EXPLANATION

SEDIMENTARY ROCKS

QUATERNARY

Pleistocene and Recent

Qal | Qd | Qp | Qls

Surficial deposits
Shown only where of appreciable extent. Alluvium may include landslide, lake-bed, and spring deposits
Qal, *alluvium*
Qd, *dune sand*
Qp, *playa deposits*
Qls, *landslide deposits*

UNCONFORMITY

TERTIARY

Miocene

Tbu | Tbv | Tbl

Bidahochi Formation
Tbu, *upper member, sandstone; some siltstone, claystone, and tuff in lower part*
Tbv, *volcanic member, lava flows, volcanic detritus, and associated spring deposits*
Tbl, *lower member, claystone and some tuff*

Tg

Gravel
Gravel to silt; may include rocks of Miocene age

UNCONFORMITY

Pliocene(?)

Tc

Chuska Sandstone
Gray to grayish-white massive and crossbedded sandstone and some interbedded siltstone

UNCONFORMITY

Paleocene

Tn

Nacimiento Formation
Gray and brown shale and tan medium-grained sandstone

Koa

Ojo Alamo Sandstone
Tan fine- to coarse-grained conglomeratic sandstone

Kku | Kkf | Kkl

Kirtland Shale
Kku, *upper greenish-gray shale member*
Kkf, *Farmington Sandstone Member, tan, fine- to medium-grained*
Kkl, *lower greenish-gray shale member*

Kf

Fruitland Formation[1]
Gray, brown, and black mudstone and siltstone; yellowish-brown and tan crossbedded sandstone, and coal

Kpc

Pictured Cliffs Sandstone[1]
Tan crossbedded medium- to massive-bedded fine- to medium-grained sandstone. In small area about 8 miles east of Newcomb, where Lewis Shale is absent, the Cliff House Sandstone is mapped with unit

Kl

Lewis Shale[1]
Light- to dark-gray claystone and mudstone, beds of concretionary limestone, and interbedded thin platy sandstone. Sandstone is commoner in the upper and lower transitional zones

Kch

Cliff House Sandstone[1]
Tan and gray crossbedded fine- to medium-grained sandstone containing varying amounts of interbedded gray siltstone

Kmf | Kmfc

Menefee Formation[1]
Alternating beds of tan and brown sandstone, gray and brown claystone and siltstone; coal, and scattered layers of ironstone and limestone concretions. In the Chuska Mountains from Toadlena southward, equivalents of rocks probably as young as Kirtland Shale are mapped with unit. Near Tohatchi, the Tohachi Formation[2] *is mapped with the upper part of the Menefee*
Kmfc, *Cleary Coal Member. Intertongues with upper part of Crevasse Canyon Formation*

Upper Cretaceous

Mesaverde Group

BLACK MESA BASIN

Ky

Yale Point Sandstone
Tan and brown sandstone

Kw

Wepo Formation
Alternating beds of olive-gray siltstone, coal, and yellowish-gray sandstone

Ktu | Kt | Ktm | Ktl

Toreva Formation
Ktu, *upper sandstone member, yellowish-gray to grayish-orange-pink, fine to very coarse grained*
Ktm, *middle carbonaceous mudstone member, variicolored*
Ktl, *lower sandstone member, light-brown to pale-yellowish-gray, fine- to medium-grained*

Kmt | Km | Ktlt

Toreva Formation and Mancos Shale
Km, *Mancos Shale, predominantly light- to dark-gray claystone and siltstone containing lesser amounts of tan fine-grained sandstone and siltstone, bedded limestone, and concretionary limestone*
Kmt, *upper tongue of the Mancos Shale*
Ktlt, *tongue of the Toreva Formation in the Padilla Mesa area, where it separates the upper tongue of the Mancos Shale from the lower part of the Mancos Shale*

Kd

Dakota Sandstone
Tan, brown, and gray sandstone, conglomeratic sandstone, and conglomerate; frequently contains partings of brown carbonaceous siltstone and lenses of coal

