

Differential VOC Recoveries: Snap Sampler, Low Flow and Remedial Decision-Making

DTSC Geosymposium
Sacramento, CA
May 10, 2007

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THE **SNAP SAMPLER**[™]

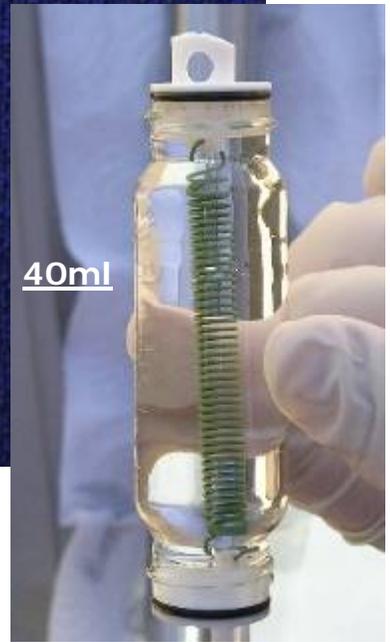


2006 Equipment Design Award Winner

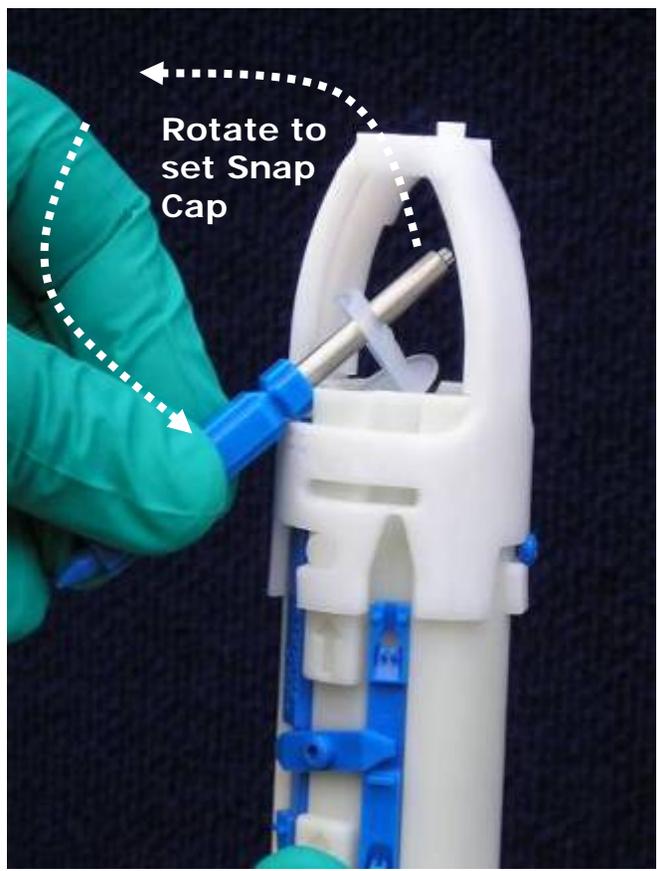
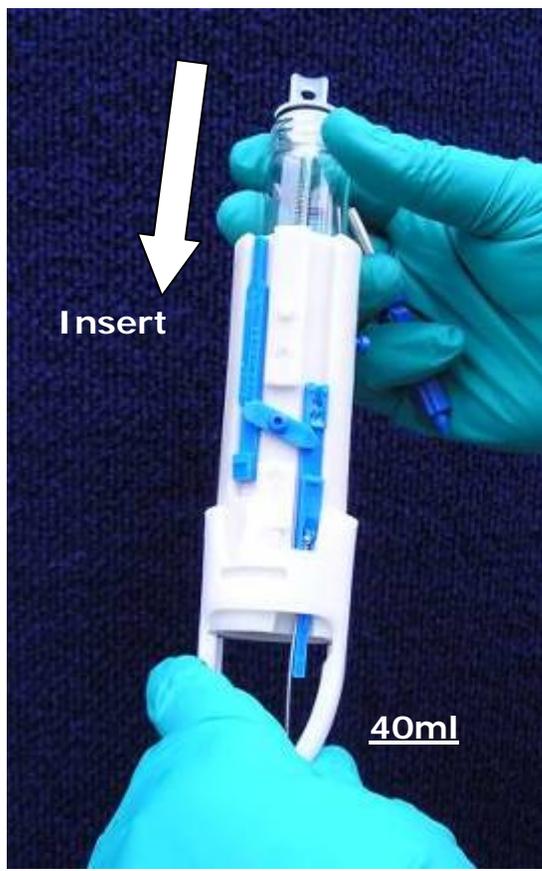
SNAP SAMPLER



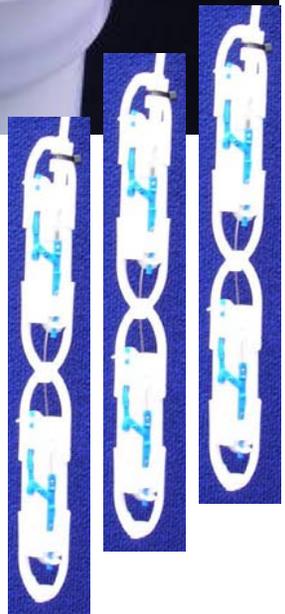
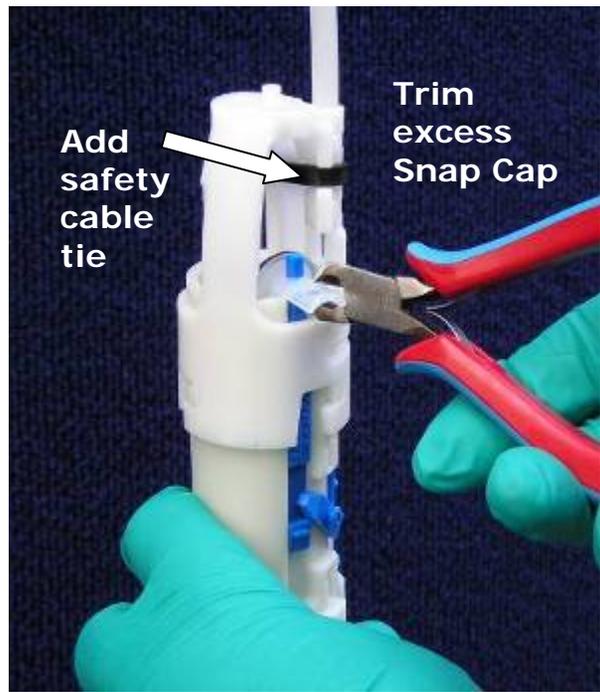
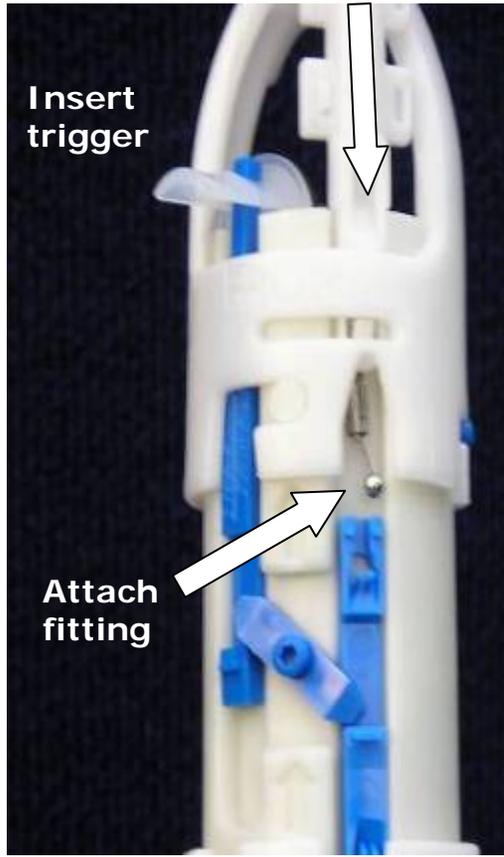
- ▶ *Equilibrated* Grab Sampler
- ▶ Double-ended bottles with spring-activated “Snap Caps”
- ▶ Sample bottles deployed downhole in open position
- ▶ Equilibrate between sampling events
- ▶ Samples sealed *in situ*
 - Lab-ready bottles
 - 40 ml VOA
 - 125 ml Plastic



How the Snap Sampler works....

