Rb-Sr ages of granitic rocks in the Rawah batholith, Medicine Bow Mountains, northern Colorado

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RB–SR AGES OF GRANITIC ROCKS IN THE RAWAH BATHOLITH, MEDICINE BOW MOUNTAINS, NORTHERN COLORADO

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Six samples of granitic rocks from the Rawah batholith of Boulder Creek age in the Medicine Bow Mountains of northern Colorado were analyzed by Rb-Sr whole rock methods. Analytical procedures were the same as those described by Peterman, Hedge, and Braddock (1968) and Peterman, Doe, and Bartel (1967).

Decay constants used in the Rb-Sr calculations are as follows: Rb^{87} $\lambda\beta = 1.39 \times 10^{-11}$/yr and Rb^{87} = 0.283g/g Rb. Sr isotopic data are normalized to Sr^{86}/Sr^{88} = 0.1194. Analyses were performed by C. E. Hedge of the U. S. Geological Survey, Denver, Colorado.

GEOLOGIC DISCUSSION

Reconnaissance mapping in the Medicine Bow Mountains of northern Colorado has revealed a large pluton of Boulder Creek age emplaced into a sillimanite-grade metasedimentary sequence. Although precise limits of the pluton have not yet been established, it occupies an area in excess of 600 square mi (1,560 km^2) in the southern portion of the Medicine Bow Mountains. It underlies the Rawah peaks and is named, accordingly, the Rawah batholith. Units of the pluton have been traced from the Cameron Pass area as far north as the Wyoming State line and as far east as the Deadman Hill area (Fig. 1). The western outcrop boundary is marked by a prominent scarp where granitic rocks of the batholith are in contact (fault and unconformity) with sedimentary units of the North Park basin.

Rawah batholith rocks range in composition from quartz diorite to granite, but the predominant phase is a biotite, plagioclase-rich quartz monzonite that is locally hornblende bearing. Appreciable assimiliation is reflected by hybrid phases that have a considerable range of bulk composition and are common at interfaces with metamorphic host rocks. The hybrid phases are especially enriched in Al_2O_3, which is very abundant in the pelitic metasediments of the area. Many host rock inclusions are strongly migmatized.

Medium-grained and coarse-grained equigranular phases predominate, but fine-grained and porphyritic units also occur. Very fine-grained to aplitic phases appear to be younger than most of the batholith rocks, although locally they are engulfed by coarser material that may have been remobilized. Some of the porphyritic quartz monzonite is very coarse grained and crosscuts finer grained plutonic associates. These coarse-grained phases commonly have a rapakivi-like texture and appear to be products of very late synkinematic magmatic activity.

Most phases of Rawah batholith rocks reflect considerable deformation and show moderate to well-developed foliation. Cataclastic textures predominate, although alignment of tabular feldspars and biotite (along with schlieren and small host rock inclusions in some phases) is probably a primary igneous feature. Some locally well-developed layering may also be a primary flow structure; however, most layered phases are clearly products of intense cataclasis. At least two unrelated major episodes of pre-Silver Plume cataclasis affected the rocks of the Rawah batholith. The first cataclastic event (in part protoclastic) apparently accompanied and followed syntectonic intrusion that was associated with the high-grade regional metamorphic event responsible for the formation of the sillimanite facies sequence. Foliations produced in batholithic rocks during this event are roughly conformable with those of deformed host rocks. The second cataclastic event occurred well after emplacement of the Rawah batholith and resultant fabric is related to shear zones, some of which are cut by a small pluton of Sherman Granite. Another Sherman pluton several miles to the east has been dated at 1410 m.y. by Peterman, Hedge, and Braddock (1968, p. 2287).

Compositional, textural, and structural relationships of the Rawah batholith are very similar to plutons of the 1.7+ b.y. Boulder Creek Granite to the south and southeast that have been described by numerous workers (for example, Lovering and Goddard, 1950; Harrison and Wells, 1959; Wells and others, 1964; Wells, 1967; Peterman and others, 1968; Hickling and others, 1970; Stern and others, 1971; and Phair and others, 1971). Although granodioritic

