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Groundwater development leads to decreasing arsenic concentrations in the San Joaquin Valley, California

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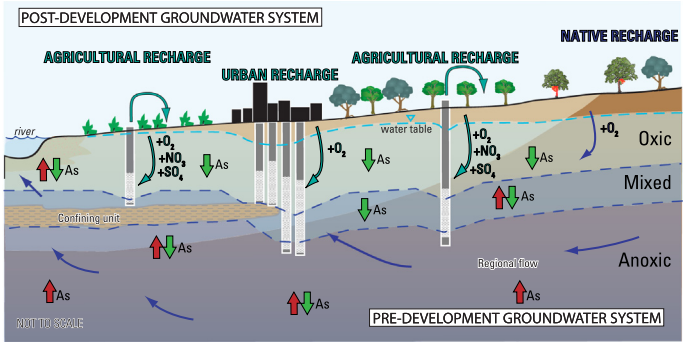
HIGHLIGHTS

- Arsenic concentrations in most wells (76%) are generally low and are not changing.
- Decreasing arsenic trends are more common (16.6%) than increasing trends (7.2%).
- Decreasing arsenic trends are due in part to downward moving oxidizing groundwater.
- Arsenic trends were inversely related to co-occurring nitrate and sulfate trends.
- Increasing arsenic trends are more common in deep groundwater in the valley trough.

GRAPHICAL ABSTRACT



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ABSTRACT

In the San Joaquin Valley (SJV), California, about 10% of drinking water wells since 2010 had arsenic concentrations above the US maximum contaminant level of 10 μg/L. High concentrations of arsenic are often associated with high pH (greater than 7.8) or reduced geochemical conditions. Although most wells have low arsenic (<3 μg/L) and do not have changing arsenic concentrations, this study found that most wells with concentrations above 10 μg/L had arsenic trends. Overall, about 24% of wells had time-series trends since 2010 and 59% had paired-sample trends since 2000. Most wells had decreasing arsenic trends, even in wells with higher arsenic concentrations. These wells often had co-detections of increasing nitrate and sulfate trends that reflect oxic groundwater likely derived from agricultural recharge. Wells with increasing arsenic trends were deeper or located in the valley trough where aquifer materials are more fine-grained and where reducing conditions favor arsenic mobility. Wells with arsenic trends also tend to be clustered near areas of higher well density. Groundwater pumping in these areas has likely increased the contribution of younger, more oxic groundwater in wells with declining arsenic or, less frequently, increased the contribution of higher pH or reduced groundwater in wells with rising arsenic. Projections of arsenic trends indicate that 37 wells with high arsenic presently will be below 10 μg/L in ten years. Unfortunately, these improvements will be largely offset by 31 wells that are expected to increase above 10 μg/L in addition to expected rises in nitrate in wells where arsenic decreased. This study shows how human-altered flow systems can impact the natural geochemical character of water in both beneficial and deleterious ways.

1. Introduction

Arsenic is a potential human health concern for people that rely on groundwater for drinking water because it is ubiquitous in most aquifer

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