UNCONFORMITY

Lower Cretaceous

SAN JUAN BASIN

Kpl | Kplh

Point Lookout Sandstone[1]
Tan and brown sandstone containing lesser amounts of gray siltstone
Kplh, *Hosta Tongue; in southern part of area separated from main body of Point Lookout by Satan Tongue of Mancos Shale*

Kcg | Kcb | Kcda | Kcbd | Kcs | Kcd

Crevasse Canyon Formation[1]
Alternating beds of tan irregularly bedded and lenticular sandstone, drab siltstone and claystone, and coal
Kcg, *Gibson Coal Member*
Kcb, *Bartlett Barren Member*
Kcbd, *Bartlett Barren Member and Dilco Coal Member; along the Arizona State line in the Manuelito-Window Rock Coal Mine area*
Kcda, *Dalton Sandstone Member*
Kcd, *Dilco Coal Member*
Kcs, *"stray" sandstone, field designation of Sears, Hunt, and Hendricks (1941); in Shiprock area, mapped with the Dilco Coal Member*

Kg

Gallup Sandstone[1]
Tan, brown, and pinkish-gray thin- to massive-bedded sandstone containing lesser amounts of brown carbonaceous siltstone, gray siltstone, and lenses of coal. Along southern part of Mesa de los Lobos, the Dilco Coal Member of the Crevasse Canyon Formation is mapped with unit

Kmu | Kms | Kmm | Kml

Mancos Shale[1]
Light- to dark-gray claystone and siltstone containing lesser amounts of tan fine-grained sandstone, limestone, and concretionary limestone
Kmu, *upper part*
Kms, *Satan Tongue*
Kmm, *Mulatto Tongue*
Kml, *lower part, present only in southern part*

Kd

Dakota Sandstone
Tan, brown, and gray sandstone, conglomeratic sandstone, and conglomerate; frequently contains partings of brown carbonaceous siltstone and lenses of coal. Age of the Dakota is Early and Late Cretaceous where the Burro Canyon is not differentiated

UNCONFORMITY

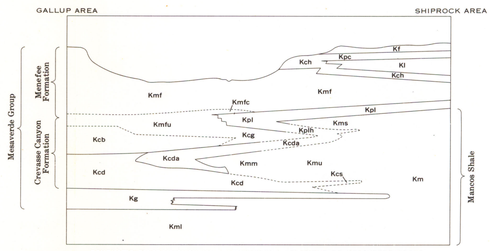
Kbc

Burro Canyon Formation
Greenish-gray to brown siltstone and mudstone. Present north of the San Juan River in Utah

Kmfu

Cleary Coal Member of Menefee Formation and Gibson Coal Member of Crevasse Canyon Formation[1]
Mapped only where Point Lookout Sandstone is absent

[1] See schematic diagram below
[2] Allen and Balk (1954)



SCHEMATIC DIAGRAM SHOWING INTERTONGUING RELATIONS OF MESAVERDE GROUP EQUIVALENT FORMATIONS, AND THE MANCOS SHALE

QUATERNARY

Pleistocene and Recent

Qe

Extrusive igneous rocks
Includes some flows that may be late Pliocene in age. Present only in the southwestern part of the area

Te

Extrusive igneous rocks

TERTIARY

Miocene(?) and Pliocene

Tt

Tuffaceous igneous rocks
Extrusives and intrusives include some spring deposits in the Hopi Buttes. Most tuffaceous rocks in the Hopi Buttes are assigned to the volcanic member of the Pliocene Bidahochi Formation

Ti

Intrusive igneous rocks
Includes, in the Carrizo Mountains, stock-laccoliths that possibly are older than Miocene(?)

