THE NEWSLETTER OF THE GULF COAST SECTION SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS

GCSSEPM NEWS

Volume 59 **Number 3** **Fall 2012**

Highlights

The GCSSEPM News is published three times a year. Please send any comments or suggestions to Charlotte Jolley, GCSSEPM Secretary at charlotte.jolley@shell.com, or contact your local business representative. Visit the GCSSEPM Website at www.gcssepm.org for Section and Foundation news and information.

The President's Column

This summer has been a busy one for me — with preparing for the GCAGS/GCSSEPM meeting in Austin, as well as travel to Italy, the Alps, and Austin to work and attend conferences. Conferences are important for networking with new and old colleagues, learning new aspects of your own and others' sciences, and expanding your geological horizon.

I just returned from presenting a talk on my current research topic of Upper Permian mudrocks of Germany at the International Association of Sedimentologists (IAS) Conference that was held in Schladming, Austria, and organized by the University of Leoben, Austria. It was a truly international conference, with attendees from all over Europe, China, Japan, Australia, and the USA. The quality of presentations and excellence in scientific contributions were outstanding. This meeting is not very well attended by American geologists, but I highly recommend your attending a future IAS meeting. A variety of sessions ranging from karst sediments, tectono-sedimentary processes, geobiology, organofacies, mass-transport deposits, climate, modeling, and many others offered a high-powered scientific program.

If you don't want to travel as far as Europe, though, you may experience, and recharge at, a conference right in our own backyard! The Bureau of Economic Geology and the Austin Geological Society have been instrumental in setting up the 62nd annual GCAGS/GCSSEPM meeting and putting together an outstanding program that emphasizes energy, environment, and economics. This year's meeting is especially notable because an entire extra day (Wednesday, October 24) is devoted to a Special Symposium on Sharing Knowledge to Add Value, comprising selected Asociación Mexicana de Geólogos Petroleros (AMGP) presentations and posters from the cancelled 61st annual meeting slated for Veracruz, Mexico, last year.

This year's program will not only address the challenges of managing and discovering new oil and gas potential in the Gulf Coast, such as resources and conventional plays, but it will also consider how these discoveries and existing fields will impact the Gulf Coast economically and environmentally. An interactive panel discussion on economy, environment, and policy, as well as a variety of interesting short courses, field trips, talks, and posters, guarantee an outstanding program. Please sign up and attend the meeting.

By the way, our past president, John Holbrook, will teach a GCSSEPM-sponsored short course on fluvial stratigraphy for students only. So please, if you are a student or an advisor, attend or encourage others to attend this course for an excellent opportunity to further your knowledge in fluvial stratigraphy. The short course is one of GCSSEPM's initiatives for offering a free short course to students taught by GCSSEPM members or officers, and we are working on a permanent date for holding one short course per year.

Another important event to attend at the conference will be our GCSSEPM luncheon on Tuesday, October 23, at which you will have the opportunity to visit with our distinguished award winners and guests. During the luncheon, Professor David Budd and current SEPM President—our invited speaker—will present what promises to be a fascinating talk on self-organizing processes in sedimentary diagenesis. This luncheon has been underwritten by a generous contribution from BHP Billiton! Thank you BHP!

I hope to see you all at GCAGS/GCSSEPM 2012 in Austin, October 21st!

Auf Wiedersehen,
Ursula Hammes
President

GCSSEPM Dues Reminder

Members, *please* remember that yearly dues were due by April 1st. The number in the upper right hand corner of your mailing label indicates the last year of paid dues. Please check your status and use the membership form on the back of this newsletter or renew your membership online at **www.gcssepm.org.**

The Director's Chair

It is now September 1st. A cool August for Houston (no temperatures over 100), Hurricane Issac tried to wash away the central Gulf Coast, and we are about to be inundated by political advertisements. Fortunately, the football season has started.

The GCAGS/GCSSEPM convention will be in Austin, Texas, this October and a very interesting program has been announced. I am still amazed as to how the topic of interest has changed from limestone and sandstone to shale. We hope that you will be there and drop by our booth to say hello.

This time of the year also means increased activity regarding the December conference. Early indications suggest that we will have a fairly large turnout. Certainly, when you consider that papers range from the eastern Mediterranean to offshore Brazil to offshore New Zealand, we do offer something for everybody.

In the last issue, we noted that we had granted 14 partial fellowship awards. The list was very varied regarding areas and topics. We would like to feature two very, very, very different proposals that we found intriguing enough to support.

The first is by Lydia Tarhan, from University of California-Riverside. Her proposal has to do with microbialites. Considering the fact that several of our papers are on Campos Basin microbialite reservoirs, this topic is very appropriate.

On a completely different note, Andrew Macumber, from Carleton University in Ottawa, Canada, proposed a high-resolution multi-proxy paleoclimatic reconstruction of the southern Northwest Territories (NT) using lake sediments from the Tibbitt to Contwoyto Winter Road (TCWR), NT, Canada.

