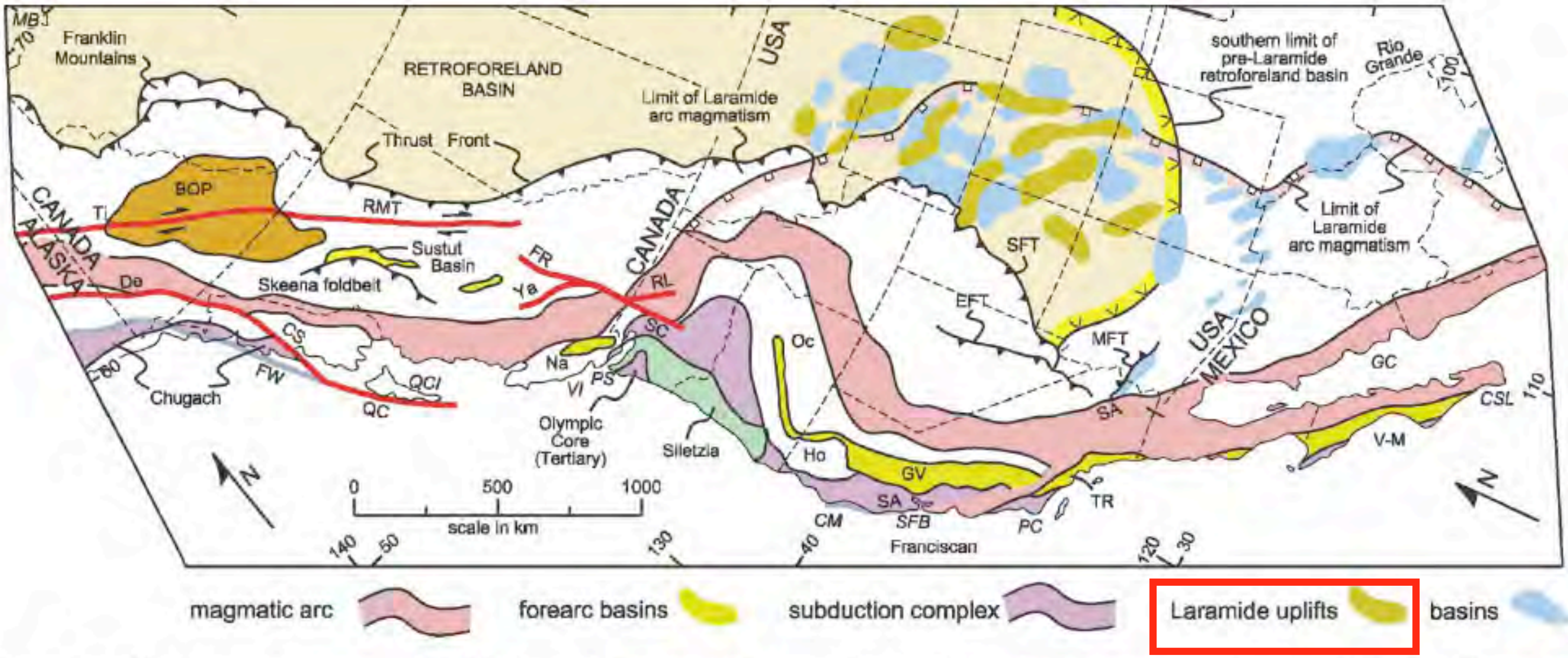


Figure 9 Mid-Early Cretaceous (~120 Ma) to mid-Cenozoic (Eocene/Oligocene boundary) geotectonic features of the Cordilleran arc-trench system, including the Laramide province of intracontinental deformation. The main batholith belt is delineated as the magmatic arc, but subsidiary arc magmatism spread inland for varying distances (BOP, Omineca zone of backarc mid-Cretaceous plutonism). Active Paleogene strike-slip faults (*red lines*): De-CS, Denali-Chatham Strait; FR, Fraser River; QC, Queen Charlotte; RL, Ross Lake; SC, Straight

Dickinson 2004

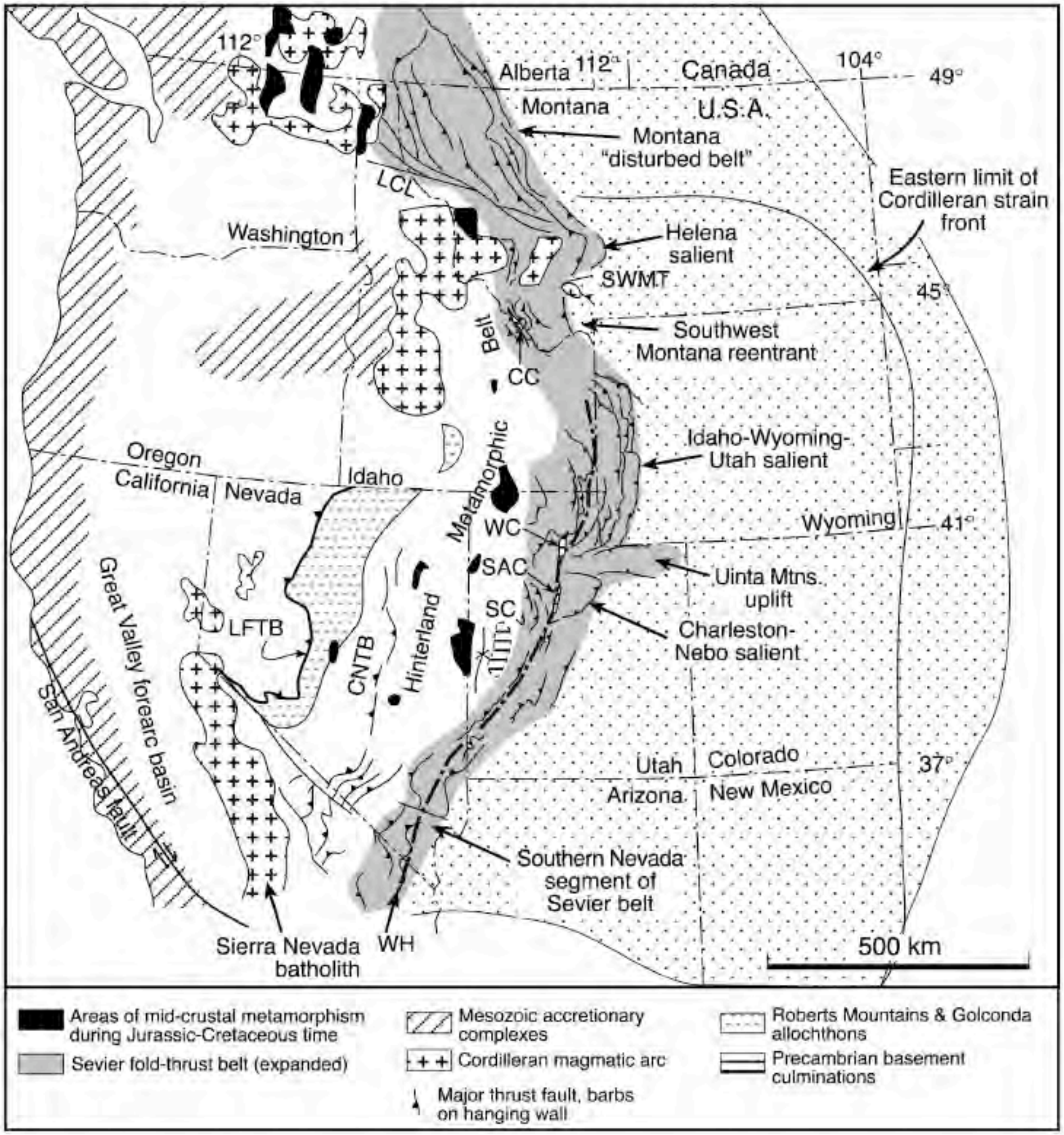


Fig. 5. Simplified version of figure 2, showing some of the major tectonic features in the Cordilleran thrust belt discussed in the text. Abbreviations as follows: LCL, Lewis and Clark line; SWMT, Southwest Montana transverse zone; CC, Cabin culmination; WC, Wasatch culmination; SAC, Santaquin culmination; SC, Sevier culmination; CNTB, Central Nevada thrust belt; LFTB, Luning-Fencemaker thrust belt; WH, Wasatch hinge line. Stippled region represents Cordilleran foreland basin system.

DeCelles 2004

Folded Cretaceous strata, 2 km east Turner Valley, AB

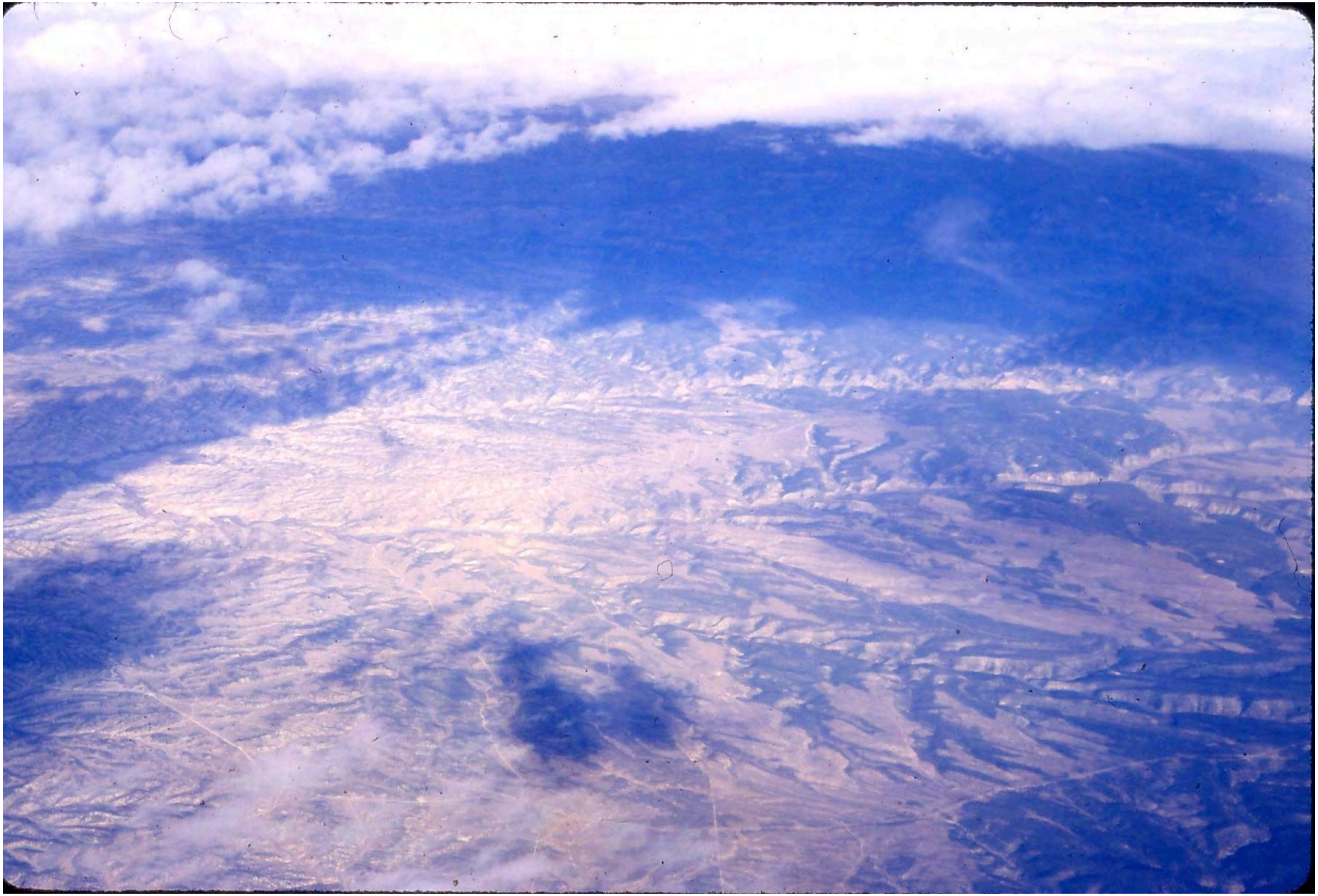
Mt Kidd, Banff National Park, Alberta

Mt Kidd, Banff National Park, Alberta

Banff National Park, Alberta

Thrust Fault cut-off, Kanaskia National Park, Alberta

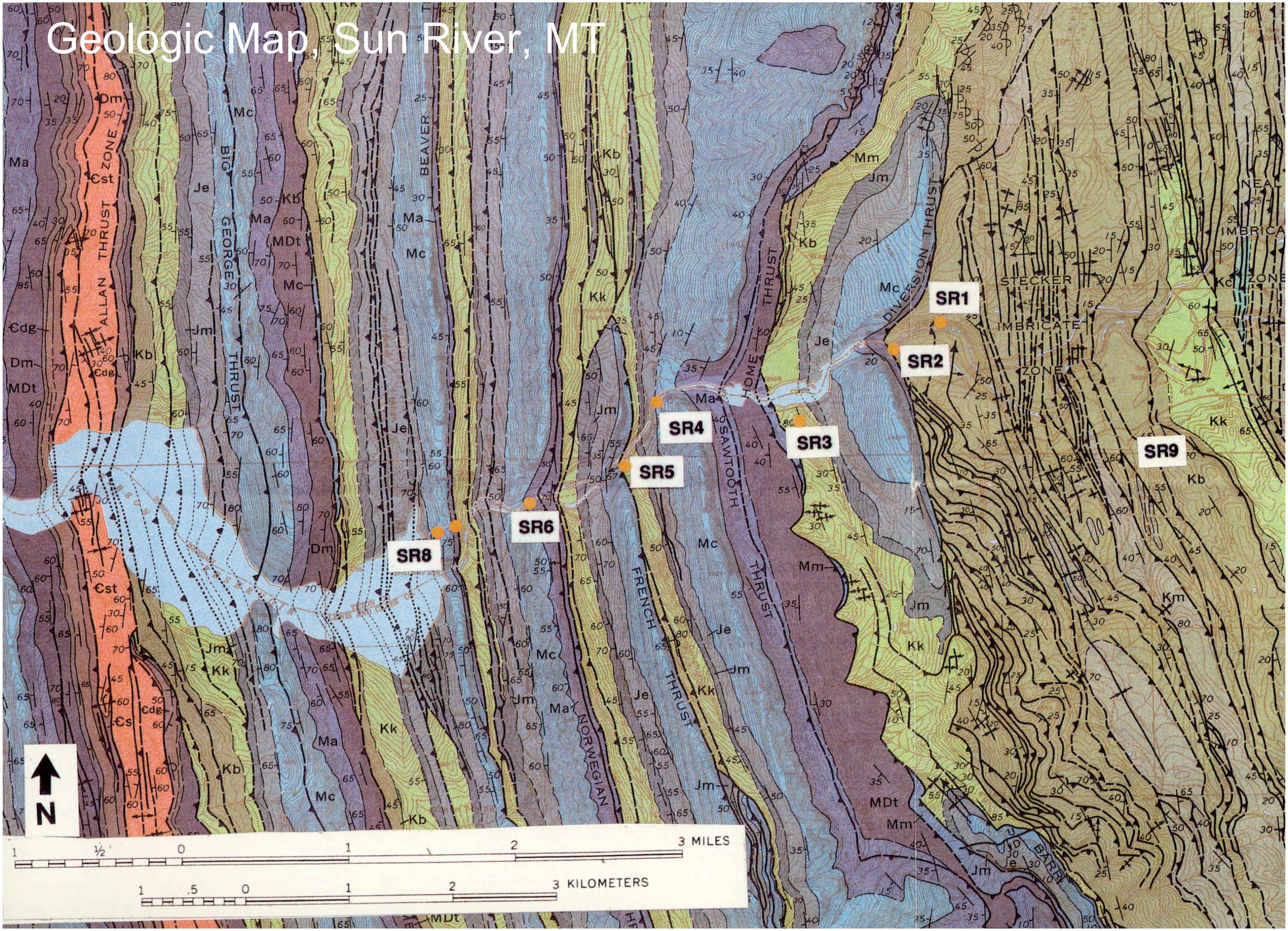
Turner Valley, Alberta



Great Falls, Mt

Thrust Fault, near Choteau, Montana

Thrust Fault, near Choteau, Montana


Geologic Map, Sun River, MT
SR1
SR2
SR3
SR4
SR5
SR6
SR8
SR9
N
3 MILES
3 KILOMETERS
ALLAN THRUST ZONE
BIG GEORGE THRUST
BEAVER
FRENCH THRUST
NORWEGIAN
SAWTOOTH THRUST
DIVERSION THRUST
STECKER IMBRICATE ZONE

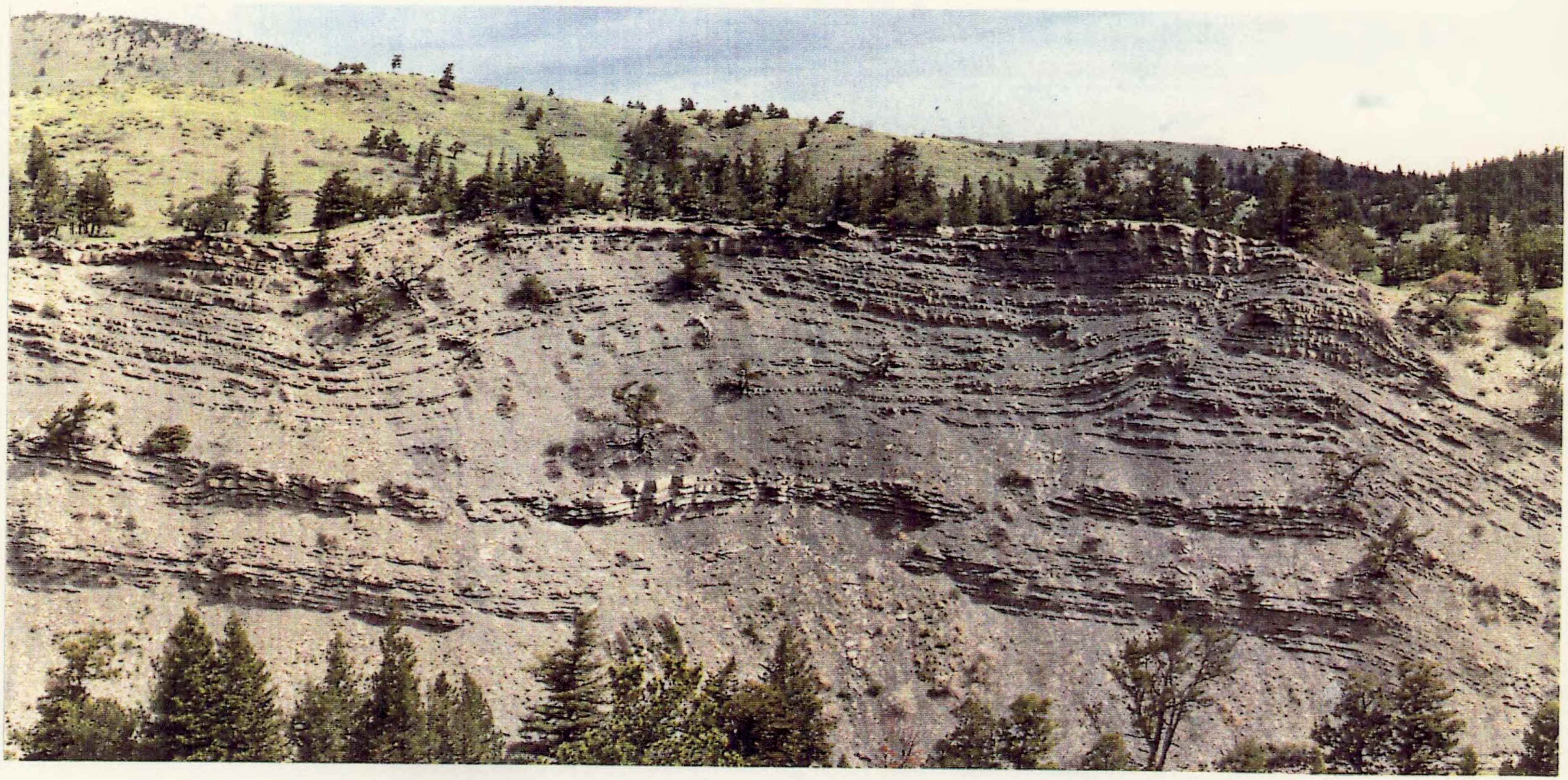


Figure 7. Stop SR 1. Fold-related thrusts in Cretaceous units in the Stecker imbricate zone in the Disturbed Belt .

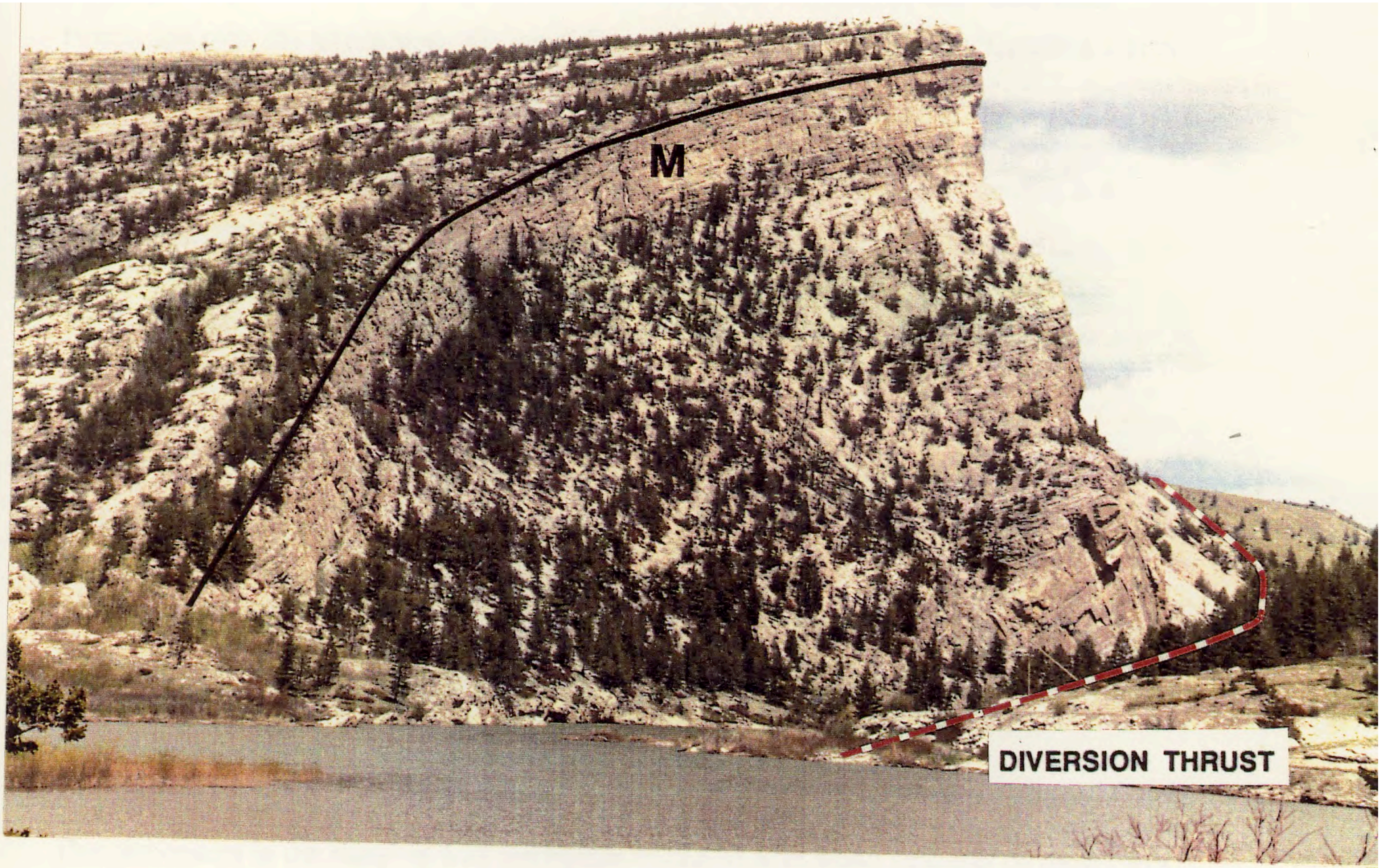


Figure 13. Stop SR 2. Hanging wall cutoff of Mississippian carbonates in the Diversion thrust. View looking east.

