

# Faulting, Fault Sealing and Fluid Flow in Hydrocarbon Reservoirs

Geological Society Special Publications

*Series Editors*

A. J. FLEET  
R. E. HOLDSWORTH  
A. C. MORTON  
M. S. STOKER

GEOLOGICAL SOCIETY SPECIAL PUBLICATION NO. 147

Faulting, Fault Sealing and Fluid Flow in  
Hydrocarbon Reservoirs

EDITED BY

G. JONES, Q. J. FISHER

AND

R. J. KNIPE

Rock Deformation Research  
Department of Earth Sciences  
The University of Leeds  
UK

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 8500. It has countrywide coverage and approximately 1500 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 1-86239-022-3

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.  
Cityhouse Tama 204  
Tsurumaki 1-3-10  
Tama-Shi  
Tokyo 206-0034  
Japan

(Orders: Tel. (0423) 57-7650  
Fax (0423) 57-7651)

# Contents

KNIPE, R. J., JONES, G. & FISHER, Q. J. Faulting, fault sealing and fluid flow in hydrocarbon reservoirs: an introduction	vii
<b>Fault array mapping, geometry and evolution</b>	
TOWNSEND, C., FIRTH, I. R., WESTERMAN, R., KIRKEVOLLEN, L., HÅRDE, M. & ANDERSEN, T. Small seismic-scale fault identification and mapping	1
STEEN, Ø., SVERDRUP, E. & HANSSSEN, T. H. Predicting the distribution of small faults in a hydrocarbon reservoir by combining outcrop, seismic and well data	27
MARCHAL, D., GUIRAUD, M., RIVES, T. & VAN DEN DRIESSCHE, J. Space and time propagation processes of normal faults	51
<b>Faulting processes and fault seal characterization</b>	
ADAMS, J. T. & DART, C. The appearance of potential sealing faults on borehole images	71
FOXFORD, K. A., WALSH, J. J., WATTERSON, J., GARDEN, I. R., GUSCOTT, S. C. & BURLEY, S. D. Structure and content of the Moab Fault Zone, Utah, USA, and its implications for fault seal prediction	87
PEACOCK, D. C. P., FISHER, Q. J., WILLEMSE, E. J. M. & AYDIN, A. The relationship between faults and pressure solution seams in carbonate rocks and the implications for fluid flow	105
FISHER, Q. J. & KNIPE, R. J. Fault sealing processes in siliciclastic sediments	117
KROOSS, B. M., SCHLOEMER, S. & EHRLICH, R. Experimental investigation of molecular transport and fluid flow in unfaulted and faulted pelitic rocks	135
FAULKNER, D. R. & RUTTER, E. H. The gas permeability of clay-bearing fault gouge at 20°C	147
<b>Experimental and numerical modelling of deformation and fluid flow</b>	
MATTHÁI, S. K., AYDIN, A., POLLARD, D. D. & ROBERTS, S. G. Numerical simulation of departures from radial drawdown in a faulted sandstone reservoir with joints and deformation bands	157
D'ONFRO, P. S., RIZER, W. D., QUEEN, J. H., MAJER, E. L., PETERSON, J. E., DALEY, T. M., VASCO, D. W., DATTA-GUPTA, A. & LONG, J. C. S. An integrated approach for characterizing fractured reservoirs	193
MAILLOT, B., COWIE, P. & LAGUE, D. Simulating polyphase faulting with a tensorial 3D model of fault growth	209
FLEMING, C. G., COUPLES, G. D. & HASZELDINE, R. S. Thermal effects of fluid flow in steep fault zones	217
HENDERSON, J. R. The influence of fault compaction on fault zone evolution	231
LEARY, P. C. Relating microscale rock–fluid interaction to macroscale fluid flow structure	243
LESNIC, D., ELLIOTT, L., INGHAM, D. B., KNIPE, R. J. & CLENNELL, B. An inverse problem to determine the piecewise homogeneous hydraulic conductivity within rocks	261
<b>Structure and seal analysis of hydrocarbon fields</b>	
KNAI, T. A. & KNIPE, R. J. The impact of faults on fluid flow in the Heidrun Field	269
OTTESEN ELLEVSET, S., KNIPE, R. J., SVAVA OLSEN, T., FISHER, Q. J. & JONES, G. Fault controlled communication in the Sleipner Vest Field, Norwegian Continental Shelf; detailed, quantitative input for reservoir simulation and well planning	283
ERICSSON, J. B., MCKEAN, H. C. & HOOPER, R. J. Facies and curvature controlled 3D fracture models in a Cretaceous carbonate reservoir, Arabian Gulf	299
Index	313

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

JONES, G., FISHER, Q. J. & KNIPE, R. J. (eds) 1998. *Faulting, Fault Sealing and Fluid Flow in Hydrocarbon Reservoirs*. Geological Society, London, Special Publications, **147**.

TOWNSEND, C., FIRTH, I. R., WESTERMAN, R. *et al.* 1998. Small seismic-scale fault identification and mapping. *In*: JONES, G., FISHER, Q. J. & KNIPE, R. J. (eds) *Faulting, Fault Sealing and Fluid Flow in Hydrocarbon Reservoirs*. Geological Society, London, Special Publications, **147**, 1–25.