

## **Exploring deepwater sedimentary systems in 2023: past, present and future**

**By J. R. Rotzien**

The 39th Annual GCSSEPM Foundation Perkins-Rosen Conference, focused on Deepwater Exploration and Potential, was held at Equinor US in Houston from 4-6 December 2023. The conference started in 1980 as the Gulf Coast Section SEPM (GCSSEPM) Research Conference. The GCSSEPM Foundation was established in 1981 as a 501c3 tax-exempt corporation to organize and conduct the Research Conference, which acquired its present name sequentially in grateful recognition and appreciation of the major contributions of the first Executive Directors of the Foundation, Bob F. Perkins and Norman "Norm" C. Rosen. The Perkins-Rosen Research Conference has created a rich legacy of exploring timely and important sedimentary geology topics, routinely featuring many of the most notable and diverse geoscientists in their respective fields – Chief Geologists, Subject Matter Experts, Presidents & Vice Presidents, Professors, Wildcatters – making it one of the premier and most forward-thinking research conferences in the world every year. In 2023, over 30 presenters and ~40 additional delegates working all oil-producing continents showed the latest results of their deepwater exploration plays and research activities. Conference sponsors included Equinor (venue sponsor), Chevron, ExxonMobil, Petrostrat, RohmTek, and ConocoPhillips.

The conference focused on themes that have matured over the last thirty years since the first deepwater-focused conference in 1994. In 1994, submarine fans and their architecture, processes and deposits were headliners. Some of the key aspects explored last December included:

- Deepwater exploration play types: what has worked and not worked
- New modeling techniques enabling better prediction of deepwater deposits
- Source-to-sink methods that have increased drilling success
- Plays in basins with mobile substrates including salt and mud
- Dogma-busting: where we were 30 years ago, and how we could be thinking about the value of deepwater systems over the next decades
- Deepwater mudrocks and their role as source, reservoir and seals

The conference technical committee was led by some of the most esteemed deepwater explorers from industry, academic institutions and government agencies including Luke Walker, Juan Fedele, Tao Sun, Lori Fremin, Daniel Minisini, Samuel Plitzuweit, Kevin Reece and John Snedden.

The conveners included the editors of the deepwater treatise published by Elsevier in 2022: Cindy Yeilding, Richard Sears, F. Javier Hernández-Molina and Jon Rotzien. John Suter of the GCSSEPM Foundation and Howard Harper and Theresa Scott of SEPM are sincerely thanked for their leadership and help in developing and executing the 2023 conference. Cassie Turley and Michele Tomlinson of SEPM are particularly

thanked for their sterling efforts with conference logistics, abstract handling and editing, and proceedings volume preparation.

John Suter, Executive Director of the GCSSEPM Foundation, said, "We were thrilled by the success of the 2023 Perkins-Rosen Research Conference. Attendance was very good, and the participants represented a good cross-section of industry, academia, government agencies, students and early career geoscientists. The quality of the presentations, posters, and the final-day short course were uniformly excellent. We saw results of some of the latest deepwater-related research and exploration activities from all petroleum producing continents, focusing on the Gulf of Mexico, the home basin, as it were, of the GCSSEPM. Numerous presenters focused on new/unrecognized or under-appreciated/forgotten exploration plays and encouraged the audience to bring a disruptive or out-of-the-box mindset to exploration. Discussions had very good audience participation, and daily panels highlighted salient presentations and generated further spirited discussions about the science and industry, present and future. Overall, it was a great technical meeting! Feedback has been very positive, and we hope to build on this success going forward."

### **Monday, December 4 – Day 1 of the Perkins-Rosen Research Conference**

On Monday, December 4, the conference kicked off with the first keynote titled "Onlap trapping in deepwater settings: a global overview" by Fernando Sanchez Ferrer (Shell). This presentation examined deepwater stratigraphic traps and where these giant play types are headed globally.

Fernando Sanchez said: "It impressed me that there's continued research into deepwater systems. Their prospectivity still commands the industry's interest, especially strat-trap plays in frontier areas. High resolution 3D provided exceptional definition of sediment architecture. Regional studies addressed system evolution through time. Modelling provided insights on authigenic processes relevant to prospectivity assessment, in particular channel avulsion and lateral migration. I particularly appreciated the integration of field work. This was demonstrated in several talks, dealing with both carbonate and clastic systems. Field studies are the great paradigm breaker, and we need to keep doing them. The audience was cognizant of the need of 'disruptive' insights to keep evolving and improving. I was glad to see that there remains a close and fruitful interaction between industry and academia around deepwater systems. I noticed a certain lack of younger attendees and presenters. We need to think how to keep the field of petroleum geology still appealing to the new generations. The atmosphere was great. There was openness and lively debate. People were respectful and humorous. With the industry diversification into renewables, exploration has become more difficult and takes a lot of determination. AI has made the more mechanical processes easier. Yet, nothing will replace the multi-disciplinary experience and intuition that explorers and field geologist acquire through their carriers. It's important to read and be familiar with existing work, as a great deal of the new opportunities may be in established areas."

