

# AASG

# 2018

## 110th Annual Meeting

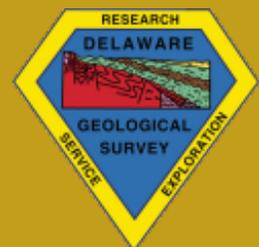


June 3<sup>rd</sup> – 7<sup>th</sup>

Rehoboth Beach, Delaware

### Program Guide

*“Applied Geosciences for a Changing Planet”*



# AASG President's Welcome

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*Steven S. Masterman  
President, AASG*

It's a pleasure to welcome you to the 110<sup>th</sup> annual meeting of the Association of American State Geologists. This year's meeting finds us on the Atlantic coast in Delaware. Delaware is named "The First State" and as it is seeing the impacts of our changing planet first hand, I cannot think of better setting for the nation's geoscience leaders to discuss how to evolve geoscience to meet societal needs in a changing world.

On May 12, 1908, 121 years after Delaware became the first state to ratify the U.S. Constitution, a group of visionaries met in the downtown Washington, D.C., offices of the United States Geological Survey and formed an organization to advocate for geology-related policies. That first meeting was convened in response to problems the country and states faced regarding use and preservation of our natural resources, and the wise administration of our forests, minerals, soils, and water. One hundred ten years after that first meeting of the AASG, many of the same issues are in focus again as increased resource competition demands greater understanding of the planet and its response to change.

To provide the geoscience required for a growing society on a changing planet, we must be forward looking, innovative, and bold. We must ensure that science is integral to societal decision making, and that you, as geoscience leaders, take an active role in providing the right science, and ensuring its use. This week, as we explore the topic of evolving geoscience for our changing society and planet, let us think about our role in ensuring a safe, prosperous and sustainable society for future generations.

Thank you all for coming and have a great meeting!

A handwritten signature in blue ink that reads "S. Masterman".

Steven S. Masterman  
AASG President, 2017-2018



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The Association of American State Geologists (AASG) is an organization of the chief executives of the state geological surveys in 50 states and Puerto Rico. The responsibilities of the various state surveys differ from state to state, depending on the enabling legislation and the traditions under which the survey evolved. Almost all function as a basic information source for their state governments' executive, legislative, and judicial branches. Some have regulatory responsibilities for water, oil and gas, land reclamation, etc.

The first state survey was established in 1823 in North Carolina. By 1840, there were at least 15 state surveys, most of which were charged with the discovery of mineral, energy, land, and water resources in their state or territory. The State Geologists began formal meetings with the U.S. Geological Survey in 1879, the year that organization was established. Since 1908, the Association has met regularly to discuss issues of common interest and to initiate united actions when warranted.

## AASG 2018 Welcome

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*David R. Wunsch*  
State Geologist, Delaware

On behalf of the Delaware Geological Survey, I want to welcome you to Delaware for the 110<sup>th</sup> Annual Meeting of the Association of American State Geologists. Delaware's moniker as the First State is derived from our colonial leaders being the first to ratify the Constitution of the United States. And our small state has maintained its reputation of producing national leaders throughout our nation's history—most recently demonstrated by Delaware's favorite son, Vice President Joe Biden.

The theme of our meeting is *Applied Geoscience for a Changing Planet*, which is ever so appropriate for Delaware, which has the lowest mean elevation of the 50 United States, so salt-water intrusion, coastal flooding, and beach erosion exacerbated by sea level rise are major issues that affect our state, and the entire mid-Atlantic region as well.

DGS staff have been working hard along with AASG leaders to put together an excellent program where we will examine the balance between geoscience information and policy considerations that are related to energy and mineral production, water resource management and natural hazards, as well as share information and technological advances that can assist us all in our work.

Our meeting venue is beautiful Rehoboth Beach, with our hotel adjoining the iconic boardwalk and Atlantic Ocean beach. The meeting field trip will have a coastal geology focus, with stops along Indian River inlet and Cape Henlopen State Park—including historic Fort Miles. Guest trips include

Longwood Gardens, one of the premier botanical gardens in the world, a tax-free shopping excursion, and numerous opportunities on your own for enjoying the beach, art galleries, and nearby historic Lewes, the First Town in the First State. Our post-meeting field trip will take us to the Hagley Museum, which showcases the life and times of 18<sup>th</sup> century workers, the process for making black powder, and the intricate mechanical infrastructure used to harness the water that powered the world's largest black powder mill. In the afternoon, we will examine Piedmont geology, traveling via an antique train operated by the Wilmington & Western Railroad.

Our banquet speaker is Dr. Art Trembanis, from the University of Delaware's Marine Science and Policy Program, who will share interesting discoveries from the colorful undersea world he and his colleagues are exploring using underwater autonomous vehicles or UAVs.

This meeting would not have been possible without the generosity of our sponsors, who are identified in this book, as well as other meeting materials. Please thank any members of a sponsoring organization during the meeting for their support of AASG and the geosciences.

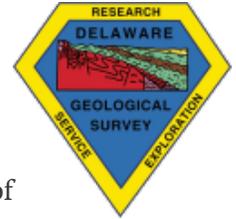
We hope you enjoy your stay in Delaware. Our meeting should be a great forum for scientific exchange, developing and strengthening partnerships, and sharing time with old and new friends.

*David R. Wunsch*

David R. Wunsch  
Director and State Geologist

# AASG 2018 Host: Delaware Geological Survey

A geologic survey of Delaware was originally authorized in 1837 for a period of four years under the direction of James C. Booth, State Geologist. A permanent state geological survey was established by the Delaware General Assembly in 1951 and is funded by direct state appropriation.



The 1951 statute founding the Survey contains its fundamental charges: study the geology of Delaware, investigate mineral and water resources, advise state government, and provide the results of its studies to the citizens and agencies of Delaware through publication and consultation. Additional responsibilities have been assigned over the years as the varied applications of the Survey's basic mission were recognized: notable among these are spatial data coordination, direct support for emergency planning, response, and recovery, and involvement in water-supply planning. The DGS has a unique position both as a University research and service unit and as a state agency.

Financial, personnel, and other administrative matters are managed by the University of Delaware. The DGS budget is funded by an annual direct appropriation from the State of Delaware with related reporting responsibilities to both the Office of the Governor and the Delaware General Assembly. The DGS provides objective, factual information for the benefit of our stakeholders, impacting public policy decisions as well as solutions for individuals, business, and industry. In addition, we contribute to the educational mission of the University through collaboration with faculty and students on research projects of value to Delawareans. Solidifying that relationship, the DGS became formally affiliated within the University's growing College of Earth, Ocean, and Environment in July, 2008. Most DGS scientists have secondary faculty appointments in the College's Department of Geological Sciences.

## Leadership

Five individuals have served as State Geologist:

- James C. Booth, 1837 – 1841
- Johan J. Groot, 1951 – 1969
- Robert R. Jordan, 1969 – 2003
- John H. Talley, 2003 – 2011
- David R. Wunsch, 2011 – Present





# Financial Support

*The AASG acknowledges the generous contributions of the following organizations without whose support this meeting would not have been possible.*



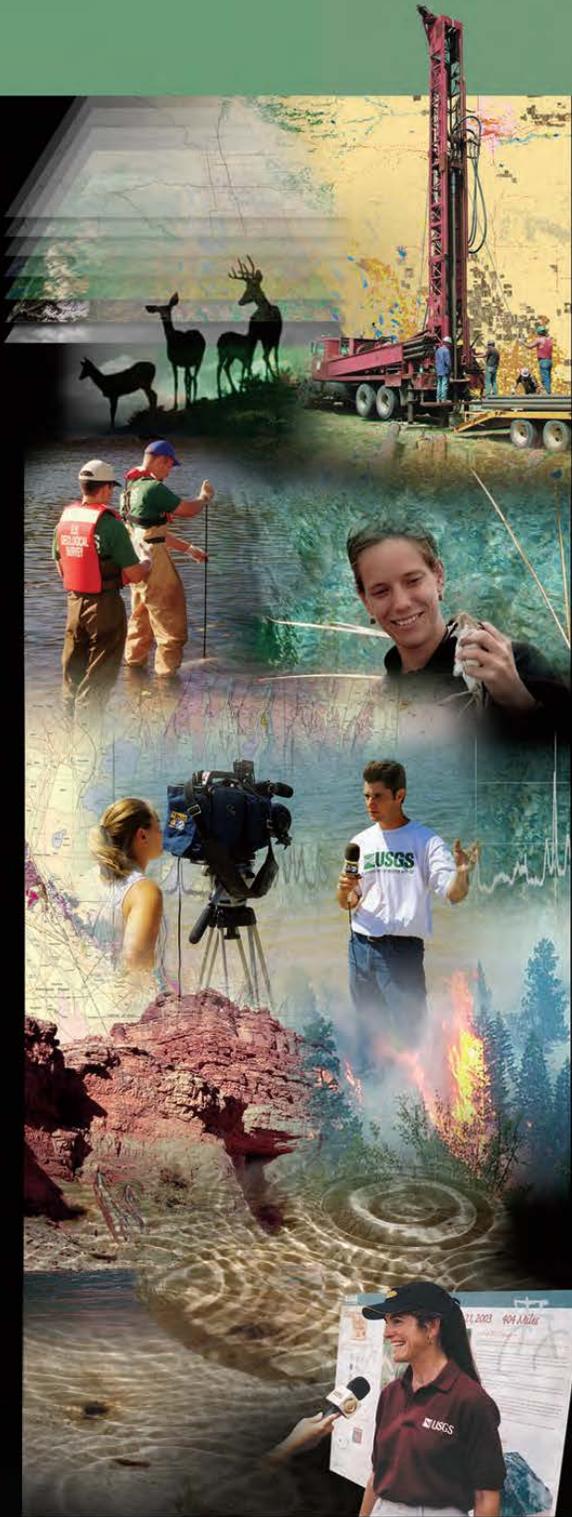
## U.S. Geological Survey

1-888-ASK-USGS  
(1-888-275-8747)

As an unbiased, multidisciplinary science organization, the U.S. Geological Survey (USGS) is dedicated to the timely, relevant, and impartial study of the landscape, our natural resources, and the natural hazards that threaten us.

Visit us at [www.usgs.gov](http://www.usgs.gov)  
and follow us on social media at  
<http://www.usgs.gov/socialmedia/>

U.S. Department of the Interior  
U.S. Geological Survey





## Financial Support

*The AASG acknowledges the generous contributions of the following organizations without whose support this meeting would not have been possible.*

The AASG Foundation promotes the importance of geosciences to society, promotes state geological surveys as sources of geoscience needed to address local, state, and national issues.

**AASG**  
Foundation

The AASG Foundation is a 501(c)3 non-profit that supports operational, education, and research activities of the Association of American State Geologists.

[http://www.stategeologists.org/aasg\\_foundation](http://www.stategeologists.org/aasg_foundation)

**BOEM**  
BUREAU OF OCEAN ENERGY MANAGEMENT

*The Mission of the Bureau of Ocean Energy Management is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.*

*The Vision of the Bureau of Ocean Energy Management is excellence in the management of Outer Continental Shelf energy and mineral resources for environmental sustainability, economic development, and national security.*

<https://www.boem.gov/>



UNIVERSITY OF  
DELAWARE

College of Earth, Ocean,  
& Environment

*At the College of Earth, Ocean, & Environment, we are working to reach a deeper understanding of our planet, improve stewardship of our environmental resources, and prepare the next generation of environmental science and policy leaders. We examine and integrate complex information from multiple disciplines, with the knowledge that science and society are firmly linked and that solutions to environmental challenges can be synonymous with positive economic impact.*

*Join us as we "Discover Our World!"*  
*Estella Atekwana, Dean*

[www.ceoe.udel.edu](http://www.ceoe.udel.edu)



## Financial Support

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The Delaware Coastal Programs is a cooperative program between the State of Delaware and the National Oceanic and Atmospheric Administration. We help manage Delaware's federal coastal zone and balance the use and protection of its resources through the combined efforts of the Delaware Coastal Management Program and Delaware National Estuarine Research Reserve.



<http://www.dnrec.delaware.gov/coastal>



### **Our mission**

NGWA is a community of groundwater professionals working together to advance groundwater knowledge and the success of our members through education and outreach; advocacy; cooperation and information exchange; and enhancement of professional practices.

### **Our vision**

NGWA's vision is to be the leading groundwater association advocating the responsible development, management, and use of water.

