Rb-Sr whole rock age determinations for Sandia Granite and Cibola Gneiss, New Mexico

Taggart, J.E.' Brookins, D.G.

Isochron/West, Bulletin of Isotopic Geochronology, v. 12, pp. 5

This page is intentionally left blank to maintain order of facing pages.

RB-SR WHOLE ROCK AGE DETERMINATIONS FOR SANDIA GRANITE AND CIBOLA GNEISS, NEW MEXICO

J. E. Taggart
New Mexico Bureau of Mines & Mineral Resources
Socorro, NM 87801
and
D. G. Brookins
Department of Geology
University of New Mexico
Albuquerque, NM 87131

ANALYTICAL PROCEDURES

Concentration of rubidium and strontium were measured by replicate x-ray fluorescence spectrography; G-1, G-2, GSP-1, BCR-1, DTS-1 and AGV-1 were used as standards. The precision of the ^{87}Rb/^{86}Sr ratios (Table 1) is better than three percent based on analyses of rock standards as unknowns.

Strontium isotope compositions were measured on a 12-inch, 90-degree sector, mass spectrometer with a single filament mode of ionization. All ^{87}Sr/^{86}Sr ratios measured were normalized to ^{86}Sr/^{88}Sr = 0.1194. The precision of the strontium isotopic analyses is assumed to be better than ±0.0005 based on 12 analyses of Eimer and Amend Standard $SrCO_3$ for which we obtained 0.7080 ± 0.0001 (2 standard deviations) during the course of this investigation.

The slope, initial ^{87}Sr/^{86}Sr ratio, and error (one standard deviation) of each isochron (Figures 2 and 3) were calculated by the least squares regression method of York (1966) assuming a decay constant for ^{87}Rb of 1.39×10^{-11}/y.

TABLE 1 – Sample Descriptions

	Location					
Sample	W. Long.	N. Lat.	^{87}Sr/^{86}Sr	Rb (ppm)	Sr (ppm)	^{87}Rb/^{86}Sr†
Sandia Granite:						
3001-S	35°10′44″	106°28′42″	0.7758	255	216	3.49
3002-S	35°11′30″	106°28′05″	0.7613	251	265	2.79
3003-S	35°11′38″	106°28′26″	0.7481	184	251	2.17
Cibola Gneiss (all samples are meta-arkose):						
3012-A	35°01′52″	106°27′50″	0.7594	117	125	2.79
3012-B	35°01′52″	106°27′46″	0.7742	130	115	3.34
3013-A	35°02′45″	106°27′04″	0.9090	134	42	9.73
3013-B	35°02′45″	106°27′04″	0.8558	146	64	6.80
3014	35°03′11″	106°26′49″	0.8059	180	130	4.42
3015	35°03′49″	106°25′08″	0.7699	156	166	2.79
3016	35°04′24″	106°25′11″	1.2524	139	13	32.58

† determined directly from counting data

Analyses were made in 1974 at the geochronology laboratory of the University of New Mexico. All samples were collected by J. E. Taggart.

[Isochron/West, no. 12, April 1975]

GEOLOGIC DESCRIPTION

The Sandia Granite forms the main mass of the Sandia Mountains in north-central New Mexico. The Sandia Mountains are the northernmost mountains of a chain that includes the Manzanitas, Manzanos, and Los Pinos (Kelley, 1963; Reiche, 1949; Stark, 1956; Myers and McKay, 1970; 1971; 1972). The Cibola Gneiss (also referred to as the Tijeras Gneiss in earlier literature) occurs south of the Sandia Granite in the Tijeras Canyon section. The occurrences of the Cibola Gneiss and Sandia Granite are shown in Figure 1.

