Tectonics, Structural Setting and Tectono-Sedimentary processes in the Corinth rift

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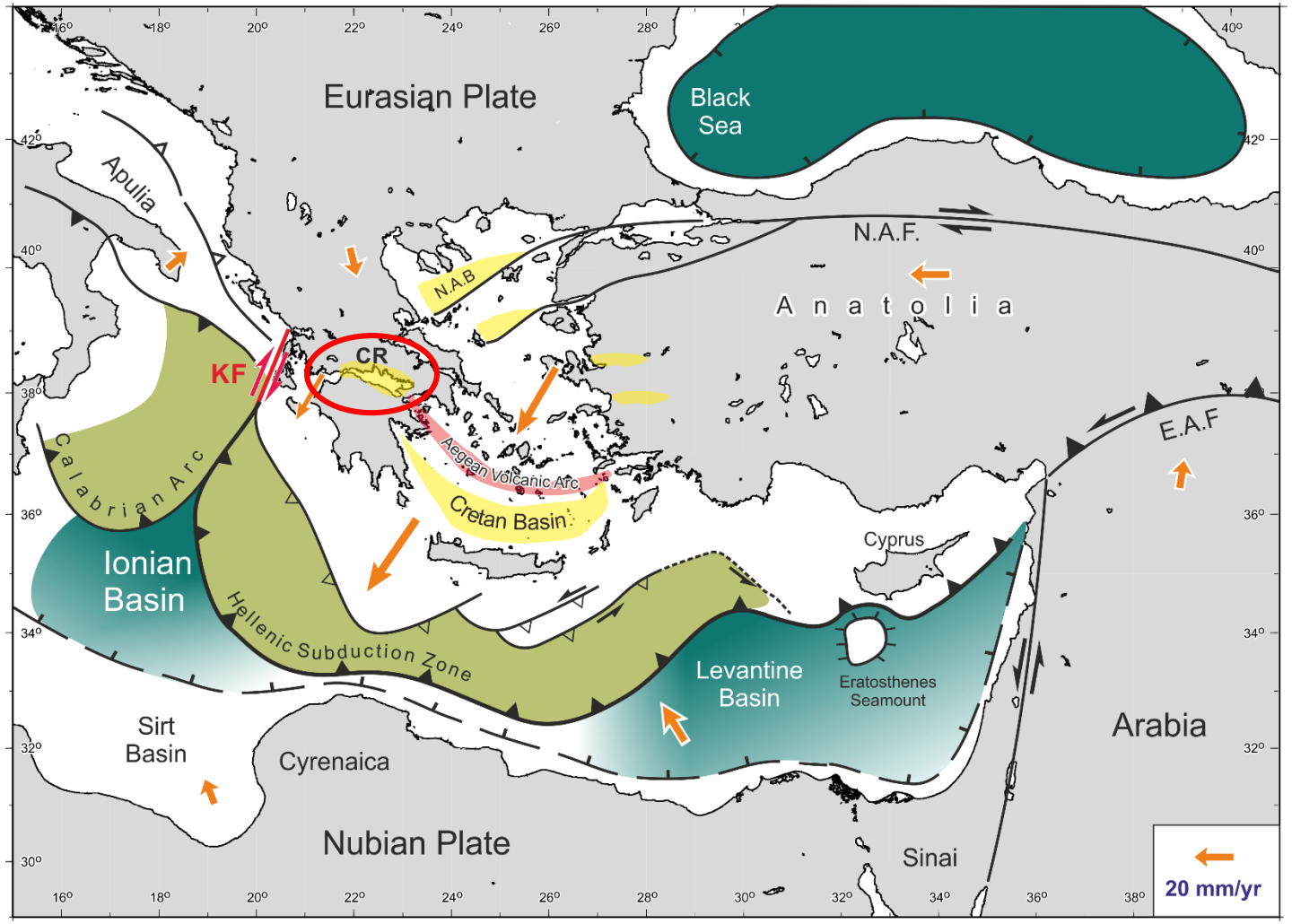
CRL School 2018, Patras-Nafpaktos 21-25 September 2018

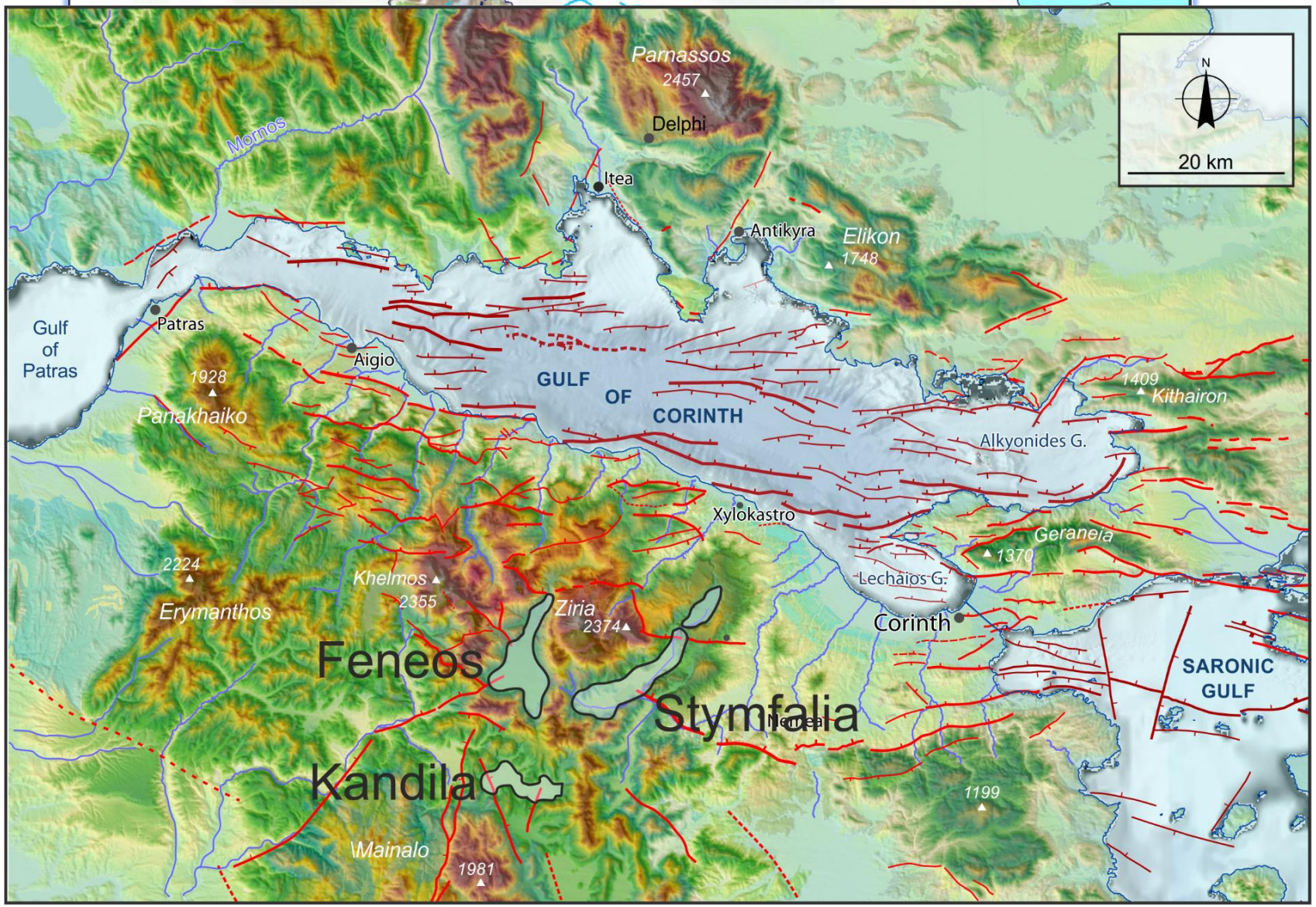
The Eastern Mediterranean: geodynamic context



Modified from Papanikolaou et al., 2004

SYN-RIFT SYSTEMS

Phy



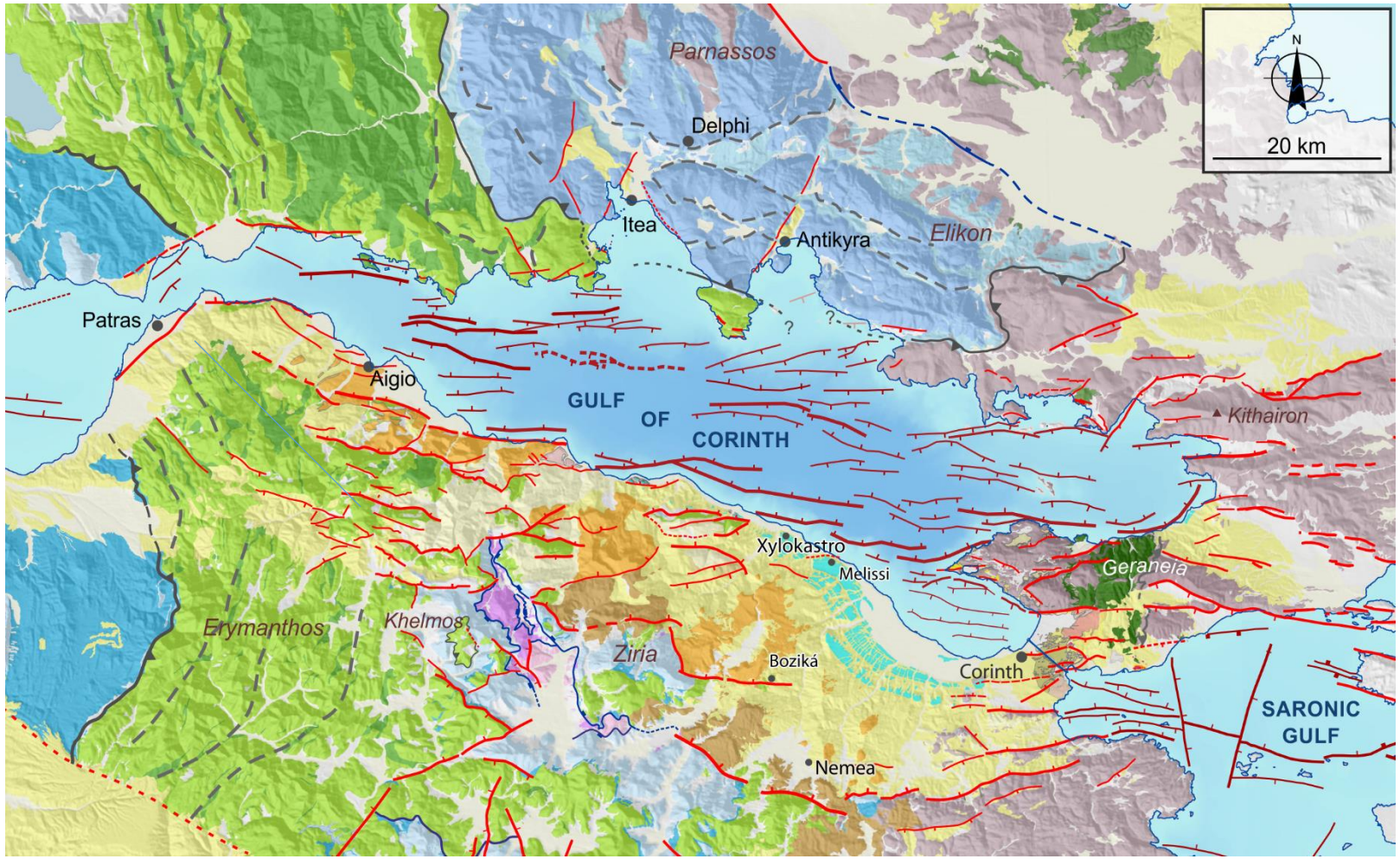
- Most drainage comes from the south; Major catchments in the west
- Gradual shift in sediment flux (currently S: 53% S vs N:47%)

