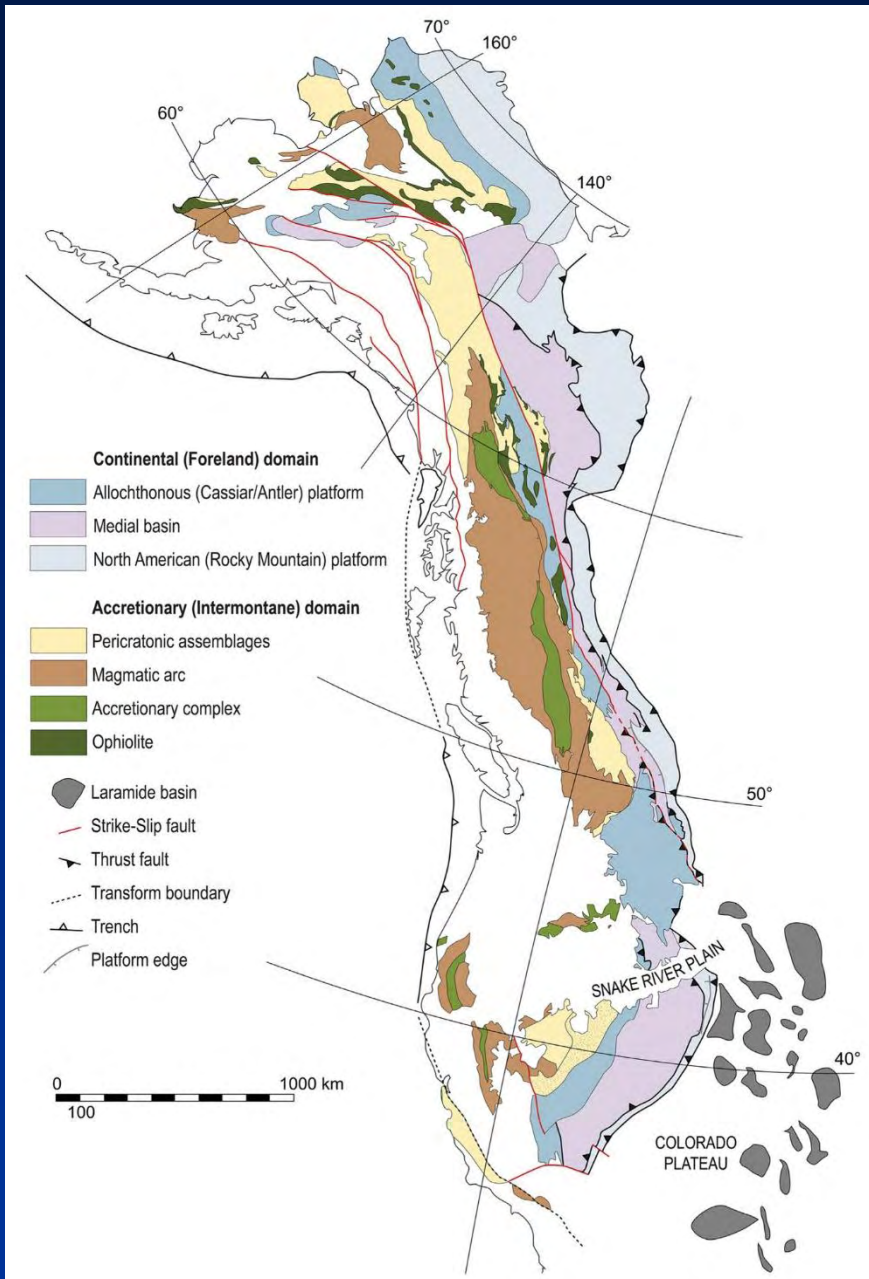


Associazioni di sovrascorrimenti-accavallamenti e pieghe: Le Rocky Mountains



Le Rocky Mountains (e la Cordillera)



https://commons.wikimedia.org/wiki/File:Tectonic_plates_boundaries_detailed-en.svg

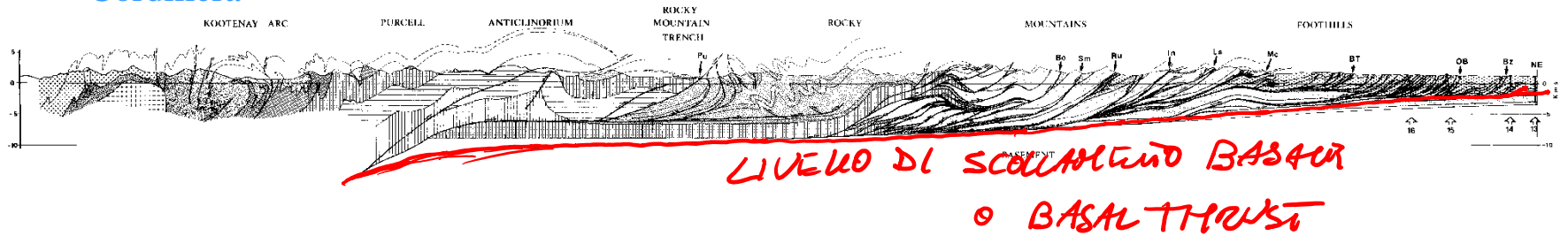
Subduzione di crosta oceanica, sistemi di accrezione (vedi prismi di accrezione), arco magmatico, deformazione del continente, foreland fold and thrust belt

Le Rocky Mountains

Da Price, 1981

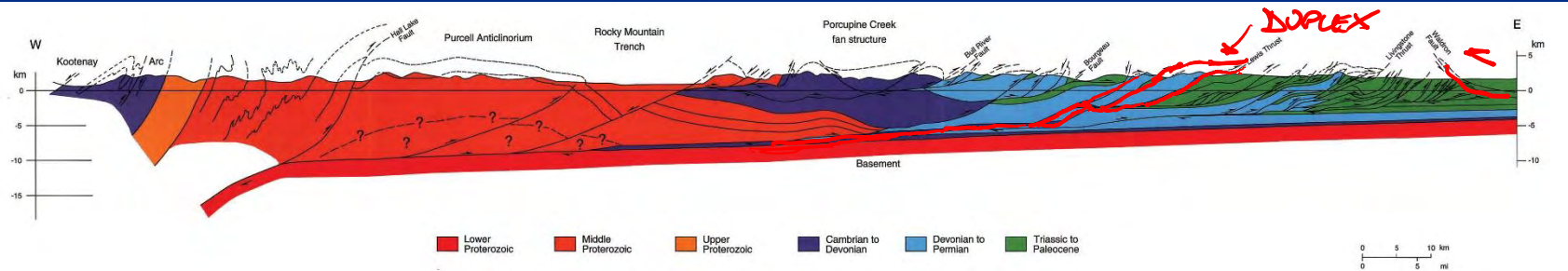
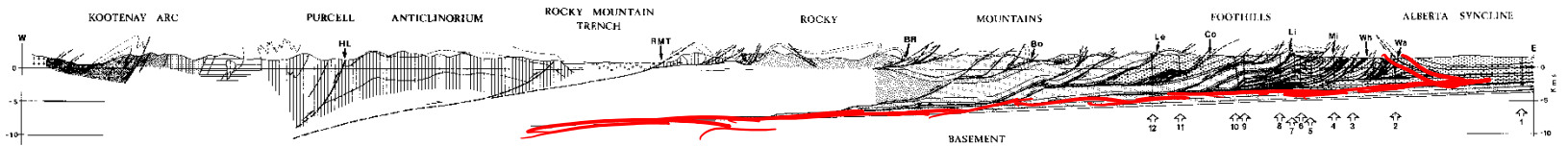
Cordillera

Rocky Mountains

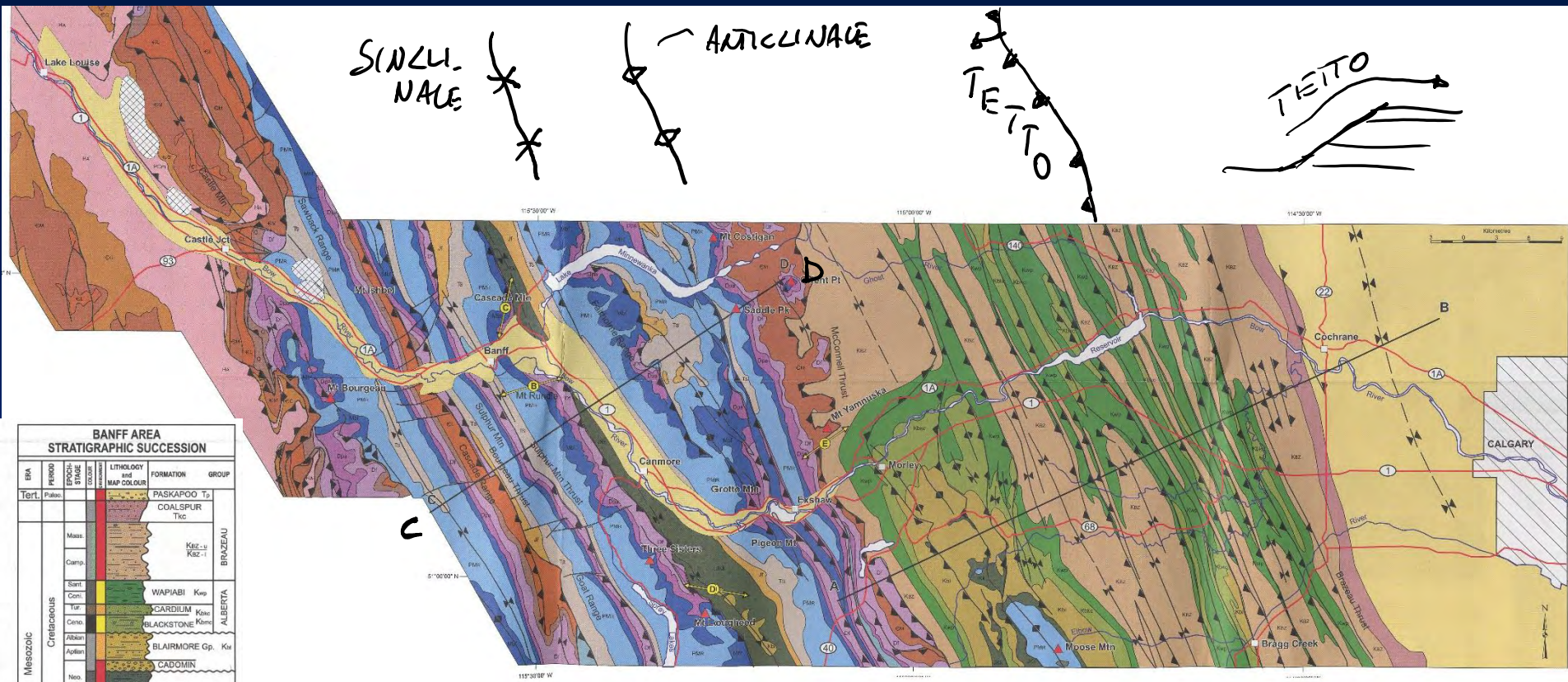


Cordillera

Rocky Mountains



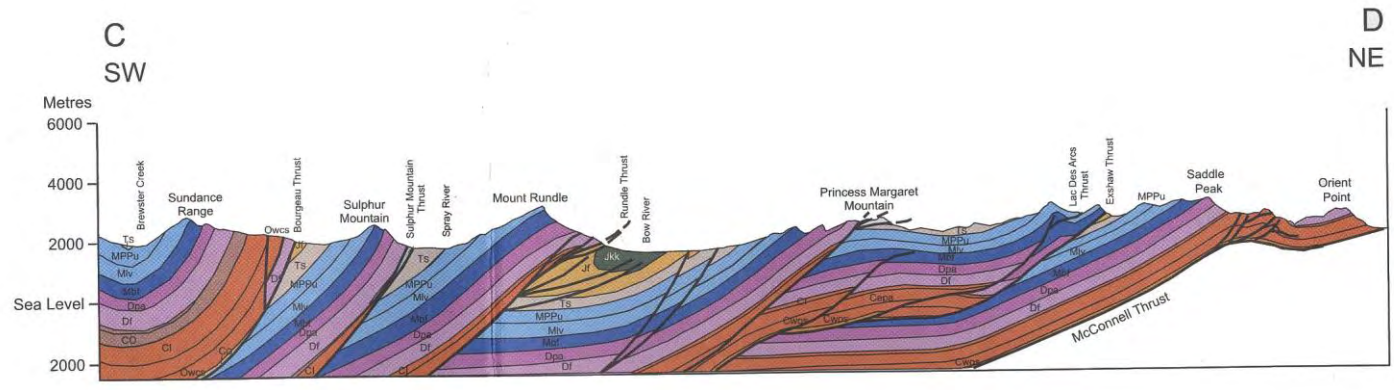
Da Price, Capitolo 2 in «Atlas of the Western Canada sedimentary basin» Alberta Geological Survey.



BANFF AREA STRATIGRAPHIC SUCCESSION

ERA	PERIOD	STAGE	MAP COLOUR	LITHOLOGY	FORMATION	GROUP
Mesozoic	Tertiary	Paleoc.			PASKAPOO T ₂	BRADZEAU
					COALSPUR T _{1c}	
	Cretaceous	Maas.			K ₂ -L ₁	ALBERTA
		Camp.			K ₂ -L ₁	
		Sant.			WAPIABI K ₂ cp	ALBERTA
		Tar.			CARDIUM K ₂ cc	
		Cont.			BLACKSTONE K ₂ bc	ALBERTA
		Albian			BLAIRMORE Gp. K ₂ bl	
		Neoc.			CADOMIN	
		Paleozoic	Jurassic			KOOTENAY J ₁ k ₁
				FERNIE J ₂ f ₂		
Triassic				SULPHUR MTN T ₃	SPRUY SPRAY RIVERS	
				ISHBEL Gp.		
Permian				KANANASKIS	P.M.R.	
				TUNNEL MTN		
Penns.				ETHERINGTON	P.M.R.	
				MT. HEAD		
Paleozoic	Mississippian				LIVINGSTONE	P.M.R.
					BANFF M ₁	
	Devonian			PALLISER D ₂ p ₂	P.M.R.	
				ALEXO D ₁		
	Ordovician			SOUTHESK D ₁ s	P.M.R.	
				CAIRN D ₁ c		
	Cambrian			ELDON C ₂ e ₂	C.M.	
				STEPHEN C ₁ s		
	Cambrian			CATHEDRAL C ₁ cs	C.M.	
				MT. WHYTE C ₁ w		
Precambrian				G.O.G.		

