

NATIONAL CAVE AND KARST RESEARCH INSTITUTE
SYMPOSIUM 2

SINKHOLES AND THE ENGINEERING AND ENVIRONMENTAL IMPACTS OF KARST

**PROCEEDINGS OF THE THIRTEENTH MULTIDISCIPLINARY
CONFERENCE**

**May 6 through 10, 2013
Carlsbad, New Mexico**

EDITORS:

Lewis Land

*New Mexico Bureau of Geology and Mineral Resources
and National Cave and Karst Research Institute*

Daniel H. Doctor

U.S. Geological Survey

J. Brad Stephenson

CB&I



Published and distributed by

National Cave and Karst Research Institute

Dr. George Veni, Executive Director

400-1 Cascades Ave.
Carlsbad, NM 88220 USA
www.nckri.org

Peer-review: Organizing Committee of the Thirteenth Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst.

The citation information:

Land L, Doctor DH, Stephenson JB, editors. 2013. Sinkholes and the Engineering and Environmental Impacts of Karst: Proceedings of the Thirteenth Multidisciplinary Conference, May 6-10, Carlsbad, New Mexico: NCKRI Symposium 2. Carlsbad (NM): National Cave and Karst Research Institute.

ISBN 978-0-9795422-7-5

TECHNICAL PROGRAM CHAIRS AND EDITORS

Lynn B. Yuhr
Technos Inc.

Lewis Land
New Mexico Bureau of Geology and Mineral Resources
and the National Cave and Karst Research Institute

Daniel H. Doctor
United States Geological Survey

J. Brad Stephenson
CB&I

Cover Photo:

Aerial view of the JWS sinkhole, Eddy Co., New Mexico, about six weeks after initial collapse. Photo compliments of the National Cave and Karst Research Institute.

CONTENTS

Organizing Committee IX

Foreword XI

Keynote Speakers XII-XVI

Engineering and Geotechnical Aspects of Karst

Towards a karst assessment standard practice

Robert K. Denton, Jr. 1-12

Geotechnical case history for sinkhole investigation and stabilization methods along a high pressure petroleum pipeline

John T. Pusey, Jr. and John M. Caccese 13-21

Problems associated with the use of compaction grout for sinkhole remediation in west-central Florida

Edward D. Zisman and Daniel J. Clarey 23-26

Evaluating karst risk at proposed windpower projects

William J. Bangsund and Kenneth S. Johnson 27-36

Application of stability charts and reliability concepts for simplified analysis of a void in soil overlying karst bedrock

Timothy C. Siegel, Danner F. Drake, and Eric C. Drumm 37-44

If it's weight of hammer conditions, it must be a sinkhole?

Edward D. Zisman and Daniel J. Clarey 45-52

Exploratory grouting of a subsurface detention/infiltration system

Joseph A. Fischer, Todd K. Miller, Michael J. Miluski, and Joseph J. Fischer 53-59

Need for a standardized approach to characterizing, permitting, and constructing landfills in karst geologic settings

Robert C. Bachus and Richard B. Tedder 61-69

A calibration test of karst collapse monitoring device by optical time domain reflectometry (BOTDR) technique [Poster]

Guan Zhende, Jiang Xiaozhen, and Gao Ming 71-77



Induced sinkhole formation associated with installation of a high-pressure natural gas pipeline, west-central Florida [Poster]
Ted J. Smith and George C. Sinn79-88

Cover-collapse sinkhole development in the Cretaceous Edwards limestone, central Texas [Poster]
Brian B. Hunt, Brian A. Smith, Mark T. Adams, Scott E. Hiers, and Nick Brown.....89-102

Evaporite Karst

Salt karst and collapse structures in the Anadarko Basin of Oklahoma and Texas
Kenneth S. Johnson.....103-112

Evaporite karst in the Permian Basin region of west Texas and southeastern New Mexico: The human impact
Lewis Land.....113-121

Evaporite karst and hydrogeology of the Castile Formation: Culberson County, Texas and Eddy County, New Mexico
Kevin W. Stafford123-131

Gypsum karst causes relocation of proposed Cedar Ridge Dam, Throckmorton County, Texas
Kenneth S. Johnson and J. Mark Wilkerson133-139

The role of sulfate-rich springs and groundwater in the formation of sinkholes over gypsum in eastern England
Anthony H. Cooper, Noelle E. Odling, Phillip J. Murphy, Claire Miller, Christopher J. Greenwood, and David S. Brown.....141-150

