



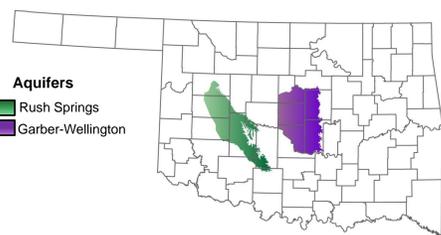
Geochemistry and Occurrence of Arsenic in the Rush Springs Sandstone, Caddo County, Oklahoma

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Introduction



Human exposure to arsenic can cause both short-term and long-term health effects. In 2000 the United States EPA reduced the Maximum Contaminant Level (MCL) of arsenic in drinking water from 50 ppb to 10. This then put many public water-supply systems at risk for exceeding the new MCL, including some in the Rush Springs Aquifer.

Figure 1: Map showing Rush Springs and Garber-Wellington Aquifers.

When water quality was reassessed by Becker and others 2010 the arsenic levels in wells sampled exceeded the new (2006) MCL. The source of arsenic in the nearby Permian red sandstone Garber-Wellington (Central Oklahoma) aquifer has been determined by utilizing chemical data collected from rock and water samples. A similar study needed to be conducted on the Rush Springs Sandstone to determine the potential source of arsenic; this study analyzed the rock samples to better understand the potential source(s). Studies have been done to assess the structure and rock type of the Rush Springs but a full geochemical profile has not been established.

Objective

The purpose of this study was to gain a better understanding of the chemical composition of the Rush Springs Sandstone and possible chemical implications to the groundwater that flows through it.

Study Site

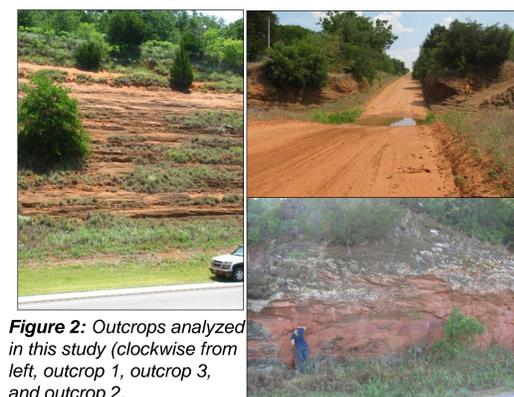


Figure 2: Outcrops analyzed in this study (clockwise from left, outcrop 1, outcrop 3, and outcrop 2).

The study area is located in Caddo County, Western Oklahoma. The Rush Springs Sandstone is a well-sorted, fine-grained, poorly-cemented Permian Red Bed that is part of the Rush Springs Aquifer. The Rush Springs Sandstone is generally massive with frequent sections of cross-bedding. The depositional environment was a nearshore marine environment associated with eolian formations (MacLachlan, 1967).

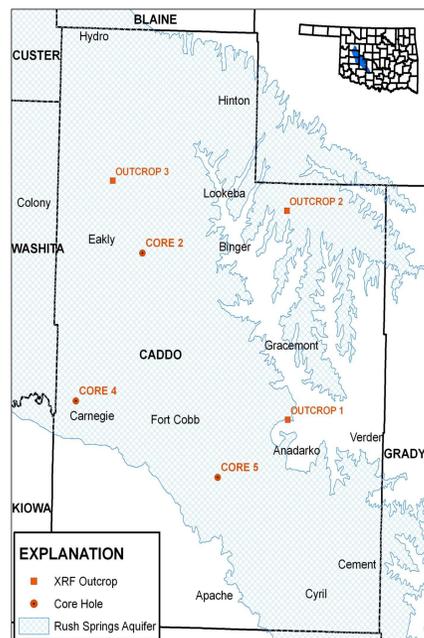


Figure 3: Study site and analysis locations

Methods



Figure 4: Utilizing handheld XRF on outcrop 2.

The Thermo Scientific Niton XL3T handheld X-Ray Fluorescence (XRF) analyzer with GOLDD technology was used to determine chemical composition in the Rush Springs Sandstone.

Two cores and three outcrop sites were analyzed for metals with the XRF.



