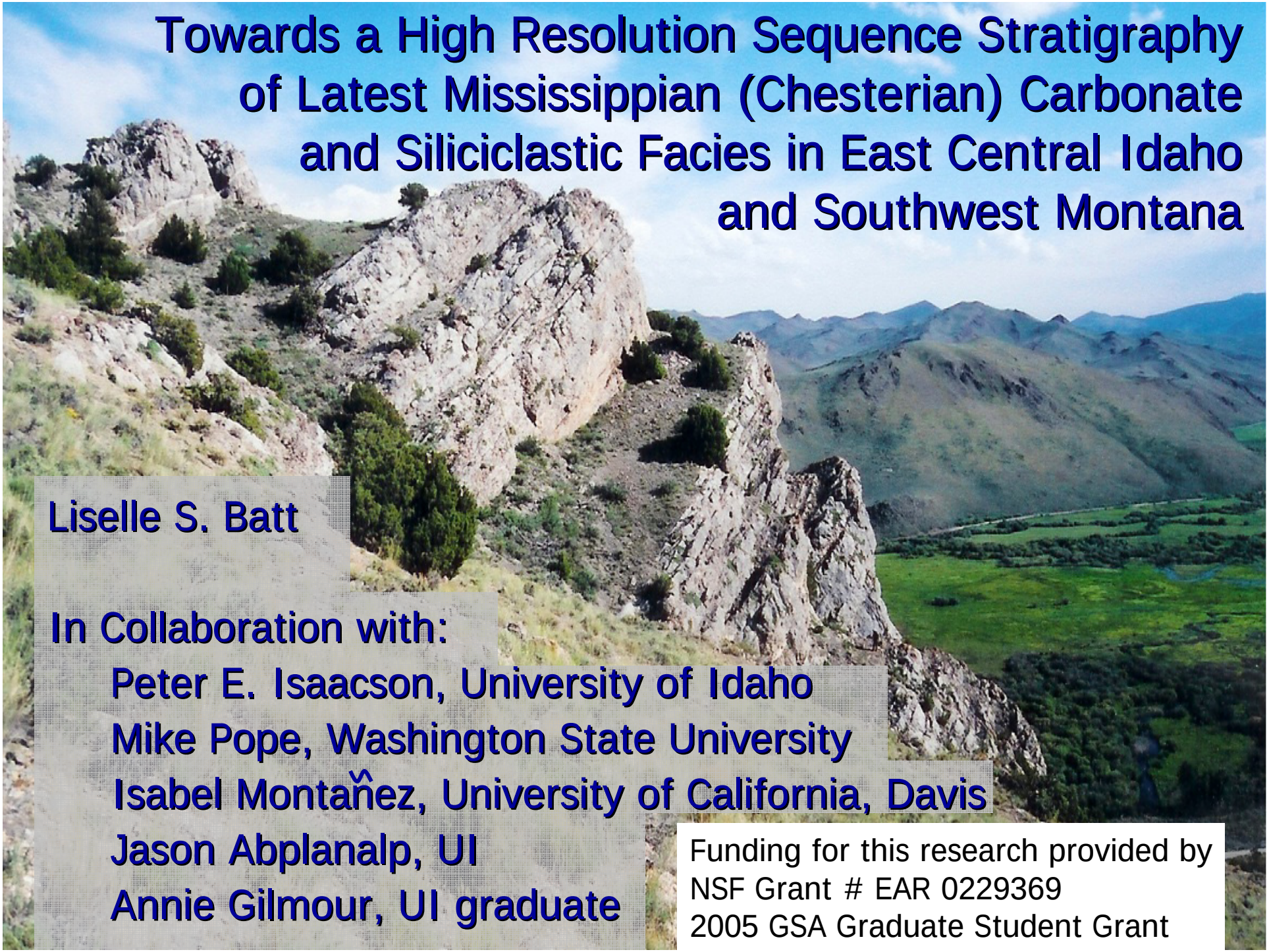
Towards a High Resolution Sequence Stratigraphy of Latest Mississippian (Chesterian) Carbonate and Siliciclastic Facies in East Central Idaho and Southwest Montana



Liselle S. Batt

In Collaboration with:

Peter E. Isaacson, University of Idaho

Mike Pope, Washington State University

Isabel Montañez, University of California, Davis

Jason Abplanalp, UI

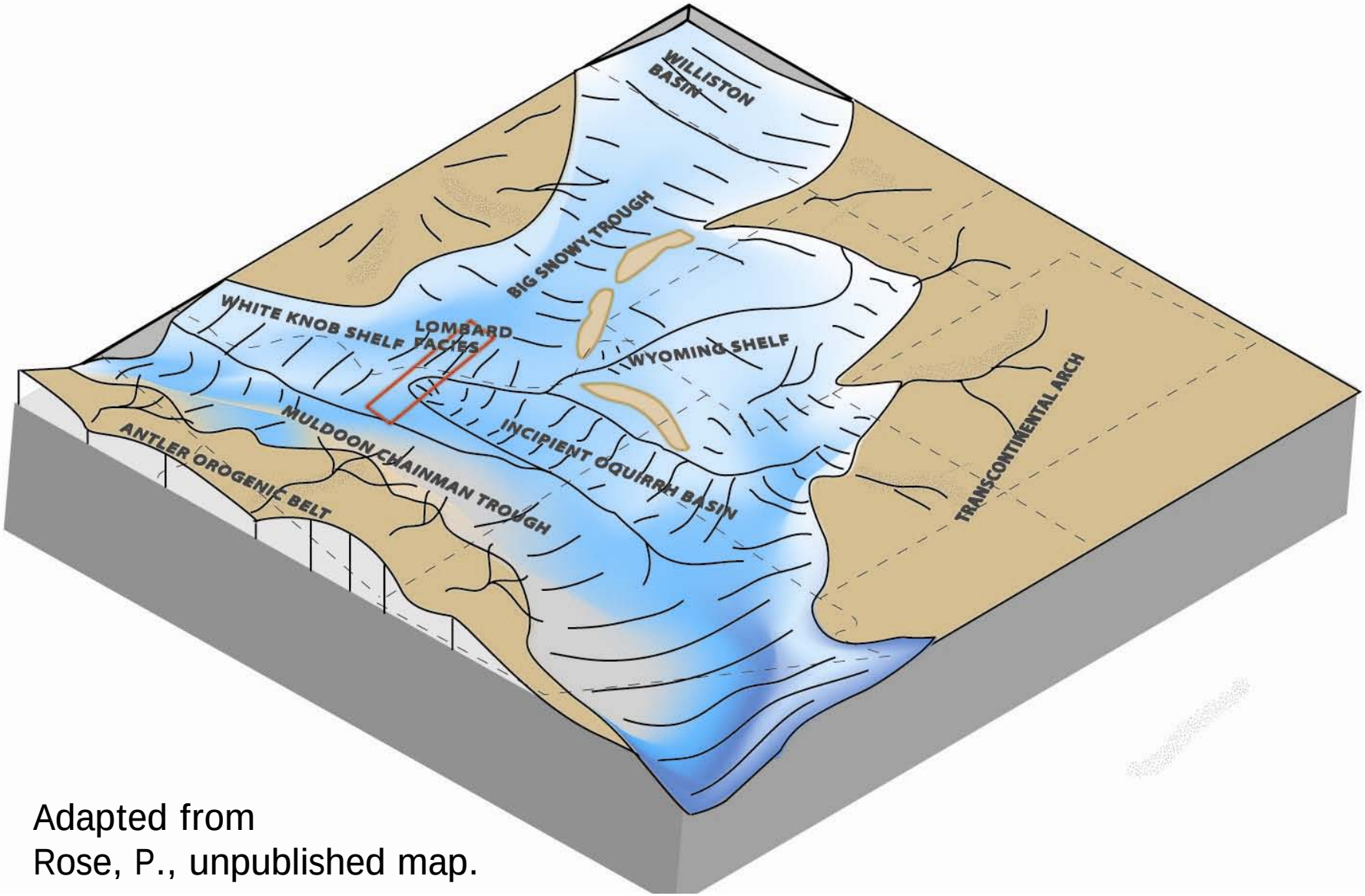
Annie Gilmour, UI graduate

Funding for this research provided by
NSF Grant # EAR 0229369
2005 GSA Graduate Student Grant

Key Points

- Parasequences and parasequence stacking patterns indicate that accommodation decreases up-dip and up-section.
- An overall 2nd order regression is punctuated by higher order tectonic-related subsidence events.
- Laterally discontinuous facies distributions and the presence of an intrashelf basin do NOT indicate a homoclinal ramp profile.
- Siliciclastic influx in the Late Chester may record the initial transition into a global icehouse climate.

Geologic Setting

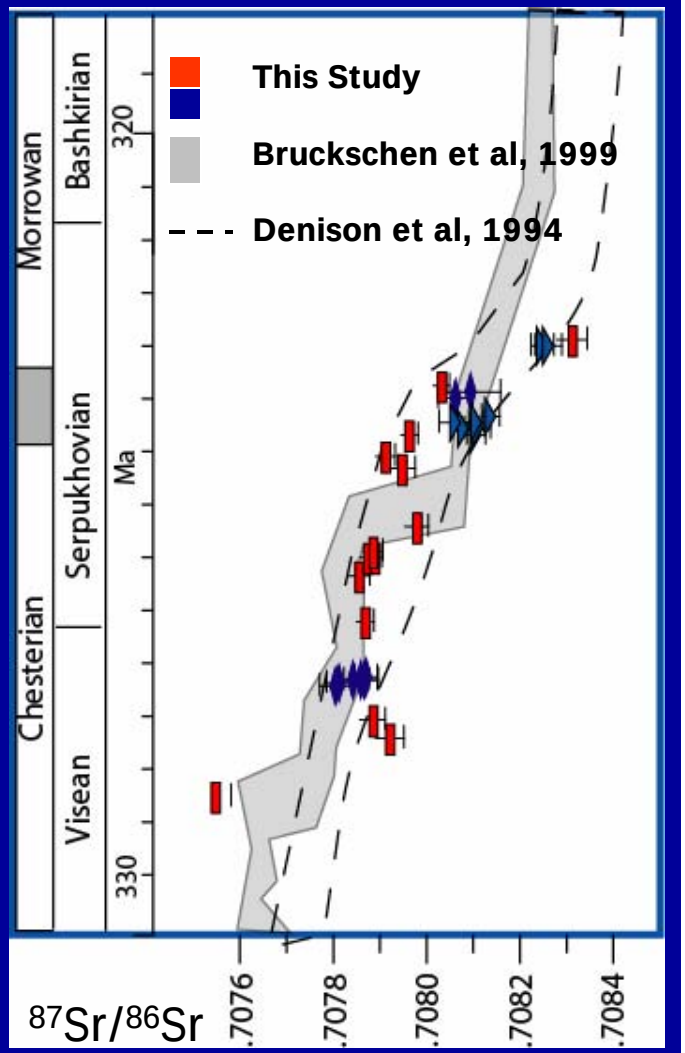


Adapted from
Rose, P., unpublished map.

Chronostratigraphic Framework

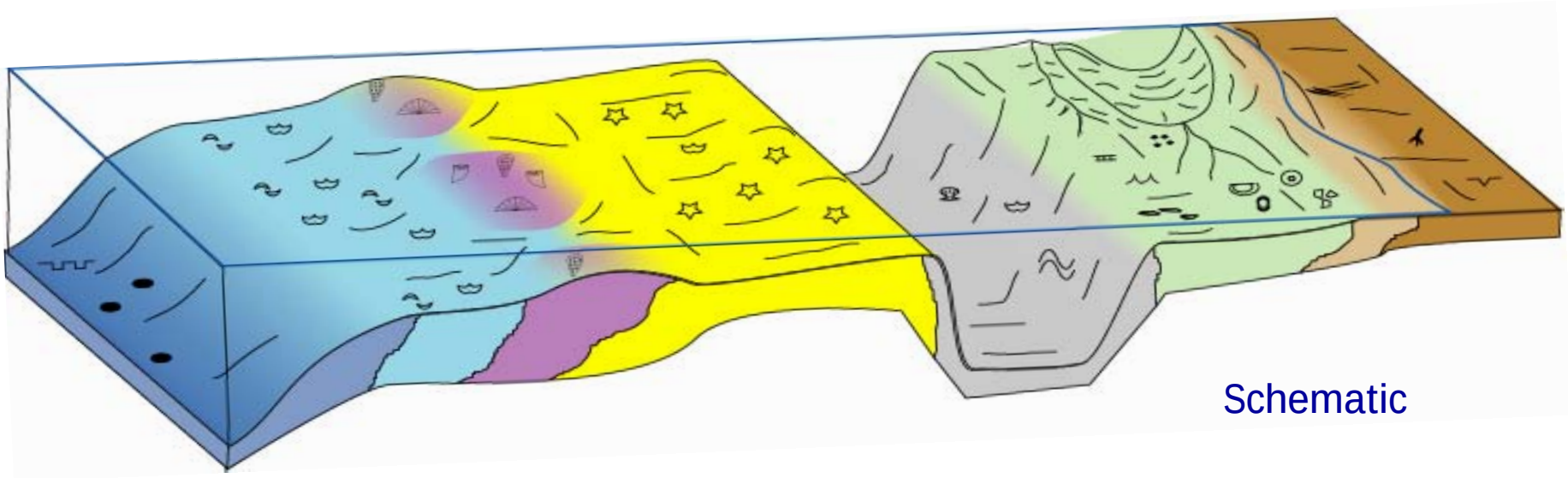
Age: M.Y.A.	Systems (NA)	Series (NA)		Global Foram Zones	Western European Faunal Zones	Western Interior Coral Zones	U.S. Rocky Mountain Megafauna Zones	Conodont Zonation: Western U.S. (Sando, Sandberg, and Gutschick, 1981; Sandberg, 1992))	
310									
318	Penn.	Morr.		20	H2			Not Zoned	5
					H1			R. muricatus	4
	Mississippian		Serpukhovian	19		VI	Post-K	A. unicornis	3
		Chesterian		18	E2			Cavusgnathus naviculus	2
				17	E1	B	K		
326			Visean	16s	V3c	V A		bilineatus - Upper	1
				16i			Pre-K		

