Growth of Arctic Sea Ice Algae in an Analogue of Icy Worlds

**Student:** Jonathan Durkin

**Mentor:** Susanne Neuer
Introduction

- Arctic Sea Ice Algae: *Melosira arctica*

- Centric Diatom, creates energy via photosynthesis and is cornerstone of Arctic Food Web.

- By adjusting light, salinity and temperature, I am testing the limits of growth for *Melosira arctica*.

- Gives insight into adaptability of life on Earth and credence of possibility of life on other icy worlds in solar system.
Land Fast Sea Ice Environment

Brine Melt Channels:
Melt in Spring -> More Fresh Water -> Less Salty Waters

Freeze over in Fall -> Brine Exclusion -> Saltier Waters
Experimental Setup and Methods

- Media made in sterile conditions using artificial seawater of varying salinities.
- Flasks placed in incubators of varying temperatures.
- Cells Counted under Zeiss microscope using Hemocytometer.
- Cell counts used to generate growth rates in Excel by using exponential growth rate formula.
Results

Growth Rate (d⁻¹), By Temperature and Salinity

<table>
<thead>
<tr>
<th>Salinity</th>
<th>0 Degrees</th>
<th>4 Degrees</th>
<th>10 Degrees</th>
<th>15 Degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>S5</td>
<td>N/A</td>
<td>0</td>
<td>0</td>
<td>N/A</td>
</tr>
<tr>
<td>S15</td>
<td>X</td>
<td>0.28</td>
<td>0.36</td>
<td>X</td>
</tr>
<tr>
<td>S30</td>
<td>X</td>
<td>0.36</td>
<td>0.53</td>
<td>X</td>
</tr>
<tr>
<td>S60</td>
<td>To Do</td>
<td>0.24</td>
<td>0.39</td>
<td>X</td>
</tr>
<tr>
<td>S75</td>
<td>To Do</td>
<td>0.30</td>
<td>0.29</td>
<td>X</td>
</tr>
</tbody>
</table>

X – Survives but does not grow.

For Comparison

- Average Arctic Sea Water Temp: -1.8 °C
- Average Sea Water Salinity: 35 ppt
- Cloudy Winter Day in Flagstaff:
  ~ 50 µmol/m²/s
- Bright Sunny Day in Tempe:
  ~ 2000 µmol/m²/s

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Introduction
Environment
Methodology
Results
Icy Worlds Analogue
Future Research

GROWTH RATE AS A FUNCTION OF SALINITY AND DIFFERENT TEMPERATURES AT 50 µMOL/M2/S

Growth rate µ (d⁻¹)

Salinity (ppt)

0 0.1 0.2 0.3 0.4 0.5 0.6

0 Degrees 4 Degrees 10 Degrees 15 Degrees

ASU School of Earth and Space Exploration
Arizona State University

School of Life Sciences
Arizona State University
Icy World Analogue

- Ingredients for Life: Liquid Water + CHNOPS there
  
  **Enceladus vs. Arctic:**
  - Less Light, higher reliance on hydrothermal energy
  - Methanogenesis vs Photosynthesis
  - Enceladus 73.75 times dimmer than Earth
  - 27 µmol/m²/s In Growth Range of Melosira arctica
  
Question Remains Open: *Given the adaptability of life on Earth to similar conditions, could there be life on an icy world such as Enceladus or Europa?*
Potential Future Research

- Morphological Study
- Nutrient Limitation Study
- Europa Clipper
Acknowledgements

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Questions?