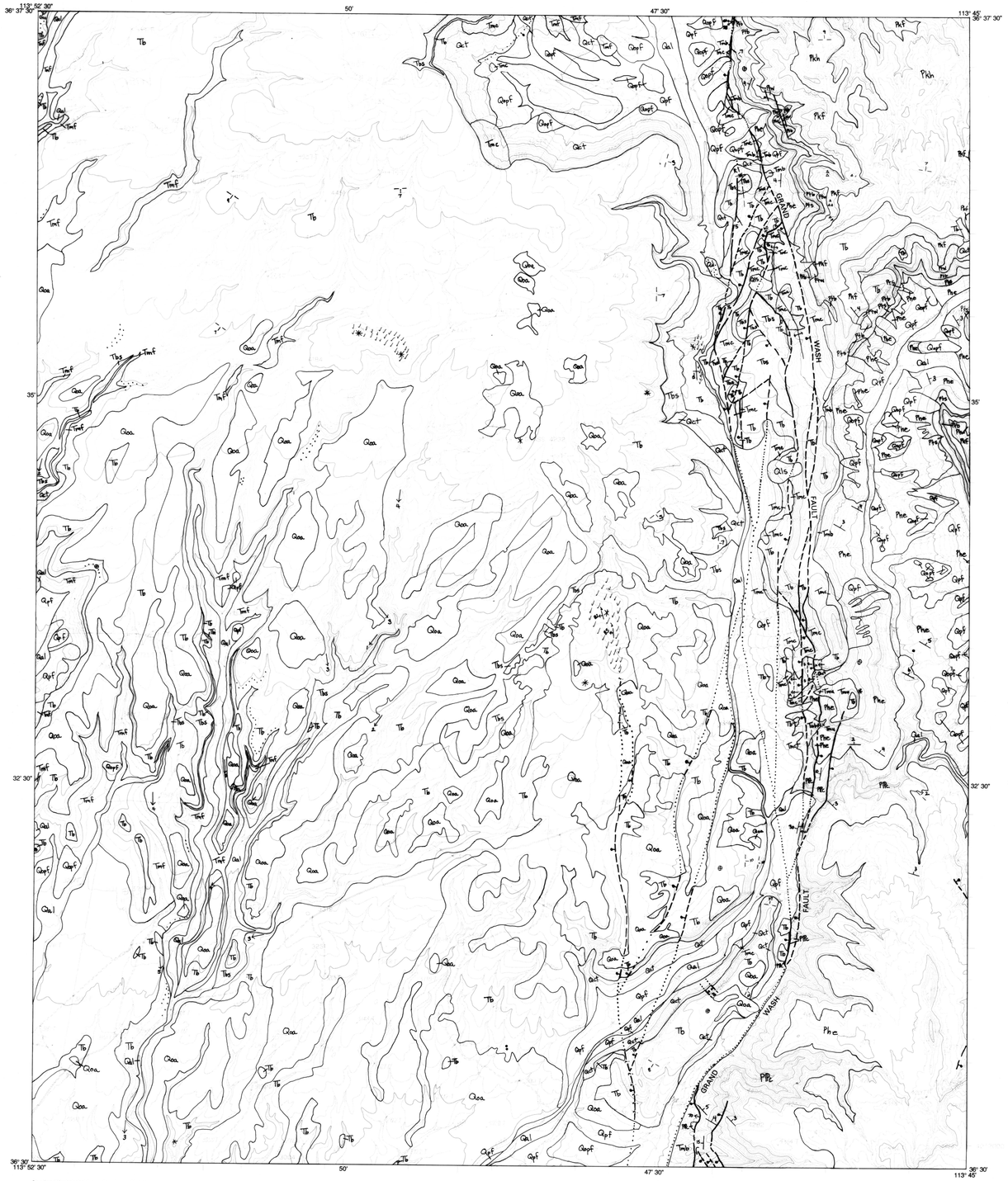
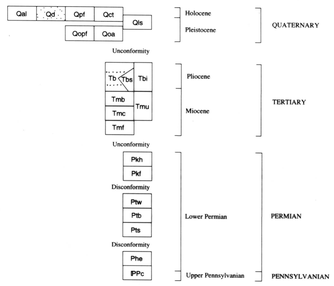
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