Strontium Isotope Curve

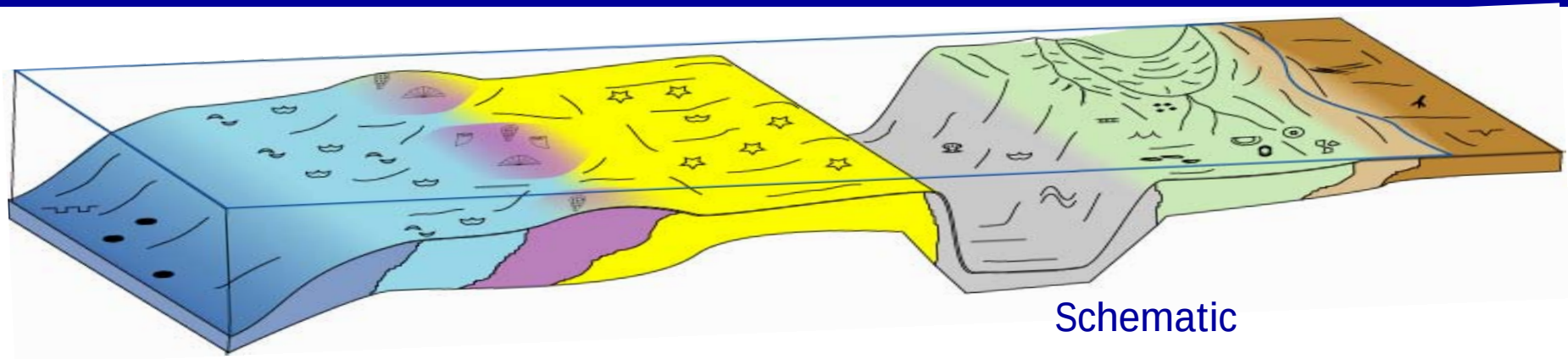


Depositional Facies

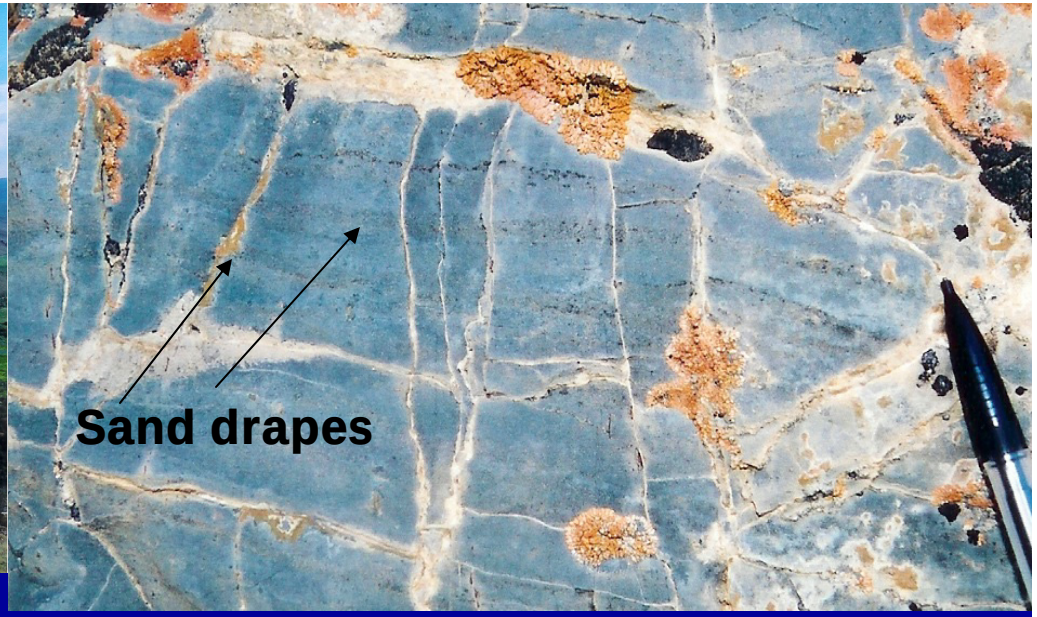
Deep Subtidal	Shallow Subtidal	Skeletal Build-up	Shallow shoal/ shoreface	Intrashelf Facies	Peritidal Facies	Fluvio-estuarine Facies

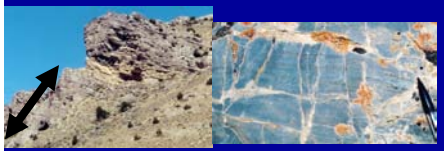


Deep Subtidal	Shallow Subtidal	Skeletal Build-up	Shallow shoal/ shoreface	Intrashelf Facies	Peritidal Facies	Fluvio-estuarine Facies

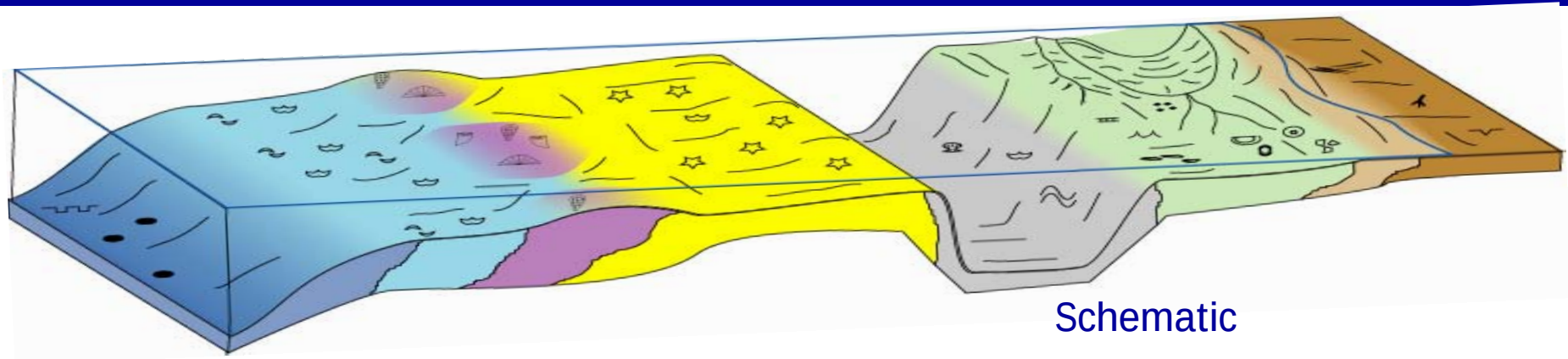


Schematic



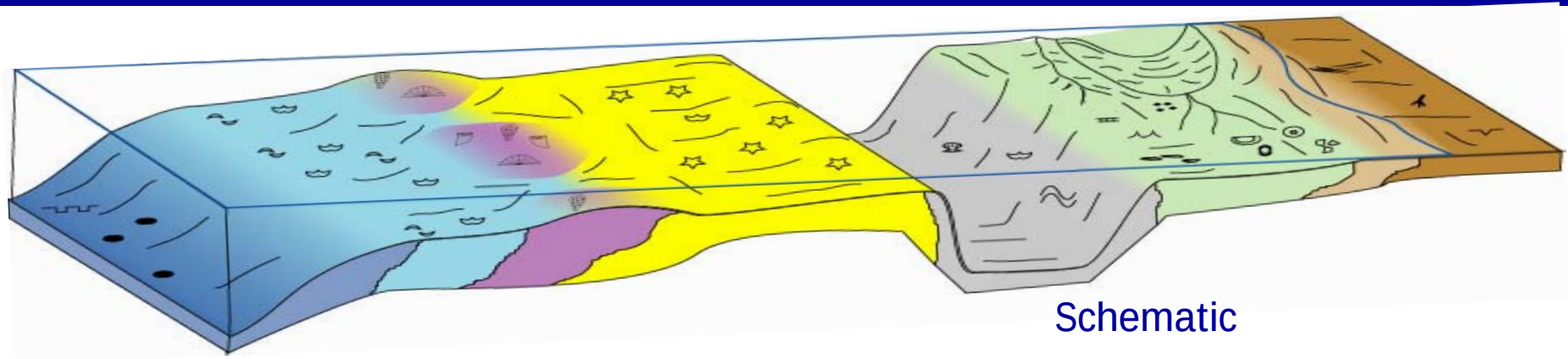


Deep Subtidal | Shallow Subtidal | Skeletal Build-up | Shallow shoal/ shoreface | Intrashelf Facies | Peritidal Facies | Fluvio-estuarine Facies



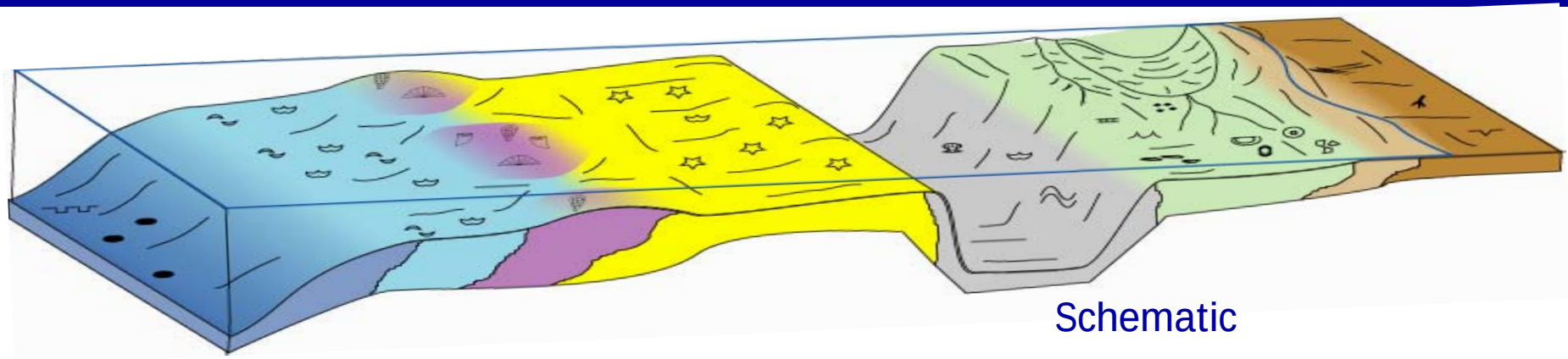
Schematic

Deep Subtidal	Shallow Subtidal	Skeletal Build-up	Shallow shoal/ shoreface	Intrashelf Facies	Peritidal Facies	Fluvio-estuarine Facies

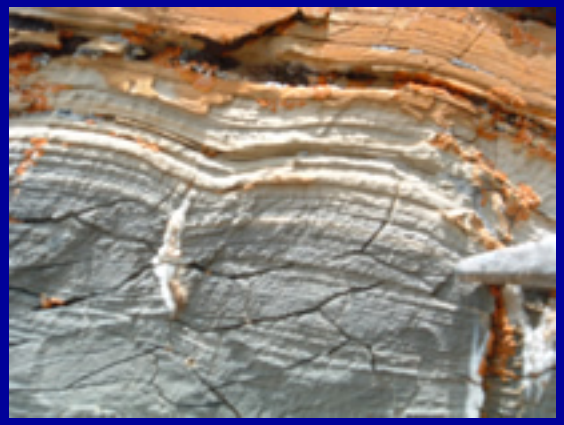


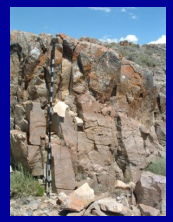
Schematic

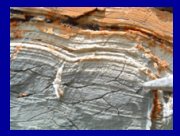
Deep Subtidal	Shallow Subtidal	Skeletal Build-up	Shallow shoal/ shoreface	Intrashelf Facies	Peritidal Facies	Fluvio-estuarine Facies



