Perspectives in Carbonate Geology
A Tribute to the Career of Robert Nathan Ginsburg

Edited by
Peter K. Swart
Gregor P. Eberli
Judith A. McKenzie

Special Publication Number 41 of the International Association of Sedimentologists

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Perspectives in Carbonate Geology: a Tribute to the Career of Robert Nathan Ginsburg

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Preface

Robert Ginsburg in characteristic South Florida field gear.

Robert Nathan Ginsburg’s career in carbonate sedimentology began in 1950 when he left the University of Chicago to become a research assistant at the University of Miami’s Marine Laboratory, the precursor of the present Rosenstiel School of Marine and Atmospheric Science. Subsequently he moved, first to establish and lead a research and training programme on Quaternary carbonates for the Shell Development Company (1954–60), then to become Professor of Geology and Oceanography at The Johns Hopkins University (1960–65). In 1970 he was persuaded by Cesare Emiliani to come back to the University of Miami as Professor of Sedimentology. At that time he organized the T. Wayland Vaughan Laboratory for Comparative Sedimentology headquartered on ocean-facing Fisher Island at the entrance to the Port of Miami.

His first published paper appeared soon after his initial arrival in Miami, ‘Intertidal Erosion on the Florida Keys’ (1953). It was a harbinger of his future career as it questioned the prevailing chemical explanation for shoreline erosion by offering a biological alternative. In the following half century, with his associates, post-doctoral fellows and students he has authored or co-authored a series of seminal papers, books and reports on the links between contemporary and Holocene processes and products of carbonate deposition and their fossil counterparts. These publications have been on subjects ranging from the formation of dolomite (Shinn et al., 1965), precipitation of cements in reefs (Ginsburg & James, 1976; James et al., 1976), health of coral reefs (Ginsburg, 1997; Ginsburg et al., 2001), sedimentation patterns on carbonate platforms (Beach & Ginsburg, 1980; Ginsburg, 2005), stromatolites (Logan et al., 1964) and the history and development of carbonate platforms (Eberli & Ginsburg, 1987a,b; Ginsburg, 2001; Ginsburg et al., 1991; Schlager & Ginsburg, 1981). Within this corpus of contributions are an editorial exhortation, ‘So What’, to develop the wider implications of our specific findings (Ginsburg, 1982), a paper emphasizing the feedback of sediments on their deposition ‘Disobedient Sediments’ (Ginsburg, 2005) and what is termed the Ginsburg Model of autocyclic accumulation of shoaling-upward successions (Ginsburg, 1971).

These works, combined with the several issues of two informal periodicals he founded and edited (Sedimenta and Geological Milestones), together with countless field trips he has led and lecture tours in North America, Europe, North Africa and Australia, have had a most significant influence world-wide on research, teaching and the petroleum geology of carbonate deposits. A measure of this impact is the award of Fellowship in the American Association for the Advancement of Science and the Geological Society of America, the Twenhofel Medal of the Society for Sedimentary Geology, the Sorby Medal of the International Association of Sedimentology and honorary membership in four professional societies.

