

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

DE-NT0005671

Goal

Data collected during this Uinta Basin water study will help regulators, as well as oil and gas operators, mitigate problems associated with disposal of produced saline water – a by-product of increased conventional hydrocarbon production. This gathered information will also assist in evaluating water-related environmental barriers to possible oil shale development.

Performers

Utah Geological Survey, Salt Lake City, Utah, 84114

Collaborators

- Uinta Basin Petroleum Companies – Questar, Anadarko, Newfield, Enduring Resources, Bill Barrett, Berry Petroleum, EOG Resources, El Paso, FIML, Wind River Resources, Devon, Rosewood, Flying J, Gasco, Mustang Fuel, Forest, Royale, BT Operating, Elk Resources, McElvain, Summit Operating, Whiting Petroleum, Pendragon, Bayless, JW Operating, Oil Shale Exploration Company
- Utah Division of Oil, Gas, and Mining
- U.S. Bureau of Land Management
- U.S. Geological Survey
- U.S. Environmental Protection Agency – Region 8

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 67% of Utah's total crude oil production and 70% of Utah's total natural gas, the latter of which has increased 60% in the past 10 years (Utah Division of Oil, Gas and Mining, 2009). 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 impacts to 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 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). It is believed that saline water can be injected below this depth without damage to overlying fresh-water aquifers. Several oil and gas operators working in the basin believe this dated study requires 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 identified as fresh water aquifers).



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.

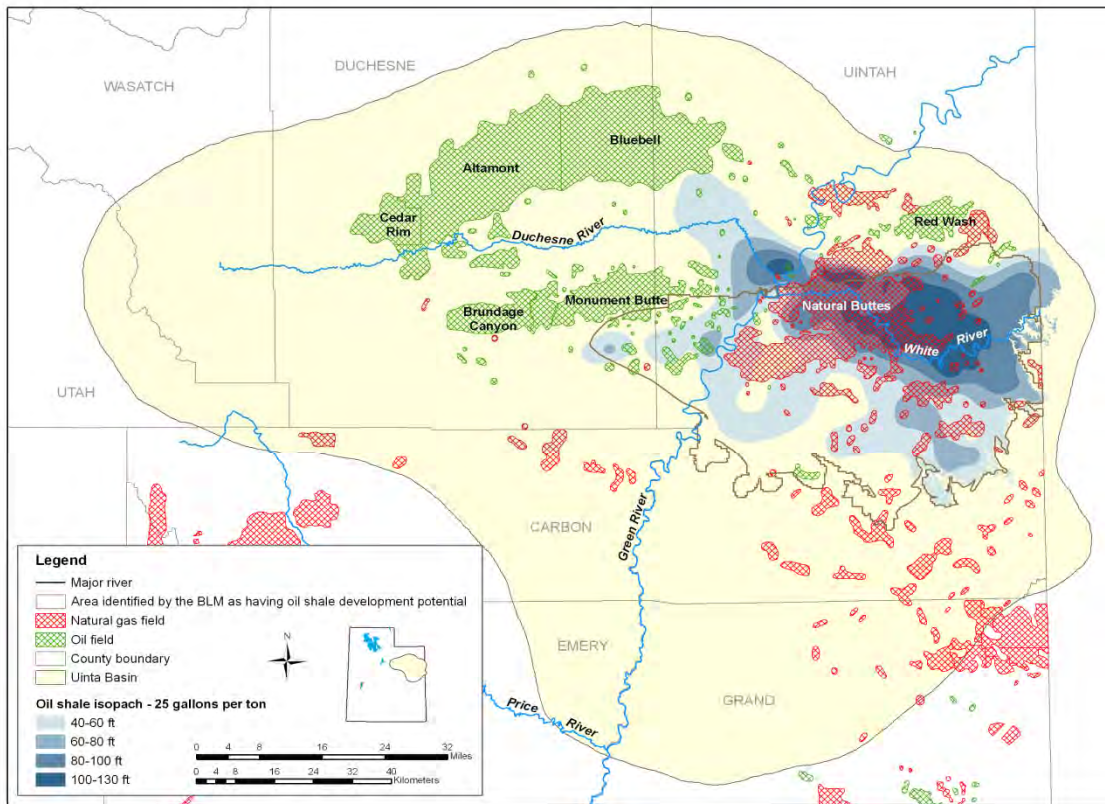


Figure 2. Map showing study area, Uinta Basin, Utah. Note the prime oil shale area overlaps with several natural gas fields.

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 can commence. 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). By increasing saline water discharge into the aquifer, the Birds Nest water quality could degrade, creating 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 covering proposed oil shale development lands (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 Geographic Information System (GIS) database would provide the baseline water information needed to understand potential impacts of future oil shale development.

Impact

Each successful part of this multi-faceted study will provide the information needed to achieve the above stated goals: mitigate problems associated with produced saline water disposal as a means to facilitate increased conventional hydrocarbon production and identify water disposal practices that could create environmental barriers to potential oil shale development.

Utilizing the newly developed GIS maps, regulators and oil and natural gas operators will be able to make more informed saline water disposal management decisions and protect fresh water resources. If new, appropriate

saline water disposal intervals can be identified, similar to the Birds Nest aquifer, oil and natural gas production can continue to increase, supplying the nation's growing demand with safe, convenient domestic resources. Additionally, 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 water sample collection and analysis
- Collected over 2300 water chemistry analyses from over 1200 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 detailed analyses on 10 of 21 cores capturing all or part of the Birds Nest aquifer
- Presented project overview and preliminary results at several national meetings: American Association of Petroleum Geologists, Ground Water Protection Council, Annual Oil Shale Symposium
- Hosted first annual review meeting in Vernal, UT in October 2009
- Prepared an article for the May 2010 *Survey Notes* summarizing project goals and results (*Survey Notes* is a UGS magazine published three times a year).

Current Status (July 2010)

With the project just past the halfway point, the study is on schedule to achieve the goal of better understanding aquifers in the Uinta Basin to help facilitate safe and efficient saline water disposal. The Task 2 team has collected hundreds of down-hole water chemistry analyses and hundreds of digitized log files to aid in picking the base of the moderately saline aquifer. The Task 3 team has described 10 of an available 21 cores containing all or part of the Birds Nest aquifer as a means to better understand the zone's lateral and stratigraphic characteristics. The Task 4 team has collected the third consecutive set of samples from ~20 sites in central Uintah County as part of a biannual sampling plan to develop baseline water quality in the area. Several more months of data collection and analysis are scheduled before the final interpretation and synthesis can begin in year three.

Project Start: October 1, 2008

Project End: September 30, 2011

DOE Contribution: \$688,222

Performer Contribution: \$172,056

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