Preliminary Geochemical Studies of Pollutant and Natural Organic Compounds in Sediments from Sonoma Baylands —A Wetland Restoration Project in San Francisco Bay, California—

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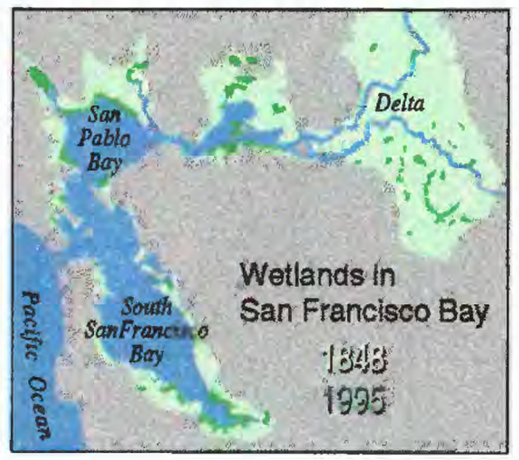
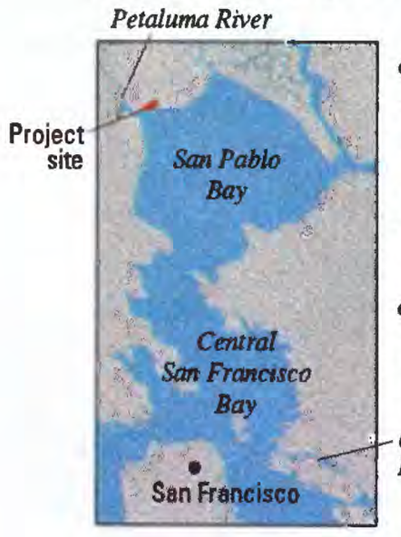
Sonoma Baylands Restoration Project: *A model for restoring wetlands*

San Francisco Bay has lost most of its freshwater wetlands and salt marshes through dikes, fill, and sedimentation



The project site was diked off decades ago. This project will restore the wetland . . .



- by adding new sediment dredged from the Petaluma River and the Oakland Harbor
- by exposing the new sediment to tidal action

A RESTORED WETLAND WILL

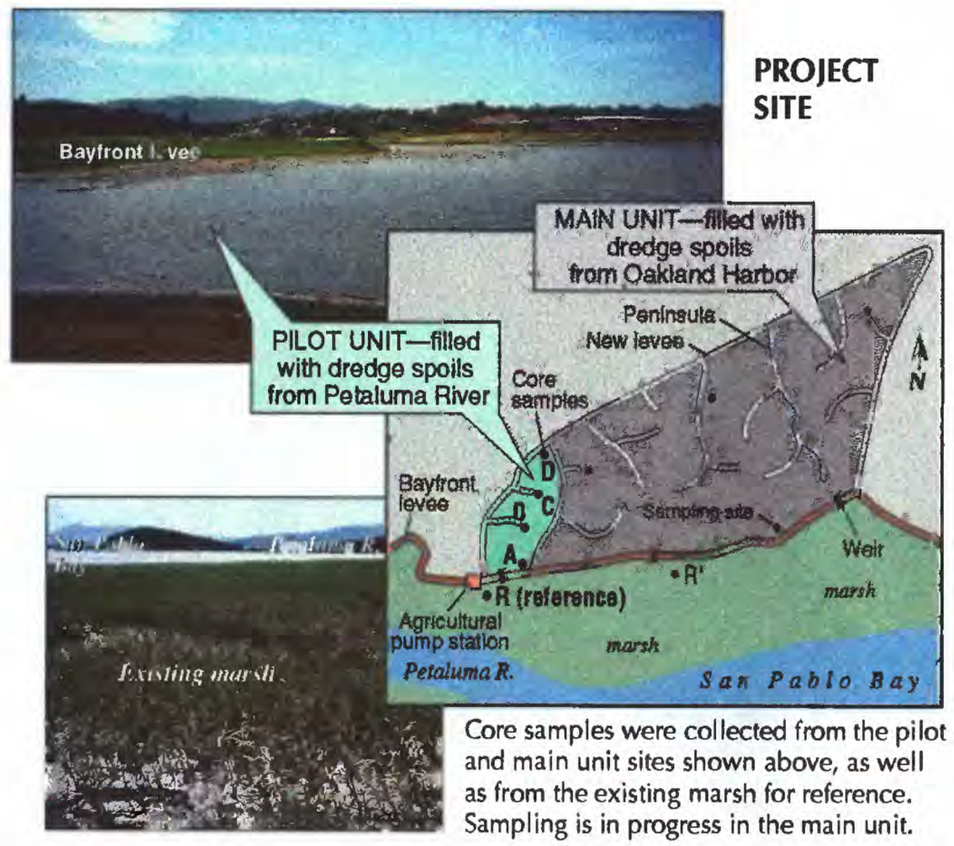
- Provide new habitat for endangered species
- Expand feeding and nesting areas for waterfowl
- Demonstrate the use of dredge spoils as a resource

