

Abiotic/Biotic Reduction of Trichloroethene and Perchlorate: Laboratory Treatability Study for a Superfund Site

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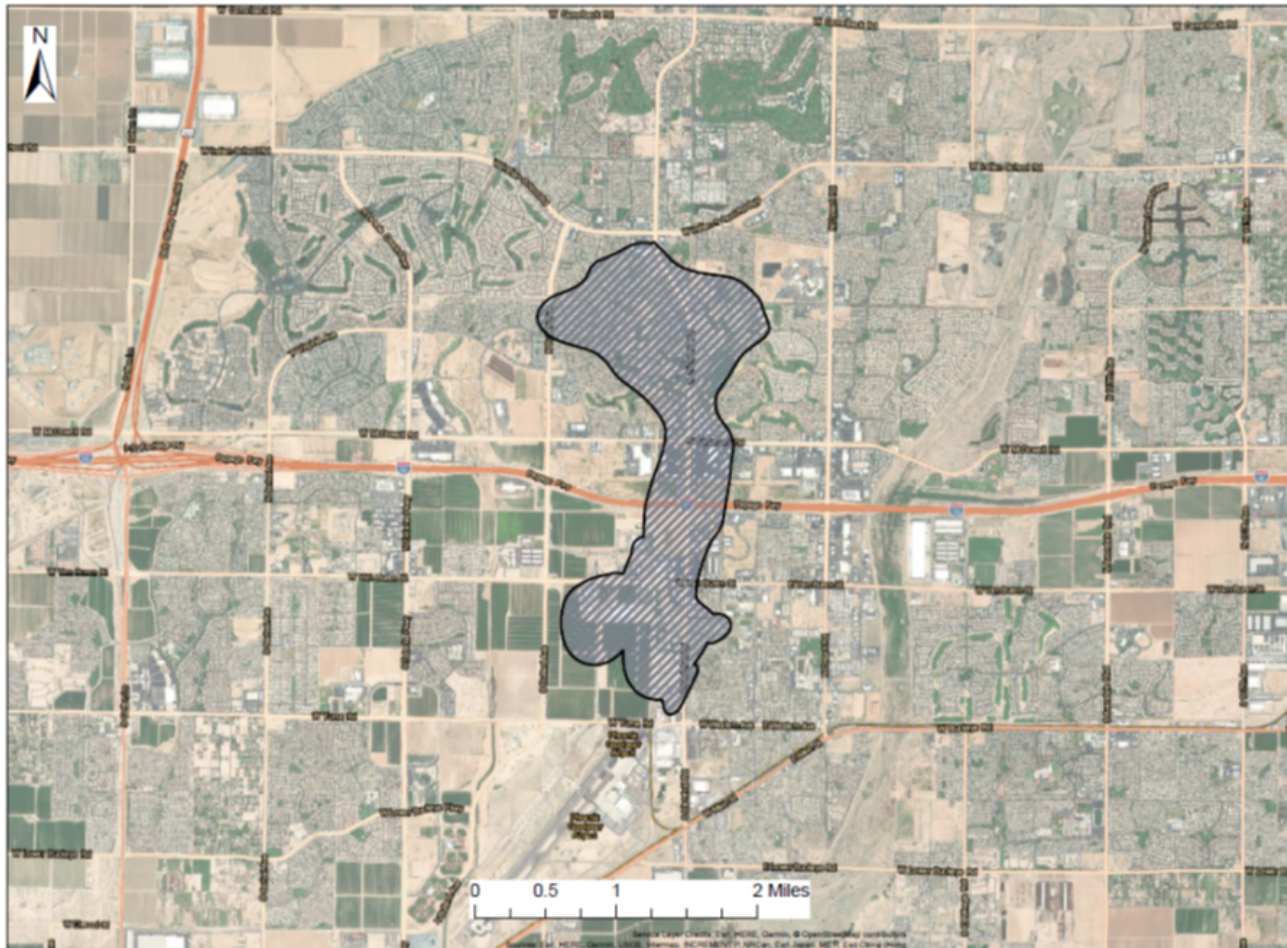
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CLUIN Webinar for Innovations in Remediation at the Center for Bio-mediated and Bio-inspired Geotechnics



Center for Bio-mediated &
Bio-inspired Geotechnics

Phoenix-Goodyear Airport North (PGA-N) Superfund Site, Goodyear, AZ



Plume boundaries depicted on the site map represent ADEQ's interpretation of data available at the time the map was constructed. The map is intended to provide the public with basic information as to the estimated geographic extent of known contamination as of the date of map production. The actual extent of contamination may be different. Therefore, the plume for this site may change in the future as new information becomes available.

