

Geologic nitrogen: sources and consequences for forest ecosystem services



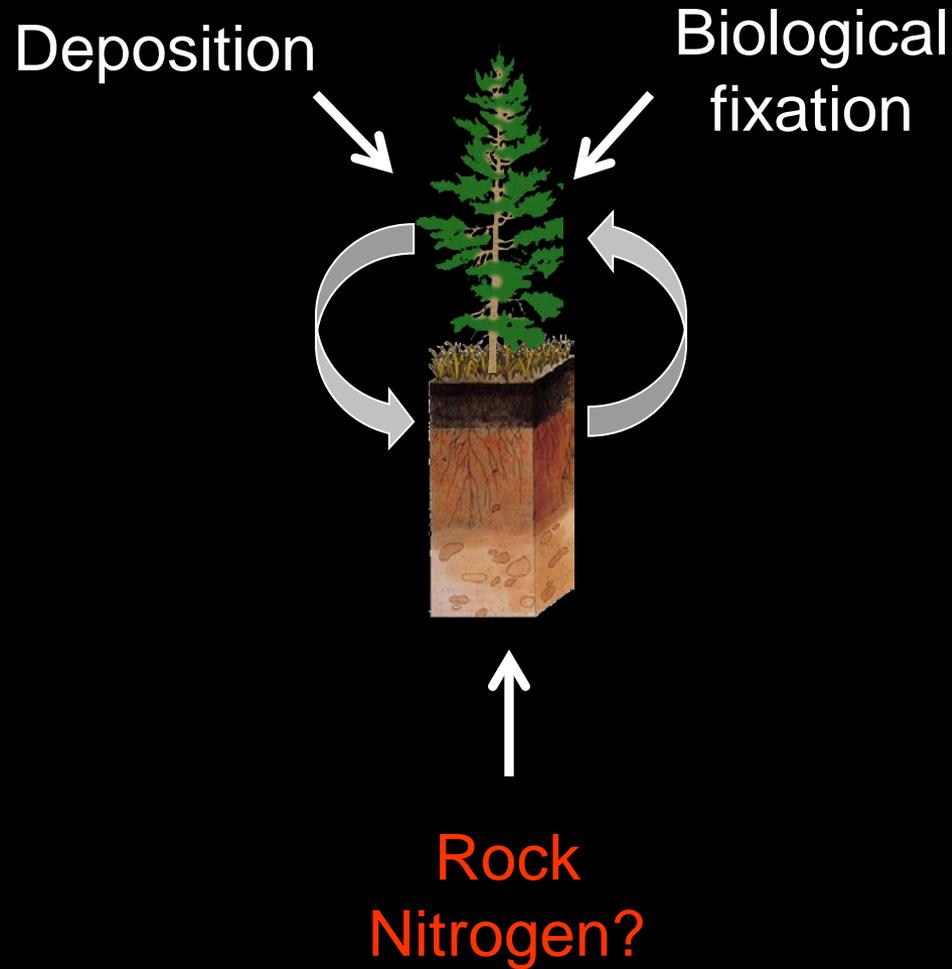
Photo by Mark Geistweite

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Roadmap

- Reconsidering the nitrogen cycle.
- Origin and composition of nitrogen rich parent material.
- Investigations of geologic N reservoirs and inputs to California ecosystems.

Nitrogen inputs



Global Nitrogen Reservoirs

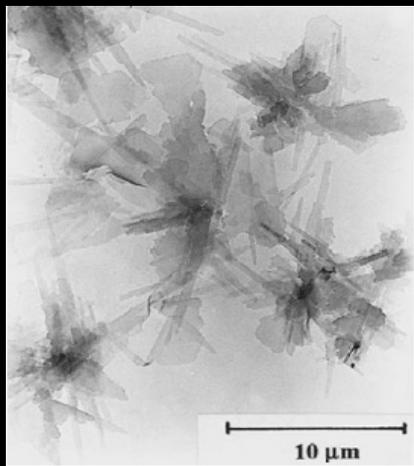


Units: exagrams of N (10^{15} kg N)