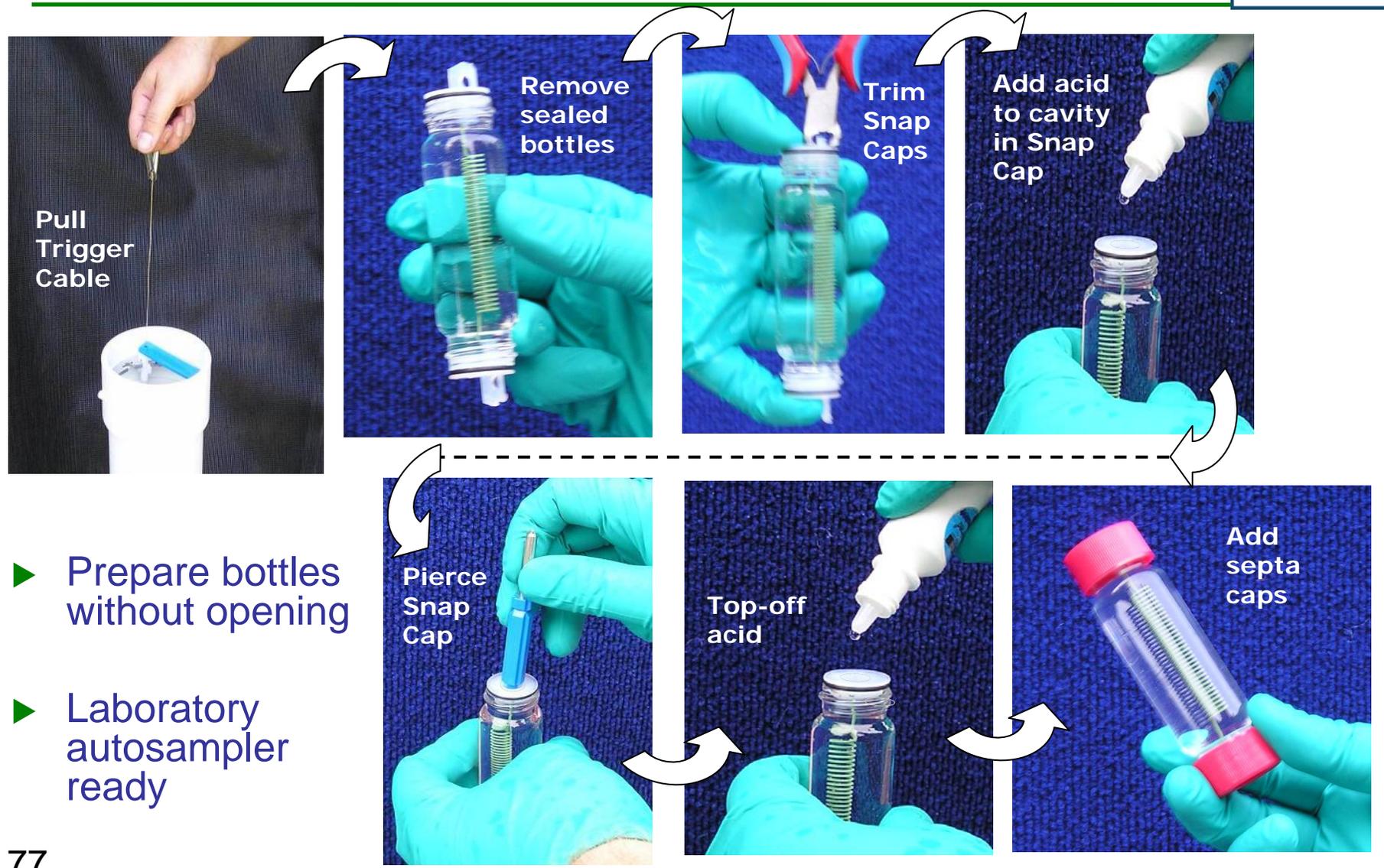


How the Snap Sampler works...cont.



- ▶ Modular samplers allow up to 4 bottles per trigger
- ▶ Multiple triggers can be used for multiple sampling depths

How the Snap Sampler works...cont.



- ▶ Prepare bottles without opening
- ▶ Laboratory autosampler ready

Advantages

- ▶ All critical actions take place submerged in the well
- ▶ Little or no downhole agitation during sampling
- ▶ No well-head sample transfer
 - Lab-ready bottles
 - No exposure to weather
 - No exposure to surface contamination
 - No exposure to off-gassing loss
- ▶ Sampling personnel have little effect on sample result



Advantages, Continued

- ▶ The Snap Sampler is hand-operated
- ▶ Minimal preparatory logistics for ongoing monitoring
 - Replacement bottles only
- ▶ All water retrieved is sample
 - No purge waste
 - No extra sample waste



No Analyte Limitations

- ▶ Snap collects a “whole water” grab sample
- ▶ Analytes not limited by diffusion
 - BTEX, MTBE
 - 1,4-Dioxane, Acetone, MEK
- ▶ SVOC, pesticides, PCBs
- ▶ General chemistry, pH, field parameters
- ▶ Emerging contaminants including perchlorate, pharmaceuticals

Limitations for Snap Sampling

- ▶ Sample volume is constrained by available bottle sizes
 - 40 ml VOA
 - 125 ml plastic
 - 350 ml plastic in development for 4 inch wells

