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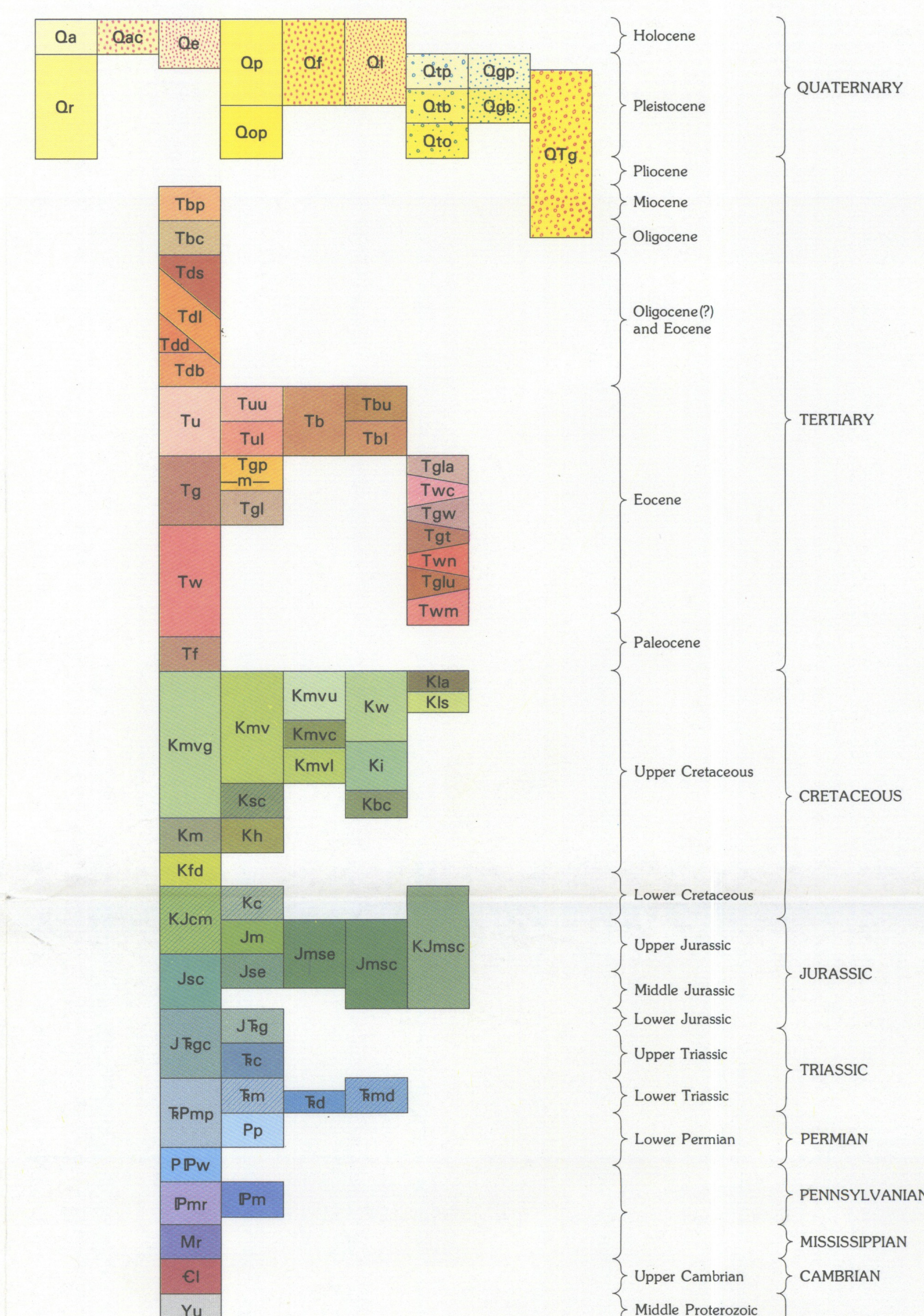
MISCELLANEOUS INVESTIGATIONS SERIES
MAP I-1526

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Note: Surficial units on this map are generalized and are not shown where they are thin or where they conceal bedrock relationships. See Carrara (1980) for details concerning surficial units.

Qa ALLUVIUM (HOLOCENE)—Silt, sand, and gravel in channels and flood plains of major drainages. May be partly of Pleistocene age

Qac ALLUVIUM AND COLLUVIUM (HOLOCENE)—Generally massively bedded clay, silt, sand, and gravel in channels and flood plains of mostly small drainages. Includes alluvial slope wash and colluvium. May be partly of Pleistocene age

Qe EOLIAN DEPOSITS (HOLOCENE AND PLEISTOCENE)—Well-sorted fine-grained windblown sand and silt, largely stabilized by vegetation

Qp DEPOSITS ON PEDIMENT SURFACES (HOLOCENE AND PLEISTOCENE)—Poorly sorted silty sand and gravel on pediments and, locally, of broad alluvial fans. Deposits on some pediments are very thin or locally missing. May include strongly modified river-terrace deposits along the Duchesne River in the southwestern part of the quadrangle

