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MAP SHOWING OUTCROPS OF PRE-QUATERNARY BASALTIC ROCKS, BASIN AND RANGE PROVINCE, ARIZONA

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INTRODUCTION

This map report is one of a series of geologic and hydrologic maps covering all or parts of States within the Basin and Range province of the western United States. The map reports contain detailed information on subjects that characterize the geohydrology of the province, including the ground-water hydrology, ground-water quality, surface distribution of selected rock types, tectonic conditions, areal geophysics, Pleistocene lakes and marshes, and mineral and energy resources. This work is a part of the U.S. Geological Survey's program for geologic and hydrologic evaluation of the Basin and Range to identify potentially suitable regions for further study relative to isolation of high-level nuclear waste (Bedinger, Sargent, and Reed, 1984).

This map was prepared, according to the geologic guidelines for the project (Sargent and Bedinger, 1984), from published geologic maps and reports, and from a map in preparation by Robert Scarborough, Arizona Bureau of Geology and Mineral Technology, of the basaltic rocks of Arizona less than 15 million years old. As used in this report, basaltic rocks include principally basalt, basaltic andesite, and diabase, but commonly the younger basaltic deposits contain interbeds of less abundant tuffaceous and sedimentary rocks. In general the map shows the occurrences in Arizona of basaltic rocks 2 million years or more in age, but locally, basalts of Quaternary age are included, where they were not separated from older rocks on the published maps. Occurrences of basalt in numerous wells, mainly in the Phoenix area, are recorded to indicate the presence of basalts beneath the extensive Quaternary surficial cover. In the Description of Map Units, the age, lithologic type, thickness, if known, and sources of data are described for the basaltic rocks within arbitrarily outlined and numbered areas in the counties in the study area. The radiometric ages of the rock units are only those which are available and do not necessarily represent the entire age range of the units.

DESCRIPTION OF MAP UNITS
[To convert feet (ft) to meters, multiply feet by 0.3048]

County-area number	Map symbol	Geologic and radiometric age in millions of years (m.y.)	Lithology and comments	References for county area
		APACHE COUNTY		
A-1	Tb	Tertiary 4 to 10.5 m.y.	Basalt, undescribed.	Luedke and Smith, 1978
A-2	Tb	Tertiary <5 to 10 m.y.	Basalt, undescribed.	Luedke and Smith, 1978
		COCHISE COUNTY		
CH-1	Tb	Tertiary 10 to 16+ m.y.	Basalt lava flows intercalated with old alluvial fill.	Cooper, 1960; Luedke and Smith, 1978
CH-2	QTb	Quaternary and Tertiary 1 to 4 m.y.	Olivine-basalt flows, tuffs, breccias, and cinder cones; 10 to more than 500 ft thick; part of the San Bernardino volcanic field where dated rocks range in age from 0.274±0.50 to 3.2 m.y.	Cooper, 1959; Luedke and Smith, 1978
	Tb	Tertiary 10.5 to 15 m.y.	Olivine-basalt flows intercalcated with older alluvium; individual flows 10 to 50 ft thick. A date of <5 m.y. indicated by Luedke and Smith (1978).	
		COCONINO COUNTY		
C-1	Tb	Tertiary 14.2±1.1 m.y.	Basaltic rocks.	Luedke and Smith, 1978; Wilson and others, 1969
C-2	QTb	Quaternary and Tertiary 1.12±0.7 to 4 m.y.	Olivine-basalt flows. Locally, contacts with older basalt flows indefinite. Part of San Francisco volcanic field.	Aldrich and Laughlin, 1981; Krieger, 1965, 1967a; Lehner, 1958; Luedke and Smith, 1978; McKee and Anderson, 1971; Robinson, 1913; Sabels, 1962; Wilson and others, 1969
	Tb	Pliocene and Miocene 4.3±0.45 to 14.4±0.46 m.y.	Flows and dikes of olivine basalt with brecciated tops and bottoms which may be vesicular to scoriaceous or agglomeratic. Flows generally 10 to 20 ft thick but locally 50 ft or more thick. Youngest basaltic flows (about 4.5 to 6.0 m.y.) and intercalated gravels comprises Perkinsville Formation along and north of Verde River, and a few flows in small outcrops in equivalent Verde Formation along Sycamore Creek. Older basaltic flows (about 7.8±0.3 to 11.9±1.3 m.y.) exposed along the Mogollon Rim at south edge of San Francisco volcanic field. Some are equivalent in age to flows in sequence of interbedded lavas and basaltic tuff, gravel, and conglomerate, comprising the Hickey Formation (10.1 to 14.6 m.y.), exposed along Sycamore Creek.	

