IGNEOUS ROCKS OF THE BASIN AND RANGE PROVINCE IN ARIZONA

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INTRODUCTION

Igneous activity was extensive in Arizona during Precambrian, Mesozoic, Tertiary, and Quaternary time but none has been recognized here for the Paleozoic era. Table 6 shows the major igneous units and their suggested ages in fourteen areas of the Basin and Range province in Arizona. This paper is limited to a brief mention of some examples of intrusive and extrusive rocks.

Recent studies have suggested the possibility of establishing correlations among certain younger volcanic units of the region and have pointed the way toward further work to expand the correlations. Results of some of the studies have furnished additional evidence of major intrusive activity during the Mesozoic era and the early part of the Tertiary period.

Regarding difficulties of correlating volcanic rocks, Ransome (1909) concluded that "carefully studied districts in Nevada reveal not only the prevailing complexity of the volcanic sequences, lavas of similar character being in some localities several times recurrent, but also the very small areal extent of many of the eruptions."

PRECAMBRIAN

Information regarding older Precambrian rocks in Arizona has been summarized for the Grand Canyon (Anderson, 1951), the Bagdad and Jerome areas (Campbell and Maxson, 1938), the Little Dragoon Mountains (Cooper and Silver, 1954) and the Mazatzal Mountains (Wilson, 1939). Anderson (1951, p. 1345) concluded: "The repetitious character and lenticularity of the andesitic and rhyolitic flows, tuffs, and tuffaceous sediments in the older Precambrian rocks introduces danger in any attempts of distant correlation." Age determinations of some intrusive rocks are cited by Anderson and Creasey (1958) and Damon (5).

Igneous rocks in the younger Precambrian Grand Canyon series were described by Walcott (1894, 1895). Diabase and basalt in the younger Precambrian Apache group of central Arizona have been described by Darton (1925) who suggested their correlation with similar rocks in the Grand Canyon series.

MESOZOIC AND TERTIARY

The Mesozoic age of some intrusive activity in four areas of Cochise County, Arizona, has been indicated by Gilluly (1956). Mesozoic ages have been assigned to intrusive rocks in these areas because the rocks intrude late Paleozoic sedimentary strata and an erosional surface cut into them underlies the Early Cretaceous Glance conglomerate. Cooper (in Gilluly, 1956) concluded that volcanic rocks occurring between Permian and Lower Cretaceous beds in the Gunnison Hills may be of early Mesozoic or Triassic or Jurassic age (Cooper, 23). The possibility of a Triassic or Jurassic age for some volcanic rocks in western Arizona is also indicated by Wilson and Moore (18). The new County Geologic Maps of Arizona, now being issued by the Arizona Bureau of Mines, show numerous areas of andesite and rhyolite as Cretaceous, and various intrusive bodies as Laramide. These designations are based principally upon deformation, lithology, and alteration.

Table 6. Chart showing names and assigned ages of igneous rocks in 14 areas in the Basin and Range province of Arizona.

			Black Mts. Ransome, 1923a Mod. by Wilson and Moore	Jerome Area Anderson and Creasey, 1958	Ajo Gilluly, 1937	Papago Indian Reservation	Tucson Mts. Brown, 1939 Kinnison, 1958	Southeastern Sierrita Mts. Lutton, 1958
CENOZOIC	QUAT.	Quaternary						
		Quaternary-Tertiary	Basalt	Basalt flows			Basalt and porphyry basalt	
	TERTIARY OR TERTIARY(?)	Pliocene(?)		Interbedded basalts and gravels	Basalt Andesite Basalt breccia Childs latite	Andesite and basalt flows Rhyolite tuffs and sediments Andesite por. Rhyolitic to dacitic tuffs, agglomerates and flows Pyroclastic rocks, andesite flows; interbedded sediments Quartz latite dikes, sills, and flows	Dacite porphyry and rhyolite porphyry masses and dikes	Rhyolite
		Pre-Pliocene					Latite porphyry dikes and sills	Granodiorite
		Middle Tertiary(?)	Rhyolite flows and tuffs Meadow Creek trachyte, Flag Spring trachyte		Sneed andesite Ajo volcanics		Rhyolite, andesite breccias	Gray granite
		Early Tertiary(?)			Cornelia quartz monzonite			Biotite diorite
	LARAMIDE	Early Tertiary to Late Cretaceous				Granite, quartz monzonite, and diorite	Granite and quartz monzonite stocks Latite porphyry dikes and sills	
MESOZOIC		Cretaceous					Andesite flows and tuffs	
		Cretaceous(?)	Gold Road latite Oatman andesite Esperanza trachyte Alcyone trachyte		Concentrator volcanics	Andesite flows Rhyolitic volcanic rocks		
		Mesozoic(?)			Chico Shunie quartz monzonite			Andesite porphyry flows
		Jurassic-Triassic						
PRECAMBRIAN		Younger						
		Older		Intrusive acid porphyries Alder group volcanic rocks Ash Creek gp. volcanic flows		Granite		

Table 6 (continued).

