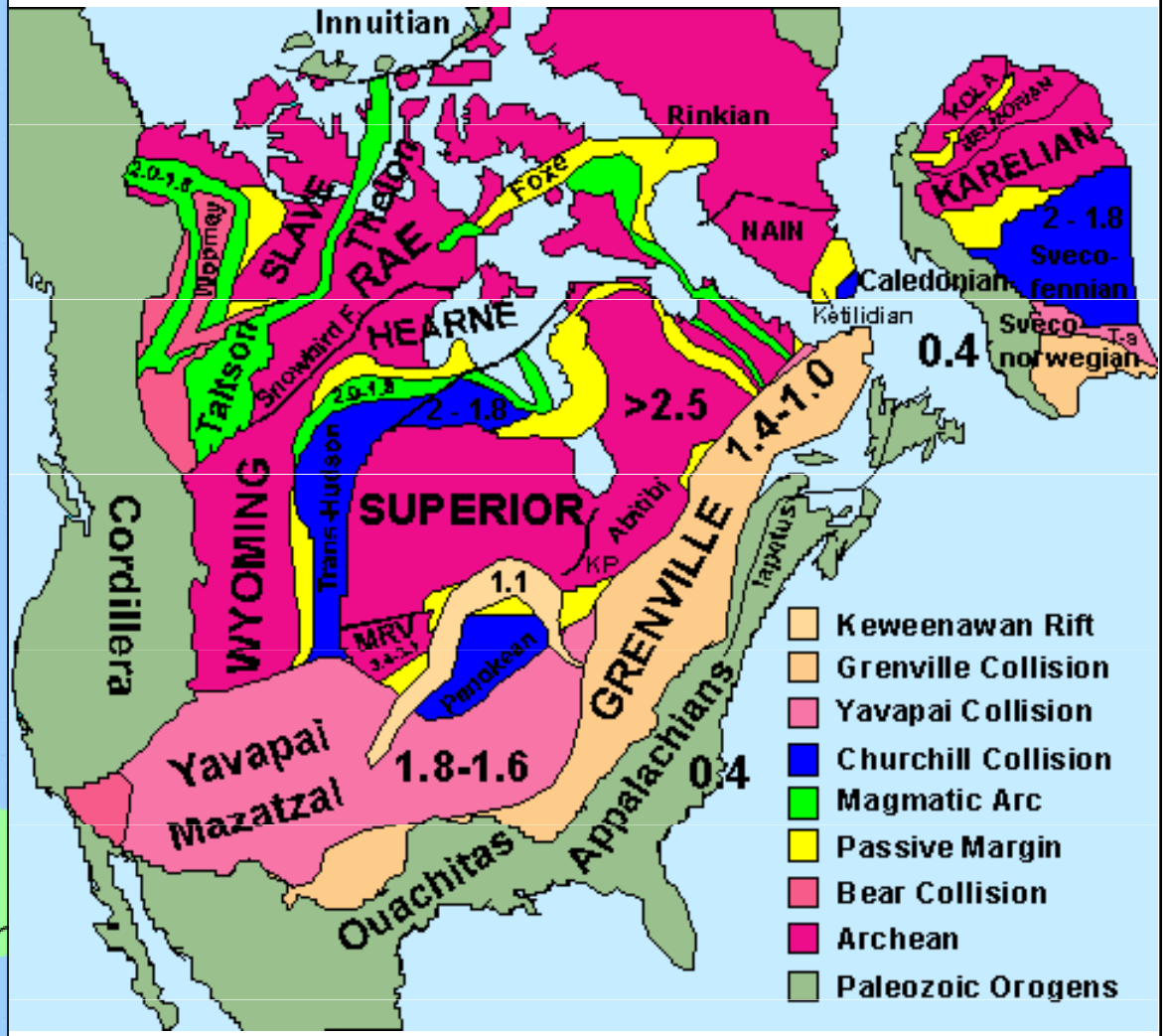
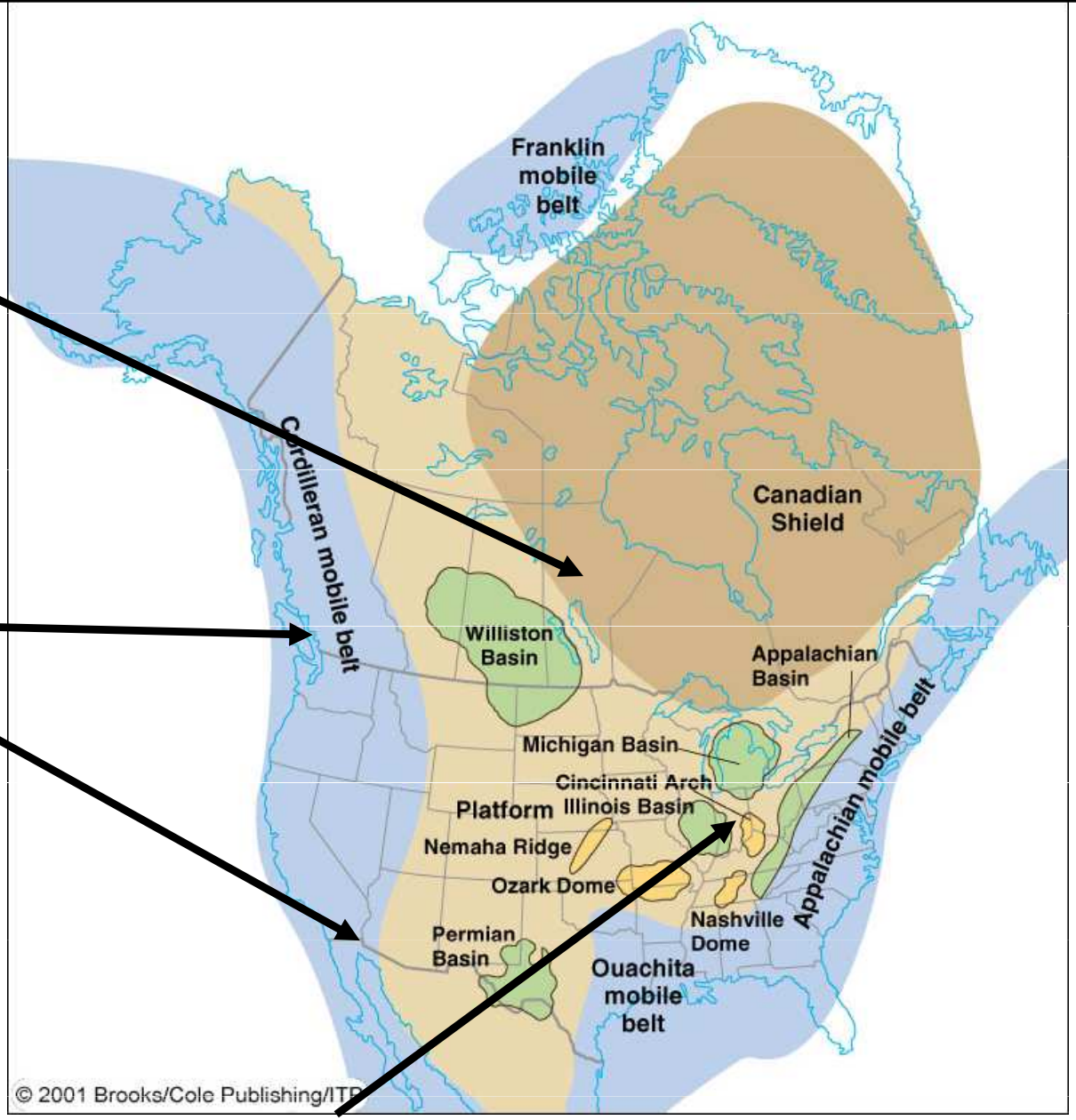
Severoamerický kraton (Laurentie)

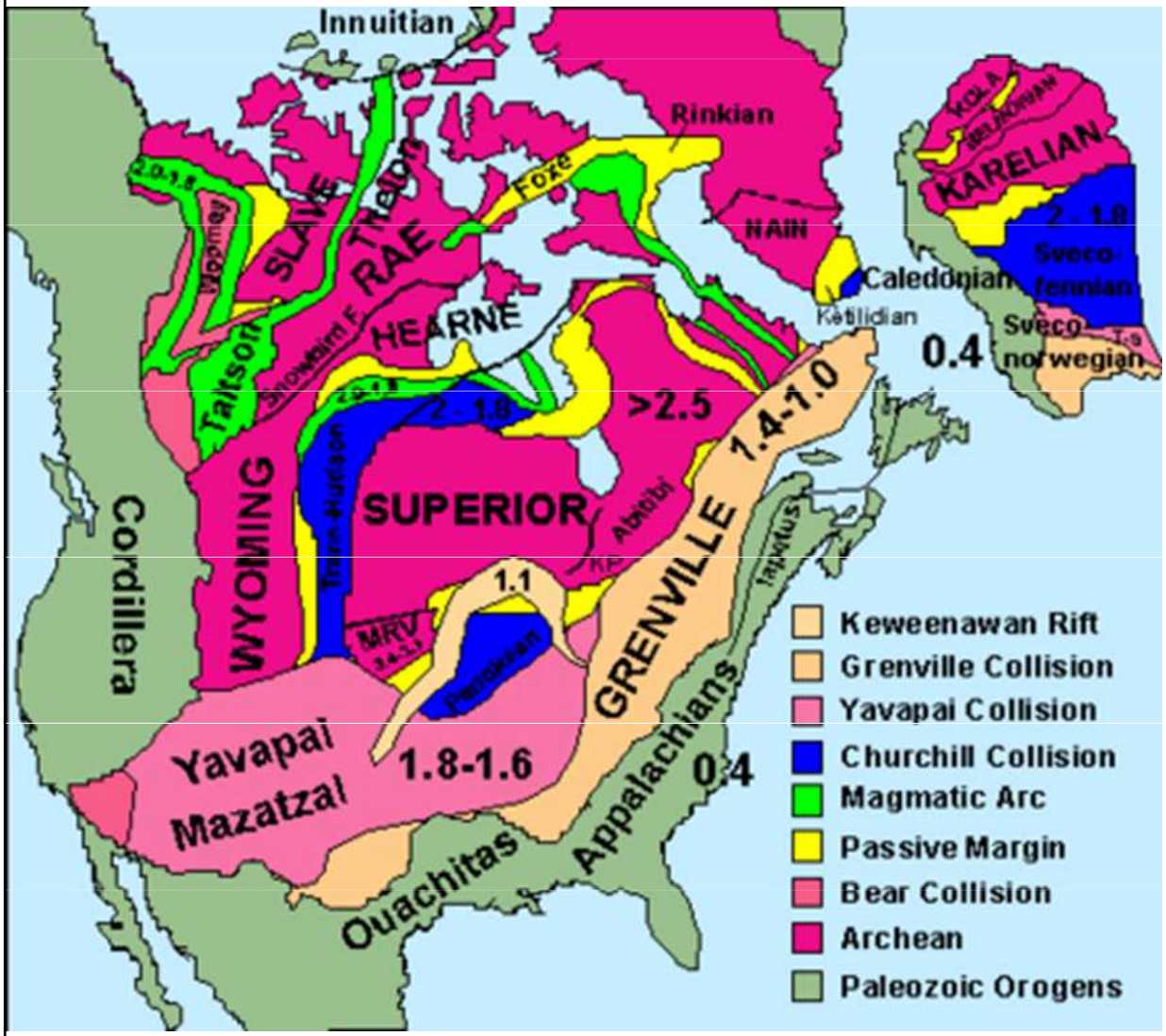


4

Canadian (Laurent) shield – not covered during Paleozoic, re-mainder of craton (light brown) was periodically cover-ed by *epeiric* (shallow, inland) *seas*. Green (basins) & yellow (domes) = local areas of gentle warpage of platform sedimentary rocks.



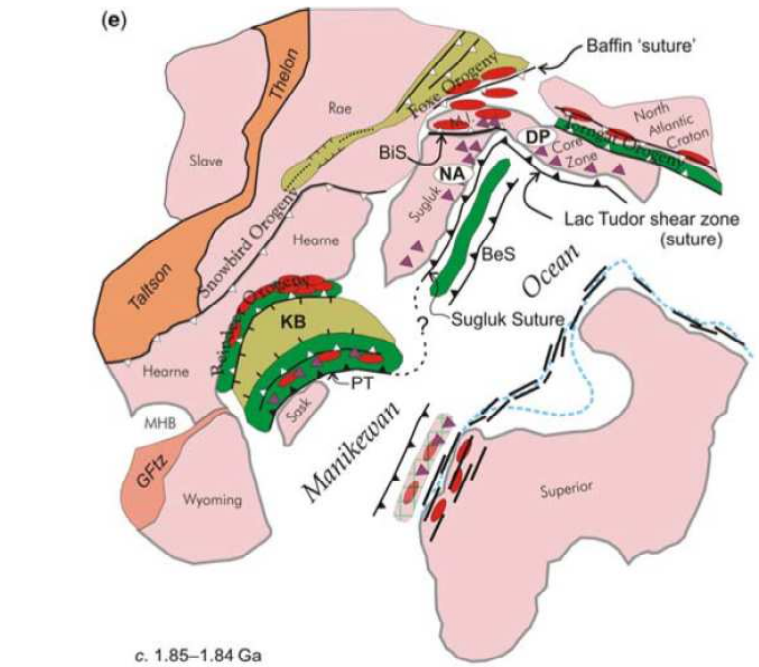
Appalachian Basin

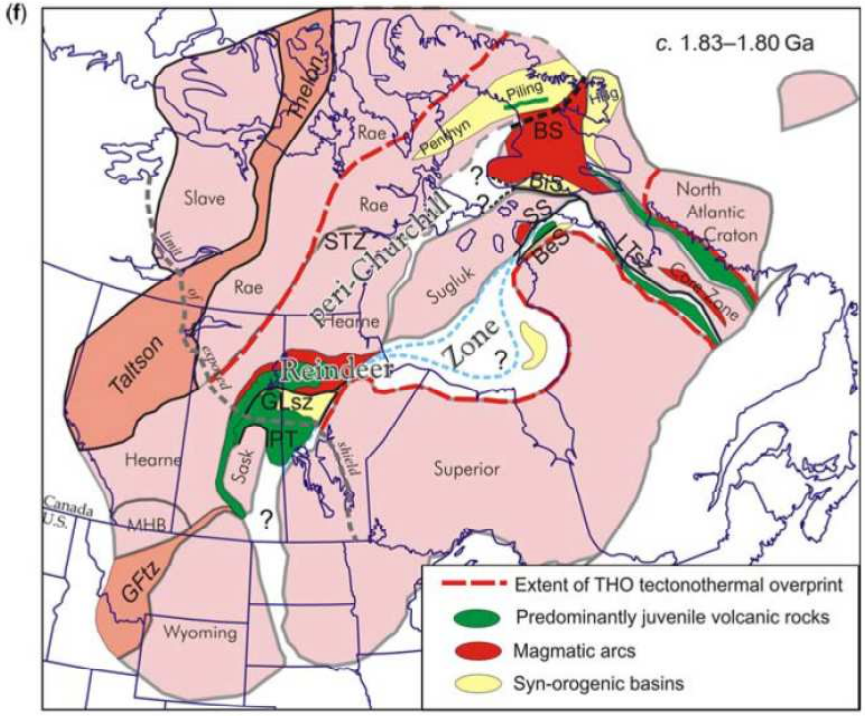


První významnou orogenezí byla na konci archaika **orogeneze algomská** (kenoranská), která vytvořila kraton **Superior**. V paleoproterozoiku **Taltson – Thelon** orogeneze přičlenila ke kratonu Rae kraton Slave. Hlavní část **laurentského kratonu** byla vytvořena při **transhudsonské orogenezi** (1,8-1,9 Ga), menší části byly přičleněny při **woopmayské, yavapaiské-mazatzalské a penocké orogenezi** (1,5-1,8). Nejmladší proterozoickou orogenezi je **grenvilská**, která skončila před 1,0 Ga.

Trans-Hudson orogeny

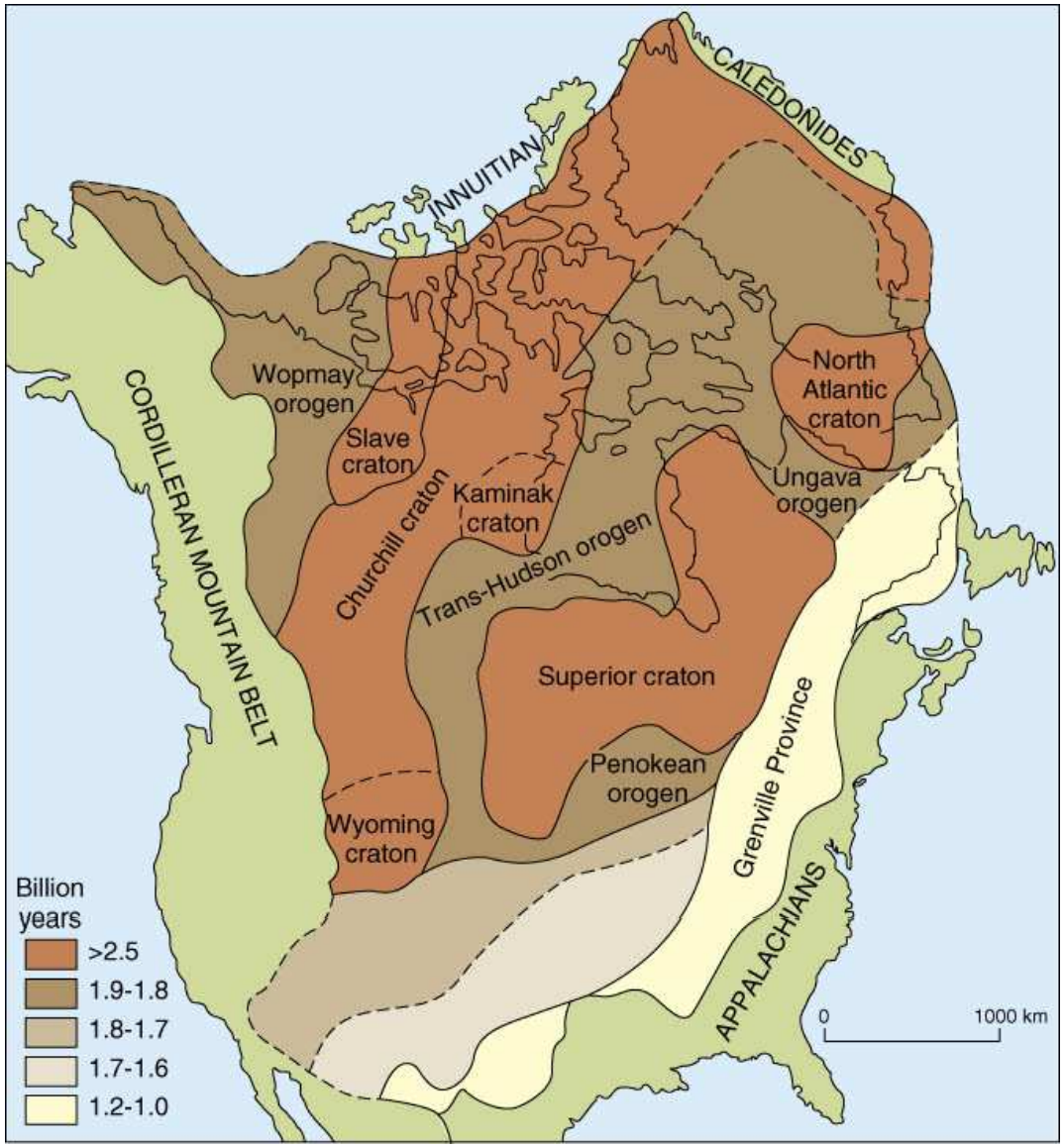
The Trans-Hudson orogeny was the major mountain building event that formed the Precambrian Canadian Shield and the North American Craton (also called **Laurentia**), forging the initial North American continent. The Trans-Hudson orogen sutured together the **Hearne-Rae**, **Slave, Wyoming and Superior** cratons to form the cratonic core of North America in a network of Paleoproterozoic orogenic belts. The Trans-Hudson orogenic belt developed as a result of closure of the **Manikewan Ocean**. Manikewan Ocean opened at approximately 2.1 Ga via rifting of a possible **Neoarchean supercontinent** along the margins of the Hearne and Superior Cratons





Sutures: BeS, Bergeron suture; BS, Baffin suture; BiS, Big Island Suture

Fig.2. Series of cartoons illustrating a map view of the geological evolution of the THO, with the main tectonic elements shown: (a) main lithotectonic elements during the interval 1.98–1.92 Ga, prior to the onset of convergence;(b) the interval 1.92–1.89 Ga; (c) the interval 1.88–1.865 Ga; (d) the interval 1.865–1.85 Ga; (e) the interval 1.85–1.83 Ga; and (f) the interval 1.83–1.80 Ga. The blue coloured hashed lines represent possible extensions of the Superior Craton at Moho. Although not discussed in text, evolution of North Atlantic Craton (shown here to include Archaean basement rocks and their cover on Hall and Cumberland peninsulas on Baffin Island (e.g. Scott 1999;Jackson & Berman 2000) and tectonostratigraphic elements of the New Quebec and Torngat orogens are after Wardle et al. (2002). Abbreviations: Am, Amer group; B, Burwell arc; BeS, Bergeron suture; BS, Baffin suture; BiS, Big Island suture; Bf, Bravo formation; Ch, Chukotat; FFG, Flin Flon–Glennie Complex; FR, Fox River belt; GFtz, Great Falls tectonic zone; GLsz, Granville Lake structural zone; Hoare Bay group; KB, Kisseynew Basin; Ke, Ketyet group; LL, La Ronge–Lynn Lake belts; LTSz, Lac Tudor shear zone; M, Molson dykes; MHB, Medicine Hatblock; M.I., Meta Incognita micro-continent; Pe, Penrhyn group; Pi, Piling group; PS, Parent arc and Spartan forearc; PT, Pelican thrust; SL, Snow Lake belt; SS, Sugluk suture; STZ, Snowbird Tectonic Zone; TA, Tasiuyak domain; TNB, Thompson Nickel Belt

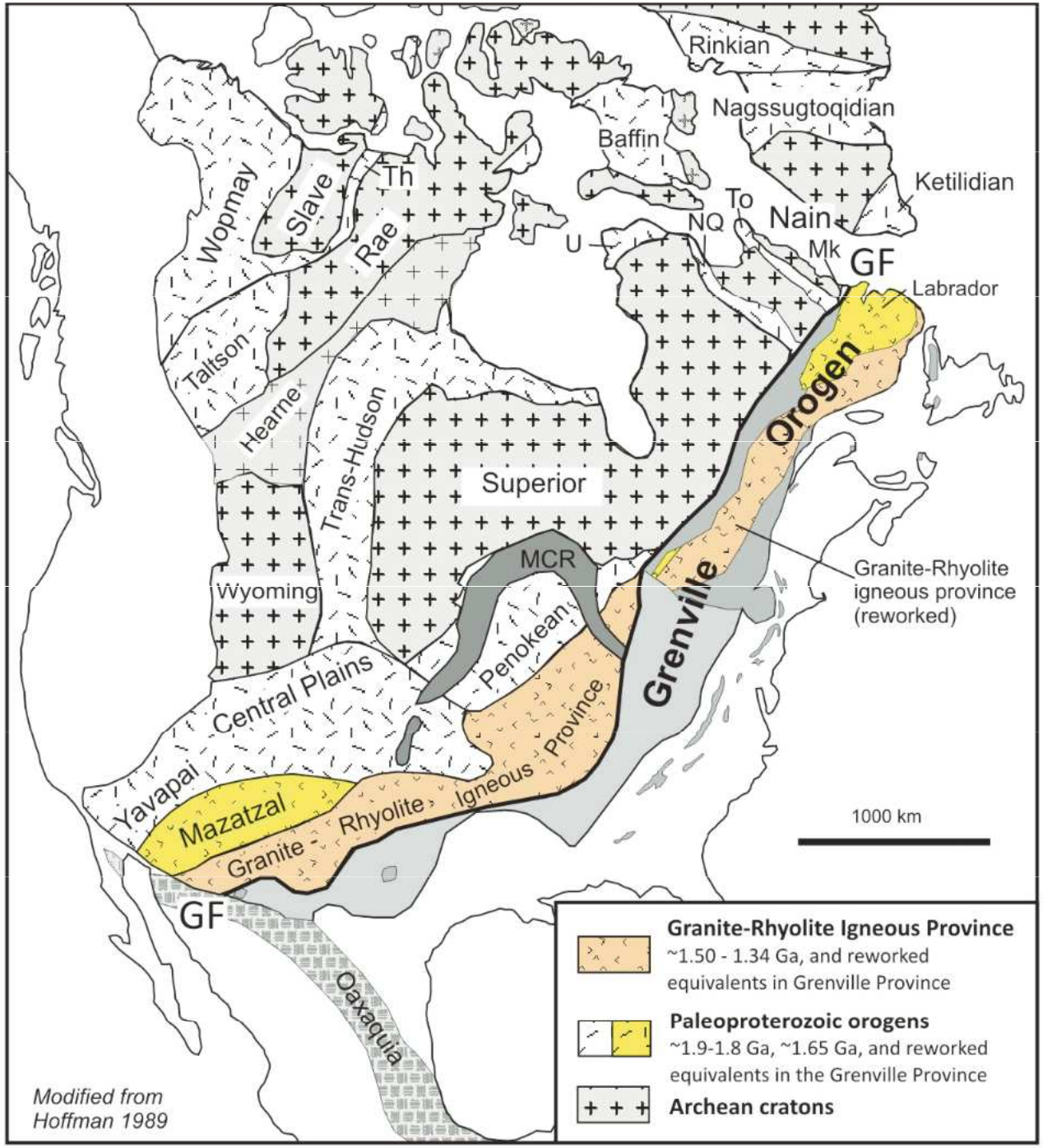

CALEDONIDES
INNUITIAN
CORDILLERAN MOUNTAIN BELT
Wopmay orogen
Slave craton
Churchill craton
Kaminak craton
Trans-Hudson orogen
North Atlantic craton
Ungava orogen
Superior craton
Penokean orogen
Wyoming craton
Grenville Province
APPALACHIANS
Billion years
>2.5
1.9-1.8
1.8-1.7
1.7-1.6
1.2-1.0
0
1000 km

Grenville Orogeny

Late Mesoproterozoic Grenville Orogeny **records convergence, arc accretion, and continent continent collision between ca. 1350 and 1000 Ma.** Within the Grenville Province of south-eastern Canada, which is the most thoroughly studied portion of this composite orogen, this period of orogenesis included (1) **an early accretionary stage** at 1.3–1.2 Ga, (2) an **interval of widespread magmatism** at 1.18–1.08 Ga, (3) and a **period of continent–continent collision** at 1.08–0.98 Ga that was rapidly followed by uplift and exhumation of the orogenic core.

The Grenville orogeny was a long-lived Mesoproterozoic mountain-building event **associated with the assembly of the supercontinent Rodinia**. Its record is a prominent orogenic belt which spans a significant portion of the North American continent, from Labrador to Mexico, as well as to Scotland. It is assumed that separate continental blocks **collided with Laurentia – Kalahari, Baltica and Amazonia**

Grenville orogeny



The Grenville orogeny was a long-lived Mesoproterozoic mountain-building event associated with the assembly of the supercontinent **Rodinia**

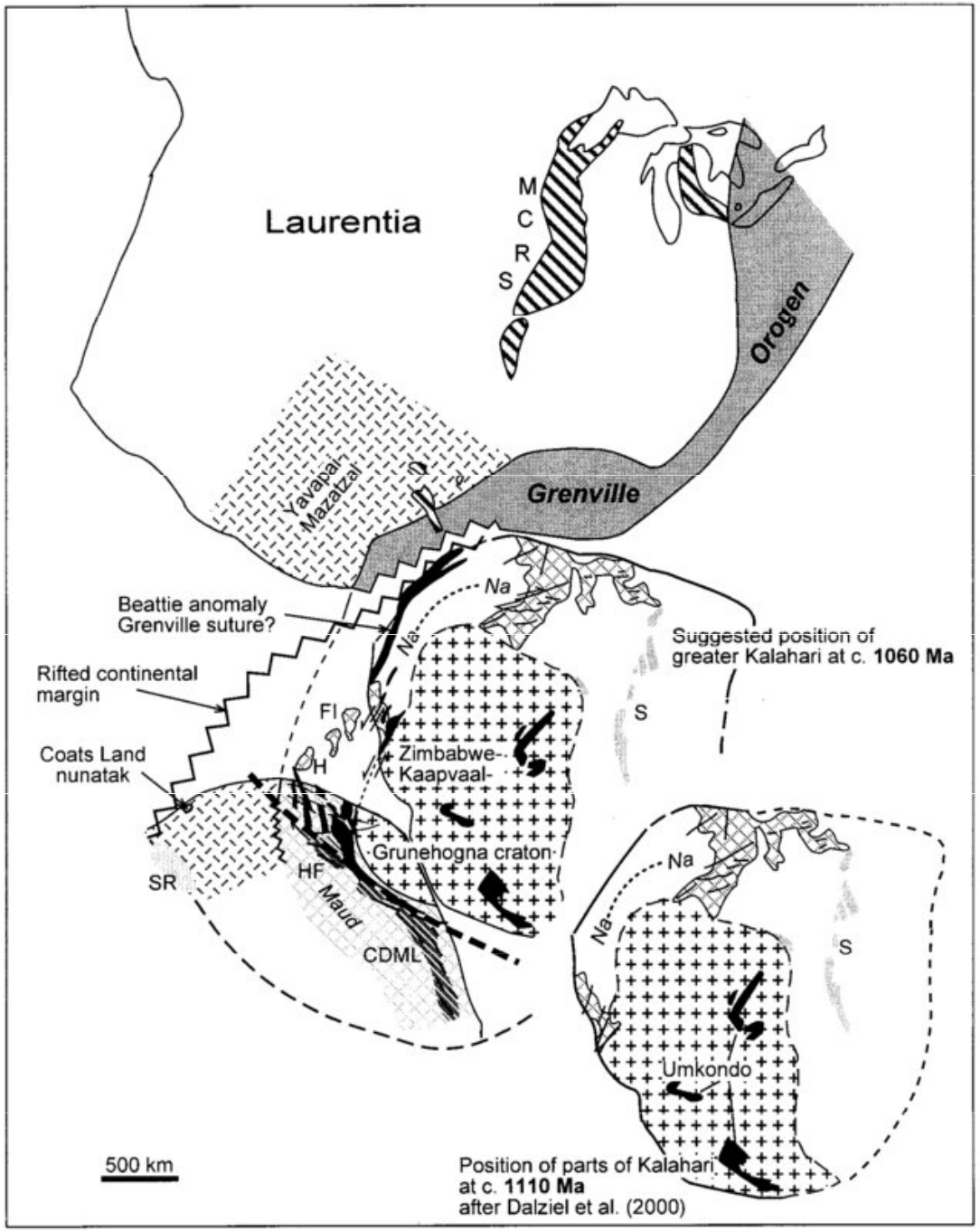
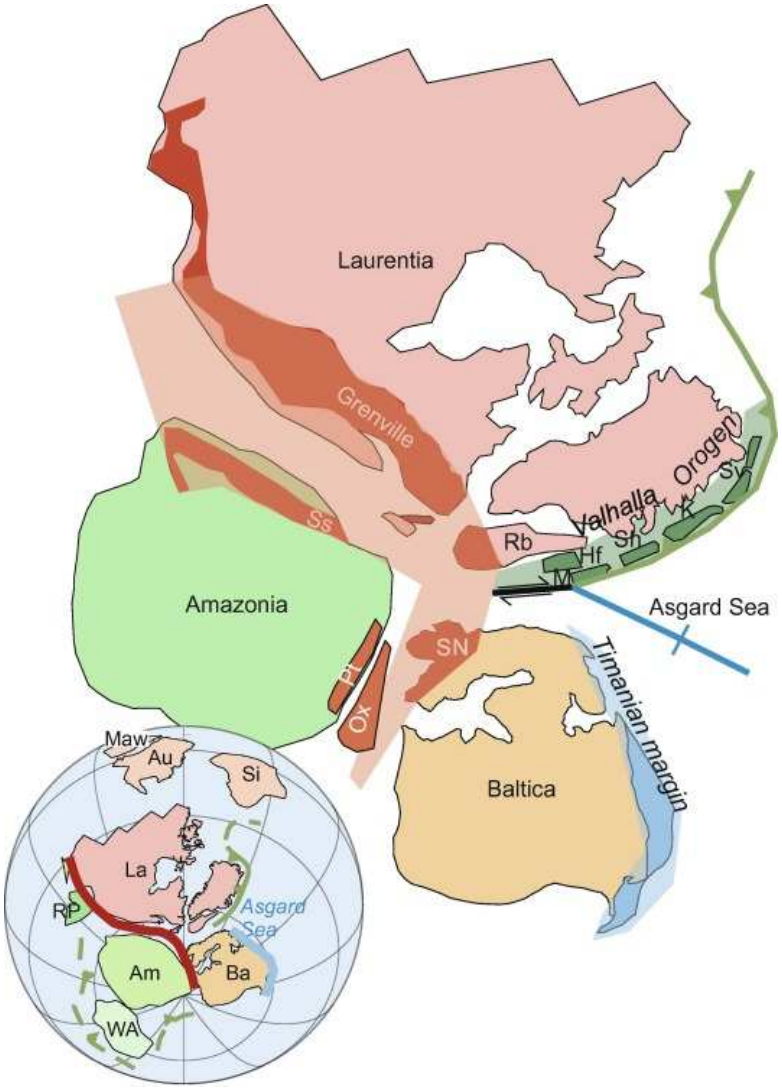
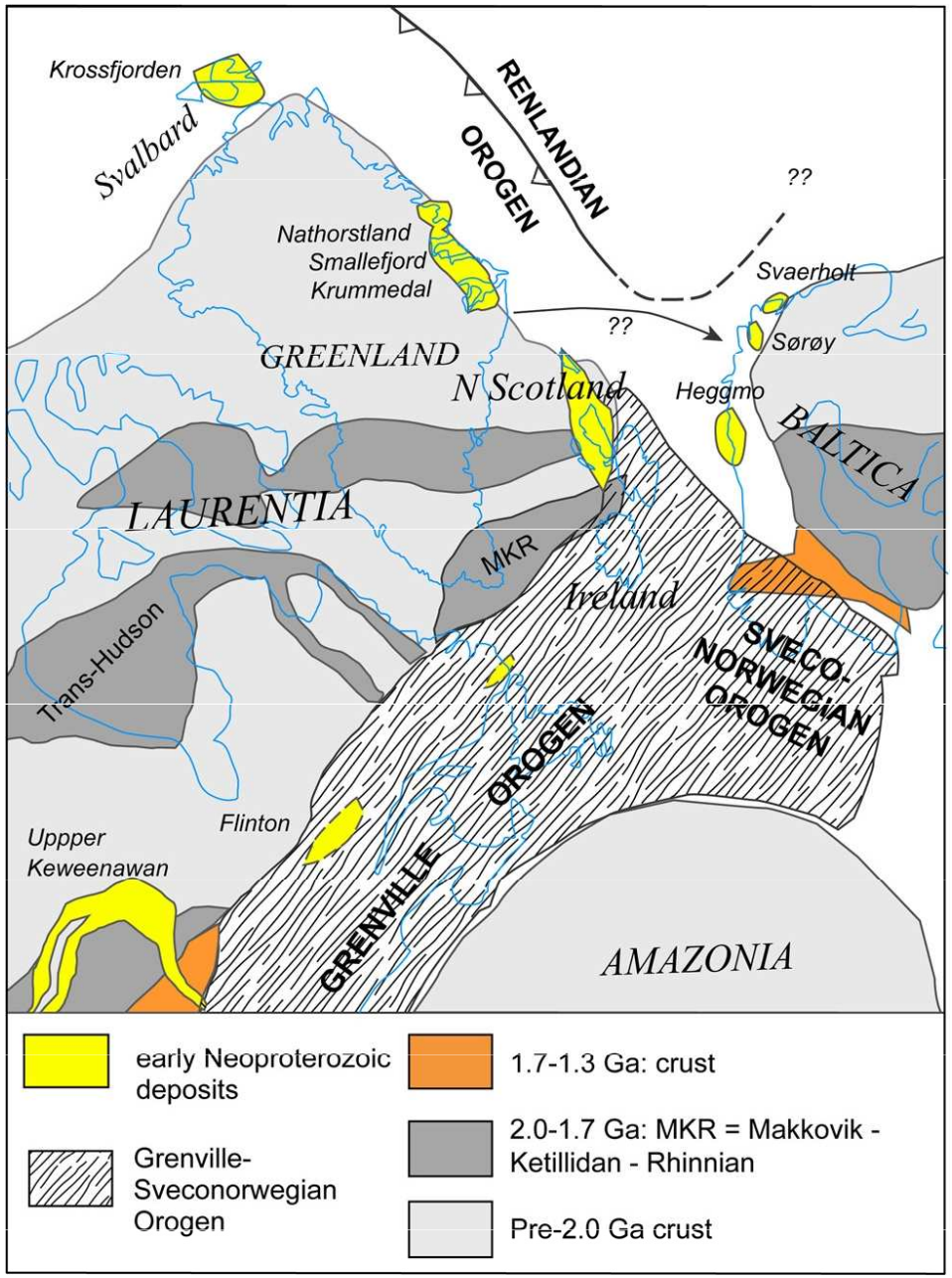


Fig. 7 Reconstruction of **Laurentia** and **Kalahari** at ca. 1,110 Ma (after Dalziel et al. 2000), and a possible closer fit at ca. 1,060 Ma at the end of the **Grenville** orogeny. Note possible correlation of Coats Land and the Yavapai-Mazatzal Province. During later rifting Kalahari inherited parts of the Laurentia foreland, i.e. Coats Land. CDML Central Dronning Maud Land; SR Shackleton Range; HF Heimefrontfjella; H Haag Nunatak; FI Falkland Islands; Na-Na Namaqua-Natal; S Sinclair Suite (ca. 1.1 Ga)


Laurentia
Grenville
SS
Amazonia
Rb
Valhalla
Orogen
Sv
Sh
Hf
M
Asgard Sea
SN
Pi
Ox
Baltica
Timanian margin
Maw
Au
Si
La
RP
Asgard Sea
Am
Ba
WA


Krossfjorden
Svalbard
RENLANDIAN
OROGEN
??
Nathorstland
Smallefjord
Krummedal
Svaerholt
??
Sørøy
GREENLAND
N Scotland
Heggmo
BALTICA
LAURENTIA
MKR
Ireland
Trans-Hudson
SVECO-
NORWEGIAN
OROGEN
Flinton
Uppper
Keweenawan
GRENVILLE
OROGEN
AMAZONIA
early Neoproterozoic deposits
1.7-1.3 Ga: crust
2.0-1.7 Ga: MKR = Makkovik - Ketillidan - Rhinnian
Grenville-Sveconorwegian Orogen
Pre-2.0 Ga crust

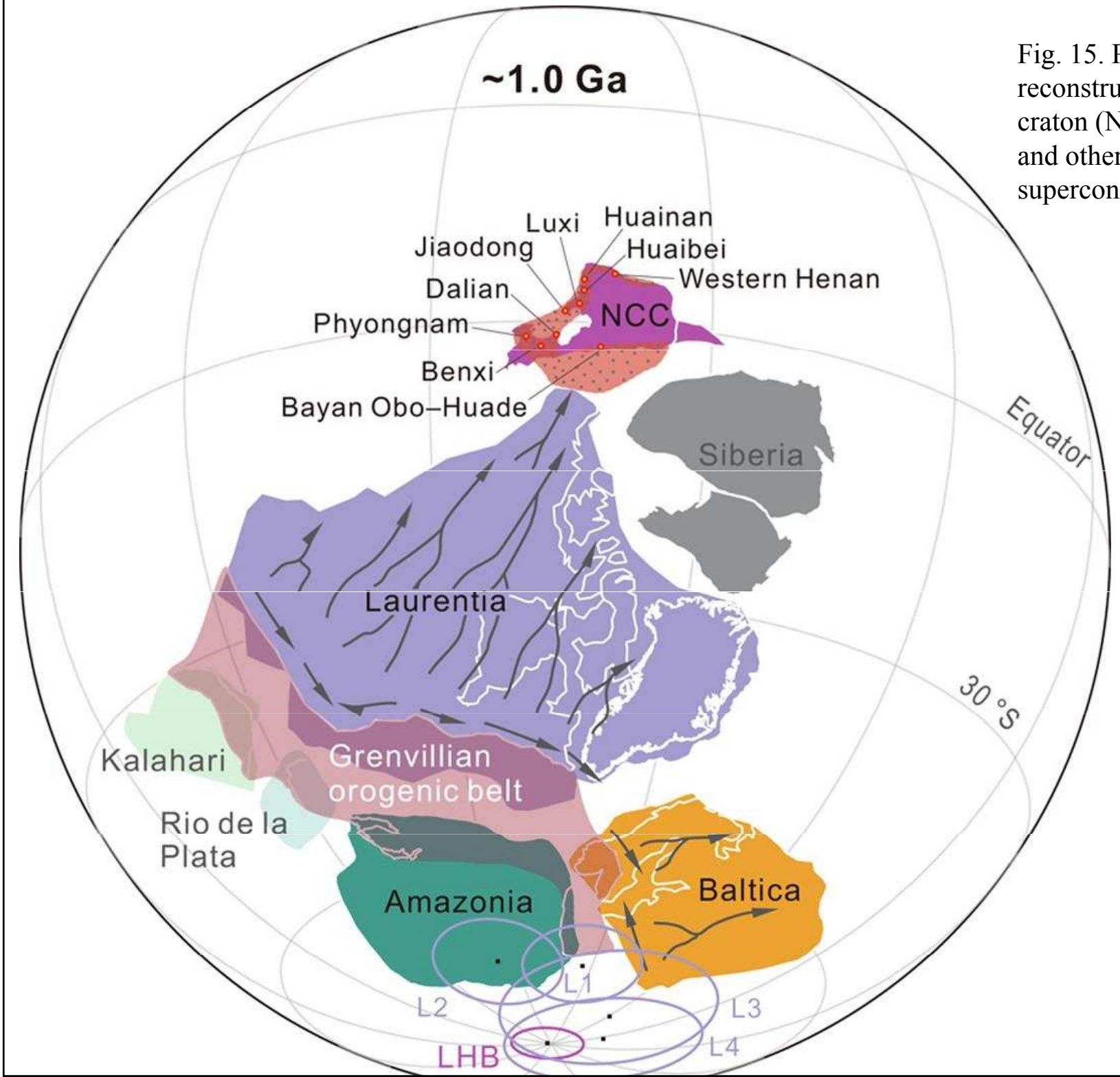


Fig. 15. Paleogeographic reconstruction of the North China craton (NCC), Laurentia, Baltica and other major cratons in supercontinent **Rodinia** at ~1.0 Ga

Fanerozoické mobilní zóny

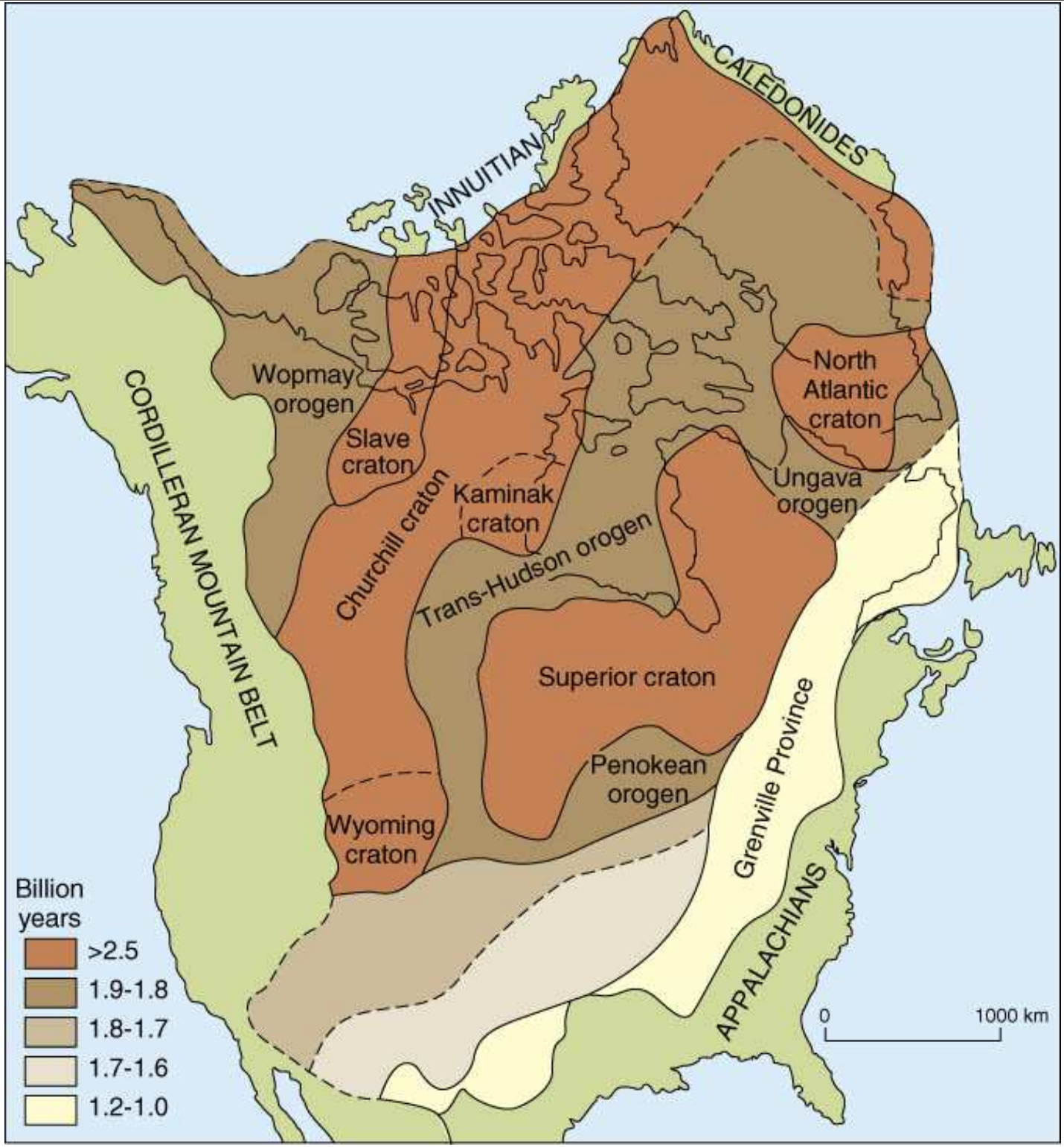
Apalačskou mobilní zónu a na ní navazující na severu britské kaledonidy a na jihu pásmo Quatchita-Marathon

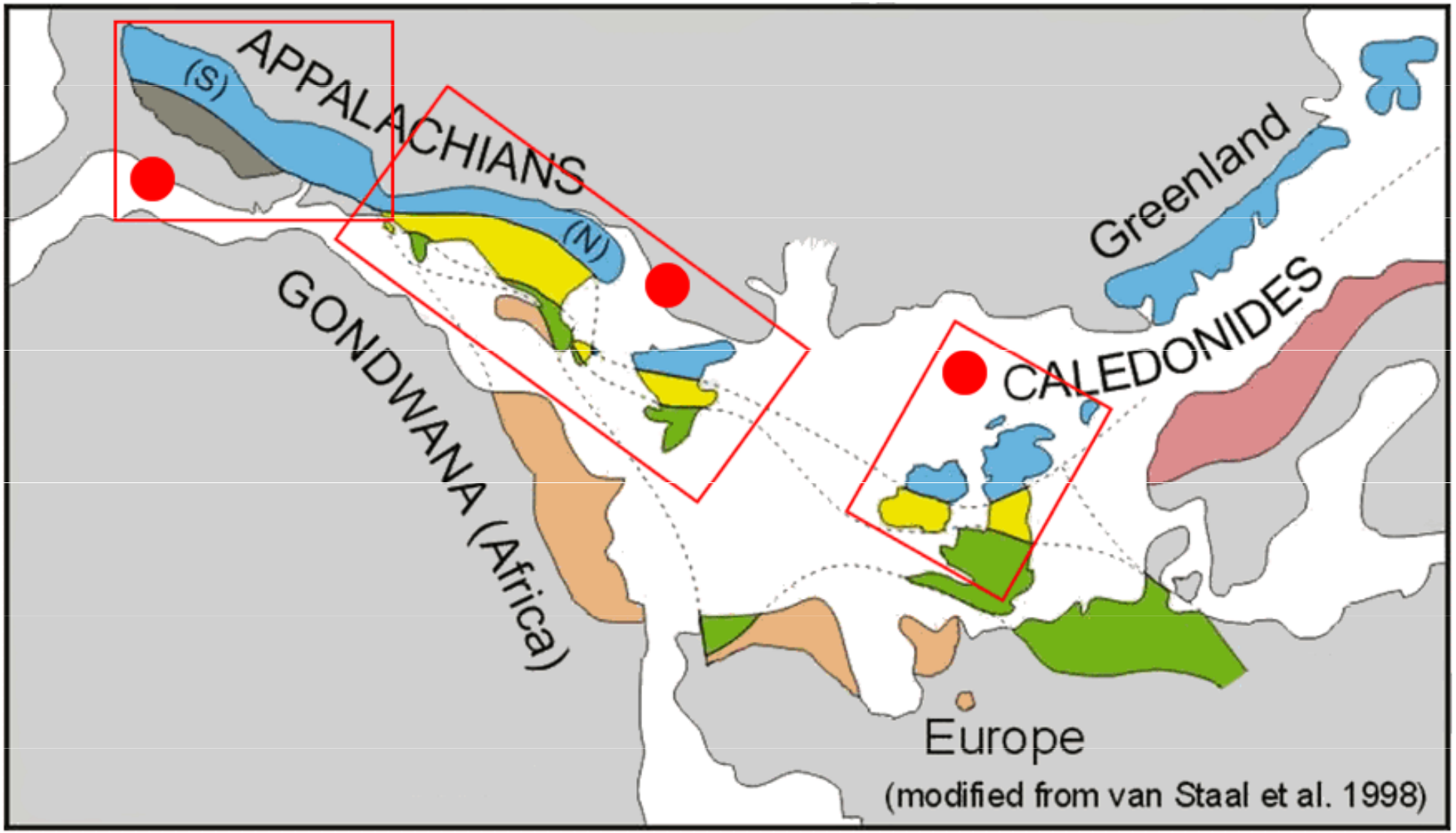
Grónské kaledonidy - kolize se skandinávskou části Evropy

Kordilerská mobilní zóna

Franklinsko-inuitská mobilní zóna

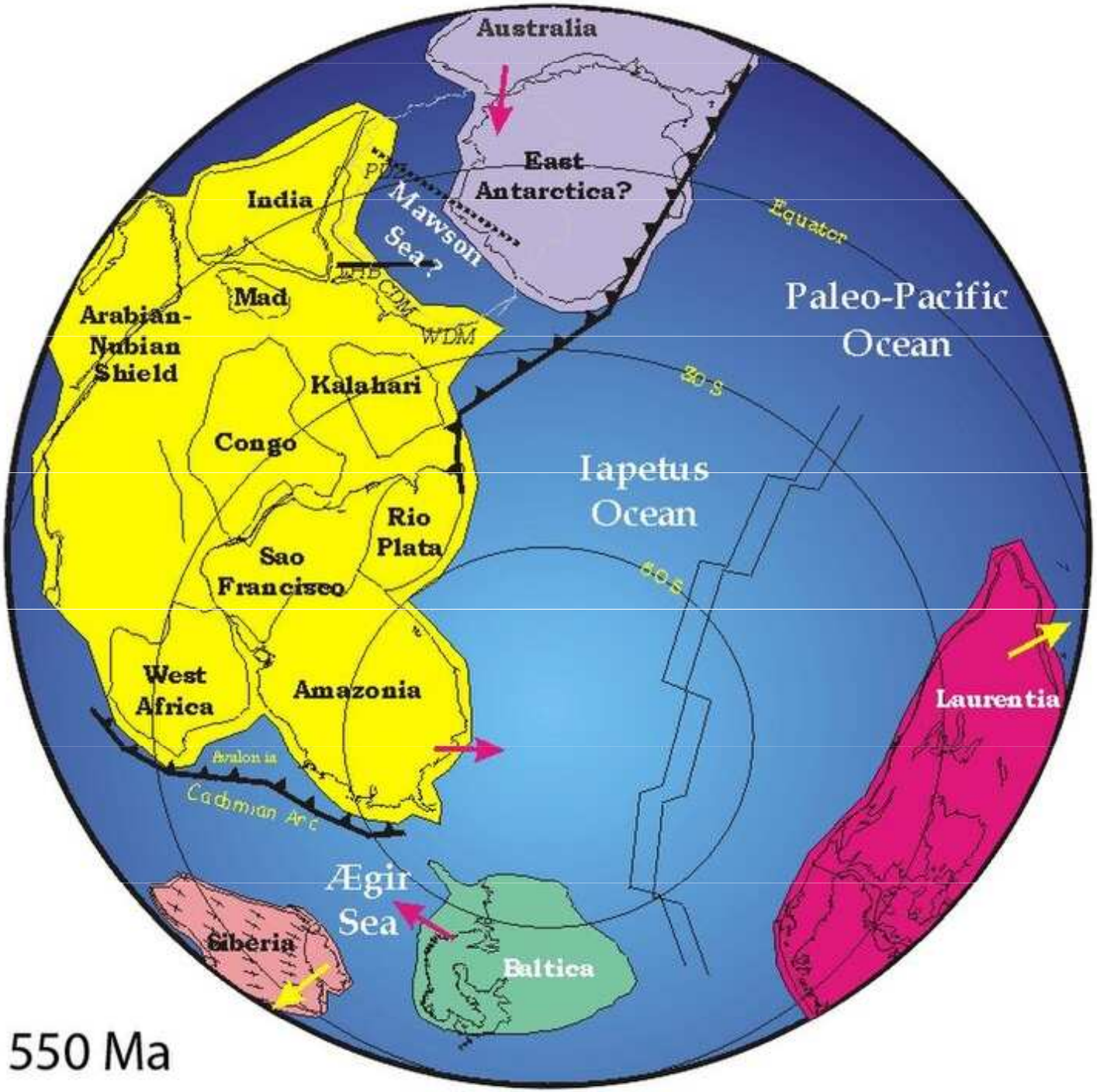

Franklin mobile belt
Cordilleran mobile belt
Canadian Shield
Williston Basin
Appalachian Basin
Michigan Basin
Cincinnati Arch
Platform
Illinois Basin
Nemaha Ridge
Ozark Dome
Nashville Dome
Appalachian mobile belt
Permian Basin
Ouachita mobile belt
© 2001 Brooks/Cole Publishing/ITP


CALEDONIDES
INNUITIAN
Wopmay orogen
Slave craton
Churchill craton
Kaminak craton
Trans-Hudson orogen
North Atlantic craton
Ungava orogen
Superior craton
Penokean orogen
Wyoming craton
CORDILLERAN MOUNTAIN BELT
Grenville Province
APPALACHIANS
Billion years
>2.5
1.9-1.8
1.8-1.7
1.7-1.6
1.2-1.0
0
1000 km


APPALACHIANS
(S)
(N)
Greenland
CALEDONIDES
GONDWANA (Africa)
Europe
(modified from van Staal et al. 1998)

KALEDONSKO-VARISKÁ OROGENEZE

As the **Rodinia** supercontinent continued to break apart, the **Iapetus Ocean** opened, splitting apart Laurentia, Baltica and Gondwana.


