Geochronologic studies in Maine—part II: Precambrian rocks from Penobscot Bay

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GEOCHRONOLOGIC STUDIES IN MAINE—PART II: PRECAMBRIAN ROCKS FROM PENOBSCOT BAY

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Precambrian rocks were first positively dated by radiometric methods in 1971 (see Brookins, 1976), but the data for the ages reported has not been previously published. The Precambrian rocks are found in high-grade metamorphic rocks (sillimanite grade) surrounded by lower-grade (greenschist-biotite grade) rocks in the Penobscot Bay Region, Maine. The high-grade rocks are cut by a pegmatite on Spruce Island, just south of Islesboro Island and north of Seven Hundred Acre Island (see Brookins, 1976). Rb-Sr and K-Ar mineral dates on the pegmatite range from 598 to 630 MYBP, while the host rocks to the pegmatite suggest an age of at least 750-800 MYBP.

ANALYTICAL PROCEDURES

Rb and Sr contents were determined by isotope dilution, and the $^{87}Sr/^{86}Sr$ ratios were calculated from the Sr data. The precision for the Rb and Sr contents is ± 0.5% (two sigma) and the precision for the $^{87}Sr/^{86}Sr$ ratio is ± 0.0000_6 (two sigma). Twelve analyses of Eimer and Amend $SrCO_3$ during the period when the Sr data were gathered yielded $^{87}Sr/^{86}Sr = 0.7080_2 \pm 0.0000_2$. All Sr data were normalized to $^{86}Sr/^{88}Sr = 0.1194$. The decay constant for ^{87}Rb was taken as 1.42×10^{-11}/y. The K and Ar data are given below.

SAMPLE DESCRIPTIONS

1. *ME168-f* K-Ar
Muscovite pegmatite (44°16.49'N, 68° 56.25'W; N shore of Spruce Island, Penobscot Bay, ME). *Analytical data:* %K = 8.75, moles; $^{*40}Ar \times 10^8/g = 1.089$; $^{*40}/^{40}Ar = 0.94$. *Sample collected by:* D. G. Brookins; *K-Ar analysis by:* R. L. Armstrong.
(muscovite)594 ± 18 MYBP

2. *ME168-g* K-Ar
Muscovite pegmatite (44°16.49'N, 68° 56.25'W; N shore of Spruce Island, Penobscot Bay, ME). *Analytical data:* %K = 8.52, moles; $^{*40}Ar \times 10^8/g = 1.068$; $^{*40}Ar/^{40}Ar = 0.92.4$. *Sample collected by:* J. A. Obradovich.
(muscovite)599 ± 15 MYBP

