GEOLOGY OF THE WILLCOX NORTH QUADRANGLE AND THE SOUTHERNMOST GREASEWOOD MOUNTAIN QUADRANGLE, ARIZONA

by
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Miscellaneous Map Series

MM 88-B

DESCRIPTION OF MAP UNITS

QTal QUATERNARY AND TERTIARY ALLUVIUM: Unconsolidated or weakly consolidated basin, alluvial fan and stream channel and flood plain deposits; includes deposits of Willcox playa. Not subdivided.

Tq QUARTZ VEINS AND PODS: Quartz bodies probably of mid-Tertiary age but possibly older. Gold, galena, and pyrite mineralization sometimes associated with this unit in the Railroad Pass quadrangle adjoining to the east (Erickson and Drewes, 1984).

Tpa PURPLE APHANITE PORPHYRY: Deep purple porphyry present in a small exposure in the easternmost Circle I Hills.

Ta HORNBLENDE ANDESITE PORPHYRY: Medium-gray, fine-grained dike unit; commonly weathers yellowish-tan. Contains circa 15% phenocrysts dominately An_{27} plagioclase to 1 cm, and smaller skeletal hornblende. Dated by crosscutting relationships with K-Ar dated units in the Railroad Pass quadrangle at 35.5 $\pm$1.0 ma (Erickson, 1981; Erickson and Drewes, 1984).

Tp ALBITE PORPHYRY DIKES: Tan-weathering dikes of albite porphyry. A mode shows 32% euhedral An_8 plagioclase to 5 mm, showing strong deuteric alteration; 2% euhedral sanidine to 0.4 mm; 1% resorbed quartz; 4% deuterically altered biotite to 0.5 mm; 2% deuterically altered hornblende now composed of radiating arrays of biotite and sphene to .5 mm; 1% opaque; and 58% groundmass composed of quartz and probable feldspars, now deuterically altered.

Tci CIRCLE I STOCK: Tan-weathering coarse-grained epidote granite stock. A mode is Sample 5 in Table 1. Plagioclase is An_{20}, euhedral, 2-10 mm; Kspar is orthoclase, subhedral, to 10 mm; quartz is 5 mm, shows relict beta-quartz outlines; biotite is brown, 1 mm; hornblende has green pleochroism, and epidote overgrowths, to 1 mm; epidote is in primary crystals to 1 mm; opaque and sphene present in traces. A K-Ar date of 28.43 $\pm$ 0.62 ma was obtained by Shafiqualla et al. (1978, Sample 21)

CAMPOMOCHO DRAW VOLCANIC SEQUENCE

Tcra RED ANDESITE OF CAMPOMOCHO DRAW: Commonly flow-banded red andesite porphyry with alternating dark gray and red bands. Locally vesicular. An_{30} plagioclase phenocrysts to 2-3 mm, together with pseudomorphous aggregates of biotite and an opaque mineral replacing probable hornblende, both in a patchy very fine-grained ground mass that appears to be devitrified glass. The ground mass is now patchy quartzofeldspathic material with minute biotite and hematite flakes. The sample contains a few 1-2 mm plagioclase-clinopyroxene xenoliths as described in the vitrophyre unit below and one Kspar-biotite xenolith. No ash-flow textures are present.

Tcv VITROPHYRE OF CAMPOMOCHO DRAW: Black vitrophyre about 10 m thick. Contains abundant An_{27} plagioclase phenocrysts to 3-4 mm together with trace Kspar and sparse biotite. Contains abundant 1-2 mm microgabbro xenoliths of An_{55} plagioclase and diopsidic augite. Crystals are 0.1-0.2 mm. Glass has perlitic cracks. Probably represents more than one flow. Campomocho Draw sequence assigned a Tertiary age because of the existence of this glass.

Tcga GRAY ANDESITE OF CAMPOMOCHO DRAW: Massive medium gray andesite. Has An_{33} plagioclase to 2 mm together with pseudomorphous aggregates of biotite, hematite, an opaque, and epidote after probable hornblende, both contained in a very fine-grained patchy quartzofeldspathic groundmass that is probably devitrified glass. Contains some microgabbro xenoliths as described in the vitrophyre unit above, and one biotite-Kspar xenolith as described in the red andesite unit above. May be a color variety of the red andesite.

