U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Base from U.S. Geological Survey, 1962.
Polyconic projection, 1927 North American datum.
10,000-foot grid based on Colorado coordinate system, north zone
1,000-meter Universal Transverse Mercator grid ticks, zone 12

APPROXIMATE MEAN DECLINATION, 1982

Geology mapped 1988-89
Edited by Diane E. Lane
Color design by Virginia Scott
Digital cartography by R.E. Van Loenen, Gary Selner, and Diane E. Lane
Manuscript approved for publication June 3, 1998

CORRELATION OF MAP UNITS

Qac, Qls, Qt	Holocene and Pleistocene	QUATERNARY
Unconformity		
Tb	Oligocene	TERTIARY
Unconformity		
Kmm	Upper Cretaceous	CRETACEOUS
Kmf		
Kmy		
Kd		
Unconformity		
Kcm	Lower Cretaceous	
Unconformity		
Jm	Upper Jurassic	JURASSIC
Unconformity		
Jsr	Middle Jurassic	
Jsc		
Unconformity		
Je		
Jca		
Unconformity		
Jg	Lower Jurassic	
Unconformity		
Tmc	Upper Triassic	TRIASSIC
Unconformity		
Tm	Middle(?) and Lower Triassic	
Unconformity		
Ppc	Lower Permian	PERMIAN
Unconformity		
PPw	Upper Pennsylvanian	PENNSYLVANIAN
Pmu		
Pml	Middle Pennsylvanian	

DESCRIPTION OF MAP UNITS

Qac **Alluvium and colluvium (Holocene and Pleistocene)**—Unconsolidated, poorly sorted clay, silt, sand, gravel, and rock fragments deposited in and along present stream channels and as slope-wash deposits at base of slopes and cliffs. Older alluvial deposits of mostly red clay, silt, and sand occur in and adjacent to present stream channels, as thick as 80 ft , and are dissected by present drainage system. Contact transitional with other surficial deposits

Qls **Landslide deposits (Holocene and Pleistocene)**—Poorly sorted debris derived from Chinle Formation and overlying Glen Canyon Sandstone east of Gunsight Gap. Springs and prominent stands of chokecherry are common on landslide deposits

Qt **Terrace deposits (Holocene and Pleistocene)**—Unconsolidated, poorly sorted sand and gravel, containing pebbles and cobbles of mainly quartzite that overlie Mancos Group in southern part of quadrangle. Thickness ranges from a few feet to nearly 100 ft

Tb **Bishop Conglomerate (Oligocene)**—Poorly consolidated, light-gray, tan, and white, thin-bedded, poorly sorted pebble, cobble, and boulder conglomerate. Conglomerate matrix is locally tuffaceous. Clasts consist mostly of red quartzitic sandstone derived from Uinta Mountain Group (Middle Proterozoic) and light- to dark-gray limestone derived from Paleozoic formations. Highly dissected outcrops occur above Wolf Creek drainage in northern part of quadrangle. Maximum thickness about 50 ft

Kmm **Mancos Group (Upper Cretaceous)**
Main body—Brownish-gray, mostly noncalcareous, marine shale interbedded with minor siltstone, very fine grained sandstone, and thin bentonite beds. Lower part is poorly exposed at base of hogback formed by Frontier Sandstone and the flats in southern part of quadrangle. Maximum thickness is about 4,400 ft (Cullins, 1969) a few miles to the southwest

Kmf Frontier Sandstone—Upper part is resistant, light-olive-gray, fine-grained, calcareous and fossiliferous sandstone. Lower part is brown and pale-blue, fissile shale and siltstone. Forms first hogback north of U.S. Highway 40 along southern limb of Skull Creek Monocline. Thickness ranges from 180 to 260 ft

Kmy Mowry Shale—Blue-gray to pale-blue, fissile, siliceous shale containing fish scales and thin bentonite beds; locally contains gypsum. Weathers to distinctive hard chips. Well exposed along Frontier Sandstone hogback. About 90 ft thick near Skull Creek, Colo.