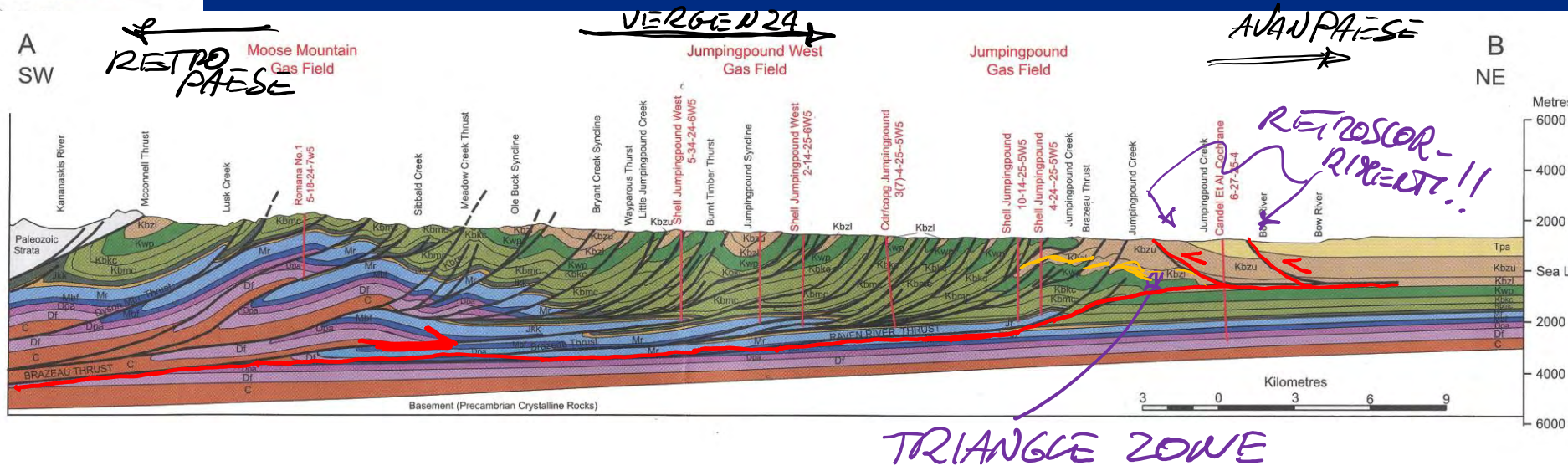
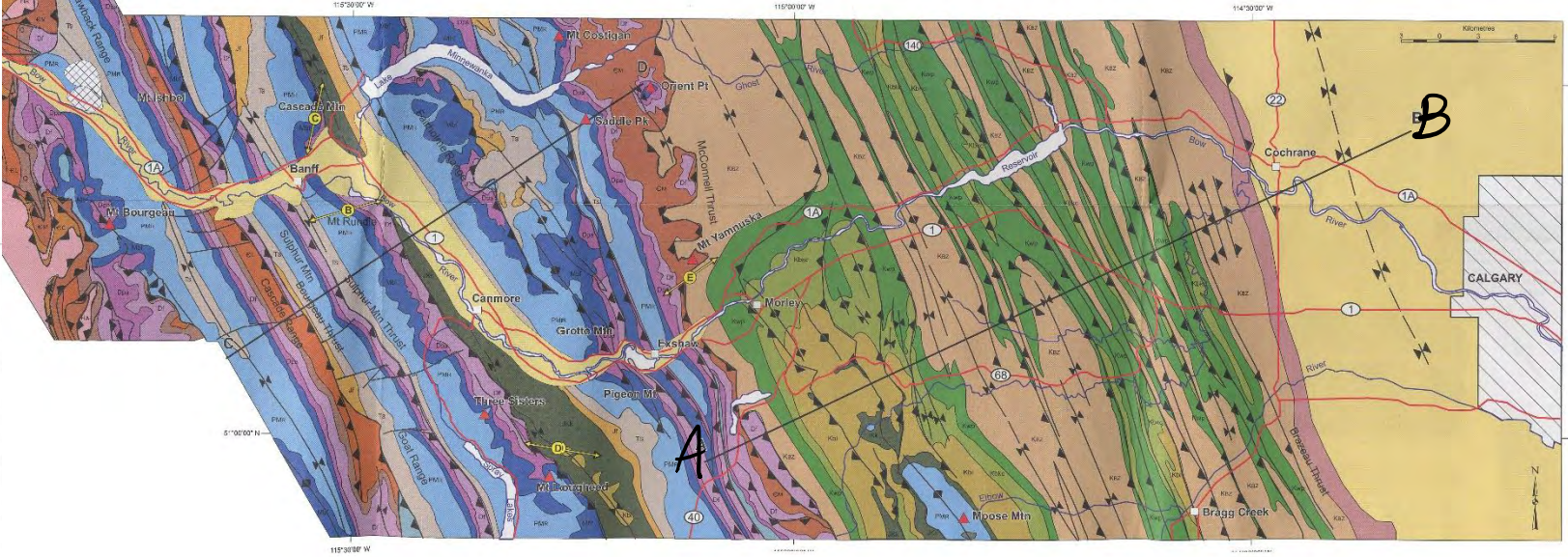
Roadside geology, Calgary - Banff (Trans-Canada Highway). Geological Survey of Canada, 1994



Roadside geology, Calgary - Banff (Trans-Canada Highway). Geological Survey of Canada, 1994

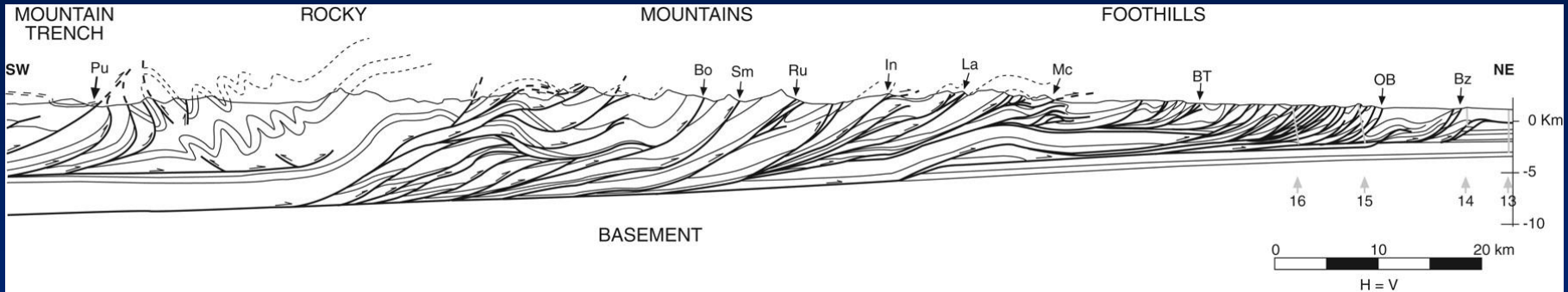
BANFF AREA STRATIGRAPHIC SUCCESSION

ERA	PERIOD	STAGE	LITHOLOGY and MAP COLOUR	FORMATION	GROUP
Tert.	Paleo.			PASKAPOO T ₁	BRITISH COLUMBIA
				COALSPIR T ₂	
Mesozoic	Cretaceous	Maas		KEL-1, KEL-2	ALBERTA
		Camp			
		Sant		WAPIABI K ₁₀	
		Con		CARDIUM K ₉	
		Tar		BLACKSTONE K ₈	
		Cen		BLAIRMORE Gp. K ₇	
		Alban		CADOMIN K ₆	
		Jur			
		Neoc		KOOTENAY J ₆	
		Jurassic			
Triassic			SULPHUR M ₁		
Permian			ISHBEL Gp.		
Paleozoic	Pennsylvanian			KANANASKIS T ₁	
				TUNNEL M ₁	
				ETHERINGTON M ₁	
				MT. HEAD M ₁	
Paleozoic	Mississippian			LIVINGSTONE M ₁	
				BANFF M ₁	
				PALLISER D ₁	
				ALEXO D ₁	
				SOUTHSK D ₁	
				CAIRN D ₁	
				FLUME D ₁	
				SUBLEY D ₁	
				STYX C ₁	
				ARCOTOMY P ₁	
Paleozoic	Devonian			ELDON C ₁	
				STEPHEN C ₁	
				CATHEDRAL C ₁	
				MT. WHITE C ₁	
				HA C ₁	

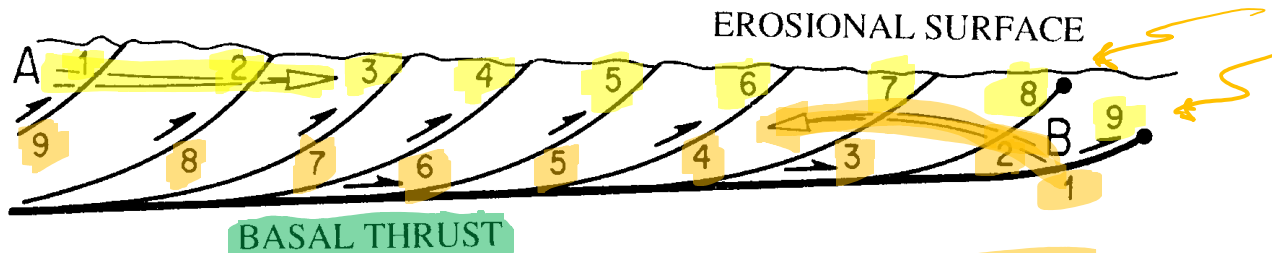


Propagazione degli accavallamenti

“piggy-back”, “overstep (o back-step)”, out-of-sequence



Da Poblet & Lisle, 2011



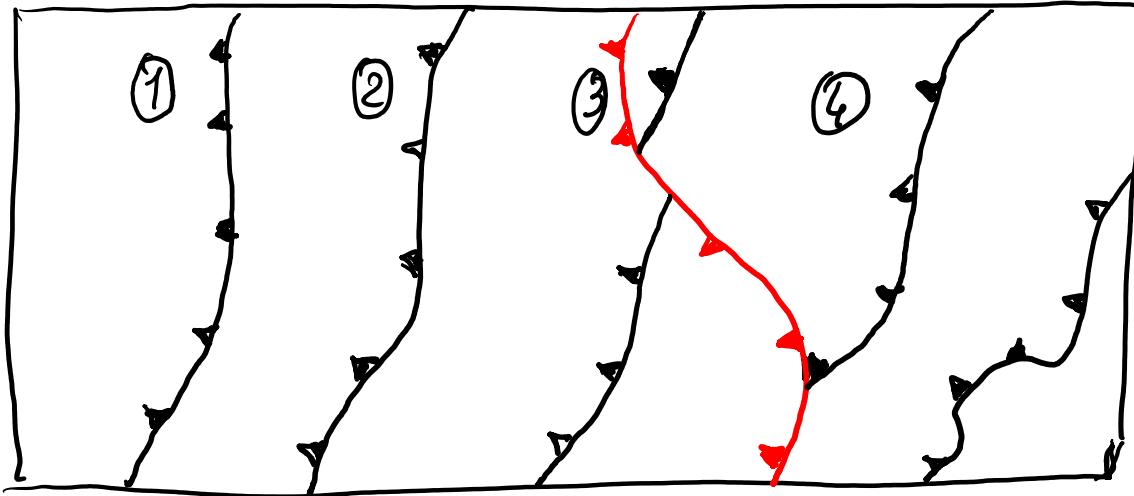
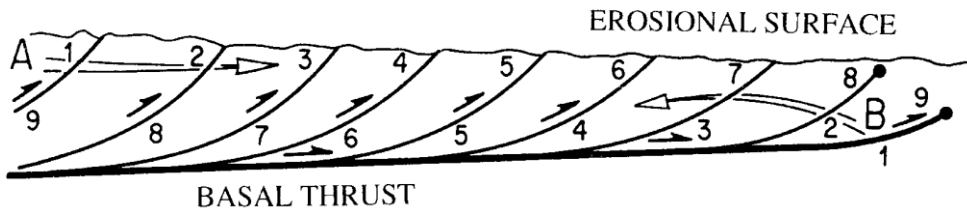
ACCAVALLA-
MENTI
CIECHI

Figure 12 - Imbricate structure and sequential development of thrusts in a piggy-back sequence (foreland propagation; arrow A and numbers indicate the order of development of thrusts). Out of sequence thrust stack (propagation of thrusts in the hanging wall; arrow B and numbers indicating the order of development of thrusts).

Da Merle, 1998

Da Merle, 1998

"FUORI SEQUENZA"
out-of-sequence thrust

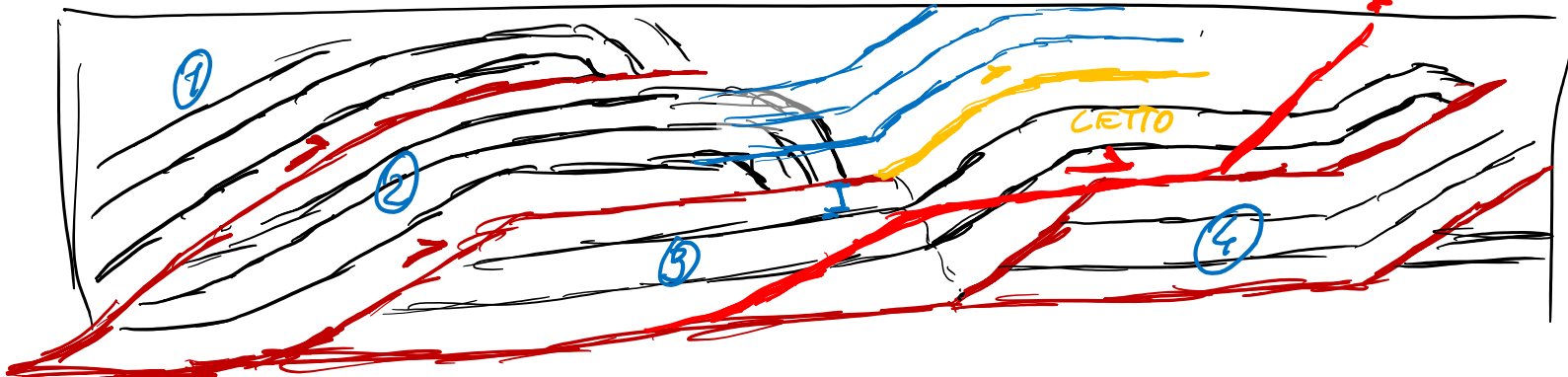


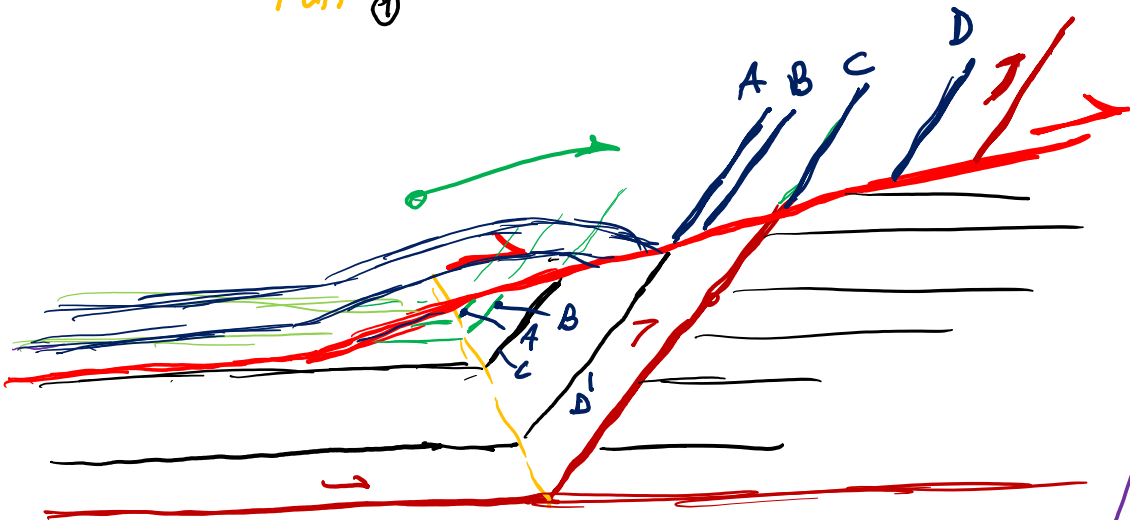
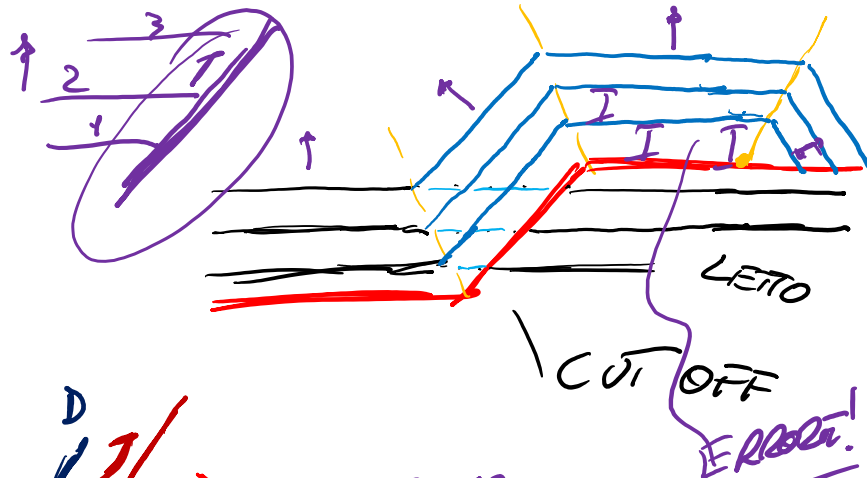
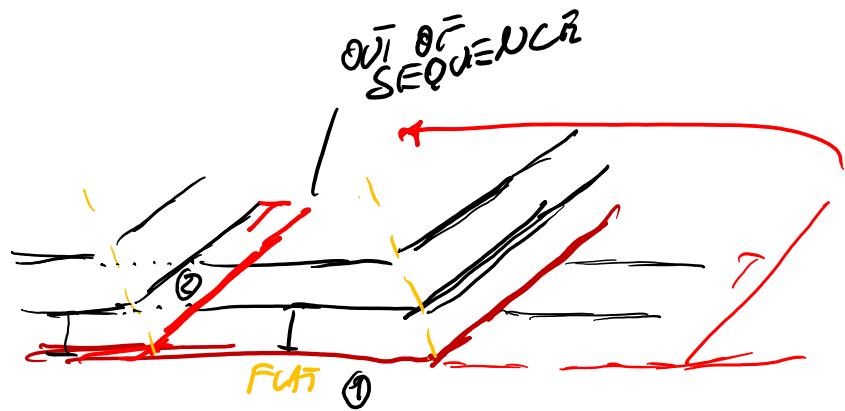
TRACCIA DI
ACCAVALLAMENTO
(I TRIANGOLI
INDICANO IL TETTO)

