The SEDIMENTARY Record

Volume 7, No. 3
September 2009

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

INSIDE: DELTA DOUBLE-STACK: JUXTAPOSED HOLOCENE AND PLEISTOCENE SEQUENCES FROM THE BENGAL BASIN, BANGLADESH

PLUS: PRESIDENT'S COMMENTS

SEDIMENTARY GEOLOGY DIVISION, GEOLOGICAL SOCIETY OF AMERICA

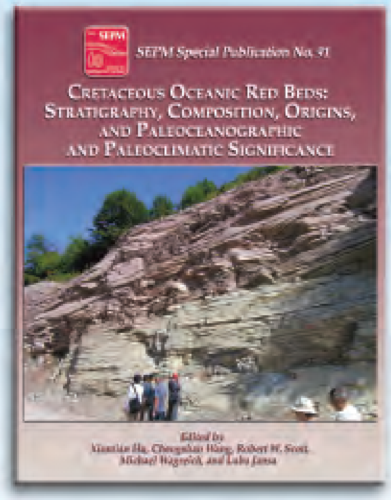
1926 SEPM
Society for Sedimentary Geology

SEPM BOOKSTORE

Special Publication #91

Cretaceous Oceanic Red Beds: Stratigraphy, Composition, Origins, and Paleoceanographic and Paleoclimatic Significance

Edited by: Xiumian Hu, Chengshan Wang, Robert W. Scott, Michael Wagreich, and Luba Jansa



The occurrence of marine red beds has been known for at least 140 years, since Stúr (1860) and Gümbel (1861) first described them from the Púchov beds in the Carpathians and the Nierental beds in the Eastern Alps. A few biostratigraphic and sedimentological studies followed, particularly in European countries. However, detailed investigations on paleoceanographic and paleoclimatic implications related to Cretaceous marine red beds were initiated by Prof. Chengshan Wang, Dr. Xiumian Hu, and their colleagues. During the late 1990s they discovered and studied Upper Cretaceous oceanic red beds in the Chuangde section, southern Tibet, which were deposited in the Eastern Tethys Ocean. Subsequently, within the framework of the IGCP 463 and 494, attention has been paid to the global distribution, correlation, and significance of the oxidation of these deposits for paleoceanographic reconstructions, and their relationships to the distinctly different, interbedded mid-Cretaceous black shales.

This collection of papers resulted from two collaborative research projects funded in part by UNESCO/IUGS International Geosciences Project IGCP 463 and IGCP 494. The IGCP 463 "Upper Cretaceous Oceanic Red Beds: Response to Ocean/Climate Global Change" (2002–2006) was led by Prof. Chengshan Wang (China University of Geosciences, Beijing, China), Prof. Massimo Sarti (Universitá Politecnica delle Marche, Italy), Dr. Robert Scott (University of Tulsa and Precision Stratigraphy Associates, USA), and Prof. Luba Jansa (Dalhousie University, Canada). The objective of IGCP 463 was to study major paleoceanographic phenomena recorded by sedimentary sequences in the world oceans. Cretaceous deposition changed several times from widespread organic-carbon-enriched shales that indicate a dysoxic to anoxic deep ocean environment, to mostly reddish clays and marls deposited in an oxic marine environment during the Late Cretaceous.

Catalog #40091 • SEPM Member Price: $89.00

Now available in CD ROM SEPM Special Publications #1 - #84, Short Course Notes, Core Workshops and Field Trip Guidebooks

SEPM Member Price: $20 per CD

Order from the SEPM Bookstore.

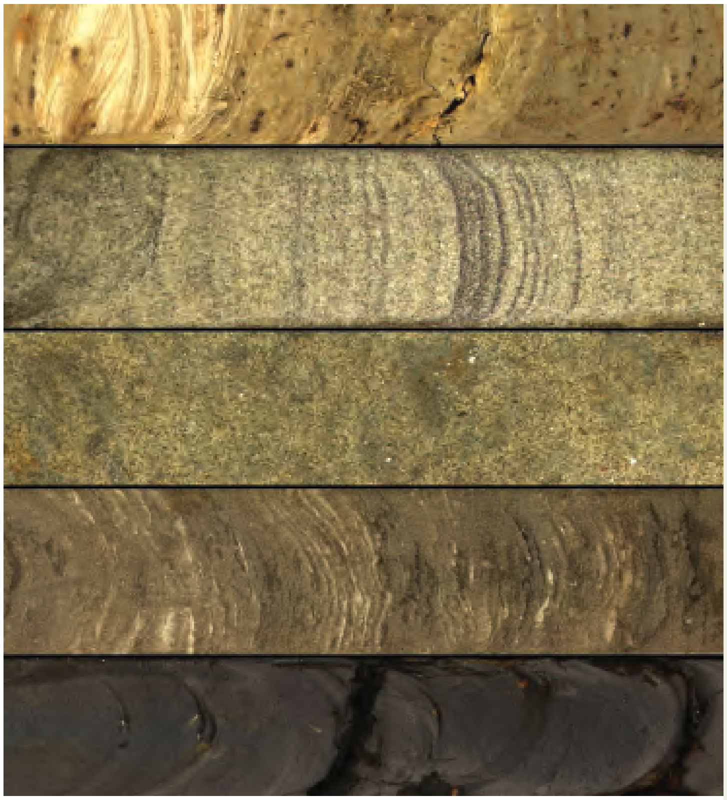
Coming Soon! Special Publication #92

External Controls on Deepwater Depositional Systems

Edited by: Ben Kneller, Ole J. Martinsen and Bill McCaffrey

The principal objective of the meeting from which this set of papers arose was to gain an overview of the current state of knowledge of the roles and interplays of external controls on deposition in deep marine environments. By external controls we mean allocyclic or allogenic factors, i.e., those that are unrelated to the self-organization of the depositional system (autocyclic or autogenic); principal among these are climate, sea level, sediment supply, and tectonics. One of the big questions that the meeting sought to address concerned the comparability of the recent high-frequency, high-resolution record with the older, generally lower-frequency stratigraphic record of "deep time"; to what extent are the apparent differences a function of resolution, or of comparisons between a glacial and a nonglacial Earth? In fact, as the papers in this volume illustrate, the variability between individual systems, even in Late Glacial time, and the paucity of constraints on older systems makes these questions difficult to answer, but some useful conclusions can be drawn.

The papers presented at the meeting were organized into themes that included: overviews of glacial sea-level change, and of climate modeling; external controls on large river-fed submarine fans, including the effects of climate and sea level on the fluvial system itself; influences of climate, sea level, and tectonics on a range of smaller modern systems; deep marine processes; the outcrop record of the pre-Pleistocene Earth; the subsurface record of the pre-Pleistocene Earth; and syntheses. The organization of the volume largely reflects this structure.



Cover Photo: Images of the major facies comprising two stacked highstand delta sequences from the Bengal Basin. The facies succession progresses from coastal and tidal facies at the base (two lower photos) through estuarine and fluvial facies (two middle photos) and capped by floodplain deposits (upper photo). Details of the facies' lithology, timing, and associated sequence development are provided in the text.

CONTENTS

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.