Dr. Norman C. Rosen
Executive Director
GCSSEPM Foundation

Examining Metazoan-Microbialite Interactions: A Case Study from the Exuma Cays, Bahamas

Lidya Tarhan (University of California, Riverside)

Precambrian carbonates, in contrast to the majority of the Phanerozoic record, are characterized by prolific, widespread and morphologically diverse microbially mediated carbonate buildups — microbialites (Grotzinger and Knoll, 1999; Riding, 2011). Decline in microbialite abundance and diversity during the late Proterozoic and early Phanerozoic is traditionally attributed to the concurrent radiation of burrowing and grazing metazoans (Garrett, 1970; Awramik, 1971; Walter and Heys, 1985). Similarly, the apparent resurgence of microbialites in the wake of Paleozoic and Mesozoic mass extinctions (e.g., Sheehan and Harris, 2004; Mata and Bottjer, 2012) is frequently linked to drastic declines in metazoan reefal communities and increased abundance of microbial communities. Recent work suggests, however, that not only are microbialites relatively common in modern carbonate environments, but they can also host dense and diverse communities of infaunal metazoans. These findings suggest that prevalent interpretations attributing Phanerozoic declines and fluctuations of microbialites to metazoan-mediated exclusion are in need of reevaluation. Moreover, close examination of modern microbialite-metazoan communities will shed light on the effect of metazoan activity upon the formation, early diagenesis and preservation of both modern and ancient microbialite fabrics. In light of growing awareness of the importance of microbialites as hydrocarbon reservoirs, a better appreciation of the role infaunal metazoan communities play in microbialite fabric development may not only significantly augment our understanding of modern and ancient microbialites, but also elucidate the processes involved in the generation of microbialite reservoirs.

On the basis of emerging awareness of the interconnectedness of microbialite and metazoan communities, I propose a detailed study of metazoan abundance and diversity across a spectrum of microbialite types and sedimentary settings at Lee Stocking Island and Little Darby Island, the Bahamas, with the objective of systematically characterizing the relationship between microbial mat-building communities, infaunal metazoan ecology and microbialite fabric development. I will employ a variety of ecological, geochemical, sedimentological and petrographic tools to more closely examine the importance of such factors as sediment stress, energy, exposure; organismal recruitment, settlement, adaptations, tolerances and food supply; and sediment and bottom-water chemistry upon the mutual development of microbialite fabrics and infaunal communities. This work will allow me to test whether spatial, chemical or ecological factors are the predominant control upon microbialite-infauna development. These findings will, in turn, be applied to the ancient microbialite record, to test the feasibility of prevailing models for microbialite decline and metazoan exclusion.

1. **Introduction**

Extensive study of modern carbonate environments, notably in the Bahamas, and a growing awareness of the importance of modern analogues to ancient sedimentary systems have done much in recent years to improve our understanding of carbonate platform sedimentary and chemical dynamics, which in turn have served as useful working models for Precambrian and Phanerozoic deposits. In the past few decades, exploratory work in the Bahamas has revealed the persistence of microbialites in the open marine settings of Eleuthera Bight (Dravis, 1983) and offshore of the Exuma Cays (Dill et al., 1986). Microbialites are extensive in the Bahamas, but this appears to be the only modern open marine environment in which they are widespread.

Although our understanding of the sedimentary processes and microbial dynamics involved in Bahamian microbialite accretion have advanced substantially in the last few decades, the relationship between microbialites and metazoan communities in open marine settings remains an unexplored frontier. Earlier work on Bahamian microbialite-metazoan interactions has largely been confined to brief notation of associated fauna, reported in the context of larger sedimentological and diagenetic studies (e.g., Dill, 1991). More in-depth studies of

Announcing
2013 GCSSEPM Executive Council

PRESIDENT Mike Blum	**SECRETARY** Charlotte Jolley
PRESIDENT-ELECT Carl Fiduk	**TREASURER** Brandi Sellepack
VICE PRESIDENT Don Van Nieuwenhuise	**PAST-PRESIDENT** Ursula Hammes

microbial-metazoan interactions (e.g., Farmer, 1992 and references therein; Konishi et al., 2001; Gingras et al., 2011) have been limited to fresh water or hypersaline systems, where infauna is predominantly composed of insect larvae, limiting their applicability as analogues for ancient marine microbialites. Moreover, most of these studies concern unlithifying microbial mats, unlike the Bahamian and recorded ancient systems, where microbialites undergo progressive lithification (e.g., Planavsky et al., 2009). In this light, I will undertake a systematic taxonomic and ecological examination of infaunal metazoan communities of various microbialite types in the Exuma Cays of the Bahamas, with the objective of characterizing the relationship between microbialites and metazoan communities.

2. **The Exuma Cays, Bahamas**

The Exuma Cays are situated on the eastern margin of the Great Bahama Bank and at the western margin of the Exuma Sound, at the interface and zone of intense mixing between the warm, salty waters of the carbonate platform and the colder waters of the Atlantic (Dill, 1991). Microbialites occur commonly in subtidal (channels or sandy embayments) and intertidal settings throughout the Exumas (Reid et al., 1995). Bahamian microbialites exhibit considerable diversity in physical, chemical and biotic microenvironments, notably degree and duration of exposure, sediment stress, framework construction (i.e., fabric) and macro-algal and metazoan colonization (Reid et al., 1995; Shapiro et al., 1995).

Bahamian lithifying microbial mats include diverse communities of autotrophic and heterotrophic bacteria and both single-celled and multi-cellular eukaryotic algae (e.g., Stolz et al., 2009; Reid et al., 2011). However, the overall structure of the mats (and thus microbialite fabric) is controlled largely by the interactions of a framework-building cyanobacterium (e.g. the oscillatoriaceans Schizothrix and Microcoleus or the nostocalean Dichothrix) with detrital carbonate flux. Therefore, reconstruction of the dominant processes of microbialite fabric formation is reliant upon understanding of the dynamics of the framework cyanobacterial community (e.g., Reid et al., 2000; Visscher et al., 2000).

