

ESTABLISHED
IN 1818
BY
BENJAMIN
SILLIMAN



AN
INTERNATIONAL
EARTH
SCIENCE
JOURNAL

EDITORS

DANNY M. RYE
NEW HAVEN, CONNECTICUT

C. PAGE CHAMBERLAIN
STANFORD, CALIFORNIA

ASSOCIATE EDITORS

TO SERVE UNTIL JANUARY 1, 2012

JAY J. AGUE
NEW HAVEN, CONNECTICUT
WILLIAM H. CASEY
DAVIS, CALIFORNIA
TIMOTHY W. LYONS
RIVERSIDE, CALIFORNIA
J. MICHAEL PALIN
DUNEDIN, NEW ZEALAND
RICHARD J. WALKER
COLLEGE PARK, MARYLAND

EDWARD W. BOLTON
NEW HAVEN, CONNECTICUT
JAMES CONNOLLY
ZURICH, SWITZERLAND
CRAIG MANNING
LOS ANGELES, CALIFORNIA
JOAQUIN RUIZ
TUCSON, ARIZONA
ROBERT WINTSCH
BLOOMINGTON, INDIANA

TO SERVE UNTIL JANUARY 1, 2013

PAUL AHARON
TUSCALOOSA, ALABAMA
PHILIP D. GINGERICH
ANN ARBOR, MICHIGAN
KATE MAHER
STANFORD, CALIFORNIA
STEPHEN PORTER
SEATTLE, WASHINGTON
STEVEN M. STANLEY
HONOLULU, HAWAII

KEN CALDEIRA
STANFORD, CALIFORNIA
ANDREAS LUTTGE
HOUSTON, TEXAS
ANDREAS MULCH
FRANKFURT, GERMANY
ZACHARY SHARP
ALBUQUERQUE, NEW MEXICO
JOHN W. VALLEY
MADISON, WISCONSIN

TO SERVE UNTIL JANUARY 1, 2014

ROBERT A. BERNER
NEW HAVEN, CONNECTICUT
DONALD E. CANFIELD
ODENSE, DENMARK
DAVID A.D. EVANS
NEW HAVEN, CONNECTICUT
MARK PAGANI
NEW HAVEN, CONNECTICUT
PETER REINERS
TUCSON, ARIZONA

RUTH E. BLAKE
NEW HAVEN, CONNECTICUT
DARREL S. COWAN
SEATTLE, WASHINGTON
MARK GHIORSO
SEATTLE, WASHINGTON
FRANK J. PAZZAGLIA
BETHLEHEM, PENNSYLVANIA
SEAN WILLETT
ZURICH, SWITZERLAND

TO SERVE UNTIL JANUARY 1, 2015

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

DENNIS K. BIRD
STANFORD, CALIFORNIA
BARB DUTROW
BATON ROUGE, LOUISIANA
GRANT GARVEN
MEDFORD, MASSACHUSETTS
JEFFREY J. PARK
NEW HAVEN, CONNECTICUT

JONATHAN PAYNE
STANFORD, CALIFORNIA

AMERICAN JOURNAL OF SCIENCE
KLINE GEOLOGY LABORATORY
YALE UNIVERSITY
NEW HAVEN, CONNECTICUT
AJSCAP 311(10) 813-910(2011)