Robust Mid-Temperature Glazes

Matthew Katz
New York State College of Ceramics
at Alfred University

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What are we looking for?

- Well formed Cone 10 glazes are very rugged.
- How do Cone 6 glazes match up?
- Glazes that are able to withstand abuse.
  - Soap
  - Water
  - Daily wear
  - Abrasion
    - Metal Utensils
  - Chemical Corrosion
    - Leaching

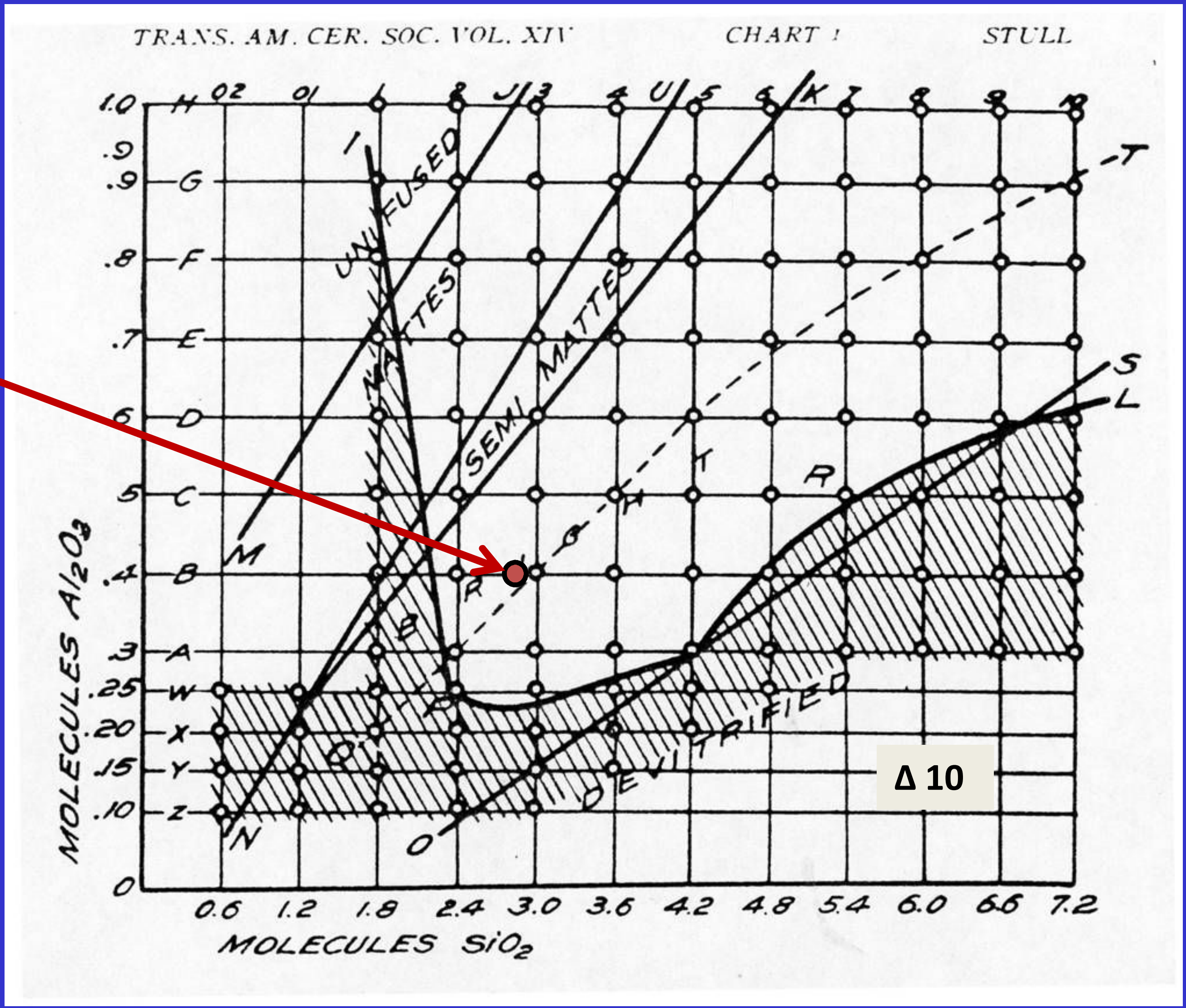
Stull

0.3 R_2O:0.7 RO

2.8 SiO_2:0.4 Al_2O_3
(7:1 SiO_2:Al_2O_3)

11 tests with constant SiO_2 & Al_2O_3 Levels

R_2O:RO
1:0 to 0:1



Gloss decreases with washing

Gloss meter reading, post firing.

50 dishwasher cycles.

