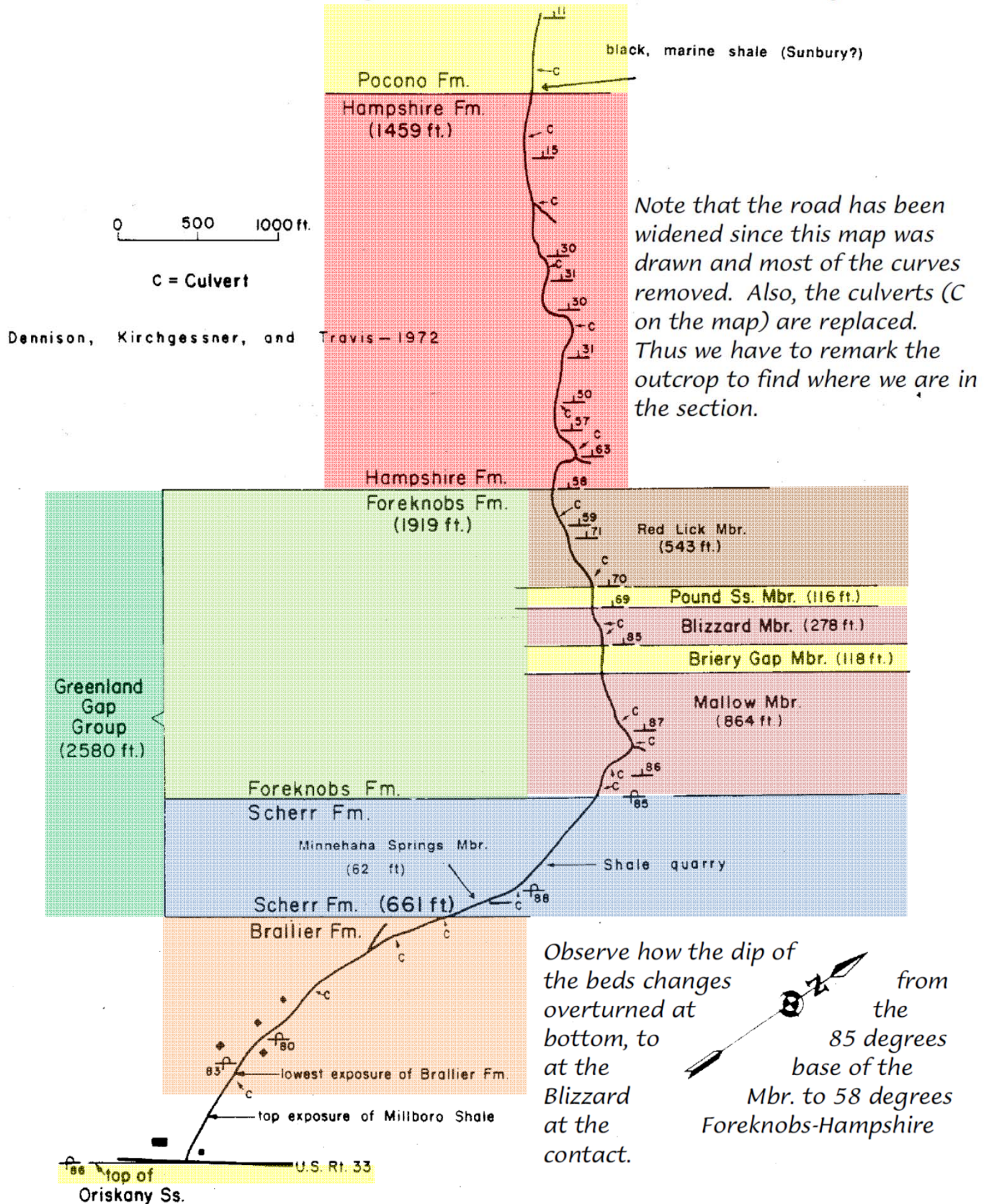


# Stratigraphy of the Central and Northern Shenandoah Valley, and Eastern West Virginia

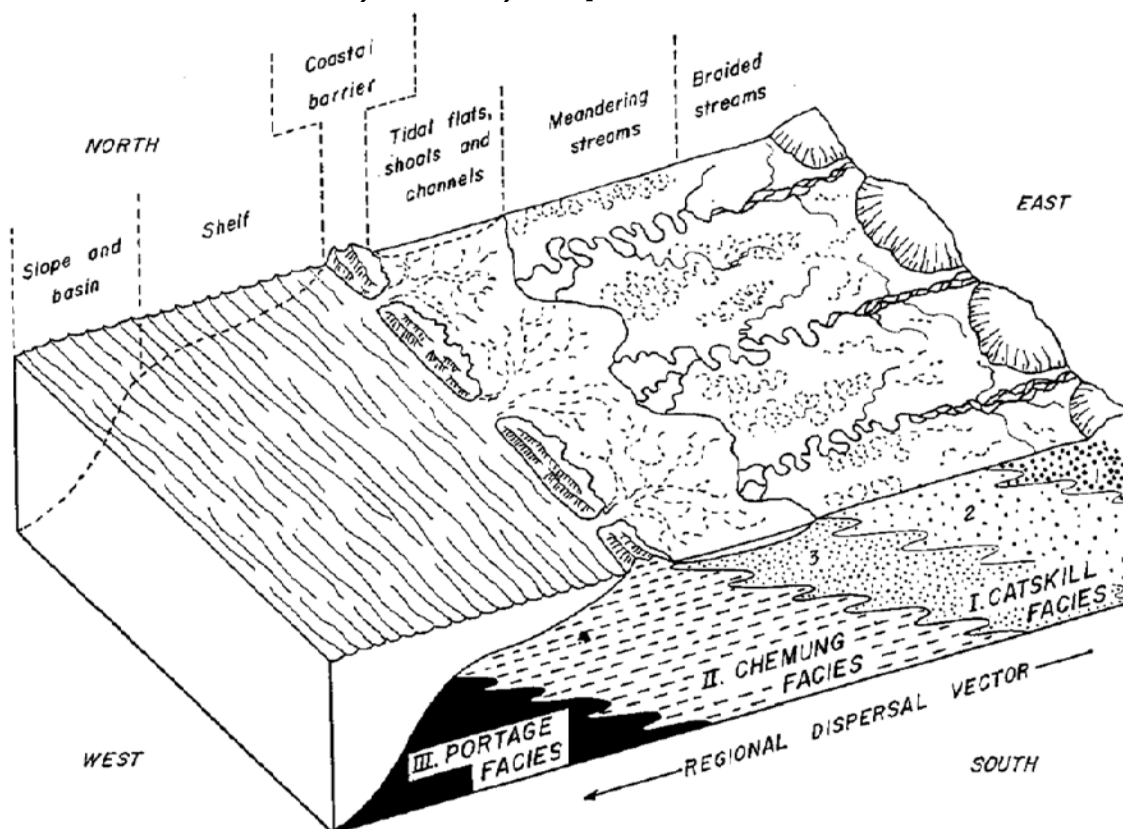
Sequence	AGE	West	FORMATION	East	Thick- ness	DESCRIPTION	Interptetation			
KASKASKIA	Miss.		<b>MAUCH CHUNK</b>			Coarse ss, silt, shale. Channels. Plant fossils common in places. Coal	Begin Alleghenian Orogeny			
			<b>GREENBRIAR</b>			Carbonate dominated (oolites, biosparites)	Orogenic Calm			
			<b>POCONO</b>		300-1700'	Quartz sandstone & conglomerate; coarse, thick, large cross beds	Acadian Orogeny Armorica terrane collides with east coast (survives as Avalon terrane).			
	Devonian		<b>HAMPSHIRE</b> (Catskill)		2000'	Point Bar Sequences; red				
			<b>GREENLAND GAP GROUP</b> (former Chemung)	<b>FOREKNOBS SCHEER</b>	2000'	Thick hummocky sequences; at top interbedded red and green fine sands and silts				
			<b>BRALLIER</b>	(Portage in Pa.)	1500-1700'	Bouma sequences				
			<b>MILLBORO</b> (Used south of Shenandoah Co.)	Tully Harrel Mahantango Marcellus	900' 350-500'	Dark gray to black silts and fine sands				
			<b>NEEDMORE</b>	Tioga bentonite	100-530'	Olive gray fine sands, silts, and shales; fossils abundant in places				
			Wallbridge Unconformity							
	Silurian		<b>ORISKANY</b>		10-125'	Quartz arenite; white, gray, tan; abundant fossils	Orogenic Calm			
			<b>HELDERBERG GROUP</b>	LICKING CREEK MANDATA NEW SCOTLAND NEW CREEK KEYSER	70-150' 17-50' 70-600'	Carbonates of many kinds; sometimes with cherts, or interbedded with shale or quartz arenites; fossils very abundant				
			(Salina in WVa.)	<b>TONOLOWAY</b>		50-250'		Tidal carbonates; ALM, ALD; mud cracks; salt casts; evaporitic to west		
			<b>CAYUGA</b>	<b>BLOOMSBURG</b>	WILLS CREEK WILLIAMSPORT McKENZIE	0-400' 0-75'		Bloomsburg: red very fine sands/silts/shale Yellow calcareous shale; fossils		
			<b>CLINTON</b>	<b>KEEFER</b> <b>ROSE HILL</b> <b>TUSCARORA</b>	<b>MASSA-NUTTEN</b>	70' 650' 50-250'	Massanutten: coarse friable quartz arenites and conglomerates with large planar X-beds Tuscarora/Keefe: quartz arenites; ripples Skolithus. Rose Hill: red fine - coarse sands and shales; loads, ripples, trace fossils	Taconic Orogeny Chopawamsic/Arvonnia Terrane collides with East Coast		
Ordovician		<b>JUNIATA</b>	?	0-200'	Red X-bedded ss; Skolithus; bedded w/sh	Gray/white, coarse X-bedded sands	?		Hum-mocky	
		<b>OSWEGO</b>	"Cub ss"	0-375'						
		<b>REEDSVILLE</b>	<b>MARTINSBURG</b>		3000'	Clastic hummocky sequences	Feldspathic/lithic Bouma sequences			
		<b>"TRENTON GROUP"</b>	?	Oranda (Liberty Hall)	40-60'	Carbonate hummocky sequences	?		Gray silty/shale	
		<b>"BLACK RIVER GROUP"</b>	?	<b>EDINBURG</b> (Lantz Mills)	425-600'	Carbonate hummocky sequences	?		Black massive micrites and shale	
		<b>LINCOLNSHIRE</b>		25-170'		Micrites, bio- and pelmicrites, chert				
		<b>NEW MARKET</b>		40-250'	abundant fossils, darkens up section Very pure micrites; tidal features					
		Knox Unconformity								
	Cambrian		<b>BEEKMANTOWN</b> (Rockdale Run)		2500'	Thick bedded dolomite, black chert; tidal				
			<b>STONEHENGE</b> (Chepultepec)		500'	Thick bedded micrite, blue; tidal features				
		<b>CONOCOCHEAGUE</b>		2500'	LS/dolo/qtz arenite ; abndt tidal structures					
		<b>ELBROOK</b>		2000'	LS/dolo/ blue-gray; tidal features					
		<b>ROME</b> (Waynesboro)		2000'	Red/green shale/dolo/micrite; very variable					
		<b>SHADY</b>		1600'	Dolomite (granular); LS at top and bottom					
		<b>CHIL-HOWEE</b>	<b>ANTIETAM</b>		500-1500'	Quartz arenite; abndt X-beds Skolithus		Thin bedded shale and graded sandstones		
		<b>WEVERTON</b>	<b>HARPERS</b>		2000' 800'	Crs feldspathic sands; large planar X-beds and Bouma sequences				
		<b>CATOCTIN</b>			2000'	Subareal , tholeiitic, flood basalts ( now greenschist)				
		<b>SWIFT RUN</b>	(LYNCHBURG)							
	<b>GRENVILLE BASEMENT</b>	East of Blue Ridge								

# Plane Table Map of the Section at Briery Gap Run

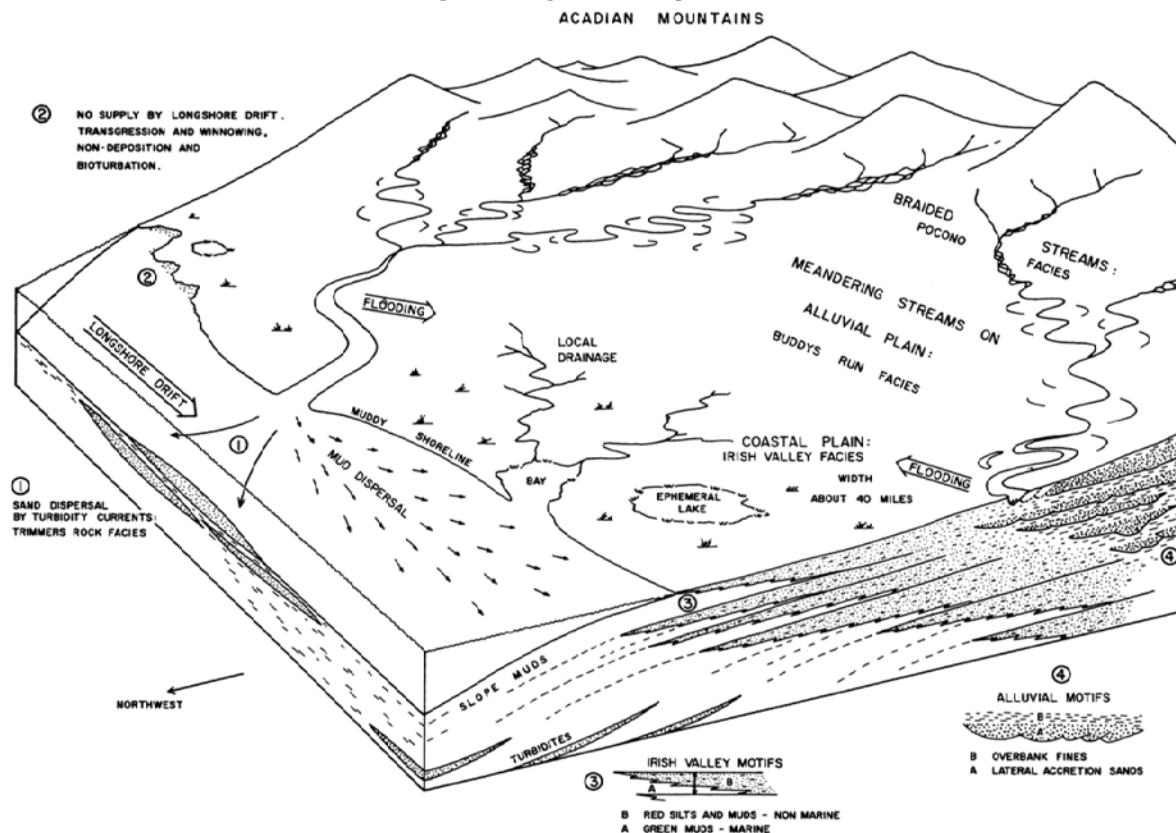
Dennison, John M., 1988, Devonian Delta East-Central West Virginia and Adjacent Virginia: Geologic Field Trip Guide, Sponsored by Appalachian Geological Society, for 1988 Eastern Section Meeting, American Association of Petroleum Geologists

