

## **Northern Cheyenne Indian Reservation (NCIR) Coalbed Natural Gas Resource Assessment and Analysis of Produced-Water Disposal Options**

**FEW-4340-72**

### **Program**

This project was selected under DOE's Oil Exploration and Production Partnership program through the Native American Initiative.

### **Project Goal**

The project objectives were to 1) analyze the coalbed natural gas (CBNG) production potential under the NCIR and 2) evaluate handling options for the coproduced water to minimize impacts on the environment with emphasis on the reinjection of produced water

### **Performers**

Idaho National Laboratory (INL)  
Idaho Falls, ID

Montana Bureau of Mines and Geology (MBMG)  
Billings, MT

Natural Resources Department  
Northern Cheyenne Tribe  
Lame Deer, MT

### **Project Results**

The achievements of the project include assessing the coal seams and CBNG resources, simulation forecasts of methane and water production, analysis of coalbed water characteristics, economics of water handling options, and an assessment of reinjecting CBNG water into channel sandstone units.

### **Benefits**

This project provided the Tribe a first-hand assessment of the CBNG and water resource on Tribal land. The best water-handling option for the Tribe might be a combination of shallow injections into channel sandstone units, with some produced water used for livestock watering, as well as domestic, municipal, and commercial uses. The methodology used in this project should be applicable to the neighboring areas in the Powder River Basin (PRB), where the CBNG water characteristics are similar.

### **Background**

CBNG development in the PRB is one of the most active natural gas plays in the United States. The NCIR is located on the northwest flank of the PRB with a total of 445,000 acres. The CBNG resource represents a significant potential asset to the Tribe. Because the production of CBNG involves the dewatering of coalbeds, the relatively large volume of the coproduced water and its potential environmental impacts are the primary concerns for the Tribe.

