

TRANSACTIONS  
OF  
THE ROYAL SOCIETY  
OF  
EDINBURGH



EARTH SCIENCES

Volume 87 Part 4

PUBLISHED BY THE ROYAL SOCIETY OF EDINBURGH

22 GEORGE STREET · EDINBURGH · EH2 2PQ

1997 (for 1996)

The Royal Society of Edinburgh is committed to the widespread dissemination of scientific knowledge. Through the *Transactions of the Royal Society of Edinburgh: Earth Sciences*, the Society continues to encourage and support the international Earth Sciences community by:

- publishing a journal of international standing and authorship;
- publishing substantial papers on all scientific aspects of the solid earth and its surfaces;
- publishing without page charges;
- reproducing photographs and artwork to the highest standard, where appropriate at a size larger than is customary; and
- having papers reviewed by two referees of international standing within three months, and usually publishing within six months of receipt of revised papers.

### Editorial Board

J. McMANUS  
University of St Andrews  
(Chairman)

E. N. K. CLARKSON  
University of Edinburgh  
(Executive Editor)

C. M. CLAPPERTON  
University of Aberdeen

A. E. FALLICK  
S.U.R.R.C., East Kilbride

J. H. HULL  
British Geological Survey, Edinburgh

A. H. F. ROBERTSON  
University of Edinburgh

D. J. FETTES  
British Geological Survey  
(Executive Editor)

B. J. BLUCK  
University of Glasgow  
(Executive Editor)

T. P. SCOFFIN  
University of Edinburgh

W. E. STEPHENS  
University of St Andrews

F. WILLETT  
(Curator)  
University of Glasgow

### Consulting Editors

SHOHEI BANNO  
Kyoto University

W. L. BROWN  
Centre de Recherches Pétrographiques  
et Géochimiques, Vandoeuvre-les-Nancy

R. L. CARROLL  
McGill University, Montreal

B. W. CHAPPELL  
Australian National University, Canberra

J. M. COLEMAN  
Louisiana State University, Baton Rouge

J. F. DEWEY  
University of Oxford

S. J. GOULD  
University of Harvard

R. W. HUTCHINSON  
Colorado School of Mines

J. KONTA  
Charles University, Prague

D. B. MCINTYRE  
Kinfauns, Perth

K. J. MÜLLER  
Rhein. Friedrich-Wilhelms-Universität Bonn

D. F. STRONG  
University of Victoria, B.C.

V. C. THAKUR  
Wadia Institute of Himalayan Geology

S. UYEDA  
University of Tokyo

R. WOODALL  
Western Mining Co., Adelaide

*Publications Manager:* Royal Society of Edinburgh: Mrs Tracey Dart

**COPYRIGHT:** It is the policy of the Royal Society of Edinburgh not to charge any royalty for the production of a single copy of any one article made for private study or research. Specific permission will not be required for photocopying multiple copies of copyright material, to be used for *bona fide* educational purposes, provided this is done by a member of the staff of the university, school or other comparable institution, for distribution without profit to student members of that institution and provided the copies are made from the original journal. Requests for the copying or reprinting of any article for any other purpose should be sent to the Royal Society of Edinburgh.

*Transactions of the Royal Society of Edinburgh: Earth Sciences* publishes one volume per year usually in three or four parts. Volume 88 will be published in 1997 in four issues. An annual subscription costs £99. Orders should be placed with CAB International (to whom cheques should be made payable), Wallingford, Oxon OX10 8DE, UK. (Tel 01491 832111; Fax 01491 826090.)

*Transactions* is indexed in the following: Current Contents/Physical, Chemical & Earth Sciences, SciSearch, CABS Database, Mineralogical Abstracts, Biosciences Information Service, Geoabstracts and GEOBASE.

© 1997 The Royal Society of Edinburgh.