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

www.sepm.org

Delta Double-Stack: Juxtaposed Holocene and Pleistocene Sequences from the Bengal Basin, Bangladesh

Russell D. Pate[1,2], Steven L. Goodbred, Jr.[2], Sirajur Rahman Khan[3]

[1] NOAA Commissioned Officer Corps, 8403 Colesville Road, Suite 500, Silver Spring, Maryland 20910 USA

[2] Department of Earth and Environmental Sciences, Vanderbilt University, Nashville, Tennessee 37235, USA

[3] Coastal and Marine Geology Division, Geological Survey of Bangladesh, Segunbagicha, Dhaka 1000, Bangladesh

ABSTRACT

Analogs – ancient and modern – are key to our understanding and interpretation of the stratigraphic record, which is too often incomplete and sparingly exposed. Here we describe an upward-coarsening Holocene delta sequence that sits unconformably on another, remarkably comparable, delta sequence of Pleistocene age. Such a complete and well-preserved Pleistocene example is rare given extended periods of sea-level lowstand and fluvial incision during the past 200 ka. These stacked delta sequences allow us to consider how analogous our well-studied Holocene analogs are. The comparison reveals a nearly identical facies succession, with modest differences only in the relative timing of delta response to rising sea level. One key difference, though, is a unique facies in the Pleistocene sequence suggesting that major floods from the Himalayas impact the Bengal margin, perhaps periodically, during glacial-interglacial climate transitions.

INTRODUCTION

In the modern world of high sea level, our geologic perspective is often dominated by recent and Holocene-age coastal systems where depositional processes and basin setting are well constrained. However, the extended period of relatively stable climate and sea level during the Holocene is exceptional through at least the Quaternary period, bringing to question how representative Holocene sedimentary analogs are within the geologic record. Here we present detailed stratigraphic, paleoenvironmental, and provenance data for a deep borehole from the lower Ganges-Brahmaputra (G-B) delta plain to better understand the longer-term patterns of Quaternary margin evolution.

BACKGROUND AND METHODS

The G-B delta system sits at the eastern, tectonically active cusp of the South Asian continental collision. Here the already complex regional orogen is overprinted by local tectonics of the Bengal Basin, which together affect delta development through overthrusting, compression, strike-slip, and normal faulting (Steckler et al. 2008). In the upstream catchment, erosional fluxes, source terrains, and sediment transport regimes all respond acutely to intense climatic, tectonic, and glacial processes (e.g., Finnegan et al., 2008; Gabet et al., 2008; Montgomery et al., 2004; Pratt et al., 2002). Many of these catchment signals are strongly and rapidly translated downstream and affect the processes and history of development of the G-B delta system (e.g., Goodbred, 2003; Sarkar et al., 2009). However, much work remains to unravel the mechanisms responsible for the depositional history of the G-B margin in relation to fluvial dynamics, sediment flux, and sediment provenance.

Discharge to the G-B delta system is strongly seasonal and driven by runoff from the southwest summer monsoon, during which the rivers transport 80-90% of their water and 95% of their sediment load. Presently, the Ganges and Brahmaputra rivers deliver about one billion tons (10^9) of sediment to the Bengal Basin annually. However, these South Asian fluvial systems are also strongly influenced by long-term climatic variability, with the intensity and distribution of monsoon precipitation varying at orbital periodicities during the Quaternary (Prell and Kutzback, 1987). Under these fluctuations in monsoon strength, the G-B sediment load has varied by a factor of two both higher and lower than present (Goodbred, 2003).

Initial Holocene development of the G-B delta begins around 11,000 yr BP with the widespread trapping of fine-grained sediments on the lowstand exposure surface (Goodbred and Kuehl, 2000). From 11,000-7000 yr BP, monsoon-enhanced sediment discharge was sufficient for the delta to keep pace with rapid sea-level rise. After this period of delta aggradation, the system began prograding with slowing rates of sea-level rise after 7000 yr BP, despite declining sediment input with a weakening mid-Holocene monsoon. During the last 7000 years of relative sea-level highstand, the delta has prograded steadily and the G-B sediment load equally partitioned across the subaerial delta, subaqueous delta, and canyon-fan system (Goodbred and Kuehl, 1999).

The 123-m long borehole presented in this study was collected near the town of Raipur, Bangladesh, which is located ~10 km east of the modern rivermouth estuary in the southeastern region of the delta (Fig. 1). The borehole was drilled using a reverse-circulating hollow-stem auger with a PVC-lined split-spoon sampler with a recovery rate of 20-30%. A few meters next to the borehole was installed a PVC-cased tubewell from which continuous downhole logs of natural gamma and conductivity were collected using a custom slim-line logging tool. In the lab, core sections were logged for high-resolution imaging, density, and magnetic susceptibility using a Geotek multi-sensor core logger. Grain size (0.1-1000 μm) was measured using a Malvern laser-diffraction particle-size analyzer, and major and trace elements were determined using an Oxford Instruments MDX 1080 multi-dispersive X-ray

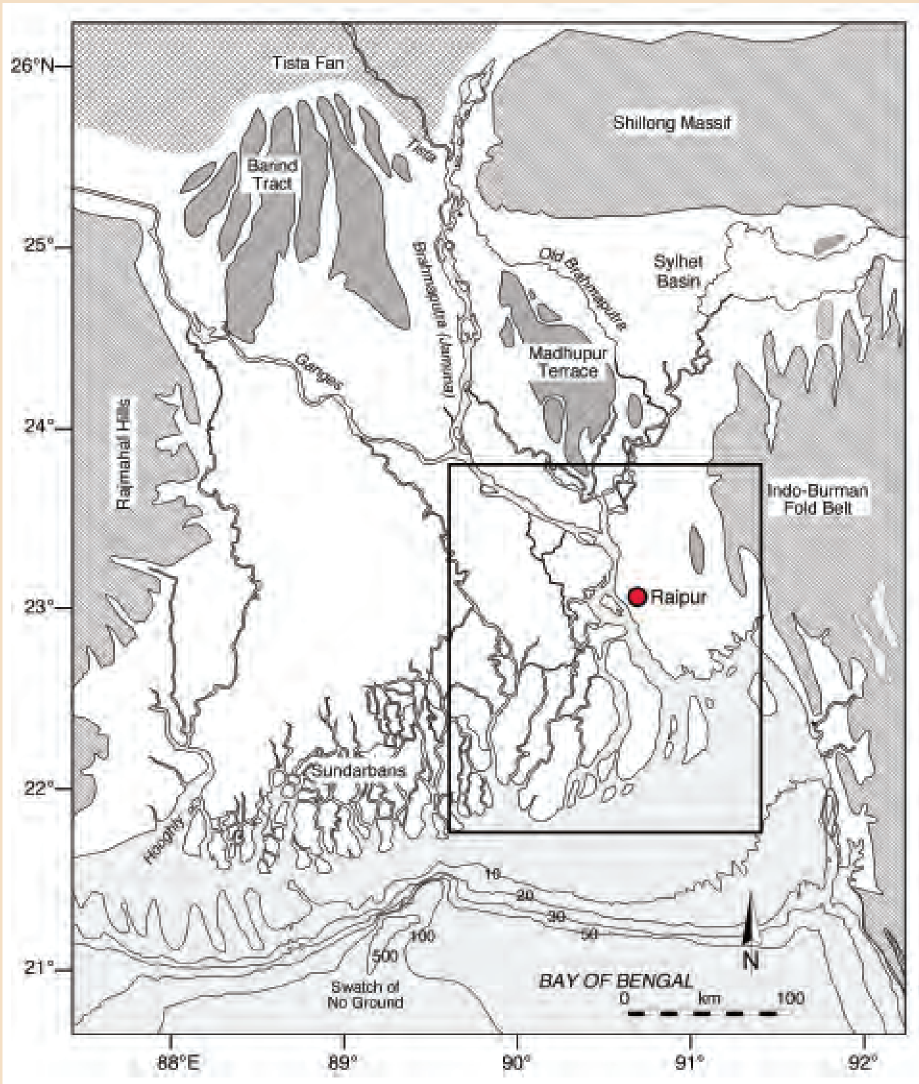


Figure 1. Physiographic map of the Bengal Basin and Ganges-Brahmputra river delta. Location of the 123-m long Raipur borehole is shown on the east bank of the upper rivermouth estuary. Inset box shows the location of Figure 4.

fluorescence spectrometer. All XRF samples were decarbonated by combustion at 600°C for 72 hours and leached with a 15% acetic acid. Three wood samples were radiocarbon dated at the National Ocean Sciences Accelerator Mass Spectrometry Facility and results converted to calendar ages (2σ range) using Calib 5.0.2 software.