Tbr

Breccia
Associated with intrusive rocks in the Carrizo Mountains

Contact
Dashed where approximately located

Indefinite contact
Used for showing surficial deposits where contact is generalized in order to simplify detail

Gradational contact
Used to show approximate boundaries of units having gradational contacts

Double contact
Used to show a change in horizon of a contact due to intertonguing of units

Fault
Dashed where approximately located. U, upthrown side; D, downthrown side

Anticline
Showing trace of axial plane and direction of plunge. Dashed where approximately located

Syncline
Showing trace of axial plane and direction of plunge. Dashed where approximately located

Monocline
Composed of an anticlinal bend and a synclinal bend; longer arrow indicates flatter dip. Dashed where approximately located

50
Strike and dip of beds

50
Strike and dip of overturned beds

Strike of vertical beds

Horizontal beds

145
Quadrangle number

Mine or quarry

Fossil locality

CRETACEOUS

Upper Cretaceous

Mesaverde Group

Ky — Yale Point Sandstone
Tan and brown sandstone

Kw — Wepo Formation
Alternating beds of olive-gray siltstone, coal, and yellowish-gray sandstone

Ktu, Kt, Ktm, Ktl — Toreva Formation
Ktu, *upper sandstone member, yellowish-gray to grayish-orange-pink, fine to very coarse grained*
Ktm, *middle carbonaceous mudstone member, variicolored*
Ktl, *lower sandstone member, light-brown to pale-yellowish-gray, fine- to medium-grained*

Kmt, Km, Ktlt — Toreva Formation and Mancos Shale
Km, *Mancos Shale, predominantly light- to dark-gray claystone and siltstone containing lesser amounts of tan fine-grained sandstone and siltstone, bedded limestone, and concretionary limestone*
Kmt, *upper tongue of the Mancos Shale*
Ktlt, *tongue of the Toreva Formation in the Padilla Mesa area, where it separates the upper tongue of the Mancos Shale from the lower part of the Mancos Shale*

Kd — Dakota Sandstone
Tan, brown, and gray sandstone, conglomeratic sandstone, and conglomerate; frequently contains partings of brown carbonaceous siltstone and lenses of coal

UNCONFORMITY

Lower Cretaceous

Kpl, Kplh — Point Lookout Sandstone[1]
Tan and brown sandstone containing lesser amounts of gray siltstone
Kplh, *Hosta Tongue; in southern part of area separated from main body of Point Lookout by Satan Tongue of Mancos Shale*

Kcg, Kcb, Kcda, Kcbd, Kcs, Kcd — Crevasse Canyon Formation[1]
Alternating beds of tan irregularly bedded and lenticular sandstone, drab siltstone and claystone, and coal
Kcg, *Gibson Coal Member*
Kcb, *Bartlett Barren Member*
Kcbd, *Bartlett Barren Member and Dilco Coal Member; along the Arizona State line in the Manuelito-Window Rock Coal Mine area*
Kcda, *Dalton Sandstone Member*
Kcd, *Dilco Coal Member*
Kcs, *"stray" sandstone, field designation of Sears, Hunt, and Hendricks (1941); in Shiprock area, mapped with the Dilco Coal Member*

Kg — Gallup Sandstone[1]
Tan, brown, and pinkish-gray thin- to massive-bedded sandstone containing lesser amounts of brown carbonaceous siltstone, gray siltstone, and lenses of coal. Along southern part of Mesa de los Lobos, the Dilco Coal Member of the Crevasse Canyon Formation is mapped with unit

Kmu, Kms, Kmm, Kml — Mancos Shale[1]
Light- to dark-gray claystone and siltstone containing lesser amounts of tan fine-grained sandstone, limestone, and concretionary limestone
Kmu, *upper part*
Kms, *Satan Tongue*
Kmm, *Mulatto Tongue*
Kml, *lower part, present only in southern part*

Kd — Dakota Sandstone
Tan, brown, and gray sandstone, conglomeratic sandstone, and conglomerate; frequently contains partings of brown carbonaceous siltstone and lenses of coal. Age of the Dakota is Early and Late Cretaceous where the Burro Canyon is not differentiated

UNCONFORMITY

Kbc — Burro Canyon Formation
Greenish-gray to brown siltstone and mudstone. Present north of the San Juan River in Utah

Kmfu — Cleary Coal Member of Menefee Formation and Gibson Coal Member of Crevasse Canyon Formation[1]
Mapped only where Point Lookout Sandstone is absent

