Putting Geoscience to Work for Arizona

Arizona Mineral Resources

Metals & Industrial Minerals

Protecting Arizona

Geologic Hazard Assessment

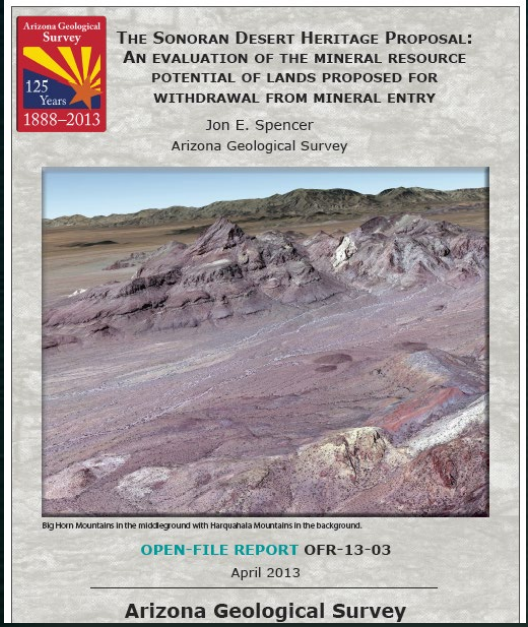
Serving our Stakeholders

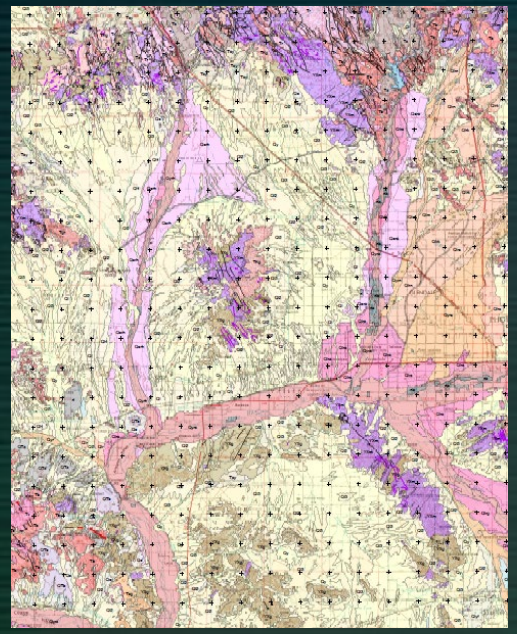
State, Federal, Tribal, County, the public

UA SCIENCE

Arizona Mineral Resources

- ✓ Mineral assessment of public lands to inform decision-making
- ✓ Engaging with Arizona's mineral industry
- ✓ Online publications & mining repositories – 24/7/365
- ✓ Geologic mapping & resource assessment



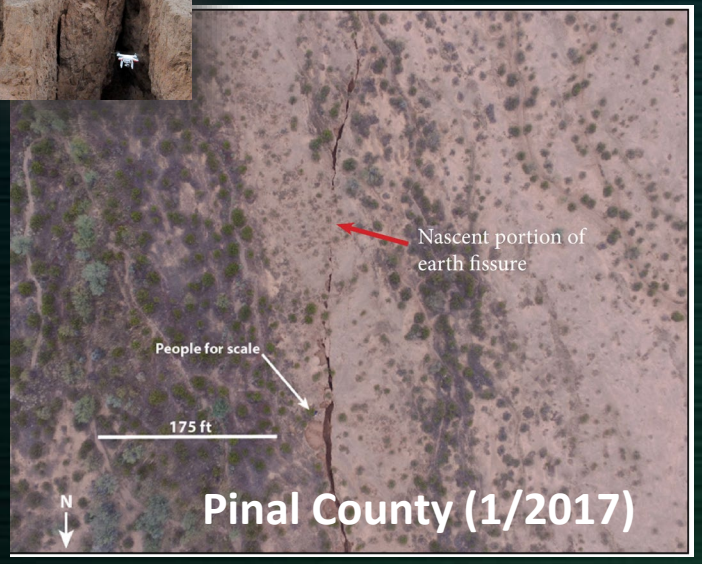


Protecting Arizona – Geohazard Assessment & Communication

Natural Hazards in Arizona Viewer

http://data.azgs.az.gov/hazard-viewer/

Earth Fissures & Subsidence



Pinal County (1/2017)