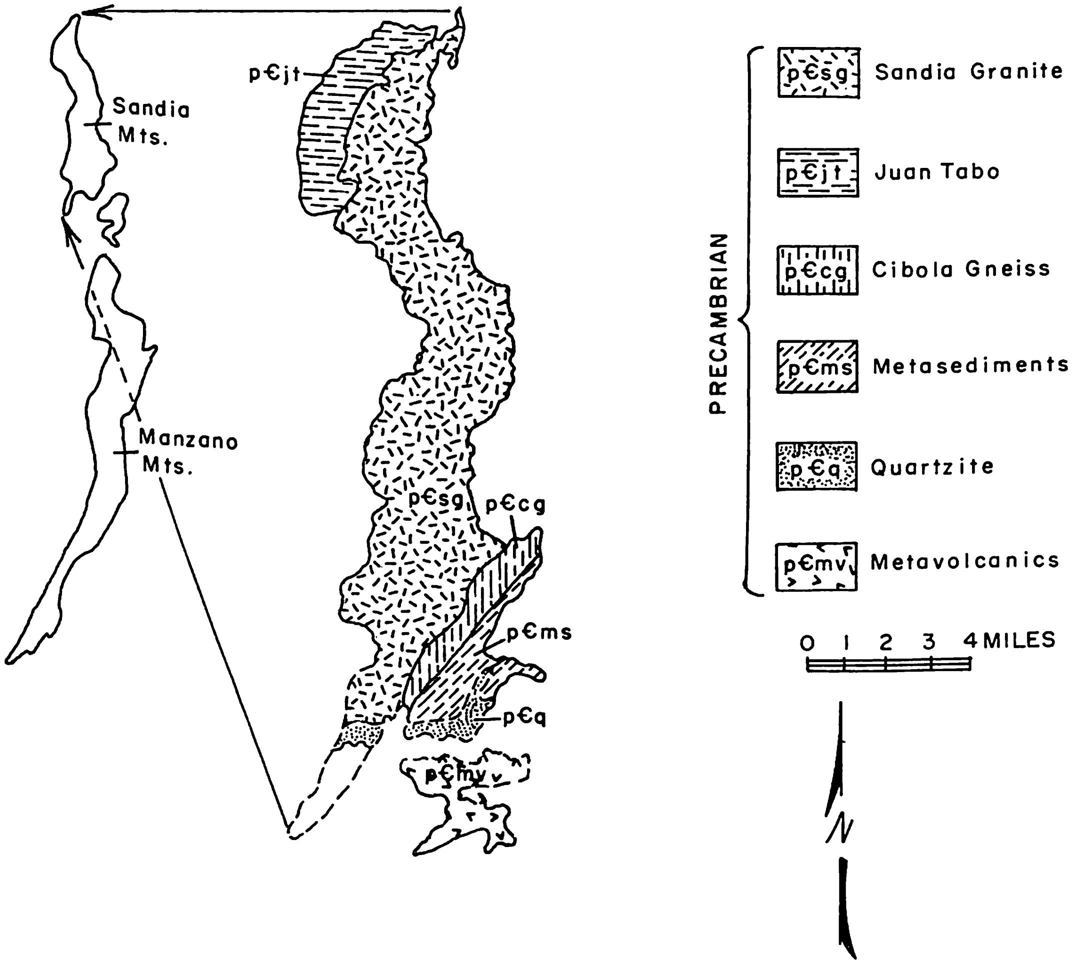

Figure 1. Generalized geology of the Sandia Mountains showing outcropping of Precambrian rocks. (See text and Table 1 for sample locations).

The Sandia Granite is a relatively homogeneous, porphyritic rock with distinctive microcline phenocrysts in a granitoid groundmass of quartz, feldspars, and micas. Details on the mineralogy of the Sandia Granite are set forth in Fitzsimmons (1961), Kelley (1963), Shomaker (1965), and Feinberg (1969). Analyses of several samples of the Sandia Granite (Robert Enz, personal communication) indicate that the Sandia is a true magmatic granite with all samples of quartz-microcline-oligoclase-biotite granite plotting near the hypothetical minimum on the normative quartz-albite-orthoclase ternary.

