Lower andesite (intermediate andesite unit of Simons, 1964) (0-100 ft).—Medium-gray, light-brown-weathering, very coarsely porphyritic andesite (the so-called turkey-track porphyry of Cooper, 1961) with platelike plagioclase as much as 2 cm long and 0.2 cm thick; small (mostly less than 1 mm) olivine(?) altered to orange iddingsite (bowlingite?), and minor clinopyroxene in a groundmass of plagioclase laths, clinopyroxene, iron ore, altered olivine, and apatite needles. Some andesite has only small olivine and 2-3 mm plagioclase phenocrysts. Staining with cobaltinitrite reveals some potassium feldspar in the groundmass.

ARAVAIPA MEMBER (WHITE TUFF AND UPPER WELDED TUFF UNITS OF SIMONS, 1964) (200-300 FT, THIN TO ABSENT WHERE IT LAPS AGAINST HILLS OF OLDER ROCKS)

Here named Aravaipa Member for exposures in its type locality, Aravaipa Canyon, NE¼ sec. 17, T. 6 S., R. 18 E., where the thickest and most complete section is exposed, except for basal vitrophyre, which is below the floor of the canyon. Reference sections in Holy Joe Peak quadrangle (Krieger, 1967b) on north side of Table Mountain, sec. 8, T. 7 S., R. 18 E.; along unnamed gulch in sec. 5, T. 7 S., R. 18 E.; and along Bear Springs Canyon, sec. 32, T. 6 S., R. 18 E. Rhyolitic ash-flow tuff, a simple cooling unit and possibly a single flow unit, with a well-developed zonal pattern. Contacts between most zones are abrupt. Composed of pumice shards and lapilli, crystal fragments (not abundant) of quartz, sanidine, plagioclase, and biotite, and minor accidental fragments; some rhyolite lapilli in upper nonwelded zone.

Upper nonwelded zone (0-100 ft).—Massive, slope-forming white tuff, characterized by devitrification and vapor-phase crystallization.

Partly welded, welded, and lower nonwelded zones (200-250 ft in most places).—Largely cliff-forming and consisting of, from top to bottom: (1) Columnar-jointed, vapor-phase zone (0-80 ft, thickest in Aravaipa Canyon). Very light shades of gray and brownish-gray, slightly welded, devitrified tuff with vapor-phase crystallization pronounced in pumice lapilli. (2) Welded, devitrified zone (0-160 ft). Light shades of brown and red, mostly dark-weathering tuff that becomes darker colored and densely welded downward. Some vapor-phase crystallization in pumice lapilli in upper part. Thoroughly devitrified, becoming less so near base. The lower two-thirds is characterized by large vugs and silica-lined or filled lithophysae (the "vuggy" zone). (3) Thoroughly welded zone (0-30 ft). Black and dark-brownish-gray vitrophyre with local brown oxidized lenses and devitrified spots. (4) Lower nonwelded zone (0-10 ft). Grayish-orange-pink vitric tuff, becoming lighter colored to nearly white at base. The distal end of the flow is exposed intermittently in canyon walls from Bear Springs to Cave Canyons and the change from welded to nonwelded tuff completely exposed along lower White Wash Canyon.

TUFF AND CONGLOMERATE OF BEAR SPRINGS CANYON

Conglomerate (0-50 ft).—Includes conglomerate above and below the tuff (Ttb). Above the tuff (0-25 ft), fragments are Paleozoic rocks and older members of the Galiuro Volcanics. Below the tuff, fragments are largely andesite and diabase.

Tuff (0-100 ft).—Rhyolitic ash-flow tuff composed of pumice lapilli, crystal and some accidental fragments. Upper part, where remnant, is columnar-jointed to very light-olive- and brownish-gray, partly welded tuff showing vapor-phase crystallization and containing local lithophysae near base. Lower part is moderate-orange-pink poorly welded tuff, grading down into light-colored nonwelded vitric tuff with slight clay alteration.

ANDESITE AND CONGLOMERATE OF DEPRESSION CANYON

Conglomerate (0-50 ft).—Composed of older rocks, including older members of the Galiuro Volcanics. In the northwest part it includes material from the Late Cretaceous and (or) early Tertiary volcanic and intrusive rocks (Krieger, 1967a).

Andesite (Tertiary basalt and andesite of Willden, 1964)[4] *(0-600 ft).* Massive, flow-banded, to agglomeratic, gray, brown, and olive andesite that weathers to lighter shades of brown. Local tuff and breccia beds are 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 isolated thin beds of rhyolite tuff suggests that thicker sections may include upper andesite of Virgus Canyon, or younger andesites.

TUFF OF OAK SPRINGS CANYON (0-100? FT)

White to grayish-orange-pink, partly welded(?) rhyolitic tuff with crystal fragments (quartz, feldspar, and biotite), pumice lapilli, and accidental fragments. Shown only on sections A-A′, C-C′, and F-F′. Exposed in Holy Joe Peak quadrangle (Krieger, 1967b).

HOLY JOE MEMBER (LOWER WELDED TUFF UNIT OF SIMONS, 1964) (0-40 FT)

Quartz-latite ash-flow tuff. Largely black and brown vitrophyre, composed of abundant crystal fragments (quartz, plagioclase, biotite, and sanidine), pumice lapilli, and accidental fragments in a firmly welded shard matrix; nonwelded at base, upper part slightly devitrified, except where overlain by a thin vitrophyre. South of the quadrangle (Krieger, 1967b) the member is 200-300 ft thick and forms a single cooling unit composed of several flows, the top flow being a vitrophyre.

WHITETAIL(?) CONGLOMERATE (0-200 FT)

Composed of pebbles and cobbles of Precambrian and Paleozoic rocks, largely diabase, quartzite, and limestone. It includes a bed of white rhyolite tuff (0-25 ft thick) in Aravaipa Canyon and below the tuff a small mass of andesite (unmapped) on the north side of the creek about 0.7 mile northeast of Wagner Ranch.

NACO LIMESTONE (0-250 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, and 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, and local chert nodules and layers. Low relief on the pre-Naco surface can locally be recognized, but in many places the contact with the Escabrosa Limestone 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 (0- ABOUT 400 FT)

Massive, cliff-forming, thick-bedded, mostly coarse-grained, limestone in shades of gray and yellowish to greenish gray. The cliffs, as much as 50 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 basal part is crossbedded, coarse-grained brown sandstone and dolomitic sandstone (0-10 ft) overlain by limestone that resembles beds near the top of the Martin Formation. Fossils are abundant and include crinoids, brachiopods, and corals, and in the upper part many ostracodes. Dark-brown chert breccia, common in some areas, may represent pre-Naco solution and erosion.

MARTIN FORMATION (150-250 FT)

A slope-forming shale unit generally with overlying and thinner underlying carbonate beds. The shale is olive to reddish brown, with interbedded reddish-brown and light-brownish-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. The top in thicker sections consists of coarse-grained, light-gray Escabrosa-like limestone. Brachiopods, bryozoa, and crinoids are common in the limestone beds. The shale may rest directly on the Abrigo Formation, or be separated from it by as much as 25 ft of very fine grained, pale-reddish-brown or light-gray, medium-grained limestone. The base is generally a few inches of hematite-rich sandstone with granules and small pebbles of quartz and abundant shark teeth and arthrodiran fish fragments (F. C. Whitmore, Jr., and D. H. Dunkle, written communications, 1961 and 1962). The hematitic beds

[4]Lower tuff unit of Simons (1964) includes tuff of Bear Springs Canyon and andesite of Depression Canyon.

occur at the same horizon as the oolitic hematite bed on the Christmas quadrangle (Willden, 1960, 1964).

ABRIGO FORMATION[5] (165-600 FT)

Upper (or brown sandy) member (116-165 ft).—The upper part (70-100 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, intraformational conglomerate, irregular surficial chert, and a few thin chert beds and lenses. Silicified specimens of the brachiopod *Billingsella* (A. R. Palmer, oral communication, 1960) occur in a narrow horizon near the middle of thicker sections. The lower part (75-95 ft) is cliff-forming, dark-brown-weathering, thin- to thick-bedded (8 in. to 8 ft, mostly 3 ft), 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 (0- about 280 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 40-ft massive unit has smooth bedding surface, no fossils, and only sparse shaly 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 (0- about 155 ft).—A thin-bedded, slope-forming, poorly sorted, argillaceous and sandy unit that weathers to shades of brown and yellowish to reddish brown. It consists of massive to very thin bedded (½-2 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 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. 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 smaller and less abundant than in the middle member. Where the formation rests on diabase the base generally is a conglomerate (0-50 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.

DIABASE

Dark-gray to dark-greenish- or olive gray, medium-grained diabase occurring mostly as sills and multiple sills (totaling more than 1,000 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[5] (0-280 FT)

Upper unit (0-120 ft).—White to yellowish-gray, 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 (0-160 ft).—Dark-brownish-gray outcrops of medium-gray and 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

Only part of the middle of the three formations that make up the Apache Group is present in the quadrangle.

DRIPPING SPRING QUARTZITE (MAXIMUM OF 250 FT EXPOSED, DUE TO INTRUSION BY DIABASE)

The upper member (20-50 ft) is thin-bedded (¼-12 in.), very fine grained, feldspathic to arkosic quartzite and siltstone that are shades of gray, brown, red, and yellow. Some beds are ripple marked; others contain shallow crossbeds. The middle member (200 ft) is medium-grained, locally fine- to coarse-grained, red to pink, feldspathic to arkosic quartzite, with a little nonfeldspathic quartzite. It is thin to very thick bedded (2-12 ft) and crossbedded. The Barnes Conglomerate Member is not present in this area.

PORPHYRY

Massive to slightly foliated, fine-grained porphyritic rock in shades of red, brown, and gray. Sparse to abundant phenocrysts of quartz and plagioclase (1 to rarely 3 mm) and scattered lithic fragments (2 cm long or more) are in a dense groundmass of quartz, alkalic feldspar, variable amounts of sericite, and some epidote, biotite, magnetite, and chlorite. The phorphyry is locally cut by minute quartz veins, or by larger gash or ladderlike veins of milky quartz.

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

MAP GQ-669

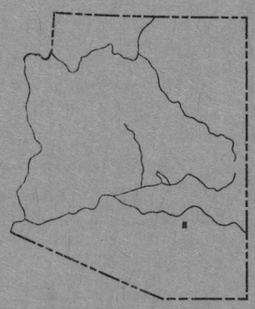
3.60

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

GEOLOGIC QUADRANGLE MAPS OF THE UNITED STATES

GEOLOGIC MAP OF THE HOLY JOE PEAK QUADRANGLE PINAL COUNTY, ARIZONA

By
Medora H. Krieger



QUADRANGLE LOCATION

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MAP GQ-669

GEOLOGIC MAP OF THE HOLY JOE PEAK QUADRANGLE PINAL COUNTY, ARIZONA

By
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DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

Alluvium (0- about 15 ft).—Flood-plain deposits along Aravaipa Creek composed of sandy silt, mudstone, and some sand and gravel, locally cemented with caliche; along washes largely unconsolidated sand.

Landslides (0-100? ft).—Consist largely of Galiuro Volcanics locally cemented with caliche.

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

Gravel veneer on pediments and lower terraces (0-25 ft).—Largely subangular pebbles and cobbles of Paleozoic and Precambrian rocks in a generally reddish-brown, fine- to coarse-grained matrix. Reddish-brown color less pronounced on younger terraces and generally lacking on higher level (above 4,000 ft), older(?) surfaces where gravels are composed largely of Galiuro Volcanics. Locally includes some pediments and terraces stripped of gravels.

Surficial deposits, undivided (0-20 ft).—Include fine-grained colluvium and alluvium, talus, and some pediment and terrace gravels.

GILA CONGLOMERATE (0-3,000? FT)

A conglomeratic and a fine-grained, lacustrine facies with intertonguing contact; the change generally occurs within ¼ mile 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 (maximum of 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, a few of white rhyolite tuff, diatomite, and opaline-appearing material. Arborescent manganese concretions (6 in. or more high) of probable hydrothermal origin occur in the fine-grained facies in a gulch (NE¼ sec. 29, T. 7 S., R. 17 E.) north of Zapata Wash. Forms vertical cliffs along many washes; elsewhere largely concealed by unmapped alluvium, colluvium, and pediment and terrace gravels.

Coarse-grained facies (0- about 600 ft exposed).—Fanglomerate consisting of subangular to subrounded pebbles, cobbles, and small boulders of Precambrian and Paleozoic rocks, lesser amounts of Galiuro Volcanics, and in the southern part Upper Cretaceous and (or) lower Tertiary rocks. Matrix is light shades of gray, green, and brown and generally well cemented, and is composed of small-pebble to silt-sized particles.

Rhyolite tuff (0-50 ft).—White rhyolite tuff bed.

