January/February 2021

MONTANA GEOLOGICAL SOCIETY NEWSLETTER

Vol 65 No. 2

Guess the View

Where in Montana is this?
Answer on Page 9.

Inside this Issue:

Upcoming Events:

Feb 17 - MGS Zoom Talk- Dr. P. Ted Doughty *(see page 4)*
Mar 18 - MGS Zoom Talk- Clayton Schultz *(see page 7)*

Contact Us:
mtgeo.org / montanageologicalsociety@gmail.com

PO Box 844
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Add our email address to your contacts so your Newsletters & Luncheon announcements don't end up in Spam!

Letter from the Editor

MGS Membership,

2021 is here, and in the opening month it has been, volatile, to say the least. One thing is for certain, the MGS continues on. Our new members on the board have already brought some great ideas to the table to increase opportunities for outreach to our membership, and we are excited to have a slate of speakers lined up this spring. These days, volatility seems to be the big topic (GME anyone?), so let us discuss something related to volatility that any geologist might love: The Volcanic Explosivity Index (VEI).

Developed in 1982, the VEI is the brainchild of Chris Newhall of the USGS and Stephen Self of the University of Hawaii. Three items determine the VEI value, including volume of product erupted, eruption cloud height, and qualitative observations (i.e., “Woah, that was colossal!”; or, “Meh, just a burp.”) The scale is technically open-ended, though the largest eruption in history was given a magnitude of 8. Recent, well-known examples include Mount St. Helens (1980, magnitude 5), Mount Pinatubo (1991, magnitude 6), and Tambora (1815, magnitude 7). Those reaching magnitude 8, include what most consider “super volcanoes”. During the Holocene, the Global Volcanism Program of the Smithsonian Institution has catalogued 7,752 volcanic eruptions (about 75-percent of the total eruptions during the last 11,700 years). Of these eruptions, 49-percent have a VEI of 2 or less, and 90-percent have a VEI magnitude of 3 or less. In the 21st century, only one eruption (Puyehue-Cordón Caulle, 2011, Chile) was given a VEI of 5 or greater.

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One thing to consider, is that VEI does not necessarily correlate with casualties. The eruptions with the most casualties from the 21st century came from eruptions with VEI magnitudes of 3 (Anak Krakatoa, 2018, Indonesia, 426 casualties), 4 (Mount Merapi, 2010, Indonesia, 353 casualties), and 1 (Mount Nyiragonga, Democratic Republic of the Congo, 2002, 245 casualties). Some of these eruptions were directly responsible for tsunamis or landslides (or landslides which caused tsunamis), which are arguably the primary contributors to loss of life from these eruptions. Engineering and construction best management practices (BMPs) are likely contributors to reducing hazards from eruptions, in addition to improvements to the worldwide monitoring array, sensor technology, and observations, including computer modeling and forecasting.

Additionally, eruptions may cause substantial economic harm. The eruption of Eyjafjallajökull in 2010, given a VEI magnitude of 4, caused some of the worst flight disruption over Europe since World War II. The 1991 eruption of Mount Pinatubo, albeit shorter in duration than the eruption of Eyjafjallajökull, resulted in worldwide weather abnormalities and a decrease in global temperatures over the next few years.

Volatility in geological processes is certainly something that interests many of us. It drives our profession, whether it be economic prices, the uncertainty of the Earth’s processes, or seasonal fluctuations in ground water, to name a few. It leaves many unknowns when we attempt to forecast the future. Some technological advances, like computer modeling, improved sensors, and increased processing power, have helped reduce volatility in our line of work. Despite these advances, just like trying to forecast the weather on a weekly (or daily, for that matter) basis, understanding the Earth continues to require more research. I wish you all a less volatile 2021 and hope to continue to see great advances in the name of science.

