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PRELIMINARY REPORT ON THE BEHAVIOR OF U-Pb ZIRCON AND K-Ar SYSTEMS IN POLYMETAMORPHOSED OPHIOLITIC ROCKS AND BATHOLITHIC ROCKS, SOUTHWESTERN SIERRA NEVADA FOOTHILLS, CALIFORNIA

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Ophiolitic rocks of the southwest Sierra Nevada foothills form part of the western metamorphic wall of the Sierra Nevada batholith (fig. 1). Geochronological studies were undertaken to determine: (1) The igneous petrogenetic age of the ophiolite; (2) The age of a prebatholith dynamic greenschist to amphibolite facies metamorphic event experienced by the ophiolite; and (3) The emplacement ages of the batholithic rocks. Geochronological work was interfaced with detailed structural and petrologic studies. A summary of the geochronological data is given in figure 2.

Zircon from four widely spaced leucocratic dikes within the ophiolite yield suites of internally consistent discordant U-Pb ages. Each zircon sample was split into size and magnetic fractions, which were analyzed separately. Each sample showed the same pattern of greater discordance with increase in U concentration and decrease in grain size. Zircon discordance is attributed to regional thermal metamorphism related to emplacement of the Sierra Nevada batholith. Metamorphism affected the hornblende hornfels facies, but one of the main factors which is believed to have affected the zircon is the intense metasomatic system, which was set up between the batholithic rocks and serpentinite that enclosed the ophiolitic blocks containing the sampled dikes.

Numerous concordant zircon ages measured on the cross-cutting batholithic rocks of gabbroic to granodioritic composition range from 100 to 125 m.y. Mafic metaigneous rocks of the ophiolite, which enclose the leucocratic-dike rocks, were sampled for K-Ar age determinations. The K-Ar ages were reset to ages which fall within the range of concordant batholithic-zircon ages. Concordia plots made for each of the discordant ophiolitic zircon populations yielded lower intercept ages, which are in agreement with the concordant batholithic-zircon ages and the reset ophiolitic K-Ar ages.

The intercept age ranges for each ophiolitic-zircon population are derived by fitting a family of lines through the error brackets of the discordant U-Pb points on a concordia plot, and noting the ranges over which these lines intercept concordia. The upper intercept falls around 300 m.y. and may represent an initial crystallization age for the ophiolitic-dike rocks. The oldest $^{206}Pb/^{238}U$ age obtained from the discordant populations is 247 m.y. $^{206}Pb/^{207}Pb$ ages for the discordant populations range back to 275 m.y. These data together suggest that the igneous ages of the ophiolitic-dike rocks are between 250 and 300 m.y. The dike rocks are an integral part of the ophiolite assemblage and thus this petrogenetic age range is assigned to the entire igneous assemblage of the ophiolite. The petrogenetic age is considered an oceanic spreading center age.

Mafic metamorphic tectonites of amphibolite facies were sampled from the ophiolite in domains of lowest textural and mineralogic contact metamorphic grade. K-Ar ages on amphibole represent a minimum age on the dynamic metamorphic event that was related to tectonic disruption of the ophiolite. The minimum ages range from 179 m.y. to 190 m.y. Where sampled adjacent to the batholith a similar mafic tectonite sample (not shown on fig. 2) had its K-Ar system reset to the batholithic-zircon age. Geological relations suggest that the dynamic metamorphic age should be close to the petrogenetic age of the ophiolite, and that this metamorphism occurred