			GILA COUNTY	
G-1	Ydb	Middle Proterozoic	Gray, diabasic to ophitic, partly granophyric diabase, in sills, and some dikes, ranging from about 3 to 1,500 ft thick. Intrudes all Proterozoic rocks, and is overlain unconformably by Paleozoic sedimentary rocks.	Banks and Krieger, 1977; Cornwall and Krieger, 1978
G-2	QTb	Quaternary and Tertiary 1 to 7 m.y.	Basalt, undescribed.	Cornwall and Krieger, 1978; Peterson, N. P., 1961; Shafiqullah and others, 1980; Willden, 1964; Wilson and others, 1969
	Tb	Miocene 7.46±0.59 m.y.	Basalt in 3 flows at top of Bucket Mountain caps pediment cut on granite which stands about 300 ft above modern alluvial surface.	
	Ydb, pЄdb	Middle Proterozoic and Precambrian	Description as in G-1.	
G-3	pЄdb	Precambrian	Olivine diabase, aphanitic to coarsely crystalline. Intrudes older Precambrian rocks as sills ranging from a few feet to about 400 ft in thickness.	Peterson, N. P., 1954; Peterson, N. P., and others, 1951; Ransome, 1904; Wilson and others, 1969
G-4	Tb	Tertiary 10 to 16+ m.y.	Lamproite flows, sills, and dikes in northern part of area, and scattered basalt, undescribed, elsewhere.	Bergquist and others, 1981; Finnell, 1966; Gastil, 1958; Luedke and Smith, 1978; Wilson and others, 1969
	Ydb, pЄdb	Middle Proterozoic and Precambrian	Dark olivine-diabase, fine to coarsely crystalline, in sills as much as 1,150 ft thick. Intrudes Proterozoic rocks.	
G-5	Tb	Tertiary	Basalt, undescribed.	Bergquist and others, 1981; Granger and Raup, 1959, 1969; Wilson, 1939; Wilson and others, 1969
	Ydb	Middle Proterozoic 1,075 m.y.	Dark olivine-diabase in sills from a few feet to as much as 1,150 ft thick. Intrudes older Proterozoic rocks.	
			GRAHAM COUNTY	
GR-1	QTb	Quaternary and Tertiary 1 to 7 m.y.	Basalt flows in part interbedded with overlying sedimentary rocks of the Gila Conglomerate.	Aldrich and Laughlin, 1981; Bromfield and Shride, 1956; Luedke and Smith, 1978; Ratté and others, 1969; Wilson and others, 1969
	Tb	Tertiary 5 to 10 m.y. and 23.3±0.7 m.y.	Extensive area of rhyolitic, andesitic, and basaltic flows, breccias, and tuffs, poorly described except locally on east side of area adjacent to the Blue River, where there is as much as 2,000 ft of basaltic andesite containing a flow dated at 23.3±0.7 m.y.	
	pЄdb	Precambrian	Diabase. Crops out along west edge of area.	
GR-2	pЄdb	Precambrian	Diabase.	Wilson and others, 1969

