A Compilation of K-Ar-ages for Southern California

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Introduction

The purpose of this report is to make available a large body of conventional K-Ar ages for granitic, volcanic, and metamorphic rocks collected in southern California. Although one interpretive map is included, the report consists primarily of a systematic listing, without discussion or interpretation, of published and unpublished ages that may be of value in future regional and other geologic studies.

From 1973 to 1979, 468 rock samples from southern California were collected for conventional K-Ar dating under a regional geologic mapping project of Southern California (predecessor of the Southern California Areal Mapping Project). Most samples were collected and dated between 1974 and 1977. For 61 samples (13 percent of those collected), either they were discarded for varying reasons, or the original collection data were lost. For the remaining samples, 518 conventional K-Ar ages are reported here; coexisting mineral pairs were dated from many samples. Of these K-Ar ages, 225 are previously unpublished, and identified as such in table 1. All K-Ar ages are by conventional K-Ar analysis; no $^{40}Ar/^{39}Ar$ dating was done.

Subsequent to the rock samples collected in the 1970s and reported here, 33 samples were collected and 38 conventional K-Ar ages determined under projects directed at (1) characterization of the Mesozoic and Cenozoic igneous rocks in and on both sides of the Transverse Ranges and (2) clarifying the Mesozoic and Cenozoic tectonics of the eastern Mojave Desert. Although previously published (Beckerman et al., 1982), another eight samples and 11 conventional K-Ar ages are included here, because they augment those completed under the previous two projects.

Sample List

All of the collected rock samples are listed in Table 1 by field number, along with rock description, mineral(s) ages, K_2O content, radiogenic argon content, and location, where available. Previously unpublished K-Ar ages are so indicated. Sample sets represent specific geographic regions in southern California: in general, T-labeled samples are from the Transverse Ranges (Santa Monica Mountains, San Gabriel Mountains, and San Bernardino Mountains), M-labeled samples from the Mojave Desert, and P-labeled samples from the Peninsular Ranges batholith. During the collecting, however, especially in the early years, some samples from the Mojave Desert and Peninsular Ranges were inadvertently labeled T, and some collected in the Transverse Ranges labeled M or P, as is evident on figure 1, where all K-Ar ages are tied to sample numbers.

Most rock descriptions are from 35-year-old field notes and vary in quality from scant to detailed. Nearly all rock types are from field descriptions; very few have been augmented by thin section examination or rock chemistry. Most P-labeled samples were described by D.M. Morton; some M7-labeled, all M8- and M9-labeled, and most V-labeled samples were described by J.

Morton; samples following sample CMG1-68 in Table 1 were described by D.M. Miller; and all other samples were described by F.K. Miller. Informally or formally named plutons are indicated for several rock samples, but most samples were from unnamed bodies.

K_2O content is listed as a general guide to mineral-separate purity. Mineral separates from rocks described as showing any chloritization or oxidation were cleaned to include only the pure, unaltered mineral species dated. All T-, M-, and P- labeled sample mineral separates were checked in immersion oils for purity. Purity, as we use the term, means that no discernable contaminates were observed under oils. Mineral separates that could not be cleaned to purity were not analyzed. A few K-Ar ages are on whole-rock separates, chiefly for fine-grained volcanic rocks and ultra-fine-grained mylonites.

Radiogenic argon content is listed for evaluation of the argon extractions and spectrometer runs. Radiogenic-Ar content for most biotite and muscovite age determinations ranges from 80 to 95 percent, and for most hornblende age determinations from 50 to 80 percent.

Most sample locations were plotted on 7.5' quadrangle maps when collected. Latitudes and longitudes were obtained by manual measurement, using a template with 1" accuracy at the 7.5' map scale. A few localities, primarily in the northern Mojave Desert, were plotted on smaller-scale maps; these localities, preceded by an asterisk in table 1, are located as accurately as possible but to no better than 10" of latitude or longitude. Many of the samples listed as undated had to be discarded because a box of sample locality maps was disastrously lost in the mail partway through the project.

Some K-Ar ages in table 1 were reported before 1977 with different ages because all K-Ar ages in this report were calculated or recalculated by using Steiger and Jäger’s (1977) constants. A few previously reported K-Ar ages have been changed very slightly after reevaluation of spectrometer and (or) computer output.

Maps

Two maps (oversize figs 1, 2) are included in this report. Although sample sites are located as accurately as possible, neither map is edited to U.S. Geological Survey standards, and as such, both maps should be treated as sketch maps.

Figure 1

This map of southern California shows locations of all dated samples and their mineral ages as well as traces of the major Neogene faults. Key to mineral separates dated: h, hornblende; m, muscovite; p, plagioclase; s, sanidine; w, whole rock; no symbol, biotite.

Figure 2

This map of southern California shows locations of intrusive rocks dated by biotite. Interpretive contours of the biotite ages indicate possible cooling relations in selected parts of the region. Contouring is done by structural block; for example, only K-Ar ages east of the Elsinore Fault Zone and west of the San Jacinto Fault Zone are used in contouring that structural block, with no influence from ages west of the Elsinore Fault Zone or east of the San Jacinto Fault Zone.

All contouring was done by hand. Because many of the structural blocks are small and some contain relatively few K-Ar ages, computer contouring resulted in unrealistic distortions. The paucity of rock samples in some areas undoubtedly translates to localized inaccuracy of contour position and configuration. In addition, the influence of Mesozoic through Miocene structural boundaries other than those shown on the map was not considered.

The 2-m.y. contour interval shown here, though not justified by the approximately ±3 percent of additive effects of analytical uncertainties, is used to visually enhance the trends and forms of the contours, neither of which change materially when using a 5-m.y. contour interval. A 10-m.y. contour interval, shown with a blue-gray background, is used in places where the age gradient is extremely steep.

On much of the map (fig. 2), designated by a pale-brown overprint, K-Ar ages do not form decipherable patterns, making credible contouring of K-Ar ages possible only for small subareas, and connecting these subareas impossible. The complex patterns include some of the blue-gray 10-m.y. contour intervals. Causes for undecipherable patterns of K-Ar ages include: (1) K-Ar ages represent overlapping cooling histories of differing ages, for example, a later cooling event partly superimposed on an earlier one; (2) the biotite K-Ar ages in some subareas represent mixed cooling and emplacement ages; (3) unrecognized Mesozoic through Miocene structural boundaries may affect the patterns; (4) intrusive rocks with widely varying emplacement ages create complex K-Ar age patterns; and (5) age control is too sparse to project contours between subareas.

Apparent offset of contours across faults is related to fault offset in only a general way. Because the contours represent ground-surface traces of three-dimensional surfaces of equal K-Ar age, only smooth age surfaces with known strike and dip can be correlated across faults, and ratios of strike-slip and dip-slip components of offset on a fault must be independently known.

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