SEPM President’s Reception and Awards Ceremony
Date: Tuesday, May 13
Time: 7:00-8:30 p.m.
Location: The Salt Lake City Marriott Hotel Downtown

SEPM President Peter McCabe and the Council of the Society invite you to an evening of celebration to honor the 2003 awardees of the Society for Sedimentary Geology (SEPM):
- Twenhofel Medal
  - Gerard Middleton
- Raymond C. Moore Medal
  - George Pemberton
- Pettijohn Medal
  - Lawrence Hardie
- Francis P. Shepard Medal
  - Harry Roberts

Honorary Award
- Samuel Bentley

Honorary Membership
- Edward B. Picou, Jr.

Outstanding Paper in JSR, 2001:
- Stephen Meyers, Bradley Sageman
- Linda Hinnow

Outstanding Paper in PALAIOS, 2001:
- T.D. Olszewski
- M.E. Patzkowsky

Excellence of Oral Presentation, 2002:
- A.R. Sprague, P.E. Patterson
- R.E. Hill, C.R. Jones
- K.M. Campion, J.C. Van Wagoner
- M.D. Sullivan, D.K. Larue
- H.R. Feldman, T.M. Demko
- R.W. Wellner, and J.K. Geslin

Excellence of Poster Presentation, 2002:
- D.C. Twitchell, V.A. Cross
- M. Rudin

SEPM will also be recognizing the members of the 2003 Local Organizing Committee and student winners.

The reception will begin at 7:00 p.m., with cash bars and hors d’oeuvres. The ceremony will start at 7:30 p.m.

Research Groups
- Clastic Diagenesis
- Carbonates
- Marine Micropaleontology
- Quantitative Stratigraphy
- Sequence Stratigraphy

6-7pm, Tues. May 13:
- CRER-Working Group IV
  - 7:30-9:30pm, Tues. May 13:
- Deep Water

SEPM Foundation Activities
9-10am, Mon. May 12
Foundation Board Meeting
10-11am, Mon. May 12
Foundation Members Meeting
6-7pm, Tues. May 13
Foundation Donors Reception

The SEPM Council
2002 - May 2003:
- President: Peter McCabe
- President-Elect: John B. Anderson
- Secretary-Treasurer: William A. Morgan
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- New officers for 2003 - 2004:
  - President: John B. Anderson
  - President-Elect: Rick Sarg
  - Councilor for Sedimentology: Maria Mutti
  - Councilor for Paleontology: Dawn Sumner
Welcome to The Sedimentary Record

This is the inaugural issue of The Sedimentary Record, a new series published quarterly in both online and paper format by SEPM (Society for Sedimentary Geology). The Sedimentary Record contains peer-reviewed science articles on topics of broad and current interest to the membership of SEPM, as well as shorter, editor-reviewed articles addressing a variety of topics, including society business and media reviews. We welcome written contributions from members of the Society for inclusion in the journal. We also look forward to receiving suggestions concerning how The Sedimentary Record should evolve in order to meet its dual goals of serving 1) as an outlet for communicating information important to the Society; and 2) as a focal point for discussion of current topics, and topics pertinent to the future of sedimentary geology.

Manuscripts to be considered for publication should be submitted to the editors in electronic format, and preferably by e-mail. Upon acceptance, it is anticipated that papers will be published quickly. Publication will include online availability through the SEPM website.

We are proud to be associated with this new publication venue of SEPM, and look forward to working with many of you in the membership of the Society to bring important, current topics to publication in a rapid manner.

— The Editors

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The Sedimentary Record is provided as part of membership dues to the Society for Sedimentary Geology.
The Precambrian-Cambrian Transition in the Southern Great Basin, USA