Plume update: 07/01/2018

Date Map Saved: 7/23/2018



Publication Number: M 18-41

http://www.azdeq.gov/Portals/0/PGA-N_Superfund_Site_Map.pdf

- Added to the NPL in 1983
- Groundwater impacted by trichloroethene (TCE) and perchlorate
- Chromium, cadmium, aluminum, and copper in certain source area soils
- Subunit A - Interbedded sands, silty sands, and clayey sands with localized sand and gravel sequences; groundwater depth 90-140 feet bgs; groundwater flow direction north-northwesterly

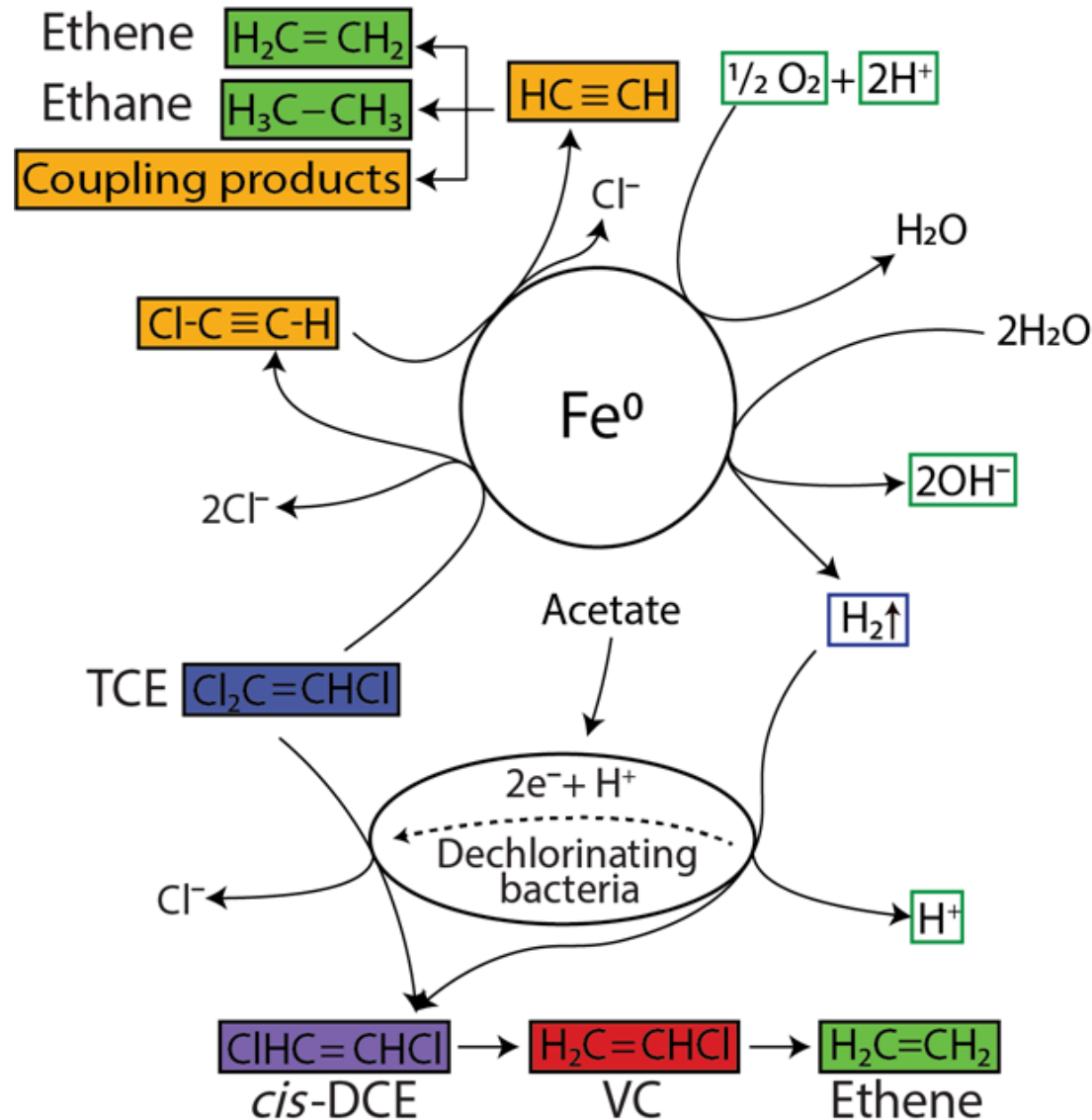
Proposed source area remediation



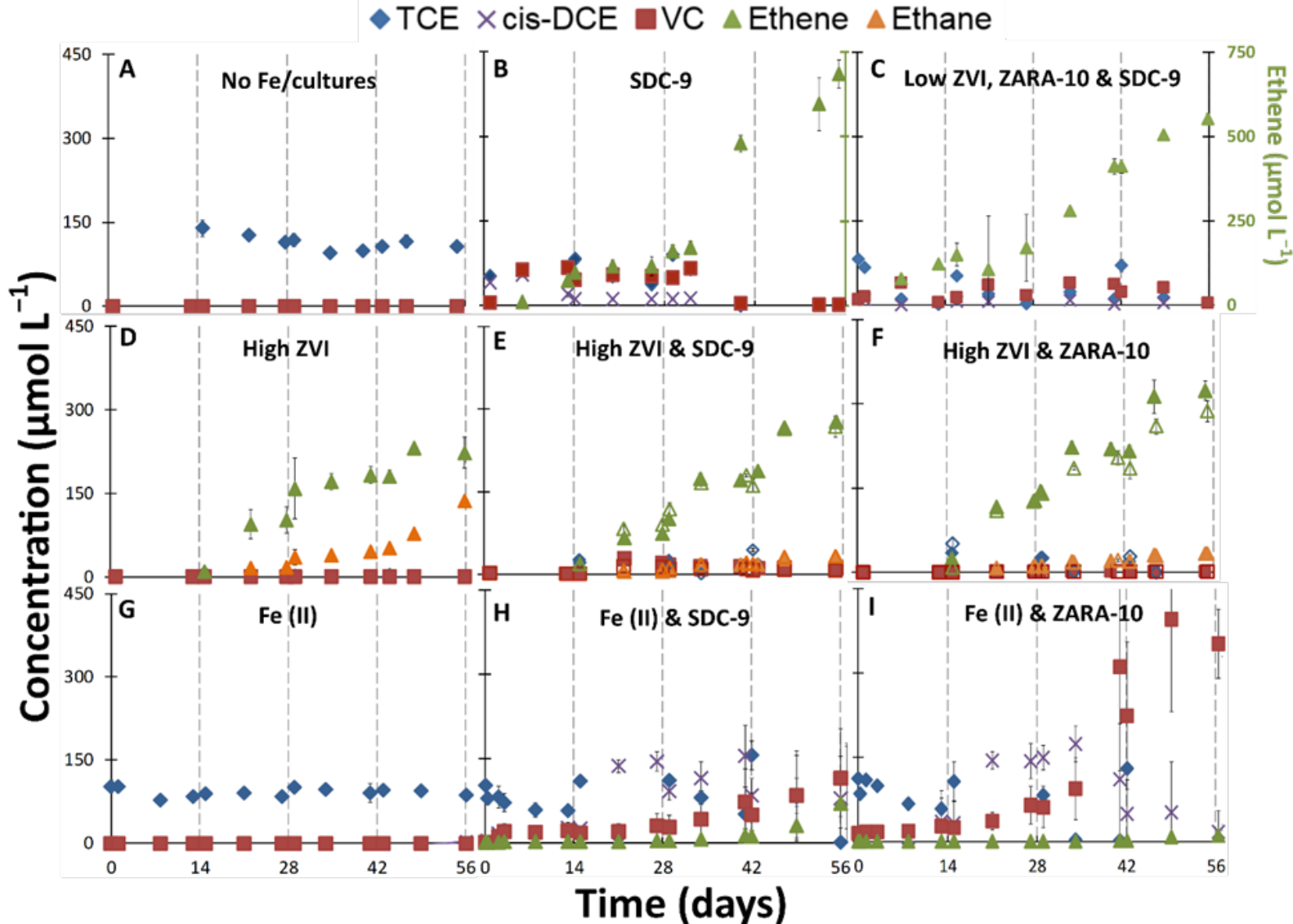
Photo courtesy of Catherine Brown, EPA

- Five groundwater pump and treat systems returning cleaned water using reinjection, infiltration and irrigation.
- In situ chemical reduction has been employed on a limited scale.
