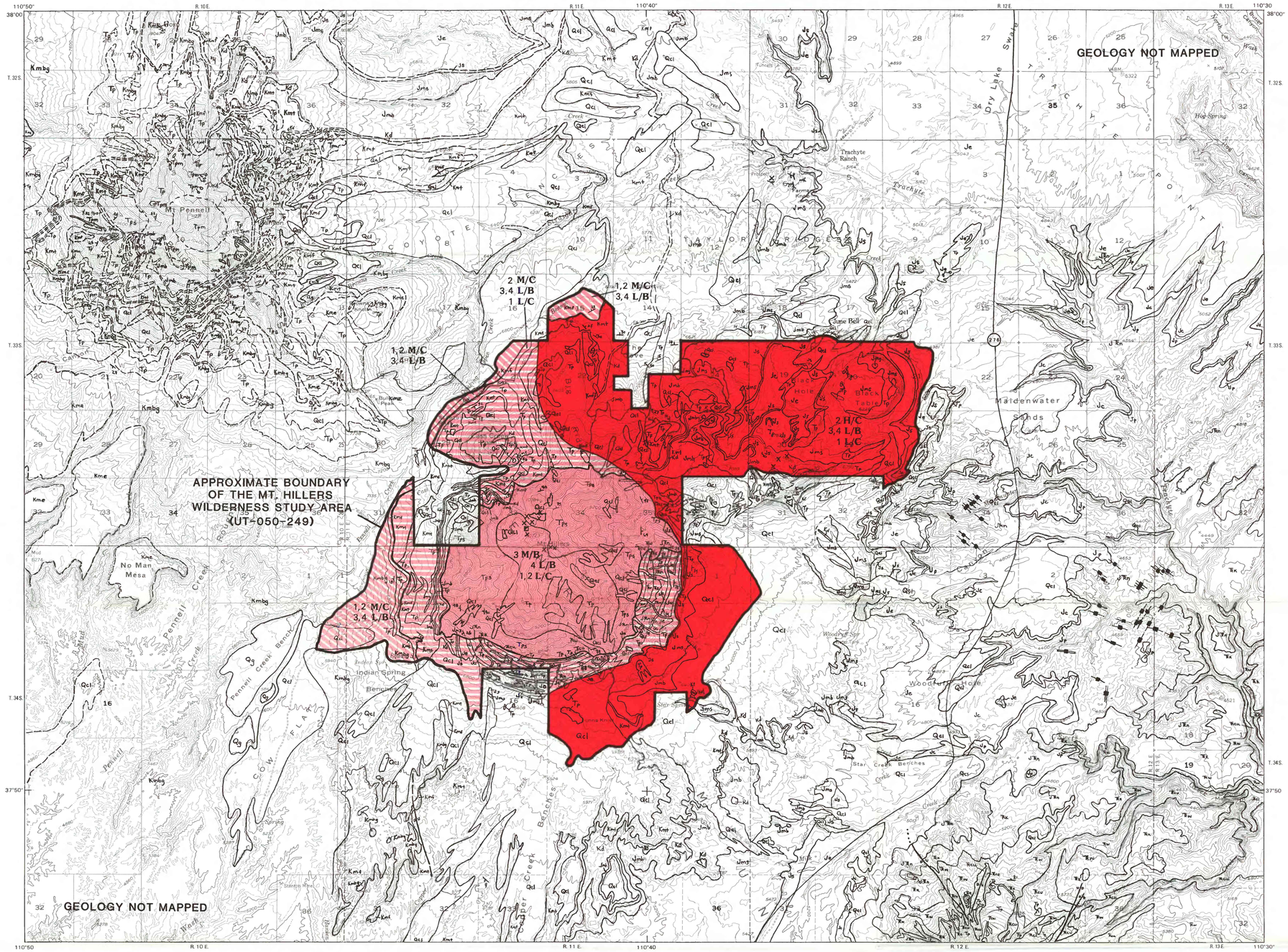


Base from U.S. Geological Survey, 1:62,500
Mt. Hillers, 1952; Mt. Pennell, 1953

Geology from Larson and others, 1985

EXPLANATION OF MINERAL RESOURCE POTENTIAL

2 H/C 3, 4 L/B 1 L/C	Geologic terrane having high mineral resource potential for commodity 2, with certainty level C; geologic terrane having low mineral resource potential for commodities 3 and 4, with certainty level B; geologic terrane having low mineral resource potential for commodity 1, with certainty level C
3 M/B 4 L/B 1, 2 L/C	Geologic terrane having moderate mineral resource potential for commodity 3, with certainty level B; geologic terrane having low mineral resource potential for commodity 4, with certainty level B; geologic terrane having low mineral resource potential for commodities 1 and 2 with certainty level C
2 M/C 3, 4 L/B 1 L/C	Geologic terrane having moderate mineral resource potential for commodity 2, with certainty level C; geologic terrane having low mineral resource potential for commodities 3 and 4, with certainty level B; geologic terrane having low mineral resource potential for commodity 1, with certainty level C
1, 2 M/C 3, 4 L/B	Geologic terrane having moderate mineral resource potential for commodities 1 and 2, with certainty level C; geologic terrane having low mineral resource potential for commodities 3 and 4, with certainty level B

Commodities
1. Coal
2. Uranium and vanadium
3. Base (copper, lead, zinc) and precious (gold) metals
4. Oil and gas and geothermal energy

CORRELATION OF MAP UNITS

Units	Epoch	Period
Qal, Qcl, Qg	Holocene, Pleistocene	QUATERNARY
Unconformity		
Tp, Tps, Tpm	Eocene	TERTIARY
Unconformity		
Kme, Kmbg, Kmf, Kmt, Kd	Upper Cretaceous	CRETACEOUS
Unconformity		
Jmb, Jms	Upper Jurassic	JURASSIC
Unconformity		
Js, Je, Jc, Jp	Middle Jurassic	JURASSIC
Unconformity		
