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THEMATIC SECTION I

The World Deltas Conference: A Tribute to the Late Professor James Plummer Morgan: 1919–1995

Gregory W. Stone and Jami Donley

Coastal Studies Institute
Louisiana State University
Baton Rouge, LA 70803 U.S.A.

Shortly after the death of James Plummer Morgan in August, 1995, several of his colleagues and former students agreed that an appropriate forum to honor his many contributions to coastal and deltaic processes would be a conference, truly international in breadth. The concept was rapidly formalized through a generous financial donation provided by Ocean Energy Inc. The World Deltas Symposium was held in New Orleans during August 23–29, 1998. The site seemed appropriate in that the city is located on one of the most expansive, complicated and comprehensively studied deltaic environments, the Mississippi River deltaic plain, and one where Morgan carried out much of his pioneering work.

The world's deltas are among the most productive, populated, modified, and, at the same time, fragile systems on earth. New information, such as the United Nations Intergovernmental Panel on Climate Change, demonstrates that deltas are among those regions most vulnerable to harm from natural processes and human activities. Today, science and technology have progressed to a level where deltaic systems are better understood than ever before. Thus, a primary objective of the conference was to build on this accumulated knowledge from an international perspective.

The purpose of the symposium was to inform scientists, engineers and decisionmakers about available information and concepts needed for working and living in this dynamic environment. A panel of scientists, supported by an international academy of delta experts, selected eight populated deltas across the globe for emphasis at the conference. As shown in Figure 1 these deltas are the Ob, Lena, Yenisey, Mackenzie, Yukon and Colville (Arctic); Mississippi (United States of America); Rhine (The Netherlands); Ebro (Spain); Po (Italy); Nile (Egypt); Ganges-Brahmaputra (Bangladesh); and Yangtze (China). Internationally-recognized experts in the physical, biological and engineering disciplines were selected to present their research at the conference, and a "keynote" speaker was selected for each delta. The keynote speakers prepared a manuscript for their respective deltas, which was subsequently subjected to the normal peer-review process. Those manuscripts are presented in this thematic section.

The first paper "Mississippi Delta: An Overview," written by J.M. Coleman, H.H. Roberts and G.W. Stone, provides a detailed account of the Holocene Mississippi River delta plain development and the critical concept of delta switching. Significant relocations of the river have resulted in five Holocene delta complexes and a sixth one in the early stages of development, the latter being a product of the latest Atchafalaya River diversion. The authors demonstrate that, collectively, these deltas cover an area approximating 30,000 km^2 and account for 41% of all coastal wetlands in the United States. Delta switching has taken place approximately once every 1000 to 2000 years and has resulted in a most complicated surficial geomorphology, and equally complicated series of thick sequences of deltaic deposits. The authors describe the importance of differential loading and mass movement processes on the delta front, and explain how the effects associated with natural processes (namely subsidence) have been exacerbated by anthropogenic activity. Wetland loss and coastal erosion are at critical levels, and projections have been made indicating total barrier island loss in some areas in the early 21st century. This will likely increase marsh loss rates.

In the second paper, entitled "Arctic Deltas," H.J. Walker presents evidence indicating that these high latitude systems are among the most unique and yet fragile of any deltas worldwide. The uniqueness stems from a suite of cryospheric processes, such as thermoerosion, which are characteristic of high latitude environments and result in unique suites of morphological features, including ice-wedge polygons. The author provides general background information on the regional setting of this environment prior to giving accounts of the deltaic environments and processes. Numerous deltas are presented, including the Ob, Lena, Yenisey, Mackenzie, Yukon and Colville. Human impacts on arctic deltas are also discussed, two of the most significant being navigation for commercial activity and resource exploitation. In conclusion, the author presents some of the most important challenges confronting arctic delta management, one of which is associated with predicted atmospheric warming. The response is