CENOZOIC SURFICIAL DEPOSITS

Qal **Alluvium (Holocene and Pleistocene?)**—Silt, sand, pebbles, cobbles, and boulders in bottoms of largest and most active drainages. Poorly sorted, angular to subround constituents as large as several meters in diameter. High albedo, little or no soil development, and sparse vegetation. Maximum thickness about 2 m

Qd **Dune deposits (Holocene and Pleistocene?)**—Medium- to fine-grained, orange-red sand in active dunes covered by sparse vegetation. Little or no soil development

Qpf **Pediment and alluvial fan deposits (Holocene and Pleistocene?)**—Silt, sand, pebbles, cobbles, and boulders in widespread, sheet-like deposits on pediment surfaces that connect to sediment source. Poorly to moderately sorted, subround to angular constituents as large as several meters in diameter. Dissected 5 m or less. Soil zones incipient to well developed; vegetation common. Maximum thickness about 5 m

Qct **Colluvium and talus (Holocene and Pleistocene?)**—Silt, sand, pebbles, cobbles, and boulders in thin deposits on steep slopes, commonly beneath cliffs. Poorly to moderately sorted, angular to subround constituents as large as several meters in diameter; unconsolidated and locally derived. Dissected 5 m or less. Maximum thickness about 5 m

Qls **Landslide deposits (Holocene? and Pleistocene)**—Two landslide blocks consist of chaotic masses of basalt (Tb) and Tertiary sediments (Tmc) on east side of Black Canyon. Thickness unknown

Qopf **Older pediment and alluvial fan deposits (Pleistocene)**—Silt, sand, pebbles, cobbles, and boulders in sheet-like deposits on gently- to steeply-sloping surfaces. Topographically higher than pediment deposits (Qpf) and disconnected from sediment source. Poorly sorted, angular to subround, unconsolidated, and locally derived. Soil zones incipient to well developed; vegetation common. Typically dissected 25 m or less. Maximum thickness about 5 m

Qoa **Older alluvium (Pleistocene)**—Silt, sand, pebbles, cobbles, and boulders on gently sloping surface of basalt flows (Tb). Clasts poorly sorted, angular to subround. Deposit is heavily calichified, fills channels; includes clasts of calcrete up to 0.5 m. Locally unconsolidated to well consolidated. Typically dissected 250 m or less. Maximum thickness about 1.5 m

CENOZOIC VOLCANIC AND SEDIMENTARY ROCKS

Volcanic rocks, dikes and associated sediments (Pliocene and Miocene)—Basalts capping the north-central plateau in the quadrangle are locally derived from vents in central part of quadrangle and to the west, and from Mud Mountain area, (6.87 ±0.20 and 4.73±0.18 Ma; Reynolds, et al., 1986). A radiometric age from a down-faulted basalt flow in northern Black Canyon in northeast corner of quadrangle is 5.45 Ma, (Reynolds, et al., 1986). Basalts along eastern edge of quadrangle are assumed to be equivalent in age and origin to Hobble basalt east of map area (3.6±0.54 Ma; G.H. Billingsley, 1994). Relations between basalts of Mud Mountain, the Hobble basalts, and local-vent flows are not well understood owing to subsequent faulting, landslide blocks, talus cover and similar lithology.

Tb **Basalt**—Light-gray to black, vesicular to non-vesicular, porphyritic basalt, with as much as 10% 1-3 mm. in diameter, mostly iddingsitized olivine; and scarce plagioclase and pyroxene up to 1mm. in length in aphanitic ground mass. Basalt conformably overlies sediments similiar to the Muddy Creek Formation (Tmu, Tmf). Contact with underlying sediments planar to undulating; some flows fill paleochannels. Forms caprock of local plateaus. As many as 5 flows with little or no sediment between flows. Intrabasaltic sediments (Tsb) are shown as rows of dots within the basalts (Tb) where too thin to map separately. Minimum thickness of individual flows is about 1.5 m. As much as 120 m thick in southeast corner of quadrangle

