Project 4
Measurement of Selenium Flux – Amendment No. 2
Sediment Coring Activities to Identify Areas of Active Sedimentation and Associated Selenium Removal Rates

CH2M HILL TASK ORDER NO. 5. SUBCONTRACT WITH:	University of Utah/USGS
PRINCIPAL INVESTIGATORS:	Dr. David Naftz/USGS
CONTRACT VALUE:	$36,750
SCHEDULE:	May 1, 2007 through November 30, 2007 (elapsed time: 7 months)

Problem: Recent (July 2006) sediment cores collected from three sites in the south arm of Great Salt Lake (GSL) indicate that active sedimentation and associated selenium removal was only occurring at one site (fig. 1). The area with active sedimentation was at site 3510, with an annual sedimentation rate of approximately 0.043 g/cm^2.

At sites 2267 and 2565, the unsupported lead-210 (^{210}Pb, 22.3 yr half-life) activities were significantly lower than in core 3510. In core 2267, unsupported ^{210}Pb was detected in the upper most (0-2 cm) interval; whereas no measurable unsupported ^{210}Pb was observed in core 2565. Based on the radioisotope profile of ^{210}Pb from coring sites 2565 and 2267, very little active sedimentation is occurring in these areas of the lake (sedimentation rate = < 2 cm/100 years).

The existing sediment-coring information is not adequate to identify the areas within the south arm of GSL where active sedimentation is occurring. Additional samples are needed to verify these initial cores, further define sedimentation rates throughout the lake, and provide an additional level of confidence in sedimentation rates.

Objectives: The overall objective of the proposed work is to determine the annual amount of selenium that is lost from the water column via permanent sedimentation from throughout the south arm of GSL. Specific objectives include: (1) utilize the presence or absence of activity of selected radioisotopes (^{7}Be, ^{137}Cs, and unsupported ^{210}Pb) in near-surface sediment grab samples to identify areas of active sedimentation; (2) utilize existing surface geophysical data (D. Dinter, University of Utah) to map regions of long-term sedimentation during the Holocene; (3) collect shallow (approximately 50 cm) lake cores from five sites where active sedimentation has been identified using results from objectives 1 and 2; and (4) determine annual sedimentation and sediment selenium loss rates at each of the five coring sites.

Approach:

Objective 1

A small box-coring device will be used to collect 20, near-surface (0 to 1 cm) and 20 below surface (4-5 cm) sediment samples along a series of north-south and east-west transects in the south arm of GSL. Transect locations will be based on previous coring results, lake bathymetry, and present knowledge of persistent currents in GSL. The surface (0 to 1 cm) sediment samples will be composited from the surface of the box core. The deeper sample will be collected by subcoring the box core with a 3-cm diameter tube. Each sample will be composited into a wide-mouthed plastic bottle from three locations at each site to reduce small-scale variance. Samples will be chilled upon collection and frozen within 12 hours of sample collection in the event that the samples will be used for future mercury species analysis. After freeze drying, the samples will be analyzed for ^{7}Be, ^{137}Cs, and ^{210}Pb at the USGS Radioisotope Research Laboratory in Menlo Park, California. The activity of these radioisotopes will be used to map areas of active sedimentation and to assist in the selection of five sites for the collection and analysis of sediment cores.

Objective 2

Existing high-resolution seismic reflection (Chirp and Geopulse) data from the south arm of the Great Salt Lake clearly image the base of fine-grained Holocene lacustrine deposits at depths of 1 to 10 meters below the lakebed, consistent with long-term sedimentation rates on the order of 0.1 to 1.0 mm/yr. An isopach map of Holocene sediment thickness will be prepared from these data and used to guide choices of further sampling locations. The main assumption of this approach is that long-term Holocene sedimentation rates are representative of present-day sedimentation rates. Preliminary analysis of 30 seismic transects of the south arm basin indicates that the general shape of the Holocene stratum is an eastward-thickening wedge, typical of a west-facing half-graben system. Thus, an east-west sampling transect with locations chosen to avoid local faults, sand bars, carbonate mounds, and current scours will sample the full range of sedimentation rates in the lake. The integration of near-surface radionuclide data with the isopach map of Holocene sediment thickness will provide the most robust tool for selected five additional lake-coring sites.

Objective 3

Five lake cores (about 50 cm in length) will be collected from the south arm of GSL using a combination of box coring and gravity coring equipment according to the methods described in the Project 4 SOPs and QAPP. After collection, the cores will be sectioned into 1 to 2 cm slices. In the event that sample splits will be analyzed for mercury species by UDEQ, the core sections will be stored frozen until they can be freeze dried.

After freeze drying, the upper 10 samples from each core will be used to develop a core chronology using a combination of ^{137}Cs and ^{210}Pb age-dating techniques. In addition, the upper 3 sections of each core will be analyzed for the short-lived

radioisotope ^{7}Be to assess sediment resuspension events (Th is not useful because of low dissolved ^{238}U in the lake water). A split of each core slice will be submitted to the contract laboratory for determination of total selenium (total of 50 samples). The remaining core sections and sample splits will be archived for future use.

