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K-Ar AGES OF TERTIARY VOLCANIC AND INTRUSIVE ROCKS IN SOCORRO, CATRON, AND GRANT COUNTIES, NEW MEXICO

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INTRODUCTION

Absolute ages for several volcanic rock units in the Datil–Mogollon volcanic field and for intrusive stocks in the Magdalena mining district have been obtained by the K-Ar method. No absolute ages heretofore have been available for igneous rocks in this region. Guess dates that have been applied were tenuously established within relatively broad limits by local stratigraphic relationships and by extrapolation from limited paleontological dating of sediments outside the area.

Dated samples include four from the Datil Formation in widely separated localities, one of which is the type section of the Hells Mesa Member (Tonking, 1957), consisting of welded rhyolite tuff, rhyolite vitrophyre, obsidian, and perlite. The first three of these gave consistent age values averaging 30.6, 28.3, and 27.2 m.y., respectively. The fourth, a perlite showing some alteration, gave inconsistent ages of 23.1 and 42.6 m.y. on successive runs.

Three samples of presumably post-Datil volcanic glass included perlite, obsidian, and pumiceous glass (a commercial "perlite"). The perlite and obsidian gave ages of 14.3 and 18.6 m. y., respectively, whereas the pumiceous "perlite" gave inconsistent ages of 23.7 and 33.2 m. y. on successive runs.

Two samples from the Magdalena mining district consisted of monzonite from the Nitt stock and granite from the adjacent Anchor Canyon stock (Loughlin and Koschmann, 1942). The monzonite gave an age of 28.0 m. y., and the granite an age of 28.3 m. y.

TECHNIQUES

Preparation and analysis of the samples was by Bassett, using the facilities of the Brookhaven National Laboratory, under the auspices of the U.S. Atomic Energy Commission. A summary of the techniques employed is given by Bassett et al. (1963a, 1963b) and will not be repeated herein.

Age calculations were made by Bassett using decay constants derived from radiochemical data by McNair et al. (1956):

$$\lambda_e = 0.585 \times 10^{-10} \text{ years}^{-1}$$
$$\lambda_\beta = 4.83 \times 10^{-10} \text{ years}^{-1}$$
$$K^{40} \text{ half life} = 1.28 \times 10^{9} \text{ years}$$
$$\text{Branching ratio} = 0.121 = \lambda_e / \lambda_\beta$$

Results of the analyses and the calculated ages are shown in Table 1. Instrumental error (mean deviation) is approximately 5 percent.

TABLE 1. K-Ar AGES, WEST-CENTRAL NEW MEXICO

Sample	Location	Percent K	Percent Radiogenic Argon	Age (M.Y.)
Post-Datil volcanics				
(1) Perlite	Magdalena Stendel deposit	3.88	74 64	14.0 14.6
(2) Obsidian nodules	Mule Creek	4.13	60	18.6
Post-Datil (?) volcanics				
(3) Pumiceous "perlite"	Socorro Great Lakes Carbon deposit	4.16	46 60	23.7 33.2
Datil Formation				
(4) Obsidian nodules	Mogollon	4.02	79 79	27.6 26.7
(5) Glass from vitrophyre	Reserve	3.18	64 64	27.9 28.7
(6) Biotite from welded tuff	Bear Mountains type section	6.77	52 64	29.4 31.8
Datil (?) Formation				
(7) Perlite	Indian Spring	3.78	41 72	23.1 42.6
Tertiary intrusives				
(8) Biotite from monzonite	Magdalena Nitt stock	7.55	41	28.0 (poor run)
(9) Biotite from granite	Magdalena Anchor Can. stock	7.40	51 46	28.3 28.2

SAMPLE DESCRIPTIONS AND LOCATIONS

Samples were collected specifically for age determinations by the K-Ar method, with the exception of samples (4) and (7), which were provided by Max E. Willard from a collection made previously. Consequently, an attempt was made to select material that had not only stratigraphic and petrologic significance but also consisted of apparently fresh glass or contained appreciable amounts of fresh biotite.

(1) *Perlite*. Massive, porphyritic, finely perlitic, pale gray glass. From a prospect pit in the Stendel deposit 4½ miles south of Magdalena, NE¼SW¼ sec. 14, T. 3 S., R. 4 W. Phenocrysts of quartz, sanidine, plagioclase, biotite, and hornblende, comprising about 17 percent of the rock by volume, are set in a matrix of glass with a very fine-grained perlitic structure. Although local zones within the perlite are highly altered to zeolites (mainly clinoptilolite) and smaller amounts of montmorillonite (Weber, 1957), the analyzed sample was free of significant alteration. A chemical analysis shows this rock to be a high-silica rhyolite.

