The Role of the Mississippi in Deltaic Research: Contributions of James M. Coleman, Harry H. Roberts, and P. Shea Penland*

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Abstract

Deltas were among the first depositional systems built into widely utilized facies models. Elegant process-response classifications of Holocene examples as river, wave, or tide-dominated provided the building blocks for facies analysis, influencing the field to this day. The Mississippi River and Delta served as one of the primary natural laboratories for the development of these models, as the type example of river dominance. Proximity to the Mississippi made Louisiana State University a global center of deltaic geology, resulting in a vast number of studies of the Mississippi by a series of distinguished scientists. The seminal contributions of the three individuals in whose honor this session is named: James M. Coleman, Harry H. Roberts, and P. Shea Penland, not only helped crystallize this process-response view of deltaic systems, but also provided understanding and insights into the complexities of dynamic, continuously evolving systems. With a series of co-workers, Jim Coleman characterized the Mississippi system, from the modern Balize (bird foot) lobe to the shelf, to the Mississippi Fan. Besides working with Jim Coleman on the Mississippi Delta and in many other parts of the world, Harry Roberts contributed significantly to the understanding of shelf margin deltas (the Lagniappe delta) and is a principal architect of the bayhead delta models based on the Atchafalaya and Wax Lake deltas. The late Shea Penland's legacy encompasses research on the transgressive evolution of the abandoned Mississippi deltas; the Chenier Plain; Lake Ponchartrain, along with a lifelong devotion to understanding, quantifying, and amelio-rating the consequences of shoreline erosion and land loss in the Mississippi Delta and the northern Gulf of Mexico. In addition, all three served as scientific partners, teachers and mentors to large numbers of geologists, all three spent significant time as administrators, and all were important contributors to grappling with the societal implications of Mississippi delta evolution.

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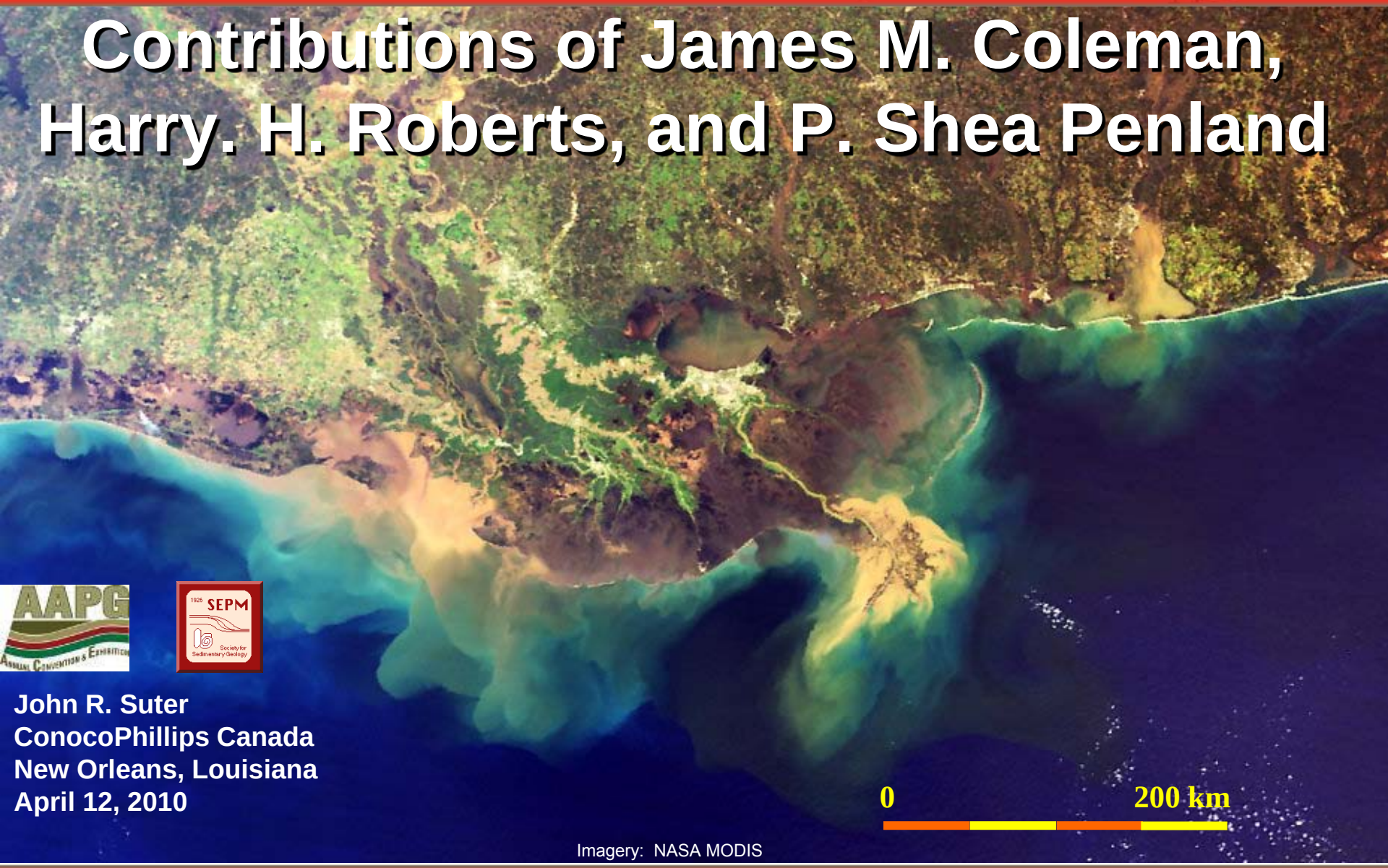
The Role of the Mississippi in Deltaic Research:

Contributions of James M. Coleman, Harry. H. Roberts, and P. Shea Penland



John R. Suter
ConocoPhillips Canada
New Orleans, Louisiana
April 12, 2010

Imagery: NASA MODIS

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Acknowledgements

- ConocoPhillips
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- SEPM
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- Mike Blum
- Harry Roberts
- Ron Boyd

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Presentation Outline

- **Discuss importance of Mississippi Delta in geoscience research & society**
- **Commemorate and honor the contributions of James M. Coleman, Harry H. Roberts, and P. Shea Penland**

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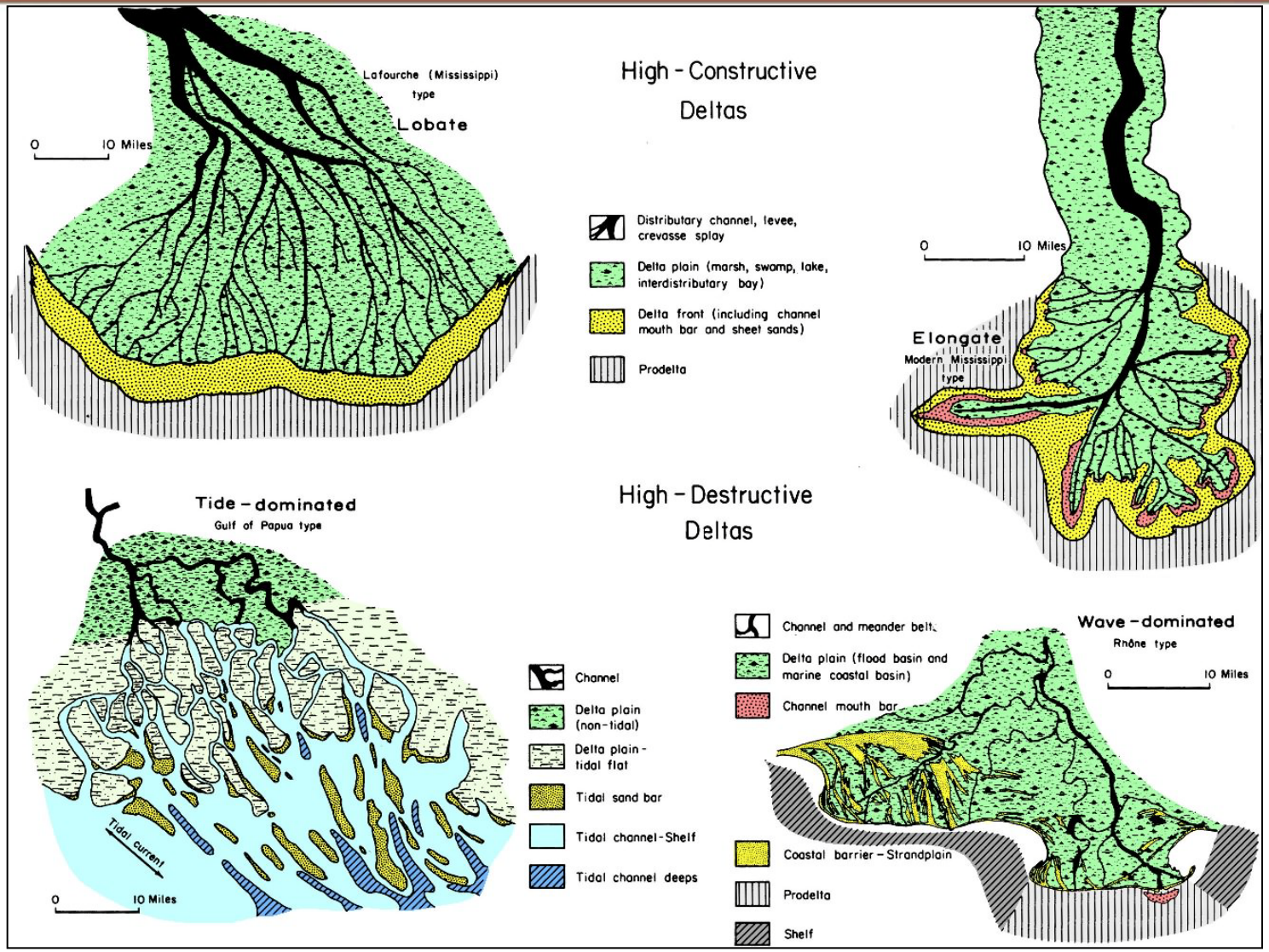
Classic Holocene Deltas



(after Fisher, Brown , Scott, and McGowen, 1969)

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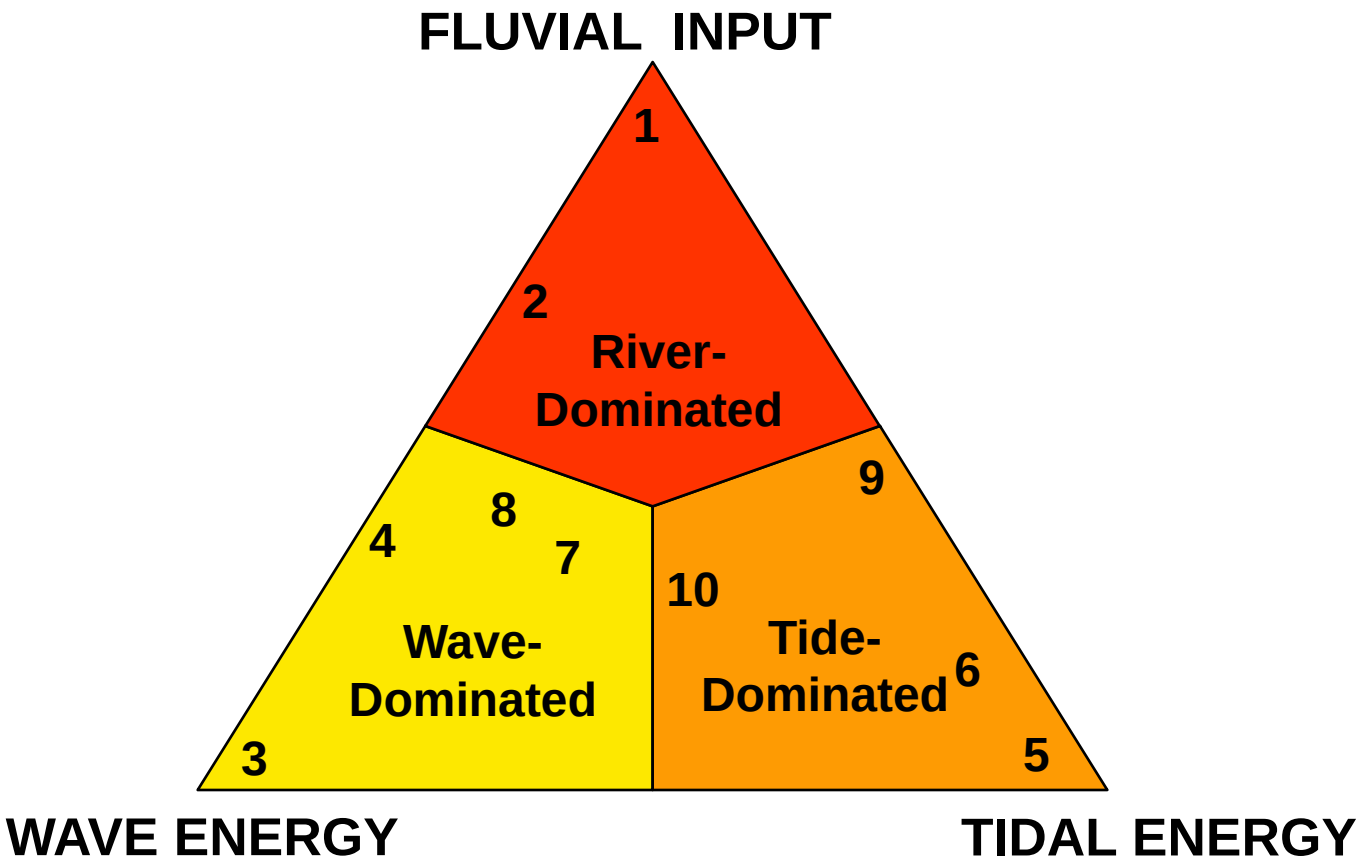
Deltaic Classification:
Process-Response and Delta Front Morphology