Tbi **Intrusive basalt**—Medium- to dark-gray basalt. Moderately vesicular, vesicles as much as 5 mm. in diameter. Approximately 5% to 10% moderately iddingsitized olivine crystals as long as 4 mm. in diameter. Felty plagioclase laths as long as 1 mm. in length on weathered surface; diktytaxitic texture. Found associated with basalt flow and may be feeder dike. Thickness unknown

Tbs **Intrabasaltic sediments**—Light-brown to moderate orange-brown, medium to fine, poorly sorted, subround quartz sandstone and siltstone, between flows; with weak calcite cement. Contains scattered pebbles of basalt as much as 30 cm. in diameter, typically 1 to 3 cm. in diameter, and pebbles and granules of other lithologies including black chert, white chert, metavolcanic rocks, and sandstone. Clasts define sub-horizontal bedding. Bedding is indistinct, horizontal, and locally trough cross stratified. Caliche common as root casts, nodules, and fracture fill. Where too thin to map separately, intrabasaltic sediments (Tbs) are included within basalts (Tb) and represented by rows of dots. In absence of lower basalt flows, intrabasaltic sediments (Tbs) cannot be distinguished from fine-grained sediments of Muddy Creek Formation (Tmf) and are included in Tmf. As much as 80 m thick

Coarse- and fine-grained sediments of Muddy Creek Formation (Miocene)—Clastic sediments composed of silt, sand, conglomerate, and breccia assumed to be correlative with Muddy Creek Formation (Miocene), which is red siltstone and sandstone facies present to west of this quadrangle and as far south as Lake Mead (Lucchitta, 1966)

Tmf **Fine-grained sediments**—Brownish-red to pink, fine- to medium-grained, quartz sandstone. Grains poorly sorted, subangular to well-rounded, weakly consolidated. Bedding indistinct to horizontal; locally undulating, trough cross stratification common. Includes local lenses of pebbles and cobbles; imbrication indicates direction of paleoflow is from north to south. Clast lithologies include: chert, quartzite, metavolcanic rocks, quartz sandstone, lithic sandstone, carbonate rocks, and petrified wood. Caliche present as nodules and root casts. Base covered. In places where lower basalt flows are absent, intrabasaltic sediments (Tbs) and fine-grained sediments of Muddy Creek Formation (Tmf) are included in this unit. As much as 75 m in exposed thickness

Tmb **Breccia**—Medium-gray to grayish-tan silt to boulders as much as 2.5 m in diameter. Where consolidated, this unit is matrix-supported, poorly sorted; includes chaotically oriented angular clasts of locally derived Paleozoic limestone and sandstone. Well-indurated to weakly cemented or unconsolidated. Lower contacts unconformable with Hermit Shale and Esplanade Sandstone (Phe), and conformable with conglomerate of Muddy Creek Formation (Tmc). Contacts are planar and undulating. Unit present in eastern part of quadrangle, along north-trending paleoalignment of the Grand Wash Fault. As much as 30 meters thick

Tmc **Conglomerate**—Clast-to-sand-supported, medium-orange, conglomerate composed of poorly-sorted, well-rounded, pebbles to cobbles. Lithologies include: chert, quartzite, metavolcanic rocks, lithic sandstone, quartz sandstone, and carbonate rocks. Weakly cemented to unconsolidated. Clasts locally fill scour-like depressions. Imbrication indicates direction of paleoflow is from north to south. Beds horizontal to lenticular; some defined by fining-upward sequences. Base covered. As much as 140 m in exposed thickness

Tmu **Breccia (Tmb) and conglomerate (Tmc), undifferentiated**—Mapped where poor exposures prevent delineation of complex contact between units

PALEOZOIC SEDIMENTARY ROCKS

Kaibab Formation (Lower Permian)—Thinly-bedded, fossiliferous, cherty and sandy limestone. Subdivided into Harrisburg and Fossil Mountain Members

