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Valley-Fill Sandstones in the Kootenai Formation on the Crow Indian Reservation, South-Central Montana

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VALLEY-FILL SANDSTONES IN THE KOOTENAI FORMATION ON THE CROW INDIAN RESERVATION, SOUTH CENTRAL MONTANA

QUARTERLY TECHNICAL REPORT

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Abstract

Subsurface data continues to be collected, organized, and a digital database is being prepared for the project. An ACCESS database and PC-Arcview is being used to manage and interpret the data. Well data and base map data have been successfully imported into Arcview and customized to meet the needs of this project. Log tops and other data from about ¾ of the exploration wells in the area have been incorporated into the data base.

All of the four 30' X 60' geologic quadrangles have been scanned to produce a digital surface geologic data base for the Crow Reservation and all are nearing completion. Formal technical review prior to publication has been completed for all the quadrangles; Billings, Bridger; Hardin, and Lodge Grass. Final GIS edits are being made before being forwarded to the Bureau's Publications Department.

Field investigations were completed during the third quarter, 1997. With the help of a student field assistant from the Crow Tribe, the entire project area was inventoried for the presence of valley-fill deposits in the Kootenai Formation. Field inventory has resulted in the identification of nine exposures of thick valley-fill deposits. These appear to represent at least four major westward-trending valley systems. All the channel localities have been measured and described in detail and paleocurrent data has been collected from all but one locality. In addition, two stratigraphic sections were measured in areas where channels are absent. One channel has bee traced over a distance of about 60 miles and exhibits definite paleostructural control. An abstract describing this channel has been submitted and accepted for presentation at the Williston Basin Symposium in October, 1998.

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Executive Summary

Subsurface data is being collected, organized, and a digital database is being prepared for the project. An ACCESS database and PC-Arcview are being used to manage and interpret data. Land grid data (Township, Range, and Section) and well data have been imported into Arcview. Logs from about ¾ of the oil and gas exploration wells in the area have been correlated and data has been incorporated in the data base.

All of the four 30' X 60' geologic quadrangles have been scanned to produce a digital surface geologic data base for the Crow Reservation and all are nearing completion. Formal technical review of all the quadrangles is complete and final GIS revisions are underway. These maps will be forwarded to Bureau Publications Division shortly to begin the printing process.

Field investigations were completed during the third quarter, 1997 With the help of a student field assistant from the Crow Tribe, the entire project area was inventoried for the presence of valley-fill deposits in the Kootenai Formation. Field inventory has resulted in the identification of nine exposures of thick valley-fill deposits. These appear to represent at least four major westward-trending valley systems. All the channel localities have been measured and described in detail and paleocurrent data has been collected from all but one locality. In addition, two stratigraphic sections were measured in areas where channels are absent. All of these data have been compiled and processed digitally. Some of these channels have been identified in the subsurface. Locally, channels over 100 feet thick have been identified on well logs.

Introduction

The stratigraphic study of the valley-fill sandstones in the Kootenai Formation was begun in August, 1996 with reconnaissance field work to locate the exposures of channel sandstone deposits. Subsurface aspects of the project were begun in the second quarter and are continuing.

The production and publication of surface geologic maps of the Crow Reservation area is nearing completion. An oil and gas training seminar for Crow Tribal members was completed in the third quarter.

Results and Discussion

Subsurface data collection was begun in the second quarter of this project, and continues this quarter. A collection of most of the oil and gas well logs for the Crow Reservation area was donated to the project by a company that had initiated an exploration program on the Reservation several years ago. These have been filed and inventoried to determine missing well coverage. Subsurface log cross sections have been constructed for correlation purposes and to identify channel facies.

A digital data base of commercially available "scout card" data has been generated using Microsoft Access. PC-Arcview is being used for map generation and interpretation. The well data and land grid data (Township, Range, and Section) have been imported into Arcview. Data tables for stratigraphic well log data specific to this project have been designed and data is currently being compiled. Logs from about ¾ of the exploration wells in the study area have been correlated and tops and other data have been entered into the data base. Several Greybull valley-fills have been identified in the subsurface; some of which are about 100 feet thick.

