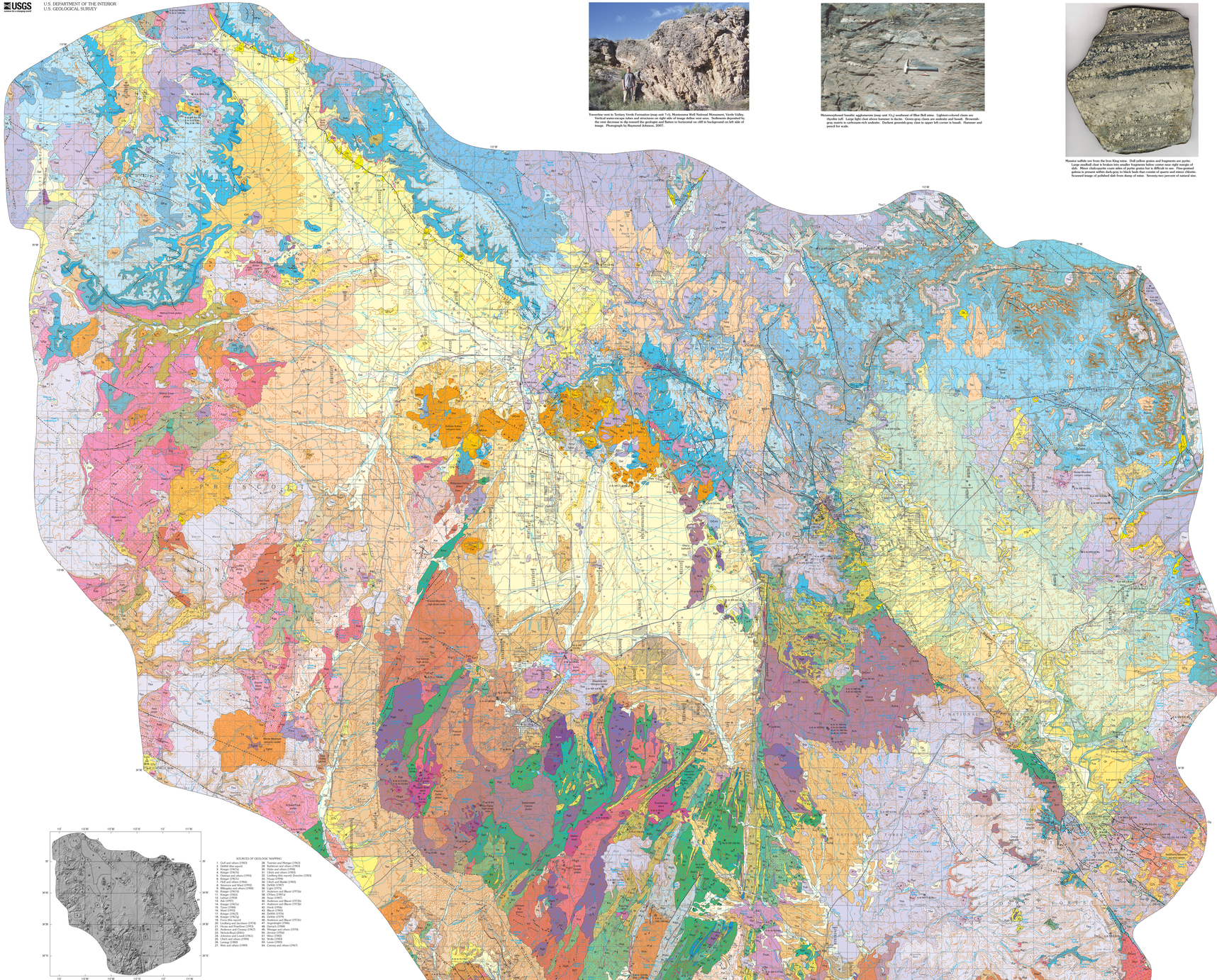
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

SCIENTIFIC INVESTIGATIONS MAP 2996
Pamphlet accompanies map



Travertine vent in Tertiary Verde Formation (map unit Tvf). Montezuma Well National Monument, Verde Valley, Yavapai County, Arizona. Vertical travertine layers are about 1 meter thick. Photograph by Raymond Johnson, 2002.