TRACCIA DI
ACCAVALLAMENTO
FUORI SEQUENZA
(I TRIANGOLI INDICA-
NO IL TETTO)

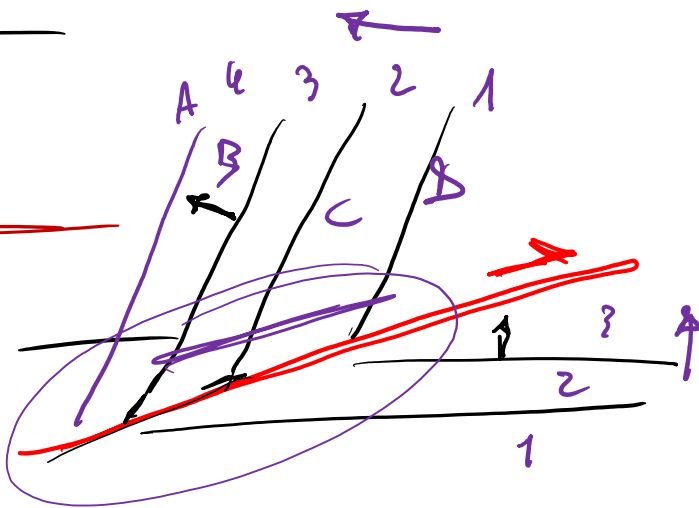
+ UCCARCO + RECESSO
1 → 2 → 3 → 4
RIGOR-BACK "CLASSICA"

FUORI SEQUENZA



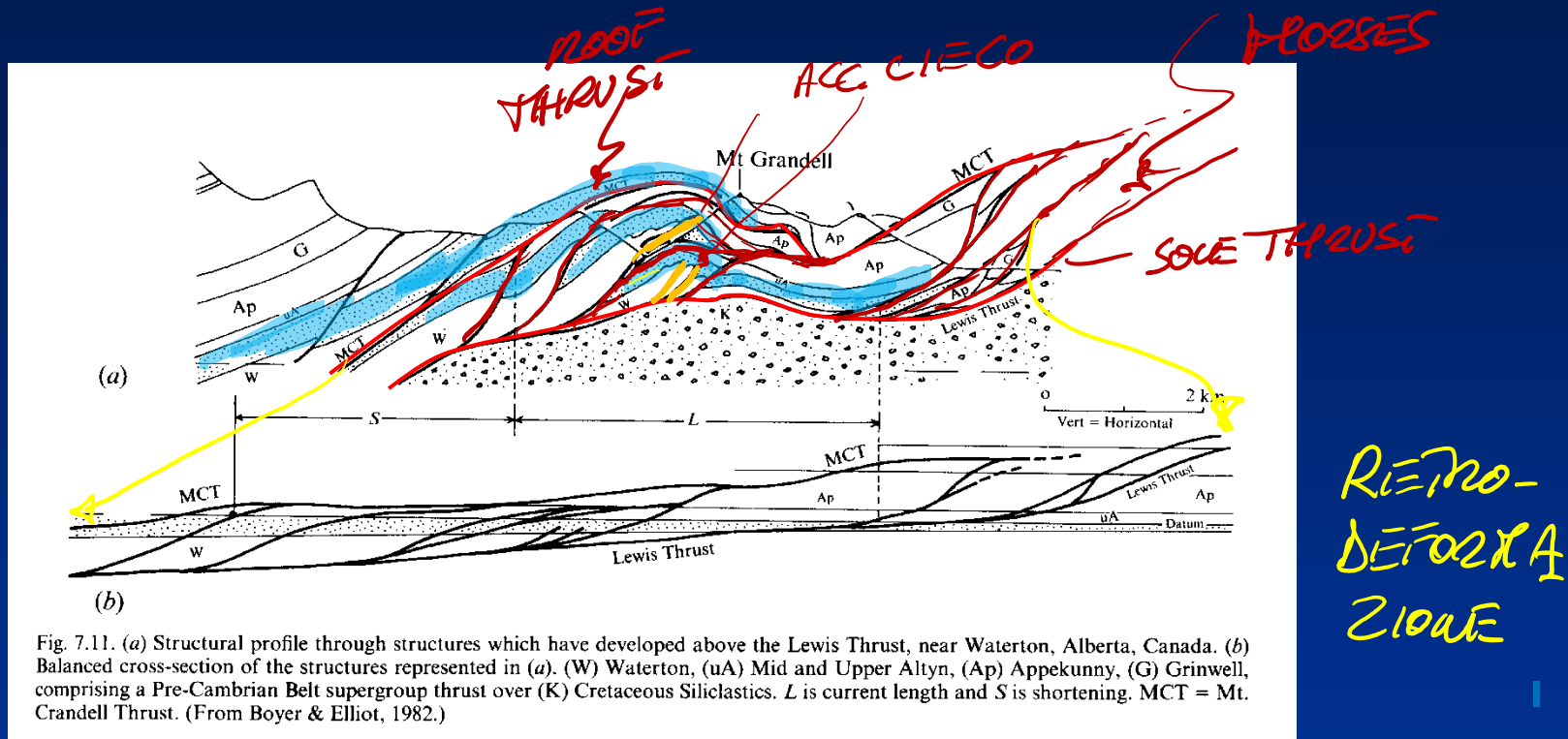


RASPA DI LETTO
OUT OF SEQUENCE



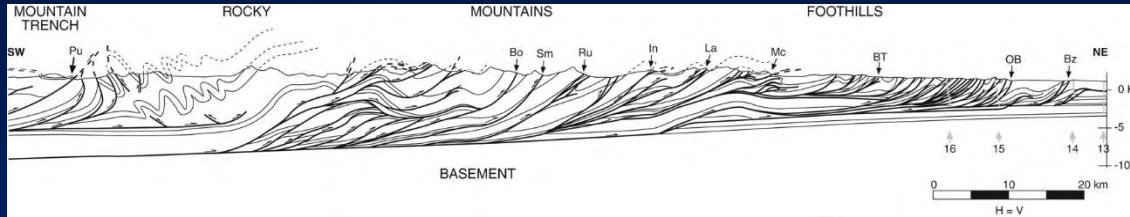
!! SEGBRA !!
UNA PAGLIA !!
NO ROTALE
DOWN OF SEQUENCE
CUT OFF

Duplex nelle Rocky Mountains (Mt. Grandell and Lewis Thrusts)

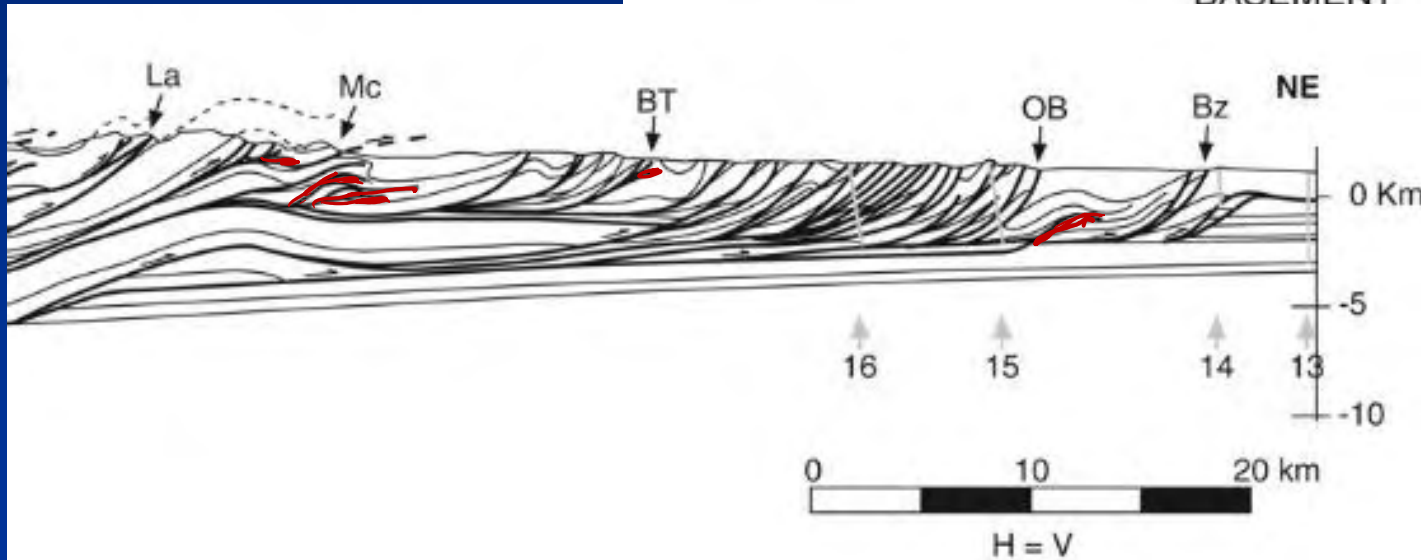
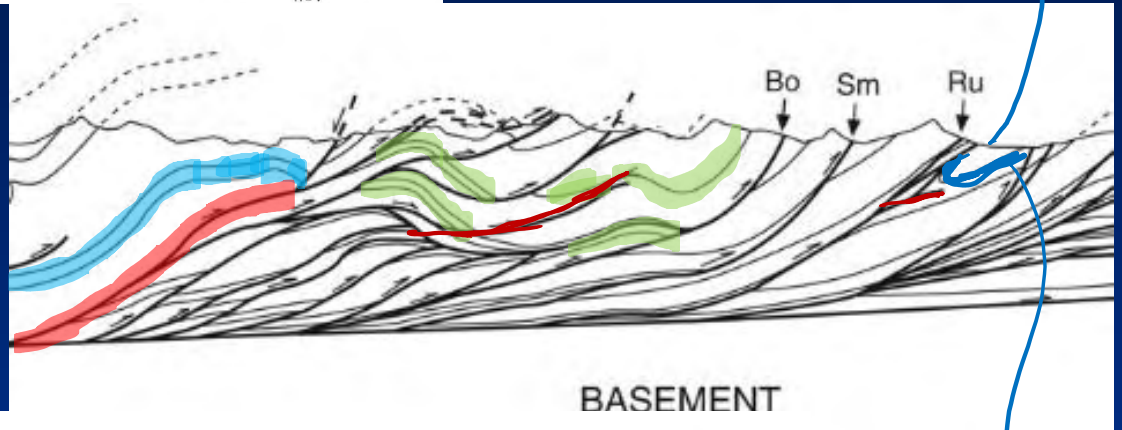


Da Price and Cosgrove, 1990

Rocky Mountains: pieghe associate ai sovrascorrimenti e duplex, accavallamenti ciechi

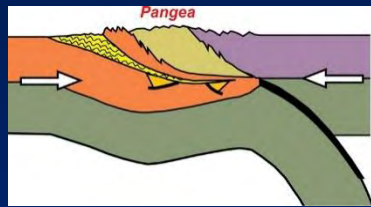
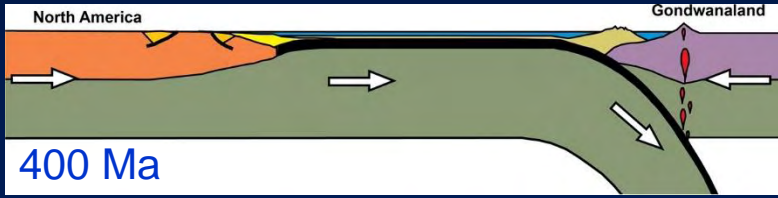


PIEGA
NEL
LETTO!!!?

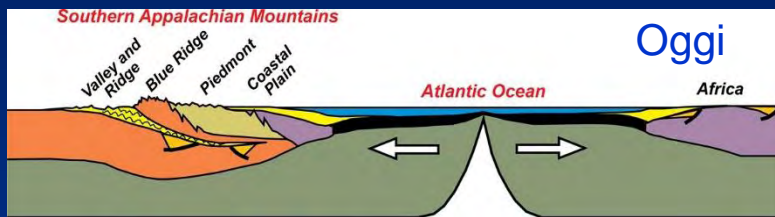


QUITE
A
MODERN!

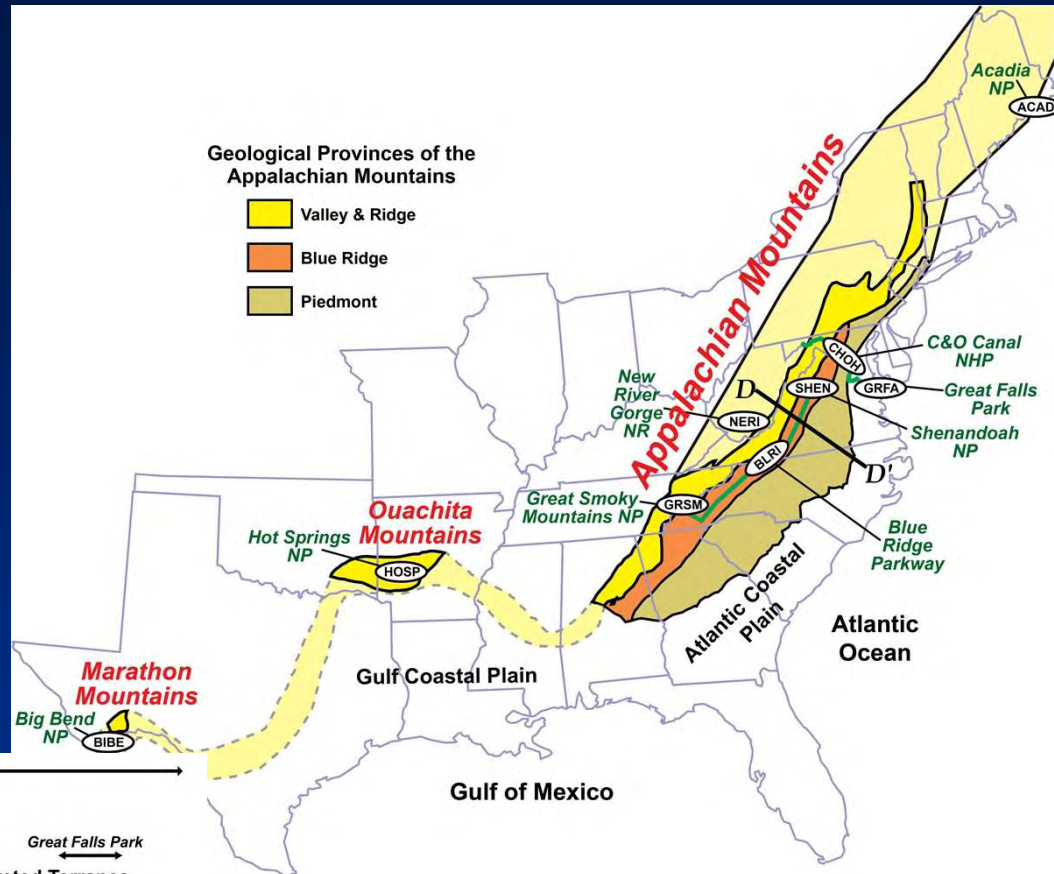
Pieghe, duplex e sovrascorrimenti: Appalachians



