

Water-Related Issues Affecting Conventional Oil and Gas Recovery and Potential Oil Shale Development in the Uinta Basin, Utah

DE-NT0005671

Goal

The Uinta Basin water study will help alleviate problems associated with produced saline water as a means to facilitate increased conventional hydrocarbon production and help resolve water-related environmental barriers to possible oil shale development.

Performers

Utah Geological Survey, Salt Lake City, Utah

Background

Saline water disposal is the single most pressing issue with regard to increasing petroleum and natural gas production in the Uinta Basin of Utah. Conventional oil fields in the basin provide 69% of Utah's total crude oil production and 71% of Utah's total natural gas, the latter of which has increased 175% in the last 10 years (Utah Division of Oil, Gas and Mining, 2008). As petroleum production increases, so does saline water production, creating an increased need for economic and environmentally responsible disposal plans. Current water disposal wells are near capacity and permitting for new wells is being delayed because of a lack of technical data regarding potential disposal aquifers and questions concerning contamination of fresh water sources. Many Uinta Basin operators claim that petroleum and natural gas production cannot reach its full potential until a suitable, long-term saline water disposal solution is determined.

Currently, the agencies responsible for regulating the disposal of produced water use 20-year-old data amassed in a publication titled "Base of Moderately Saline Ground Water in the Uinta Basin, Utah" to try and determine zones suitable for water disposal (Howells and others, 1987). This hard copy publication provides a paper map showing the depth of the transition between moderately saline and very saline water (10,000 mg/L), below this depth it is believed saline water can be injected without damage to overlying fresh-water aquifers. Several oil and gas operators working in the basin believe this dated study needs substantial revision. The original map was based solely on calculations of water quality from geophysical logs, a method with several limitations (e.g. tar sands were recognized as fresh water aquifers).

Eastern Uinta Basin gas producers claim that one of the only aquifers suitable for large volume saline water disposal is the Birds Nest aquifer located in the Parachute Creek Member of the Green River Formation (Figure 1). After an extensive literature search, it was determined that the Birds Nest aquifer is poorly understood and further study is necessary before large scale saline water disposal commences. The Birds Nest aquifer is typically several hundred feet above the richest oil shale interval called the Mahogany zone. A significant concern is that saline water disposal into the Birds Nest by conventional gas producers may hinder oil shale development by creating unforeseen economic and technical hurdles. In many areas containing rich oil shale deposits, the Birds Nest contains fresh to slightly saline water (Holmes and Kimball, 1987) (Figure 2). With increased saline water disposal, the quality of the water in the Birds Nest could degrade and create additional water disposal problems for oil shale development companies.

In addition to the water-related problems mentioned above, there is a regulatory need for baseline water quality and quantity data for lands proposed for oil shale development



Figure 1. Birds Nest aquifer as exposed in outcrop, Evacuation Creek, Uintah County, Utah. This aquifer lies several hundred feet above the richest oil shale unit.