Metamorphosed basaltic agglomerate (map unit Ym) southeast of Blue Bell mine. Lightest-colored clasts are about 10 cm long. Most clasts are dark-gray to black, fine-grained, porphyritic basalt. Green clasts are altered basaltic clasts; gray matrix is carbonate-rich andesite. Darkest greenish-gray clast in upper left-center is basalt. Hammer and pencil for scale.

Massive sulfide ore from the Iron King mine. Dull yellow grains and fragments are pyrite. Large mudball clast is broken into smaller fragments below center near right margin. Clasts of dark-gray sphalerite are scattered throughout the specimen. Most of the visible galena is present within dark-gray to black beds that consist of quartz and minor chlorite. Scanned image of polished slab from dump of mine. Seventy-two percent of natural size.

INDEX TO SOURCES OF GEOLOGIC MAPPING

SOURCES OF GEOLOGIC MAPPING

1. Goff and others (1963)
2. DeWitt (this report)
3. Krieger (1962a)
4. Krieger (1965)
5. Ottenoy and others (1963)
6. Krieger (1962c)
7. Krieger and others (1964)
8. Stevenson and Ward (1992)
9. Stevenson and others (1968)
10. Krieger (1962b)
11. Krieger (1962d)
12. Lahren (1958)
13. Ash (1963)
14. Ward (1963a)
15. Tyson (1964)
16. Ward (1963)
17. Krieger (1962e)
18. Krieger (1962g)
19. Force (this report)
20. Anderson and Blacet (1972)
21. House and Pearthree (1993)
22. Anderson and Creasey (1967)
23. Krieger (1962f)
24. Johnson and Lovell (1961)
25. Ulrich and others (1984)
26. Wilson (1962)
27. Metz and others (1969)
28. Tweeton and Metzger (1963)
29. Hathaway and others (1963)
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31. Wilson and others (1960)
32. Lindberg (this report, Dutchie 1963)
33. House (1976)
34. Wilson and others (1963)
35. Quiffat (1967)
36. Wilson (1962)
37. Anderson and Blacet (1972a)
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40. Anderson and Blacet (1972b)
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42. Hook (1974)
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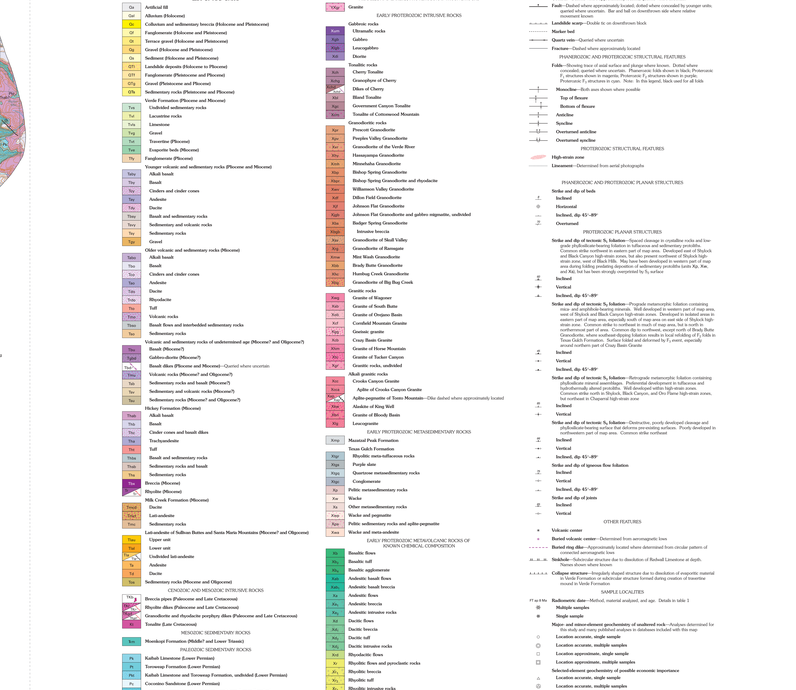
44. Blacet (1966)
45. Quiffat (1979)
46. Anderson and Blacet (1972c)
47. Wilson and Stewart (1974)
48. Darrach (1968)
49. Wenger and others (1973)
50. Wilson (1960)
51. Wise (1963)
52. Wolfe (1963)
53. Wolfe (1964)
54. Conway and others (1967)

