

MESOZOIC AND CENOZOIC THERMAL HISTORY OF THE EASTERN MOJAVE
DESERT, CALIFORNIA AND WESTERN ARIZONA, WITH EMPHASIS ON THE
OLD WOMAN MOUNTAINS AREA AND THE CHEMEHUEVI METAMORPHIC
CORE COMPLEX

by

David A. Foster

A Dissertation

Submitted to the State University of New York at Albany

in Partial Fulfillment of

the Requirements for the Degree of

Doctor of Philosophy

College of Sciences and Mathematics

Department of Geological Sciences

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ABSTRACT

Mesozoic thickening and Cenozoic extension resulted in the juxtaposition of upper and middle crustal rocks in the eastern Mojave Desert, southeastern California and western Arizona. The application of $^{40}\text{Ar}/^{39}\text{Ar}$ thermochronology and petrology/thermobarometry to rocks in this region provides information about the timing and nature of thrusting, plutonism, metamorphism, denudation, and detachment faulting. $^{40}\text{Ar}/^{39}\text{Ar}$ ages of 175 to 125 Ma from the Clipper, Piute, Turtle, Mohave, Bill Williams, and Hualapai Mountains are interpreted to be the result of a middle Mesozoic thermal event(s) caused by crustal thickening. This is supported by the presence of *ca.* 150 Ma dikes that locally intruded Paleozoic meta-sediments at ~ 3.5 kbars in the Old Woman Mountains. Orogenesis culminated during the Late Cretaceous when rocks exposed in the Old Woman-Piute, Chemehuevi, and Sacramento Mountains attained temperatures >500 °C. High grade metamorphism in the Old Woman Mountains area was caused by the intrusion of the Old Woman-Piute batholith at 73 ± 1 Ma; Cretaceous mineral assemblages in Proterozoic pelites increase in grade from greenschist to upper amphibolite facies, and $^{40}\text{Ar}/^{39}\text{Ar}$ hornblende ages from Proterozoic amphibolites decrease in age from ~ 1600 Ma to 73 ± 1 Ma, in the direction of 73 Ma plutons. Pluton emplacement and metamorphism occurred at 3 to 3.5 kbars and 400 to >600 °C in the Piute Mountains, and 3.5 to 4.5 kbars and 530 to >650 °C in the Old Woman Mountains. Cooling rates following batholith emplacement in the Old Woman Mountains were ~ 100 °C/Ma between 73 and 70 Ma, and 5 to 10 °C/Ma from 70 to ~ 30 Ma. This rapid cooling between 73 and 70 Ma requires unroofing rates of 1 to 2 km/Ma for this interval. Following the Cretaceous, the eastern Mojave Desert underwent a period of cooling at a rate of 2 to 10 °C/Ma between 65 and 25 Ma. By 30 Ma rocks exposed in the Old Woman-Piute, Marble, Ship, Clipper, and Turtle Mountains were below ~ 100 °C. $^{40}\text{Ar}/^{39}\text{Ar}$ ages from the Sacramento Mountains suggest that mylonitization caused by the

onset of regional extension occurred at 23 ± 1 Ma. When extension started in the Chemehuevi Mountains, rocks exposed in the southwestern and northeastern portions of footwall to the Chemehuevi detachment fault were at ~ 180 °C and ~ 350 °C, respectively, which suggests that this fault initiated at a dip of 5 to 30°. Unroofing of the footwalls to detachment faults in the Sacramento and Chemehuevi Mountains resulted in cooling rates of 10 to 50 °C/Ma between 22 and 15 Ma.

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