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THE MULE MOUNTAIN STOCK, AN EARLY MIDDLE DEVONIAN PLUTON IN NORTHERN CALIFORNIA

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The elliptical Mule Mountain stock west of Redding, Calif., is about 16 km long and 8 km wide and is composed mainly of highly altered and deeply weathered trondhjemite and albite granite. The stock intruded the Balaklala Rhyolite and Copley Greenstone of pre-late Middle Devonian age and is in turn intruded by the 134-m.y.-old Shasta Bally batholith. The age of the stock has been regarded on geologic grounds as Late Jurassic (Kinkel and others, 1956). A sample of unweathered and little altered hornblende quartz diorite has yielded concordant K-Ar hornblende and U-Pb zircon ages. K-Ar ages presented in this report are calculated using the following constants: K^{40} = 0.01167 atom percent, $\lambda\beta$ = 4.962 × 10^{-10} year^{-1}, $\lambda\epsilon$ + $\lambda'\epsilon$ = 0.581 × 10^{-1} year^{-1}, *Ar^{40} = radiogenic argon.

The concordance of these ages is remarkable in that even the $^{208}Pb/^{232}Th$ age is within about 3 percent of the others, and the K-Ar age is about midway between the zircon extremes, well within their analytical uncertainty and eminently compatible. It is evident that the Mule Mountain stock is one of the few well dated Paleozoic plutonic rocks in the western United States, and on the basis of the most recent estimate of the age of the Silurian-Devonian boundary (Ross and others, 1978), it appears that the stock is of early Middle Devonian age.

The pre-late Middle Devonian age of the Copley Greenstone and intertonguing Balaklala Rhyolite previously has been based on the fossiliferous Kennett Formation, which the Balaklala appears to underlie conformably. The new radiometric data not only support this age inference but also strongly suggest that volcanic rocks of the Copley and Balaklala, chiefly albitized andesite and dacite, may be generally cogenetic with Mule Mountain stock, as they are petrologically compatible. Barker and others (1979) concluded from petrologic studies that the trondhjemite of the Mule Mountain stock is cogenetic with extrusive rocks of the Balaklala, and we conclude that inasmuch as the Copley Greenstone intertongues with the Balaklala, the Copley must also be coeval and cogenetic. The stock thus intruded its own volcanic pile during island arc magmatism in early Middle Devonian time. The stratabound massive sulfide deposits of the West Shasta mining district, which are enclosed within the Balaklala Rhyolite, were also in part a product of this event.

SAMPLE DESCRIPTION

1.   K-Ar, U-Th-Pb
Hornblende quartz diorite (40°4'N,122°29'30"W; W of Redding, CA). *Analytical data:* K-Ar: (hornblende) K_2O = 0.182; *Ar^{40} = 11.483 × 10^{-11} moles/gm; *$Ar^{40}/\Sigma Ar^{40}$ = 56%. U-Th-Pb: (zircon) U = 520.3 ppm; Th = 196.7 ppm; Pb = 33.96 ppm; Pb 206/204 = 5472.6; Pb 207/204 = 314.0; Pb 208/204 = 681.8.

(hornblende)392 ± 3 m.y.
(zircon)Pb^{206}/U^{238} = 400 m.y.
Pb^{207}/U^{235} = 400 m.y.
Pb^{206}/Pb^{207} = 400 m.y.
Pb^{208}/Th^{232} = 387 m.y.

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