Rb-Sr Data

Pegmatite of Spruce Island*

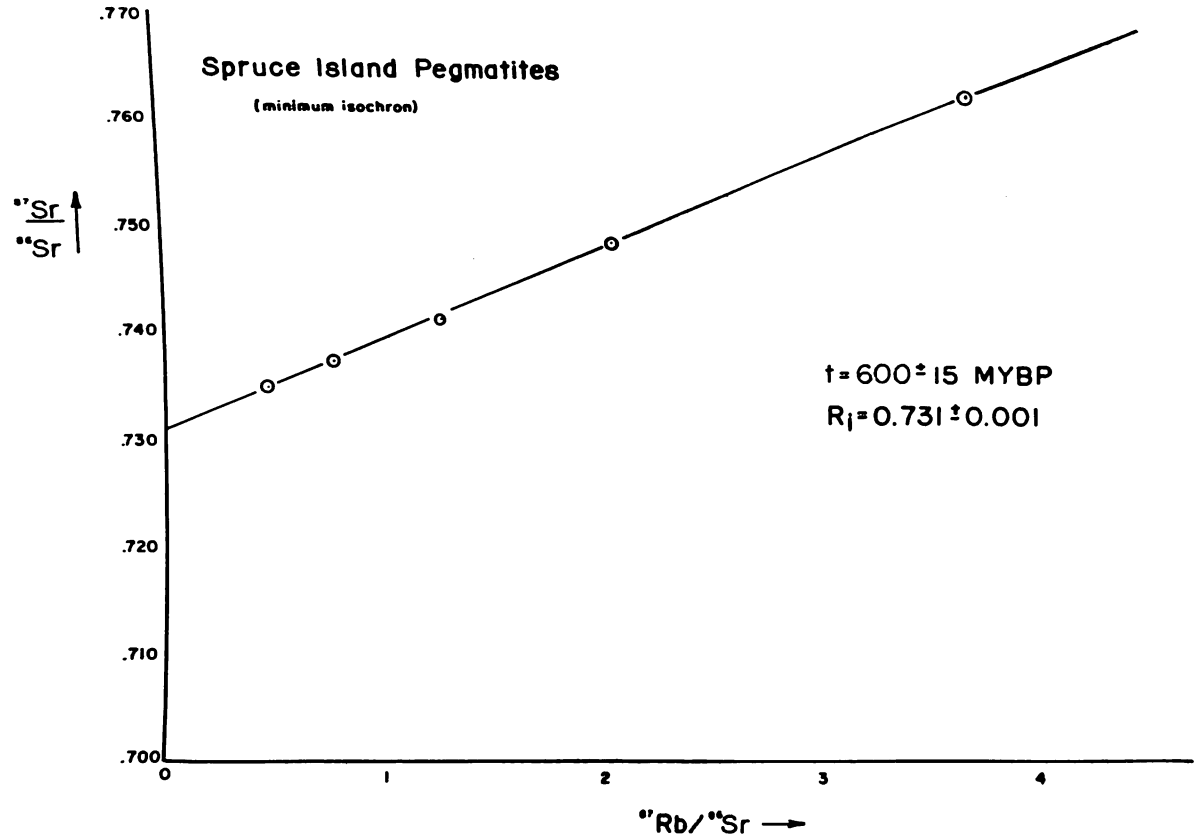
	Sample	W. Longitude	N. Latitude	$^{87}Sr/^{86}Sr$	Rb(ppm)	Sr(ppm)	$^{87}Rb/^{86}Sr$
3.	*ME168-a*	68°56.25'	44°16.49'	0.7624	50.8	40.6	3.64
4.	*ME168-b*	68°56.25'	44°16.49'	0.7482	18.6	27.0	2.02
5.	*ME168-c*	68°56.25'	44°16.49'	0.7371	19.2	73.8	0.75
6.	*ME168-d*	68°56.25'	44°16.49'	0.7349	13.2	79.8	0.46
7.	*ME168-e*	68°56.25'	44°16.49'	0.7412	20.2	48.4	1.22

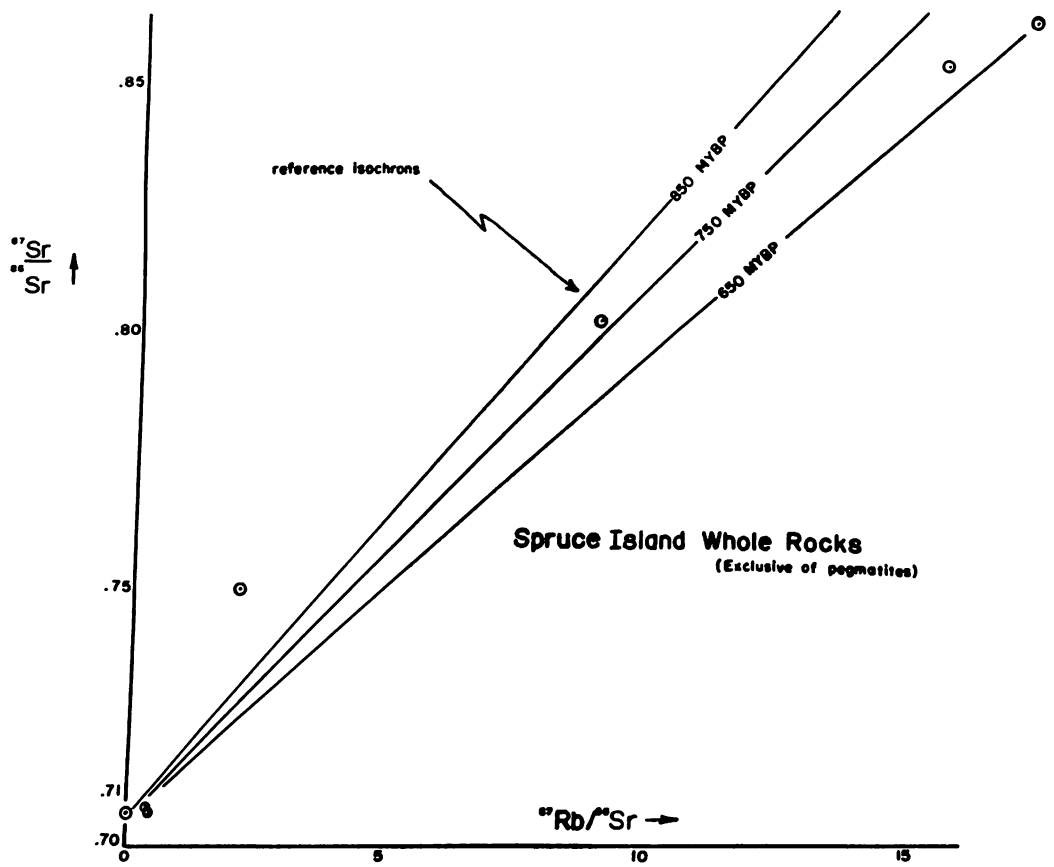
*All samples of a muscovite-quartz-feldspar pegmatite; samples a—e were obtained by handpicking material with different muscovite/feldspar abundances.

