Map Unit Properties Table: Fort Union National Monument

Colored rows indicate units mapped within Fort Union National Monument. Italicized sub-headings correspond to report sections.

Age	Map Unit (Symbol)	Geologic Description	Geologic Issues	Geologic Features and Processes	Geologic History and Park Connections
QUATERNARY (Holocene)	Alluvium (Qa)	Unconsolidated stream-deposited gravel, sand, silt, and clay along major streams.	*Wolf Creek*—**Qa** covers floodplain and channel; indicates area of potential flooding. Streams transported and deposited **Qa** along Wolf Creek. Deposits occur within main unit. *Soil Ruts*—soil map unit TA (Tinaja gravelly loam, moderately steep) and geologic map unit **Qa** are equivalent. TA has a high potential for water erosion, a low potential for wind erosion, and a moderate potential for rutting. TA covers terraces in the southern corner of the main unit.	*Paleontological Resources*—potential for fossils such as musk ox or bison.	Rivers and streams continue to transform the Fort Union landscape and deposit **Qa**.
	Lake deposits (Ql)	Thin veneer of mixed clay, calcium carbonate, and carbonaceous material.	Unknown.	*Dakota Sandstone*—lake deposits (**Ql**) occur on the uplifted mesa of Dakota Sandstone (**Kd**) west of the smaller unit.	Ephemeral lakes on the landscape.
	Alluvial cone deposits (Qac)	Unconsolidated mass of basalt and shale fragments on southeastern slope of Black Mesa.	None reported.	None reported.	An alluvial cone deposit (**Qac**) emanates from the southeastern slope of Black Mesa. Fluvial processes redistributed basalt and shale fragments away from the Ocaté volcanic field.
	Alluvial fan deposits (Qaf)	Unconsolidated stream-deposited gravel, sand, silt, and clay.	None reported.	None reported.	An alluvial fan (**Qaf**) occurs at the mouth of Higgins Canyon.
QUATERNARY (Holocene and Pleistocene)	Talus (Qt)	Colluvial veneer of broken blocks of basalt.	*Landslides and Rockfall*—mass-wasting processes active at present; induced by freeze-thaw cycles, summer rainstorms, and seismic activity. *Seismic Activity*—dislodging of talus blocks induced by seismic activity.	*Caves*—potential for talus caves.	During Fort Union's 40-year lifespan, prostitutes, gamblers, and whiskey sellers set up businesses in nearby caves, possibly talus caves. Occurs mainly on slopes of Black Mesa.
QUATERNARY (Pleistocene)	Younger terrace deposits (Qty)	Unconsolidated stream-deposited gravel and sand.	*Soil Ruts*—soil map unit TA covers terraces. TA has a high potential for water erosion, a low potential for wind erosion, and a moderate potential for rutting.	*Paleontological Resources*—potential for fossils such as musk ox and bison.	Occur along Mora River. Represent floodplains during the Pleistocene Epoch. Deposited when valley glaciers flowed in the Sangre de Cristo Mountains.
	Landslide deposits (Qls)	Rotational block-glide landslides of basalt resting on Carlile Shale (**Kc**).	*Landslides and Rockfall*—no landslide deposits occur within Fort Union National Monument; deposits occur north of the national monument along the Los Gavilanes fault. *Seismic Activity*—seismic activity may have induced landsliding.	None reported.	Landslides occurred on the slopes of Black Mesa during the Pleistocene Epoch.
	Older terrace deposits (Qto)	Semi-consolidated stream-deposited gravel and sand.	*Soil Ruts*—soil map unit TA covers terraces. Soil map unit TA has a high potential for water erosion, a low potential for wind erosion, and a moderate potential for rutting.	*Paleontological Resources*—potential for fossils such as musk ox and bison.	Occur above the channel of the present-day Mora River. Represent floodplains during the Pleistocene Epoch. Deposited when valley glaciers flowed in the Sangre de Cristo Mountains.