JTk, Ꞧk, Ꞧw	Upper Triassic(?)	TRIASSIC(?)
Unconformity		
Ꞧcu, Ꞧcl	Upper Triassic	TRIASSIC
Unconformity		
Ꞧm	Middle(?) and Lower Triassic	TRIASSIC

DESCRIPTION OF MAP UNITS

Qal **Alluvium (Holocene)**—Poorly sorted deposits of clay, silt, sand, and gravel along stream courses

Qcl **Colluvium (Holocene)**—Talus, landslide debris, Toreva blocks, and unsorted boulders, gravel, sand, and mud; thickness 0–100 ft or more

Qg **Gravel deposits (Holocene and Pleistocene)**—Poorly sorted mud, sand, and gravel on pediment and terrace surfaces; thickness 0–50 ft

Tp **Diorite porphyry (Eocene)**—Stocks, laccoliths, and minor intrusive masses; K-Ar dates of 44 and 48 m.y. (million years) (Armstrong, 1969) and fission track ages of 21.2–29.2 m.y. (Sullivan, 1987)

Tps **Diorite porphyry (Eocene)**—Irregular zone of complexly intruded radial dikes, sills, and minor intrusive masses of diorite porphyry and shattered sedimentary rocks in a zone surrounding the stock; sedimentary units include the Middle(?) and Lower Triassic Moenkopi Formation and Permian rocks on the south side of the stock, and include Jurassic and older rocks on the west, north, and east sides of the stock

Tpm **Monzonite porphyry (Eocene)**—Stock, dikes, and minor, intrusive satellite bodies; restricted to Mt. Pennell

Mancos Shale (Upper Cretaceous)—Vertically alternating marine and nonmarine units aggregating 3,200–3,600 ft in thickness

Kme **Emery Sandstone Member**—Light- to dark-brown, fine- to medium-grained sandstone; upper part interbedded with greenish-gray, laminated to thinly bedded mudstone, black carbonaceous mudstone, and coal seams; sandstone often thinly bedded or cross-stratified; generally forms alternating slopes and cliffs; marginal marine, lagoonal-paludal, and alluvial-plain deposits. Corresponds to Muley Canyon Sandstone Member of Smith (1983); approximate thickness 300–445 ft