  [data from Pechlivanidou (2018) (work in progress)]

Faults from a compilation of the authors own work and published maps:
Offshore: HCMR, 1988; Leeder et al., 2005; McNeill et al., 2005; Sakellariou et al., 2007; Bell et al., 2008, 2009, 2011; Taylor et al., 2011; Charalampakis et al., 2014; Beckers et al., 2015
Onshore: Collier & Dart, 1991; Rohais et al., 2007; Skourtsos & Kranis, 2009; Ford et al., 2013; Leeder et al., 2013

SYN-RIFT SYSTEMS

Geology and Tectonics



Kranis et al., 2016

SYN-RIFT SEDIMENTS

- Holocene
- U. Quaternary marine terraces
- Pst fan- and Gilbert-type Deltas
- Pl-Q Volcanics
- U. Miocene - Quaternary (incl. GoC synrift)

HELLENIDE UNITS

- Parnassos
  - Flysch
  - Shelf Carbonates
- Pindos
  - Flysch
  - Pelagic carbonates & cherts
- Tripolis
  - Flysch
  - Shelf Carbonates
  - Tyros Beds
  - Phyllites-Quartzites
- Ophiolites
- Sub-Pelagonian & Beotian
  - Carbonates and clastics
- Zarouchla complex

STRUCTURAL DATA

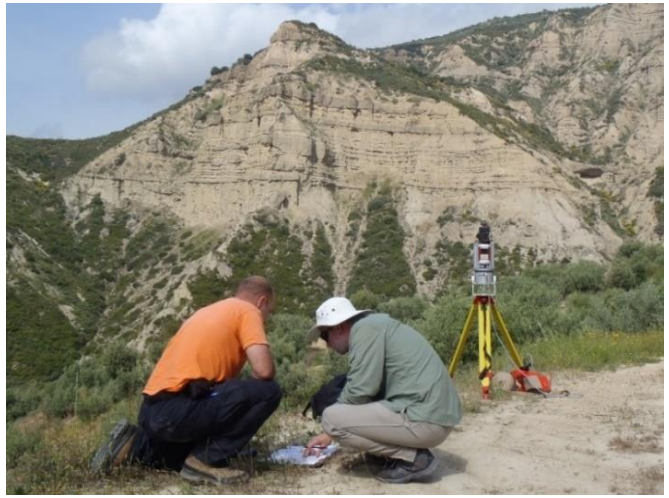
Onshore
- Major/basement f.
- Secondary/intrabasinal f.
- Low angle/detachment f.
- Tertiary Thrust
- Structural grain

Offshore
- Major/basement f;
- Secondary/intrabasinal f.

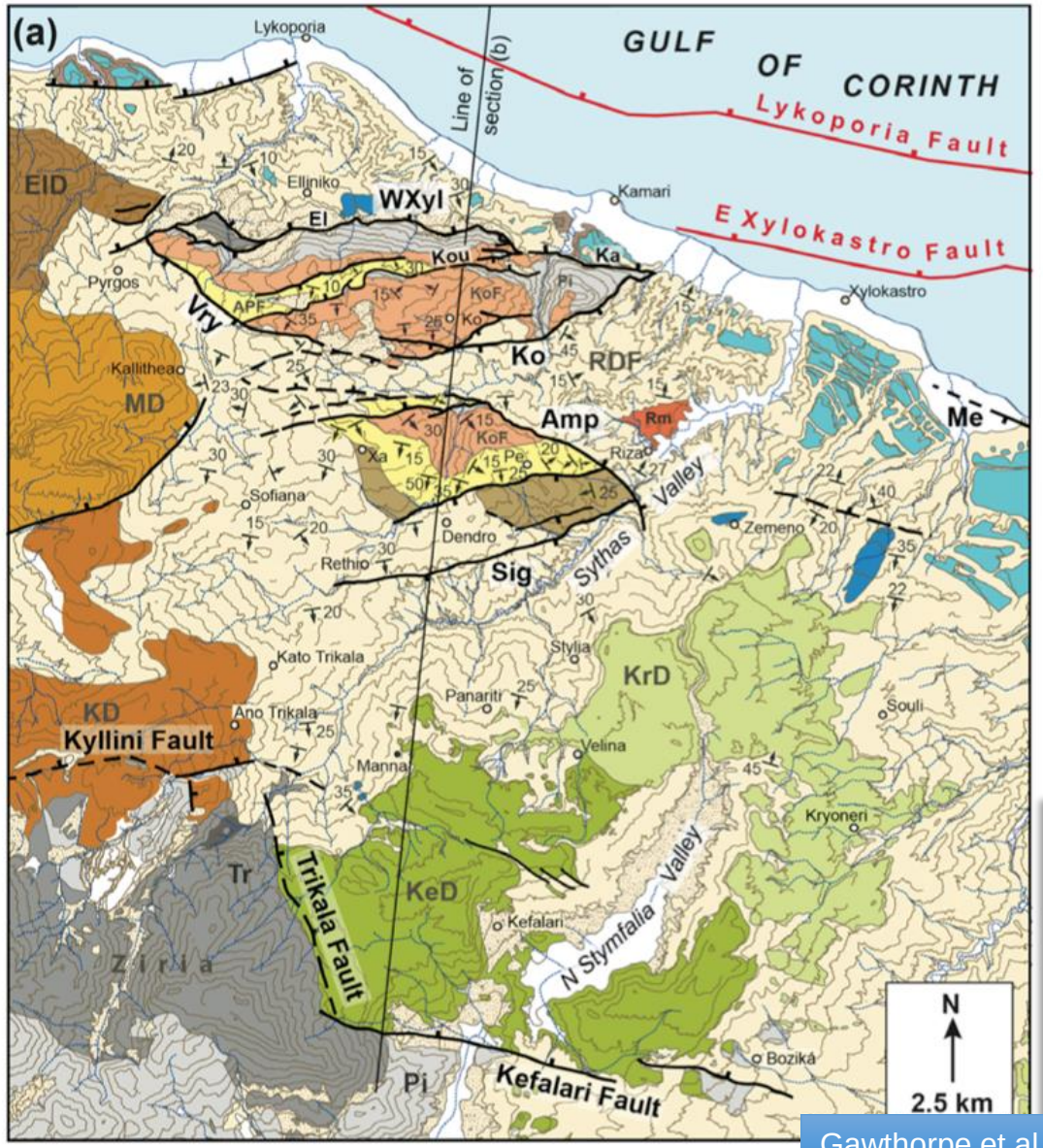
SYN-RIFT SYSTEMS

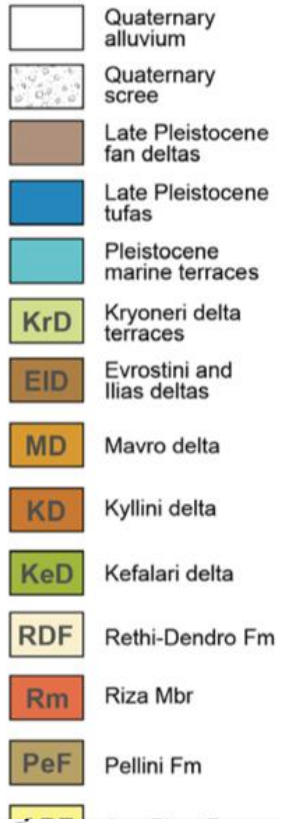
Syn-rift Systems Project

- "Traditional" fieldwork
- Terrestrial and UAV LIDAR scanning and photogrammetry (100 stations, 16 km^2)
- Digital outcrop modelling
- Drilling and coring (750 m of core)

