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Rb–Sr ISOCHRON AGES OF SOME PRECAMBRIAN PLUTONS IN SOUTH-CENTRAL NEW MEXICO

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Precambrian rocks are exposed along the flanks of the Rio Grande Rift in New Mexico. Plutons from the central and southern part of this area were analyzed for their Rb and Sr concentrations and their Sr isotopic compositions. The data were used to determine the time of crystallization and the source regions of the magmas in order to add to the time-stratigraphic framework of the Precambrian geochronology of New Mexico. The area of investigation is shown in figure 1.

Rb and Sr concentrations were determined by X-ray fluorescence spectrometry at the New Mexico Bureau of Mines and Mineral Resources at Socorro, New Mexico. Sr isotope measurements were made on the Miami University mass spectrometer at Oxford, Ohio. Uncertainties in the Rb/Sr ratio is less than 2.0 percent and replicate analyses of the Eimer and Amend $SrCO_3$ standard was 0.7080 ± 0.0001. All uncertainties are at one standard deviation. $^{87}Sr/^{86}Sr$ ratios were normalized to a $^{88}Sr/^{86}Sr$ value of 8.375; the decay constant used was ^{87}Rb = 1.39 x 10^{-11} y^{-1}. Ages were calculated using the method of York (1966).

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ISOTOPIC RESULTS

Results of the isotopic analyses are presented below. The data are presented by geographic area, summarized in table form, and shown graphically as an isochron diagram.

The Ojita Pluton. The Ojita pluton is located in the north Manzano Mountains and intrudes older metasediments; it is in turn, intruded by younger basaltic dikes (Reiche, 1949; Myers and MacKay, 1971). The pluton is a light gray, massive, medium-grained biotite granodiorite body overlain by Paleozoic sediments. The isotopic data are presented in table 1 and summarized in an isochron diagram in figure 2. These data show an age of 1560 ± 39 m.y. with an initial $^{87}Sr/^{86}Sr$ ratio of 0.7016 ± 0.0010. This indicates crystallization of mantle derived magma at about 1560 m.y. with little subsequent geochemical alteration.

Ladron Pluton. The Ladron pluton is quartz monzonitic and forms the major part of the Ladron Mountains (fig. 1). It is light orange to buff and composed of orthoclase, sodic plagioclase, quartz, biotite, muscovite, apatite, magnetite and epidote (Condie, 1976). It discordantly intrudes the older Capirote pluton, metavolcanic sequence and metasedimentary rocks. Samples L-23B and L-26 have been omitted from the age calculation as they are below the isochron and have anomalously low model ages. This departure from linearity may be due to hydrothermal alteration along the contact of the metavolcanic sequence.

The Ladron pluton yields an age of 1319 ± 51 m.y., when L-23B and L-26 are omitted, with an initial $^{87}Sr/^{86}Sr$ ratio of 0.7101 ± 0.0037 (fig. 3 and table 2). These values are interpreted to reflect the time of crystallization of a magma that was generated within the continental lithosphere.

Magdalena Pluton. The Magdalena pluton crops out on the northern end of the Magdalena Mountains (fig. 1). This pluton is a pink to orange granite that varies from fine- to coarse-grained. Major minerals are quartz, perthitic orthoclase, sodic plagioclase and biotite (Condie and Budding, in press). Although samples of this granite are indistinguishable in hand specimen or thin section the isotopic data define two sub-parallel linear arrays. Field evidence for two discrete magma batches was not recognized; mixing of two magmas is discounted due to the high amount of contaminant calculated to change the initial ratios. Possibilities to account for the resulting sub-parallel isochron arrays include the following: (A) assimilation of country rocks enriched in radiogenic ^{87}Sr with incomplete rehomogenization following incorporation; (B) the systematics have been partially re-set at about 28 m.y. related to pervasive propylitization of Tertiary igneous activity in the area (C. E. Chapin, person. comm.).