Kd **Dakota Sandstone (Lower Cretaceous)**—Resistant, yellowish-brown to light-gray, medium- to thick-bedded, medium- to coarse-grained sandstone interbedded with conglomerate and minor thin shale. Weathers rusty and forms hogback along much of southern limb of monocline in southern part of quadrangle. About 100 ft thick near Massadona, Colo., in southeast corner of quadrangle, but only about 40 ft thick 12 mi to the west near Plug Hat (Rowley and Hansen, 1979a)

Kcm **Cedar Mountain Formation (Lower Cretaceous)**—Comprises two members: an upper unnamed shale member and lower Buckhorn Conglomerate Member. Upper member consists of slope-forming, pale-olive and purple shale and mudstone units interbedded with thin, fine-grained sandstone and resistant, light-brownish-gray limestone and red jasper near base. Buckhorn Conglomerate Member is ledge-forming, thick-bedded, medium-gray to light-gray conglomerate and fine- to coarse-grained sandstone; conglomerate contains distinctive black chert pebbles. Thickness about 110 ft thick near Massadona, Colo., but as thick as 200 ft to the west (Rowley and Hansen, 1979a). Buckhorn Member ranges from 0 to 20 ft thick. Unconformable contact with Morrison Formation is placed below chert-pebble conglomerate of Buckhorn or, where Buckhorn is not present, below red-jasper limestone of upper member

Jm **Morrison Formation (Upper Jurassic)**—Slope-forming, variegated pale-olive, dark-red, and reddish-brown siltstone, claystone, and shale interbedded with light-gray to olive-gray, fine- to medium-grained sandstone, conglomeratic sandstone, minor glauconitic sandstone, and argillaceous and nodular limestone. Conglomeratic sandstone bed (unnamed member), about 30 ft thick, occurs near middle of the Morrison and locally contains fossil dinosaur bones and teeth that weather out on dip slopes. Lowermost fine- to medium-grained sandstone is strongly crossbedded. Unconformable contact with Redwater Member of Stump Formation at base of crossbedded Morrison sandstone. Thickness ranges from 560 to 650 ft

Jsr **Stump Formation (Upper and Middle Jurassic)**
Redwater Member (Upper Jurassic)—Light-gray and pale-olive glauconitic shale interlayered with siltstone, sandy limestone, coquina, and thin sandstone beds. Weathers to a greenish cast. Fossils include brachiopods, pelecypods, cephalopods (belemnites very common), and ammonites. Contact with Curtis Member distinct; located between soft green beds of the Redwater and hard light-gray beds of the Curtis. Thickness ranges from 85 to 120 ft; usually well exposed at base of Curtis flatirons

Jsc Curtis Member (Middle Jurassic)—Very resistant, ledge-forming, light-gray to greenish-gray, fine- to coarse-grained, thin- to medium-crossbedded sandstone. Glauconite and fossils are common; "trash" beds (as much as several feet thick and locally containing uranium and copped of petrified wood and other plant debris are common at base. Unconformable contact with Entrada Sandstone is sharp. Thickness variable, 0–30 ft

Je **Entrada Sandstone (Middle Jurassic)**—Resistant, light-gray, fine- to medium-grained, thick-bedded, massive sandstone; glauconitic in upper part. Exposed along southern flank of Skull Creek Monocline. Where underlying Carmel Formation (unit Jca) is absent (generally east of Skull Creek) the contact between Entrada and Glen Canyon Sandstones is inferred and mapped along a topographic low between the two similar units. Thickness ranges from 90 to 150 ft