			GREENLEE COUNTY	
GN-1	Tb	Miocene 23.3±0.7 m.y.	Typically, flows of basaltic andesite are black to dark grey, holocrystalline, vesicular to amygdaloidal, and a few tens of feet thick. Locally interbedded with thin gravel beds. Oxidized flow breccia at top or bottom or both. Lighter-colored flows appear more dacitic or latitic than basaltic. Unit is as much as 2,000 ft thick and contains a 0- to 300-ft-thick layer of distinctive peralkaline rhyolite ash-tuff.	Ratté and others, 1969; Wilson and others, 1969
GN-2	Tb	Miocene and Oligocene	Andesite and basalt, undivided; nonporphyritic lava flows and flow breccia ranging in composition from olivine basalt to pyroxene andesite; flow units commonly 15 to 35 ft thick; includes some layers of volcaniclastic rocks; unit thickness 0 to about 2,000 ft.	Ratté, 1982; Wilson and others, 1969
GN-3	Tb	Tertiary 10 to 16+ m.y.	Mostly basaltic andesite. Flows are scoriaceous to massive and locally platy; includes some basaltic alluvial gravel. Maximum thickness nearly 2,000 ft.	Luedke and Smith, 1978; Morrison, 1965; Wilson and others, 1969
			LA PAZ COUNTY	
L-1	Tb	Tertiary 10 to 16+ m.y.	Basaltic rocks. May be as much as 25 m.y. old.	Luedke and Smith, 1978; Wilson and others, 1969
L-2	Tb	Tertiary 17.24±0.43 m.y.	Olivine-bearing basalt; an upper unit about 700 ft thick of basalt only, and a lower unit 400 to 500 ft thick of basalt interbedded with tuffaceous rocks in beds averaging about 10 ft thick but some as much as 50 ft thick; is basalt of Black Mesa of Miller (1970). Locally, outcrops of an older, highly altered, amygdaloidal and massive, undated basalt about 1,200 ft thick.	Miller, 1970; Shafiqullah and others, 1980
L-3	Tb	Tertiary 18.31±0.42 to 29.3±3.1 m.y.	Olivine basalt and basaltic andesite, commonly intercalcated with coarse clastics; younger flows cap mesas. Youngest isotopic dates from flow on northeastern flank of Kofa Mountains and in Eagle Tail Mountains. Older dates reported from southern part of area adjacent to Palomas Plain.	Eberly and Stanley, 1978; Shafiqullah and others, 1980; Wilson and others, 1969
L-4	Tb	Pliocene or late Miocene 3 to 11 m.y.(?)	Dark, flat-lying basaltic flow.	Aldrich and Laughlin, 1981; Garner and others, 1982; Wilson and others, 1969

			MARICOPA COUNTY	
MA-1	Tb	Miocene 13.5±0.3, 14.51±0.2, and 16.7±1.1 m.y.	Olivine basalt and basaltic andesite flows which commonly overlie tuff, tuffaceous sandstone, or conglomerate; locally as much 1,540 ft thick in Vulture Mountains area.	Rehrig and others, 1980; Shafiqullah and others, 1980; Wilson and others, 1969
MA-2	Tb	Middle Miocene 15±2.1 to 19.20±0.47 m.y.	New River Mesa basalt: Olivine-basalt flows capping high mesas. In New River Mesa area the sequence contains 8 flows and is 410 to 590 ft thick. Directly overlies the Chalk Canyon formation of Gomez, 1979. The younger age date is from an apparently comparable basalt capping a mesa in Yavapai County, just north of this area. The older date is from basalt at base of structurally deformed volcanic sequence near summit of Lookout Mountain just northeast of Glendale.	Eberly and Stanley, 1978; Gomez, 1979; Shafiqullah and others, 1980; Wilson and others, 1969
		Lower Miocene 22.4±2.6 and 23.3±2.7 m.y.	Chalk Canyon formation of Gomez (1979): Upper part, interbedded marl, dolomite, alluvial clastics, and trachybasalt; lower part, trachybasalt, basalt, and tuff. Maximum thickness of formation 485 ft; wedges out to south. Age dates from near base of formation.	
MA-3	Tb	Tertiary 4 to 18.15±0.44 m.y.	Basalt, largely undescribed. Small outcrop just south of Horseshoe Reservoir on Verde River contains rocks 4 to 7 m.y. old. Oldest dated basalt flow in disturbed volcanic sequence above tilted conglomerate to south near Herder Mountain .	Luedke and Smith, 1978; Shafiqullah and others, 1980; Wilson and others, 1969
MA-4	Tb	Miocene 15.53±0.39 m.y.	Basaltic andesite flanked by flat-lying gravel.	Shafiqullah and others, 1980; Wilson and others, 1969
MA-5	Tb	Miocene 17.8±3.1 m.y.	Basalt and basanite about 75 ft thick.	Stuckless and Sheridan, 1971; Wilson and others, 1969
MA-6	Tb	Tertiary 10 to 16+ m.y.	Basalt.	Luedke and Smith, 1978; Wilson and others, 1969
MA-7		Miocene 22±1.2 m.y.	Biery No. 1 Federal well. At depth of: 4,692 to 4,731 ft, basaltic andesite.	Eberly and Stanley, 1978
MA-8		22±1.9 m.y. Lower Miocene and upper Oligocene	Sperry Gyroscope No. 1 well. At depth of: 728 to 889 ft, basalt; 1,529 to 1,549 ft, basaltic andesite.	Eberly and Stanley, 1978
MA-9		Miocene 20±2.6 m.y.	John Jacobs Probe No. 2 well. At depth of: 1,247 to 1,253 ft, basalt.	Eberly and Stanley, 1978