Australia
East Antarctica?
India
Mawson Sea?
Mad
Arabian-Nubian Shield
Kalahari
Congo
Rio Plata
Sao Francisco
West Africa
Amazonia
Avalonia
Cadomian Arc
Ægir Sea
Siberia
Baltica
Laurentia
Paleo-Pacific Ocean
Iapetus Ocean
Equator
20°S
40°S
550 Ma

Grónské kaledonidy - kolize se skandinávskou části Evropy

Apalače – **teránní stavba u kaledonské orogeneze (takonská, salinická, akadská fáza)**
variské (alleghanská) orogeneze – kolize s Gondwanou
Britské kaledonidy-pokračování Apalačí

Pásmo Quatchita-Marathon – **alleghanská fáze, kolize s jihoamerickou části Gondwany**


LAURENTIA
BALTICA
AVALONIA
Acadian orogeny
Fish Scotia Caledonides
Greenland Caledonides
Scandinavian Caledonides
North German Polish Caledonides
Mid European Caledonides
ARMORICA ??

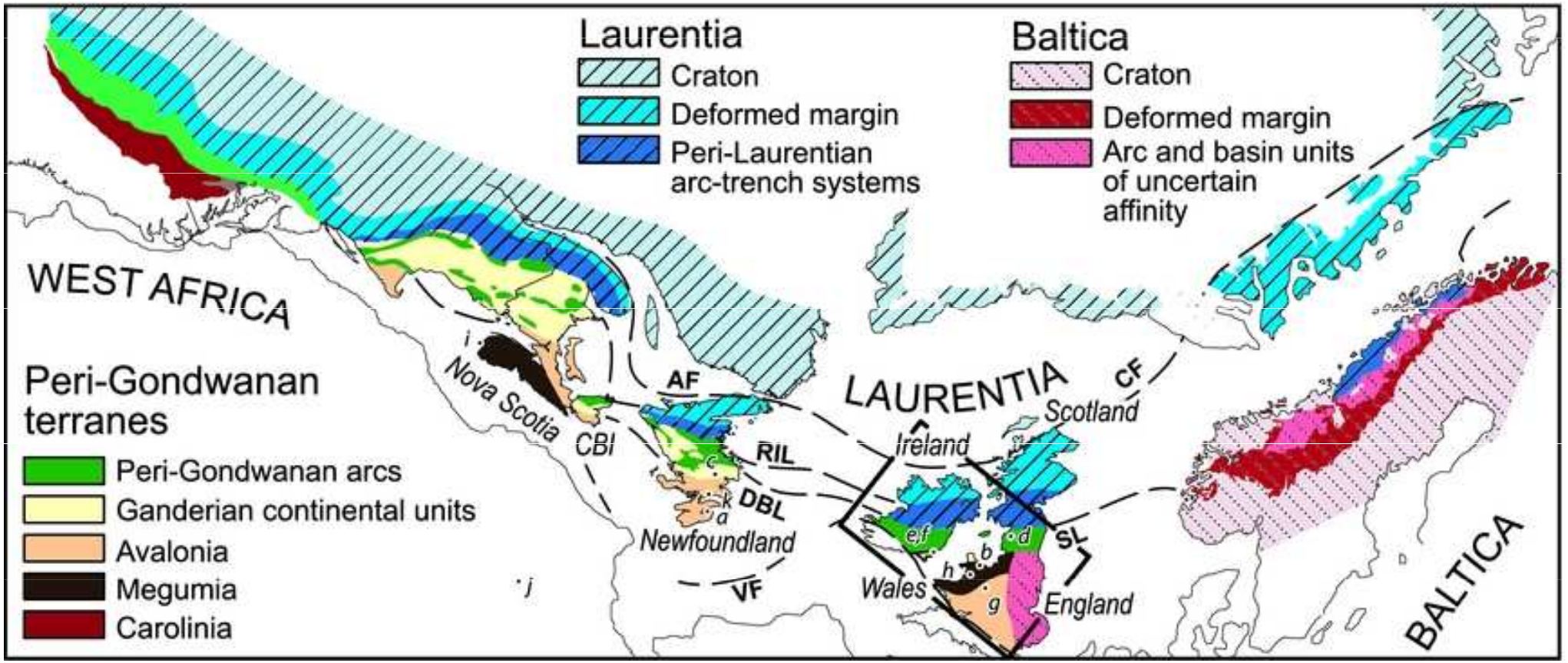
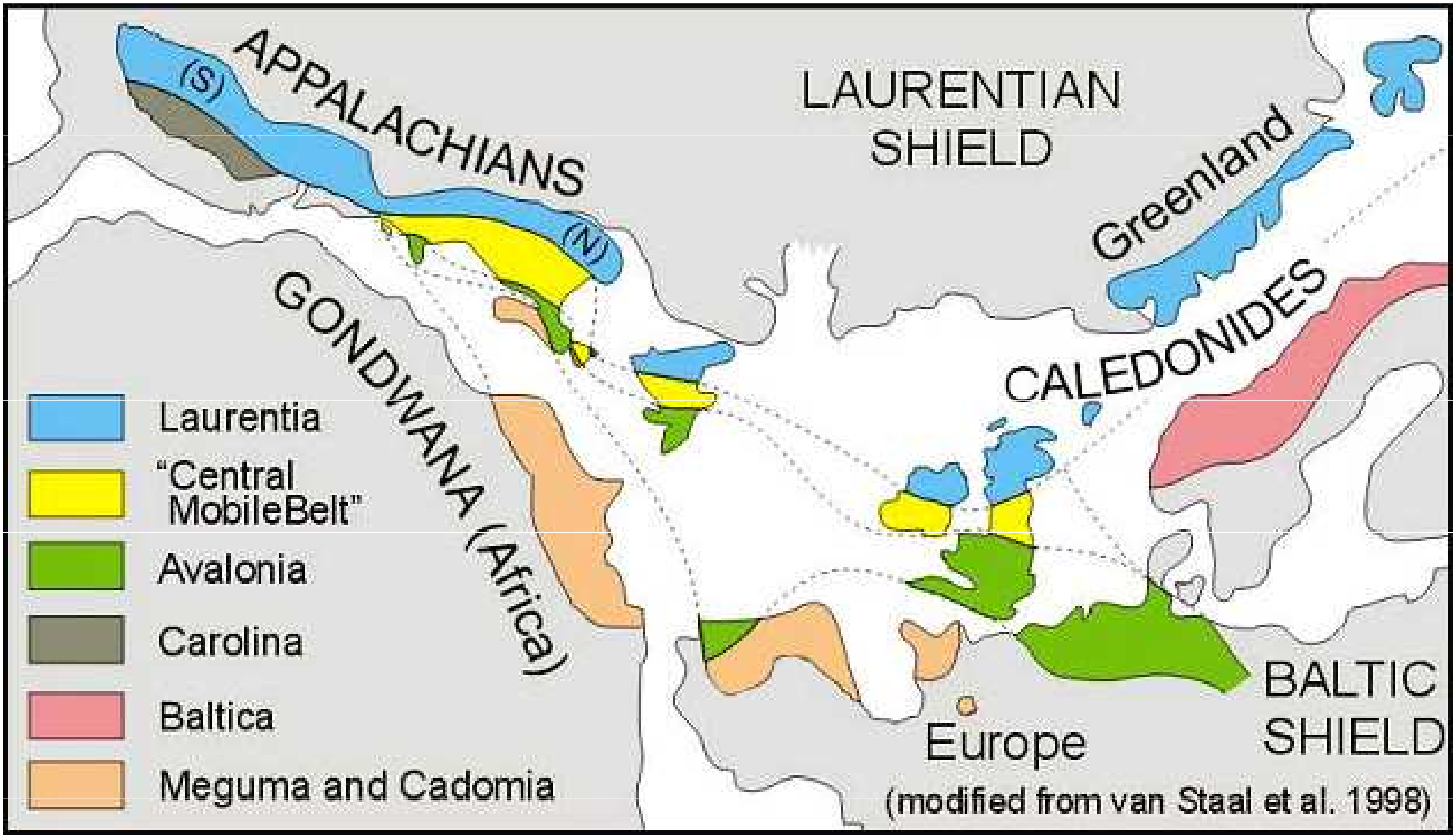


Figure 1. Map of the Appalachian–Caledonide Orogen superimposed on a 'Pangea' reconstruction prior to Atlantic opening, after Waldron et al. Reference Waldron, Schofield, Murphy and Thomas(2014b). Locations a–k correspond to samples plotted in Figures 3–5. AF – Appalachian Front; CBI – Cape Breton Island; CF – Caledonide Front; DBL – Dog Bay Line; RIL – Red Indian Line; SL – Solway Line; VF – Variscan Front.


APPALACHIANS
(S)
(N)
LAURENTIAN
SHIELD
Greenland
CALEDONIDES
GONDWANA (Africa)
Laurentia
"Central
MobileBelt"
Avalonia
Carolina
Baltica
Meguma and Cadomia
BALTIC
SHIELD
Europe
(modified from van Staal et al. 1998)

APALAČE

As the **Rodinia** supercontinent continued to break apart, the **Iapetus Ocean** opened, splitting apart Laurentia, Baltica and Gondwana. Appalachian orogeny started with the closure of the **Iapetus** and continued with the closure of the **Rheic** ocean - collision with **African** part of **Gondwana**

Accretionary orogen with final collision of African part of Gondwana in the southern part

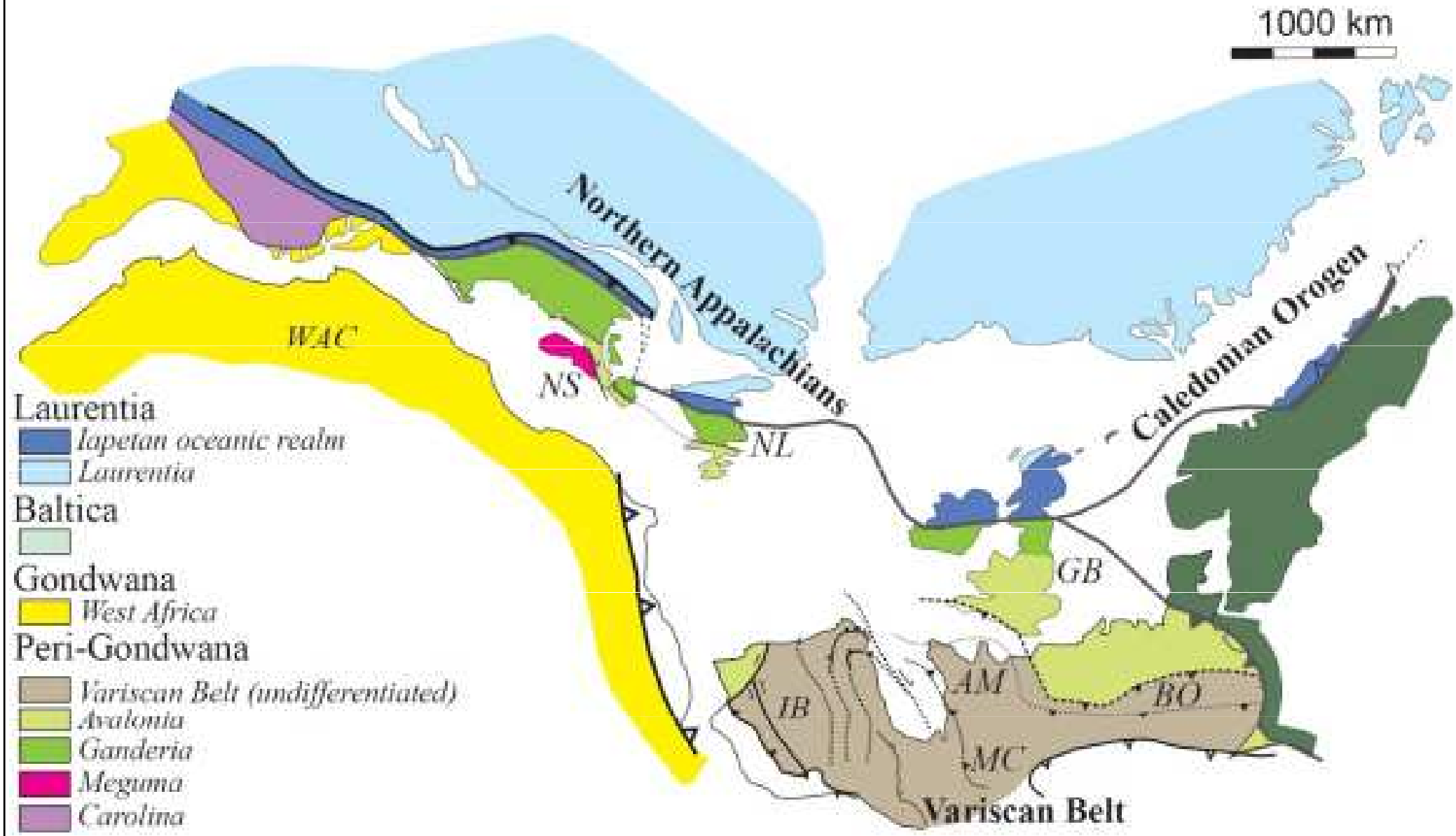
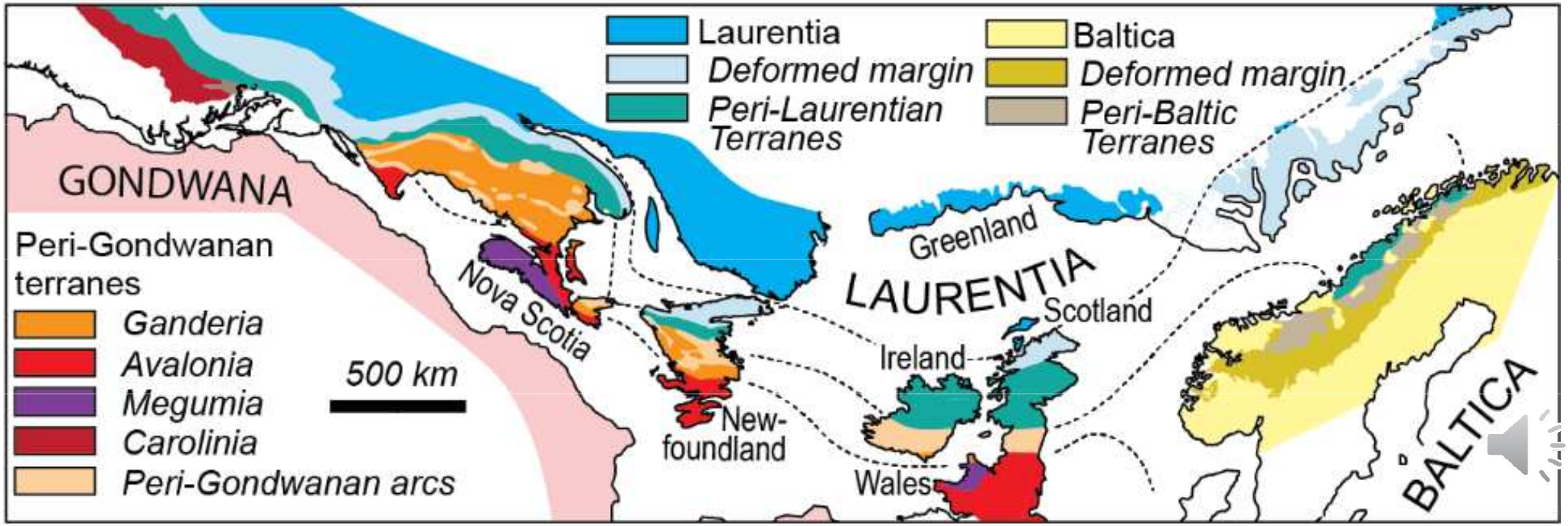
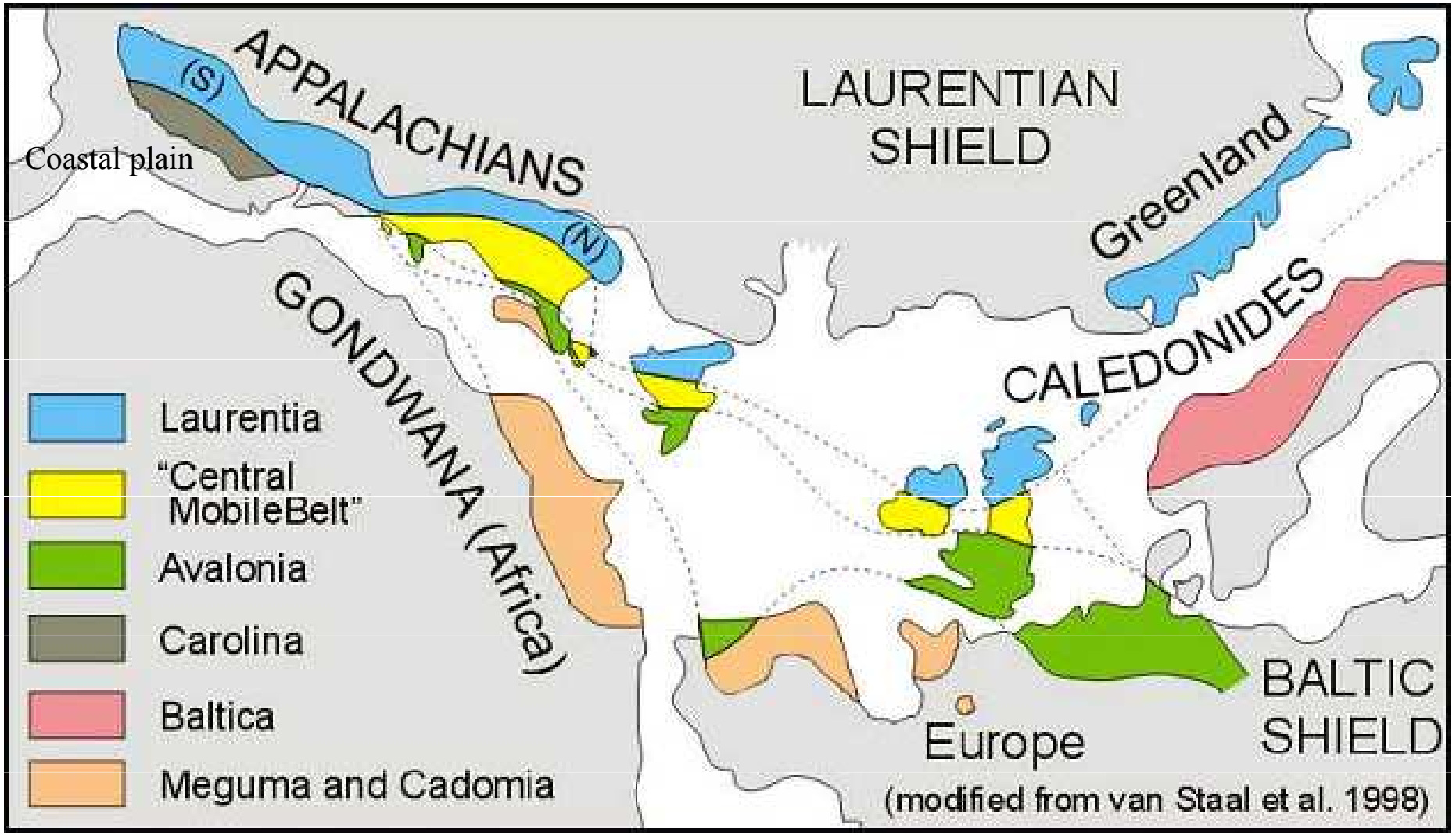


Fig. 1. Tectonic map of the Appalachian-Variscan-Caledonian orogen

Apalače představují složený orogen, jehož tvorba probíhala jak během **kaledonských** fází tak během **variských** fází. Údaje seismiky ukazují, že celá jižní část Apalačí je pravděpodobně podstýlána velkou zónou odlepení a celý horský hřeben je alochtonní.

Apalače byly utvářeny při 4 hlavních orogenezích. **Takonská** orogeneze zahrnovala kolize **perilaurentskými** bloky **Notre Dame** a **Inner Piedmont** situovanými v oceanu **Iapetus** v části přiléhající k Laurentii. **Salinická** kolizi Ganderie s Laurentii. **Akadská** a **neoakadská** fáze kolizi **Ganderie** a **Avalonie** a Avalonie a **Megumy** na severu a superteránu **Carolina** na jihu s tehdejším okrajem Laurentie. **Alleghanská** orogeneze potom kolizi s africkou částí **Gondwany**. Ta je reprezentováná teránem **Atlantic coastal plain**




APPALACHIANS
(S)
(N)
Coastal plain
LAURENTIAN
SHIELD
Greenland
CALEDONIDES
GONDWANA (Africa)
Laurentia
"Central
MobileBelt"
Avalonia
Carolina
Baltica
Meguma and Cadomia
BALTIC
SHIELD
Europe
(modified from van Staal et al. 1998)

Hlavní tektonické jednotky Apalačí

Okraje Laurentie – skupina I, Humber, more to the south Valley and Ridge, Blue-Ridge teranes

Centrální zóna – terány II. a III. skupiny složitá **akreční melanž teránů různé povahy situvaných v oceánu Iapetus** a při jeho okrajích. **Kontinentálních fragmenty**, vulkanické oblouky, oceánické sedimenty. V podstatě se dají rozlišit **terány, které vznikaly při okraji Laurentie a terány, které vznikaly při okraji perigondwany**.

Perilaurentské terány skupiny II

V severní části Apalačí to je zejména zóna **Notre Dame**, vznikající na fragmentu **Humberu**. V jižní části zóna **Inner Piedmont** vznikající na fragmentu Blue Ridge okraje Laurentie. Fragmenty **Laurentie** a vulkanické oblouky **Iapetu**

Perigonwanské terány skupiny III – fragmenty **Gondwany** a přilehlé vulkanické oblouky **Iapetu**

Je to **perigondwanská Ganderie** tvořená fragmentem Gondwany (Gander) a vulkanickými oblouky oceanické a kontinentální povahy (Popelogan arc – fragment Ganderu) a horninami zaobloukové pánve. V jižní části Apalačí je to perigondwanský **superterán Carolina**

Perigondwanské terány – terány IV a V -Avalonia,, Meguma-původně součástí Gondwany
Gondwana - Atlantic coastal plain

Peri-laurentské a peri-gondwanské vulkanické oblouky oceánu Iapetus nejde vždy dobře oddělit

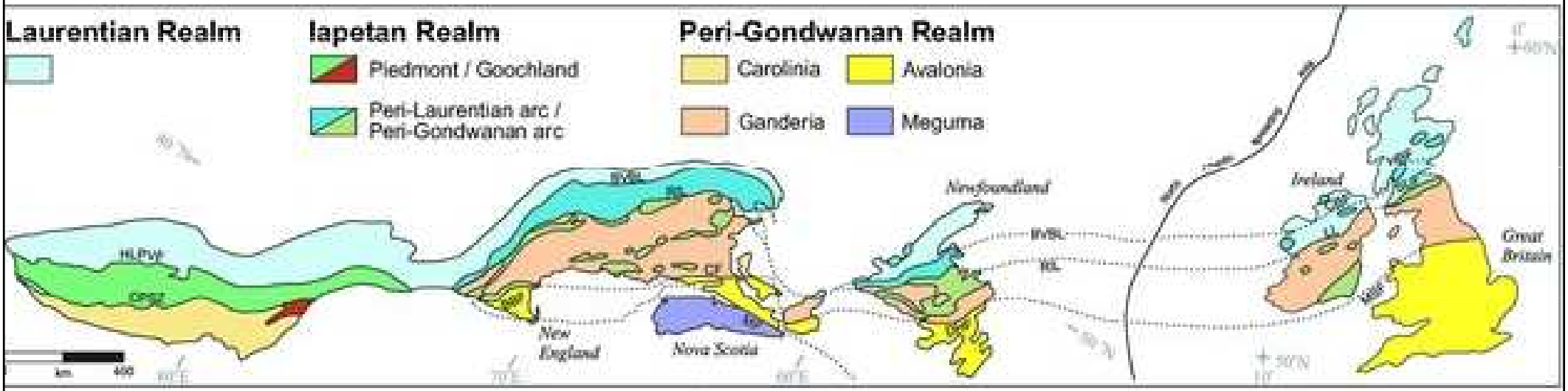


Figure 1. Appalachian lithotectonic realms and their continuation into Britain and Ireland (modified after Pollock et al. 2012). BBF = Bloody Bluff fault; BVBL = Baie Verte Brompton Line; CF = Caledonia fault; CPSZ = Central Piedmont shear zone; CBF = Clew Bay fault; DHF = Dover-Hermitage Bay fault; HBF = Highland Boundary fault; HLPVF = Hollins Line-Pleasant Valley fault; LL = Leadhills Line; MF = Minas fault; MSF = Menai Strait fault; RIL = Red Indian Line; SUF = Southern Uplands fault.

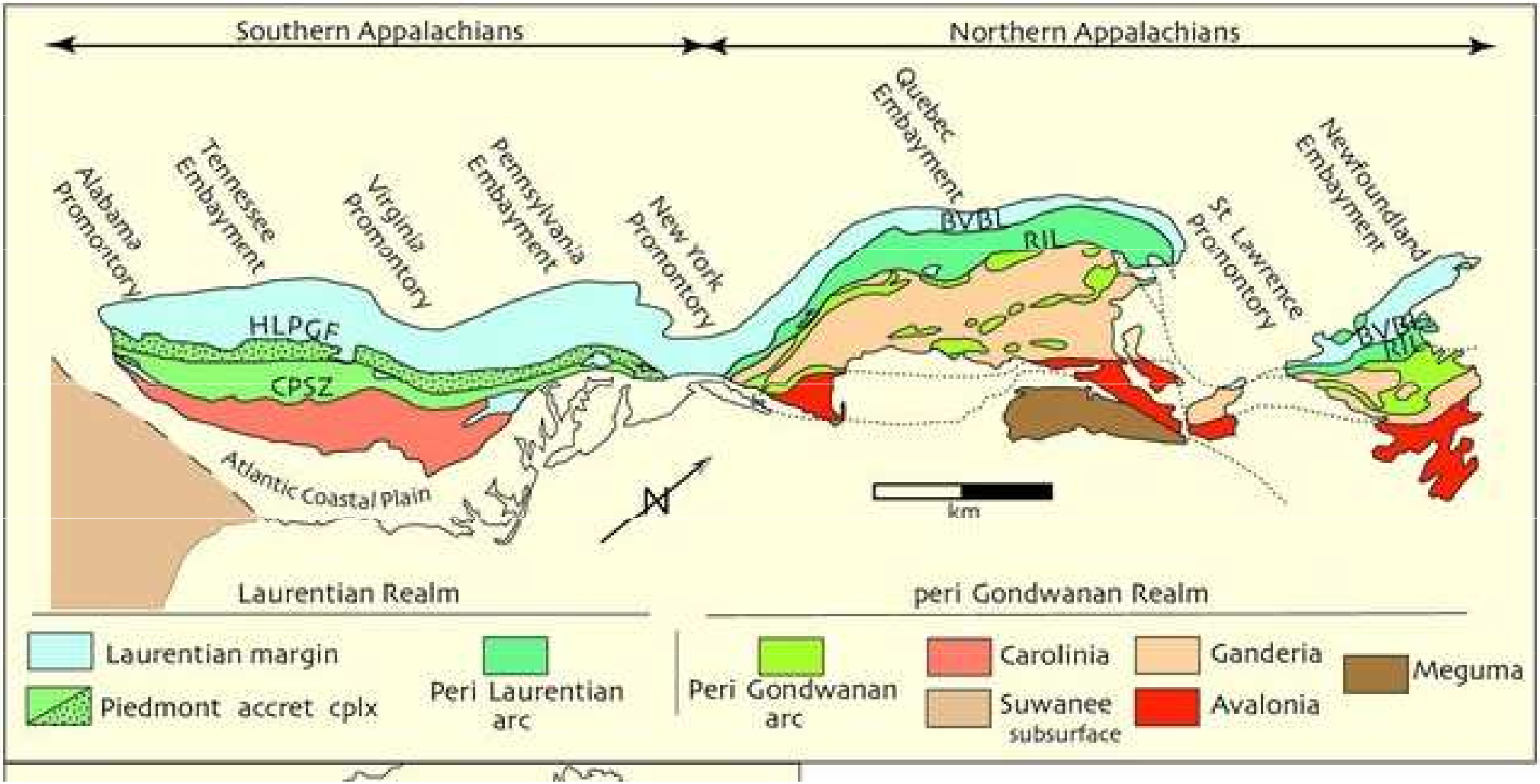


Figure 1. First-order architecture of the Appalachian orogen depicting distribution of the major, mainly preSilurian, lithotectonic divisions. BVBL = Baie VerteBrompton line; CPSZ = central Piedmont shear zone; HLPGF = Hollins line-Pleasant Grove fault system; **RIL = Red Indian line.**

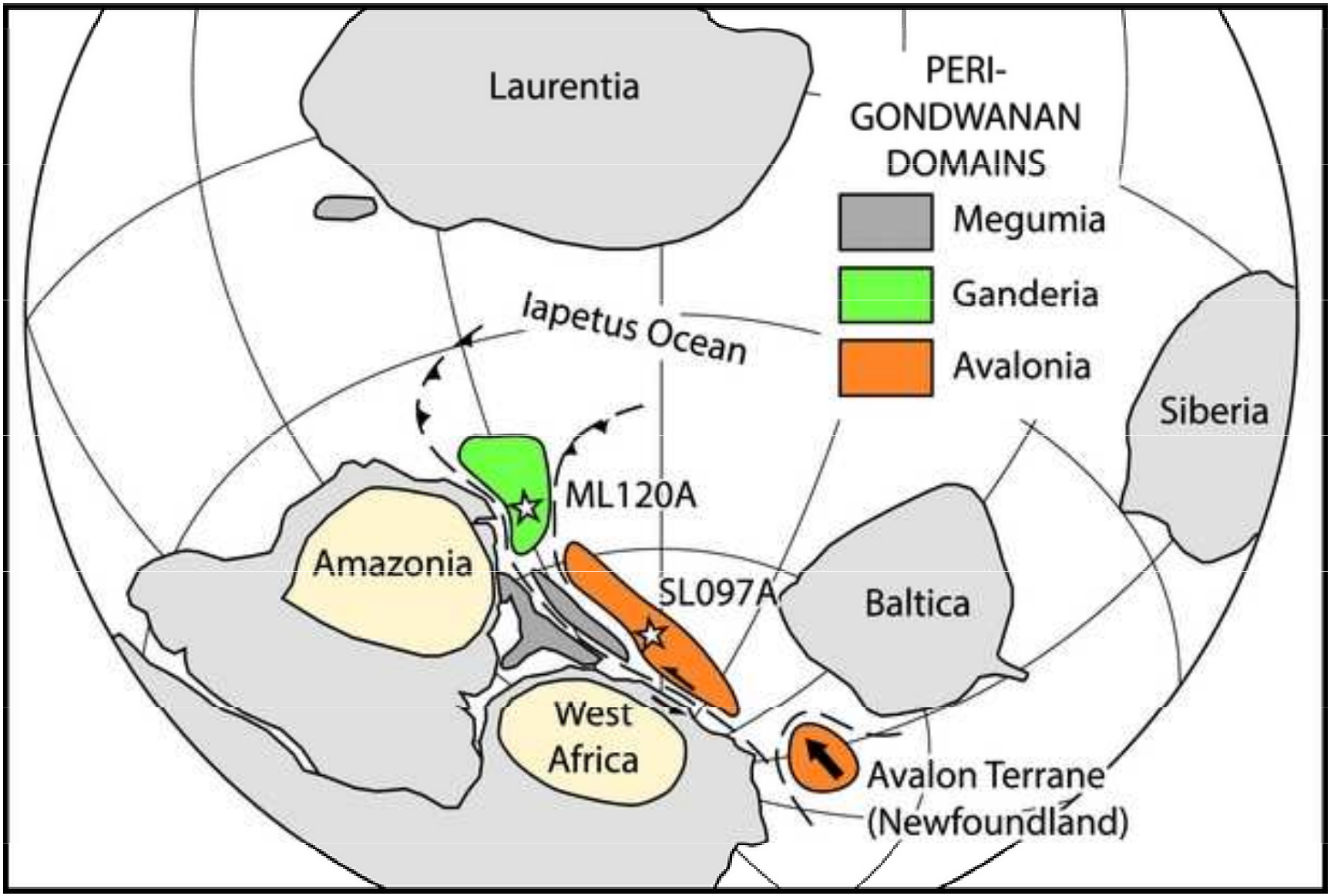


Figure 7. Highly schematic cartoon showing possible terrane relationships of selected peri-Gondwanan terranes in Cambrian time, based on Murphy et al. (Reference Murphy, Waldron, Schofield, Barry and Band2014), Waldron et al. Reference Waldron, Schofield, Murphy and Thomas(2014b) and Pothier et al. (Reference Pothier, Waldron, Schofield and DuFrane2015a,b).

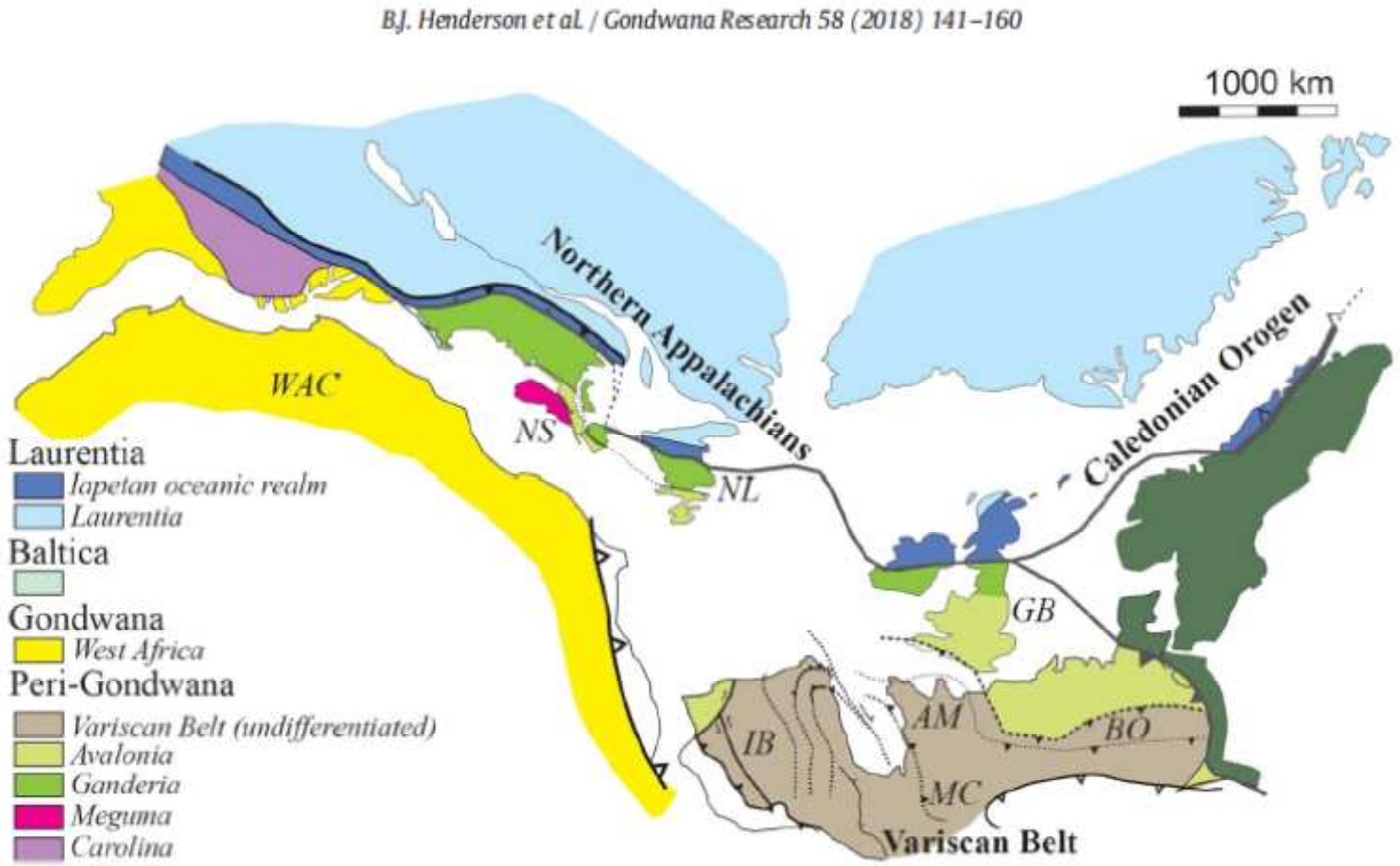


Fig. 1. Tectonicmap of the Appalachian-Variscan-Caledonian orogen. Tectonicmap showing the distribution of the Appalachian, Variscan and Caledonian belts at the end of the Paleozoic.
Shown are themajor cratonic andmicrocontinental components within the orogenic belts including Iberia (IB), Amorican Massif (AM), Massif Centrale (MC), Bohemian Massif (BO) and
theWest African Craton (WAC). This represents the approximate configuration of Pangea following late Paleozoic convergence between Laurentia and Gondwana.
The figure is modified from Hibbard et al. (2007), Barreiro et al. (2007), Keppie et al. (2008) and Pollock et al. (2011).

Severní Apalače

Terán Humber – terán skupiny I

Tektonicky modifikovaný okraj Laurentie. Tento terán zahrnuje **miogeosynklinálu** situovanou na laurentinském pasivním kontinentálním okraji. Táhne se od SZ Newfoundlandu do zóny **Valley and Ridge a Blue Ridge na jihu**. Basement se skládá z **grenvilských** rul (1,0Ma) na kterých spočívají klastické a karbonátové riftové **sedimenty** kambria až spodního ordoviku.

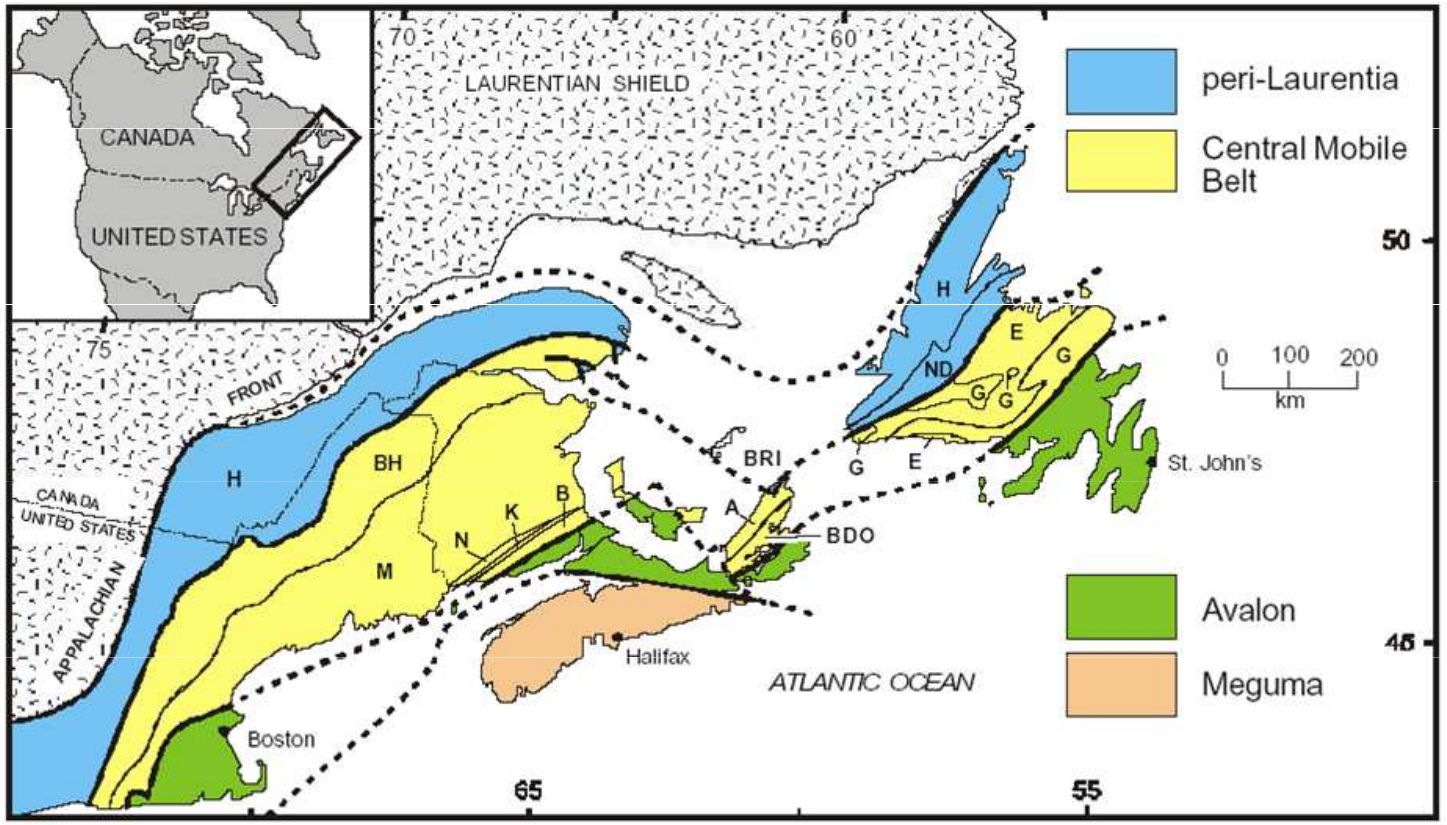


Figure 1. Simplified map of the northern Appalachian orogen showing crustal blocks and terranes (A, Aspy; B, Brookville; BDO, Bras d'Or; BH, Bronson Hill; BRI, Blair River inlier; E, Exploits; G, Gander; H, Humber; K, Kingston; M, Miramichi; N, New River; ND, Notre Dame;

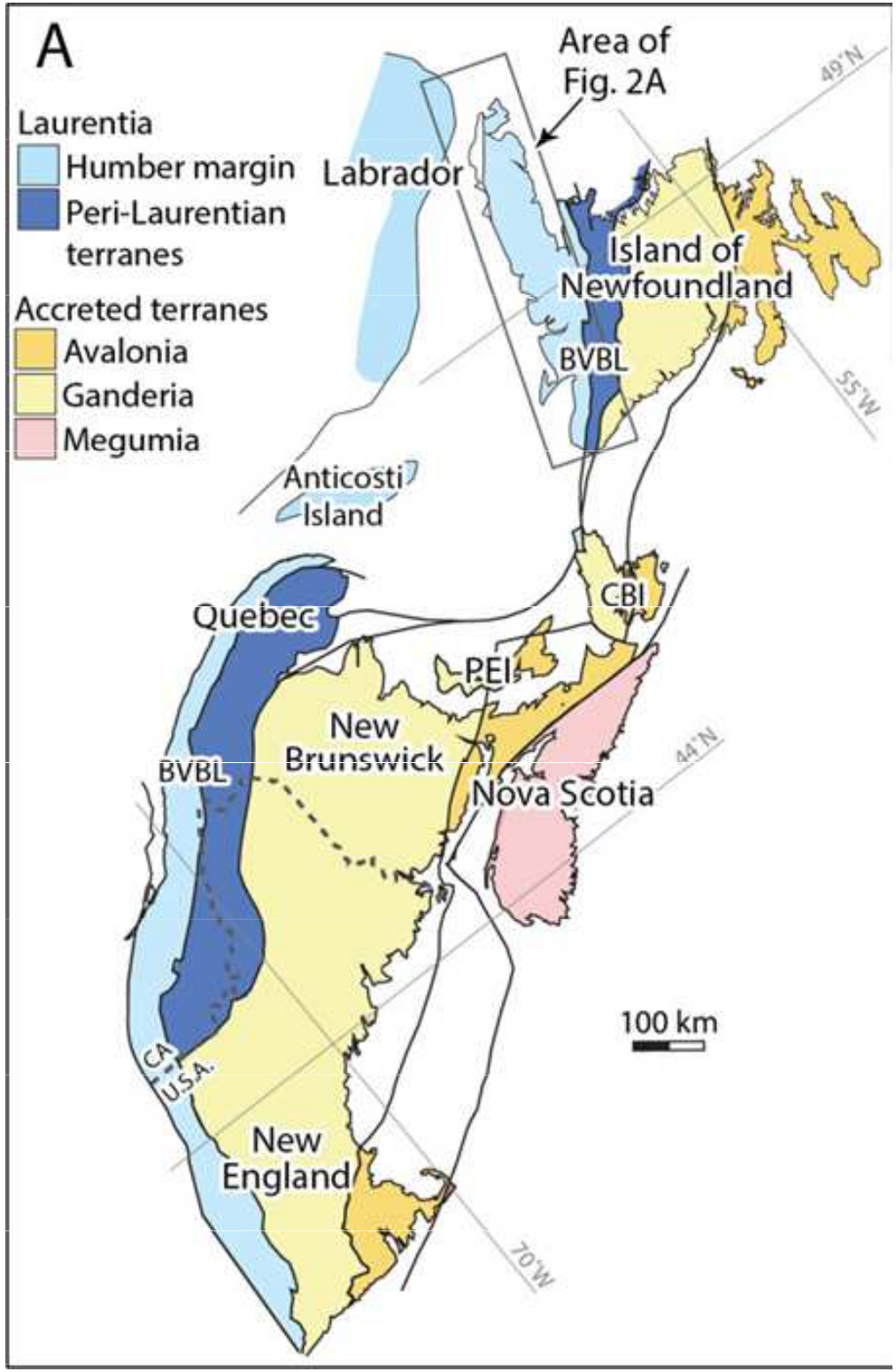
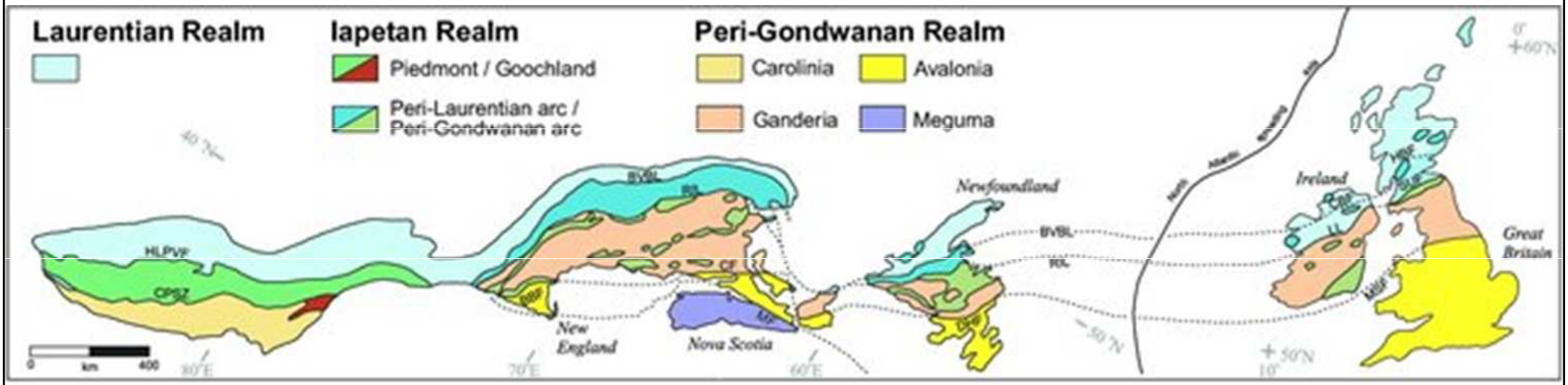


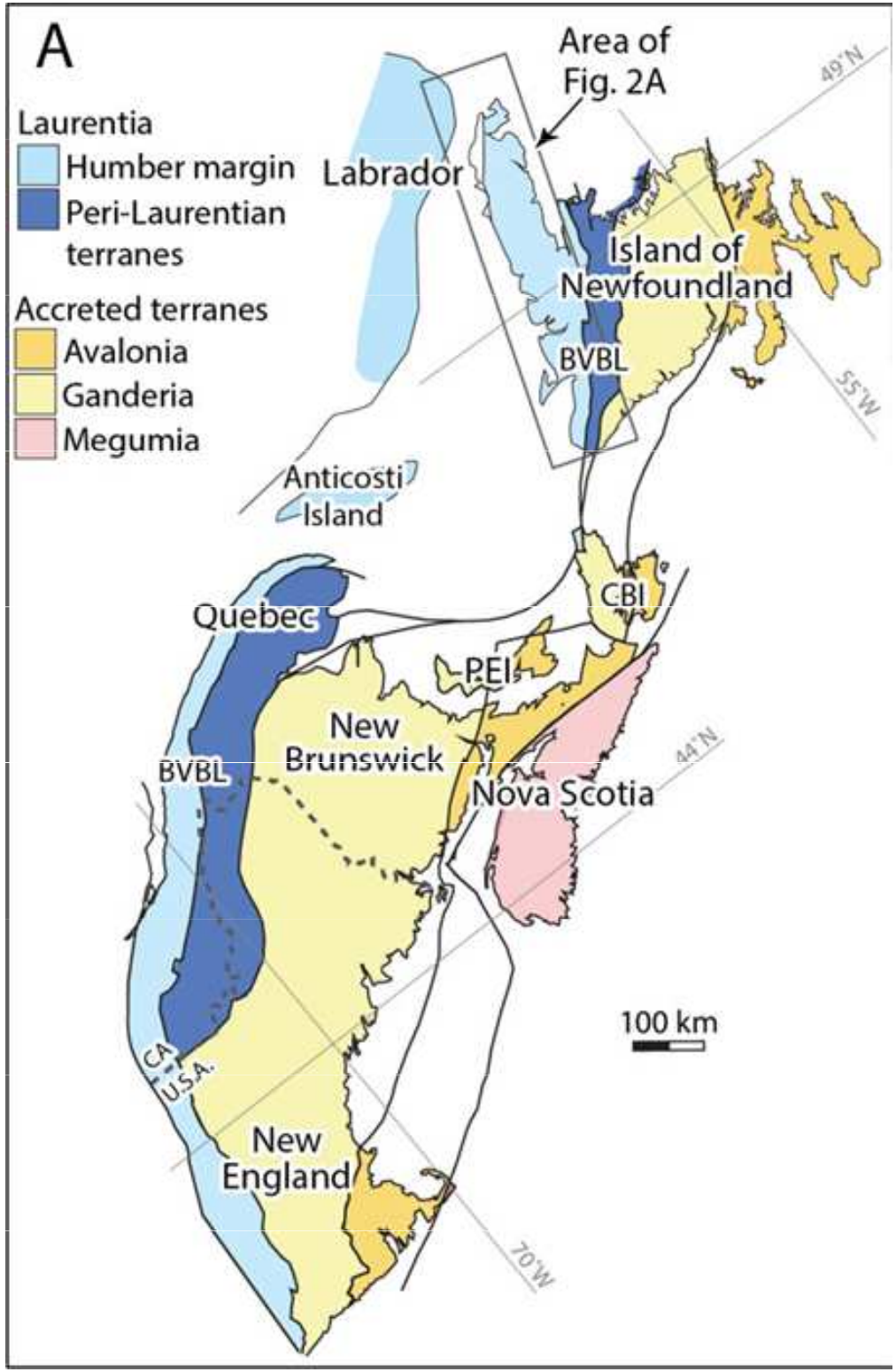
Figure 1. (A) Simplified map of the northern Appalachian orogen modified from Hibbard et al. (2006). Humber margin rocks include autochthonous and allochthonous continental margin units exposed in the westernmost Appalachians. CA - Canada; CBI - Cape Breton Island; PEI - Prince Edward Island; U.S.A. - United States of America. (B) Interpreted continental margin geometry of eastern Laurentia modified from Allen et al. (2010) that assumes formation by a simple-shear, low-angle detachment rift system. The ocean-continen transition is oversimplified and does not show zones of hyperextended crust and exhumed continental mantle in outboard regions. Selected igneous rock occurrences: BC - Birchy complex (556–564 Ma, van Staal et al. , 2013); BR - Blair River dikes (576 Ma and 581 Ma: Miller & Barr , 2004); BM - Baie des Moutons complex (583 M: McCausland et al. , 2011); DH - Disappointment Hill pluton (607 Ma: Hodgin et al. , 2021); LRD - Long Range dikes (615 Ma: Kamo et al., 1989, 1995); LM - Lac Matapédia volcanics (565 Ma: Hodych & Cox , 2007); LS - Lady Slipper pluton (555 Ma: Cawood et al. , 2001); MR - Mont Rigaud syenite (533 Ma: McCausland et al. , 2007); RP - Round Pond granite (602 Ma: Williams et al. , 1985); SC - Skinner Cove Formation volcanics (Cawood et al. , 2001); SI - Sept Îles complex (564 Ma, Higgins & van Breemen , 1998); SH - St. Honoré complex (571 Ma: McCausland et al , 2009); TH - Tibbit Hill Formation volcanics (554 Ma: Kumarapeli et al. , 1989). Ar-Ar cooling ages of pseudotachylyte from O'Brien and van der Pluijm (2012). Zircon (U-Th)/He cooling ages from Powell et al. (2018).

