

# U Isotopic Observations of the Spring 2009 Passive Rise Experiment

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**Center for Isotope Geochemistry**



# Conclusions

- IFRC sediments have significant U isotopic variability both horizontally and vertically, including within the “smear” zone.
- IFRC Plot groundwater has a consistent and recurring “background” U isotopic signature & concentration.
- Water table rises into the “smear” zone mobilizes U with distinct isotopic compositions that can be mapped back to local sediment within the “smear” zone.
- Significant spatial (and temporal) variation is observed in the U isotopic composition of 300 Area groundwater allowing the tracking of water masses independent of U concentration

U isotopes provide a built-in tracer.

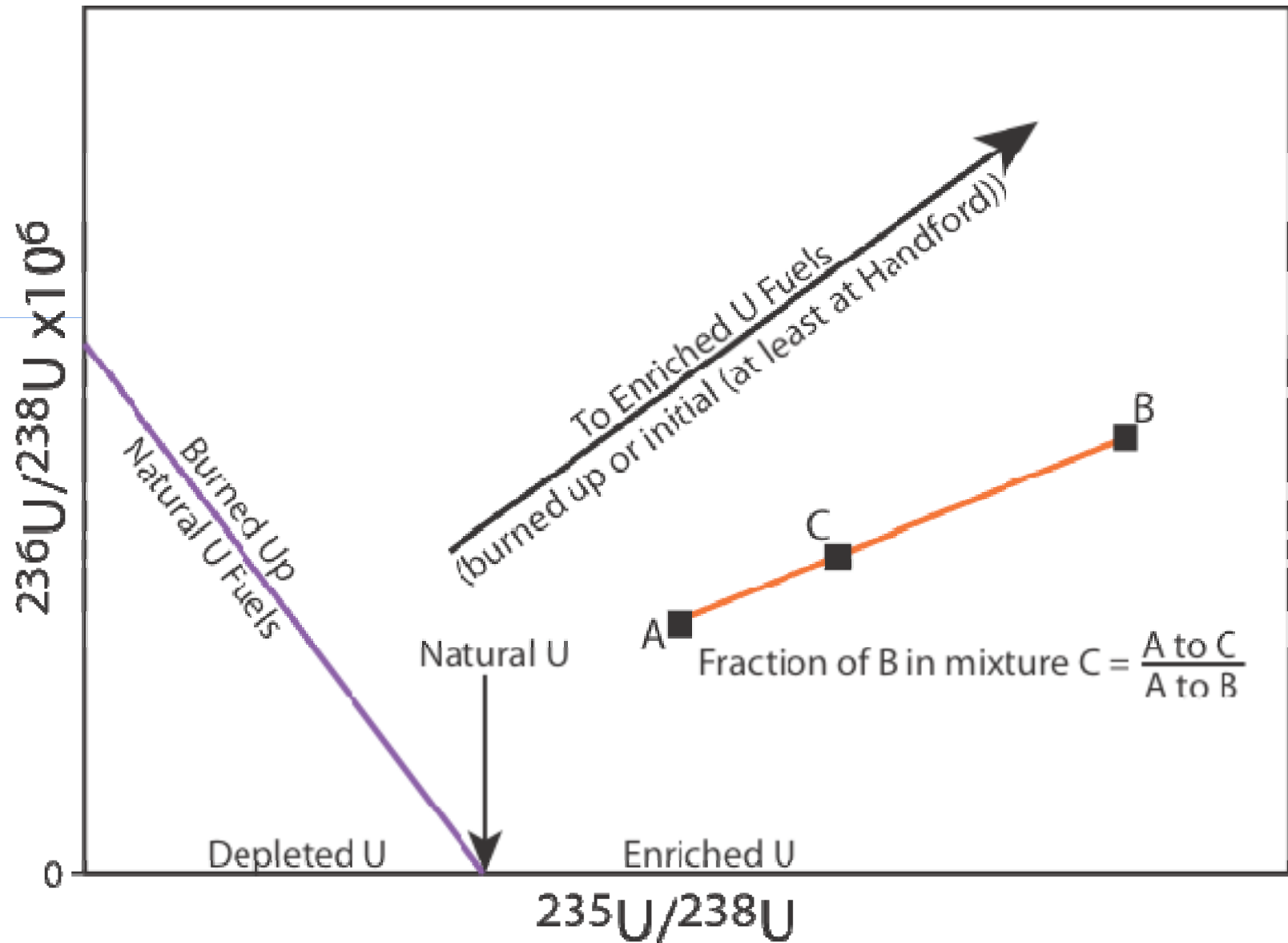
# Today's Outline

- U Isotope Primer
- U Isotopic Overview of 300 Area Groundwater
- Sediment U Isotopic Variation
- IFRC Well U Isotopic Context
- Spring 2009 Passive Rise Experiment
- Water Isotopes

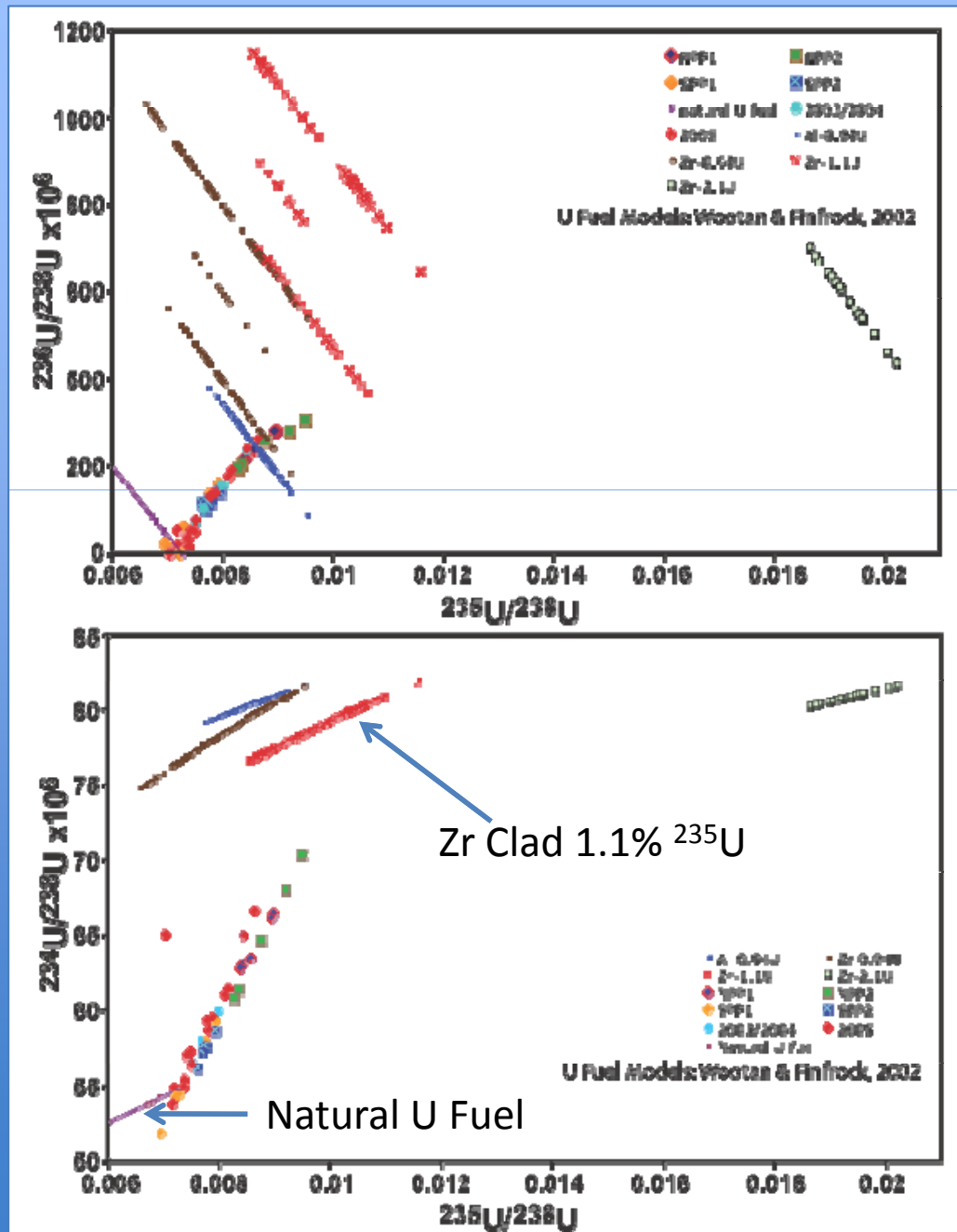
# Uranium Isotopic Signatures

Source	$^{234}\text{U}/^{238}\text{U} \times 10^6$	$^{236}\text{U}/^{238}\text{U} \times 10^6$	$^{235}\text{U}/^{238}\text{U}$
U-Ore	~54.8	<0.0001	~0.00725
U in groundwater	>55	~0	~0.00725
Depleted U	<<55	~0 (or >0)	<0.00725
Natural U fuel	~55	~0	~0.00725
Enriched U fuel (Hanford)	>75	400 or more	>0.00725
Reacted U fuel	<55 or >55	>0 to ~1000	<0.00725 or >0.00725

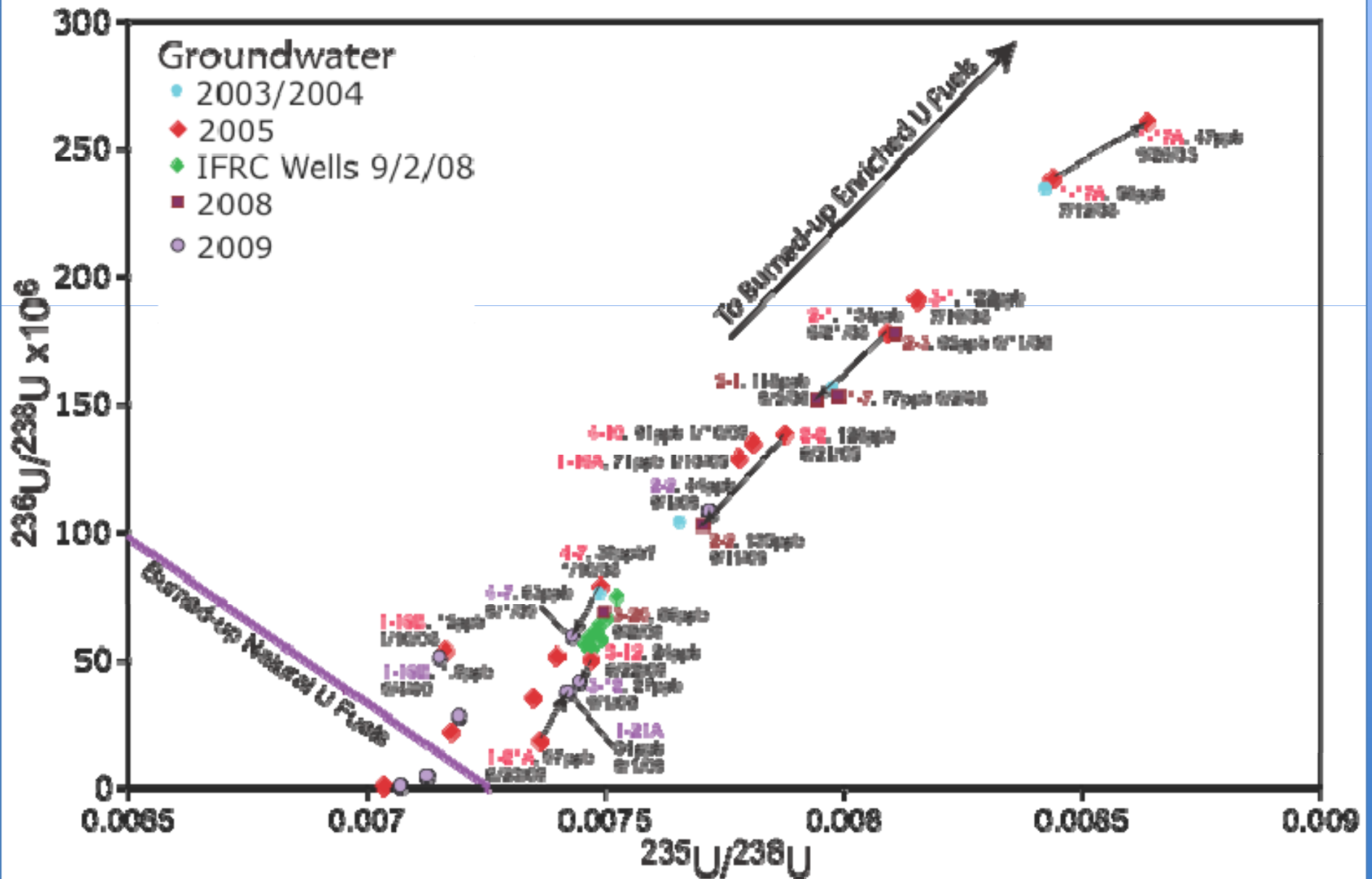
# $^{236}\text{U}/^{238}\text{U}$ vs. $^{235}\text{U}/^{238}\text{U}$