GALIURO VOLCANICS

Includes andesite of Table Mountain, Apsey Conglomerate Member, Hells Half Acre Tuff Member, andesite and conglomerate of Virgus Canyon, Aravaipa Member, tuff and conglomerate of Bear Springs Canyon, andesite and conglomerate of Depression Canyon, tuff of Oak Springs Canyon, Holy Joe Member, and andesite of Little Table Mountain. K-Ar determinations on biotite and sanidine from the Hells Half Acre Tuff, Aravaipi, and Holy Joe Members, and from the tuff of Bear Springs Canyon yielded ages of 22.4 to 25.9 million years (S. C. Creasey, oral communication, 1965) indicating a Miocene age.

ANDESITE OF TABLE MOUNTAIN[1] (ABOUT 400 FT)

Medium-light- to dark-gray, vesicular to nonvesicular, nearly horizontal flows and flow breccias, some of which have prominent platy jointing and flow structure. Phenocrysts are of olivine (mostly less than 0.5 mm) that are mostly altered to iddingsite, lesser amounts of small pyroxene, and abundant magnetite (mostly less than 0.1 mm) in a groundmass of plagioclase, magnetite, pyroxene, and rutile. Some flows have plagioclase and a few pyroxene phenocrysts (both mostly less than 0.3 mm) and a few large, completely altered olivines(?) in a trachytic groundmass of plagioclase laths (mostly less than 0.1 mm), magnetite, and glass. Staining with cobaltinitrite reveals some potassium feldspar(?) in the groundmass of both types.

APSEY CONGLOMERATE MEMBER[2] (40-NEARLY 300 FT)

Cliff-forming, thin-bedded, yellowish- to light-gray conglomerate and some conglomeratic and agglomeratic tuff; composed of pebbles, cobbles, and scattered boulders largely derived from the rhyolite-obsidian member (Krieger, 1967a). It also contains sparse to abundant fragments from older rocks, including older members of the Galiuro Volcanics. The well-indurated, sandy, mostly noncalcareous matrix consists of quartz, feldspar, and many small rock and crystal fragments. Pumice shards and lapilli are common in some of the conglomerate. The lower part for some distance north of Table Mountain is a steep slope-forming sandstone to cobble conglomerate that contains little or no rhyolite or pumice.

HELLS HALF ACRE TUFF MEMBER[2] (0-ABOUT 50 FT)

White, air-fall and partly reworked vitric, crystal, and lithic tuff with rhyolite and pumice lapilli and a few accidental fragments. Lower units are not present in this quadrangle.

ANDESITE AND CONGLOMERATE OF VIRGUS CANYON

Conglomerate (0-50 ft).—Pebbles and cobbles derived from lower andesite of Virgus Canyon and older rocks in a sandy matrix.

Lower andesite (intermediate andesite unit of Simons, 1964) (0-100 ft).—Medium-gray, light-brown-weathering, mostly very coarsely porphyritic andesite (the so-called turkey-track porphyry of Cooper, 1961) with platelike plagioclase as much as 2 cm long and 0.2 cm thick; small (mostly less than 1 mm) olivine(?) altered to orange iddingsite (bowlingite?), and minor clinopyroxene in a groundmass of plagioclase laths, clinopyroxene, iron ore, altered olivine, and apatite needles. Staining with cobaltinitrite reveals some potassium feldspar in the groundmass.

ARAVAIPA MEMBER (WHITE TUFF AND UPPER WELDED TUFF UNITS OF SIMONS, 1964) (150-200 FT, LOCALLY 300 FT; THIN OR ABSENT WHERE IT LAPS OUT AGAINST HILLS OF OLDER ROCKS)

Rhyolitic ash-flow tuff, a simple cooling unit and possibly a single flow unit[3], with a well-developed zonal pattern. Contacts between most zones are abrupt. Composed of pumice shards and lapilli, crystal fragments (not abundant) of quartz, sanidine, plagioclase, and biotite, and minor accidental fragments.

Upper nonwelded zone (0-100 ft).—Massive, slope-forming white tuff characterized by devitrification and vapor-phase crystallization. Local honeycomb or Swisscheese effect in lower part due to irregular case hardening of surface, later pitted by wind erosion. Contact with underlying zone sharp,

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[1] Andesite of Table Mountain occupies the same stratigraphic position as the upper andesite unit of Simons (1964), north of Aravaipa Canyon, Klondyke quadrangle; and basalt of the Gila Conglomerate (Willden, 1964) in southern part of the Christmas quadrangle.

[2] Upper tuff unit of Simons (1964) includes Apsey Conglomerate and Hells Half Acre Tuff members.

[3] Terminology for pyroclastic rocks from Ross and Smith (1961) and Smith (1960).

except where more intense vapor-phase crystallization has crossed the contact.

Partly welded, welded, and lower nonwelded zones (150-200 ft).—Largely cliff-forming and consisting of from top to bottom: (1) Columnar-jointed, vapor-phase zone (10-50 ft, mostly less than 25 ft). Very light shades of gray and brownish-gray, slightly welded, devitrified tuff with vapor-phase crystallization pronounced in pumice lapilli. (2) Welded, devitrified zone (about 100 ft). Light shades of brown and red, dark-weathering tuff that becomes darker colored and densely welded downward. Some vapor-phase crystallization in pumice lapilli in upper part. Thoroughly devitrified, becoming less so near base. Basal 50 ft or so is characterized by large vugs and silica-lined or filled lithophysae (the "vuggy" zone). Locally "thunder eggs" at the base are as much as 10x15 cm. (3) Thoroughly welded zone (20-30 ft). Black and dark-brownish-gray vitrophyre with local brown oxidized lenses and devitrified spots. (4) Lower nonwelded zone (10 ft). Grayish-orange-pink vitric tuff, becoming lighter colored to nearly white at base.

TUFF AND CONGLOMERATE OF BEAR SPRINGS CANYON[4]

Conglomerate (0-50 ft).—Includes conglomerate above and below the tuff (Ttb). Composed of fragments from Paleozoic and younger Precambrian rocks and older members of the Galiuro Volcanics.

Tuff (0-120 ft).—Rhyolitic ash-flow tuff composed of pumice lapilli, crystal and some accidental fragments. Upper part, where remnant, is columnar-jointed, very light olive- and brownish-gray, partly welded tuff showing vapor-phase crystallization. Lower part is moderate-orange-pink poorly welded tuff, grading down into nearly white, nonwelded vitric tuff, with some clay alteration.

ANDESITE AND CONGLOMERATE OF DEPRESSION CANYON[4]

Conglomerate (0-50 ft).—Includes conglomerate above and below the andesite of Depression Canyon; locally may include conglomerate older or younger than this member. Composed of fragments of older rocks, including older members of the Galiuro Volcanics and andesite of Depression Canyon where above the andesite.

Andesite (0-25 ft).—Thin flows and flow remnants of gray, brown, and olive andesite, containing small phenocrysts of plagioclase, olivine (altered or partly altered to iddingsite), pyroxene, and(or) magnetite in a groundmass of plagioclase microlites, pyroxene, iddingsite, magnetite, and some K-feldspar. Small masses in northwest corner and andesite above the Holy Joe Member near Zapata Wash are tentatively assigned to this member.

TUFF OF OAK SPRINGS CANYON[4] (0-100 FT)

White to grayish-orange-pink, partly welded(?) rhyolitic tuff with crystal fragments (quartz, feldspar, and biotite), pumice lapilli, and accidental fragments. Separated in most places from Holy Joe Member and from tuff of Bear Springs Canyon (where andesite of Depression Canyon is missing) by a few feet of unmapped conglomerate.

HOLY JOE MEMBER (LOWER WELDED TUFF UNIT OF SIMONS, 1964) (0-300 FT)

Here named Holy Joe Member. Type locality on Holy Joe Peak, sec. 7, T. 7 S., R. 18 E.; more complete reference sections on north side of Table Mountain, sec. 8, T. 7 S., R. 18 E., and in Oak Springs Canyon, secs. 5 and 6, T. 7 S., R. 18 E. Quartz-latite ash-flow tuff, a single cooling unit of several ash flows; composed of abundant crystal fragments (quartz, plagioclase, biotite, and some sanidine), pumice shards and lapilli, and accidental fragments. The section in Oak Springs Canyon consists of, from top to bottom: (1) 5 ft of red (5R5/2), firmly welded, slightly devitrified tuff underlain by 20 ft of dark-gray to black, thoroughly welded vitrophyre (present at top of section almost everywhere) that grades down into about 25 ft of light-brownish-gray to pale-red welded tuff, exhibiting slight vapor-phase crystallization; (2) 60-70 ft of pale-red to light-brownish-gray welded tuff, showing considerable devitrification and vapor-phase crystallization; (3) 50 ft of brownish-gray to pale-brown, devitrified welded tuff, less devitrified downward; (4) 30 ft of medium-dark-gray, thoroughly welded vitrophyre, underlain by 8 ft of pale-brown vitrophyre; (5) 4 ft of grayish-orange-pink to white (at base), nonwelded, vitric tuff. Individual flows in places are separated by pumice lapilli rafted on top of flows, and by fumeroles that end beneath the next overlying flow. Thin outcrops, largely of vitrophyre, north of Oak Springs Canyon may represent the upper vitrophyre, rather than the lower one. Effect of buried hills on ash flows is well illustrated in NW¼ sec. 6 and SE¼ sec. 5, T. 7 S., R. 18 E., where the vitrophyre crosses flow lines. Around Table Mountain and Holy Joe Peak the member forms dark cliffs with prominent horizontal planes that represent individual flows and(or) zones of intense welding.

ANDESITE OF LITTLE TABLE MOUNTAIN

Porphyritic andesite[5] (0-60 ft, except near Zapata Wash, where thicker section includes some nonporphyritic andesite).—Dark-gray and brownish-gray, somewhat vesicular, very coarsely porphyritic andesite (the so-called turkey-track porphyry of Cooper, 1961). Phenocrysts are of platelike plagioclase (as much as 15 x 2 mm), less abundant altered olivine(?), and minor magnetite; some flows have sparse pyroxene phenocrysts. The groundmass consists of plagioclase laths, magnetite, pyroxene, iddingsite, and some potassium feldspar(?).

Andesite[5] (0-600 ft, increasing to over 1,000 ft southeast of quadrangle, Simons, 1964, p. 70).—Gray and red, vesicular, nonvesicular, and platy andesite, forming flows, flow breccia, and agglomerate; very minor amounts of interbedded tuff. Some cliff-forming flow breccia on southwest slope of Little Table Mountain is 50 ft thick and contains many 1-ft blocks and scattered 6- to 8-ft blocks of andesite in a fragmental matrix. Phenocrysts (mostly less than 1 mm) are of plagioclase (largest), pyroxene, and magnetite; olivine or altered olivine(?) is locally present; some are 2-3 mm in diameter. Some flows have completely altered, reddish-brown phenocrysts (2-3 mm). The groundmass is dense and fine-grained, and composed of plagioclase microlites, pyroxene, opaque oxides, and some interstitial K-feldspar. Chalcedonic, platelike and flowerlike nodules, as much as 2 in. in diameter, are common, especially near the saddle between Table and Little Table Mountains.

Andesite dike.—Four small dikes of mafic rock cut the Glory Hole Volcanics and Copper Creek Granodiorite. Possibly related to andesite of Little Table Mountain. The one in the eastern part of sec. 29 contains large phenocrysts of hornblende.

Latitic lavas of Zapata Wash (500 ft?).—Very fine grained, aphanitic to almost glassy flows, flow breccias, and vent material in shades of gray, brown, and olive. Swirly and straight flow banding is defined by variations in abundance of tiny flattened vesicles and by differences in devitrification. Many vesicles are lined or partly filled with cristobalite(?) spherules and zeolites(?). The phenocrysts are of fresh, zoned plagioclase (3 mm, mostly smaller), a little pyroxene and(or) fresh olivine (mostly less than 1 mm), and magnetite in a groundmass of plagioclase microlites, pyroxene and(or) olivine, magnetite, and glass or devitrified glass. Staining with cobaltinitrite indicates fairly abundant potassium-bearing material. Unit includes some flows of olivine andesite. The vent material is very contorted and brecciated, gray and brown, dense to almost glassy and contains angular fragments of reddish-brown vesicular latite, light- to dark-gray lithic fragments, some flow-banded rhyolite fragments, and crystal fragments (mostly plagioclase).

WHITETAIL(?) CONGLOMERATE (0-100 FT)

Composed of pebbles and cobbles of Paleozoic and Precambrian rocks and, south of Table Mountain, some Glory Hole Volcanics.

SEDIMENTARY BRECCIA

Seven small masses, probably landslide blocks; three of them rest on Glory Hole Volcanics and four of them on Copper Creek Granodiorite. Six are of Troy(?) Quartzite, one (sec. 4, T. 8 S., R. 18 E.) is of Escabrosa(?) Limestone. The largest mass (southeast corner of the quadrangle) appears to be in sedimentary contact with the overlying Glory Hole Volcanics; both may be part of a landslide block. Underlying contacts here and elsewhere are talus covered.

