

Abstract

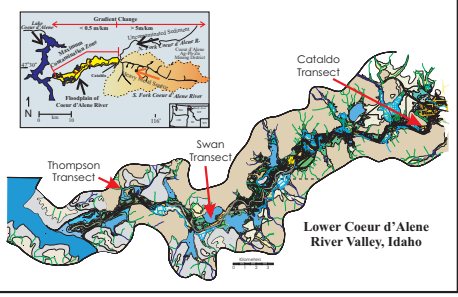
Extensive lead, silver, and zinc mining in the Coeur d'Alene River Valley, Idaho during the late 1800s - mid 1900s produced mine tailings that were reworked downstream by fluvial processes. Mine tailings containing lead, iron, arsenic, cadmium, silver, copper, zinc, antimony and mercury have been redistributed in levee, lacustrine and wetland environments. Environmental remediation requires an accurate assessment of trace metal distribution within the sediment.

Our study focuses on oxidized sediments from river levees near Cataldo and Swan Lake. Sequential Extraction and Scanning Electron Microscope techniques are used to evaluate the distribution of manganese, iron, copper, zinc, silver, cadmium, antimony, lead, and arsenic. Vertical geochemical patterns suggest the levee is periodically recharged with sulfide tailings during floods. As sulfide minerals are oxidized, they release both sulfuric acid and a wide range of trace metals. Preliminary results indicate manganese and iron resulting from carbonate (siderite, (Mn,Fe)CO₃) dissolution form iron and manganese oxide crusts that readily incorporate and bind other metals such as copper, zinc, cadmium, silver, and lead. These oxide crusts are fine grained and the metals are relatively bioavailable with small changes in the geochemical environment. Arsenic and antimony are bound in very resistant, coarse grained detrital minerals and have low bioavailability.

Trace Metal Distribution Within Levee Samples in the Coeur d'Alene River, Idaho

Brooke Fahrenkrog, Adam Krieger, Jill Ferguson, Robert L. Hooper, J. Brian Mahoney

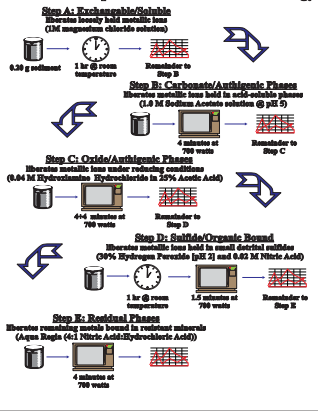
Department of Geology, University of Wisconsin Eau Claire



Purpose

Levees are built along river edges as sediment accumulates during overbank flood events. In the Coeur d'Alene River valley, levees accumulate reworked mine tailings during every spring flood. These mine tailings are rapidly oxidized in the levee environment, releasing heavy metals. This investigation is designed to examine the lateral and vertical variation in heavy metal distribution in the levee environment throughout the lower Coeur d'Alene River.

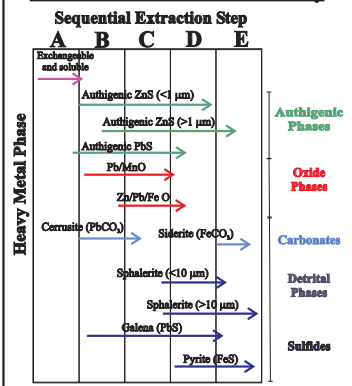
Calibrated Sequential Extraction Methodology



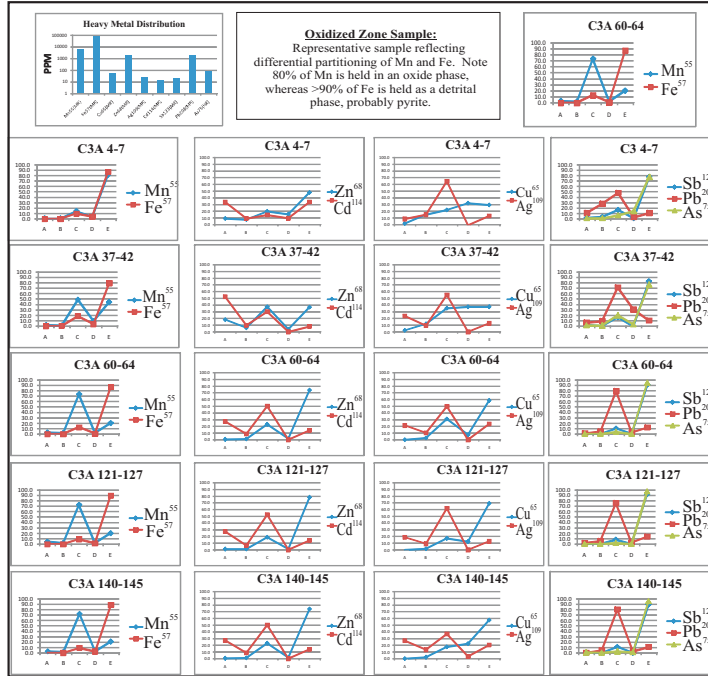
Procedure

- Sequential Extraction is a technique that utilizes wet chemistry to mimic naturally occurring chemical reactions, in order to determine how heavy metals are bound in the fluvial environment.
- ICPMS is used to quantitatively assess elemental (Fe, Mn, Pb, Zn, Cd, Sb, Cu, Ag, As) concentration in each sequential extraction step.
- Electron microscopy (SEM/TEM) constrains surface morphology and elemental distribution within sediment samples.

