Impact of climatologic factors on the airborne lead (Pb) in northeastern Oklahoma

Julie McDonald-Gillespie[1], Hayden Curtis[2], Junran Li[1]

[1]Department of Geosciences, The University of Tulsa, Tulsa, OK 74104; [2]Jenks High School, Jenks, OK 74037

Contact: Julie McDonald-Gillespie
jmm732@utulsa.edu

INTRODUCTION

Picher, Oklahoma is home to the Tar Creek Superfund site, which is part of the Tri-State mining district (TSMD). The mines were in production from 1850 to 1950. One hundred years of production has left numerous chat piles on the surrounding environment directly affecting the town of Picher. One such byproduct of TSMD includes lead (Pb) dust that have been transported around the town settling throughout and seeped into groundwater, lakes, ponds and rivers. Due to the contamination, many children in the area have elevated Pb levels in their bodies, which have led to learning disabilities and other problems. By 2009 the town of Picher was found to be unhabitable, leaving behind an estimated 75 million tons of chat (DEQ *et al.*,2004).

Studies have shown that average background levels of Pb in sediment/soil range from 17-23 mg/kg in TSMD (Horowitz et al., 1991; Pope, 2005; Garvin, 2016). In contrast, streambed sediments contaminated by the chat piles showed 20 times higher than background levels (Garvin 2016). While many studies have focused on surface water and groundwater contamination, no studies have attempted to distinguish the contributions of different sources, particularly from the atmospheric deposition, of heavy metals to the aquatic environment.

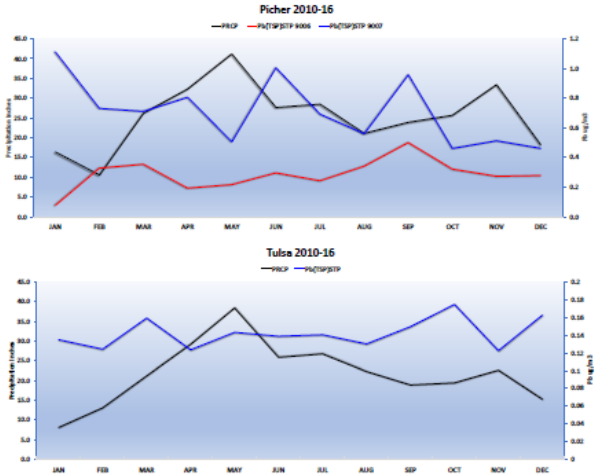
The objective of this study is to investigate the spatial and temporal variations of airborne Pb, in locations within and outside of the TSMD, and the factors that impact these variations. The results of this study will enhance our understanding of how atmospheric Pb is transported and deposited to the aquatic environment. Therefore to provide highly-pertinent management strategies for tribal human health and welfare.

METHODS

- Data for both Tulsa and Picher Oklahoma, was collected from the EPA air quality monitors for TSP of Pb (https://www.epa.gov/outdoor-air-quality-data).
- The data was presented on a 9-day cycle from 2010-2016.
- Daily precipitation was collected from NOAA for the area's encompassing Tulsa as well as Picher Oklahoma by way of Miami Oklahoma.
- All data was cleaned of noise before compressing into a monthly format.
- Yearly line graphs were made for each location with both atmospheric Pb and precipitation to better view patterns.

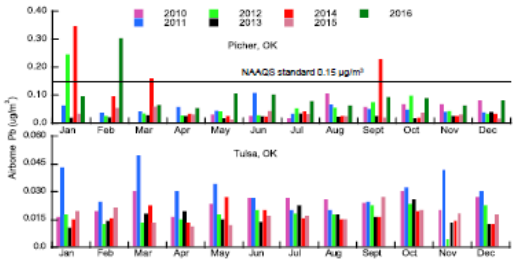
RESULTS

- **Monthly variation of airborne Pb**

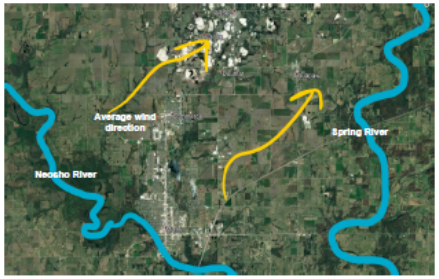


- The month to month variation of airborne Pb is stronger in Picher than in Tulsa
- The highest airborne Pb appeared in Jan, Jun and Sept in Picher.
- There appears to be an negative relationship between precipitation and atmospheric Pb, and this pattern is more notable in Picher (R^2=-0.52) than Tulsa.

- **Annual variation of airborne Pb**



DISCUSSION



- This negative relationship of atmospheric Pb can be an added source of contamination to both surface water and ground water.
- Taking wind speed and direction into account, could locate other contamination points outside of the initial site.

REFERENCES

Garvin, E.M. (2016). Heavy metal contamination within the Oklahoma portion of the Grand Lake watershed: Assessment of toxicity risks to aquatic and terrestrial biota and implications to tribal human health, The University of Tulsa dissertation, Tulsa, Oklahoma.

Horowitz, A. J. (1991). A primer on sediment-trace element chemistry, 2nd/Ed. Lewis Publishers, Chelsea, Michigan.

Oklahoma Department of Environmental Quality (DEQ). (2004, January 01). *Oklahoma Plan for Tar Creek* [PDF]. DEQ.

Pope, L. M. (2005). Assessment of contaminated streambed sediment in the Kansas part of the historic Tri-State lead and zinc mining district, U.S. Geological Survey Scientific Investigations Report 2005-5251.

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