

# Papers Presented at the 33rd Annual GCSSEPM Foundation Bob F. Perkins Research Conference

---

OMNI Houston Westside  
Houston, Texas  
January 26–28, 2014

**Click on the titles below to navigate to the session and paper you wish to view.**

Session 1: Concepts in rifting and passive margin development

---

Session 2: Rifting continued, and South Atlantic margins

---

Session 3: Ocean crustal fabrics, Atlantic kinematic history, and mantle tomography

---

Session 4: Northern South America

---

Session 5: Equatorial Atlantic margins

---

Session 6: Central Atlantic

---

Session 7: Gulf of Mexico

---

Session 8: Stratigraphic concepts in exploration

---

Posters Only

---

Student Posters

---

---

## Foreword

---

“Mommy, where do basins come from?”

Children do ask good questions!

On the one hand, it might seem that this is a rather esoteric question; on the other hand, the simple explanation of plates ramming together or pulling apart does not fully suffice as a satisfactory answer. From the exploration point of view, how the basin formed is of fundamental importance in determining source rock, reservoir, and their distribution in the basin. Although the exact origin of basins is not the main theme of this conference, our goal is cognizance of their origin and to understand better how this affects petroleum systems. For us in the oil and gas business, this is a matter of prime importance.

Our talks, therefore, start with rifting, as passive margins are from the hydrocarbon point-of-view of extreme importance, and then by area. Finding analogs to plays is as important as finding inspiration in the ideas of others and we certainly hope that all attendees will get something out of the conference.

This conference also has one innovation. There has been much discussion by all groups that more must be done to bring the younger generation into our community. Therefore, we sponsored a poster contest with prizes, a course on the structure and stratigraphic framework of the northern Gulf of Mexico, and invited the students to attend the conference. We hope they will understand that face-to-face contact with colleagues (i.e., networking) is just as important (if not more so) than tweeting and texting. Carl Fiduk organized the effort; course teachers were Ursula Hammes, Mike Blum, Bruce Hart, and Carl Fiduk. Thank you for your time and effort in this endeavor.

Unfortunately, I must add the same paragraph that I had in our last conference: My apology for not having the Proceedings ready for distribution at the time of the conference. It used to be that people had time to write and communicate their results and obtaining permission to do so was a relatively easy task. Now the paper must be completed (often later than expected because of work load) and then submitted for approval by people who are not concerned about our deadlines. If all goes well, we will be mailing the DVDs in March 2014.

There are many people to thank for this conference. Alan Lowrie first proposed the topic. Jim Pindell and Brian Horn then took on the task of getting the show on the road. They pulled together an excellent technical committee to recommend and edit papers. Of course, my thanks to the authors who spent the time in writing the papers and preparing a poster. Mike Nault has been invaluable in ensuring adequate physical arrangements for the conference; Arden Callender was once again in charge of arranging for poster boards; Gail Bergan is in charge of getting the

---

program book and Proceedings DVD together; and Sheila Barnette once again volunteered to be at our registration table. A special thank you also goes to our corporate sponsors who are generously supporting our cause. None of this would have been possible without all of the above. Finally, I thank all of the attendees for coming; it would be difficult to have a conference without you.

*Norman Rosen*  
*Coordinator*

---

## Introduction

---

The 33<sup>rd</sup> Annual GCSSEPM Foundation Bob F. Perkins Research Conference sought to highlight the structural and depositional diversity of sedimentary basins and continental margins, and their associated petroleum systems. This diversity encompasses rifts, sag basins, pull-apart and low-angle detachment basins, foreland basins, and divergent and transform passive margins.

Technological advances in data acquisition are changing our conceptual models of many facets of geology. This, in turn, impacts the way we think, interpret data, and explore for energy resources. Thus, for the first time in the history of the Perkins meetings, a diverse array of seismic sections were provided in the form of a super-poster by ION Geophysical. The super-poster afforded conference-goers the opportunity to examine and discuss with colleagues many of the phenomena presented in the technical sessions, thereby adding to the practical effectiveness of the meeting in general. In addition, an array of 19 student posters was shown throughout the meeting, providing a chance for our industry's future to talk with and gain impressions from the active professionals at the meeting; congratulations to Carl Fiduk for getting this program going.