Iapetan realm

Broadly, the **Iapetan realm** is subdivided into **peri-Laurentian** oceanic crust referred to as either the Taconic or Humber Seaway) and **peri-Gondwanan** domain thought to be **separated by the Red Indian Line** that bounds the **eastern limit of the Notre Dame Subzone** The former Dunnage zone (or terrane) can be divided into two portions characterized by peri-Laurentian and peri-Gondwanan arcs, corresponding respectively to the **Notre Dame** and **Ganderia**

Terány II a III zahrnují fragmenty kontinentů a **vulkanické oblouky**, **ofiolity** a přidruženou **akreční melánž**, Jedná se o **peri-laurentskou** (perihumberskou) zónu **Notre Dame (skupina II) a perigondwanskou Ganderii (III)**. Seismické údaje ukazují, že terány Notre Dame, a Ganderie jsou **alochtonní** nad spodní kontinentální kůrou a že seveoamerický okraj pokračuje 70 km pod ně. Tyto zóny představují jenom velmi hrubé rozdělení, protože **každá z nich se skládá ze značného počtu fragmentů** (nebo dílčích teránů?) různého původu. Vedle **fragmentů Laurentie** nebo **Gondwany** obsahují mnoho **ofiolitů** a **vulkanických oblouků** odvozených z **lapetu** a deformovaných během kolize kontinentálních okrajů Laurentie Ganderie a Avalonie.


Laurentian Realm
Iapetan Realm
Piedmont / Goochland
Peri-Laurentian arc / Peri-Gondwanan arc
Peri-Gondwanan Realm
Carolinia
Avalonia
Ganderia
Meguma
40°N
HLPVF
CPSZ
BVSL
RSL
New England
Nova Scotia
Newfoundland
Ireland
Great Britain
0 km 400
30°E
70°E
60°E
50°N
10°
0°
+60°N



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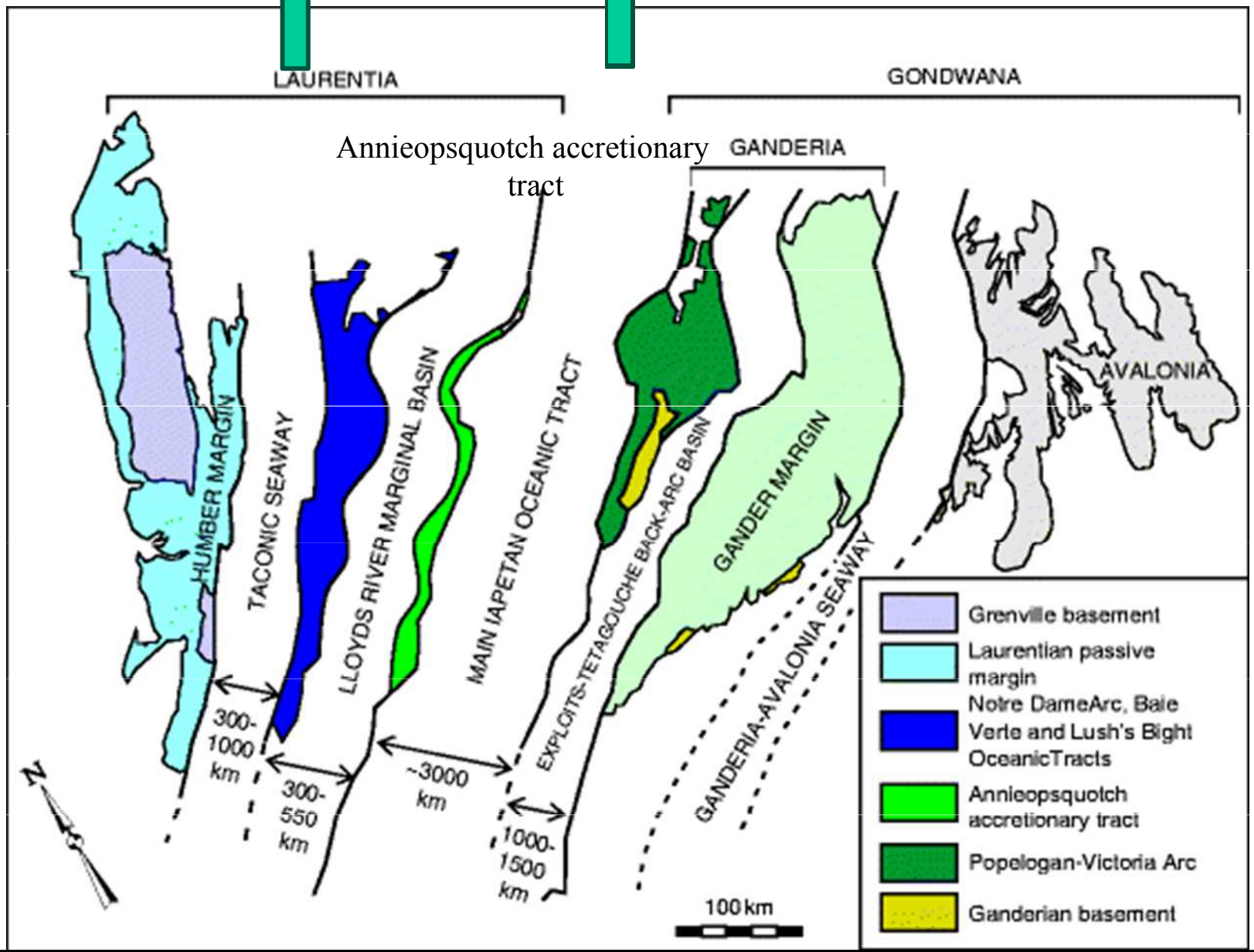
Notre Dame

Humber

Peri-lauretian group II

Perigondwanan group III

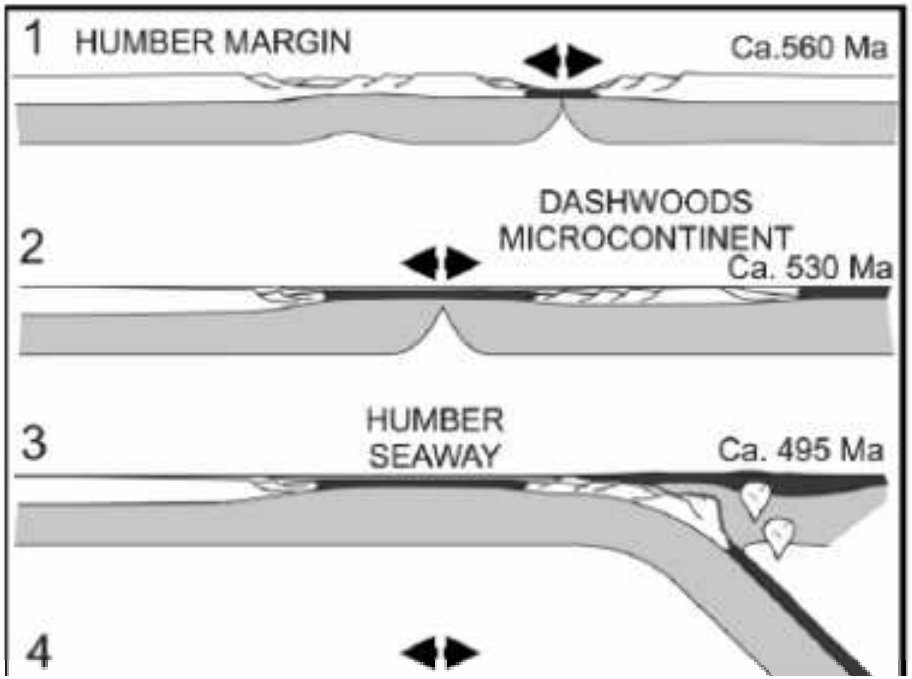


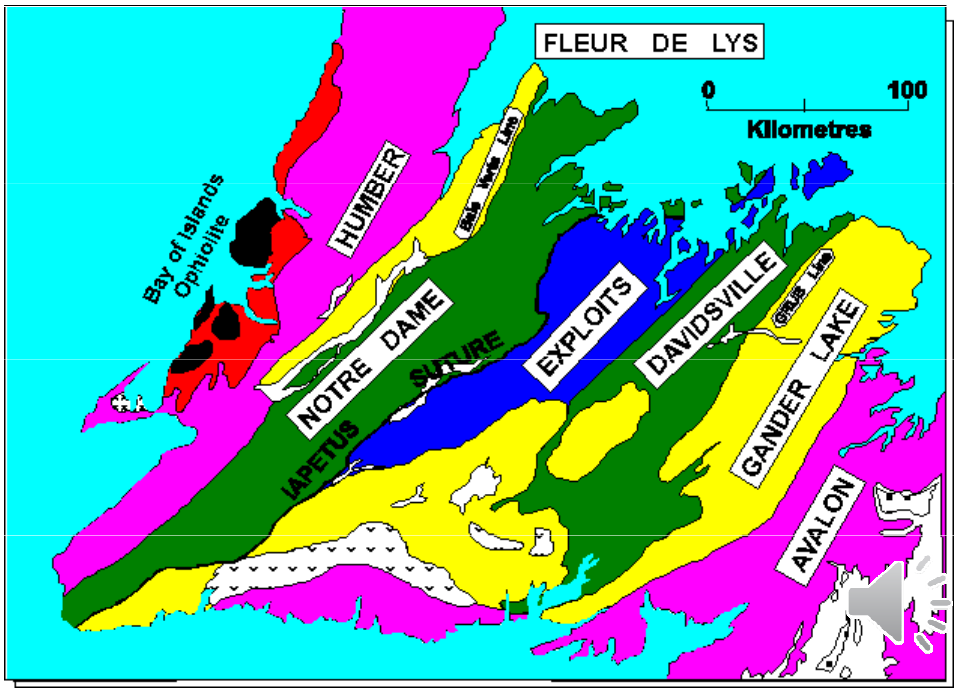
Peri-Laurentian domain

Notre Dame zone

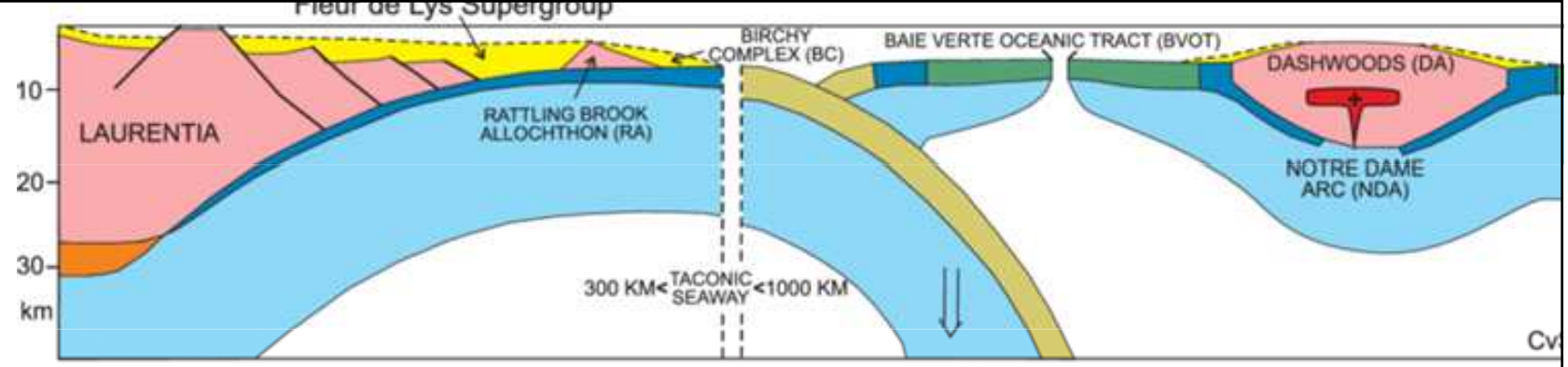
V první fázi se od terránu Humber odděli terán **Dashwood**. **Takonská** orogeneze potom souvisela s uzavíraním okrajového oceánu a s kolizí terránu Dashwood s Humber – okrajem Laurentie.

Na kontinentální okraj jsou obdukovány **dva typy teránů – Fleur de Lys Supergroup** (metapelity a meetapsamity interpretované jako **sedimenty** kontinentálního svahu na jv od karbonátové sedimentace + **ofiolity**) a **velké alochtony** obsahující **ofiolity** jako jsou **Bay of Island Complex** nebo **Baie Verte** oceanic tract), který byly obdukovány v llanvirnu.

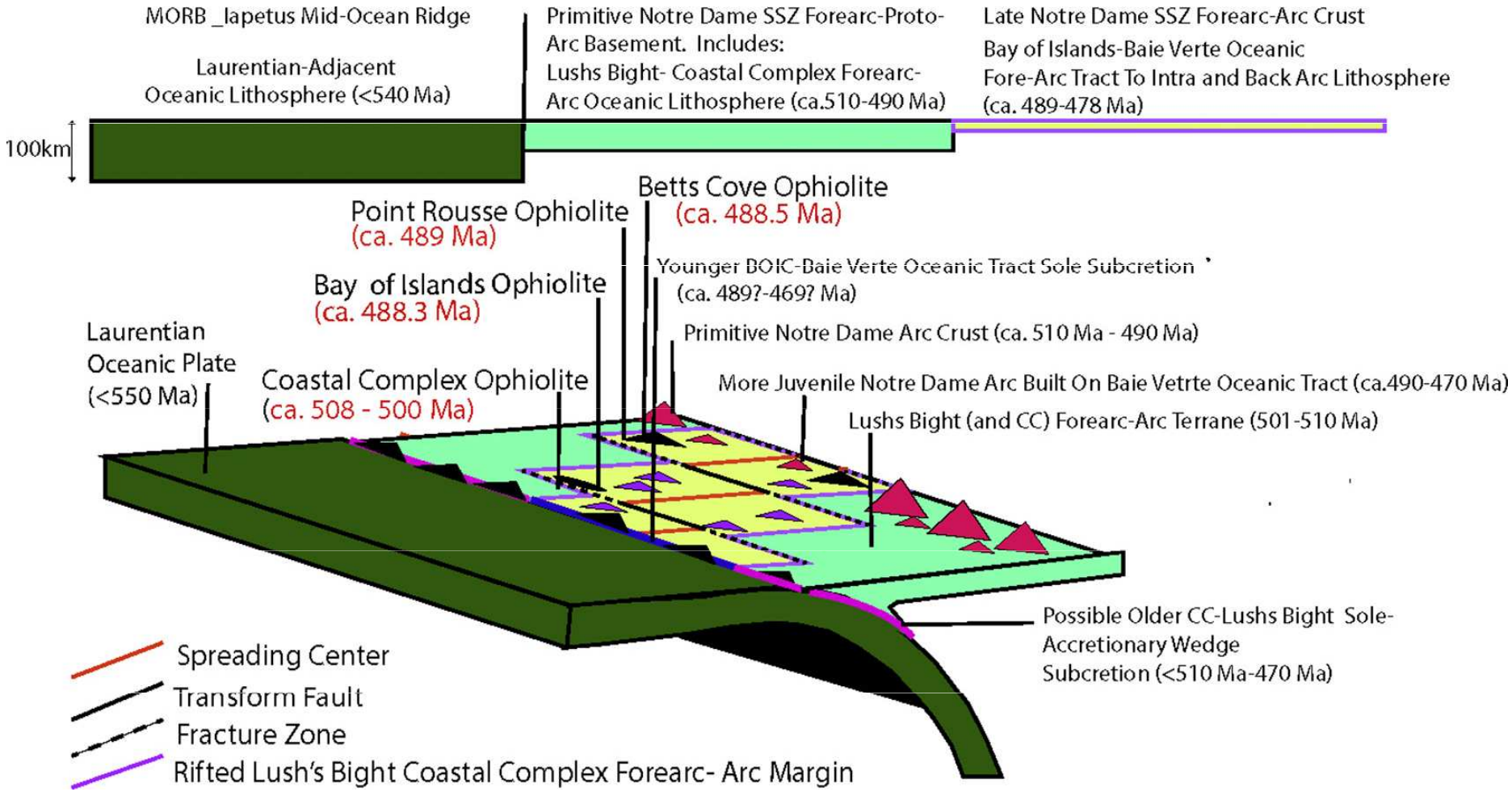




Vznik komplexu Bay of Island



Ofiolity nasunuté na Humber



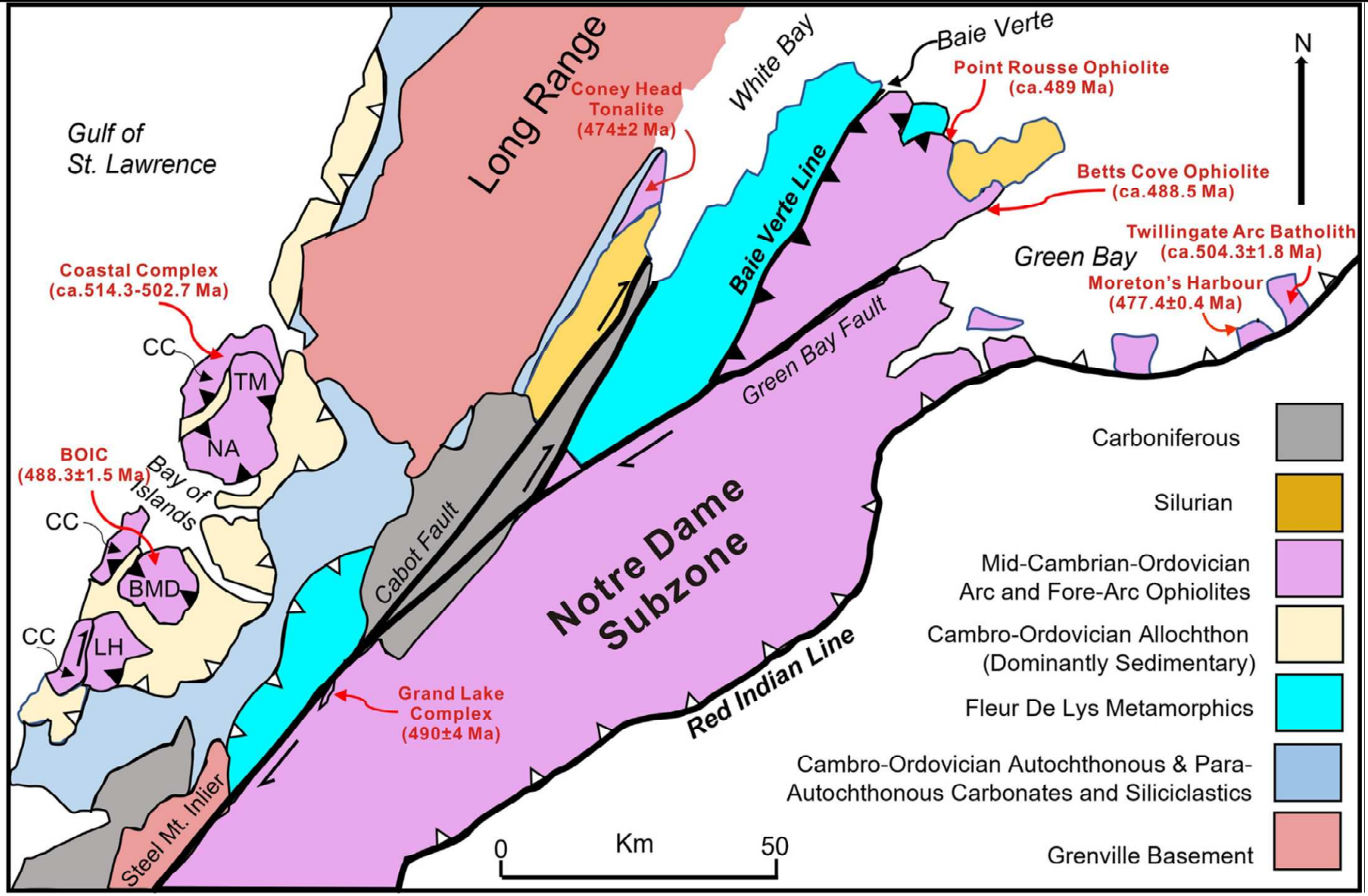
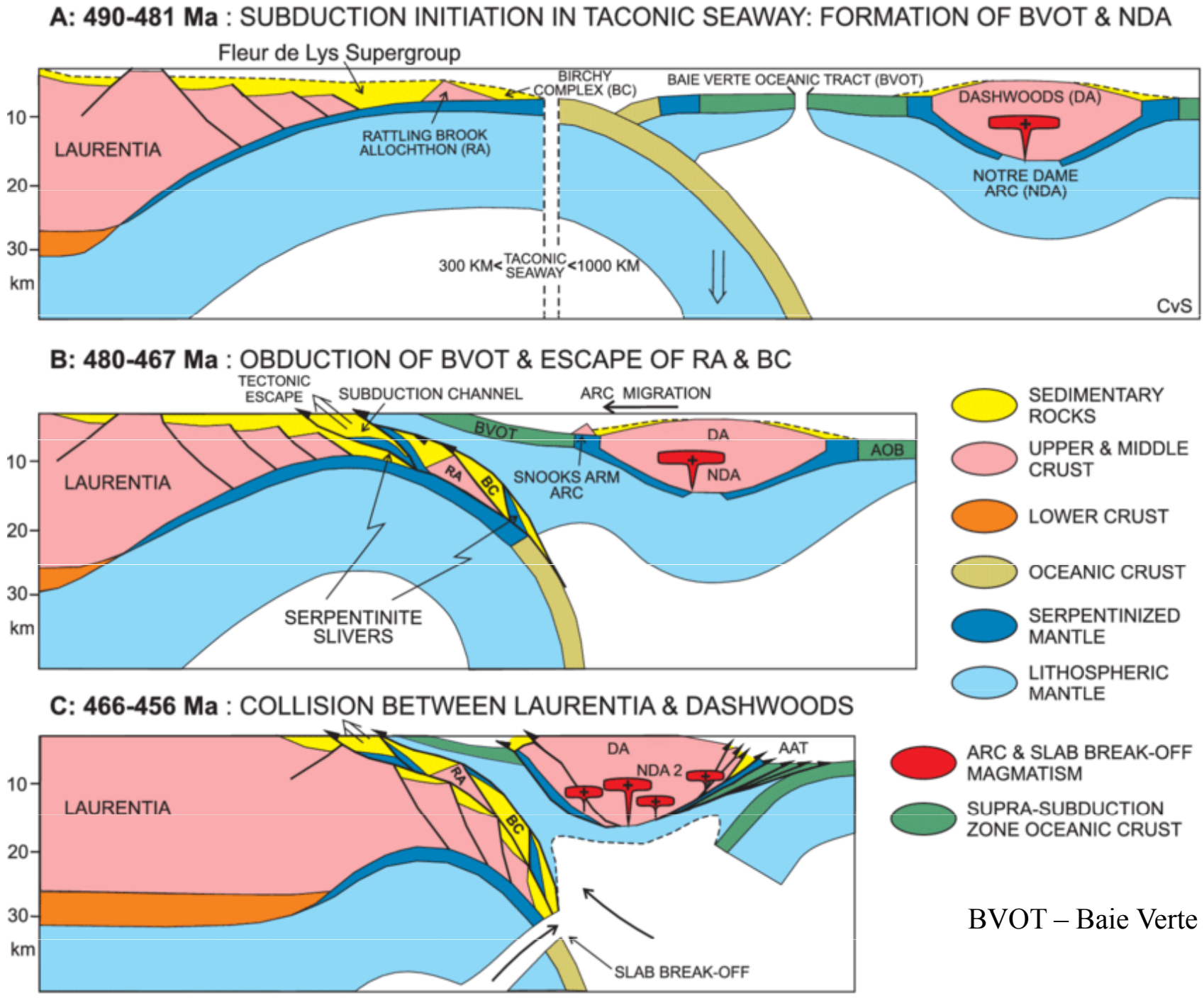


Fig. 1. Generalized geologic map of the distribution of major rock units in Western Newfoundland including **Humber Zone** to the west and **Notre Dame Subzone** to the east, that are approximately separated by the Baie Verte Line (modified from Dewey and Casey, 2021). The eastern edge of the Notre Dame Subzone is bounded by **the Red Indian Line** interpreted to be the **boundary between peri-Laurentia and peri-Gondwana terrane** accreted to Laurentia (also see Fig. 2 inset). The allochthonous **"forearc" Bay of Islands Complex (BOIC) and Coastal Complex (CC) ophiolitic klippen** in the Humber Zone were originally contiguous with the Notre Dame Subzone before isolated by tectonism and erosion in the allochthons of the Humber Zone.



BVOT – Baie Verte oceanic tract

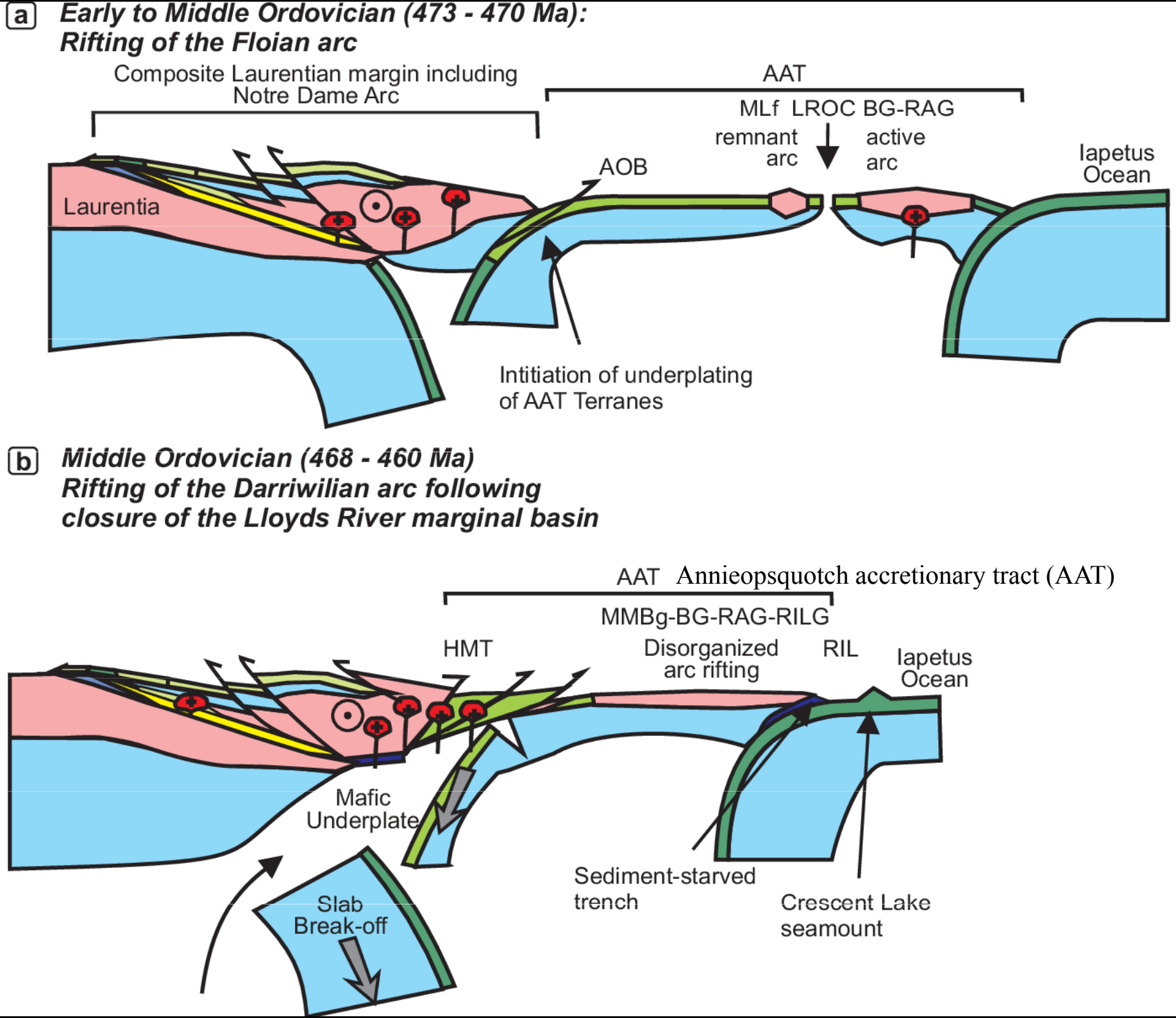
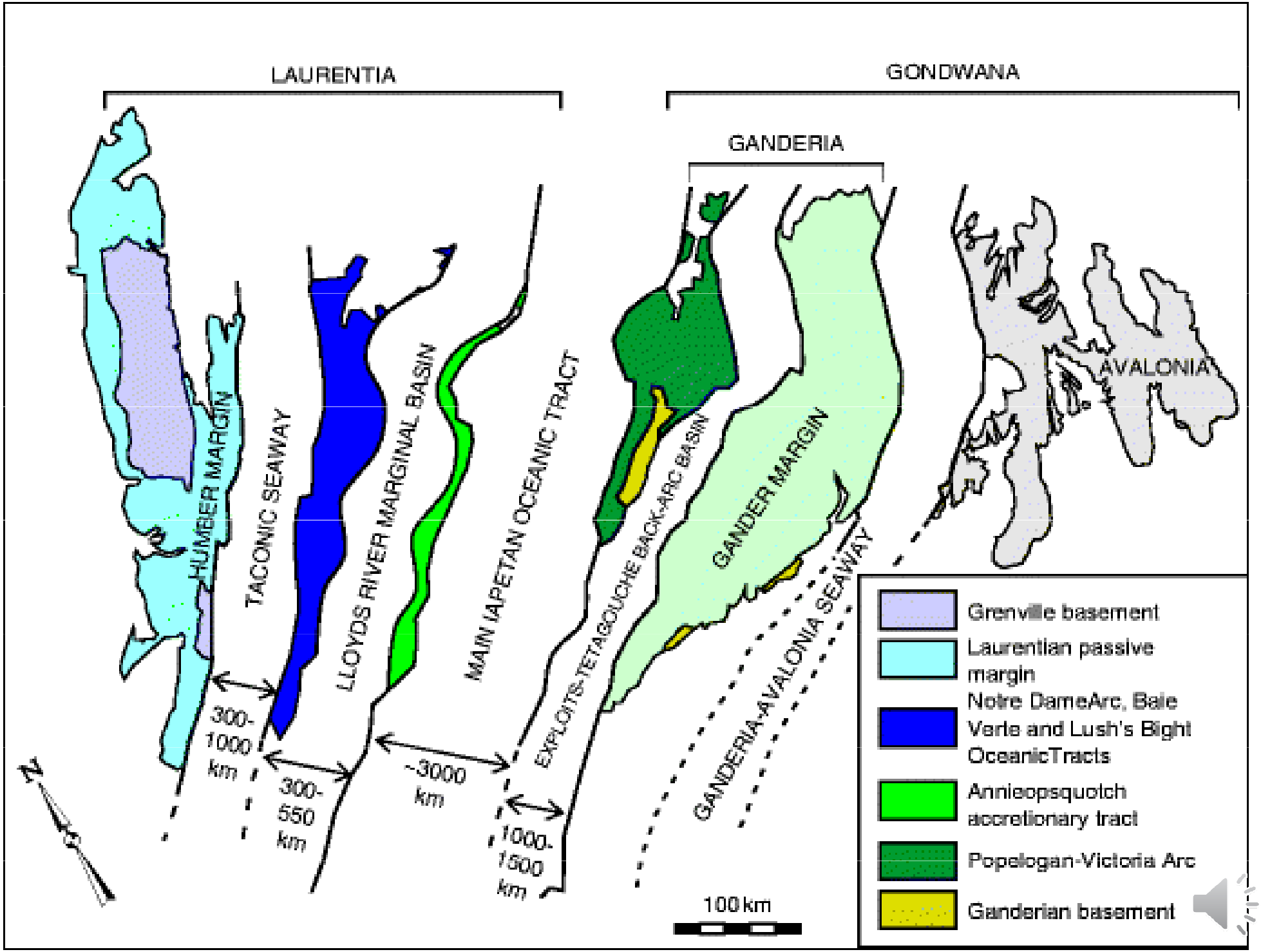

a
Early to Middle Ordovician (473 - 470 Ma):
Rifting of the Floian arc
Composite Laurentian margin including
Notre Dame Arc
AAT
MLf LROC BG-RAG
remnant
arc
active
arc
AOB
Iapetus
Ocean
Laurentia
Intitiation of underplating
of AAT Terranes
b
Middle Ordovician (468 - 460 Ma)
Rifting of the Darriwilian arc following
closure of the Lloyds River marginal basin
AAT Annieopsquotch accretionary tract (AAT)
MMBg-BG-RAG-RILG
HMT
Disorganized
arc rifting
RIL
Iapetus
Ocean
Mafic
Underplate
Slab
Break-off
Sediment-starved
trench
Crescent Lake
seamount

Figure 11. Schematic tectonic evolution of the closure of the Taconic sea-way and the Notre Dame arc-Laurentia collision between 490 and 456 Ma.. **A**: **Initiation of eastdirected subduction** in the Taconic sea-way at ca. 490 Ma, which led to suprasubduction zone spreading and formation of the boninitic ophiolites of the Baie Verte oceanic tract (BVOT) and **first phase of the Notre Dame arc** (489-476 Ma). The BVOT became basement to the forearc basin attached to the Notre Dame arc, as indicated by ample continental arc fragments in the basal part of the Flat Water Pond/Snooks Arm groups deposited above the BVOT (Skulski et al. 2010). These figures are a continuation of Figure 9 of van Staal et al. (2013), which illustrated the progressive hyperextension of the Humber margin with exhumation of lithospheric continental mantle onto the seafloor and the subsequent spreading that led to formation of the oceanic Taconic sea-way and isolation of Dashwoods.**B**: **Start of the Taconic collision**. Entrance and partial escape of former extensional allochthons (Rattling Brook allochthon) and transitional oceanic crust (Birchy Complex) of the hyperextended Humber margin of Laurentia into a progressively widening subduction channel. The hanging wall lid of the subduction channel is the partially obducted BVOT. Progressive steepening of the down-going Humber margin slab caused arc magmatism to locally migrate onto the BVOT, forming the 476-467 Ma extensional Snooks Arm arc. Onset of collision had initiated west-directed subduction east of Dashwoods (outside picture) forming the suprasubduction zone Annieopsquotch ophiolite belt (AOB, van Staal et al. 2007). **C**: **Further steepening of the down-going slab, fullscale collision between Dashwoods and Humber** margin, obduction of the BVOT onto the margin platform and further escape of the Rattling Brook allochthon and Birchy Complex above the closure temperature for argon diffusion in white mica. Magmatism following influx of asthenosphere after slab break-off took place in Dashwoods and locally in the obducted BVOT. Westdirected subduction east of Dashwoods formed the Annieopsquotch accretionary tract (AAT).

Perigondwana domain

Ganderia, Avalonia, Meguma


LAURENTIA
GONDWANA
GANDERIA
AVALONIA
HUMBER MARGIN
TACONIC SEAWAY
LLOYDS RIVER MARGINAL BASIN
MAIN IAPETAN OCEANIC TRACT
EXPLOITS-TETAGOUCHE BACK-ARC BASIN
GANDER MARGIN
GANDERIA-AVALONIA SEAWAY
300-1000 km
300-550 km
~3000 km
1000-1500 km
100 km
N
Grenville basement
Laurentian passive margin
Notre DameArc, Bale Verte and Lush's Bight OceanicTracts
Annieopsquotch accretionary tract
Popelogan-Victoria Arc
Ganderian basement

Ganderia

Ganderie zahrnuje **terány Gander** s perigonwanskými terány **Iapetu**. Terány **Ganderu** jsou tvořeny **metasedimenty** a horninami **magmatického oblouku** uloženými na paleoproterozoickém-mesoproterozoickém basementu, které se oddělily od **Gondwany** na začátku paleozoika.
Během dalšího vývoje rifting nejprve oddělil fragment od okraje Ganderu a vznikl na něm vulkanický oblouk **Penobscot** a mezi Ganderem a odděleným **vulkanickým obloukem Penobscot** vznikla zaobloukovou pánev (~515–485 Ma), která byla uzavřena po **penobscotské orogenezi** na počátku ordoviku~485 Ma . Pokračující subdukce potom na okraji **Ganderie** vytvořila oblouk **Popelogan-Victoria** a za ním zaobloukovou pánev~478 and 450 Ma. K uzavření zaobloukové pánve i oceánu **Iapetus** došlo **kolizí Ganderie s Laurentii** během **salinické** fáze na počátku **siluru**.

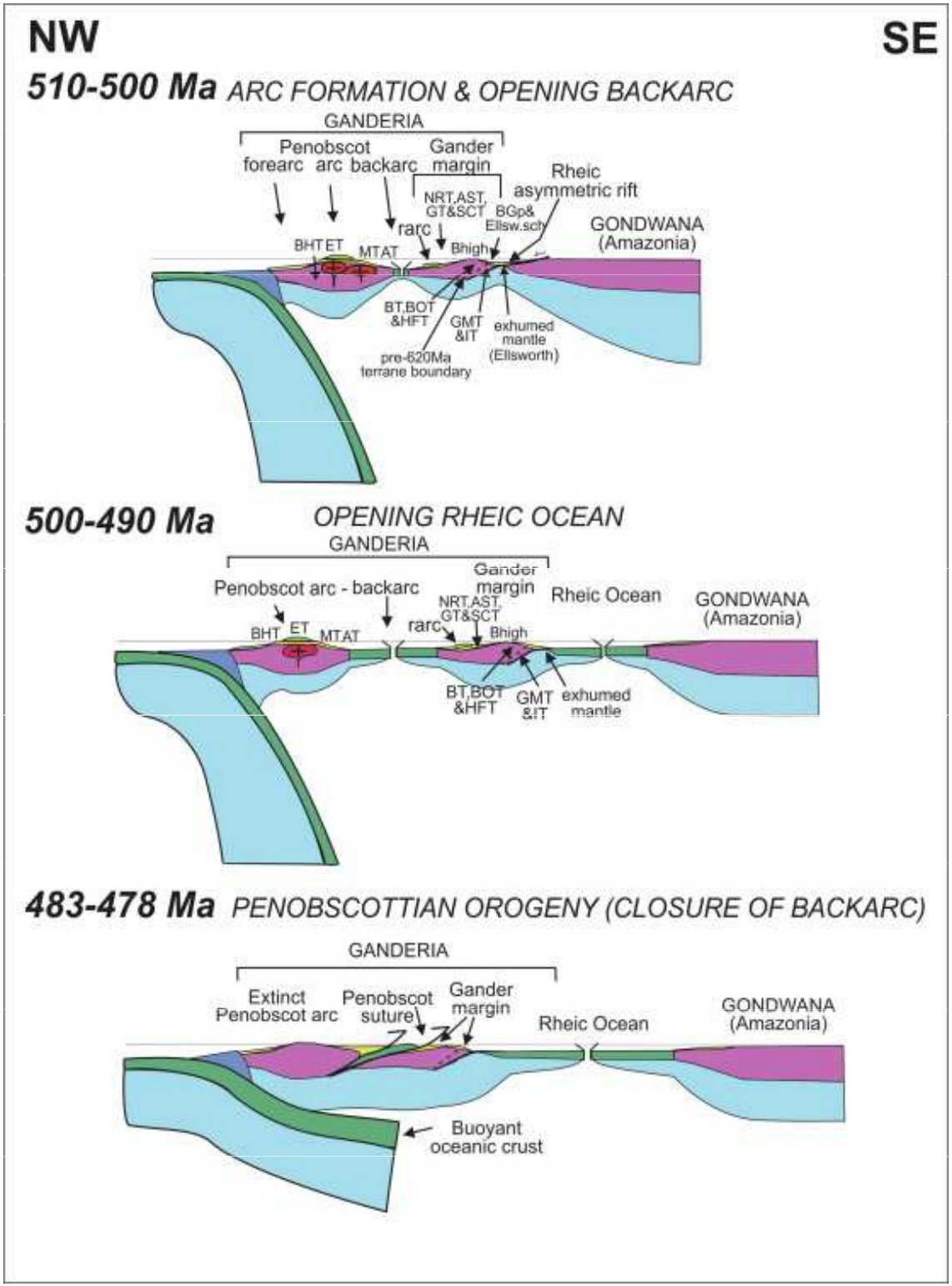
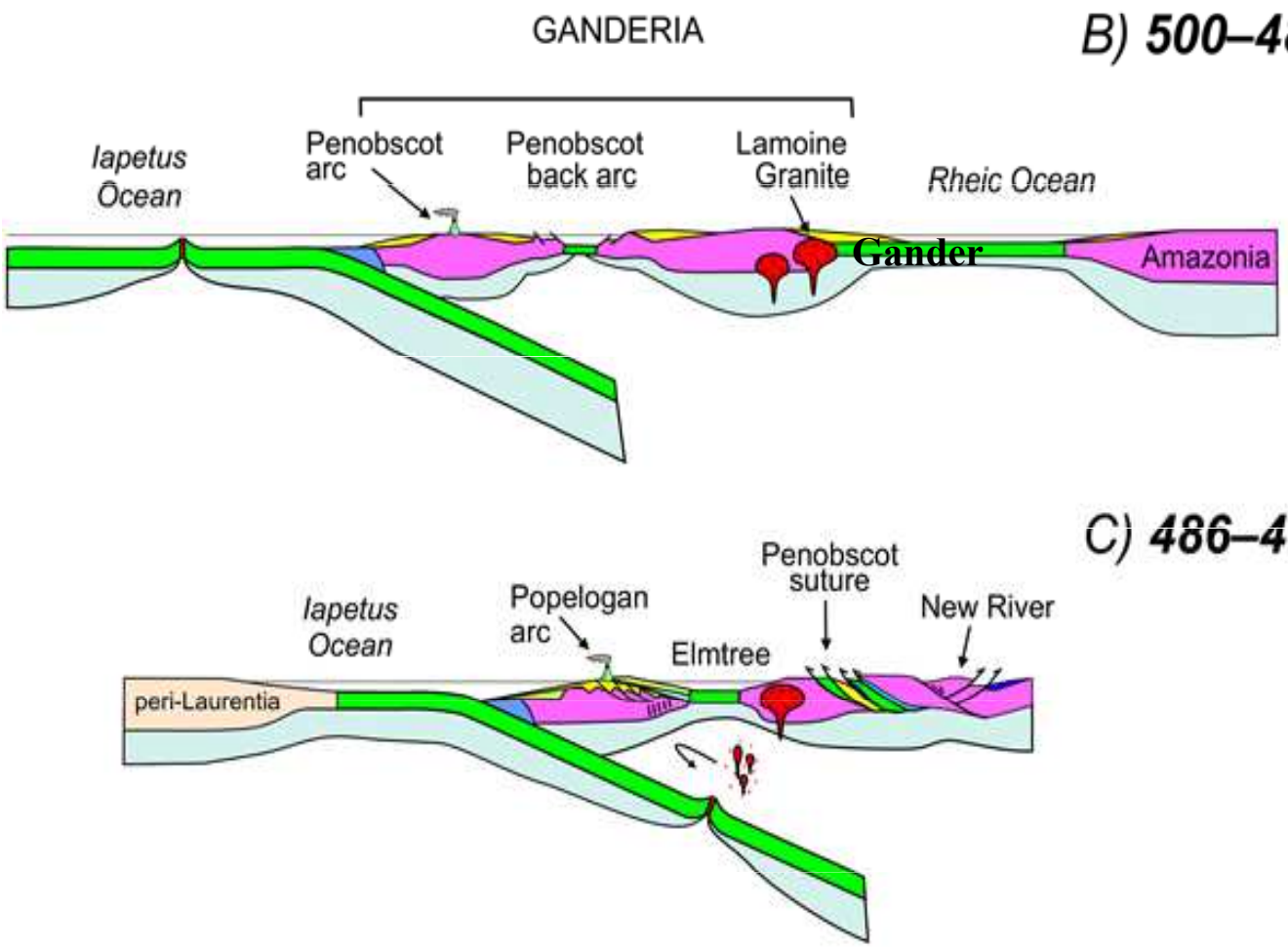


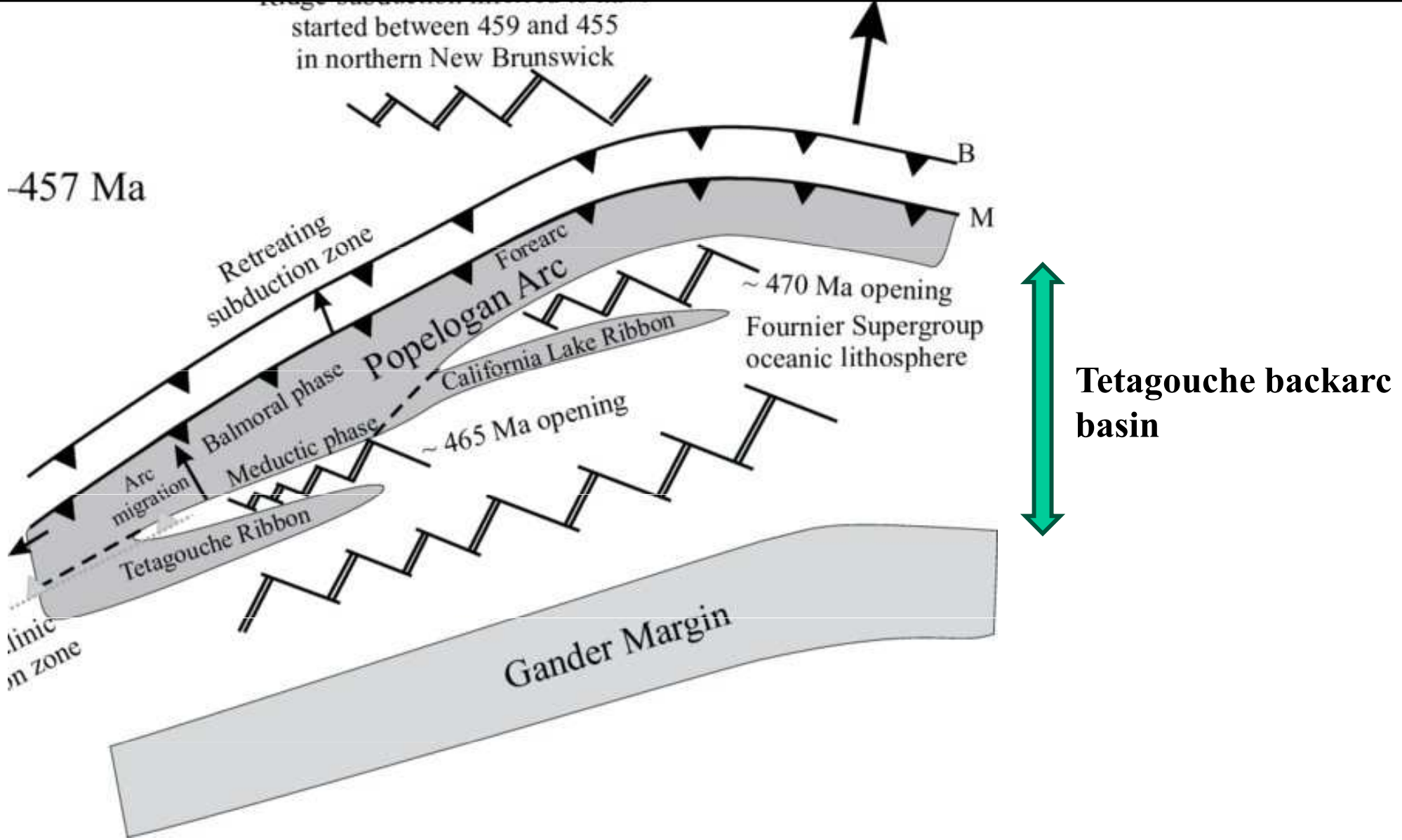
Fig. 3. Tectonic model for the evolution of the Penobscot arc-backarc system and associated opening of the Rheic Ocean between 515 and 478 Ma modified from van Staal and Barr (2012).. AST: Aspy terrane; AT: Annidale terrane; BHT: Bronson Hill terrane; BOT: Bras d'Or terrane; BT: Brookville Terrane; Bhigh: basement high; Ellsw. Sch.: Ellsworth schist; ET: Exploits terrane; GT: Gander terrane; GMT: Grand Manan terrane; HFT: Hermitage Flexure terrane; IT: Isleboro terrane; MT: Miramichi terrane; rarc: remnant arc; SCT: St. Croix terrane.

Deposition of the Gander Zone in the metaclastic-dominated terranes was followed by an orogenic episode or episodes, known as **Penobscottian**, Cambrian arc to backarc igneous rocks termed the **Penobscot arc** which resulted in **emplacement** of Penobscot arc ophiolitic and rift-related rocks **above Gander zone** during the **Early Ordovician**



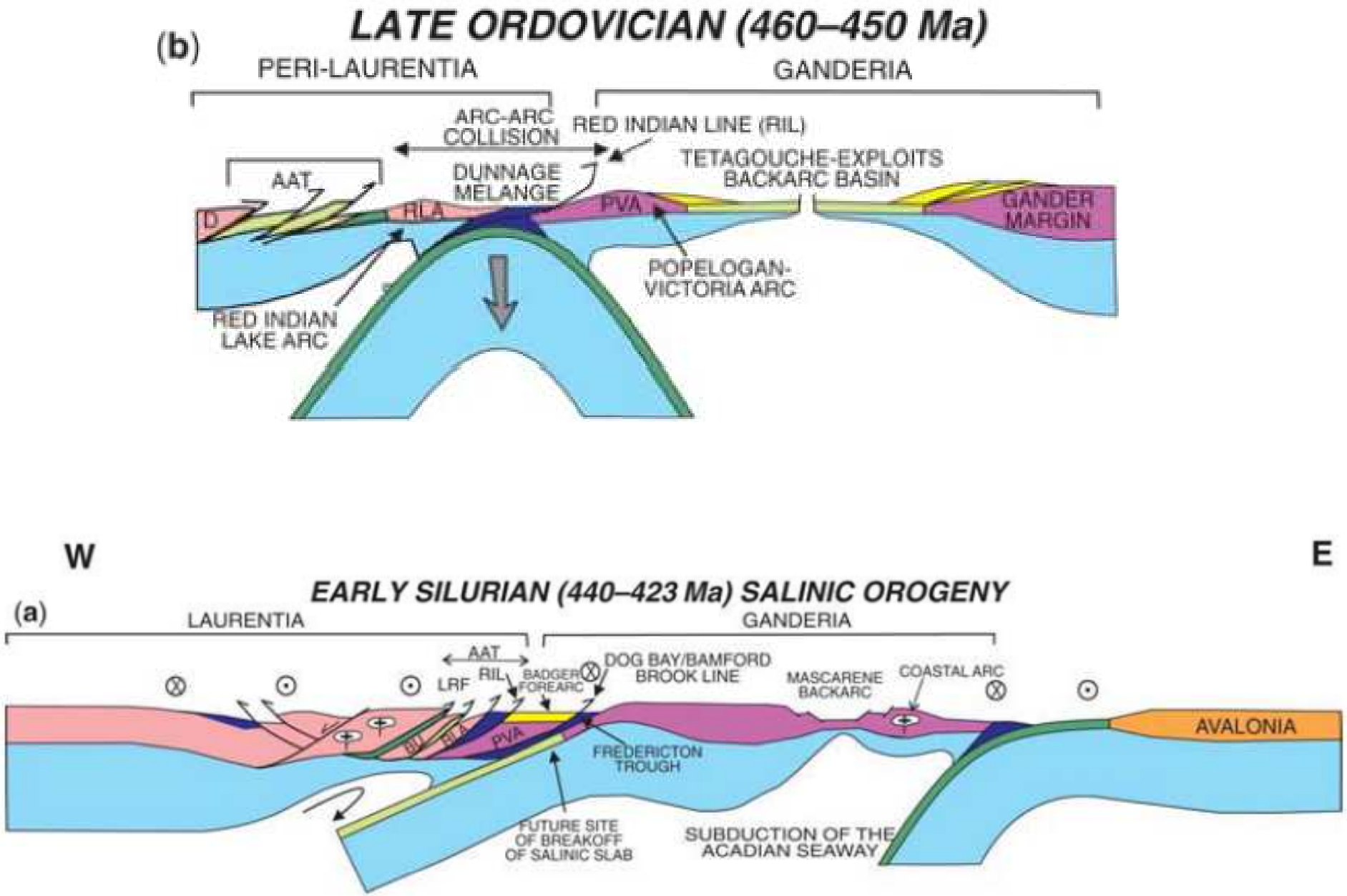
The Popelogan-Victoria arc was built upon Ganderian basement.

SE-directed subduction (present coordinates) of Iapetan oceanic lithosphere in the Cambrian to Early Ordovician led to construction of the **Penobscot** (ca. 515–483 Ma) and **Popelogan–Victoria** (ca. 476–453 Ma) **arc systems** (Fig. 1A), and associ ated backarc basins, on Ganderia's leading



Popelogan arc was built on the leading edge of Ganderia and represents a predominantly continental calc-alkaline arc.