COPPER CREEK GRANODIORITE

Medium-gray, fine- to medium-grained granodiorite composed of plagioclase laths (mostly less than 3 mm), smaller and less abundant pyroxene, biotite, magnetite, and interstitial potassium feldspar and quartz. Intrudes the Glory Hole Volcanics as a large stock, and along the margins as sills,

[4] Lower tuff unit of Simons (1964) includes tuffs of Bear Springs and Oak Springs Canyons and andesite of Depression Canyon.

[5] Lower andesite unit of Simons (1964) includes porphyritic andesite and andesite of Little Table Mountain.

irregular knobs, lenses, and dikes. Near some contacts it contains numerous rectangular blocks of the Glory Hole. The granodiorite is cut by aplite, granophyre, and graphic granite masses. Locally it is heavily tourmalinized with the formation of spherical rosettes of tourmaline and quartz as much as 5 in. in diameter. The Glory Hole Volcanics, Pinal Schist, and locally the Martin and Escabrosa Formations have been hornfelsed near the granodiorite. Along narrow zones and in breccia pipes the granodiorite has been altered to fine-grained aggregates of quartz and sericite. The granodiorite has a calculated age of 68 million years, based on K-Ar determinations on biotite (Creasey and Kistler, 1962), indicating a Late Cretaceous and(or) early Tertiary age. (See also Simons, 1964, p. 56-62, 127-131).

WILLIAMSON CANYON VOLCANICS (400 FT)

Massive, porphyritic to nonporphyritic andesitic breccia, agglomerate, tuff, flow, and flow breccia. 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 (see Krieger, 1967b; named by Simons, 1964, p. 44-47).

GLORY HOLE VOLCANICS (0-1,000 FT OR MORE)

Tuffs, ash-flow tuffs, breccias, flows, and flow breccias, largely of dacitic and andesitic composition. Dominantly pyroclastic. The ash-flow tuffs are shades of gray, yellowish- and brownish-gray, with crystal, lithic (accidental), and vitric (pumice and shard) fragments. The typical streaky character of welded tuffs is still visible on weathered surfaces, even where hornfelsed. Flow breccias are light-olive-gray, porphyritic rocks with medium- , slightly bluish- or purplish-gray porphyritic fragments similar in texture to the matrix, but less altered. The phenocrysts are plagioclase, magnetite, and a little K-feldspar. Much epidote alteration has occurred in some areas. Hornfelsed rocks generally are medium dark gray to dark gray; the plagioclase is fresher looking. Along narrow alteration zones and in breccia pipes the volcanics have been altered to fine-grained aggregates of quartz and sericite (see Simons, 1964, p. 38-41, 127-131).

MESOZOIC(?) SEDIMENTARY ROCKS (0-40? FT)

Interbedded white to brown and grayish-red, fine- to very fine-grained sandstone and siltstone, containing abundant kaolinite, and variable amounts of goethite-hematite. (See Krieger, 1967b for more complete section.)

ESCABROSA LIMESTONE (300-500 FT)

Massive, cliff-forming, thick-bedded, mostly coarse-grained limestone in shades of gray and yellowish to greenish gray. The cliffs 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. The base is crossbedded, coarse-grained, brown sandstone and dolomitic sandstone (0-10 ft), overlain by limestone that resembles beds near the top of the Martin Formation. Fossils are abundant and include crinoids, brachiopods, and corals.

MARTIN FORMATION (150-200 FT)

A slope-forming shale unit, generally with overlying and thinner underlying carbonate beds. The shale is olive to reddish brown, with interbedded reddish-brown and 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. The top, in thicker sections, consists of as much as 50 ft of coarse-grained, light-gray Escabrosa-like limestone. Fossils in the limestone beds include brachiopods, bryozoans, and crinoids. The shale may rest directly on the Abrigo Formation, or be separated from it by a few of Abrigo-like carbonate. The base of the formation in most places is a few inches or feet of hematitic, in part oolitic, sandstone with granules and pebbles of quartz and abundant shark teeth (*Cladodus*) and teeth and dorsal spine fragments of an arthrodiran fish (*Ptyctodus* cf. *P. calceolus* Newberry and Worthen), according to F. C. Whitmore, Jr., and D. H. Dunkle (written communications, 1961 and 1962). The hematitic beds occur at the same horizon as the oolitic hematite beds in the Christmas quadrangle (Willden, 1960, 1964).

ABRIGO FORMATION[6] (ABOUT 500 FT)

Upper (or brown sandy) member (about 170 ft).—The upper part (about 100 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, intraformational conglomerate, irregular surficial chert, and a few thin chert beds and lenses. Silicified specimens of the brachiopod *Billingsella* (A. R. Palmer, oral communication, 1960) occur in a narrow horizon near the middle of the unit. The lower part (70 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 (about 270 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 shaly 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 influx of sand in the upper part of the lower member.

Lower (mudstone) member (about 155 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 (½-2 in.), in part thinly laminated, olive- to greenish-gray 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. The unit 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 smaller and less abundant than in the middle member. The basal part is transitional into the Bolsa Quartzite.

BOLSA QUARTZITE[6] (10-160 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. The upper part (about 60 ft) is a very thin bedded to thinly laminated, well-sorted, fine- to medium-grained sandstone that grades downward into thin-bedded, medium- to coarse-grained sandstone. The lower part (absent in many places where underlain by Troy Quartzite) is thick- to thin-bedded (3 ft to 6 in.), medium- to coarse-grained sandstone with some gritty (granule) beds and angular fragments of Troy Quartzite. The base, where it rests on diabase, is very dusky red-purple to dusky and grayish-red conglomerate (as much as 25 ft thick) in a sandy matrix containing abundant diabasic detritus. Cobbles and small boulders are of Troy Quartzite and locally of older rock fragments.

DIABASE

Dark-gray to dark-greenish- or olive-gray, medium-grained diabase occurring mostly as sills and multiple sills (totaling more than 1,000 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 fresh, massive, dark-gray rock into crumbly, red to purple rock with a pronounced platy structure.

TROY QUARTZITE[6] (0-730 FT)

Upper unit (0-520 ft).—White to very light gray, locally grayish-red, somewhat lenticular, thin- to thick-bedded (mostly 1-3 ft), feldspathic (white feldspar or clay alteration) to nonfeldspathic sandstone, quartzite, and granule to small-pebble

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

(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 (0-210 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 most 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

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 (10-150 ft).—The upper member is thin-bedded (¼-12 in.), very fine grained, feldspathic to arkosic quartzite and siltstone that are shades of gray, brown, red, and yellow. The middle member is thin- to 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. On the north side of the large granitic mass, the few feet of quartzite above the granite contain angular quartz and granitic fragments.

Barnes Conglomerate Member (0-10 ft).—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. Present only in the NE¼ sec. 29, T. 7 S., R. 18 E.; on Martinez Mountain, sec. 23, T. 7 S., R. 17 E., where it is overlain by a few feet of the middle member (unmapped); and north of the major fault, secs. 13-14, T. 7 S., R. 17 E.

GRANITIC ROCKS, UNDIVIDED

Composed largely of granodiorite or nonporphyritic quartz monzonite, and some alaskite. The granodiorite or quartz monzonite is medium grained (mostly less than 5 mm), pale red to grayish orange pink with olive-gray spots. Composed of saussuritized plagioclase (a few as much as 1 cm); K-feldspar, quartz, altered hornblende and biotite, and accessory sphene, magnetite, and allanite. Texturally the rock resembles neither the porphyritic quartz monzonite or the granodiorite in the Lookout Mountain quadrangle (Krieger, 1967c). The alaskite is medium to coarse grained and orange pink to pale red and contains microcline, plagioclase, quartz, and a little biotite, muscovite, and magnetite-chlorite alteration. Close to the pre-Apache surface the granitic rock is generally redder in color, richer in K-feldspar (in places to the exclusion of plagioclase), and poorer in mafic minerals, but this rock and the alaskite appear to grade down into the granodiorite or quartz monzonite.

PINAL SCHIST

Mostly flows, tuffs, and flow breccias of andesitic composition and some rhyolitic tuffs. The mafic flows and breccias are largely dark gray, greenish gray, and dusky yellow. The bedded tuffs are lighter colored, very fine grained rocks, some of which have been tightly drag folded. Most of the rock is nonschistose; locally a pencil structure has been formed by the intersection of two cleavages. The Pinal has locally been replaced by quartz and carbonate veins that contain tourmaline or pyrite, or by wide veins of dark-purplish-black quartz. North and south of Aravaipa Canyon, most of the Pinal is medium-gray to medium-light-gray, fine-grained, bedded quartz-sericite-magnetite rock with slaty cleavage. It contains some medium-dark-greenish-gray chloritic rocks, probably volcanic breccia, conglomerate, or mafic flow, and some massive pink rhyolite tuff or flow.

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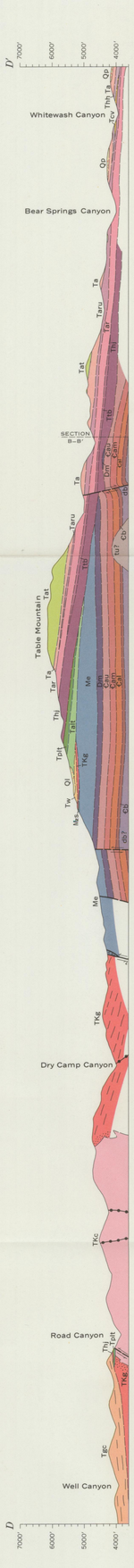
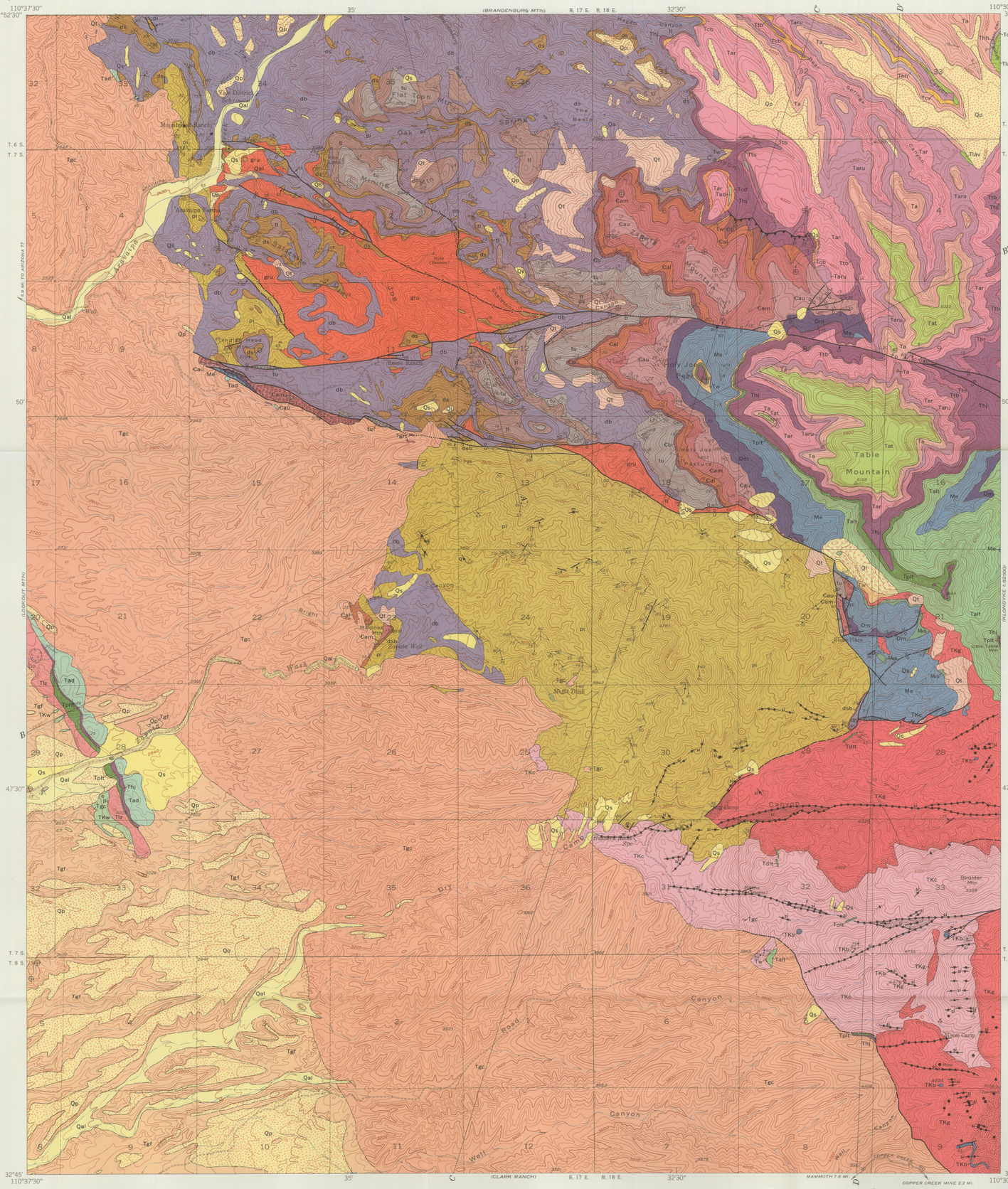
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

GEOLOGIC QUADRANGLE MAP
HOLY JOE PEAK QUADRANGLE, ARIZONA
GQ–669





Base by U.S. Geological Survey, 1949

TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1968

SCALE 1:24 000

1 ½ 0 1 MILE

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

ARIZONA
QUADRANGLE LOCATION

Geology by Medora H. Krieger, Beth M. Madsen, and Kathleen McQ. Montgomery 1959–62

EXPLANATION

QUATERNARY

Pleistocene to Recent

Qal | Ql | Qt | Qp | Qs

Surficial deposits
Qal, *alluvium*
Ql, *landslides*
Qt, *talus*
Qp, *gravel veneer on pediments and lower terraces*
Qs, *surficial deposits, undivided*

DISCONFORMITY(?)