300 Ma

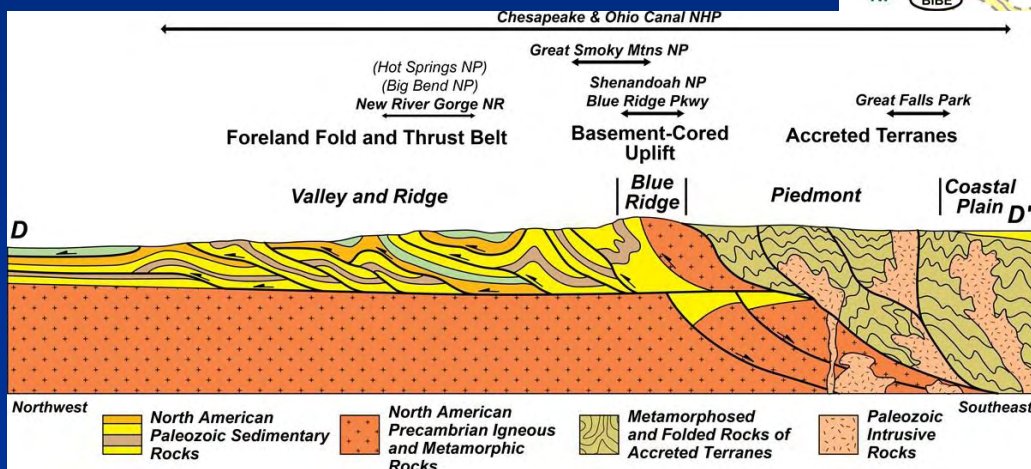


Da National Park Service, tratto da Marshak, 2001



Da National Park Service, tratto da Lillie, 2005

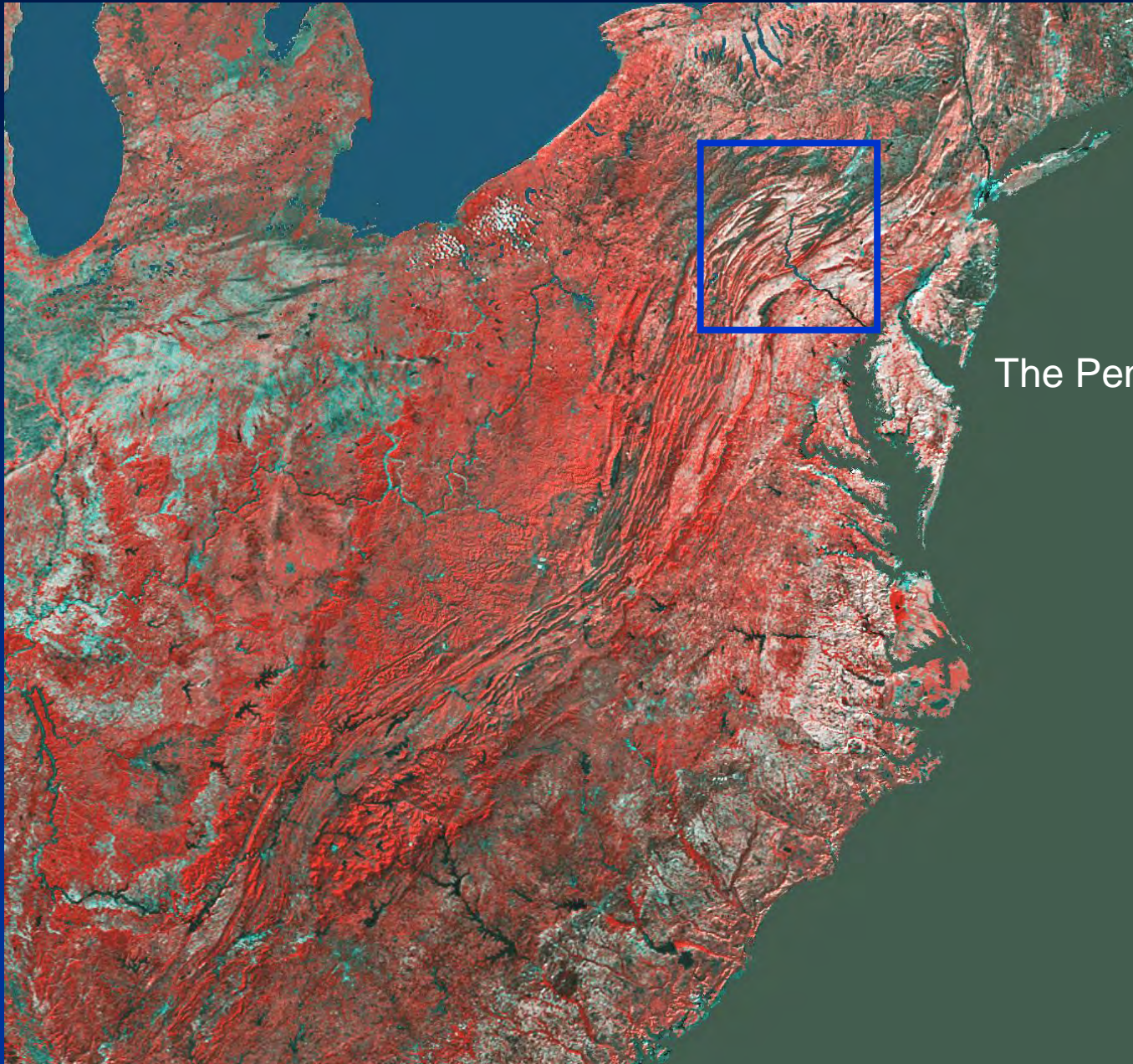
Sistema di catene da prismi di accrezione e collisione continentale (400-300 Ma)



Da National Park Service, tratto da Lillie, 2005

<https://www.nps.gov/subjects/geology/plate-tectonics-collisional-mountain-ranges.htm>

Pieghe, duplex e sovrascorrimenti: Appalachians

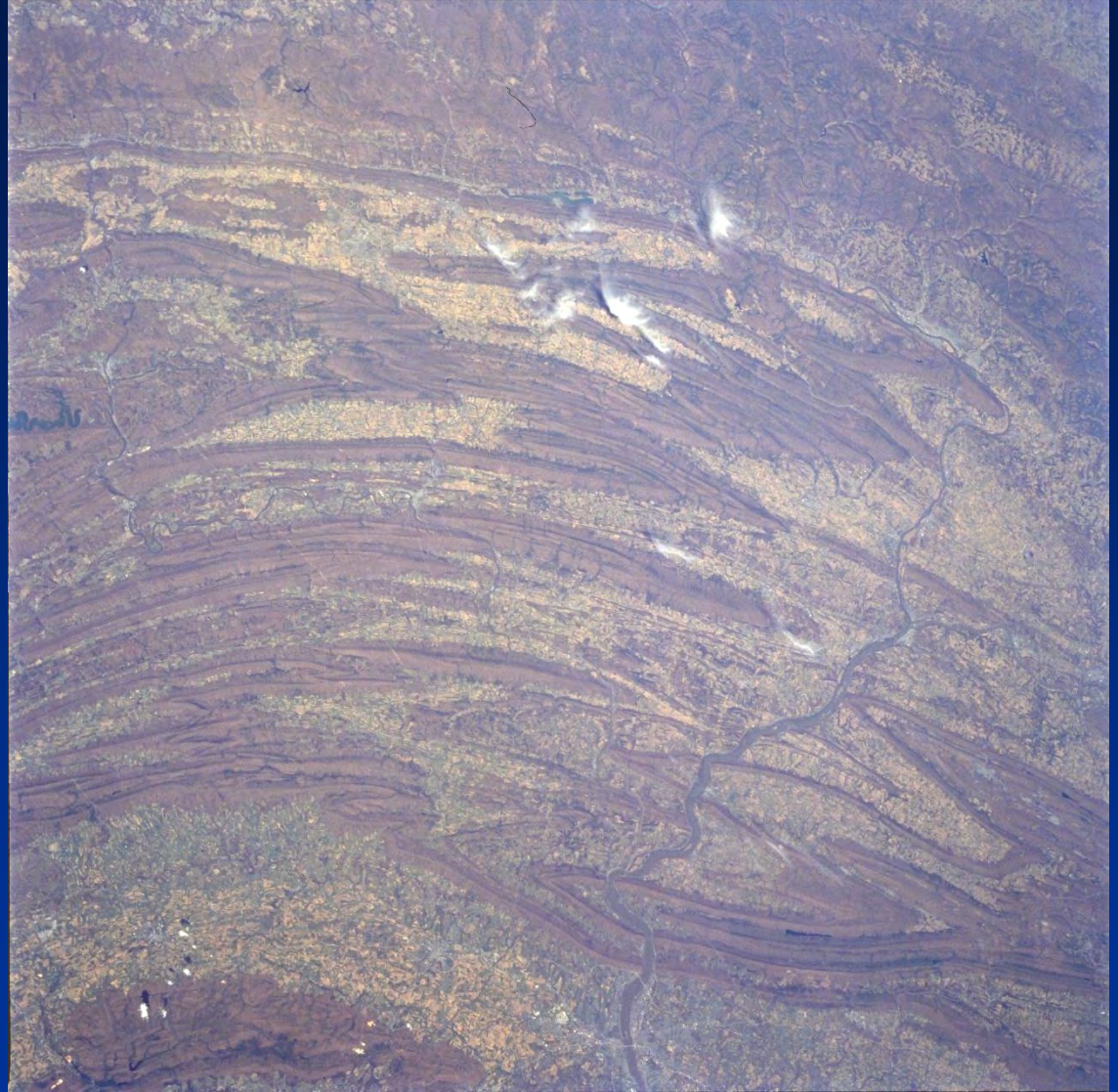


The Pennsylvania Salient

Da USGS
Mosaico dati
satellitari AVHRR,
falsi colori

Pieghe: Appalachians

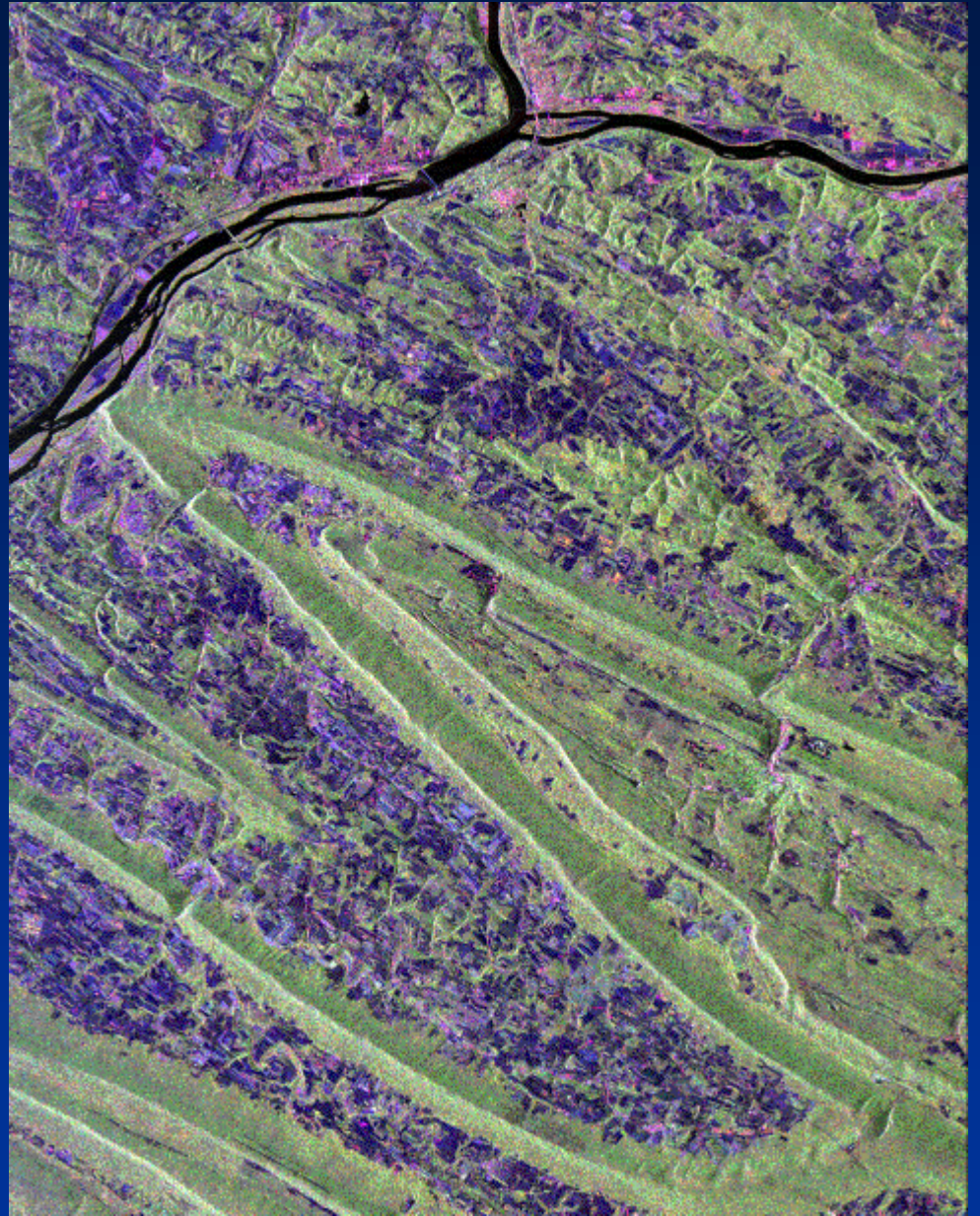
Quale origine?



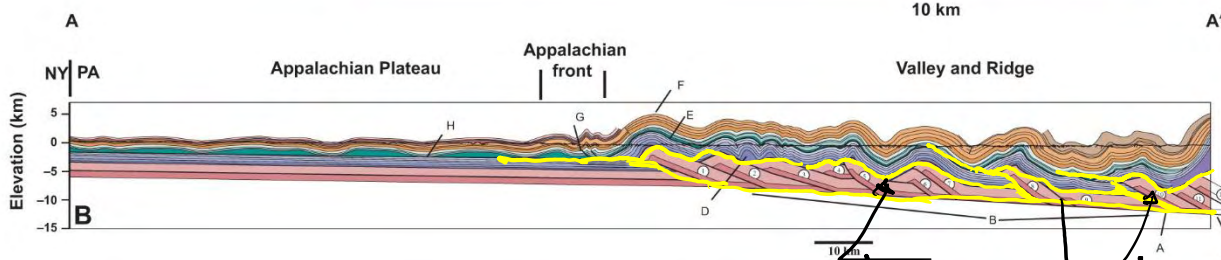
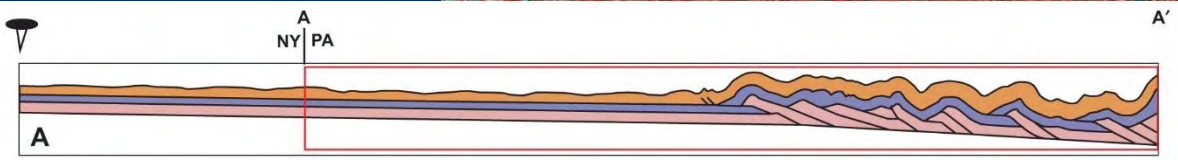
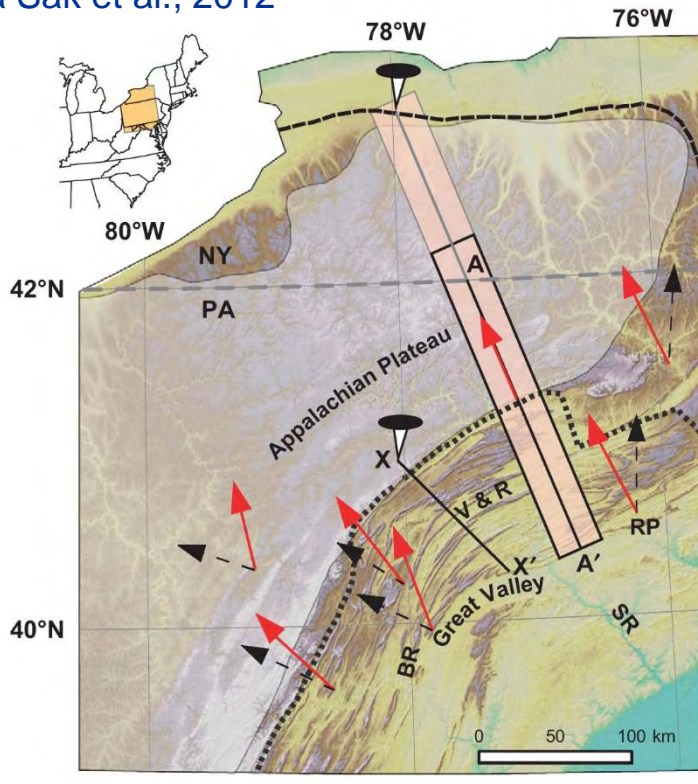
Da NASA-JPL Photo Directory

Pieghe: Appalachians

Quale origine?