GEOLOGIC MAP OF THE PRESCOTT NATIONAL FOREST AND THE HEADWATERS OF THE VERDE RIVER, YAVAPAI AND COCONINO COUNTIES, ARIZONA

By
Ed DeWitt[1], Victoria Langenheim[1], Eric Force[1], R.K. Vance[2], P.A. Lindberg[3], and R.L. Driscoll[1]
2008

[1]U.S. Geological Survey
[2]Georgia Southern University, Statesboro, Ga.
[3]Consulting geologist, Sedona, Ariz.



LIST OF MAP UNITS

Qa Artificial fill
Qae Alluvium (Holocene)
Qc Colluvium and sedimentary breccia (Holocene and Pleistocene)
Qf Fanglomerate (Holocene and Pleistocene)
Qt Terrace gravel (Holocene and Pleistocene)
Qg Gravel (Holocene and Pleistocene)
Qs Sediment (Holocene and Pleistocene)
Qls Landslide deposits (Holocene to Pliocene)
Qfl Fanglomerate (Pleistocene and Pliocene)
Qfg Gravel (Pleistocene and Pliocene)
QTs Sedimentary rocks (Pleistocene and Pliocene)
Verde Formation (Pliocene and Miocene)
Tsv Undivided sedimentary rocks
Tsl Lacustrine rocks
Tsls Limestone
Tsg Gravel
Tst Travertine (Pliocene)
Tss Evaporite beds (Pliocene)
Tfg Fanglomerate (Pliocene)
Younger volcanic and sedimentary rocks (Pliocene and Miocene)
Tabv Alkali basalt
Tbv Basalt
Tcv Cinders and cinder cones
Tav Andesite
Tdv Dacite
Tbsv Basalt and sedimentary rocks
Tsvv Sedimentary and volcanic rocks
Tsv Sedimentary rocks
Tgv Gravel
Older volcanic and sedimentary rocks (Miocene)
Tabo Alkali basalt
Tbo Basalt
Tco Cinders and cinder cones
Tao Andesite
Tdo Dacite
Tcho Rhyodacite
Tto Tuff
Tvso Volcanic rocks
Tbso Basalt flows and interbedded sedimentary rocks
Tso Sedimentary rocks
Volcanic and sedimentary rocks of undetermined age (Miocene? and Oligocene?)
Tbu Basalt (Miocene?)
Tgbd Gabbro-diorite (Miocene?)
Tbua Basalt (Miocene and Miocene)—Quarried where uncertain
Tvu Volcanic rocks (Miocene? and Oligocene?)
Tsu Sedimentary rocks and basalt (Miocene?)
Tsv Sedimentary and volcanic rocks (Miocene?)
Tu Sedimentary rocks (Miocene? and Oligocene?)
Hickey Formation (Miocene)
Thab Alkali basalt
Thb Basalt
Thc Cinder cones and basalt dikes
Tha Trachyandesite
Tht Tuff
Ths Basalt and sedimentary rocks
Thsb Sedimentary rocks and basalt
Ths Sedimentary rocks
Tbx Breccia (Miocene)
Rhyolite (Miocene)
Milk Creek Formation (Miocene)
Tmcd Dacite
Tmcl Latandesite
Tmcs Sedimentary rocks
Latandesites of Sullivan Buttes and Santa Maria Mountains (Miocene? and Oligocene)