~ 275 miles of fissure in S-C AZ

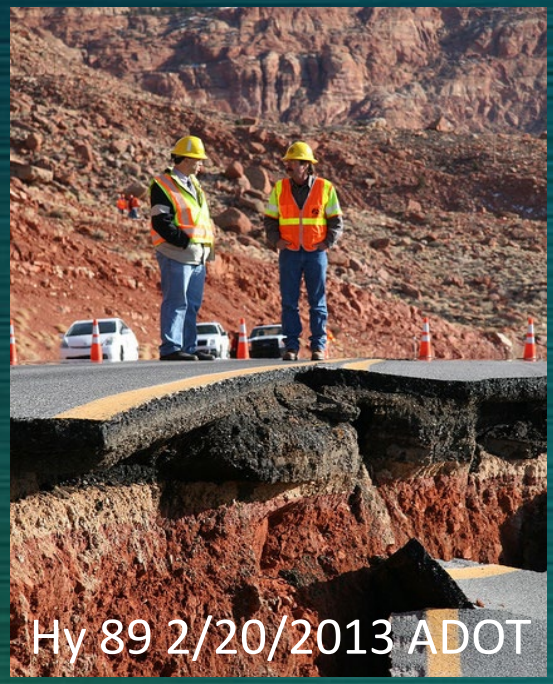
Earthquakes

M 3-7 Events

Landslides

June 2017 - **AzSLID**

AZ Landslide Inventory



Hy 89 2/20/2013 ADOT

Putting Geoscience to work for Arizona

MISSION – Inform public & industry understanding of the state's geologic character, mineral resources, and geologic hazards

AZGS Staff *fields of expertise*

- ✓ Environmental Geology
- ✓ Geologic Mapping
- ✓ Hazard Assessment
- ✓ Geoinfomatics
- ✓ Economic Geology (pending)
- ✓ Outreach Edu. & Communications

Sunset Crater in snow, Flagstaff, Arizona

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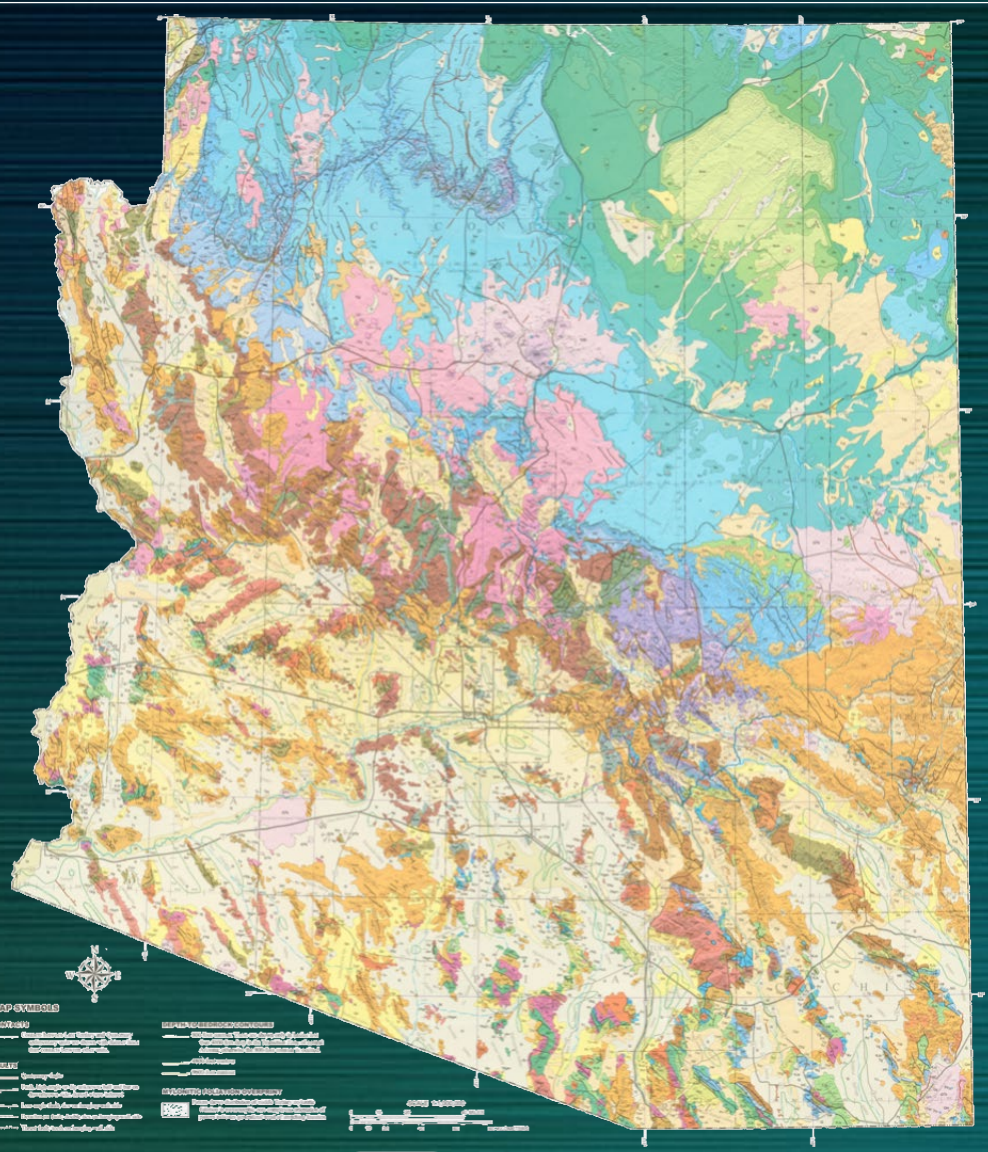
Our Partners & Stakeholders