Preliminary findings from Highborne Cay and Little Darby Island suggest that certain microbialites are associated with abundant and diverse populations of infaunal metazoans. Equally intriguing, these fauna-rich microbialites occur within meters of fauna-poor microbialites, suggesting that neither macro-environmental factors nor patterns of metazoan settlement significantly influence variability in microbialite infaunal populations or fabric development. However, further fieldwork is needed in order to verify preliminary findings and to investigate additional localities, including a new locality at Little Darby Island, as well as subtidal microbialites off of Lee Stocking Island (the home of the famed "giant stromatolites" [Dill et al., 1986] that first put Bahamian microbialites on the map). The core of this proposed work consists of rigorous testing of these initial observations and deciphering the mechanisms controlling the abundance of microbialite-hosted infauna.

3. **Objectives**

The Exuma Cay microbialites offer an exciting opportunity to resolve metazoan-microbialite interactions in modern normal marine settings. The preliminary results obtained from Highborne Cay and Little Darby Island are compelling but incomplete. These results require replication and further study is needed to elucidate the mechanisms controlling infaunal abundances. Specifically, additional work is required to determine 1) whether the coexistence of microbialites and diverse metazoan communities persists across a variety of environments, 2) whether this relationship is observed across a broad range of microbialite morphologies and cyanobacterial framework-builders or whether it is confined to microbialites constructed by particular cyanobacteria (e.g., Schizothrix, Dichothrix and Microcoleus), 3) what is the chemical relationship between microbialites and metazoan infauna and 4) what is the relationship between the infaunal community and microbialite fabric development.

Samples collected during pilot field studies were taken from microbialites accreting in the intertidal zone and subtidal sandy embayments off of Highborne Cay and Little Darby Island, respectively and rich infaunal metazoan communities were observed in both environments. However, microbialites occur across a wide range of settings throughout the Exuma Cays. For instance, it is unknown whether the microbialites in the high-energy (currents up to 150 cm/s [Dill, 1991]) subtidal channels offshore of Lee Stocking Island host metazoan communities comparable to those of Highborne Cay and Little Darby Island. Investigation of this possibility is especially pertinent in light of the fact that the stromatolites of Lee Stocking Island are commonly touted as 'Precambrian analogues' (Dill et al., 1986). Exploration of further microbialite-bearing localities like Lee Stocking Island is necessary to determine to what extent environmental conditions may permit or exclude microbialite colonization by infauna. Microbialites of a previously undescribed morphology (tentatively attributed to the oscillatoriacean cyanobacterium Phormidium) were also recently discovered growing in peritidal sand flats along the northwestern shore of Little Darby Island. Investigation of possible microbialite-hosted infaunal communities in these periodically exposed, quiet water settings may therefore help to clarify the role of sedimentological factors in the dynamics of microbialite-metazoan communities and microbialite fabric development.

It has long been recognized that microbialites in the Exumas occupy a morphological continuum far more complex than the simple dichotomy of 'laminated' and 'clotted' (Reid et al., 1995; Planavsky and Ginsburg, 2009). Further characterization of microbialite mesofabric is requisite if we are to come to a better understanding of the relationship between microbialite fabric and infaunal community structure. As the preliminary results from Highborne Cay and especially Little Darby Island indicate, the community of cyanobacterial framework builders appears to have some bearing upon infaunal community development that transcends gross microbialite mesostructure (e.g., 'laminated' vs. 'clotted;' see Shapiro, 2000). The Little Darby microbialites, in spite of their 'stromatolitic' (laminated) mesostructure, possess a rich and diverse infauna comparable to that of the Highborne Cay thrombolites. This suggests that we need to turn to the microscopic community of mat-builders in order to better decipher the differences between fauna-rich and fauna-poor microbialites in the Exumas. Therefore, I will examine as wide and varied a range of microbialite morphologies as possible, in order to discover relationships among the microstructure of individual microbialites. A closer examination of the bacterial framework-building community of lithifying microbial mats may shed important light upon the formation of microbialite fabrics and help to highlight differences between fauna-rich and fauna-poor microbialites.

Moreover, toxicity assessment will be employed to determine if metazoan-poor microbialites at Highborne Cay and Little Darby are the result of chemical exclusion by toxic strains of cyanobacteria, thereby testing for biochemical controls on microbial fabric development. A recent area of interest in the microbiological community is the extent and effect of toxicity among benthic cyanobacteria. As highlighted in recent studies (e.g., Golubic et al., 2010; Mankiewicz et al., 2003), toxicity in benthic cyanobacteria can be trophically transferred to and concentrated in metazoans (e.g., ciguateric fish and giant clams), with potentially fatal results to human consumers. It is unknown whether any of the lithifying, mat-forming cyanobacteria responsible for the Exumas microbialites include toxic strains and to what

Continued on page 4

Examining Metazoan-Microbialite Interactions

Continued from page 3

extent these may be associated with infaunal communities. Toxicity in cyanobacteria is diverse at both the species and sub-species level; morphological features traditionally used in taxonomic study are not much use for the assessment of toxicity (Golubic et al., 2010). Moreover, expression of toxicity may be environmentally-driven; not all genetically toxic strains may produce toxins in all environments (Golubic et al., 2010). Analytical work is needed to determine whether the lack or dearth of infauna in certain Schizothrix-dominated microbialites may be toxin-induced. Traditional enrichment methods (e.g. extraction of microbialite organic matter, placed in culture with known infaunal species or typical toxicity assay templates, such as the nematode Caenorhabditis elegans [Swatloski et al., 2004]) or standard screening for specific toxic compounds may shed new light upon the potential toxicity of Bahamian microbialite framework-building cyanobacteria.