FACIES AND STRATIGRAPHY

First-order stratigraphy of the 123-m long borehole is straightforward, comprising two upward coarsening deltaic sequences about 56 m (Holocene) and 66 m (Pleistocene) thick (Fig. 2). The Holocene deltaic sequence lies unconformably on the Pleistocene section along a highly weathered sequence boundary. The two sequences share five distinct sedimentary facies, beginning with Facies A at the base and continuing up-sequence to the capping unit Facies E (Fig. 2). A sixth, unrelated facies, Facies X from the Pleistocene sequence, is enigmatic and discussed separately in the next section.

Facies A is defined as a gray to black clay-rich mud with disseminated organics and wood fragments (Fig. 3). The large tree roots and blackish muds are similar to those found today in low-lying areas of the Sundarbans mangrove forest on the lower delta plain (Fig. 1). Although distant from the active rivermouth, this portion of the delta accretes through river plume dispersal by tides and monsoon coastal circulation (Allison and Kepple, 2003). Based on these characteristics Facies A is interpreted to represent the widespread (pre-human) tidal mangrove environments of the lower delta plain (Fig. 4). The overlying Facies B comprises heterolithic sediments with alternating laminae of silty clays and fine sands. The laminae form regular coarse-fine bedding sets, with bundles of 7-10 of these sets varying between sand- and mud-dominant lithologies (Fig. 3). These characteristics define the facies as tidal rhythmites, which today are found in rapidly accreting areas at the shoreline to a few meters water depth (Allison et al., 2003). Specifically, modern tidal rhythmites are deposited as linear tidal bars at the leading edge of the active rivermouth estuary (Fig. 4). Since the contact of Facies B with the underlying Facies A muds is gradational, this suggests a slow conversion of vegetated coastal-plain to intertidal and shallow-subtidal environments.

Facies C marks a transition into sand-dominated sediments, which here are gray to brown, muddy fine sands with discontinuous, bioturbated bedding (Fig. 3). Such deposits are characteristic today of the upper rivermouth estuary where the main channel begins to split into distributaries (Fig 4). This reach of the river is tidally influenced but still dominated by fluvial processes, as indicated by the sandy lithology and coarse, irregular bedding. The estuarine sands of Facies C contrast with the much finer mud-rich tidal rhythmites that underlie them, and this stratigraphic transition reflects a shift from vertical aggradation to a more progradational trajectory of the delta system. Overlying the estuarine sands is the somewhat similar Facies D, which differs in the absence of muds and more frequent, better-preserved bedding, including common mica-rich laminae (Fig. 3). These changes in lithology reflect the transition to a completely fluvial environment, where tidal influence is lost as the system progrades, and muds are no longer trapped by the bidirectional, convergent flow regime.

An important characteristic of both Facies C and D are the patterned grain-size variations that alternately fine and coarsen over 2-5 m intervals. This pattern is robust and observed in both the core-sampled grain-size data and the downhole gamma-ray logs (Fig. 2), with sizes ranging from coarse silts/very fine sands (~100 μm) to fine-medium sands (~250 μm). However, the structure of these units is variable with some examples coarsening upwards and others appearing to fine. This pervasive pattern in the fluvially dominated Facies C and D is interpreted to reflect bar, dune, and chute development within the braided river system (Fig. 4). Such thick, graded

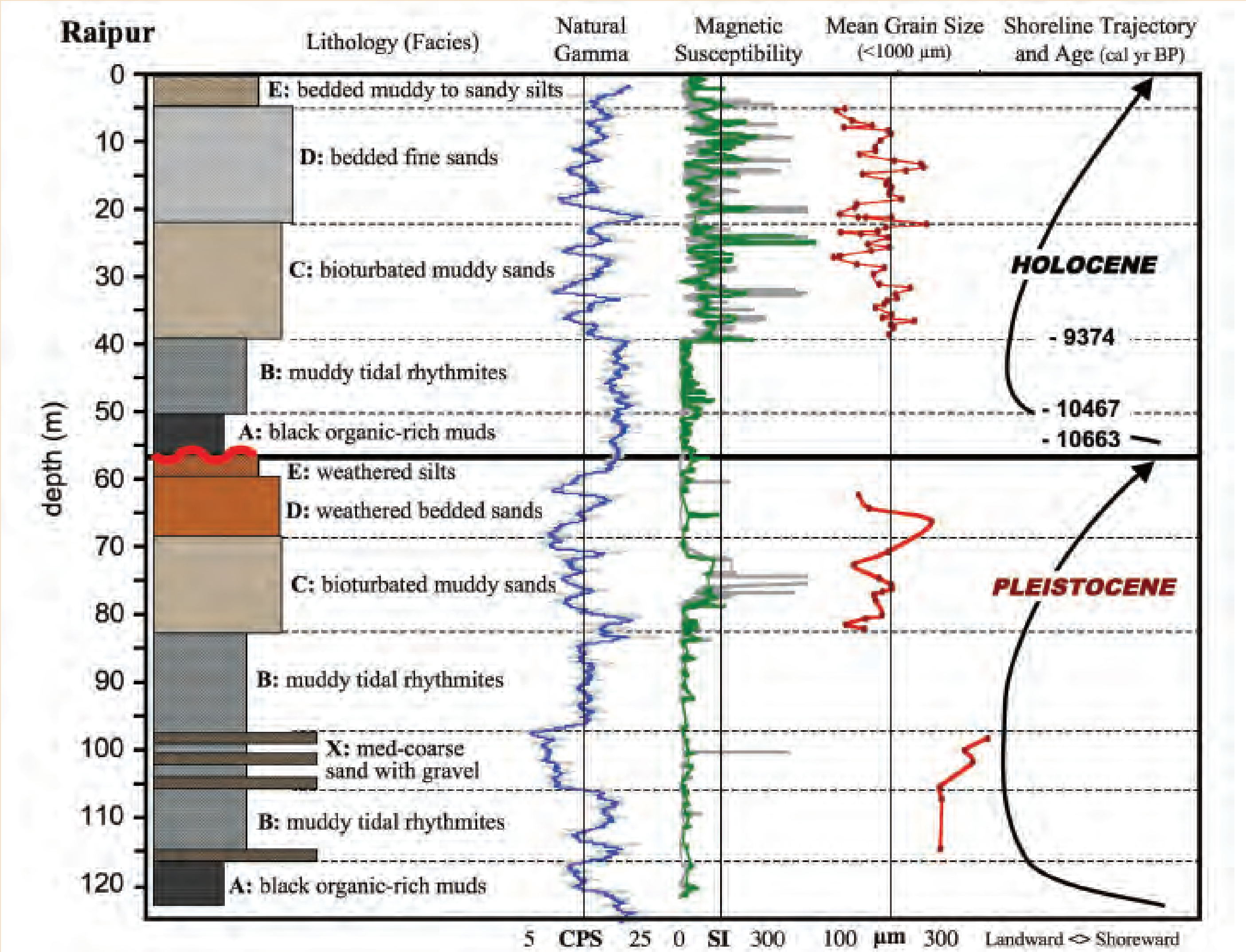


Figure 2. Litholog for the Raipur borehole, including continuous downcore gamma counts (blue), and magnetic susceptibility (green) and grain size measures (red) from the core samples. General transgressive/regressive tendency is plotted in the last column, along with calibrated radiocarbon ages.

sand units are well described from the modern braidbelt, where tall (1-5 m) composite bars and bedforms are exposed during low-river stage (Bristow, 1987). Overlying these channel braidbelt deposits is the silt-dominated Facies E, which ranges from rooted clayey silts to planar or cross-laminated silts to very fine sand (Fig. 3). This facies is typical of the modern floodplain within a few kilometers of the braidbelt (Fig. 4), which is regularly affected by overbank flooding, sheet flow, and local channelization (Allison et al., 1998). The variations of structure and lithology within Facies E reflect seasonal to interannual differences in the fluvial hydrograph and resulting flooding patterns. Facies E is the capping unit of the highstand delta sequence, representing the final infilling of accommodation on the delta plain and the continued progradation of the active delta front (Fig. 2).

