

# Water-related issues affecting conventional oil and gas recovery and potential oil shale development in the Uinta Basin, Utah

## **Task 3:** **Birds Nest Aquifer**



**Year 1 Review**  
October 8, 2009

Project website: [geology.utah.gov/emp/UBwater\\_study](http://geology.utah.gov/emp/UBwater_study)

## Task 3: Geologic Examination of the Birds Nest Aquifer

**Problem:** The Birds Nest aquifer is poorly understood and needs further study to determine potential impacts of saline water disposal

- Relationship to fresh water resources
- Potential affects on future oil shale development

### Proposed Research:

- Literature review – data collection
- Evaluate Birds Nest in core, outcrop, and on geophysical logs
- Determine how gilsonite veins might influence water flow and saline mineral dissolution
- GIS database and maps showing:
  - Outcrop
  - Thickness
  - Water quality
  - Interburden between Birds Nest and “economic” oil shale zones



## Task 3: Geologic Examination of the Birds Nest Aquifer

### Deliverables:

- Database of well and water quality information
- Maps – isopach, structure contour, “interburden”, outcrop, etc.
- Cross sections and core descriptions

### Schedule:

- **Year 1 – gather historical information, analyze well logs, analyze core, start fieldwork**
- Year 2 – fieldwork, collect well data, analyze core
- Year 3 – fieldwork, analyze core, create maps



## Task 3: Geologic Examination of the Birds Nest Aquifer

**Description:** The Birds Nest aquifer formed from the dissolution of saline minerals (mostly nahcolite) within the upper Green River Formation

- Aquifer could include Horse Bench Sandstone where present





## Task 3: Geologic Examination of the Birds Nest Aquifer

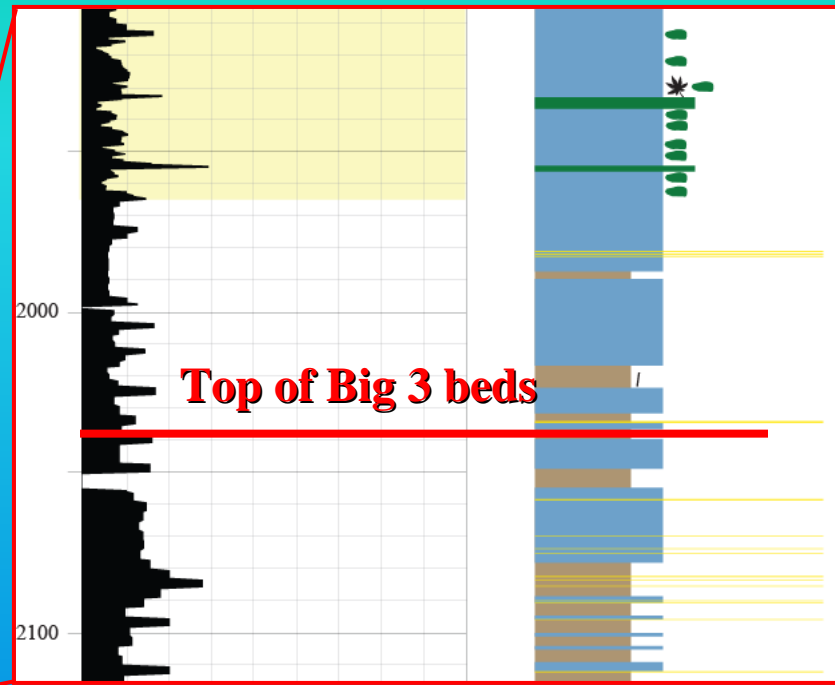
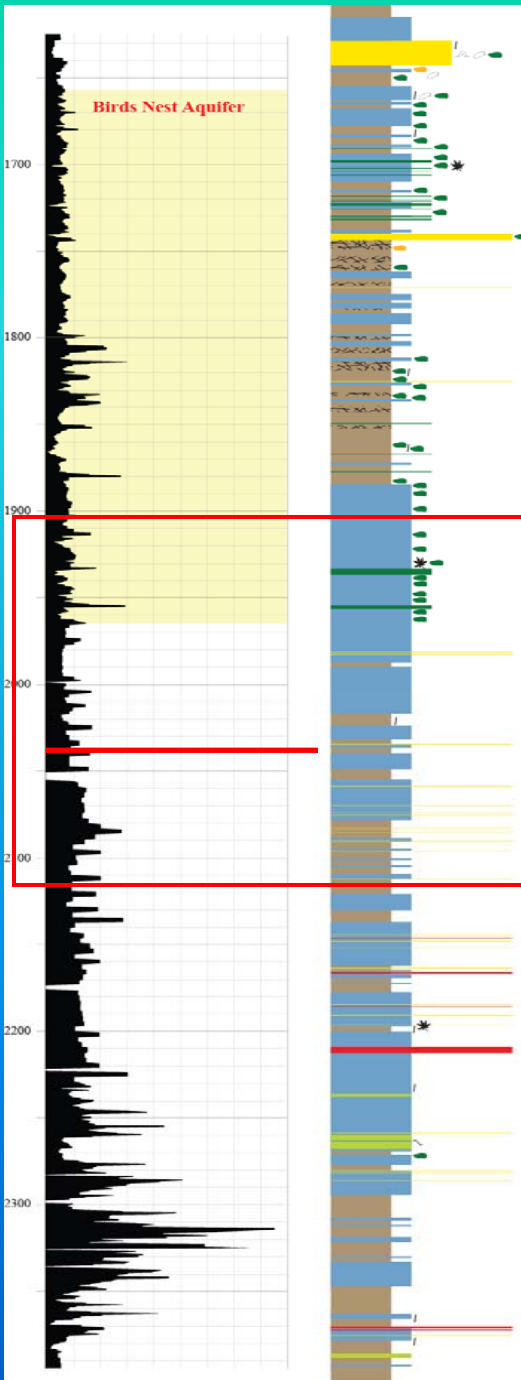
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## Task 3: Geologic Examination of the Birds Nest Aquifer

**Relation to oil shale deposits – What is the economic top?**



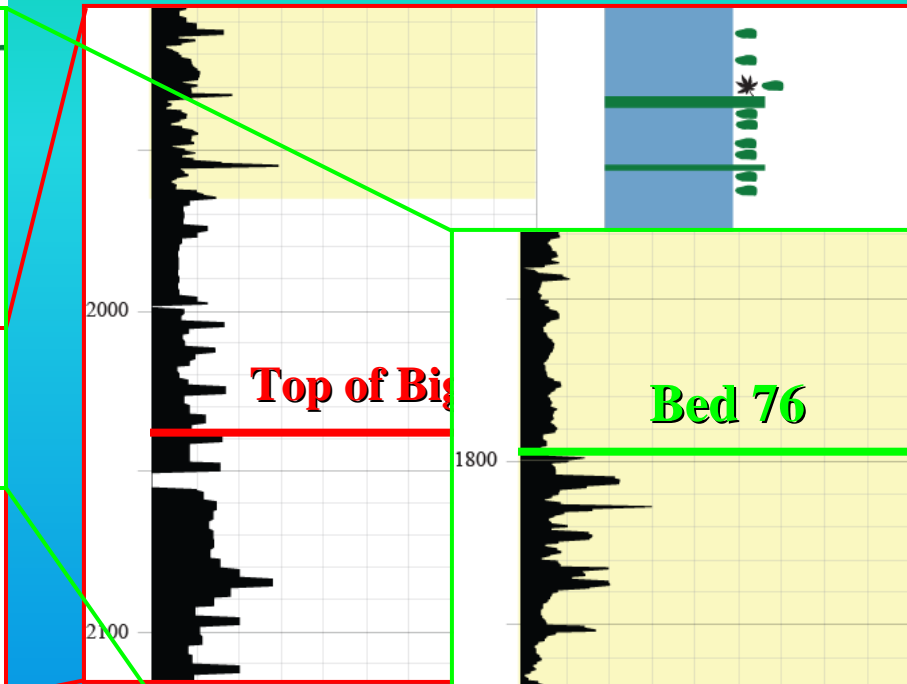
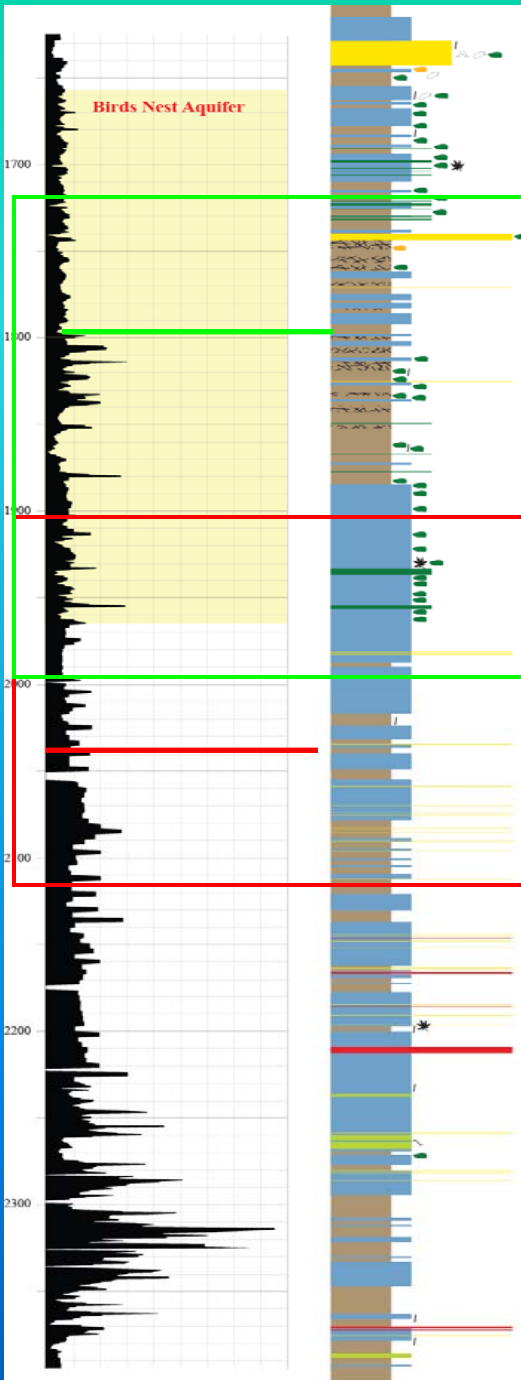
**Option 1:**