JURASSIC

Upper Jurassic

Jm | Jmu | Jmb | Jmw | Jmr | Jms — Morrison Formation
Jmu, *upper part*
Jmb, *Brushy Basin Member, green, purple, and gray mudstone and siltstone; gray and tan sandstone and conglomeratic sandstone (locally, equivalents of the Burro Canyon Formation may be mapped with unit)*
Jmw, *Westwater Canyon Member, yellowish-gray sandstone containing conglomeratic lenses and dark-reddish-brown siltstone*
Jmr, *Recapture Member, white and brown fine- to medium-grained sandstone, siltstone, and conglomerate*
Jms, *Salt Wash Member, white and moderate-orange very fine to medium-grained sandstone, grayish-red shale, and gray limestone*

Jcs — Cow Springs Sandstone
Greenish-gray to light-yellowish-gray fine- to medium-grained crossbedded sandstone, intertongues with Morrison Formation and grades into upper units of San Rafael Group. Lower part of Morrison Formation mapped with unit in some areas

San Rafael Group

Jb — Bluff Sandstone
Gray to brown medium- to coarse-grained sandstone

Jbsu — Bluff Sandstone and upper sandy member of the Summerville Formation undifferentiated

Js | Jsu | Jsl — Summerville Formation
Moderate-reddish-brown fine- to medium-grained sandstone and argillaceous siltstone
Jsu, *upper sandy member*
Jsl, *lower silty member; in northeastern part of reservations grades into the upper sandy member to the west, southwest, and south*

Jt — Todilto Limestone
Gray thin-bedded limestone and reddish-brown sandy shale and siltstone. Present only in the eastern part of the area

Je | Jeu | Jem | Jel — Entrada Sandstone
Reddish-brown fine-grained sandstone and siltstone
Jeu, *upper sandy member in the area between Lupton and canyon of Black Creek mapped with middle silty member*
Jem, *middle silty member*
Jel, *lower sandy member*

Jec — Entrada Sandstone and Carmel Formation undifferentiated

Middle and Upper Jurassic

Jc — Carmel Formation
Red sandstone and siltstone

UNCONFORMITY

Upper Triassic(?)

Glen Canyon Group

JTRn — Navajo Sandstone
Grayish-orange-pink even-grained highly crossbedded sandstone

TRkt | TRk — Kayenta Formation
TRkt, *silty facies, grayish-red mudstone, siltstone, and silty sandstone, southwest*
TRk, *sandy facies, pale-red crossbedded sandstone, northeast*

TRmos | TRmod — Moenave Formation
TRmos, *Springdale Sandstone Member, orangish-red crossbedded sandstone*
TRmod, *Dinosaur Canyon Sandstone Member, orangish-red crossbedded and flat-bedded sandstone and sandy siltstone*

TRw | TRwl | TRwr — Wingate Sandstone
TRwl, *Lukachukai Member, reddish-brown fine-grained crossbedded sandstone*
TRwr, *Rock Point Member, reddish-brown siltstone that grades southward into mudstone*

Upper Triassic

TRcu | TRcco | TRcpu | TRcp | TRcps | TRcpl | TRcm | TRcs — Chinle Formation
TRcu, *Chinle Formation excluding Shinarump Member*
TRcco, *Church Rock and Owl Members undifferentiated in Monument Valley-Piute Canyon area. Includes only Owl Rock Member in other parts of the reservations. Church Rock Member, reddish-brown siltstone and silty sandstone and grayish-orange-pink mudstone to silty sandstone in the Monument Valley area. Lateral equivalent of the Rock Point Member of the Wingate Sandstone. Owl Rock Member, mottled light-gray and grayish-pink interbedded limestone and calcareous siltstone. Also includes Hite Bed in Monument Valley area and along San Juan River. Hite Bed is a pale-reddish to purple sandstone*
TRcpm, *Petrified Forest and Monitor Butte Members undifferentiated; quadrangles 9, 10, and 22 in eastern Monument Valley*
TRcp, *Petrified Forest Member, claystone, siltstone, and minor amounts of sandstone. On Defiance Plateau, upper and lower parts, separated by Sonsela Sandstone Bed, recognized but not differentiated*
TRcpu, *upper part*
TRcps, *Sonsela Sandstone Bed, light-gray sandstone and conglomerate*
TRcpl, *lower part*
TRcm, *Monitor Butte Member, siltstone, sandstone, and limepellet conglomerate; includes lower part of Petrified Forest Member in Monument Valley area*
TRcs, *Shinarump Member, light-gray to yellowish-gray sandstone and conglomerate; Monitor Butte Member between Lupton and the canyon of Black Creek, Mesa Redondo Member in southern Defiance Plateau, and sandstone and siltstone member in Cameron-Lees Ferry area mapped with unit*