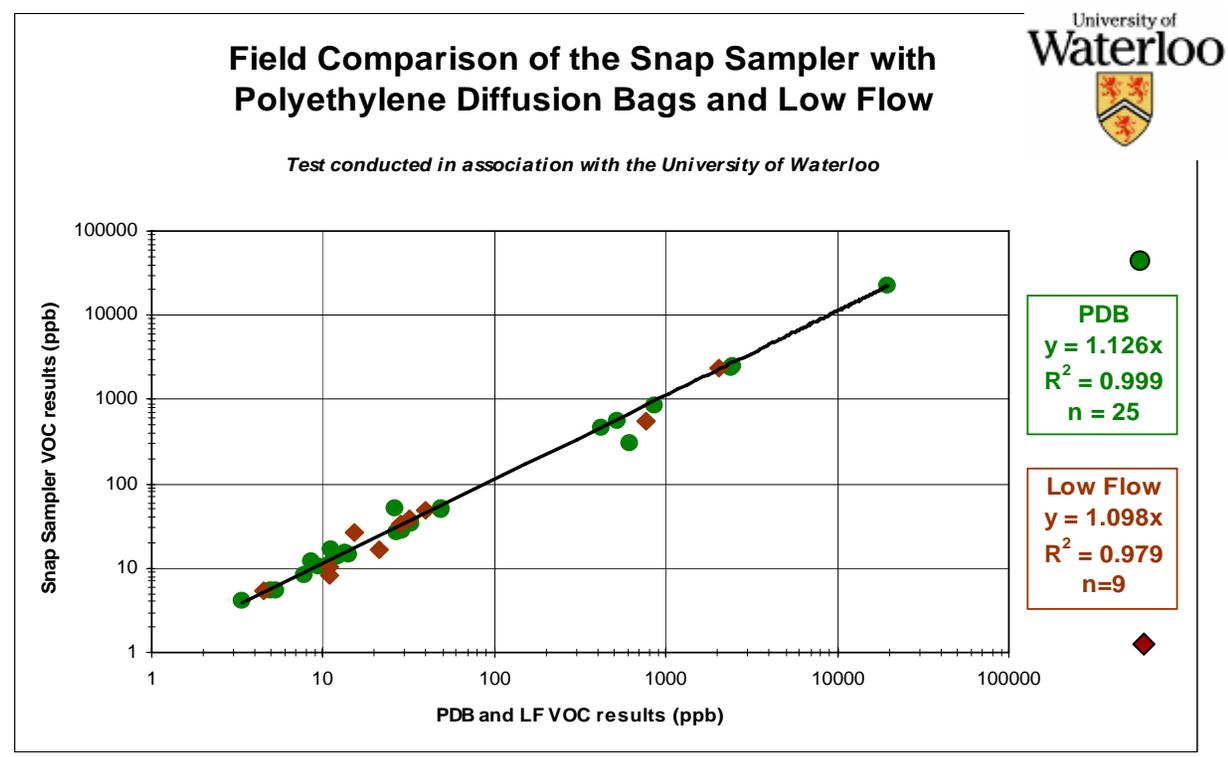
- ▶ Wells with long analyte lists may not be viable candidates