AGE AND TIMING

Timing of the Holocene sequence is constrained by three AMS-dated wood fragments from Facies A and B at core depths of 40 m, 50.5 m, and 53 m, with the latter just 3 m above the sequence boundary. The calibrated 2σ age ranges are 9275-9472, 10369-10577, and 10515-10785 cal BP, respectively. The two deeper dates near the sequence base are consistent with results from other portions of the delta, which indicate that delta formation began ~11,000 yr BP.

Comparing with sea level, the age-depth relationship places all of the dated samples ~2-3 m below the global eustatic curve (Fig. 5). Correcting these values for the core-site elevation of +2 m would shift the radiocarbon dates very close to eustatic sea level, which is entirely consistent with an interpretation of upper intertidal to shallow subtidal facies. In fact, these radiocarbon ages yield accretion rates of 1 cm/y for the tidally influence Facies A and B, indicating that sediment discharge to the delta was sufficiently large to offset the rapid rate of sea-level rise during the early Holocene. These results also suggest that this portion of the delta has been tectonically stable through the Holocene, or at least that the sum of multiple vectors is neutral, either of which is rare in the Bengal Basin.

The underlying Pleistocene sequence has no absolute age control but most likely dates to marine-isotope stage MIS 5e (~120,000 yr BP). The MIS 5e highstand is estimated to have been +2 to +10 m above present, but more importantly follows >120 m of glacioeustatic rise following the intense MIS 6 glaciation. This large, rapid transgression would have been able to generate adequate accommodation for the 66-m-thick Pleistocene sequence to develop. In contrast sea level at MIS 3 (~45,000 yr BP) was –20 to –50 m below present, which provides only

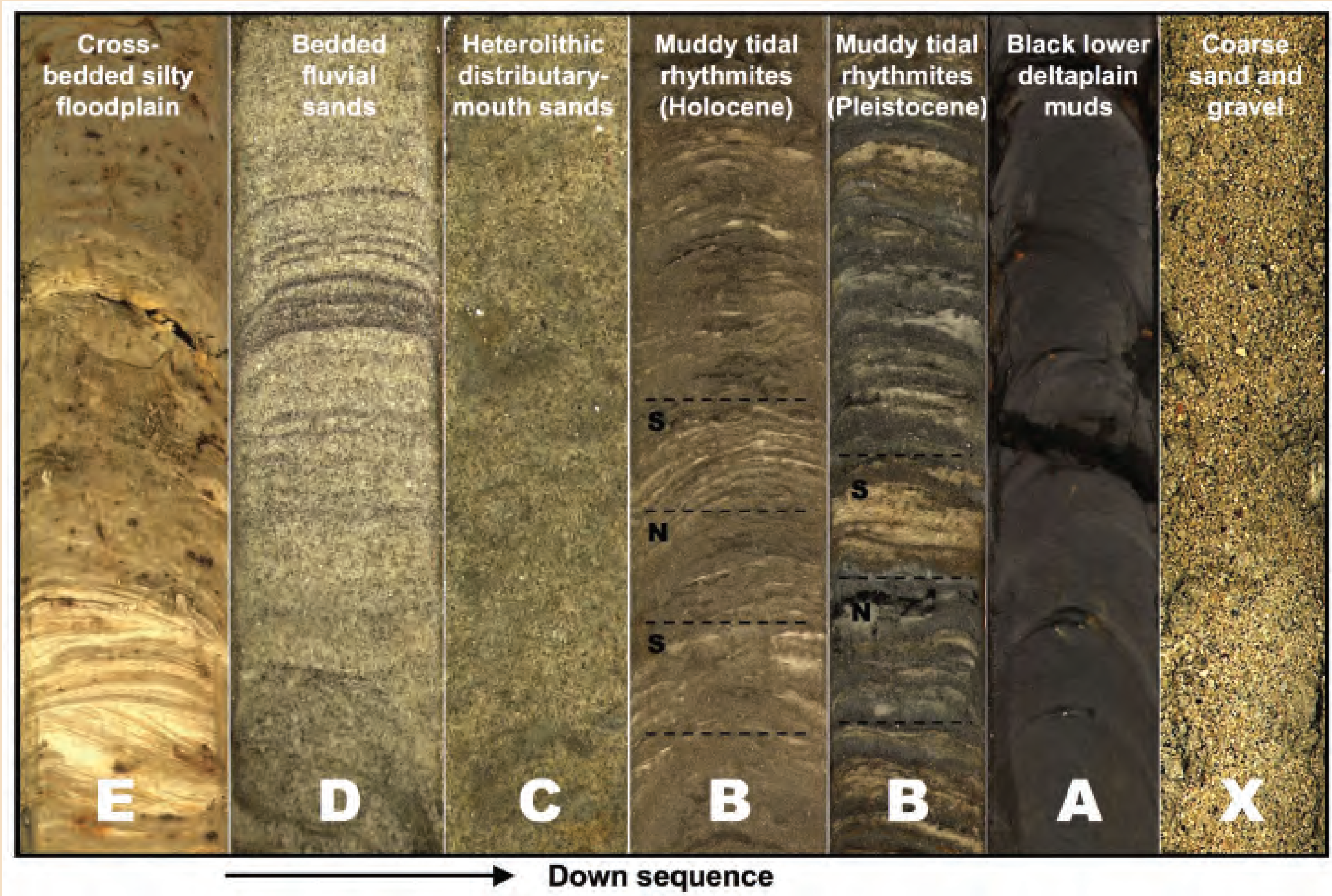


Figure 3. Digital images of sedimentary facies from Raipur borehole (Facies A-E, X). For tidally deposited Facies B, alternating sandy and muddy bundles of laminae are highlighted and correspond to Spring (S) and Neap (N) tidal conditions, respectively.

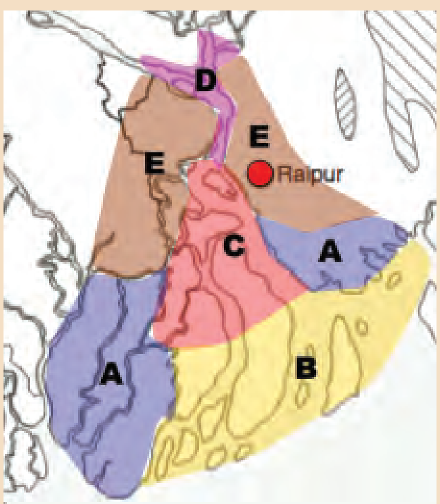


Figure 4. Map showing the distribution of modern environmental analogs for the major sedimentary facies in the Raipur borehole. Note that all facies can be found within or near the rivermouth estuary, indicating that the Raipur stratigraphy reflects a relatively stable highstand delta setting for both the Holocene and Pleistocene sequences. Location of inset map shown in Figure 1.

30-60 m of accommodation above the preceding MIS 4 lowstand. If the Pleistocene sequence does indeed date to MIS 5e, then this would also require a long-term subsidence rate of about 0.5 mm/yr to account for its current depth (-56 m).

