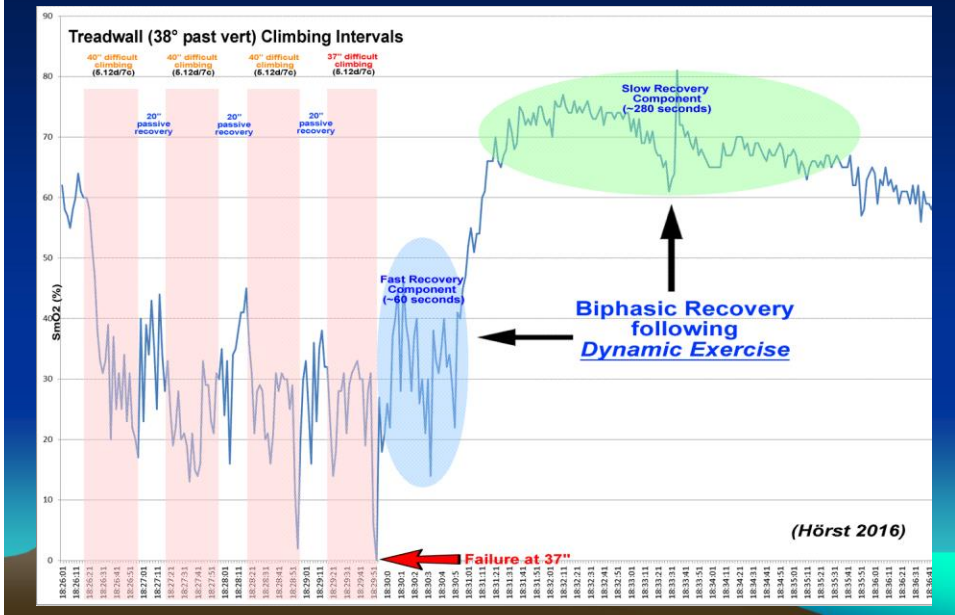


• I believe so!

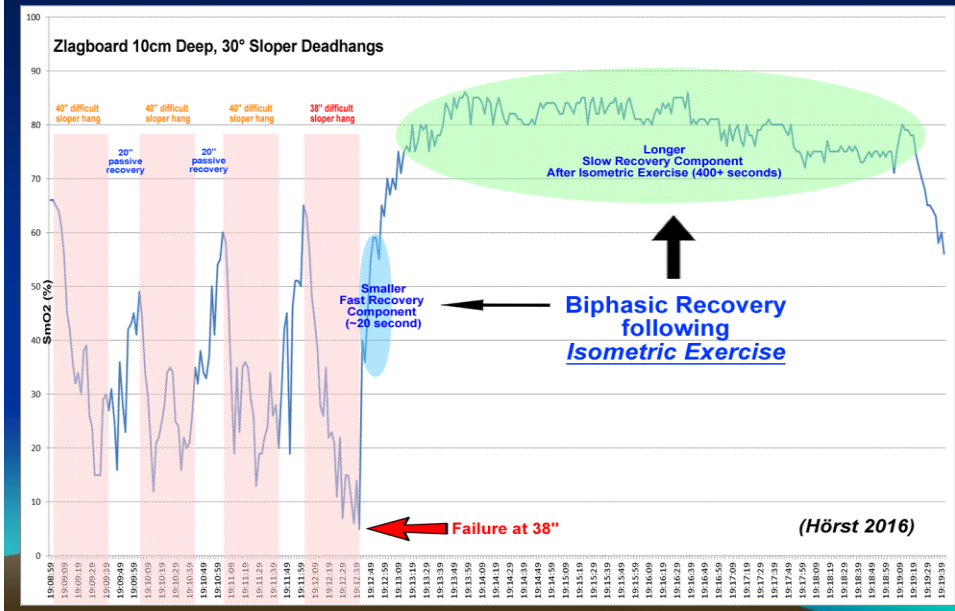
Hörst Training Suggestions...

- Elite climbers should train more like intermittent sprint athletes...with a more polarized program of training maximum strength & power (anaerobic lactic) and local aerobic endurance (oxidative capacity).
 - Effective alactic training must be brief and near-maximal...with an intention to increase limit strength, rate of force development (contact strength), and pulling power. Do brief climbing “sprint intervals” to develop aerobic power.
 - Effective local aerobic endurance training must focus on improving local oxidative capacity (local VO₂) by way of increasing local blood flow and capillary density, increasing mitochondrial density/efficiency, and improving O₂ diffusing .
- A period (2 – 3 weeks) of targeted strength/power-endurance training (anaerobic lactic) is essential, however, prior to “performance climbing” or competition. This is the least trainable energy system, and excessive anaerobic lactic training will produce lackluster results...and may lead to overtraining & performance decline.

My "Research"



My "Research"



Question & Comments?

Contact me at:
Eric.Horst@TrainingForClimbing.com

Training for Climbing
3rd edition
Coming August 2016!