<http://www.ngwa.org>

# **BATTELLE**

## **It can be done**

Battelle's vision is to be a major force in science and technology discovery and in the translation of knowledge into innovative applications that have significant societal and economic impacts.

[www.battelle.org](http://www.battelle.org)



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**CENTRAL MINE EQUIPMENT COMPANY**

<http://cmeco.com/>

## Additional Support

### Meeting Contributors

Big Oyster Brewery  
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Total Wine & More  
Trimble

### DGS Staff

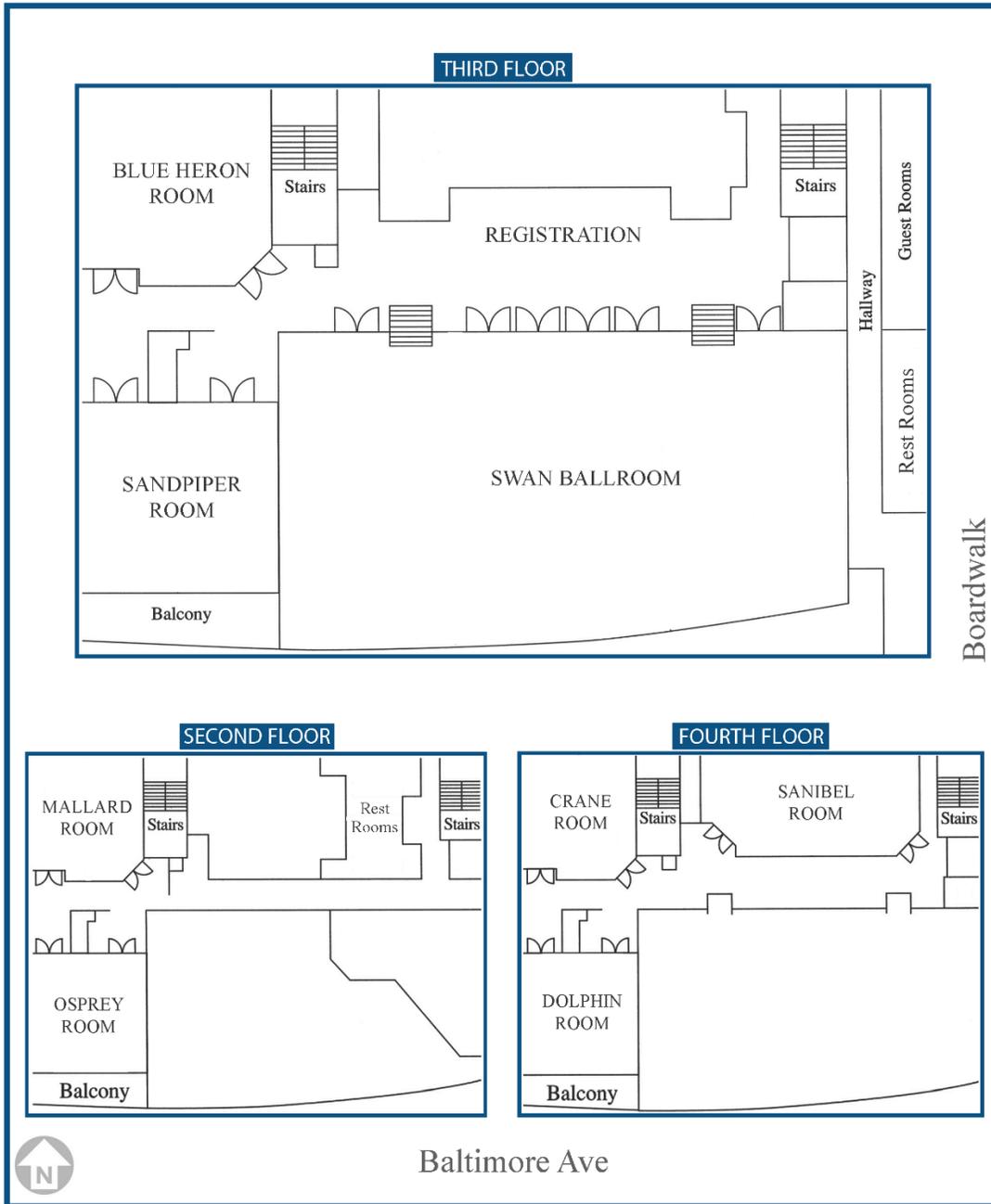
Scott Andres	Jaime Tomlinson
Stefanie Baxter	Lillian Wang
John Callahan	Laura Wisk
Changming He	Sheng Yao
Denise Helderfer	
Moji KunleDare	
Robin Mattheus	
Steve McCreary	
Tom McKenna	
Pete McLaughlin	
Rachel McQuiggan	
Kelvin Ramsey	
Sandy Schenck	
Tom Smith	

### Students

Sierra Patterson  
Brandon Wunsch

# Hotel Layout

## AASG 2018 Atlantic Sands Hotel & Conference Center



# Meeting Attendees

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## State Geological Surveys (State Geologists in Bold)

<b>Steven Masterman</b>	ALASKA DNR/ DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS	<b>Jeffrey Hoffman</b>	NEW JERSEY GEOLOGICAL & WATER SURVEY
<b>Nick Tew</b>	ALABAMA GEOLOGICAL SURVEY	<b>Nelia Dunbar</b>	NEW MEXICO BUREAU OF GEOLOGY & MINERAL RESOURCES
<b>Bekki White</b>	ARKANSAS GEOLOGICAL SURVEY	Virginia McLemore	NEW MEXICO BUREAU OF GEOLOGY & MINERAL RESOURCES
Scott Ausbrooks	ARKANSAS GEOLOGICAL SURVEY	<b>James Faulds</b>	NEVADA BUREAU OF MINES & GEOLOGY
Martha Kopper	ARKANSAS GEOLOGICAL SURVEY	<b>Thomas Serenko</b>	OHIO DNR/ DIVISION OF GEOLOGICAL SURVEY
<b>Phil Pearthree</b>	ARIZONA GEOLOGICAL SURVEY	Michael Angle	OHIO DNR/ DIVISION OF GEOLOGICAL SURVEY
<b>John Parrish</b>	CALIFORNIA GEOLOGICAL SURVEY	Paul Spahr	OHIO DNR/ DIVISION OF GEOLOGICAL SURVEY
<b>Karen Berry</b>	COLORADO GEOLOGICAL SURVEY	<b>Jeremy Boak</b>	OKLAHOMA GEOLOGICAL SURVEY
<b>Margaret Thomas</b>	CONNECTICUT GEOLOGICAL SURVEY	<b>Gale Blackmer</b>	PENNSYLVANIA GEOLOGICAL SURVEY
<b>David Wunsch</b>	DELAWARE GEOLOGICAL SURVEY	Scott Howard	SOUTH CAROLINA GEOLOGICAL SURVEY
<b>Jonathan Arthur</b>	FLORIDA GEOLOGICAL SURVEY	<b>Ronald Zurawski</b>	TENNESSEE GEOLOGICAL SURVEY
Keith Schilling	IOWA GEOLOGICAL SURVEY	<b>Scott Tinker</b>	TEXAS BUREAU OF ECONOMIC GEOLOGY
John Brabb	IDAHO GEOLOGICAL SURVEY	Michael Young	TEXAS BUREAU OF ECONOMIC GEOLOGY
<b>Michael Ratchford</b>	IDAHO GEOLOGICAL SURVEY	<b>Rick Allis</b>	UTAH GEOLOGICAL SURVEY
<b>Richard Berg</b>	ILLINOIS STATE GEOLOGICAL SURVEY	Mike Hylland	UTAH GEOLOGICAL SURVEY
Steven Brown	ILLINOIS STATE GEOLOGICAL SURVEY	<b>David Spears</b>	VIRGINIA DEPARTMENT OF MINES, MINERALS & ENERGY/ DIVISION OF GEOLOGY & MINERAL RESOURCES
Steve Whittaker	ILLINOIS STATE GEOLOGICAL SURVEY	<b>Marjorie Gale</b>	VERMONT GEOLOGICAL SURVEY
Lee Florea	INDIANA GEOLOGICAL & WATER SURVEY	<b>Dave Norman</b>	WASHINGTON GEOLOGICAL SURVEY
<b>Todd Thompson</b>	INDIANA GEOLOGICAL & WATER SURVEY	<b>Ken Bradbury</b>	WISCONSIN GEOLOGICAL & NATURAL HISTORY SURVEY
<b>William Haneberg</b>	KENTUCKY GEOLOGICAL SURVEY		
<b>Stephen Mabee</b>	MASSACHUSETTS GEOLOGICAL SURVEY		
<b>Richard Ortt</b>	MARYLAND GEOLOGICAL SURVEY		
<b>Robert Marvinney</b>	MAINE GEOLOGICAL SURVEY		
<b>John Yellich</b>	MICHIGAN GEOLOGICAL SURVEY		
<b>Harvey Thorleifson</b>	MINNESOTA GEOLOGICAL SURVEY		
Jerry Prewett	MISSOURI GEOLOGICAL SURVEY		
<b>David Dockery</b>	MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY		
<b>John Metesh</b>	MONTANA BUREAU OF MINES & GEOLOGY		

# Meeting Attendees, *continued*

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## Honoraries and Emeriti

Laurence Becker	VERMONT
Robert Fakundiny	NEW YORK
Bill Kelly	NEW YORK
Marvin Miller	MONTANA
Karl Muessig	NEW JERSEY
Jay Parrish	PENNSYLVANIA
Jonathan Price	NEVADA
Robert Segall	MICHIGAN
John Talley	DELAWARE

## Other Professionals

William Alley	NATIONAL GROUND WATER ASSOCIATION (NGWA)
Roger Barlow	U.S. GEOLOGICAL SURVEY (USGS)
Maeve Boland	UNIVERSITY COLLEGE DUBLIN
Idrissa Boube	BUREAU OF OCEAN ENERGY MANAGEMENT (BOEM)
Jamie Brainard	U.S. GEOLOGICAL SURVEY (USGS)
John Brock	U.S. GEOLOGICAL SURVEY (USGS)
Grant Bromhal	U.S. DEPARTMENT OF ENERGY (USDOE)
Ashley Chappell	NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)
Alan Cohen	U.S. DEPARTMENT OF ENERGY (USDOE)
Tom Crafford	U.S. GEOLOGICAL SURVEY (USGS)
Lindsay Davis	GEOLOGICAL SOCIETY OF AMERICA (GSA)
Craig Dobson	NATIONAL AERONAUTICS AND SPACE AGENCY (NASA)
Perle Dorr	INCORPORATED RESEARCH INSTITUTIONS FOR SEISMOLOGY (IRIS)
Elizabeth Eide	NATIONAL ACADEMY OF SCIENCES
Diane Eldridge	U.S. GEOLOGICAL SURVEY (USGS)
Alfred Elser	U.S. DEPARTMENT OF INTERIOR – BUREAU OF LAND MANAGEMENT
William Ernst	NATIONAL ASSOCIATION OF STATE BOARDS OF GEOLOGY (ASBOG)
Kevin Gallagher	U.S. GEOLOGICAL SURVEY (USGS)
Amy Gilmer	U.S. GEOLOGICAL SURVEY (USGS)
Leila Gonzales	AMERICAN GEOSCIENCES INSTITUTE (AGI)
Susan Hamm	OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY
Kelly Hammerle	BUREAU OF OCEAN ENERGY MANAGEMENT (BOEM)
Aaron Johnson	AMERICAN INSTITUTE OF PROFESSIONAL GEOLOGISTS (AIPG)
Paul Knorr	BUREAU OF OCEAN ENERGY MANAGEMENT (BOEM)
Joseph Maloney	BUREAU OF OCEAN ENERGY MANAGEMENT (BOEM)
Ben Mandler	AMERICAN GEOSCIENCES INSTITUTE (AGI)
Michael Marketti	U.S. GEOLOGICAL SURVEY (USGS)
Darcy McPhee	U.S. GEOLOGICAL SURVEY (USGS)
Anna Normand	AMERICAN GEOSCIENCES INSTITUTE (AGI)
Connor O'Loughlin	U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA) – REGION 3
Renee Orr	BUREAU OF OCEAN ENERGY MANAGEMENT (BOEM)

## Meeting Attendees, *continued*

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### Other Professionals, *continued*