Qf FAN DEPOSITS AND COLLUVIUM (HOLOCENE AND PLEISTOCENE)—Poorly sorted silty sand and gravel deposited in alluvial fans and talus cones at the base of steep slopes. Includes colluvium on and below steep slopes

Ql LANDSLIDE DEPOSITS (HOLOCENE AND PLEISTOCENE)—Predominantly earthflows and rotational slumps on steep slopes

Qr RIVER-TERRACE DEPOSITS (PLEISTOCENE)—Gravel and subordinate sand and silt that form alluvial remnants on dissected benches along rivers. In some areas, as in the Uinta Basin, may be modified by sheet wash or may include pediment deposits. In the Roosevelt area, may include glacial outwash of Bull Lake or older age (Osborn, 1972)

Qtp TILL OF PINEDALE AGE (PLEISTOCENE)—Unsorted gravel and sand deposited by glaciers. Locally occurs as well-defined moraines. Found in Uinta Mountains near western edge of map area

Qgp GLACIAL OUTWASH OF PINEDALE AGE (PLEISTOCENE)—Poorly sorted gravel and sand deposited by glacial melt water. Exposed in Whiterocks-Roosevelt area and west of Corson Peak

Qtb TILL OF BULL LAKE AGE (PLEISTOCENE)—Unsorted gravel and sand deposited by glaciers. Found in Uinta Mountains near western edge of map area

Qgb GLACIAL OUTWASH OF BULL LAKE AGE (PLEISTOCENE)—Poorly sorted gravel and sand deposited by glacial melt water. Deposits south of Roosevelt (Osborn, 1972) may be a downstream facies of outwash. Exposed in Whiterocks-Roosevelt area

Qop DEPOSITS ON OLDER PEDIMENT SURFACES (PLEISTOCENE)—Poorly sorted silty sand and gravel from dissected remnants of pediments and alluvial fans. Deposits on some old pediments are thin or locally missing. May include modified river-terrace deposits or older glacial outwash. May include deposits of Tertiary age

Qto OLD TILL (PLEISTOCENE)—Unsorted gravel and sand deposited by glaciers. Probably pre-Bull Lake in age. Recognized only in the area of West Fork Carter Creek in the Uinta Mountains near western edge of map area

QTg OLD GRAVEL DEPOSITS (PLEISTOCENE TO OLIGOCENE)—Unconsolidated to moderately consolidated gravel and sand capping high-level erosion surfaces. May not all be of same age; may locally include Bishop Conglomerate (**Tbc**) or Browns Park Formation (**Tbp**). Maximum thickness about 50 m

Tbp BROWNS PARK FORMATION (MIOCENE)—White, light-gray, and tan, poorly to moderately consolidated, generally crossbedded, partly tuffaceous sandstone, subordinate conglomerate, siltstone, and white crystal-poor, glassy, rhyolitic air-fall tuff, and minor limestone. Includes massive chert beds west of Little Snake River. Mostly of fluvial and eolian origin, but includes lacustrine claystone and air-fall tuff in Browns Park. Characterized by abundant, fine-grained volcaniclastic material. Especially near base may contain light-red, light-orange, and light-yellow conglomerate beds that contain abundant clasts of the Uinta Mountain Group (**Yu**) and subordinate Paleozoic limestone. Preserved mostly within the Uinta Mountains and eastward to and beyond Maybell. At the base of the unit, in the Maybell-Elk Springs area (Dyni, 1968; McKay, 1974; McKay and Bergin, 1974; Izett and others, 1981), a conglomerate bed 0-10 m thick is here correlated with the Bishop Conglomerate (**Tbc**), but is too thin to be so shown on this map. Basal sandy conglomerate beds in the unit near Irish Lake west of Vermillion Creek, however, must belong to the Browns Park Formation, as noted by Bradley (1936, pl. 36), because they are much less coarse and much lower topographically than nearby Bishop exposures at and near Diamond Peak and because they contain a locally derived lithology different from the nearby Bishop. Tuff beds in the formation have potassium-argon and fission-track ages of 25 to 10 m.y. (Izett and others, 1970; Winkler, 1970; Damon, 1970; Izett, 1975; Hansen and Rowley, 1980). Thickness highly variable; maximum about 500 m

Tbc BISHOP CONGLOMERATE (OLIGOCENE)—Light-gray and pink, poorly to moderately consolidated, fluvial, partly tuffaceous conglomerate, sandstone, and minor light-gray to light-pinkish-gray biotitic air-fall tuff. Clasts are mostly from the Uinta Mountain Group (**Yu**) but partly from Paleozoic limestone (locally predominant) and other rock types. Commonly rests on the prominent high-level Gilbert Peak erosion surface (Bradley, 1936); this surface, warped and faulted in many places, is widespread on and north of the Uinta Mountains, mostly in higher parts of the range. Along the Little Snake River west of Cross Mountain and north of Elk Springs, Bishop Conglomerate caps a high bench below which topographically lower Browns Park Formation fills the valley. Just east of Elk Springs, however, the Bishop passes beneath the Browns Park Formation, locally in angular unconformity. The Bishop designation for deposits on the high erosion remnant of Lookout Mountain near Powder Wash follows the mapping of Sears (1925, pl. 35). Deposits about 30 km west-northwest of Maybell that were formerly interpreted to be a basal unit of the Browns Park Formation (McKay, 1974) and deposits on a high erosion surface near the head of Goslin Creek west of Clay Basin (Hansen, 1965) probably are correlative with the Bishop. Biotite and hornblende from tuff beds in the formation have given potassium-argon ages ranging from 41 (Eocene) to 26 m.y. (Oligocene) (G. R. Winkler in Damon, 1970; Winkler, 1970; Hansen and others, 1981). Thickness highly variable; maximum about 150 m