SIMILARITIES AND SURPRISES

The sediments and facies character for the two delta sequences are largely the same, with mean grain size, natural gamma, and magnetic susceptibility patterns highly comparable among the fluvial Facies C, D and E (Fig. 2). The vertical succession of facies is also nearly identical in the Holocene and Pleistocene delta sequences. Taken together these findings suggest that marine and fluvial boundary conditions, as well as response of the delta to post-glacial transgression, were remarkably similar at two times separated by ~100,000 years. This finding of repeatedly similar delta response is especially important for the G-B system, which had been previously recognized as unique in developing several thousand years earlier than other Holocene deltas (Goodbred and Kuehl, 2000). The results here confirm this pattern for the MIS 5/6 post-glacial transgression and suggest that the co-phasing of rapid sea-level rise with a strong monsoon system and high sediment flux can regularly lead to early and thick "transgressive phase" delta aggradation.

Looking further, one aspect in which the sequences differ slightly is their overall thickness, at 56 m for the Holocene and 67 m for the Pleistocene (Fig. 2). Given the similarity in facies succession and delta behavior, though, it is tempting to consider that the Pleistocene's extra ~10 m is a consequence of the higher peak sea level at MIS 5e. If true, this would underscore importance of the magnitude of sea-level excursions in defining sequence thickness given an adequate sediment supply. Another difference lies in thickness of the fluvial facies (C, D, E) versus tidal/coastal facies (A, B), which are a total of 40 m and 16 m thick for the Holocene, and 27 m and 40 m thick for the Pleistocene, respectively. These differences suggest that the coastal-to-fluvial facies transition (i.e., aggradation to progradation) at the Raipur site occurred

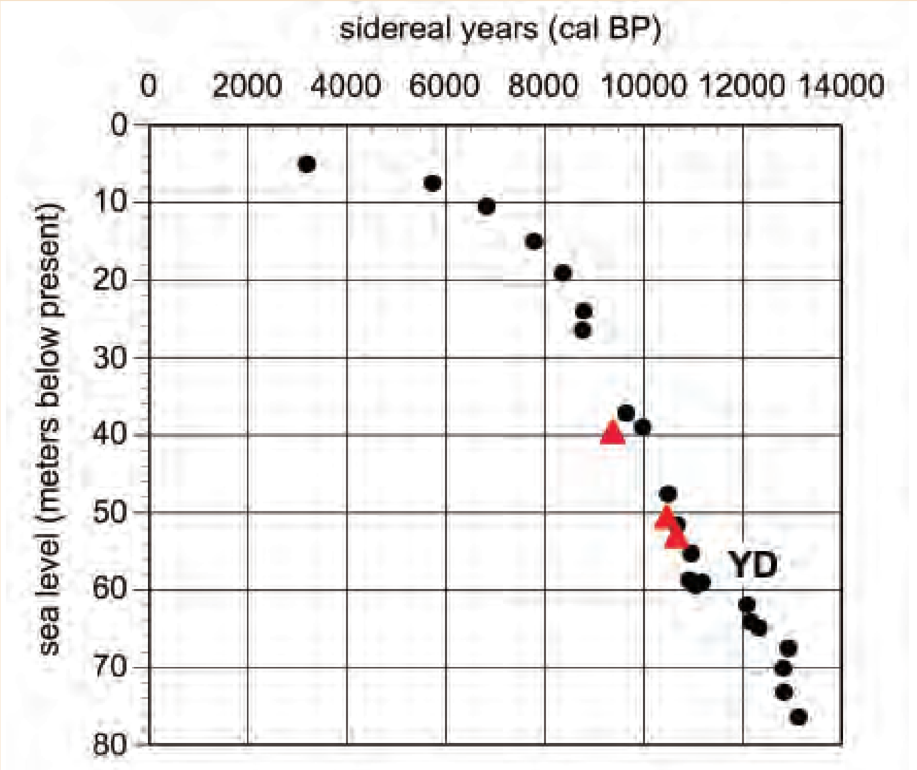


Figure 5. Age-depth relationship for calibrated radiocarbon dates from the Raipur borehole (red triangles) and global eustatic values from Barbados and Huon Peninsula (after Fairbanks, 1989; Edwards et al., 1993). Note that the deepest date lies three meters above the Holocene sequence base, indicating that initial delta development began around 11,000 yr BP shortly after the Younger Dryas (YD) episode. The three Raipur dates also closely track sea level, demonstrating that the G-B delta was largely able to keep pace with rapid sea-level rise (~1 cm/yr) in the earliest Holocene.

comparatively earlier in the Holocene transgression than in the Pleistocene. This pattern, though, is only defined for the Raipur core site and cannot necessarily be extrapolated to the rest of the delta.

Despite so many similarities, there is one major difference with the presence of Facies X in the lower section of the Pleistocene sequence (Fig. 2). Specifically, Facies X is a medium-coarse sand with a small fraction of pea-sized gravel and lithic fragments (Fig. 3). There is no apparent sorting or structure to these deposits, which are at least 50 cm thick. The facies' coarse-grained lithology is anomalous within the 123-m long borehole (Fig. 6) and is also not found in the modern delta system or upstream reaches of the river braidbelts. Perhaps more surprising is that these coarse sediments are found interspersed within the muddy tidal rhythmites of Facies B, placing the coarse sands and gravel at the coast of a fine-grained delta system. The facies' enigmatic lithology and stratigraphic position are confirmed from both the core samples and the continuous downhole natural-gamma logs of the adjacent tubewell (Fig. 2).

So what is the origin of these deposits? They are almost certainly fluvially transported, containing neither mud matrix or angular clasts of a debris flow, nor shell or sorting of marine processes. Geochemical analysis of the sediments reveals low Sr concentrations (70-80 ppm) compared with those of Ganges (90-120 ppm) or Brahmaputra (150-200 ppm) sands, but which are typical of the nearby Tista river (Singh and France-Lanord, 2002). The Tista is a medium-sized Himalayan river that forms a sand/gravel alluvial fan at the northern edge of the Bengal Basin (Fig. 1). Although no coarse Tista sediments reach the delta today, it remains the most likely source given the coarse texture and geochemical character of the sediments. Therefore, we suggest that Facies X is the product of high-energy floods such as bursts of glacial, landslide, or tectonically dammed lakes within the Tista or nearby Himalayan catchment. Precedence for such large bursts is already documented from ice-dammed lake terraces along the Tibetan reach of the Brahmaputra river, which date to the early Holocene (Montgomery et al., 2006). Comparable sands and gravels are found at the same depths in the upper Bengal basin, which is exclusively fluvial, but may correlate with the unusual coarse deposits at the coast.

CONCLUSIONS

The Holocene and Pleistocene sections are sufficiently alike to conclude that delta formation, sequence development, fluvial processes, and marine boundary conditions must also have been remarkably similar at these times. These results help codify the model of a strong South Asian monsoon driving immense sediment flux to the Bengal margin, where tides and coastal circulation efficiently distribute sediments across a broad delta plain at rates sufficient to offset even rapid rates of sea-level rise. This pattern of behavior may also yield insight as to how the Ganges-Brahmaputra and other monsoon delta systems could respond to future changes in climate and sea level, whereby a stronger monsoon and sediment flux could mitigate the impacts of rising ocean levels.

ACKNOWLEDGEMENTS

Drilling was supported by NSF grant EAR-0309536 and conducted by the Bangladesh Water Development Board. Logistical support and field arrangements were gratefully provided by the Geological Survey of Bangladesh.

REFERENCES

ALLISON, M.A., 1998, Historical changes in the Ganges–Brahmaputra delta front: Journal of Coastal Research, v. 14, p. 1269–1275.