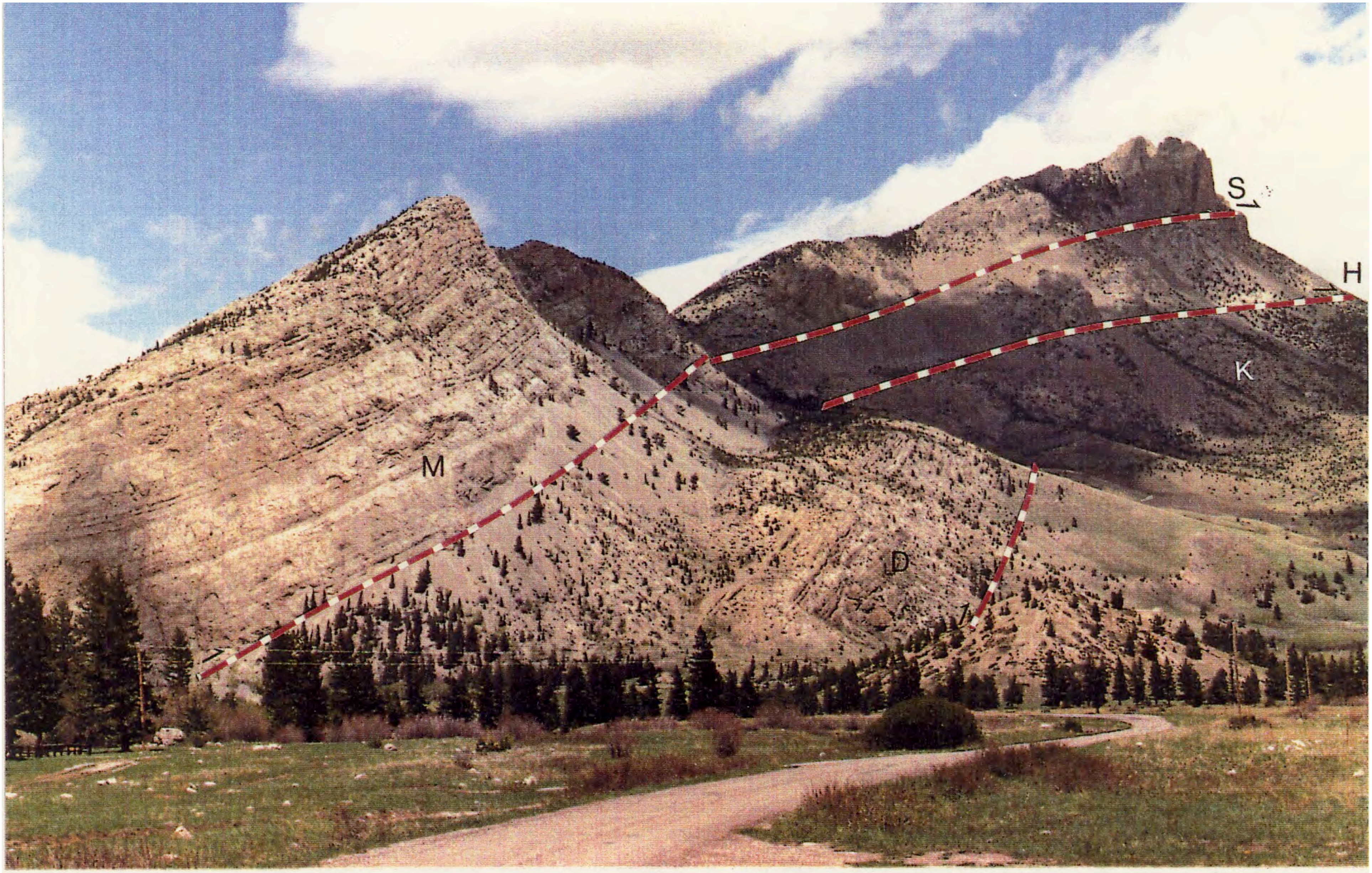
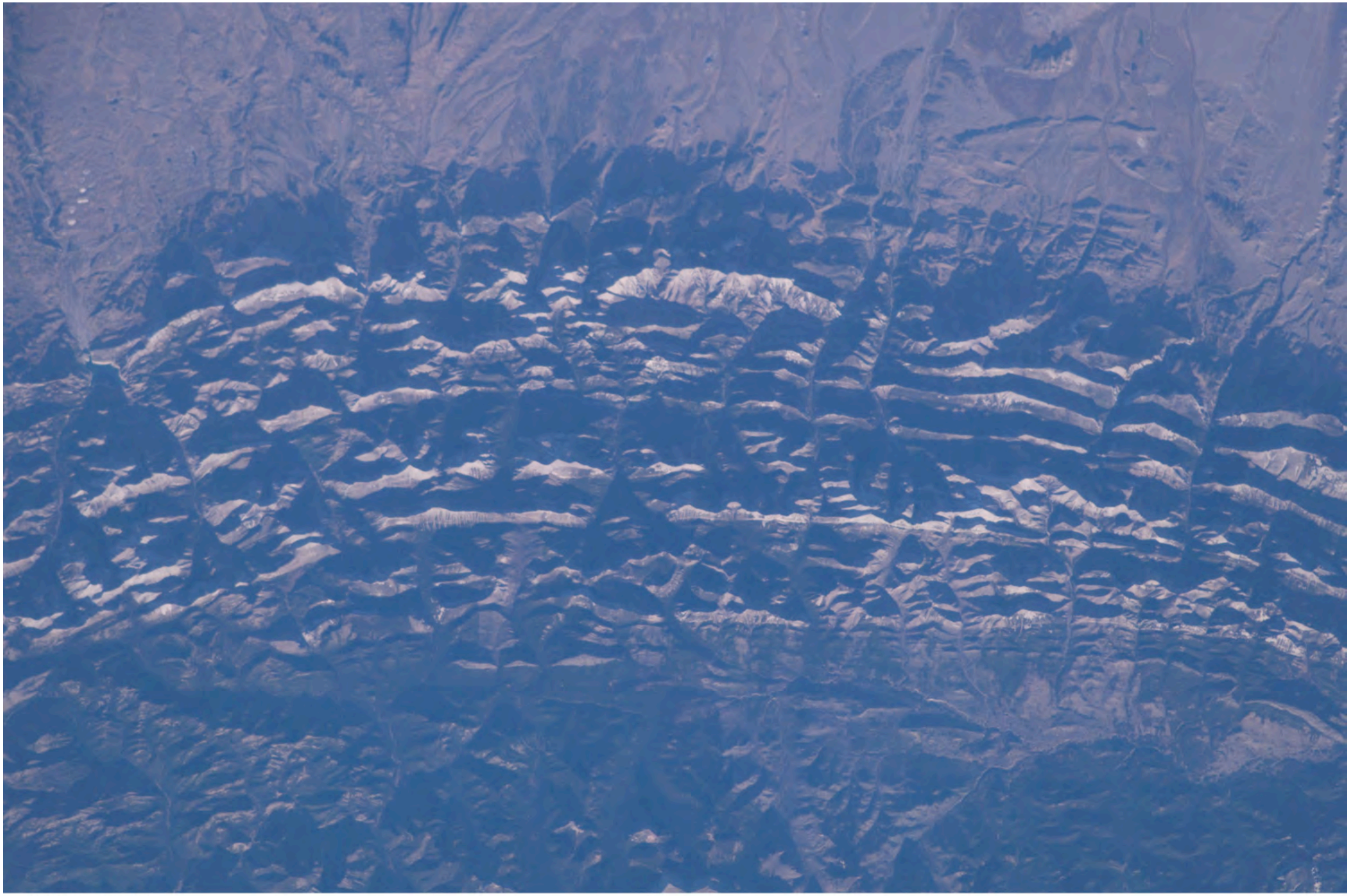


Figure 14. Stop SR 3. View looking north of the Home and Sawtooth thrust at Castle Reef.

Figure 22. Stop SR 8. View looking east from Gibson Reservoir ovelook. The hanging wall rocks of the Diversion, Home and Norwegian thrusts form a sawtooth pattern. Note that the dips increase progressively westward.



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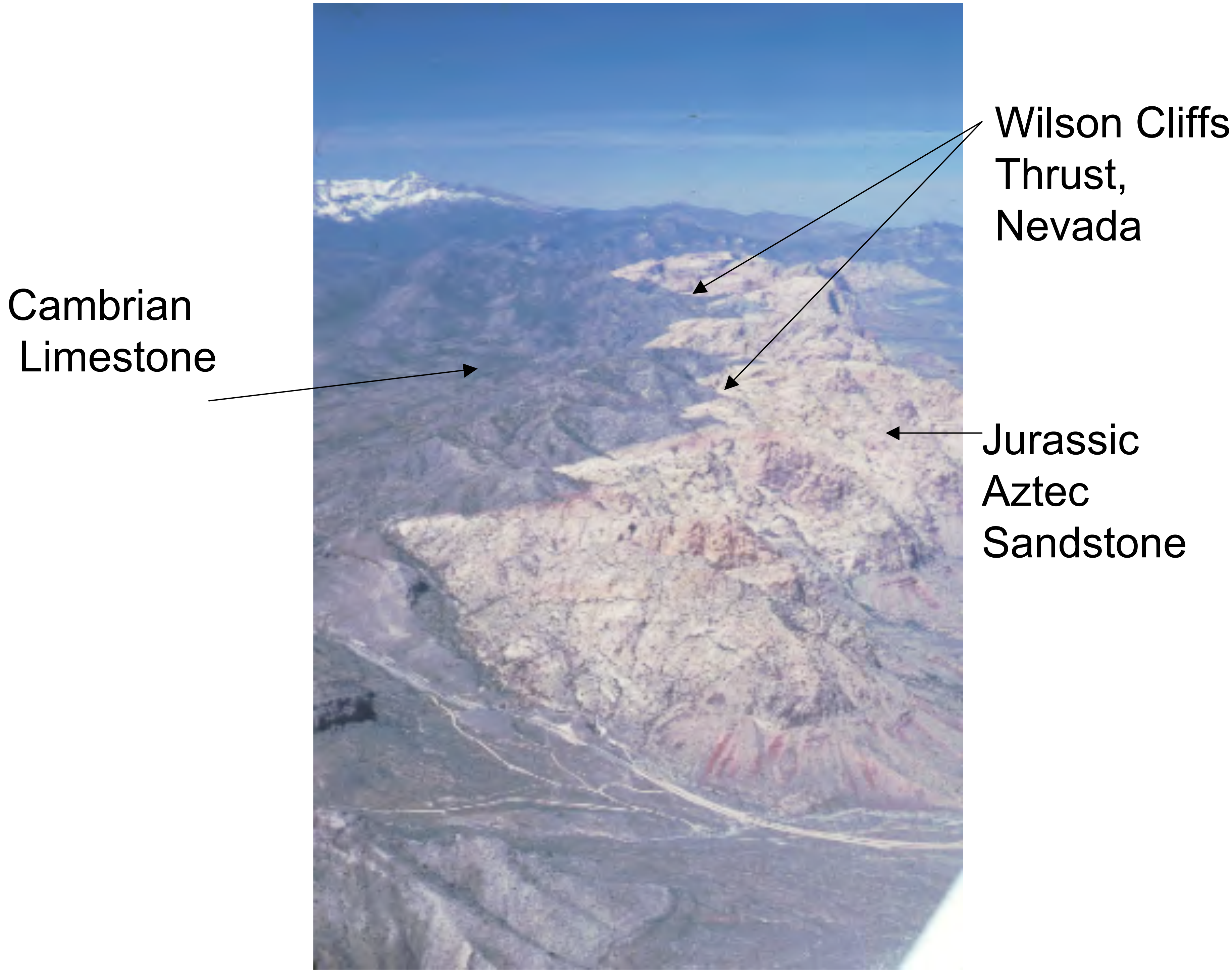
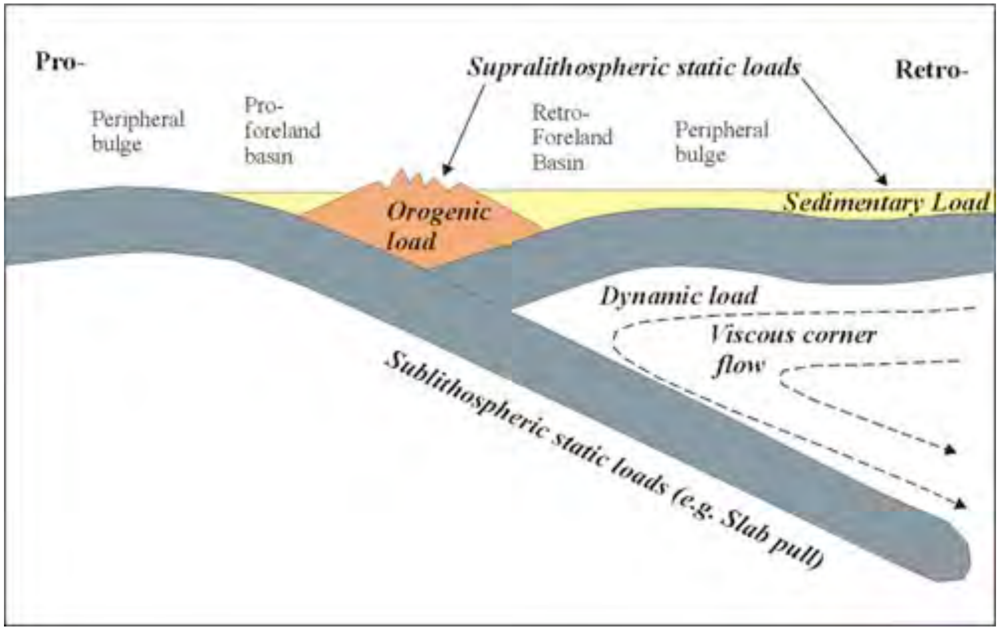
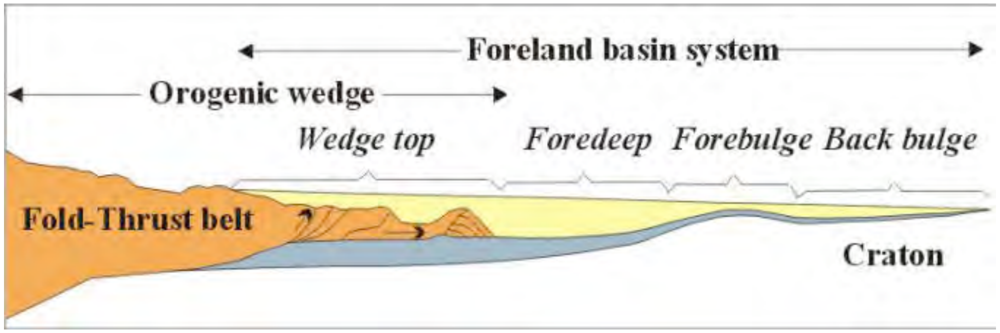


Wilson Cliffs Thrust, Nevada
Cambrian Limestone
Jurassic Aztec Sandstone





http://manhattan.unipv.it/sedgeo/Research/Basin%20Analysis.htm

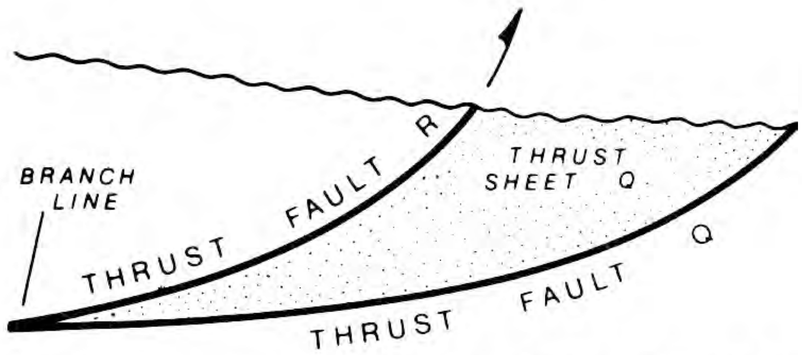


FIG. 1—Cross section through thrust sheet (Q), which is ume of rock above leading fault (Q) and below trailing (R).

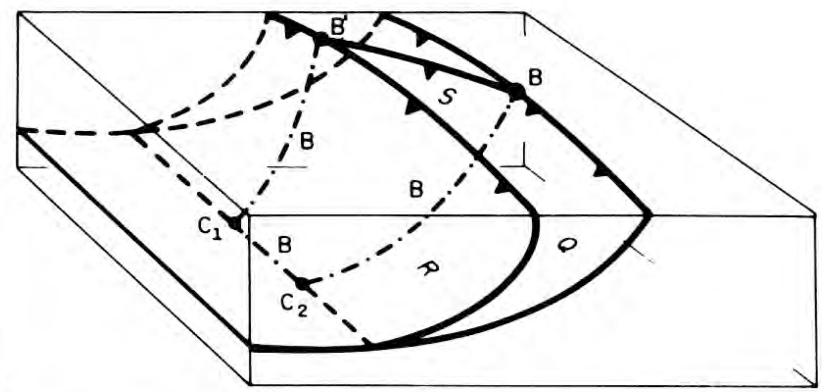
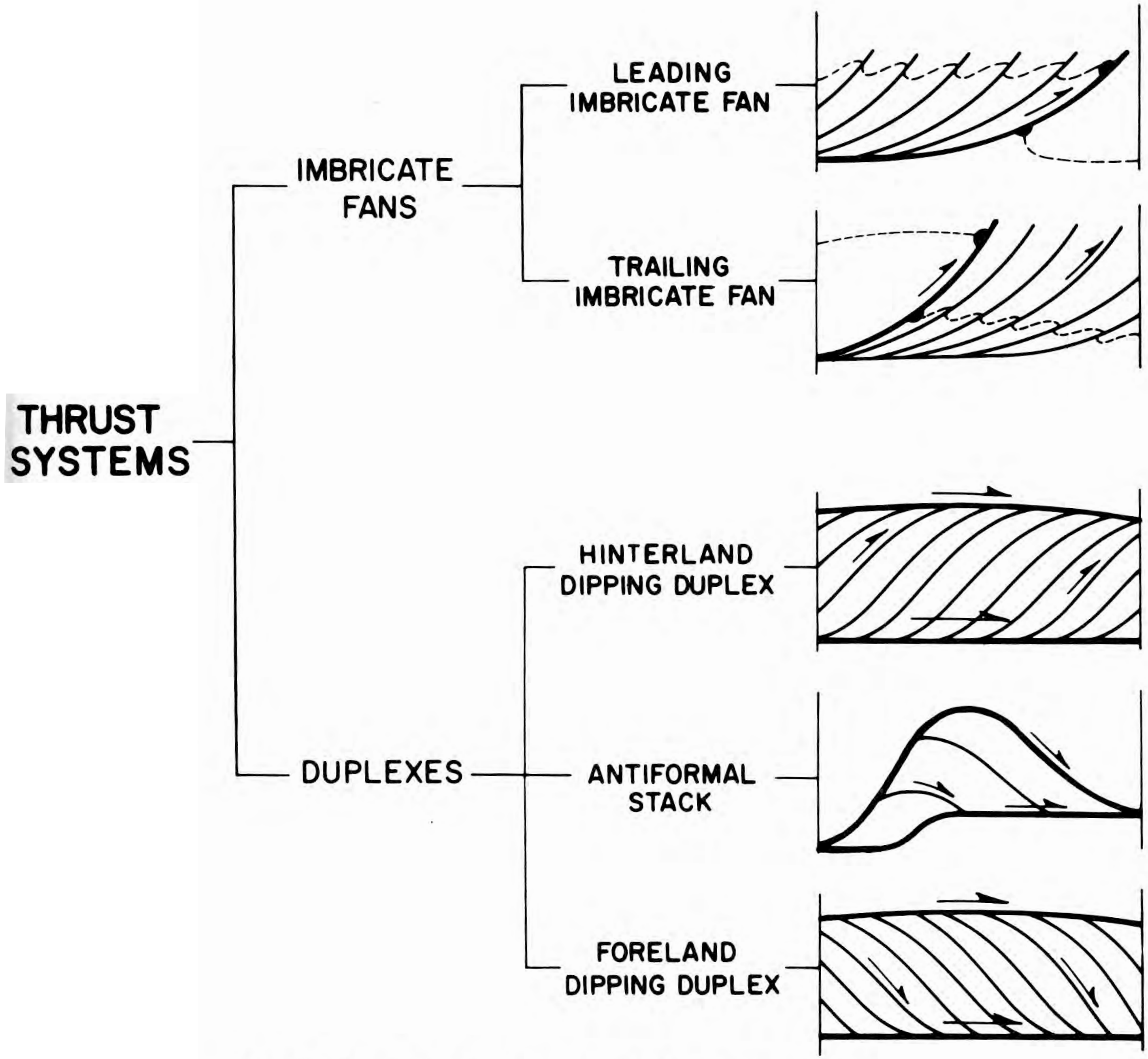


FIG. 7—Two major faults (Q, R) with connecting splay (S). Two branch lines (B) have surface terminations (B, B′) and one branch line at depth has two corners (C_1, C_2).

Boyer and Elliott 1982



Boyer and Elliott 1982

FIG. 12—Classification of different systems of thrusts; most are imbricate.

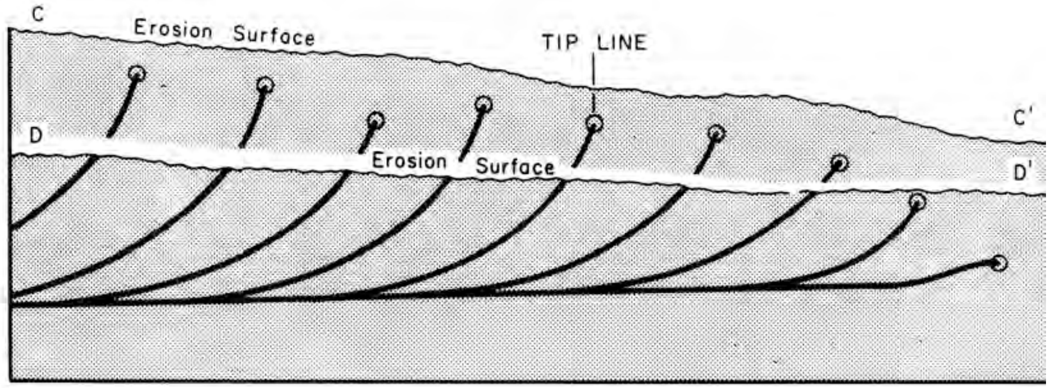


FIG. 11—Cross section of imbricate fan at two different levels of erosion. Each thrust sheet is an upward-opening crescentic slic and all curve asymptotically downward to a common basal sole thrust. If most faults cut synorogenic erosion surface DD′ we ha an emergent imbricate fan. Alternatively, it is possible that tip lines do not reach synorogenic erosion surface CC′, producing blir imbricate fan. Note that subsequent erosion (CC′ down to DD′) may obliterate any means of distinguishing two kinds of imbı cate fans.

