



Delta Tributaries Mercury Council

~ Meeting Minutes ~

Tuesday, 13 May 2008

12:30 p.m. – 4:30 p.m.

Sacramento Regional County Sanitation District

Conference Room 162

Mather, CA

Facilitator: Stephen McCord, LWA

Meeting Minutes by: Hope McCaslin and Stephen McCord, LWA

Attendees

In Person

Charlie Alpers, USGS

Shaun Ayers, UC Davis

Ken Ballard, City of Sacramento

Janis Cooke, CVRWQCB

Jacob Fleck, USGS

Vicki Fry, SRCSD

Peter Green, UC Davis

Peter Halpin, Caltest Analytical Laboratory

Douglas John, CA Dept of Conservation

Jody Johnson, Shaw E & I

Dave Lawler, BLM – CASO

Kyle Leach, Holdrege & Kull

G. Fred Lee, G. Fred Lee & Associates

Sara Martin, SRWP

Hope McCaslin, LWA

Cynthia McClain, UC Davis

Patrick Morris, CVRWQCB

Doug Nelson, UC Davis

Tony Pirondini, City of Vacaville

Greg Reller, Burleson Consulting

David Sedlak, UC Berkeley

Ivan Sturman, Ad Hoc Anti-Hg Committee

Dave Tamayo, Sacramento County SW Program

Patrick Ulrich, UC Berkeley

Becky Wood, ATS

Michelle Wood, CVRWQCB

Via Webcast

Tom Smythe, Lake Co. Dept. Public Works

Jennifer Hunt, SFEI

I. Introductions and Agenda Review

II. Presentations

Methylation inhibition research I – “Can we use iron to control methylation rates in wetlands?” by David Sedlak (UC Berkeley)

Dr. Sedlak presented the results of two microcosm studies that aimed to reduce mercury methylation in sediments. Iron and sulfate are the main electron acceptors in sediments, with mercury speciation dominated by HgS. Changing the equilibrium of mercury-sulfide reactions

can influence the bioavailability of mercury. Iron affects sulfur speciation by lowering concentrations of HS^- , and thereby shifting the equilibrium away from bioavailable mercury.

The first study focused on the effect of iron on mercury methylation in sediment slurries. High levels of mercury were added in these experiments. Iron was found to have no effect on sulfate reduction, but lowered bisulfide activity in experiments involving both pure cultures and mixed microbial communities. Results were promising enough to proceed with more realistic levels of these constituents.

The second study focused on microbial communities in microcosms, where bacteria are spatially segregated, iron-containing minerals experience aging, natural organic matter is present, and mercury levels are closer to ambient levels. The study utilized sediments from San Francisco Bay wetlands, with simulated tidal and sunlight cycles. They found that iron addition did not reduce sulfate reduction, but that sulfide activity was consistently reduced over time. Treatment with both high ($\sim 700 \text{ g/m}^2$) and medium ($\sim 350 \text{ g/m}^2$) iron levels decreased mercury methylation by 12-94% and dissolved mercury, while a lower iron treatment ($\sim 200 \text{ g/m}^2$) resulted in methylation and dissolved mercury levels that were slightly higher than the control.

In summary, iron addition is looking promising as a way of controlling mercury methylation during wetland restoration. This could be a way to restore wetlands without exacerbating the mercury problem. Future research issues under consideration include the dose of iron, form of iron, frequency of application, and the role of plants and vegetation. Anyone interested in collaborating is encouraged to contact Dr. Sedlak.

Methylation inhibition research II – “Mercury methylation by iron- and sulfate-reducing bacteria in situ and in culture for contaminated locations both in the freshwater Clear Lake and in estuarine Walker Marsh” by Doug Nelson (UCD)

Doug Nelson presented a former student’s research of microbial communities in two mining-impacted locations, Clear Lake and Walker Marsh, which provided an additional level of complexity to the understanding of the dominant mercury-methylating bacteria species. For the past 20 years, sulfate-reducing bacteria have been accepted as the dominant species responsible for methylation of mercury.

In a study using Clear Lake sediments, the researchers inhibited sulfate-reducing bacteria (SRB) using molybdate (which stereochemically resembles sulfate), and measured the resulting decrease in methylmercury (MeHg) production. They found that MeHg production decreased by 50%, indicating that SRB are only responsible for close to a half of MeHg production. They isolated an iron-reducing bacteria (FeRB) species from Clear Lake sediment, which was found to methylate mercury at approximately the same rate as SRB. The current working hypothesis is that methylation in Clear Lake is at least in part attributed to FeRB.

In a study using sediment from Walker Marsh, incubated with radiolabelled sulfate, the researchers similarly found that molybdate inhibited mercury methylation by 50%. When the sediments were subjected to 16s rRNA sequence analysis, the predominant bacterial group was identified as *Geobacter*, which are iron reducers. They concluded that FeRB are responsible for up to 50% of methylation in Walker Marsh.

The overall conclusion was that the view of sulfate-reducing bacteria as predominant mercury methylators is simplistic. Practical implications of the research include considerations of sediment capping as a remediation strategy, since iron may be available as an electron acceptor

at greater depths than sulfate. It was noted that lake sediments are generally less stratified and less organic than wetlands, which may lead to different remediation strategies.