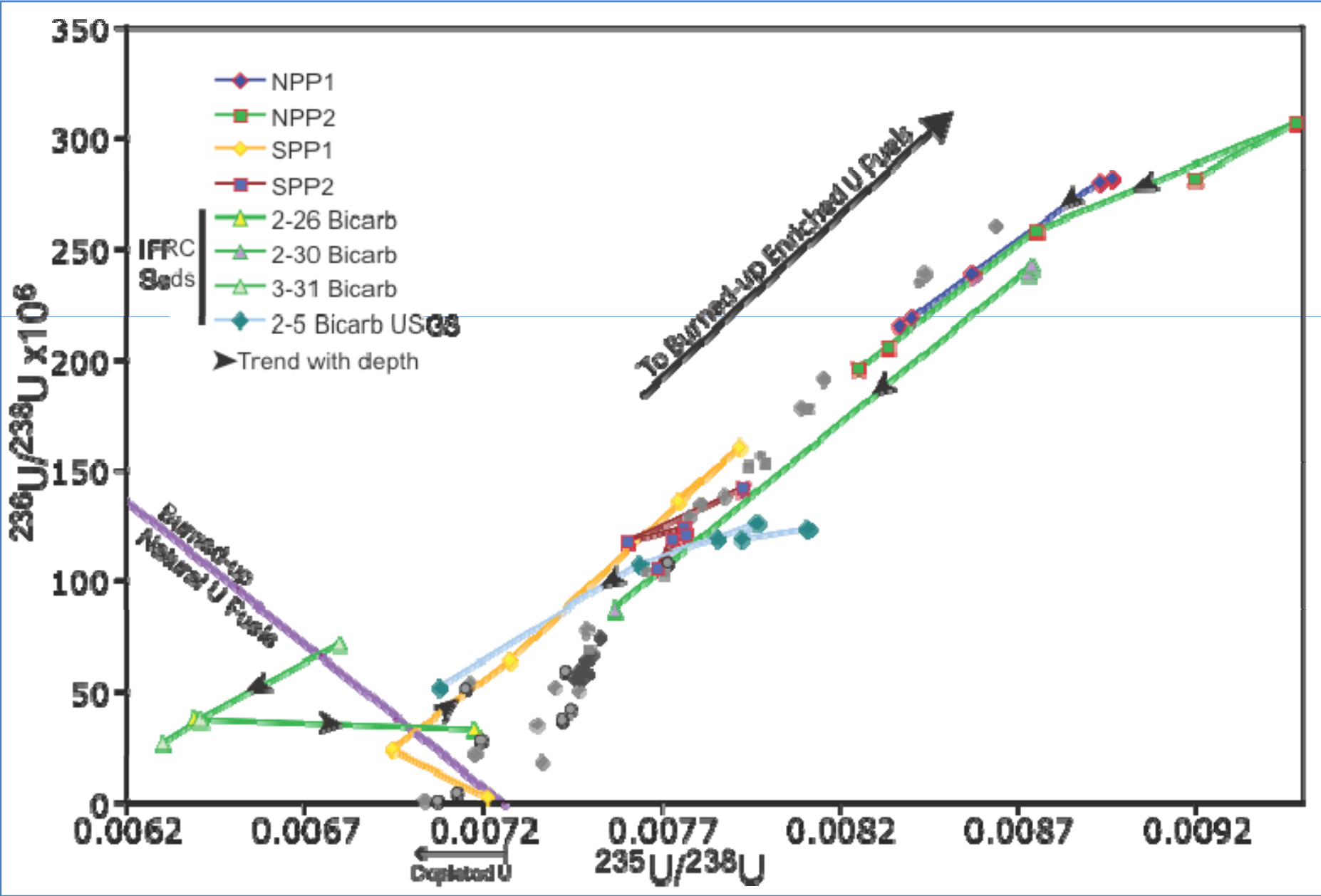
# 300 Area U Sources



# 300 Area Groundwater U Isotopes

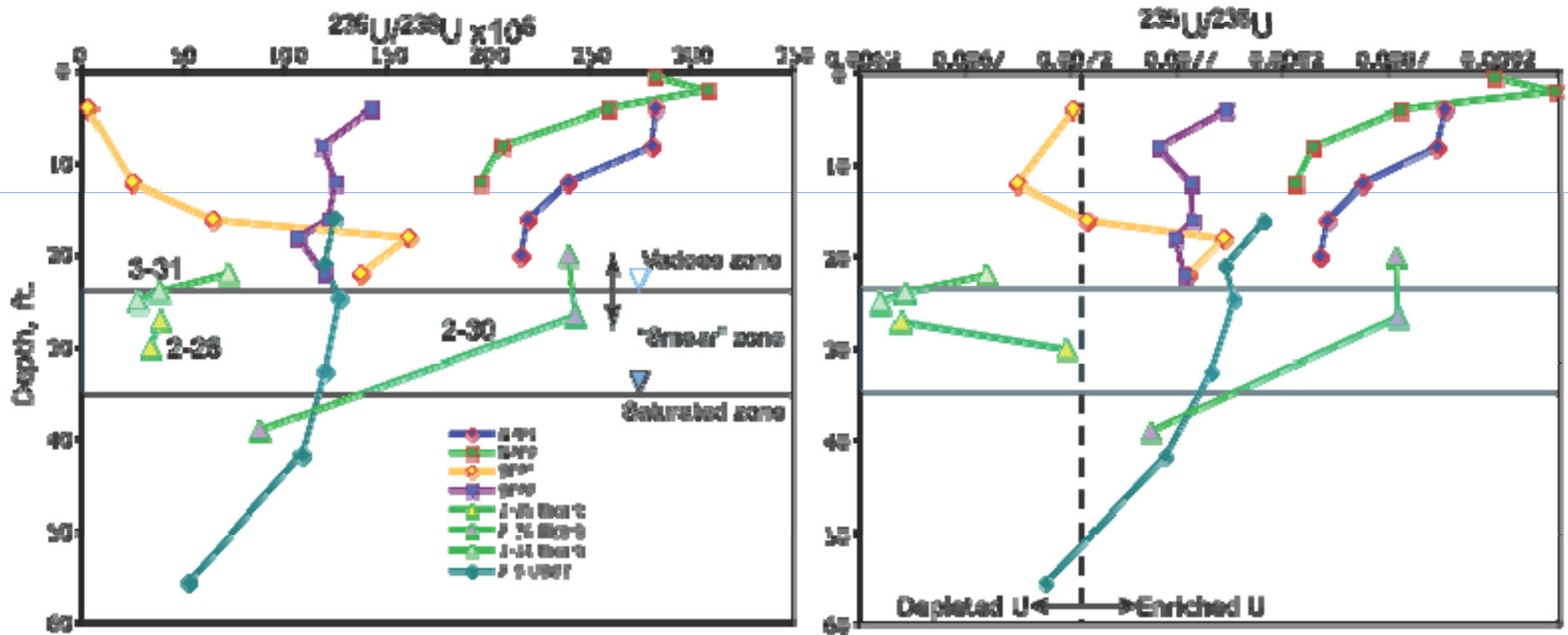


# Sediment compared to Groundwater

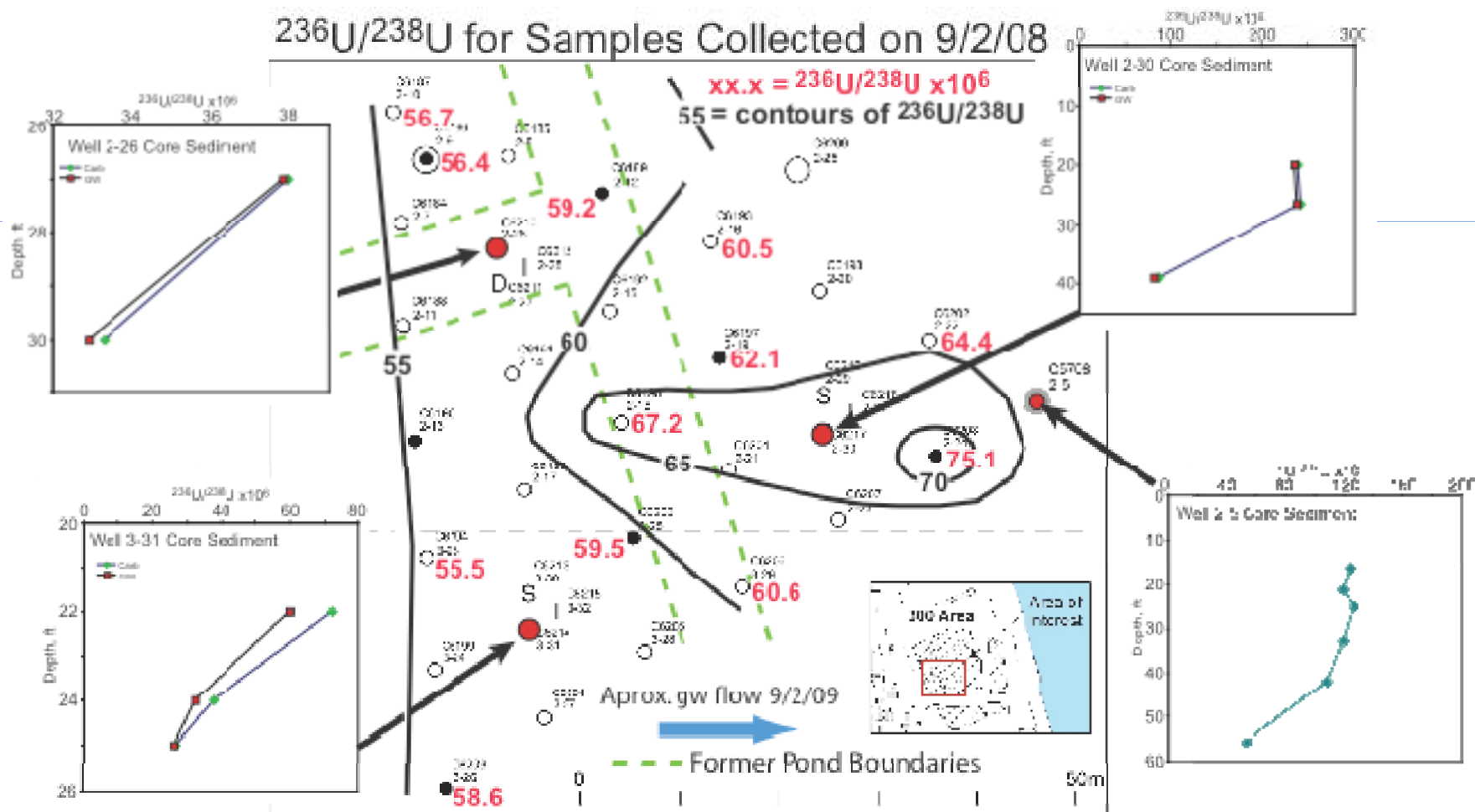




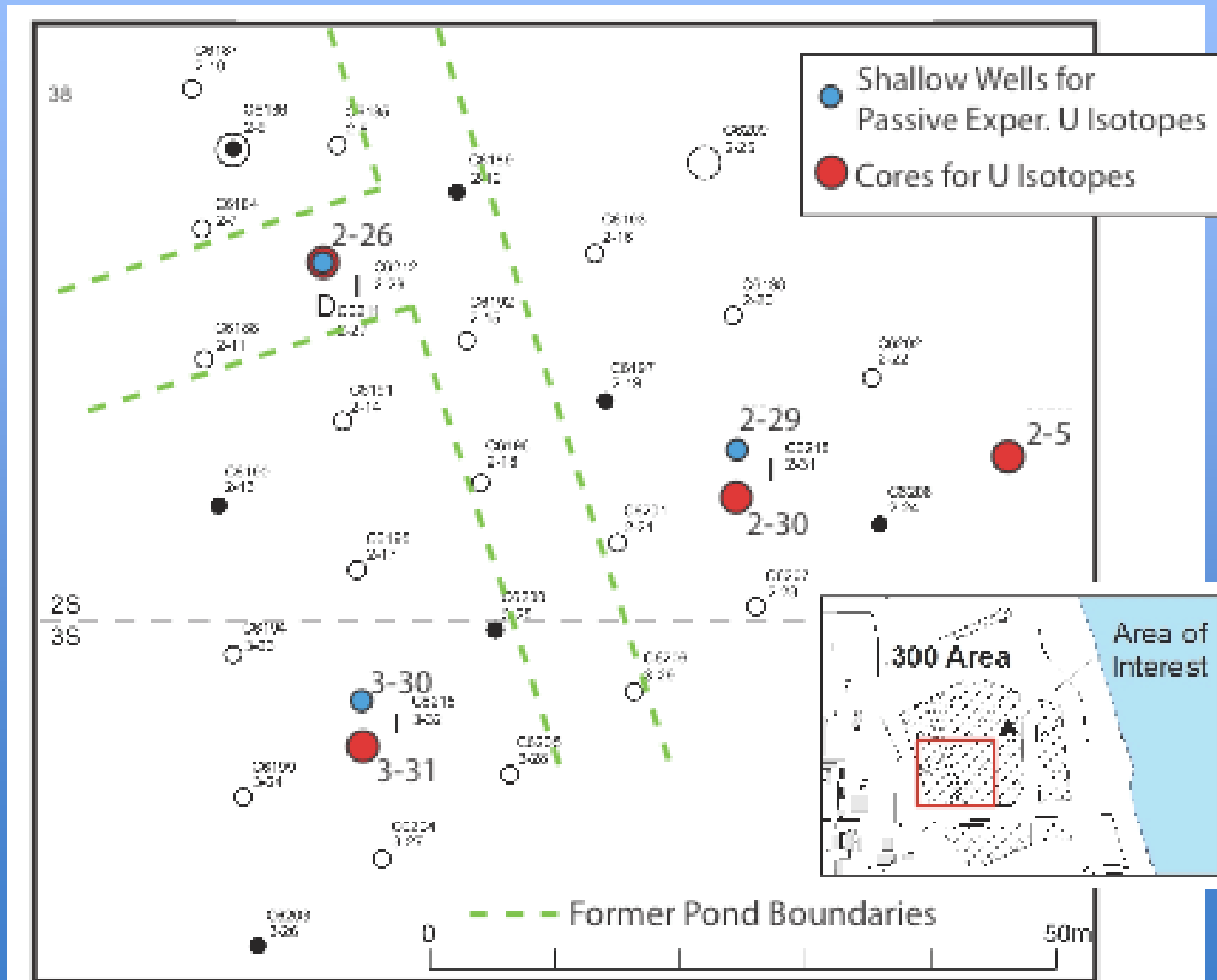