MGS President,
Spenser Kuhn

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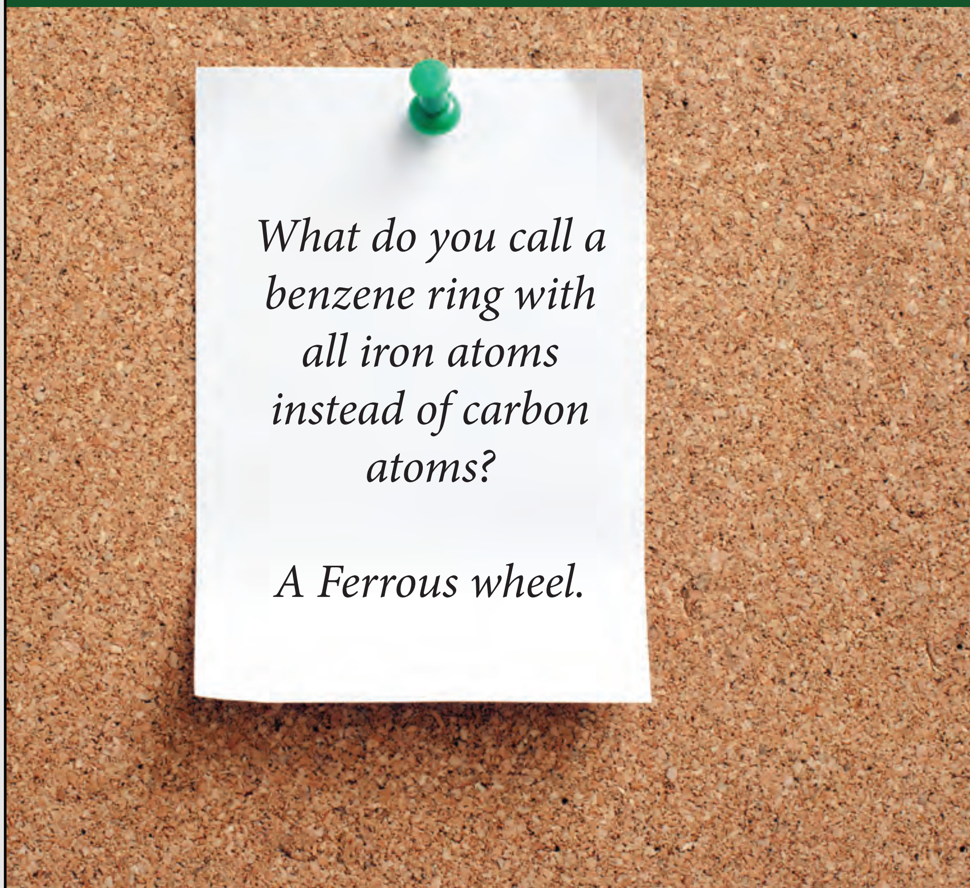

Have something geological to sell, give, or find?

Place a free ad in our MGS Classifieds!

Contact the Newsletter Editor for more information.

MGS Virtual Luncheon Meeting
Wednesday, February 17th
12:00 – 1:00pm

Open to MGS members via Zoom

RSVP to montanageologicalsociety@gmail.com
by Tuesday February 16th to receive the Zoom link

P. Ted Doughty, PhD

PRISEM Geoscience Consulting

Stratigraphy and Sedimentology of Productive Lower Carboniferous Reservoirs in the Bakken Petroleum System, western Montana and Alberta

Lower Carboniferous strata in the Bakken Petroleum System of the United States and Canada are the Banff Formation (part), upper Sappington Shale, Cottonwood Canyon Member of the Lodgepole Formation and to the east, the Upper Bakken Shale. The western facies records major basin reorganization and erosion related to the Antler Orogeny. They overlie an erosional surface that locally rests on the Jefferson/Duperow and extends as far east as Elm Coulee Field. The upper surface is also an erosional boundary beneath the Lodgepole/ Banff limestones that has locally stripped them from paleohighs. This unconformity-bound sequence is its own transgressive systems tract that passes into a correlative conformity in the Williston and Elbow Basins, where the upper Bakken shale has historically been seen as having sharp, but conformable contacts.

Internally, the western facies consist of two members; a lower black shale identical to the Upper Bakken Shale and an overlying sandstone that is not present in the Williston Basin. The sandstone is a very fine-grained, medium bedded, very carbonaceous sandstone with black mudstone laminae intensely bioturbated in the *Zoophychos* Ichnofacies (intermediate subtidal depth). A high gamma-ray signature makes it difficult to identify on logs. A western source for the sand and plant fragments is postulated, perhaps from an uplifted forebulge extensively colonized by terrestrial plants.

