

DENIN Environmental Scholars Internships

Dates of internship: June – August, 2019

Location: Harker ISE Lab, University of Delaware, Newark, DE 19711

Number of positions available: 1

Faculty Mentor: Donald L. Sparks

Graduate Student Mentor: Aaron R. Betts

Professional Staff Mentor: Matthew Fischel

Project Title: Iron mineral transformation and chromium sequestration in oxygen-limited soil

Research Description:

Wetlands, riparian areas and reduced soils have been called ‘natures kidneys’ because they filter surface water of excess sediment, nutrients and contaminants. When oxygen is limited, microbes respire carbon using iron (Fe) as the electron acceptor and cause major shifts in Fe minerals including meta stable but highly reactive mixed Fe(II)-Fe(III) hydroxides. These Fe minerals are also called ‘green rusts’ because of their vibrant blue-green color. These minerals can sequester or detoxify contaminants such as chromium but environmental conditions can alter the green rust mineral as well as its reactivity. To better understand mechanisms of natural attenuation, we plan on employ a host of advanced experiments and techniques to elucidate the transformation of Fe minerals and their effects on chromium sequestration in pure as well as complex natural conditions. Understanding the soil biogeochemistry of these systems will help us understand the ecosystem services these critical environments provide. The specific project goals will be formed to cater to students’ interests.

Research Questions:

How do naturally-formed Fe minerals in reduced soil differ from synthetic minerals and how does this change their reactivity and sequestration of Chromium?

1. What are the mineralogical differences in pure and naturally-formed Fe minerals in natural sediments?
2. How does Fe mineral reactivity with Chromium differ between pure and naturally formed Fe(II) minerals and what is the significance to toxicity

Student Learning Objectives: Professional and Research Skills

This internship focuses on the development of the following professional and scientific skills.

Broad Professional Skills	Specific Skills
Planning and time management	Ability to set and complete specific goals of varying scope
Work independently	Independent work ethic - work independently to problem-solve
Collaborative skills	Learning to complete tasks efficiently and effectively with others
Express ideas in writing and verbally	Communicate with diverse audiences - Development of impactful poster and oral presentations. Honing ability to deliver scientific results/impacts to people of interdisciplinary background.
Broad Scientific Research Skills	Specific Skills
Understand scientific terms	Mechanistic and applied concepts regarding sorption and redox chemistry
Literature analysis	Ability to effectively find and utilize scientific manuscripts related to environmental chemistry
Use scientific tools	X-ray absorption spectroscopy, X-ray diffraction, Ultra violet and visible spectrophotometry, Infrared spectroscopy, scanning electron microscopy, and additional advanced physical and chemical techniques
Recognize simple patterns in research data	Applying soil environmental chemistry concepts to qualitative and quantitative data.
Apply research tools and techniques in research experiments	Work in controlled glove-box atmosphere, Selective extractions, sorption reactivity experiments, redox experiments
Analyze research data	MATLAB, R, Excel, Plotly, Origin, and instrument-specific software utilization to form effective figures and tables.
Understand, apply, and explain scientific concepts and theories	Freedom to form questions and plan methods for addressing challenges. Learning to effectively communicate results through oral presentations and manuscript writing.

Prerequisites:

Introductory experience with chemistry.

Work Environment and Expectations:

Laboratory environment: Harker ISE Lab 4th floor. Hours are flexibly determined between student and mentor. Students will work part time during summer semester June-August 2019. Students will also participate in a retreat, communications workshop and end of internship fall symposium.

This project is limited to students at University of Delaware.

Stipend:

\$3,500 Direct deposit is required.

Funding Source:

National Science Foundation, Delaware EPSCoR Track I

How to apply: https://ugresearch.udel.edu/PUB_Program.aspx