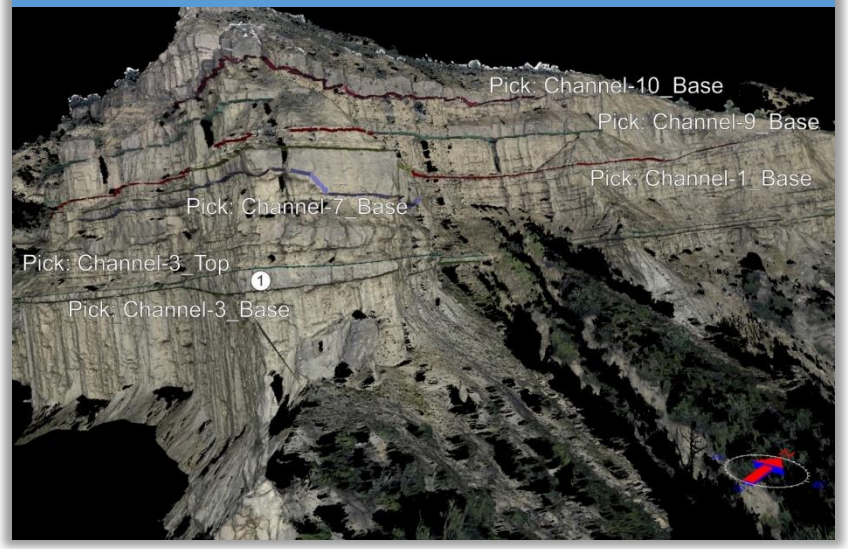


Syn-Rift Systems Project

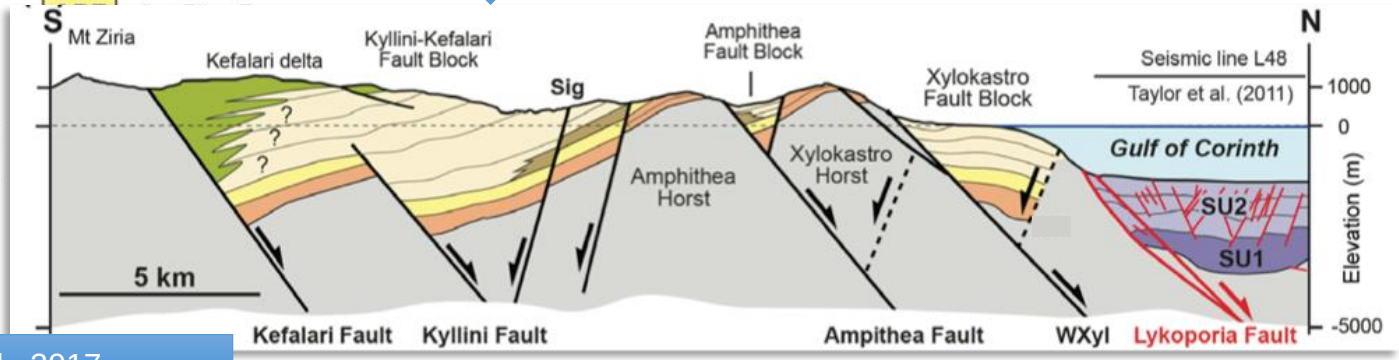




Digital Outcrop Model (D.O.M) of Rift 1 Sediments



Synrift thickness > 3 km

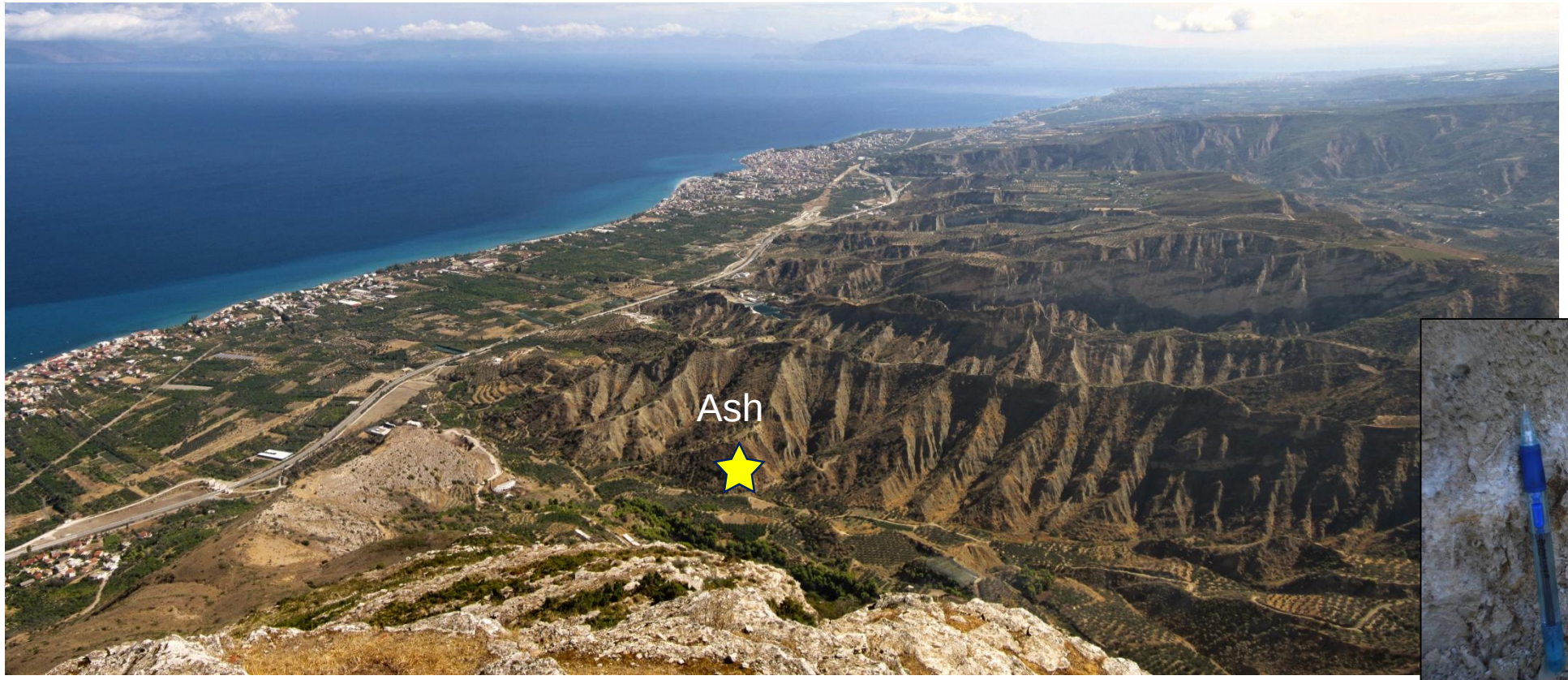


Gawthorpe et al., 2017

SYN-RIFT SYSTEMS

The Synrift: Rift 1

The Rethi-Dendro Formation -RDF



Ash: $^{40}Ar/^{39}Ar$ dating by single crystal CO_2 laser fusion 2.550 ± 0.007 Ma

