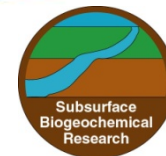


Geostatistical Analysis of Extractable Uranium and K_d for U-233

- ▶ Chris Murray
- ▶ Yi-Ju Bott
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- ▶ John Zachara

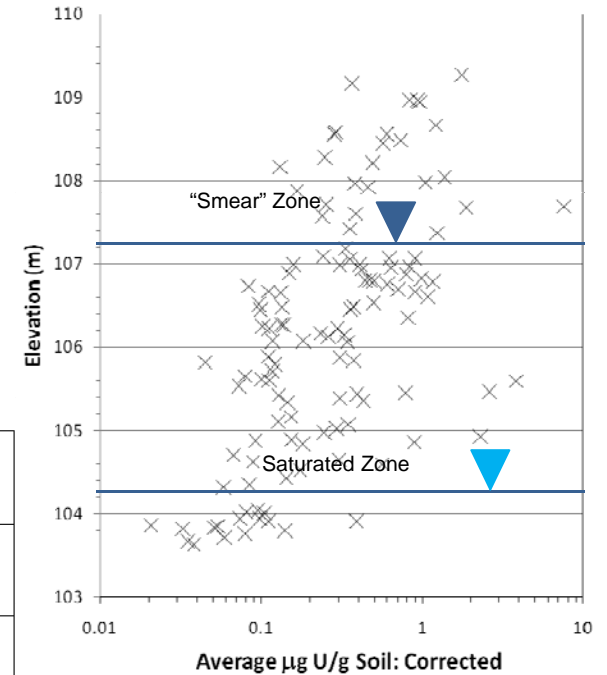
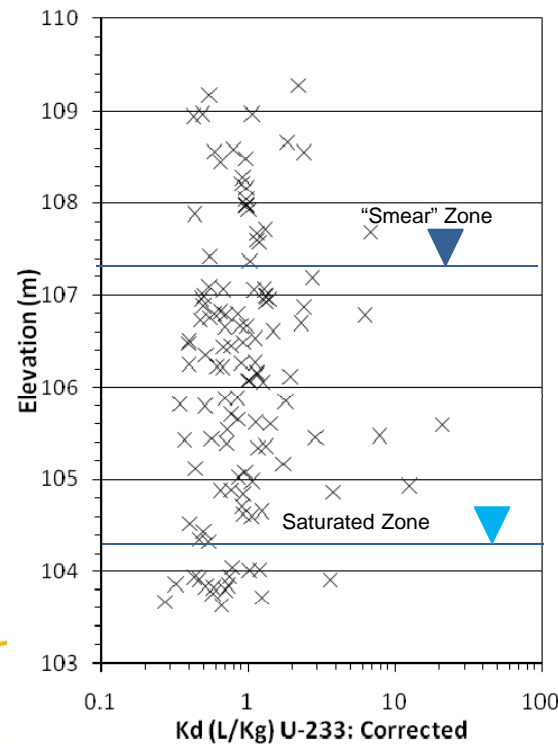


Introduction

- ▶ Map distribution of bicarbonate extractable uranium (BEU) and uranium K_d
 - Provide spatial distribution of geochemical parameters that can help support more refined surface complexation model for U(VI)
 - Anomalies in K_d data for U-238, so using U-233
 - Examine spatial correlations between geochemical variables
- ▶ Provide probabilistic estimates of mass of BEU in the smear zone at the study site