**Interburden –  
70 to 100 ft**

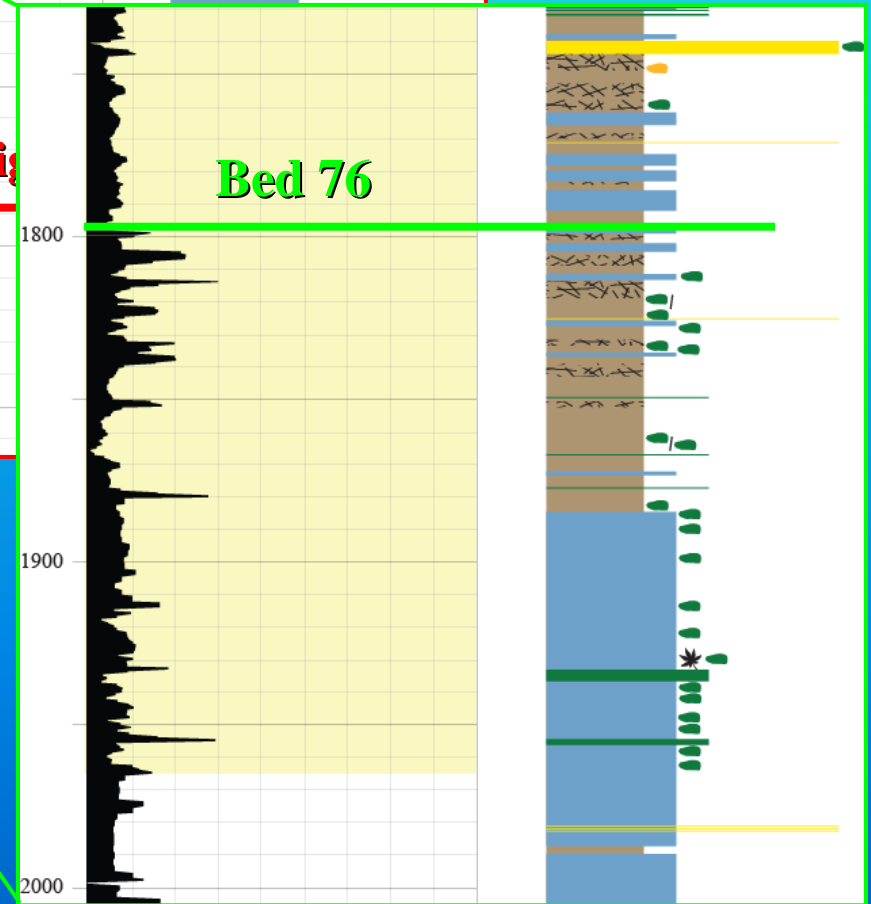
**Mahogany Zone**

# Task 3: Geologic Examination of the Birds Nest Aquifer

Relation to oil shale deposits – What is the economic top?



Option 2:



Option 1:

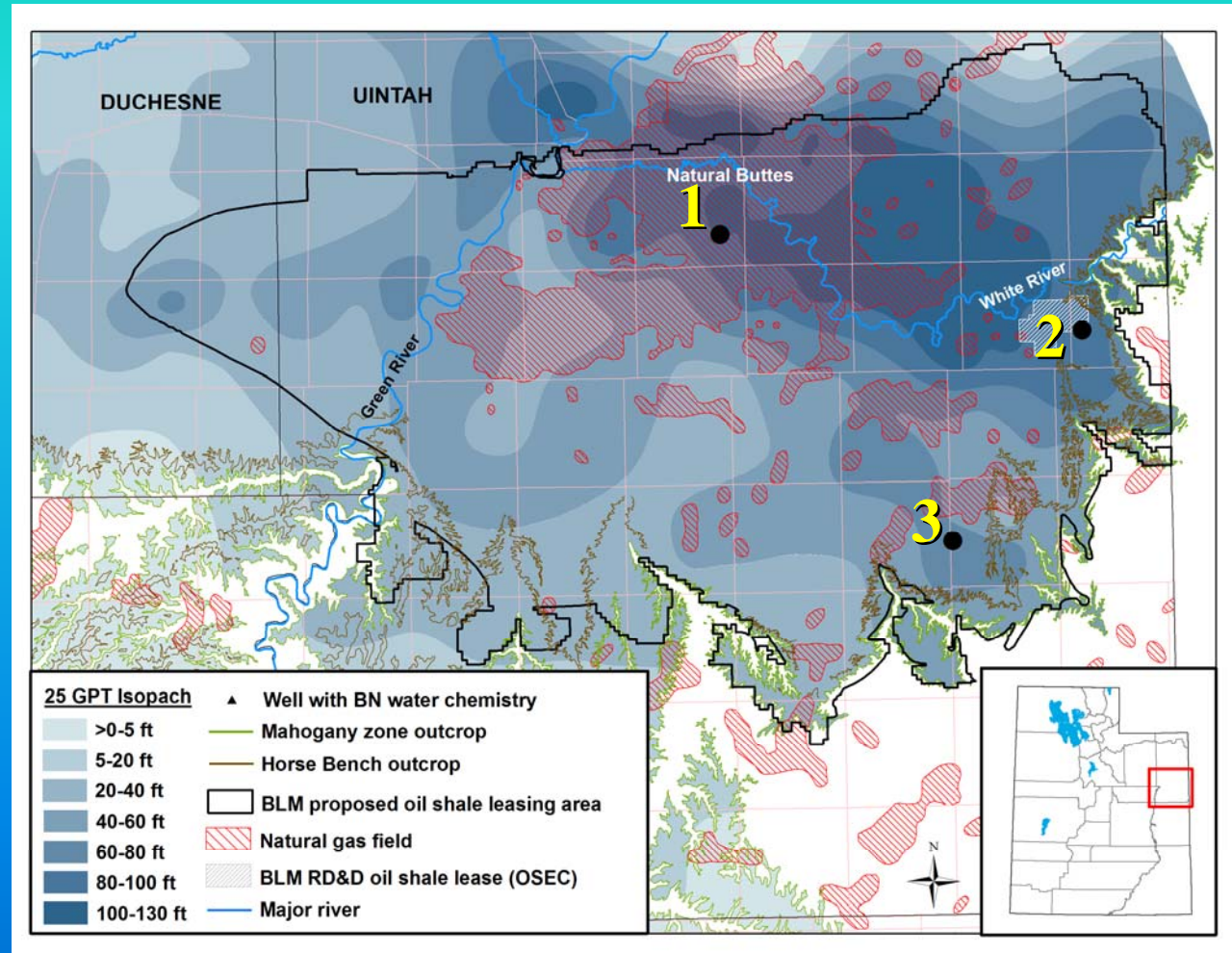
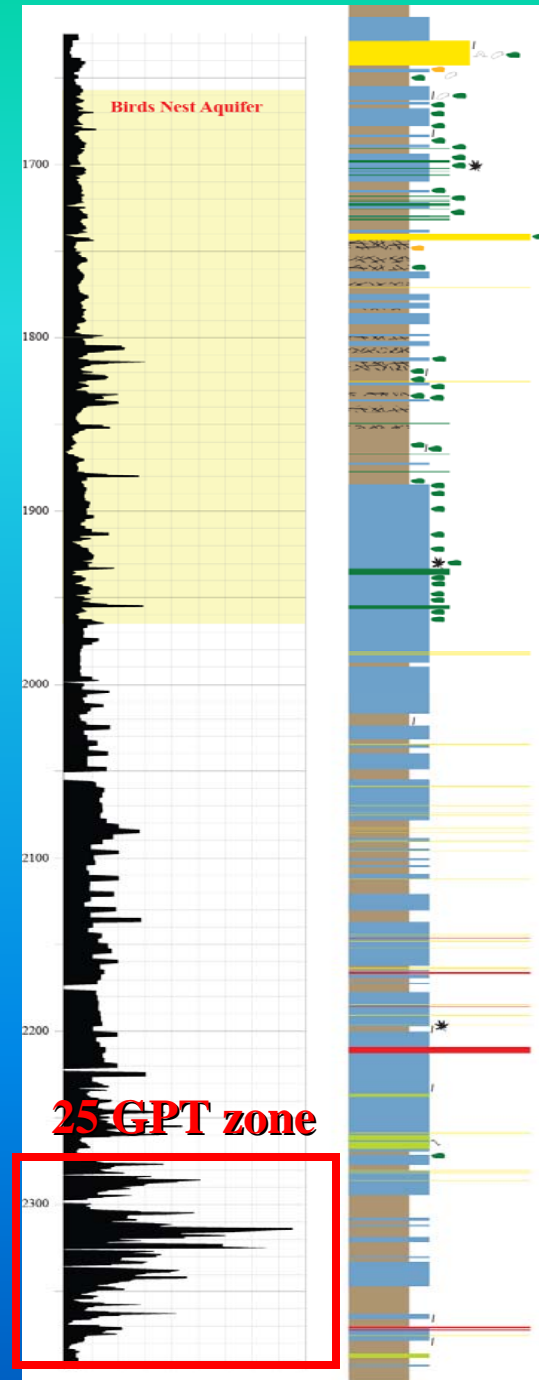
Interburden –  
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# Task 3: Geologic Examination of the Birds Nest Aquifer

