Hydrogeologic Study of the Mimbres Basin Aquifer System – A Transboundary Multi-use Aquifer (Related to Urban Areas, Agriculture, and Open Space)

Luke Sprecker
Cal State LA
Work: lukesprecker2@gmail.com
School: lsprecker@wisc.edu

Keywords: Hydrogeology, Mimbres Basin, Groundwater, Aquifer, Water Management

Introduction

In summer 2024, I participated in a summer internship at Cal State LA. I mainly focused on looking at the hydrogeologic study of the Mimbre Basin Aquifer System, which is located in New Mexico. This internship was part of the Research Experience for Undergraduates (REEU) program under Dr. Barry Hibbs. The primary objective was to investigate the groundwater characteristics and dynamics of the transboundary, multi-use aquifer system of the Mimbres basin, which is located in parts of the United States and Mexico. To understand more of the area of interest, "the Mimbres Basin covers approximately 13,000 km^2 and includes diverse land uses such as forests, rangeland, lowlands, and irrigated cropland". This region is crucial for both urban and agricultural water needs, making it very important to understand the hydrogeologic properties of this basin (New Mexico Geological Society, 2000).

Objectives

This is the first year of a five year study on the Mimbres Basin. The Mimbres Basin is a large binational aquifer system that lacks isotopic and specialized isotopic data on a regional scale. The objective of this research is to investigate ways to fill this data vacuum by conducting research on age-date groundwater, confirm modern groundwater flowpaths and map out possible paleo-groundwater flowpaths, map out areas of modern groundwater recharge, determine areas where pluvial groundwater is in storage in aquifer sub-basains, and determine mechanisms of groundwater salinization. These are all important as this research has never been done before on the Mimbres Basin. The motivation for this research is to provide new and updated groundwater data for a growing urban and existing agriculture area that is shared by the United States and Mexico.

Methods

Precipitation Collectors

Precipitation Collectors were a small portion of the research that was conducted. These are simple, inexpensive devices that are designed to collect rainfall at a given location. Evey three months, the collection bottle is removed and returned to the lab where a stable isotope sample of the rainfall is collected. How these precipitation collectors work is that rainfall passes through a fununel and is directed by a tube/hose to a collection bottle. Mineral oil is used to seal the water from further evaporation due to being lighter than water and floats on top. This is a critical step because the rainfall must be sealed with mineral oil to prevent subsequent evaporation.

Well Samples

Collecting samples from wells was the majority of the research that was conducted using a multi parameter sonde, which gave us the index field parameters: pH, Conductivity, Temperature, Dissolved Oxygen, and Oxidation Reduction Potential, all of which were measured at the wellhead/stream. Collection bottles were then used to collect the water that went through the multi parameter sonde. Each bottle was rinsed out three times before collecting the sample. These bottles were then sent to a lab for further testing of general minerals (example: Chloride, Sodium), trace elements (large suite of trace elements - example: Arsenic, Selenium, Lithium, and Chromium), and environmental isotopes (Carbon 14, Tritium, and Stable Isotopes of O, H, C, and S).

Results

At the end of my time at the internship, most of the data was still being processed in the lab, so I used some previous data that was collected in Feburary

2024 (Old), along with field parameters gathered in July 2024 (New). For TDS, our research found that all the samples that were collected all were within the range of 0-1000 mg/L, classified as “Fresh.” The other parameters looked at in this research study were Nitrate, Chloride, and Lithium. All the samples of Nitrate were below the EPA standard of 10 mg/L. All the samples of Chloride were below the EPA standard of 250 mg/L. All but one of the samples of Lithium were under the EPA “health reference level” of 10 ug/L (U.S. Environmental protection Agency, 2016). The results show from the data collected seem to indicate that the water that is being pumped from wells is relatively (safe) clean water. Communities rely on well water for agriculture, livestock, domestic use, and drinking water. When Total Dissolved Solids (TDS) is high, that means there is high salinity which creates negative outcomes, especially for agriculture as plants do not like high salinity water. These results are important year-one baseline data that informs the next phase of studies of aquifers and salinity evolution. Limitations with this study is time, as it takes time for the lab to process the data.

Conclusion

Accurate data regarding well water composition is essential in transboundary, multi-use aquifers like the Mimbres Basin as well as providing new and updated groundwater data for a growinig urban and existing agriculture area that is shared by the United States and mexico. Continuation of this five-year study will cover a range of isotopic/hydrochemical analysis, while providing a formative contribution to our understanding of a transboundary Mimbres Basin Aquifer System. Understanding this system is essential as the world is changing and communities rely on well water, so it is important to be informed on what is happening to the groundwater over time. Projects will include future REEU grant students and will continue each summer for the next four years.

References

Drinking water regulations and contaminants | US EPA. (2024, February 14). US EPA. https://www.epa.gov/sdwa/drinking-water-regulations-and-contaminants

The hydrogeologic framework of basin-fill aquifers and associated ground-water-flow systems in southwestern New Mexico-An overview. (2000). *New Mexico Geological Society*. https://nmgs.nmt.edu/publications/guidebooks/downloads/51/51_p0235_p0244.pdf

Acknowledgements

Special thanks to:

USDA – NIFA REEU Grant
Dr. Barry Hibbs
Dr. Geoffrey Rawlings
Chris Christales