Jca **Carmel Formation (Middle Jurassic)**—Slope-forming, reddish-brown, fine-grained sandstone, siltstone, and mudstone. Redbeds of the Carmel display striking contrast to eolian sandstone beds in the overlying Entrada Sandstone (unit Je) and the underlying Glen Canyon Sandstone (unit Jg). The Carmel is present between the Entrada and Glen Canyon Sandstones, along southern flank of Skull Creek monocline, but is too thin to map separately. Contact between the Carmel and underlying Glen Canyon is mapped at a color change; however, an unconformity occurs about 10 ft below this color change within lithologies similar to Glen Canyon Sandstone (Pipiringos and O'Sullivan, 1975). Unconformity is marked by a very thin (less than 1 in. thick) layer of chert pebbles. The Carmel is 60 ft thick at Plug Hat Rock (12 mi west of quadrangle) (Rowley and Hansen, 1979a) and thins eastward across quadrangle from a few feet to only a few inches about 1 mi west of village of Skull Creek. The Carmel is mostly absent east of Skull Creek

Jg **Glen Canyon Sandstone (Lower Jurassic)**—Massive, thick-bedded, well-sorted, light-gray to grayish-pink, medium- to fine-grained sandstone. Sandstone contains medium-scale to very large scale sand-dune crossbedding, is relatively resistant, and weathers to rounded buttes. The Glen Canyon is exposed extensively around Skull Creek Monocline and forms the caprock of Skull Creek Rim. Thickness ranges from 560 to 760 ft

Tmc **Chinle Formation (Upper Triassic)**—Includes main body and Gartra Member (not mapped separately) at base. Main body is slope-forming, moderate-red to moderate-pink siltstone interbedded with very fine grained sandstone beds of similar color. Gartra Member is ledge-forming, light-gray, coarse-grained, conglomeratic sandstone; usually crossbedded; contains streaks of heavy minerals, angular clasts as large as 1 ft, and local petrified wood locally; forms a conspicuous brush-covered bench, 10-30 ft thick, in otherwise relatively soft red cliffs around Skull Creek Dome. Unconformable contact with Moenkopi Formation is sharp. Total thickness of Chinle ranges from 240 to 280 ft

Tm **Moenkopi Formation (Middle? and Lower Triassic)**—Moderate-reddish-brown, yellowish-gray, and pale-olive micaceous siltstone interbedded with minor amounts of mudstone and very fine grained sandstone. Gypsum is common. Unconformable contact with Park City Formation, covered in most places, was mapped below lowermost reddish-brown Moenkopi siltstone bed; subtle color change occurs from Moenkopi redbeds to orangish Park City. Thickness ranges from 450 to 600 ft

Ppc **Park City Formation (Lower Permian)**—Alternating slope-forming, pale-orange and pale-olive mudstone and resistant, ledge-forming, yellowish-brown siltstone; contains minor fine-grained, lenticular sandstone beds. All lithologies are calcareous. Thought to be correlative with Franson Member of Park City (Hansen and Rowley, 1980). Poorly exposed around Skull Creek Monocline. Possible unconformable contact with Weber Sandstone is marked locally by a 2-ft-thick conglomerate containing coarse quartz pebbles and angular rock fragments as large as 1 in. Thickness is estimated at 125 ft

PPw **Weber Sandstone (Lower Permian and Upper and Middle Pennsylvanian)**—Upper and lower parts exposed in structurally separate areas. Upper part is mainly light-gray, massive, thick-bedded, fine-grained sandstone except near top, where the sandstone is pale yellowish brown and slightly calcareous; large-scale crossbedding is common. Upper part is exposed at center of Skull Creek Monocline, where several canyons locally expose 500-600 ft of sandstone. Lower part is highly indurated, interbedded light-gray (predominant) to pale-yellowish-orange, fine-grained, mostly thin bedded, commonly crossbedded, calcareous sandstone. Lower part also contains light-gray, fine-grained, mostly thin-bedded, commonly cherty, somewhat crossbedded, fossiliferous, locally sandy limestone. Lower part is exposed in steeply dipping beds north of Wolf Creek Fault. Contact with Morgan Formation mapped at top of uppermost Morgan redbed. Reported to be about 1,000 ft thick where mapped about 6 mi north of quadrangle (Hansen and others, 1980)

