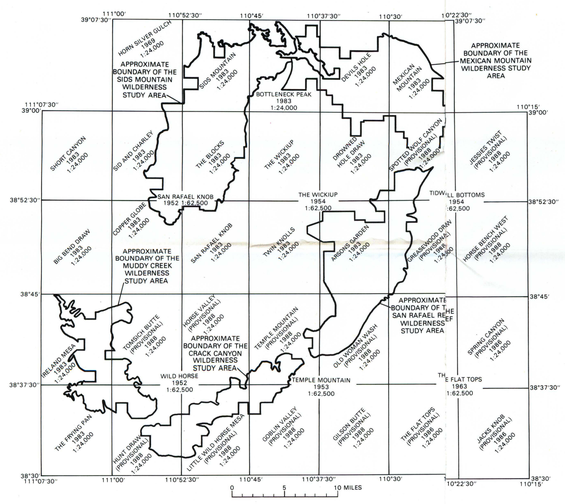
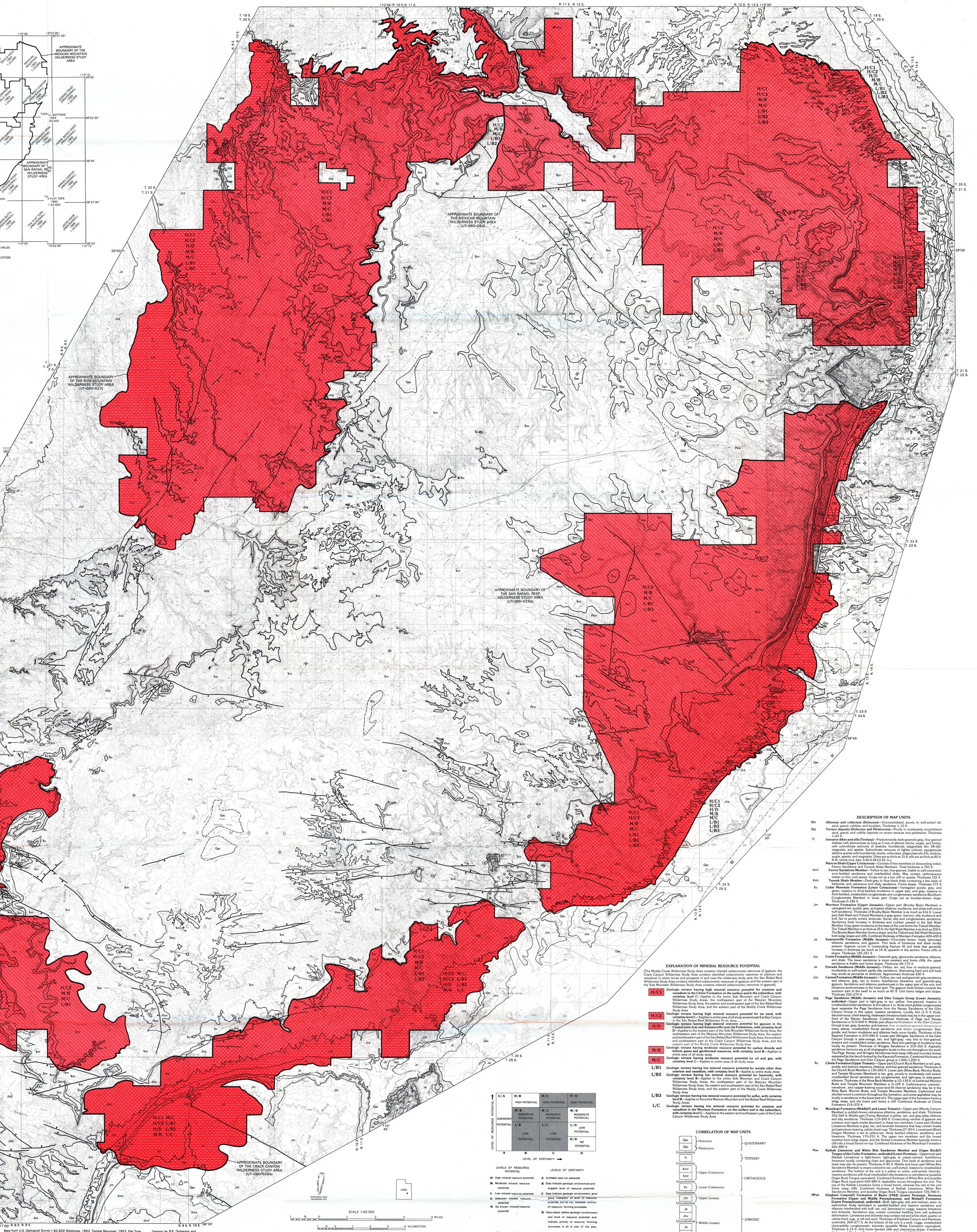