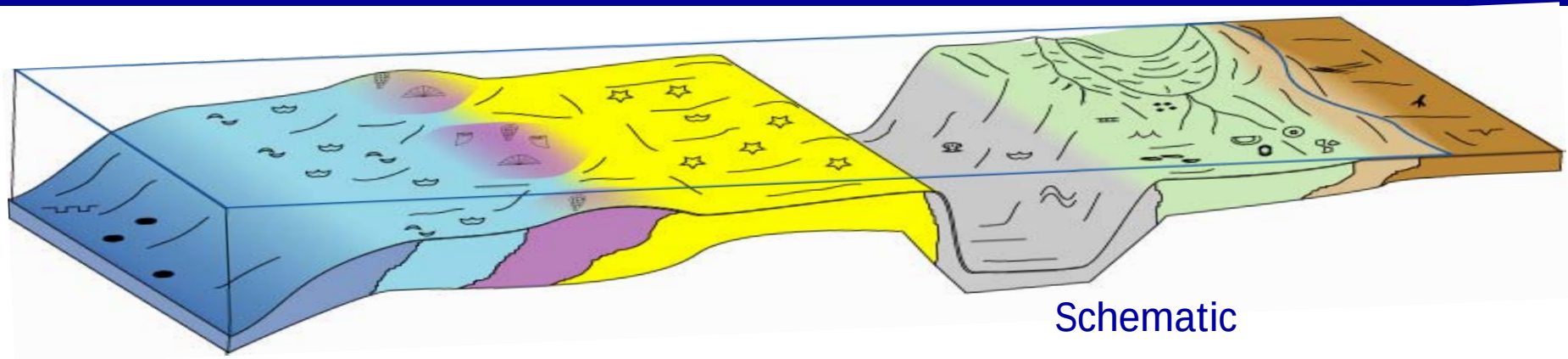
Schematic



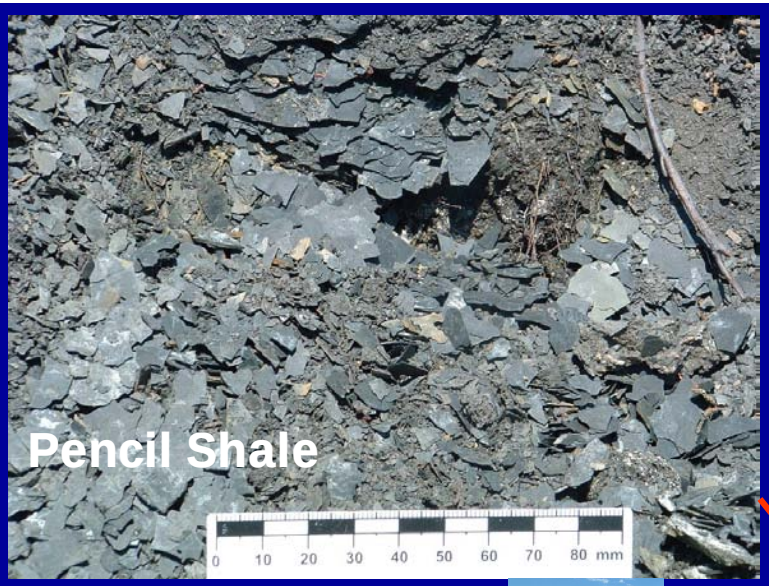




Deep Subtidal	Shallow Subtidal	Skeletal Build-up	Shallow shoal/ shoreface	Intrashelf Facies	Peritidal Facies	Fluvio-estuarine Facies

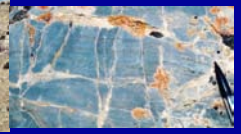


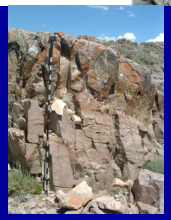
Schematic

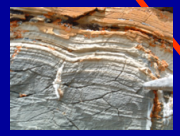


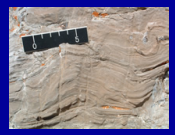
Stromatolite

Intraclast Carbonate Conglomerate

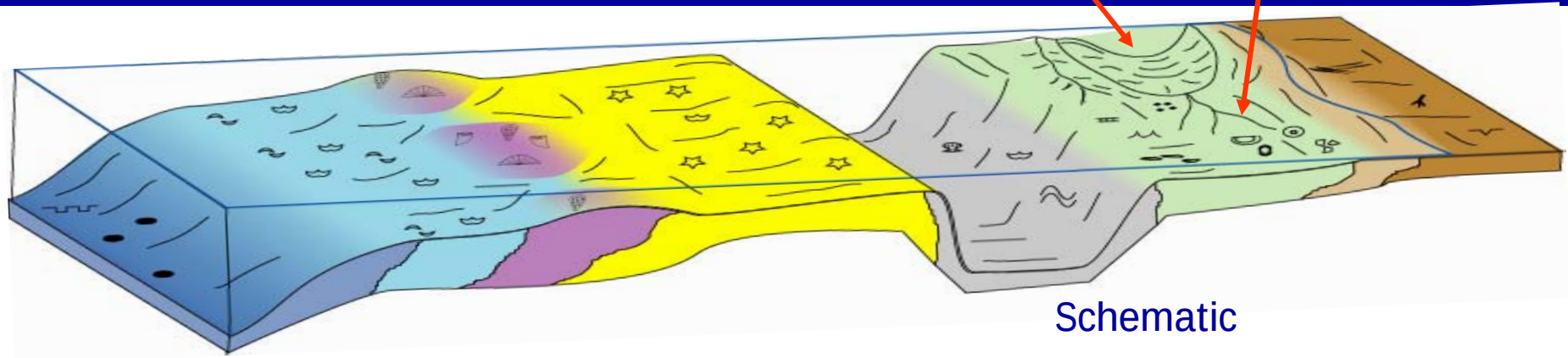




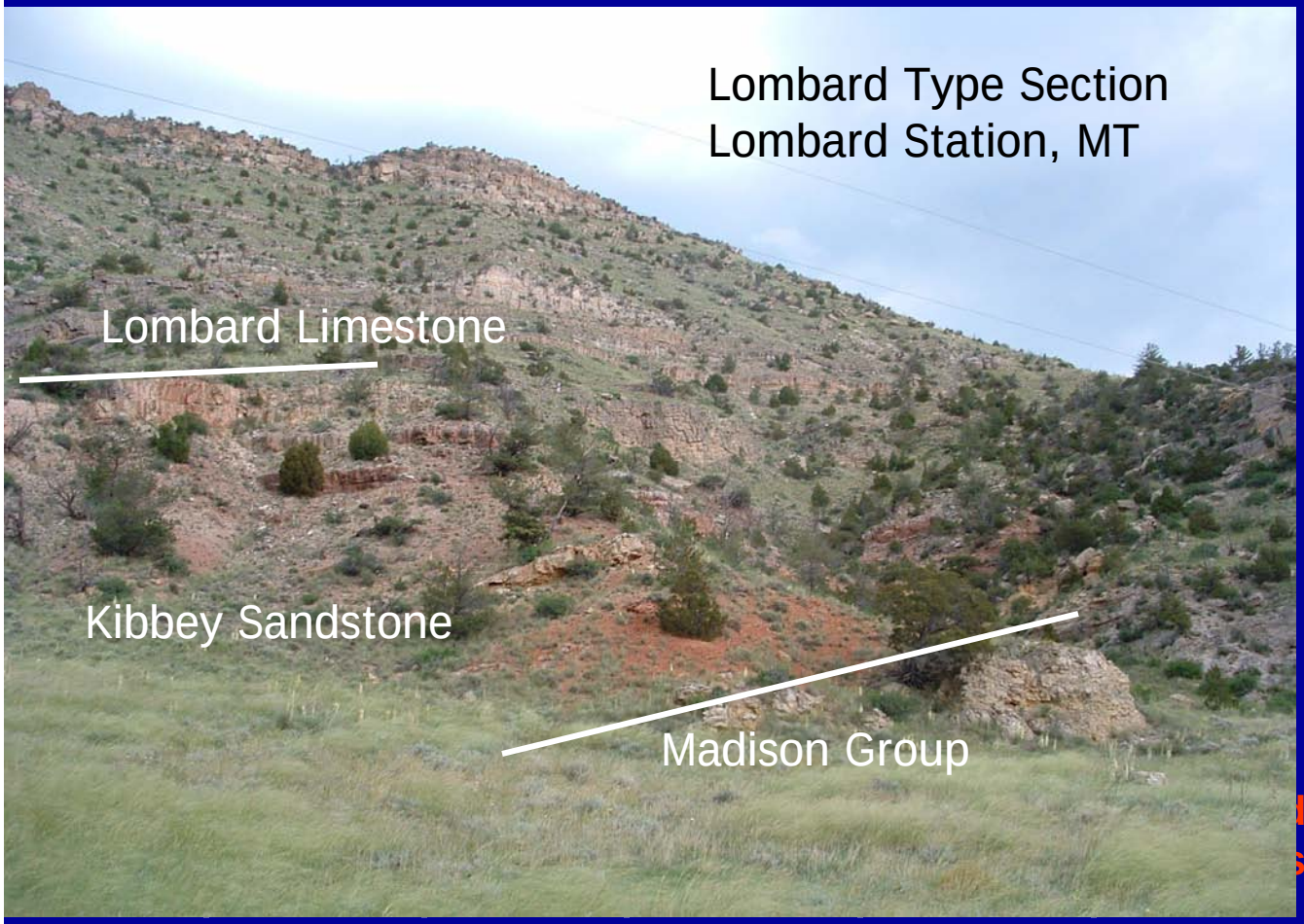




Deep Subtidal | Shallow Subtidal | Skeletal Build-up | Shallow shoal/ shoreface | Intrashelf Facies | Peritidal Facies | Fluvio-estuarine Facies