Tim Petty	U.S. DEPARTMENT OF THE INTERIOR
Geoffrey Plumlee	U.S. GEOLOGICAL SURVEY (USGS)
Daryll Pope	U.S. GEOLOGICAL SURVEY (USGS)
Lindsay Powers	U.S. GEOLOGICAL SURVEY (USGS)
Jeffrey Reidenauer	BUREAU OF OCEAN ENERGY MANAGEMENT (BOEM)
Cassandra Rose	AMERICAN GEOSCIENCES INSTITUTE (AGI)
Deana Sneyd	NATIONAL ASSOCIATION OF STATE BOARDS OF GEOLOGY (ASBOG)
Dave Steensen	NATIONAL PARK SERVICE, GEOLOGIC RESOURCES DIVISION
Allison Stork	BUREAU OF OCEAN ENERGY MANAGEMENT (BOEM)
Ren Thompson	U.S. GEOLOGICAL SURVEY (USGS)
Michael Tischler	U.S. GEOLOGICAL SURVEY (USGS)
Jeffrey Waldner	BUREAU OF OCEAN ENERGY MANAGEMENT (BOEM)
Stephen White	NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)
Scott Wilkinson	DELAWARE RETIRED GEOLOGIST
Robert Woodward	INCORPORATED RESEARCH INSTITUTIONS FOR SEISMOLOGY (IRIS)
Dan Yates	GROUND WATER PROTECTION COUNCIL

### Guests/Guest of

Barbara Elk Arthur	FLORIDA/Jon Arthur
Terri Ausbrooks	ARKANSAS/Scott Ausbrooks
Eileen Dallabrida	DELAWARE/David Wunsch
Gratia Deane	NEW YORK/William Kelly
Peter Gale	VERMONT/Marjorie Gale
Diane Klund	NEVADA
Rosemary Kowalchuk	MINNESOTA/Harvey Thorleifson
Yvonne Metesh	MONTANA/John Metesh
Gerald Mitchell	ARKANSAS
Betsy Muessig	NEW JERSEY/Karl
Beth Price	NEVADA/Jonathan Price
Kalyn Tew	ALABAMA/Nick Tew
Linda Thompson	INDIANA/Todd Thompson
Jennifer Thornburg	CALIFORNIA/John Parrish
Karen Yellich	MICHIGAN/John Yellich
Angie Zurawski	TENNESSEE/Ronald Zurawski

# Daily Schedule

## Sunday, June 3

8:00 AM – 5:00 PM	<b>SELF-INTERPRETIVE PRE-MEETING TRIP</b> <i>"Characteristics of Delaware Beach Sand"</i> <i>Rehoboth Beach ~ At your leisure</i>	
3:00 PM – 8:00 PM	<b>REGISTRATION</b>	3 <sup>rd</sup> Floor Atrium
3:00 PM – 5:00 PM	<b>AASG EXECUTIVE COMMITTEE MEETING - CLOSED</b>	Mallard
7:00 PM – 9:00 PM	<b>WELCOMING RECEPTION - LIGHT HORS D'OEUVRES</b>	Swan B & C
9:00 PM – 11:00 PM	<b>HOSPITALITY SUITE OPEN</b>	Hospitality Suite

## Monday, June 4

6:30 AM – 8:00 AM	<b>BREAKFAST</b> – All Registrants	Swan A/Sandpiper
7:00 AM – 8:00 AM	<b>AASG FOUNDATION BREAKFAST MEETING</b>	Mallard
6:30 AM – 5:00 PM	<b>REGISTRATION</b>	3 <sup>rd</sup> Floor Atrium
8:00 AM – 10:00 AM	<b>OPENING PLENARY SESSION (All attendees)</b>	Swan B & C
7:15 AM – 5:15 PM	<b>GUEST FIELD TRIP</b> ♦ <i>Longwood Gardens and the Festival of Fountains –</i> <i>[LUNCH ON YOUR OWN]</i> <i>Leader: Sandy Schenck, DGS</i>  7:15 AM: Start loading bus 5:15 PM: Bus arrives back at hotel	In front of hotel
10:00 AM – 10:30 AM	<b>BREAK</b>	Sandpiper
10:30 AM – 12:00 PM	<b>AASG BUSINESS MEETING - CLOSED</b>	Swan B & C
10:30 AM – 12:00 PM	<b>TECHNICAL SESSION I</b> <i>Highlighting Regional Research Topics</i>	Sanibel
12:00 PM – 1:30 PM	<b>LUNCH</b> – On Your Own	Rehoboth boardwalk restaurants

## Daily Schedule, *continued*

1:30 PM – 3:00 PM	<b>BREAKOUT SESSION I</b> <i>A: Adapting Business Practices for Geological Surveys I</i> <i>B: Current Topics in Geologic Mapping</i>	Sanibel Crane
3:00 PM – 3:30 PM	<b>BREAK</b>	Sandpiper
3:30 PM – 5:00 PM	<b>BREAKOUT SESSION II</b> <i>A: Adapting Business Practices for Geological Surveys II</i> <i>B: Measuring Sustainability in Water</i>	Sanibel Crane
5:00 PM – 6:00 PM	<b>STATEMAP/EDMAP Update and Discussion</b> (Darcy McPhee, USGS)	Sanibel
5:00 PM – 6:00 PM	<b>HONORARY MEMBER MEETING/SOCIAL</b>	Mallard
6:00 PM	<b>DINNER</b> – On Your Own	Rehoboth boardwalk restaurants
7:00 PM – 9:00 PM	<b>Live Music – Open Mic</b> (Host: Dave Wunsch, featuring the Delaware Genealogical Scurvy)	Atlantic Boardwalk Grill
9:00 PM – 11:00 PM	<b>HOSPITALITY SUITE OPEN</b>	Hospitality Suite

### Tuesday, June 5

6:30 AM – 8:00 AM	<b>BREAKFAST</b> – All registrants	Swan A/Sandpiper
7:30 AM – 12:00 PM	<b>REGISTRATION</b>	3 <sup>rd</sup> Floor Atrium
7:00 AM – 8:00 AM	<b>ASSOCIATE’S BREAKFAST</b>	Mallard
8:00 AM – 9:30 AM	<b>BREAKOUT SESSION III</b> <i>A: Critical Minerals-International Supply and Domestic</i> <i>B: Offshore Sand Resources and Marine Minerals</i>	Sanibel Crane
9:30 AM – 10:00 AM	<b>BREAK</b>	Sandpiper
10:00 AM – 10:30 AM	<b>SPECIAL SESSION I: BOEM 5-Year Plan</b>	Swan B & C
10:45 AM – 11:30 AM	<b>SPECIAL SESSION II: 3DEEP – Update and Planning</b>	Swan B & C

## Daily Schedule, *continued*

11:45 AM – 8:00 PM	<b>MID-MEETING FIELD TRIP</b> ♦ <i>“The Delaware Coast: Geology, History, and the Challenges of a Dynamic Environment”</i> [trip cost & lunch included in meeting registration fee] <b>Leaders: Kelvin Ramsey and Scott Andres, DGS</b>  11:45 PM: Start loading buses	In front of hotel
5:30 PM – 8:00 PM	<b>POST-TRIP EVENING SOCIAL</b> 5:30 PM Dinner: barbecue/crab cakes (Park Pavilion) 8:00 PM All buses load and return to hotel	Cape Henlopen State Park
9:00 PM – 11:00 PM	<b>HOSPITALITY SUITE OPEN</b>	Hospitality Suite

### Wednesday, June 6

6:30 AM – 8:00 AM	<b>BREAKFAST</b> – All registrants	Swan A/Sandpiper
7:30 AM – 12:00 PM	<b>REGISTRATION</b>	3 <sup>rd</sup> Floor Atrium
7:30 AM – 10:00 AM	<b>AASG CLOSING BUSINESS MEETING</b> (AASG members only)	Swan B & C
8:45 AM – 3:00 PM	<b>Guest Field Trip</b> ♦ <i>Beach Outlet Stores: Tax-Free Shopping</i> (lunch on your own) <b>Host: Jaime Tomlinson, DGS</b>	In front of hotel
8:30 AM – 10:00 AM	<b>TECHNICAL SESSION II</b> – <i>Federal Partner Special Session</i>	Sanibel
10:00 AM – 10:30 AM	<b>BREAK</b>	Sandpiper
10:30 AM – 12:00 PM	<b>BREAKOUT SESSION IV</b> <i>A: Coastal Shoreline Dynamics</i> <i>B: Airborne LiDAR as an Essential Tool</i> <i>C: Energy Issues</i>	Sanibel Crane Dolphin
12:00 PM – 1:30 PM	<b>LUNCH</b> – On Your Own	Rehoboth boardwalk restaurants
1:30 PM – 3:30 PM	<b>CLOSING PLENARY SESSION</b>	Swan B & C
3:45 PM – 4:15 PM	<b>AASG Meeting Photos</b>	On the Beach

## Daily Schedule, *continued*

6:00 PM – 9:00PM	<b>CLOSING RECEPTION AND BANQUET</b> All Registrants <i>Dr. Art Trembanis, UD College of Earth, Ocean, and Environment</i>	Swan Ballroom
9:00 PM – 11:00 PM	<b>HOSPITALITY SUITE OPEN</b>	Hospitality Suite

### Thursday, June 7

	<b>BREAKFAST</b> - On Your Own	
6:30 AM – 7:30 PM	<b>POST-MEETING FIELD TRIP</b> ♦ <i>"Blue Rocks, Black Powder, and Geology by Train"</i> (LUNCH INCLUDED) <i>Leaders: Sandy Schenck and Pete McLaughlin, DGS</i> 6:30 AM: Safety briefing and load buses 6:45 AM: Bus departs hotel 7:30 PM: Arrive Rehoboth Beach <i>Dinner – on your own</i>	In front of hotel

# Opening Plenary Session

All Registrants

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**Monday, June 4, 8:00 AM – 10:00 AM**

**Rooms: Swan B & C**

8:00– 8:15      **AASG PRESIDENT WELCOME AND REMARKS**

*Steven Masterman, President, AASG*

8:15– 8:35      **HOST PRESENTATION**

*David Wunsch, Director and State Geologist*

8:35– 8:45      **U.S. DEPARTMENT OF THE INTERIOR REMARKS**

*Timothy R. Petty, Assistant Secretary for Water and Science, U.S. Department of Interior*

8:45– 9:00      **U. S. GEOLOGICAL SURVEY REMARKS**

*Dr. James Reilly, Director, U.S. Geological Survey*

**METAL AND MINERALS FOR CHANGING INDUSTRY**

*Geoffrey Plumlee, Acting Director of Energy and Minerals, U.S. Geological Survey*

9:00– 9:15

Mineral resources are the building blocks of civilization, and they continue to be strategically vital to the security and economy of the United States and nations worldwide. The technological revolution of the last 70 years has led to a corresponding revolution in the types of mineral commodities being used and the ways that they are used. This presentation will use recent U.S. Geological Survey minerals research and information to illustrate the changing technological, geological, and societal landscape of metals and minerals in our changing world. It will also underscore the needed roles for economic geology, geochemistry, geophysics, and many other science disciplines in helping the Nation meet the ever-growing demands for mineral resources while maintaining effective environmental stewardship.

# Opening Plenary Session, *continued*

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## **A VISION FOR THE NEXT GENERATION OF TOPOGRAPHIC MAPPING**

*Kevin Gallagher, Associate Director, U.S. Geological Survey*

9:15–9:30

Water – too much, too little, poor quality – is among the defining issues of our times. USGS foundational elevation and hydrography data have long supported a range of critical applications including monitoring water quality and availability, flood forecasting and risk management, fisheries management, environmental health, among many others. The Hydrography Requirements and Benefits Study documented annual benefits of the current program of \$538M, with the potential to increase to \$1.14B if all user needs are met through the development of the next generation of hydrography data. The USGS is in the early stages of defining a vision to develop both the next generation of the 3D Elevation Program (3DEP) and hydrography data derived from and integrated with 3DEP LiDAR data. This session will provide an overview of the strategic vision and serves as a starting point for AASG to provide feedback that will help shape the future generation of USGS topographic information.

## **GROUNDWATER MANAGEMENT IN A CHANGING PLANET**

*William Alley, National Ground Water Association*

9:30–9:50

The evolving role of geoscientists in engaging with stakeholders on groundwater issues is discussed. For most of the public, groundwater is out of sight and out of mind. Our inability to readily see groundwater and limited measurements of this resource contribute to its lack of visibility in discussions of water policy and management. Almost invariably, groundwater is more locally managed than surface water and has a larger and more diverse set of stakeholders.