1 Mississippi
2 Lafourche
3 Sao Francisco
4 Nile
5 Fly
6 Ganges
7 Niger
8 Orinoco
9 Mahakam
10 Mekong

(Redrawn from Galloway, 1975)

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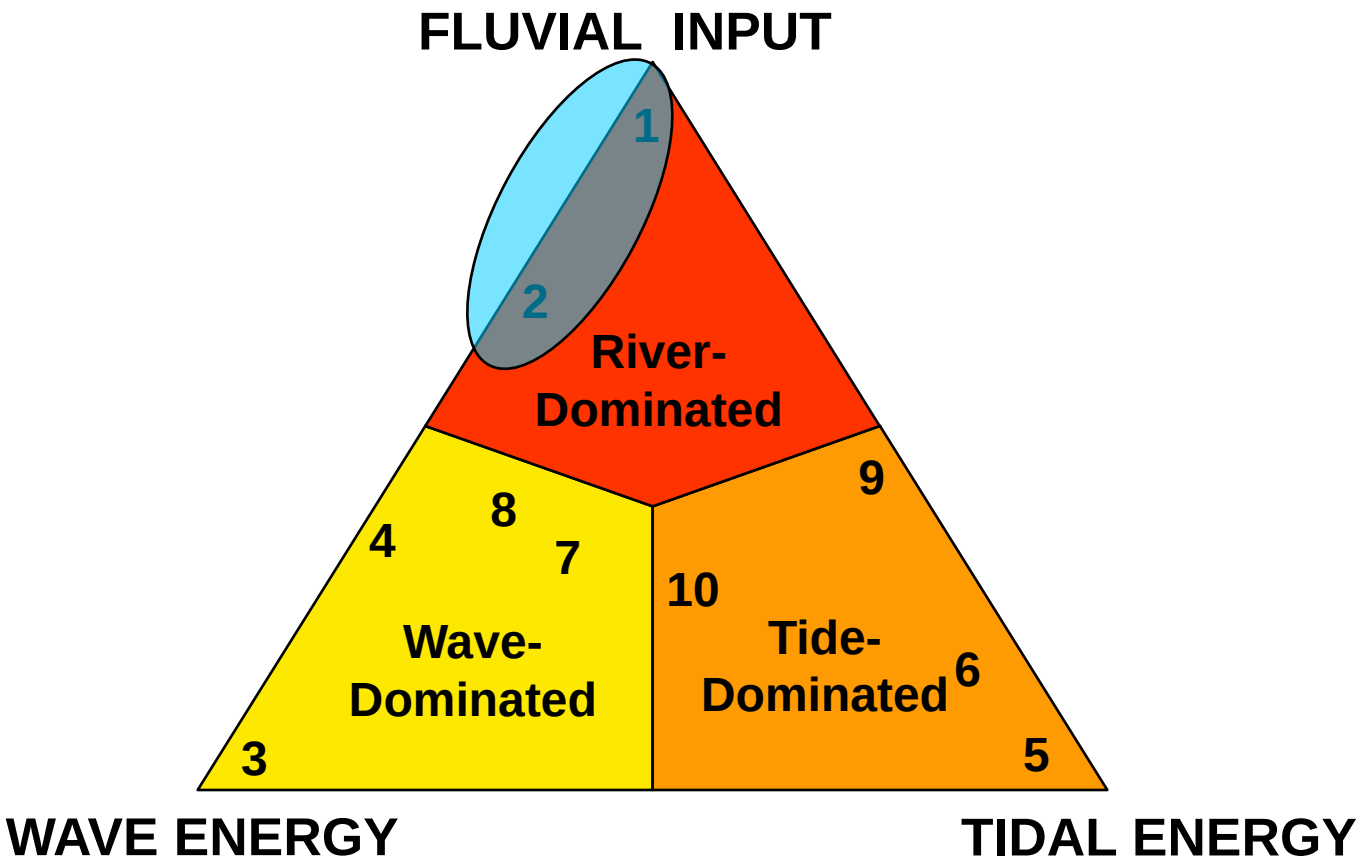
Deltaic Classification:
Process-Response and Delta Front Morphology

Click to View Notes by Presenter



1 Mississippi
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(Redrawn from Galloway, 1975)

Notes by Presenter (for previous slide):

Galloway (1975) formulated the most widely used process-response classification of modern deltas, which reflects the competition between sediment supply (fluvial input), and reworking by receiving basin processes, here represented by wave and tidal energy. The modern Balize complex of the Mississippi Delta is the "type-section" of river-dominated deltas. Most other marine deltas, including the abandoned Mississippi deltas, show considerably greater reworking by waves and tides. This is an excellent conceptual diagram, but it has several drawbacks. The biggest of these is that the geomorphology of a delta at any point in time, such as today, is a "snapshot" of an evolving system.

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Lobes, Complexes, and Delta Switching

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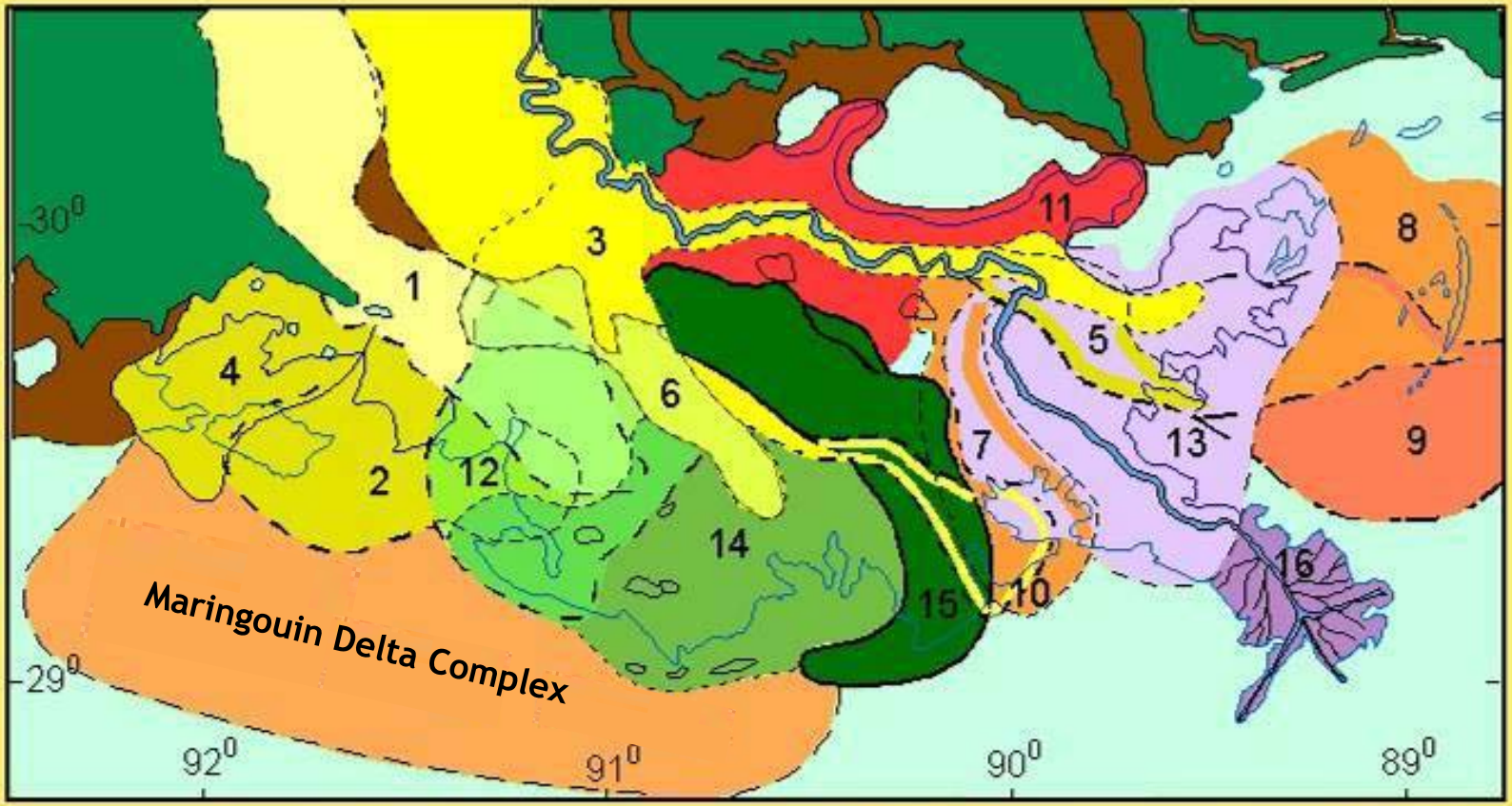

(Redrawn from Frazier, 1967)

Notes by Presenter (for previous slide):

Utilizing previous work (e.g. Fisk, 1944, Kolb and Van Lopik, 1957) and a database from offshore petroleum exploration, Frazier (1967) grouped the numerous deltaic successions of the Mississippi into the familiar lobe and complex terminology that exists today. In this model, a particular reach of the Mississippi River occupies a general area for about 1,000 years, forming a delta complex made up of individual lobes. Each lobe is a parasequence, each complex can be considered a parasequence set (Kosters and Suter, 1993). When the river becomes hydraulically inefficient, it avulses or switches to a new location. This autocyclic process is exemplified today by the desire of the Mississippi to avulse to the Atchafalaya River, several hundred kilometers to the west of the Modern Delta.

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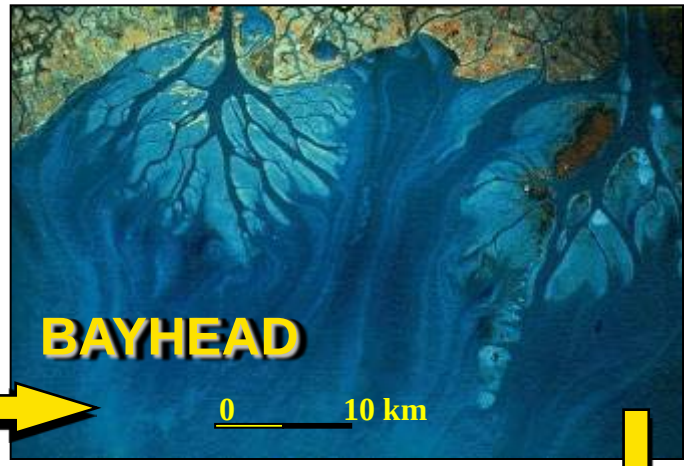
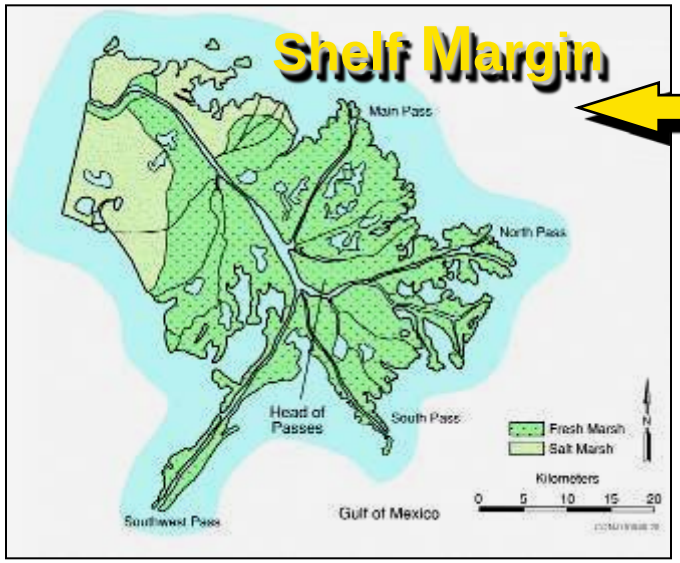
Mississippi Delta Complex Evolution





(photos courtesy of E. Kosters and O. Huh)

