Research on Polar Organics Composition

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While I will be discussing results of a Chevron funded research program, all the opinions expressed are mine.

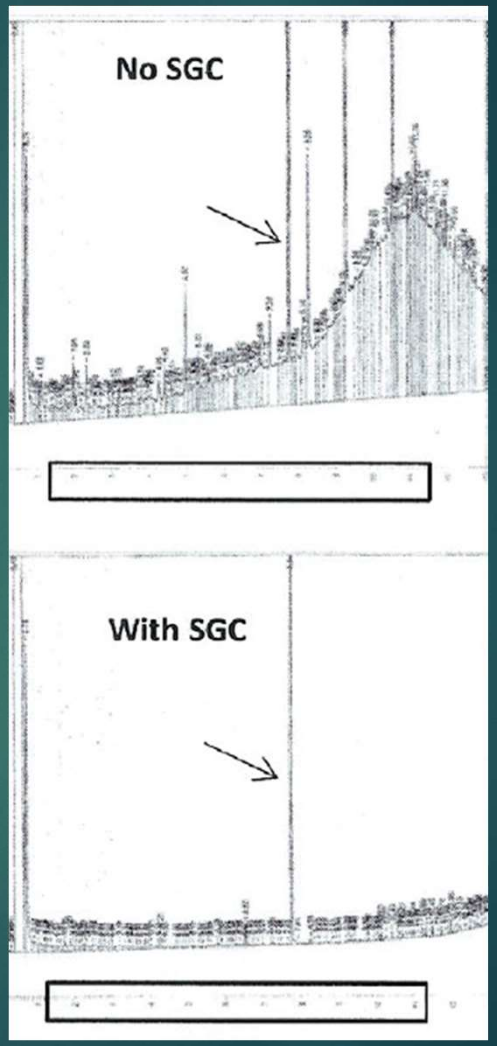
My perspective is as a biochemist, not a toxicologist.

Key Readings

- Zemo et al. Life Cycle of Petroleum Biodegradation Metabolite Plumes, and Implications for Risk Management at Fuel Release Sites. Integrated Environmental Assessment and Management 2017, 3:714-727.
- Zemo, D. White Paper: Approaches to Development of Human Toxicity Factors and Drinking Water Screening Levels for Petroleum Biodegradation Metabolite Mixtures in Groundwater. 2022. Submitted with comments on the WSDOE Draft Guidance.

The Issue

- TPH is a non-specific analytical method that measures extractable organics.
- At some petroleum release sites there are positive results for TPH in groundwater that contains no hydrocarbons.
- Treating solvent extracts with silica gel removes non-hydrocarbon polar organics.
- The goal of our programs was to characterize the nature and risk of polar compounds removed by silica gel cleanup (SGC).

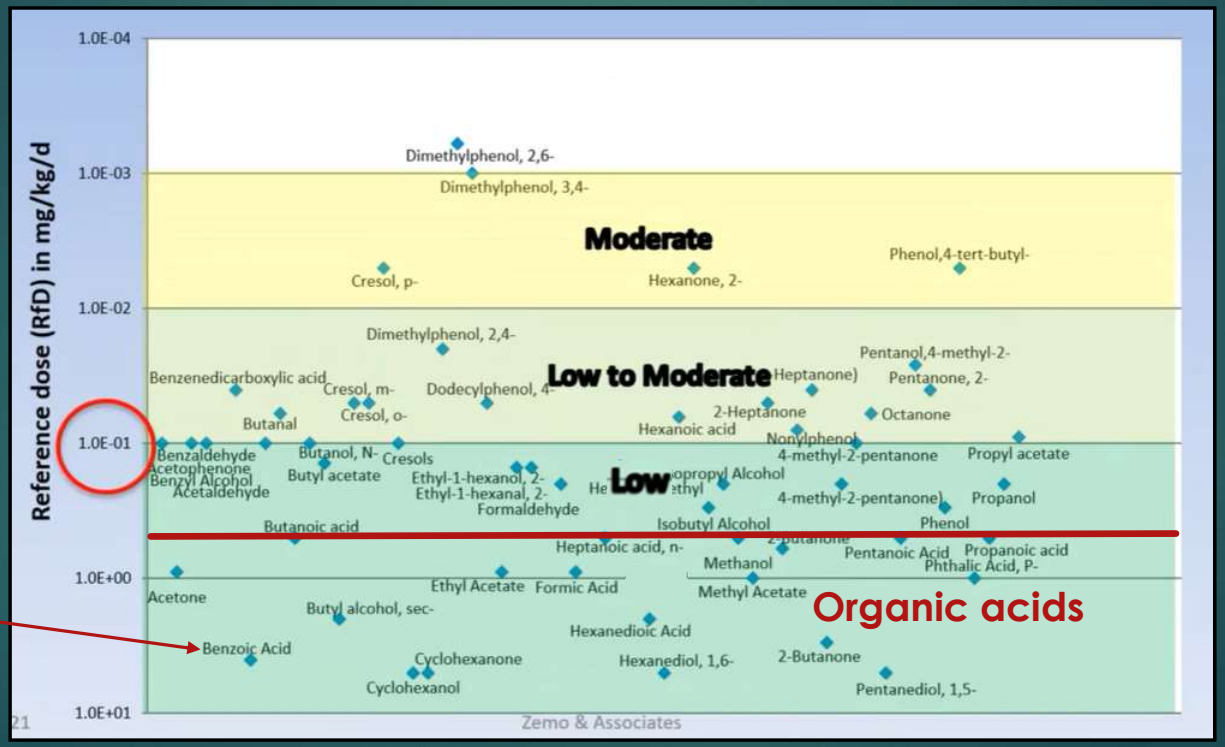


The Process

- Use non-targeted 2D GC-MS and targeted GC-MS to identify polar organics in groundwater extracts.
- Analyze over 100 samples from 22 sites to characterize upgradient, source area, and downgradient groundwater.
- Assign the 1000+ tentively identified compounds (TICs) to 5 families and 22 structural classes.
- Use available toxicity data on structural class members to estimate the toxicity of compounds without toxicity data.
- Develop a conceptual model for managing the risk of polar organics.

The most common polar organics are low toxicity (non-toxic?) organic acid / esters

Benzoic Acid is a common food additive



Risk Management Based on Stages

- Most wells at the service stations evaluated were either at Stage I (hydrocarbon and polars organics) or Stage 4 (low toxicity polar organics only).
- The presence of hydrocarbons drive the risk in Stage 1 wells.
- Stage 4 wells without hydrocarbons should not be evaluated as if they have hydrocarbons, even if Stage 1 wells in the source area occur at the site.
- While Stage 2 & 3 wells less common, the methods allow for calculating clean-up goals.

Recent Findings / Hypotheses

- Most polar organics found in Stage 4 wells are also found in background wells.
- Polar organics may not be degradation intermediates, but evidence of complete degradation and microbial growth.
- The generation of polar organics may play a positive role in natural attenuation.

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