

# Wintertime Copper and Iron Speciation around the Shackleton Fracture Zone, eastern Antarctic Peninsula

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# Copper and Iron Organic Speciation in Antarctic Peninsula Waters: Methods and Background

## Methods

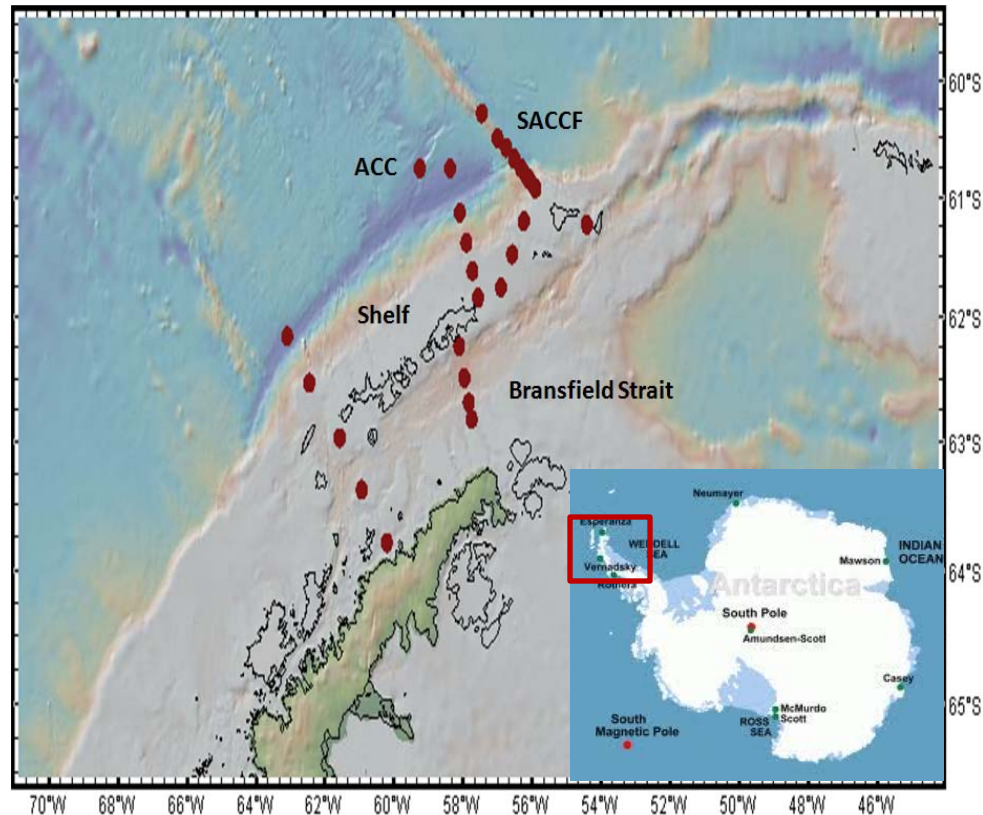
- Surface samples collected in winter for iron and copper speciation
  - Minimum in biological activity; inner shelf-ocean gradients; little existing speciation data for the region
- Speciation analyses using electrochemical technique (CLE-ACSV), totals using ICP-MS (Lohan et. al. 2005)

## Background

- Copper organic speciation
  - Known sources of strong ligands: production by some cyanobacteria and diatoms
  - Known sources of weak ligands: sediments
- Iron organic speciation
  - Known sources of strong ligands: production by some bacteria and phytoplankton
  - Known sources of weak ligands: grazing , photochemistry, sediments

