

January 2015

MGS Luncheons,

<u>Anatomy of a Petroleum</u> <u>Source Rock</u> presented by Dr. Barry J. Katz on Thursday, Jan 22nd, pg 3

<u>Event deposition in</u> <u>siliciclastic mudstones –</u> <u>Bjorkasholmen Formation,</u> <u>Sweden; Woodford Shale,</u> <u>OK; and Bakken Shale,</u> <u>North Dakota</u> presented by Dr. Sven Egenhoff on Wenesnay, Feb 4th, pg 5

<u>Model the Rock!</u> <u>Using Diagenesis</u> <u>Simulation for Rock</u> <u>Property Prediction</u> presented by Dr. Robert Lander Thursday, Feb 25th, pg 7

MGS Past President's Dinner, Feb 20th, pg 10

An Upcoming Workshop by PTTC!! Hydraulic Fracturing – Measurement, <u>Characterization,</u> and Analysis Tuesday, Feb 24th, pg 9

Members can RSVP by email or by calling Doretta Brush at Ballard Petroleum 406-259-8790

All meetings are held at the Billings Petroleum Club at 11:45 a.m. unless otherwise noted

MGS HOME PAGE: www.montanags.com MGS EMAIL: montanageologicalsociety@ gmail.com MGS Vol. 59 No. 1

Presidents Letter:

2015 – A new beginning. It is around this time of the year that I always get nostalgic, thinking of past "new years". I remember back when I was in High School and every January 1st at 12:01 one of my friends and his family would come storming through our house with pots and pans screaming at the top of their lungs. The best part is that a couple of the times that they marched through I wasn't even home to witness it. Needless to say, my father would often reply with his own choice words, matching their volume level. Nowadays I am lucky to make it to 11:00 before I decide to turn in (knowing that the kids will be up at 7:00 am, rain or shine). In fact, this year we were fortunate enough to find a new years countdown video on Netflix that we promptly started at 8:59 so that the kids could celebrate (it is new years in Nova Scotia at that time!).

With that in mind I want to talk briefly about the inception of a few concepts that have led us to the profession/passion that we all share today; Geology. In school we all learned about Hutton, Steno, and Darwin, but did you know that as far back as 4th century BC Aristotle dabbled in geology? It is noted that he made many "critical observations of the slow rate of geological change" (1). In fact, he even formulated a theory where the "earth changes at a slow rate and that these changes cannot be observed during one person's lifetime" (2). Pretty cool for someone without the benefits of modern technology! These concepts, along with others that he came up with were centuries more advanced than the common beliefs of his peers. Year later, in the middle ages Abu al-Rayhan al-Biruni (AD 973-1048), a Muslim geologist living in India, hypothesized that "the Indian subcontinent was once a sea."(2). In China Shen Kuo (1031-1095) was leap years ahead of Al Gore when he formulated a theory of gradual climate change. This was based on his observation of petrified bamboo found in an extremely dry region of china (3).

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Doretta Brush

I would have loved to sit in on a "brown bag lecture" given by one of these "geologists" that studied the earth so long ago (with a translator of course...Oh, and of course modern plumbing). Just like these great men and women that studied the earth years ago and shared their findings, we today still have the opportunity to hear, on a monthly basis, some of the newest theories and concepts being shared in our geological community. How you ask? Through the MGS luncheons! Our good Speaker Coordinator Riley Brinkerhoff has lined us up with a handful of exceptional talks in the next coming months. I hope to see you all there!

Mark Millard

(1) Aristotle. Meteorology. Book 1, Part 14

(2) Asimov, M. S.; Bosworth, Clifford Edmund (eds.). The Age of Achievement: A.D. 750 to the End of the Fifteenth Century : The Achievements. History of civilizations of Central Asia. pp. 211–214

(3) http://Wikipedia.org



Geologic Puzzle

MGS Luncheon Meeting

<u>Thursday, January 22nd</u> 11:45 am – Billings Petroleum Club

Please join us for lunch (\$14) and the talk (no charge)

RSVP – <u>montanageologicalsociety@gmail.com</u>, or 406-259-8790 An email reminder will be sent 3 days prior to the talk

DR. BARRY J. KATZ

J. Ben Carsey Distinguished Lecturer Chevron Fellow and Team Leader

Anatomy of a Petroleum Source Rock

With the growing global attention in shale gas and shale oil plays there has been a renewed interest in source rock geochemistry. This has resulted in a number of key questions concerning source characterization, including: 1) how much internal variability might be anticipated; 2) what is the potential impact of the variability on resource assessment; and 3) how best may a source be sampled to "fully" understand its variability?

