UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

K-Ar age of alunite alteration at Red Mountain, Lake City area, western San Juan Mountains, Colorado

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OPEN-FILE REPORT

79-1642

1979

This report is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards and nomenclature.

INTRODUCTION

The San Juan Mountains of southwestern Colorado are famous for rich vein deposits of base and precious metals and for patterns of conspicuous hydrothermal alteration. Areas of acid-sulfate alteration, characterized by extensive base leaching of volcanic rocks or hypabyssal plutons, are of current interest because of their local association with Au, Ag, and, in some cases, U mineralization (Lipman and others, 1976; Cunningham and others, 1978; Steven and others, 1979). Potential may also exist for recovery of aluminum from altered rocks rich in alunite (Hall, 1978). Alunite has been shown to be suitable for K-Ar dating in other mining districts (Mehnert and others, 1973b; Ashley and Silberman, 1976). We report here two concordant K-Ar ages determined on hydrothermal alunite from Red Mountain, in the Lake City area of the western San Juan Mountains.

GEOLOGIC SETTING

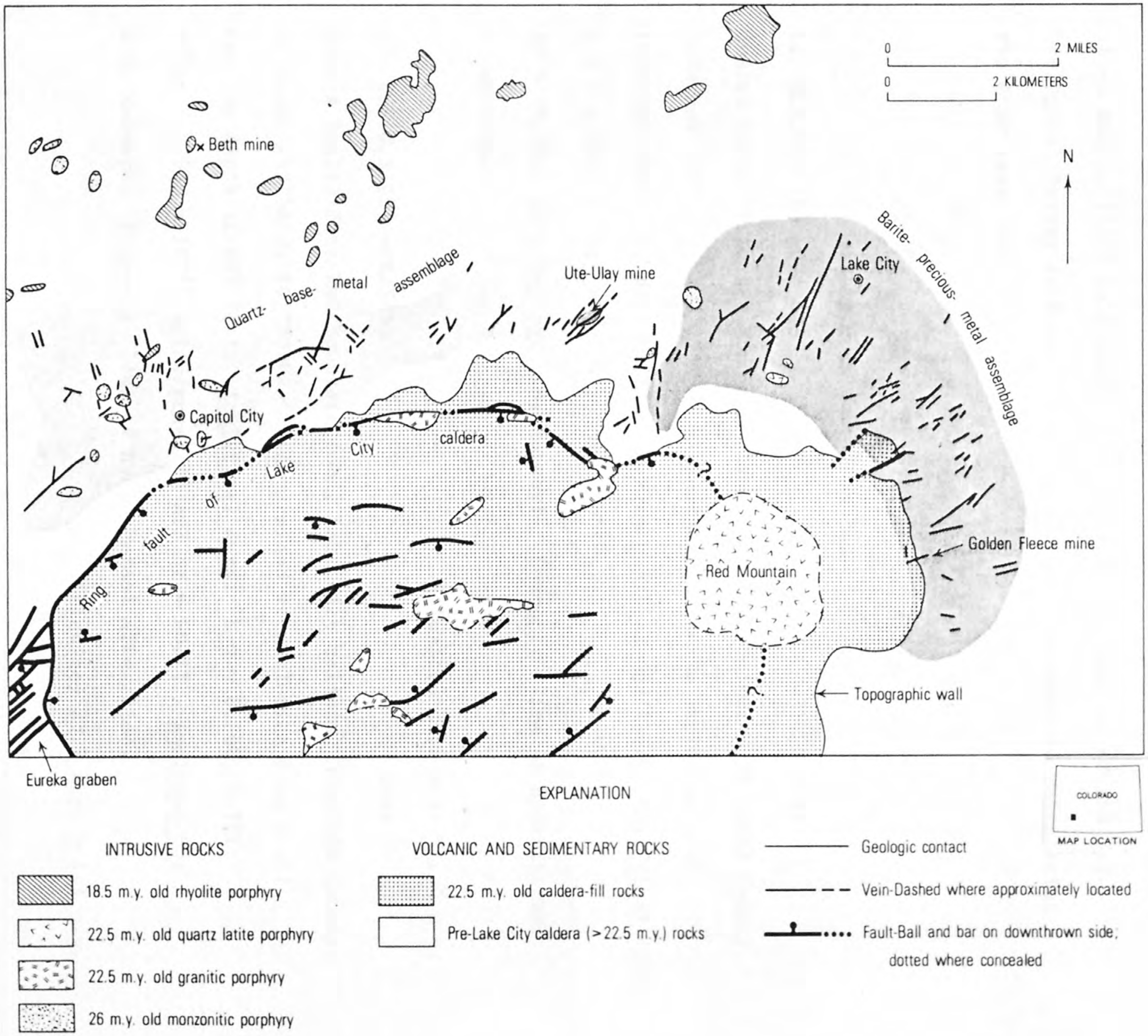
The San Juan Mountains comprise a large continental volcanic field chiefly of middle Tertiary age (Larsen and Cross, 1956; Lipman and others, 1970). Initial volcanism, in early Oligocene time, was dominated by andesitic stratovolcanoes that produced a coalesced platform of lavas, breccias, and mudflows. During the late Oligocene and Miocene, silicic ash-flow tuffs were erupted from at least 15 caldera sources (Steven and Lipman, 1976). The youngest caldera is Lake City caldera, in the western San Juan Mountains (Lipman and others, 1973). The Lake City caldera formed 22.5 m.y. (million years) ago, in response to pyroclastic eruptions of the Sunshine Peak Tuff; the age assignment is based on K-Ar dating of both the intracaldera and outflow tuff members (Mehnert and others, 1973a).