DUCHESNE RIVER FORMATION (OLIGOCENE? AND EOCENE)—Fluvial and, locally, lacustrine sedimentary rocks. Age of mammalian fossils from the formation is controversial (Emry, 1981), but a potassium-argon age of a tuff bed is 40 m.y. old, Eocene (McDowell and others, 1973). Mapped in the Uinta Basin

Tds Starr Flat Member of Anderson and Picard (1972)—Moderately resistant, light- to medium-red and tan sandstone, mudstone, and subordinate conglomerate. About 150 m thick

Tdl Lapoint Member of Anderson and Picard (1972)—Mostly soft, light-red, tan, and yellow sandstone, siltstone, and mudstone and minor conglomerate containing diagnostic light- to medium-gray or blue-gray bentonite beds. Thickness 120-300 m

Tdd Dry Gulch Creek Member of Anderson and Picard (1972)—Soft to moderately resistant, light- to medium-gray, medium-red, purplish-gray, and yellow sandstone, mudstone, shale, and conglomerate. Thickness about 150 m

Tdb Brennan Basin Member of Anderson and Picard (1972)—Soft to moderately resistant, light- to medium-red, light-gray, light-brown, yellow, and tan ledgy sandstone, mudstone, conglomerate, shale, and siltstone. Lower part west-southwest of Vernal, on Asphalt Ridge, consists largely of light-gray, tan, and pink conglomerate. In places impregnated by oil on Asphalt Ridge. Base locally intertongues with Uinta Formation (**Tu**). Thickness about 600 m south of Vernal, thinning to west and east

Tu UINTA FORMATION (EOCENE)—Greenish-gray, dirty yellow, grayish-orange, and purple fluvial and lacustrine shale, marlstone, siltstone, and sandstone. Locally tuffaceous. Unit is divided in some places into upper and lower parts; the contact between them is transitional. A tuff bed in the formation has a potassium-argon age of 43 m.y. (Mauger, 1977). Mapped in Uinta and Piceance Creek Basins. In Uinta Basin, it locally pinches out in the vicinity of Asphalt Ridge-Raven Ridge

Tuu Upper part—Soft, light-gray, white, greenish-gray, maroon, grayish-purple, red, tan, and yellow shale, mudstone, claystone, and minor sandstone. Consists mostly of Horizon C_1 of Osborn (1929), Peterson and Kay (1931), and Kay (1934). Locally intertongues with the lower part of Duchesne River Formation (Brennan Basin Member of Anderson and Picard, 1972; **Tdb**); contact is drawn where beds above are largely of Brennan Basin lithology and beds below are mostly of Uinta lithology. Maximum thickness about 250 m, thinning northward

Tul Lower part—Includes two units, which generally correspond to Horizons A and B of Osborn (1929), Peterson and Kay (1931), and Kay (1934). Upper unit is soft, light-gray and light-purple claystone and sandstone containing interbedded, resistant, greenish-gray, light-green, brown, and yellow, crossbedded lenticular shoestring sandstone and conglomerate beds. Lower unit is mostly resistant or moderately resistant, pale-yellow, brown, or red sandstone and minor conglomerate and shale. Maximum thickness at least 300 m, thinning northward

Tb BRIDGER FORMATION (EOCENE)—Soft, gray, green, tan, red, brown, white, yellow, and turquoise-blue fluvial and lacustrine shale, mudstone, claystone, siltstone, and minor sandstone and limestone. Locally tuffaceous. Locally contains silicified snail fossils and algal heads. Exposures in the northeastern part of the quadrangle are largely equivalent to the Adobe Town Member of the Washakie Formation in the Washakie Basin in Wyoming (Roehler, 1973). Thickness about 200 m

Tbu Upper part—Resistant, light-gray, tan, and yellow conglomerate, sandstone, and limestone. Mapped only in the Corson Peak area in northwestern corner of the quadrangle, where it is about 450 m thick

Tbl Lower part—Mostly soft, tan, pale-yellow, light-gray, and light-green sandstone, shale, and limestone. Mapped only in northwestern corner of the quadrangle, where it is about 150 m thick

Tg GREEN RIVER FORMATION (EOCENE)—Soft to moderately resistant, light-gray and buff marlstone, oil shale, limestone, siltstone, sandstone, and conglomerate. Lacustrine and locally fluvial in origin. Mapped in northeastern Piceance Creek Basin and west of the town of Dinosaur

Tgp Parachute Creek Member—Moderately resistant, light-gray, dark-tan, white, and light-yellow, thin-bedded fissile oil shale, marlstone, limestone, oolite, siltstone, sandstone, and air-fall tuff. Tuff beds in the member have potassium-argon ages of 47-46 m.y. (Mauger, 1977; O'Neill and others, 1981). Mapped in Uinta and Piceance Creek Basins. Thickness 150-500 m, increasing southward