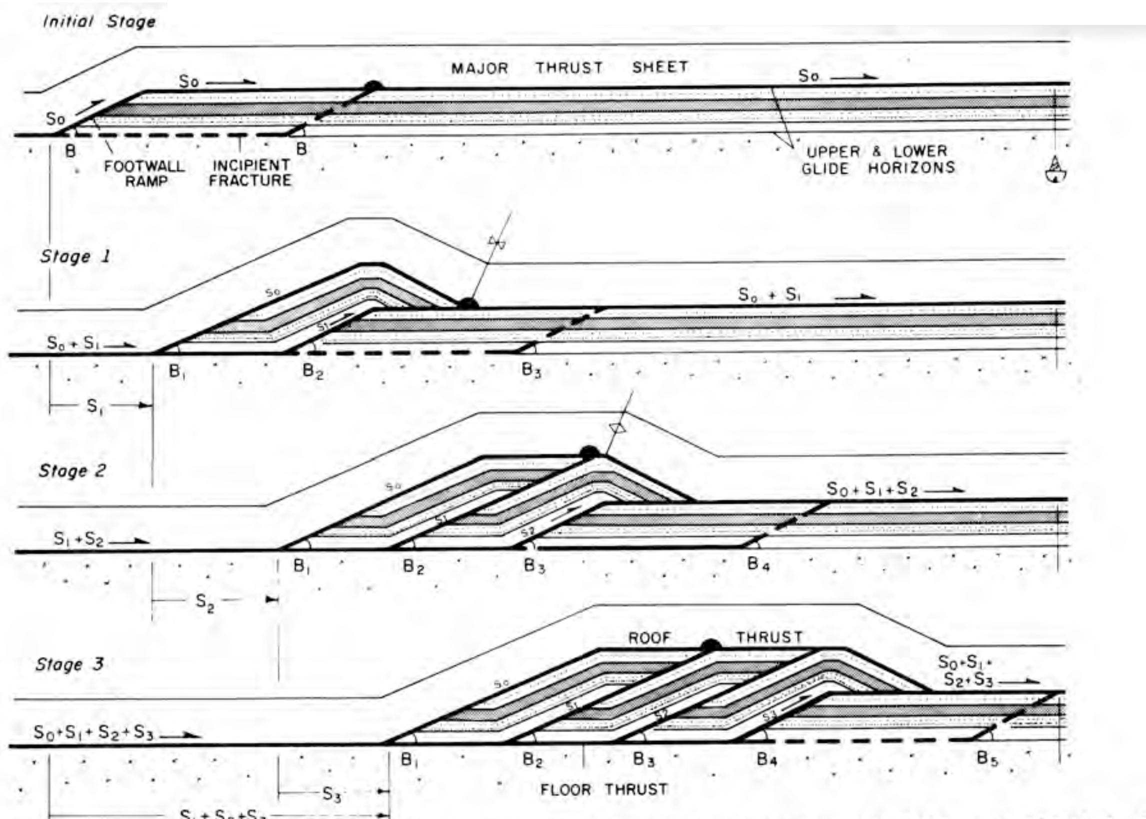


FIG. 19—Progressive collapse of footwall ramp builds up duplex. This is measured graphical experiment, assuming plane strain and kink folding, with angles and ratios of dimensions typical of natural examples (Table 1). Roof thrust sheet undergoes complex sequence of folding and unfolding, seen by following black half dot. Modified from Boyer (1978).

Boyer and Elliott 1982

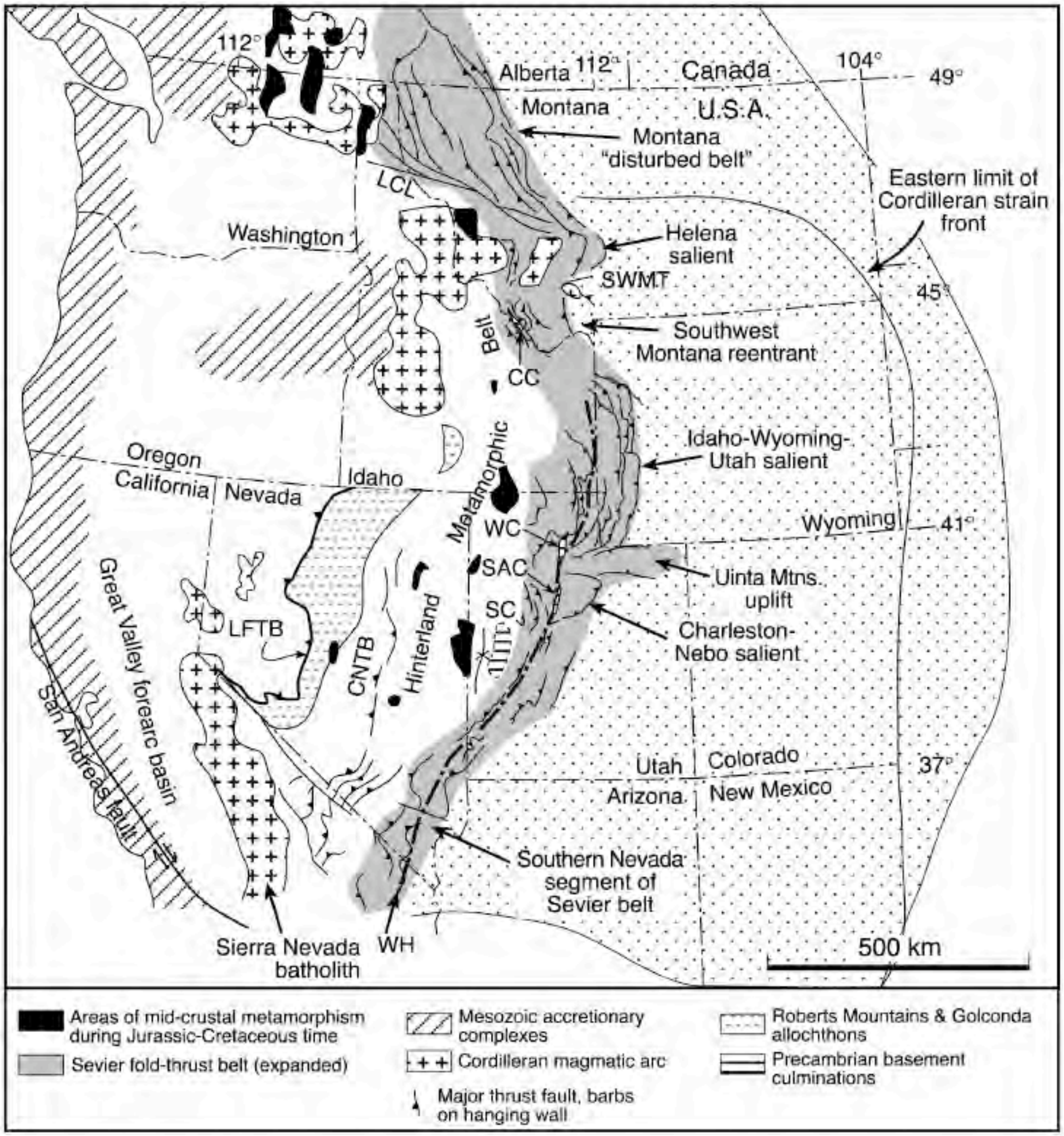
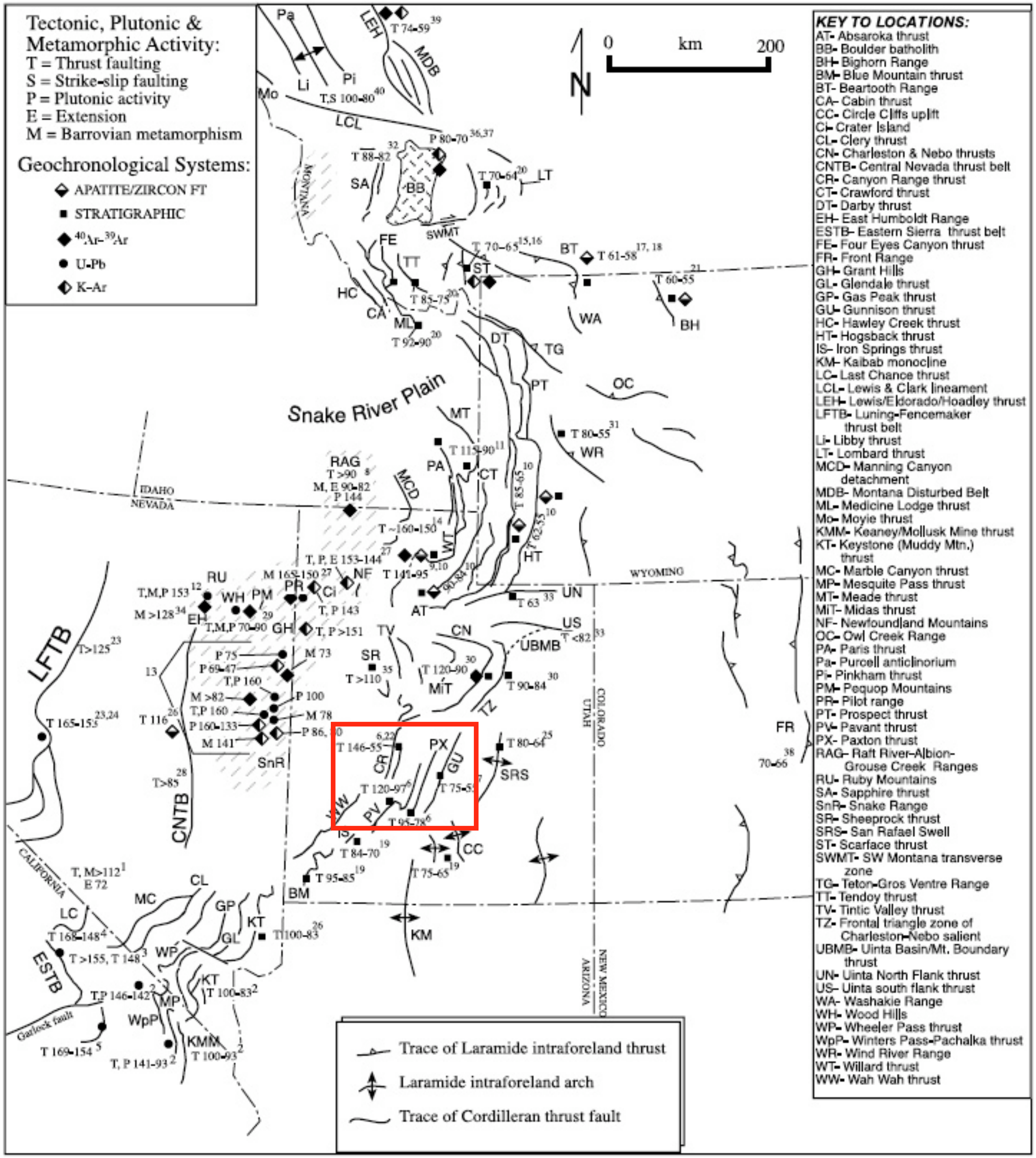


Fig. 5. Simplified version of figure 2, showing some of the major tectonic features in the Cordilleran thrust belt discussed in the text. Abbreviations as follows: LCL, Lewis and Clark line; SWMT, Southwest Montana transverse zone; CC, Cabin culmination; WC, Wasatch culmination; SAC, Santaquin culmination; SC, Sevier culmination; CNTB, Central Nevada thrust belt; LFTB, Luning-Fencemaker thrust belt; WH, Wasatch hinge line. Stippled region represents Cordilleran foreland basin system.

DeCelles 2004



DeCelles 2004

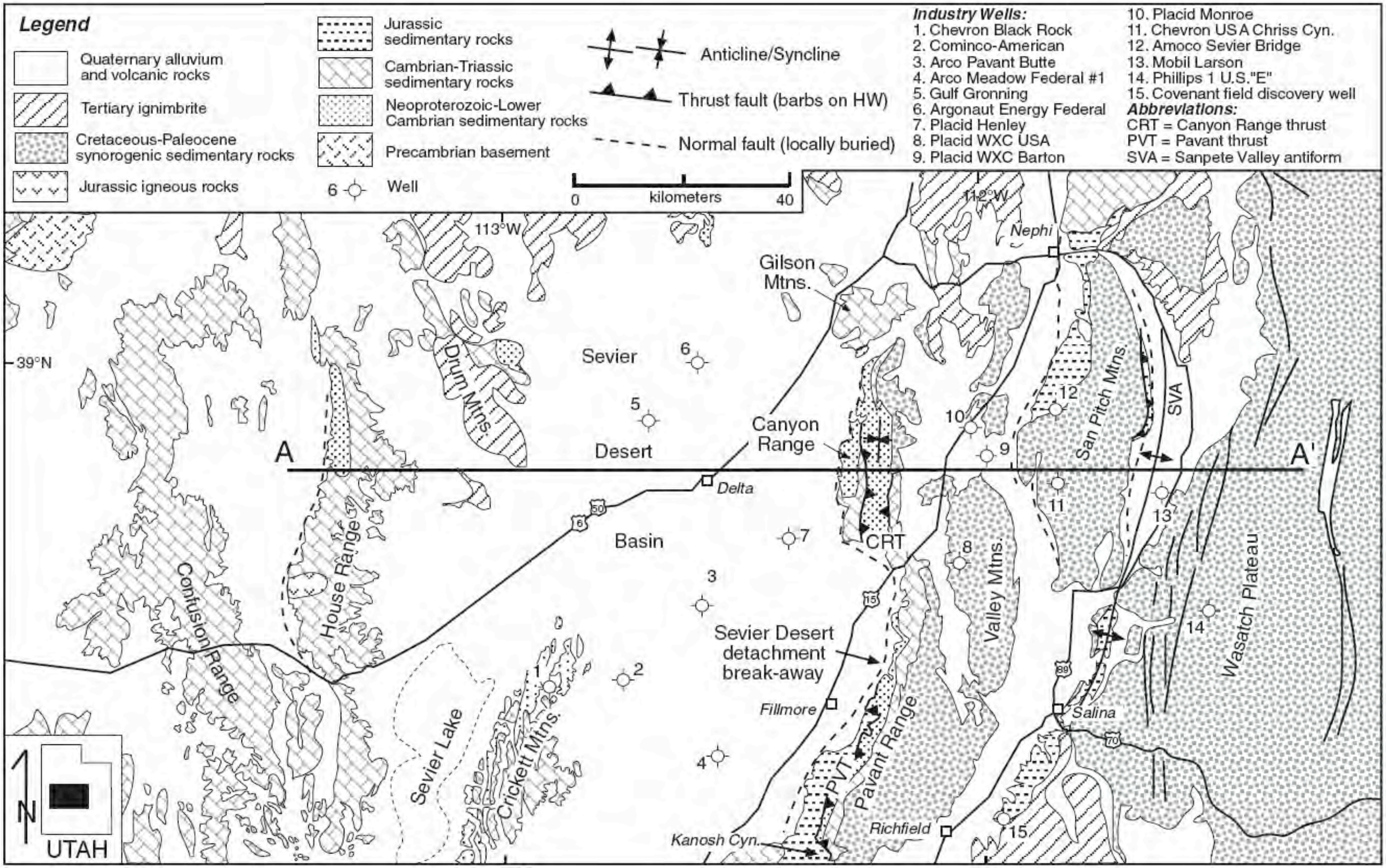
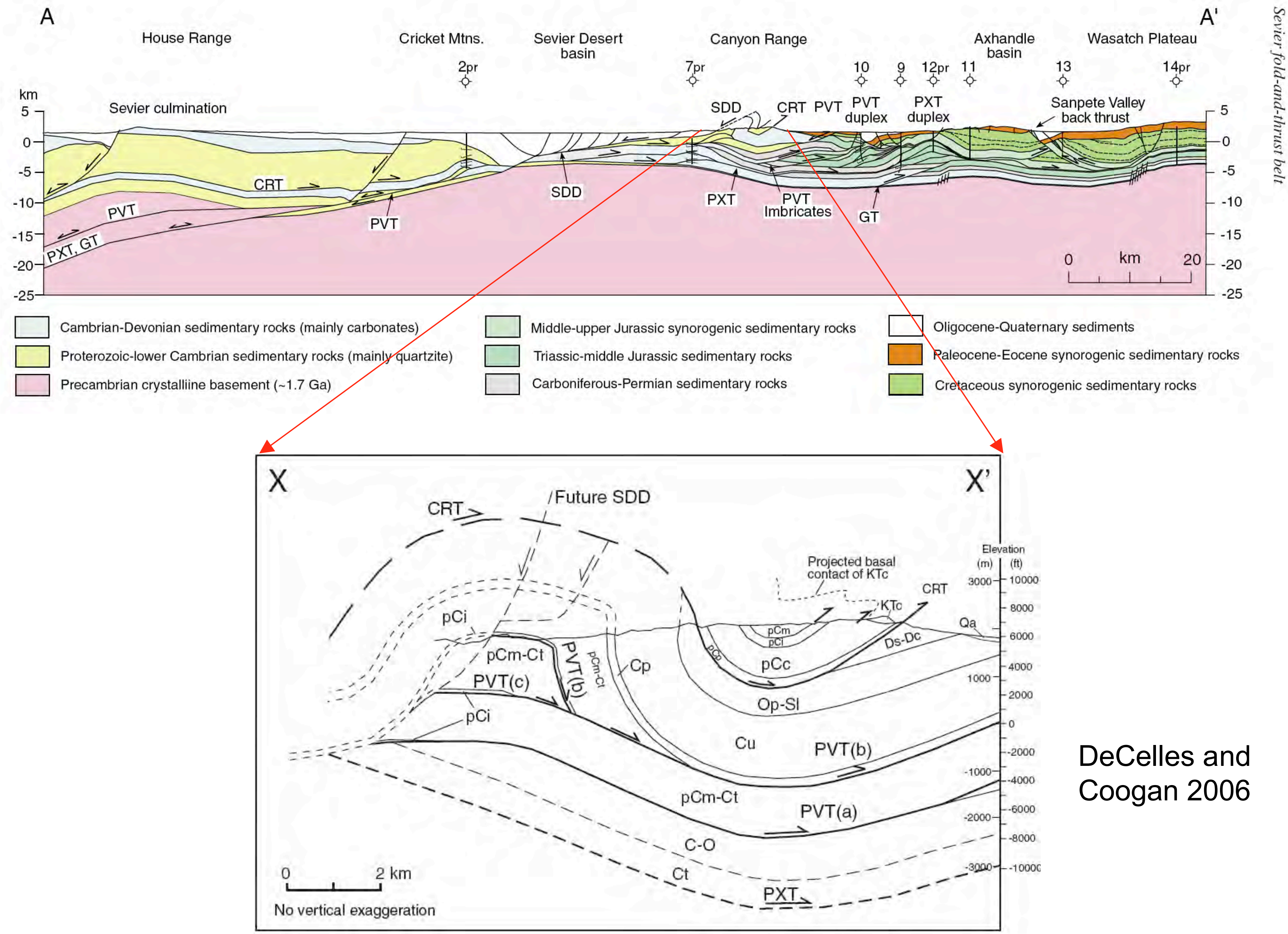


Figure 2. Geological map of central Utah after Hintze (1980), showing relevant hydrocarbon industry wells. A–A′ marks the line of cross section shown in Figure 3. HW—hanging wall

