UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PRELIMINARY GEOLOGIC MAP OF THE PAROWAN GAP QUADRANGLE, IRON COUNTY, UTAH

By

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DESCRIPTION OF MAP UNITS

[Phenocryst contents are averages]

Qt **Talus deposits (Holocene)**--Deposits of unsorted, unstratified angular rock fragments as large as 3 m in diameter that have moved down steep bedrock slopes and collected at the base. Rock fragments are generally in contact and the interstices are commonly filled with a matrix of sand, silt, and sparse clay. Forms slopes of about 30°. Thickness less than 5 m

Ql **Little Salt Lake playa deposits (Holocene and Pleistocene)**--Calcareous, saline, and gypsiferous gray clay, silt, and sand deposited on the flat playa floor of intermittent Little Salt Lake. Includes some dunes of windblown silt. Playa formed behind a structural dam created by Quaternary uplift of the Red Hills (Threet, 1952; Anderson and Christenson, 1989). Depth of the playa basin is controlled by a dam created by small, active alluvial fans that extend across Parowan Gap canyon near its eastern end (Neilson, 1983). Thickness at least 5 m

Qlm **Playa-margin deposits (Holocene)**--Calcareous, saline, and gypsiferous gray clay, silt, sand, and pebbles of volcanic rocks and quartzite deposited on gentle slopes around the margin of Little Salt Lake playa. Subject to periodic flooding during high lake stands. Includes slope wash alluvium, stream alluvium, small alluvial fans, and windblown sand and silt. Forms slopes of less than 1°. Thickness less than 4 m

Qsc **Stream channel alluvium (Holocene)**--Pebbles, cobbles and sparse boulders supported by a sand matrix. Deposits poorly sorted and locally contain low-angle channel cross bedding. Depositional form of channel bars within intermittently active stream channels is preserved. Subangular clasts of Tertiary volcanic rocks eroded from the northern Red Hills and reworked from old basin fill deposits are predominant except in the south-central part of the quadrangle, where conglomerates of the Claron Formation (Tc) and the sedimentary and volcaniclastic rocks and tuffs of Red Hills (Trs) yield abundant rounded quartzite cobbles as large as 15 cm in diameter. Forms slopes of less than 1°. Thickness less than 3 m

Qsf **Stream floodplain alluvium (Holocene)**--Channel fill gravel, sand, and silt overlain by overbank and slope wash deposits of laminated fine sand and silt. Young soils with a thin mollic epipedon (surface horizon darkened by organic matter from grassy vegetation) developed on depositional surface. Surface covered with a loosely packed pavement of pebbles with fine sediment between clasts. Locally includes small channel deposits and small alluvial fan deposits derived from the valley sides. Depositional surface as high as 4 m above stream channel bottoms. Forms slopes of less than 1°. Maximum observed thickness 4 m

Qst **Stream terrace alluvium (late Pleistocene)**--Thin deposits of stream alluvium preserved on benches cut in old alluvium (QTl and QTh). Weak calcium carbonate cementation occurs between 50 and 75 cm depth (Crandell, Gorden, U.S. Soil Conservation Service, Cedar City, Utah, 1989, written commun.). Surface covered with a moderately packed pavement of closely spaced pebbles. Depositional surface as high as 8 m above stream flood plains. Slopes less than 1°. Thickness less than 3 m

Alluvial fan deposits undivided (Holocene and Pleistocene)--Poorly sorted, very poorly bedded pebbles, cobbles, and sparse boulders supported by a silty sand matrix. Subangular clasts of Tertiary volcanic rocks eroded from the northern Red Hills and reworked from old basin fill deposits are predominant except in the south-central part of the quadrangle, where conglomerates of the Claron Formation (Tc) and the sedimentary and volcaniclastic rocks and tuffs of Red Hills (Trs) yield abundant rounded quartzite cobbles as large as 15 cm in diameter.

