

## Dating and Duration of Fluid Flow and Fluid–Rock Interaction

Geological Society Special Publications

*Series Editors*

A. J. FLEET

A. C. MORTON

A. M. ROBERTS

It is recommended that reference to all or part of this book should be made in one of the following ways:

PARNELL, J. (ed.) 1998. *Dating and Duration of Fluid Flow and Fluid–Rock Interaction*. Geological Society, London, Special Publications, **144**.

SYLTA, O., PEDERSEN, J. I. & HAMBORG, M. 1998. On the vertical and lateral distribution of hydrocarbon migration velocities during secondary migration. *In*: PARNELL, J. (ed.) *Dating and Duration of Fluid Flow and Fluid–Rock Interaction*. Geological Society, London, Special Publications, **144**, 221–232.

GEOLOGICAL SOCIETY SPECIAL PUBLICATION NO. 144

# Dating and Duration of Fluid Flow and Fluid–Rock Interaction

EDITED BY

**J. PARNELL**

School of Geosciences  
Queen's University of Belfast  
Belfast

1998

Published by  
The Geological Society  
London

# THE GEOLOGICAL SOCIETY

The Society was founded in 1807 as The Geological Society of London and is the oldest geological society in the world. It received its Royal Charter in 1825 for the purpose of 'investigating the mineral structure of the Earth'. The Society is Britain's national society for geology with a membership of around 8000. It has countrywide coverage and approximately 1000 members reside overseas. The Society is responsible for all aspects of the geological sciences including professional matters. The Society has its own publishing house, which produces the Society's international journals, books and maps, and which acts as the European distributor for publications of the American Association of Petroleum Geologists, SEPM and the Geological Society of America.

Fellowship is open to those holding a recognized honours degree in geology or cognate subject and who have at least two years' relevant postgraduate experience, or who have not less than six years' relevant experience in geology or a cognate subject. A Fellow who has not less than five years' relevant postgraduate experience in the practice of geology may apply for validation and, subject to approval, may be able to use the designatory letters C Geol (Chartered Geologist).

Further information about the Society is available from the Membership Manager, The Geological Society, Burlington House, Piccadilly, London W1V 0JU, UK. The Society is a Registered Charity, No. 210161.

Published by The Geological Society from:  
The Geological Society Publishing House  
Unit 7, Brassmill Enterprise Centre  
Brassmill Lane  
Bath BA1 3JN  
UK  
(Orders: Tel. 01225 445046  
Fax 01225 442836)

First published 1998

The publishers make no representation, express or implied, with regard to the accuracy of the information contained in this book and cannot accept any legal responsibility for any errors or omissions that may be made.

© The Geological Society 1998. All rights reserved. No reproduction, copy or transmission of this publication may be made without written permission. No paragraph of this publication may be reproduced, copied or transmitted save with the provisions of the Copyright Licensing Agency, 90 Tottenham Court Road, London W1P 9HE. Users registered with the Copyright Clearance Center, 27 Congress Street, Salem, MA 01970, USA: the item-fee code for this publication is 0305-8719/98/\$10.00.

## **British Library Cataloguing in Publication Data**

A catalogue record for this book is available from the British Library.

ISBN 1-86239-019-3  
ISSN 0305-8719

Typeset & printed by the Alden Group, Oxford.

## **Distributors**

### *USA*

AAPG Bookstore  
PO Box 979  
Tulsa  
OK 74101-0979  
USA  
(Orders: Tel. (918) 584-2555  
Fax (918) 560-2652)

### *Australia*

Australian Mineral Foundation  
63 Conyngham Street  
Glenside  
South Australia 5065  
Australia  
(Orders: Tel. (08) 379-0444  
Fax (08) 379-4634)

### *India*

Affiliated East-West Press PVT Ltd  
G-1/16 Ansari Road  
New Delhi 110 002  
India  
(Orders: Tel. (11) 327-9113  
Fax (11) 326-0538)

