Rb-Sr whole rock age of gneisses from the Horse Creek area, Tobacco Root Mountains, Montana

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RB-SR WHOLE ROCK AGE OF GNEISSES FROM THE HORSE CREEK AREA, TOBACCO ROOT MOUNTAINS, MONTANA

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The Tobacco Root Range, one of several uplifts of Precambrian rocks in southwestern Montana (fig. 1), is primarily a structural dome consisting of multiple deformed and metamorphosed Precambrian rocks surrounded by outwardly dipping Paleozoic and Mesozoic sedimentary rocks and cored by the Tobacco Root Batholith, a Laramide age intrusive. The Precambrian rocks are dominantly quartzofeldspathic gneisses with lesser amounts of amphibolites, marbles, quartzites, and schists.

The quartzofeldspathic gneiss of the Tobacco Root Mountains is a leucocratic, pervasively foliated rock containing quartz, K-feldspar, and oligoclase with subsidiary amounts of garnet, biotite, and hornblende. Muscovite, clinopyroxene, and orthopyroxene are rarely present and, when found, are rimmed by K-feldspar or biotite and hornblende respectively. Chlorite, epidote, sericite, and paragonite may be present in the gneiss in considerable amounts along shear zones, near faults, and in areas surrounding later intrusions.

Bulk samples of quartzofeldspathic gneiss were collected from several outcrops within a refolded but stratigraphically equivalent layer of quartzofeldspathic gneiss from the Horse Creek area in the southwestern portion of the Tobacco Root Mountains (fig. 2). Whole rock chemical analyses of two samples suggest typical calc-alkaline compositions; SiO_2 ranges from $\sim$54% to $\sim$73%, total alkalies are $\sim$7% to 8% and K_2O/Na_2O ratios are $\sim$0.8. The five whole rock samples isotopically analyzed in this study yield an age of 2667 $\pm$ 66 m. y. (2σ, $\mu\beta = 1.39 \times 10^{-11} yr^{-1}$) with an $(^{87}Sr/^{86}Sr)_0$ of .707 $\pm$ .002 (fig. 2). All samples were analyzed by isotope dilution and plot within analytical error of the line at 2σ.

Textures and field relations suggest that the quartzofeldspathic gneiss has been subjected to three metamorphic events, M_1, M_2, and M_3. The earliest event (M_1) was probably of granulite facies and the pyroxenes present in the gneiss are thought to be relics of that event. The dominant paragenesis in the gneisses, however, is thought to have been generated during M_2. The presence of sillimanite and K-feldspar in schists associated with the gneiss suggests equilibration in the upper amphibolite facies (M_2). A later, greenschist facies event (M_3) probably produced the chlorite, epidote, sericite, and paragonite.

The samples collected for analysis were chosen because of their lack of minerals associated with either the M_1 or M_3 events. The age of 2667 $\pm$ 66 m. y. is suggested to be best interpreted as a minimum time for the M_2 event. The younger K-Ar and Rb-Sr ages of $\sim$1700 m. y. reported by Giletti (1966) are probably related to the M_3 event. With regard to the time of M_1, assuming a $(^{87}Sr/^{86}Sr)_0 = .700$ and Rb av/Sr av = .783, a relatively short prior crustal history of 200 m. y. to 300 m. y. can be inferred and suggests that M_1 and M_2 were not greatly separated in time.

In conclusion, it is suggested that the 2667 $\pm$ 66 m. y. age for samples of quartzofeldspathic gneiss from the Horse Creek area of the southern Tobacco Root Mountains is a minimum age for the amphibolite facies metamorphism (M_2) in this area. Although somewhat young, this age is within the general range of many Archean terrains in the Wyoming Province (e.g. Reed and Zartman, 1973) and represents one of the most westerly appearances of Archean rocks in the United States.

