Isolated Carbonate Platforms – Lessons Learned from Great Bahama Bank*

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Abstract

Studies of carbonate platforms in the Bahamas continue to refine stratigraphic, depositional, and diagenetic models. Stratigraphic insights include understanding how isolated platforms may coalesce through progradation along leeward margins by highstand shedding of bank-top derived sediment; also, that seismic reflectors in pure carbonate systems have been shown to be the result of lithologic and diagenetic change, and many regionally correlatable seismic sequence boundaries are indeed chronostratigraphic horizons. The failure of platform margins and slopes and subsequent deposition of megabreccias may occur during both lowstands and highstands of sea level.

Lithofacies, which are relatively consistent across platforms, are dependent upon paleogeography and paleoceanography. The role of antecedent topography in initiating development of both reefal and sand bodies is strongly coupled to a windward margin location, and the sedimentary make-up (grain vs. mud dominated) of proximal slope facies is also dependent on the windward/leeward orientation of the margin. In addition, details of the genesis of shallowing-upward cycles in different environments, coupled with the realization that unfilled accommodation space is common, adds to our understanding of ancient platform equivalents and suggest limitations inherent to cyclostratigraphic correlation.

Syndepositional marine cementation takes place in shallow subtidal and intertidal environments, but also to much greater depths, suggesting that paradigms associated with slope stabilization and the formation of submarine hardgrounds and seismic reflector horizons need to be revisited. Other recent work has focused on the role of microbial communities in cementation and documenting the presence of “meteoric-like” moldic porosity fabrics in the deep marine phreatic environment.

Isolated Carbonate Platforms Lessons learned from Great Bahama Bank

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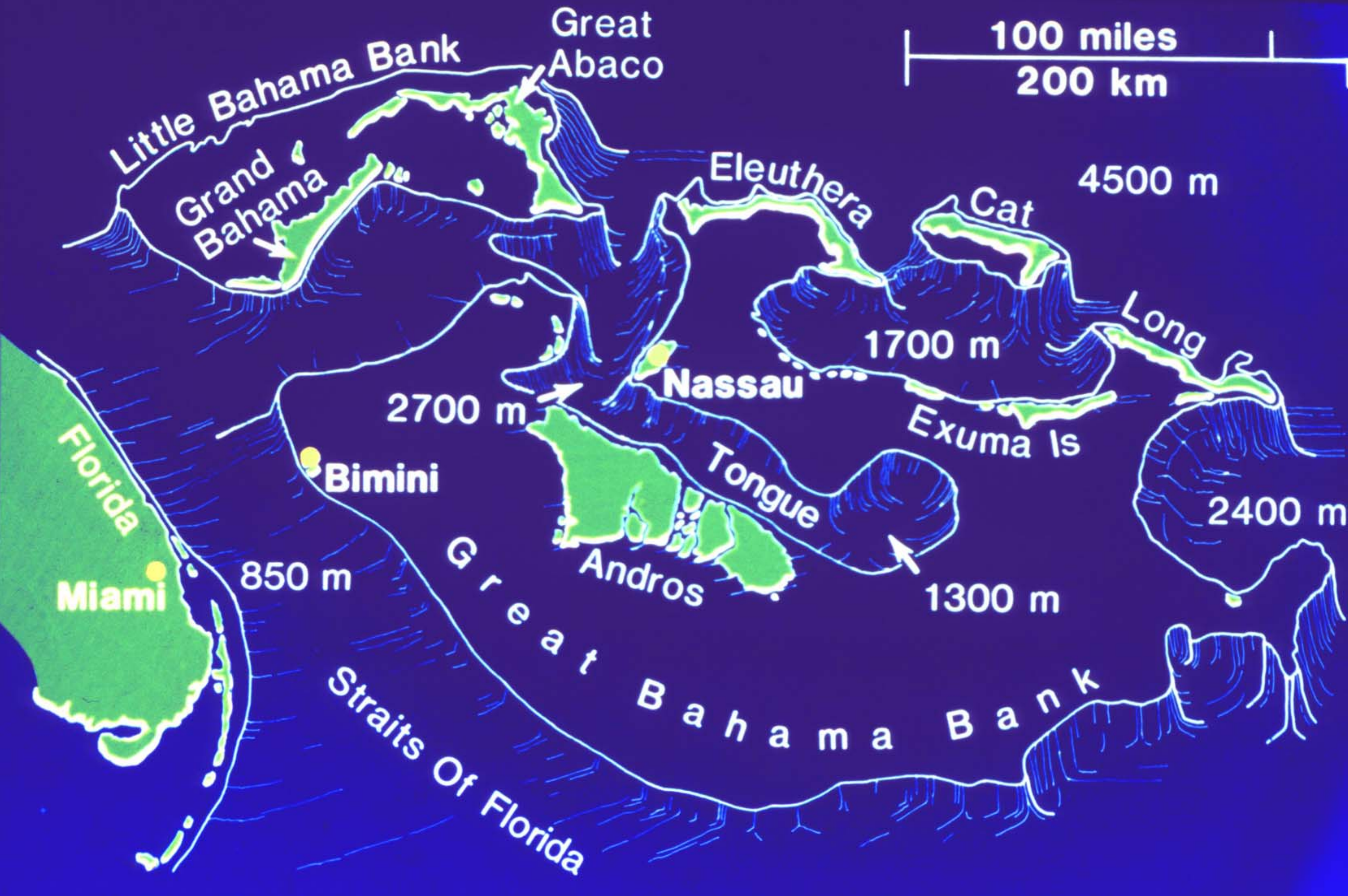
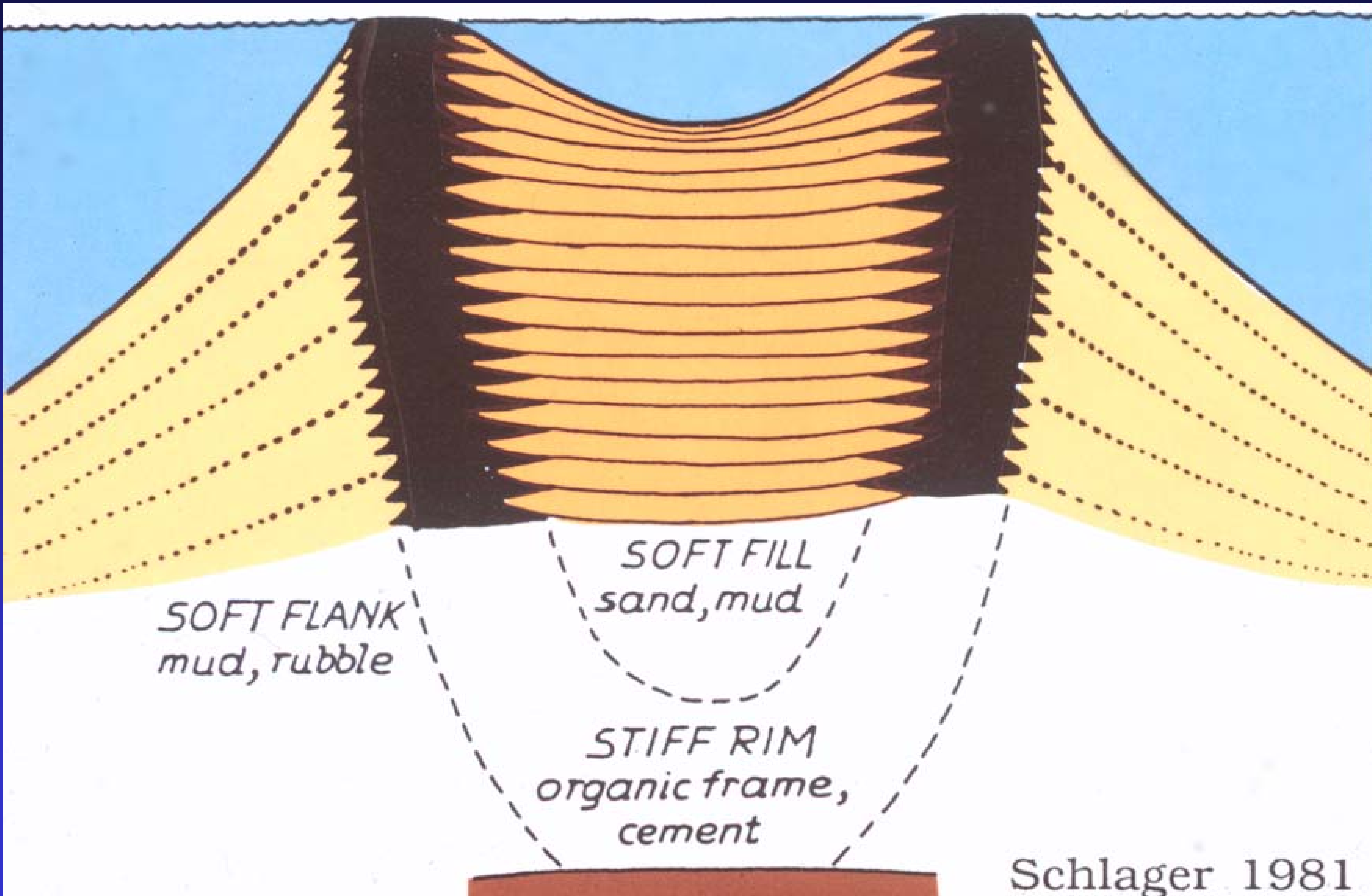
CSL

