

**Cruise Report**  
**1999 Regional Monitoring Program**  
**Sediment Sampling Cruise #21**

**July 21-23, 26-29, 1999**

1. INTRODUCTION

This report describes activities associated with the 1999 dry-season sediment sampling cruise of the Regional Monitoring Program (RMP) for Trace Substances in the San Francisco Estuary. Sediment sampling is one component of this program that is designed to provide long-term data on concentrations of trace metals and organic compounds, as well as toxicity, throughout the estuary.

Sediment samples were collected and distributed to seven laboratories for analysis under RMP protocols. Sample distribution is shown on Table 1.

2. CRUISE REPORT

2.1 Objectives

The objectives of this cruise were:

1. Collect sediment samples at 26 stations for the analysis of:
  - Trace metals and trace organics by Bay Area Dischargers Authority (BADA)
  - As, Hg, Se by Brooks Rand, LTD (BRL)
  - Grain size, TOC and total nitrogen by UC Santa Cruz (UCSC)
  - Pore water pH and ammonia by Applied Marine Sciences (AMS)
  - Pore water sulfides by Marine Pollution Studies Lab (MPSL)
  - CTD profiles by AMS
  - Methylmercury by Chesapeake Biological Laboratory (CBL)
2. Collect sediment samples at 14 stations for the analysis of:
  - Toxicity by MPSL
  - Surface Water Interface Cores (SWICs) by MPSL
3. Collect sediment samples at nine stations for the analysis of:
  - Benthic infauna by City and County of San Francisco (CCSF)
4. Collect sediment samples at three stations for the intercalibration analysis of:
  - Trace elements by UCSC
  - Trace organics by Texas A&M University (GERG)
  - As, Se, Hg by BADA
5. Collect sediment splits at one "blind" station for the intercalibration analysis of:
  - Trace elements by UCSC
  - Trace organics by GERG
7. Collect sediment samples at eleven stations for analysis of:
  - Methylmercury by UCSC

## 2.2 Personnel

The personnel and work assignments for this cruise were as follows:

| <u>Name</u>                 | <u>Affiliation</u> | <u>Duties</u>                                                   |
|-----------------------------|--------------------|-----------------------------------------------------------------|
| David Bell                  | AMS                | Cruise Manager, sediment chemistry, pH; CTD, watershed sampling |
| Jordan Gold (7/29)          | AMS                | Watershed sampling                                              |
| Michael Kellogg (7/23)      | CCSF               | Benthic sample collection                                       |
| Sarah Lowe                  | SFEI               | Sample collection                                               |
| Paul Salop                  | AMS                | Sample collection, sediment chemistry, and CTD                  |
| Gordon Smith                | UCSC               | Vessel skipper                                                  |
| Laura Targart (7/26-27)     | CCSF               | Benthic sample collection                                       |
| Witek Vwpiekarski (7/27-28) | MPSL               | SWIC collection                                                 |

## 2.3 Activities

| <u>Date</u>            | <u>Time</u> | <u>Activity</u>                                                                                                                      |
|------------------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Day 1<br>July 21, 1999 | 1500-1900   | Demobilized water cruise gear and mobilized sediment cruise gear aboard <i>R/V David Johnston</i> , Benicia Marina.                  |
| Day 2<br>July 22, 1999 | 0730-0800   | Mobilized remaining sediment cruise gear and conducted safety briefing at Benicia Marina. Departed for Sacramento River site (BG20). |
|                        | 0850-0940   | Sampled Sacramento River, departed for San Joaquin River site (BG30).                                                                |
|                        | 1115-1210   | Sampled San Joaquin River, departed Honker Bay site (BF40).                                                                          |
|                        | 1320-1350   | Sampled Honker Bay, departed for Grizzly Bay site (BF21).                                                                            |
|                        | 1435-1515   | Sampled Grizzly Bay, departed for Pacheco Creek site (BF10).                                                                         |
|                        | 1550-1630   | Sampled Pacheco Creek, departed for Benicia Marina.                                                                                  |
|                        | 1650-1720   | Arrived at Benicia Marina. M. Kellogg loads benthic infauna sampling gear onto vessel.                                               |