Pieghe, duplex e sovrascorrimenti: Appalachians



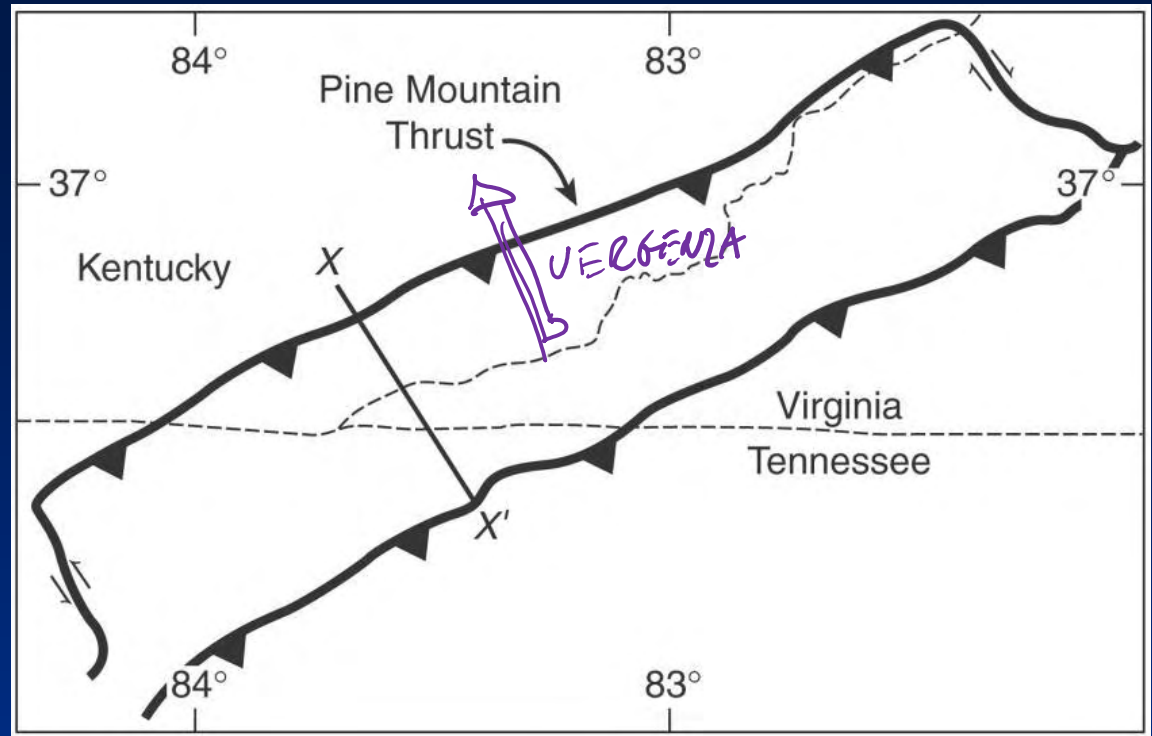
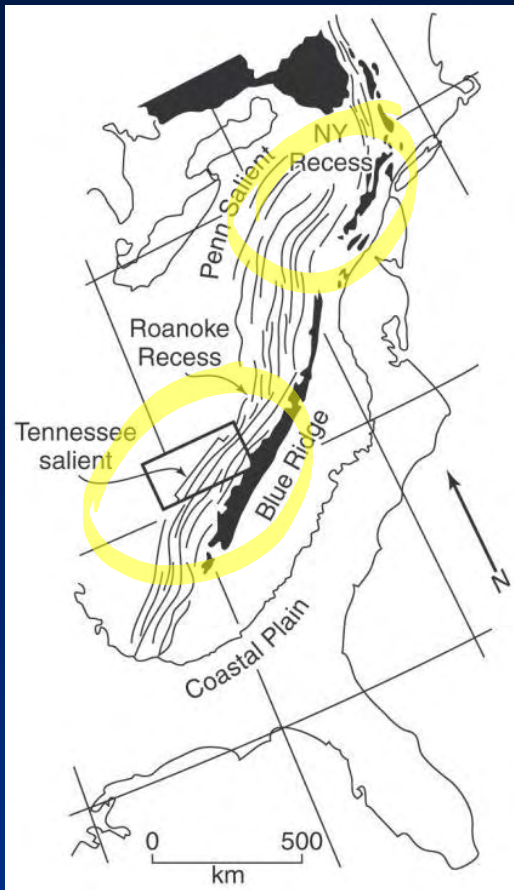
Cover sequence strata (younger than Swc)
 Cover sequence strata (older than Swc)
 Imbricated carbonate sequence

Explanation	
 Mmc	Mauch Chunk
 Mb	Burgoon Fm
 Mp	Pocono Fm
 Md	Huntley Mtn Fm
 Mds	Specky Kopf Fm
 Dcbr	Buddies Run Mbr
 Dcd	Duncannon Mbr
 Dccf	Clarks Ferry Mbr
 Dccsl	Shermans Creek Mbr
 Dciv	Irish Valley Mbr
 Dclh	Lock Haven Mbr
 Dtr	Trimmers Rock
 Dh	Hamilton Gp
 Doo	Onondaga/Old Port Fms
 Dskt	Keyser/Tonoloway Fms
 Swc	Wills Creek Fm
 Smb	Millintown and Bloomsburg Fms, undivided
 Sc	Clinton Gp
 St	Tuscarora Fm
 Oj	Juniata Fm
 Obe	Bald Eagle Fm
 Or	Reedsville Fm
 Om	Martinsburg Fm
 O	Stonehenge – Coburn/Salona Fms, undivided
 W	Waynesboro – Gatesburg Fms, undivided

Note. Vertical color bars reflect groupings depicted in the restored cross section.

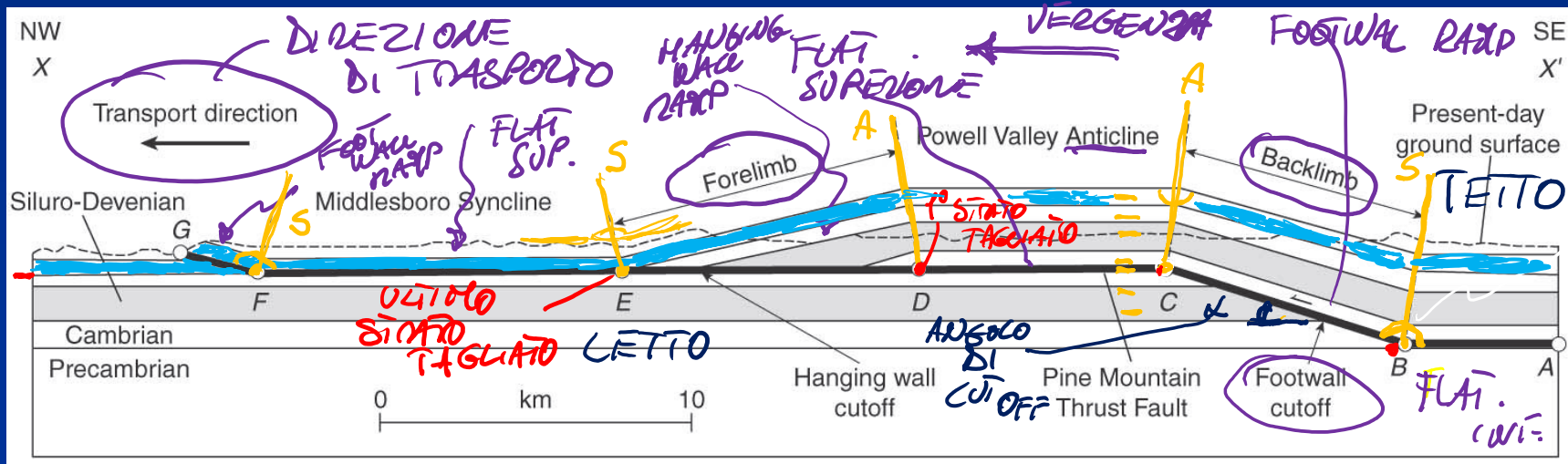
DUPLEX 3
D1

Pieghe e sovrascorrimenti: Appalachians

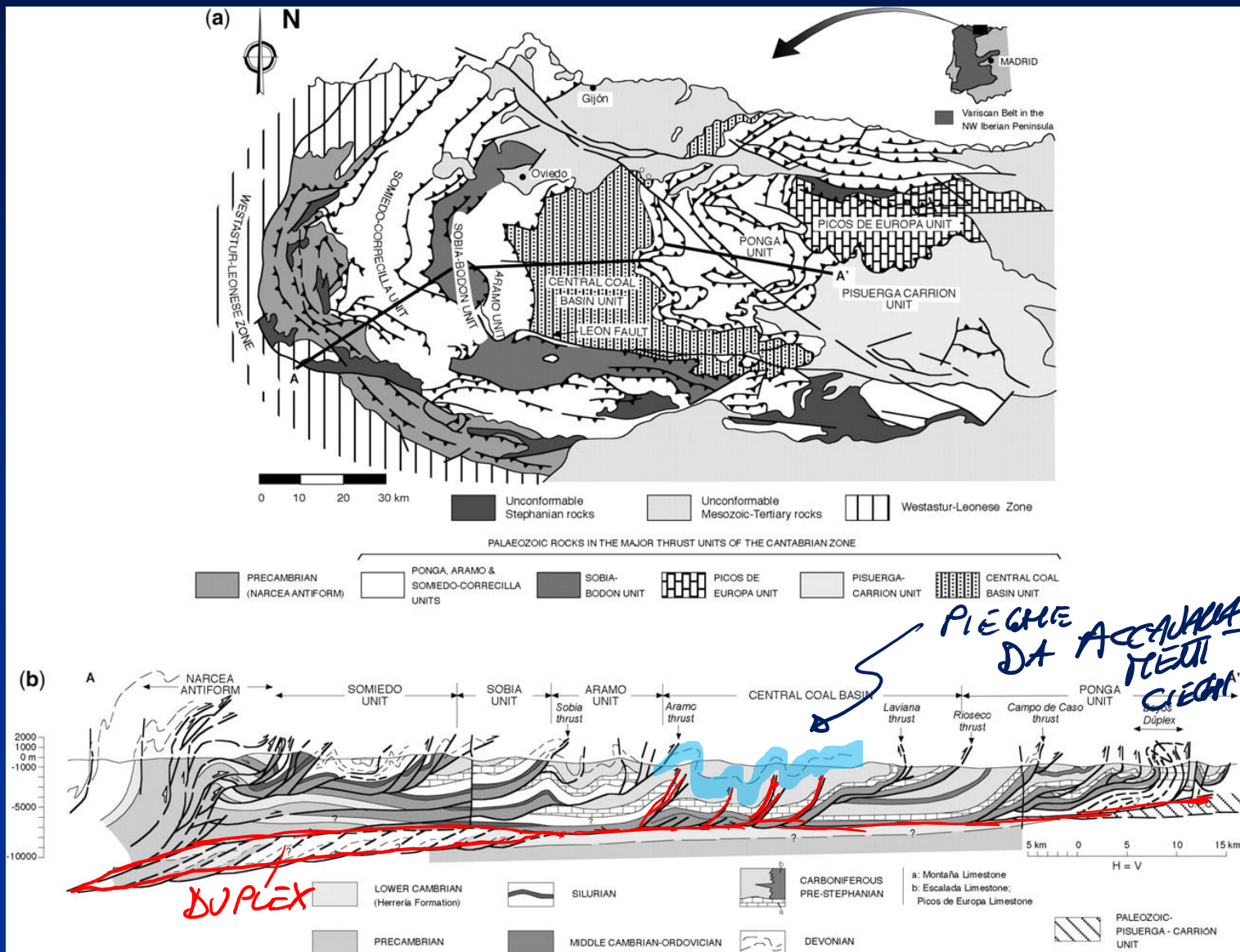


Da van der Pluim & Marshak, 2004

STAIR CASE THRUST



Pieghe, duplex e accavallamenti ciechi: i Pirenei



Accavallamenti e pieghe, altri termini

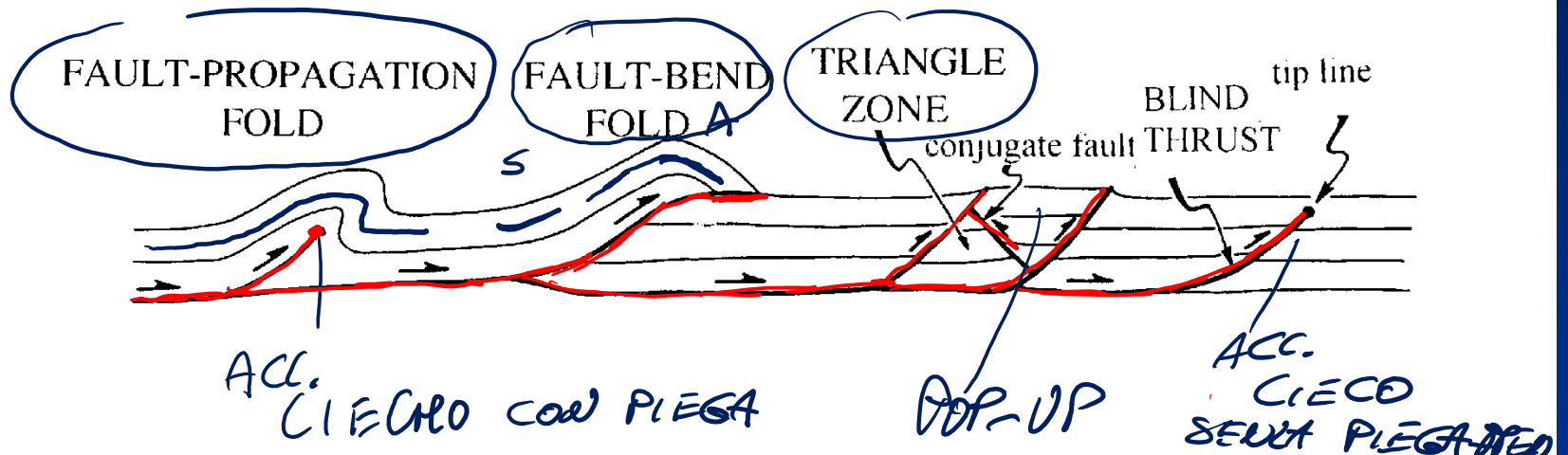


Figure 11 - Structures associated with the formation of reverse faults in thrust belts.

Da Merle, 1998

Pieghe e accavallamenti:
tre tipi

" FAULT-(THRUST-)
RELATED FOLDS "

" PIEGHE
ASSOCIATE
(DETERMINATE
DA)
AD ACCAVALLAMENTI
E
SOVRASCORRIMENTI
TI.