Pkh **Harrisburg Member**—Forms slope with ledges. Light-gray, fossiliferous, sandy, finely- to medium-crystalline limestone. Includes interbedded red and gray gypsiferous siltstone and gray gypsum beds several meters thick. Forms ledgy slope with cliff near top underlain by gray, thin-bedded, cherty limestone and sandy limestone. Bedding locally distorted by solution of interbedded gypsum. As much as 90 m thick

Pkf **Fossil Mountain Member**—Cliff-forming, yellow-gray to gray, fossiliferous, sandy, cherty, finely- to medium-crystalline, thinly-bedded limestone. Chert weathers black in cliff outcrops. Gradational contact with overlying Harrisburg Member (Pkh) placed between cherty limestone cliff of Fossil Mountain Member (Pkf) and siltstone slope of Harrisburg Member (Pkh). As much as 90 m thick

Toroweap Formation (Lower Permian)—Heterogeneously-bedded shale, siltstone, sandstone, gypsum and fossiliferous dolomitic limestone. Subdivided into the Woods Ranch, Brady Canyon, and Seligman Members

Ptw **Woods Ranch Member**—Slope-forming gray siltstone and pale-red shale with thick interbeds of massive, white to gray gypsum. Commonly covered by talus. Much subsidence and distortion of beds in drainages owing to solution of gypsum. Contact with Fossil Mountain Member of Kaibab Formation (Pkf) unconformable, marked by topographic break between cliff of Kaibab Formation and slope of Toroweap Formation, caused by channel and solution erosion with local relief as much as 5 m; map contact generalized because of extensive talus cover. Gradational contact with underlying Brady Canyon Member (Ptb). Approximately 55 m thick

Ptb **Brady Canyon Member**—Cliff-forming, gray to dark-gray, fossiliferous, fetid, medium- to coarsely-crystalline, medium-bedded limestone. Includes thin-bedded dolomite in upper and lower part. Gradational contact with underlying Seligman Member (Pts), placed at bottom of limestone cliff. Approximately 85 m thick

Pts **Seligman Member**—Slope-forming, consists of upper interbedded gray thin-bedded dolomite and gypsiferous sandstone.; middle part gray to red, thin-bedded, interbedded siltstone, sandstone and gray gypsum; and lower part consists of brown and yellow, fine-grained, thin-bedded, low-angle crossbedded and flat-lying sandstone. Disconformable, sharp, planar contact with underlying Hermit Shale and Esplanade Sandstone (Phe). Forms slope with ledges in upper and lower part. Thickness approximately 55 m

Phe **Hermit Shale and Esplanade Sandstone, undifferentiated (Lower Permian)**—Hermit Shale is steep slope-forming red, pale red and white, fine- to medium-grained, thin- to medium-bedded sandstone and siltstone with ledge-forming sandstone beds common in upper and lower part. Disconformable contact with underlying Esplanade Sandstone marked by shallow channels as much as 3 m in relief. Contact difficult to place because of similar lenticular erosional channels within lower 30 m of unit. Esplanade Sandstone forms tan to white sandstone cliffs interrupted at top by thin recesses of red cross-stratified siltstone. Includes red and white, fine- to medium-grained, medium- to thick-bedded sandstone and siltstone and gray, thin- to medium-bedded, cross-stratified, calcareous sandstone in lower slope. Gradational contact with underlying Pakoon Limestone and Calville Limestone (PPc). Thickness approximately 220 m

PPc **Pakoon Limestone and Calville Limestone (Lower Permian to Upper Pennsylvanian)**—Forms cliffs and ledges of medium- to dark-gray, finely-crystalline sparry limestone and dolomite and pink, purple, or buff calcareous sandstone or sandy limestone and dolomite separated by beds of orange to red siltstone and sandstone. White, yellow and pink chert common. Contact between Pakoon Limestone and Calville Limestone undefined. Pakoon Limestone is within upper 60 m. Lower part of unit dominated by locally oolitic limestone and sandy limestone. Finely laminated and locally planar and cross stratified where sandy. Contains abundant crinoids, corals, fusilinids, and brachiopods at top and base. Base covered. Breccia ted locally. Exposed thickness approximately 290 m