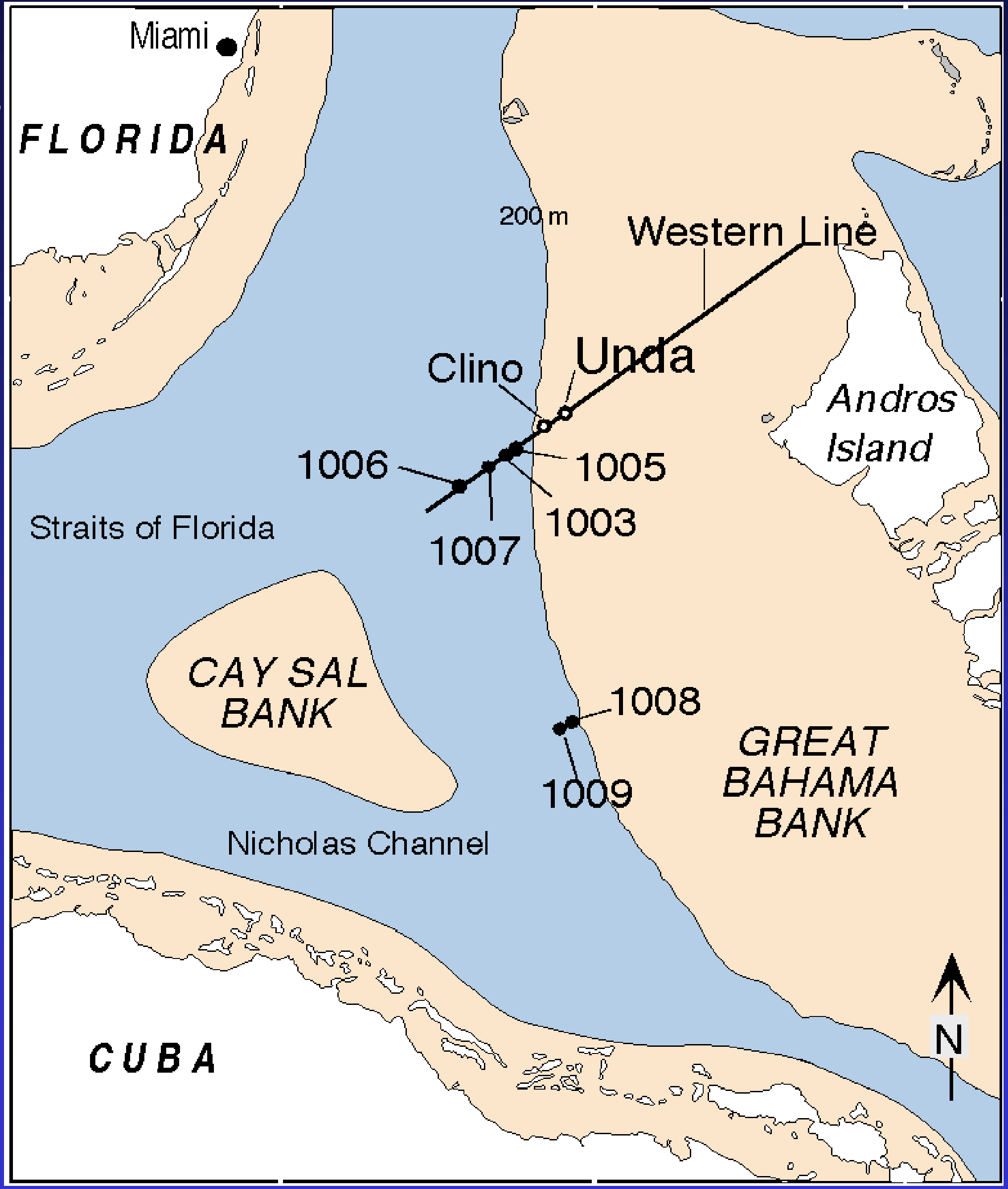
ChevronTexaco



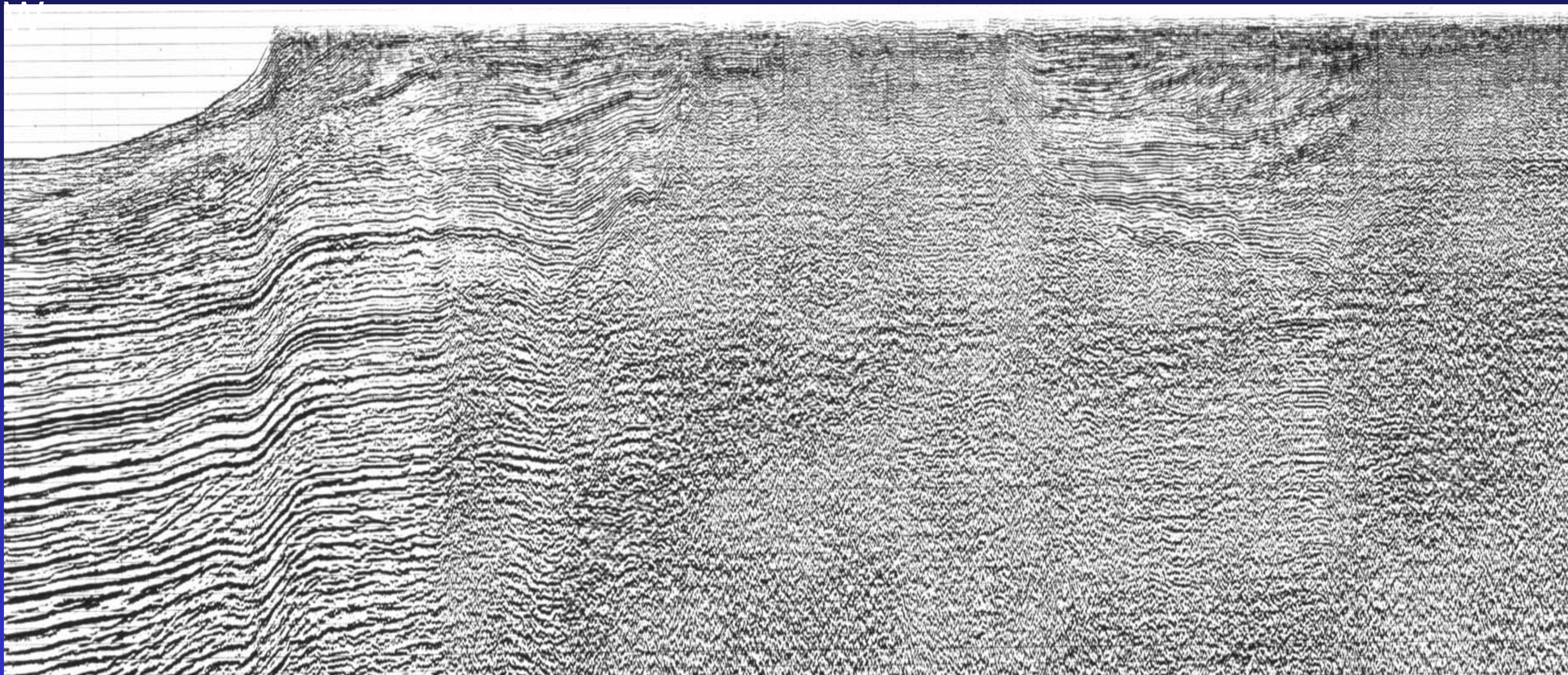
100 miles
200 km
Little Bahama Bank
Great Abaco
Grand Bahama
Eleuthera
4500 m
Cat
Long
1700 m
Nassau
2700 m
Exuma Is
Bimini
Tongue
2400 m
Florida
Miami
850 m
Andros
1300 m
Great Bahama Bank
Straits Of Florida


SOFT FILL
sand, mud
SOFT FLANK
mud, rubble
STIFF RIM
organic frame,
cement
Schlager 1981

