

Project Objectives: Please type your responses, and answer the questions in a style appropriate for laymen.

ProjectObjectives_10

GOALS

Evaluate the impacts on sediment supply to San Francisco Estuary tidal marshes of altered fresh water inflow from the Delta.
Evaluate the role of climate variability over time in sediment supply for local tidal marshes, on timescales of decades to centuries.

SPECIFIC OBJECTIVES TO MEET GOALS

Characterize geochemical signatures of suspended sediments (primarily clays) transported by the Sacramento and San Joaquin rivers and local streams and creeks in the North Bay, a sub-basin of the Estuary and determine the current relative inputs of suspended sediments to local marshes.

Characterize the surface sediments (modern) of tidal marshes in the North Bay.

Evaluate changes in geochemical composition of tidal marsh sediments that reflect changes in the sources of those sediments over time, on time-scales of decades to 200 years.

Determine whether the current amount of sediments supplied to the North Bay tidal marshes may be sufficient to accommodate planned restoration of tidal wetlands.

Determine the relative contributions of organic sediments (autochthonous inputs) versus mineral sediments (allochthonous inputs) to selected marsh sites over time, on timescales of decades to centuries.

Summary of progress in meeting each of these goals and objectives

ProgressSummary_11

During the water year for 2004-2005, I collected 30 samples of suspended sediments from tributaries to the Sacramento-San Joaquin rivers, and from local creeks that drain to San Pablo Bay. I also collected surface sediments from marsh sites around the Bay and collected 3 sediment cores from marshes along the Napa river. The suspended sediments provide information about the end-member sources of sediments to the Bay estuary, to answer the question of how much of the sediments supplying local tidal marshes originate from tributaries of the Sacramento and San Joaquin rivers versus from local creeks to the Estuary. Marshes along the Napa river reflect a large marsh system within the north Bay as the Napa River drains a relatively large area in the local bay watershed.

Four sediment cores collected from marsh locations along Novato Creek were split, cut and subsampled for sedimentary analyses including loss on ignition (for organic content), magnetic susceptibility, trace element concentrations and strontium isotope ratios. Samples have also been collected for lead-210 dating for each core. These cores reflect conditions of a small marsh system in San Pablo Bay and the changes in sediments down core will aid reconstruction of changing relative contributions from the different sediment sources.

Approximately 250 sediment samples, including approximately 50 suspended sediment and marsh surface samples and 200 marsh core samples, were analyzed for element concentrations using a fusion method to get samples into solution and a combination of ICP-MS and ICP-OES for elemental determinations. 25 samples, including river sediments and sediments from the Novato marsh cores, have been prepared and determinations made of their strontium isotopic ratios. The data results have been reduced using excel and JMP statistical packages for multivariate and principal components analyses. These analyses will provide identifying information about the sources for tidal marsh sediments and will aid in developing a mixing model.

We have presented our results at the State of the Estuary conference (October 4-6) and are currently preparing two papers for publication with the tentative titles:

"Trace Element Concentrations and 87/86Sr isotope ratios in Suspended Sediments in Sacramento and San Joaquin tributary river waters"; and "Identifying sediment sources for a tidal marsh in the San Francisco Bay estuary using geochemical signatures".

PROJECT MODIFICATIONS: Please explain any substantial modifications in research plans, including new directions pursued. Describe major problems encountered, especially problems with experimental protocols and

how they were resolved. Describe any ancillary research topics developed.

Modifications_12

We have had to modify our sample preparation protocol somewhat. We are using the Li-Borate fusion method (described previously) to bring samples into solution and last year we used a ratio of 350 mg of Li-Borate to 50 mg of sample. That resulted in a total dissolved solids content that was too great for the ICP-MS. We modified the protocol using 200 mg of Li-Borate to 50 mg of sample, and then further diluted our samples by adding more 2% nitric acid. This resulted in samples that the ICP-MS could easily analyze.

BENEFITS AND APPLICATIONS: Suggest the relevance of these new findings to management. Describe any accomplishment, that is significant effects your project has had on resource management or user group behavior. CALFED is looking for "management cue" (see <http://science.calwater.ca.gov/pdf/soemgmtcues.pdf>).