DeCelles and Coogan 2006



DeCelles and Coogan 2006

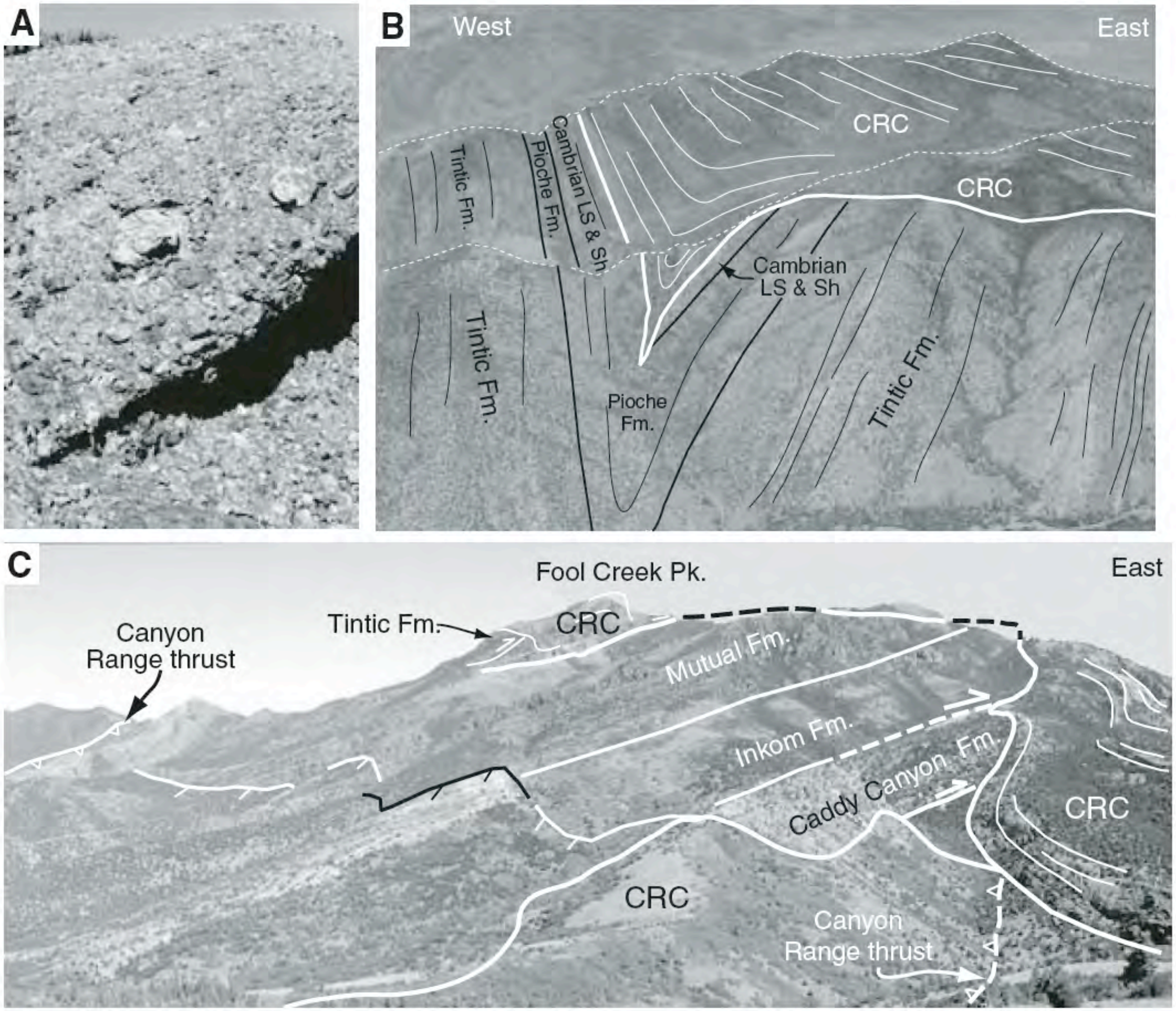
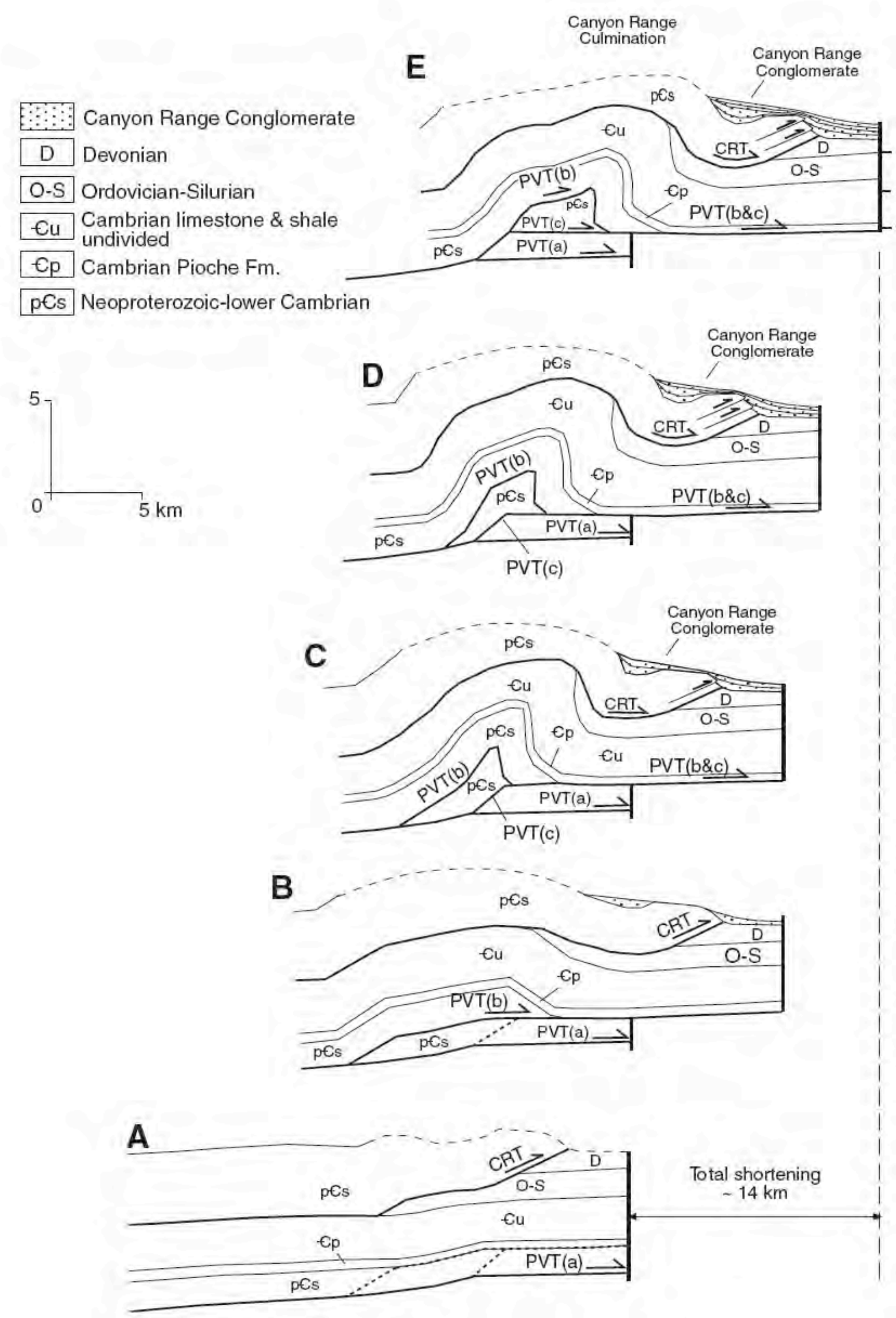
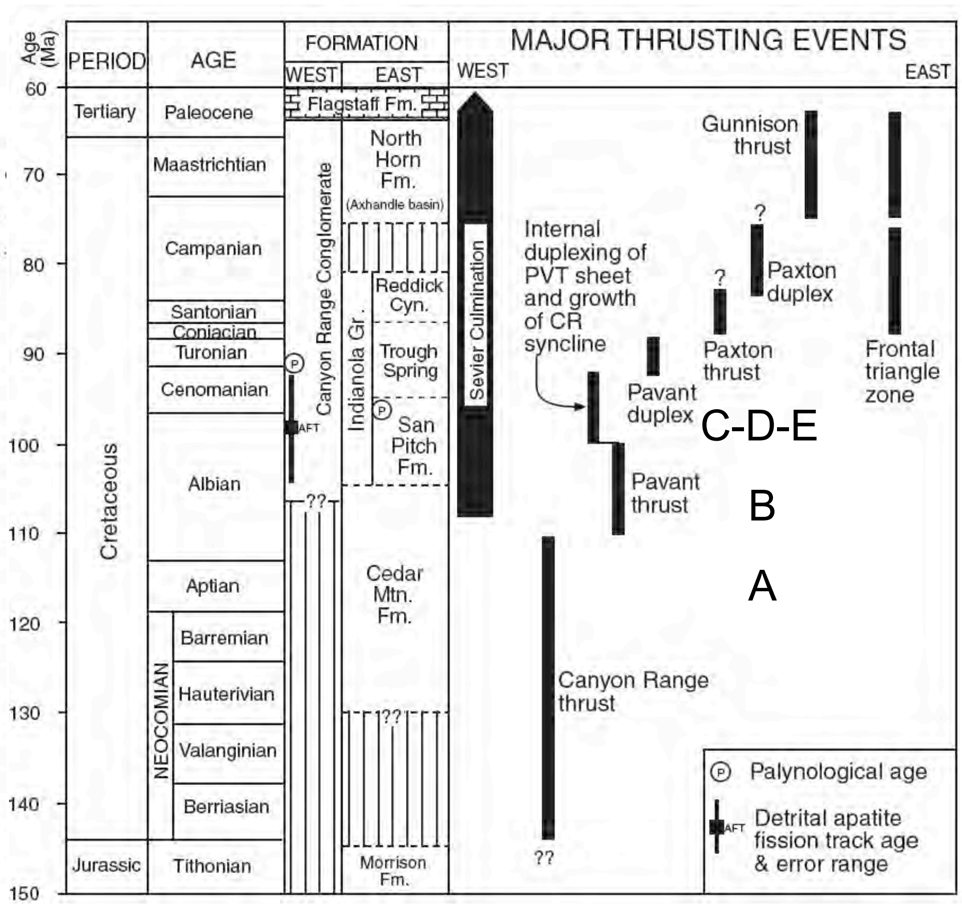


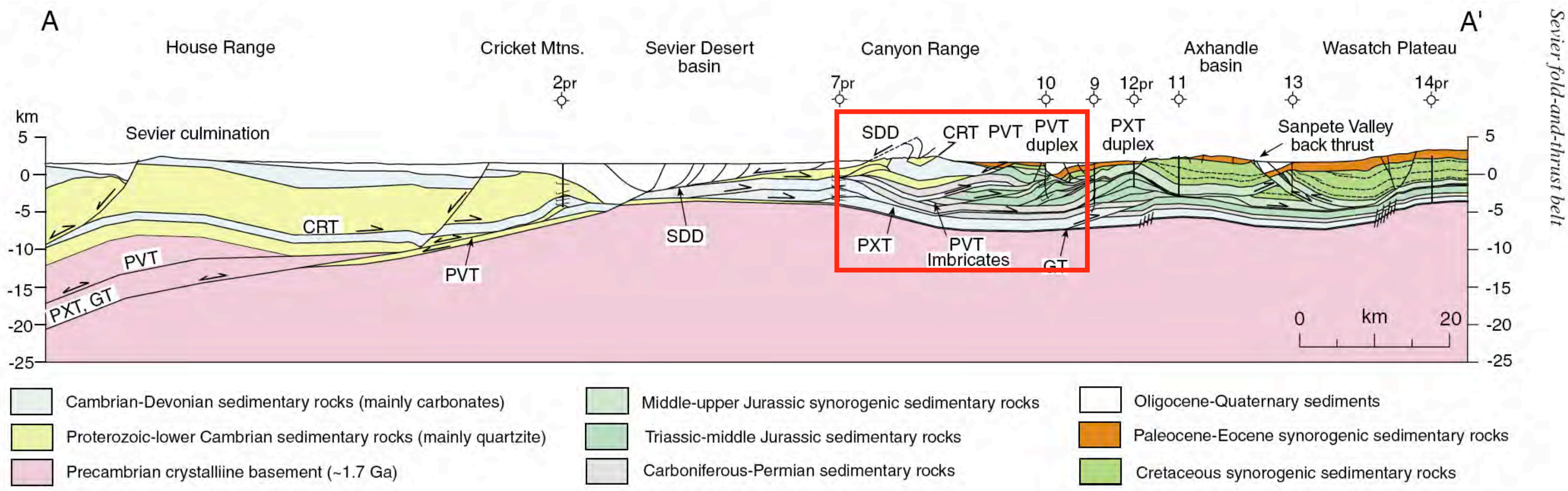
Figure 7. (A) Boulder-conglomerate lithofacies, dipping westward, in Canyon Range Conglomerate just below Fool Creek Peak. (B) Oblique aerial photograph of the core of the Canyon Range synform between Dry Fork and Wildhorse Peak (see Fig. 4 for location). Note the tight synclinal fold in the Paleozoic section, the overlapping angular unconformity at the base of the Canyon Range Conglomerate (CRC), and the growth syncline in the CRC. LS—limestone; Sh—shale. Width of image is ~3 km. (C) Panoramic photograph of the north side of Oak Creek Canyon, showing the western trace of the Canyon Range thrust (far left), the approximate location of the eastern, buried trace of the thrust (lower right), the eastern limb of the Canyon Range synform, and overlapping, growth-folded Canyon Range Conglomerate (CRC). Width of image is ~5 km.

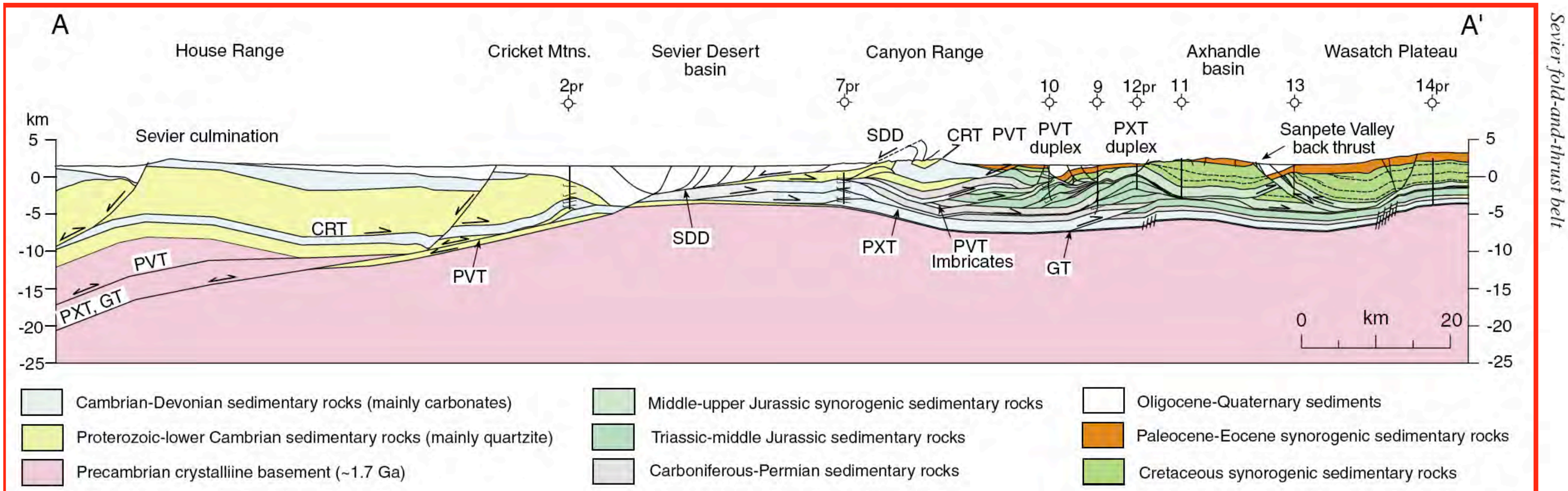
DeCelles and Coogan 2006



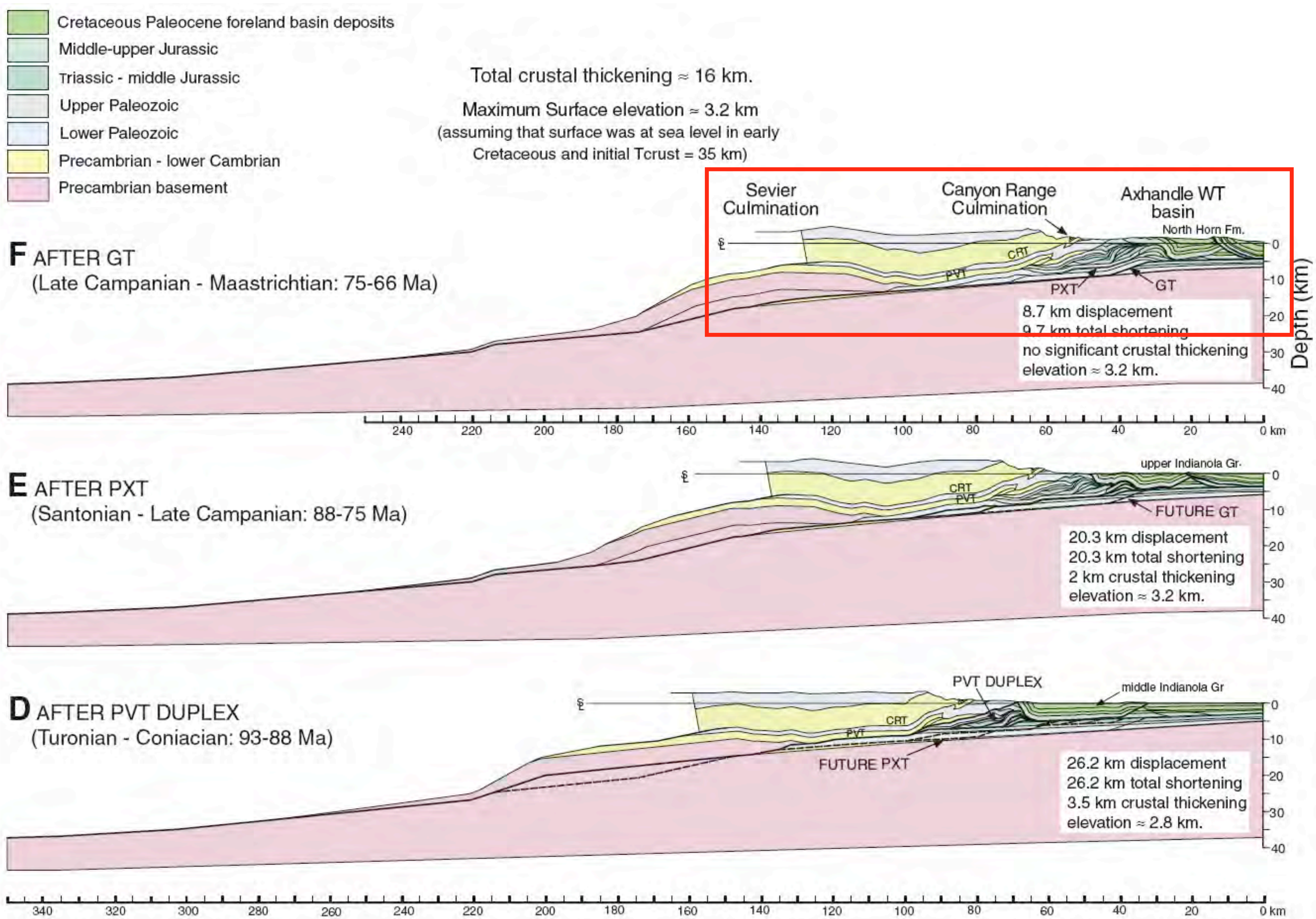


DeCelles and Coogan 2006





DeCelles and Coogan 2006



DeCelles and Coogan 2006

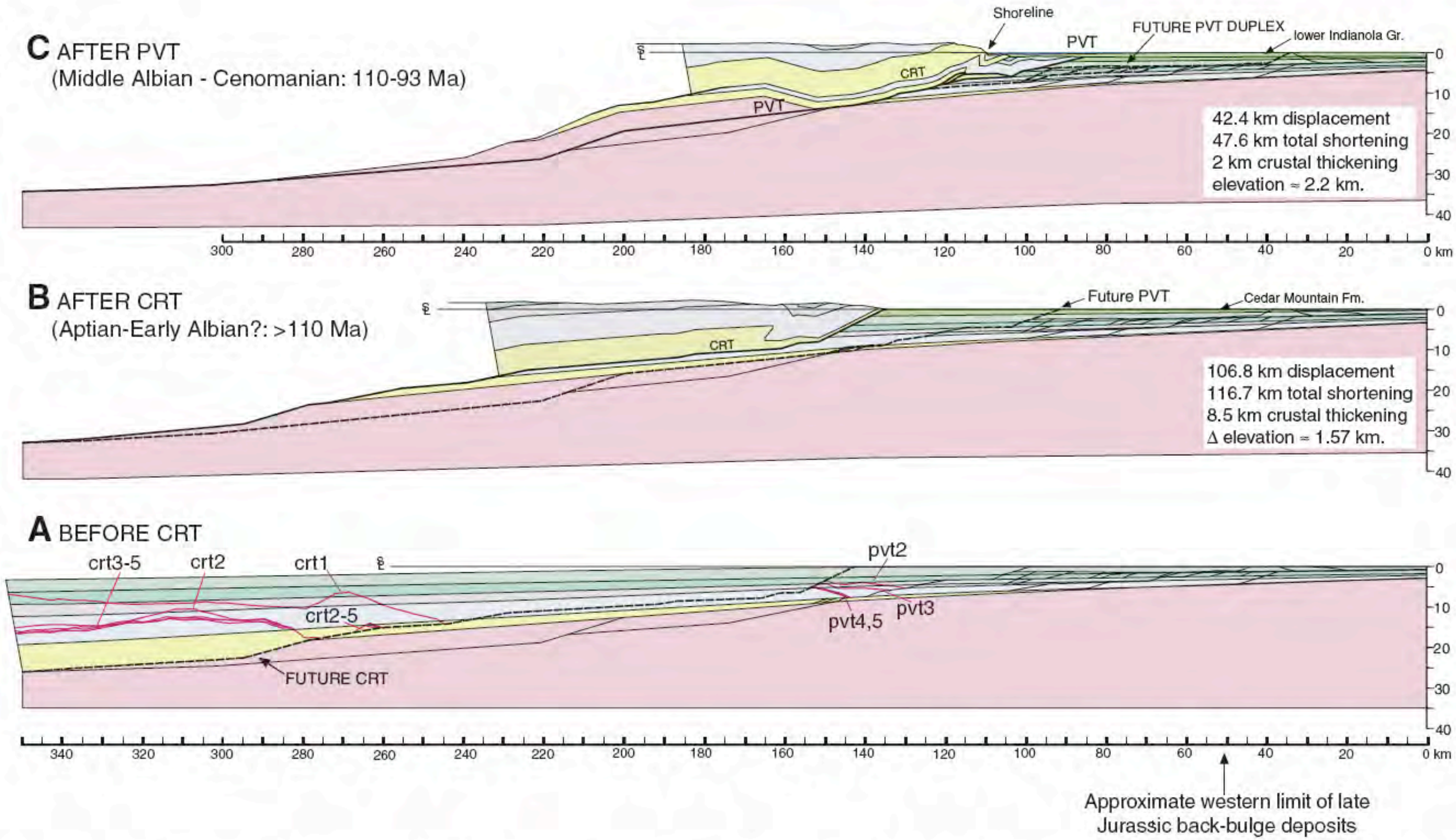


Figure 8 (*on this and previous page*). Balanced, incremental retrodeformation of the central Utah segment of the Sevier thrust belt, based on initial deformed state (with Cenozoic extension restored) of cross section shown in Figure 3. In panel A, the dotted lines represent erosion surfaces in the Canyon Range (CRT) and Pavant (PVT) thrust sheets through time. PXT—Paxton thrust; GT—Gunnison thrust; SDD—Sevier Desert detachment.

DeCelles and Coogan 2006

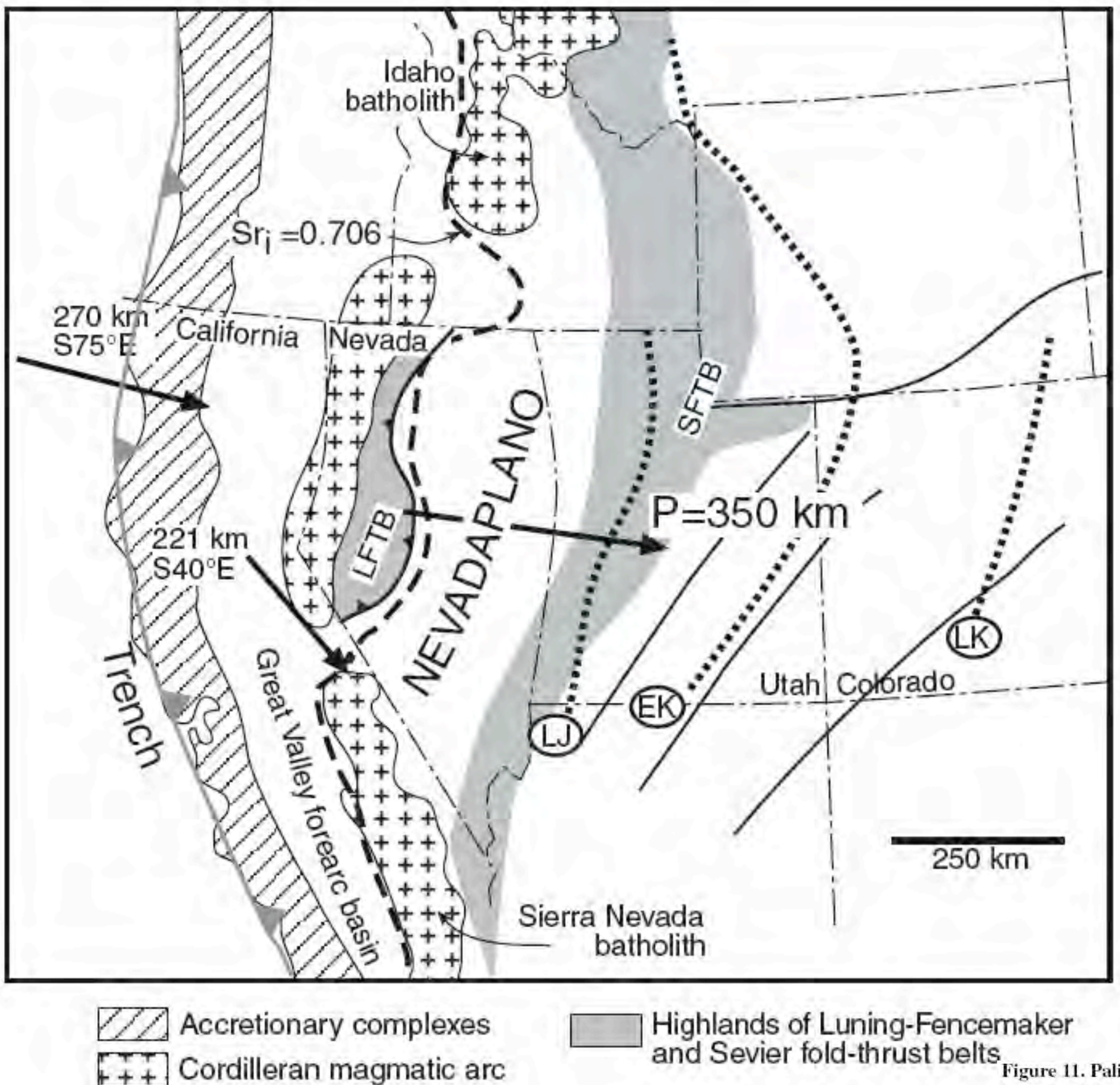


Figure 11. Palinspastically reconstructed tectonic-paleogeographic map of the North American Cordilleran orogenic belt in the western United States. Arrows indicate distances and directions of restored Neogene extension, from Wernicke et al. (1988), Snow and Wernicke (1994), and Dickinson and Wernicke (1997). Bold arrow labeled P indicates approximate distance of forward propagation of the thrust belt from Late Jurassic through Cretaceous time. Solid lines in eastern Utah and southern Wyoming represent Precambrian shear zones after Karlstrom and Williams (1998). Dashed lines indicate approximate restored positions of the crest of the forebulge in the foreland basin system at times corresponding to the labels as follows: LJ—Late Jurassic (Currie, 1997); EK—Early Cretaceous (Currie, 2002; DeCelles and Burden, 1992); LK—Late Cretaceous (White et al., 2002). LFTB—Luning-Fencemaker thrust belt; SFTB—Sevier fold-and-thrust belt.

