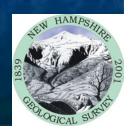
Town Of Hollis Water Quality Study --Preliminary Results--

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March 27, 2006





Today's Presentation

- Project Background
- Geology
- Data, Variability, and Statistics
- Results
- Questions

Study Backgroud

- Cooperative project between Hollis town residents and NH Geological Survey
- Samples collected in June, 2005
- Samples analyzed by NHDES state lab
- Data analyzed by NHGS

Concept

- Geology affects water quality
- Need robust suite of analytes to look at associations with water quality, natural contaminants, etc
- Create baseline data for monitoring ground water in Hollis

"Types" of Water Chem Studies

- Level 1
 - (+) Collect sample from faucet, send to lab
 - (-) Little Quality control, preservation
- Level 2 (Hollis)
 - (+) Collect sample to specified protocol, pre-filter, preserve (ice, acid)
 - (+) Analyze major suite of cations, contaminants
 - (-) Unstable parameters checked at lab, only "total" constituents evaluated
- Level 3
 - (+) Collect sample, pre-filter, preserve (ice, acid)
 - (+) Measure parameters (pH, Temp, etc) in the field by qualified technician
 - (+) Field filtered to determine "total" and "dissolved" constituents
 - (+) Allows for more robust analysis and chemical modeling

Bedrock Geology - Hollis, NH

De9: Exeter Diorite (Early Devonian)

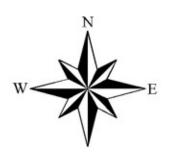
P1m: Gray biotite granite

SOb: Berwick Formation

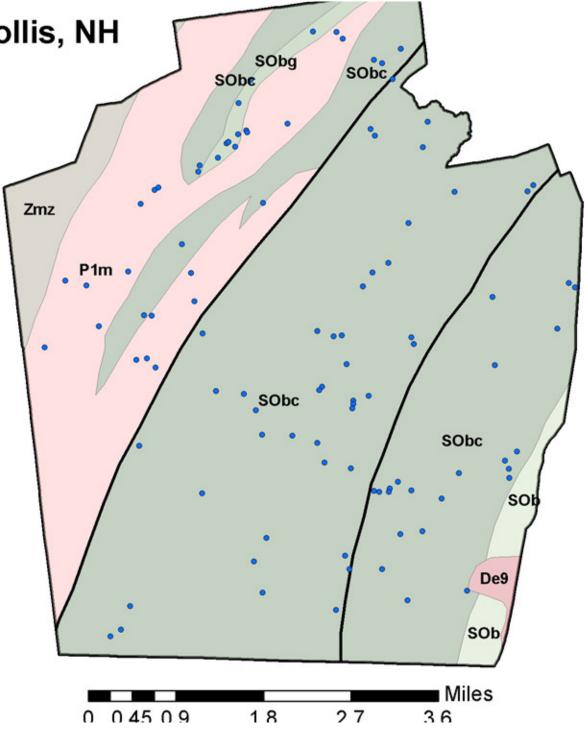
SObc: Berwick Formation (Unnanmed Mamber)

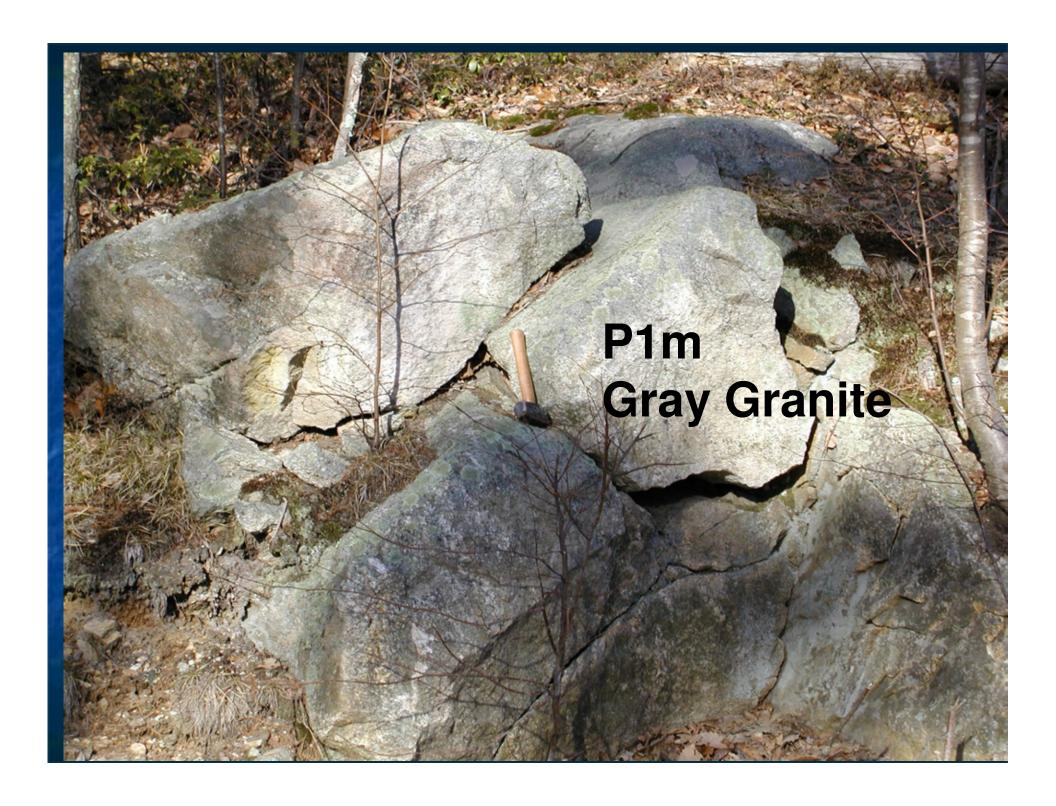
SObg: Berwick Formation (Gove Member)

