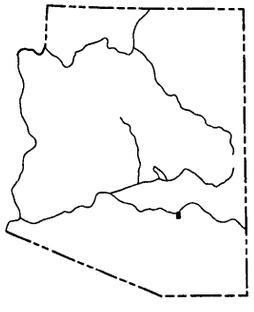
MAP GQ-671

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

GEOLOGIC QUADRANGLE MAPS OF THE UNITED STATES

GEOLOGIC MAP OF THE SADDLE MOUNTAIN QUADRANGLE PINAL COUNTY, ARIZONA

By
Medora H. Krieger



QUADRANGLE LOCATION

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DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

Alluvium (0-15 ft exposed).—Flood-plain deposits along San Pedro River composed of sandy silt, mudstone, and some sand and gravel, locally cemented with caliche; along the washes largely unconsolidated sand. Some undivided alluvium and gravel veneer on low terraces is locally included.

Older alluvium (0-100 ft or more).—Well-cemented channel gravels overlain by reworked fine-grained facies of the Gila Conglomerate. Absence of regular bedding and presence of sandy to conglomeratic beds and lenses distinguish the reworked material from the fine-grained Gila. Includes much unmapped alluvium, colluvium, gravel veneer on pediments and terraces, and fine-grained facies of the Gila Conglomerate.

Talus (0- about 50 ft).—Rock debris consisting of large angular blocks to silt-sized particles, locally cemented by caliche.

Gravel veneer on pediments and lower terraces (0-25 ft).—Largely subangular pebbles and cobbles of Paleozoic and Precambrian rocks, locally of andesite of Depression Canyon and Late Cretaceous and(or) early Tertiary volcanic and intrusive rocks. The matrix is generally reddish-brown and fine- to coarse-grained, except on lower terraces where it is lighter colored. Locally includes some pediments and terraces stripped of gravels.

Surficial deposits, undivided (0-20? ft).—Alluvium, colluvium, talus, and gravel veneer on pediments and terraces.

GILA CONGLOMERATE (0-3,000? FT)

A conglomeratic and a fine-grained, lacustrine facies with intertonguing contact. The change occurs within ¼ mile where unfaulted and probably reflects a buried fault. The Gila in this area is assigned to the Pliocene because of the presence of pre-Blancan vertebrate fossils in presumably equivalent beds (J. F. Lance, oral communication, 1963) southeast of Mammoth.

Fine-grained facies (0- about 400 ft exposed).—Thin- and evenly-bedded, grayish-orange-pink to yellowish-gray clay, silt, marl, and very fine grained sand; thin beds of gypsum and a few of white rhyolite tuff; commercial gypsum deposits in southern part. Forms vertical cliffs along some washes; elsewhere largely concealed by unmapped alluvium, colluvium, and pediment and terrace gravels.

Coarse-grained facies (0-400 ft exposed).—Fanglomerate consisting of subangular to subrounded pebbles, cobbles, and small boulders of Precambrian and Paleozoic rocks, Galiuro Volcanics, and locally Upper Cretaceous and(or) lower Tertiary rocks. Matrix is light shades of gray, green, and brown, generally well cemented and is composed of small-pebble to silt-sized particles. Around hills of andesite near the San Pedro River it includes andesitic talus that interfingers with and underlies the fine-grained facies.

GALIURO VOLCANICS

Includes Apsey Conglomerate Member, Hells Half Acre Tuff Member, and andesite of Depression Canyon. K-Ar determinations on biotite and sanidine from Hells Half Acre Tuff Member and other members of the Galiuro Volcanics (Krieger, 1967a, b) yielded ages of 22.4 to 25.9 million years (S. C. Creasey, oral communication, 1965).

Apsey Conglomerate Member[1] *(0-50 ft).*—Yellowish- to light-gray conglomerate and conglomeratic tuff containing pebbles, cobbles, and scattered boulders, largely derived from the rhyolite-obsidian member (Krieger, 1967a), with sparse to abundant fragments of older rocks.