These characteristics present significant challenges in its management and highlight the importance of a widely shared understanding of groundwater systems. Recent years have seen considerable interest in promoting responsible collective action by the many actors involved in groundwater, including well owners, public agencies, the private sector, and water consumers.

The importance of a multi-scale perspective is emphasized along with the challenges of addressing concepts of sustainability and resilience, capture vs storage depletion, long response times, and the importance of integrated monitoring and modeling.

9:50–10:00

## **HOST ADMINISTRATION INSTRUCTIONS**

*David Wunsch, Director and State Geologist*

# Technical Session I

All Registrants

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**Monday, June 4, 10:30 AM – 12:00 PM**

**Room: Sanibel**

## **Regional Scientific Initiatives Relevant to State Surveys**

**Lead: Peter McLaughlin, Jr., Delaware Geological Survey**

### **LIDAR VERTICAL BIAS ESTIMATION AND DEM CORRECTION IN A TIDAL SALT MARSH**

*John Callahan, Associate Scientist, Delaware Geological Survey*

### **ENVIRONMENTAL OBSERVING IN DELAWARE: COOPERATION AND INNOVATION**

*Daniel Leathers, Delaware State Climatologist, Professor, College of Earth, Ocean, and Environment*

### **RELATING GROUNDWATER USE TO SUBSURFACE GEOLOGY IN THE COASTAL PLAIN OF DELAWARE**

*Peter McLaughlin, Jr., Senior Scientist, Delaware Geological Survey*

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### **LIDAR VERTICAL BIAS ESTIMATION AND DEM CORRECTION IN A TIDAL SALT MARSH**

*John Callahan, Delaware Geological Survey*

In tidal wetlands, small differences in elevation can have large impacts on the present hydrology, vegetation, and habitat. LiDAR-derived Digital Elevation Models, currently used throughout Delaware as the best measure of elevation over large areas, suffer from errors in dense vegetated areas, reducing their effectiveness in hydrologic and topographic wetland applications. This presentation will describe an ongoing DGS project and some preliminary results to better understand and reduce vertical bias in LiDAR-based DEMs for the tidal salt marshes in St. Jones and Blackbird Creek Research Reserves.

### **ENVIRONMENTAL OBSERVING IN DELAWARE: COOPERATION AND INNOVATION**

*Daniel Leathers, University of Delaware*

The Delaware Geological Survey and the Office of the Delaware State Climatologist have been working together for more than 20 years in an effort to bring the most useful real-time data and value-added products to the decision makers, emergency management community and citizens of the Delmarva Region. This cooperation is critical, as most environmental issues are multifaceted including aspects of the lithosphere, the hydrosphere and the atmosphere. Several examples of this cooperation, and the resulting decision-support tools will be reviewed, and possibilities for future collaboration will be considered.

# Technical Session I, *continued*

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## **RELATING GROUNDWATER USE TO SUBSURFACE GEOLOGY IN THE COASTAL PLAIN OF DELAWARE**

*Peter McLaughlin, Jr., Delaware Geological Survey*

Groundwater is the sole source of drinking water and the main source of water for agriculture and industry in central and southern Delaware. The Delaware Geological Survey conducted a study to map each aquifer in Kent and Sussex Counties, assign groundwater withdrawals for 2004 to 2008 to the appropriate aquifer, and assess of groundwater withdrawals for each type of water use by geographic area. The study found that annual groundwater withdrawals for all uses in the study area ranged from approximately 89 to 144 Mgal/d. Withdrawals from the unconfined aquifer provided more than half of the groundwater pumped. Three shallow confined aquifers mostly used in Sussex County (confined Columbia, Pocomoke, and Manokin) provided approximately between 8 and 11 percent each. Withdrawals for the three most important confined aquifers in Kent County (Cheswold, Frederica, and Piney Point) each represent 3 to 5 percent of withdrawals.

# Breakout Session I-A

All Registrants

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**Monday, June 4, 1:30 PM – 3:00 PM**

**Room: Sanibel**

## **Adapting Business Practices for Geological Surveys I**

**Lead: Jon Arthur, State Geologist, Florida**

### **COPING IN A .GOV WORLD WITH A VISION FOR INNOVATION**

*Gale Blackmer, Director and State Geologist, Pennsylvania Geological Survey*

### **FROM .GOV TO .EDU: REINFORCING RELEVANCE IN THE ERA OF “SMALLER GOVERNMENT”**

*Philip Pearthree, Director and State Geologist, Arizona Geological Survey*

### **EFFICIENCIES THROUGH TOTAL PROJECT MANAGEMENT**

*Todd Thompson, Director and State Geologist, Indiana Geological & Water Survey*

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### **COPING IN A .GOV WORLD WITH A VISION FOR INNOVATION**

*Gale Blackmer, Pennsylvania Geological Survey*

For a couple of decades now, the Pennsylvania Geological Survey and its parent Department of Conservation and Natural Resources has intentionally made use of innovative web and database technologies to effectively reach our customers. In particular, the Survey stopped selling print publications, scanned our entire archive, and made our publications available by direct download from links on a web page, or through a spatial search using our web-mapping application (PaGEODE). The publications page received about 103,000 hits annually, and PaGEODE received about 15,000. Last year, all the state’s websites were moved to a Sharepoint platform, which severely restricts format and content, causing consternation across the Department. The pages with links to our publications could not be accommodated at the new web site. A department-wide e-Library is in the works, but has not yet materialized. We fell back on supplying the publication links in an Excel workbook that can be downloaded from the website. The Department did fight to keep access to all of its web mapping applications, so PaGEODE is still available. However, a complete reorganization of the way IT services are delivered to state agencies interrupted the steady flow of IT work in 2017. This affects our plans to update and improve PaGEODE, as well as continued development of public-facing databases of oil/gas well and water well data, and internal databases of geologic data. We are still in the middle of these change processes, working and hoping for an outcome that enhances our ability to serve the citizens of Pennsylvania.

## Breakout Session I-A, *continued*

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### **FROM .GOV TO .EDU: REINFORCING RELEVANCE IN THE ERA OF “SMALLER GOVERNMENT”**

*Philip Pearthree, Arizona Geological Survey*

The Arizona Geological Survey faced an existential crisis in 2016-17. Having survived 40% state budget cuts associated with the Great Recession, the Governor’s Office proposed transferring us to the University of Arizona in early 2016. The nominal rationale was: (1) general streamlining of state government; (2) our science and service orientation was a better fit with the university. Legislation was finalized without detailed scrutiny as part of the budget process near the end of the legislative session, giving us 1.5 months’ notice to move into UA space that is about ¼ of our previous footprint; dismantle nearly all of our 100-year old library collection; cease selling publications; and adapt to new, more complex rules for budgeting and retrieving Indirect Costs for externally funded projects. The biggest issue, however, was that no state funding accompanied the transfer – a clear threat to our continued existence. UA leadership provided 1 year of funding at the level we had received as a state agency with no promises beyond that, so we faced a grim future as a soft-funded research entity that could hardly function as a state geological survey. Fortunately, under the outstanding 10-year leadership of Lee Allison we had substantially increased the profile of the AZGS with important stakeholders in industry, the professional geologic community, and state legislators. We produced geologic maps and reports that were useful to the metallic mineral and aggregate producers and environmental and engineering geologic consultants, and collaborated with many state and federal agencies. Our primarily on-line products addressed availability of geologic resources and water resources, identified geologic hazards, and highlighted the importance of geology in attracting tourists to the state. All of this served us well when a high-ranking legislator introduced legislation in 2017 to establish a line item in the UA budget at the same funding level we had received as a state agency. Although we are not allowed to lobby and the official UA position was neutral, key industry representatives and legislative supporters provided us opportunities to describe the breadth of our activities to many legislators who knew little or nothing about us, and our stakeholder support was strong. During a few nerve-racking months in the spring of 2017, legislation assuring our funding for at least 3 years passed with almost no opposition and was signed into law by the Governor. We now have state funding to match federal programs, are maintaining existing partnerships, and are developing new collaborative efforts with researchers in the UA and other state universities, so our future is reasonably bright. It remains critically important that we maintain positive relationships with a broad range of stakeholders and legislators by continuing to promote our services and their value to the state.

## Breakout Session I-A, *continued*

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### **EFFECIENCIES THROUGH TOTAL PROJECT MANAGEMENT**

*Todd Thompson, Indiana Geological & Water Survey*

During the past 15 years, the Indiana Geological and Water Survey has experienced an almost 50% reduction in staffing due to a significant budget cut followed by a flat state appropriation. A new management model was needed. Two significant changes were undertaken two years ago: 1) the section-based hierarchy was eliminated, and the administration collapsed into the Director and a team of three Assistant Directors for Research, Information Services, and Business; and 2) a cradle-to-grave project management system was implemented for all internal and external Survey activities that extend longer than two weeks. Both have had a significant impact on productivity, performance, and survey-wide collaboration. With the elimination of sections, section heads became researchers once again, and day-to-day activities were elevated to the administration team. This gave the administration better knowledge of Survey activities and needs but increased the management burden on the administration and support staff. Implementing total project management placed a focus on timely deliverables within a constrained budget, reigning in perpetually ongoing projects and duplication of efforts. Moreover, projects are evaluated based on the Survey's strategic plan, and teams are created based on staff capabilities and availability. Collaboration now extends across the old section lines, and the administration can better allocate limited funds for projects and equipment of the greatest need.

# Breakout Session I-B

All Registrants

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**Monday, June 4, 1:30 PM – 3:00 PM**

**Room: Crane**

## **Progress Towards Implementing the 2018 – 2030 NCGMP Strategy**

**Leads: Harvey Thorleifson, State Geologist, Minnesota**

**John Brock, National Cooperative Geologic Mapping Program**

### **INTRODUCTION**

*John Brock, Program Coordinator, USGS National Cooperative Geologic Mapping Program*

### **A NEW START ON INTERMOUNTAIN WESTERN U.S. GEOLOGIC FRAMEWORK INTEGRATION**

*Ren Thompson, U.S. Geological Survey*

### **ENGAGING THE STATE GEOLOGICAL SURVEYS IN NCGMP STRATEGY IMPLEMENTATION**

*David Spears, State Geologist, Virginia Division of Mines, Minerals, & Energy*

### **ESTABLISHING THE 3DEP STATE PLAN**

*Diane Eldridge, U.S. Geological Survey*

### **MAPPING THE STATUS OF GEOLOGIC MAPPING IN THE U.S.**

*Harvey Thorleifson, State Geologist, Minnesota Geological Survey*

### **QUESTION AND ANSWER PANEL DISCUSSION WITH THE SPEAKERS**

*Harvey Thorleifson, State Geologist, Minnesota Geological Survey*

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## **A NEW START ON INTERMOUNTAIN WESTERN U.S. GEOLOGIC FRAMEWORK INTEGRATION**

*Ren Thompson, U.S. Geological Survey*

The Rocky Mountains, Colorado Plateau and Basin and Range provinces constitute nearly 20% of the United States land mass (1.8 million km<sup>2</sup>). Seamless geologic map coverage more detailed than 1:500k-scale does not currently exist across the eleven states in this region, presenting a significant obstacle to the NCGMP Mission to “characterize, interpret, and disseminate a national geologic framework model of the Earth through geologic mapping and associated research”. Consequently, we propose a new geologic mapping, subsurface modeling and research strategy based on digital synthesis of “best available” geologic information at scales no less than 1:250k, organized along E-W crustal transects that span administrative and geologic province boundaries, in tandem with focused scientific research addressing topics of scientific and societal relevance to the region. Research efforts based on regional tectonic, magmatic and landscape evolution bear directly on resource-related groundwater, energy and mineral themes identified as critical by federal, state and academic stakeholders.

## Breakout Session I-B, *continued*

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### **ENGAGING THE STATE GEOLOGICAL SURVEYS IN NCGMP STRATEGY IMPLEMENTATION**

*David Spears, Virginia Division of Mines, Minerals & Energy*

The NCGMP Decadal Strategic Plan distributed in early 2017 was the product of months of collaboration between USGS and AASG. Now, as we envision how the Plan will be implemented, working groups composed of federal and state partners have been formed around each of the major geologic provinces of the coterminous United States. The working groups have drafted “Province-level Templates” which identify the major scientific and societal themes that will drive geologic mapping over the next twelve years. Continued state and federal collaboration will be necessary to achieve the ambitious goals of the Plan.