Zmz: Massabesic Gneiss Complex4 (Late Proterozoic)





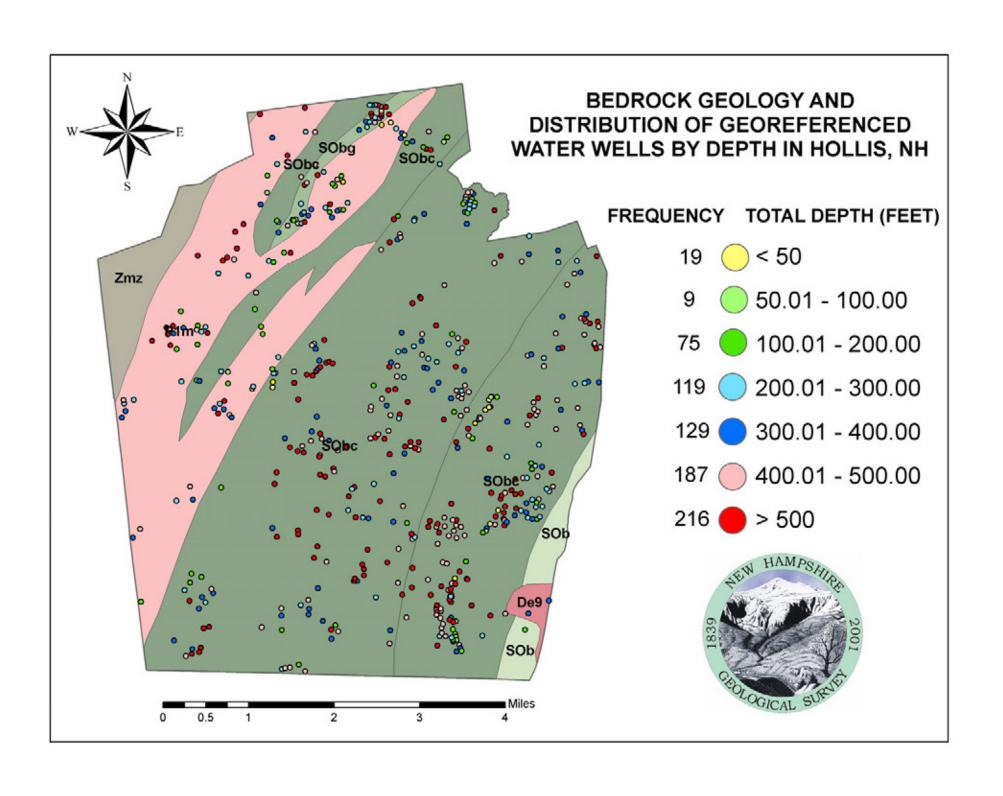




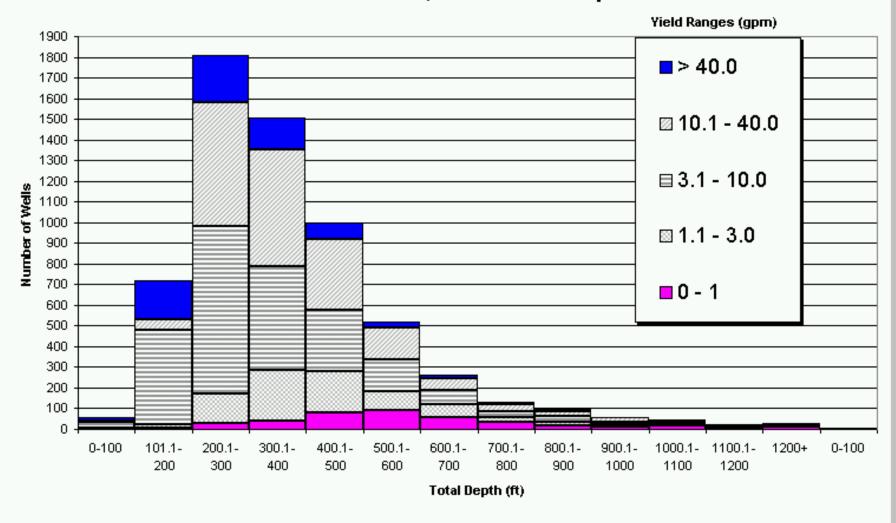




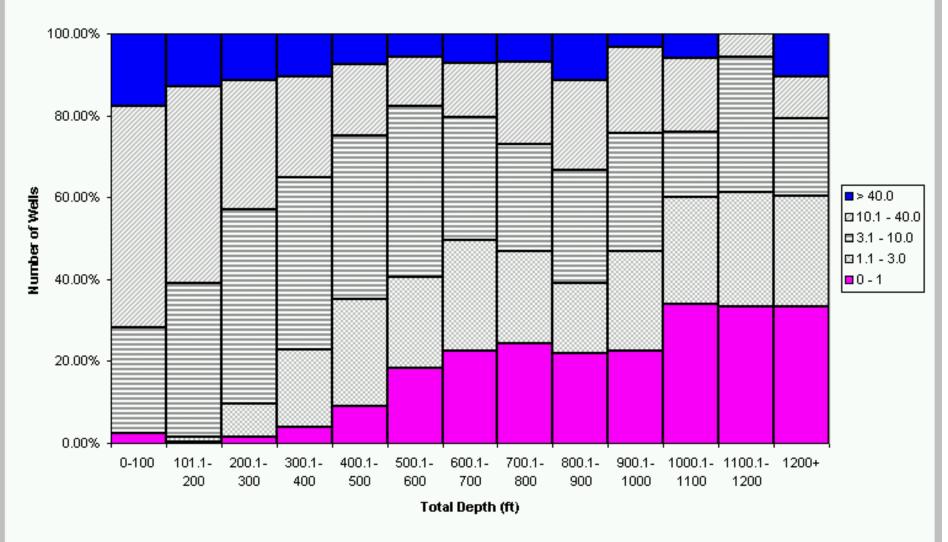


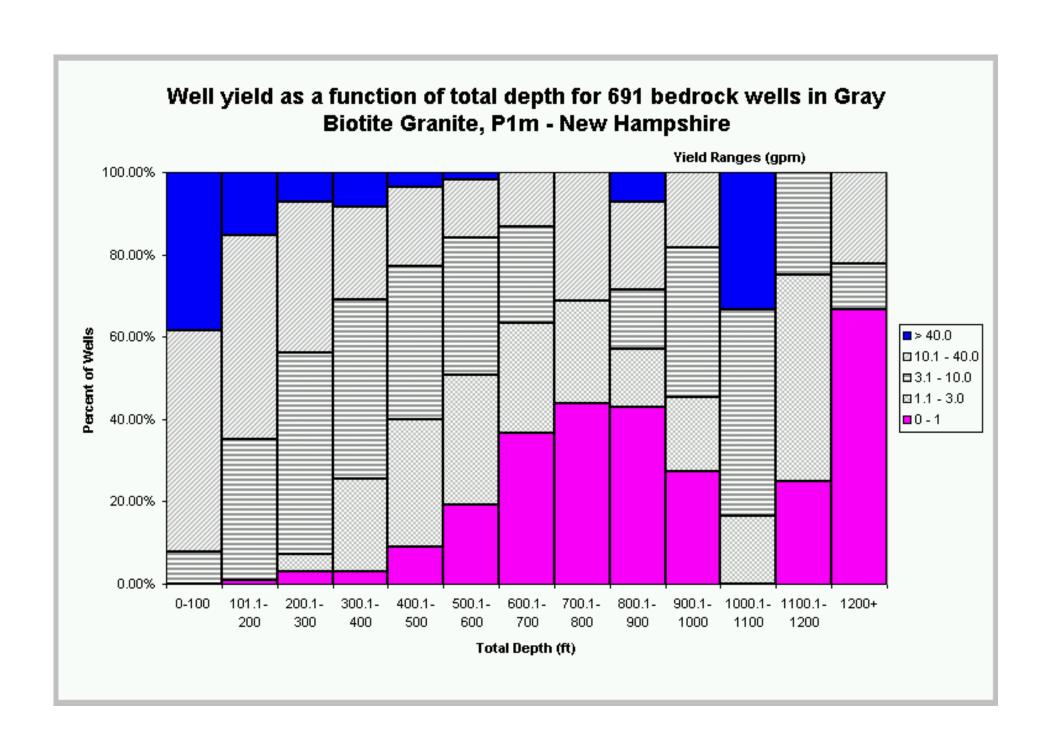


Well yield as a function of total depth for 6257 bedrock wells in the Berwick Formation, Sob - New Hampshire









State of New Hampshire
Department of Environmental Services
29 Hazen Drive POB 95
Concord NH 03302-0095
(603)271-3445 FAX (603)271-2997
Business Hours: 8 am - 4 pm, Monday - Friday

WATER TEST SUBMITTAL FORM

(please fill out completely)

The lab cannot accept bacteria samples after 12:00 on Fridays or the day before a holiday

The following is information about where the sample(s) was collected:

Owners Name (of well)		
Street Address (well location)		
City/Town		
State & Zip Code		
Phone Number		
Circle appropriate information about your sample for each of	the following:	
	SPRING OTHER	OTHER
Has this well been disinfected recently? NO If there is a water treatment/filtration system on line, what are	YES DATE	
	DECORE LETTE	
If there is water treatment/filtration on line, was sample taken Comments about the sample		treatment?
onwhents about the sample		
he following is the mailing address where you would like u		
The following is the mailing address where you would like u		
	is to send the laboratory report:	
The following is the mailing address where you would like u	is to send the laboratory report:	
	is to send the laboratory report:	
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LEASE CHECK TEST CHOICE	is to send the laboratory report:	
LEASE CHECK TEST CHOICE Standard Analysis	* These tests are includ	\$10 \$20
LEASE CHECK TEST CHOICE	* These tests are includ Drinking Water Bacteria Basic Analysis* Swimming Water Bacteri	\$10 \$20 a\$10
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LEASE CHECK TEST CHOICE Standard Analysis	* These tests are includ Drinking Water Bacteria Basic Analysis* Swimming Water Bacteri	
LEASE CHECK TEST CHOICE Standard Analysis	* These tests are includ Drinking Water Bacteria* Basic Analysis*. Swimming Water Bacteria E coli in Surface Water. Fluoride*	\$10 \$20 a \$10 \$10 \$10 \$51



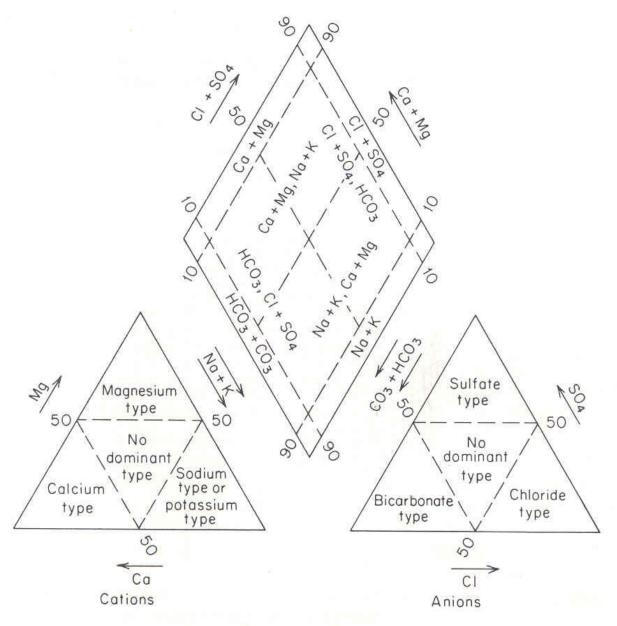


Figure 7.9 Classification diagram for anion and cation facies in terms of major-ion percentages. Water types are designated according to the domain in which they occur on the diagram segments (after Morgan and Winner, 1962; and Back, 1966).

(Freeze and Cherry, 1979)

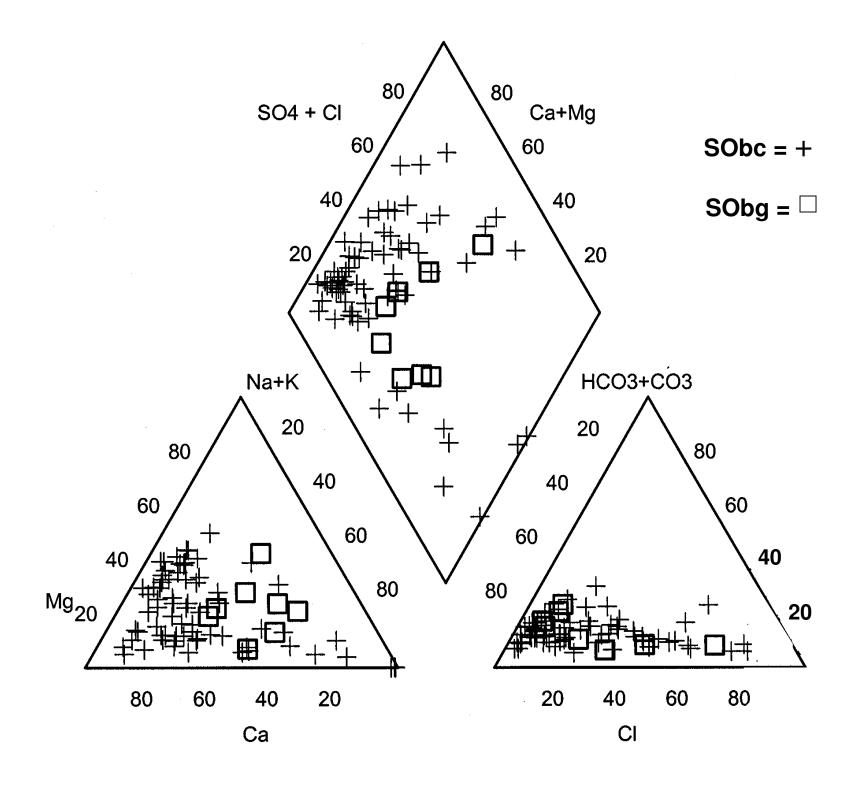
Top is "Home"

