MINING CONTAMINATION AND LEGACY FLOODPLAIN SEDIMENTATON IN TURKEY CREEK, TRI-STATE MINING DISTRICT, SOUTHWEST MISSOURI

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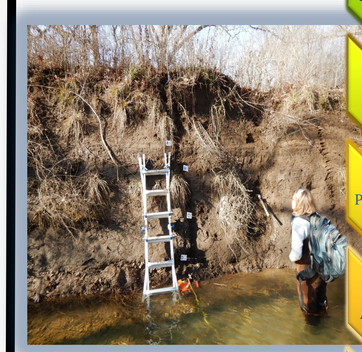
Abstract

Historic mining activities often leave a legacy of metal contamination in channel sediments and floodplain soils that can degrade water quality long after mine closure. The Tri-State Mining District (1870-1950) was a global producer of zinc (Zn) and lead (Pb) in Missouri, Kansas and Oklahoma. Several studies have assessed metal contamination risk in active channel sediments. However, none have evaluated the role of floodplain deposits as storages and long-term sources of metal pollution. This study evaluates the vertical and downstream trends in Zn and Pb contamination in floodplain deposits along Turkey Creek (30 km long) which drains heavily mined areas in Missouri. Landform characteristics, deposit stratigraphy, and mining/land-use trends will be used to assess dispersal and storage patterns of legacy sediment and metals at the watershed-scale. Channel and floodplain surveys were completed at 11 sites at each site 2-3 overbank profiles sampled in 10 and 20 cm intervals then analyzed for Zn and Pb, sand, and organic content. Spikes in metal profiles are expected to occur during the heaviest mining periods with depths and thicknesses of contaminated deposits increasing downstream. Floodplain sedimentation rates were likely highest along Turkey Creek during periods with highest soil erosion rates and ore production.

Methods



- **Sample Collection**
  - 11 sample sites on Turkey Creek
  - Vertical overbank samples (10-20 cm)
  - Depth of overbank profiles (1 – 3 m)
- **Channel Cross Sections**
  - Each sampled bank
- **Processing**
  - Dried and sieved (>2 and <2 mm fractions)
- **Lab Analyses**
  - XRF (concentrations of Zn, Pb, Fe, Ca, Cd)
  - LOI (organic content) - TBD
  - Sand fraction percentage - TBD
- **Land Use & Mining History**
  - Agricultural and land use records
  - Mining history
  - GLO-surveys (historical channel widths)

Preliminary Results

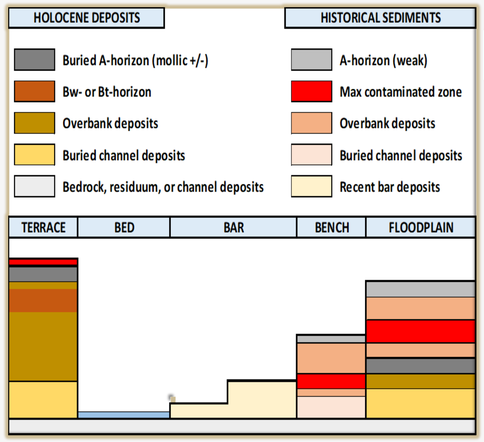
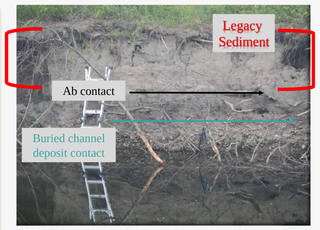


Figure 10



- **Terrace**
  - Contamination at top (<0.5 m)
- **Floodplain**
  - Contamination above buried soil (1.2-1.5)
- **Bench**
  - Contamination throughout (1.2+ m)

Site - Bank	River km	Land-form	Max Ca (ppm)	Max Pb (ppm)	Max Zn (ppm)
3 B2	19.0	TER	6,895	217	775
3 B3	19.0	BEN	17,908	1,944	8,743
6 B1	20.8	FP	155,039	4,561	26,632
8 B2	24.0	FP	79,991	2,162	28,099
5 B1	26.3	FP	52,365	1,682	16,352
7 B1	29.5	TER	16,835	844	7,171
7 B2	29.5	BEN	105,722	1,459	44,072
4 B2	31.0	FP	52,083	2,346	20,620

Table 1

Note: These results reaffirm findings from Smith (2016) in the Turkey Creek Region, wherein the maximum Zn concentrations were located in the upper 2 m of floodplain deposits.

Site -Bank	Height (m)	Land-form	Depth to Contamination (m)	Percent Contaminated	Depth to Max Zn (m)
9 B3	2.2	FP	1.35	61	0.65
6 B1	3.4	FP	1.35	40	0.75
8 B2	2.9	FP	1.20	41	0.95
5 B1	2.9	FP	1.25	43	0.85
4 B2	2.4	FP	1.35	56	1.05

Table 2

Background & Study Area

- Tri-State Mining District (OK, KS, MO)
- Extensive mining: Pb & Zn
- (1838) Lead ore discovered
- (1870s) Mining Boom: Shallow ore deposits along Joplin Creek
- (1950s) Major mining ends
- (1930-1939) Mining declines (Great Depression)
- (1900-1920) MO mining peaks
- Mining waste begins: Pb, Zn, Cd released into environment
- 1980s: EPA declares Superfund Sites
- Remediation

Background Concentrations (ppm)			
Terrace Soil (this study)		From Pope 2005	
Zn	240	Zn	100
Pb	44	Pb	20