Tmu Upper unit
Tml Lower unit
Undivided latandesite
Ta Andesite
Td Dacite
Tss Sedimentary rocks (Miocene and Oligocene)
CENOZOIC AND MESOZOIC INTRUSIVE ROCKS
Tbx Breccia pipes (Paleocene and Late Cretaceous)
Rhyolite dikes (Paleocene and Late Cretaceous)
Granodiorite and rhyodacite porphyry dikes (Paleocene and Late Cretaceous)
Ta Tonalite (Late Cretaceous)
MESOZOIC SEDIMENTARY ROCKS
Ksc Moenkopi Formation (Middle? and Lower Triassic)
PALEOZOIC SEDIMENTARY ROCKS
Pl Kaibab Limestone (Lower Permian)
Pt Toroweap Formation (Lower Permian)
Pkt Kaibab Limestone and Toroweap Formation, undivided (Lower Permian)
Pc Coconino Sandstone (Lower Permian)
Ptc Toroweap Formation and Coconino Sandstone (Lower Permian)
Psh Schnebly Hill Formation (Lower Permian)
Ph Hermit Formation (Lower Permian)
Pshh Schnebly Hill and Hermit Formations, undivided (Lower Permian)
Ps Supai Formation (Lower Permian to Upper Mississippian (or Upper Pennsylvanian of Blakey))
PIPsu Schnebly Hill, Hermit, and Supai Formations, undivided (Lower Permian and Upper Pennsylvanian)
Mr Redwall Limestone (Mississippian)
Dm Martin Formation (Upper and Middle? Devonian)
MDrm Redwall Limestone and Martin Formation, undivided (Mississippian through Middle? Devonian)
DCzu Martin Formation and Tapeats Sandstone, undivided (Upper Devonian through Lower Cambrian)
Ck Bright Angel Shale (Middle Cambrian)
Ct Tapeats Sandstone (Middle and Lower Cambrian)
Czu Bright Angel Shale and Tapeats Sandstone, undivided (Middle and Lower Cambrian)
MIDDLE PROTEROZOIC INTRUSIVE ROCKS
Gabbros
Xg Granite of Granite Basin
Yg Granite of Walnut Creek
Ygcb Breccia in granite of Walnut Creek
Ygd Granite of Kirkland Peak
Ydg Dells Granite
Yy Granodiorite of Yava
MEDDLEJOHN AND EARLIOIS PROTEROZOIC INTRUSIVE ROCKS
Vfgp Granite
EARLY PROTEROZOIC INTRUSIVE ROCKS
Gabbroic rocks
Eum Ultramafic rocks
Eg Gabbro
Ynl Leucogabbro
Ynd Diorite
Tonalitic rocks
Ktt Cherry Tonalite
Ktg Granophyre of Cherry
Kd Dikes of Cherry
Kbt Bland Tonalite
Kgt Government Canyon Tonalite
Ktc Tonalite of Cottonwood Mountain
Granodioritic rocks
Kpr Prescott Granodiorite
Kpv Peeples Valley Granodiorite
Kgr Granodiorite of the Verde River
Kbg Hassayampa Granodiorite
Kbm Mountainaba Granodiorite
Kbp Bishop Spring Granodiorite
Kbbp Bishop Spring Granodiorite and rhyodacite
