

ESTABLISHED
IN 1818
BY
BENJAMIN
SILLIMAN



AN
INTERNATIONAL
EARTH
SCIENCE
JOURNAL

EDITORS

JAY J. AGUE

DANNY M. RYE

ASSOCIATE EDITORS

TO SERVE UNTIL JANUARY 1, 2004

PHILIP A. CANDELA
COLLEGE PARK, MARYLAND
JAMES CONNOLLY
ZURICH, SWITZERLAND
CRAIG MANNING
LOS ANGELES, CALIFORNIA
CARL I. STEEFEL
LIVERMORE, CALIFORNIA
MICHAEL A. VELBEL
EAST LANSING, MICHIGAN

WILLIAM H. CASEY
DAVIS, CALIFORNIA
ANDREW H. KNOLL
CAMBRIDGE, MASSACHUSETTS
JILL D. PASTERIS
ST. LOUIS, MISSOURI
ROBERT D. TUCKER
ST. LOUIS, MISSOURI
RICHARD J. WALKER
COLLEGE PARK, MARYLAND

TO SERVE UNTIL JANUARY 1, 2005

PHILIP D. GINGERICH
ANN ARBOR, MICHIGAN
STEPHEN C. PORTER
SEATTLE, WASHINGTON
ZACHARY SHARP
ALBUQUERQUE, NEW MEXICO

ANDREAS LUTTGE
HOUSTON, TEXAS
LEIGH H. ROYDEN
CAMBRIDGE, MASSACHUSETTS
STEVEN M. STANLEY
BALTIMORE, MARYLAND

JOHN W. VALLEY
MADISON, WISCONSIN
TO SERVE UNTIL JANUARY 1, 2006

ROBERT A. BERNER
NEW HAVEN, CONNECTICUT
C. PAGE CHAMBERLAIN
STANFORD, CALIFORNIA
MARK S. GHIORSO
SEATTLE, WASHINGTON

DONALD E. CANFIELD
ODENSE, DENMARK
DARREL S. COWAN
SEATTLE, WASHINGTON
MARY S. HUBBARD
MANHATTAN, KANSAS

FRANK J. PAZZAGLIA
BETHLEHEM, PENNSYLVANIA
TO SERVE UNTIL JANUARY 1, 2007

ETHAN F. BAXTER
BOSTON, MASSACHUSETTS
MARK T. BRANDON
NEW HAVEN, CONNECTICUT
JOHN M. FERRY
BALTIMORE, MARYLAND
JOHN I. GARVER
SCHENECTADY, NEW YORK
JEFFREY J. PARK
NEW HAVEN, CONNECTICUT

DENNIS K. BIRD
STANFORD, CALIFORNIA
WILLIAM R. DICKINSON
TUCSON, ARIZONA
BARB DUTROW
BATON ROUGE, LOUISIANA
GRANT GARVEN
BALTIMORE, MARYLAND
KATHRYN L. NAGY
CHICAGO, ILLINOIS
ALAN BRUCE THOMPSON
ZURICH, SWITZERLAND

AMERICAN JOURNAL OF SCIENCE
KLINE GEOLOGY LABORATORY
YALE UNIVERSITY
NEW HAVEN, CONNECTICUT

Published 10 times a year
ISSN: 0002-9599
AJSCAP 303(10) 865-989(2003)