- ▶ Triggers are fixed length

- ▶ Triggers are manufactured for each specific well

Snap Sampling data comparisons

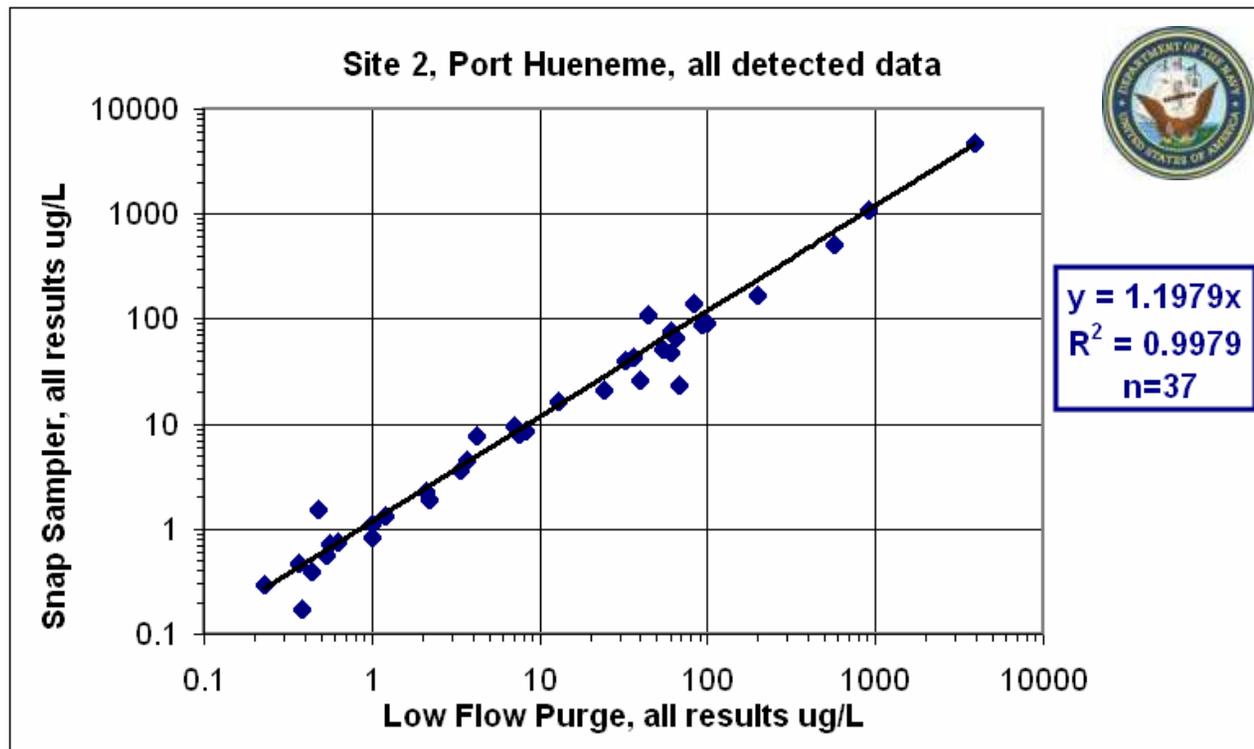
▶ Waterloo CVOC Study



- ▶ Very good correlations
- ▶ Snap slightly higher than low flow and PDB

Data comparisons, continued

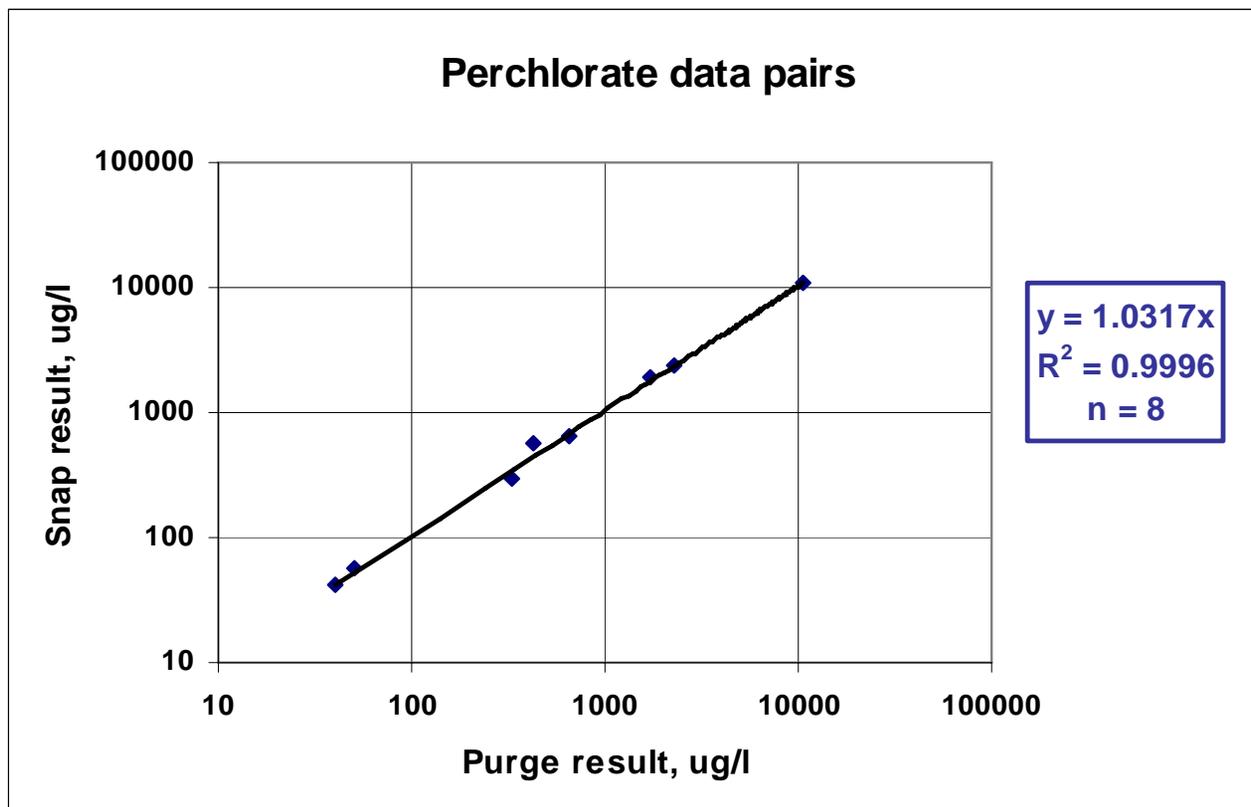
▶ Port Hueneme BTEX/MTBE Study



- ▶ Very good correlation