—m— Mahogany ledge oil-shale unit—Resistant, dark-gray oil shale. Thickness 10-70 m where mapped

Tgl Lower part—Garden Gulch, Douglas Creek, and Anvil Points Members, undivided. Soft to moderately resistant, light-gray, light-yellow, and tan siltstone, shale, sandstone, marlstone, limestone, oil shale, and conglomerate. Mapped in Uinta and Piceance Creek Basins. Thickness 500-1,000 m

Tgla Laney Member—Soft, light- to medium-brown, tan, yellowish-tan, and light-yellow thin-bedded fissile oil shale, claystone, sandstone, marlstone, siltstone, limestone, and air-fall tuff. Limestone beds locally contain agatized gastropods, pelecypods, and algal heads. Tuff beds have potassium-argon ages of 47-45 m.y. (Mauger, 1977; O'Neill and others, 1981). Mapped in Sand Wash basin and Manila area. Thickness 50-250 m, except in Manila area where it is thinner and pinches out

Tgw Wilkins Peak Member—Soft, light- to medium-gray fissile saline oil shale, shale, siltstone, sandstone, minor white beds of algal limestone and minor air-fall tuff. Tuff beds have potassium-argon ages of 50-47 m.y. (Mauger, 1977; O'Neill and others, 1981). Mapped in and west of Sand Wash basin. Thickness 50-150 m

Tgt Tipton Tongue—Moderately resistant, brown oil shale, light-gray sandstone, and greenish-gray claystone and siltstone. Mapped in and west of Sand Wash basin. Thickness 40-100 m

Tglu Luman Tongue—Moderately resistant, light- to medium-brown fissile oil shale, siltstone, sandstone, limestone, carbonaceous shale, coal, and conglomerate. Mapped in Vermillion Creek area. Thickness 100-150 m

Tw WASATCH FORMATION (EOCENE AND PALEOCENE)—Soft, light-gray, red, green, white, yellow, and purple claystone, shale, sandstone, siltstone, and conglomeratic sandstone. Fluvial and lacustrine in origin. Intertongues with the Green River Formation. Mapped on the northern margins of the Piceance Creek and Uinta Basins. Maximum thickness about 1,400 m, thinning northward and pinching out along Asphalt Ridge-Raven Ridge

Twc Cathedral Bluffs Tongue (Eocene)—Soft, light- to medium-gray, red, pink, yellow, and maroon shale, claystone, mudstone, siltstone, and minor lenticular sandstone and oil shale. Mapped in and west of Sand Wash basin. Thickness 300-1,000 m

Twn Niland Tongue (Eocene)—Soft and moderately resistant, tan, light- to dark-gray, brown, red, and yellow sandstone, shale, siltstone, oil shale, carbonaceous shale, and coal. Mapped in Vermillion Creek area. Thickness 30-140 m

Twm Main body (Eocene and Paleocene)—Soft, tan, gray, yellow, and red shale, claystone, sandstone, conglomeratic sandstone, and marly limestone. Very conglomeratic along northern flank of Uinta Mountains. Mapped in northern and northeastern parts of quadrangle. Thickness about 700-1,100 m

Tf FORT UNION FORMATION (PALEOCENE)—Mostly soft, light-gray, white, tan, light-green, and brown sandstone, shale, and claystone, and subordinate carbonaceous shale, coal, siltstone, and conglomerate. Mainly of fluvial and lacustrine origin. Exposed thickness and subsurface thickness 0-900 m

Kmvg MESAVERDE GROUP, UNDIVIDED (UPPER CRETACEOUS)—Largely resistant, light-gray, tan, yellow, purplish-brown crossbedded sandstone, dark-gray shale, and minor black coal. Locally conglomeratic on northern flank of Uinta Mountains. Mostly of continental origin. Locally impregnated by oil on Asphalt Ridge. Exposed thickness 0-600 m where mapped

Units of Mesaverde Group and Buck Tongue of Mancos Shale (Upper Cretaceous) in Douglas Creek arch, northwestern Piceance Creek Basin

Kmvu Upper unit—Resistant, tan, light-gray, and yellow lenticular crossbedded sandstone and subordinate shale, carbonaceous shale, and minor coal. Thickness 300-350 m

Kmvc Coal unit—Moderately resistant, light- to medium-gray, light-yellow, light-orange, and tan crossbedded sandstone, carbonaceous shale, and coal. Thickness 125-200 m

Kmvl Lower unit—Moderately resistant, tan, light- to medium-gray, and light-yellow crossbedded sandstone and subordinate shale, carbonaceous shale, and coal. Thickness 200-250 m

Kmv Upper, coal, and lower units, undivided

Ksc Sego Sandstone, Buck Tongue of Mancos Shale, and Castlegate Sandstone—Sego Sandstone is resistant, light-gray, tan, buff, and orange marine sandstone and shale; thickness 0-75 m. Buck Tongue is soft, medium- to dark-gray, yellow-weathering marine shale and, locally, tan thin-bedded sandstone; thickness 70-170 m. Castlegate Sandstone is resistant, light-gray, yellow, and tan marine sandstone and minor shale; thickness 0-30 m