Geologic maps of all four 30' X 60' quadrangles that encompass the Crow Reservation have been digitally scanned for the geologic data base that will be provided to the Crow Tribe. These are all nearing completion. Technical reviews prior to publication of the all the quadrangles are completed and final GIS revisions are underway. These will all be forwarded the Bureau Publications Division shortly to begin the printing process

Field investigations were completed during the third quarter, 1997. The entire project area was inventoried for the presence of valley-fill deposits in the Kootenai Formation. Field inventory has resulted in the identification of nine exposures of major valley-fill deposits. These appear to represent at least four major westward-trending valley systems. All the channel localities have been measured and described in detail and paleocurrent data has been collected from all localities. In addition, two stratigraphic sections were measured in areas where channels are absent. All the measured sections have been digitally plotted using LogPlot97 by Rockware. Paleocurrent data from all exposures

have been compiled, tabulated, and rose diagrams have been constructed using SpheriStat for Windows by Pangaea Scientific.

One channel has been mapped over a distance of about 60 miles. Paleocurrent data, and the trace of the channel, document definite paleostructural control on the trend of this channel (Figure 1). This fact will be extremely useful in predicting the subsurface extensions of Greybull channels. An abstract describing this channel has been submitted and accepted for presentation at the Williston Basin Symposium in October, 1998. A copy of the abstract follows at the end of this report.

Reconnaissance investigations of valley-fill deposits in the Bighorn Basin to the west have also been conducted. Preliminary results indicate that some of these channels appear to be continuations of the channels identified on the Crow Reservation.

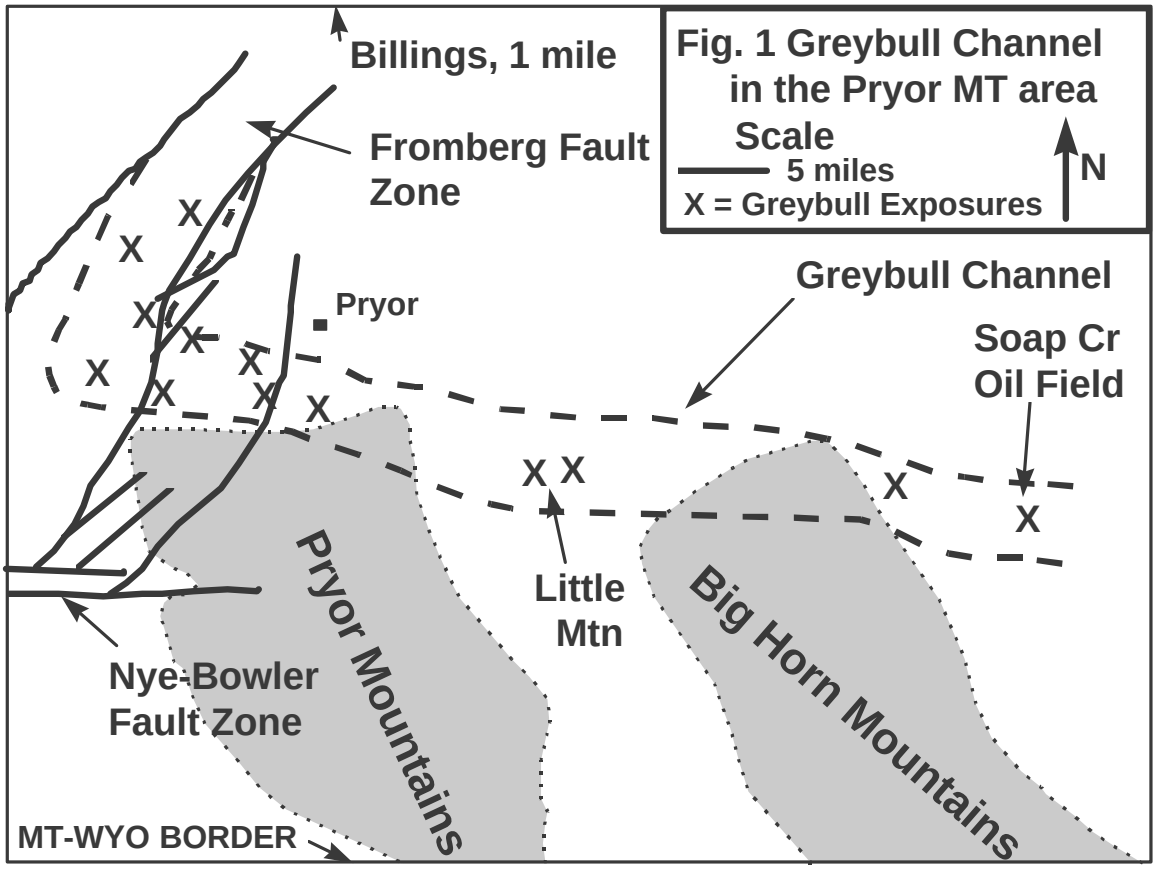
Two follow-on proposals to this project have been submitted to the Department of Energy office in Tulsa, Oklahoma during this quarter. The first proposes to do a soil-gas evaluation of leads generated by this project. The second proposes to extend the subsurface evaluation designed for this project eastward across the adjoining Northern Cheyenne Reservation.