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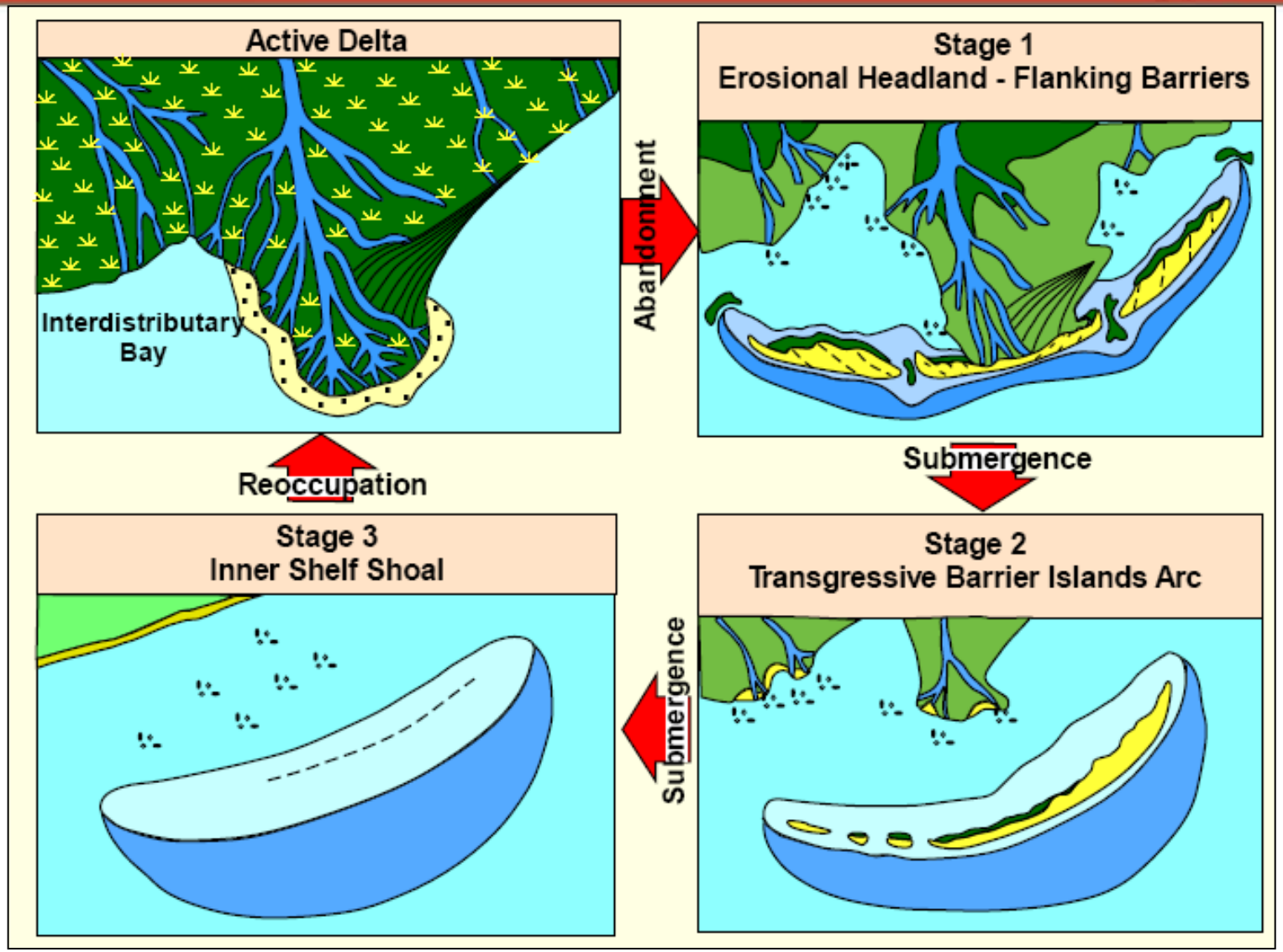
Full Delta Cycle: 3-stage Model



(Redrawn from Penland et al, 1988)

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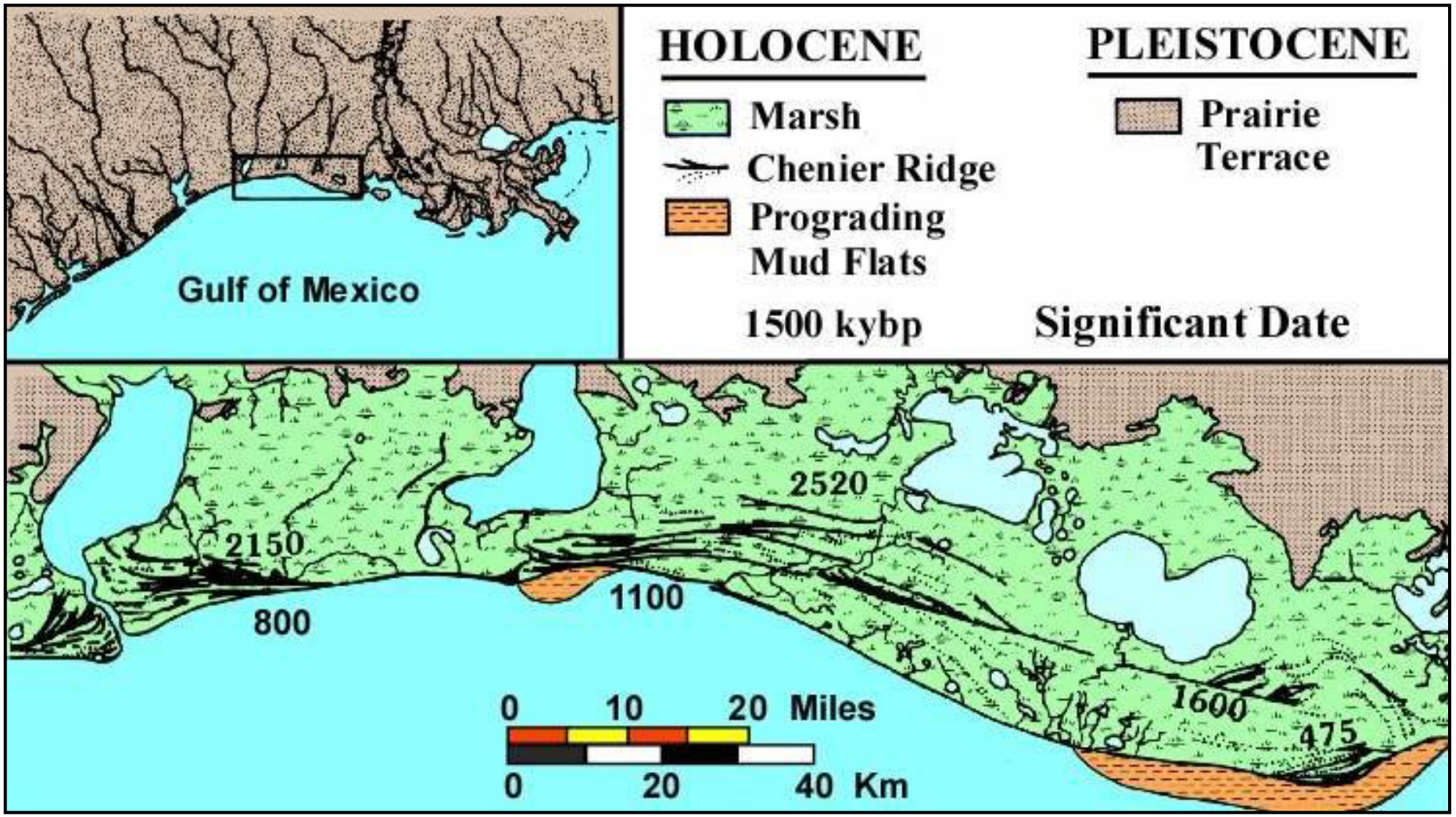
Chenier Plain



(Redrawn from Gould and McFarlan, 1959)

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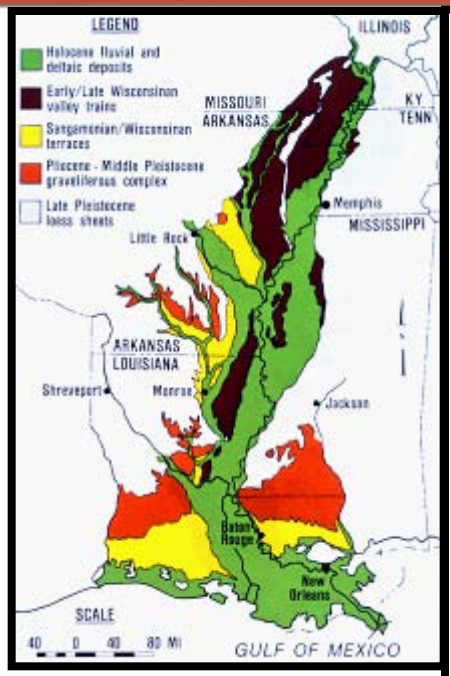
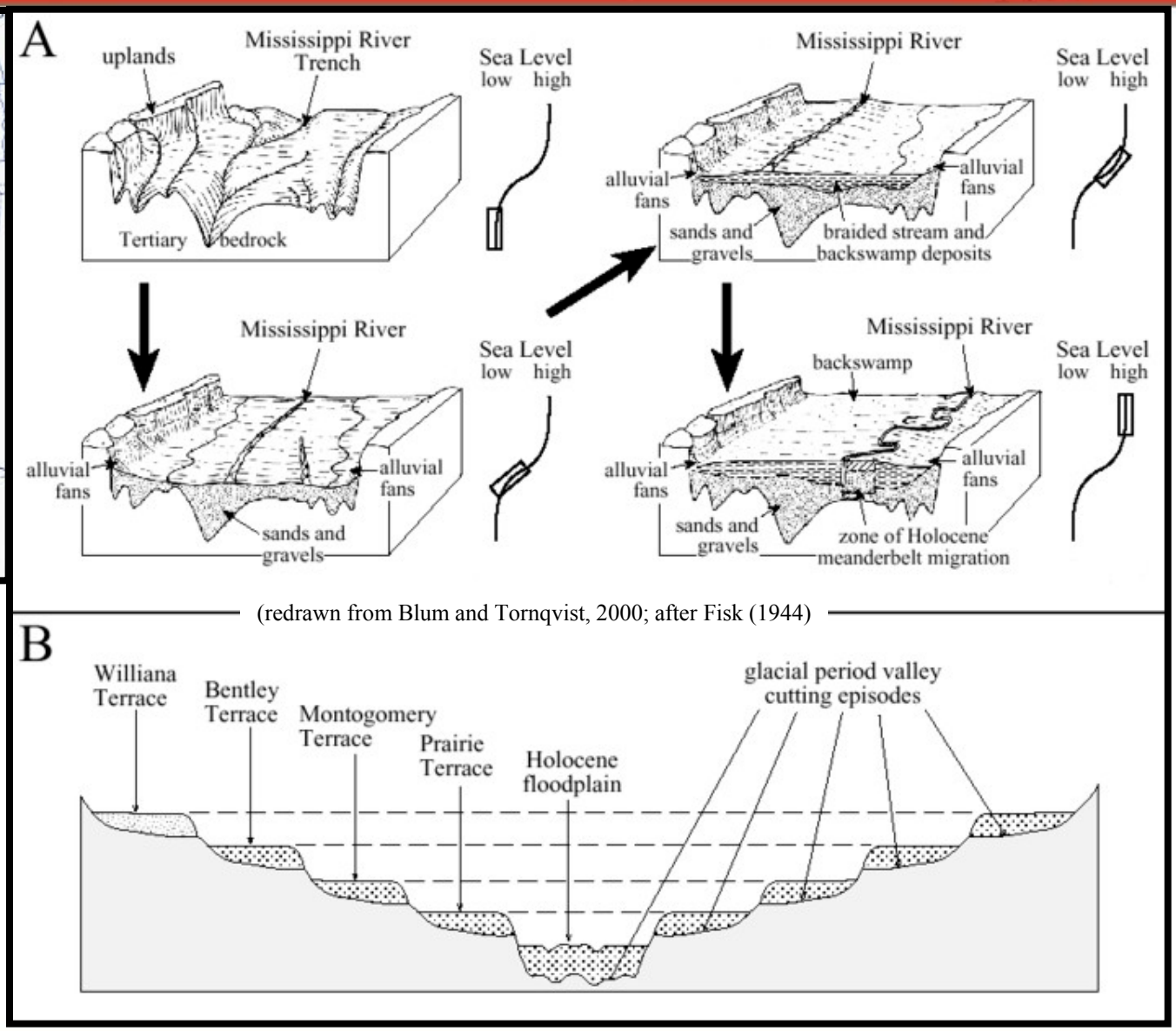
Entrenched Streams = Incised Valleys – Fisk's Model



Louisiana Geological Survey, 1989



(redrawn from Blum and Tornqvist, 2000; after Fisk (1944)

