Stratigraphic record of dynamic topography in the Andean foreland basin, South America

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THEMES:

- Long-lived unconformities in retroarc foreland basins
- Multiple potential geodynamic mechanisms
- Modern Andes = reveal active foreland processes

Sharing is encouraged

Active processes:

- *Flat slab subduction*
- *Active ridge subduction*

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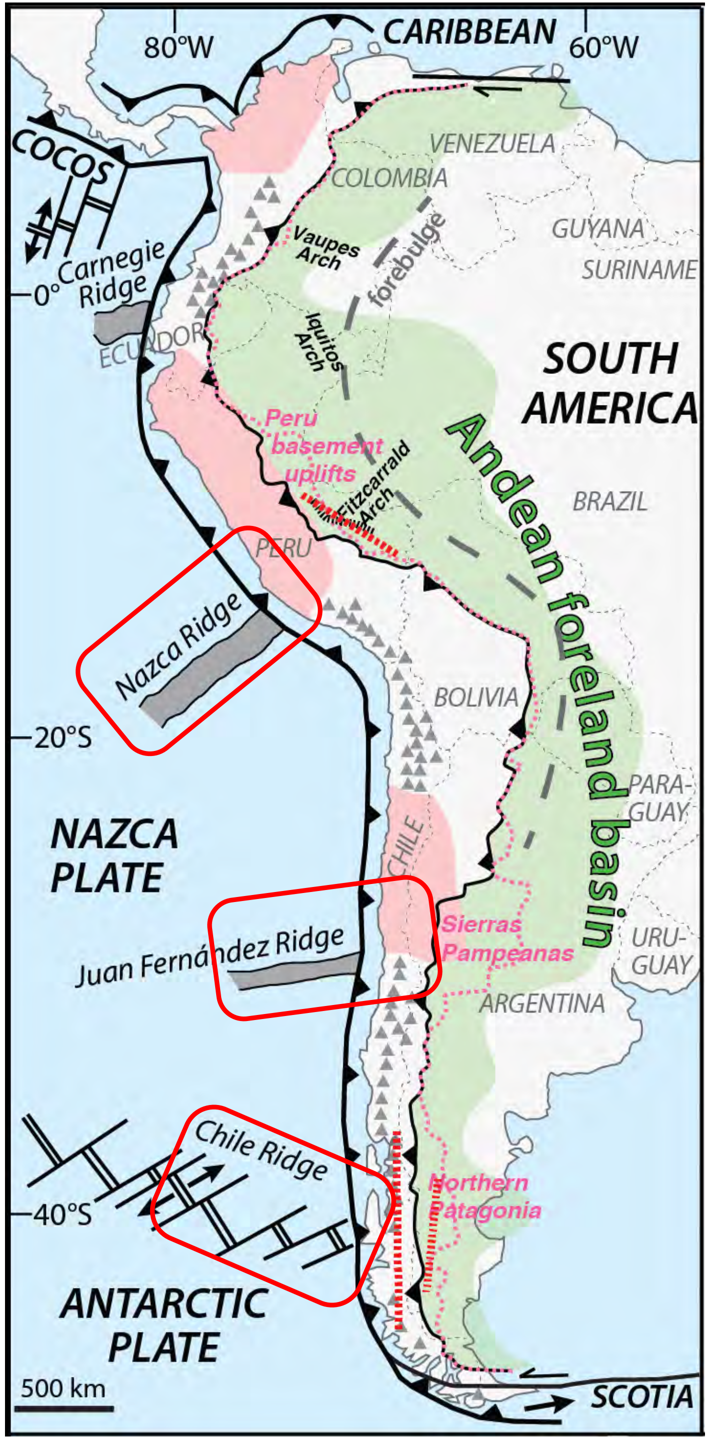

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Motivation

Response to late Cenozoic processes

- How has the retroarc foreland responded to:
  - Flat-slab subduction ?
  - Active ridge subduction (slab window development) ?

Dynamic topography: stratigraphic record

- Foreland basin = not simply long-lived subsidence (also phases of basin uplift and stasis/quiescence).

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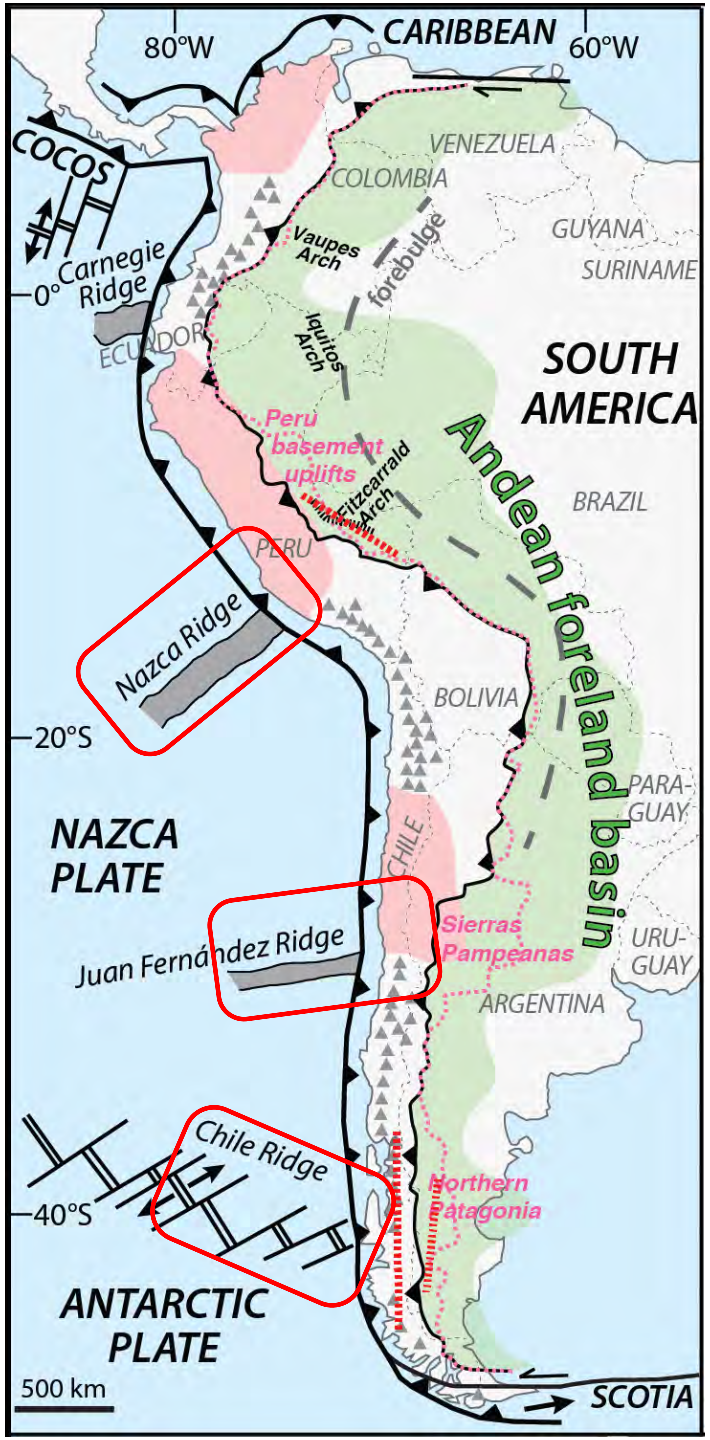
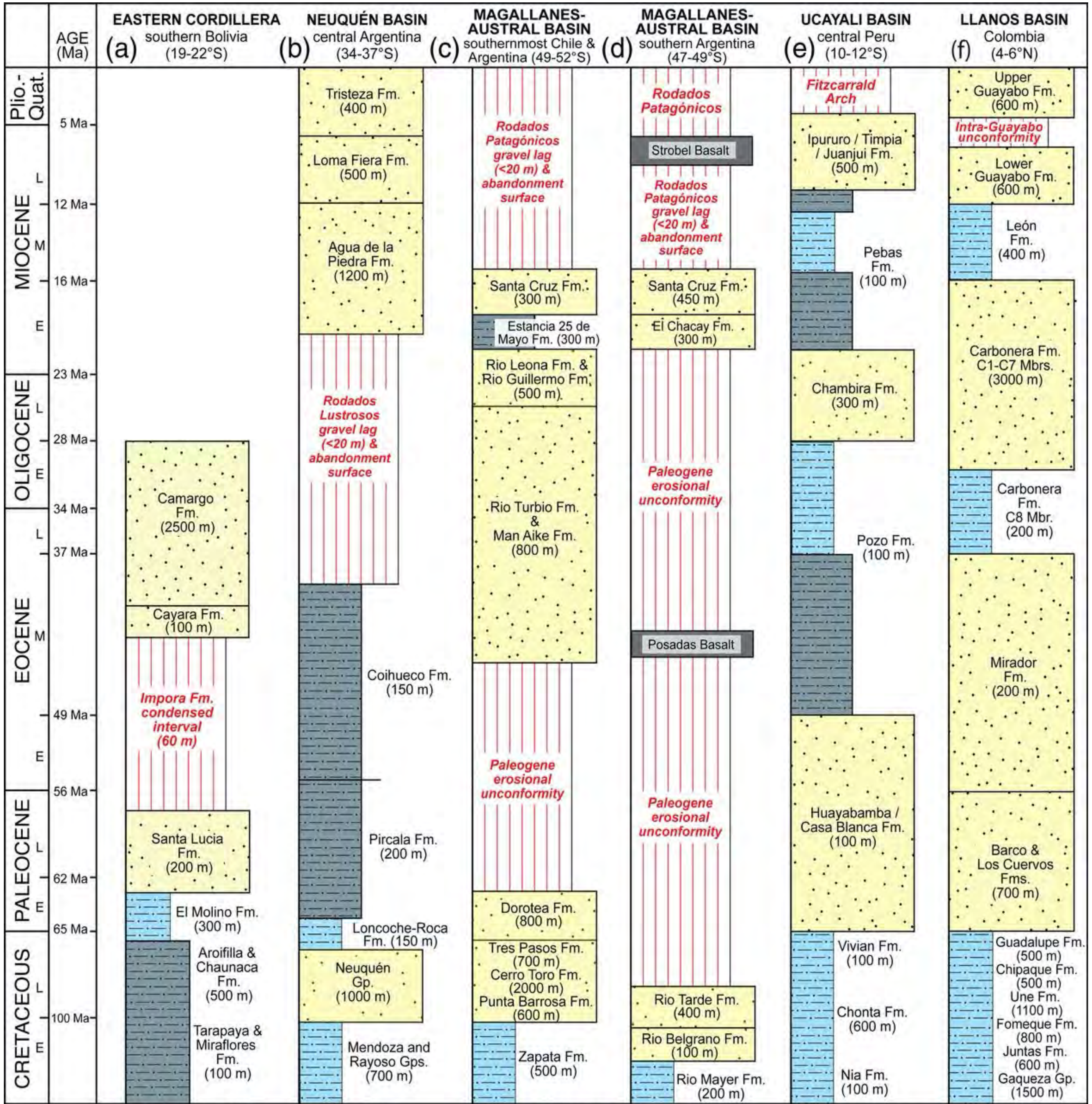
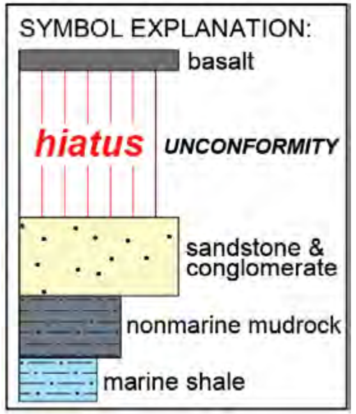