In southern Alberta, this sandstone reaches thicknesses of 45+ feet and produces in the Ferguson field, down dip of the Kevin-Sunburst Dome. Here it is referred to as the Banff Sand or the "Alberta Bakken" emphasizing that it is not correlative to the older Middle Bakken or Exshaw. The Ferguson and related sand bodies are erosional remnants of what was once a much thicker depositional system that has been extensively eroded beneath the basal Lodgepole/Banff unconformity. Trapping occurs by truncation of the reservoir along the flank of a paleohigh in an up-dip position on the northern flank of the Dome.

Biography

Dr. Doughty has 20 years of experience as a field geologist, research project leader, associate professor, and, most recently as the founder of PRISEM Geoscience Consulting. He has extensive international

Montana Geological Society
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• E-Mail: montanageolocialsociety@gmail.com
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Montana Geological Society
2020-2021 Annual Research Scholarships

Purpose

The Montana Geological Society (MGS) is a non-profit organization created in 1949 "...to promote interest and research in geology and allied sciences and their practical application, and to encourage fellowship and cooperation among the members." This annual award supports these goals by providing financial assistance for up to two student dissertation, thesis, or senior projects involving Montana geology and by providing a venue for students to present their work to geology professionals in Montana.

Award

Up to two scholarships, one for **$2,000** , and one for **$1,000**, may be awarded each year to the most qualified applicants. The successful applicants agree to present their research results at a luncheon meeting of the MGS in Billings, MT, and will receive reimbursement for travel expenses to and from Billings in addition to the scholarship amount.

Basis of Award

All projects will be reviewed by a committee composed of Officers and Board Members of the MGS. The award will be made based on project merit, difficulty, and innovation appropriate for the applicant's educational level. Projects in the early to middle stages of research will receive preferential consideration over those at or near completion. The awards will only be made to fully qualified and deserving applicants, if any, as determined by the committee.

Eligibility

Scholarships are available only to full-time students working toward a BA, BS, MS, or Ph. D degree in an accredited geology or earth science program at a Montana college or university. The research area must be based at least partially in the state of Montana.

Application Packet

Applicants must submit **1.)** a **brief** cover letter that summarizes the applicant's educational background, current student status (B.S., M.S., Ph. D), anticipated graduation date, and research interests. Include name, mailing address, email address, and phone number, **2.)** a **short** (300 words or less), **concise** summary of their approved or proposed project that includes study area, purpose, and applicability of research to Montana geology, along with an advisor's signature, **3.)** a work flow timeline, and **4.)** an estimated itemized annual budget which specifies how the funds from this award will be used. The budget must include the amount and source of all other project funding.

Deadlines

Applications can be emailed (preferred) or mailed. Emailed applications (as attached file(s) in any standard format) must be sent to montanageologicalsociety@gmail.com no later than 11:59 p.m., **February 28th**. Mailed applications must be post marked no later than **March 1st**, and should be addressed to: Montana Geological Society, PO Box 844, Billings, MT 59103. Awards will be announced and payment made in the form of a check to the successful applicant no later than **April 15st**.

Geology: *In the News*

"Diamonds need voltage"

"In addition to heat and high pressure, small electric fields can also play a decisive role in the formation of this extremely hard carbon compound."

To read the article, please visit:
https://www.sciencedaily.com/releases/2021/01/210121131726.htm

"Tiny bubbles tell tales of big volcanic eruptions"

"Nanocrystals may explain staggering number of bubbles in erupted lava"

To read the rest of the article, please visit:
https://www.sciencedaily.com/releases/2021/01/210119122058.htm

"Rocks show Mars once felt like Iceland"

"Crater study offers window on temperatures 3.5 billion years ago"

To read the article, please visit:
https://www.sciencedaily.com/releases/2021/01/210121131947.htm

"Researchers trace geologic origins of Gulf of Mexico 'super basin' success"

"Only a fraction of the oil has been extracted and much remains buried beneath ancient salt layers, just recently illuminated by modern seismic imaging."

To read the article, please visit:
https://www.sciencedaily.com/releases/2021/01/210115115240.htm

MGS Virtual Luncheon Meeting

Thursday, March 18th

12:00 – 1:00pm

Open to MGS members via Zoom

RSVP to montanageologicalsociety@gmail.com
by Tuesday March 16th to receive the Zoom link

CLAYTON SCHULTZ

SM ENERGY, DENVER, COLORADO

Controls on diagenesis of the Sappington Formation, Bridger Range, southwestern Montana: understanding the significance of facies, stratigraphic architecture, and faults on cement distribution

Diagenesis has a profound effect on the porosity and permeability of sediments, and it is necessary to integrate the depositional, stratigraphic, and structural frameworks together with the burial history to unravel the diagenetic history. This outcrop study from the late Devonian to early Mississippian Sappington Formation of southwestern Montana, USA, investigates the complex interplay of these different geologic factors and their controls on the distribution of diagenetic alterations.