These questions were examined, in part, through the detailed sampling of the Kimmeridge Clay at the type locality. A representation of variability was obtained from basic source rock data collected on fresh outcrop samples. Total organic carbon contents, for this world-class source rock, varied between 0.88 and 21.35 wt.%, with a mean of 9.13 wt.%. Samples with greater than 1.0 wt.% TOC had total pyrolysis yields ranging between 6.31 and 126.65 mg HC/g rock, with a mean of 54.16 mg HC/g rock. Hydrogen index values ranged from 240 to 611 mg HC/g TOC, with a mean of 516 mg HC/g TOC.

Even these ranges do not fully capture the variability of the source, if data from elsewhere in the North Sea region are included. For example, TOC values exceeding 40 wt% have been measured. Although the hydrogen index values suggested similar liquid hydrocarbon products at Kimmeridge Bay across the outcrop the variability across the North Sea suggests that there are regions that are more gas-prone character. The differences in organic carbon content and hydrocarbon yields, which range by more than an order of magnitude, would have direct impact on estimates of both conventional and unconventional resources, if assessments were based on individual discrete samples.

Discrete sampling either from an outcrop or a core commonly results in bias. Historically, these biases have been skewed toward the more organically enriched samples. This can be overcome through an increase in the number of samples and the incorporation of lithologic information, so that weighted averages can be generated to obtain a better representation of the unit. The analysis of cuttings samples introduces a different suite of problems, associated with representativeness and positioning. Regional variation also needs to be incorporated through an examination of the depositional systems of the unit, ensuring that the key environments are sampled accounting for the impact of factors such as sedimentary dilution, influence of storms, and oxygen content of the water column

Biography

Barry Katz is a Chevron Fellow and team leader for hydrocarbon charge in Chevron's Energy Technology Company. He received his B.S. in geology from Brooklyn College in 1974 and his Ph.D. from the University of Miami in 1979 in marine geology and geophysics.

After receiving his doctorate, Barry joined Texaco's Bellaire Research Center where he held numerous technical and supervisory positions. He continued with Chevron after the merger in 2001, where he has been part of Chevron's Energy Technology Company. His work has focused on petroleum systems, lacustrine basins and the applications of geochemistry



to petroleum exploration and development. He has been engaged in both research and technical support activities and has worked in approximately 50 basins on six continents.

Barry has authored more than 75 peer-reviewed papers and has edited five books. He serves on the editorial boards of four journals, including the AAPG Bulletin as Senior Associate Editor and as Editor-in-Chief of The Open Geology Journal. He has been chairman of IODP's Environmental Protection and Safety Panel for the past decade and serves on the AAPG Research Committee. His honors include being named a Chevron Fellow, Honorary AAPG Member, recipient of AAPG's Robert H. Dott, Sr. Memorial Award, AAPG's Distinguished Service Award, and Nigerian Association of Petroleum Explorations' Best Presentation Award. He served as Elected Editor for the Houston Geological Society and as President of HGS.

He continues to pursue his interests in a broad range of geochemical topics including:

- · Source rock variability and its implications on exploration risk and resource assessment
- · Lacustrine basins: their unique characteristics and implications on exploration and production
- · Geochemical aspects of unconventional petroleum systems

MGS Luncheon Meeting <u>Wednesday, February 4th</u> 11:45 am – Billings Petroleum Club

Please join us for lunch (\$14) and the talk (no charge) RSVP – <u>montanageologicalsociety@gmail.com</u>, or 406-259-8790 An email reminder will be sent 3 days prior to the talk

DR. SVEN EGENHOFF

Professor of Geology at Colorado State University

Event deposition in siliciclastic mudstones – Bjorkasholmen Formation, Sweden; Woodford Shale,OK; and Bakken Shale, North Dakota