Pmu **Morgan Formation (Middle Pennsylvanian)**
Upper member—Ledge-forming, interbedded light- to medium-red, fine-grained, crossbedded sandstone, gray to pale-lavender cherty fossiliferous limestone, and purplish-red siltstone. Pink to red chert nodules are conspicuous. Beds range from 2 to 10 ft thick. Breccia of red siltstone and limestone fragments occurs as float in upper part. Contact with lower member placed at break in slope at base of ledges formed by relatively resistant limestone and sandstone units of upper member. A complete section is not present in map area, but Hansen and others (1980) reported the member to be about 690 ft thick a few miles north

Pml Lower member—Slope-forming, interbedded varicolored gray, red, and lavender shale and siltstone and minor grayish-pink to pale-lavender limestone and calcareous sandstone. Base not exposed in quadrangle but reported as about 280 ft thick nearby (Hansen and others, 1980)

Contact—Dashed where inferred

Normal fault—Bar and ball on downthrown side; dashed where inferred, dotted where concealed

Thrust fault—Sawteeth on upper plate; dotted where concealed

Monocline—Showing trace of axial surface and direction of plunge

Joint

Strike and dip of inclined beds

Mine or prospect

INTRODUCTION

The Skull Creek quadrangle is located about 15 mi north of Rangely, Colo., along the southeastern edge of the Uinta Mountains. The eastern part of Dinosaur National Monument is about 5 mi north of the quadrangle. Hogbacks and picturesque cliffs of the Skull Creek Rim can be seen from U.S. Highway 40, which passes along the southern boundary of the quadrangle. The central part of the quadrangle, the Skull Creek Basin, contains an ancient piñon and juniper forest. A gravel road links U.S. Highway 40 near Skull Creek to a county road that runs east-west across the northern part of the quadrangle. Large tracts of private land are in the southern part of the quadrangle, and the rest of the land is administered by the U.S. Bureau of Land Management.

The Skull Creek quadrangle includes the eastern one-third of the Willow Creek and Skull Creek Wilderness Study Areas, located in Skull Creek Basin just below the prominent Skull Creek Rim. The geology and mineral resources of the study areas and vicinity were mapped and assessed by Van Loenen and others (1990). Geologic mapping of the study areas and the remaining parts of the Skull Creek quadrangle was done on color aerial photographs at a scale close to 1:24,000. The geology was transferred from the photographs to the topographic base map using a photogrammetric plotter.

GEOLOGIC HISTORY

The geologic history of rocks exposed in the Skull Creek quadrangle began about 300 million years ago when sediment of the Morgan Formation (Middle Pennsylvanian) was deposited nearshore on older marine limestones and just offshore under shallow ocean conditions (Hansen and others, 1980). Deposition of sediment was interrupted from time to time, ending about 30 million years ago (during the Oligocene) when the area was covered by the Bishop Conglomerate.

During Middle Pennsylvanian to earliest Permian time, the Weber Sandstone was deposited over the Morgan Formation. The Weber is chiefly shallow marine, intertidal, and eolian sandstone that was deposited in a trough or basin in the ancestral Rocky Mountains. The Front Range and Uncompahgre Uplifts of the ancestral Rocky Mountains provided sediment to this region during late Paleozoic and part of Mesozoic time. Deposition of the Weber was episodic as the sea level rose and in response to Pennsylvanian glaciation in the southern hemisphere.

Thick deposits of the Lower Permian Park City Formation accumulated in marine and shelf environments of the Oquirrh Basin west of the quadrangle, but deposits of the Park City in the Skull Creek quadrangle accumulated in very shallow water, and some may include fluvial deposits. Only the upper part of the Park City Formation is present in this region (Rowley and Hansen, 1979b).