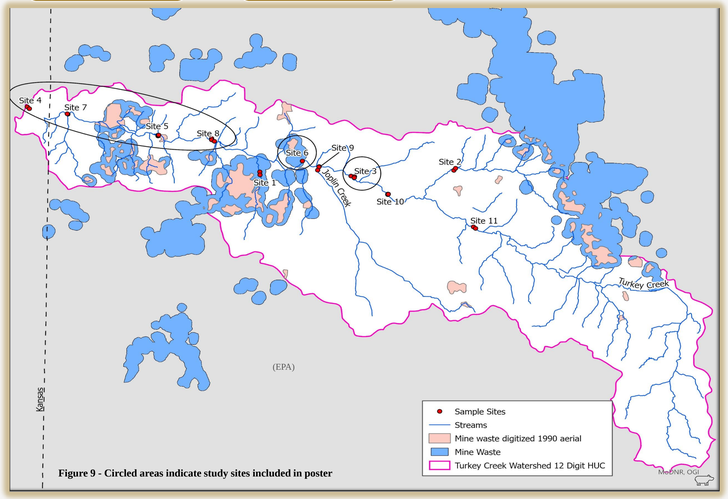


Figure 9 - Circled areas indicate study sites included in poster

Preliminary Pb and Zn Concentrations (XRF)

Upstream → Downstream

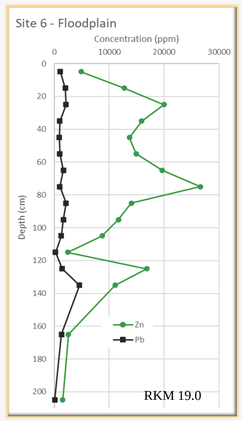


Figure 1

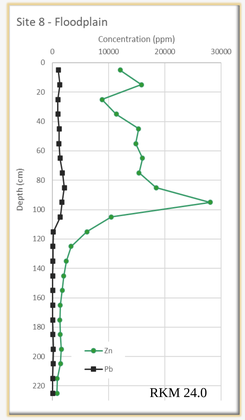
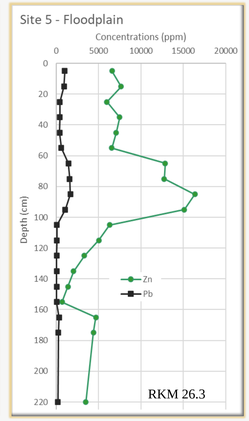


Figure 2



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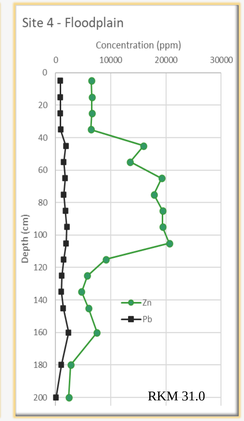

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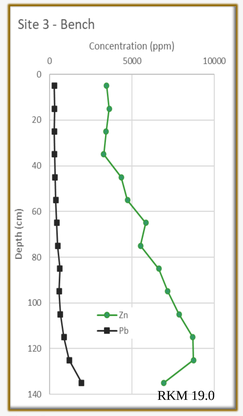
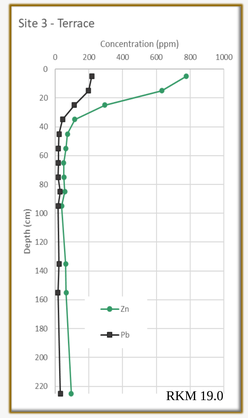


Figure 5



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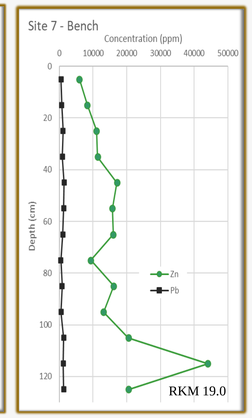

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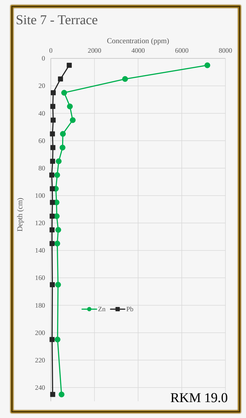

Figure 8

Discussion

The purpose of this study is to use floodplain stratigraphy, sedimentology, and mining-metal profiles to evaluate fluvial response to historical land-use changes in the Turkey Creek watershed. Preliminary results are promising and show that metal contamination profiles correlate with deposit type and age. Higher terraces are only contaminated at the surface (<0.5 m), floodplains are contaminated above buried-A horizons that are interpreted to indicate the pre-settlement surface, and lower bench deposits are contaminated throughout indicated a mining period age (>1870). On average, overbank floodplain deposits are contaminated to 1.3 m and reflect the minimum depth of legacy deposits. These results are supported by previous floodplain studies in the TriState District by Juracek (2013) and Smith (2016). Future work will include characterization of buried soils using OM%, channel morphology and flood capacity analysis, and development of specific land use and mining histories for Turkey Creek watershed.

References

Juracek, K.E. 2013. Occurrence and Variability of Mining-Related Lead and Zinc in the Spring River Flood Plain and Tributary Flood Plains, Cherokee County, Kansas, 2009-11. United States Geological Survey. Scientific Investigations Report 2013-5018.
Smith, D. C. (2016). Occurrence, Distribution, and Volume of Metals-Contaminated Sediment of Selected Streams Draining the Tri-State Mining District, Missouri, Oklahoma, and Kansas, 2011-12. United States Geologic Society. Scientific Investigations Report 2016-5144.