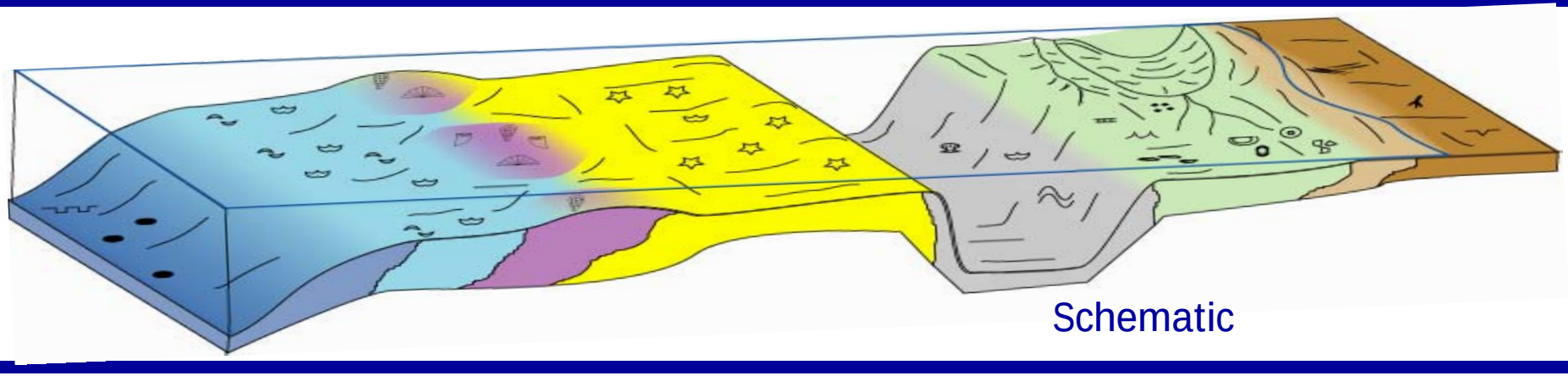


Schematic



Cross-bedding
Kibbey SS

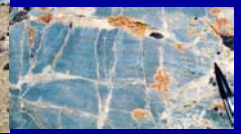
Fluvio-estuarine Facies



Schematic

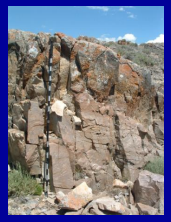
Depositional Facies

Deep Subtidal

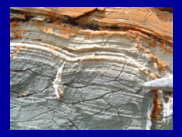


Shallow Subtidal

Skeletal Build-up



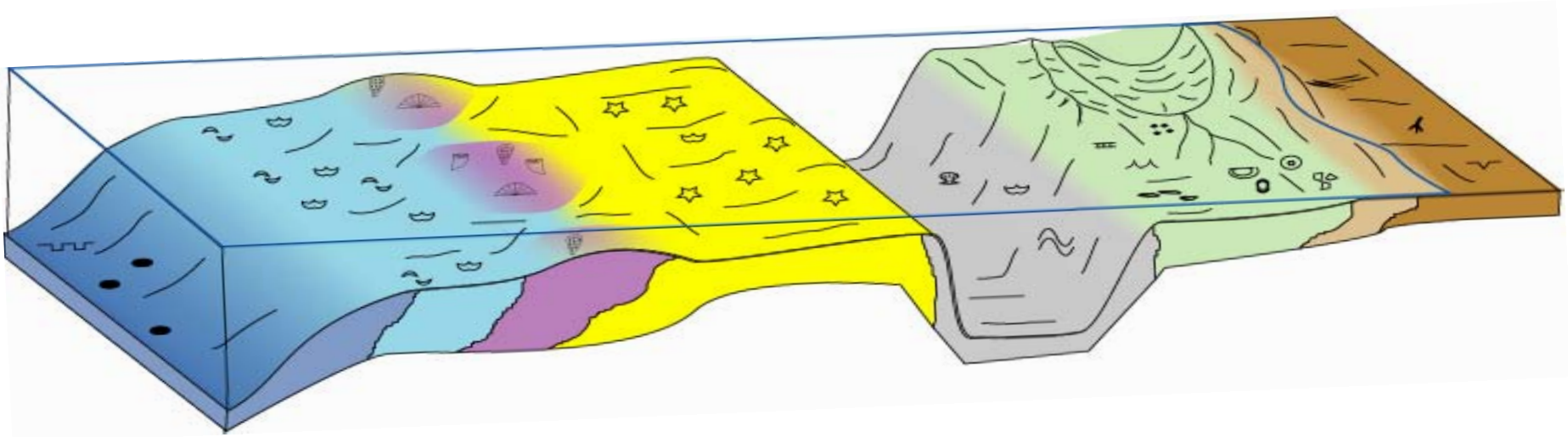
Shallow shoal/ shoreface

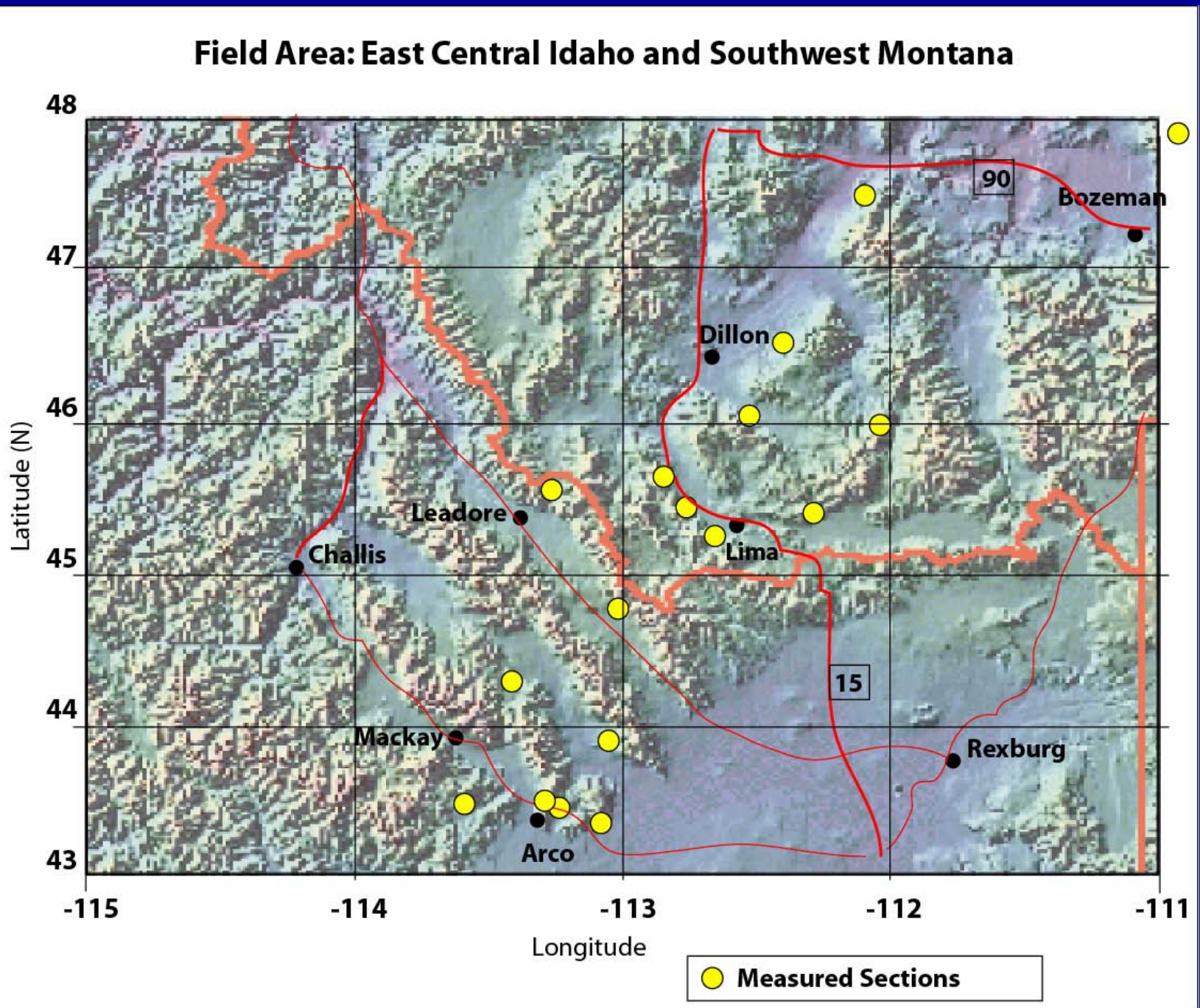


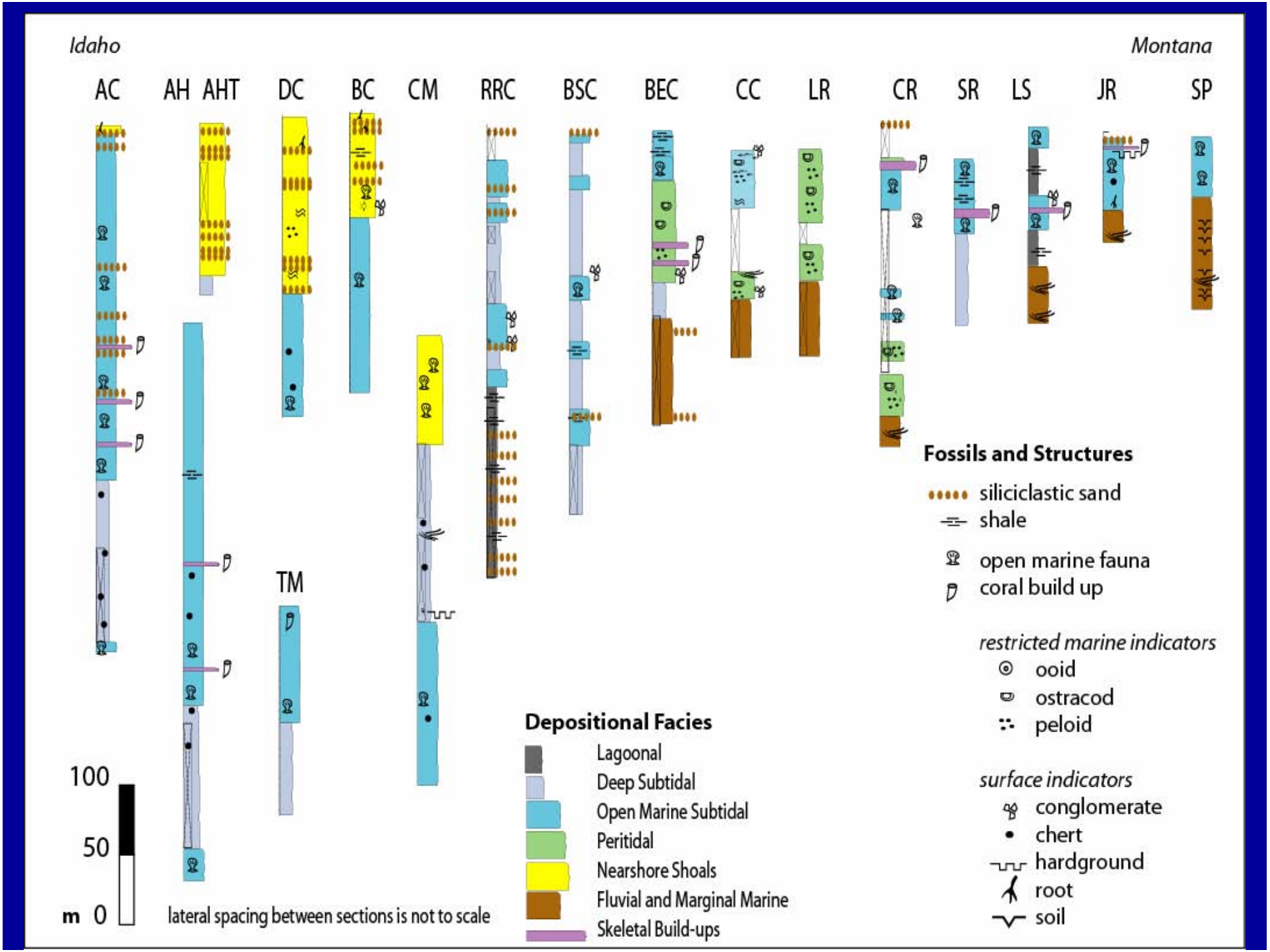
Intrashelf Facies

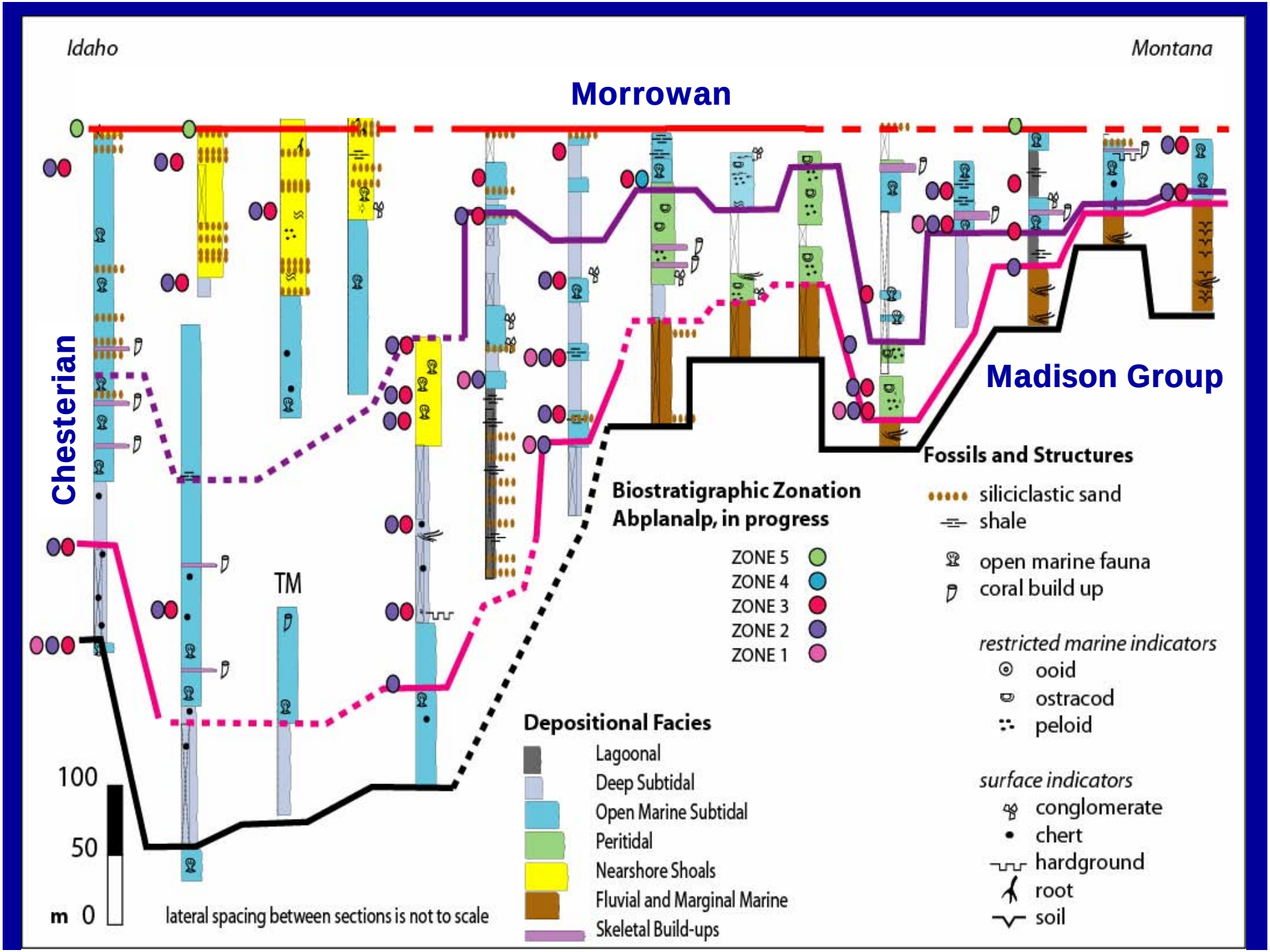
Peritidal Facies

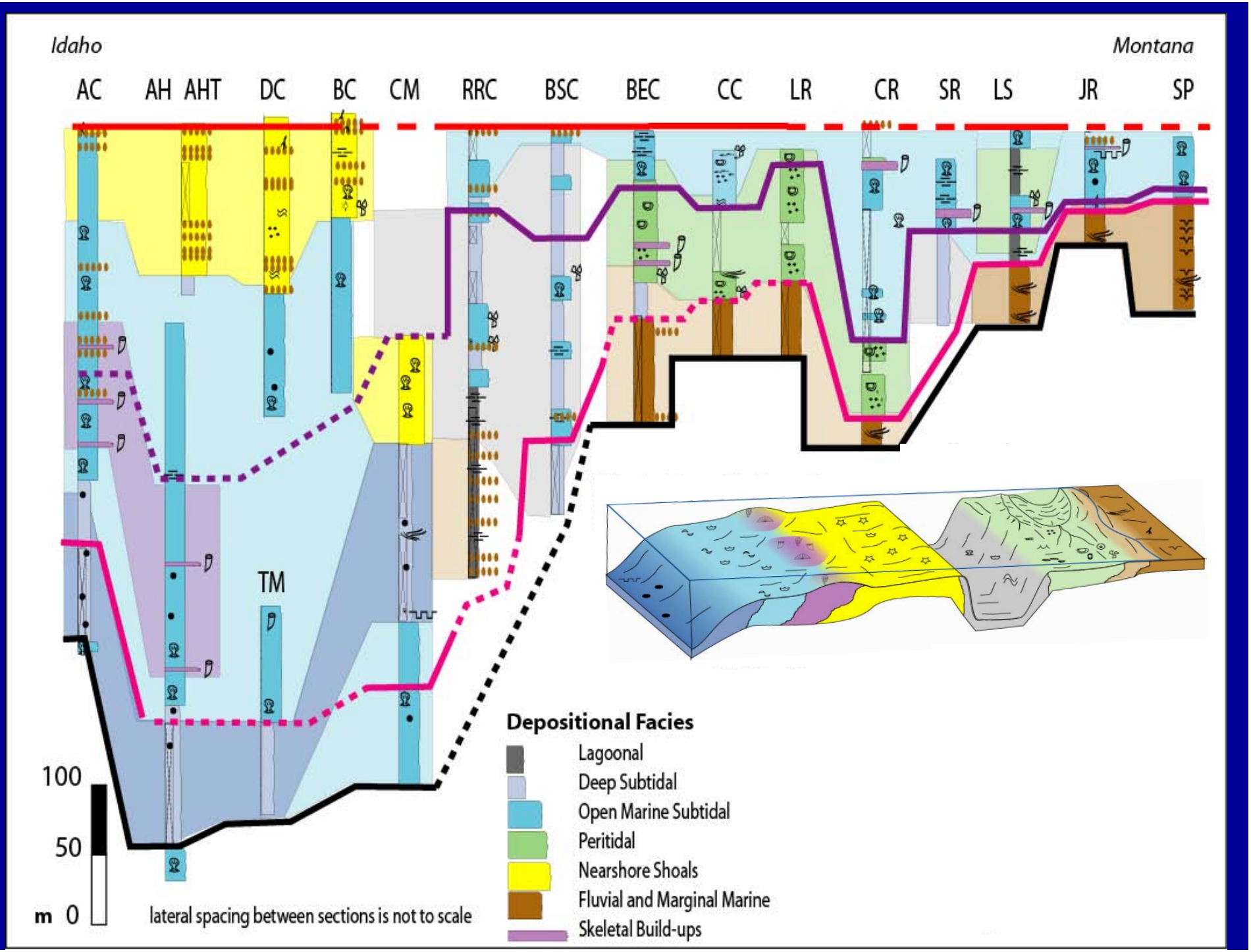
Fluvio-estuarine Facies

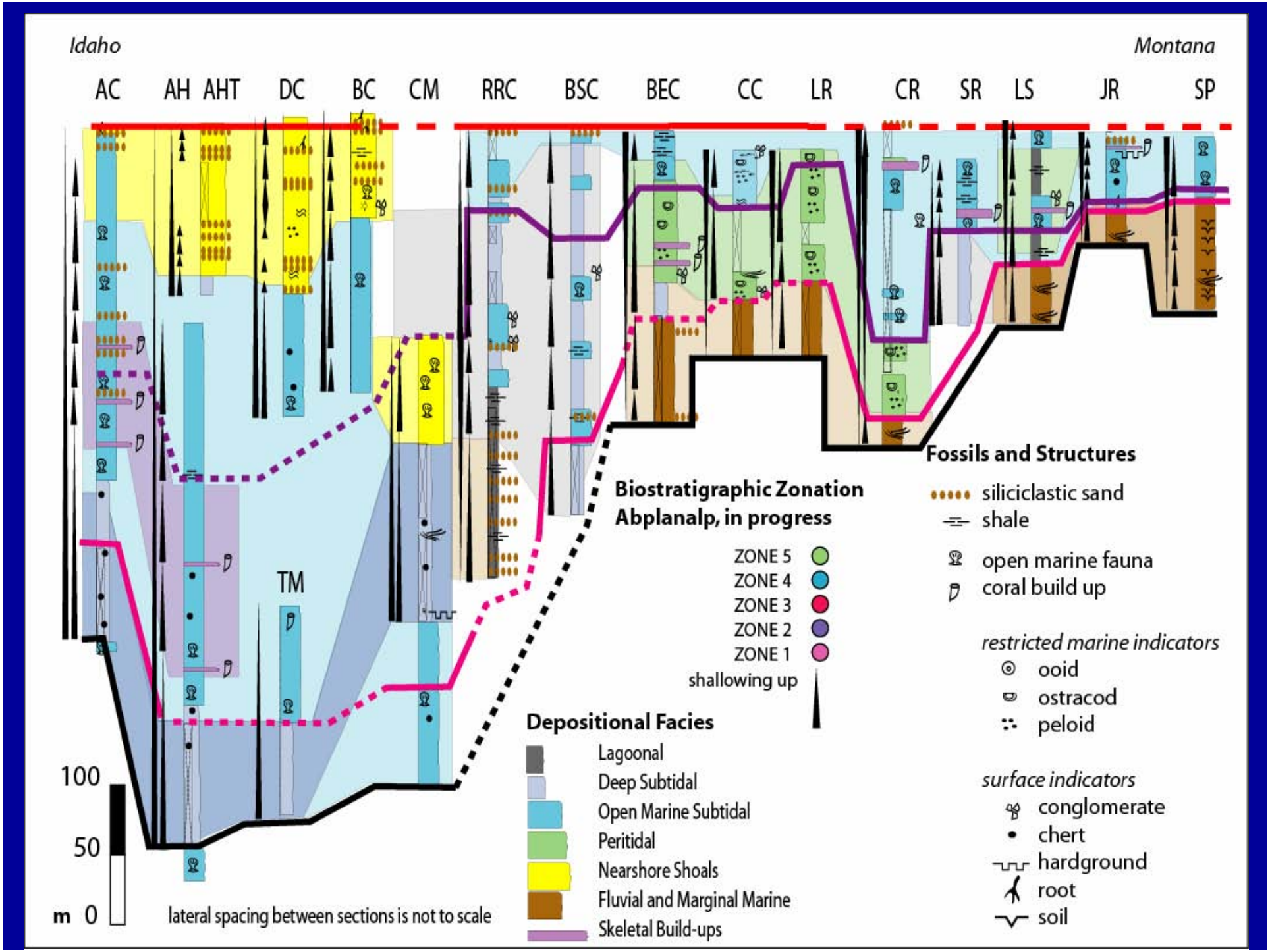


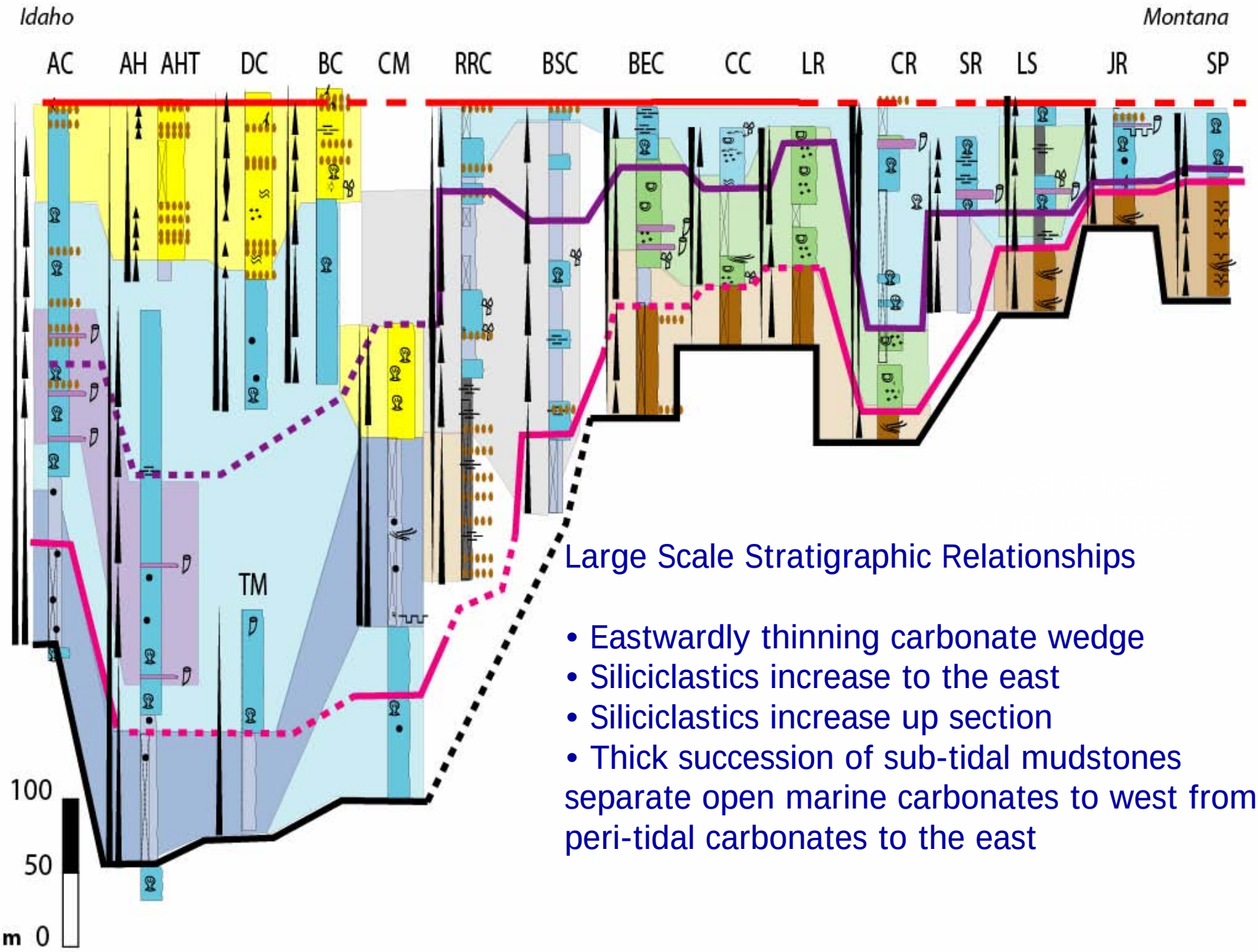

Field Area: East Central Idaho and Southwest Montana
48
47
46
45
44
43
Latitude (N)
-115
-114
-113
-112
-111
Longitude
90
15
Bozeman
Dillon
Leadore
Challis
Lima
Mackay
Rexburg
Arco
Measured Sections


Idaho
Montana
AC
AH
AHT
DC
BC
CM
RRC
BSC
BEC
CC
LR
CR
SR
LS
JR
SP
TM
100
50
m 0
lateral spacing between sections is not to scale
Depositional Facies
Lagoonal
Deep Subtidal
Open Marine Subtidal
Peritidal
Nearshore Shoals
Fluvial and Marginal Marine
Skeletal Build-ups
Fossils and Structures
siliciclastic sand
shale
open marine fauna
coral build up
restricted marine indicators
ooid
ostracod
peloid
surface indicators
conglomerate
chert
hardground
root
soil


Idaho
Montana
Morrowan
Chesterian
Madison Group
TM
Biostratigraphic Zonation
Abplanalp, in progress
ZONE 5
ZONE 4
ZONE 3
ZONE 2
ZONE 1
Fossils and Structures
siliciclastic sand
shale
open marine fauna
coral build up
restricted marine indicators
ooid
ostracod
peloid
surface indicators
conglomerate
chert
hardground
root
soil
Depositional Facies
Lagoonal
Deep Subtidal
Open Marine Subtidal
Peritidal
Nearshore Shoals
Fluvial and Marginal Marine
Skeletal Build-ups
100
50
m 0
lateral spacing between sections is not to scale

