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NEW K-Ar AGES OF VOLCANIC ROCKS NEAR AJO, PIMA, AND MARICOPA COUNTIES, SOUTHWESTERN ARIZONA

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The volcanic field near Ajo, Arizona (fig. 1), is a tripartite constructional volcanic field composed predominantly of Tertiary lavas that include the entire compositional range between basalt and rhyolite. These rocks outcrop over an area of approximately 5000 km² extending from the Mexican border to just north of U.S. Interstate Highway 8 and from the Growler and Aguila Mountains on the west to the Vekol-San Simon valleys on the east. Scattered Tertiary volcanic rocks farther east (Dockter and Keith, 1977; Rytuba and others, 1978; Briskey and others, 1979); are considered older than and apparently not related to those described here. Previous mapping in the area is of reconnaissance nature and is summarized on the Geologic Map of Arizona (Wilson and others, 1969). Much of the area lies within restricted access areas of Luke Air Force Range. A limited number of K-Ar ages of Tertiary rocks in the area have been published by Shafiquallah, et.al. (1980), Eberly and Stanley (1978), Jones (1974), and Tosdal (1979).

We report here 13 new K-Ar ages from volcanic rocks of the Ajo volcanic field samples as part of the USGS Ajo 2°x1° CUSMAP project. The dates are used in the study of the volcanic stratigraphy of the area and were selected because they define the age range of units within each of the tripartite sections. A more detailed compilation of isotopic age dates for the volcanic field is currently in progress (Miller and others, in preparation).

Geological Discussion

The Tertiary rocks of the Ajo volcanic field rest upon an extensive erosional unconformity cut on granitic and metamorphic rocks ranging in age from Proterozoic to early Tertiary (Haxel, et.al. 1980). Tertiary volcanic rocks in the area are divided into 3 sequences separated by angular unconformities: (1) the oldest sequence is late Oligocene to early Miocene in age and consists of red fanglomerate and coarse arkosic sandstone intercalated with andesite, rhyolite, rhyodacite, and local pyroclastic rocks; (2) a complex middle sequence consists of early and middle Miocene basalt, latite, silicic flows, and associated pyroclastic rocks; and (3) the youngest sequence, of middle Miocene age, is composed of basaltic andesite and andesite.

The oldest group is exposed in scattered areas along the western edge of the field, mainly northwest and southwest of the Sauceda Mountains. The unit is characterized by steeply tilted volcanic rocks intercalated with coarse clastic sedimentary strata. Initiation of volcanism was contemporaneous with local uplift and unroofing of crystalline basement rocks. In the Ajo area (Gilluly, 1946) and Growler Mountains (Gray and others, 1984) massively bedded coarse fanglomerate consists mostly of locally derived Proterozoic granite and gneiss. The coarse fanglomerate grades upward into coarse arkosic sandstone. Volcanic interbeds are increasingly abundant in the upper part of the unit. An age of 23.8 ± 0.8 m.y. was obtained on the volcanic rocks near Ajo Peak (fig. 1, no. 81AM176). These flows are in the upper part of the tilted fanglomerate-andesite sequence and thus represent a minimum age for the accumulation of the fanglomerates. A tuff stratigraphically above the tilted andesite-fanglomerate sequence yielded an age of 22.0 ± 0.7 m.y. (fig. 1, no. 81AM96).