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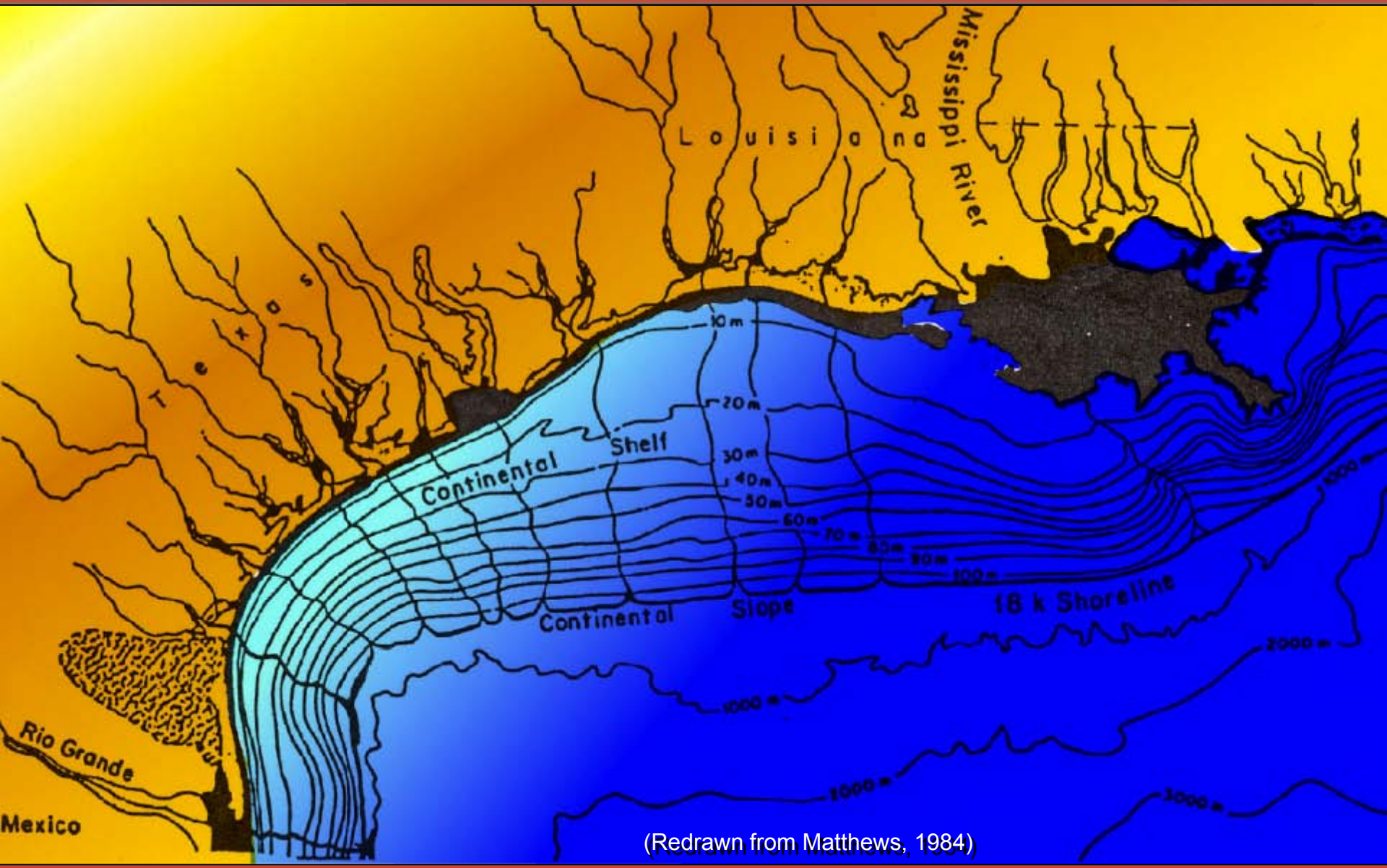
Entrenched Streams = Incised Valleys – Fisk's Model



(Redrawn from Matthews, 1984)

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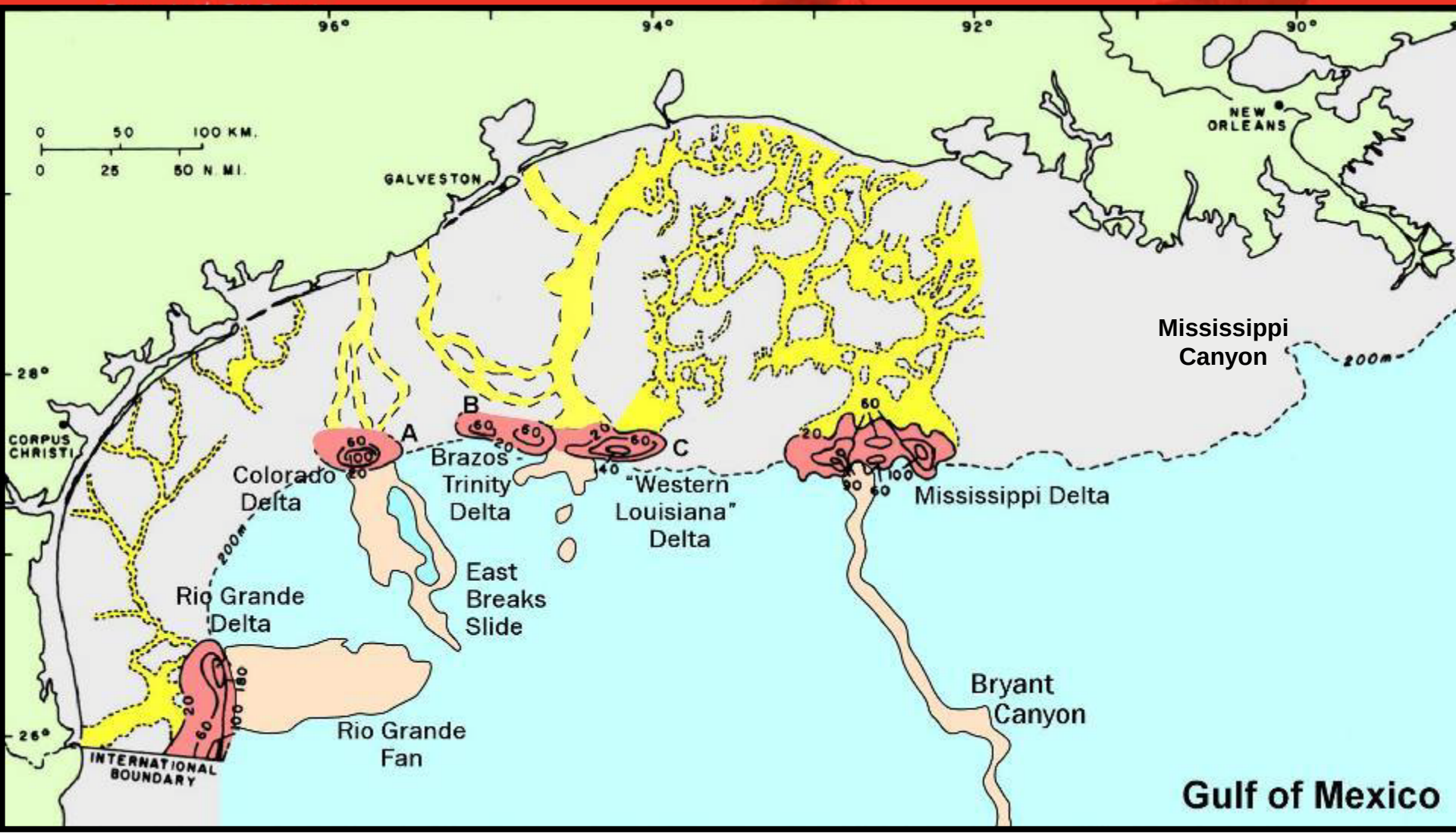
Valleys, Shelf Margin Deltas, and Beyond



(Suter, 2003; data from Suter and Berryhill, 1985; Abdulah, 1995, Anderson et al, 1996; Winker and Booth, 2000)

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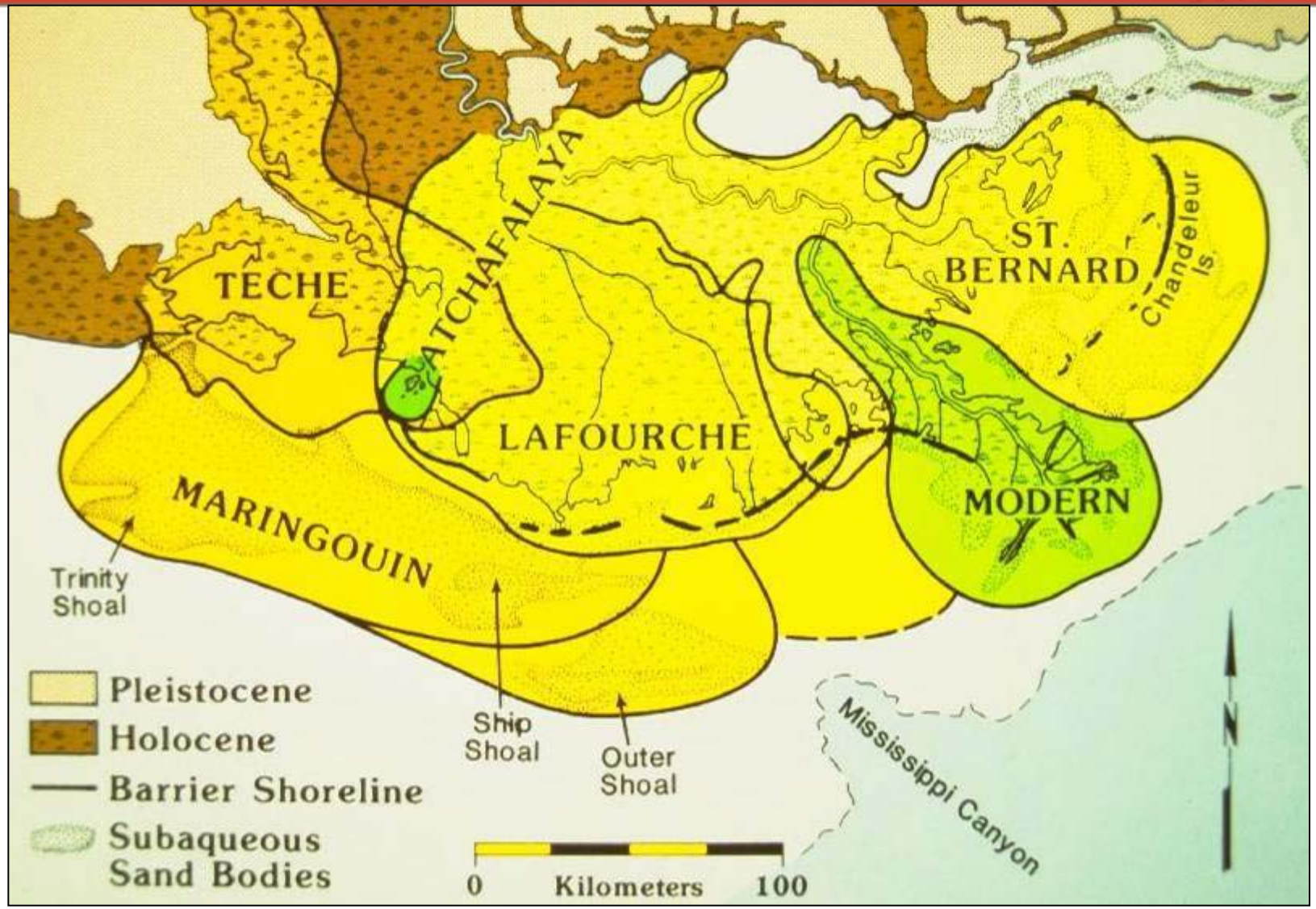
Quaternary Sequence Stratigraphy: Mississippi Delta Systems Tract View



(Redrawn From Boyd et al, 1989)

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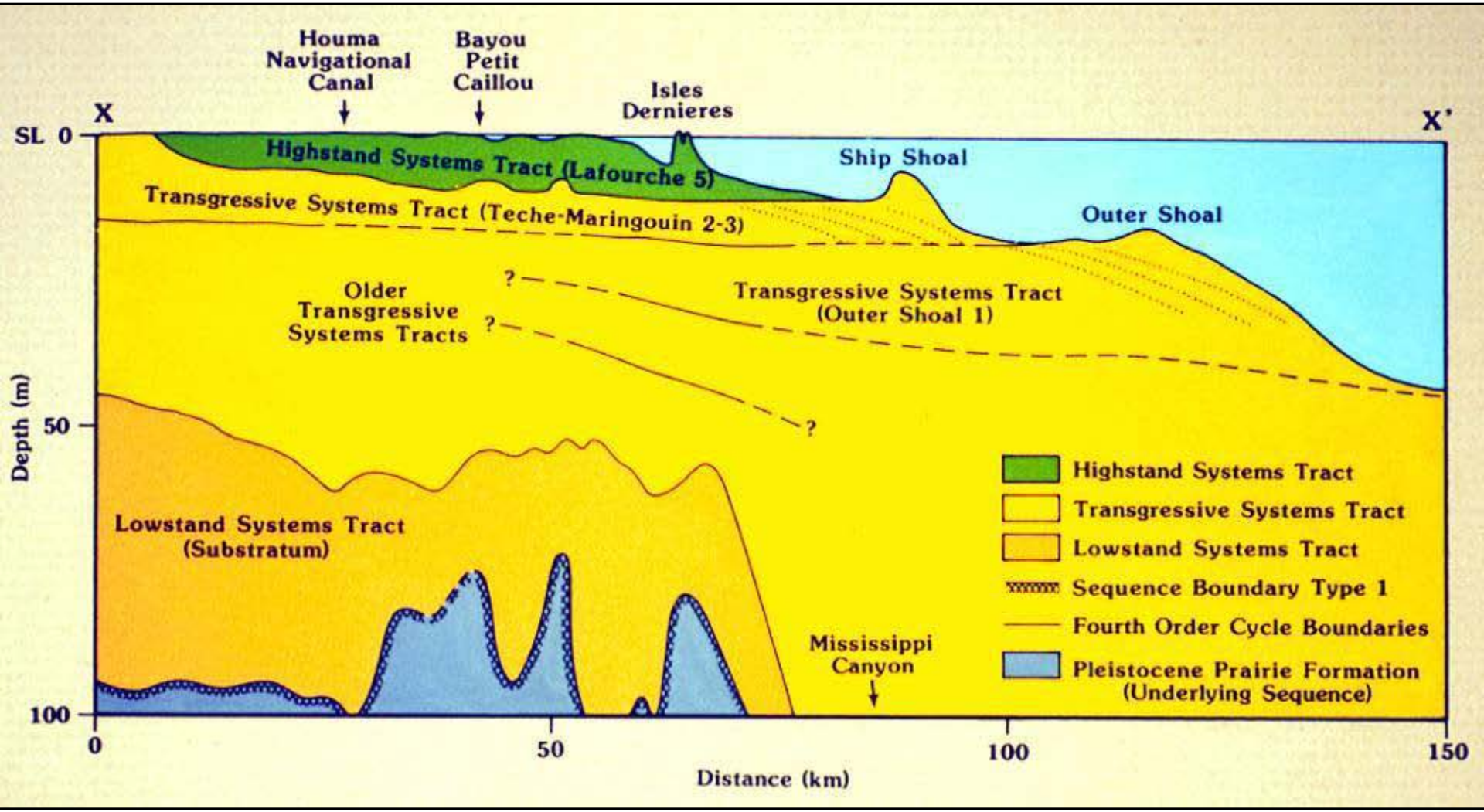
Mississippi Delta Sequence Stratigraphy



