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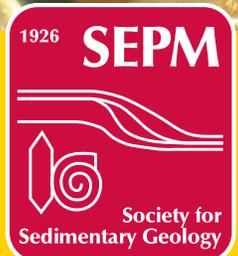
A publication of SEPM Society for Sedimentary Geology
with the Sedimentary Geology Division of GSA

Record

doi: 10.2110/sedred.2011.3
Volume 9, No. 3, September 2011

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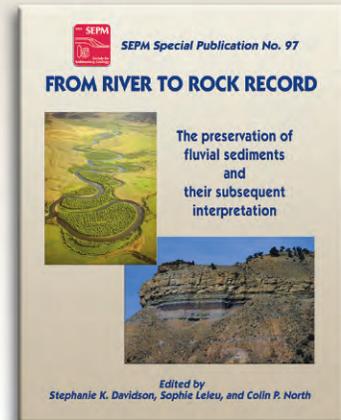
Special Publication #97

From River to Rock Record: The Preservation of Fluvial Sediments and their Subsequent Interpretation

Edited by: *Stephanie K. Davidson, Sophie Leleu, and Colin P. North*

Over the last couple of decades, fluvial geomorphology and fluvial sedimentary geology have been developing in parallel, rather than in conjunction as might be desired. This volume is the result of the editors' attempt to bridge this gap in order to understand better how sediments in modern rivers become preserved in the rock record, and to improve interpretation from that record of the history of past environmental conditions. The catalyst for the volume was a conference with the same that was hosted at the University of Aberdeen School of Geosciences, in Aberdeen, Scotland, on 12-14 January 2009. The conferences brought together a broad spectrum of geomorphology and sedimentology researchers, from academia and industry. This interdisciplinary mix of experts considered and discussed ideas and examples ranging through timescales from the annual movement of individual river bars to sequence stratigraphic analysis of major sedimentary basins spanning millions of years. The articles in this volume are a mixture of novel concepts, new evaluations of the perceived wisdom about rivers and their sediments, and improved understanding derived from recent experience in interpreting the rock record. This volume usefully illustrates the current state of knowledge and will provide a stimulus for further research, particularly work that integrates geomorphological and sedimentological approaches and emphasizes cross-disciplinary communication.

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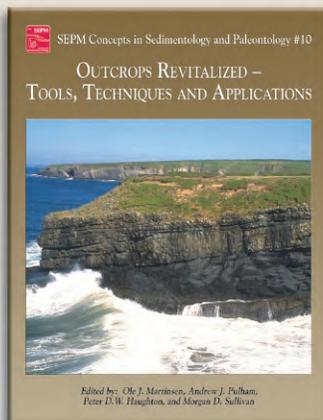
Concepts in Sedimentology and Paleontology #10

Outcrops Revitalized: Tools, Techniques, and Applications

Edited by: *Ole J. Martinsen, Andrew J. Pulham, Peter D.W. Haughton, and Morgan D. Sullivan*

Outcrops are fundamental to everything we hope to achieve in geological understanding. They are gateways to geological processes, earth history and they help ground-truth remote sensing applications. With increasing resolution of subsurface tools and techniques, one could be forgiven in believing that outcrops have had their day and their utility is less than in the past great eras of field mapping and the development of facies models. This premise is far from the truth and this new SEPM volume illustrates how new analytical techniques are revitalizing outcrops and in the process creating a wealth of new data and fresh geological understandings. In this book you will find a compilation of the growing arsenal of outcrop tools and techniques and a consideration of future developments. This collection of papers, delivered at a SEPM Research Conference on the West coast of Ireland in the summer of 2008, is a smorgasbord of case studies, workflows, modeling, and applications which spans clastic and carbonate settings. Whatever your interest in outcrop geology and its application there is something in this volume for you. If you are seeking guidance for using new outcrop tools, looking for efficiencies in data collection or desiring new insights for old and favorite outcrops, this volume is a must have. This volume also makes an excellent reference or textbook for any group of professionals or students working or studying the new technologies that have allowed new insights from outcrops. We also consider this a superbly timed publication because many new outcrop tools are now becoming mainstream via reduced purchase and operating costs. Once you read this volume, and there are reduced prices for SEPM members and students, please share your new experiences with the authors and editors and help continue the revitalization of our shared and continually surprising outcrop library of the earth.

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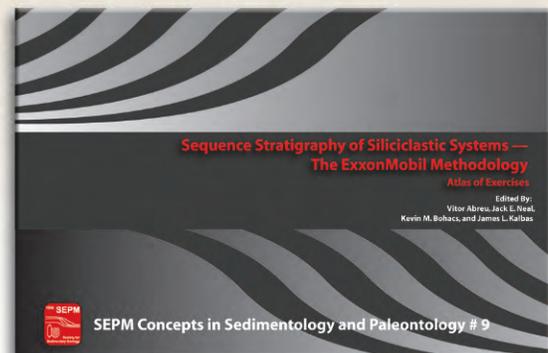
Concepts in Sedimentology and Paleontology #9

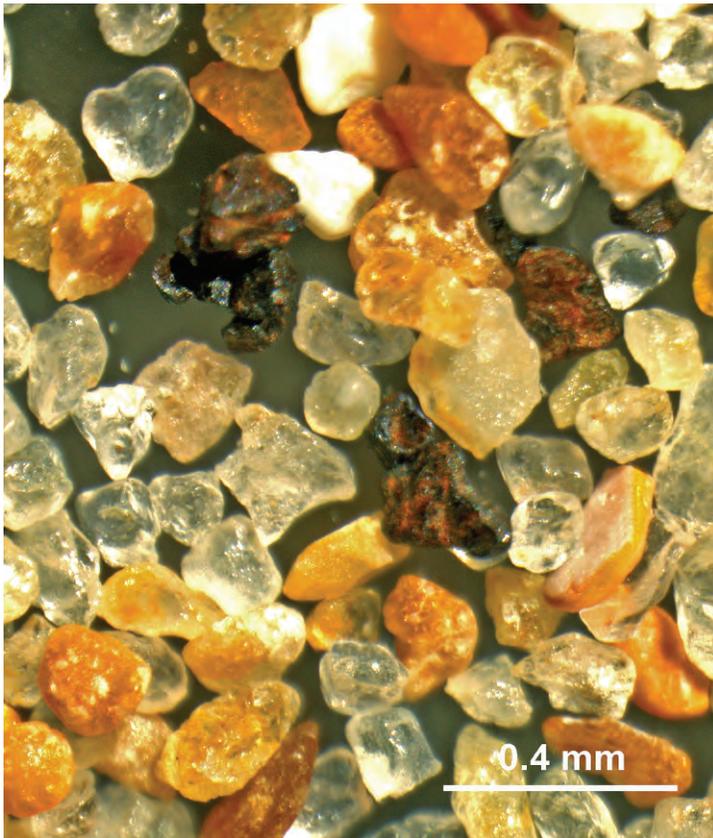
Sequence Stratigraphy of Siliciclastic Systems – The ExxonMobil Methodology

Edited by: *Vitor Abreu, Jack E. Neal, Kevin M. Bohacs and James L. Kalbas*

The stratigraphic concept of a depositional sequence was introduced to the scientific literature by Exxon Production Research Company (EPRco) in the late 70s, building on the shoulders of giants like Chamberlain, Sloss and Wheeler. Since then, several papers compared and contrasted the original Exxon (and later, ExxonMobil) sequence-stratigraphic school with other approaches to subdivide the geologic record, as well as, debating the ExxonMobil model validity and impact on the community. At its core, the ExxonMobil "model" is really a stratigraphic interpretation method, which was never explicitly documented in the literature. The objective of this book is to present the ExxonMobil sequence stratigraphic method in its current form in an attempt to clarify its usage and application in diverse geologic data and depositional environments. This publication is the result of more than 3 decades of sequence stratigraphy research and application at EPRco and at the ExxonMobil Upstream Research Company (URC). The objective is to emphasize the most important aspects of Sequence Stratigraphy – a method to guide geologic interpretation of stratigraphic data (seismic profiles, well-logs, cores and outcrops) across scales (from local to regional and global) and depositional environments (from continental to deep marine).