MA-10		Tertiary 23±7.7 m.y. 51±3.3 m.y.	G. D. Isabel No. 1, Maricopa County. At depth of: 945 to 1,066 ft, basalt; 1,923 to 2,001 ft, basalt.	Eberly and Stanley, 1978
MA-11		Miocene 10.5±4.5 m.y.	Goodyear Farm water well. At depth of: 1,538 to 1,598 ft, basalt. In a well about 2 mi to the north, the basalt overlies thick halite.	Eberly and Stanley, 1978
MA-12		Miocene 10.52±0.61 m.y.	Goodyear Farm drill hole No. 1729. At depth of: 1,034 ft, basalt of unknown thickness occurs near top of thick evaporite deposit (not penetrated).	Shafiqullah and others, 1980
MA-13	Tb	Tertiary 10 to 16+ m.y.	Basalt undescribed.	Luedke and Smith, 1978; Wilson and others, 1969
MA-14	Tb	Tertiary 15.01±0.42 and 10 to 16+ m.y.	The only dated rock is the lowest basalt flow in Hot Rock Hill which is above unconsolidated gravel a short distance north of Tonopah.	Luedke and Smith, 1978; Shafiqullah and others, 1980; Wilson and others, 1969
MA-15	QTb	Quaternary and Tertiary 1.28±0.26 to 6±1.8 m.y.	Fine-grained olivine basalt of Sentinel Plain volcanic field and smaller volcanic fields to northeast. Most flows probably 1 to 4 m.y. old.	Aldrich and Laughlin, 1981; Eberly and Stanley, 1978; Luedke and Smith, 1978; Shafiqullah and others, 1980; Tucker, 1980; Wilson and others, 1969
	Tb	Miocene 17.9±0.7 to 20.70±0.5 m.y.	Porphyritic basalt, basaltic andesite, and andesite. At several localities flows are faulted and steeply tilted.	
MA-16	Tb	Pliocene and Miocene 14.00±0.32 and 10.5 to 15 m.y.	Fine-grained olivine basalt, some with iddingsite alteration; minor amount of andesitic basalt; most flows underlie a broad mesa.	Shafiqullah and others, 1980; Tucker, 1980
MA-17	Tb	Tertiary 10 to 16+ and 20.44±0.45 m.y.	Olivine basalt; at east end of this area, on south flank of Maricopa Mountains, a flow (20.44 m.y.) caps the surface of a fanglomerate.	Luedke and Smith, 1978; Shafiqullah and others, 1980; Wilson and others, 1969

MOHAVE COUNTY

M-1	QTb	Quaternary and Tertiary 2.0±1.4, 2.28, and 1 to 4 m.y.	Dense, fine-grained basalt.	Hamblin, 1970; Luedke and Smith, 1978; Moore, 1972; Shafiqullah and others, 1980; Throckmorton, 1980; Wilson and others, 1969
	Tb	Tertiary 3.79±0.46, 5.2±1.3, 6.7±0.20, and 4 to 10.5 m.y.	Dense, fine-grained basalt flows, in places intercalated with and overlies gravels. Total thickness at least as much as 360 ft west of Black Rock Gulch. Several small outcrops north and east of Seegmuller Mountain maybe as old as 10.5 m.y.	