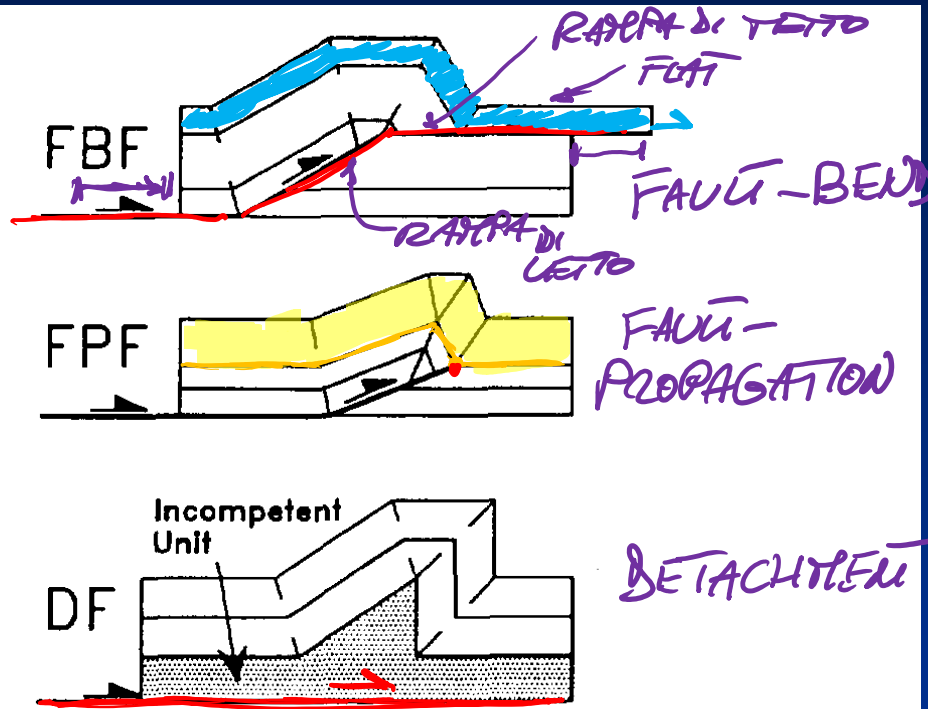
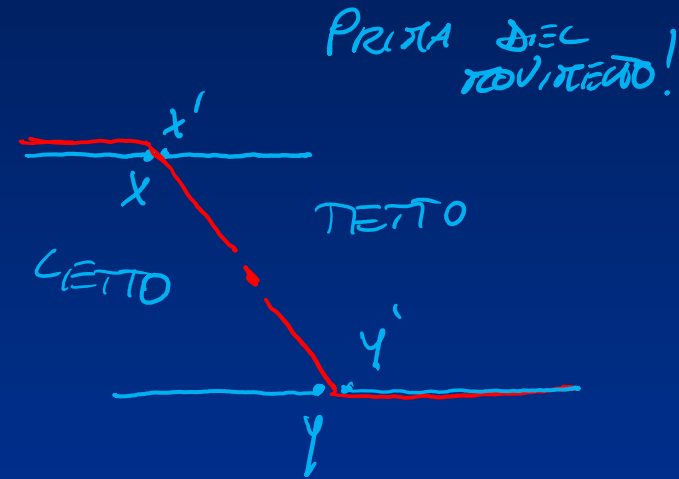
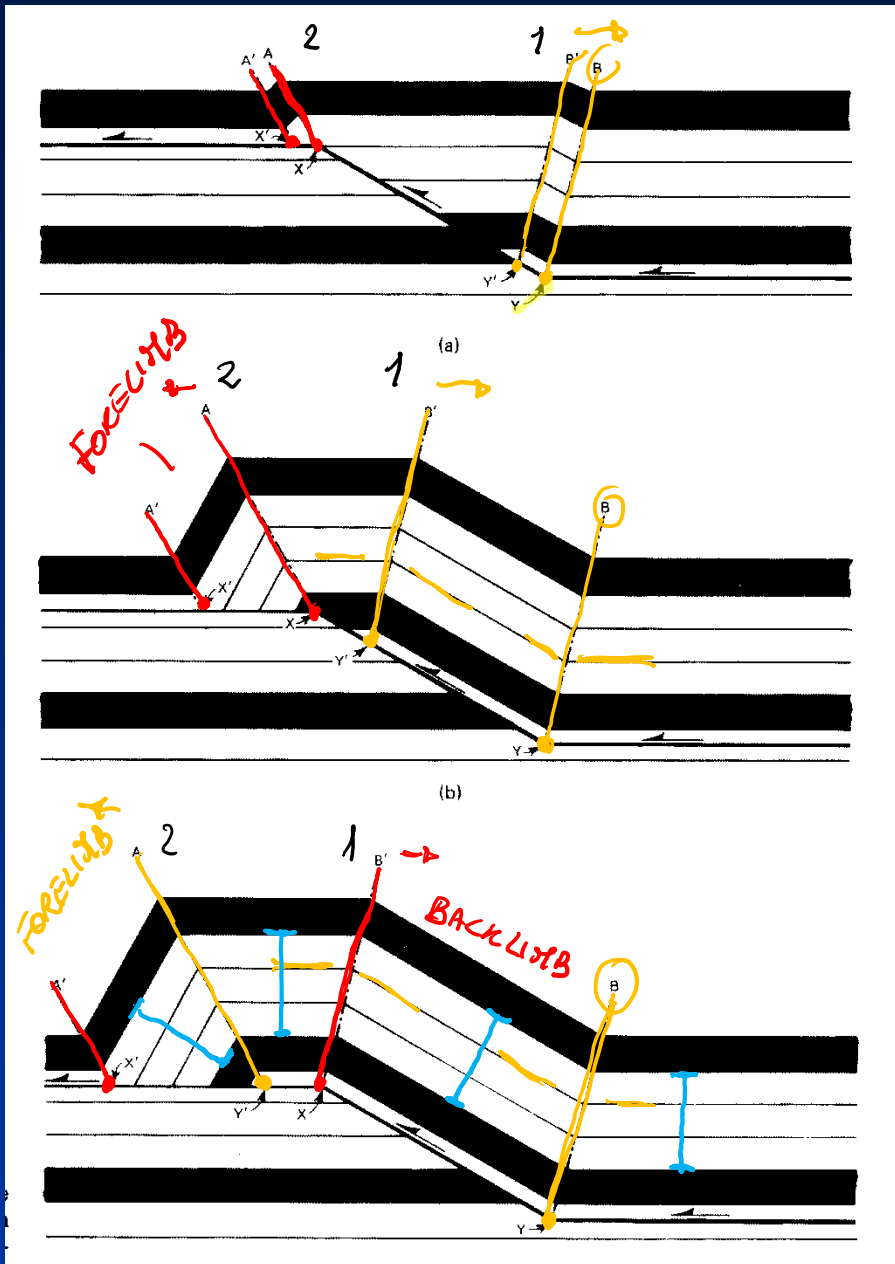


Fig. 1. Three major types of thrust-related folds in fold-and-thrust belts: fault-bend fold (FBF), fault-propagation fold (FPF), and detachment fold (DF).

Da Homza and Wallace, 1995

Pieghe e accavallamenti: fault-bend folds



Da Suppe, 1985

Fault-propagation fold, Meilin anticline, Taiwan

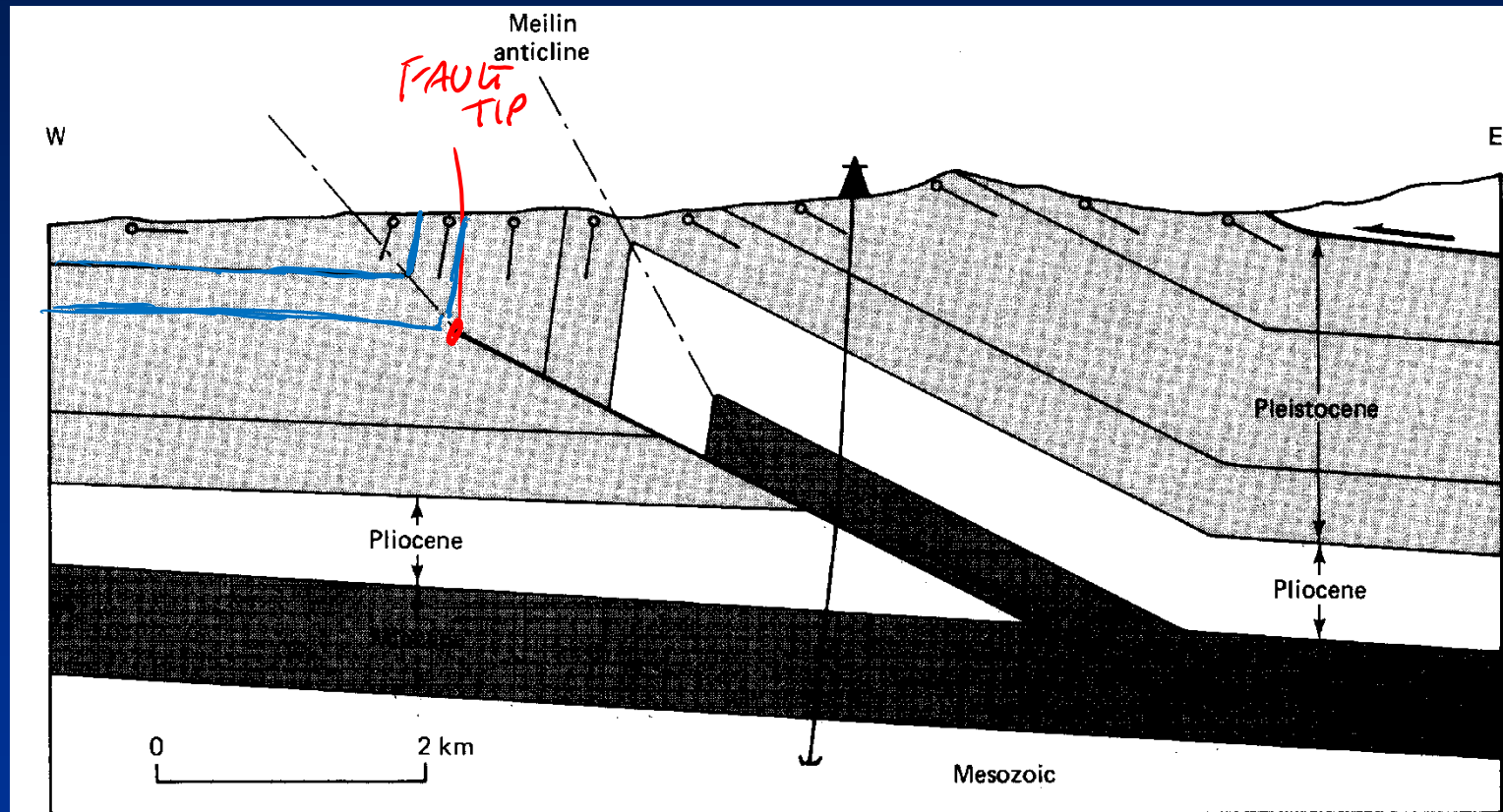
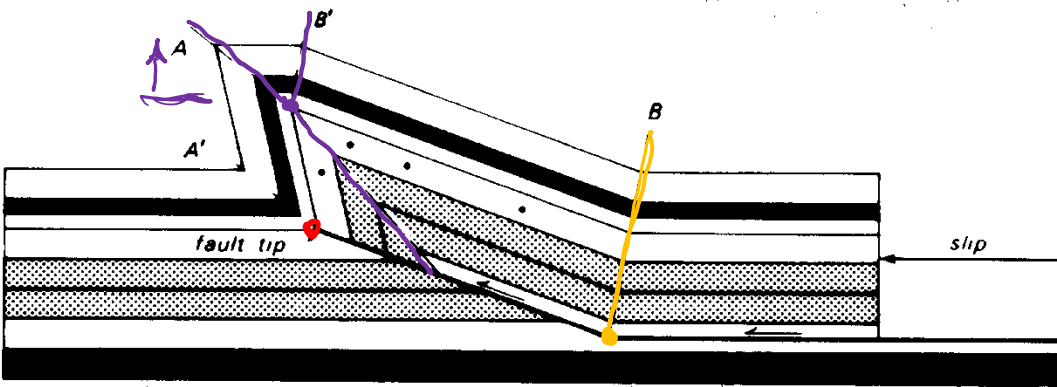
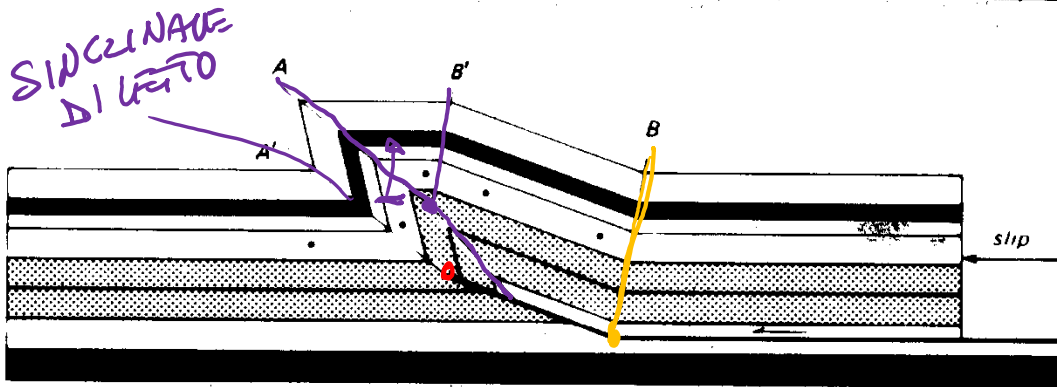
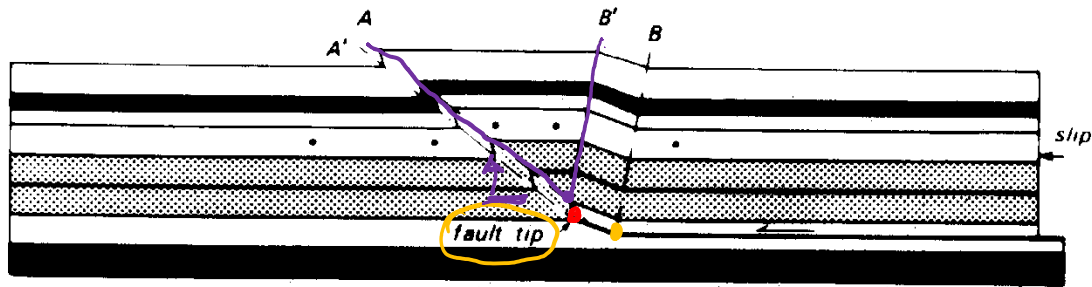