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Cover image: Omaha Beach sand seen through a binocular microscope. Pastel grains are carbonate rock fragments, carbonate skeletal grains, and iron-oxide-coated quartz grains. Rust coated shrapnel grains are visible in the center of the photo. (Mean grain size = 0.2 mm.)

CONTENTS

- 4** Shrapnel in Omaha Beach Sand
- 9** Sedimentary Geology Division – GSA
- 13** President's Comments
- 16** New Research Conference Scheduled

The Sedimentary Record (ISSN 1543-8740) is published quarterly by the Society for Sedimentary Geology with offices at 4111 S. Darlington, Suite 100, Tulsa, OK 74135-6373, USA.

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The Sedimentary Record is provided as part of membership dues to the Society for Sedimentary Geology.

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Shrapnel in Omaha Beach Sand

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doi: 10.2110/sedred.2011.3.4

Unlike what happens to other great battles, the passing of the years and the retelling of the story have softened the horror of Omaha Beach on D-Day. This fluke of history is doubly ironic since no other decisive battle has ever been so thoroughly reported in the official record.

— S. L.A. Marshall, 1960

The sand at Omaha Beach is golden in color, firm and fine, perfect for sunbathing and picnicking and digging, but in extent the beach is constricted. It is slightly crescent-shaped, about ten kilometers long overall. At low tide, there is a stretch of firm sand of three hundred to four hundred meters in distance. At high tide, the distance from the waterline to the one-to three-meter bank of shingle (small round stones) is a few meters.

— Stephen E. Ambrose, 1998, p. 117

INTRODUCTION

Soon after dawn on 6 June 1944—a day later than originally planned because of a fierce storm on the 5th—more than 160,000 Allied troops began the assault on Normandy, northwest France (Figure 1). It became a turning point of World War II, an invasion long planned and known as OVERLORD. More than 5,000 ships and 13,000 airplanes, the largest invasion armada in history, supported the soldiers on the ground. The fighting was furious, quickly escalating into the horror that became bloody Omaha Beach.

Omaha Beach was the code name for one of five coastal sectors in the Allied landings. From east to west, it faces the English Channel, and is about 5 mi long (8 km). Of the five D-day landing sites Omaha Beach was the largest. Bound at each end by rocky cliffs, it is a gently sloping tidal area, on average about 300 yards (273 m) between low and high-water marks (Figure 2).

German forces under the overall command of Field Marshall Erwin Rommel (1891-1944) occupied strategic points along the coast, entrenched in high ground commanding the beach. Rommel himself was in Germany, believing that the bad weather “would not permit an Allied invasion before his return” to the front (D’Este, 1983, p. 111). Arching bluffs as high as 200 ft (60 m) above Omaha Beach offered tactical defensive positions. No parts of the beach had been left uncovered of men and their weapons. Resistance was centered at the entrance to ravines, running from the shore to the plateau behind it. Opposing the landing was the German 352nd Infantry Division,

commanded by General Dietrich Kraiss, (1889-1944). Partly made up of troops from the Russian front, it was a first class fighting force that had been moved into the area in May, about 7,800 strong. Rommel’s battle plan was to stop the invasion at the water line, which he and Kraiss believed was possible. Quickly, however, one-fifth of the 352nd troops were gone.

THE BATTLE

Capturing Omaha Beach was the objective of U. S. Army forces commanded by Lieutenant General Omar Nelson Bradley (1893-1981). They numbered 34,250. The U. S. Navy provided sea transport, assisted by elements of the British Royal Navy. Strategically, the landings were necessary to join with American forces to the west at Utah Beach and with British forces at Gold Beach to the east (D’Este, 1983; Ambrose, 1997).

Very little went as originally planned for the Allies. Clouds obscured the beach. Most of the landing craft missed their target; many of them never reached the beach at all. Defenses were unexpectedly strong. The pre-landing Naval bombardment was ineffective and likely inadequate for the battle. Only 40 minutes had been allotted for air and naval bombardment (D’Este, 1983, p. 113). Few German combatants but many cattle were killed back of the beach.

Engineers struggled to remove obstacles. The waters offshore and the beaches were heavily mined. For many hours Allied troops could not get off the beach, many drowned, and the assault nearly failed. It was the most tenuous of all Normandy landings. At one point, General Bradley considered evacuating Allied forces. Historians suggest that the U. S. 1st Infantry Division (the veteran “Big Red One”), a National Guard unit (the 29th Infantry Division), and U. S. Army Rangers suffered about 3,000 casualties (Musée Omaha 6, June 1944). Actually the number of casualties was probably greater than that. More specifically, Murray and Millett (2000, p. 422) say that on the first day “approximately 2,500 Americans died on Omaha Beach.” No one will ever know that precise number, or the number of Germans who died. Though the original plan failed, a tenuous beachhead was established.

THE BEACH

On the morning of 8 June 1988, forty-four years after the landing, we collected a sample of sand on the high-tide point from Omaha Beach near the War Memorial. It had rained during the night and was raining still. The tide was out, as it had been during the landings. Mollusk shells (pelecypods and gastropods) glistened, and water ran through rills. Long before our visit the beach had been swept clean of

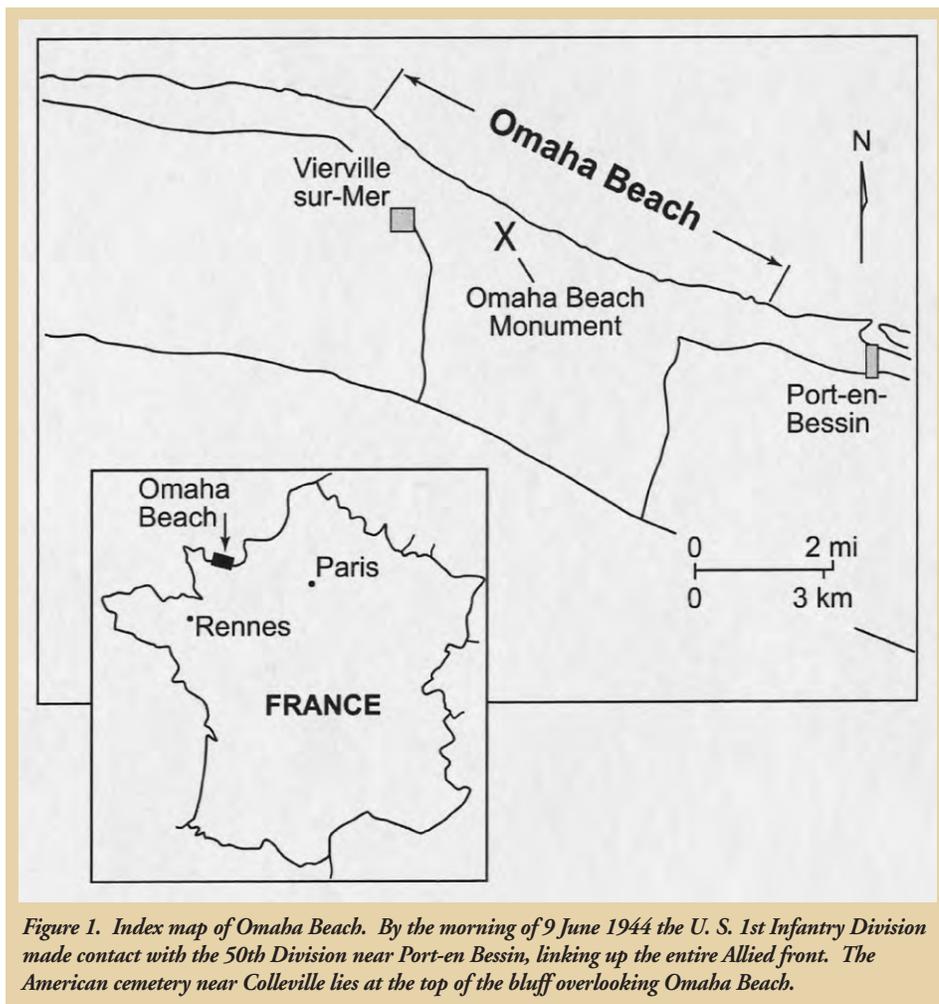


Figure 1. Index map of Omaha Beach. By the morning of 9 June 1944 the U. S. 1st Infantry Division made contact with the 50th Division near Port-en Bessin, linking up the entire Allied front. The American cemetery near Colleville lies at the top of the bluff overlooking Omaha Beach.

obvious artifacts of the war. There was little indication other than faint relics of trenches and the solitary casemates above the beach of the harrowing destruction. Collectors of sand and sandstone around the world for more than five decades, we never miss an opportunity to gather sand from shores.