The phenomena addressed by speakers and demonstrated by the posters and super-posters include recognition of the ongoing dynamics of "passive" margins, visualization of the Moho with implications for heat flow history and crustal balancing during extension, appreciation for low-angle detachment faults in extension, exhumation of subcontinental mantle at continent-ocean transition zones, subsalt imaging, and generation of seaward-dipping reflector packages, all of which help to control subsidence histories at passive margins, and the depositional processes that take advantage of that subsidence.

Special thanks are given to Paul Weimer, Menno Dinkleman, Allen Lowrie, Richard Fillon, James Granath, and Lorcan Kennan, who formed the program committee, suggesting several papers, and assisting with reviews of submitted papers. It should be noted that the original concept for this meeting was suggested by Alan Lowrie. We also would like to thank Dr. Norman Rosen for once again being chief cat herder, as well as our corporate sponsors who generously subsidized the cost of the conference.

*James Pindell (Tectonic Analysis Ltd)*  
*Brian Horn (ION Geophysical)*

---

## Abbreviations (Acronyms and Initialisms)

---

It seems each year that the use of abbreviations increases in the literature. I have not figured out whether this is because journals are trying to save space, whether authors are reflecting trends in texting and tweeting, or people really believe they sound more erudite by using abbreviations. It used to be understood that no abbreviation would be used without a first definition. This is not always done; and when it is done in a 30 page paper, defining it on page 3 and then using the acronym on page 27 often requires the reader to scurry back through the article to find out what the author really means.

Through the years, some abbreviations have become standardized and part of the jargon, such as BOE, Ro, and TOC, at least for us who are involved with hydrocarbon exploration. Many others have not, unless you are writing to a specific subgroup that uses them all the time. However, scientific papers are supposed to be designed for clarity of thought, not writing as quickly as possible. Although clearly informal and spoken English evolves with time, there is a strong rationale for maintaining standards in scientific papers. Excessive use of abbreviations makes for disjointed reading, causing the reader to lose the trend of the argument as he/she deciphers the message. Worse, some acronyms mean different things to different groups (e.g., LOC: is this location, or limit of oceanic crust?) and should be avoided completely.

Authors are vaguely aware that I am the final editor of style in this publication. One of my pet peeves (besides the overuse of the word "with") are acronyms and if they (the authors) had bothered to read the *Instructions to Authors* we give them, we ask specifically that acronyms should **NOT** be used. Despite this, they are. I try to take them out as much as possible, but I cannot eliminate them when used in figures and normally leave them in figure captions; and because of system overload I occasionally let them through in the text. Of course, authors go ahead and use them anyway in their presentation.

For those of us who are not "Great Tectonic Thinkers," the following is an explanation of some of the acronyms used in the following papers and oral presentations. I regret it is not a complete list.

**FA:** Free Air

**FZ:** Fracture Zone

**COB:** Continental-Oceanic (crust) Boundary

**ILOC:** Inward Limit of Oceanic Crust

**LOC:** Limit of Oceanic Crust

**OA2:** Second Oceanic Anoxic Event

**OCB:** Oceanic-Continental (crust) Boundary

**SDR:** Seaward-Dipping Reflectors.

*Norman Rosen, Coordinator*

---

## Table of Contents—Papers Listed by Session

---

### Session 1: Concepts in rifting and passive margin development

<i>Role of Magmatic Evacuation in the Production of SDR Complexes at Magma-Rich Passive Margins</i> .....	1
Pindell, James; Graham, Rod; and Horn, Brian	
<i>Collapse on Passive Margins</i> .....	16
Graham, Rod; Pindell, Jim; and Horn, Brian	
<i>Rifted Continental Margins: Geometric Influence on Crustal Architecture and Melting</i> .....	18
Lundin, Erik R.; Redfield, Thomas F.; and Péron-Pindivic, Gwenn	