### **ESTABLISHING THE 3DEP STATE PLAN**

*Diane Eldridge, U.S. Geological Survey*

3DEP aspires to systematically collect enhanced elevation data in the form of LiDAR data over the continental United States, Hawaii and the U.S territories and ifsar data over Alaska. 3DEP is a collaborative program which relies on funding from Federal Agencies, State, Tribal and Local governments, and non-profit agencies. Private sector firms under contract to the government collect the data and provide essential technology solutions to manage and deliver 3DEP products and services. To reach the goal of national coverage, 3DEP is building a national acquisition plan in the form of state-based acquisition plans. USGS is working with the National States Geographic Information Council (NSGIC) in the development of these plans. Recognition and inclusion of the State Geological Surveys is essential to the success of the program. This presentation will lay out the framework to achieve national 3DEP coverage and will define opportunities, roles and responsibilities for the State Geological Surveys to assure the 3DEP State and National Acquisition Strategies incorporate and support State Geologist in pursuit of their mission objectives.

## Breakout Session I-B, *continued*

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### **MAPPING THE STATUS OF GEOLOGIC MAPPING IN THE U.S.**

*Harvey Thorleifson, Minnesota Geological Survey*

What gets measured gets managed. While being a blunt instrument, rankings have consequences, mostly good. In geological mapping, as in all mapping, a status map may well be our most powerful instrument - to stimulate funding, to cause us all to strive, and to promote consensus; superb examples are the 3DEP and the soil mapping status maps. In geologic mapping, we have many excellent status maps, each for one type of mapping – built through much greatly-appreciated effort by NGMDB. What is now needed is a single map showing a composite score, that is based on facts, as well as on much needed judgement, on topics such as what level of resolution is needed for each area and what maps need to be redone. It therefore is proposed that willing State Geologists lead an assessment over the coming year, based on needed consultation, that will produce an assessment of the status of geological mapping, onshore and offshore, that is more detailed than state geologic maps, at a resolution and currency not meant to be upgraded in the foreseeable future, for assessing status and not priority, utilizing polygons such as counties or quadrangles, according to state preference. Pending discussion, included will be geologic maps, surficial maps, and bedrock maps, with consideration of digitizing, elevation data, geophysics, statewide compilation, and database standard. Also included will be consideration of depth to bedrock and to basement, subdivision of sediments and layered rocks into strata, specification of properties needed to facilitate modeling, and basement mapping. Discussion and advice will be needed and welcomed.

# Breakout Session II-A

All Registrants

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**Monday, June 4, 3:30 PM – 5:00 PM**

**Room: Sanibel**

## **Adapting Business Practices for Geological Surveys II**

**Lead: Jon Arthur, State Geologist, Florida**

### **A STORY OF SURVEY DE-CONSTRUCTION WITH RENEWAL BY AN ARMY OF ONE**

*John Yellich, Director, Michigan Geological Survey*

### **MORE THAN DATA PRESERVATION: IMPROVING ACCESSIBILITY TO STATE GEOLOGICAL RESOURCES**

*Lindsay Powers, Program Director NGGDPP, U.S. Geological Survey*

### **TIPS FOR COMMUNICATING AND ENGAGING YOUR STAKEHOLDERS**

*Leila Gonzalez, American Geosciences Institute*

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### **A STORY OF SURVEY DE-CONSTRUCTION WITH RENEWAL BY AN ARMY OF ONE**

*John Yellich, Michigan Geological Survey*

The role of geological surveys across America is changing and many have responded to the current societal needs; however, for a few, recent changes have been draconian and cold blooded that have impacted the foundation of the geological sciences in their respective states. The Michigan changes occurred over 30 years ago and the State has used “fake” science to support geologic data needs and now there is a question, why don’t we understand what is happening? The Michigan Geological Survey (MGS) was legislatively transferred from a defunct role in the State regulatory system to Western Michigan University Geological and Environmental Sciences in October 2011, with no funding. John Yellich was appointed Director in October 2013 and as a staff of one, has worked the entire funding system to capture grants (USGS Federal mapping, NGWA, State DEQ, Qatar, and State Legislature) averaging ~\$400k/year for five years, produced validated geologic information, but as of today, no annual line item budget. MGS cannot hire any staff without annual funding, no soft money, except the Directors salary and expenses. The State has been faced with many geologic problems in these 6 years and the dilemma is that those institutions that postulated the “fake” science continue to sell their programs and where are we now. Questions now are more vocal, why can’t we adequately assess our water resources, can we bottle and ship water, where are the aggregate resources for infrastructure projects, where is the PFAS going and why can’t we predict where we will find another impacted area? Just a few questions MGS is attempting answer with geology in the search to present the case(s) for annual funding.

## Breakout Session II-A, *continued*

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### **MORE THAN DATA PRESERVATION: IMPROVING ACCESSIBILITY TO STATE GEOLOGICAL RESOURCES**

*Lindsay Powers, U.S. Geological Survey*

The National Geological and Geophysical Data Preservation Program is working with states to share knowledge in recommended practices for data and sample preservation, with the expectation that the preserved resources will be more readily accessible to stakeholders. NGGDPP is facilitating working groups on various data preservation and management topics, as well as holding bi-monthly webinars on topics of interest to state surveys. The forthcoming new NGGDPP website will host a collection of recommended practices in data preservation, many of which are contributed by the states. In addition, NGGDPP is working with USGS partners to provide digital infrastructure to serve state data and images to the public, expanding the reach of many state surveys. We are moving beyond just the preservation of data and physical objects to meet the expectations of stakeholders in their ability to readily access public data.

### **TIPS FOR COMMUNICATING AND ENGAGING YOUR STAKEHOLDERS**

*Leila Gonzalez, American Geosciences Institute*

This talk highlights strategies that can be useful for building and improving communication with stakeholders, including identifying and engaging your primary stakeholder audiences, finding ways to encourage those stakeholders to advocate on your behalf to others, and leveraging partnerships to expand exposure and reach. This talk draws on strategies that have been tested by AGI's Critical Issues program; research and collaborations with the state geological surveys, including several years of joint webinars on outreach, communication and web presence; and input from service learning projects conducted by students from Bentley University that have analyzed the Critical Issues program's outreach, marketing and overall business strategies.

## Breakout Session II-B

All Registrants

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**Monday, June 4, 3:30 PM – 5:00 PM**

**Room: Crane**

### Measuring Sustainability in Water Resources

**Lead: Robert Marvinney, State Geologist, Maine**

#### **GROUNDWATER AT REGIONAL AND NATIONAL SCALES: BUILDING THE NATIONAL GROUNDWATER MONITORING NETWORK TO ASSESS GROUNDWATER CONDITIONS**

*Daryll Pope, NGWMN Program Manager, U.S. Geological Survey*

#### **MISSOURI STATE WATER PLAN**

*Joe Gillman, State Geologist, Missouri Geological Survey*

#### **ASSESSING WATER USE AND THE APPLICATION OF SOIL-WATER BALANCE RECHARGE MODELLING IN MAINE**

*Robert Marvinney, State Geologist, Maine Geological Survey*

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#### **GROUNDWATER AT REGIONAL AND NATIONAL SCALES: BUILDING THE NATIONAL GROUDWATER NETWORK TO ASSESS GROUNDWATER CONDITIONS**

*Daryll Pope, U.S. Geological Survey*

The Subcommittee on Ground Water of the Federal Advisory Committee on Water Information has guided the development of the National Ground-Water Monitoring Network (NGWMN). The Network will provide water-level and water-quality data for groundwater resources at a scale appropriate for evaluating the USGS designated Principal Aquifers in the Nation. This presentation will describe the NGWMN, the growth and status of the Network, and examples of assessing groundwater at the Principal aquifer scale.

The key to the NGWMN is the data providers. Maps and graphs showing the current status of the NGWMN and growth of the Network since 2015 will be presented. AASG member participation in the Network will be highlighted. Benefits of participating shared by existing data providers will be presented. Information on how to become a new data provider will also be presented. One of the major purposes of the NGWMN is to provide a tool to help assess groundwater conditions at the Principal aquifer scale. Examples of this type of assessment will be shown for the Northern Atlantic Coastal Plain aquifer system and the High Plains aquifer system.

## Breakout Session II-B, *continued*

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### **MISSOURI STATE WATER PLAN**

*Joe Gillman, Missouri Geological Survey*

The Missouri Water Resources Plan is a long-range, comprehensive strategy to provide an understanding of the state's water resource needs. It will help insure Missouri's water resources will be available to meet projected demands by identifying future shortfalls in water supplies, and exploring options to address those water needs.

### **ASSESSING WATER USE AND THE APPLICATION OF SOIL-WATER BALANCE RECHARGE MODELLING IN MAINE**

*Robert Marvinney, Maine Geological Survey*

The Maine Geological Survey is the primary agency for the compilation of water use information. Through several USGS Water Use Data and Research grants, we compiled water use information across twelve categories and three tiers of detail. Agricultural water use has been a primary focus. Working with the Maine Association of Conservation Districts, we surveyed agricultural producers in ten of Maine's sixteen counties about their use of water during the 2016 calendar year, which contained the driest growing season in over a decade for much of the State. Farms that use water for irrigation or livestock operations were the focus of the survey effort. Data was collected about crop types, irrigated acreage, numbers of livestock, water volumes, irrigation technology and decision making, water sources, and other related information. Three hundred nineteen farms responded to the survey, 199 of which reported using water to irrigate a crop or water livestock.

Thirty-six percent of respondents reported irrigating a crop, and 45% reported watering livestock. Farms that provided their irrigated acreage reported a total of 3,352 irrigated acres, or 12% of the USDA total in the ten counties surveyed. The total water volume reported for crop irrigation in the survey was 549 million gallons, with an area-weighted mean irrigation depth of 8.89 inches applied in 2016. Excluding crops grown under protection, 375 million gallons were applied to crops in the open, with an area-weighted mean irrigation depth of 6.20 inches. The survey successfully captured the temporal patterns of crop irrigation through the growing season for several well-reported crop types. Despite only surveying a subset of Maine's agricultural producers, the design of the survey allowed us to use results to provide predictive factors, such as area-weighted mean irrigation depth, water use per animal, and variables related to other on-farm uses of water. These factors can be used to extrapolate the results of this survey to larger estimates or published values for statewide irrigated crop acres, livestock herds, and farm operations.

Water demand by crop type will be used in a model based on a statewide Soil-Water-balance groundwater recharge model developed by USGS to better estimate irrigation demands.

# STATEMAP/EDMAP Update and Discussion

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## All Registrants

**Monday, June 4, 5:00 PM – 6:00 PM**

**Room: Sanibel**

## **Lead: Darcy McPhee, USGS National Cooperative Geologic Mapping Program**

The STATEMAP program, a component of the National Cooperative Geologic Mapping Program (NCGMP), is a partnership between the U.S. Geological Survey and State Geological Surveys. Congress established the NCGMP and its components in 1992 because, while geologic mapping is a shared interest by federal and state government and academia, no single group has the capability to meet the current and future need for detailed geologic maps. STATEMAP provides state surveys with 1:1 matching funds to produce new geologic mapping projects in their state, leveraging the expertise of their geologists to meet State mapping priorities.

EDMAP is a partnership between the U.S. Geological Survey (USGS) and colleges and universities that provides mentorship and training opportunities to geology students. EDMAP allows upper-level undergraduate and graduate students to gain meaningful experience working on geologic mapping projects under the guidance of a faculty member for a 1-year project. Between 1996 and 2018, EDMAP funded research projects for over 1200 students at over 150 universities. Every Federal dollar awarded is matched by a University dollar.

The STATEMAP and EDMAP Program Officer, Darcy McPhee, will provide a 15-minute update on both programs. Topics to be covered will include updates on the 2018 cooperative agreements, USGS grant approval status, and changes to the program announcements, among others. Discussion and feedback will be encouraged from the State participating members.