THE SAND

A thin section of the sand contains a large number of angular, non-spherical, opaque grains. Like normal detrital magnetite (named for Pliny's shepherd Magnes), they were strongly magnetic. Shard-like, they were only slightly rounded. Some were well laminated. Magnetite is an isometric mineral.

These magnetite grains were also associated with small spherical beads of iron and glass. We were astonished. In a few days, we concluded that the metal and glass particles were human made—particles generated from the explosions of munitions during the Normandy landings at Omaha Beach. The initial excitement and pleasure of the discovery soon became a mixed-up one.

The sand is light-gray (10YR 7/2), well-sorted, subangular to subrounded, fine-grained (Figure 3 and cover page), and dominantly detrital quartz (78%) supplied to the coast by the Seine and several smaller rivers. Our sample also contains 9% feldspar, 4% carbonate grains (limestone clast and modern bioclasts), 4% shrapnel, 3% heavy minerals, 2% chert, other rock fragments, and beads of metal and glass. Because of the potential plasing of shrapnel and heavy minerals by waves and currents on the day we

collected our sample, we do not know how representative it is of the beach sand as a whole.

THE SHRAPNEL

Shrapnel grains range from very fine to coarse sand size (0.06 to 1.0 mm, Figure 5). Shrapnel displays a remarkable variety of shapes and degrees of roundness. Nearly all grains retain their original non-spherical shapes, but all grains, even the most shard-like, have undergone some degree of rounding of sharp edges (Figures 5 and 6). Typical of sand-grain populations, the coarsest grains generally have undergone more rounding than finer grains. Although rounding of edges is strong on some of the coarser grains, none have been abraded sufficiently to become spherical. The majority of grains have a laminate structure visible at magnifications > 200 times.

Shrapnel grains have a dull metallic luster where red and orange rust survives on parts of grains protected from abrasion. At magnifications greater than 200 times, grains display various degrees of roughness, although laminated grains display smooth surfaces up to magnifications of 500 times. Roughness is imparted by microporous surfaces produced during iron production and post-explosion corrosion products. Corrosion products, as best that we could identify them, are a mixture of hematite (Figure 7), other iron oxides and hydrates (probably goethite), unidentified mineral grains, bacteria (Figure 8), and an irresolvable mat that is likely a biofilm produced by iron-oxidizing microbes. Corrosion products coat almost all surfaces, even those not covered by rust. The corrosion layers commonly exceed 5 μm in thickness.



Figure 2. Omaha Beach (Dog Green sector) in 2001 looking south. Photo courtesy of Chris Bell.

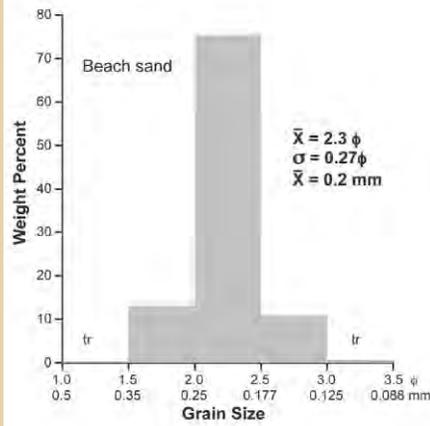


Figure 3. Histogram of sieve analysis of Omaha Beach sand.

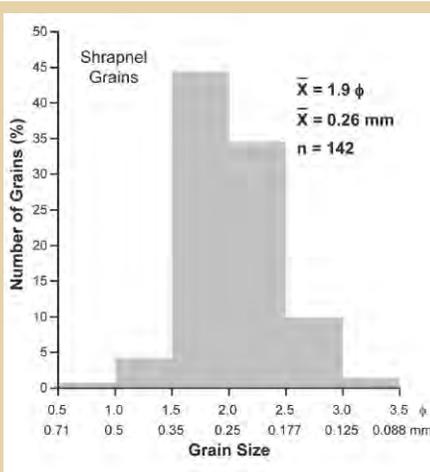


Figure 4. Histogram of shrapnel grain sizes.

The only primary crystallization texture of metal that we found is a dendritic crystal morphology (Figure 9), the most common solidification texture found in metals, according to Professor Eric Taleff of the University of Texas at Austin. The three-dimensional geometry of dendrites depends upon composition of the metal and of the cooling rate (Vander Voort, 2000).

IRON BEADS

In addition to the shrapnel, we also recovered thirteen intact spherical iron beads and five broken ones (Figures 11 to 12). They range in size from 0.1 to 0.3 mm in diameter. Most of them display a shiny luster on their outer surfaces and are nearly free of corrosion products. Two beads exhibited a matte surface. Magnifications greater than 400 times indicates that the beads are composed of intergrown iron crystals with various textures (i.e., tapered crystals, subequant polygonal

crystals, or chains of microbeads), all of which are variants of the dendritic texture.

GLASS BEADS

The twelve glass beads that we recovered are remarkably uniform in size, between 0.5 to 0.6 mm in diameter (Figures 13 and 14). Nearly all are spherical, but one glass bead is slightly oblate, another has a blister-like appendage. The surfaces of beads are mostly smooth with topographic imperfections <0.3 μm except for scattered divots and rare scratches and conchoidal spall pits (Figure 13). Divots have formed where angular, rather than conchoidal pieces, were chipped out of a bead. The beads are composed of clear glass, but they have various degrees of cloudiness, depending on the abundance of bubble inclusions (Figure 14).

The glass is not a pure silica glass. Energy dispersive spectrometer data show the presence of small amounts of calcium, sodium, and magnesium, in addition to silicon and oxygen.

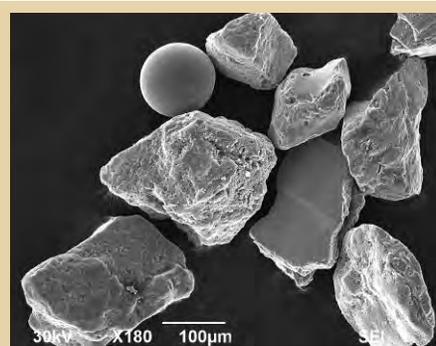


Figure 5. Scanning electron image of shrapnel grains and an iron bead. Several grains show laminated structure.

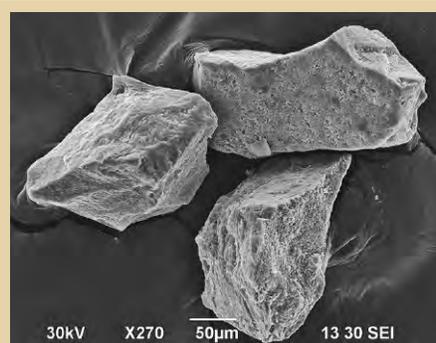


Figure 6. Abrasion has slightly blunted edges of shrapnel grains. Note the rough, corroded surfaces.

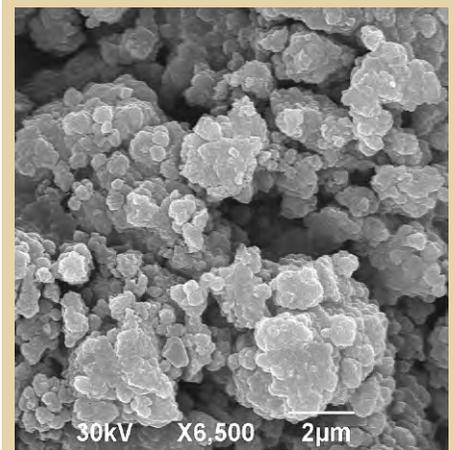


Figure 7. SEM image of poorly crystallized hematite on a rough corrosion surface.

