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Sr ISOTOPIC INITIAL RATIOS FOR MID-CENOZOIC VOLCANIC ROCKS FROM THE MOGOLLON–DATIL VOLCANIC FIELD, SOUTHWESTERN NEW MEXICO

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We report eleven new $^{87}Sr/^{86}Sr$ initial ratios on mid-Cenozoic volcanic rocks from the Mogollon–Datil volcanic field, southwestern New Mexico. The rocks studied range in age from approximately 37 to 18 M.Y.B.P. In this study, we restricted our samples to the more silicic rocks of the field. Stinnett (1982) and Stinnett and Stueber (1976) have studied the more mafic rocks of the field.

DISCUSSION

The mid-Cenozoic volcanic rocks of the Mogollon–Datil field can be divided into two major coexisting groups: 1) cauldron rocks, mainly rhyolitic, which erupted from ash-flow tuff cauldrons; and 2) noncauldron rocks, mainly andesitic, which erupted from stratovolcanoes (Bornhorst and Elston, 1981; Bornhorst, 1980; Elston and Bornhorst, 1979). Samples 1–9 are cauldron rocks and samples 10 and 11 are noncauldron rocks. Calculated initial $^{87}Sr/^{86}Sr$ ratios from this study and other studies suggest cauldron rocks are characterized by ratios of 0.7055–0.7124 (data are too few to suggest a dominant value) and noncauldron rocks are characterized by ratios of 0.706–0.709 (figure 1).

There is no significant correlation between initial $^{87}Sr/^{86}Sr$ and SiO_2 (figure 2) except that values greater than 0.710 are confined to rocks with SiO_2 greater than 65 weight percent (mainly cauldron rocks). There is a weak positive correlation between initial $^{87}Sr/^{86}Sr$ and K_2O, but it is apparently best developed for the cauldron rocks. Sr-isotopic values greater than 0.709 are confined to rocks in which K_2O is greater than 4.0 weight percent (mainly cauldron rocks). There is a weak positive correlation between initial $^{87}Sr/^{86}Sr$ and Rb/Sr ratio for noncauldron rocks. This correlation might represent a "pseudoisochron" (Brooks and others, 1976) or more likely crustal contamination (DePaolo, 1981). There is no significant correlation for cauldron rocks.

The Sr-isotope data and extensive major- and trace-element and mineralogical data of Bornhorst (1980) cannot uniquely define a genetic model for the mid-Cenozoic volcanic rocks. The data are consistent with contamination of the noncauldron magma by enriched upper mantle rocks or lower crustal rocks and direct derivation of most of the cauldron rocks from partial melting of the lower crustal rocks. Upper crustal contamination cannot be ruled out. We suggest that the lower crust plays an important role in volcanism of the Mogollon–Datil volcanic field, a conclusion also reached by Stinnett and Stueber (1976).

ANALYTICAL PROCEDURES

Rb and Sr concentrations were determined by x-ray fluorescence techniques. The precision of the analyses is about ±6% for Rb and ±4% for Sr (of amount reported). Each sample was analyzed on an energy dispersive instrument at Los Alamos National Laboratory and on a wavelength dispersive instrument at Michigan Technological University to insure accuracy of the reported values. Sr isotope analyses were carried out at the University of New Mexico by conventional mass spectrometry. Replicate runs of the Eimer and Amend $SrCO_3$ yielded 0.70803 ±0.00004 (two sigma).

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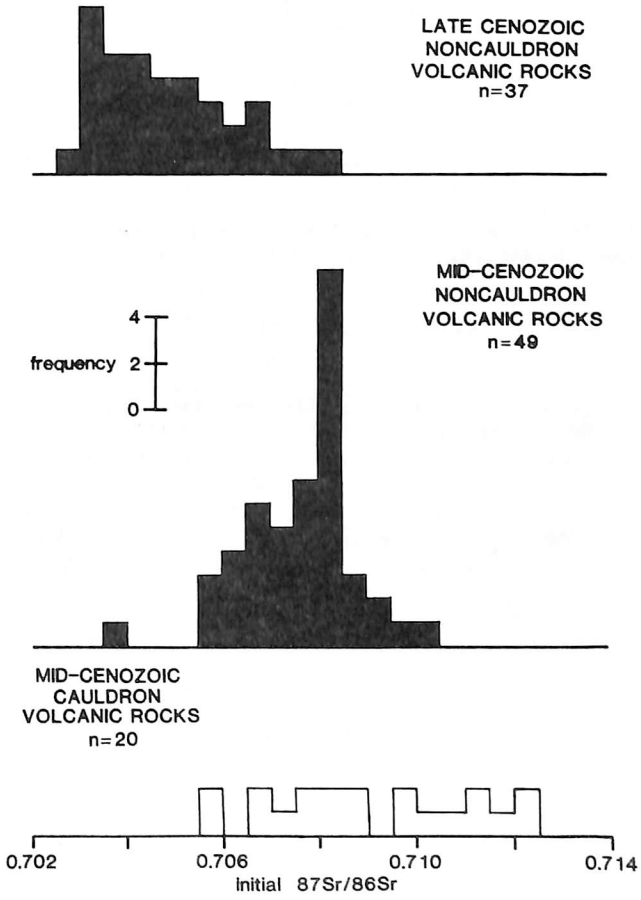