TERTIARY

Pliocene

Tgf | Tgrt | Tgc

Gila Conglomerate
Tgf, *fine-grained facies*
Tgc, *coarse-grained facies*
Tgrt, *rhyolite tuff*
Approximate attitude shown in sections by dashed lines

DISCONFORMITY(?)

Miocene

Galiuro Volcanics

Tat
Andesite of Table Mountain

DISCONFORMITY(?)

Ta
Apsey Conglomerate Member

Thh
Hells Half Acre Tuff Member

DISCONFORMITY

Tcv | Tlav
Andesite and conglomerate of Virgus Canyon
Tcv, *conglomerate*
Tlav, *lower andesite*

DISCONFORMITY

Taru | Tar
Aravaipa Member
Taru, *upper nonwelded zone*
Tar, *partly welded, welded, and lower nonwelded zones*

DISCONFORMITY(?)

Ttb | Tcb
Tuff and conglomerate of Bear Springs Canyon
Tcb, *conglomerate*
Ttb, *tuff*

Tcd | Tad
Andesite and conglomerate of Depression Canyon
Tcd, *conglomerate*
Tad, *andesite*

Tto
Tuff of Oak Springs Canyon

DISCONFORMITY(?)

Thj
Holy Joe Member (new)

DISCONFORMITY(?)

Tpit | Talt | Tdit | Tlz
Andesite of Little Table Mountain
Tpit, *porphyritic andesite*
Talt, *andesite*
Tdit, *andesite dike*
Tlz, *latite lava of Zapata Wash. Vent shown by chevron overprint*

DISCONFORMITY(?)

Tw
Whitetail(?) Conglomerate

UNCONFORMITY(?)

Upper Cretaceous and (or) lower Tertiary

TKb
Sedimentary breccia

UNCONFORMITY(?)

TKc
Copper Creek Granodiorite

TKw
Williamson Canyon Volcanics

TKg
Glory Hole Volcanics
Dotted where hornfelsed

UNCONFORMITY

MESOZOIC(?)

Mss
Sedimentary rocks

DISCONFORMITY

MISSISSIPPIAN

Me
Escabrosa Limestone

DISCONFORMITY

DEVONIAN

Upper Devonian

Dm
Martin Formation

DISCONFORMITY

CAMBRIAN

Middle and Upper Cambrian

Cau | Cam | Cal
Abrigo Formation
Cau, *upper (or brown sandy) member*
Cam, *middle (sandstone) member*
Cal, *lower (mudstone) member*

Middle Cambrian

Cb
Bolsa Quartzite
Dots indicate basal cobble conglomerate

PRECAMBRIAN

REGIONAL DISCONFORMITY

db
Diabase

Younger Precambrian

tu | tl
Troy Quartzite
tu, *upper unit*
tl, *lower unit*

DISCONFORMITY

Apache Group

ds | dsb
Dripping Spring Quartzite
ds, *upper and middle members*
dsb, *Barnes Conglomerate Member*

ANGULAR UNCONFORMITY

Older Precambrian

gru
Granitic rocks, undivided

pi
Pinal Schist

Contact
Dashed where approximately located; dotted where concealed

Fault, showing dip where known
Dashed where approximately located; dotted where concealed; queried where doubtful. U, upthrown side; D, downthrown side

Thrust or low-angle reverse fault, showing dip
Sawteeth on upper plate

Monolithologic fault or landslide(?) breccia

Inclined | Vertical | Overturned | Horizontal
Bedding

Syncline | Drag fold
Folds, showing plunge

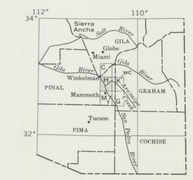
Vertical | Inclined
Foliation

Lineation, showing plunge
Indicates pencil structure where not combined with bedding, foliation, fault, or joint symbol

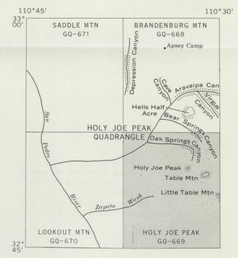
Vertical | Inclined
Joints, showing dip

Veins and alteration zones, showing dip where known
q, quartz vein
m, quartz-magnetite vein
si, mineralized veins and alteration zones (largely quartz-sericite)
t, tourmaline mineralization

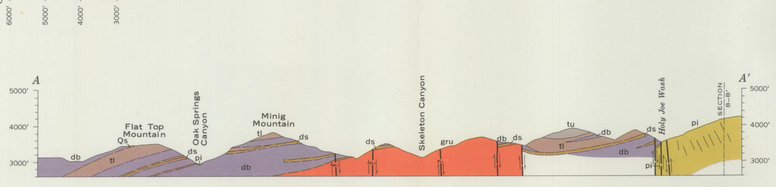
Breccia pipes



INDEX MAP OF SOUTHEASTERN ARIZONA SHOWING FIVE 15-MINUTE QUADRANGLES C. CHRISTMAS; H. HOLY JOE PEAK; K. KLONDYKE; M. MAMMOTH; G. GALIURO MOUNTAINS
wc indicates location of Williamson Canyon
f indicates fossil locality in the Gila Conglomerate



INDEX MAP OF THE HOLY JOE PEAK 15-MINUTE QUADRANGLE SHOWING 7½-MINUTE QUADRANGLES AND TOPOGRAPHIC FEATURES REFERRED TO IN THE EXPLANATION

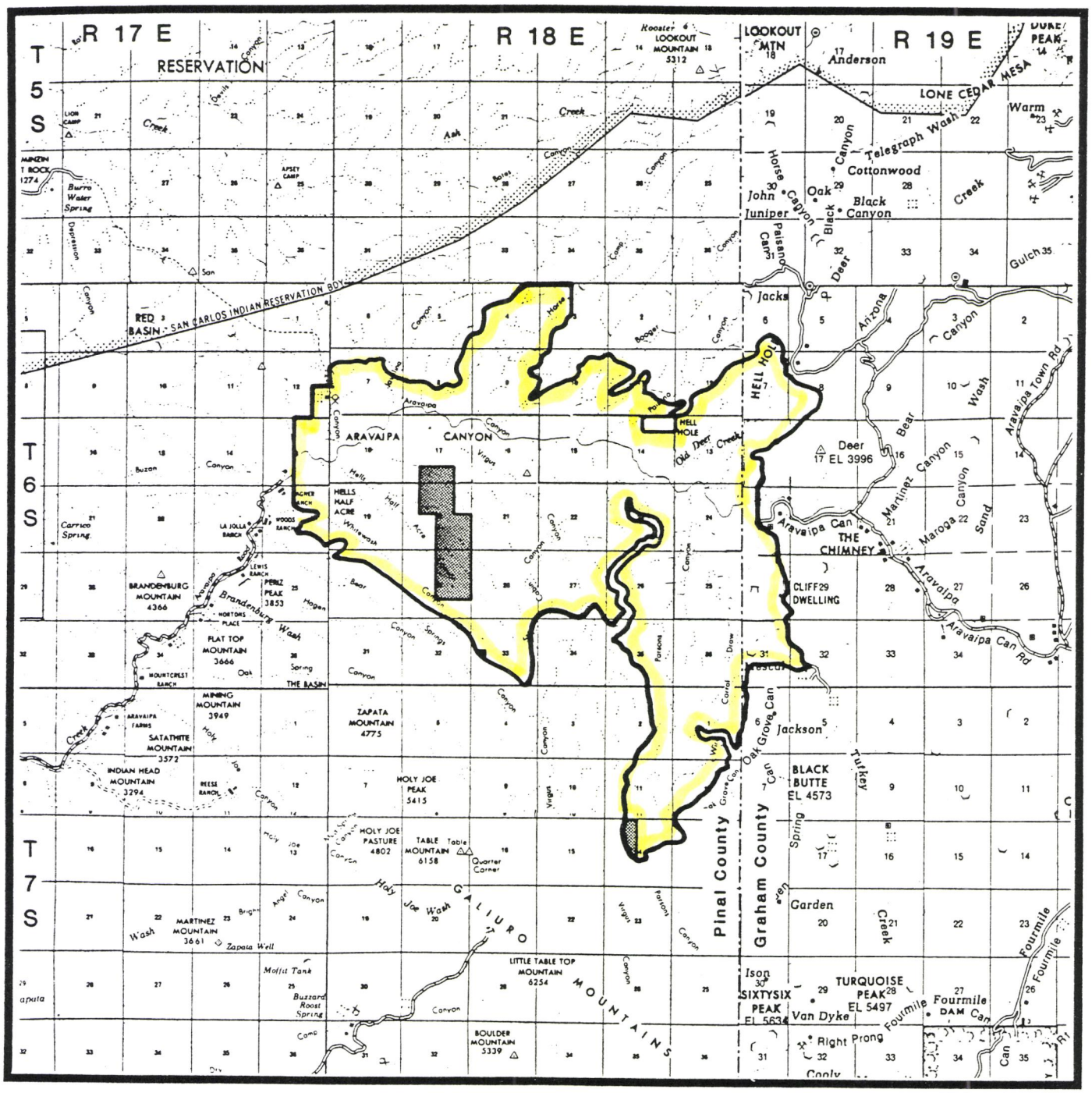


GEOLOGIC MAP OF THE HOLY JOE PEAK QUADRANGLE, PINAL COUNTY, ARIZONA

By
Medora H. Krieger
1968

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—1968—G67105

For sale by U.S. Geological Survey, price $1.00



U.S. Department of the Interior
Bureau of Land Management
Safford District

ARAVAIPA CANYON WILDERNESS

Basemap © ADOT

WILDERNESS AREA BOUNDARY

NONFEDERAL LAND WITHIN WILDERNESS AREA

N

SCALE 0 — 4 Miles

LOCATION MAP

1990

ARAVAIPA CANYON WILDERNESS

Location and Description

The 19,410-acre Aravaipa Canyon Wilderness is 120 miles southwest of Phoenix, Arizona in Graham and Pinal counties.

The wilderness includes the 11-mile long Aravaipa Canyon, as well as, the surrounding tablelands and nine side canyons. Within the colorful 1,000-foot canyon walls, outstanding scenery, wildlife, and rich history are all protected. Seven species of native desert fish, desert bighorn sheep, and over 200 species of birds live among shady cottonwoods along the perennial waters of Aravaipa Creek.

Permits

A permit is required before you enter into Aravaipa Canyon. Use is limited to 50 people per day. This provides solitude for the visitor and reduces impacts to the environment. An in-depth Aravaipa Canyon Wilderness brochure is available to explain permit requirements.

Access

From Phoenix, take US Highway 60 to Superior. At Superior, take State Highway 177 to Winkelman. At Winkelman, take State Highway 77 south for 11 miles to Aravaipa Road. Follow Aravaipa Road 12 miles east to the trailhead. Access to the east end of the wilderness is west of Klondyke, Arizona.

Nonfederal Lands

Some lands around and within the wilderness are not federally administered. Please respect the property rights of the owners and do not cross or use these lands without their permission.

Leave No Trace

Leave the area as you would like to find it. Pack out all trash; do not bury it, as animals will dig it up after you leave. Dogs disturb wildlife and other visitors; if you bring a dog, keep it under control at all times. If you need a fire, keep it small and away from rock outcrops. If you build a fire ring, please dismantle it when you're through and bury the ashes before leaving the area. Cigarette butts, pull-tabs, orange peels, etc., are all litter. *PACK IT IN — PACK IT OUT.*

Safety

As with other types of outdoor activities, wilderness travel poses some potential hazards. You may encounter flashfloods, poisonous snakes and insects, poisonous plants, or lightning storms. Be aware of your exposure to heat or cold. Don't panic if you get lost. Carry an ample supply of water with you since many areas may have inadequate or contaminated water sources.

