LOWER UPPER CRETACEOUS STRATA, BIGHORN BASIN,
WYOMING AND MONTANA

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INTRODUCTION

Sedimentary rocks of early Late Cretaceous age (Cenomanian through Coniacian) are included in the Frontier Formation and the lower part of the Cody Shale in the Bighorn Basin of northwestern Wyoming and south-central Montana. The Frontier consists mainly of shale, siltstone, and sandstone of marine and continental origin and probably ranges in thickness from about 400 to 800 feet (122 to 244 m). It lies conformably on the Lower Cretaceous Mowry Shale and is conformably overlain by the Upper Cretaceous Cody. Figure 1 depicts outcrops of the Frontier Formation on the flanks of the Bighorn Basin. The Cody Shale is composed dominantly of shale and siltstone of marine origin and ranges in thickness from about 1,700 to 3,600 feet (518 to 1,097 m) (Fox, 1954, p. 102). Locally, the lower part of the Cody intertongues with the upper part of the Frontier (Table 1).

The purpose of this report is to describe the lower Upper Cretaceous strata in the Bighorn Basin, emphasizing evidence of major unconformities and the temporal and spatial distribution of those unconformities. Data used in this investigation were obtained from 13 measured sections, about 50 fossil localities, and the electric logs from about 210 wells. Of the well logs examined, 20 are represented on the illustrations in this report. The locations of the wells and measured sections are shown on Figure 1 and described in Table 2.

Fossil mollusks collected from the rocks were compared with mollusks that comprise the revised sequence of Western Interior zone fossils (Merewether and Cobban, 1973) and the fossiliferous rocks were thereby related to the reference sequence of lower Upper Cretaceous formations in the northern Black Hills of Wyoming and Montana (Table 1). The collections of fossils, which are herein represented by numbers, include the species listed in Table 1 or other species of the same age.

Lower Upper Cretaceous rocks are a major source of petroleum in the Bighorn Basin. Prior to 1974, the Frontier Formation produced more than 70 million barrels of oil and 450 billion cubic feet of gas (Wyoming Oil and Gas Conserv. Comm., 1974?). Most of the production has been from anticlines, but the Frontier probably contains many unexplored stratigraphic traps (Weldon, 1972). The sandstone units in the formation that grade laterally into shale or are truncated by unconformities may contain additional reserves of oil and gas.

LITHOLOGIC CHARACTER

Outcrops of the Frontier Formation on the flanks of the Bighorn Basin are composed of shale, siltstone, and sandstone, and minor amounts of conglomerate, bentonite, and coal (Figs. 2, 3 and 4). The shale is chiefly dark gray to brownish gray, silty, and soft, but near Deep Lake (Section H, Fig. 1), Cody (Section I, Fig. 1), and Pitchfork (Section J, Fig. 1), on the western side of the basin, a small part of the shale is brownish black to grayish black and carbonaceous. Most of the siltstone is light gray to dark gray to light brownish gray, clayey or sandy and poorly cemented, except along the western margin of the basin where some of it is brownish black and carbonaceous. The Frontier includes a few thin beds of coal at the Deep Lake and Cody sections (Fig. 1). Bentonite beds in the formation are yellowish gray to light brownish gray or greenish gray and are poorly indurated. Sandstone units are light gray or medium gray to brownish gray, very fine grained and silty to coarse grained and conglomeratic, and friable to well cemented. The grain size increases from the base to the top of many units. Conglomeratic sandstone commonly occurs at the tops of sandstone sequences (Figs. 2, 3, and 4), but it also forms thick discrete units. Lenticular bodies of conglomeratic sandstone in the lower part of the Frontier crop out near Cody, Wyoming (Fig. 3). Most sandstone units are thin bedded and laterally discontinuous. Their sedimentary structures include well-defined horizontal beds, irregular horizontal beds, ripple marks, and crossbeds.

THICKNESS

At the wells and sections depicted in this report, the Frontier Formation ranges in thickness from about 400 feet (122 m), in the north-central part of the Bighorn Basin, to about 800 feet (244 m) in the southeastern part of the basin. This variation is caused largely by the lenticularity of the sandy beds that define the top of the formation (Figs. 5-8). The uppermost sandstone or sandy siltstone can be located at most outcrops but may not be recognizable on electric logs; consequently, the formation thicknesses derived from surface and subsurface measurements in some areas may not be similar.

FOSSILS

Invertebrate fossils of marine origin are common in the upper part of the Frontier and the lower part of the Cody, especially on the eastern side of the Bighorn Basin, but they are sparse in the lower part of the Frontier. They consist mainly of ammonites and pelecypods that indicate parts of the Cenomanian, Turonian, and Coniacian Stages of the Upper Cretaceous Series (Table 1). Many of the beds in the lower Upper Cretaceous sequence also contain trace fossils.

Fossils of Cenomanian, latest Turonian, and Coniacian age have been collected in the eastern and...