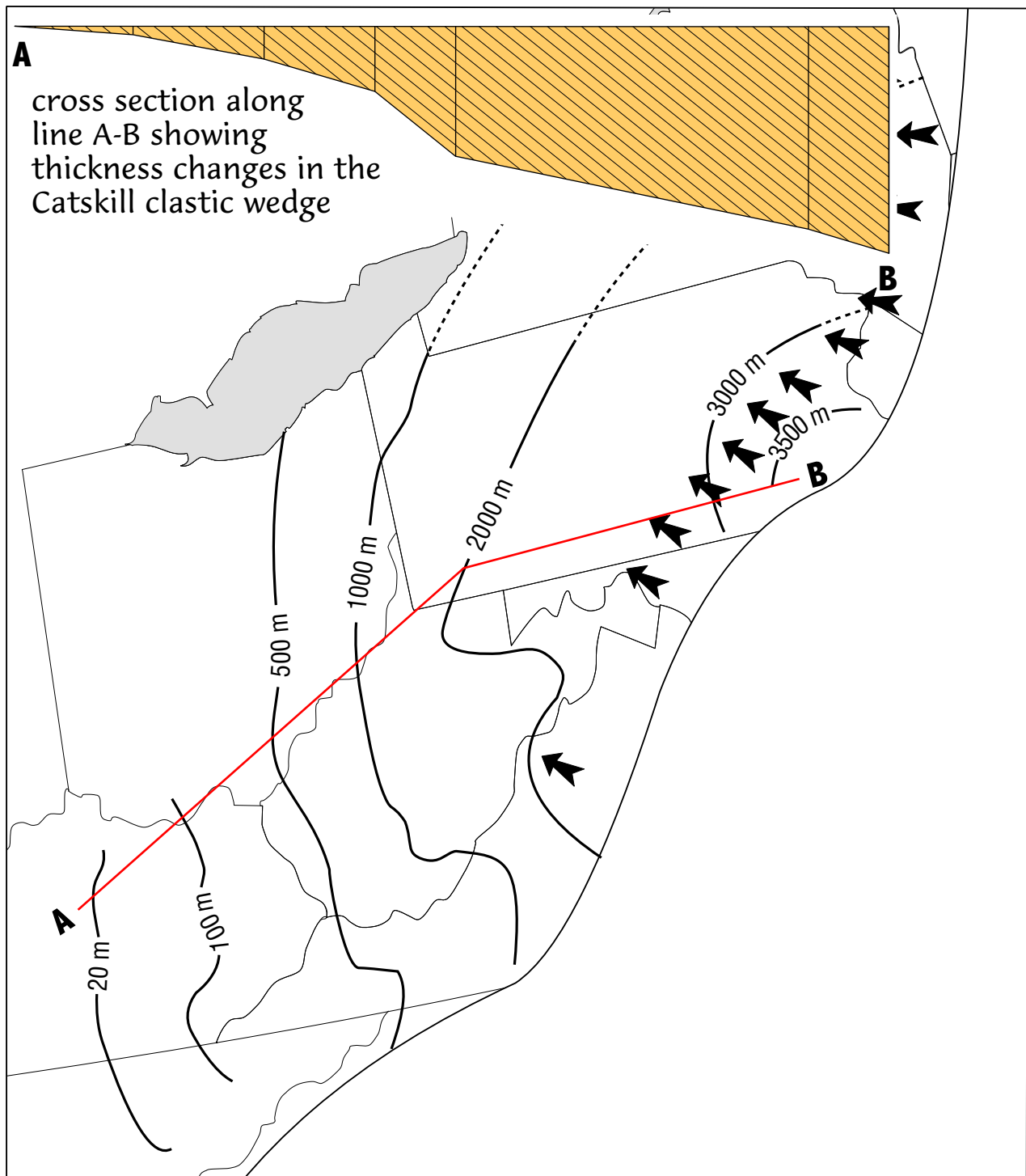


## Allen and Friend, 1968, Deposition of the Catskill Facies



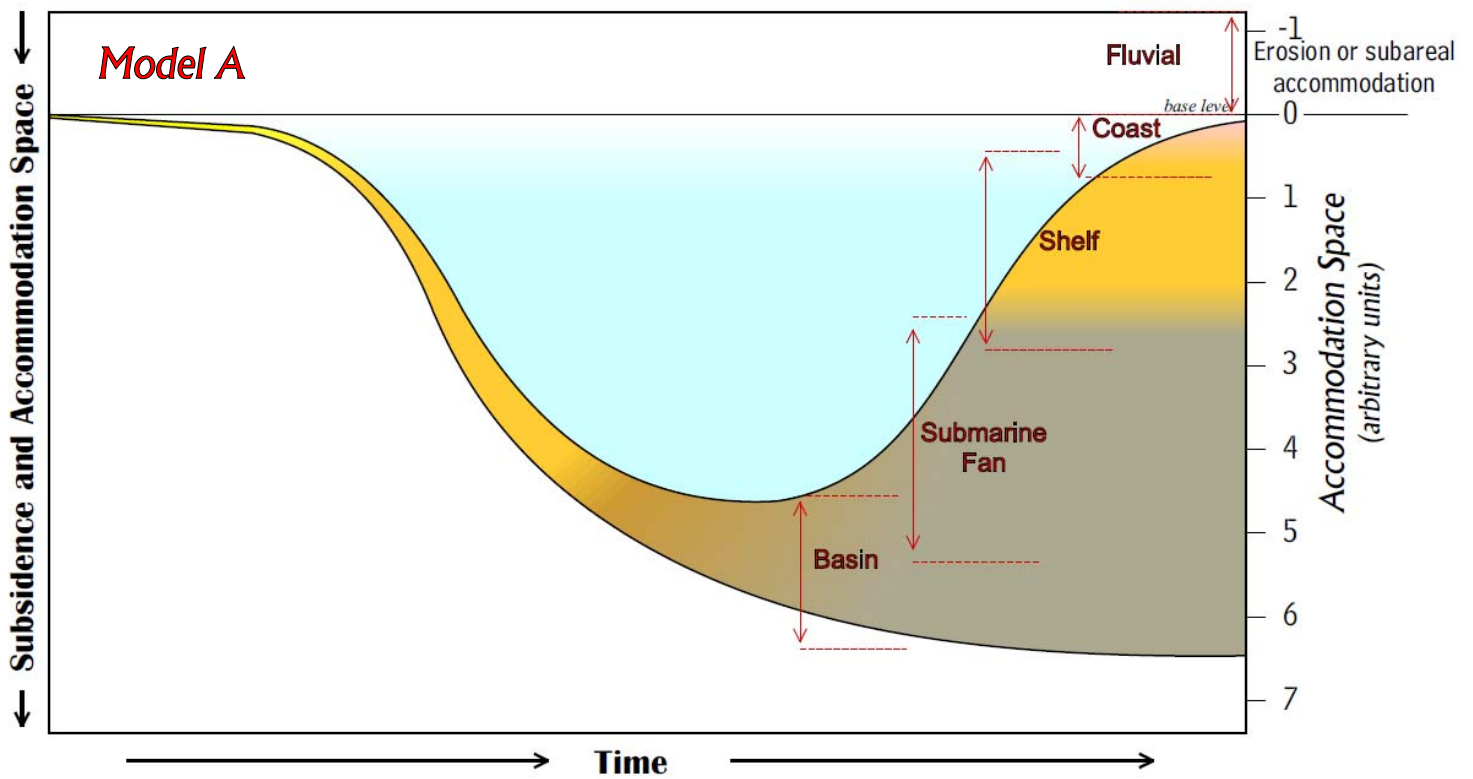
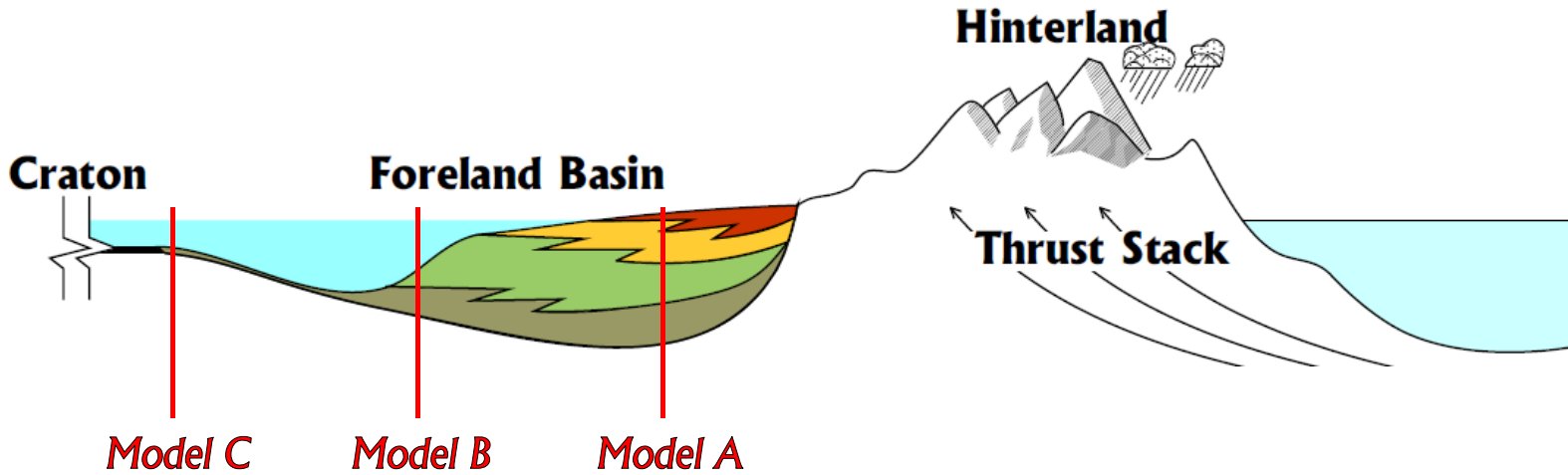
## Walker and Harms, 1971, The "Catskill Delta": A Prograding Muddy Shoreline

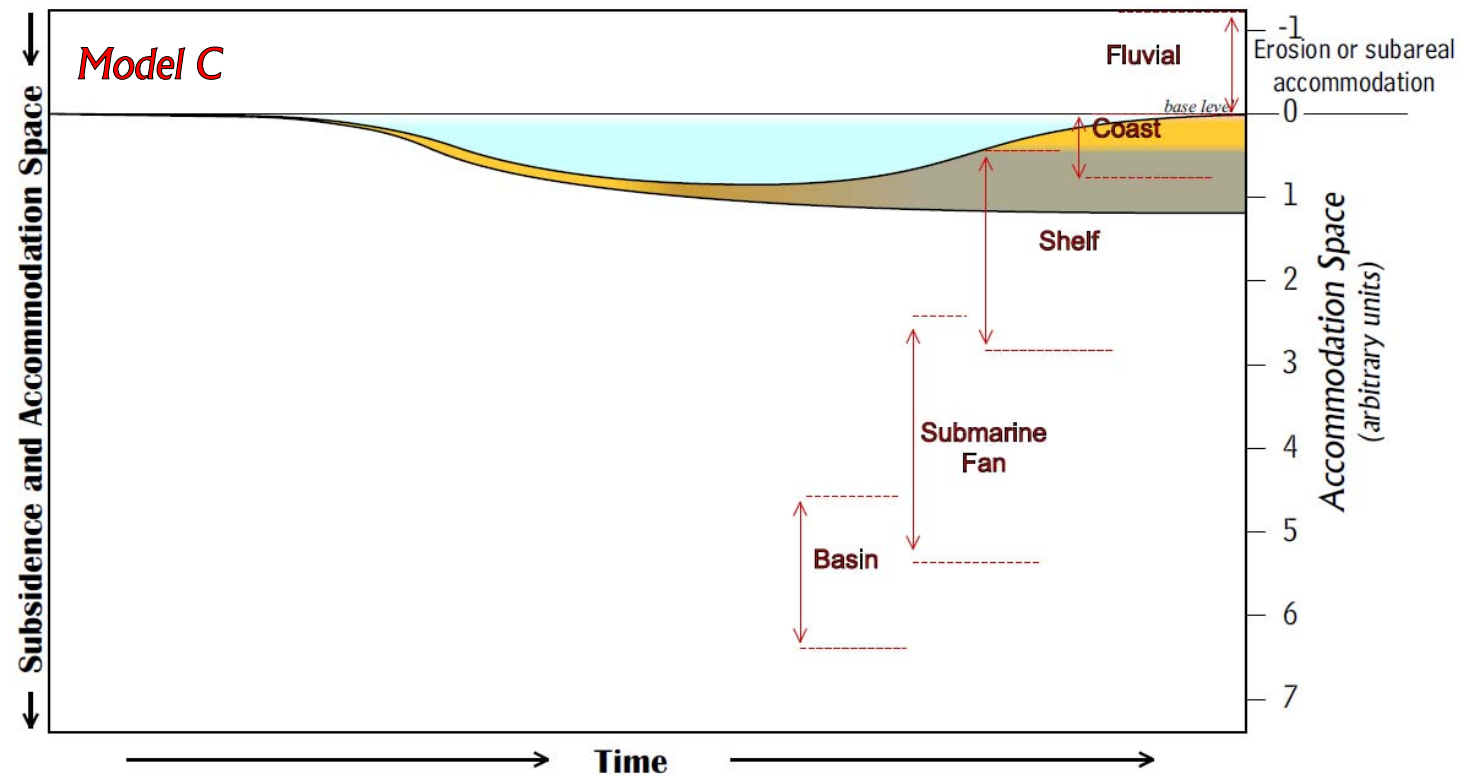
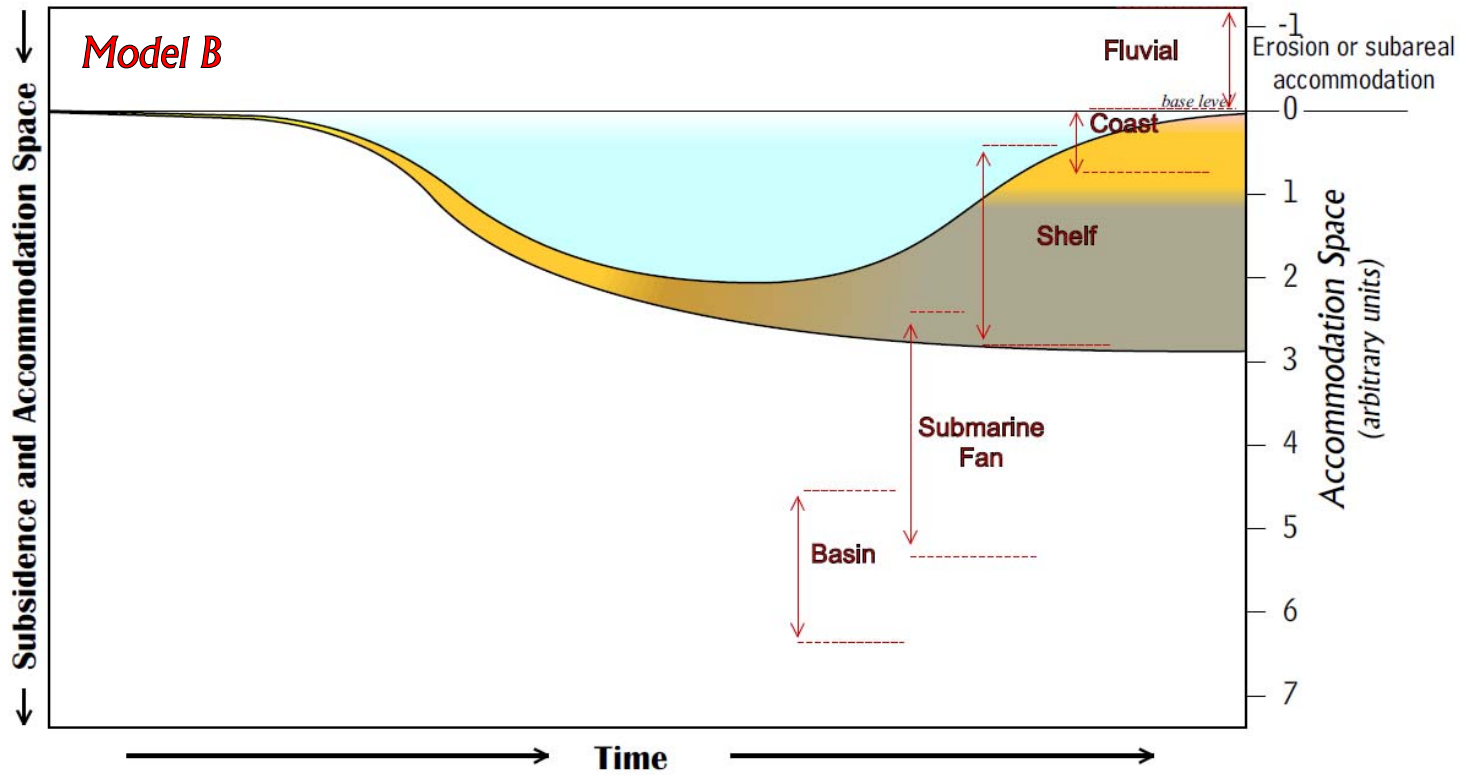




