



Depositional model of the sandstone beds in the Tongue River Member of the Fort Union Formation (Paleocene), Decker, Montana
by Margaret Ann Widmayer

A thesis submitted in partial fulfillment of the requirements of the degree of MASTER OF SCIENCE
in Earth Sciences
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Abstract:

The Tongue River Member of the Fort Union Formation (Paleocene) is a fluvial deposit of sandstone, siltstone, shale, and coal. A depositional model of the Tongue River Member was developed based on sedimentary structures, paleocurrent direction measurements, and grain size studies of large, well-exposed outcrops of cross-bedded sandstone in the northern part of the Powder River Basin, near Decker, Montana (Fig. 1).

A meandering stream flowing from northwest to southeast, and having a width of approximately 117m and a depth of 13.6m is suggested as the type of fluvial system responsible for the fluvial deposits of the Tongue River Member. Quantitative geomorphologic parameters of Leopold and Wolman (1957, 1960) have been determined for the stream (Fig. 19).

An alluvial flood plain model (Fig. 21) is presented which infers a very broad, flat-lying (slope = 9.41×10^{-4} m/m) flood plain on which a meandering stream slowly migrated. The Powder River Basin was slowly subsiding in response to regional tectonic events in the early Paleocene. However, the area near Decker was stable during multiple intervals of time as evidenced by widespread, thick accumulations of coal throughout the Tongue River Member. The eastern front of the Rocky Mountains in western Montana is postulated as the source area for Tongue River sediments in the Decker area.

An economic evaluation of the usefulness of the depositional models is presented. Ground water aquifer potential of sandstone and coal is discussed with respect to the models and ease of discovery of aquifers. Coal and uranium prospecting is also presented as it relates to model interpretation.

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Date September 19, 1977

DEPOSITIONAL MODEL OF THE SANDSTONE BEDS IN THE TONGUE RIVER
MEMBER OF THE FORT UNION FORMATION (PALEOCENE), DECKER, MT.

by

MARGARET ANN WIDMAYER

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of the requirements of the degree

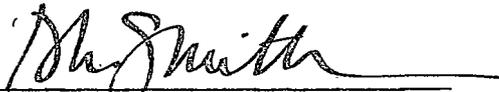
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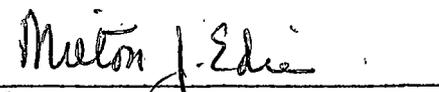
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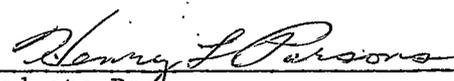
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Plate

1. Fence Diagram of Subsurface Stratigraphy in the Decker Area

ABSTRACT

The Tongue River Member of the Fort Union Formation (Paleocene) is a fluvial deposit of sandstone, siltstone, shale, and coal. A depositional model of the Tongue River Member was developed based on sedimentary structures, paleocurrent direction measurements, and grain size studies of large, well-exposed outcrops of cross-bedded sandstone in the northern part of the Powder River Basin, near Decker, Montana (Fig. 1).

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Chapter 1

INTRODUCTION

Scope and Objectives

The stratigraphic record of the late Cretaceous and Paleocene periods in the Powder River Basin reflects uninterrupted deposition as the region underwent a transition from marine to non-marine sedimentation. The Fort Union Formation of Paleocene age is the first unit of the non-marine environment. It is part of a clastic wedge of sediment that spread eastward from the Rocky Mountains and were trapped in the gradually subsiding Powder River Basin. The Fort Union Formation is a heterogeneous accumulation of sandstone, siltstone, and shale representing various phases of alluvial plain deposition. Much attention has been directed toward economic prospects of coal and uranium in the Fort Union Formation. Aside from the economic aspects, very little information has been published about the sedimentation and stratigraphy of the formation.

The main purpose of this investigation is to determine the depositional environment of the Tongue River Member, youngest member of the Fort Union Formation, in the Decker, Montana area. The Tongue River Member is a fluvial package of sediment consisting of inter-stratified fine-grained sandstone, siltstone, organic-rich shale, and thick layers of subbituminous coal. The lateral relationships of the different lithologies are indicative of flood plain

sedimentation. A model has been developed which delineates the proximal relations of the Tongue River sedimentary rocks.

A second facet of this report is to describe the origin of the Tongue River sandstone beds. In the study area, large, well-exposed outcrops of cross-bedded sandstone provide information about the type of stream system that was responsible for the thick Tongue River Member alluvial deposits. From detailed observations of the vertical sequence of sedimentary structures, the sandstones are interpreted as point bar deposits of a low gradient, meandering stream. Values for stream parameters such as stream depth, velocity, Froude numbers, depositional rates, and flow direction are obtainable from the point bar deposits of the study.

The point bar and alluvial plain models developed in this paper should prove useful in mineral and energy resource exploration. A good understanding of the alluvial plain model may aid in the discovery of isolated coal and uranium deposits in the northwest part of the Powder River Basin near Decker. Likewise, a good alluvial plain model could be invaluable when evaluating groundwater potential. Sandstone and coal beds in the Decker area are sources of water for domestic and agricultural use. A knowledge of the lateral extent of these water-bearing units is needed to determine availability and usefulness of water in the semi-arid region near Decker.

Location

The Powder River Basin is a Cenozoic structural basin that is open to the north and is flanked by the Bighorn Mountains on the west, the Black Hills on the east, the Hartville uplift, Laramie Range, and the Casper arch on the south (Fig. 1). The basin includes an area of about 19,350 square km. The axis of the basin parallels the eastern flank of the Bighorn Mountains (Curry, 1971). The mountains are the source area for the major streams which drain to the northeast. In the Decker area just north of Sheridan, Wyoming, all of the streams are first- and second-order distributary streams of the Tongue River which flows northeastward to join with the Yellowstone River system. The distributary streams are ephemeral because of the low moisture regime of the area. The region is classified as semiarid, and receives 27-33cm of precipitation annually.

Field studies were conducted in the western portion of the basin in southeastern Montana, approximately 30km north of Sheridan, Wyoming. Concentrated research was conducted in the Pearl School 7½ minute quadrangle, along Squirrel Creek and Dry Creek (Fig. 2). Additional studies were performed in an area 19km east of the Pearl School quadrangle study site. The area to the east is currently being examined for its groundwater hydrology potential; the project is being conducted by request of the Environmental Protection Agency.