# Breakout Session III-A

All Registrants

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**Tuesday, June 5, 8:00 AM – 9:30 AM**

**Room: Sanibel**

## Critical Minerals – International Supply Chains and Domestic Resources

**Lead: Ed Ratchford, State Geologist, Idaho**

### ORE DEPOSITS OF MONTANA

*John Metesh, State Geologist, Montana Geological Survey*

### CRITICAL MINERALS – INTERNATIONAL SUPPLY CHAINS AND DOMESTIC RESOURCES

*Jamie Brainard, Mineral Resources Program, U.S. Geological Survey*

### CRITICAL MINERALS IN NEW MEXICO

*Virginia McLemore, Senior Economic Geologist, New Mexico Geological Survey*

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### ORE DEPOSITS OF MONTANA

*John Metesh, Montana Geological Survey*

Montana started earning its nickname “the Treasure State” with the discovery of placer gold in 1964; within a few years Montana became a world-class producer of gold, silver, copper, lead, zinc, and manganese. When America was “electrified” in the late 1880s, copper became king and Butte, Montana led the production of copper and based metals producing 3 million ounces of gold, 725 million ounces of silver, 433 million pounds of molybdenum, 855 million pounds of lead, 3.7 billion pounds of manganese, 4.9 billion pounds of zinc, and 24 billion pounds of copper in the 20th century. The mills and smelters of Butte supported production of hundreds of smaller mines throughout western Montana. The Beartooth Mountains of south-central Montana hosts the world-class Stillwater Complex Deposit first prospected in the 1880s. Some nickel and copper were produced late in the 19th century, but an extensive chromite deposit led to an aggressive exploration program that revealed new economic value of the complex. Annual production of platinum and palladium is on the order of 100Koz and 500koz, respectively. Montana also hosts numerous base-metal deposits including strata-bound Cu, sedimentary exhalative (SEDEX), banded-Fe, red-bed-Cu, Au-and W-skarn, polymetallic vein (Ag Pb Zn Au Cu), and epithermal-Au as well as porphyry-Cu/Mo. Uranium, thorium, and REEs generally coincide with base- and precious-metal deposits, but there are several notable singular occurrences. Changes in Federal and State laws, CERCLA/RCRA (Superfund/MT Superfund), and public interest has changed the pace and production of precious- and base-metal mining; unresolved Wilderness Areas, proposed new-exploration/mining near Yellowstone National Park, and the ongoing orphan-cost of reclaiming centuries-old environmental impacts has unsettled mining industry in Montana. Exploration and permitting of new mines to exploit critical minerals will require long-term investment in finances, education, and neighbor relations; a renewed commitment to mapping mineral resources will support activities in less sensitive areas.

## Breakout Session III-A, *continued*

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### CRITICAL MINERALS – INTERNATIONAL SUPPLY CHAINS AND DOMESTIC RESOURCES

*James Brainard, U.S. Geological Survey*

There has been recent highlighting of critical minerals for the United States, with emphasis on understanding the domestic supply. However, most of the minerals and materials that are deemed “critical” have origins abroad; and for many of these minerals the U.S. is nearly 100% reliant on imports to meet demand. The supply chain for many of these critical materials is not quite as simple as this appears though - materials cross multiple borders and undergo various stages of processing in different nations. Several of the critical materials that have a high import reliance to the United States have origins in exported domestic ores that are processed overseas. In addition, the U.S. supplies of many of these critical materials that are lost during domestic processing due to insufficient capacity or low economic potential. Here, we attempt to highlight the current state of U.S. critical materials supply with an emphasis on the materials that may have feasible domestic sources. By doing so, we will disentangle some of the international supply chains to illustrate how trade flows are as important as domestic mining in understanding the availability of critical materials for U.S. consumption.

### CRITICAL MINERALS IN NEW MEXICO

*Virginia McLemore, New Mexico Geological Survey*

The growing market for alternative technologies like solar panels, wind turbines, batteries, electric cars, desalination, and carbon capture and storage require nontraditional elements for their manufacture, some of which are considered critical minerals. A “critical mineral,” as defined by EO No. 13817, “is a mineral (1) identified to be a nonfuel mineral or mineral material essential to the economic and national security of the United States, (2) from a supply chain that is vulnerable to disruption, and (3) that serves an essential function in the manufacturing of a product, the absence of which would have substantial consequences for the U.S. economy or national security”. Critical minerals are mineral resources that are essential to our economy and whose supply may be disrupted; many critical minerals are 100% imported into the U.S.

Both uranium and potash are important commodities in New Mexico and are considered critical minerals. Rare earth element deposits are also found in New Mexico. REE-Th-U veins are found in the Gallinas, Capitan, and Cornudas Mountains and Laughlin Peak-Chico Hills; all are associated with Tertiary alkaline to alkalic-calcic igneous rocks. A small amount of bastnaesite, a REE mineral, was recovered during processing of fluorite mined in the Gallinas Mountains. Resources in the Gallinas Mountains amount to at least 537,000 short tons of 2.95% total REE. Disseminated Y-Zr deposits in Proterozoic syenite and nepheline syenite are known at Pajarito Mountain on the Mescalero Apache Indian Reservation near Ruidoso, where one sample contained 6,869 ppm total REE.

Other critical minerals are found in New Mexico. Past production of beryl has been from pegmatites in the Sangre de Cristo Mountains. Past drilling in the Apache Warm Springs deposit in the Sierra Cuchillo by BE Resources, Inc. has identified mineralized zones in altered rhyolite. The deposit is classified as

## Breakout Session III-A, *continued*

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volcanogenic beryllium deposit. Tellurium is also found in New Mexico, where tellurium production has occurred from the Lone Pine deposit (Wilcox district) in the Mogollon Mountains (approximately 5 tons of tellurium ore were produced). Gold-tellurides are found with gold, silver, pyrite, and fluorite in fracture-filling veins in rhyolite at Lone Pine, with reported assays as much as 5,000 ppm Te. Tellurium-bearing deposits also are found in the Organ Mountains, Sylvanite, Tierra Blanca, Grandview Canyon, and Hillsboro districts. Other critical minerals are associated with various mineral deposits in New Mexico. For example, vanadium and molybdenum, by-products of uranium mining, as well as commodities such as selenium and REE, are associated with sandstone uranium deposits in the Grants uranium district. Rhenium is found in porphyry copper and porphyry molybdenum deposits in New Mexico. Coal deposits are abundant in the state and could be source of several critical minerals (REE, Se, V, Ge), but more work is needed to fully understand the distribution of critical minerals in New Mexico coal deposits.

## Breakout Session III-B

All Registrants

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**Tuesday, June 5, 8:00 AM – 9:30 AM**

**Room: Crane**

### Offshore Sand Resources and Marine Minerals

**Lead: Richard Ortt, State Geologist, Maryland**

#### **DEVELOPING A ROADMAP TO ADDRESS AN INCREASING DEMAND FOR SAND FROM THE OUTER CONTINENTAL SHELF**

*Jeffrey Reidenauer, Chief, Minerals Branch, Bureau of Ocean Energy Management*

#### **SAND RESOURCE EVALUATION OF THE SOUTHEAST U.S. COAST**

*Scott Howard, Chief Geologist, South Carolina Geological Survey*

#### **INTEGRATION OF OFFSHORE SAND RESOURCE EVALUATION AND GEOLOGIC MAPPING: A COOPERATIVE EFFORT**

*Kelvin Ramsey, Scientist, Delaware Geological Survey*

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This session includes presentations highlighting the cooperative efforts between the Bureau of Ocean and Energy Management (BOEM) and state geological surveys with a focus on the highly regarded Atlantic Sand Assessment Project (ASAP). This program has benefitted many coastal states with identifying sand resources for beach nourishment and restoration, and is a model that could benefit other U.S. coastal regions as well.

#### **DEVELOPING A ROADMAP TO ADDRESS AN INCREASING DEMAND FOR SAND FROM THE OUTER CONTINENTAL SHELF**

*Jeffrey Reidenauer, Bureau of Ocean Energy Management*

The Bureau of Ocean Energy Management's (BOEM) within the Department of Interior is the sole Federal agency with jurisdiction over Outer Continental Shelf (OCS) marine minerals. The interest in non-energy OCS marine minerals has been primarily for sand for beach nourishment and coastal restoration projects along the Atlantic and Gulf of Mexico coasts. The demand for OCS sand and the average amount of OCS sand used for individual projects has increased over the past 20 years and BOEM anticipates the trend will continue. BOEM foresees situations where there will be multiple requests for the same limited resources in the near future. One of the fundamental tools BOEM is developing to address this evolving issue is a comprehensive National Offshore Sand Inventory. As the environmental steward of OCS sand, BOEM needs to know resource locations, characteristics, and volumes. To that end, BOEM is compiling and centralizing data collected from its historic and ongoing cooperative agreements with coastal states along with data acquisition projects such as its Atlantic Sand Assessment Project (ASAP) into a Marine Minerals Information System (MMIS).

## Breakout Session III-B, *continued*

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### **SAND RESOURCE EVALUATION OF THE SOUTHEAST U.S. COAST**

*Scott Howard, South Carolina Geological Survey*

Following the widespread impact of Hurricane Sandy along the Atlantic coastline in 2012, the Bureau of Ocean Energy Management (BOEM) provided funding for a series of state-level projects under the Hurricane Sandy Atlantic Sand Assessment Project (ASAP). This funding was to assist with identification of sand resources on the Outer Continental Shelf (OCS), which could be mobilized for future renourishment needs, thereby improving community resilience in the wake of large storms. In 2016, BOEM established a southeast Regional Cooperative consisting of state partners from Georgia, North Carolina, and South Carolina. The goal of the Regional project is to evaluate geophysical and geotechnical data collected for ASAP during Phase I and develop a regional understanding of offshore sand resources in the southeast. During Phase I, results of previous multi-year projects by state, local, and federal governments were combined with data collected from universities and private consulting firms to assess the potential value of existing data and to develop a needs assessment of beach communities. In Phase II, work will provide resource assessments developed from geophysical data collected by CB&I in 2015 under contract to BOEM. Other studies to support the Regional project will include: geophysical and geochemical logging of vibracores collected in 2015; more detailed grain-size analyses; detailed lithologic logging of vibracores; age dates of vibracore intervals using <sup>14</sup>C, AAR, and U-Pb in detrital zircon techniques; and detailed mineralogical studies to better understand the heavy mineral and REE content of these offshore sands.

### **INTEGRATION OF OFFSHORE SAND RESOURCE EVALUATION AND GEOLOGIC MAPPING: A COOPERATIVE EFFORT**

*Kelvin Ramsey, Delaware Geological Survey*

Over the past 30 years, a cooperative effort between the Delaware Geological Survey (DGS) and several State and Federal Agencies has resulted in the integration of onshore Coastal Plain stratigraphy into an well-developed offshore stratigraphic framework. The DGS has been involved in projects evaluating onshore and offshore (State and Federal waters) sandy stratigraphic units for beach nourishment since the 1980s with MMS, ACOE, BOEM, and the Maryland Geological Survey. Since 1999, over 300 offshore cores have been added to the DGS Core and Sample Repository as a result of these collaborations. New geophysical data and cores from BOEM and State Survey Cooperatives in 2014 and the Atlantic Sand Assessment Project (ASAP) allowed for the integration of onshore and offshore geology from previous STATEMAP projects into offshore geologic interpretations. The ASAP Project has also resulted in a BOEM-funded regional consortium of the New Jersey, Delaware, Maryland, and Virginia State Surveys along with cooperators from USGS Woods Hole and several universities. This joint project allowed researchers to maximize the geologic information from the data collected in the Delmarva Peninsula region. A major result of this project was the identification of potential sand resources for beach protection at NASA's Wallops Island facility in Virginia.

# Special Session I

All Registrants

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**Tuesday, June 5, 10:00 AM – 10:30 AM****Rooms: Swan B & C**

## **BOEM 5-Year Plan and Offshore Oil and Gas Resource Assessment**

**Lead: Renee Orr, Chief of BOEM's Office of Strategic Resources**

The Bureau of Ocean Energy Management (BOEM) is an agency with the Department of Interior that manages oil and natural gas resources on the U.S. Outer Continental Shelf (OCS). The OCS Lands Act (OCSLA) sets forth procedures for leasing, exploration, development, and production of oil and gas resources, and calls for the preparation of a nationwide OCS oil and gas leasing program with a five-year schedule of lease sales designed to best meet the Nation's energy needs. BOEM is responsible for implementing the requirements of the OCSLA as it relates to the preparation of the leasing program.