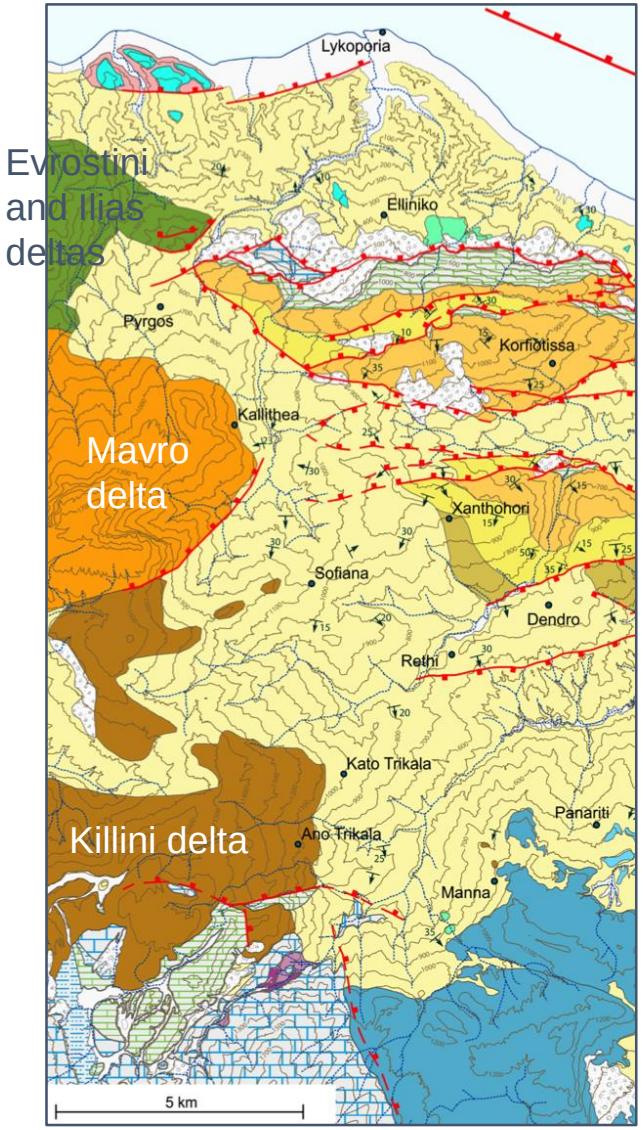
SYN-RIFT SYSTEMS

The Synrift: Rift 1

The Mavro (Oros) Delta

SYN-RIFT SYSTEMS

The Synrift: Deltas

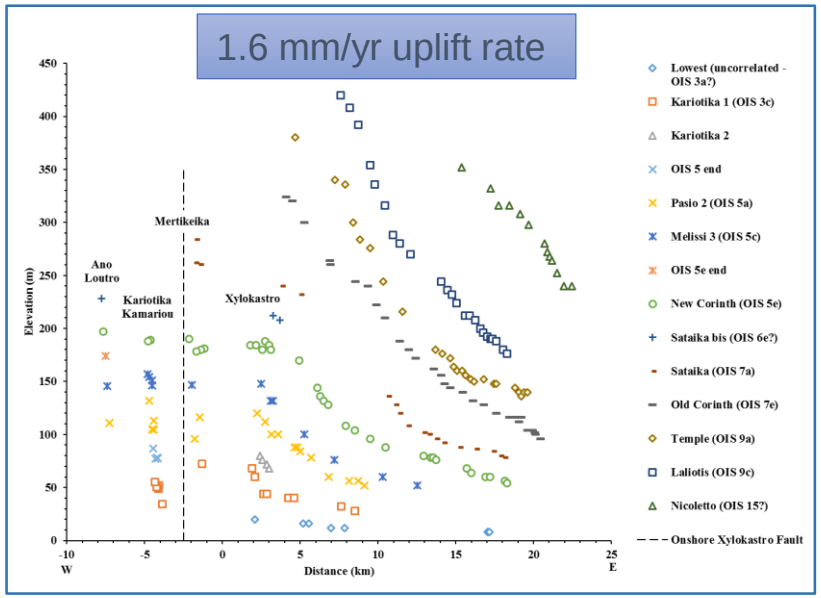


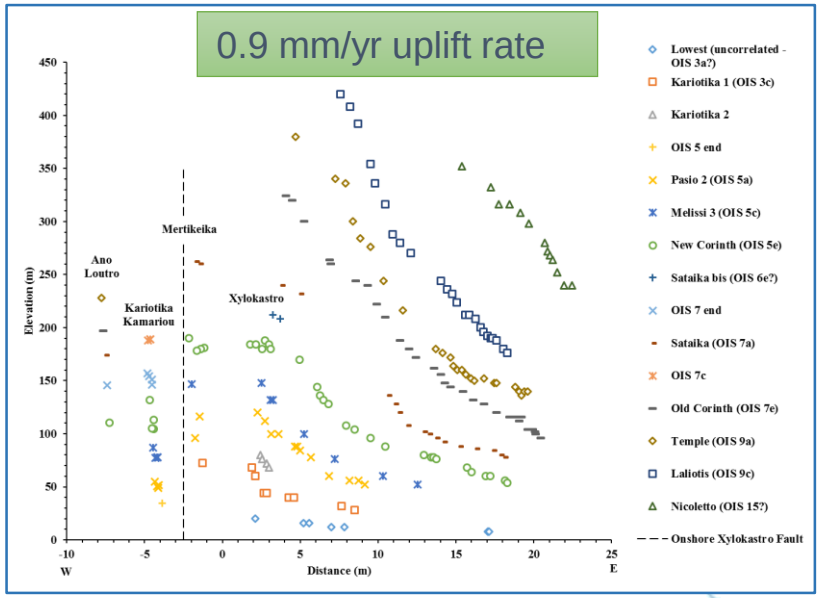
Rift 2 Delta

Rift 1 Delta

SYN-RIFT SYSTEMS

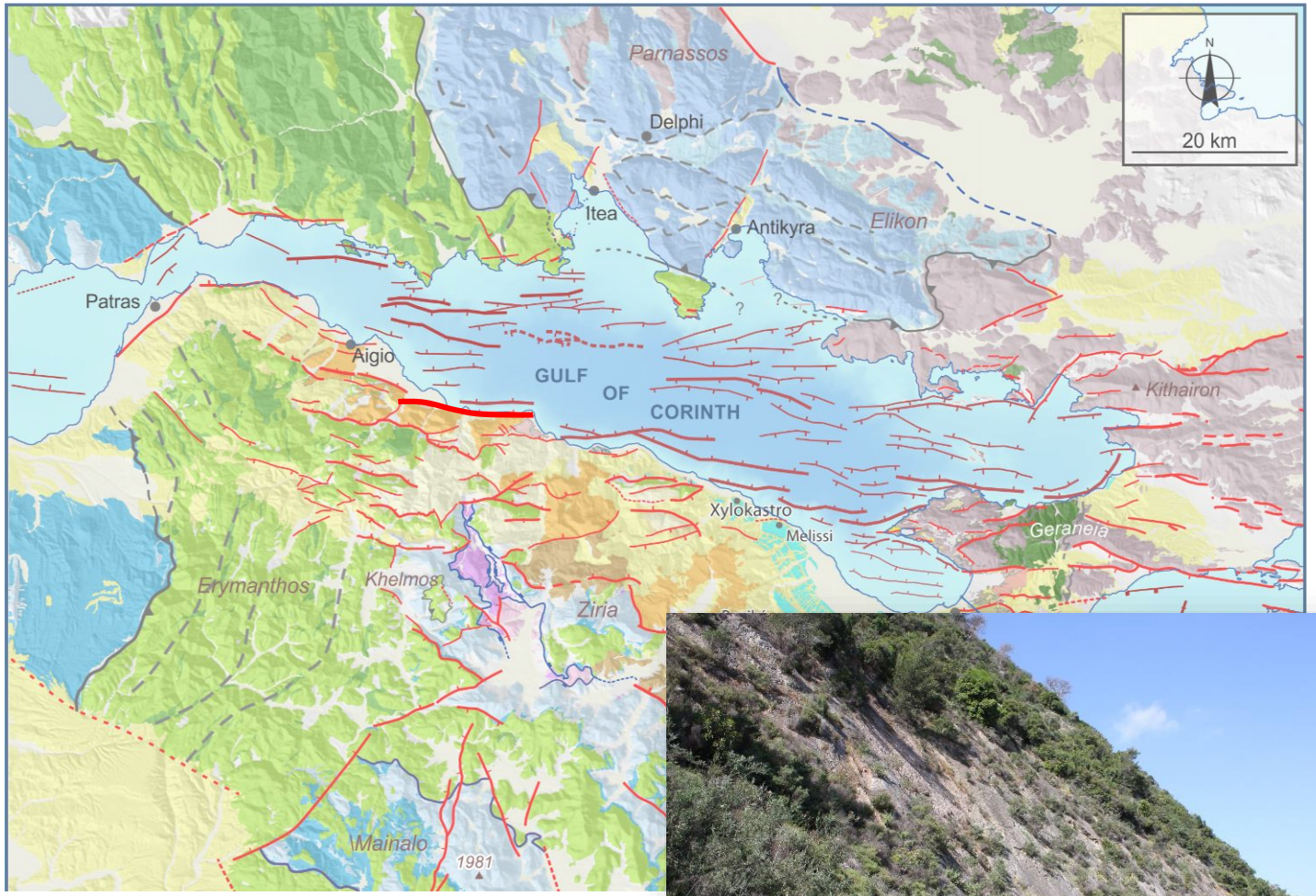
Rift 2: flank uplift





SYN-RIFT SYSTEMS

Extensional Structures

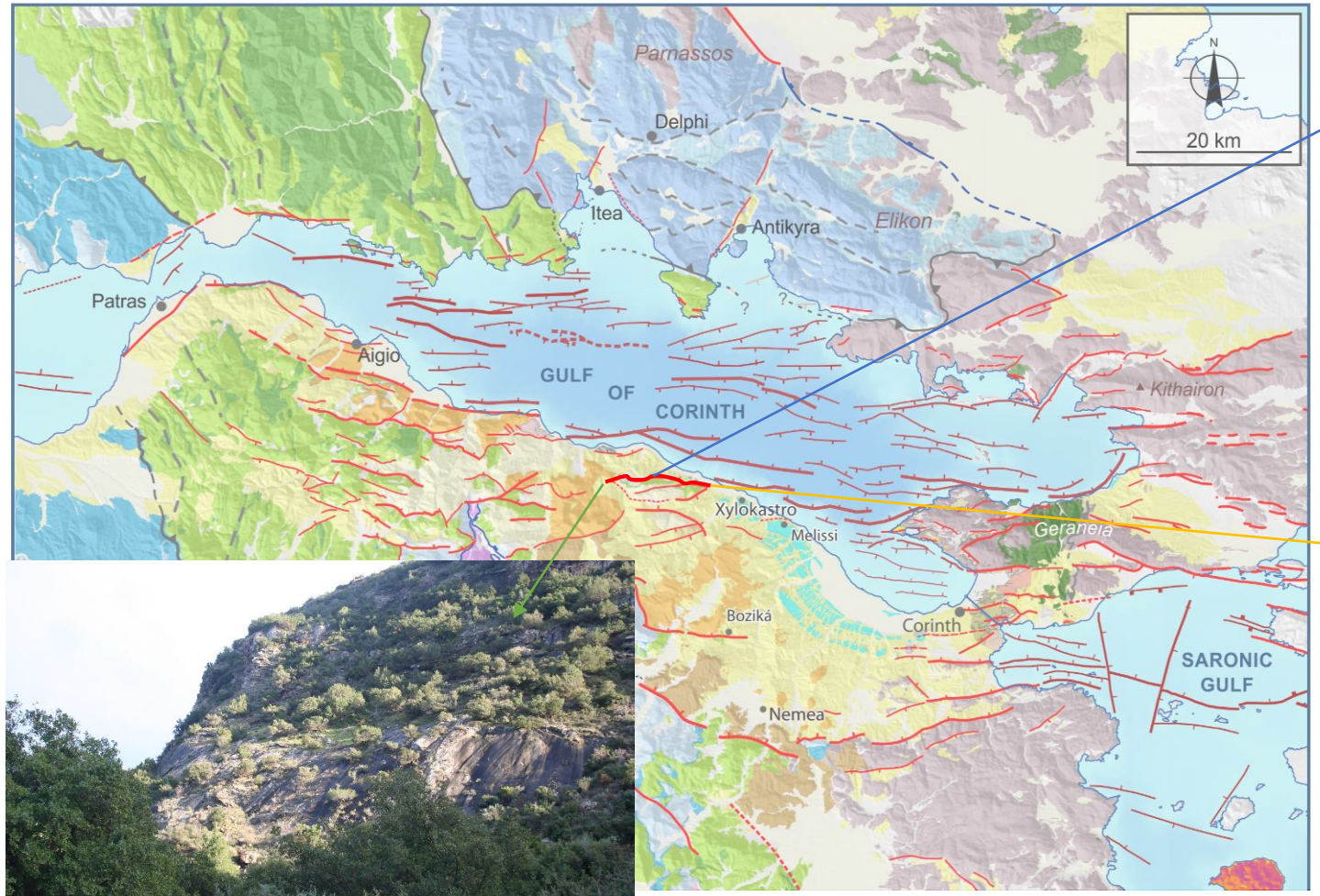


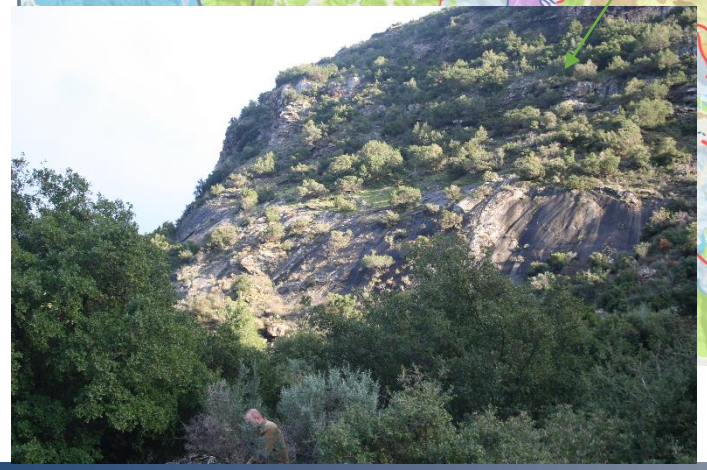