Mark Shann (Westlawn Americas Offshore) presented the second keynote titled “The search for disruptive-scale exploration discoveries in deepwater systems and how global play analogues might be represented in the remaining play potential of the Gulf of Mexico.” Shann explained some of the recent giants including Zama (Sierra) and the potential for future GOM discoveries, recognizing that ‘rebel thinking’ plays a key role in busting exploration dogma.

Mark Shann said, “The US Gulf of Mexico continues to deliver a strong exploration prospect inventory from the application of cutting-edge seismic technology and in the adoption of frack-type completion for the Lower Tertiary reservoirs, where significant STOOIP has already been proven. Is there potential for remaining “disruptive scale” exploration discoveries in the US GoM and in new plays? Global analogues are supportive of both upper-slope sandy debrite reservoir type plays, potentially under the present-day flex trend and in middle-slope channelized turbidites (a Girassol type play), as well as drill-out of the remaining lower-slope turtle structures, where all three play types can concentrate NTG. Deeper play potential also exists in the Cretaceous, potentially in isolated carbonates across the eastern gulf and even potential for sub-salt lacustrine turbidites.”

### **Exploring for Giants**

Following the mid-morning poster and refreshment break, Samuel Plitzuweit (ExxonMobil) and Daniel Minisini (Shell) co-chaired the first session titled “Exploring for Deepwater Giants” inspired by the recent volume coordinated by Charles Sternbach. The prolific Minisini, who has authored numerous prominent works on deepwater, the Vaca Muerta and other unconventional plays featured in keynote talks (GeoGulf '23) and on his YouTube channel, delivered the presentation “Natural seepage in the Gulf of Mexico, an overview and the link with exploration” in a first-of-its-kind music video format, with the music written by DJ Minisini himself. According to Shell and various executives including Bill Langin (IMAGE '23), this method may highlight a more direct interpretation of giant fields at depth and usher a new wave of deepwater discoveries in basins around the world.

Daniel Minisini, now with ExxonMobil, spoke about the conference: “The present status is not as healthy as it was few years ago (Pre-Covid), mainly because of the lack of new acolytes (geological departments have less and less students, best students look at other disciplines) and shrink of exploration (less long-term view, less investment, less courage to drill). However, because of this reality deepwater sedimentary geology has learned to survive by making more multidisciplinary and multiscale efforts. In the future, sedimentary geology will have to understand the links with petrophysics and answer the needs of geomechanicists to get closer to the higher interest in near field exploration and field development. This means increasing the resolution of all studies (in horizontal and vertical scales, in geological time, in 4D). Studies related to permeability, thin rates of reservoirs, timing of salt movement, frequency of events, unconformities and disconformities will have more attention. And – mudrocks will have to be included in the

classic studies of siliciclastic and carbonate reservoirs. In fact, the sedimentology of mudrocks will represent a new vessel to add value in the statistical net-to-gross analysis, the pore-pressure driven seal assessment, the mostly geochemically definition of source rocks. Furthermore, I think that chronostratigraphic frameworks will be key to create a common platform to host new big datasets.”

Plitzuweit, one of XOM’s most talented subsurface interpreters, discussed “Impact of provenance and depositional processes on mudrock properties and hydrocarbon exploration in ultra-deepwater reservoir systems.” This presentation was a rarity, as it discussed some of the novel and valuable results from the ExxonMobil team co-led by industry legend James Macquaker and senior advisor David Abt from the Eastern Hemispheres team.

Concluding this first session was Paul Mann (University of Houston) with “The final frontier of deepwater exploration: the continent–ocean transition zone.” Mann and his team at the industry-leading Conjugate Basins, Tectonics and Hydrocarbons (CBTH) Consortium have arguably published more impactful research on these topics than any other team in the world. Recently featured in AAPG volumes and setting the stage for *Deepwater Sedimentary Systems*, Mann’s talk discussed the key themes that make the continent-ocean transition zone highly prospective. This dogma has been challenged for a nearly a decade, most recently in AAPG Memoir 125: Giant Fields of 2010-2020.

Paul Mann said, “This was a great conference showing some important links between large-scale tectonics and sedimentary deposition – both key elements for deepwater exploration.”

Following lunch, conference delegates were invited to enjoy coffee and dessert while interacting with poster presenters from 12:45-1:30pm.

Following lunch and the poster break, John Snedden (University of Texas Institute for Geophysics) and Cindy Yeilding (retired, bp; Denbury, Inc.) – the original dogma busters themselves (i.e., Thunder Horse, *The Explorer’s Mindset*, etc.) – co-chaired the second session titled “Paradigm- and Dogma-Busting in Deepwater System Research and Applications.”