Arctrench migration and backarc basin opening were **caused by a retreating subduction zone**. Slab retreat prior to 467 Ma was at least partially accommodated by arc migration, but thereafter, it was mainly accommodated by extension and spreading in the associated **Tetagouche backarc basin**


(b)
LATE ORDOVICIAN (460–450 Ma)
PERI-LAURENTIA
GANDERIA
ARC-ARC COLLISION
RED INDIAN LINE (RIL)
AAT
DUNNAGE MELANGE
TETAGOUCHE-EXPLOITS BACKARC BASIN
D
RILA
PVA
GANDER MARGIN
POPELOGAN-VICTORIA ARC
RED INDIAN LAKE ARC
W
E
EARLY SILURIAN (440–423 Ma) SALINIC OROGENY
(a)
LAURENTIA
GANDERIA
AAT
RIL
LRF
BADGER FOREARC
DOG BAY/BAMFORD BROOK LINE
MASCARENE BACKARC
COASTAL ARC
AVALONIA
PVA
FREDERICTON TROUGH
FUTURE SITE OF BREAKOFF OF SALINIC SLAB
SUBDUCTION OF THE ACADIAN SEAWAY

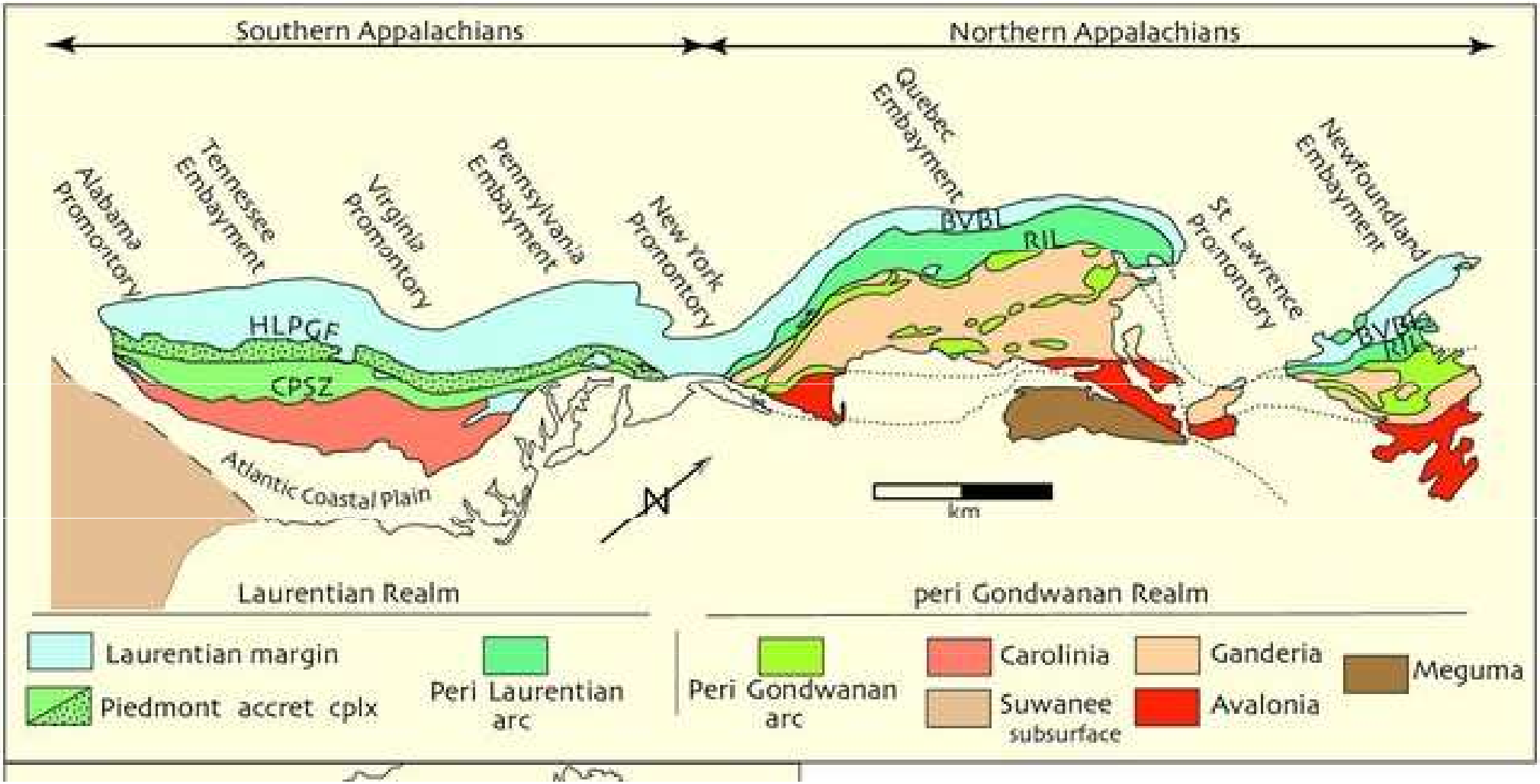
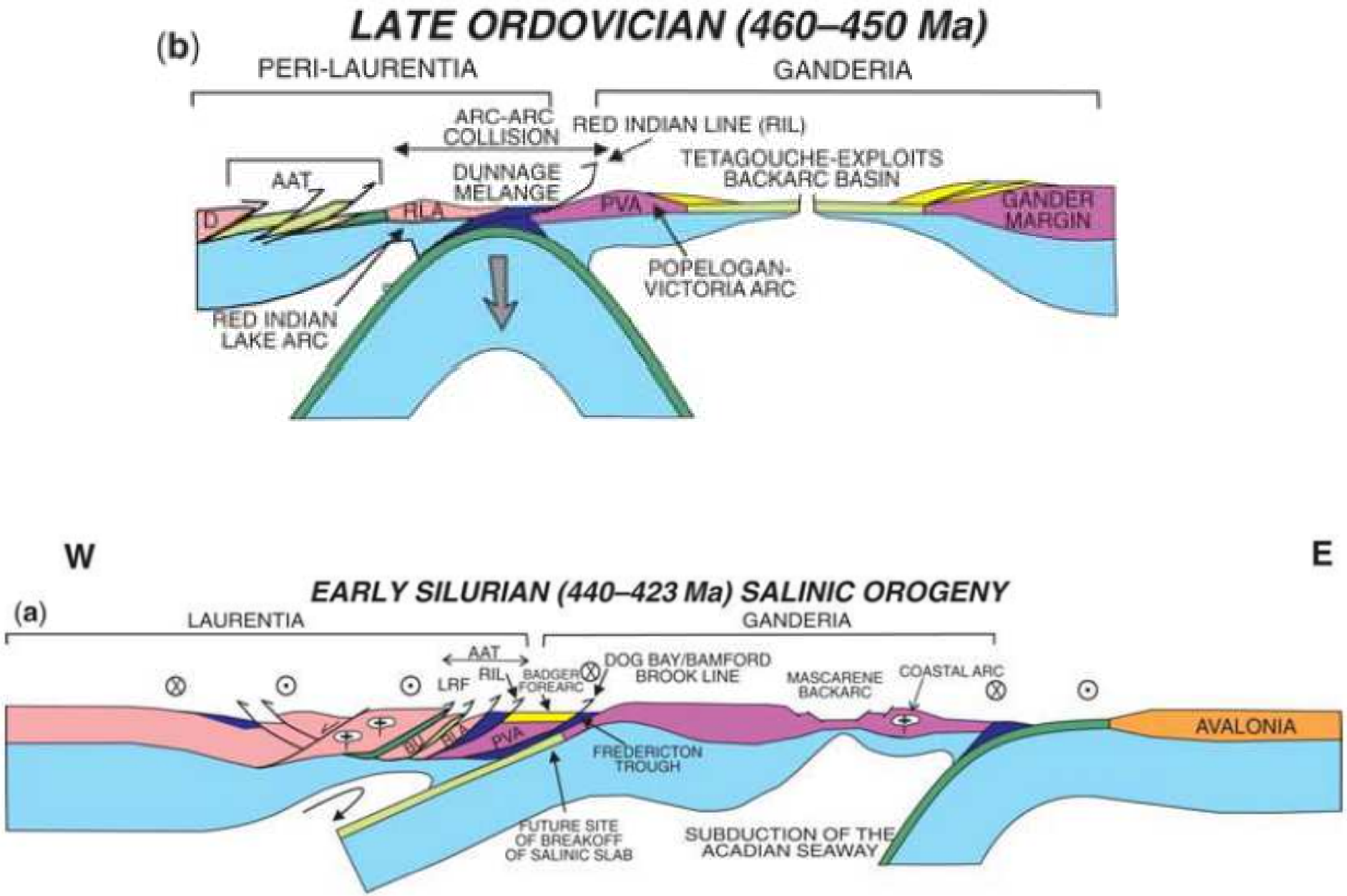


Figure 1. First-order architecture of the Appalachian orogen depicting distribution of the major, mainly preSilurian, lithotectonic divisions. BVBL = Baie VerteBrompton line; CPSZ = central Piedmont shear zone; HLPGF = Hollins line-Pleasant Grove fault system; **RIL = Red Indian line.**


(b)
LATE ORDOVICIAN (460–450 Ma)
PERI-LAURENTIA
GANDERIA
ARC-ARC COLLISION
RED INDIAN LINE (RIL)
AAT
DUNNAGE MELANGE
TETAGOUCHE-EXPLOITS BACKARC BASIN
D
RILA
PVA
GANDER MARGIN
POPELOGAN-VICTORIA ARC
RED INDIAN LAKE ARC
W
E
EARLY SILURIAN (440–423 Ma) SALINIC OROGENY
(a)
LAURENTIA
GANDERIA
AAT
RIL
LRF
BADGER FOREARC
DOG BAY/BAMFORD BROOK LINE
MASCARENE BACKARC
COASTAL ARC
AVALONIA
PVA
FREDERICTON TROUGH
FUTURE SITE OF BREAKOFF OF SALINIC SLAB
SUBDUCTION OF THE ACADIAN SEAWAY

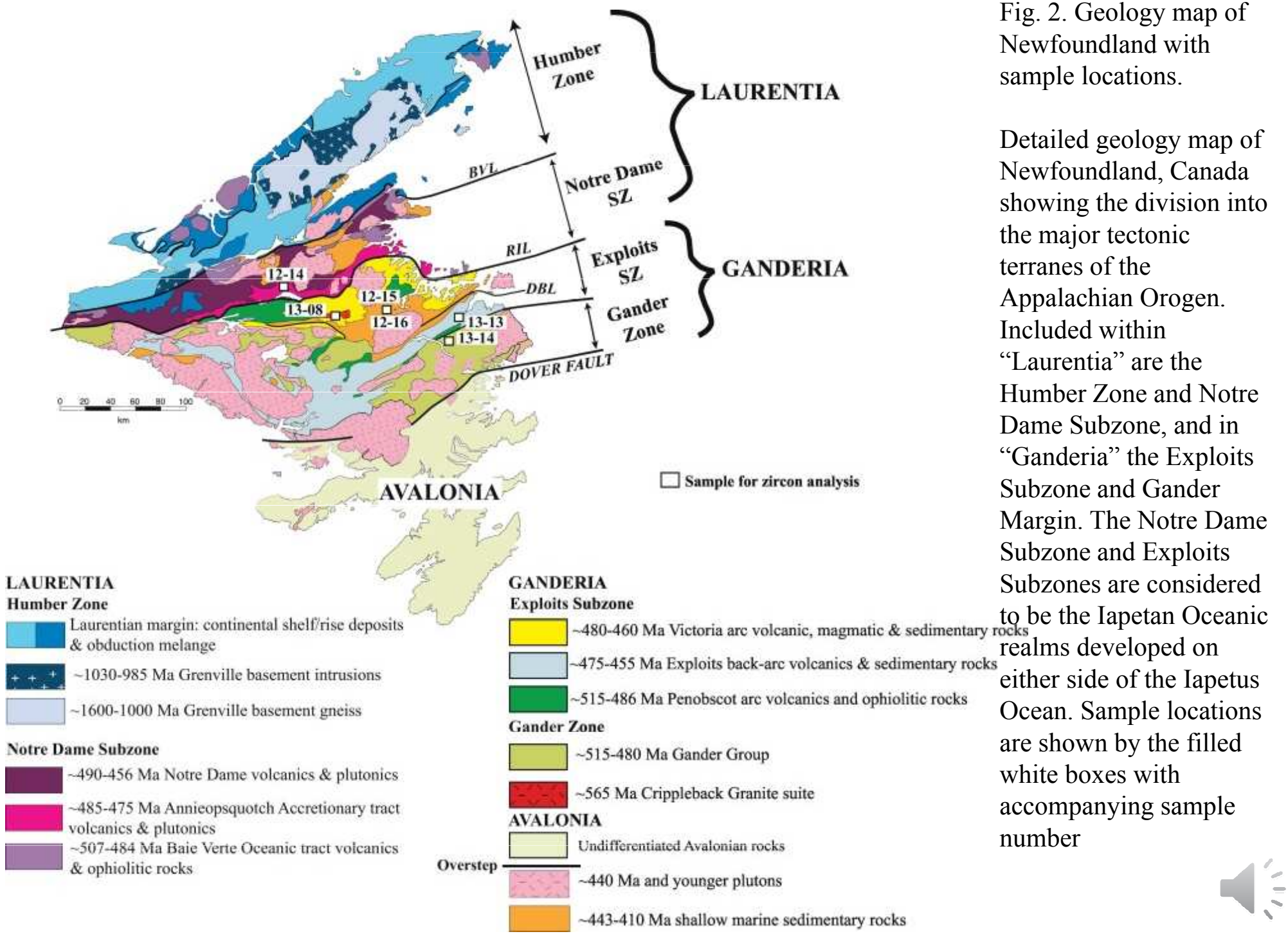
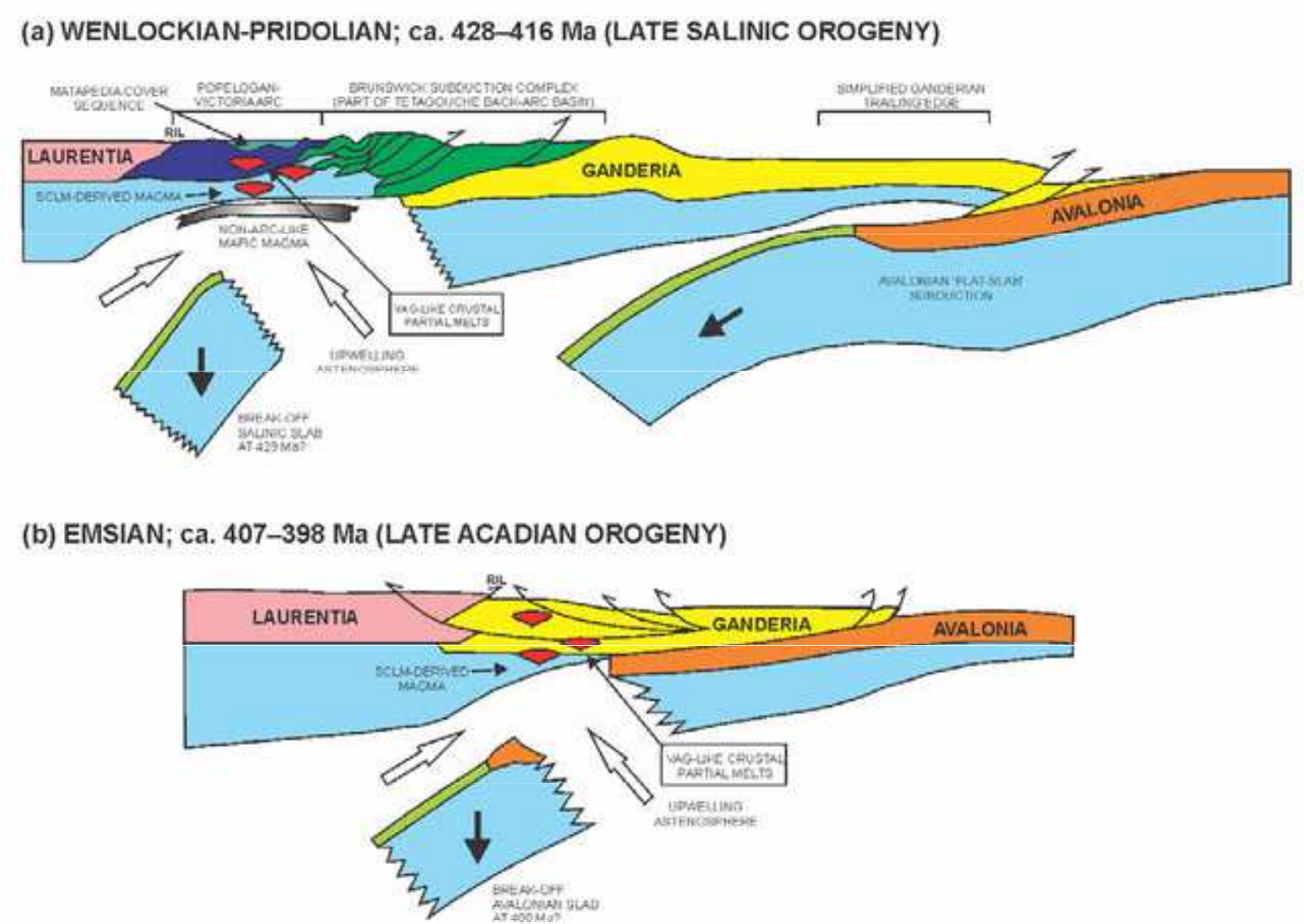


Fig. 2. Geology map of Newfoundland with sample locations.

Detailed geology map of Newfoundland, Canada showing the division into the major tectonic terranes of the Appalachian Orogen. Included within "Laurentia" are the Humber Zone and Notre Dame Subzone, and in "Ganderia" the Exploits Subzone and Gander Margin. The Notre Dame Subzone and Exploits Subzones are considered to be the Iapetan Oceanic realms developed on either side of the Iapetus Ocean. Sample locations are shown by the filled white boxes with accompanying sample number



ig. 13. tectonic models for the northern Appalachian orogen in the Silurian-Devonian and post-closure slab break-offrelated magmatism within the Popelogan-Victoria arc. (a) Salinic to late Salinic orogeny showing the already accreted Popelogan-Victoria arc (PVA), amalgamation of the Brunswick Subduction Complex (BMC) and Ganderia. (b) Devonian Acadian orogeny showing the collision of the leading-edge of Avalonia with composite Ganderia (including PVA and BMC). Diagrams are modified after van Staal et al. (2008, 2009) and Whalen et al. (2006). Abbreviation: Ril; Red indian line, SClM; sub-continental lithospheric mantle, VAG: volcanic-arc granite.

Terány skupiny IV a V

Terány Gander, Avalon a Meguma byly původně součástí **Gondwany**. Terán **Gander** se oddělil od Gondwany na konci **neoproterozoika**, Na rozdíl od ostatních postrádá krystalinické podloží a jeho další vývoj byl úzce spjat s **vulkanickými oblouky Iapetu. Proto je diskutován v rámci Ganderie**.
Avalonský terán se oddělil v **kambriu**. **Avalonie** se vyvinula jako vulkanický oblouk na okraji Gondwany a je tvořena především **neoproterozoickými magmatickými horninami** kontinentálního okraje a **fosiliferními kambrickými sedimenty**. Má jinou předsilurskou historii než terán Gander a obzvláště odlišnou kambrickou trilobitovou faunu. Terán **Meguma** je tvořen hlavně **flyšoidnímim metasedimenty** kambria a ordoviku a ordovickými až devonskými **mělkovodními sedimenty** a bimodálními riftovými **vulkaknity**.
Ganderia kolidovala s **Laurentii** během **salinické** fáze v siluru, **Avalonie s Ganderii** na hranici siluru a devonu a **Meguma s Avalonii** během spodní části devonu (akadské fáze). V karbonu potom došlo během **alleghanské** orogeneze ke kolizi **Laurentie** a **Gondwany**. Podle některých názorů ale **Meguma** představovala **okraj Gondwany**.

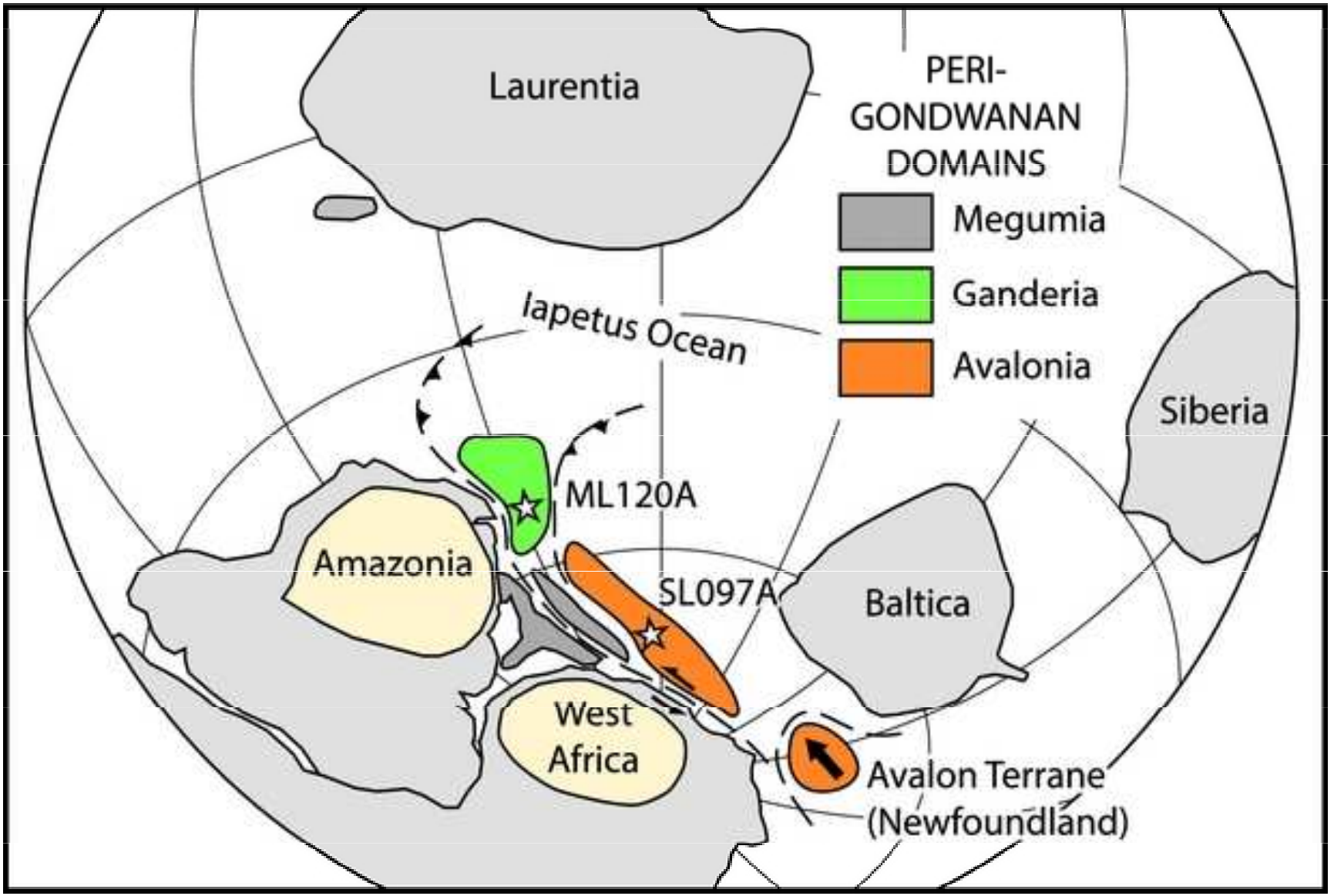


Figure 7. Highly schematic cartoon showing possible terrane relationships of selected peri-Gondwanan terranes in Cambrian time, based on Murphy et al. (Reference Murphy, Waldron, Schofield, Barry and Band2014), Waldron et al. Reference Waldron, Schofield, Murphy and Thomas(2014b) and Pothier et al. (Reference Pothier, Waldron, Schofield and DuFrane2015a,b).

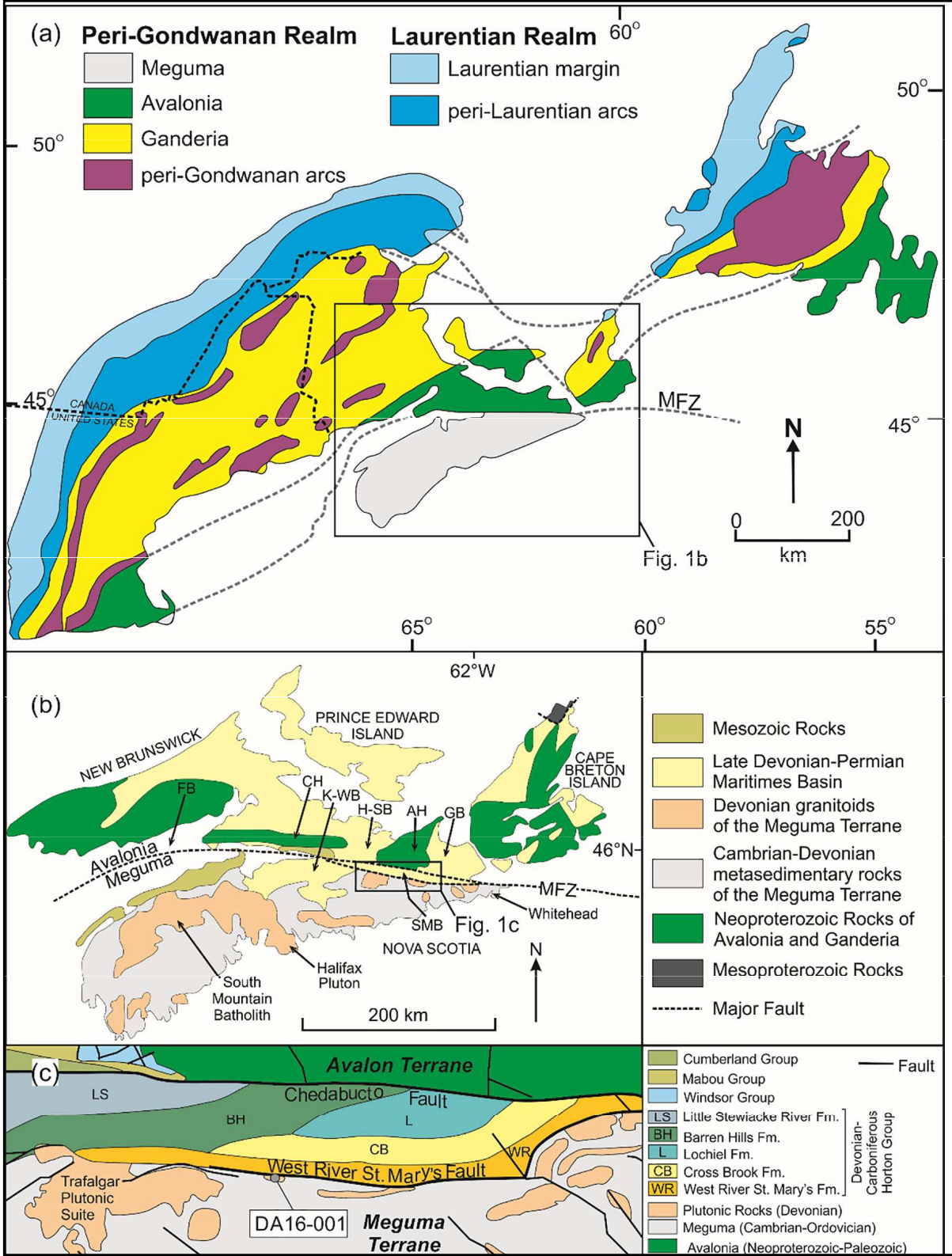


Fig. 1. (a) Regional map of the northern Appalachian Orogen showing the location of Minas Fault Zone (MFZ) and its relationship to the Meguma and Avalon terranes, modified after Hibbard et al. (2006). (b) A general map of the MFZ that separates the Avalon terrane to the north and the Meguma terrane to the south. AH, Antigonish Highlands; CH, Cobequid Highlands; FB, Fundy Basin; SMB, St. Mary's Basin; K-WB, Kennetcook-Windsor Basin; GB, Guysborough Basin; H-SB, Hopewell and Stellarton Basins (modified after Murphy et al., 2011b). (c) Summary geological map of the St. Mary's Basin and surrounding geology showing the sampling location (modified after Murphy and Rice, 1998).

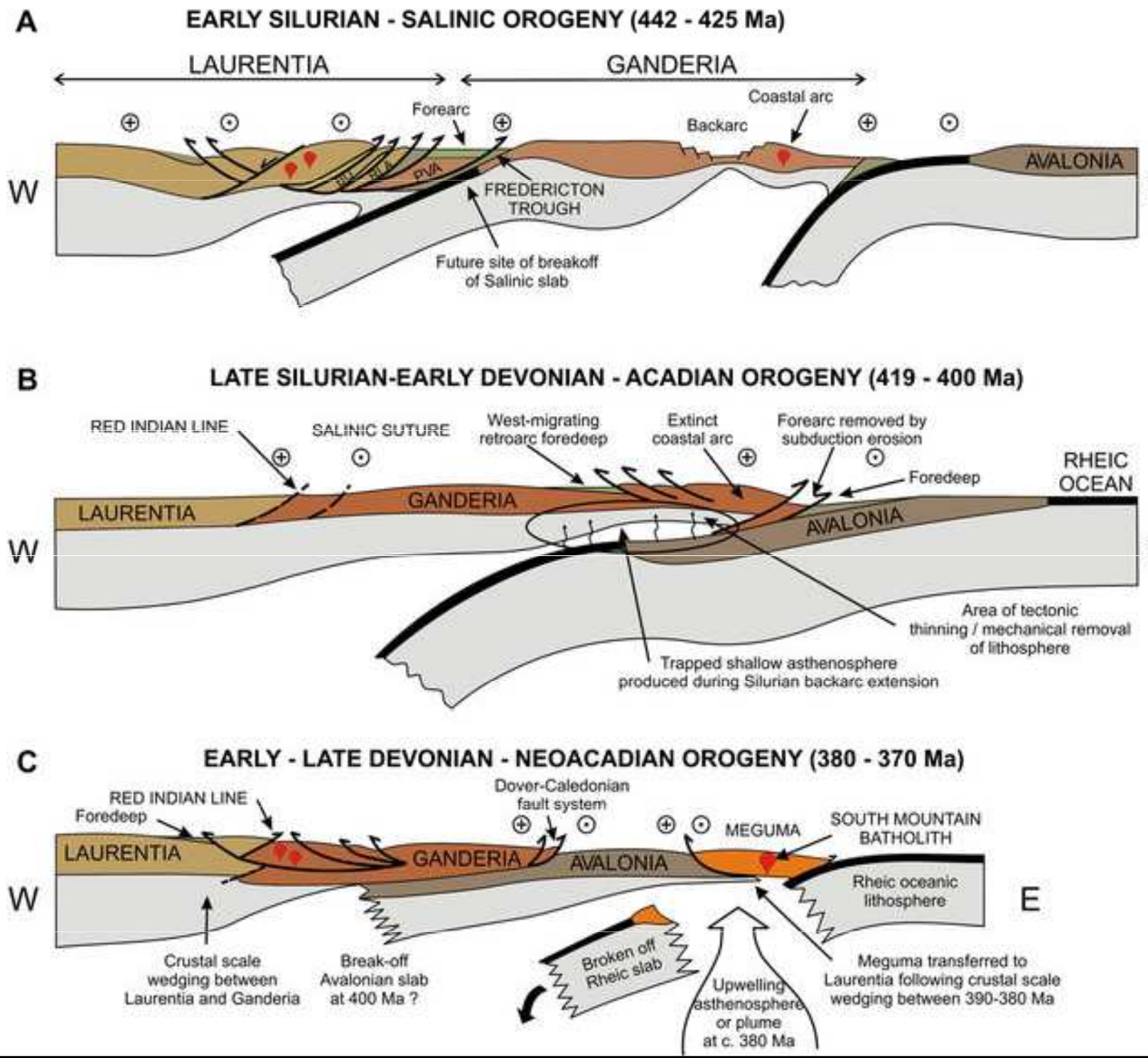


Fig. 3. Accretion of peri-Gondwanan terranes (based on van Staal et al., 2009). A. Late Ordovician-Silurian Salinic orogeny due to closure of a backarc basin. B. Silurian closure of the seaway that separated Ganderia and Avalonia, which led to the Acadian orogeny. C. Accretion of Meguma, which is interpreted to have been accompanied by wedging and breakoff of the downgoing Rheic slab. A new west-dipping subduction zone was probably established outboard of Meguma, necessary to accommodate convergence of Laurussia with Gondwana.

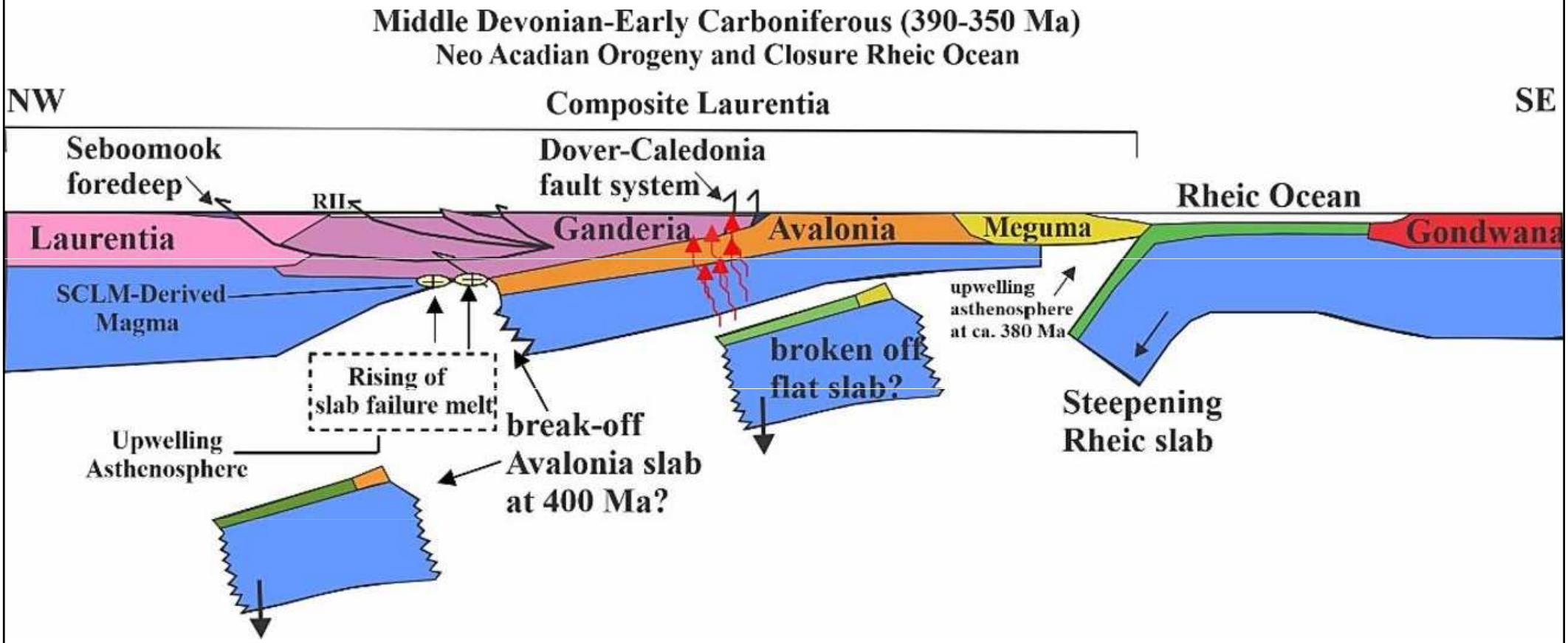


Fig. 20. Schematic geotectonic diagram for southwestern New Brunswick (modified after van Staal and Barr, 2012) highlighting the regional geodynamic setting for the emplacement of the Evandale Granodiorite.

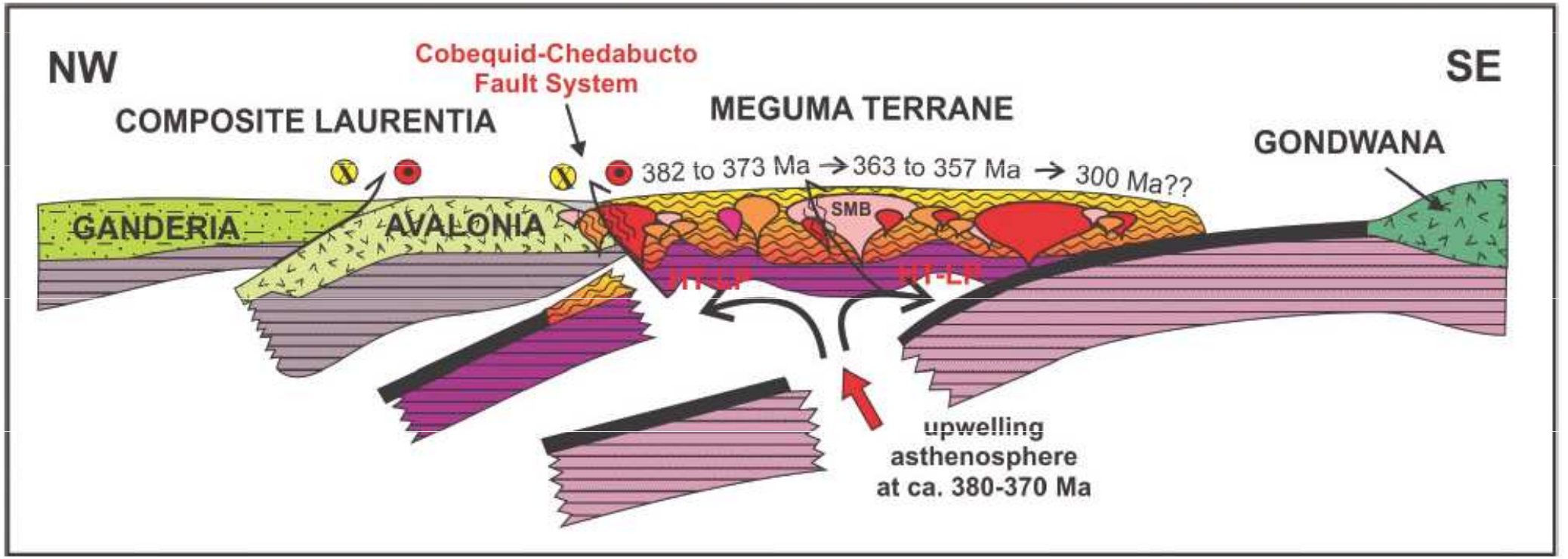
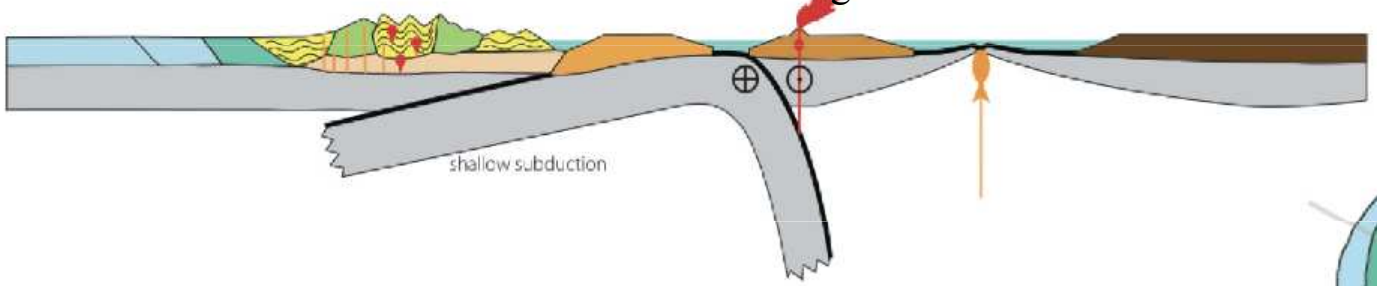


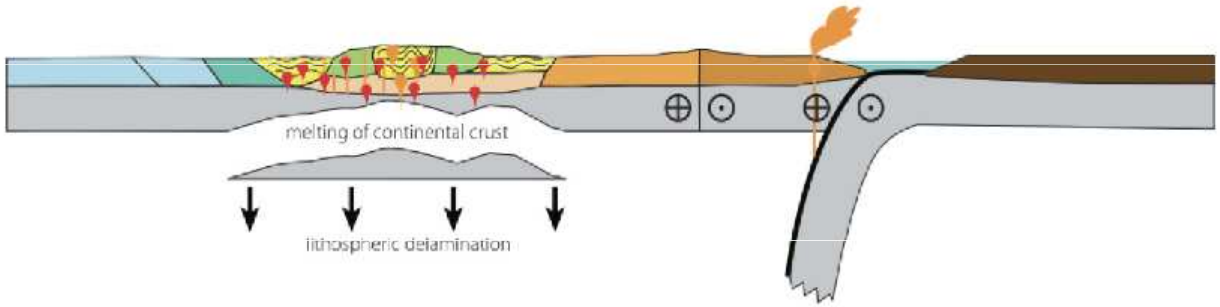
Figure 3. A tectonic model for the Neoacadian orogeny and related pluton emplacement (after Moran et al. 2007). Pluton emplacement in Meguma terrane may have been related to subduction of the Rheic Ocean lithosphere outboard of Meguma, likely combined with slab-breakoff which also caused high-temperature/low-pressure (HT-LP) metamorphism.

400 million years ago, Acadian Orogeny

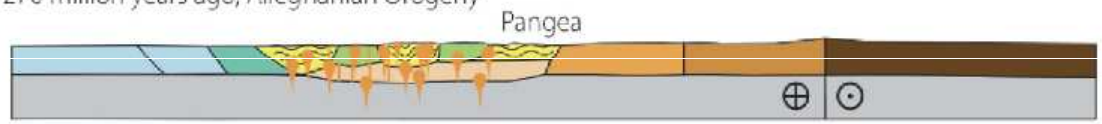
Gander Avalon Meguma Gondwana

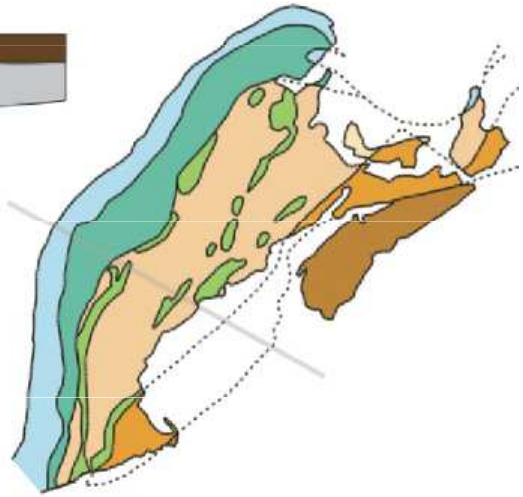


360 million years ago, Neoacadian Orogeny



270 million years ago, Alleghanian Orogeny





Laurentia

Laurentian Volcanic arc

Gander

Gander Volcanic arc

Avalon

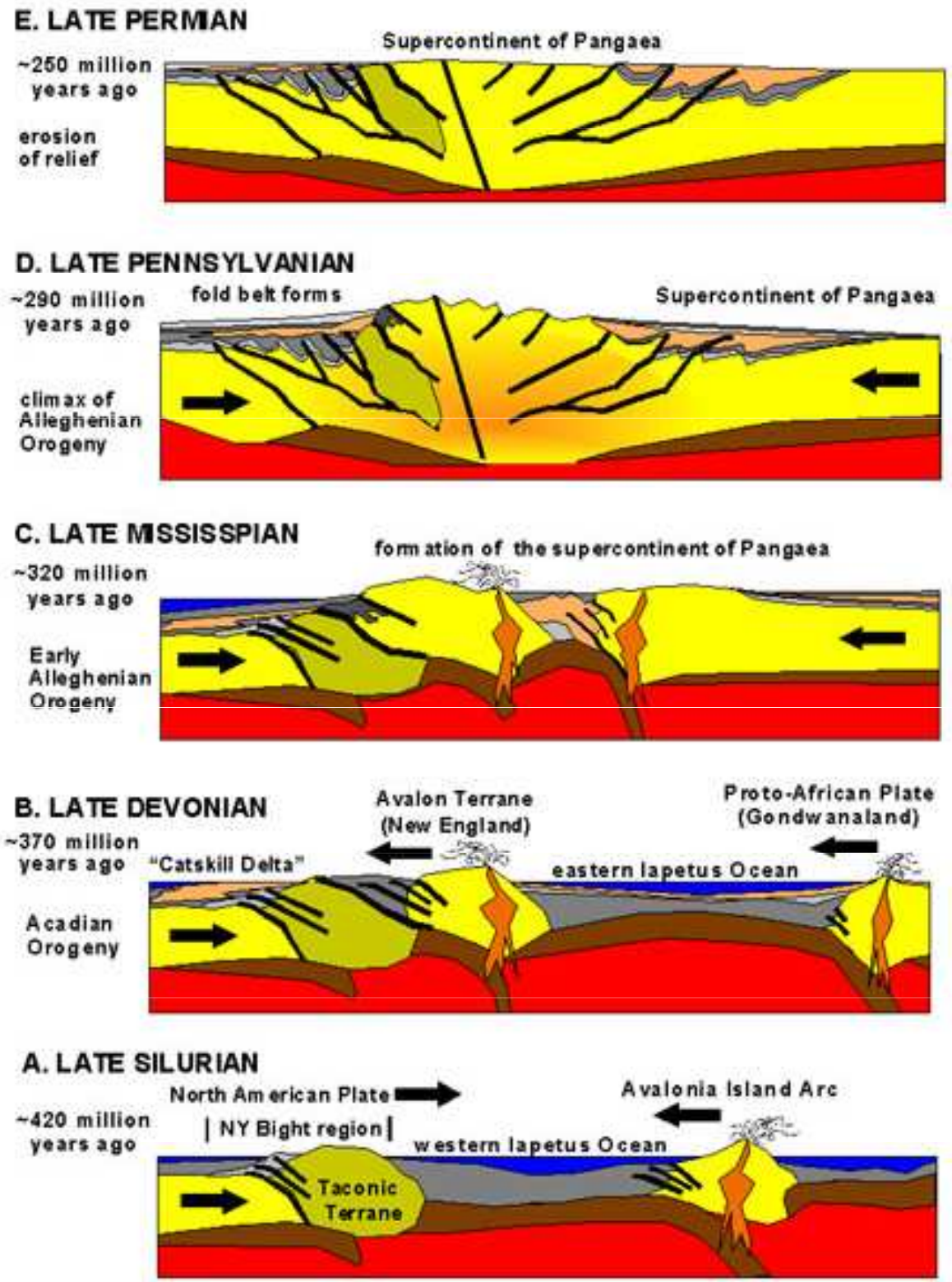
Meguma

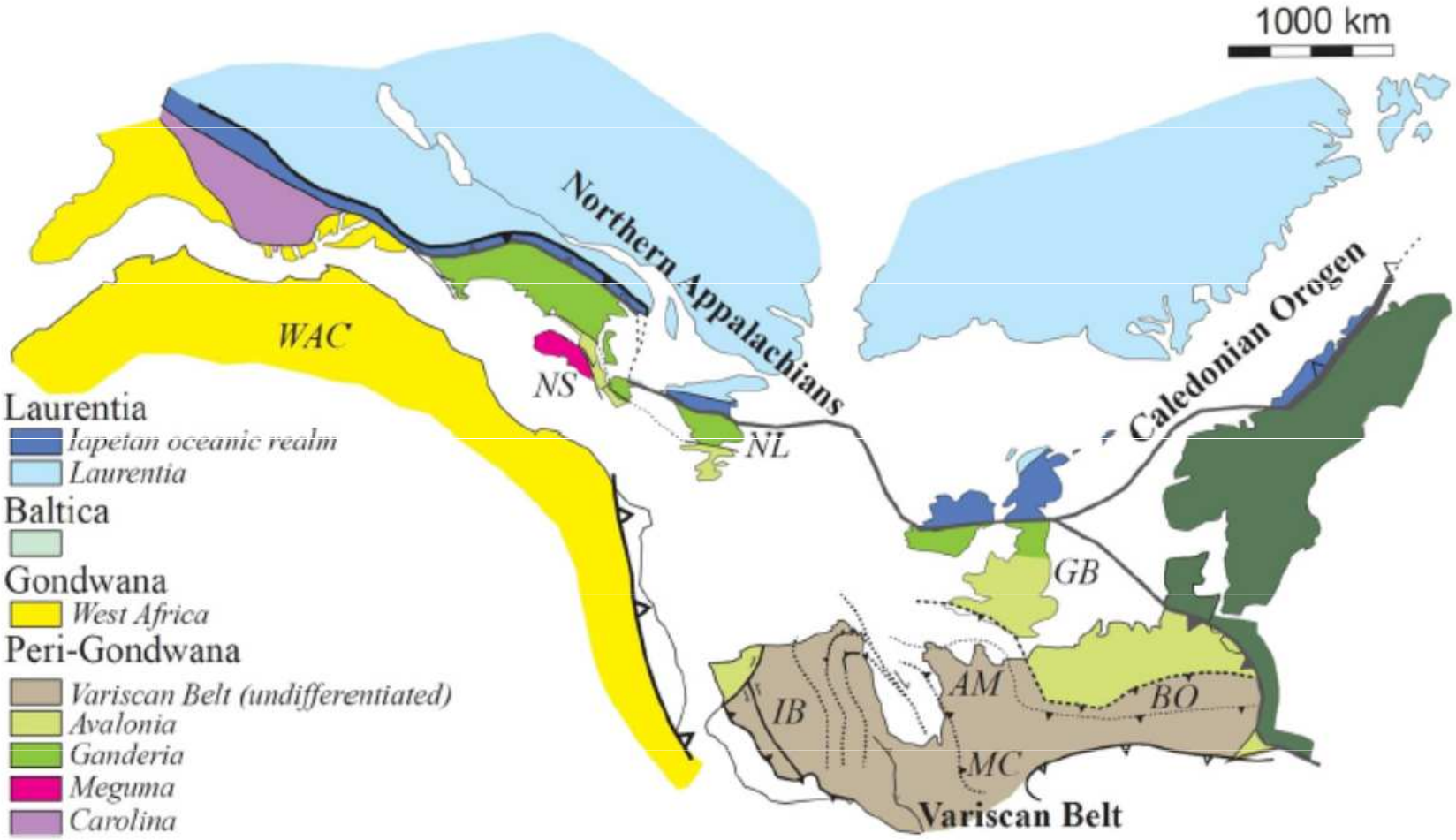
Sedimentary basins

Comerford Intrusives
orange is crystallized

Magma Intrusives
orange is crystallized

Ocean


E. LATE PERMIAN
Supercontinent of Pangaea
~250 million years ago
erosion of relief
D. LATE PENNSYLVANIAN
~290 million years ago
fold belt forms
Supercontinent of Pangaea
climax of Alleghenian Orogeny
C. LATE MISSISSPIAN
formation of the supercontinent of Pangaea
~320 million years ago
Early Alleghenian Orogeny
B. LATE DEVONIAN
Avalon Terrane (New England)
Proto-African Plate (Gondwanaland)
~370 million years ago
"Catskill Delta"
eastern Iapetus Ocean
Acadian Orogeny
A. LATE SILURIAN
North American Plate
Avalonia Island Arc
~420 million years ago
NY Bight region
western Iapetus Ocean
Taconic Terrane


1000 km
Northern Appalachians
Caledonian Orogen
WAC
NS
NL
GB
AM
BO
IB
MC
Variscan Belt
Laurentia
Iapetan oceanic realm
Laurentia
Baltica
Gondwana
West Africa
Peri-Gondwana
Variscan Belt (undifferentiated)
Avalonia
Ganderia
Meguma
Carolina

Hlavní tektonické jednotky Apalačí

Okraje Laurentie – skupina I, Humber, more to the south Valley and Ridge, Blue-Ridge teranes

Centrální zóna – terány II. a III. skupiny složitá **akreční melanž teránů různé povahy situvaných v oceánu Iapetus** a při jeho okrajích. **Kontinentálních fragmenty**, vulkanické oblouky, oceánické sedimenty. V podstatě se dají rozlišit **terány, které vznikaly při okraji Laurentie a terány, které vznikaly při okraji perigondwany**.

Perilaurentské terány skupiny II

V severní části Apalačí to je zejména zóna **Notre Dame**, vznikající na fragmentu **Humberu**. V jižní části zóna **Inner Piedmont** vznikající na fragmentu Blue Ridge okraje Laurentie. Fragmenty **Laurentie** a vulkanické oblouky **Iapetu**

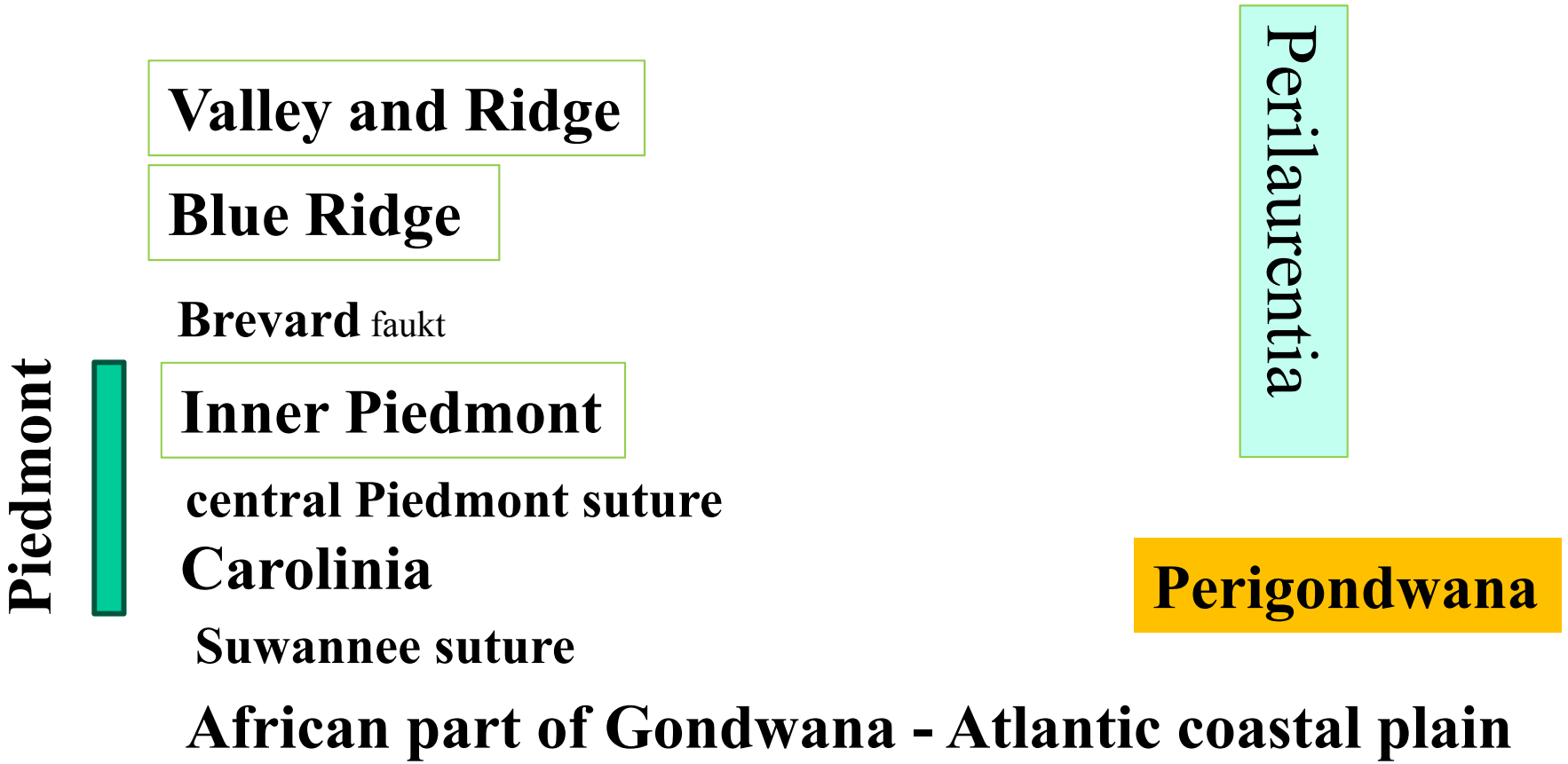
Perigonwanské terány skupiny III – fragmenty **Gondwany** a přilehlé vulkanické oblouky **Iapetu**

Je to **perigondwanská Ganderie** tvořená fragmentem Gondwany (Gander) a vulkanickými oblouky oceanické a kontinentální povahy (Popelogan arc – fragment Ganderu) a horninami zaobloukové pánve. V jižní části Apalačí je to perigondwanský **superterán Carolina**

Perigondwanské terány – terány IV a V -Avalonia,, Meguma-původně součástí Gondwany
Gondwana - Atlantic coastal plain

Southern Appalachians

The major provinces include the Blue Ridge, Inner Piedmont, and Carolina terranes, though there are important internal boundaries within each terrane. The **present configuration** of the terranes is **largely a product of the Alleghanian collision**,



The major provinces include the **Blue Ridge** (Laurentia margin), **Inner Piedmont**, and **Carolin**ia terranes, Inner Piedmont was acreted to Laurentia during **Taconic** orogeny in Ordovician, Carolinia to the Laurentian margin probably during the **Salinic** orogeny in Silurian. Collision with African Gondwana was during **Alleghanian** orogeny. The present configuration of the terranes is largely a product of the Alleghanian collision.