- ▶ Snap slightly higher than low flow

Data comparisons, continued

▶ Private Site Perchlorate Study



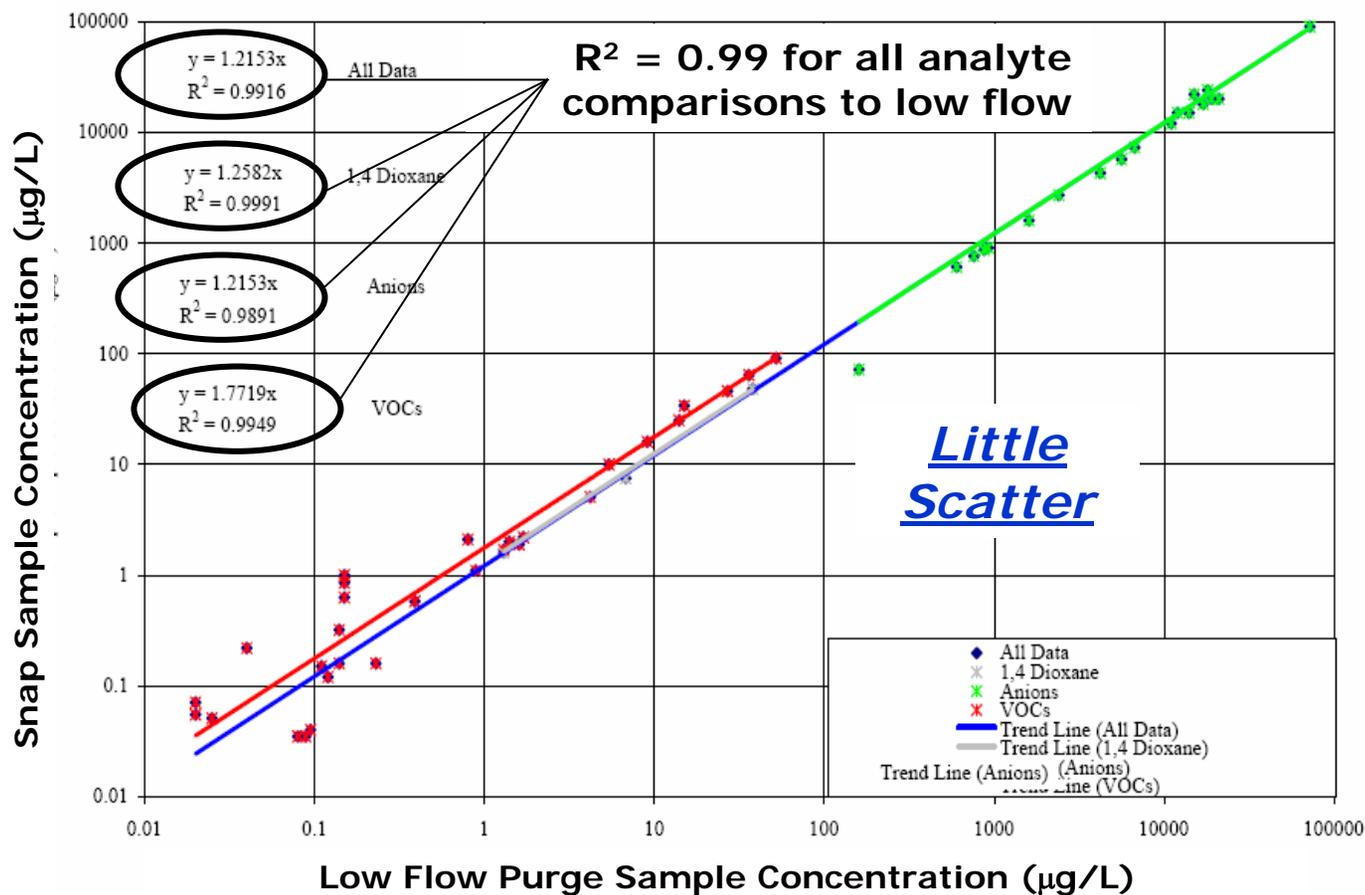
▶ Very good correlation

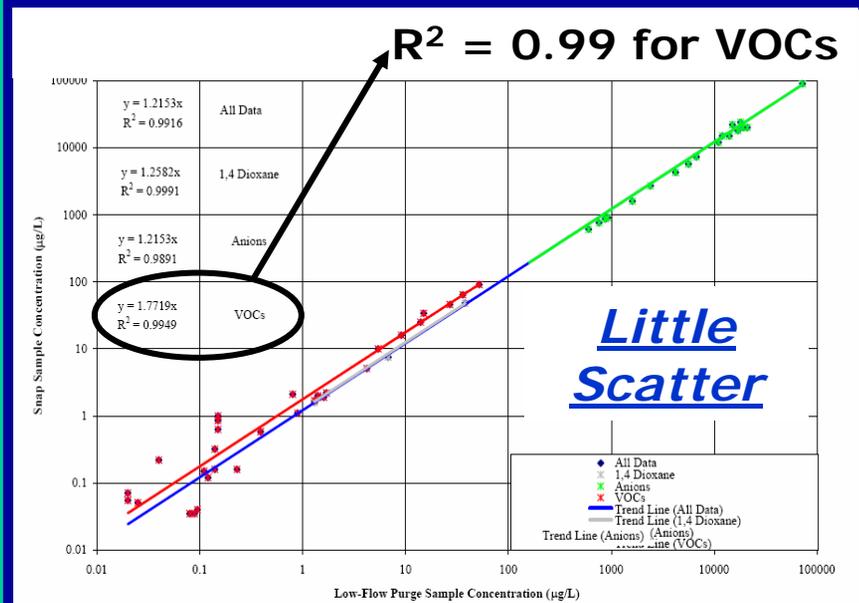
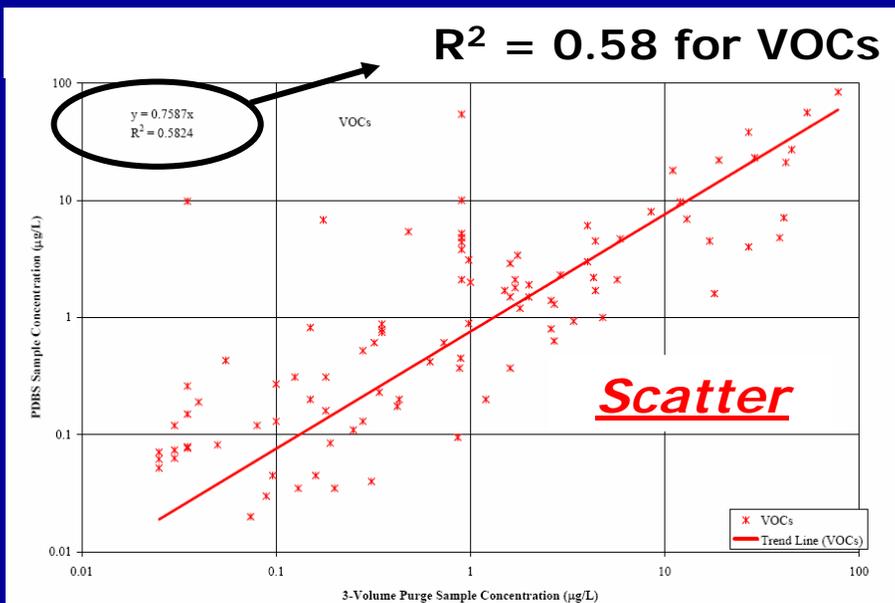
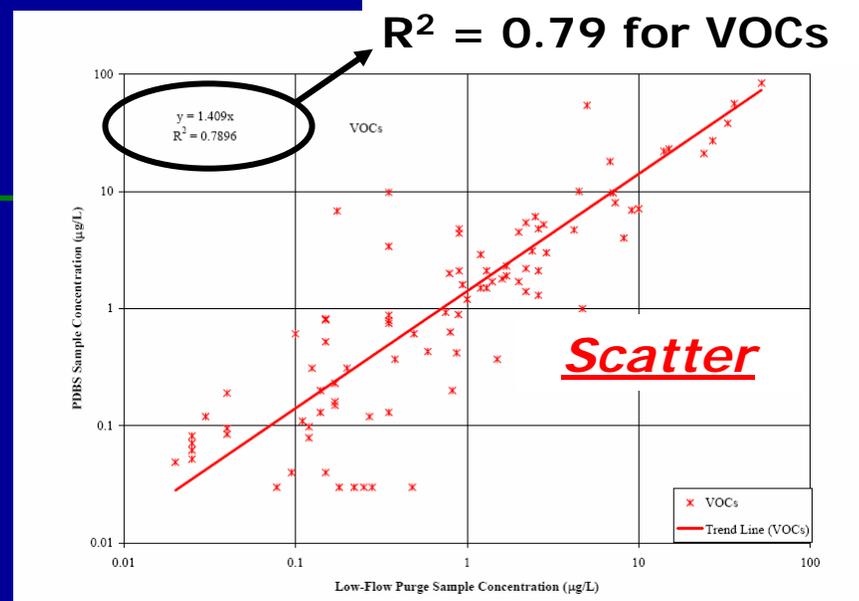
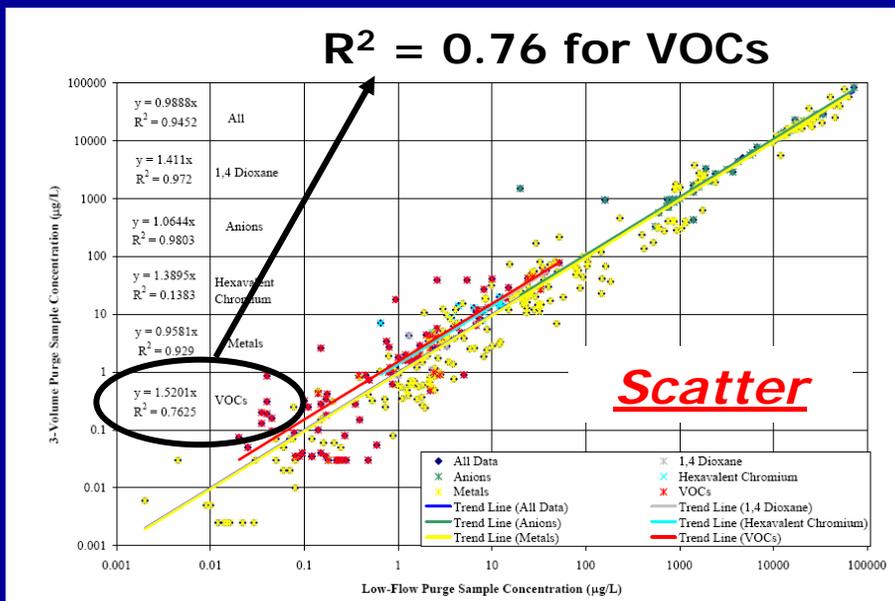
▶ Non-VOC shows concentration parity