First up was “A roadmap for relevant research” presented by Richard A. Sears (retired, Shell; Gamechanger) with co-author Cindy Yeilding. This powerful duo, bringing together nearly 80 years of experience largely with Shell and BP, demonstrated how teams within a company and outside of a company can work together to build valuable knowledge in deepwater exploration and production. Sears, who has also held posts at MIT and Stanford, recently served as Chief Scientist of the Deepwater Horizon Commission and led the study and publication for the National Academy of Sciences special report on Systemic Risk in the Deepwater Gulf of Mexico, a must-read for anyone working deepwater or offshore anywhere in the world.

Rich Sears said, “For decades, Perkins-Rosen Research Conferences have brought together key practitioners in topical areas to share their latest thinking and discuss future paths. The Conference on *Deepwater Systems* built on the legacy of past conferences and provided a platform for today’s deepwater practitioners to share their latest thinking on processes and prospects at an important time for deepwater. With more than three decades of major deepwater discoveries behind us, deepwater is broadly viewed as an environmentally and economically important venue for future discoveries. Our continued success is enabled by conferences like this.”

Next was Snedden presenting “Assessing the suitability of “paleo deepwater” reservoirs for storage of anthropogenic CO<sub>2</sub> in the northern Gulf of Mexico.” Snedden chairs the Gulf of Mexico Basin Depositional Synthesis (GBDS) team at University of Texas, one of the most multi- and interdisciplinary teams focused on understanding the GoM Super Basin. Most recently, this work was published in the first-of-its-kind and best-selling tome *The Gulf of Mexico Sedimentary Basin* with Bill Galloway (Cambridge, 318 p.). This presentation work co-authored by celebrated subsurface specialists Tim Whiteaker and Alex Bump.

John Snedden said, “There were many informative papers. I liked key points from Sanchez-Ferrer (onlap trapping styles as underappreciated and over risked stratigraphic traps type), Sears (not all data needs to be considered secret, his categorization (public, worth knowing, important, strategic and core) needs to be used by company legal teams who usually find almost anything is proprietary); Pascoe (Middle to Lower Miocene play in the Gulf of Mexico is under drilled; good seismic and depositional models can be combined to derisk plays like these). Many others, as I took about 20 pages of notes, but these are the most compelling. [What impacted me the most was] seeing a lot of experts integrate technology in innovative ways, a hallmark of deepwater research and application. The full-length papers that I assume will be written following the conference proceedings and/or discoveries that will be made globally; education of new young professionals, though I wish more would attend events like these. (i.e. LinkedIn is not the way to learn new stuff, it’s more like a commercial).

On the collegiality of the conference, Snedden added, “In spite of some company's reluctance to publish or present, good people find a way to get their work out in the public domain.”

Snedden said, “Keep networking! You never know where your career will take you! Join professional societies like GCSSEPM, for greater networking and mentoring.”

Closing out this session on busting dogma and facilitating new exploration pathways was “Paradigm busting: observations from giant fields” by Robert K. Merrill, Charles A. Sternbach, John Dolson, the authors of AAPG Memoir 125: Giant Fields of 2010-2020. This memoir introduced new gamechangers including large stratigraphic traps, fields on highly attenuated to oceanic crusts, tilted OW contacts, turbidite-contourite fields and ultradeep fields >9km below mudline. Standing in for Merrill was Dick Bishop, the

famous Exxon petroleum systems analyst and independent oil and gas finder who began his career as one of the first salt tectonics gurus following his PhD from Stanford.

Dick Bishop said, “I have always found the GCSSEPM conferences to have diverse, pertinent and high-quality presentations and this one added to its reputation. Among the surprises was John Snedden’s presentation in which he illustrated why there is some concern that the GOM might not be able to hold all the CO<sub>2</sub> that is estimated to be injected.”

### **Are Mixed Systems Part of the Next Oil and Gas Revolution?**

Following the mid-afternoon poster and refreshment break, Juan Fedele (ExxonMobil) chaired the rather lightheartedly titled session “Downslope, Along-Slope, and...to the Future and Beyond for Mixed Systems.” However, this session was far from light. This session built on complex themes introduced at the first-ever AAPG Geoscience Technology Workshop on Mixed Deepwater Systems held in June 2023 in Lisbon, Portugal. Fedele held a leadership position on the organizing committee for that GTW, along with Hernández-Molina, Viana, Eggenhuisen, Davoli, Raison, Mutti, Rodriguez, and several others. This session at Perkins-Rosen examines other important exploration plays in more detail.

