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MAP SHOWING OUTCROPS OF PRE-QUATERNARY ASH-FLOW TUFFS, BASIN AND RANGE PROVINCE, SOUTHERN CALIFORNIA

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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. Other map reports in this series contain data on 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 prospective regions for further study relative to isolation of high-level nuclear waste (Bedinger, Sargent, and Reed, 1984).

This map report on the ash-flow tuffs of southern California was prepared from published geologic maps and reports utilizing the project guidelines defined in Sargent and Bedinger (1984). The map shows the known occurrences of pre-Quaternary ash-flow tuffs. Rocks associated with ash-flow tuffs, such as volcaniclastics, tuff breccias, and agglomerates, also are included on the map. The Description of Map Units includes the geologic and, if available, radiometric age, the lithology, thickness where available, and sources of data for the tuffaceous units in outlined and numbered areas within the counties of the study area. The listed radiometric ages do not necessarily represent the entire age range of a geologic unit.

DESCRIPTION OF MAP UNITS
[To convert feet (ft) to meters, multiply feet by 0.3048; to convert miles (mi) to kilometers, multiply miles by 1.609]

PART A--TUFFS

County-area number	Map symbol	Geologic unit	Geologic and radiometric age in millions of years (m.y.)	Lithology and comments	References for county area
			IMPERIAL COUNTY (IM)		
IM-1	Tt	Tuffs and volcanic rocks	Early Miocene and late Oligocene 23 to 27 m.y.	In northern Palo Verde Mountains, rhyodacite plug-domes, locally overlain by welded rhyolite ash-flow tuffs. Tuffs pinch out in central part of mountains. Similar, but younger ash-flow tuffs in western part of area. A thin, even younger rhyolite ash-flow tuff occurs in southeastern Palo Verde Mountains.	Crowe and others, 1979
IM-2	Tv	Volcanic rocks and tuffs	Miocene and Oligocene 22 to 28 m.y.	Silicic pyroclastic rocks, including ash-flow tuff, tuff breccia, and agglomerate; also lava flows, and plug-domes in the southern Chocolate Mountains.	Crowe and others, 1979; Jennings, 1967
IM-3	Tt	Tuffs and volcanic rocks	Miocene and Oligocene 22 to 28 m.y.	Welded and nonwelded ash-flow tuffs in sequence of silicic lava plug-domes, lava domes, and lava flows.	Crowe and others, 1979
IM-4	Tt	Ignimbrite of Ferguson Wash and volcanic rocks	Oligocene 26 m.y.	Widespread rhyolite ash-flow tuff, called the ignimbrite of Ferguson Wash, which locally exceeds 1,150 ft in thickness in the Picacho Peak area. Associated with silicic domes and lava flows, and volcaniclastic deposits.	Crowe, 1978
IM-5	Tt	Jacumba Volcanics	Pliocene(?) or Miocene	Primarily interbedded andesitic tuffs, agglomerates, and gravels.	Brooks and Roberts, 1954; Strand, 1962
			INYO COUNTY (IN)		
IN-1	Tt	Tuff	Pliocene	Rhyolitic tuff in northern Last Chance Range.	Nelson, 1971; Ross, 1967; Strand, 1967
	Tv	Volcanic rocks	Tertiary	Rhyolitic volcanics in Last Chance and Saline Ranges; include rhyolite tuff, lava, obsidian, and perlite.	
IN-2	Tt	Tuff	Tertiary	Rhyolitic volcanic rocks in the southern Saline Range. Includes tuffs which vary from welded ash-flows to pumiceous tuff interbedded with small amounts of reworked volcanic debris. In part intrusive. Rocks dip gently eastward and are cut by numerous north-northeast-trending normal faults.	Burchfiel, 1969; Ross, 1967