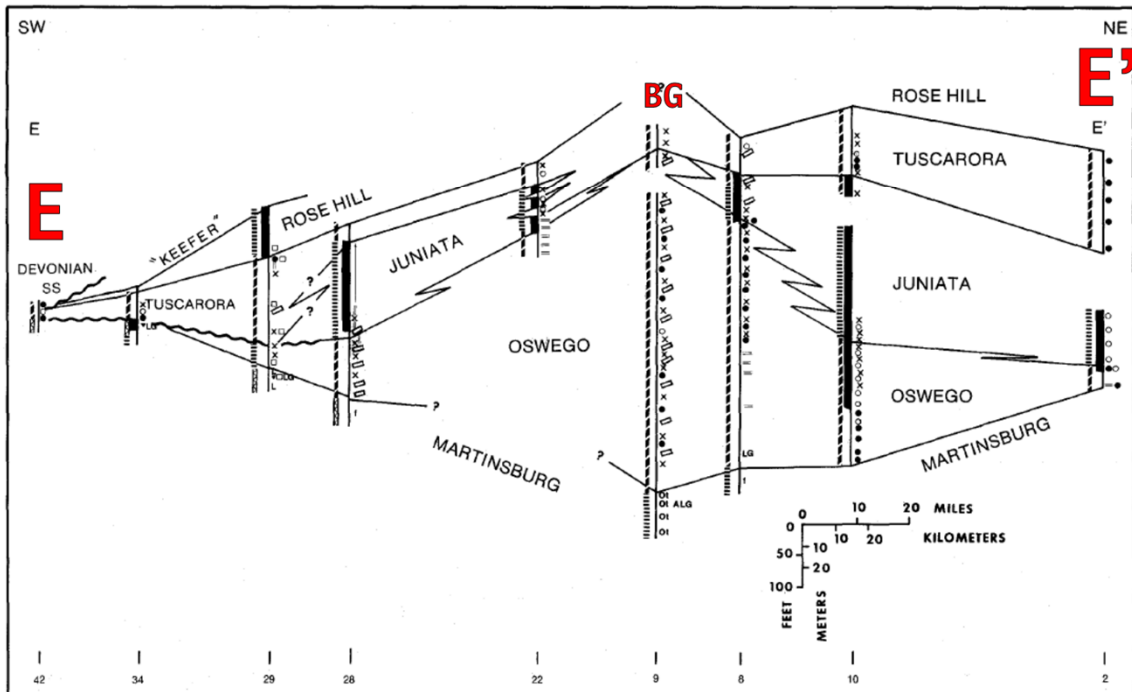
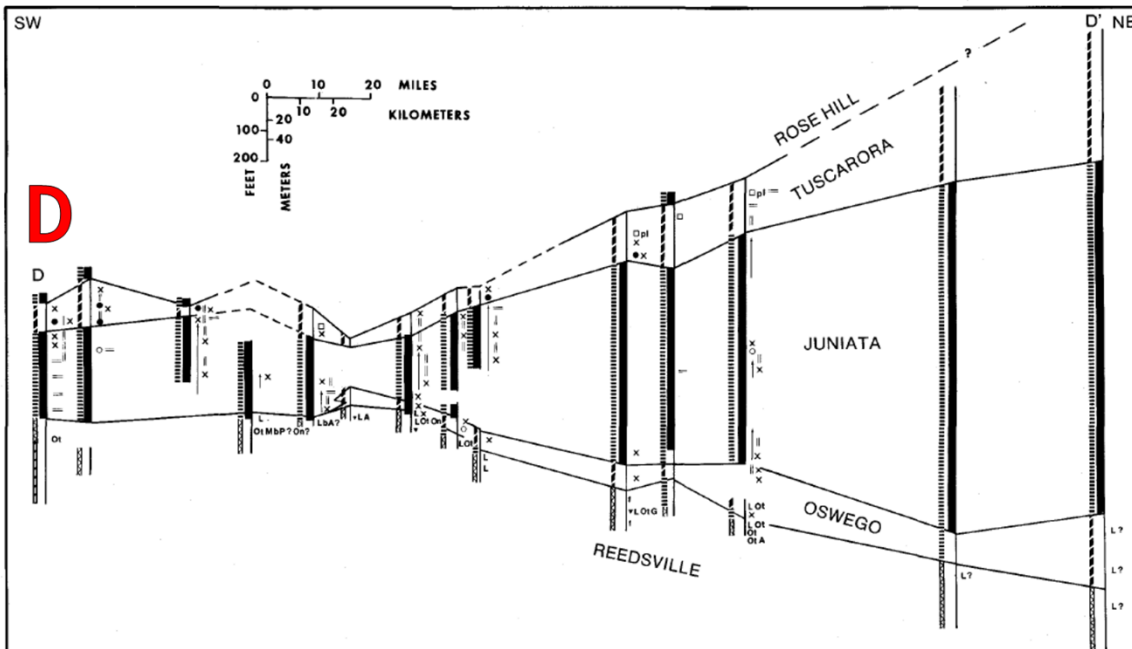
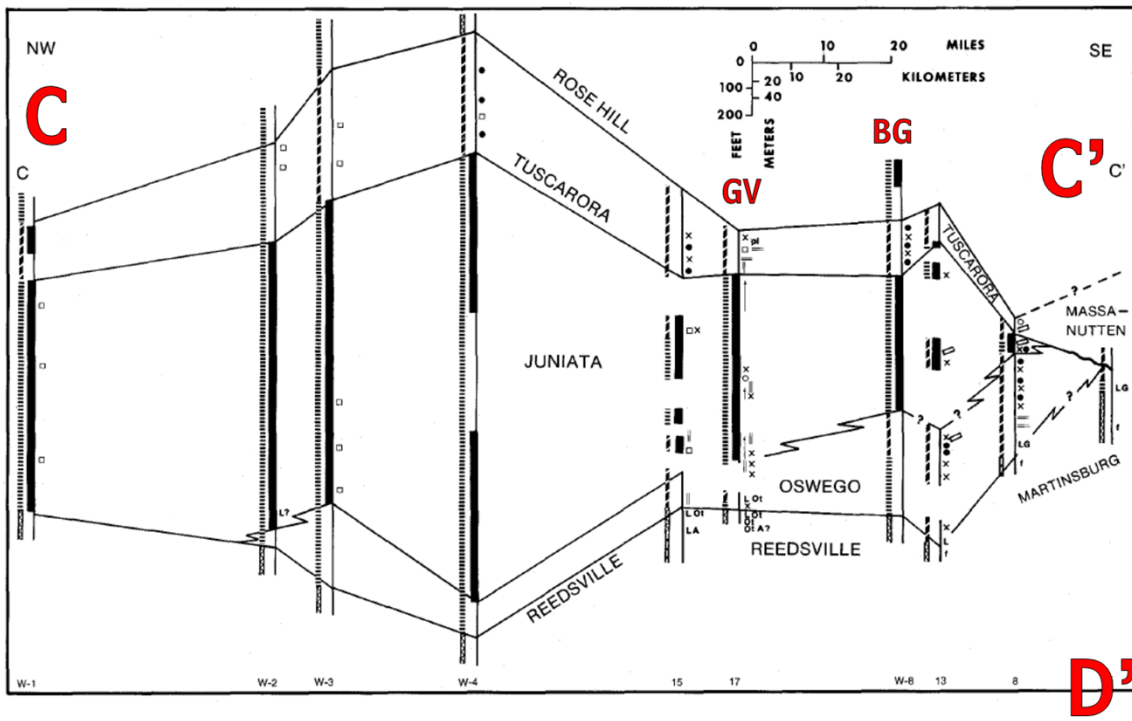
Isopach (thickness) map for the Catskill clastic wedge. Note that the thickest (deepest) portion of the clastic wedge is in southeast Pennsylvania and that it thins (shallows) to the west and southwest.. The cross section at the top is along line A-B and shows the rapid thinning of the clastic wedge .

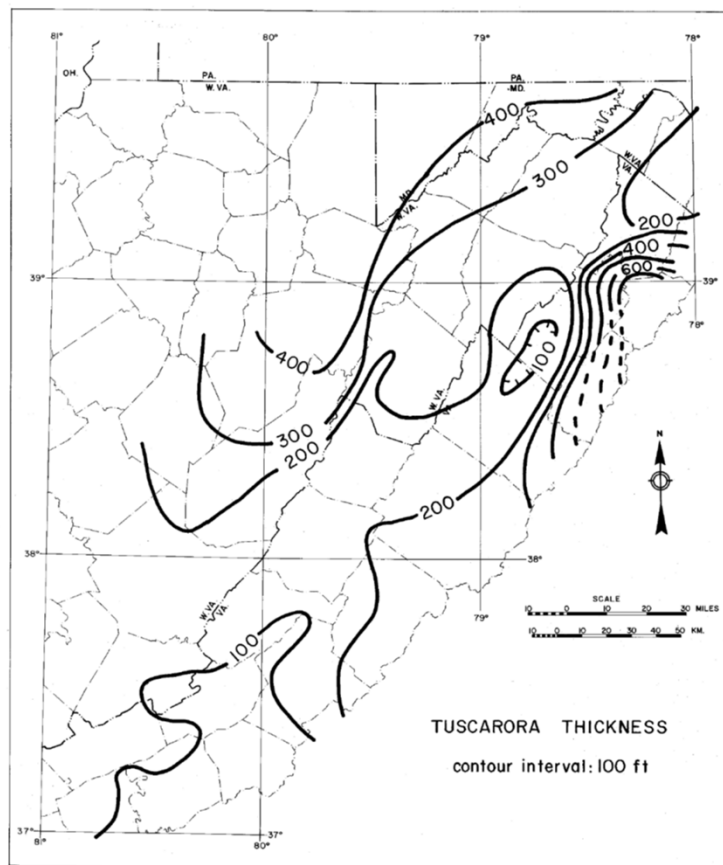
# Foreland Basin SATS Model: Variations













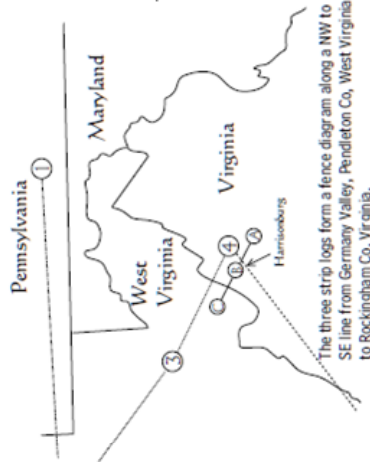
Germany Valley



Brocks Gap

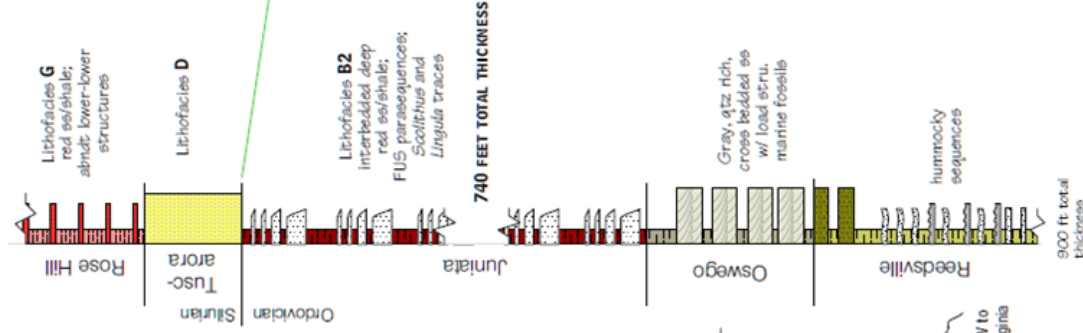


Massanutten Mountain

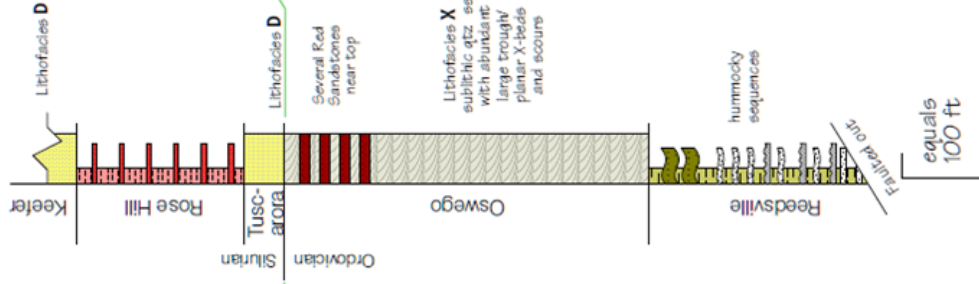


# Evolution of the Central Appalachian Basin Geology 230 - Evolution of the Earth Sheet Four - Mid to Late Ordovician and Early Silurian

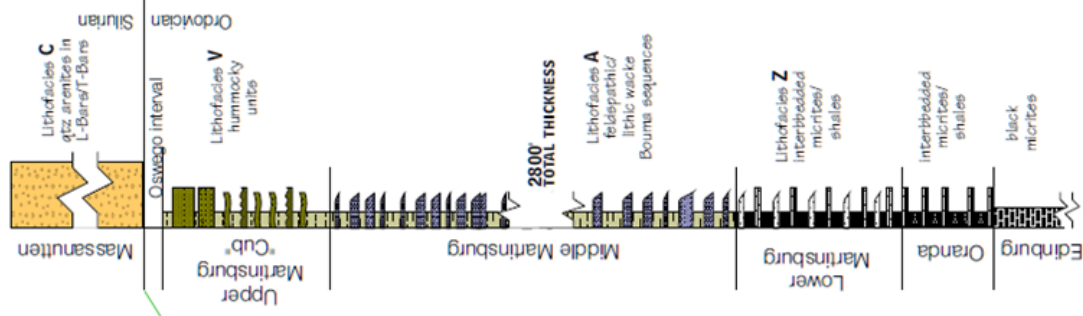
## WEST GERMANY VALLEY LOCAL SECTION C



## BROCKS GAP LOCAL SECTION B



## EAST MASSANUTTEN MOUNTAIN LOCAL SECTION A



# BEACH/BARRIER ISLAND DEPOSITIONAL SYSTEMS

## Shoreface

- Facies vary with flow regime
- Low wave activity = physical and biogenic structures
- High wave activity = physical structures dominantly

