THERMOCHRONOLOGY OF A SUBDUCTION COMPLEX
IN WESTERN BAJA CALIFORNIA

by

Suzanne Louise Baldwin

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
1988
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in Western Baja California

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ABSTRACT

A thermochronologic study of blueschists and related high pressure rocks from a subduction complex in west-central Baja California has provided constraints on the timing of subduction-related metamorphism and timing of subsequent uplift. Subduction-related metamorphism of coherent blueschists occurred in late Early Cretaceous time. One portion of the subduction complex was uplifted from a depth of 25 km to the surface of the Earth at an average rate of 0.1 mm/yr. The relatively slow uplift rate and the lack of any higher temperature overprinting assemblages in the coherent blueschists of the Western Baja terrane suggest that synsubduction uplift was gradual and proceeded through a dynamic accretionary wedge characterized by low geothermal gradients. An increase in uplift rate to 1 mm/yr during post-Miocene time coincides with a change from a convergent to a transform plate boundary.

Ages and mineral assemblages for exotic blocks within serpentinite-matrix melange indicate the blocks have experienced different P-T-t histories. Mid-Jurassic epidote amphibolite facies blocks are likely derived from oceanic crust and associated sediments that were metamorphosed during initiation of subduction. $^{40}$Ar/$^{39}$Ar analyses of white micas from blueschist blocks indicate the blocks experienced subduction-related metamorphism at approximately the same time as the coherent blueschists. However, age spectra for white micas from blueschist blocks show evidence for varying degrees of diffusional loss of $^{40}$Ar suggesting that the blocks remained in portions of the accretionary wedge where temperatures were high enough to cause partial outgassing of the white micas. Mid-Jurassic amphibolite facies blocks from East San Benito Island were partially overprinted by blueschist facies mineral assemblages and represent an intermediate type of block which records both events.

Results of isothermal, hydrothermal experiments on metamorphic hornblendes support a previously reported estimate of the activation energy of $^{40}$Ar in hornblende
(~60 kcal/mol). However, phyllosilicate intergrowths and exsolution lamellae within metamorphic hornblende result in extremely small diffusion domains which lead to lower Ar retentivities and closure temperatures of $440^\circ$C, assuming a cooling rate of $5^\circ$C/Ma.

Preliminary results of thermal modeling of a subduction complex indicate that the temperature-time history of the accretionary wedge is strongly dependent on the choice of the angle between the subducting plate and the overlying wedge and not affected by low values (0.1 mm/yr) of the advection term.
ACKNOWLEDGMENTS

It is with great pleasure that I am able to acknowledge the friends and colleagues who have influenced me throughout the course of my graduate study. Mark Harrison has been a mentor and friend; I am especially grateful for the support and encouragement he has given me during the course of this study. The members of my committee - Steve DeLong, Tim Byrne, and Greg Harper - are thanked for carefully reading this dissertation and providing helpful comments and criticisms. Diana Paton is gratefully acknowledged for helping me prepare the final copy of this dissertation.

The graduate students and faculty of S.U.N.Y. at Albany, R.P.I., and Stanford are thanked for technical support and helpful discussions. I especially wish to acknowledge Matt Heizler for assistance with the $^{40}\text{Ar}/^{39}\text{Ar}$ analyses, Prof. Bruce Watson and Bob Rapp for help in running the diffusion experiments at R.P.I., Mary Roden for her assistance in the fission track lab at R.P.I., and Dr. Ron Kistler of the U.S.G.S. at Menlo Park for performing the Rb-Sr analyses. Ricardo Sedlock, Dave Larue, and Jon Hagstrom are especially thanked for their assistance in the field (and in the town of Cedros!), as well as their kind hospitality during the fall of '86. A special thanks to Ricardo for constantly reminding me that one should always strive for high adventure and for many stimulating conversations.

The thermal model discussed in the appendix would not have been possible without the assistance of Romek Dabrowski. The many hours he devoted to teaching me the finite element method and to helping me turn my ideas into the thermal model presented in the appendix are truly appreciated.

The time spent working on this dissertation has been most difficult as I suffered the loss of the two most influential women in my life - my mother, Barbara Y. Baldwin, and my paternal grandmother, Elsie B. Martin. This thesis is dedicated to their memory.
Special thanks go to my family, friends, and colleagues who helped me through these
difficult times and encouraged me to continue my work.

Last, but certainly not least, I thank Dave Bonner for his love, patience, support,
and encouragement, for always being there when I needed him, and for teaching me
how to live in n-dimensions.

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