Qfa **Active fan alluvium (Holocene)**--Generally makes up active alluvial fans that are little incised and postdate most faults, although they are locally offset less than 1 m by the most recent fault movement. Locally deposited on the downthrown side of fault scarps after faulting. Locally includes deposits of small stream channels and floodplains. Very little soil development, although the surface is covered with a loosely packed pavement of pebbles with fine sediment between. Forms slopes of less than 10°. Maximum observed thickness 20 m

Qf **Fan alluvium (late Pleistocene)**--Unit occurs as remnants of alluvial fans that no longer receive sediment because of incision resulting from late Pleistocene faulting or uplift. Unit locally includes thin alluvium that covers pediments cut on older alluvium. Soil weakly cemented by calcium carbonate between 35 and 75 cm depth (Crandell, Gorden, 1989, written commun.). Thin carbonate films occur on bottoms of clasts. Surface covered with a well developed pavement of closely packed pebbles and cobbles. Forms slopes of less than 15°. Maximum observed thickness 20 m

Qfo **Older fan alluvium (middle? Pleistocene)**--Unit occurs as abandoned remnants of alluvial fans preserved as terraces. Locally includes thin alluvium that covers pediments cut on older alluvium. Soil moderately cemented by calcium carbonate between 35 and 90 cm depth (Crandell, Gorden, 1989, written commun.). Carbonate deposited on the bottom of clasts forms rinds and pendants about 5 mm thick. Surface covered by well developed pavement of closely spaced pebbles. Forms slopes of less than 15°. Maximum observed thickness 10 m

Qp **Pediment alluvium (middle? Pleistocene)**--Poorly sorted, weakly bedded, subangular, pebbles, cobbles, and sparse boulders of Tertiary volcanic rocks supported by a silty sand matrix. Surface has moderately packed pavement of pebbles and cobbles overlying about 4 cm of silt-rich, vesicular A soil horizon. Thin calcium carbonate rinds deposited on bottom of some surface clasts, but no strong carbonate horizon development. Soil formed at relatively high altitude in low carbonate sediment under conifers. Slight desert varnish on surface clasts. Unit deposited as a relatively thin veneer that covers fan-shaped surfaces generally eroded on soft sedimentary rocks of the Claron Formation (Tc), the sedimentary and volcaniclastic rocks and tuffs of Red Hills (Trs), and old alluvial basin fill deposits of Long Hill (QTh). Extends from about 2100 m (6900 ft contour) altitude at the base of steep hills of volcanic rocks westward about 3.7 km at a slope of about 3°. Pediment surface is incised to a maximum depth of 60 m. This deposit covers several pediment surfaces developed at slightly different levels. 1 to 4 m thick

Qpo **Old pediment alluvium (early? Pleistocene)**--Poorly sorted, very weakly bedded, subangular to subrounded volcanic pebbles, cobbles, and boulders as large as 30 cm supported by a silty sand matrix. Carbonate pendants about 1 cm thick on bottom of surface clasts. Soil is "plugged" and strongly cemented by calcium carbonate (75 percent of matrix) between 25 and 150 cm depth (Crandell, Gorden, 1989, written commun.). Surface is extensively eroded down to laminar layers of pedogenic calcium carbonate that yield abundant light-tan tabular chips that mantle the surface. Deposited as relatively thin veneers on fan-shaped surfaces eroded on old alluvial basin fill deposits of Long Hollow (QTl). Pediment alluvium is usually coarser, more rounded, and richer in basaltic clasts than the underlying basin fill alluvium of Long Hollow. Unit is present on several levels of pediment. Forms slopes of less than 1°. Thickness 1 to 5 m

Qbr **Basalt lava flows of Red Hills (Pleistocene)**--Black, grayish-black to medium-gray, dense, vesicular-olivine bearing lava flows. Locally fills in paleotopography in the Navajo Sandstone. Vent is located just west of mapped area in Enoch Quadrangle (sec. 17, T.34 S., R.10 W.) (Rowley and Threet, 1976). K-Ar whole-rock age of unit reported to be 1.3 ± 0.3 Ma (Best and others, 1980). Thickness about 60 m