Topographic Maps

7 1/2 minute: Booger Canyon, Brandenburg Mountain, Holy Joe Peak, Oak Grove Canyon

Game and Fish Management Units-31, 32

For more information contact

Bureau of Land Management
Gila Resource Area
711 14th Avenue
Safford, AZ 85546
(602) 428-4040

U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

The best and most beautiful things in the world cannot be seen or even touched. They must be felt with the heart. Helen Keller

T7S R18E sec. 14 open

Sec. 15 Mountain #1-2, 7-18 Lotes Ass. year

Hanson Doug Jr. 1992

(SW, S2, SE)

sec. 22 Mountain #3-4 Hanson Doug Jr.

sec 21 Mountain #5, 6, 19, 20 "

T7S R19E sec. 30 SW Plata #1-4 Verdugo Roy

Sec 31 N2, NW Corbe #1-4 "

NE Oro #2-4, Cobre #5,6 "

In sec. 33 S2, SW, SE → NewMont, Magma, Exxon loc. 1972

T8S, R18E sec. 1 S2, SW. " " Lot. Ass. yr 1985

TABLE MOUNTAIN-FOURMILE CREEK GROUP

Several small copper prospects and one old copper mine lie along a broad belt that extends southeast from the Table Mountain mine and Little Table Mountain to the Left Prong of Fourmile Creek and is underlain principally by the lower andesite unit of the Galiuro Volcanics. The division between this group of mines and prospects and those of the Copper Creek area is taken arbitrarily to be the southwestern limit of the andesite unit. Claim notices were found at a few prospects, but most are nameless. Mines and prospects will be described in geographical order from northwest to southeast.

TABLE MOUNTAIN MINE

The Table Mountain mine is on the west side of Virgus Canyon in the SE¼ sec. 15 and the NE¼ sec. 22, T. 7 S., R. 18 E., about 1¼ miles north-northeast of Little Table Mountain. The mine may be reached over a fair truck or jeep road from the valley of the San Pedro River near the mouth of Aravaipa Creek, or by way of a very rough jeep road that branches off the Turkey Creek road in sec. 32, T. 6 S., R. 19 E. The mine area is covered by 12 patented claims, 11 of which are shown on figure 42. The Table Mountain No. 1–10 claims are owned by Mollie Morgan, Evelyn Sandstrom, and Mattie Young, of Mammoth, and the Grand Duke and Louisville claims by Marion Gillis, address unknown.

No description of the mine has been published, and the following historical data, as well as the claim map, are taken from several private reports kindly made available to me by Mrs. Young.

The Table Mountain ore deposits were first prospected in the late 1870's for gold. During 1898–1900, a road was built from Klondyke, a small crushing and smelting works constructed, and a little copper-gold ore smelted; the size of the slag pile suggests that only a few hundred tons could have been smelted, and the very high silica content of the ore together with the nearly total lack of sulfide minerals must have posed serious smelting problems. According to one report, development work of the period totaled 2,000 feet of adits and drifts from which about 100,000 tons of ore containing 7–9 percent copper and $4 per ton in gold was mined. Production prior to 1928 is estimated at 400–600 tons of crude ore assaying more than 14 percent copper. Ore on the dump at present assays 2–3 percent copper, 0.5–0.6 ounce of silver per ton, and 0.14–0.15 ounce of gold per ton. Sorted chrysocolla ore averages 20–25 percent copper. The slag assays 2.4 percent copper and 0.02 ounce of gold per ton.

At present the former main adit (No. 6, fig. 42) is caved at 200 feet from the portal but is reported to have been 700 feet long and to have had a winze 40 feet deep. At a distance of 450 feet from the portal, the adit is rumored to have cut a vein of vanadinite-wulfenite-quartz ore 10 feet wide; the vein assayed 3–4 percent lead, 1–2 percent vanadic oxide, 2–3 ounces of silver per ton, and $5–$18 in gold per ton. Caves found in this adit also are said to have been lined with wulfenite and vanadinite; one cave is reported to be 300 feet long and 50–60 feet wide.

Rocks of the Table Mountain mine area are cherty and dolomitic Escabrosa Limestone overlain unconformably by the lower andesite unit of the Galiuro Volcanics; the relations were described in the sections on Escabrosa Limestone (p. 26) and Galiuro Volcanics (p. 70). The north end of the eastern contact between limestone and volcanics is a fault, but the remaining contacts are depositional.

The principal ore-bearing rock at the mine is a layer of gray or mottled red, brown, and white massive jasperoid or jasperoid breccia that on the west side of the mine ridge may be as much as 100 feet thick. In the mine area the jasperoid layer seems to be 20–25 feet thick and is overlain directly by volcanic rocks. Over an area at least 1,000 feet long and 500 feet wide, the jasperoid and, to a lesser degree, the limestone contain sporadic and irregular concentrations of supergene copper minerals in pods, along fault and joint surfaces, and coating weathered surfaces. The jasperoid has been thoroughly prospected for about 500 feet north of the main opencuts, and at intervals for several hundred feet more.

Several copper minerals have been identified from the mine area; chrysocolla is by far the most abundant, but malachite and azurite are common; dioptase in vugs was formerly fairly abundant but has been so assiduously sought by mineral collectors that little remains, and conichalcite and planchéite are reported by Bideaux and others (1960). Other minerals reported are wulfenite, vanadinite, mimetite, austinite, and willemite. During the present study, only dioptase, wulfenite, and vanadinite among the rarer species were recognized. Vanadinite was seen only in dump material, where it forms small yellow to orange crystals in a matrix of rudely crustified granular quartz that fills open spaces in brecciated jasperoid. Other than jasperoid and quartz, the only common gangue mineral is barite, which forms large plates that evidently grew in open spaces and now have supergene copper minerals in their interstices.

No satisfactory evidence was found bearing on the age of the volcanic rocks relative to that of the cop-

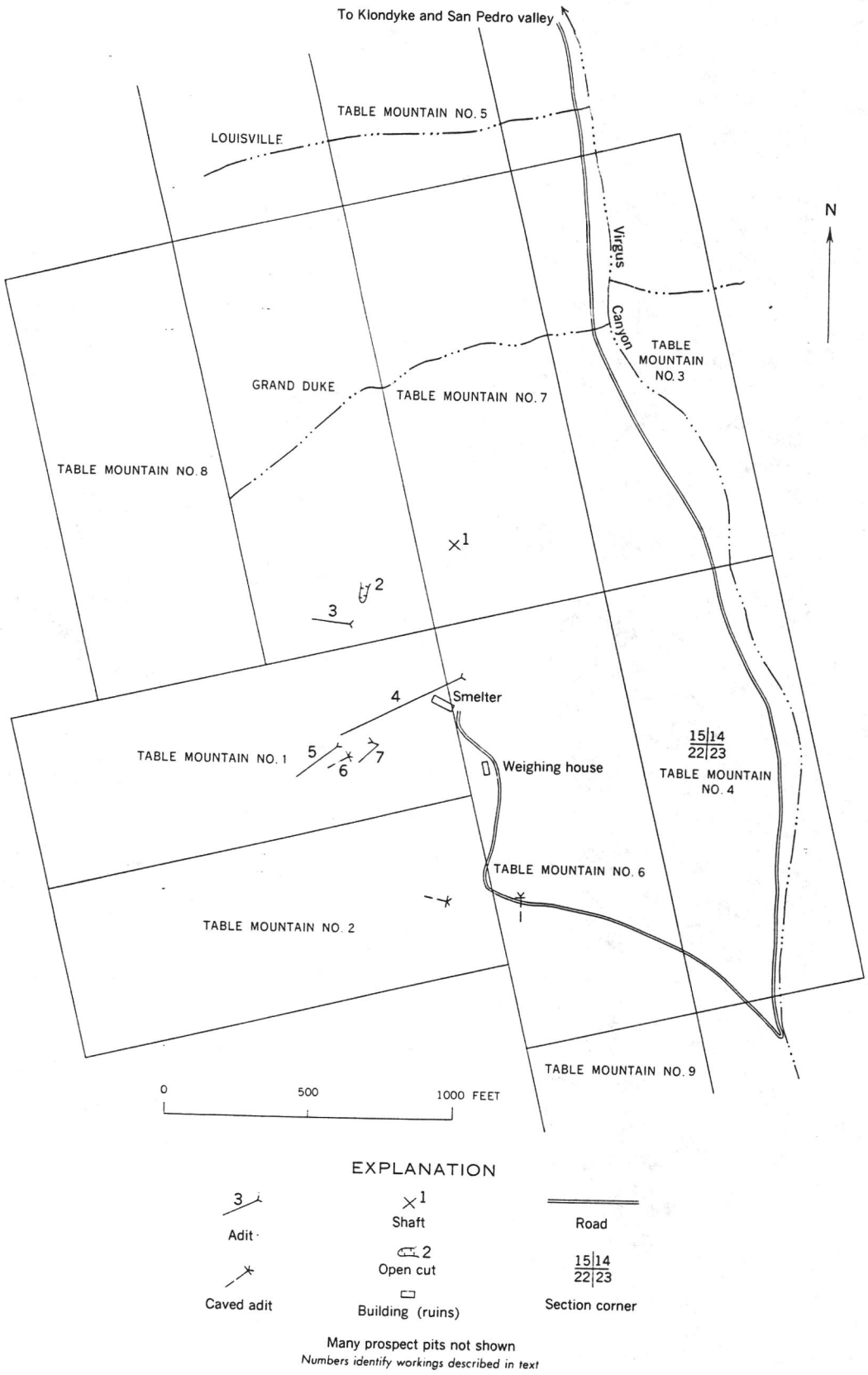


FIGURE 42.—Claim map of Table Mountain mine area. (Slightly modified after U.S. Mineral Survey No. 3313, April 1937.)

per mineralization. The fact that no sulfide minerals were seen or have been reported suggests however that oxidation has been thorough and may have occurred prior to the deposition of the volcanic rocks.

Inasmuch as the principal workings of the mine are inaccessible, no coherent account of the ore occurrences is possible. Instead, the various workings shown by number on figure 42 will be described briefly.

1. A shaft 25 feet deep explores a vertical fault zone in limestone. The fault strikes about N. 55° E. Limestone along the fault contains a little malachite, azurite, chrysocolla, and manganese oxide.
2. Pieces of barite-chrysocolla ore are on the dump of a caved opencut in jasperoid. No ore is exposed in the cut itself.
3. An adit 145 feet long trends N. 85° W. At the portal the adit is in jasperoid having sparse copper stains along joints, but at 100 feet from the portal it passes through a faulted wedge of limestone 15 feet wide. At 135 feet from the portal, the adit enters limestone below the jasperoid along a contact that dips 25° E. and is marked by several inches of gouge.
4. An adit 475 feet long having its portal about 50 feet below the slag pile and old smelter. The adit is entirely in light-gray fine-grained thick-bedded barren limestone striking N. 25° E. and dipping 15° NW. Underlying the limestone is 50 feet or more of interbedded pinkish-gray fine-grained cherty dolomitic limestone and dark-gray limestone.
5. An adit about 175 feet long trends S. 50°–55° W. in limestone just below the base of the jasperoid layer. In the southwesternmost 140–150 feet, the roof of the adit is rubbly jasperoid.
6. Former main adit, now caved at 200 feet from the portal. The accessible part of the adit is entirely in cherty limestone.
7. Adit in limestone that strikes east and dips 15°–20° N.; the portal is in rubble. This adit trends S. 70° E. for 15 feet, then turns abruptly S. 45° W. and continues 95 feet to a raise 20–25 feet high. No ore was seen.

MISCELLANEOUS PROSPECTS

A small copper prospect is just south of the divide between Turkey Creek and the Right Prong of Fourmile Creek in the NW¼SE¼ sec. 28, T. 7 S., R. 19 E. A narrow fracture in coarse porphyritic "turkey-track" andesite strikes N. 45° W. and dips 75° SW. The fracture surfaces are filmed by chrysocolla and a little malachite.

Another small prospect is on the south side of the Right Prong of Fourmile Creek, on a ridge just north of the number 32, sec. 32, T. 7 S., R. 19 E. Dark-gray to dark-red porphyritic olivine andesite is cut by a vertical fracture zone striking N. 70° W. Fracture surfaces are coated by a little blue-green and green chrysocolla. The fracture zone is explored for 30 feet along an opencut. A second opencut 100 feet to the northwest and 25 feet long explores a vertical fault that strikes N. 60° W. Fault surfaces are polished and are filmed with a little chrysocolla and sparse malachite. A third prospect is 1,600 feet north and on the north side of the Right Prong in the NW¼ sec. 32. Purplish-gray pepper-and-salt textured olivine andesite is cut by a fracture zone that strikes N. 70° W. and dips 80°–90° SW. Fracture surfaces are coated by as much as a millimeter of blue-green chrysocolla and a little malachite. The fracture is explored by a vertical shaft about 60 feet deep and by an incline off the shaft at a depth of about 50 feet.