BenefitsApplic_13

This research is relevant to the issue of sediment supply for Bay-Delta restoration, particularly tidal marsh restoration. Determining where the sediments accreting on the marsh surfaces came from can inform decisions on restoration sites most likely to succeed, particularly when it becomes clear how the sediment sources have changed over the last 100 - 200 years.

By analyzing core results against precipitation and land use records, we can assess not only the impacts of human activities on the Estuary marsh ecosystems, but also the impacts of climate variability on timescales of decades to centuries, which can be particularly useful to management as variability is expected to increase as a result of global warming (and also part of the natural cycle of climate variability).

PUBLICATIONS: List any publications, presentations, or posters that have resulted from this funded research. Give as many details as possible, including status of paper (e.g., in review; in press), journal name, conference location and date of presentation. Please note (as outlined in the conditions of the award) that each fellow is required to submit an abstract for an oral or poster presentation at each State of the Estuary conference and CALFED Science Conference during the duration of the fellowship.

Publications 14

- Malamud-Roam, F., Ingram, L., and K. Malamud-roam. Sediment source study for Novato creek marsh in the San Francisco Estuary. State of the Estuary Conference. October, 2005. Oakland, CA. Abstract.
- Malamud-Roam, F., Ingram, L., and Malamud-Roam, K. Trace Element Concentrations and 87/86Sr isotope ratios in Suspended Sediments in Sacramento and San Joaquin tributary river waters. In preparation.
- Malamud-Roam, F., Ingram, L., Collins, J. and Malamud-Roam, K. Identifying sediment sources for a tidal marsh in the San Francisco Bay estuary using geochemical signatures. In preparation.
- October, 2005: Malamud-Roam, F., Dettnger, M., Ingram, L., Hughes, M., and J. Florsheim. Climatic influences on the San Francisco Bay estuary and its watershed during the past 4,000 years. Submitted to San Francisco Estuary and Watershed Science online journal.
- December 2004: F. Malamud-Roam, B. Lynn Ingram, and J. Collins. Trace elemental analyses of Suspended Sediments in the San Francisco Estuary and its tidal marshes. Poster presentation at Association of Geophysical Union 2004 Fall meeting, San Francisco.
- October 9, 2004: F. Malamud-Roam, B. Lynn Ingram and J. Collins. Sediment Sources for Local Tidal Marshes in the San Francisco Estuary. Poster presentation at the Chapman Conference on Salt Marsh Geomorphology: Physical and Ecological Effects on Landform, 2004, Halifax.
- October 5, 2004: F. Malamud-Roam, B. Lynn Ingram and J. Collins. Sediment Sources for Local Tidal Marshes in the San Francisco Estuary. Oral presentation at CALFED Science Conference, October 4 ñ 6, 2004, Sacramento.
- October 2004: F. Malamud-Roam, B.Lynn Ingram M. Hughes and J. Florsheim. Late Holocene Paleoclimate records from the San Francisco Bay Estuary and Watershed, CALIFORNIA. Review paper accepted to Journal of Quaternary Science Reviews.

A large rectangular area with horizontal lines and a dotted midline, serving as a space for handwritten responses to the questionnaire.

COOPERATING ORGANIZATIONS: List those agencies and/or persons who provided financial, technical or other assistance to your project since inception. Describe the nature of their collaboration.

CoopOrganiz_15

United States Geological Survey: Dr. David Schoellhamer has been a mentor for this work and the USGS has been collecting suspended sediments from sites in the Estuary and Delta during regularly scheduled monitoring trips in the Bay.

San Francisco Estuary Institute: Dr. Josh Collins has been a mentor for this work.

Bay Area Sea Kyakers: several kayakers have assisted with suspended sediment collection from local tributaries to the north Bay.

AWARDS: List any special awards or honors that you, or mentor or members of the research team, have received during the duration of this project.

Awards_16

Dr. Lynn Ingram has recently been nominated as a Fellow to the CA Academy of Sciences.

KEYWORDS: List keywords that will be useful in indexing your project.

Keywords_17

sediment sources; strontium isotope ratios; trace elements; san francisco estuary; tidal marshes; environmental change

PATENTS: List any patents associated with your project.

Patents_18

does not apply