Neal Auchter (Shell), along with the “who’s who” of Shell’s deepwater brain trust – Nadeer Khan, David Reed, Patricio Desjardins, Andrew Parent – presented “Reservoir architecture of a mixed turbidite–bottom current system, Sinu Basin, Offshore Colombia, SW Caribbean.” Auchter is one of the rising stars of Shell’s deepwater program who is changing how our industry thinks about deepwater exploration and potential. With big shoes to fill such as those belonging to Sears, Prather, Pirmez and others who helped get Shell to the forefront of deepwater systems understanding, it is great to see the next generation including Auchter take the lead with his team.

Neal Auchter said, “As a first-time attendee to the Perkins-Rosen Conference, I was energized and inspired by the depth, breadth, and overall quality of the presentations. I had no idea what I was missing, but I won’t make that mistake again. It is clear that Deepwater Sedimentary Systems research remains an important and exciting space within the industry and I’m already looking forward to learning more at the next conference.”

Next was “Evolution of deepwater systems in the Perdido Fold Belt, US Gulf of Mexico” also by creative and productive Shell exploration team, led by a UCL top graduate Thomas Heard with Aitor Ichaso, Hongjiao Yu, Supratik Sarkar, Meijuan Jiang, Neal Auchter, John Martin and Tat Banga. You may recognize these names from their prolific work in applied geoscience journals. *How has our knowledge increased since BAHA-1?* This was an in-depth and detailed view using some of the highest quality data in the Gulf of Mexico to date.

Concluding this session was a presentation by Fedele and his team from ExxonMobil, “Initiation of contouritic moats and other longitudinal features on continental slopes, shelves, and contouritic terraces.” Fedele’s teams have been responsible for much success when it comes to understanding deepwater processes and deposit prediction. He doesn’t present very often, but when he does, it is generally to packed venues with standing room only.

Summarizing the day was a conversation with Cindy Yeilding and Richard Sears. This discussion highlighted themes in exploration potential and involved audience participation to determine where deepwater exploration is now and where it is headed over the next decades.

The conference ice breaker followed outside in the dining area on the Equinor US campus. All chatted, enjoyed food and drink, saw old friends and made new ones. December is generally a wonderful time to enjoy the outdoors in Houston, and this was no exception.

## **Tuesday, December 5 – Day 2 of the Perkins-Rosen Research Conference**

On Tuesday, December 5th, the second day began with the session “Deepwater Gravity Flow Processes and Products.”

We were very fortunate to have David Mohrig (University of Texas at Austin) present “Connecting deep-marine stratigraphy to seascape morphodynamics.” A pioneer in the field, Mohrig has made contributions to nearly every facet of deepwater sediment transport and deposition throughout his career spanning from Exxon to MIT and now UT Austin. He has mentored and cultivated many bright minds in deepwater research who are leaders in their fields including Jeff Nittrouer, Anjali Fernandes and John Shaw, to name just three. Mohrig has had a highly productive career and has been awarded on numerous occasions with global keynote talks, such as one particularly impactful keynote at the Gilbert Club meeting in San Francisco following AGU. Mohrig currently leads the UT Morphodynamics Lab.

One of the most celebrated researchers in deepwater stratigraphy since his discovery of giant wave fields in outcrops in the USA Midcon that has attracted the attention of the global community, it was really an honor and a privilege to hear C. Robertson Handford (Consultant) present “Giant sediment-wave field in gentle Mississippian slopes, an outcrop perspective of supercritical flows and crinoid gravel.” Bringing these paradigm-changing outcrops into the boardroom, Handford showed how these outcrops are changing how the world interprets deepwater sedimentary systems.

C. Robertson Handford said, “The 39th Annual Perkins-Rosen Research Conference offered a stimulating smorgasbord of topics for everyone and with presentations from world-class geologists. I’ve never attended this conference before and did not realize that it was not going to be a GoM-centric meeting but instead was global, which made the event more memorable for me. As much as the high-level technical content left me

satisfied, I was really gratified to have had the opportunity to meet some of the giants in sedimentary geology. Finally, I was really appreciative of having a receptive audience and positive feedback for my presentation on ancient sediment waves and the need to revisit/revise how we think about ramp carbonate systems.”

To cap off the distinguished lineup for this session, Paul Myrow (Colorado College) presented “Middle Ordovician mass-transport deposits from western Inner Mongolia, China: mechanisms and implications for basin evolution” together with distinguished co-authors Wenjie Li, Jitao Chen and Anne Hakim. One of the most accomplished sedimentary geology field researchers, in part due to his record-setting distance running times, Myrow has made numerous sedimentological and paleontological discoveries around the world, from mountain tops in the Himalaya to the South Pole (for example, wave-modified turbidites in Antarctica ~2002). Myrow routinely collaborates with diverse teams of researchers, including at Caltech and MIT here in the USA.

Paul Myrow added, “The conference had a great array of talks and speakers and it opened my eyes to a wide range of research techniques and data sets. A fantastic experience!”