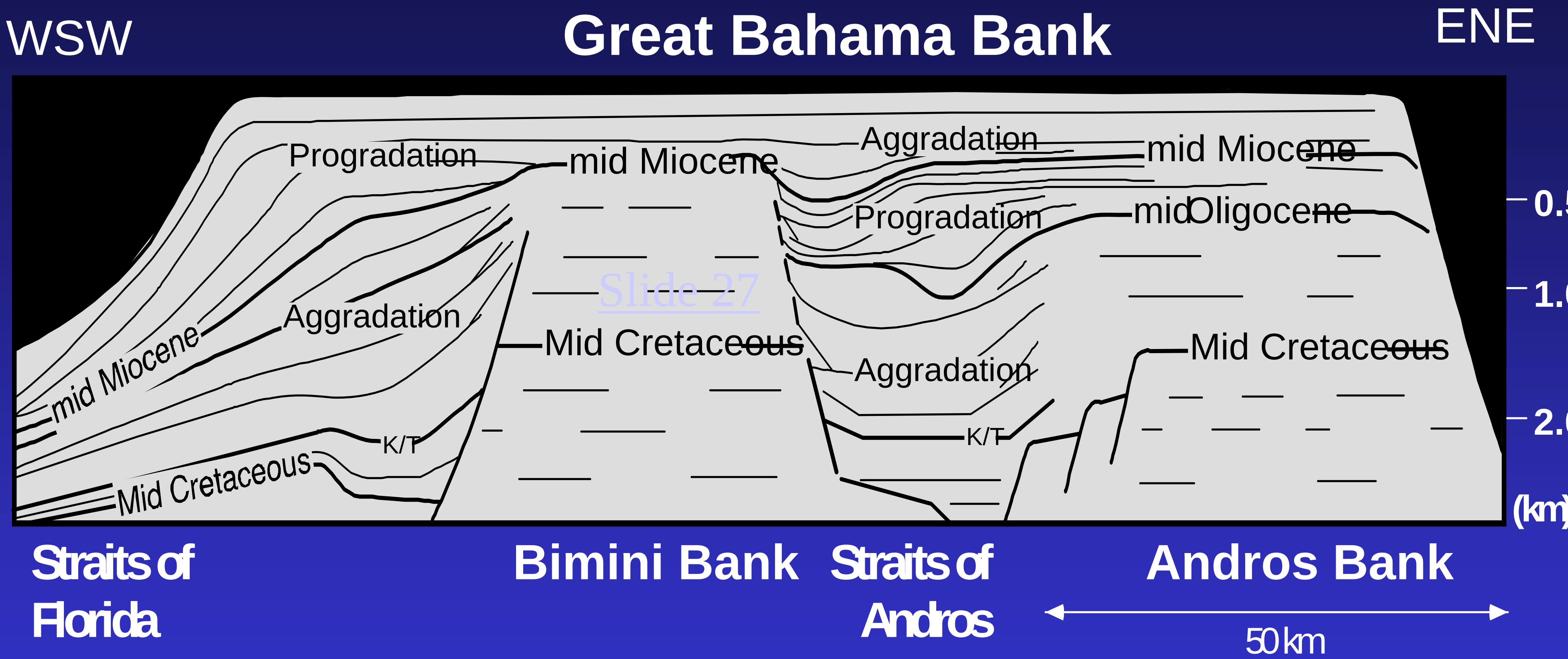
Bahamas Transect Location map



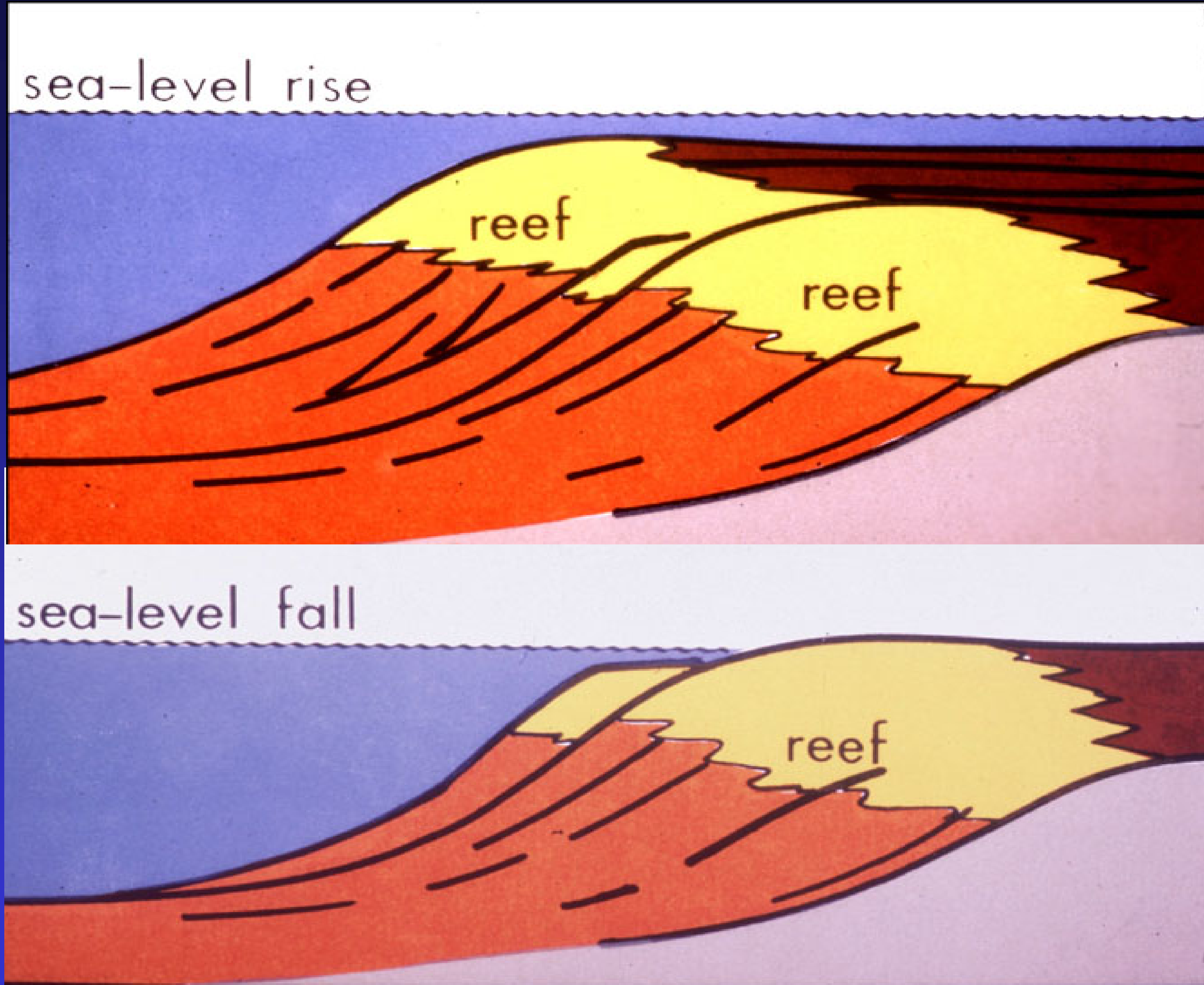
Great Bahama Bank



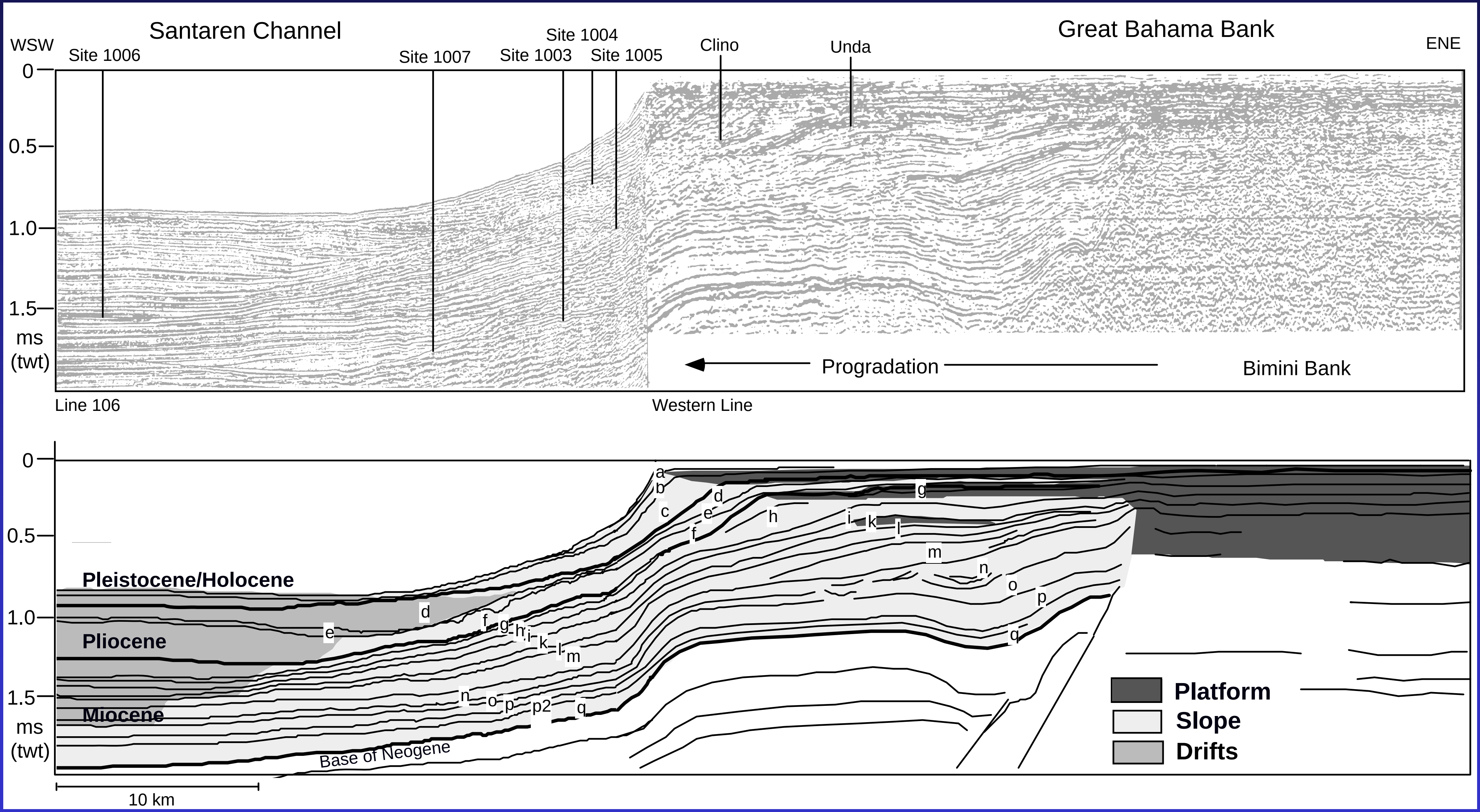
Great Bahama Bank

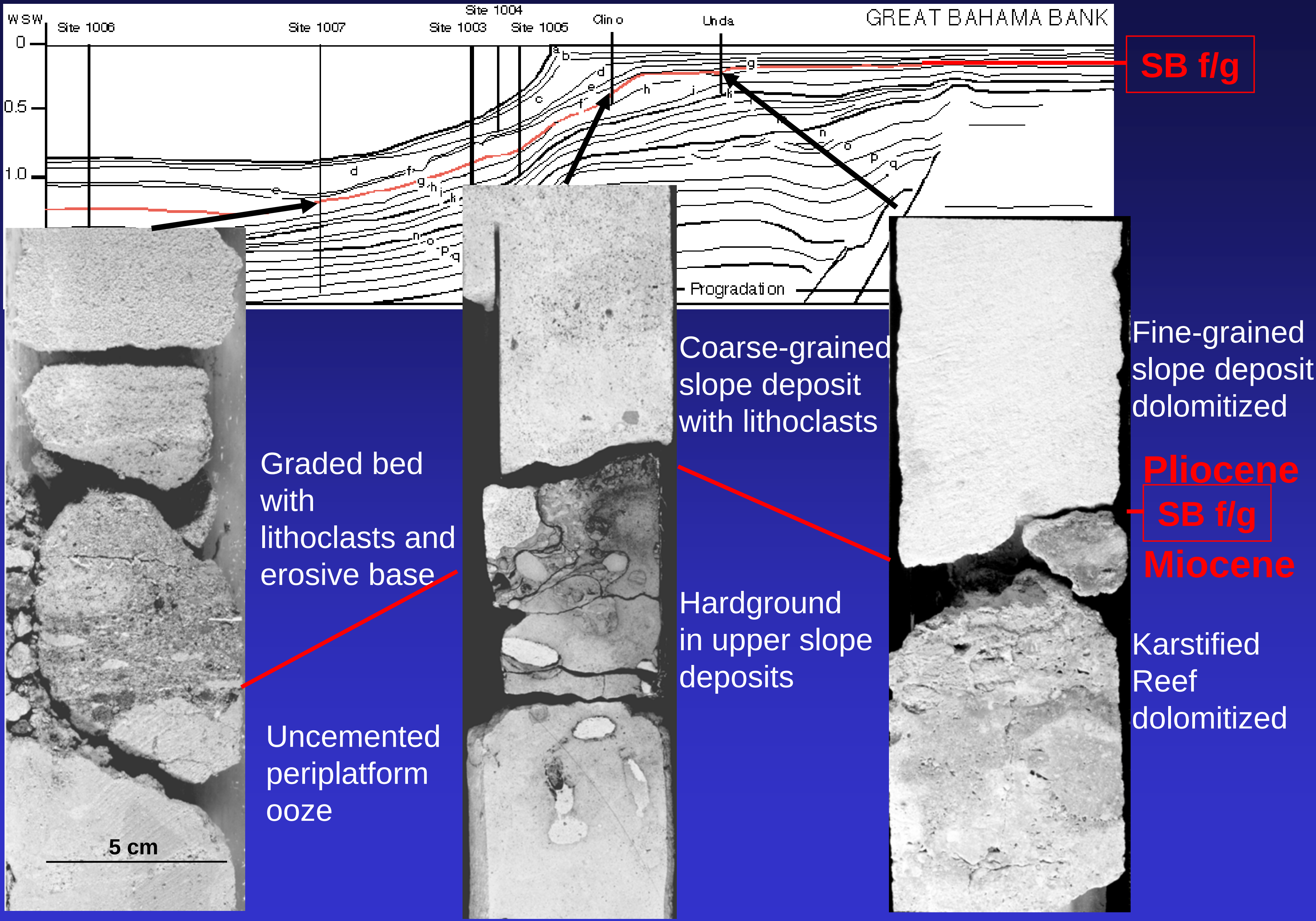


- Steep-sided core platforms
- Asymmetric platform expansion
- Pulsed progradation