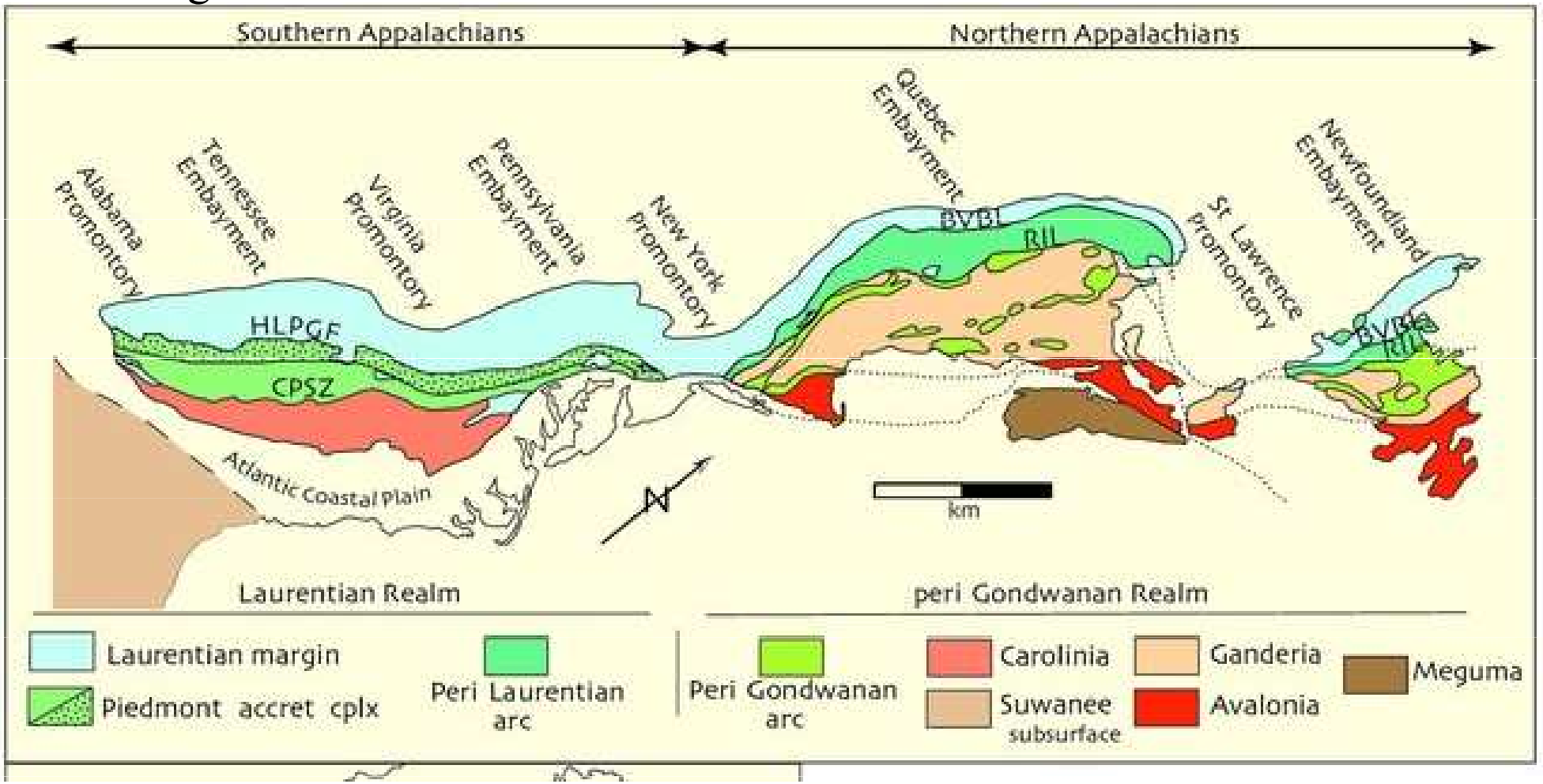


Figure 1. First-order architecture of the Appalachian orogen depicting distribution of the major, mainly preSilurian, lithotectonic divisions. BVBL = Baie VerteBrompton line; CPSZ = central Piedmont shear zone; HLPGF = Hollins line-Pleasant Grove fault system; RIL = Red Indian line.

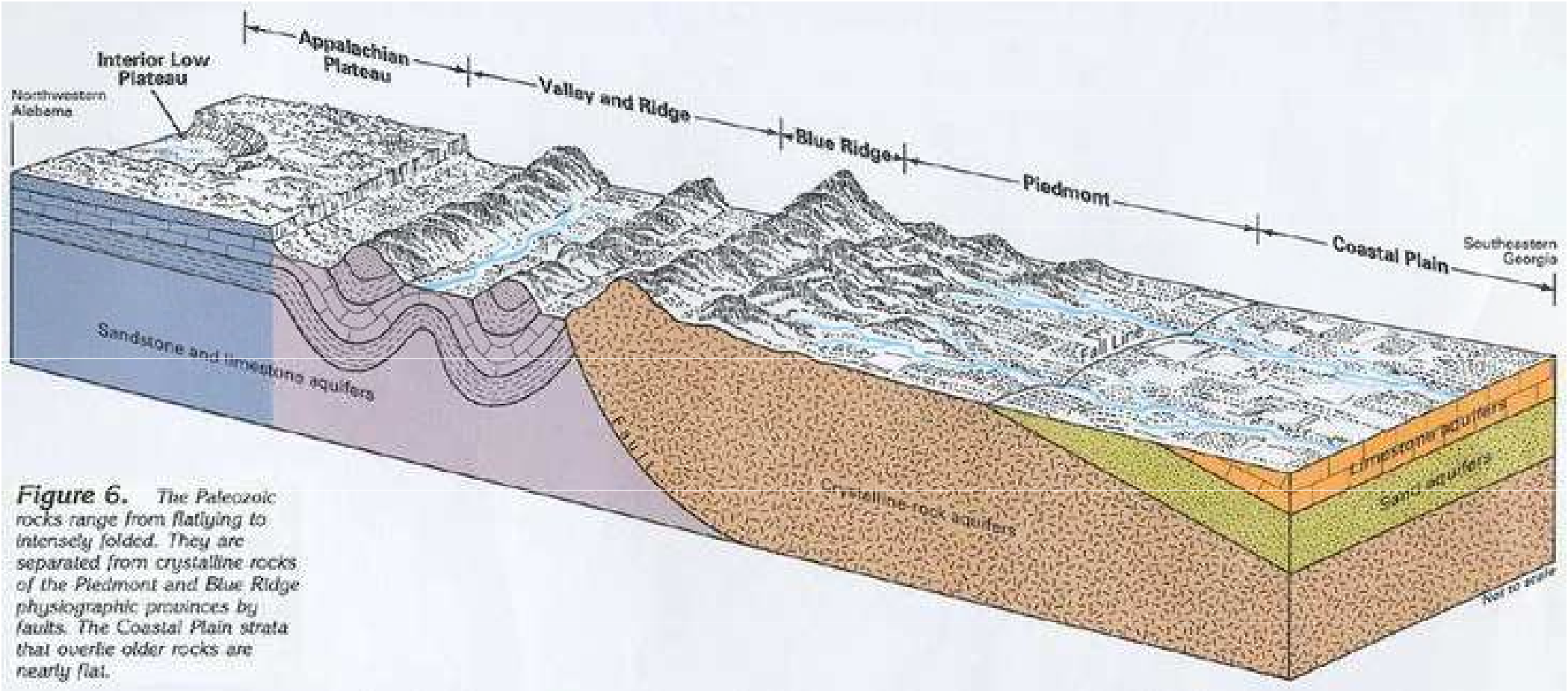
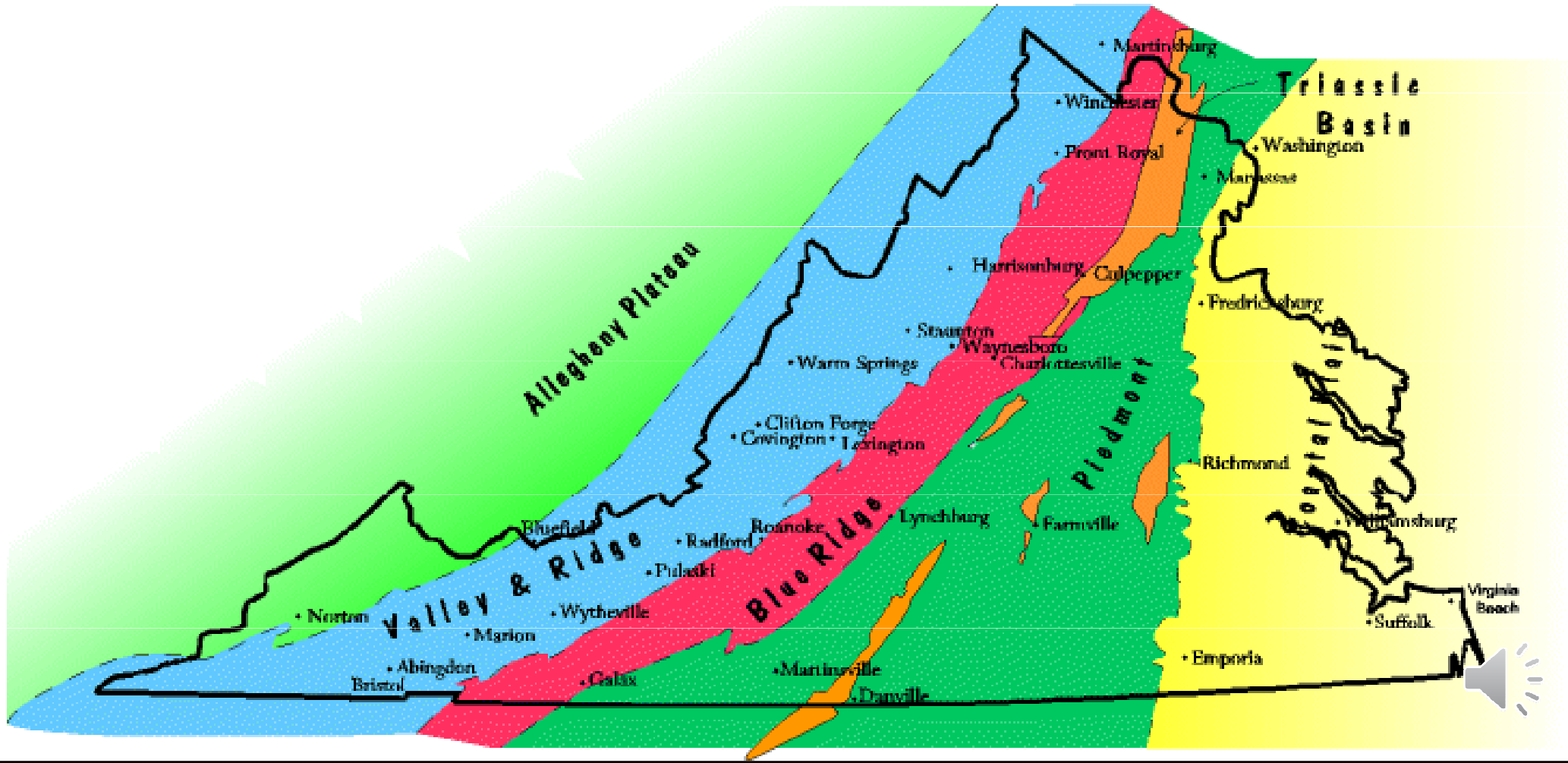
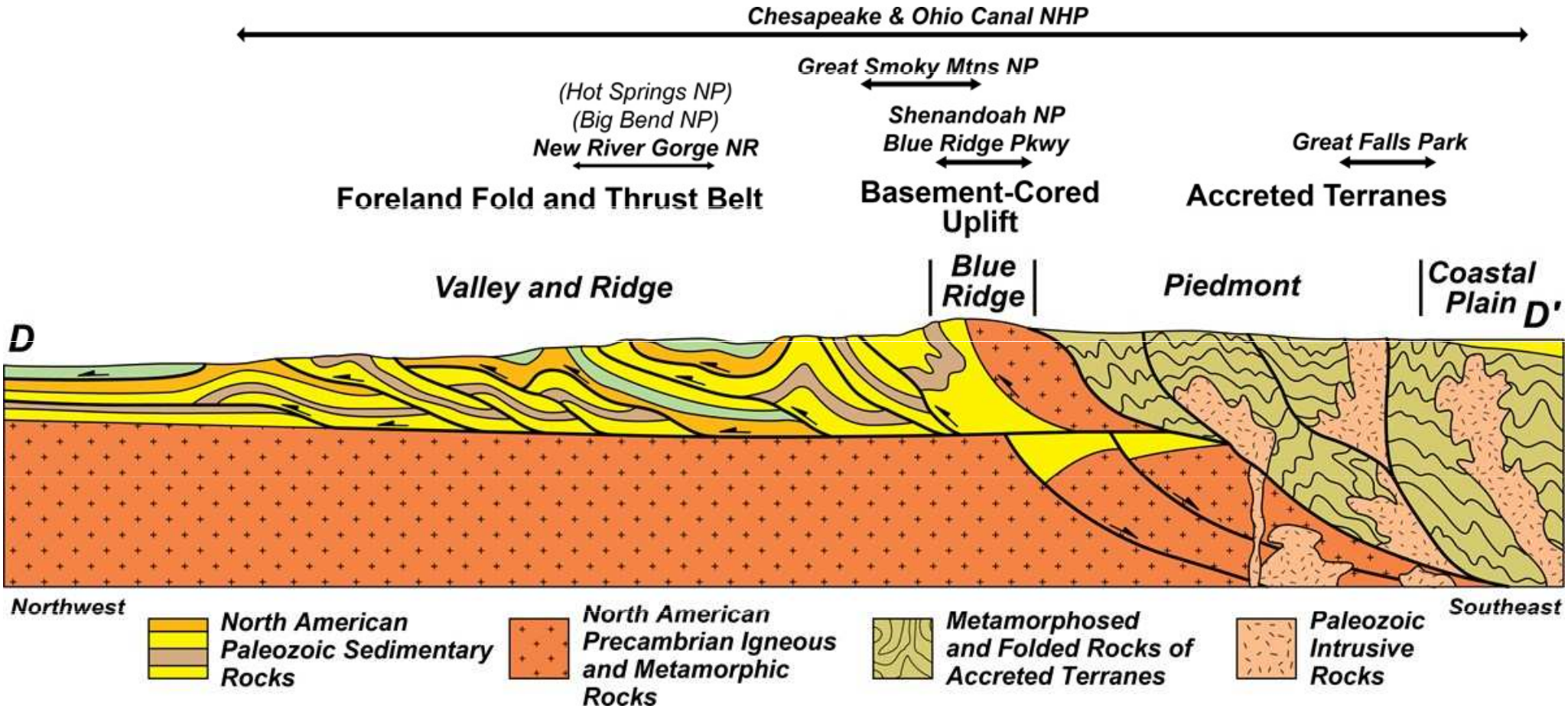


Figure 6. *The Paleozoic rocks range from flatlying to intensely folded. They are separated from crystalline rocks of the Piedmont and Blue Ridge physiographic provinces by faults. The Coastal Plain strata that overlie older rocks are nearly flat.*

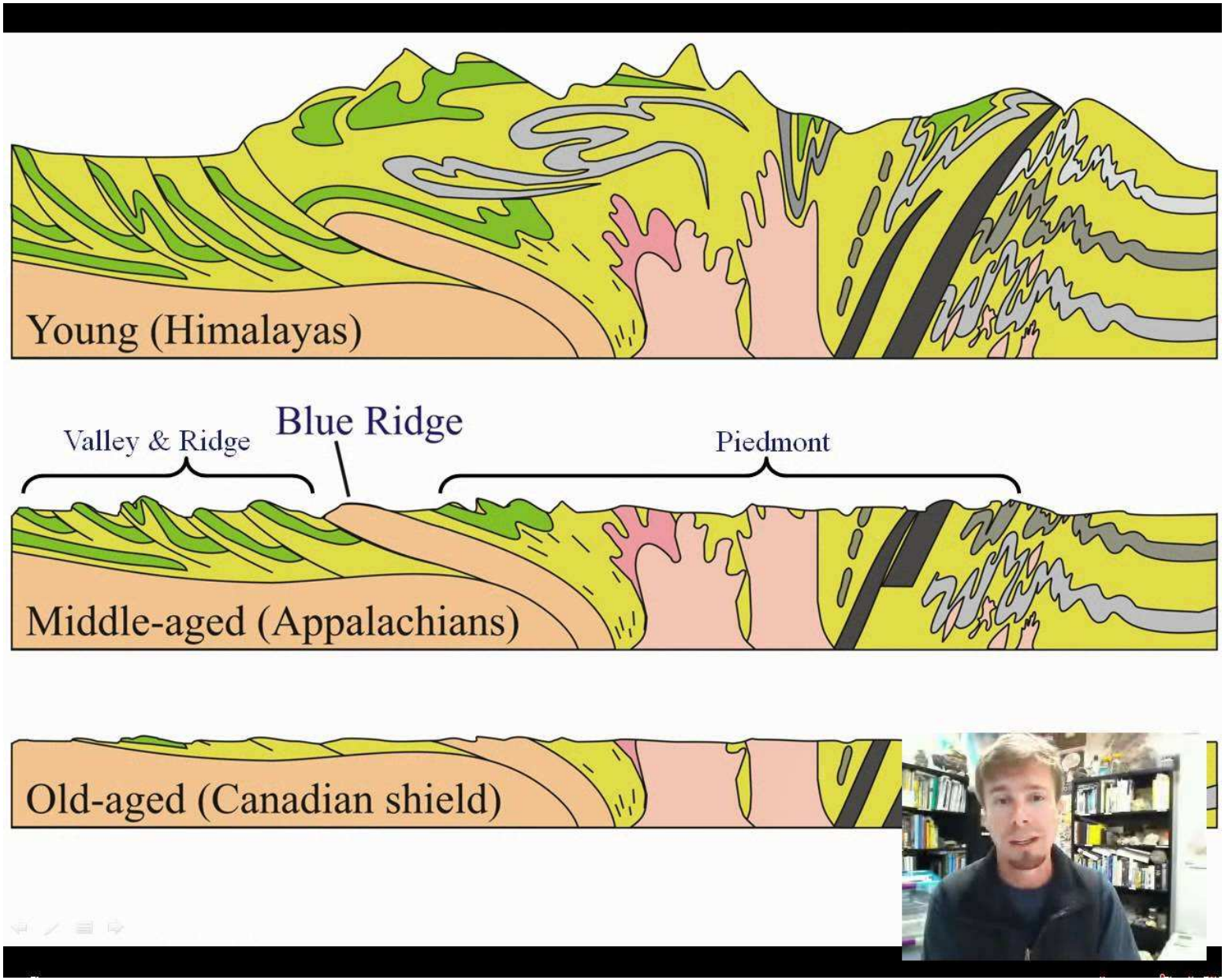
Tektonicky modifikované okraje Laurentie zahrnují na západě provincii **Valley and Ridge** tvořenou spodnopaleozoickými sedimenty okraje Laurentie a na východě provincii **Blue Ridge** tvořenou především mesoproterozoickým krystalinikem (metamorfity, granitiody) a méně neoproterozoickými a spodnopaleozoickými sedimenty. Od Inner Piedmont je Blue Ridge oddělen zónou **Brevard**

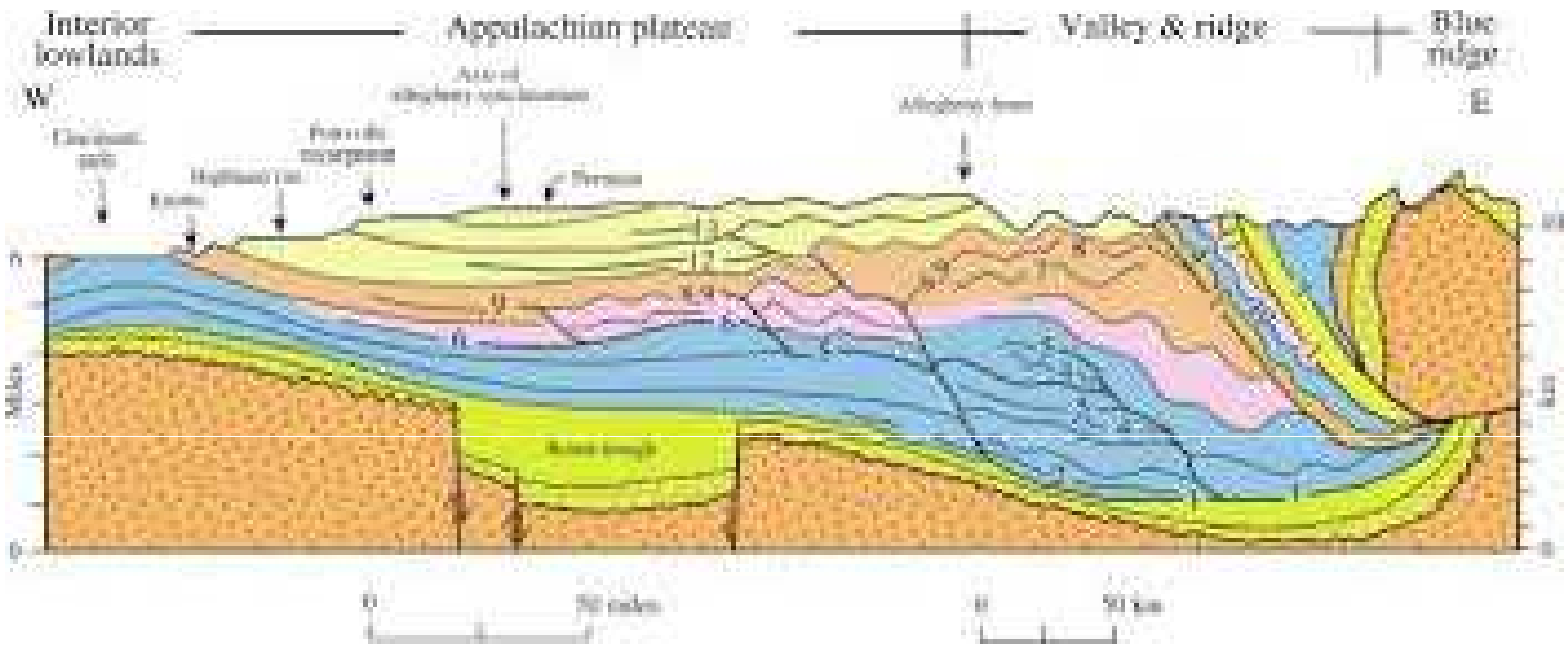


The **Blue Ridge** province lies east of the **Appalachian foreland basin** and is bounded by the **Brevard** zone on its eastern flank



The central Blue Ridge (BR) recorded **burial depths of 33 km** (9.8 kb, pyx granulite) during the Taconian orogeny (480 450 Ma); the Inner Piedmont (IP) 23 km (7.1 kb, sill II) during the Acadian Neoacadian orogeny (407 350 Ma);

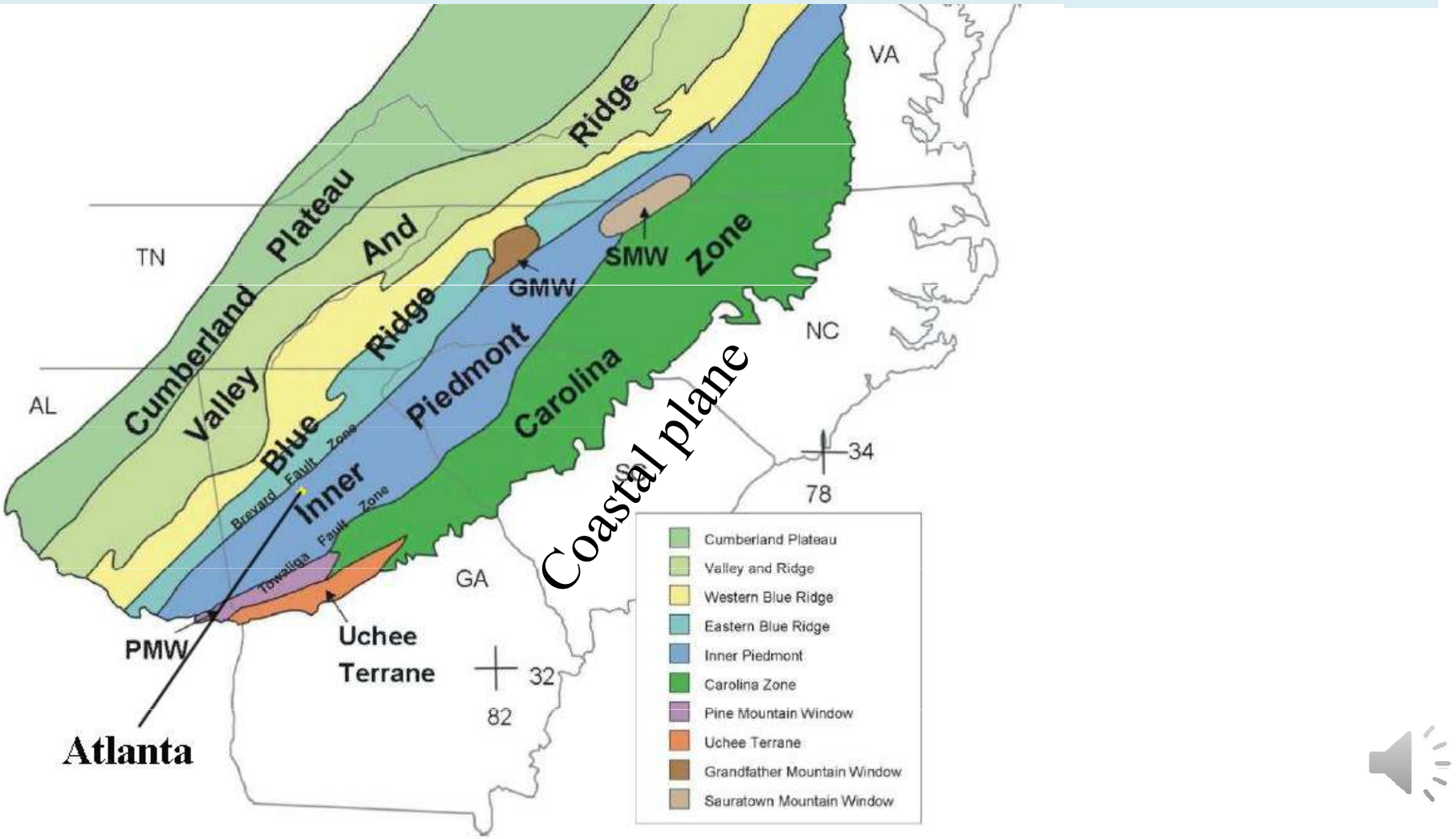




The commercial **coal** beds occur only in strata deposited during the **Pennsylvanian** Period of geologic time, while **oil and gas** deposits are found in strata from throughout the Paleozoic Era.

https://www.youtube.com/watch?v=fJZy_BCKrIU

Terány II a III jsou v jižní části Apalačí tvořeny **perilaurentským** superteránem (zónou) **Inner Piedmont** a superteránem (zónou) **Carolinia** vzniklou v blízkosti jihoamerické části Gonwany. **Carolinia** je řazena mezi perigondwanské terány, je to ale složený vulkanický oblouk, který obsahuje fragment Gondwany podobně jako Gander v podobě metasedimentů.



Inner Piedmont

The Inner Piedmont is bound to the west by the **Brevard** zone and to the east by the **Central Piedmont suture** zone. It contains a Laurentian component (eastern **Tugaloo** terrane) and an internal terrane (**Cat Square**) that contains both Laurentian and Gondwanan detrital zircons, separated by the Brindle Creek fault. Cat Square terrane rocks likely accumulated in a **Devonian remnant ocean** that closed beginning c. 400 Ma.

Inner Piedmont was overthrusted on the Laurentian margin during the Ordovician **Taconic event**

Zóna(superterán) **Inner Piedmont** je tvořena hlavně **perilaurentským** terénem **Tugaloo** a taránem **Cat Square**, Je oddělen od zóny **Blue Ridge** zlomem **Brevard**. **Tugaloo** zahrnuje riftovaný **fragment Laurentie (východní Blue Ridge)** tvořený metamorfovanými sedimenty a akreční melánž a vulkanity. Na jih od něj je situovám další menší fragment Blue Ridge, **vulkanický oblouk Dadeville**. **Cat Square** terán reprezentuje silurodevonské akreční prizma sedimentů, které se ukládaly v mělkém oceánu **mezi Piedmontem a blížící se Carolinou** (jeho sedimenty obsahují jak **laurentské** tak **perigodwanské** zirkony). Během **takonské** orogeneze v ordoviku **Tugaloo** kolidoval s Laurentii podobně jako **Notre Dame** v severních Apalačích.

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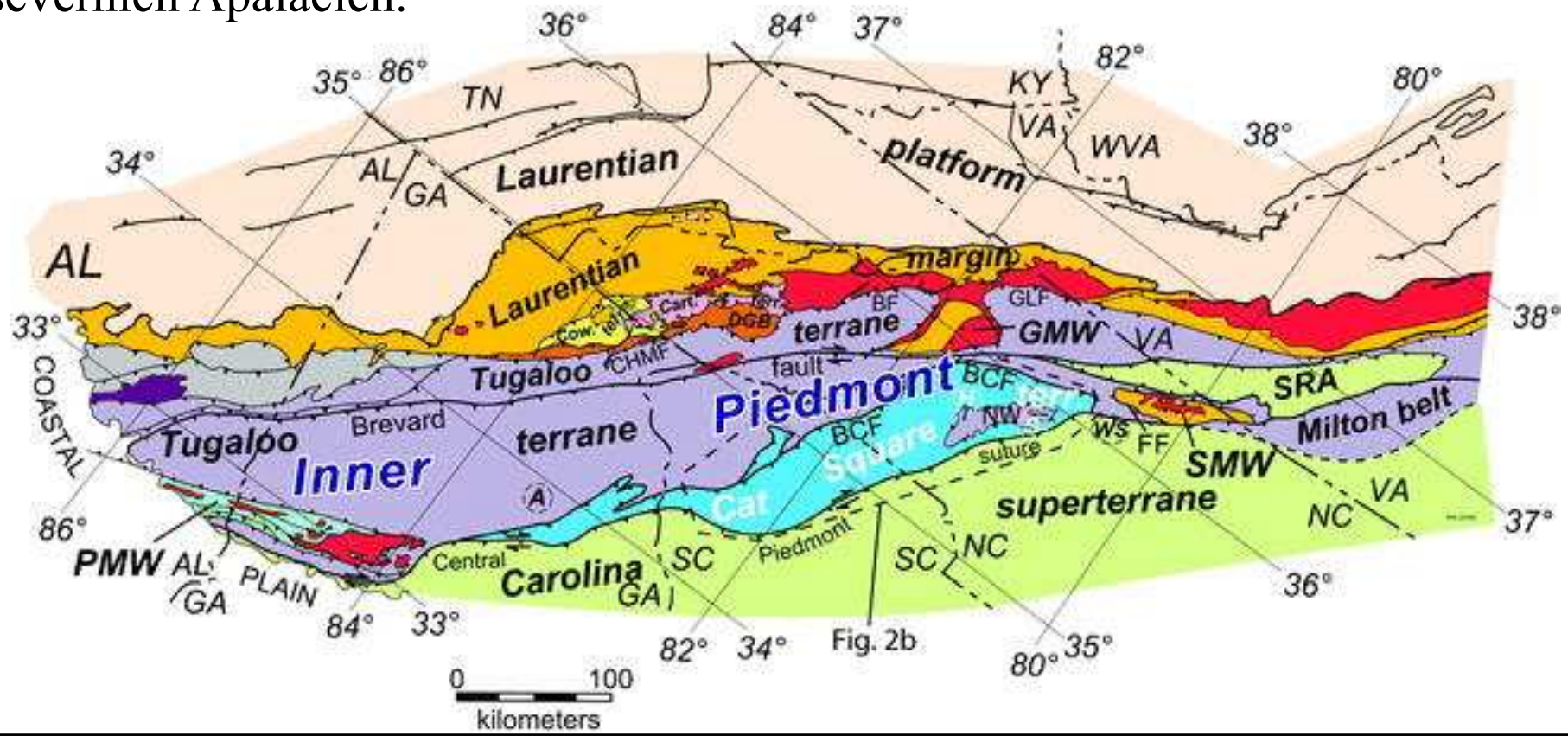


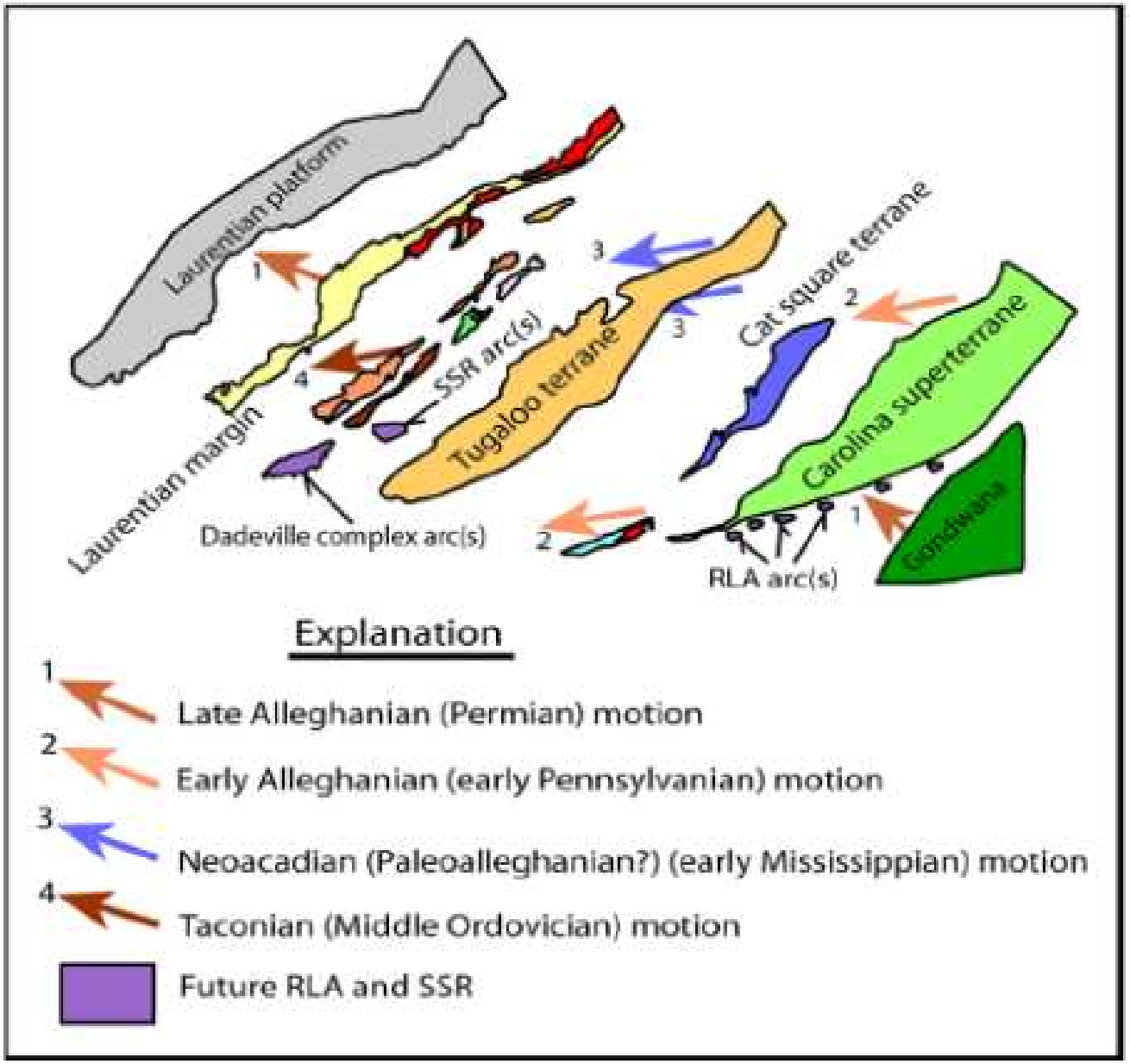
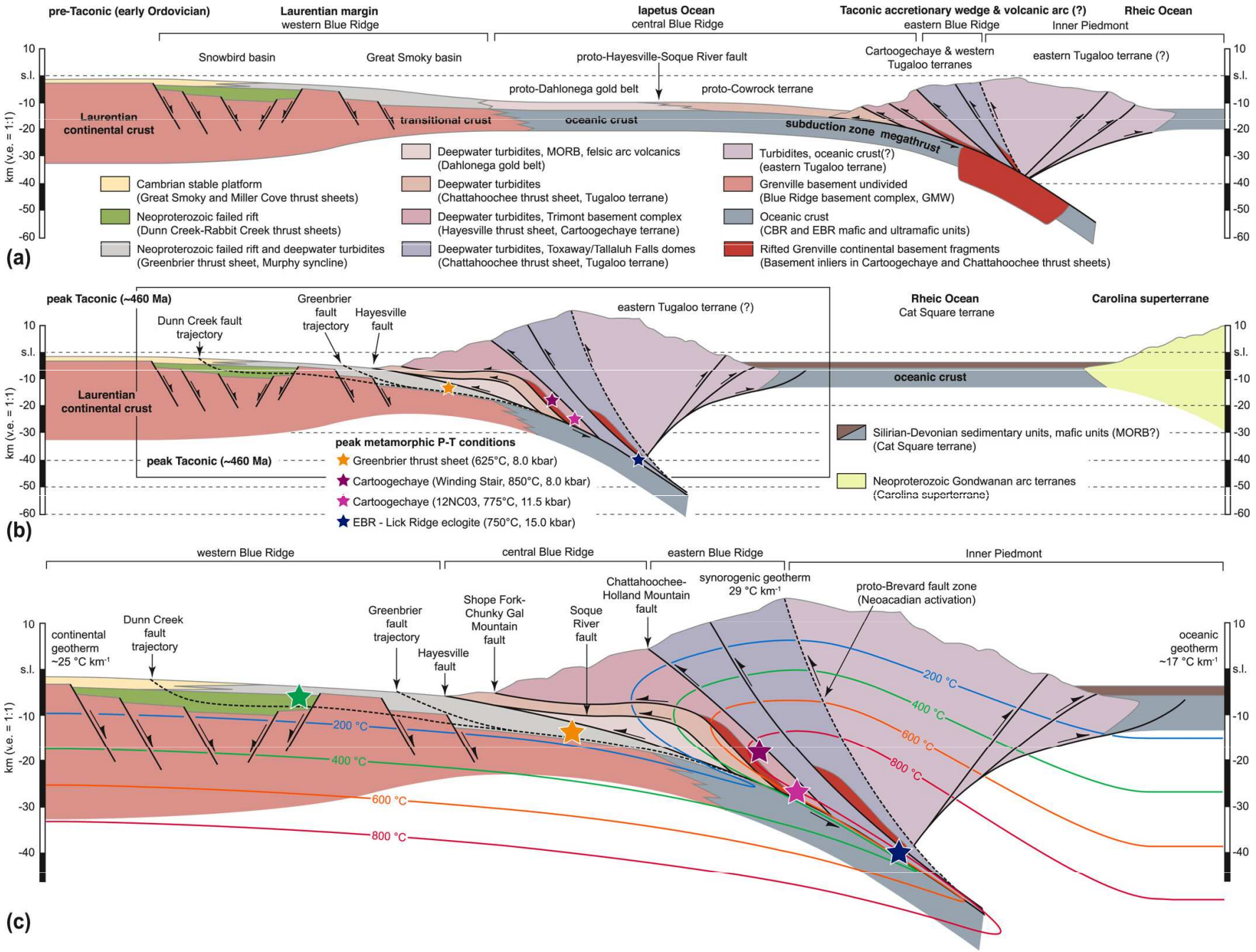


Fig. 15 Retrodeformed tectonostratigraphic terranes in the southern Appalachians with arrows indicating broad kinematics of assembly. Arrows shown are color-coded to show accretion timing (after Hatcher et al. 2007). Included are approximate positions of both the RLA and the SSR prior to thrusting of the SSR onto Tugaloo terrane and the RLA on the Carolina terrane due to terrane collision during final assembly of Pangea

Tugaloo terane



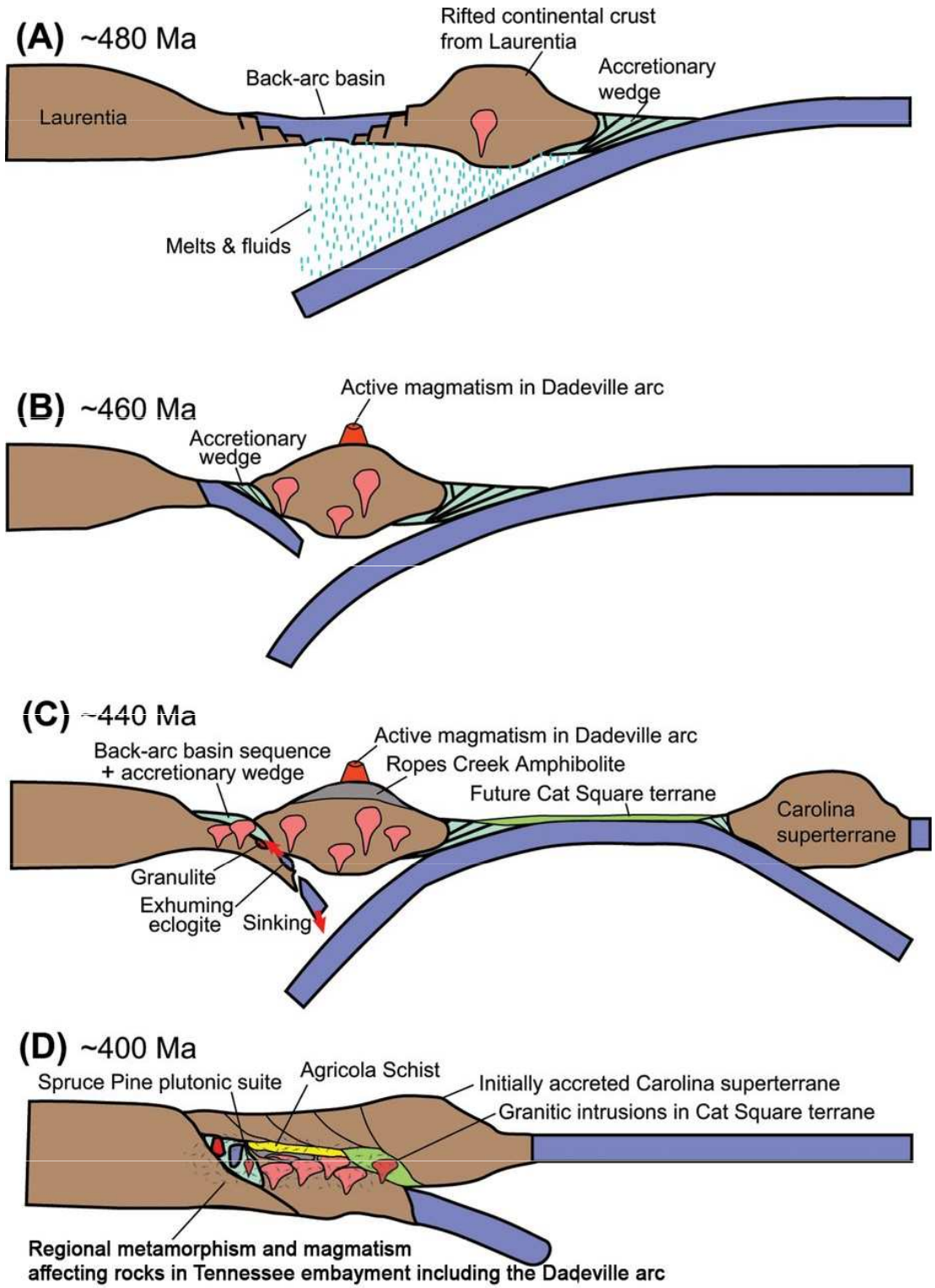


Fig. 10. Tectonic model for the formation and metamorphism of the Dadeville arc and associated back-arc in the Tennessee embayment region during and after the Taconian orogeny, prior to the orogen-parallel translation of Dadeville arc to Alabama promontory. (A) Westward subduction of oceanic crust under a rifted continental margin and back-arc basin (for example, Anderson and Moecher, 2009). (B) Partial subduction of the back-arc basin to high-pressure conditions (subduction direction is after Miller and others, 2006; Merschat and others, 2017) and active magmatism on the Dadeville arc. (C) Closure of the back-arc basin, exhumation of continental crust incorporating eclogites, and continued magmatism on the Dadeville arc. (D) Regional metamorphism affecting the Dadeville arc and eastern Blue Ridge rocks due to the tectonic burial by the approaching Carolina superterrane (Merschat and others, 2017).

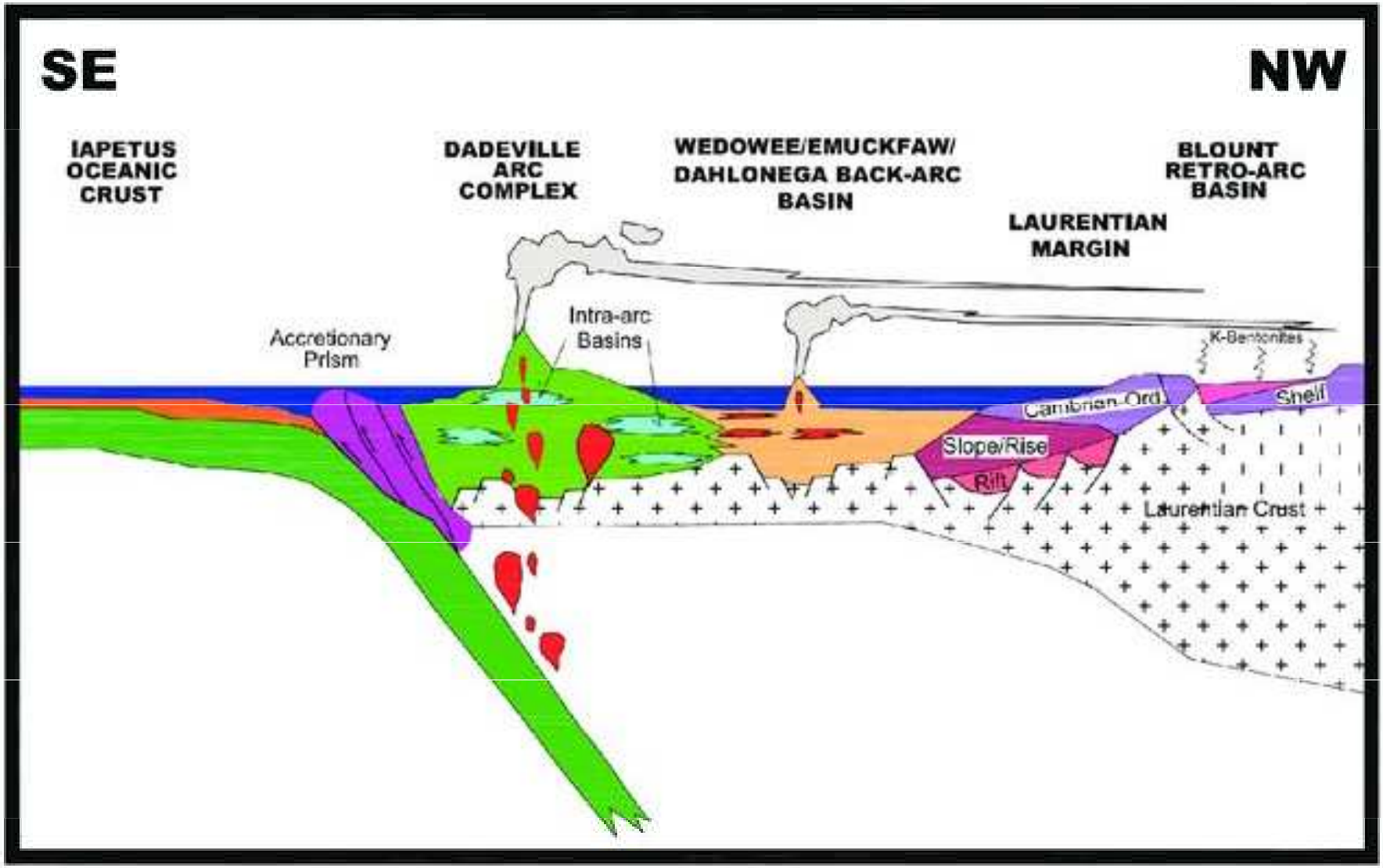
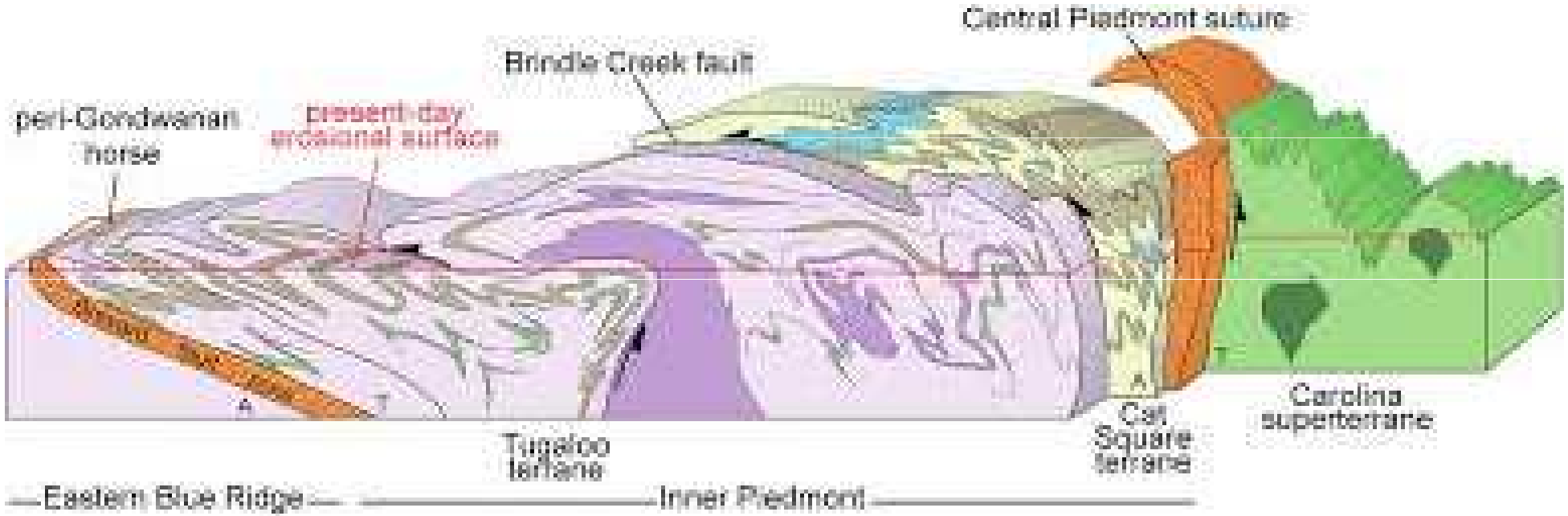


Figure 2.8. Schematic tectonic reconstruction of the Laurentian margin at 445-465 Ma at the current latitude of Georgia and Alabama. The Dadeville complex is interpreted as a fringing arc built on extended Laurentian continental crust. Also note the intra-arc basins interpreted from the Agricola Schist and Ropes Creek metasedimentary rocks. The Dadeville complex formed just outboard of the Wedowee/Emuckfaw basin in this reconstruction.