Table 3 and figure 4 show the data for this pluton. Isochron A yields an age of 1274 ± 63 m.y. with an initial $^{87}Sr/^{86}Sr$ ratio of 0.7160 ± 0.0076. Isochron B yields an age of 1355 ± 139 m.y. with an initial $^{87}Sr/^{86}Sr$ ratio of 0.7380 ± 0.0202. The large uncertainty associated with the initial ratio of Isochron B is due in part to the lack of data points near the $^{87}Sr/^{86}Sr$ axis of the diagram. The age of this pluton is tentatively interpreted as 1274 ± 63 m.y.; its high initial $^{87}Sr/^{86}Sr$ ratio indicates a continental lithospherically derived magma.

Oscura Pluton. The Oscura pluton forms most of the core of the Sierra Oscuras (Condie and Budding, in press). The predominant rock type is a gray to pink, medium-grained biotite granite. Approximately 90 percent of the rock is composed of plagioclase, potassium feldspar, quartz, biotite, hornblende, and chlorite. The Oscura pluton yields an age of 1367 ± 26 m.y. with an initial $^{87}Sr/^{86}Sr$ ratio of 0.7060 ± 0.0016 (fig. 5 and table 4). These values reflect the time of crystallization of a magma generated in the crust with a short residence time.

COMMENT

The northernmost of the granitic plutons analyzed, the Ojita pluton, is distinctly older in age (1560 ± 39 m.y.) and has an initial $^{87}Sr/^{86}Sr$ ratio (0.7016 ± 0.0010) suggesting a mantle derived magma. The Ladron, Magdalena, and Oscura plutons, near the center of the study area, yield ages of about 1320 m.y. with relatively high initial $^{87}Sr/^{86}Sr$ ratios (0.7060–0.7380) similar to those of Cenozoic plutons of continental lithospheric derivation. The ages show that magmatism was an essentially continuous or semi-continuous process during the period 1300–1400 m.y. and the dominant source area was a continental lithosphere.

