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K/AR AGES OF MIDDLE TERTIARY IGNEOUS ROCKS FROM SOUTHERN NEW MEXICO

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Southern New Mexico was the site of widespread Late Cretaceous and Cenozoic volcanism and intrusion, which culminated in construction of major volcanic fields in mid-Tertiary time. The earliest of the mid-Tertiary volcanic rocks in southern New Mexico is a calc-alkalic suite of andesite and latite overlain by quartz latite and rhyolite (Elston and others, 1976). Some of these mid-Tertiary rocks rest on Laramide andesites, and it is difficult to distinguish the Laramide and mid-Tertiary andesites in the field. Known representatives of the basal mid-Tertiary andesite are the Rubio Peak and Palm Park Formations, both of which have wide spans of ages (C. E. Chapin and R. E. Clemons, 1979, oral communs.). Other probable early andesites of the mid-Tertiary sequence are the Macho Andesite of Jicha (1954) and the "early andesite sequence" at Kingston (Kuellmer, 1954). The overlying quartz latite and rhyolite are characterized by formation of cauldron complexes. Middle Tertiary plutons, probably associated with the calc-alkalic volcanism, are exposed throughout southern New Mexico.

DISCUSSION OF NEW RADIOMETRIC DATES

A sample of hornblende andesite porphyry from Kuellmer's (1954) "early andesite sequence" in the Black Range west of Kingston (Fig. 1) yielded a K-Ar date on hornblende of 36.7 ± 1.4 m.y. Hedlund (1977) mapped this unit as Rubio Peak. Marvin and Cole (1978) reported a 37.3 ± 2.3 m.y. date from the Rubio Peak Formation 0.4 mile south of Emory Pass in the Black Range.

The Macho Andesite of Jicha (1954) in the Macho and Old Hadley districts at the south end of the Black Range (Fig. 1) appears to be older than Kuellmer's (1954) "early andesite sequence". A lithic dacite tuff in the Macho yielded a 40.7 ± 1.4 m.y. K-Ar date on biotite. Our Macho date is older than the 37 m.y. Rubio Peak age reported by Elston and others (1976) and older than our 36.7 m.y. date on rocks called Rubio Peak by Hedlund (1977). However, the Rubio Peak Formation may have been deposited over a long span of time, perhaps ranging from about 45 m.y. ago (Clemons, 1980, in prep.) to 37 m.y. ago, which would include the period of deposition of Jicha's (1954) Macho Andesite.

The Cooke's Peak granodiorite stock lies due west of the Old Hadley district (Fig. 1) and intrudes Silurian through Upper Cretaceous sedimentary rocks (Jicha, 1954, and Elston, 1957). The stock is in fault contact with the Macho Andesite, so direct evidence for their relative ages is lacking. Jicha (1954) reported the presence of granodiorite pebbles in sandstones in the lower part of the Macho. Although Jicha (1954) speculated on a Late Cretaceous or early Tertiary age for the stock, similar to the age of intrusions near Silver City, a K-Ar date of 38.8 ± 1.4 m.y. places the Cooke's Peak stock near the Eocene–Oligocene boundary. Within limits of error, the ages of the stock and Macho Andesite cannot be distinguished. The two ages are so close that they lead us to suspect that the granodiorite pebbles Jicha (1954) found in the lower Macho series might have come from a source other than the Cooke's Peak stock; alternatively, the granodiorite pebbles may be in a conglomerate stratigraphically above the lower Macho series.

To the east-southeast, across the Rio Grande Valley, the Organ batholith intrudes Paleozoic sedimentary rocks and mid-Tertiary volcanic rocks as a four-or five-phase pluton (Seager and Brown, 1978). The northern phase of the batholith is a quartz monzonite porphyry stock (W. R. Seager, 1979, oral commun.), which is in faulted intrusive contact with highly sericitized sills. Both the sills and stock are cut by hornblende latite porphyry dikes that appear to be responsible for much of the mineralization in the Organ mining district. Samples of monzonite (32.8 ± 0.5 m.y.), altered sills (34.4 ± 1.1 m.y.), and hornblende latite (32.1 ± 1.1 and 32.9 ± 1.2 m.y.) (Fig.1) yielded dates which are indistinguishable within the margins of error. Kottlowski and others (1969) reported a date of 27 m.y. on the Organ Mountains quartz monzonite. Since they did not give any information on the sample locality, we cannot compare their result to our dates. Seager (1975) and Seager and Brown (1978) noted that there is a 32.7 m.y. old ash-flow tuff cauldron in the southern Organ Mountains of which the Organ batholith may be a resurgent phase.

These dated samples of volcanic and intrusive rocks of southern New Mexico appear to fall in the early and late phases of mid-Tertiary calc-alkalic activity described by Elston and others (1976). The Macho Andesite and Kuellmer's (1954) "early andesite sequence" west of Kingston plus the Cooke's Peak stock represent early andesitic activity. The Organ Mountains intrusions are younger, more siliceous rocks associated with formation of an ash-flow tuff cauldron.

