



In Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy
Cyrus Hester

Will defend his prospectus

**Investigating Long-term Trace Metal Pollution in the Sonoran
Desert**

Abstract

Like numerous other cities across the globe, the Phoenix metropolitan area hosts elevated levels of potentially-toxic heavy metals, such as copper, lead, and zinc. Yet, information is lacking on how trace metal pollution in Phoenix has changed over the long-term. It is also unclear which social or environmental factors may have contributed to such changes. To address these gaps, a tripartite research project on the environmental, industrial, and political history of metals in the greater Phoenix area is proposed. First, a novel paleoecological approach will be used to produce a consistent, long-term record of ambient biogeochemistry for the study area. To do so, isotopically-derived dating techniques will be combined with spectrometric measures of metal concentrations extracted from the sequentially-grown spines of long-lived, saguaro cacti (*Carnegiea gigantea*). The resulting multi-element time-series will then be analyzed via statistical decomposition and breakpoint techniques to identify any long-term trends and significant transitions in Phoenix's environmental history. Second, the history of metal usage by industrial society will be investigated using an automated text analysis of patent records. Word frequency counts and term association networks will be constructed to trace the prevalence, combination, and intended purpose of metals linked to technologies developed over the past century. Trends in the industrial use of metals will then be analyzed with respect to the paleoecological record, referenced above, and local land use records. I predict that metals incorporated into a greater diversity of uses, especially consumer goods, are more likely to exhibit a steady rate of accumulation in the local environment. Meanwhile, metals with fewer end-uses or which have predominately been incorporated into

production (i.e., capital) goods will exhibit stable or declining trends in the environment following the environmental regulations and outsourcing of production which began in the 1960s. Finally, the political-economic history of metals will be researched via a discourse analysis of archival documents addressing the regulation of metals and metal-dependent industries in Arizona. Here, my attention will be directed principally toward the partitioning of rights and duties concerning the use of metals over time, as well as claims made to justify or challenge a given management regime. Taken together, this research project aims to illuminate the long-term industrial and institutional drivers associated with the emergence of a distinct urban biogeochemistry in the Sonoran Desert.

Monday, April 10, 2017
9:00 a.m.
Wrigley Hall, Room 401

Faculty, students, and the general public are invited.

Supervisory Committee:
Dr. Kelli Larson, co-chair
Dr. Manfred Laubichler, co-chair
Dr. Joshua MacFadyen, member