UNCONFORMITY

Lower and Middle(?) Triassic

TRm | TRmh — Moenkopi Formation
Reddish-brown mudstone, siltstone, and silty sandstone. Moenkopi(?) in the Fort Wingate School area
TRmh, *Hoskinnini Tongue of Triassic(?) age. Present only in Monument Valley; mapped separately in western and central part*

TRIASSIC(?)

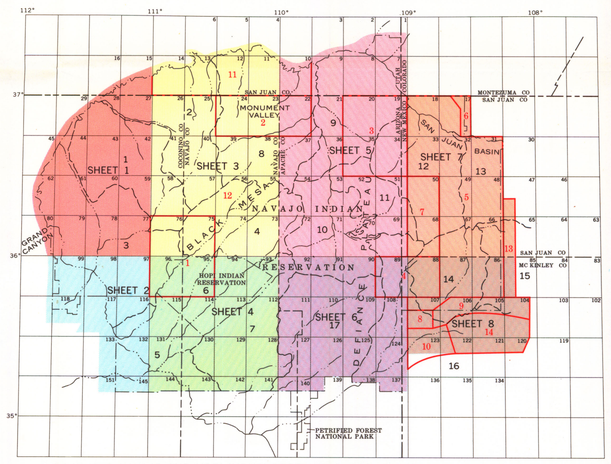
TRIASSIC

GRAND CANYON AREA	DEFIANCE PLATEAU AREA	MONUMENT VALLEY AREA	WESTERN SAN JUAN AREA		
UNCONFORMITY			UNCONFORMITY		
Pk — **Kaibab Limestone** *Yellowish-gray to light-gray limy sandstone and sandy magnesian limestone and light-brown crystalline dolomitic limestone*	UNCONFORMITY	UNCONFORMITY	Psa — **San Andres Limestone** *Grayish-orange-pink to light-brown limestone. Exposed only near Fort Wingate*	PERMIAN	
UNCONFORMITY					
Pt — **Toroweap Formation** *Light-colored crossbedded and gnarly bedded sandstone containing some siltstone lenses*					
Pco — **Coconino Sandstone** *Very pale orange to grayish-orange crossbedded sandstone, which is almost white in places*	Pdc, Pdcu, Pst, Pdcl — **De Chelly Sandstone and Supai Formation** Pdc, *De Chelly Sandstone, undifferentiated north of Hunters Point*; Pdcu, *upper member of De Chelly Sandstone, grayish-orange-pink to moderate-reddish-orange fine- to medium-grained sandstone*; Pst, *tongue of the Supai Formation*; Pdcl, *lower member of De Chelly Sandstone, moderate-reddish-orange layers of fair-sorted fine- to medium-grained sandstone and flat-bedded silty sandstone*	Pcdc, Pcor, Pccm, Pcha — **Cutler Formation** Pcdc, *De Chelly Sandstone Member, moderate-reddish-orange to very pale orange thick to very thick bedded sandstone*; Pcor, *Organ Rock Tongue, deep-reddish-brown silty sandstone, sandy siltstone, siltstone, and a few beds of impure limestone*; Pccm, *Cedar Mesa Sandstone Member, light-colored very thick bedded sandstone, siltstone, and limestone*; Pcha, *Halgaito Tongue, light-bluish-gray to medium-gray limestone and limestone conglomerate*	Pcdc, Pcl — **Cutler Formation** Pcdc, *De Chelly Sandstone Member, reddish-orange and pale-orange sandstone*; Pcl, *lower part, exposed in the Carrizo Mountains area only*		
PIPhs — **Hermit Shale and Supai Formation undifferentiated**	PIPs — **Supai Formation** *Alternating moderate-reddish-brown and moderate-reddish-orange sandstone and siltstone units*	PIPr — **Rico Formation** *Pale-reddish-brown to moderate-reddish-orange siltstone, pale-red to light-gray sandstone, and medium-gray limestone*		PENNSYLVANIAN	CARBONIFEROUS
		IPh — **Hermosa Formation** *Alternating beds of medium-dark-gray to light-gray limestone, medium-gray to black limy shale, and gray or light-brown sandstone*			
UNCONFORMITY					
Mr — **Redwall Limestone** *Light-gray and grayish-blue very thick bedded crystalline limestone containing chert*		Not exposed		MISSISSIPPIAN	
UNCONFORMITY	UNCONFORMITY				
Cm — **Muav Limestone** *Bluish-gray impure thin-bedded limestone and thin lenses of buff or greenish siltstone. In this area the Muav locally includes small outcrops of the Upper(?) Devonian Temple Butte Limestone*		Not exposed		CAMBRIAN	
Cba — **Bright Angel Shale** *Soft green micaceous sandy mudstone and siltstone and thin partly crossbedded sandstone; "snuff-colored" limestone; soft greenish micaceous sandy siltstone; and alternating layers of shale and purplish-brown sandstone*					
Ct — **Tapeats Sandstone** *Moderate-orange-pink to light-gray sandstone, which weathers to hues of reddish brown and brown*					
UNCONFORMITY					
pCgc — **Grand Canyon Series**	pCr — **Undifferentiated rocks** *Exposed only in Defiance Plateau*	Not exposed		PRECAMBRIAN	

