

## Regulatory Challenges Posed by Petroleum Metabolites in Groundwater

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**Background/Objectives.** The increasing awareness that partial breakdown products of petroleum hydrocarbons (polar petroleum metabolites or oxyhydrocarbons) can persist in groundwater raises questions about the management of large petroleum release sites. Due to their greater solubility, these polar compounds constitute the bulk of petroleum-derived chemicals in groundwater at larger and older release sites. This awareness undermines long-standing beliefs such as: 1) petroleum risk can be adequately characterized by only measuring indicator compounds; 2) all hydrocarbons completely mineralize to water and carbon dioxide in a reasonable timeframe; and 3) residual NAPL poses no threat to water quality.

The SF Bay Regional Water Board (Regional Board) took action after one group kept arguing that metabolite concentrations should not even be measured because the potential adverse effects to humans are negligible and that samples should therefore be routinely treated with silica gel cleanup (SGC). Such a claim runs counter to the fact that the adverse health effects of many chemicals, hydrocarbons included, are caused by their metabolites. Similar arguments that these compounds pose no ecological risks are not consistent with data from our own cases. Past aquatic toxicity testing performed under our oversight at large petroleum release sites near the bay margin demonstrated ecological toxicity at concentrations as low as 600 µg/L.

**Approach/Activities.** Responding to a need for clarification the Regional Board spelled out its approach in the 2013 Environmental Screening Levels (ESLs). Routine samples are to be processed without SGC and an estimate of metabolite concentrations may be obtained by comparing duplicate samples analyzed with and without SGC. Subsequently, we conducted a literature review to further inform our handling of the metabolite issue, and prepared a technical memorandum in 2016. Our approach treats the toxicity of bulk metabolites the same as bulk hydrocarbons (i.e. compares them to the same regulatory criteria, which requires only one analysis without SGC) when measured by extractable TPH analysis. In addition, the technical memo describes measurement and subtraction of background biogenic compounds and chromatogram review. We continue to refine our ideas through: 1) project oversight; 2) discussions with researchers; and 3) more literature review.

**Results/Lessons Learned.** Over the past few years, we have worked with consultants and dischargers to help them better understand our concerns and to appropriately evaluate their sites. We find that progress in managing these compounds is hampered by antiquated analytical technologies; inability to track the changing metabolite composition at a given site; practitioners' poor understanding of TPH analysis methods and rationale for SGC; and limited toxicological information for both parent hydrocarbon mixtures and the metabolites. Despite these challenges, we are making progress on evaluating sites of heightened concern due to proximity to the bay, and are working on new guidance to explain in more detail how we evaluate contaminated groundwater discharges to surface water.