6 case studies



Types of hiatuses:

- non-angular unconformities
- disconformities
- condensed intervals

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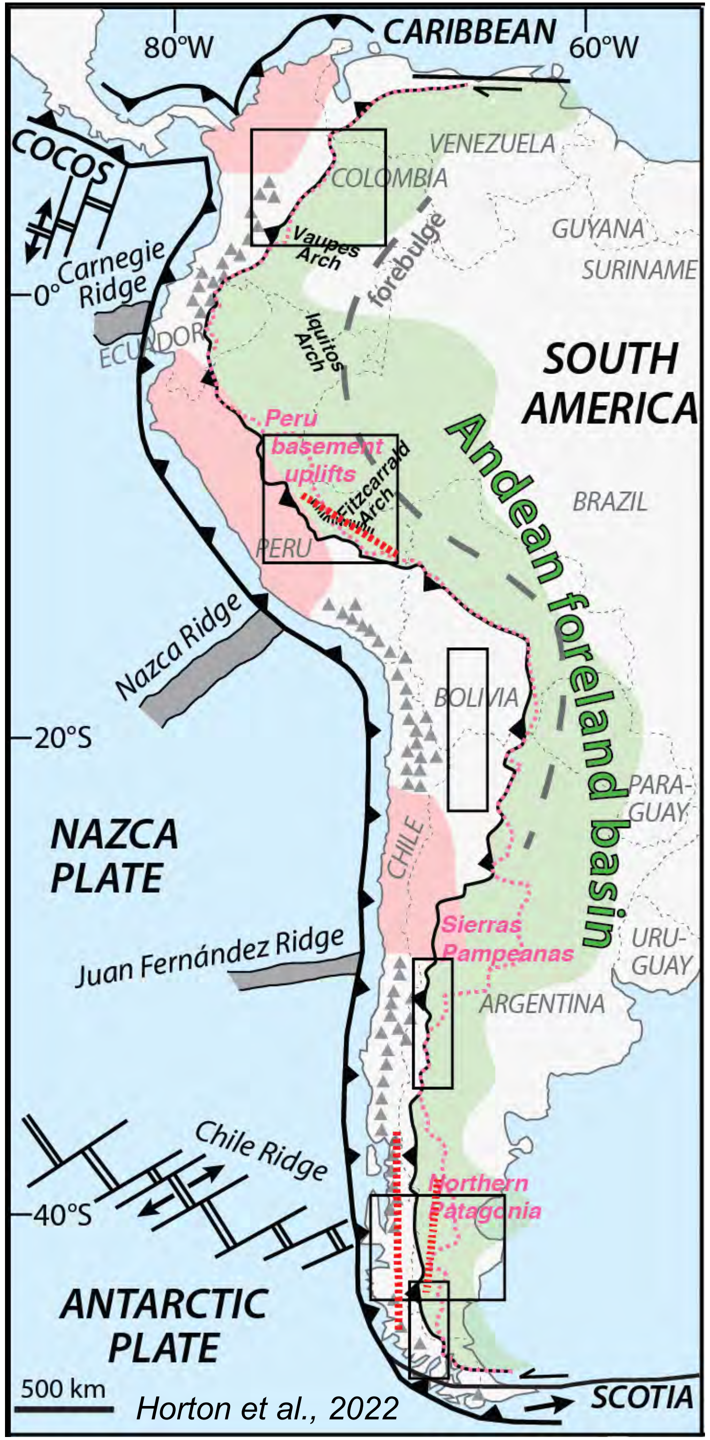

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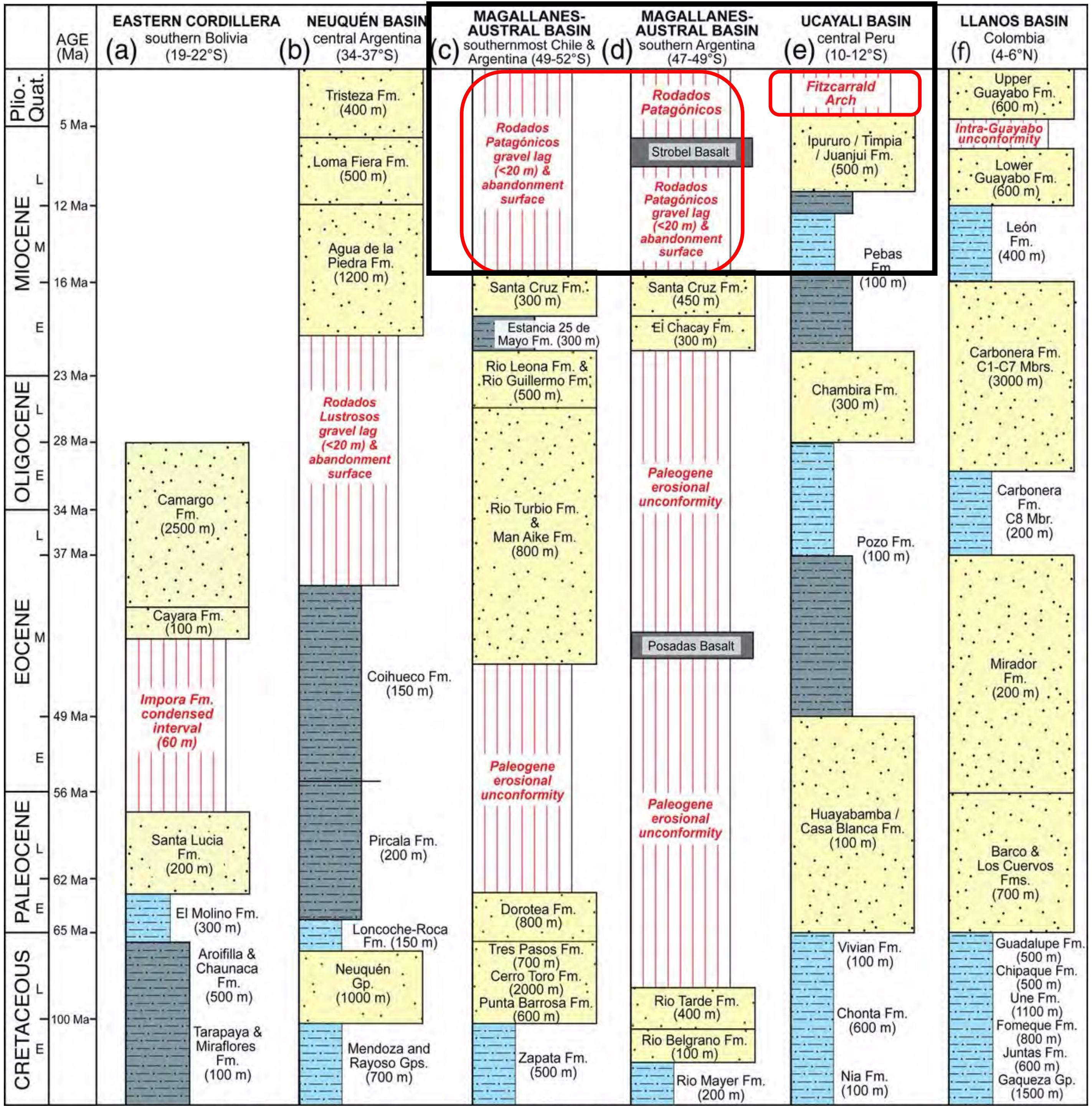
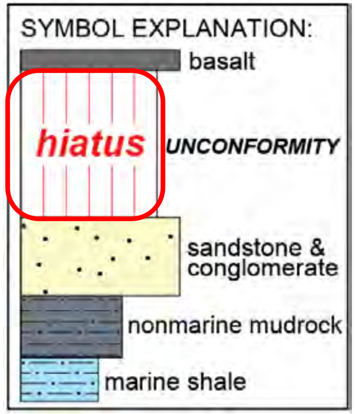