FIGURE 1. Histograms of initial $^{87}Sr/^{86}Sr$ for mid-Cenozoic volcanic rocks of the Mogollon–Datil volcanic field and late Cenozoic volcanic rocks of New Mexico. Representative late Cenozoic noncauldron data shown are from Zimmerman and Kudo (1979), Bikerman (1976), Stinnett and Stueber (1967), Stinnett (1982) and Laughlin and others (1971, 1972); mid-Cenozoic noncauldron and cauldron data are from Stinnett and Stueber (1976), Stinnett (1982), Bornhorst (1980), W. E. Elston and P. E. Damon (unpub. data) and this article. Lower isotopic ratios, around 0.704 for the late Cenozoic noncauldron rocks, are consistent with uncontaminated mantle melts (Lipman and others, 1978; Leeman, 1982). Higher ratios for late Cenozoic andesites may indicate crustal contamination (Zimmerman and Kudo, 1979).

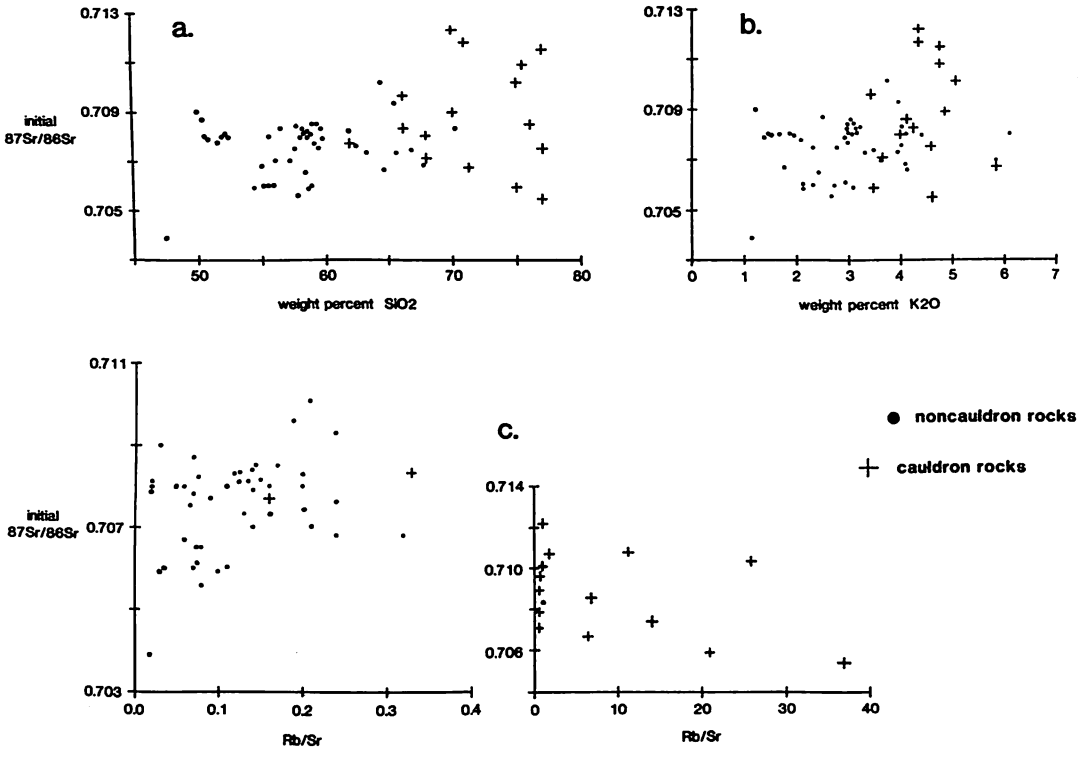

FIGURE 2. Variation of initial $^{87}Sr/^{86}Sr$ versus (a) weight percent SiO_2, (b) weight percent K_2O, and (c) Rb/Sr concentration ratio. Data are from Stinnett (1982), Bornhorst (1980) and this paper.

SAMPLE DESCRIPTIONS

1. *T-409*
Datil Well Tuff, rhyolite ash-flow tuff (NE¼ S36,T15S,R11W; 34°10'48"N, 107°55'48"W; Catron Co., NM). Rb content = 238 ppm; Sr content = 37 ppm; $^{87}Sr/^{86}Sr_N$ = 0.7162. Age of unit = 36.7 m.y., average of fission-track and K-Ar dates (Bornhorst and others, 1982).
(whole rock) $^{87}Sr/^{86}Sr$ initial ratio = 0.7067