(2) *Obsidian nodules*. Characteristic small nodules of dark gray to black obsidian (marekanites or "Apache tears") embedded in perlite. From west of Mule Creek, Grant County, SE¼ sec. 6, T. 14 S., R. 21 W. Except for a thin gray surface film, these nodules are fresh and unaltered. The generalized geology of the area has been illustrated by Weber and Willard (1959b), who placed the obsidian-bearing perlite in their upper rhyolite sequence (Tur).

(3) *Pumiceous "perlite."* Pale gray buff, flow-banded, nonperlitic, pumiceous glass. From the open pit mine of the Great Lakes Carbon Corporation 3½ miles southwest of Socorro, SW¼NW¼ sec. 27, T. 3 S., R. 1 W. Although locally altered to montmorillonite and stained by films of manganese oxides, apparently fresh samples are available throughout most of the deposit. The geology of this deposit is summarized by Weber elsewhere in this guidebook.

(4) *Obsidian nodules*. Typical marekanites of fresh, lustrous, black obsidian in flow-banded rhyolite in Ewe Canyon, 17½ miles east-northeast of Mogollon, Catron County, W½ sec. 32, T. 9 S., R. 16 W. The rhyolite flows in this area have been correlated by Willard with the upper part of the Datil Formation (Weber and Willard, 1959b). Sample collected by Max E. Willard.

(5) *Glass from vitrophyre*. Brownish black, pitchy-lustered vitrophyre containing abundant phenoclasts of feldspar, quartz, and minor biotite, plus scattered reddish brown spherulites, in a slightly perlitic matrix of fresh glass. From the eastern face of the Saliz Mountains 5½ miles southwest of Reserve, Catron County, SW¼ sec. 33, T. 7 S., R. 19 W. The vitrophyre is present only locally at the base of the tuff member (Tdt) in the upper part of the Datil Formation, immediately above a volcanic conglomerate (Tdc) (Weber and Willard, 1959a). Textural and stratigraphic features indicate that the vitrophyre is a welded tuff.

(6) *Biotite from welded tuff*. Hard, pale pinkish gray welded rhyolite tuff with abundant phenoclasts of sanidine, quartz, biotite, and sphene, plus lithic inclusions. From the eastern face of the Bear Mountains 10½ miles north of Magdalena, NE¼SW¼ sec. 17, T. 1 N., R. 4 W. The sample was in the basal portion of the Hells Mesa Member of the Datil Formation immediately above the contact with the underlying Spears Member in the type section of these units (Tonking, 1957).

(7) *Perlite*. Gray, vitreous, finely perlitic glass containing sparse small phenocrysts of feldspar, quartz, and biotite. Narrow seams and small irregular patches of alteration are apparent in hand specimen. From outcrop in the Luera Mountains east of Indian Spring, Catron County, SE¼ sec. 26, T. 6 S., R. 9 W. According to Max E. Willard, who provided the sample (personal communication, 1962), the perlite appeared intrusive into the latite-rhyolite facies (Tdlr) of the Datil Formation. The generalized geology of the area is illustrated by Willard (1957).

(8) *Biotite from monzonite*. Medium buffish gray, fine medium-grained, granitoid rock composed of potash and plagioclase feldspar, minor quartz, and lustrous plates of biotite. From outcrop in the Nitt stock southwest of the Hardscrabble mine 2½ miles southeast of Magdalena, SE¼ sec. 25, T. 2 S., R. 4 W. Somewhat coarser-grained than the typical monzonite described by Loughlin and Koschmann (1942, p. 37) and lacks recognizable pyroxene in hand specimen.

(9) *Biotite from granite*. Pale gray, somewhat porphyritic, medium-grained, granitoid rock composed of potash and plagioclase feldspars, quartz, and glomeroporphyritic clusters of lustrous black biotite, green hornblende, and magnetite. Sphene is a conspicuous accessory. From a roadcut in the Anchor Canyon stock 2½ miles east of Magdalena, NE¼NE¼ sec. 25, T. 2 S., R. 4 W. Conforms closely with the granite described by Loughlin and Koschmann (1942, p. 40).

EVALUATION AND SIGNIFICANCE OF AGE DATA

With but two exceptions, samples (3) and (7), the calculated ages derived from K-Ar analyses are wholly consistent with observed geologic relationships and serve to reinforce correlations made on lithologic and stratigraphic bases. Some generalized concepts may require modification if these ages are supported by additional field and laboratory evidence.