- Treatability Study: develop design-related insights for a potential remedy for Subunit A source area groundwater (approved by the EPA and contained in the Record of Decision Amendment Sep 2014).

Combined remedy using zero-valent iron and microbial reductive dechlorination

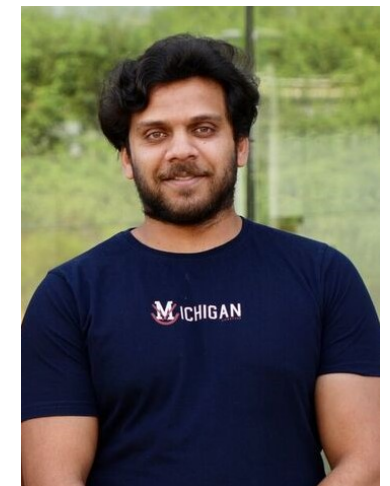


Semi-batch microcosm study – TCE reduction



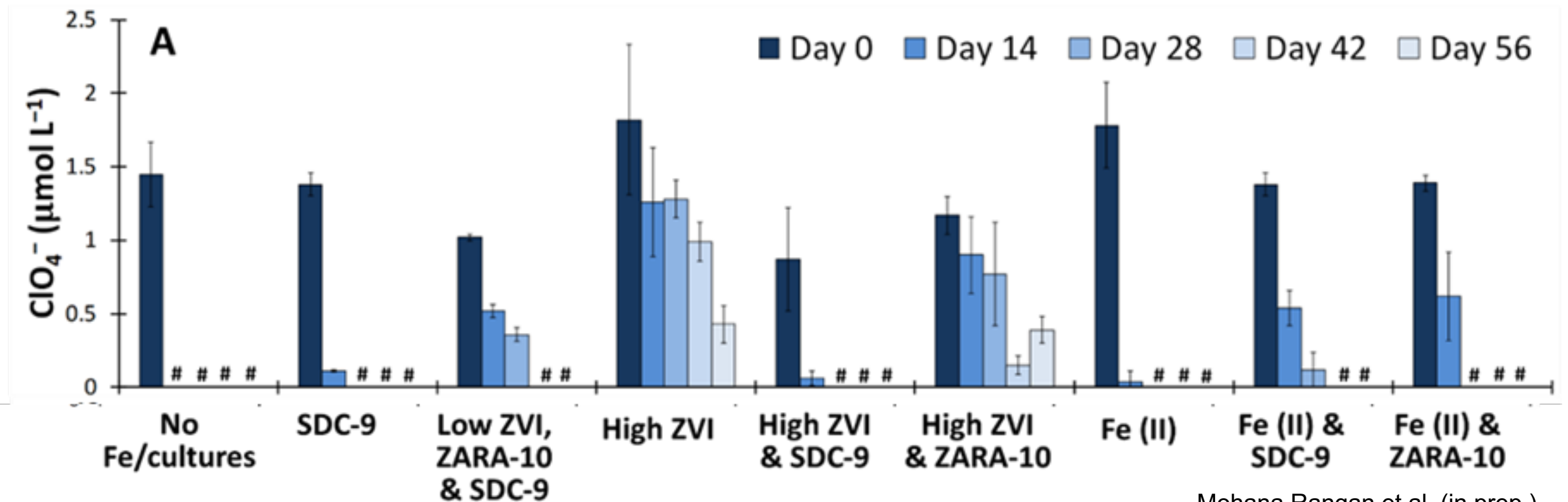
Microcosms – 25 g soil and 75 mL groundwater

