Observing Bacterial Diversity in Arsenic Contaminated Glacial Till Core Samples from Western Minnesota

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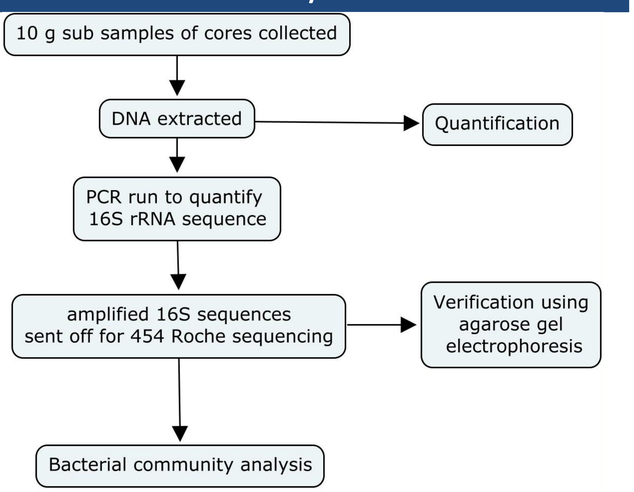
Introduction

- 50% of domestic wells in western Minnesota are contaminated with arsenic levels higher than the EPA maximum containment level (MCL) EPA (1)
- Previous studies show the arsenic is in the glacial till of the Des Moines Lobe (1)
- Wells in this lobe have on average a higher amount of arsenic contamination in them than those outside of the Des Moines lobe, even though the arsenic levels in the till are comparable with other surrounding glacial sediment (2)
- Wells present in the Des Moines lobe are not universally contaminated with > 10ppb levels of arsenic (2)
- This suggests contamination is caused by several factors

Objective

- The objective of this project was to assist in the on-going research of alleviating toxic arsenic contamination by analyzing differences in bacterial diversity between the aquifer and confining layer interfaces of glacial sediment to see if particular bacteria could be identified that could play a role in the arsenic contamination of wells

Materials/Methods



- Difficulty was originally found using only 1 g of soil, so it was increased by a factor of 10
- Quantification of DNA extracted was done using a Qubit fluoremeter

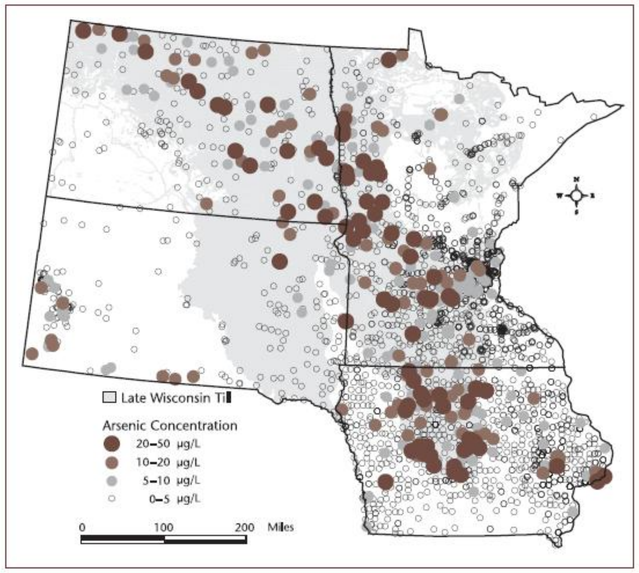


Figure 1: Map of the Des Moines Lobe across four states, Courtesy of Erickson & Barnes (1). This figure shows the distribution of arsenic levels across the Dakotas, Minnesota and Iowa. From this one can observe the differences in arsenic concentrations within the lobe.

Figure 2: A picture of the machinery used to extract the core till samples from the sites, Courtesy of Ericson and Barnes (1). All samples were sterile and are stored in freezers to prevent any microbial growth.

Figure 3: Preparing sediment samples for the extraction process . Two of the kits used had a capacity of 0.25g sediment while the other two allowed for up to 10g of sediment.

Figure 4: Example of one of four DNA extraction kits performed on sediment samples. Photo Credit: http://www.mobio.com/images/products/12988-10.jpg

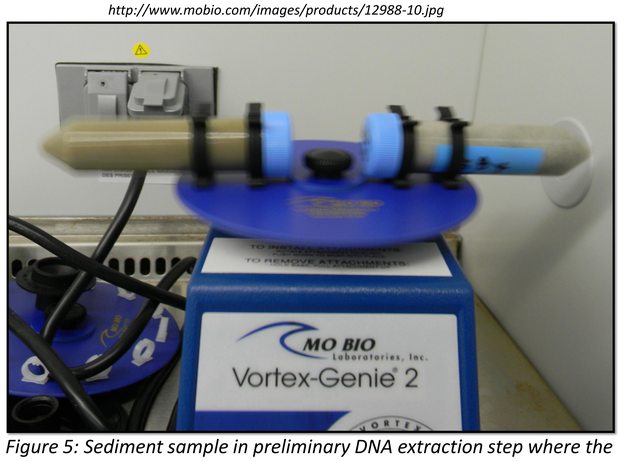


Figure 5: Sediment sample in preliminary DNA extraction step where the cells are mechanically agitated in the presence of glass beads on a vortex machine in order to free DNA from the cell structure.

Results

- The project was only able to succeed in getting as far as DNA extraction
- Able to test four different DNA extraction kits of varying capacities and procedures.
- All four DNA extraction kits yielded no quantifiable DNA.
- Although none of the extraction kits utilized in this study were successful in extracting DNA.
- More aggressive forms of extraction are needed as the project moves forward.
- This was an essential step in the method development that can now inform future attempts.

Future Directions

- The results show that refined DNA extraction techniques must be used to determine the levels of DNA in the soil
- The data found from this experiment can be taken and used to create functional assays to observe for specific proteins possibly testing for arsenic reducing genes
- Direct correlation between arsenic contamination and the presence of specific bacterial species is a future goal.

References

1. Erickson, M. L., & Barnes, R. J. (2006). Arsenic in Groundwater□: Recent Research and Implications for Minnesota. *Spring*.

2. Erickson, M. L., & Barnes, R. J. (2005). Glacial sediment causing regional-scale elevated arsenic in drinking water. *Ground water*, *43*(6), 796-805. doi:10.1111/j.1745-6584.2005.00053.

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