# 300 Area Sub-pond Sediments U Isotopic Stratigraphy



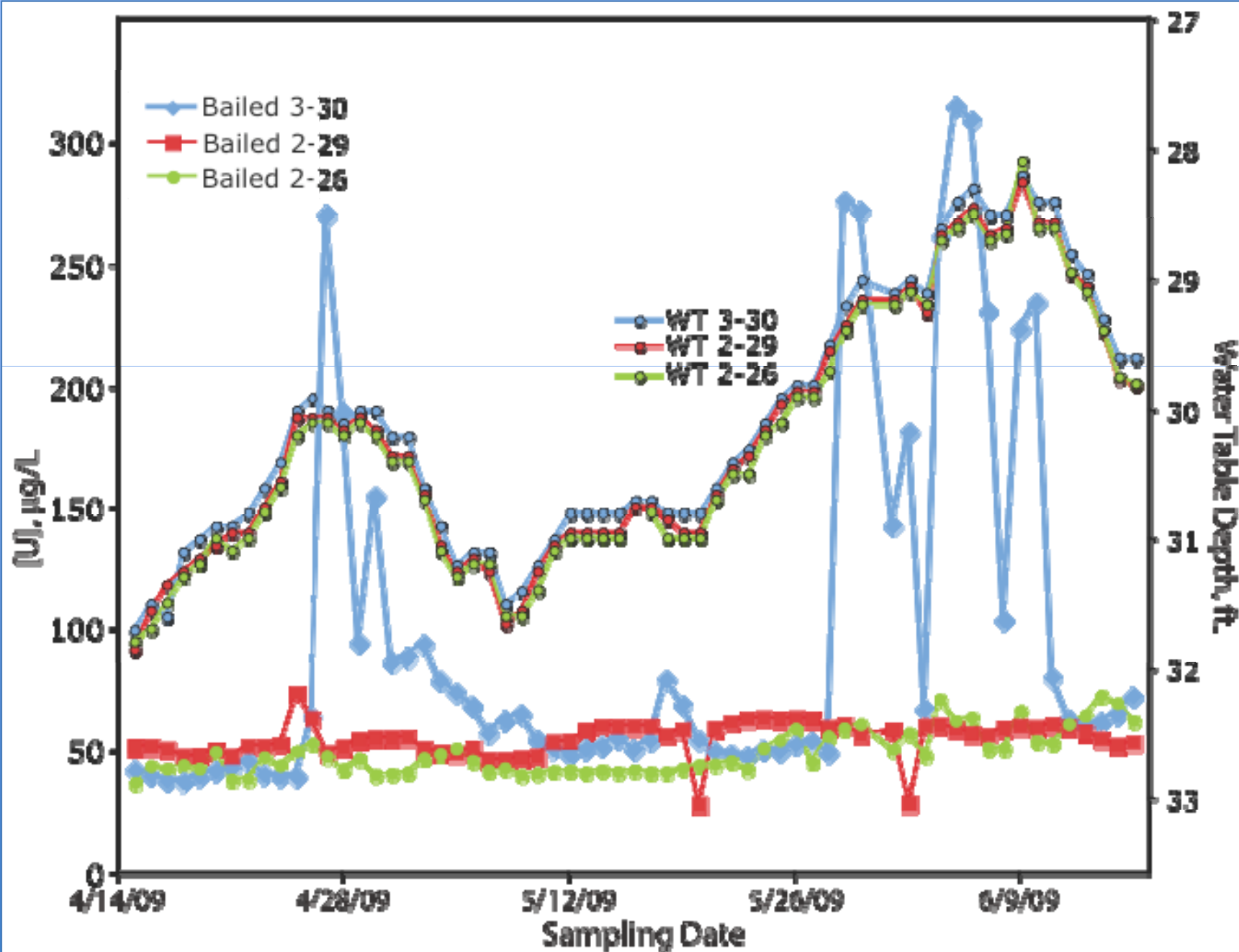
# IFRC Plot Groundwater $^{236}\text{U}/^{238}\text{U}$ Map



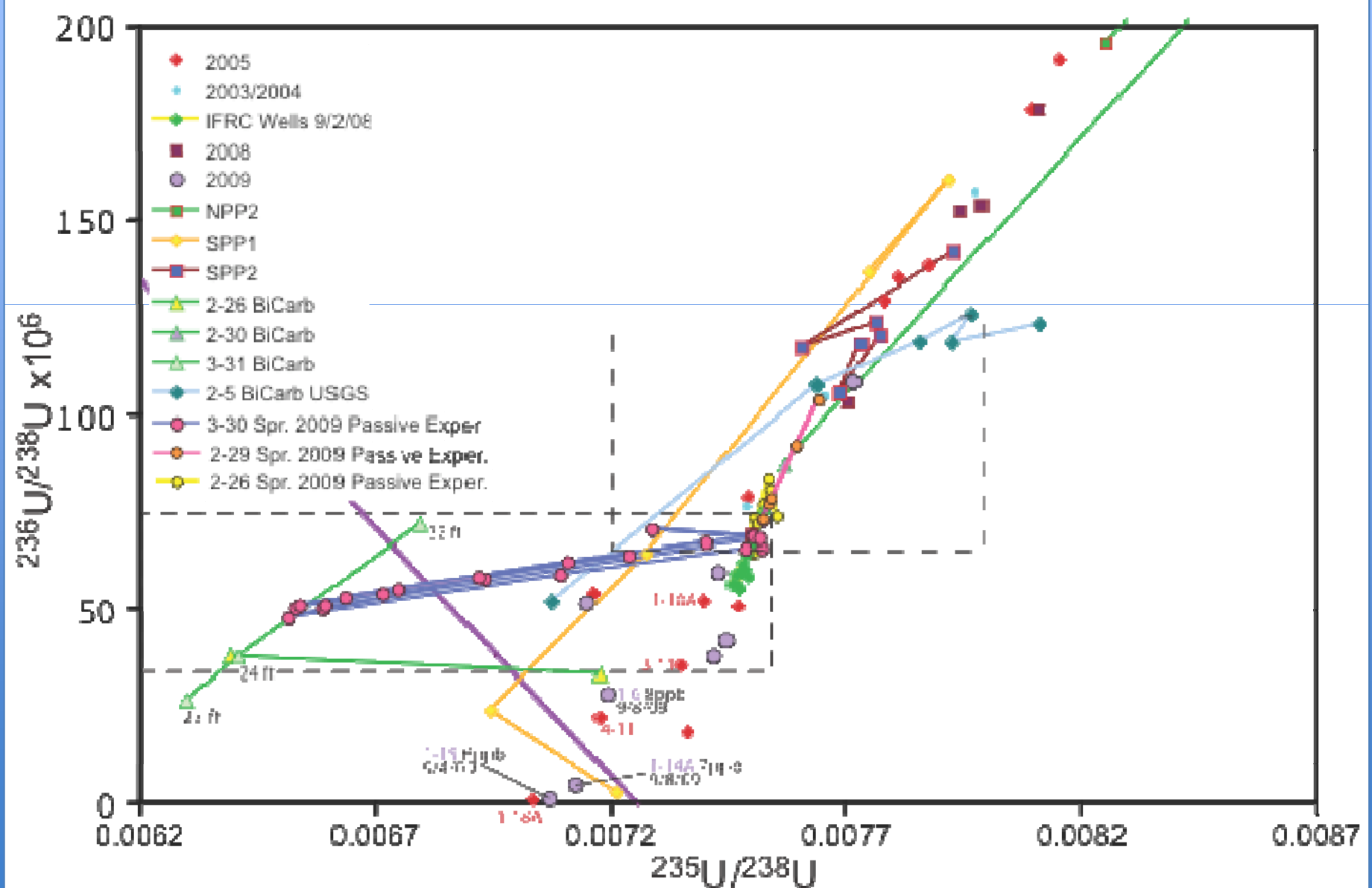
# Sample Locations for Spring 2009 Passive Experiment