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ABSTRACT: The Precambrian-Cambrian boundary presents an interesting stratigraphic conundrum: the trace fossil used to mark and correlate the base of the Cambrian, *Treptichnus pedum*, is restricted to siliciclastic facies, whereas biomineralized fossils and chemostratigraphic signals are most commonly obtained from carbonate-dominated sections. Thus, it is difficult to correlate directly between many of the Precambrian-Cambrian boundary sections, and to assess details of the timing of evolutionary events that transpired during this interval of time. Thick sections in the White-Inyo region of eastern California and western Nevada, USA, contain mixed siliciclastic-carbonate lithofacies, and therefore promote correlation between these classic, well-studied lithologic end-members. An integrated stratigraphic approach was applied to the White-Inyo succession, combining lithologic, paleontologic, and chemostratigraphic data, in order to address the temporal framework within the basin, and to facilitate worldwide correlation of the boundary. Results from the southern Great Basin demonstrate that the negative δ13C excursion that is ubiquitous in carbonate-dominated successions containing small shelly fossils occurs within stratigraphic uncertainty of the first occurrence of *T. pedum*. This global geochemical marker thus provides a link with the primary biostratigraphic indicator for the Precambrian-Cambrian boundary.

INTRODUCTION

The Precambrian-Cambrian (PC-C) transition records one of the most important intervals in the history of life, because it encompasses the appearance and diversification of metazoans, the invasion of the infaunal realm, the advent of biomineralization and predation, as well as dramatic isotopic and atmospheric changes (Lipps and Signor, 1992; Bengston, 1994; Knoll and Carroll, 1999; Bottjer et al., 2000; Knoll, 2000; Babcock et al., 2001; Fig. 1). Here we draw a distinction between the PC-C transition, represented by the post-glacial terminal Proterozoic through the early Cambrian (ca. 600-520 Ma), and the PC-C boundary, a chronostratigraphic boundary represented by a point in rock (Global Standard-stratotype Section and Point, or GSSP) in the Fortune Head, Newfoundland, section (Landing, 1994). The GSSP section is composed predominantly of siliciclastics (Narbonne et al., 1987), and the fossil chosen to coincide with the boundary, *Treptichnus* (or *Phycodes*) *pedum*, is restricted to siliciclastic facies. *T. pedum* recently has been demonstrated to occur ~ 4 m below the GSSP (Gehling et al., 2001). Approximately 70% of all PC-C boundary successions are siliciclastic (Landing, 1994). However, many carbonate successions around the world have been more intensely studied because they record the advent of widespread biomineralization and easily obtainable δ13C chemostratigraphic records (summarized in Kaufman et al., 1997; Shields et al., 1997; Bartley et al., 1998; Shields, 1999; Corsetti and Hagadorn, 2000; Shen and Shidlowksi, 2000). Due to endemic biotas and facies control, it is difficult to correlate directly between siliciclastic- and carbonate-dominated successions. This is particularly true for the PC-C boundary interval because lowermost Cambrian biotas are highly endemic and individual, globally distributed guide fossils are lacking (Landing, 1988; Geyer and Shergold, 2000).

Determination of a stratigraphic boundary generates a large amount of interest because it provides scientists with an opportunity to address a variety of related issues, including whether the proposed boundary position marks a major event in Earth history. Sometimes the larger-scale meaning of the particular boundary can be lost during the process of characterization. This is demonstrated in a plot of PC-C boundary papers through time (Fig. 2): an initial “gold rush” to publish on the boundary occurred after the formation of the working group on the PC-C boundary in the early 1970s; papers trailed off though the 1980s, and plummeted after the GSSP was ratified by the International Union of Geological Sciences (IUGS) in 1992 (Rowland and Corsetti, 2002). As our understanding of this interval of Earth history grows, we focus more on the “bigger picture” issues (e.g., evolution and diversification of the Metazoa), and focus less on the “boundary issues.” However, we will inevitably seek tie points with which to link fossils from siliciclastic sections to the geochemical and climate-change data from carbonate-dominated sections so that we can improve our understanding of this critical interval.

Mixed siliciclastic-carbonate successions become crucial in the search for stratigraphic tie points. Although a number of important lower Cambrian sections containing mixed siliciclastic-carbonate successions are...
known (e.g., Mongolia, Brasier et al., 1996; Olenik uplift, Siberia, Knoll et al., 1995; Mackenzie Mountains, northwestern Canada, Narbonne and Aitken, 1995; southern Great Basin, Corsetti and Hagadorn, 2000), not all of these contain the PC-C boundary. Also, not all the sections contain an appropriate juxtaposition of carbonate- and trace-fossil-rich siliciclastic strata. Thick, relatively complete, well-exposed, and easily accessible successions in the southern Great Basin contain siliciclastic units and the boundary-marking fossil, T. pedum, in association with carbonate units recording a complete δ13C chemostratigraphic profile (Corsetti and Kaufman, 1994; Corsetti et al., 2000; Corsetti and Hagadorn, 2000; Hagadorn and Waggner, 2000). The southern Great Basin sections provide an excellent opportunity to compare results from a variety of stratigraphic approaches that have emerged as useful for correlating potential stage and series boundaries within the Cambrian (e.g., Geyer and Shergold, 2000).