Lastly, morphological-ichnological and petrographic work may do much to clarify the role of metazoan infauna in the formation and early diagenesis of microbialite fabrics. It has been suggested that metazoan-mediated modification may be one cause of thrombolitic fabric development in modern microbialite (Planavsky and Ginsburg, 2009). However, the extent to which metazoan activity may be implicated in the development of other fabrics has been largely unexplored. In addition to thin section work, traditional macro-ichnological methods (e.g., Curran and Martin, 2003), previously unapplied to microbialites, such as creating polyester resin casts by infilling burrows with liquid resin, may help to determine the degree to which infaunal activity can influence microbialite fabric development, for instance the relationship between burrows and clots, as well as more generally between burrows and micro-porosity.

Continued exploration of microbialite-metazoan communities across a wide range of microbialite types, microbial framework communities and sedimentological settings will reveal the extent and diversity of microbialite-hosted metazoan communities. Additionally, in-depth chemical, taxonomic, petrographic and ichnological work will help pinpoint the mechanisms responsible for the abundance and diversity of infauna in various microbialite-metazoan systems.

4. **Materials and Methods**

Sediment samples will be collected for faunal, chemical and petrographic analysis from microbialites at Highborne Cay, Little Darby Island and Lee Stocking Island. Analyses will be performed in situ, at Little Darby Island Field Station (maintained by the Rosenstiel School of Marine and Atmospheric Science, University of Miami) and at the University of California, Riverside.

For faunal analysis, sediment samples will be carefully extracted by knife from the unlithified upper portions of each microbialite and placed intact in a plastic bag. Standard techniques (e.g., Higgins and Thiel, 1988) will be employed to assess metazoan abundance and diversity. Microbialite samples will be gently crushed and all living macro- and meiofauna will be extracted at 10x magnification under a binocular microscope. All macro- and meiofauna will be taxonomically identified, described and photographed. A 10% magnesium chloride solution will be used as a relaxant and a 10% buffered formalin solution (transferred after 24 hours to 70% ethanol) will be used as a preservative to allow for further taxonomic work. Taxon-specific and total abundances for each microbialite sample will be normalized to sediment volume. Further, a portion of each sediment sample will be retained and homogenized (powdered) to measure total organic carbon (TOC) concentration, in order to test for a bulk organic substrate control upon infaunal abundance. TOC contents will be determined by the difference between total carbon by combustion (at 1450° C) and total inorganic carbon by acidification using an ELTRA carbon/sulfur determinator at the University of California, Riverside.

The potential toxicity of Schizothrix framework-builders in fauna-poor microbial mats will be assessed by means of standard culture work and screening for known toxins. Following procedures outlined by Laurent et al. (2008), collected samples will be placed in plastic bags, sealed underwater and vigorously agitated to dislodge cyanobacteria. The resulting solution will be successively sieved up to 45 μm. The retentate will be cultured and introduced to cultures of living microbialite-extracted metazoans and Caenorhabditis elegans to assess potential toxicity. Schizothrix-dominated microbial mat samples from fauna-poor microbialites will also be collected for toxicity assay work. Fresh bulk microbial samples will be physically isolated from sediments and mixed with de-ionized (DI) water to form an organic-rich slurry. The slurry will be lyophilized and the resulting dry bulk sample will be sent to a commercial laboratory (e.g. Green Water Laboratories/CyanoLab) for toxicity assessment – specifically screening for aplysiatoxins (the only toxins currently known to be associated with any species of Schizothrix) via liquid chromatography mass spectrometry (LC-MS) (e.g., Hamilton et al., 2002).

Sedimentology, cyanobacterial framework and algal community will also be observed under magnification and recorded for each collected sediment specimen. Lithologic replicate samples will be retained in order to determine macro- and micro-porosity, respectively. Replicate microbialite samples will also be collected for neo-ichnological study. Samples will be thoroughly impregnated with polyester resin (e.g., Curran and Martin, 2003); the resulting internal molds will be used to assess the extent of burrow development, burrow interconnectedness and relationship to original microbialite fabric.

5. **Broader Impacts**

The proposed work in the Exumas will do much to clarify the enigma of metazoan-microbialite relations. Previous modern microbialite studies have dismissed, overlooked or only briefly noted a metazoan presence without attempting further analysis or discussion. Yet, as preliminary findings have demonstrated, coexistence of microbialites and infaunal metazoans is not a rarity in the Exumas and the mutual development of microbialite and metazoan communities merits further investigation. A fuller understanding of the nature and causes of this interconnectedness is vital if we are to address the energy needs of today's society. The importance of microbialites as hydrocarbon reservoirs is receiving growing attention in the petroleum industry, with the recently discovered lower Cretaceous deposits in the offshore-Brazil Santos basin providing the foremost example of a significant microbialite reservoir. A clear understanding of the processes involved in fabric development in carbonate reservoir rocks is a necessary step in the development of an exploration strategy. The manner in which metazoan diversity and abundance influence the formation, early diagenesis and preservation of modern microbialite fabrics holds important implications for our understanding of both modern and ancient microbialites, as well as of microbialite reservoir development.