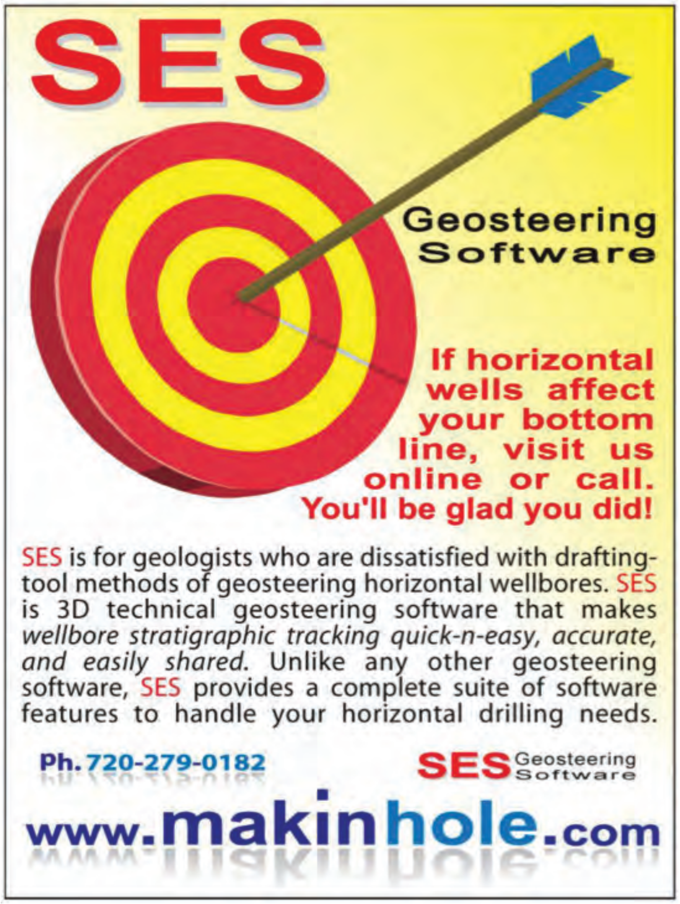
Our results suggest that the principal control on the distribution of diagenetic minerals is the thickness of the lower, middle, and upper Sappington shale members. The sedimentary architecture plays a secondary role as clinoform boundaries and stratigraphic surfaces compartmentalized fluid flow. Structural features are of local importance and depositional facies display little effect on the distribution of diagenetic minerals.

Six dominant cement types were recognized in the Sappington Formation. Quartz and clay cements are the earliest recognized cements and formed on the surfaces of detrital grains during early diagenesis and are relatively minor phases (<5%vol). These are postdated by a series of carbonate cements that dominate the diagenetic mineral assemblage (upwards of >60% vol) and include two forms of dolomite, and two forms of calcite. Dolomite is the most abundant diagenetic mineral and is observed as zoned, euhedral to subhedral rhombs with a nearly stoichiometric core and a series of ferroan rims and as subhedral to anhedral ferroan rhombs without zonation. Calcite cements are most common as a rim on the outer extents of dolomite rhombs but also occur as a replacement of dolomite or detrital feldspar.

The outcrop-based model presented here – the first comprehensive diagenetic model of the Sappington Formation in SW-Montana, USA – can be used to guide hydrocarbon development in tight hybrid plays, such as the Bakken Formation in the Williston Basin, USA, and allows for the relationship between the depositional architecture and the diagenetic alterations to be extended into the second and third dimensions.

Biography

Clayton is a geologist at SM Energy in Denver, Colorado. He received his B.S. in Geological Science from the University of Idaho and his M.S. from the University of Montana. His research interests include clastic depositional systems, sequence stratigraphy, reservoir characterization, and the interplay between tectonics and sedimentation.