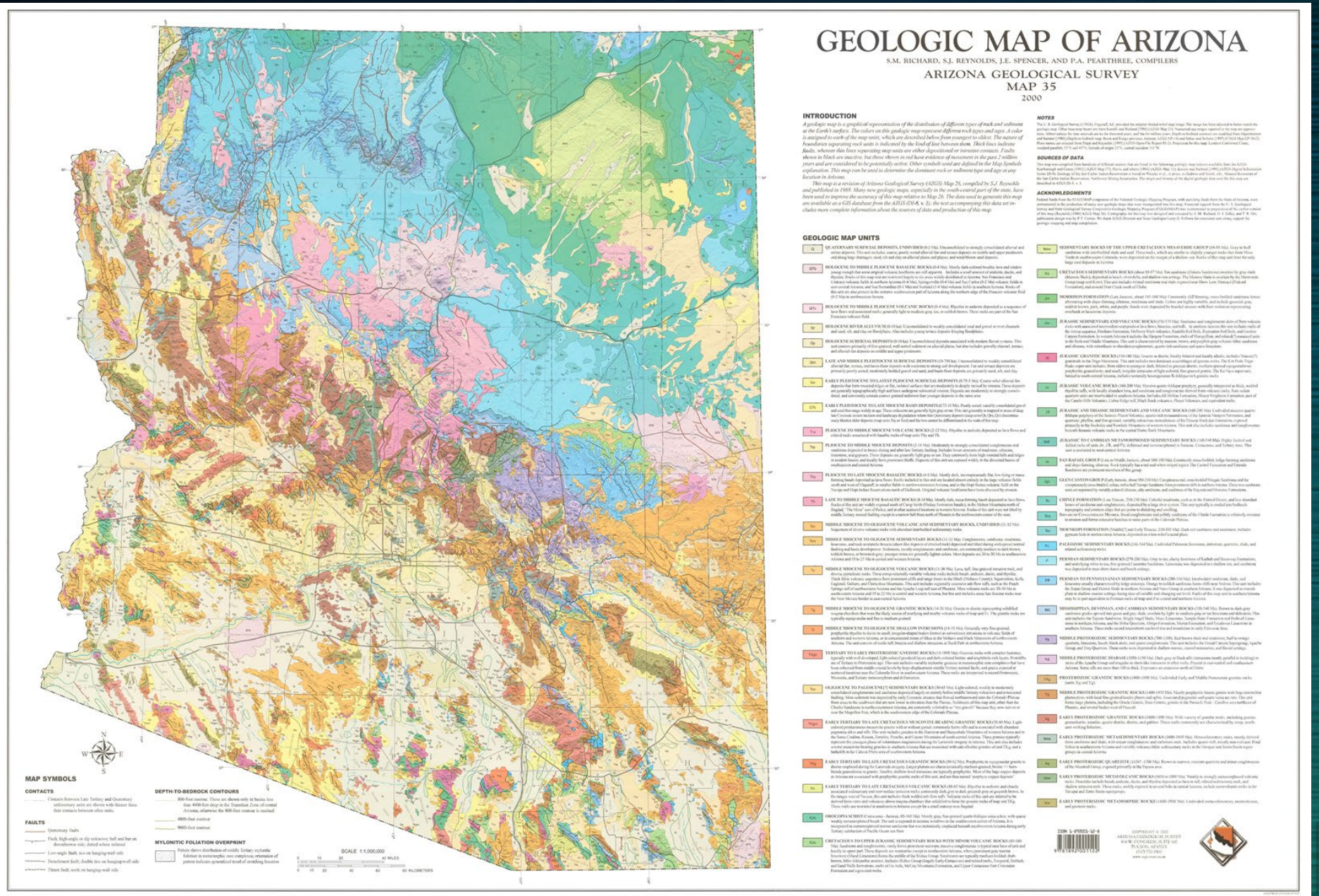
J.Q. Public



ADEQ Arizona Department of Environmental Quality

U.S. DEPARTMENT OF ENERGY

UA SCIENCE



GEOLOGIC MAP OF ARIZONA

S.M. RICHARD, S.J. REYNOLDS, J.E. SPENCER, AND P.A. PEARTHREE, COMPILERS

ARIZONA GEOLOGICAL SURVEY
MAP 35
2000

INTRODUCTION

A geologic map is a graphical representation of the distribution of different types of rock and sediment at the Earth's surface. The colors on this geologic map represent different rock types and ages. A color is assigned to each of the map units, which are described below from youngest to oldest. The nature of boundaries separating rock units is indicated by the kind of line between them. Thick lines indicate faults, wherein thin lines separating map units are either depositional or intrusive contacts. Faults shown in black are inactive, but those shown in red have evidence of movement in the past 2 million years and are considered to be potentially active. Other symbols used are defined in the Map Symbols explanation. This map can be used to determine the dominant rock or sediment type and age at any location in Arizona.

