

Distinguished Professor Lecture

David Malone

FROM FIRE TO ICE: THE GEOLOGIC HISTORY
OF ILLINOIS AS TOLD THROUGH SAND

Wednesday, October 30, 2019 • 5 p.m.
Circus Room • Bone Student Center
Illinois State University



**ILLINOIS STATE
UNIVERSITY**
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FROM FIRE TO ICE: THE GEOLOGIC HISTORY OF ILLINOIS AS TOLD THROUGH SAND

Sand is a commodity that impacts our lives in a great many ways. We enjoy it between our toes on a beach, yet we lament it when a wedge shot goes awry. Sand has many uses in our modern society, including abrasives, construction materials, hydraulic fracturing, and the making of glass. Many of Illinois' sand deposits are important aquifers. Sand can be of many compositions and shapes and is transported by wind, water, and ice to distant sites of deposition, and with luck may be preserved as part of the geologic record. Thus, scientific observations of sand deposited at a particular place and time provide important clues about sedimentary provenance, ancient climates, weathering, sediment transport, paleogeography, and mountain building.

Zircon is a mineral that is present in trace amounts in sand, and along with the ubiquitous quartz, is among the most valuable of the sand grains

for scientific investigation. With the development of laser technologies and the refinement of mass spectrometry during the past 20 years, age determinations for large detrital zircon data sets are now possible. Zircon is the mineral of choice because it is durable both chemically and physically, is abundant in granitic magma, and captures much of the magma's uranium as it crystallizes. Zircon is the perfect clock for deciphering Earth history.

The sedimentary succession of Illinois ranges from a few thousand feet near Rockford to more than 10,000 feet in the deepest parts of the Illinois Basin near Mount Vernon. The basement rocks in Illinois consist of granite and rhyolite; they were formed over a billion years ago. These rocks were weathered and then cleaned off by the "Snowball Earth" glaciers 650-750 million years ago. The first succession of sand in Illinois was deposited beginning about 530 million years ago in rift

In tonight's lecture, David Malone will talk about sand, in particular how the mineral zircon grains in sand deposits are used to interpret geologic history. Malone will finish by discussing how he has used the mineral zircon to provide an understanding of the Cambrian and Carboniferous geology of Illinois.

basins formed during the breakup of the supercontinent Rodinia.

These early Cambrian sands are locally sourced and short traveled. By late Cambrian time, the rift basins were filled, and the local basement was buried as a marine incursion inundated the continental interior. Late Cambrian and Ordovician sands in Illinois were generated at distal source areas to the north and east and were transported by a combination of wind and water. This "sand factory" produced some of the purest deposits at any time or anywhere on Earth.

The second major sand-bearing succession in Illinois, which formed after the vast inland seas receded, was deposited during the Carboniferous Period (300-360 million years ago), and it is here that much of Illinois' energy resources reside. The Carboniferous time was dominated by receding seas, the development of mountains in the Appalachian region as Pangea was assembled, and continental glaciation in

Gondwana. Carboniferous sandstones are a mixture of grains that were recycled from older sandstone and newly unroofed granite that became exposed as the Appalachian Mountains were uplifted. These sands were transported to Illinois through river systems that rival the largest modern rivers and deposited in a series of deltas and estuaries that existed here at that time.

About Tonight's Lecturer

David Malone

David Malone is a broadly trained structural geologist with subspecialties in sedimentary geology, ore deposits, Quaternary geology, and geochronology. His work is strongly field based, and it emphasizes geologic mapping and related methodologies. Malone earned a B.S. in geology from Illinois State University in 1988. He completed an M.S. and Ph.D. in geology at the University of Wisconsin in 1990 and 1994 respectively.

Malone has spent his entire academic career at Illinois State. He arrived on campus as an assistant professor in 1994 and was promoted to associate professor and department chairperson in 2000. He was promoted to professor in 2006 and was named University Professor in 2013. He was selected as Outstanding University Teacher in 2005 and is a charter member of the

University's Million Dollar Club, which recognizes grant productivity. In 2013 he was honored as a fellow of the Geological Society of America and was selected Outstanding College Researcher; he also retired as department chairperson and resumed teaching and research full time. In 2015 he received the College of Arts and Sciences' Janice W. Neuleib Award for Outstanding Scholarly Achievement, and two years later he was named the college's Distinguished Lecturer. The Illinois State University Field Camp, which Malone has directed since 2001, was awarded the 2017 ExxonMobil Field Camp Excellence Award by the Geological Society of America.