Objective 4

The core chronology, associated cumulative dry mass of sediment (corrected for salinity), and sediment selenium content will be combined to calculate recent and historical selenium sedimentation rates. The lake areas likely impacted by the selenium sedimentation rates determined from the coring sites will be calculated using Kriging or other appropriate geostatistical techniques that will integrate the likely areas of recent sediment accumulation identified in objective 1 with the sediment coring results.

Schedule:

Task	MAY	JUN	JUL	AUG	SEP	OCT
Collect 40 near-surface sediment samples						
Preparation and review of map report showing areas of active sedimentation during the Holocene						
Analyze near-surface sediment samples for selected radioisotopes						
Construct map showing areas of active sedimentation in south arm of GSL using near-surface sediment radioisotope data						
Collect and process sediment cores from 5 sites						
Analyze sediment cores for selected radioisotopes and selenium						
Calculate annual selenium loss via active sedimentation loss within the south arm of Great Salt Lake						
Revisions to Project 4 report (as needed)						

Information Product: The Project 4 report regarding estimates of selenium sedimentation rates in the south arm of GSL will be revised according to the additional data collected during the proposed lake-coring work. This revision to the Project 4 report will be completed on or before October 19, 2007.

References:

Baskin, R.L., and Allen, D.V., 2005, Bathymetric map of the south part of Great Salt Lake, Utah: U.S. Geological Survey Scientific Investigations Map 2894.

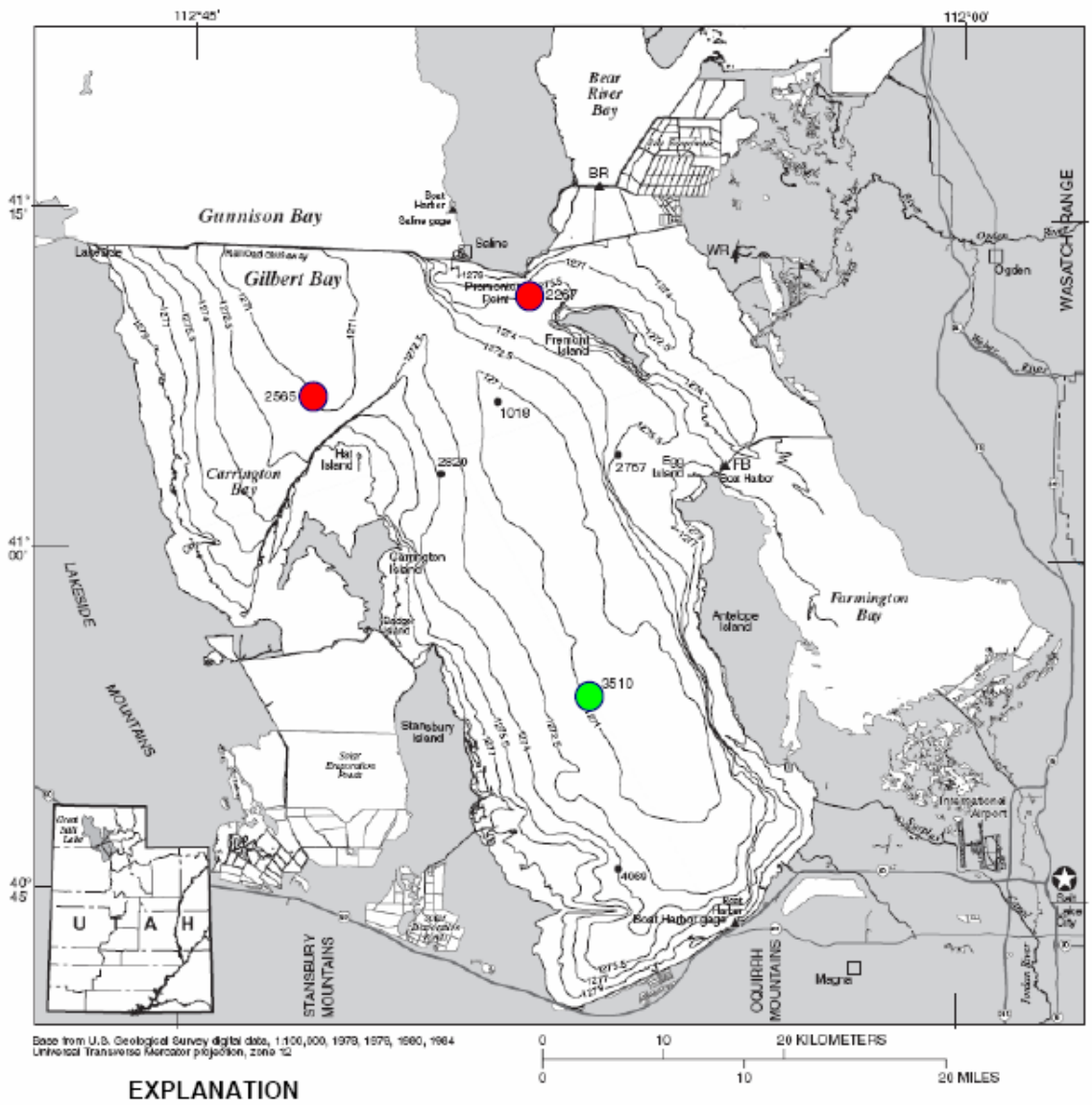

Figure 1. Location of lake-coring sites and measured sediment accumulation rates in the south arm of Great Salt Lake, Utah.