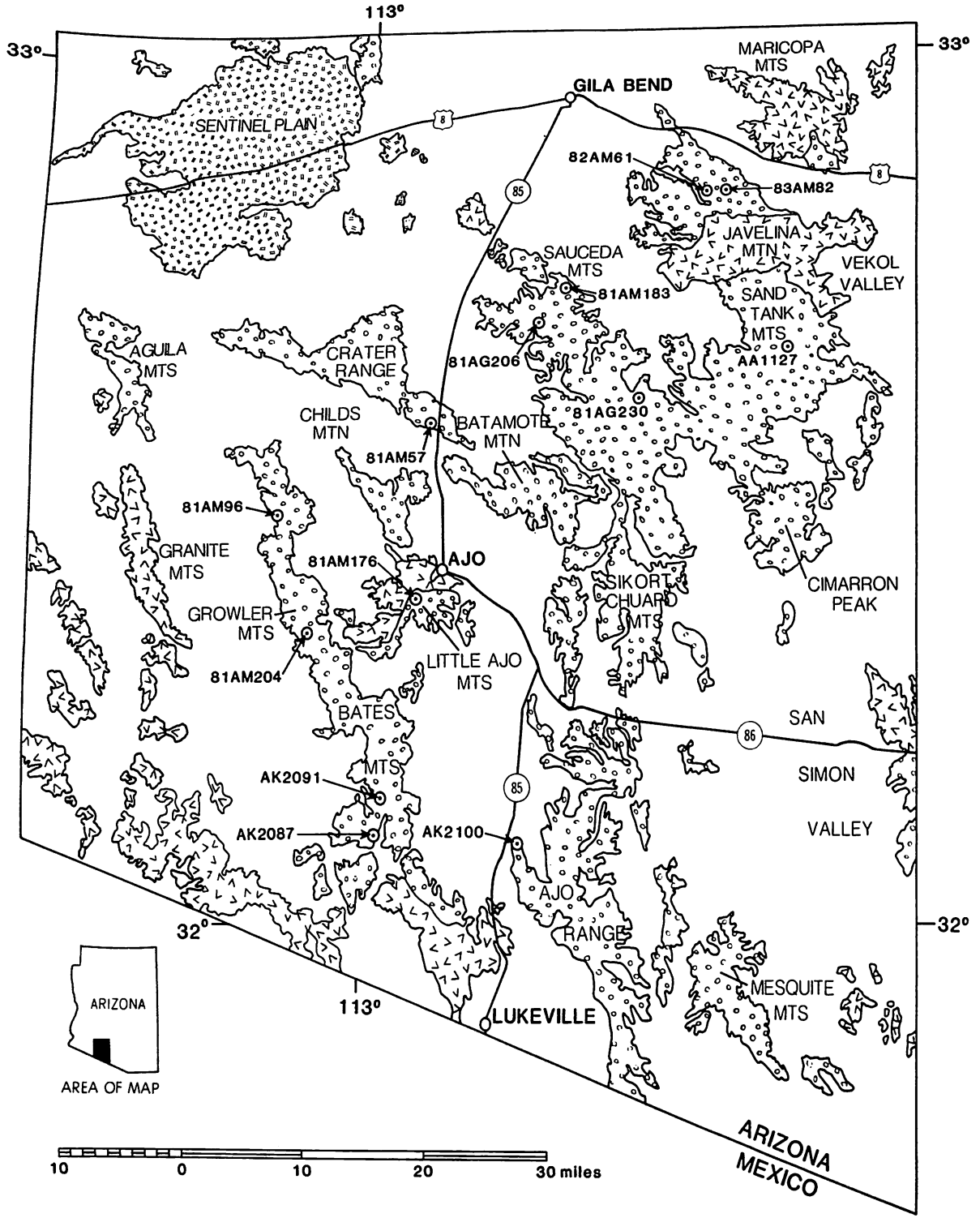
The middle unit is the most widespread of the three and forms a heterogeneous assemblage of basalt, andesite and rhyolitic rocks. The oldest rocks in the unit are rhyolitic to rhyodacitic flows and pyroclastic tuffs. Following eruption of these, volcanism progressed westward, then southward. An eroded rhyodacite dome in a composite volcano in the Sand Tank Mountains stands approximately 300 m high. A dacite flow from the flank of the dome yields a K-Ar age of 21.8 ± 0.7 m.y. (no. AA1128). A lava flow in the vicinity of Hat Mountain and the adjacent Sauceda Mountains is dated at 20.7 ± 0.6 m.y. (no. 81AG206). Silicic volcanism migrated southward into the Sikort Chuapo Mountains and the Ajo Range, eventually forming the tuffaceous rocks and rhyolitic flows of the Mt. Ajo area at around 15.4 m.y. (Tosdal, unpub. data; Jones, 1974; May and others, 1981).