M-2	Tb	Pliocene and Miocene 3.79±0.46 to 14.6±0.3 m.y.	Fortification Basalt Member of Muddy Creek Formation: Mainly thin flows of dark-gray to black olivine basalt intercalated with and overlying sedimentary rocks along oxidized and brecciated contact zones; commonly glassy and vesiculated throughout; locally more than 200 ft thick. Age from 3.79±0.46 to 10.6±1.1 m.y. Mount Davis Volcanics: Olivine-bearing basalt and basaltic andesite, in flows 10 to 30 ft thick, interbedded with thin beds of tuffaceous or coarsely clastic sedimentary rocks. Age from 11.8 to 14.6 m.y.	Anderson, R. E., 1978; Anderson R. E., and others, 1972; Wilson and others, 1969
M-3	Tb	Miocene 5 to 15 m.y.	Basalt flows capping Iron Mountain.	Blacet, 1975
M-4	Tb	Tertiary 10 to 16+ m.y.	Basaltic rocks; those in Black Mountains associated with ash-flow tuffs and tuffaceous volcanics possibly as much as 25 m.y. old.	Luedke and Smith, 1978; Wilson and others, 1969
M-5	Tb	Tertiary 6.8±0.2 to about 22 m.y.	In area along the Bill Williams River all Tertiary volcanic rocks have isotopic ages of 6.8 to 16.5 m.y. The older volcanics are faulted and steeply dipping; youngest beds only slightly faulted. In descending order, volcanic units are: (1) Megacryst-bearing alkali-olivine-basalt flows (7 to 8 m.y.) which reflect present topography and drainage. (2) Mesa-capping basalt and basaltic andesite flows (10 to 14 m.y.) interbedded with clastic sediments as much 350 ft thick. (3) Quartz-bearing basalts (10.3 to 15.1 m.y.) that grade laterally into rhyolite volcanics. (4) Trachybasalt, alkali-olivine basalt and trachyandesite (16.5±0.2 m.y.) that underlie the widespread Peach Spring Tuff, dated by Damon and others (1966) at 16.9±0.4 m.y.; as much as 656 ft exposed at Black Peak southeast of Parker. Isotopic ages of 20 to 22 m.y. of basalts, reported by Eberly and Stanley (1978), are considerably divergent from ages of similar rocks reported by other authors.	Armstrong and others, 1976; Damon and others, 1966; Eberly and Stanley, 1978; Lasky and Webber, 1949; Lucchitta and Suneson, 1977; Luedke and Smith, 1978; Shafiqullah and others, 1980; Suneson and Lucchitta, 1978, 1979; Wilson and others, 1969
		NAVAJO COUNTY		
N-1	Tb	Tertiary 4 to 10.5 m.y.	Basalt, undescribed. Age from unpublished map by Arizona Bureau of Geology and Mineral Technology.	McKee and McKee, 1972
N-2	QTb	Quaternary and Tertiary 1 to 4 m.y.	Basalt, undescribed. Age from unpublished map by Arizona Bureau of Geology and Mineral Technology.	Wilson and others, 1969
	Tb	Tertiary	Basalt, undescribed.	

