

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

Quarterly Technical Report

Reporting Period: 07/01/1998 - 09/30/1998

Authors: David A. Lopez

Report Issue Date: 10/14/1998

DE-FG22-96BC14996 -02

Montana Bureau of Mines and Geology
MSU-Billings, Campus Box 112
1500 N 30th Street
Billings, MT 59101

Disclaimer

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

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 most of the exploration wells in the area have been incorporated into the data base; only a few wells outside the reservation remain to be incorporated.

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. All four quadrangles are in the Bureau's Publications Department being prepared for submittal to a printer.

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 been 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.

A follow on proposal to conduct a soil gas geochemical survey of the reservation was approved and the contract was received in late August. The sampling will be conducted next summer and will involve Crow students.

Table of Contents

Abstract	2
Executive Summary	4
Introduction	5
Results and Discussion	5
Conclusion	6

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 most 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 have been made. These maps are all in the Bureau Publications Division being prepared for submittal to a printer.

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.

A follow-on proposal to conduct a soil gas geochemical analysis of the reservation has been approved and the contract was received in late August. The field work for this part of the project take place in early summer 1999. Two Crow students will be hired to help with this survey; it is intended that the students will be from Little Big Horn College, the Crow tribal college.

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 most of the exploration wells in the study area have been correlated and tops and other data have been entered into the data base. Only a few wells in the area just outside the reservation remain to be added to the database. 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. Technical reviews prior to publication of the all the quadrangles are completed as well as final GIS revisions. All four quadrangles are in the Bureau Publications Division being prepared for submittal to a printer that can handle the publication of full color maps.

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.

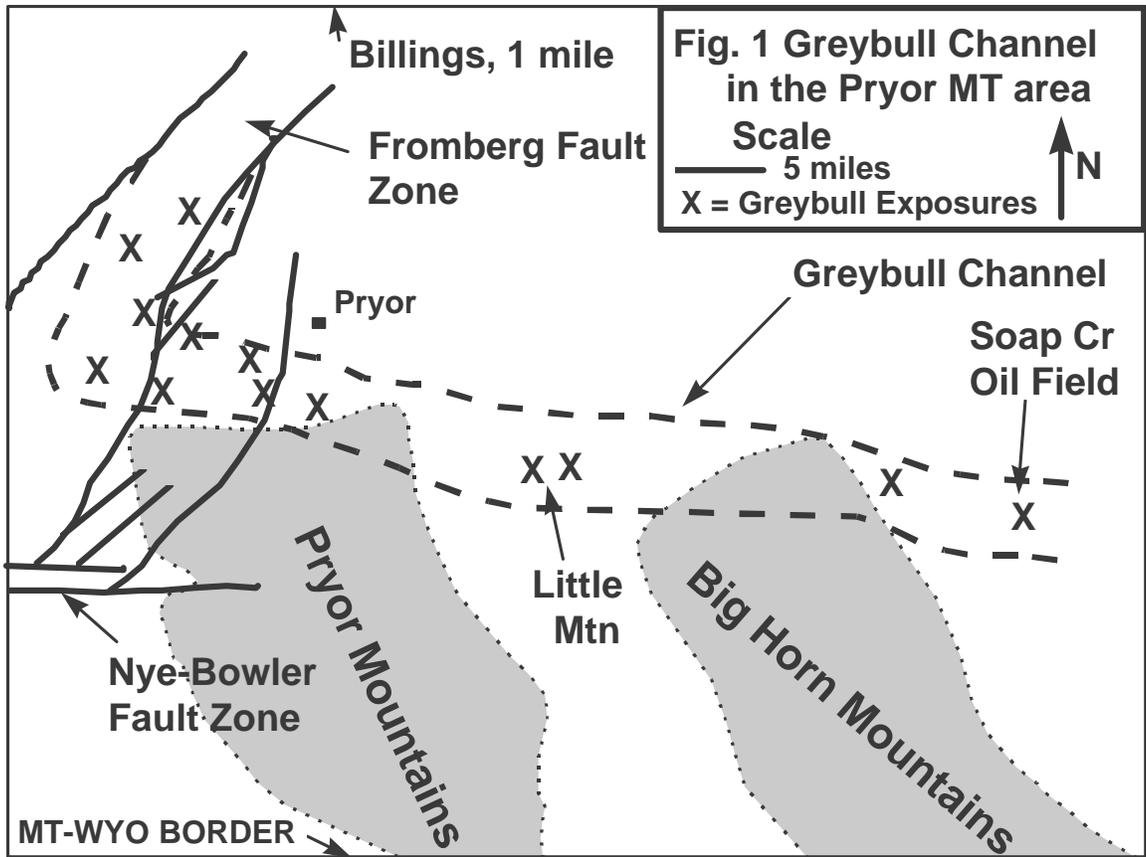
Two follow-on proposals to this project have been submitted to the Department of Energy office in Tulsa, Oklahoma during this quarter. The first proposes to do a soil-gas evaluation of leads generated by this project. It has been approved and the contract was signed in late August. Because of the lateness of the award the sampling had to be postponed until next summer and a one-year extension has been requested. The second proposes to extend the subsurface evaluation designed for this project eastward across the adjoining Northern Cheyenne Reservation. It is being evaluated by the NPTO in Tulsa. It has been determined that this proposal will require a new contract because of the involvement of another Tribe.

Conclusion

Subsurface data is being collected, organized, and a digital database is being prepared for the project. Data from most of 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 as well as all GIS revisions. All four quadrangles are being prepared for submittal to a printer.

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.



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

David A. Lopez, Montana Bureau of Mines and Geology, Billings, Montana

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.