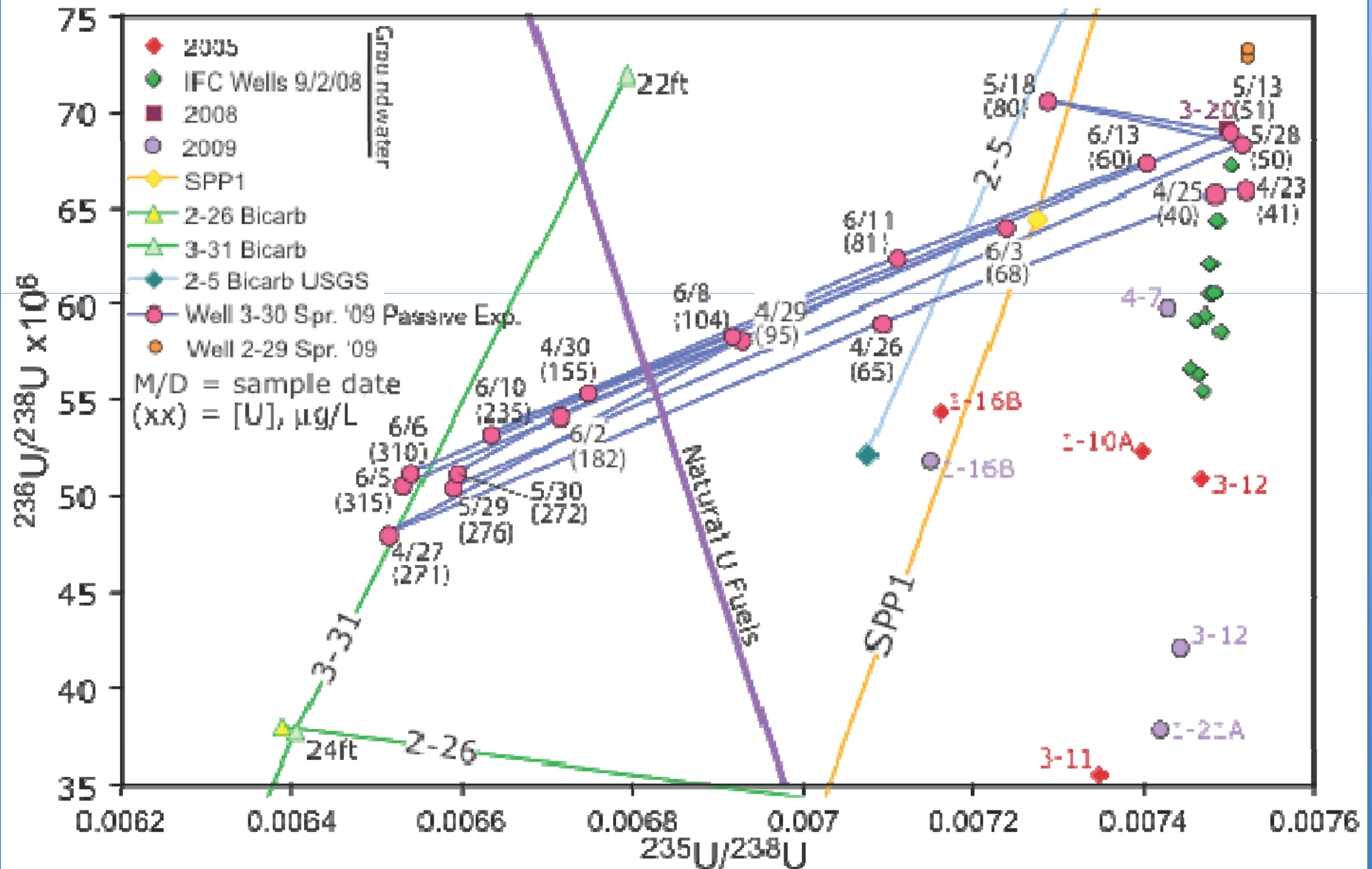
# U Concentration Compared to Water Table Depth