Kbc Buck Tongue of Mancos Shale and Castlegate Sandstone

Units of Mesaverde Group, northeastern Piceance Creek Basin

Kw Williams Fork Formation—Moderately resistant, light- to medium-brown, orange, tan, and gray lenticular beds of sandstone, shale, claystone, carbonaceous shale, and coal. Thickness 400-900 m

Ki Iles Formation—Resistant to moderately resistant, light-gray, tan, and orange sandstone, shale, claystone, carbonaceous shale, and coal. In the Elk Springs area, includes the Sego Sandstone. Locally includes, at the top, the Trout Creek Sandstone Member, a light-gray crossbedded sandstone as much as 30 m thick. Thickness 180-430 m

Kla LANCE FORMATION AND FOX HILLS SANDSTONE (UPPER CRETACEOUS)—Exposed at surface only in Maybell area

Lance Formation—Resistant, light-gray and yellowish-brown sandstone, siltstone, shale, and coal. Mostly of continental origin. Thickness about 250-400 m

Fox Hills Sandstone—Moderately resistant, gray and buff lenticular sandstone. Mostly of marine origin. Thickness less than 30 m

Kls LEWIS SHALE (UPPER CRETACEOUS)—Soft, dark-gray limy marine shale and subordinate sandstone. Exposed at surface only in Maybell area, where thickness is 170-400 m

Km MANCOS SHALE (UPPER CRETACEOUS)—Soft, medium- to dark-gray, yellow-weathering bentonitic, locally fossiliferous, marine shale and minor siltstone and sandstone. Thickness 1,400-1,700 m

Kh HILLIARD SHALE (UPPER CRETACEOUS)—Soft, medium- to dark-gray, yellow-weathering marine shale and minor sandstone. Mapped only near northern edge of quadrangle west of 109° W. Thickness about 1,900 m

Kfd FRONTIER SANDSTONE AND MOWRY SHALE MEMBERS OF MANCOS SHALE, AND DAKOTA SANDSTONE (UPPER AND LOWER CRETACEOUS)

Frontier Sandstone Member of Mancos Shale (Upper Cretaceous)—Resistant, yellow and tan, fossiliferous, locally crossbedded, marine sandstone and minor continental carbonaceous shale and coal. Thickness 35-90 m

Mowry Shale Member of Mancos Shale (Lower Cretaceous)—Soft, silver-gray and bluish-gray, siliceous marine shale and bentonite. Contains abundant fish scales. Thickness 10-70 m

Dakota Sandstone (Lower Cretaceous)—Resistant, yellow and light-gray, crossbedded, mostly fluvial sandstone and subordinate pebble conglomerate, and minor shale and coal. Thickness 10-80 m

KJcm CEDAR MOUNTAIN FORMATION (LOWER CRETACEOUS) AND MORRISON FORMATION (UPPER JURASSIC)—Mapped in Vernal-Elk Springs area

Kc CEDAR MOUNTAIN FORMATION (LOWER CRETACEOUS)—Consists of two members of mainly fluvial origin: an upper member of soft, purple, gray, and greenish-gray shale, mudstone, siltstone, and minor limestone; and a lower member, the discontinuous Buckhorn Conglomerate Member of resistant, medium- to dark-gray and tan crossbedded conglomerate and sandstone. Mapped in Dinosaur area. Thickness 0-60 m

KJmsc CEDAR MOUNTAIN FORMATION (LOWER CRETACEOUS), MORRISON FORMATION, STUMP FORMATION, ENTRADA SANDSTONE, AND CARMEL FORMATION (UPPER AND MIDDLE JURASSIC)—Mapped northeast of the town of Blue Mountain

Jm MORRISON FORMATION (UPPER JURASSIC)—Soft, light-gray, olive-gray, red, and light-purple shale, claystone, siltstone, and minor interbedded, crossbedded sandstone and bentonite. Mainly of fluvial origin. Includes the Brushy Basin Member, mostly mudstone and minor sandstone, and the underlying Salt Wash Member, interbedded sandstone and mudstone. Locally map unit includes, at the base, the thin Windy Hill Sandstone Member of the Sundance Formation (Upper Jurassic), a soft, gray sandstone. Thickness 150-350 m, thinning from west to east

Jmse MORRISON FORMATION, STUMP FORMATION, AND ENTRADA SANDSTONE (UPPER AND MIDDLE JURASSIC)—Mapped north of Elk Springs

Jmsc MORRISON FORMATION, STUMP FORMATION, ENTRADA SANDSTONE, AND CARMEL FORMATION (UPPER AND MIDDLE JURASSIC)

Jsc STUMP FORMATION, ENTRADA SANDSTONE, AND CARMEL FORMATION (UPPER AND MIDDLE JURASSIC)

Stump Formation—Consists of two members of marine origin: the Redwater Member (Upper Jurassic) of soft, olive-green and light-green, fissile glauconitic shale and siltstone and sparse, interbedded, tan and gray, ripple-marked sandy fossiliferous glauconitic oolitic limestone and sandstone; and the underlying Curtis Member (Middle Jurassic) of resistant, light-gray crossbedded fossiliferous glauconitic sandstone (Pipiringos and Imlay, 1979). Thickness 0-80 m