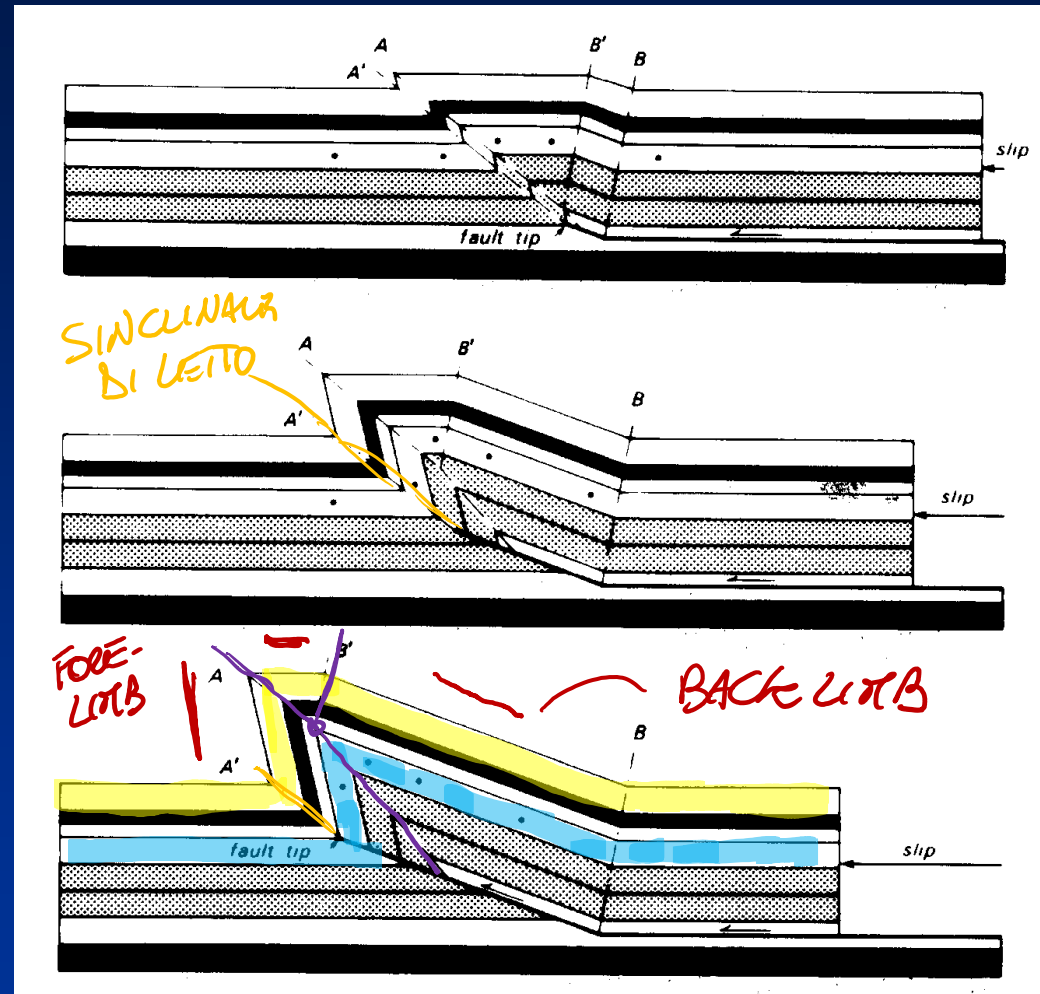
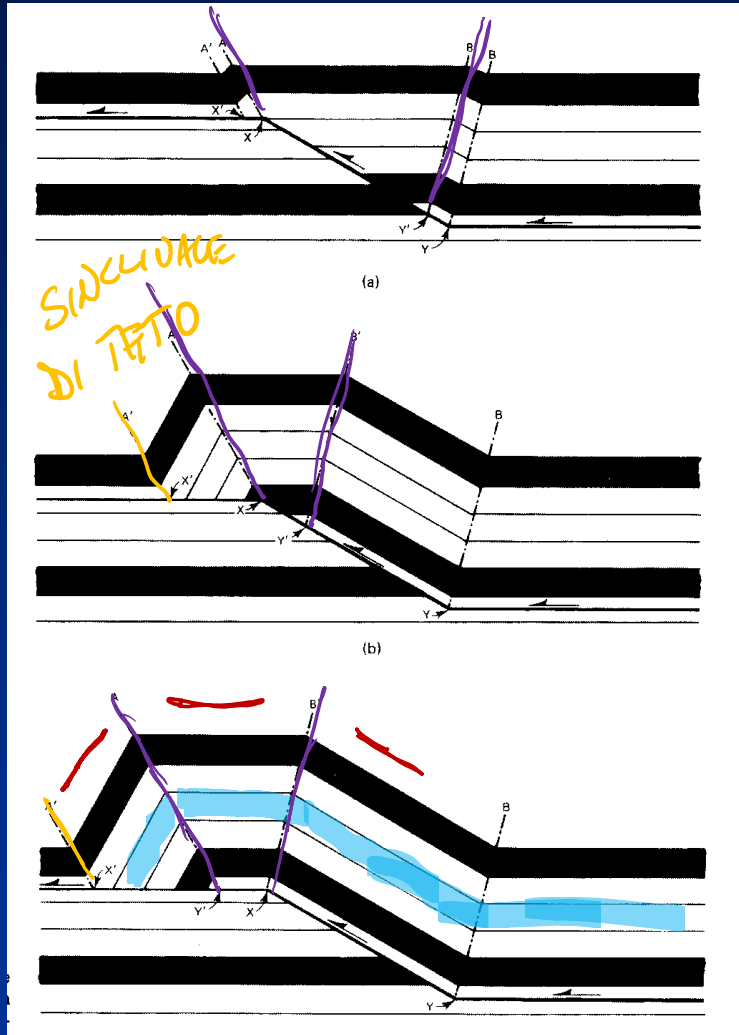
FIGURE 9-48 Cross section of a fault-propagation fold similar to the schematic diagram in Figure 9-47. Meilin anticline, western Taiwan.



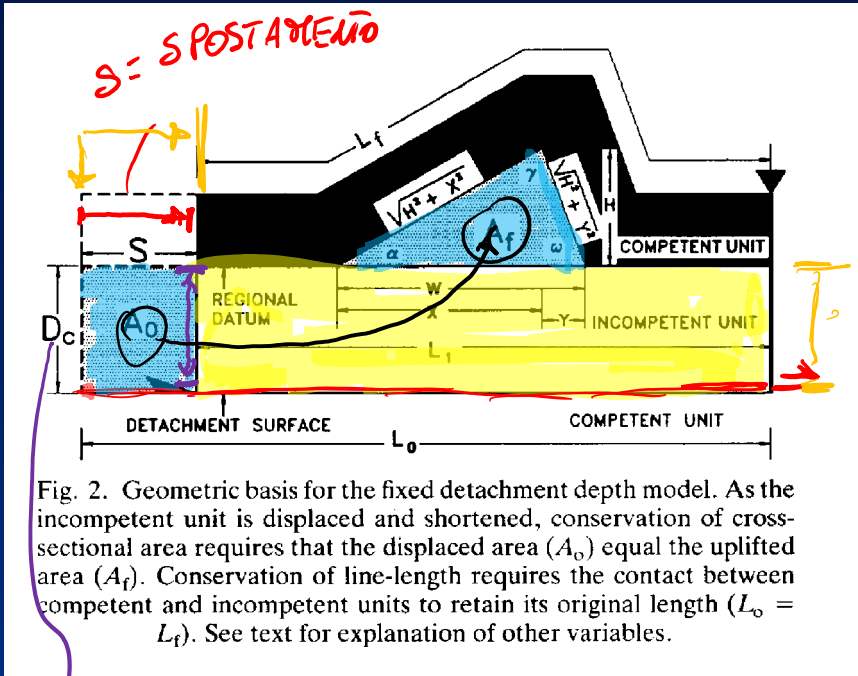
Pieghe e
accavallamenti:
Fault-propagation folds

Da Suppe, 1985

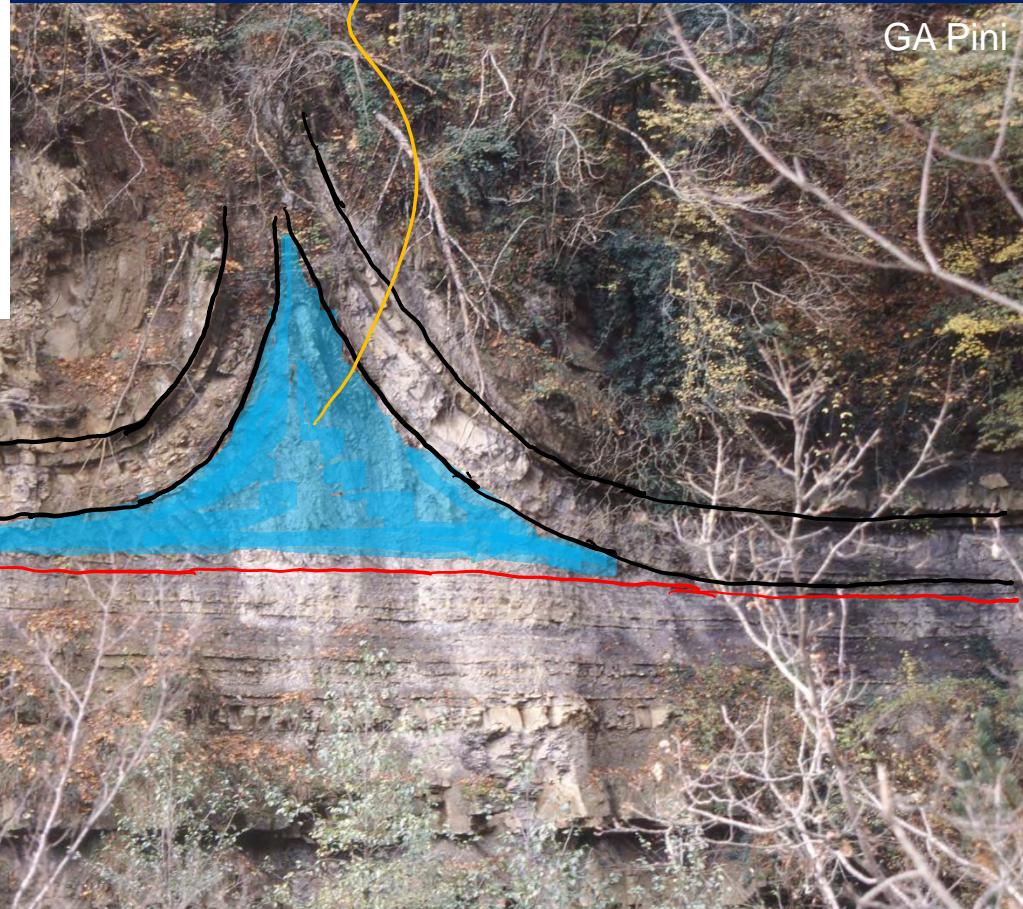
Pieghe e accavallamenti: Fault-bend fold Vs. fault-propagation folds