The Cibola Gneiss (Figure 1) forms an outcrop area roughly a mile wide and five miles long adjacent to the Sandia Granite on the southeast. The gneiss is foliated and contains distinctive quartzite beds. As the contact with the granite is approached, the gneiss grades from a metasediment (showing relic rounded quartz grains) to a foliated gneiss. Further, Lodewick (1960) observed that the gneiss is markedly more coarse grained as the granite contact is approached. Lodewick (1960) also notes that the high amounts of quartz, and to a lesser degree K-feldspar (relative to plagioclase and mica) suggests that the rock has been derived from arkosic to orthoquartzitic sediments.

Although, in places, the contact with the Sandia Granite appears gradational, unmistakable intrusive contacts of the granite into the gneiss are observed in Tijeras Canyon. Nowhere is there evidence for the granitization of sedimentary strata that could be responsible for formation of the Sandia Granite. Lodewick (1960) further notes that the zircons in the Cibola Gneiss are rounded whereas those from the Sandia Granite are not.

Brookins (1974) has summarized the available radiometric data for the Sandia Granite and proposes a minimum age of formation of the granite at 1.48 ± 0.02 b.y. ago; a fission track date on apatite is 50 m.y., presumably dating uplift of the granite above the apatite annealing isotherm. No previous data for the Cibola Gneiss are available.

ANALYTICAL RESULTS

The whole rock isochrons for the Cibola Gneiss and for the Sandia Granite are shown in Figures 2 and 3. The whole rock age for the Cibola Gneiss is 1.610 ± 0.073 b.y. with initial ^{87}Sr/^{86}Sr = 0.7022 ± 0.0010. Sample 3016 is a sample of granite gneiss from a location near the granite contact. The data for the sample clearly does not plot on the isochron, and indicates an open whole rock system probably as a result of the intrusion of the Sandia Granite. Sample 3016 was not used in construction of the whole rock isochron for the Cibola Gneiss (Figure 2). In the latter, the data for the three new samples (3001, 3002, 3003) plus that for apatite with lowest ^{87}Sr/^{86}Sr from Wasserburg and Steiger (1967; Figure 1), were combined and the resultant isochron (Figure 3) yields 1.504 ± 0.015 b.y. with initial ^{87}Sr/^{86}Sr = 0.7027 ± 0.0005. This age agrees closely with the "best date" of 1.48 ± 0.02 b.y. (based on U, Th-Pb, Pb-Pb, and a Rb-Sr mineral isochron by others) proposed by Brookins (1974).

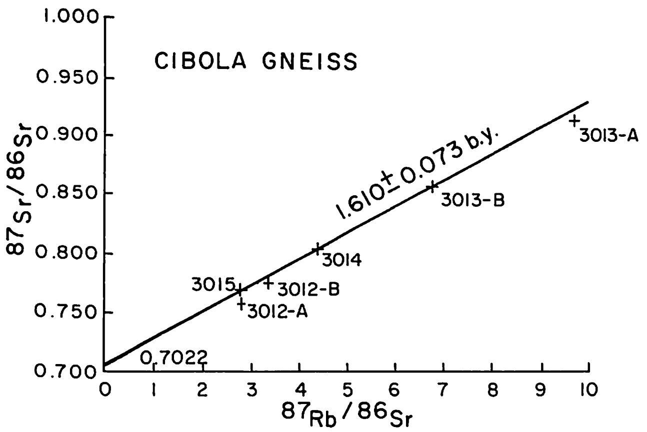

Figure 2. Rb-Sr Whole Rock Isochron, Cibola Gneiss.