A prospect on the north side of the Right Prong of Fourmile Creek, in the center of the NW¼ sec. 33, T. 7 S., R. 19 E., is along a poorly defined fracture zone in the fine-grained basal part of a wedge of coarsely porphyritic "turkey-track" andesite just above the latite subunit of the Galiuro Volcanics. The fracture zone strikes N. 80° W. and dips 65° N. Fractures are filled with thin seams of malachite and chrysocolla. The prospect consists of two short inclines. Very little copper stain is apparent at a short distance below the surface.

Several small prospects are on or near the crest of the Galiuro Mountains in the SW. cor. sec. 32, T. 7 S., the NW. cor. sec. 5, and the NE. cor. sec. 6, T. 8 S., all R. 19 E. On the crest of the range in sec. 5, a partly timbered shaft 50–60 feet deep explores an east-striking vertical fracture in "turkey-track" andesite. Dump material includes andesite cut by irregular veinlets 2–3 mm thick of blue-green chrysocolla, a little malachite, and white chalcedony. One vug was lined with bright-green dioptase.

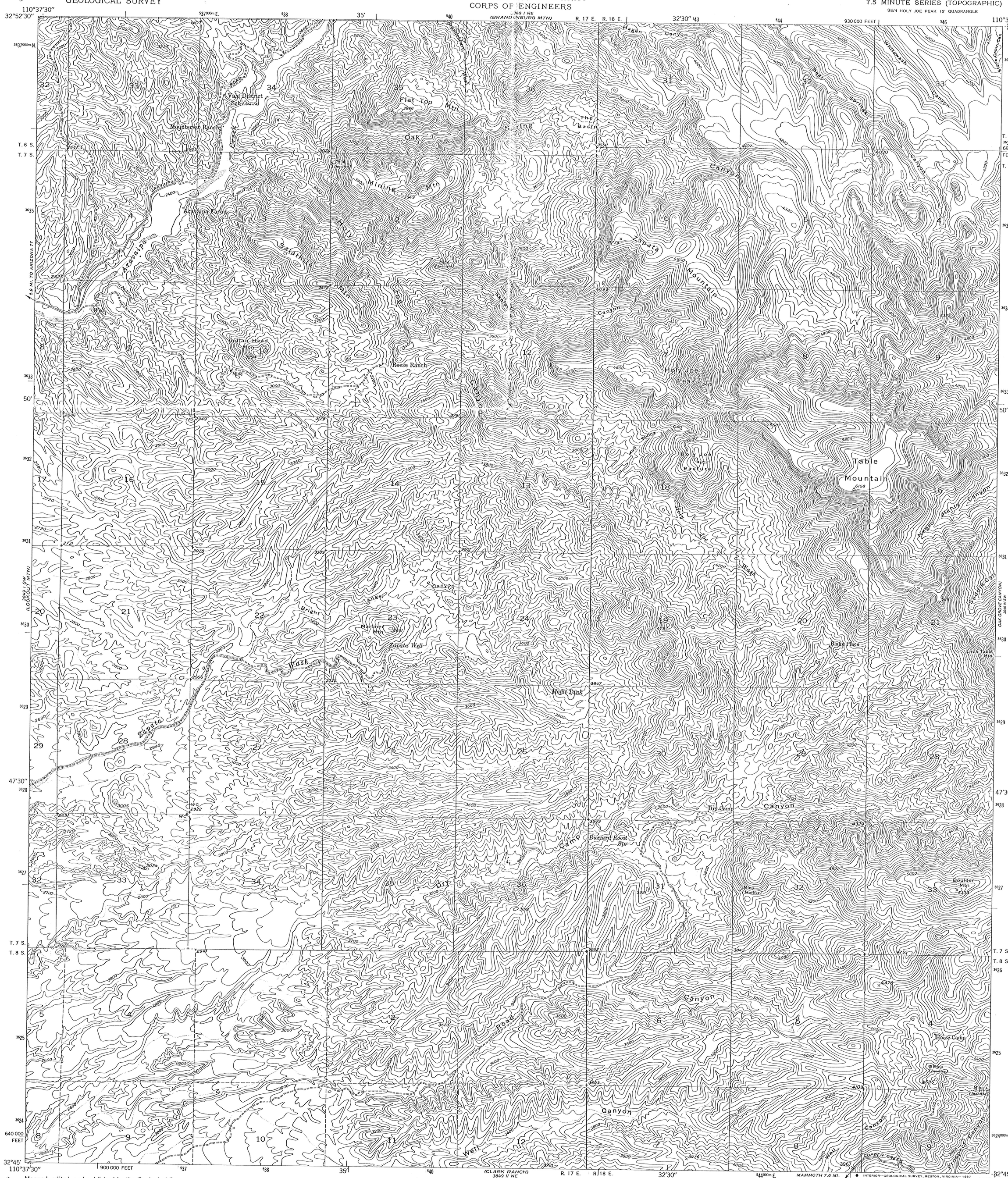
About 200 feet farther west and slightly below is an open stope 20 feet long and 25 feet deep along a fracture zone some 2 feet wide. Fracture surfaces are filmed by chalcedony, chrysocolla, and malachite.

The prospect in sec. 32 consists of two shafts 10–12 feet deep on a fracture zone less than a foot wide in coarse "turkey-track" pillow lava and flow breccia. The zone strikes east and dips 80° S. Fracture surfaces are coated with chrysocolla. Part of the wall-rock at this prospect is a peculiar pale-red (10*R* 6/2) breccia consisting of fragments 1–10 mm across of

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

HOLY JOE PEAK QUADRANGLE
ARIZONA—PINAL CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 HOLY JOE PEAK 15' QUADRANGLE



Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography from aerial photographs by multiplex methods
Aerial photographs taken 1947. Field check 1949

Polyconic projection. 1927 North American datum
10,000-foot grid based on Arizona coordinate system, central zone

Dashed land lines indicate approximate location

1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue

To place on the predicted North American Datum 1983 move the projection lines 4 meters south and 61 meters east as shown by dashed corner ticks

UTM GRID AND 1949 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

QUADRANGLE LOCATION

Map photoinspected 1972
No major culture or drainage changes observed

ROAD CLASSIFICATION
1963
Light-duty ——— Unimproved dirt - - - - -

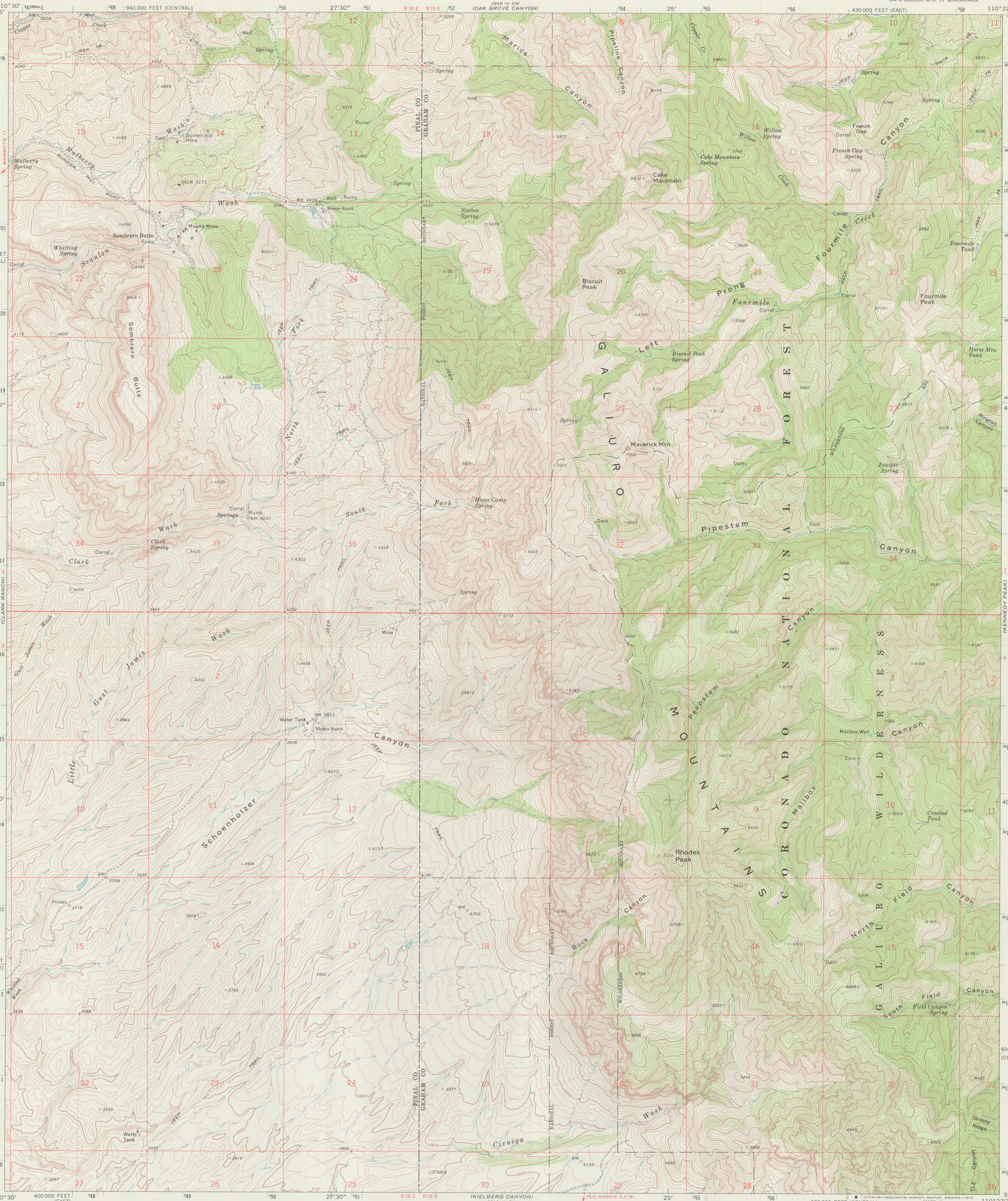
HOLY JOE PEAK, ARIZ.
SE/4 HOLY JOE PEAK 15' QUADRANGLE
32110-G5-TF-024

1949
PHOTOINSPECTED 1972
DMA 3849 I SE-SERIES V898

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1987

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

RHODES PEAK QUADRANGLE
ARIZONA
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW/4 GALIURO MTS. 15' QUADRANGLE



Mapped, edited, and published by the Geological Survey

Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1971. Field checked 1972

Projection: Arizona coordinate system, east zone (transverse Mercator)
10,000-foot grid ticks based on Arizona coordinate system, east and central zones
1000-metre Universal Transverse Mercator grid ticks, zone 12, shown in blue. 1927 North American datum

Fine red dashed lines indicate selected fence lines

UTM GRID AND 1972 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

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A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

QUADRANGLE LOCATION

ROAD CLASSIFICATION

Primary highway, hard surface
Light-duty road, hard or improved surface
Secondary highway, hard surface
Unimproved road
Interstate Route
U. S. Route
State Route