USGS Geochemical Studies for the Sonoma Baylands Demonstration Project

PROBLEM Investigate the occurrence, fate, and accumulation of organic contaminants in sediments and biota

APPROACH

- Define baseline conditions before restoration
- Monitor geochemical changes that occur during restoration

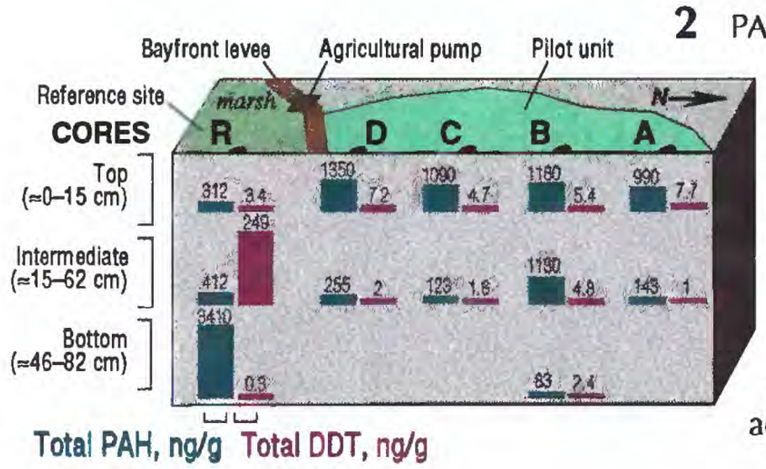


Core samples were collected from the pilot and main unit sites shown above, as well as from the existing marsh for reference. Sampling is in progress in the main unit.

CONSTITUENTS ANAYLYZED	*IMPLICATIONS*
1 Aliphatic hydrocarbons and biomarkers	*Aliphatic hydrocarbons indicate terrigenous input* *Aliphatic biomarkers indicate weathered petroleum (anthropogenic)*
2 Anthropogenic compounds Dichlorodiphenyltrichloroethanes (DDTs) Polycyclicaromatic hydrocarbons (PAHs) Polychlorinated biphenyls (PCBs)	*These show levels and sources of contamination*
3 Atomic C, H, and N	*These will show geochemical changes as the wetland develops*
4 Natural plant constituents Aldehydes, sterols, and fatty acids	*These will show geochemical changes as the wetland develops*