modern cases



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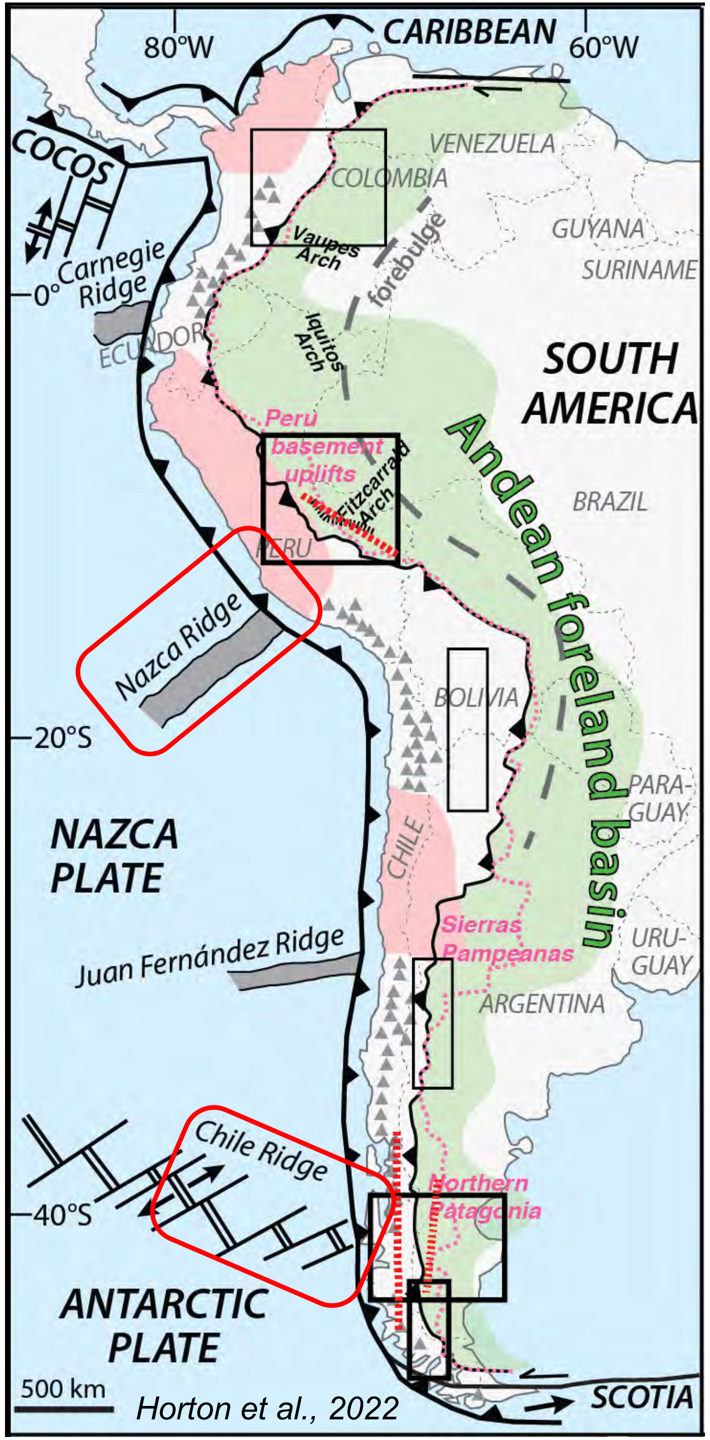

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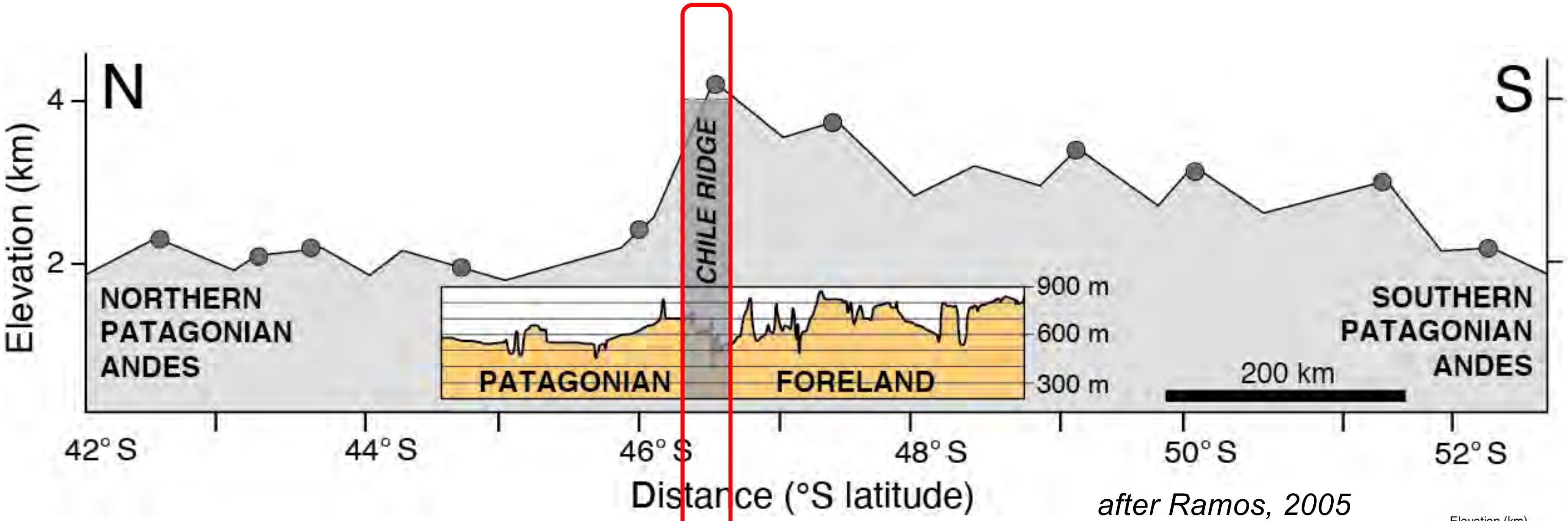
Subduction of Chile Ridge (active ridge)



after Ramos, 2005

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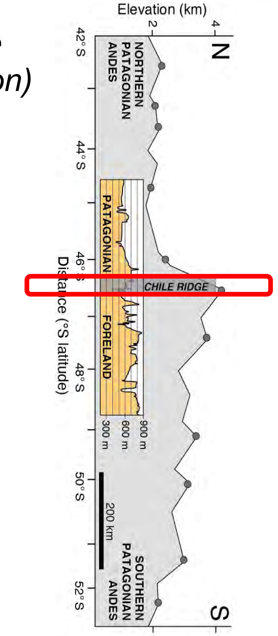
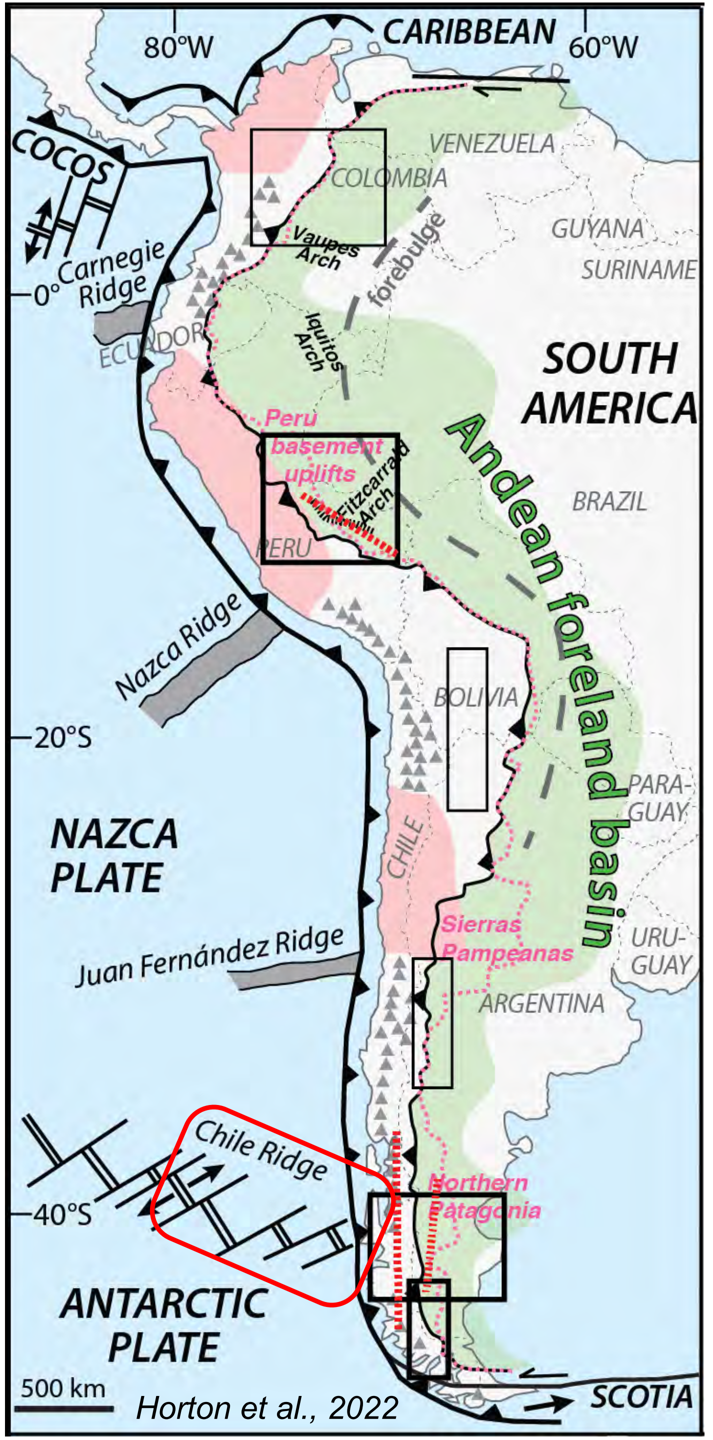