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1975

RHODES PEAK, ARIZ.
NW/4 GALIURO MTS. 15' QUADRANGLE
N3237.5—W11022.5/7.5

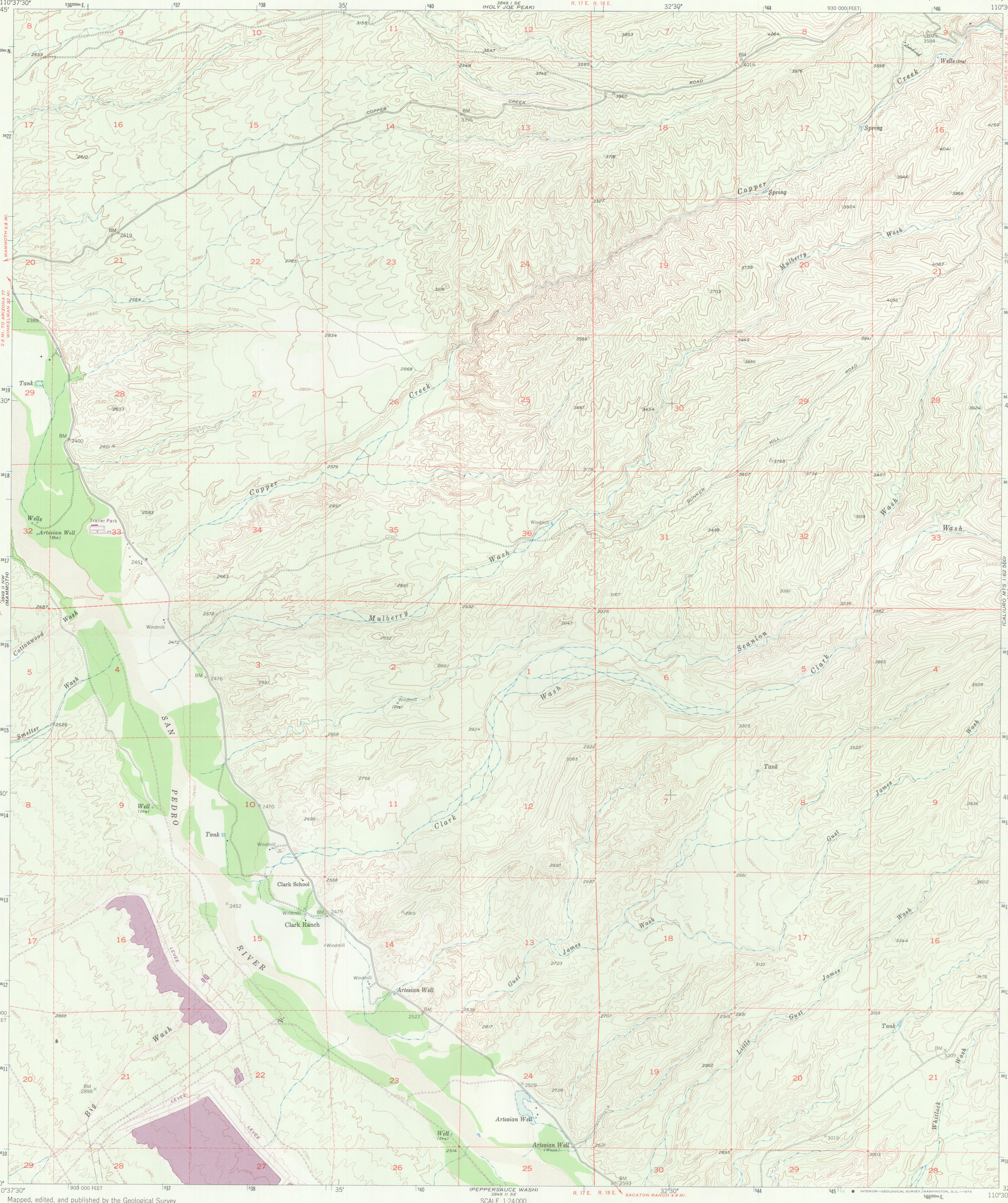
1972

AMS 3949 III NW—SERIES V898

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

CLARK RANCH QUADRANGLE
ARIZONA—PINAL CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)



Mapped, edited, and published by the Geological Survey

Control by USGS

Topography from aerial photographs by multiplex methods
Aerial photographs taken 1945. Field check 1948

Polyconic projection. 1927 North American datum
10,000-foot grid based on Arizona coordinate system, central zone

1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue

Dashed land lines indicate approximate locations

Revisions shown in purple compiled from aerial photographs taken 1972. This information not field checked

UTM GRID AND 1972 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR WASHINGTON, D. C. 20242
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

QUADRANGLE LOCATION

ROAD CLASSIFICATION

HARD-SURFACE ALL WEATHER ROADS — DRY WEATHER ROADS
Heavy-duty — 4 LANE | 6 LANE — Improved dirt
Medium-duty — 4 LANE | 6 LANE — Unimproved dirt
Loose-surface, graded, or narrow hard-surface
U. S. Route — State Route

CLARK RANCH, ARIZ.
N3237.5-W11030/7.5

1948
PHOTOREVISED 1972
AMS 3849 II NE—SERIES V898

TABLE MOUNTAIN PROSPECT

ACQUISITION REPORT

October 5, 1981

ENERGY RESERVES GROUP, INC.
Southwest District Office
W. S. Dubyk, Exploration Geologist

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TABLE MOUNTAIN PROSPECT
ACQUISITION REPORT

Introduction

The Table Mountain Prospect is located in Pinal County, Arizona, in Sections 14, 15, 22 and 23, Township 7 South, Range 18 East (Figure 1). The Table Mountain Prospect was acquired during October of 1981 as the prospect's geology was similar to other recently discovered disseminated precious metal deposits in the western U.S. The prospect presently consists of approximately 35 unpatented claims.

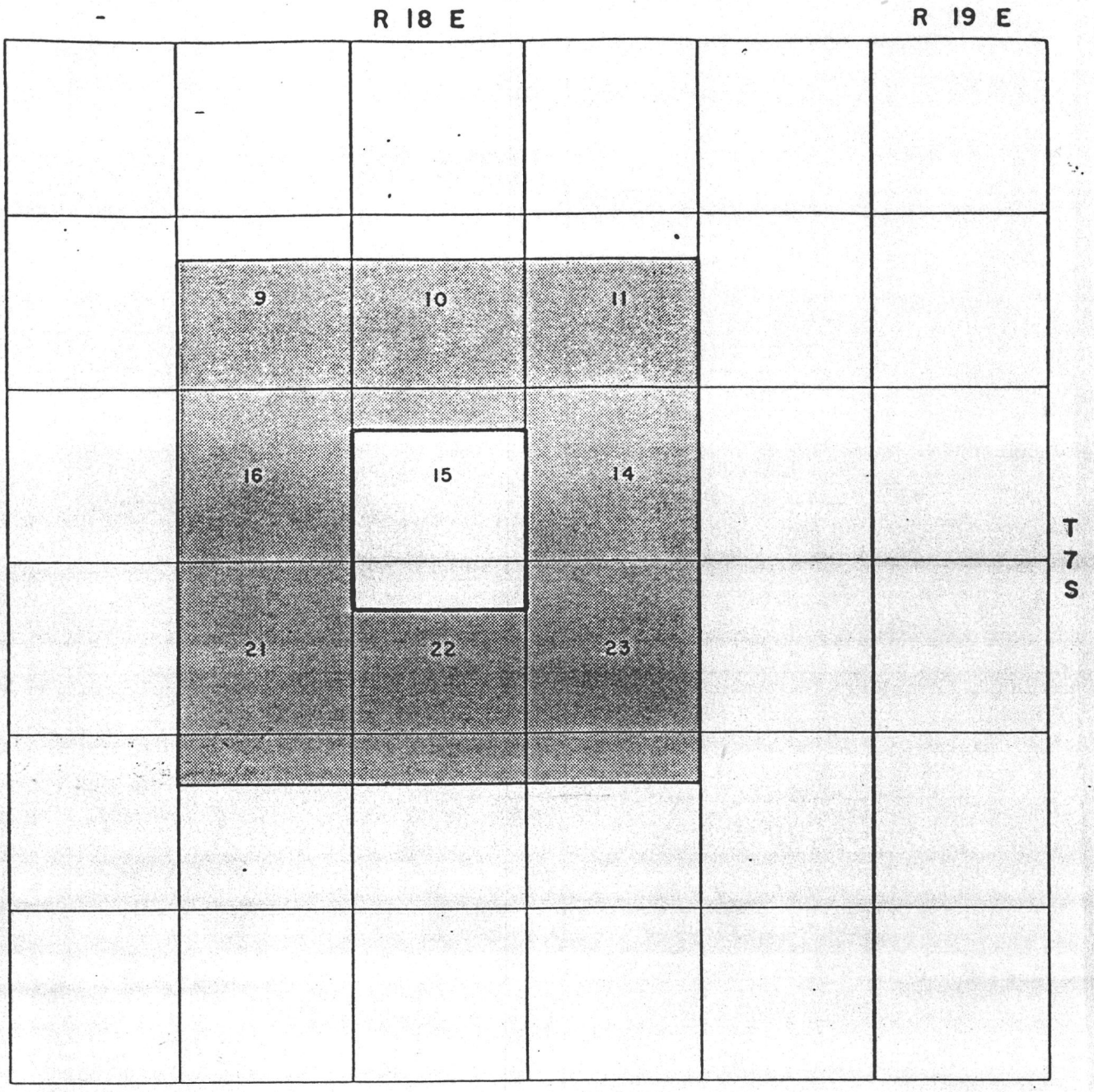
The Table Mountain Prospect lies on the northeast flank of the rugged Galiuro Mountains at an elevation of 5,000 feet. Access to the property can be gained by traveling northeast from Tucson, Arizona on Highways 80 and 77 to Mammoth, Arizona. From Mammoth a turnoff to the east onto a dirt road leads to the property.

Land Status

The Table Mountain Prospect consists of approximately 35 unpatented lode mining claims that were located by Energy Reserves Group. As of this writing, there are also two patented claims in the area and the owners of these claims will soon be contacted although obtaining a lease is not expected to pose any problems (Figure 2).

General Geology

The geology of the Table Mountain Prospect area consists of Paleozoic Escabrosa Formation which has been faulted, intruded and overlain by the Tertiary Galiuro Formation consisting of andesitic volcanic rocks. The Mississippian Escabrosa Formation is typically a light to medium-gray, thick to thin-bedded, crinoidal limestone. Thin beds of chert are also present in the massive limestones of the Table Mountain Prospect area. Limestone predominates greatly over dolomite and the darker limestones in the section are fetid.



Energy Reserves Group
SOUTHWEST DISTRICT OFFICE

TABLE MTN. PROSPECT
AREA OF NON-COMPETE

SCALE: 1" = 5000'	BY: PH	DATE: 10-81

PROSPECT AREA

AREA OF ONE-YEAR NON-COMPETE

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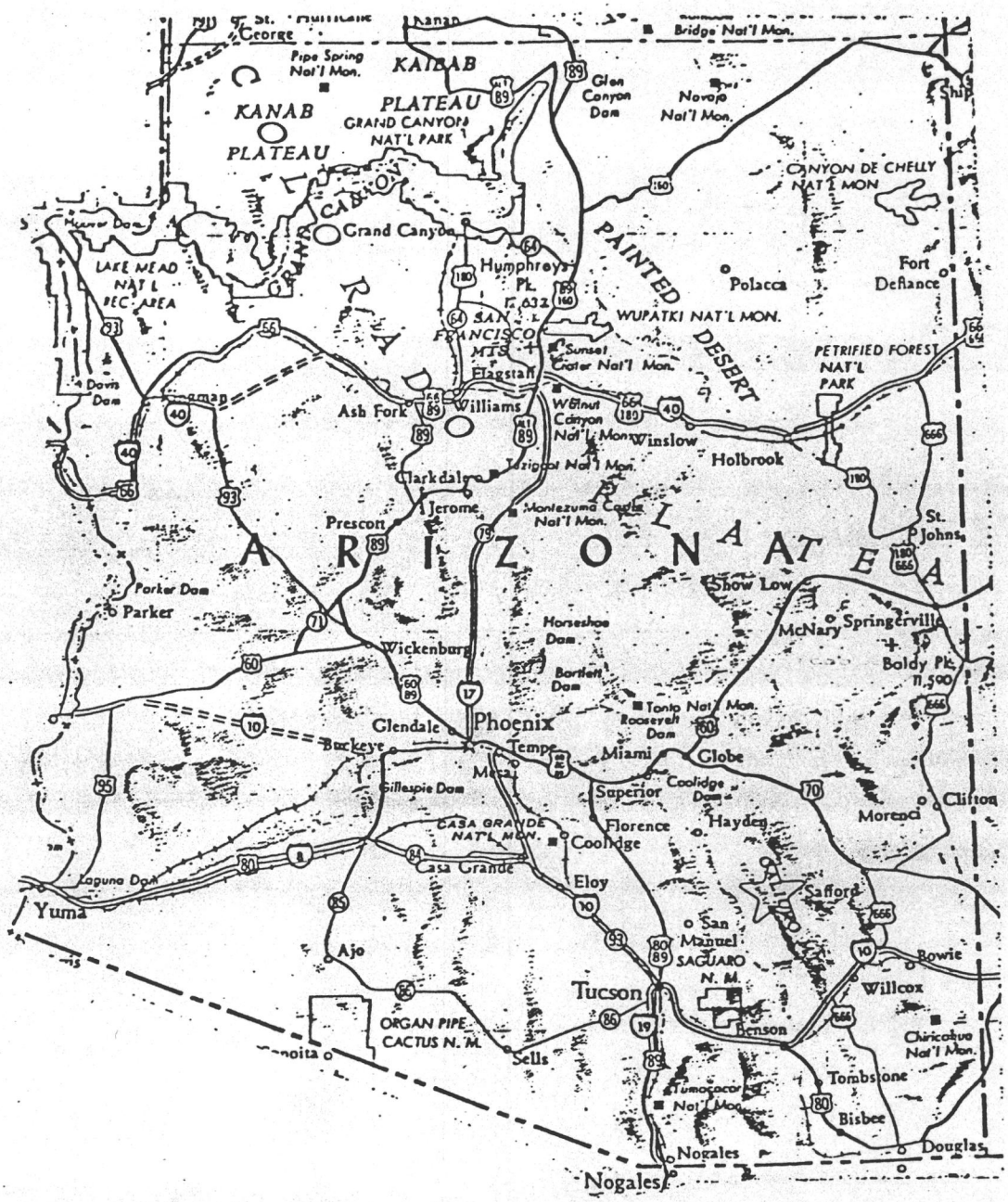

FIGURE I. LOCATION MAP, TABLE MOUNTAIN PROSPECT, ARIZONA.