- High ZVI: 15 g L⁻¹ mZVI & 1.5 g L⁻¹ nZVI
- Low ZVI: 2.5 mL spent ZVI from High ZVI microcosms
- Fe (II) 0.25 g L⁻¹
- 560 mg/L lactate and 170 mg/L emulsified vegetable oil (biostim)
- SDC-9 and ZARA-10: *Dehalococcoides mccartyi* bioaugmentation cultures



Mohana Rangan et al. (in prep.)

Semi-batch microcosm study – Perchlorate reduction

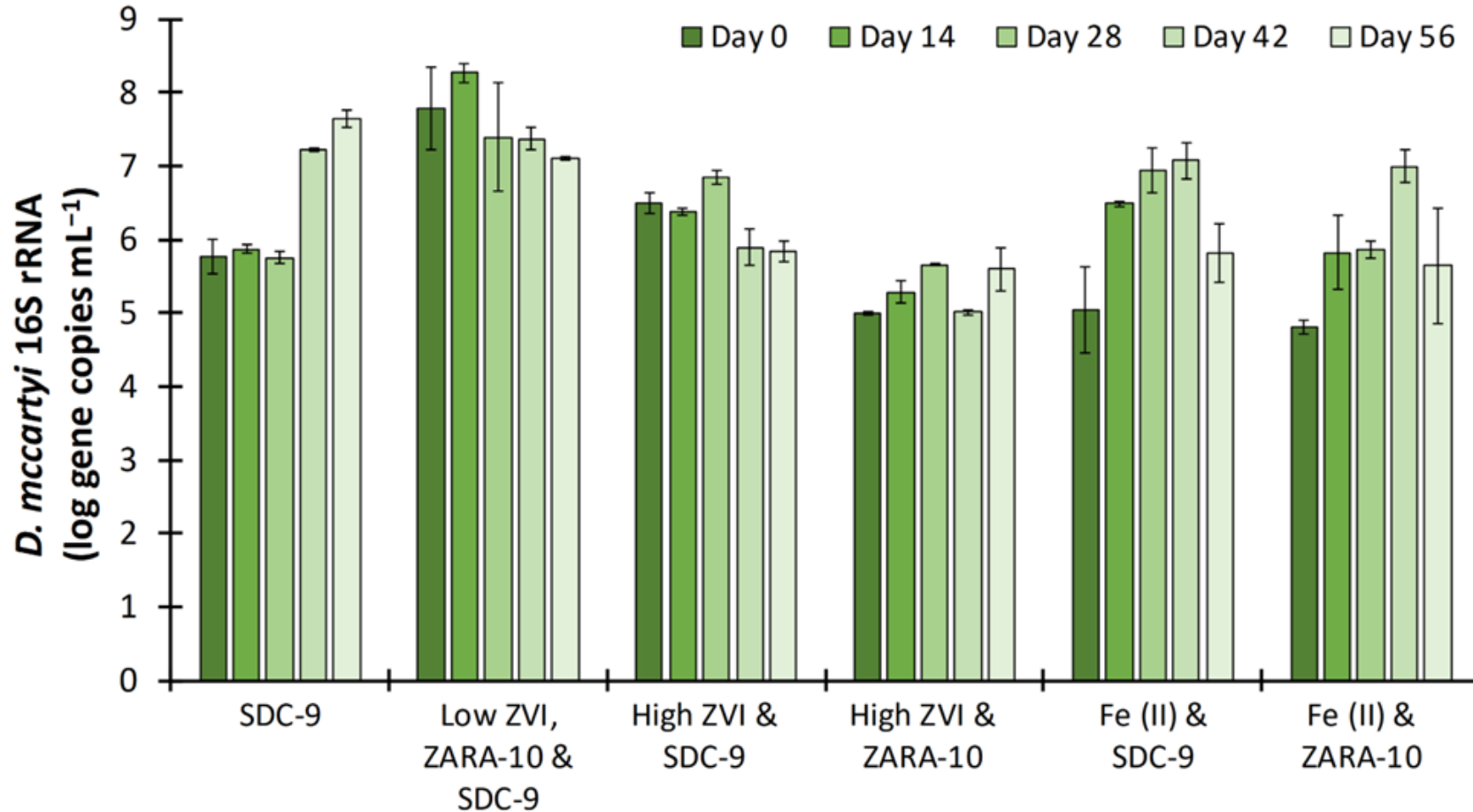


Mohana Rangan et al. (in prep.)