## Relation to oil shale deposits – What is the economic top?

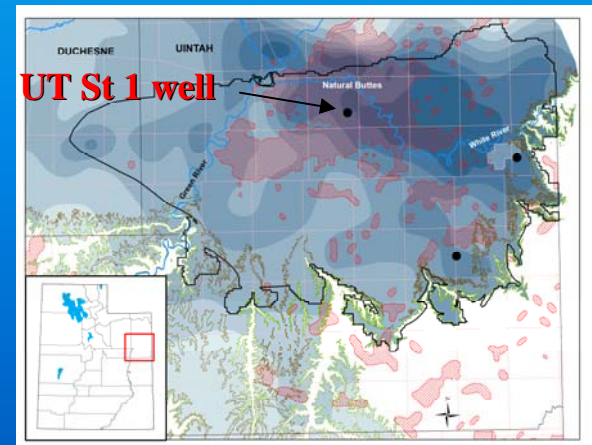
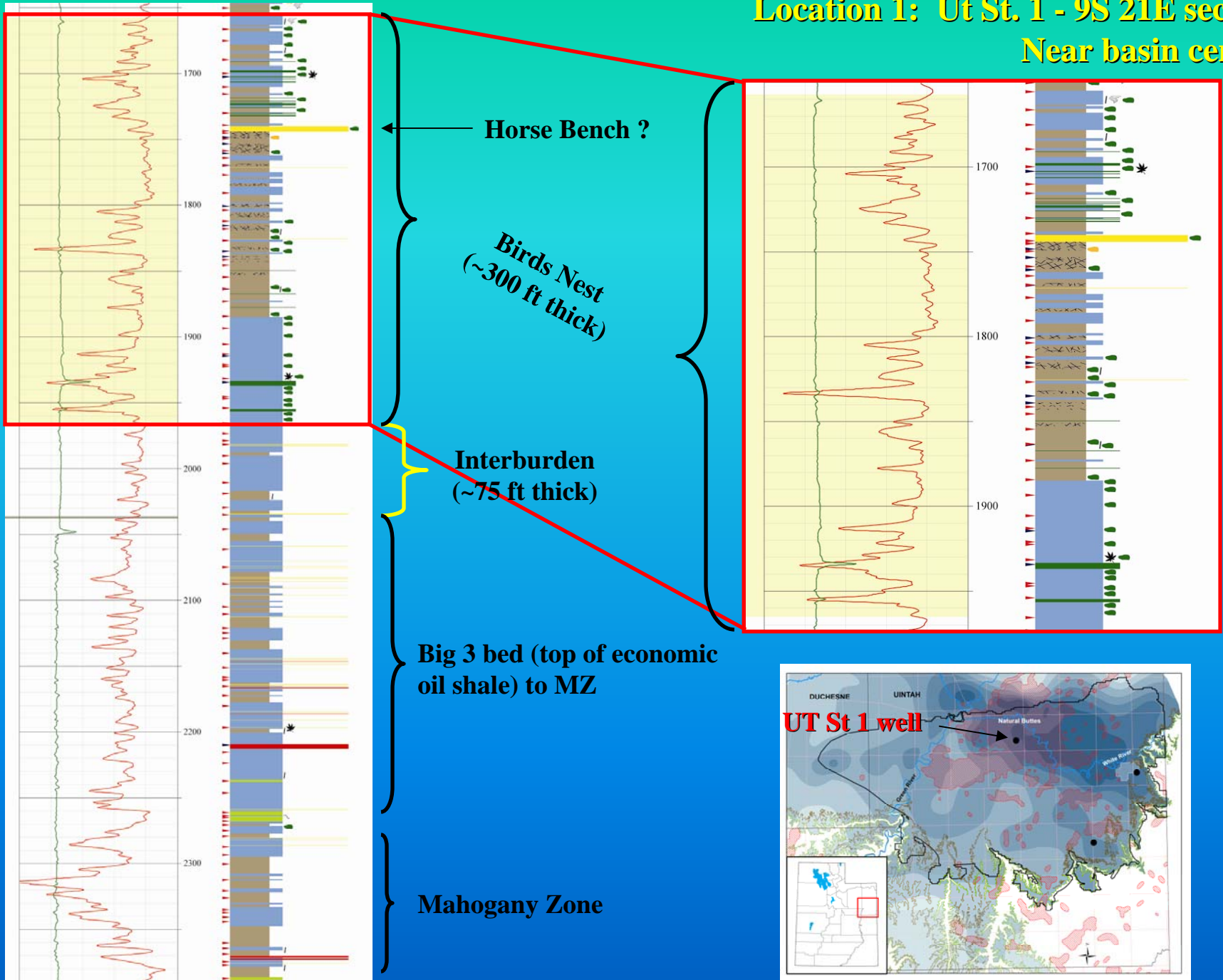


