# Palaeo-tracers: A brief overview of some chemical tracers used to reconstruct past aquatic environments

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# Palaeo-ecology

- Palaeo-insights
  - Understanding past ecosystem variability to predict and manage now and into the future
  - Timing of and ecosystem responses to stressors
- Tracers derived from wetland sediments
  - Many other fossil proxies such as sedimentation rates and chemical composition, fossilized plant and animal remains etc.
- Currently applying many of these techniques with collaborators
  - North Stradbroke and Fraser Island
  - Cape York
  - Burdekin

# Palaeo-How?

- Collect cores, age cores
  - ($C_{14}$, OSL, $Pb_{210}$, $CS_{137}$, *Pinus* pollen)
- Develop age model relating core depth to age
- Sample core at intervals
- Analyse samples for chemical tracers
- Recreate and apply ages to past environmental and ecological conditions

Queensland
Government

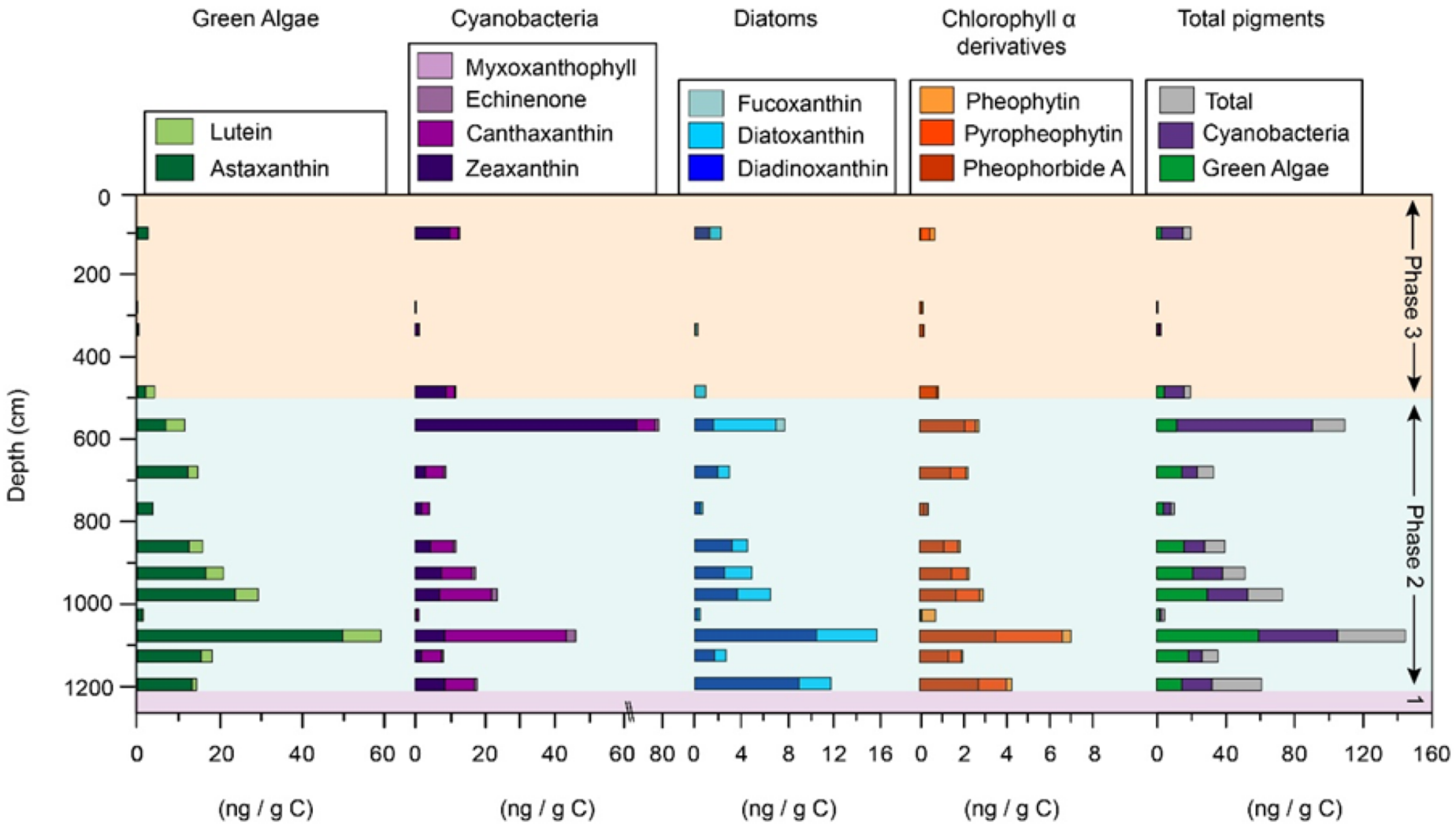

eppendorf
Aluminium foil
150
T FW18/2 0-1 m

Queensland
Government

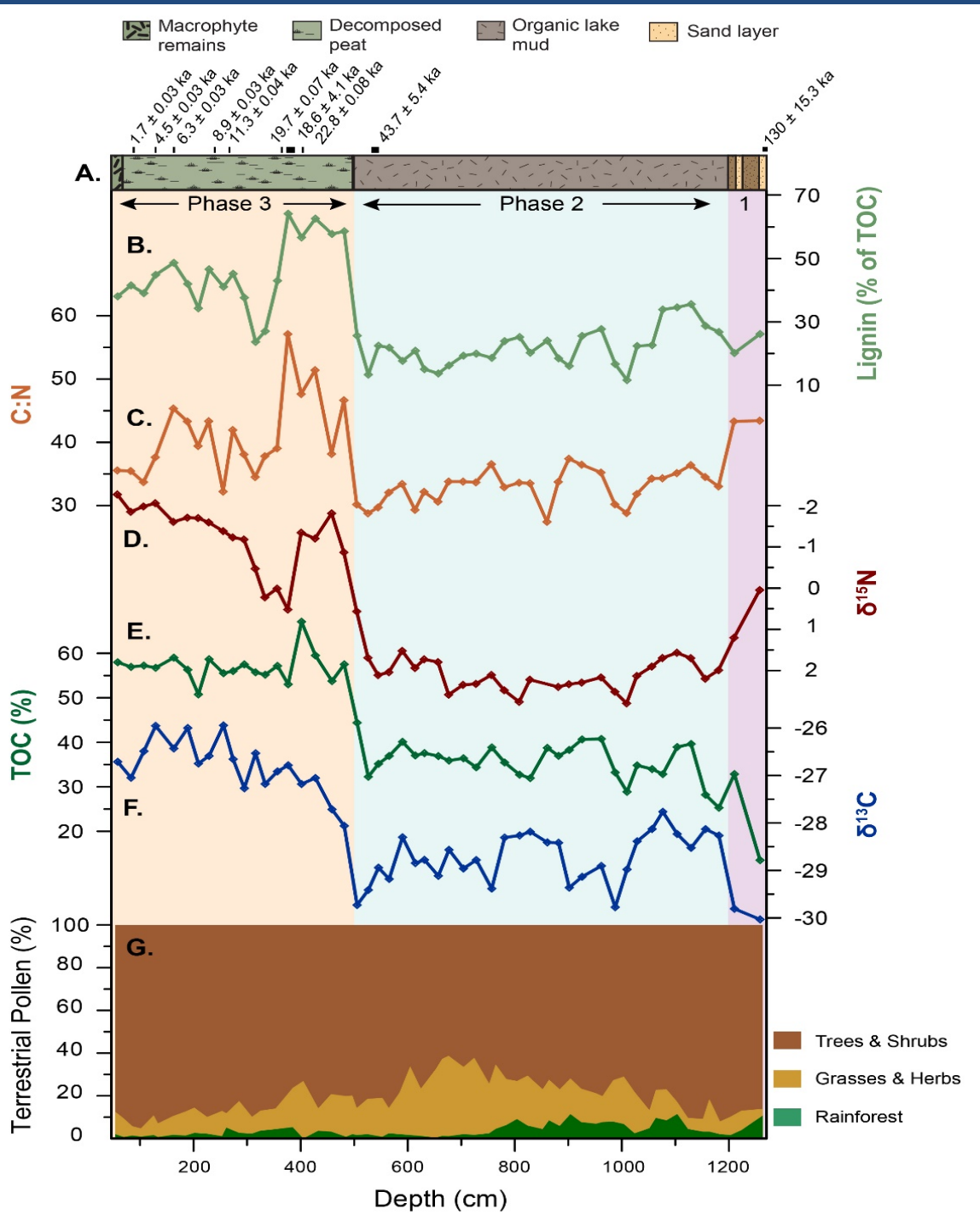
# Past Basal Food Resources

- C:N
  - contribution of terrestrial vs aquatic organic sediment sources
- C and N stable isotopes
  - contribution of terrestrial vs aquatic organic sediment sources
- Algal pigments
  - Composition and dominance of algal production from different algal taxa
- Palaeo-eDNA
