# Theme 1: Biological uptake and trace element bioavailability

# 1. How does stoichiometric plasticity connect to trace metal distribution and inventories?

Mark Moore presentation

## i) Largest scales: oceanic inventories

Trace metals have differential availability (relative to biological demands) within the modern ocean

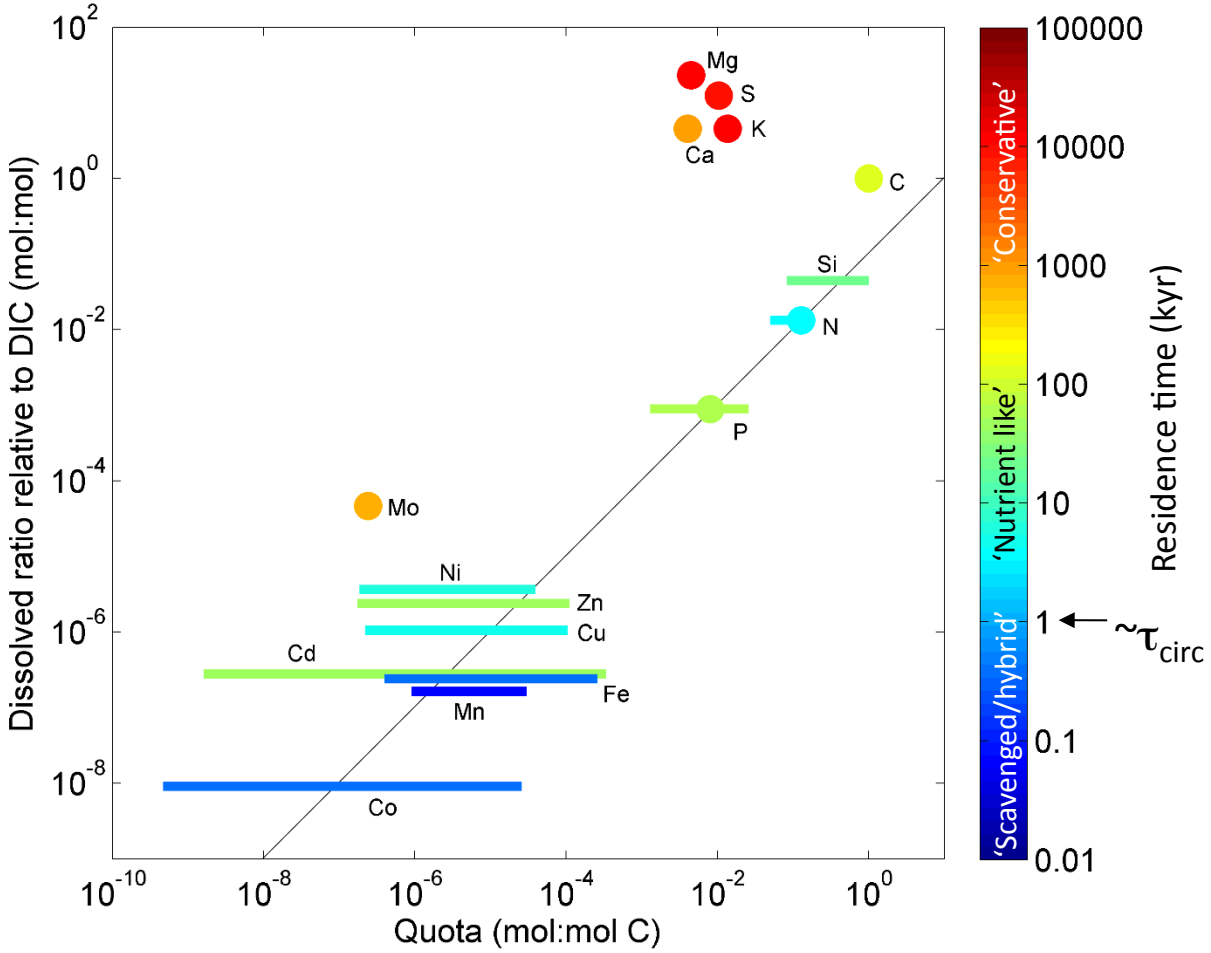


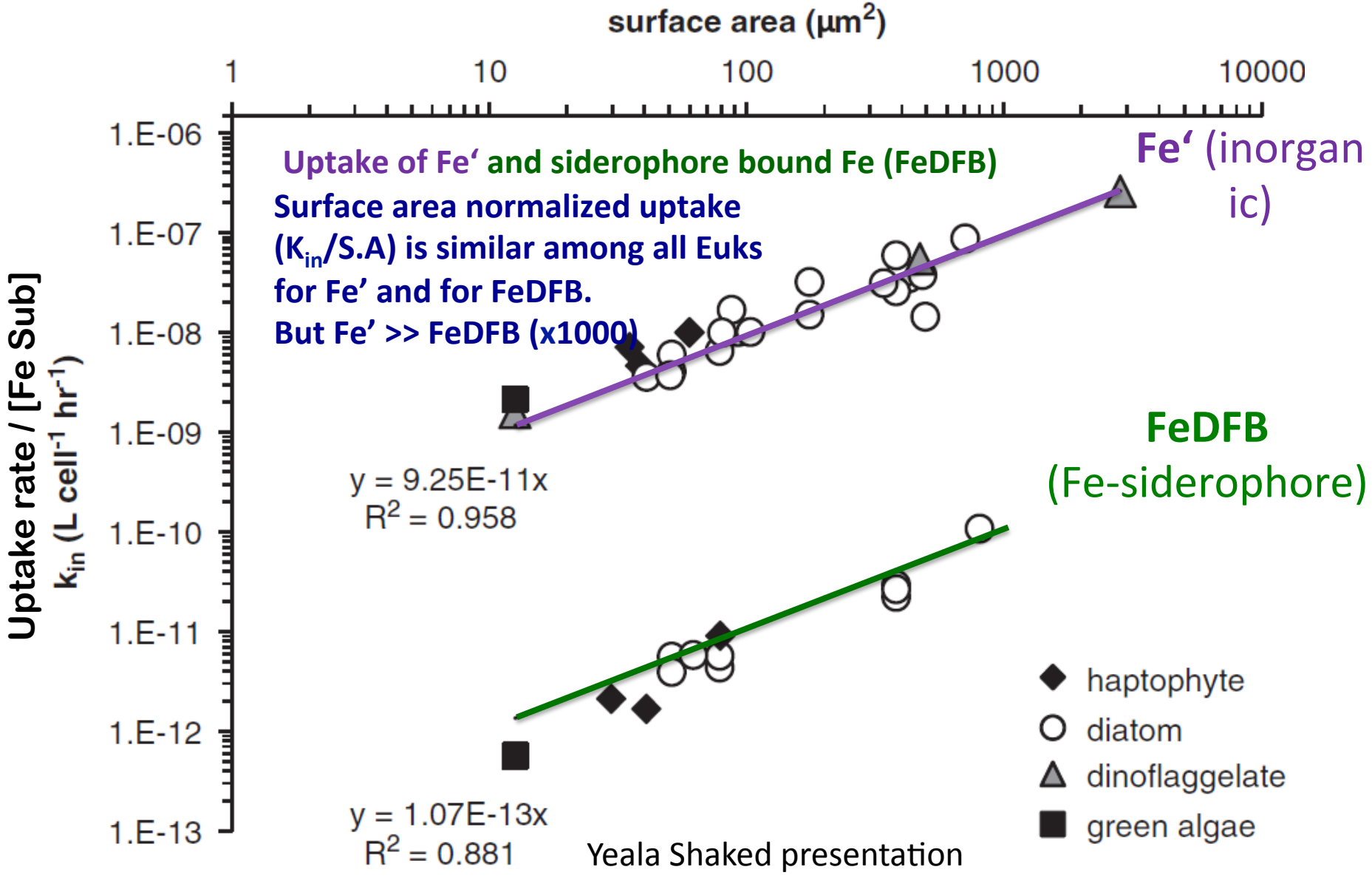

Figure adapted from Moore et al. (2013) *Nature Geo.*

'…you conveniently ignore all that stoichiometric variability…'
(Gideon Henderson, GEOTRACES mtg., London, Dec 2015)