**Mahogany Zone**



# Location 1: Ut St. 1 - 9S 21E sec. 26

Near basin center



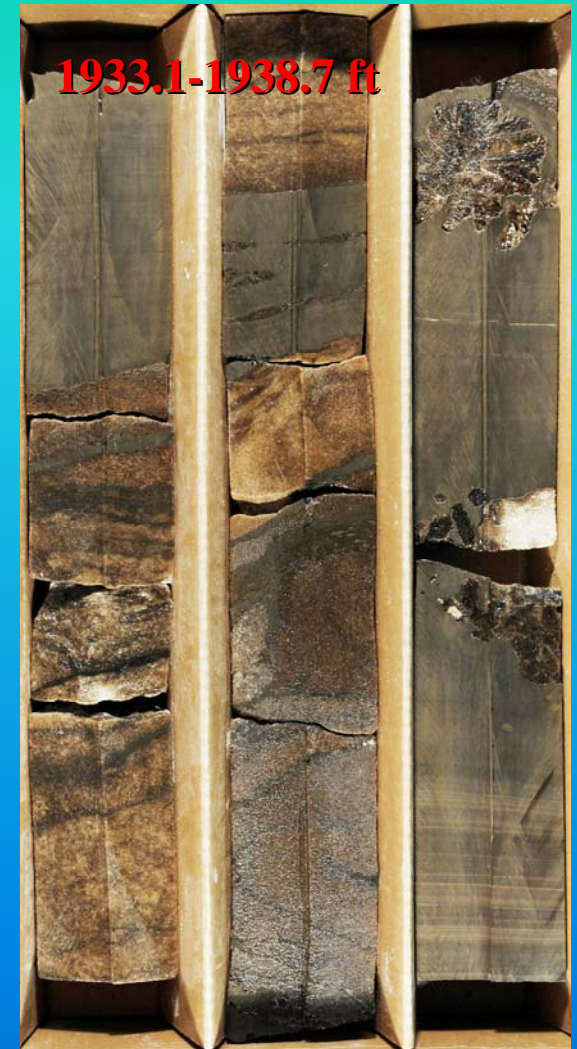
**Location 1: Ut St. 1 - 9S 21E sec. 26**  
**Near basin center**



**Possible basinward  
extent of Horse Bench**



**Shortite fracture fill**

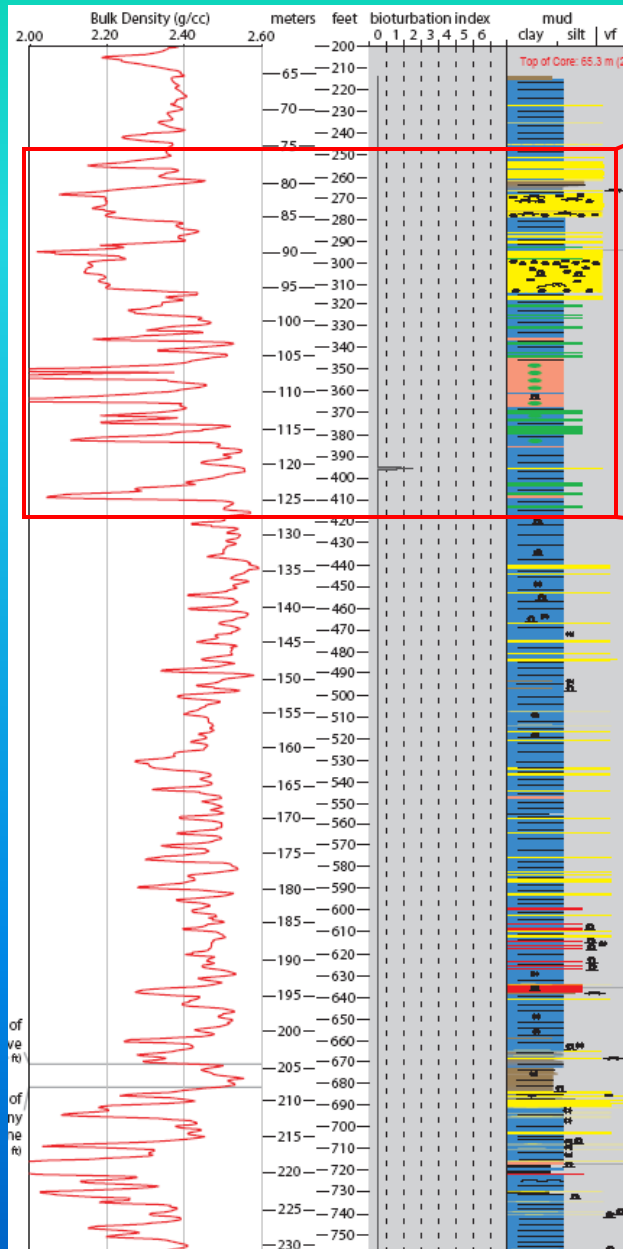


**Nahcolite beds and  
nodules**



# Location 2: P-4 - 10S 25E sec. 19

## Eastern side of basin



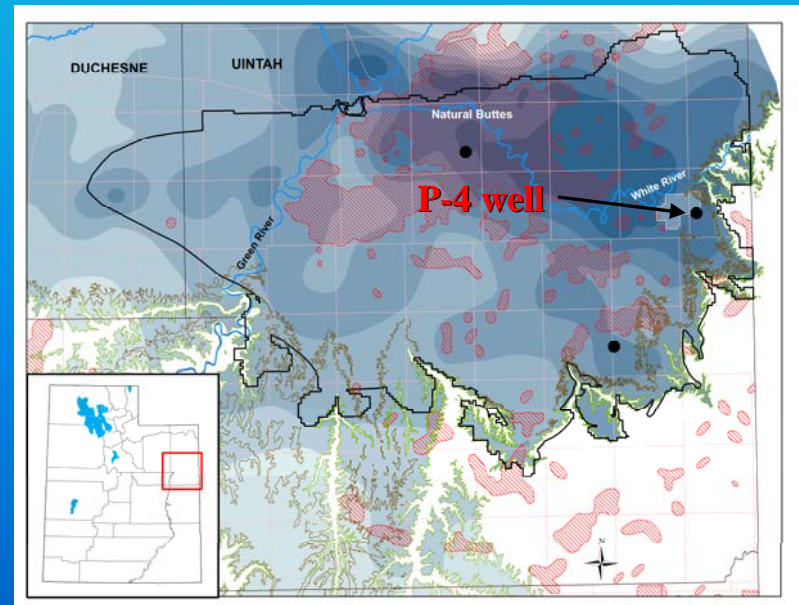
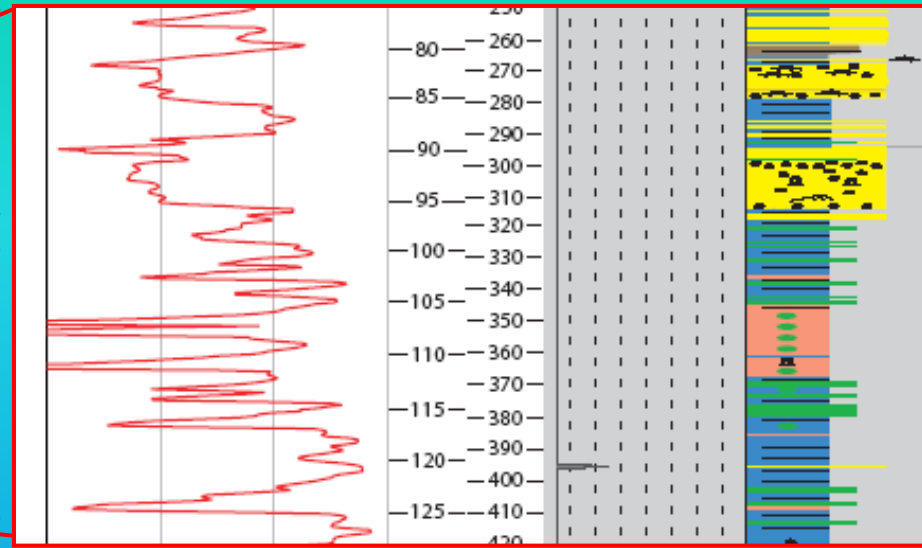
**Horse Bench**

