Nevada Space Grant:
Geobiology Summer Short Course

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The Genesis:

- BallonSat, RockOn
- TEA- Teachers
  Experiencing Antarctica
- Spaceward Bound
- Antarctica- Biology Class
- Nevada Earth and Space Science Initiative (NESSI)
**Geomicrobiological Principles:**

- Energy Sources
- Materials - life building blocks
- Water Activity
- Environmental Constraints - e.g. pH, Radiation,
Overall Aims: (Win:Win:Win?)

- Develop Research (exploratory or otherwise) Beneficial to PI-based Research
- Develop Graduate Research- Train graduate students on analytical skills in environmental and microbial ecology
- Develop Participant’s Research Skills- experimental approaches as well as inferential approaches
- Embed Elementary Teachers into Field Research
  - so that they could experience the first-hand collection of data through actually doing real science (increase depth-of knowledge).
  - see if having a teacher on a research project would help scientists develop skills enabling more effective instruction and delivery of content
  - see if this partnership would have any effect on classroom science instruction by the teachers
“5 E” Learning Cycle of teaching (Educator/Teacher Infused)

- Engagement – Hook – Introduces concept and activates prior knowledge
- Exploration – hands-on activity where experience allows construction of knowledge
- Explanation – Through careful questioning, content is conveyed, *Vocabulary reinforced*.
- Elaboration – A second hands-on learning experience where the knowledge is used to extend new knowledge or practice new knowledge
- Evaluation – both Formative and Summative
Week 1:

- Orientation (NASA Branding):
- Field Trip to Eastern Nevada
  - Leehman Caves,
  - Snow Fields,
  - Rock outcrops
  - Hot Springs
  - Industry Engagement
• Engaged, Explored, Explained Concepts Central to Geomicrobiology and Astrobiology and the search for life and signs of life.
Soda Lake: Terminal- Amictic Lake

- Freshwater over top of Saline Water
- Does not Mix
- Bottom Waters Anoxic
- Analogues for terminal lakes elsewhere
Soda Lake: Terminal- Amictic Lake

Analytical Skills
- Spectrophotometry
- Fluorometry
- Microscopy
- Chromatography
  - Ion and gas
- Concepts
  - Buoyancy-Mixing
  - Ecosystem Energy
  - Oxidation Reduction
  - Respiration of other things besides Oxygen!
Hot Springs

The Nitrogen Cycle

Oxidized

Reduced

Nitrile NO$_2^-$

Nitrite NO$_3^-$

Nitric oxide NO

Nitrous oxide N$_2$O

Ammonia NH$_3$

Nitrogen gas N$_2$

Nitrogen gas NH$_4^+$

Nitrogen gas NO

uM NH$_4^+$

uM NO$_2^-$

uM NO$_3^-$

sum N

85 75 65 55 45
Snowfields
Cryptoendoliths
Cryptoendoliths
Results

• Presentations
  – 8 student presentations and counting...
  – 2 faculty presentations and counting...

• K-12 Class Activities
• Graduate Thesis?
• Papers?
• Proposals?
• Anecdotal Confessions
• Ongoing Requests from in-service Teachers and graduate students
Transferring Knowledge to Classroom

Last Week:
- Roger Corbett Elementary
- Tier 1 School, 90% ELL,
Outlook

- More Evaluation
  - Feedback
  - Effectiveness
  - pre/post, Students
    faculty etc..
- Future Offerings
  - in South?
  - Regional?
  - National?
- Additional Partnerships
- More NASA personnel
**INTRODUCTION**

Big Soda Lake, Nevada, is a terminal, volcanic crater lake whose water level is maintained exclusively by groundwater. The crater is composed of volcanic basaltic sand and the lake is ~60 m deep (Rush, 1972). The lake is meromictic with a distinct chemocline (Kimmel et al. 1978). The chemocline currently rests at ~40 m and is reflected in both specific conductivity and salinity measurements. Below the chemocline a redox gradient develops with highly reducing conditions. The pH is consistent throughout the depth of the lake at ~9.5, with highly reducing conditions. The pH is currently rests at ~40.

**RESULTS - CHEMICAL AND NUTRIENT**

The Zooplankton population is comprised of copepods and cladocerans. Cladocerans represent 81% of the population. Previous work shows that the cladoceran *Moinia hutchinsoni* is most abundant in summer and the copepod *Daphnia miscissipiensis* most abundant in spring (Cloern et al. 1983).

At 30 m we found evidence of purple non sulfur bacteria (likely *Rhodospirillum*).

**RESULTS - BIOLOGICAL**

The upper region of the mixing zone is dominated photoautotrophs and chemosynthetic/heterotrophs. The chlorophyll a obtained by fluorometry shows two peaks: one at 5 m and another at 20 m. BGA concentrations (relative fluorescence) peaks around 20 to 25 m. This is consistent with turbidity that shows a spike at 25 m.

**SUMMARY**

In the stratification of Big Soda Lake there are varying biogeochemical processes. Within the numerous gradients there is a diverse array of microbial activities that likely follow the Winogradsky column model. Big Soda Lake provides an excellent opportunity to study this model in an active environmental system. Having a real environmental system to work with can raise unexpected questions such as: why does the cation and anion data show differences in some of the conservative parameters on a temporal scale? It also gives us the opportunity to investigate the system in greater detail. The oxic-anoxic interface and chemocline have fluctuating biogeochemical processes. Identification of the alkalophilic, halotolerant methanogenes and alkaliphilic sulfate-reducing bacteria and their mechanisms would be well worth while to investigate.

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Evaluating Snow Microbial Assemblages

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Abstract

Aim: To determine if snow microbial assemblages vary across multiple cryospheric regions.

Methods: We collected DNA samples from sites in Canada, Alaska, Russia, and the United States, and used 16S rRNA gene sequencing to identify microbial communities. We then compared the relative abundances of different taxa across sites.

Results: We found significant differences in microbial communities across sites, with the Canadian and Russian sites showing the greatest diversity. The United States site had a more limited community structure.

Discussion: These results suggest that snow microbial assemblages are highly influenced by geographic location and climate.

Aims and Methods

1. Snow sampling
2. DNA extraction
3. 16S rRNA gene sequencing
4. Comparative analysis

Results

Snow sampling

SNP Typing

Microbial community analysis

Globular snow samples were collected from sites in Canada, Alaska, Russia, and the United States. DNA was extracted and sequenced using the Illumina MiSeq platform.

Conclusion

Our study provides new insights into the diversity and composition of snow microbial communities across different regions.

Future Directions

Future work should focus on understanding the ecological implications of these differences and how they might influence snow processes.

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Literature Cited


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