Entrada Sandstone (Middle Jurassic)—Resistant, light-gray, buff, or pink, prominently crossbedded sandstone. Mainly of eolian origin. In Manila area, contains interbedded reddish-brown siltstone (Preuss? Red Beds). Thickness 30-75 m, thinning from west to east

Carmel Formation (Middle Jurassic)—Soft, medium- to dark-red and green sandy shale, sandstone, siltstone, mudstone, limestone, and gypsum. Marine in origin. In Manila area, contains 20-25 m of fossiliferous limestone at base. Thickness 0-120 m, thinning eastward and northeastward and pinching out at the approximate longitude of Skull Creek, Colo.

Jse STUMP FORMATION AND ENTRADA SANDSTONE (UPPER AND MIDDLE JURASSIC)—Mapped northwest of Elk Springs

JTRgc GLEN CANYON SANDSTONE (LOWER JURASSIC AND UPPER TRIASSIC) AND CHINLE FORMATION (UPPER TRIASSIC)

JTRg GLEN CANYON SANDSTONE (LOWER JURASSIC AND UPPER TRIASSIC)—Resistant, pink, light-gray, and buff, prominently crossbedded sandstone. Mainly of eolian origin. Unit formerly called Navajo Sandstone or, in the north, Nugget Sandstone. Thickness 200-300 m, thinning from west to east

TRc CHINLE FORMATION (UPPER TRIASSIC)—Soft to moderately resistant, medium- to dark-red, light-gray, purple, and light-green, ripple-marked siltstone, sandstone, claystone, shale, and conglomerate. Mainly of fluvial and lacustrine origin. At base locally includes Gartra Member, a light-yellow, light-gray, or pink crossbedded fluvial sandstone and conglomerate as much as 30 m thick. Thickness of formation 60-140 m, generally thinning from west to east

TRPmp MOENKOPI FORMATION (LOWER TRIASSIC) AND PARK CITY FORMATION (PERMIAN)

TRm MOENKOPI FORMATION (LOWER TRIASSIC)—Moderately resistant, medium- to dark-red, reddish-brown, green, and gray, ripple-marked siltstone and shale. Marine and continental in origin. Locally sandy and gypsiferous. Thickness 150-340 m, thinning from west to east

TRmd MOENKOPI FORMATION AND DINWOODY FORMATION (LOWER TRIASSIC)—Mapped in northwestern part of quadrangle

TRd DINWOODY FORMATION (LOWER TRIASSIC)—Soft, light-gray, greenish-gray, or white, thin-bedded ripple-marked marine shale, siltstone, sandstone, and minor limestone. Mapped in northwestern part of quadrangle. Thickness 0-160 m, thinning from north to south

Pp PARK CITY FORMATION (LOWER PERMIAN)—Soft, light-gray, light-greenish-gray, light-yellow, and red, locally fossiliferous siltstone, sandstone, dolomite, limestone, and shale underlain by resistant, light-gray, tan, and light-yellow, locally fossiliferous sandstone, sandy cherty limestone, dolomite, claystone, and phosphatic shale. Marine in origin. In the northwestern part of the quadrangle, includes the Franson Member, which consists of cherty dolomite, limestone, mudstone, sandstone, siltstone, and shale from 25 to 50 m thick, and the Meade Peak Phosphatic Shale Member of the Phosphoria Formation, which consists of phosphatic rocks as much as 15 m thick. Thickness 0-130 m, thinning eastward and southeastward

PIPw WEBER SANDSTONE (PERMIAN AND PENNSYLVANIAN)—Resistant, light-gray and buff, prominently crossbedded sandstone. Eolian and marine in origin. Large-scale eolian crossbeds separated by diastems; eolian sands deposited by winds that blew chiefly from the north (Fryberger, 1979). Permian age (Wolfcampian) designation based on Permian foraminifera near the top of the formation (Bissell and Childs, 1958; Bissell, 1964). Thickness 200-470 m, thinning from west to east, as well as north and south of the Uinta Mountains

IPm MORGAN FORMATION (MIDDLE PENNSYLVANIAN)—Resistant, light- to medium-red, yellow, and gray, locally crossbedded sandstone and interbedded light- to medium-gray limestone, and minor soft, red shale; underlain by mostly soft, light-gray, red, and green shale, siltstone, sandstone, and limestone. Marine in origin. Limestone contains invertebrate fossils and red chert concretions. Top intertongues with the base of the Weber Sandstone; the top of the Morgan Formation is placed at the top of the highest limestone or red sandstone. Thickness 10-350 m, thinning from west to east, as well as north and south of the Uinta Mountains

IPmr MORGAN FORMATION AND ROUND VALLEY LIMESTONE (PENNSYLVANIAN)

Round Valley Limestone (Lower Pennsylvanian)—Resistant, light- to medium-gray and blue-gray limestone and interbedded soft, light-gray and red shale. Marine in origin. Limestone generally fossiliferous and contains red and pink chert concretions. Thickness 50-150 m, thinning away from the Uinta Mountains