The East Helike Fault

SYN-RIFT SYSTEMS

Extensional Structures

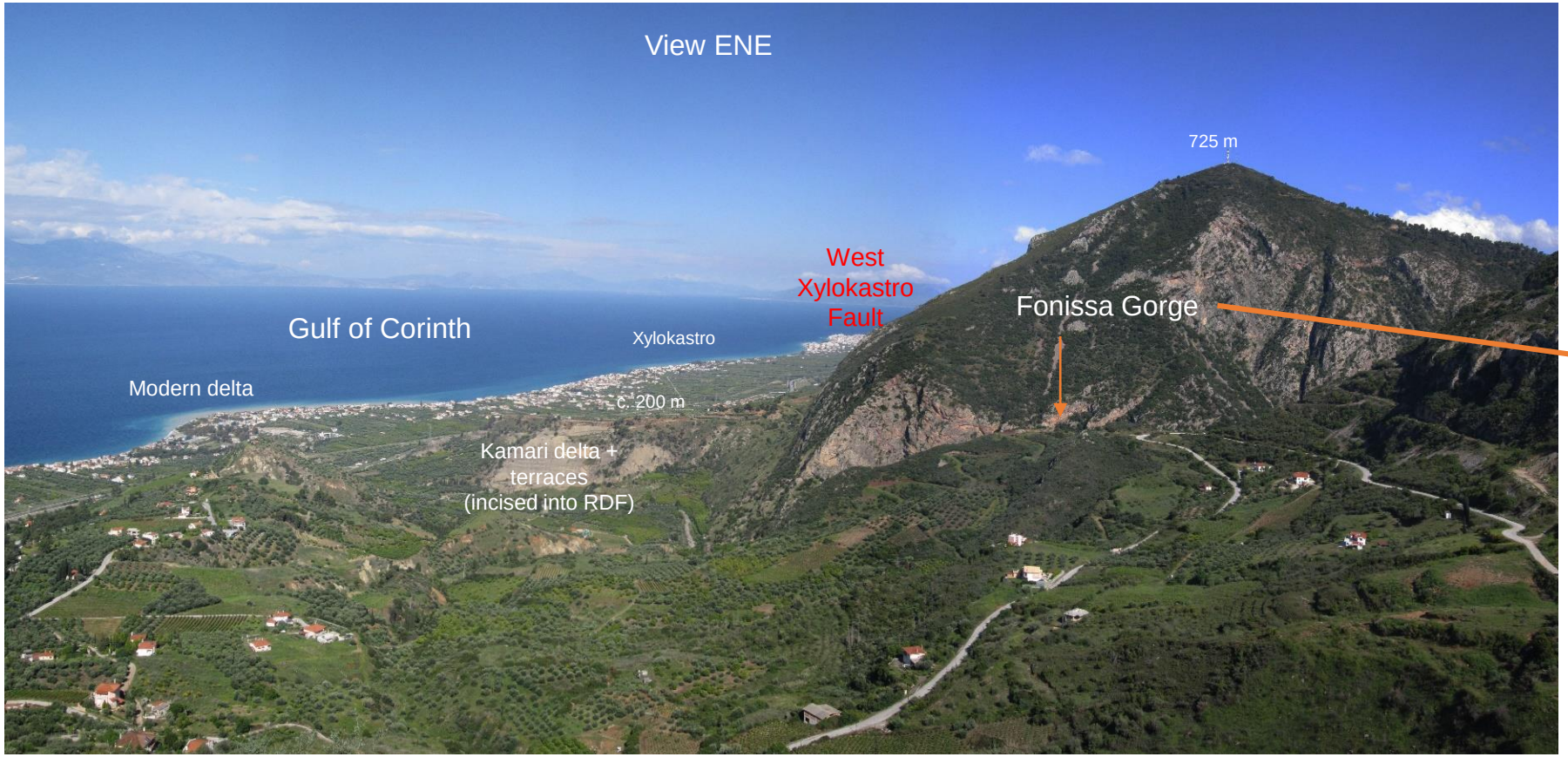
The West Xylokastro Fault

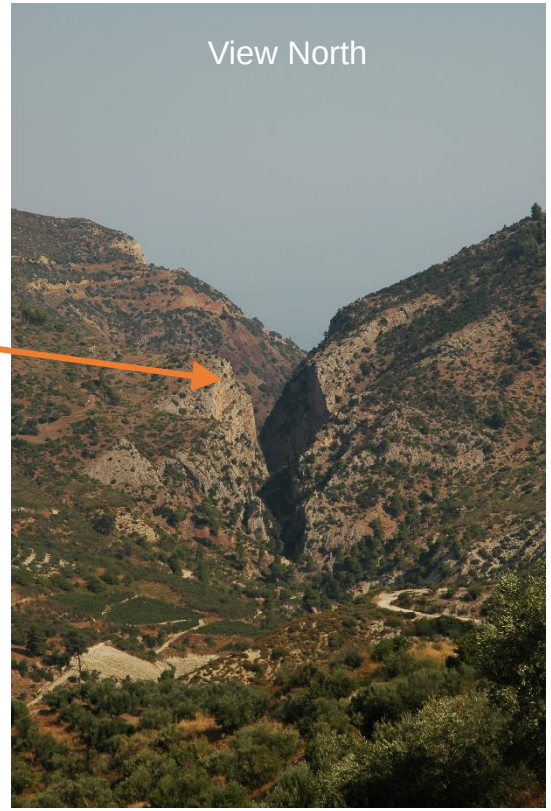




SYN-RIFT SYSTEMS

The West Xylokastro Fault



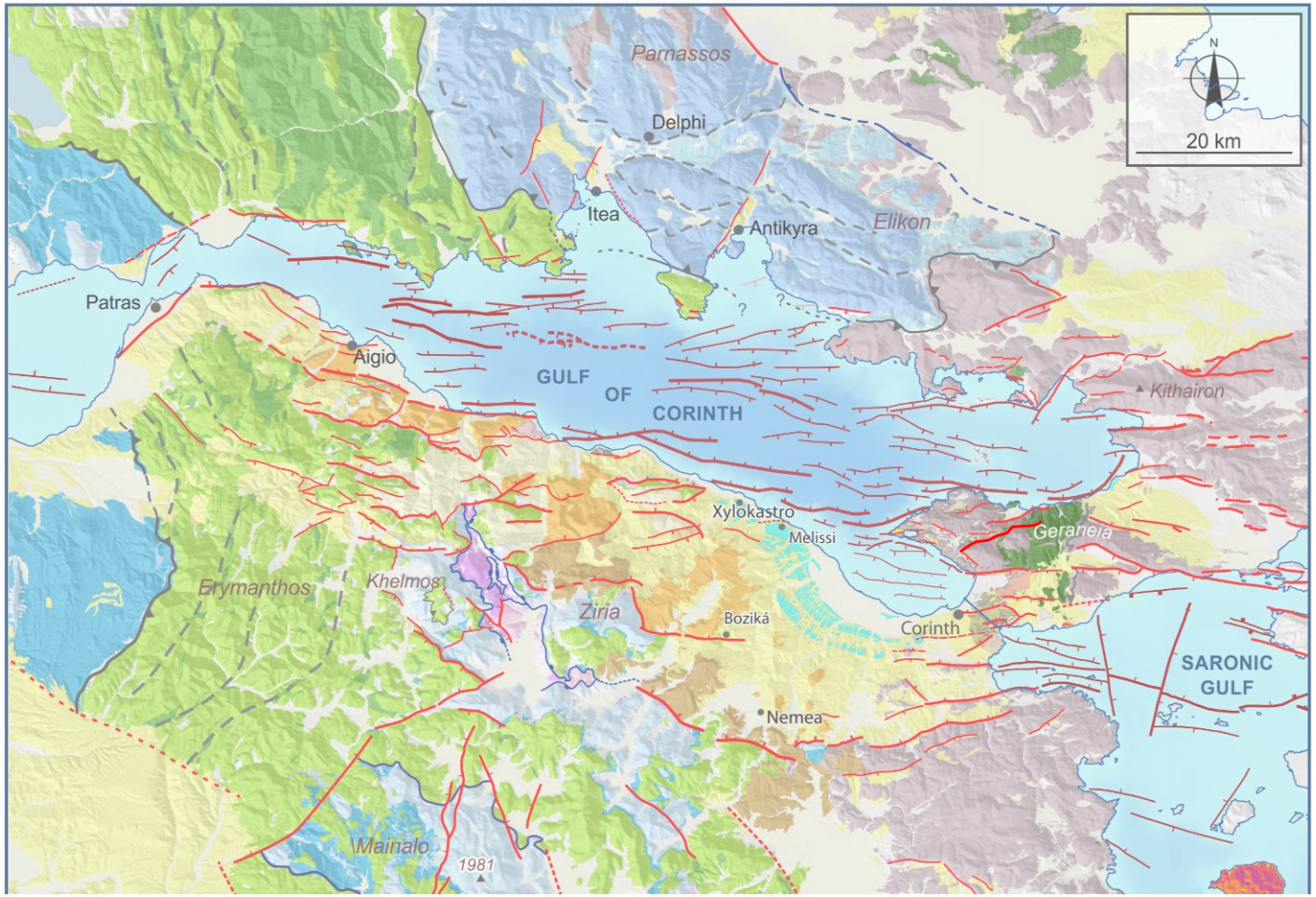


Slot gorges on antecedent drainage

SYN-RIFT SYSTEMS

Extensional Structures

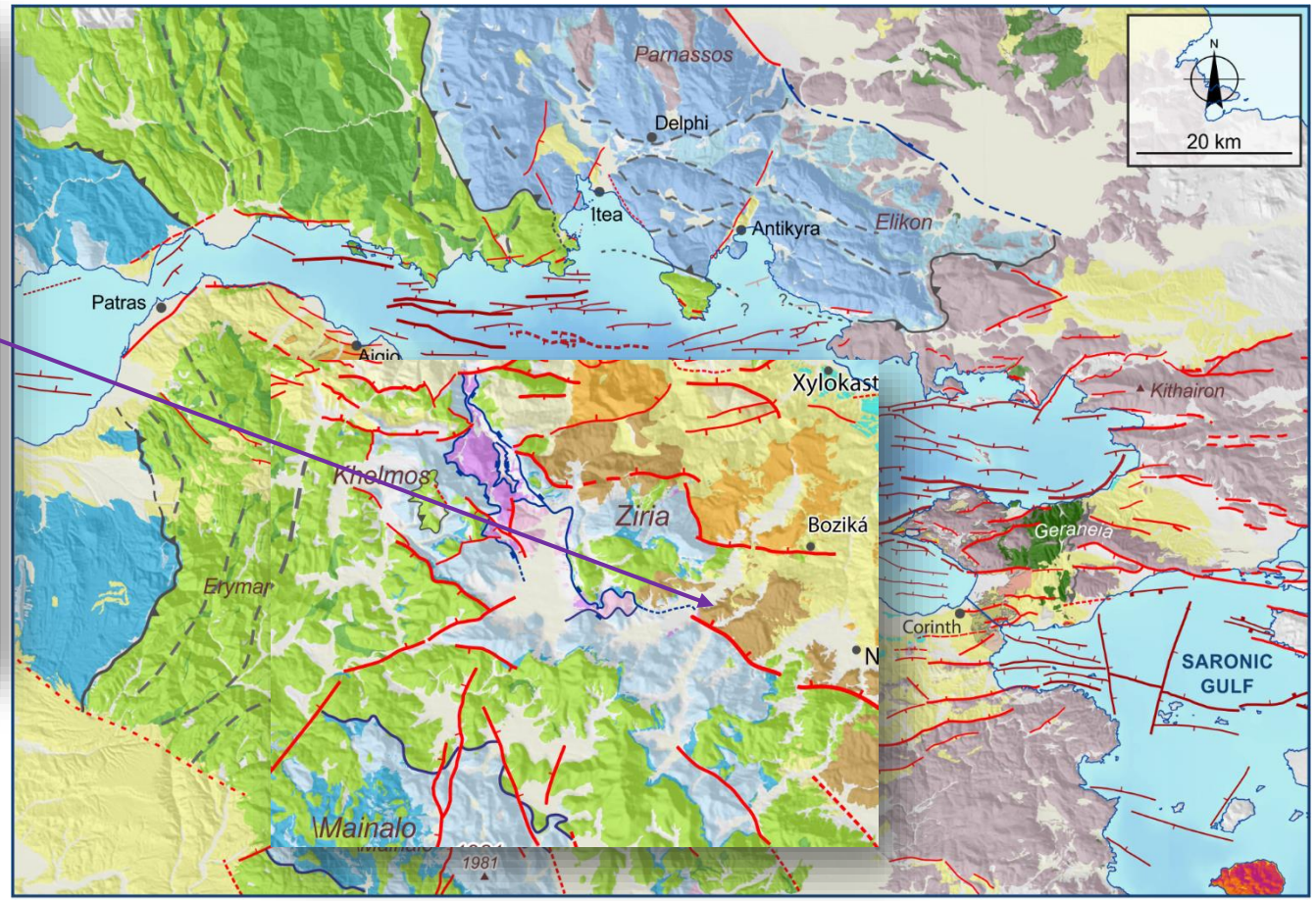
The Pissia Fault



SYN-RIFT SYSTEMS

Extensional Structures: earlier ones