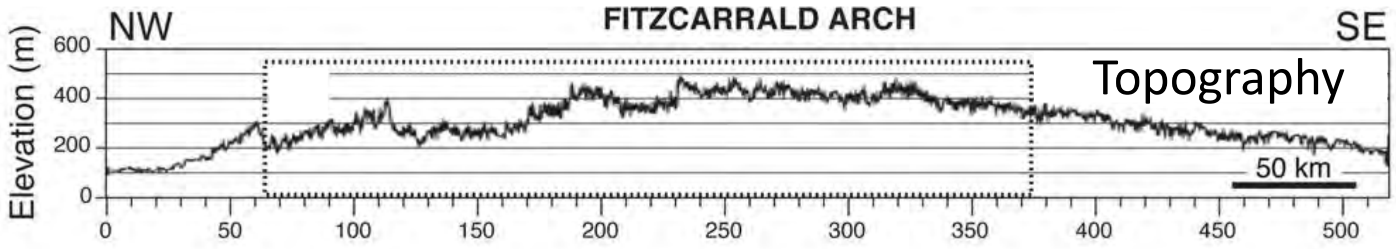


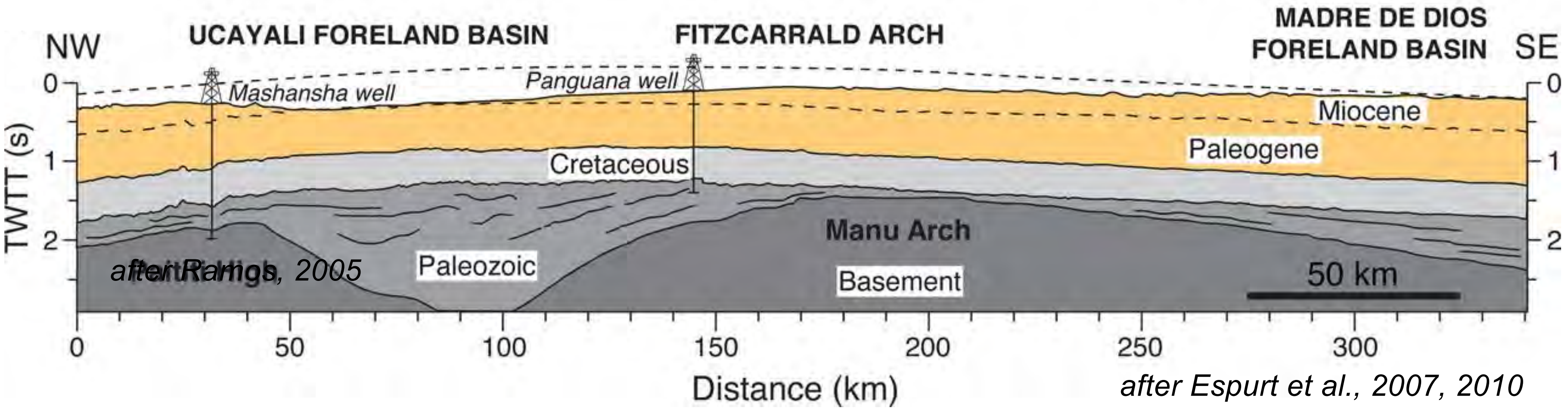
N. Magallanes-Austral Basin

Development of Patagonia slab window:

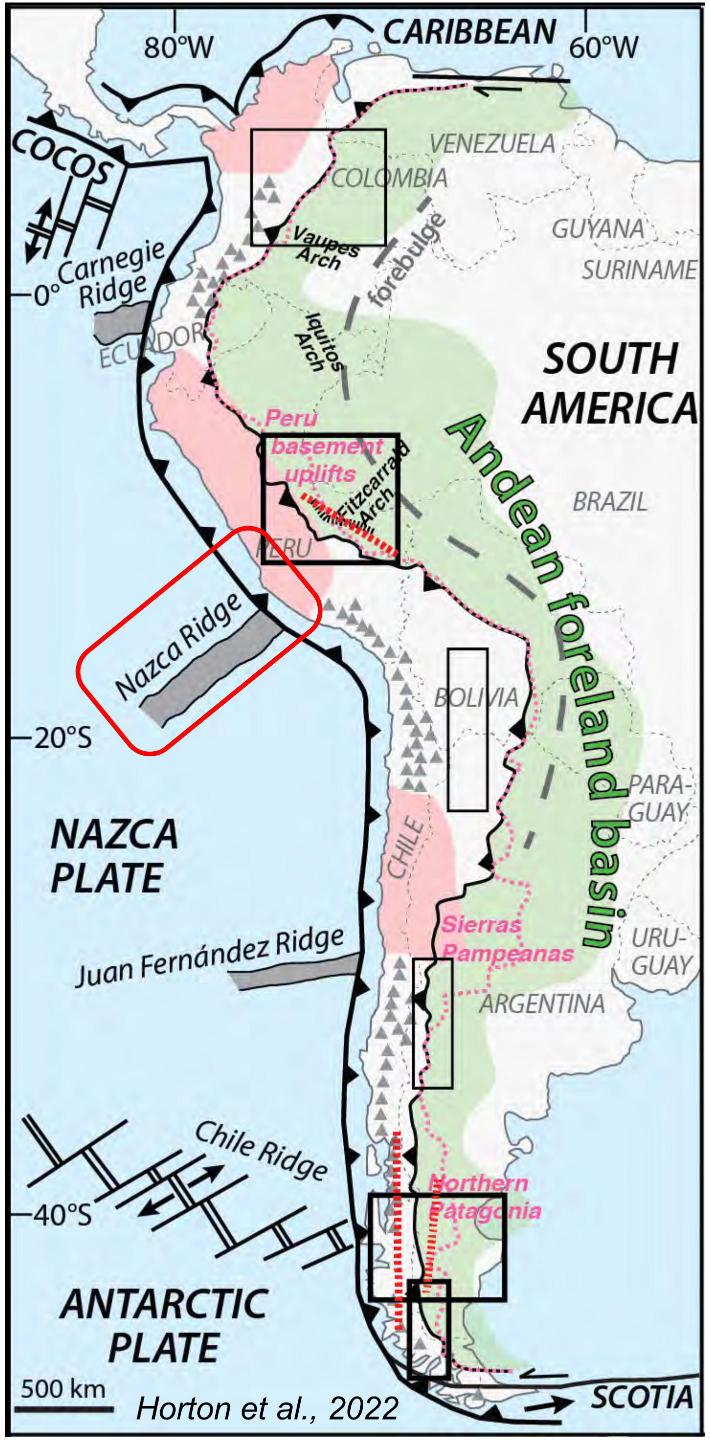
- Topographic steps in Andes and in foreland basin.
- Regional uplift of foreland basin, with sediment bypass & minor erosion.

Subduction of Nazca Ridge (aseismic ridge)





after Espurt et al., 2007, 2010



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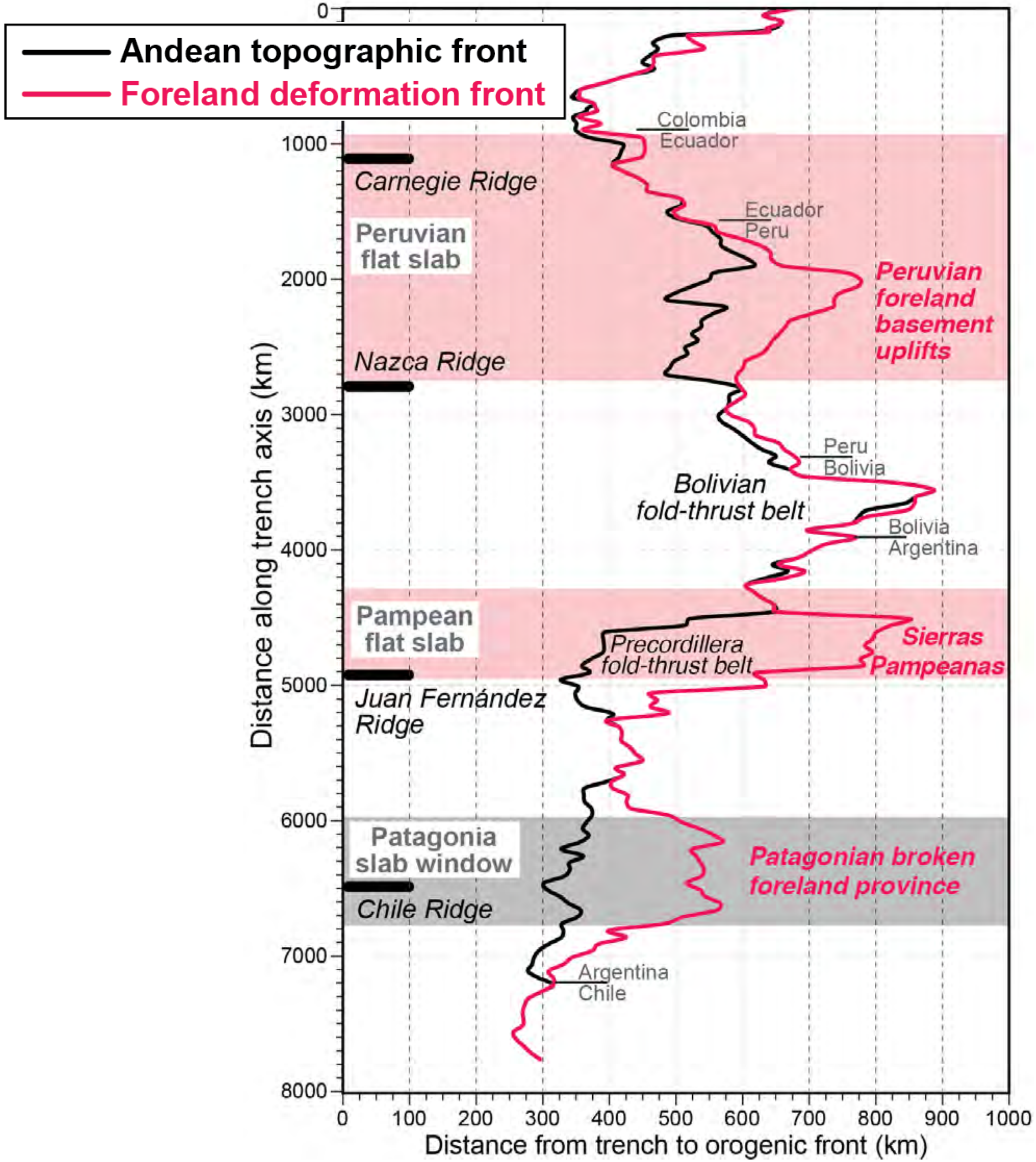
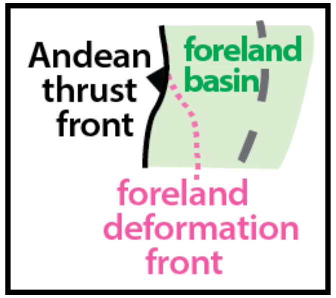
Peru foreland basin

Development of Fitzcarrald Arch:

- Broad basement high & topographic bulge.
- Regional uplift of basin, with sediment bypass & minor erosion.