# Preliminary Hypothesis

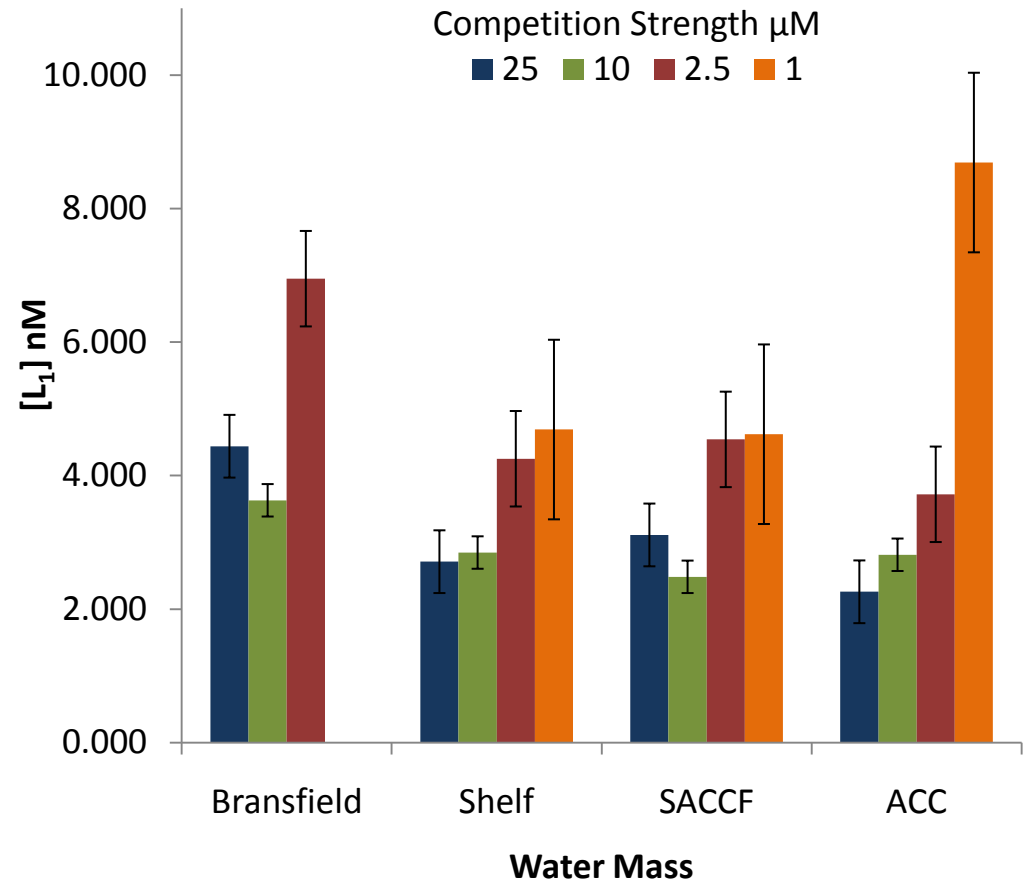
Few, if any, strong Cu or Fe ligands will be present due to wintertime minimum in biological activity, and weak ligands will dominate on the shelf due to sediment sources.