IN-3	Tt	Tuff	Early Miocene 20 to 22 m.y.	Welded ash-flow tuffs and sediments, and minor interbeds of air-fall tuffs and rhyolite lava flows. Unit as much as 1,200 ft thick; source area in southwestern Nevada. All rocks broken by late Cenozoic high-angle normal faults which flatten out at depth.	Reynolds, 1976
IN-4	Tt	Tuff	Pliocene	Welded rhyolite tuffs.	Streitz and Stinson, 1974
			KERN COUNTY (K)		
K-1	Tt	Tuff and volcanic rocks	Miocene	Tuff, tuff breccia, and agglomerate.	Jennings and others, 1962
			MONO COUNTY (M)		
M-1	Tt	Eureka Valley Tuff	Miocene approximately 9.5 m.y.	Poorly to densely welded, crystal-rich, quartz latitic to trachyandesitic ash-flow tuff.	Chesterman, 1968; Gilbert and others, 1968; Kleinhampl and others, 1975; Noble and others, 1974, 1976; Slemmons, 1966
M-2	Tt	Eureka Valley Tuff	Miocene 11.1 to 11.9 m.y.	Welded ash-flow tuff of trachy-andesitic to latitic composition; as much as 700 ft thick.	Gilbert and others, 1968; Kleinhampl and others, 1975; Krauskopf and Bateman, 1977
M-3	Tt	Tuff	Miocene and Oligocene 12 to 28 m.y.	Fine-grained, andesite tuff, 12 to 22 m.y. old; and fine-grained, partially welded, rhyolitic ash-flow tuff, 22 to 28 m.y. old.	Gilbert and others, 1968; Krauskopf and Bateman, 1977; Strand, 1967
			RIVERSIDE COUNTY (RI)		
RI-1	Tt	Tuff	Early Miocene or late Oligocene 23.3±0.7 and 23.7±0.3 m.y.	Single compound cooling unit of unwelded and welded rhyolite ash-flow tuff. Dips moderately to northeast. Cut by north-south-trending normal faults. Exposed thickness 330 ft.	Crowe and others, 1979
			SAN BERNARDINO COUNTY (SB)		
SB-1	Tt	Pickhandle Formation, Opal Mountain Volcanic Member	Miocene 18.9±1.3 m.y.	Opal Mountain Volcanic Member: A single cooling unit of quartz latite, welded tuff and shallow-intrusive bodies. Opal Mountain is upper member of Pickhandle Formation which is un-welded lithic tuff and tuff breccia.	Burke and others, 1982

SB-2	Tt	Lane Mountain Quartz Latite	Early Miocene 23.1±0.2 m.y.	Several welded, quartz latite, ash-flow sheets which locally contain unwelded tuff and vitrophyre at base.	Burke and others, 1982
SB-3	Tt	Hole-in-the-Wall tuff	Miocene	Dozens of individual, unwelded to densely welded, pyroclastic units, 3 to 330 ft thick; includes flow breccia and air-fall tuff. Total thickness as much as 1,200 ft. Overlain by rhyolite lava flows 11 m.y. old.	McCurry, 1980, 1982
	Tr	Volcanic rocks	Miocene 18 m.y.	Quartz trachytic to rhyolitic welded tuff, domes, and lava flows.	
SB-4	Tt	Tuff	Late or middle Tertiary, possibly late Miocene	Air-fall and ash-flow tuff of rhyolite, rhyodacite, and dacite composition; some are water-laid. Includes minor lava flows and clastic material. Called andesitic lava flow by Miller (1944).	Bishop, 1963; Miller, 1944
SB-5	Tt	Tuff	Miocene	Massive rhyolitic tuff composed of angular fragments of rhyolitic felsite in matrix of welded rhyolitic tuff.	Dibblee and Bassett, 1966

PART B--CALDERA AND CAULDRON

Name	Description	References
Adobe Hills volcanic center	Inferred, buried cauldron. Outline is projection of cauldron pattern shown in adjacent Nevada by Ekren and others (1976).	Ekren and others, 1976
Woods Mountains caldera	Formed by eruption of the Hole-in-the-Wall tuff about 11 m.y. ago and probably resurgently domed during emplacement of shallow rhyolitic intrusions. Caldera centered over negative gravity anomaly.	McCurry, 1980, 1982

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