

UNDERSTANDING BIOGEOCHEMICAL TRANSFORMATION AND MOBILIZATION OF Hg FROM RIVER BANK SOILS: SOUTH RIVER, VIRGINIA

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INTRODUCTION

Between 1929 and 1950, mercury (Hg) was extensively used by the DuPont plant in the production of rayon acetate fiber in Waynesboro, VA and released into the South River. The contamination of Hg was discovered in the 1970s and remains elevated in water, soil, sediments, and biota.

The major objectives of this study are to investigate the processes that govern biogeochemical transformation and mobilization of Hg from the floodplain soils at South River Mile 3.5, understand geochemical gradients within river bank soils and how they change over time using sensor technology, and characterize how Hg cycling and transport is affected. Our over-arching hypothesis is to test if leaching of bank soils is a significant source of dissolved inorganic Hg (IHg).

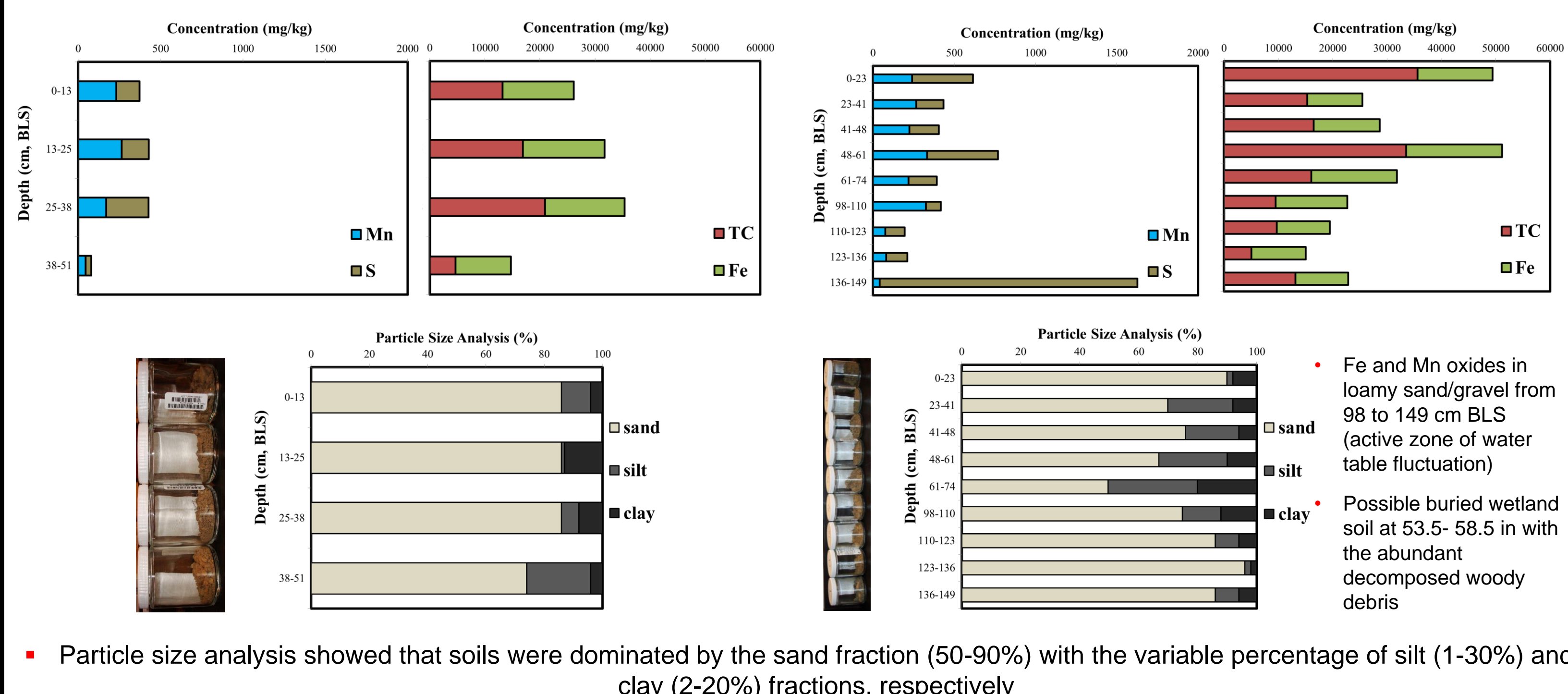
Our major hypotheses are: (1) soil inundation of bank soils are due to horizontal flow through a highly transmissive gravel zone at the base of the bank, vertical drainage of precipitation, and upgradient groundwater flow; (2) drainage occurs predominantly through gravel zone wetting an organic rich soil; and (3) hydraulics facilitate the downward or upward movement of the capillary fringe affecting soil redox potential, mineral dissolution, and leaching of inorganic Hg into dissolved/colloidal phases that are either directly transported to the river or methylated within the saturated zone of the bank and subsequently released.