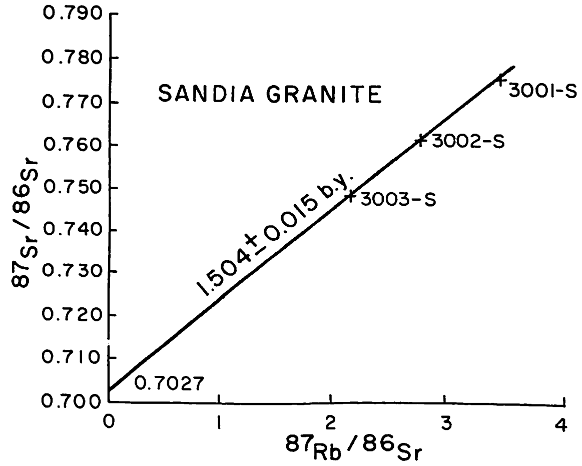

Figure 3. Rb-Sr Whole Rock Isochron, Sandia Granite.

CONCLUSIONS

The initial ratios for the Sandia Granite and for the Cibola Gneiss are identical within experimental error; but the ages are clearly resolved and are consistent with field observations indicating that the granite is indeed intrusive into the gneiss and that the granite is truly magmatic, whereas the gneiss has been derived from sedimentary rocks. These sediments must not include old sialic crustal detritus, however, to have such a low initial ^{87}Sr/^{86}Sr. This conclusion is further supported by the disruption of the gneiss whole rock system near the granite contact. Thus a "metasomatic" origin of the granite from the gneissic rocks is precluded.

ACKNOWLEDGMENTS

S. L. Bolivar, B. Mukhopadhyay, and M. J. Lee of the University of New Mexico assisted with the chemistry and mass spectrometry. The Research Allocations Committee of the University of New Mexico provided partial financial support as did the New Mexico Bureau of Mines and Mineral Resources. J. Renault reviewed the manuscript.

REFERENCES

Brookins, D. G. (1974) Radiometric age determinations from the Sandia Granite, New Mexico: Summary and interpretation: Isochron/West, no. 10, p. 11-14.

Feinberg, H. (1969) Geology of the central portion of the Sandia Granite, Sandia Mountains, Bernalillo County, New Mexico: New Mexico M. S. thesis.

Fitzsimmons, J. P. (1961) Precambrian rocks of the Albuquerque country: New Mexico Geol. Soc. Guidebook 12th Field Conf., Albuquerque Country, p. 90-96.

Kelley, V. C. (1963) Geologic Map of the Sandia Mountains and vicinity: New Mexico Bureau Mines Mineral Resources Geologic Map 18.

Lodewick, R. B. (1969) Geology and petrology of the Tijeras Gneiss, Bernalillo county, New Mexico: Univ. of New Mexico M. S. thesis.

Myers, D. A., and McKay, E. J. (1970) Geologic map of the Mount Washington quadrangle, Bernalillo and Valencia counties, New Mexico: U. S. Geol. Survey Map GQ-886.

---- (1971) Geologic map of the Bosque Peak quadrangle, Torrance, Valencia, and Bernalillo counties, New Mexico: U. S. Geol. Survey Map GQ-948.

---- (1972) Geologic Map of the Capilla Peak quadrangle, Torrance, and Valencia counties, New Mexico: U. S. Geol. Survey Map GQ-1008.

Reiche, P. (1949) Geology of the Manzanita and north Manzanos Mountains, New Mexico: Geol. Soc. America Bull., v. 60, no. 7, p. 1183-1212.

Shomaker, J. W. (1965) Geology of the Southern portion of Sandia Granite, Sandia Mountains, Bernalillo County, New Mexico: Unpub. Univ. New Mexico M. S. thesis.

Stark, J. T. (1956) Geology of the south Manzano Mountains, New Mexico: New Mexico Bureau Mines Mineral Resources Bull. 34.

Wasserburg, G. J., and Steiger, R. H. (1967) Systematics in the Th-U-Pb systems and multiphase assemblages: Int. Atomic Energy Agency, Radioactive dating and methods of low level counting, p. 331-347.

York, D. (1966) Least squares fitting of a straight line: Canad. Jour. Physics, v. 44, p. 1079-1086.