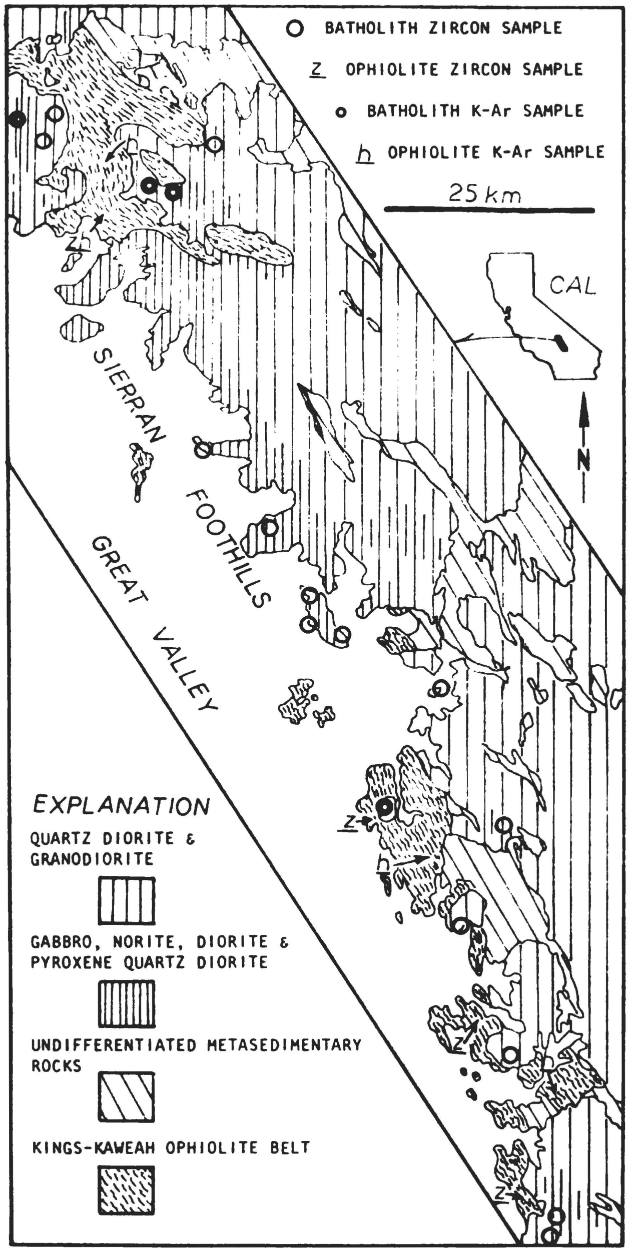

Fig. 1.--Generalized geologic map of part of the southwestern Sierra Nevada foothills showing locations of geochronological samples.

in the ocean domain (Saleeby, 1977).

An older deformed fraction of the batholith, which cuts the ophiolite near its northern end, yields concordant-zircon ages of 169 m.y. and 157 m.y. These older plutons, in addition to the ophiolite, are cut by the voluminous younger batholithic rocks. K-Ar systems on the older plutons have been reset to the age range of the younger batholithic rocks.

Concordant zircon ages of 121 m.y. and 120 m.y. were measured on two plutons along the western margin of the batholith for which Evernden and Kistler (1970) report hornblende-biotite K-Ar pairs of 121 to 113 m.y. and 115 to 114 m.y. The zircon ages are interpreted as crystallization ages whereas the K-Ar ages are interpreted as cooling ages. The close correspondence between the zircon and K-Ar ages, which is in contrast to the older batholithic rocks, is consistent with the plutons being young and located at the extreme western edge of the batholith.

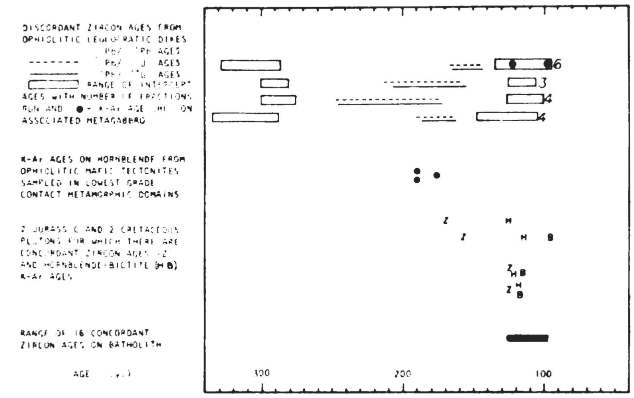

Fig. 2.--Plot of zircon U-Pb and K-Ar age data for ophiolitic and batholithic rocks. K-Ar data on two Cretaceous plutons after Evernden and Kistler (1970).

The following conclusions can be drawn from this study:

1. Even though the ophiolite consists of a polymetamorphic assemblage of mafic and ultramafic rocks, its igneous petrogenesis can be placed between 250 m.y. and 300 m.y.

2. The first high-grade metamorphism of the ophiolite occurred prior to 190 m.y. This metamorphism may have occurred in the oceanic realm in conjunction with igneous petrogenesis.

3. Plutons of 169 m.y. and 157 m.y. ago intruded the disrupted ophiolite and then were deformed and later contact metamorphosed.

4. Voluminous plutons ranging in age from 125 m.y. to 100 m.y. intruded the ophiolite and older plutons and caused high-grade contact metamorphism, which is isotopically recorded in ophiolite zircon discordance and in partial to complete resetting of K-Ar systems in both the ophiolitic and the older plutonic rocks.

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