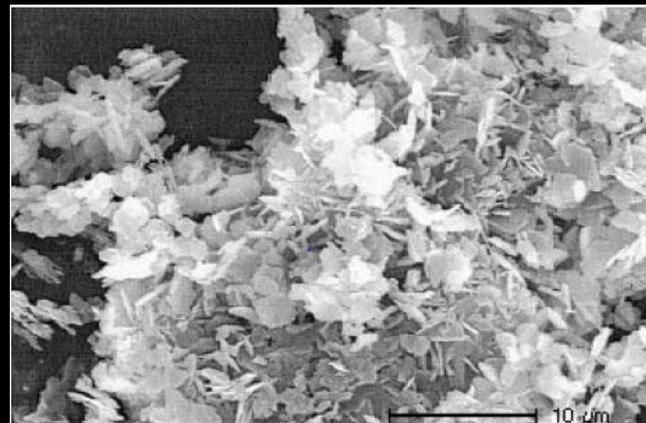
Origin of Geologic Nitrogen

- Nitrogen in rock is primarily derived from ancient productivity
- Nitrogen is incorporated into rock as either relict organic N or as NH_4
- N is found as both Org-N and NH_4 -N in sedimentary rocks, but only as NH_4 in metamorphic rocks
- N is generally lost from rocks in metamorphic regimes where temperatures exceed 500 °C