Kwo Williamson Valley Granodiorite
Kdf Dillon Field Granodiorite
Kfj Johnson Flat Granodiorite
Kjgb Johnson Flat Granodiorite and gabbro migmatite, undivided
Kbr Badger Spring Granodiorite
Kbgi Intrusive breccia
Kcv Granodiorite of Shell Valley
Kfr Granodiorite of Hassayampa
Kmw Mint Wash Granodiorite
Kbb Brady Butte Granodiorite
Kbh Hornbaug Creek Granodiorite
Kdb Granodiorite of Big Bug Creek
Granitic rocks
Kmg Granite of Mingusser
Kst Granite of South Butte
Kgo Granite of Oregano Basin
Kcf Cornfield Mountain Granite
Kcg Gneissic granite
Kcc Crazy Basin Granite
Kfm Granite of Horse Mountain
Kcr Granite of Tucker Canyon
Kg Granitic rocks, undivided
Alkali granitic rocks
Kcc Crooks Canyon Granite
Kcn Aplite of Crooks Canyon Granite
Kpa Aplite-pegmatite of Tonto Mountain—Dike dashed where approximately located
Kbm Alaskite of King Well
Kbd Granite of Bloody Basin
Kg Leucogranite
EARLY PROTEROZOIC METASEDIMENTARY ROCKS
Xmp Mazatzal Peak Formation
Texas Gulch Formation
Xbp Rhyolite ash-flow-tuff
Xgp Purple slate
Xqp Quartzose metasedimentary rocks
Xcp Conglomerate
Xp Pelitic metasedimentary rocks
Xw Wacke
Xs Other metasedimentary rocks
Xwp Wacke and pegmatite
Xpp Pelitic sedimentary rocks and aplite-pegmatite
Xsw Wacke and meta-andesite
EARLY PROTEROZOIC METAVOLCANIC ROCKS OF KNOWN CHEMICAL COMPOSITION
Basaltic flows
Xbt Basaltic tuff
Basaltic agglomerate
Andesitic basalt flows
Andesitic basalt breccia
Andesitic flows
Andesitic breccia
Andesite intrusive rocks
Dacitic flows
Dacitic breccia
Dacitic tuff
Dacitic intrusive rocks
Rhyodacitic flows
Rhyolite flows and pyroclastic rocks
Rhyolite breccia
Rhyolite tuff
Rhyolite intrusive rocks
EARLY PROTEROZOIC HYDROTHERMALLY ALTERED METAVOLCANIC ROCKS RELATED TO VOLCANOGENIC MASSIVE SULFIDE DEPOSITS
Altered basaltic rocks
Altered andesitic rocks
Altered dacitic rocks
Altered dacitic breccia
Altered rhyolitic and pyroclastic rocks
Altered rhyolite breccia
Altered rhyolitic tuff
Altered rocks
EARLY PROTEROZOIC METAVOLCANIC ROCKS OF APPROXIMATELY KNOWN CHEMICAL COMPOSITION
Mafic rocks
Amphibolite
Intermediate-composition rocks
Felsic rocks
EARLY PROTEROZOIC METASYNEFACEOUS, CHEMICALLY PRECIPITATED, AND GRIESIC ROCKS
Tuffaceous metasedimentary rocks
Iron-formation, metachert, and siliceous metavolcanic rocks
Greisen
Migmatite