RESULTS

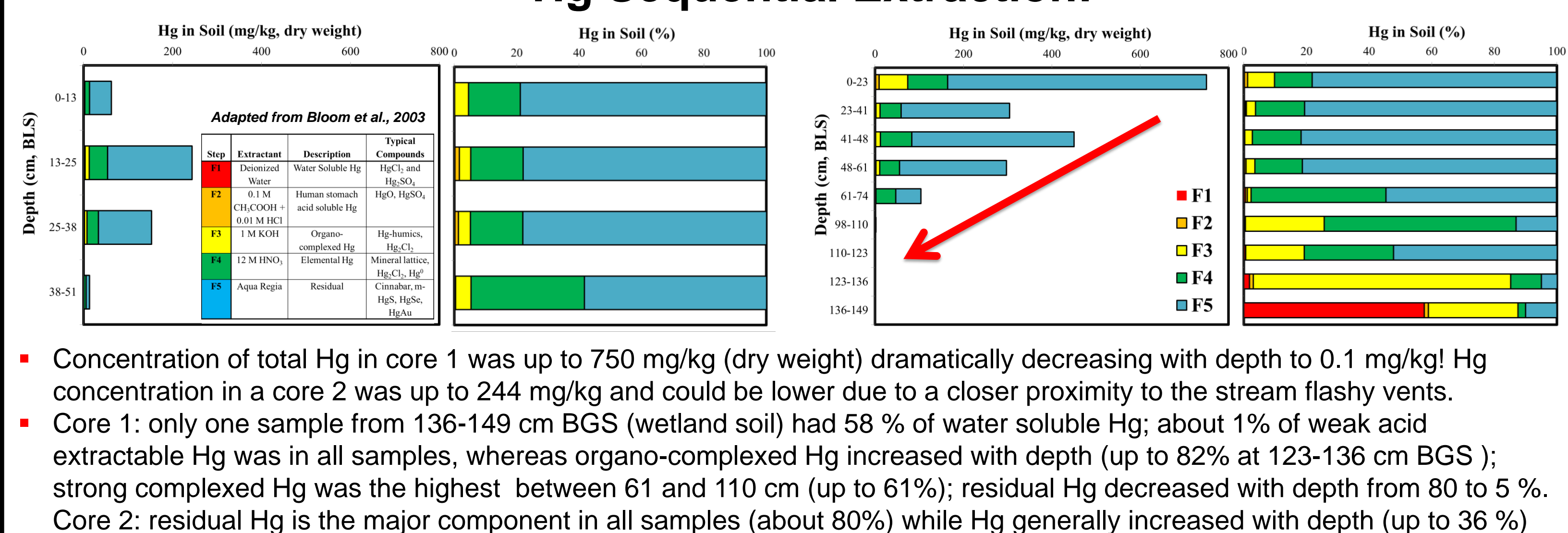
CORE 2: 0.6 m from bank

CORE 1: 1.8 m from bank

SOIL CHEMISTRY:

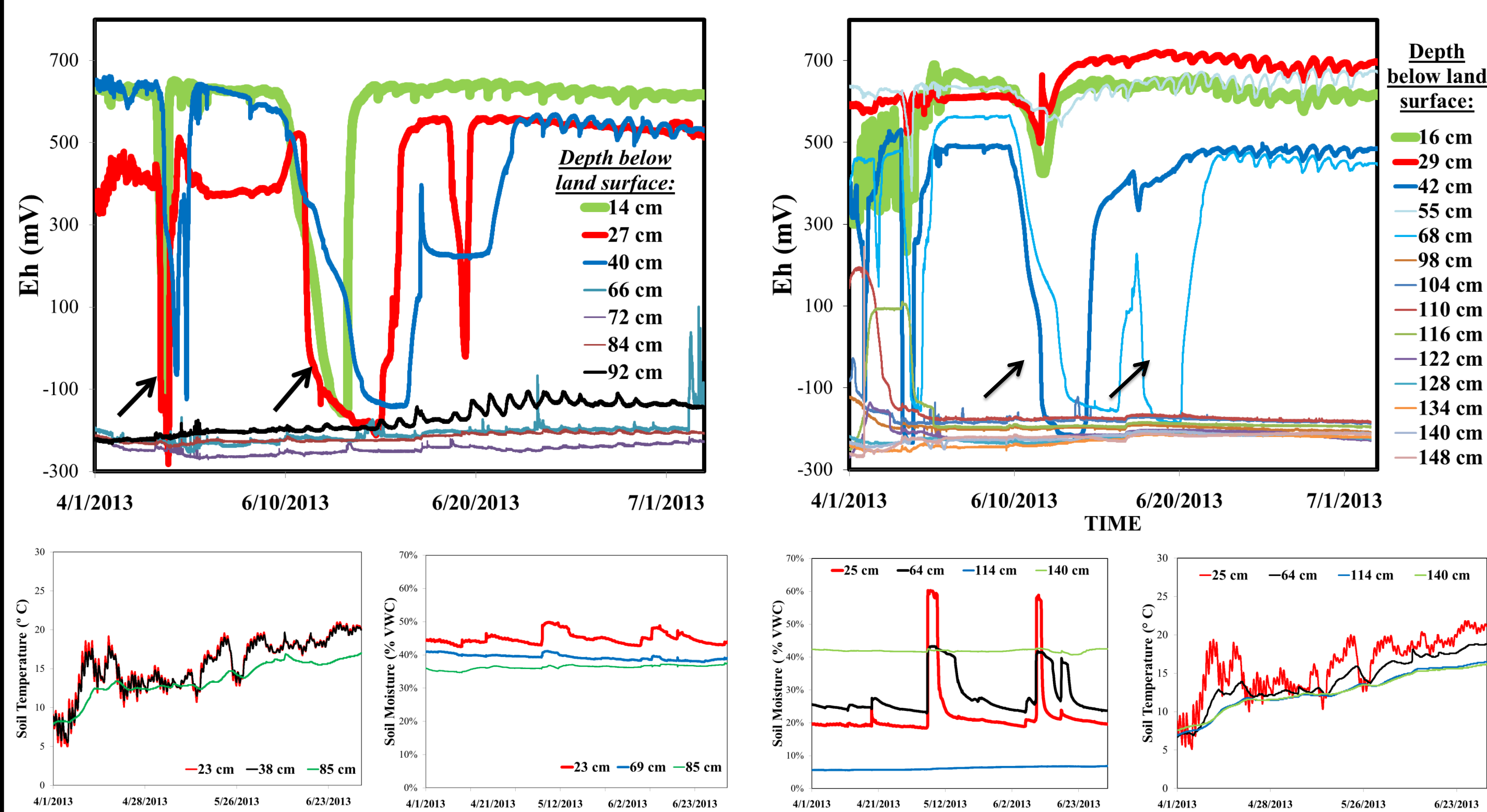


Hg Sequential Extraction:

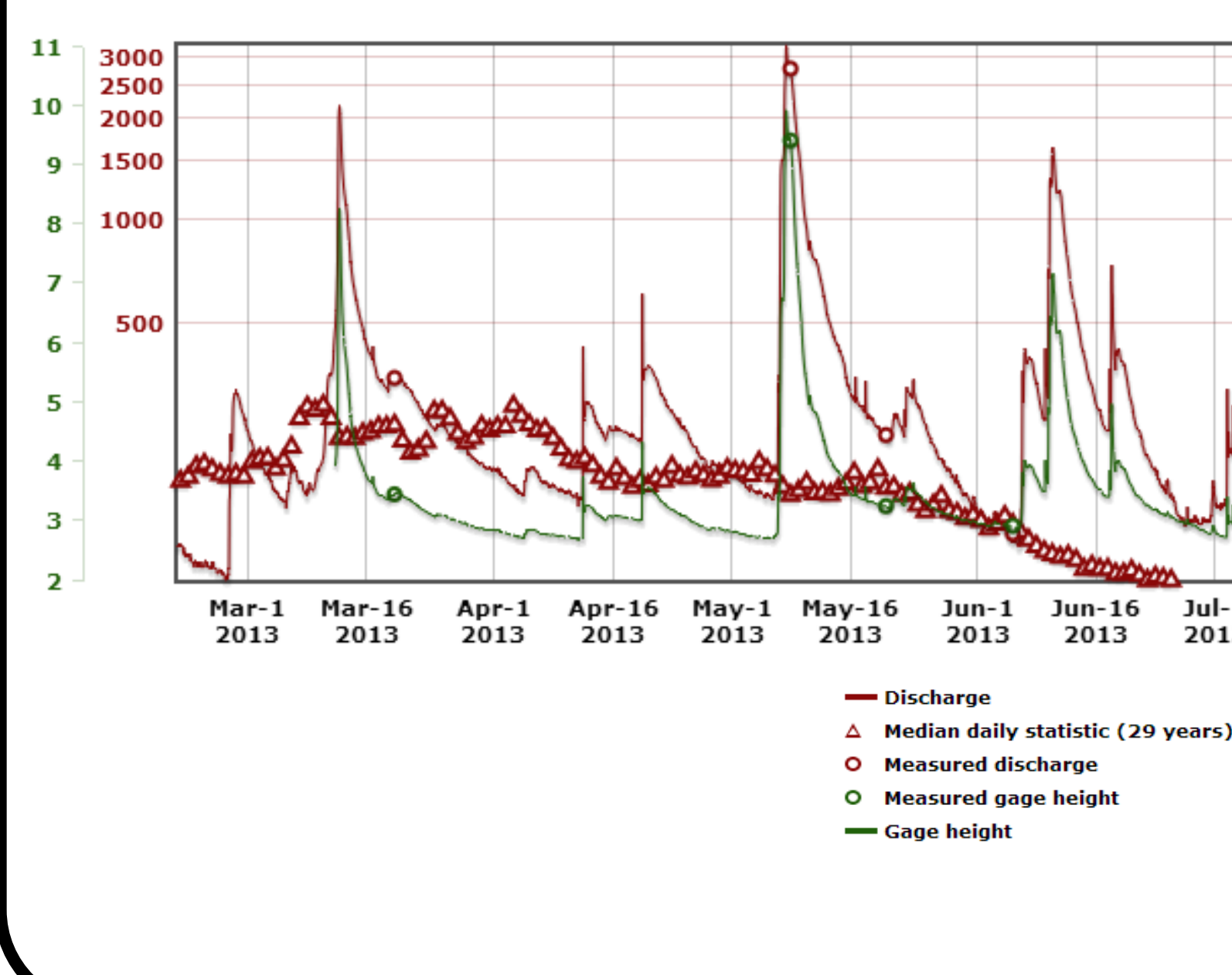


IN-SITU SENSOR DATA:

The sensors are used to characterize geochemical gradients and how they change over time, and to enable targeted sampling at Hg loading hot spots



