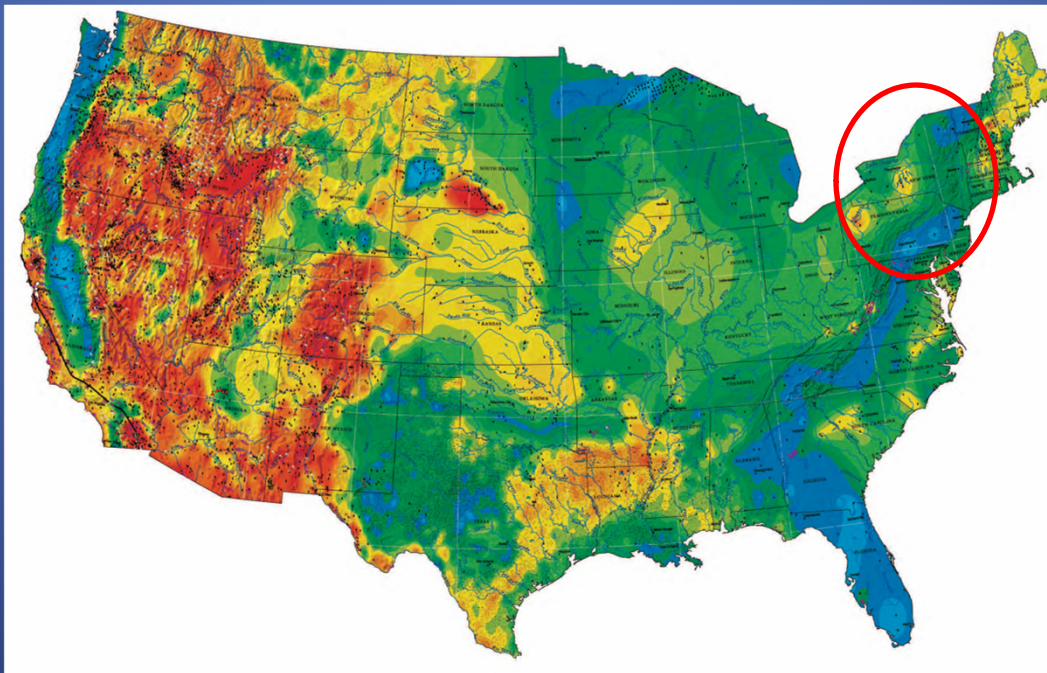


# New York Geothermal Overview

November 9, 2010

John P. Martin, Ph.D.

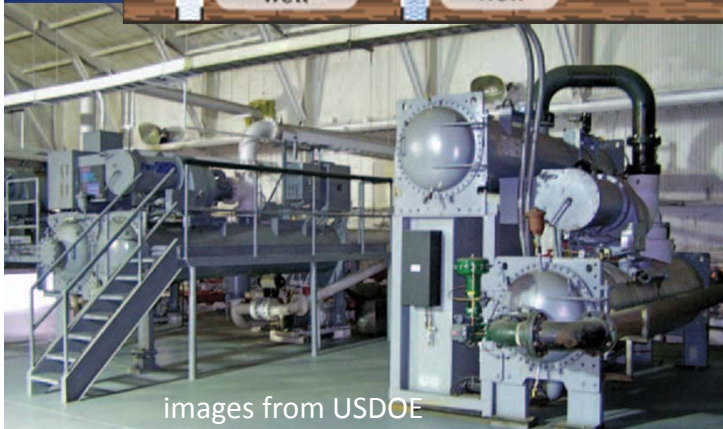
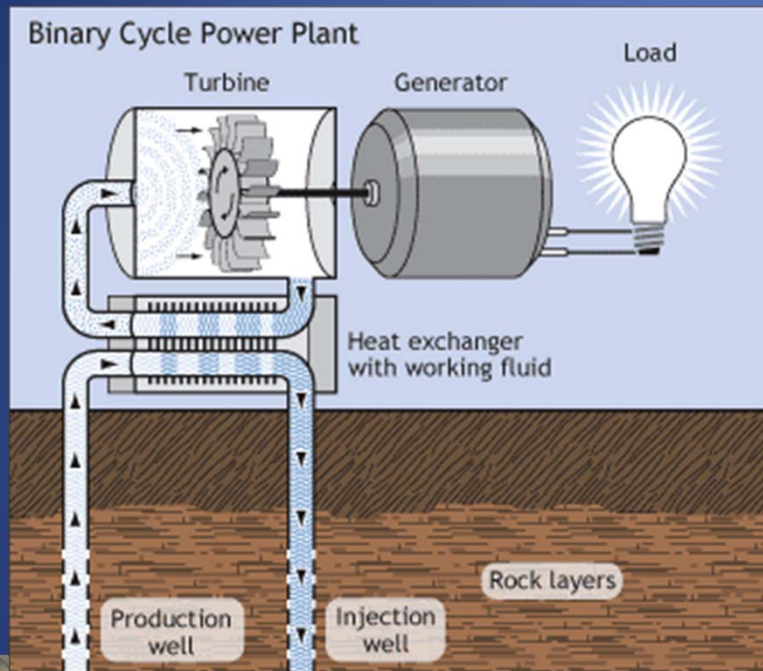
New York State Energy Research and  
Development Authority