On the shelf, below normal but above storm wave base, fine-grained mudstones are deposited during fair weather, and silt- to sandstone intercalations are deposited from storms. The storm deposits become less apparent as shelfal environments approach storm wave base (~50-80 m depth), and below this level bottom waters are thought to be tranquil even during high-energy events. Thus, it has previously been assumed that sediment is principally deposited from suspension settling as particles slowly sink through the water column. However, recent findings in deep (>50-80m depth) shelf strata show that sediment in "shales" were often not deposited from suspension in a tranquil environment. Instead, many shale successions show laminae that resulted from currents depositing organo-mineralic floccules as bed load, e.g. laminae displaying unidirectional ripples. These findings contradict our general ideas of deep shelf quiet-water suspension sedimentation and paint a new picture of a dynamic shelf below storm wave base.

Deep shelf "shales" are exposed in the Ordovician Bjørkåsholmen Formation in Sweden, the Devonian Woodford Shale in the Arbuckle Mountains of Oklahoma, and the Mississippian upper Bakken shale of North Dakota. All of these "shales" appear massive in either outcrop or core, but they all show distinct millimeter- to sub-millimeter laminae in thin section. Siliciclastic mudstones in the Bjørkåsholmen Formation consist largely of 1) intercalated millimeter-thick alternating light- and dark-colored laminae, with organic matter only present in the dark laminae, 2) laterally irregular geometries, and 3) local accumulations of shell or phosphate debris at the bases of the light-colored laminae. Siliciclastic mudstone laminae in the Woodford have a two-fold subdivision with a dark-colored, organic-matter-rich lower part, and a lighter-colored upper organic-lean part in which *Planolites* burrows cluster near each lamina top. Laminae in the upper Bakken shale are less well defined than in the two other examples and original sedimentary structures have been generally modified by burrows from which the organism left variably-oriented fecal strings. In places, the upper Bakken shale shows sub-mm thick "pure" massive mudstones with little to no silt content whereas most mudstones in this unit contain 10-20% of silt.

Each of the laminae are here interpreted to be deposited by a single sedimentary event. The debris at the base of the Bjørkåsholmen Formation laminae indicates waning of the flow prior to the deposition of the light or dark-colored mud. The Woodford Shale example shows deposition of organic-rich mud, likely as fluid mud, and that organisms were grazing through the top portion of each lamina after deposition, depleting it in organic matter, whereas the organic matter-rich basal portion remained unchanged. In the upper Bakken Shale, only the rarely occurring "pure" mudstone laminae may reflect suspension settling

during fair weather whereas the bulk of the succession represents deposition from currents, likely during storm events.

Therefore, similar to observations from the Recent Eel delta, much of the sediment from these three units was most likely deposited by a series of events, punctuated by periods of quiescence that facilitated limited burrowing but did not preserve much sediment. The burrowing and/or presence of fecal strings in all three examples also confirm that these mudstones were deposited in an oxic or dysoxic environment; the presence of organisms clearly argues against anoxia at the time of deposition.

Biography

I was born in Germany, and raised in Germany, Iran, and Argentina which helped shape my career path as a geologist. After finishing high school I studied at the University of Clausthal and Heidelberg, and obtained my Diploma (equivalent to a Masters' degree) from Heidelberg University, Germany, on a field study in the breathtaking Italian Dolomites. Moving to Technische Universität Berlin, Germany, I received my PhD in 2000 for a study on basin analysis in southern Bolivia. After a five year lecturer position at Technische Universität Bergakademie Freiberg in south-eastern Germany I accepted the position as Assistant Professor at Colorado State University in 2006 and was promoted to Associate Professor in 2010. My areas of expertise are understanding sedimentary processes and facies architecture in carbonates and shales, applying those depositional models to characterize oil and gas reservoirs, and to reconstruct fossil habitats of long extinct animal groups such as graptolites.