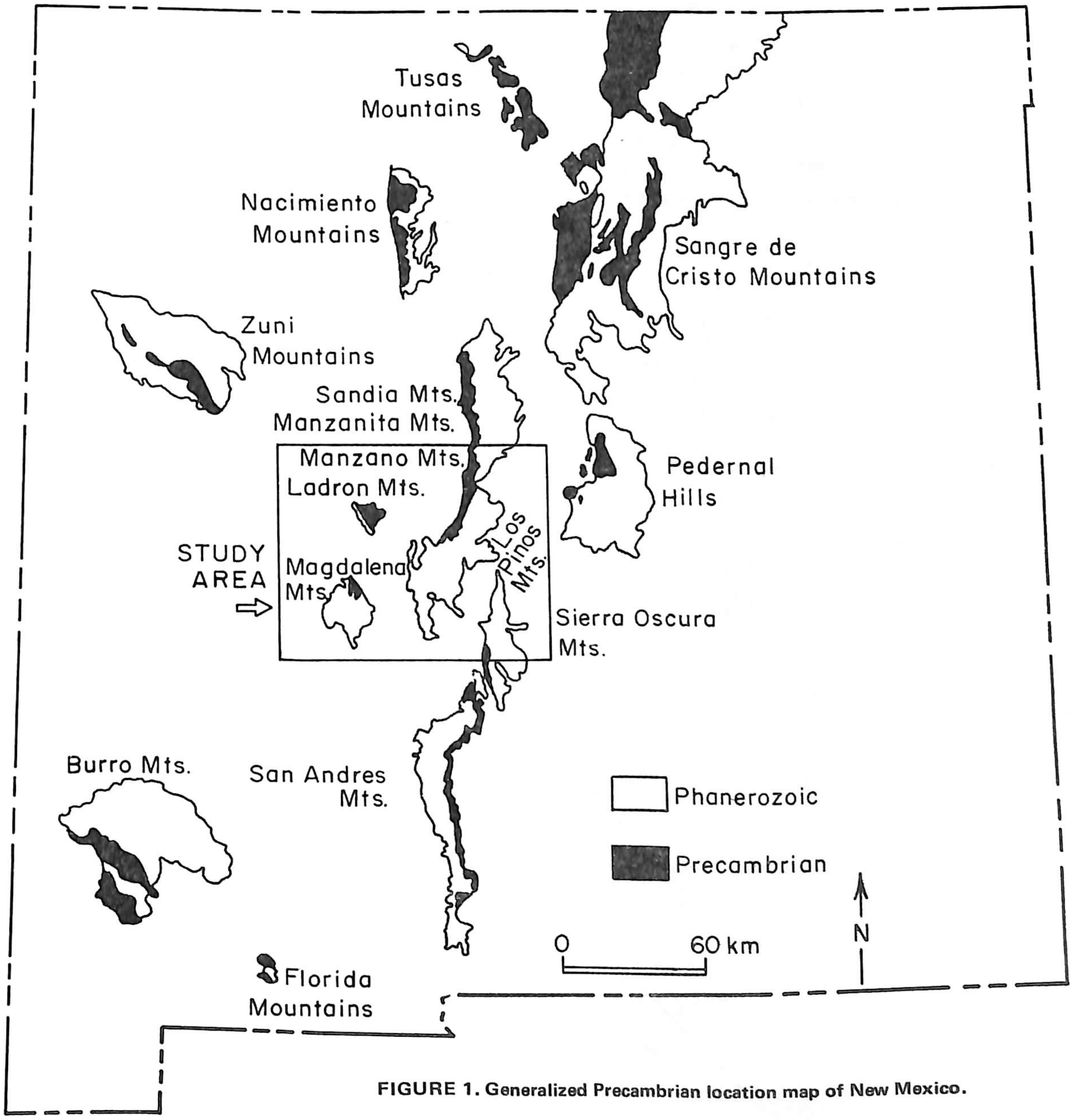

FIGURE 1. Generalized Precambrian location map of New Mexico.

TABLE 1. Data for the Ojita Pluton

Sample	Rb (ppm)	Sr (ppm)	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$	Latitude	Longitude
OJ–107	64	316	0.59	0.7130±0.0008	34°47′45″	106°26′00″
OJ–105	67	251	0.77	0.7191±0.0014	34°47′30″	106°25′45″
OJ–104	105	213	1.43	0.7344±0.0005	34°47′30″	106°26′30″
OJ–8	153	181	2.46	0.7545±0.0005	34°47′30″	106°26′15″
OJ–2	162	174	2.71	0.7601±0.0009	34°48′10″	106°26′30″
OJ–1	153	156	2.85	0.7641±0.0004	34°48′00″	106°25′45″
OJ–15	161	160	2.93	0.7653±0.0027	34°49′00″	106°24′00″
OJ–12	159	155	2.99	0.7668±0.0008	34°49′30″	106°26′15″
OJ–108	183	173	3.03	0.7673±0.0016	34°48′45″	106°26′15″
OJ–10	181	118	4.47	0.7926±0.0010	34°47′30″	106°27′00″

Age = 1560±39 m.y.
$(^{87}Sr/^{86}Sr)_o$ = 0.7016±0.0010 (a priori error)
Correlation Coefficient, r^2 = 0.99