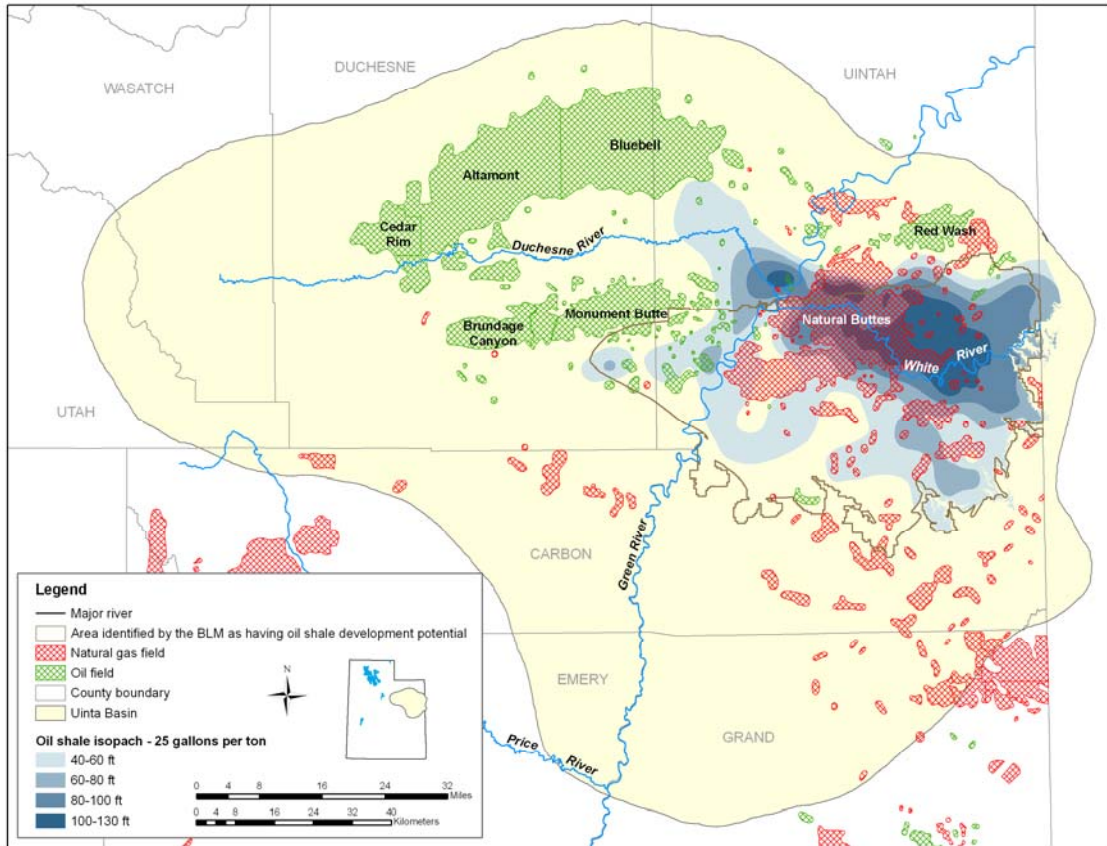


Figure 2. Map showing study area, Uinta Basin, Utah. Note the prime oil shale area overlaps with several natural gas fields.

(Figure 2). Water-quality degradation could result from new oil shale developments, via mining and surface retort or in-situ processes. An up-to-date GIS database would provide the baseline water information needed to understand potential impacts of future oil shale development.

Potential Impacts

Each successful part of this multi-faceted study will provide the information needed to achieve our two goals: alleviating problems associated with produced saline water as a means to facilitate increased conventional hydrocarbon production and resolving environmental barriers to possible oil shale development.

Utilizing the newly developed GIS maps, regulators and oil and natural gas operators can make informed saline water disposal management decisions and protect fresh water resources. If new, appropriate saline water disposal intervals can be identified, like the Birds Nest aquifer, oil and natural gas production can continue to increase, supplying the nation's growing demand with safe, domestic resources. In addition, environmentally sound water management solutions for a future oil shale industry can be developed once the sensitivities of alluvial and bedrock aquifers within potential oil shale development regions are understood.

Accomplishments

- Created project website: http://geology.utah.gov/emp/UBwater_study
- Completed a Water Quality Assurance Plan and initiated sample collection
- Collected water chemistry data from over 1100 wells in the Uinta Basin
- Developed improved techniques for determining the base of the moderately saline aquifer from geophysical logs
- Created an extensive (>350 wells) database of oil shale formation tops

- Performed a detailed core analysis of the Birds Nest aquifer (2 wells)
- Presented poster outlining project at the AAPG Annual meeting in June 2009

Current Status

The project is moving along as scheduled with plans to complete the following by the end of the year:

- Finish collecting first-year water samples and begin sample analysis
- Continue examining well logs to determine the base of the moderately saline aquifer
- Analyze the Birds Nest aquifer in outcrop and additional core
- Present paper at the 29th Oil Shale Symposium detailing the relationship between the Birds Nest aquifer and potentially economic oil shale deposits

Project Start: October 1, 2008

Project End: September 30, 2011

DOE Contribution: \$688,222

Performer Contribution: \$172,056

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