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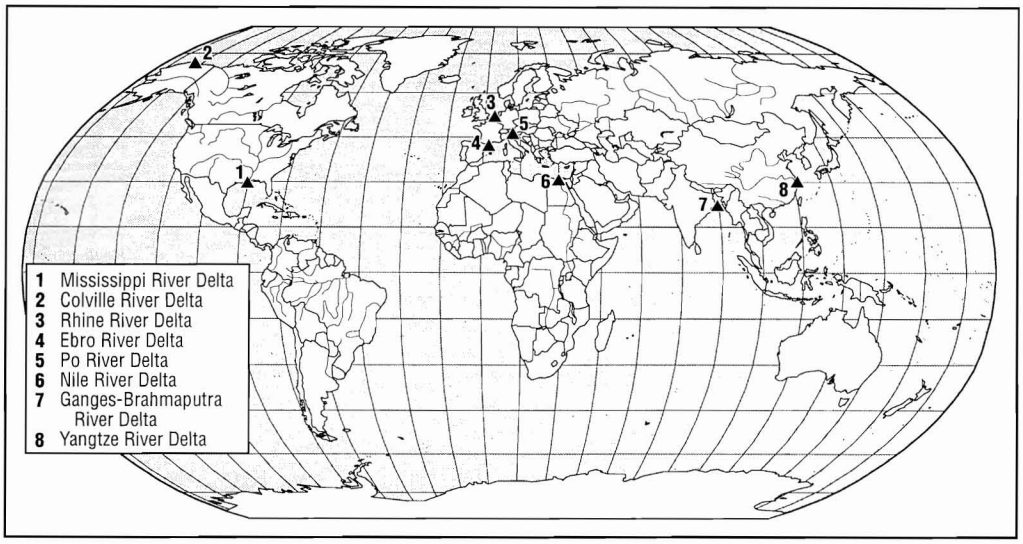

Figure 1. Map of the world showing the location of the eight deltas that were the focus of discussions at the World Deltas Conference, New Orleans, August 23–29, 1998.

expected to be very complex, particularly when considering such factors as cloudiness, albedo, evapotranspiration, storm intensity, sea-ice formation and decay, permafrost, and active-layer thickness.

The third paper, authored by H.J.A. Berendsen, is entitled "Birds-Eye View of the Rhine-Meuse Delta (The Netherlands)." The author presents an account of the geologic framework of the system and emphasizes the significance of sea level on the Holocene evolution of the deltaic plain, in addition to sediment availability, tidal range and river inundation. Currently, the Rhine-Meuse delta is controlled by human activity. The author points out that an interesting debate is occurring in the Netherlands between those that view space as being so precious that virtually every meter is protected, and those who promote adaptation to natural conditions where possible. Efforts are being taken to reduce pollution and eutrophication levels in the fluvial systems and purchases made by the government of agricultural lands for future nature reserves. Rates of relative sea-level rise are increasing and will likely result in necessary dam and dyke adaptation early in the next millenium.

The fourth paper, entitled "The Ebro Delta: Morphodynamics and Vulnerability" was written by A. Sanchez-Arcilla, J.A. Jimenez and H.I. Valdemoro. The Ebro, located on the Spanish Mediterranean coast, is renowned for its ecological richness. The authors discuss the problems associated with river dams and flow regulation and attribute the latter to the high subsidence and coastal erosion being experienced in this delta. After describing the geologic framework of the Ebro delta, the authors present the coastal morphodynamics of the system. They present a framework in which coastal changes are addressed within relevant time and space scales, with the objective of providing useful information to practitioners of coastal management. Vulnerability analyses are performed in an attempt to identify more complete, sustainable deltaic management and lead to several important conclusions, including a need for more sand supply from the river, the importance of episodic events in determining sand budgets, and the need for continued observation/monitoring programs because of the highly dynamic nature of the system.