# Geothermal Systems:

## What's possible in NY?

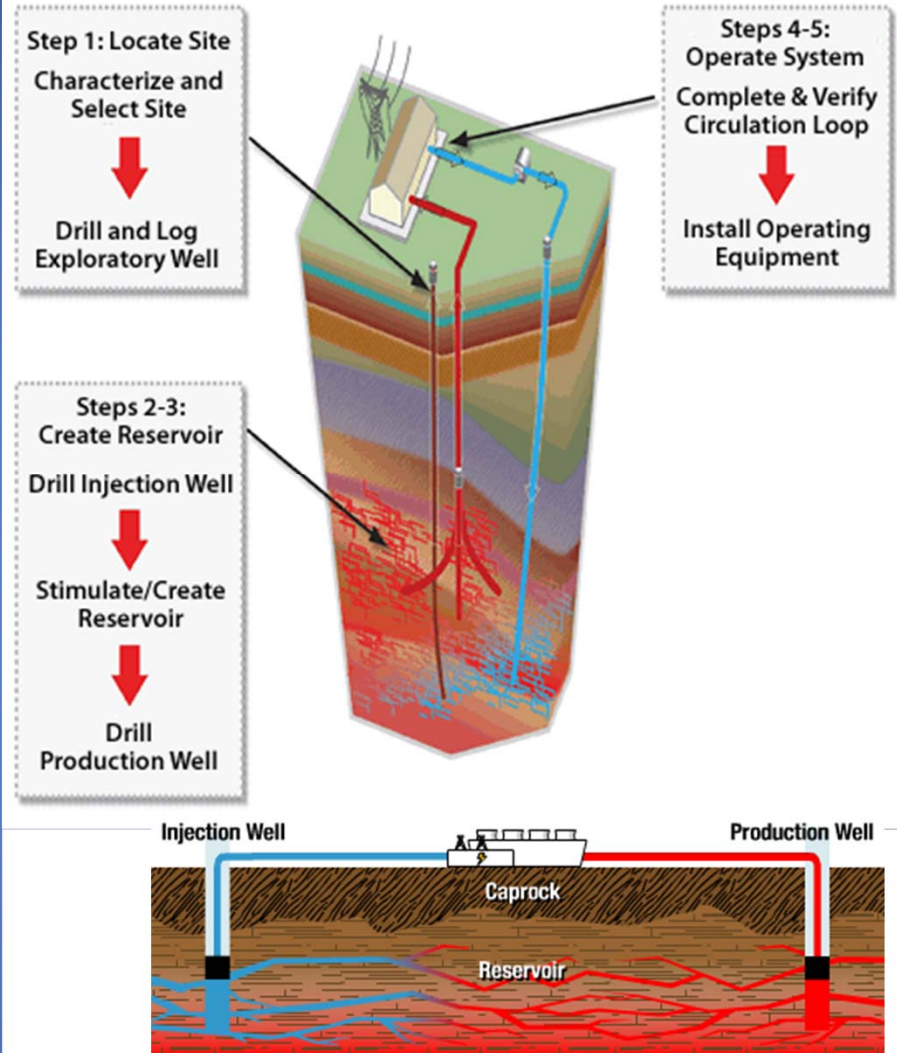
### Hydrothermal Systems



images from USDOE

Chena Hot Springs Resort, in Alaska, uses a low temperature geothermal resource for power production

#### EGS Development Sequence



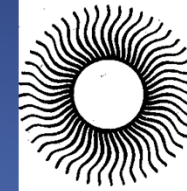
## Enhanced Geothermal Systems

# NY's Large-Scale Geothermal Potential

- Electricity Generation
  - Organic Rankine Cycle or similar technology needed for such a low temperature resource
  - Expensive
- Cogeneration
  - Heating in winter and electricity generation in summer
  - Need to amortize generation equipment
- Direct Use
  - No conversion losses
  - Heating a major need in New York State
  - Offsets natural gas and fuel oil usage
  - This was the concept for the Auburn Low-Temperature Geothermal Well project (hydrothermal system)