Hells Half Acre Tuff Member[1] *(0-100 ft).*—Cliff- and slope-forming, white, air-fall and partly reworked rhyolite tuff composed of shards, crystal and lithic (rhyolite and pumice lapilli) fragments. Lower units are not present in this quadrangle.

ANDESITE OF DEPRESSION CANYON

Conglomerate (0-50 ft).—Composed of andesite of Depression Canyon(?) and Late Cretaceous and(or) early Tertiary volcanic and intrusive rocks. Conglomerate below the Hells Half Acre Tuff Member may belong to a younger member.

Andesite (Tertiary basalt and andesite of Willden, 1964) (0-600 ft).—Massive, flow-banded, to agglomeratic, gray, brown, and olive andesite that weathers pale to lighter shades of brown. Local tuff and breccia beds at base and between flows. The vesicular, nonvesicular, or amygdaloidal andesite contains a few to abundant, mostly small phenocrysts of plagioclase, olivine (altered or partly altered to iddingsite, rarely to serpentine), pyroxene, and magnetite. The groundmass consists of plagioclase microlites, pyroxene, iddingsite, magnetite, and some K-feldspar. The presence of conglomerate beds within the andesite suggests that some of the upper flows may be correlative with younger andesites present in adjacent areas. Basal flows around Saddle Mountain are of andesite similar to the hornblende andesite dikes west of Saddle Mountain. Andesite near the San Pedro River (tentatively correlated with this member) contains calcite veins and manganese minerals including ramsdellite (D. F. Hewett, oral communication, 1958).

Hornblende-andesite dike.—Light-gray and brownish-gray fine-grained andesite with phenocrysts (as much as 10 x 1.5 mm) of hornblende, locally of pyroxene and altered basaltic hornblende, and minor plagioclase (as much as 0.6 mm). The groundmass consists of plagioclase, K-feldspar (identified from staining with cobaltinitrite), pyroxene, magnetite, and rutile, or of plagioclase laths in an unresolved, potassium-rich groundmass. Probably the same as some of the Cretaceous(?) or Tertiary hornblende andesite of Willden (1964).

WHITETAIL(?) CONGLOMERATE (0-400 FT)

Composed of pebbles and cobbles of Precambrian and Paleozoic rocks, and Late Cretaceous and(or) early Tertiary volcanic and intrusive rocks. Small pebbles of rhyolite are abundant near the intrusive rhyolite outcrops; some of these accumulated as talus.

INTRUSIVE RHYOLITE

Massive, locally flow-banded, light-gray and pinkish-gray rhyolite containing phenocrysts of biotite (mostly 1 mm or less, a few to 4 mm), quartz and plagioclase (0.5-1 mm, a very few to 3 mm) in a microcrystalline granular aggregate of quartz and alkalic feldspar. Locally it has a somewhat trachytoid texture with plagioclase laths (0.3-0.6 mm long). Some plagioclase phenocrysts are replaced by calcite. Weathering along steeply and gently dipping joints results in columns and balanced rocks. The outcrop from a distance resembles that commonly developed on granite. Biotite from the rhyolite has been dated as 61 million years by the potassium-argon method (S. C. Creasey, oral communication, 1964).

DIORITE

Medium-light-gray to slightly brownish- or greenish-gray porphyritic diorite. The phenocrysts, varying in size and

[1] Tertiary tuff and rhyolite of Willden (1964) includes Apsey Conglomerate and Hells Half Acre Tuff Members of this report.

abundance from place to place but generally making up 50-70 percent of the rock, consist of black hornblende and white plagioclase with oscillatory zoning (both as much as 6 mm long, mostly 1-2 mm), and magnetite (as much as 1 mm). The holocrystalline groundmass consists of K-feldspar, plagioclase, some hornblende and magnetite, and a little quartz, apatite, and zircon. Feldspar porphyries, which have not been mapped separately, are light olive gray. The phenocrysts are plagioclase (as much as 3 mm, mostly altered to sericite and calcite), a little quartz, and small mafic minerals (hornblende?) that are completely altered to calcite and chlorite. The groundmass is aphanitic and altered. On weathering or alteration, the porphyry becomes darker colored and can be distinguished with difficulty from some of the massive flows of Williamson Canyon Volcanics. Biotite from the diorite in the Christmas quadrangle (microdiorite of Willden, 1964, p. E27-E31) has been dated as 62 million years by the potassium-argon method (Creasey and Kistler, 1962).