Clastic redbeds of the Lower and Middle(?) Triassic rocks of the Moenkopi Formation were deposited on fluvial flood plains under and conditions and by shallow marine seas. The basal conglomerate of the Upper Triassic Chinle Formation was deposited on the eroded surface of the Moenkopi. This coarse sediment was deposited by high-energy streams and was in turn covered by the main body of the Chinle, a clastic redbed sequence of silts and sands deposited on alluvial plains. The Chinle Formation was covered by dune sands of the Glen Canyon Sandstone during Early Jurassic time. The spectacular scenery along the Skull Creek Rim results from erosion of the soft Moenkopi and Chinle redbeds when they are left unprotected by the relatively hard overlying Glen Canyon Sandstone. The Glen Canyon forms the high plateau around the Skull Creek Monocline. The return of shallow marine conditions over much of the region during the Middle Jurassic brought deposition of thin mud and silt of the Carmel Formation. The Carmel is thin to absent in the Skull Creek quadrangle, but traces of reddish-brown Carmel mudstone impart a distinctive stain to the uppermost part of the Glen Canyon and the overlying Entrada Sandstone in many places of the quadrangle. Dune sands of the Entrada Sandstone (Middle Jurassic) covered the region before the sea again covered the area and deposited the Curtis Member of the Stump Formation. The Curtis forms flatirons along the southern part of the Skull Creek Monocline.

Deep-sea marine conditions existed during the Late Jurassic, and these deposits are represented by the Redwater Member of the Stump Formation. The sea again retreated, exposing a land surface that was covered with continental deposits of the Morrison Formation (Upper Jurassic). The Morrison includes fluvial, eolian, and possible lacustrine deposits. Following deposition of the Morrison and periods of erosion, the Cedar Mountain Formation and the overlying Dakota Sandstone represent the first deposits of sediments in the initial development of the Western Interior Cretaceous Sea. These are largely fluvial deposits in a near-shore continental environment that were later covered by thick marine deposits of the Upper Cretaceous Mancos Group.

Tectonic deformation that began near the end of Cretaceous time is largely responsible for the geologic setting as it appears today. The large Uinta Anticline was formed during the Laramide orogeny. During Oligocene time (30 million years ago), fluvial deposits containing very coarse material covered parts of the quadrangle. Remnants of these deposits (Bishop Conglomerate) are preserved in the northern part. Since at least Bishop time, the area of the Skull Creek quadrangle has remained above sea level and exposed to erosion.

With the exception of the Park City Formation, all bedrock formations are very well exposed throughout the quadrangle. Much of the Park City Formation is covered by alluvium. Deep canyons cut in the Skull Creek Monocline expose several hundred feet of Pennsylvanian and Lower Permian rocks. Older Pennsylvanian rocks are exposed only on the high plateaus in the northern parts of the quadrangle. Triassic rocks are exposed nearly uninterrupted around the Skull Creek Rim. Excellent exposures of Jurassic through Cretaceous rocks form in the steeply dipping hogbacks in the southern part of the Skull Creek quadrangle.

STRUCTURE

The predominant structural features in the Skull Creek quadrangle are the Skull Creek and Wolf Creek Monoclines. Asymmetrical folds or monoclines are common in the eastern Uinta Mountains (Rowley and Hansen, 1979a) and are considered to be formed by movement along thrust faults as older rocks were displaced over younger rock.

The Skull Creek Monocline is an east-west-trending structure that extends for about 30 mi from near the Utah-Colorado border to the southeast corner of the quadrangle. The northern limb of the monocline dips very gently north at 2°–5°, and the southern limb dips steeply south at 25°–50°. The Skull Creek Monocline forms an ellipsoidal dome that has a large reentrant along the southern border. The dome, herein referred to as the "Skull Creek dome," extends into the adjoining quadrangle to the west and is approximately 5 by 10 mi in dimension. The Weber Sandstone is exposed in the core of the dome, and younger rock is exposed in the surrounding Skull Creek Rim. The Skull Creek Monocline formed as a result of movement along the Willow Creek fault, a thrust fault deep in the subsurface that trends east-west just south of the quadrangle. Movement along the fault is from north to south. The Willow Creek Fault was encountered in a drill hole at a depth of 8,000 ft near Dinosaur National Monument headquarters, about 12 mi to the west (Powers, 1986). Where encountered in the drill hole, the fault placed Precambrian rock over Paleozoic rock. The reentrant in the south side of the Skull Creek Monocline at Miller and Skull Creeks is a conspicuous structural feature that may be related to stress that developed along the Willow Creek Fault. A basement high could cause such stress.