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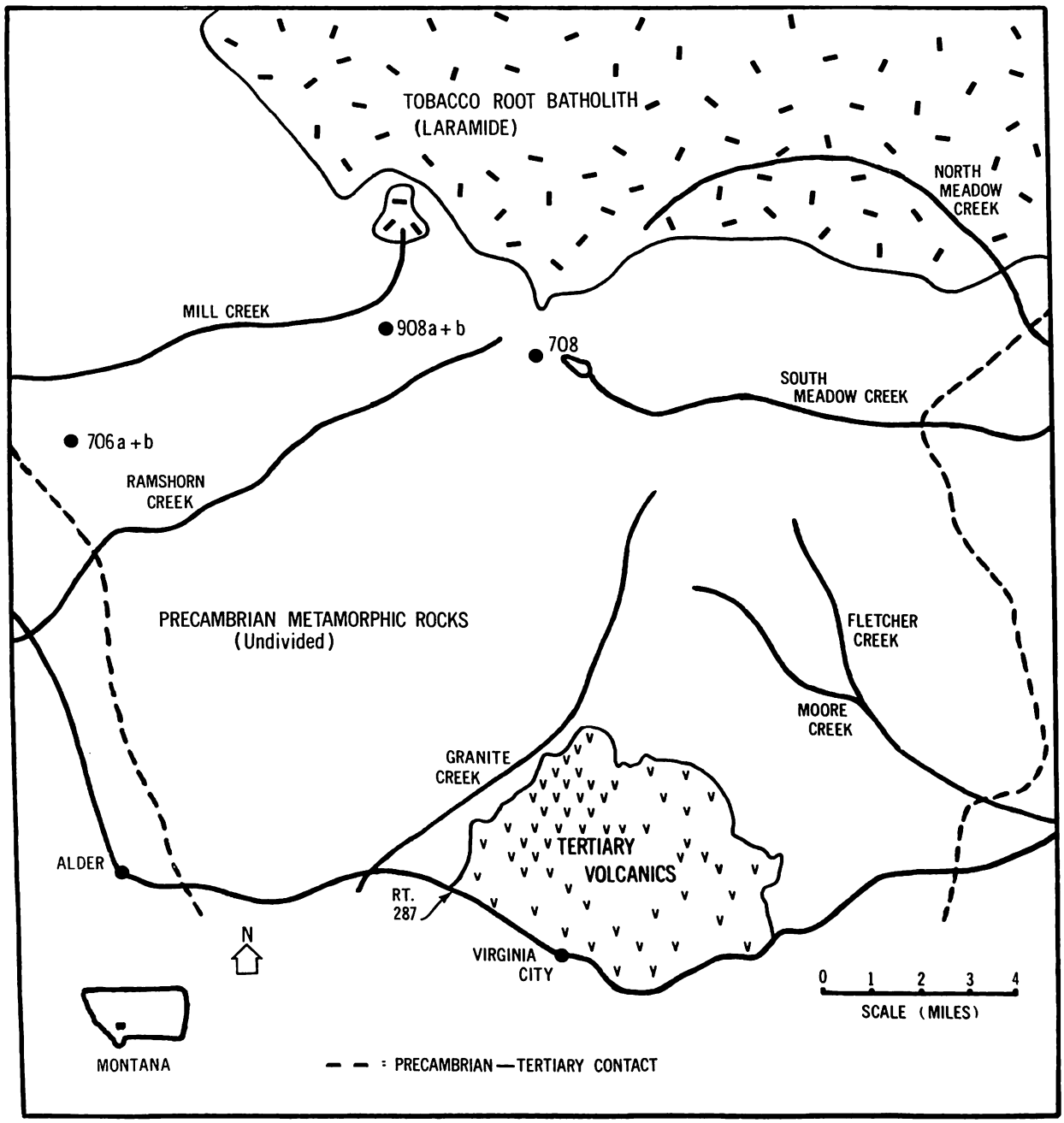

FIGURE 1. Map showing sample locations in the southern Tobacco Root Mountains.