WILLIAMSON CANYON VOLCANICS (0-1,000 FT)

Massive, porphyritic to nonporphyritic andesitic breccia, agglomerate, tuff, flow, flow breccia, mudflow, and volcanic and some nonvolcanic (unmapped) conglomerate. The andesite is shades of red, brown, and gray. Phenocrysts are of plagioclase and hornblende. The phenocrysts and the fine-grained groundmass have been extensively altered to various mixtures of epidote, calcite, chlorite, sericite, magnetite, and hematite. (Named by Simons, 1964, p. 44-47; same as unnamed volcanic and sedimentary rocks of Willden, 1964, p. E26-E27).

Conglomerate (0-100? ft).—Well-rounded cobbles and small boulders, largely of quartzite and Precambrian granitic rocks, some Pinal Schist and Paleozoic limestone.

PINKARD(?) FORMATION (0- ABOUT 300 FT)

Fine- to coarse-grained, crossbedded sandstone in shades of orange-pink, brownish- and olive-gray; some pale-red tuffaceous(?) sandstone. Composed of quartz, microcline (locally abundant), kaolinite, and chert. Some beds contain fossil wood and tree trunks as much as a foot in diameter; dark beds contain carbonaceous material. The base is as much as 1 ft of pebble conglomerate containing well-rounded pebbles of Paleozoic rocks and angular pieces of chert (from the Naco?) and white siltstone from the Mesozoic(?) sedimentary rocks. (Unnamed sedimentary rocks of Willden, 1964, p. E25-E26; see also Simons, 1964, p. 34-37.)

MESOZOIC(?) SEDIMENTARY ROCKS (0-125 FT)

Consists of four units, from top to bottom: (1) Variegated, fine-grained sandstone (50 ft in thicker sections). (2) Red beds (30 ft) consisting of siltstone and very fine grained sandstone. Spherical concretions, as much as 2 ft in diameter, are generally present near the middle of unit two. They are composed of well to poorly developed, fibrous, plumose crystals that are now calcite in the well-formed concretions, but dolomite in the poorly formed ones. The concretions are shades of yellow, olive gray, and orange. Some have a core and some concentric layers of red-bed material. (3) Interbedded white and shades of brown, red, and yellow, very fine grained sandstone and siltstone (30 ft) with carbonized wood and plant material. Brown, fine-grained sandstone contains casts and molds of gastropods and beaks of valves of pelecypods (possibly not younger than Triassic, according to J. B. Reeside, Jr., E. L. Yochelson, and N. F. Sohl, written communications, 1958 and 1959). (4) Chert breccia and conglomerate (0-15 ft). All units are characterized by abundant kaolinite and absence of feldspar; some have calcite and(or) dolomite in variable amounts; some have goethite and hematite; some are iron rich.

NACO LIMESTONE (750 FT, POSSIBLY 1,000 FT)

A slope-forming unit with characteristic grain due to evenly spaced resistant and less resistant beds. Most of the limestone is medium to thin bedded, fine grained, brownish to light gray, and weathers nearly white; some is mottled red. It contains interbeds of coarse-grained limestone, dolomitic to silty or marly limestone, thin beds or seams of pink to yellow calcareous shale and siltstone, local chert nodules and layers, and near the base a few sandstone, chert-breccia, and conglomerate beds. Low relief on the pre-Naco surface can locally be recognized, but in many places the contact with the Escabrosa is arbitrarily located because the lower 50 ft of the Naco lacks fusulinids and contains brown dolomitic and silty limestone beds that resemble some beds in the Escabrosa. Fossils include fusulinids, brachiopods, corals, crinoids, bryozoans, and ostracodes. The Naco here probably is largely equivalent in age and lithology to the Horquilla Limestone, the lowest of the six formations into which the Naco Group farther south has been divided (Gilluly and others, 1954, p. 6).