### **From Source to Sink**

Following the mid-morning poster and refreshment break, Mike Sweet and Ariana Osman returned to chair the session titled “Source to Sink: the never-ending puzzle.” S2S is a key theme that has emerged over the last 10-15 years as one of the main ways to understand geologic risk and uncertainty in exploration to appraisal.

Chevron Fellow (the highest technical distinction given to Chevron employees) Kenn Ehman led off with the presentation “Vertical and lateral relationships of mass-transport deposits with channel and distributary lobe complexes, shallow subsurface, deepwater Gulf of Mexico.”

Kenn Ehman said, “I was honored and privileged to be invited to be a keynote speaker at the 39th Annual GCSSEPM Foundation Perkins-Rosen Research Conference, December 4-6, 2023 hosted by Equinor in west Houston. Chevron was a Diamond Level Sponsor for the event (thank you Kevin Chambers and Matt Duke!). On the technical program committee, newly appointed Chevron Fellow, Tao Sun, presented his cutting-edge work on Computational Stratigraphy: Closing the gap in subsurface characterization and modeling through computational stratigraphy (co-authors Lewis Li, Elena Sapozhnikov, Boxiao Li, Fabien Laugier, and Julio de la Colina). Tao and Fabien, ran a very successful Computation Stratigraphy workshop to close out the conference. The conference celebrates nearly three decades of progress in understanding deepwater sedimentary systems and focuses on big themes that have matured over the last thirty years since the first deepwater-focused Perkins-Rosen Research Conference in 1994. Chevron is an established leader in the understanding of deepwater stratigraphy. I presented Vertical and lateral relationships of mass transport deposits with channel and distributary lobe complexes, shallow subsurface, deepwater Gulf of

Mexico. Attendees from Chevron included Melissa Beaman, Ryan Grimm, Erin Meyers, Zishann Khan, Peter Robertson, and Jianlie Liu. Special thanks to our supporters who helped make our presentations possible: Philip Richardson, Jeff Nealon, Ke Wang, Walter Harston, Alex Parker, Frank Bilotti, Imelda Johnson, Ash Harris, Brooks Ryan, Steve Christian, Haijing Wang, Zishann Khan, Chloe Merrill, and our partners at TGS for allowing us to show the seismic data.”

Ariana Osman, a protégé of her co-author Ronald J. Steel, presented one of the most comprehensive and impactful talks of the conference with “Sediment density flows on the shelf; an important source-to-sink component.” Responsible for numerous scientific discoveries on how sediment is transported and deposited in deltaic to deepwater settings, the Steel research group has inspired generations with monumental research achievements.

Ariana Osman said, “We are now beginning to understand subaqueous deltas in the rock record. These deltas can extend up to 100 km from their coeval shoreline, and store as much as 40% of the sediment budget. This presents an interesting source-to-sink problem: more sediment could be retained on the shelf, or conversely, sediment could bypass to the deepwater, even during periods of relatively high sea level! Testing this conceptual model will be challenging, but hopefully by integrating old and new datasets alongside computational and experimental models will not only lead us to better understand the sediment budget but also the quality of sediment delivered to the deepwater at different times.”

Next up, Michael L. Sweet analyzed “What is the long-term flux of sediment off the shelf? Insights from the Cenozoic of the northern Gulf of Mexico” in his presentation co-authored by Tim Whiteaker. One of the most charismatic source-to-sink and deepwater industry geoscientists of the 21st century, Sweet delivered an analysis that has built and improved upon work in the GoM for decades. Sweet’s unique insight has been captured by numerous publications and research journals from everything from the GoM to Western North America to Mediterranean depositional systems.

Mike Sweet said, “Historically, the Perkins-Rosen Research Conference has played an outsized role in furthering the understanding of deep-water depositional systems and reservoirs. The conferences of 1994 “Submarine Fans and Turbidite Systems, Sequence Stratigraphy, Reservoir Architecture and Production Characteristics” and 2000, “Deep-Water Reservoirs of the World” were remembered by the deep-water community as breakthrough events. Jon and his co-convenors added to this legacy by assembling an outstanding program for the 2023 Research Conference with a wide-ranging program covered topics from seafloor processes to flow modeling and deep-water reservoirs.”

## **21st Century Deepwater Systems Modeling**

Following lunch and the poster break, Tao Sun (Chevron) and Kevin Reece (Tulane University) co-chaired the session titled “Modeling Advancements in Deepwater Sedimentary Systems.”