Mr MISSISSIPPIAN ROCKS—Includes Doughnut Shale, Humbug Formation, Madison Limestone, and correlative rocks. Thinning away from the Uinta Mountains

Doughnut Shale (Upper Mississippian)—Soft, dark-gray, light-green, and red clay shale and moderately resistant, light-gray and light-yellow sandstone and limestone. Marine and continental in origin. Thickness 10-170 m

Humbug Formation (Upper Mississippian)—Soft to moderately resistant, tan, pink, light-gray, and red, locally crossbedded sandstone, limestone, and red and black shale. Marine in origin. Thickness 30-110 m

Madison Limestone (Lower Mississippian)—Resistant, tan, light-yellow, and light- to dark-gray, locally fossiliferous, cherty marine limestone, locally dolomitic. Thickness 130-300 m

Єl LODORE FORMATION (UPPER CAMBRIAN)—Ledgy, light-brown, pink, and greenish-gray sandstone and pebble conglomerate; overlain by soft, pink, tan, and light-greenish-gray, fossiliferous glauconitic shale and interbedded tan and light-green crossbedded sandstone. East of Canyon of Lodore, shale has been largely removed by pre-Mississippian erosion. Marine in origin. Thickness 0-180 m; mostly less than 15 m thick southwest of Hiawatha

Yu UINTA MOUNTAIN GROUP (MIDDLE PROTEROZOIC)—Resistant, light- to dark-red, crossbedded, locally pebbly sandstone and locally gray, green, and red silty shale. Fluvial and marine in origin. Includes grayish-red and greenish-gray shale and fine-grained sandstone of the Red Pine Shale in the upper part of the group at the western edge of the map area. A shale bed within the group in the eastern Uinta Mountains has a rubidium-strontium whole-rock age of about 1 billion years (Hansen and others, 1981), similar to a rubidium-strontium whole-rock age from the group west of the quadrangle (Crittenden and Peterman, 1975). Maximum thickness of group probably more than 7,000 m

XWr RED CREEK QUARTZITE (EARLY PROTEROZOIC? AND LATE ARCHEAN)—Resistant, white, gray, tan, and light-green metaquartzite, subordinate quartz-muscovite schist and ortho-amphibolite, and minor marble. Mostly metamorphosed sedimentary rocks, but includes metamorphosed igneous rocks. Map unit includes granitic and quartzo-feldspathic gneiss of the Owiyukuts Complex of Sears and others (1982), located north of Browns Park astride the Colorado-Utah State line. Locally cut by pegmatite dikes and amphibolite masses of Middle and(or) Early Proterozoic age (Hansen, 1965; Graff and others, 1980). Crops out only west and north of Browns Park. The Red Creek Quartzite is considered to be older than a 2,300 m.y. rubidium-strontium muscovite age (Hansen, 1965); Sears and others (1982) consider it to be Early Proterozoic in age based on similarities in lithology and structural setting with rocks in Wyoming. Graff and others (1980) reported a rubidium-strontium isochron of 2,700 m.y. for the Owiyukuts Complex. Maximum thickness probably more than 6,000 m; the Owiyukuts Complex alone is at least 3,000 m thick

CONTACT—Some contacts under lakes and reservoirs are dotted. Geology under Flaming Gorge Reservoir shown in detail by Hansen (1965)

HIGH-ANGLE FAULT—May include some reverse faults. Dashed where approximately located; dotted where concealed; queried where uncertain. Bar and ball on downthrown side; bar and ball not shown where relative offset unknown

REVERSE FAULT—Many are thrust faults. Dashed where approximately located; dotted where concealed. Sawteeth on upper plate

(U) REVERSE FAULT AND YOUNGER NORMAL FAULT—Along part of the Uinta fault, extending from about east of Dutch John Mountain to the Diamond Peak-Talamantes Creek area, minor normal faulting (northern side upthrown; indicated by U) followed the more typical reverse faulting (southern side upthrown; indicated by sawteeth) along either the same fault plane or a nearby parallel one. Dashed where approximately located; dotted where concealed

ANTICLINE—Showing direction of plunge. Dashed where approximately located; dotted where concealed

SYNCLINE—Showing direction of plunge. Dashed where approximately located; dotted where concealed

STRIKE AND DIP OF BEDS

14 Inclined

⊕ Horizontal

GILSONITE DIKE— Dotted where concealed

d IGNEOUS DIKE—Dotted where concealed. Gabbroic dike near Leidy Peak in the western part of the quadrangle and trachitic dike near the Canyon of Lodore in the central part of the quadrangle. The trachitic dike has received a rubidium-strontium whole-rock age of 491 m.y. (Lower Ordovician or Upper Cambrian; Hansen, Carrara, and Rowley, 1983); the gabbroic dike also may be of early Paleozoic age (Ritzma, 1974)

NOTE CONCERNING THE THRUST FAULTS

Seismic profiles, unavailable to the authors, clearly show that both the northern and southern flanks of the Uinta Mountains contain numerous foreland-type reverse faults or thrust faults dipping under the range. Few of these faults, however, are shown on the map because few reach the surface. Either the faults pass upwards into drape folds, as demonstrated by detailed mapping in Dinosaur National Monument (Cook and Stearns, 1975; Rowley and Hansen, 1979; Hansen, Rowley, and Carrara, 1983), or the traces of the faults are covered by younger rocks. The reverse or thrust faults shown on the map consist of the Uinta fault on the northern flank of the Uinta Mountains and other faults of smaller length exposed elsewhere on the flanks and interior of the range.