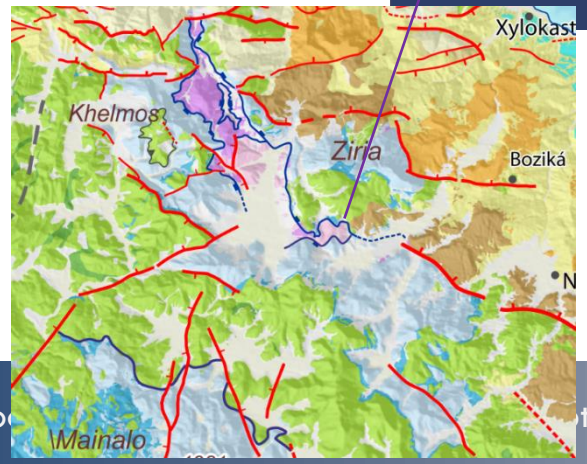
The Stymfalia Basin

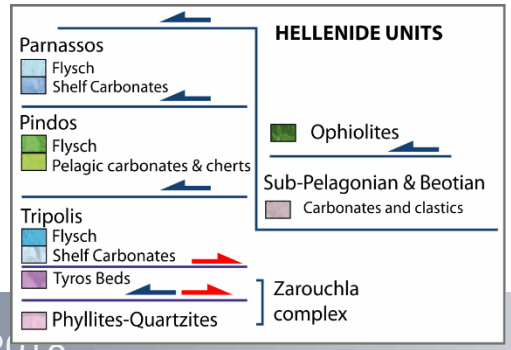


SYN-RIFT SYSTEMS

Extensional Structures: earlier ones

Hanging-wall rotation on the Khelmos Fault at Mt Ziria

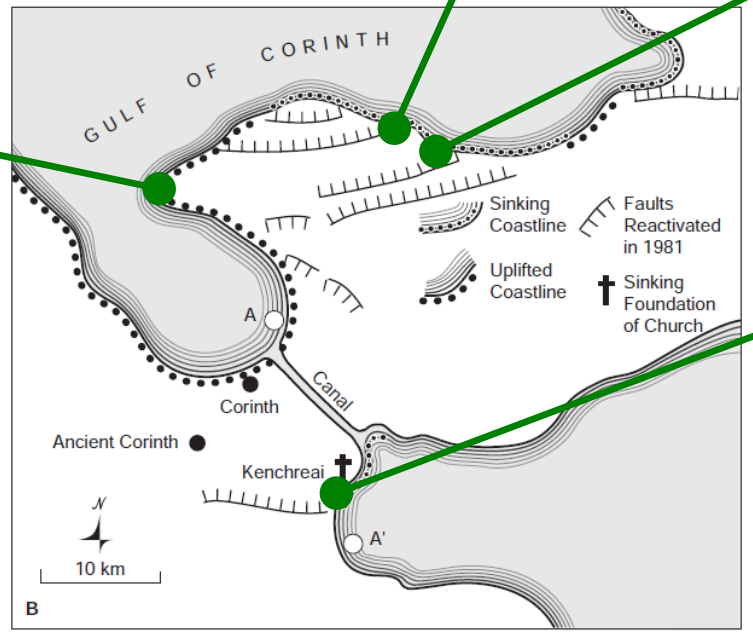




Skourtsos and Kranis, 2009

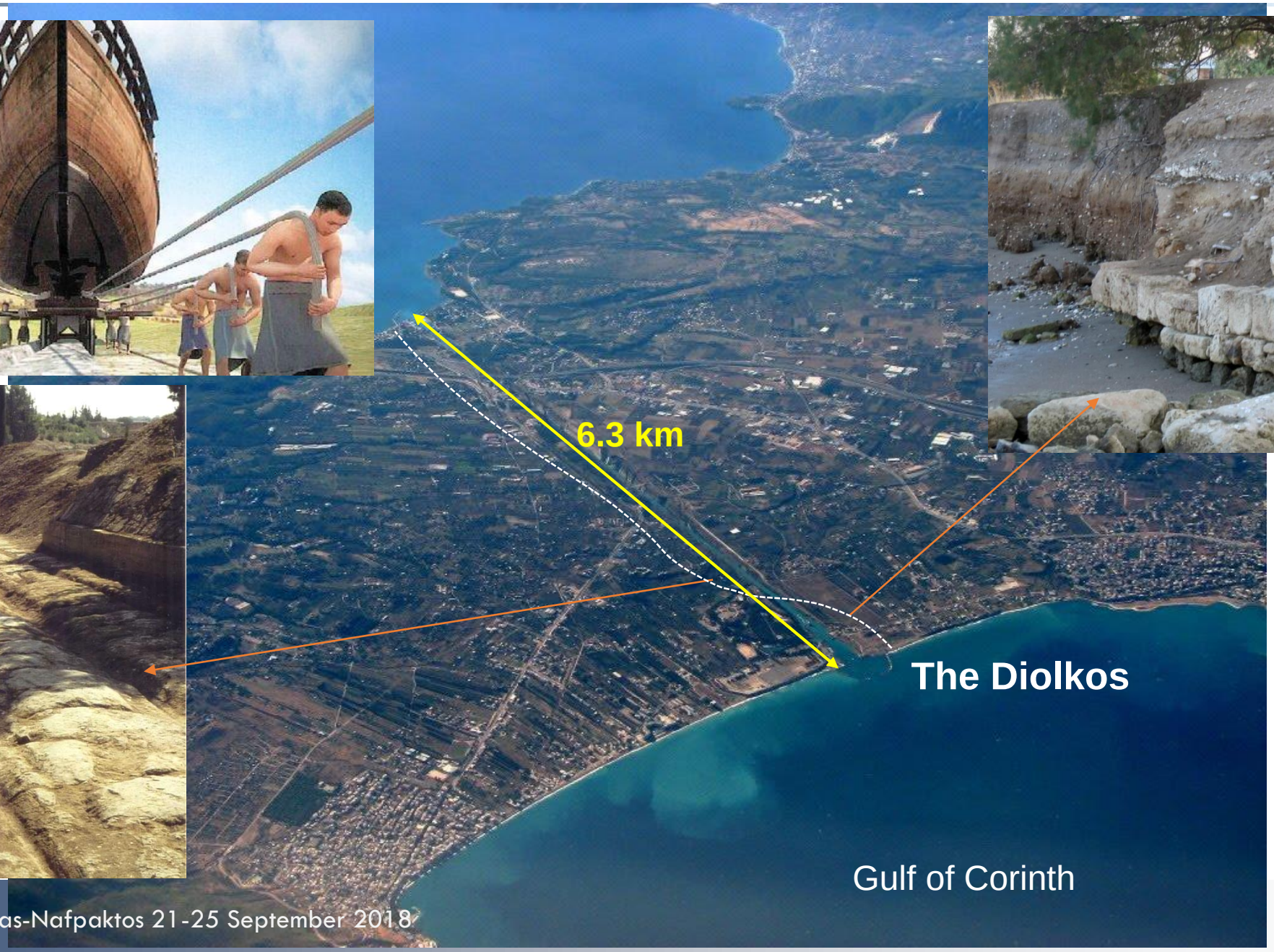
SYN-RIFT SYSTEMS

The Holocene: Recent Earth Movements (*)



SYN-RIFT SYSTEMS

The Holocene: Recent Earth Movements (*)