Spatial correlation of flat slab subduction foreland deformation front



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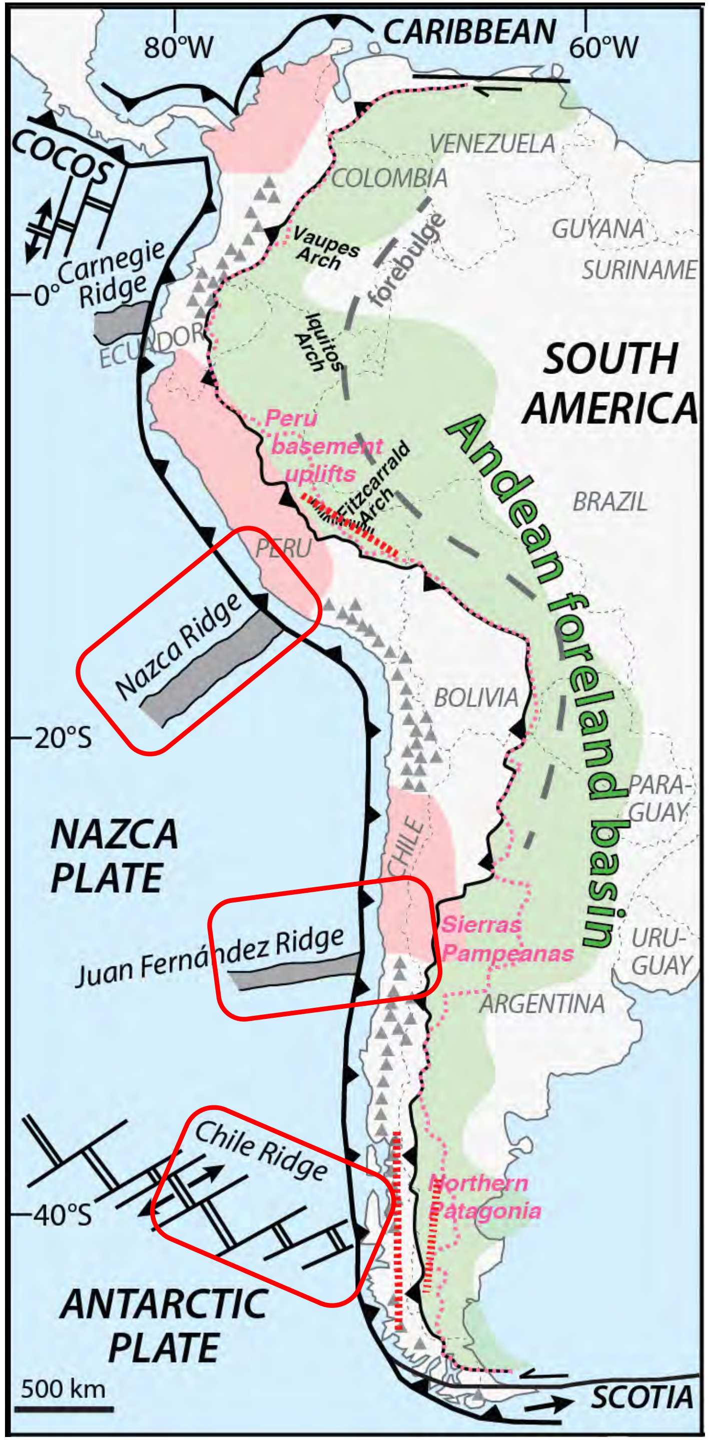

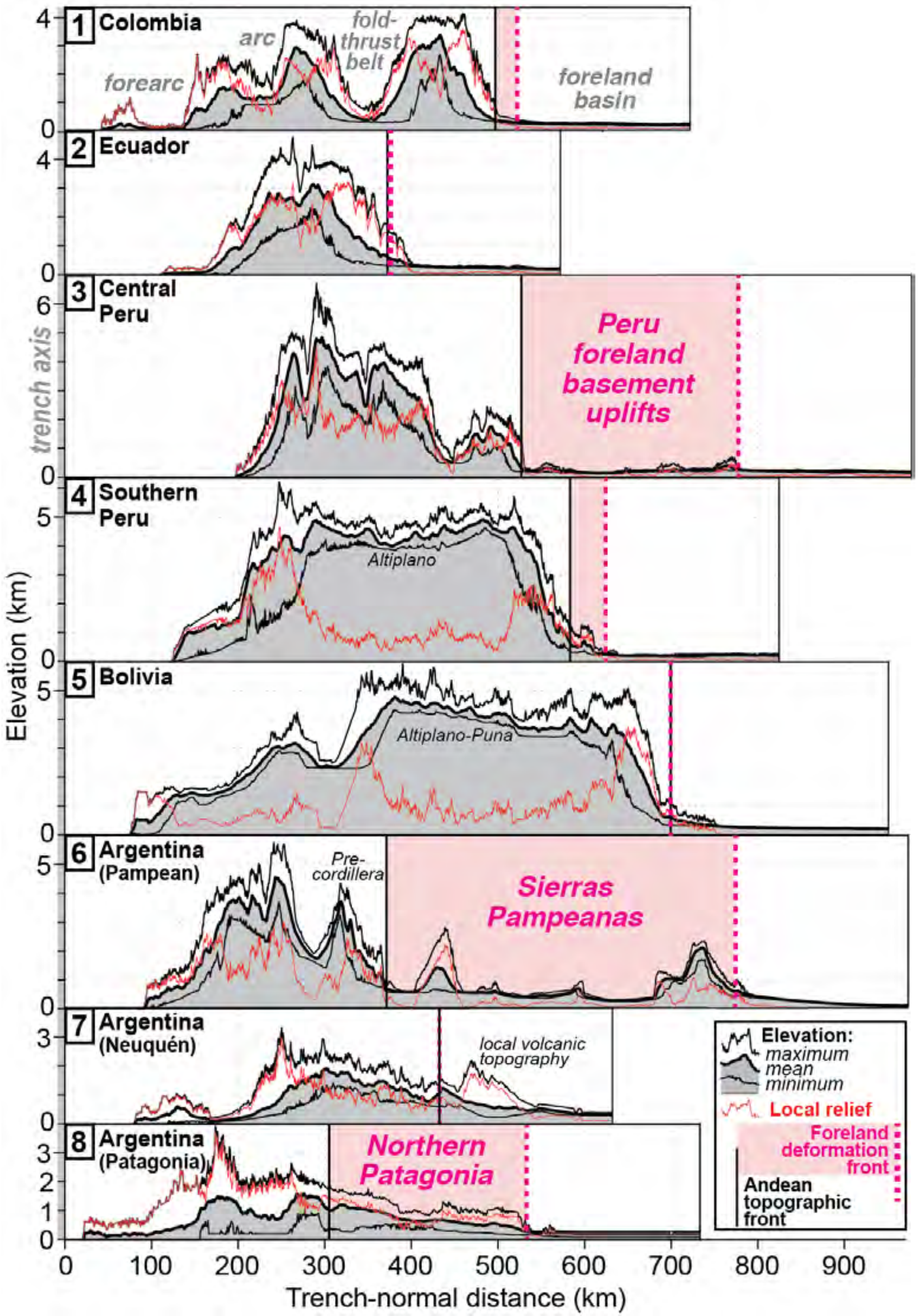

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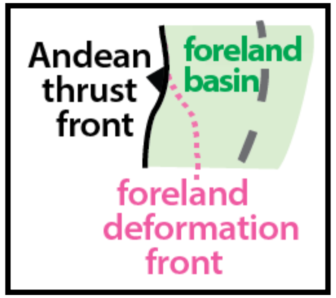

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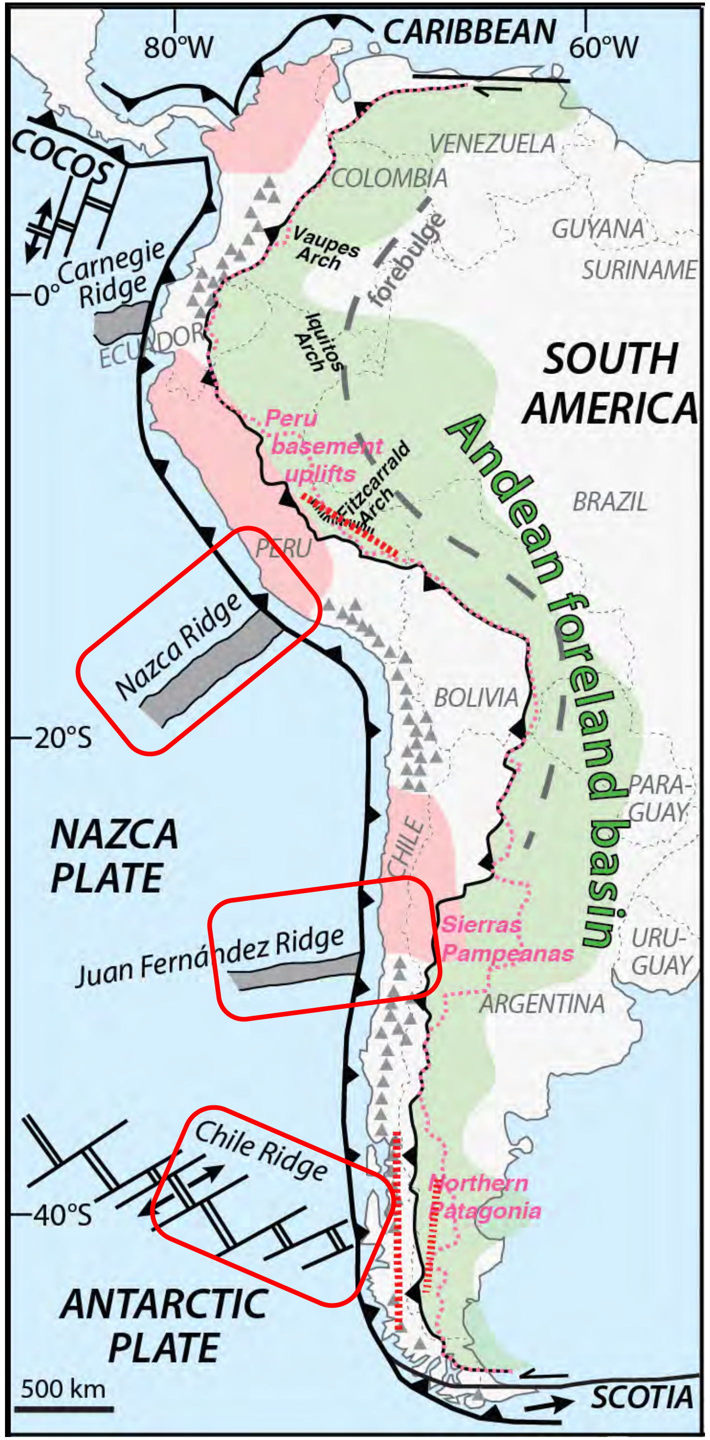