DeCelles and Coogan 2006

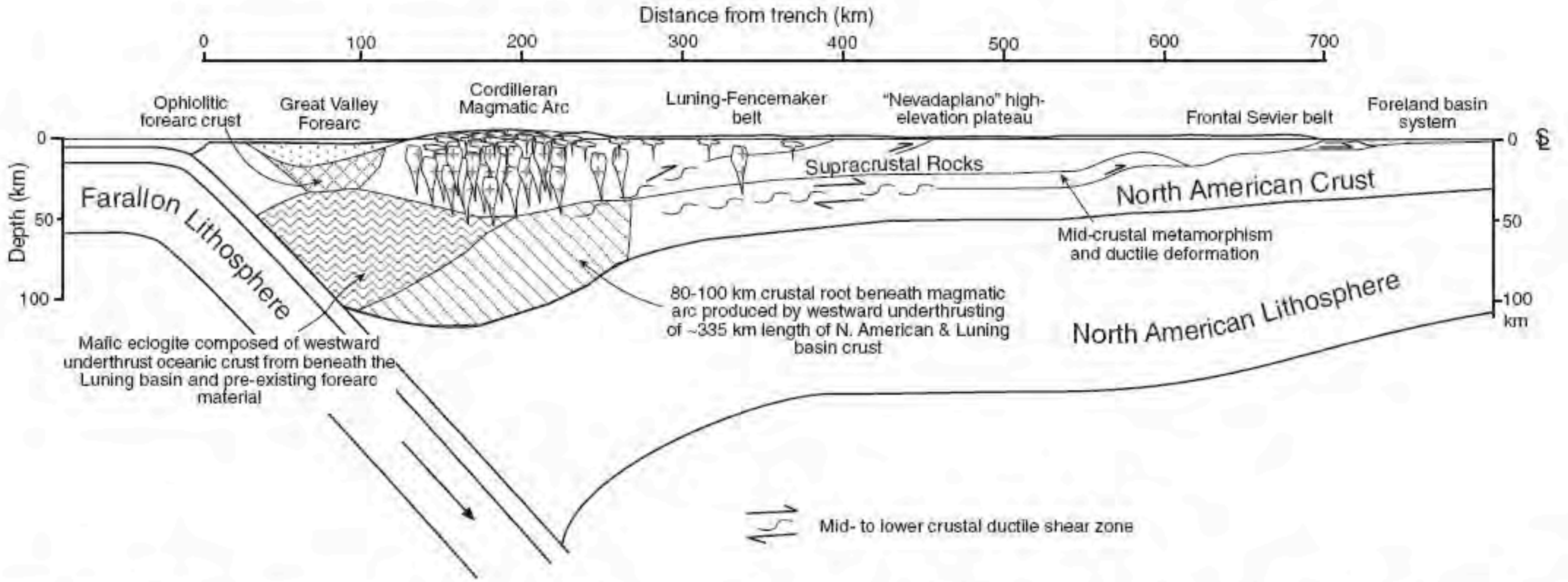
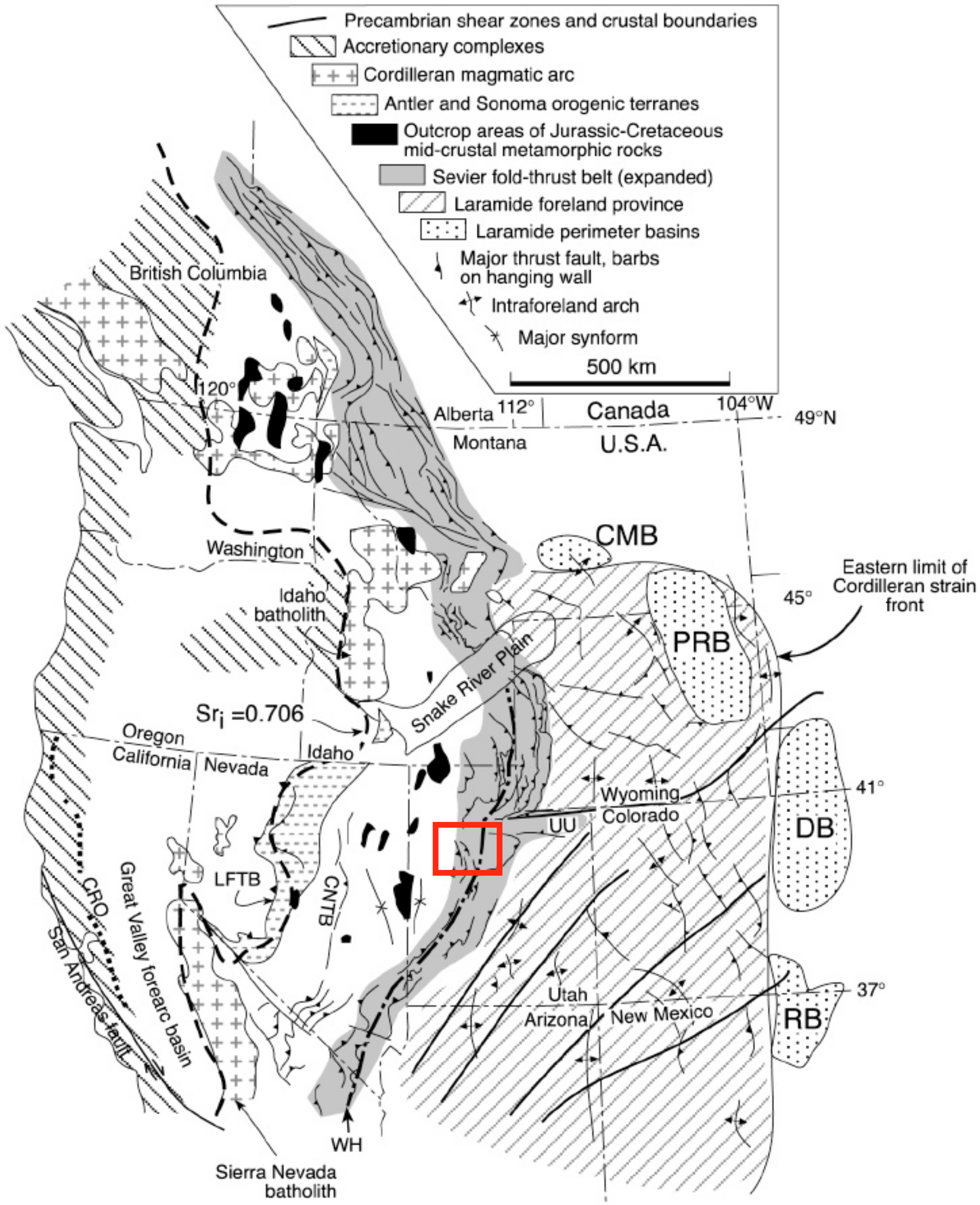
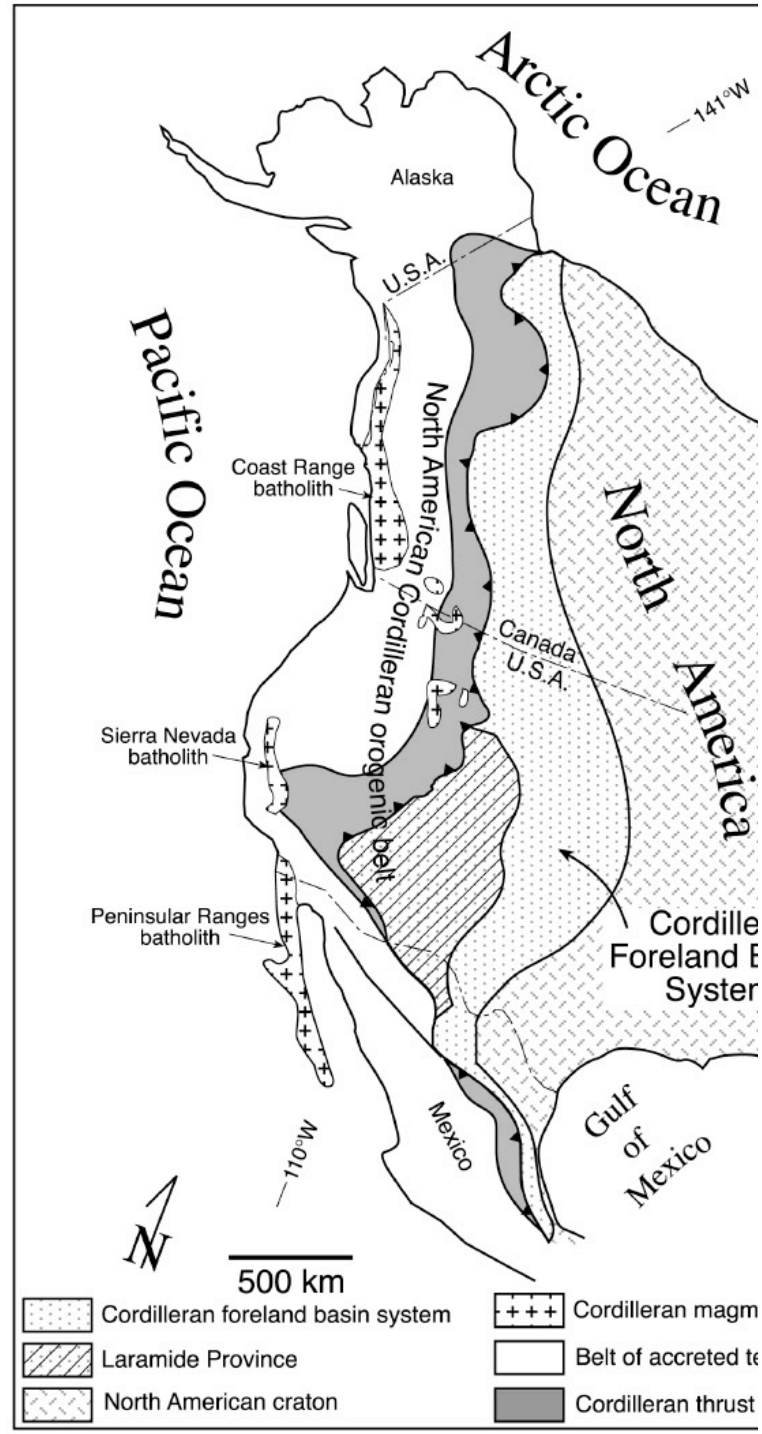


Figure 12. Schematic, reconstructed cross section of the Cordilleran orogenic belt at the latitude of central Utah during Late Cretaceous time. Geology beneath the magmatic arc is after Ducea (2001).