			PIMA COUNTY	
PM-1	Tb	Miocene 15.52±5.4 and 15±2.2 m.y.	Batamote andesite: Basaltic olivine-andesite, augite andesite, and some hornblende andesite in flows 20 to 60 ft thick. Thickness more than 1,500 ft.	Eberly and Stanley, 1978; Gilluly, 1946; Luedke and Smith, 1978; Shafiqullah and others, 1980; Wilson and others, 1969
PM-2	Tb	Tertiary 15.39±0.45 and 10 to 16+ m.y.	Rocks undescribed, except for flat basalt flow in sequence above rhyolitic flow in Gu Vo Hills dated at 15.39 m.y.	Luedke and Smith, 1978; Shafiqullah and others, 1980; Wilson and others, 1969
PM-3	Tb	Tertiary 10 to 16+ m.y.	Basalt, undescribed.	Luedke and Smith, 1978; Wilson and others, 1969
PM-4	Tb	Tertiary 10 to 16+ m.y.	Dark vesicular, olivine-basalt flows, slightly porphyritic and seriate.	Briskey and others, 1978; Luedke and Smith, 1978
PM-5	Tb	Tertiary 10 to 16+ m.y.	Dark, locally vesicular, porphyritic andesite and basalt flows.	Luedke and Smith, 1978; Rytuba and others, 1978
PM-6	Tb	Tertiary 10 to 16+ m.y.	Andesite and trachyandesite flows; both rock types locally porphyritic. Flows, flat lying, dense to locally vesicular, flow banded, and locally have brecciated margins. Individual flows 3 to 32 ft thick but laterally discontinuous.	Haxel and others, 1978; Luedke and Smith, 1978; May and Haxel, 1980
PM-7	Tb	Tertiary 10 to 16+ m.y.	Dark, vesicular to dense, sparsely porphyritic basalt flows.	Haxel and others, 1978; Luedke and Smith, 1978
PM-8	Tb	Tertiary 10 to 16+ m.y.	Dark, dense to vesicular basalt flows.	Haxel and others, 1978; Luedke and Smith, 1978
PM-9	Tb	Tertiary 14.4±2.4 to 23.5±1.4 m.y.	Vesicular basalt flows, containing phenocrysts of olivine, plagioclase, and pyroxene.	Keith, 1976
PM-10	Tb	Miocene 19.5±0.8 and 22.2±0.9 m.y.	Light to dark vesicular basalt flows and flow breccias.	Banks and Dockter, 1976; Banks and others, 1978; Bergquist, Blacet, and Miller, 1978
PM-11	Tb	Miocene and Oligocene 17.6±1.3 and 26.6±0.8 m.y.	Vesicular basalt flows and flow breccias and minor vesicular olivine-pyroxene trachyandesite. Dates are on the Cerro Prieta Basalt.	Banks and Dockter, 1976; Bergquist, Banks, and Blacet, 1978 Eberly and Stanley, 1978; Wilson and others, 1969

PM-12		Miocene 23.4±0.6 m.y. 16.1±0.6 m.y. 18.02±2.0 m.y.	Exxon State (32) No. 1 well. At depth of: 7,940 to 7,960 ft, andesitic basalt; 9,498 to 9,508 ft, andesitic basalt, interpreted to be intrusive body; 9,751 to 9,850 ft, andesitic basalt.	Eberly and Stanley, 1978
PM-13	Tb	Tertiary 10 to 16+ m.y.	Basalt, undescribed.	Luedke and Smith, 1978; Wilson and others, 1969
		PINAL COUNTY		
P-1	Tb	Tertiary 21.37±0.53 and 23±5.2 m.y.	Vesicular olivine-basalt flows and flow breccias which contain phenocrysts of olivine, augite, and plagioclase; in eastern part, equivalent rocks called vesicular olivine-pyroxene trachyandesite flows. Locally more than 150 ft thick.	Balla, 1972; Bergquist, Banks, and Blacet 1978; Blacet and others, 1978; Dockter and Keith, 1978; Eberly and Stanley, 1978; Shafiqullah and others, 1980; Wilson and others, 1969
P-2	Tb	Miocene 8.12±0.64 and 7 to 10.5 m.y.	Olivine basalt intercalated in gravels at Poston Butte just north of Florence dated at 8.12 m.y. Luedke and Smith (1978) believe basalts are less than 5 m.y. old.	Balla, 1972; Luedke and Smith, 1978; Shafiqullah and others, 1980
P-3	Tb	Tertiary 10 to 16+ m.y.	Basalt, undescribed.	Creasey and others, 1975; Luedke and Smith, 1978; Peterson, D. W., 1960, 1969; Theodore and others, 1978; Wilson and others, 1969
	pЄdb	Precambrian	Dark medium-grained to locally coarse-grained and porphyritic diabase. Intrudes older Precambrian rocks and overlain by Paleozoic or younger sedimentary rocks. Forms sills, dikes, and irregular masses. As mapped, commonly includes basalt unit at top of Apache Group (Middle Proterozoic) which is older and generally intruded by the diabase. Basalt, as much as 320 ft thick, is dark, aphanitic, locally vesicular and amygdaloidal, and includes breccia layers.	
P-4	Ydb	Middle Proterozoic 1,150 m.y.	Dark fine- to coarse-grained diabase that intrudes Precambrian sedimentary rocks as dikes and sills as much as 1,000 ft thick, and as discordant bodies and sheets or sill-like masses in Precambrian granite. Thicker sills probably composite bodies. A drill hole north of Hayden recorded a sequence of diabase 1,345 ft thick. Overlain by upper Proterozoic sedimentary rocks.	Banks and Krieger, 1977; Cornwall and Krieger, 1975; Cornwall and others, 1971; Krieger, 1974