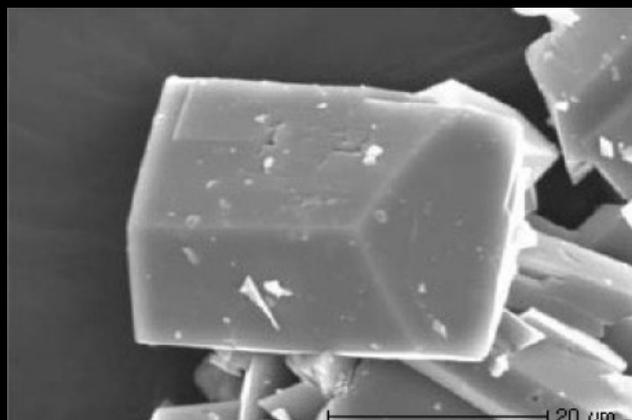
Nitrogen in Silicate Minerals



Ammonium illite



Tobelite

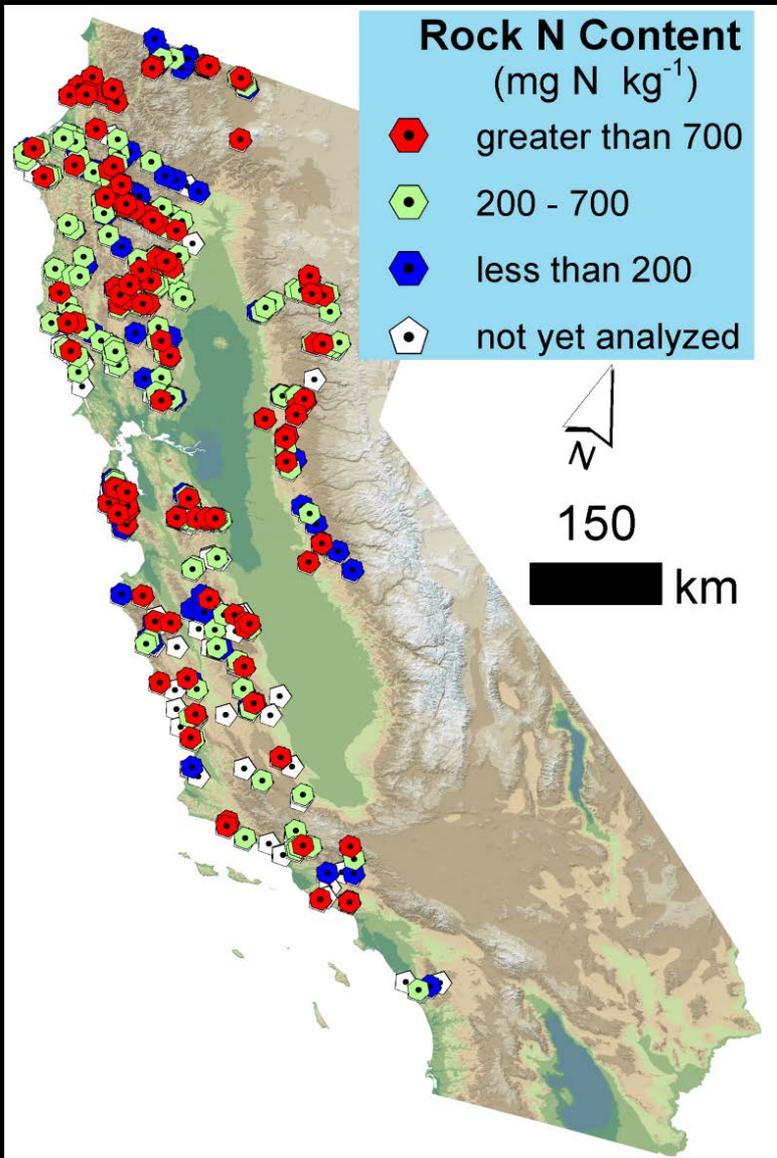


Buddingtonite

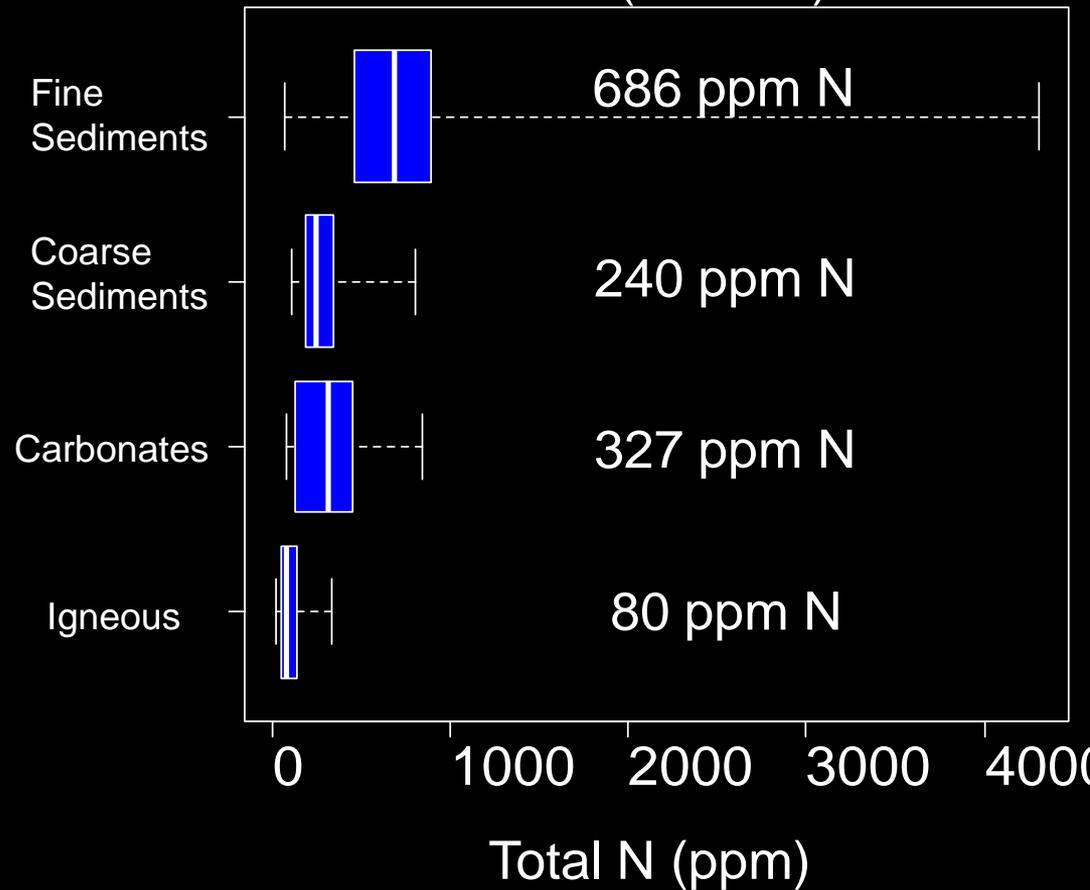


Sucha *et al* 1998 - *Am. Min.*
Harlov *et al* 2001 - *PCM*
Adapted from Watenphul 2007