END CAMPOMOCHO DRAW SEQUENCE

Tqa QUARTZ ANDESITE: A gray porphyritic unit containing to 50% 1-2 mm plagioclase crystals. Contains An_{45} plagioclase and much less abundant resorbtion-textured quartz crystals in a groundmass of very fine-grained quartzofeldspathic material containing <0.1 mm plagioclase. Blotchy epidote, pennine, and carbonate to 0.1 mm are present. Deuteric alteration is strong and has affected most phenocrysts.

Tb BASALT: Dark greenish-gray hornblende-bearing basalt dikes and irregular bodies. Sample 3 of the basalt in the Railroad Pass quadrangle (Erickson and Drewes, 1984) is 60% plagioclase, 17% hornblende, 3% magnetite, and 20% epidote, chlorite, and carbonate; the rock shows strong deuteric alteration. A whole-rock K-Ar date on this sample (Erickson, 1981) gives 48.8 ± 1.5 ma.

Kvb VOLCANIC BRECCIA: Intrusive volcanic breccia of peak 5052 in the Circle I Hills. A microbreccia composed of up to 5 mm angular fragments of many different aphanite porphyries together with single crystals and crystal fragments of plagioclase and of less abundant quartz with resorbtion textures. Essentially identical to the main green breccia in the Dos Cabezas Mountains (Erickson, 1969) and given the same age assignment.

Xs GRANITE GNEISS OF THE SOMMER STOCK: Reddish-weathering strongly foliated very leucocratic equigranular granite gneiss. The unit has strongly granulated quartzofeldspathic layers and biotite-chlorite-sericite layers. K-spar is perthitic microcline in the Dos Cabezas mountains, and nonperthitic microcline in the Circle I Hills. Plagioclase in the Circle I Hills exposures is albite and the rock is a trondjhemite gneiss. Plagioclase in the Dos Cabezas mountains is An_{30} and the rock is a granite gneiss. Modal analyses 1 to 4 of the Sommer stock for this quadrangle are given in Table 1; 5 more are given in the data section of the Railroad Pass quadrangle map (Erickson and Drewes, 1984). The pluton is synkinematic to the metamorphism of the Pinal Schist with which it shares concordant foliation and metamorphic mineralogy. Some marginal parts of the pluton in the Dos Cabezas mountains are not foliated. A biotite K-Ar date of 1110 $\pm$ 30 ma on sample 1 is reset and the unit is probably older than 1690 ma (Erickson, 1981).

Xsa APLITE: Irregular leucocratic masses and dikes of sugary-textured quartzofeldspathic minerals. Found within or adjacent to the Sommer stock, and probably genetically related to it.

Xpa AMPHIBOLITE: Foliated and unfoliated amphibolites sharing a common metamorphic mineralogy with the Pinal Schist and Sommer gneiss within which they crop out. A typical unit is composed of green hornblende, low An plagioclse, epidote, and chlorite, indicating a greenschist facies metamorphic environment. A K-Ar age on a sample in the Dos Cabezas mountains located on this map is 1190 $\pm$ 35 ma, reset from an original age probably greater than 1690 ma (Erickson, 1981). One amphibolite in the Circle I Hills (Xpal) is unfoliated and preserves relict clinopyroxene and plagioclase with a diabasic texture.

Xp UNDIFFERENTIATED PINAL SCHIST: Undivided metasedimentary and metavolcanic rocks, metamorphosed to the greenschist facies.

Xpb METABASALT FLOW: A metabasalt with relict flow orientation of relict hornblende and plagioclase. Outcrop quarried away in recent years. Base of flow was exposed in 1965 and held a quartzite cobble showing that the Pinal sequence was upright.

Xpm MARBLE: Thin layer of tremolite-bearing marble. Only known metacarbonate in the Pinal Schist.

Xpq QUARTZITE OF THE PINAL SCHIST: Massive white quartzite, nearly pure quartz, with occasional dark layers a few mm thick which appear to mark the attitude of relict bedding. In this quadrangle only found in the Spike E Hills, which are wholly composed of this unit.