Contemporaneous with silicic volcanism approximately 21 m.y. ago basalt, olivine basalt, and basaltic andesite were extruded in the region from the northern Sauceda Mountains to the southern Sand Tank Mountains. An age of 18.4 ± 0.9 m.y. (no. 82AM61) obtained on plagioclase from that sequence is considered to be too young based on geological evidence. The basalt flows occur in a composite volcano at Cimarron Peak and in fissure eruptions elsewhere. These basalts form prominent cliffs and plateaus throughout the eastern part of the volcanic field. The most distinctive rock type of the middle sequence is a coarsely porphyritic Childs Latite in the Ajo area (Gilluly, 1946). Its stratigraphic continuity makes it useful as a marker unit. The K-Ar age from the Childs Latite is 18.3 ± 0.6 m.y. (no. 81AM57; see also Eberly and Stanley, 1978, no. 107).

Basaltic andesite extrusive rocks dated between 16 and 14 m.y. were the next materials to be erupted. The major source for flows in the western part of the Ajo volcanic field was Batamote Mountain, a dissected shield volcano. Minor vents and oxidized cinder-cone deposits are present in the Cipriano Hills and the Growler and Bates Mountains farther west.

The Sentinel and Pinacate basalt flows located adjacent to the northern and southwestern parts respectively, of the volcanic field, postdate most Basin and Range block faulting. These basalts range in age from 5 m.y. to recent and are not considered here as part of the Ajo Volcanic Field Tertiary sequence (Eberly and Stanley, 1978, no. 1–6).

Sample preparation and argon and potassium analyses were carried out in the U.S. Geological Survey laboratories at Menlo Park, California. Mineral concentrates were obtained using magnetic and heavy-liquid separation techniques after crushing rock samples to either the 60 to 100 or 60 to 140 mesh fraction. Potassium analyses were performed by a lithium metaborate flux fusion-flame photometry method using lithium as an internal standard (Ingamells, 1970). Argon extraction and purification techniques are similar to those described by Dalyrmple and Lanphere (1969). Argon composition was determined by standard isotope-dilution procedures using a 60° sector, 15.2 cm radius, Neir-type mass spectrometer. The precision of the



EXPLANATION

	Alluvium	QUATERNARY
	Post-Basin and Range volcanic rocks	QUATERNARY/ TERTIARY
	Undifferentiated volcanic, minor sedimentary rocks	TERTIARY
	Granite, schist and gneiss	PRE-TERTIARY

CONTACT

⊙ AK2100 SAMPLE SITE

FIGURE 1. GENERALIZED GEOLOGIC MAP OF THE AJO AREA SHOWING SAMPLE LOCALITIES.

date is the estimated analytical uncertainty at one standard deviation and is based on experience with replicated analyses in the Menlo Park laboratories. The decay constants used in the age calculations are: $\lambda\epsilon = 0.581 \times 10^{-10}\ yr^{-1}$; $\lambda\beta = 4.962 \times 10^{-10}\ yr^{-1}$; and $^{40}K/K_{tot} = 1.167 \times 10^{-4}$.

SAMPLE DESCRIPTIONS

1. *81AM176* K-Ar
Agglomeratic andesite flow breccia (32°21'05"N, 112°55'00"W; near Ajo Mine, AZ) porphyritic medium- to light-gray rock with abundant phenocrysts of biotite and plagioclase, lesser amounts of hornblende; biotite is incipiently replaced by calcite. *Analytical data:* K_2O = 8.23%; $^{40}Ar^{rad} = 2.861 \times 10^{-10}$ mole/g; $^{40}Ar^{atm}/^{40}Ar^{ToT}$ = 45%. *Comment:* Steeply tilted volcanic unit interbedded with the top of the Locomotive Fanglomerate (see Gilluly, 1946); these volcanic rocks and equivalent age units throughout the study area were affected by precursory Basin and Range tilting.
(biotite)23.8 ± 0.8 m.y.