Redrawn from Boyd et al (1989)

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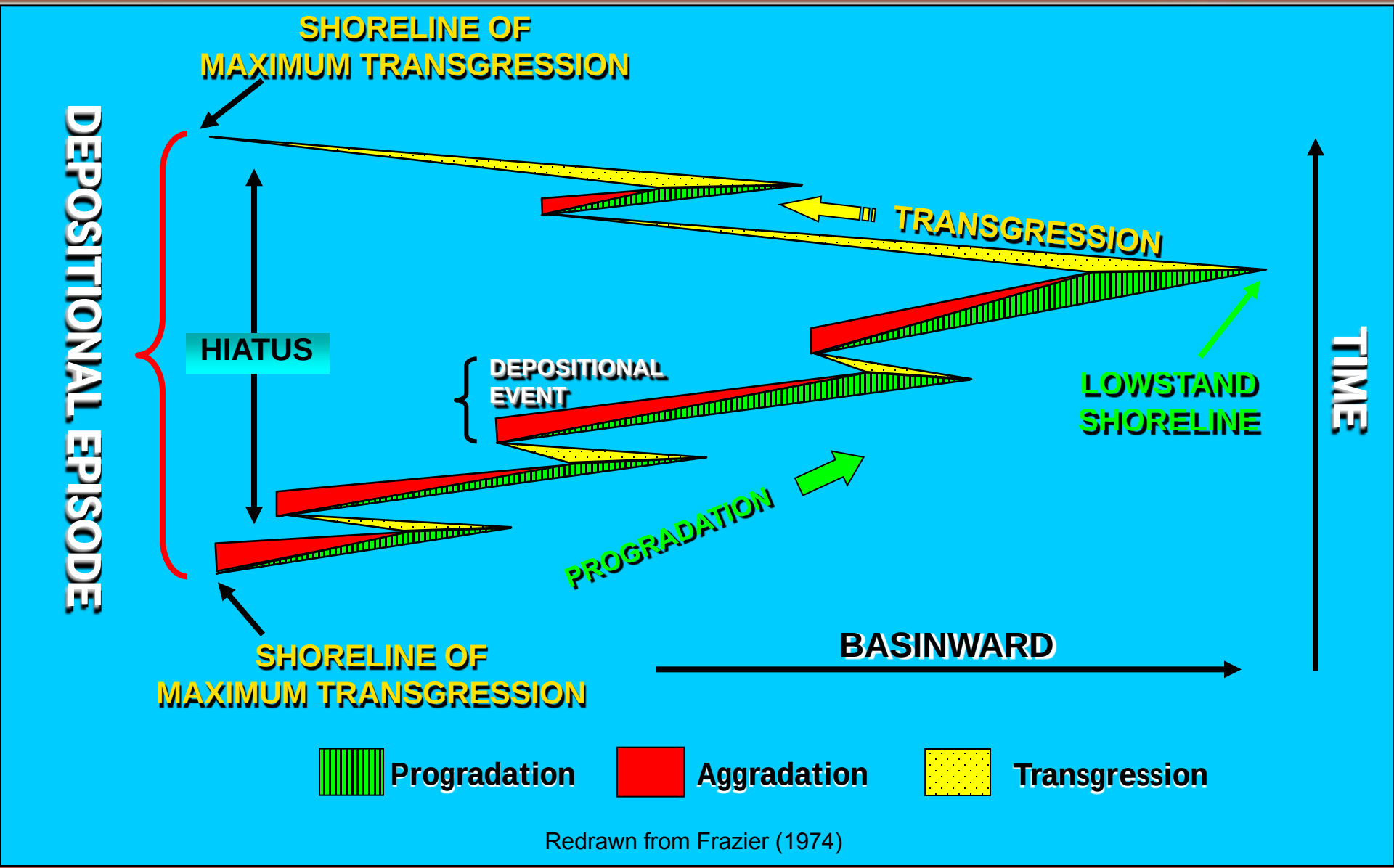
Depositional Episode



Redrawn from Frazier (1974)

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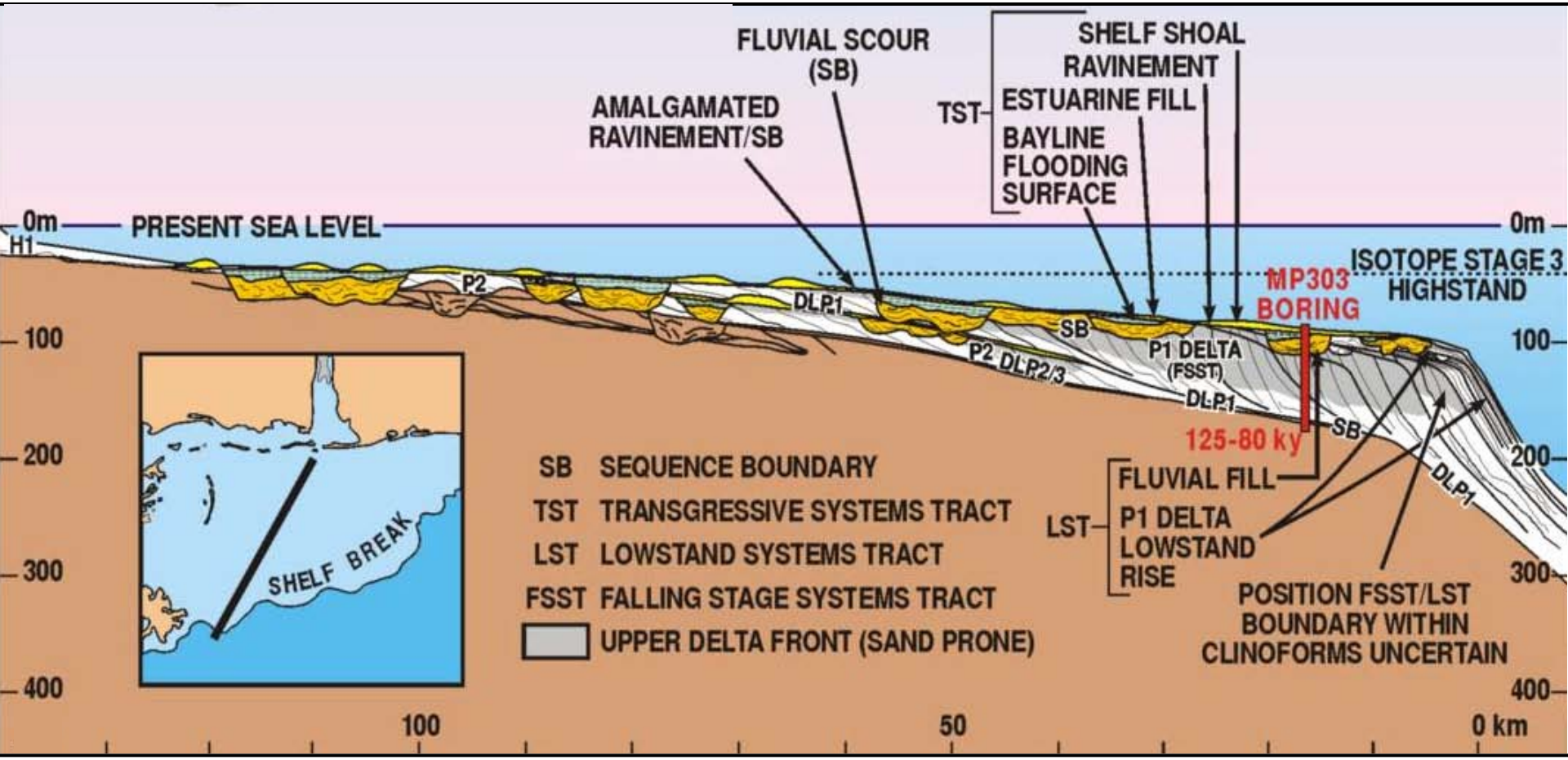
Shelf-Margin Deltas



(Redrawn from Roberts et al, 2002)

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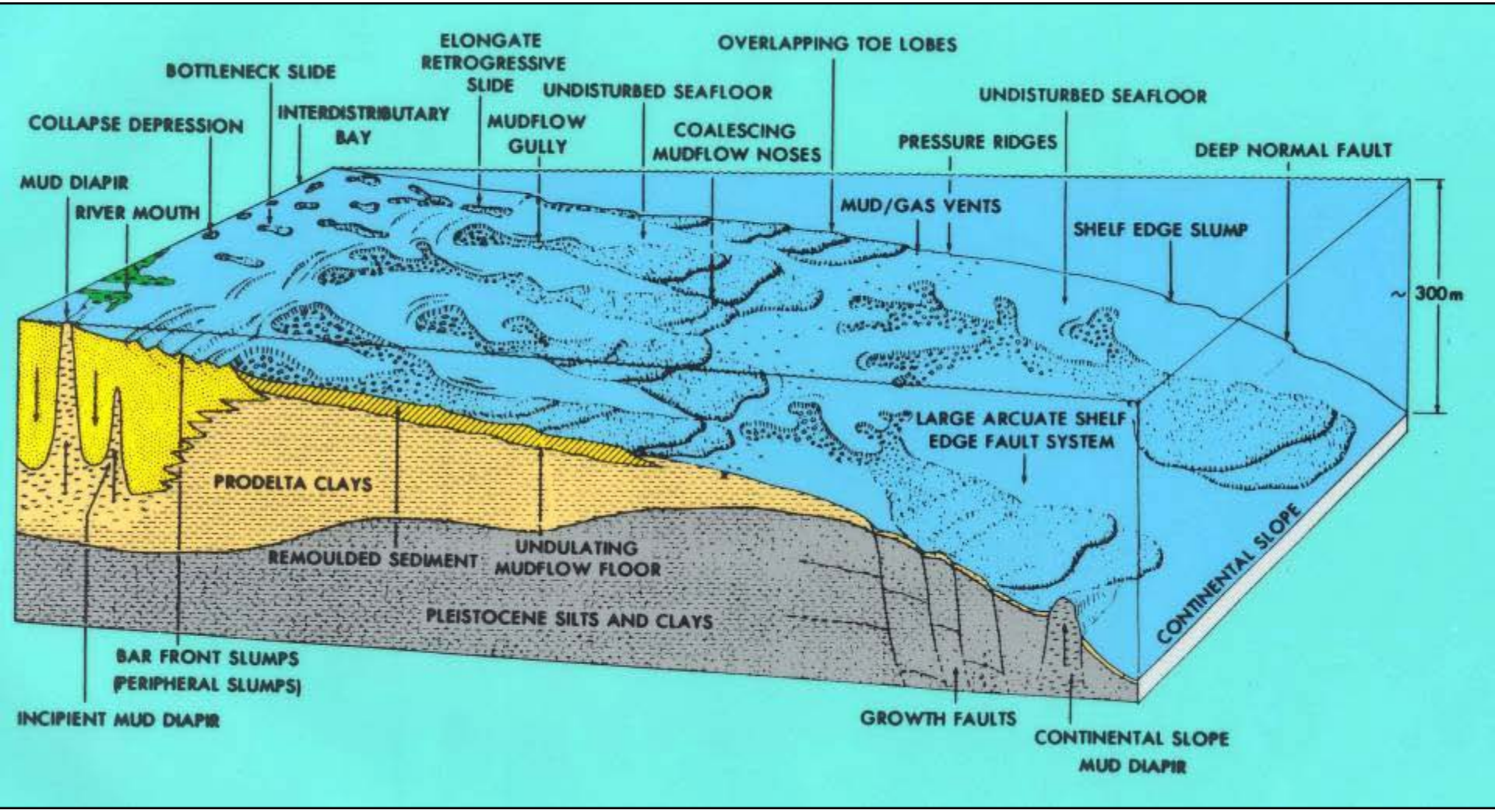
Delta Front Instability



(Redrawn from Coleman and Prior, 1980)

