

QUATERNARY DATING METHODS – A USER'S GUIDE

Edited by
P.L. SMART & P.D. FRANCES

Quaternary Research Association

Technical Guide No. 4

CONTENTS

1	GENERAL PRINCIPLES	
	<i>P.L. Smart</i>	
	Why do we need dating techniques?	1
	What Constitutes an Acceptable and Reliable Age Estimate?	4
	What are the types of Quaternary Dating Methods?	6
	How do I select a Dating Method?	8
	Expression of Age Estimates	11
2	RADIOCARBON DATING	
	<i>J.R. Pilcher</i>	
	Theory	16
	Sample Selection	20
	Selection of a Radiocarbon Laboratory	22
	Interpreting and Using Radiocarbon Dates	24
	Contamination	29
	Special Cases	32
	Conclusions	33
3	POTASSIUM-ARGON AND ARGON-ARGON DATING	
	<i>D.A. Richards and P.L. Smart</i>	
	Conventional K-Ar Dating	37
	$^{40}\text{Ar}/^{39}\text{Ar}$ Dating	39
4	URANIUM SERIES DATING	
	<i>P.L. Smart</i>	
	General Principles	45
	The $^{230}\text{Th}/^{232}\text{Th}$ Method for Dating Volcanic Rocks	51
	The ^{230}Th Excess, ^{231}Pa Excess, $^{230}\text{Th}/^{232}\text{Th}$ and $^{230}\text{Th}/^{231}\text{Pa}$	
	Methods for the Dating of Deep Sea Sediments	52
	The Helium/Uranium Method	55
	The $^{234}\text{U}/^{238}\text{U}$ Method	58
	The $^{230}\text{Th}/^{234}\text{U}$ Method	61
	The $^{231}\text{Pa}/^{235}\text{U}$ and $^{231}\text{Pa}/^{230}\text{Th}$ Methods	63
	Sample Selection and Test Criteria for Application of the	
	$^{230}\text{Th}/^{234}\text{U}$ $^{231}\text{Pa}/^{235}\text{U}$ and $^{231}\text{Pa}/^{230}\text{Th}$ Methods in	
	Geological materials	64
	The Uranium Trend Method	76
	Conclusions	78

CONTENTS

5	FISSION TRACK DATING	
	<i>A.J. Hurford</i>	
	Principles	84
	What Can be Dated?	90
	Practical Considerations	92
	Uncertainties in Fission Track Dating	97
	Quaternary Applications - a synopsis	100
	Assessing Fission Track Data	101
	Summary	104
6	LUMINESCENCE DATING	
	<i>A.G. Wintle</i>	
	What is TL?	108
	Zeroing of Earlier Geological Signals	110
	Fired Materials	111
	TL Measurements	111
	Dose Rate Determination	115
	Time Limits	119
	Sources of Error	120
	Sample Collection	121
	Conclusions	123
7	ELECTRON SPIN RESONANCE (ESR) DATING	
	<i>P.L. Smart</i>	
	Principles of ESR Dating	128
	ESR Dating Methods	130
	Applications of ESR Dating	143
8	AMINO ACID DATING	
	<i>G. Sykes</i>	
	Historical Background	161
	Chemical Background	161
	Principles of Amino Acid Dating	164
	Conclusion	172

CONTENTS

9	PALAEOMAGNETIC DATING	
	<i>R. Thompson</i>	
	Introduction	177
	The Palaeomagnetic Method	180
	Magnetostratigraphic Application of the Pleistocene Polarity	
	Time Scale	183
	Other Magnetic Correlation Methods	188
	British Pleistocene Magnetostratigraphy	190
	Summary	194
10	OXYGEN ISOTOPE CHRONOSTRATIGRAPHY	
	<i>A.J. Patience and D. Kroon</i>	
	Introduction	199
	Factors Influencing the Oxygen Isotope Composition of	
	Foraminifera	202
	Analytical Techniques	209
	Construction of a Standard Reference Curve	210
	Correlation of New Curves with the Reference Curve	212
	More Ancient Records	217
	Climate Variations	218
	Concluding Considerations	221
	Index	229-233