Kmbg **Blue Gate Member**—Gray to dark-gray bentonitic marine shale, horizontally laminated and (or) ripple cross-laminated; locally interbedded with very fine grained sandstone; forms broad slope; offshore marine deposits; approximate thickness 1100–1500 ft

Kmf **Ferron Sandstone Member**—Yellowish-gray to light-brown, fine- to medium-grained, laminated, crossbedded sandstone; upper part interbedded with black carbonaceous mudstone and coal beds; forms alternating slopes and cliffs; marginal marine, lagoonal-paludal, and alluvial-plain deposits; approximate thickness 200–385 ft

Kmt **Tununk Member**—Gray to bluish-gray bentonitic mudstone and silty shale locally interbedded with yellowish-gray, very fine grained to fine-grained, laminated to thin-bedded, calcareous sandstone; forms a broad bench; offshore marine deposits; approximate thickness 530–720 ft

Kd **Dakota Sandstone (Upper Cretaceous)**—Light-gray to light-brown, fine- to medium-grained sandstone and locally conglomeratic sandstone; sandstone moderately to well cemented, horizontally laminated and (or) crossbedded, and interbedded in lower part with black, carbonaceous mudstone and thin, subeconomic coal seams; forms cliffs and slopes; fluvial, lagoonal-paludal, and marginal marine deposits; thickness ranges 0 to 90 ft or more

Morrison Formation (Upper Jurassic)—Continental deposits 265–655 ft thick

Jmb **Brushy Basin Member**—Light-gray to gray-green and reddish-brown to purple bentonitic mudstone containing several lenses of chert pebble conglomerate; forms slope; alluvial plain, mudflat, and probable lacustrine deposits; approximate thickness 100–250 ft

Jms **Salt Wash Member**—Light-gray to light-brown, fine- to medium-grained, crossbedded or laminated sandstone, conglomeratic sandstone, and conglomerate; interstratified with grayish-green to reddish-brown siltstone and mudstone; locally a major uranium-bearing unit; forms cliffs; alluvial plain, mudflat, and lacustrine deposits; approximate thickness 100–500 ft

Js **Summerville Formation (Middle Jurassic)**—Moderate-reddish-brown, laminated to very thin bedded mudstone and siltstone; locally containing light-gray to grayish-green gypsum lenses 0–3 ft thick; forms broad slopes with prominent cliff at top; shallow-water, restricted-marine and, locally, evaporite deposits; approximate thickness 130–250 ft

Je **Entrada Sandstone (Middle Jurassic)**—Reddish-orange to reddish-brown, very fine grained to fine-grained sandstone and silty sandstone; very thin to thick-bedded; generally forms slope; eolian and sabkha deposits; approximate thickness 300–700 ft

Jc **Carmel Formation (Middle Jurassic)**—Yellowish-orange to moderate reddish-brown, very fine grained to fine-grained sandstone and dark-reddish-brown mudstone; locally contains gray to greenish-gray limestone and coarsely crystalline white gypsum; marine, tidal flat, and sabkha deposits; approximate thickness 100–625 ft

Jp **Page Sandstone (Middle Jurassic)**—Reddish-orange to moderate-reddish-brown, very fine grained to fine-grained, well-sorted sandstone; contains large-scale planar and trough crossbedding; eolian deposits; approximate thickness 0–60 ft

JTRn **Navajo Sandstone (Jurassic and Upper Triassic?)**—Light-gray to light-orange, fine- to medium-grained, well-sorted sandstone; thickly crossbedded; locally contains minor lenses of mudstone, cherty limestone, or dolomite; cliff former; eolian and minor playa deposits; approximate thickness 500–820 ft

Ꞧk **Kayenta Formation (Upper Triassic?)**—Reddish-orange to reddish-brown, fine- to medium-grained, crossbedded sandstone, and laminated sandy siltstone; interbedded with minor limestone and mudstone; forms ledges and steep slopes; largely fluvial deposits, locally includes overbank, lacustrine, sabkha, and eolian deposits; approximate thickness 240–330 ft

