

Understanding Granites: Integrating New and Classical Techniques

Geological Society Special Publications

Series Editors

A. J. HARTLEY

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.

CASTRO, A., FERNÁNDEZ, C. & VIGNERESSE, J. L. (eds) 1999. *Understanding Granites: Integrating New and Classical Techniques*. Geological Society, London, Special Publications, **168**.

CRUDEN, A. R., SJÖSTRÖM, H. & AARO, S. 1999. Structure and geophysics of the Gasborn granite, Central Sweden: an example of fracture-fed asymmetric pluton emplacement. *In*: CASTRO, A., FERNÁNDEZ, C. & VIGNERESSE, J. L. (eds) *Understanding Granites: Integrating New and Classical Techniques*. Geological Society, London, Special Publications, **168**, 141–160.

GEOLOGICAL SOCIETY SPECIAL PUBLICATION NO. 168

Understanding Granites: Integrating New and Classical Techniques

EDITED BY

ANTONIO CASTRO
Universidad de Huelva, Spain

CARLOS FERNÁNDEZ
Universidad de Huelva, Spain

and

JEAN LOUIS VIGNERESSE
Université Nancy, France

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 UK.

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)1225 442836)
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 1-86239-058-4
ISSN 0305-8719

Typeset by WKS, Westonzoyland, UK

Printed by Whitstable Litho, Whitstable, UK

Distributors

USA

AAPG Bookstore
PO Box 979
Tulsa
OK 74101-0979
USA

Orders: Tel. +1 918 584-2555
Fax +1 918 560-2652
Email bookstore@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

Japan

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

CASTRO, A., FERNÁNDEZ, C. & VIGNERESSE, J. L. Understanding granites: integrating new and classical techniques	1
THOMPSON, A. B. Some time–space relationships for crustal melting and granitic intrusion at various depths	7
DINGWELL, D. B. Granitic melt viscosities	27
AMÉGLIO, L. & VIGNERESSE, J. L. Geophysical imaging of the shape of granitic intrusions at depth: a review	39
PATÍÑO DOUCE, A. E. What do experiments tell us about the relative contribution of crust and mantle to the origin of granitic magmas?	55
ROMÁN-BERDIEL, T. Geometry of granite emplacement in the upper crust: contributions of analogue modelling	77
HECHT, L. & VIGNERESSE, J. L. A multidisciplinary approach combining geochemical, gravity and structural data: implications for pluton emplacement and zonation	95
COBBING, J. E. The Coastal Batholith and other aspects of Andean magmatism in Peru	111
TRZEBSKI, R., LENNOX, P. & PALMER, D. Contrasts in morphogenesis and tectonic setting during contemporaneous emplacement of S- and I-type granitoids in the Eastern Lachlan fold belt, southeastern Australia	123
CRUDEN, A. R., SJÖSTRÖM, H. & AARO, S. Structure and geophysics of the Gasborn granite, Central Sweden: an example of fracture-fed asymmetric pluton emplacement	141
DIETL, C. Emplacement of the Joshua Flat–Beer Creek Pluton (White Inyo Mountains, California): a story of multiple material transfer processes	161
ALONSO OLAZABAL, A., CARRACEDO, M. & ARANGUREN, A. Petrology, magnetic fabric and emplacement in a strike-slip regime of a zoned peraluminous granite: the Campanario–La Haba pluton, Spain	177
FERNÁNDEZ, C. & CASTRO, A. Brittle behaviour of granitic magma: the example of Puente del Congosto, Iberian Massif, Spain	191
HIGGINS, M. D. Origin of megacrysts in granitoids by textural coarsening: a crystal size distribution (CSD) study of microcline in the Cathedral Peak granodiorite, Sierra Nevada, California	207
SAWYER, E. W., DOMBROWSKI, C. & COLLINS, W. J. Movement of melt during synchronous regional deformation and granulite-facies anatexis: an example from the Wuluma Hills, Central Australia	221
MOURI, H. & KORSMAN, K. Partial melting and <i>P–T</i> evolution of LP/HT metamorphic terranes: an example from the Svecofennian K-feldspar-poor leucosome migmatite belt, southern Finland	239
MENÉNDEZ, M. & ORTEGA, L. A. Magmatic hybridization related with feeding zones: the synkinematic Guitiriz granitoid, northwest Iberian Massif, Spain	255
Index	273

Preface

The modern view of the granite problem requires the application of many different theoretical, experimental and empirical resources provided by geophysics, geochemistry, experimental petrology, structural geology, scale modelling and field geology. Following this philosophy, we have edited this volume with the intention of providing an integrated approach in the study of topical granite-related problems, rather than to concentrate on individual facets. The edition of this volume was inspired by an international workshop entitled 'Modern and Classical Techniques in Granite Studies' that was held in the University of Huelva (Spain) in November 1997. The editors wish to acknowledge reviews by the following colleagues: A. Aranguren; M. P. Atherton; P. Barbey; C. G. Barnes; K. Benn; G. Bergantz; A. Berger; M. Brown; M. A. Bussell; L. G. Corretgé; A. R. Cruden; J. Dehls; J. de la Rosa; T. Dempster; D. Dingwell; E. Ferré; A. E. Helmers; R. Knoche; J. P. Lefort; K. McCaffrey; C. Miller; A. Nédélec; E. Rutter; M. Sandford; W. E. Stephens; C. J. Talbot; G. Watt; R. Weinberg.

Antonio Castro
Carlos Fernández
Jean Louis Vigneresse