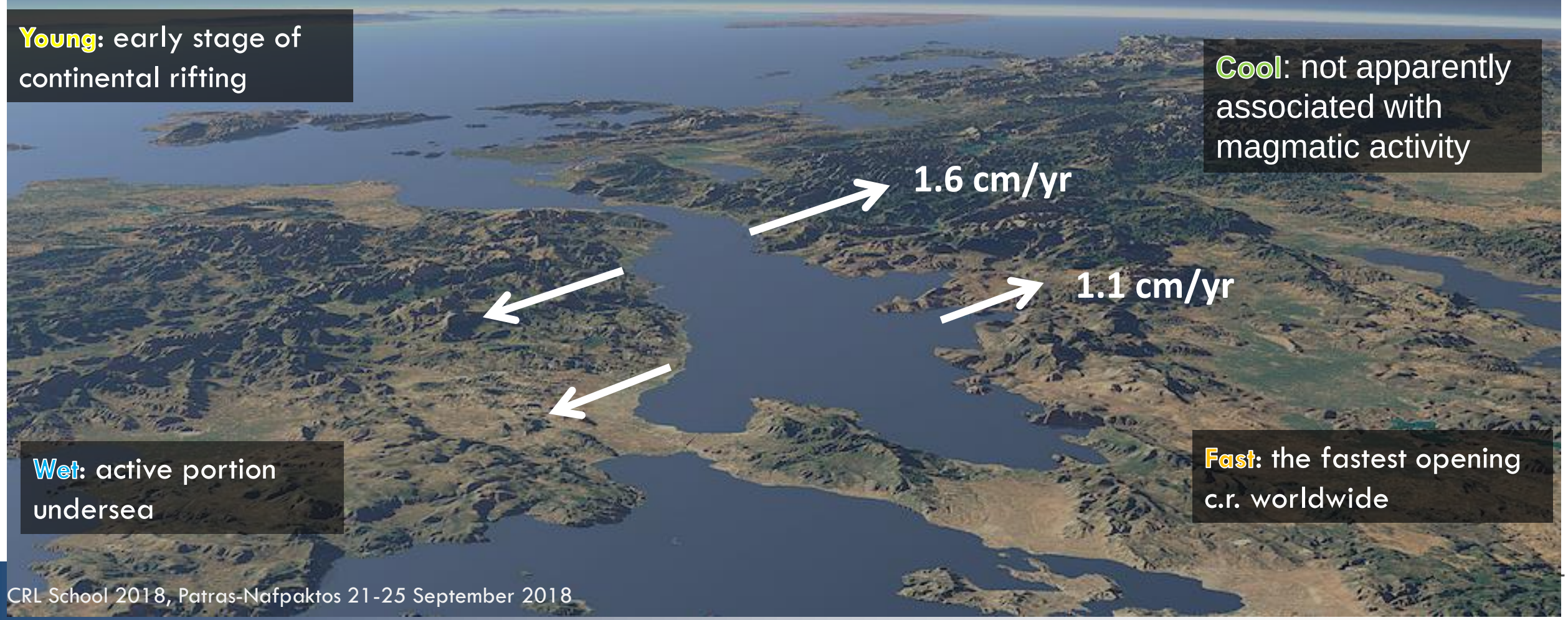
SYN-RIFT SYSTEMS

The Culf of Corinth Rift: Young, Cool, Wet and Fast

Initiated c. 5 Ma; extends from the Rion Straits and Mt Panachaikon to Alkyonides and Corinth.

Northern portion is actual Gulf of Corinth (max depth 850 m.)

Southern portion: a 20 km-wide landstrip, hosting > 3km of synrift deposits



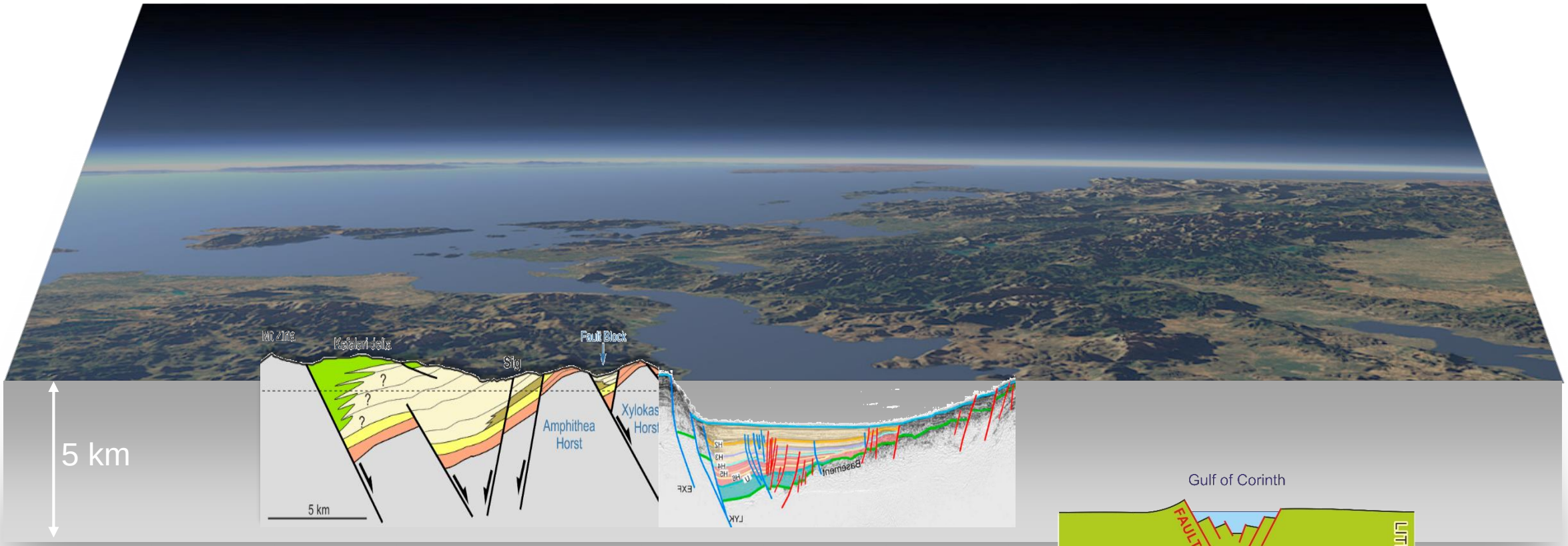
Young: early stage of continental rifting

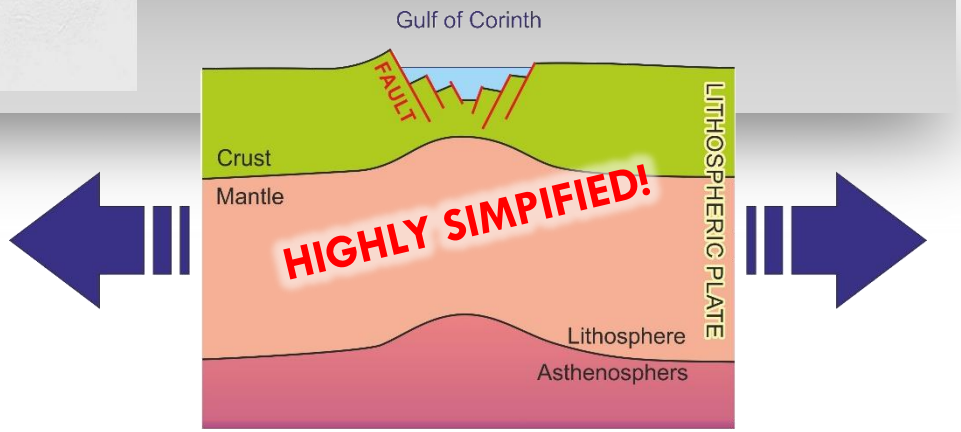
Cool: not apparently associated with magmatic activity

