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K-Ar AGES OF GRANITIC PLUTONISM AND HYDROTHERMAL ALTERATION IN THE WESTERN PART OF THE TONOPAH 1x2° SHEET, NEVADA

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The ages reported here are a product of a program of dating plutonic rocks and hydrothermal mineral deposits in Nevada as part of Tonopah CUSMAP (Conterminous United States Mineral Assessment Program) project jointly supported by the U.S. Geological Survey and the Nevada Bureau of Mines and Geology. Granitoids, ranging in composition from granite to diorite, form about 60 plutons in the western part of the Tonopah 1x2° quadrangle, Nevada (fig. 1). Previous investigations of radiometric ages of these rocks suggest that plutonic activity occurred from earliest Jurassic to middle Tertiary time (about 206 to 30 m.y.; Speed and Armstrong, 1971; Silberman and others, 1975; Bonham and Garside, 1979; Shaver, 1984; Kleinhampl and Ziony, 1985; Shawe and others, 1986). As part of the Tonopah CUSMAP project, the geology of the granitoids and hydrothermal alteration and mineralization associated with these rocks were systematically studied. During this project, several granitic bodies and hydrothermal alteration products in granitic rocks were dated by either K-Ar or Rb-Sr methods. In this paper we present three new K-Ar dates. Two dates represent alteration events in the southern Paradise Range and in the eastern Toiyabe Range, whereas the third date is an emplacement age of the Fraziers Well pluton in the San Antonio Mountains.

Analytical methods. Sample preparation and argon and potassium analyses were carried out in the U.S. Geological Survey laboratories, Menlo Park, California. Potassium analyses were performed by a lithium metaborate flux fusion-flow photometry technique, the lithium serving as an internal standard (Ingamells, 1970). Argon analyses were performed by standard isotope dilution procedures using a 60° sector, 15.2-cm radius Neir-type mass spectrometer operated in the static mode for mass analysis or with a five-collector system for simultaneous measurement of argon isotope ratios also with a Neir-type mass spectrometer. The precision of the data, shown as the ± value in years, is the estimated analytical uncertainty at one standard deviation. It represents uncertainty in the measurement of radiogenic ^{40}Ar and K_2O in the sample and is based on experience with replicate analyses in the Menlo Park laboratories. The decay constants used for ^{40}K are those adopted by the International Union of Geological Sciences Subcommission on Geochronology (Steiger and Jager, 1977).

GEOLOGICAL DESCRIPTION

Fraziers Well pluton. The Fraziers Well pluton is a small (approx. 10 km²) intrusion exposed about 8 km north of Tonopah (fig. 1). It was previously mapped and described by Bonham and Garside (1979) and has an unusual composition and texture that sets it apart from most other granitoids in the western Great Basin. The pluton is a coarse-grained, coarsely porphyritic quartz monzodiorite that contains scattered white to pink potassium feldspar megacrysts as much as 5 cm long. It contains about 15 to 20 percent hornblende + biotite, but unlike most other megacryst-bearing granitoids, hornblende is about twice as abundant as biotite. Bonham and Garside (1979) reported fission track ages of 67.9 ± 8.4 m.y. (zircon) and 59.3 ± 7.4 m.y. (sphene) and suggested that the pluton was part of an episode of Late Cretaceous plutonism that also included the Hall stock (Shaver, 1984) and the Lone Mountain pluton (fig. 1).

