Arsenic mobilization in an aquifer in the Mekong Delta, Vietnam

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INTRODUCTION

Aquifer contamination with As is a major global threat to human health affecting roughly **80 million people** in SE Asia (e.g., Vietnam, see Fig. 1). Although most researchers attribute As mobilization to the reductive dissolution of As-bearing Fe-oxides or Fe oxyhydroxides [1,2], **S** could also exert an important **influence on As speciation and concentration** via the **formation of highly mobile thioarsenate species** [3-8] (see Fig. 2).

Hence, the **aim** of this research is to **shed light on the importance of S cycling in the release of As,** and specifically the **role of thioarsenates in As mobilization** at the field scale in the sulfate-reducing groundwater in the An Giang province of the Mekong delta (Vietnam, Fig.1).

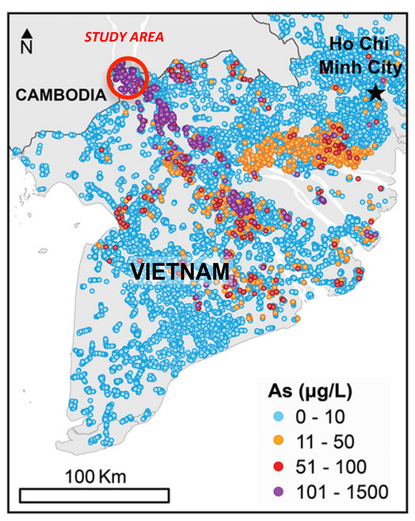


Fig. 1. *As in Mekong delta groundwater (data from [9]). Location of field site indicated by circle.*

HYPOTHESES

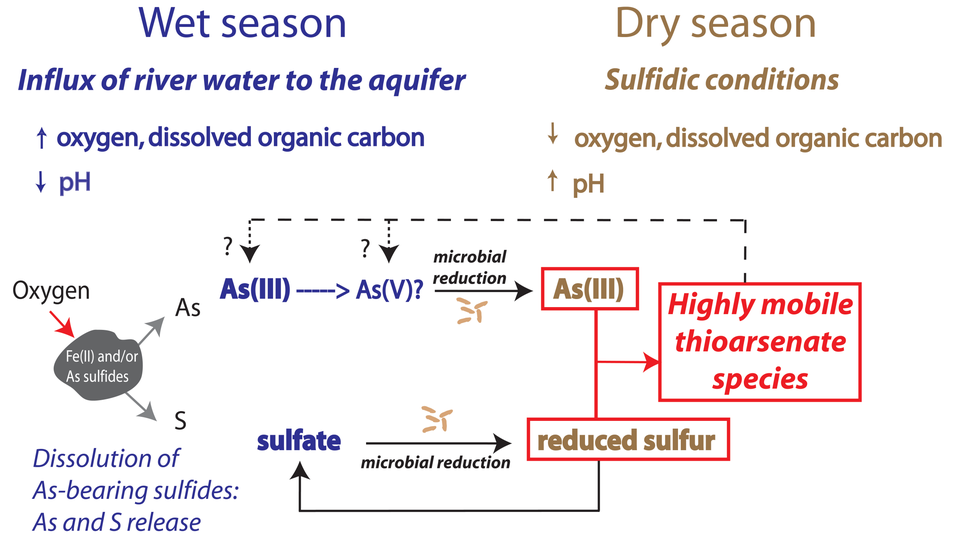


Fig. 3. *Hypothesized model for the formation of thioarsenate species in the study area (An Giang province, Mekong delta, Vietnam).*

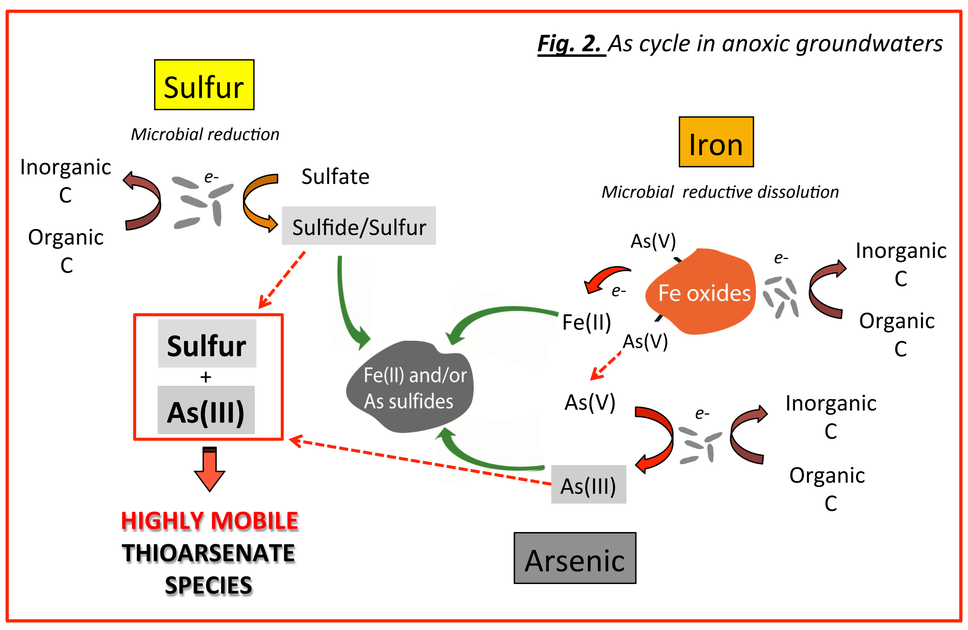


Fig. 2. *As cycle in anoxic groundwaters*

METHODOLOGY

Groundwater sampling under anoxic conditions

- Sampling campaigns during the dry (May 2014 and January 2015) and wet seasons (August 2014)
- pH, DO, ORP and conductivity: measured on site.
- Samples for cation, anion, DOC/DIC, As, Fe and S speciation: preserved for laboratory analysis.