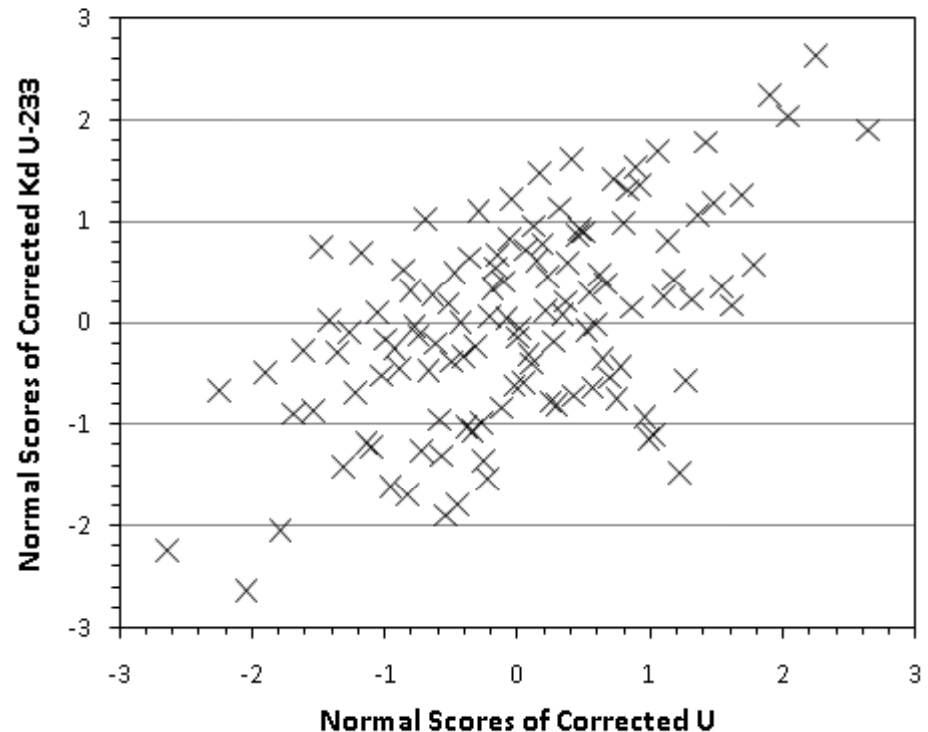
Depth Distribution of BEU & K_d U-233

- ▶ Average BEU values much higher in smear zone and lower vadose zone
- ▶ K_d U-233 appears relatively constant with depth