GEOLOGIC BACKGROUND

From the time of Walcott (1908), the thick, superbly exposed, and highly fossiliferous Lower Cambrian strata from the southwestern United States (Figs. 3, 4, cover photo) have proved instrumental for understanding the Cambrian biotic explosion, and have even been suggested for a potential basal Cambrian stratotype (Cloud, 1973). Proterozoic—lower Paleozoic strata in the southern Great Basin were deposited on a thermally subsiding trailing margin created through rifting of the Laurentian craton in the Neoproterozoic (e.g., Stewart, 1966, 1970; Stewart and Suczek, 1977; Armin and Mayer, 1983; Bond et al., 1985).

Neoproterozoic-Cambrian strata in the southwestern United States thicken from southeast to northwest, and can be grouped into four distinct but interfingering successions: Craton, Craton Margin, Death Valley (proximal-shelf), and White-Inyo (proximal- to mid-shelf) successions (Stewart, 1970; Nelson, 1976, 1978; Mount et al., 1991; Corsetti and Hagadorn, 2000; Fedo and Cooper, 2001; Fig. 3). This sequence boundary is traceable from the Craton Margin through the Death Valley succession to the White Inyo succession, and probably represents the “Sauk I” disconformity (Palmer, 1981). The boundary interval resides below this unconformity where incision was limited. The Death Valley succession records both appropriate trace fossil biostratigraphy and carbon isotopic data (Corsetti and Hagadorn, 2000). However, the sections are relatively thin and the carbonates from which the δ13C record was recovered are particularly thin. The White-Inyo succession is thickest, but, until now, has been considered poorly fossiliferous with respect to earliest Cambrian guide fossils (e.g., Signor and Mount, 1986). Trilobites, which are important guide fossils in Lower Cambrian sections in the Great Basin (e.g., Nelson, 1976; Palmer, 1981, 1998; Hollingsworth, 1999), make their first appearance well above this interval (Hollingsworth, 1999).

White-Inyo Succession

In ascending order, the White-Inyo Succession consists of the Wyman Formation, Reed Dolomite, Deep Spring Formation, Campito Formation, Poleta Formation, Harkless Formation, and the Mule Spring Limestone (Nelson, 1962; Fig. 4). The White-Inyo Mountains have been the focus of intense PC-C boundary study, but the paucity of earliest Cambrian fossils has been problematic (e.g., Cloud and Nelson, 1966; Taylor, 1966; Alpert, 1977;
The Wyman Formation consists of interbedded mudrock, siltstone, and quartzite, with lensoidal oolitic, pisolitic, and oncotic carbonate layers that increase in number upsection. Near Andrews Mountain in the Inyo Range, the formation exceeds 3000 meters in thickness (Nelson, 1962). The section primarily represents shallow marine deposition. The base of the formation is not exposed, so the nature of any underlying contact in not known (Nelson, 1962). The Reed Dolomite rests unconformably on the Wyman at most localities and is divided into three members: the Lower Member, Hines Tongue, and the Upper Member. The Lower Member is characterized by coarsely-crystalline pink dolostone with cross-bedded oolitic horizons, and minor domal stromatolite horizons. This suggests subtidal to intertidal marine deposition. The Hines Tongue is a southward-thickening siliciclastic unit consisting of hummocky-crossbedded sandstone and minor siltstone with minor carbonate interbeds. Thus suggests deposition below normal wave base but above storm wave base. The Hines Tongue is thickest in the Hines Ridge area of the Inyo Range, and thins dramatically to the north in the White Mountains and Esmeralda County, Nevada. The Upper Member is characterized by massive dolostones. Minor karstification is present at the contact with the overlying Deep Spring Formation at some localities.