**Birds Nest  
(~100 ft thick)**

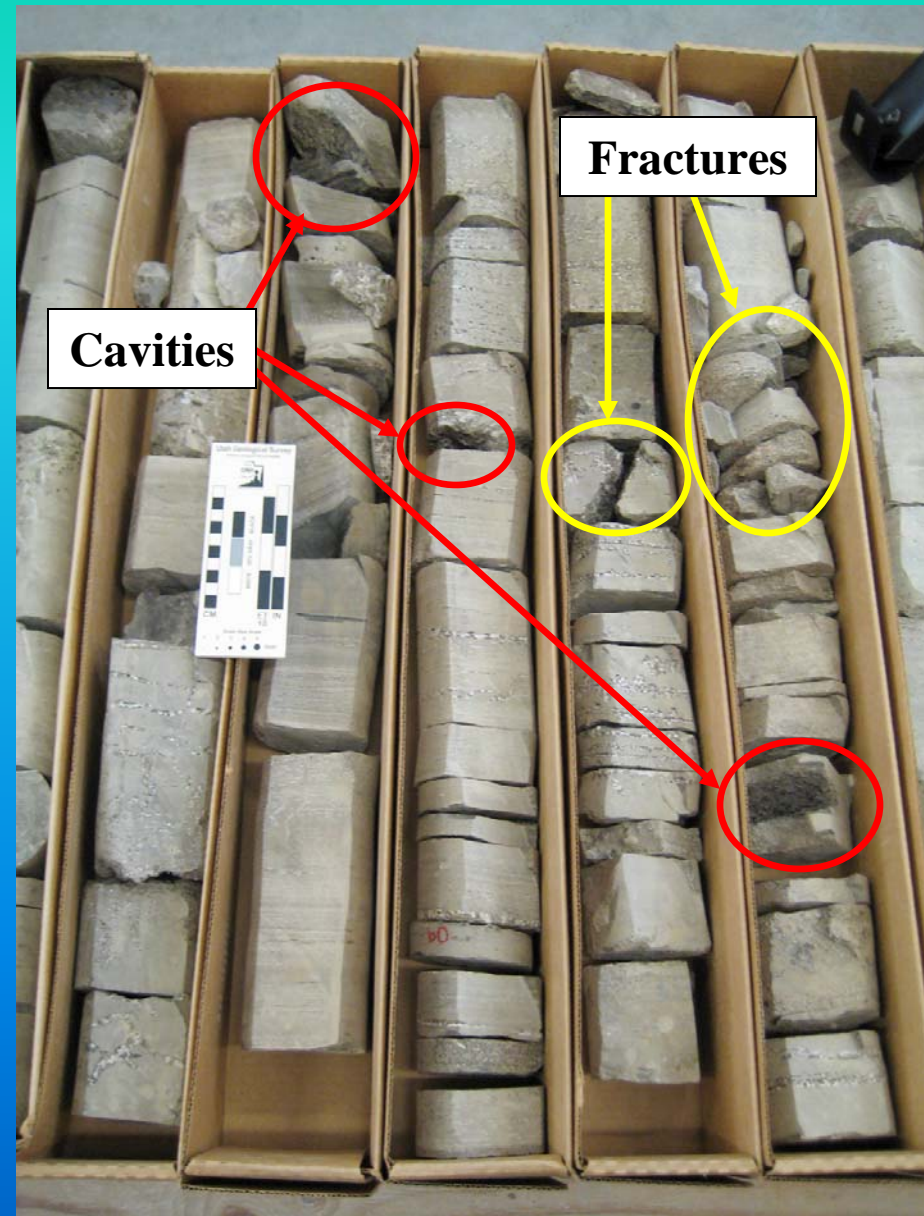
**Interburden  
(~75 ft thick)**

**Big 3 bed to MZ –  
Top of economic oil  
shale**

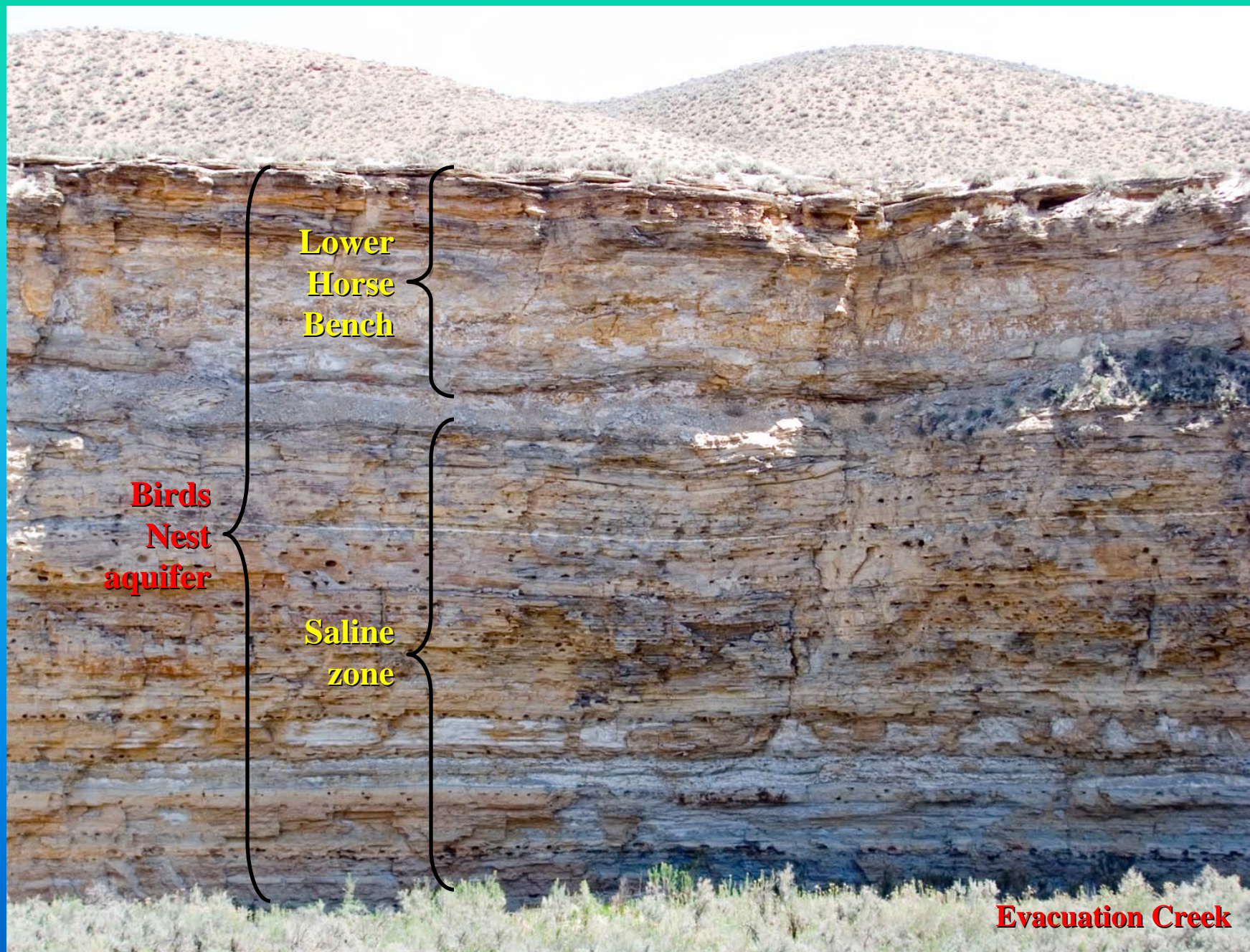
**Mahogany Zone**



**Location 2: P-4 - 10S 25E sec. 19**  
**Eastern side of basin**







**Lower  
Horse  
Bench**

**Birds  
Nest  