Malone has published 80 peer-reviewed journal articles and field guides, half of which included student co-authors. He and his students have

published about 50 detailed (1:24,000 scale) geologic maps of areas throughout Illinois. He has published in the leading journals in geology, including *Geology*, *Geological Society of America Bulletin*, *Journal of Geology*, *Geosphere*, *Precambrian Research*, *Earth-Science Reviews*, *Interpretation*, *Geoscience Frontiers*, and *Journal of Structural Geology*. He has served as principal investigator on 54 competitive, peer-reviewed grants and contracts from the U.S. Geological Survey, the National Science Foundation, and the Illinois Board of Higher Education that total nearly \$2 million.

His research efforts have led to a better understanding of the Heart Mountain Slide, which at 5,000 km² in extent, is the largest subareal landslide that ever occurred on Earth. The Heart Mountain Slide occurred in the Absaroka Mountains near Yellowstone Park in Wyoming. The slide was formed by the collapse of a volcano similar in scale to Mount Rainier (in Washington) 49 million years ago, over a period of hours,

and was emplaced at a rate of several hundred kilometers per hour.

Malone also has advanced the understanding of Illinois geography through projects such as delineating the aquifer potential of the Ticona buried bedrock valley in LaSalle County, understanding the geometry and dynamics of escaped gas pockets overlying gas storage fields, mapping the distribution of sand and gravel resources, determining the aquifer potential of glacial sand units in McHenry County, and developing 3-D geologic models for oil fields in Southern Illinois.

Most recently, Malone's work has evolved to continental and global scales using U-Pb ages of detrital zircons in sandstone to understand sedimentary provenance, sediment dispersal patterns, paleogeography, and paleotectonics. This work has spanned much of Earth's history, from the Archean to the Quaternary, with emphasis on the Cambrian, Carboniferous, and Tertiary.

Malone teaches Structural Geology, Stratigraphy, Petroleum Geology, and a variety of field geology courses. He also serves as academic advisor for geology majors. He has mentored 80 undergraduate and 25 graduate student researchers.

Distinguished Professorship

Appointments at Illinois State University

1967

Arthur Larsen
College of Education

1968

Helen M. Cavanaugh
History
Stanley Marzolf
Psychology

1982

Herman Brockman
Biological Sciences
Edward Schapsmeier
History

1983

Roque Cordero
Music
G. Alan Hickrod
Educational
Administration
and Foundations

1984

Franzie Loepp
Industrial Technology
Edward Mockford
Biological Sciences

1985

Ray Lewis White
English

1986

Rati Ram
Economics

Arlan Richardson
Chemistry and
Biological Sciences

1987

Ann Nolte
Health Sciences
Cheryl Stevenson
Chemistry

1988

Harold Gregor
Art

1989

John Dossey
Mathematics
Thomas Fitch
Curriculum and
Instruction

1990

Anthony Liberta
Biological Sciences

Rodger Tarr
English

1991

Frances Anderson
Art

John Freed
History

1992

Paul Baker
Educational
Administration
and Foundations

Carol Thornton
Mathematics

1993

Joel Myers
Art
Douglas West
Chemistry

1994

Roger Anderson
Biological Sciences
Richard Payne
Political Science

1995

Laura Berk
Psychology
Lanny Morreau
Specialized Educational
Development

1996

Lucia Getsi
English
Brian Wilkinson
Biological Sciences

1997

Edward Hines
Educational
Administration
and Foundations
Mark Wyman
History

1998

Diane Urey
Foreign Languages
Ralph Weisheit
Criminal Justice Sciences

1999

Charles E. Orser Jr.
Sociology and
Anthropology

2000

James D. Butler
Art

Timothy D. Lash
Chemistry

2001

Richard A. Stivers
Sociology and
Anthropology

2002

Steven A. Juliano
Biological Sciences

2003

Willard Bohn
Foreign Languages

2004

David Borst
Biological Sciences
Rainer Grobe
Physics

2005

No Appointments Made

2006

Scott Sakaluk
Biological Sciences

John Shields
English

2007

Curtis White
English

2008

**Radheshyam K.
Jayaswal**
Biological Sciences
Glenn D. Reeder
Psychology

2009

Susan Sprecher
Sociology and
Anthropology

2010

Victor Devinatz
Management and
Quantitative Methods
John Pryor
Psychology

2011

Paul Garris
Biological Sciences

2012

James M. Skibo
Sociology and
Anthropology

2013

Roberta S. Trites
English

2014

Saad I. El-Zanati
Mathematics

2015

No Appointments Made

2016

Q. Charles Su
Physics

2017

Rachel M. Bowden
Biological Sciences
Steven Taylor
Marketing

2018

David Malone
Geography, Geology and
the Environment
Ali Riaz
Politics and Government

2019

Den Patten
Accounting