550.93 : 549.623.54(789)

K-Ar Ages on Biotite from Questa Mine Area, New Mexico, U. S. A.

By

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Abstract

Two vein-forming biotite samples were dated by a K-Ar method. The results were $21\pm2\times10^6$ years for that of the Questa main deposits and $23\pm3\times10^6$ years for that of a small deposit of the Log Cabin area. They are both correlated to early Miocene and agree with field observations in the previous studies.

INTRODUCTION

This is a short note on results of age determination of biotite from two localities in the Questa molybdenum mine area. The Questa molybdenum deposits (ISHIHARA 1967), a hydrothermal fissure filling-type, are situated in the western slope of the Taos Range of the Sangre de Cristo Mountains in Taos County, northern New Mexico, U. S. A. The Taos Range is made up chiefly of regional metamorphic rocks on which flows, tuffs, and breccias of andesitic, latitic, quartz latitic, and rhyolitic composition are extruded. The volcanism is characterized by the earliest stage of lava eruption, the middle of pyroclastic fall deposition, and the final of pyroclastic flow activity. The earlier extrusive rocks are generally more mafic in composition.

These rocks are intruded by monzonite, quartz monzonite, granite, and quartz porphyry of dike and plug in shape. Granite and aplite forming three small stocks also intrude the extrusive rocks. These igneous rocks chemically show characteristics of a calc-alkali rock series rock, but highly potassic. Molybdenum mineralization is genetically connected with the most differenciated phases of the stock-forming granitic rocks.

The Questa molybdenum deposits are located at the west flank of the Questa mine aplite, which is one of the three stocks. The mineralization is controlled by the aplite boundary, local faults, and cooling joints. Molybdenite occurs in veins with quartz, sericite, and pyrite, and small amounts of biotite, carbonates, fluorite, sphalerite, chalcopyrite, and galena.

No fossils have been reported in any of the rock units, and none of the rocks have been so far dated by isotope methods. However, the regional metamorphic rocks are assigned tentatively to the Precambrian for the geologic situation in the United States. Ages between 1,200 and 1,600 million years were given to similar rocks in the surrounding area in the previous studies (BICKFORD and WETHERILL, 1965).

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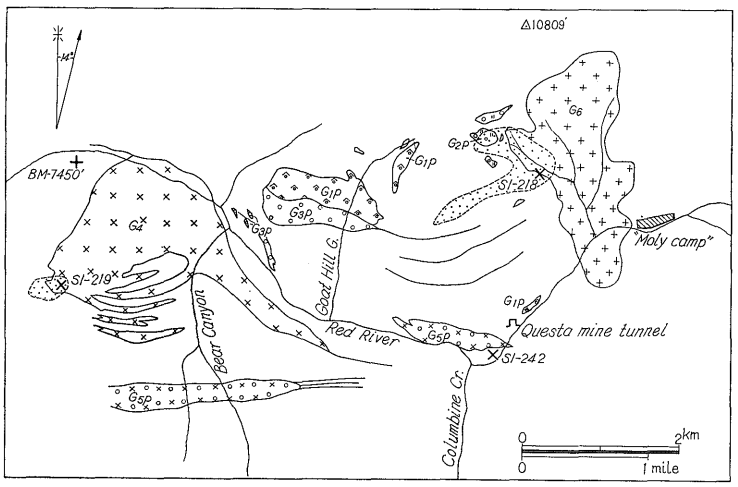
The extrusive rocks are regarded as Miocene in correlation with similar rocks in the San Juan Mountains (SCHILLING, 1956, p. 25).

SPECIMENS AND RESULTS

Examined biotite specimens were separated from molybdenite-biotite-quartz vein material of Z tunnel mine dump and Log Cabin old prospect. Their localities are given in Table 1 and Figure 1. At the Questa mine vein biotite is known to be abundant in the ore shoots (ISHIHARA, 1967, p. 51). The specimen of the Z tunnel (SI-218) should demonstrate the main mineralization stage of the Questa deposits; while that of the Log Cabin prospect (SI-219) indicates also the main mineralization stage of a low grade ore body at the west flank of the Log Cabin granite (G_4).