INDEX MAP SHOWING QUADRANGLE LOCATION



Base from U.S. Geological Survey 1:62,500 Wildhorse, 1952, Temple Mountain, 1953, Flat Tops, Tidwell Bottoms, 1954; 1:24,000 Horn Silver Gulch, 1969, Arsons Garden, Big Bend Draw, Bottleneck Peak, Copper Globe, Devils Hole, Drowned Hole Draw, Ireland Mesa, Mexican Mountain, Molen, San Rafael Knob, Short Canyon, Sid and Charley, Sids Mountain, The Blocks, The Frying Pan, The Wickiup, Twin Knolls, 1983

Geology by R.P. Dickerson and Susan Bartsch-Winkler, 1987–89; modified from Witkind (1989) north of lat 39°

SCALE 1:62 500

CONTOUR INTERVAL 80 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

DESCRIPTION OF MAP UNITS

Qac **Alluvium and colluvium (Holocene)**—Unconsolidated, poorly to well-sorted silt, sand, gravel, cobbles, and boulders. Thickness 1–10 ft

Qtp **Terrace deposits (Holocene and Pleistocene)**—Poorly to moderately consolidated sand, gravel, and cobble deposits on recent terraces and pediments. Thickness 1–50 ft

Ti **Intrusive dikes and sills (Tertiary)**—Predominantly dark-greenish-gray, fine-grained diabase with phenocrysts as long as 3 mm of altered olivine, augite, and biotite, with subordinate amounts of analcite, hornblende, plagioclase (An 38–62), magnetite, and apatite. Subordinate amounts of lighter colored, equigranular alkaline syenite with hornblende, biotite, orthoclase, plagioclase (An 55), analcite, augite, apatite, and magnetite. Dikes are as thick as 15 ft; sills are as thick as 80 ft. K-Ar whole-rock date 3.42±4.68±0.25 m.y.

Mancos Shale (Upper Cretaceous)—Consists of two members (in descending order): Ferron Sandstone and Tununk Shale Members. Total thickness is 700 ft

Kmf **Ferron Sandstone Member**—Yellow to tan, fine-grained, friable to well-cemented, even-bedded sandstone and interbedded shale. May contain carbonaceous matter or thin coal seams. Crops out as a low cliff or questa. Thickness 125 ft

Kmt **Tununk Shale Member**—Dark-gray to blue-black shale containing a few beds of bentonite, and calcareous and shaly sandstone. Forms slopes. Thickness 575 ft

Kc **Cedar Mountain Formation (Lower Cretaceous)**—Variegated purple, gray, and green, massive to thick-bedded mudstone in upper part; and gray, massive to thick-bedded, crossbedded conglomerate and conglomeratic sandstone (Buckhorn Conglomerate Member) in lower part. Crops out as boulder-strewn slope. Thickness 0–185 ft

Jm **Morrison Formation (Upper Jurassic)**—Upper part (Brushy Basin Member) is variegated red, purple, gray, and green siltstone, mudstone, and shale with minor buff sandstone. Thickness of Brushy Basin Member is as much as 416 ft. Lower part (Salt Wash and Tidwell Members) is gray-green, maroon, silty mudstone and buff, fair to poorly sorted, lenticular, fluvial, silty and conglomeratic sandstone. Sandstone beds increase in thickness and number upward in the Salt Wash Member. Gray-green mudstone at the base of the unit forms the Tidwell Member. The Tidwell Member is as thick as 35 ft; the Salt Wash Member is as thick as 258 ft. The Brushy Basin Member forms a slope, and the Tidwell and Salt Wash Members form ledge slopes and cliffs. Combined thickness of Morrison Formation 400–690 ft