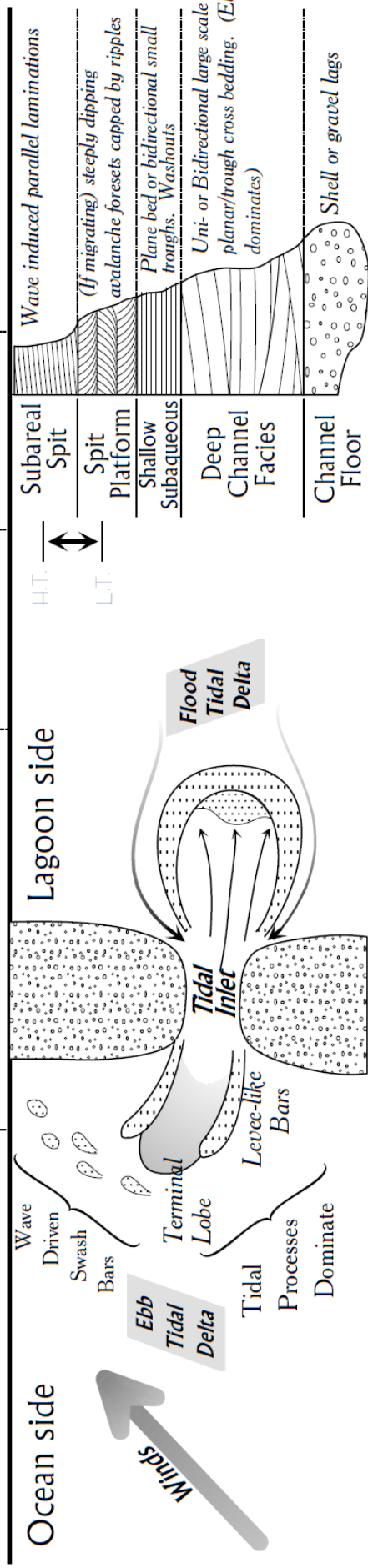
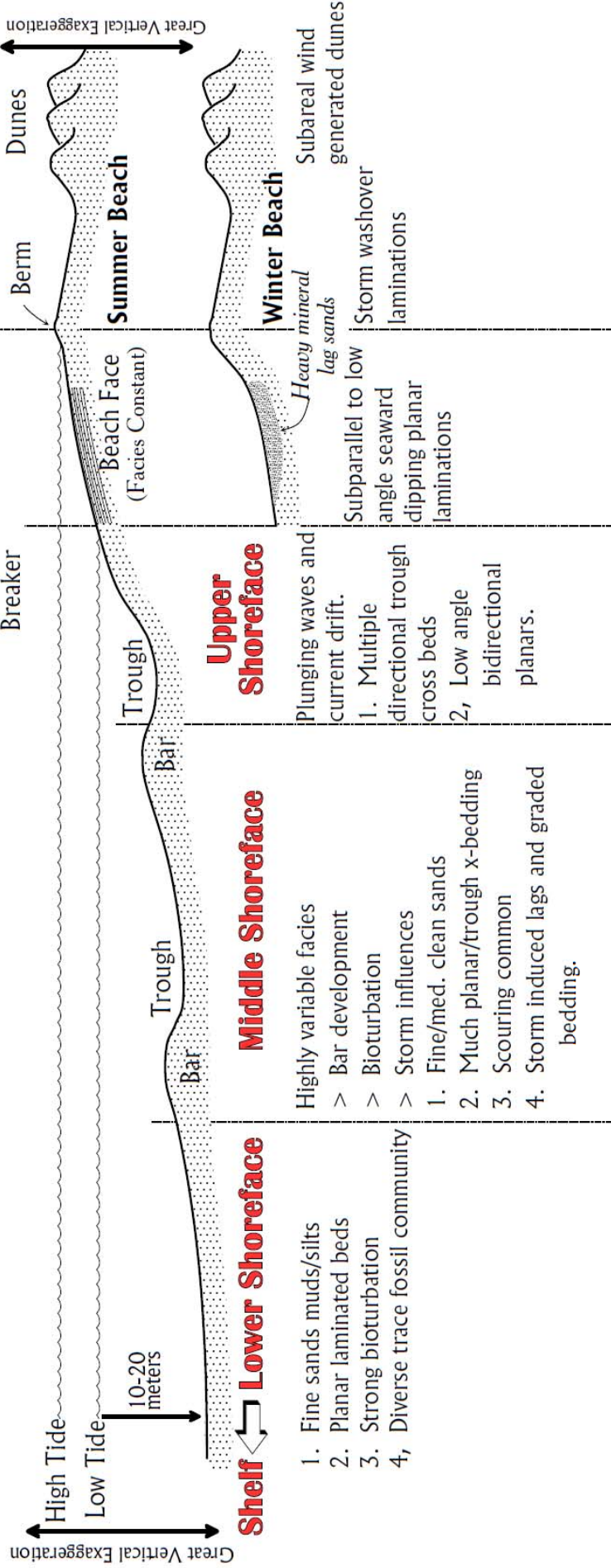
## Foreshore

Swash Zone

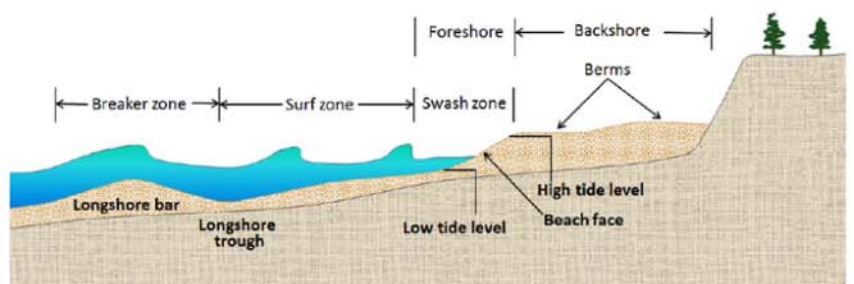
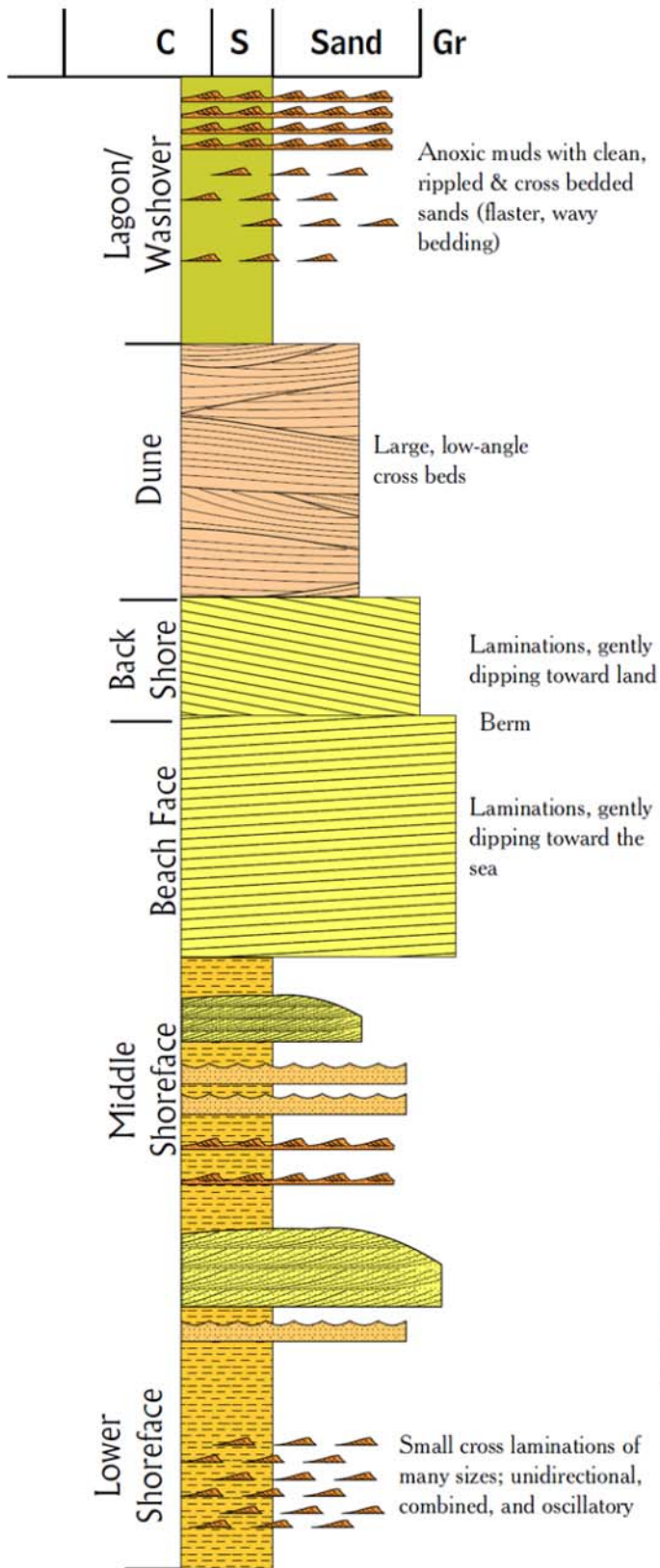
Surf

Breaker

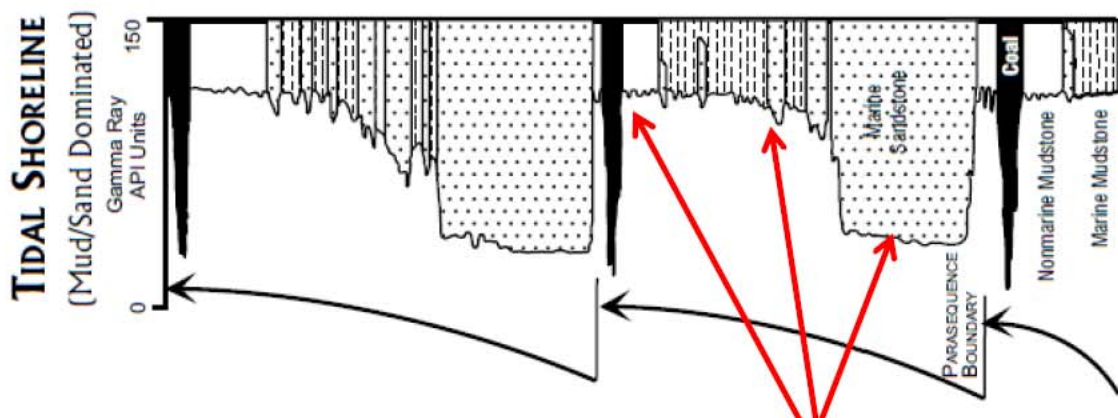
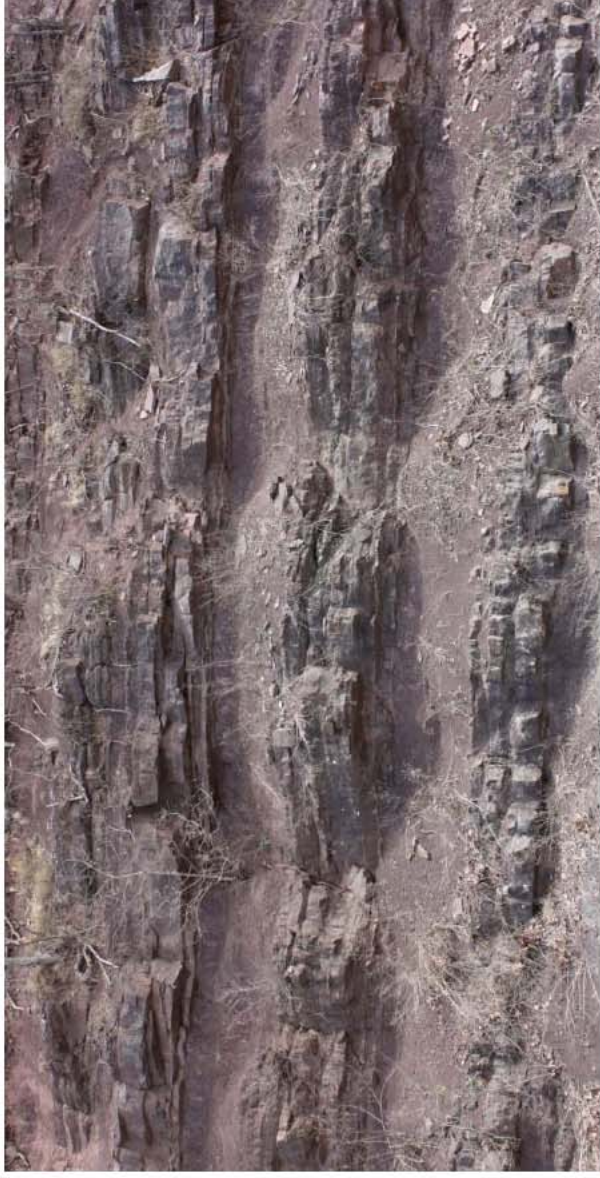
## Backshore



# Prograding Beach/Barrier Island Sequence



# Model for Juniata Formation Tidal Parasequences at Wills Mountain (Germany Valley, West Virginia)



# Tuscarora Sandstone, Wills Mountain Section – Page 1



*Juniata Tidal flats  
(red cross bedded sands/shales; FUS parasequences)*



*Base of Tuscarora  
(Scolithus; white sands)*

*Begin Shoreface*

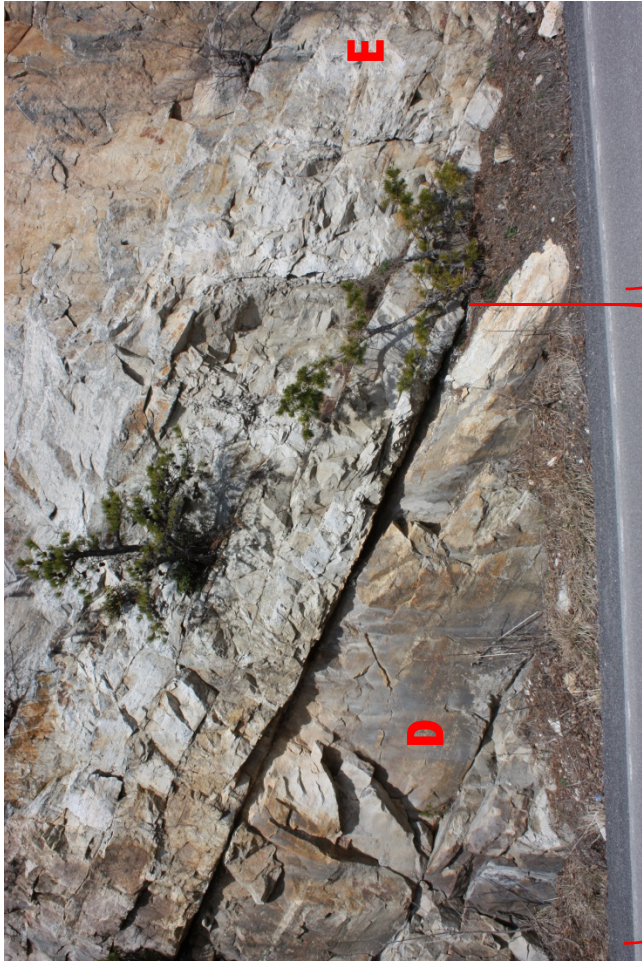


*Shoreface facies (large cross beds)*



*Shoreface facies*

# Tuscarora Sandstone, Wills Mountain Section - Page 2



Foreshore  
(Gentle dipping laminations)

Tidal Inlet  
(antidunes)



Tidal Inlet  
(antidunes)