1st base = Ca-HCO3

2nd base = Na-HCO3

3rd base = Na-Cl

Home = Ca-Mg-SO4



Differences in Alkalinity and Hardness

- Average HCO3 (SObc) = 137 mg/L
- Average Hardness (SObc) = 133 mg/L
- Average HCO3 (SObg) = 53 mg/L
- Average Hardness (SObg) = 44 mg/L
- Hardness: > 150 mg/L very hard
 100 150 hard
 60 80 med hard
 60 soft
- The NH Bedrock map (Lyons and others, 1997) indicates that the SObc has up to 15% calc-silicate minerals compared to only 5% in the SObg

Chloride - Hollis, NH

LEGEND

DATA POINTS

CHLORIDE VALUES

0 - 50

50.1 - 100

100.1 - 150

150.1 - 200

200.1 - 250

250.1 - 300

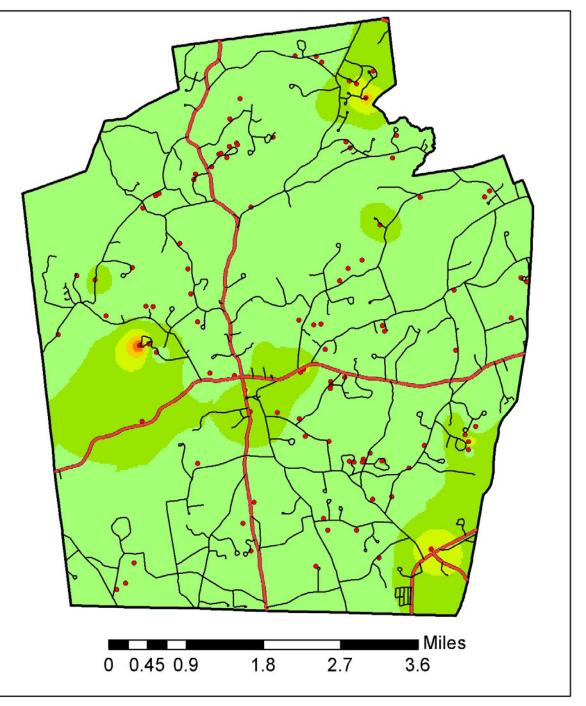
ROAD DATA

— Road

State Route

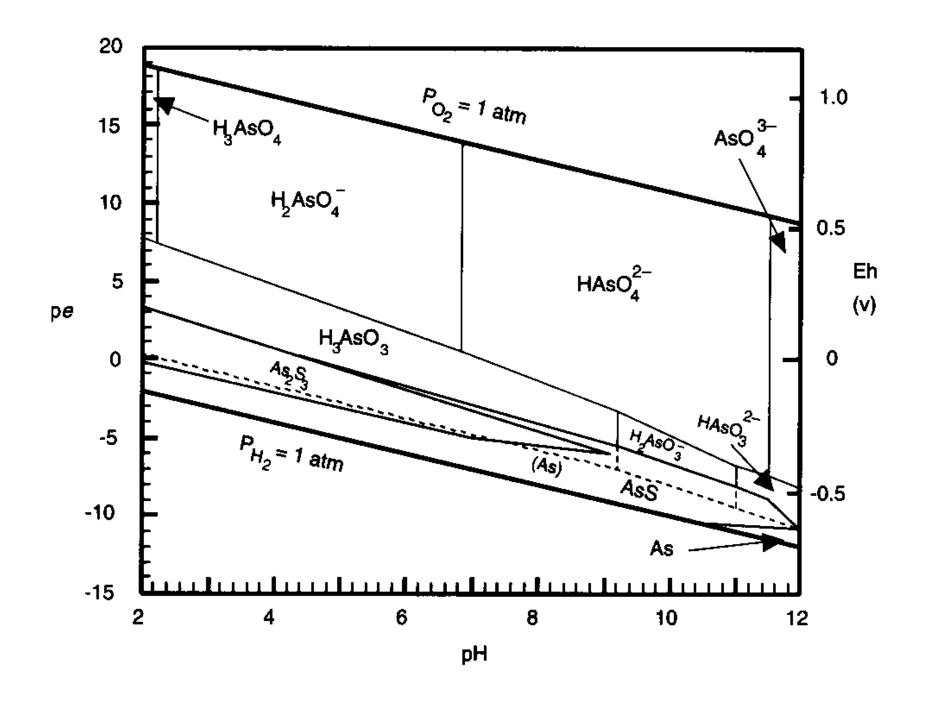






Arsenic

■ New EPA MCL = .010 mg/L or 10 ug/L