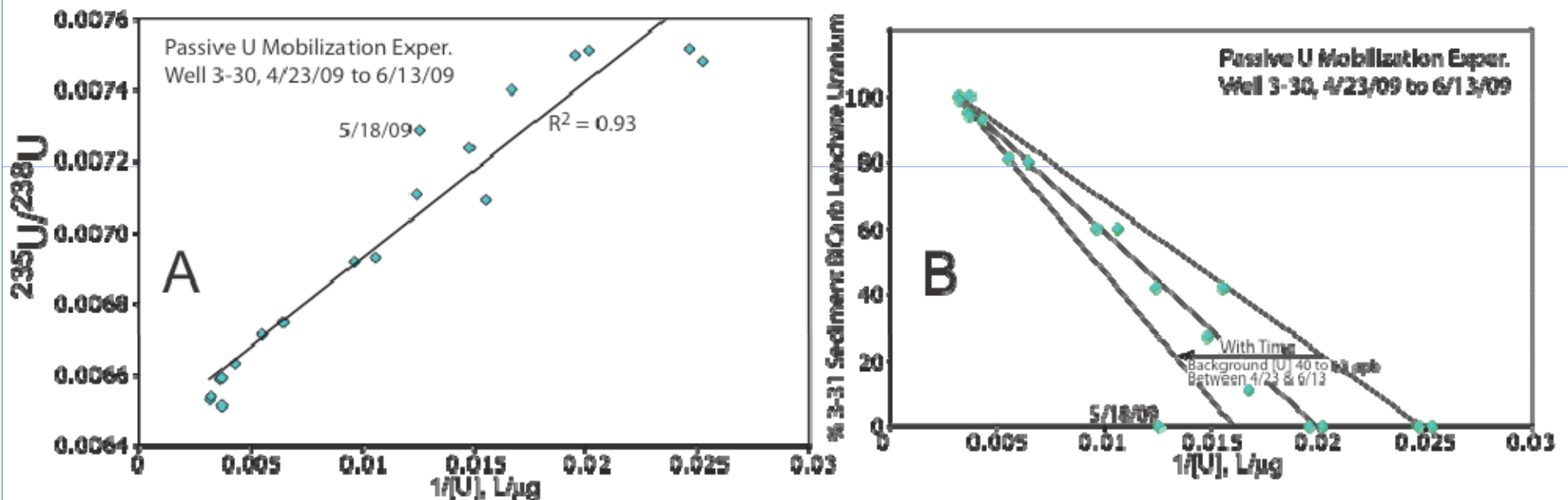
# Spring 2009 Passive Experiment



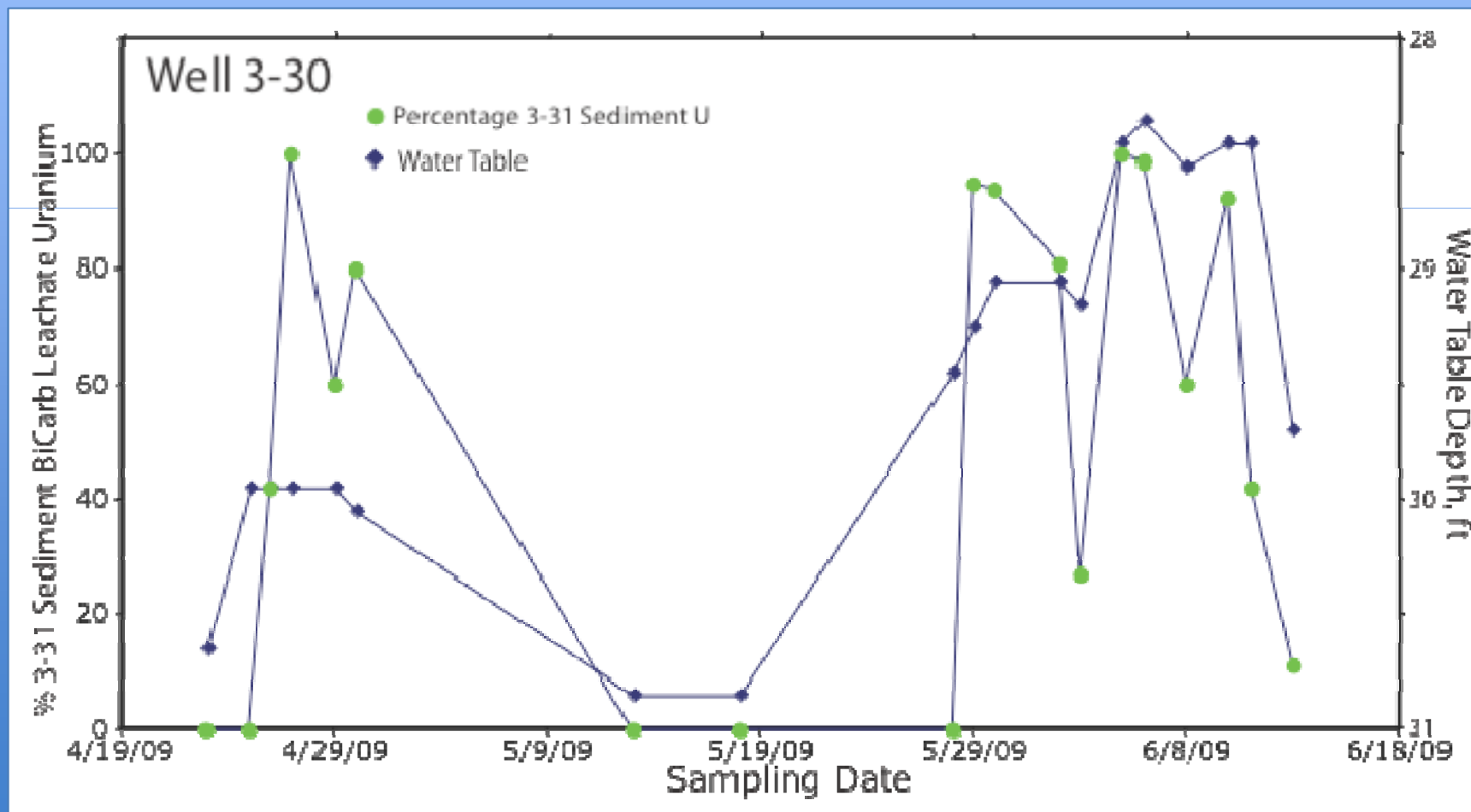
# Focus on Well 3-30 Spring 2009



# 3-30 Mixing Relations

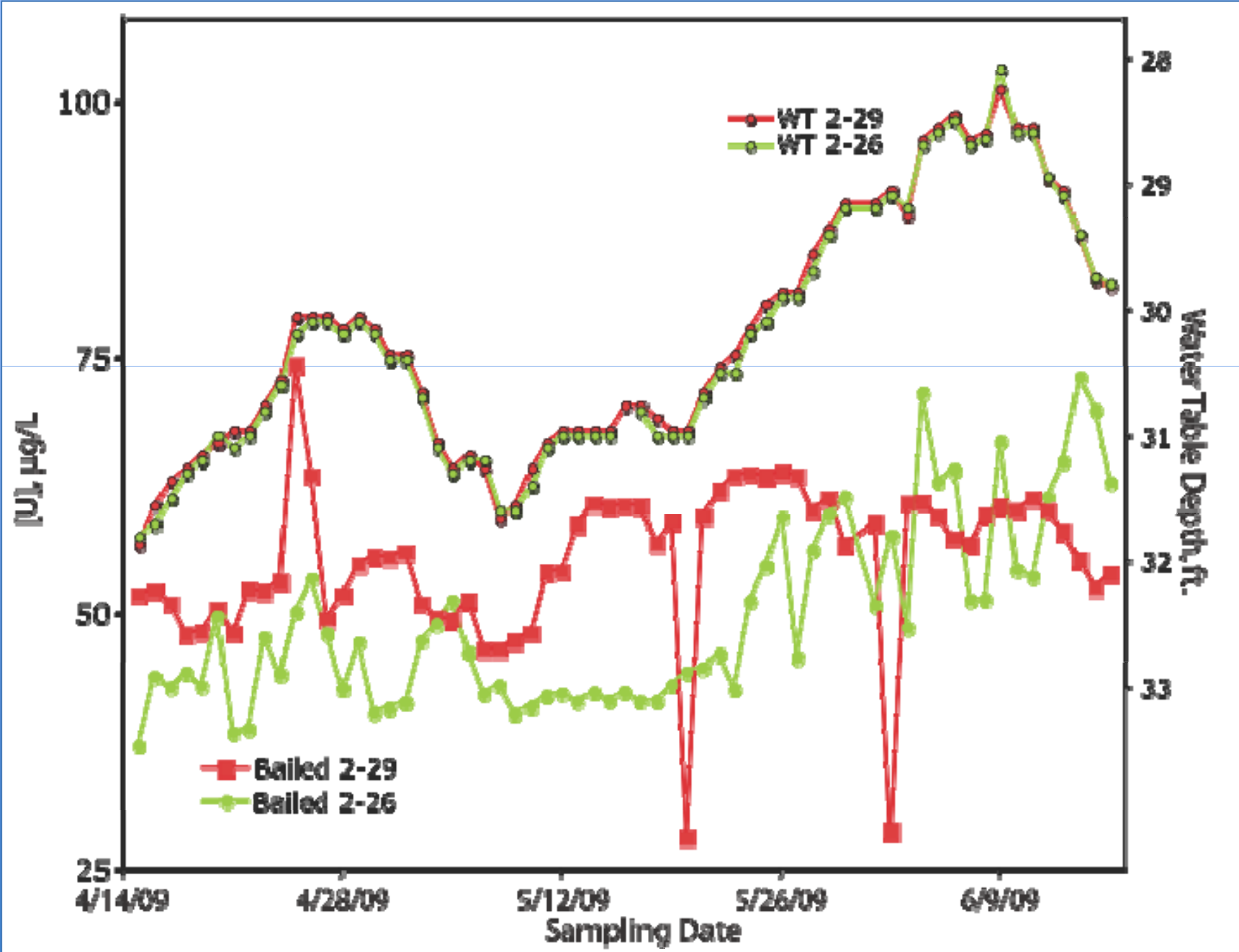