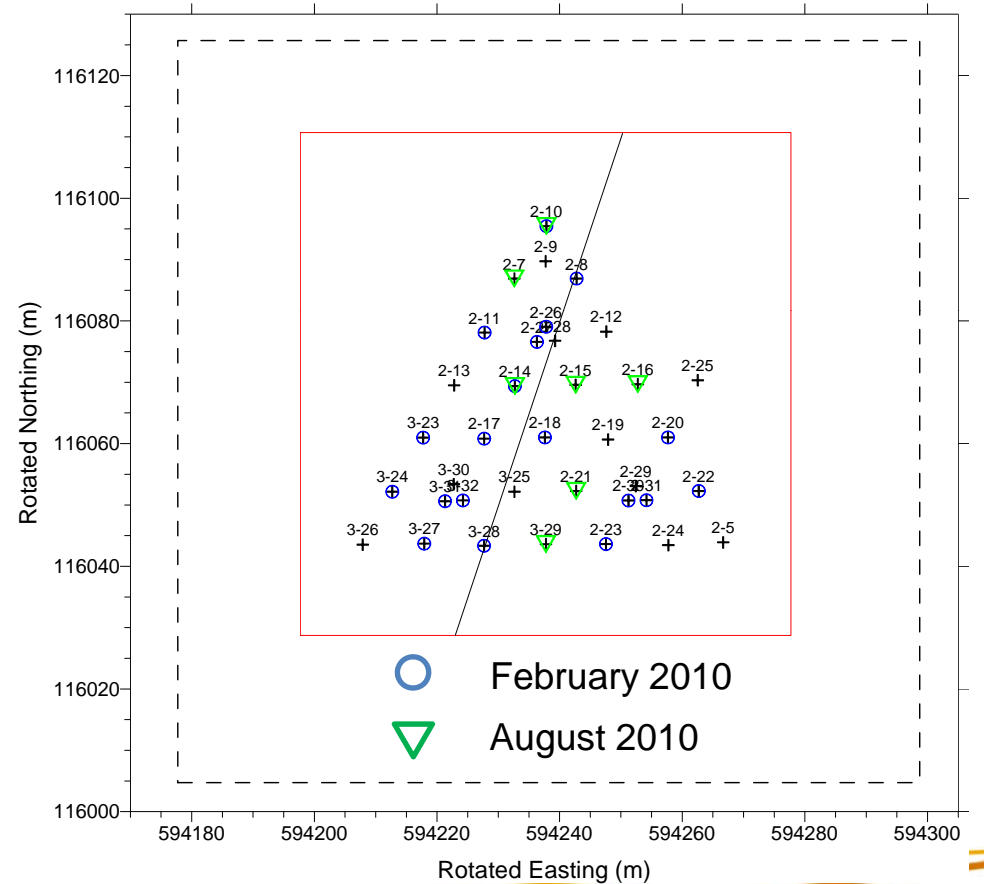
Correlation of BEU and K_d U-233

- ▶ Weak correlation found between normal scores (0.56)
 - Weaker for uncorrected data from < 2mm fraction (0.45)
- ▶ Variables simulated independently



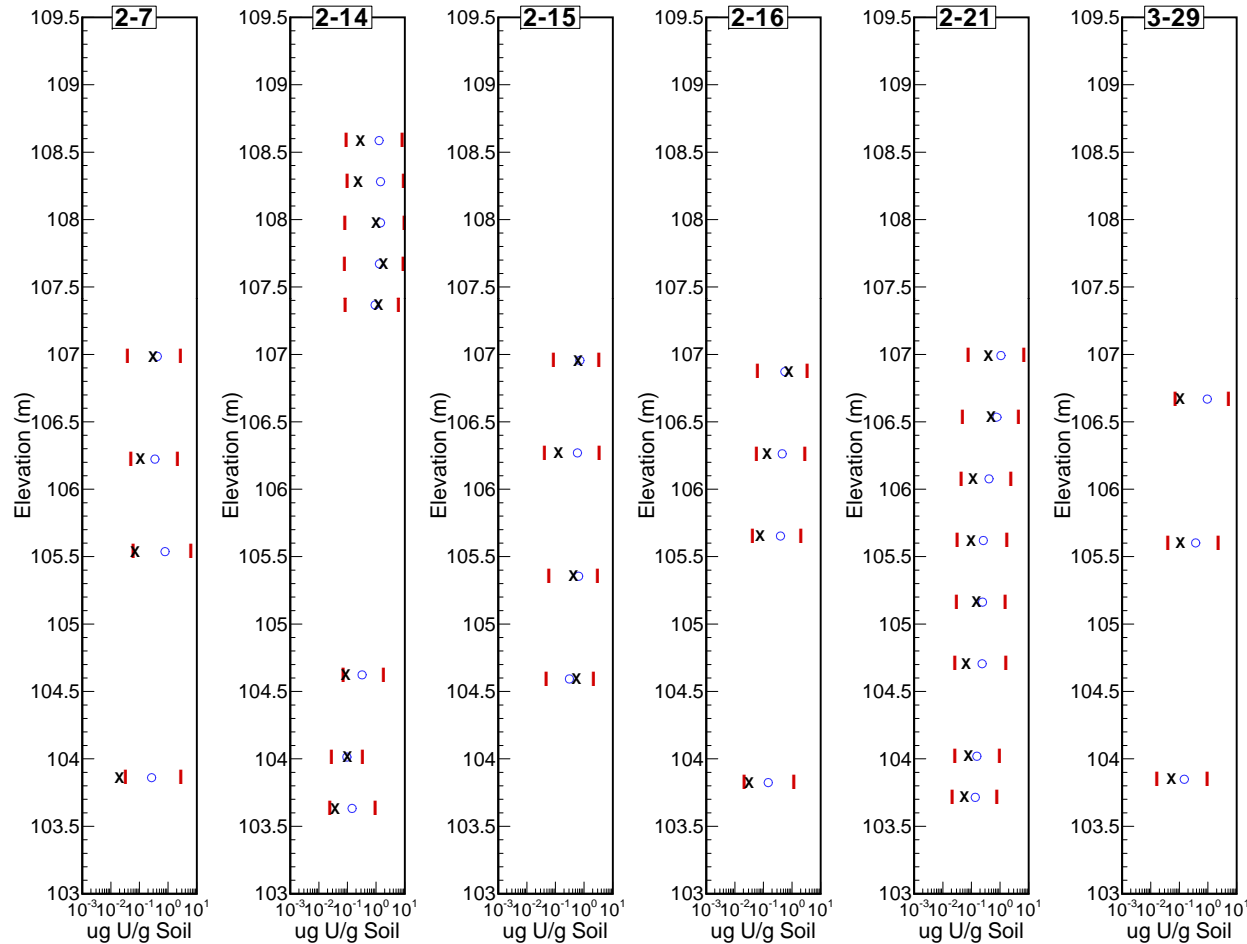
Geostatistical Analysis of Extractable U & K_d