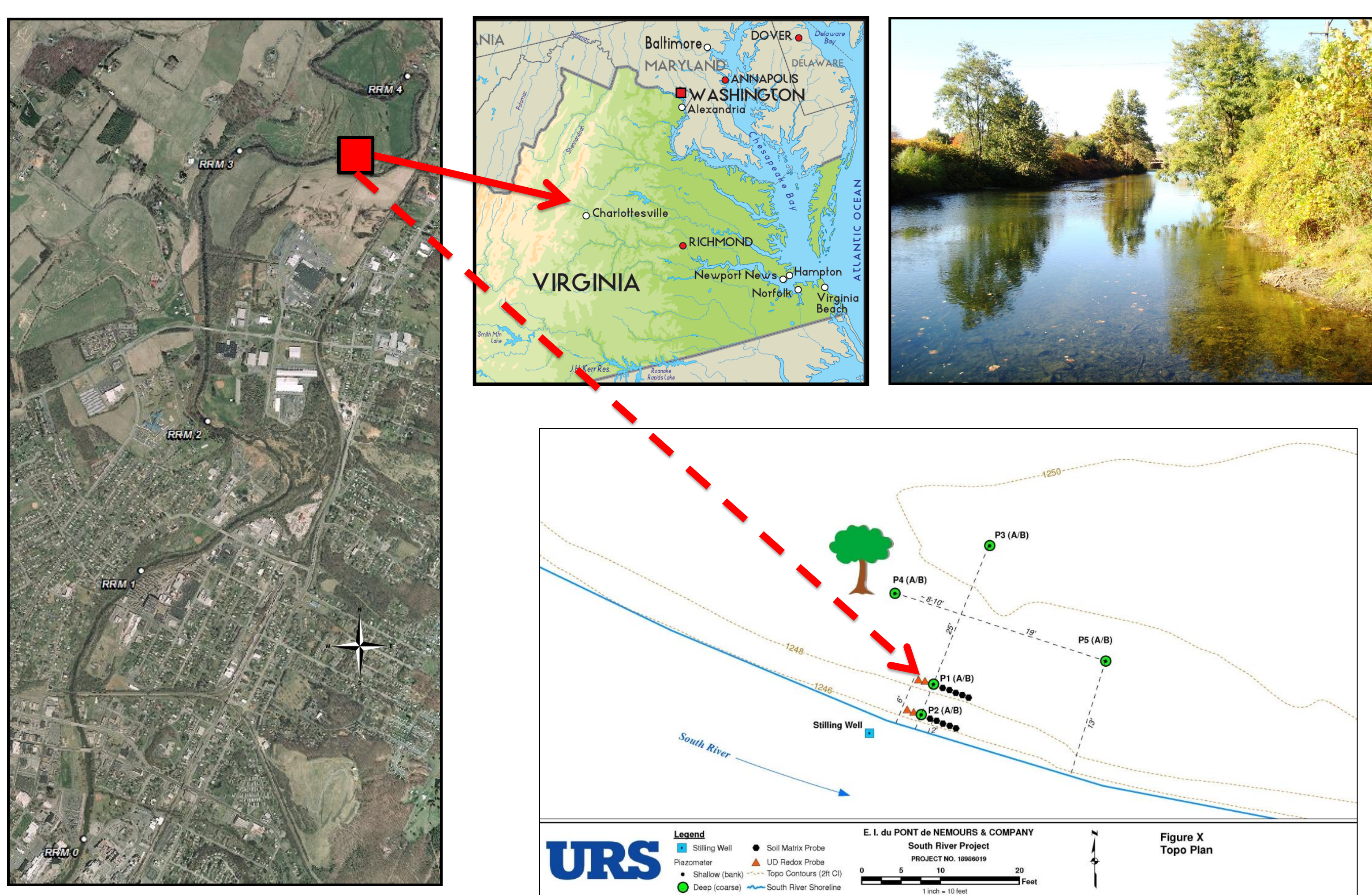
Discharge and Gage Height at USGS site 01626850 SOUTH RIVER NEAR DOOMS, VA



PRELIMINARY CONCLUSIONS:

- There is a significant redox gradient across the floodplain soil profile.
- Within the top 40 - 70 cm of Hg-rich soil, major changes in redox conditions from oxidizing (Eh ≈ +600 mV) to very reducing (Eh ≈ -300 mV) corresponded to heavy rainfall and overbank flooding events.
- High variations in stream stage may govern the surface water - groundwater exchange affecting soil redox potential, stability of Hg-bearing minerals and mobilization of Hg.

RESEARCH AREA



METHODS

Installation of in-situ real-time monitoring sensors

- Conductivity, water level and temperature (Solinst)
- Redox (Paleoterra)
- Soil moisture, temperature (Decagon)
- Sampling and analysis of soil cores, stream water, and shallow groundwater
- The chemical analysis included the following: pH; cation exchange capacity plus exchangeable cations (K, Ca, Mg, Na); total carbon and total nitrogen; particle size analysis; ICP analysis of digestates (Fe, Mn, Al, S, Si); DCB extraction for Fe oxides, total Hg, methyl Hg and sequential extraction Hg analyses.