

Heavy metal sequestration in settling ponds: A mechanism for the removal of metals associated with mined lands

Project investigator(s) and affiliation

Dr. Aaron W. Johnson
Assistant Professor of Geology
University of Virginia's College at Wise
236 Science Center
1 College Avenue
Wise, VA 24293

Trrey Akridge, Shadrack Nthusi, and Janet Yates
Undergraduate Students
University of Virginia's College at Wise
1 College Avenue
Wise, VA 24293

Project Summary

This study used field research to teach undergraduate students at UVa-Wise. Students conducted field and laboratory studies to determine the presence, distribution, and mobility of metals in mined lands. In addition, this study attempted to address the efficacy of settling ponds as a mechanism to sequester metals and remove them from the hydrologic system. The three students who participated directly in this study gained insight into using science as an investigative tool. Furthermore, the results of this study will provide some insight into the presence and concentration of metals in aquatic sediments and may aid in identifying potential stressors that may impact aquatic communities.

At present, the project is incomplete. Due to a merger of EMI labs with Spectrum labs in Wise, a significant analytical backup has occurred. All samples related to this project have been collected, processed, and sent to the lab for analysis, but the sample analysis has yet to be completed. At this time we (my research students and I) are unable to draw direct conclusions relating to metals and mobility at the PRP site. We can, however, make some qualitative comments.

Meeting Project Objectives

The three primary goals of this project were: (1) To use scientific research as a teaching tool to educate talented undergraduate students; (2) To assess the degree to which mobility and accumulation may be affected by seasonal variation; and (3) To compare the concentration of metals in ponds to those found in sediments in the Powell River. To some degree, we have been able to meet each of these objectives

Scientific Research as a teaching tool

Three undergraduate science majors at UVa-Wise participated in this project: Trey Akridge, a junior chemistry major, Shadrack Nthusi, a Senior environmental science major, and Janet Yates, a junior environmental science major. Each gained valuable field and laboratory experience, learning proper field and laboratory techniques, and participating in meetings to discuss the complexities of field research, especially when circumstances dictate changes to experimental design. Both Janet Yates and Shadrack Nthusi submitted FINS (Felloships in Natural Sciences) proposals as a result of their participation in this research project.

In addition to benefits to participants, this project provided an enormous benefit to science students at UVa-Wise. This grant provided funding to purchase a hot block sediment digestion apparatus for use on this project as well as similar projects being pursued by students and faculty at UVa-Wise. As of August 2007, three other undergraduate research projects are utilizing this apparatus. Without the funding and equipment provided by the Powell River Project, none of those projects would be possible. Each of these projects displays considerable scientific merit, but one, involving the accumulation of metals in biota may be such that it will result in peer-reviewed publication when combined with the results of previous studies by other UVa-Wise students and faculty.

Seasonal Variation in Metal Mobility

Because we are waiting on laboratory results we are as yet unable to determine if seasonality affects metal mobility. However, based on qualitative data, as well as pH other data, seasonal variation is unlikely.

Comparisons to the Powell River

Because we are waiting on laboratory results, we are as yet unable to compare data from settling ponds to that from the Powell River. However, based on qualitative data, we can make the following comments.

First, in areas distant to the PRP (>3 miles) metal concentrations are much lower in the Powell River than in settling ponds on the PRP. Second, immediately downstream from the PRP, there appears to be a significant amount of Acid Mine Drainage from mine workings unrelated to the PRP. This drainage likely will contribute a significant amount of metals to stream sediments near the source.

Data and Results

At this time the data set is incomplete. Because of a backlog at EMI, we are unable to provide data on metal concentration in stream sediments. However, we can provide ranges of pH, temperature, and alkalinity data at this time. A full data set will be provided to the PRP when all data are available.

The pH values recorded at the PRP range from a low 5.9 to a high of 7.1. Values appear not to be coincident with temperature, and exhibit a narrow range of values at each sample site. Temperatures ranged from 4-20 degrees Celsius, and were strongly seasonal. Alkalinity ranged from 109-134 ppm (moderately hard) bicarbonate equivalents.

Deliverables

The lack of analytical data makes any report on the project impossible at this time. However, we will receive data from EMI prior to October 1, 2007. While this delay will create some problems for the PI and undergraduate students working on this project, it also illustrates to students the complexity of scientific research, and the vagaries of working with partners. As unforeseen consequences arose, each student adapted to meet the new challenges presented.

The results of this project likely will be presented at the 2008 meeting of the Southeastern Section of the Geological Society of America in Charlotte, NC. The final detailed report will be presented to the PRP as soon as the data are available for analysis. It is our hope that this work will be completed by December, 2007. In any case, a full report will be available to the PRP by the August deadline of 2008.