Preliminary Results

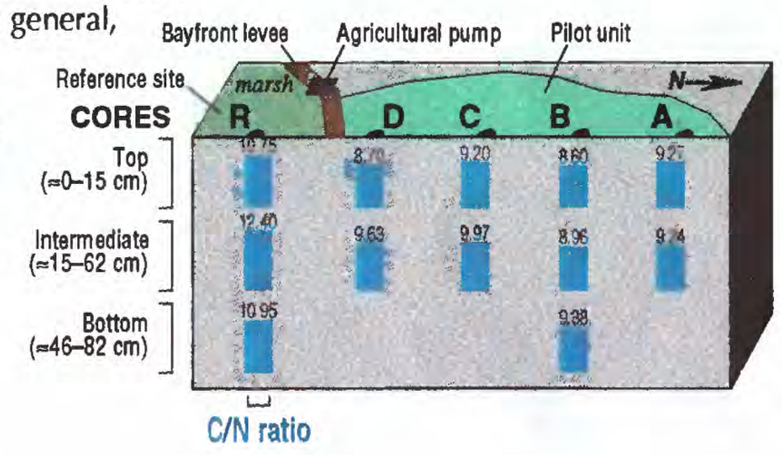
1 ALIPHATIC HYDROCARBONS—Sediments at the pilot unit are stratified. Whereas concentrations of terrigenous *n*-alkanes are about the same in the three core horizons, biomarker profiles (triterpanes and steranes) and the presence of an unresolved complex mixture (UCM) of hydrocarbons in the top horizon of the cores indicate the presence of weathered and biodegraded petroleum.



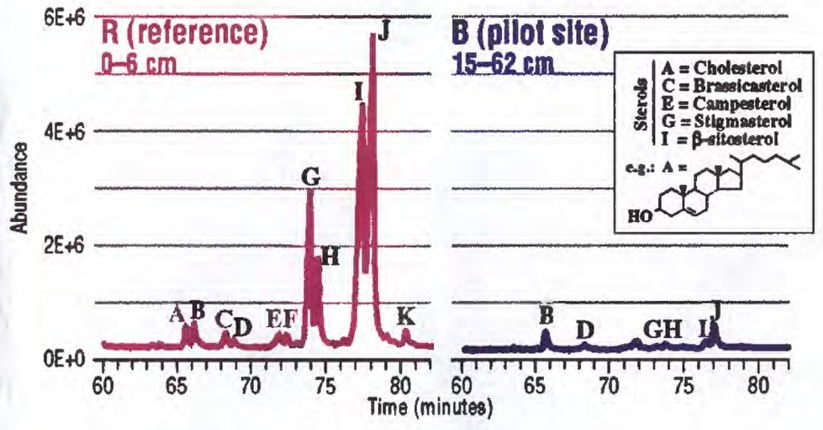
2 PAHs and DDT—Sediments from both the pilot unit and reference site contain low concentrations of PAHs, with fluoranthene and pyrene as the major compounds, and low levels of the chlorinated pesticide DDT and its degradation products DDE and DDD, with DDE being the major compound. In the pilot unit cores, total PAHs range from 83 to 1350 ng/g, and total DDT from 1 to 7.2 ng/g. The highest values are in the top horizon.

In the reference core, by contrast, the intermediate horizon is contaminated with very high levels of DDE (249 ng/g), and the bottom horizon with high levels of PAHs. This contamination likely accumulated at a nearby agricultural pump and drain.

3 ATOMIC C/N RATIOS—The ratios in the pilot unit cores range from 8.6 to 10.0. The ratios are higher in the reference core, from 10.8 to 12.8. In general, sediments with high terrigenous organic input would have C/N ratios in the range of 12–14, whereas those with marine phytoplankton input would be substantially lower (≈6). The observed values represent a mix of sources which is expected to change with time as the wetland develops.



Gas Chromatography/Mass Spectrometry (GC/MS) of Sterols



4 STEROLS—Sediments from the pilot unit and the adjacent established wetland were analyzed for several classes of organic compounds. The greatest difference between the sediments from the two locations is in the more polar constituents, especially sterols and fatty acids. These compounds will therefore be used as source tracers to monitor the wetland over several years as it reverts back to its natural state.

Preliminary Conclusions

- Petaluma River dredge spoils contribute only trace levels of contaminants to the wetland site
- The surrounding established wetlands may contain higher levels of contaminants than the pilot unit, and therefore should be monitored
- Sterols and fatty acids show the most promise for following the changes in sediment geochemistry as the wetland develops