The Deep Spring Formation is formally divided into the Lower, Middle, and Upper Members, each consisting of a siliciclastic-carbonate couplet (Gevirtzman and Mount, 1986; Mount et al., 1991). The siliciclastic half-cycle of each member contains green, ripple cross-laminated siltstones, and quartzites with hummocky cross-stratification, indicating deposition in relatively shallow water above storm wave base. The boundary between the siliciclastic and carbonate half-cycle is transitional at most localities. The carbonate half-cycle is commonly characterized by rhythmically interbedded carbonate wackestone and siliciclastic-rich siltstone, crossbedded oolite, and intraclastic grainstone; a high-energy, shallow-water depositional environment is indicated. The top of each carbonate half-cycle is commonly dolomitized, and often shows minor karstification; periodic emergence is indicated. Overall, sedimentary stacking patterns, sedimentary structures, and facies associations suggest that each member represents a shallow-upward parasequence. Sharp discontinuities divide the members (but see Mount et al., 1991). The Campito, Poleta, Harkless (and Saline Valley), and Mule Spring formations record similar shallow marine, mixed-siliciclastic carbonate strata (e.g., Moore, 1976; Mount and Bergk, 1998), and have similar sedimentary origins.

The White-Inyo succession contains a number of body and trace fossils. We have identified bed-parallel tubular trace fossils, including Helminthoidichnites and Planolites (Fig. 5A), in the Wyman Formation; we cannot falsify the hypothesis that some of these are body fossils. The Hines Tongue of the Reed Dolomite contains a depauperate suite of bed-parallel trace fossils, such as Helminthoidichnites, Planolites, and Torrowangea, and the Upper Member contains packstones of the body fossil Cloudina. Carbonates of the Lower and Middle Members of the Deep Spring Formation contain Cloudina (in skeletal lags and isolated occurrences; Figs. 5C, D). These fossils were initially identified as Cambrian small shelly fossils (Signor et al., 1983) but were subsequently reinterpreted as the Neoproterozoic Cloudina (Grant, 1990). It remains unclear whether all of the forms reinterpreted as Cloudina are, in fact, Cloudina or whether some are small shelly fossils. Siliciclastics of the Middle Member also contain rare examples of Cloudina and bed-parallel trace fossils, including Planolites and Plagiogmus. Treptichnus pedum (Fig. 5E), which delineates the PC-C boundary, occurs near the top of the Middle Member in the Mt. Dunfee area and at the base of the Upper Member in the White Mountains; in the latter case, T. pedum is associated with a moderately diverse ichnofossil assemblage (including Cruziana and Rusophycus, Fig. 5F). The Campito Formation contains trilobites characteristic of the Fallotaapis and Nevarella zones (see Hollingsworth, 1999), abundant trace fossils, and limited archaeocyathid bioherms (Nelson, 1976, 1978).

δ13C CHEMOSTRATIGRAPHY

Faunal data are broadly useful for correlation across the PC-C interval in the southern Great Basin, but δ13C chemostratigraphy provides another important technique for constraining intrabasinal and interre-
The robust rules out many sections from serious consideration. We do not experience significant heating, and that procedure requires that the analyzed section did not experience significant heating. Numerous sections are excluded from study for this reason. A carbon isotope reference curve does not exist for the PC-C interval, but broadly similar chemostratigraphic patterns exist among many PC-C sections (Shields, 1999). Ignoring low amplitude variations, the major δ13C trends include: 1, a latest Paleozoic major positive carbon isotope excursion (slightly older than 548 Ma; Grotzinger et al., 1995), associated with Cloudina, simple horizontal trace fossils, and Ediacaran-type fossils; followed by 2, a pronounced negative carbon isotope excursion nearly coincident with the PC-C boundary, at ca. 543-542 Ma (Bowering et al., 1993; Grotzinger et al., 1995). The precise position of the negative excursion with respect to the paleontologic marker of the boundary was unclear for a number of years, although it was commonly assumed that the negative excursion coincided with the boundary horizon. Corsetti and Hagadorn (2000) demonstrated that T. pedum does in fact occur within one negative-δ13C shift of the boundary horizon in the Death Valley succession, and this potentially resolves the question.