The Wolf Creek Monocline extends east-west across the northern part of the Skull Creek quadrangle. North of the monocline axis, beds dip very gently south; south of the axis, beds dip very steeply south to vertical in places along its southern limb. Unlike the deep Willow Creek Fault, the thrust fault that caused the folding here breaches the surface. It is called the Wolf Creek Fault and has, for the most part, juxtaposed Weber and Moenkopi rock at the surface. Near the eastern edge of the quadrangle, the fault cuts the Park City and Moenkopi Formations.

Normal faulting is rare within the Skull Creek quadrangle. One such fault does displace Jurassic rocks near The Sloughs in the northeastern part of the quadrangle. Displacement along this fault increases from the west to east into the MF Mountain quadrangle. Northeasterly trending joints have developed in the Weber and Glen Canyon Sandstones. Most of the drainage, which is from north to south, does not follow the joints or faults but intersects the fractures at acute angles.

MINERAL AND ENERGY RESOURCES

Little, if any, potential exists within the Skull Creek quadrangle for mineral or energy resources. Formations within the quadrangle and nearby that contain traces of metals (discovered by early-day prospectors) include the Chinle and Stump Formations. The Weber Sandstone is a reservoir for oil and gas south of the quadrangle (Van Loenen and others, 1990).

During the early uranium "boom" of the 1950's, small deposits of uranium and related minerals were discovered in several localities within the Skull Creek quadrangle. Favorable depositional conditions apparently existed in sandstones, where fossil plant remains served to localize ore.

In the Skull Creek Rim, in the eastern part of the quadrangle (near center of sec. 20), a small amount of uranium-bearing petrified wood and clay was mined. This occurrence is in the Gartra Member (the coarse basal conglomerate) of the Chinle Formation. Another mine, near Skull Creek, produced a small amount of uranium, vanadium, and copper from the Curtis Member of the Stump Formation. The deposit contains several relatively rare secondary oxide minerals containing arsenic, copper, lead, selenium, uranium, and vanadium. "Trash" beds, composed mainly of carbonized plant remains in mudstone and sandstone may have served as a reductant for primary minerals. Similar, but smaller deposits occur at this stratigraphic interval in several places in the quadrangle, and most have been explored in prospect pits. Evidence of mineralization is readily recognized as a distinctive copper bloom (blue azurite). Petrified wood fragments, dinosaur bones, and some sandstone beds in the Morrison Formation are slightly radioactive; however, these levels of radioactivity are not unusual for the Morrison.

Just outside the northeast corner of the quadrangle, near Peterson Post Flat Reservior, uranium was mined from the Weber Formation. Mineralized rock was probably confined to the Wolf Creek fault zone. Several exploratory dozer cuts were made across the same fault zone in the Skull Creek quadrangle, but apparently no uranium ore was found.

The Moenkopi Formation is typically a redbed sequence throughout the Colorado Plateau; however, some Moenkopi beds in the Skull Creek Rim are altered to a conspicuous greenish-gray. This unusual alteration is accompanied by slight metal enrichment along the interface between the red and green beds (Cadigan, 1972). Apparently, reaction occurred at the contact between the red rocks (which represent an oxidized environment) and the green rocks (which represent an invading reducing environment). Due to the low permeability of the Moenkopi mudstones, the flow of fluids and sites for mineral deposition were greatly limited.