ESCABROSA LIMESTONE (250-700 FT)

Massive, cliff-forming, thick-bedded, mostly coarse-grained limestone in shades of gray and yellowish to greenish gray. The cliffs, 50-200 ft high, are separated by narrow slopes of thin-bedded, medium- to fine-grained gray limestone and brown silty and dolomitic limestone. Chert nodules are common in some beds, especially in upper part. The lower contact is arbitrarily located in a 25- to 50-ft zone, because of interbedding of coarsely crystalline, Escabrosa-like limestone and brown limestone beds similar to those in the upper part of the Martin. Fossils are abundant and include crinoids, brachiopods, corals, and, in the upper part, many ostracodes. Dark-brown chert breccia, common in the upper part in some areas, especially south of Green Lantern Wash, may represent pre-Naco solution and erosion.

MARTIN FORMATION (100-200 FT)

Slope-forming shale unit generally with overlying and thinner underlying carbonate beds. The shale is olive to reddish brown, with interbedded brown to gray limestone beds (2 in. to 4 ft thick) in the upper part. These limestone beds weather to rounded surfaces that are light shades of brown and red; locally they contain a fauna, including *Paurorhyncha endlichi* (Meek), (C. W. Merriam, written communication, 1958), characteristic of the Upper Devonian Ouray Limestone. Crinoids, bryozoans, and other brachiopods are common in the limestone beds. The shale may rest directly on sandstone or carbonate beds at the top of the Abrigo, or be separated from them by a few feet of limestone.

ABRIGO FORMATION[2] (400-500 FT)

Upper (or brown sandy) member (90-105 ft).—Upper part (25-40 ft) is slope-forming thin-bedded (½-1 ft, locally 2 ft), medium- to coarse-grained dolomite and dolomitic sandstone in light shades of brown. It contains some argillaceous and glauconitic beds, and intraformational conglomerate. The lower part (50-80 ft) is cliff-forming, dark-brown-weathering, thin- to thick-bedded (8 in. to 8 ft, mostly 3 ft) medium- to coarse-grained, mostly poorly sorted and crossbedded dolomitic and glauconitic sandstone; some dolomite, sandy and glauconitic dolomite, light-colored sandstone and quartzite, intraformational conglomerate, and siltstone; local granule and small-pebble conglomerate beds. Phosphatic brachiopod scraps are generally abundant in the dark-brown-weathering beds. Fucoids and *Scolithus* occur in light-colored sandstones.

Middle (sandstone) member (150-220 ft).—Predominantly cliff-forming, yellowish-gray, thin- to thick-bedded (3 in. to 3 ft), mostly poorly sorted sandstone and argillaceous sandstone; some granule conglomerate and thin to very thin silty or shaly partings. Most bedding surfaces are irregular due largely to abundant fucoids. *Scolithus* also are generally abundant. The upper part contains local beds of pronounced, steep crossbedding and 2- to 6-in. beds of white quartzite. Locally in the lower part a 10- to 40-ft massive unit has smooth bedding surfaces, no fossils, and only sparse shale partings; it is overlain by 2-30 ft of mudstone-siltstone beds like those in the lower member. Contact with the lower member is arbitrarily located in some places and is not everywhere at the same horizon, partly because of variations in the influx of sand in the upper part of the lower member.