# Water Table Depth and % 3-31 Sed.U

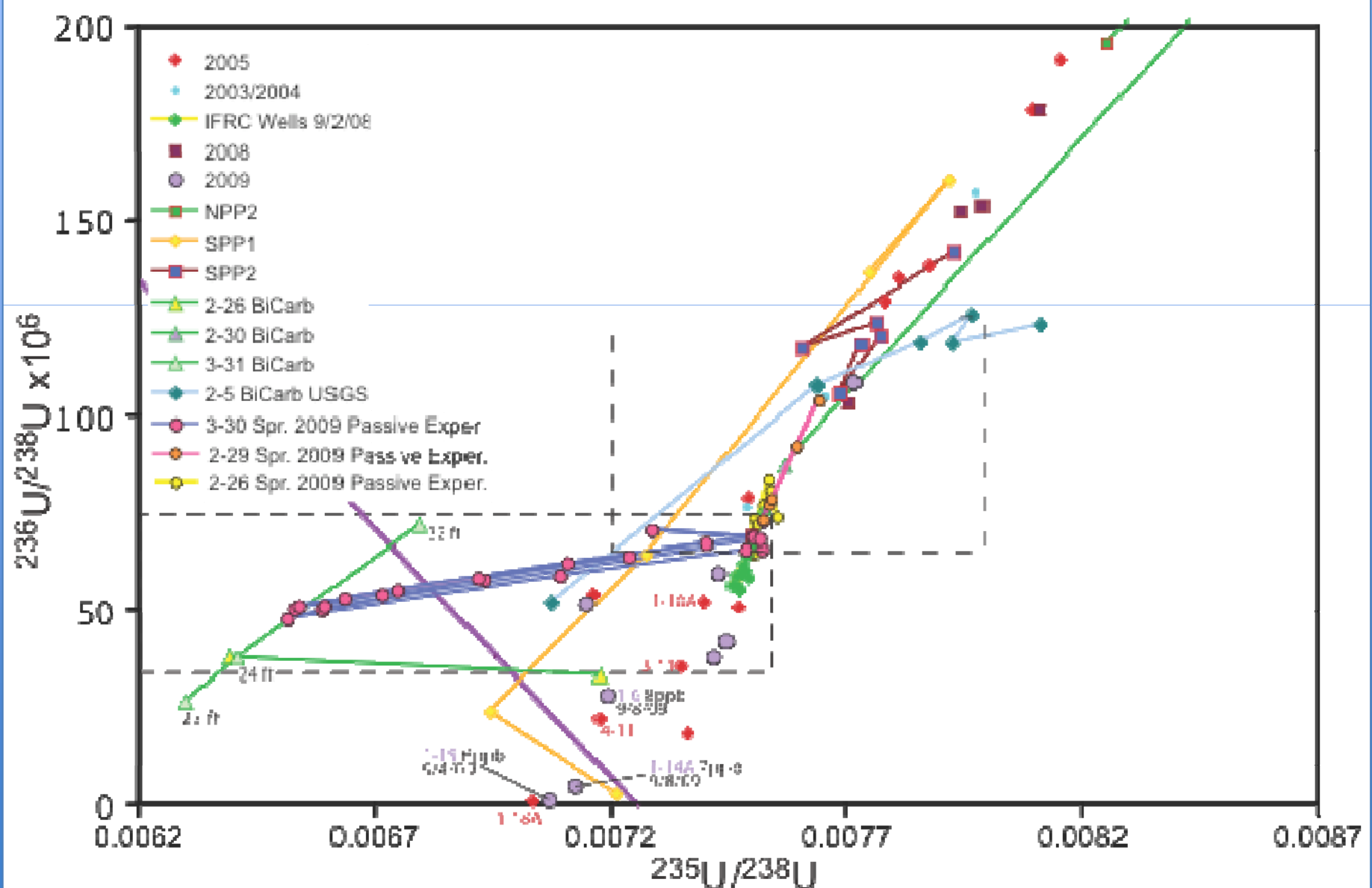




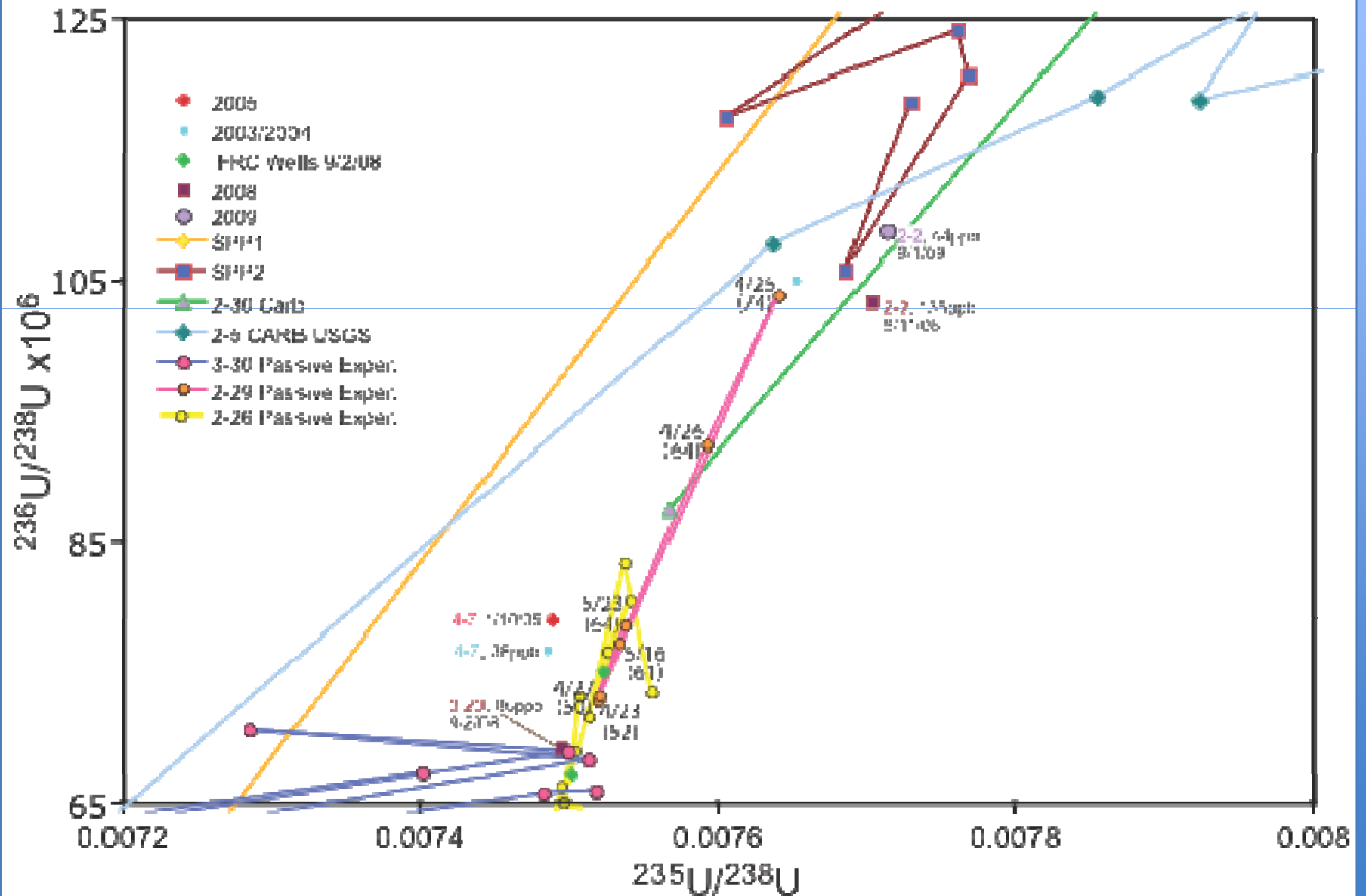
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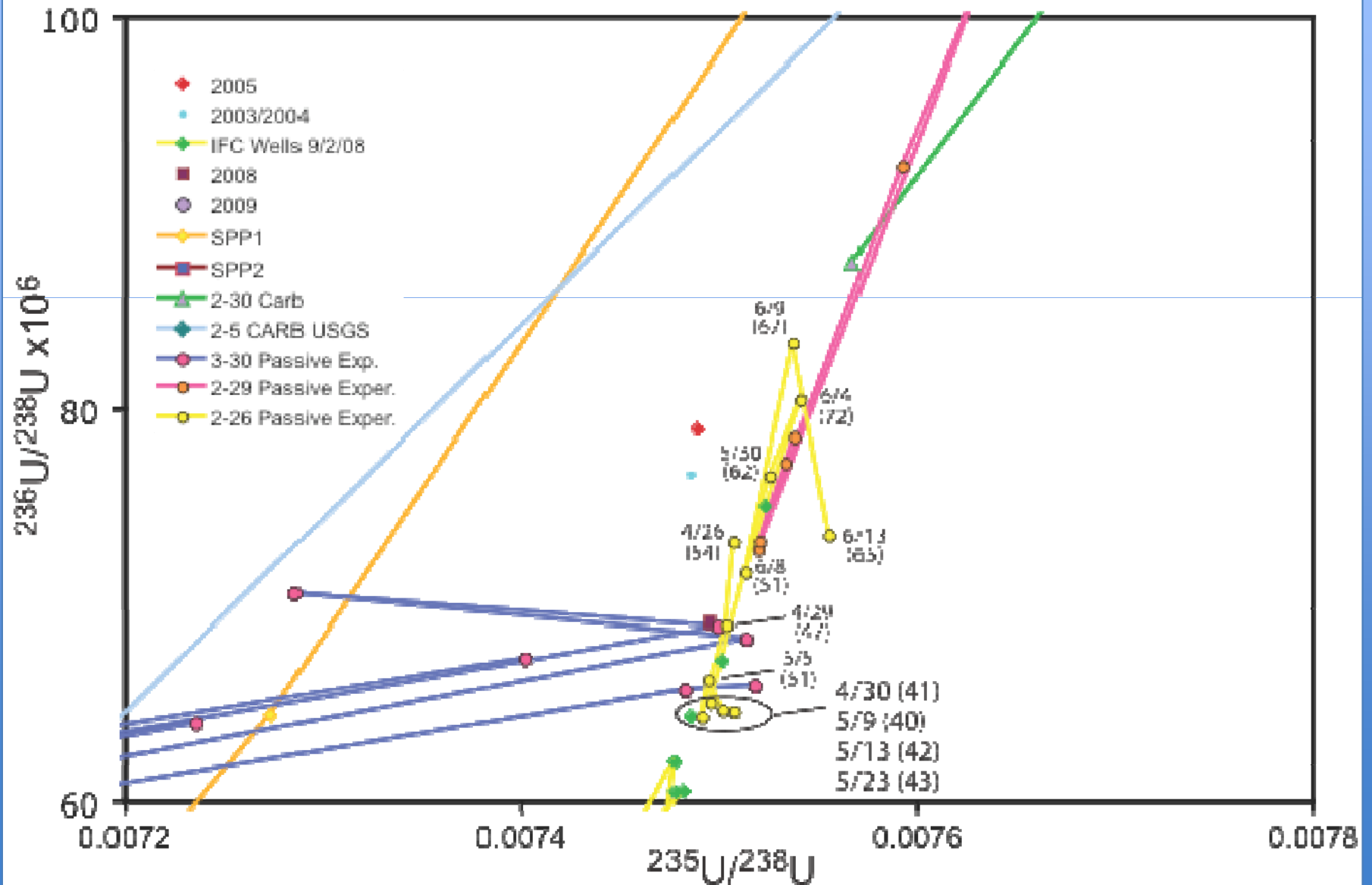
# Spring 2009 Passive Experiment