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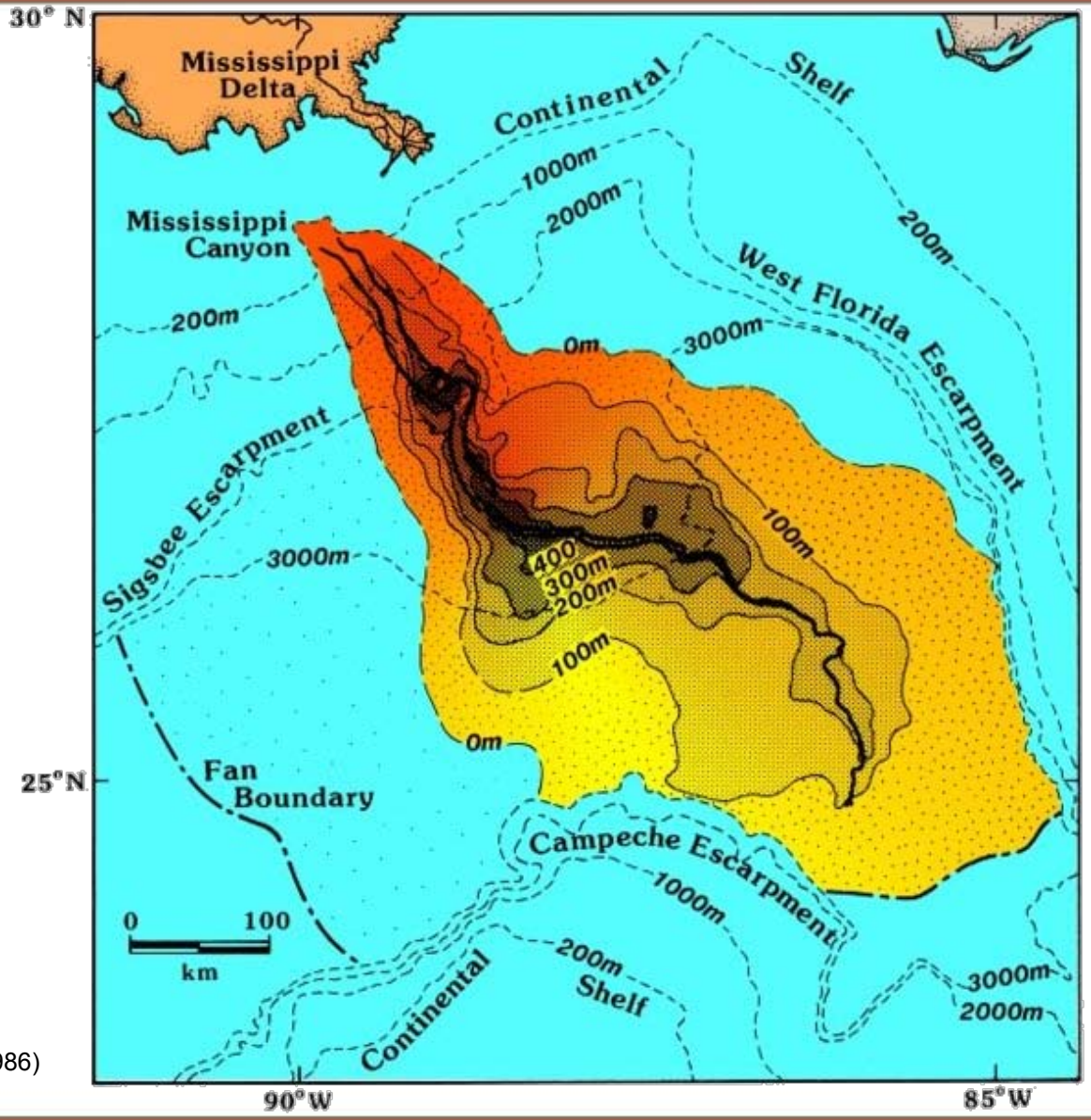
Mississippi Fan



(Redrawn from Bouma et al, 1986)

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Mississippi Delta:
the only constant is change

NASA MODIS Imagery

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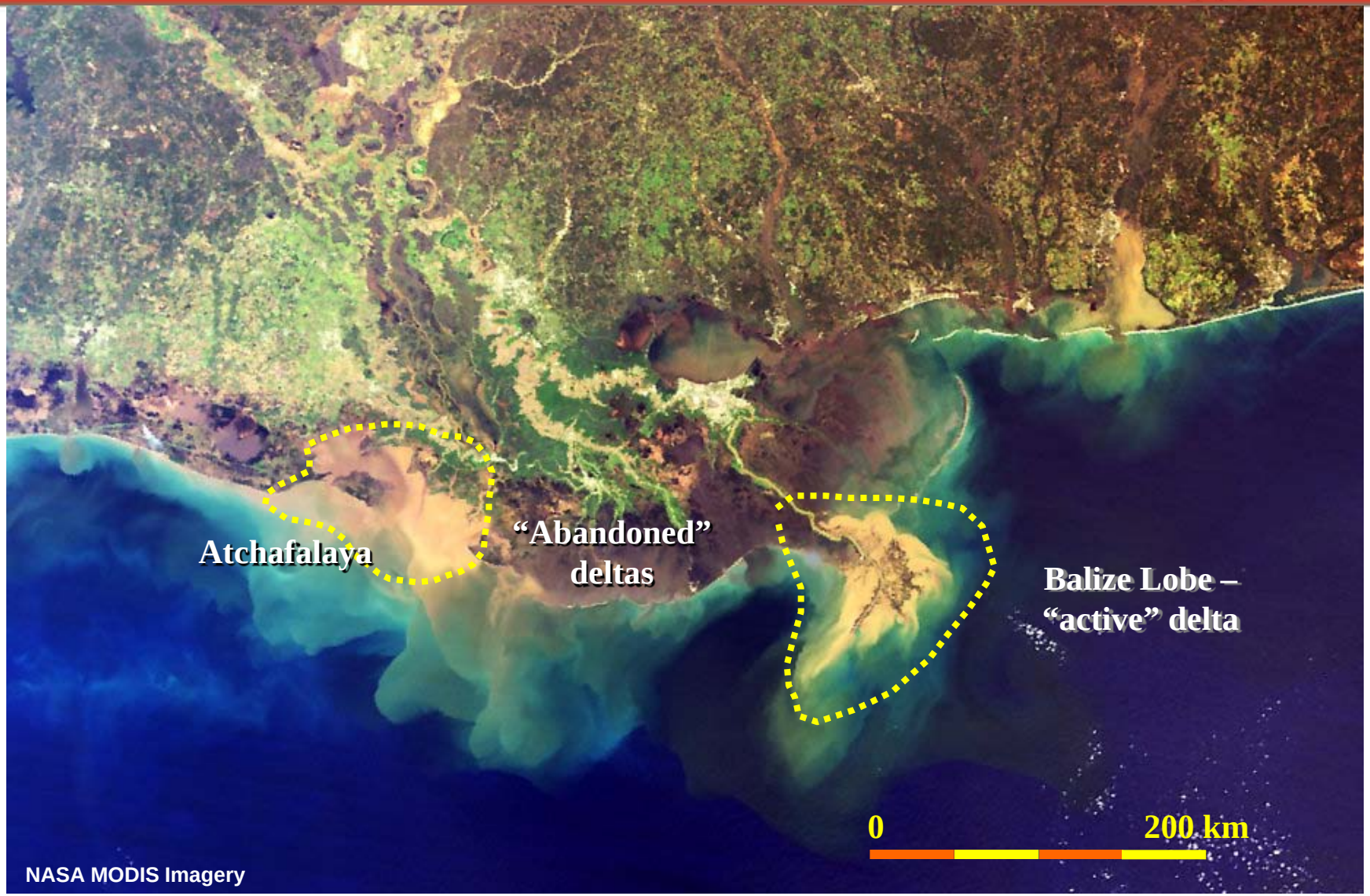
Mississippi Delta:
the only constant is change



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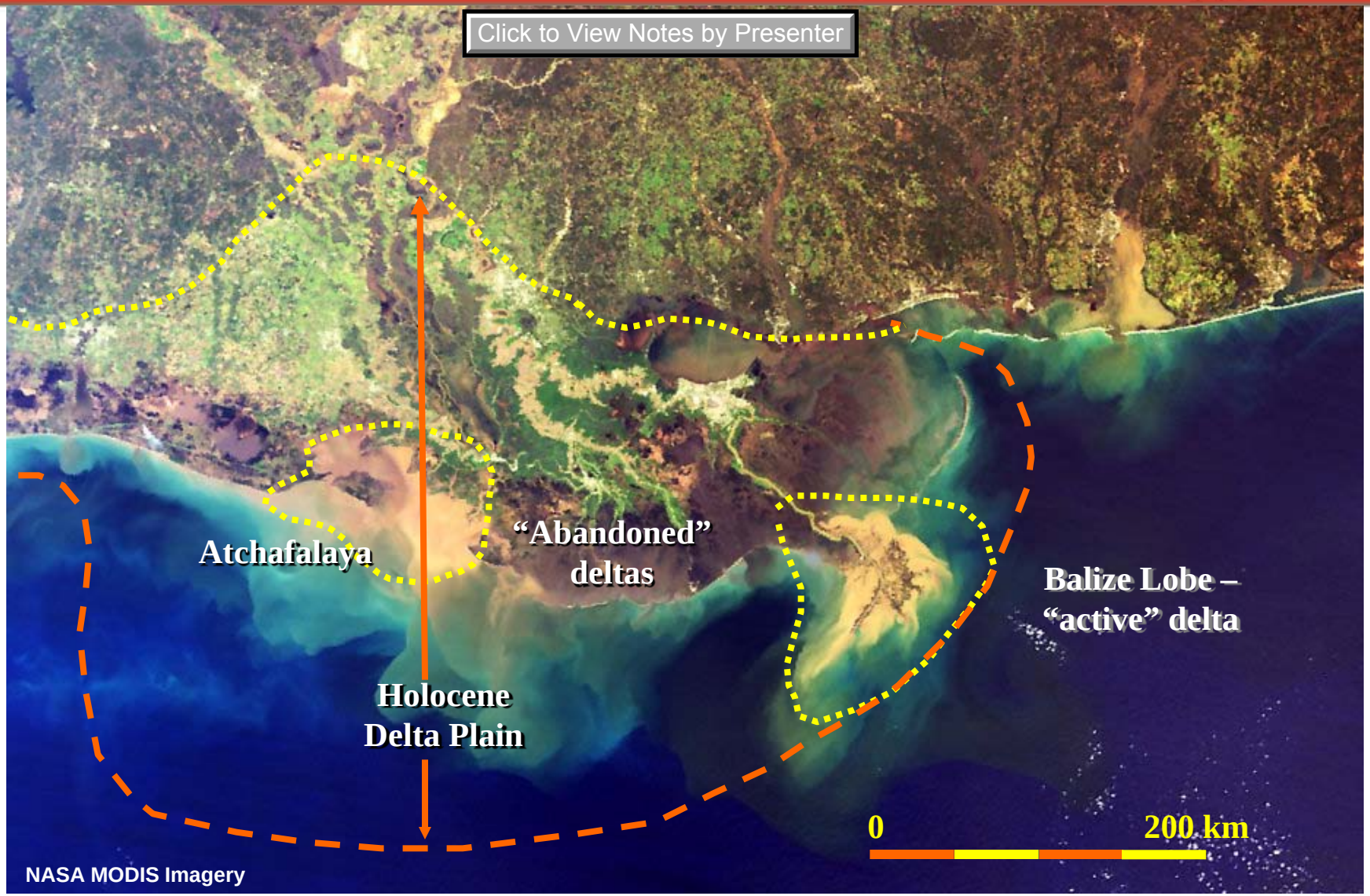
Mississippi Delta:
the only constant is change



Notes by Presenter (for previous slide):

The Mississippi Delta in the Northern Gulf of Mexico is probably the best known and most written about deltaic system in the world. All of this has formed in the last 10,000 or so years, illustrating the power of high sediment supply even against a rising sea level. The Balize lobe is the active portion of the delta, comprising a relatively small percentage of the total delta plain. The abandoned portions of the delta are labeled. The Mississippi is the type section of a fluvially-dominated delta and formed the basis of most deltaic facies models for many years since LSU, Shell and Exxon geologists began publishing their studies in the 1930's. However, as we shall see, this delta is really an end member and not necessarily representative of the many other deltas in the world, or in the subsurface.