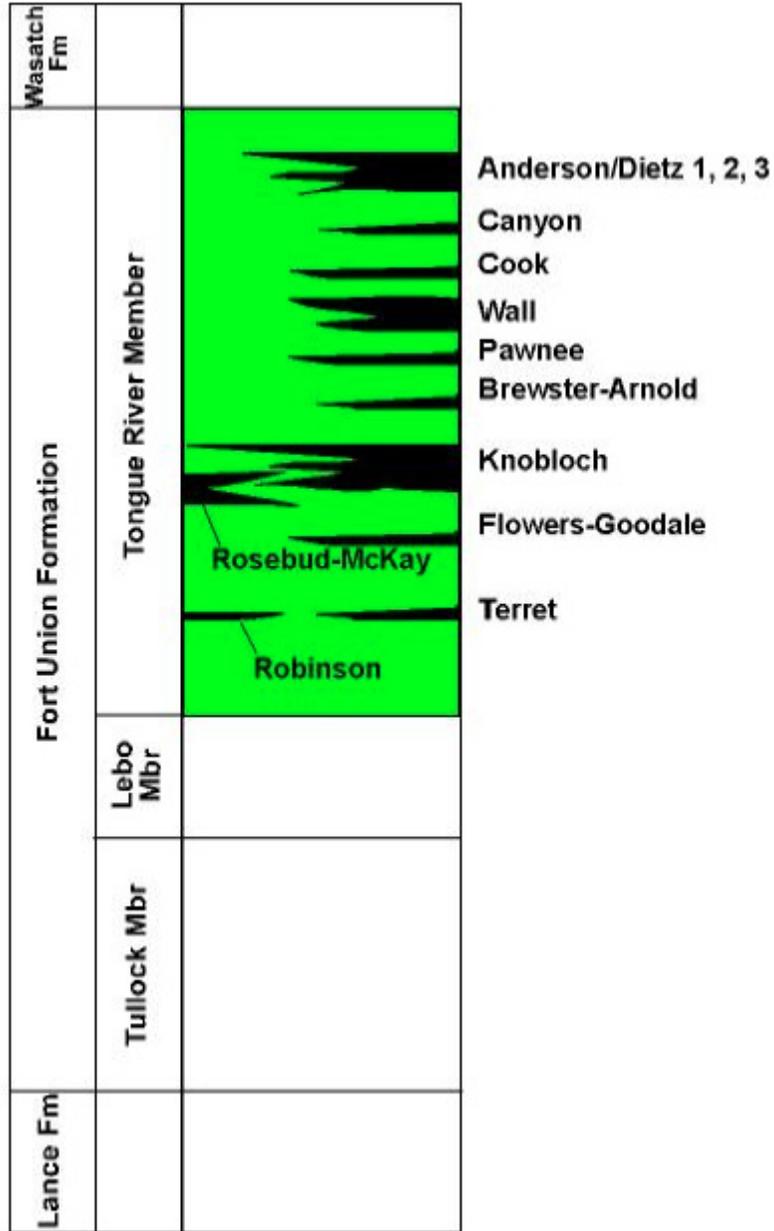
### **Project Summary**

The distribution of major coal beds and the potential original-gas-in-place (OGIP) have been assessed. Estimates of CBNG resources are restricted by an agreement between the Tribe and project partners. They are considered proprietary data and are not presented in the final report. Other accomplishments include 1) a detailed description of regional geology and stratigraphic column of coal beds, 2) identifying and mapping shallow channel sandstones suitable for water disposal by reinjection, 3) assessing the water in the coal beds, 4) simulating and forecasting water production for major coal seams, 5) evaluating CBNG water quality and its potential impacts and beneficial uses, 6) reviewing the economics of alternative water-handling options, and 7) assessing the water injectivity in the identified channel sandstones. The sodium adsorption ratio (SAR) values from collected water samples range from 33 to 66, compared with an average value of 25.5 in the PRB. Surface discharge of untreated CBNG water will have adverse impacts on local soil and native plants. Although the Environmental Protection Agency (EPA) and the State of Montana currently do not have any numeric criteria for surface water, the Tribe has submitted a Draft Surface Water Quality Standard (DSWQS) to EPA. For the waters in the Tongue River, Rosebud Creek, and their tributaries, monthly average values of 3.0 for SAR, 2.0 dS/m for electrical conductivity, and 1,320 mg/L for total dissolved solids were proposed for the non-irrigation period (November 15-March 31). Even lower numeric criteria were proposed for the irrigation period (April 1-November 15). It is very likely that any surface-discharged CBNG water will be required to meet the Tribe's DSWQS. The quality of CBNG water is sufficient for domestic and livestock uses and other anticipated industrial and economic uses. Four options were evaluated for dealing with CBNG produced water: 1) surface discharge with water treatment, 2) direct use without treatment, 3) deep injection below the Lebo Member of the Fort Union Formation, or 4) shallow injection into the channel sandstone units above the Lebo Member. Various treatment technologies for SAR reduction have been tested, but most of them have not been proven to be economical. Surface discharge probably will not be economical for the Reservation if discharged CBNG water is required to meet the Tribe's DSWQS. Deeper injection is apparently more expensive than shallow injection. More importantly, the valuable CBNG water could be degraded by deeper injections. Therefore, the best

option for the Tribe might be a combination of shallow injection with some of the produced water being directly used for livestock watering and domestic, municipal, and commercial uses.

**Current Status (October 2005)**

The project is completed.



Coal stratigraphy in the Northern Cheyenne Indian Reservation.



Channel sandstones at the north edge of the Northern Cheyenne Indian Reservation.

**Publications**

Wo, Shaochang, Lopez, David A., and Whiteman Sr, Jason, Northern Cheyenne Reservation Coal Bed Natural Resource Assessment and Analysis of Produced-Water Disposal Options, final report submitted to DOE, July 2004.

Lopez, David A., Resource Assessment and Analysis of Produced-Water Disposal Options North Cheyenne Reservation, Southeast Montana, AAPG Annual Convention, Salt Lake City, UT, May 11-14, 2003.

**Project Start:** September 13, 2001

**Project End:** April 30, 2004

**Anticipated DOE Contribution:** \$250,000

**Performer Contribution:** \$0

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