P-5	Tb	Miocene 8.45±0.22 m.y.	Vesicular to scoriaceous basalt and minor andesite in flows 10 to 25 ft thick. Grades southward into andesite. Age date from high-level flows.	Kreiger, 1968a, 1968b, 1968c; Shafiqullah and others, 1980; Willden, 1964
	p€db	Precambrian	Dark, medium-grained diabase mostly as single and multiple sills, locally totaling more than 1,000 ft in thickness. Intrudes older Precambrian rocks and unconformably overlain by Paleozoic sedimentary rocks.	
P-6		Miocene 17±1.0 m.y. 14.9±0.3 m.y.	Exxon State (74) No. 1 well. At depth of: 9,165 to 9,210 ft, basalt; 9,262 to 9,594 ft, ultrapotassic trachyte.	Eberly and Stanley, 1978; Shafiqullah and others, 1976
		SANTA CRUZ COUNTY		
SC-1	Tb	Miocene 13 and 14 m.y.	Andesitic basalt flows intercalcated with gravel about 3 to a few tens of feet thick.	Drewes, 1980
		YAVAPAI COUNTY		
YA-1	Tb	Tertiary 10 to 16+ m.y.	Mostly olivine-basalt flows, cones, and tuffaceous deposits, locally includes some conglomerate and andesite. In Bagdad area extensive mesa-capping basalts are called Sanders basalt and are part of vast basalt sheet in this part of state. Olivine-basalt flows generally 5 to 50 ft thick but locally as much as 200 ft thick. Sanders overlies Wilder Formation and locally basalt interfingers with lava flows of the Wilder. Only eastern and southern edges of area mapped in detail. Basaltic rocks generally north of Mohon Mountains probably more than 15 m.y. old.	Anderson, C. A., and others, 1955; Krieger, 1967a, 1967b, 1967e; Wilson and others, 1969
YA-2	Tb	Tertiary 10.02±0.35 to 16+ m.y.	Mostly olivine-basalt flows, cones, and tuffaceous deposits; locally includes some conglomerate and andesite, and overlies unit of thin basalt flows, tuffs, and conglomerate. Basaltic rocks in southern one-third of area poorly described.	Krieger, 1967a, 1967b, 1967c, 1967d, 1967e; Luedke and Smith, 1978; Shafiqullah and others, 1980; Wilson and others, 1969
YA-3	Tb	Tertiary 14.6±0.5 m.y.	Basalt, undescribed.	Luedke and Smith, 1978; Wilson and others, 1969