Day 3  
July 23, 1999

|           |                                                                                                                                                                                                                                                                                    |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0700-0715 | Mobilized gear aboard <i>R/V David Johnston</i> at Benicia Marina. Departed for Napa River site (BD50).                                                                                                                                                                            |
| 0800-0845 | Sampled Napa River, departed for Davis Point site (BD41).                                                                                                                                                                                                                          |
| 0920-1020 | Sampled Davis Point, departed for Pinole Point site (BD30).                                                                                                                                                                                                                        |
| 1055-1125 | Sampled Pinole Point, departed for San Pablo Bay site (BD20).                                                                                                                                                                                                                      |
| 1145-1210 | Sampled San Pablo Bay site, departed for Petaluma River site (BD15).                                                                                                                                                                                                               |
| 1405-1430 | Sampled Petaluma River site, departed for Red Rock (BC60).                                                                                                                                                                                                                         |
| 1500-1600 | Sampled Red Rock, departed for Emeryville marina.                                                                                                                                                                                                                                  |
| 1655-1730 | Arrived at Emeryville Marina, demobilized vessel. All samples for trace elements, organic compounds and intercalibration were transferred to a BADA lab representative. All other chemistry and toxicity samples were kept aboard the vessel on dry ice and wet ice, respectively. |

Day 4  
July 26, 1999

|           |                                                                                                                                          |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------|
| 0800-0815 | Mobilized gear aboard <i>R/V David Johnston</i> , conducted safety briefing at Emeryville Marina. Departed for Point Isabel site (BC41). |
| 0900-0935 | Sampled Point Isabel, departed for Richardson Bay site (BC32).                                                                           |
| 1020-1045 | Sampled Richardson Bay, departed for Horseshoe Bay site (BC21).                                                                          |
| 1100-1200 | Sampled Horseshoe Bay site, departed for Alameda site (BB71).                                                                            |
| 1310-1400 | Sampled Alameda, departed for Yerba Buena Island site (BC11).                                                                            |
| 1430-1520 | Sampled Yerba Buena Island, departed for Emeryville Marina.                                                                              |
| 1540-1600 | Arrived at Emeryville Marina. Demobilized vessel.                                                                                        |

|                            |                        |                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Day 5<br>July 27, 1999     | 0700-0720              | Mobilized gear aboard <i>R/V David Johnston</i> , conducted safety briefing at Emeryville Marina. Departed for Oyster Point site (BB30).                                                                                                                                                                                                            |
|                            | 0835-0920              | Sampled Oyster Point, departed for San Bruno Shoal site (BB15).                                                                                                                                                                                                                                                                                     |
|                            | 0955-1045              | Sampled San Bruno Shoal, departed for Redwood Creek site (BA41).                                                                                                                                                                                                                                                                                    |
|                            | 1115-1140              | Sampled Redwood Creek, departed for Dumbarton Bridge site (BA30).                                                                                                                                                                                                                                                                                   |
|                            | 1220-1250              | Sampled Dumbarton Bridge, departed for South Bay site (BA21).                                                                                                                                                                                                                                                                                       |
|                            | 1315-1345              | Sampled South Bay, departed for USGS dock, Redwood City.                                                                                                                                                                                                                                                                                            |
|                            | 1500-1530              | Arrived Redwood City USGS dock, demobilized vessel. Benthic infauna samples removed by CCSF. All other samples stored on dry or wet ice on the vessel.                                                                                                                                                                                              |
|                            | Day 6<br>July 28, 1999 | 0920-0935                                                                                                                                                                                                                                                                                                                                           |
| 1045-1125                  |                        | Sampled Coyote Creek, departed for San Jose site (C-3-0).                                                                                                                                                                                                                                                                                           |
| 1155-1235                  |                        | Sampled San Jose, departed for Sunnyvale site (C-1-3).                                                                                                                                                                                                                                                                                              |
| 1335-1410                  |                        | Sampled Sunnyvale, departed for Emeryville Marina.                                                                                                                                                                                                                                                                                                  |
| 1745-1830                  |                        | Arrived Emeryville Marina, demobilized vessel. All remaining samples for trace elements, organic compounds and intercalibration were transferred to a BADA lab representative. SWICs, toxicity, and pore water sulfide samples were taken by W. Vwpiekarski. Cognates, archives, methylmercury, and As, Se, and Hg samples were transferred to AMS. |
| Day 7<br><br>July 29, 1999 | 0800-0830              | Bell and Gold mobilized for watershed sites. Departed for Standish Dam site (BW15).                                                                                                                                                                                                                                                                 |
|                            | 0930-1000              | Sampled Standish Dam (BW15), departed for Guadalupe River site (BW10).                                                                                                                                                                                                                                                                              |
|                            | 1030-1100              | Sampled Guadalupe River. All samples were returned to AMS for distribution                                                                                                                                                                                                                                                                          |

## 2.4 Discussion

### *Sample Collection and Handling Procedures*

Prior to sampling, all equipment was thoroughly cleaned. The cleaning process began with a thorough washing with Alconox<sup>®</sup> detergent. The scoops and stirrers were soaked in detergent for two days before washing. Following the detergent wash, the grab and compositing bucket were rinsed with tap water, followed by three rinses with de-ionized water, a rinse with 10% HCl, and a rinse with petroleum ether. The utensils were rinsed three times with de-ionized water, soaked three days with 10% HCl, and rinsed with petroleum ether. Cleaned utensils were sealed in Ziploc<sup>®</sup> bags until used in the field.