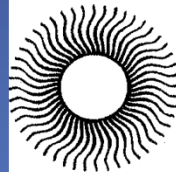


# NYSERDA's Geothermal Research



**Geothermal Resource Evaluation:  
Eastern New York State**

NYSERDA 79-6

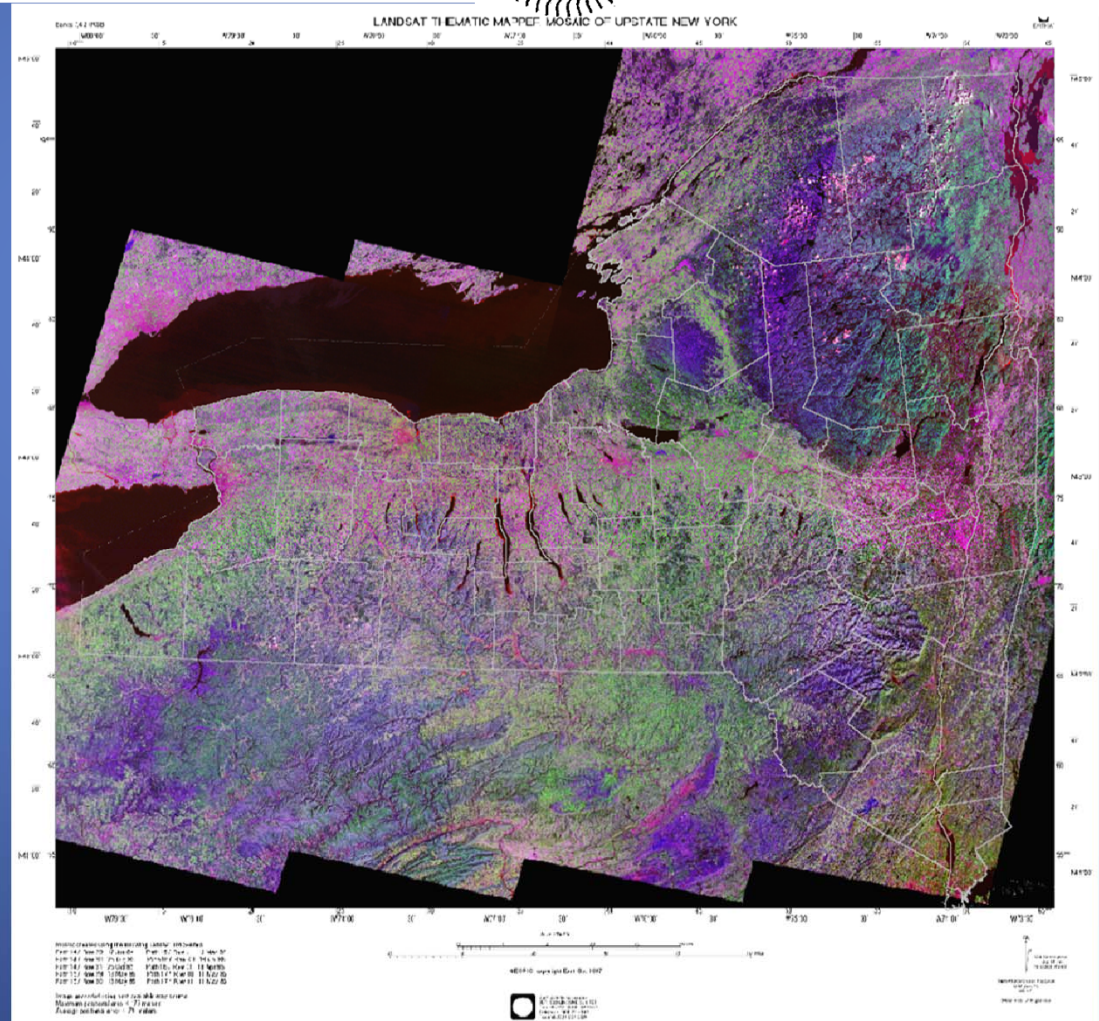


**Microseismic Monitoring for  
Evidence of Geothermal  
Heat in the Capital District  
of New York**



**Exploration and Drilling for  
Geothermal Heat in the  
Capital District, New York**

- **Hydrothermal Systems Research:**
  - heat flow studies
  - resource assessments
  - Auburn Geothermal Well
- **Enhanced Geothermal Systems Research:**
  - mainly “rock” studies with applicability:
    - deep wells
    - seismic
    - structural and stratigraphic