MGS Luncheon Meeting

<u>Thursday, February 25th</u> 11:45 am – Billings Petroleum Club

Please join us for lunch (\$14) and the talk (no charge)

RSVP – <u>montanageologicalsociety@gmail.com</u>, or 406-259-8790 An email reminder will be sent 3 days prior to the talk

DR. ROBERT LANDER

Haas-Pratt Distinguished Lecturer Director of the Consortium for the Quantitative Prediction of Sandstone Reservoir Quality

Model the Rock! Using Diagenesis Simulation for Rock Property Prediction

With the growing global attention in shale gas and shale oil plays there has been a renewed interest in source rock geochemistry. This has resulted in a number of key questions concerning source characterization, including: 1) how much internal variability might be anticipated; 2) what is the potential impact of the variability on resource assessment; and 3) how best may a source be sampled to "fully" understand its variability?

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Biography

Rob Lander's primary interest is in understanding the controls on diagenetic processes in clastic rocks and using this understanding to develop accurate models of rock properties away from well control and through geologic time. He is the inventor or co-inventor of several simulation systems for diagenesis and reservoir quality prediction including Touchstone[®], T>Map[®], T>Earth[®], Prism2D[®], Exemplar[®], and Cyberstone[®].

Rob co-founded Geocosm LLC and co-directs the company's *Consortium for the Quantitative Prediction of Sandstone Reservoir Quality (RQC)*, which was established in 2001 and currently has 23 members. He also is a Research Fellow with



the Bureau of Economic Geology and collaborates with the *Fracture Research and Applications Consortium* at The University of Texas at Austin. Rob established Geocosm in 2000 after a stint as Technical Director of Geologica AS in Stavanger, Norway. Prior to his time in Norway he was a Senior Research Geologist at Exxon Production Research in Houston, Texas.

Rob has published a number of papers on topics involving diagenesis and reservoir quality prediction (including several Notable Papers in the AAPG Bulletin) and received the Wallace E. Pratt Memorial Award for best paper published in the AAPG Bulletin in 2010. He has a Ph.D. in Geology from the University of Illinois at Urbana-Champaign and a B.A. in Geology from Knox College.



An Upcoming Workshop by PTTC!!



Hydraulic Fracturing - Measurement, Characterization, and Analysis

Petroleum Club, Billings Montana

Tuesday, February 24, 2015: 08:30 AM - 05:00 PM

This one-day workshop is intended to demonstrate recent advances in hydraulic fracturing techniques and how they can be used to characterize the producing reservoir. The basics of hydraulic fracturing are discussed and lead into the complexities associated with treatment design and analysis. Special issues such as non-Darcy flow, G-function analysis, and "mapping" techniques are covered. Case studies demonstrating analysis and various fracturing practices (such as "slickwater" fracs) are presented. The class is designed to be accommodating to all disciplines.

Fee: \$250 MGS Members, \$275 Non-members, includes food, workbook, and PDH certificate.

Instructor

Jennifer L. Miskimins is Senior Consulting Engineer for Barree & Associates in Lakewood, CO. Prior to joining Barree & Associates in 2012, she was an Associate Professor in the Petroleum Engineering Department at the Colorado School of Mines (CSM) in Golden, CO, where she still holds a faculty appointment. Dr. Miskimins holds B.S., M.S., and Ph.D. degrees in petroleum engineering. Prior to joining CSM, she worked for Marathon Oil Company in a variety of locations. Dr. Miskimins is the founder and past Director of the Fracturing, Acidizing, Stimulation Technology (FAST) Consortium at CSM. She teaches a variety of short courses including completions and stimulation classes. She is a member of SPE, SPWLA, and AAPG and was an SPE Distinguished Lecturer for 2010-2011 and 2013-2014.



Register online: www.pttcrockies.org

For more information, contact Mary Carr, 303.273.3107, mcarr@mines.edu

MGS PAST PRESIDENT'S DINNER

In honor of Past President Jay Gunderson, will be held

Friday February 20nd, 2015

Cocktails @ 6:00 pm; Dinner and Program at @ 6:45pm at the Billings Petroleum Club

Please RSVP by Feb 17th to

montanageologicalsociety@gmail.com

(Also, please note if you will be eating Chicken or Beef)

Chicken: Bacon Wrapped Chicken Roulade Beef: Carved Roast Prime Rib



This dinner is OPEN TO ALL MGS MEMBERS and their spouses.

