

GEOLOGIC MAP OF THE FORT PECK AREA, MONTANA, SHOWING STRUCTURE CONTOURS ON TOP OF THE JUDITH RIVER FORMATION

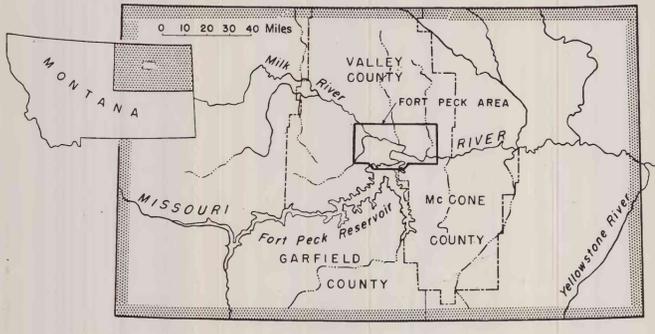
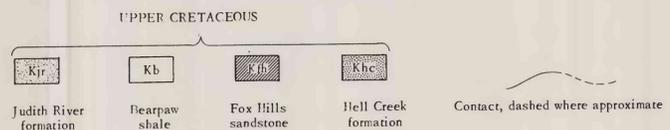
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EXPLANATION

- Accuracy of structure contours can be judged from spacing of points of control:
 - Points of control of greater accuracy are shown by dots (●). Most of these are based on surface data.
 - Points of control of lesser accuracy are shown by circles (○). Most of these are based on water well data.
 - Points of control beyond the immediate vicinity of the map are indicated along the margins.
- Elevations were measured with a Paulin altimeter, checked against bench marks every 10 to 40 minutes. A few bench marks are shown (i.e., BM2305) to indicate the general level of the land surface.
- Faults are present but are not generally traceable on the surface. Those encountered are indicated by the letter F, except at Tiger Butte (NE part of T. 27 N., R. 40 E.) where there are several faults.

U. S. GEOLOGICAL SURVEY
OPEN FILE REPORT

This map is preliminary and has not been edited or reviewed for conformity with Geological Survey standards or nomenclature.