2. *81AM96* K-Ar
Rhyodacitic crystalline tuff (32°26'40"N, 113°06'30"W; located on W face of Growler Mountains at 360 m [1200 ft] elevation, 5 km N of Growler Peak, AZ) pink, densely welded, partially devitrified tuff containing abundant biotite up to 3 mm in diameter, sparse plagioclase, clinopyroxene, occasional flattened pumice lapilli and rock fragments; lithic fragments are dominantly porphyritic basalt. *Analytical data:* K_2O = 8.11%; $^{40}Ar^{rad} = 2.587 \times 10^{-10}$ mole/g; $^{40}Ar^{atm}/^{40}Ar^{ToT}$ = 46%. *Comment:* Underlies flows equivalent to the Childs Latite and overlies the Sneed Andesite; puts a minimum age on the Sneed Andesite and equivalent flows.
(biotite)22.0 ± 0.7 m.y.

3. *83AM82* K-Ar
Crystal-rich rhyolitic tuff (32°49'48"N, 112°29'10"W; at the N end of the Sand Tank Mountains, AZ) reddish-brown, partially welded airfall tuff containing biotite and plagioclase phenocrysts, partial vapor phase recrystallization of the glass. *Analytical data:* K_2O = 8.24%; $^{40}Ar^{rad} = 2.61 \times 10^{-10}$ mole/g; $^{40}Ar^{atm}/^{40}Ar^{ToT}$ = 19.7%. *Comment:* Tuff is interbedded with olivine basalt flows.
(biotite)21.9 ± 0.7 m.y.

4. *AA1128* K-Ar
Dacite flow (32°37'50"N,112°23'35"W; lies in the central Sand Tank Mountains at approximately 850 m [2800 ft] elevation, AZ) biotite-hornblende dacite consists of abundant phenocrysts of biotite, hornblende, and plagioclase in an aphanitic brown flow banded groundmass. *Analytical data:* K_2O = .777%; $^{40}Ar^{rad} = 0.246 \times 10^{-10}$ mole/g; $^{40}Ar^{atm}/^{40}Ar^{ToT}$ = 62.5%. *Comment:* Overlain by porphyritic basalt flows; earliest flows of middle volcanic sequence associated with large dacite dome.
(hornblende)21.8 ± 0.7 m.y.

5. *81AM183* K-Ar
Ash flow tuff (32°42'10"N,112°42'30"W; northern Sauceda Mountains, AZ) pink to white welded vitric tuff containing abundant plagioclase with quartz, biotite, and hornblende phenocrysts. *Analytical data:* K_2O = 8.14; $^{40}Ar^{rad} = 2.555 \times 10^{-10}$ mole/g; $^{40}Ar^{atm}/^{40}Ar^{ToT}$ = 46%. *Comment:* Unit overlain by capping porphyritic basalts.
(biotite)21.7 ± 0.7 m.y.

6. *81AG206* K-Ar
Rhyolite vitrophyre (32°39'30"N,112°44'20"W; located in the Sauceda Mountains, AZ) consists of biotite, plagioclase, and sanidine phenocrysts in a unaltered glass matrix. *Analytical data:* K_2O = 8.51%; $^{40}Ar^{rad} = 2.556 \times 10^{-10}$ mole/g; $^{40}Ar^{atm}/^{40}Ar^{ToT}$ = 58%. *Comment:* Rhyolite flows overlie porphyritic basalt in the area. Sample represents dike from large northwest-southeast-trending rhyolitic vent complex.
(biotite)20.7 ± 0.6 m.y.

7. *81AG239* K-Ar
Porphyritic rhyolite (32°34'10"N,112°35'50"W; approx. 700 m [2300 ft] elevation, AZ) abundant phenocrysts of reddish-brown biotite, and sanidine in quartz, K-feldspar, felsitic groundmass. *Analytical data:* K_2O = 8.78; $^{40}Ar^{rad} = 2.474 \times 10^{-10}$ mole/g; $^{40}Ar^{atm}/^{40}Ar^{ToT}$ = 29%. *Comment:* Rhyolite flows overlie porphyritic basalt. Source region is in southern Sauceda Mountains.
(biotite)19.5 ± 0.6 m.y.