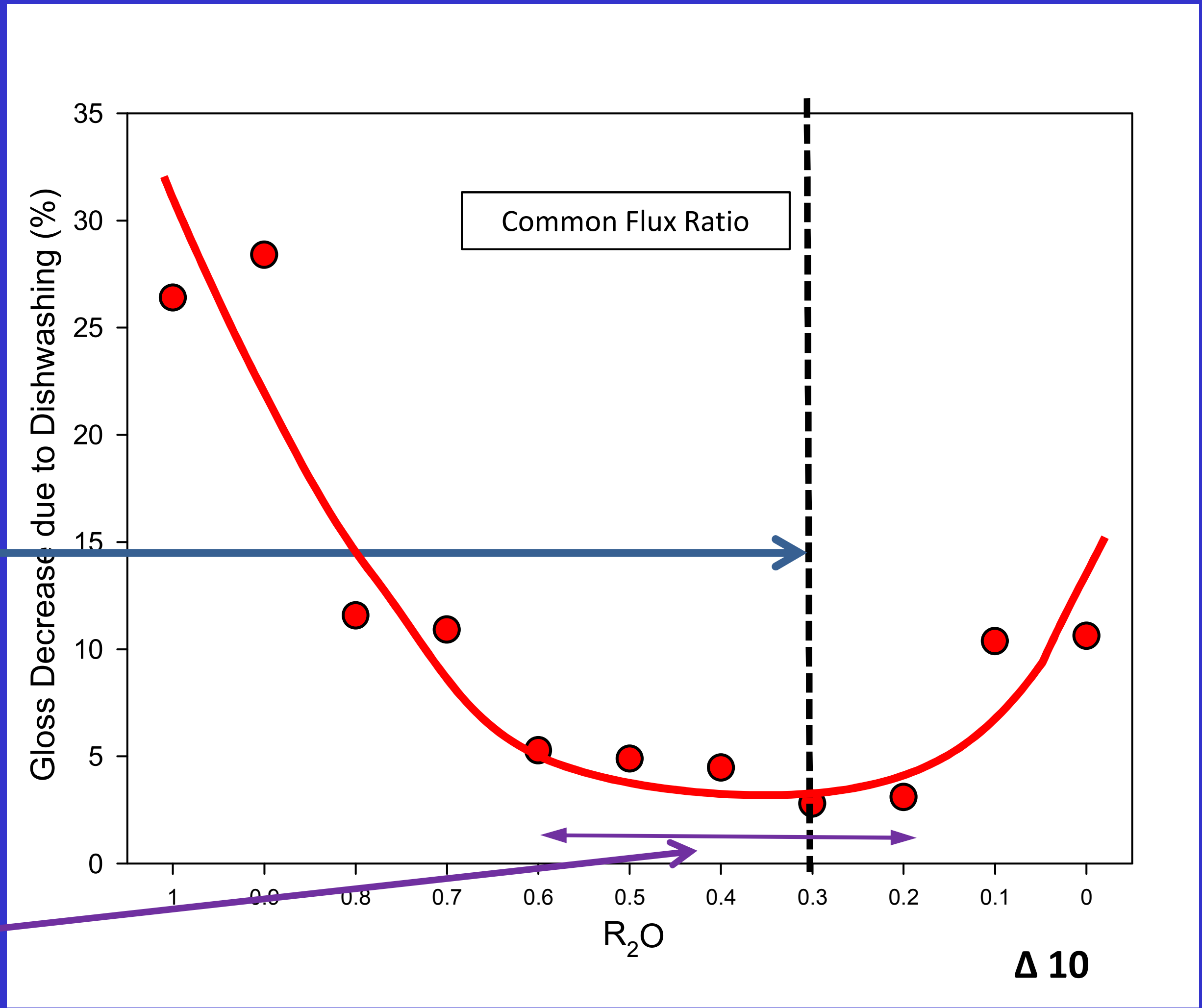
Second gloss meter reading.

Gloss decrease % calculated.

0.3 R_2O:0.7 RO is the most rugged, 2.7% degradation.

Average degradation 10.8%.

Degradation in the quality region was 4.1%.



What about mid-temperature?

Three ways to achieve mid-temperature.

- Reduce glass formers.
  - SiO_2 & Al_2O_3.
- Increased alkali metal fluxes (R_2O).
  - From 0.3 R_2O:0.7 RO to 0.5 R_2O:0.5 RO
- Add Boron (B_2O_3).

Reduce glass formers

Seger tells us this works.

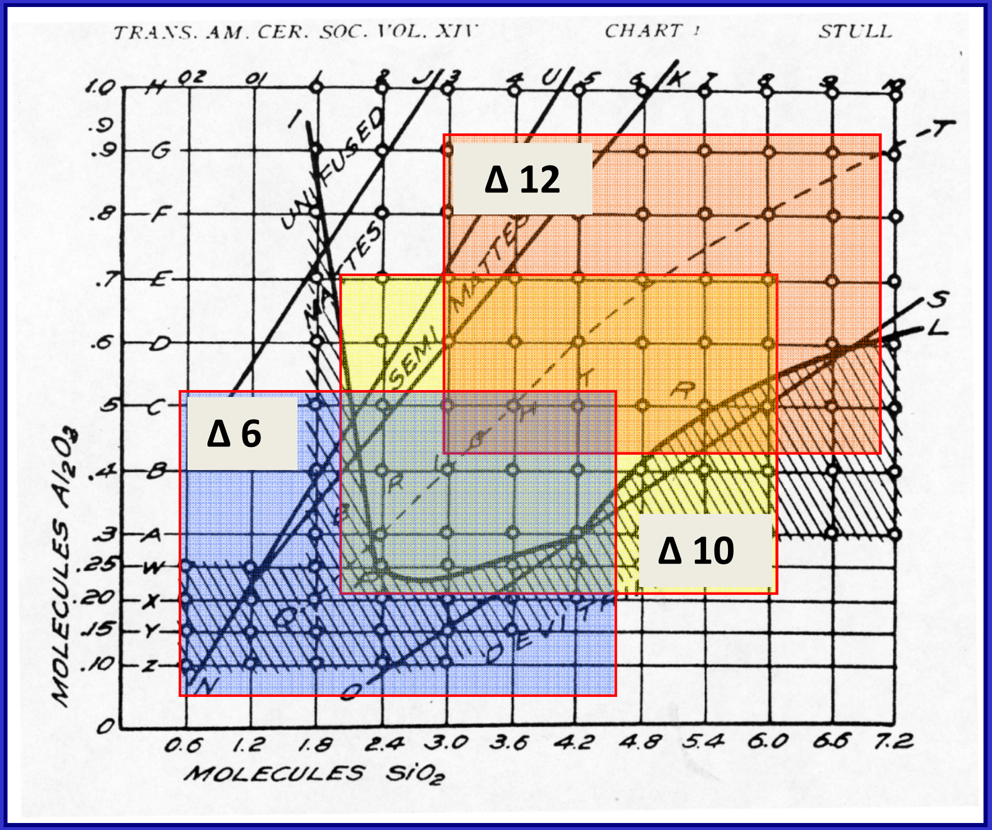
Constant 0.3 R_2O:0.7 RO reduced SiO_2 and Al_2O_3.