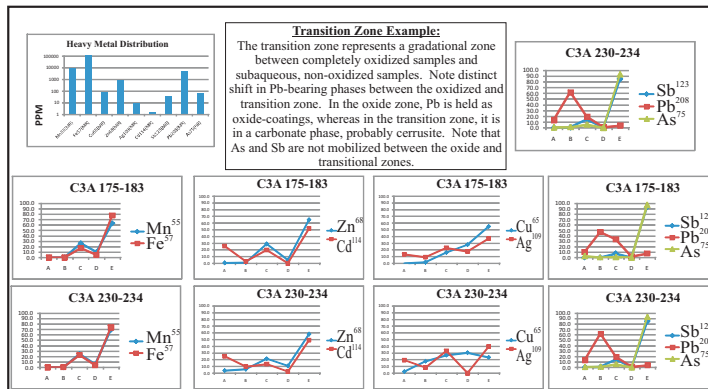
Observed Particulate Extractability



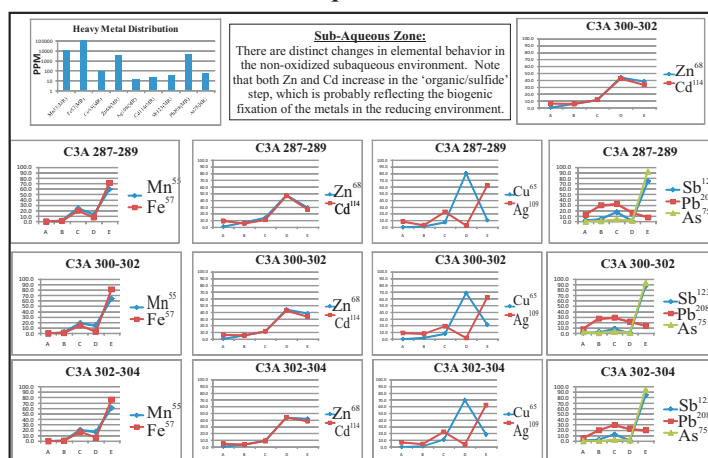
Oxidized Zone



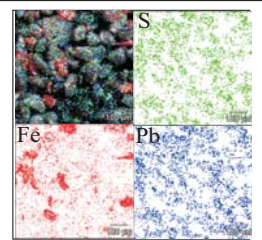
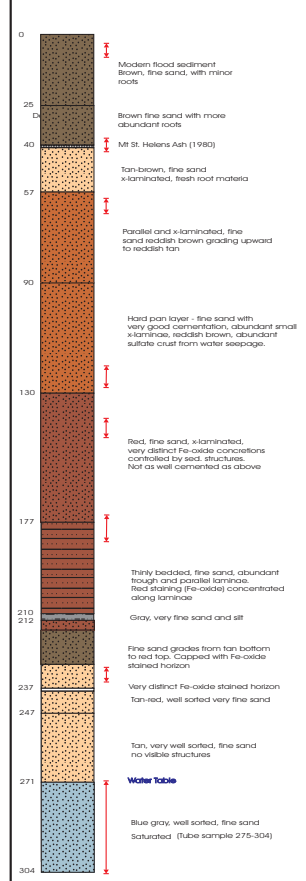
Transitional Zone



Sub-Aqueous Zone

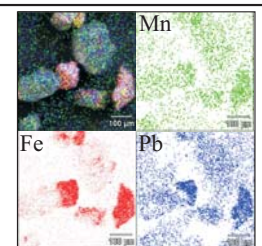


Cataldo Levee



C3 300-302cm

SEM EDS dot maps for C3 300-302cm. Below transition zone (175-183cm). Grains in SEM image are authigenic sulfides. Show by the overlap of blue (Pb), green(S) and red (Fe). Recognizing the correlation between Pb, Fe and S in the white zones. This image represents the shift to the authigenic sulfide zone.



C3 175-183cm

SEM EDS element dot maps for C3-175-183cm. Above the water table (273cm) Pb is found primarily in Fe-oxide coatings. Grains in SEM images with magenta shading are the result of red (Fe) and blue (Pb) overlap. Note excellent correlation between red and blue x-ray dot maps. This is consistent with SE data for samples above 145cm. The 175-183cm zone is the transition zone to sulfide dominated systems