The fifth paper was written by C. Cencini and is entitled "Physical Processes and Human Activities in the Evolution of the Po Delta, Italy." The evolution of the Po has been extremely complex and was largely natural until the end of the Middle Ages. The author provides an overview of the older deltas pertaining to the Po and discusses how the most recent lobate delta is largely the result of human intervention. The latter has been accomplished through alteration of sedimentation patterns in the river network, reclamation of marshes, and the development of agriculture, fishing, tourism and industry. Unfortunately, according to the author, this has had the combined result of degraded environmental quality, beach erosion, dune deflation, enhanced subsidence, and pollution. To offset the potential negative impacts associated with flooding, several defense structures have been constructed to protect inhabitants and infrastructure.

The sixth paper, entitled "Nile Delta in its Destruction Phase," written by D.J. Stanley and A.G. Warne, is based on years of extensive research on the geologic evolution and morphodynamics of the Nile deltaic system. The authors point out that while all deltas undergo periods of construction and destruction depending on the interplay between fluvially-derived sediment input and marine coastal processes, the last 7,000 years has been characterized by delta construction. As in the case of many deltas, over the historic time frame (centuries), the Nile has converted to a destruction phase, specifically within the last 150 years. The authors present indicators of delta destruction that include accelerated coastal erosion, shoreline straightening, reduction in wetland coverage, increased landward incursion of saline groundwater, and the

build-up of salt and pollutants to toxic levels in wetlands and the delta plain. The authors argue that water regulation has disrupted the balance between sediment influx and the erosive effects of incident coastal processes. These problems will likely be exacerbated if new irrigation and municipal projects in the Egyptian desert are realized. The authors conclude that re-establishing some level of natural hydrology is the only credible solution to help mitigate some of the problems presented.

The seventh paper was authored by M.A. Allison and is entitled "Geologic Framework and Environmental Status of the Ganges-Brahmaputra Delta." The Ganges-Brahmaputra delta, located in Bangladesh, is one of the more complicated deltaic systems on earth. Formed by the confluence of the Ganges and Brahmaputra Rivers, the deltaic system is characterized by subaqueous sand bodies at the river mouths that form a delta clinoform, which is prograding seaward over the topset beds of a muddy subaqueous delta. The author, after providing a description of the physical setting, weather and climate and an overview of the Bengal Basin, divides the delta into upper and lower reaches and discusses the Holocene evolution. Recent work has emphasized a more comprehensive understanding of the continental shelf, although, as the author states, a number of poorly understood geological processes throughout the entire system will undoubtedly stymie well-informed decision making on a myriad of environmental concerns. These include rising sea level, saline intrusion, water rights, fish stocks, flood control, soil fertility, water-borne pollution, and river channel migration.

The eighth and final paper for Thematic Session I was written by Chen Xiqing and is entitled "Changjiang (Yangtze) River Delta, China." After reviewing previous research and providing an overview of the physical setting of the Yangtze River, delta and estuary, the author provides a summary of the geological framework in which the recent vertical tectonic movement is emphasized because of its importance regarding earthquakes and relative sea level changes. The Holocene sedimentary architecture of the delta is presented along with an overview of the historical delta evolution. The author presents the significance of physical and biological processes with regard to temporal and spatial variations in water salinity, suspended sediment concentration, sedimentation rates and primary productivity. A detailed review of contemporary problems pertaining to estuarine freshwater resources, water diversions, harbors and navigation problems, subsidence, rising sea levels and flood hazards is presented at the end of the manuscript.

These papers, when combined with oral and poster presentations made at the symposium, illustrate that, while significant advances have been made towards unraveling the geological evolution and morphodynamic maintenance of delta systems, a significant amount of work remains unfinished within the deltaic plains, and particularly offshore, on the delta front. Additionally, the impacts of humans and the drastic alterations that have been and continue to be made to these generally ephemeral and fragile systems have resulted in an accelerated rate of delta destruction worldwide.

Our intention has been to provide a forum to pay tribute to the late James P. Morgan for his many substantive contributions to deltaic and coastal science. It is hoped that we have also accomplished a second goal, namely, that of providing a useful set of scientific papers that will not only assist scientists and engineers in their research, but help managers work toward derailing the destructive track on which many deltas are currently set.