

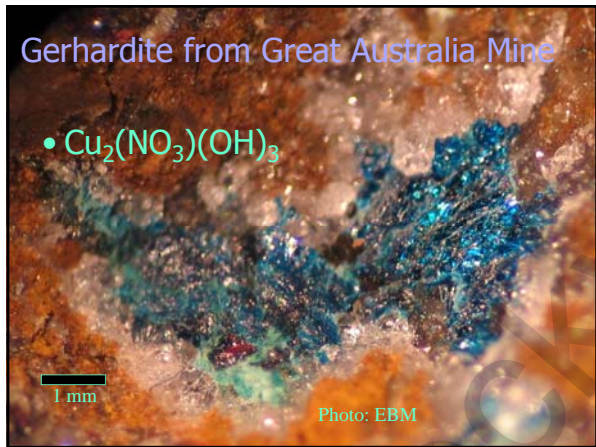
Sex, Death, Eusociality and Biologically Mediated Mineralization: Nitrogen from termite mounds and the origin of gerhardite

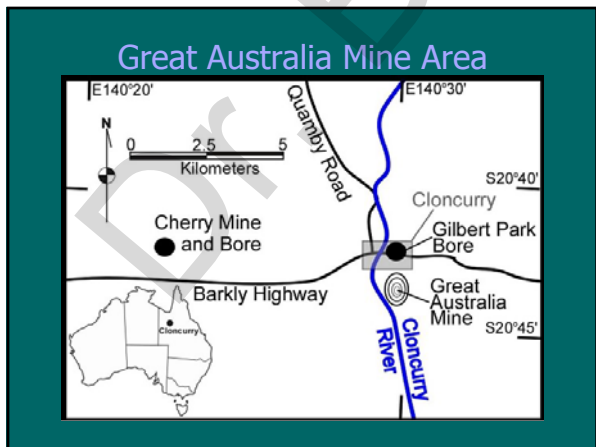
at the Great Australia Mine, Cloncurry, Queensland, Australia

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(California State University, San Bernardino)

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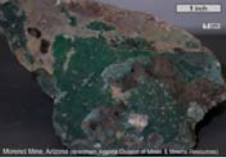
Timothy Rose
(Lawrence Livermore National Laboratory)





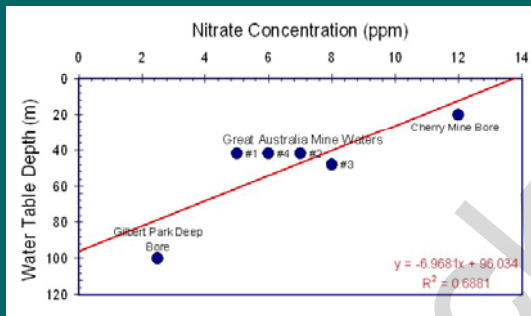
Why Nitrogen?

- Copper deposits are relatively common.
- Carbonate is usually the dominant anion.
- Gerhardtite & other Cu + N minerals are rare.

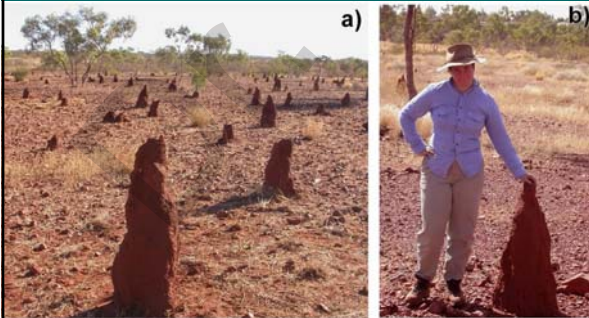


- Why does a nitrogen mineral form here?
- What is the nitrate source?

Surficial Nitrate Source



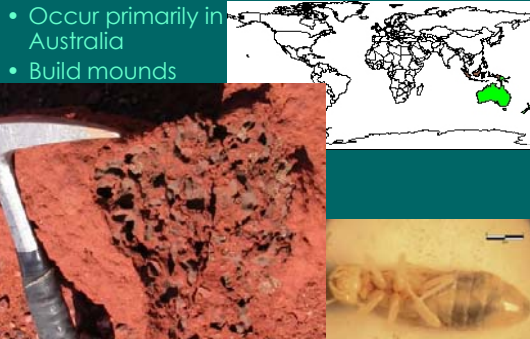
So What's on the Surface?