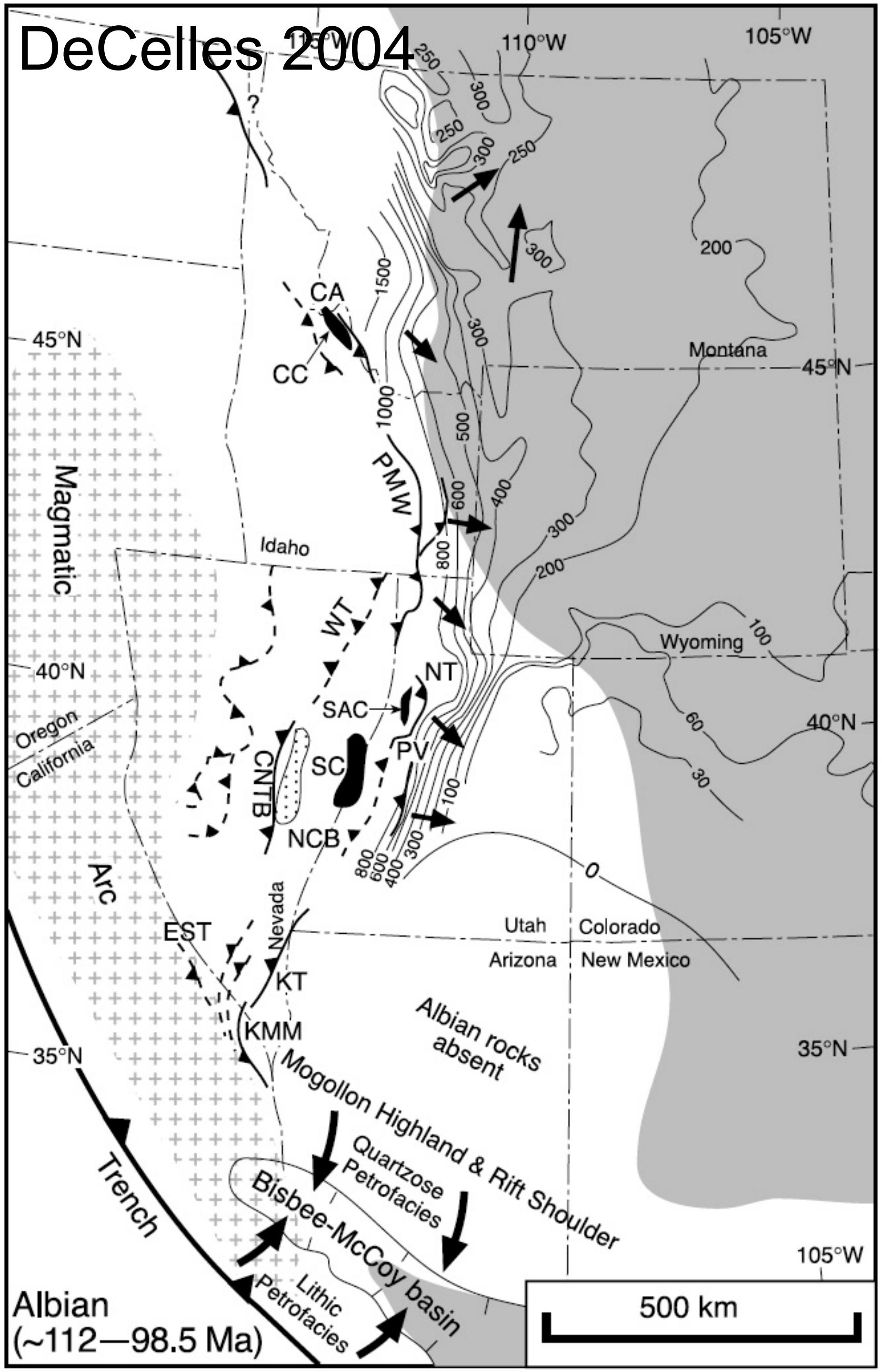
DeCelles and Coogan 2006

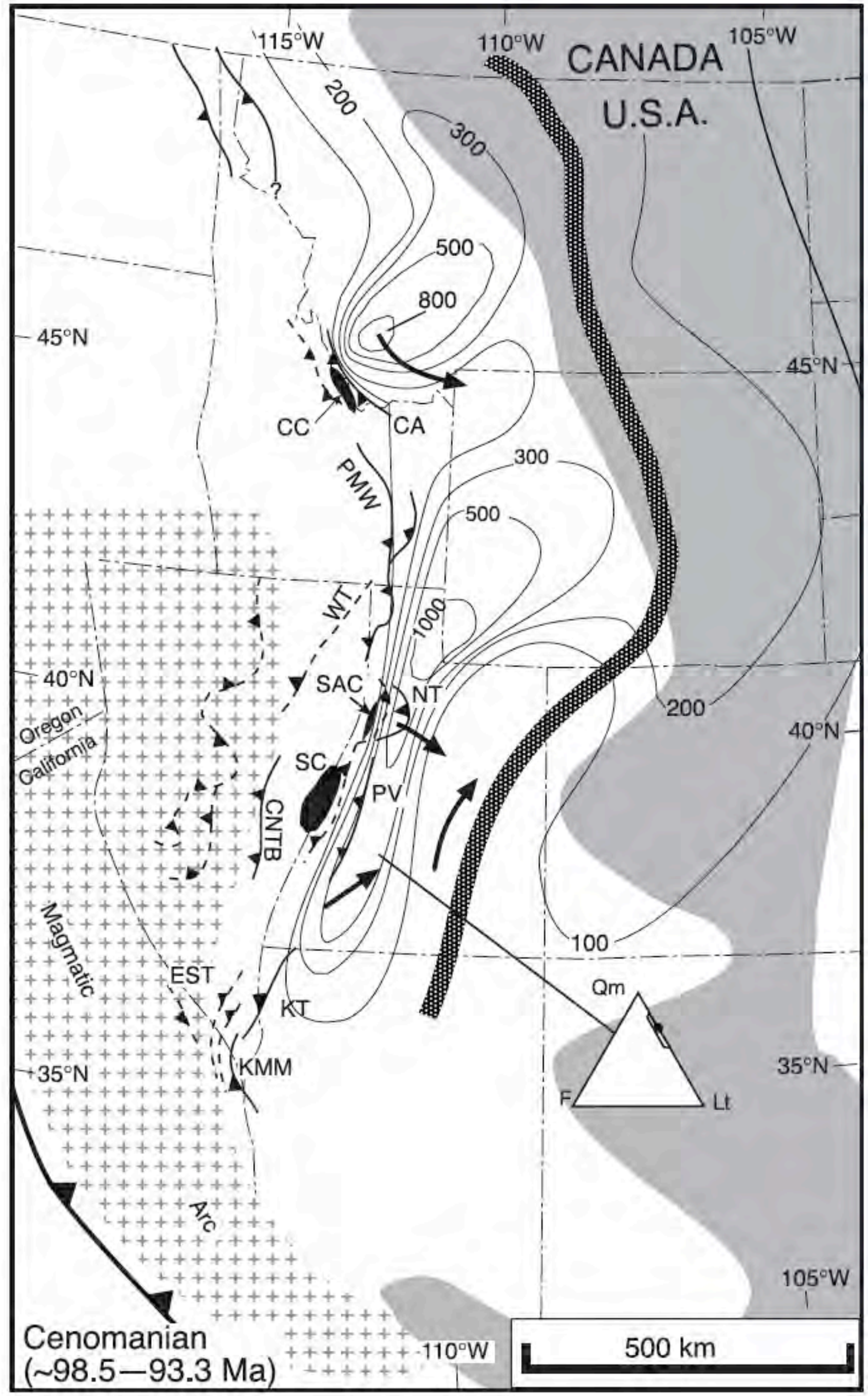


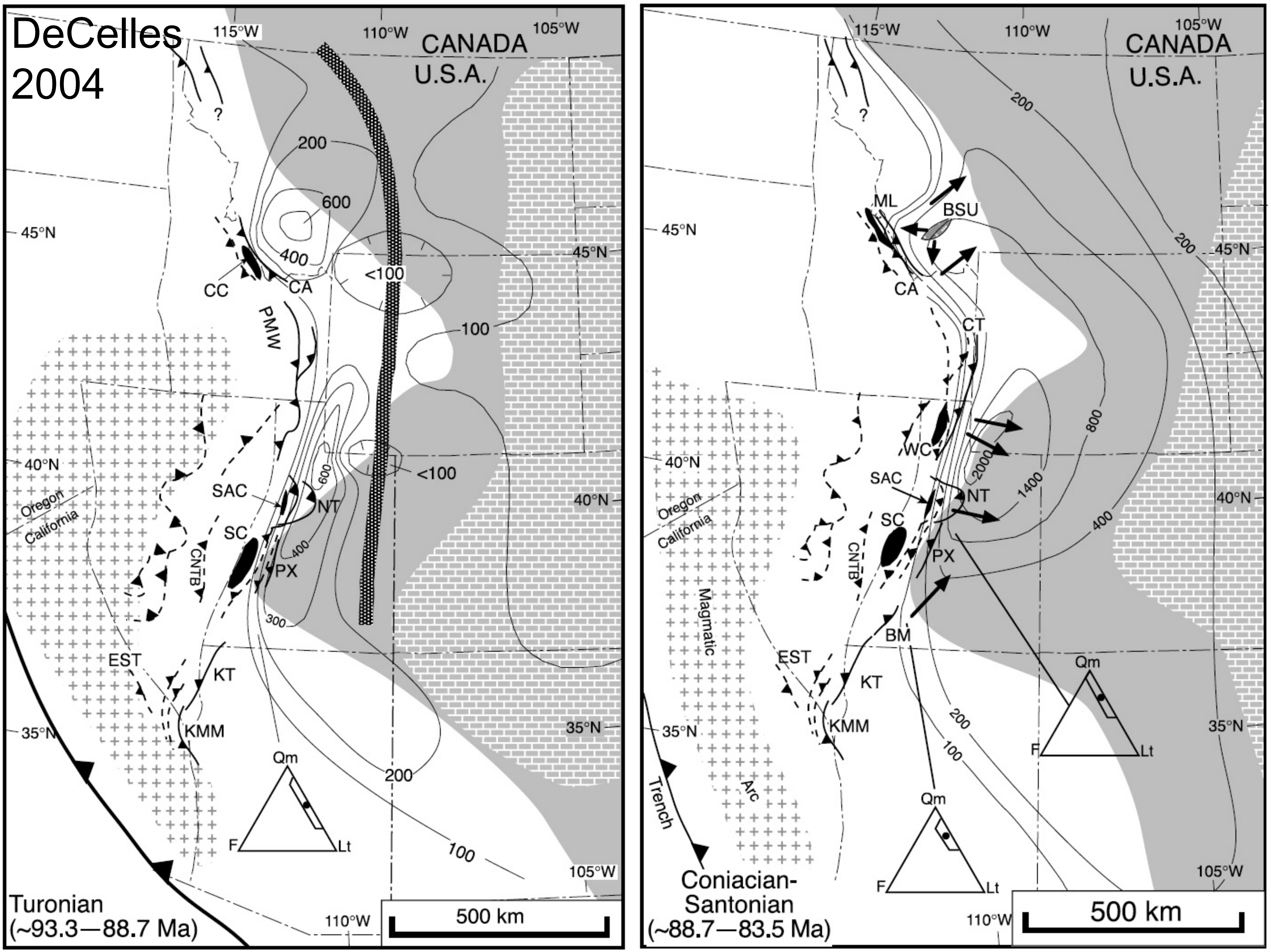
DeCelles 2004



DeCelles 2004






DeCelles
2004
115°W
110°W
105°W
CANADA
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200
600
400
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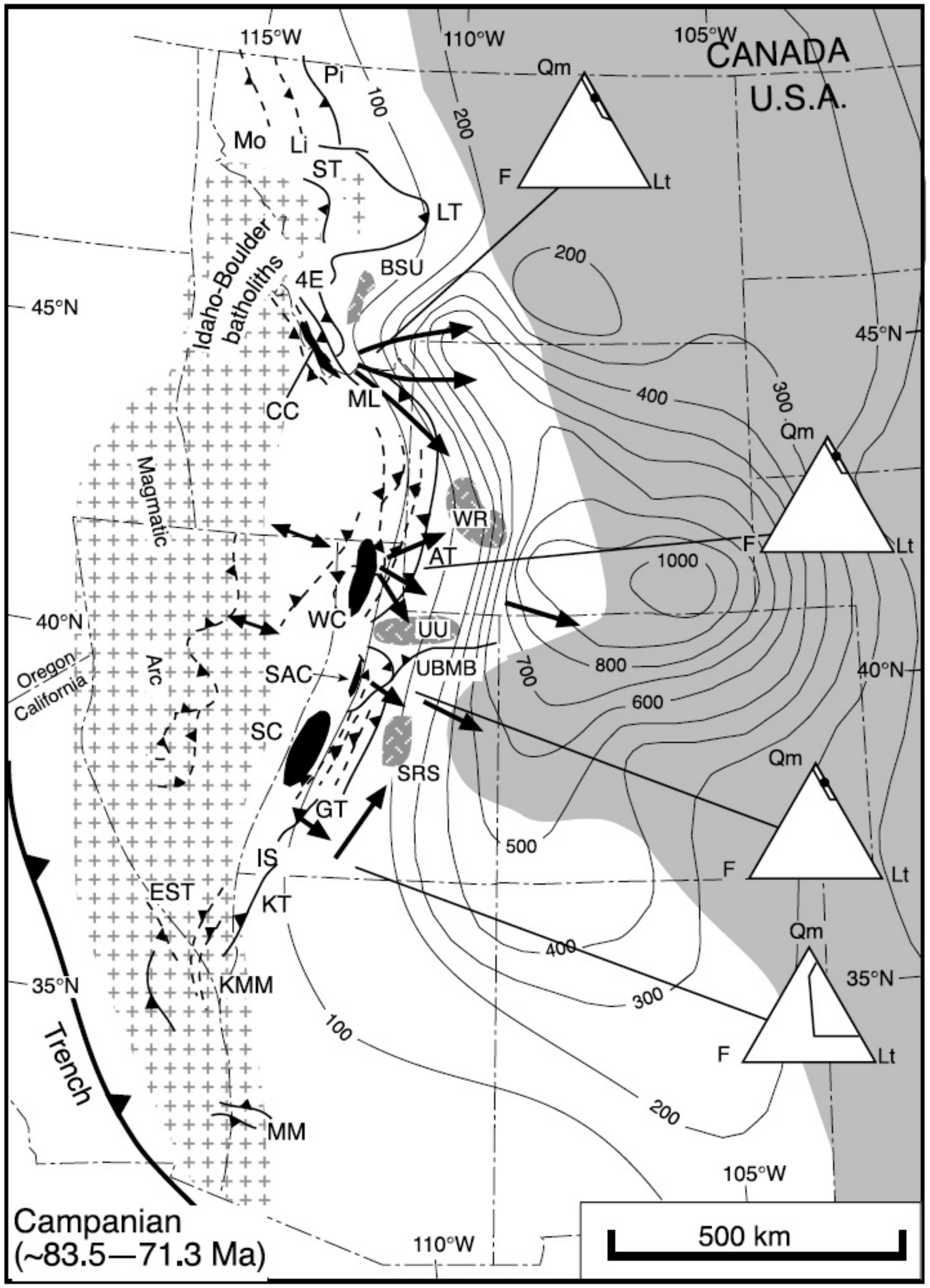
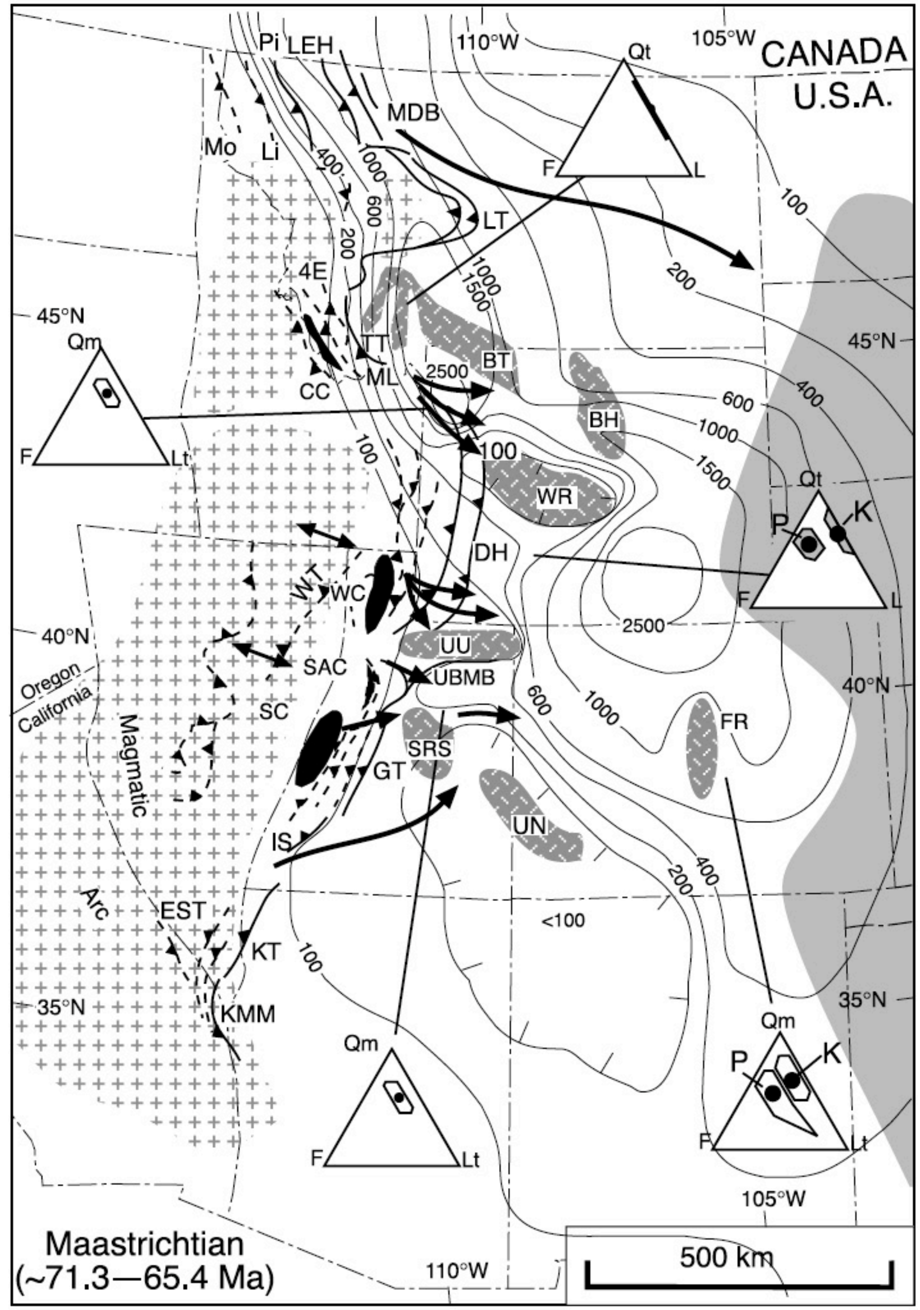
PMW
40°N
SAC
NT
SC
PX
CNTB
Oregon
California
300
EST
KT
KMM
35°N
Qm
F
Lt
Turonian
(~93.3—88.7 Ma)
500 km
ML
BSU
CT
WC
800
2000
1400
BM
Magmatic
Arc
Trench
Coniacian-
Santonian
(~88.7—83.5 Ma)





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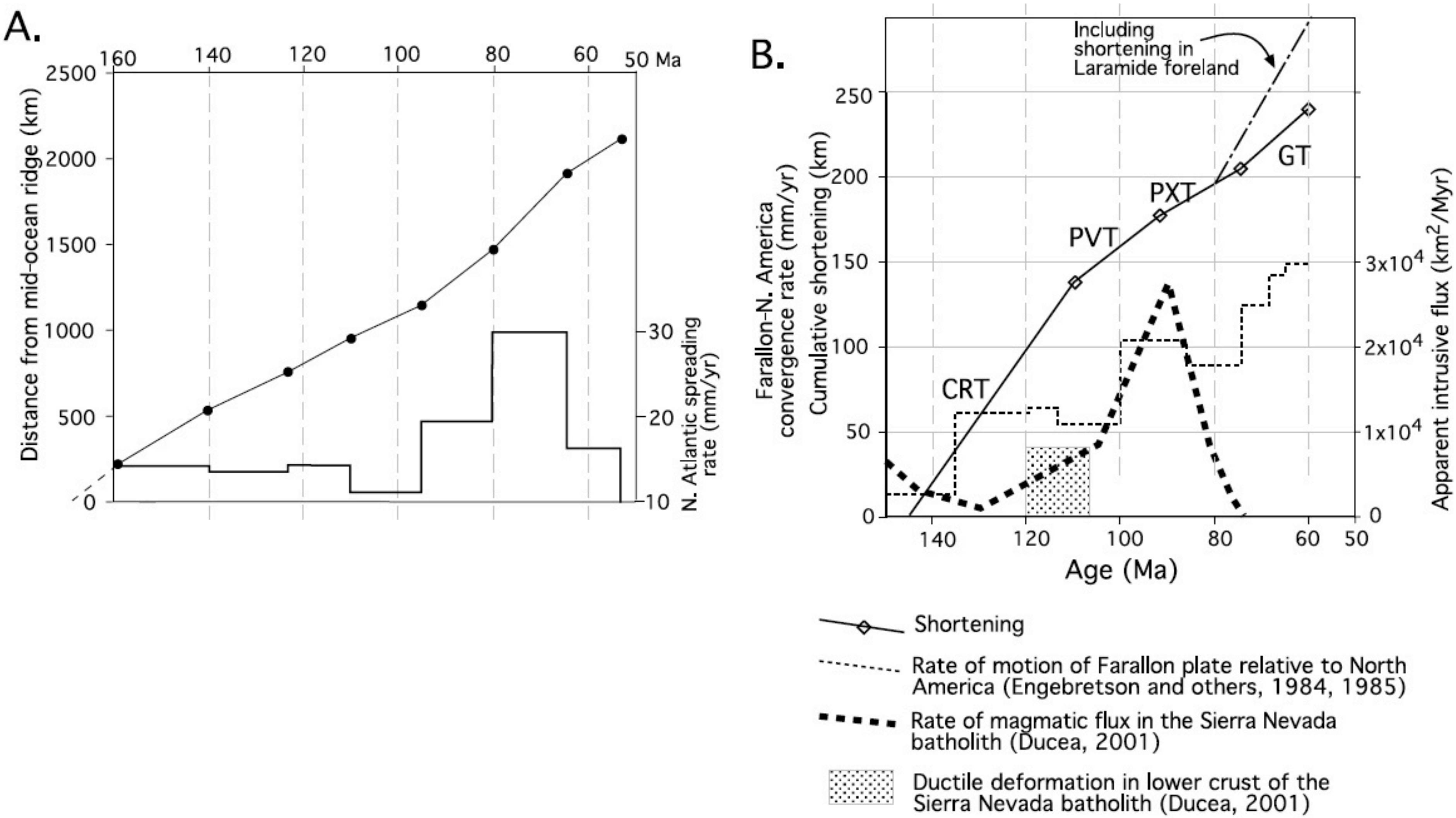

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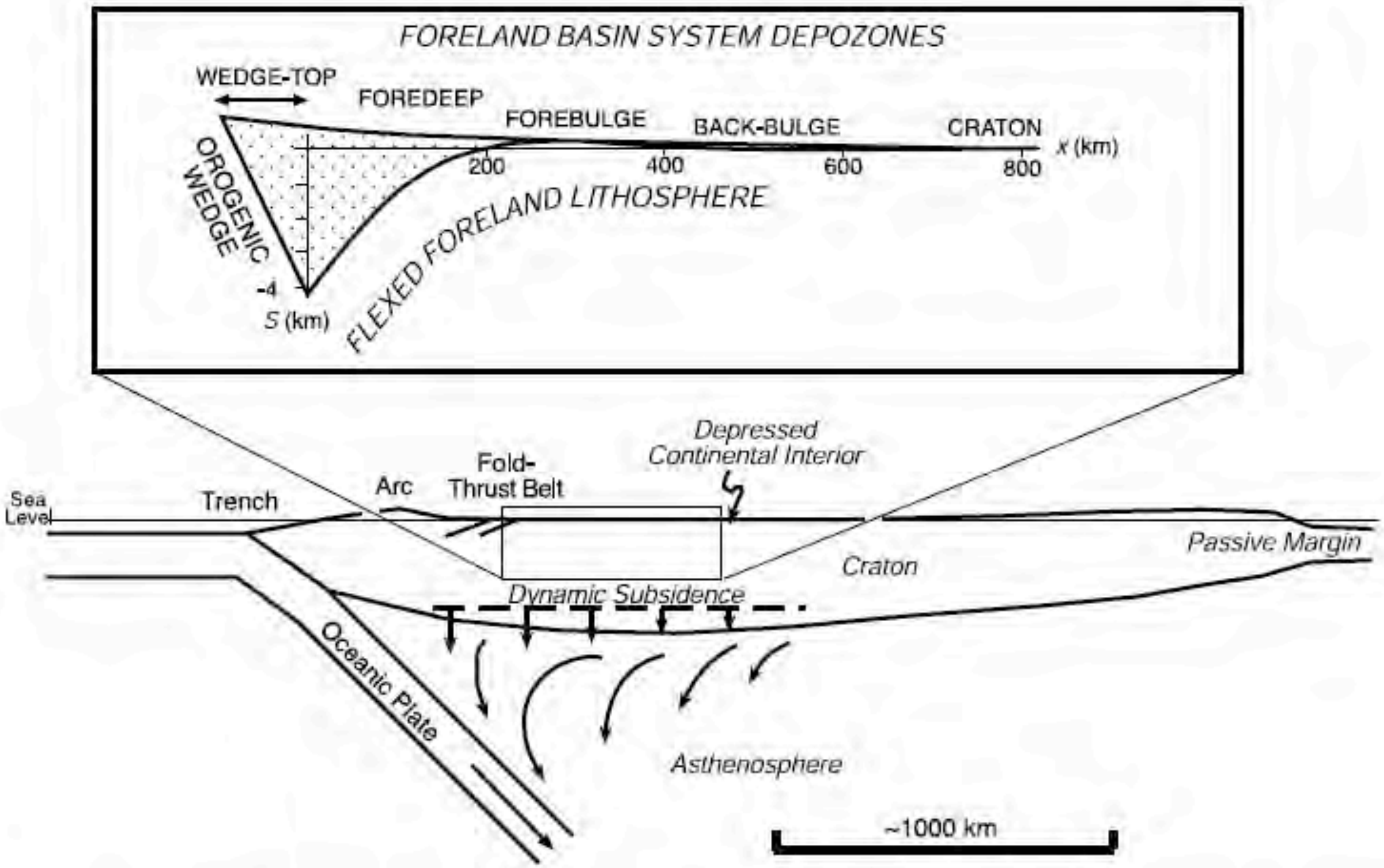
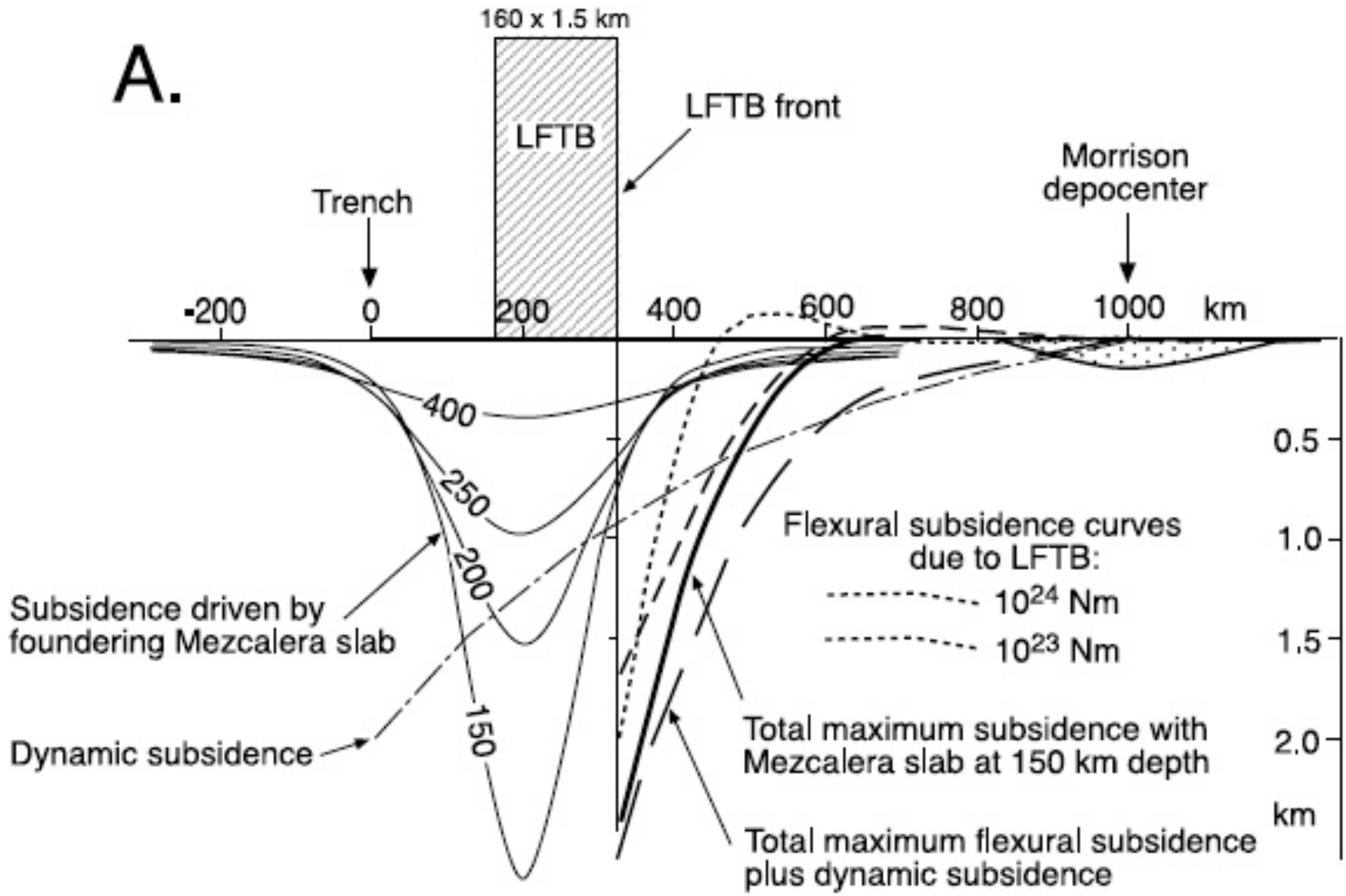


Fig. 6. Schematic cross sections illustrating the principal mechanisms of subsidence in retroarc foreland basins (modified from DeCelles and Giles, 1996). Lower panel shows the effect of long-wavelength dynamic subsidence (Gurnis, 1992), which tilts the craton downward toward the trench. Upper panel depicts shorter-wavelength flexural subsidence (S) versus lateral distance (x) owing to the topographic load of the orogenic wedge, and the four depozones that characterize many foreland basin systems. Note the extreme vertical exaggeration in the upper panel.

DeCelles 2004



DeCelles 2004

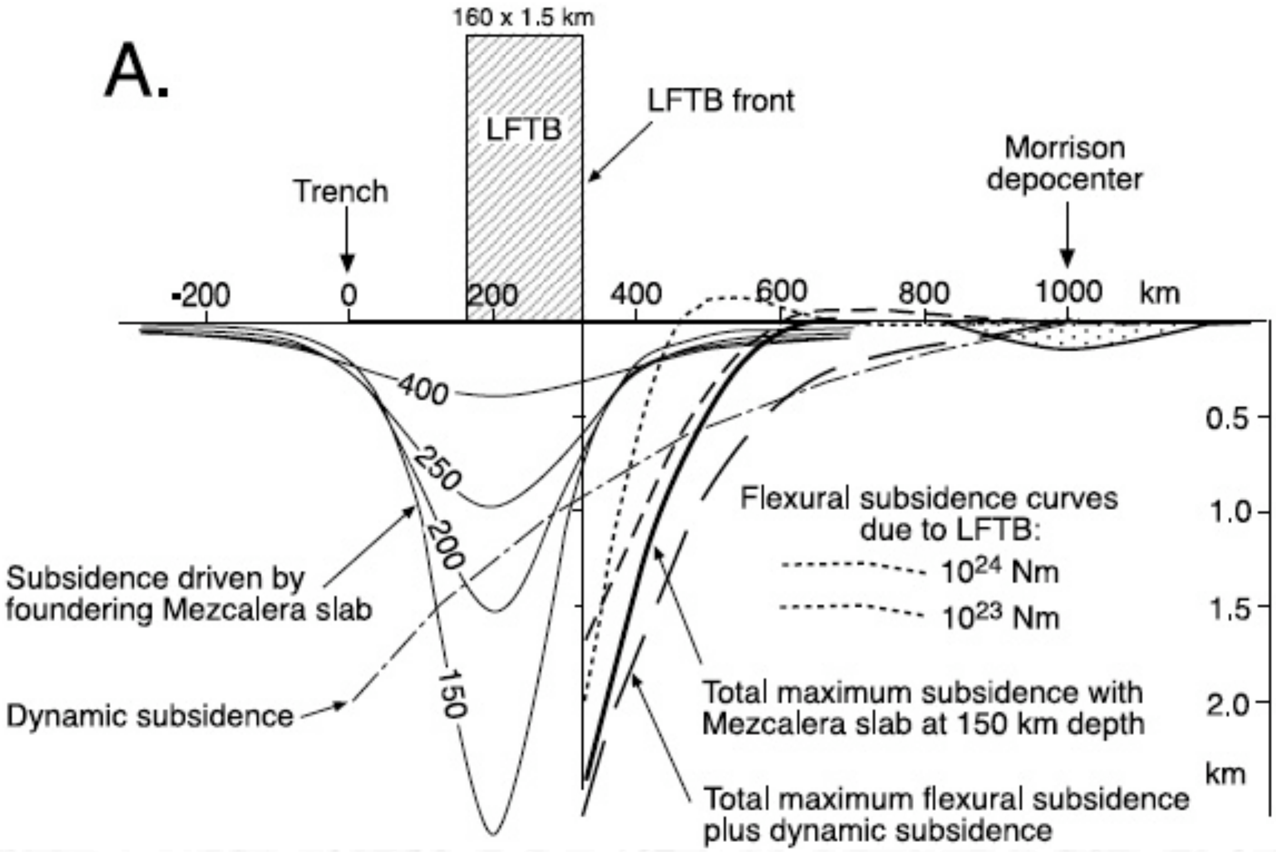
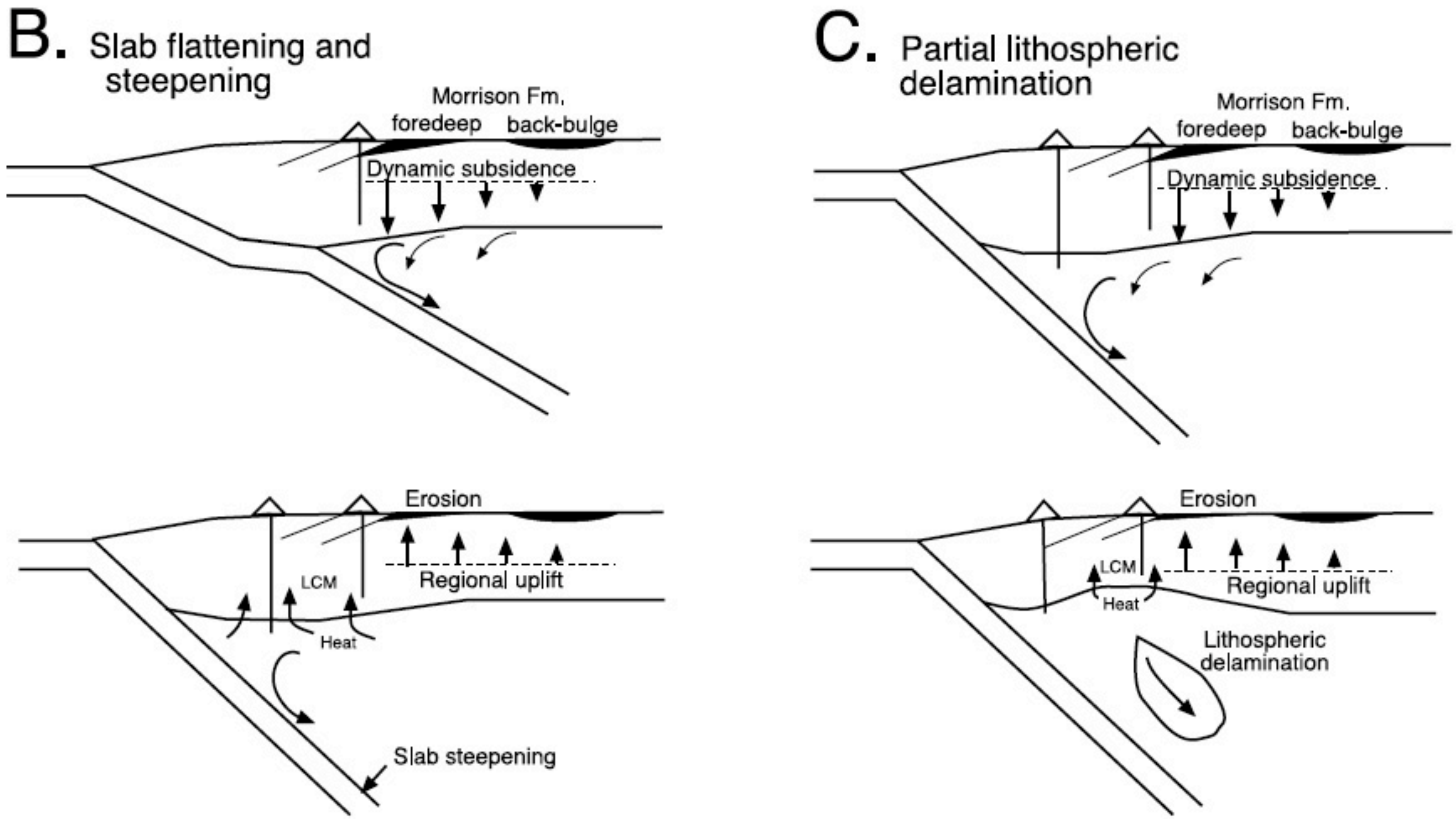