Data comparisons, continued

► McClellan Multi-analyte Study

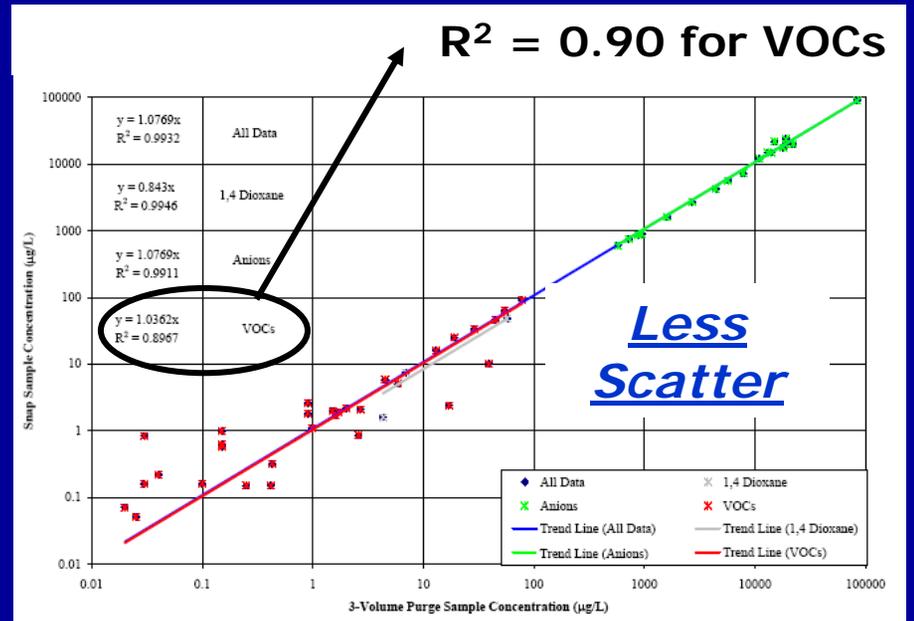
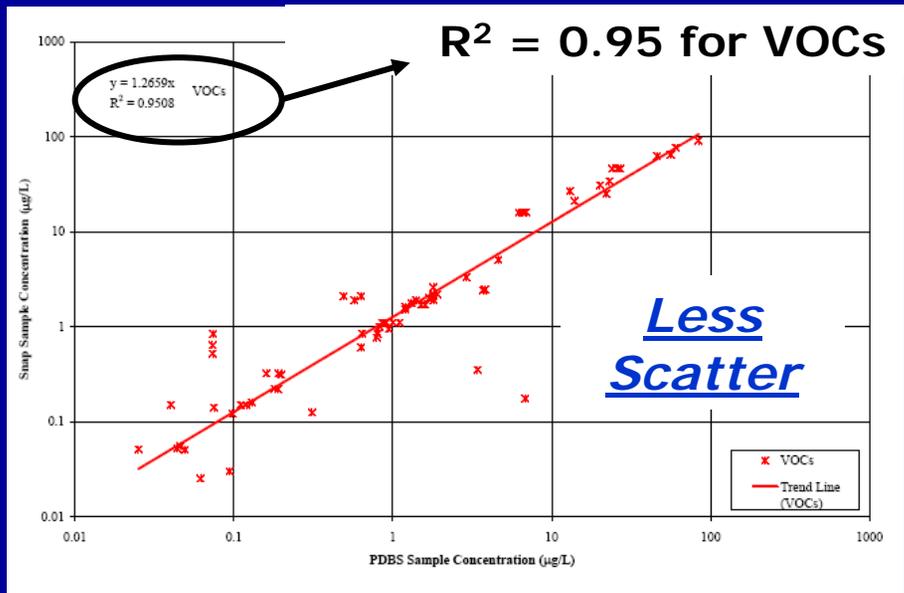
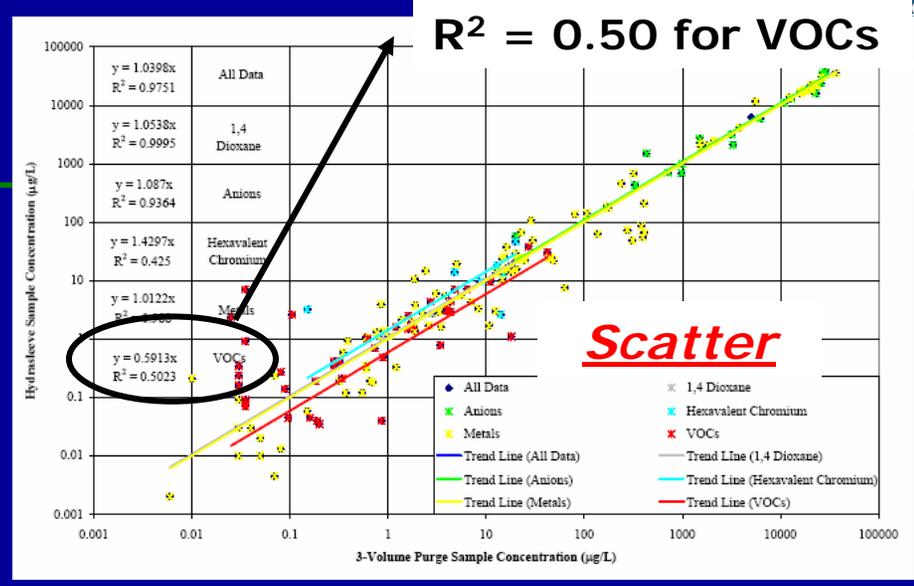
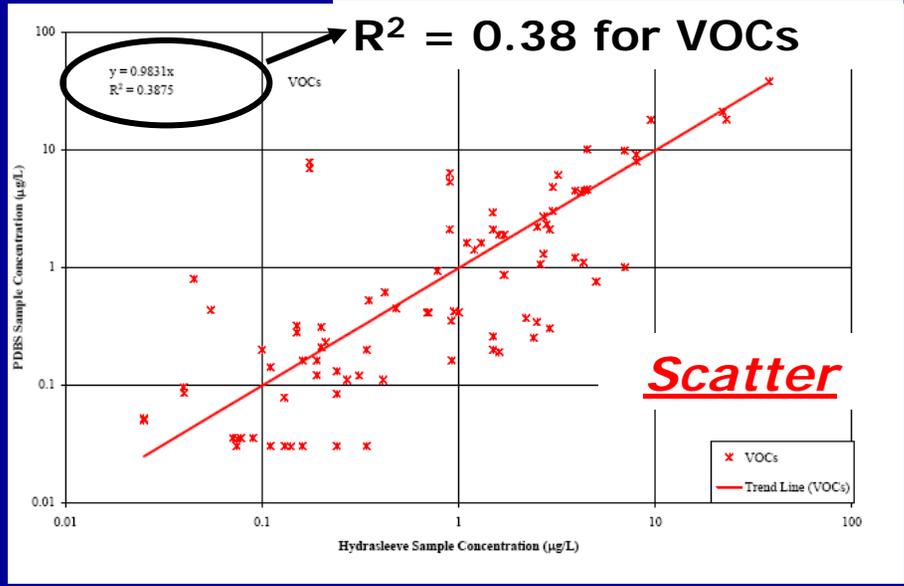
Snap Sampler vs. Low Flow