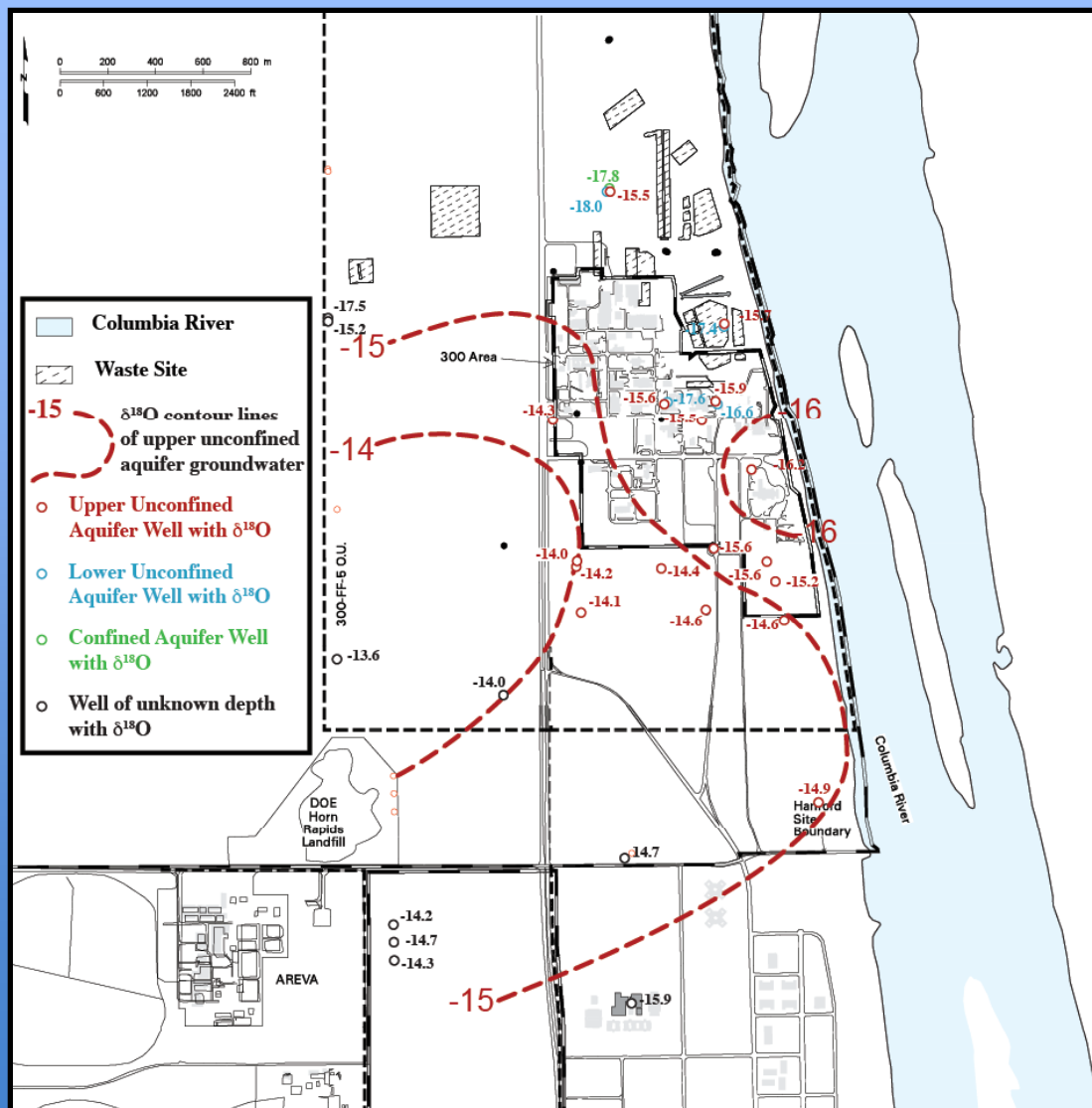
# Focus on Well 2-29 Spring 2009



# Focus on Well 2-26 Spring 2009

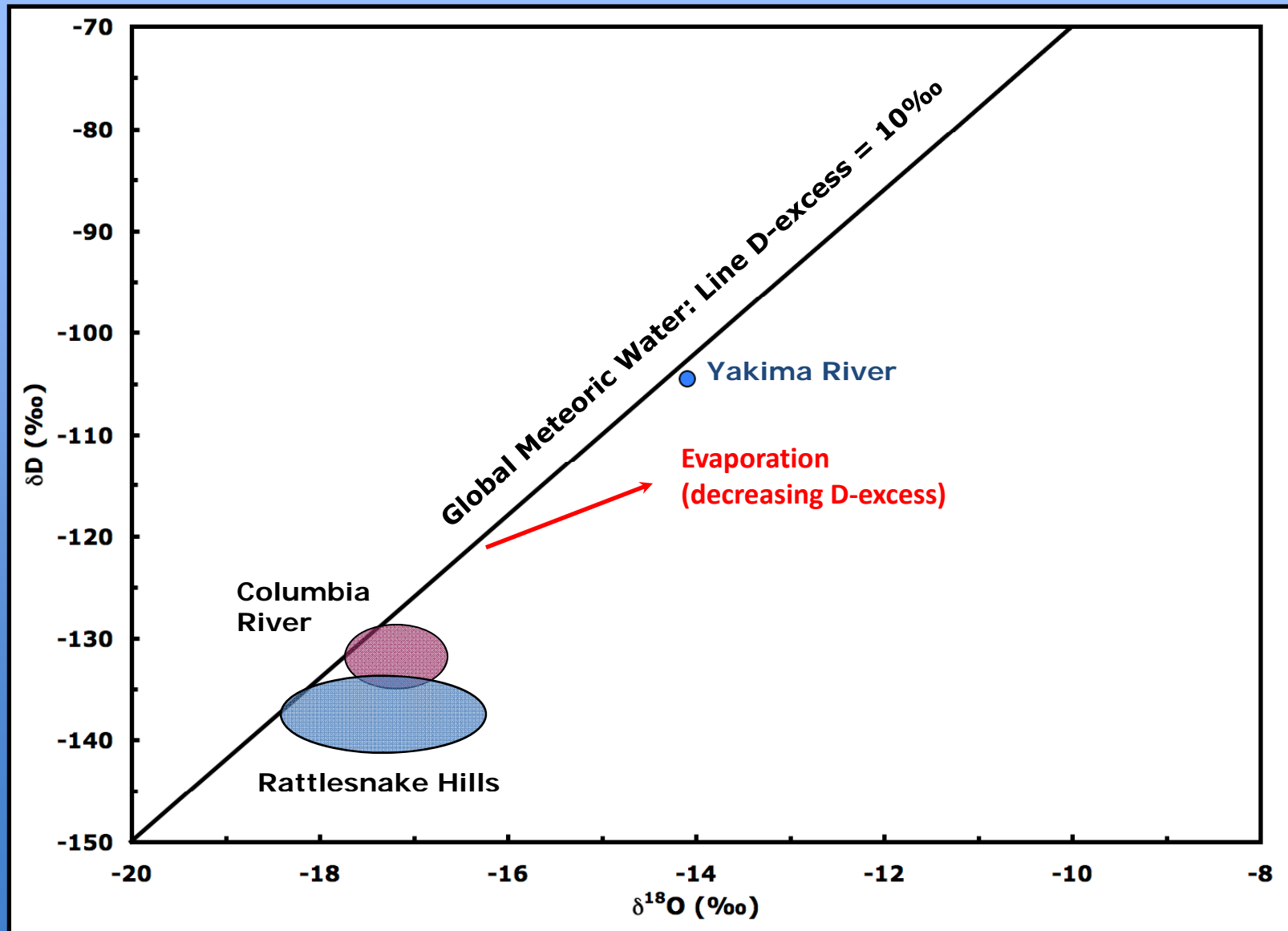


# 300 Area Groundwater Oxygen Isotopes

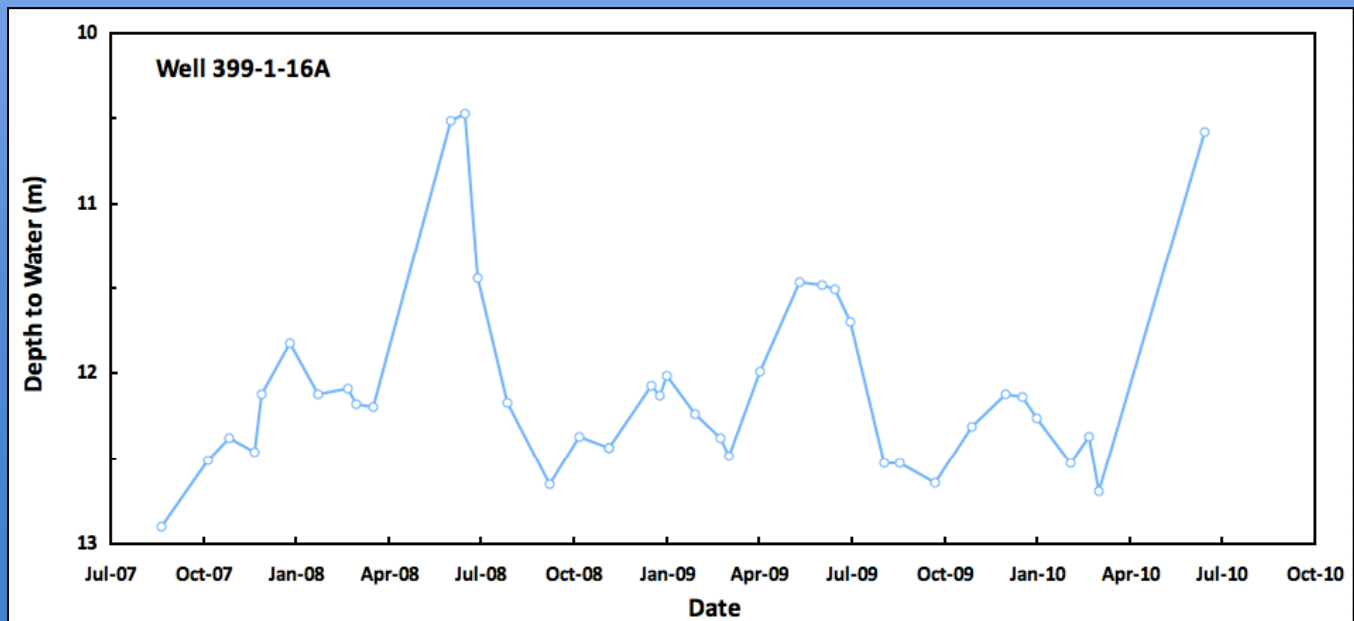
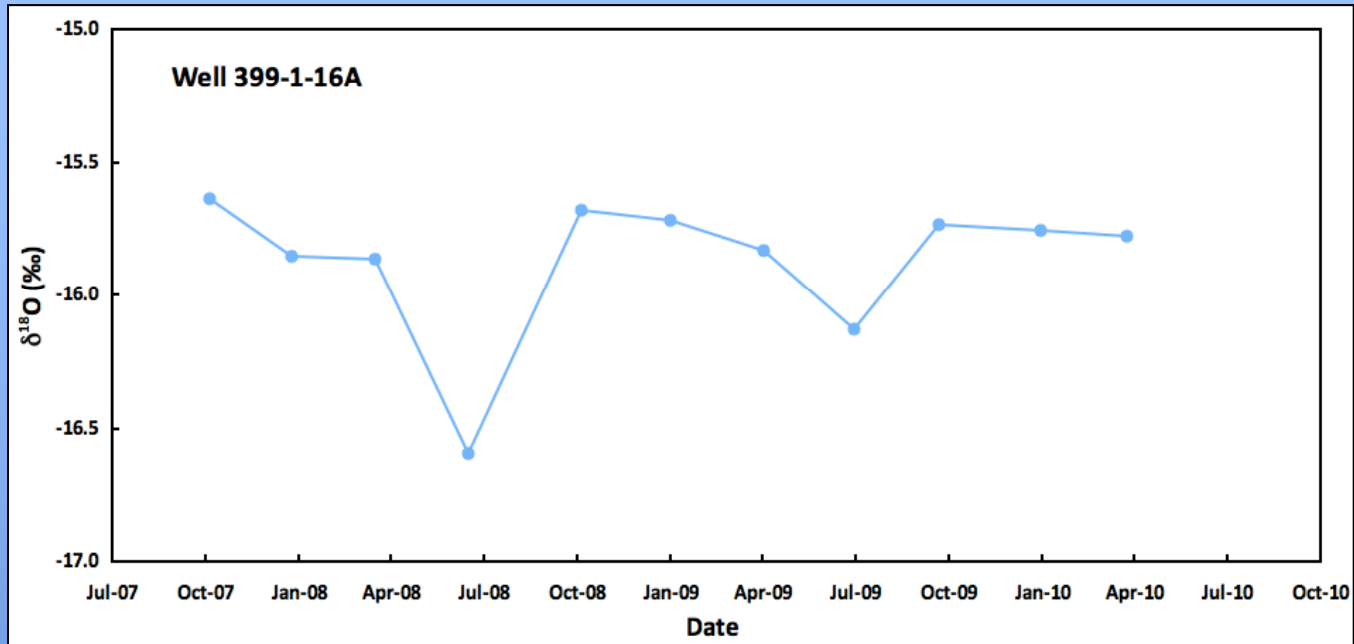


- The  $\delta^{18}\text{O}$  values of water from the upper Hanford formation range from -13.6‰ to -16.2‰ with values increasing inland. D-excess also increases inland. This pattern suggests mixing between local infiltration and Columbia River water.
- The  $\delta^{18}\text{O}$  values of samples from the lower Hanford formation and the underlying Ringold Formation range from -16.7‰ to -18.0‰ reflecting waters derived basalt recharge zones (not the Yakima River).

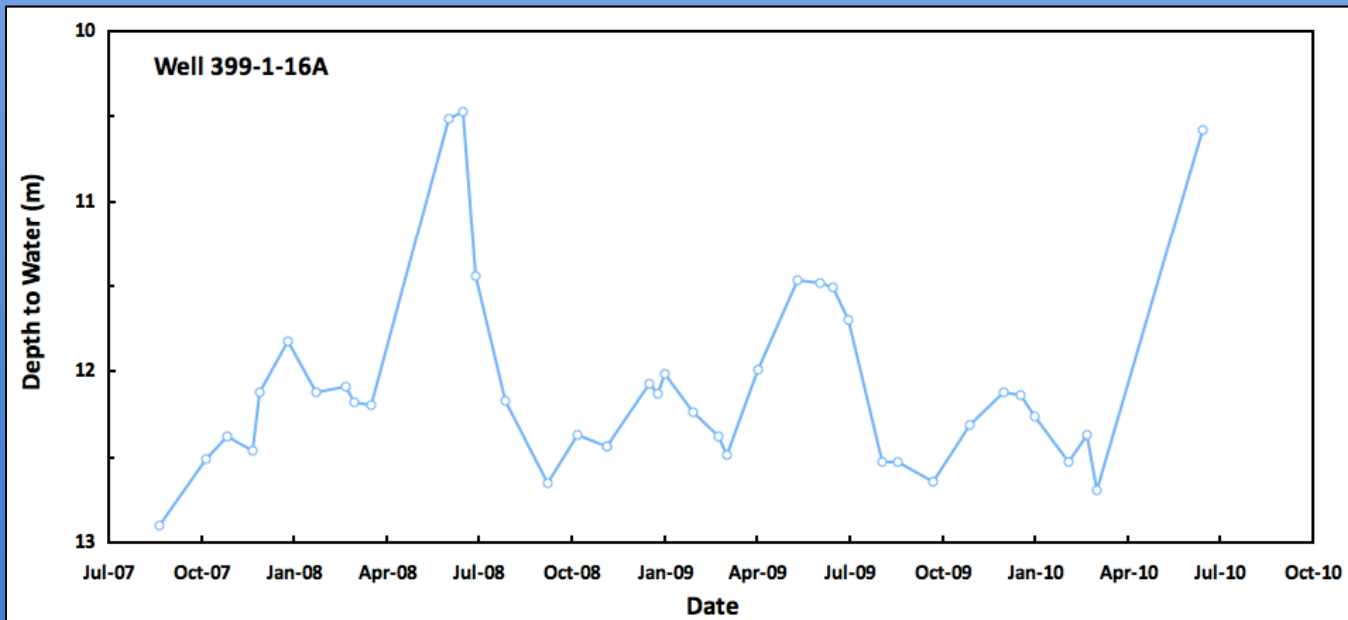
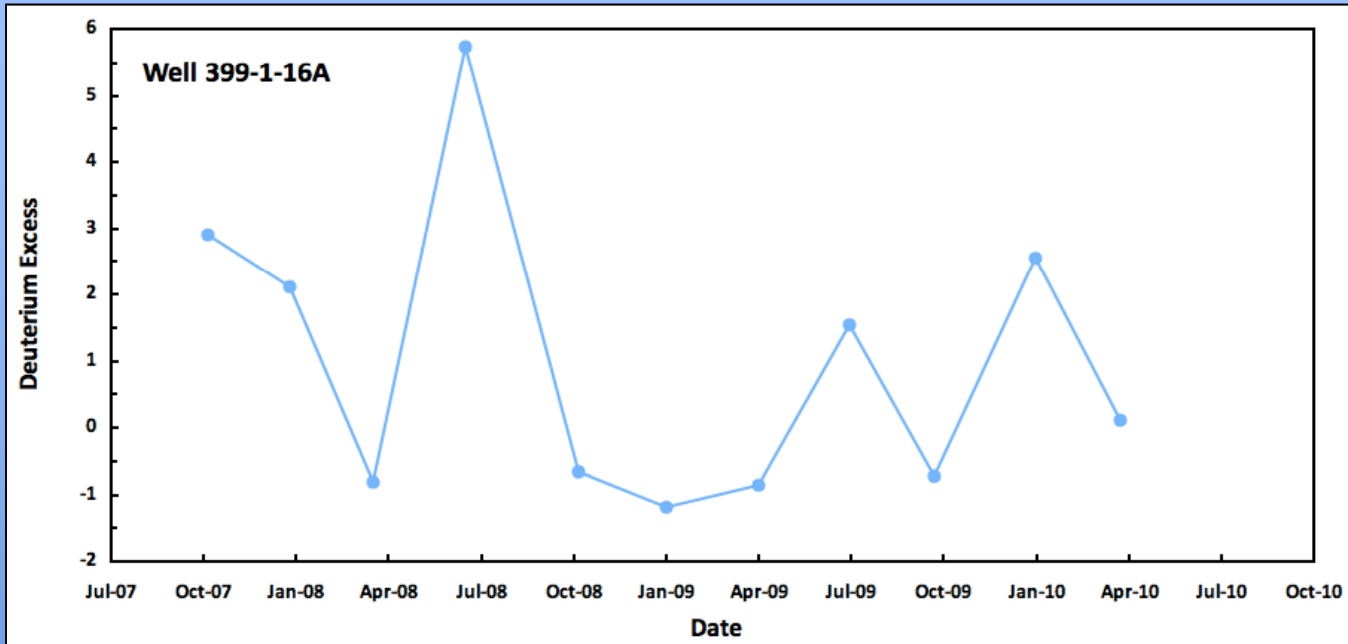
# Water Isotopes ( $\delta D$ , $\delta^{18}O$ )