ALLISON, M.A., KUEHL, S.A., MARTIN, T.C., and HASSAN, A., 1998, The importance of floodplain sedimentation for river sediment budgets and terrigenous input to the oceans: insights from the Brahmaputra–Jamuna River: Geology, v. 26, p. 175–178.

ALLISON, M.A. and KEPPLE, E.B., 2001, Modern sediment supply to the lower delta plain of the Ganges–Brahmaputra River in Bangladesh. Geo-Marine Letters v. 21, p. 66–74.

ALLISON, M.A., KHAN, S.R., GOODBRED JR., S.L., and KUEHL, S.A., 2003, Stratigraphic evolution of the late Holocene Ganges-Brahmaputra lower delta plain: Sedimentary Geology, v. 155, p. 317 – 342.

BRISTOW, C.S., 1987, Brahmaputra River: Channel migration and deposition, in Etheridge, F.G., Flores, R.M., and Harvey, M.D., eds., Recent developments in fluvial sedimentology: Tulsa, SEPM (Society for Sedimentary Geology), p. 63–74.

EDWARDS, R.L., et al., 1993, A large drop in atmospheric 14C/12C and reduced melting in the Younger Dryas, documented with 230Th ages of corals: Science, v. 260, p. 962–968.

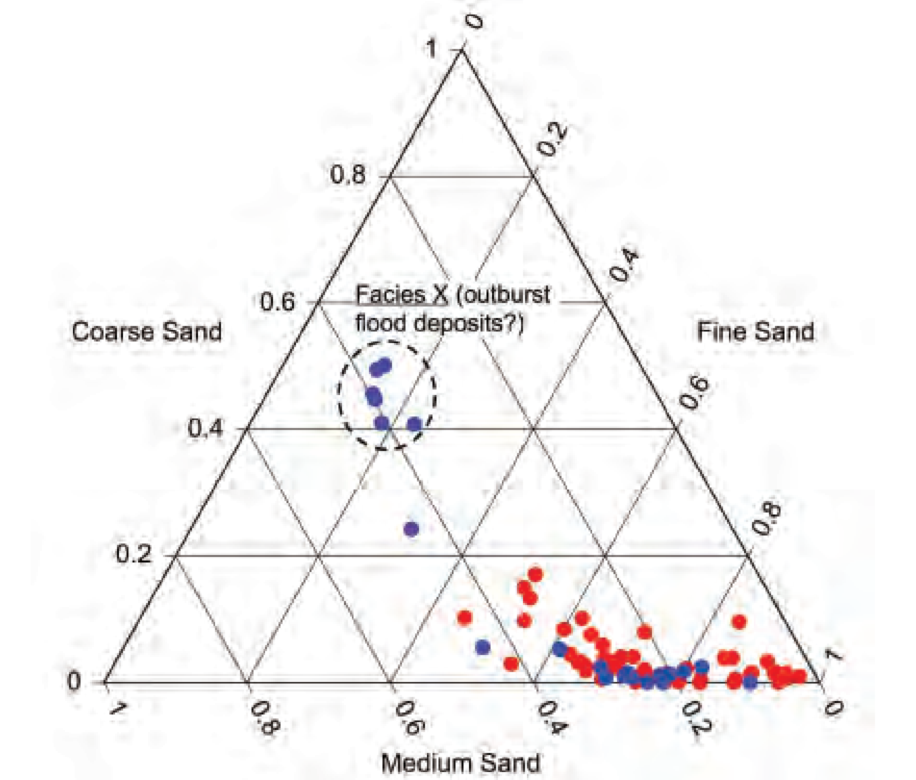


Figure 6. Ternary plot of grain-size distributions for the sand fraction only (63-1000 μm). Data include samples from the Holocene (red) and Pleistocene (blue) sequences. Note that both sequences share the same general grain size distribution for the fluvial sands, except for the anomalously coarse Facies X from the Pleistocene, which is entirely distinct within the borehole stratigraphy.

FAIRBANKS, R.G., 1989. A 17,000-year glacio-eustatic sea level record: influence of glacial melting rates on the Younger Dryas event and deep-ocean circulation: Nature v. 342, p. 637–642.

FINNEGAN, N.J., HALLET, B., MONTGOMERY, D.R., ZEITLER, P.K., STONE, J.O., ANDERS, A.M., and LIU, Y., 2008, Coupling of rock uplift and river incision in the Namche Barwa-Gyala Peri massif, Tibet: Geological Society of America Bulletin, v. 120, p. 142-155.

GABET, E.J., BURBANK, D.W., PRATT-SITAULA, B., PUTKONEN, J., and BOOKHAGEN, B., 2008, Modern erosion rates in the High Himalayas of Nepal, Earth and Planetary Science Letters: 267, 482-494.

GOODBRED, S.L., and KUEHL, S.A., 1999, Holocene and modern sediment budgets for the Ganges–Brahmaputra River: Evidence for highstand dispersal to flood-plain, shelf, and deep-sea depocenters: Geology, v. 27, p. 559–562.

GOODBRED, S.L., and KUEHL, S.A., 2000, The significance of large sediment supply, active tectonism and eustasy on margin sequence development: Late Quaternary stratigraphy and evolution of the Ganges–Brahmaputra delta: Sedimentary Geology, v. 133 p. 227–248.

GOODBRED, JR., S.L., 2003, Response of the Ganges dispersal system to climate change: a source-to-sink view since the last interstade, Sedimentary Geology, v. 162, p. 83-104.

MONTGOMERY, D.R., HALLET, B., LIU, Y., FINNEGAN, N.J., ANDERS, A., and GILLESPIE, A., 2004, Evidence for Holocene megafloods down the Tsangpo gorge, southeastern Tibet: Quaternary Research, v. 62, p. 201-207.

PRATT, B., BURBANK, D.W., HEIMSATH, A., and OJHA, T., 2002, Impulsive alluviation during early Holocene strengthened monsoons, central Nepal Himalaya: Geology, v. 30, p. 911 – 914.

PRELL, W.L. and KUTZBACH, J.E., 1987, Monsoon variability over the past 150,000 years: Journal of Geophysical Research, v. 92 (D7), p. 8411 – 8425.

SARKAR, A., SENGUPTA, S., MCARTHUR, J.M., RAVENSCROFT, P., BERA, M.K., BHUSHAN, R., SAMANTA, A., and AGRAWAL S., 2009, Evolution of Ganges–Brahmaputra western delta plain: Clues from sedimentology and carbon isotope: Quaternary Science Reviews, in press.

SINGH, S. K. and FRANCE-LANORD, C., 2002, Tracing the distribution of erosion in the Brahmaputra watershed from isotopic compositions of stream sediments: Earth and Planetary Science Letters, v. 202, p. 645–662.

STECKLER, M.S., AKHTER, S.H., and SEEBER, L., 2008, Collision of the Ganges–Brahmaputra Delta with the Burma Arc: Implications for earthquake hazard: Earth and Planetary Science Letters, v. 273, p. 367–378

Accepted August 2009

PRESIDENT'S COMMENTS

STUDENTS' PERSPECTIVES ON SEPM – WHAT WE HEARD FROM THEM, AND A REQUEST FOR YOUR INPUT AND RESPONSES

Recently we held a "Seds and Suds" Forum at the 2009 Annual Meeting in Denver CO that emphasized one-on-one interactions with current and potential new SEPM student members. Estimated student attendance was more than 70 students. After about an hour to eat, drink and mingle, Emcee John Holbrook took the microphone, introduced both him and other SEPM officers, and then explained why we had convened the meeting, which was to gain a better understanding of what students were seeking from SEPM and how the Society could better serve them. Almost immediately the group opened up and we had about 1 hour of free exchange of ideas. Both Council and Staff helped address questions, and some were fielded by NSF program officers. Paper copies of a survey were also distributed at the forum (it is available to students online at: www.sepm.org/students/studentquestion.htm.) Here's what we heard.