More efficient melt formation.

Glossy at Cone 6.

Not the best solution.

Has 15% gloss degradation.



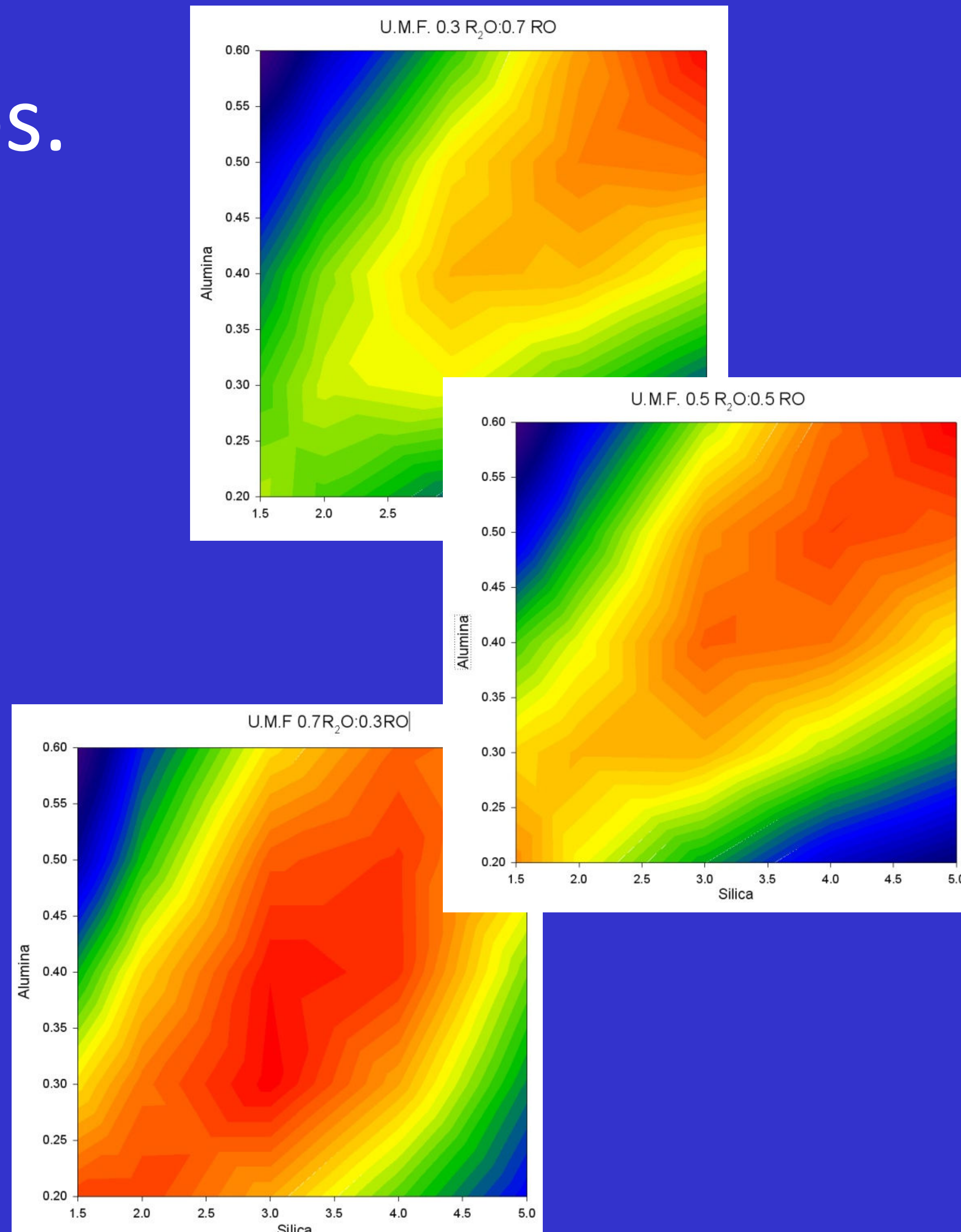
Altering Flux Ratios.

The most common mid-temperature method.

Simple: made with four base materials.

Clay, Alkaline Earth, Feldspar, Quartz.

Most common ratio is $0.5\ R_2O:0.5\ RO$



Cone 6 results

The same 11 compositions, fired to Cone 6.