- ▶ Additional samples analyzed after initial geostatistical study
 - Original study had 90 samples from 14 distinct locations
 - 31 additional samples and 5 new locations added later in 2010
 - Provided opportunity to evaluate previous model and update 3-D maps



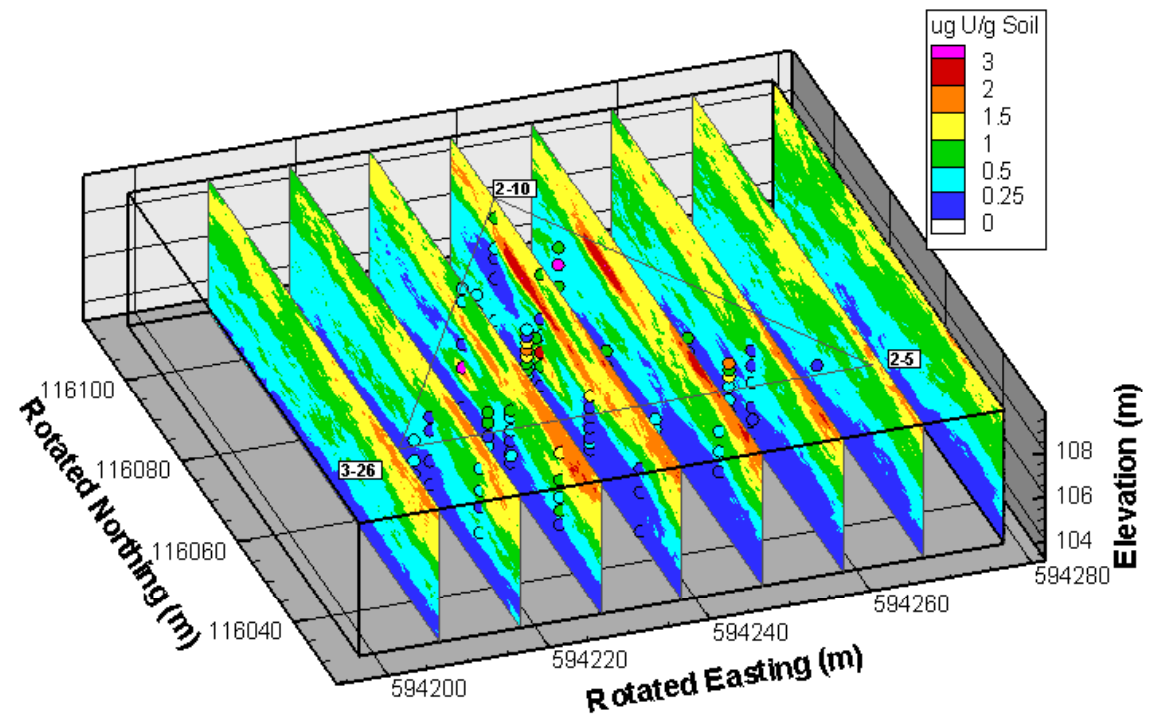
Validation of Previous Geostatistical Model

