



Paleoenvironment and taphonomy of the fauna of the Tullock Formation (early Paleocene), McGuire Creek area, McCone County, Montana  
by Yoshihiro Katsura

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Earth Sciences  
Montana State University  
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**Abstract:**

Late Cretaceous to early Paleocene rocks are well exposed around Fort Peck Reservoir in Garfield and McCone Counties, Montana. Numerous fossil vertebrates were found in the lower part of the Tullock Formation (early Paleocene) in the south area of the McGuire Creek. Previous studies gave no consideration to taphonomy preferring instead to concentrate on one particular aspect such as paleontology or sedimentology. This study attempts to reconstruct the paleoenvironment and faunal content of the Tullock Formation in the local area through detailed sedimentologic, paleontologic, and taphonomic analysis.

Seven major sedimentary facies are recognized: 1) trough cross-stratified sandstones interpreted as main stream channel deposits, 2) inclined beds of sandstone and alternating sandstone and mudstone interpreted as point bar deposits of stream channels, 3) planar-laminated and/or massive mudstones containing parallel-bedded iron concretion bands interpreted as flood plain deposits, 4) a thin, clay pebble conglomerate associated with mudstone interpreted as a crevasse channel deposit, 5) lignites interbedded with the mudstone or lying on inclined beds of alternating sandstone and mudstone interpreted as swamp deposits, 6) a thin lignite associated with the bottom of inclined beds of sandstone interpreted as a channel lag deposit. Analyses of the taphonomy of the bones can be used to support the interpretation of the depositional environments of these facies.

The analyses suggest that broad alluvial systems consisting of a dominant flood plain with swamps and a few stream channels developed in the subsiding foreland basin in northeastern Montana during the early Paleocene. The fauna investigated in the study is considered to represent an early Paleocene aquatic and riparian fauna which inhabited alluvial plains. However, the vertebrates from sandstone and conglomerate-mudstone facies, including the microvertebrate assemblage, are possibly contaminated with Cretaceous ones because of the closeness of these localities to the K-T boundary and the allochthonous character of the fossils.

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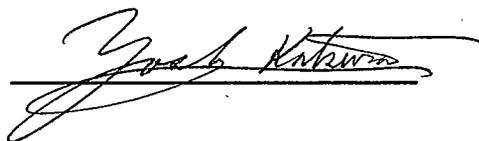
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## ABSTRACT

Late Cretaceous to early Paleocene rocks are well exposed around Fort Peck Reservoir in Garfield and McCone Counties, Montana. Numerous fossil vertebrates were found in the lower part of the Tullock Formation (early Paleocene) in the south area of the McGuire Creek. Previous studies gave no consideration to taphonomy preferring instead to concentrate on one particular aspect such as paleontology or sedimentology. This study attempts to reconstruct the paleoenvironment and faunal content of the Tullock Formation in the local area through detailed sedimentologic, paleontologic, and taphonomic analysis.

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The analyses suggest that broad alluvial systems consisting of a dominant flood plain with swamps and a few stream channels developed in the subsiding foreland basin in northeastern Montana during the early Paleocene. The fauna investigated in the study is considered to represent an early Paleocene aquatic and riparian fauna which inhabited alluvial plains. However, the vertebrates from sandstone and conglomerate-mudstone facies, including the microvertebrate assemblage, are possibly contaminated with Cretaceous ones because of the closeness of these localities to the K-T boundary and the allochthonous character of the fossils.

## REGIONAL SETTING

### Introduction

During the summers of 1989 and 1990 an articulated champsosaur, remains of other champsosaurs, crocodiles, turtles, and other vertebrate fossils were found in the lower parts of the early Paleocene Tullock Formation in the McGuire Creek area near Fort Peck Reservoir in northeastern Montana (Figure 1). Numerous bones were collected from several different rock units during the summer of 1991. Of particular significance are a well-preserved champsosaur skull and an almost complete juvenile champsosaur collected from the mudstone facies. Surface collecting also yielded many bones.