Central Piedmont suture
Brindle Creek fault
peri-Gondwanan horse
present-day erosional surface
Carolina superterrane
Tugaloo terrane
Eastern Blue Ridge
Inner Piedmont

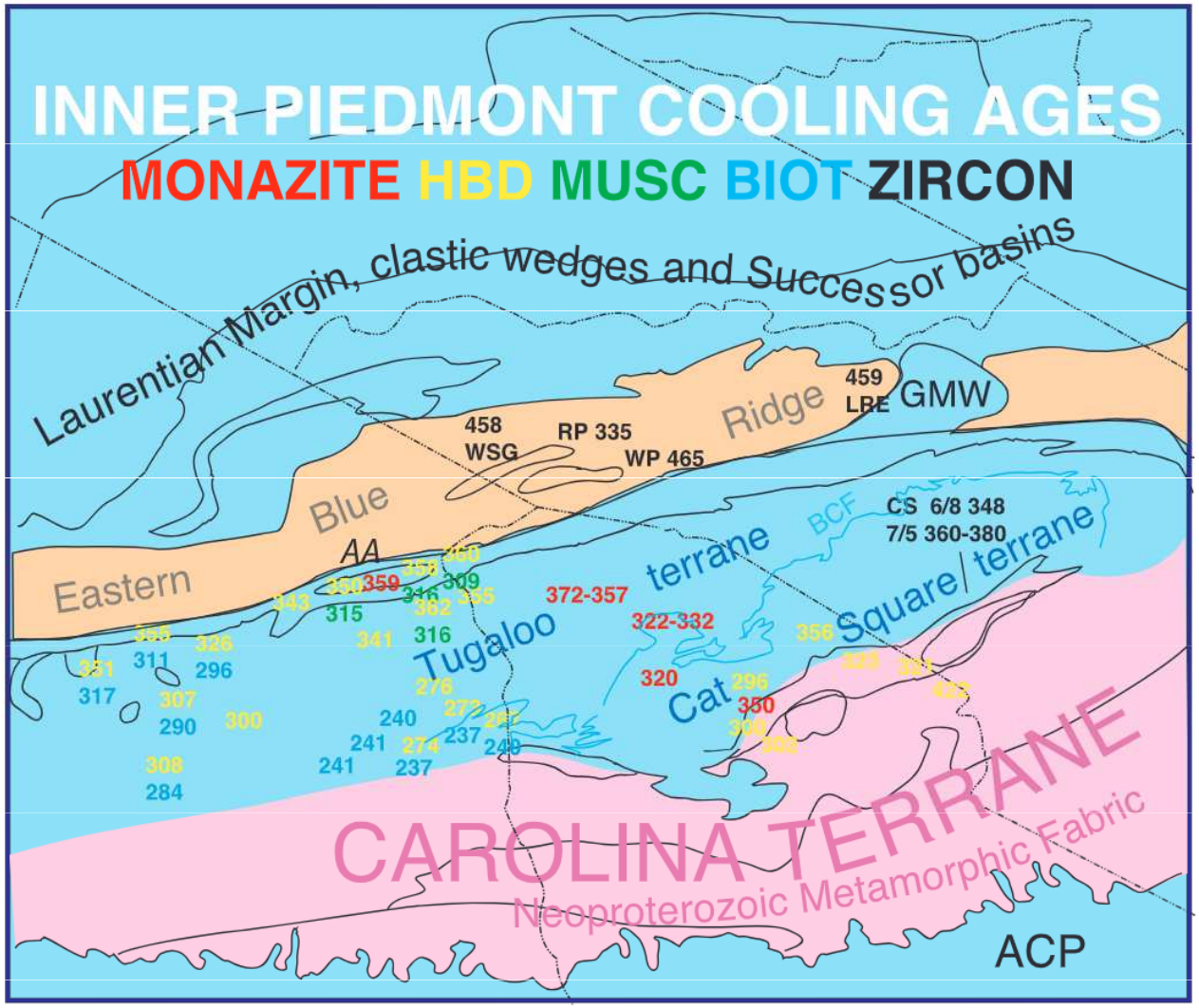


Figure 2. The primary purpose of this figure is to show that the thermal peak of the Inner Piedmont occurred ca. 355–365 Ma as revealed by monazite U-Pb thermal-ionization mass spectrometry (TIMS) and that this peak is different from that observed in adjacent terranes: eastern Blue Ridge (ca. 458 Ma granulite facies for Winding Stairs Gap; eclogite facies for Lick Ridge eclogite) and Carolina (Neoproterozoic; Dennis and Wright, 1997b). This figure was adapted from Dennis and Wright (1997a). Data are from Dennis and Wright (1997a), Dallmeyer et al. (1986), Dallmeyer (1988), Miller et al. (2000), Busch et al. (2002), Miller et al. (2006), Hatcher (2002), and Moecher et al. (2004). AA—Alto allochthon, ACP—Atlantic Coastal Plain, BCF—Brindle Creek fault, CS—Cat Square, GMW—Grandfather Mountain Window, LRE—Lick Ridge eclogite, RP—Rabun pluton, WP—Whiteside pluton, WSG—Winding Stairs Gap.

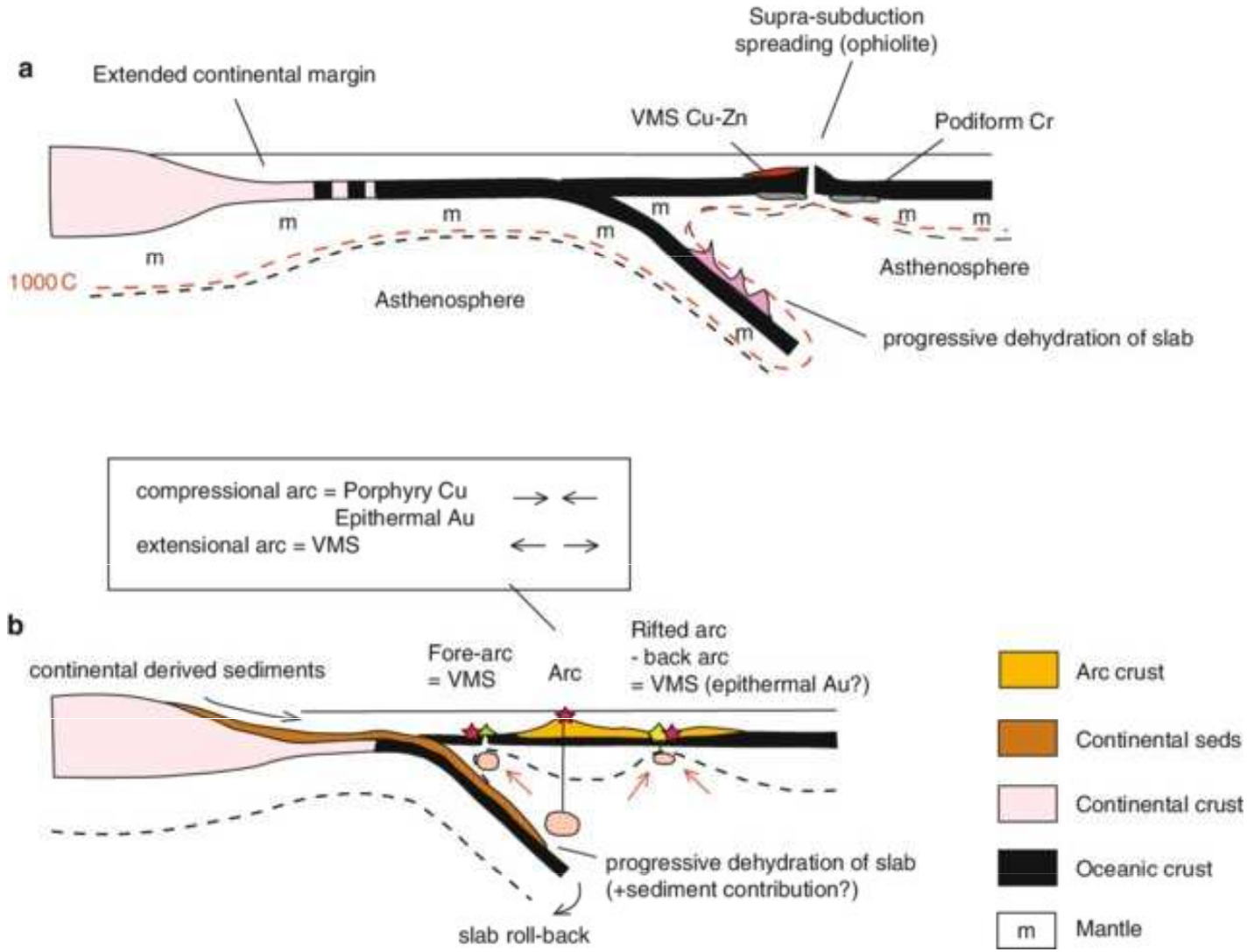
Carolinia

Carolinia is Neoproterozoic island arc system which was created at ca. 550 Ma during stitching of the two largest components, the **Carolina** and **Charlotte** terranes.

The terrane comprises Neoproterozoic to Early Cambrian **felsic-to-mafic metaplutonic and metavolcanic rocks**, intruded by later Paleozoic plutons. There is consensus among workers that these sequences collectively represent a long-lived, **suprasubduction zone (SSZ) magmatic arc** system. **SSZ ophiolites form during the initial stages of subduction prior to the development of any volcanic arc**.

These rocks underwent at least **four metamorphic/deformation events**, and so their original textures and mineralogies have been **significantly altered**

Carolinia terrane likely experienced significant translation in a Middle Paleozoic **dextral shear system** along the Laurentian margin prior to the Alleghanian continental collision



Supra-subduction zone (SSZ) ophiolites have the geochemical **characteristics of island arcs** but the **structure of oceanic crust** and are thought to have formed by sea-floor spreading directly above subducted oceanic lithosphere.

Fig. 6.1 (a) Simplified section of an **early supra-subduction (infant arc)** setting showing ophiolite formation and key related mineral deposits. (b) Section of maturing arc setting showing fore-arc and back-arc rifting and possible magma source regions. Subduction of continent derived sediment enters subduction channel and yields components to metasomatise the sub-arc mantle wedge. (compiled from various published sources including Winter 2001; Garson and Mitchell 1977; Robb 2005).

The **Carolina terrane** forms the heart of **Carolinia**, one of the largest accreted peri-Gondwanan crustal tracts within the Appalachian Orogen. The Carolina terrane consists of **two major lithotectonic elements**, the older **Neoproterzoic Hyco magmatic arc**, ca. 633-612 Ma, and the **younger Neoproterozoic-early Paleozoic Albemarle magmatic arc**, ca. 555-<528 Ma. A third lithotectonic unit consisting of clastic sedimentary rocks with subordinate volcanics, the **Virgilina sequence**, intervenes between them. The **Carolina** terrane appears to have **departed from its peri-Gondwanan source area in the Early to Middle Cambrian**. **Two major tectonothermal events** have overprinted rocks of the terrane. The Neoproterozoic **Virgilina deformation**, ca. 578-545 Ma, appears to overlap in time with the **stitching** of the two largest components of **Carolinia**, **the Carolina and Charlotte terranes** at ca. 550 Ma. The second event, the **Cherokee orogeny**, started in the Late Ordovician and likely continued into the Early Silurian. The Cherokee orogeny most likely marks the **accretion of Carolinia to Laurentia**.

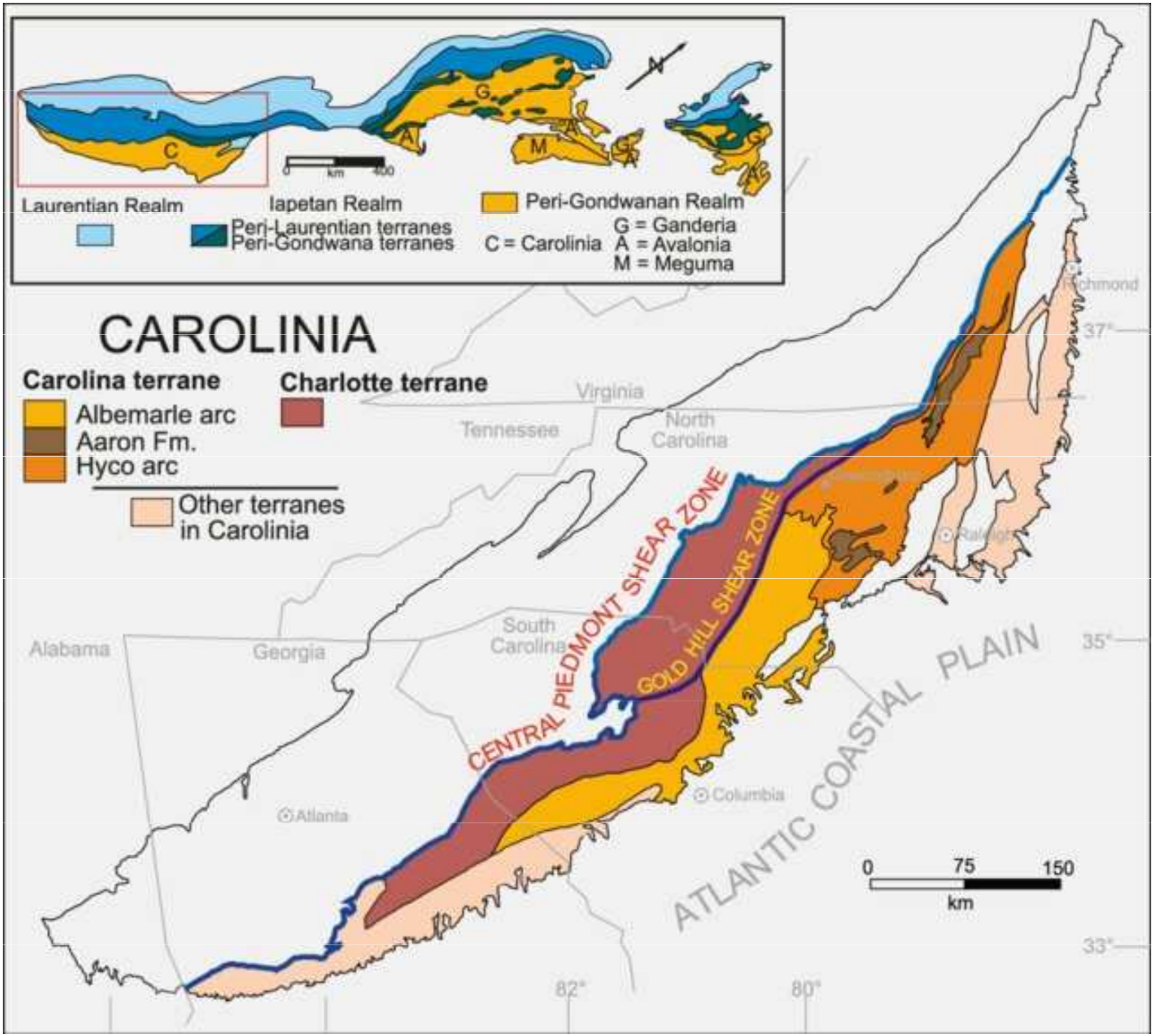
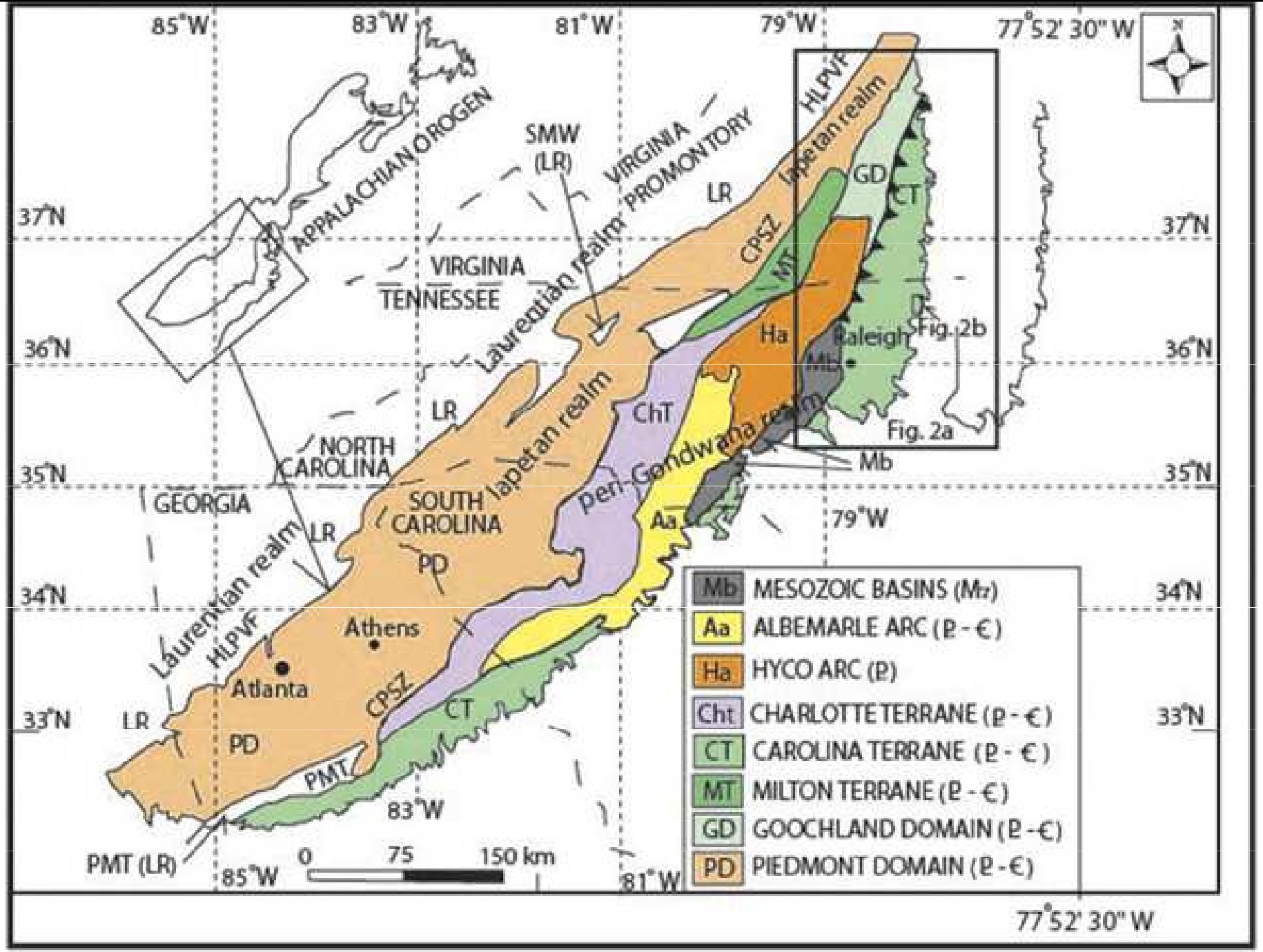


Fig. 2. Distribution of the major tectonic elements of Carolinia and adjoining terranes (Hibbard et al. 2002). CPsz, Central Piedmont shearzone; GHF, Gold Hill fault; PMB, Pine Mountain Belt.



Simplified lithotectonic map of the southern Appalachians showing the superterranes and other rock units (after Hibbard et al. 2006, 2007). Abbreviations: HLPVF, Hollins Line-Pleasant Valley fault system; CPSZ, Central Piedmont shear zone; LR, Laurentian realm; PMT, Pine Mountain terrane; SMW, Sauratown Mountain window. Location of Fig. 2 is also shown.

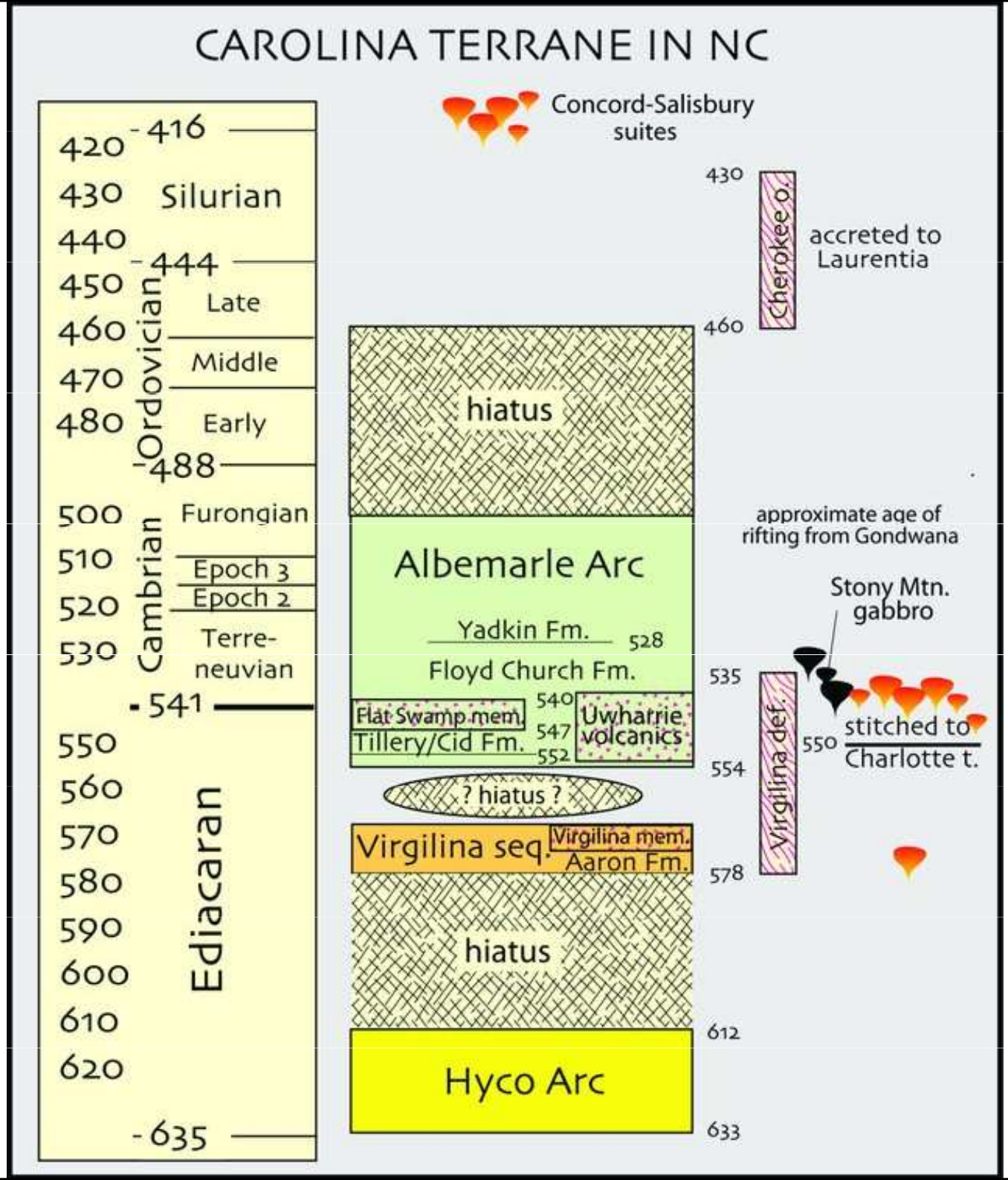


Figure 2. First-order components and events of the Carolina terrane in North Carolina.

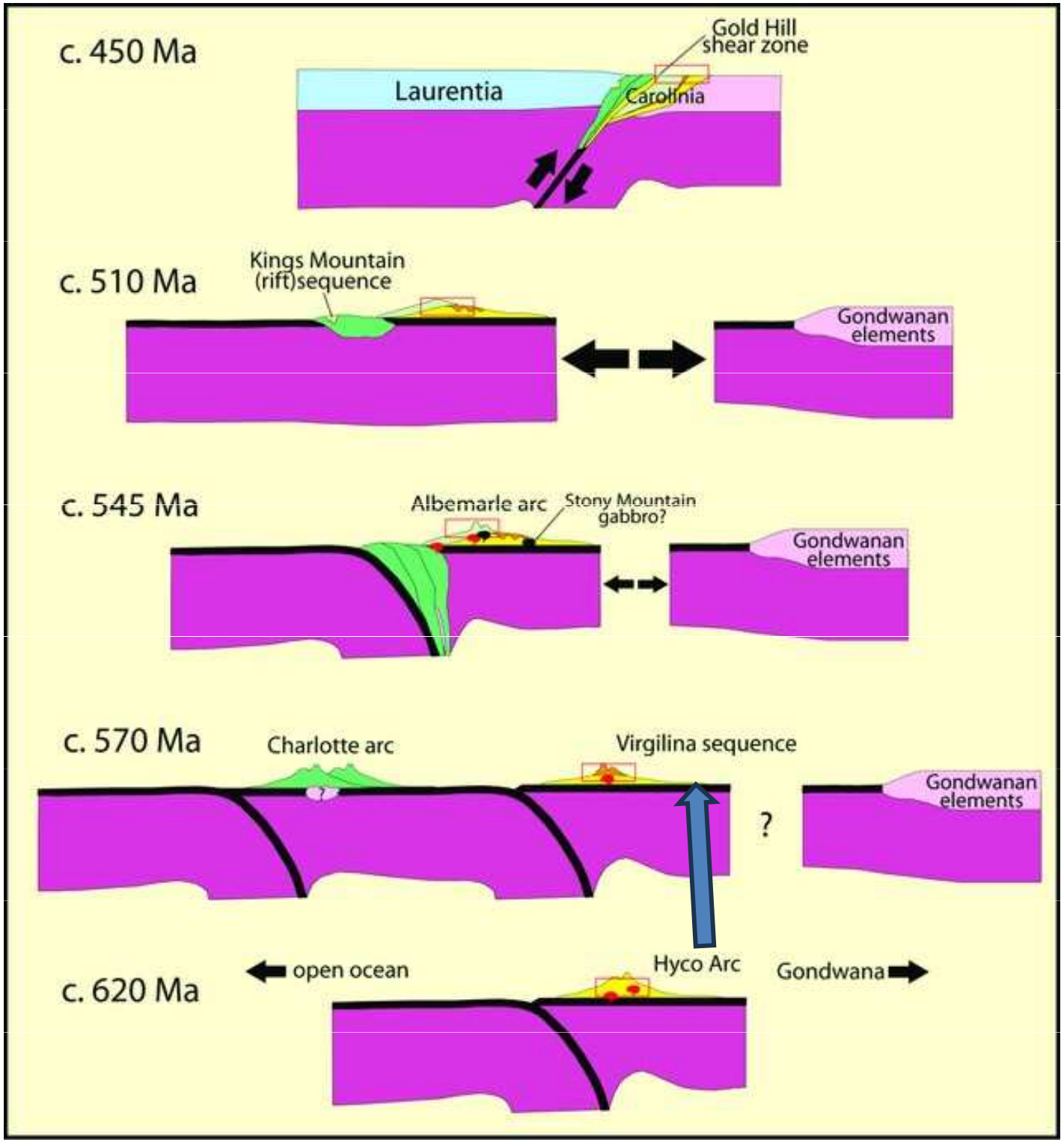
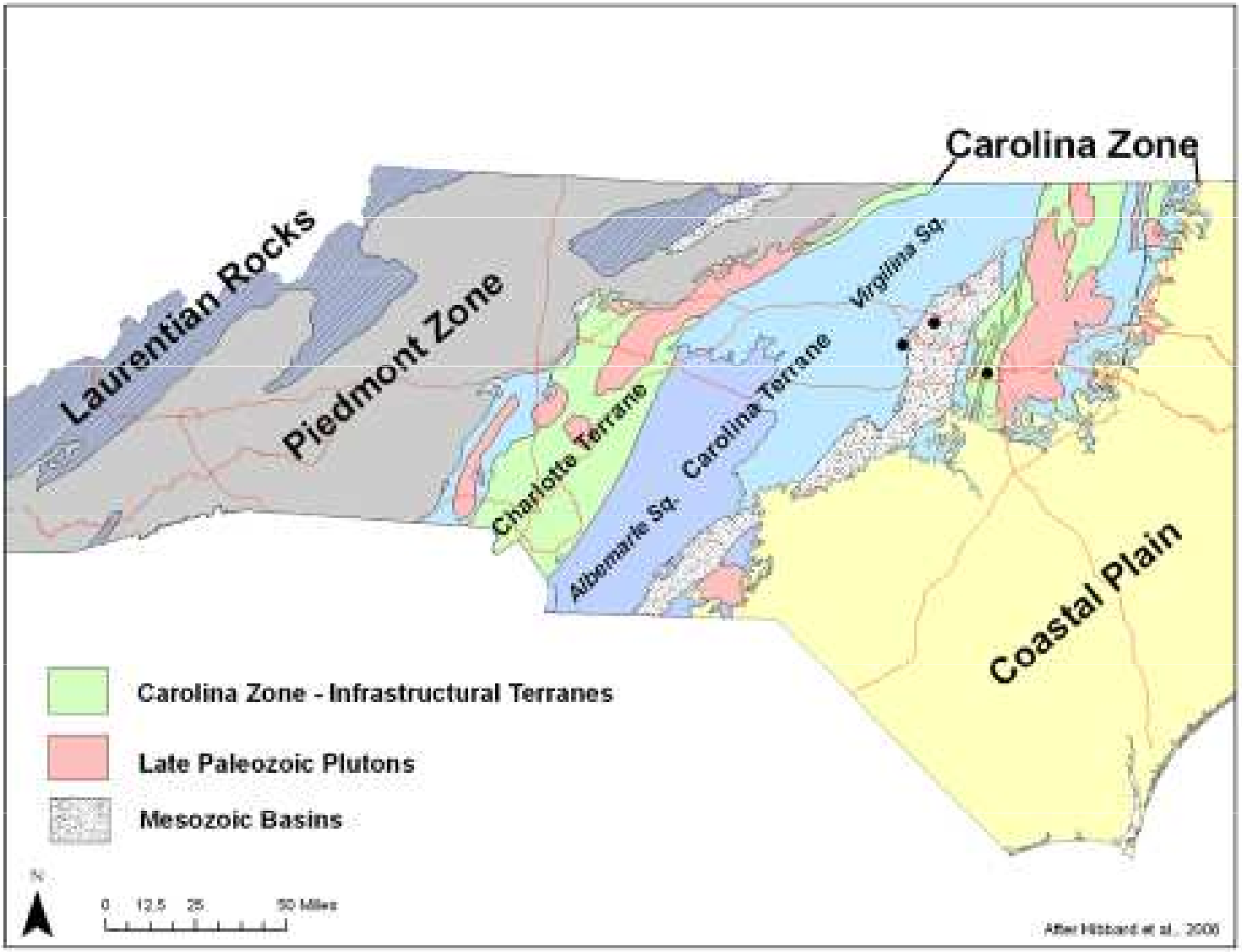
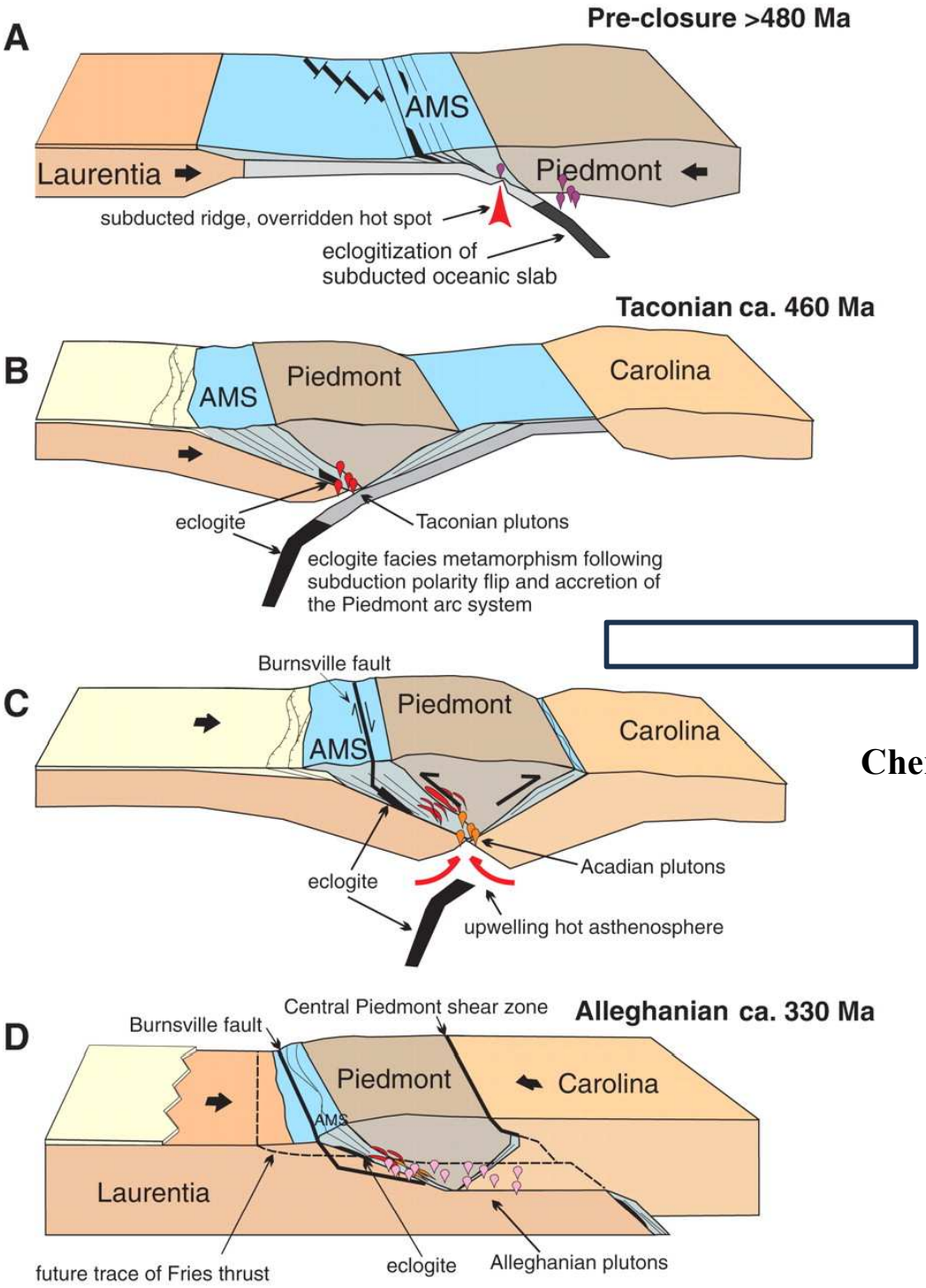


Figure 10. A possible schematic lithosphere-scale model for the Ediacaran-Ordovician plate tectonic evolution of the Carolina terrane. Red box in each time frame indicates approximate location of corresponding time frame in Figure 9.

Carolinia zahrnuje terán **Carolina**, složený vulkanický oblouk, který se vytvořil poblíž jihoamerické části Gondwany a vulkanický oblouk **Charlotte** a **další vulkanické oblouky**, které byly do stavby zóny začleněny na počátku paleozoika. O datování kolize s **Inner Piedmont** se vedou diskuse, pravděpodobně to bylo v siluru během salinické fáze, Inner Piedmont byl začleněn do stavby Laurentie během **takonské** fáze. Kolizi s africkou částí Gondwany během **alleghanské** orogeneze v karbonu odpovídají **Coastal Plains**



Souhern Appalachians



Cherokee. Late Ordovician - Early Silurian

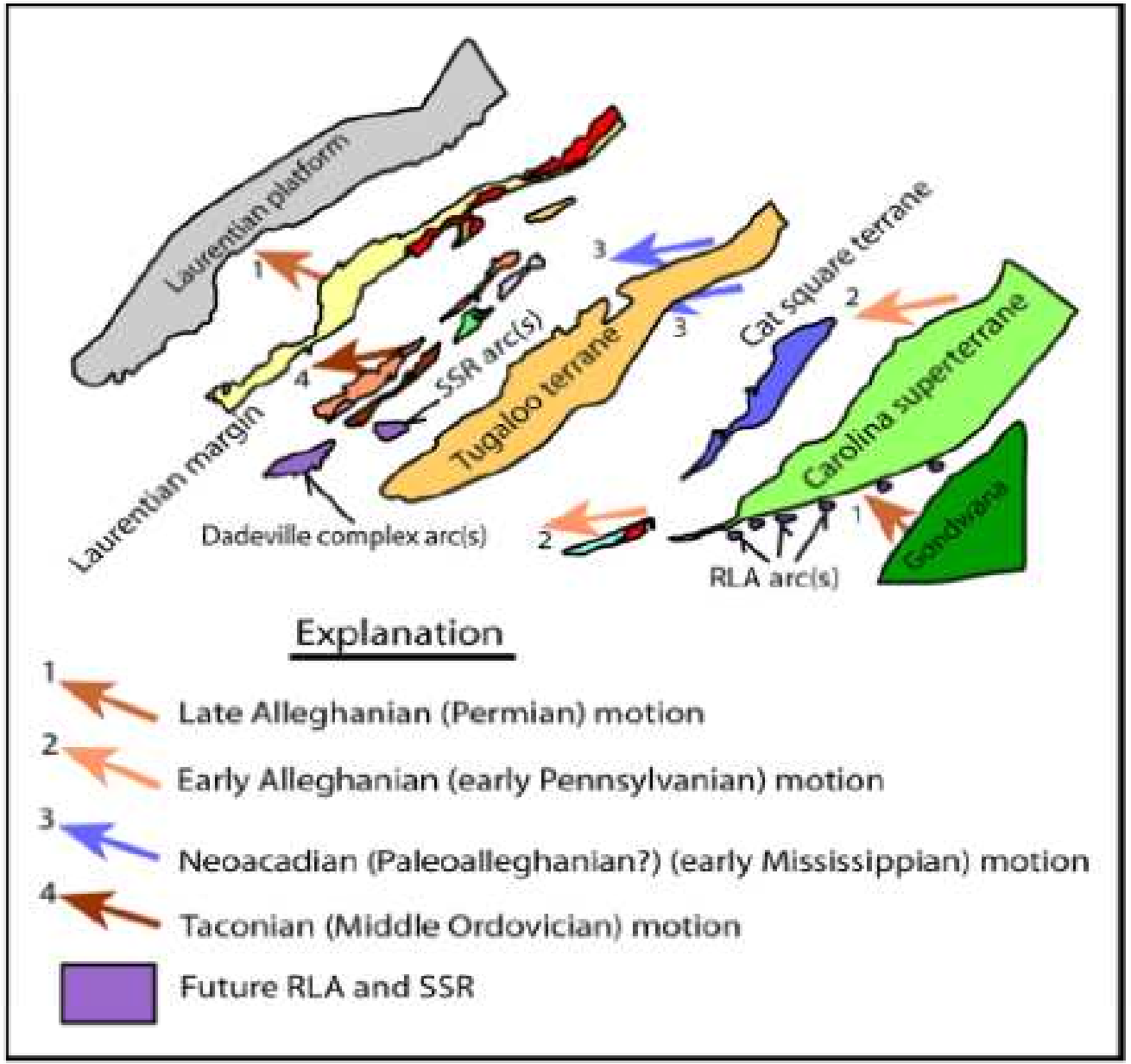
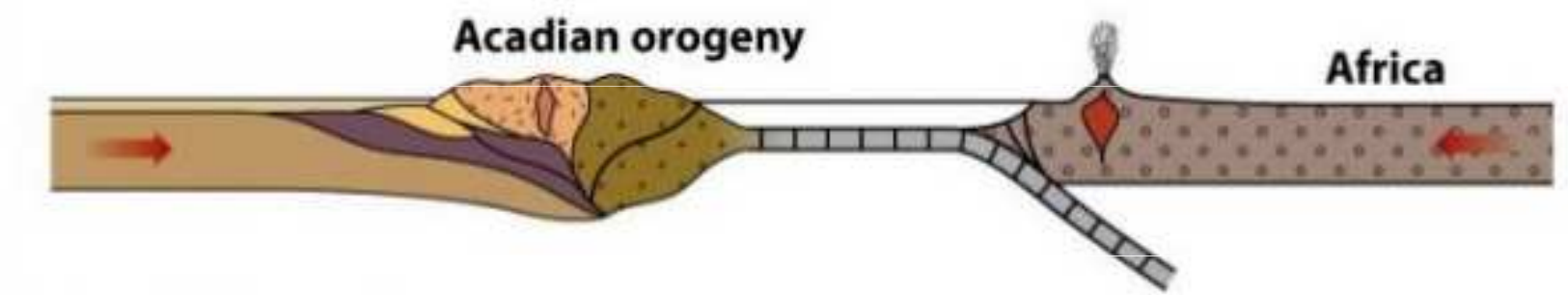


Fig. 15 Retrodeformed tectonostratigraphic terranes in the southern Appalachians with arrows indicating broad kinematics of assembly. Arrows shown are color-coded to show accretion timing (after Hatcher et al. 2007). Included are approximate positions of both the RLA and the SSR prior to thrusting of the SSR onto Tugaloo terrane and the RLA on the Carolina terrane due to terrane collision during final assembly of Pangea

Case Study - Appalachians

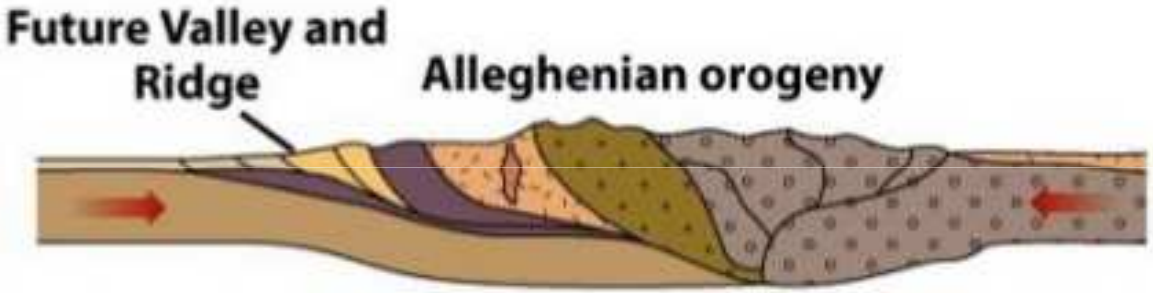
E-dipping subduction continued to close the ocean.



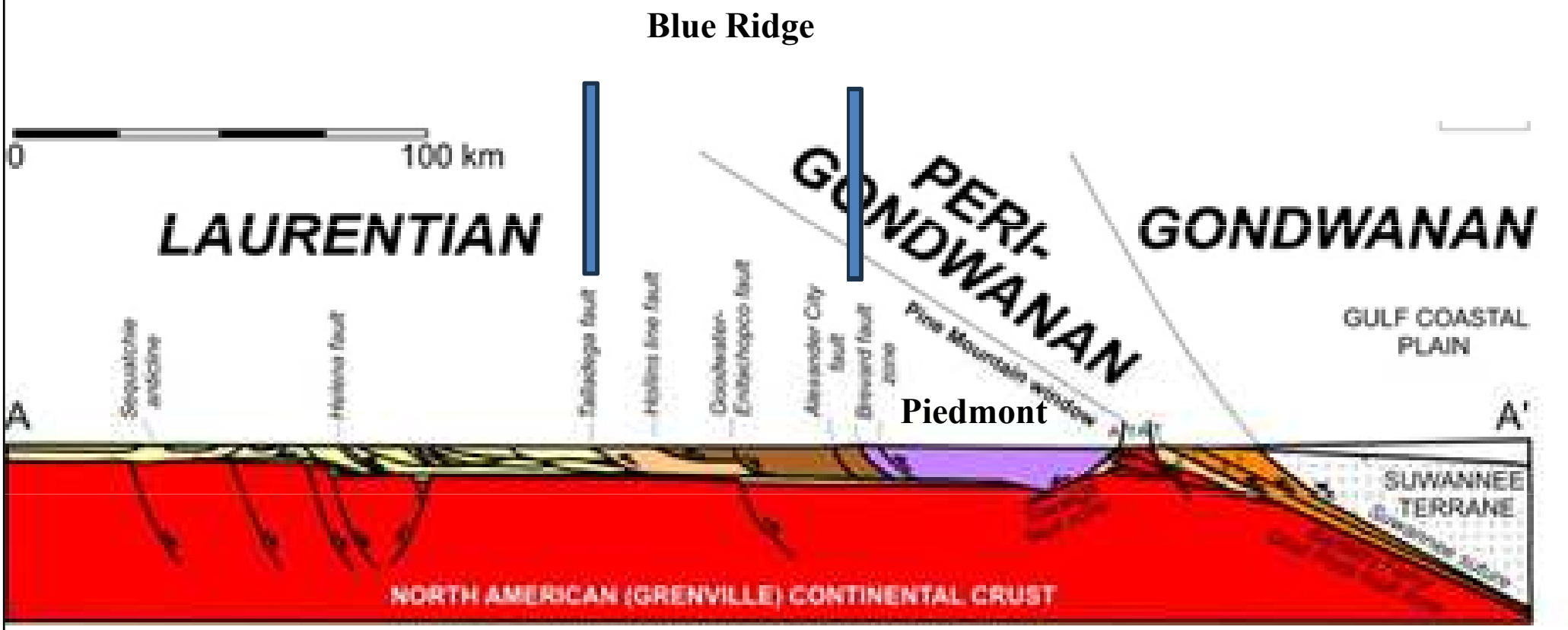
Alleghenian orogeny (~270 Ma): Africa collided w/ N.A.

Created huge fold & thrust belt

Assembled supercontinent of Pangaea.



Piedmont = Inner Piedmont+Carolinia



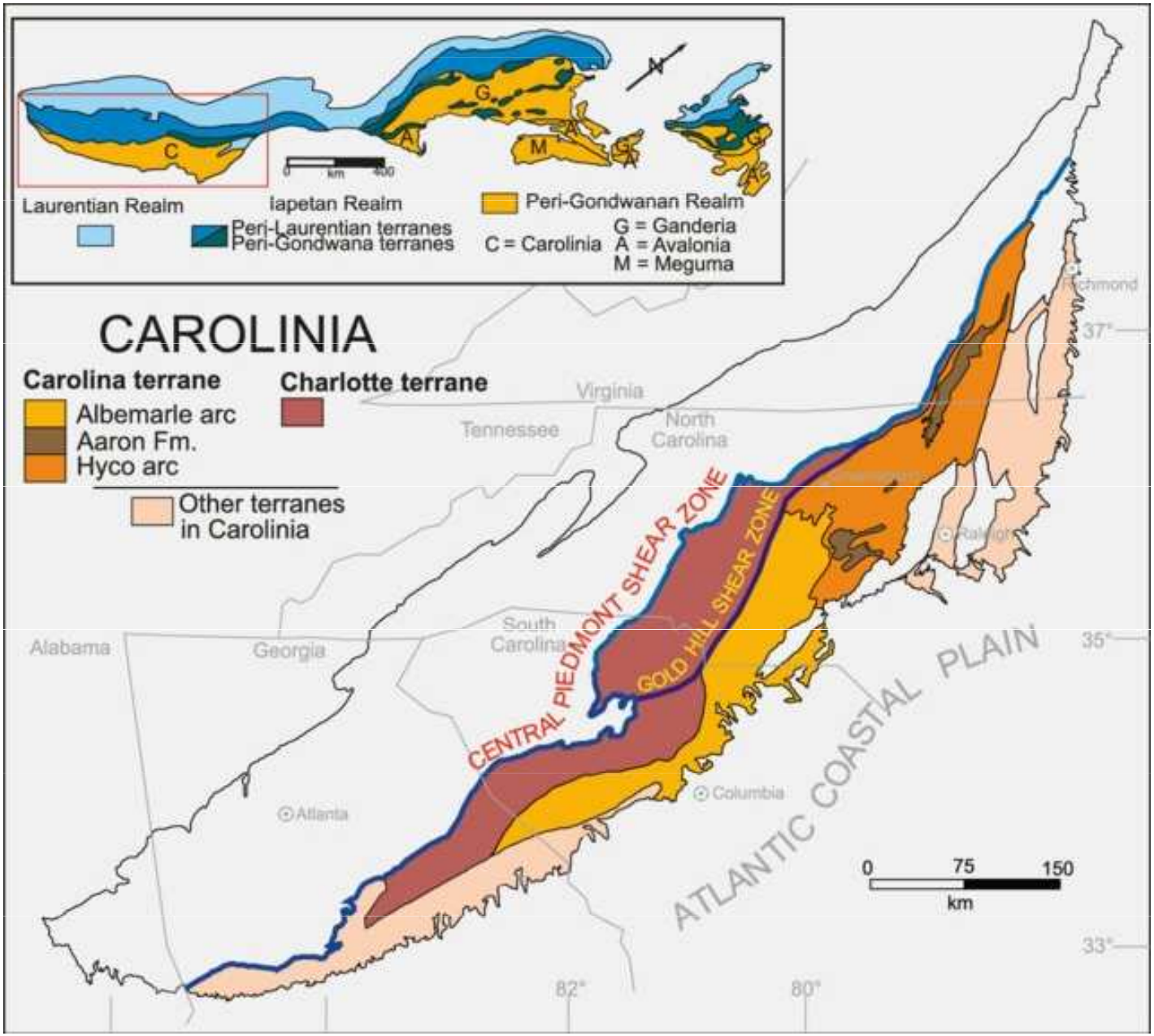
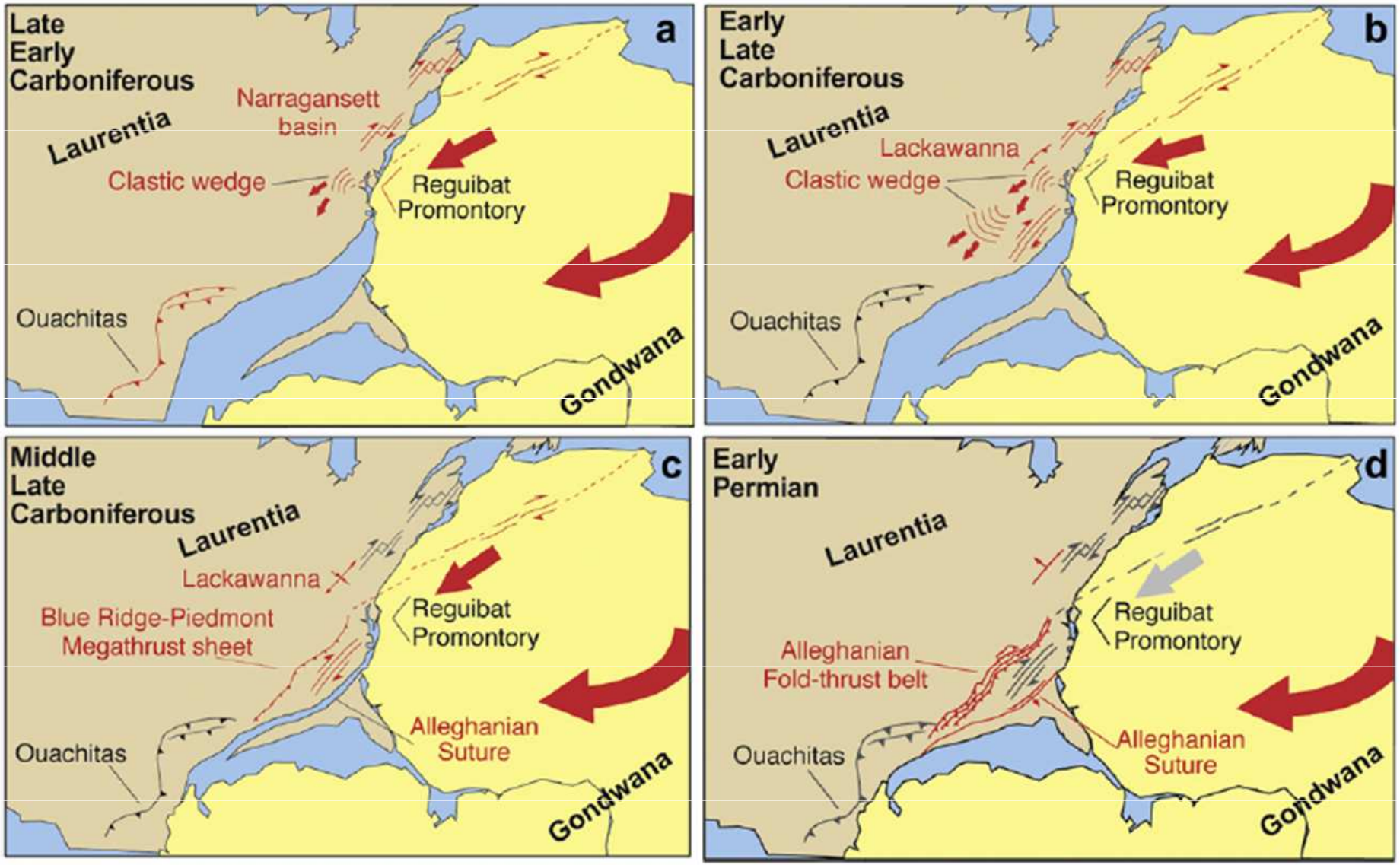


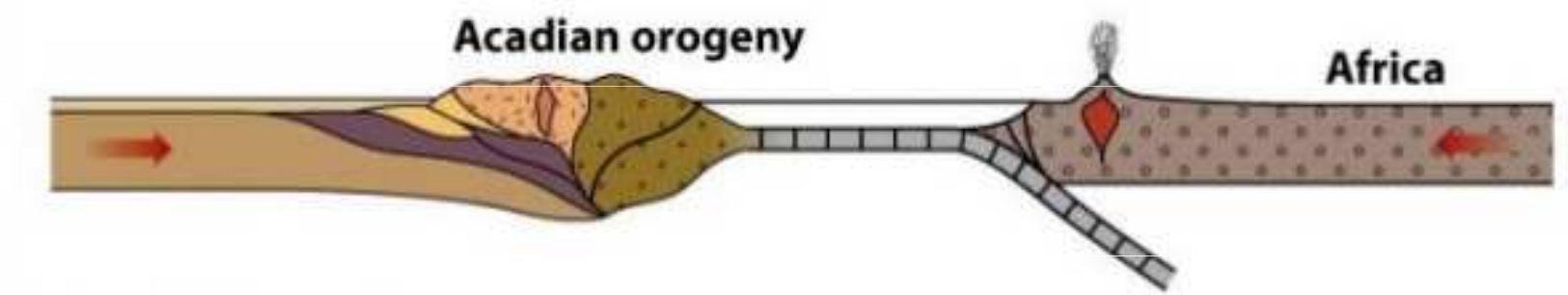
Fig. 2. Distribution of the major tectonic elements of Carolinia and adjoining terranes (Hibbard et al. 2002). CPsz, Central Piedmont shearzone; GHF, Gold Hill fault; PMB, Pine Mountain Belt.

Alleghanian orogeny



Case Study - Appalachians

E-dipping subduction continued to close the ocean.