Recognise it and embrace it… (e.g. *Sarmiento et al. 2004 Nature; Weber and Deutsch 2012 Nature; DeVries and Deutsch 2014 Nature Geo.; Galbraith and Martiny 2015 PNAS*)

**2. How much do we know about the different TE acquisition systems of microorganisms?**

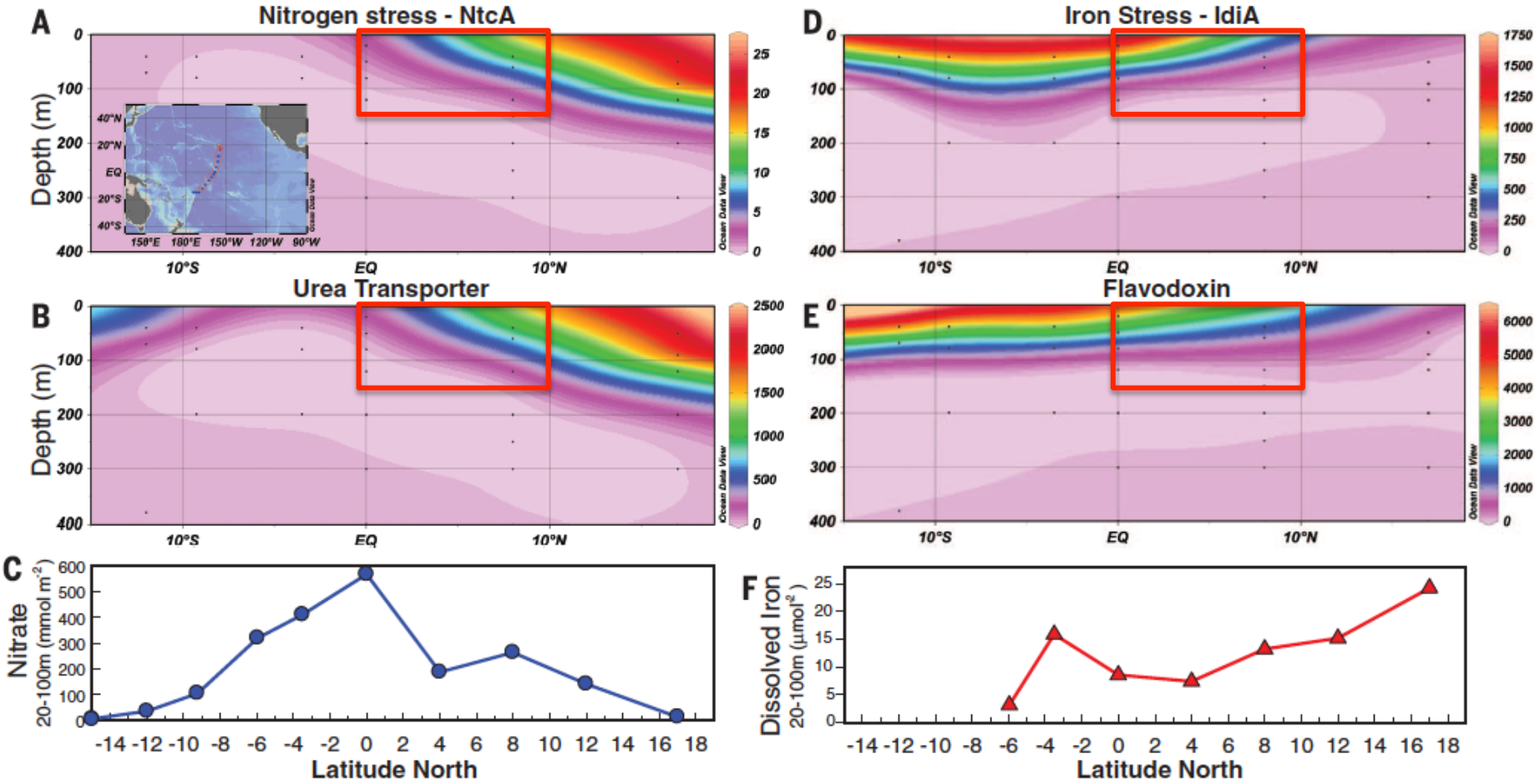
**3. What 'modes' of metal (M) uptake dominate in different natural systems?**