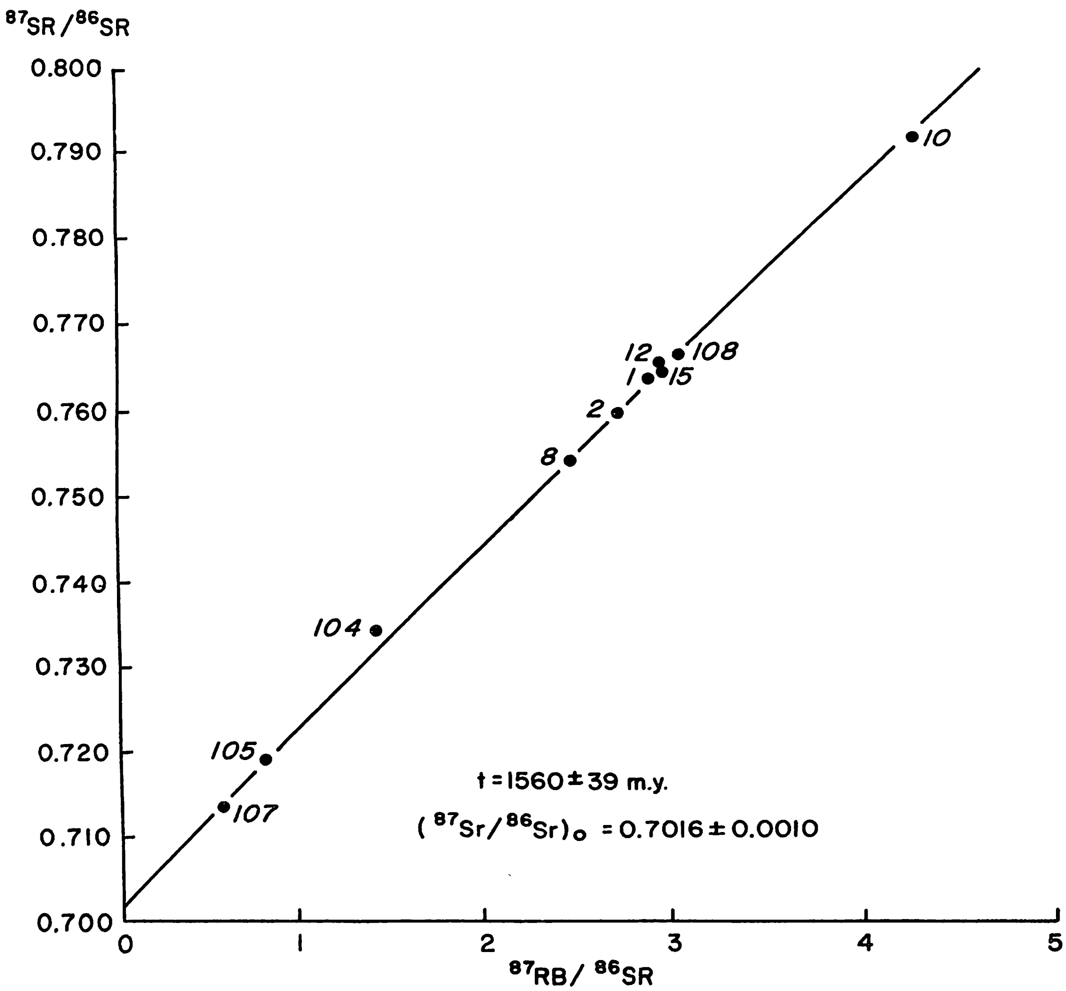

FIGURE 2. Isochron diagram for the Ojita Pluton, Manzano Mountains.

TABLE 2. Data for the Ladron Pluton

Sample	Rb (ppm)	Sr (ppm)	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$	Latitude	Longitude
L–49	190	262	2.11	0.7487±0.0029	34°26'50"	107°07'30"
L–26	284	21	39.2	0.7371±0.0003	34°27'45"	107°05'30"
L–23	159	138	3.36	0.7713±0.0009	34°28'05"	107°05'31"
L–23B	266	84	9.33	0.7713±0.0009	34°27'50"	107°05'31"
L–24	178	96	5.42	0.8094±0.0008	34°28'00"	107°06'00"
L–28	121	42	8.46	0.8546±0.0005	34°27'30"	107°05'45"
L–31	163	48	10.0	0.9125±0.0011	34°27'05"	107°05'50"
L–56	350	48	21.9	1.1184±0.0089	34°27'05"	107°05'35"
L–30	686	51	41.6	1.4292±0.0027	34°27'10"	107°05'30"

Age = 1371±384 m.y.
$(^{87}Sr/^{86}Sr)_o$ = 0.6995±0.0276 (error + scatter)
Correlation Coefficient, r^2 = 0.30

Age = 1319±51 m.y. (excluding L–23B and L–26)
$(^{87}Sr/^{86}Sr)_o$ = 0.7101±0.0037 (error + scatter)
Correlation Coefficient, r^2 = 0.99