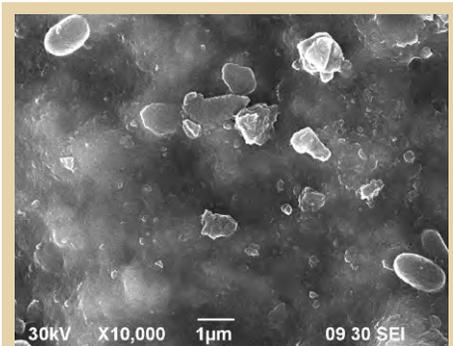


Figure 8. SEM image of bacteria on a biofilm.

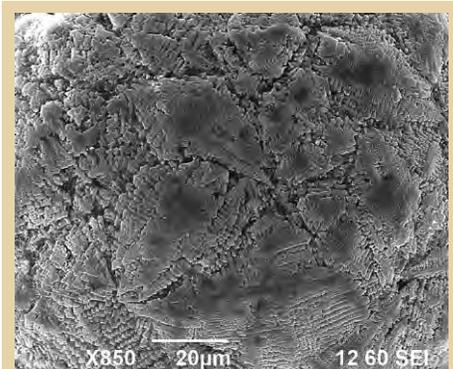


Figure 9. Complex dendritic structure of iron crystals in a shrapnel grain.

HOW THE GRAINS EVOLVED

In the years since the man-made particles formed and have been part of the beach and near-beach environments, the shrapnel grains have undergone blunting of edges that has slightly improved their roundness. There has been, however, little increase in sphericity as a measure of shape. Such a result is not surprising, given the hardness of shrapnel (Mohs hardness of iron = 5.5; steel = 6.5), and the experimental work of Kuenen (1960,

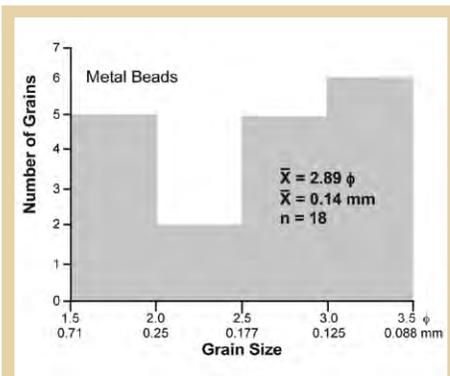


Figure 10. Histogram of iron bead sizes.



Figure 11. Dendritic structure of a broken iron bead.

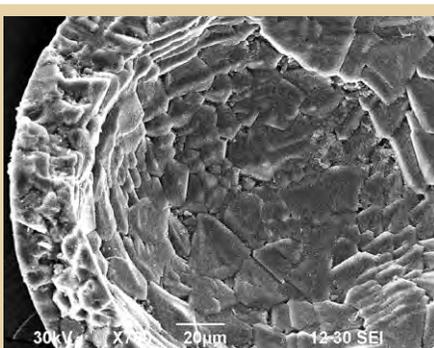


Figure 12. Polygonal structure of a broken iron bead.

1964), who long ago found that prolonged abrasion of sand-size quartz ($H=6$) by beach swash does not significantly round or modify the shape of grains (Cordua, 1998).

Importantly, the disparity in degree of rounding of grains of the same size shows that, although originating on the same day and barring no major differences in hardness, the grains have not all had the same abrasion history. Some grains spent variable amounts of time in residence on the storm beach, the

coastal berm, or an inner-shelf setting, and they have not undergone continuous abrasion on the beach.

The ubiquitous corrosion of shrapnel grains is the result of their deposition in seawater, a fluid that is optimally suited to corrode ferrous metals because of the availability of oxygen, salts, and microbes. Grain impacts during swash action kept red/orange rust from forming except on protected parts of grains. Nevertheless, at least a thin film of oxidized iron, and generally a layer of corrosion products $5\ \mu\text{m}$ thick or greater, coats shrapnel and iron beads.

Munitions explosions were hot enough to melt iron and heat quartz, generating the glass beads. Although the melting point of pure iron is 1538°C (2800°F) (Lide, 2003), iron and carbon form a eutectic system that permits melting of the mixture below 1200°C (2192°F). Cast iron, for example, melts at $\approx 1260^\circ\text{C}$ (2300°F). Michael Martinez, supervising forensic scientist and a specialist for the Bexas County, Texas, generously gave us some insight into likely explosion temperatures and iron bead structures. Martinez noted also that bomb explosions commonly produce hollow metal beads, which are also produced by phreatomagmatic eruptions, according to Morrisey et al. (2000).

Quartz melts at 1710°C ($\sim 3110^\circ\text{F}$) (Hampel and Hawley, 1973), but silica in the presence of sodium and calcium, as used in the glass-making industry, can melt around $1400\text{--}1600^\circ\text{C}$ ($\sim 2550\text{--}2900^\circ\text{F}$) (De Jong, 1989). The presence of sodium and calcium in seawater and calcium in marine shells provided the metal cations that allowed quartz to react below its melting point. It is likely that the scratches on the exterior of glass beads formed seconds after the explosion that generated them while they were soft and undergoing turbulent rotation and impact with other particles. Divots and spall scars formed from impacts with other particles when the glass had solidified, although whether this occurred in the air following the explosion (most likely), or on the beach, is uncertain.

THE RECORD

The preceding paragraphs summarize our study of shrapnel and iron and glass beads found in sand on Omaha Beach. From there



Figure 13. SEM image of glass bead with divots, conchoidal spall pits, and scratches.

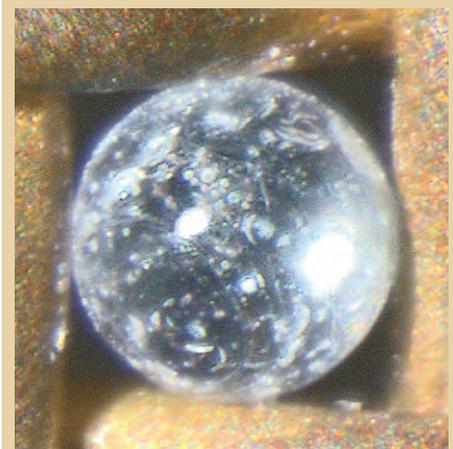


Figure 14. Glass bead caught in the opening of a 0.5 mm brass sieve. White spots are light reflections off the glass surface and off bubble inclusions in the bead.

we went to Utah Beach, a much less fiercely fought landing location. We saw no shrapnel in our only sample. We didn't go to the other landing sites.

Shrapnel survived in Omaha Beach sand for 40-plus years. Likely it is there still. How long these particles will remain is uncertain, but iron alone can probably survive beach abrasion for hundreds of thousands of years. The combination of chemical corrosion and abrasion may destroy such grains in a century or so.

Visitors to Normandy all go to see the War Memorial and so did we. Overlooking the beach, the thousands of small white crosses, democratically equal in size and in giving only bare statistics (name, rank, place of birth) evoke ghosts of those who lie there. The shrapnel in the sand at Omaha Beach, though the only remaining microscopic record of the battle, inadequately represents the extent of devastation and deaths suffered by those directly engaged in the Second World War in Europe.

ACKNOWLEDGEMENTS

We called upon and were helped by a great variety of scientists and engineers. Dr. Erik Taleff, Professor in the Department of Mechanical-Materials Engineering at the University of Texas, Austin, and his student, Alan Viosca, contributed initially to our understanding of the shrapnel. Michael Martinez, supervising forensic scientist for Bexar County, Texas, provided insight on bomb explosions and the resulting products. In an early stage of our study, Ravi Chandran, Professor in the Department of Metallurgical Engineering, University of Utah, commented on a couple SEM images of the shrapnel grains and iron beads. Christopher M. Keane and Megan Sever, Editor and Managing Editor, respectively, of the magazine *Earth*, offered suggestions and alternatives to an earlier but less scientifically complete manuscript (McBride and Picard, 2011). They gathered five photographs that were added to that piece, which was printed in *Earth*. None of them are included here. James Shea, long time editor of *The Journal of Geoscience Education*, took the time to review this article. We appreciated and used the recommendations of Xavier Janson and Wayne Wright. Bennet Picard did most of the word processing.

