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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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°C, assuming a cooling rate of 5°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.

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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.

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TABLE OF CONTENTS

Page

ABSTRACT i
Acknowledgments iii
TABLE OF CONTENTS v
LIST OF FIGURES vii
LIST OF TABLES xi

CHAPTER 1: INTRODUCTION

Nature of the problem 1
Geochronology of subduction complexes 2
Regional geologic setting 4
Area of study 5

CHAPTER 2: GEOCHRONOLOGY OF THE WESTERN BAJA TERRANE

Geology of the Western Baja terrane 14
Previous work 15
Experimental techniques 15
Results 17
Discussion 22
Future Work 23
Conclusions 24

CHAPTER 3: GEOCHRONOLOGIC, PETROLOGIC, AND GEOCHEMICAL CONSTRAINTS FOR THE P-T-t HISTORY OF SERPENTINITE-MATRIX MELANGE FROM WEST-CENTRAL BAJA CALIFORNIA

Introduction 43
Area of study 44
Previous work 45
Analytical techniques 46
Geochronologic results 48
  A) Blueschist blocks
    1) ^{40}Ar/^{39}Ar analyses 48
    2) Rb-Sr analyses 50
    3) Fission track analyses 50
  B) Epidote amphibolite facies blocks
    1) ^{40}Ar/^{39}Ar analyses 51
    2) Rb-Sr analyses 55
    3) Fission track analyses 55
  C) Overprinted amphibolite blocks
    1) ^{40}Ar/^{39}Ar analyses 56
Geochemistry of blocks in melange 58
Petrologic constraints 60
Discussion 61
Future Work 66
Conclusions 67

Page

CHAPTER 4: GEOCHRONOLOGY OF THE CHOYAL TERRANE

Geology of the Choyal terrane 130
Analytical technique 134
Results 134
Discussion 136
Conclusion 138

CHAPTER 5: DIFFUSION OF ^{40}AR IN METAMORPHIC HORNBLENDES

Introduction 153
Previous work 153
Purpose 155
Starting Materials 156
Experimental Methods 157
Theory 159
Results 160
Discussion 163
Conclusion 166

CHAPTER 6: THERMAL MODELING OF SUBDUCTION COMPLEXES

Previous work 181
Model analysis 182
  Method of solution 183
  Geometry and boundary conditions 185
  Initial temperature distribution 185
  Uplift term 186
  Heat production term 186
Preliminary results 186
Future work 187
Concluding remarks 188

CHAPTER 7: CONCLUDING STATEMENTS

Interpretation of age spectra from high P metamorphic rocks 191
Tectonic implications 193
Schematic evolution of subduction complex 194
Implications of results for the Franciscan Complex of California 197
Conclusions 198

Appendix: Numerical Methods

A.1.a) The finite element method 206
A.1.b) Derivation of equations for the finite element method 208
A.1.c) Example of matrix coefficient computation 212
A.2) The Runge-Kutta method 213
A.3.a) Program **Timestep** 213
A.3.b) Test of finite element portion of program 214
A.3.c) Test of Runge-Kutta portion of program 214
A.3.d) Test of program **Timestep** 214

REFERENCES 232

LIST OF FIGURES

Figure Number		Page
1.1	Thermochronologic constraints on subduction/ accretion processes.	11
1.2	Bathymetry and major structural features of the Baja California borderland	12
1.3	Tectonostratigraphic terranes of west-central Baja California	13
2.1	Geologic map of southern Cedros Island and San Benito Islands	25
2.2	Photomicrographs of sample 2871	26
2.3	Age spectrum and isochron plot for sample 2871 . . .	27
2.4	Age spectrum and isochron plot for sample CGLC . . .	28
2.5	Age spectrum for sample 28714	29
2.6	Age spectrum for sample 687168	29
2.7	Age spectrum for sample CGLB	30
2.8	Age spectra for sample E	31
2.9	Photomicrograph of metasandstone (E)	32
2.10	Age spectrum for untreated and treated Benson Mines orthoclase	33
2.11	Backscattered electron image of Benson Mines orthoclase	34
2.12	Photomicrograph of sample CGLB	35
2.13	P-T-t path for rocks of subterrane 2	36
3.1	Geologic map of southern Cedros Island and the San Benito Islands	68
3.2	Age spectrum and isochron plot for sample SCSB . . .	69
3.3	Backscattered electron image of sample SCSB	70
3.4	Age spectrum and isochron plot for sample BC-1 . . .	71
3.5	Age spectrum and isochron plot for sample BC-2 . . .	72