sea-level rise
reef
reef
sea-level fall
reef

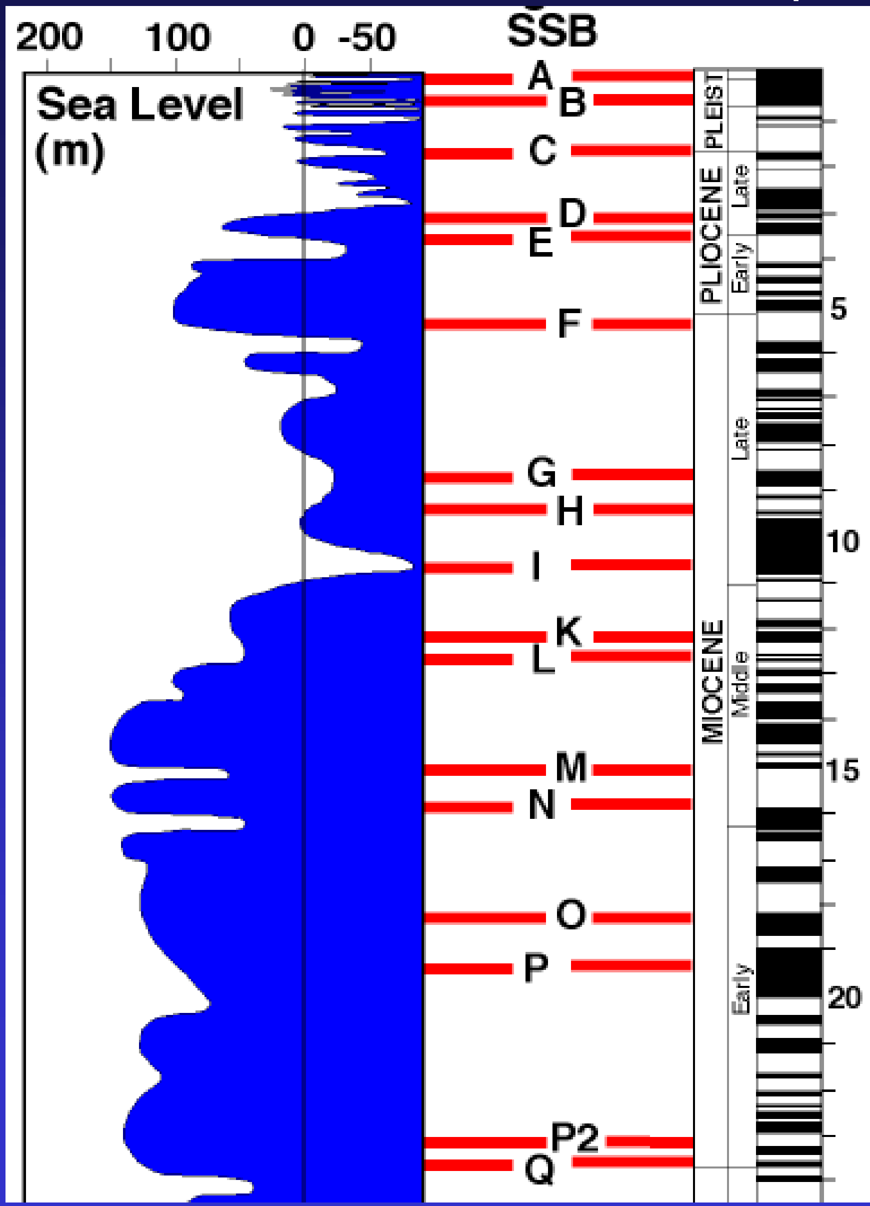
Bahamas Transect: 7 Drill Sites across Prograding Margin of Great Bahama Bank

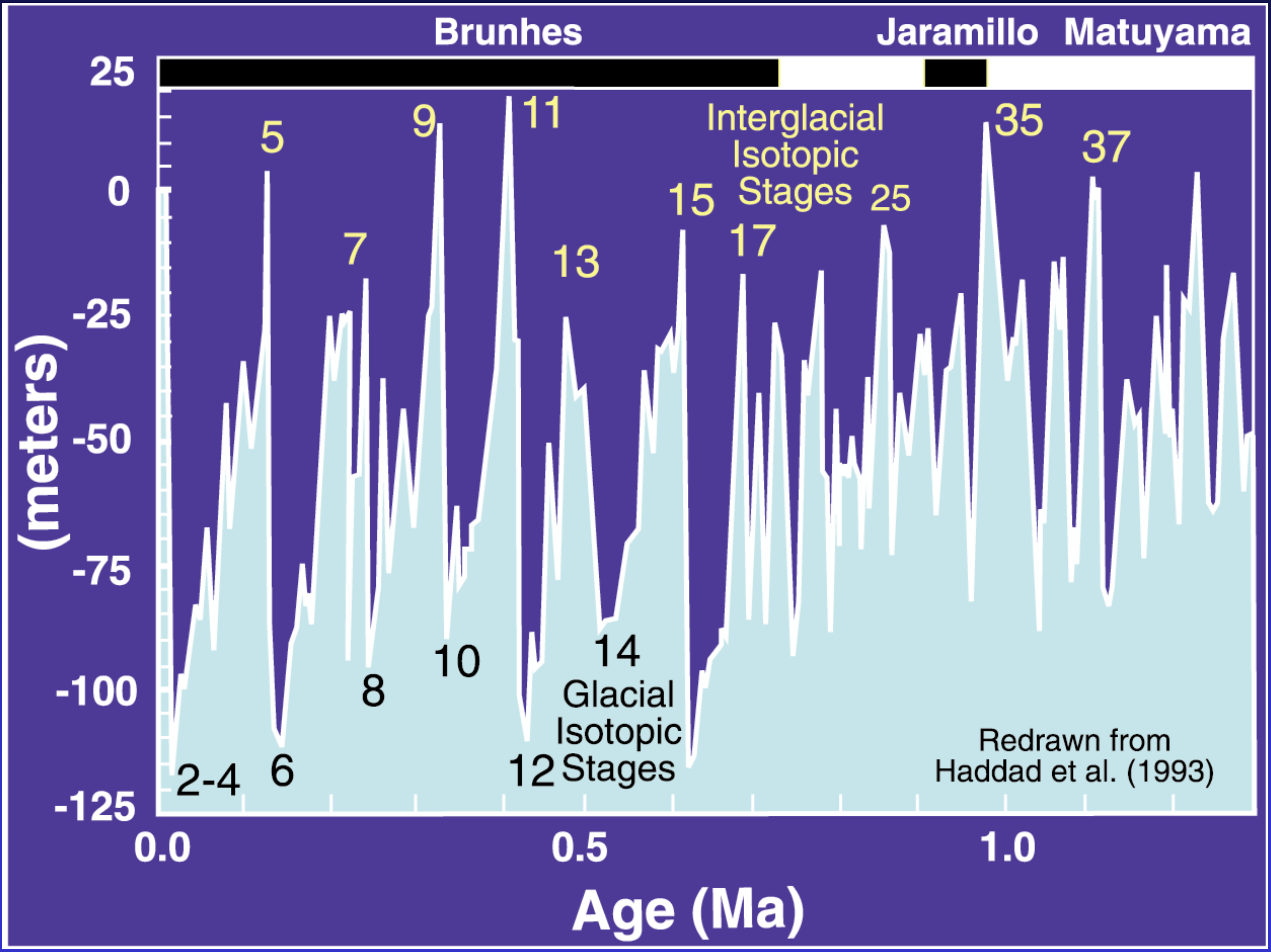



WSW
Site 1006
Site 1007
Site 1004
Site 1003
Site 1005
Clino
Unda
GREAT BAHAMA BANK
SB f/g
0
0.5
1.0
Progradation
5 cm
Graded bed with lithoclasts and erosive base
Uncemented periplatform ooze
Coarse-grained slope deposit with lithoclasts
Hardground in upper slope deposits
Fine-grained slope deposit dolomitized
Pliocene
SB f/g
Miocene
Karstified Reef dolomitized