EXPLANATION

Contact

Fault—Dashed where approximately located; dotted where concealed; queried where inferred. Arrow indicates direction and amount of dip of fault plane. Diamond-head arrow indicates bearing and plunge of slip indicators such as slickenslides, mullions and grooves. Bar and ball on downthrown side, where determined

Fold—Showing trace of axial plane. Dashed where approximately located, dotted where concealed
- Syncline
- Anticline
- Monocline—Axial trace dashed where approximately located
  - —Trace of anticlinal axis
  - —Trace of synclinal axis

Strike and dip of beds—Leadered dots show location of measurement
- Horizontal
- Inclined—Number indicates dip angle
- Approximate—Approximated dip or dip calculated from topographic expression
- Apparent dip—Shown in areas of low dip or poor exposure

Area of silicified breccia

Vent

Vent area

Dike
- Inclined—Number indicates dip angle
- Vertical

Location of radiometric-age sample

REFERENCES CITED

Billingsley, G.H., 1991a, Geologic map of the Mustang Knoll quadrangle, northern Mohave County, Arizona: U.S. Geological Survey Open-File Report 91-560, scale 1:24,000.

Billingsly, G.H., 1991b, Geologic Map of the St. George Canyon quadrangle, northern Mohave County, Arizona: U.S. Geological Survey Open-File Report 91-561, scale 1:24,000.

Billingsley, G.H., 1994, Geologic map of the Sullivan Draw and vicinity, Mohave County, northwestern Arizona: U.S. Geological Survey Miscellaneous Investigations Series Map I-2396, scale 1:31,680.

Bohannon, R.G., 1991, Geologic map of the Jacobs Well and southern part of the Elbow Canyon quadrangles, Mohave County, Arizona: U.S. Geological Survey Miscellaneous Investigations Series Map I-2167, scale 1:24,000.

Bohannon, R.G., 1992, Geologic map of the Red Pockets quadrangle: U.S. Geological Survey Miscellaneous Investigations Series Map I-2288, scale 1:24,000.

Bohannon, R. G. and Lucchitta, Ivo, 1991, Geologic map of the Mount Bangs quadrangle, Mohave County, Arizona: U.S. Geological Survey Miscellaneous Investigations Series Map I-2166, scale 1:24,000.

Lucchitta, Ivo, 1966, Cenozoic geology of the upper Lake Mead area adjacent to the Grand Wash cliffs, Arizona: Unpublished Dissertation, Pennsylvania State University, 219 p.

Lucchitta, Ivo and Beard, L.S., 1981, Preliminary geologic map of the Olaf Knolls quadrangle, Mohave County, Arizona: Open-File Report 81-1322, scale 1:24,000.

Reynolds, S.J., Florence, F.P., Welty, J.W., Roddy, D.A., Currier, D.A., Anderson, A.V., and Keith, S.B., 1986, Compilation of radiometric age determinations in Arizona: Arizona Bureau of Geology and Mineral Technology Bulletin 197, 258 p.

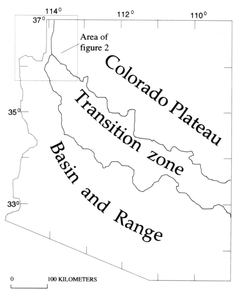


Figure 1. Map of Arizona showing major tectonic provinces and location of Figure 2.

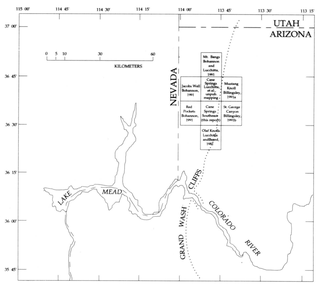


Figure 2. Index map showing published U.S. Geological Survey Open-File Reports and Miscellaneous Investigations Series Maps relative to the Cane Springs Southeast 7½ quadrangle.

GEOLOGIC MAP OF THE CANE SPRINGS SOUTHEAST QUADRANGLE, NORTHERN MOHAVE COUNTY, AZ.

By
Ivo Lucchitta, Carol M. Dehler and Peggy G. Basdekas

1995