### Session 2: Rifting continued, and South Atlantic margins

<i>What Evidence is There for a Thermal Gravity Anomaly at Rifted Continental Margins?</i> .....	54
Longacre, Mark B.	
<i>Contrasting Structural Styles, Brazilian and West African South Atlantic Volcanic and Nonvolcanic Margins: The Impact on Presalt Petroleum Systems</i> .....	64
Love, Frank	
<i>New Insights into Late Synrift Subsidence from Detailed Well Ties and Seismic Mapping, Campos Basin, Brazil</i> .....	98
Lewis, David S.; Ensley, Ross; and Leander, Mark	
<i>Restoring the Angolan Margin: From Crustal Stretching to Salt Nappe Formation, and the Relevance of the 3rd Dimension in Modeling</i> .....	117
von Nicolai, Christina and Scheck-Wenderoth, Magdalena	

---

### **Session 3: Ocean crustal fabrics, Atlantic kinematic history, and mantle tomography**

<i>Formation of Oceanic Core Complexes at Spreading Centers and Implications For Rifted Margins</i> .....	129
Casey, John F.	
<i>Early Central Atlantic Plate Kinematics, and Predicted Subduction History of the proto-Caribbean and Caribbean Lithospheres: Implications for Meso-American Geology</i> .....	131
Pindell, James	
<i>Atlantic Subduction Beneath the Caribbean and Its Effects on the South American Lithosphere</i> .....	146
Levander, Alan; Pindell, James; and Schmitz, Michael	

### **Session 4: Northern South America**

<i>Regional Geology, Tectonics, and Paleogeography of the Cretaceous Colombian Passive Margin Basins: A Predictive Lens Towards Unconventional Prospectivity</i> .....	148
Jensen, Luke A.*; Sanchez-Ferrer, Fernando; Pindell, James; and Kennan, Lorcan	

### **Session 5: Equatorial Atlantic margins**

<i>Crustal Type and Tectonic Evolution of Equatorial Atlantic Transform Margin: Implications to Exploration</i> .....	157
Casey, Katya	
<i>Structure, Evolution, and Petroleum Systems of the Tano Basin, Ghana</i> .....	164
Lake, Stuart; Derewetzky, Aram; and Frewin, Neil*	
<i>Multiage Plays in Offshore Nigeria: Hidden Plays of Neogene Shale Structures, and Robust Lower Miocene to Paleogene Deposition</i> .....	187
Connors, Christopher D. and Radovich, Barbara J.	

---

## **Session 6: Central Atlantic**

- Petroleum Systems of the Central Atlantic Margins, from Outcrop and Subsurface Data* ..... 197  
Wach, Grant; Pimentel, Nuno; and Pena dos Reis, Rui
- Analysis of the Petroleum Systems of the Lusitanian Basin (Western Iberian Margin)—A Tool for Deep Offshore Exploration* ..... 228  
Pena dos Reis, Rui and Pimentel, Nuno
- Overview of the Origin, Depositional Histories, and Petroleum Systems of the Sedimentary Basins of the Eastern United States* ..... 256  
Coleman, James L.

## **Session 7: Gulf of Mexico**

- Geologic and Geophysical Constraints on Crustal Type and Tectonic Evolution of the Gulf of Mexico* ..... 323  
Ross, Malcolm; Mukherjee, Souvik; Kennan, Lorcan; Steffens, Gary S.; Barker, Steve; Hunter-Huston, Holly; Biegert, Ed; Bergman, Steve; and Petitclerc, Tim
- Source-to-Sink Sediment Budgets for Paleogene Gulf of Mexico Deep-Water Stratigraphic Predictions* ..... 329  
Covault, J. A.; Carvajal, C.; Lyons, R.; Milliken, K.; Pyrcz, M.; Sun, T.; and Zarra, L.
- Paleocene-Eocene Drawdown and Refill of the Gulf of Mexico—Concept History and Status* ..... 330  
Rosenfeld, Joshua H.