Santa Catalina Mts. DuBois (19)	Northern Dragoon Mts. Gilluly, 1956	Southern Dragoon Mts. Gilluly, 1956	Tombstone Hills Butler, Wilson, and Rasor, 1938	Mule Mts. Gilluly, 1956	Northern Chiricahuas Sabins, 1957b	Peloncillo Mts. Gillerman, 1958	Ray, Miami, Globe, Ransome, 1919
		Basalt	Basalt			Rhyolite dike	
					Welded tuffs	Quartz latite, latite porphyry	
	Pearce volcanics	Quartz latite porphyry dikes	Andesite volcanics		Quartz monzonite	Rhyolite, latite, and monzonite Flows and tuffs	Dacite and tuff
	Lamprophyre		Intrusive rhyolite	Intrusive rhyolite			
	Siliceous dikes Stronghold granite	Hornblende andesite			Diorite	Quartz latite Porphyry flows	
Intrusive dikes Catalina granite intrusion Pegmatite formation Metamorphism and gneiss formation Leatherwood quartz diorite intrusion	Granite gneiss	Sugarloaf quartz latite	Bronco volcanics			Quartz monzonite dikes and sills	Schultz granite batholith Last Gulch quartz monzonite Granodiorite Willow Springs granodiorite
			Schieffelin granodiorite				
		Andesite volcanics	Uncle Sam porphyry quartz-latite			Cienega Peak granite	
							Andesite Tuff and breccia
Quartz latite diabase							Diabase dikes and sills — granite and qtz. monz.
	Cochise Peak quartz monzonite	Turquoise granite Gleeson qtz. monzonite Copper Belle qtz. monz.		Juniper Flat granite			
					Aplite dikes Rattlesnake Point granite Sheep Canyon granite		Basalt flows
Metamorphism and Oracle granite	Saussuritic quartz diorite	Gneissic granite	Albite granite	Quartz diorite		Granite Gap granite	Madera dior. Solitude gr. Ruin granite Rhyolite

Assignment of a Mesozoic age to igneous rocks in southern Arizona is not new. It was suggested by Ransome (1904) for intrusive rocks in the Bisbee area, by Lindgren (1905) for porphyry at Morenci, and by Gilluly (1937) for some of the intrusive activity at Ajo. Campbell (1904) and Ross (1925) proved that a volcanic series in the Christmas region is of Upper Cretaceous age.

Many igneous rock units must, because of lack of evidence to the contrary, be assigned to the interval of time between the Cretaceous and Tertiary periods. Geologic work currently being undertaken on intrusive and extrusive rocks in Arizona may contribute knowledge about the igneous events which took place during the "Laramide" time span. The basis upon which these correlations have been suggested is primarily lithological, but in several instances, principally in the Tucson Mountains, the Santa Rita Mountains, and at Silver Bell, the correlation has been of rock groups rather than of isolated volcanic rock units.

Richard and Courtright (1954) have recognized intrusive and extrusive igneous rocks of determinable mutual age relations and speculate that these rock units may represent Laramide activity.

Courtright (1958) has summarized the results of a regional study of Laramide extrusive rocks and their possible relations to sedimentary rock types of the Cretaceous and Tertiary periods. He suggests that a sequence of volcanic rocks, recognized at Silver Bell, represents a "pronounced shift in the course of geologic events, which may have occurred late in Cretaceous time, or very early in the Tertiary period." He also pointed out a possible correlation of some extrusive rocks in the Tucson Mountains with similar ones near Silver Bell.

In the Black Mountains of northwestern Arizona, a thick series of volcanic rocks ranges in composition from rhyolite to basalt and according to Ransome (1923), its preponderant members range from latitic andesite to latitic trachyte. As stated by Ransome (1923, p. 11-12), "The discrimination and classification of rocks which are so closely akin and between which there are no very definite distinctions present considerable difficulty, particularly as lavas of practically identical composition were erupted at different times."

TERTIARY AND QUATERNARY

Tertiary and Quaternary volcanic rocks in the Jerome area and evidence for dating them are described by Anderson and Creasey (1958). In the Clifton-Morenci area of east-central Arizona, voluminous volcanic eruptions consisted of thrice-repeated flows of rhyolite and of basalt with subordinate flows of andesite (Lindgren, 1905). Correlations for extrusive rocks in the Peloncillo and Chiricahua Mountains have been suggested by Gillerman (1958). A correlation of late(?) Tertiary volcanic rocks in the Tucson Mountains with an extrusive sequence in the Santa Rita Mountains has been proposed by Kinnison (1958). Rocks of known or supposed Quaternary age in Arizona consist mainly of basalt and possibly to a small extent of rhyolite. Basalt of Tertiary and/or Quaternary age is widespread, as indicated on the Geologic Map of Arizona (1924).

Work is continuing in Arizona on problems related to origin and development of igneous and granitoid rocks. Certain of the granitoid rocks of the Catalina Mountains may owe their origin in part to metamorphic processes (DuBois, 19, 20).