This map is a revision of Arizona Geological Survey (AZGS) Map 26, compiled by S.J. Reynolds and published in 1988. Many new geologic maps, especially in the south-central part of the state, have been used to improve the accuracy of this map relative to Map 26. The data used to generate this map are available as a GIS database from the AZGS (DS-8, v. 2); the text accompanying this data set includes more complete information about the sources of data and production of this map.

NOTES

The U. S. Geological Survey (USGS), Flagstaff, AZ, provided the original shaded-relief map image. The image has been adjusted to better match the geologic map. Other base-map layers are from Kandell and Richard [1990] (AZGS Map 23). Numerical age ranges reported in the map are approximate. Abbreviations for time intervals are ka for thousand years, and Ma for million years. Depth-to-bedrock contours are modified from Oppenheimer and Sumner [1980] (Depth-to-bedrock map, Basin and Range province, Arizona: AZGS MF-141) and Sellers and Jachens [1985] (USGS Misc GIP-1612). Place names are selected from Trapp and Reynolds [1995] (AZGS Open-File Report 95-2). Projection for this map: Lambert Conformal Conic, standard parallels, 33°N and 45°N, latitude of origin 23°N, central meridian 111°W.

SOURCES OF DATA

This map was compiled from hundreds of different sources that are listed in the following geologic map indexes available from the AZGS: Scarborough and Cornet [1983] (AZGS Map 17); Harris and others [1984] (AZGS Map 16); Kinnaird and Richard [1990] (AZGS Digital Information Series DIS-9); Geology of the San Carlos Indian Reservation in Gresham-Wrucke et al., in press; in Gladwin and Nowlin, eds., Mineral Resources of the San Carlos Indian Reservation, Northwest Mining Association. The origin and history of the digital geologic data used for this map are described in AZGS DS-8, v. 3.

ACKNOWLEDGMENTS

Federal funds from the STATEMAP component of the National Geologic Mapping Program, with matching funds from the State of Arizona, were instrumental in the production of many new geologic maps that were incorporated into this map. Financial support from the U. S. Geological Survey and State Geological Survey Cooperative Geologic Mapping Program (#1434HQ96AP) was instrumental in preparation of the earlier version of this map (Reynolds [1988] AZGS Map 26). Cartography for this map was designed and executed by S. M. Richard, D. J. Jolley, and T. R. Orr; publication design was by P. T. Cornac. We thank AZGS Director and State Geologist Larry D. Fellows for consistent and strong support for geologic mapping and map compilation.

GEOLOGIC MAP UNITS

Qa QUATERNARY SURFICIAL DEPOSITS, UNDIVIDED (0-2 Ma). Unconsolidated to strongly consolidated alluvial and eolian deposits. This unit includes coarse, poorly sorted alluvial fan and terrace deposits on middle and upper piedmonts and along large drainages; sand, silt and clay on alluvial plains and playas; and wind-blown sand deposits.

QTb HOLOCENE TO MIDDLE PLIOCENE BASALTIC ROCKS (0-4 Ma). Mostly dark-colored basaltic lava and cinders young enough that some original volcanic landforms are still apparent. Includes a small amount of andesite, dacite, and rhyolite. Rocks of this map unit are restricted largely to six areas widely distributed in Arizona: San Francisco and Uinkaret volcanic fields in northern Arizona (0-4 Ma), Springerville (0-4 Ma) and San Carlos (0-2 Ma) volcanic fields in east-central Arizona, and San Bernardino (0-1 Ma) and Sentinel (3-4 Ma) volcanic fields in southern Arizona. Rocks of this unit are also present in the extreme southwestern part of Arizona along the northern edge of the Pinacate volcanic field (0-2 Ma) in northwestern Sonora.

QTr HOLOCENE TO MIDDLE PLIOCENE VOLCANIC ROCKS (0-4 Ma). Rhyolite to andesite deposited in a sequence of lava flows and associated rocks; generally light to medium gray, tan, or reddish brown. These rocks are part of the San Francisco volcanic field.

Qr HOLOCENE RIVER ALLUVIUM (0-10 ka). Unconsolidated to weakly consolidated sand and gravel in river channels and sand, silt, and clay on floodplains. Also includes young terrace deposits forming floodplains.

Qy HOLOCENE SURFICIAL DEPOSITS (0-10 ka). Unconsolidated deposits associated with modern fluvial systems. This unit consists primarily of fine-grained, well-sorted sediment on alluvial plains, but also includes gravelly channel, terrace, and alluvial-fan deposits on middle and upper piedmonts.

Qm LATE AND MIDDLE PLEISTOCENE SURFICIAL DEPOSITS (10-750 ka). Unconsolidated to weakly consolidated alluvial-fan, terrace, and basin-floor deposits with moderate to strong soil development. Fan and terrace deposits are primarily poorly sorted, moderately bedded gravel and sand, and basin-floor deposits are primarily sand, silt, and clay.

