CHARACTERIZATION OF PLEUROBEMA RUBRUM SHELLS

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Background

○ Mussels produce a band of $\text{CaCO}_3$ each year during growth.
○ The width of bands can be measured to gain insight into climate and weather conditions.
○ During production of the $\text{CaCO}_3$ crystal structure, other ions in the water may be incorporated into the lattice. This includes heavy metals and transition metals which serve as indicators of rivers conditions.
○ To study these effects, several historic and pre-historic specimens of *Pleurobema rubrum* sp. were selected from sites along the Green River in Kentucky.

Background

● DeWeese Shell Mound
  ○ Late Archaic (~3000-1000 BC)
● Annis Mound
  ○ Mississippian (~1100-1450 AD)
● Baber Hotel
  ○ Historic (1830-1840)
Map of Green River with major archaeological sites, locations of shells circled in red. Retrieved from Morey, Crothers, et al. (Geoarchaeology, 2002).
Background

- Annual growth bands
  - Light + dark
- Two layers
  - Nacreous
  - Prismatic

Left: DeWeese shell 1 prismatic layer
Above: Annis shell umbo
Results

Microscope image of DeWeese shell 2

DeWeese shell 2 umbo with measurements
Results

The growth trend of shells should be decreasing however, DeWeese shell 2 is the only one that seems to fit the trend.

All sample shells had shorter lifespans compared to previous graph.
Results

SEM backscatter electron images of Annis shell
### Results

<table>
<thead>
<tr>
<th>Element</th>
<th>Atomic %</th>
<th>Atomic % Error</th>
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<tbody>
<tr>
<td>C</td>
<td>30.5</td>
<td>0.1</td>
</tr>
<tr>
<td>O</td>
<td>52.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Si</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Cl</td>
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<td>0.0</td>
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<tr>
<td>Ca</td>
<td>16.6</td>
<td>0.1</td>
</tr>
<tr>
<td>Mn</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

SEM backscatter electron image of Annis shell
Results

Above: Optical image of Annis shell
Right: XRF images of Annis shell
Conclusion

* Historic and prehistoric shells were identified and prepared for cross-sectional analysis using optical and electron microscopy for annual growth band width measurements.
* Expected downward trend in band width was overshadowed by yearly growth variations, likely due to the shorter life-span of these mussels.
Conclusion

- Elemental analysis was performed via EDS and scanning micro-XRF.
- The majority of shell was CaCO3. Trace levels of Mn were also found which varied between growth bands and within a single band.
- Mn concentration in the CaCO3 structure has been shown to correlate with an increase in biological or organic material in the water habitat as well as decreased shell growth rates in winter.

(Siegele, Orlie et al. 2001)
(Langlet, Alleman et al. 2007)


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QUESTIONS?