The 22 papers in this volume Perspectives in Carbonate Geology: a Tribute to the Career of Robert Nathan Ginsburg were mainly presented at a special symposium at the 2005 meeting of the Geological Society of America meeting at Salt Lake City to mark Robert’s 80th birthday. Of the 60 authors on the 22 papers, 20 are either former or current associates, students, postdoctoral associates, or students of former students and associates.
The fact that the majority of the papers in this publication are connected with modern carbonate sediments is appropriate as Robert pioneered the concept of comparative sedimentology, that is using the modern to compare to and relate to and understand the ancient. These studies are concerned with Robert’s areas of passion, coral reefs and sea-level (Hubbard), submarine cementation and formation of beach rock (Shinn), surface sediments on Great Bahama Bank and other platforms (James, Gischler, Swart and Reijmer), origin of ooids (Kindler), coastal sediments (Vlaswinkel), formation of stromatolites (Andres), impact of storms on sediments (Reeder), and the formation of dolomite (Mónica Sánchez-Román). Two of these studies in particular draw on some of Robert’s and his colleagues seminal papers. For example, Mónica Sánchez-Román demonstrates the formation of dolomite under the influence of aerobic bacteria, a mode of formation which could explain the dolomite forming on the tidal flats of Andros Island, Bahamas described in the classic 1965 paper (Shinn et al., 1965). The second set of papers (John Reijmer and Peter Swart) follows up work carried out by the Shell group in the mid-1950s and not published until over a decade later on the distribution of sedimentary facies on Great Bahama Bank (Traverse & Ginsburg, 1966). In two papers in this volume the issue of the sediment distribution and their isotopic and mineralogical compositions are revisited, making use of navigational and computer methods not available to the workers in the mid-1950s. It is also gratifying to see that many of Robert’s early colleagues (Shinn, James, Gischler and Kindler) have contributed papers in this section. Gene Shinn, a research technician with Robert at Shell Development Laboratory in Coral Gables in the early 1960s, revisits one of Robert’s favourite subjects, syndepositional cementation, in his tale of Beach Rock formation and a subject discussed in Robert’s earlier papers. Noel James, a former postdoctoral research assistant at the Fisher Island Station in the early 1970s, discusses epiphyte production of carbonate sediment in cool-water carbonates, once again an area Robert has extensively investigated in subtropical carbonates (Nelsen & Ginsburg, 1986). Finally in this section there are papers by
the ‘grandchildren’ of Robert Ginsburg, Miriam Andres and Brigitte Vlaswinkel. Miriam, who recently completed a postdoctoral position with Pam Reid at the University of Miami, describes modern stromatolites from the Bahamas, while Brigitte, a recent graduate student from Miami, presents a paper on the effect of sea-level rise and sedimentation on the coast of the Everglades. These are all areas that were pioneered in studies by Robert.

Application of the study of modern environments to ancient sediments is the theme of six papers which study rocks ranging in age from the Pleistocene to the Proterozoic. The first of these by Albert Hine draws on work published by Ginsburg, that showed the presence of siliciclastic sediments derived from the north as underpinning the Pleistocene of South Florida (Chung & Ginsburg, 1985; Warzeski et al., 1996). Several papers in this section (Strasser, Forkner and Pope) draw on the lessons learned in the Bahamas (Ginsburg et al., 1977) and use what is apparently one of the most cited abstracts in geology (Ginsburg, 1971) describing the landward movement of mud on carbonate platforms. These include the paper by Andrée Strasser and Stéphanie Védrine dealing with the Jurassic, that by Robert Forkner, Linda Hinnov, Robert Goldhammer and Laurie Hardie with the Triassic, and by Mike Pope, Steve Holland and Mark Patkowsky with the Ordovician. The contribution by Mike Grammer (a former Ginsburg student) and Audrey Ritter describes phylloid algae similar to that in a previous Ginsburg collaborative study (James et al., 1988) and the paper by Linda Kah, Julie Bartley and Alice Stagner deals with Proterozoic stromatolites. All these papers take the lessons learned from the modern and apply them to the ancient: comparative sedimentology in action and application.

Finally there are five papers dealing with processes common to all time periods. The first of these, by Harold Wanless, deals with layering, a subject often discussed in Robert’s writings (Ginsburg et al., 1977). Wolfgang Schlager, a colleague of Robert’s at the University of Miami in the 1970s and 1980s, together with Georg Warrlich deals with changing sedimentation during sea-level oscillations, a topic previously investigated by Robert in the Bahamas (Ginsburg, 2001). The third paper by a former student (Don McNeill) and postdoctoral associate (Gregor Eberli), addresses fracturing in carbonate rocks collected during the Bahamas Drilling Project, an ambitious drilling operation conceived and organized by Robert in the late 1980s (Ginsburg, 2001). In this expedition two deep holes were drilled from a jack-up barge on the western margin of the Bahamas. The last two papers in this section, one by Bernard Riegl and Sam Purkis and one by Carl Drummond and Liliah Marlow, present modelling aspects of the development of facies on carbonate platforms supporting some of Robert Ginsburg’s original work (Ginsburg, 1971, 1974; Shinn et al., 1969).