First up, Kyle Straub (Tulane University) presented “Exploration of the controls that set the shape of submarine fans and their stratigraphic architecture using numerical and physical experiments” along with distinguished co-authors Abdul Wahab, J. Kevin Reece, David C. Hoyal, Mrugesh Shringarpure and Robert Dorrell. A bright mind and a most successful research leader in deepwater sedimentary systems transport and deposition, Straub often delivers keynotes at global conferences, so we’re delighted and honored he could open this session with the results of decades of research with industry and academic teams. One of the most skilled in bringing together top researchers since his early days at the Shell BTC, Straub has led a unique and profound career. We’re excited to see what he accomplishes next.

Kyle Straub said, “I was excited to see such sophisticated numerical models (particularly CompStrat) and experimental methods (particularly the UT Austin work on mobile substrates) at Perkin-Rosen '23. I think an exciting avenue for the future will be comparing numerical model results to outcomes of physical experiments, as a mechanism to benchmark models.”

Kevin Reece presented “Influence of minibasin topographic variations on turbidity current fluid dynamics and linked turbidite shape: a 3-D laboratory study” with co-authors Robert Dorrell and his PhD advisor, Kyle M. Straub. An up-and-coming leader who has grown under the expert tutelage of Straub as a PhD student, Reece has offered solutions on one of deepwater’s most difficult challenges, which is how sediment gravity flows operate and deposit sediment in minibasins. These minibasins are home to prolific plays in the deepwater GOM and abroad in just over 30 deepwater salt basins globally (see some of Hudec’s recent contributions).

Kevin Reece said, “The 39th Annual GCSSEPM Foundation Perkins-Rosen Research Conference facilitated the transfer of groundbreaking ideas on deepwater sedimentary systems across industry, academia, and government sectors. What struck me the most was the collaborative spirit and collegiality among participants, igniting a spark for innovation in the oil exploration frontier and nurturing curiosity in the next generation that will chart new territories in sedimentary and energy domains.”

Tao Sun took the session to a flourishing finish with “Closing the gap in subsurface characterization and modeling through computational stratigraphy.” Sun, recognized by his peers as the mind behind many of Chevron’s recent process stratigraphy concepts, patents and valuable competitive advantages, rarely gets the green light to give presentations at international meetings. This presentation offered a glimpse inside what has propelled Chevron to the forefront of deepwater systems modeling. As one of the premier deepwater companies alongside the likes of ExxonMobil, Shell, BP, and international companies including Petrobras and TotalEnergies, Chevron’s ability to

model deepwater at a very detailed level will result in great success for decades to come, thanks in part to Sun's leadership in this important discipline. A quote from Tao:

*"As oil and gas exploration and production occur in deeper basins and more complex geologic settings, accurate characterization and modeling of reservoirs become paramount. Existing technologies for reservoir characterization and modeling have proven inadequate for delivering detailed 3D predictions of reservoir architecture, connectivity and rock quality at scales that impact subsurface flow and reservoir performance. "*

*"The rapid advancement in digital and computational technology has enabled the development of new technologies such as Computational Stratigraphy. These technologies can link flow and sediment transport processes to the emergence of earth surface geomorphic structures and predictable stratigraphic patterns at multiple scales. They can help us overcome the data sparsity and resolution gap in our subsurface data, and hold the key to making quantitative predictions of reservoir heterogeneity in 3D, across all scales and for any depositional environment, including fluvial, shallow marine, and deep-water."*

*"This conference has celebrated nearly three decades of progress in understanding deepwater sedimentary systems and focuses on big themes that have matured over the last thirty years since the first deepwater-focused Perkins-Rosen Research Conference in 1994."*

Following the mid-afternoon poster and refreshment break, Luke Walker (Equinor) and Lori Fremin (Haltermann Carless; retired, Shell) co-chaired the session titled "Exploring for Deepwater Giants." Walker and Fremin are no strangers to giants, having worked giants in the Gulf of Mexico for decades, while at different companies. Their combined expertise in geoscience and engineering unite to form an impactful session marrying these disciplines that are key to success in giant hunting.

First, Kyle Reuber (TGS) presented "Exploration potential in the numerous deepwater plays offshore Mauritania." One of the finest purveyors of high-quality seismic data, TGS has been responsible for producing some of the first seismic interpretations of frontier settings and illustrating a number of play types. A veteran interpreter of very difficult frontier geology, Reuber set the stage for some very interesting plays that can be extended from Mauritania to the rest of West Africa.

Kyle Reuber said, "The 2023 Perkins-Rosen conference was packed with highly technical content. Many of the presentations focused on deepwater sedimentary systems, showing relevance to the recent high-profile discoveries in these depositional settings. Thanks to all of the presenters for sharing their ideas!"

Concluding the Exploring for Giants session, Robert Pascoe (Dynamic Group) took us to the giants that are lurking in plain sight in the presentation "Lower and Middle Miocene Intraslope Minibasins of the Outer West Louisiana Shelf: An Underexplored Play" with co-author Peter Nuttall (Dynamic Data Services). Many operators worked this area for decades; in fact it was one of the first places that companies went far offshore onto the shelf in the early to middle 20th century. Today, with ILX becoming an important strategy for many companies seeking to find deeper giants close to existing

infrastructure, more discussions need to be focused on this area. Thank you to Robert for including this important talk at Perkins-Rosen '23.