2. *76T306*
Kneeling Nun Tuff, rhyodacite ash-flow tuff (NE¼ NE¼ S8,T18S,R12W; 32°45'39"N, 108°5'51"W; Grant Co., NM). Rb content = 143 ppm; Sr content = 343 ppm; $^{87}Sr/^{86}Sr_N$ = 0.7086. Age of unit = 34.4 m.y., K-Ar date (McDowell, 1971).
(whole rock) $^{87}Sr/^{86}Sr$ initial ratio = 0.7080

3. *76T293*
Pollack Quartz Latite, rhyodacite lava dome (SW¼ SW¼ SW¼ S21,T18S,R8W; 32°43'21"N, 107°57'37"W; Luna Co., NM). Rb content = 169 ppm; Sr content = 355 ppm; $^{87}Sr/^{86}Sr_N$ = 0.7077. Age of unit = ~33.5 m.y., based on stratigraphic position in relationship to dated units.
(whole rock) $^{87}Sr/^{86}Sr$ initial ratio = 0.7071

4. *76T249*
Mimbres Peak Formation, high silica rhyolite lava dome (SSE of center, S11,T17S,R8W; 32°50'29"N, 107°38'21"W; Grant Co., NM). Rb content = 220 ppm; Sr content = 6 ppm; $^{87}Sr/^{86}Sr_N$ = 0.7541. Age of unit = 32.9 m.y., K-Ar date (Elston and others, 1973).
(whole rock) $^{87}Sr/^{86}Sr$ initial ratio = 0.7055

5. *76T20*
Tadpole Ridge Quartz Latite, rhyolite ash-flow tuff (SE¼ NW¼ S30, T16S, R13W; 32°53'22"N, 108°13'49"W; Grant Co., NM). Rb content = 164 ppm; Sr content = 160 ppm; $^{87}Sr/^{86}Sr_N$ = 0.7135. Age of unit = 31.9 m.y., average K-Ar date (Elston and others, 1973; Marvin and Cole, 1978).
(whole rock) $^{87}Sr/^{86}Sr$ initial ratio = 0.7122

6. *76T79*
Tuff of Shelley Peak, rhyolite ash-flow tuff (NE¼ S7,T9S,R20W; 33°32'27"N, 108°56'3"W; Catron Co., NM). Rb content = 210 ppm; Sr content = 212 ppm; $^{87}Sr/^{86}Sr_N$ = 0.7112. Age of unit = 28.2 m.y., average of fission-track and K-Ar dates (Ratte and Finnell, 1978).
(whole rock) $^{87}Sr/^{86}Sr$ initial ratio = 0.7101

7. *76T16*
Bloodgood Canyon Tuff, high-silica rhyolite ash-flow tuff (NW¼ S5,T13S,R14W; 32°12'2"N, 108°19'13"W; Grant Co., NM). Rb content = 260 ppm; Sr content = 18.5 ppm; $^{87}Sr/^{86}Sr_N$ = 0.7232. Age of unit = 27.8 m.y., based on K-Ar and fission-track age dates (Elston and others, 1973; Ratte and Finnell, 1978; Marvin and Cole, 1978) and stratigraphic position relative to other dated units.
(whole rock) $^{87}Sr/^{86}Sr$ initial ratio = 0.7075

8. *76T318A*
Lemintar Tuff, high-silica rhyolite ash-flow tuff (NE¼ NE¼ S26,T4S,R6W; 33°56'54"N, 107°26'14"W; Socorro Co., NM). Rb content = 280 ppm; Sr content = 41.5 ppm; $^{87}Sr/^{86}Sr_N$ = 0.7162. Age of unit = 27 m.y. (Chapin and others, 1978).
(whole rock) $^{87}Sr/^{86}Sr$ initial ratio = 0.7086

9. *R526*
Mule Mountain Rhyolite, high-silica rhyolite lava dome (S1,T14S,R20W; 33°7'N, 180°52'W; Grant Co., NM). Rb content = 238 ppm; Sr content = 21 ppm; $^{87}Sr/^{86}Sr_N$ = 0.7193. Age of unit = 18.6 m.y., K-Ar date (Weber and Bassett, 1963).
(whole rock) $^{87}Sr/^{86}Sr$ initial ratio = 0.7108

10. *K-56*
Salt Creek Member of the Alum Mountain Formation, dacite lava flow (33°2'52"N, 108°9'14"W; Grant Co., NM). Rb content = 106 ppm; Sr content = 501 ppm; $^{87}Sr/^{86}Sr_N$ = 0.7103. Age of unit = 30.6 m.y., K-Ar date (Ratte and Gaskill, 1975).
(whole rock) $^{87}Sr/^{86}Sr$ initial ratio = 0.7100

11. *T-274*
Rhyolite lava flow from the Horse Mountain volcano, one of the earliest eruptive units (NE¼ S3,T4S,R12W; 33°59'19"N, 108°4'29"W; Catron Co., NM). Rb content = 146 ppm; Sr content = 166 ppm; $^{87}Sr/^{86}Sr_N$ = 0.7090. Age of unit = ~19 m.y., based on speculative regional correlation and a poorly etched fission-track date.
(whole rock) $^{87}Sr/^{86}Sr$ initial ratio = 0.7083

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