The relative synchronicity of the first appearance of T. pedum and the negative δ13C excursion in the southern Great Basin can be further tested by comparing samples from the thinner Death Valley succession to samples from the much thicker, carbonate-rich White-Inyo succession. High-resolution sampling for carbon isotope chemostratigraphy was conducted through the Deep Spring Formation at multiple sections across the basin, in concert with biostratigraphic sampling (Fig. 6). Most of the Lower Deep Spring Formation, where Cloudina is present, shows a positive isotopic excursion (to ~+4‰ PDB). The excursion is progressively omitted in the onshore direction, and reaches only ~+2‰ in more onshore sections. A negative excursion, commonly down to ~−5‰, is recorded from the top of the Lower Member through the middle of the Middle Member. Cloudina also occurs in this interval. The negative excursion is most pronounced in offshore sections, where isotopic compositions plummet to ~−7‰. Curiously, the isotopic nadir is associated with unusually abundant stromatolite and thrombolite development (Oliver and Rowland, 2002).

At Mt. Dunfee, which represents the most offshore section, δ13C values rise to near 0‰, then return to mildly negative values beneath the Middle-Upper Deep Spring contact. This excursion is missing from the other, less complete sections in the onshore direction. T. pedum occurs in association with this return to negative δ13C values. The Upper Deep Spring Formation records a positive excursion to ~+2‰. Thus, the presence of T. pedum in association with the negative excursion is verified in the White-Inyo succession, and it provides a global tie-point useful for correlations between siliciclastic-dominated sections and carbonate-dominated sections.

In addition to providing a tool for chronostratigraphic work, secular variation in the δ13C record can be used to address issues of basin scale. For example, if we use the δ13C record as a chronostratigraphic tool, there is a progressive omission of the δ13C record in the onshore direction. The most complete isotopic and stratigraphic records are present in the most offshore sections. This trend is not unexpected. However, previously it was not possible to determine the magnitude of stratal omission using available lithostratigraphic or biostratigraphic information.

GLOBAL IMPLICATIONS Integrated biostratigraphic and chemostratigraphic information from the southern Great Basin demonstrate that the first occurrence of T. pedum, the trace fossil used to correlate the PC-C boundary, co-occurs with the ubiquitous negative carbon isotope excursion recorded in carbonate-dominated successions around the world. It is beyond the scope of this paper to correlate between all the carbonate- and siliciclastic-dominated sections because endemism, hiatuses, and diagenesis complicate the global picture. Using the trace fossil and chemostratigraphic records from the Great Basin as a bridge, however, it appears that the first occurrence of small shelly fossils was relatively synchronous with the first appearance of T. pedum.

If we ignore potential facies control on the first appearance of T. pedum in the Mt. Dunfee section, it could be argued that small shelly fossils just barely predate T. pedum because the first small shelly fossils appear in association with relatively negative δ13C values (Knoll et al., 1995). Given the relatively small amount of stratigraphic uncertainty, the debate regarding the choice of trace fossils vs. small shelly fossils as the stratotype marker is, in our view, rendered moot. The PC-C transition is well calibrated (Bowering et al., 1993; Grotzinger et al., 1995), and the duration of the negative excursion is constrained to less than one million years. This implies that phosphatic biomineralization and vertically-oriented burrowing developed quickly and nearly synchronously (probably in less than one million years). Interestingly, the δ13C and trace fossil biostratigraphic records from the Mt. Dunfee area closely match the hypothetical, composite reference section proposed by Shields (1999).
CONCLUSION

Stratigraphic sections in White-Inyo Mountains, California-Nevada, provide a well-exposed and easily accessible PC-C boundary interval through a mixed siliciclastic-carbonate succession. In this succession, δ^13C chemostatigraphy has been combined with biostratigraphy to provide well-constrained correlations, and these correlations have application for correlating between siliciclastic- and carbonate-dominated successions globally. The ubiquitous negative δ^13C excursion near the base of the Cambrian is confirmed to coincide with the first occurrence of *T. pedum* in multiple sections across the southern Great Basin. From the time of Walcott to the present day, the Neoproterozoic-Cambrian succession in the southwestern United States continues to provide important data on one of the most interesting intervals in Earth history.