## **Session 8: Stratigraphic concepts in exploration**

- Deep-Water Sequence Stratigraphy and Exploration Plays in a Frontier Basin: Offshore Tanzania and Mozambique* ..... 350  
McDonough, Katie Joe; Horn, Brian\*; and Brouwer, Friso
- Source-to-Sink Sediment Budget and Partitioning in a Laramide Deep-Water Basin* ..... 371  
Carvajal, Cristian and Steel, Ron



---

<i>Utilizing Channel-Belt Scaling Parameters to Constrain Discharge and Drainage Basin Character with Application to the Mungaroo Formation, Northwest Shelf Australia</i> .....	372
Milliken, K.T.; Willis, B.J.J.; Sun, T.; Payenberg, T.H.D.; Sixsmith, P.; Bracken, B. and Connell, S.D.	

## Posters Only

---

<i>Transportation of Fluids from Ocean Through Sediments and Crust to Mantle, both Ascending and Descending, as Geologically Reasonable in the Northern Gulf of Mexico</i> .....	375
Lowrie, Allen and Fillon, Richard H.	
<i>An Interpretation of Crustal Types across the Northern Gulf of Mexico using Seismic, Potential Fields and 1D Basin Modeling</i> .....	391
Thomas, Kimberly and Ruder, Michal	
<i>A Critical Look at the Creation of Accommodation Space for Salt in the Gulf of Mexico</i> .....	393
Pindell, James; Graham, Rod; and Horn, Brian	

## Student Posters

<i>Imaging Buried Culverts Using Ground Penetrating Radar: Comparing 100 MHz Through 1 GHz Antennae</i> .....	413
Aziz, A. A.; Stewart, R. R.; and Green, S. L.	
<i>Changes in Late Cretaceous-Quaternary Caribbean Plate Motion Directions Inferred from Paleostress Measurements from Striated Fault Planes</i> .....	415
Batbayar, Kherlen; Mann, Paul; and Hippolyte, Jean-Claude	
<i>Paleogeography of the Cenozoic Passive Margin of Northeastern South America in Eastern Venezuela and Trinidad from Seismic Data and Well Information</i> .....	417
Castill, Karilys	
<i>The National Geothermal Data System and Geothermal Gradients in the US Exclusive Economic Zone of the Gulf of Mexico</i> .....	419
Christie, Cory; Nagihara, S.; Badger, C.; Ogiamien, N.; and Ajiboye, O.	

<i>Geomechanical and Acoustic Properties Measurements on Reconsolidated Mudrock Constituents at Reservoir Stresses</i> .....	421
Coleff, Daniel M.	
<i>Understanding Controls on Production Optimization in the Bakken Petroleum System, Williston Basin: A Geologic Study of Shale Heterogeneities at the Field Level</i> .....	423
Crews, Corbin W. II	
<i>The Lobo Formation of Southern New Mexico: A Laramide Syntectonic Deposit</i> .....	424
De los Santos, Marie G.; Lawton, Tim; Copeland, Peter; Hall, Stuart; and Quade, Jay	
<i>Three-Dimensional Reconstruction of Marine Clay Nano- and Microfabric: Importance to Fluid Flow Dynamics</i> .....	426
Douglas, Jessica; Curry, Kenneth J.; and Bennett, Richard H.	
<i>Velocity Analysis by Residual Moveout after Migration from VSP Data</i> .....	427
Du, Yue; Stewart, Robert R.; and Willis, Mark E.	
<i>Comparison of the Depositional and Halokinetic History of Suprasalt and Subsalt Minibasins at Patawarta Diapir, Flinders Ranges, South Australia</i> .....	428
Gannaway, C.E.; Giles, K.A.; Kernen, R.A.; Rowan, M.G.; and Hearon, T.E. IV	
<i>Stages of Mesozoic Rifting, Magmatism, and Salt Deposition in the Eastern Gulf Of Mexico Inferred from a Grid of Deep-Penetration Seismic Reflection Data</i> .....	430
Hasan, Murad and Mann, Paul	
<i>Oblique Extension and Basinward Tilting along the Cañones Fault Zone, West Margin of the Rio Grande Rift</i> .....	432
Liu, Yiduo and Murphy, Michael	
<i>Miocene to Recent Rift History of the Virgin Islands Basin from Integration of Offshore Seismic Data, Inland, Striated Fault Planes, and GPS Results</i> .....	434
Loureiro, Patrick; Mann, Paul; Wang, Guoquan; and Hippolyte, Jean-Claude	