# Tapping Hydrothermal Systems: Auburn Low Temperature Geothermal Well

- The Auburn Geothermal Well in Auburn, Cayuga County NY was drilled by NYSERDA (original owner) and the USDOE in 1982 to tap into an anomalously-high thermal gradient for direct heating.
- The prevailing theory for the anomaly's existence was hydrothermal convection through a radiogenic heat zone in a granitic pluton near the top of the basement into the wet, porous zone.
- The well produced both hot water for direct heating (using a heat exchanger) and natural gas for the boiler at the East Middle School. Only gas is produced today.

# Auburn Project Location

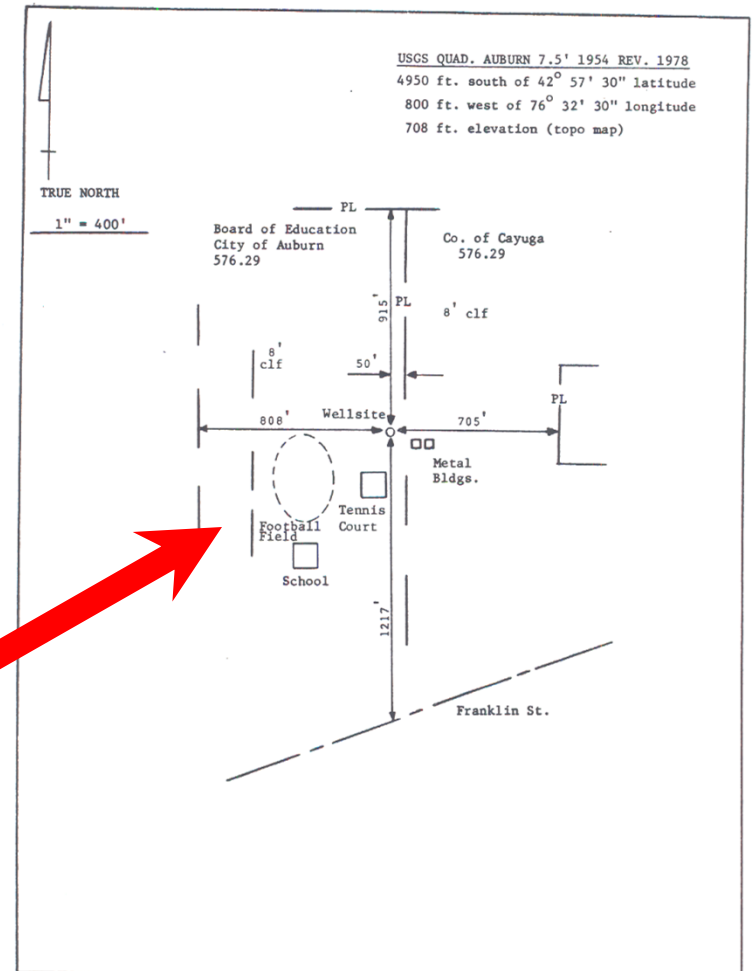
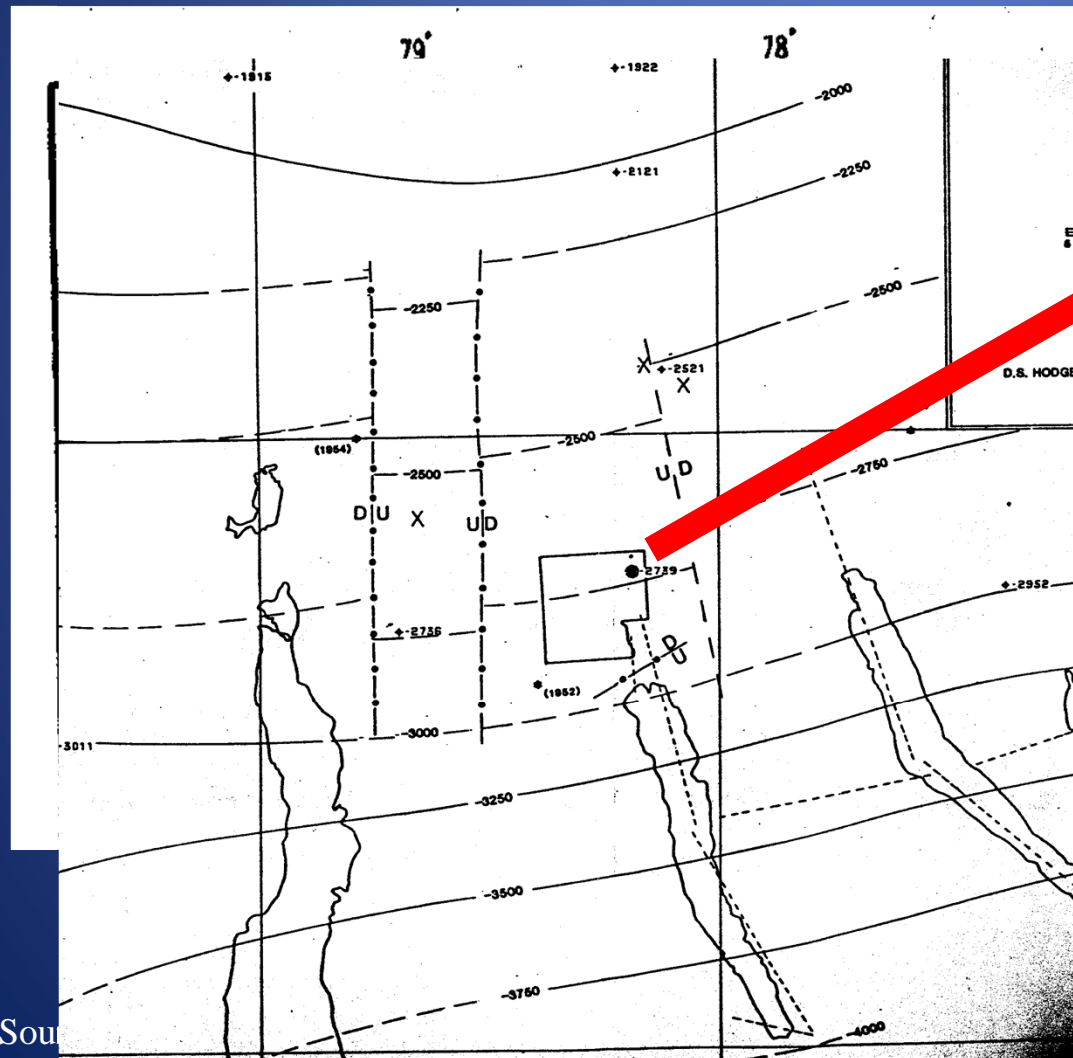
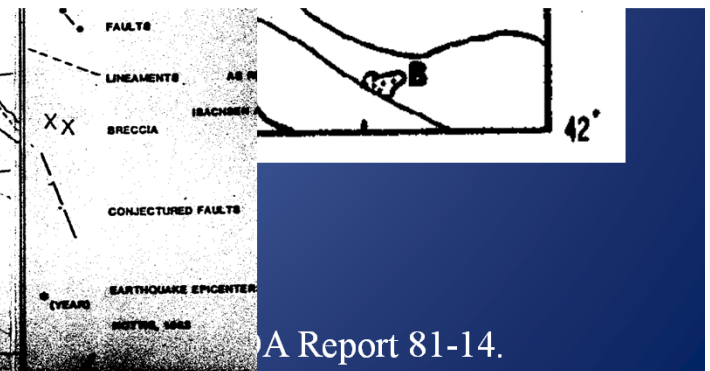