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Accepted August 2011

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- ***Physical Principles of sedimentary basins analysis***, by Magnus Wangen, 2010
- ***Erosion and sedimentation***, by Pierre Julien, 2010

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GEOLOGICAL SOCIETY OF AMERICA

THE ANNUAL GSA MEETING IS JUST AROUND THE BEND!

The 2011 GSA Annual Meeting is just around the corner. This year we will meet in Minneapolis, Minnesota. The meeting is a little earlier than usual this year, coming to you on October 7th – 10th. It'll be here before ya' know, ya' know. Your SGD and SEPM committees took a proactive role at encouraging sessions in Sedimentary Geology at GSA this year, and the strength of the technical session reflects the effort. We needed an extra page or two to in the newsletter to get them all listed, and a strong and interesting bunch they are indeed. In this issue, we'd like to summarize the many activities our Division has to offer.

2010 LAURENCE L. SLOSS AWARD RECIPIENT

The GSA SGD is pleased to announce that Dr. John Grotzinger of California Institute of Technology is the 2011 Laurence L. Sloss Award recipient. Dr. Grotzinger has left his mark on many aspects of Sedimentary Geology. He has applied his diverse understanding of the fundamentals of sedimentology and stratigraphy to the earliest record of life, and made pioneering advances in our understanding of the interplay between physical environments and development of the earliest skeletal life. His work on Proterozoic carbonates has shed new insights into the Proterozoic oceans and the enduring nature of carbonate deposition. Topping off his science achievements, John has contributed to sedimentary geology in very publically visible ways through his role as a senior scientist with the Mars Rover Project. Most notably, John holds the distinction of being the first to measure a stratigraphic section on another planet. All these efforts and more contributed to John's 2002 induction into the National Academy of Sciences. Please plan to join us at the SEPM-sponsored SGD and Limnogeology Division Joint Business Meeting and Awards Reception scheduled for Tuesday, October 9th, to bestow Dr. Grotzinger with this fitting honor.

**2011 Laurence L. Sloss
Award winner
John Grotzinger**



2011 SGD STUDENT RESEARCH AWARD RECIPIENT

Congratulations to Theo Mylnowski, this year's winner of the Student Research Grant! Theo is a graduate student at the University of Northern British Columbia (UNBC), Canada and is supervised by Dr. Brian Menounos. Theo will use photogrammetric methods to examine how dimensional and surface mass balance changes of Peyto Glacier relate to the sediment yield derived from lake sediments collected from within the Peyto Basin. He strives to improve understanding and methods for reconstructing past glacier activity, climates, and environments.

**Theo Mylnowski,
2011 SGD Student Research
award winner.**

Please join us at the SEPM-sponsored SGD and Limnogeology Division Joint Business Meeting and Awards Reception as we recognize Theo's efforts as well as those of the SGD student poster and student travel award recipients.



THE 2011 STEPHEN E. LAUBACH STRUCTURAL DIAGENESIS RESEARCH AWARD

We welcome with great appreciation this newest award opportunity. The Stephen E. Laubach award is a truly interdisciplinary award that promotes research combining structural geology and diagenesis. The award is given jointly by the Sedimentary Geology and Structural Geology and Tectonics divisions and is presented at our respective awards ceremonies. This year it is our turn. Please check out the SGD awards ceremony to meet Veerle Vandeginste, the second annual winner of this award.

**Veerle Vandeginste,
2011 winner of the
Stephen E. Laubach Award**



Veerle is currently a post-doctoral research associate working in the Carbonate Research Group lead by Cédric John at Imperial College London. Her main focus is on fault-related dolomitization, working on a project within the framework of the Qatar Carbonates and Carbon Storage Research Centre. The Laubach award will provide funds for geochemical analyses for the project titled "Linking fractures and fluid flow: investigating the structural control on calcite and barite cementation in the Cretaceous carbonate carapace of a salt dome (Jebel Madar, Oman)".

Do you know a colleague who would be particularly deserving of the Laurence L. Sloss Award for Sedimentary Geology? Please forward nominations to Richard Lanford at riplangford@gmail.com.

SEPM GOES THE EXTRA MILE AT GSA

The partnership between SEPM and GSA SGD has proven good all around and has improved each year. We would like to give a special thank you to SEPM from all of us at SGD for extending that extra measure of support for the program this year. This year, SEPM will be judging and adding \$1500 in extra funding for the awards for the best student posters (session T37). In addition, SEPM will be supporting \$2000 in travel awards to key note speakers and students who will give presentations in session T45, **Formation, Development, and Preservation of Bed Morphologies**. Hats off to SEPM for their generous support of sedimentary geology at GSA!

2011 GSA ANNUAL MEETING MINNEAPOLIS, MINNESOTA

Sedimentology has a strong presence at the GSA Annual Meeting. The GSA SGD and SEPM are sponsoring or co-sponsoring 32 theme sessions, two field trips, and three short courses. This represents twice the sessions as last year, and promises to be an exciting year for sedimentary geology at GSA. In Minneapolis on Saturday the 6th of October, the "Seds and Suds" forum and icebreaker will be held from 6:00 – 9:00pm, the evening just before GSA. This is the annual open icebreaker and discussion for anyone and everyone in the sedimentary research community. This is your opportunity to help develop a research agenda for the sedimentary community. It's also an increasingly popular event to just meet your colleagues and enjoy a cool beverage. We will include a discussion on Funding Challenges and Opportunities in the New Tight-Budget Era.

We are hoping that many of you will have ideas to present; however, any and all topics are open for discussion. If you are interested in having any particular topic added to the agenda, please feel free to contact us and we'll make time available.

We plan to have the 2011 SGD and Limnogeology Division Joint Business Meeting and Awards Reception on Tuesday evening, October 9th, to avoid overlap with alumni parties that are scheduled for Monday night. The meeting will be in the Convention Center. Please plan to join us for the celebration with good food and cash bar. The first 100 attendees will receive a ticket for a free beer, wine, or soft drink.

We welcome additional sponsors for the SGD and Limnogeology Divisions Joint Business Meeting and Awards Reception at GSA in Denver.

I) TOPICAL SESSIONS

T9. Tectonic Development of the Northern North American Cordillera *GSA Structural Geology and Tectonics Division; GSA Sedimentary Geology Division; GSA Geophysics Division*
Jeffrey M. Trop, Brian A. Hampton, John I. Garver

T10. Toward a Better Understanding of the Uplift History and Mechanisms of the Tibetan Plateau
GSA Structural Geology and Tectonics Division; GSA Geophysics Division; GSA Sedimentary Geology Division
Junsheng Nie, Gregory D. Hoke

T14. From The Bottom to the Top of the Arabia/Africa-Eurasia Collision: Lithospheric Scale Controls on Upper Crustal Structures and Basins in the Anatolian/Iranian Orogen
GSA Structural Geology and Tectonics Division; GSA Geophysics Division; GSA Sedimentary Geology Division
Joel E. Saylor, A. Arda Ozacar

T16. Linking Modern and Ancient Orogens
GSA Structural Geology and Tectonics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geophysics Division; SEPM (Society for Sedimentary Geology); GSA Sedimentary Geology Division
Clinton I. Barineau, Christopher S. Holm-Denoma

T18. Proterozoic to Modern Rifts: Sedimentary and Volcanic Processes and the Role of Inherited Structures
GSA Structural Geology and Tectonics Division; GSA Sedimentary Geology Division
Melissa A. Lamb, Thomas Hickson, Paul J. Umhoefer

T37. New Frontiers in Sedimentary Geology: SGD/SEPM Students (Posters)
GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)
Richard P. Langford

T38. Provenance Analysis in Modern and Ancient Sedimentary Systems
GSA Sedimentary Geology Division
Christopher M. Fedo, Michael C. Pope

T39. Integrated Sedimentary Systems: Applying Source-to-Sink Concepts across Geologic Time
GSA Sedimentary Geology Division; GSA Quaternary Geology and Geomorphology Division
Andrea Fildani, Jacob A. Covault

T40. Thresholds and Pathways of River Avulsion
GSA Sedimentary Geology Division; GSA Quaternary Geology and Geomorphology Division
Elizabeth Hajek, Douglas Edmonds

T41. Paying Attention to Mudstones: Priceless!
GSA Sedimentary Geology Division; GSA Limnogeology Division
Neil Fishman, Sven Egenhoff

