Muds and Mudstones: Physical and Fluid-Flow Properties

Geological Society Special Publications

Series Editors

A. J. FLEET

R. E. HOLDSWORTH

A. C. MORTON

M. S. STOKER

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

APLIN, A. C., FLEET, A. J. & MACQUAKER, J. H. S. (eds) 1999. *Muds and Mudstones: Physical and Fluid Flow Properties*. Geological Society, London, Special Publications, 158.

DEWHURST, D. N., APLIN, A. C. & YANG. Y. 1999. Permeability and fluid flow in natural mudstones. *In:* APLIN, A. C., FLEET, A. J. & MACQUAKER, J. H. S. (eds) *Muds and Mudstones: Physical and Fluid Flow Properties.* Geological Society, London, Special Publications, **158**, 23–43.

Muds and Mudstones: Physical and Fluid-Flow Properties

EDITED BY

ANDREW C. APLIN (University of Newcastle, UK)

ANDREW J. FLEET (Natural History Museum, London)

and

JOE H. S. MACQUAKER (University of Manchester, UK)

1999 Published by The Geological Society London

THE GEOLOGICAL SOCIETY

The Geological Society of London was founded in 1807 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' and is now Britain's national society for geology.

Both a learned society and a professional body, the Geological Society is recognized by the Department of Trade and Industry (DTI) as the chartering authority for geoscience, able to award Chartered Geologist status upon appropriately qualified Fellows. The Society has a membership of 8600, of whom about 1500 live outside the ÚK.

Fellowship of the Society is open to persons holding a recognized honours degree in geology or a cognate subject and who have at least two years' relevant postgraduate experience, or not less than six years' relevant experience in geology or a cognate subject. A Fellow with a minimum of five years' relevant postgraduate experience in the practice of geology may apply for chartered status. Successful applicants are entitled to use the designatory postnominal CGeol (Chartered Geologist). Fellows of the Society may use the letters FGS. Other grades of membership are available to members not yet qualifying for Fellowship.

The Society has its own Publishing House based in Bath, UK. It produces the Society's international journals,

books and maps, and is the European distributor for publications of the American Association of Petroleum Geologists (AAPG), the Society for Sedimentary Geology (SEPM) and the Geological Society of America (GSA). Members of the Society can buy books at considerable discounts. The Publishing House has an online bookshop (http://bookshop.geolsoc.org.uk)

Further information on Society membership may be obtained from the Membership Services Manager. The Geological Society, Burlington House, Piccadilly, London W1V 0JU (Email: enquiries@geolsoc.org.uk; tel: +44 (0)171 434 9944).

The Society's Web Site can be found at http://www.geolsoc.org.uk/.The Society is a Registered Charity, number 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. +44 (0)1225 445046

Fax +44(0)1225442836

Online bookshop: http://bookshop.geolsoc.org.uk

First published 1999

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 of London 1999. 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 0305-8719/99/\$15.00.

British Library Cataloguing in Publication Data

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

ISBN 1-86239-044-4 ISSN 0305-8719

Typeset by WKS, Westonzoyland, UK

Printed by Alden Press, Oxford, UK

Distributors

USAAAPG Bookstore PO Box 979 Tulsa OK 74101-0979 USA (Orders: Tel. +1 918 584-2555 Fax +1 918 560-2652 Email bookstore(a)aapg.org)

Australia

Australian Mineral Foundation Bookshop 63 Conyngham Street Glenside South Australia 5065 Australia (Orders: Tel. +61 88 379-0444 Fax +61 88 379-4634

Email bookshop@amf.com.au)

India

Affiliated East-West Press PVT Ltd G-1/16 Ansari Road, Daryaganj New Delhi 110 002 India (Orders: Tel. +91 11 327-9113

Fax +91 11 326-0538)

Kanda Book Trading Co. Cityhouse Tama 204 Tsurumaki 1-3-10 Tama-shi Tokyo 206-0034 Japan

(Orders: Tel. +81 (0)423 57-7650 Fax +81 (0)423 57-7651)

Contents

APLIN, A. C., FLEET, A. J. & MACQUAKER, J. H. S. Muds and mudstones: physical and fluid-flow properties	1
Physical properties	
Pearson, F. J. What is the porosity of a mudrock?	9
DEWHURST, D. N., YANG, Y. & APLIN, A. C. Permeability and fluid flow in natural mudstones	23
MIDTTØMME, K. & ROALDSET, E. Thermal conductivity of sedimentary rocks: uncertainties in measurement and modelling	45
Petley, D. N. Failure envelopes of mudrocks at high confining pressures	61
BJØRLYKKE, K. Principal aspects of compaction and fluid flow in mudstones	73
Experimental studies	
Clennell, M. B., Dewhurst, D. N., Brown, K. M. & Westbrook, G. K. Permeability anisotropy of consolidated clays	79
Peters, M. G. & Maltman, A. J. Insights into the hydraulic performance of landfill-lining clays during deformation	97
HARRINGTON, J. F. & HORSEMAN, S. T. Gas transport properties of clays and mudrocks	107
Case Studies	
Ingram, G. M. & Urai, J. L. Top-seal leakage through faults and fractures: the role of mudrock properties	125
Skar, T., van Balen, R. T., Arneson. L. & Cloetingh, S. Origin of overpressures on the Halten Terrace, offshore mid-Norway: the potential role of mechanical compaction, pressure transfer and stress	137
DORSCH, J. & KATSUBE, T. J. Porosity characteristics of Cambrian mudrocks (Oak Ridge, East Tennessee, USA) and their implications for contaminant transport	157
Walraevens,K.&Cardenal,J.PreferentialpathwaysinanEoceneclay:hydrogeologicalandhydrogeochemicalevidence	175
Index	187