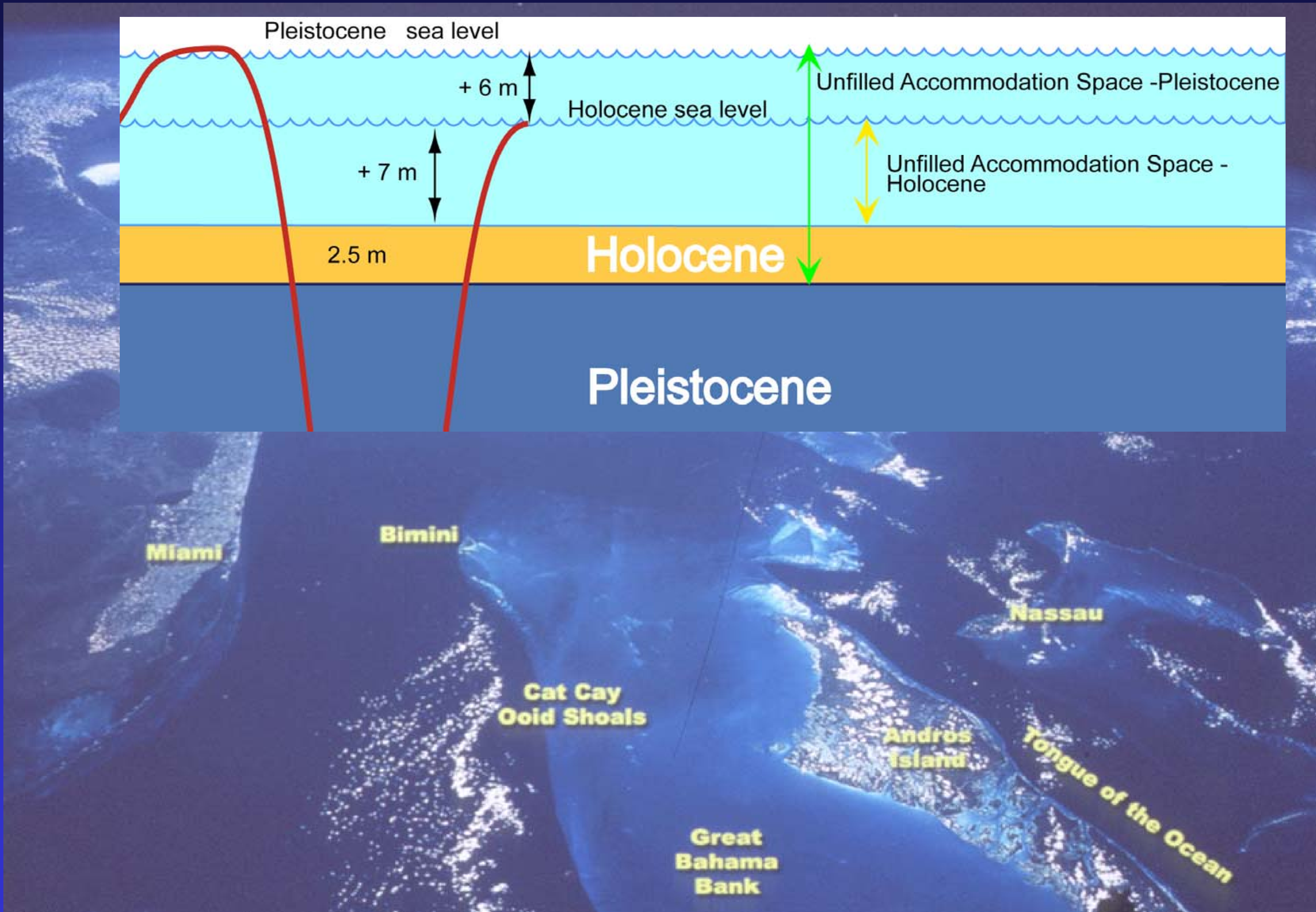
Leg 166
Seismic Sequence Boundary ages

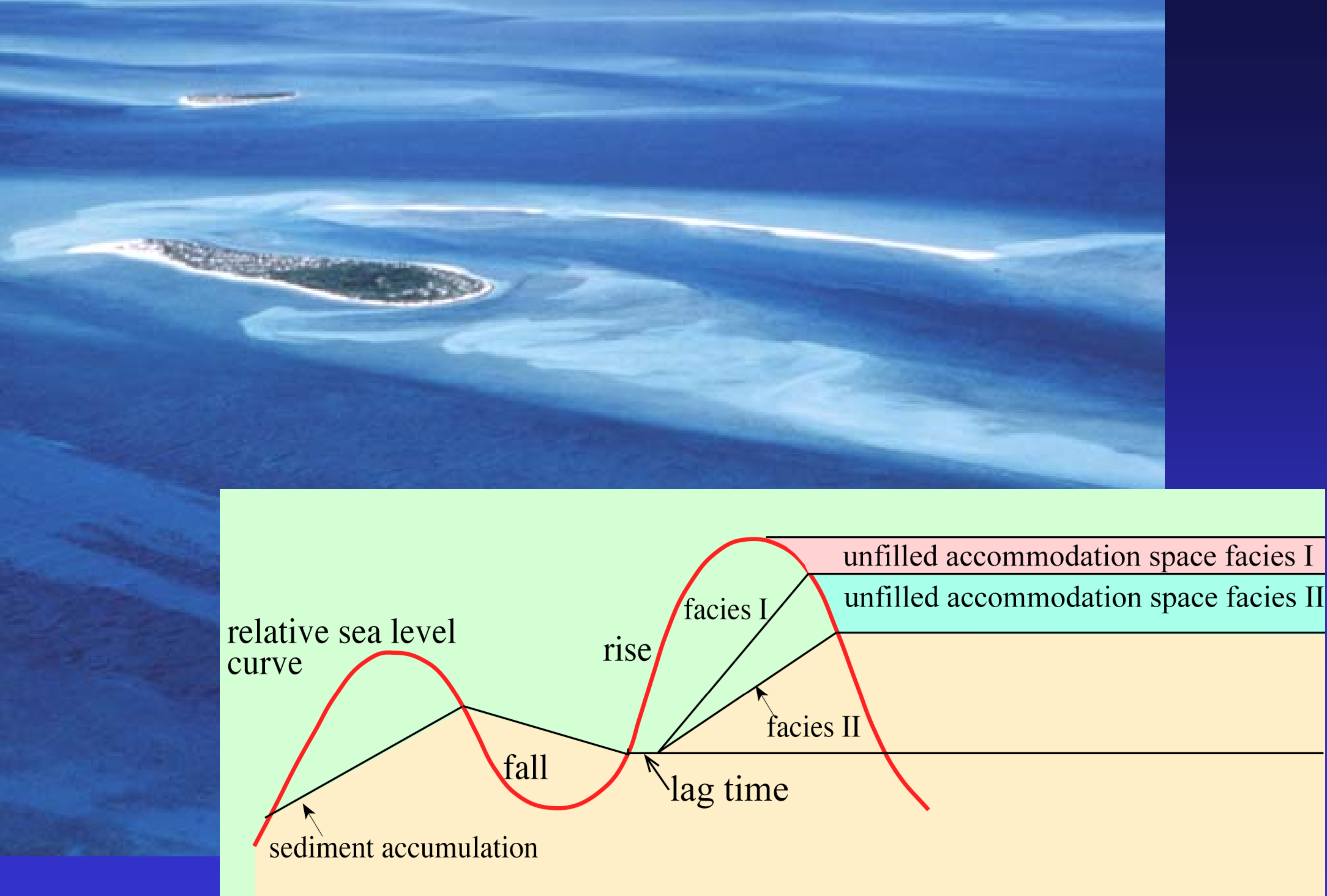
Haq Curve





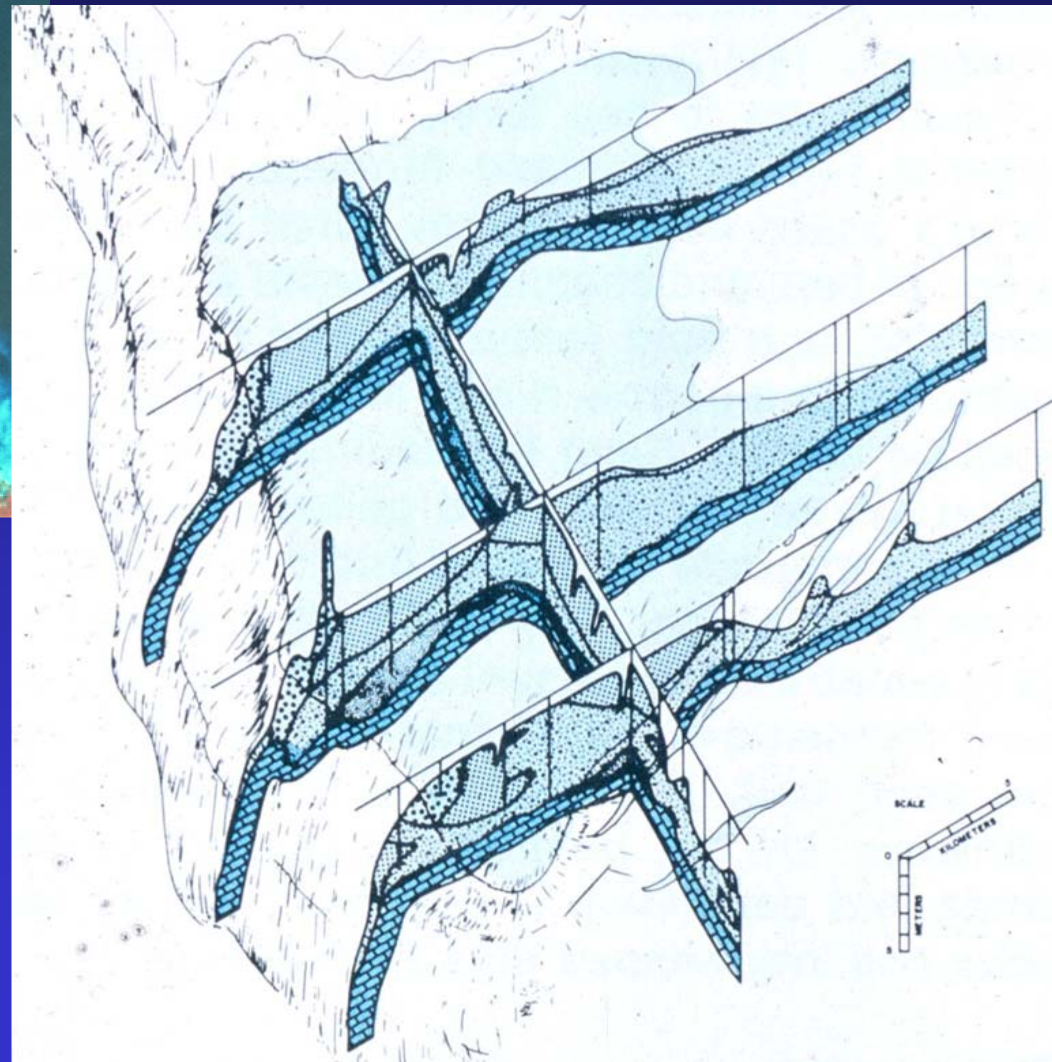
Brunhes
Jaramillo
Matuyama
25
0
-25
-50
-75
-100
-125
(meters)
5
7
9
11
13
15
17
Interglacial Isotopic Stages
25
35
37
2-4
6
8
10
12
14
Glacial Isotopic Stages
Redrawn from Haddad et al. (1993)
0.0
0.5
1.0
Age (Ma)


Pleistocene sea level
+ 6 m
Holocene sea level
Unfilled Accommodation Space -Pleistocene
+ 7 m
Unfilled Accommodation Space - Holocene
2.5 m
Holocene
Pleistocene
Miami
Bimini
Nassau
Cat Cay Ooid Shoals
Andros Island
Tongue of the Ocean
Great Bahama Bank



unfilled accommodation space facies I
unfilled accommodation space facies II
facies I
relative sea level curve
rise
facies II
fall
lag time
sediment accumulation

Joulters Cay
Facies architecture

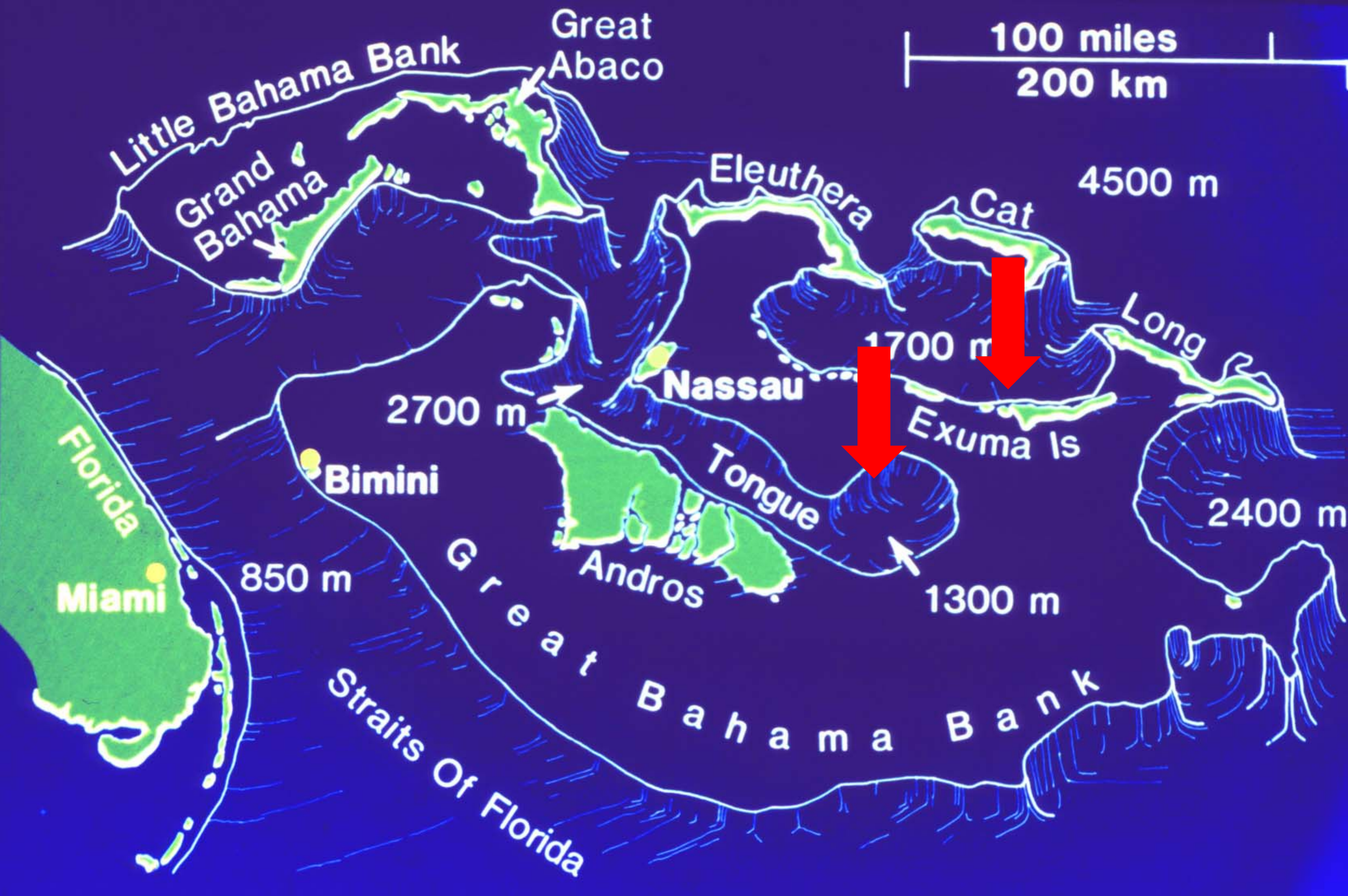


Unfilled accommodation space:

Creates andecedent topography
Controls facies distribution

Summary of lessons from sea level and architecture

- *Isolated platforms have enormous lateral growth potential*
- *Progradation occurs in sea level controlled pulses*
- *Platforms have unfilled accommodation space*
- *Facies dependent filling of accommodation space creates topography on platform, which controls facies distribution during next sea level cycle*



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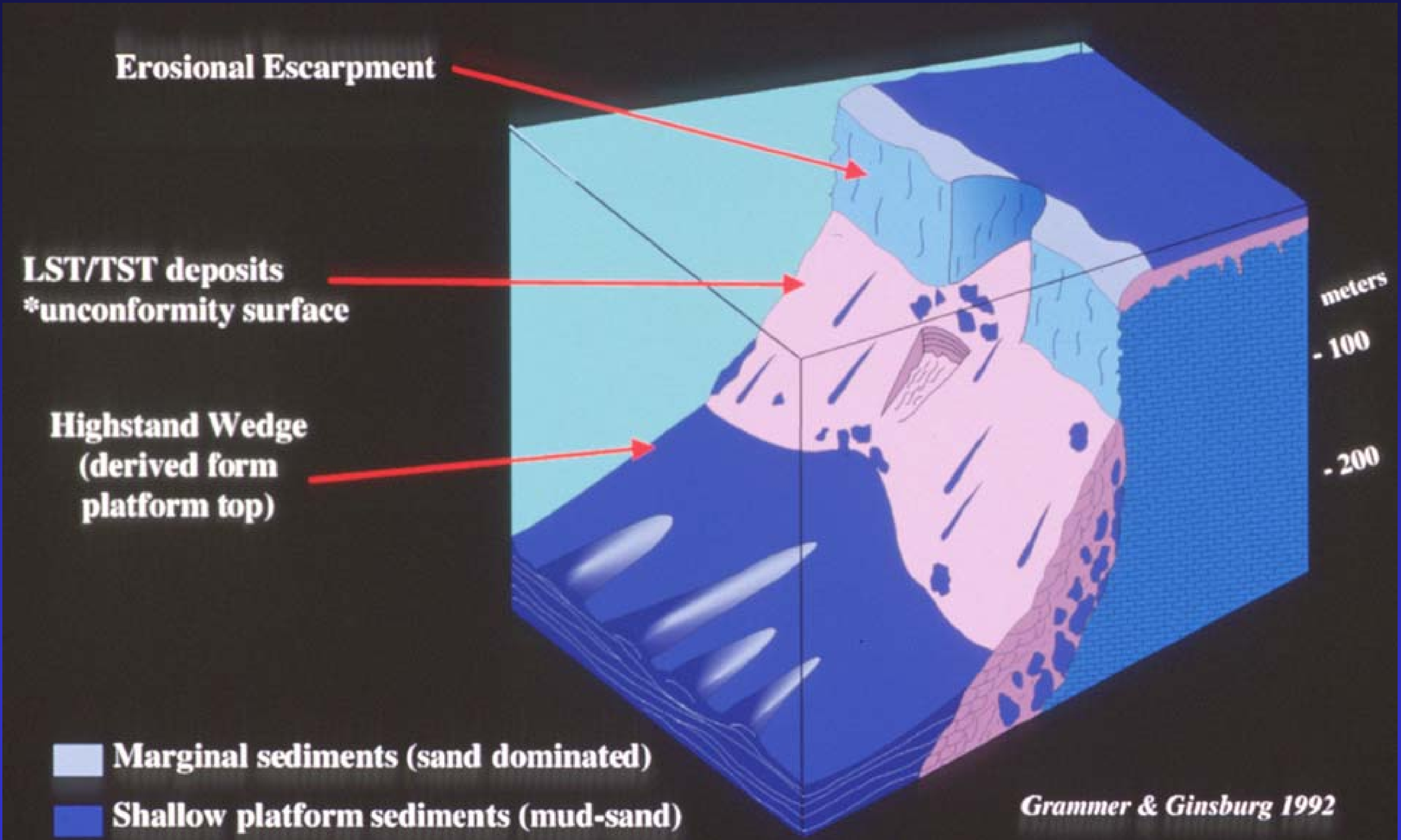
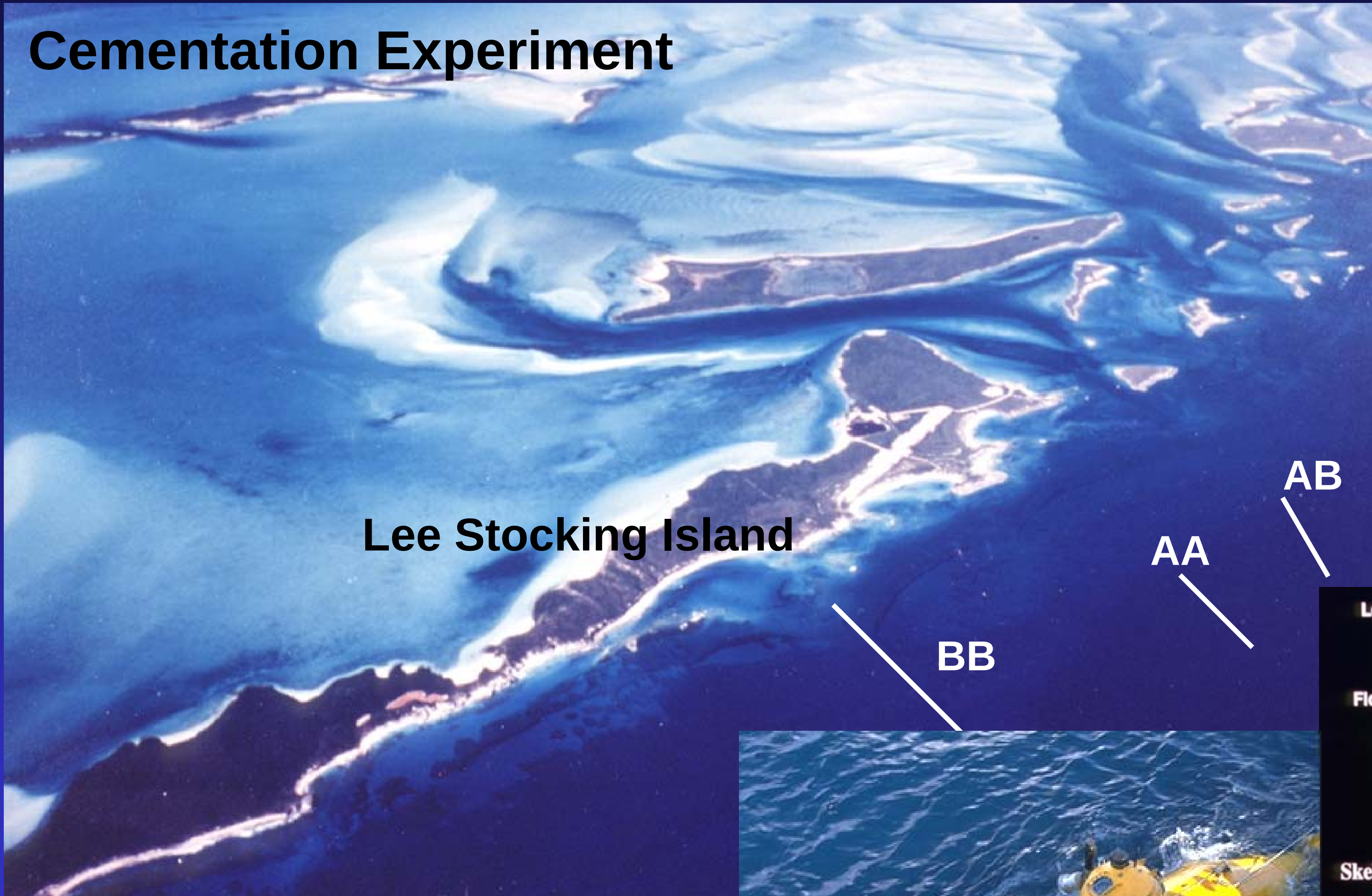
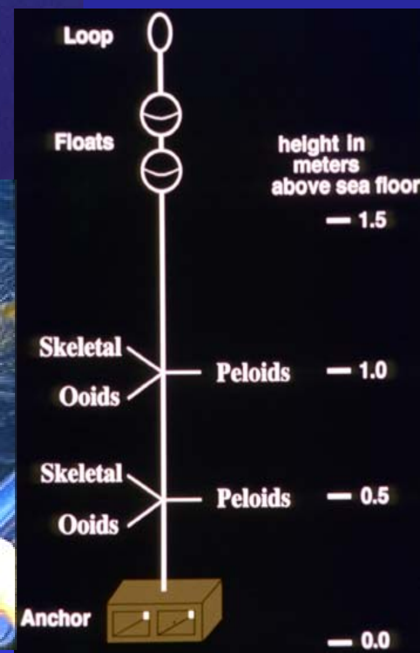
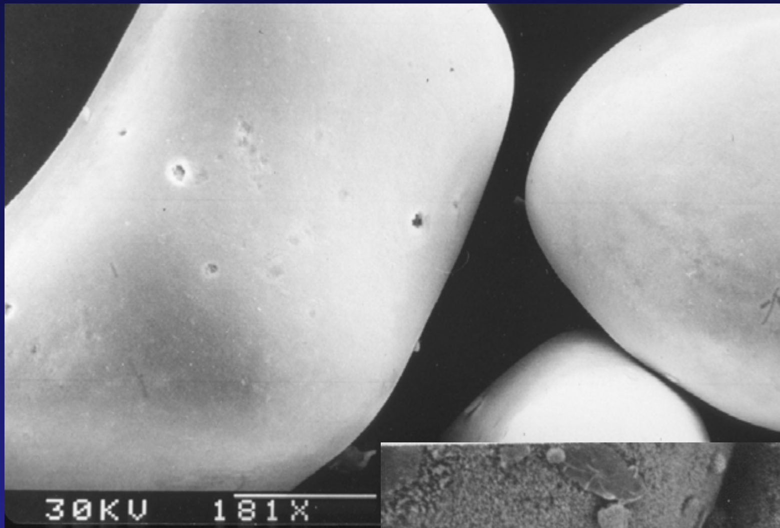

Erosional Escarpment
LST/TST deposits
*unconformity surface
Highstand Wedge
(derived form
platform top)
meters
- 100
- 200
Marginal sediments (sand dominated)
Shallow platform sediments (mud-sand)
Grammer & Ginsburg 1992