QTl **Basin-fill deposits of Long Hollow (early Pleistocene and late Tertiary)**--Thick, extensive deposits of poorly sorted, poorly bedded gravelly fan alluvium filling the deep fault basin west of the Red Hills. Angular to sub-angular gravel of primarily volcanic lithologies and rare rounded quartzite cobbles supported by a matrix of light reddish-brown sand. Deposits locally weakly to moderately cemented by calcium carbonate. Clasts average 6 cm in diameter and are as large as 50 cm in diameter. Original depositional form is not preserved. In the central part of the basin the deposits are slightly displaced along small normal faults, but are little deformed. On the eastern and western basin margins, the beds are tilted as steeply as 20°. Pediments have been cut across the surface at several levels, and streams are entrenched as deep as 60 m. The valley sides are mantled with colluvium and good exposures of the map unit are rare. Best exposures are along Long Hollow in the northwest corner of the mapped area. Eroded into slopes as steep as 20°. Exposed thickness more than 60 m, but 900 m west of the quadrangle boundary, in sec. 31, T. 33 S, R. 10 W., drilling reached a depth of 918 m without penetrating the base (Rowley, 1975)

QTs **Basin-fill deposits of Slough Bench (early Pleistocene and late Tertiary)**--Eroded remnants of uplifted distal alluvial fan and basin-center slope wash deposits in Parowan Valley. Finest beds contain as much as 50 percent clay. Coarsest beds contain about 35 percent of quartzite and volcanic rocks as large as 3 cm in diameter. Calcareous (less than 37 percent), gypsiferous, and strongly saline (Crandell, Gorden, 1989, written commun.). These deposits form low hills consisting of uplifted, structural blocks along the axis of the Parowan Valley. The deposits are poorly exposed and commonly veneered with windblown sand and silt from the Little Salt Lake playa. Named for the block forming Slough Bench, 3 km east of the quadrangle boundary. Soils are 1.5 m thick with natric and carbonate-enriched horizons (Crandell, Gorden, 1989, written commun.). Eroded to slopes of less than 5°. Thickness greater than 180 m (Bjorklund and others, 1977)

QTh **Basin fill deposits of Long Hill (early Pleistocene and late Tertiary)**--Eroded remnants of uplifted and faulted basin-fill deposits of gravelly fan alluvium preserved on the west flank of the Red Hills. Deposits are poorly bedded, poorly sorted, and locally weakly cemented by calcium carbonate. Clasts are angular to sub-angular and primarily of volcanic lithologies averaging 6 cm in diameter and as large as 1 m diameter in the northern part of the quadrangle; southward the clast type changes gradually into rounded quartzite cobbles less than 10 cm in diameter. Clasts are supported by matrix of light reddish brown sand that becomes redder and more calcareous southward. Original depositional form is not preserved. Well exposed on the southeast side of Long Hill in the north central part of the quadrangle. Allochthonous blocks of volcanic rock as long as approximately 400 m are present in this map unit. This unit is distinguished from the basin-fill deposits of Long Hollow (QTl) to the west by the presence of exotic blocks and greater dissection. It may represent an older, basal part of the basin fill exposed by faulting, uplift, and erosion along the west side of the Red Hills structural block. Slopes are mantled with colluvium and good exposures are rare. Eroded into hill slopes of less than 12°. Base not exposed. Thickness more than 150 m

Tbd **Basalt(?) dike (Miocene?)**--Resistant yellow-gray to light-olive-gray aphanitic dike about one meter wide. Highly altered. Intrude fractures or faults. In southwest corner of quadrangle where it intrudes the Navajo Sandstone and in section 8 where is intrudes the Trs unit

Tm **Megabreccia deposit (Miocene)**-- Consist of a chaotic mixture of gravity-slide blocks that are composed of parts of two or more of the following units: Leach Canyon Formation (Tl), Bear Valley Formation (Tbv), Baldhills Tuff Member of Isom Formation (Tib), Wah Wah Springs Formation (Tnw), and Cottonwood Wash Tuff (Tnc). Larger blocks locally differentiated and labled with map unit symbols of individual parent rock units

Td **Mount Dutton Formation (Miocene and Oligocene)**--Predominantly soft volcanic mudflow breccia containing angular to subrounded pebble-to cobble-size clasts, mostly of intermediate-composition volcanic rocks and lesser tuffaceous sandstone in a grayish-orange-pink, pale-red, light-gray, and dusky-brown, muddy to sandy matrix. Subordinate aphanitic to porphyritic lava flows of intermediate composition locally present; some flows contain augite and hornblende phenocrysts as large as 0.5 cm. Defined by Anderson and Rowley (1975). K-Ar age ranges from about 21-26 Ma (Anderson and Rowley, 1975). Exposed incomplete thickness about 60 m

Condor Canyon Formation of Quichapa Group (Miocene)--Defined by Cook (1965).