Moreover, our growing awareness of microbialite-metazoan associations indicates that prevailing theories for the post-Precambrian demise and periodic resurgence of microbialites in post-extinction intervals are in need of significant revision. The healthy persistence of microbialites, in conjunction with grazing, boring and burrowing metazoans, in modern open marine settings suggests that supposed end-Proterozoic declines in microbialite abundance and diversity cannot be attributed to concomitant radiations of metazoan phyla alone. Likewise, brief resurgences of microbialites in reefal settings in the wake of events of profound biotic crisis during the Paleozoic and

Mesozoic cannot be causatively linked to contemporaneous declines in certain metazoan guilds; the fluctuating shape of the microbialite record throughout earth history cannot be simply laid at the door of metazoans. However, with a better comprehension of the nature of microbialite-metazoan interactions at minute spatial and temporal scales, we can begin to extrapolate our modern observations to an improved and uniformitarian understanding of ancient processes.

REFERENCES

Awramik, S.M., 1971: Science, v. 174, p. 825-827.

Curran, H.A. and Martin, A.J., 2003: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 192, p. 229- 245.

Dill, R.F., Shinn, E.A., Jones, A.T., Kelly, K. and Steinen, R.P., 1986: Nature, v. 324, p. 55–58.

Dill, R.F., 1991, in Osborne, R.H., ed., From Shoreline to Abyss: SEPM, Society for Sedimentary Geology, Tulsa, Oklahoma, p. 147–171.

Dravis, J.J., 1983: Science, v. 219, p. 385–386.

Farmer, J. D., 1992, in Schopf, J. W., ed., The Proterozoic Biosphere: Cambridge, Cambridge University Press, p. 1348.

Garrett, P., 1970: Science, v. 169, p. 171-173.

Gingras, M., Hagadorn, J. W., Seilacher, A., Lalonde, S. V., Pecoits, E., Petrash, D., and Konhauser, K. O., 2011: Nature Geoscience, v. 4, no. 6, p. 372-375.

High-resolution multi-proxy paleoclimatic reconstruction of the southern Northwest Territories (NT) using lake sediments from the Tibbitt to Contwoyto Winter Road (TCWR), NT, Canada

Andrew Macumber (Carleton University in Ottawa, Canada)

Project Rationale: The Tibbitt to Contwoyto Winter Road (TCWR) is the sole overland route that services mines and exploration activities in the Northwest Territories (NT) (including the Diavik Kimberlite Mine) and in Nunavut. It is the world's longest heavy haul ice road, and is critical to the economy of the region with more than $500 million per year in goods passing over it, and essential for the operation of an industry which comprises over 30% of the gross territorial product. Without the TCWR important mine sites would most likely never have been developed, and current expansion of mining activity would not be possible. Cold winter temperatures are critical to the viability of the TCWR, since the majority (495 km, 87%) of its length is comprised of frozen lakes. Recent climate variability has resulted in changing ice stability, thickness, and duration of ice cover. This has greatly impacted the use of the road particularly as large highway semi-tractor trailers require ice thicknesses in excess of 100 cm for safe operation. Mild and stormy winter conditions during the 2006-2007 season, related to an El Niño/Southern Oscillation (ENSO) event, shortened operations to 26 days below average, resulting in only 6841 loads going north (in contrast to 10,922 loads north in 2007). With the current rate of expansion of this system it is expected that loads north will need to exceed 14000 by 2013. Resource managers lack sufficient records of this region's natural climate variability that are needed in order to make a critical review of the viability of current and future infrastructure. In order to estimate the impacts that future climate change will have on both the aquatic and terrestrial environments, there needs to be deep understanding of how this region has responded to climate variability.

The purpose of this study is to reconstruct the climatic variability and identify climate phenomenon (i.e., ENSO) that have impacted the southern Northwest territories over the last 3500 year period during which the modern climate became established. A high temporal resolution sub-sampling methodology will provide a resolution useful (i.e. sub-decadal to decadal) to resource managers in their assessment of the viability of current and future infrastructure.

Areas of the NT have seen annual temperatures warm by ~2 ºC since the 1940s, when instrumental records were first kept. Meteorological data show that northern regions continue to warm at a rate twice as fast as the rest of the world and general circulation models predict that the NT may become 2-3ºC warmer over the next 50 years. Since the 1980s there has been a realization that rapid climate change on the scale of human life was possible. That it may be related to atmospheric increases in anthropogenically produced greenhouse gases has provided a major impetus for research into climate change. There is also the realization that human induced climate change is only a subset of possible climate system behavior, and that rapid climate change as a result of natural climate variability may also present a significant challenge to our civilization. A long term perspective is necessary to identify how the environment has responded to similar climatic conditions and identify decadal to centennial oscillation of climate phenomenon that impact this region.

Modern atmospheric-oceanic conditions became established along the Pacific coast of North America between 4200 and 3000 yr BP. The warmer and dryer conditions that characterized the mid-Holocene gave away to the cooler and wetter conditions of the Late Holocene. Instrumental and geologic records of climatic conditions have shown decadal oscillations in the North Pacific and the interior North America are linked to global climate phenomenon such as the Pacific Decadal Oscillation (PDO), and ENSO variability. Fluctuations in precipitation on a decadal scale have been correlated to changes in North East Pacific sea surface temperatures that are in turn correlated to regime shifts associated with positive and negative phases of the PDO. The PDO is long lived ENSO-like pattern of Pacific climate variability, which has two periodicities: 15-25 years and 50-70 years. According to the Nyquest sampling theorem, in order to capture the oscillations of a climate cycle, such as the PDO, we must subsample at a temporal frequency that is two times greater than that of the climate cycle of interest. To be able to look for the PDO specifically our temporal resolution needs to be 15 or 25 years. A large body of palynological research has occurred in the NT, but mostly focused on the tree line or the Mackenzie region. Very few multi-proxy studies of environmental change have been conducted in the central NT and the temporal resolution of this previous work is relatively coarse (centennial scale). This scale is far too coarse to capture high frequency oscillations of climate systems that may be impacting the region. Understanding which climate systems impact the NT is necessary to understand the regions natural climate variability.