We obtained a K-Ar age of 220.9 ± 6.6 m.y. from hornblende in a sample of the Fraziers Well pluton (no. 3, fig. 1); this age suggests that it is one of the oldest plutons in the western Great Basin. We believe that this age dates the emplacement of the pluton and that the younger fission track ages represent a thermal event probably related to emplacement of the Hall stock. Evidence supporting this interpretation comes from the Crow Springs pluton about 30 km west-northwest at the south end of the Royston Hills (fig. 1). This pluton, which is megascopically identical to Fraziers Well pluton, has a K-Ar age of about 206 m.y. (Speed and Armstrong, 1971); its Sr-isotope composition is similar to the Fraziers Well pluton and its Rb-Sr age is about 200 m.y. (A. C. Robinson and D. A. John, unpublished data). An early Jurassic alteration age of about 198 m.y. reported by Silberman and others (1975) for a porphyritic granodiorite about 3 km south-southeast of Gilbert (fig. 1) suggests that several small plutons were emplaced along an east-west zone during Triassic and earliest Jurassic time.

Paradise Range. Several small bodies of coarse-grained biotite granite near the southern end of the Paradise Range (fig. 1) are strongly sericitized and pyritized and contain abundant quartz veins with muscovite selvages. We obtained a K-Ar age of 74.2 ± 1.9 m.y. on sericite from a pod of green sericite + quartz + pyrite + fluorite in a body of biotite granite about 2 km south of Paradise Peak (no. 1, fig. 1). This alteration may be related to a quartz-monzonite-type porphyry molybdenum system that occurs about 2 km southeast of this body beneath a low-angle fault (South thrust) between Mesozoic and Paleozoic greenstones and Triassic carbonate rocks. The pluton near Paradise Peak does not intrude the "South thrust" as previously shown by Vitaliano and Callaghan (1963) (N. J. Silberling, written commun., 1986), and if the molybdenum mineralization is related to this pluton, our date suggests that the South thrust is a Late Cretaceous or Tertiary structure that is not related to Late Jurassic thrust faulting as previously inferred (Vitaliano and Callaghan, 1963; Kleinhampl and Ziony, 1985).

Toiyabe Range. Several granitic plutons crop out along the east side of the Toiyabe Range (fig. 1). The pluton at the north edge of the Tonopah quadrangle consists of at least three granodioritic and tonalitic intrusions. Tungsten-bearing skarns formed in small pendants of Paleozoic carbonate rocks in these intrusions, and a large area (2 + km²) near the western margin of this pluton contains stockwork quartz + pyrite + muscovite veins. We obtained a K-Ar age of 68.0 ± 1.6 m.y. on a coarse-grained muscovite selvage from this zone of stockwork veins (no. 2, fig. 1). This age is similar to the age of muscovite alteration (approx. 68 m.y.) in the north end of the Ophir pluton about 6 km to the south (F. G. Poole, written commun., 1986).

SAMPLE DESCRIPTIONS

All samples were collected by D. A. John. Mineral separations were performed by D. A. John and M. T. Garrison, and the samples were dated by E. H. McKee.

1. *82-DJ-58A* K-Ar
   Sericite pod in granite (38°46'32"N,117°49'40"W; crest of the Paradise Range about 2 km S of Paradise Peak; NV). *Analytical data:* K_2O = 10.96%; $^{40}Ar^*$ = 1.19466 × 10^{-9} mole/g; $^{40}Ar^*/^{40}Ar$ = 87.8%.
   (sericite) 74.2 ± 1.9 m.y.

2. *82-DJ-208* K-Ar
   Quartz-pyrite vein with muscovite selvage (38°59'15"N,117°13'30"W; S side of Timblin Creek, Toiyabe Range; NV). *Analytical data:* K_2O = 10.81%; $^{40}Ar^*$ = 1.07874 × 10^{-9} mole/g; $^{40}Ar^*/^{40}Ar$ = 60.2%.
   (muscovite) 68.0 ± 1.6 m.y.

3. *82-DJ-167* K-Ar
   Quartz monzodiorite (38°09'00"N,117°12'11"W; San Antonio Range about 8 km N of Tonopah; NV). *Analytical data:* K_2O = 1.075%; $^{40}Ar^*$ = 3.63691 × 10^{-10} mole/g; $^{40}Ar^*/^{40}Ar$ = 76.0%.
   (hornblende) 220.9 ± 6.6 m.y.

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