Figure 2-1. Wellsite Location for the City of Auburn, Lot 39, #1 Well





# Well Completion

Small gas shows at 1,618', 1,651' and 2,046 ft. Major gas shows from 4,150' and 4,160' at bottom of Trenton/top of Black River.

The Theresa and Potsdam were hydraulically-fractured with shut-in pressure of ~1,600 psi.

Hydrothermal fluids:

- 125° F (52° C)
- up to 300,000 ppm TDS

Bound and finite reservoir:

- 3.5 year life @100 gpm (no reinjection)
- 286 gpm with reinjection

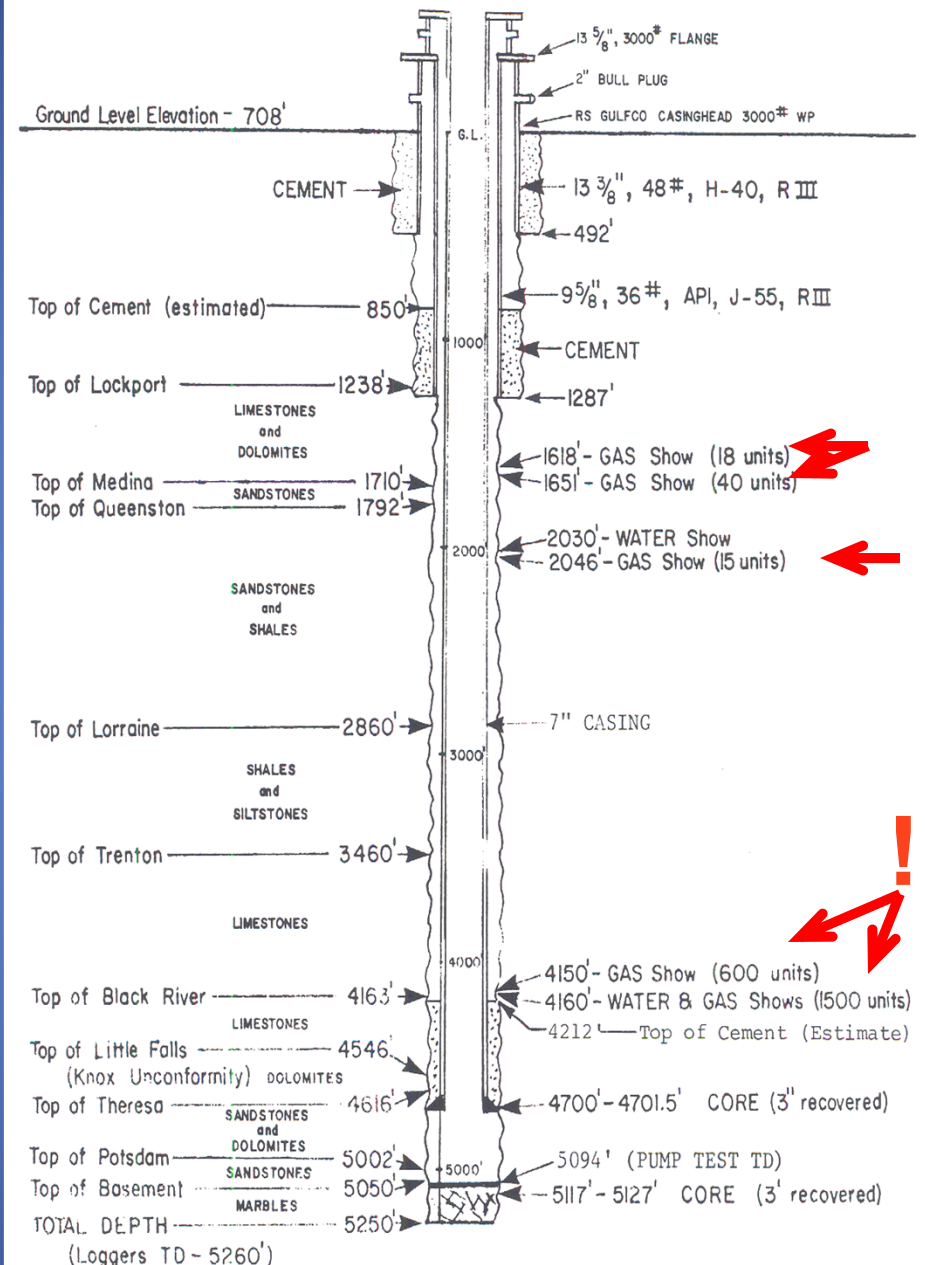
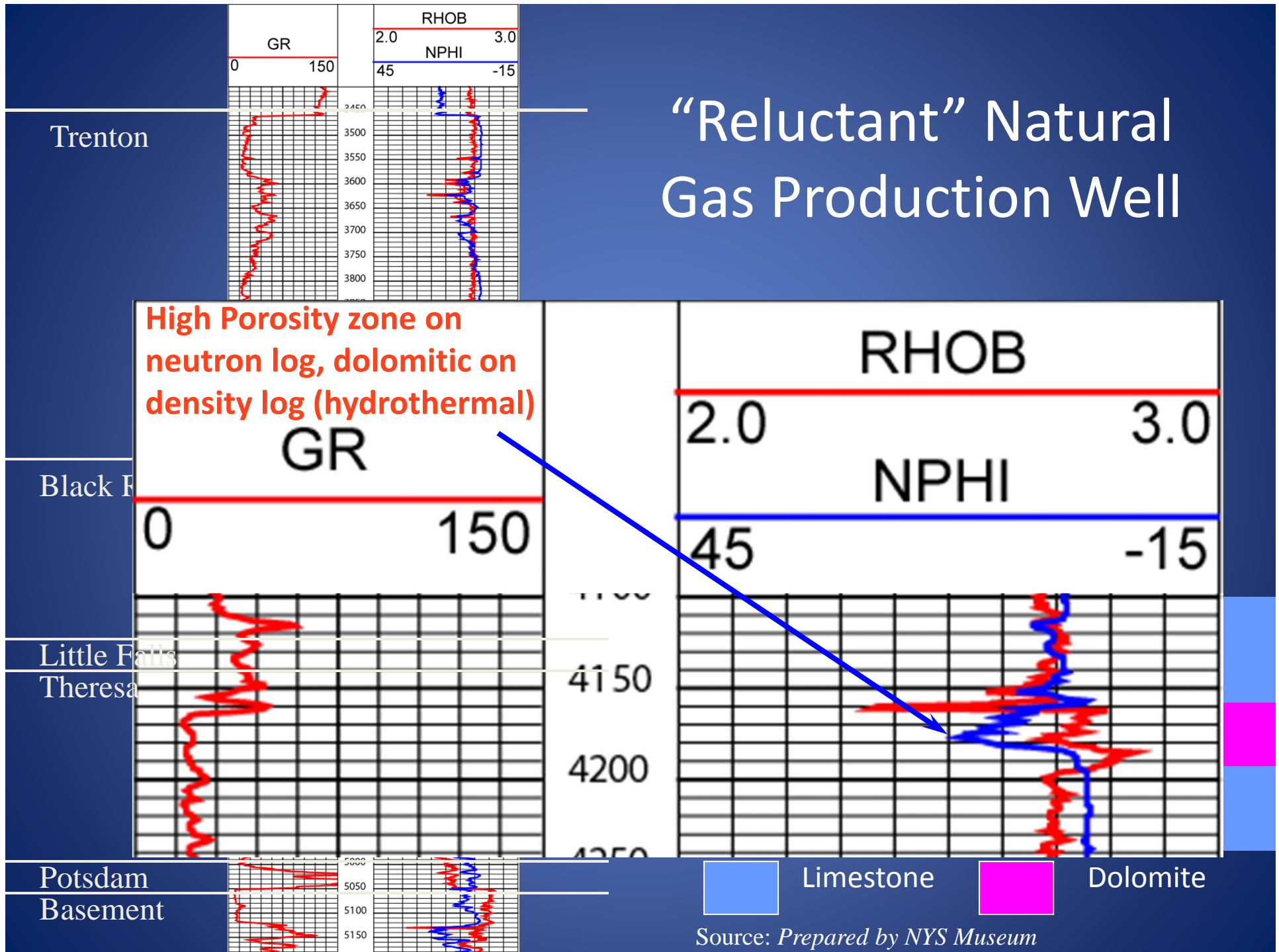


Figure B-1. Auburn Geothermal Well - Completion and Lithological Cross-Section (Donohue, Anstey & Morrill, 1983)

