

Cambridge University Press

0521830575 - Quantitative Thermochemistry: Numerical Methods for the Interpretation of Thermochemical Data

Jean Braun, Peter van der Beek and Geoffrey Batt

Table of Contents

[More information](#)

Contents

<i>Preface</i>	<i>page ix</i>
1 Introduction	1
1.1 Thermal history: the accumulation of thermochemical age	3
1.2 Cooling, denudation and uplift paths	7
1.3 Thermochemistry in practice	13
2 Basics of thermochemistry: from t-T paths to ages	19
2.1 The isotopic age equation	19
2.2 Solid-state diffusion – the basic equation	20
2.3 Absolute closure-temperature approximation	23
2.4 Dodson’s method	24
2.5 Numerical solution	27
2.6 Determining the diffusion parameters	30
3 Thermochemical systems	33
3.1 Ar dating methods	33
3.2 (U–Th)/He thermochemistry	42
3.3 Fission-track thermochemistry	48
4 The general heat-transport equation	60
4.1 Heat transport within the Earth	60
4.2 Conservation of energy	61
4.3 Conduction	63
4.4 Advection	64
4.5 Production	65
4.6 The general heat-transport equation	66
4.7 Boundary conditions	66
4.8 Purely conductive heat transport	68

5	Thermal effects of exhumation	76
5.1	Steady-state solution	76
5.2	Thermal effects of exhumation: transient solution	81
5.3	Thermal effects of exhumation: the general transient problem	83
6	Steady-state two-dimensional heat transport	105
6.1	The effect of surface topography	105
6.2	The age–elevation relationship – steady state	110
6.3	Relief change	113
7	General transient solution – the three-dimensional problem	115
7.1	Pecube	115
7.2	Time-varying surface topography	116
7.3	Surface relief in the Sierra Nevada	118
8	Inverse methods	122
8.1	Spectral analysis	122
8.2	An example based on synthetic ages	124
8.3	Application of the spectral method to the Sierra Nevada	127
8.4	Sampling strategy	129
8.5	Systematic searches	130
9	Detrital thermochronology	131
9.1	The basic approach	131
9.2	Deconvolution of detrital age distributions	136
9.3	Estimating denudation rates from detrital ages	140
9.4	Estimating relief from detrital ages	144
9.5	Interpreting partially reset detrital samples	148
10	Lateral advection of material	151
10.1	Lateral variability in tectonically active regions	151
10.2	Exhumation and denudation in multi-dimensional space	152
10.3	Consequences of lateral motion for thermochronology	153
10.4	Scaling of lateral significance with closure temperature	154
10.5	Evaluation of the significance of lateral variation	155
11	Isostatic response to denudation	164
11.1	Local isostasy	164
11.2	Flexural isostasy	166
11.3	Periodic loading	167
11.4	Isostatic response to relief reduction	168

Cambridge University Press

0521830575 - Quantitative Thermochronology: Numerical Methods for the Interpretation of
Thermochronological Data

Jean Braun, Peter van der Beek and Geoffrey Batt

Table of Contents

[More information](#)

<i>Contents</i>		vii
11.5	Effects on age distribution	168
11.6	Effects on age–elevation distributions	170
11.7	Application to the Dabie Shan	171
12	The evolution of passive-margin escarpments	177
12.1	Introduction	177
12.2	Early conceptual models: erosion cycles	179
12.3	Thermochronological data from passive margins	180
12.4	Models of landscape development at passive margins	182
12.5	Combining thermochronometers and modelling	186
13	Thermochronology in active tectonic settings	192
13.1	A simple model for continental collision	192
13.2	Heat advection in mountain belts	196
13.3	The Alpine Fault, South Island, New Zealand	199
13.4	Application of the Neighbourhood Algorithm to Southern Alps data	202
<i>Appendix 1</i>	<i>Forward models of fission-track annealing</i>	207
<i>Appendix 2</i>	<i>Fortran routines provided with this textbook</i>	210
<i>Appendix 3</i>	<i>One-dimensional conductive equilibrium with heat production</i>	211
<i>Appendix 4</i>	<i>One-dimensional conductive equilibrium with anomalous conductivity</i>	214
<i>Appendix 5</i>	<i>One-dimensional transient conductive heat transport</i>	216
<i>Appendix 6</i>	<i>Volume integrals in spherical coordinates</i>	220
<i>Appendix 7</i>	<i>The complementary error function</i>	222
<i>Appendix 8</i>	<i>Pecube user guide</i>	224
<i>Appendix 9</i>	<i>Tutorial solutions</i>	228
<i>References</i>		237
<i>Index</i>		255