- ▶ Checked predicted values from previous geostatistical model against new data
 - Blue circle is predicted mean
 - X is measured value
 - Red bars are 95% confidence interval
- ▶ All K_d predictions fell in 95% CI and tend to be closer to the mean



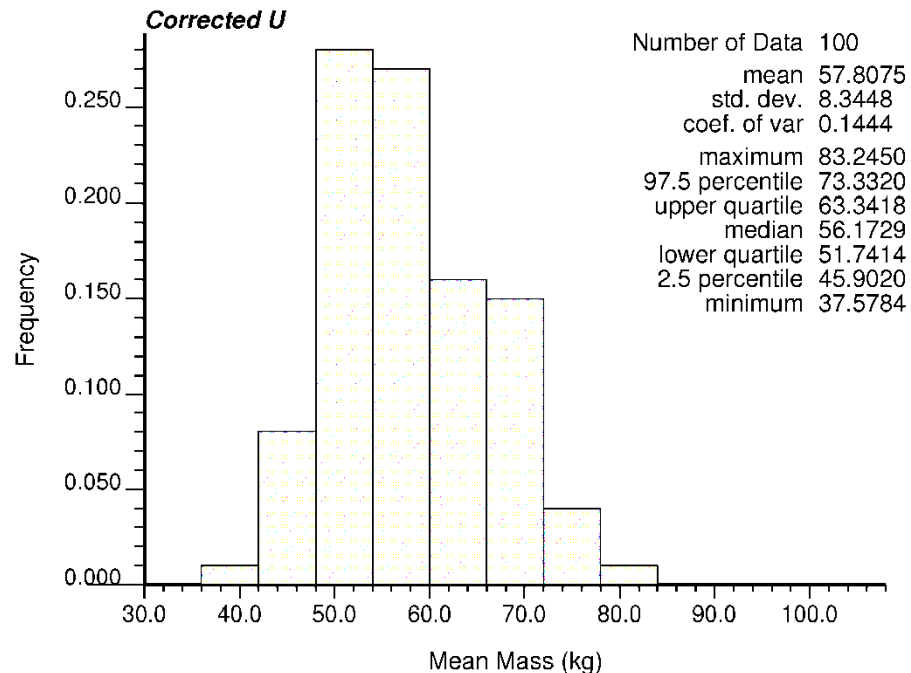
3-D Model of Extractable Uranium

- ▶ Gravel-corrected concentrations
- ▶ E-type estimate
 - Sequential Gaussian simulation
 - Avg of 100 realizations
 - No horizontal anisotropy
- ▶ Areas of higher concentration spatially variable in upper portion of grid (lower vadose zone)