Rock N reservoirs across California



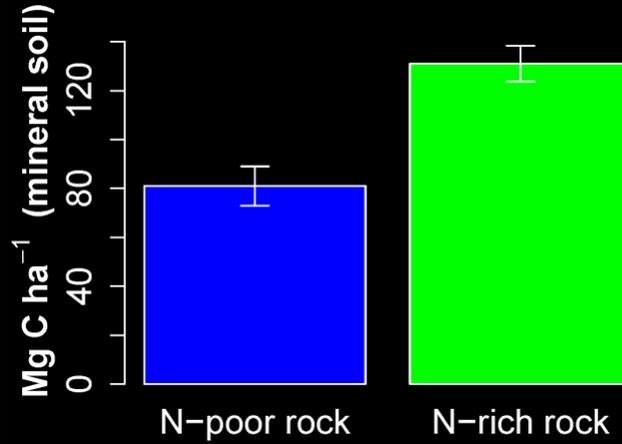
N content by protolith
(median)



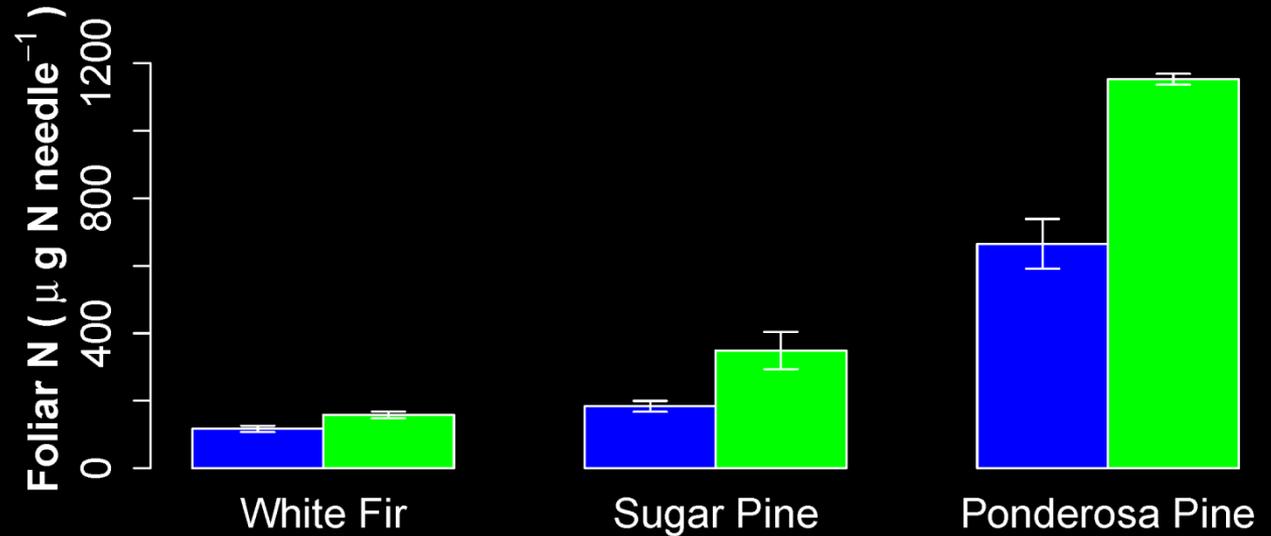
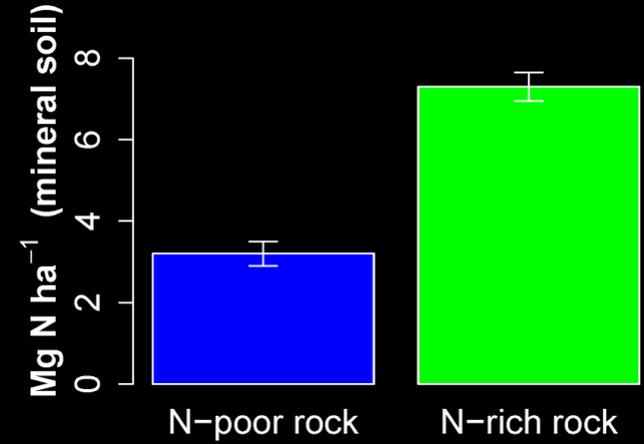
Evidence: differences in forest N accumulation and systematics