Host Rocks to Pegmatite*

	Sample	W. Longitude	N. Latitude	$^{87}Sr/^{86}Sr$	Rb(ppm)	Sr(ppm)	$^{87}Rb/^{86}Sr$
8.	*ME170*	68°56.30'	44°16.49'	0.7065	10.	420.	0.02
9.	*ME171a*	68°56.35'	44°16.49'	0.8628	214.1	36.1	17.46
10.	*ME171b*	68°56.35'	44°16.49'	0.8540	220.2	41.1	15.77
11.	*ME171c*	68°56.35'	44°16.49'	0.8022	164.0	53.2	9.02
12.	*ME172*	68°56.44'	44°16.54'	0.7078	36.3	265.0	0.40
13.	*ME173*	68°56.46'	44°16.54'	0.7495	87.2	123.3	2.06
14.	*ME175*	68°56.46'	44°16.49'	0.7069	56.4	357.2	0.46

*Descriptions: *ME170*—dolomitic marble; *ME171*—garnet-quartz-mica-amphibolite (a,b,c contain different quantities of mica); *ME172*—meta-andesite; *ME173*—mica quartzite with minor sillimanite, garnet; *ME175*—metavolcanic greenstone.


Spruce Island Pegmatites
(minimum isochron)
$^{87}Sr/^{86}Sr$
.770
.760
.750
.740
.730
.720
.710
.700
0
1
2
3
4
$^{87}Rb/^{86}Sr$
t = 600 ± 15 MYBP
R_I = 0.731 ± 0.001


reference isochrons
850 MYBP
750 MYBP
650 MYBP
$^{87}Sr/^{86}Sr$
.85
.80
.75
.71
.70
0
5
10
15
$^{87}Rb/^{86}Sr$
Spruce Island Whole Rocks
(Exclusive of pegmatites)

COMMENT

The approximate 600 MYBP date for minerals from the pegmatite confirms their suspected Precambrian age, although the true formational age of the pegmatite may be older. The host rocks to the pegmatite exhibit much scatter in $^{87}Sr/^{86}Sr$ and $^{87}Rb/^{86}Sr$; this is not surprising considering that different rocks from possibly more than one formation were sampled. All that can be said is that the host rocks are older than 600 MYBP and some are possibly older than 800 MYBP.

ACKNOWLEDGMENTS

R. L. Armstrong (formerly of Yale University; now of the University of British Columbia) and J. A. Obradovich (U.S. Geological Survey) kindly provided the K-Ar analyses reported here. D. B. Stewart (U.S. Geological Survey) provided field expertise for the sampling. Some of the Rb-Sr work was carried out at Kansas State University with the assistance of R. L. Methot; the work at the University of New Mexico was made possible by the assistance of B. Mukhopadhyay.

REFERENCE

Brookins, D.G. (1976) Geochronologic contributions to stratigraphic interpretation and correlation in the Penobscot Bay area, eastern Maine: Geological Society of America Memoir 148, p. 129-145.