### *Japan*

Kanda Book Trading Co.  
Tanikawa Building  
3-2 Kanda Surugadai  
Chiyoda-Ku  
Tokyo 101  
Japan  
(Orders: Tel. (0423) 57-7650  
Fax (0423) 57-7651)

# Contents

PARNELL, J. Introduction: Approaches to dating and duration of fluid flow and fluid–rock interaction	1
<b>Specific techniques for dating of fluids and fluid flow</b>	
ELMORE, R. D., CAMPBELL, T., BANERJEE, S. & BIXLER, W. G. Palaeomagnetic dating of ancient fluid-flow events in the Arbuckle Mountains, southern Oklahoma	9
SYMONS, D. T. A., LEWCHUK, M. T. & LEACH, D. L. Age and duration of the Mississippi Valley-type mineralizing fluid flow event in the Viburnum Trend, Southeast Missouri, USA, determined from palaeomagnetism	27
DUDDY, I. R., GREEN, P. F., HEGARTY, K. A., BRAY, R. J. & O'Brien, G. W. Dating and duration of hot fluid flow events determined using AFTA <sup>®</sup> and vitrinite reflectance-based thermal history reconstruction	41
PINTI, D. L. & MARTY, B. The origin of helium in deep sedimentary aquifers and the problem of dating very old groundwaters	53
WILKINSON, J. J., LONERGAN, L., FAIRS, T. & HERRINGTON, R. J. Fluid inclusion constraints on conditions and timing of hydrocarbon migration and quartz cementation in Brent Group reservoir sandstones, Columba Terrace, northern North Sea	69
<b>Isotope techniques for dating of fluid flow</b>	
ZWINGMANN, H., CLAUER, N. & GAUPP, R. Timing of fluid flow in a sandstone reservoir of the north German Rotliegend (Permian) by K–Ar dating of related hydrothermal illite	91
SPÖTL, C., KUNK, M. J., RAMSEYER, K. & LONGSTAFFE, F. J. Authigenic potassium feldspar: A tracer for the timing of palaeofluid flow in carbonate rocks, Northern Calcareous Alps, Austria	107
WAYNE, D. M. & McCAIG, A. M. Dating fluid flow in shear zones: Rb–Sr and U–Pb studies of syntectonic veins in the Néouvielle Massif, Pyrenees	129
WALSHAW, R. D. & MENUGE, J. F. Dating of crustal fluid flow by the Rb–Sr isotopic analysis of sphalerite: a review	137
<b>Case studies assessing timing of fluid flow events</b>	
PAGEL, M., CLAUER, N., DISNAR, J.-R., MOSSMAN, J.-R., SUREAU, J.-F., STEINBERG, M. & VINCHON, C. Thermal history and timing of fluid flow at the Ardèche palaeo-margin, France	145
HOLLIS, C. Reconstructing fluid history: an integrated approach to timing fluid expulsion and migration on the Carboniferous Derbyshire Platform, England	153
MORRIS, G. A. & NESBITT, B. E. Geology and timing of palaeohydrogeological events in the MacKenzie Mountains, Northwest Territories, Canada	161
QING, H. Geochemical constraints on the origin and timing of palaeofluid flow in the Presqu'île barrier reef, Western Canada Sedimentary Basin	173
<b>Timing, duration and speed of oil migration</b>	
LISK, M., EADINGTON, P. J. & O'BRIEN, G. W. Unravelling complex filling histories by constraining the timing of events which modify oil fields after initial charge	189
CARRUTHERS, D. & RINGROSE, P. Secondary oil migration: oil-rock contact volumes, flow behaviour and rates	205

SYLTA, O., PEDERSEN, J. I. & HAMBORG, M. On the vertical and lateral distribution of hydrocarbon migration velocities during secondary migration	221
<b>Dating of Quaternary fluid flow events</b>	
METCALFE, R., HOOKER, P. J., DARLING, W. G. & MILODOWSKI, A. E. Dating Quaternary flow events: a review of available methods and their application	233
FUKUCHI, T. & IMAI, N. ESR isochron dating of the Nojima fault gouge, southwest Japan, using ICP-MS: an approach to fluid flow events in the fault zone	261
Index	279