42. Sediment Transport in Modern and Ancient Environments
GSA Sedimentary Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Environmental and Engineering Geology Division
Brandon McElroy, Wonsuck Kim

T43. Prediction in Stratigraphy
GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology); National Center for Earth-Surface Dynamics
Christopher Paola, Paul L. Heller

T44. Quantitative Provenance in Sediment Genesis via Various Analytical Techniques; a Necessary Multidisciplinary Step toward a Source-to-Sink Model: Pathway for Basin Analysis Interpretations
GSA Sedimentary Geology Division; PEMEX/PEP; ExxonMobil/Upstream Research Company; CoreLabs; Leica; Petzl; REI; Outdoor Industry Association; Salewa; Alta Vertical; VERTIMANIA
Igor Ishi Rubio-Cisneros, Yam Zul Ernesto Ocampo-Díaz

T45. Formation, Development, and Preservation of Bed Morphologies

GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology); International Association of Sedimentologists
Mauricio M. Perillo, Paul M. Myrow

T46. Application of New Stratigraphic Tools to Precambrian and Igneous Rocks: Challenges and Solutions

Precambrian [At Large]; North American Commission on Stratigraphic Nomenclature; ICS Subcommission on Precambrian Stratigraphy; International Subcommission on Stratigraphic Classification; SEPM (Society for Sedimentary Geology)
Robert Michael Easton, Rob Rainbird

T50. Applications of Bio-, Chemo-, and Lithostratigraphy to Sequence Stratigraphy

Paleontological Society; GSA Sedimentary Geology Division
Alicia C.M. Kahn, Douglas McCarty, Miriam E. Katz

T62. Frontiers in Foraminiferal Research: Implications for Interpreting the Past, Understanding the Present, and Predicting the Future

Cushman Foundation for Foraminiferal Research; SEPM (Society for Sedimentary Geology); SEPM - North American Micropaleontology Section; Paleontological Society; GSA Geobiology & Geomicrobiology Division
Pamela Hallock, Susan T. Goldstein

T63. Permian-Triassic Changes and Extinction Event: New Insights from Sedimentary, Geochemical, and Paleobiological Records and Modeling Approaches

GSA Sedimentary Geology Division; GSA Geobiology & Geomicrobiology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division
Arne M.E. Winguth, Thomas J. Algeo

T76. A Multidisciplinary Approach to Understanding the Dynamics of Sinuous Channel Evolution in Different Environments

GSA Sedimentary Geology Division; National Center of Earth Surface Dynamics; GSA Quaternary Geology and Geomorphology Division
Anjali M. Fernandes, Virginia B. Smith

T92. Buried Valley Aquifers: What Do We Know and How Do We Move Forward for Sustained Groundwater Management?

GSA Hydrogeology Division; GSA Quaternary Geology and Geomorphology Division; GSA Sedimentary Geology Division; GSA Geophysics Division; GSA Environmental and Engineering Geology Division
Hazen A.J. Russell, David R. Sharpe, Robert Shaver, Bruce D. Smith

T106. The Mono Lake Basin: A Gathering of Disciplines

GSA Limnogeology Division; GSA Quaternary Geology and Geomorphology Division; GSA Structural Geology and Tectonics Division; GSA Geobiology & Geomicrobiology Division; GSA Geophysics Division; GSA Hydrogeology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Sedimentary Geology Division
Susan Herrgesell Zimmerman, Sidney Hemming

T107. Lacustrine Carbonates

GSA Limnogeology Division; GSA Geobiology & Geomicrobiology Division; GSA Sedimentary Geology Division
Elizabeth Gierlowski-Kordesch, Walter E. Dean

T108. Lake Margin Environments as Dynamic Recorders of Fossils and Climate Change

GSA Limnogeology Division; GSA Sedimentary Geology Division; GSA Quaternary Geology and Geomorphology Division
Cynthia M. Liutkus

T109. Limnogeology: Interdisciplinary Studies of Lakes and Paleolakes (Posters)

GSA Limnogeology Division; GSA Sedimentary Geology Division
Daniel Deocampo, Amy Myrbo

T111. Geology of Unconventional Fossil Energy Resources

GSA Sedimentary Geology Division
Daniel Soeder, Thomas Mroz

T120. Limits on Human Systems—Lessons from the Geologic Record

GSA Geology and Society Division; GSA Geology and Public Policy Committee; GSA Environmental and Engineering Geology Division; GSA Geoinformatics Division; GSA Geology and Health Division; GSA Hydrogeology Division; GSA Quaternary Geology and Geomorphology Division; GSA Sedimentary Geology Division
Craig Cooper, Jon Goodwin

T130. Topics in Geoarchaeology: Reconstructions of Ancient Landscapes and Paleoenvironments

GSA Archaeological Geology Division; GSA Sedimentary Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Limnogeology Division
Kathleen Nicoll, Laura Murphy

T131. Are There Links between Springs and Archaeological Sites?

GSA Archaeological Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Limnogeology Division; GSA Hydrogeology Division; GSA Sedimentary Geology Division
Gail M. Ashley, Vance T. Holliday

T132. The History of Humans and the Hydrologic System: Exploring Relationships between Cultures, Climate, and Hydrology through Time

GSA Archaeological Geology Division; GSA Sedimentary Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Environmental and Engineering Geology Division
Gary Stinchcomb, Tim Messner

T181. Teaching and Learning in the Field: Helping Students to “Read the Record” and “Tell the Story of Earth”

GSA Geoscience Education Division; National Association of Geoscience Teachers; GSA Structural Geology and Tectonics Division; GSA Sedimentary Geology Division; GSA Hydrogeology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division
David W. Mogk, J.W. Geissman, Christopher Bailey, Miriam Barquero-Molina

T212. Impact Cratering on the Earth, Moon, and Planets: Remote, Field, and Lab Studies

GSA Planetary Geology Division; GSA Sedimentary Geology Division; GSA Geophysics Division; GSA Structural Geology and Tectonics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; International Continental Drilling Program
Christian Koeberl, Jeffrey Plescia

T215. Terrestrial Analogs in Solar System Studies

GSA Planetary Geology Division; GSA Structural Geology and Tectonics Division; GSA Geophysics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Sedimentary Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Geobiology & Geomicrobiology Division; GSA Limnogeology Division; GSA Hydrogeology Division
Simon A. Kattenhorn

II) FIELD TRIPS**431. Distal Signatures of Late Ordovician Oceanic Anoxia—New Data and Interpretations of a Classic Eperic Ramp Transect.**

Wed.–Sat., 12–15 Oct. US\$418 (L, R, 3ON).

Cosponsor: Great Lakes Section SEPM.

Leaders: Patrick McLaughlin, Wisconsin Geological and Natural History Survey; Norlene Emerson; Brian J. Witzke; Bryan Sell; Poul Emsbo.

445. Event History and Sequence Architecture of the Middle–Upper Devonian Eperic Carbonate Platform of the Iowa Basin.

Wed.–Sat., 12–15 Oct. US\$350 (L, R, 3ON).

Cosponsors: Great Lakes Section SEPM; Illinois State Univ. Dept. of Geography & Geology; International Commission on Stratigraphy–Subcommission on Devonian Stratigraphy; North-Central Section GSA; GSA Divisions: Geobiology & Geomicrobiology; Sedimentary Geology.

Leader: James (Jed) E. Day, Illinois State Univ.

III) SHORT COURSES

502. Sequence Stratigraphy for Graduate Students.

Fri.–Sat., 7–8 Oct., 8 a.m.–5 p.m.

\$25; includes continental breakfast and lunch. Limit: 55. CEU: 1.8.

Cosponsors: *ExxonMobil Exploration Company; Chevron Energy Technology Company; British Petroleum; GSA Sedimentary Geology Division.*

Art Donovan, British Petroleum; Kathryn Lamb-Vozniak, ExxonMobil Exploration Co.; Morgan Sullivan, Chevron Energy Technology Co.

506. Structural and Stratigraphic Concepts Applied to Basin Exploration.

Fri.–Sat., 7–8 Oct., 9 a.m.–5 p.m.