Project Methodology: The entire region was glaciated during the last glacial maximum and as a result the landscape shows abundant glacial erosional features. This and the influence of permafrost have disrupted drainage patterns resulting in an abundance of lakes. Lake sediments archive continuous records of environmental change and are arguably the most complete records available of aquatic and terrestrial change. Lake beds contain natural archives of

Continued on page 6

Continued from page 5

limnological, atmospheric temperature and precipitation conditions and changes. Utilizing both microfossil and sediment proxies a high resolution paleoclimatic record will be reconstructed. Enumeration of arcellaceans, a well fossilized and abundant benthic protest, will allow for the interpretation of current and ancient lake conditions. Variation in precipitation and snow volume leads to variation in catchment energy and variations in size of grains washing into lacustrine systems. Analyzing grain size changes at a millimeter resolution using time series analysis will identify significant frequencies that can be correlated with previously identified climate phenomenon. Understanding which climate phenomenon impact this region is critical in modeling how this region will respond in the future to climate change. Detailed core analysis will be restricted to portions deposited within the last 3500 years which encompasses the Late Holocene when modern circulation and climatic conditions developed.

Three lake sediment cores will be studied, each from a different climatic zone. The first from below the tree line, the second at the tree line and third will be located within the arctic tundra. This will complete a 2ºC climatic gradient. A freeze corer will be used to collect a complete and undisturbed record, including the soupy sediment water interface which reflects modern conditions. Freeze corers are ideal in low sedimentation regimes, and the frozen slabs are easy to handle and subsample. All cores will be x-rayed, and described sedimentologically. Cores will be dated using ^{210}Pb & ^{137}Cs isotopes for times scales less than 100 years linking the geological record to the instrumental record which began only 40 years ago. Cores will be dated using 14C isotopes for longer time scales. Bayesian age-depth modeling will be used to associate depth with time and the accuracy of this process (i.e. the number of dates) is essential for time series analysis and accurate interpretations of the regions climate history.

Using a slab microtome Late Holocene sediments will be accurately subdivided into 1 mm thick slabs suitable for high resolution grain size analysis. Composites of slices will be used for more labour intensive. Organic content of lake sediments, as measured by loss-on-ignition, have been correlated with lake and watershed productivity, and positively correlated to temperature in the NT. The relative concentration of biogenic silica in northern lakes is related to the productivity of siliceous diatoms and chrysophytes, which is in turn most likely correlated to the NT summer temperatures and consequently to the length of the ice free period. Thecamoebians (testate amoebae) are mostly benthic protists that are abundant in lacustrine habitats, and possess tests that fossilize well in Holocene sediments. Variation in thecamoebian assemblages reflect environmental changes such as: eutrophication, pH, temperature, and oxygen levels. They have been used previously to reconstruct paleoclimate throughout North America, including the NT.

Project Objectives: The data will be used to construct a high resolution (decadal) and multi-proxy description of climate variability for this economically important corridor, spanning a 2º latitudinal gradient. Understanding how this system has responding in the past will facilitate inference of what affect future climate variability will have on aquatic and terrestrial environments in the central NT. We will recognize cycles and trends in the late Holocene using time series analysis. In this way we can quantify the dominant paleoclimate cycles and trends, and correlate them with known continental climate signals recorded elsewhere in North America. This will provide resource managers with the dynamic baseline conditions for this region, greatly facilitating and lending guidance in their evaluation of the viability of current and future infrastructure practices.

REFERENCES

Golubic, S., Abed, R.M.M., Pali´nska, K., Pauillac, S., Chinain, M. and Laurent, D., 2010: Toxicon, v. 56, p. 836-841.

Grotzinger, J.P. and Knoll, A.H., 1999: Annual Review of Earth and Planetary Sciences, v. 27, p. 313- 358.

Hamilton, B., Hurbungs, M., Jones, A. and Lewis, R.J., 2002: Toxicon, v. 40, p. 1347-1353.

Higgins, R.P. and Thiel, H., 1988, Introduction to the study of meiofauna, Smithsonian Institution Press, Washington D.C.

Konishi, Y., Prince, J. and Knott, B., 2001: Hydrobiologia, v. 457, p. 39-47.

Laurent, D., Kerbrat, A.-S., Darius, H.T., Girard, E., Golubic, S., Benoit, E., Sauviat, M.-P., Chinain, M., Molgo, J., Pauillac, S., 2008: Harmful Algae, v. 7, p. 827–838.

Mankiewicz, J., Tarczynska, M., Walter, Z., Zalewski, M., 2003: Acta Biologica Cracoviensia, v. 45, p. 9–20.

Mata, S. A., and Bottjer, D. J., 2012: Geobiology, v. 10, no. 1, p. 3-24. Planavsky, N.J. and Ginsburg, R.N., 2009: Palaios, v. 24, p. 5-17.

Planavsky, N.J., Reid, R.P., Andres, M., Visscher, P.T., Myshrall, K.L. and Lyons, T.W., 2009: Geobiology, v. 7, p. 566-576.