Sampling procedures ensured that samples are collected from a localized area at each site to reduce uncontrolled temporal and spatial variation. In the field, the vessel was anchored at the coordinates listed in Table 2. The coordinates were checked throughout sampling to ensure that the anchor had not dragged. Coordinates were recorded for two grabs from each site.

The first sampling operation at each site, where required, was the collection of the benthic samples with the Ponar grab. After the required benthic samples were collected, the Ponar grab was replaced with the Van Veen grab for collection of chemistry samples. After being sieved, benthic samples were preserved in buffered 10% formalin/seawater according to the standard operating procedures used by the City of San Francisco.

When the Van Veen grab was brought on deck, the procedure to be followed for sampling was dependent upon the samples required for each station. At stations requiring toxicity samples, the first acceptable grab was used to collect SWICs; for this process, six 3" cores were placed into the sediment to a depth of 5 cm. After the surface water was drained, the cores were removed sequentially, wrapped in parafilm, capped, then rinsed and labeled.

After SWICs were taken (or at stations not requiring SWICS), the following procedure was followed. After any overlying water was siphoned off, glass cores containing sediment were removed for measurement of pH, ammonia, and total sulfides in pore water. Finally, the remaining top 5-cm of sediment was scooped from each of two replicate grabs (from each of three grabs where a third grab was required for methylmercury analysis) and mixed in the bucket to provide a single composite sample for each site for analysis of chemistry, TOC, grainsize, and toxicity. Portions of the composited sample were placed into containers provided by each laboratory. Duplicate chemistry samples were collected from this composite for archival. Cores collected for analysis of pore water were centrifuged onboard the vessel, with 5 ml of supernatant preserved for analysis of sulfides by MPSL. The remainder of the supernatant was to be analyzed on-board for pH and ammonia levels.

The quality of grab samples was ensured by requiring each sample to satisfy a set of criteria concerning the depth of penetration and disturbance of the sediment within the grab. Each sample normally contained the top 5-cm of sediment within the area of the grab jaws. Samples were rejected for the following conditions:

- There was a rock or shell fragment wedged between the jaws of the grab allowing the sample to wash out.
- The surface of the sample was significantly disturbed.

- The sample was uneven from side to side, indicating that the grab was tilted when it penetrated the sediment.
- The surface of the sample was in contact with the top doors of the grab, indicating over-penetration of the grab and possible loss of material around the doors.

Samples were collected from each site, composited in the bucket and placed into containers as indicated in Table 3.

#### *General Comments*

AMS altered its methods from previous cruises in the manner in which pH and ammonia samples were analyzed. Porewater samples were obtained and centrifuged in the same manner, but the pH and ammonia probes used previously were replaced by a Cole Parmer™ pH 20 meter and a Hach™ DR/850 colorimeter. These meters required less porewater to process, and both units functioned consistently and effectively maintained calibration throughout the cruise.

An additional analyte, methylmercury in sediment, was added by the San Francisco Bay Regional Water Quality Control Board just prior to the initiation of the cruise. Composite samples were taken at all sites for analysis by Chesapeake Biological Laboratory. Also, composite samples were taken at eight sites, and three individual grab samples were collected at an additional three sites, for analysis of methylmercury by UCSC.

**Table 1. Sample Distribution List for Sediment Cruise 21, Dry Season 1999.**

| Sample Type                                                            | Laboratory | # of Sites Sampled |
|------------------------------------------------------------------------|------------|--------------------|
| Pore water ammonia, pH                                                 | AMS        | 26                 |
| As, Hg, Se                                                             | BRL        | 26                 |
| Trace elements                                                         | BADA       | 26                 |
| Organic compounds                                                      | BADA       | 26                 |
| Archive                                                                | AMS        | 26                 |
| Intercalibration of trace elements                                     | BADA       | 3                  |
| Intercalibration of organic compounds                                  | GERG       | 3                  |
| Intercalibration of As, Se, Hg                                         | BADA       | 3                  |
| Blind intercalibration sample for trace elements and organic compounds | UCSC, GERG | 1                  |
| Benthic infauna                                                        | CCSF       | 9                  |
| Toxicity                                                               | MPSL       | 14                 |
| Pore water sulfides                                                    | MPSL       | 26                 |
| Surface Water Interface Cores                                          | MPSL       | 14                 |
| TOC, total N, and grain size                                           | UCSC       | 26                 |
| Methylmercury                                                          | UCSC       | 11                 |
| Methylmercury                                                          | CBL        | 26                 |