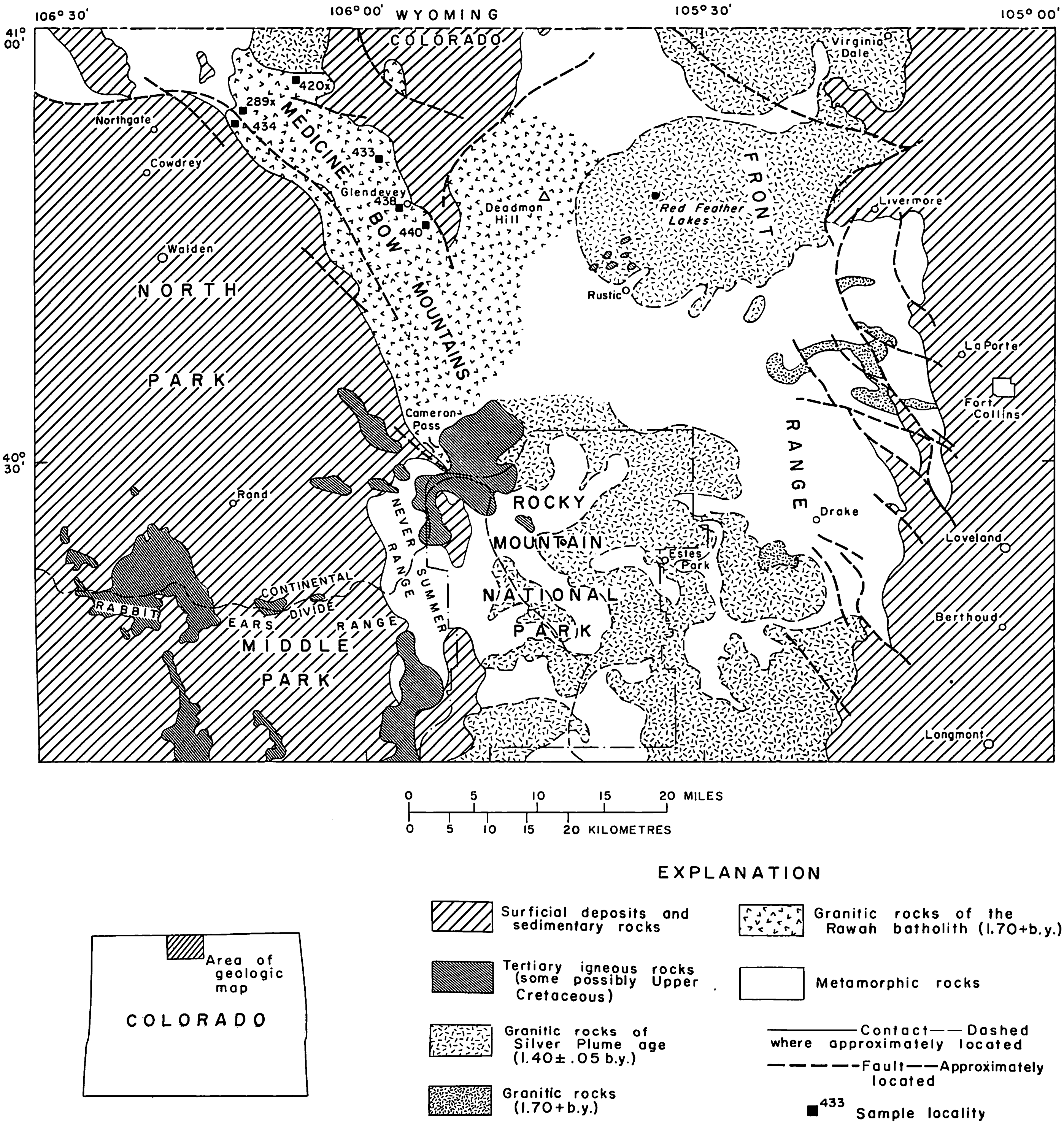

FIGURE 1 – Generalized geologic map of North Park, the Medicine Bow Mountains,and Front Range of northern Colorado. Compiled from Burbank, Lovering, Goddard, and Eckel (1935), Lovering and Goddard (1950, pl. 1), Hedge, Peterman, Braddock (1967, p. 552), and Peterman, Hedge, and Braddock (1968, p. 2278), with additions from M. E. McCallum (unpub. data, 1971-1973) in the Medicine Bow Mountains area.

compositions are more abundant at the type locality in the canyon of Boulder Creek west of Boulder, Colorado, quartz monzonitic phases are also present and comprise important zones of many of the Boulder Creek plutons. Boulder Creek batholith contacts are characterized by extensive assimilation of country rock and significant variations in bulk composition of granitic phases near the boundaries (Stern and others, 1971, p. 1618). Wells (1967, p. 51) noted that rocks of the Boulder Creek batholith were subjected to at least two episodes of pre-Silver Plume cataclasis. These features are identical to those observed in rocks of the Rawah batholith, and a comparable age was tentatively postulated in the field.