Robert Pascoe said, “30 years after being present at the first Deepwater Systems GCSSEPM conference it was great to return and see that sedimentary research is still thriving in the Gulf of Mexico. The last decade has been commercially challenging for the basin with head winds due to the shale revolution and oil and gas prices. However, given the low carbon aspects of the basin the future looks bright and that future will be dominated by deepwater depositional systems.”

Lori Fremin, President at Haltermann Carless, said, “1. The Annual GCSSEPM Foundation Perkins-Rosen Research conference on Deepwater Systems was an insightful, challenging and much needed networking opportunity to bring an active cross section of precious talent together. The panels and sessions were designed to generate discussions that will enable our energy future. I was honored to be a part of the conference and would recommend this conference to geoscientists and engineers who are working to safely and effectively develop our earth's scarce resources that support our daily lives. 2. The energy demand is increasing each year, while our scarce energy resources are depleting. The conference was an energizing event that brought precious talent together to learn from each other, and grow a deeper understanding of our increasingly complex problems. 3. The Annual GCSSEPM Foundation Perkins-Rosen Research conference on Deepwater Systems was large enough to host a broad range of topics and discussions. Yet it was not too large, as it fostered deeper discussions and created the space for people to create and grow strong cross industry relationships. 4. I would recommend this conference to mid-career and junior professionals, as this is a perfect event to bring the next generations of our scarce energy workforce along.”

Summarizing the day was a conversation with Juan Fedele, Tao Sun and Daniel Minisini. This discussion highlighted themes in deepwater exploration potential and involved audience participation.

### **Wednesday, December 6 – Day 3 of the Perkins-Rosen Research Conference**

On Wednesday, December 6th, the third day began with John Snedden and Cindy Yeilding returning to the helm to co-chair the second edition of “Paradigm- and Dogma-Busting in Deepwater System Research and Applications.”

Standing in for Patricio Desjardins, Daniel Minisini presented “Deepwater stratigraphic framework of the fine-grained Wolfcamp Formation, Permian Basin.” With abundant data onshore in the Permian (>300,000 wells) that can be used with AI/ ML/ DL strategies, this presentation provided a very nice contrast to other forms of deepwater exploration in frontier settings with very little well control.

Neal Auchter returned for his second presentation of the conference with “Advances in machine learning for sub-seismic interpretations: application for core and bore hole image logs” and his inventive, prolific and distinguished co-authors from Shell

representing disciplines in research and digitalization including Oriol Falivene, John Solum, Patricio Desjardins, Gonzalo Astorga and Pedram Zarian.

Famed Gulf Coast explorer Peter Mullin (Werrus Aquamarine) presented “An emerging play in the eastern Gulf of Mexico shelf” with co-authors Jerry Coggins and John Kulha, seasoned consultants who have worked all over the world. This play has garnered a lot of attention from Gulf Coast explorers, recently featured by the Houston Geological Society and GeoGulf '23. Where are the next giants to be found in the GoM? Mullin’s presentation offered several possibilities.

Peter Mullin said, “As a superbasin, it is anticipated that with ongoing technology advances and with continuing adoption of new exploration paradigms, the GoM will continue to provide robust economic developments, in all its sectors.”

Juan Pablo Lovecchio stood in for Leeds-educated senior geologist Ofelia Silio to deliver the talk “Interaction between along-slope bottom currents and turbidite flows in the northern offshore Argentina Basin” with distinguished co-authors María Eugenia Pascariello, Facundo Pagan, Sebastián Arismendi, Néstor Bolatti and Gonzalo Flores. You may have seen their work featured in deepwater and mixed systems conferences, as this Argentinian team is among the most knowledgeable regarding these processes in the world. We were delighted and honored they chose to feature their work this year at Perkins-Rosen.

Juan Pablo Lovecchio said, “Deepwater exploration is one of the most challenging frontiers in the current days. We have been exploring the deep seas for more than 50 years now, and we realize that we continue learning and developing knowledge and technology to cope with the very unique challenges of these plays. The 2023 Perkins-Rosen Research Conference was a fantastic occasion to meet colleagues working in deepwater across the world. Although there was a focus in the GoM, many contributions brought insights from other regions where deepwater exploration is still an exploration frontier. Sedimentary processes, such as interactions between turbidity and contour currents, were also discussed together with their influence on reservoir distribution and quality and their impact on exploration and development strategies.”

### **Closing Remarks**

Following the mid-morning poster and refreshment break, the second edition of “Deepwater Gravity Flow Processes and Products” was chaired by multiple committee members.