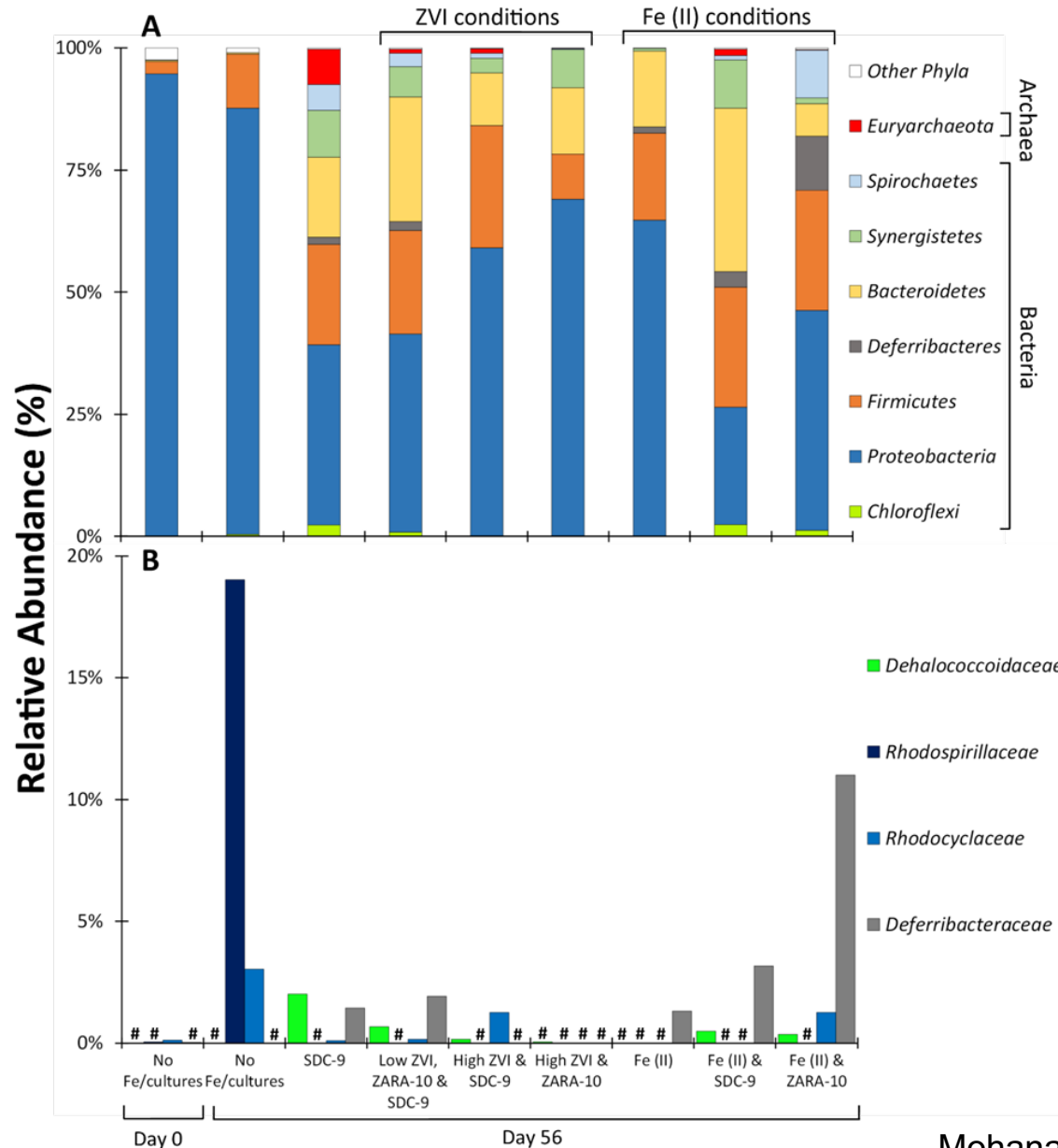
= non-detect

SDC-9 and ZARA-10: *Dehalococcoides mccartyi* bioaugmentation cultures

Growth of *Dehalococcoides mccartyi* in the presence of ZVI and Fe (II)



Microbial communities enriched in microcosms



Microcosms – 25 g soil and 75 mL groundwater

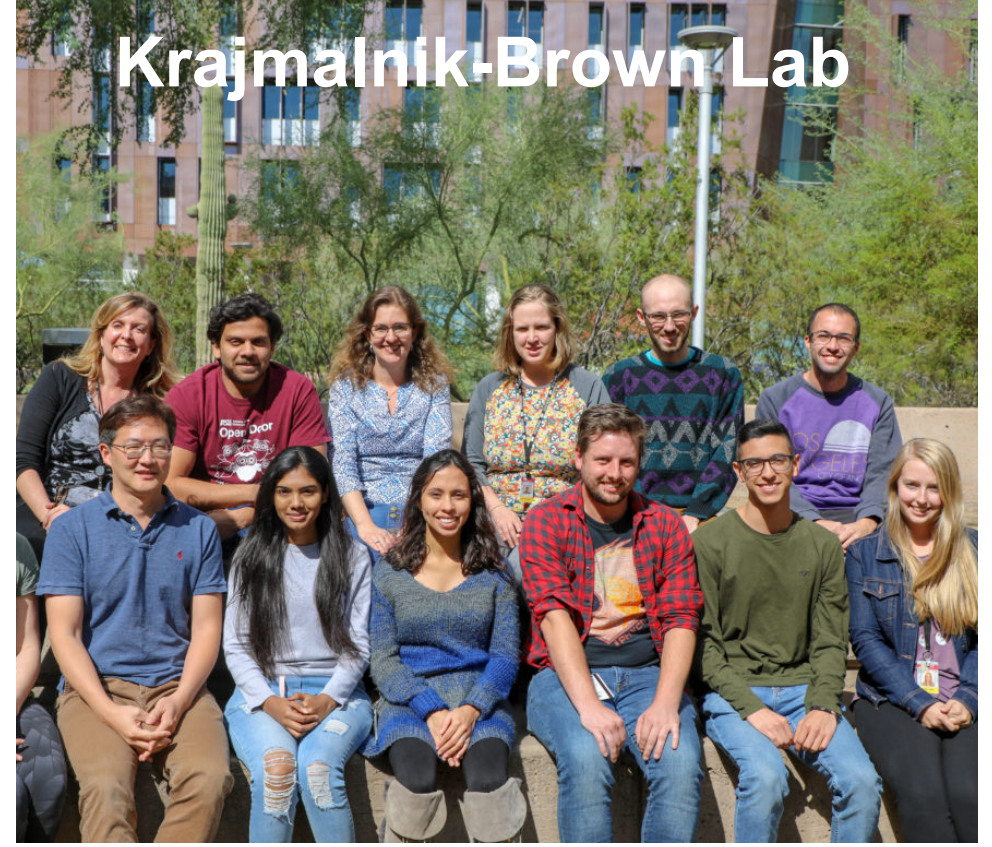
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- i. Abiotic TCE reduction to ethene and ethane was highly effective at high ZVI concentrations.
- ii. Microbial perchlorate reduction was partially inhibited at high ZVI and Fe (II) concentrations.
- iii. Microbial TCE reductive dechlorination was a significant process at low but not high ZVI concentrations
- iv. Synergy between abiotic and biotic reduction processes was observed under flow-through conditions.
- v. Biostimulation/bioaugmentation (no ZVI) achieved similar outcomes in terms of complete TCE dechlorination to ethene.

Delgado Lab



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Thank you!

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