Antidunes



Foreshore

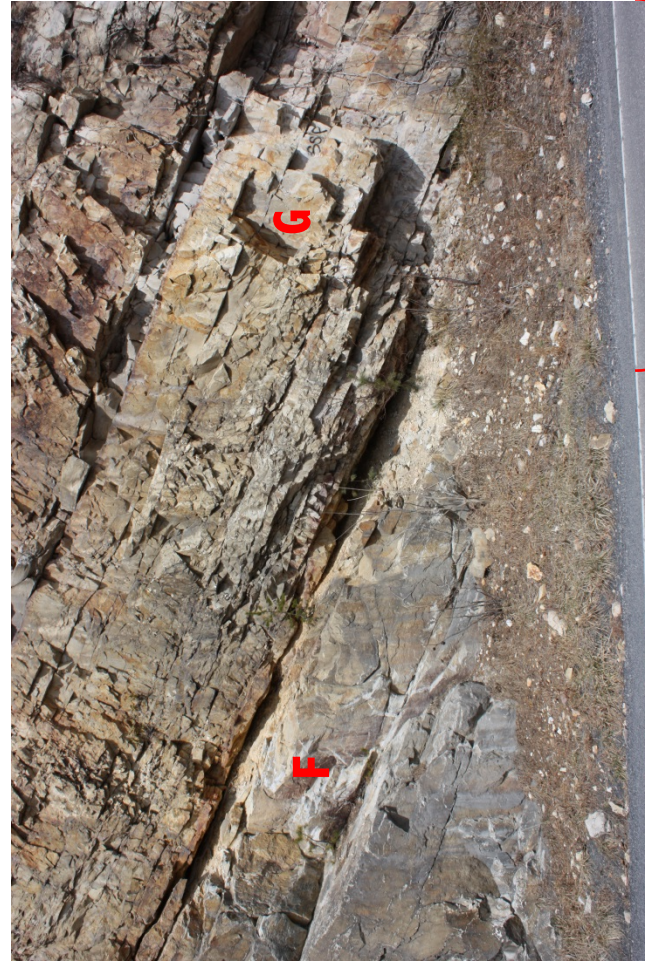
**Tuscarora Sandstone, Wills Mountain Section – Page 3**



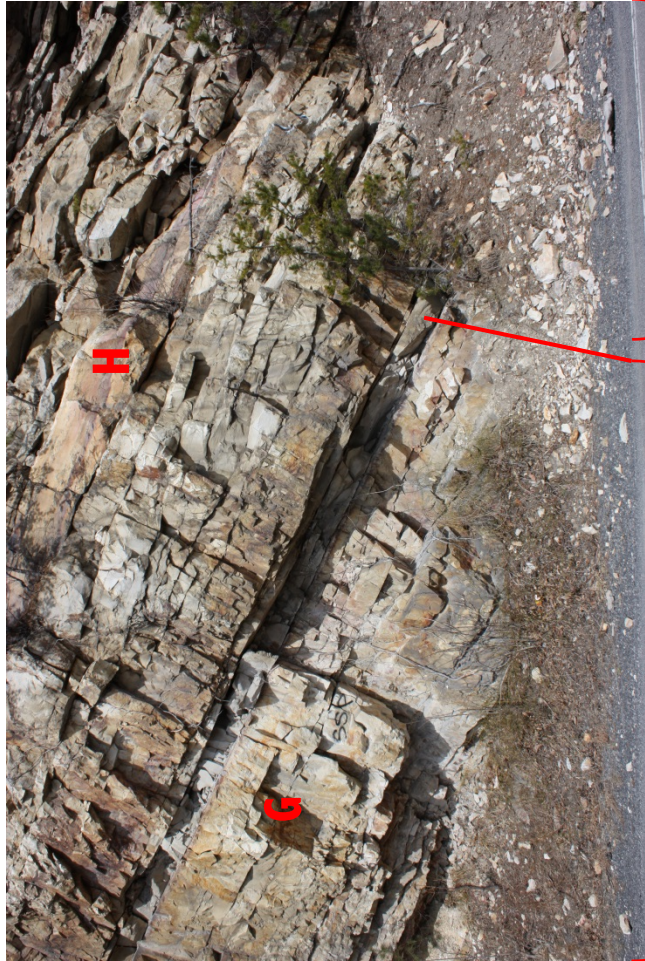
*Foreshore*



*Dune  
(ultrafine qtz sands)*



*Dunes  
(ultrafine qtz sands)*



*Dune  
(ultrafine qtz sands)*

*Lagoon*

# Tuscarora Sandstone, Wills Mountain Section – Page 4



Lagoon  
(amalgamated storm washover sands)



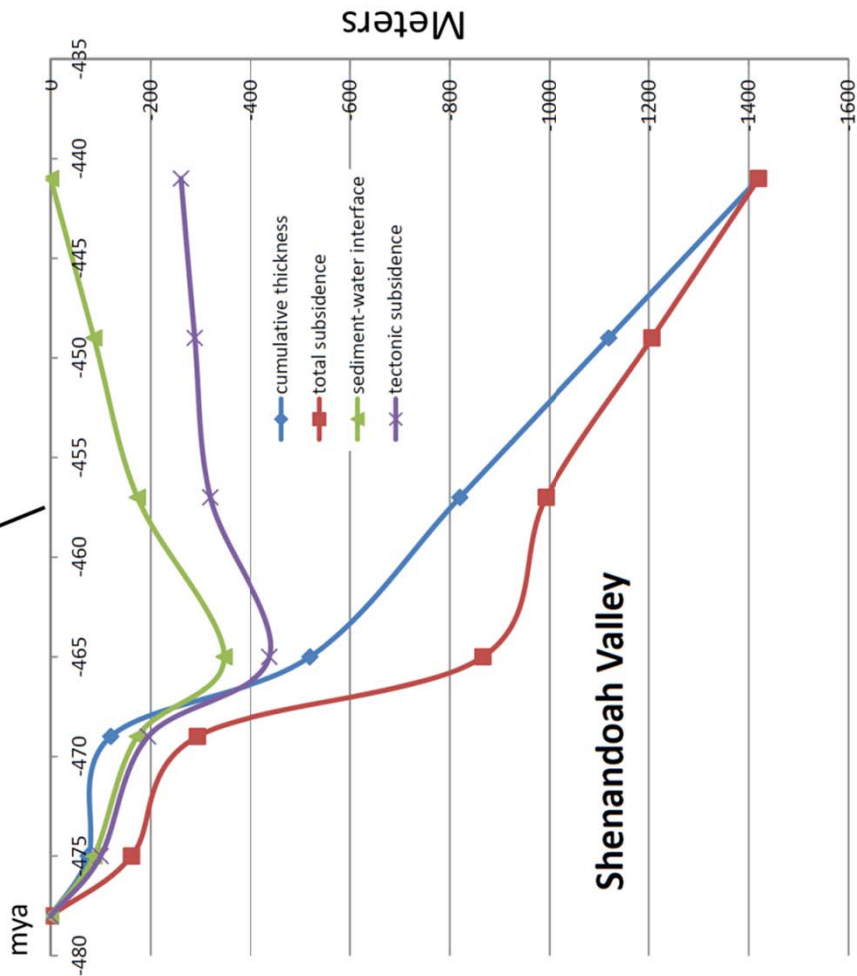
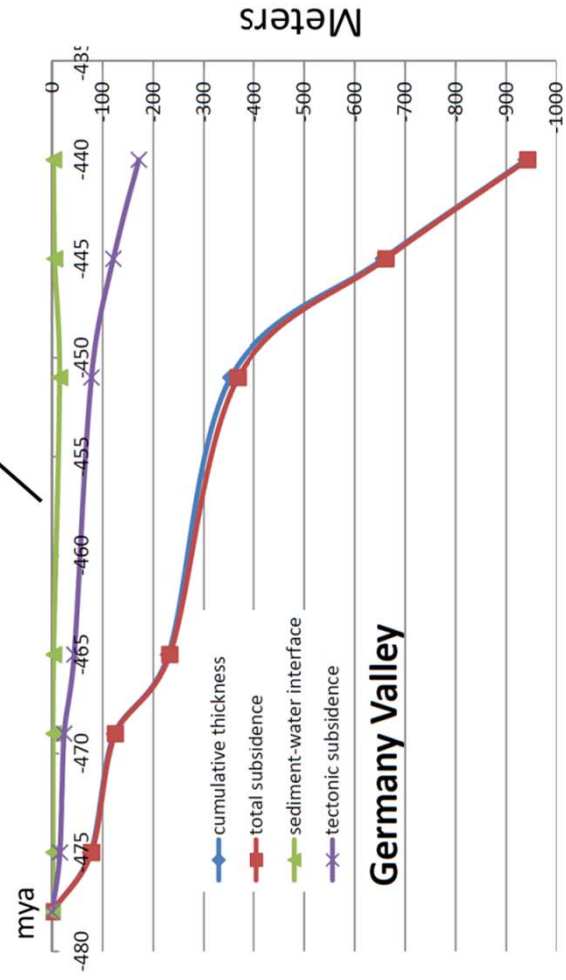
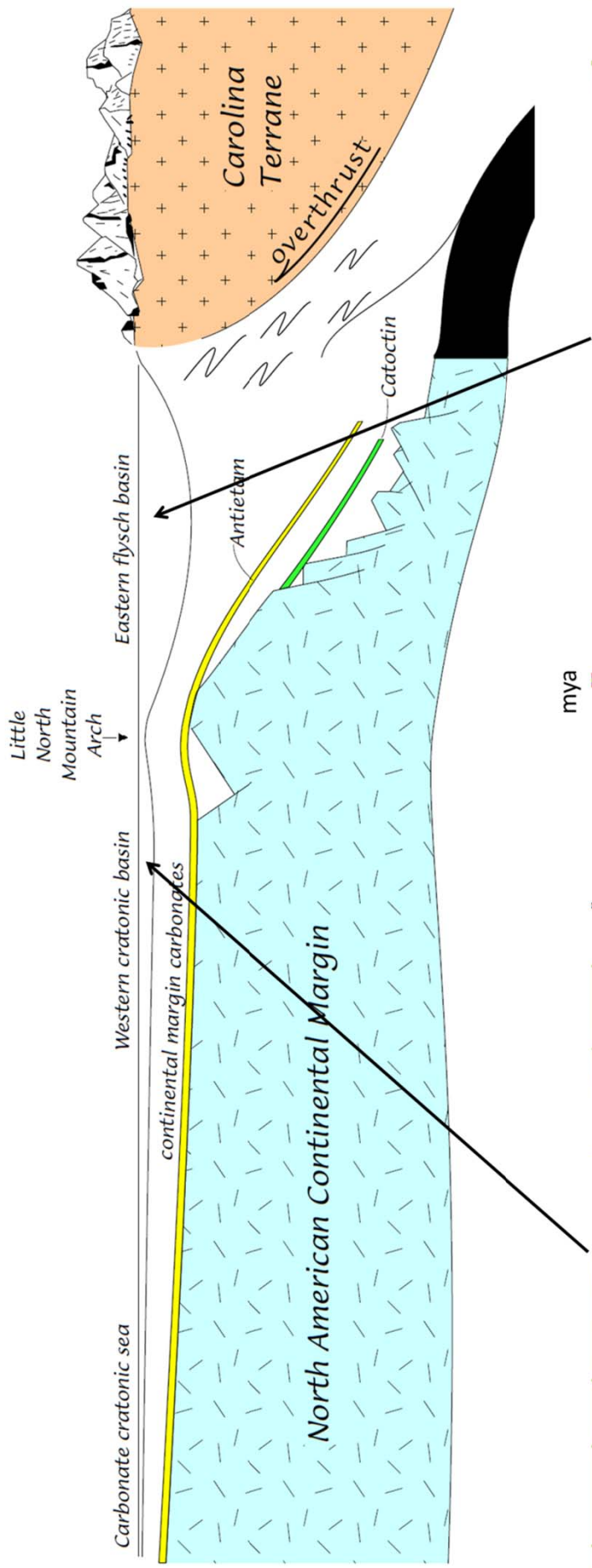
Lagoon  
(thin sands with black shales with Arthropycus traces)



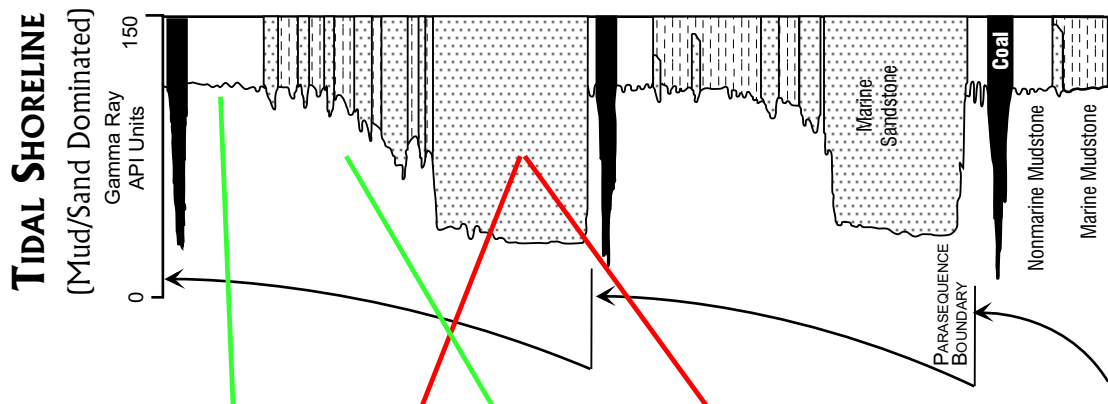
Lagoon  
(thin sands with black shales with Arthropycus traces)



Arthropycus trace fossils  
(bottom of sand beds)