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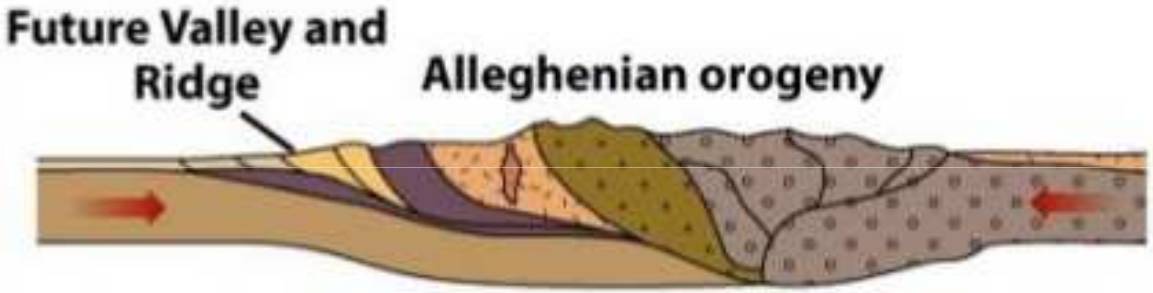
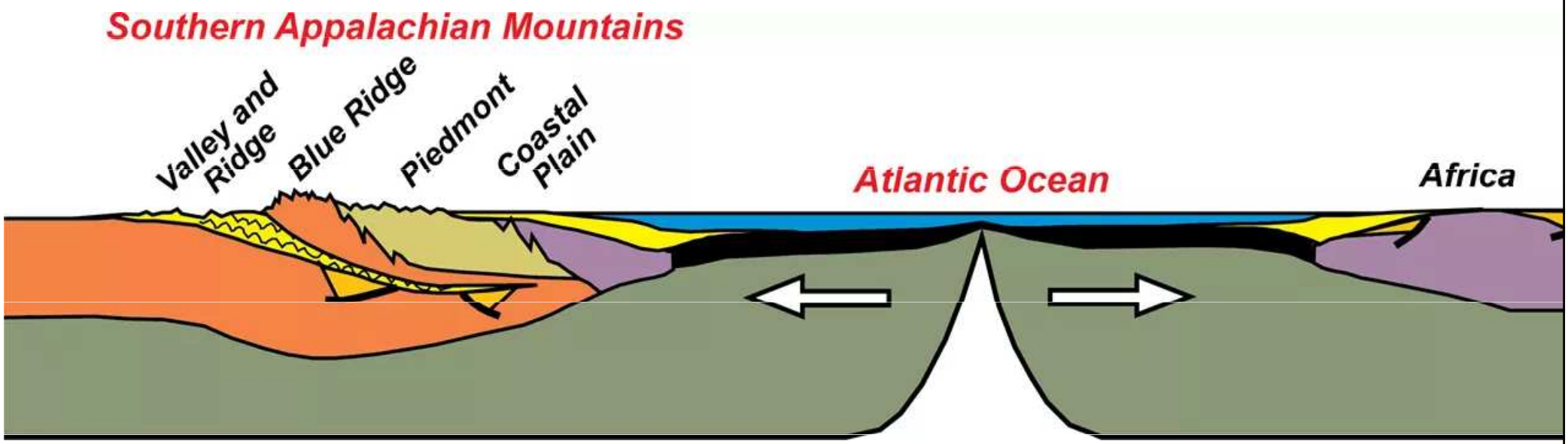
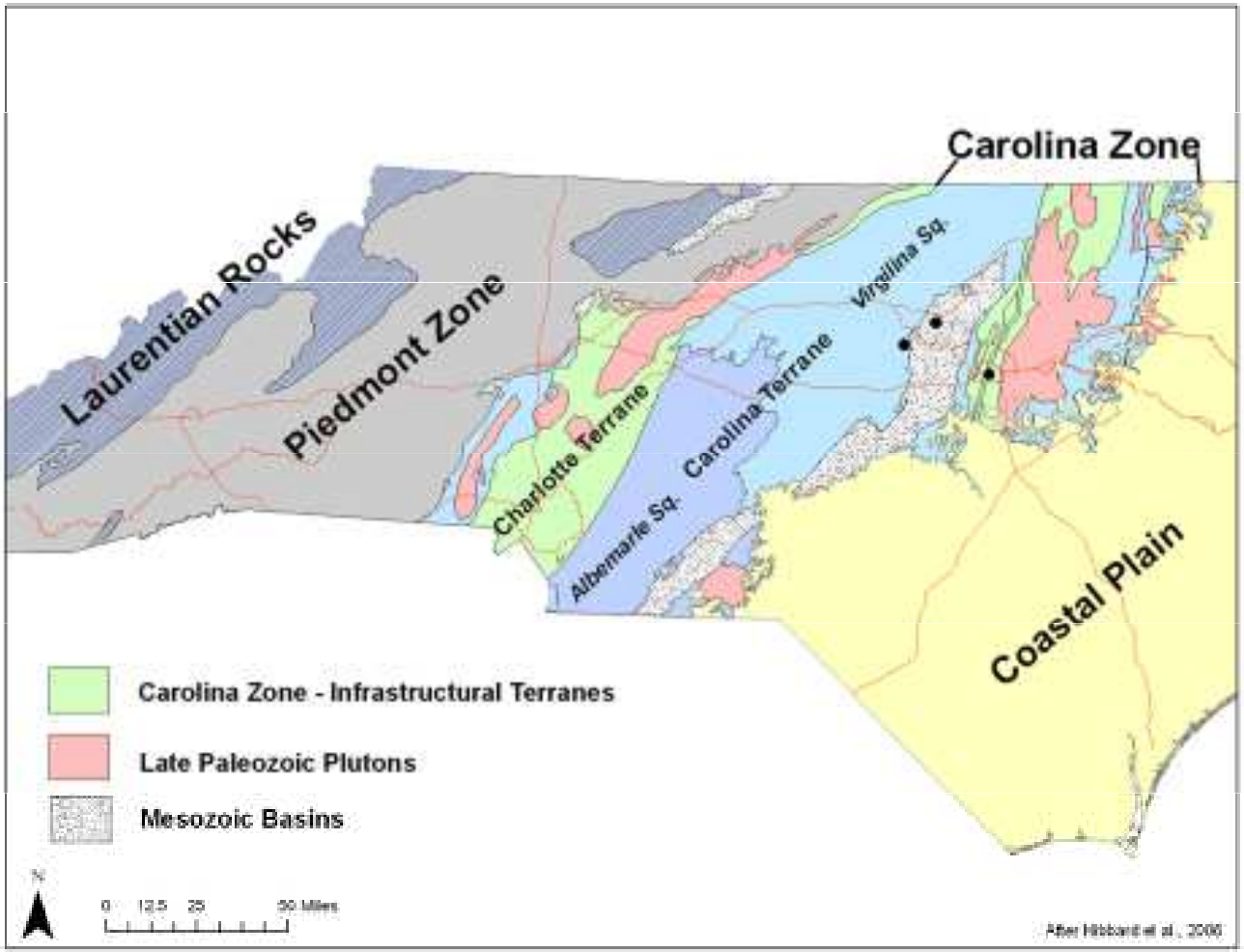


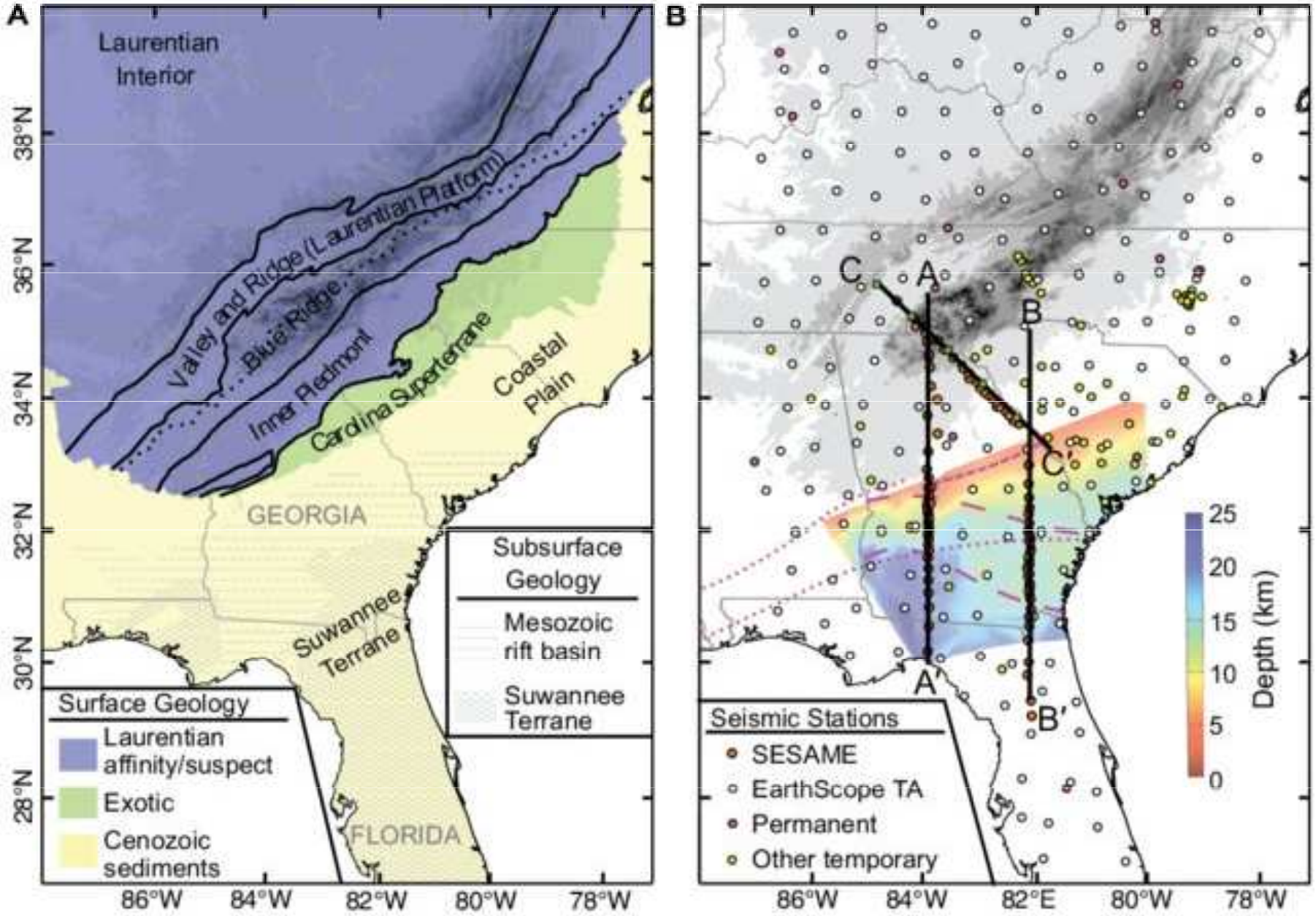


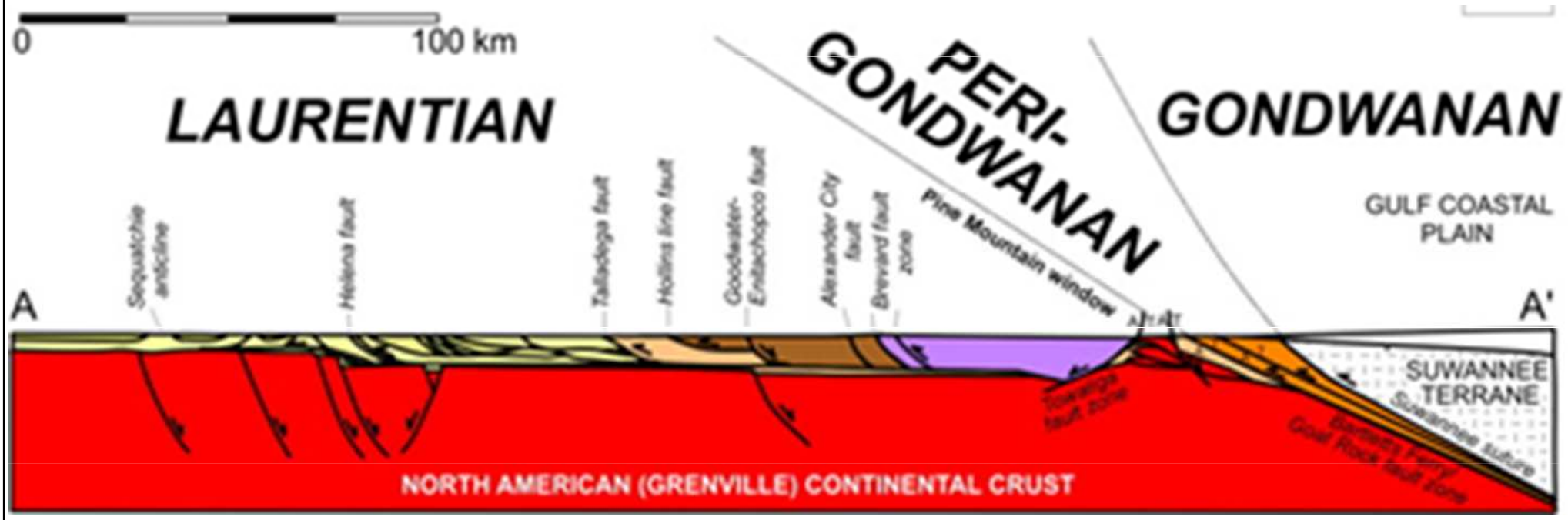
Atlantic Ocean Opens. Ancient ocean rocks are left behind as the Piedmont Province, along with a sliver of Africa that now lies beneath the Coastal Plain of Florida and offshore regions of Georgia and the Carolinas (purple).

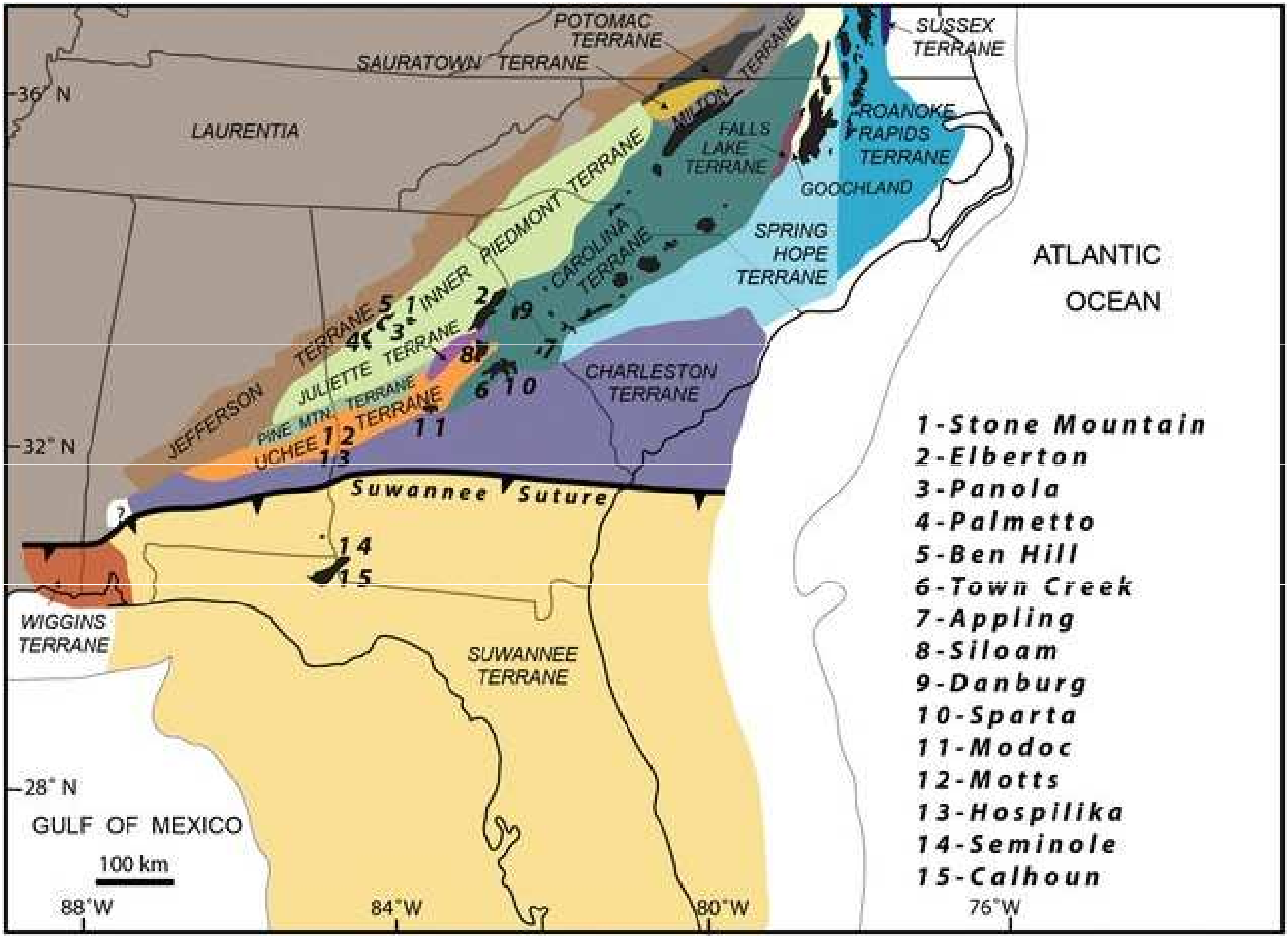
Atlantic coastal plain

Atlantic coastal plain – z velké části tvořená **africkou** částí **Gondwany** překrytou mladšími mezozoickými a terciérními sedimenty. Probíhá zde sutura Suwanee, detekovaná geofyzikálně. Odděluje gondwanský terán **Charleston**, **Suwanee** a další od zóny Carolinia



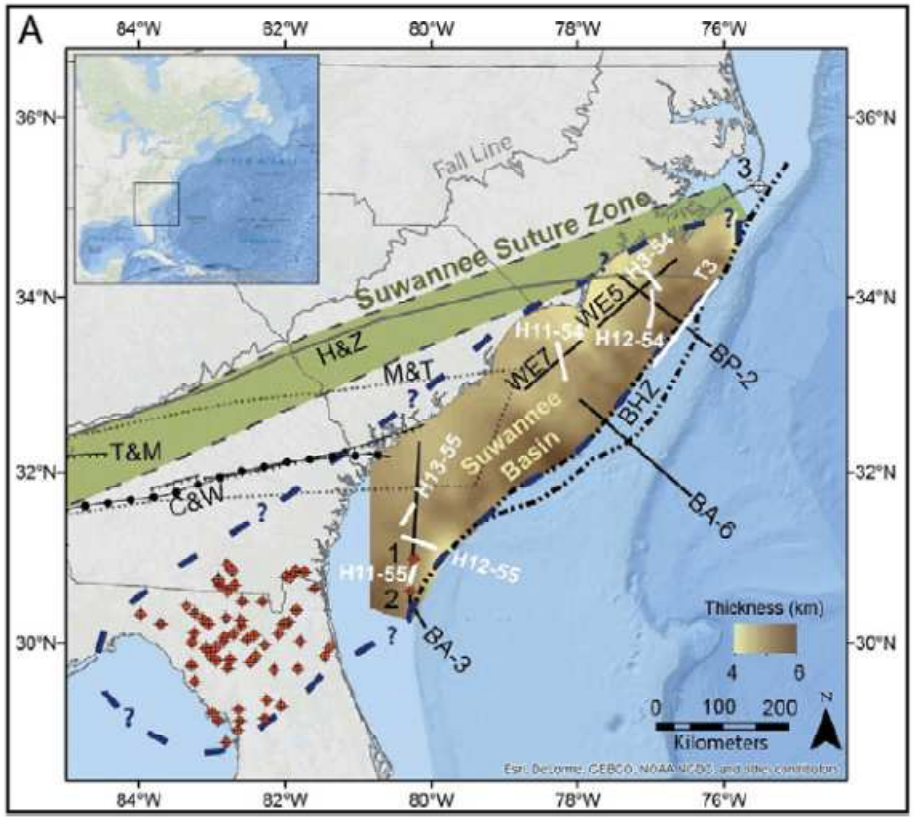

A
Laurentian Interior
Valley and Ridge (Laurentian Platform)
Blue Ridge
Inner Piedmont
Carolina Superterrane
Coastal Plain
GEORGIA
Suwannee Terrane
FLORIDA
Subsurface Geology
Mesozoic rift basin
Suwannee Terrane
Surface Geology
Laurentian affinity/suspect
Exotic
Cenozoic sediments
38°N
36°N
34°N
32°N
30°N
28°N
86°W
84°W
82°W
80°W
78°W
B
C
A
B
C'
A'
B'
Seismic Stations
SESAME
EarthScope TA
Permanent
Other temporary
25
20
15
10
5
0
Depth (km)
86°W
84°W
82°E
80°W
78°W

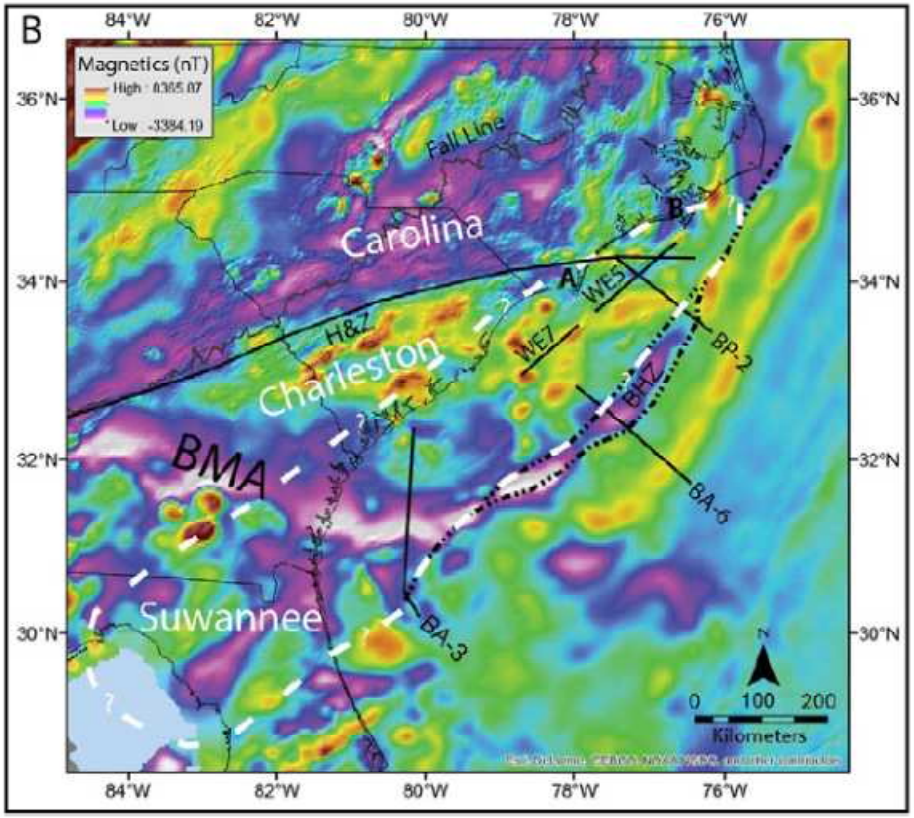

0
100 km
LAURENTIAN
PERI-GONDWANAN
GONDWANAN
GULF COASTAL PLAIN
Sequatchie anticline
Helena fault
Talladega fault
Hollins line fault
Goodwater-Enitachopco fault
Alexander City fault
Brevard fault zone
Pine Mountain window
A
A'
SUWANNEE TERRANE
NORTH AMERICAN (GRENVILLE) CONTINENTAL CRUST



Older interprettaion od Suwanee suture

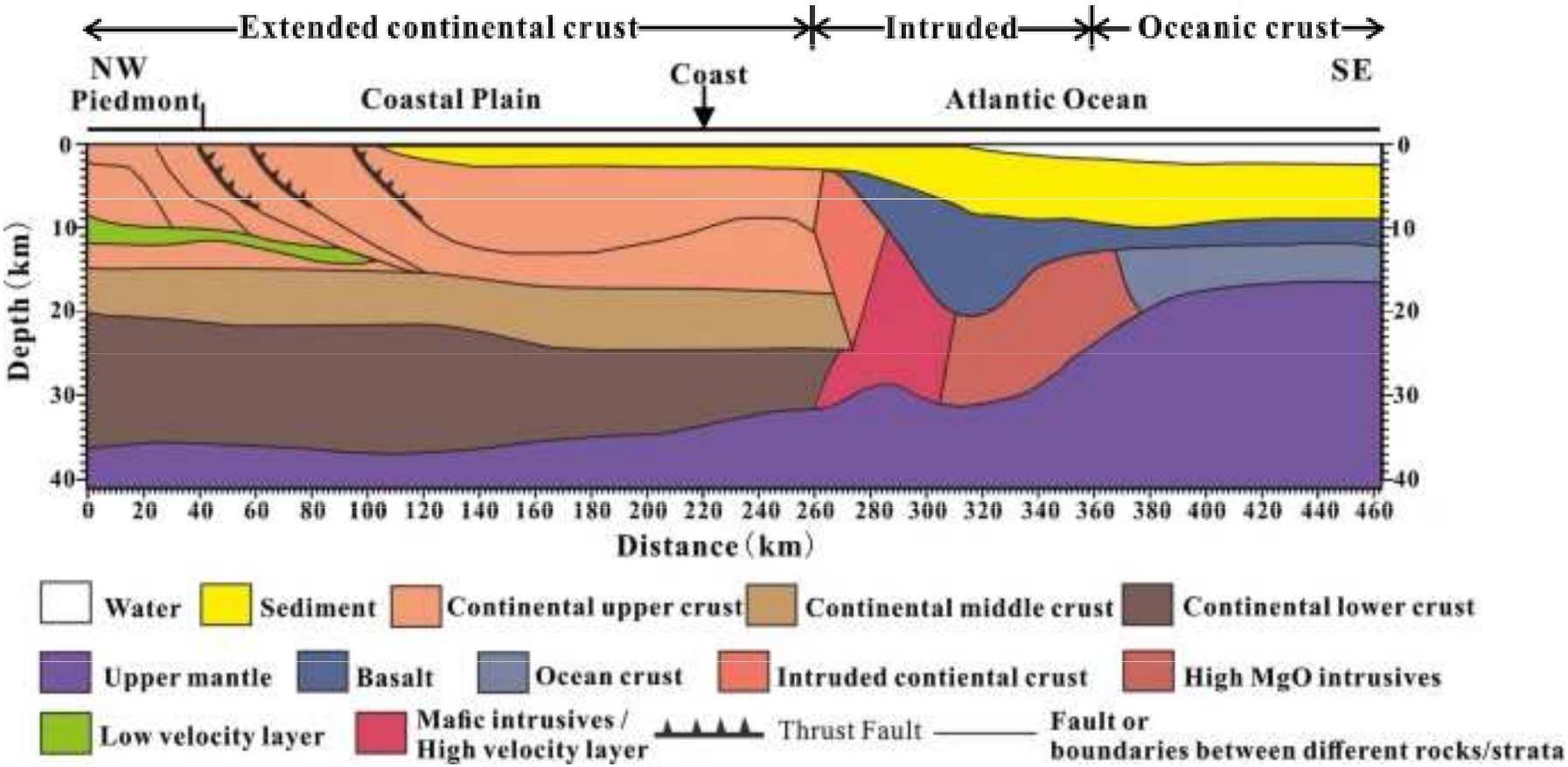
Sutura **Suwanee** oddělující zónu **Carolina** od **africké části Gondwany**, která po otevření Atlantiku zůstala součásti Severní Ameriky.

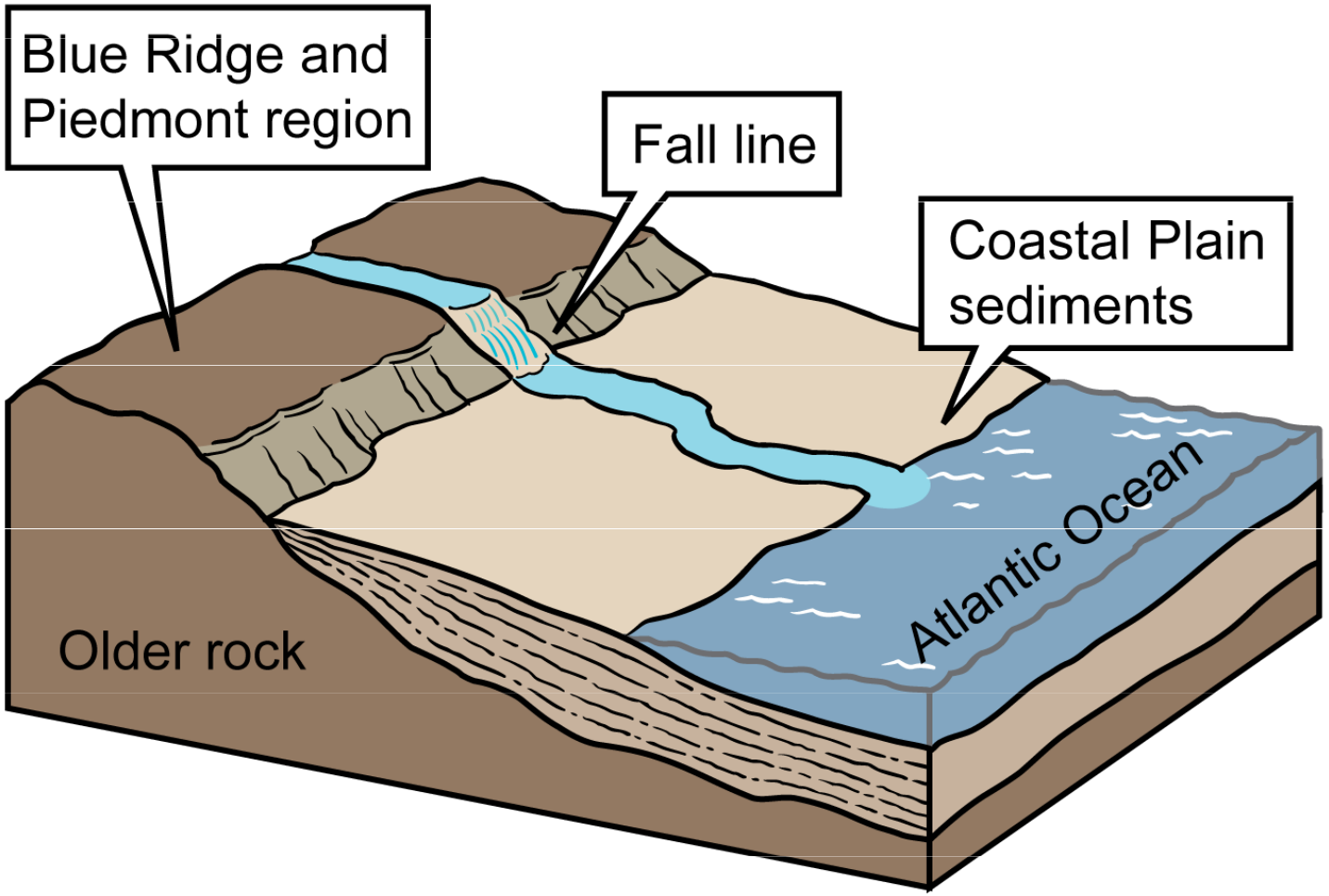


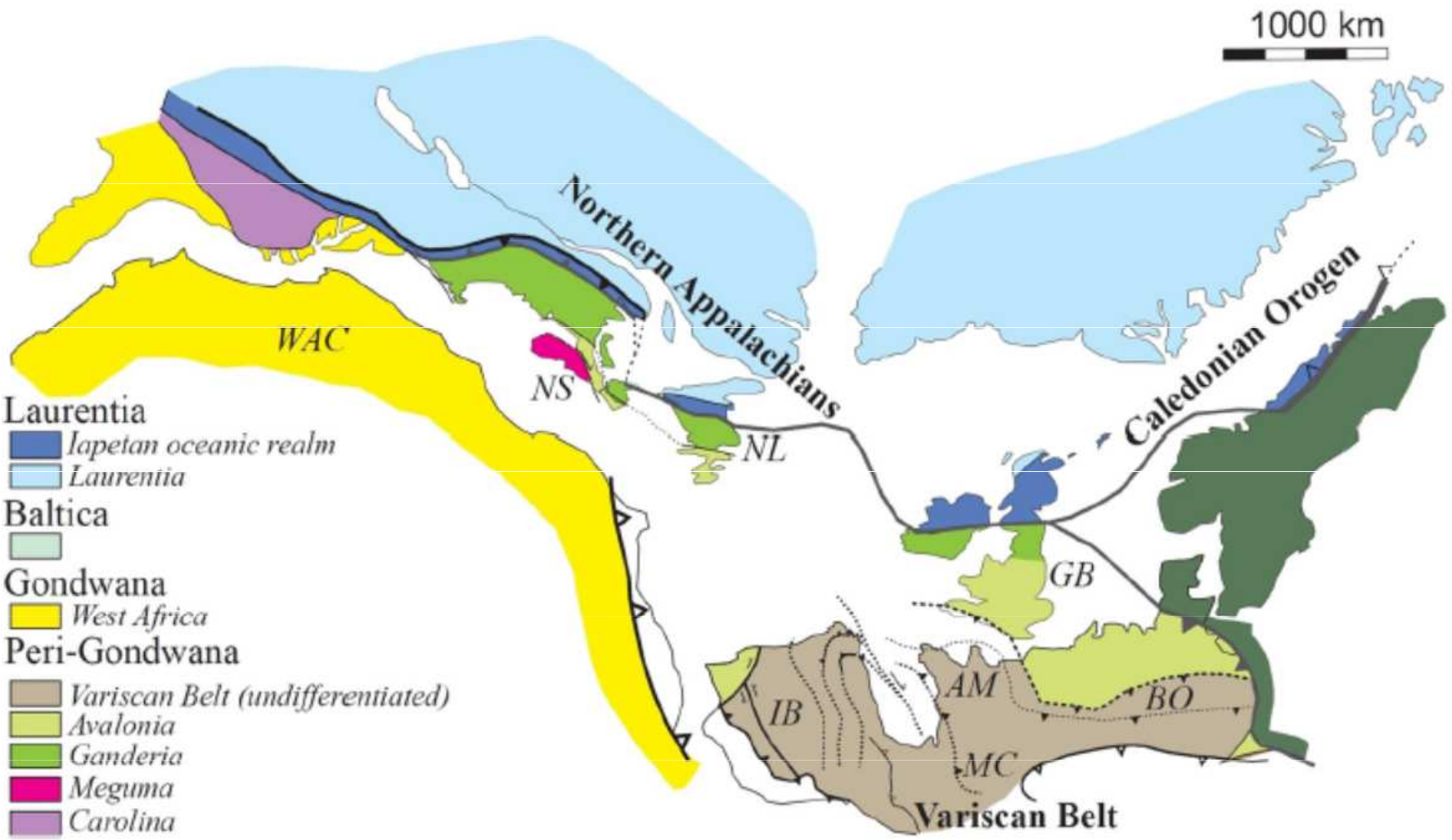


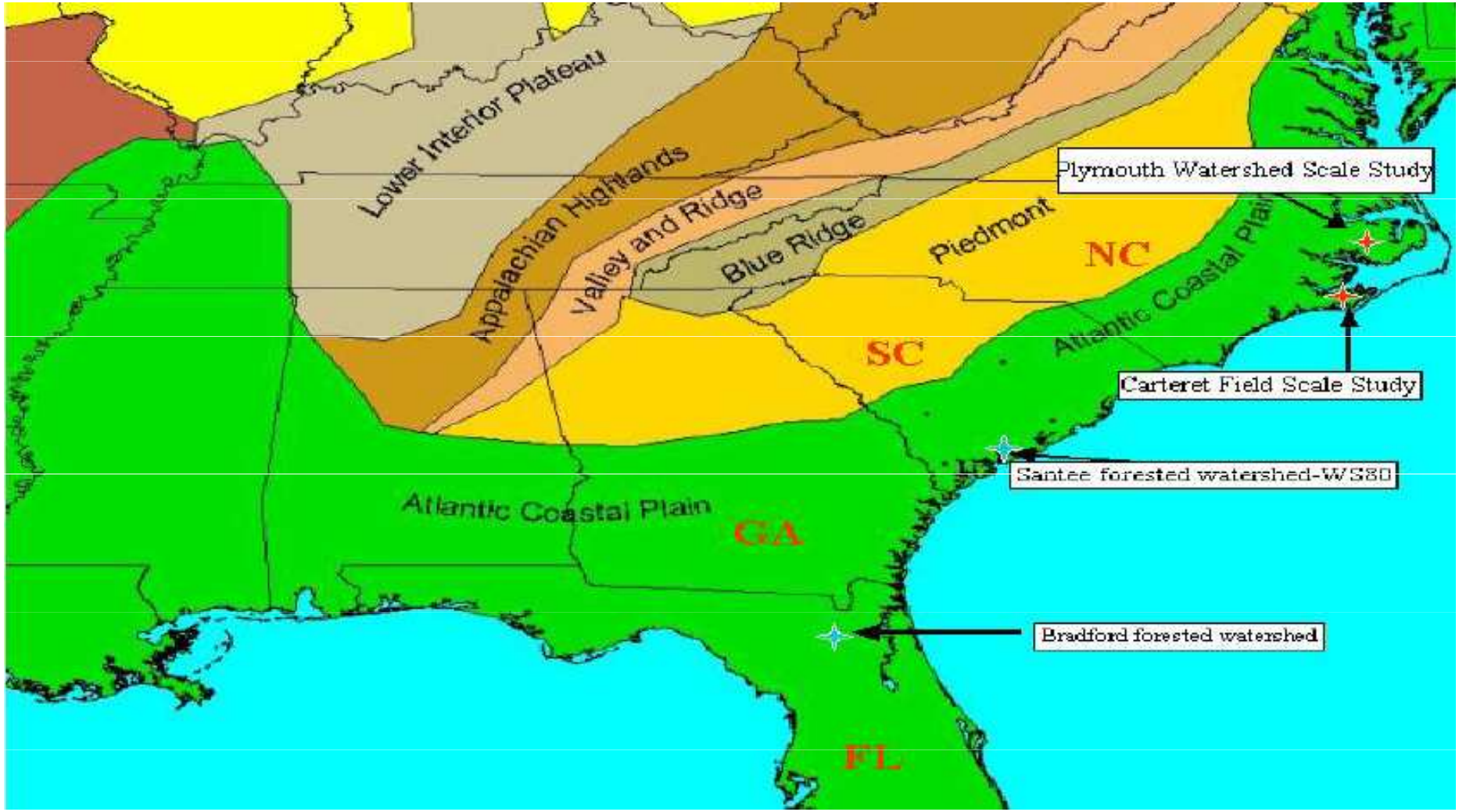
Terranes Charleston, Brunswick, Suwannee, Northern Florida, Uchee, Savanah were continuous piece of Gondwanan continental crust

In the Mesozoic, **continental rifting** and break-up of **Pangea** resulted in the development of onshore Triassic-Jurassic rift basins, emplacement of mafic rocks of the Central Atlantic Magmatic Province (~201 Ma), and ultimately the **formation of the Atlantic passive margin leaving a fragment of Gondwana attached to North America.**




Blue Ridge and
Piedmont region
Fall line
Coastal Plain
sediments
Atlantic Ocean
Older rock


1000 km
Northern Appalachians
Caledonian Orogen
WAC
NS
NL
GB
AM
BO
IB
MC
Variscan Belt
Laurentia
Iapetan oceanic realm
Laurentia
Baltica
Gondwana
West Africa
Peri-Gondwana
Variscan Belt (undifferentiated)
Avalonia
Ganderia
Meguma
Carolina


Lower Interior Plateau
Appalachian Highlands
Valley and Ridge
Blue Ridge
Piedmont
NC
SC
GA
FL
Atlantic Coastal Plain
Plymouth Watershed Scale Study
Carteret Field Scale Study
Santee forested watershed-WS80
Bradford forested watershed

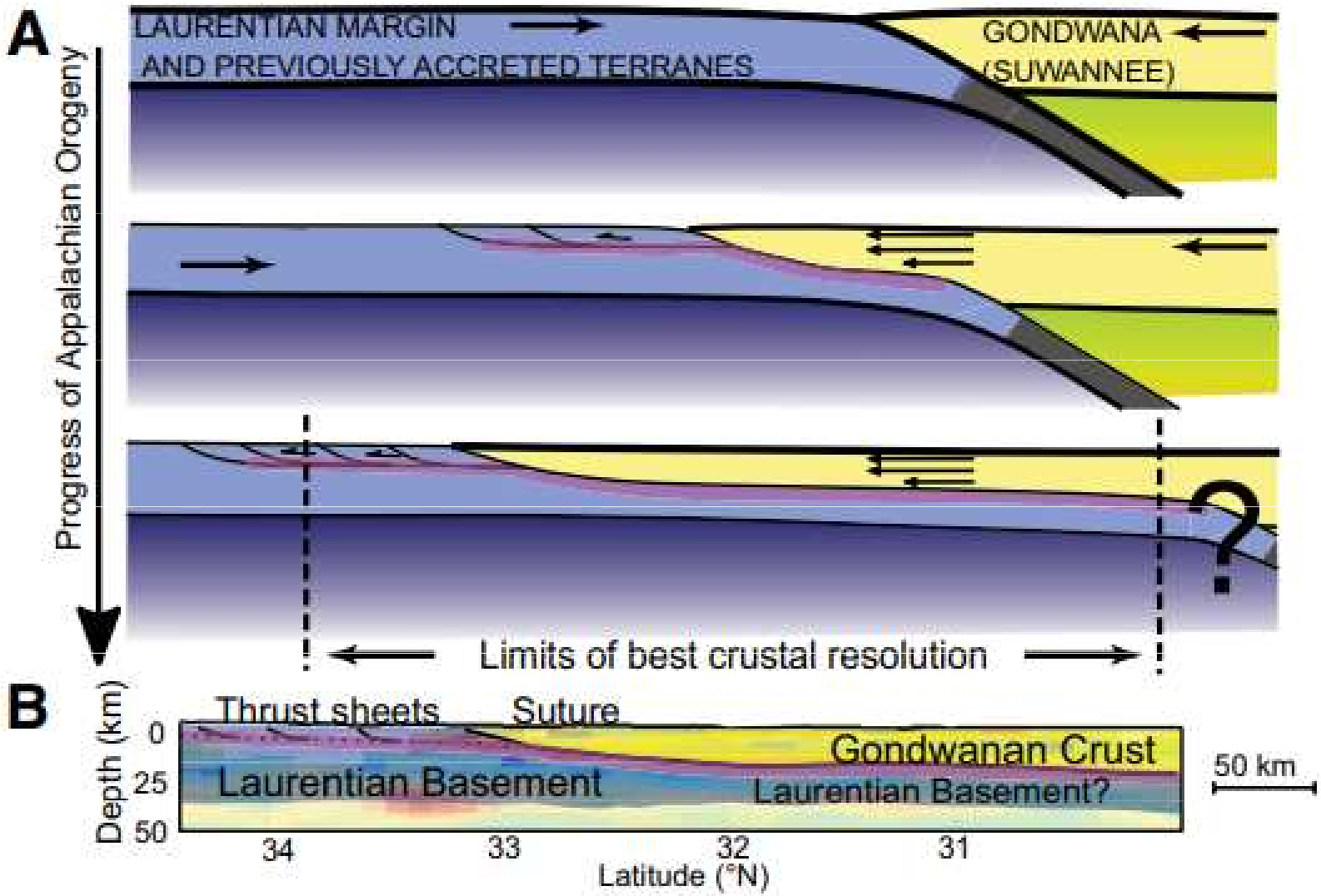
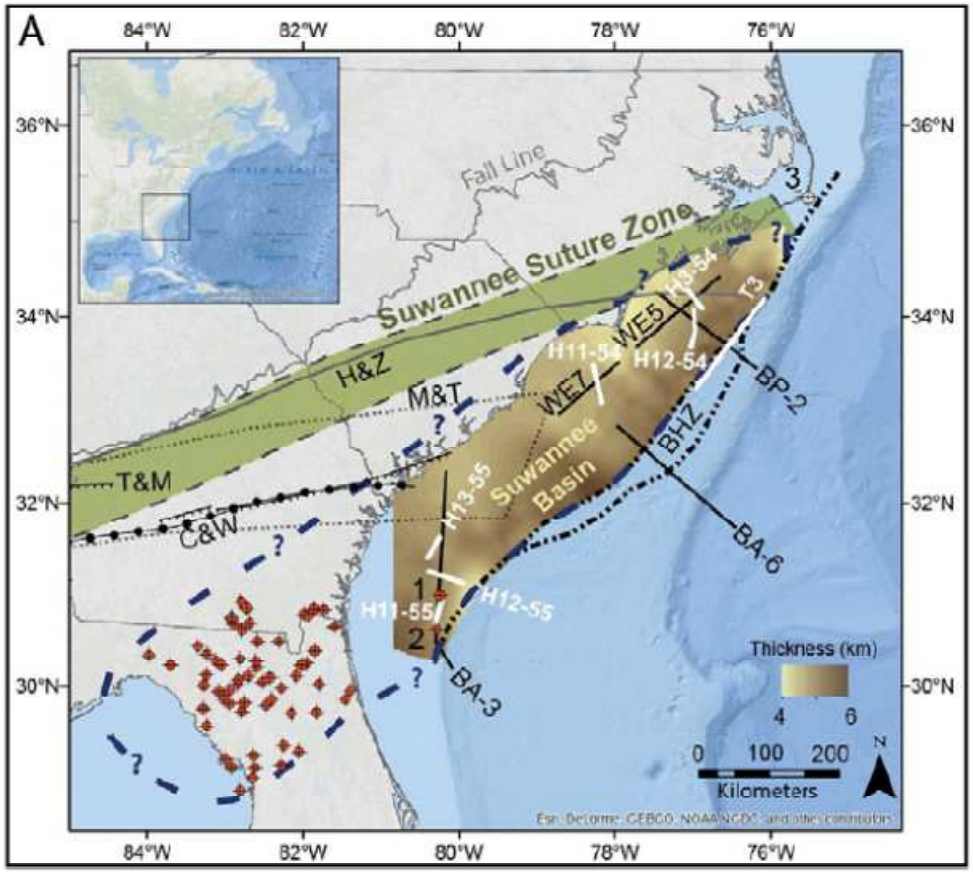
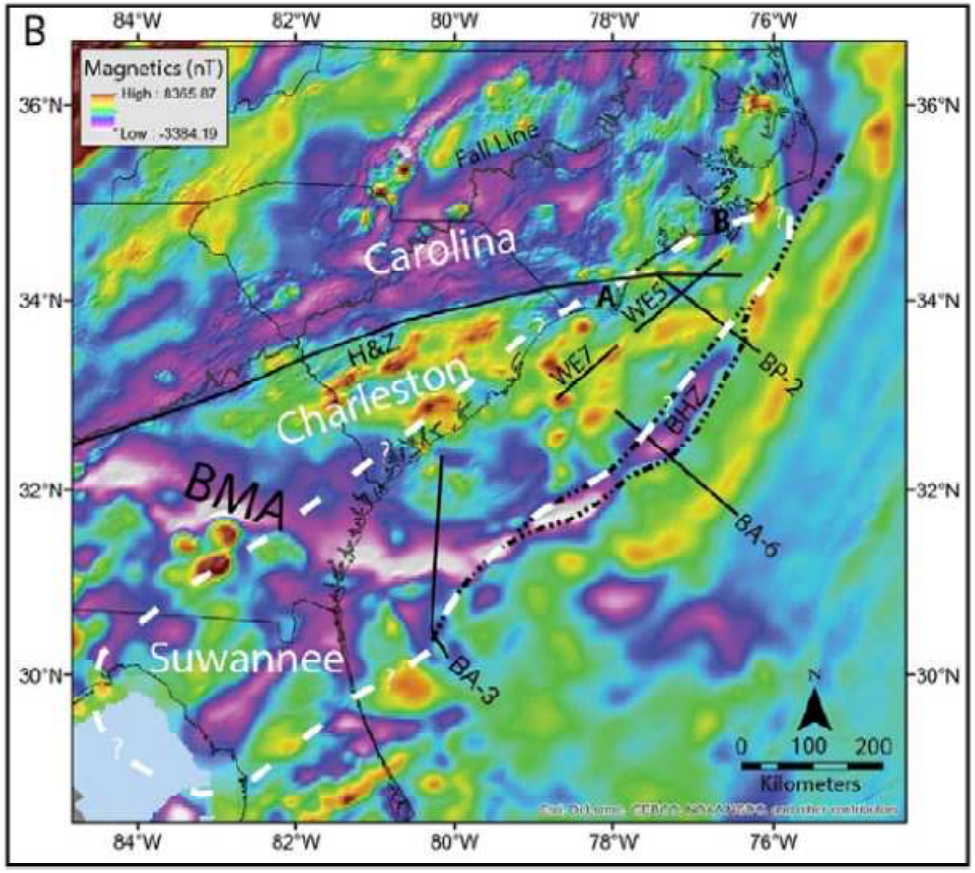
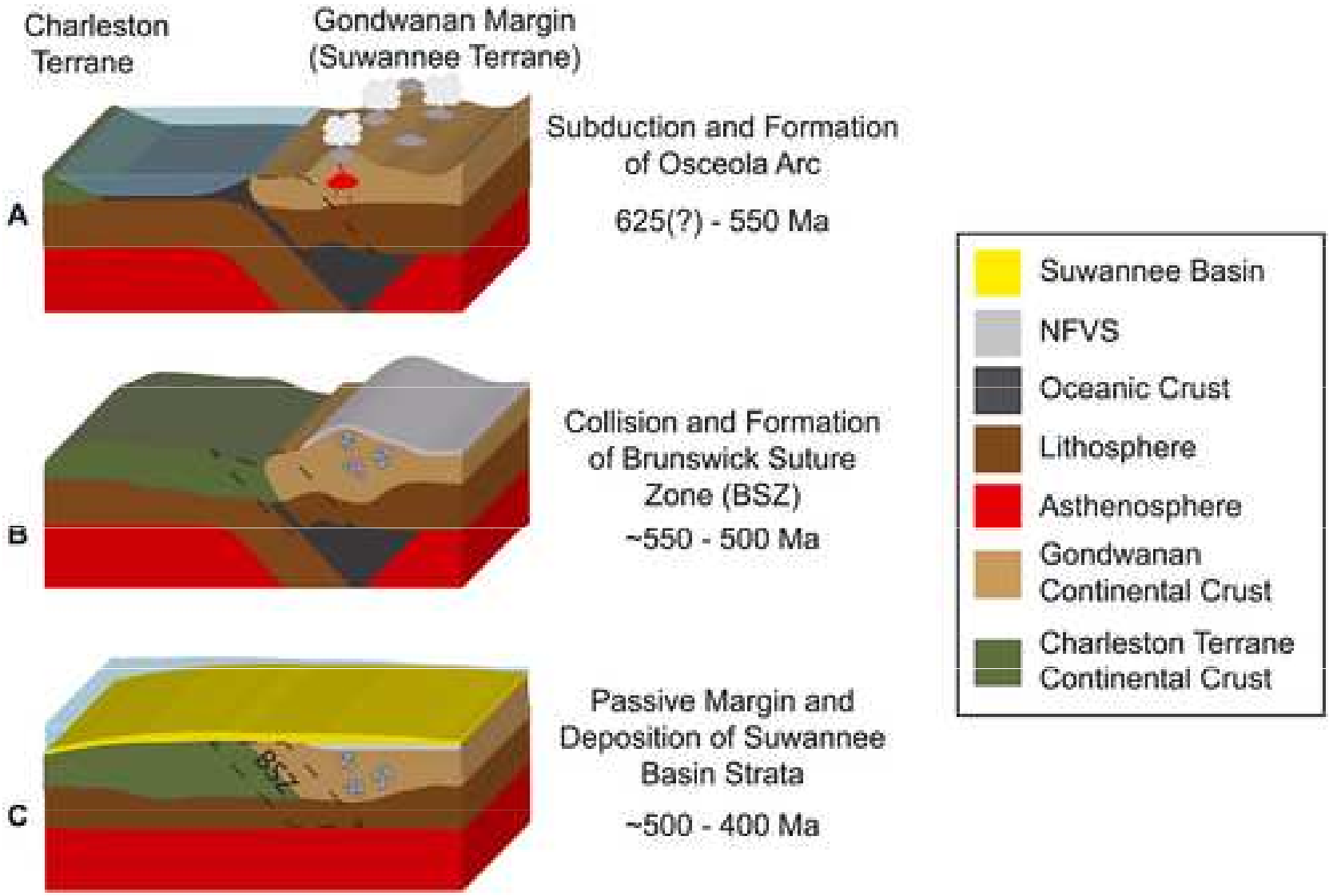


Figure 4. Interpretation ofcrustal structure observed in the southeastern UnitedStates (see Fig. 2). A:Schematic showing pro - posed progression of final stages of Appalachian orogeny, from late Mis -sissippian (top panel) toend of collision in Permian(bottom panel). (18) (PDF) Reconstructing the end of the Appalachian orogeny. Available from: https://www.researchgate.net/publication/309874824_Reconstructing_the_end_of_the_Appalachian_orogeny [accessed Nov 02 2024].





Terranes Charleston, Brunswick, Suwannee, Northern Florida were continuous piece of Gondwanan continental crust



Cartoon depicting the inferred tectonic evolution of the Gondwanan continental margin (present-day combined Suwannee and Charleston terranes) from mid-Neoproterozoic through Early Devonian time. The Osceola continental margin arc (documented in 40 wells that penetrate the Coastal Plain unconformity) evolved above a south dipping (present-day coordinates) subduction zone, culminating in collision of the Charleston terrane with Gondwana/Suwannee and formation of the Brunswick suture zone. Subsequently, passive margin sediments (Suwannee Basin) buried the margin and suture zone. Data and interpretations presented here constitute a significant departure from previous interpretations of the age and tectonic significance of the southeast dipping crustal-scale reflectivity associated with the Brunswick Magnetic Anomaly.