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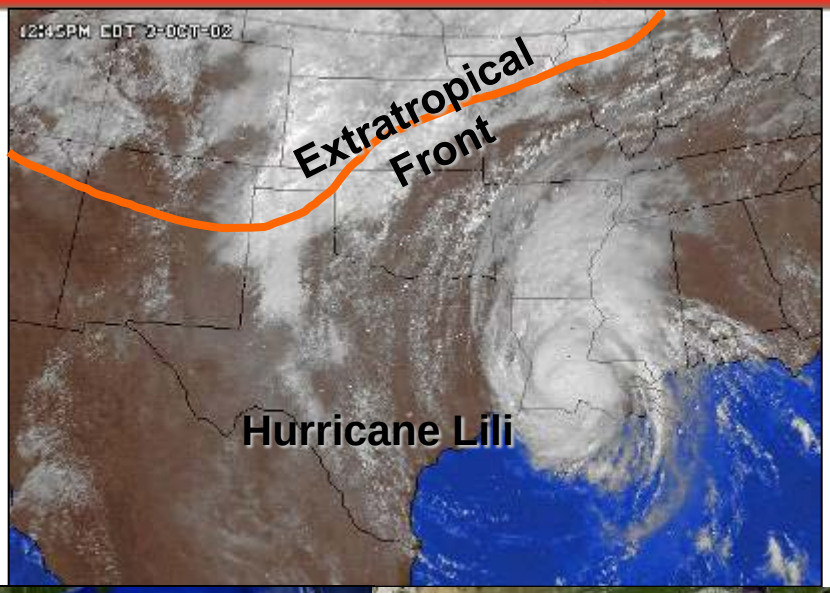
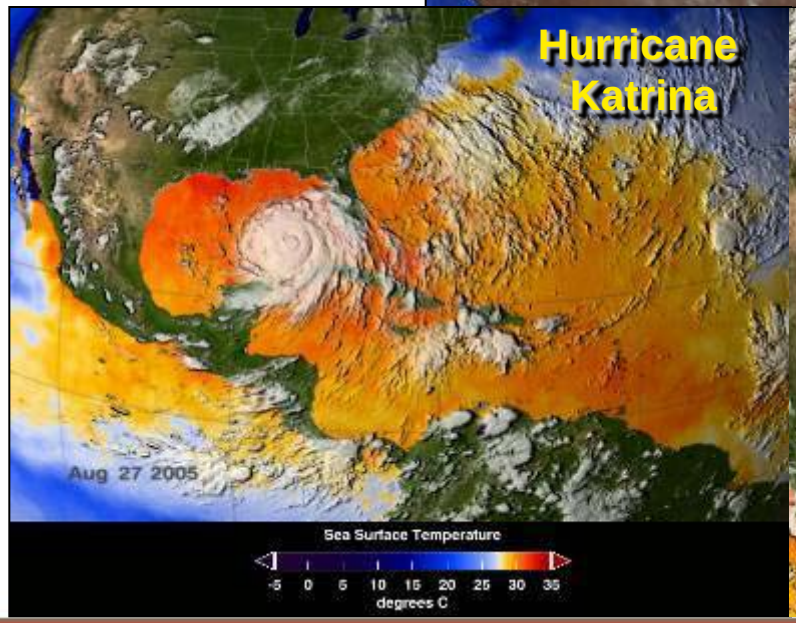
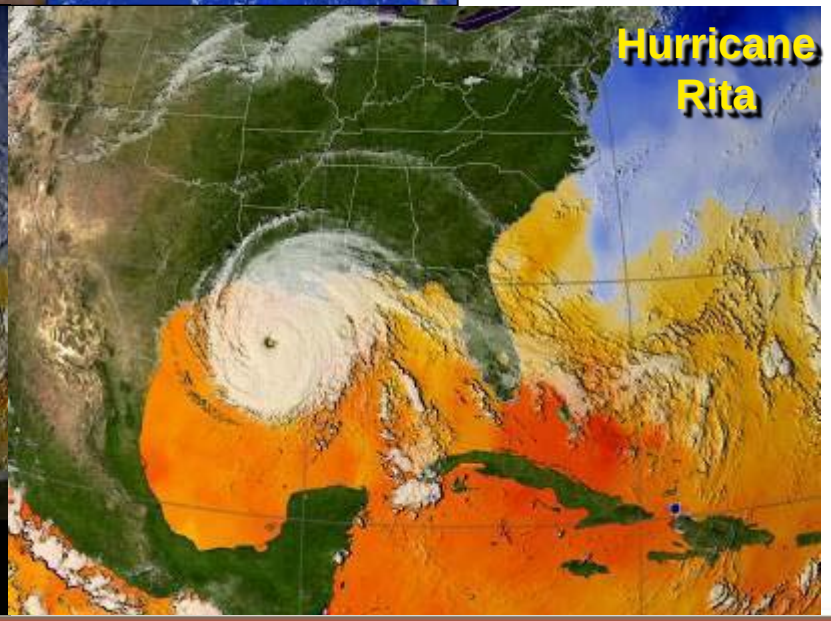
Storms: Extratropical; Tropical, and Hurricanes

Imagery from NOAA,
NASA/Goddard Flight Centre







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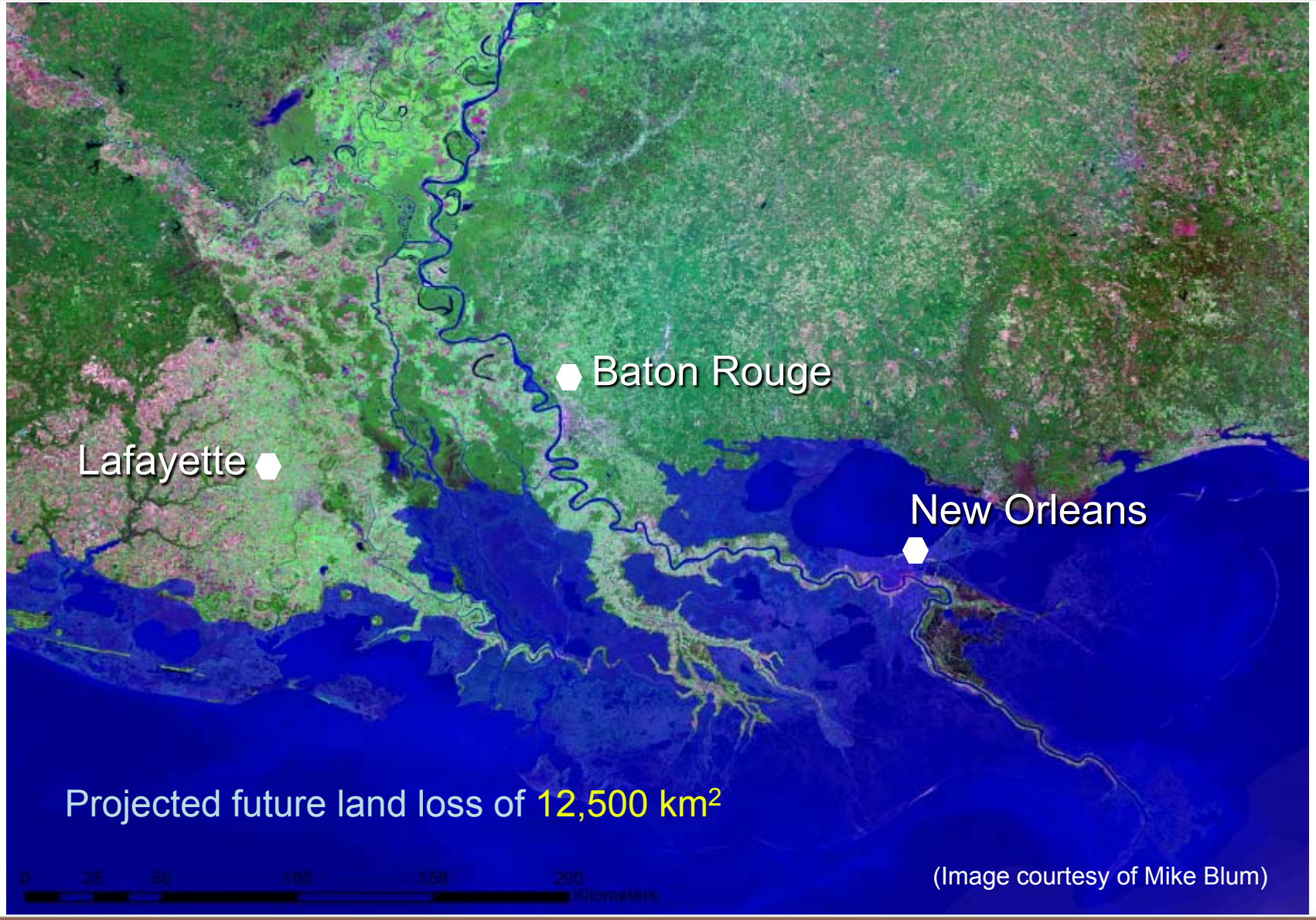
THE LOUISIANA COAST IN 2100?



(Image courtesy of Mike Blum)

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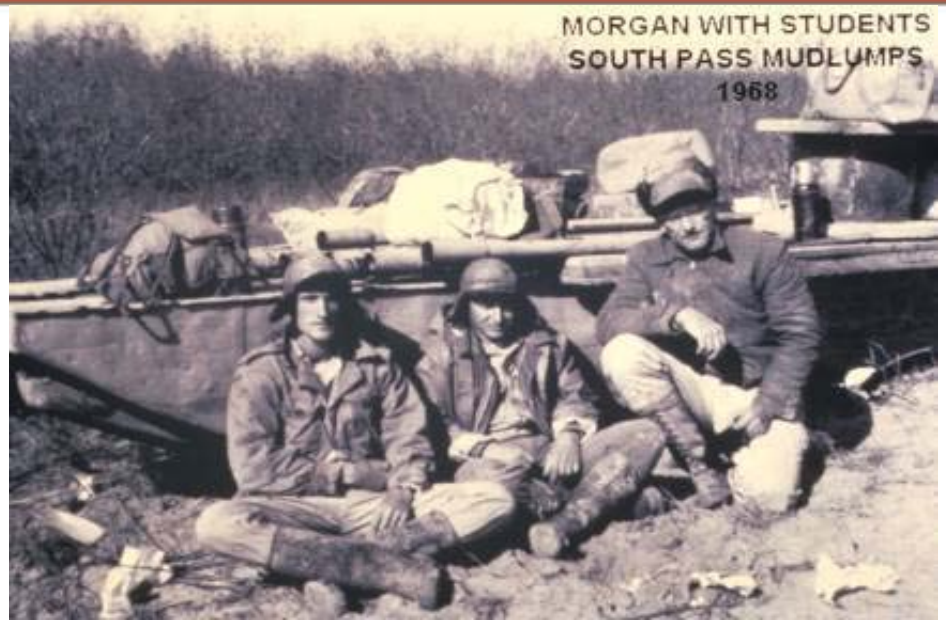
James M. Coleman



Photos courtesy of Harry H. Roberts

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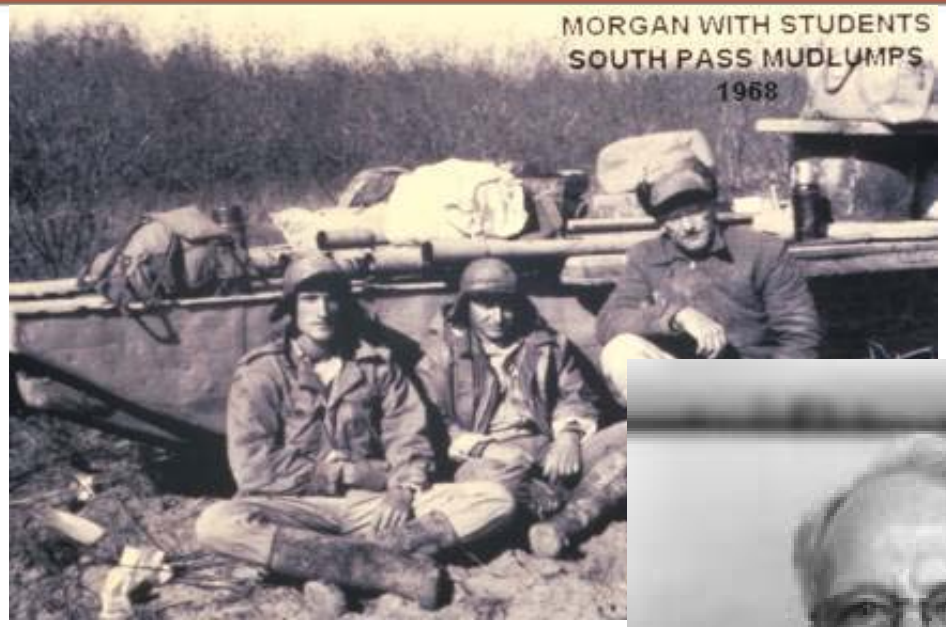
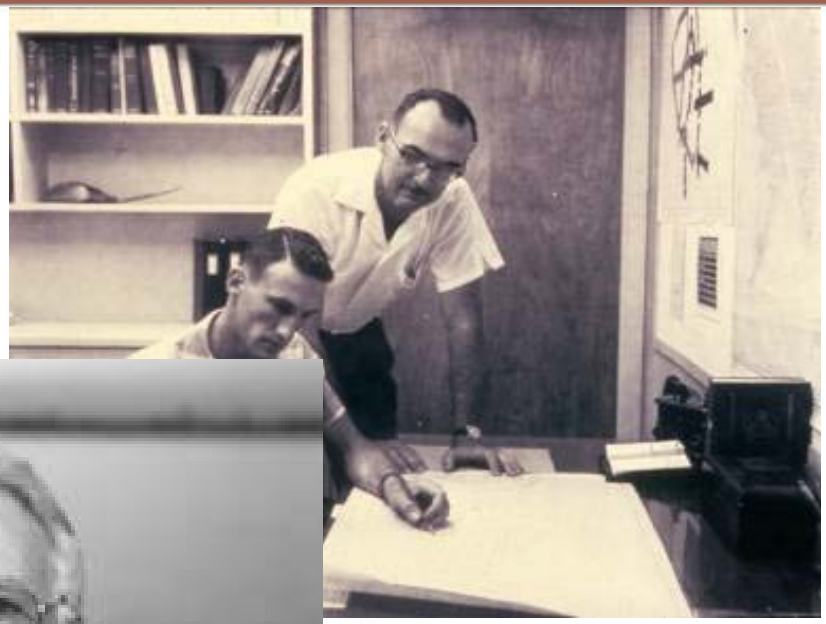
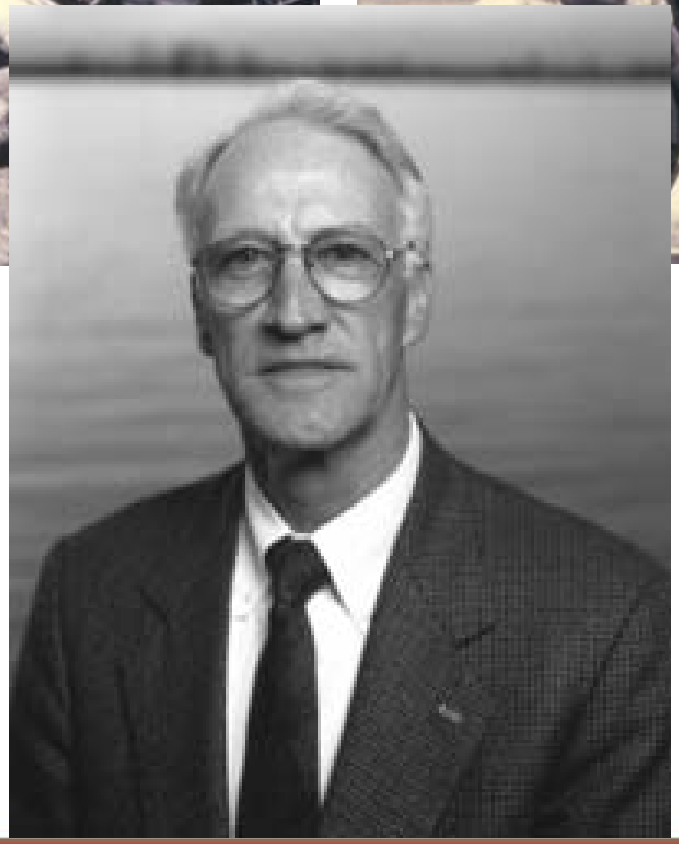
James M. Coleman