YA-4	Tb	Miocene 10.1 to 14.6 m.y.	Hickey Formation: Massive to vesicular olivine-basalt flows with some columnar jointing in interior of flows and some minor interbeds of sand and gravel. Flows range in thickness from 20 to 50 ft, and occur mostly at top of Hickey Formation, and are underlain by unit of conglomerate, sandstone, and siltstone interbedded with thin olivine-basalt flows. Most of basalt north of Prescott appears comparable to basalt of upper part of the Hickey Formation, but some is partially overlain by pediment and valley fill. Small Tertiary basalt outcrop in southwest part of area is part of Milk Creek Formation.	Anderson, C. A., 1972; Anderson, C. A., and Blacet, 1972a, 1972b, 1972c; Anderson, C. A., and others, 1971; Krieger, 1965, 1967d; McKee and Anderson, 1971
	Xb	Early Proterozoic 1,770±10 to 1,820+ m.y.	Yavapai Series: Iron King Volcanics of Big Bug Group: Upper sequence of mixed mafic and rhyolitic tuffaceous rocks. Lower sequence pillow and amygdaloidal andesitic and basaltic flows with interbeds of sedimentary rocks; flows several feet to more than 100 ft thick. Iron King Volcanics probably nearly 15,000 ft thick, and separated from underlying Green Gulch Volcanics by 12,000 ft of andesitic and rhyolitic strata of Spud Mountain Volcanics. Green Gulch Volcanics of Big Bug Group: Basaltic amygdaloidal and pillow lava flows which commonly are interbedded with lithic tuffs and with beds as much as 50 ft thick of sedimentary rocks. Basaltic flows occur in sequence with rhyolite flows and tuffs. Green Gulch Volcanics have minimum thickness of 7,000 ft.	
YA-5	Tb	Pliocene and Miocene 4.5 to 6.0 m.y.	Perkinsville and Verde Formations: Perkinsville is sequence about 300 to 500 ft thick of gravel and intercalated basaltic flows exposed north and south of Perkinsville on Verde River. The equivalent Verde Formation is sequence at least 2,000 ft thick of limestone, gravel, sand, clay, and saline materials of lacustrine origin, and includes two basaltic flows which crop out along Verde River near Sycamore. Lower basalt is younger in age.	Anderson and Creasey, 1958, 1967; Krieger, 1965, 1967c, 1967d, 1967f; Lehner, 1958; Luedke and Smith, 1978; McKee and Anderson, 1971; Twenter and Metzger, 1963; Wilson and others, 1969
		Miocene 10.1 to 14.6±1.1 m.y.	Hickey Formation: Upper part commonly contains many massive to vesicular olivine-basalt flows, commonly showing columnar jointing; around Mingus Mountain, volcanic pile about 1,400 ft thick; local interbeds of basaltic sand and gravel. Flows generally 10 to 20 ft but locally 50 ft or more thick. Remainder of Hickey Formation is largely coarse gravel, conglomeratic sand, and silt and a few basalt flows.	

YA-6	QTb	Quaternary and Tertiary 1 to 4 m.y.	Basaltic rocks, not described. Crops out only in northern part of area. Contact with older flows in part indefinite.	Aldrich and Laughlin, 1981; Anderson and Blacet, 1972a; Anderson and Creasey, 1967; Canney and others, 1967; Eberly and Stanley, 1978; Elston and others, 1974; Luedke and Smith, 1978; McKee and Anderson, 1971; Sabels, 1962; Shafiqullah and others, 1980; Twenter and Metzger, 1963; Wilson, 1939; Wilson and others, 1969
	Tb	Pliocene and Miocene 3 to 13.9 13.9±1.6 m.y.	Basalts interbedded with sandstone, conglomerate, and dacitic tuffs in the Thirteenmile Rock volcanics and underlying Hickey Formation within the upper Verde River volcanic field. Locally basalts may be as much as 1,000 ft thick, but most are much thinner. Southern part of Black Hills may contain basaltic rocks older than 15 m.y.	
			YUMA COUNTY	
Y-1	Tb	Tertiary 10 to 16+ m.y.	Basaltic rocks. Maybe as much as 25 m.y. old.	Luedke and Smith, 1978; Wilson and others, 1969
Y-2	Tb	Tertiary 16.12±0.41 and 17.81±0.52 m.y.	Hornblende andesite in agglomeratic flow units and in dikes and pipes that served as conduits for lava flows.	Shafiqullah and others, 1980; Wilson and others, 1969
Y-3		Tertiary	Exxon Yuma-Federal No. 1 well. At depth of: 10,099 to 10,197 ft, andesitic basalt, interpretated as intrusive, possibly sill or dike (20±10 m.y.). Shafiqullah and others (1980) record basalt from this well at 10,237 to 10,270 ft, and give date of 5.4±1.0 m.y.	Eberly and Stanley, 1978; Shafiqullah and others, 1980

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