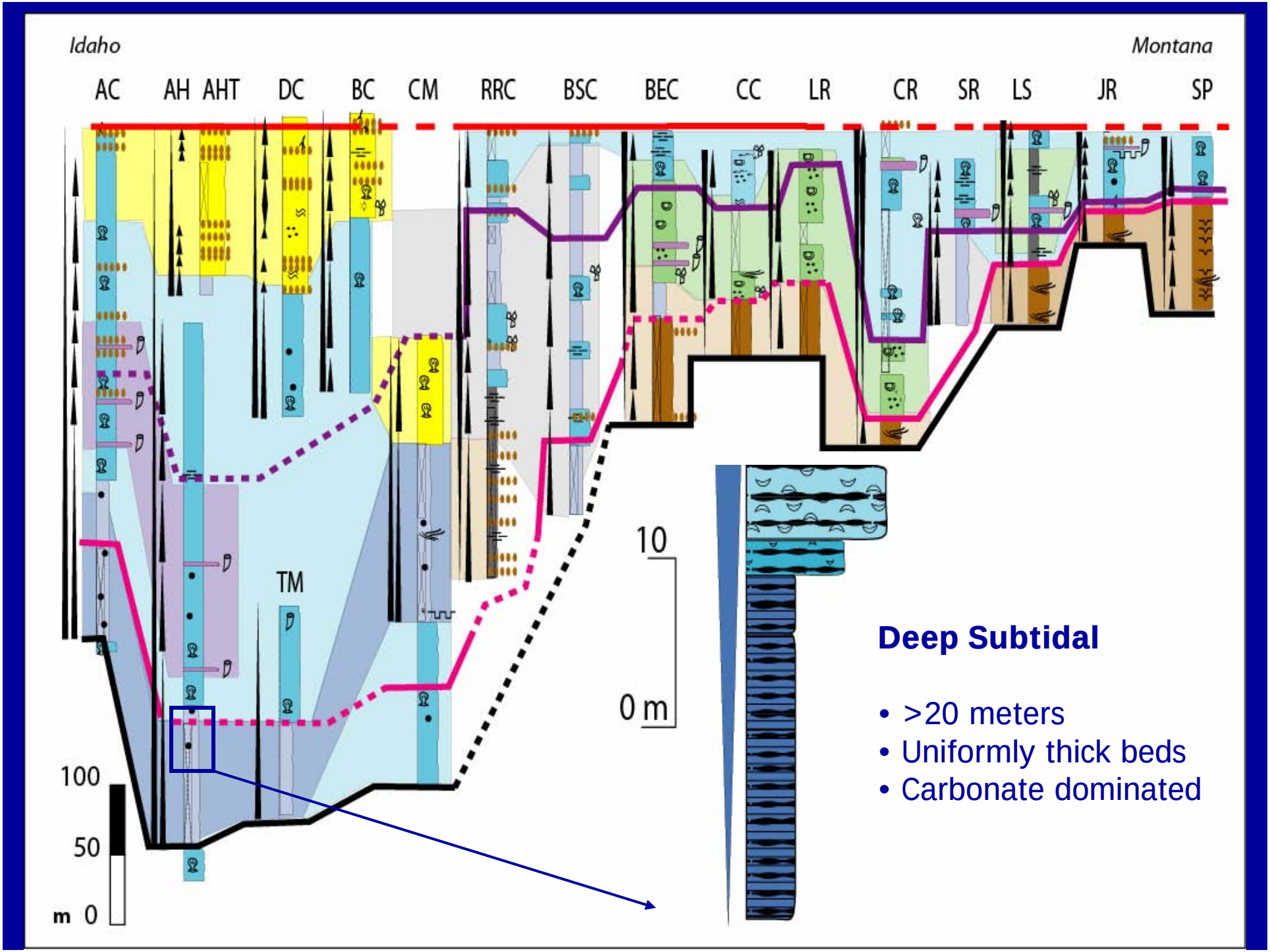

Idaho
Montana
AC
AH
AHT
DC
BC
CM
RRC
BSC
BEC
CC
LR
CR
SR
LS
JR
SP
TM
100
50
m 0
lateral spacing between sections is not to scale
Depositional Facies
Lagoonal
Deep Subtidal
Open Marine Subtidal
Peritidal
Nearshore Shoals
Fluvial and Marginal Marine
Skeletal Build-ups

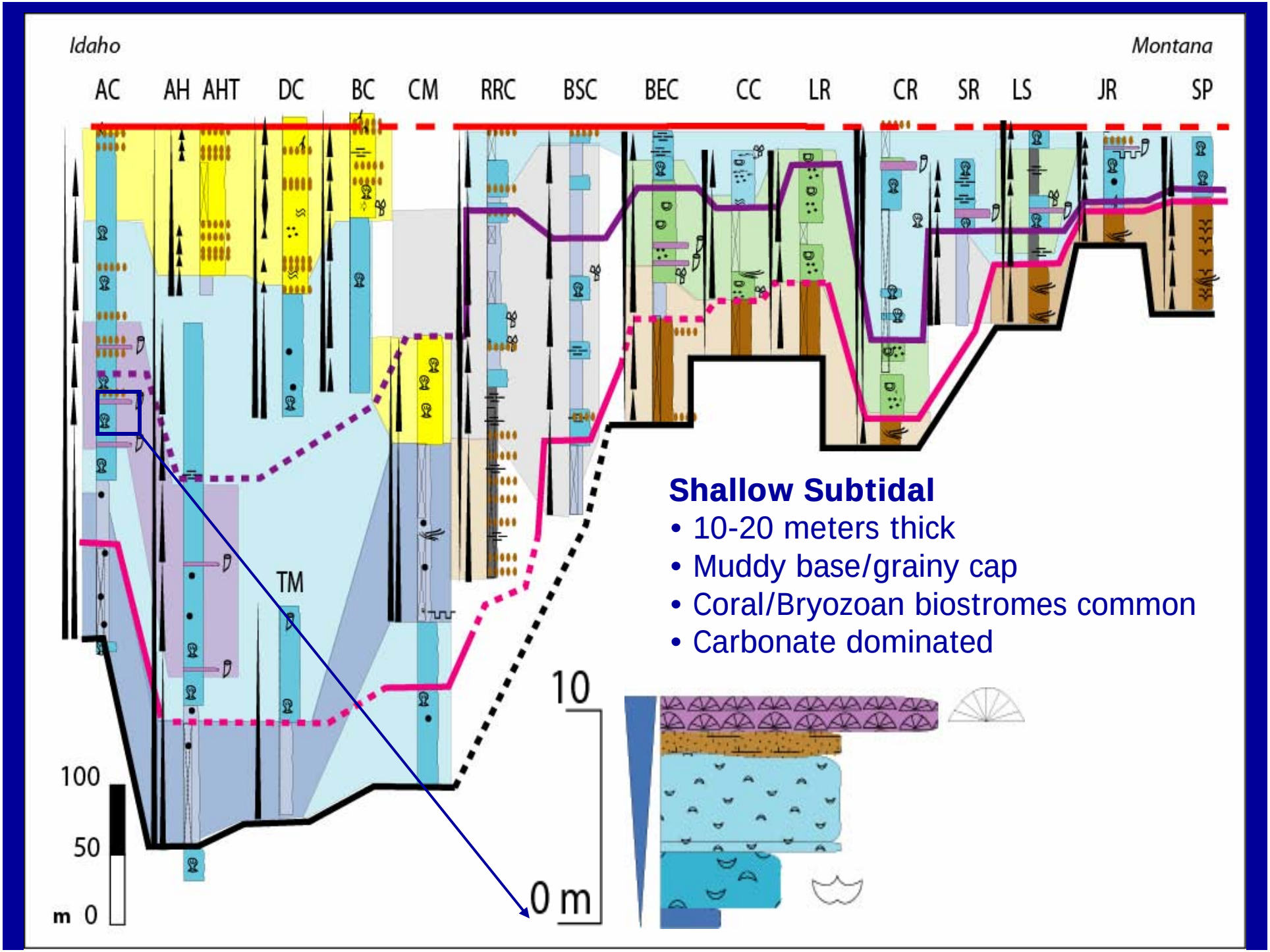

Idaho
Montana
AC
AH
AHT
DC
BC
CM
RRC
BSC
BEC
CC
LR
CR
SR
LS
JR
SP
TM
Biostratigraphic Zonation
Abplanalp, in progress
ZONE 5
ZONE 4
ZONE 3
ZONE 2
ZONE 1
shallowing up
Depositional Facies
Lagoonal
Deep Subtidal
Open Marine Subtidal
Peritidal
Nearshore Shoals
Fluvial and Marginal Marine
Skeletal Build-ups
Fossils and Structures
siliciclastic sand
shale
open marine fauna
coral build up
restricted marine indicators
ooid
ostracod
peloid
surface indicators
conglomerate
chert
hardground
root
soil
100
50
m 0
lateral spacing between sections is not to scale

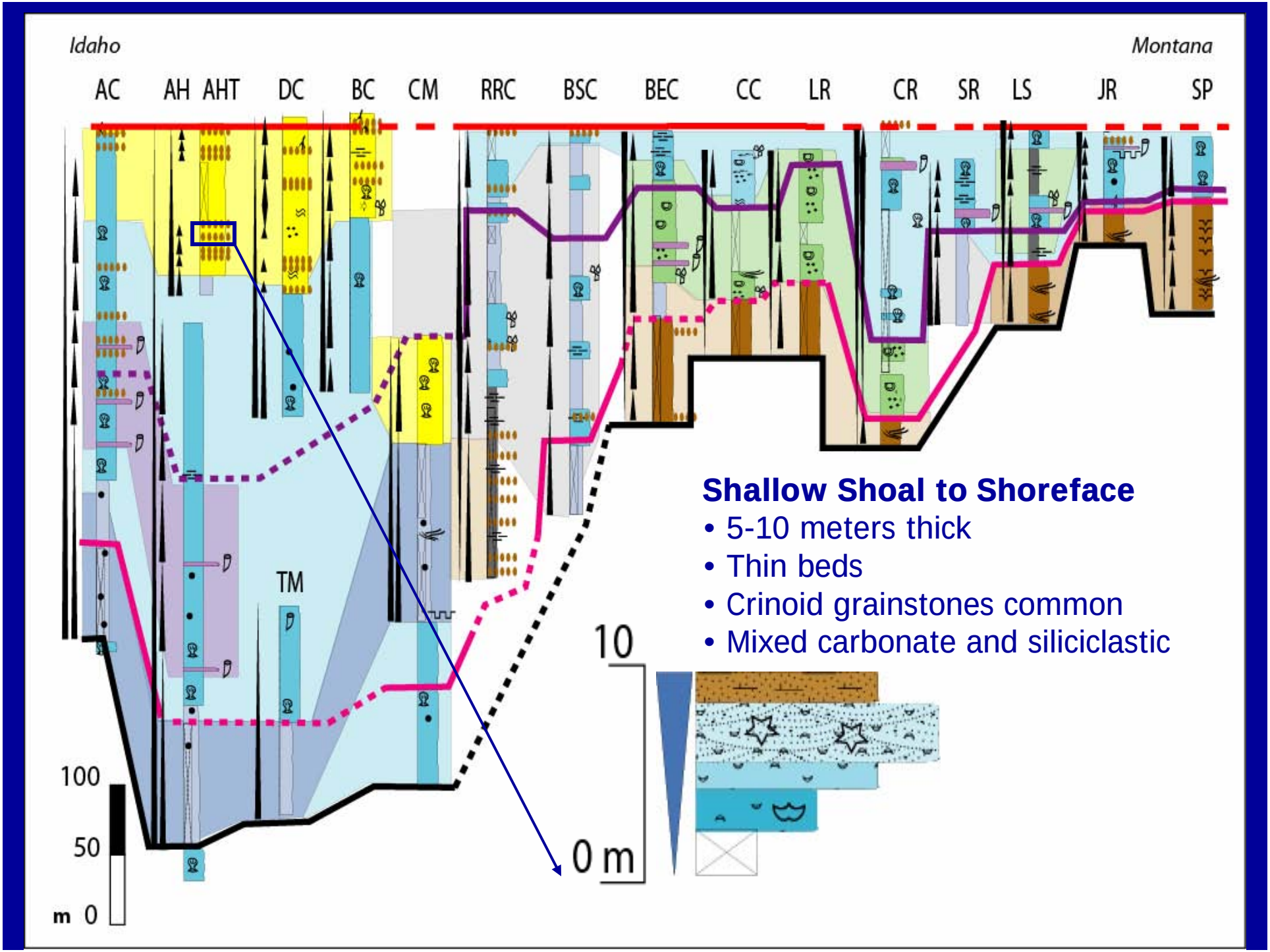


Large Scale Stratigraphic Relationships

- Eastwardly thinning carbonate wedge
- Siliciclastics increase to the east
- Siliciclastics increase up section
- Thick succession of sub-tidal mudstones separate open marine carbonates to west from peri-tidal carbonates to the east

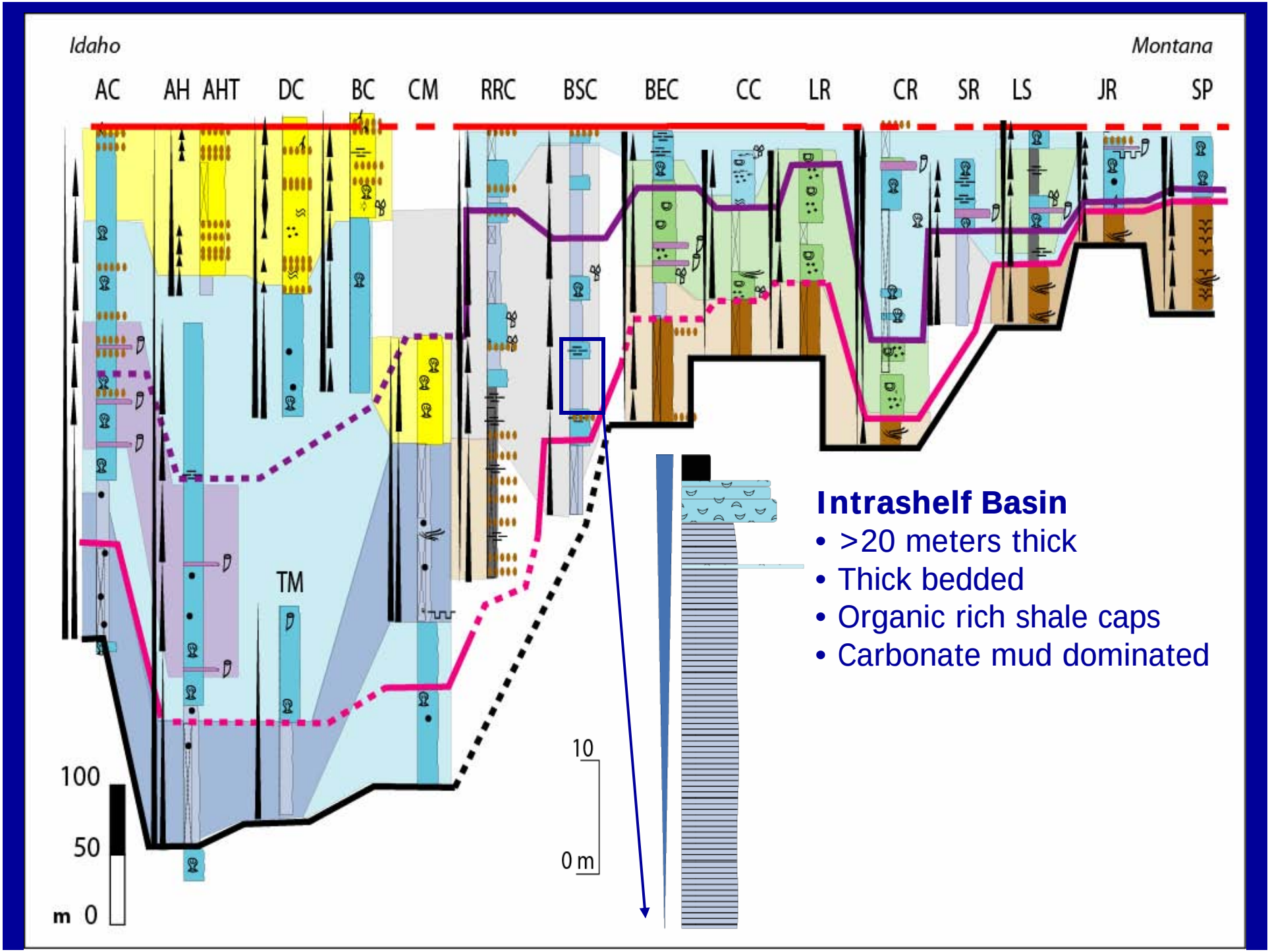

Idaho
Montana
AC
AH
AHT
DC
BC
CM
RRC
BSC
BEC
CC
LR
CR
SR
LS
JR
SP
TM
10
0 m
100
50
m 0
Deep Subtidal
• >20 meters
• Uniformly thick beds
• Carbonate dominated