aquifer**

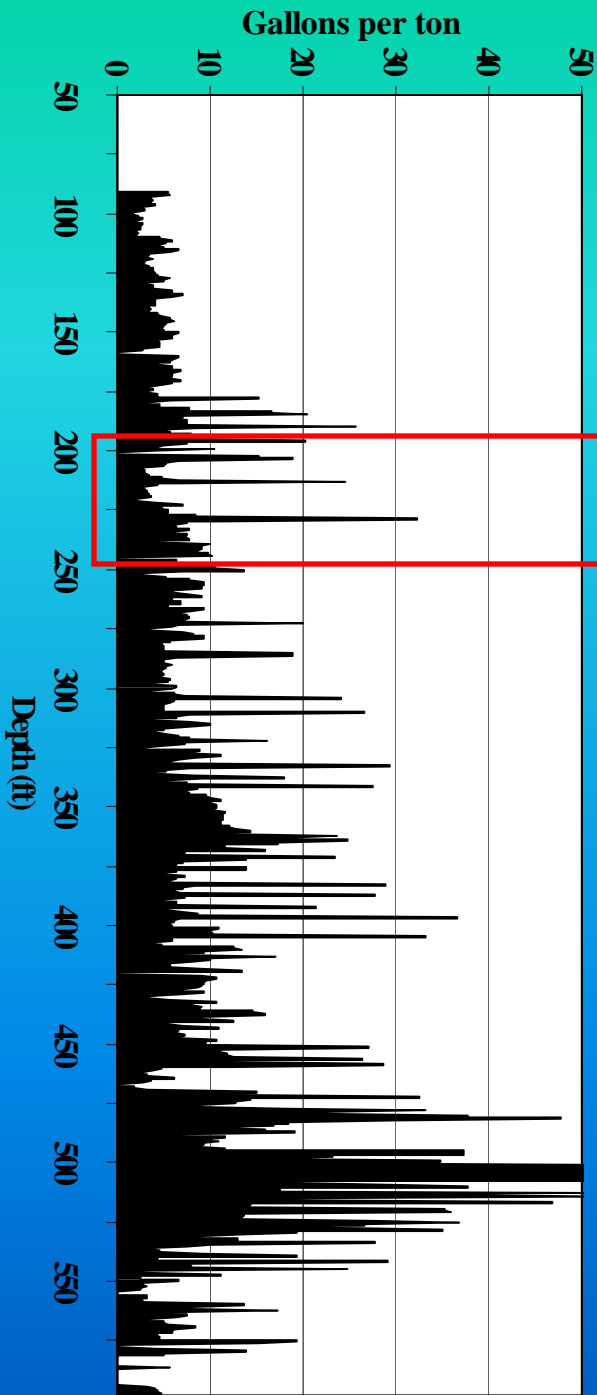
**Saline  
zone**

**Evacuation Creek**





**Location 3: SUB 12 - 12S 24E sec. 19**  
**Near basin margin**



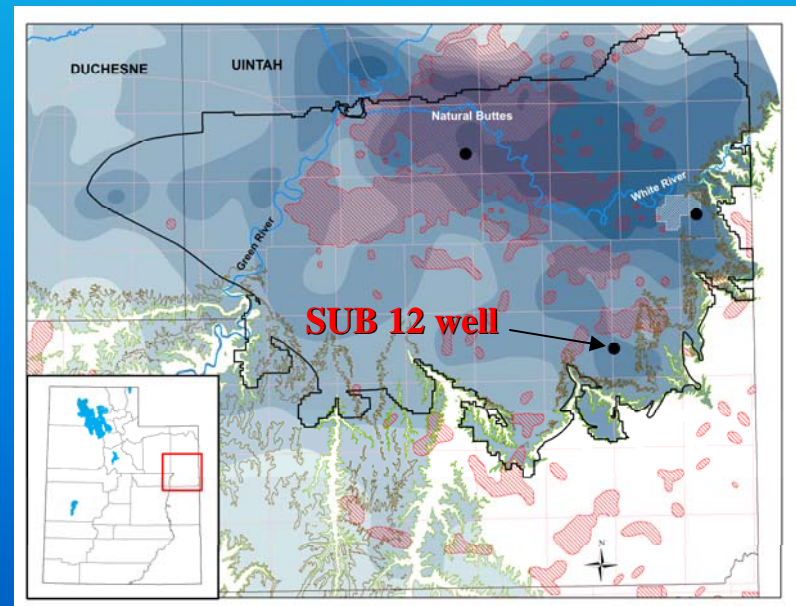
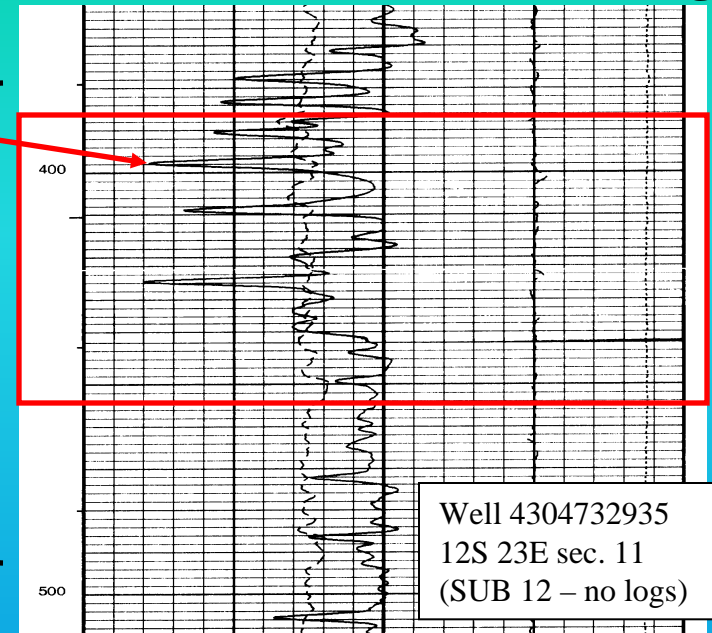
**No diagnostic spikes to low density (these reflect rich oil shale / high organics)**