**Table 2. Coordinates of Regional Monitoring Program Sediment Sampling Sites**

| Site Name/Code        | Latitude   | Longitude   | Depth (m) | Sediment Description from 2/94                                                                                     |
|-----------------------|------------|-------------|-----------|--------------------------------------------------------------------------------------------------------------------|
| Standish Dam/BW10     | 37° 27.20' | 121° 55.45' | shore     | Soft brown mud mixed with sand                                                                                     |
| Guadalupe River/BW15  | -          | -           | shore     | silty sand                                                                                                         |
| San Jose/ C-3-0       | 37° 27.60' | 121° 58.55' | 2.5       | approximately 5 cm of coarse sand with shell debris over mud                                                       |
| Sunnyvale/C-1-3       | 37° 26.09' | 122° 00.60' | 2.5       | soft to semi-soft light brown sediment with some plant debris                                                      |
| South Bay/BA20        | 37° 29.55' | 122° 05.20' | 4.5       | top 8–10 cm of sediment very soft light brown with Potamocorbula                                                   |
| Coyote Creek/BA10     | 37° 28.08' | 122° 03.76' | 4.5       | Shell debris and sandy silt over gray clay                                                                         |
| Dumbarton Bridge/BA30 | 37° 30.77' | 122° 08.02' | 6         | soft brown sediment with shell debris and numerous polychaete tubes near surface over dark gray clayey sediment    |
| Redwood Creek/BA41    | 37° 33.56' | 122° 12.56' | 4.5       | shell debris near the surface with numerous polychaete tubes over dark gray clayey sediment                        |
| San Bruno Shoal/BB15  | 37° 36.92' | 122° 16.92' | 11.5      | sandy mud with shell debris over gray clay                                                                         |
| Oyster Point/BB30     | 37° 40.12' | 122° 19.73' | 9         | soft brown sediment with shell debris and numerous polychaete tubes near the surface over very firm dark gray clay |

| Site Name/Code          | Latitude   | Longitude   | Depth (m) | Sediment Description from 2/94                                                           |
|-------------------------|------------|-------------|-----------|------------------------------------------------------------------------------------------|
| Alameda/BB70            | 37° 44.80' | 122° 19.34' | 10.5      | soft brown sediment with numerous polychaete tubes near the surface over gray clay       |
| Yerba Buena Island/BC11 | 37° 49.37' | 122° 20.89' | 6         | mixed soft sediment with shell debris over clay                                          |
| Horseshoe Bay/BC21      | 37° 49.86' | 122° 28.64' | 12        | very soft light brown sediment with sulfide pockets, over gray clay                      |
| Richardson Bay/BC32     | 37° 51.73' | 122° 28.74' | 3         | soft light brown surficial sediment over firm dark clay                                  |
| Point Isabel/BC41       | 37° 53.27' | 122° 20.55' | 2         | soft dark brown surficial sediment with dense polychaete tubes over firm, dark clay      |
| Red Rock/BC60           | 37° 54.88' | 122° 25.96' | 10        | heavy shell debris and coarse sand                                                       |
| Petaluma River/BD15     | 38° 06.64' | 122° 29.20' | 3.5       | soft light brown surficial sediment over dark gray mud/clay                              |
| San Pablo Bay/BD22      | 38° 02.88' | 122° 25.34' | 3.5       | soft light brown surficial sediment over dark gray mud/clay                              |
| Pinole Point/BD30       | 38° 01.48' | 122° 21.78' | 6.5       | soft light brown surficial sediment over dark gray clay                                  |
| Davis Point/BD41        | 38° 03.05' | 122° 16.78' | 6.5       | sandy silt with shell debris                                                             |
| Napa River/BD50         | 38° 05.31' | 122° 15.66' | 4         | soft light brown silty mud with high density of Potamocorbula                            |
| Pacheco Creek/BF10      | 38° 02.83' | 122° 05.77' | 5.5       | sandy sediments with layers of soft fine material, with occasional oil droplets          |
| Grizzly Bay/BF21        | 38° 06.92' | 122° 02.37' | 1.5       | very soft light brown sediment                                                           |
| Honker Bay/BF40         | 38° 04.03' | 121° 56.00' | 2         | very soft light brown sediment                                                           |
| Sacramento River/BG20   | 38° 03.51' | 121° 48.72' | 9         | soft light brown silty sand with high densities of Potamocorbula, over sandier sediments |
| San Joaquin River/BG30  | 38° 01.38' | 121° 48.47' | 8         | sandy sediments with plant debris and Corbicula                                          |