Lower (mudstone) member (100-170 ft).—A thin-bedded, slope-forming, poorly sorted, argillaceous and sandy unit that weathers to shades of brown and yellowish or reddish brown. It consists of massive to very thin-bedded (½ to 2 in.), in part thinly laminated, olive- to greenish-gray and grayish-red mudstone, siltstone, and sandy mudstone; interbedded argillaceous sandstone beds (1 in. to 1 ft and locally 3 ft) and thin (mostly about 1 in.), well-sorted, light-colored quartzite and sandstone beds, paper-thin shale, and local beds and lenses of granule to small-pebble conglomerate. Fine-grained sandstone that crops out and parts like mudstone and has a similar color is more abundant in the upper part in some places. The member becomes more sandy and lighter colored upward. Most bedding surfaces are extremely irregular and pellety. Phosphatic brachiopod scraps are generally abundant; fucoids and *Scolithus* are present, but are mostly

[2] For discussion of the Troy and Cambrian formations see Krieger (1961).

smaller and less abundant than in the middle member. The basal part is characterized by sandstone beds with abundant fucoids, *Scolithus*, and some phosphatic brachiopod scraps. The contact with the Bolsa, where present, is transitional. Where the formation rests on diabase the base generally is a conglomerate (0-15 ft) composed of cobbles to small boulders (largely Troy Quartzite) in a grayish-red, sandy, diabasic matrix. Overlying beds commonly contain dolomite as cement, or as layers, lenses, nodules, and detrital pebbles.

BOLSA QUARTZITE[2] (0-220 FT)

Light-colored, color-banded, brown-weathering, thin- to thick-bedded (1 in. to 3 ft, rarely 10 ft), partly crossbedded and poorly sorted, gritty to fine-grained sandstone. In thicker sections it consists of three transitional units that in general are thinner bedded, better sorted, and finer grained upward. The upper part (40 to 60 ft, forms most of the formation in many places), is thin-bedded, fine- to medium-grained, well-sorted (at least better sorted than underlying beds) sandstone. The middle part is thick- to thin-bedded, poorly sorted, gritty sandstone (granule conglomerate) and local pebble conglomerate, but it contains abundant medium- to fine-grained, fairly well sorted sandstone or quartzite beds in the upper part. A basal conglomerate of variable composition and thickness contains pebbles of Precambrian rocks. Where it rests on diabase the matrix is generally reddish silt and sand containing abundant diabasic detritus and cobbles and small boulders largely of Troy Quartzite.

DIABASE

Dark-gray to dark-greenish- or olive-gray, medium-grained diabase occurring mostly as sills and multiple sills (totaling more than 600 ft in places). The texture is diabasic, ophitic, or poikilitic. The rock contains plagioclase (mostly about 5 mm, locally 2 cm), smaller pyroxene (poikilitic crystals are as much as 2 cm across), magnetite, ilmenite, and minor olivine. Some thicker sills contain aplitic and pegmatitic differentiates. The chilled contact of diabase against older rocks (including earlier sills) contrasts with the weathered appearance of diabase beneath Paleozoic rocks, where, within a zone as much as 20 ft thick, diabase grades upward from the fresh, massive, dark-gray rock into crumbly, red to purple rock with a pronounced platy structure.

TROY QUARTZITE[2] (0-640 FT)

Upper unit (0-400 ft).—White to yellowish-gray, and grayish-orange-pink, somewhat lenticular, thin- to thick-bedded (mostly 1-3 ft), feldspathic (white feldspar or clay alteration) to nonfeldspathic sandstone and granule to small-pebble (less than ½ in.) conglomerate. Pebbles are composed largely of quartz; some are concentrated on tops of beds. The unit contains local slump structures and large-scale crossbedding. Surficial silicification obscures some bedding features.

Lower unit (0-240 ft).—Dark-brownish-gray outcrops of medium-gray to pale-red conglomerate and sandstone that are mostly thin-bedded (many are 6 in. or less), lenticular, and channeled. The upper part consists of light-colored sandstone and quartzite interbedded with and replaced downward by dark sandstone, granule to small-pebble conglomerate, and thin beds of greenish-gray argillite. Much of the conglomerate contains abundant pink to orange fragments of feldspar and quartz porphyry or rhyolite. The basal 30-50 ft consists of pale-red sandstone and conglomeratic sandstone, in places metamorphosed (by diabase) to light bluish-gray, underlain by pebble to small-cobble conglomerate that locally contains sparse to closely packed, well-rounded pebbles derived from the Barnes Conglomerate Member of the Dripping Spring Quartzite.