Tcb **Bauers Tuff Member**--Resistant light-brown-gray, rhyolitic densely welded ash-flow tuff, containing about 15 percent phenocrysts consisting of plagioclase (55 percent), sanidine (35 percent), biotite (7 percent), Fe-Ti oxides (3 percent), and trace amount of pyroxene (Anderson and Rowley, 1975). Characterized by conspicuous bronze biotite and light-gray flattened lenticules that may be flattened pumice. Source area is the Clover Creek caldera (Rowley and Siders, 1988), within the Caliente caldera complex, Lincoln County, Nevada (Ekren and others, 1977). Defined by Mackin (1960). 40 Ar/39 Ar age is 22.78 Ma (Best, Christiansen, and Blank, 1989). Found only as blocks in the Long Hill area. Exposed incomplete thickness about 30 m

Tl **Leach Canyon Formation of Quichapa Group (Oligocene)**--Moderately resistant to resistant, white to grayish-orange-pink rhyolitic partly to moderately welded ash-flow tuff. Contains about 15-25 percent phenocrysts of plagioclase (35-45 percent), quartz (25-30 percent), sanidine (20-30 percent), biotite (5 percent), hornblende (2 percent), Fe-Ti oxides (2 percent), and pyroxene (1 percent) (Anderson and Rowley, 1975). Characterized by high content (about 5 percent) of lithic fragments that are predominantly red. Thin vitrophyre, approximately 0.5 m thick, locally present at base. Typically erodes to hoodos. May include both Table Butte Member and underlying Narrows Tuff Member. Defined by Williams (1967). Average K-Ar age is 24.7 Ma (Armstrong, 1970). Maximum exposed thickness about 120 m

Tbv **Bear Valley Formation (Oligocene)**--Poorly resistant olive-gray, yellow-gray, and medium-green, commonly crossbedded tuffaceous sandstone that has been interpreted to be of eolian in origin (Anderson, 1971). Composed of subangular to well-rounded volcanic clasts, glass shards, and mineral grains mostly of feldspar, pyroxene, hornblende, biotite, magnetite, and quartz. Cemented by the zeolite clinoptilolite (Anderson, 1971). Locally includes thin conglomerate at base of the formation. Formation locally missing because of Tertiary erosion or tectonism. Resembles tuffaceous sandstone within the sedimentary and volcaniclastic rocks and tuffs of Red Hills unit (Trs). Defined by Anderson (1971). K-Ar age of about 25 Ma determined on interbedded tuff beds within the formation that have been indentified in other areas (Fleck and others, 1975). Incomplete thickness about 0-15 m

Tib **Baldhills Tuff Member of Isom Formation (Oligocene)**--Moderately resistant to resistant, composed of many densely welded, trachytic ash-flow tuff cooling units that contain 5-20 percent phenocrysts, mostly of plagioclase and minor pyroxene and Fe-Ti oxides in a glassy to devitrified groundmass (Anderson and Rowley, 1975). In the Red Hills area, nine cooling units may be present and are in descending order: (1) yellowish-gray, relatively crystal-rich tuff, containing abundant spherical vesicles and locally overlain by a black vitrophyre that may represent remnant of a younger cooling unit; (2) cliff-forming pale-red to grayish-red, crystal-rich tuff, characterized by elongated vesicles and secondary flowage structures that are both flattened and folded and resemble flowage features in lava flows; (3) cliff-forming, pale-red to grayish-red, crystal-rich tuff containing common elongated vesicles; (4) slope-forming, yellowish-gray, relatively crystal-poor tuff, containing common spheroids; (5) slope-forming, light-brown, crystal- and lithic-rich tuff; (6) slope-forming, pale-reddish-brown, crystal-rich tuff; (7) slope-forming, yellowish-gray, crystal-poor tuff, containing abundant enlongated vesicles; (8) slope-forming, very dusky red, crystal-poor tuff; and (9) slope-forming, pale-reddish-purple, crystal-poor tuff. Uppermost part of member may locally include a thin tuff, too thin to map separately, of the Hole-in-the-Wall Member of the Isom Formation, (Anderson and Rowley, 1975). Defined by Mackin (1960). Caldera source of the Baldhills is probably at the northwest edge of the Escalante Desert (Best, Christiansen, and Blank, 1989). K-Ar age of 25.9 ± 0.4 Ma determined by Fleck and others (1975). Maximum thickness about 245 m