Reid, R.P., MacIntyre, I.G., Browne, K.M., Steneck, R.S. and Miller, T., 1995: Facies, v. 33, p. 1–17.

Reid, R.P., Visscher, P.T., Decho, A.W., Stolz, J.F., Bebout, B.M., Dupraz, C., MacIntyre, I.G., Paerl, H.W., Pinckley, J.L., Prufert-Bebout, L., Steppe, T.F. and Des Marais, D.J., 2000: Nature, v. 406, p. 989–992.

Reid, R.P., Foster, J.S., Radtke, G. and Golubic, S., 2011, in Reitner, J., ed., Advances in Stromatolite Geobiology: Lecture Notes in Earth Sciences 131, Springer-Verlag, Berlin, p. 77-89.

Riding, R., 2011, in Reitner, J., ed., Advances in Stromatolite Geobiology: Lecture Notes in Earth Sciences 131, Springer-Verlag, Berlin, p. 29-74.

Shapiro, R.S., Aalto, K.R., Dill, R.F. and Kenny, R., 1995, in Curran, H.A., and White, B., eds., Terrestrial and Shallow Marine Geology of the Bahamas and Bermuda: Geological Society of America Special Paper 300, p. 139–156.

Shapiro, R.S., 2000: Palaios, v. 15, p. 166-169.

Sheehan, P.M. and Harris, M.T., 2004: Nature, v. 430, p. 75-78.

Stolz, J., Reid, R. P., Visscher, P., T., Decho, A. W., Norman, R. S., Aspden, R. J., Bowlin, E. M., Franks, J, Foster, J. S., Paterson, D. M., Przekop, K. M., Underwood, G. J. C., and Prufert-Bebout, L., 2009: Atoll Research Bulletin, v. 567, p. 1-29.

Swatloski, R.P., Holbrey, J.D., Memon, S.B., Caldwell, G.A. Caldwell, K.A. and Rogers, R.D., 2004: Chemical Communications, v. 6, p. 668-669.

Visscher, P.T., Reid, R.P. and Bebout, B.M., 2000: Geology, v. 28, p. 919–922.

Walter, M. R., and Heys, G. R., 1985: Precambrian Research, v. 29, p. 149-174.

GCSSEPM FOUNDATION

ED PICOU Fellowship Grant For Graduate Studies in Earth Science

Programs and Rules for 2013-2014

Founded in 1981, the **GCSSEPM Foundation** is a tax-exempt, nonprofit organization whose primary objective is to promote the science of stratigraphy through research in sedimentary petrology, reservoir quality, paleontology, and any other related geological and geophysical fields, especially as it relates to petroleum geology, with emphasis in (but not limited to) the Gulf Coast region.

Among the activities which the **Foundation** may engage in are:

- Conduct research directly or through promotion, assistance, encouragement, or support of studies and research in the field of stratigraphy and in the science related thereto;
- Dissemination of information relating to stratigraphy and related fields through lectures, seminars, research conferences, symposia, publications, educational courses, teaching aids, and by other means and material;
- To carry on programs of continuing education in stratigraphy and related studies;
- To assist in career guidance to persons interested in stratigraphy and related studies;
- To assist public and private schools and colleges and universities and technical schools in teaching and education in the field of stratigraphy and related fields.

Therefore, we are hoping to support students whose thesis or dissertation is related to our primary objective. **We are primarily concerned about quality of work and how it relates to our objectives. If you look at past winners of the Fellowship, we are not limited to a particular geographic area. We are interested in research on projects in North America/Caribbean in general, the Gulf Coast Basin in particular.** Maximum grant will be for $2500.

The program is open to graduate students of **Canadian, Mexican, and United States universities only**. Interested students should submit all material electronically **only**: **(1)** a short description of their proposed work, approximately 4-6 pages (in type no smaller than 11 point and with standard margins). **(2)** A separate file of expenses and other support should be included; please note, valid expenses should be for field work and support thereof; we normally do **not** support attendance at conferences or meetings. **(3)** The student's advisor should write an appropriate document of support in digital format sent from their university e-mail address **and** in written format by snail mail. **(4)** We also require a short biography of the student as well as a digital picture. In your cover e-mail, insure that your full name, your university, your snail-mail address, your e-mail address, the name of your adviser, and their e-mail address are included. We do accept Word format but prefer if files are send in PDF as they are much smaller and are easier to send as e-mail attachments. The e-mail address for submission is: ***gcssepm@comcast.net*.**

The adviser's snail-mail letter of support should be mailed to: **Dr. Norman C. Rosen, Executive Director, GCSSEPM Foundation, 2719 S. Southern Oaks Drive, Houston, TX 77068.**

Submission of a proposal to the GCSSEPM indicates acceptance of the following conditions.

(1) The GCSSEPM Foundation will be acknowledged in the work.
(2) This money is being granted for the defraying of the cost of thesis/dissertation work associated with a degree program only. In the event that this work is not done, the money must be returned to us.
(3) We request a note at six (6) month intervals letting us know about the progress of the research. The first such note will be due (*i.e.*, posted) by December of the year in which the award is granted
(4) You will submit two notes (expanded abstracts) for publication in our GCSSEPM News Letter. The first will refer to the goals of your study; the proposal for the grant in general will be used. The second will be a summary of results of the work after completion.
(5) If the topic is appropriate for submittal to the GCAGS-GCSSEPM, we request that you present your work at a GCAGS-GCSSEPM convention.
(6) Please note that if awarded a grant, acceptance **must be signed by both the student and the adviser.**

Failure to comply with these terms may result in our refusal to consider future proposals from students of your professor and university. (Please make your advisor aware of this.)