BOEM is currently in the process of preparing a 2019–2024 national OCS oil and gas leasing program (generally referred to as the National Program) to replace the existing 2017–2022 National Program. The Draft Proposed Program (DPP; published January 4, 2018) is the first in a series of three proposals made by the Secretary of the Interior consistent with OCSLA, before he may take final action to approve the National Program. The DPP describes a schedule of 47 lease sales that cover all four regions of the U.S. OCS: 19 lease sales in the Alaska Region, seven sales in the Pacific, 12 sales in the Gulf of Mexico, and nine sales in the Atlantic. The DPP would make more than 90 percent of the OCS acreage available to consider for oil and gas leasing during the 2019–2024 period. The next phase of the National Program is the publication of the Proposed Program (anticipated at the end of 2018).

To support the development of the National Program, BOEM periodically prepares an assessment of undiscovered oil and gas resources for the OCS. The most recent BOEM effort is the 2016 assessment of the technically and economically recoverable oil and gas resources for the OCS. The assessment incorporates advances in petroleum exploration and development technologies and includes new global analogue fields. Estimates of undiscovered technically recoverable resources (UTRR) and undiscovered economically recoverable resources (UERR) are used to support and provide the foundation for the economic, social and environmental analysis used to inform the National Program. A comprehensive geologic play-based approach is used and involves developing play models, delineating the geographic limits of each play, and compiling data on critical geologic and reservoir engineering parameters.

In total, BOEM assesses a mean UTRR of 148.8 billion barrels of oil equivalent (BBOE) for the entire U.S. OCS, including 73.7 BBOE in the Gulf of Mexico OCS, 50.7 in the Alaska OCS, 13.1 in the Pacific OCS, and 11.4 in the Atlantic OCS. Economically recoverable resources vary based on an array of price assumptions. The BOEM 2016 assessment includes several changes from the previous BOEM assessment published in 2011. The 2016 assessment shows a decreased UTRR in Gulf of Mexico shallow water gas-prone geologic plays; changes in Atlantic OCS resources due to new information from analogue fields; and decreases in Arctic UERR based on new economic assumptions.

## Special Session II

All Registrants

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**Tuesday, June 5, 10:45 AM – 11:30 AM**

**Rooms: Swan B & C**

### **USGS Partnership Plan to Map and Improve the Nation's Understanding of Subsurface Critical Mineral Resources (3DEEP)**

**Leads: Geoffrey Plumlee, Acting Director of Energy and Minerals, U.S. Geological Survey  
Kevin Gallagher, Associate Director, U.S. Geological Survey  
Tom Crafford, U. S. Geological Survey**

**Panelists: Steve Masterman, Dick Berg, Tom Crafford, Diane Eldridge, John Brock**

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#### **U.S. GEOLOGICAL SURVEY PARTNERSHIP PLAN TO MAP AND IMPROVE THE NATION'S UNDERSTANDING OF SUBSURFACE CRITICAL MINERAL RESOURCES — AKA 3DEEP**

In response to Executive Order 13817, “A Federal Strategy To Ensure Secure and Reliable Supplies of Critical Minerals” and Secretarial Order 3359, “Critical Mineral Independence and Security”, the USGS Mineral Resources Program (MRP), National Cooperative Geologic Mapping Program and National Geospatial Program, have jointly prepared a “Draft U.S. Geological Survey Partnership Plan to Map and Improve the Nation’s Understanding of Subsurface Critical Mineral Resources” (the Plan) that was submitted to Department of Interior Secretary Zinke on April 19, 2018. Originally dubbed 3DEEP, the Plan makes the case for a nationwide program of geologic, geophysical and topographic mapping and data collection to better assess the Nation’s critical minerals resources, and to help ensure U.S. competitiveness and independence in the minerals sector. Although the initial focus is critical minerals, the Plan also acknowledges other vital needs for the data to be gathered, in areas such as ground water resources, geologic hazards, energy resources, and infrastructure development. The Plan discusses the types of needed information and outlines a process by which target critical minerals and regions can be prioritized for data collection and assessment. The Plan proposes mechanisms by which activities can be coordinated with and funds provided to non-federal partners such as the state geological surveys. It also includes sections on data delivery and timelines. The President's Proposed Budget for Fiscal Year 2019 included an increase of \$10.6 million for the USGS MRP to begin work meeting the goals of the plan. This presentation will summarize the Plan and provide a forum for discussion with AASG members on the process going forward.

# Technical Session II

All Registrants

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**Wednesday, June 6, 8:30 AM – 10:00 AM**

**Room: Sanibel**

## Federal Partner Special Session

**Lead: John Brock, USGS National Cooperative Geologic Mapping Program**

### 3D NATION

*Ashley Chappell, Integrated Ocean and Coastal Mapping Coordinator, NOAA*

### NHD PLUS HIGH RESOLUTION

*Roger Barlow, National Map Liaison, U.S. Geological Survey*

### THE INTERMOUNTAIN WEST 3D GEOLOGIC FRAMEWORK PROJECT – AN INTEGRATED APPROACH OF IDENTIFYING CRITICAL MINERAL RESOURCES

*Amy Gilmer, Geosciences and Environmental Change Science Center, U.S. Geological Survey*

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### 3D NATION

*Ashley Chappell, NOAA*

NOAA and USGS are sponsoring a study to design a 3D Nation Requirements and Benefits Study. This study will be a follow-on to the National Enhanced Elevation Assessment (NEEA) and will update the NEEA study for terrestrial elevation, and collect requirements and benefits from users of coastal/nearshore and offshore bathymetry. The 3D Nation Requirements and Benefits Study will take into account new technologies for elevation data collection as well as new uses of the elevation data. It will also take into account the refresh requirements for different activities and geographies, to include coastal areas.

This presentation will include an overview of the plan for collecting user requirements and benefits as well as the study timeline. Study considerations will include target study participants, what activities they are currently engaged in, their geographic area of interest, their data requirements for an integrated national elevation dataset, and the future benefits they could expect to realize if their stated requirements for elevation data were met.

## Technical Session II, *continued*

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### **NHD PLUS HIGH RESOLUTION**

*Roger Barlow, U.S. Geological Survey*

The NHDPlus High Resolution (NHDPlus HR) is a scalable geospatial hydrography framework built from the 1:24,000-scale National Hydrography Dataset, nationally complete Watershed Boundary Dataset, and 1/3 arc-second (10 meter ground spacing) 3D Elevation Program data. The NHDPlus HR brings modeling and assessment down to a neighborhood level, while nesting seamlessly into the national context. Users will find that the NHDPlus HR, which increases the number of features nationally from about three million at 1:100,000-scale in the NHDPlus Version 2, to over 30 million in NHDPlus HR which provides richer, more current content that also can be used at a variety of scales. Observational data on the stream network, such as water quality samples, streamgage measurements, or fish distribution, can be linked to the framework. Together, the framework and linked data can support a wide range and type of applications.

### **THE INTERMOUNTAIN WEST 3D GEOLOGIC FRAMEWORK PROJECT – AN INTEGRATED APPROACH OF IDENTIFYING CRITICAL MINERAL RESOURCES**

*Amy Gilmer, U.S. Geological Survey*

All mineral resource assessments must begin by identifying permissible geologic settings for ore deposit occurrences. Time constraints for such focused studies typically prohibit remapping. This requires rapid assembly of the best available geologic mapping for the study area, and, in many cases, this data may be at a variety of scales, have mismatched boundaries, or even be completely unavailable. Phase I of the Intermountain West 3D Geologic Framework Project will compile and integrate existing and new geologic map data, as well as ancillary data (e.g. geochemistry, geophysics, and geochronology), for a transect area extending across the CO-NM-UT-AZ- NV border region, centered about the 37<sup>th</sup> parallel, into a seamless regional 3-D geologic map framework model. This ready-to-use digital framework will be an essential component for predicting critical mineral occurrences, identifying prospective targets and providing a regional geologic framework for integrated models of ore formation.

# Breakout Session IV-A

All Registrants

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**Wednesday, June 6, 10:30 AM – 12:00 PM**

**Room: Sanibel**

## Coastal Shoreline Dynamics

**Lead: Richard Ortt, State Geologist, Maryland**

### **DETERMINATION OF FUTURE SEA-LEVEL RISE PLANNING SCENARIOS FOR DELAWARE**

*John Callahan, Associate Scientist, Delaware Geological Survey*

### **LAND SUBSIDENCE ON MARYLAND COASTAL PLAIN**

*Richard Ortt, State Geologist, Maryland Geological Survey*

### **NOAA'S USE OF REMOTE SENSING TECHNOLOGY FOR ITS COASTAL MAPPING PROGRAM**

*Stephen White, NGS Remote Sensing Division, NOAA*

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### **DETERMINATION OF FUTURE SEA-LEVEL RISE PLANNING SCENARIOS FOR DELAWARE**

*John Callahan, Delaware Geological Survey*

Globally, sea-level rise (SLR) is primarily due to melting glaciers and thermal expansion, however, regional processes cause the rate of SLR in Delaware to be about twice the global average. With its low, flat topography and significant amount of natural resources and development along the coast, Delaware is extremely vulnerable to the potential impacts of SLR. This presentation will summarize the findings of the 2017 SLR Technical Committee and present new SLR planning scenarios for the state of Delaware.

### **LAND SUBSIDENCE ON MARYLAND COASTAL PLAIN**

*Richard Ortt, Maryland Geological Survey*

Measured sea-level rise is a culmination of both global sea-level rise, local hydrodynamics, and land subsidence. In the mid-Atlantic States, land subsidence is derived from glacial forebulge collapse and groundwater withdrawal creating compaction. Maryland Geological Survey has explored land subsidence through the use of continuously operating GPS reference stations (NOAA CORS) and localized GPS campaign locations to identify regional and local land subsidence. We are in year two of a twenty year program.

## Breakout Session IV-A, *continued*

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### **NOAA'S USE OF REMOTE SENSING TECHNOLOGY FOR ITS COASTAL MAPPING PROGRAM**

*Stephen White, NOAA*

Advancements in acquiring bathymetry and capturing features below the water's surface have significantly improved our knowledge of what lies beneath rivers, lakes, and oceans. Surveying techniques utilize methods such as multibeam sonar, side scan sonar, laser scanners, satellite derived bathymetry (SDB) and topographic-bathymetric LiDAR.

Of these methods, bathymetric LiDAR is becoming the emergent sensor of choice to survey nearshore bathymetry (0-4 meters typically). Bathymetric LiDAR for the acquisition of the nearshore coastal environment, typically uses a narrow, low power beam to transmit a pulse of light and detect its return signal. These sensors provide an efficient, cost effective and overall a safer method to acquire coastal bathymetry versus multibeam, which can be utilized more effectively beyond the 4 meter depth curve. NOAA's National Geodetic Survey (NGS) operates the Riegl VQ-880G LiDAR sensor and surveys coastal shorelines, as well as monitoring the spatial and temporal nature of nearshore bathymetry. NGS also acquires photogrammetry via Trimble Digital Sensor Systems to aid bathymetric LiDAR data collection and independently verify shoreline changes. At times, NGS must also utilize satellite imagery to monitor shoreline changes. These are especially important for remote regions such as Alaska or small areas where aircraft logistics is not ideal to maximize utilization of NOAA's platforms and competing priorities. In this paper, we will describe the historical perspective of remote sensing in NGS, the different remote sensing technologies used today, and the outlook for optical technologies used at NGS in the future.