Photos courtesy of Harry H. Roberts

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JMC: A very brief synopsis

- **Born in Louisiana, Jim has spent his entire educational and professional career at LSU, earning three geology degrees, finishing the Ph.D. in 1966**
- **Long list of seminal papers on deltaic processes and deposits; ranging from the details of sedimentary structures on the delta plain to the architecture of the Mississippi Fan**
- **Long list of honors and awards**
- **Mentorship and supervision to numerous students; continuing education and consultant to the energy industry; consulting and advice to local, state, and federal government**
- **Served as Boyd Professor, Director of Coastal Studies Institute, Chairman of Geology and Geophysics, Head of School of Geoscience, Dean of Basic Sciences, and Executive Vice Chancellor of LSU**

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Harry H. Roberts

Photos courtesy of Harry H. Roberts
and Mike Blum

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HHR: A very brief synopsis

- **Born in West Virginia**
- **Received Ph.D. at LSU in 1969**
- **Long list of seminal papers on deltaic processes and deposits; focusing on modern deltaic sediments, shelf-edge deltas, and surficial sediments of the NWGOM**
- **Long list of honors and awards**
- **Mentorship and supervision to numerous students; continuing education and consultant to the energy industry; consulting and advice to local, state, and federal government**
- **Served LSU as Boyd Professor, Director of Coastal Studies Institute**

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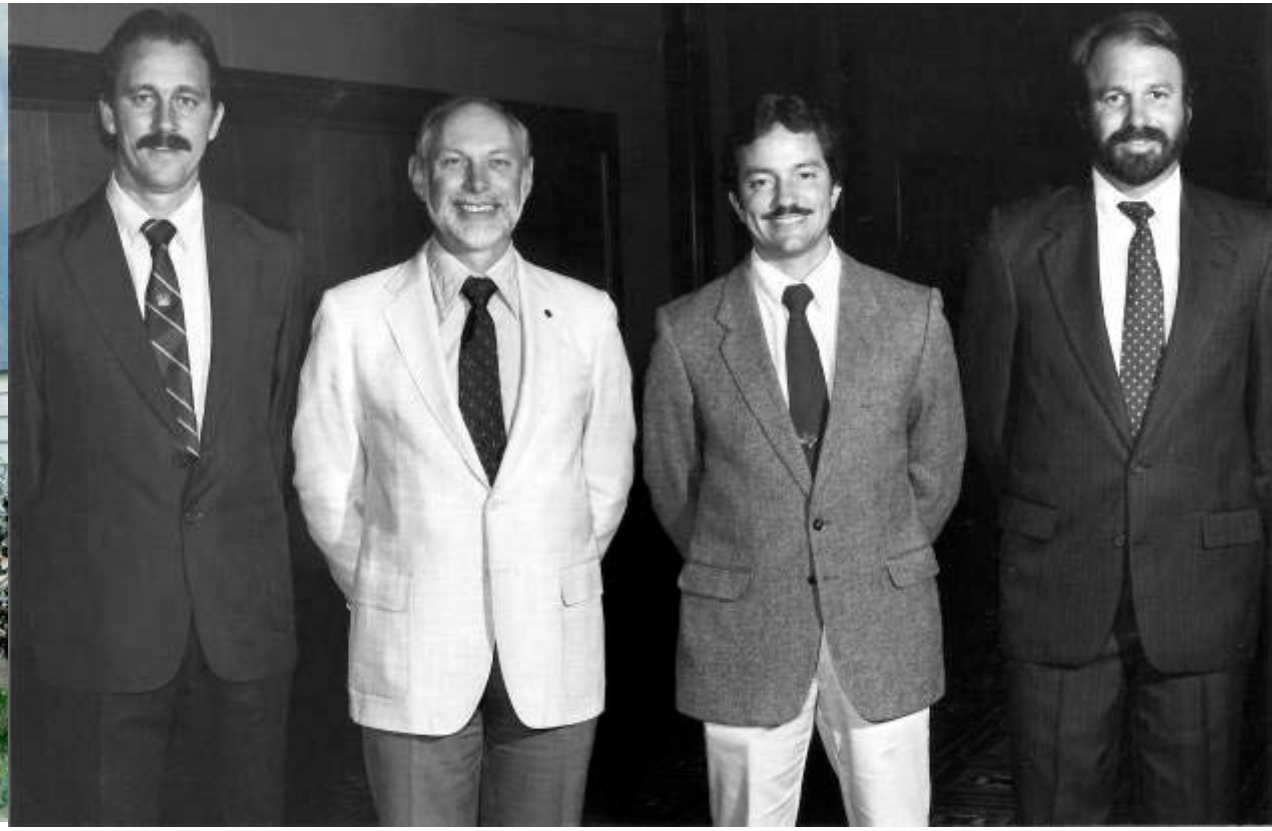
Patrick Shea Penland, 1954-2008



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Patrick Shea Penland, 1954-2008

Photos courtesy of Ron Boyd

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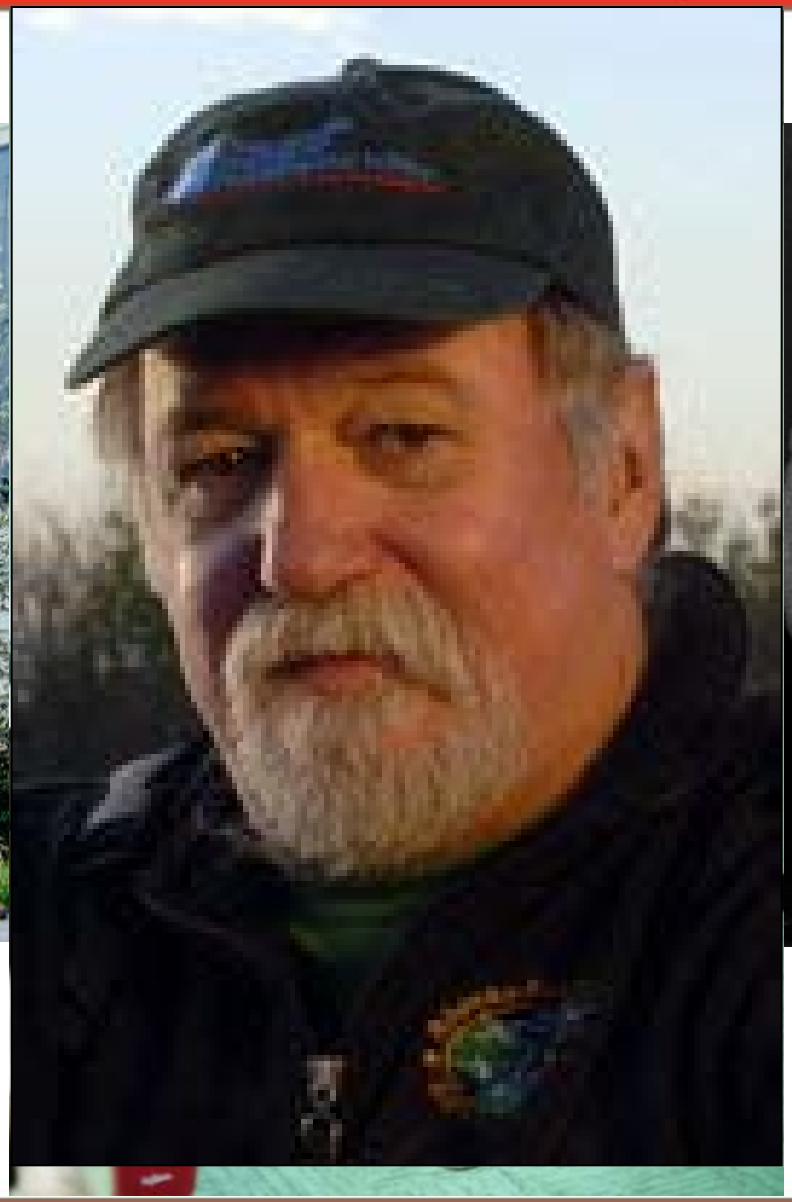
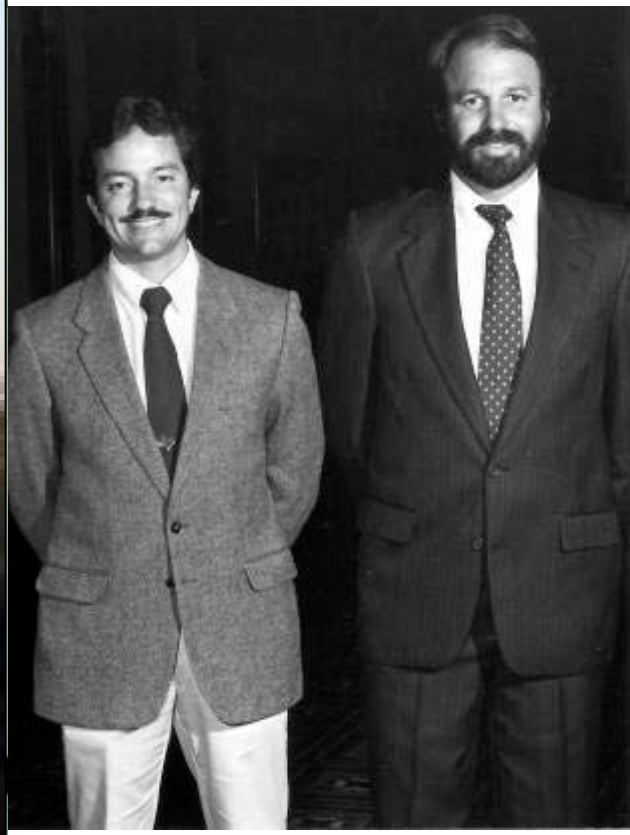
Patrick Shea Penland, 1954-2008





Photos courtesy of Ron Boyd

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PSP: A very brief synopsis

- **Born in Florida; came to Louisiana in the late 1970's and "went native"**
- **Received Ph.D. at LSU in 1990**
- **Long list of seminal papers on deltaic processes and deposits; primary foci on transgressive evolution and coastal issues**
- **Long list of honors and awards**
- **Mentorship and supervision to numerous students and colleagues; continuing education and consultant to the energy industry, state-federal cooperative projects; deep involvement with public affairs and coastal issues**
- **LSU and Louisiana Geological Survey until 1997, UNO thereafter**
- **Career long dedication to the problems of coastal restoration in Louisiana**
- **Braunstein Professor and Director of UNO Ponchartrain Institute of Environmental Sciences until his untimely death in 2008**

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Summary

- **Studies of the Mississippi River, Delta, and associated environments have had a profound and lasting impact on geoscience AND society**
- **Jim Coleman, Harry Roberts, and Shea Penland made immense contributions to both of these areas**
- **This SEPM Session commemorates and honors them and their work**