Soil carbon



Soil nitrogen



N-rich Bedrock

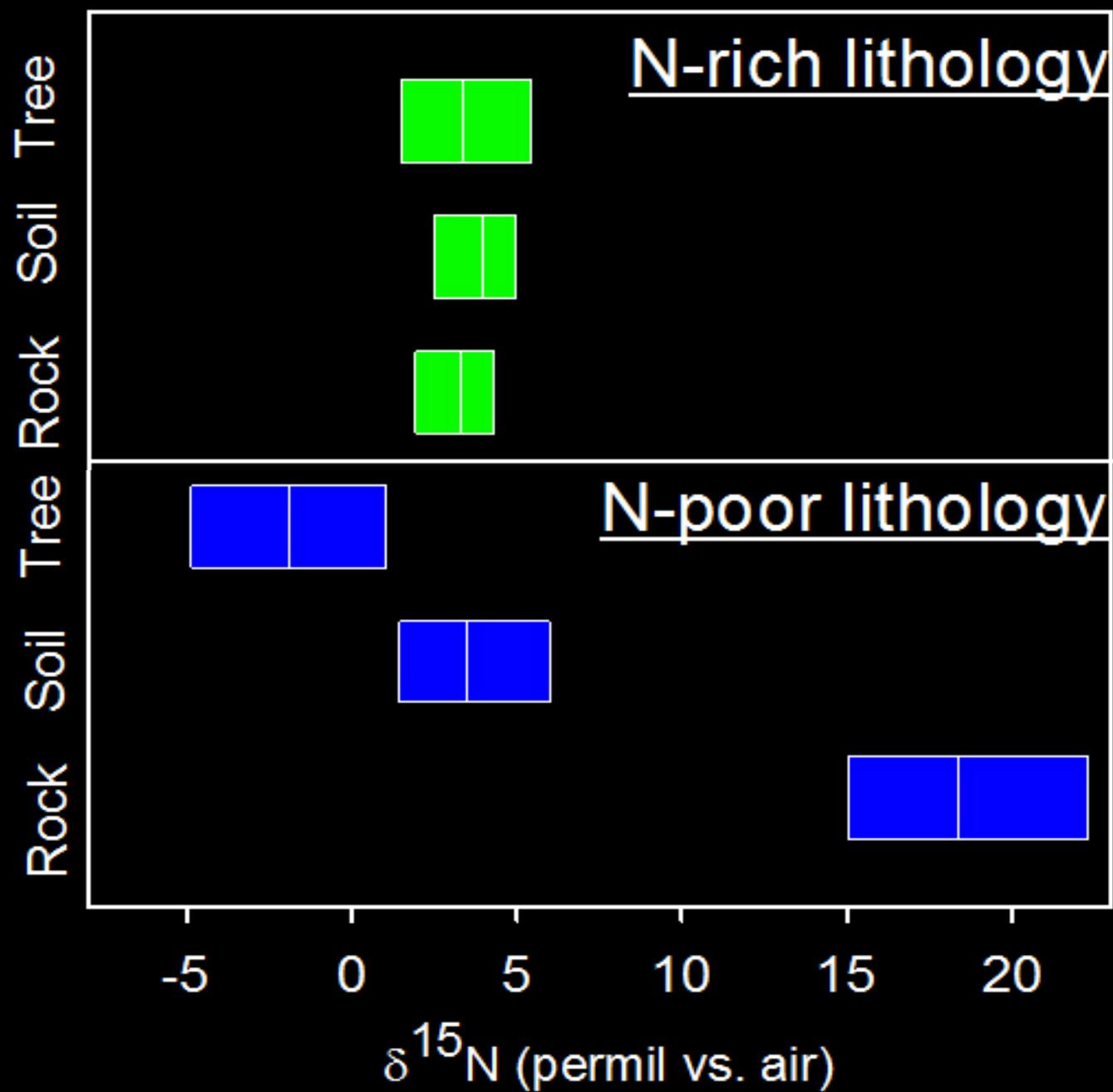


N-poor bedrock

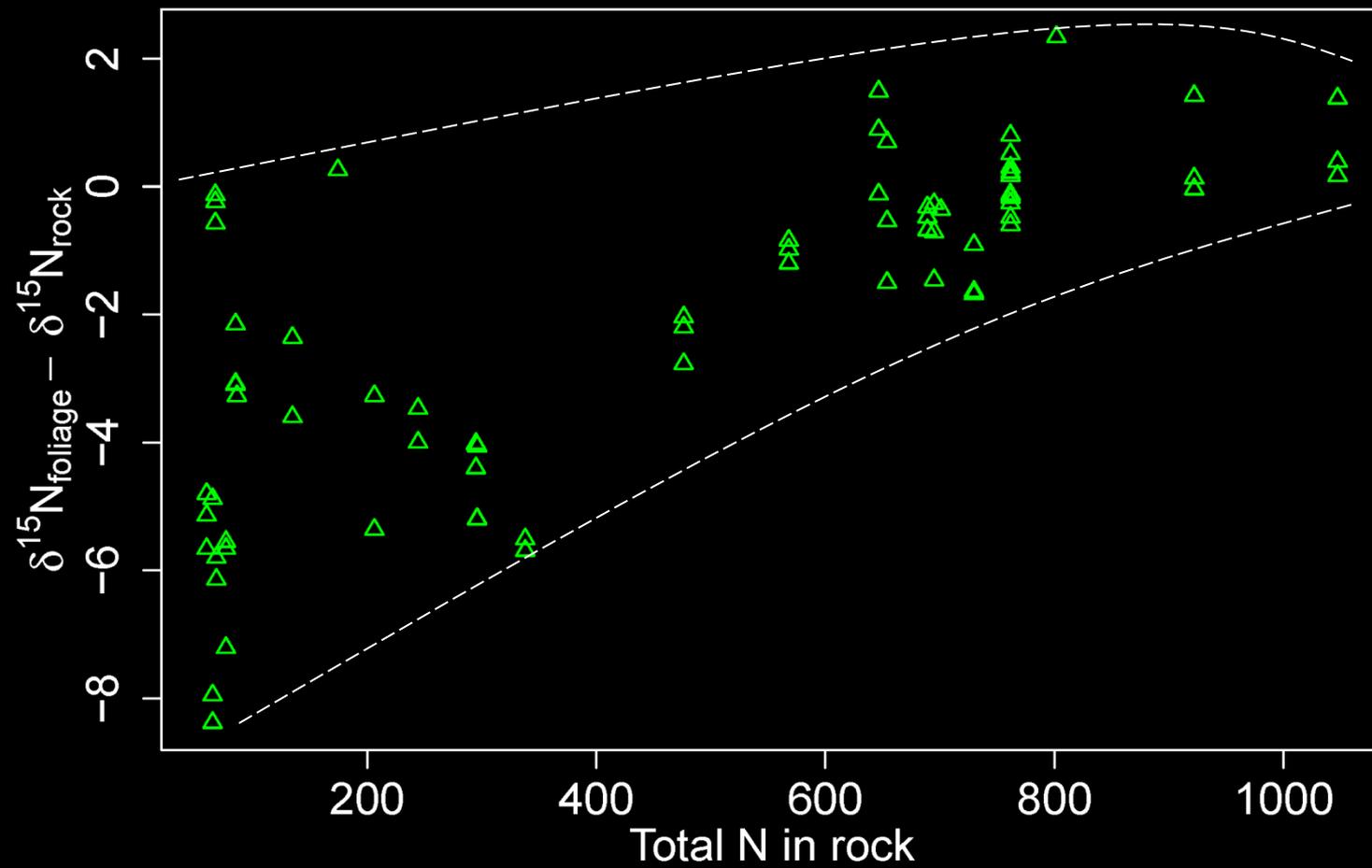


42% more carbon in aboveground biomass





Douglas-fir





Redwood Creek – Redwood National Park



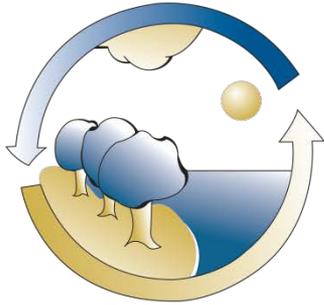
Condrey Mountain – Siskiyou Crest



Colebrooke Mountain – Rogue River Forest



- Nitrogen rich parent material is common in sedimentary and metasedimentary lithologies of California.
- Bedrock is a substantial source of N fertility to some California forests.
- Nitrogen rich bedrock may contribute to enhanced productivity and C sequestration in forests of northwestern California.