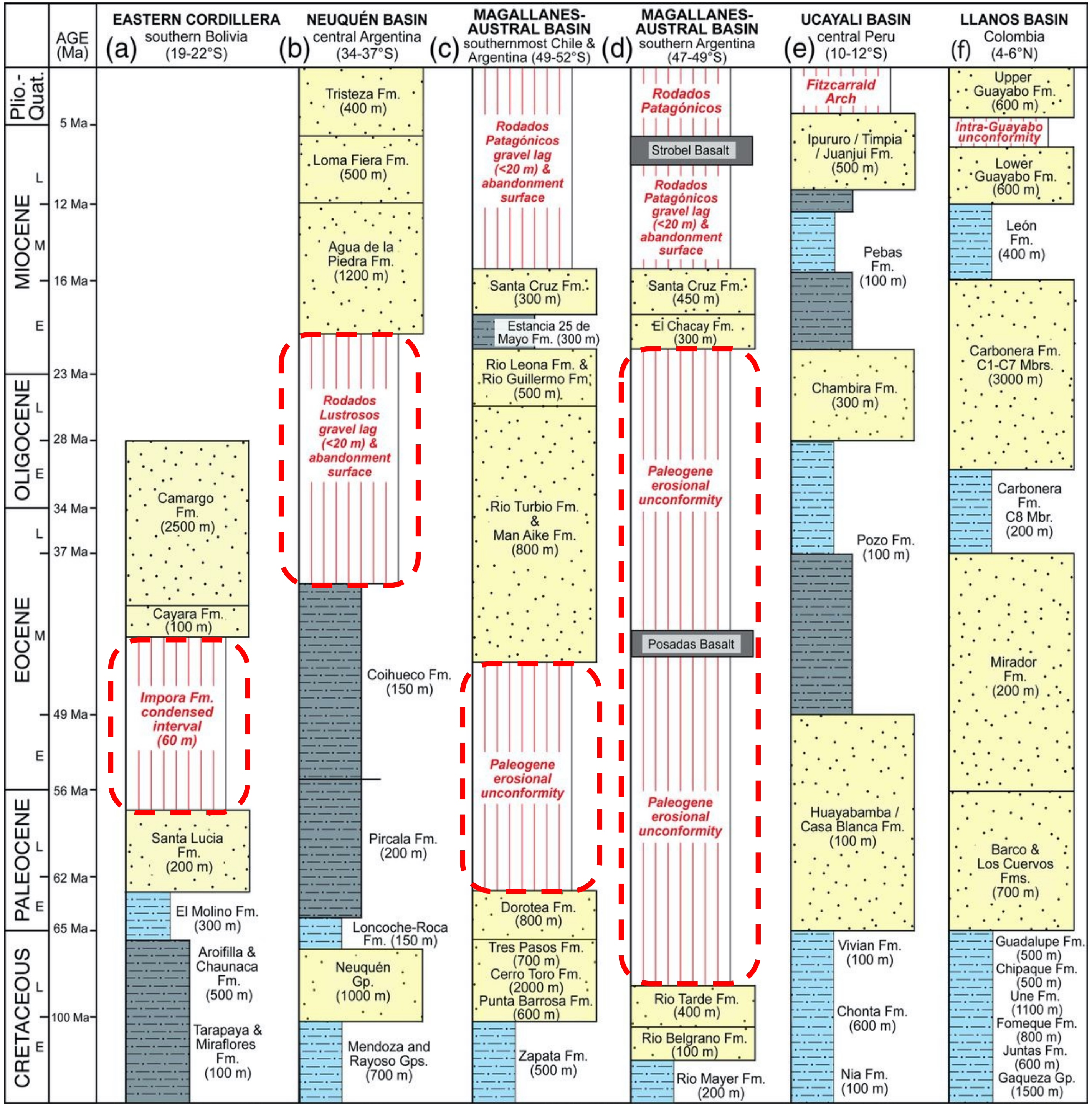

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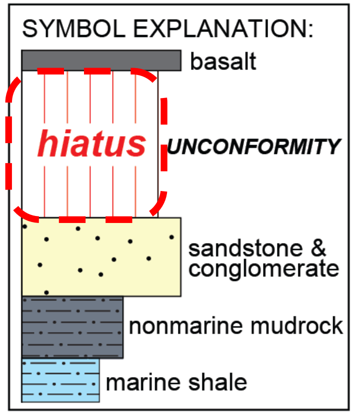

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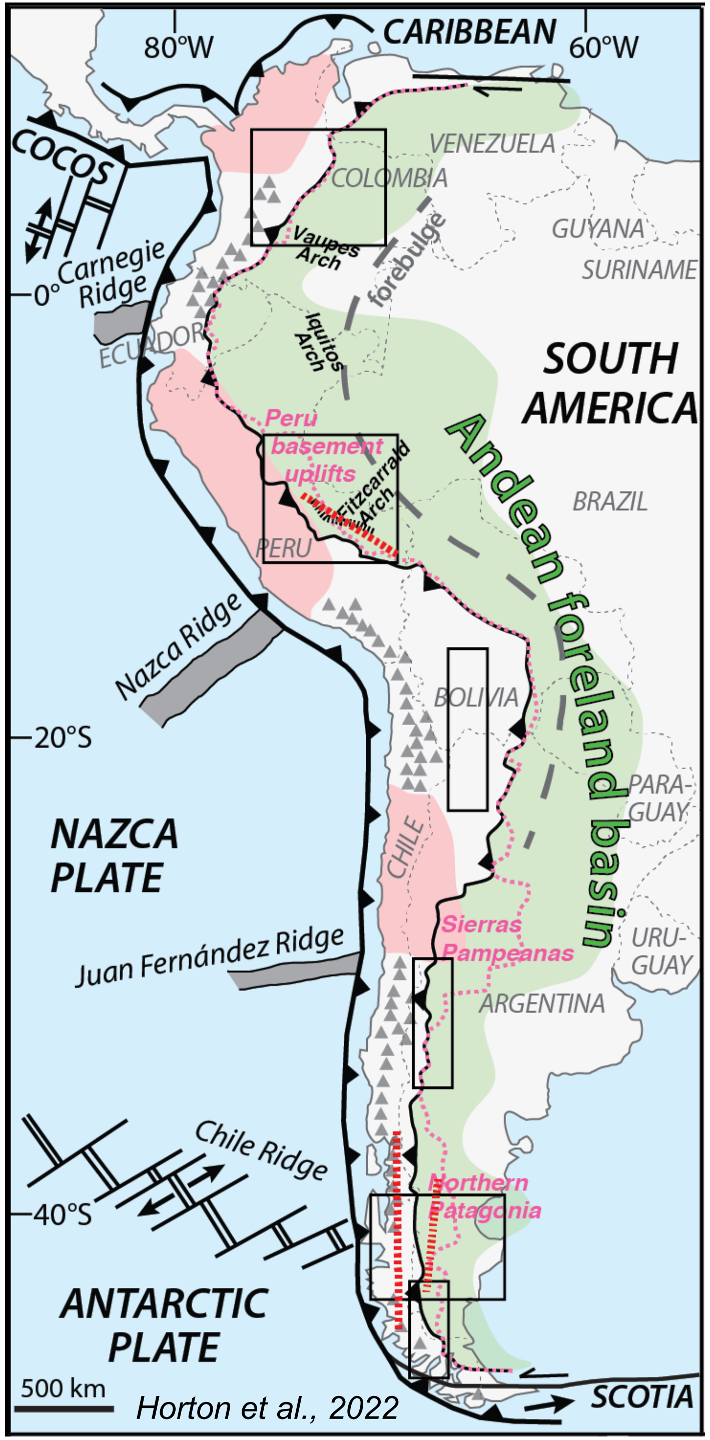