So that is our (Swart, Eberli and McKenzie) and the authors of this volume tribute to Robert Nathan Ginsburg on his 80th birthday. I am sure that the countless students, young and old, who have been influenced by Robert will share in the following sentiments. Robert’s enthusiasm has shaped our lives and we hope that this compilation in some way pays tribute to his career, although that would be a difficult task.


In particular we would like to thank Greta Mackenzie, Tom Stevens, Ian Jarvis and Stella Bignold who dealt with the final copy editing issues.

Peter K. Swart, Gregor Eberli, and Judith McKenzie
December 2007

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Dedication to Robert N. Ginsburg

With this volume, his friends wish to honour Robert N. Ginsburg, one of the founders of carbonate sedimentology and a driving force in sedimentary geology for more than half a century.

Bob Ginsburg started his university education right after World War II – at a time when Georges de Buffon’s advice ‘collect facts, from those arises the thought’ was a popular motto in the natural sciences. It was an understandable attitude under the circumstances. During the war, technological development had advanced much faster than scientific observation, and there were many powerful tools – such as isotope chemistry – ready to be applied in the natural sciences. During his education at the University of Chicago, Ginsburg certainly came to appreciate the potential of the new techniques but he also realized that collecting data is much more productive when guided by focused questions. He became a master of linking sharp perception with asking the right questions about what has been observed. ‘What? Why? So what?’ These questions became his compass to both discovery and synthesis. They already guided his early work on carbonate sediments of South Florida as well as the studies on modern and ancient stromatolites. Many subsequent contributions on the modern carbonate sediments of Florida, the Bahamas and the Caribbean demonstrate Ginsburg’s mastery of linking process to product by careful observation and asking fundamental questions.

Two other qualities contribute to Ginsburg’s deep impact in geology. He is a superb organizer and he is magically attracted by unknown territory. In this spirit, he launched the studies of the reef walls and the subsurface of the Bahamas. In typical Ginsburgian fashion, the subsurface work started as a nickel-and-dime operation using cores from water wells; it culminated with two deep wells drilled by a jack-up rig. The results, in turn, led to ODP drilling in the Florida Straits. The sum total of the Bahamian research drilling is a platform-to-basin transect that sets a new standard for the study of carbonate platforms around the world.

Ginsburg has always been able to mobilize people and set things in motion. Initiatives such as the Global Sedimentary Geology Program or the International Year of the Reef found world-wide response. However, he prefers to work in small, family-size groups where people know each other well and the formal structure is kept to a minimum. One such group was the Shell Research Laboratory at Coral Gables, 1954–65; another one developed in 1965–70 in the Department of Geology at Johns Hopkins University when Ginsburg held the Chair of Geology and oceanography; the most enduring group was the Fisher Island Laboratory of the Rosenstiel School of Marine and Atmospheric Science, University of Miami, 1971–90. Each group earned international fame in carbonate field research and in every instance Bob Ginsburg was the decisive force that brought them to life.