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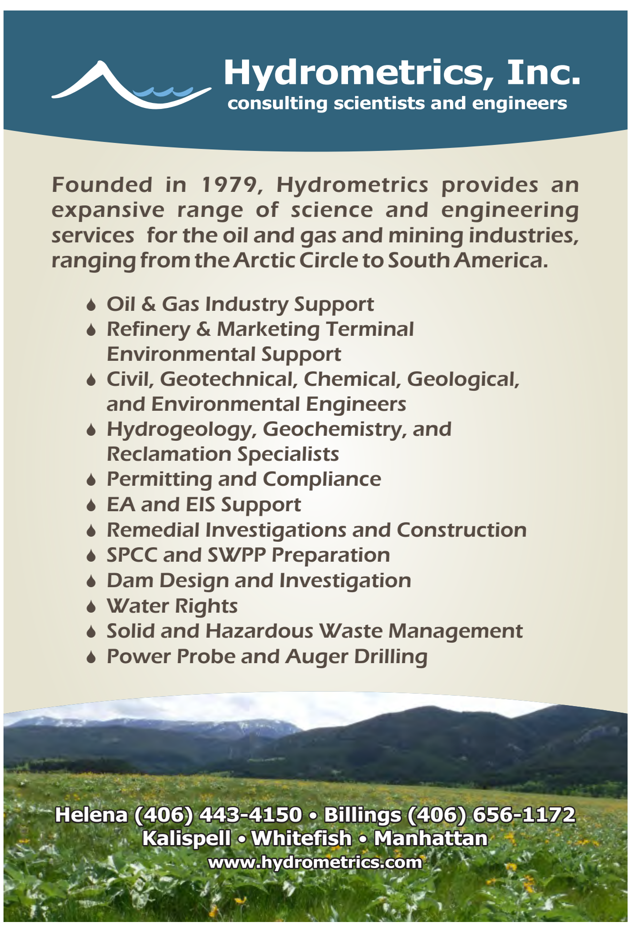

Continued Biography of Dr. P. Ted Doughty, page 4...

experience, working on projects in Colombia, Nigeria, the Netherlands, and over a significant part of offshore and on-shore North America. He began his career working for Amoco Production company in 1990 as an Exploration Geologist in the Arkoma basin of Oklahoma. He then moved to Exxon where some of his duties included 2-D and 3-D seismic interpretation, giving lectures at schools and Exxon classes, as well as leading projects using ground-penetrating radar to map fault zone materials. In 2000 he took on an Associate Professor role at the Eastern Washington University, and was involved in structural geology, tectonics and petroleum geology. Currently he is the President of PRISEM Geoscience Consulting and has worked with such respected companies such as Halliburton Colombia, Rosetta Resources, Petrobakken, Crescent Point, Talisman Energy, Hess Corporation, Husky Energy, and Amarok Energy to name a few.

Guess the View - Answer!

This photo is of **Seeley Lake,**
located in Missoula County.
(Photo taken by Austin Cooper.)

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message us on Facebook.

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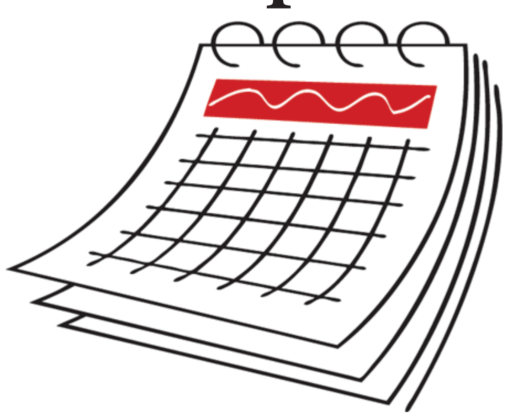

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PUBLICATION	QUANTITY	PRICE	TOTAL
2006 Montana Oil & Gas Fields CD		$65.00	
2006 AAPG Datapages - MGS Publications DVD		$180.00	
2006 AAPG Datapages - MGS Publications DVD (MGS Member price)		$150.00	
2000 50th Anniversary Symposium		$20.00	
1999 Thrust Systems of the Helena Salient		$20.00	
1998 8th Int'l Williston Basin Symposium		$20.00	
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1997 Big Horn Basin Symposium		$20.00	
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1997 AAPG - Rocky Mtn. Section Meeting / Abstract Volume		$10.00	
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1993 Energy and Mineral Resources of Montana		$20.00	
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1991 Sequence Stratigraphy of Eagle Sandstone		$7.50	
1990 Bakken Workshop Short Course Study Notes #1		$10.00	
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