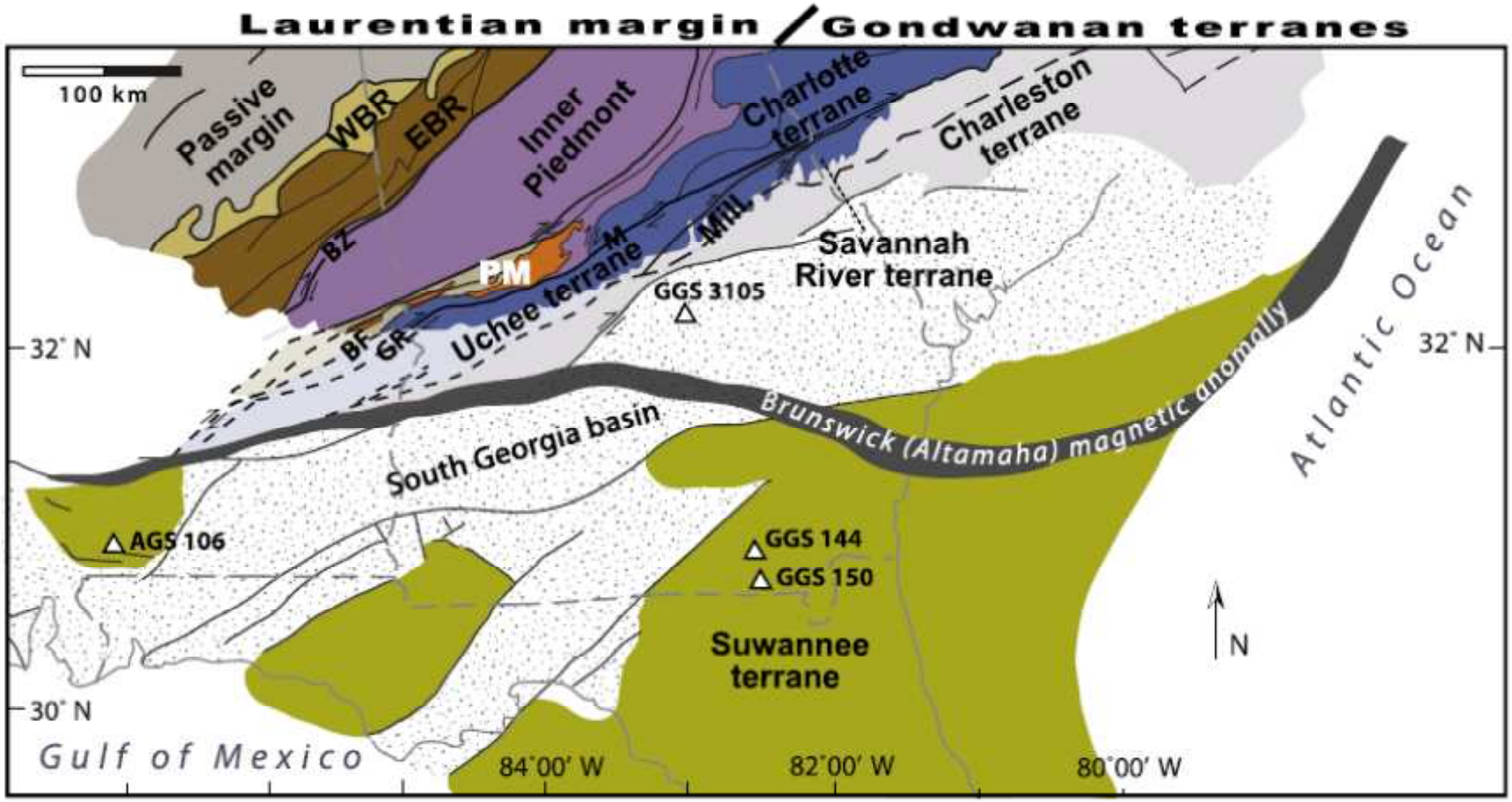
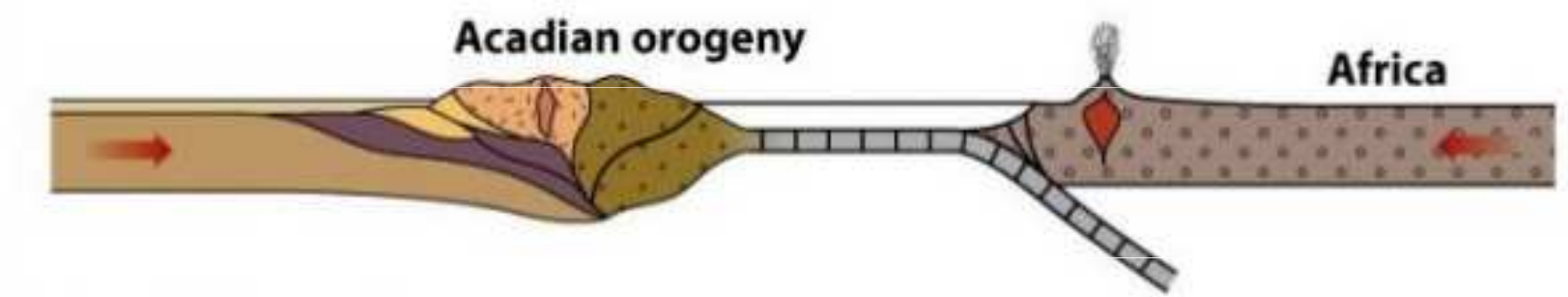


Fig. 2. Schematic depiction of themajor terranes and structureswithin and adjacent to the Suwannee suture zone in the southern Appalachians compiled fromHeatherington andMueller (1999) and Steltenpohl et al. (2008); and our interpretations. Also shown are the Brunswick (Altamaha)magnetic anomaly (a Paleozoic orMesozoic feature that does notmark the suture) and the Mesozoic South Georgia basin. Abbreviations: PM, Pine Mountain block; EBR, eastern Blue Ridge; WBR, western Blue Ridge; BZ, Brevard zone; Mill, Milledgeville terrane; BF, Barlett's Ferry shear zone; GR, Goat Rock shear zone; andM, Modoc shear zone. The Charleston-Savannah River terrane boundary remains poorly defined and is not included on themap.

Case Study - Appalachians

E-dipping subduction continued to close the ocean.



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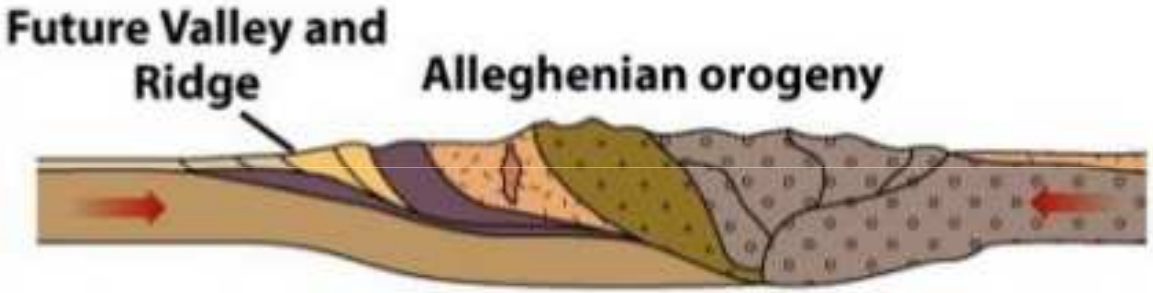


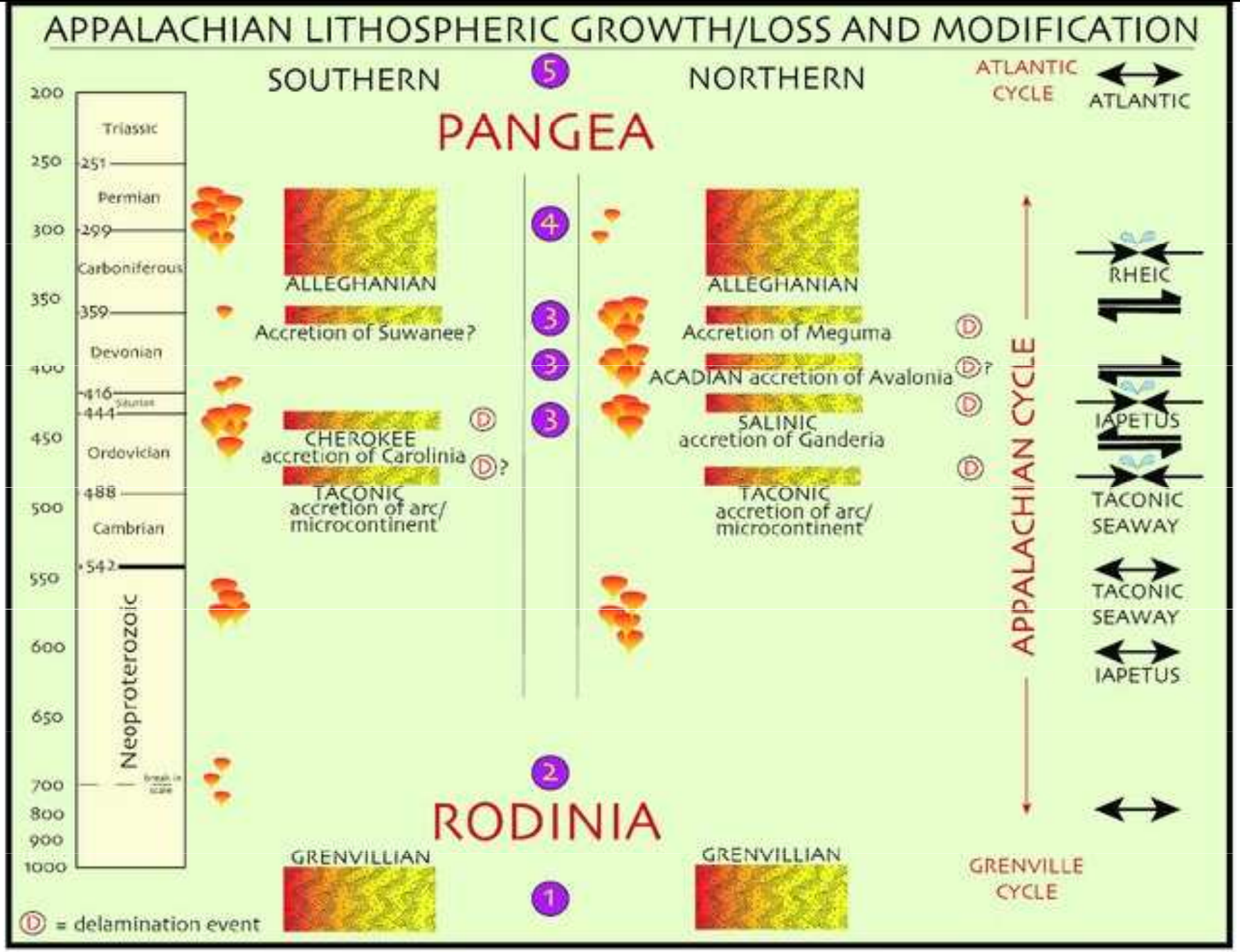


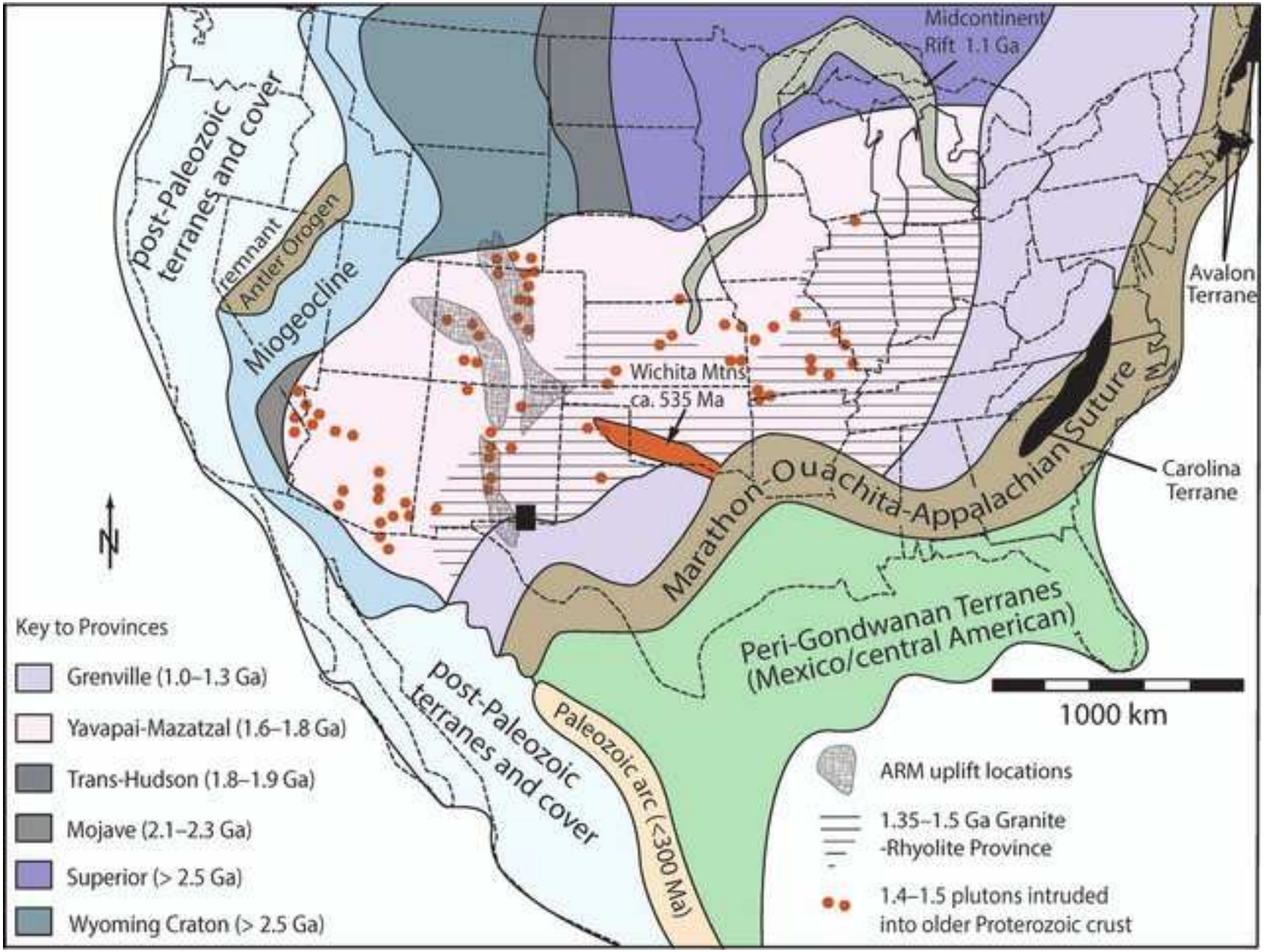
Figure 3. Timeline of the Appalachian cycle, showing major episodes of lithospheric growth, modification, and loss; encircled numbers correspond to descriptions cited in text. Patterned boxes = times of major tectonothermal events, balloons = qualitative representation of volume of magmatism, diverging black arrows = rift events, converging black arrows = ocean closure events, opposing black arrows = sense of dominant strike slip component of plate motion.

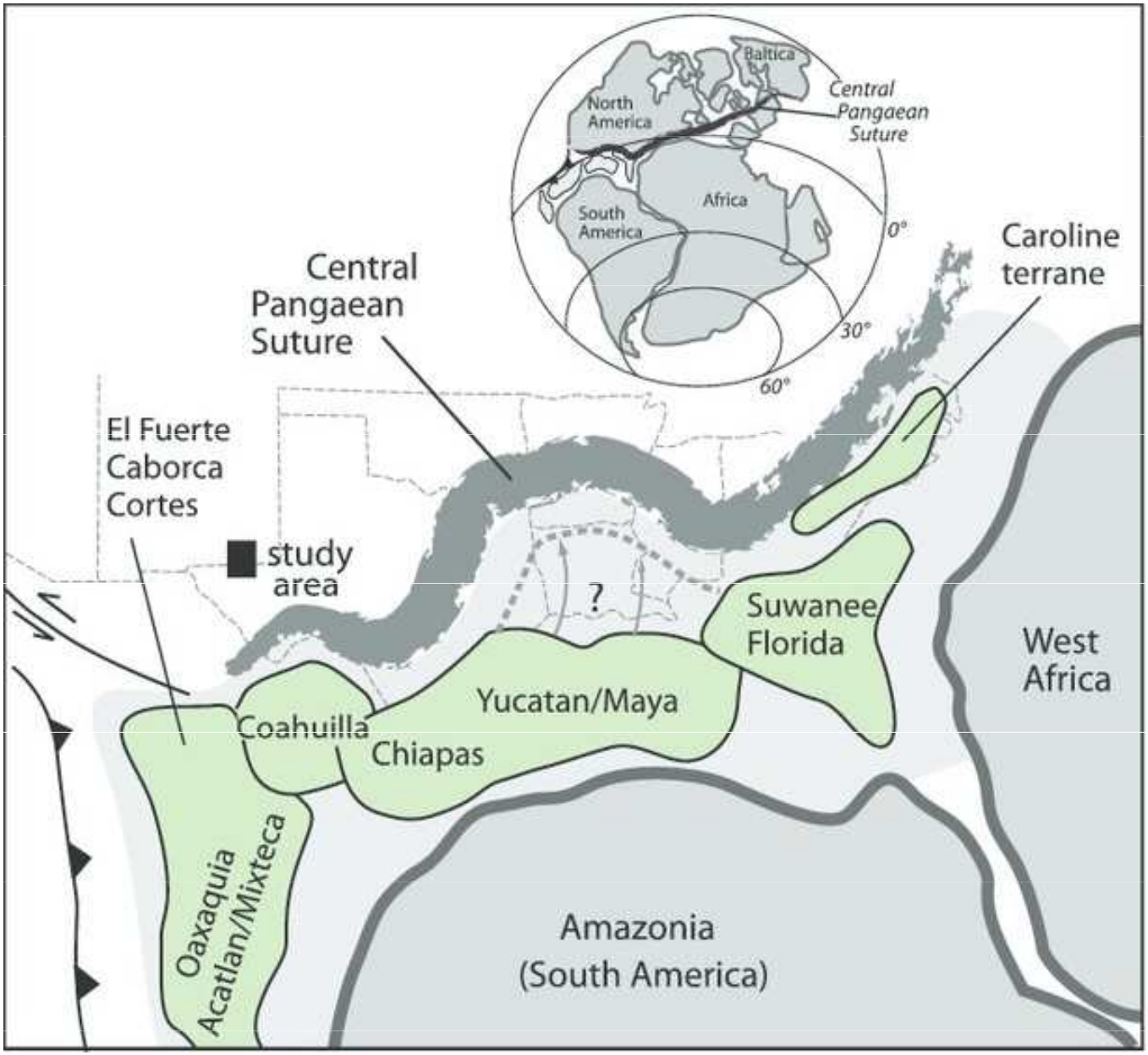
https://www.youtube.com/watch?v=jzYJVFD0MRo

Pásmo Quachita-Marathon

Orogeneze Quachita-Marathon zahrnovala kolizi **Gondwany** a jižního okraje Severní Ameriky. Během **alleghanské** orogeneze v období mezi 325 až 260 Ma se uzavřel **Rheický** oceán a **laurentská** deska subdukovala pod na sever se sunoucí **jihoamerický** kontinentální oblouk.

South America approached Laurentia as the intervening oceanic crust was subducted. The collision of South American and Laurentian continental crust compressed and **uplifted the region to form the Ouachita Mountains**. The Ouachita Mountains were extensively **eroded between the Permian and the Jurassic**, and much of the Ouachita system was subsequently **buried** beneath **Mesozoic and Cenozoic sediments** to the southeast and southwest. The structures there have only been revealed through deep **drilling in petroleum** exploration


Midcontinent Rift 1.1 Ga
post-Paleozoic terranes and cover
remnant Antler Orogen
Miogeocline
Wichita Mtns ca. 535 Ma
Avalon Terrane
Marathon-Ouachita-Appalachian Suture
Carolina Terrane
Peri-Gondwanan Terranes (Mexico/central American)
post-Paleozoic terranes and cover
Paleozoic arc (<300 Ma)
1000 km
N
Key to Provinces
Grenville (1.0–1.3 Ga)
Yavapai-Mazatzal (1.6–1.8 Ga)
Trans-Hudson (1.8–1.9 Ga)
Mojave (2.1–2.3 Ga)
Superior (> 2.5 Ga)
Wyoming Craton (> 2.5 Ga)
ARM uplift locations
1.35–1.5 Ga Granite -Rhyolite Province
1.4–1.5 plutons intruded into older Proterozoic crust



Interpretations vary for the exact placements and relative positions of these peri-Gondwanan Mexican **terranes**

FIG. 8.—Map depicting terranes accreted and uplifted by Permian time in the Ouachita orogenic belt and terranes of Mexico and Central America. Modified from Dickinson and Lawton (2001), Centano-Garcia (2005), Vega-Granillo et al. (2008), and Weber et al. (2008). Note that, on the basis of our new provenance data (see text), we suggest that the Yucatan–Maya terrane may have been closer to the Ouachita suture than these previous authors depicted. Top inset shows larger tectonic context of these terranes in the Central Pangean suture (modified from Keppie et al. 2004).

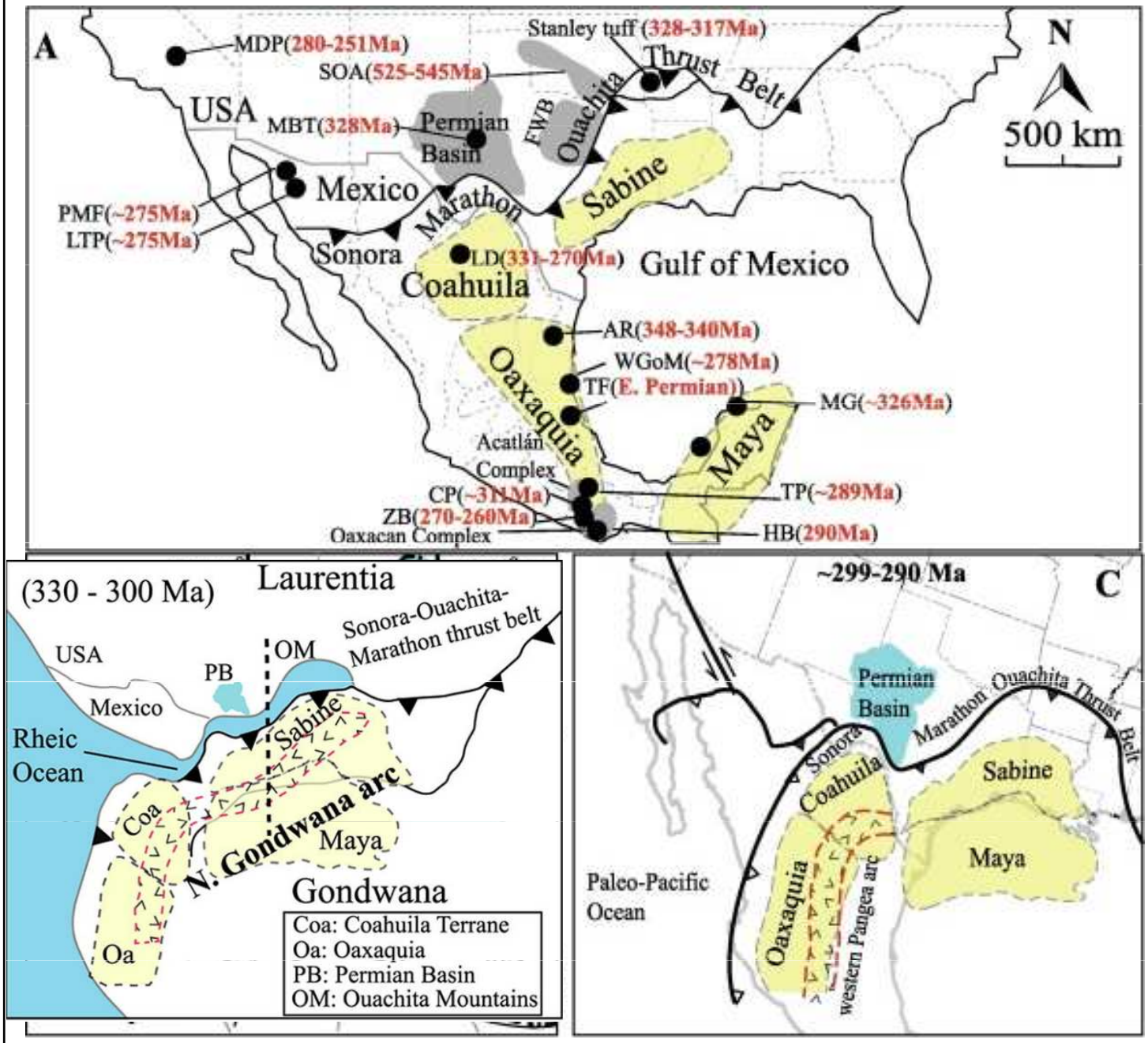


Fig. 1. Simplified geologic map of A) southern North America showing the locations of Peri-Gondwana terranes, the Ouachita-Marathon-Sonora fold and thrust belt, the Permian Basin. C) Paleogeographic map of southern Laurentia and northern Gondwana at ~299–290 Ma.

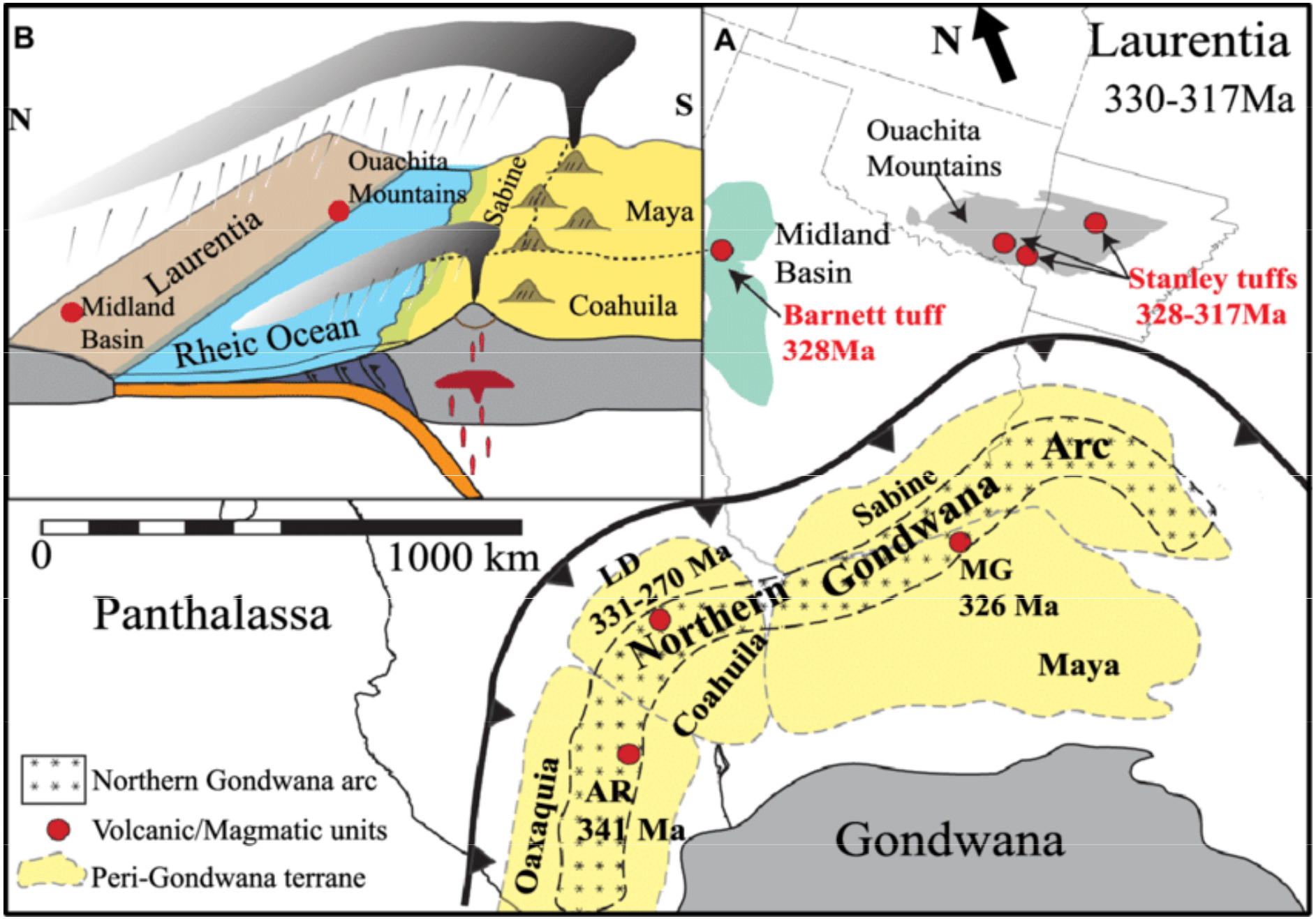


Figure 4. (A) Paleogeographic reconstruction at 330-317 Ma showing location of the Gondwana arc and rock units described in this paper, modified after Lawton et al. (2021). (B) Tectonic model for Late Mississippian magmatic activity in northern Gondwana. AR-Aserradero Rhyolite; LD-Las Delicias arc; MG-granitoids from the Chicxulub Scientific Drilling Project (https://www.icdp-online. org/projects/world/northand-central-america/ chicxulub-2-mexico/) in the Maya block.

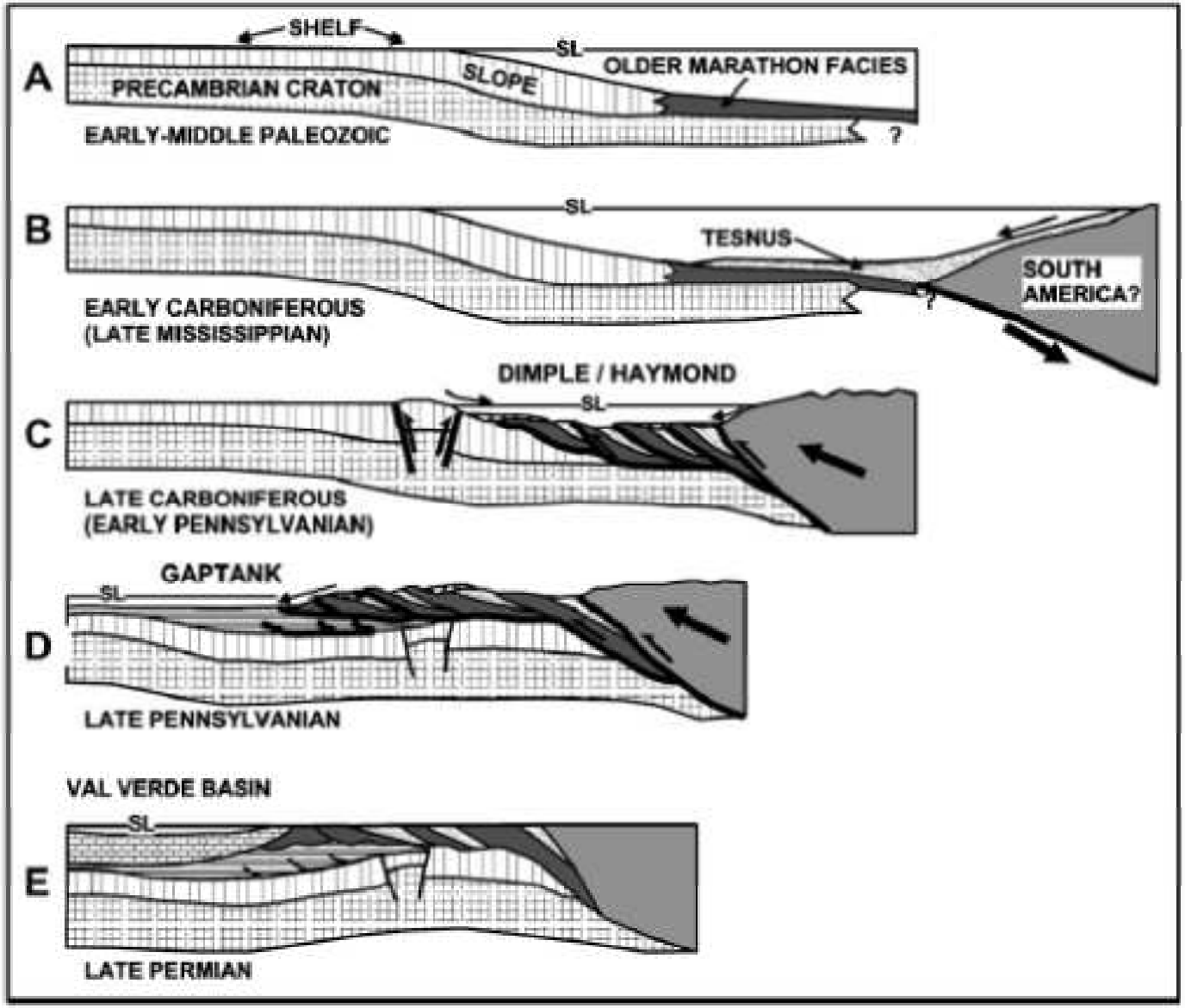


Fig. 9. Schematic diagram showing stages of the evolution of the Marathon thrust belt.

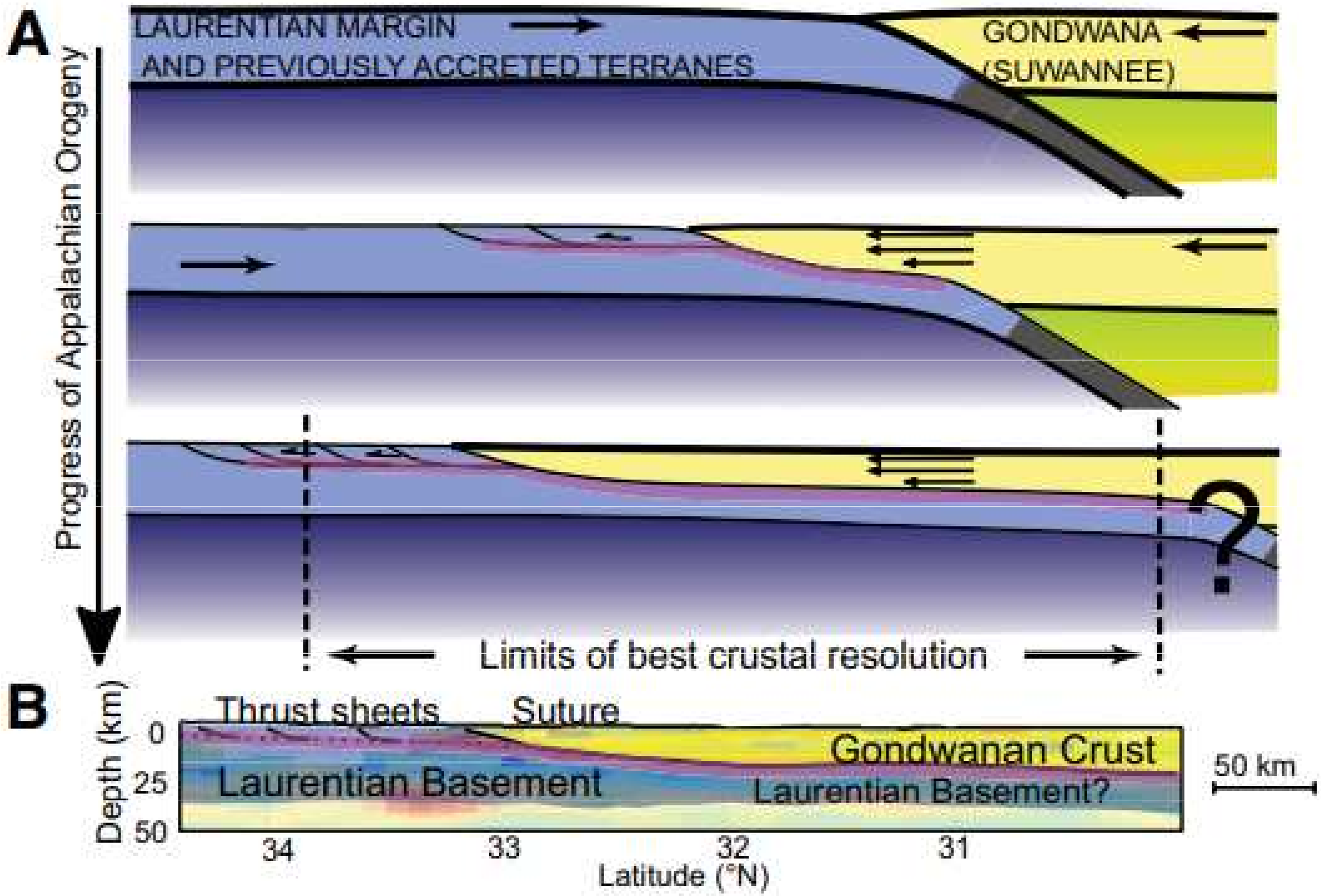
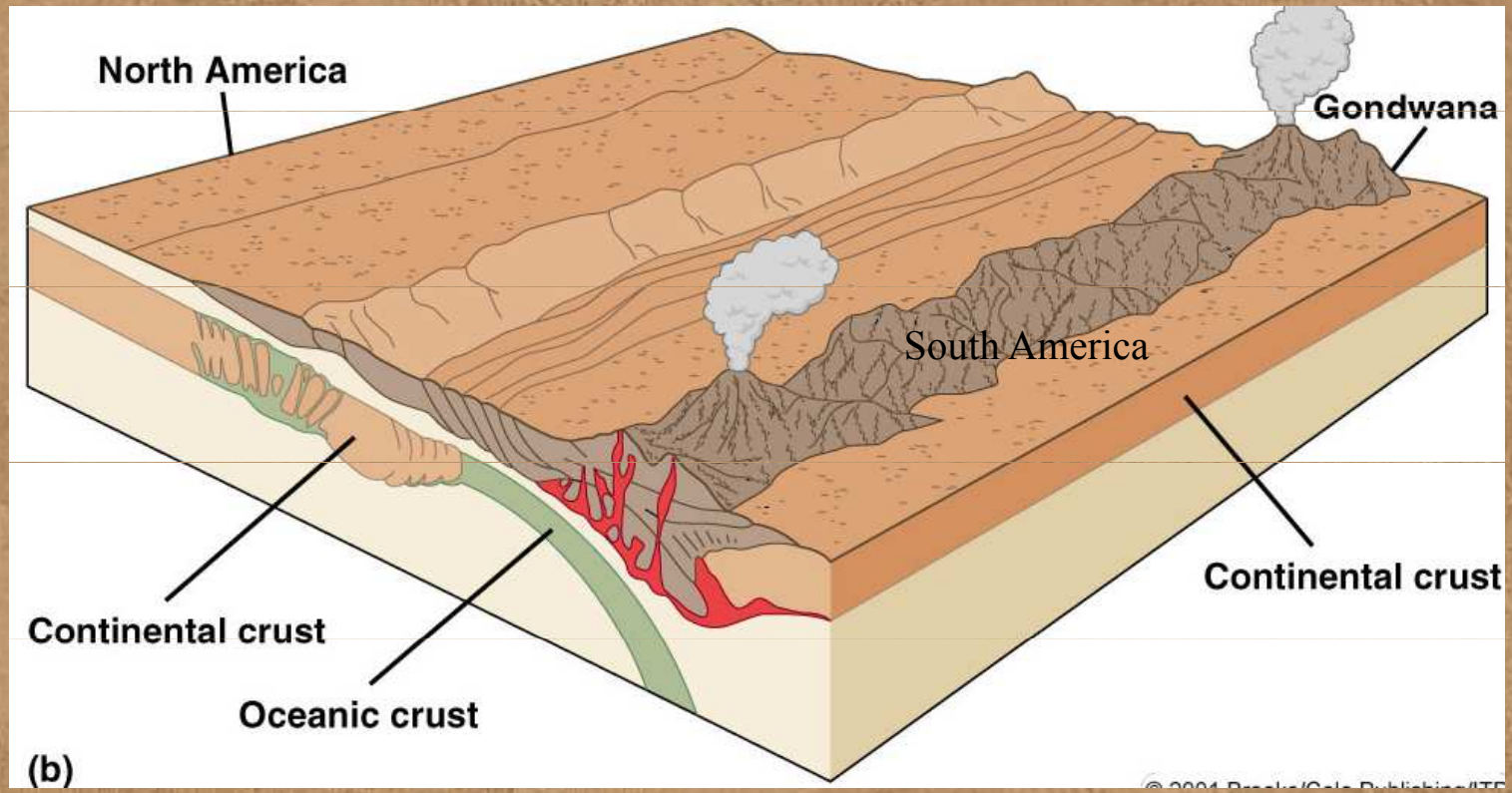


Figure 4. Interpretation ofcrustal structure observed in the southeastern UnitedStates (see Fig. 2). A:Schematic showing pro - posed progression of final stages of Appalachian orogeny, from late Mis -sissippian (top panel) toend of collision in Permian(bottom panel). (18) (PDF) Reconstructing the end of the Appalachian orogeny. Available from: https://www.researchgate.net/publication/309874824_Reconstructing_the_end_of_the_Appalachian_orogeny [accessed Nov 02 2024].

Ouachita Mobile Belt

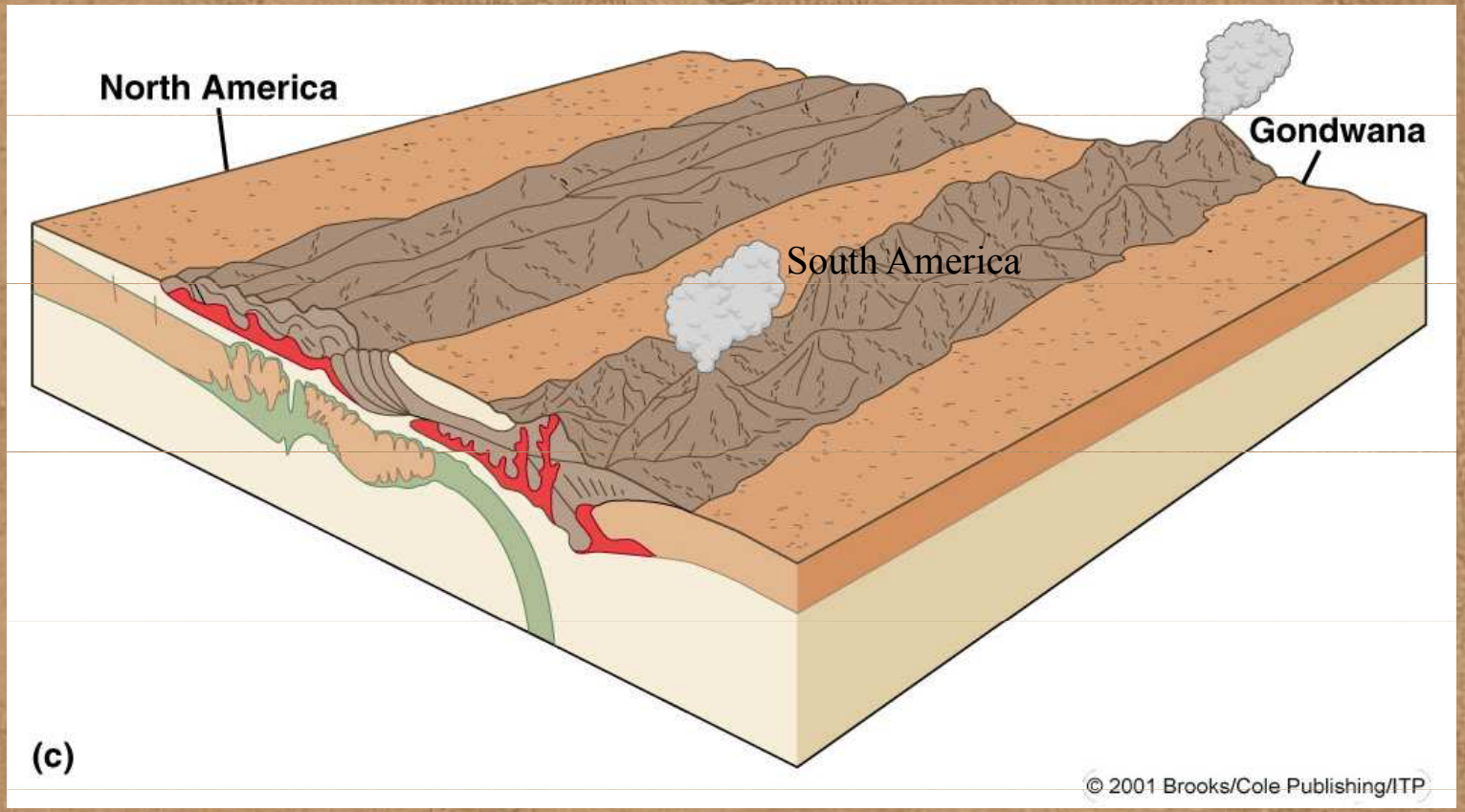
- Incipient continental collision between



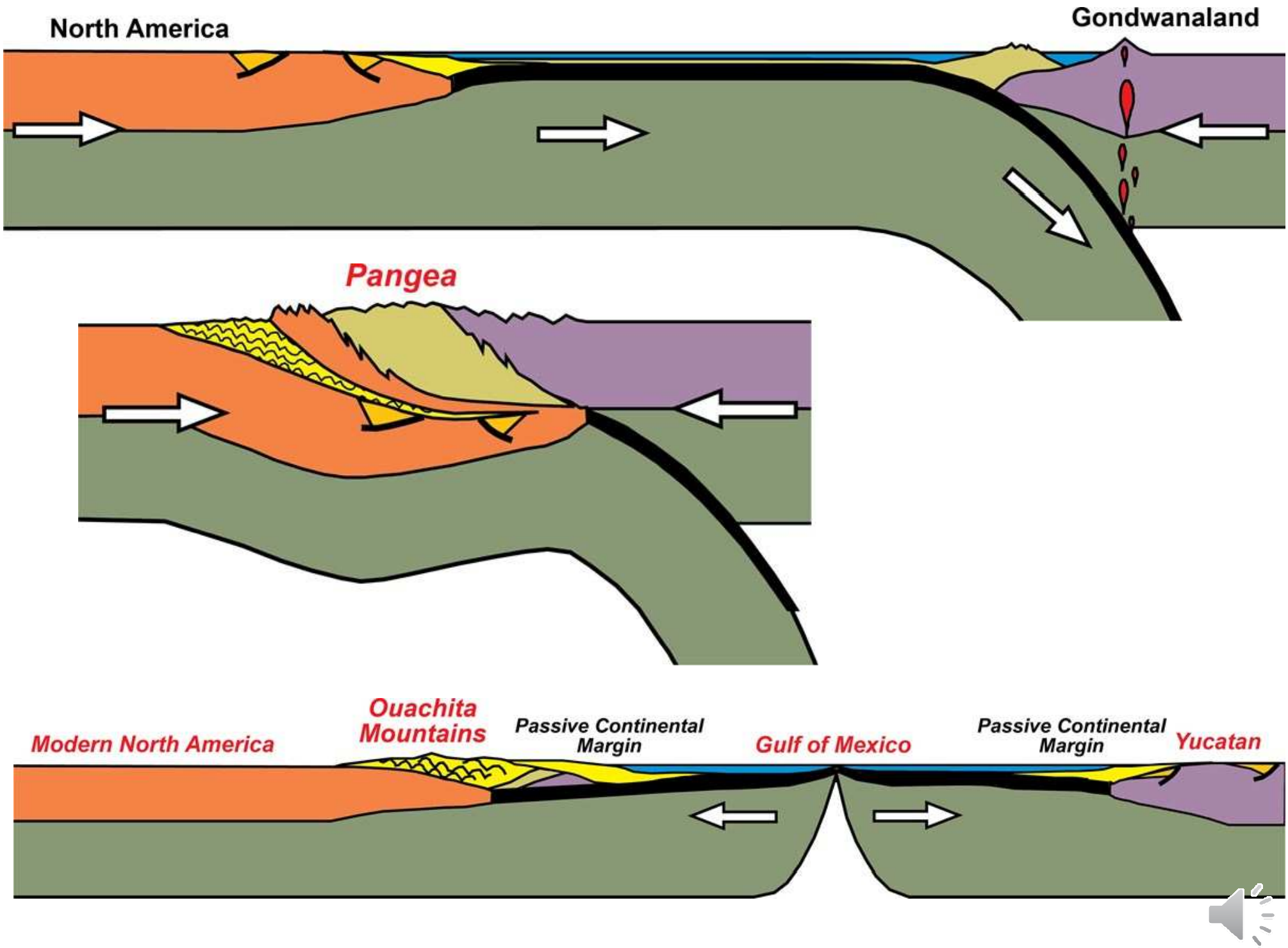
North America and Gondwana began during the Mississippian to Pennsylvanian

Ouachita Mobile Belt

- Continental collision continued during the



Pennsylvanian Period


North America
Gondwanaland
Pangea
Modern North America
Ouachita Mountains
Passive Continental Margin
Gulf of Mexico
Passive Continental Margin
Yucatan

Orogeneze Quachita-Marathon reaktivovala starší zlomové struktury v předpolí, kde se vytvořily v Texasu a Novém Mexiku významné **permské pánve** s důležitými ložisky **nafty a plynu**

The Permian Basin is a complex sedimentary system located in the foreland of the Marathon–Ouachita orogenic belt

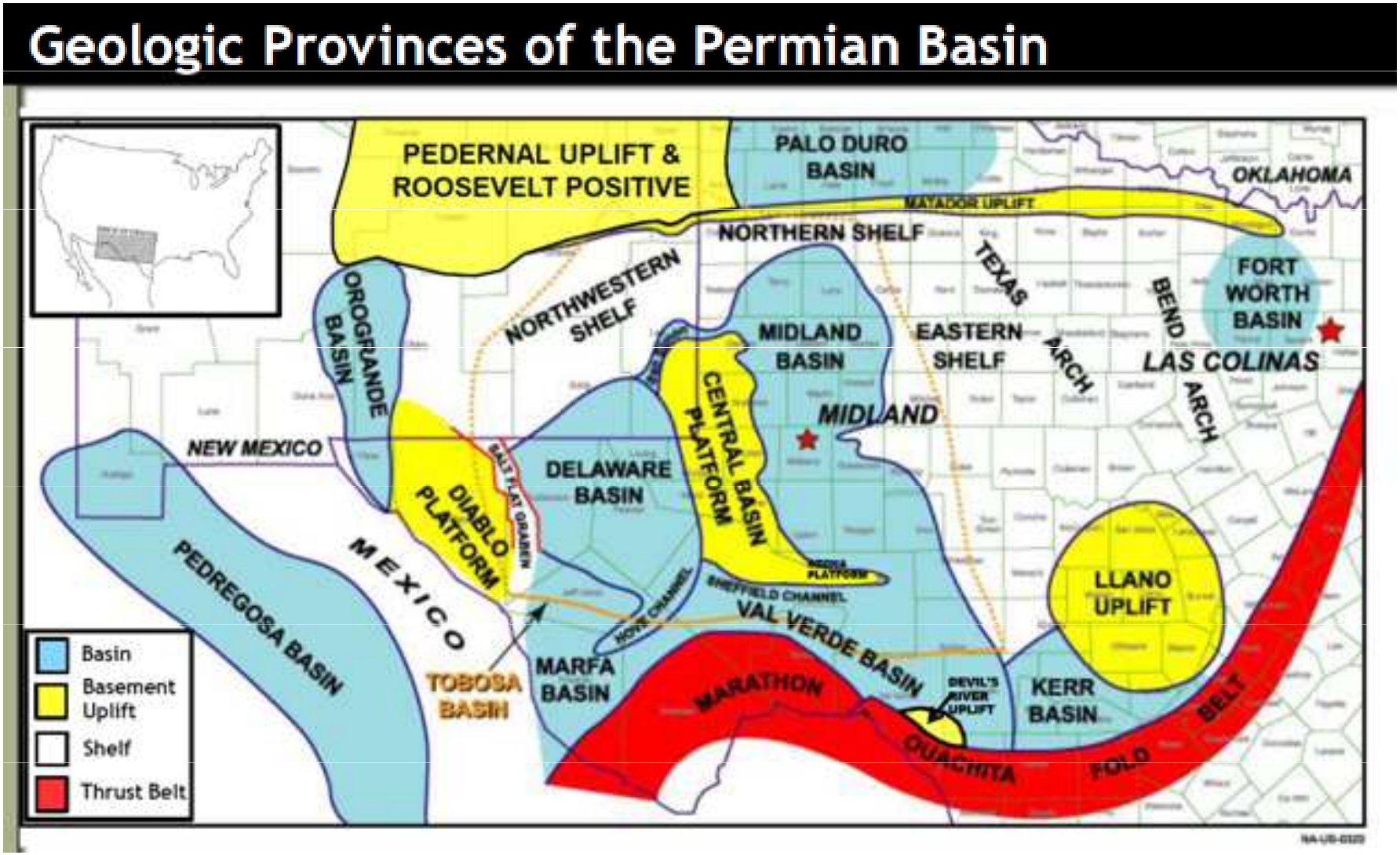
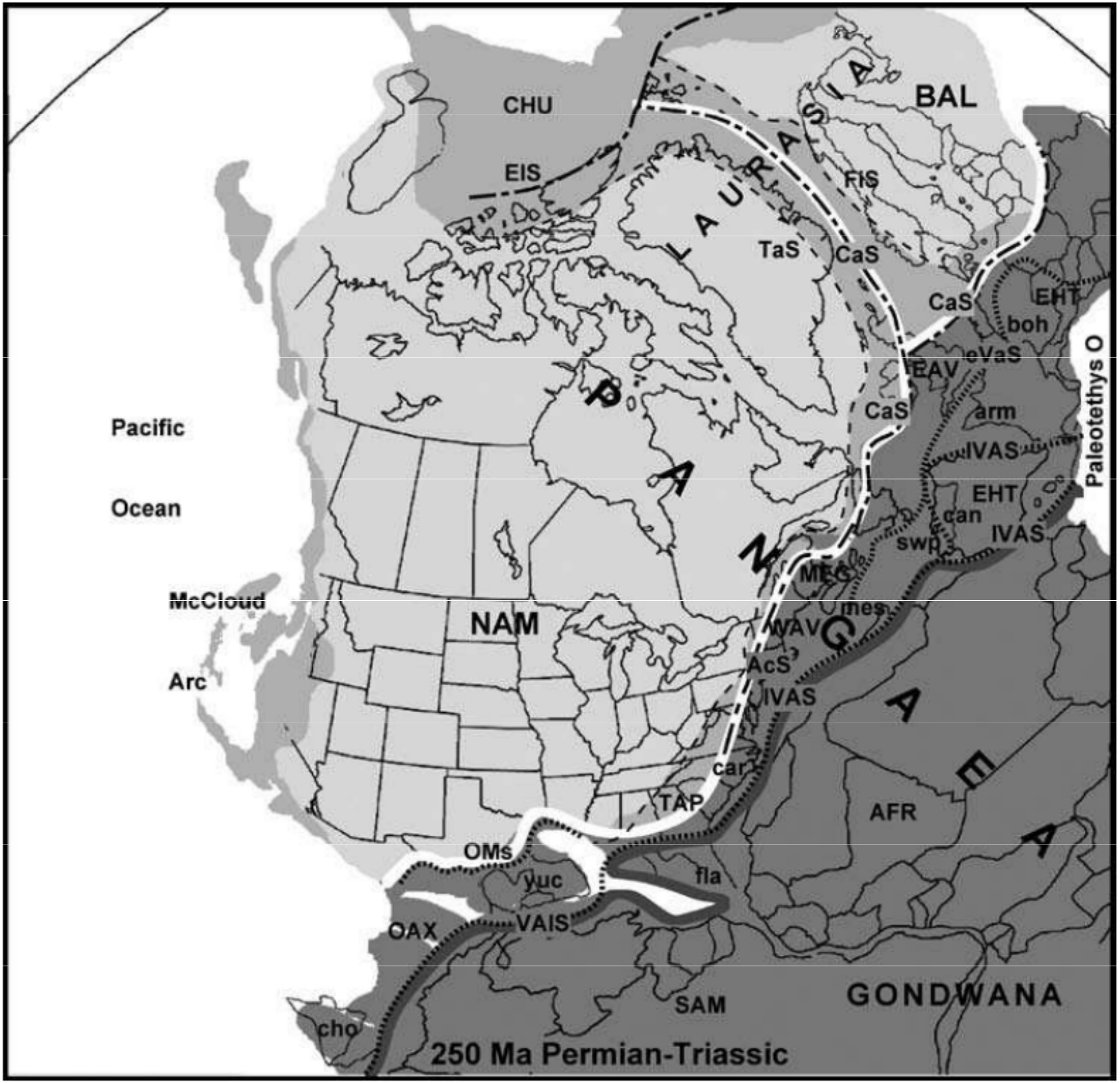


Fig. 1. The Permian Basin and its tectonic setting, after Pioneer Natural Resources.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Pacific
Ocean
McCloud
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NEOTETHYS
Paleotethys O