T. W. Stern (U. S. Geological Survey, 1964) and Stern, Phair, and Newell (1971) established a Boulder Creek batholith emplacement age of 1720-1730 m.y. by isotopic lead-uranium determinations on zircons. Similar ages of approximately 1700 m.y. were determined for rocks of Boulder Creek age north of Boulder Creek by Peterman and Hedge (1968) and Peterman, Hedge, and Braddock (1968) using whole rock Rb-Sr methods. The whole rock Rb-Sr ages for Rawah batholith rocks determined in this study are approximately 1710 m.y., which confirms the Boulder Creek equivalency already postulated on textural and structural evidence. Analytical data are given in sample descriptions and presented as an isochron plot in Figure 2. The relatively high Sr^{87}/Sr^{86} ratios of two samples (KC420X and KC433) suggest that some older crustal material was incorporated. These data are in agreement with the evidence for widespread assimilation.

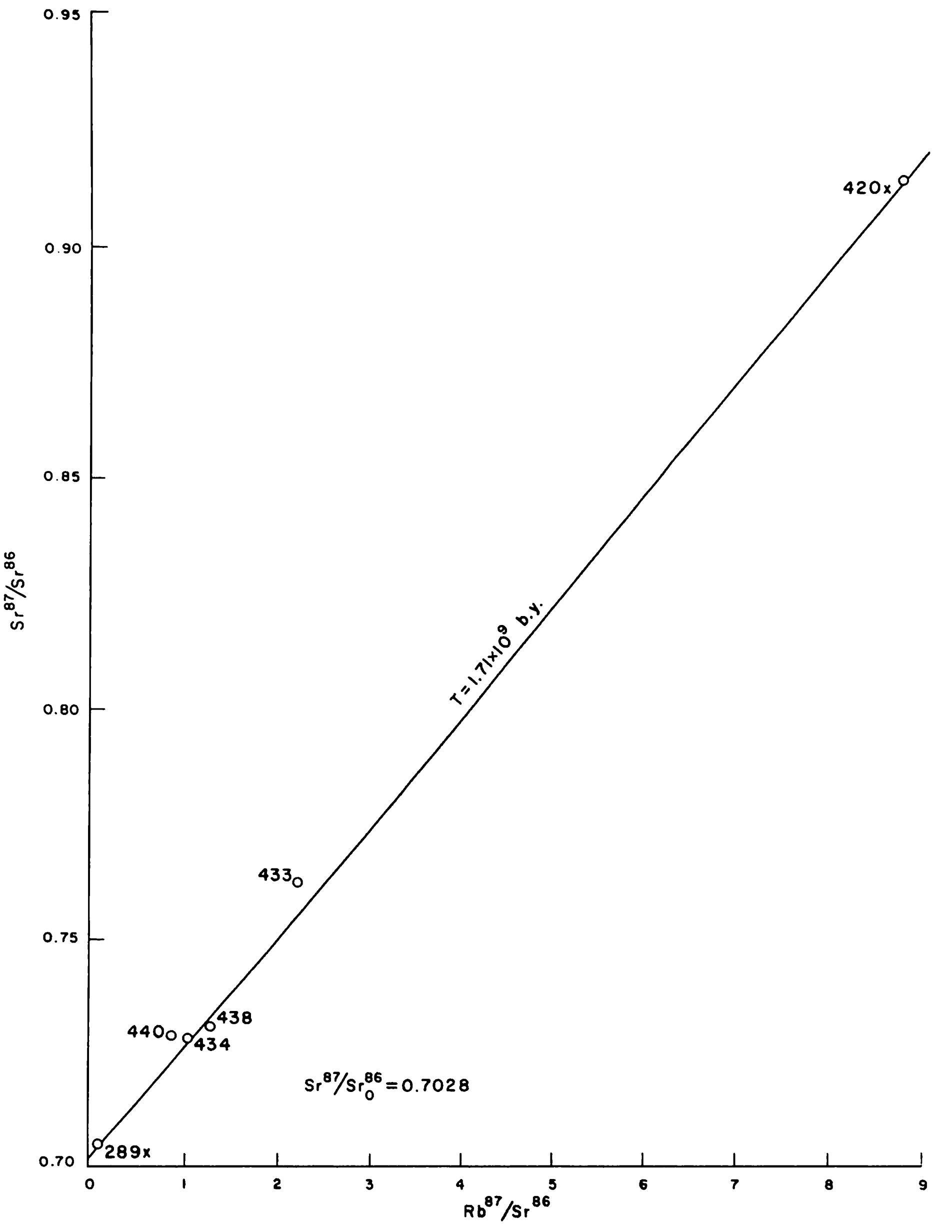

FIGURE 2 – Rb-Sr isochron plot for samples from the Rawah batholith in the Medicine Bow Mountains of northern Colorado.