River water sampling

RESULTS AND DISCUSSION

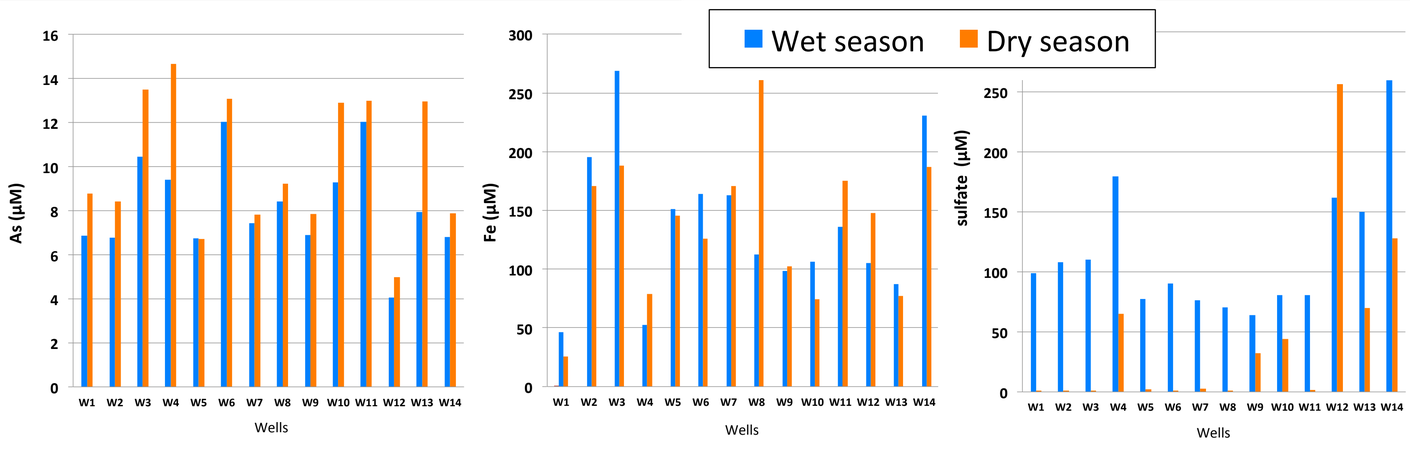
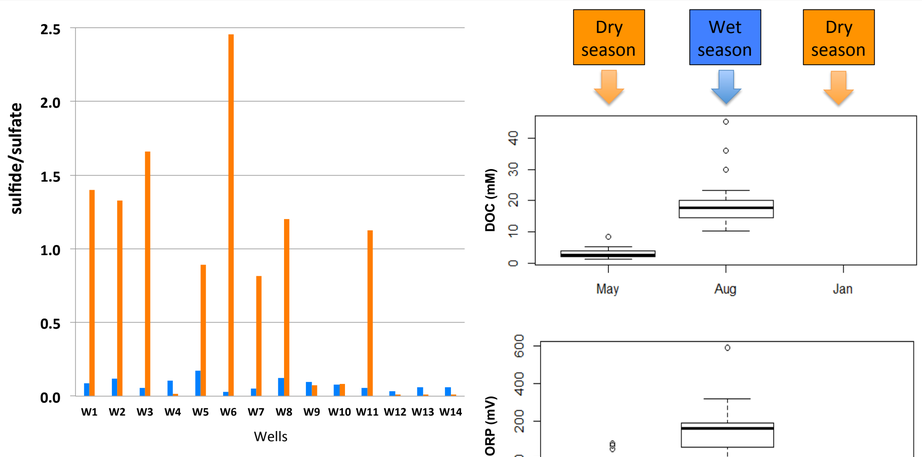


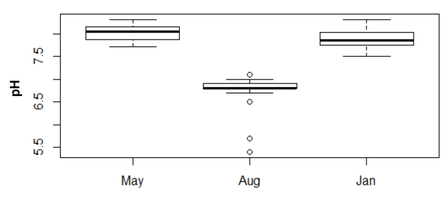
Fig. 4.
Seasonal variation in total arsenic, iron, sulfate and sulfide/sulfate ratios in groundwater samples of the An Giang province.



The results from analysis of anoxic groundwaters of the An Giang province suggest a **seasonally variable water geochemistry** (Figs. 4 and 5). The results show:

- ✓ Variable concentration of sulfide suggesting **microbially-mediated sulfate reduction**.
- ✓ **Evidence** for the formation of **thioarsenate** species (5.25 ppb of monothioarsenate in W15, sampling of May 2014).
- ✓ **No correlation** between **As and Fe** concentration.
- ✓ Total **As** concentration **increases** during the **dry season**; As(III) is the main species in both seasons (> 80% of total As).
- ✓ **Sulfate** concentration **increases** during the **wet season**.
- ✓ **The ratio of sulfide/sulfate increases** in the **dry season**.
- ✓ **Higher DOC and ORP values in the wet season** suggesting an influx of more oxidized, organic matter-bearing river water into the aquifer, which could cause the dissolution of sulfide minerals in the aquifer explaining the **lower pH** values.

Fig. 5.
Seasonal variations in DOC, ORP and pH measured in groundwater samples of the An Giang province.



SUMMARY

- ✓ Our results to date suggest that **As maybe linked to S cycling** in the aquifer under sulfate-reducing conditions, which are propitious for the formation of soluble thioarsenate species.
- ✓ **Future sampling** is needed to better evidence the **role of sulfur in As mobilization in An Giang groundwater** and corroborate our hypothesis.

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