DEADLINES

This program is designed to support research starting summer 2013 and into the 2013-2014 calendar/academic year. Therefore, we ask that all requests be sent after January 1, 2013 and received by us no later than March 1, 2013. We hope to notify award winners by the end of March, 2013.

Microfossils III: Geologic Problem Solving with Microfossils

March 10-13, 2013
University of Houston
Houston, TX USA

The North American Micropaleontology Section (NAMS) of SEPM announces the ***Third Geological Problem Solving with Microfossils Conference*** (Microfossils III) to be held March 10th-13th, 2013 at the University of Houston, Houston, Texas. The mission of Microfossils III is to bring together geoscientists from academia, industry and government to focus on the use of microfossil to solve geologic problems. The conference is open to all microfossil specialties.

Conference activities include: oral and poster technical presentations, a regional pre-meeting field trip, post-meeting short courses, ice breaker, and plenary dinner at the Houston Museum of Natural Science. Session themes are:

- The Microfossil record of Major Oceanic Events
- Microfossils and Unconventional Resources: The New Frontier
- High-resolution Biostratigraphy, Chronostratigraphy, and Geochronology
- Reconstructing Past Environments Using Microfossils
- Paralic and Lacustrine Micropaleontology
- Microfossils and Biofacies Analysis: Applications and Challenges
- Paleoclimate, Paleooceanography, and Relative Sea-level Change
- Taxonomy, Phylogeny, and Evolution
- New Technologies and Techniques in Microfossil Studies

Abstract submittal deadline: November 11, 2012

For information on the meeting and abstract submission, visit **http://www.sepm.org/nams/meetings.htm#abstracts** or contact **Dr. Mark Leckie** at MLeckie@geo.umass.edu

GCSSEPM Short Courses

Two short courses will be offered by the GCSSEPM in the upcoming months. The instructors for both courses are former society Presidents.

John Holbrook (TCU) will offer his Fluvial Stratigraphy short course on Sunday October 21, as part of the 62nd Annual 2012 GCAGS-GCSSEPMConvention in Austin. This course gives participants an overview of the river processes that generatestrata as well as teaching them a range of techniques for mapping and interpretation of fluvial rock. John has previously taught this course for the AAPG Summer and Winter education conferences, the Mexican Petroleum Congress, the CSPG Education conference, GeoIndia, and elsewhere. Visit the conference website (http://www.gcags2012.com/) for more information.

Bruce Hart (ConocoPhillips) will offer his Introduction to Seismic Interpretation short course exclusively for students on January 10 & 11, 2013 at the University of Louisiana, Lafayette. This is a follow up to a popular similar offering in 2010. The course topics range from the physical basis of the seismic method to advanced techniques for undertaking stratigraphic and structural interpretations. Bruce has previously taught this course for AAPG, SEPM, CSPG, and elsewhere. Enrollment will be limited to 30 participants. Interested students should contact Professor Brian Lock (belock@cox.net) for details.

GCSSEPM
LOST MEMBERS

We no longer have contact information for the following individual.

Martha Barnes

If you can provide information please contact Brandi Sellepack, *brandi.p.sellepack@*

Gulf Coast Section – Society of Economic Paleontologists and Mineralogists

MEMBERSHIP APPLICATION AND RENEWAL

PLEASE USE THIS FORM FOR MEMBERSHIP APPLICATION, MEMBERSHIP RENEWAL AND ADDRESS CORRECTIONS AND CHANGES

Check appropriate box(es): ❑APPLICATION ❑RENEWAL ❑ADDRESS OR E-MAIL CHANGE

Membership dues for the year *2012* are now due. If the date shown on the name line of your mailing label is not **12** or later, please remit dues with this form as soon as possible in order to remain a member of the GCSSEPM and continue to receive this Newsletter. **You can also renew online at *www.gcssepm.org*.**

Today's Date: ______________________

Name (Last, First, Middle Initial): ______________________

Company or University: ______________________

Mailing Address: ______________________

City, State/Country, Zip: ______________________

Business Telephone: (_____)_______________ Daytime Telephone: (_____)_______________

E-mail Address: ______________________

Are you a member or associate member of National SEPM? ❑ Yes ❑ No

Please Check:

RECOMMENDED
❑ **5 Year Membership or Renewal $40.00** (check or credit card)
❑ 3 Year Membership or Renewal $25.00 (check or credit card)
❑ 1 Year Membership or Renewal $10.00 (by check only)
❑ Lifetime Membership $300.00 (check or credit card)

Method of Payment*: ❑ Check enclosed ❑ Discover ❑ Visa ❑ MasterCard ❑ American Express

**** Credit Card Payment can be accepted for 3 year, 5 year or Lifetime Memberships only***

______________________ Credit Card Account Number ______________________ Card Expiration Date

______________________ Printed Name on Card ______________________ Authorized Signature for Card

Mail this form with payment to: GCSSEPM Treasurer, 2719 S. Southern Oaks, Houston, Texas 77068 or Fax to (281) 586-0833 *(Fax available for Credit Card Payment Only)*

Gulf Coast Section
Society of Economic Paleontologists
and Mineralogists
2719 South Southern Oaks Drive
Houston, TX 77068-2610

Non-profit Organization
U.S. Postage
PAID
Winsted, CT 06098
Permit No. 140