Conclusion

Subsurface data is being collected, organized, and a digital database is being prepared for the project. Data from about ¾ the exploration wells in the area has been compiled. The database is being managed with Microsoft Access and PC-Arcview, which is also being used for map generation and interpretation.

All four 30' X 60' geologic quadrangles have been scanned to produce a digital surface geologic data base for the Crow Reservation. All quadrangles are nearing completion. Technical reviews for the all the quadrangles are completed and GIS revisions are being made.

Field investigations were completed in the third quarter, 1997. Four major westward-trending valley systems have been identified. Measured sections of all localities have been completed, and compiled and plotted digitally. Paleocurrent data has also been compiled and statistically analyzed using digital methods. Several of these channels have been identified on well logs in the subsurface.


Billings, 1 mile
Fig. 1 Greybull Channel
in the Pryor MT area
Scale
5 miles
X = Greybull Exposures
N
Fromberg Fault
Zone
Greybull Channel
Pryor
Soap Cr
Oil Field
Little
Mtn
Pryor Mountains
Big Horn Mountains
Nye-Bowler
Fault Zone
MT-WYO BORDER

A Lower Cretaceous Fluvial Channel (Greybull Sandstone) in south-central Montana

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The Greybull Sandstone occupies incised valleys that were cut into the top of the Lower Cretaceous, non-marine Kootenai Formation during a marine low stand. On the Crow Reservation four major Greybull channels have been identified in surface exposures. These valley-fill sandstones are about 30 m (100 feet) thick, and are up to 3 km (2 miles) wide. Paleo-current analysis of these fluvial sandstones indicates that transport was generally westward. The source of the sand is presumed to be the Sioux Quartzite in the South Dakota—Minnesota area.

One of these Greybull channels can be traced on the surface for about 100 km (60 miles) from Soap Creek Oil Field, near the north end of the Big Horn Mountains, to Cottonwood Creek located northwest of the town of Pryor. East of Pryor the channel trend and transport directions are generally westward. Southwest of Pryor, the channel turns abruptly northward. Then in the Cottonwood Creek area the channel swings to the northeast before it reaches the limit of its surface exposure. Both paleo-current data and the mapped trace of the valley-fill display this pattern.

The abrupt changes in direction coincide with faults of the Nye-Bowler and Fromberg Fault systems. These faults are basement controlled and are interpreted to have exerted structural control on the trace of the Greybull channel, causing the abrupt changes in flow direction. An understanding of structural control will be important in helping to predict the location of this and other Greybull channels in the subsurface for oil and gas exploration.