Qo EARLY PLEISTOCENE TO LATEST PLIOCENE SURFICIAL DEPOSITS (0.75-3 Ma). Coarse relict alluvial-fan deposits that form rounded ridges or flat, isolated surfaces that are moderately to deeply incised by streams. These deposits are generally topographically high and have undergone substantial erosion. Deposits are moderately to strongly consolidated, and commonly contain coarser grained sediment than younger deposits in the same area.

QTb EARLY PLEISTOCENE TO LATE MIOCENE BASIN DEPOSITS (0.75-10 Ma). Poorly sorted, variably consolidated gravel and sand that range widely in age. These sediments are generally light gray or tan. This unit generally is mapped in areas of deep late Cenozoic stream incision and landscape degradation where thin Quaternary deposits (map units Qy, Qm, Qo) discontinuously blanket older deposits (map units Tby or Tcs) and the two cannot be differentiated at the scale of this map.

Tvr PLIOCENE TO MIDDLE MIOCENE VOLCANIC ROCKS (2-12 Ma). Rhyolite to andesite deposited as lava flows and related rocks associated with basaltic rocks of map units Tby and Tb.

Tby PLIOCENE TO MIDDLE MIOCENE DEPOSITS (2-16 Ma). Moderately to strongly consolidated conglomeratic and sandstone deposited in basin-fill and other late Tertiary faulting. Includes lesser amounts of mudstone, siltstone, limestone, and gypsum. These deposits are generally light gray or tan. They commonly form high rounded hills and ridges in modern basins, and locally form prominent bluffs. Deposits of this unit are exposed widely in the structural basins of southeastern and central Arizona.

Tbs PLIOCENE TO LATE MIOCENE BASALTIC ROCKS (4-13 Ma). Mostly dark, inconspicuously flat, low-lying or mesa-forming basalt deposited as lava flows. Rocks included in this unit are located almost entirely in the large volcanic fields south and west of Flagstaff, in smaller fields in northwestern Arizona, and in the Hopi Buttes volcanic field on the Navajo and Hopi Indian Reservations north of Holbrook. Original volcanic landforms have been obscured by erosion.

Tb LATE TO MIDDLE MIOCENE BASALTIC ROCKS (8-16 Ma). Mostly dark, mesa-forming basalt deposited as lava flows. Rocks of this unit are widely exposed south of Camp Verde (Hickey Formation basalt), in the Mohon Mountains north of Flagstaff, "The Mesa" east of Parker, and at other scattered locations in western Arizona. Rocks of this unit were not tilted by middle Tertiary normal faulting except in a narrow belt from north of Phoenix to the northwestern corner of the state.

Tvc MIDDLE MIOCENE TO OLIGOCENE VOLCANIC AND SEDIMENTARY ROCKS, UNDIVIDED (11-32 Ma). Sequences of diverse volcanic rocks with abundant interbedded sedimentary rocks.

Tsm MIDDLE MIOCENE TO OLIGOCENE SEDIMENTARY ROCKS (11-32 Ma). Conglomeratic, sandstone, mudstone, limestone, and rock-avalanche breccia (debris flow deposits of crystal-rich rock) deposited and tilted during widespread normal faulting and basin development. Sediments, mostly conglomeratic and sandstone, are commonly resistant to dark brown, reddish brown, or brownish gray; younger strata are generally lighter colors. Most deposits are 20 to 30 Ma in southeastern Arizona and 15 to 25 Ma in central and western Arizona.

Tv MIDDLE MIOCENE TO OLIGOCENE VOLCANIC ROCKS (11-38 Ma). Lava, tuff, fine-grained intrusive rock, and diverse pyroclastic rocks. These compositionally variable volcanic rocks include basalt, andesite, dacite, and rhyolite. Thick Mid-c volcanic sequences form prominent cliffs and range fronts in the Black (Mohawk–Comobabi), Superstition, Kofa, Eagletail, Galiuro, and Chiricahua Mountains. This unit includes regionally extensive ash-flow tuffs, such as the Peach Springs tuff of northwestern Arizona and the Apache Leap tuff near Phoenix. Most volcanic rocks are 29–30 Ma in southeastern Arizona and 18 to 22 Ma in central and western Arizona, but this unit includes some late Eocene rocks near the New Mexico border in east-central Arizona.

Tg MIDDLE MIOCENE TO OLIGOCENE GRANITIC ROCKS (14-26 Ma). Granite to diorite representing solidified magma chambers that were the likely source of overlying and nearby volcanic rocks of map unit Tv. The granitic rocks are typically equigranular and fine to medium grained.

Ti MIDDLE MIOCENE TO OLIGOCENE SHALLOW INTRUSIONS (14-35 Ma). Generally very fine-grained, porphyritic rhyolite to dacite in small, irregular-shaped bodies (intrusive equivalents of volcanic fields of southern and western Arizona, or in concentrated zones of dikes in the Mohawk and Black Mountains of northwestern Arizona. The unit consists of exotic tuff, breccia and shallow intrusions at Hualf Park in northwestern Arizona.