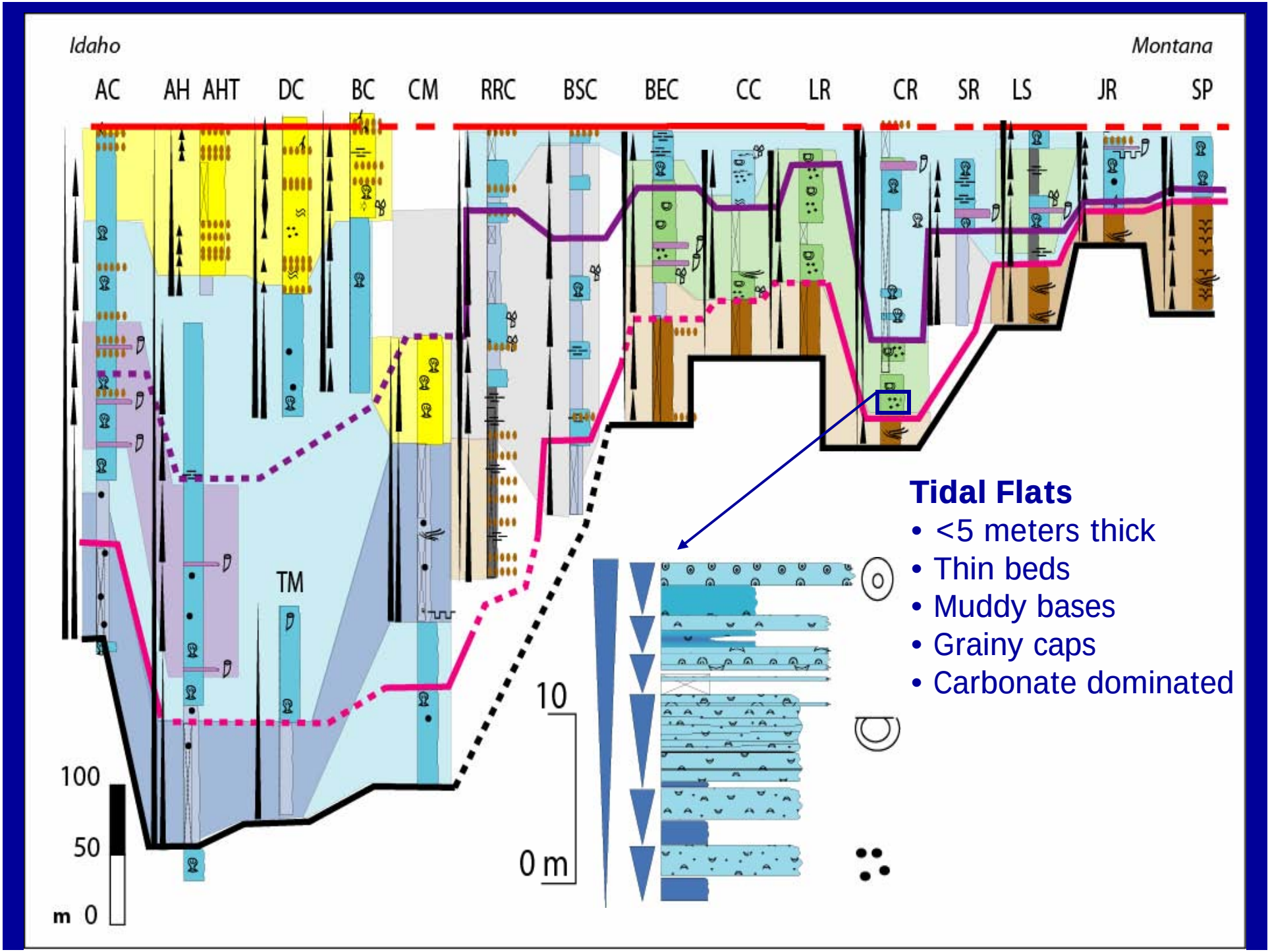

Idaho
Montana
AC
AH
AHT
DC
BC
CM
RRC
BSC
BEC
CC
LR
CR
SR
LS
JR
SP
TM
100
50
m 0
10
0 m
Shallow Subtidal
• 10-20 meters thick
• Muddy base/grainy cap
• Coral/Bryozoan biostromes common
• Carbonate dominated

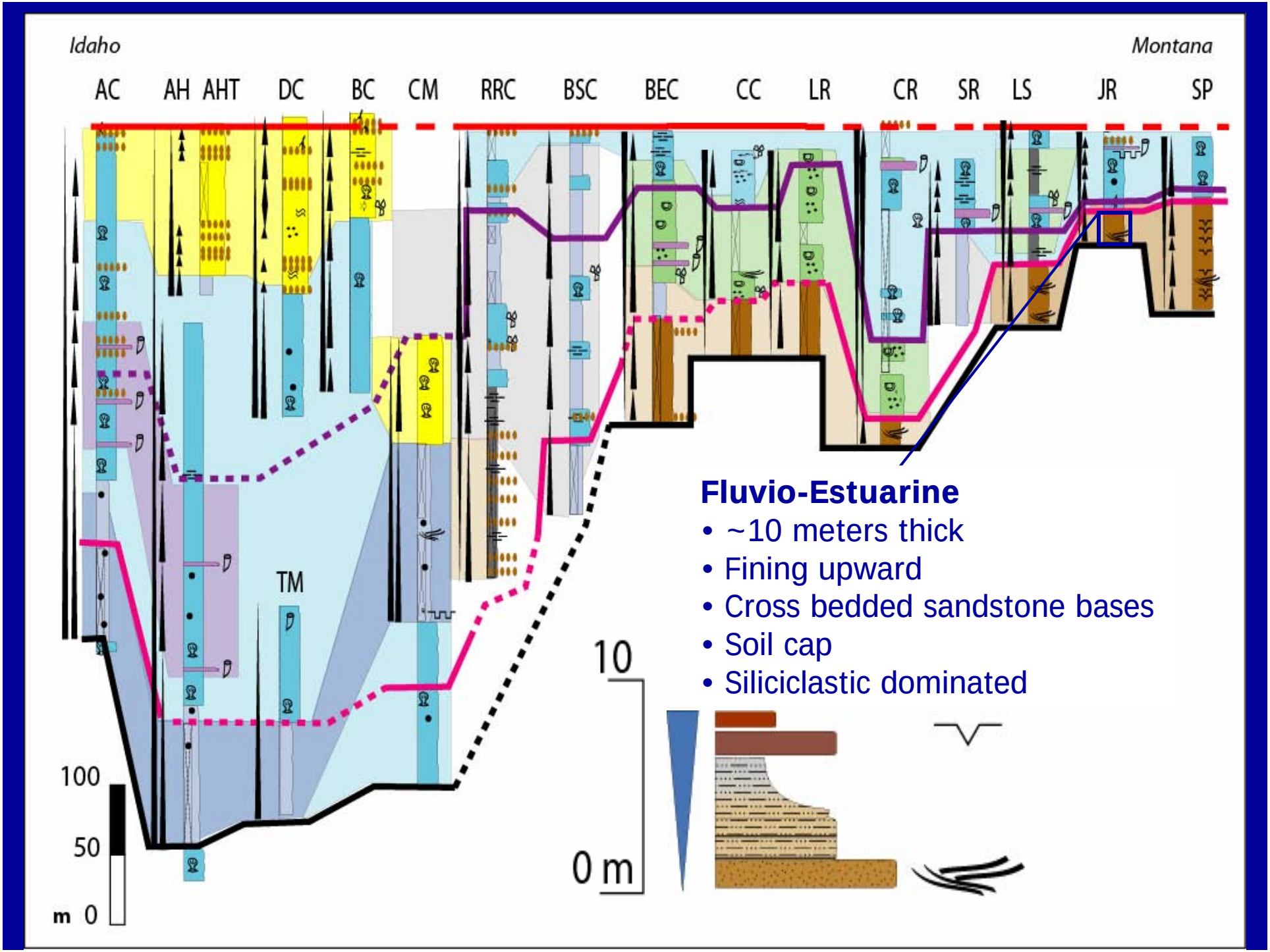


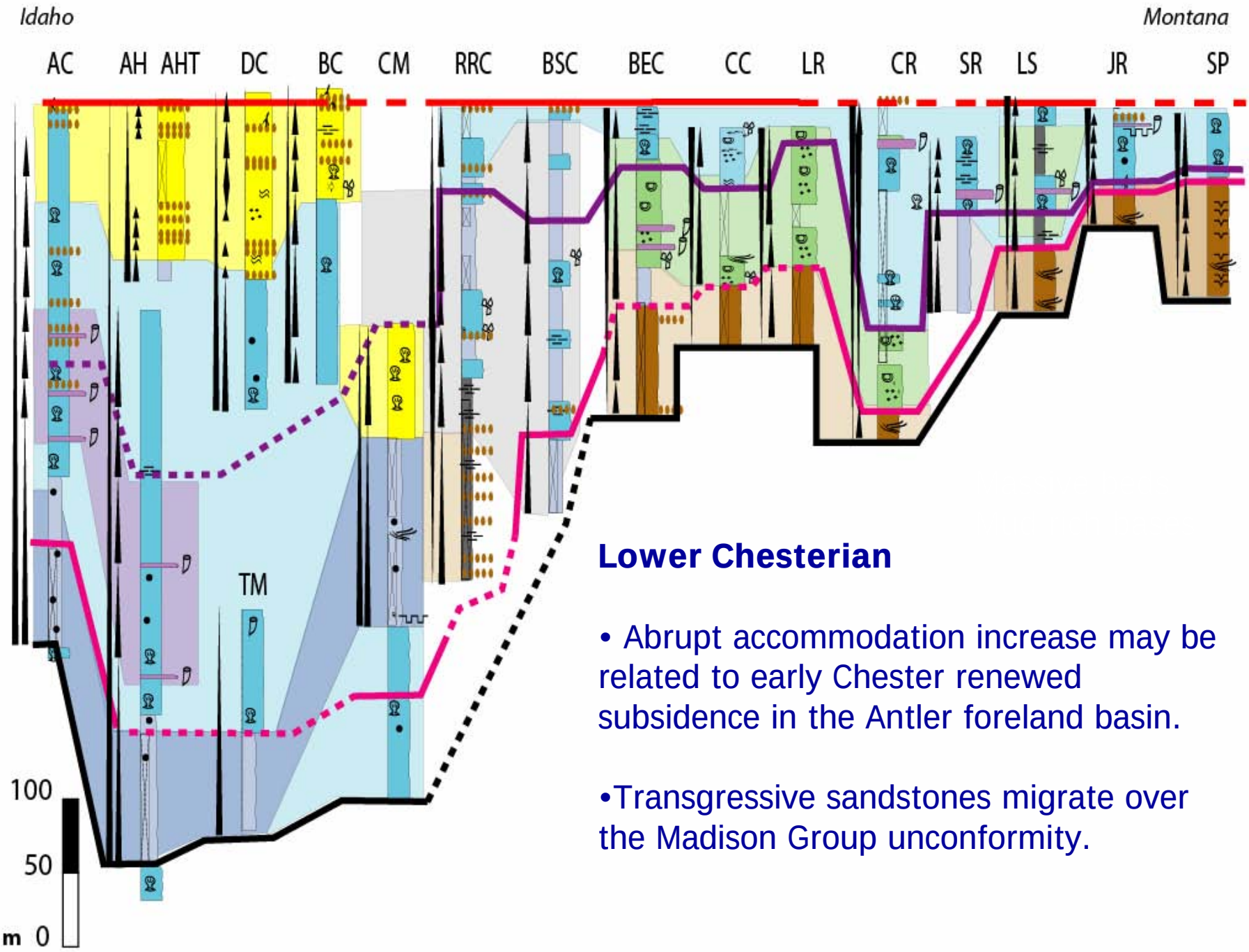
Shallow Shoal to Shoreface

- 5-10 meters thick
- Thin beds
- Crinoid grainstones common
- Mixed carbonate and siliciclastic