Cementation Experiment





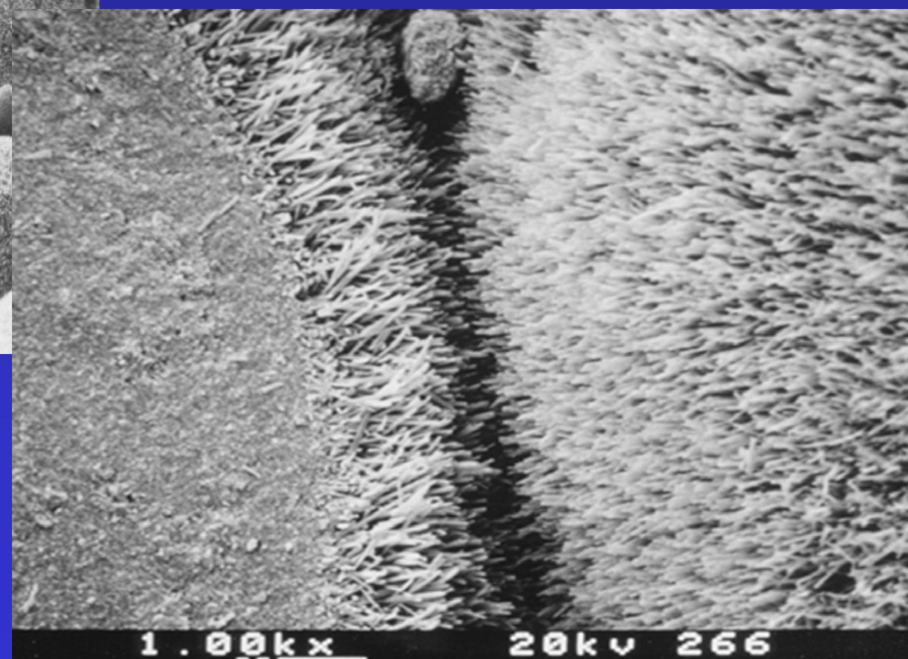
Cementation Experiment Results Location BB, 100ft

