Geochemical Characterization of Groundwater from Natural Springs in Northeast Ohio

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Background

Northeast Ohio is populated with many natural springs and the groundwater from these springs is often used as drinking water. The surrounding geology and surface conditions associated with these springs influences the water quality, which can have implications for its safety as drinking water [1].

This study aimed to analyze the chemistry of groundwater from 9 springs in northeast Ohio, to describe groundwater pathways, and to assess the springs as drinking water sources.

Figure 1. (a) Spring sites. (b) Spring locations by county.

Methods

Water Chemistry

- Water samples were collected at springs during the Fall of 2025 and analyzed for various water quality constituents

Geologic Cross Sections

- Relative site geology was referenced with ODNR water well log descriptions
- Elevation profiles were drawn to visualize the topography around the sites
- Groundwater flow pathways were estimated based on geology and topography

Results

Groundwater Classification

	pH	Conductivity (µS/cm)	TDS (mg/L)
Mean	7.29	555.2	262.8
Minimum	7.06	245.1	57.13
Maximum	7.54	894.6	492.5

Table 1. Water quality data from the spring sites.

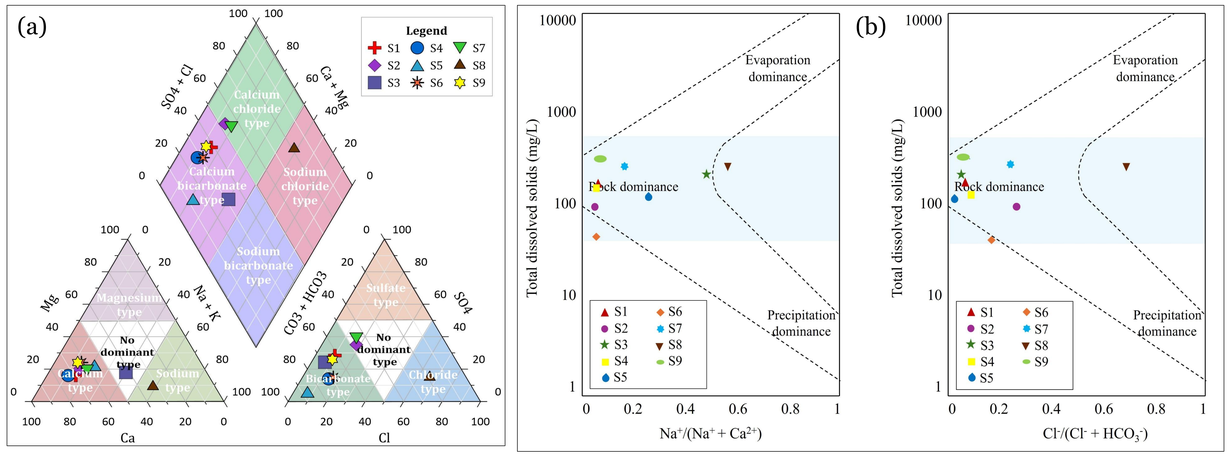

Figure 2. (a) Hydrochemical facies classification of sites based on cation and anion species dominance. (b) Gibbs diagram of processes controlling the chemistry of water samples by TDS, Na^+/Ca^{2+}, and Cl^-/HCO_3^- weight ratios. All samples fall within the rock dominance field (light blue box) [2].

Cross Section Models

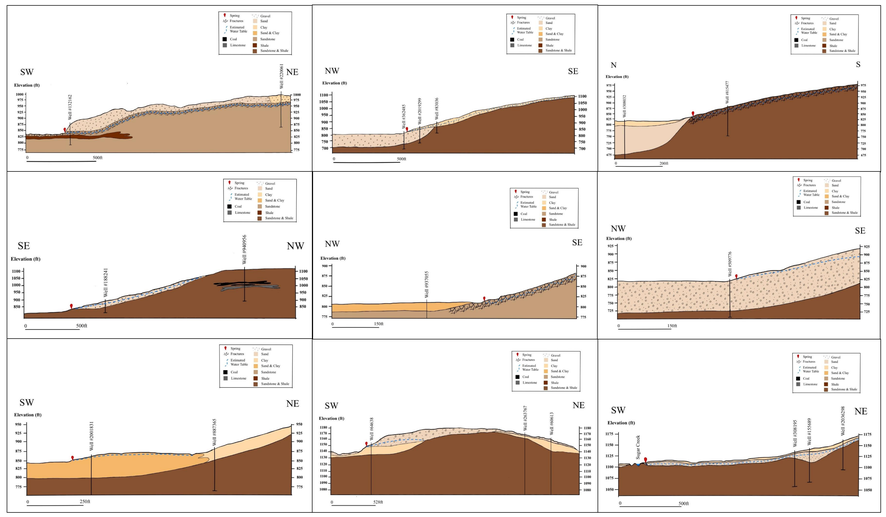

Figure 3. Cross section models of the geology surrounding each spring site that show likely groundwater pathways towards each spring.

Conclusion

Groundwater is primarily comprised of major ionic constituents (Na^+, Ca^{2+}, Mg^{2+}, K^+, Cl^-, SO_4^{2-}, HCO_3^-, CO_3^{2-}), which provide insight into groundwater interactions within aquifers. The water from the springs was classified as Ca-HCO_3 type, Ca-Cl type, and Na-Cl type, in order of abundance, and was dominated by rock interactions, except for sites dominated by Na^+ and Cl^-, which were influenced by surface activities. The groundwater chemistry results and cross section models suggested groundwater pathways through locally recharged, unconsolidated aquifers (sand, gravel, clay) or fractured bedrock aquifers (sandstone, shale). Comparisons with U.S. EPA water quality standards revealed that most of the spring sites were suitable for consumption.

Acknowledgements

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Figure 4. Sampling at a spring site.

References

[1] Cherry, J.A., and Freeze, R.A, 1979, Groundwater: https://fc79.gw-project.org/.

[2] Gibbs, R., 1970, Mechanisms Controlling World Water Chemistry, Science, v. 170, no. 3962, p. 1088-1090.