Xpv METAVOLCANIC ROCKS OF THE PINAL SCHIST: Pale weathering quartz phyllites with very low phyllosilicates. Foliation and lineation marked by flattened and elongated quartz crystal aggregates representing crushed phenocrysts; aggregates abundant. Relict microcline and low-An plagioclase phenocrysts are also present in a few mode %; these are in various stages of becoming porphyroclasts. Some crystals show strain-shadow auge textures. Matrix is 50-50 quartz and probable albitic plagioclase. Muscovite-rich bands are present in varying proportion. The rocks appear to be metarhyolite flows. One sample contains poorly formed sparse garnets and fine-grained biotite, indicating transition of metamorphic conditions to the uppermost greenschist facies.

Xps METASEDIMENTARY ROCKS OF THE PINAL SCHIST: These crop out on the southeast slope of peak 5052 in the southern Circle I Hills where they are quartz-muscovite-biotite-garnet-epidote-plagioclase phyllites. One specimen has relict quartz crystals displaying resorbtion textures and a finer-grained matrix than others, and is a metatuff. This unit is structurally more complex than the metavolcanic Pinal rocks; two foliations are present in some exposures. These rocks were developed under upper greenschist facies conditions. Exposures of this unit in the Dos Cabezas Mountains are of simple quartz-sericite phyllites.

SUMMARY OF GEOLOGIC HISTORY

A very thick sequence of siliceous flows together with associated shaly and sandy sediments of unknown age were deformed and metamorphosed to greenschist facies conditions at ca. 1690 ma (Erickson, 1981) to form the Pinal Schist. The Sommer stock and a large number of mafic bodies were intruded toward the end of this episode and share metamorphic mineralogy and foliation but not lineation with the Pinal units. Garnets in the Pinal in two locations in the Circle I Hills indicate an unusually high metamorphic grade.

Probably at some time in the Precambrian the Apache Pass fault formed, causing major lateral offset between the Precambrian terrains of the northern and southern Dos Cabezas mountains (Erickson, 1969). In this quadrangle the fault is presumed to lie close to the southwestern border of the Dos Cabezas and to pass between the Spike E and Circle I Hills, since the quartzites of the Spike E Hills are like those of the southern Dos Cabezas and the metasediments and metavolcanics of the Circle I Hills are like those of the northern Dos Cabezas.

Intrusion of a small breccia stock in the Circle I Hills occurred in latest Cretaceous time correlative with the intrusion of the similar much larger mass in the Dos Cabezas mountains at about 63 ma (Erickson, 1981).

The volcanic sequence of Campomocho Draw was erupted in the Tertiary and faulted. The Circle I stock was intruded at 28 ma; intrusion of albite porphyry dikes in the southern Circle I Hills may be related. Hornblende andesite porphyry dikes were intruded into the western Dos Cabezas 35 ma ago, closely followed by intrusion of numerous quartz dikes and pods (Erickson, 1981).

In the last 20 ma Basin and Range faulting has blocked out the present ranges.

REFERENCES CITED

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TABLE 1: MODES OF UNITS*

Sample	Quartz	K-spar	Plag.	Biotite	Misc.	Opaques	Other
			Sommer Gneiss				
1	43%	19%	23%	8%	7%	-	-
2	41	56	1	1	-	1	-
3	38	34	20	1	6	1	-
4	35	30	24	1	6	2	2 (unid.)
			Circle I Stock				
5	24	43	29	3	-	-	1 (ep)

*All modes counted on single thin sections at 1.5 mm spaced rectilinear grids; about 300 points each.

EXPLANATION OF SYMBOLS

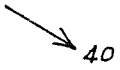
Contact - dashed where approximately located

Fault - dashed where approximated, dotted where interpeted

Strike and dip of flow layers or interflow contacts in lava

Strike and dip of foliation in metaplutonic rocks

Strike and dip of foliation in non-metaplutonic metamorphic units



Trend and plunge of lineation

Dated sample site

Mode sample site; number matches Table 1

Dated and modally analyzed site