Finally, a word on Bob Ginsburg’s style and attitude in scientific matters. Spreading the word by heated scientific debate and dogmatic declaration never was his style. He is at his best in the informal ambience of field seminars and short courses where he can both teach and learn by observing and questioning Mother Nature. And Nature, he keeps telling us, should not only be studied but also cared about. I vividly remember a scene that encapsulates his style and attitude. It happened in Heidelberg, Germany, 1996. Ginsburg, silver-haired but in youthful enthusiasm, was delivering the evening lecture on coral reefs to introduce the International Year of the Reef that he had just initiated. He outlined the scientific challenges of the complex reef systems, but he also called for empathy with the reefs, likening them to cities under the sea that needed our attention and protection. I could not help but imagine quite different scholarly disputes that happened in this very room centuries ago: on the galleries above our heads still rose the pulpits of the opponents in theological disputes of the past when scholars were facing each other across the hall in often warlike confrontations. I was happy to find myself back in our time, with teachers and friends such as Bob Ginsburg, who embodies this special combination of qualities so well captured in French: ‘grand géologue, grand savant, grand monsieur’!

Wolfgang Schlager
DEPTH-RELATED AND SPECIES-RELATED PATTERNS OF HOLOCENE REEF ACCRETION IN THE CARIBBEAN AND WESTERN ATLANTIC: A CRITICAL ASSESSMENT OF EXISTING MODELS

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ABSTRACT
Reef-accretion rate was measured in 151 core intervals from 12 Caribbean and western Atlantic locations. Palaeowater depth for each core interval was determined by comparing its position to the curve of Lighty et al. (1982), based on calendar years before 1950. While the majority of the data points fell within the upper 15 m of the water column, no clear depth-related pattern of reef accretion emerged. This is in sharp contrast to the widely held assumption that reef accretion will decrease exponentially with water depth at rates approximately an order of magnitude below the corresponding rates of coral growth at the same depths. Similarly, reef-accretion rates from facies dominated by branching Acropora palmata (3.83 m kyr⁻¹) versus those associated with massive corals (3.07 m kyr⁻¹) were not significantly different (α = 0.05), owing to high variance across all water depths. Reef accretion showed a tendency to increase at higher rates of sea-level rise, but that relationship was also non-significant.

It is proposed that the known depth-related decrease in carbonate production may be offset by a parallel drop in bioerosion. While available data generally support this hypothesis, quantitative verification must await careful measurements of both biological degradation and transport along a depth gradient. Nevertheless, bioerosion appears to not only play an important role in creating reef fabric, but to perhaps affect patterns of reef accretion as much as initial calcification. Regardless of the cause, the patterns revealed by this study fly in the face of the assumptions that underlie our most widely accepted Holocene reef models. Clearly new ones are needed that emphasize the varying contribution of biological material to what is largely a process of physical aggradation – in short reef corals grow, coral reefs accrete.

KEYWORDS Reef accretion, Caribbean, Holocene, bioerosion, sea level, Acropora.

INTRODUCTION
What emerges from the myriad definitions of reefs is that they are resistant structures that stand above their surroundings, thus exerting some degree of influence over local circulation. Reefs can be built by organisms as large as modern corals or Cretaceous rudists, or as small as Precambrian microbes. They might emerge as fringing and barrier reefs or form submerged features along shelf margins (Macintyre et al., 1981; Hubbard et al., 1997, 2005), or even in very deep water well below the photic zone (Fossà et al., 2002; Reed et al., 2005). Disagreements focus on how resistant these features need to be and what is responsible for that rigidity. Throughout most of the twentieth century, descriptions of modern reefs emphasized the constructive role of corals, corallines and other organisms that secrete calcium carbonate and ‘build reefs’. Mention is made of physical damage and bioerosion by grazers and infauna (e.g. Ginsburg, 1958; Scoffin, 1992) but the role of construction was until recently perceived as overwhelmingly dominant. As a result, discussion of reefs throughout the later twentieth century focused on reef ‘framework’ as the architect of this rigidity (Lowenstam, 1950; Newell et al., 1953) and the importance of ‘large, colonial or gregarious, intergrown skeletal organisms in general growth position’ in creating it (Fagerstrom, 1987).

More recently, the interiors of some Caribbean coral reefs have been likened to ‘garbage piles’ that comprise as much sediment and toppled corals as in-place or interlocking organisms (Hubbard et al., 1990). These ideas challenge the primacy