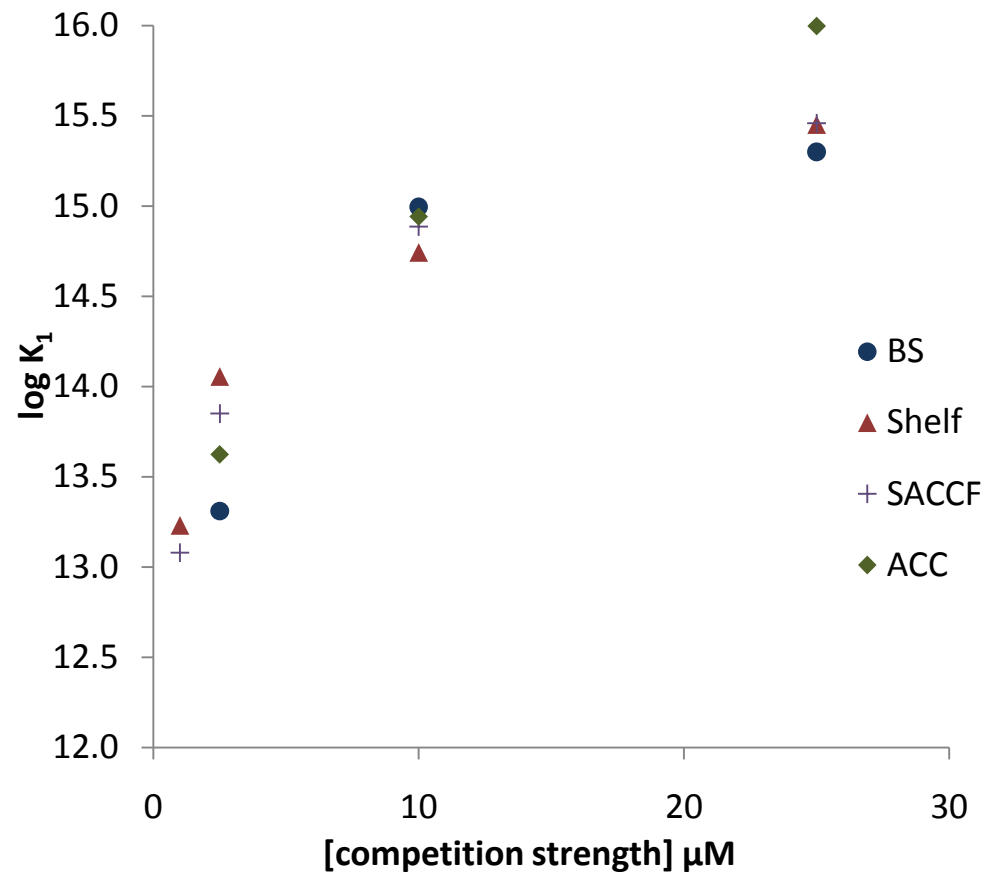
# Pool of Strong Cu-Binding Ligands Assayed Using Multiple Competition Strengths

- Strong Cu-binding ligands ( $L_1$ ) present in every water mass
- ACC has the highest ambient concentration of strong Cu ligands



# Conditional Stability Constants for Strong Cu-Binding Ligands

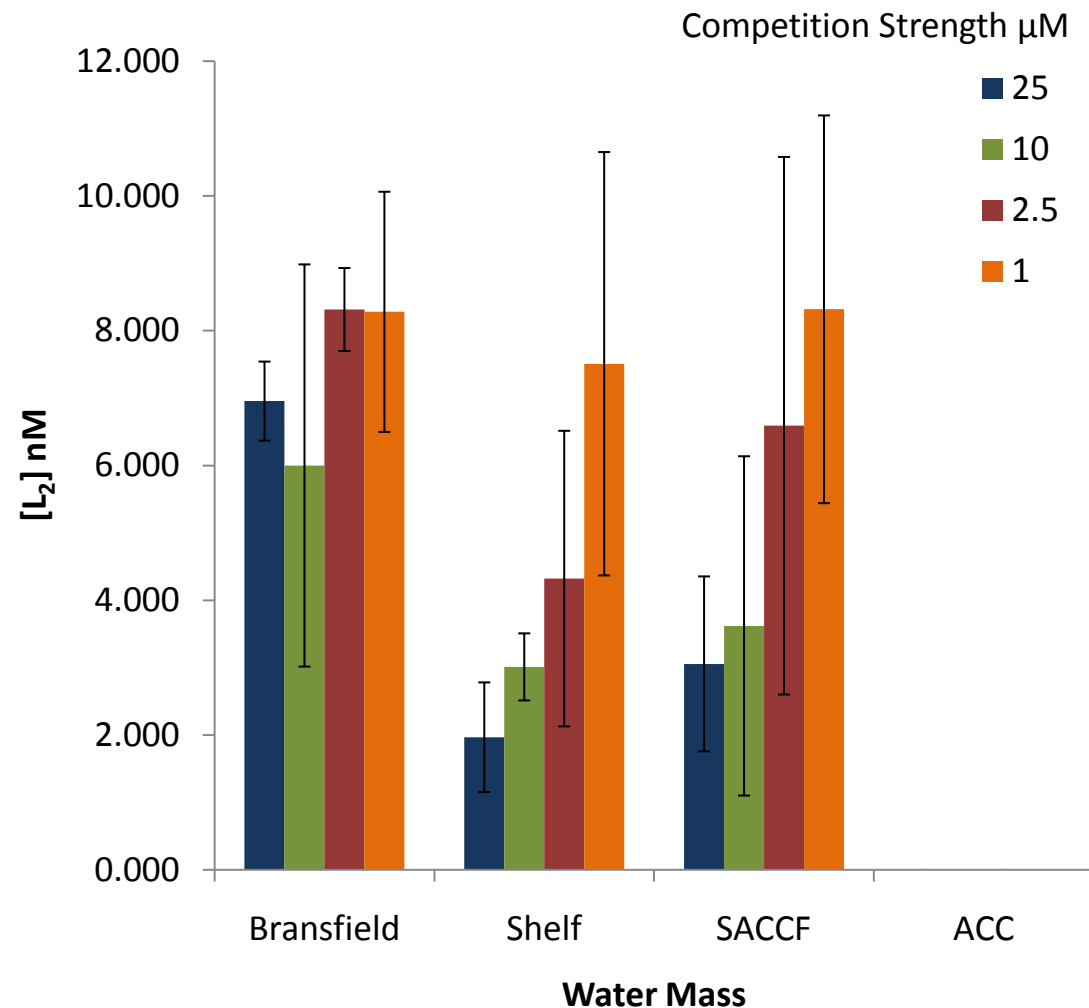
- Strongest ligands seen at the highest competition strength
- Strongest Cu ligands in the ACC
- Strong ligand pool ranges from  $\log K_1 = 13.0 - 16.0$