This region was explored for oil and gas because of a geologic setting similar to the nearby Rangely oil field. Oil and gas were discovered in 1933 in the Rangely field about 15 mi south of the Skull Creek quadrangle. The principal reservoir rock at the field is the Middle Pennsylvanian to Lower Permian Weber Sandstone. Oil is trapped in a large monocline very similar to the Skull Creek Monocline. Although the Weber is present in a structural setting similar to that of the Rangely field, it has very little potential for oil and gas within the Skull Creek quadrangle. Erosion has removed all of the Mesozoic and Cenozoic rock from the Skull Creek Monocline, thus exposing the Weber Sandstone and allowing any oil and gas accumulations to escape. Several wells drilled within the Skull Creek quadrangle and nearby, to test the Weber and older Paleozoic rock, met with little success (Van Loenen and others, 1990).

Other reservoirs for oil and gas in this region are foreland subthrust traps. The Willow Creek Fault, which lies beneath the southern boundary, has been an exploration target for this kind of trap. Powers (1986) analyzed the play from seismic data and from a drill hole located about 10 mi to the west of the Skull Creek quadrangle. Oil was found, but the amount of closure beneath the subthrust is too restricted in extent and the reservoir rock qualities are poor (Powers, 1986). This play has not been tested by drilling within the Skull Creek quadrangle.

Gravel is abundant in terrace and alluvial deposits in the southern part of the quadrangle. Limestone from the Cedar Mountain Formation and shale from the Mowry Shale have been quarried a few miles to the west in the Lazy Y quadrangle for use as road metal. Both are equally abundant in the Skull Creek quadrangle.

REFERENCES CITED

Cadigan, R.A., 1972, Geochemical anomalies and alteration in the Moenkopi Formation, Skull Creek, Moffat County, Colorado: U.S. Geological Survey Professional Paper 761, 21 p.

Cullins, H.L., 1969, Geologic map of the Mellen Hill quadrangle, Rio Blanco and Moffat Counties, Colorado: U.S. Geological Survey Geologic Quadrangle Map GQ-835, scale 1:24,000.

Hansen, W.R., Carrara, P.E., and Rowley, P.D., 1980, Geologic map of the Haystack Rock quadrangle, Moffat County, Colorado: U.S. Geological Survey Geologic Quadrangle Map GQ-1535, scale 1:24,000.

Hansen, W.R., and Rowley, P.D., 1980, Geologic map of the Hells Canyon quadrangle, Moffat County, Colorado: U.S. Geological Survey Geologic Quadrangle Map GQ-1536, scale 1:24,000.

Pipiringos, G.N., and O'Sullivan, R.B., 1975, Chert pebble unconformity at the top of the Navajo Sandstone in northeastern Utah: Four Corners Geological Society Guidebook, 8th Field Conference, Canyonlands 1975, p. 149–156.

Powers, R.B., 1986, The Willow Creek fault, eastern Uinta Mountains-Geological analysis of a foreland subthrust play, in Stone, D.S., ed., New interpretations of northwest Colorado geology: Denver, Colo., Rocky Mountain Association of Geologists, p. 183–190.

Rowley, P.D., and Hansen, W.R., 1979a, Geologic map of the Plug Hat Rock quadrangle, Moffat County, Colorado: U.S. Geological Survey Geologic Quadrangle Map GQ-1514, scale 1:24,000.

———1979b, Geologic map of the Split Mountain quadrangle, Uintah County, Utah: U.S. Geological Survey Geologic Quadrangle Map GQ-1515, scale 1:24,000.

Van Loenen, R.E., Folger, H.W., Bryant, W.A., and Korzeb, S.L., 1990, Mineral resources of the Willow Creek and Skull Creek Wilderness Study Areas, Moffat County, Colorado: U.S. Geological Survey Bulletin 1717–D, 20 p.

Van Loenen, R.E., Selner, Gary, and Bryant, W. Anthony, 1999, Geologic map of the Lazy Y Point quadrangle, Moffat County, Colorado: U.S. Geological Survey Geologic Investigations Series I–2646, scale 1:24,000.