Gypsum karst and potential risk in siting wind turbines in Blaine County, Oklahoma
Kenneth S. Johnson, William J. Bangsund, and Neal A. Hines151-159

Evaporite karst in the Black Hills, South Dakota and Wyoming, and the oil play in the Williston Basin, North Dakota and Montana
Jack B. Epstein and Daniel H. Doctor.....161-175

Variations in evaporite karst in the Holbrook Basin, Arizona [Poster]
James T. Neal, Kenneth S. Johnson, and Paul Lindberg177-186

Monitoring evaporite karst activity and land subsidence in the Holbrook Basin, Arizona using interferometric synthetic aperture radar (InSAR) [Poster]

Brian D. Conway and Joseph P. Cook.....187-194

Geophysical Investigations in Karst Terrain

Geophysical investigations of the Edwards-Trinity aquifer system at multiple scales: Interpreting airborne and direct-current resistivity in karst

Marcus O. Gary, Dale F. Rucker, Bruce D. Smith, David V. Smith, and Kevin Befus195-206

Subbottom profiling investigation of sinkhole lake structure in Bay and Washington Counties, Florida

Thomas L. Dobecki, Sam B. Upchurch, Thomas M. Scott, Beth Fratesi, and Michael C. Alfieri.....207-211

Improved imaging of covered karst with the multi-electrode resistivity implant technique

David Harro and Sarah Kruse.....213-219

Reconnaissance evaluation of a potential future sinkhole using integrated simple surface geophysics and surface monitoring points

Michael L. Rucker, Sean Hulburt, and Mark D. Edwards221-229

Ground-penetrating radar, resistivity and spontaneous potential investigations of a contaminated aquifer near Cancún, Mexico

Philip J. Carpenter, Ryan F. Adams, Melissa Lenczewski, and Rosa M. Leal-Bautista231-237

Typical methods for forecasting karst collapse in China [Poster]

Yan Meng, Jianling Dai, Long Jia, Mingtang Lei, and Feng Ji.....239-245

Statistical analysis of GPR and SPT methods for sinkhole investigation in covered karst terrain, west-central Florida, USA [Poster]

Henok Kiflu, Michael Wightman, and Sarah Kruse.....247-253

Integrated geophysical methods for groundwater exploration in a karst area with or without thin cover – a case study from Tai’an City, Shandong Province, China [Poster]

Fuping Gan, Yixiang Chen, Wei Zhao, Yuling Chen, and Wei Liu.....255-261

Formation Processes of Karst and Sinkholes

Examples of anthropogenic sinkholes in Sicily and comparison with similar phenomena in southern Italy

Marco Vattano, Mario Parise, Piernicola Lollino, Marco Bonamini, Di Maggio, and Giuliana Madonia.....263-271

Development of sinkholes in a thickly covered karst terrane

Sam B. Upchurch, Thomas L. Dobecki, Thomas M. Scott, Steven H. Meiggs, Sarah E. Fratesi, and Michael C. Alfieri273-277

Paleokarst crust of Ordovician limestone and its capability in resisting water intrushes in coal mines of north China

Lin Mou and Gongyu Li.....279-284

Deep time origins of sinkhole collapse failures in sewage lagoons in southeast Minnesota

E. Calvin Alexander, Jr., Anthony C. Runkel, Robert G. Tipping, and Jeffrey A. Green.....285-292

Emergency investigation of extremely large sinkholes, Maohe, Guangxi, China

Mingtang Lei, Yongli Gao, Xiaozhen Jiang, and Zhende Guan293-297

Karst landforms in the Saraburi Group limestones, Thailand

Gheorghe Ponta, Bashir Memon, James LaMoreaux, Jade Julawong, and Somchai Wongsawat299-309

Clastic sinkhole and pseudokarst development in east Texas [Poster]

Kevin W. Stafford, Melinda G. Shaw-Faulkner, and Wesley A. Brown311-319

Characterization of karst collapse hazard based on groundwater fluctuations in Qingyun Village, Guigang, Guangxi, China [Poster]

Xiaozhen Jiang, Mingtang Lei, Yongli Gao, and Zhende Guan321-326

Investigations of large scale sinkhole collapses, Laibin, Guangxi, China [Poster]

Yongli Gao, Weiquan Luo, Xiaozhen Jiang, Mingtang Lei, and Jianling Dai.....327-331