Js **Summerville Formation (Middle Jurassic)**—Chocolate brown, finely laminated siltstone, sandstone, and gypsum. Thin beds of limestone and shale locally present. Gypsum occurs in crosscutting fracture fill and beds that generally increase in thickness (as much as 14 ft) upwards in the section. Forms cliffs or slopes. Thickness 125–331 ft

Jcu **Curtis Formation (Middle Jurassic)**—Greenish-gray, glauconitic sandstone, siltstone, and shale. The lower sandstone is more resistant and forms cliffs; the upper sandstone is friable and forms slopes. Thickness 50–170 ft

Je **Entrada Sandstone (Middle Jurassic)**—Yellow, tan, red, fine- to medium-grained, moderately to well-sorted, partly silty sandstone. Alternating hard and soft beds may erode as pinnacles or slickrock. Approximate thickness 430 ft

Jca **Carmel Formation (Middle Jurassic)**—Yellow, tan, red, and greenish-gray sandstone and siltstone, gray, tan to brown, fossiliferous limestone, and greenish-gray gypsum. Sandstone and siltstone predominate in the upper part of the unit, and limestone predominates in the lower part. The gypsum beds thicken towards the southern part of the swell to as much as 40 ft. Unit forms ledges and slopes. Thickness 230–270 ft

Jpg **Page Sandstone (Middle Jurassic) and Glen Canyon Group (Lower Jurassic), undivided**—Upper part is light-gray to tan, yellow, fine-grained, massive to crossbedded eolian sandstone. A thin (about 1 m. thick) chert-pebble conglomerate layer separates the Page Sandstone from the Navajo Sandstone of the Glen Canyon Group in this upper, massive sandstone. Locally thin (1–5 ft thick), discontinuous, chert-bearing, freshwater limestone beds may be in the upper one-third of the Navajo Sandstone. Combined thickness of Page and Navajo Sandstones is 513–600 ft. Middle part (Kayenta Formation of the Glen Canyon Group) is tan, gray, lavender, and maroon, fine- to medium-grained, micaceous in many places, crossbedded fluvial sandstone and minor conglomerate. Red, purple, and brown mudstone and siltstone beds occur locally. Thickness of the Kayenta Formation is 210–240 ft. Lower part (Wingate Sandstone of the Glen Canyon Group) is pale-orange, tan, and light-gray, very fine to fine-grained, massive and crossbedded eolian sandstone. Rare thin partings of mudstone may locally be present. Thickness of Wingate Sandstone is 310–350 ft. Asphaltic sandstone horizons are at all stratigraphic levels in this unit throughout the swell. The Page, Navajo, and Wingate Sandstones form steep cliffs and rounded domes separated by the bench formed by the Kayenta Formation. Combined thickness of the Page Sandstone and Glen Canyon group is 1,000–1,200 ft

Ŧc **Chinle Formation (Upper Triassic)**—Upper part (Church Rock Member) is red, gray, purple, and maroon claystone, siltstone, and fine-grained sandstone. Thickness of the Church Rock Member is 130–250 ft. Lower part (Moss Back, Monitor Butte, and Temple Mountain Members) is tan, gray, poorly to moderately well sorted, crossbedded fluvial sandstone and conglomerate, and light-gray to pale-green siltstone. Thickness of the Moss Back Member is 12–130 ft, of combined Monitor Butte and Temple Mountain Members is 0–100 ft. Carbonaceous uranium-vanadium-, and copper-bearing scour-and-fill channel sandstone may be in the Moss Back, Monitor Butte, and Temple Mountain Members. Carbonized and silicified wood is common throughout the formation, and some asphaltite may be locally in sandstone in the lower part of it. The upper part of the formation forms a ledgy slope, and the lower part forms a cliff. Combined thickness of Chinle Formation 215–370 ft