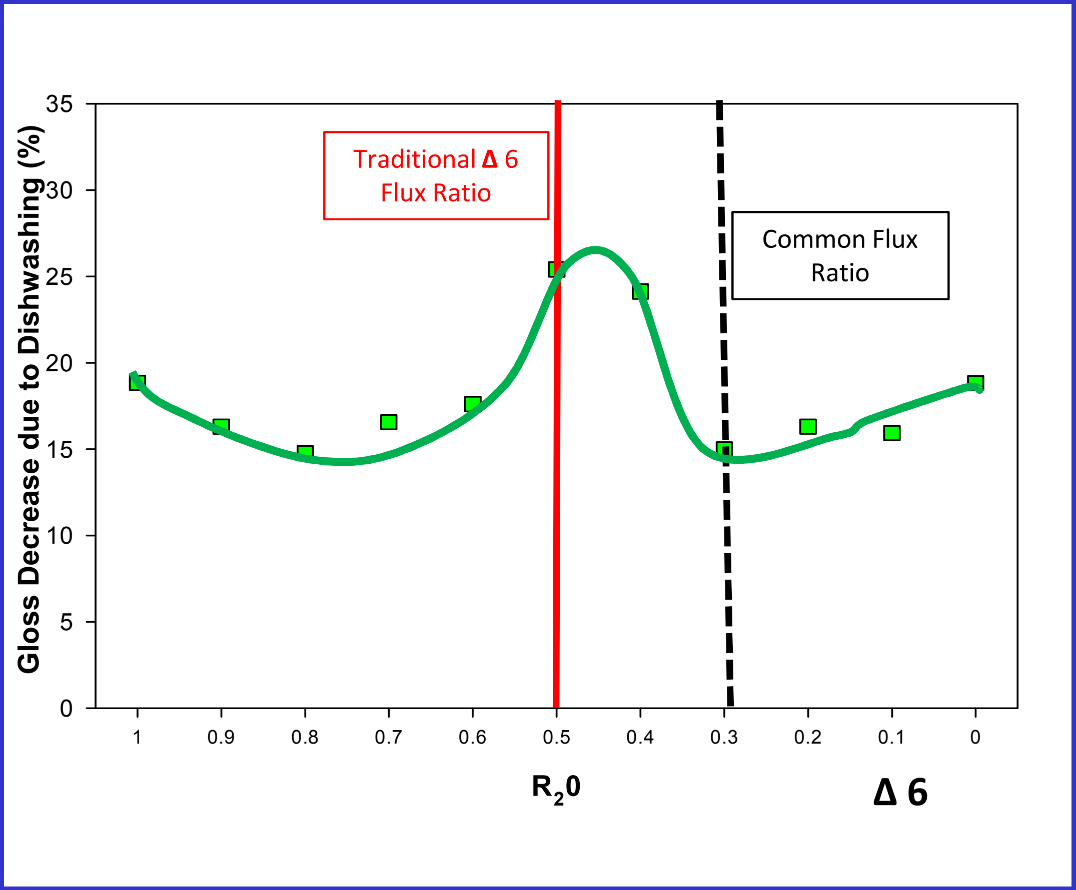
$0.3\ R_2O{:}0.7$ is best.

15% degradation.

$0.5\ R_2O{:}0.5\ RO$ had 25.4% degradation.

Unknown if caused by composition or test method.

Average degradation 18.2%.



Cone 10 versus Cone 6

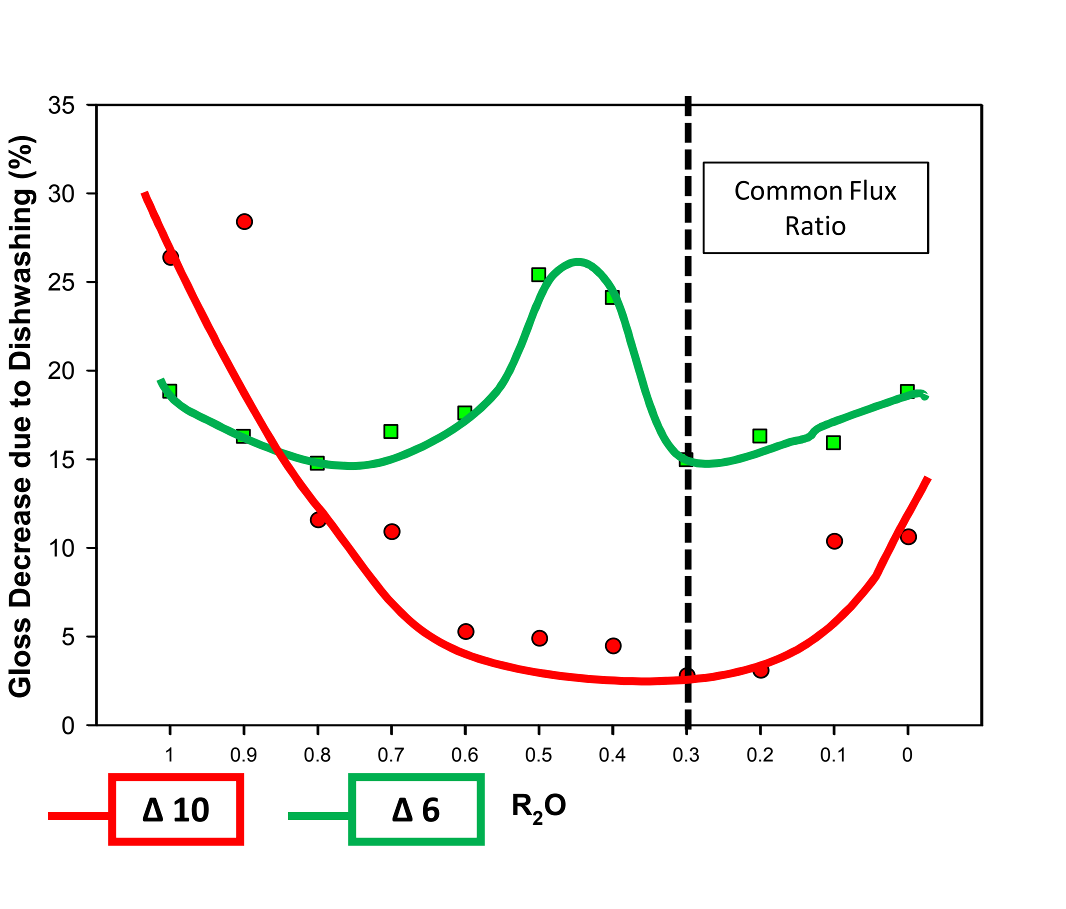
Basic glazes are rugged at cone 10.

0.3 R_2O:0.7 RO is the most robust.

Temperature independent .

Lower SiO_2 & Al_2O_3 or altered flux ratios glazes appear rugged at Cone 6.

Do not perform well when exposed to stresses.



Boron

- Boron is a lower temperature glass former.
  - Not a flux.
- Boron is not without its own problems.
  - Cost.
  - Material availability.
  - How to utilize the chemistry.
- Irrelevant if performance is poor.