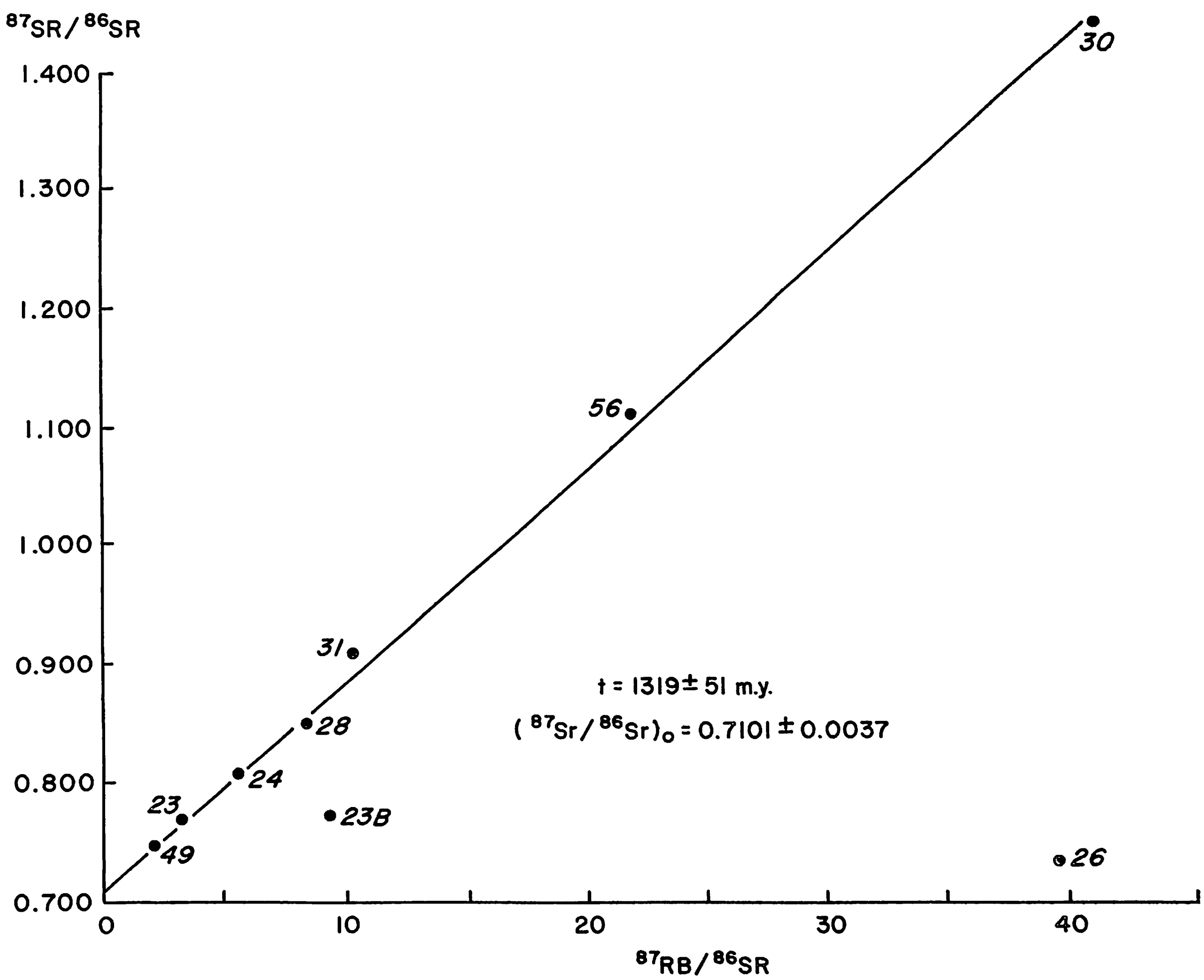

FIGURE 3. Isochron diagram for the Ladron Pluton, Ladron Mountains. (Age calculations does not include samples L–23B or L–26).