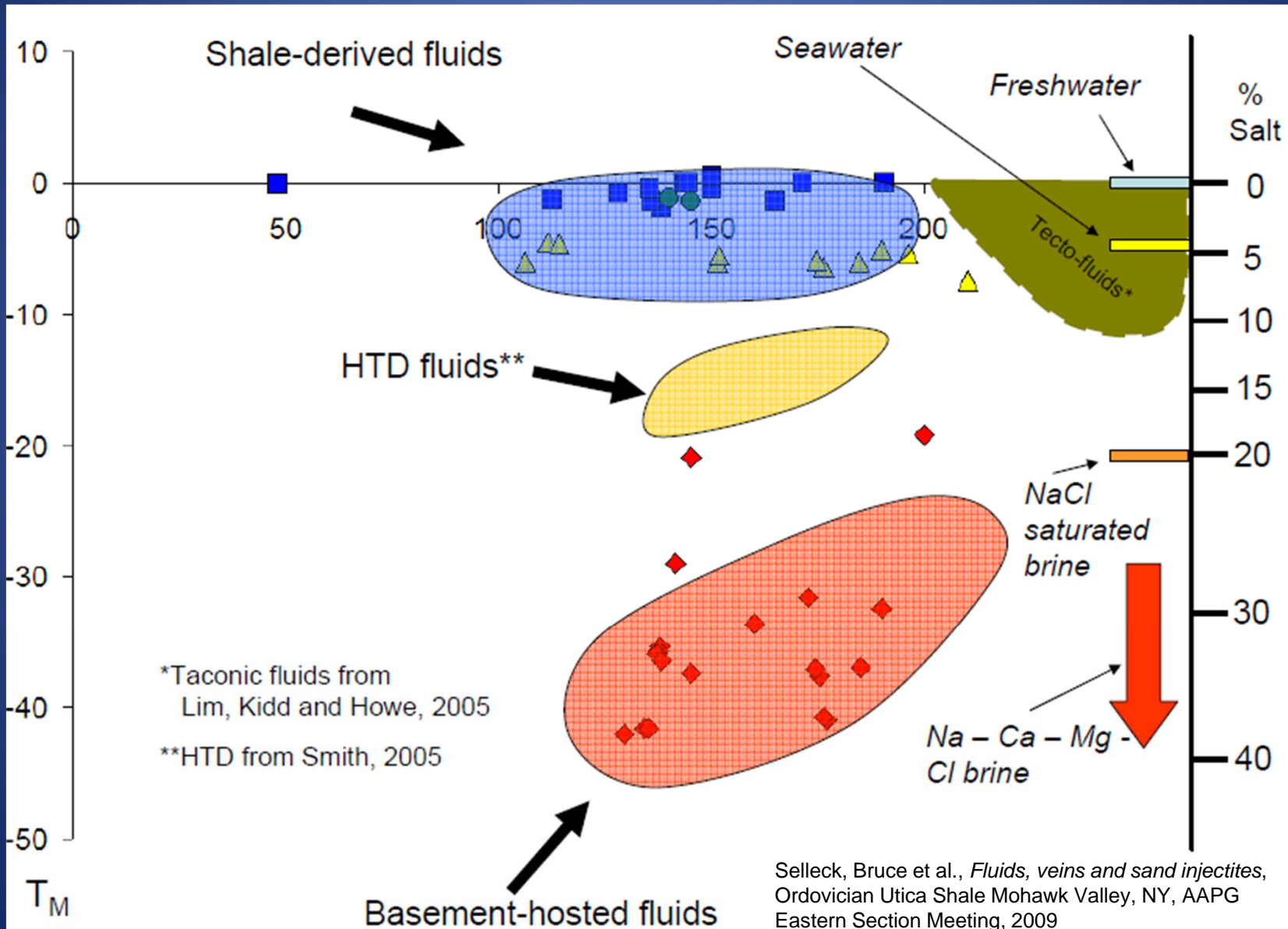
# “Reluctant” Natural Gas Production Well





# How Nasty Are the Hydrothermal Fluids?

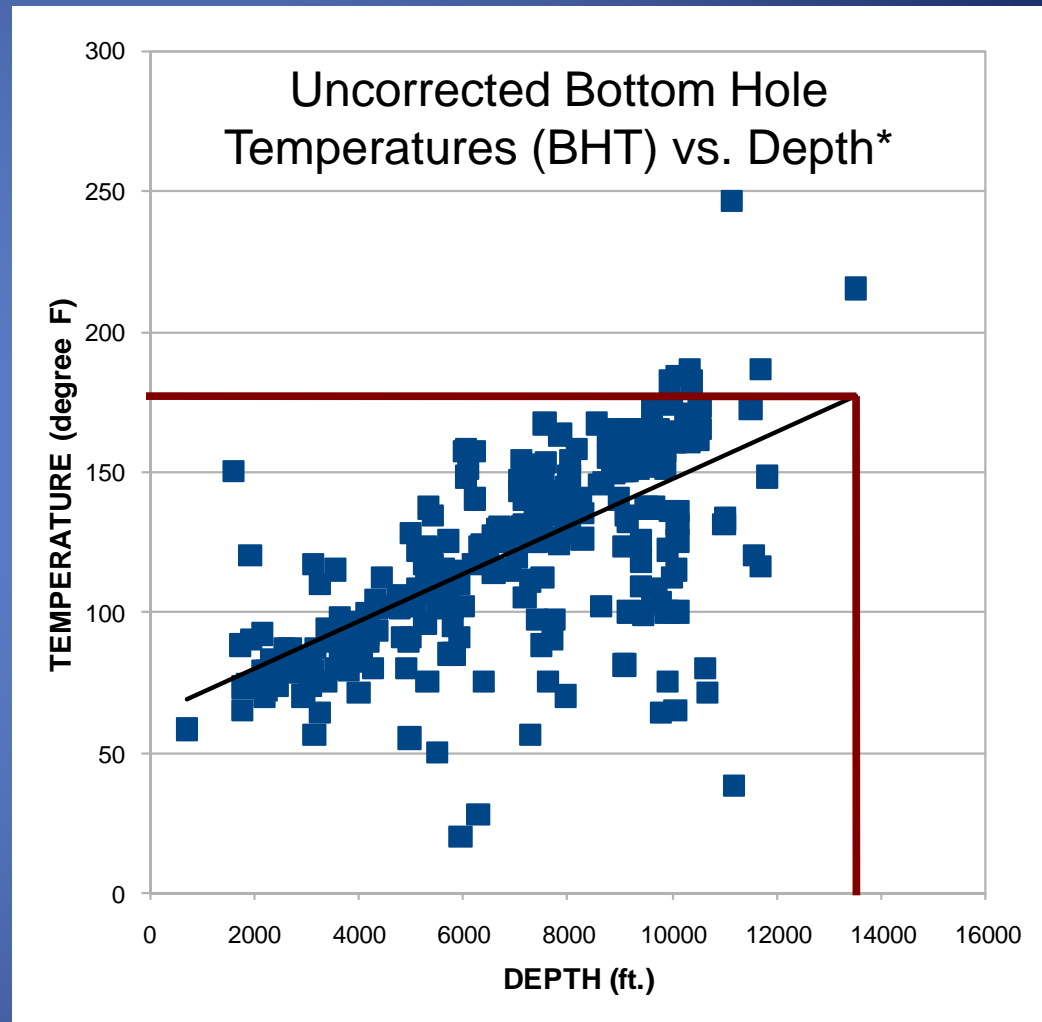
## fluid inclusion analysis from central New York