Fig. 8. (A) Comparison of predicted flexural subsidence owing to the surface load of the Luning-Fencemaker thrust belt (LFTB) (dashed and dotted curves, for different flexural rigidities using equations of Turcotte and Schubert, 2002), subsidence driven by viscous foundering of a hypothetical Mezcalera slab at depths of 150 km, 200 km, 250 km, and 400 km (calculated according to Morgan, 1965, assuming a spherical geometry with a diameter of 200 km), and dynamic subsidence driven by viscous coupling between the subducting Farallon slab and North American craton (after Gurnis, 1992). The origin of the horizontal scale is the approximate location of the trench during Late Jurassic time. Thick line represents sum of the subsidence owing to Mezcalera slab foundering (when the slab was at only 150 km depth) and flexure of lithosphere with flexural rigidity of 10^{24} Nm. The distribution of the Morrison Formation is shown at ~1000 ± 200 km from trench. Note that the Morrison depocenter is situated approximately where a back-bulge depozone is predicted for flexed lithosphere of rigidity = 10^{24} Nm. Predicted subsidence driven by the foundering Mezcalera slab is several hundred kilometers farther west. The long dashed curve is the sum of subsidence for flexed lithosphere of rigidity = 10^{24} Nm and dynamic subsidence. (B) and (C)

DeCelles 2004



DeCelles 2004

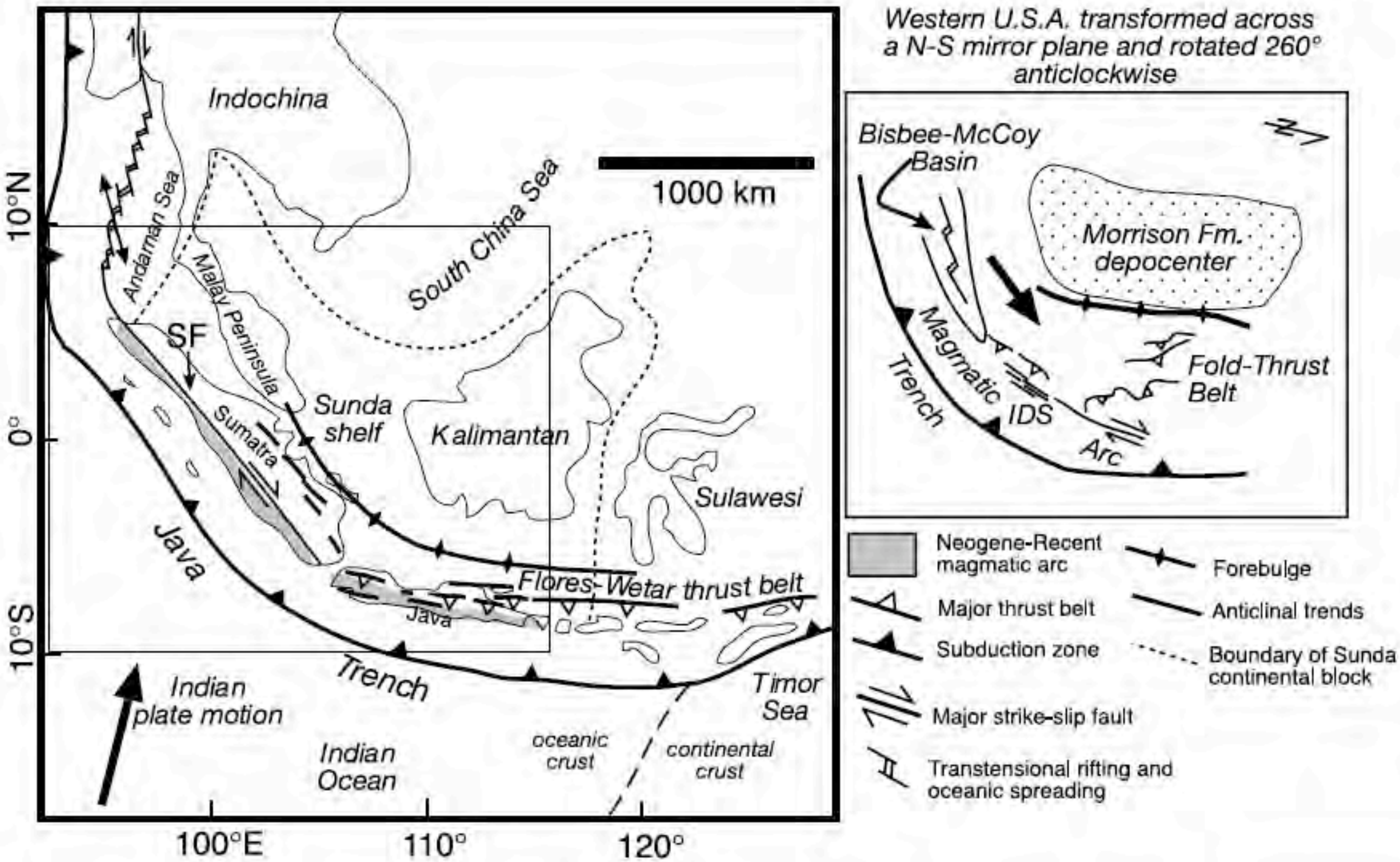


Fig. 9. Generalized tectonic maps (at same scale) of the Indonesian orogenic system (left) and western U.S.A. Cordilleran orogenic system during Late Jurassic time (right). The box in the Indonesian map indicates the same-sized region as depicted in the Late Jurassic map. Abbreviations: SF, Sumatran fault system; IDS, Independence dike swarm. Large arrows indicate relative plate convergence directions. The Late Jurassic map has been simplified from figure 6 and transformed as indicated in title. The Indonesian map is after Hamilton (1979), Silver and others (1983), McCaffrey and Nabelek (1987), and Lee and Lawver (1995).

DeCelles 2004

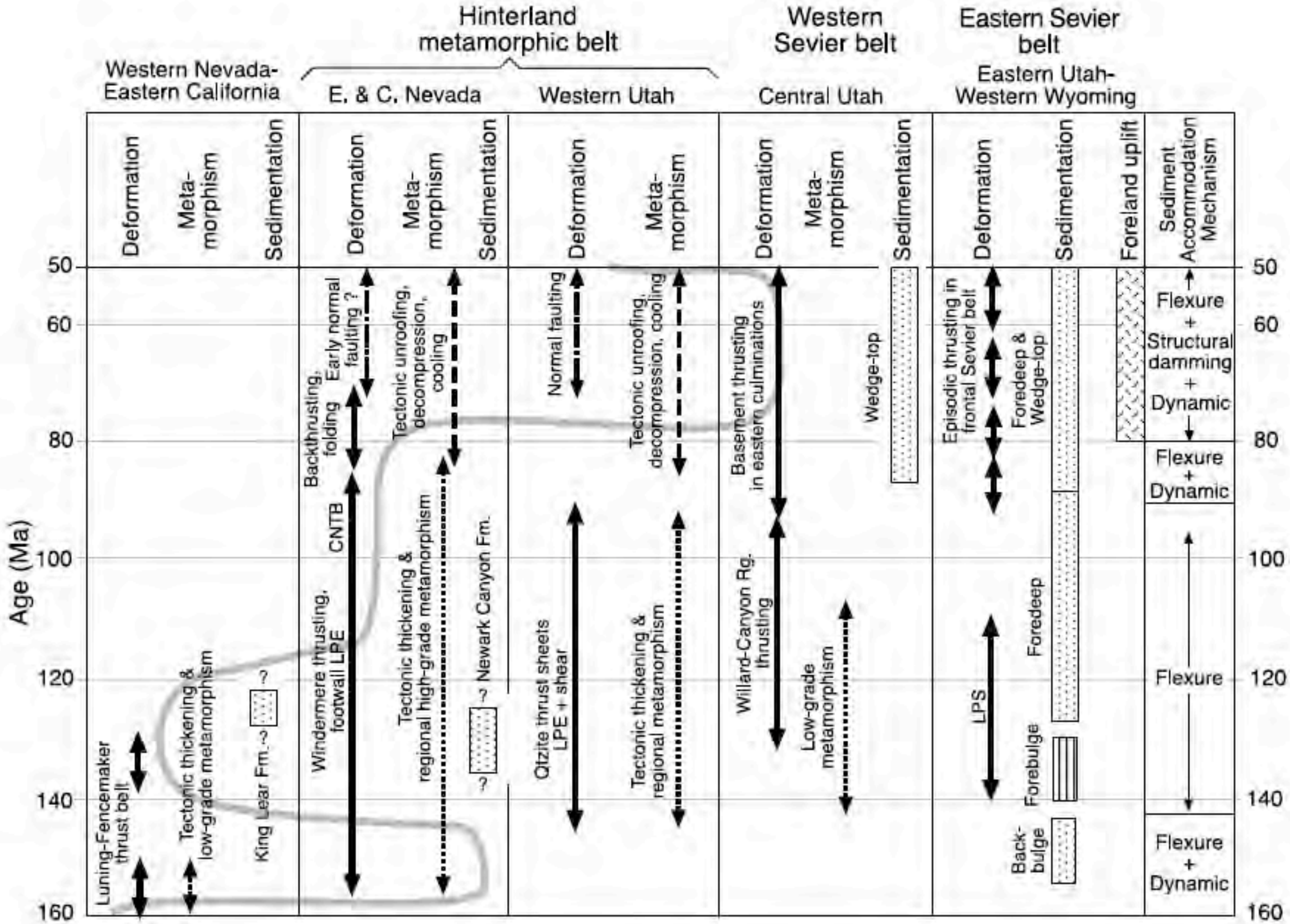
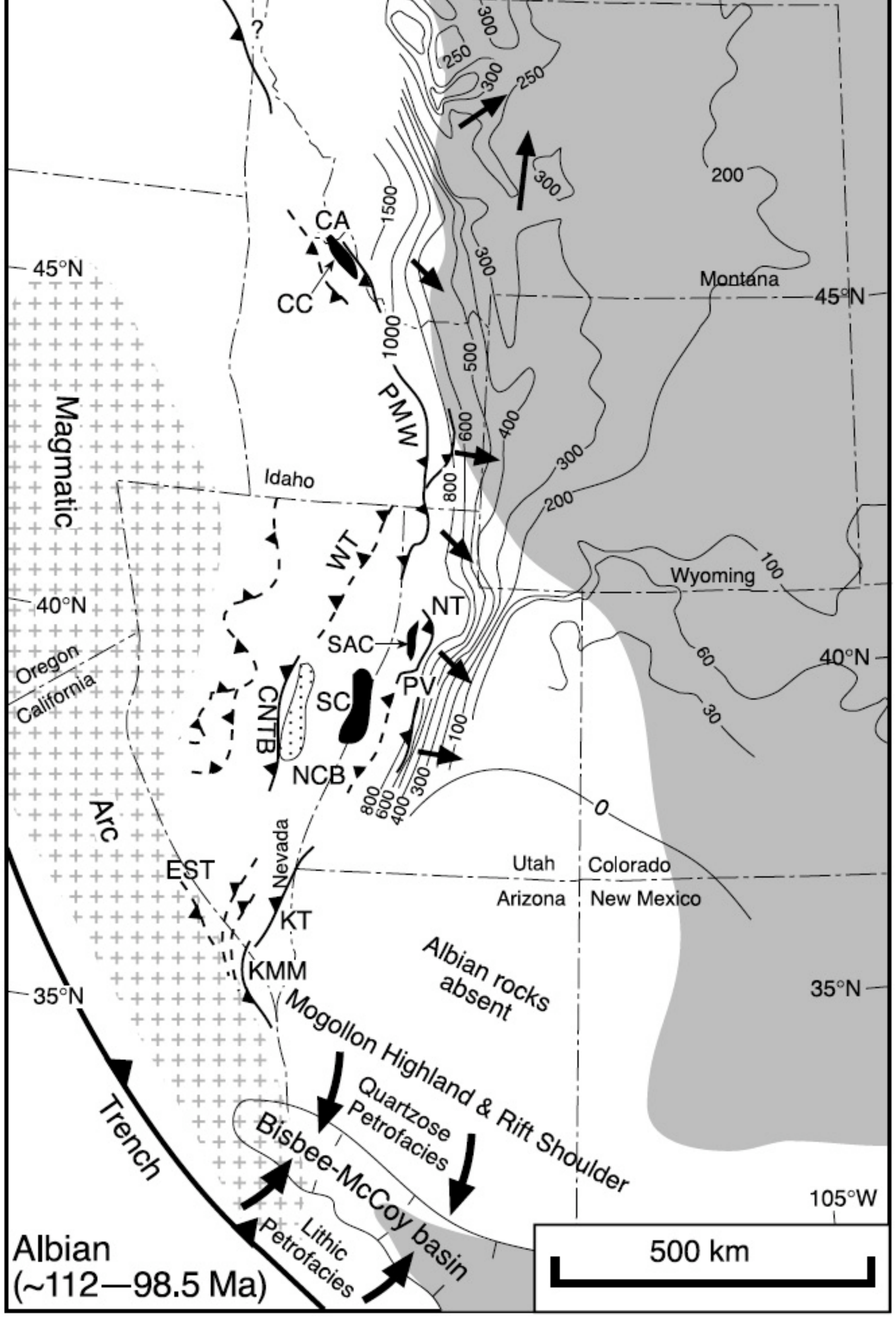
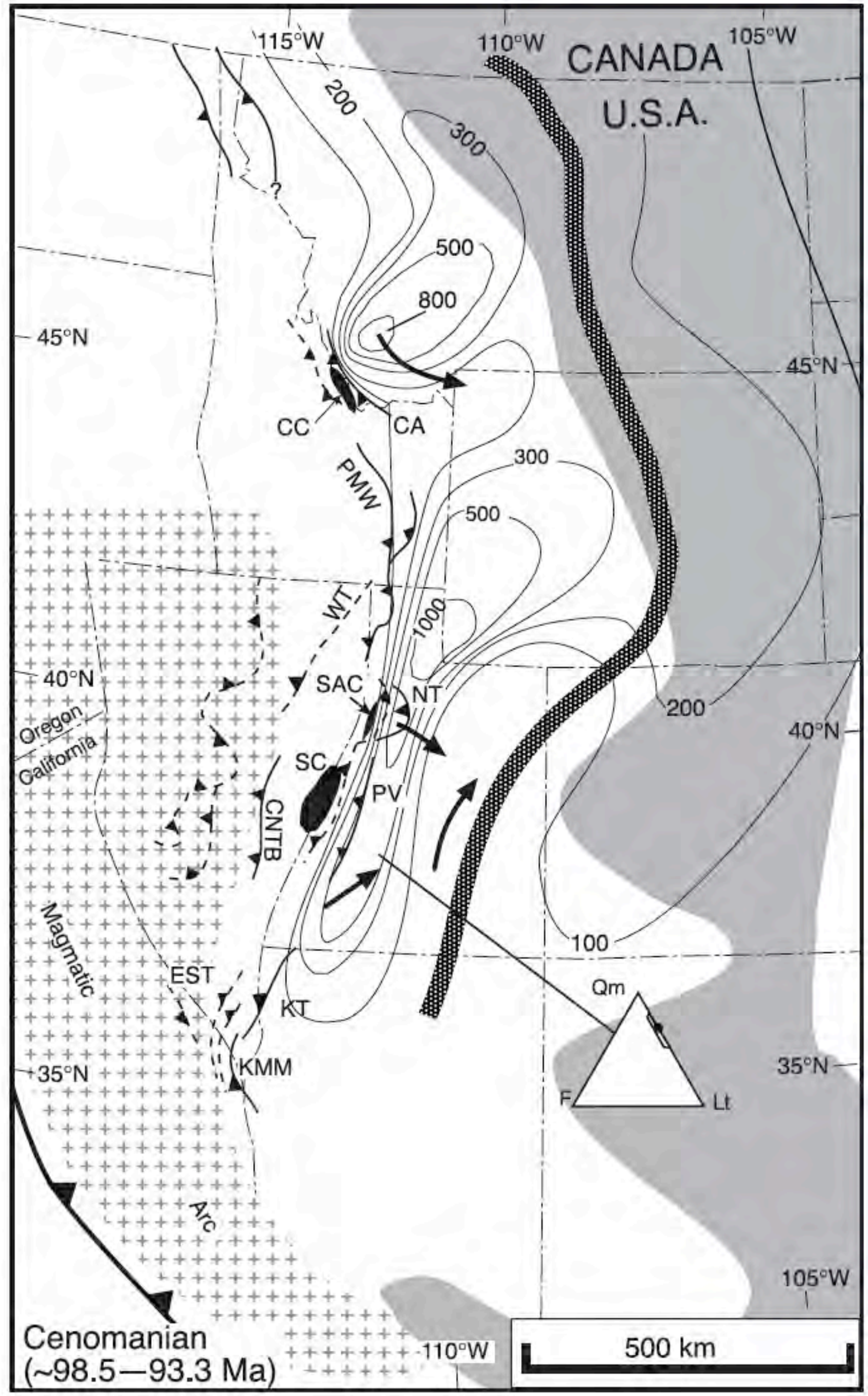


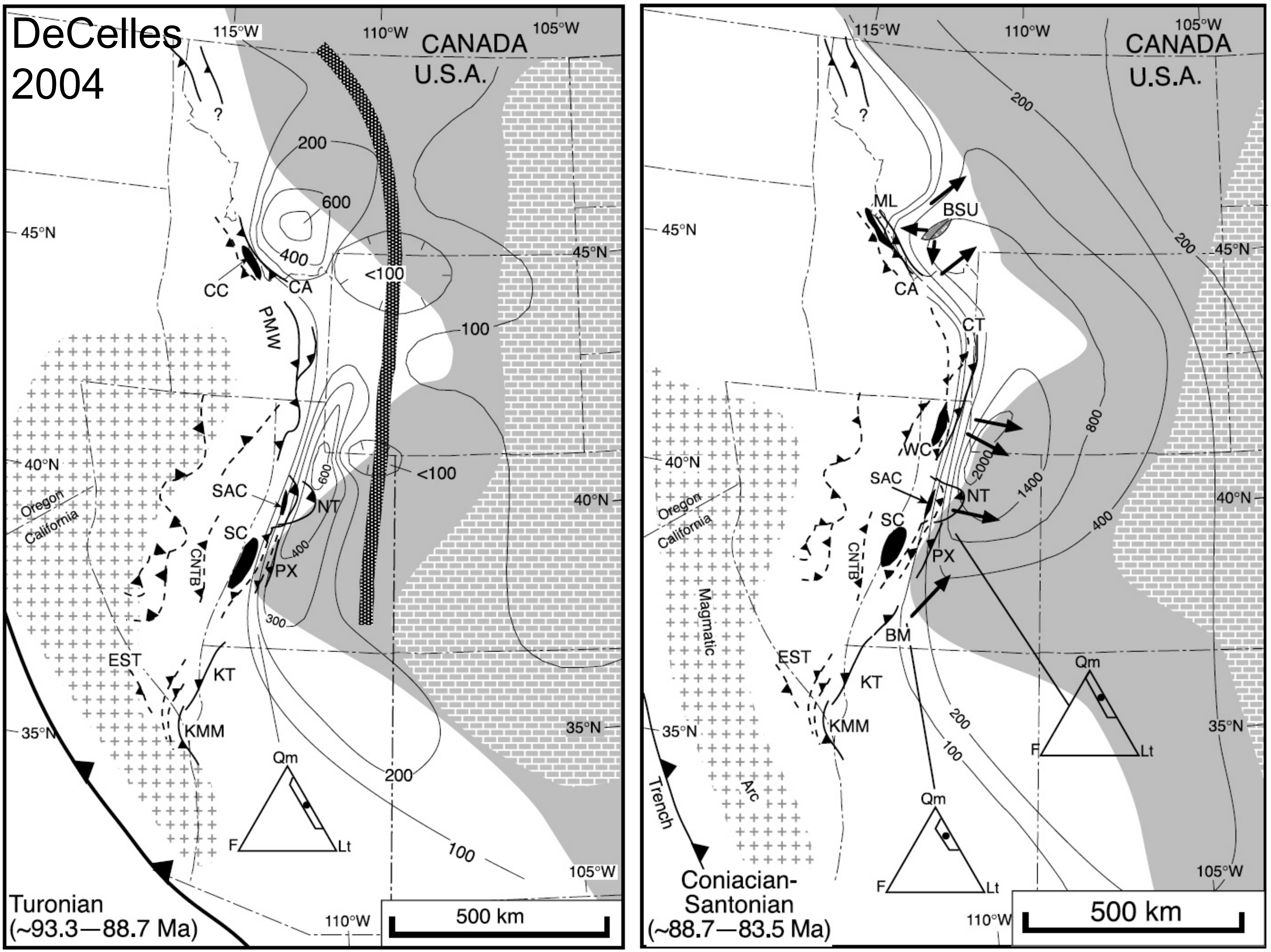
Fig. 17. Diagram illustrating timing of major tectonic, metamorphic, and depositional events in an east-west transect across the Cordilleran orogenic belt and foreland basin system at the approximate latitude of 41°N (northern Utah). Compiled from sources discussed in the text and previous figures. Gray line indicates the approximate eastern front of magmatic activity (after Christiansen and others, 1994).