The Dinner will be free for all members, but we ask that you make a small donation to the MGS <u>Scholarship Fund.</u>

Also, if you have any compromising photos of Jay, please forward them to <u>montanageologicalsociety@gmail.com</u>.

The photos may just make an appearance in his "Roast" that evening

We sincerely hope you can join us in one of the <u>most important</u> MGS social functions of the year! Please feel free to share stories of Jay, or just come to socialize with other members and thank Jay for his tireless service and dedication.



June 24-25, 2015 Billings, Montana Metrapark Expo Center



Technical Sessions Presented by American Institute of Professional Geologists



Located in the Rimrock Arena During the Expo

- CALL FOR ABSTRACTS —

Join the American Institute of Professional Geologists (AIPG) at the 2015 Energy Exposition in Billings, Montana! Present and attend the technical sessions organized and hosted by AIPG on June 24th-25th with an optional field trip on Friday, June 26th. The schedule is structured to allow plenty of time to browse and participate in the Energy Exposition. Registration will include 'Breakfast and a Movie' both days, lunch, and reduced ticket pricing for the Expo dinner on June 25th. Go to http://energyexposition. com/ for additional information on the Energy Exposition.

The technical session presentations will be held at the Rimrock Arena within the MetraPark Expo Center, 308 6th Avenue N., Billings, MT 59101.

How To Submit an Abstract

To have your abstract considered for a presentation please go to http:// www.aipg.org/abstract/ to submit an abstract online by March 9, 2015. Abstracts must be in Word format, single spaced, 12 point Times New Roman, and should not exceed one page. No tables or pictures will be accepted. You will be notified by March 27, 2015 if your abstract has been accepted. Authors who wish to publish a paper in AIPG's "The Professional Geologist" (TPG) can contact AIPG for additional information.

The host hotels for the Energy Exposition 2015 are:Crowne PlazaNorthern Hot27 N. 27th Street19 N. BroadwBillings, MT 59101Billings, MT 59(406) 252-7400(406) 867-676Expo rate: \$129 per nightExpo Rate: \$1

tion 2015 are: C Northern Hotel H 19 N. Broadway To Billings, MT 59101 C (406) 867-6767 Expo Rate: \$135 per night

These downtown hotels provide free shuttle service to/from the Billings International Airport. The Energy Exposition will provide free shuttle service to/from the MetraPark Expo Center.

Please contact Cathy Duran at AIPG if you have additional questions. Phone: (303) 412-6205; E-mail: cld@aipg.org

Call for Abstracts Important Dates

March 9, 2015 Abstracts Due March 27, 2015 .. Authors Notified

Suggested Technical Session Topics Include, but are not Limited to:

- Alternative Energy
- CO₂ Activities
- Coal Production
- Enhanced Oil Recovery (EOR)
- Federal, State, Tribal, and Local Regulatory Issues
- Flaring Alternatives
- Frac Sand
- Geothermal Resources
- Hydraulic Fracturing Technologies
- Logging

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- Mining and Economic Geology
- Mitigation Technologies
- Nanoscale Technology/Research - Oil and Gas
- Produced Water Reuse
- Propping Agents and Stimulation Activities
- Safety in the Oilfield
- Social Licensing to Operate
- Stray Gas Migration
- Unconventional Reservoirs
- Uranium Exploration and Production

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	(non-members) -	\$	180.00
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1998 Core Workshop Guide for Williston Basin Symposium		\$	30.00
1997 Bighorn Symposium Guidebook		\$	50.00
1997 MGS-TRGS Field Conference Guide		\$	25.00
"The Edge of the Crazies: Where the Mountains Meet the Plains	"		
1996 AAPG Rocky Mountain Section Meeting Expanded Abstracts Volu	ıme	\$	25.00
1995 Guidebook: Seventh International Williston Basin Symposium			100.00
1993 Guidebook: Energy and Mineral Resources of Central Montana			54.00
1991 6th International Williston Basin Symposium		\$	55.00
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1978 Economic Geology of the Williston Basin		\$	100.00
1971 Catalog of Stratigraphic Names		\$	10.00
1969 Guidebook: Economic Geology of Montana			8.50
1951 BGS 2 nd Annual Central Montana Field Conference			12.50
1950 BGS 1st Annual Field Conference		\$	12.50

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