Needles Range Group (Oligocene)--Defined as a formation by Mackin (1960) and later elevated to group status by Best and Grant (1987)

Tnw **Wah Wah Springs Formation**--Simple cooling unit of moderately resistant, grayish-orange-pink, dacitic, moderately welded ash-flow tuff. Contains approximately 35 percent phenocrysts of plagioclase (70 percent), hornblende (15 percent), biotite (5 percent), quartz (5 percent), Fe-Ti oxides (3 percent), sanidine (2 percent), and trace amounts of pyroxene, apatite, and zircon (Anderson and Rowley, 1975). Ferromagnesium mineral crystals are generally smaller than those in underlying Cottonwood Wash Tuff and matrix is generally lighter color. Long collapsed pumice common. Fractures commonly parallel to the plane of compaction foliation. Locally contains spheriodal masses of tuff as large as 0.3 m in diameter in the uppermost part of the unit. At the base of the formation is a unit about 4 m thick composed predominantly of pale-greenish-yellow tuffaceous sandstone and subordinate pebbly conglomerate consisting of volcanic rock fragments. Source area of the formation is the Indian Peak caldera (Best and Grant, 1987, Best, Christiansen, and Blank, 1989, Best and others, 1989) along the central Utah-Nevada border. Defined by Mackin (1960) and later elevated to formational status (Best and Grant, 1987). Average K-Ar age is 29.5±0.5 Ma (Best and Grant, 1987). Maximum thickness about 60 m

Tnc **Cottonwood Wash Tuff**--Simple cooling unit of moderately resistant grayish-orange-pink to light-brownish-gray, dacitic, moderately welded, ash-flow tuff. Contains approximately 40 percent phenocrysts of plagioclase (65 percent), hornlende (15 percent), quartz (10 percent), biotite (5 percent), Fe-Ti oxides (3 percent), sanidine (2 percent), and trace amount of pyroxene, apatite, and zircon (Anderson and Rowley, 1975). Long collapsed pumice common. Fractures commonly parallel to the plane of compaction foliation. Vitrophyre present locally at base. Source area probably located in an alluvial valley between the Fortification Range of eastern Nevada and the Mountain Home Range of southwestern Utah (Best and Grant, 1987). Defined by Mackin (1960) and later elevated to formational status (Best and Grant, 1987). Average K-Ar age is about 30.6 (Best and Grant, 1987). Maximum thickness about 120 m

Tn **Needles Range Group undivided**--Composed of Wah Wah Springs Formation and Cottonwood Wash Tuff

Trs **Sedimentary and volcaniclastic rocks and tuffs of Red Hills (Oligocene)**--Mostly poorly resistant pebble- to boulder-size conglomerate, sandstone, minor limestone and limy shale beds, tuffaceous sandstone, mudflow breccia, and thin gray ash-fall tuff(?) and moderate-orange-pink ash-flow tuff. The moderate-orange-pink tuff, present near the top of the map unit and thick mudflow breccia are locally mapped separately as units Trst and Trsm respectively. Upper part of the overall map unit consists of conglomerate beds containing boulder-size clasts predominantly of ash-flow tuff (some resemble tuffs of the Needles Range Group), lava flows of intermediate composition, and minor amounts of quartzite and limestone. The boulder conglomerate beds contain local interbedded thin pale-red sandstone, pebble conglomerate, and mudflow(?) breccia. The mudflow(?) breccia contains volcanic clasts and grains of quartz, feldspar, hornblende, pyroxene, and trace amounts of garnet. Pebble conglomerate and coarse-grained sandstone beds are more common below the boulder conglomerate beds. The pebble conglomerate beds contain predominately quartzite and limestone clasts. In general, volcanic clasts are more common near the top of the unit and quartzite and limestone clasts are more common near the base. Thin yellowish-gray and light-gray tuffaceous sandstone beds are interbedded throughout and are thicker in the lower half of unit. The sandstones are laminated and crossbedded; they contain abundant biotite that gives the sandstone a salt and pepper texture. The sandstones resemble those in the Bear Valley Formation. The upper part of unit is equivalent to "local volcanic and sedimentary strata", a unit on the Markagunt Plateau (Anderson and others, 1987). Lower part of unit is equivalent to the upper part of the "white" subunit (Doelling and others, 1989) of the Claron Formation and mapped separately here from the Claron Formation because of different lithology. Maximum thickness about 210 m