**Birds Nest (~60 ft thick)**

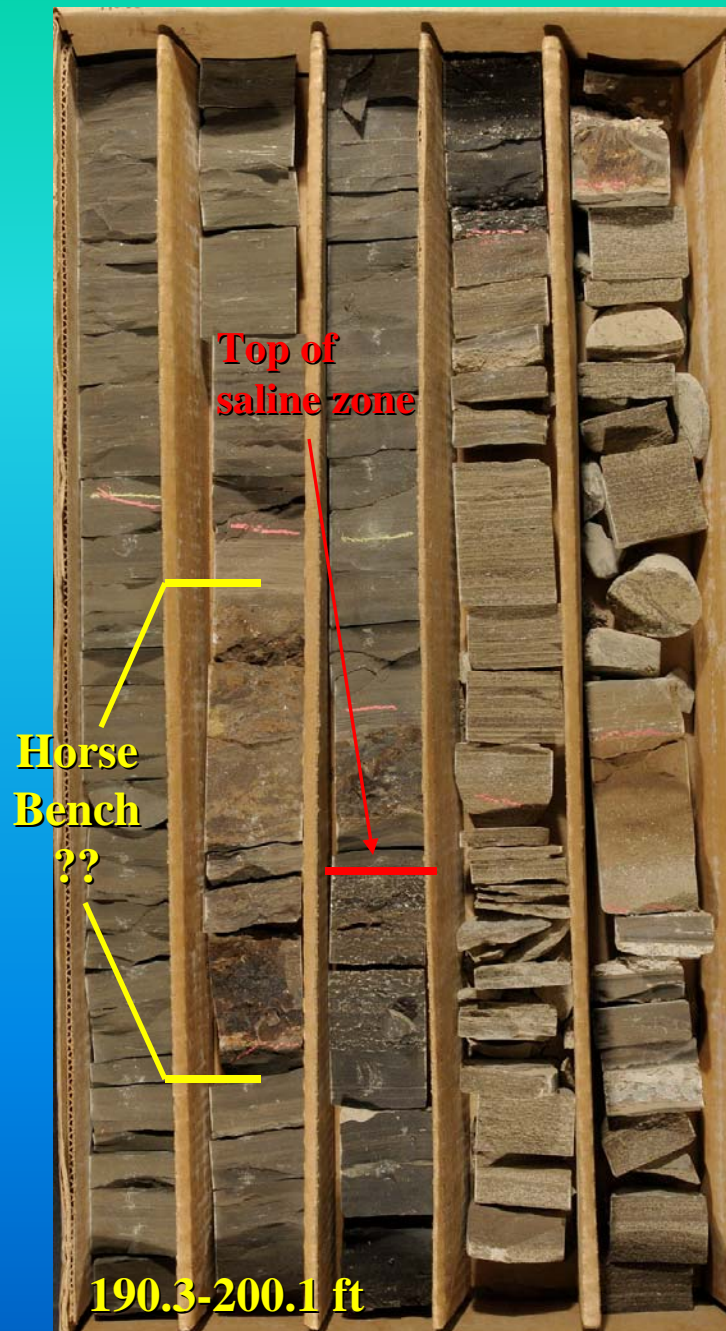
**Interburden (~90 ft thick)**

**Big 3 bed (top of economic oil shale) to MZ**

**Mahogany Zone**

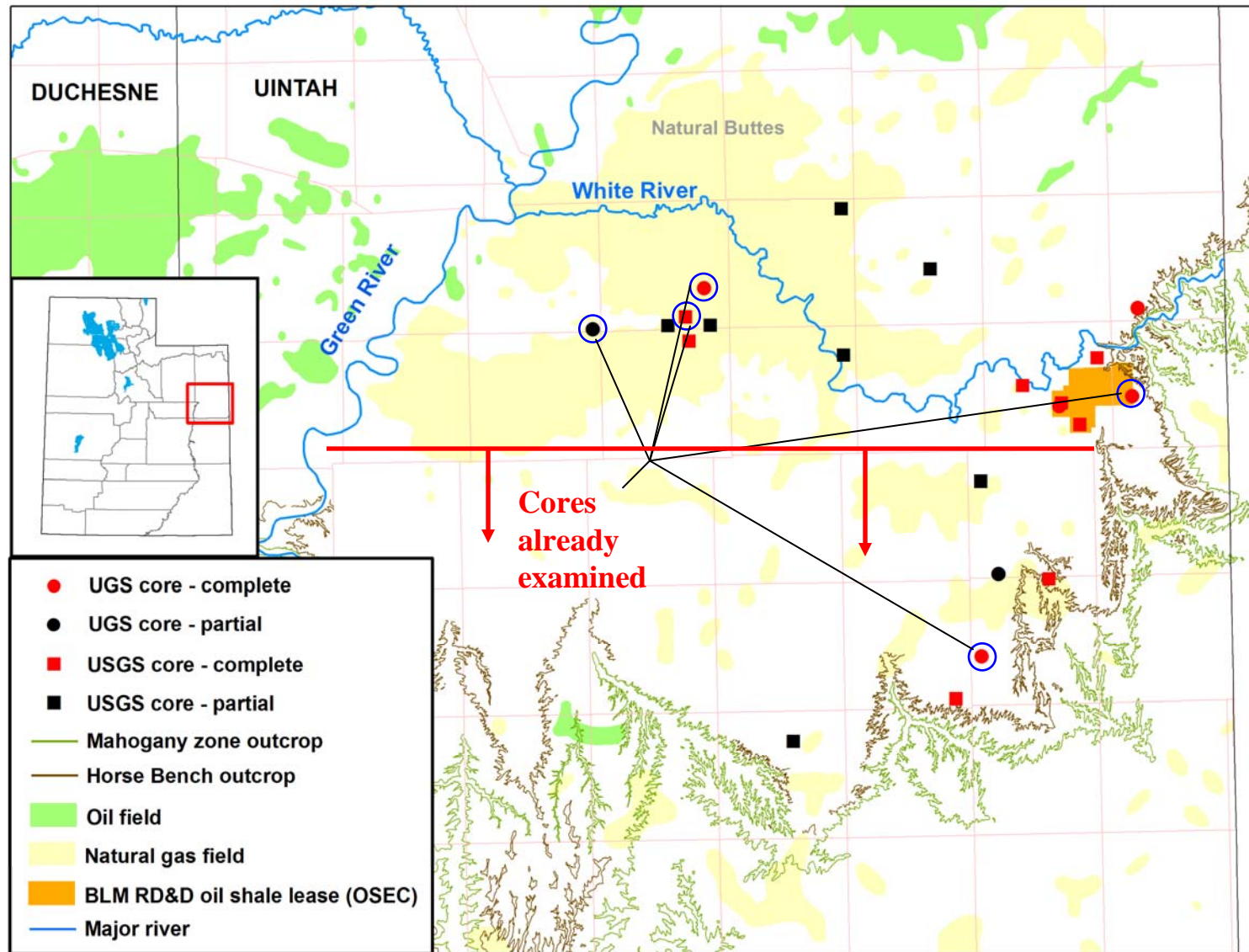




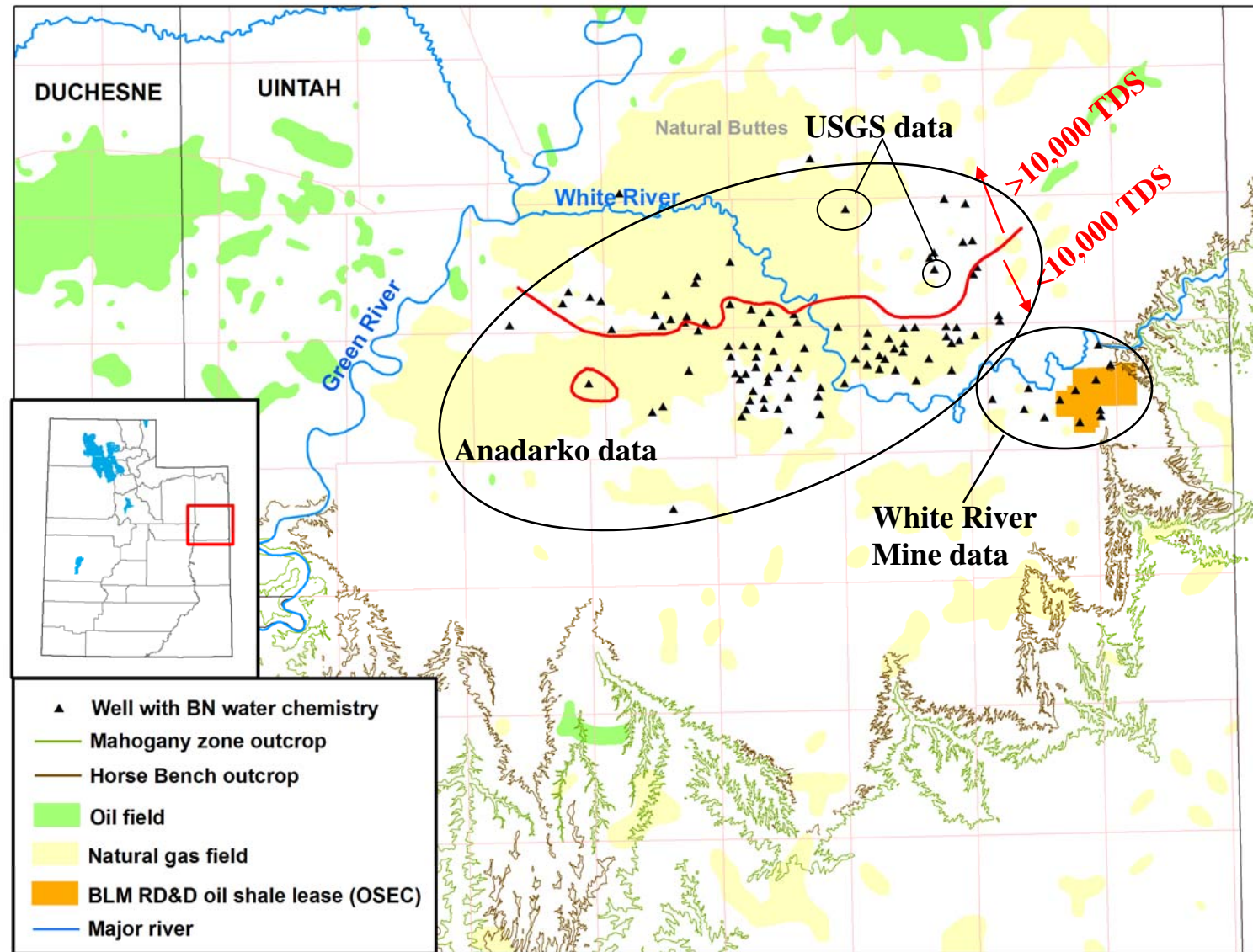




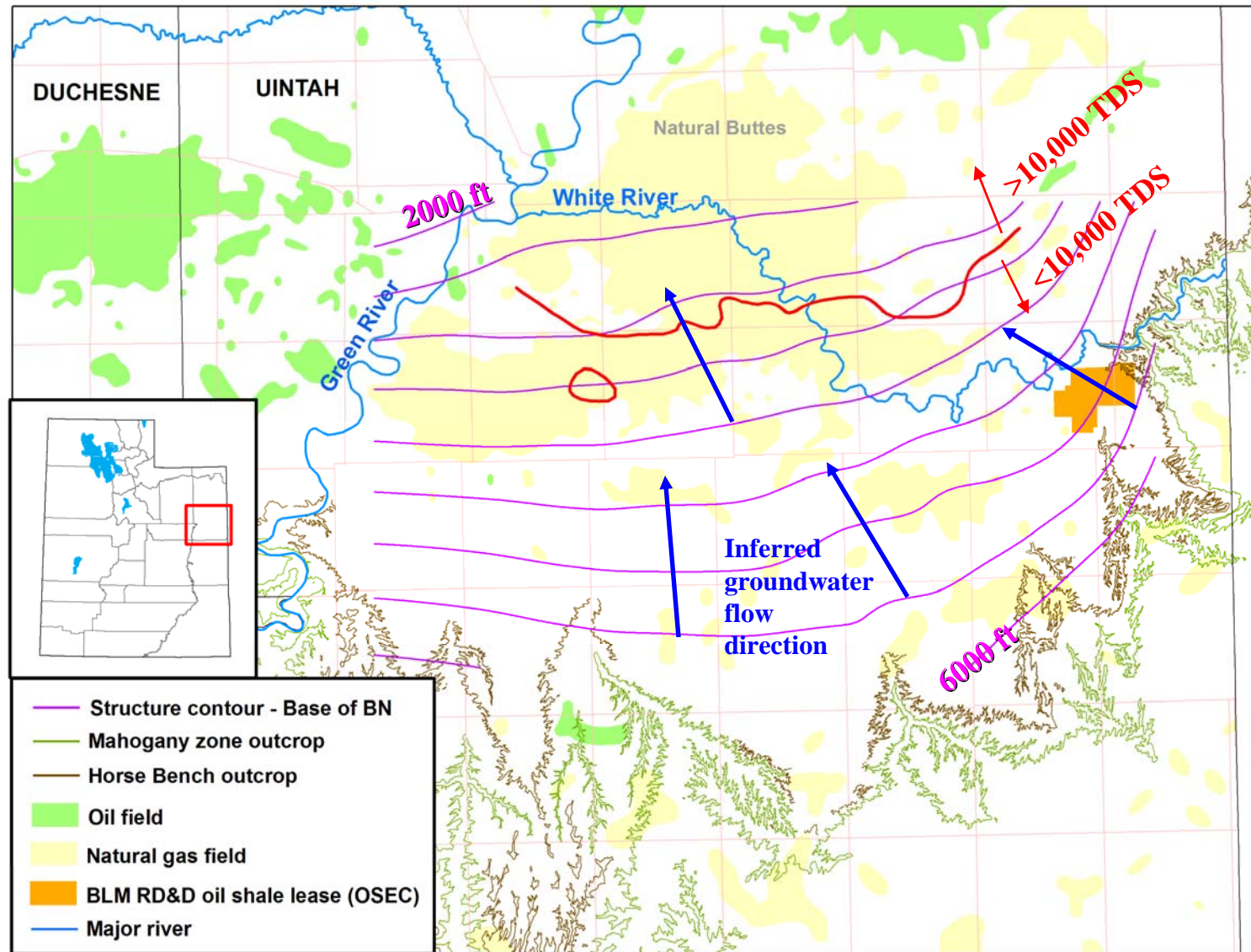
# Core is the key to understanding the Birds Nest aquifer



# Water quality in the Birds Nest (BN) aquifer

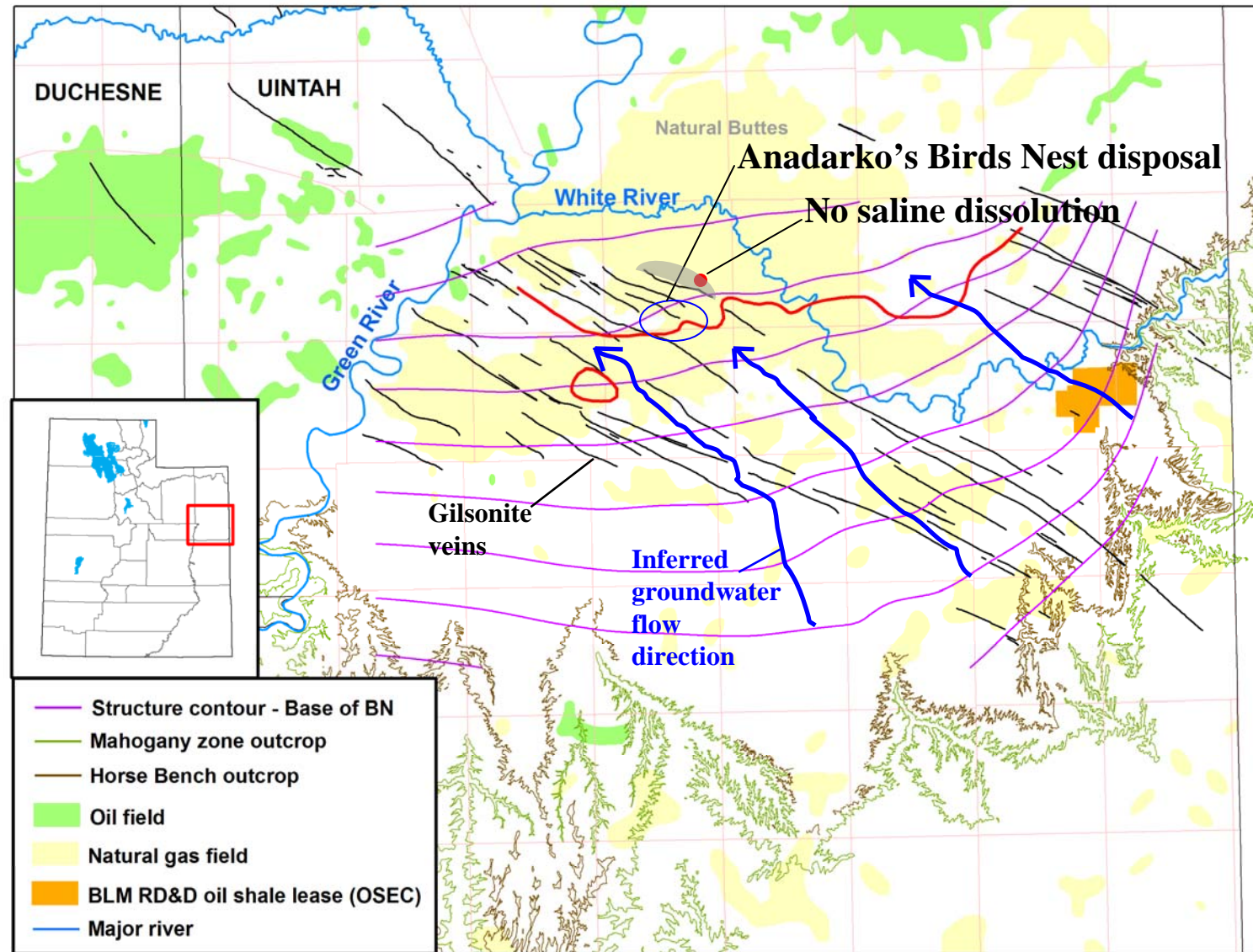


# Water quality in the Birds Nest (BN) aquifer





# Water Movement May be Affected by Gilsonite Veins





# Thoughts, Conclusions, and Future Work

- **It is difficult to recognize the Birds Nest aquifer on geophysical logs**
  - This zone can only be recognized on a bulk density log (or possibly on a decent caliper log) where significant nahcolite beds/nodules (or dissolution) are present - this only occurs in the center of the basin (~8S to 10 S)
  - Saline deposition further south (11S to 13S) shows no log signature (core shows a lack of large beds/nodules)
  - It is important not to mistake low-density, high-organic oil shale as saline minerals

**Future Work: Evaluate logs where the Birds Nest is visible and record top, bottom, etc.**

- **The key to regional characterization will be core descriptions**
  - These oil shale cores have only recently become available
  - To date, UGS has looked at 5 cores