TYgn TERTIARY TO EARLY PROTEROZOIC GNEISSIC ROCKS (1.7-1800 Ma). Gneissic rocks with complex histories, typically with well-developed, light-colored granitoid layers and dark-colored biotite- and amphibolite-rich layers. Protoliths are of Tertiary to Proterozoic age. This unit includes variably mylonitic gneisses in metamorphic core complexes that have been exhumed from middle crustal levels by large-displacement middle Tertiary normal faults, and gneiss exposed at scattered locations near the Colorado River in southwestern Arizona. These rocks are interpreted to record Proterozoic, Mesozoic, and Tertiary metamorphism and deformation.

Tsu OLIGOCENE TO PALEOCENE(?) SEDIMENTARY ROCKS (30-65 Ma). Light-colored, weakly to moderately consolidated conglomeratic and sandstone deposited largely or entirely before middle Tertiary volcanism and extensional faulting. Most sediment was deposited by early Cenozoic streams that flowed northeastward onto the Colorado Plateau from areas to the southwest that are now lower in elevation than the Plateau. Sediments of this map unit, other than the Chuska Sandstone in northeastern Arizona, are commonly referred to as "red gravels" because they were not cut or over the Mogollon Rim, which is the southwestern edge of the Colorado Plateau.

TYgpt EARLY TERTIARY TO LATE CRETACEOUS MUSCOVITE-BEARING GRANITIC ROCKS (50-80 Ma). Light-colored peraluminous muscovite granitic rock or without garnet, commonly forms cliffs and is associated with abundant pegmatite dikes and sills. This unit includes granites in the Harcuvar and Harquahala Mountains of western Arizona and in the Santa Catalina, Rincon, Tortolita, Pinaleño, and Coyote Mountains of south-central Arizona. These granites typically represent the youngest phase of voluminous magmatism during the Laramide orogeny in Arizona. This unit also includes several muscovite-bearing granites in southern Arizona that are associated with calc-alkaline granites of unit TKg, and a batholith in the Cabeza Prieta area of southwestern Arizona.

TYg EARLY TERTIARY TO LATE CRETACEOUS GRANITIC ROCKS (50-92 Ma). Porphyritic to equigranular granite to diorite emplaced during the Laramide orogeny. Largest plutons are characteristically medium-grained, biotite +/- hornblende granodiorite to granite. Smaller, shallow-level intrusions are typically porphyritic. Most of the large copper deposits in Arizona are associated with porphyritic granitic rocks of this unit, and ore thus named "porphyry copper deposits."

Tv EARLY TERTIARY TO LATE CRETACEOUS VOLCANIC ROCKS (50-82 Ma). Rhyolite to andesite and closely associated sedimentary and non-marine sedimentary rocks; commonly dark gray to dark greenish gray or greenish brown, in the Sierra Vieja of Texas, this unit includes thick welded ash-flow tuffs. Volcanic rocks of this unit are inferred to be derived from vents and volcanoes above magma chambers that solidified to form the granitic rocks of map unit TKg. These rocks are restricted in southwestern Arizona except for a small outcrop near Ajo.

Kch CHOCOPA SCHIST (Cretaceous - Jurassic, 65-165 Ma). Mostly gray, fine-grained quartz-feldspar-mica schist, with sparse weakly metamorphosed basalt. The unit is exposed in tectonic windows in the southwestern corner of Arizona. It is interpreted as metamorphosed oceanic sandstone that was tectonically emplaced beneath southwestern Arizona during early Tertiary subduction of Pacific Ocean sea floor.

Kcb CRETACEOUS TO UPPER JURASSIC SEDIMENTARY ROCKS WITH MINOR VOLCANIC ROCKS (65-160 Ma). Sandstone and conglomeratic, rusty-brown pronounced outcrops, massive conglomerate is typical near base of unit and locally in upper part. These deposits are nonmarine except in southwestern Arizona, where prominent gray marine limestone (Mural Limestone) forms the middle of the Bisbee Group. Sandstones are typically medium-bedded, dark-brown, litho-feldspathic arenites. Includes Bisbee Group (largely Early Cretaceous) and related rocks, Temporal, Bolinda, and Sand Wells formations, rocks of Gu Achi, McCoy Mountains Formation, and Upper Cretaceous–Fort Crittenden Formation and equivalent rocks.

Kmv SEDIMENTARY ROCKS OF THE UPPER CRETACEOUS MESAVERDE GROUP (84-95 Ma). Gray to buff sandstone with interbedded shale and coal. These rocks, which are similar to slightly younger rocks that form Mesa Verde in southwestern Colorado, were deposited on the margin of a shallow sea. Rocks of this map unit host the only large coal deposits in Arizona.

Kcs CRETACEOUS SEDIMENTARY ROCKS (about 65-97 Ma). Tan sandstone (Dakota Sandstone) overlain by gray shale (Mancos Shale); deposited in beach, shoreface, and shallow-sea settings. The Mancos Shale is overlain by the Mesaverde Group (map unit Kmv). This unit includes related nonmarine seal shale exposed near Show Low, Nutrioso (Finkel Formation), and around Dont Creek south of Globe.