ŦRm **Moenkopi Formation (Middle(?) and Lower Triassic)**—Upper part (Moody Canyon Member) is reddish-brown calcareous siltstone, sandstone, and shale. Thickness 355–540 ft. Middle part (Torrey Member) is yellow, tan, and gray platy siltstone and silty sandstone. Thickness 110–265 ft. Crosscutting veinlets of gypsum are common and ripple marks abundant in these two members. Lower part (Sinbad Limestone Member) is gray, tan, and lavender limestone that may contain fossils and petroleum-bearing, calcite-lined vugs. Thickness 27–45 ft. Lowest part (Black Dragon Member) is tan to yellow-tan, thinly bedded siltstone, sandstone, and limestone. Thickness 170–210 ft. The upper two members and the lowest member form ledge slopes, and the Sinbad Limestone Member typically forms a cliff with a broad bench on top. Combined thickness of the Moenkopi Formation 465–880 ft

PŦpk **Kaibab Limestone and White Rim Sandstone Member and Organ Rock(?) Tongue of the Cutler Formation, undivided (Lower Permian)**—Uppermost part (Kaibab Limestone) is light-brown, light-gray to cream-colored, fossiliferous limestone locally containing chert and glauconite. Thin beds of sandstone and shale may also be present. Thickness 0–85 ft. Middle and lower part (White Rim Sandstone Member) is cream-colored to tan, well-sorted, massive to crossbedded sandstone. The bottom of the unit is a yellow to ochre, well-sorted, limonitic, massive sandstone with local interbedded silty limestone or red siltstone (possible Organ Rock Tongue equivalent). Combined thickness of White Rim and possible Organ Rock equivalent 650–880 ft. Asphaltite occurs throughout the unit. The top of the Kaibab Limestone forms a broad bench, whereas the rest of the unit forms steep cliffs. Combined thickness of Kaibab Limestone, White Rim Sandstone Member, and possible Organ Rock Tongue equivalent 720–980 ft

PIPeh **Elephant Canyon(?) Formation of Baars (1962) (Lower Permian), Hermosa Formation (Upper and Middle Pennsylvanian), and Molas(?) Formation (Lower Pennsylvanian), undivided**—Buff, light-gray, red, and maroon, poor- to well-sorted, finely laminated to parallel-bedded and massive sandstone and siltstone interbedded with buff, tan, red, laminated to vuggy, massive limestone and dolomite. Sandstone may contain contorted bedding from soft sediment deformation. Limestone and dolomite may contain red and white chert, quartz- or calcite-lined vugs, or silt and sand. Thickness of Elephant Canyon and Hermosa, undivided, 269–277 ft. At the bottom of the unit is a pink, vuggy, crossbedded chert-pebble conglomeratic dolomite (possible Molas Formation equivalent). Thickness 3–12 ft. Unit forms banded cliffs and intervening slopes. Combined thickness of Elephant Canyon, Hermosa, and Molas(?) 272–310 ft

Pec **Carbonate rocks (Paleozoic)**—Light-gray, massive dolomite and limestone with some fossils and minor vugs in the upper part. Beds and nodules of pink, red, and white chert in the lower part, decreasing in abundance upward. Forms a steep cliff. Exposed thickness 120 ft

Contact, dashed where inferred

Normal fault—Dashed where inferred; dotted where concealed. Bar and ball on downthrown side; D, downthrown side; U, upthrown side

Strike and dip of bed

Mine

Prospect

Dry hole

Oil seep

Collapse feature

EXPLANATION OF MINERAL RESOURCE POTENTIAL

[The Muddy Creek Wilderness Study Area contains inferred subeconomic resources of gypsum; the Crack Canyon Wilderness Study Area contains identified subeconomic resources of uranium and vanadium in seven mines and prospects in and near the wilderness study area; the San Rafael Reef Wilderness Study Area contains identified subeconomic resources of gypsum; and the western part of the Sids Mountain Wilderness Study Area contains inferred subeconomic resources of gypsum]

H/C1 **Geologic terrane having high mineral resource potential for uranium and vanadium in the Chinle Formation on the surface and in the subsurface, with certainty level C**—Applies to the entire Sids Mountain and Crack Canyon Wilderness Study Areas, the northeastern part of the Mexican Mountain Wilderness Study Area, the eastern and southeastern part of the San Rafael Reef Wilderness Study Area, and the western part of the Muddy Creek Wilderness Study Area

H/C2 **Geologic terrane having high mineral resource potential for tar sand, with certainty level C**—Applies to entire area of all study areas except Eardley Canyon in the San Rafael Reef Wilderness Study Area.