Karst Hydrology

Mapping flood-related hazards in karst using the KARSYS approach: Application to the Beuchire-Creugenat karst system (Ju, Switzerland)

Jonathan Vouillamoz, Arnauld Malard, Gabrielle Schwab Rouge, Eric Weber, and Pierre-Yves Jeannin.....333-342

Conceptualization of groundwater flow in the Edwards Aquifer through the Knippa Gap hydrogeologic constriction, Uvalde County, Texas

Jennifer Adkins.....343-352

Delineating source areas to cave drips and cave streams in Austin Texas, USA

Nico Hauwert and Brian Cowan.....353-365

Use of physical and chemical response in cave drips to characterize upland recharge in the Barton Springs segment of the Edwards Aquifer, central Texas, USA

Brian Cowan and Nico Hauwert.....367-375

The need for presumptive habitat considerations in working with subterranean aquatic species of concern: Three Ozark region case histories, USA

Shiloh L. Beeman, Thomas J. Aley, and Michael Slay.....377-381

Mapping and Management of Karst Regions

A chronological catalogue of sinkholes in Italy: The first step toward a real evaluation of the sinkhole hazard

Mario Parise and Carmela Vennari.....383-392

Lessons learned from occurrence of sinkholes related to man-made cavities in a town of southern Italy

Pietro Pepe, Nunzia Pentimone, Giuditta Garziano, Vincenzo Martimucci, and Mario Parise.....393-401

Restoring land and managing karst to protect water quality and quantity at Barton Springs, Austin, Texas

Kevin Thuesen.....403-409

The use of drought-induced “crop lines” as a tool for characterization of karst terrain
Samuel V. Panno, Donald E. Luman, Walton R. Kelly, and Matthew B. Alschuler..... 411-419

Mapping surface and subsurface karst geohazards for highway projects: SR 71 South Knoxville Boulevard Extension, Knox County, Tennessee
Harry L. Moore.....421-431

Government Canyon State Natural Area: An emerging model for karst management
George Veni.....433-440

Combining LiDAR, aerial photography, and Pictometry® tools for karst features database management
Scott C. Alexander, Mina Rahimi, Erik Larson, Cody Bomberger, Brittany Greenwaldt, and E. Calvin Alexander, Jr......441-448

An evaluation of automated GIS tools for delineating karst sinkholes and closed depressions from 1-meter LiDAR-derived digital elevation data
Daniel H. Doctor and John A. Young449-458

Delineation and classification of karst depressions using LiDAR: Fort Hood military installation, Texas [Poster]
Melinda G. Shaw Faulkner, Kevin W. Stafford, and Aaron W. Bryant.....459-467

Locating sinkholes in LiDAR coverage of a glacio-fluvial karst, Winona County, MN [Poster]
Mina Rahimi and E. Calvin Alexander, Jr......469-480

ORGANIZING COMMITTEE

Conference Co-Chairs

- George Veni, Ph.D., P.G., National Cave and Karst Research Institute (NCKRI), Carlsbad, NM
- Jim LaMoreaux, Ph.D., P.E. LaMoreaux & Associates, Inc., Tuscaloosa, AL

Program Co-Chairs

- Lynn B. Yuhr, P.G., Technos, Inc., Miami, FL
- Lewis Land, Ph.D., New Mexico Bureau of Geology & Mineral Resources and National Cave and Karst Research Institute, Carlsbad, New Mexico

Proceedings Managing and Assistant Editors

- Lewis Land, Ph.D., New Mexico Bureau of Geology & Mineral Resources and National Cave and Karst Research Institute, Carlsbad, NM
- Daniel H. Doctor, Ph.D., U.S. Geological Survey, Eastern Geology & Paleoclimate Science Center, Reston, VA
- J. Brad Stephenson, P.G., L.R.S., CB&I, Knoxville, TN

Field Trips

- Lewis Land, Ph.D., New Mexico Bureau of Geology & Mineral Resources and National Cave and Karst Research Institute, Carlsbad, NM

Short Courses

- E. Calvin Alexander, Jr., Ph.D., Department of Earth Sciences, University of Minnesota, Minneapolis, MN

Invited Speakers

- Yongli Gao, Ph.D., University of Texas-San Antonio, San Antonio, TX

Beck Scholarship

- E. Calvin Alexander, Jr. Ph.D., Department of Earth Sciences, University of Minnesota, Minneapolis, MN
- Dianne Joop, National Cave and Karst Research Institute, Carlsbad, NM
- Ira D. Sasowsky, Ph.D., P.G., Geosciences, University of Akron, Akron, OH