Red Mountain is a topographically prominent flow dome that was emplaced along the eastern ring fault zone of the Lake City caldera (fig. 1). Extensive talus and poor exposures prevent detailed mapping, but the dome is believed to extend downwards into a volcanic neck (Lipman, 1976). Most of the dome appears to be variably altered quartz latite porphyry, containing phenocrysts of quartz, sanidine, and plagioclase. Hydrothermal alteration is locally pervasive and has in some places destroyed primary volcanic textures. Major alteration minerals are quartz, alunite, and kaolinite. The alunite occurs as irregular disseminations, as replacements of feldspar phenocrysts, or, less commonly, as thin veinlets. Alunite for isotopic dating was obtained from drill core furnished by Earth Sciences, Inc., Golden, Colorado (see fig. 1 for drill-hole location). K-Ar ages were determined on a sample of massive alunite from a crosscutting veinlet in the core at a depth of 647 feet, and on a sample of disseminated alunite from 683 feet. The K-Ar data yield concordant ages of 23.3 m.y. $\pm$ 1.1 m.y. and 22.9 m.y. $\pm$ 1.6 m.y., respectively.

DISCUSSION

The K-Ar dates on alunite from Red Mountain indicate that the hydrothermal alteration there was coeval with the Lake City caldera cycle. They also agree, within analytical uncertainty, with a mean K-Ar age of 22.8 m.y. ± 0.6 m.y. determined for an unaltered lava flow that overlies altered flows probably related to venting of the Red Mountain dome (Mehnert and others, 1973a). The acid-sulfate alteration assemblage at Red Mountain is considered to be a shallow facies of the same hydrothermal system that deposited base and precious metals, as well as local U (at the Golden Fleece mine, fig. 1), in nearby fissure veins (Slack and Lipman, 1979). The entire system developed during the waning stages of the caldera cycle, and the hydrothermal solutions probably vented as solfataric hot-springs above the present crest of Red Mountain.

Figure 1. Sketch map of the Lake City caldera and vicinity, showing veins and principal ore assemblages (from Slack and Lipman, 1979). Drill hole is located near the summit of Red Mountain, in the center of the mapped area of quartz latite porphyry.


0 2 MILES
0 2 KILOMETERS
N
Beth mine
Quartz- base- metal assemblage
Ute-Ulay mine
Lake City
Barite- precious- metal assemblage
Capitol City
Ring fault of Lake City caldera
Golden Fleece mine
Red Mountain
Topographic wall
Eureka graben
COLORADO
MAP LOCATION
EXPLANATION
INTRUSIVE ROCKS
18.5 m.y. old rhyolite porphyry
22.5 m.y. old quartz latite porphyry
22.5 m.y. old granitic porphyry
26 m.y. old monzonitic porphyry
VOLCANIC AND SEDIMENTARY ROCKS
22.5 m.y. old caldera-fill rocks
Pre-Lake City caldera (>22.5 m.y.) rocks
Geologic contact
Vein-Dashed where approximately located
Fault-Ball and bar on downthrown side; dotted where concealed

SAMPLE DESCRIPTIONS

Fresh alunite for isotopic dating was obtained from drill core furnished by Earth Sciences, Inc., Golden, Colorado. Mineral separations and analyses were carried out in the laboratories of the U.S. Geological Survey in Denver, Colorado. Constants used in calculating the K-Ar ages are:

$^{40}K_{\lambda\varepsilon} = 0.581 \times 10^{-10}/y$, $^{40}K_{\lambda\beta} = 4.962 \times 10^{-10}/y$, $^{40}K/K = 1.167 \times 10^{-4}$. Analytical uncertainty is quoted as 2σ.

1. U.S.G.S.(D) -DKA3633 K-Ar

Quartz latite from Red Mountain dome, Lake City caldera, Hinsdale County, Colorado (37°58'N, 107°20'W). Disseminated alunite replacement of feldspar phenocrysts in drill core from depth of 683 feet. Analytical data: K_2O = 4.54%, 4.55%; $*^{40}Ar = 1.508 \times 10^{-10}$ moles/gram; $*^{40}Ar$/ Ar = 38.5%. Analyzed by: H.H. Mehnert. Comment: Time of hydrothermal alteration.

(alunite) 22.9 m.y. ± 1.5 m.y.

2. U.S.G.S.(D) -DKA3635 K-Ar

Quartz latite from Red Mountain dome, Lake City caldera, Hinsdale County, Colorado (37°58'N, 107°20'W). Fine-grained vein alunite from drill core at depth of 647 feet. Analytical data: K_2O = 8.76%, 8.79%; $*^{40}Ar = 2.956 \times 10^{-10}$ moles/gram; $*^{40}Ar$/ Ar = 60.7%. Analyzed by: H.H. Mehnert. Comment: Time of hydrothermal alteration.

(alunite) 23.3 m.y. ± 1.1 m.y.

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