<i>Role of the Offshore Pedro Banks Left-Lateral Strike-Slip Fault Zone in the Plate Tectonic Evolution of the Northern Caribbean</i> .....	436
Ott, Bryan	
<i>Recent Advances in In-Situ Stress Estimation Through Inversion of Wide Azimuth Seismic Data at the Middle Bakken Formation, Williston Basin</i> .....	438
Silva, Josimar; Bachrach, Ran; and Sayers, Colin M.	
<i>Cenozoic Basin Evolution and Uplift History of the Central Andean Plateau, Southern Peru</i> .....	439
Sundell, Kurt E. and Saylor, Joel E.	
<i>Detrital Zircon U-Pb and U-Th/He Double Dating of Lower Miocene Samples from the Gulf of Mexico Margin: Insights into Sediment Provenance and Depositional History</i> .....	441
Xu, Jie; Stockli, Daniel F.; Snedden, John W.; and Fulthorpe, Craig S.	
<i>Is There Deep-Seated Subsidence in the Houston-Galveston Area?</i> .....	443
Yangbo, Yu	
<i>Tectonic-Controlled Stratal Architecture Variability of Shelf-Edge, Growth Faulted Deltaic Systems: A Case Study from the Frio Formation in Corpus Christi Bay, South Texas</i> .....	444
Zhang, Jinyu and Ambrose, William A.	

<b>Author Index</b> .....	<b>A-1</b>
---------------------------	------------

---

# GCSSEPM Foundation

---

## Trustees and Executive Director

### **Anthony D'Agostino (Chairman)**

Hess Corporation  
Houston, Texas

### **Jory Pacht**

Pintail Oil and Gas  
Sugar Land, Texas

### **Patricia Santogrossi**

Consultant  
Houston, Texas

### **Bruce Hart**

Statoil  
Houston, Texas

### **Norman C. Rosen, Executive Director**

NCR & Associates  
Houston, Texas

## Executive Council

### **President**

J. Carl Fiduk  
Schlumberger WesternGeco  
Houston, Texas

### **President Elect**

Paul Post  
BOEM  
New Orleans, Louisiana

### **Vice President**

Thomas Hearon  
Colorado School of Mines  
Golden, Colorado

### **Secretary**

Charlotte Jolley  
Shell International  
Houston, Texas

### **Treasurer**

Brandi Pool Sellepack  
ConocoPhillips  
Houston, Texas

### **Past-President**

Mike Blum  
ExxonMobil Upstream Research Company  
Houston, Texas

---

## Audio-Visual and Poster Committee

**Michael J. Nault (Chairman)**

Applied Biostratigraphix

**Arden Callender**

Applied Biostratigraphix

---

## Technical Program Co-Chairmen

**James Pindell**

Tectonic Analysis, Inc.

**Norman C. Rosen**

NCR & Associates

**Brian Horn**

ION Geophysical, Inc.

## Technical Program Committee

**Paul Weimer**

University of Colorado

**Richard Fillon**

Earth Studies Associates

**Menno Dinkelman**

ION Geophysical, Inc.

**James Granath**

Granath and Associates Consulting

**Allen Lowrie**

Consultant

**Lorcan Kennan**

Shell

---

# Contributors to the GCSSEPM Foundation

---

## Sponsorship Categories

Please accept an invitation from the GCSSEPM Section and Foundation to support Geological and Geophysical Staff and Graduate Student Education in Advanced Applications of Geological Research to Practical Problems of Exploration, Production, and Development Geology.

