

USGS NSF GRIP, GSP Opportunity

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 USGS Center:	National Research Program - Central
 Project Title:	The Influence of Natural Organic Matter on the Biogeochemistry, Fate and Transport of Metals, Metal Colloids and Nanoparticles in the Aquatic Environment
 Summary:	This work will explore the frontiers of organic-inorganic geochemistry by investigating the fundamental nature of dissolved organic matter (DOM)-metal interactions for metals and nanomaterials of environmental significance.
 Project Hypothesis or Objectives:	<p>Dissolved organic matter (DOM) plays important roles in numerous geochemical and environmental processes that affect the functioning of aquatic ecosystems. In particular, DOM exerts control on the biogeochemistry of trace metal contaminants by (1) complexing metal ions ultimately influencing metal speciation, transport, and sorption interactions with mineral surfaces, (2) participating in redox reactions with redox-active metals (e.g., Fe, Cu, U), and (3) controlling the formation, bioavailability, and mobility of colloidal particles in aquatic systems. DOM-metal interactions have significant implications for water quality and ecosystem health. Despite the general recognition that DOM interacts strongly with metals and colloids and behaves as an oxidant and reductant under different environmental redox regimes, a more precise mechanistic understanding of these interactions has remained elusive. As a result, the development of predictive geochemical, transport, and transformation models for these materials has been hampered. Therefore, improved understanding of the influences of DOM on the geochemistry, fate and transport of metals (e.g., Cu, U, Hg), metal colloids (e.g., CuS, UO₂, amorphous Fe oxides), and both natural and engineered nanoparticles (e.g., Fe₂O₃) is critical for assessing the ecological and human health effects associated with these materials.</p> <p>This work will address the fundamental nature of DOM-metal interactions for a range of metals and nanomaterials of</p>

environmental significance. We seek a student to expand ongoing studies related to DOM chemistry and its influences on: (1) the biogeochemistry of metals and nanomaterials (e.g., Fe, Cu, and U); and (2) to investigate the effect of interactions of DOM on metal binding and the formation, stability, surface properties and redox activity of metal colloids and nanoparticles in aquatic systems. Well-characterized organic matter isolates representing the range of DOM chemistry from diverse environments are available to determine the properties of the DOM that drive different reactions with metals and metal colloids. USGS laboratories have instrumental capabilities required for this project, including dynamic light scattering, zetasizer (surface charge), ICP-MS, high-speed centrifugation, ultrafiltration, and redox cells to manipulate and study DOM redox chemistry. In addition, the research is expected to complement ongoing metal bioavailability studies with aquatic invertebrates

- Duration:** Up to 12 months
- Internship Location:** Boulder, CO
- Field(s) of Study:** Chemistry, Geoscience
- Applicable NSF Division:** EAR Earth Sciences, DEB Environmental Biology, CBET Chemical, Bioengineering, Environmental, and Transport Systems, CHE Chemistry
- Intern Type Preference:** Either Type of Intern
- Keywords:** Environmental Geochemistry, Nanomaterials, Redox Chemistry, natural organic matter
- Expected Outcome:** The proposed research will address fundamental questions related to the influence of DOM on the biogeochemistry and bioavailability of metals, colloids, and nanoparticles in aquatic systems that are critical for effective modeling of the fate, transport, and bioavailability of these materials in both surface and groundwater. Findings will be relevant to a wide range of aquatic environments that differ in organic matter quality. The intern will receive mentorship and opportunities to broaden their professional network, and have a unique opportunity to work at the interface between environmental organic and inorganic chemistry. This research is relevant to a number of USGS Mission Areas, including Environmental Health (Contaminant Biology and Toxic Substances Hydrology) and Ecosystems (Microbiology and Environments). In addition, the information derived from this effort will serve to meet the needs of other federal agencies, such as the US EPA and US DOE, and resource management agencies (e.g. CALFED, NPS and USFWS) interested in ecosystem restoration, and ecosystem and human health effects.

● **Special skills/training
Required:**

The intern will require knowledge of basic chemistry and/or geochemistry, have experience working in a laboratory setting, and be able to perform experiments after initial guidance. Additional lab and chemical safety certifications will be provided at the start of the internship.

● **Duties/Responsibilities:**

The intern will be part of a collaborative research team and will be working within an existing collaboration between organic geochemistry and a redox biogeochemistry projects. The intern will independently conduct laboratory experiments, guided by an experienced research team.