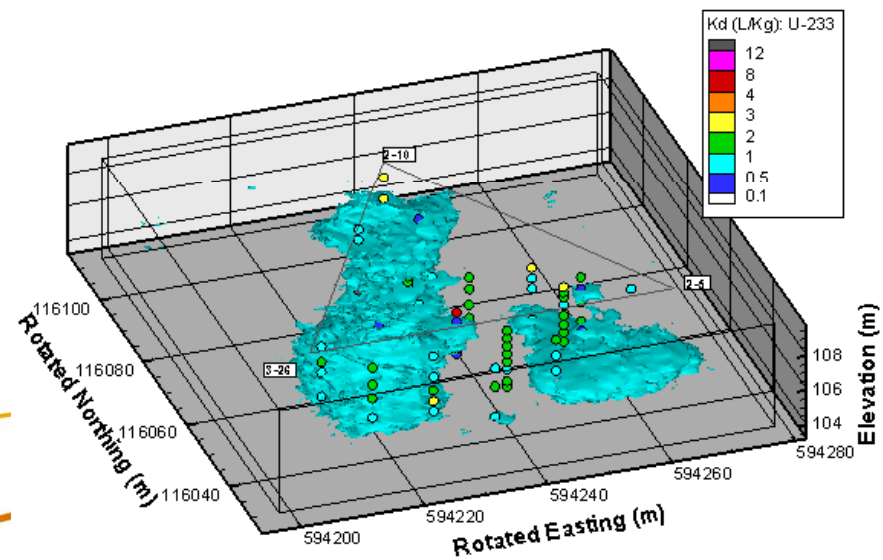
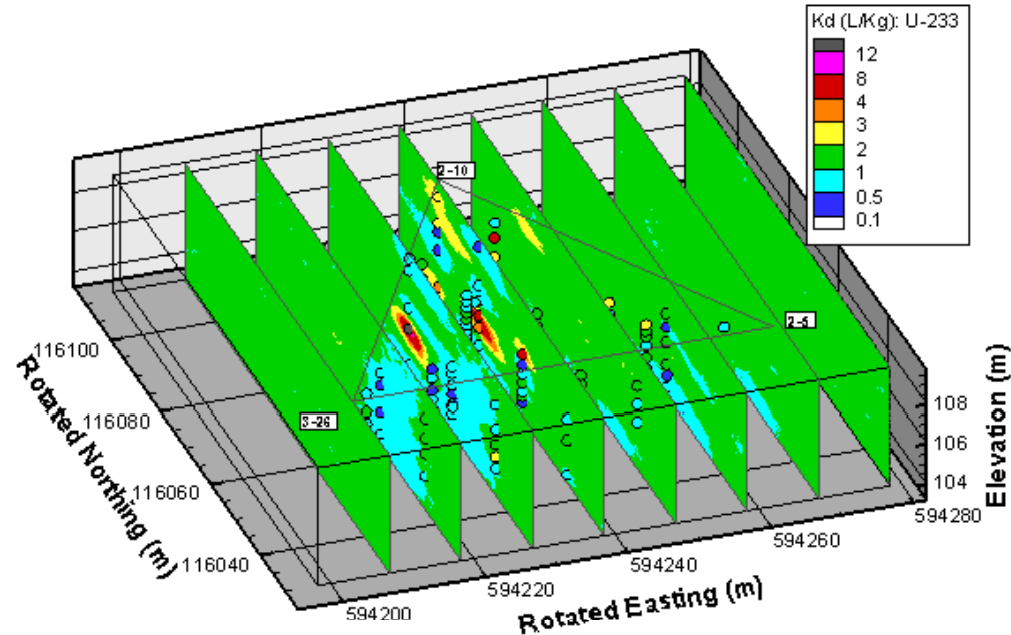
Mass Estimates of Extractable Uranium

- ▶ Each of 100 geostatistical realizations of BEU was associated with a randomly drawn value of the bulk density of the Hanford formation
 - Assumed a normal distribution for bulk density, with a mean and std deviation derived from Williams et al. (2007, Report PNNL-16435, Table 6.5).
- ▶ Mass calculated for each cell in the 3-D geostatistical grid, then summed for each realization.
- ▶ Mean estimate over 100 realizations is ~ 58 kg of BEU. The 95% probability interval ranges from 45.8 kg to 73.4 kg.
- ▶ Mean smear zone inventory of BEU is an important metric for U-fluxes to and from the IFRC domain.



3-D Model of K_d for U-233

- ▶ Gravel-corrected K_d
- ▶ Much shorter total horizontal variogram range for K_d relative to BEU
- ▶ Western area of grid appears to be zone of somewhat higher K_d



Summary

- ▶ Geostatistical models of BEU and K_d U-233 updated to include additional data
 - Provided opportunity to validate previous models
- ▶ BEU appears to have greater horizontal correlation than K_d U-233
 - Zones of high BEU concentrations are spatially variable in smear zone and upper vadose zone
 - Not correlated with fraction < 2 mm
- ▶ Zone of slightly higher K_d U-233 along western edge of well field
- ▶ Probabilistic mass estimates of BEU suggest ~ 58 kg present in 3-D grid
- ▶ Will evaluate correlation of geochemical parameters with geophysical data, especially borehole geophysical data