The region around Fort Peck Reservoir has been studied extensively because of the presence of abundant vertebrate fossils, especially dinosaurs, and because the Cretaceous-Tertiary transition is observable in the region although the boundary is not clearly defined (Brown, 1907; Jensen and Varnes, 1964). The paleoenvironments of late Cretaceous to early Paleocene age (Hell Creek and Tullock Formations) in this region have been studied recently (Fastovsky and Dott, 1986; Fastovsky, 1987; Smit et al., 1987; Rigby and Rigby, 1990). The faunas present during the Cretaceous-Tertiary transition also have been studied (Simpson,

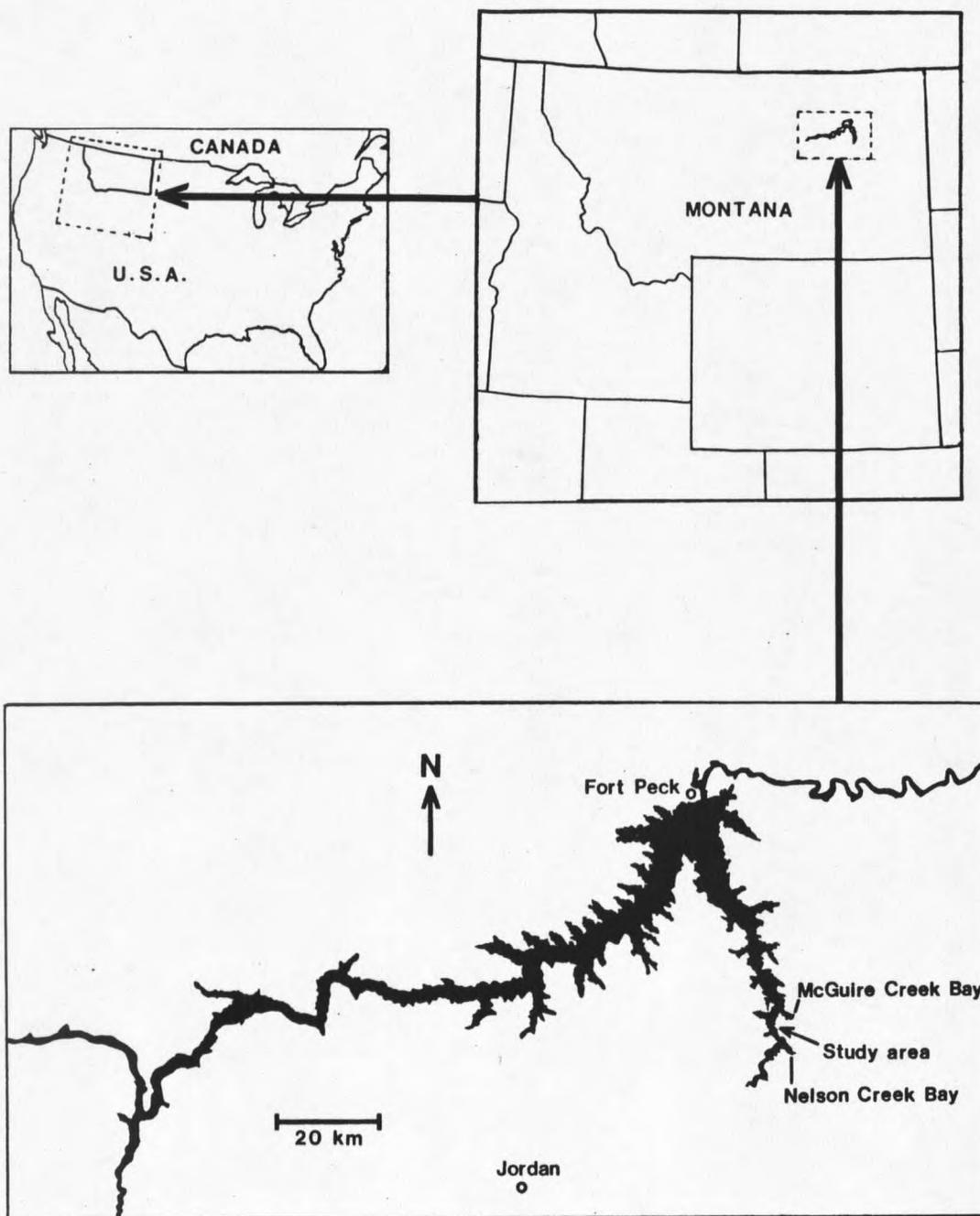


Figure 1. Generalized map showing location of the study area, McGuire Creek at Fort Peck Reservoir, McCone County, Montana.