Degradation

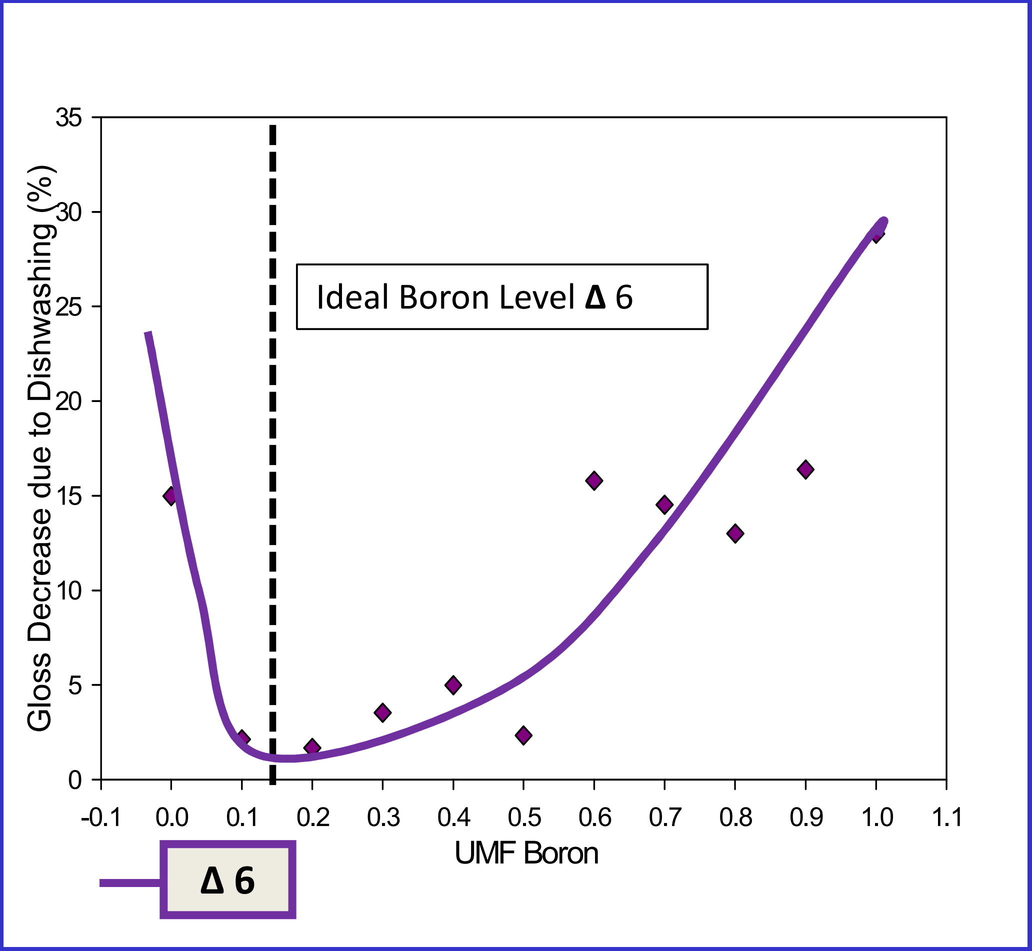
2.8 SiO_2:0.4 Al_2O_3, 0.3 R_2O: 0.7 RO

Boron is the ideal candidate.

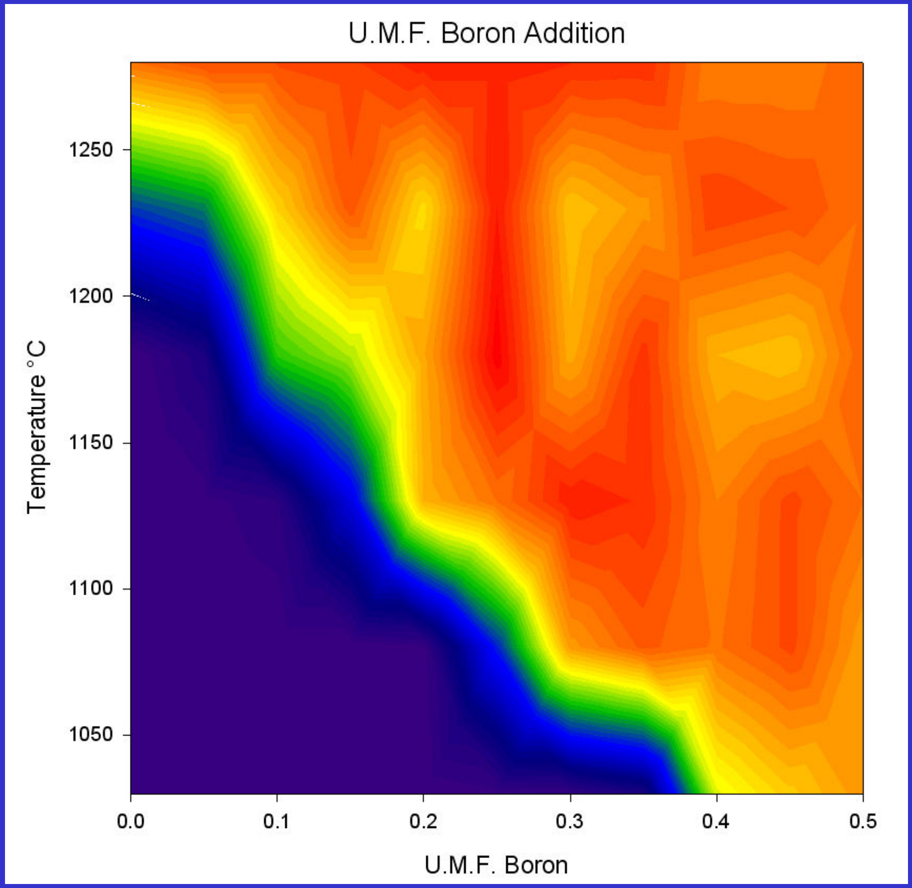
It produces highly glossy, rugged glazes at a lower temperature.

Better than a Cone 10 glaze.

1.7% vs. 2.8% degradation.

