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Stratigraphy, structure, and potassic alteration of Miocene volcanic rocks in the Sleeping Beauty area, central Mojave Desert, California

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Abstract

The Sleeping Beauty area of the southeastern Cady Mountains, central Mojave Desert, contains a sequence of volcanic rocks >3 km thick which was erupted approximately 20 m.y. ago. Plate reconstructions indicate that the change from subduction to transform-fault tectonics off the coast of California occurred about 20 m.y. ago as well, and so these rocks contain a record of volcanism, extensional faulting, and potassic metasomatism during this time of tectonic transition.

The volcanic sequence comprises basalt to rhyolite flows and tuffs which are overlain by the widespread Peach Springs Tuff and by terrestrial sediments. Bedding below the Peach Springs Tuff generally dips 10°-50° to the southwest and is cut by numerous steep northwest- to north-trending faults. Tilting predated deposition of the Peach Springs Tuff. Bedding-fault relationships indicate that deformation was not by "tilted-book" geometry in its simplest form. No significant low-angle faults are exposed, but such faults occur to the west and may underlie the area. A major open, southeast-trending anticline in the area may be a drag fold related to the post- late Miocene, right-lateral, north-trending Ludlow fault.

All units below the Peach Springs Tuff were locally affected by severe potassic metasomatism, which raised measured K_2O contents to as high as 13.3 wt%. Metasomatized rocks occur in irregular zones that follow northwest-trending faults and are best developed around northwest-trending breccia zones which have jasper matrices. Ba and Mn prospects are invariably found in metasomatized rocks. Geologic and geochemical constraints indicate that metsomatism occurred at shallow depth (<1 or 2 km) and low temperature (<150 °C). Metasomatism occurred in at least two distinct pulses and apparently predated deposition of the Peach Springs Tuff. The K may have been derived from percolating closed-basin brines or through hydrogen metasomatism of rocks deeper in the complex.

GeoRef Subject

California celestine Cenozoic geochemistry geochronology alkaline earth metals Mojave

Desert Cady Mountains Neogene neotectonics alkali metals folds K/Ar metasomatism Miocene metals pyroclastics potassium Tertiary Southern California metal ores manganese ores strontium strontium ores absolute age San Bernardino County California stable isotopes tuff barite deposits Sr-87/Sr-86 structural geology sulfates economic geology isotopes lava igneous rocks tectonics United States volcanic rocks

First Page Preview

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ABSTRACT

The Sleeping Beauty area of the southeastern Cady Mountains, central Mojave Desert, contains a sequence of volcanic rocks >3 km thick which was erupted approximately 20 m.y. ago. Plate reconstructions indicate that the change from subduction to transform-fault tectonics off the coast of California occurred about 20 m.y. ago as well, and so these rocks contain a record of volcanism, extensional faulting, and potassic metasomatism during this time of tectonic transition.

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INTRODUCTION

Tertiary volcanism and extensional faulting in the southwestern United States occurred as a northward-moving wave which swept through the central Mojave Desert about 20 m.y. ago (Armstrong and Higgins, 1973; Glazner and Bartley, 1984). This wave apparently tracked the northward progression of the Mendocino triple junction and thus occurred during the change from subduction to transform-fault tectonics off the coast of California. Volcanic rocks and associated structures in the Mojave Desert record details of this plate reorganization. In spite of the tectonic significance of the Mojave region, however, there are few published studies of the petrology and structure of the Tertiary volcanic rocks found there.

The Sleeping Beauty area of the southeastern Cady Mountains (Figs. 1, 2) is a 90-km^2 region of tilted volcanic rocks which lies in the center of the Mojave Desert. This sequence of rocks is of particular interest because (1) rocks in the area record three distinct but closely spaced periods of volcanism and accompanying mineralization and coarse-clastic sedimentation; (2) the sequence was tilted by extensional faulting, and the timing of faulting can be tightly constrained; and (3) the volcanic rocks were affected by intense potassic metasomatism. Potassic metasomatism is now known to be widespread in the southwestern United States (Chapin and Glazner, 1983), and in most areas, metasomatism is associated with crustal extension. Field and petrographic relations of metasomatism are better displayed in the Sleeping Beauty area than in most of the other areas cited by Chapin and Glazner (1983).

This paper provides a summary of the geology of the Sleeping Beauty area. The goals of the study were to determine (1) the petrologic char-

TABLE 1. K-Ar AGE DETERMINATIONS

Sample	8-7	12-3	AG-3	11-1A
Unit	FSB	FAS	DCM	PST
Material	pl	wr	wr	san
K_2O, wt%	1.135	1.585	3.475	6.425
$^{40}Ar^*$, 10^{-10} mol/g	0.3257	0.4562	1.0145	1.862
$\%^{40}Ar^*$	64	64	69	56
$^{40}Ar^*/^{40}K \times 10^5$	116	116	118	117
Age, m.y.	19.8	19.9	20.2	20.0
$\pm 2\sigma$	1.4	0.7	1.3	1.0

Note: FSB = formation of Sleeping Beauty Ridge, FAS = formation of Argos Station, DCM = dacite of Cady Mountains, PST = Peach Springs Tuff; $^{40}Ar^*$ = radiogenic argon; pl = plagioclase separate, wr = whole rock, san = sanidine separate; ^{40}K constants: $\lambda_\epsilon = 0.584 \times 10^{-10}$/yr, $\lambda_\beta = 4.720 \times 10^{-10}$/yr, atomic abundance = 1.19×10^{-4}; analyses by R. F. Marvin, H. H. Mehnert, and V. M. Merritt at U.S. Geological Survey laboratories.

Additional material for this article (an appendix) may be obtained free of charge by requesting Supplementary Data 8804 from the GSA Documents Secretary.

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Index Terms/Descriptors

absolute age | alkali metals | alkaline earth metals | areal geology | barite deposits | Cady Mountains | California | celestine | Cenozoic | dates | economic geology | extension tectonics | folds | geochemistry | geochronology | igneous rocks | isotopes | K/Ar | lava | lithostratigraphy | manganese ores | metal ores | metals | metasomatism | Miocene | Mojave Desert | Neogene | neotectonics | potassium | pyroclastics | San Bernardino County California | Southern California | Sr-87/Sr-86 | stable isotopes | strontium | strontium ores | structural geology | sulfates | tectonics | Tertiary | tuff | United States

Latitude & Longitude

N34°45'00" - N34°49'60", W116°16'60" - W116°13'00"

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