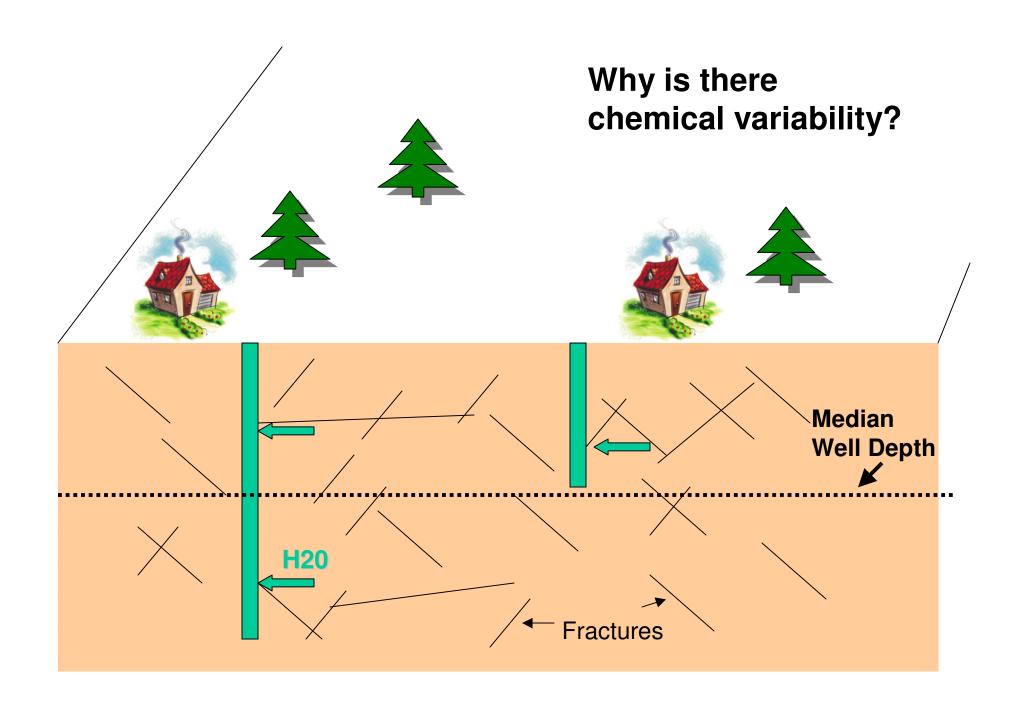


Formation P1m (Granite)

- Median depth = 300 ft
- Not difference observed in arsenic concentration in wells from < median depth (0.0010 mg/L As) or > than median (0.0013 mg/L)
- No wells in the P1m have arsenic above the 10 ug/L EPA MCL

Formation S0b (all Schists)

- ◆ Median well depth = 500 ft
- ◆ Mean As < 500ft = 0.009 mg/L</p>
- Mean As > 500ft = 0.016 mg/L (but not statistically significant)
- Wells with depths > 500 more likely to have pH > 8.0 (47% of samples) compared to samples from less than < 500 ft (17%)
- ◆ 23% of wells in the S0b have arsenic above the 10 microgram per liter EPA MCL



Comparison of As in S0b and P1m

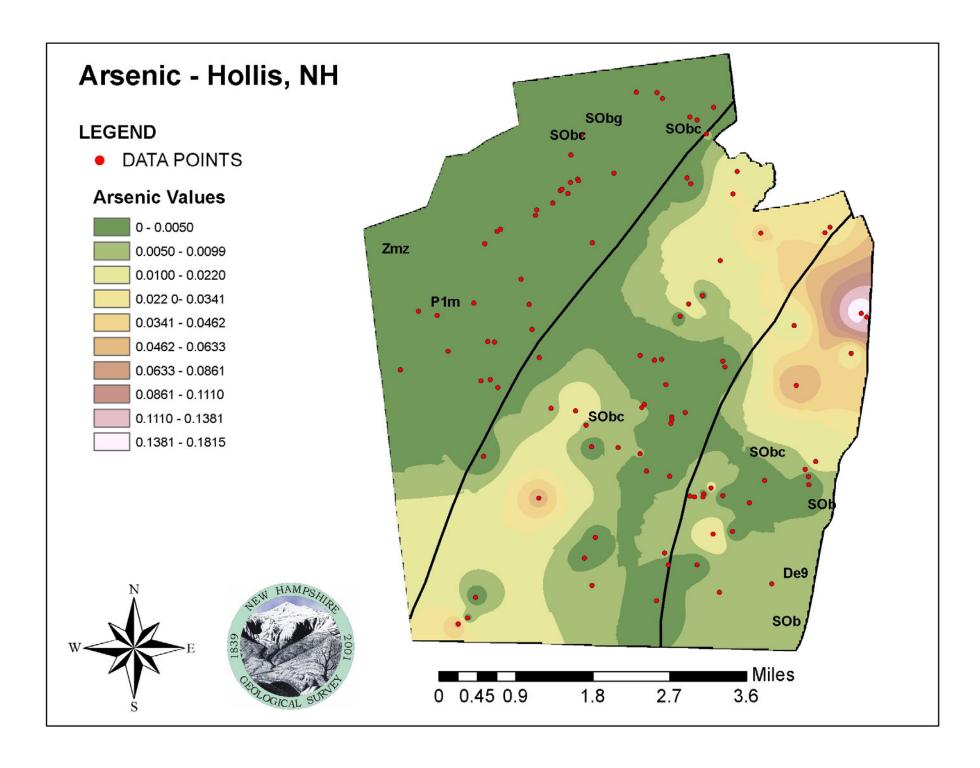
- Mean As (S0b) = 0.0121 mg/L
- \bullet Mean As (P1m) = 0.0012 mg/L