Beck Memorial

- Jim LaMoreaux, Ph.D., P.E. LaMoreaux & Associates, Inc., Tuscaloosa, AL
- Dianne Joop, National Cave and Karst Research Institute, Carlsbad, NM
- Brian Smith, Ph.D., Barton Springs/Edwards Aquifer Conservation District, Austin, TX
- J. Brad Stephenson, P.G., L.R.S., CB&I, Knoxville, TN

Conference Management

- Dianne Joop, National Cave and Karst Research Institute, Carlsbad, NM
- Debbie Herr, National Cave and Karst Research Institute, Carlsbad, NM
- Suzanna Langowski, National Cave and Karst Research Institute, Carlsbad, NM

Circulars and Publicity

- Samuel V. Panno, CGWP, Illinois State Geological Survey, Prairie Research Institute, University of Illinois, Champaign, IL
- Harry L. Moore, P.G., Golder Associates, Atlanta, GA

Program with Abstracts

- Brian Smith, Ph.D., Barton Springs/Edwards Aquifer Conservation District, Austin, TX
- Brian Hunt, Barton Springs/Edwards Aquifer Conservation District, Austin, TX

Website

- Dianne Joop, National Cave and Karst Research Institute, Carlsbad, NM
- Gheorghe Ponta, P.G., P.E. LaMoreaux and Associates, Tuscaloosa, AL

Session Chairs

- Engineering and Geotechnical Aspects of Karst - Joe Fischer, Ph.D., P.E., Geoscience Services, Clinton, NJ
- Evaporite Karst - Ken Johnson, Oklahoma Geological Survey, Norman, OK
- Geophysical Investigations in Karst Terrain - Mustafa Saribudak, Ph.D., P.G., Environmental Geophysics Associates, Austin, TX
- Formation Processes of Karst and Sinkholes - Harry L. Moore, Golder Associates, Atlanta, GA
- Karst Hydrology - Geary Schindel, P.G., Edwards Aquifer Authority, San Antonio, TX
- Mapping and Management of Karst Regions – Samuel V. Panno, CGWP, Illinois State Geological Survey, Prairie Research Institute, University of Illinois, Champaign, IL

Session Subcommittees

- Tony Cooley, P.E., P.G., EEC-DEP Division of Waste Management, Solid Waste Branch, Closure Section, Frankfort, KY
- Jeff Schaumburg, P.E., Dynamic Earth, Chester, NJ
- Dave Weary, National Cooperative Geologic Mapping Program, U.S. Geological Survey, Reston, VA
- Phil Carpenter, Ph.D., Dept. of Geology and Environmental Geosciences, Northern Illinois University, DeKalb, IL
- Thomas L. Dobecki, Ph.D., P.G., SDII Global Corporation, Tampa, FL
- Bruce Smith, U.S. Geological Survey, Denver Federal Center, Denver, CO

AEG and SAGEEP Liaison

- Mustafa Saribudak, Ph.D., P.G., Environmental Geophysics Associates, Austin, TX

ASCE/Geo-Institute Liaison

- Rob Schweinfurth, Geo-Institute of ASCE, Reston, VA

EWRI Liaison

- Brian Parsons, P.E., Environmental and Water Resources Institute, Reston, VA

Highway Geology Symposium Liaison

- Harry L. Moore, P.G., Golder Associates, Atlanta, GA

Members at Large

- Ralph Ewers, Ph.D., EWC Ewers Water Consultants Inc., Richmond, KY
- Geary Schindel, P.G., Edwards Aquifer Authority, San Antonio, TX
- Wanfang Zhou, ERT, Inc., Knoxville, TN
- Gheorghe Ponta, P.G., P.E. LaMoreaux and Associates, Tuscaloosa, AL

FOREWORD

Welcome to the Thirteenth Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst in sunny Carlsbad, New Mexico. This will be the farthest west the Sinkhole Conference, as it is informally known, has met since its inception in 1984. The setting will provide conference participants with a unique opportunity to view karst phenomena such as gypsum cenotes that are uncommon outside the southwestern United States, and world-class caves and karst features that occur (for better or worse) within and adjacent to giant oil fields of the Permian Basin region.