Contact—Dashed where approximately located, queried where uncertain
Fault—Dashed where approximately located, dotted where concealed by younger units, queried where uncertain. Bar and ball on downthrown side where relative movement known
Landslide scarp—Double tic on downthrown block
Marker bed
Quarry site—Queried where uncertain
Fracture—Dashed where approximately located

PHANEROZOIC AND PROTEROZOIC STRUCTURAL FEATURES
Folds—Axes of folds where approximately known. Dashed where approximately located, queried where uncertain. Phanerozoic folds shown in black; Proterozoic F_1 structures shown in magenta; Proterozoic F_2 structures shown in purple; Proterozoic F_3 structures in cyan. Note: In this legend, black used for all folds
Monocline—Bulb axes shown where possible
Top of fissure
Bottom of fissure
Anticline
Syncline
Overturned anticline
Overturned syncline

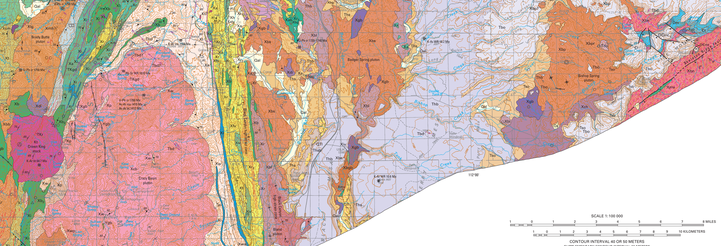
PROTEROZOIC STRUCTURAL FEATURES
High-strain zone
Lineament—Determined from aerial photographs

PHANEROZOIC AND PROTEROZOIC PLANAR STRUCTURES
Strike and dip of beds
Inclined
Horizontal
Inclined, dip 45°–89°
Overturned

PROTEROZOIC PLANAR STRUCTURES
Strike and dip of tectonic S_1 foliation—Spaced cleavage in crystalline rocks and low-grade schist. Dashed where approximately located, queried where uncertain. Common strike northwest in eastern part of map area. Developed east of Shylock and Black Canyon high-strain zones, but also present northwest of Shylock high-strain zone and in Black Hills. May be well developed in eastern part of map area during folding preceding deposition of sedimentary protaliths (units Xp, Xsc, and Xs), but has been strongly overprinted by S_2 surface
Inclined
Vertical
Inclined, dip 45°–89°
Strike and dip of tectonic S_2 foliation—Penetrative metamorphic foliation containing phyllosilicate mineral assemblages. Preferred development in biotite-rich hydrothermally altered protaliths. Well developed within high-strain zones. Common strike north in Shylock, Black Canyon, and Oro Flame high-strain zones, but northeast in Chaparral high-strain zone
Inclined
Vertical
Strike and dip of tectonic S_3 foliation—Destructive, poorly developed cleavage and crenulation cleavage in hydrothermally altered metapelites and sulfates. Poorly developed in southeastern part of map area. Common strike northeast
Inclined
Vertical
Inclined, dip 45°–89°
Strike and dip of igneous flow foliation
Inclined
Vertical
Inclined, dip 45°–89°
Strike and dip of joints
Inclined
Vertical

OTHER FEATURES
Volcanic center
Buried volcanic center—Determined from aeromagnetic lows
Buried ring dike—Approximately located where determined from circular pattern of aeromagnetic anomalies
Sinkhole—Subcircular structure due to dissolution of Redwall Limestone at depth. Names shown where known
Collapse structure—Irregularly shaped structure due to dissolution of evaporitic material in Verde Formation or subcircular structure formed during creation of travertine mound in Verde Formation

SAMPLE LOCALITIES
Radiometric date—Method, material analyzed, and age. Details in table 1
Multiple samples
Single sample
Major- and minor-element geochemistry of unaltered rock—Analyses determined for this study and many published analyses in databases included with this map
Location accurate, single sample
Location accurate, multiple samples
Location approximate, single sample
Location approximate, multiple samples
Selected-element geochemistry of possible economic importance
Location accurate, single sample
Location accurate, multiple samples
Location approximate, multiple samples
Selected water well—Black symbol shows Arizona Department of Water Resources well with well-log information available. Additional information on these wells is in Description of Map Units; depths to feet indicate top and bottom of units encountered. Registry number and map units omitted for gray symbols. See table 2. Data from Arizona Department of Water Resources CD-ROM, Spring 2007. Complete listing of all water wells in Excel file included with this map; but file contains original information from drillers; not interpretation of geology based on this study



Base from U.S. Geological Survey: Bagdad, 1978; Bradshaw Mts., Flagstaff, Fossil Springs, Government Peak, Hackberry, Hillside, Kirkland Valley, Mount Tipton, Paulden, Prescott, Sullivan Buttes, Tuzigoot, Yarnell, Yavapai Point, 1983; Sedona, 1980; Valentine, 1984; Williams, 1983 Universal Transverse Mercator grid, Universal Transverse Mercator zones 11 and 12
1927 North American Datum

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