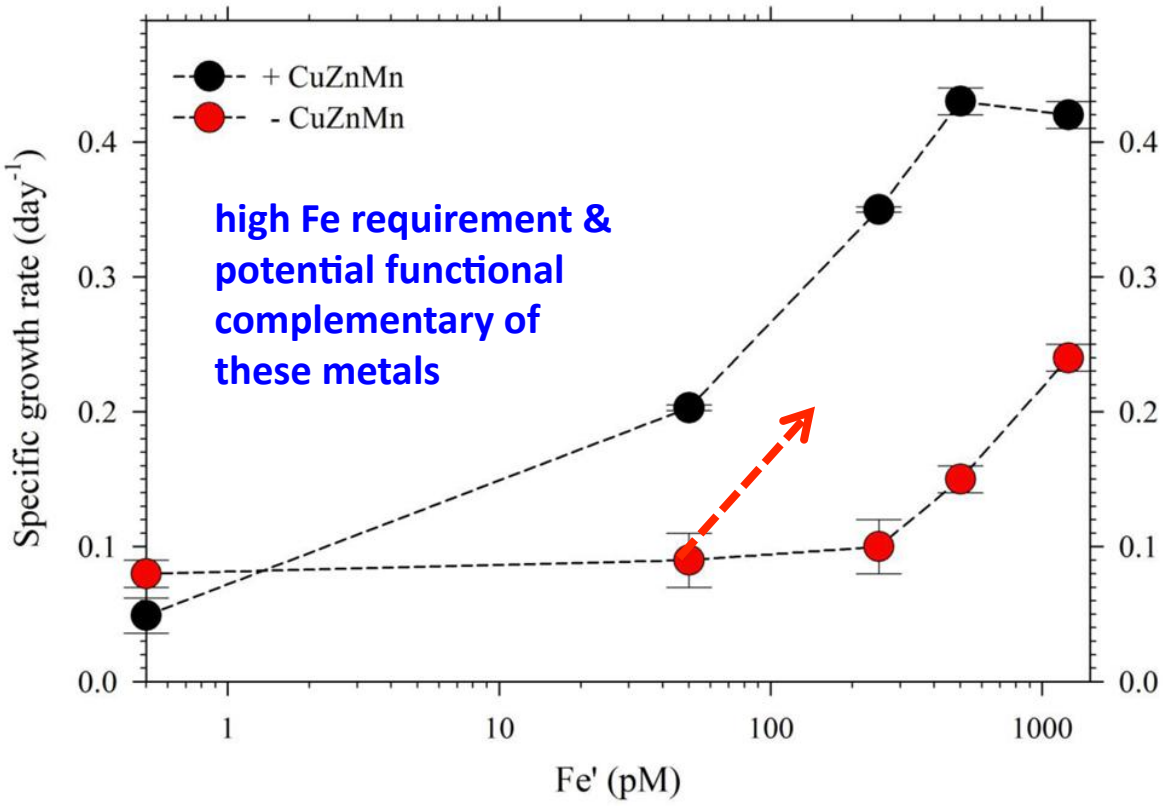
# 4. How important are co-limitations?

- N and Fe stress markers in *Prochlorococcus*:
  - Successfully track biome shifts (N lim, Fe lim)
  - Highlight areas of possible co-limitation

