

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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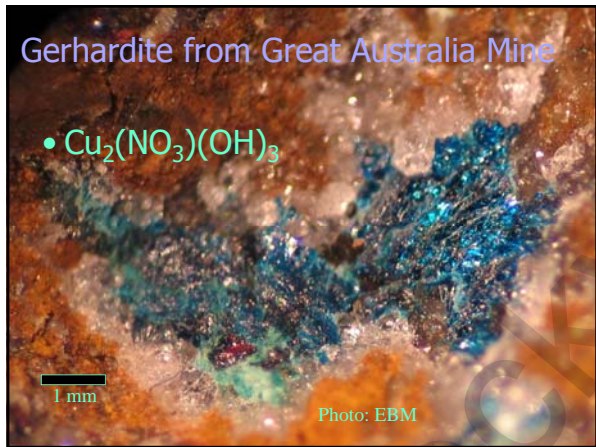
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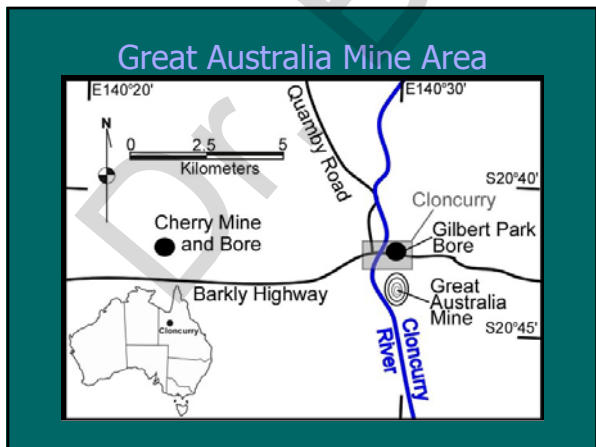
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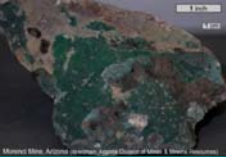
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## Why Nitrogen?

- 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?

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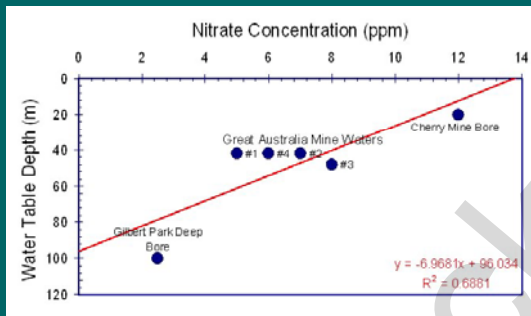
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## Surficial Nitrate Source




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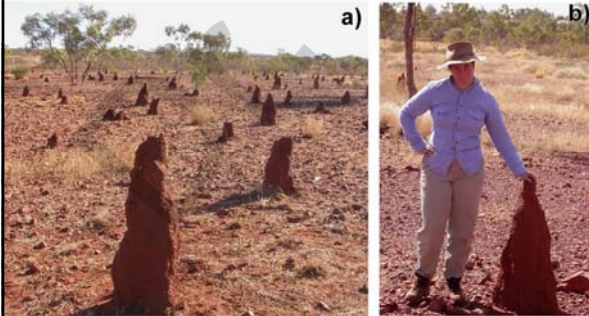
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## So What's on the Surface?



Are termites the source of the nitrate, and why?

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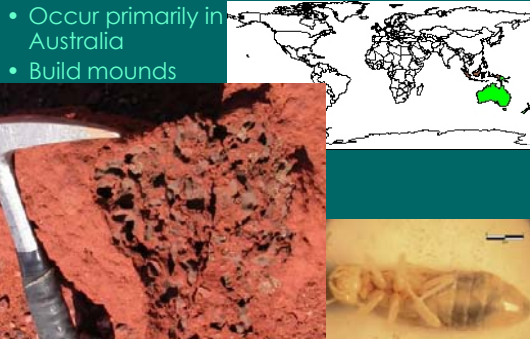
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### *Amitermes vitosus*

- Occur primarily in Australia
- Build mounds




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### Two unique features of termites

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




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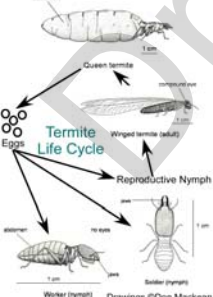
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### Two unique features of termites

- 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




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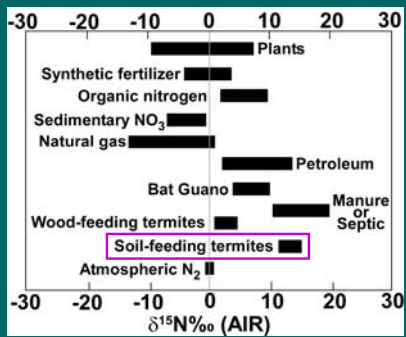
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## Comparing $\delta^{15}\text{N}$ Values




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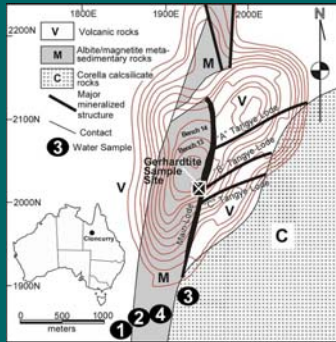
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## Are Termites Really the Source?



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

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## 1. Sampling Groundwater: Collecting Water Samples




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### 1. Sampling Groundwater: Filtering the Samples



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### 1. Sampling Groundwater: Collecting Nitrate with Resin Columns



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### 2. Sampling Gerhardite



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### 3. Sampling Termites & Mounds



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



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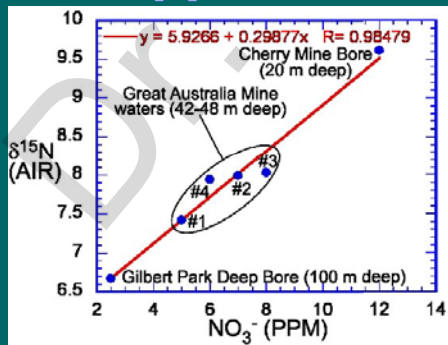
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### [N] & $\delta^{15}\text{N}$



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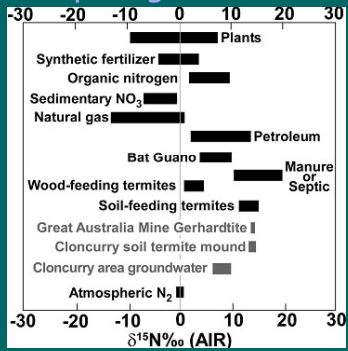
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## Comparing $\delta^{15}\text{N}$ Values




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## 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.

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YES!!!

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

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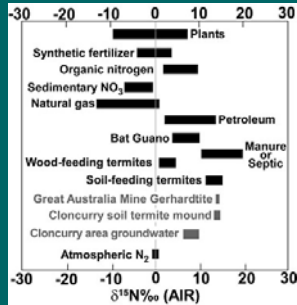
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## Other Potential Nitrogen Sources for Gerhardite



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

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## ACKNOWLEDGEMENTS

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