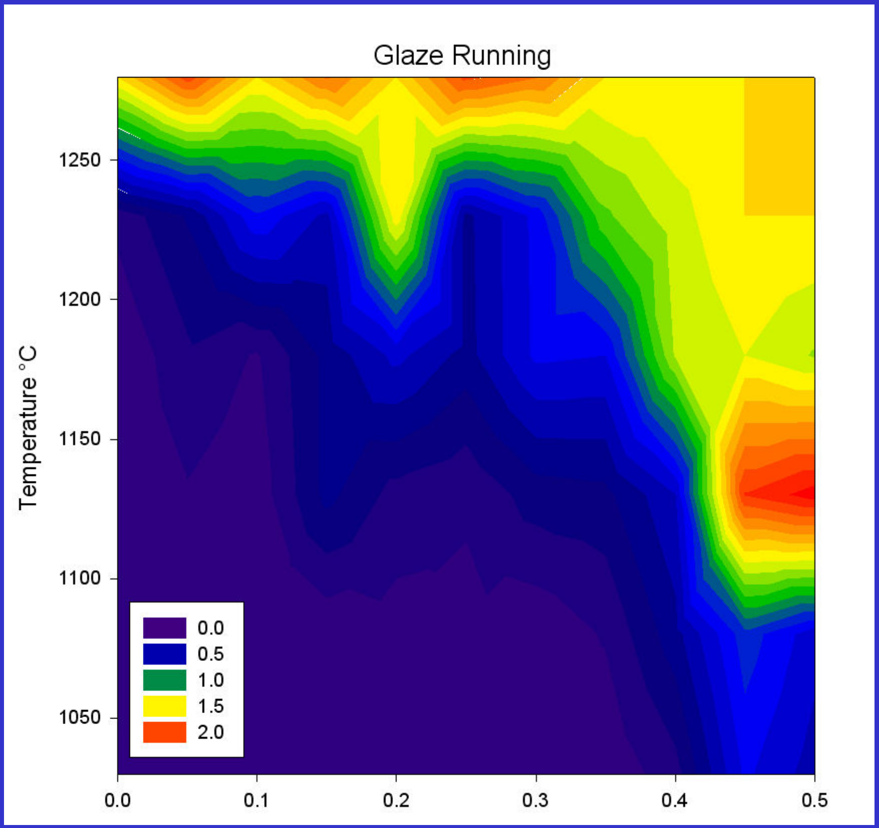


How much Boron is too much?



Boron contribution appears to be confusing and poorly defined.

We have been able to define the levels clearly.



0.3 R_2O: 0.7 RO

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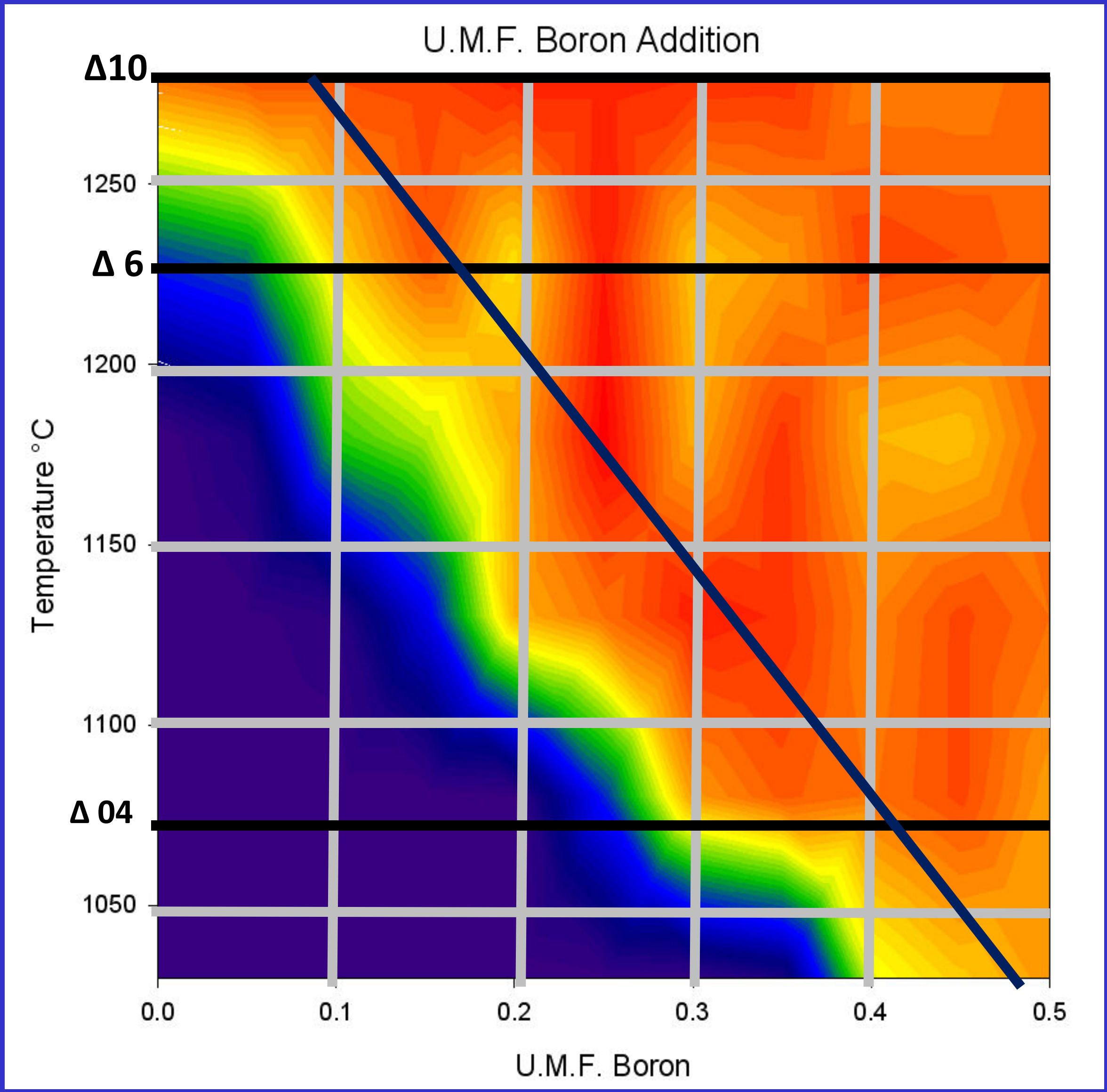
7:1 SiO_2:Al_2O_3