In 2011 the National Cave and Karst Research Institute (NCKRI) assumed responsibility for hosting the Sinkhole Conference series. NCKRI, a non-profit organization dedicated to pure and applied research on caves, karst phenomena, and karst hydrology is well-positioned to assume a leadership role in organizing and hosting the conference. Several of the staff of NCKRI have a long history of participation in past Sinkhole Conferences, and we look forward to supporting and hosting future meetings in other areas of the United States and abroad. The fourteenth conference will be held in Minneapolis, Minnesota in 2015, and discussion has begun on the possibility of an international setting for a future conference.

We wish to dedicate this year's proceedings volume to the memory of Barry Beck, who died in 2011. Barry initiated the Sinkhole Conference series in 1984 and was instrumental in maintaining the series of meetings over the years through several sponsors. Although his energy and enthusiasm will be greatly missed by future conference organizers, we are honored to carry Barry's legacy into the future.

Edited by:

Lewis Land
New Mexico Bureau of Geology and Mineral Resources
and the National Cave and Karst Research Institute
400-1 Cascades Ave.
Carlsbad, NM 88220 USA
Phone: 575-887-5508
E-mail: lland@nckri.org

Daniel H. Doctor
U.S. Geological Survey
12201 Sunrise Valley Dr.
MS 926A, Reston, VA 20192 USA
Phone: 703-648-6027
E-mail: dhdoctor@usgs.gov

J. Brad Stephenson
CB&I
312 Directors Drive
Knoxville, TN 37923
Phone: 865-694-7336
E-mail: brad.stephenson@cbi.com



KEYNOTE SPEAKER

SPELEOLOGICAL, HYDROGEOLOGICAL AND ENGINEERING GEOLOGICAL CHALLENGES OF TUNNELING IN KARST AREAS

Dr. Mladen Garašić

University of Zagreb, Croatia

In the Classical Dinaric Karst of Croatia, over 11,500 caves have been explored so far, more than 1,000 of which were discovered during construction works. Caves discovered on the construction sites of highways lacked natural entrances on the surface. Over the past 20 years they have been systematically investigated and remediated to allow completion of the roads. Some special examples will be presented during the lecture, such as the large hall in the Vrata Tunnel of the Zagreb – Rijeka Highway, and caves in Croatia's longest tunnels. Due to the size, shape, position, and hydrogeological parameters of the cave within the karst system, it was necessary to design and construct a special bridge through the cave in the Vrata Tunnel. The cave's vaulted ceiling had to be reinforced and stabilized. This presentation will include video and photos of the most interesting karst and cave locations in Dinaric Karst.

Biography

Mladen Garašić, PhD. Geology, Hydrogeology, and Geological Engineering. Born in Zagreb, Croatia, in 1951, Dr. Garašić graduated in geology and karst hydrogeology in 1977, master of science 1981, and doctorate in geosciences and geological engineering in 1986. He is a scientist, and a professor of geology, karst hydrogeology, applied geology, engineering geology and speleology at the University of Zagreb, and has authored

more than 330 scientific and professional papers. He serves as a committee member for the Croatian Academy of Science and Arts, UNESCO World Heritage Team for the Dinaric Karst, International Association of Hydrogeologists, and International Association for Engineering Geology and the Environment.

Dr. Garašić started skiing in 1955 and won the Junior Skiing competition of Croatia in 1963. He has been a member of the Croatian Mountaineering Association since 1955 and was awarded by the Association in 1969 and 1981. He started caving in 1963 and is the founder and president of several caving clubs in Croatia. He served as first president of the Croatian Speleological Federation from 1990 to 2010 and is a life member of the U.S. National Speleological Society. Since 1993, he has served as Croatia's delegate to the International Union of Speleology and to the European Speleological Federation beginning in 2009.

Dr. Garašić has conducted research in, and explored and visited nearly 5,000 caves in 64 countries. He has led many speleological expeditions in the longest and deepest caves in Croatia, Europe, and the world. He has also studied about 1,000 caves without natural entrances, discovered by tunnels and quarries, and evaluated their hydrogeology and engineering geology.