Lower Permian — Aubrey Group

Middle Cambrian — Tonto Group

Lower Cambrian — Tonto Group



MAP OF THE NAVAJO AND HOPI INDIAN RESERVATIONS, SHOWING ADMINISTRATIVE DISTRICTS OF THE BUREAU OF INDIAN AFFAIRS AND SOURCES OF GEOLOGIC DATA

0 10 20 30 40 MILES

EXPLANATION

11
Bureau of Indian Affairs district boundary and number of district

26
Number of 15-minute quadrangle

SOURCES OF GEOLOGIC DATA

1. J. T. Callahan, M. E. Cooley, O. L. Dilworth, G. H. Dixon, J. H. Irwin, R. B. O'Sullivan, and C. A. Repenning, 1950–55
2. Witkind and Thaden (1963)
3. Modified from Strobell (1956)
4. Modified from Allen and Balk (1954)
5. O'Sullivan and Beaumont (1957)
6. Hayes and Zapp (1955)
7. Beaumont (1954)
   Harshbarger and Repenning (1954)
   Ziegler (1955)
8. J. D. Sears and E. C. Beaumont (unpub. map)
9. Sears (1934)
10. Sears (1935)
11. Geology from Baker (1936); modified by J. P. Akers, M. E. Cooley, J. H. Irwin, C. A. Repenning, and P. R. Stevens, 1952–55; and by M. E. Cooley, 1957–59, 1966
12. J. P. Akers, J. T. Callahan, M. E. Cooley, S. E. Galloway, J. H. Irwin, R. L. Jackson, H. G. Page, C. A. Repenning, and P. R. Stevens, 1950–55
13. R. B. O'Sullivan (unpub. map)
14. J. P. Akers, J. T. Callahan, R. L. Cushman, J. W. Harshbarger, R. L. Jackson, and H. A. Whitcomb (unpub. map)

BASE CREDIT

Base compiled from uncontrolled aerial photograph mosaics by the Bureau of Indian Affairs, during the 1930's. Later modifications by the U. S. Geological Survey

Many new roads have been constructed and old ones relocated and paved since 1955. New trading posts have been built and many of the old ones have been abandoned or relocated since 1955

INDEX MAP SHOWING LOCATION OF PROJECT

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—1968—W65423

GEOLOGIC MAP OF THE NAVAJO AND HOPI INDIAN RESERVATIONS, ARIZONA, NEW MEXICO, AND UTAH

EXPLANATION FOR SHEETS 1–8