SAMPLE DESCRIPTIONS

Rawah batholith granitic rocks

1. USGS(D)–KC289X Rb-Sr (whole rock) 1.71 b.y.
Medium-grained, foliated biotite quartz monzonite (NW/4 SW/4 sec. 18, unsurveyed T11N, R78W; exposure along E side of Pinkham Creek road approximately 2 mi (3 km) E of intersection with Colorado Highway 127 at Kings Canyon railhead; Jackson Co., CO). Analytical data: Rb = 17.4 ppm; Sr = 568.4 ppm; Rb^{87}/Sr^{87} = 0.089; Sr^{87}/Sr^{86} = 0.7049. Comment: Well-developed foliation locally imparts a strongly gneissic fabric. Foliation is at least in part cataclastic.

2. USGS(D)–KC420X Rb-Sr (whole rock) 1.71 b.y.
Medium-grained to coarse-grained, weakly to moderately foliated biotite quartz monzonite (SE/4 NW/4 sec. 17, T11N, R77W; exposure in small draw 200 ft (60 m) SW of jeep trail; Larimer Co., CO). Analytical data: Rb = 151.8; Sr = 51.3 ppm; Rb^{87}/Sr^{87} = 8.743; Sr^{87}/Sr^{86} = 0.9132. Comment: Cut by abundant small pegmatite and fine-grained to medium-grained quartz monzonite dikes. Locally has a weak cataclastic fabric; granulation especially prominent along boundaries of large perthitic microcline grains.

3. USGS(D)–KC433 Rb-Sr
Fine-grained to medium-grained muscovite-biotite quartz monzonite (SE/4 NW/4 sec. 1, unsurveyed T10N, R77W; approx. 150 ft (46 m) S of Shipman Park jeep trail; Larimer Co., CO). Analytical data: Rb = 156.7 ppm; Sr = 206.1 ppm; Rb^{87}/Sr^{87} = 2.212; Sr^{87}/Sr^{86} = 0.7625. Comment: Very massive rock, little to no foliation. The plotted position of the analytical data on Fig. 2 (above the 1.71 b.y. isochron) indicates that older crustal material has been incorporated in this rock. A specific Rb-Sr age cannot be calculated for this sample.

4. USGS(D)–KC434 Rb-Sr (whole rock) 1.71 b.y.
Medium-grained, foliated biotite quartz monzonite (SW/4 SW/4 sec. 18, unsurveyed T11N, R78W; exposure NE of jeep trail approx. 1000 ft from intersection with Pinkham Creek road; Jackson Co., CO). Analytical data: Rb = 54.5 ppm; Sr = 151.8 ppm; Rb^{87}/Sr^{87} = 1.041; Sr^{87}/Sr^{86} = 0.7285. Comment: Well-developed foliation locally imparts a strongly gneissic fabric. Foliation is at least in part cataclastic.

5. USGS(D)–KC438 Rb-Sr (whole rock) 1.71 b.y.
Medium-grained to coarse-grained, well-foliated, biotite granodiorite (NW/4 SE/4 sec. 29, T10N, R76W; exposure in roadcut W of Glendevey Village near Hooligan Roost campground; Larimer Co., CO). Analytical data: Rb = 116.0 ppm; Sr = 334.8 ppm; Rb^{87}/Sr^{87} = 1.272; Sr^{87}/Sr^{86} = 0.7310. Comment: Abundant biotite (up to 20%) imparts a strongly gneissic fabric. Prominent tabular phenocrysts of microcline roughly parallel foliation planes. Local presence of garnet may reflect partial assimilation (or anatexis) of garnet-bearing, pelitic metasedimentary host rocks.

6. USGS(D)–KC440 Rb-Sr
Medium-grained to coarse-grained, porphyritic, gray-white quartz monzonite (SE/4 NW/4 sec. 34, T10N, R76W; exposure just N of bend in road at Bench Mark (8445 ft); Larimer Co., CO). Analytical data: Rb = 98.0 ppm; Sr = 326.4 ppm; Rb^{87}/Sr^{87} = 0.871; Sr^{87}/Sr^{86} = 0.7288. Comment: Nonfoliated, undeformed porphyritic phase with abundant microcline phenocrysts (up to 2 cm). Allanite crystals (up to 3 mm) are very prominent; most have metamict black irregular cores surrounded by yellowish-orange birefringent allanite, although some crystals are entirely anisotropic. The allanite may have a replacement origin similar to that described by Hickling, Phair, Moore, and Rose (1970, p. 1981) for allanite in the Boulder Creek batholith. The plotted position of the analytical data on Fig. 2 (above the 1.71 b.y. isochron) indicates that older crustal material has been incorporated in this rock. A specific Rb-Sr age cannot be calculated for this sample.

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