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REFERENCES


A Global Earth

We live in difficult times. In many locations around the world terrorism is replacing political discussion, thuggery is replacing democracy, conflict is replacing diplomacy, and civil liberties are being trampled by some espousing freedom. While for the majority of us these events have resulted only in inconveniences and anxieties, others have been profoundly affected. A friend of mine, for example, suddenly found himself helping in the recovery efforts after the Bali bombing last October. In such a troubled world it is tempting to turn inward and worry only about what is going on in our local community. To do so is dangerous. The world is too small to ignore what is going on elsewhere.

Scientists are used to thinking of a global community. We value creative minds and innovative thinkers regardless of their nationality, gender, age, or any other factor that may define the individual. A different perspective is seen as an asset rather than a threat. Scientific societies believe that their health and vitality is dependent on attracting a membership of highly qualified individuals from around the world. The SEPM Society for Sedimentary Geology began in the United States over 75 years ago but today it is truly an international society. We have members in many countries and, although our membership is still dominated by geologists living in the U.S., the majority of our new members are from outside the U.S. As the society membership evolves, it is important that the society itself adapts and provides better services to members around the world. We always welcome your suggestions as to how we can better serve you.

SEPM is committed to being a leader in providing communication within the global sedimentary geology community. This first issue of the Sedimentary Record is an initial step in creating what I hope will become a forum for the SEPM membership to learn about news and recent developments in our community. I urge you to see this publication as a forum to let others know about exciting developments in your area. We all know communication is vital to a thriving global scientific community — here is your opportunity. Maybe in a small way we can set an example by showing that international cooperation benefits all participants. I wish the Sedimentary Record every success and let us hope that the coming months bring more peace to the world.

Peter J. McCabe, President pmccabe@usgs.gov

The SEPM Foundation

The goal of the SEPM Foundation is to raise and distribute funds in support of SEPM (Society for Sedimentary Geology) activities. The Foundation is essentially the fund raising arm of the Society. Because our students are the future of our science, one of our most important areas is the support of student research in sedimentary geology. This year we are supporting a student research section that was organized by Dave Budd and Toni Simo at the SEPM/AAPG Annual Meeting (P80). A total of 16 student posters will be presented on Tuesday morning (13 May). Each student presenter is supported by a travel grant from the Mobil Foundation Student Participation Fund. The abstracts, available online at http://aapg.confex.com/aapg/sl2003/techprogram/session_2020.htm, show the amazing diversity and strength of current student research in sedimentary geology. If you are at the annual meeting, I strongly encourage you to make time for this session. You will not be disappointed.

Our other area of support for students is research grants. We are pleased to announce that in 2003 the Foundation has awarded four research grants from the Robert and Ruth Weimer, John Sanders funds, and for the first time the Gerald Friedman Fund. Funds were provided to the following students:

Stephen A. Welch, University of Tennessee (Friedman Fund)  
Deciphering Eustatic and Tectonic Influences during Parasequence Development in the Mesoproterozoic Helena/Wallace Formations, Belt Supergroup

Diane C. Jorgensen, James Cook University, Australia (Sanders Fund)  
Quaternary Paleowinds and Paleoclimates of Western Australia

Elizabeth Leslie, University of Wisconsin (Weimer Fund)  
The Climatic Signature of the Golden Valley Formation (Western North Dakota): Implications for Carbon Cycling During the Initial Eocene Thermal Maximum

Jesse T. Korus, University of Wisconsin (Weimer Fund)  
The Alluvial Wasatch Formation, Green River Basin, Wyoming: A Bridge in the Gap between Lacustrine Stratigraphy and Drainage Basin Dynamics

Congratulations to these students. However, this year funding requests for student research greatly exceeded available funding. Please consider contributing in support of the sedimentary geologists of the future. If you wish to create an enduring tribute, consider establishing a fund in the name of a beloved mentor or colleague. More information on how you can assist the Foundation is available online or from headquarters or me at any time.