The volcanic glasses, including obsidian, perlite, and vitrophyric welded tuff appear to give results that are commensurate with those from biotite when fresh, unaltered samples are used. They are, however, relatively unstable and sensitive to attack by thermal solutions and alkaline ground waters. Previous work by Bassett et al. (1963a) has shown the relationship between alteration and decreased apparent ages of volcanic glass, probably as a result of argon leakage. Samples (3) and (7) illustrate inconsistencies in apparent age that may have resulted from alteration. The fresh glasses gave radiogenic argon percentages ranging upward from those of biotite in the samples analyzed.

Dates from the Datil Formation show only a modest range in the Oligocene, if sample (7) is excepted. There is no conflict with stratigraphic relationships and a predicted age of Miocene or older. Confirmation by an equivalent age from two other samples of the Datil was received while this report was being written. Robert D. Walker, of the Research Department of Socony-Mobil Oil Company, kindly supplied preliminary results of K-Ar determinations (personal communication, July 1963) on biotite from the Hells Mesa Member of the Datil Formation in the Gallinas Mountains, and from a latite tuff-breccia in Cibola Canyon southeast of La Joya. Both samples were indicated to be Oligocene in age.

The sample from the Spears Member was collected by Weber from a hornblende-biotite latite tuff breccia at a stratigraphic level appreciably below the local base of rhyolite tuffs and welded tuffs of the overlying Hells Mesa Member. Inasmuch as the Spears rests directly on the Baca Formation less than one mile to the southeast, an upper limit for the age of the Baca in this area is also indicated. A rather tenuously established Eocene(?) age has been suggested for the Baca (Wilpolt et al., 1946) on the basis of a fossil tooth collected by Gardner (1910) from beds in the Carthage coal field that were later assigned by Wilpolt and Wanek (1951) to the Baca Formation. The Spears Member was, however, mapped by them with the Baca Formation in the Carthage area, thus clouding the correlation with the type section of the Baca. Nevertheless, an Eocene age for the Baca is compatible with Oligocene dates from the overlying Datil Formation. Formal definitions of the member units of the Datil will be found in a report by Tonking (1957). (Final age determinations by Burke et al., reported elsewhere in this guidebook, indicate a latest Eocene age of 37.1 m.y. for the latite tuff breccia from Cibola Canyon.)

The ages obtained from the perlite, sample (7), are difficult to evaluate. Visible alteration may account for the lower value of 23.7 m.y. and the lower argon content of that run. If the greater age of 42.6 m.y. is reliable, two possibilities must be considered: (1) the Datil Formation has a greater downward age range than is indicated by the other age determinations or (2) the dated sample is from the older pre-Datil volcanic group. According to Max E. Willard (personal communication, July 1963), the field relationships noted during reconnaissance mapping of the area (Willard, 1957) did not completely eliminate the possibility that the perlite might be part of the older group of andesitic to latitic volcanic rocks that crops out about one mile to the east. The relatively slight degree of alteration and devitrification, however, conflict with the expected character of a glass in the older group, which is characteristically appreciably altered. If the 42.6 m.y. age is actually excessive, an explanation involving selective leaching of K^{40} or enrichment of Ar^{40} enters the realm of speculation.

A similar problem is posed by the inconsistent values obtained from sample (3). Here, the correlation with the post-Datil group is by no means certain, owing to the lack of diagnostic stratigraphic relationships (see Geologic Features of the Socorro Perlite Deposit, elsewhere in this guidebook). Zones of alteration are recognizable in the deposit, and the rock is quite porous due to the abundance of microvesicles. The older value of 33.2 m.y. may actually indicate that this unit is correlative with the Datil Formation.

Samples (1) and (2) gave values that accord with the field relationships, although somewhat older than expected. The perlite from the Stendel deposit (Weber, 1957) is within a sequence of post-Datil rhyolite tuffs, flows, and volcanic domes and intrusives that appear to interfinger with at least the basal portion of a sequence of gravels. If correlation of these gravels with the Santa Fe Group is justifiable, which it seems to be (Willard, 1959), an implied age of about 14 m.y. for the basal beds of the Santa Fe group in this area supports the Miocene age proposed for the older parts of the Santa Fe Group in the Rio Grande trough.

Similarly, rhoylite tuffs, flows, and intrusives in the vicinity of Mule Creek interfinger with conglomerates and sandstones that have been correlated with the basal portion of the Gila Conglomerate (Weber and Willard, 1959b). The rhyolites also interfinger with a sequence of basalts and basaltic andesites that are separated from the underlying Datil Formation by a regional unconformity. The 18.6 m.y. K-Ar age of obsidian from the rhyolite sequence, sample (2), is in accord with the Miocene age commonly assigned to older portions of the Gila Conglomerate.

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