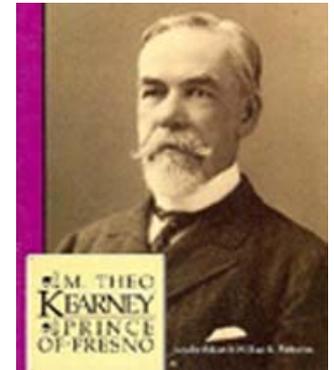


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Thank You!

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Too much of a good thing?



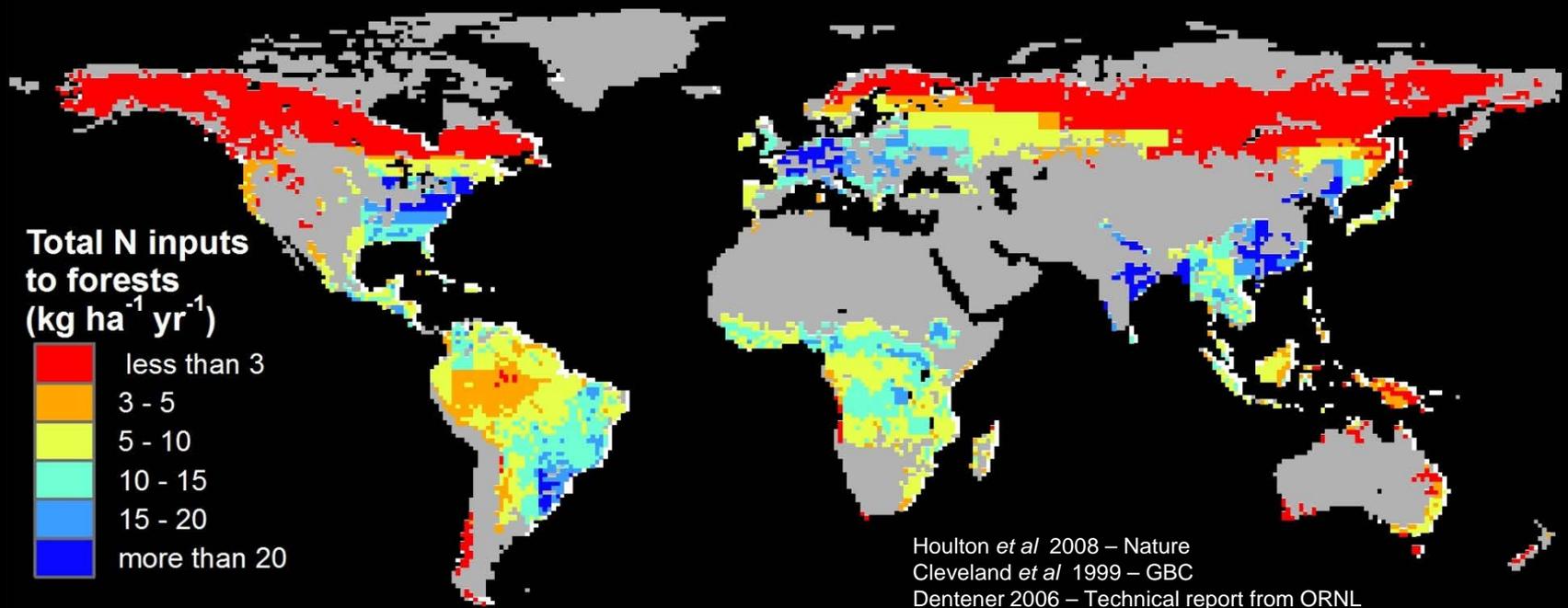
Dahlgren 1994 - *Nature*



barrens

*Proposed
Rough Gulch and
South Fork Mountain
cRNA*

Potential implications



- Modern estimates of global N Inputs to forests : $\sim 30 \text{ Tg yr}^{-1}$
- Additional N inputs by rock: $4.6 - 6.7 \text{ Tg yr}^{-1}$
- **Forest C storage attributable to rock-N: $0.23 - 0.93 \text{ Pg yr}^{-1}$**