APACHE GROUP

Except for a few small unmapped exposures, only the middle of the three formations that make up the Apache Group is present in the quadrangle.

DRIPPING SPRING QUARTZITE

Upper and middle members (about 400 ft).—The upper member (maximum of 200 ft, mostly less than 100 ft) is thin-bedded (¼ to 12 in.), very fine grained, feldspathic to arkosic quartzite and siltstone that is shades of gray, brown, red, and yellow. Some beds are ripple marked; others contain shallow crossbeds. The middle member (maximum of 200 ft) is thin- to very thick-bedded (2-12 ft), crossbedded, medium-grained, locally fine- to coarse-grained, red to pink, feldspathic to arkosic quartzite, with a little nonfeldspathic quartzite. Isolated remnants (a few feet thick) of the Mescal Limestone (dolomite and silty to cherty dolomite and limestone) overlie the quartzite south of Green Lantern Wash (SW¼ sec. 1 and SE¼ sec. 2, T. 6 S., R. 16 E.).

Barnes Conglomerate Member (0-50 ft, in most places less than 10 ft thick).—Ellipsoidal, extremely well rounded pebbles (¼-6 in.) of quartzite, quartz, and red jasper, mostly closely packed, locally sparsely scattered, in a matrix of red to gray, arkosic sandstone or quartzite. South of Ash Creek and in the bottom of the main gulch in SW¼ sec. 12, T. 6 S., R. 16 E., a few feet of sandstone and basal conglomerate, the Scanlan Conglomerate Member of the Pioneer Formation, is mapped with the Barnes. It consists of scattered angular quartz fragments in sandstone that resembles the middle member of the Dripping Spring.

GRANITIC ROCKS, UNDIVIDED

Mostly dioritic to granodioritic rocks; some aplite, alaskite, and alaskite porphyry.

PINAL SCHIST

Consists of medium-dark-gray to dark-gray, massive to foliated, fine-grained, amygdaloidal or porphyritic mafic flow and flow breccia, and dark-gray to medium-light-gray quartz-sericite schist, some of it probably derived from silicic flows and tuffs.

REFERENCES

Creasey, S. C., and Kistler, R. W., 1962, Age of some copper-bearing porphyries and other igneous rocks in southeastern Arizona, *in* Short papers in geology, hydrology, and topography: U.S. Geol. Survey Prof. Paper 450-D, p. D1-D5.

Gilluly, James, Cooper, J. R., and Williams, J. S., 1954, Late Paleozoic stratigraphy of central Cochise County, Arizona: U.S. Geol. Survey Prof. Paper 266, 49 p.

Krieger, M. H., 1961, Troy quartzite (younger Precambrian) and Bolsa and Abrigo formations (Cambrian), northern Galiuro Mountains, southeastern Arizona, *in* Short papers in the geologic and hydrologic sciences: U.S. Geol. Survey Prof. Paper 424-C, p. C160-C164.

————1967a, Geologic map of the Brandenburg Mountain quadrangle, Pinal County, Arizona: U.S. Geol. Survey Geol. Quad. Map GQ-668.

————1967b, Geologic map of the Holy Joe Peak quadrangle, Pinal County, Arizona: U.S. Geol. Survey Geol. Quad. Map GQ-669.

————1967c, Geologic map of the Lookout Mountain quadrangle, Pinal County, Arizona: U.S. Geol. Survey Geol. Quad. Map GQ-670.

Simons, F. S., 1964, Geology of the Klondyke quadrangle, Graham and Pinal Counties, Arizona: U.S. Geol Survey Prof. Paper 461, 173 p.

Willden, Ronald, 1964, Geology of the Christmas quadrangle, Gila and Pinal Counties, Arizona: U.S. Geol. Survey Bull. 1161-E, p. E1-E64.