What Students Said They Like About SEPM

"Twice a year free books is the best benefit offered!"

SEPM Short Courses are important and of excellent quality.

Students really like the two journals and the Special Publications – they really define SEPM!

The "Sequence Stratigraphy for Graduate Students" Short Course was the best $10 that I ever spent!"

Student-Ranked Member Benefits (ranked as 1 = most important, 9 = least important, circa 70 student respondents completed the survey)
Journals = 2.53; **Book discounts** = 3.43; **Short courses** = 3.43; **Student grants** = 3.64; **Research conferences** = 4.83; **Field trips** = 4.86; **Networking** = 5.25; ***Sedimentary Record*** = 6.39

What Students Said That They Need From SEPM

Students want affordable SEPM short courses, research conferences and field trips.

The survey results indicate that only a small fraction of student respondents have ever attended an SEPM short course, field trip or research conference, citing price and schedule as inhibiting factors.

Students want to be better informed about what SEPM offers student members and to be part of a web-based community of scholars who like the same kinds of Sedimentary Geology and Paleontology.

The survey results indicated a very low level of awareness of what benefits are offered by SEPM to its student members, with about half of the student respondents indicating that they were not aware that there were student discounts for attending short courses, field trips and research conferences. Knowledge about the existence of SEPM student research and travel grants was only slightly higher. At the Seds and Suds forum there was a suggestion that we develop an SEPM equivalent of "Facebook" for student members. I think that we need to run this idea by more students.

Students desire support for their research and for travel to meetings.

The survey results indicated a very low level of participation in the SEPM student grants in aid of research program – only 8% of the students had ever applied for a research grant and only 5% of the respondents had ever applied for an SEPM travel grant.

Questions asked during the Seds and Suds forum included: (1) Are research grants only for graduate students? Tim Carr, SEPM Foundation President, replied that there are no restrictions, though most awardees are graduate students. (2) Does SEPM have specific funds earmarked for students from developing countries? Tim Carr said that none are earmarked as such, and we welcome all proposals. About 30% of SEPM's membership is currently from outside of North America!

SEPM needs to be an advocate for U.S. federal funding on behalf of Sedimentary Geology.

Questions asked during the Seds and Suds forum included: (1) Does SEPM have an influence on NSF funding? NSF Director Rich Lane and former NSF Manager Walt Snyder described their efforts at advocacy, but admitted that Sedimentary Geology is suffering because it is too fragmented within Earth Sciences Directorate. (2) Does SEPM have a paid professional lobbyist? SEPM Executive Director Howard Harper said no we do not, but described our efforts working through AGI.

So now I ask you SEPM members – do you also identify with the issues important to the students? How <u>can</u> we better serve SEPM student members? Clearly the reasons that students join SEPM today are very different and more complex than when I first joined in 1978 on the advice of my major professor who said to me "Steve, you know, you should join SEPM because it's a good idea to belong to a professional society!"

Steve Driese, President
SEPM Society for Sedimentary Geology

Sedimentary Geology Division

Geological Society of America

Greetings SEPM and GSA Sedimentary Geology Division (SGD) Members!

In this issue of the SGD Newsletter, I summarize the SGD- and SEPM-sponsored events at the upcoming GSA annual meeting October 18 - 21 in Portland, Oregon, and formally announce the Laurence L. Sloss Award and SGD Student Research Award recipients. In addition, I explore the expanding boundaries of internet-based communications and their potential utility to the Sedimentary Geology community.

2009 Laurence L. Sloss Award winner
Ray Ingersoll

2009 Laurence L. Sloss Award Recipient

The GSA SGD is pleased to announce that Dr. Raymond Ingersoll of the University of California at Los Angeles is the 2009 Laurence L. Sloss Award recipient. Dr. Ingersoll has made important contributions in the areas of clastic sedimentation and tectonics, basin analysis, and sandstone petrology. His research publications span topical and spatial scales from microscopic surface textures to mountain systems and their adjacent depositional basins. He has served the SEPM and GSA in numerous capacities over the years, and is a past chair of the GSA SGD. Please plan to join us at the SEPM-sponsored SGD and Limnogeology Division Joint Business Meeting and Awards Reception scheduled for Tuesday, October 20th, to bestow Dr. Ingersoll with this fitting honor.

2009 SGD Student Research Award Recipient

The 2009 GSA SGD Student Research Award recipient is Eric Hogan, a graduate student at the University of Tennessee-Knoxville. Eric is working on a sequence stratigraphic problem with his advisor, Dr. Chris Fedo, at the basal Sauk sequence (Precambrian-Paleozoic boundary) in the Mojave Desert, California. The results from his research should have important implications for sedimentary processes during the initial Paleozoic transgression as well as solving several regional stratigraphic puzzles. Please join us at the SEPM-sponsored SGD and Limnogeology Division Joint Business Meeting and Awards Reception as we recognize Eric's efforts as well as those of the SGD student poster and student travel award recipients.

2009 SGD Student Research Award Recipient Eric Hogan

Do you know a colleague who would be particularly deserving of the Laurence L. Sloss Award for Sedimentary Geology?
Please forward nominations to John Holbrook at holbrook@uta.edu.

2009 GSA Annual Meeting Portland, Oregon

The SEPM, GSA SGD and sedimentary geology community will have an impressive presence at the upcoming GSA Annual Meeting. The GSA SGD is sponsoring or co-sponsoring five field trips, five short courses, twenty-two topical sessions, and one Pardee symposium, all of which are listed below. An effort was made to reach beyond the typical areas of SGD sponsorship to push the envelope of application of our sedimentary science.

Seds and Suds, the SGD- and SEPM-sponsored meeting icebreaker and informal forum, will start the meeting off on Saturday, October 17th, from 6:00 to 9:00 pm in the Hilton, Pavilion West. The topic for this year's forum is directed toward the next generation of sedimentary geologists: "Sedimentary Geology Societies and You – What Students and Young Professionals Need from Professional Societies." In-coming SGD Chair John Holbrook and current SGD Chair Dan Larsen, as well as representatives from several other sedimentary geology societies, will be there to provide their perspectives and guide the discussion. Please plan to join us for light hors d'oeuvres and beverages, and contribute to this notoriously lively discussion group.

We plan to have the 2009 SGD and Limnogeology Division Joint Business Meeting and Awards Reception on Tuesday evening, October 20th, to avoid overlap with alumni parties that are scheduled for Monday night. Please plan to join us for the celebration with light hors d'oeuvres 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 Portland.