METHODS USED

K – Atomic absorption
Ar – Isotope dilution with high purity Ar^{38} spike
$\lambda_\beta = 4.962 \times 10^{-10}$ yr^{-1}
$\lambda_\epsilon = 0.581 \times 10^{-10}$ yr^{-1}
$K^{40}/K_{total} - 1.167 \times 10^{-4}$

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SAMPLE DESCRIPTIONS

1. *KGN-v* K-Ar

Hornblende andesite porphyry. (Approx. S23,T16S, R9W (unsurveyed); Kingston mining district; 32°54′20″N, 107°44′50″W; Hillsboro 15′ quad, Sierra Co., NM). *Analytical data*: %K = 0.518; radiogenic Ar^{40} = 0.07467 x 10^{-5} cc STP/g (33.31 x 10^{-12} moles/g); radiogenic Ar^{40}/total Ar^{40} = 0.400. *Collected by*: R. B. Loring. *Analyzed by*: R. L. Armstrong and J. E. Harakal, Univ. British Columbia. *Comment*: "Early andesite sequence" of Kuellmer (1954).

(hornblende) 36.7 ± 1.4 m.y.

2. *OH-Mch* K-Ar

Lithic dacite tuff. (cS29,T20S,R8W; Old Hadley mining district; 32°32′18″N, 107°41′11″W; Lake Valley quad, Luna Co., NM). *Analytical data*: %K = 6.40; radiogenic Ar^{40} = 1.023 x 10^{-5} cc STP/g (456.41 x 10^{-12} moles/g); radiogenic Ar^{40}/total Ar^{40} = 0.825. *Collected by*: R. B. Loring and A. K. Loring. *Analyzed by*: R. L. Armstrong and J. E. Harakal, Univ. British Columbia. *Comment*: Macho Andesite of Jicha (1954).

(bitotie) 40.7 ± 1.4 m.y.

3. *CPK* K-Ar

Granodiorite stock. (SE/4 S4,T21S,R9W; W side of Cooke's Range; 32°30′20″N, 107°46′25″W; Dwyer quad, Luna Co., NM). *Analytical data*: %K = 6.99; radiogenic Ar^{40} = 1.066 x 10^{-5} cc STP/g (475.60 x 10^{-12} moles/g); radiogenic Ar^{40}/total Ar^{40} = 0.728. *Collected by*: R. B. Loring and A. K. Loring. *Analyzed by*: R. L. Armstrong and J. E. Harakal, Univ. British Columbia. *Comment*: Cooke's Peak granodiorite stock.

(biotite) 38.8 ± 1.4 m.y.

4. *OGN-mn* K-Ar

Monzonite stock (S6,T22S,R4E; Organ Mountains; 32°25′N, 106°34′W; Organ quad, Dona Ana Co., NM). *Analytical data*: %K = 6.95; radiogenic Ar^{40} = 400.05 x 10^{-12} moles/g, 396.75 x 10^{-12} moles/g; atmospheric Ar^{40} = 25.8%, 25.5%. *Collected by*: R. B. Loring. *Analyzed by*: Paul Damon, Laboratory of Isotope Geochemistry, Univ. Arizona. *Comment*: Organ stock, Organ Mountains.

(biotite) 32.8 ± 0.5 m.y.

5. *OGN-ss* K-Ar

Sericitized quartz-feldspar porphyry sill. (NW/4 S36, T21S,R3E; Organ mining district; 32°26′N, 106°35′W; Organ quad, Dona Ana Co., NM). *Analytical data*: %K = 7.97; radiogenic Ar^{40} = 1.077 x 10^{-5} cc STP/g (480.5 x 10^{-12} moles/g); radiogenic Ar^{40}/total Ar^{40} = 0.764. *Collected by*: R. B. Loring and A. K. Loring. *Analyzed by*: R. L. Armstrong and J. E. Harakal, Univ. British Columbia.

(muscovite) 34.4 ± 1.1 m.y.

6. *OGN-ed* K-Ar

Unaltered hornblende latite porphyry dike. (SE/4 S36, T21S,R3E; Organ mining district; 32°26′N, 106°35′W; Organ quad, Dona Ana Co., NM). *Analytical data*: %K = 0.728; radiogenic Ar^{40} = 0.09155 x 10^{-5} cc STP/g (40.84 x 10^{-12} moles/g); radiogenic Ar^{40}/total Ar^{40} = 0.352. *Collected by*: R. B. Loring and A. K. Loring. *Analyzed by*: R. L. Armstrong and J. E. Harakal, Univ. British Columbia. *Comment*: Dike intrudes the monzonite stock and altered sill in the Organ Mountains mining district.