The Devonian age Martin Formation outcrops to the west of Table Mountain in Dry Camp Canyon and consists predominantly of variegated shales and limestones (Figure 3). The uppermost part of the Martin Formation consists of pink to gray, fine-grained dolomite and limestone. Below these units is a distinctive, highly fissile, green shale which is diagnostic of the Martin Formation in this area. The Martin Formation is locally silicified beneath the overlying Tertiary Galiuro Volcanics in the Dry Camp Canyon area but does not outcrop from beneath the overlying Escabrosa Formation in the Table Mountain Mine area. The Martin Formation may however represent a significant "blind" drilling target in prospect area.

In the prospect area, a massive layer of jasperoid breccia, 50 to 100 feet thick, caps the Escabrosa Formation (Plate I). The jasperoid is a non-bedded gray, red and white siliceous rock that is locally mottled with red and brown iron oxides. It is composed of angular jasperoid fragments that have been cemented by jasperoid, and less commonly, by quartz, chrysocolla, barite and other oxidized copper minerals. Below the massive jasperoid in the mine area, the Escabrosa is fine-grained, light gray, and contains abundant light gray chert beds a few inches thick; chert may constitute up to a third of the formation here.

In the mine area the jasperoid usually forms the surface on which the Tertiary Galuiro volcanics were deposited. This is the case throughout the Galiuro Mountain area, although the jasperoid is often much thinner (10 to 20 feet thick) and is not mineralized. It has been suggested that the jasperoid may have acted as an erosional platform on which the overlying rocks were laid down.

Breccia pipes, probably Cretaceous in age, intrude the Martin Formation west of Table Mountain. They range from three to twenty-five feet in diameter and, where well exposed, consist of angular fragments and blocks of granodiorite and andesite in a highly altered (probably volcanic) reddis matrix. They are locally silicified and have silicified their wall rocks. Hematite-staining is usually significant.

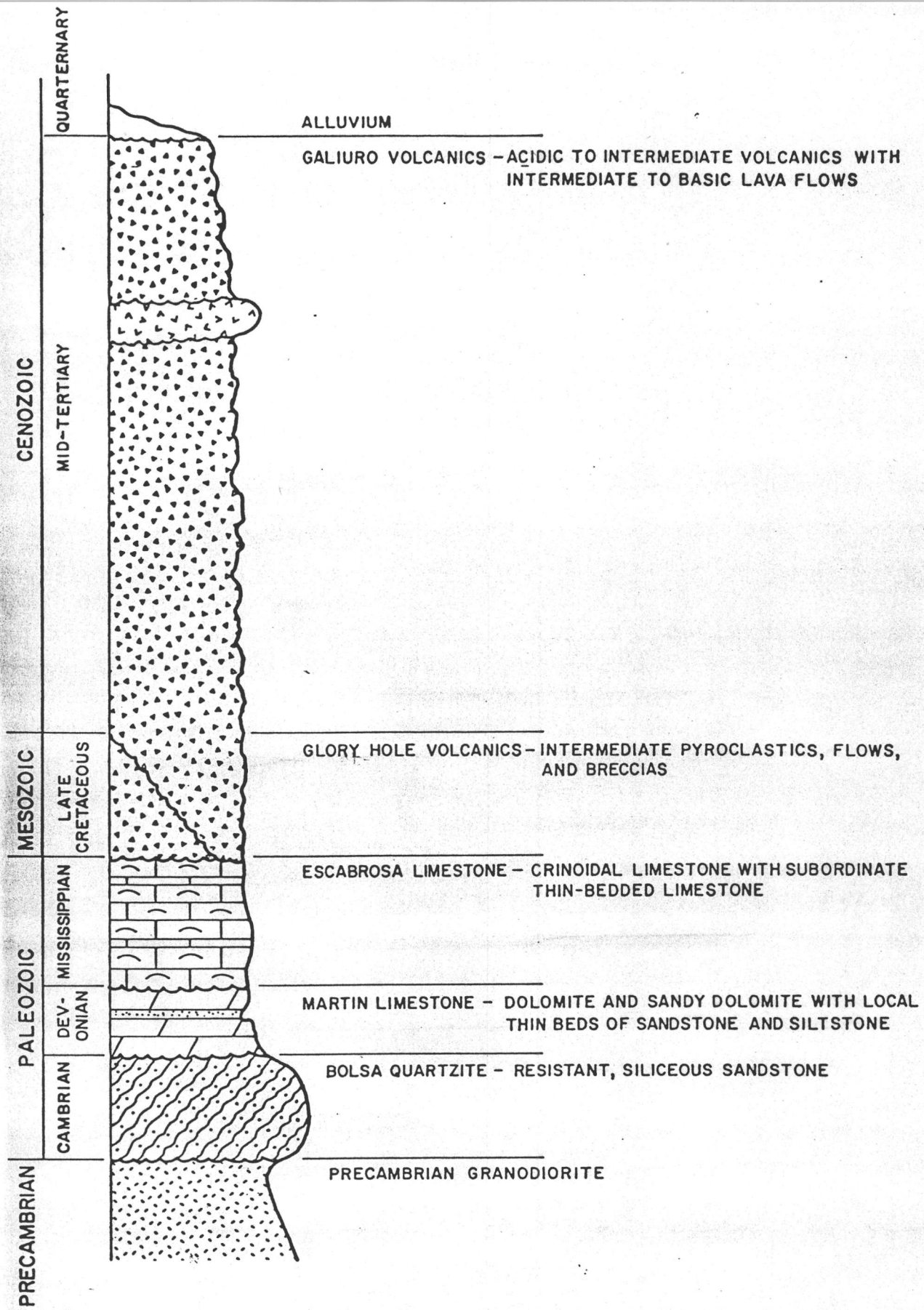

FIGURE 3. GENERALIZED STRATIGRAPHIC COLUMN, TABLE MOUNTAIN PROSPECT, ARIZONA

The Galiuro volcanics overly all formations in the Table Mountain area. Two units of the Galiuro volcanics occur in the prospect area and these are the lower andesite unit and the lower welded tuff unit. The bulk of the lower andesite consists of fine-grained, grayish-red, platey, extrusive rocks containing abundant plagioclase phenocrysts and rare olivine. The base of the andeiste is marked by a thin conglomerate composed of limestone and jasperoid fragments and fills shallow channels cut into the underlying Escabrosa Formation.

The lower welded tuff is the caprock on Table Mountain and Little Table Mountain located to the west of the prospect area. This tuff is a lithologically distinct unit composed primarily of glassy, biotite-rich latite which forms sheer outcrops and is usually black, brown, red or orange.

Structure

Normal and low-angle reverse (thrust) faulting is the dominant structural feature of the prospect area. The rocks are otherwise relatively flat-lying and undeformed (Figure 4).

Normal faults, striking east-west and northeast-southwest, cut the Escabrosa and Galiuro Formations. Displacement is minor, except at the southern end of the claims, where Escabrosa is faulted against the Galiuro volcanics. Jasperoid and argillic alteration can often be found along the trace of these faults.

A series of north-south trending normal faults exist on the claimblock but have been obscured by intense silicification of the Escabrosa Formation. Mining efforts in the early 1900's reportedly encountered large solution caverns in the Escabrosa limestone which were developed along these north-south trending zones. Also, mining in the early days was concentrated on high grade veins (or feeder structures) that trended north-south indicating that it may be the set of fractures that acted as the main conduit for upward rising mineralizing solutions.

Low-angle reverse or thrust-faulting also occur on the claimblock. This thrusting disrupted both the Escabrosa and Galiuro Formations and is late-Tertiary in age. Thrusting is probably due to reactivation of faults formed during emplacement of nearby Tertiary granitic rocks.

Alteration

Alteration in the Table Mountain Prospect area consists of silicification and argillization. The uppermost Escabrosa Formation has been silicified, brecciated and resilicified to form a prominent jasperoid unit which attains a thickness of up to 100 feet. Silicification appears to be related to both north-south and east-west trending normal faults.

Argillic alteration is often found adjacent to jasperoids that have formed along faults and can be quite extensive in nature.

Mineralization

Mineralization in the Table Mountain Prospect probably migrated upward along the north-south, northeast-southwest and thrust faults found throughout the prospect areas. As the mid-Tertiary Galiuro volcanics above the faults are unaltered, the age of the mineralization is placed at pre mid-Tertiary. The source of the mineralization found at the Table Mountain Mine may be the result of hydrothermal events that were associated with the deposition of the Late-Cretaceous-Early Tertiary glory hole volcanics. The Glory Hole volcanics are not exposed in the prospect area, but do outcrop several miles to the west and it is theorized that they were removed prior to the deposition of the Galiuro volcanics.

Mineralization found at the Table Mountain Mine consists of gold, copper, cerrusite, vanadinite, wulfenite and barite. Gangue minerals consist of jasperoid and calcite indicating low temperatures of deposition. A 1928 report of the Table Mountain Mine, which is now inaccessible, describes the mineralization as well as

how and where the various minerals occur. It is from this description and from our own outcrop examinations that it was determined that the mineralization found at the Table Mountain Mine was deposited under conditions that greatly resemble those of the Carlin model. The 1928 report indicates that mineralization probably migrated upward along the low and high angle faults. When the mineralization encountered massive limestones, jasperoid developed. When mineralizing solutions came into contact with thin-bedded sediments they were able to migrate laterally away from the feeder faults where they altered and mineralized the host rock. The report indicates that the precious metal mineralization is immediately overlain by jasperoid which is consistent with the Carlin model.

Gold mineralization was produced in the 1880's and again in the 1900's from north-south trending, vertical veins of considerable width that contained gold-bearing jasperoid quartz. In places the jasperoid was associated with clear quartz which was extremely rich. This mineralization was undoubtedly concentrated along vertical feeder structures up which the solutions had migrated.

Additional mineralization, and our exploration objective, is reported to have occurred in "the residual limestone of the orebody." This type of mineralization is reported as "being of lower tenor", to "exist on a very large scale", "the probable ore amounting to millions of tons."

The 1928 report also raises the "point to be decided whether the ore be won from below by glory holing from a series of raises to the horizontal orebody or by simple open cutting." It is obviously encouraging to note that the possibility of an open pit mining situation existed in 1928.

Geochemical Anomalies

The prospect area contains significant geochemical anomalies associated with the jasperoids. Most gold anomalies (from 0.05 ppm to 1.77 ppm) occur in jasperoid containing abundant Fe, Mn or Cu-staining. Silver (up to 12 ppm), antimony (up

to 792 ppm) and arsenic (up to 1080 ppm) anomalies tend to be closely associated with jasperoids and copper mineralization. Argillized material is slightly anomalous (0.05 ppm).

Conclusions and Recommendations

The Table Mountain Prospect may contain appreciable amounts of gold-bearing jasperoid related to weak metasomatic deposition. Gold-bearing jasperoids have provided ore during previous mining operations and there is a possibility that the Escabrosa or underlying Martin Formation may contain a unit of sufficient thickness, permeability and chemical reactivity to have allowed the formation of a "typical" Carlin-type (stratigraphically controlled) ore zone of sufficient size and grade to permit open-pit operations.

APPENDIX I

TABLE MOUNTAIN PROSPECT - SAMPLE RESULTS

PROSPECT TABLE MOUNTAIN

ENERGY RESERVES GROUP

COUNTY/STATE Pinal, Arizona

SAMPLE NO.	LOCATION T	R	S	FNL	FEL	COLLECTOR	DATE	RESULTS Au (ppm)	Ag (ppm)	As (ppm)	Sb (ppm)					DESCRIPTION
1811	7S	18E	15	4900	1200	SS	8-18-81	.05	1.2	30	100					Argillite, jasperoid and siliceous rock in adit 200' in and along fault, hematite staining, recrystallized limestone and bats.
1812	"	"	"	4900	1200	SS	"	.04	1.6	30	71					Same as #1811.
1813	"	"	"	4900	1200	SS	"	[redacted]	[redacted]	40	120					Same as #1811.
1814	"	"	"	4900	1500	SS	"	.04	1.4	10	69					Sample along outcrop above and west of #1811. Samples white to hematite stained argillite and FeOx stained jasperoid. Argillite often occurs next to massive jasper or recrystallized limestone.
1815	"	"	"	5280	1200	SS	"	[redacted] (.07oz/t)	[redacted] (0.4oz/t)	1080	672					Dump sample dominantly of jasper - no argillic material is present. Jasper is breccia to massive, white to red with FeOx, CuOx, barite from main mine area.
1816	"	"	"	5280	1250	SS	"	[redacted]	2.8	40	81					Argillically altered rock, recrystallized limestone, jasperoids and fault gouge, some copper mineralization, hematite staining and some manganese in jasperoids above main mine portals.