Trst **Ash-flow tuff**--Mapped locally. Pumice rich, moderate orange-pink, partly to moderately welded ash-flow tuff. Composed of approximately 5 percent phenocrysts of sanidine, plagioclase, quartz (resorbed), biotite, and trace amount of, zircon, apatite, Fe-Ti oxide, and opaque mineral. Calcite common in matrix and in pumice vugs. Contains about 2 percent red and gray lithic fragments. May correlate with a tuff unit mapped as part of a unit called "local volcanic and tuffaceous sedimentary rocks", by Anderson, Rowley, and others (in press) in the Bear Valley area approximately 10 km east of the Red Hills, where the tuff unit has been dated at 31.9 Ma (Fleck and others, 1975) Maximum thickness about 60 m

Trsm **Mudflow breccia**--Mapped locally. Contains clasts of intermediate-composition lava flow and light-yellowish-green tuffaceous sandstone in a pale-red, dusky-brown, and grayish-orange-pink matrix. Matrix composed of plagioclase, hornblende, pyroxene, and opaque mineral. Resembles mudflow breccia in the Mount Dutton and in the Bear Valley Formations

Tc **Claron Formation (Eocene)**--Poorly to moderately resistant fluvial and lacustrine deposits composed of intercalated sandstone, mudstone, limestone, and quartzite-limestone pebble conglomerate beds that contain well-rounded quartzite and limestone clasts. Conglomerate beds are more abundant in the map area than indicated for the same unit in other areas. Unit is mottled and varicolored, composed of pale-red, pale-reddish-brown, moderate-red, gray-yellow, moderate-reddish-orange, very pale orange, and gray-orange-pink beds. Fluvial and lacustrine deposits are intrepreted to have been altered by pedogenic processes (Mullett and others, 1988, Mullett, 1989). Contact with overlying sedimentary and volcaniclastic rocks of Red Hills (Trs) not exposed, so mapped contact is approximately located. Claron formation as mapped in this study is Eocene age, however, basal beds may be Paleocene or latest Cretaceous (Anderson and Rowley, 1975). Equivalent to the "pink" subunit (Doelling and others, 1989) of the Claron Formation. Limestone and clastic rocks equivalent to the lower part of the "white" subunit of the Claron Formation that overlie the "pink" subunit are not present in quadrangle but present in adjacent Summit quadrangle to the south. Maximum thickness of about 370 m (Threet, 1952, 1963)

Tpc **Conglomerate of Parowan Gap (Paleocene? and Upper Cretaceous?)**--Predominantly massive conglomerate beds locally interbedded with thin, coarse-grained sandstone. Well-rounded clasts predominantly quartzite and limestone and lesser amounts of sandstone and chert of pebble, cobble, and boulder size. In the Parowan Gap area, the massive conglomerate beds form two distinctive resistant cliffs that are less obvious north and south of the gap. Conglomerate deposits are found locally as channel fills on an erosional surface cut on the underlying Iron Springs Formation that corresponds to an angular unconformity. Previously mapped as the lower part of the Claron Formation by Threet (1952) but mapped her separately from the Claron Foramation because of different litholgy. Correlative with the Beehive unit of Hilton (1984), exposed in the western part of the Markagunt Plateau approximately 16 km east of quadrangle. Maximum thickness about 90 m

Iron Springs Formation (Upper? Cretaceous)--Defined by Mackin (1947) for exposures in the Iron Springs mining district about 10 km south of the quadrangle, where the unit is about 1000 m thick.