KEYNOTE SPEAKER

NATURAL AND ANTHROPOGENIC SINKHOLES: FROM IDENTIFICATION, TO SURVEYING, STUDYING AND MODELING A SUBTLE HAZARD

Mario Parise

National Research Council of Italy, Institute of Research for the Hydrogeological Protection

Sinkholes are the most common hazard in karst, being related to the presence of natural caves, and to their interaction with the ground surface. In the last decades, however, the study of sinkholes widened well beyond the boundaries of karst, including situations where cavities produced by man in different epochs and for different purposes interact in some way with the built-up environment, and represent a likely threat to the society. As a matter of fact, several urban areas in many countries worldwide have been recently affected by sinkhole occurrence which caused severe damage; sinkholes in Guatemala City, and other events in Italy, Germany and Turkey are only some of the many that characterize the last several years.

In terms of civil protection issues, the topic has become of high interest in Italy, and much work has been devoted to it at CNR-IRPI. This presentation briefly describes the activities carried out, as they concern both natural and anthropogenic sinkholes, and to share the experiences so far developed. These latter cover all the phases of sinkhole analysis: from the identification of the sinkhole-prone areas, to surveying the underground environment (by combining speleological techniques and modern technologies in order to get reliable and precise surveys), to recognizing the type of rock failures and characterizing the rock mass in terms of mechanical properties, to eventually modeling the case studies through numerical codes in order to forecast the likely evolution of underground failures, their upward propagation, and evaluating the possibility of sinkhole occurrence at the ground surface. A particular focus will be given to historical research, and its use in identifying ancient and/or buried caves, as the first step in the assessment of the sinkhole susceptibility and hazard. All of this will be illustrated through a number of case studies in southern Italy, dealing with natural karst caves and anthropogenic cavities as well. The final part of the presentation will

also cover some issues related to land-use problems in sinkhole-prone areas, and the utilization of the outcomes from sinkhole studies in civil protection programs at the local and national level, aimed at safeguarding and protecting private and public properties and the local populations.

Biography

After graduating with honors in Geology in 1988 at the Faculty of Sciences of the University of Naples, Mr. Parise received grants from the National Research Council of Italy and spent several periods working in cooperation with the U.S. Geological Survey at Golden, Colorado, and the University of South Florida at Tampa, Florida. Since 1994 he has worked as a Research Geologist at the National Research Council, Institute of Research for Hydrogeological Protection (CNR-IRPI) in Bari, Italy. He has organized and convened several international workshops and conferences on the topics of karst, karst hazards, and slope movements (European Geosciences Union Assemblies, Geological Society of America Meetings, Italian Forums of Earth Sciences), and is the scientist responsible for several projects between CNR-IRPI and different public administrations and private companies.

Since 1990, Mr. Parise has developed research mainly into the geological and geomorphological analysis of slope movements. Much of his research deals with the identification of areas susceptible to different types of slope movement (debris flows, deep-seated gravitational slope deformations, mass wasting processes, etc.) by means of stereoscopic interpretations of aerial photographs and field surveys. Particular focus is given to multi-temporal analyses, aimed at understanding the likely evolution of slopes, even in relationship with anthropogenic activities, and/or as a consequence of specific triggering events (rainstorm, earthquakes, etc.). For several sites

in southern Italy, he has created a framework of the influence of weathering in the predisposition of slope movements. He has also contributed to the analysis of rapid landslides (debris avalanches, rock avalanches) in different geological settings in Italy and abroad, and to studying the occurrence of debris flows and erosional processes in areas recently affected by wildfires.

He began caving in 1998 and since 2002 he also works in the field of karst research, focusing on the evaluation

of natural and anthropogenic hazards that occur in karst territories, with particular regard to sinkholes related to both natural caves and man-made cavities. He is the author of over 100 papers published in international journals and proceedings of international conferences. He has given several presentations in international symposia and workshops. Mr. Parise has guest edited 10 special issues for ISI international journals, published two books with the Geological Society of London, and reviews papers for several international journals.