The GCSSEPM Foundation is *not* part of the SEPM Foundation. In order to keep our conferences priced at a low level and to provide funding for university staff projects and graduate scholarships, we must have industry support. The GCSSEPM Foundation provides several categories of sponsorship. In addition, you may specify, if you wish, that your donation be applied to Staff support, Graduate support, or support of our Conferences. Please take a moment and review our sponsor categories for 2014, as well as our current and past sponsors. In addition, we ask that you visit our sponsors' Web sites by clicking on their logo or name. Thank you for your support.

### Corporate Sponsorships

<b>Diamond</b> (\$15,000 or more)	<b>Silver</b> (\$4,000 to \$5,999)
<b>Platinum</b> (\$10,000 to \$14,999)	<b>Bronze</b> (\$2,000 to \$3,999)
<b>Gold</b> (\$6,000 to \$9,999)	<b>Patron</b> (\$1000 to \$1,999)

### Individuals & Sole Proprietorships

<b>Diamond</b> (\$3,000 or more)	<b>Silver</b> (\$500 to \$999)
<b>Platinum</b> (\$2,000 to \$2,999)	<b>Bronze</b> (\$300 to \$499)
<b>Gold</b> (\$1,000 to \$1,999)	<b>Patron</b> (\$100 to \$299)

---

## Sponsor Acknowledgment

For 2014, all sponsors will be prominently acknowledged on a special page inserted in the 2014 and 2015 Conference Abstracts volume and CDs, and with large placards strategically placed throughout the meeting areas during these conferences.





Corporate-level Diamond sponsors will be acknowledged by having their logo displayed on the back cover of the jewel case for the Conference CD, and having their logo placed in the front matter of the Program & Abstracts volume. Corporate level Platinum sponsors will be acknowledged by having their logo placed in the front matter of the Program & Abstracts volume. All contributions used for scholarships and/or grants will be given with acknowledgment of source.

In addition to the recognition provided to our sponsors in GCSSEPM publications, we proudly provide a link to our sponsors' Web sites. Just click on their logo or name to visit respective GCSSEPM sponsors.

**The GCSSEPM Foundation is a 501(c)(3) exempt organization.** Contributions to the organization are tax deductible as charitable gifts and contributions.






For additional information about making a donation as a sponsor or patron, please contact Dr. Norman C. Rosen, Executive Director, GCSSEPM Foundation, 2719 S. Southern Oaks Drive, Houston, TX 77068-2610. Telephone (voice or fax) 281-586-0833 or e-mail at [gcssepm@comcast.net](mailto:gcssepm@comcast.net).

## 2013–2014 Sponsors

Sponsorship Category	Corporations	Individuals and Sole Proprietorships
Diamond	 <p>ION → Charged to innovate. Driven to solve.™</p>	
Platinum	 	Michael Styzen
Gold		Michael J. Nault ( <a href="#">Applied Biostratigraphix</a> ) J. Carl Fiduk
Silver		Richard Fillon
Bronze		Barbara Radovich



## 2012 Sponsors

Sponsorship Category	Corporations	Individuals and Sole Proprietorships
<b>Platinum</b>	 	Michael Styzen
		
<b>Gold</b>		Michael J. Nault ( <a href="#">Applied Biostratigraphix</a> )
<b>Silver</b>		Ed Picou Patricia Santogrossi Andy Pulham (ESCA&T) Richard Fillon (Earth Science Associates)
<b>Bronze</b>		Nancy Engelhardt-Moore

---

## Credits

---

### CD ROM Design and Publishing by



Rockport, Texas  
[www.bergan.com](http://www.bergan.com)

### Cover Image

The cover image chosen for this year's conference is the Eyjafjallajökull glacier and volcano in southern Iceland. The volcano erupted in April 2010. The ash cloud from the eruption caused cancellation of flights all over the world and for some time closed the entire European airspace. Photo taken May 15, 2010 and obtained from [www.dreamstime.com](http://www.dreamstime.com).

Basins form when continental plates collide or pull apart. The Mid-Atlantic Ridge is the spreading center for the American plate to the west in the North Atlantic and the European plate to the east. It continues to the south and separates Africa from South America. In Iceland the spreading center is exposed, and its volcanoes are part of the Mid-Atlantic Ridge.