# Pool of Weak Cu-Binding Ligands Assayed Using Multiple Competition Strengths

- Generally, the greatest concentrations of weak ligands ( $L_2$ ) are detected at the lowest competition strength
- No weak Cu ligands detected in the ACC

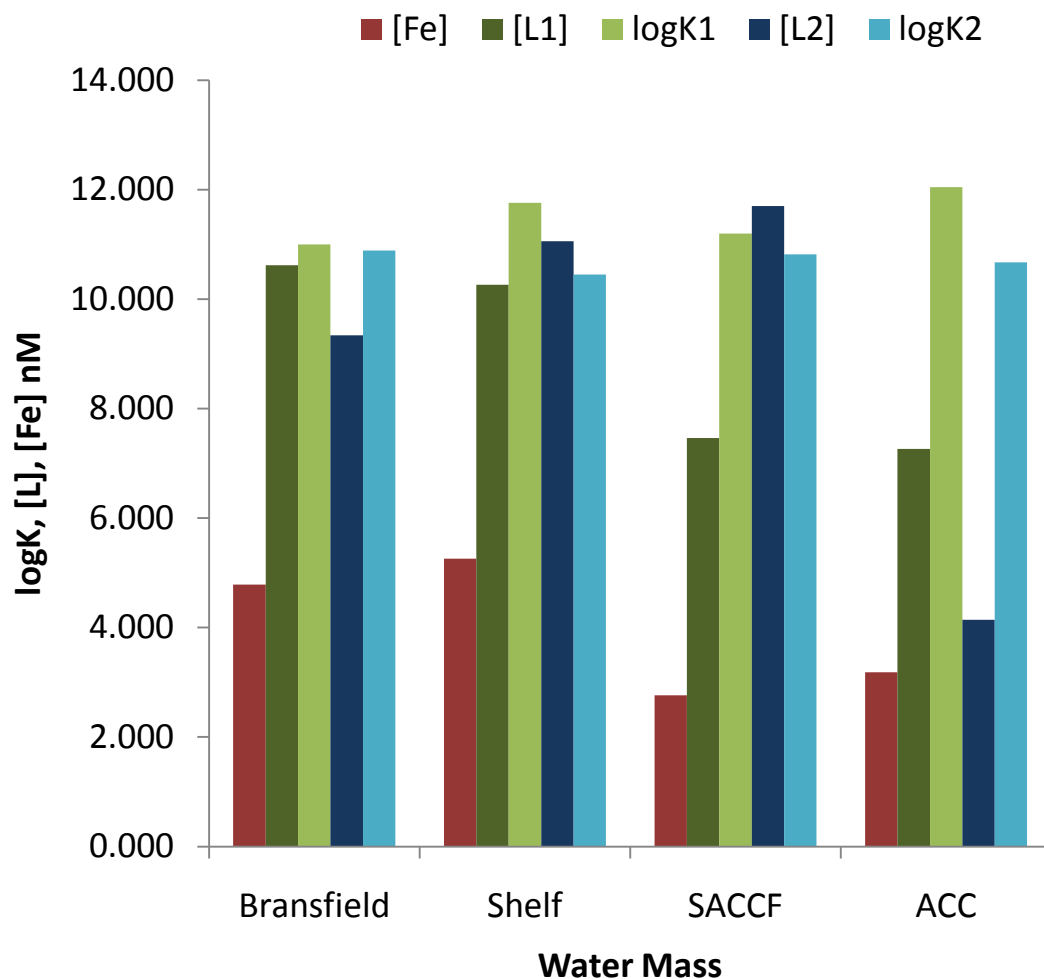


# Copper-Binding Ligand Conclusions

- Strong copper-binding ligands detected in ACC despite local absence of phytoplankton known to produce them
  - Refractory Cu L<sub>1</sub> ligands?
- Weak ligands were absent in the ACC
  - Suggests a shelf source of Cu L<sub>2</sub> ligands