3 Volume vs. PDB

Low Flow vs. Snap Sampler



Snap Sampler vs. PDB

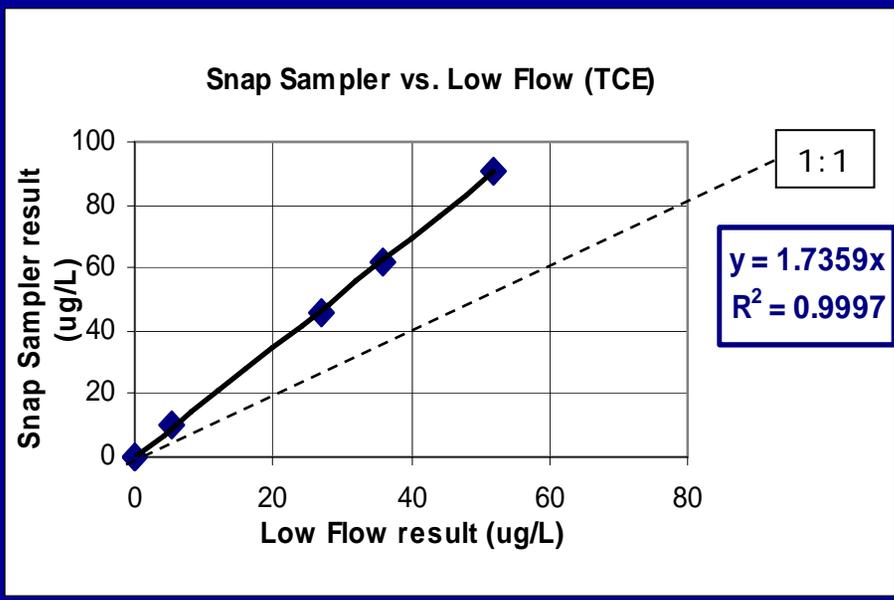
Snap Sampler vs. 3 volume

16 Snap Sampler Data

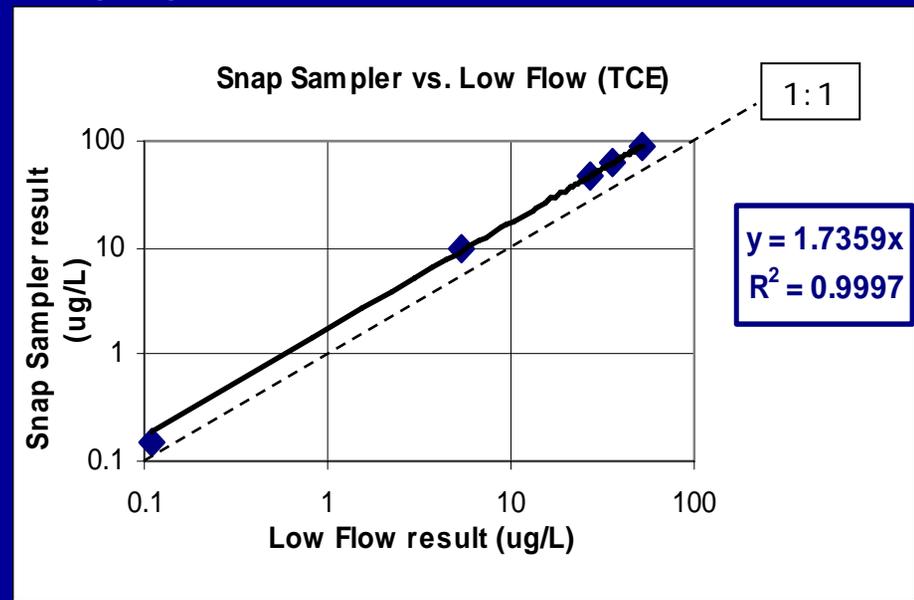
Great Correlations

but what about recovery?

Normal Scale



Log-Log Scale



Data from: "McClellan Study"

Parsons, 2005, Demonstration of No-Purge Groundwater Sampling Devices, **McClellan AFB**, Sacramento, CA

Overall VOC Results Comparison. Snap Sampler vs. Five Methods



Snap vs. RPPS	Snap vs. RCS	Snap vs. PDBS	Snap vs. LF	Snap vs. 3Vol	
n=77	n=78	n=77	n=29	n=28	<< number (1)
+26%	+29%	+22%	+52%	+12%	<< Median RPD (2)
77%	75%	80%	59%	89%	<< <u>Median Recovery Percent</u> (3)
1.35	1.35	1.26	1.74	1.15	<< Trendline Slope (4)
59:18	67:11	68:9	25:4	21:7	<< Snap higher:lower ratio (5)
2579:424	2827:254	2777:226	417:18	302:104	<< sum of ranks ratio (6)
1119	1156	1119	98	116	<< Wilcoxon T critical (7)
99%	99%	99%	99%	95%	<< Statistical Confidence (8)

- 1) Sample size
 - 2) Median of the relative percent differences of the n comparison pairs: $RPD=100*[(A-B)/(A+B)/2]$, where Method A is always the Snap Sampler
 - 3) Median Recovery Percent relative to the Snap Sampler. $Rec.\%= Method\ B/Snap$
 - 4) XY scatter plot slope. 1.0 slope indicates 1:1 correspondence, >1 indicates Snap Sampler trends higher
 - 5) Instances where Snap Sampler was higher vs. instances where Snap Sampler was lower
 - 6) Wilcoxon nonparametric matched pairs signed ranks test, sum of ranks of Snap Sampler vs. comparator
 - 7) Wilcoxon T critical is the highest number the smaller of the comparators can be in order to yield the percent confidence in (8)
 - 8) Percent confidence in the difference between variables.
- Yellow highlight indicates measures of difference; blue highlight indicates measures of data strength

Data from: "McClellan Study"
Parsons, 2005, Demonstration of No-Purge Groundwater Sampling Devices, McClellan AFB, Sacramento, CA.

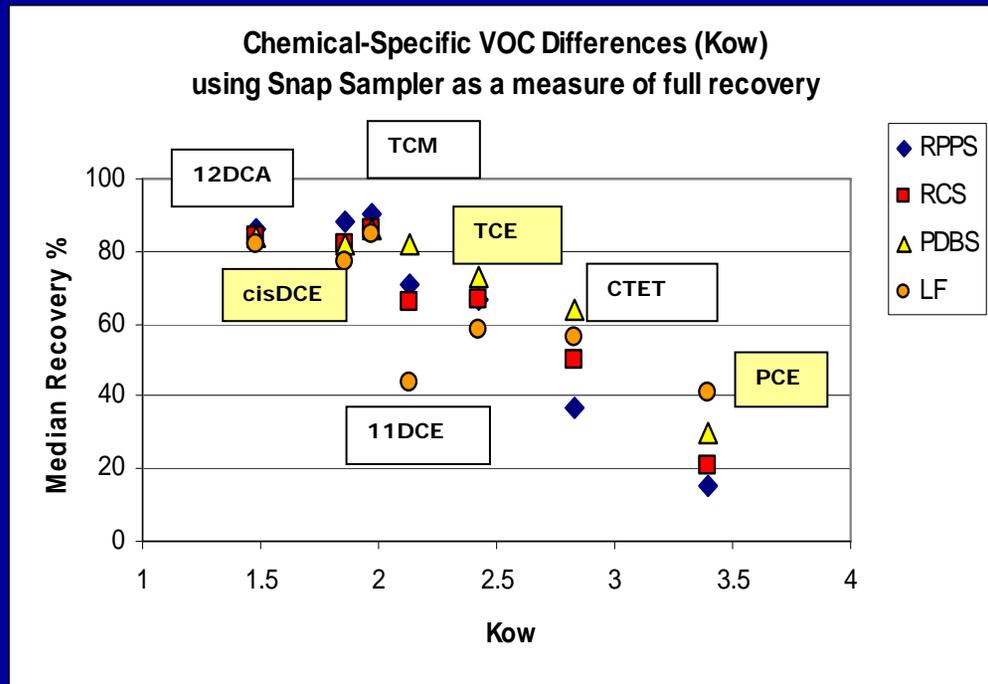
18 Carbon Tetrachloride

SNAP vs RPPS	SNAP vs. RCS	SNAP vs. PDBS	SNAP vs. LF	SNAP vs. 3Vol	
n=8	n=8	n=8	n=3	n=3	<< number (1)
+92%	+68%	+46%	+56%	+21%	<< Median RPD (2)
37%	50%	64%	56%	81%	<< Median Recovery Percent (3)
2.01	1.34	1.11	1.74	1.47	<< Trendline Slope (4)
8:0	8:0	6:2	3:0	3:0	<< Snap higher:lower ratio (5)
36:0	36:0	31:5	6:0	6:0	<< sum of ranks ratio (6)
0	0	6	N/A	N/A	<< Wilcoxon T critical (7)
99%	99%	90%	SND	SND	<< Statistical Confidence (8)