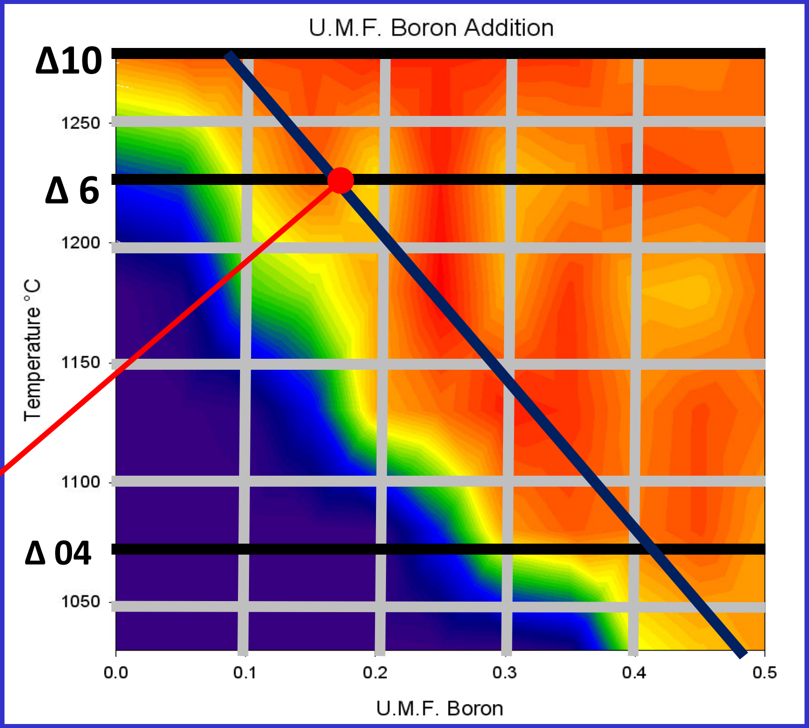


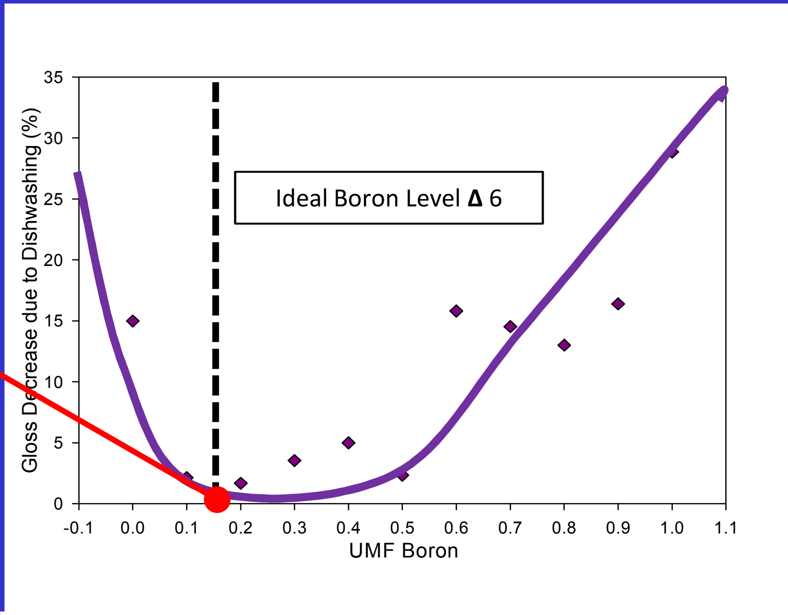
U.M.F. Boron Addition
Δ10
Δ 6
Δ 04
Temperature °C
1250
1200
1150
1100
1050
0.0
0.1
0.2
0.3
0.4
0.5
U.M.F. Boron

Predictable

The relationship of Boron to temperature is linear.

The ideal Cone 6 Boron level correlates to robust Boron level, ~0.15





*This does not mean that we can simply add Boron to Cone 10 glazes to bring their temperature down and match.

Flux Ratio

0.3 R_2O: 0.7 RO is temperature independent.

Ancient glazes similar to Modern glazes.

Frit 3124:

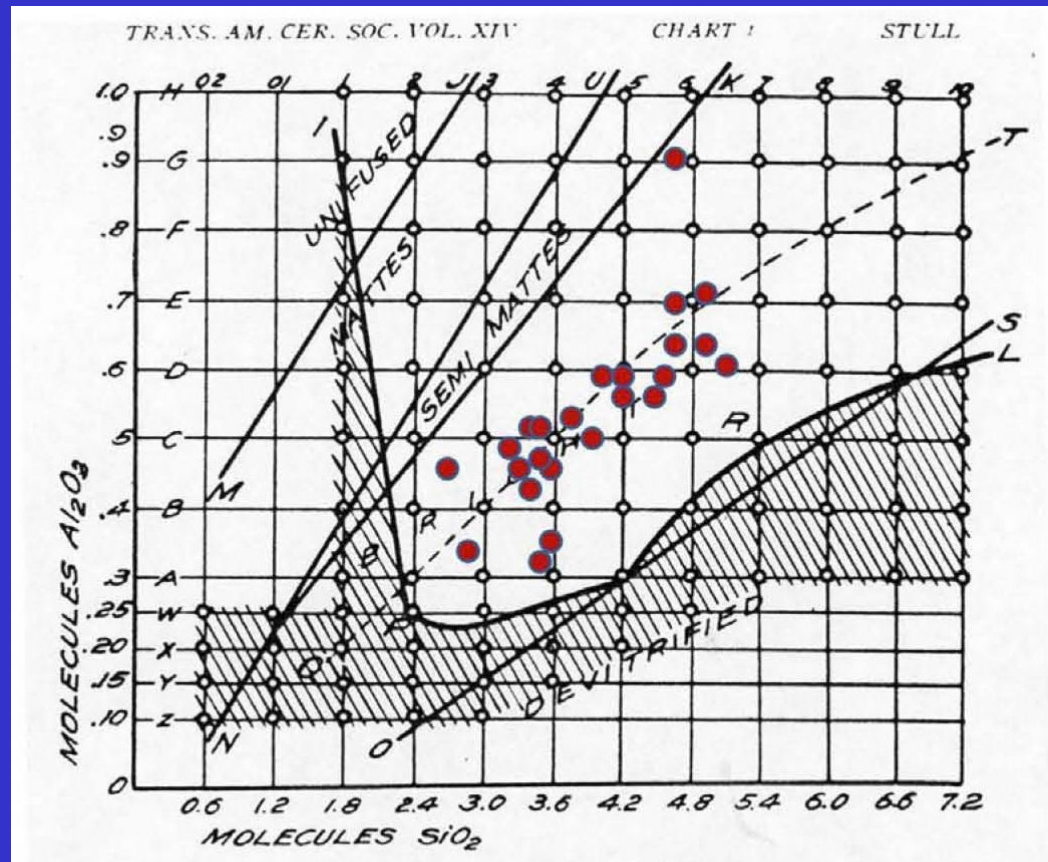
2.6 SiO_2:0.27 Al_2O_3

0.55 B_2O_3

0.3 R_2O: 0.7 RO

Perfect Cone 04 Gloss

(+10 % clay to keep it suspended)

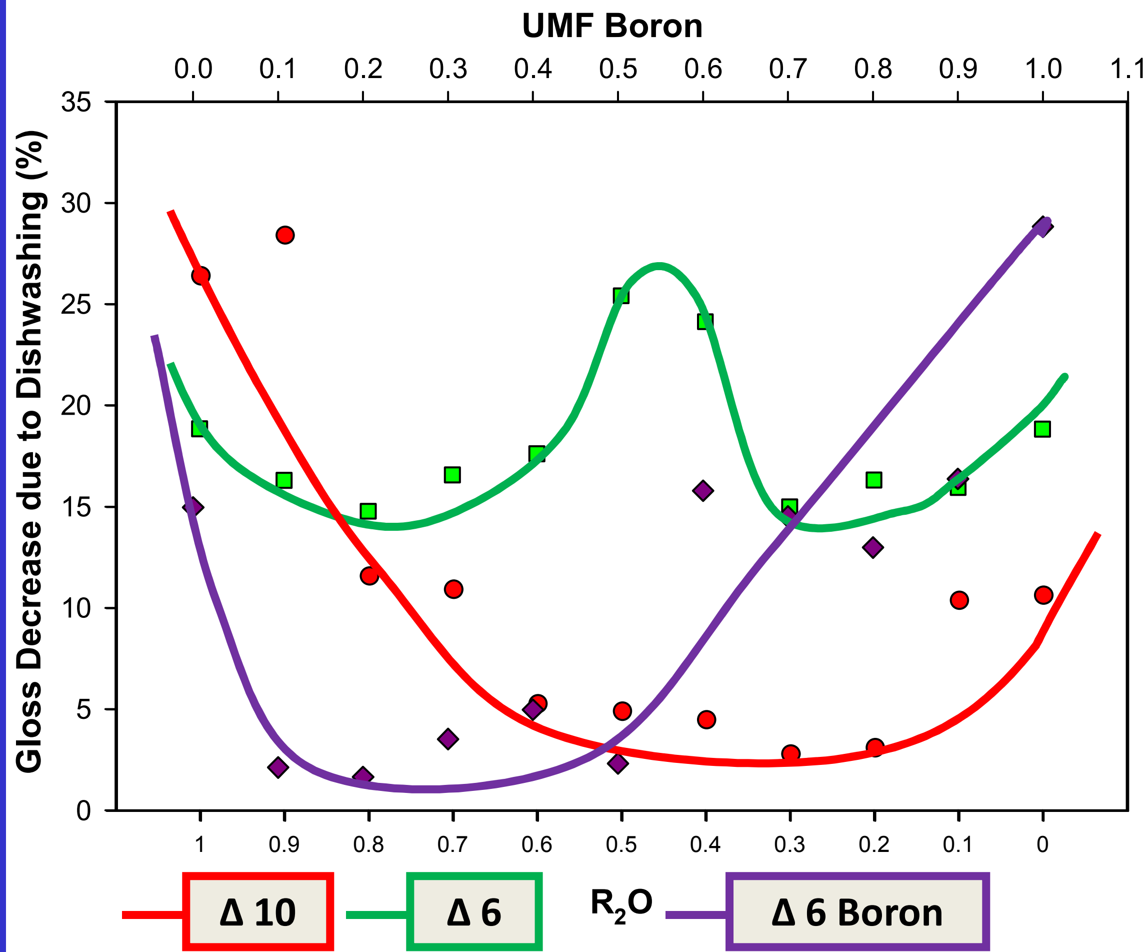


Conclusions

Two of the three methods for mid-temperature lead to weak glazes that can fail, degrade, or otherwise be problematic.

High quality, Robust **Δ**6 glazes:

0.3 R_2O: 0.7 RO
+
Boron (0.1-0.2)



Thanks!

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Mr. Baby

Gratuitous Baby Shot