H/D **Geologic terrane having high mineral resource potential for gypsum in the Carmel (unit Jca) and Summerville (unit Js) Formations, with certainty level D**—Applies to the western part of the Sids Mountain Wilderness Study Area, the northeastern part of the Mexican Mountain Wilderness Study Area, the eastern and southeastern part of the San Rafael Reef Wilderness Study Area, the southern and southeastern part of the Crack Canyon Wilderness Study Area, and the western part of the Muddy Creek Wilderness Study Area

M/B **Geologic terrane having moderate resource potential for carbon dioxide and helium gases and geothermal resources, with certainty level B**—Applies to entire area of all study areas

M/C **Geologic terrane having moderate resource potential for oil and gas, with certainty level C**—Applies to entire area of all study areas

L/B1 **Geologic terrane having low mineral resource potential for metals other than uranium and vanadium, with certainty level B**—Applies to entire study areas

L/B2 **Geologic terrane having low mineral resource potential for bentonite, with certainty level B**—Applies to the entire Sids Mountain and Crack Canyon Wilderness Study Areas, the northeastern part of the Mexican Mountain Wilderness Study Area, the eastern and southeastern part of the San Rafael Reef Wilderness Study Area, and the western part of the Muddy Creek Wilderness Study Area

L/B3 **Geologic terrane having low mineral resource potential for sulfur, with certainty level B**—Applies to the entire Mexican Mountain and San Rafael Reef Wilderness Study Areas

L/C **Geologic terrane having low mineral resource potential for uranium and vanadium in the Morrison Formation on the surface and in the subsurface, with certainty level C**—Applies to the eastern and southeastern part of the Crack Canyon Wilderness Study Area

LEVEL OF RESOURCE POTENTIAL ↑ / LEVEL OF CERTAINTY →	A	B	C	D
U/A	H/B HIGH POTENTIAL		H/C HIGH POTENTIAL	H/D HIGH POTENTIAL
UNKNOWN POTENTIAL	M/B MODERATE POTENTIAL		M/C MODERATE POTENTIAL	M/D MODERATE POTENTIAL
	L/B LOW POTENTIAL		L/C LOW POTENTIAL	L/D LOW POTENTIAL
				N/D NO POTENTIAL

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 these study areas

CORRELATION OF MAP UNITS

Qac	Holocene	QUATERNARY
Qtp	Pleistocene	QUATERNARY
Unconformity		
Ti		TERTIARY
Unconformity		
Kmf, Kmt	Upper Cretaceous	CRETACEOUS
Unconformity		
Kc	Lower Cretaceous	CRETACEOUS
Unconformity		
Jm	Upper Jurassic	JURASSIC
Unconformity		
Js, Jcu, Je, Jca	Middle Jurassic	JURASSIC
Unconformity		
Jpg	Lower Jurassic	JURASSIC
Unconformity		
Ŧc	Upper Triassic	TRIASSIC
Unconformity		
Ŧm	Middle(?) and Lower Triassic	TRIASSIC
Unconformity		
Pkw	Lower Permian	PERMIAN
PIPeh	Upper to Lower Pennsylvanian	PENNSYLVANIAN
Unconformity(?)		
Pec		PALEOZOIC

REFERENCE CITED

Witkind, I.J., 1989, Geologic map of the Huntington 30′ × 60′ quadrangle, Carbon, Emery, Grand, and Uintah Counties, Utah: U.S. Geological Survey Miscellaneous Investigations Series Map I–1764, scale 1:100,000.

MINERAL RESOURCE POTENTIAL AND GENERALIZED GEOLOGIC MAP OF THE SAN RAFAEL SWELL WILDERNESS STUDY AREAS, INCLUDING THE MUDDY CREEK, CRACK CANYON, SAN RAFAEL REEF, MEXICAN MOUNTAIN, AND SIDS MOUNTAIN WILDERNESS STUDY AREAS, EMERY COUNTY, UTAH