In the Vernal quadrangle, exploratory oil wells have penetrated apparent thrust faults in at least two places north of the Uinta Mountains and in at least three places south of the Uinta Mountains (for example, Gries, 1981). South of upper Talamantes Creek on the O-Wi-Yu-Kuts Plateau, Champlin Petroleum well No. 1 Federal (elev. 2,592 m; T.D. 4,209 m; sec. 19, T. 11 N., R. 102 W., Moffat County, Colo.) penetrated rocks of the Precambrian Uinta Mountain Group (**Yu**) to a depth of 2,164 m, at which place it crossed a thrust or reverse fault and continued down through an orderly stratigraphic succession starting from Upper Cretaceous Mancos Shale (**Km**) at 2,164 m to Permian and Pennsylvanian Weber Sandstone (**PIPw**) at the bottom of the hole. Pan American Petroleum well No. 1-A M.P. Gilbert (elev. 2,816 m; T.D. 2,743 m), drilled north of Talamantes Creek on the southern side of Diamond Peak (sec. 4, T. 11 N., R. 102 W., Moffat County, Colo.), penetrated brecciated Paleozoic(?) rocks overlying an apparent thrust fault at about 2,414 m below the surface.

On the southern flank of the Uinta Mountains, Tennessee Gas Transmission Co. well No. 1-A Hicks-Government (elev. 1,902 m; T.D. 2,856 m) penetrated two shear planes of the Willow Creek thrust fault at about 2,400 m below the surface northeast of the town of Dinosaur (sec. 3, T. 5 N., R. 103 W., Moffat County, Colo.; Anderman, 1961; Berg, 1962; Rowley and Hansen, 1979); rocks of the Uinta Mountain Group overlie the main fault plane, whereas Pennsylvanian and Permian rocks underlie the fault plane. Not far south of this well, Pure Oil Co. well No. 1 Government (elev. 1,807 m; T.D. 2,762 m; sec. 15, T. 3 N., R. 103 W., Moffat County, Colo.) passed through the same fault, within the Mancos Shale, at about 1,158 m below the surface (Anderman, 1961; Berg, 1962; Cullins, 1969). The fault penetrated by these two holes has not been recognized at the surface south of these holes (Cullins, 1969), perhaps because fault displacement was taken up by folding in the Mancos Shale. Similar relations in well holes were described by Campbell (1975) in the Jensen area 30 km to the west, where Toledo Mining Co. well No. 2 Napoleon (elev. 1,480 m; T.D. 2,759 m; sec. 9, T. 6 S., R. 22 E., Uintah County, Utah) penetrated at about 2,750 m depth an apparent thrust fault that separated Jurassic rocks above from Upper Cretaceous rocks below. This fault, which is unconformably overlain by younger (lower Tertiary) rocks, is interpreted by Campbell (1975) to extend along strike in the subsurface past the western boundary of the Vernal quadrangle.

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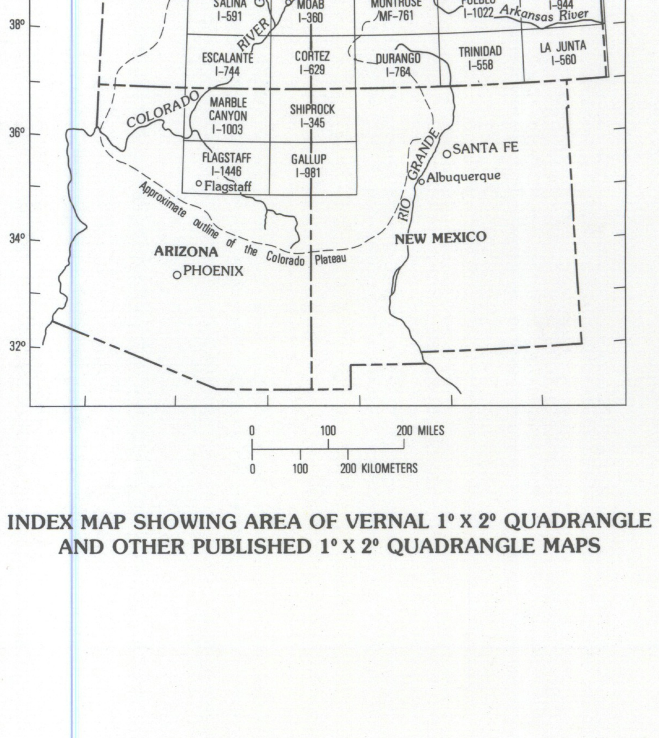

INDEX MAP SHOWING AREA OF VERNAL 1° X 2° QUADRANGLE AND OTHER PUBLISHED 1° X 2° QUADRANGLE MAPS

OLORADO, UTAH, AND WYOMING

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