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Age	Map Unit (Symbol)	Geologic Description	Geologic Issues	Geologic Features and Processes	Geologic History and Park Connections
QUATERNARY–"TERTIARY"* (Pliocene and Pleistocene?)	Basalt of Wolf Creek (QTw)	Locally vesicular basalt. Contains scattered phenocrysts of olivine. May be more than 24 m (80 ft) thick.	None reported.	*Caves*—potential for lava-tube caves. *Building Materials*—potential decorative building material for fort (not yet identified). *Paleontological Resources*—potential for fossils such as tree molds.	Represent lava flows that issued from the Ocaté volcanic field, 2.59 million–2.18 million years ago. Occurs near the western corner of the main unit. During Fort Union's 40-year lifespan, prostitutes, gamblers, and whiskey sellers set up businesses in nearby caves, possibly lava-tube caves.
"TERTIARY"* (Pliocene)	Basalt of Black Mesa (Tbm)	Locally vesicular basalt. Contains scattered phenocrysts of olivine. More than 37 m (120 ft) thick.	None reported.	*Caves*—potential for lava-tube caves. *Building Materials*—potential decorative building material for fort (not yet identified). *Paleontological Resources*—potential for fossils such as tree molds.	Represent lava flows that issued from the Ocaté volcanic field, 2.59 million–2.18 million years ago. Caps Black Mesa north of the national monument. During Fort Union's 40-year lifespan, prostitutes, gamblers, and whiskey sellers set up businesses in nearby caves, possibly lava-tube caves.
UPPER CRETACEOUS	Carlile Shale (Kc)	Gray shale. Base poorly exposed or covered. More than 61 m (200 ft) thick.	*Oil and Gas Development*—potential for shale gas.	*Paleontological Resources*—potential for fossils such as ammonites, bivalves, foraminifera, and fish bones and teeth.	Deposited in the Western Interior Seaway in shallow marine waters. Widespread across the western United States.
	Greenhorn Limestone (Kgn)	Light-gray limestone containing interbedded gray calcareous shale. Base poorly exposed or covered. 12–18 m (40–60 ft) thick.	*Oil and Gas Development*—potential for shale gas and oil.	*Building Materials*—source of lime for mortar. *Paleontological Resources*—potential for fossils such as ammonites, oysters, foraminifera, and fish.	Deposited in the Western Interior Seaway in shallow marine waters. Widespread across the western United States.
	Graneros Shale (Kgs)	Dark-gray shale and some interbeds of silty and sandy shale and a few thin beds of bentonite. Up to 46 m (150 ft) thick.	*Oil and Gas Development*—potential for shale gas. *Seismic Activity*—Fort Union fault separates Dakota Sandstone (**Kd**) from strata of Graneros Shale (**Kgs**).	*Turkey Mountains*—**Kgs** occurs on the flanks of the uplift. *Building Materials*—source of clay for adobe. *Paleontological Resources*—potential for fossils such as bivalves, gastropods, and foraminifera	Deposited in the Western Interior Seaway in a variety of marine environments, ranging from offshore, low-energy waters of midshelf depth to moderately active waters below the wave base. Widespread across the western United States.
LOWER CRETACEOUS	Dakota Sandstone (Kd)	Upper part: tan to brown sandstone with thin gray shale. Middle part: black carbonaceous and locally coaly shale with thin interbeds of shale and siltstone. Lower part: tan to brown, locally conglomeratic sandstone. Base poorly exposed. More than 61 m (200 ft) thick.	*Wolf Creek*—**Kd** is the source of the groundwater aquifer that feeds Wolf Creek and supplies the national monument's well. *Landslides and Rockfall*—mass-wasted blocks of sandstone from cliffs/mesa west of smaller unit have potential to impact resources, including ruins of the first fort and the third fort's arsenal. *Seismic Activity*—Fort Union fault separates Dakota Sandstone (**Kd**) from strata of Graneros Shale (**Kgs**). *Oil and Gas Development*—potential for natural gas.	*Dakota Sandstone*—resistant sandstone that forms hogbacks, ridges, mesas, and cliffs within and in the vicinity of Fort Union National Monument. *Turkey Mountains*—**Kd** occurs on the flanks of the uplift. *Building Materials*—used in construction of the fort as foundations, walkways, walls, and chimneys. Mined from the cliffs behind the first fort (smaller unit). *Paleontological Resources*—potential for fossils such as petrified wood and marine shell fragments.	Deposited in the Western Interior Seaway as seas advanced from the north/northwest. Widespread across the western United States. Hogback ridges on the eastern edge of the uplifted Sangre de Cristo Mountains serve as a backdrop for Fort Union and are the boundary between the Southern Rocky Mountains and Great Plains physiographic provinces. Forms cliffs/mesa on western side of smaller unit.

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Age	Map Unit (Symbol)	Geologic Description	Geologic Issues	Geologic Features and Processes	Geologic History and Park Connections
UPPER JURASSIC	Morrison Formation (Jm)	Upper part: greenish-gray siltstone and shale with thin to thick beds of reddish-gray sandstone and conglomeratic sandstone and a few thin beds of limestone. Middle part: buff to light-red sandstone with interbedded red, purple, and gray shale. Lower part: thin green to red sandy shale with nodules of jasper. Base poorly exposed. About 122 m (400 ft) thick.	*Oil and Gas Development*—potential for natural gas.	*Turkey Mountains*—**Jm** forms concentric band of rock around central uplifted core. *Paleontological Resources*—potential for dinosaur fossils.	Deposited in a savannah environment by perennial and intermittent streams.
	Todilto Limestone (Jt)	Gray, bituminous, and slightly sandy limestone containing some gypsum. Base poorly exposed. About 8 m (25 ft) thick.	None reported.	*Paleontological Resources*—potential for dinosaur tracks, algal structures, fish scales, ostracodes, and worm burrows.	Deposited in a restricted marine embayment with an ephemeral connection to the sea.
	Entrada Sandstone (Je)	Buff to gray sandstone. Base poorly exposed. About 30 m (100 ft) thick.	*Oil and Gas Development*—potential for carbon dioxide (CO_2) gas.	*Turkey Mountains*—**Je** forms concentric band of rock around central uplifted core. *Eolian Features and Processes*—ancient eolian deposit (sand dunes).	Easily recognizable massive, "white," even-grained, cross-bedded sandstone. Deposited in a vast coastal desert called a "sabkha."
UPPER TRIASSIC	Chinle Formation (TRc)	Red shale, tan to red sandstone, and a few thin limestone lenses and limestone pebbles. Base does not crop out within quadrangle. Less than 152 m (500 ft) thick.	None reported.	*Turkey Mountains*—**TRc** encircles the central core of Triassic Santa Rosa Sandstone (not mapped as part of Fort Union dataset) of the uplifted dome. *Paleontological Resources*—potential for petrified wood.	Deposited in a vast terrestrial lowland as river channels, floodplains, swamps, and small lakes.

***The term "Tertiary" is now used informally for the period of geologic time preceding the Quaternary Period. It has been formally replaced by the Paleogene and Neogene periods (65.5 million—2.6 million years ago).**