  - Presence of individual taxa and assemblage composition
- Fatty Acids
  - FA composition from different basal sources

# Algal Pigments example



# SI example


Macrophyte remains
Decomposed peat
Organic lake mud
Sand layer
1.7 ± 0.03 ka
4.5 ± 0.03 ka
6.3 ± 0.03 ka
8.9 ± 0.03 ka
11.3 ± 0.04 ka
19.7 ± 0.07 ka
18.6 ± 4.1 ka
22.8 ± 0.08 ka
43.7 ± 5.4 ka
130 ± 15.3 ka
A.
Phase 3
Phase 2
1
B.
C.
D.
E.
F.
G.
C:N
Lignin (% of TOC)
δ15N
TOC (%)
δ13C
Terrestrial Pollen (%)
Trees & Shrubs
Grasses & Herbs
Rainforest
Depth (cm)

# Past Ecological Assemblages

- Palaeo-eDNA
  - Presence of individual taxa and assemblage composition
- Faecal sterols, bile acids and stanols
  - Presence and broad composition of vertebrate taxa (pigs, cows, humans, birds etc)

# Past Water Chemistry, Movement and Growth

- Fossil otoliths and shells
  - Middens, natural deposits

# Water regimes

- $\delta C_{leaf}$
  - Rainfall reconstruction from carbon isotope fractionation in leaves
- Oxygen isotopes ($\delta^{18}O$) in organic compounds
  - CCSI of oxygen in plant cellulose and leaf waxes
  - CCSI of oxygen in silicates from diatoms and sponges
  - CCSI of oxygen in chironomid, ostracod and cladoceran remains
- Leaf wax lipids
  - Chemical structure and CCSI of leaf wax alkenes

# Water Temperature

- Fatty Acids
  - Glycerol dialkyl glycerol tetraether (GDGT) chemical structure from bacterial cell membranes


Questions?