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







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Year 2 Review

UGS project website: geology.utah.gov/emp/UBwater_study

Outline

- Project Overview Birds Nest aquifer introduction
- Examination of cores
- Examination of outcrops
- Regional cross sections
- Relationship with gilsonite veins

Research Project

- Overall Goal: Assess aquifers in the Uinta Basin to determine where saline water (produced along with conventional petroleum development) can be disposed without harming fresh water resources
- Specific Problem: The Birds Nest aquifer has been identified by Uintah County natural gas producers as a zone suitable for large-scale saline water disposal; however, this aquifer is poorly understood and needs further study to determine potential impacts of proposed/active disposal
 - Relationship to fresh water resources
 - Potential effects on future oil shale development





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- U.S. DOE National Energy Technology Laboratory
- Utah Geological Survey

Task 3: Geologic Examination of the Birds Nest Aquifer

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, write report



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





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Location: Restricted to central Uintah County



Water quality in the Birds Nest (BN) aquifer



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Core is the key to understanding the Birds Nest Aquifer



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Southern margin: SUB 12 - 12S 24E sec. 19

Southern margin: SUB 12 - 12S 24E sec. 19

Eastern margin: P-4 - 10S 25E sec. 19

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Outcrop studies

Bitter Creek Section – no large saline nodules

SNAWATO

Outcrop studies

Long Draw Section – no large saline nodules

- Mahogany zone outcrop
 Horse Bench outcrop
 Oil field
 Natural gas field
- BLM RD&D oil shale lease (OSEC)
- Major river

Outcrop studies

Watson Section – three thin layers of large saline nodules

Outcrop studies

Evacuation Creek Section – abundant large saline nodules

Horse Bench SS

Saline zone

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Earliest Saline Deposition

Earliest Saline Deposition

Latest Saline Deposition

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Figure 6. Cross section of a typical gilsonite vein (from Eldridge, 1901).

Gilsonite Veins

Birds

Nest

Evidence for gilsonite influencing groundwater

Evidence for gilsonite influencing groundwater

Bonanza Vein
- Highly fractured gilsonite
- 630 ft depth (Uinta Em)
- Lots of water infiltration
(from wall rock and vein)

OLYMPUS

Independent Vein - "Solid" gilsonite - 230 ft depth (Uinta Fm) - Minor water infiltration (from wall rock)

Gilsonite vein cross-cutting the Birds Nest aquifer

Gilsonite vein cross-cutting the Birds Nest aquifer

Gilsonite vein cross-cutting the Birds Nest aquifer

Work to complete before Sept 2011

- Finish core logs (8 more) and measured sections (at least 1 more)
 correlate
- Finish three more regional cross sections to help determine areal extent
- Create various isopach/structure contour maps
- Complete database of water chemistry and tops information
- etc.

Thoughts and Conclusions

• The effect of saline water disposal into the Birds Nest aquifer on oil shale development depends on the value of leaner deposits

- The saline zone in general will likely be bypassed by both mining and in-situ processes

- Oil shale within the saline zone is lean compared to richer targets below
- Mining will focus on outcrop sections of rich oil shale below the saline zone
- In-situ extraction will likely target deposits below the Big-3 bed, ~70 feet below the saline zone
- However, if water can travel vertically through the section via fractures or gilsonite veins, future development could be adversely affected

• Core descriptions are key to the regional characterization of the Birds Nest aquifer

- These oil shale cores have only recently become available
- Geophysical logs only recognize the large saline nodules and layers
- To date, UGS has described 14 of 22 cores

Thoughts and Conclusions

• Gilsonite veins may act as barriers to flow in some areas and pathways for vertical movement of water in others

- Depends on the type of gilsonite (solid or fractured)
- Depends on vein thickness
- Little information is available on the gilsonite veins found at depth near the center of the basin where active saline water disposal is taking place