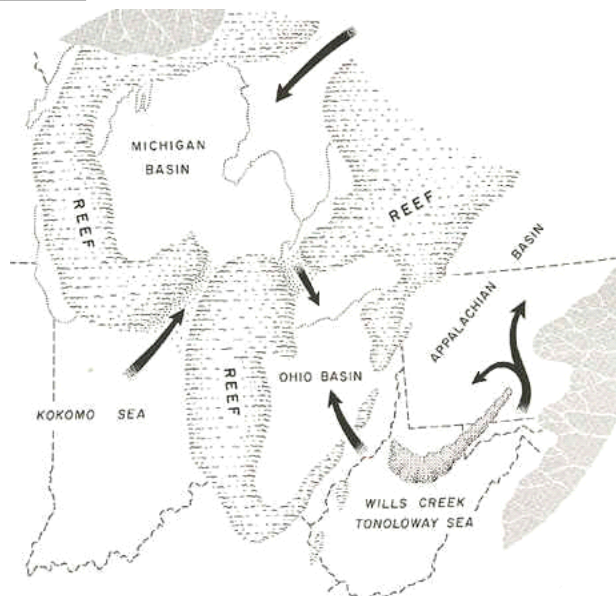


# Rose Hill Tidal Fining Upward Parasequences

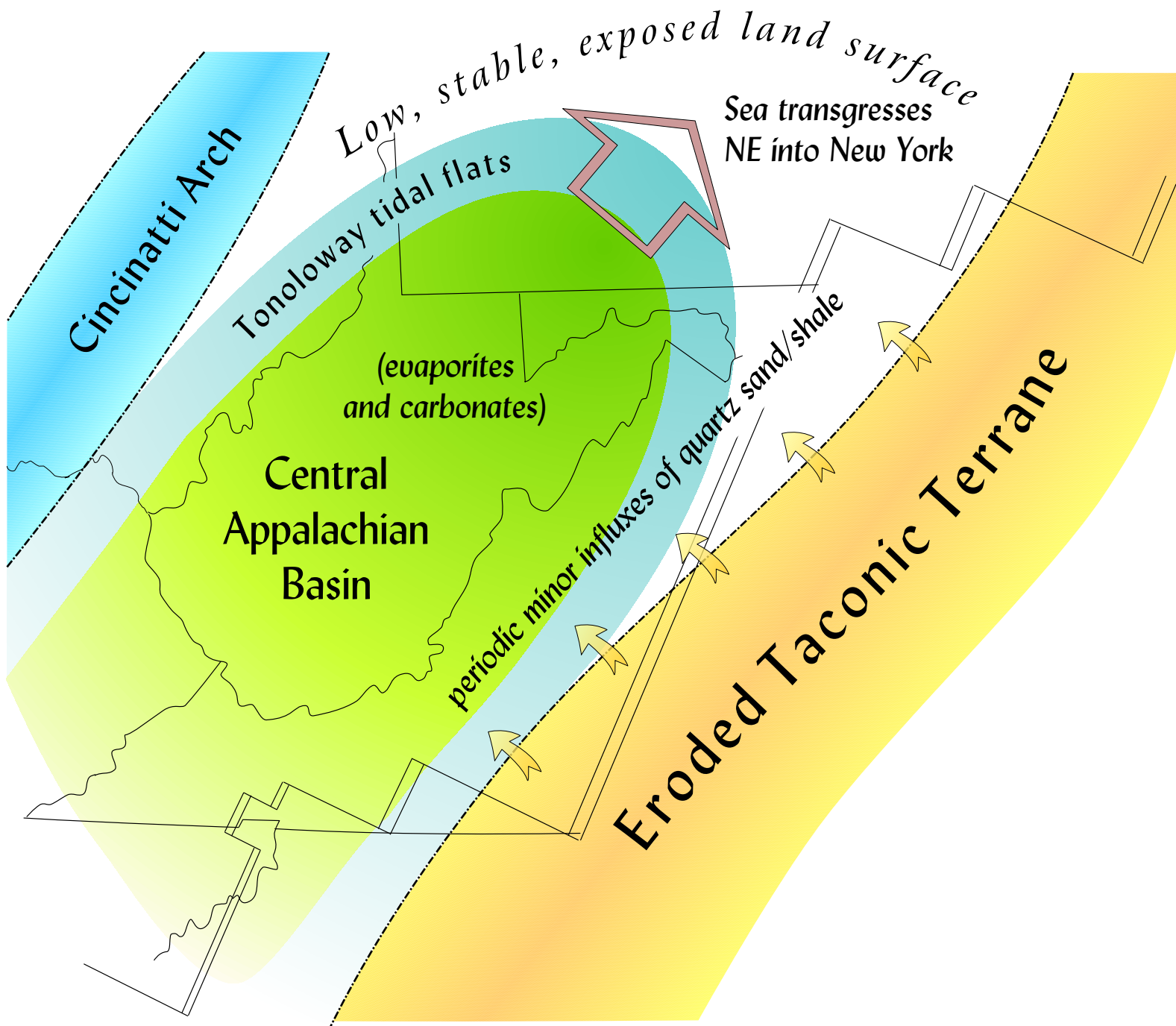


# Silurian-Lower Devonian Stratigraphy of Western Virginia/West Virginia

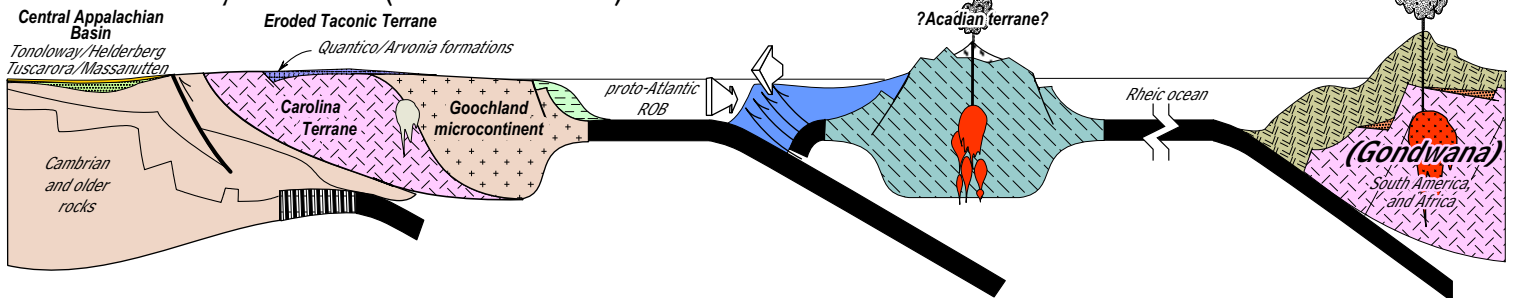
Devonian	ROCKY GAP SANDSTONE	Huntersville Fm.	Needmore Shale	1000 ft.	Dark gray to black shales and silts; thinly laminated; fossiliferous (trilobites, brachiopods, bastropods, nautiloids, traces)
		Ridgley/Oriskany SS		130 ft.	Quartz arenite: abundant brachiopod molds; cross bedding, high velocity laminations
		Healing Springs Sandstone	Licking Creek Limestone	63 ft.	Cherty, siliceous, dark limestone weathering sandy; abundant fossils
			Mandata	57 ft.	Black chert, weathering buff, in limestone with shale.
			New Scotland L.S.	160 ft.	Highly fossiliferous limestone; very cherty; thick bedded
			Coeymans	18 ft.	Biosparite; crinoids, bryozoans.
		Clifton Forge SS	Upper Limestone Mbr.	140 ft.	Massive, coarse-grained fossiliferous calcarenite with corals, algae, brachiopods, and bryozoans.
			Big Mtn. Sh.	18 ft.	Yellowish gray shale; calcareous (mostly covered).
			Lower L.S. Mbr.	25 ft.	Massive, coarse-grained fossiliferous calcarenites with corals, algae, brachs, bryo.
		Tonoloway Fm.		306 ft.	Algal laminate micrites; mud cracks; salt casts; flat pebble congl., ostracods.
Silurian			Cayuga	0-400	Wills Creek Bloomsburg McKenzie
			Keefer	70 ft.	
			Rose Hill	650 ft.	
			Tuscarora	50-250	



# SILURIAN AND EARLY DEVONIAN CENTRAL APPALACHIAN BASIN



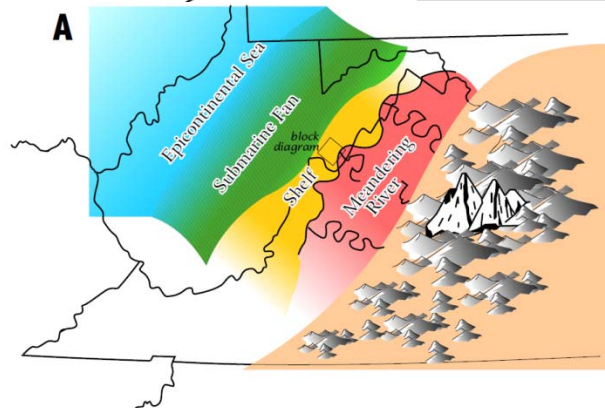
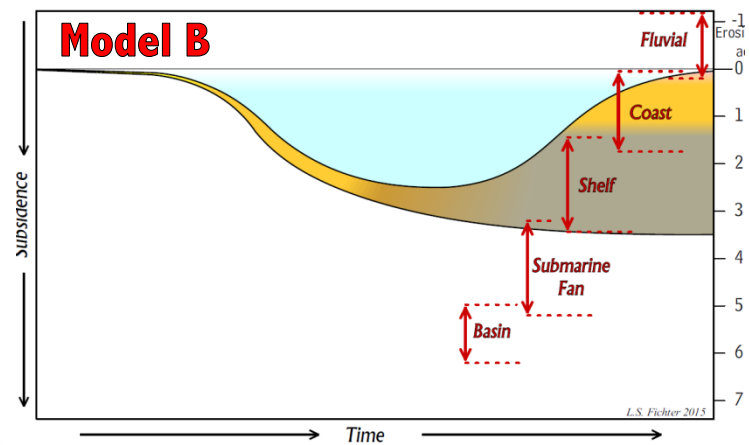
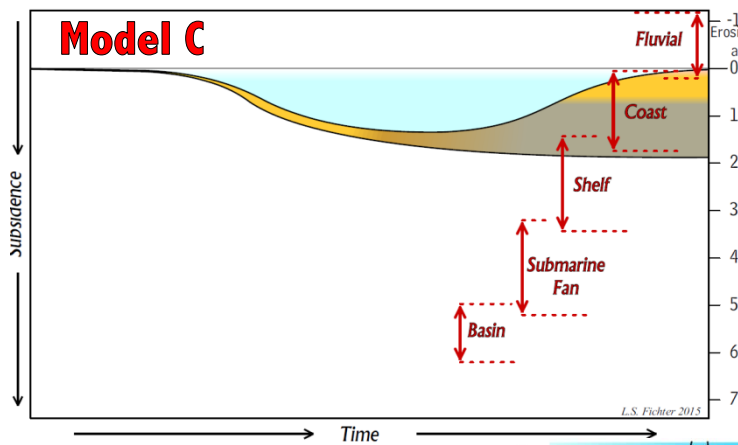
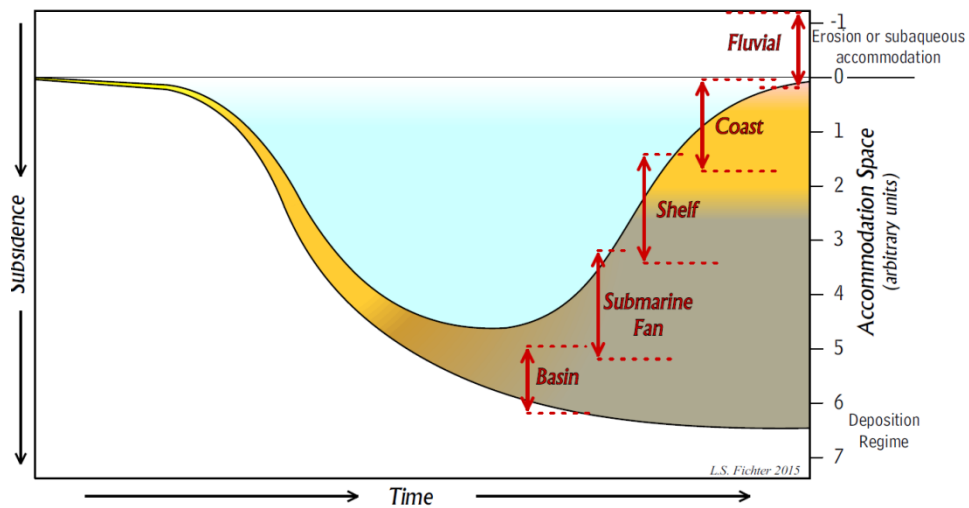
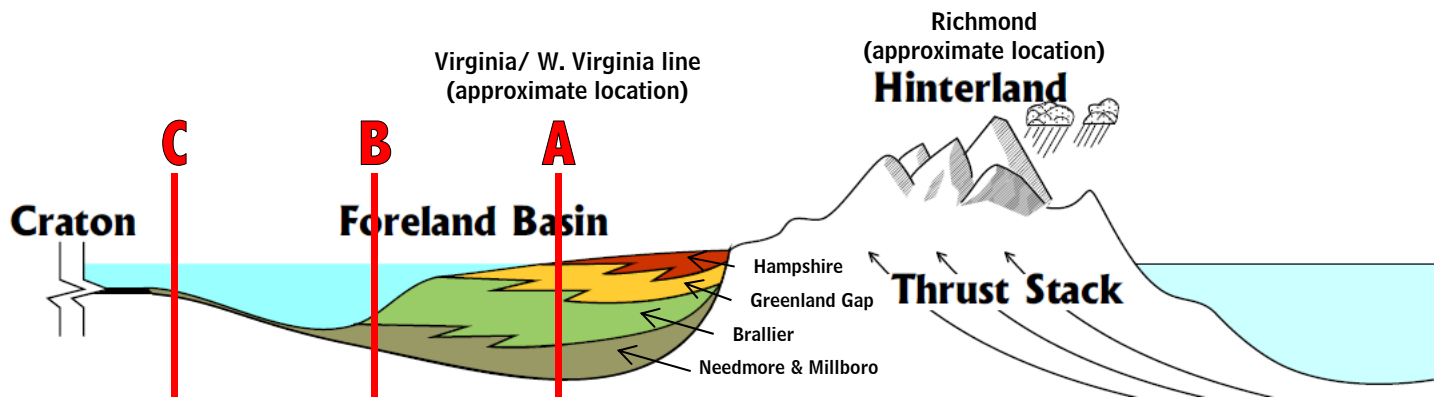
## K - Silurian-Early Devonian (438- ~385 Ma)

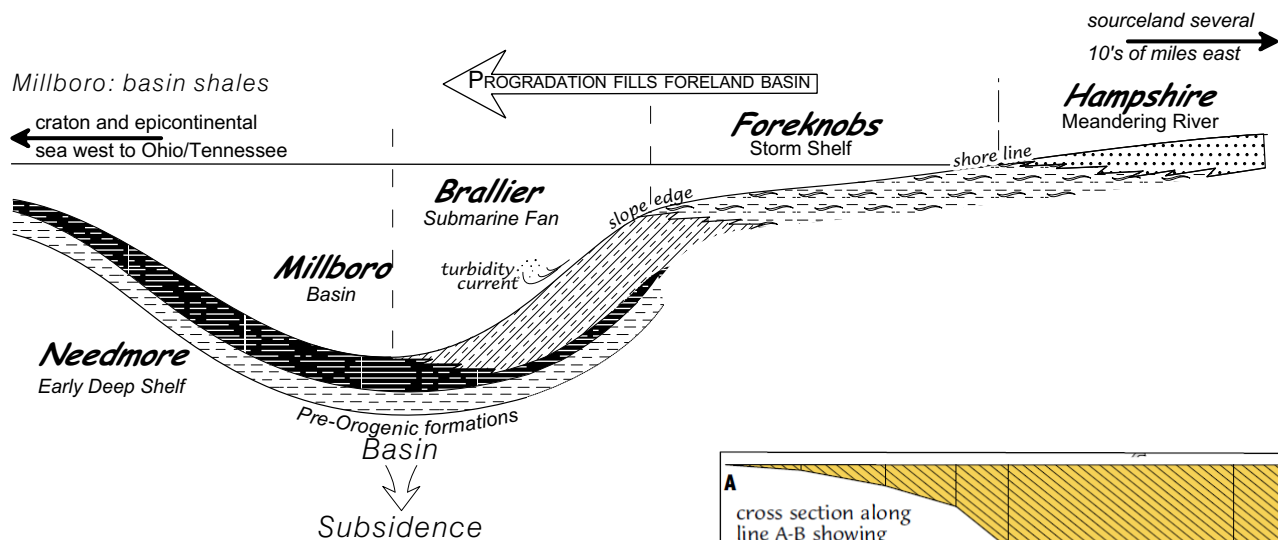


Taconic mountains are eroded, and the piedmont where the mountains once stood, is a low peneplain. West of the modern Blue Ridge the orogeny end is marked by the Tuscarora/Massanutten quartz sandstones. They and their equivalents blanket the entire region from New York to Tennessee.