Idaho
Montana
AC
AH
AHT
DC
BC
CM
RRC
BSC
BEC
CC
LR
CR
SR
LS
JR
SP
TM
100
50
m 0
10
0 m
Intrashelf Basin
• >20 meters thick
• Thick bedded
• Organic rich shale caps
• Carbonate mud dominated


Idaho
Montana
AC
AH
AHT
DC
BC
CM
RRC
BSC
BEC
CC
LR
CR
SR
LS
JR
SP
TM
100
50
m 0
10
0 m
Tidal Flats
• <5 meters thick
• Thin beds
• Muddy bases
• Grainy caps
• Carbonate dominated

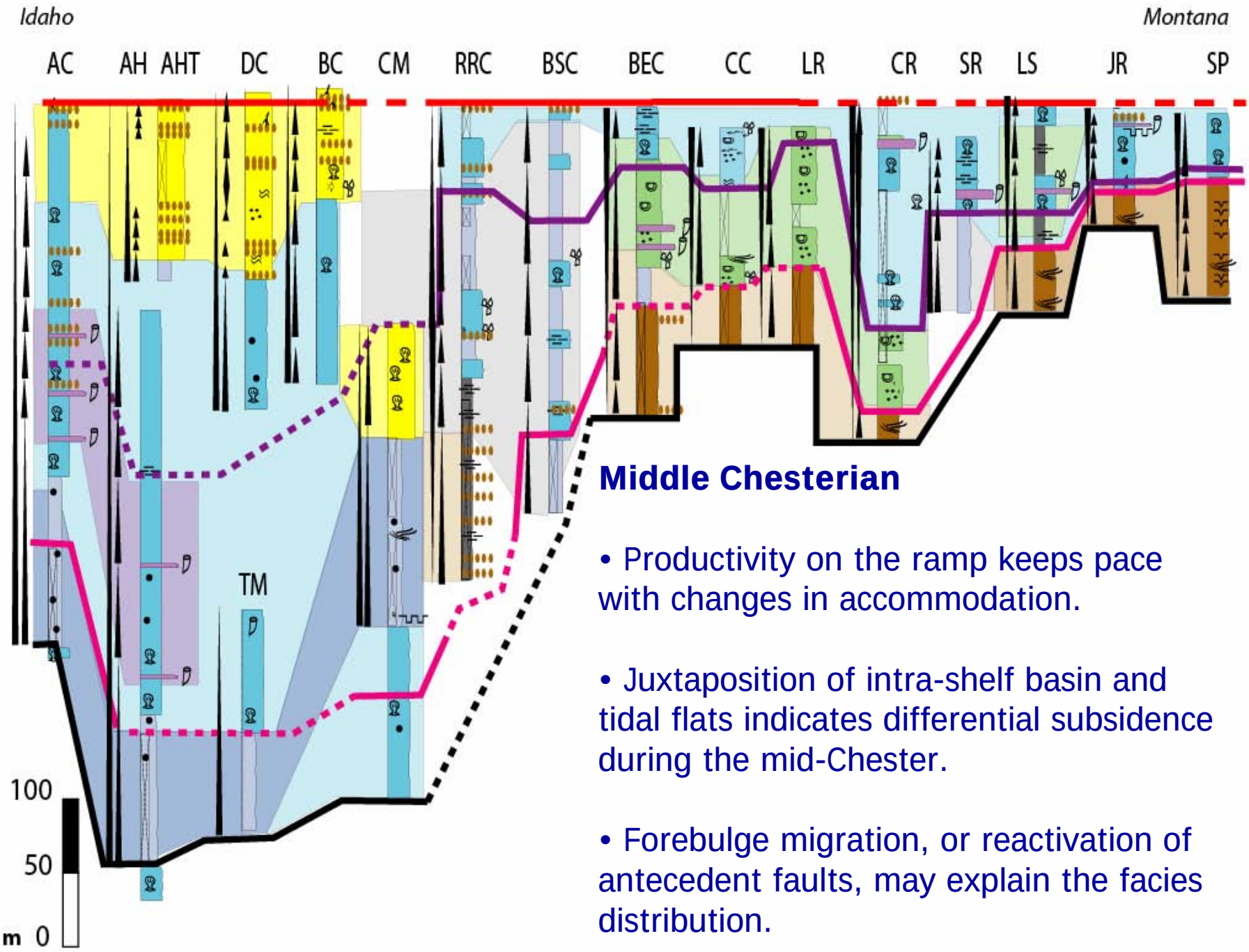

Idaho
Montana
AC
AH
AHT
DC
BC
CM
RRC
BSC
BEC
CC
LR
CR
SR
LS
JR
SP
TM
100
50
m 0
10
0 m
Fluvio-Estuarine
• ~10 meters thick
• Fining upward
• Cross bedded sandstone bases
• Soil cap
• Siliciclastic dominated



Lower Chesterian

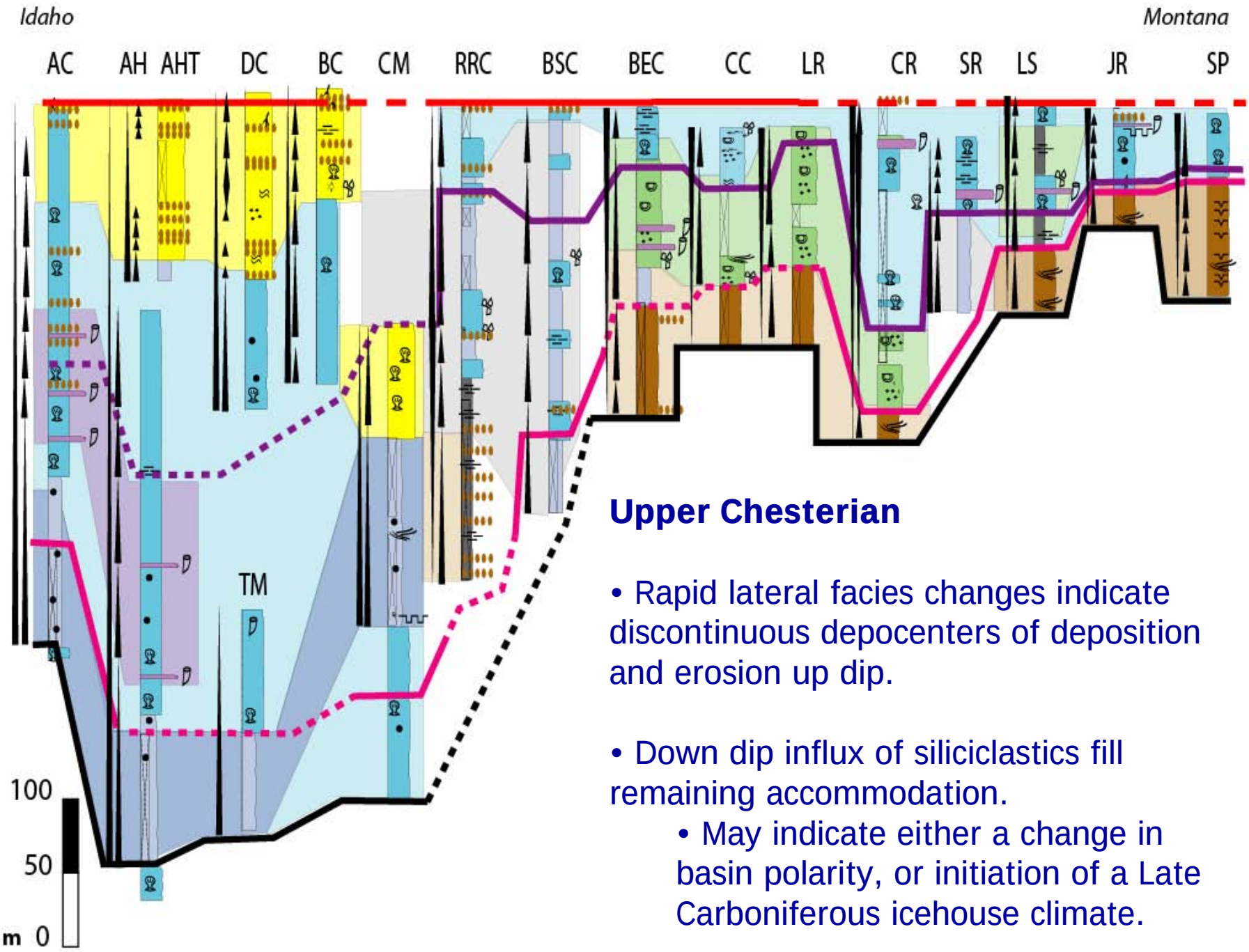
- Abrupt accommodation increase may be related to early Chester renewed subsidence in the Antler foreland basin.

- Transgressive sandstones migrate over the Madison Group unconformity.



Middle Chesterian

- Productivity on the ramp keeps pace with changes in accommodation.
- Juxtaposition of intra-shelf basin and tidal flats indicates differential subsidence during the mid-Chester.
- Forebulge migration, or reactivation of antecedent faults, may explain the facies distribution.

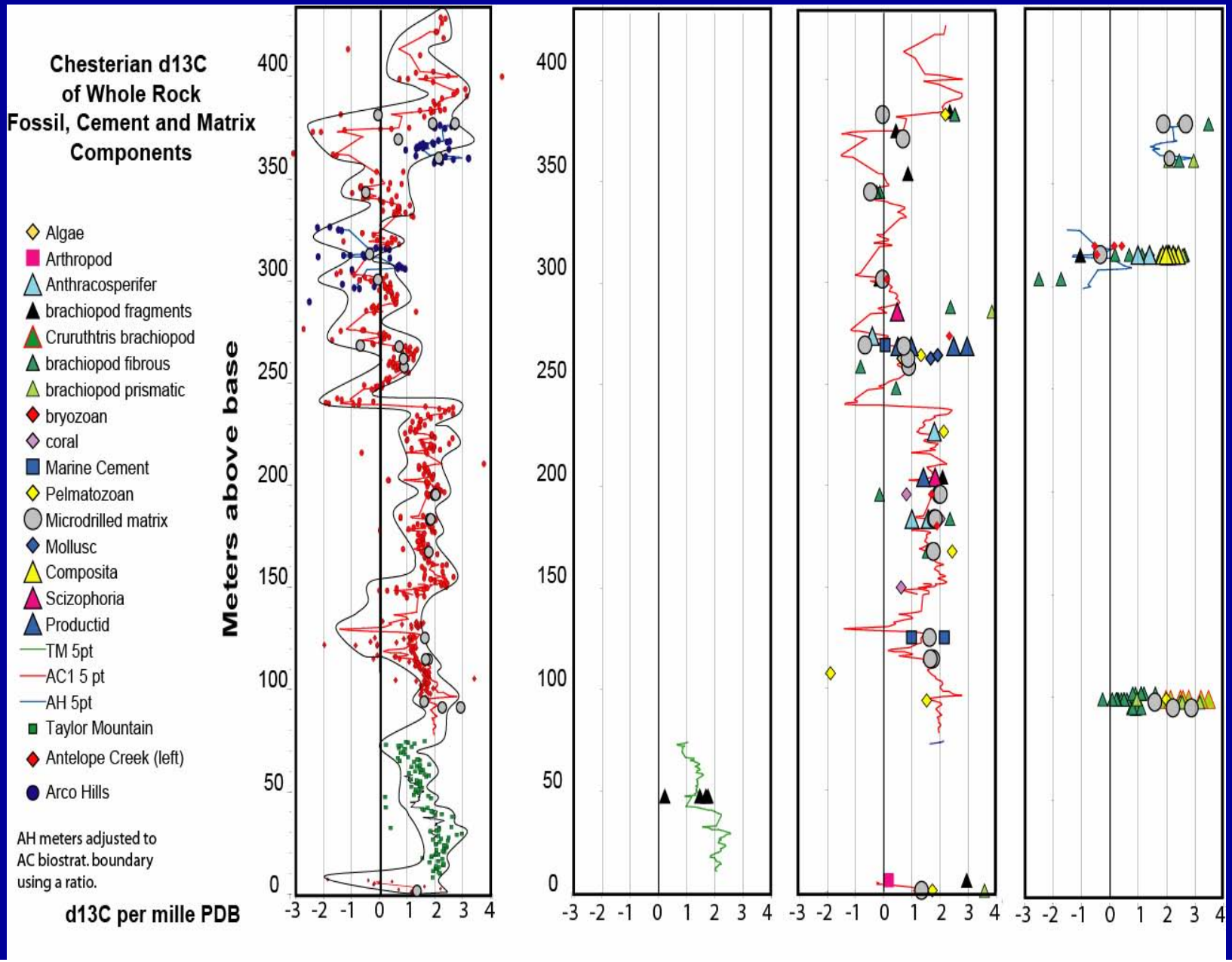


Upper Chesterian

- Rapid lateral facies changes indicate discontinuous depocenters of deposition and erosion up dip.

- Down dip influx of siliciclastics fill remaining accommodation.
    - May indicate either a change in basin polarity, or initiation of a Late Carboniferous icehouse climate.

Conclusions

- Parasequences and parasequence stacking patterns indicate that accommodation decreases up-dip and up-section.
- An overall 2nd order regression is punctuated by higher order tectonic-related subsidence events.
- Laterally discontinuous facies distributions and the presence of an intrashelf basin do NOT indicate a homoclinal ramp profile.
- Siliciclastic influx in the Late Chester may record the initial transition into a global icehouse climate.

Associated Research