Jm MORRISON FORMATION (Late Jurassic, about 145-160 Ma). Commonly cliff-forming, cross-bedded sandstone lenses alternating with slope-forming siltstone, mudstone and shale. Colors are highly variable, and include greenish gray, reddish brown, pink, white, and purple. Sands were deposited by braided streams with their sediment representing overbank or lacustrine deposits.

Jtv JURASSIC SEDIMENTARY AND VOLCANIC ROCKS (150-170 Ma). Sandstone and conglomeratic units of three volcanic rocks with associated intermediate-composition lava flows, breccias, and tuffs. In southern Arizona this unit includes rocks of the Artesa sequence, Pinnbaro Formation, McHenry Wash volcanics, Rainbow Red Rocks, Exxonmobil Red Rocks, and Canyon Formation. In western Arizona it includes the Glenpen Formation, rocks of Mangalitan, and related(?) nonmarine units in the Kofa and Middle Mountains. This unit is characterized by massive, brown, and purplish-gray volcanic-lithic sandstone and siltstone, with subordinate to abundant conglomeratic, quartz-rich sandstone and sparse limestone.

Jg JURASSIC GRANITIC ROCKS (150-180 Ma). Granite to diorite, locally foliated and locally alkalic; includes Tinaja(?) granitoids in the Dripp Mountains. This unit includes two dominant assemblages of igneous rocks. The Fort Pride–Trigo Peaks super-unit includes, from oldest to youngest: dark, foliated to gneissic diorite; medium-grained equigranular to porphyritic granodiorite; and small, irregular intrusions of light-colored, fine-grained granite. The Kai Vaya super-unit, limited to south-central Arizona, includes texturally homogeneous K-feldspar-rich granitic rocks.

Jv JURASSIC VOLCANIC ROCKS (160-200 Ma). Massive quartz-feldspar porphyry, generally interpreted as thick, welded rhyolite tuffs, with locally abundant lava and sandstone and conglomerate derived from volcanic rocks. Rare eolian quartzite units are interbedded in southern Arizona. Includes Alk Mollie Formation, Moore Wrightson Formation, part of the Camelo Hills Volcanics, Cabra Ridge tuff, Black Rock volcanics, Plaisir Volcanics, and equivalent rocks.

Js JURASSIC AND TRIASSIC SEDIMENTARY AND VOLCANIC ROCKS (160-240 Ma). Undivided massive quartz-feldspar porphyry of the Jurassic Placid Volcanics, quartz-rich nonmarine rocks of the Jurassic Vampire Formations, and quartzite, phyllite, and fine-grained, variably calcareous metasediments of the Triassic Rock dan Formation, exposed primarily in the Rockslide and Rawhide Mountains of western Arizona. This unit also includes sandstone and conglomeratic beneath Jurassic volcanic rocks in the central Dome Rock Mountains.

MzE JURASSIC TO CAMBRIAN METAMORPHOSED SEDIMENTARY ROCKS (160-540 Ma). Highly faulted and folded rocks of unds. Jr., JTr, and PZ, deformed and metamorphosed in Jurassic, Cretaceous, and Tertiary time. This unit is restricted to west-central Arizona.

Js SAN RAFAEL GROUP (Late to Middle Jurassic, about 160-180 Ma). Commonly cross-bedded, ledge-forming sandstone and slope-forming siltstone. Rock typically has a red–teal-white striped aspect. The Carmel Formation and Entrada Sandstone are prominent members of this group.

Jgc GLEN CANYON GROUP (Early Jurassic, about 180-210 Ma). Conspicuous red, cross-bedded Wingate Sandstone and the conspicuously cross-bedded, eolian, red to buff Navajo Sandstone. Formerly mapped as a single unit, these two sandstone units are separated by variably colored siltstone, silty sandstone, and sandstone of the Kayenta and Moenave Formations.

Tc CHINLE FORMATION (Late Triassic: 208-230 Ma). Colorful mudstone, such as in the Painted Desert, and less abundant lenses of sandstone and conglomerate, deposited by a large river system. This unit typically is eroded into badlands topography and contains clays that are prone to shrinking and swelling.

Trcs Shinarump Conglomerate Member. Basal conglomerate and pebbly sandstone of the Chinle Formation is commonly resistant to erosion and forms extensive benches in many parts of the Colorado Plateau.

Tm MOENKOPI FORMATION (Middle(?) and Early Triassic, 230-245 Ma). Dark-red sandstone and mudstone; includes gypsum beds in northwestern Arizona, deposited on a low-relief coastal plain.

PZs PALEOZOIC SEDIMENTARY ROCKS (240-544 Ma). Undivided Paleozoic limestone, dolostone, quartzite, shale, and related sedimentary rocks.

P PERMIAN SEDIMENTARY ROCKS (270-280 Ma). Gray to tan, cherty limestone of Kaibab and Toroweap Formations, and underlying white to tan, fine-grained Coconino Sandstone. Limestone was deposited in a shallow sea, and sandstone was deposited in near-shore dunes and beach settings.