1927; Sloan and Van Valen, 1965; Estes et al., 1969; Sloan, 1969; Estes and Berberian, 1970; Clemens and Archibald, 1980; Lupton et al., 1980; Archibald, 1982; Clemens, 1982; Hutchison, 1982; Hutchison and Archibald, 1986; Lofgren, 1990).

The Tullock Formation in the study area consists of seven main sedimentary facies; planar and/or massive mudstone, two varieties of lignite, large-scale cross-stratified sandstone, conglomeratic deposits in mudstone, and gently dipping inclined beds of sandstone and alternating sandstone and mudstone. Each facies essentially lies horizontally so that it is relatively easy to trace them laterally and vertically. Each also contains taphonomically characteristic fossils which reflect the local depositional environment.

Previous researchers have focused on either the sedimentology or paleontology (Fastovsky and Dott, 1986; Rigby and Rigby, 1990). Such a one sided approach produced incomplete taphonomic interpretations. This study attempts to describe the taphonomic and sedimentologic characteristics of the seven major sedimentary facies, interpret the depositional significance of each, and reconstruct the paleoenvironment of the Tullock Formation in this area. Comparisons will be drawn between the interpretation here and those of prior workers. Identifiable vertebrate fossils collected from the Tullock Formation of the study area are also described to illuminate the area's early Paleocene terrestrial fauna.

### Geological Setting

The North American continent was divided into two parts during the Cretaceous period by the Western Interior Seaway which ran north-south from the Gulf of Mexico to the Arctic (Kauffman, 1977). During late Cretaceous time the seaway regressed to the east, and upward-shallowing marine sediments were deposited. In northeastern Montana the coastal deposits are recorded by the Fox Hill Sandstone (Meek and Hayden, 1862), and the offshore deposits by the Bearpaw Shale (Hatcher and Stanton, 1903). A broad alluvial plain opened on the east side of the Sevier highlands as a result of the withdrawal of the sea. Consequently these marine strata were overlain disconformably by the Hell Creek Formation (Late Cretaceous) and the Tullock and Lebo Formations (early Paleocene), deposits of terrestrial origin which lie conformably upon one another in ascending order around Fort Peck Reservoir (Figure 2) (Brown, 1907; Jensen and Varnes, 1964). Archibald (1982) documented the thickness of the Tullock Formation as 88.4 m to 93 m in the valley of Hell Creek. This compares favorably with Rogers and Lee (1923) who reported a thickness of approximately 90 m in the type area, Tullock Creek, Treasure County, Montana. However, the thickness of the formation is approximately 50 m in McCone County (Collier and Knechtel, 1939) and 55 m in the Bug Creek area (Rigby and Rigby, 1990). This difference in thickness is considered to be related to the problem regarding definition of the formation discussed below.

Series	Age		Eastern Montana	Western North Dakota
Paleocene	Clarkforkian	Fort Union Group	Sentinel Butte Fm. (?)	Sentinel Butte Fm.
	Tiffanian		Tongue River Fm.	Tongue River Fm.
	Torrejonian		Lebo Fm.	Lebo Fm.
	Puercan		Tullock Fm.	Tullock Fm.
Cretaceous	Maastrichtian		Hell Creek Fm.	
			Fox Hill Ss.	
	?		Bearpaw Sh.	Pierre Sh.
	Campanian		Judith River Fm.	
			Parkman Ss.	
		Claggett Sh.		

Figure 2. Correlation and stratigraphic relations of upper Cretaceous and Paleocene rocks in eastern Montana and western North Dakota (Sloan, 1969; Erickson, 1972; Gill and Cobban, 1973; Jacob, 1976; Moore, 1976).

### Location

The study area is located between Nelson and McGuire Creeks of the Fort Peck Reservoir, McCone County, Montana (Figure 1). An enlarged topographic map of the study area is shown in Figure 3. The area is located in Sections 8 and 9 of the standard USGS 7.5 minute Nelson Creek Bay quadrangle (1973).