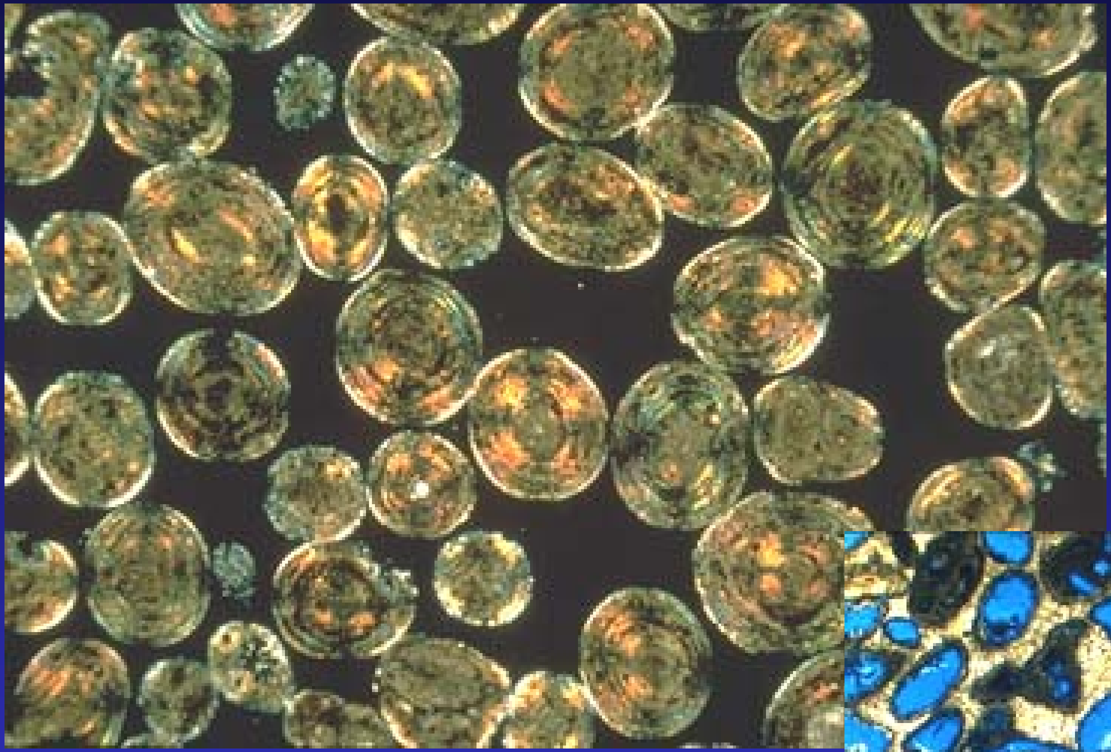


original

8 months

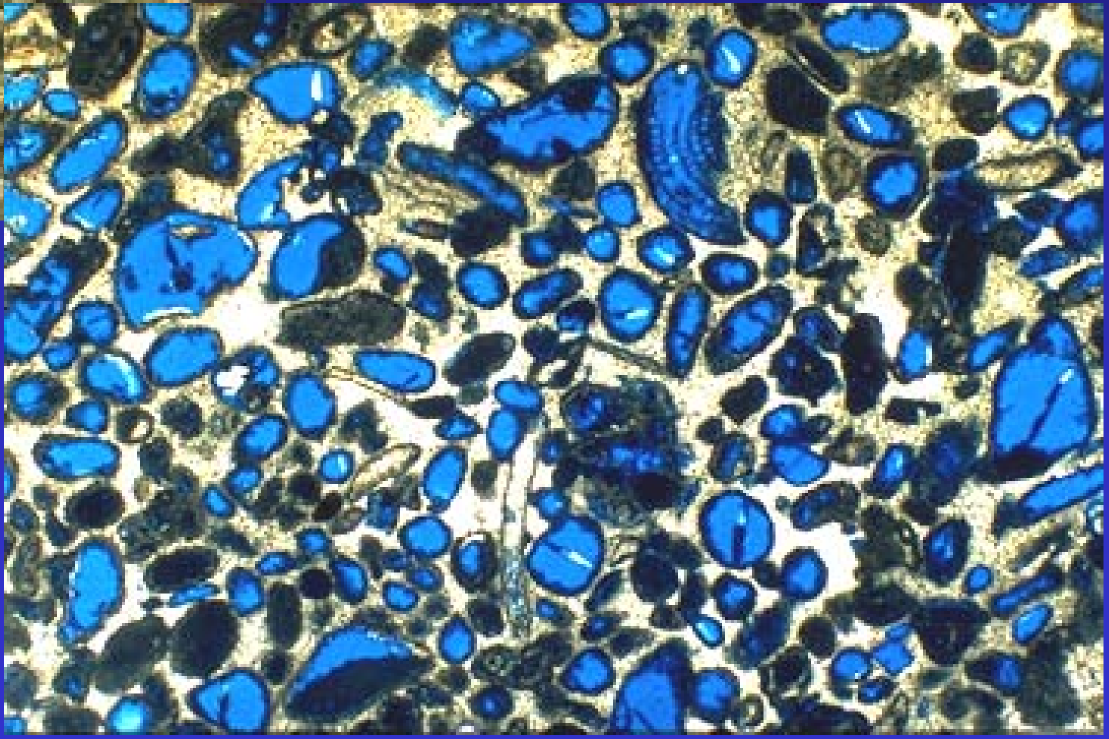
20 months



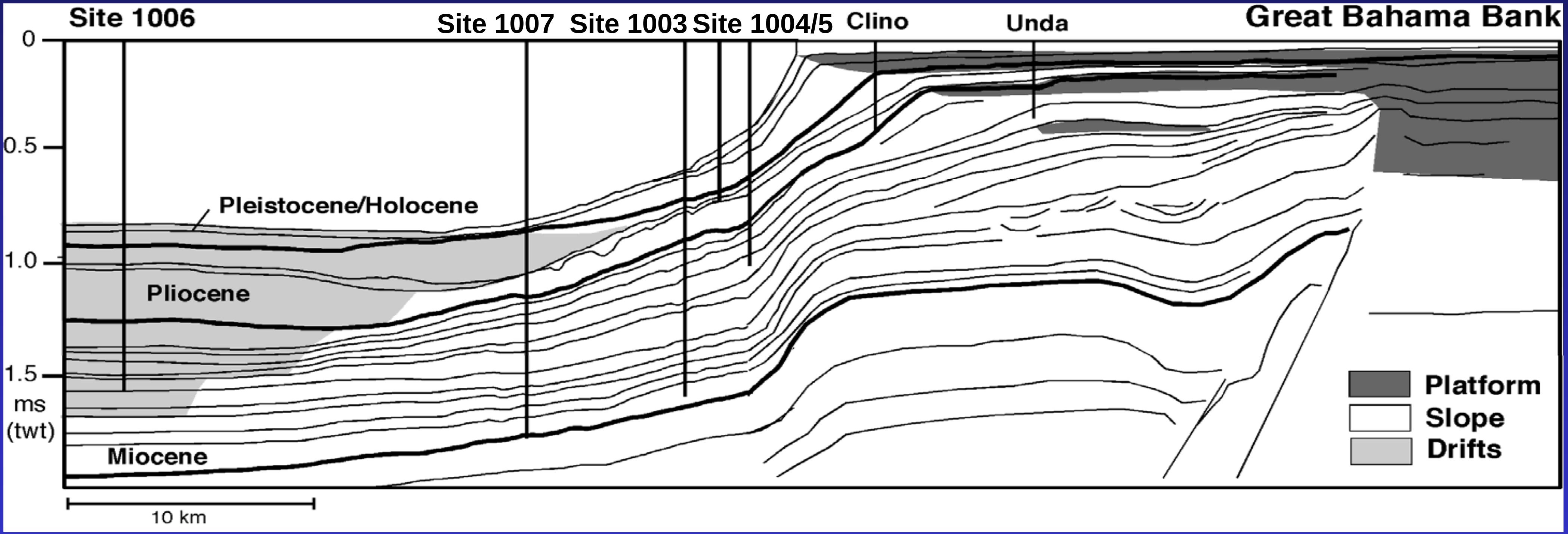


Meteoric Diagenesis

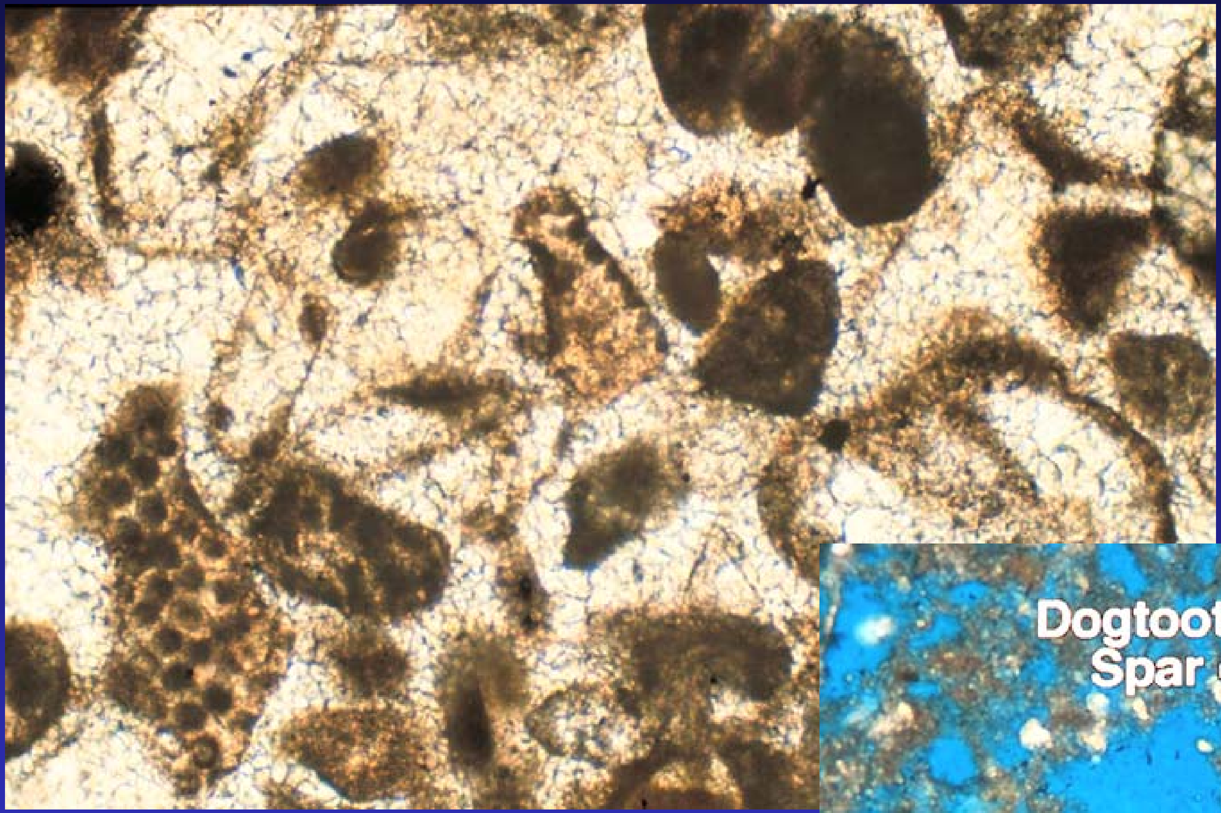
Aragonite dissolution
LMC cementation
Moldic porosity



Margin of Great Bahama Bank with drill sites of the Bahamas Transect

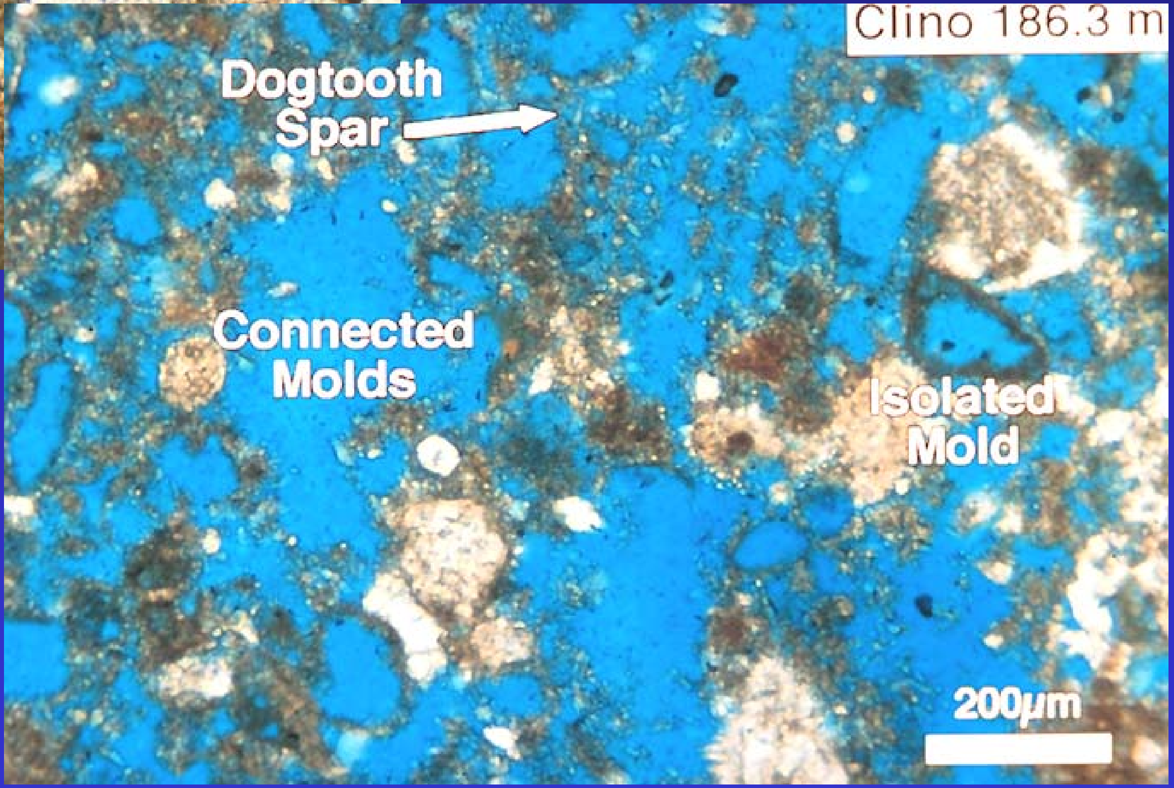


From Anselmetti et al. 2000

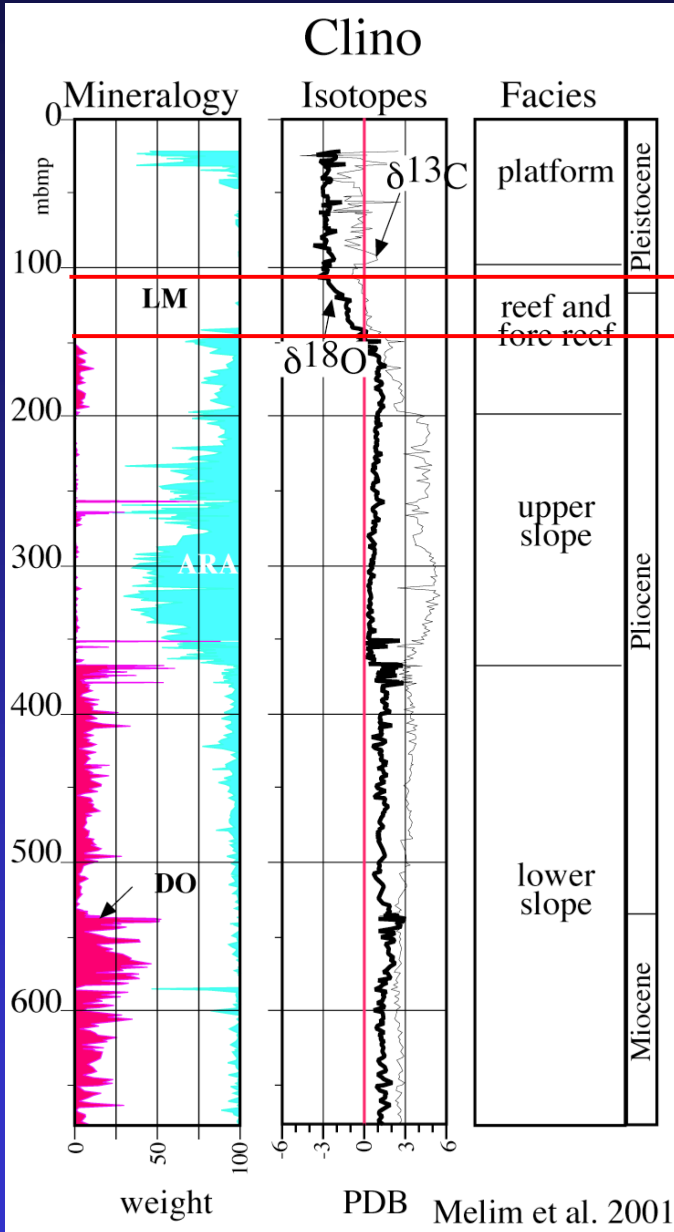


Aragonite neomorphism
Micritized grains
Calcite cementation
Blocky spar
Minor molds

Melim et al. 1995



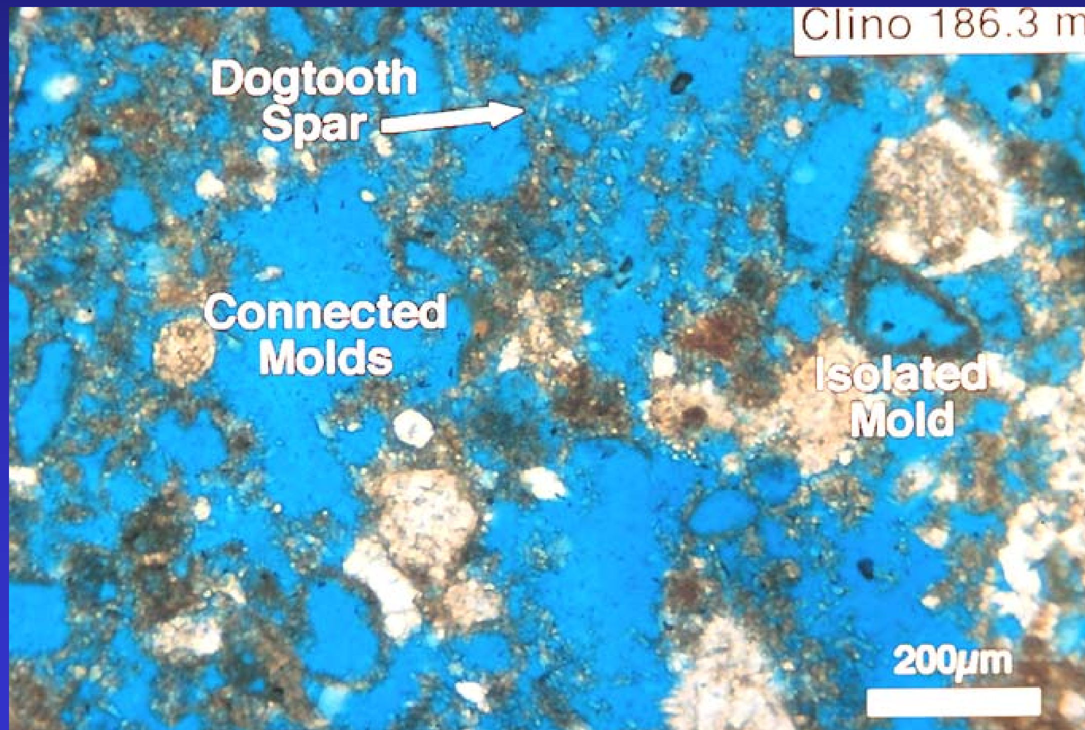
Aragonite dissolution
Moldic porosity
Dogtooth spar
Minor overgrowth



Meteoric

Mixing Zone

Marine Burial Realm



Porosity can be created in the marine diagenetic environment

Summary of diagenetic lessons

- *Cementation is occurring within months*
- *Dolomitization is episodic and by sea water*
- *Porosity can be created in marine burial environment*

Conclusions

- Architecture
  - lateral growth potential
  - sea level controls growth and diagenesis
  - unfilled accommodation space creates facies heterogeneities

- Diagenesis
  - cementation within months
  - episodic dolomitization by sea water
  - marine burial diagenesis is equal to meteoric diagenesis