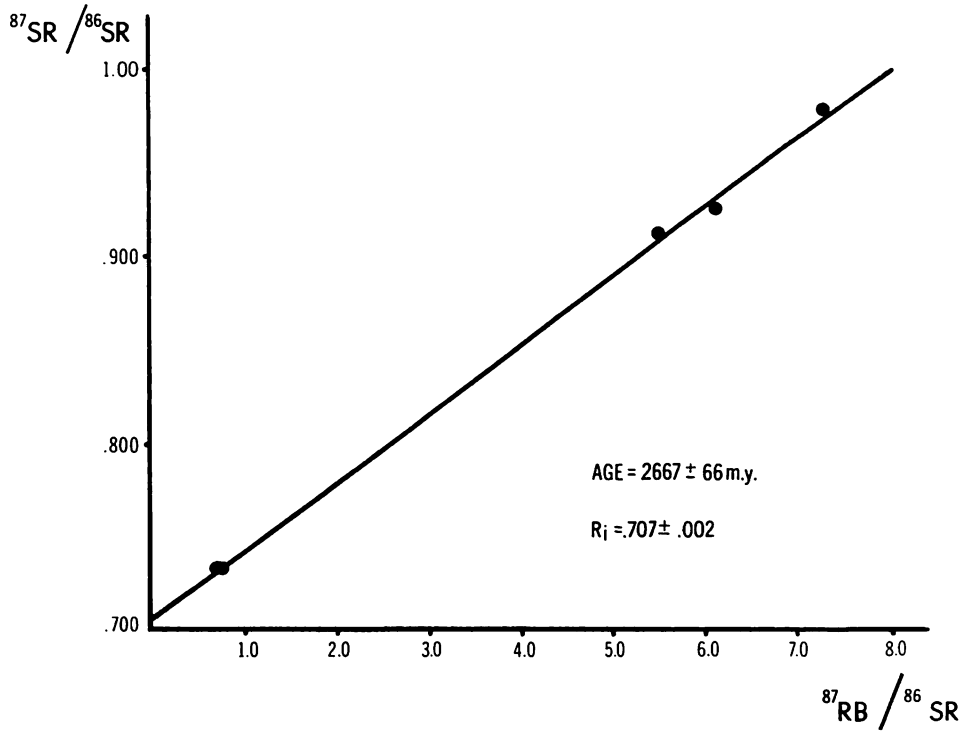

FIGURE 2. $^{87}Rb/^{86}Sr$ vs $^{87}Sr/^{86}Sr$ isochron plot for whole rock samples of quartzofeldspathic gneiss, Horse Creek area, Tobacco Root Mountains, Montana. Age according to York (1966).

SAMPLE DESCRIPTIONS

1. S-72-706A Rb-Sr

Biotitic quartzofeldspathic gneiss (small quarry on Horse Creek; NW1/4NE1/4NW1/4sec. 7, T5S, R4W, near Sheridan, Madison Co., MT). Well foliated gneiss containing quartz, oligoclase, microcline, biotite, plus or minus hornblende. Analytical data: Rb (ppm) = 252, Sr (ppm) = 124, $(^{87}Sr/^{86}Sr)_N$ = 0.9302.

2. S-72-706B Rb-Sr

Quartzofeldspathic gneiss (small quarry on Horse Creek; NW1/4NE1/4NW1/4 sec. 7, T5S, R4W; near Sheridan, Madison Co., MT). Leucocratic gneiss containing quartz, oligoclase, microcline, biotite, almandine, plus or minus biotite and hornblende. Analytical data: Rb(ppm) = 86, Sr (ppm) = 350, $(^{87}Sr/^{86}Sr)_N$ = 0.7351.

3. S-72-708 Rb-Sr

Quartzofeldspathic gneiss (cirque wall overlooking head of Mill Gulch; NW1/4NW1/4NW1/4 sec. 26, T4S, R3W; near Alder, MT). Foliated leucocratic gneiss containing quartz, microcline, oligoclase, biotite, and hornblende. Analytical data: Rb (ppm) = 188, Sr (ppm) = 77, $(^{87}Sr/^{86}Sr)_N$ = 0.9833.

4. S-72-908A Rb-Sr

Biotitic quartzofeldspathic gneiss (outcrop along divide between Mill Creek and the N fork of Ramshorn Creek; SE1/4SW1/4SW1/4 sec. 17, T4S, R3W; near Sheridan, Madison Co., MT). Foliated gneiss containing quartz, oligoclase, microcline, biotite, and hornblende. Analytical data: Rb (ppm) = 141, Sr (ppm) = 77, $(^{87}Sr/^{86}Sr)_N$ = 0.9156.

5. S-72-908B Rb-Sr

Quartzofeldspathic gneiss (outcrop along divide between Mill Creek and N fork of Ramshorn Creek; SE1/4SW1/4SE1/4 sec. 17, T4S, R3W; near Sheridan, Madison Co., MT). Leucocratic foliated gneiss containing quartz, oligoclase, microcline, hornblende, biotite, plus or minus garnet. Analytical data: Rb (ppm) = 80, Sr (ppm) = 326, $(^{87}Sr/^{86}Sr)_N = 0.7333$.

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