SERIES	GROUP	FORMATION	DESCRIPTION
		Hell Creek formation (40 feet)	More than 140 feet of conglomerate, sandstone, siltstone, shale, and clay. The basal several tens of feet are mostly medium grained sandstone, fairly uniform in grain size and color, but containing thin lenses of pebbles and cobbles conglomerate in the lower part, and a variety of concretions and fossils (bones, wood and other plant material) throughout. The sand contains an abundance of dark mineral grains, giving it a peppered appearance, and is a darker, grayer brown than the sandstone of the Fox Hills. It is differentially cemented by calcium carbonate in the same manner as the sandstone of the Fox Hills, and consequently erodes to closely similar forms. The contained conglomerate lenses are weakly cemented by iron oxides, lending a strong superficial resemblance to the nodular argillaceous concretionary lenses common in the formation. Most of the pebbles and cobbles of the conglomerate are reworked pieces of concretion, but the presence in the conglomerate lenses of light gray quartzite, bone, and fossiliferous wood are definitive. The basal sandstone rests on the channelled upper surface of the Fox Hills. Some of the channels are occupied by lenses of conglomerate.
		Fox Hills sandstone (20 ft.)	About 45 feet of very fine grained calcareous sandstone enclosing a few lenses of thin-bedded shale and siltstone. The sandstone differs much in hardness, but is sufficiently resistant to erosion to stand as a rimrock above the softer transition beds and Bearpaw shale. The harder sandstone appears to be due to concretionary accumulations of cementing material, and the resulting spheroidal, log-like, and lenticular concretions are conspicuous and varied shapes. A variety of other concretionary masses, including small pyritic sandstone spheres and small nodular clay ironstone lenses, are present at many levels. Most of the sandstone is in beds ranging from one to several feet in thickness, and some is thin-bedded, and some, especially near the top, shows the effects of current action. Viewed as a whole, this part of the formation weathers to a yellowish orange or yellowish brown color. No fossils were found other than a few carbonized plant fragments at the top. A varied but unknown thickness of strata have been removed from the top by pre-Hell Creek erosion.
			35 to 40 feet of alternating thin-bedded non-calcareous soft claystone, siltstone, and very fine sandstone, forming a sequence transitional from the Bearpaw shale to the sandstone above. Near the top are one or two discontinuous lenses up to 8 inches in thickness of lithified calcareous sandstone that show minute cross-bedding. Locally at the base is a one foot bed of silty shale rich in glauconite. The beds are unfossiliferous and are yellowish gray for the most part, but they weather to a conspicuously lighter gray.
			About 255 feet of beds, mostly gray shale, bounded below by bentonitic shale and above by the Fox Hills sandstone. The unit is distinguished on three counts: differences in weathered surface between it and contiguous units, presence of sandy shale beds, and presence of concretions unlike those of the underlying unit. The weathered surface is of soft light gray shale chips and has no rind as does the underlying unit. The overlying part of the Fox Hills sandstone weathers a very light gray and is markedly different otherwise. Three brownish gray sandy and silty shale beds, each from about 10 to about 20 feet thick, are rather evenly spaced in the unit. The concretions are mostly non-septarian fossiliferous limestone concretions that weather light gray. There are two beds of large septarian concretions - one in the middle part and one in the upper part. The lower is unusual in having cracks and other cavities filled with early calcite and late barite, and in being richly fossiliferous.
			About 265 feet of gray shale, bounded below by the distinctive bentonitic bed at the top of the underlying unit and above by a 4 inch bentonitic bed which separates bentonitic shale from non-bentonitic shale. The most conspicuous features of this unit are the cracked weathered foot-thick rind occasioned by the bentonite present, and the abundant clay-ironstone concretions. Bentonite occurs both disseminated in the shale and as multitudinous thin beds. Cutbanks and trenches dug through the weathered rind permitted plotting bentonite beds in the lower half. Bentonite beds may be equally abundant in the upper half but were not examined. Near the middle of the unit is a bentonitic bed almost immediately overlain by a one foot zone of shale stained green by an unidentified material. The characteristic weathered rind thins and is absent towards the base of the unit. Concretions are more abundant towards the upper part. The unit is present in a broad irregular belt trending east-northeast in the central or southeasterly part of the area. The upper parts are well exposed in sections 4 and 5, T. 26 N., R. 42 E., and the base is well exposed in NE 1/4 sec. 23, T. 27 N., R. 39 E.
			About 73 feet of gray shale, bounded below by the "double bentonite" of the underlying unit and above by a distinctive bentonitic bed. The unit is distinguished on two counts: differences in weathered surface between it and the overlying soft shale beds within the unit. The shale weathers to soft, small, light gray chips, hence differs from the overlying unit. It contains no oysters and hence differs from the underlying unit. There are three marker beds. The lowest is a 10 inch bentonitic bed with a bed of generally dark colored concretions, mostly clay ironstone, about 2 feet above it. Near the top are limestone concretions that weather to pieces of light gray chips. Locally these concretions are as much as 15 or 20 feet in greatest dimension and are of somewhat irregular shape, being then commonly described as "pepe butte" limestone. At the top is a slightly micaceous bentonitic bed about 16 inches thick that is made up of yellowish green (10GY 7/2) when damp and near light greenish gray (5GY 8/1) when dry. The unit is present in an irregularly shaped north-trending strip across the central part of the area and is well exposed for study in the SE 1/4 sec. 23, T. 27 N., R. 39 E.
			108 feet of fossiliferous gray shale, arbitrarily bounded below by shale beds not examined in detail and above by a distinctive marker consisting of two bentonite beds separated by 6 to 10 inches of shale. The characteristic feature of the unit is the abundant shells of an oyster, <i>Ostrea patina</i> , so common for the most part as to be a reserve inclusion in the lithologic description. Toward the top of the unit, however, they are increasingly scarce, and none are present above the "double bentonite". The oysters are not enclosed in concretions as are other fossils in the formation, but occur free in the shale. The lower of the two bentonite beds of the marker is about seven inches thick. It contains almost no mica and is cream colored. Because of its color the bed is very conspicuous in exposures. The upper bentonite bed is generally about five inches thick. It contains a large proportion of dark mica, which darkens considerably the somewhat grayish green of the bentonite and makes the bed relatively inconspicuous.
			In the upper half of the unit are one or two beds of large, dark, septarian concretions. Most are between 3 and 4 feet in diameter and some contain a small amount of manganese, whose oxides impart a blue black color. Near the base of the unit is a 15 inch bentonitic bed locally containing fossiliferous limestone concretions. Both bentonitic and limestone are pale cream-colored. The unit is present in an irregular east northeast trending strip of country in a northwesterly part of the area, and is fairly well exposed in the SE 1/4 sec. 11, T. 26 N., R. 41 E.
			76 feet of gray shale, bounded below by the distinctive bentonitic bed of the underlying unit, and arbitrarily bounded above by shale beds that were not examined in detail. The most distinctive characteristic is the presence, in the upper part, of bun-shaped limy concretions 6 to 8 feet in diameter. These weather light brownish gray, except that each is enclosed in a rusty brown envelope of concretionary matter several inches thick. A few clay ironstone concretions are present below the middle of the unit. Weathering develops a rind similar to that on the contiguous beds of the underlying unit, indicating disseminated bentonite. The unit is present near the northwest corner of the area but is so poorly exposed that data were collected to the north, in and near T. 28 N., R. 37 E.
			About 200 feet of shale beds were not examined in detail, primarily because they are at the surface in only small parts of the area -- and there are very poorly exposed -- and secondarily because where they are well exposed, i.e., T. 34 N., R. 36 E., they are intricately alumped. The shale in this interval is not resistant to erosion as compared with the shale of unit 1. It weathers for the most part to small light gray shale chips, and apparently contains two or more bentonitic beds between 10 and 12 inches thick.
			165 feet of gray shale, bounded below by the Judith River formation and above by a distinctive bentonitic bed. The shale characteristic is the bentonitic nature of the shale in the upper two-thirds of the unit, witnessed by the foot-thick weathered rind, and the dark clay-ironstone concretions in the central third. Upwards these concretions decrease gradually in number to zero, and downwards they differ in nature gradually. The bed at the top of the unit is pale greenish cream-colored bentonite, about 17 inches thick, and is unusual in that the upper and lower contacts weather rust-brown. Because of the bentonitic nature of much of the shale, the unit is comparatively resistant to erosion and is relatively prominent topographically. It is present in the northwest corner of the area but is there very poorly exposed. Most of the data were collected north of the area in and near T. 33 N., R. 37 E.
			The top of the formation is arbitrarily placed at the top of about 15 feet of beds transitional into the Bearpaw shale. These transition beds are alternating thin beds of silty shale, siltstone, and fine sandstone that weather grayish brown. The formation is about 300 feet thick in this area.

COLUMNAR SECTION

Montana (Fort Peck area). Structure. 1:96,000. 1951.