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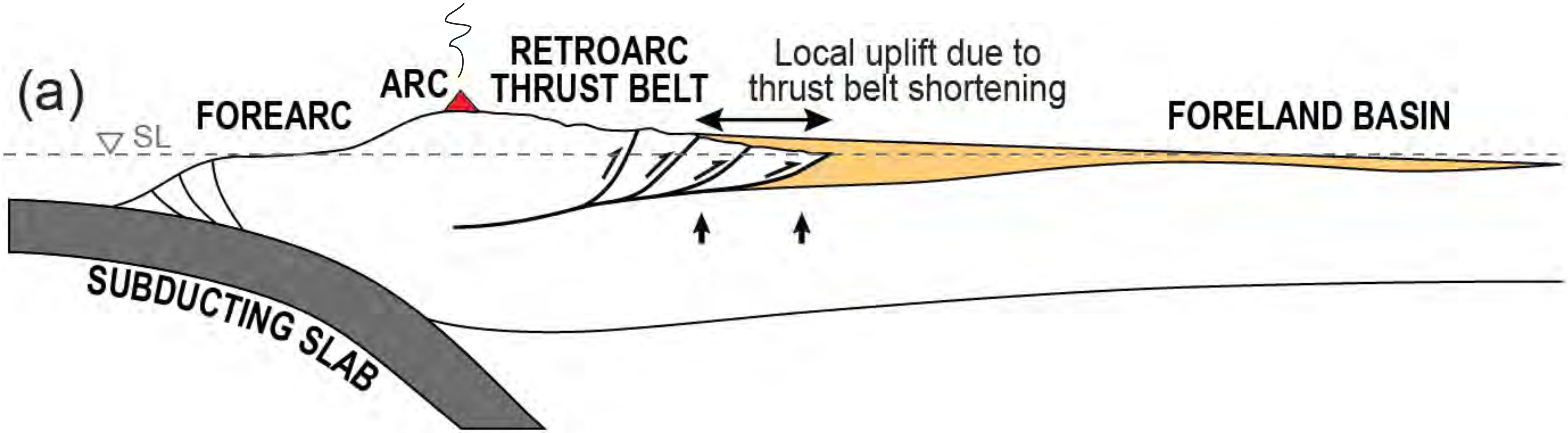
Unconformity Development – multiple potential mechanisms



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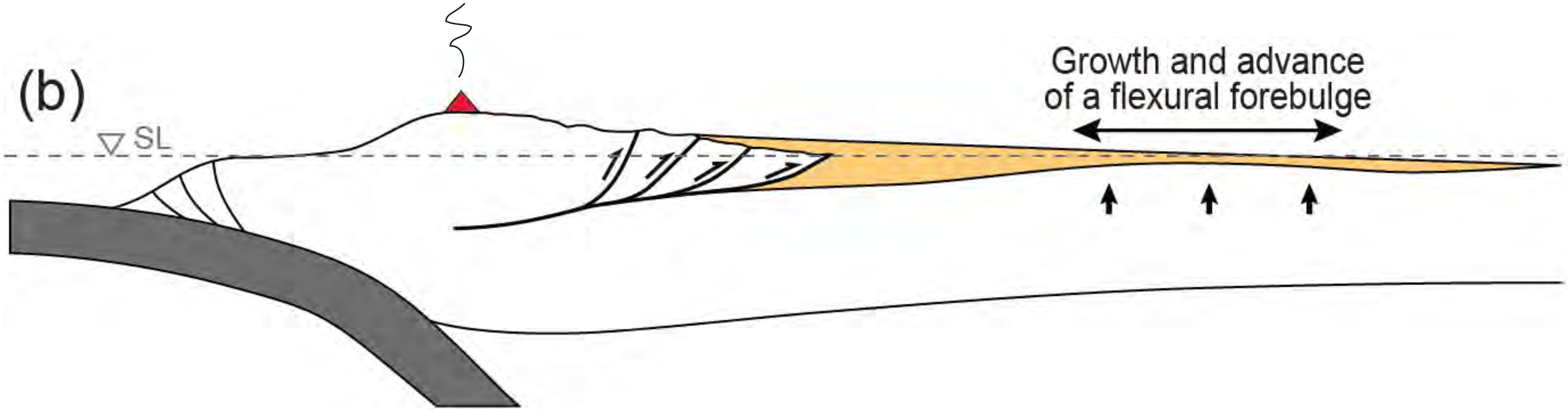

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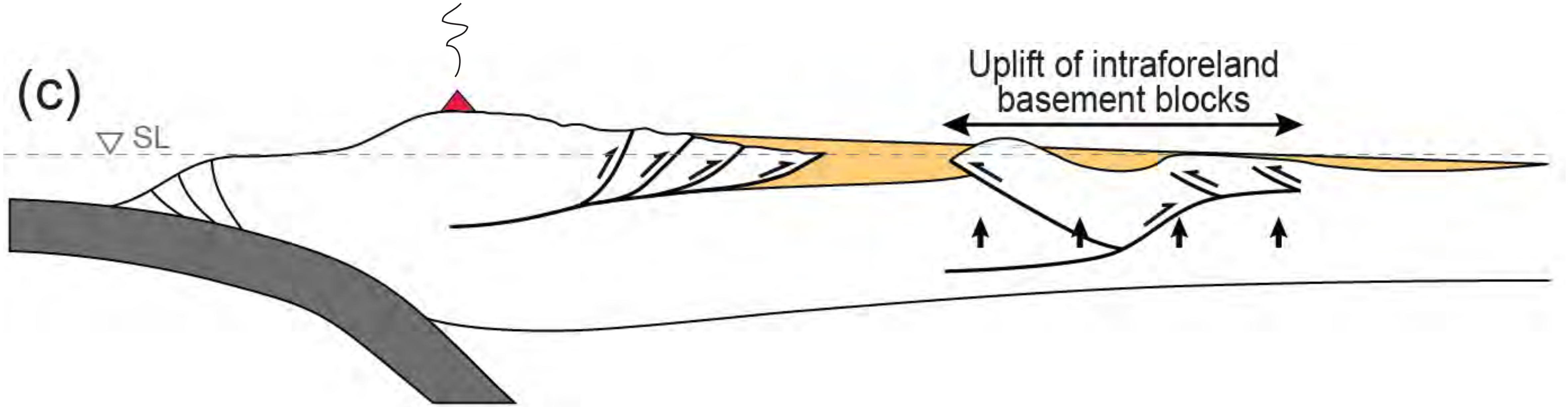

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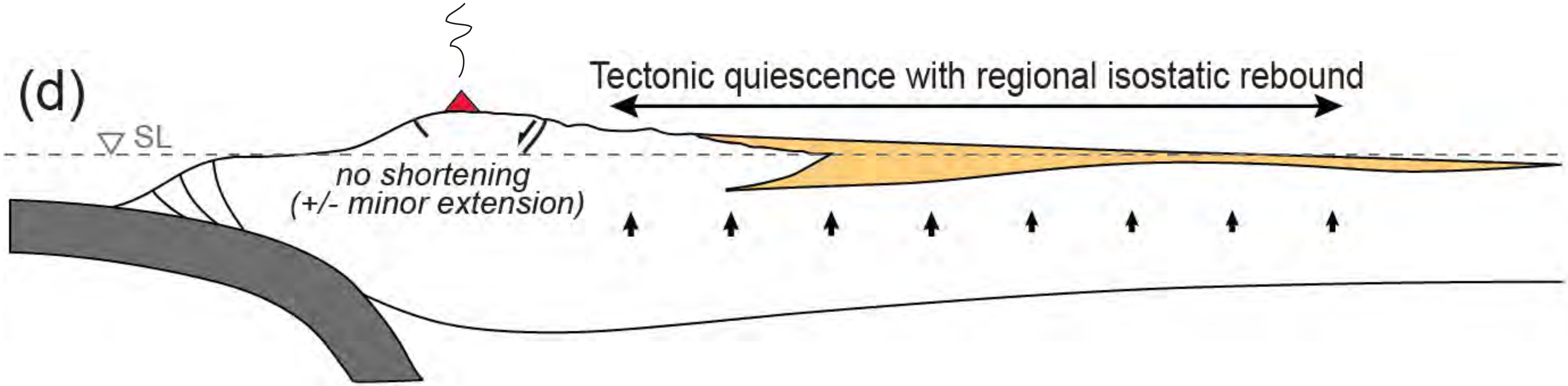

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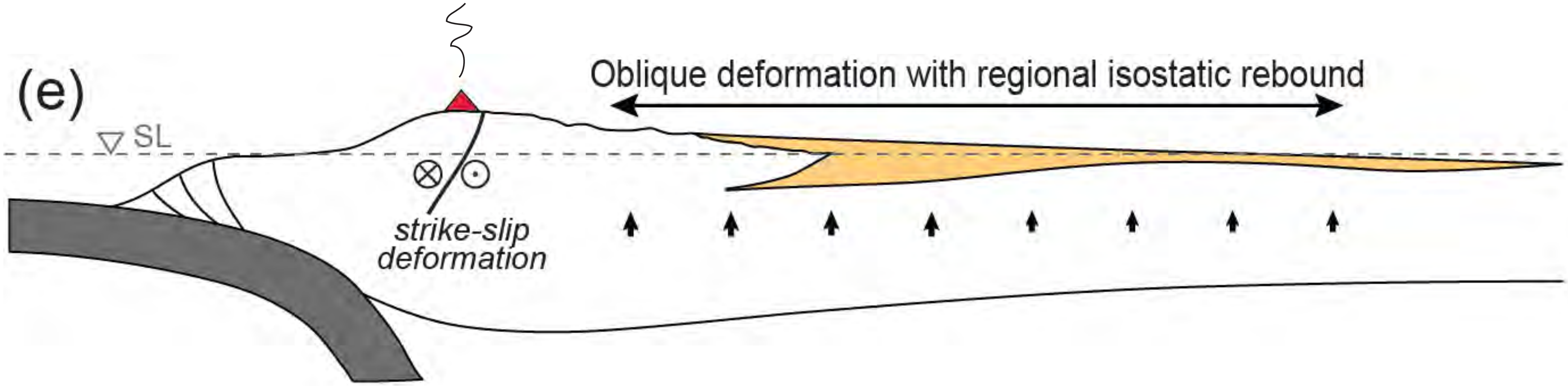