Are termites the source of the nitrate, and why?


Amitermes vitosus

- Occur primarily in Australia
- Build mounds



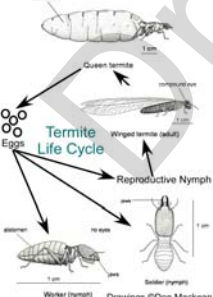
Two unique features of termites

- Gut microbes
 - Allow termites to use low-nutrient food source
 - Allow termites to glean nutrients from faeces

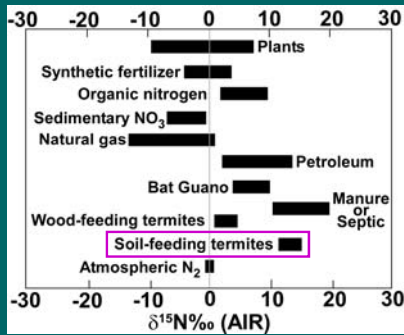


Two unique features of termites

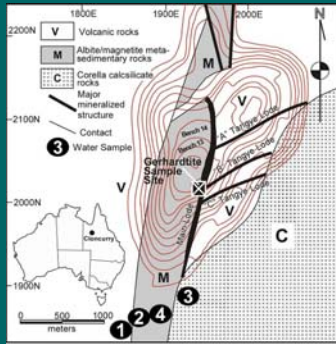
- Gut microbes
- Eusocial colony structure
 - Colonies contain thousands of members
 - Inbreeding → closely related family groups
 - > Cast system → most individuals non-reproductive
 - Necrophagy
 - Cannibalism
 - > Bioaccumulation of nitrogen → increased concentration
 - > Recycling of nitrogen → isotopic fractionation



Comparing $\delta^{15}\text{N}$ Values



Are Termites Really the Source?



- Need to sample:
 1. Groundwater
 2. Gerhardtite
 3. Termite Mound
- Determine Nitrogen Isotope Values ($\delta^{15}\text{N}$)

1. Sampling Groundwater: Collecting Water Samples



1. Sampling Groundwater: Filtering the Samples



1. Sampling Groundwater: Collecting Nitrate with Resin Columns



2. Sampling Gerhardite



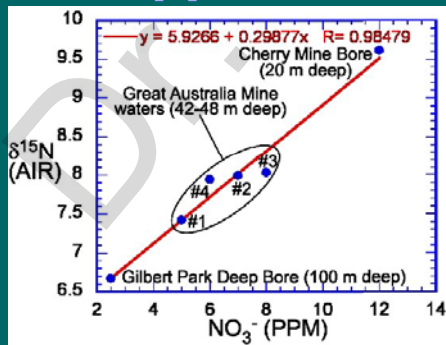
3. Sampling Termites & Mounds



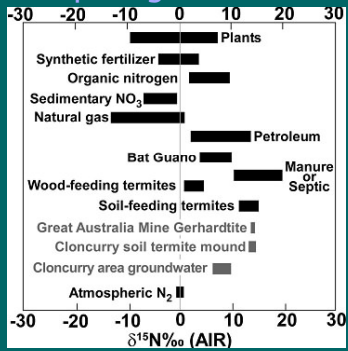
Stable Isotope Analysis ($\delta^{15}\text{N}$)



[N] & $\delta^{15}\text{N}$



Comparing $\delta^{15}\text{N}$ Values



Other Possibilities?

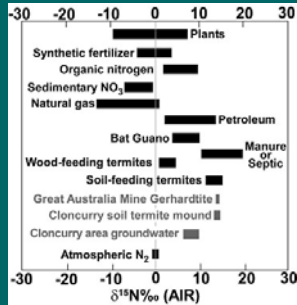


- Leaky septic systems are not a likely source of the nitrogen in Gerhardite, because it formed well before humans were in the area.

YES!!!

Termites are the source of the Nitrogen in Gerhardite from the Great Australia Mine

Other Potential Nitrogen Sources for Gerhardite



- Gerhardite in other localities may result from
 - Bat guano
 - Lightning
- Predictions:
 - High local [N]
 - Less recycling → lower $\delta^{15}\text{N}$

ACKNOWLEDGEMENTS

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