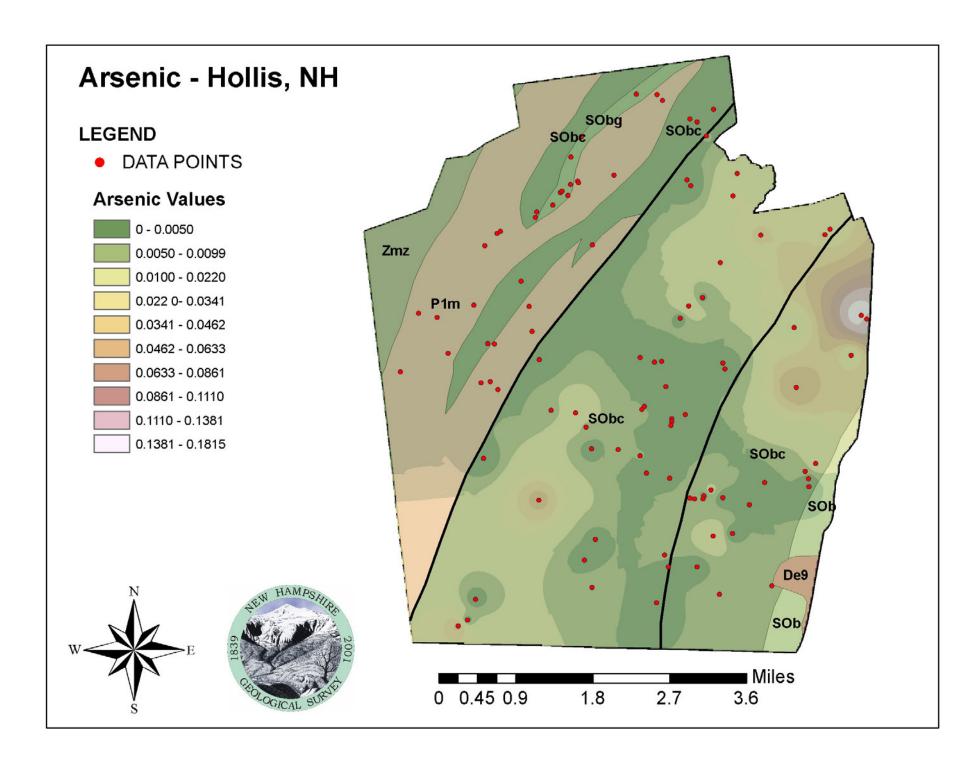
T-test

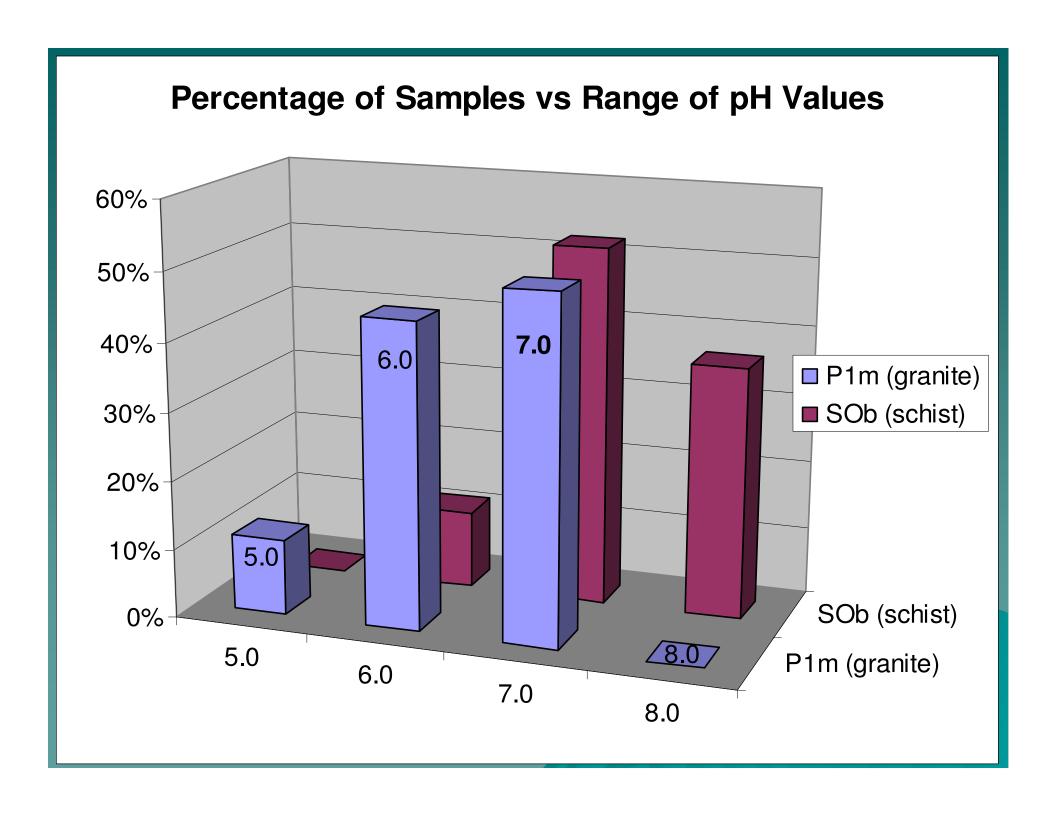
Ho: Mean(S0b) = Mean (P1m) (log transformation)