Tim Carr, President, SEPM Foundation, Inc. t carr@kgs. ukans.edu
The Evolution of the Multi-Hat Head

Sedimentology is a constantly changing discipline. It is ironic that the Greek philosopher Herodotus, a man of many talents, assigned the name delta to the mouth of the Nile River (c. 490 BC) because of its resemblance to the Greek symbol. Although little was known about deltas during the time of Herodotus, the deltaic system represents one of the most dynamic and diverse environments on this planet, not unlike the man who originally proposed the name.

The classic work on sediment we as geologists are all familiar with was mostly performed during the early to middle 1900s. Many experiments, with some of the results still important today, were performed during the early part of the last century. These include the work of Zingg (1935) and Powers (1953), both of whom contributed to the classification of individual sediment particles. Understanding the behavior of sediments at the onset of suspension was the work of Hjulst™r™n (1935) and Shields (1936), both of whom constructed diagrams, still in use today, that relate grain size to the onset of suspension. The middle 1900s witnessed a shift from studying individual sediment grains to studying the classification of those grains after lithification. The most well-known classification systems of this era are the work of Dunham (1962) and Folk (1962). Each proposed a different classification for carbonate rocks, with the former being more useful in the field and the latter being more useful in the laboratory. The late 1900s witnessed yet another change regarding the way sediments are studied. Studies of individual grains and the whole rocks evolved into a method of analyzing an entire depositional system. The work of industry research groups became important and influential throughout the 1970s and 1980s. The classic work of the Exxon Group (Vail et al., 1977) is probably one of the more important contributions to the field of sedimentology and stratigraphy during the last century.

Seismic stratigraphy, which later evolved into sequence stratigraphy, changed the basic ideas of sedimentary relationships and stacking patterns on a basin-wide scale. With the advent of sequence stratigraphy, sedimentology came to be interpreted in a more lateral fashion, although vertical detail was also enhanced.

Miall (1985) proposed the idea of architectural element analysis. This idea put forth a given set of geometries for a fluvial setting. Architectural element analysis involved a characteristic succession of sedimentary structures used in identifying a fluvial succession. This model made it more convenient for geologists to understand individual sedimentary geometries and relationships at the kilometer scale.

The true purpose of this essay is to inform graduate students who are planning careers in sedimentary geology, primarily sedimentology, as to what is needed to be successful. During a precious few years in graduate school, a student needs to carefully map out what it will take to make himself or herself more ’marketable’ upon completion of a degree. As a graduate student, many things are out of one’s control; however, there are some things that can be controlled by the individual graduate student, that I think are necessary to maximize one’s marketability after school.

Geologic research today is multifaceted. It is rare to see a graduate student write a thesis on “the settling velocity of a quartz sand grain.” In universities today, graduate student research often covers several subdisciplines. Primarily sedimentologic studies are often combined with stratigraphy, sequence stratigraphy, paleontology, and structural studies. Graduate students today must be able to develop not only a strong geologic background in the field and the classroom, but they also need to develop a multi-hat head. This multi-hat head will make an individual much more marketable when it comes time for the employment search, whether it be industry or academia.

As history has shown, sedimentology will continue to change over the next decade. In the literature today, it is rare to find an article centered on the application of one subdiscipline to a sedimentary succession (primarily sedimentology) to a given study. Even in sedimentology-based journals (i.e., Journal of Sedimentary Research, Sedimentology, etc.) recent titles include studies that relate sedimentary structures, sequence stratigraphy, glacio-eustasy, and basin analysis to basic sedimentologic studies. Broad-based skills mentioned in some of these titles are impossible to completely master. This leads to the next trend in sedimentology studies, the multi-author paper. The single author, peer-review paper is not completely extinct, but there are many more multi-author papers in today’s literature. The evolution of the multi-hat head, when involved in a multi-author paper, requires the individual to have more than a general understanding of all concepts of the paper. This may include not only your sedimentological analysis, but also a general understanding of sequence stratigraphy, structural response, and ground water movements. This capacious mode of understanding can be started in graduate school, not only through the required coursework and seminars, but also through staying ’up to date’ on the current literature. Of course, one should read the articles that relate directly to one’s own research, but also take time to scan titles, and get a general idea of the kind of research that is being carried in other fields.