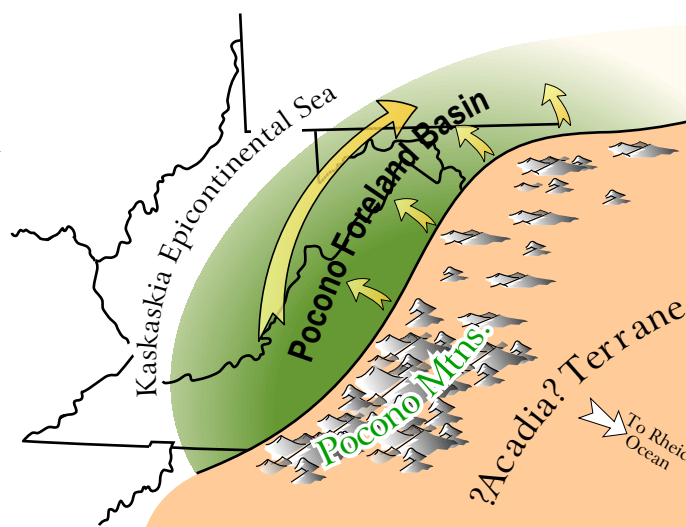
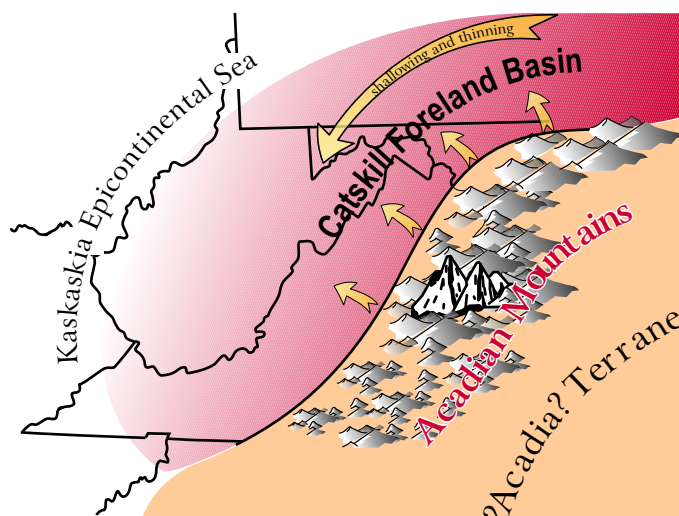
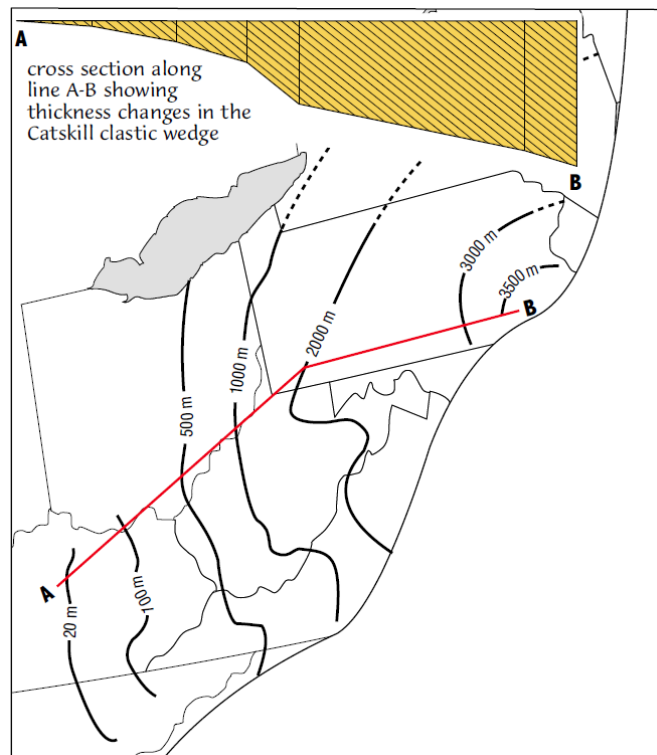
The foreland basins are now replaced by the shallow Central Appalachian Basin bordered in central Ohio and Kentucky by the Cincinnati arch, while its eastern shore lies somewhere in today's Shenandoah Valley. Laurentia is positioned in the latitude of southern tropical deserts. Hot, dry climates and rapid evaporation results in a widespread salt deposition (Salina formation, mostly halite and gypsum). Rimming the edge of the salt basin is carbonate deposition, such as the reef and shallow shelf Helderberg group, and tidal flat Tonoloway formation.

# SAATS Models for a Foreland Basin: the Catskill Clastic Wedge



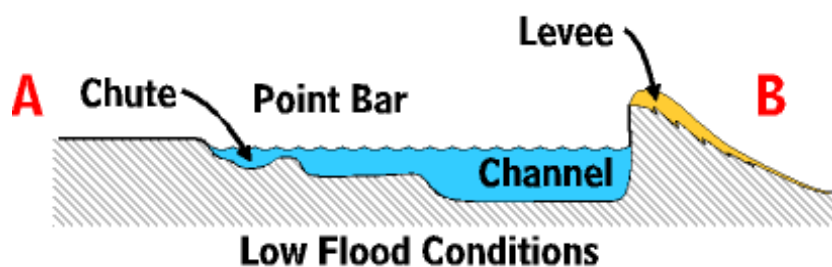
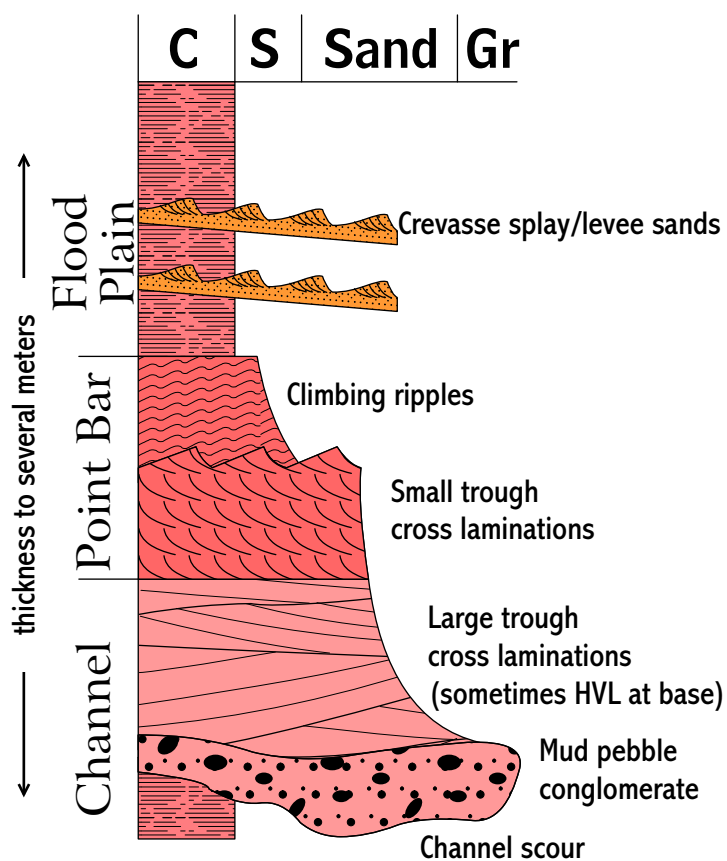


KASKASKIA	Miss.	<b>MAUCH CHUNK</b>		Coarse ss, silt, shale. Channels. Plant fossils common in places. Coal	Begin Alleghenian Orogeny
		<b>GREENBRIAR</b>		Carbonate dominated (oolites, biosparites)	Orogenic Calm
		<b>POCONO</b>	300-1700'	Quartz sandstone & conglomerate; coarse, thick, large cross beds	
		<b>HAMPSHIRE</b> (Catskill)	2000'	Point Bar Sequences; red	
		<b>GREENLAND GAP GROUP</b> (former Chemung)			
		<b>FOREKNOBS SCHEER</b>	2000'	Thick hummocky sequences; at top interbedded red and green fine sands and silts	
		<b>BRALLIER</b> (Portage in Pa.)	1500-1700'	Bouma sequences (submarine fan environment)	
	Devonian	<b>MILLBORO</b> (Used south of Shenandoah Co.)	900'-350-500'	Dark gray to black silts and fine sands	
		<b>NEEDMORE</b> (Tioga bentonite)	100-530'	Olive gray fine sands, silts, and shales; fossils abundant in places	
		<b>ORISKANY</b>	10-125'	Quartz arenite; white, gray, tan; abundant fossils	

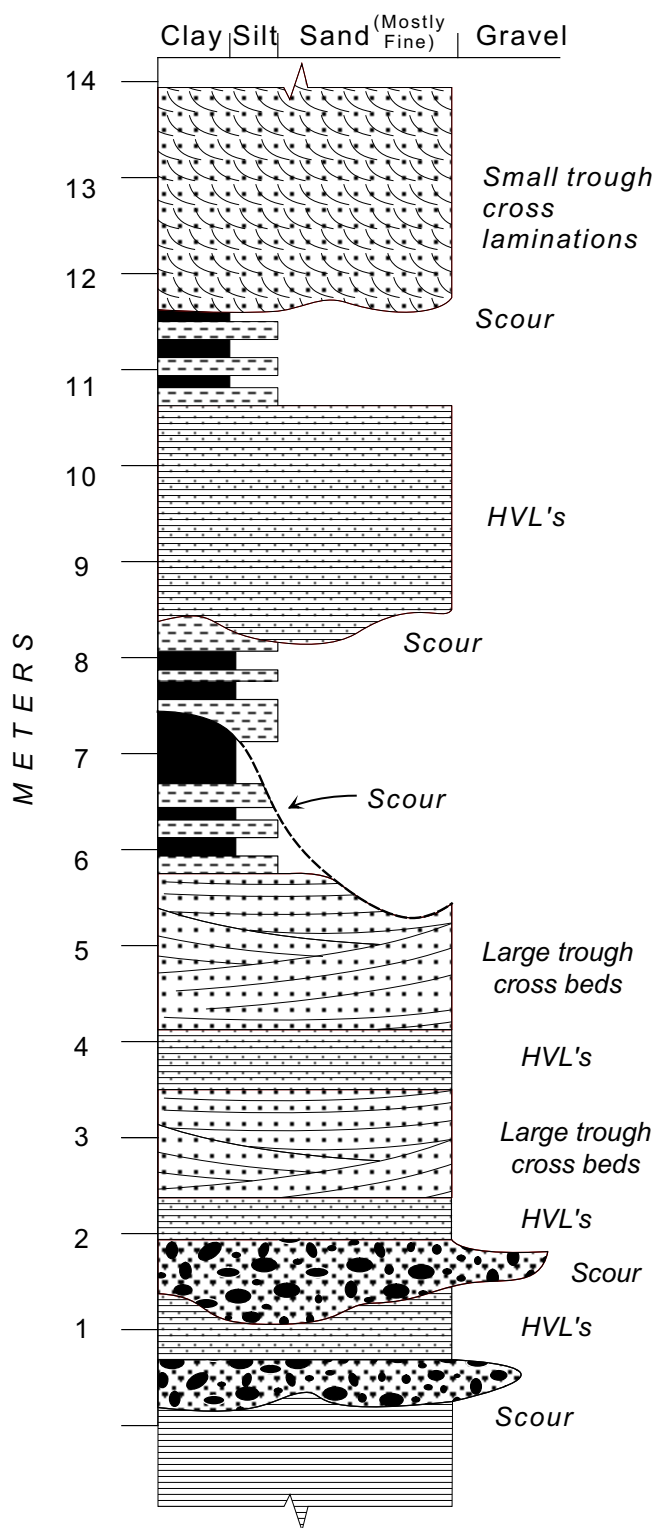


Distribution of the Mid-Late Devonian Catskill foreland basin and clastic wedge, and the Early Mississippian Pocono foreland basin and clastic wedge.