\$25; includes continental breakfast and lunch. Limit: 30. CEU: 1.6.

Cosponsors: *ExxonMobil Exploration Company; ExxonMobil Upstream Research Company; GSA Sedimentary Geology Division.*

Lori Summa, ExxonMobil Upstream Research Co.; Bob Stewart, ExxonMobil Exploration Co.

516. Teaching about Earth's Climate History.

Sat., 8 Oct., 8 a.m.–5 p.m.

\$50; includes continental breakfast and lunch. Limit: 35. CEU: 0.9.

Cosponsors: *National Science Foundation; Wiley Blackwell Publishers; GSA Sedimentary Geology Division; GSA Geoscience Education Division.*

Kristen St. John, James Madison Univ.; R. Mark Leckie, Univ. of Massachusetts–Amherst; Kate Pound, St. Cloud State Univ.; Megan Jones, North Hennepin Community College; Larry Krissek, Ohio State Univ.

SEDIMENTOLOGY GEOLOGY CONTINUES TO BRING ON THE HEAT, AS IT FORESEES THE FUTURE OF ENERGY

As near as I can tell, humans consume two things, matter and energy. It's a little hard to corner the market on matter. We humans tend to make and break a lot of things. Not so when it comes to energy. Between coal (21%) and natural and gas (25%), sediments currently produce 46% of the total energy consumed within the US, and the 9% nuclear and 2% hydroelectric do not completely escape the sedimentary sphere (US Energy Information Administration, June 2011). When it comes to mobile energy (fuels), we all feel the weight of the mighty sedimentary column every time we pay at the pump. We flirt with ethanol, are enamored with electricity, but are still making our outings with oil at 37% of energy consumption (US Energy Information Administration, June 2011). So how long can this go on? Quite a while I think. You just don't put a half a terawatt of power on the grid with wishful thinking. It takes big power sources, and we need them to be stable to supply that critical needed "base load."

So what's next? Nothing goes on forever after all. We all know of the CO₂ emission concerns of fossil fuels, and the supply issues of petroleum. By now, most people are more than ready for a change. So what else is out there? Let's consider one problem at a time. Let's set aside fuel for another discussion and think about electricity. I like solar and wind, but they are not steady or storable, and currently have limited use as they must be balanced with difficulty within the grid in order to keep power levels stable. One day wind and solar may become the primary makers of toast, but until "Duracell" becomes "Gigacell," they are just not going to be able to replace the big sedimentary energy players. I like nuclear too, and it could certainly do the job. But, let's face it, it kinda gives people the willies.

Can sediments do it again? You bet they can. Let me introduce you to the SEES (Science, Engineering and Education for Sustainability) program, coming to NSF this year. This new program addresses basic research leading to the development of the next generation of sustainable power sources. The program is aimed at adding new energy generators to the national energy portfolio that can produce energy with minor environmental impact, both long term and in large enough quantities to make a difference. Projects range from developing new or underutilized energy sources to making the sources we have a little more clean and practical. Sedimentary geology will be well represented in these future sources. Presently, a series of NSF-supported workshops are under way to set goals and strategies for the SEES program. No less than four of these workshops are sedimentary themed, with two

addressing surficial systems and two addressing the rock record. In case you have not already seen them advertized, let me introduce them to you now.

Topics for upcoming SEES workshops

- **Natural and engineered carbon sequestration**
- **Challenges to unlocking the geothermal energy potential of sedimentary basins**
- **Basic research at the intersection of marine/hydrokinetic energy and the aquatic environment**
- **Research opportunities in sustainable energy pathways for the Earth-surface process community**

Sedimentary geology has long played a pivotal role in energy supply. Energy sources will no doubt change over time. If we are to stay relevant, we have to chance with the times. That said, we still appear to remain part of the solution. So in closing, I'd say participate in a workshop and add your ideas to the discussion. Otherwise, plug into the new SEES program with a good sedimentary proposal and help assure we remain relevant to the next generation of energy consumers.

JH

Consider applying for the NSF SEES Workshop

Tracking an Energy Elephant: Science and Engineering Challenges for Unlocking the Geothermal Potential of Sedimentary Basins

For more information go to

<http://www.SedHeat.org>

SGD PERSONNEL AND COMMITTEE ASSIGNMENTS FOR THE 2010-2011 YEAR

- **John Holbrook** is the Chair.
- **Richard Langford** is the Vice-Chair.
- **Linda Kah** is the Secretary/Treasurer.
- The Joint Technical Program Committee (JTPC) representatives for SGD are **Brenda Beitler Bowen** and **Tracy Frank**.
- **Kelly Dilliard** is the web manager.
- The Sloss Award Committee comprises: **Janok Bhattacharya; Pete Decelles; Maya Elrick; Ray Ingersoll; Judy Parrish, Hugh Jenkyns**
- Stephen E. Laubach Structural Diagenesis Research Award Committee comprises: **Brenda Beitler Bowen; Laura Crossy; Peter Eichhubl; and Linda C. Kah**

If you have any suggestions regarding information that the SGD web site should contain or useful links for the sedimentary geology community, please contact **Kelly Dilliard** at kedilli1@wsc.edu.

For more links to societies and organizations of interest to sedimentary geology, visit <http://rock.geosociety.org/sed/SGD.html>.

PRESIDENT'S COMMENTS

In my previous column, I alluded to planned initiatives by the SEPM to increase the level of activity at, and variety of technical sessions and other offerings for sedimentary geologists at, future Geological Society of America annual meetings. I'd like to use this column to expand upon that theme. The reasons behind this are straightforward enough. We believe firstly that a decrease in the opportunities for sedimentary geologists at the GSA Annual Meetings in the past two years has caused some people to look elsewhere for appropriate forums at which to present their research. The GSA Annual Meeting is, nonetheless, one of the principal, recurring geological meetings in North America, and it should fully represent the broadest spectrum of the earth sciences. It could indeed be argued that our discipline is not well-served by under-representation at these meetings. Furthermore, for those whose research does not lend itself to the more applied focus of the American Association of Petroleum Geologists Annual Meetings (in which SEPM plays a pivotal role every

year), GSA has historically been the meeting of choice. The more "academic" side of sedimentary geology deserves to be better looked after, and so you will see some changes in the way we interact with GSA in the future.

You may know that SEPM already acts as a sponsor of some sessions at GSA, and collaborates in this regard with the Sedimentary Geology Division of GSA. This sponsorship is generally passive, that is to say, entails mainly "moral support" for a session or sessions. In order to make an immediate impact, I have decided to use my President's discretionary funds to provide tangible financial support for two sessions at this year's GSA Annual Meeting in Minneapolis, MN (October 9-12th). Those sessions will be T45 "Formation, Development and Preservation of Bed Morphologies", and T37 "New Frontiers in Sedimentary Geology: Student Posters". In the first case, funds have been set aside to assist in bringing top class keynote speakers to the session and to support involvement by students. In the second case, funds will

be used to support the award of prizes for the best student posters in the session. It is our hope that this will stimulate activity and engagement in the meeting by sedimentary geologists, and especially by students.

We are also planning to become more directly involved in the planning of future GSA Annual Meetings, via membership of organizing committees by SEPM representatives. This is still in the early stages of discussion, but members can expect to hear soon about an increased level of participation in the scientific planning of these meetings by SEPM, with a formal nominated representative position similar in purpose to the SEPM Vice-Chair role at AAPG meetings. The aim here is to try to ensure that in future, sedimentary geology is fully and appropriately represented in the scientific program at GSA Annual Meetings.

I'll look forward to seeing you all in Minneapolis in October.

Chris Fielding



SEPM Society for Sedimentary Geology
"Bringing the Sedimentary Geology Community Together"
www.sepm.org

2012 SEPM MEDALISTS

Twenhofel Medal - John C. Harms
 (Consultant, Littleton, CO)

Shepard Medal - James V. Gardner
 (University of New Hampshire)

Pettijohn Medal - Norman D. Smith
 (University of Nebraska)

Moore Medal - Carleton E. Brett
 (University of Cincinnati)

Wilson Award - Shahin Dashtgard
 (Simon Fraser University)

Honorary Member - TBA

Please congratulate these outstanding geologists. Awards will be given at the 2012 SEPM Annual Meeting in Long Beach (AAPG ACE) at the President's Reception, Tuesday evening, April 24.