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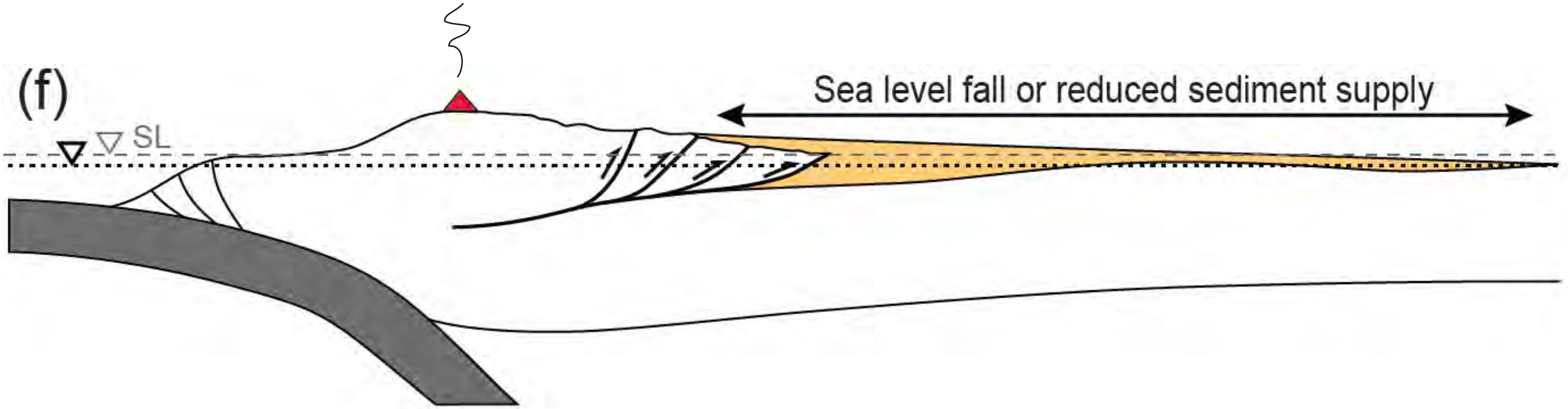

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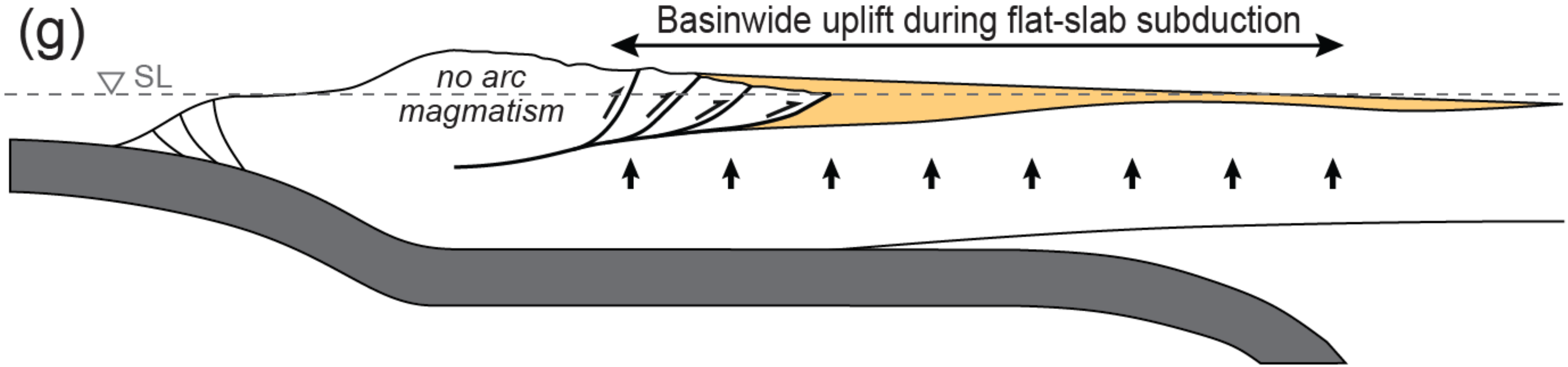

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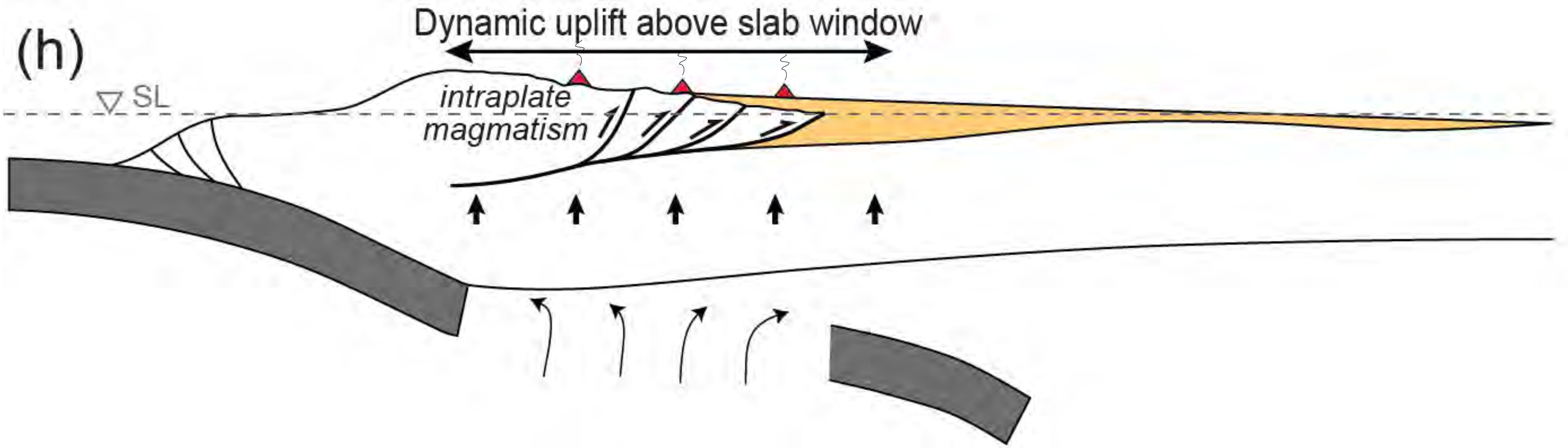

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Unconformity Development — Andean-type systems

Foreland basin unconformities —

- Long duration (>1-10 Myr)
- Non-angular.
- Commonly linked to stasis (quiescence) with limited erosion.
- Duration & magnitude are consistent with long-term positive dynamic topography (10s-100s m of vertical uplift)

Mechanisms of unconformity development —

(a) local uplift in frontal thrust belt & proximal foreland

(b) growth of a broad flexural forebulge in distal foreland

(c) uplift of intraforeland basement blocks along reverse faults

(d) tectonic quiescence with isostatic rebound

(e) oblique deformation with isostatic rebound

(f) diminished accommodation due to changes in sea level, climate, erosion

(g) flat slab subduction

(h) active ridge subduction (& slab window formation)

(i) slab breakoff

(j) elevated intraplate (in-plane) stress

(k) mantle flow variations

Bold = ancient example from the Andes

Bold red = modern example from the Andes

italics = possible mechanisms

Conclusions

- ***Long-duration unconformities*** *(>1–10 Myr) – are common, but variable in time & space.*
- **Geodynamic mechanisms –** *many viable options; regional but not applicable to entire margin.*
- **Dynamic topography –** *subsidence, stasis, & uplift in retroarc forelands (10s–100s m).*

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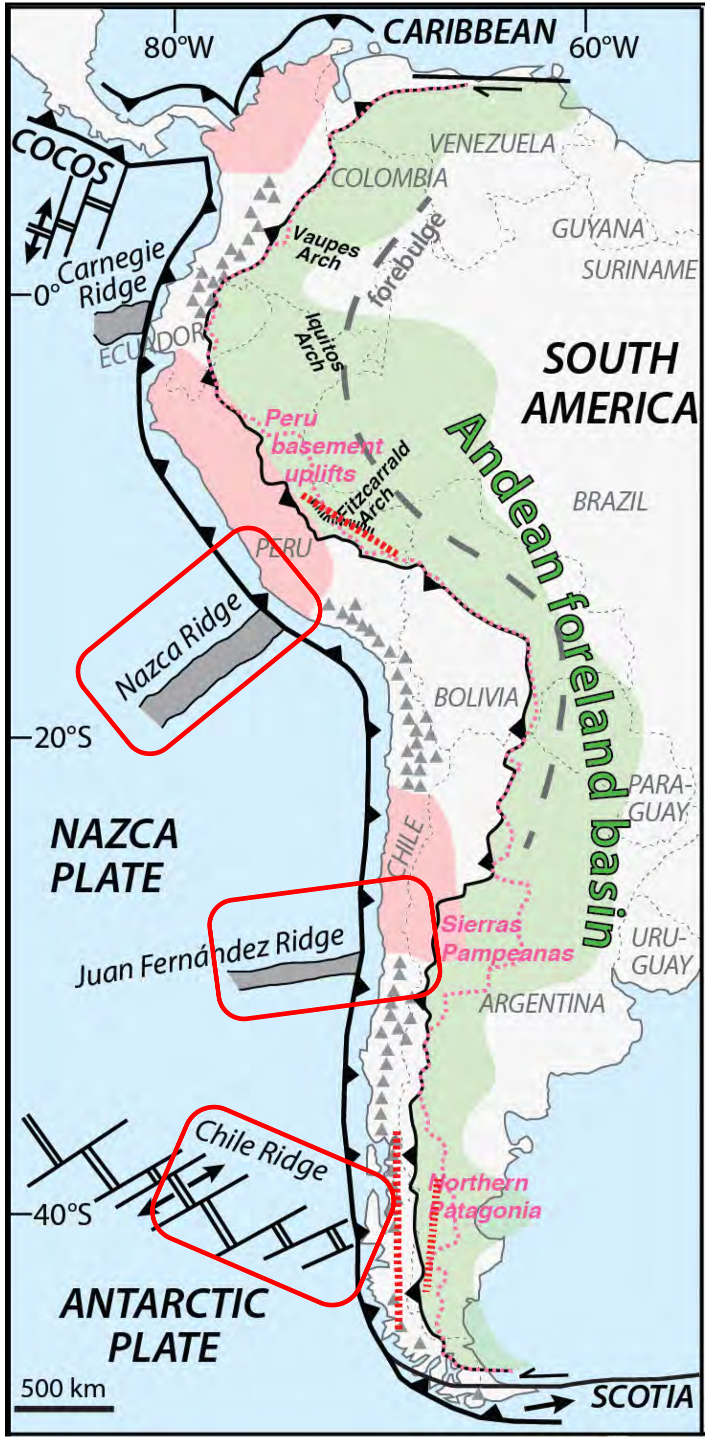

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