- Cu<sup>2+</sup> levels are generally < 10<sup>-13</sup> M
  - Extremely low free Cu, nearing levels that may limit some inducible Fe acquisition mechanisms (*Maldonado et. al. 2006*)

# Pool of Fe-Binding Ligands Assayed at a Single Competition Strength

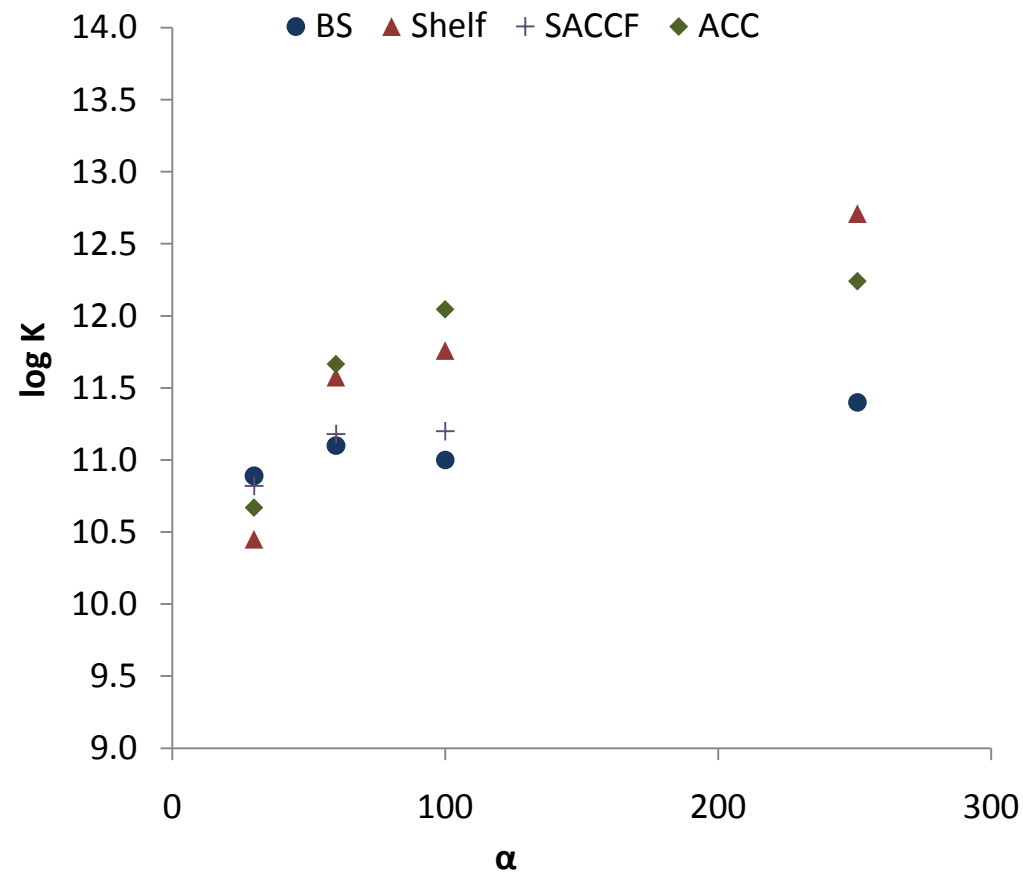
- Fe concentrations highest on the shelf and in the Bransfield Strait
- Largest pool of Fe ligands in the Bransfield, Shelf and SACCF
- Strongest Fe ligands found in the ACC
- LogKs range from 10.5-11.9