# Breakout Session IV-B

All Registrants

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**Wednesday, June 6, 10:30 AM – 12:00 PM**

**Room: Crane**

## **Shedding New Light on Familiar Ground: Airborne LiDAR as an Essential Tool for State Geological Surveys**

**Lead: David Norman, State Geologist, Washington**

### **LEVERAGING LiDAR FOR LEGITIMACY: RETAINING RELEVANCE AS A STATE GEOLOGICAL SURVEY IN THE POST-MAPPING ERA**

*Bill Haneberg, State Geologist, Kentucky Geological Survey*

### **LiDAR APPLICATIONS IN AN ELEVATION-CHALLENGED CARBONATE PLATFORM**

*Jon Arthur, State Geologist and Director, Florida Geological Survey*

### **GEOLOGIC HAZARDS VISUALIZED THROUGH LiDAR**

*Dave Norman, State Geologist, Washington Geological Survey*

### **PROGRESS TOWARD THE 3DEP 8-YEAR GOAL AND CHALLENGES AHEAD**

*Kevin Gallagher, Associate Director, U.S. Geological Survey*

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### **LEVERAGING LiDAR FOR LEGITIMACY: RETAINING RELEVANCE AS A STATE GEOLOGICAL SURVEY IN THE POST-MAPPING ERA**

*Bill Haneberg, Kentucky Geological Survey*

The continually increasing availability of airborne LiDAR coverage has revolutionized many aspects of geologic practice and research by providing billions of measurements with which to characterize Earth's surface and the processes acting upon it. Understanding the value of modern elevation data, Kentucky undertook a multi-year and multi-partner \$13M program called KyAPED to obtain statewide airborne LiDAR and multispectral orthophoto coverage. The final deliverables were provided to the state in December 2017. The KyAPED LiDAR data complement Kentucky's existing statewide 1:24,000 bedrock geologic map coverage and offer an opportunity for KGS to re-imagine itself as a post-mapping survey in a state becoming increasingly less dependent upon traditional drivers such as energy and mineral resources. To that end, KGS has established a dedicated Digital Earth Analysis Lab—DEAL—and funded a post-doctoral researcher as part of the survey's strategic goal of establishing itself as the primary source of LiDAR application expertise within the commonwealth. Beyond creating more resolute base maps to support ongoing 1:24,000 surficial mapping, KGS is using airborne LiDAR data to create relative elevation models and better understand fluvial terrace sequences along the Ohio River valley; perform landslide inventory mapping and physics based probabilistic landslide potential modeling in eastern Kentucky; identify surficial expressions of sinkholes in karst terrain at a level of detail not previously possible; explore the limits of geomorphological change detection using repeat LiDAR surveys; perform automated landform classification using pattern recognition and object-based image analysis approaches; and develop machine learning techniques that may help identify abandoned oil and gas well locations throughout the state.

## Breakout Session IV-B, *continued*

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### **LIDAR APPLICATIONS IN AN ELEVATION-CHALLENGED CARBONATE PLATFORM**

*Jon Arthur, Florida Geological Survey*

Florida's low-lying elevation and low-relief topography owes its origins to karst processes, dynamic sea-levels, evolving drainage patterns, and terraforming. Accurate elevation models are essential to address countless needs related to environmental protection and public health, safety, and prosperity. The Florida Geological Survey led an effort supporting statewide LiDAR acquisition with completion of the Florida LiDAR Assessment last summer. Subsequently, the Florida legislature approved funds for statewide, seamless LiDAR data collection. The next goal will be to establish an appropriate update frequency and funding for the new statewide elevation dataset.

Working with the existing patchwork of multi-resolution and multi-temporal LiDAR coverages, the FGS developed relative elevation models supporting refined geologic and geomorphic mapping, and developed a geospatial modeling technique for estimating sinkhole vulnerability. Once the newer, higher resolution data become available, applications will likely include refinement of the sinkhole vulnerability model, the statewide geomorphic and geologic map, and the statewide aquifer contamination potential map. These data will also allow for spatial morphometric analysis of Florida karst features, and slope analyses to identify previously undocumented geologic outcrops, steepheads and stream-to-sink features (swallets). LiDAR data may also be used to calibrate water-table models using elevations of surface water bodies. Updated (repeated) datasets would allow for assessment of temporal sinkhole occurrence, including anthropogenic relationships to sinkholes triggers, as well as assessment of temporal trends in regional water-table elevations. On a more local scale, LiDAR-data updates allow elevation change-detection, yielding coastal erosion insights.

### **GEOLOGIC HAZARDS VISUALIZED THROUGH LIDAR**

*Dave Norman, Washington Geological Survey*

The natural beauty of Washington, including its lush vegetation, hides many serious geologic hazards that present risks to public safety as well as the State's economic interests. Washington is one of the most at-risk states for a variety of geological hazards including earthquakes, volcanoes, tsunamis, and landslides. Washington Geological Survey (WGS) has an established Lidar acquisition program, Lidar Portal, and Geology Portal that people have come to rely on for day-to-day use and decisions regarding geological hazards. WGS uses Lidar in its geological mapping program and the landslide, volcano, earthquake, and tsunami hazard maps to develop the most accurate products available. In Washington, geological maps and hazard maps are used by cities, counties, state agencies and the public to make important permitting, land-use, building code, and other critical decisions. Washington citizens also want better information about the geologic hazards around them and the Lidar and Geology Portals make this readily available in easy to use formats. Lidar-based hazard maps provide information that can potentially save lives and reduce economic losses from landslides, volcanoes, earthquakes, and tsunamis.

## Breakout Session IV-B, *continued*

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### **PROGRESS TOWARD THE 3DEP 8-YEAR GOAL AND CHALLENGES AHEAD**

*Kevin Gallagher, U.S. Geological Survey*

The 3D Elevation Program (3DEP) is striving to meet increasing demand for LiDAR data for growing geologic applications. In Year 3 of the 8-year goal to complete nationwide data acquisition, support and investments in the 3D Elevation Program (3DEP) continue to grow thanks to the collaboration of key partners including AASG. The supplemental funding for hurricanes and wildfires, support for 3DEEP, and other initiatives also help to advance the 3DEP goal. USGS would like to continue to strategize with AASG as we look ahead to the challenge of completing coverage in the western US, and to defining repeat coverage as nationwide data are completed.

# Breakout Session IV-C

All Registrants

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**Wednesday, June 6, 10:30 AM – 12:00 PM**

**Room: Dolphin**

## **Energy Breakout: Updates in Oil and Gas Programs**

**Lead: Nick Tew, State Geologist, Alabama**

### **BUILDING R&D PARTNERSHIPS TO ACHIEVE ENERGY DOMINANCE – EXPLORING A DOE AND AASG PARTNERSHIP**

*Alan J. Cohen, Director of Oil and Gas Research, U.S. Department of Energy*

### **A FOCUS ON DOE BASIN-CENTERED UNCONVENTIONAL OIL AND NATURAL GAS FIELD LABORATORIES AND RELATED RESEARCH**

*Grant S. Bromhal, Research Engineer, U.S. Department of Energy, National Energy Technology Laboratory*

### **GWPC UPDATE: PRODUCED WATER, INDUCED SEISMICITY, AND SOURCE WATER PROTECTION**

*Dan Yates, Associate Executive Director, Ground Water Protection Council*

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This session will include presentations and discussions on current and future energy and related initiatives, primarily in the oil and natural gas exploration, development, and production arena, at the United States Department of Energy and the Groundwater Protection Council. It will focus on potential opportunities for AASG and the state geological surveys with energy and related programs to build new partnerships and enhance existing collaborative efforts with these entities.

### **BUILDING R&D PARTNERSHIPS TO ACHIEVE ENERGY DOMINANCE – EXPLORING A DOE AND AASG PARTNERSHIP**

*Alan J. Cohen, Director of Oil and Gas Research, U.S. Department of Energy*

DOE's Office of Oil and Natural Gas supports research and policy options to ensure responsible development of America's oil and natural gas resources. Our work helps ensure reliable supplies of energy while enhancing national energy security and protecting the environment. Efficient recovery of oil and gas resources requires advances in technology and scientific understanding to address the diverse character of the nation's oil and natural gas resource endowment. Partnering with state geologic surveys, universities and industry has been a hallmark of many DOE oil and natural gas research program initiatives. A brief overview of DOE's current oil and gas research portfolio could provide the platform to explore the prospects for and potential public benefits of a DOE and AASG partnership.

## Breakout Session IV-C, *continued*

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### **A FOCUS ON DOE BASIN-CENTERED UNCONVENTIONAL OIL AND NATURAL GAS FIELD LABORATORIES AND RELATED RESEARCH**

*Grant S. Bromhal, Research Engineer, U.S. Department of Energy*

America's abundant unconventional oil and natural gas resources are critical components of our nation's energy portfolio. A cornerstone of DOE's oil and natural gas research portfolio today includes field laboratory projects designed chiefly to address critical gaps in science and technology necessary to master development in U.S. shale basins. This presentation provides an overview of the scope, purpose, and evolving basin-centered framework for these activities.

### **GWPC UPDATE: PRODUCED WATER, INDUCED SEISMICITY, AND SOURCE WATER PROTECTION**

*Dan Yates, Associate Executive Director, Ground Water Protection Council*

The Ground Water Protection Council (GWPC) is the national association of groundwater and underground injection control (UIC) agencies. GWPC focuses on a wide range of issues including all classes of UIC, source water and wellhead protection, oil and gas regulations, environmental and compliance data management, and many more. Dan will give an update from three areas which significantly overlap with AASG. The "Produced Water Report" will be a comprehensive look at the existing and potential use of oil and gas produced water in three modules: Regulatory & Legal Frameworks; Produced Water Use in the Oilfield; and Produced Water Use & Research Needs Outside the Oilfield. GWPC supports several UIC induced seismicity issues including recent revisions to the StatesFirst Induced Seismicity Primer, creation of a web-application for Oklahoma to monitor Class II UIC and earthquake data in one interactive map tool, and support for the Regional Induced Seismicity Collaborative (RISC). Finally, GWPC is a member and co-chair of the Source Water Collaborative. Dan will discuss potential cooperative efforts between AASG, individual state geologists, and source water protection practitioners. More info available at [www.gwpc.org](http://www.gwpc.org).

# Closing Plenary Session

All Registrants

Wednesday, June 6, 1:30 PM – 3:30 PM

Rooms: Swan B & C

1:30–1:45

## CLOSING PLENARY REMARKS

*Steven Masterman, President, AASG*

## NISAR MISSION: STATUS, BASELINE PLAN, AND OPPORTUNITIES FOR AASG ENGAGEMENT

*Craig Dobson, National Aeronautics and Space Agency (NOAA)*

1:45–2:05

The NASA-ISRO Synthetic Aperture Radar (NISAR) Mission will provide open public access to global coverage of all land and ice-covered surfaces at least twice every 12-days from a sun-synchronous dawn/dusk orbit with an L-band SAR and selected coverage at S-band. The combination of precise navigation to provide repeat-pass interferometry and systematic revisit interval will afford the geoscience community with an unprecedented opportunity to quantify and monitor surface deformation associated with natural hazards such as earthquakes, volcanoes, landslides, and sinkhole/mining collapse and other processes such as subsidence or the subsurface injection or withdrawal of fluids. In addition, these data will support change detection approaches that utilize decorrelation to provide rapid estimation of damage when disaster strikes. While all NISAR data will be publicly accessible after the commissioning phase of the mission, the NISAR Data Utilization Plan provides guidance to potential stakeholders, such as the membership of AASG, regarding opportunities to engage with the NISAR Project and Science Team prior to launch.

## WHITHER AND WHEREFORE GOES GEOSCIENCE RESEARCH?

*Elizabeth Eide, National Academy of Sciences*

2:05–2:35

Those who generate, curate, steward, analyze, purvey, communicate, or otherwise apply geoscience research to address specific societal issues or support decision making have an abundant supply of challenges and opportunities to tackle. What was “interdisciplinary” or “cross-disciplinary” science now has to be aligned with approaches toward science that is “transformative” and “convergent”. Where supporting or conducting basic research once could be justified by the positive aspects of “advancing the field” and “contributing to better understanding of the Earth”, it now also has to include explicit reference toward direct societal impacts. And with the ability to collect, store, or access virtually unlimited quantities of different geoscience data and information, challenges ensue with how to manage, mine, and share these data with the advent of advanced modeling and visualization tools, citizen science, and approaches that begin to employ machine learning and ‘Big Data’ science—all without losing the sources, uncertainties, and integrity of the original data sets. These challenges and their accompanying opportunities will be discussed in the context of the action items from the various breakout sessions at the AASG meeting.

## Closing Plenary Session, *continued*

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- 2:35–2:55      **AASG 2019 ANNUAL MEETING OVERVIEW**  
*John Metesh, Director, Montana Bureau of Mines and Geology*
- 2:55–3:05      **AASG 2020 ANNUAL MEETING OVERVIEW**  
*James Faulds, Director, Nevada Geological Survey*
- 3:05–3:10      **REMARKS FROM OUTGOING PRESIDENT**  
*Steve Masterman, President, AASG*
- 3:10–3:15      **REMARKS FROM INCOMING PRESIDENT**  
*Karen Berry, President-Elect, AASG*
- 3:15–3:30      **HOST ANNOUNCEMENTS/WRAP UP**  
*David Wunsch, 2018 Annual Meeting Host*