Figure 5: Niton XL3T XRF analyzer and Rush Springs core

Results

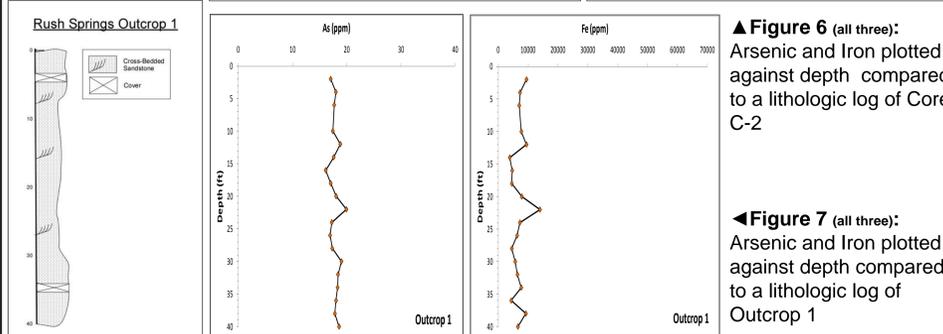
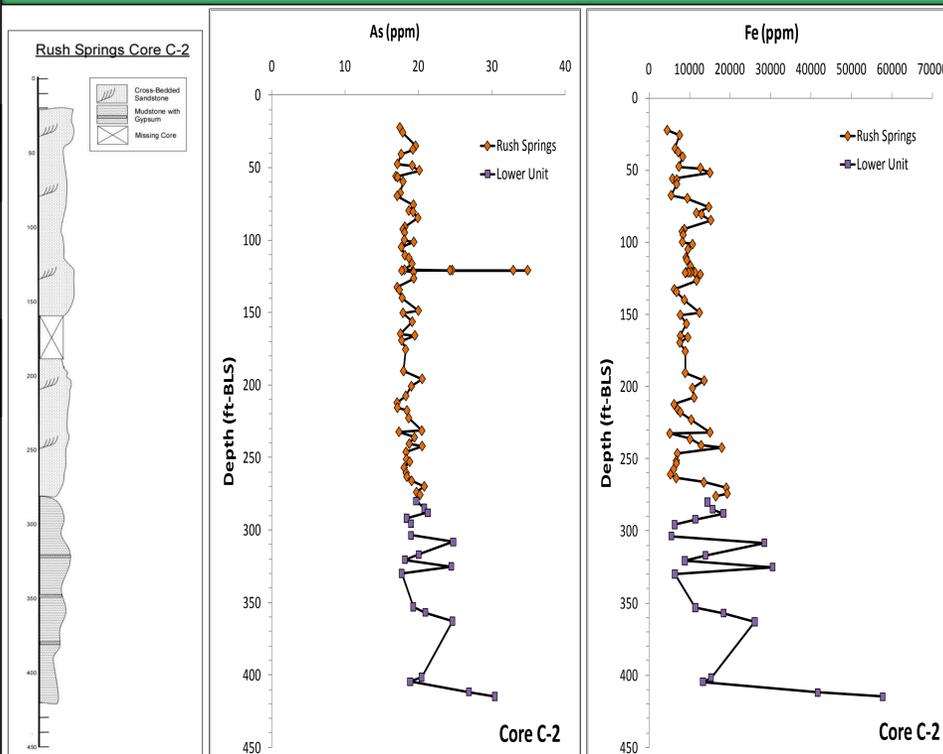


Figure 6 (all three): Arsenic and Iron plotted against depth compared to a lithologic log of Core C-2

Figure 7 (all three): Arsenic and Iron plotted against depth compared to a lithologic log of Outcrop 1

Discussion

The Rush Springs Sandstone had a higher average concentration of arsenic than the Garber-Wellington Formation, though the dissolved arsenic concentrations are higher in the Garber-Wellington Formation. Multiple factors may be affecting arsenic concentrations in those aquifers, such as pH, water type, and the other chemical constituents of each rock unit in those aquifers.

Unit	Average As Concentration, Sandstone (ppm)	Dissolved As Concentration Range (µg/L)	Average pH	Average Water Type
Rush Springs	18.6 (XRF)	7.1-18	7.3	Calcium-Sodium Bicarbonate
Garber-Wellington	14 (ICP)	0.7-124	8.2	Sodium Bicarbonate

Table 1: Comparison of aquifer data from the Rush Springs and Garber-Wellington (Modified from Becker et al, 2010 and Mosier et al, 1990).

The Garber-Wellington Formation had much more variation lithologically and in pH than the Rush Springs Sandstone thus causing more vertical variation in the arsenic concentrations in both the rock and dissolved forms. Water types also determined the amount of arsenic that is released into the groundwater system, differences in them will cause different reactions to occur.

Desorption from iron oxide due to increasing pH is what caused the arsenic to mobilize in the Garber-Wellington Aquifer. Given the data, the reaction that caused the arsenic to mobilize in the Rush Springs Aquifer appears to be different than that of the Garber-Wellington Aquifer.