(hornblende) 32.1 ± 1.1 m.y.

7. *OGN-ed* K-Ar

Unaltered hornblende latite porphyry dike. (SE/4 S36, T21S,R3E; Organ mining district; 32°26′N, 106°35′W; Organ quad, Dona Ana Co., NM). *Analytical data*: %K = 6.51; radiogenic Ar^{40} = 0.8412 x 10^{-5} cc STP/g (375.3 x 10^{-12} moles/g); radiogenic Ar^{40}/total Ar^{40} = 0.680. *Collected by*: R. B. Loring and A. K. Loring. *Analyzed by*: R. L. Armstrong and J. E. Harakal, Univ. British Columbia. *Comment*: Same rock as sample 6.

(biotite) 32.9 ± 1.2 m.y.

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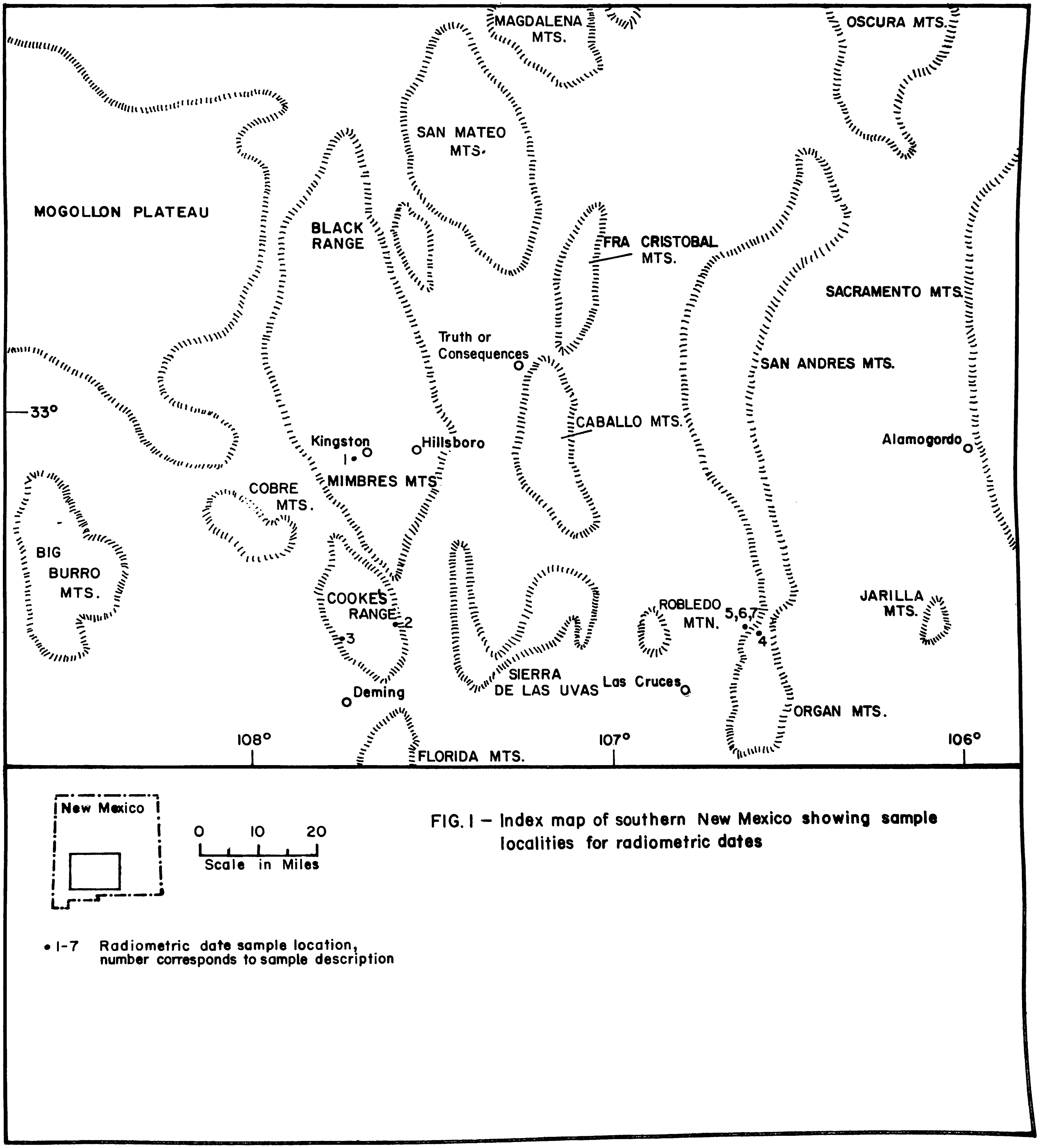

FIG. 1 – Index map of southern New Mexico showing sample localities for radiometric dates