Figure Number Page

3.6 Age spectrum for sample 585178 73

3.7 Age spectrum for sample SCSM 73

3.8 Age spectrum for sample RRG 74

3.9 Age spectrum for sample 28715 74

3.10 Composite age spectrum for white micas from blueschist blocks 75

3.11 Age spectrum for sample 585166 76

3.12 Rb-Sr isochron plot for sample SCSM 77

3.13 Age spectrum for sample RF 78

3.14 Age spectrum and isochron plot for sample NA 79

3.15 Age spectrum for sample 4862 80

3.16 Age spectrum and isochron plot for sample 118576 . . 81

3.17 Age spectrum and isochron plot for sample 28713. . . 82

3.18 Age spectrum and isochron plot for sample 2875 . . . 83

3.19 Age spectrum and isochron plot for sample 68734. . . 84

3.20 Age spectrum for sample NC-1 85

3.21 Age spectrum for sample NB-4 85

3.22 Age spectrum for sample NB-3 86

3.23 Age spectrum and isochron plot of sample 83TM116A. . 87

3.24 Age spectrum for sample 83TM119B 88

3.25 Age spectrum for sample 83TM117 89

3.26 Rb-Sr isochron plot for sample NC-1 90

3.27 Rb-Sr isochron plot for samples NB-3, NB-4 91

3.28 Age spectrum for sample 687189 92

3.29 Age spectrum and isochron plot for sample 687191 . . 93

Figure Number		Page
3.30	Age spectrum for sample 687183	94
3.31	Age spectrum for sample 687192	94
3.32	Age spectrum for sample 687184	95
3.33	Age spectrum for sample 687186	95
3.34	Age spectrum for sample 687188	96
3.35	Th-Hf-Ta discrimination diagram	97
3.36	Cr-Y discrimination diagram	98
3.37	Chrondrite normalized REE patterns and MORB normalized REE patterns	99
3.38	Photomicrographs of sample RRG	101
3.39	Photomicrographs of sample 585166	102
3.40	Photomicrographs of sample 687183	103
3.41	Photomicrographs of sample 585178	103
3.42	Photomicrographs of sample 687191 and sample 687186	104
3.43	Photomicrographs of sample 118576	105
3.44	Composite age spectrum of white micas from metasedimentary blocks	106
3.45	Composite age spectrum of white micas from overprinted amphibolite blocks	107
4.1	Geologic map of Cedros Island	140
4.2	Generalized stratigraphy of the Choyal terrane . . .	141
4.3	Age spectrum for sample PNL	142
4.4	Age spectrum and isochron plot for sample PNS. . . .	143
4.5	Age spectrum and isochron plot for sample GCR. . . .	144
4.6	Age spectrum and isochron plot for sample VP-2 . . .	145
4.7	Age spectrum for sample 687197	146

Figure Number Page

4.8 Age spectrum for sample 687198 147

5.1 Definition of closure temperature 168

5.2 Arrhenius plot of diffusivities for igneous hornblendes 169

5.3 Age spectrum and isochron plot for sample 118576 . . 170

5.4 Age spectra for treated and untreated sample RF. . . 171

5.5 Arrhenius plot for diffusion coefficients for samples RF and 118576 172

5.6 $^{40}Ar^{*}$ diffusion in hornblende 174

5.7 Backscattered electron image of sample RF 175

5.8 Backscattered electron image of sample 118576 . . . 175

6.1 Geometry and boundary conditions for thermal model . 189

6.2 Plot of T/T_0 vs. τ 190

7.1 Arrhenius plot for white micas from blueschist blocks 200

7.2 Arrhenius plot for white micas from overprinted amphibolite facies blocks 201

7.3 Schematic evolution of the western Baja terrane and Choyal terrane 203-204

A.1 Mesh of triangular elements 215

A.2 Properties of the modal function $N_I(x)$ 215

A.3 Fourth-order Runge-Kutta method 216

A.4 Structure Chart of program timestep 217

LIST OF TABLES

Table number — Page

2.1 Characteristics of the western Baja terrane 37

2.2 $^{40}Ar/^{39}Ar$ analytical data for samples from western Baja terrane 38

2.3 Microprobe analyses of feldspars, amphiboles from western Baja terrane 42

3.1 Previously reported K-Ar ages for blocks in melange. . . 108

3.2 $^{40}Ar^{39}Ar$ analytical data for samples from serpentinite-matrix melange 109

3.3 Apatite fission track analytical data 121

3.4 Rb-Sr analytical data 122

3.5 Major, minor, and trace element analyses 123

3.6 Instrumental neutron activation analyses 124

3.7 Microprobe analyses of minerals from blocks in melange . 125

4.1 $^{40}Ar/^{39}Ar$ analytical data for samples from the Choyal terrane 148

5.1 Microprobe analyses of starting materials 176

5.2 Starting concentrations 176

5.3 $^{40}Ar/^{39}Ar$ analytical data for sample 118576 177

5.4 $^{40}Ar/^{39}Ar$ analytical data for treated and untreated sample RF 178

5.5 Results of isothermal, hydrothermal experiments on hornblendes 180

7.1 Diffusion parameters for micas from blocks in melange 205

A.1 Variables used in program Timestep 218

A.2 Test of finite element portion of program Timestep . . . 219

A.3 Test of Runge-Kutta method 220

A.4 Test of program Timestep 221

A.5 Program Timestep 224