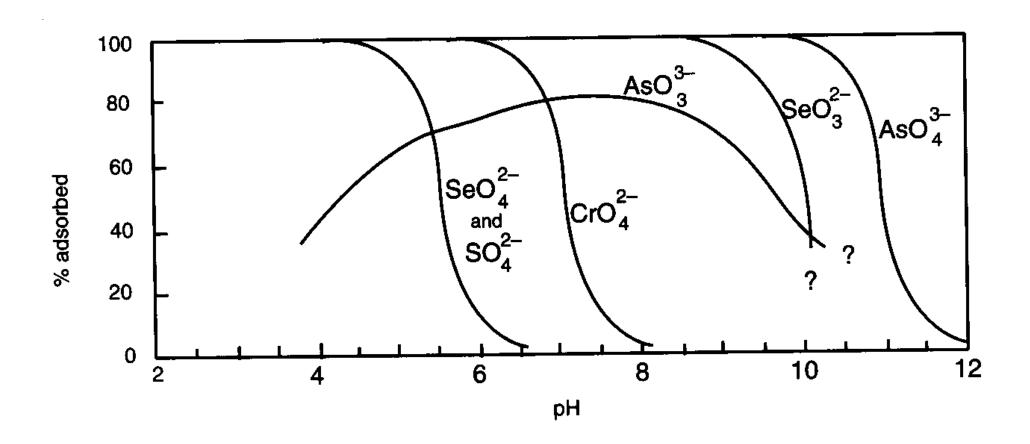
Ho: Rejected , p = 0.0001247 (99.9 % confidence)

Thus, the concentration of As in wells in the SOb are statistically different from the wells in the P1m. Wells in Sob have average concentration of As that is 10 times higher than P1m.









(from Freeze and Cherry, 1979)

Surficial Wells

 Only 4 (shallow) wells are in the surficial aquifer in this study, but all had arsenic less than 0.002 mg/L

Uranium (Ur)

◆ SOb

- 11 of 71 samples with Ur > detection, or 15%
- Average concentration = 0.89 ug/L

◆P1m

- -3 of 18 samples with Ur > detection, or 17%
- Average Concentration = 65.5 ug/L
- Roughly 70 times higher than SOb

NUMBER	TOWN	ANALYTE	RESULT	RESULT	ROCK TYPE
A91576-1	HOLLIS	RADON	1800	< 100	P1m
A91575-1	HOLLIS	RADON	2300	< 100	P1m
A92087-1	HOLLIS	RADON	27000	< 100	P1m
A92088-1	HOLLIS	RADON	1800	< 100	P1m
A92309-1	HOLLIS	RADON	23000		P1m
A91933-1	HOLLIS	RADON	26000		P1m
		Mean	13650		
A91574-1	HOLLIS	RADON	1600	< 100	Sobc
A92310-1	HOLLIS	RADON	2800		Sobc
A91573-1	HOLLIS	RADON	1600	< 100	Sobc
A91577-1	HOLLIS	RADON	3300	< 100	SObc
A91719-1	HOLLIS	RADON	900	< 100	SObc
A91725-1	HOLLIS	RADON	2300	< 100	SObc
A91731-1	HOLLIS	RADON	1200	< 100	SObc
A91740-1	HOLLIS	RADON	1200	< 100	SObc
A91921-1	HOLLIS	RADON	1700		SObc
A91932-1	HOLLIS	RADON	4900		SObc
A91936-1	HOLLIS	RADON	1300		SObc
A92079-1	HOLLIS	RADON	2400	< 100	SObc
A92081-1	HOLLIS	RADON	990	< 100	SObc
A92311-1	HOLLIS	RADON	3300		SObc
A92353-1	HOLLIS	RADON	1700	< 100	SObc
A92082-1	HOLLIS	RADON	2400	< 100	Sobg
		Mean	2099		

Average Radon
Concentration is
10x Higher in
P1m rocks
than SOb

Fluoride

- Only 4 wells in all of Hollis had high fluoride (> 1.0 mg/L)
- ◆ All had high pH (> 8.0)
- All are in the SOb rocks

Conclusions

- Areas underlain by SOb rocks tend to have hard water, higher pH, higher arsenic (10x) arsenic concentrations than areas over P1m (granite) rocks
- Within SObc rocks, deeper wells tend to have higher pH
- P1m areas have higher uranium (70x) and higher radon (10x)

Conclusions-cont'd

- SObc rocks yield water that is nearly 3x harder than SObg rocks
- Variation in overall water chemistry exist within subgroups of rock formations (Soc, SOg, etc)
- Highest chloride seen in bedrock wells near major intersections (road salt?)
- Overall, Hollis' water quality is good

Recommendations

- Resample in a few years to monitor changes?
- Enlist more well owners to fill in gaps
- More accurate geological mapping may delineate hot spots better
- Watch potential problem areas (chloride)

Special Thanks:

- Bill Beauregard volunteer extraordinaire
- Hollis Boy Scouts
- NHDES Laboratory Section
- NHGS staff
- And Hollis Residents—you made this happen!