PP PERMIAN TO PENNSYLVANIAN SEDIMENTARY ROCKS (280-310 Ma). Interbedded sandstone, shale, and limestone usually characterized by ledge outcrops. Orange to reddish sandstone forms cliffs near Sedona. This unit includes the Supai Group and Hermit Shale in northern Arizona and Naco Group in southern Arizona. It was deposited on a coastal plain to shallow-marine settings during time of variable and changing sea level. Rocks of this map unit in southern Arizona may be in part equivalent to Permian rocks of map unit P in central and northern Arizona.

MC MISSISSIPPIAN, DEVONIAN, AND CAMBRIAN SEDIMENTARY ROCKS (330-540 Ma). Brown to dark-gray sandstone grades upward into green and gray shale, overlain by light- to medium-gray or tan limestone and dolostone. This unit includes the Tapeats Sandstone, Bright Angel Shale, Muav Limestone, Temple Butte Formation and Redwall Limestone in northern Arizona, and the Bolsa Quartzite, Abrigo Formation, Martin Formation, and Escabrosa Limestone in southern Arizona. These rocks record intermittent sea-level rise and inundation in early Paleozoic time.

Yo MIDDLE PROTEROZOIC SEDIMENTARY ROCKS (700-1,000). Red-brown shale and sandstone, buff to orange quartzite, limestone, basalt, black shale, and quartz conglomerate. This unit includes the Grand Canyon Supergroup, Apache Group, and Troy Quartzite. These rocks were deposited in shallow marine, coastal-mountain, and fluvial settings.

Yd MIDDLE PROTEROZOIC DIABASE (1050-1,150 Ma). Dark-gray or black sills (intrusions nearly parallel to bedding) in strata of the Apache Group and irregular to sheet-like intrusions in other rocks. Present in east-central and southeastern Arizona. Some sills are more than 100 m thick. Equivalent are gabbros north of Globe.

YXg PROTEROZOIC GRANITIC ROCKS (1400–1700 Ma). Undivided Early and Middle Proterozoic granitic rocks (units Xg and Yg).

Yg MIDDLE PROTEROZOIC GRANITIC ROCKS (1400-1450 Ma). Mostly porphyritic biotite granite with large microcline phenocrysts, with local fine-grained basalic phases and aplite. Associated pegmatite and aplitic veins are rare. This unit forms large plutons, including the Oracle Granite, Ruin Granite, granite in the Pinnacle Peak - Cavefire area northeast of Phoenix, and several bodies west of Prescott.

Xg EARLY PROTEROZOIC GRANITIC ROCKS (1600–1850 Ma). Wide variety of granitic rocks, including granite, granodiorite, tonalite, quartz diorite, diorite, and gabbro. These rocks commonly are characterized by steep, northeast-striking foliations.

Xms EARLY PROTEROZOIC METASEDIMENTARY ROCKS (1600–1800 Ma). Metasedimentary rocks, mostly derived from sandstone and shale, with minor conglomeratic and carbonate rock. Includes quartz-rich, mostly non-volcanic Pinal Schist in southeastern Arizona and variably volcanic-lithic sedimentary rocks in the Vinegar and Yavapai–Tonto Basin supergroups in central Arizona.

Xq EARLY PROTEROZOIC QUARTZITE (1,650?–1700 Ma). Brown to maroon, resistant quartzite and minor conglomerate of the Mazatzal Group, exposed primarily in the Payson area.

Xmv EARLY PROTEROZOIC METAVOLCANIC ROCKS (1650 to 1800 Ma). Weakly to strongly metamorphosed volcanic rocks. Protoliths include basalt, andesite, dacite, and rhyolite deposited as lava or tuff, related sedimentary rock, and shallow intrusive rock. These rocks, widely exposed in several belts in central Arizona, include metavolcanic rocks in the Yavapai and Tonto Basin supergroups.

Xm EARLY PROTEROZOIC METAMORPHIC ROCKS (1600-1850 Ma). Undivided metasedimentary, metavolcanic, and gneissic rocks.

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MAP SYMBOLS

CONTACTS
Contacts between late Tertiary and Quaternary sedimentary units are shown with thinner lines than contacts between other units.

FAULTS
Quaternary faults
Fault, high-angle or dip unknown; ball and bar on downthrown side; dotted where inferred
Low-angle fault; tics on hanging-wall side
Detachment fault; double tics on hanging-wall side
Thrust fault; teeth on hanging-wall side

DEPTH-TO-BEDROCK CONTOURS
800-foot contour. These are shown only in basins less than 4000 feet deep in the Transition Zone of central Arizona; otherwise the 800-foot contour is omitted.
4800-foot contour
9600-foot contour

MYLONITIC FOLIATION OVERPRINT
Pattern shows distribution of middle Tertiary mylonitic foliation in metamorphic core complexes; orientation of pattern indicates generalized trend of mylonitic foliation

SCALE 1:1,000,000
0 10 20 40 MILES
0 10 20 40 60 80 KILOMETERS

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