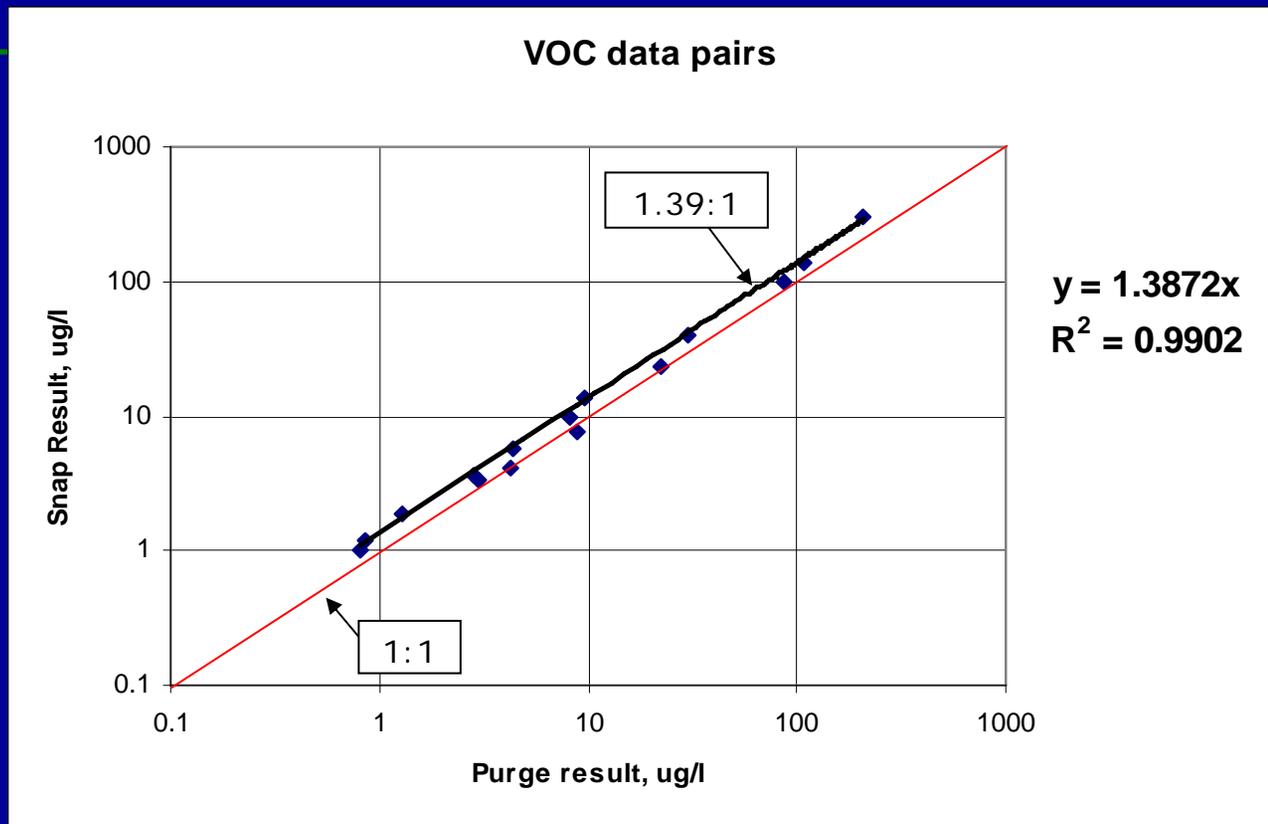
SND = significance not determined (too few data points or significance below 90%)

Recovery different for different chemicals

Tied to Henry's Const. (H)
 Octanol-Water pert. Coef. (Kow)



19 Snap Sampler Data

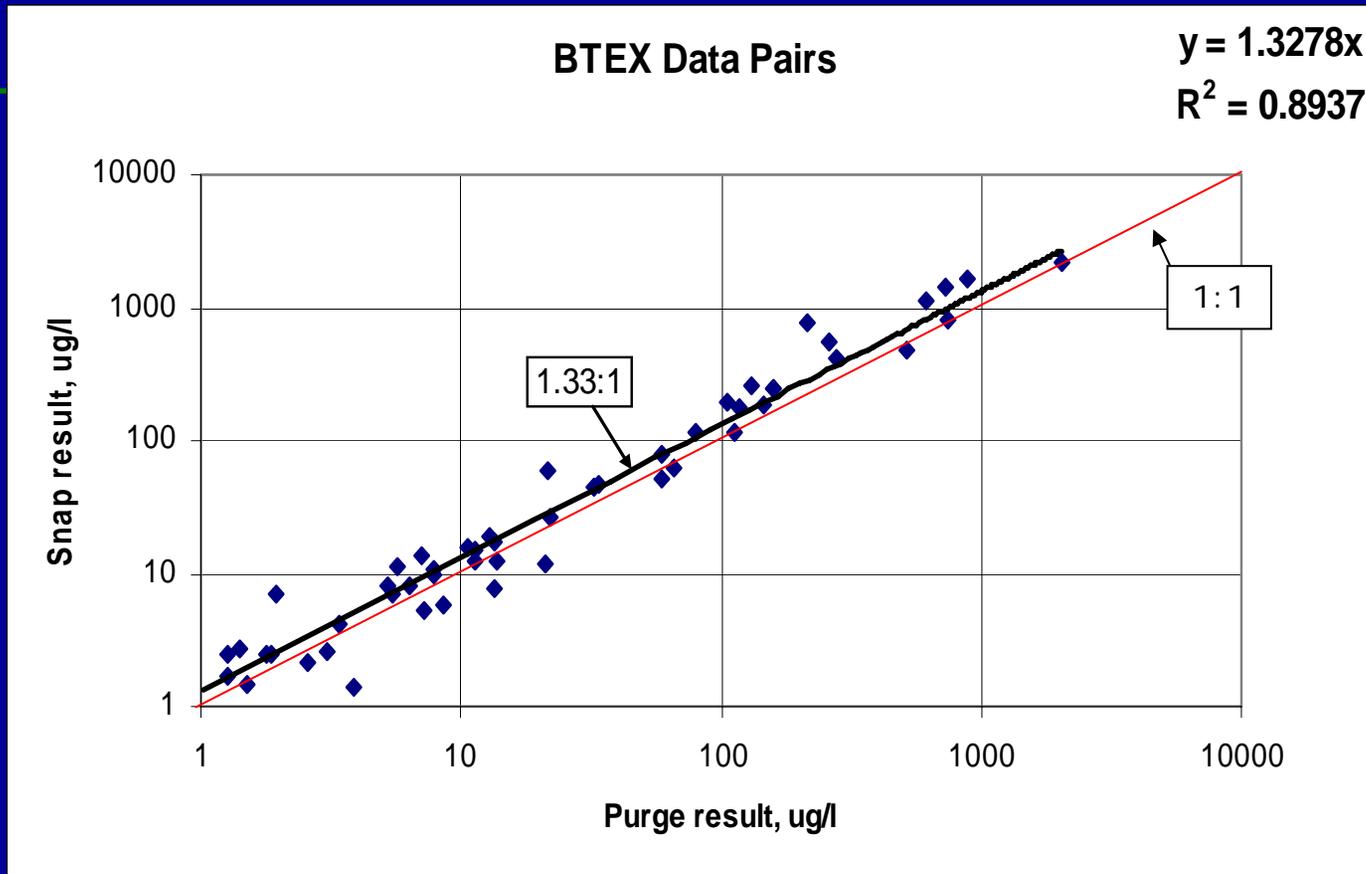


Plus 11 extra low-level detects that were "ND" in the traditional sample

Data from: Private industrial site

Confidential Client

Snap Sampler Data



Volume purge a little noisier

Data from: Private fueling station site

Confidential Client

Summary

- ▶ Snap samples sealed downhole in lab-ready bottles
- ▶ Repeatable sampling method
- ▶ No VOC losses
- ▶ Volume limited--but not specific analytes
- ▶ Strong correlations with traditional sampling methods