## Ideal Point Bar Sequence

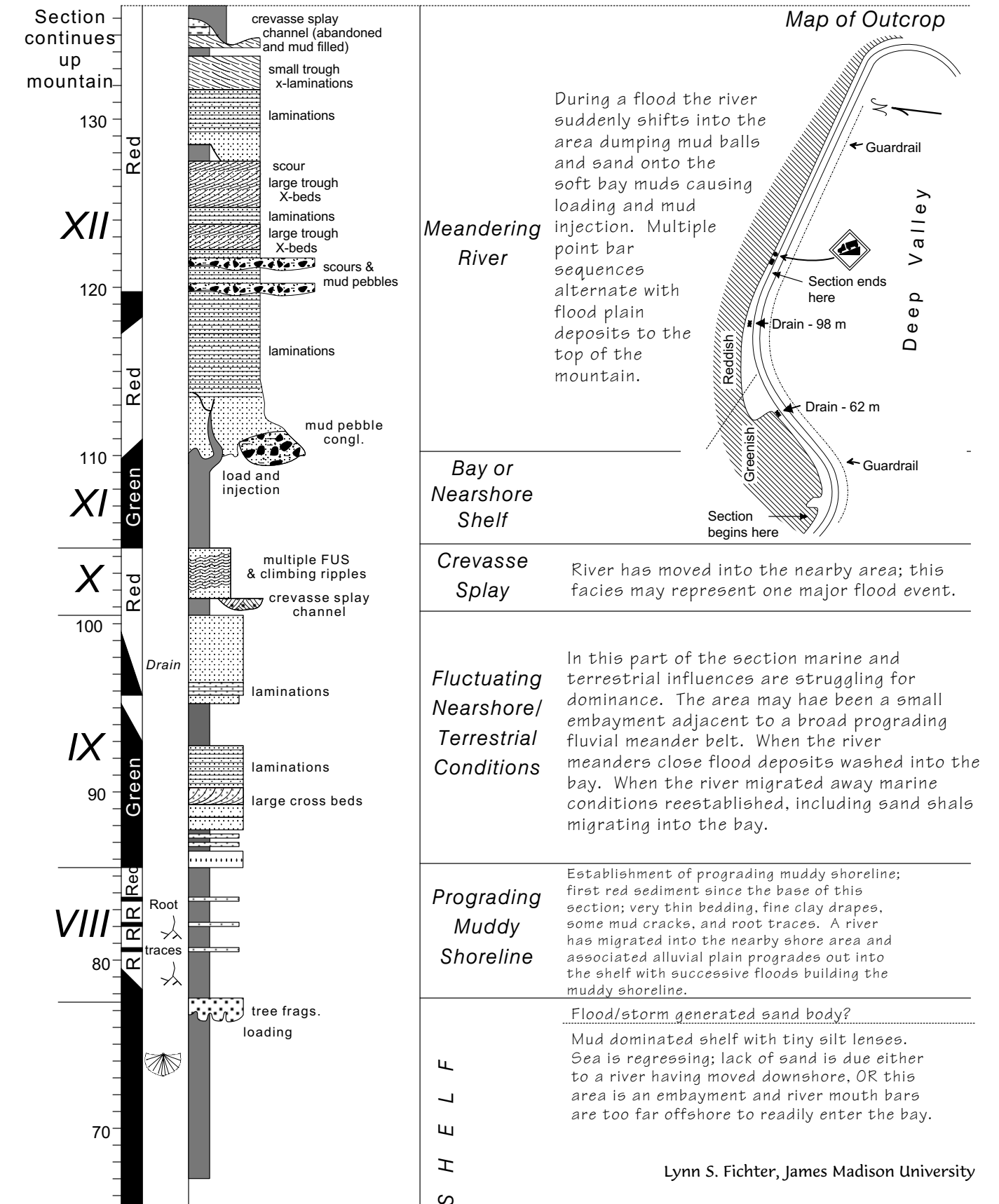


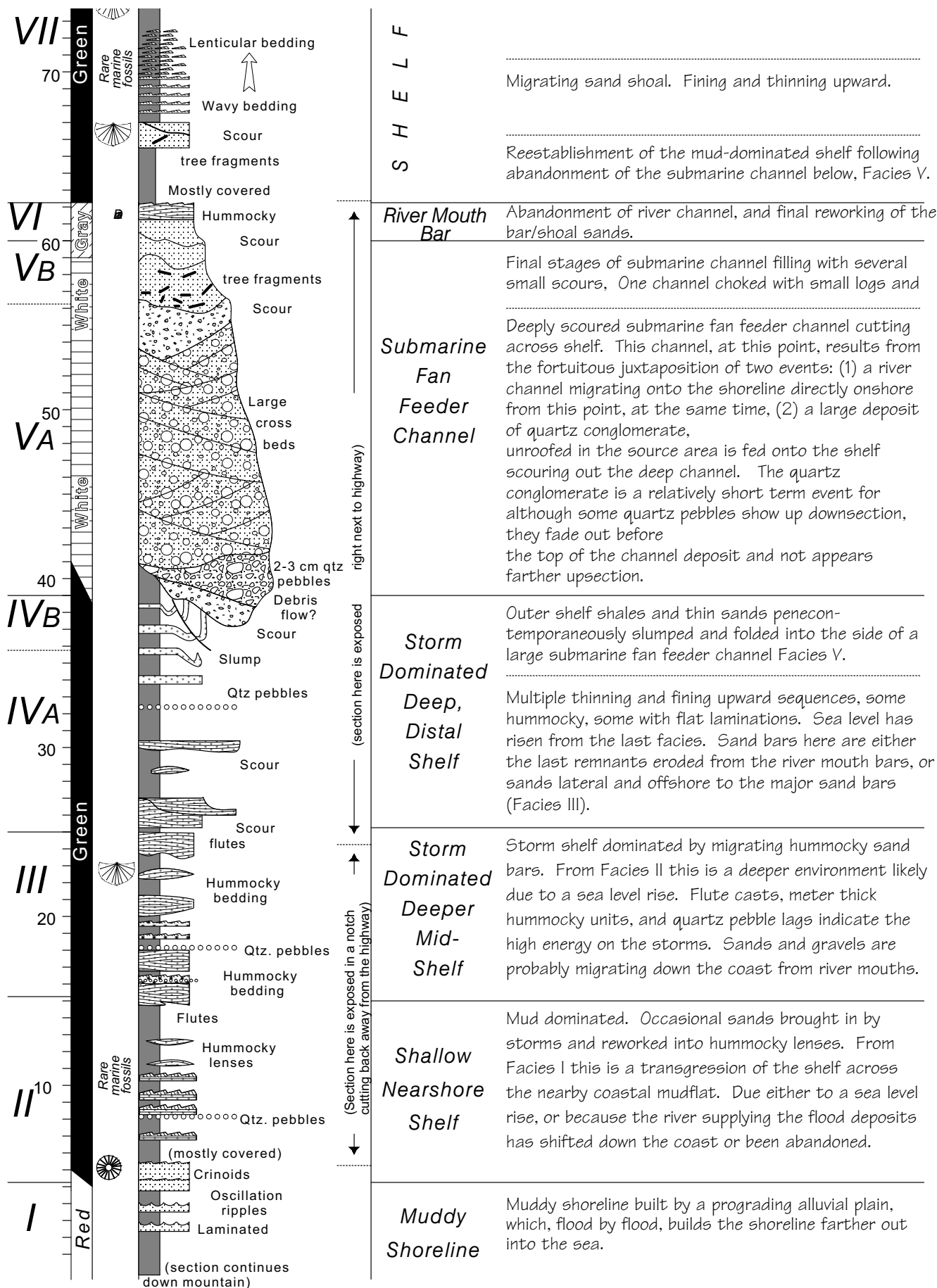
## Strip Log From the Base Of the Hampshire Formation (Devonian), Shenandoah Mountain, Pendleton Co., West Virginia



# Greenland Gap - Hampshire Transition, Rt. 33, Shenandoah Mountain, Pendleton County, West Virginia

## Upper Half of Section



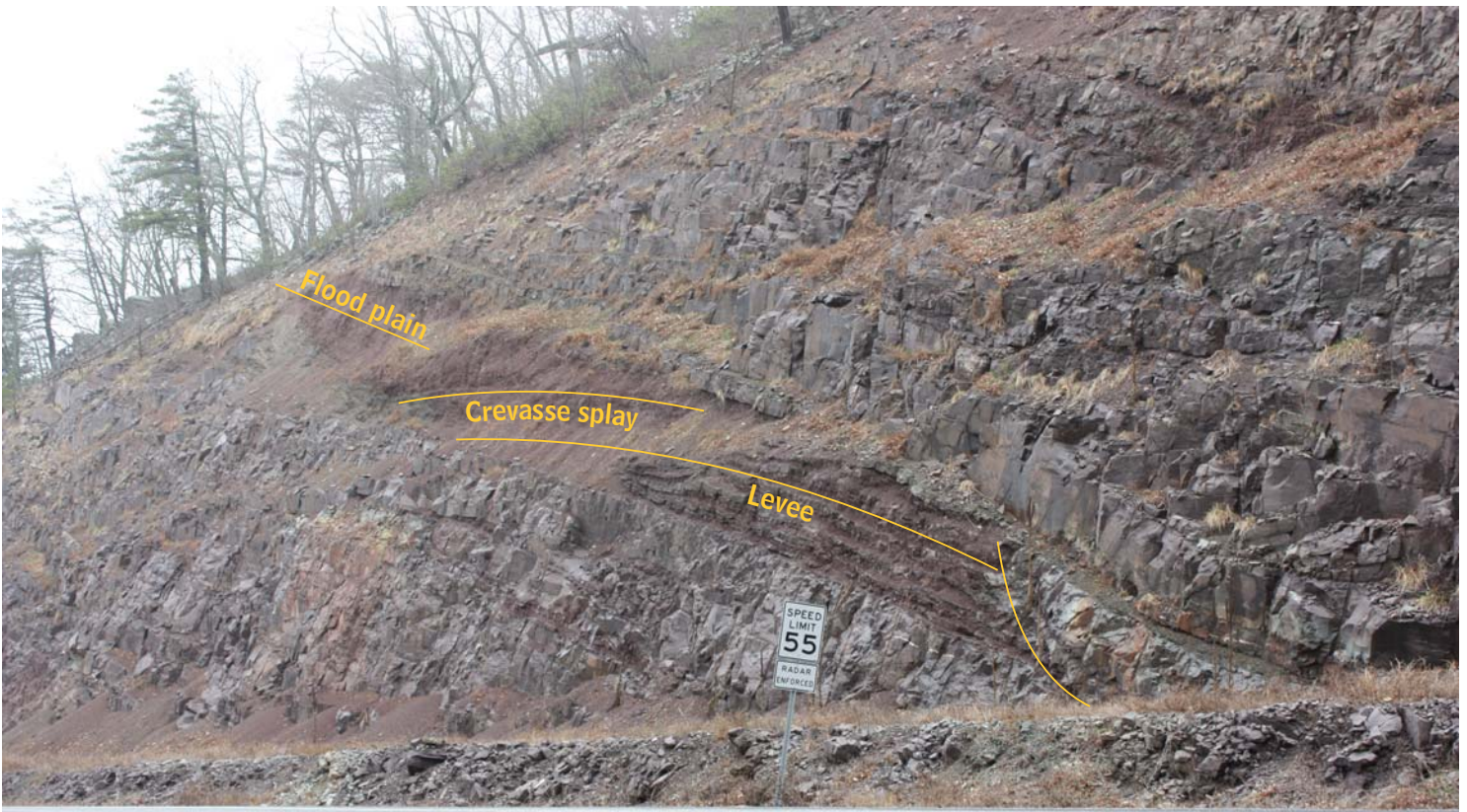


# Interpretation of a channel-levee-crevasse splay-floodplain sequence in the Hampshire formation, meandering river system along Rt 33 in Pendleton County, West Virginia.

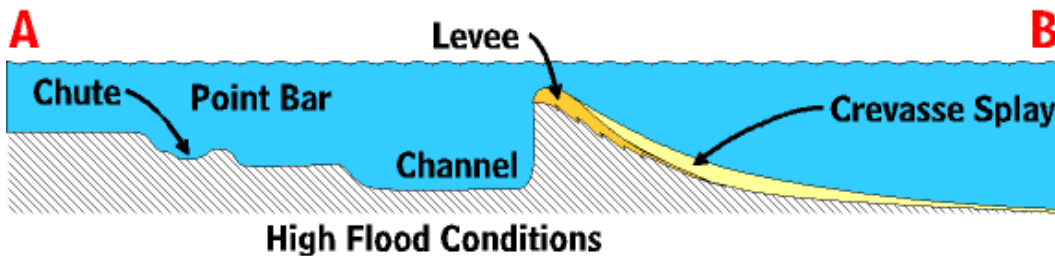
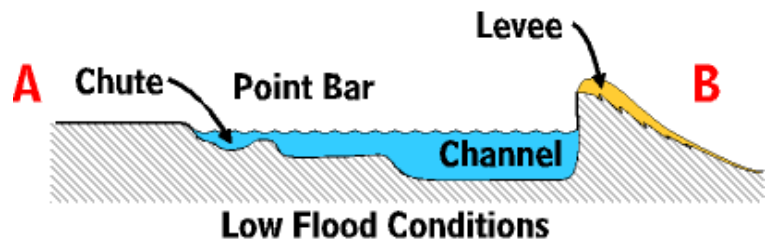
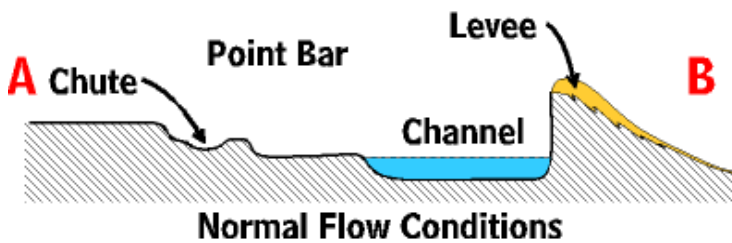
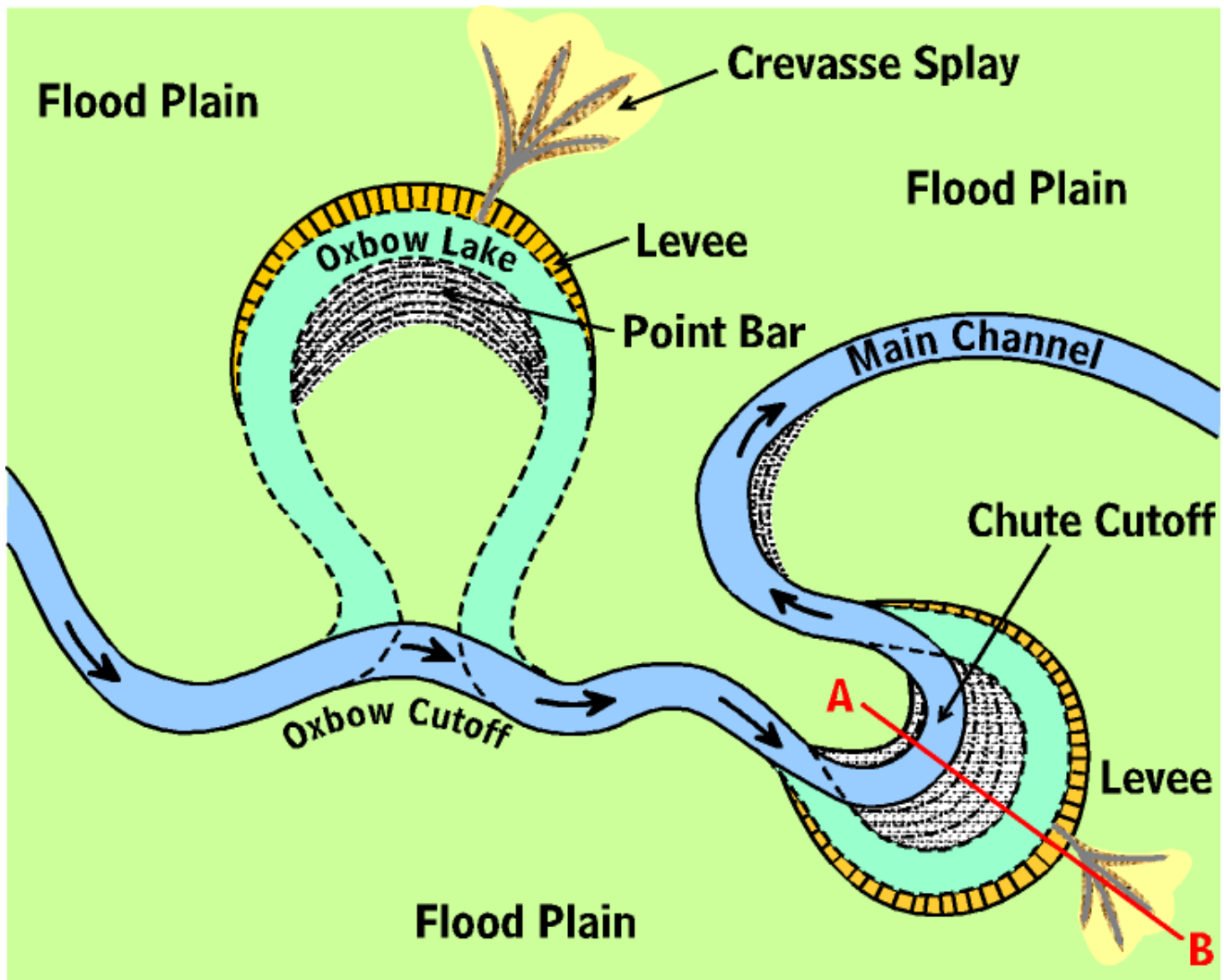
Lynn S. Fichter, Steven J. Whitmeyer, Christopher Bailey, William Burton, 2010, *Stratigraphy, Structure, and Tectonics: An East to West Transect of the Blue Ridge and Valley and Ridge Provinces, The Mid-Atlantic Shore to the Appalachian Highlands: Field Trip Guidebook for the 2010 Joint Meeting of the Northeastern and Southeastern GSA Sections of Northern Virginia and West Virginia*

## Stop 2-4

Mile 22.6 N38° 35' 19", W79° 10' 05" Shallowly east-dipping Hampshire Fm., featuring levees and crevasse splays of a meandering river system. Chlorite slickenlines can be seen on some bedding planes. (add. note: outcrop is about 1 1/2 to 2 miles down from the crest of the Shenandoah mountain - Va-WVa border - on the West Virginia side.



*Interpretation of a channel-levee-crevasse splay-floodplain sequence in the Hampshire formation, meandering river system along Rt 33 in Pendleton County, West Virginia.*



The outcrop is an almost perfect cut through a channel, levee, crevasse splay, floodplain of a meandering river system. The point-bar side of the channel is below the road level. The fact that this is even preserved implies that it represents an oxbow (cutoff meander loop); otherwise it would have been eroded out as the channel continued to erode laterally.

The cut bank is visible from the ripped up nature of the sediment on the outside bend, far left side of the channel. The levee is the more

resistant, dipping, interbedded wacke sands, silts, and clays next to the channel. The more resistant wacke sands are large, peak-floods carrying coarser debris over the top of the levee. The crevasse splay consists of finer silts and clays dipping less than the levee and extending laterally farther from the channel. Finally, distally, the clays have taken on the attitude of the underlying thick sandstone (used as a datum line) indicating we are off the levee/crevasse splay slope and out on the floodplain.

Superficially, the beds above and below look uninteresting, but contain numerous scours and reactivation surfaces indicating other river behavior.