Table 1 Localities and description of the specimens

Sample No.	Localities	Description
SI-218	Taken from mine-dump of Z tunnel	Molybdenite-biotite-quartz vein
SI-219	Old Log Cabin prospect, 290′ from the portal	Molybdenite-biotite-quartz vein, N32°E vertical.
SI-242	Near mouth of Columbine Creek, north side of road-side cutting at big curve of Highway 38.	Foliated granite



G_1p : Hornblende-biotite (quartz) monzonite porphyry
G_2p : Hornblende bearing biotite granite porphyry
G_3p : Quartz porphyry G_4 : Log Cabin biotite granite
G_5p : Columbine aplite porphyry G_6 : Questa mine aplite

Figure 1 Locality map of the analyzed specimens

Argon was extracted from biotite by direct fusion with an induction heater, mixed with spike Ar^{38}, and purified with titanium sponge. Isotopic analyses of argon were made with a Reynolds-type mass spectrometer. Potassium was determined by flame photometry. Analytical results are shown in Table 2.

Table 2 K-Ar age results on biotite from the Questa mine area

Sample No.	K_2O (%)	Ar^{40}_{rad} (ml STP/g)	Atmospheric contamination (%)	Age (m.y.)
SI-218	7.43	5.26×10^{-6}	61.6	21±2
SI-219	9.41	7.08×10^{-6}	53.8	23±3

$\lambda e=0.584\times10^{-10}$ yr^{-1}, $\lambda\beta=4.72\times10^{-10}$ yr^{-1}, $K^{40}/K=0.0119$ atm. %.

The ages of 21 and 23 m.y. for two samples of vein biotite from the Questa mine area are correlated to early Miocene, and agree with the geologically suggested age of the extrusive rocks. Therefore the time difference between the volcanism and the mineralization including formation of the stocks is supposed to be small.

A reconnaissance run of argon measurement indicated a rather small value to the foliated granite (SI-242), in comparison with those given by BICKFORD & WETHERILL (1965) to similar Precambrian granites. The sample was taken from near the Columbine aplite porphyry (G_5p). Its biotite has been partly chloritized and oxidized under the microscope. (Table 3). Argon of the biotite would have been leaked out during the alteration. Further treatments are needed on the Precambrian rock.

Table 3 Modal compositions of the foliated granite (SI-242(1))

Minerals	Percentage	
Quartz	28.2	
Potassium feldspars	21.7	
Plagioclase	45.8	
Sericite	0.4	
Biotite	1.3	3.2
Chlorite (converted from biotite)	1.9	
Epidote	0.6	
Other minerals	0.2	
Total	100.1	

Notes : A point counter method, after staining potassium feldspar. 2201 measured points in total ; 0.5 by 0.06 mm intervals. Percentage in volume.

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REFERENCES

BICKFORD, M. E. and WETHERILL, G. W. (1965) : Compilation of Precambrian geochronological data for North America. *Geochronology of North America. NAS-NRC Nuclear Science Series Rept.* no. 41, p. 21~179.

ISHIHARA, S. (1967) : *Molybdenum mineralization at Questa mine, New Mexico, U.S.A.——An importance of degree of magmatic fractionation for molybdenum concentration to form an ore deposit——*. Rept. Geol. Surv. Japan. no. 218, 63 p.

SCHILLING, G. H. (1956) : *Geology of the Questa molybdenum (Moly) mine area, Taos County, New Mexico.* N. Mex. Inst. Min. & Tech., State Bur. Mines & Miner. Res., Bull. 51, 87 p.

アメリカ合衆国ニューメキシコ州クエスタ鉱山地域の黒雲母の K-Ar 年代

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要 旨

クエスタMo 鉱床の鉱脈を構成する黒雲母の K-Ar 年代は21±2×10^{6}年 (クエスタ鉱床) と23±3×10^{6}年 (ログ・キャビン地域の小鉱床) とであつた。これらの値は，鉱脈とそれをもたらした岩株の形成に先立つ噴出岩類に対して，火山層序から推定されていた時代—中新世—に一致する。クエスタ鉱山地域の噴出→貫入→鉱化に至る火成活動は，地質時代的には比較的短期間におこなわれたと推定される。