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Third Year ARCS Scholar Wahlen/ARCS Award

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## The fields of chemical ecology and natural products chemistry focus on the small-molecule secondary metabolites that organisms produce to provide competitive advantages.

My research in these fields examine:

1. How secondary metabolites produce their biomedical effect.
2. How marine algae use an unusual element in their bioactive secondary metabolites.

### Project 1: Probing the antibiotic mechanism of action of marine natural products using a combined $^1\text{H}$ NMR and LC/IM-MS metabolomics approach

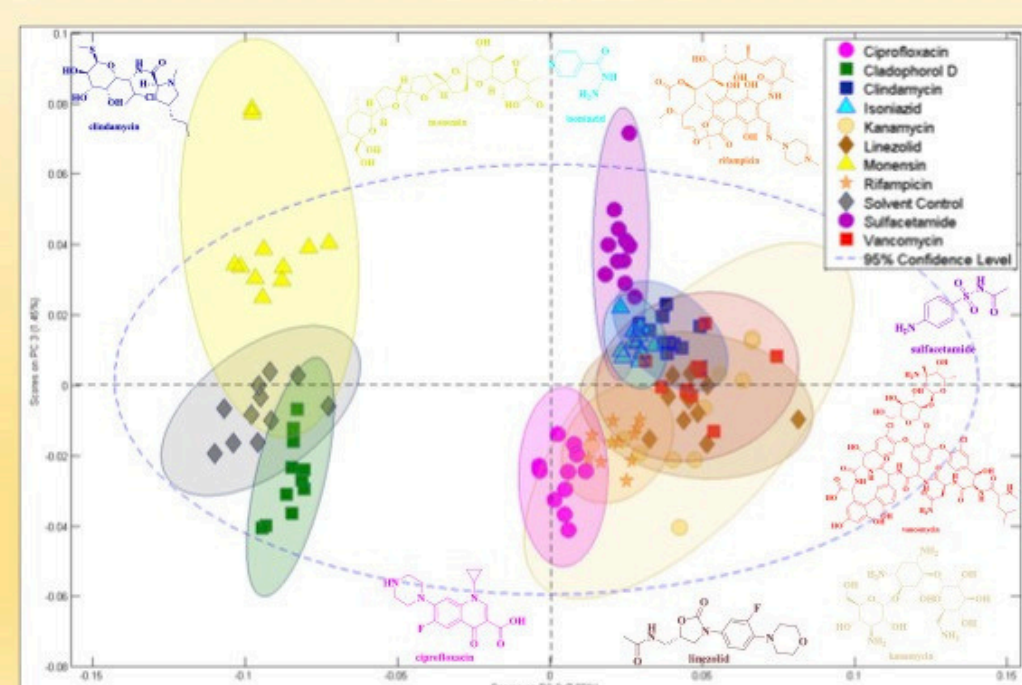
- Cladophorol family of secondary metabolites selectively kill MRSA cells via an unknown mechanism. This study aims to probe this antibiotic activity for biomedical and ecological applications.



### Background

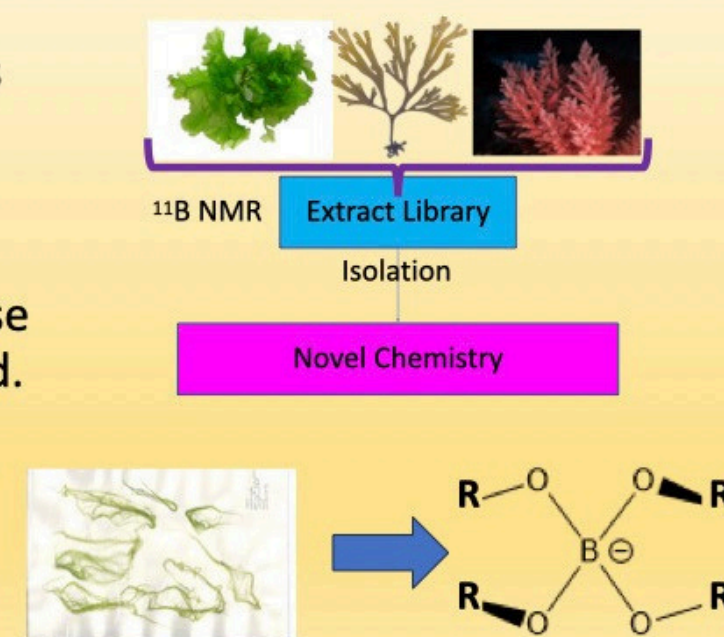
- Establishing the Mechanism of Action (MOA) of a bioactive natural product is important for understanding how it functions and advancing it as a drug.
- Systems-biology approaches, like metabolomics, are effective and efficient at generating hypotheses leading to targeted and prioritized MOA investigations.
- Metabolomics is advantageous for MOA studies: 1) detection of non-protein products of genes, 2) intermediates/products of primary metabolism, 3) metabolism of xenobiotics, 4) secondary metabolites.

### Preliminary Results: Cladophorol D has a different impact on the metabolome of MRSA than all of the antibiotics tested. New MOA?



### Project 2: Examining taxonomically diverse algae for novel boron containing chemistry

- Common algae may produce compounds that have been missed with traditional techniques.
- Rare or research-neglected algae may produce unseen/rare compounds because they have not been extensively examined.
- $^{11}\text{B}$  NMR spectroscopy allows for rapid screening and isolation of compounds containing the unusual element boron.



### Preliminary Results: A New Hit from $^{11}\text{B}$ NMR Screening with a New and Improved Method!

- Extract of *Enteromorpha/Ulva* sp. found to contain boron (10ppm).
- Chemical shift indicates borodiester motif and water solubility indicates likely bound to sugar(s) or other polar primary metabolite(s).
- Sensitive pulse sequence optimized with newer parameters to increase acquisition speed and limit of detection (<1  $\mu\text{mol/L}$ ).



*Enteromorpha/Ulva* sp. of green algae. Collected in Wrightsville Beach, NC

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