I) PARDEE SYMPOSIA

- **P3. Earth et al.-Our Planets from the Hadean to Today**

II) TOPICAL SESSIONS

- **T3. Buried Valley Aquifers: from Bedrock to Sediment Hosted Tunnel Valleys**
- **T13. Hydrogeomorphic and Ecohydrologic Consequences of Extraordinary Sediment Loading**
- **T14. Sequential and Repeat Photography as a Tool for Earth and Environmental Science Research and Education (Posters)**
- **T35. Cenozoic Lakes**
- **T42. Convergent Margin Tectonics Reflected in Forearc Basin Sedimentary Fills: Integrated geologic and Geophysical Studies**
- **T47. Lithospheric Delamination, Continental Magmatism, and Crustal Uplift in Mountain Evolution**
- **T49. Neoproterozoic through Cretaceous Evolution of the North American Cordilleran Margin:**

Contrasting Tectonics, Paleogeography, and Paleoenvironments

- **T50. New Developments in Understanding the Mesozoic Cordilleran Orogen: Linking Forearc, Arc, and Backarc Processes**
- **T55. Tectonic Inversion: Characteristics and Mechanisms**
- **T57. The Mesozoic and Cenozoic Tectonic Evolution of Northwestern Mexico and the Southwestern United States**
- **T66. New Insights into Development of the Upper Neoproterozoic-Lower Paleozoic Western Laurentian Passive Margin**
- **T67. Sedimentary Geology of the Next Generation: Student Posters (Posters)**
- **T68. Uplift or Climate Change? Evaluating Surface Uplift and Deformation in Light of Climate Change in the Andes**
- **T70. Interaction of Tectonics, Climate Change, and Eustasy in the Development of the North American Cordillera**
- **T94. Impact Cratering from the Microscopic to the Planetary Scale**
- **T97. EARTHTIME: From Developing Tools to Teaching about Time**
- **T103. Geology in the National Parks: Research, Mapping, and Education**
- **T120. Darwin, Geology, and Evolution: Impact of Darwinian Views on Scientific Theory-Making**
- **T125. Geochemical Approaches to Sedimentary Provenance Studies**
- **T152. Frontiers in Coal Science: From Basic Research to Applied Technology**
- **T154. Geoarchaeology, Reconstructions of Paleoenvironments and Past Human-Environment Interactions**

III) FIELD TRIPS

- **402. The Great Missoula Floods and the Channeled Scablands**
  - Tues.-Sat., 12-17 Oct

Salmon River Canyon, Idaho (photo courtesy of Dave Blake)

- **411. A Tectonic Transect through the Salmon River Suture Zone along the Salmon River Canyon in the Riggins Region of West-Central Idaho**
  - Thurs.-Sat., 15-17 Oct.
- **415. The Chiwaukum Structural Low, Eastern Cascade Range, Washington**
  - Thurs.-Sat., 15-17 Oct.

Triassic and Jurassic rocks in the southern Wallowa Mtns., Oregon (photo courtesy of Todd LaMaskin)

- **429. Mesozoic Sedimentation, Magmatism, and Tectonics in the Blue Mountains Province, Central Oregon**
  - Wed.–Sat., 21–24 Oct.
- **432. Eruption-Related Lahars and Sedimentation Response Downstream of Mount Hood**
  - Thurs., 22 Oct.

IV) SHORT COURSES

- **504. Sequence Stratigraphy for Graduate Students**
  - Fri.–Sat., 16–17 Oct., 8 a.m.–5 p.m.
- **506. Structural and Stratigraphic Concepts Applied to Basin Exploration**
  - Fri.–Sat., 16–17 Oct., 9 a.m.–5 p.m.
- **511. Laser Ablation ICP-MS: An overview of the technique and a look at new advances in quantitative microanalyses for geological, biological, and environmental applications**
  - Sat., 17 Oct., 8 a.m.–5 p.m.
- **513. Teaching climate change and Earth history using ocean drilling data in introductory geoscience courses**
  - Sat., 17 Oct., 8 a.m.–5 p.m.
- **520. Using and developing historical image archives to investigate landscape change**
  - Sun., 18 Oct., noon–3 p.m.

Communicating Our Science

Communication is essential to the scientific process. However, the mechanisms through which we communicate our science are continually changing. Scientific communications through the written letter (sent via "snail mail") and paperbound journals have, to varying degrees, been supplanted by e-mail and various electronic forms of journal and information delivery. Several relatively new avenues of communication may soon add to the array of web pages, list-serves, and otherwise electronic services through which sedimentary geologists relay, discuss and present their ideas. Below I discuss several internet-based approaches to communication that are beginning to find utility amongst the geological community.

Facebook, the web-based social-networking service captivating the attention of the teen and twenty-something generation, is finding increasing visibility among geoscience organizations. In contrast to traditional web sites, Facebook offers several options for interactive communication regarding meetings, new scientific ideas, as well as social activities. The GSA, NSF, and several geosciences departments maintain Facebook sites that allow for sharing information videos, photographs, etc. For example, the NSF Facebook site offers an option for short communications (the wall), a RSS feed/blog link, a video clip collection, and a discussion group. The GSA Hydrogeology Division recently launched a Facebook site that is showing some activity. Not that the SGD should simply follow the Hydrogeology Division, but perhaps a SGD Facebook site could stimulate more communication among sedimentary geologists, especially for fostering rapid idea-sharing and bringing together expertise among physically distant groups. Facebook requires membership (which is free) and allows a member to filter the amount of information shared among the community. The social-networking service MySpace offers many similar options, but seems to have less presence amongst the professional community.

Blogs, short for web logs, are commonly utilized electronic platforms for opinions and issues amongst the news and political media. Do such sites provide a useful tool for enhancing communication within the sedimentary geology community? Check out Brian Romans' Clastic Detritus blog site (clasticdetritus.com) for an example. Brian also maintains a fairly extensive list of other geosciences blog sites. These sites offer science information, picture puzzles, scientific data, all available for open commentary, both praise and criticism. These sites have no filters and are an open forum; thus, anyone can respond. In a quick perusal, however, I found several geosciences blog sites with interesting photographs and commentary.

The most recent addition to the list of quick communication platforms is Twitter, which is another social-networking service. Twitter allows text posts of up to 140 characters long, so don't expect any detailed discussions. It seems to be useful for keeping track of other people's activities (sort of like a textual Big Brother!). I'm not sure this has broad communication possibilities for the sedimentary geology community, but maybe for educational activities.

The degree to which these communication tools are successful ultimately will be determined by the community of users. Some sedimentary geologists are already using these sites to share information and ideas. They undoubtedly hold much potential for interactive communication and idea development. I encourage the sedimentary geology community to explore these sites. Perhaps the SGD Newsletter might show up on a Facebook or blog site in the future, complete with opportunity for instantaneous commentary. I will let a future SGD Chairperson wrestle with that possibility.

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

SGD Personnel and Committee Assignments for the 2008-2009 Year.

- **Daniel Larsen** is the Chair.
- **John Holbrook** is the Vice-Chair.
- **Paul Link** is the Secretary/Treasurer.
- The Joint Technical Program Committee (JTPC) representatives for SGD are **Troy Rasbury** and **Mark Kulp**.
- **Kelly Dilliard** is the web manager.
- The Sloss Award Committee comprises: **Mike Arthur**, **Peter DeCelles**, **Maya Elrick**, **Bob Garrison** (chair), **Tom Hickson**, and **Judy Parrish**.

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.

Upcoming SEPM Research Conferences

Application of Seismic Geomorphology Principles to Continental Slope and Base-of-slope Systems.
November 12-14, 2009, Houston, TX (www.sepm.org)
Registration Open

Salt tectonics, sediments and prospectivity
(Joint conference with The Geological Society of London).
January 20-21, 2010, Burlington House, London, UK
(www.geolsoc.org).
Abstracts Closed July 31

Microbial Mats in siliciclastic sediments from the Archean to present.
May 21-23, 2010, Dinosaur Ridge, Morrison, CO and Denver, CO, USA
(www.sepm.org)
Accepting Abstracts

2010 CONFERENCES IN PLANNING

Deciphering Paleoclimatic Signals from Continental Successions.
Estimated Summer, 2010, Nova Scotia.
Conveners: Jonathan Allen and Christopher Fielding
(University of Nebraska-Lincoln).

Linking Modern and Fossil Soils: Understanding Future Soil Change Based on Paleosol Records. (Jointly with Soil Science Society of America).
Estimated Fall, 2010, Petrified Forest National Park (PFNP),
Holbrook, Arizona, USA
Conveners: Steven G. Driese and Dr. Lee C. Nordt
(Baylor University), Gene Kelly (Colorado State University),
Curtis Monger (New Mexico State University),
and Cynthia A. Stiles,(USDA).

1926 SEPM Society for Sedimentary Geology