Ꞧw **Wingate Sandstone (Upper Triassic)**—Reddish-pink to reddish-orange, very fine grained to fine-grained, crossbedded sandstone; forms cliffs; eolian deposits; approximate thickness 280–380 ft

Chinle Formation (Upper Triassic)—Divided into two parts, each containing several members

Ꞧcu **Upper part, undivided**—Comprises Church Rock, Owl Rock, and Petrified Forest Members

Church Rock Member—Reddish-brown to reddish-orange siltstone; irregularly ripple laminated to thick bedded; interbedded with cross-stratified, fine- to coarse-grained sandstone; locally contains thin- to thick-bedded conglomerate and arkosic sandstone; fluvial and lacustrine deposits; approximate thickness 80–200 ft

Owl Rock Member—Pale-red to pale-reddish-brown siltstone and mudstone; interbedded with pale-red to light-greenish-gray, thin- to medium-bedded, cherty limestone; thin to medium bedded; locally contains limestone breccia; lacustrine deposits; approximate thickness 120–200 ft

Petrified Forest Member—Variegated bentonitic claystone; interbedded with minor amounts of clayey siltstone and fine- to medium-grained sandstone; thin to thick bedded; fluvial and lacustrine deposits; approximate thickness 50–200 ft

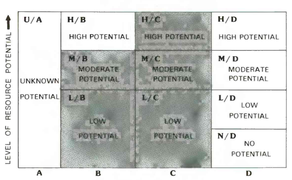
Ꞧcl **Lower part, undivided**—Comprises Moss Back, Monitor Butte, and Shinarump Members

Moss Back Member—Yellowish-gray to pale-orange, thin to thick-bedded, structureless to cross-stratified, fine- to medium-grained sandstone; locally contains lenses of pale-green claystone and siltstone, and lenses of chert- and limestone-pebble conglomerate; fluvial deposits; thickness ranges from 0–165 ft

Monitor Butte Member—Variegated to predominantly greenish-gray, micaceous, bentonitic mudstone; also contains fine-grained, grayish-green sandstone; locally contains limestone-pebble conglomerate; fluvial, lacustrine-deltaic, and lacustrine deposits; thickness 0–265 ft

Shinarump Member—Gray to yellowish-gray, medium- to thick-bedded, cross-stratified, fine-grained to conglomeratic sandstone; contains minor gray to red mudstone; locally contains uranium and copper; fluvial deposits; thickness ranges from 0–50 ft

Ꞧm **Moenkopi Formation (Middle? and Lower Triassic)**—Pale-red to reddish-brown, thin- to thick-bedded, very fine grained to fine-grained, crossbedded sandstone; also contains pale-brown to medium-brown, thin-bedded silty mudstone and limestone; locally contains brown to medium-brown, coarse-grained, lenticular conglomerate at base; marine, tidal flat, and lagoonal deposits; approximate thickness 300–500 ft



LEVELS OF RESOURCE POTENTIAL

- **H** High mineral resource potential
- **M** Moderate mineral resource potential
- **L** Low mineral resource potential
- **U** Unknown mineral resource potential
- **N** No known mineral resource potential

LEVELS OF CERTAINTY

- **A** Available data not adequate
- **B** Data indicate geologic environment and suggest level of resource potential
- **C** Data indicate geologic environment, give good indication of level of resource potential, but do not establish activity of resource-forming processes
- **D** Data clearly define geologic environment and level of resource potential and indicate activity of resource forming processes in all or part of the area

Diagram showing relationships between levels of mineral resource potential and levels of certainty. Shading shows levels that apply to this study area

SCALE 1:50 000

1 ½ 0 1 2 3 MILES

1 .5 0 1 2 3 KILOMETERS

CONTOUR INTERVAL 80 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

- Contact—Dashed where approximately located
- Normal Fault—Dashed where approximately located; dotted where concealed; U, upthrown side; D, downthrown side
- Strike and dip of beds: Apparent; Inclined
- Strike of vertical joints
- Mine
- Prospect
- Shaft

MAP SHOWING THE MINERAL RESOURCE POTENTIAL AND GEOLOGY OF THE MT. HILLERS WILDERNESS STUDY AREA, GARFIELD COUNTY, UTAH