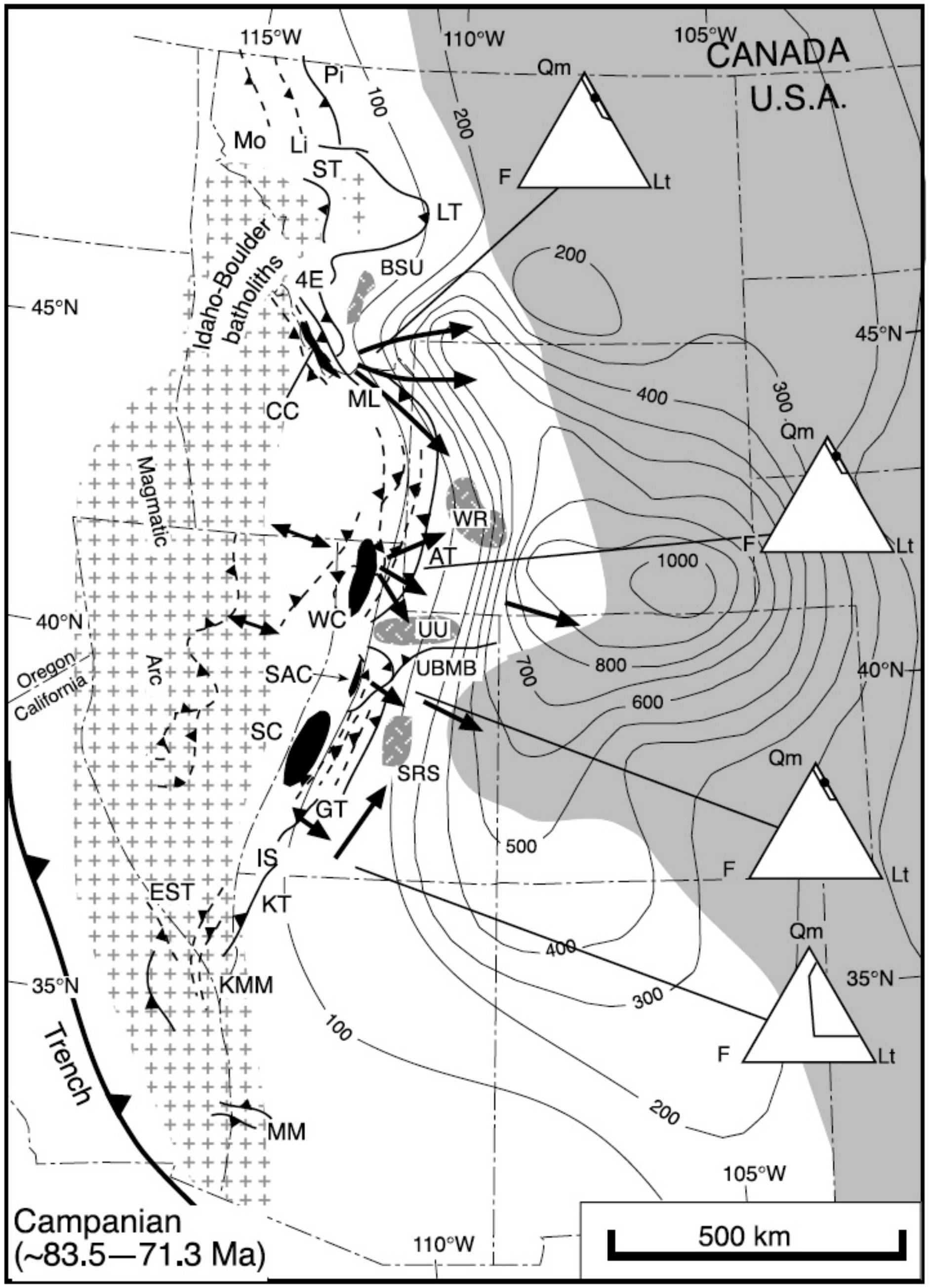
DeCelles 2004

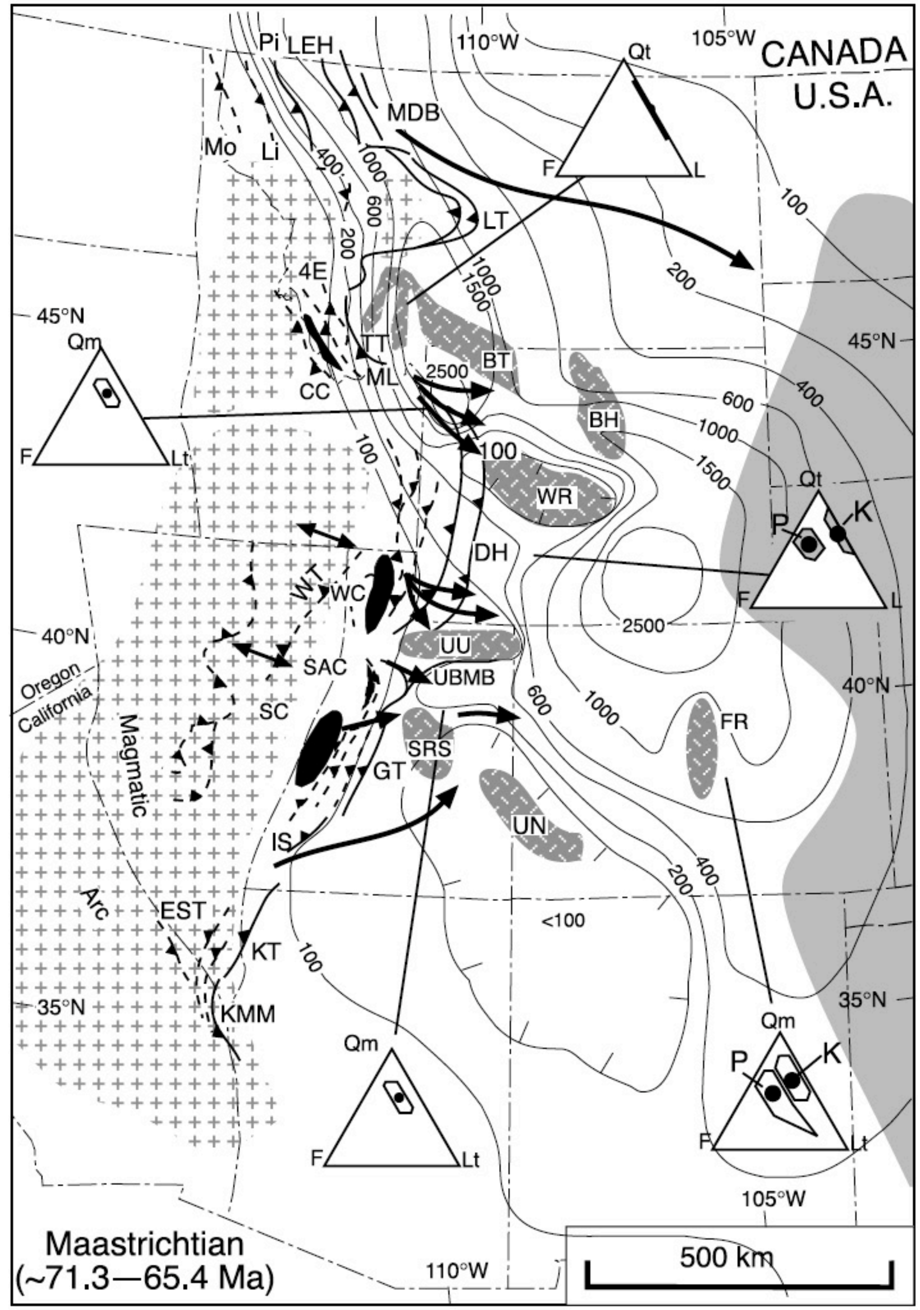




DeCelles 2004







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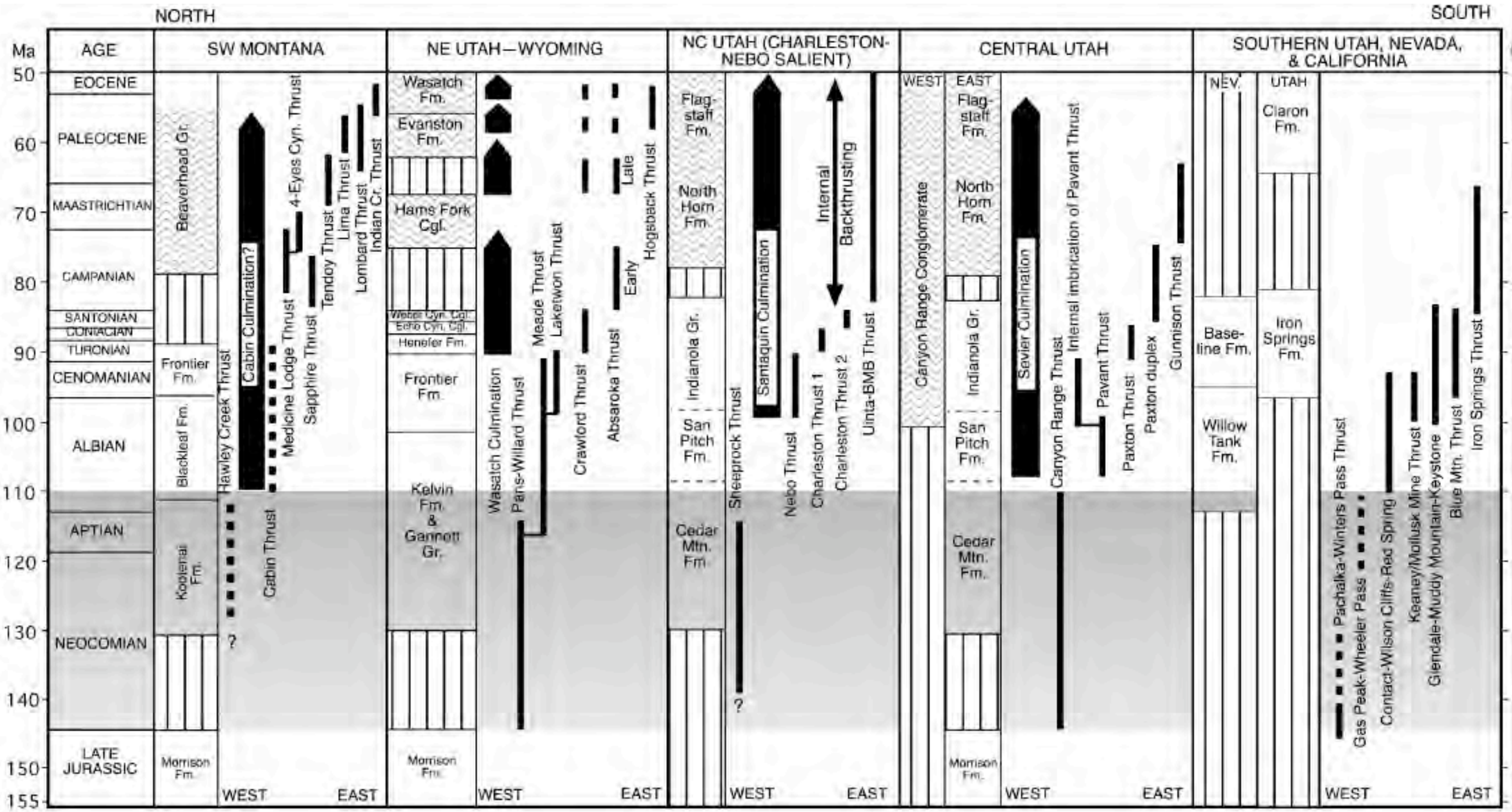
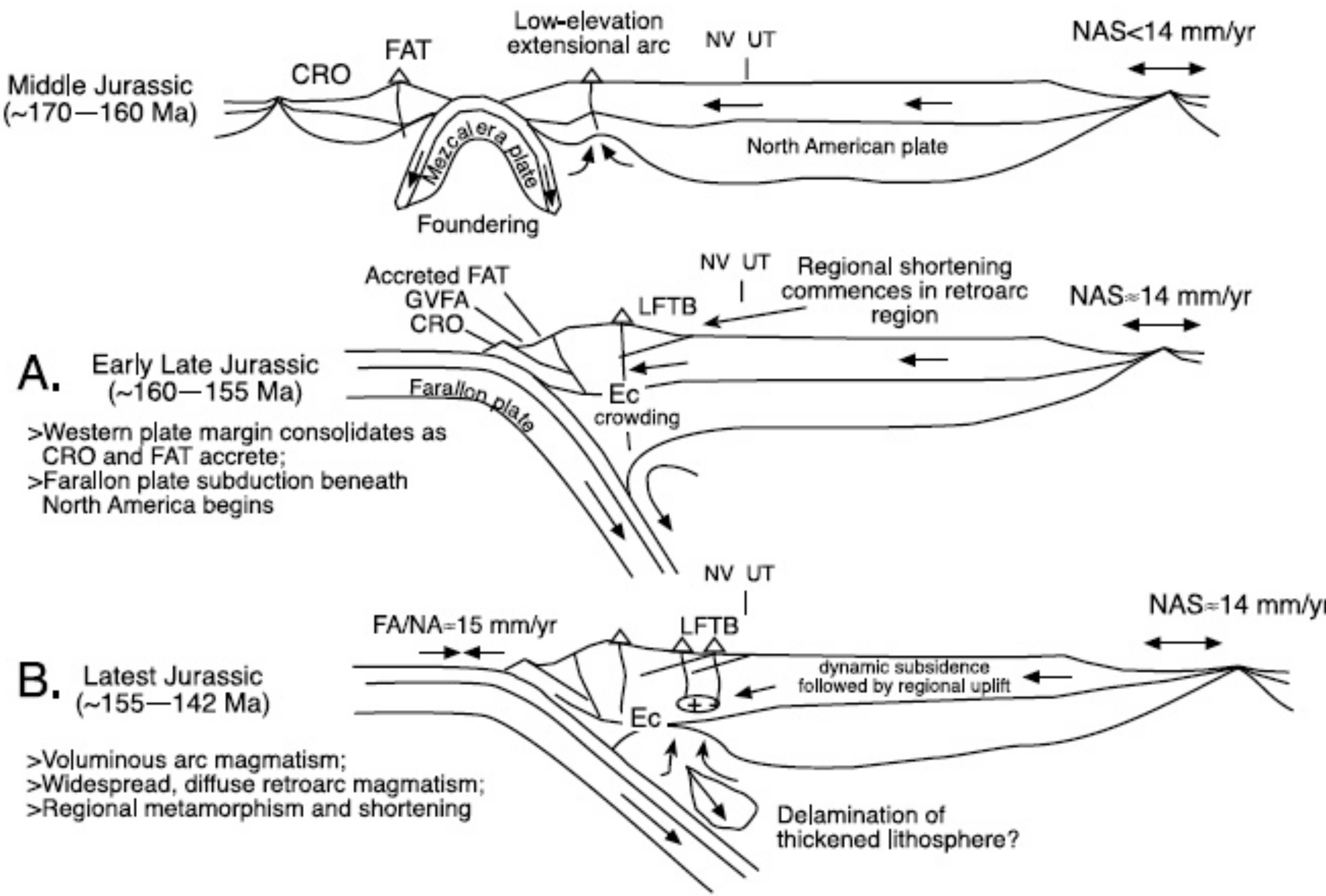
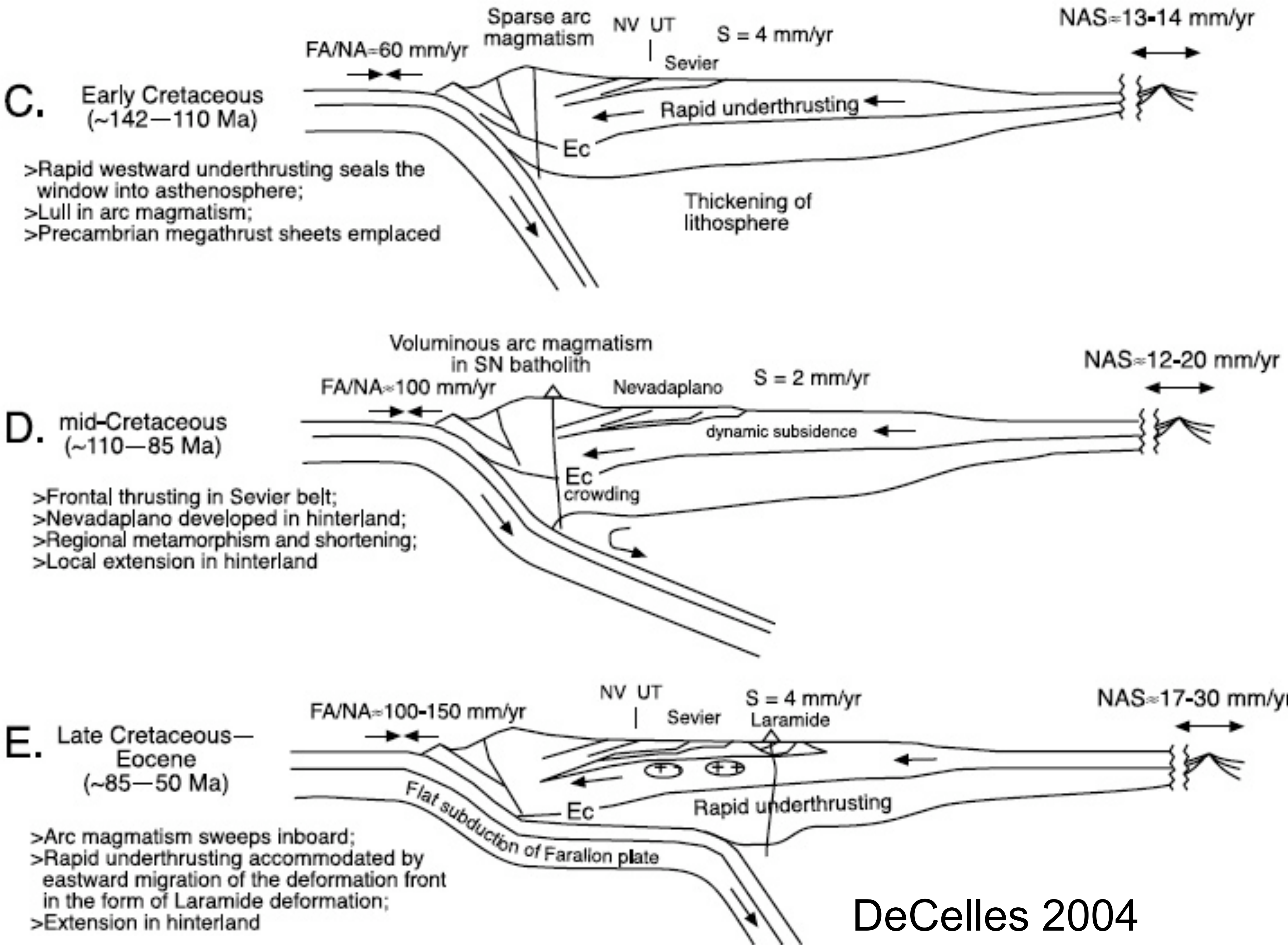


Fig. 18. Diagram illustrating the kinematic history in five selected segments of the frontal (Sevier belt) part of the Cordilleran thrust belt. The gray shaded area in lower part of the diagram indicates the period of emplacement of the Precambrian quartzite megathrust sheets. Black vertical lines indicate general estimates of timing of thrust displacement; dashed vertical lines (in southwest Montana panel) are speculative. Thick vertical arrows represent times of active uplift in basement culminations.

DeCelles 2004



DeCelles 2004



DeCelles 2004

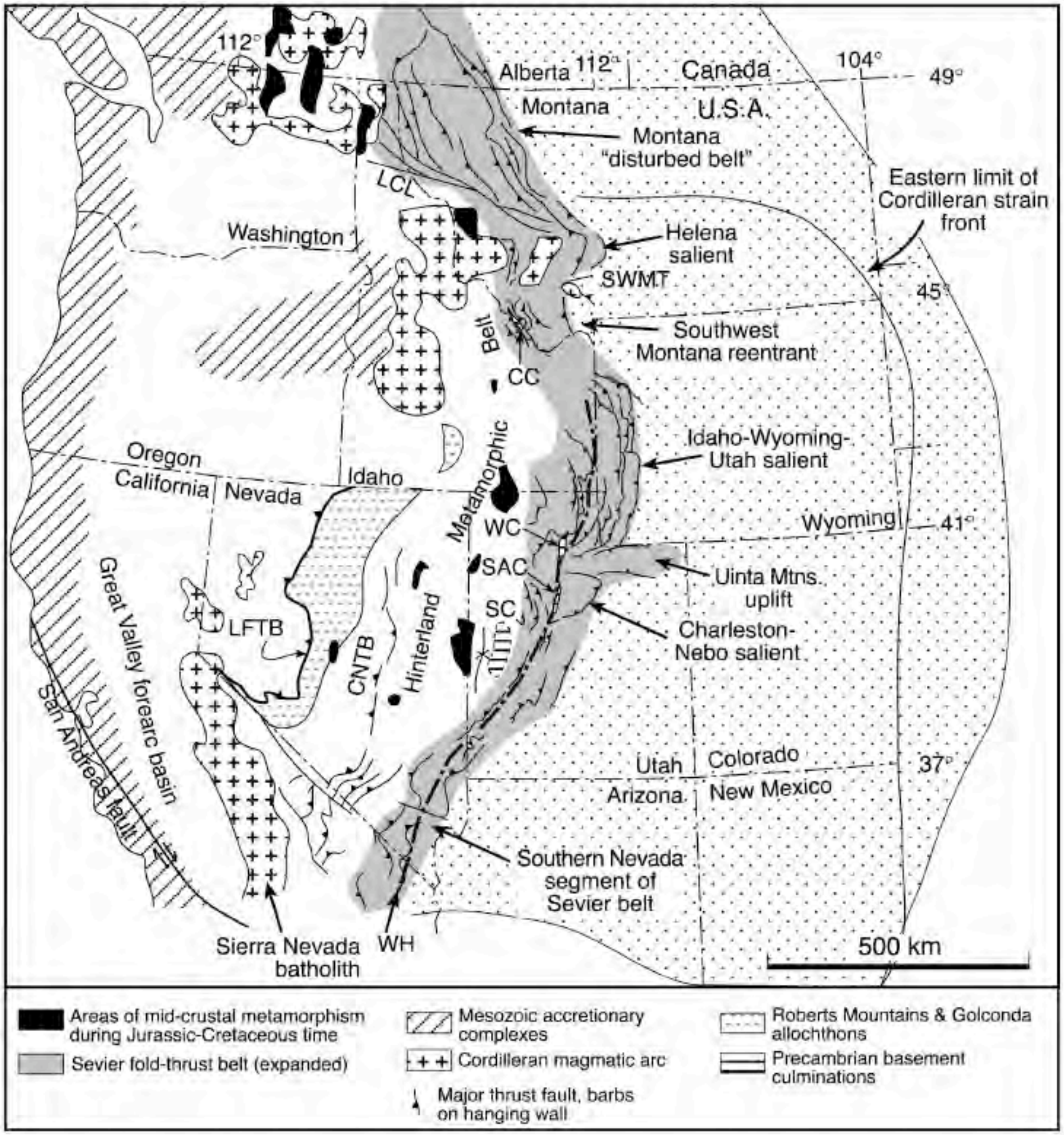


Fig. 5. Simplified version of figure 2, showing some of the major tectonic features in the Cordilleran thrust belt discussed in the text. Abbreviations as follows: LCL, Lewis and Clark line; SWMT, Southwest Montana transverse zone; CC, Cabin culmination; WC, Wasatch culmination; SAC, Santaquin culmination; SC, Sevier culmination; CNTB, Central Nevada thrust belt; LFTB, Luning-Fencemaker thrust belt; WH, Wasatch hinge line. Stippled region represents Cordilleran foreland basin system.

DeCelles 2004