**Future Work: Evaluate each core containing Birds Nest (22 total)**

# Thoughts, Conclusions, and Future Work

- **The affect of saline water disposal into the Birds Nest aquifer on oil shale development depends on where the top of the economic oil shale is picked**
  - Mining of oil shale within the Birds Nest zone is unlikely
  - *In-situ* extraction techniques might utilize oil shale within the Birds Nest zone depending on where the top of economic oil shale is picked (Bed 76 or top of Big 3)

## **Future Work: Determine oil shale resources within the Birds Nest**

- **How do gilsonite veins and associated fractures affect the Birds Nest aquifer**
  - Is water traveling up or down the gilsonite/rock interface?
  - Not all joints are filled with gilsonite, is water traveling along these unfilled joints?
  - Are gilsonite veins a barrier to flow?

## **Future Work: Examine gilsonite/wall rock properties**

# Thoughts, Conclusions, and Future Work

- **How is the Horse Bench Sandstone related to the Birds Nest Aquifer**

- The Horse Bench is prominent in the east (core and outcrop) and to the southwest (outcrop), but is not present in core from the center of the basin (maybe it is, but is only 1 to 2 feet thick)
- Is the eastern “Horse Bench” the same as the western “Horse Bench” – they seem to be different units of sand coming from different places

**Future Work: Continue outcrop and core evaluation of the Horse Bench Sandstone**