Methylation inhibition research III – “Inhibition of mercury methylation in sediments with low level selenium additions” by Nicolas Bloom (Studio Geochimica)

Nicolas Bloom presented his self-funded research on the effects of selenium (Se) on mercury methylation. Previous studies had found that selenium inhibits MeHg uptake across cell membranes, inhibiting bioaccumulation and reducing toxicity. In this study, however, since selenium is biogeochemically similar to sulfur, but Se compounds bind stronger with mercury than sulfur, they were expecting to find that Se additions directly inhibit methylation, by removing the active substrate (Hg(II)).

The study was conducted in vials containing sediments, which were incubated under anoxic conditions with water containing high TOC and low levels of Hg. The vials were spiked with HgCl₂ (at 2.0 µg/g) and various Se-compounds (from concentrations of 0.1 to 10 µg/g Se), and incubated for 7 days in the dark, upon which time methylmercury concentrations in the water were measured. It was observed that the percentage of MeHg decreased 30-95% with increasing concentrations of Se added as selenate, selenite, and selenocyanate. The addition of selenomethionine, while showing 20-60% reductions in methylation, resulted in no meaningful trend in inhibition as an effect of amount added.

The effects of Se on ecosystem health were discussed, since Se bioaccumulates and damages avian reproduction. Levels of 1-3 µg/l can be harmful to zooplankton and sensitive fish, with levels greater than 5 µg/l impacting fish populations. It was predicted based on previous distribution coefficient studies that, generally, Se concentrations released to the water column would be far lower than the lowest observed effects level (LOEL) predicted by toxicological studies.

A complete experiment in microcosms was proposed for future study, where Hg, MeHg, and Se-speciation is measured in water, sediments, pore water, and fish for a time period up to 180 days. Also, it was suggested to investigate whether areas naturally high in Se, such as in the lower San Joaquin River watershed, exhibit lower methylation rates and fish tissue mercury levels.

Delta Mercury TMDL – “Overview of draft Basin Plan Amendment” by Michelle Wood (Central Valley RWQCB)

Michelle Wood presented a summary of the key points of the draft Basin Plan Amendment (BPA), including the Delta mercury program goals, and an overview of Central Valley Water Board staff’s proposed fish tissue objectives and proposed strategies to reduce methylmercury levels in fish. Since releasing the draft BPA/TMDL reports in February 2008, the Board received over 20 comment letters representing about 30 stakeholder groups.

On April 24-25, the hearing on the draft BPA was opened, with a presentation by Board staff and comments presented by stakeholder groups. The comment period is still open, with the staff working on preliminary responses to comments and recommendations. In approximately 3 weeks, Board staff will release initial responses to the key policy questions, additional amendment options, and comments presented during the April 2008 hearing testimony. In approximately 6-8 weeks, the Board plans to hold facilitated meeting(s) with stakeholders. The hearing will continue at a later, undetermined date. Current expectation is that the Sacramento

River, Feather River, and American River mercury TMDLs will be started after a Delta program is adopted. There is not yet a strategy for addressing the other 40+ mercury-impaired water bodies in the region.

III. Discussion Items

IV. Other Updates

- CalFed fish mercury project – Didn't have anything to report.
- Prop. 40 mercury study in Yolo Bypass – Charlie Alpers, USGS, reported on results from a diurnal study that showed a 1-2 ng/l diurnal variation in methylmercury levels in rice fields; and announced that they will have a public meeting November 12.
- USGS in Bear/Yuma – Have a paper accepted; mercury loads studies are in review now.
- Sierra Fund toxic mine cleanup – The report “Mining’s Toxic Legacy” is available on Sierra Fund’s website.
- BLM mine site cleanups – Dave Lawler, BLM, reported on projects in the Harley Gulch wetland, Comanche Reservoir, and upper Putah Creek.
- State Board policy – nothing currently going on with offsets policy or methylmercury criteria.
- AML Forum – will have a meeting in June.
- CVCWA POTW methylmercury analysis – currently have a big dataset of treatment plants, which might be broadened to include the Bay Area (data from BACWA).
- SRWP – has a CalFed grant-funded project and is recruiting members for a Technical Advisory Committee with the goal of putting together a summary report on the watershed’s health. Mercury will be one pollutant of interest for the study.

V. Next Meeting

Tentatively set for Tuesday, September 16, again at the Sacramento Regional County Sanitation District’s offices in Mather.

Future agenda items could include:

- Update on status of mercury TMDLs
- CVCWA POTW database, possible addition of data from BACWA and Regional Board (for November meeting)
- Mercury TMDL approach used by the North Coast Regional Board (Don Coates)
- Mine mercury remediation projects by BLM and others
- New SRWP website, with suggestions of new content for DTMC page
- San Joaquin River watershed issues
- Presentation and feedback for a proposed Sutter Bypass excavation project
- Overview of “Mining’s Toxic Legacy” report
- USGS methylation research in Yolo Bypass (for November meeting)
- CALFED Science Conference recap (for November meeting)