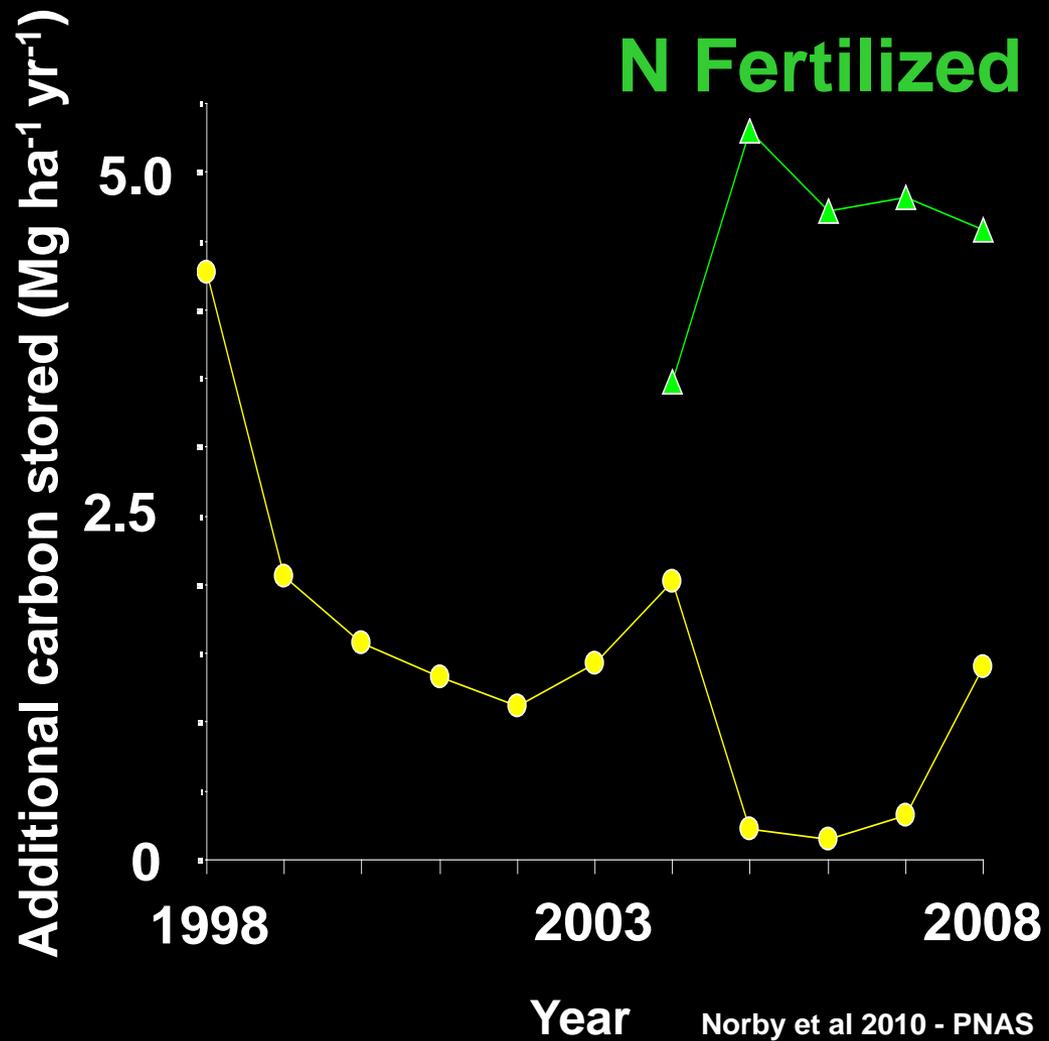


Image: Michigan Technological University