Kiu **Upper part**--Moderately resistant, fluvial deposits composed predominately of yellowish-gray, grayish-yellow, moderate-yellow, and dark-yellowish-orange, fine- to medium-grained, thin-bedded to massive sandstone. Upper part contains several interbedded, thin, light-gray siltstone beds, approximately 5 cm thick. Correlative with Free Thought unit of Moore (1982) exposed in adjacent Parowan quadrangle, in the western part of the Markagunt Plateau. Exposed thickness about 150 m

Kil **Lower part**--Moderately resistant, fluvial deposits composed predominately of sandstone and minor thin beds of conglomerate, shale, carbonaceous shale, and coal beds. Sandstone is yellowish gray, grayish yellow, moderate yellow, and dark yellowish orange, fine to medium grained, and thin bedded to massive. Lower part contains thin conglomerate beds and maroon shale. Conglomerate beds composed of well-rounded quartzite and limestone clasts. Fossils are rare but oyster shell fragments in sandstone and gastropod in shale have been described by Threet (1952). Correlative with Free Thought unit of Moore (1982) exposed east of the quadrangle in the western part of the Markagunt Plateau. Exposed thickness about 610 m

Jc **Carmel Formation (Middle Jurassic)**--Incompletely and poorly exposed outcrops of poorly to moderately resistant light-gray, bluish-gray, yellowish-gray, and tan, platy to massive limestone and dolomitic limestone, fossiliferous, with local lenses of oolite and calcarenite; white, gray to light-olive-gray, and reddish-brown to pale-red, fine- to medium-grained, thin-bedded to massive, calcareous sandstone, interbedded with pale-red silty shale (Threet, 1952, 1963). Exposed thickness about 250 m (Threet, 1952)

Jt **Temple Cap(?) Sandstone (Middle Jurassic)**--Poorly exposed outcrops of red-brown, fine- to medium grained, thin- to thick bedded, sandstone. Intensely sheared. Exposed incomplete thickness about 10 m

Jn **Navajo Sandstone (Lower Jurassic)**--Resistant, white to light-gray, fine- to medium grained, well sorted, massive, crossbedded, quartzose sandstone. Locally stained with limonite. Quartz vein stockwork locally present. Intensely brecciated. Exposed thickness about 395 m

EXPLANATION OF SYMBOLS

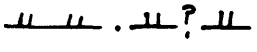
Contact--Dip of contact shown. Contacts between bedrock and alluvial deposits approximately located

Normal Fault--Dashed where approximately located; dotted where concealed; queried where uncertain. Bar and ball on downthrown side. Arrow indicates direction and amount of dip; cross indicates vertical dip

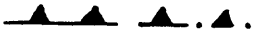
Boundary of gravity-slide block of Quaternary age deposited below cliffs along slopes, showing parent bedrock unit symbol. Locally overlie Quaternary alluvium.

Boundary of gravity-slide block deposited in basin within Quaternary and Tertiary sediments (QTh), showing parent bedrock unit symbol. Dotted where concealed

Boundary of megabreccia deposit interpreted as gravity-slide block of Miocene age. Composition of deposit shown by parent bedrock unit symbol when individual blocks are mapped separately and Tm when blocks are to small to map separately. Dotted where concealed



Shear zone--Not well exposed, approximately located, and dotted where concealed. The shear zone is low angle and has detached part of the Trs unit and overlying rocks from the underlying succession of rocks (Maldonado and others, 1990). It may occur along the contact between the Trs unit and the base of the Tertiary volcanic rocks or in some areas within the upper part of the Trs unit. The shear zone is arbitrarily placed at the contact between the Trs unit and the base of the Tertiary volcanic rocks even thought it may occur well below that contact. The shear zone may be characterizied by comminuted rock, folding, and discordence in attitudes and thinning or ommision of rocks overlying the shear zone. In some areas it maybe difficult to differentiate remnants of detached blocks from the megabreccia deposits of Tertiary age and the slide blocks deposited in unit QTh. In geologic section approximately located and queried where uncertain



Thrust fault of Parowan Gap--Teeth on upper plate. Dashed where approximately located; dotted where concealed

Strike and dip of beds

Inclined

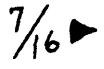
Horizontal

Vertical

Overturned

Strike and dip of foliation of pumice and lenticules in welded ash-flow tuff

Dip of foliation of pumice within selected ash-flow tuff and selected sedimentary rock units. Shown in geologic sections B-B' and C-C'



Parameters for fault scarps formed in Quaternary deposits--Height in meters over maximum slope in degrees

Prospect

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CORRELATION OF MAP UNITS