KEYNOTE SPEAKER

TECTONIC INFLUENCES ON PETROLEUM MIGRATION AND SPELEOGENESIS IN THE GUADALUPE MOUNTAINS, NEW MEXICO AND TEXAS

Harvey R. DuChene

Vecta Oil and Gas, LP

Sulfuric acid speleogenesis in the Guadalupe Mountains is a consequence of the rise of the Alvarado ridge and subsequent opening of the Rio Grande Rift during Cenozoic time. Uplands of the late Laramide (~38 – 35 Ma) Alvarado Ridge provided an immense recharge area that supplied water to aquifers draining eastward to the Permian basin. Evidence for east-directed hydrodynamic flow is the displacement, microbial degradation and subsequent recharging of hydrocarbons in large structural and stratigraphic traps in Artesia Group (Permian, Guadalupian) reservoirs in southeast New Mexico and adjacent west Texas. Prior to, or during the early stages of the development of the Rio Grande Rift, hydrostatic head in the Capitan aquifer caused water to flow eastward through Artesia Group strata toward the Permian basin. Some of this water moved upward along fractures to artesian springs in the area of the Guadalupe Mountains. This resulted in solutional enlargement of fractures and development of early stage caves. Extensional faulting since 29 Ma fragmented the east flank of the ridge, progressively reducing the size of the upland recharge area and reducing hydrostatic head. Fresh water influx introduced microbes into Artesia Group (Permian, Guadalupian) reservoirs causing biodegradation of petroleum and generating copious H₂S. The water table within the Guadalupe Mountains began to fall 14-12 Ma in response to erosion and tectonism. During this time, oxygen-rich meteoric water mixed with H₂S water to form sulfuric acid, which enlarged passages and galleries at the water table. Tectonic spasms related to the opening of the Rio Grande Rift caused abrupt drops in the water table, shifting the locus of sulfuric acid

dissolution eastward and downward. Cave levels formed by sulfuric acid record the position of the water table at a given time, and the elevation difference between levels may correlate with episodes of Rio Grande Rift tectonism since 12 Ma.

Biography

Harvey DuChene is a graduate of the University of New Mexico, earning B.A. (1968) and M.S. (1973) degrees in geology. He has 39 years of experience as a petroleum geologist, working for Amoco Production Company, Davis Oil, Axem Resources and others. He currently is a limited partner in Vecta Oil and Gas, LP, an oil and gas exploration and production company headquartered in Dallas, Texas. His primary area of expertise is petroleum exploration in basins of the Rocky Mountain province and west Texas, with additional experience in the midcontinent, Appalachian basin and offshore West Africa.

Harvey has also more than 30 years studying the speleogenesis of hypogenic caves, particularly those formed by sulfuric acid. He is interested in the connection between the evolution of hypogenic cave systems and the tectonic and geologic history of regions.

Harvey is a member of the Geological Society of America, American Association of Petroleum Geologists, American Geological Institute, Rocky Mountain Association of Geologists, New Mexico Geological Society, West Texas Geological Association and Karst Waters Institute, and he is a Fellow of the National Speleological Society.

KEYNOTE SPEAKER

WHEN THE CARBONATE PLUMBING GOES BAD: SINKHOLES, THE HYDRA, AND THE GENERAL PUBLIC

William Kochanov

Pennsylvania Department of Conservation and Natural Resources

In 1985, a program was initiated by the Pennsylvania Geological Survey to inventory (catalog) existing sinkholes and to map areas of potential sinkhole development. The program was developed to provide general background information for the initial stages of site investigations, aid in sinkhole remediation efforts, and serve as a tool for developing regional land-use planning strategies. Although the methods of data collection and distribution have evolved over the past 25 years, it has been interesting to note that the practicing professional continually has had to refine the means of sorting and sifting data much like that of a forensic specialist; each investigator having their own special challenges as the clues for remediation often lie hidden beneath the veneer of urbanization, are squirreled away in files of the local Historical Society or are muted for fear of liability. Bill will take you on a savage journey through the karstlands of Pennsylvania to marvel at some of its many wonders, examine yawning portals to the underworld, grapple with the paradox of the cultural hydra, and the ultimate in trepidation, entering the lair of the general public.

Biography

William (Bill) Kochanov (pronounced KO-CHAN'-OFF) is a Senior Geologist with the Pennsylvania Department of Conservation and Natural Resources, Bureau of Topographic and Geologic Survey, Geologic Mapping Division. Since 1985, he has been actively mapping geologically hazardous areas within the limestone regions of Pennsylvania and maintains the Bureau's sinkhole database. He has also conducted bedrock mapping projects spanning much of the Paleozoic from Pennsylvania's northern anthracite coal field and Endless Mountains Region to the Chester Valley of southeastern Pennsylvania. Bill is most noted for authoring the series of county reports, specifically designed to characterize karst surface features, their distribution, and their relation to physiographic setting. He is strongly involved with the Survey's outreach programs; translating the geology of Pennsylvania for, as Joe Fischer puts it, "the greater unwashed." Bill lives in the suburbs of Harrisburg with his wife Jane and children, Natalie and Alex, close to the forests of Stony Creek where he spends many hours tracking down the elusive edibles of the mushroom world.