Saito et al. data, Chappell presentation



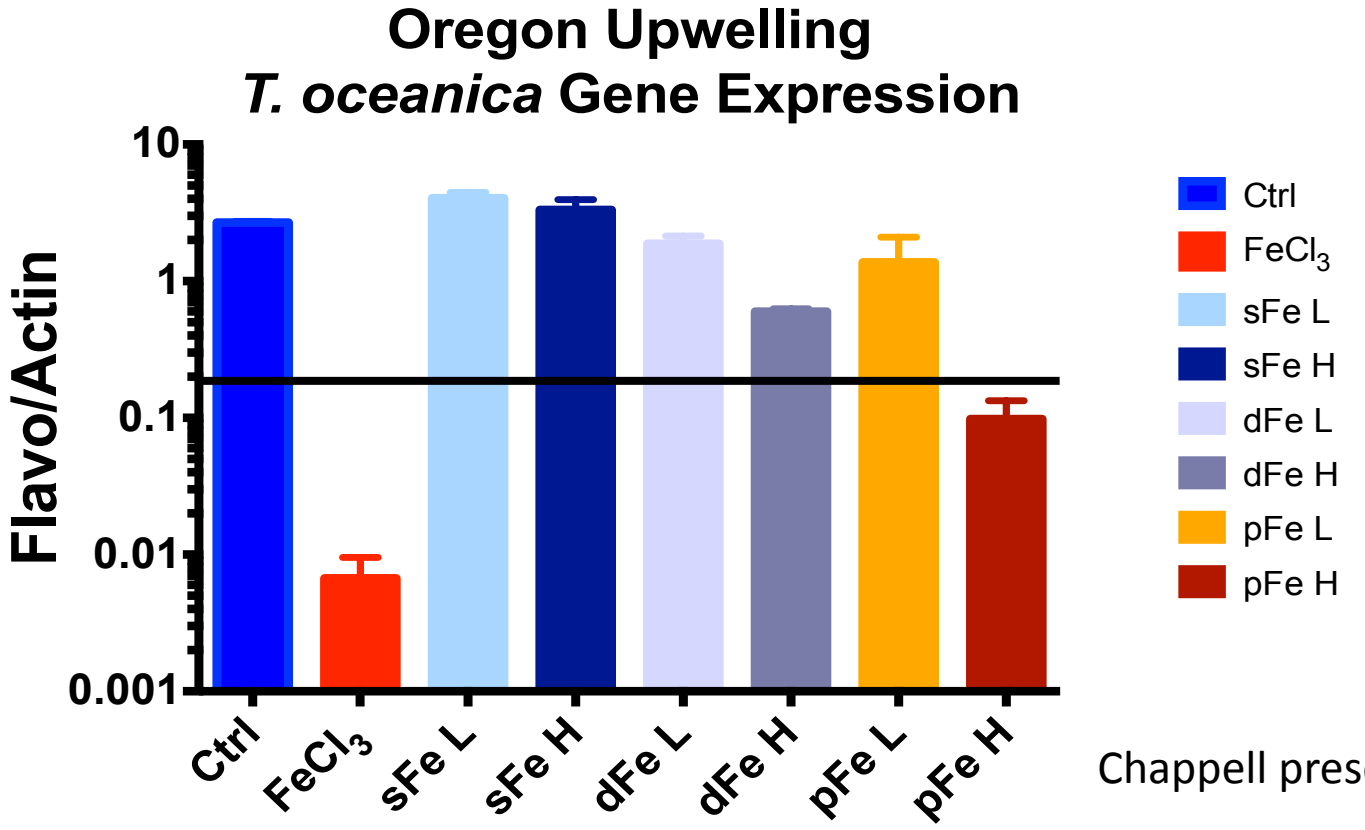
# 5. Can we consider the influence of multiple metals on organisms?




Ho presentation

## 6. How can molecular and biochemical info improve our knowledge?

Fe Stress Gene Expression from Community Incubations (Chappell, Fitzsimmons, Ohnemus unpublished)




Chappell presentation

- Expression indicative of Fe stress is evident in most treatments.
- Samples for expression analysis taken at 72hrs

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1. How does stoichiometric plasticity connect to trace metal distribution and inventories?
2. How much do we know about the different TE acquisition systems of microorganisms?
3. What 'modes' of metal (M) uptake dominate in different natural systems?
4. How important are co-limitations?
5. What are the interactions within an organism for multiple metals?
6. How can biochemical and molecular information to improve our knowledge?

7. How do we improve our understanding of TE bioavailability?
8. What is the role of TE speciation (redox, organic, and physical) for their uptake and bioavailability (link with Theme 2)?
9. Can we connect entire food-web structure with TE uptake and inventories?
10. Can we capture and understand temporal variations (early stage vs. decline of the bloom) and spatial variations?
11. How available are regenerated TEs (link with Theme 3)?
12. How can biological and biogeochemical processes be incorporated into models?
13. How do we connect large GEOTRACES datasets to their influence on the biological pump?

## The bioavailability envelope: comparing Fe substrates

**More bioavailable Fe substrates**

**Less bioavailable Fe substrates**

Yeala Shaked presentation