Conclusions

- Arsenic concentrations were generally consistent throughout the Rush Springs Sandstone ~18 ppm.
- Concentrations of arsenic in the Rush Springs Sandstone were higher than those of the Garber-Wellington Formation ~14 ppm.
- More data needs to be collected in order to determine source(s) and mobilization of arsenic in the Rush Springs aquifer.

Acknowledgements

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References

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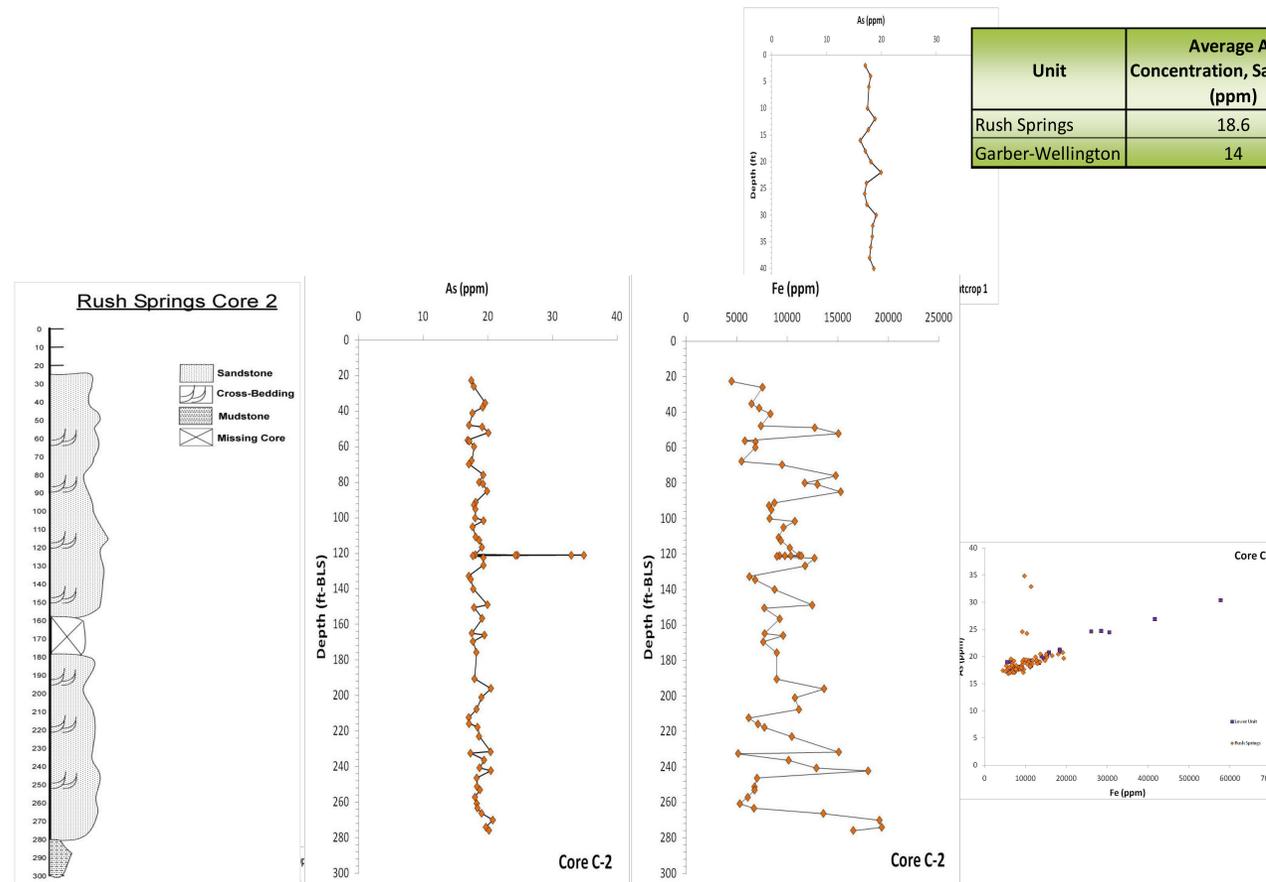


Figure 7: Lithologic log of Core 2

▼ Figure 9b: Iron compared to Depth for Outcrop 1

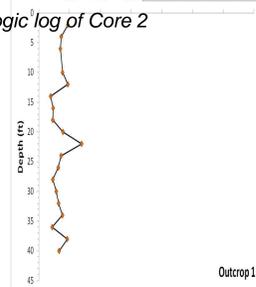


Figure 8: Arsenic compared to Iron for core C-2