# Enhanced Geothermal Systems: Temperature/Depth for New York Wells

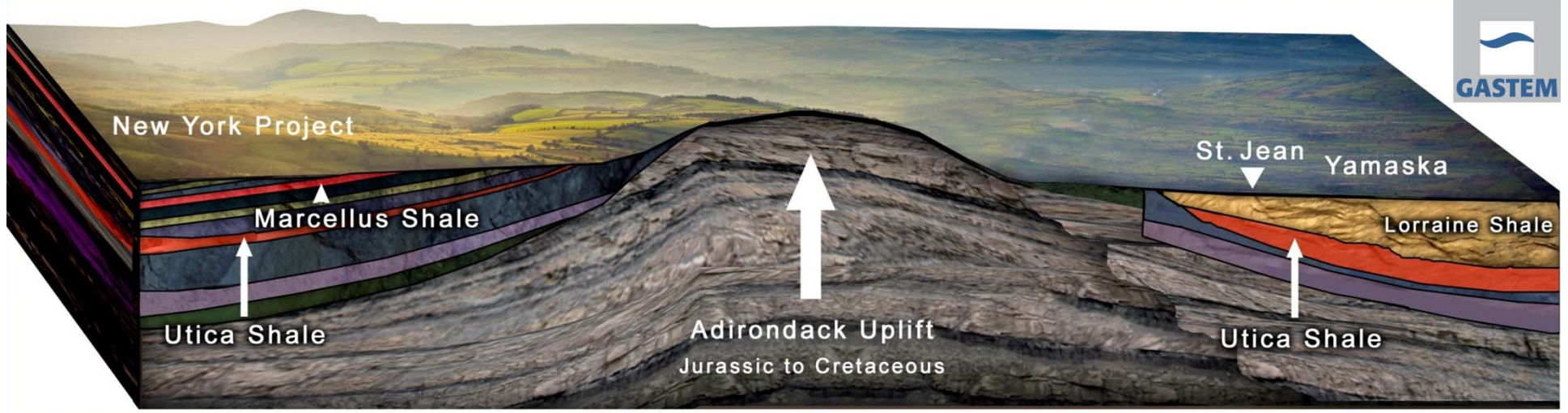
How deep to get the heat?

- Deepest well drilled in NYS: 13,537 ft
- Need to be about that depth to get the BHT heat  $>80^{\circ}\text{C}$  ( $175^{\circ}\text{F}$ )
- Can be used for direct heating and/or electricity