8. *AK2091* K-Ar
Porphyritic rhyolite (32°07'05"N,112°58'00"W; in southern Growler Mountains, AZ) consists of K-feldspar, quartz, and scattered biotite phenocrysts in a felsitic quartz, K-feldspar groundmass. *Analytical data:* K_2O = 5.70; $^{40}Ar^{rad} = 1.539 \times 10^{-10}$ mole/g; $^{40}Ar^{atm}/^{40}Ar^{ToT}$ = 27%. *Comment:* Overlain by the Childs Latite.
(sanidine)18.7 ± 0.5 m.y.

9. *82AM61* K-Ar
Porphyritic basalt (32°49'30"N,112°31'00"W; uppermost unit approx. 700 m [2300 ft] elevation, in plateau area in northern Sand Tank Mountains, AZ) flows consist of andesine plagioclase, partially iddingsite-altered olivine, and two-pyroxene phenocrysts in an aphanitic glassy groundmass. *Analytical data:* K_2O = 0.891%; $^{40}Ar^{rad} = 0.236 \times 10^{-10}$ mole/g; $^{40}Ar^{atm}/^{40}Ar^{ToT}$ = 50%. *Comment:* Forms a thick sequence of flows in northern part of area; may be a minimum age based on geologic consideration.
(plagioclase)18.4 ± 0.9 m.y.

10. *81AM57* K-Ar
Porphyritic andesite (32°32'45"N,112°53'30"W; mesa capping unit, elevation approx. 500 km [1700 ft] 1.2 km W of Arizona highway 85, AZ) reddish-brown to maroon, coarsely porphyritic rock composed of andesine phenocrysts up to 2 cm across in a groundmass of plagioclase, K-feldspar, Fe oxides, clinopyroxene, scattered altered olivine, and minor glass. *Analytical data:* K_2O = 1.194%; $^{40}Ar^{rad} = 0.318 \times 10^{-10}$ mole/g; $^{40}Ar^{atm}/^{40}Ar^{ToT}$ = 62%. *Comment:* Named the Childs Latite (Gilluly, 1946). Age similar to that reported by Shafiquallah, et.al. (1980); flows used as a widespread index unit.
(plagioclase)18.3 ± 0.6 m.y.

11. *AK2087* K-Ar
Andesite (32°04'45"N,112°58'00"W; collected

at 500 m [1700 ft] elevation in Bates Mountains, AZ) plagioclase, with less abundant orthopyroxene and clinopyroxene phenocrysts; sparse hornblende up to 2 mm across, generally partially resorbed and rimmed by opaque oxides. *Analytical data:* K_2O = 0.519%; $^{40}Ar^{rad}$ = 0.125 × 10 mole/g; $^{40}Ar^{atm}/^{40}Ar^{ToT}$ = 80.4%. *Comment:* Overlies the Childs Latite.

(hornblende)16.7 ± 0.8 m.y.

12. *AK2100* K-Ar

Andesite (32°04'30''N,112°46'00''W; 800 m [2600 ft] elevation, in western Ajo Range, AZ) plagioclase phenocrysts most abundant with lesser amounts of orthopyroxene, clinopyroxene, and hornblende set in a trachytic textured groundmass of plagioclase microlites, scattered pyroxene, and iron-rich glass. *Analytical data:* K_2O = 2.890; $^{40}Ar^{rad}$ = 0.672 × 10^{-10} mole/g; $^{40}Ar^{atm}/^{40}Ar^{ToT}$ = 45%. *Comment:* Young capping sequences in the Ajo Range, SE Kino Peak quadrangle.

(whole rock)16.1 ± 0.7 m.y.

13. *81AM204* K-Ar

Basalt (32°18'10''N,113°03'30''W; plateau-forming unit, 3 km N of Temporal Pass, Growler Mountains, AZ) phenocrysts of partially iddingsitized olivine in a groundmass of plagioclase, pyroxene, and opaque oxides, slightly vesicular. *Analytical data:* K_2O = 0.603%; $^{40}Ar^{rad}$ = 0.125 × 10^{-10} mole/g; $^{40}Ar^{atm}/^{40}Ar^{ToT}$ = 86%. *Comment:* Youngest volcanism before Basin and Range deformation extruded locally from small cinder cones.

(whole rock)14.4 ± .7 m.y.

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