Pieghe e accavallamenti: detachment folds



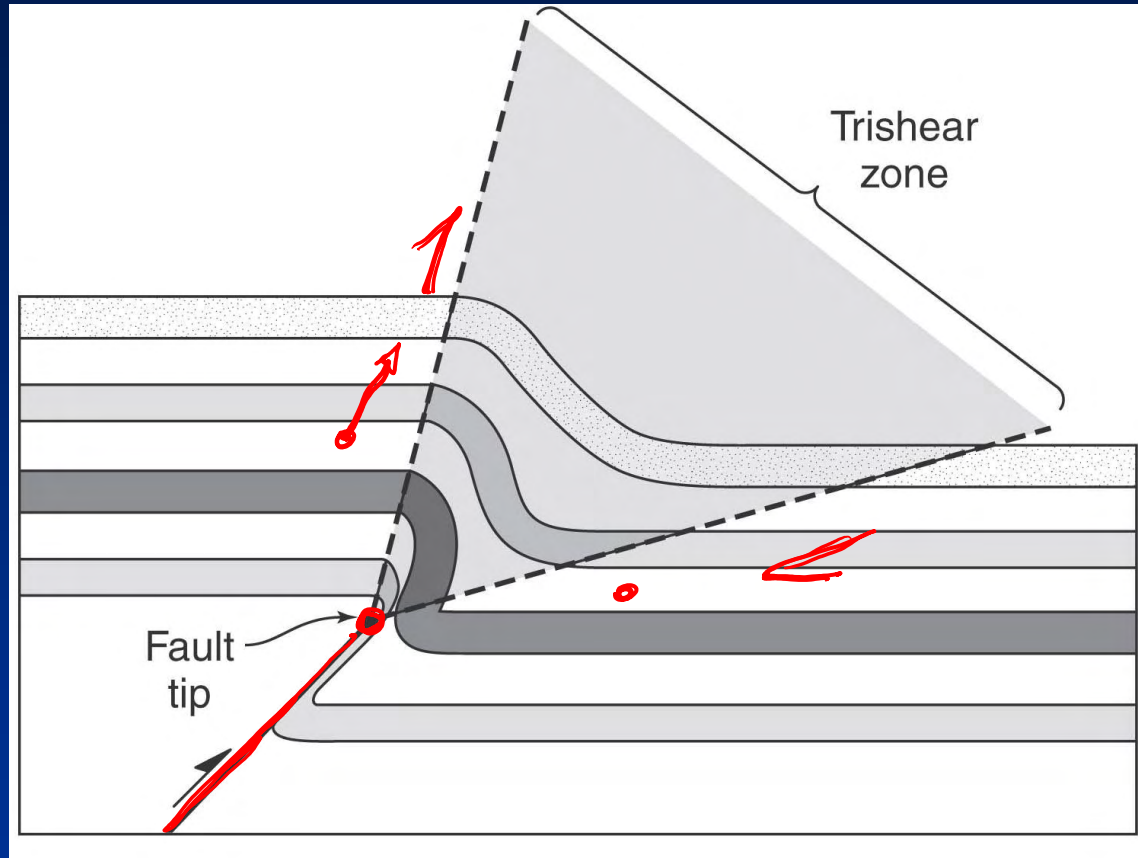
$$A_f / D = S$$



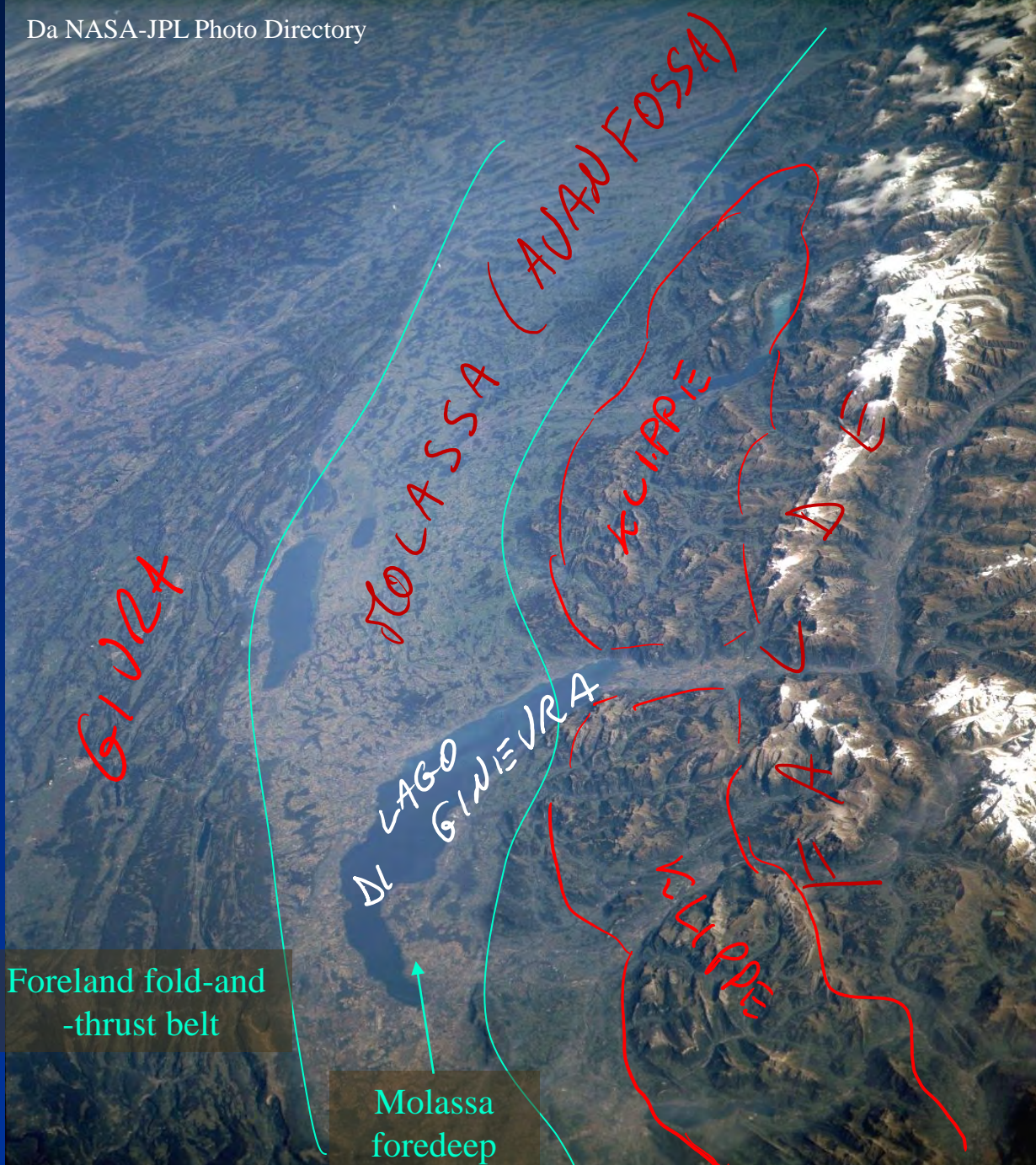
Da Homza and Wallace, 1995

$D =$
 SPESSORE
 LIVELLO
 DEFORMAZIONE
 COMPETENTE

Fault-propagation fold: modello di trishear



Da van der Pluim & Marshak, 2004



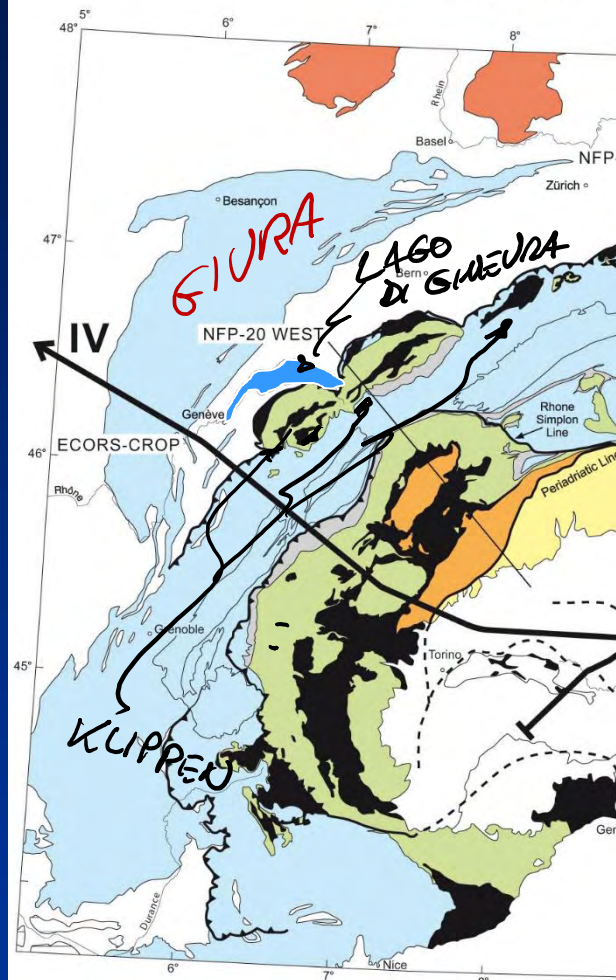
Foreland fold-and-thrust belt

Molassa foredeep

la Molassa e il Giura

MAJOR PALEOGEOGRAPHIC UNITS IN

after Schmid et



Da Schmid et al., 2004

Il Giura: tettonica di scollamento

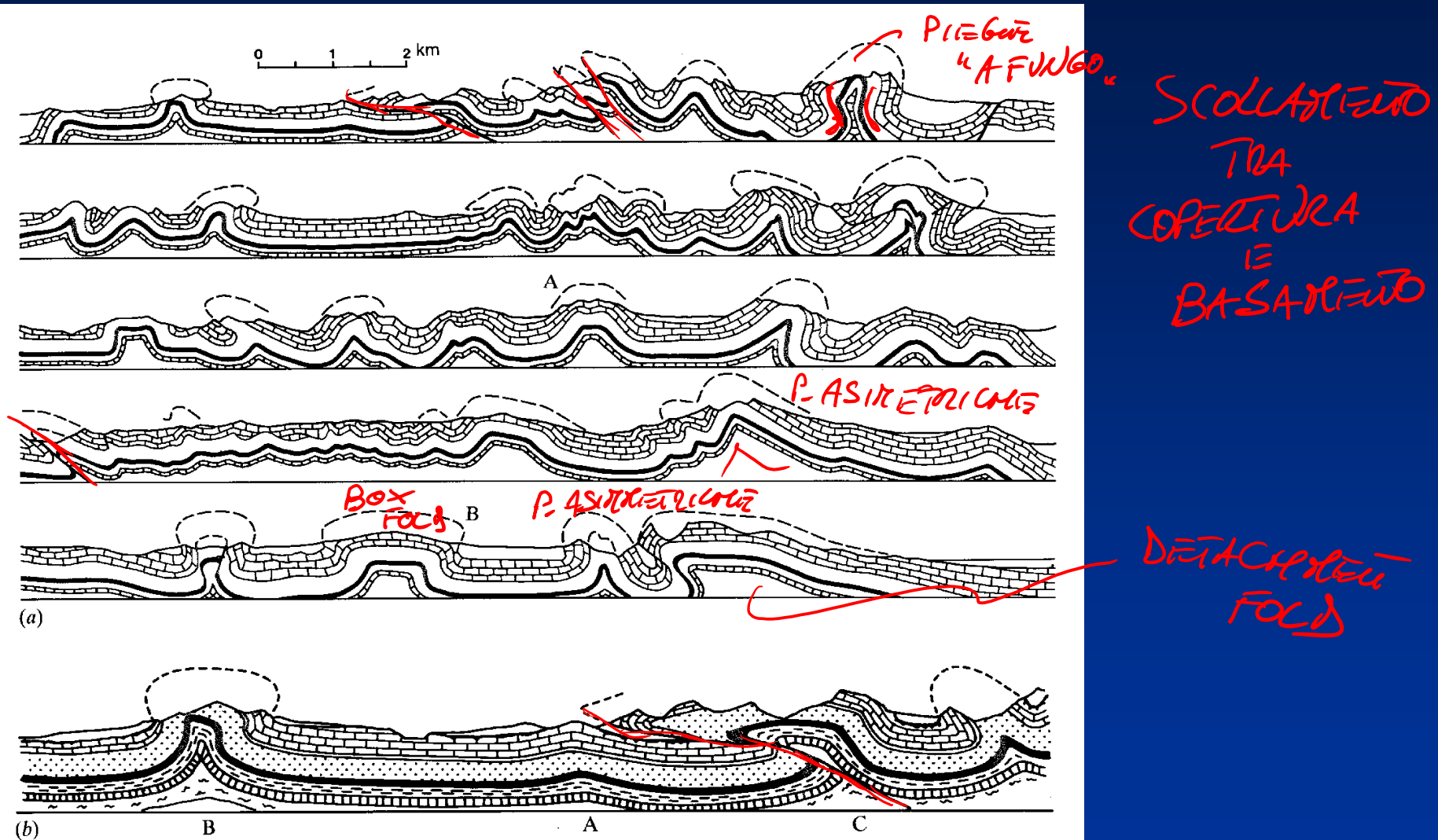
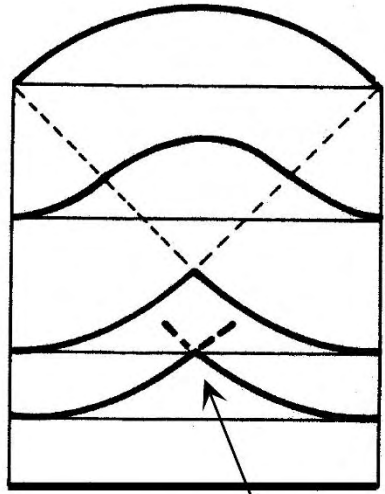
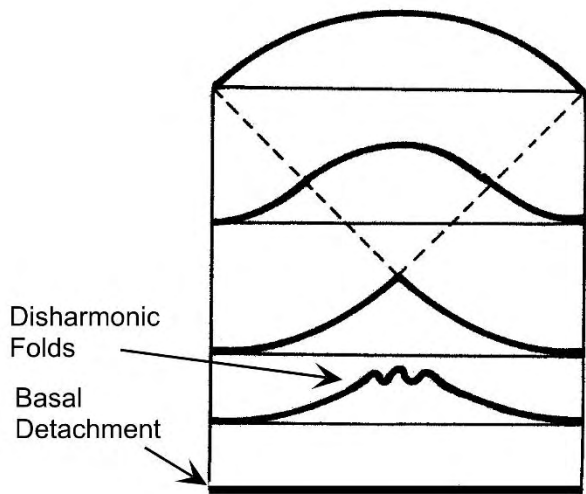


Fig. 13.2. (a) Profile sections of fold structures in the Jura Mountains after Heim (1921). (b) Detail of (a) showing three stages in the formation of a thrust from an originally symmetrical fold.



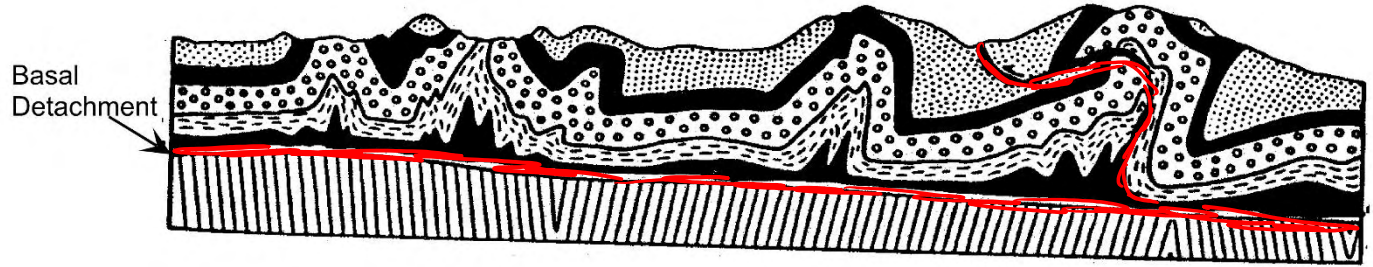
a Space Problems in Anticlinal Core



Disharmonic Folds
Basal Detachment

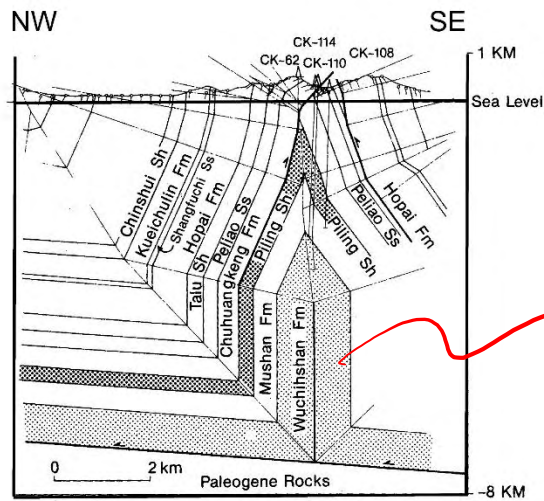
b

JURA MOUNTAINS



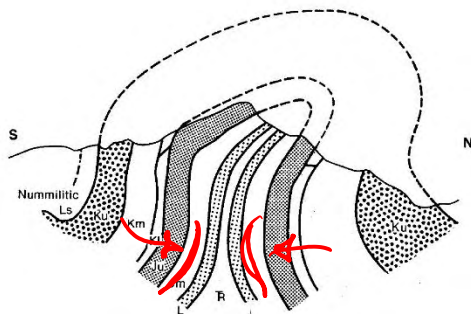
c

Fig. 1. Geometry of disharmonic detachment folds. a. Space problems in the core of a concentric fold resulting from convergence of radii of curvature to form cusped geometry. b. Space problems resolved by the formation of disharmonic folds (modified from De Sitter, 1964). c. Example of disharmonic detachment folds from the Jura Mountains, Switzerland (modified from Buxtorf, 1916).

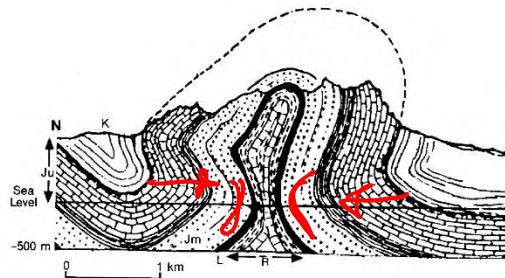


BUCKLE FOLD (LIFT OFF)

a. Chuhuangkeng Anticline, Taiwan



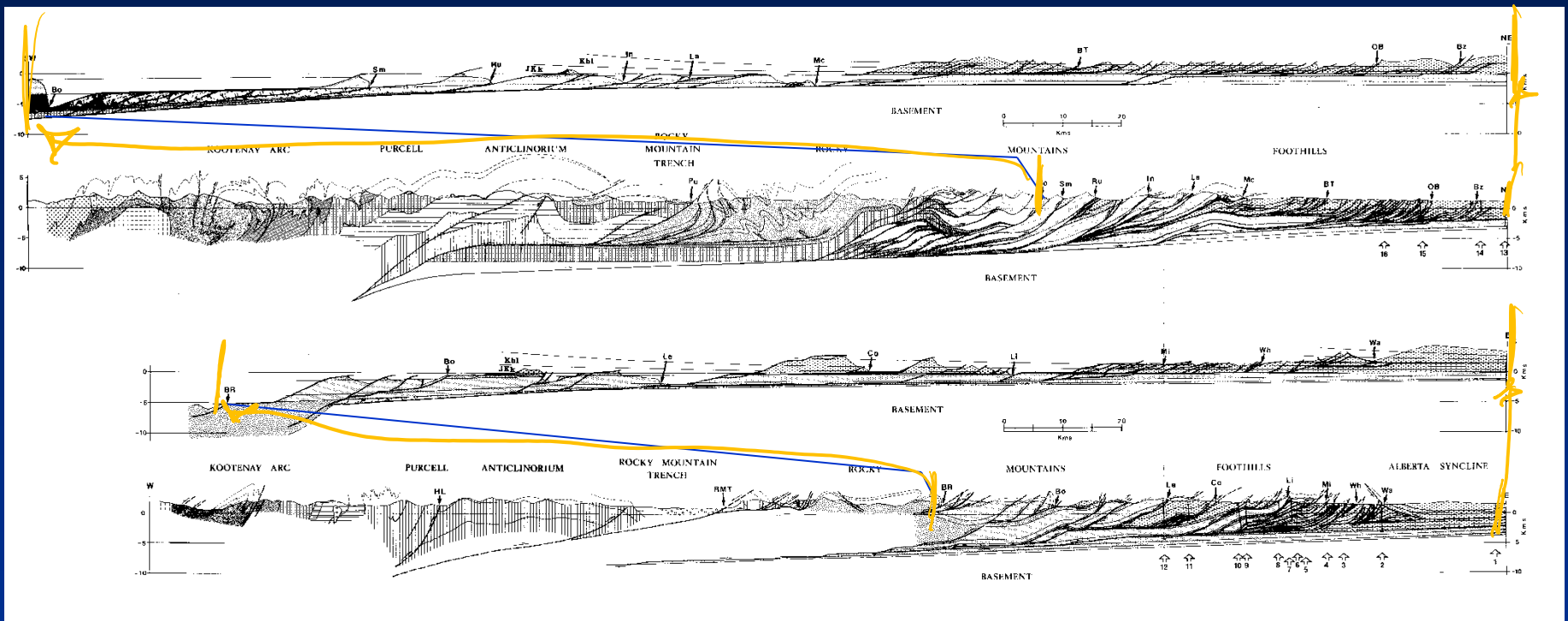
b. Gourdan Anticline, Maritime Alps



c. Weissenstein Anticline, Jura Mountains

Fig. 2. Examples of lift-off folds from (a) the Taiwan belt (from Namson, 1981), (b) the Maritime Alps (Goguel, 1962), and (c) the Jura Mountains (Buxtorf, 1916).

Retrodeformazione delle catene, Rocky Mountains



Da Price, 1981