PALEONTOLOGICAL SOCIETY DISTINGUISHED LECTURERS

The Paleontological Society is proud to support the Distinguished Lecturer Program, with the goal of bringing outstanding scientists to colleges, universities, and public events to speak about cutting-edge paleontological research, evolution, and the nature of science. We support three lecturers each year on rotating, two-year terms. Speakers have agreed to make themselves available on an expenses-only basis; no honorarium is required. **The Society provides up to \$400 toward speaker travel** to give lectures. The host institution is expected to cover on-site expenses, including meals and lodging. Travel support is currently available on a first-come, first served basis, but this process may be amended if demand is high. See <http://www.paleosoc.org/speakerseries.html>

Attributes

New Views on Seismic Imaging—
Their Use in Exploration and Production

31st Annual

GCSSEPM Foundation
Bob F. Perkins
Research Conference

December 4-7, 2011
Houston, Texas

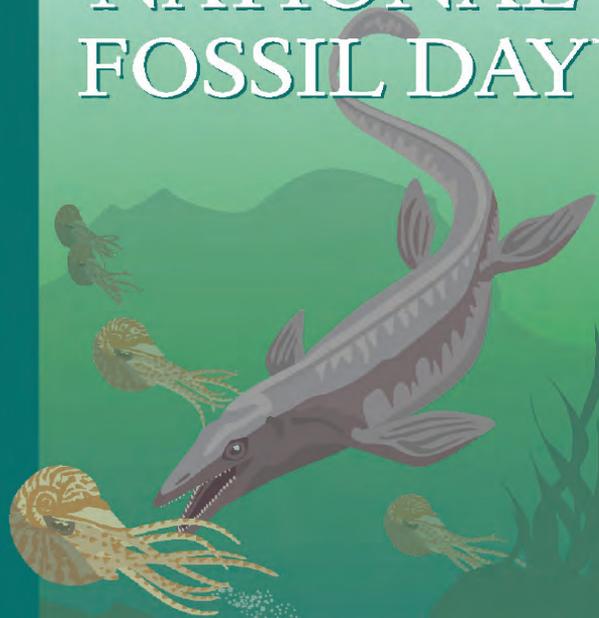


Conference information
and
online registration
available on our Web site:

www.gcssepm.org



NATIONAL FOSSIL DAY



EXPLORE • LEARN • PROTECT
OCTOBER 12, 2011

Rocky Mountain Association of Geologists

Thursday
September 22, 2011

MARRIOTT CITY CENTER DENVER

- **Keynote Speaker**
Julie A. LeFever, North Dakota Geological Survey
- **New RMAG Guidebook**
*The Bakken-Three Forks Petroleum System
in the Williston Basin*
- **Presentations • Exhibits**

Featured Topics:

- **Bakken and Three Forks Stratigraphy • Regional Structure • Field Studies • Geochemistry**

CO-Chairmen: John Robinson & Mark Sonnenfeld

www.rmag.org



Join us

SEPM BEST PRESENTATION AWARDS

Over the last several years, it has become more and more difficult to get enough volunteer judges for each SEPM session to make a creditable award. For the last two years, SEPM experimented with a new method for determining Best Presentations - using popular nominations and allowing all meeting attendees to nominate any talks or posters that impressed them enough to be considered as a potential "Best" presentation. Although heavily advertised and allowing online, texting and printed nomination methods, this attempt, also, did not produce enough numbers to make statistically sound determinations and the SEPM Council has decided to terminate this particular award for the 2011 and future meetings. For 2011 since some of the attendees considered some presentations to be of a high caliber, SEPM will recognize these presentation with a Certificate of Recognition for their efforts to communicate their science to the community.

Note that SEPM did recognize the top student posters from the SEPM Student poster session using a 5 judge committee and awarded cash prizes to the top three students. SEPM will continue judging and awarding prizes to the top student posters.

SEPM JOURNALS CONTINUE TO BE RECOGNIZED AS LEADERS IN THEIR TOPICAL AREAS

- Fast and easy online submission and review
- Little or no backlog
- Open Access Options for those the desire or need them
- Contact any of the Editors (Councilor Members or Managing) if you have any questions.

JSR Science Co-Editors: **Gene Rankey** and **Paul McCathey** (Council Members)

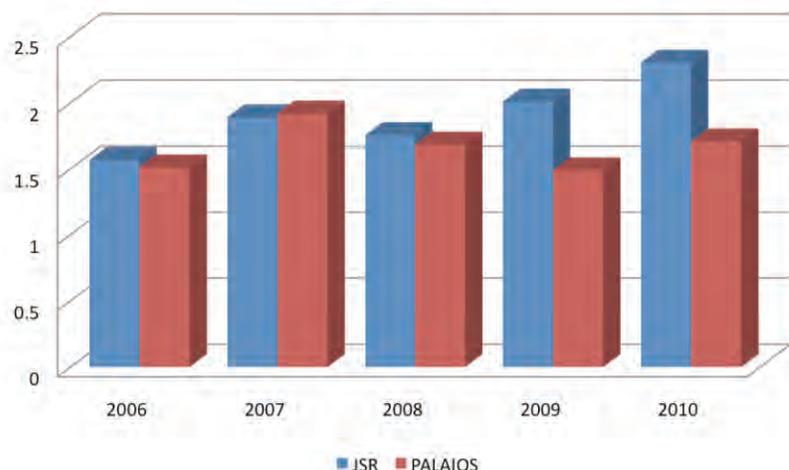
JSR Managing Editor: **Melissa Lester** (jsedres@gmail.com)

PALAIOS Science Co-Editors: **Steve Hasiotis** and **John-Paul Zonneveld** (Council Members)

PALAIOS Managing Editor: **Jill Hardesty** (palaios@ku.edu)

** Both Melissa and Jill will be at the GSA meeting in Minneapolis. Stop by the SEPM Booth to see about visiting with them at the meeting.

IMPACT FACTOR



Digital Geospatial Context for 3-D Source-to-Sink Models: New Insights into the Classic Shelf to Basin System of the Guadalupe and Delaware Mountains

April 25-May 1, 2012 Carlsbad, NM

(Immediately following 2012 AAPG/SEPM Annual Meeting)

Conveners: Charles Kerans and Jerome A. Bellian

Principal Contributors: Ned Frost, Paul (Mitch) Harris, Dave Hunt,
David Mohrig, Ted Playton, Phil Resor, and Toni Simo



Research Conference Scope:

This conference will highlight and synthesize the impact of new research and technologies on the classic Guadalupe/Delaware Mt. reef-rimmed platform to clastic deep-water basin transect. The Guadalupe and Delaware Mountains have served as outcrop analogs for carbonate and siliciclastic subsurface reservoirs worldwide for over 6 decades. Few outcrops offer the platform-to-basin continuity and scale of the Guadalupe/Delaware Mountain complex. No regional synthesis of this area has been conducted in over 30 years. Using evolving digital outcrop imaging technology including high-resolution airborne Lidar and photography, the University of Texas DGS, the Texas Bureau of Economic Geology, Chevron, ExxonMobil, ConocoPhillips, and Statoil are tackling different parts of this larger platform system.

This conference will provide a unique opportunity for both researchers active in the area and those less familiar with the Capitan-Delaware exposures to review, discuss, and synthesize diverse datasets and interests using a common template, viewing actual and virtual outcrops as a cross-disciplinary group. The extensive 5-day program will include visits to most key exposures, as well as time in the classroom and portable VR setup to discuss and review observations and models. New concepts in steep reef-rimmed carbonate slope and channel systems, the role of syndepositional fractures and fault zones, early and late diagenetic overprints, and the evolving stratigraphic framework will be highlighted.

Format:

The conference will be a combination of lectures/discussions alternating with field excursions. Lecture/discussion will be supported by a mobile 3-D visualization center provided by the Bureau of Economic Geology.

Location:

The conference will begin in El Paso, TX on April 25th, 2012 with two days of lectures and posters integrated with three and a half days of field excursions based out of Carlsbad, NM, and conclude on May 1st in El Paso, TX.