# Conditional Stability Constants of Fe-Binding Ligands at Multiple Competition Strengths

- Slightly wider range of stability constants observed using multiple competition strengths (10.5- 12.7)
- Strongest Fe ligands ( $\log K_s > 12$ ) in the ACC and in one sample on the shelf
- Weakest Fe ligands in the Bransfield Strait

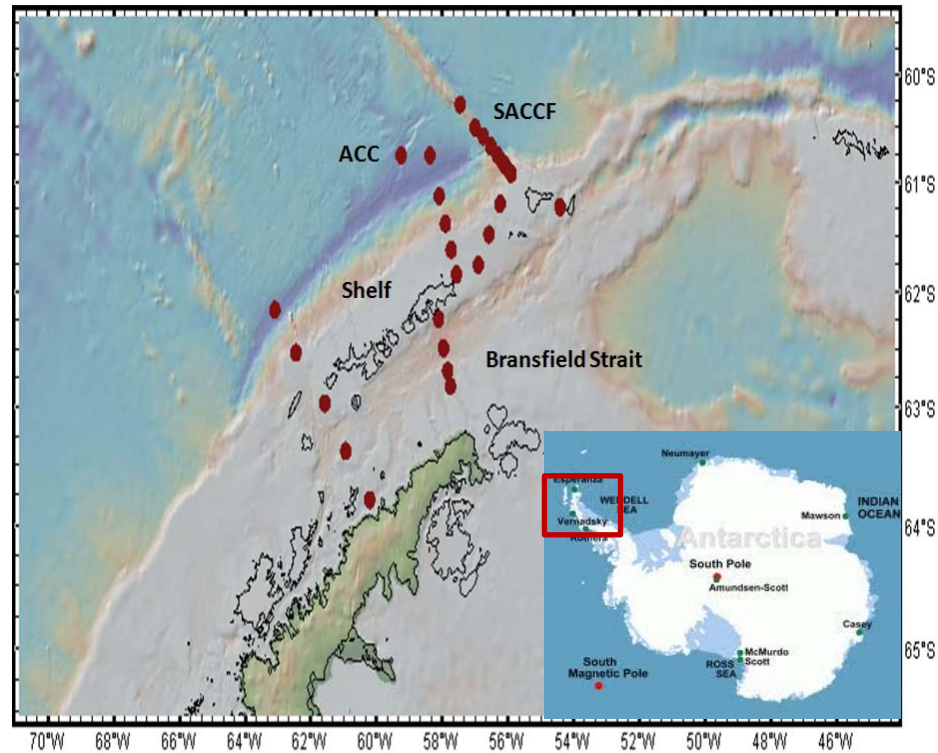


# Iron-Binding Ligand Conclusions

- Strong iron-binding ligands were detected in all water masses
  - Similar excess of strong ligands in all water masses
- Fewer weak Fe ligands detected in the ACC compared to the other water masses
- Strongest Fe ligands detected in the ACC and one station on the shelf (closest shelf station to the ACC)
- Weakest Fe ligands detected in the Bransfield Strait

# Preliminary Hypothesis

Few, if any, strong Cu or Fe ligands will be present due to wintertime minimum in biological activity, and weak ligands will dominate on the shelf due to sediment sources.



Strong Cu and Fe ligands ubiquitous, especially in ACC, despite minimal biological activity; shelf source of weak ligands confirmed.