My own research started out trying to construct a palynostratigraphic framework of the Borden Delta (Mississippian of the midwestern USA). However, once the research started, I had to gain a more complete knowledge of the sedimentologic history, at which point I decided to apply sequence stratigraphic concepts and chronostratigraphic data to gain a better understanding of the factors that controlled the deposition of the Borden sediments. Throughout my years as a graduate student, as my title lengthened and my expertise expanded, my reading list became longer. I found myself reading not only papers on palynology, but also papers on sequence stratigraphy, siliciclastic sedimentology, and Paleozoic glaciations. All these articles contributed to the evolution of my multi-hat head. Today, my collection of hats includes my primary and most worn hat, palynology; however, my closet also contains a sequence stratigraphy hat, a sedimentology hat, a Paleozoic glaciation hat, and a deltaic hat.

Whether you are starting a graduate career or are well into the thick of one, be sure to develop, slowly, through your time as a student, a collection of hats. Remember, today you have to be a jack-of-all-trades, master of one!

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References

Industry Viewpoints

Q: Has your view of sedimentary geology changed over the past decade?
A: Yes. The real change in the industry occurred approximately 20 years ago with the theories relating to Sequence Stratigraphy. The industry has had time to put these theories to a test through out the world and they have worked quite well. On a smaller field wide basis, the complexities of the sedimentary world are much more profound and harder to evaluate unless you have an abundant amount of data such as well bores with modern logs or detailed outcrop data. This data is hard to come by in these older fields such as Elk Basin.

Q: How is sedimentary geology important in your daily working life?
A: It is very important. I deal with it everyday, being a petroleum geologist working in the development of older mature fields. We are always looking at the depositional histories and environments of potentially new reservoirs in these old and very large fields. These reservoirs have been bypassed for many years by the original owners of the fields, and when new owners come along, new ideas are looked at and old biases about the reservoirs are forgotten. We have been very successful at doing this and hope to continue applying new ideas and technology to these old fields.

Q: Finish the following sentence. If I taught sedimentary geology to undergraduates, the most important things that I would stress are....
A: No matter how complex the model you predict is, in real life it will be exponentially more complex if you could really see the whole picture.

Always step back and look at the regional picture before you try and evaluate down to the local level. “You need to try and understand the whole picture before you can understand a smaller piece.”

Always try to find an example in today’s world that will relate back to what you are trying to hypothesize. We use this in the petroleum industry to help us understand what could be happening in the subsurface.

Always keep your mind open to new ideas. No matter how hard and long you work on a problem, there is always another way to look at it. Don’t get into the Oil Business. Become a Lawyer or Doctor. Just kidding. It has been a tremendous and rewarding experience being a petroleum geologist and I would highly recommend it to your students.

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FROM THE DIRECTOR’S CHAIR

I remember reading a sci-fi story where intergalactic survey teams were dominated by geologists. I was hooked on the story when the first chapter had the team leader classifying the planet based on the degree of plate tectonic activity. In this future, the best people to estimate the value of a new planet were those that understood earth science. This is of course only one possibility of the future of geology and geologists (stick them all in space ships). What do you think about the future role of geology and geologists and especially the future of sedimentary geology?

For some of my time at ARCO, I was assigned to a study to forecast geoscience technologies. Essentially, we were asked to predict the future improvement of technology and its impact on the petroleum industry. ARCO had done a similar study about 5 years prior to this one. A part of the new study was to evaluate the accuracy of the previous predictions. Overall, the predictions were about 25% correct. About half of the predictions had quantitatively overestimate or underestimated improvements in specific technologies. The rest of the predictions, however, included technologies that either had never developed or conversely had completely missed identifying, something that was having a major impact in 1995.

The question of the future of sedimentary geology or aspects of it has also been evaluated several times over that last few years.

I, respectfully, decline to put my own particular view on the future in print (I will only discuss it in very small groups and it changes each time). However, I will give you a very nice, small, package of references putting forth group and individual attempts to describe visions of the future. Some include a tapestry of the past improvements, telling the story of how sedimentary geology got to be what it is today, it’s impacts along the way and what it might be tomorrow. Each of you is, of course, responsible for your own vision of the future but I think all the thoughts expressed by these papers should give you lots of food for thought or indigestion.

These papers are located at the listed links. I think discussing them would make a very interesting graduate seminar.

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Harry E. Cook

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