Rock outcrops are well exposed because of sparse vegetation, and sedimentary layers can be traced laterally because of their nearly horizontal attitude (Figure 4). Relatively dense vegetative cover is present in some areas in close association with coal/lignite layers. Structural deformation is rare but some folds are recognized in this region (Rigby and Rigby, 1990). The stratigraphic position of the Cretaceous-Tertiary boundary coal layer (Figure 5), therefore the boundary of the Hell Creek and Tullock Formations, in one section (Section 5 in Figure 5 and Figure 3) is remarkably different from the other sections. This is thought to be the result of structural deformation, such as a fault or a fold, though evidence of such structural deformation is absent because of erosion. Sandstone bodies tend to form steeper lands than mudstone bodies because sandstone bodies are friable and more easily eroded.

The Hell Creek Formation is dominated by large-scale cross-stratified and/or massive sandstone with dark massive bentonitic mudstone becoming more predominant near the top of the unit,

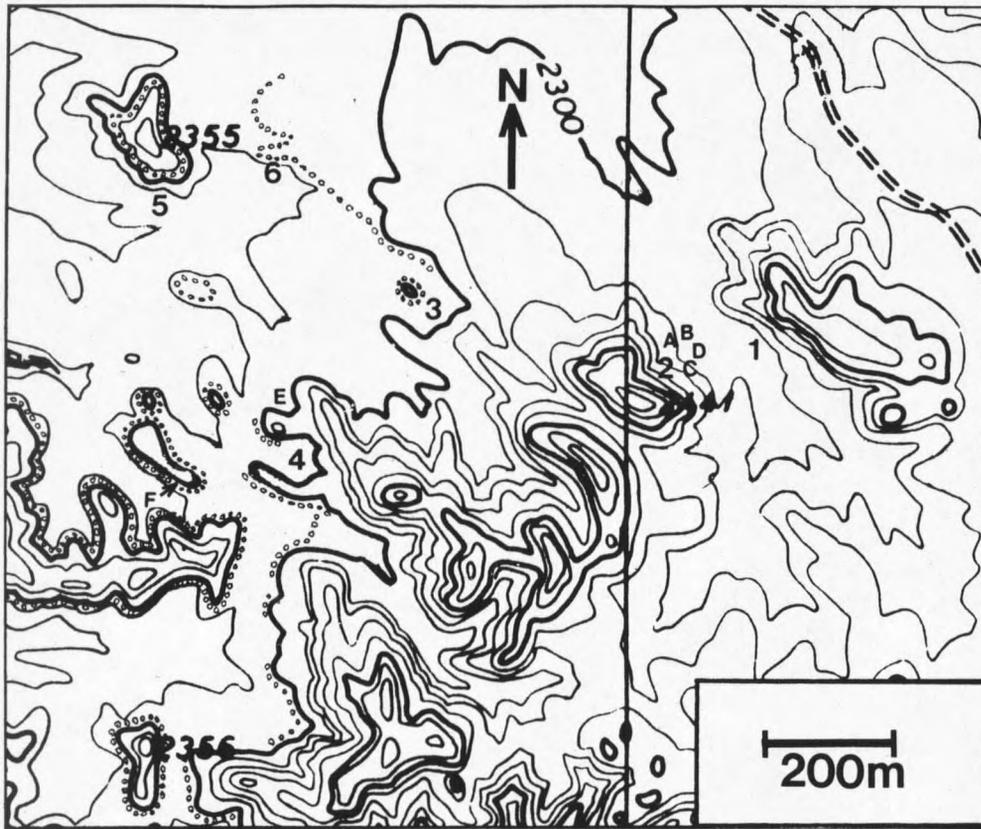


Figure 3. Topographic map of the study area.  
 Section 8 and 9 of the standard USGS 7.5 minute Nelson  
 Creek Bay quadrangle (1973) (Contour interval 20 feet).

..... McGuire Creek Cretaceous-Tertiary boundary coal (lignite)  
 layer (The boundary between the Hell Creek and Tullock  
 Formations)

A-F Fossil localities

- A. Isolated champsosaur skull in mudstone
- B. Associated champsosaur skeletons in mudstone
- C. Vertebrate fossils in a lignite layer
- D. Microvertebrate assemblage
- E. Vertebrate fossils in and from sandstone
- F. Associated champsosaur in mudstone

1-6 Section numbers of measured sections





































































































