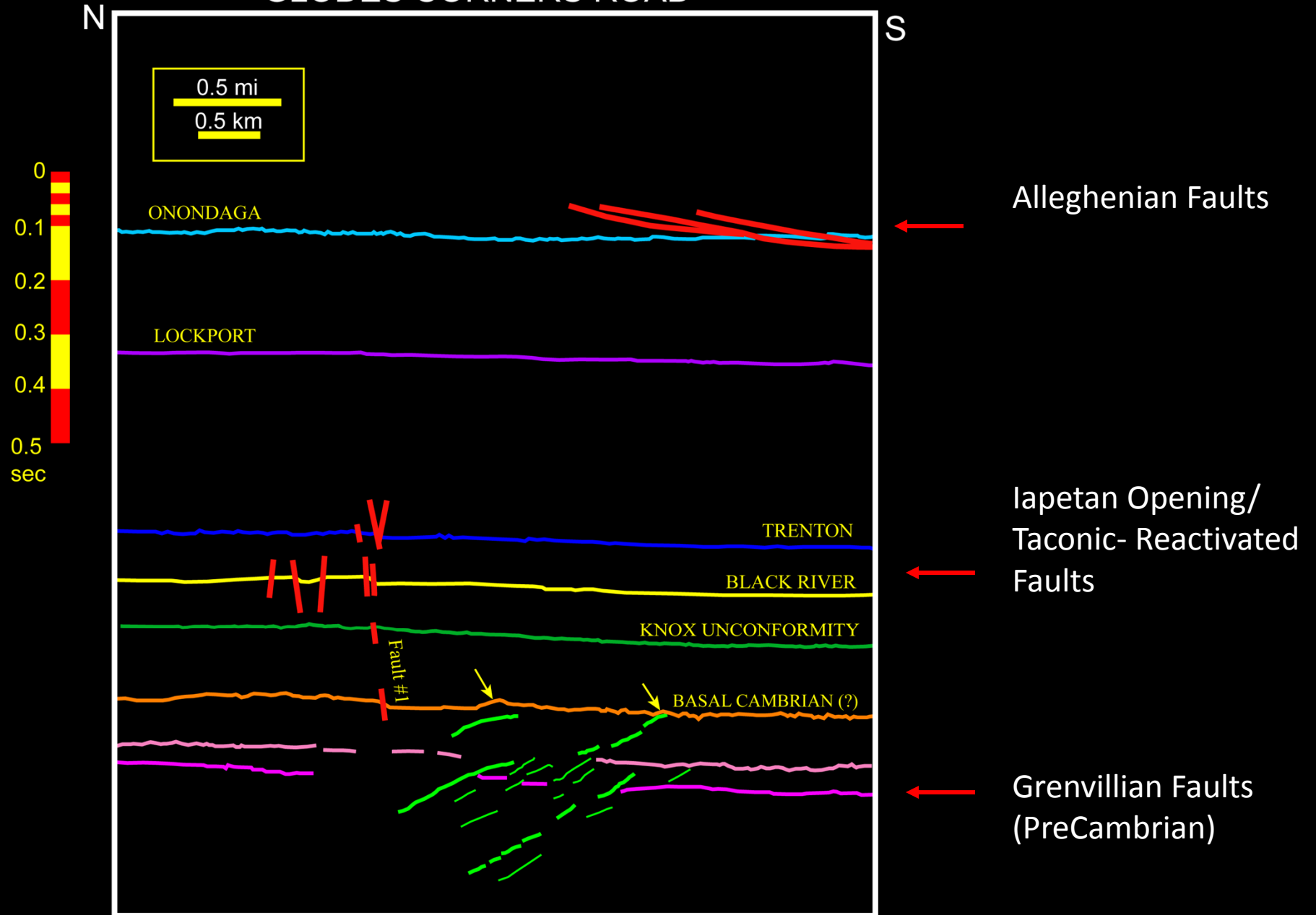


\* BHT values are usually depressed compared to actual rock temperatures due to drilling procedures





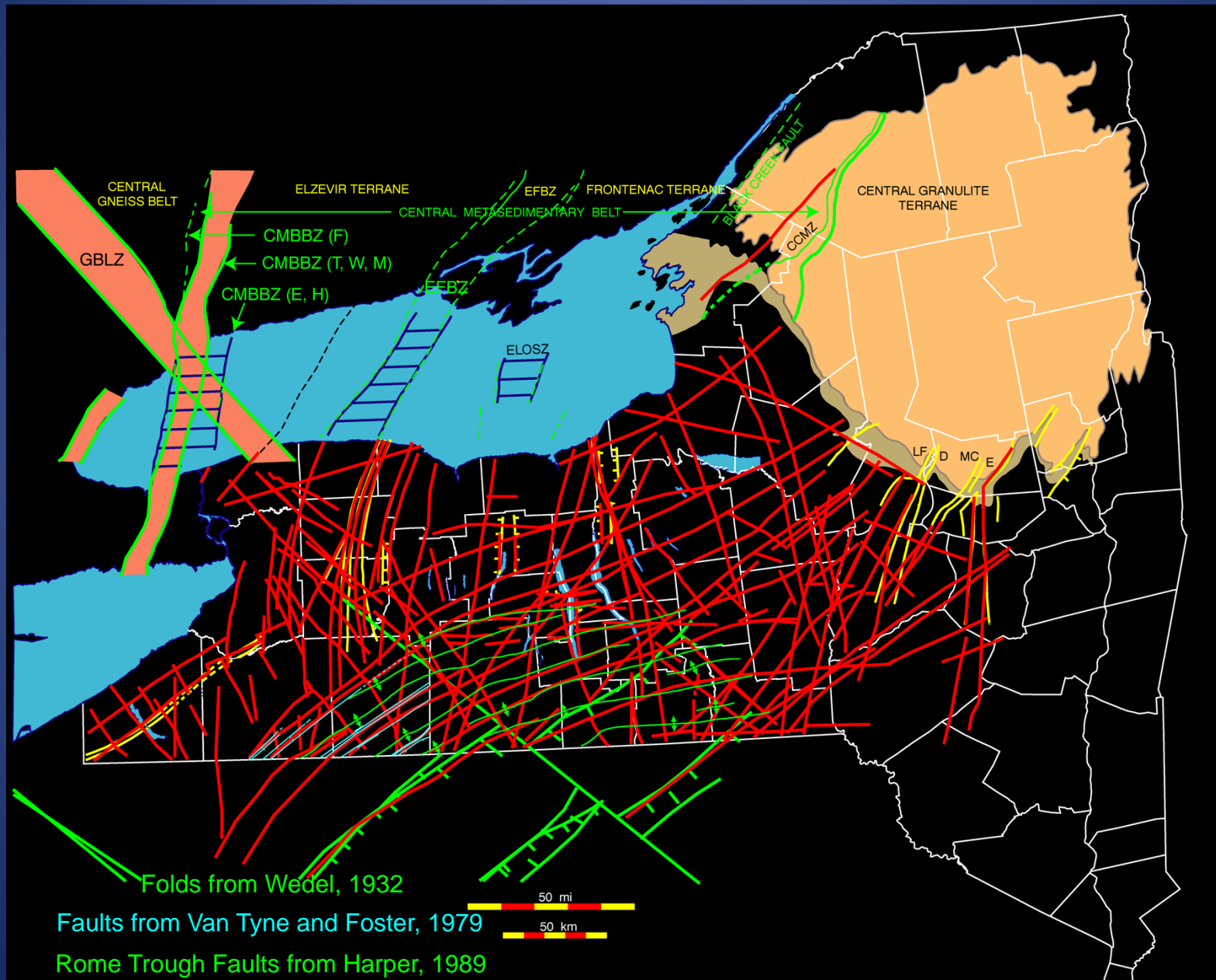
# GLODES CORNERS ROAD





# Known and Inferred Basement Structure

(Jacobi, 2005)



# Some Final (Random) Thoughts

- Due to structural complexity geological characterization is critical for
  - resource assessments
  - engineering design
- Both hydrothermal and EGS wells will likely require high-volume hydraulic fracture stimulation
- Produced water may contain naturally-occurring radioactive materials (hydrothermal more than EGR)
- Produced water is likely to have some TDS and may create a scaling/corrosion problem
- Induced earthquakes while injecting fluid into and lubricating a fault possible in either system (e.g. DFW)
- Economics of low temperature systems tough (\$0.15-0.18/kwh - 1996 NYSERDA study estimate)