TABLE 3. Data for the Magdalena Pluton

	Sample	Rb (ppm)	Sr (ppm)	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$	Latitude	Longitude
Magdalena 'A'	M–10	74	47	4.60	0.7985±0.0011	34°05'44"	107°07'14"
	M–5	140	46	8.95	0.8719±0.0019	34°05'25"	107°07'15"
	M–11	136	33	12.1	0.9128±0.0031	34°05'44"	107°07'13"
	M–13	161	43	11.0	0.9170±0.0053	34°05'42"	107°07'10"
	M–9	194	37	15.6	1.0094±0.0005	34°05'45"	107°07'15"
	M–7	172	32	15.9	0.9917±0.0010	34°05'24"	107°07'14"
Magdalena 'B'	M–1	145	50	8.55	0.8971±0.0004	34°05'30"	107°07'10"
	M–8	171	52	10.1	0.9341±0.0016	34°05'25"	107°07'11"
	M–12	176	42	12.4	0.9642±0.0004	34°05'43"	107°07'11"
	M–6	190	97	12.5	0.9764±0.0014	34°05'24"	107°07'14"

Magdalena 'A'
Age = 1274±63 m.y.
$(^{87}Sr/^{86}Sr)_o$ = 0.7160±0.0076 (scatter + error)
Correlation Coefficient, r^2 = 0.98

Magdalena 'B'
Age = 1355±139 m.y.
$(^{87}Sr/^{86}Sr)_o$ = 0.7380±0.0202 (error + scatter)
Correlation Coefficient, r^2 = 0.97