# Water Isotopes



# Water Isotopes





# Conclusions

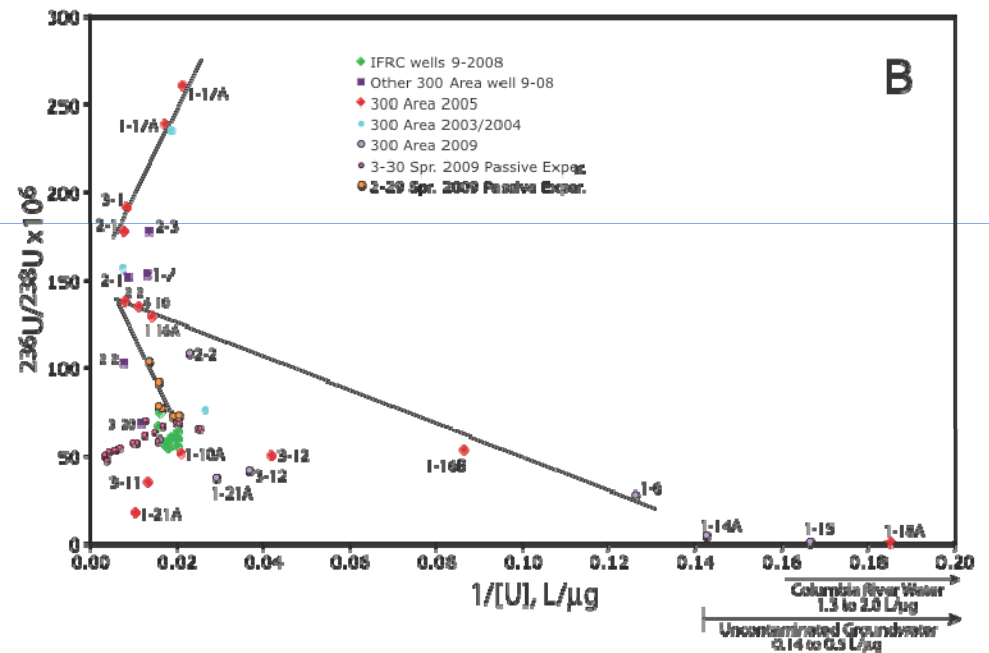
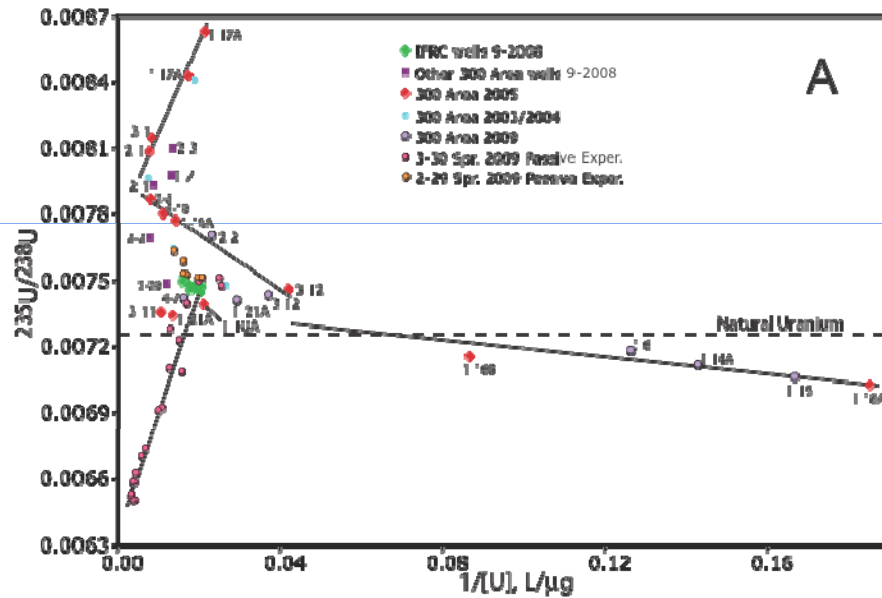
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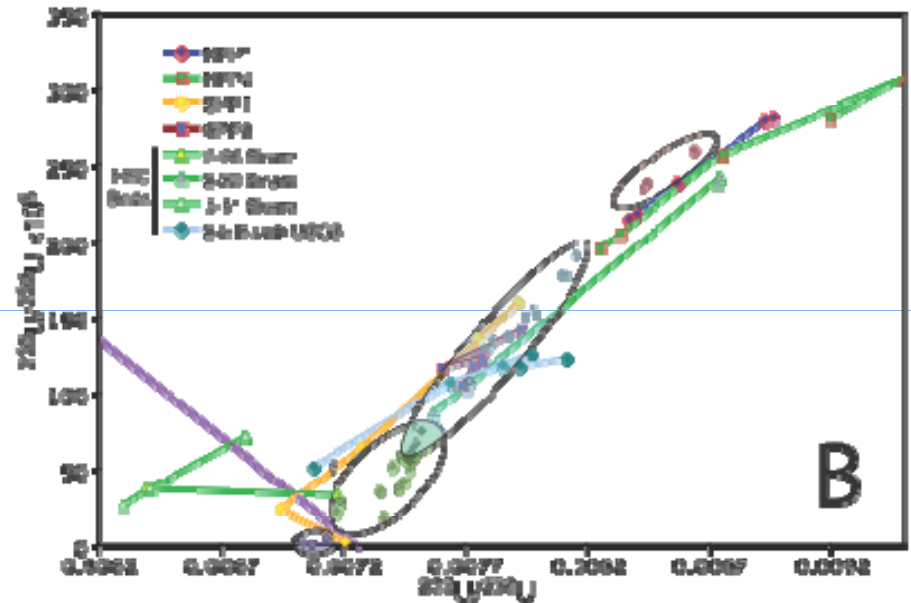
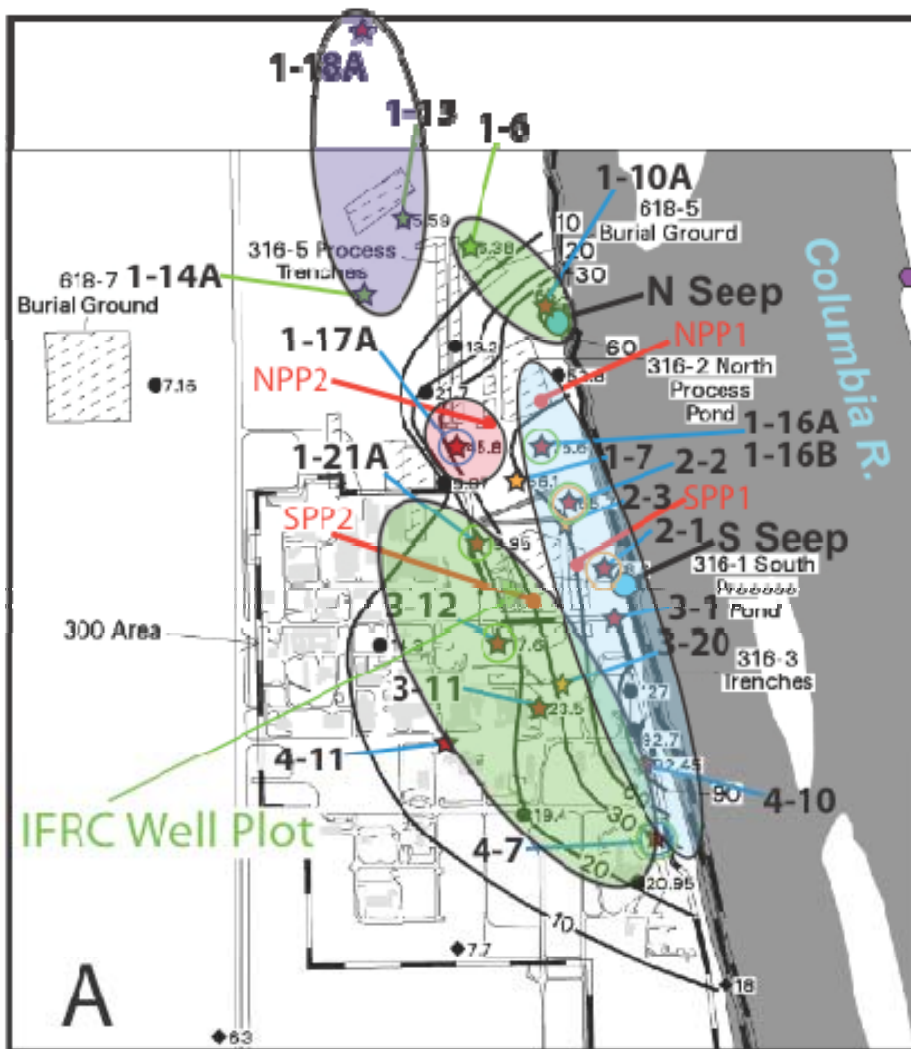
# Future Work & Experiments

- Further passive experiments with mitigated wells, providing better coverage
- Infiltration experiments (mass balance, track and source U)
- Desorption/adsorption experiments taking advantage of U isotopes
- Complete IFRC sediment U isotopic analyses
- Sr isotopic behavior during passive rise

# Mixing Diagrams, all of 300 Area



# Mapping Groundwater U Isotopes



# 300 Area Well & Sample Map