One of the best known deepwater-focused professors in the world, Tiago Alves (Cardiff University) discussed “Mass-transport, injections and other forms of sediment mobility: from the seismic to the centimeter scale” as a nod to the state-of-the-art work completed for a seminal text on mass-transport processes and deposits in 2022 with Sebastian Cardona (Tellurian) and Mérolyn Rodrigues (University of Paraná). Much of the conference up to this point had focused on more predictable and model-able sediment

gravity flow and bottom current processes. *How is catastrophism expressed in deepwater? What are the effects of mass-transport processes and deposits?* This presentation was a highlight of the 3-day conference.

Tiago Alves said, “I particularly liked two aspects that were clearly conveyed by the presenters and discussion panels; the significant scale in which CCS and other geo-storage solutions are being equated for the GoM, compared to other regions in the world, and the way the modelling of sedimentary processes is, let's say, changing its paradigm. From continental shelf and slope systems, so commonly studied in the 1990s and 2000s, academia and industry are now compelled to enter the realm of 'the continental rise', where sedimentary processes, and depositional architectures, are significantly different. This is the place where the sediment bypassing the slope is laid to rest, and tectonic, climatic, and oceanographic effects have rather different magnitudes, affecting depositional systems in distinct ways and forms, when compared to what is known on continental slopes. Stronger interactions among contourite and turbidite driven processes is an example of such a difference. In terms of the scale of CCS solutions, it will be important to reassure a new generation of explorationists that they should think broadly about what is a 'geological reservoir' – may it be for energy extraction, storage or geothermal heat production. With that in mind, I felt reassured when learning that 'old' provinces and prospects are now being revisited for different purposes (CCS being one of these purposes) and will require, very soon, new sets of eyes and open minds to (re)characterize them.”

Howard R. Feldman's (Feldman Geosciences, LLC) encyclopedic knowledge on clastic systems is world-class, and he presented the final talk of the conference titled “Danube fan in the Black Sea: a levee-dominated deepsea fan.” Feldman's co-authors included the distinguished researchers Bernard Dennielou (IFREMER) and Gilles Lericolais (SGMer).

Howard Feldman said, “The 39th annual Perkins-Rosen Research Conference on deepwater systems showed that even after a few decades of research on these systems there is a lot more to learn and that this has direct applications to petroleum exploration and production. There were many important presentations, but one of the most significant recent themes is how active deepwater systems can be even far from turbidity-current-fed fans. Deepwater currents are pervasive and the evidence has always been there for us to see. The model of thick, passive, hemipelagic deposition of clastic mud is slowly being put to rest.”

Following lunch and the poster break, conference conveners and keynote presenters Cindy Yeilding, Richard Sears and Tiago Alves discussed the achievements of the conference and where it will lead deepwater over the next decades. Their panel was titled “Summary of Learnings and Future Research Directions.”

### **Continuing Education Opportunity**

Following the panel conversation, from 2:15pm – 4:30pm, Chevron's Tao Sun and colleagues presented an interactive short course for conference participants on deepwater sedimentary processes, products and modeling.

Luke Walker, Technical Committee Chair, summarized the conference, "The GCSSEPM Perkins-Rosen conference was very successful, enjoyable and most of all, pertinent to EQNR Geoscientists. As an active player in the global deepwater exploration and development space, it is helpful to stand back and recognize that there is still much to learn and understand. We particularly appreciated the diversity of GoM topics while allowing space to explore other basins that are applicable to our frontier exploration efforts such as offshore Argentina. There were multiple presentations relevant to the geoscience issues we tackle on a routine basis – not just sedimentology. From experimental flume tanks to case studies and further to computational simulations, the breadth of methods used to address these challenges was impressive. Talks on remaining potential in the GoM, dogma busting and new ways of approaching old plays were thought provoking and appreciated.

It is so refreshing to spend time with old colleagues, meet new ones and debate ideas from outside our organization. The cross-pollination across industry and with academia is vital to future understanding and success. The Perkins-Rosen conference provided a unique opportunity to share and exchange ideas in an informal and open setting.

Thanks again to the organizers for assembling a great technical program and delivering a first-class conference. Other themes that describe the conference proceedings included "counter to my previous understanding" and "re-energizing to eye opening" as well as "thought provoking" and an "excellent networking opportunity."

### **The 40<sup>th</sup> Annual Perkins-Rosen Research Conference**

Stay tuned for more updates on the upcoming 40<sup>th</sup> annual research conference this December! The theme is "Old Rocks, New Energies" and will focus on how the Gulf Coast and adjacent basins will serve as a hub for new energies, including continuing and emerging sources like geothermal and hydrogen, as well as serving as a storage repository for anthropogenic carbon in the subsurface of onshore and offshore areas.