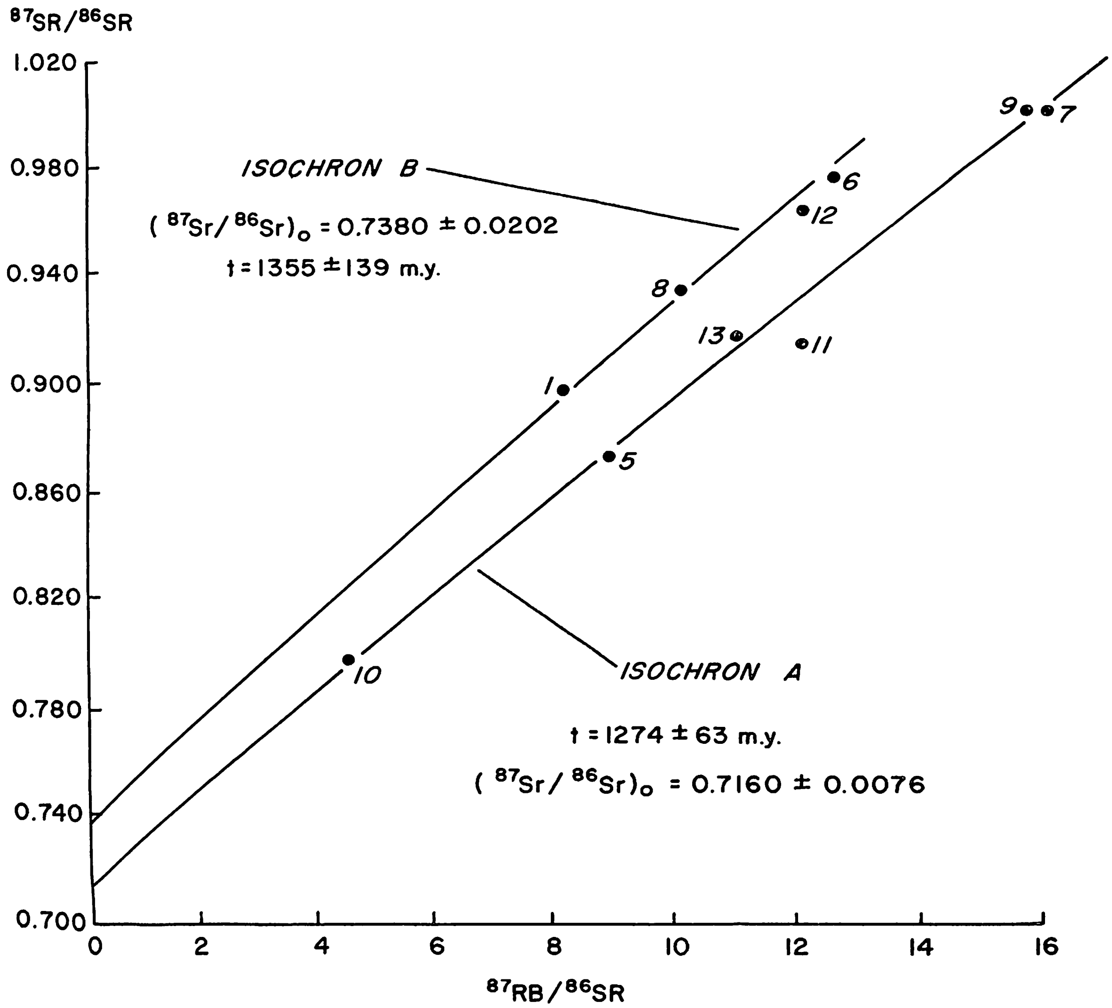

FIGURE 4. Isochron diagram for the Magdalena Pluton, Magdalena Mountains.

TABLE 4. Data for the Oscura Pluton

Sample	Rb (ppm)	Sr (ppm)	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$	Latitude	Longitude
OSC–8	203	249	2.37	0.7514±0.0010	33°35′	106°21′
OSC–4	224	190	3.43	0.7696±0.0020	33°40′	106°22′
OSC–20	240	201	3.48	0.7718±0.0019	33°43′	106°23′
OSC–6	284	184	4.51	0.7922±0.0011	33°39′	106°23′
OSC–18	165	135	5.74	0.8122±0.0010	33°41′	106°22′
OSC–15	241	114	6.20	0.8242±0.0017	33°41′	106°22′
OSC–14	323	127	7.47	0.8529±0.0023	33°34′	106°20′
OSC–13	351	113	9.14	0.8770±0.0007	33°35′	106°21′

Age = 1367±26 m.y.

$(^{87}Sr/^{86}Sr)_o$ = 0.7060±0.0016 (error + scatter)

Correlation Coefficient, r^2 = 0.99

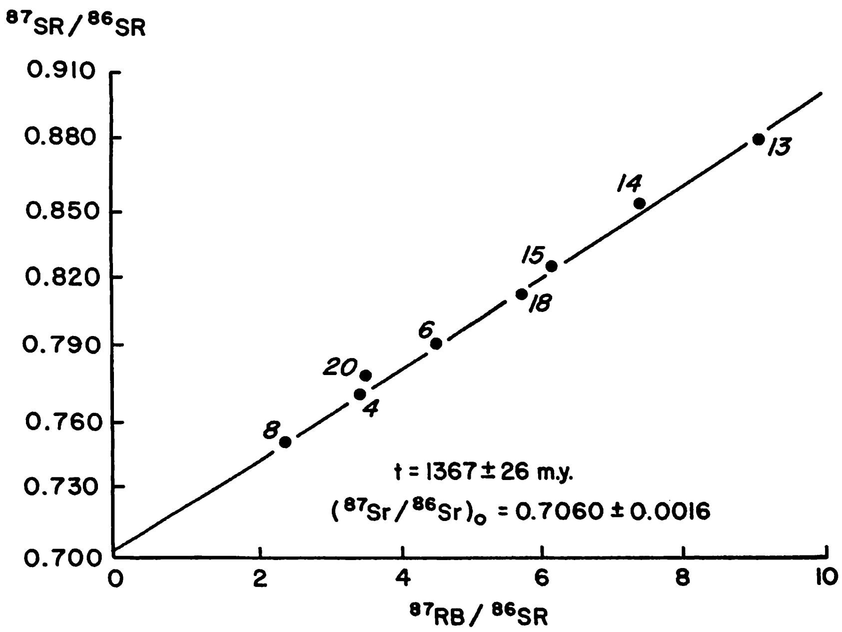

FIGURE 5. Isochron diagram of the Oscura Pluton, Oscura Mountains.

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