Wet: active portion undersea

Fast: the fastest opening c.r. worldwide

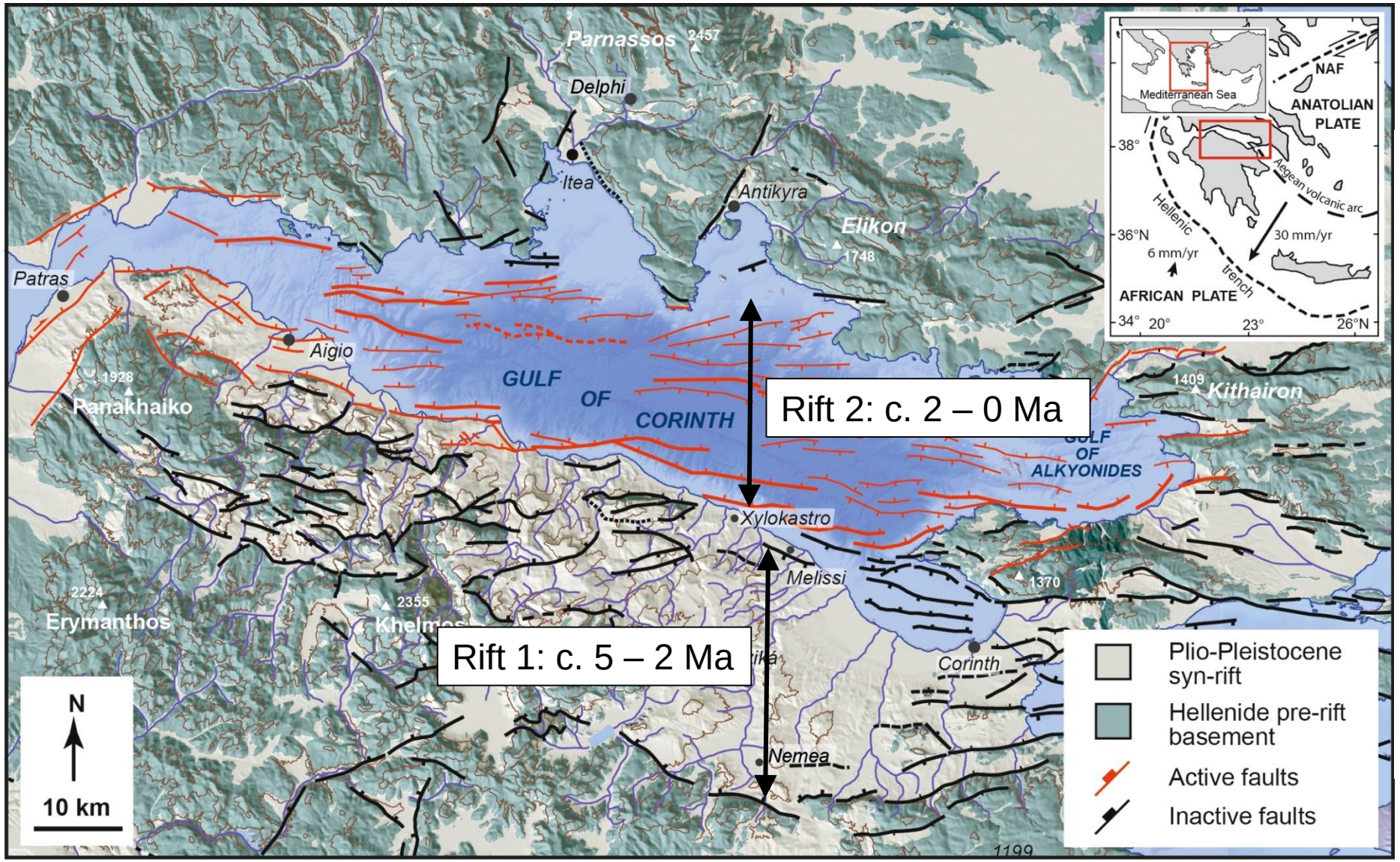
Corinth Rift Structure





SYN-RIFT SYSTEMS

Corinth Rift Evolution



RIFT 1

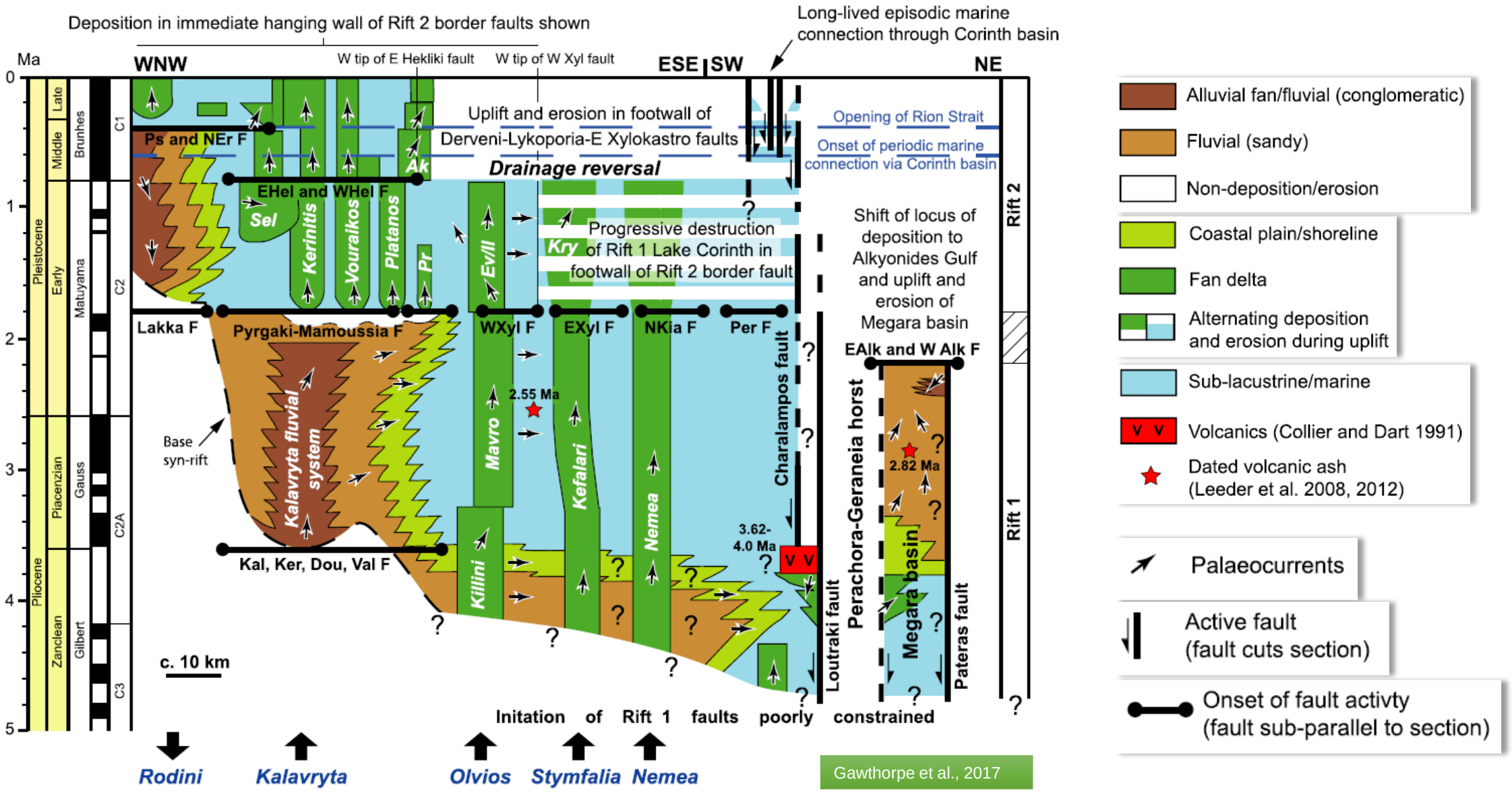
RIFT 2

- N-ward shift of rift to Gulf of Corinth with west Xylokastro fault active early, but dying by 0.8 Ma
- Uplift in footwall of southern border fault causes destruction of Lake Corinth, forced regression and erosion of RIft 1 deposits
- Reversal of Olvios and Stymfalia drainage.

Gawthorpe et al., 2017

SYN-RIFT SYSTEMS

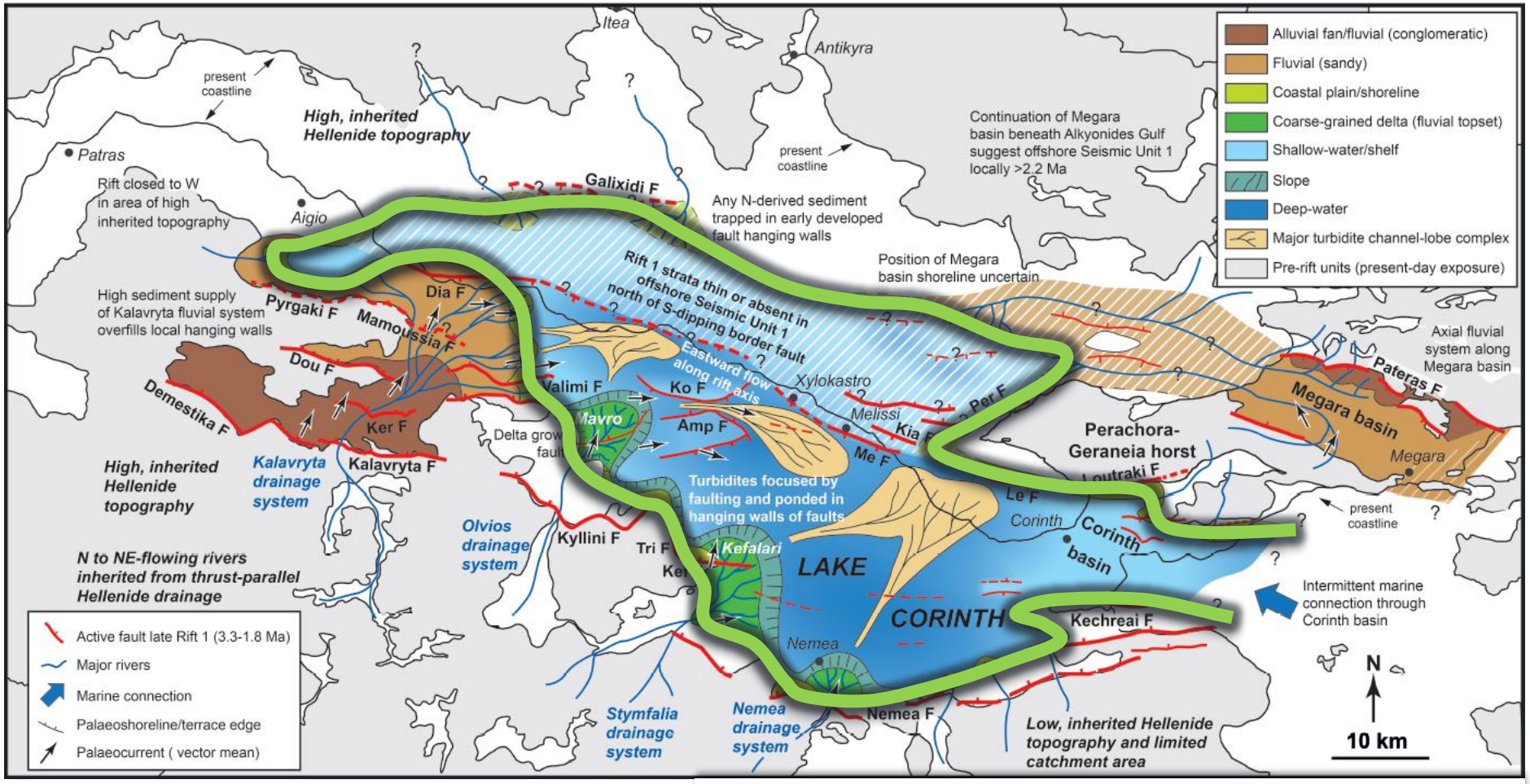
Chronostratigraphic evolution



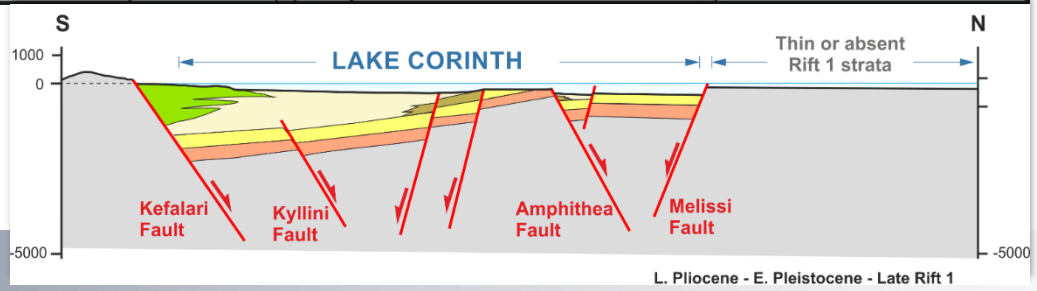
Gawthorpe et al., 2017

SYN-RIFT SYSTEMS

Corinth rift evolution



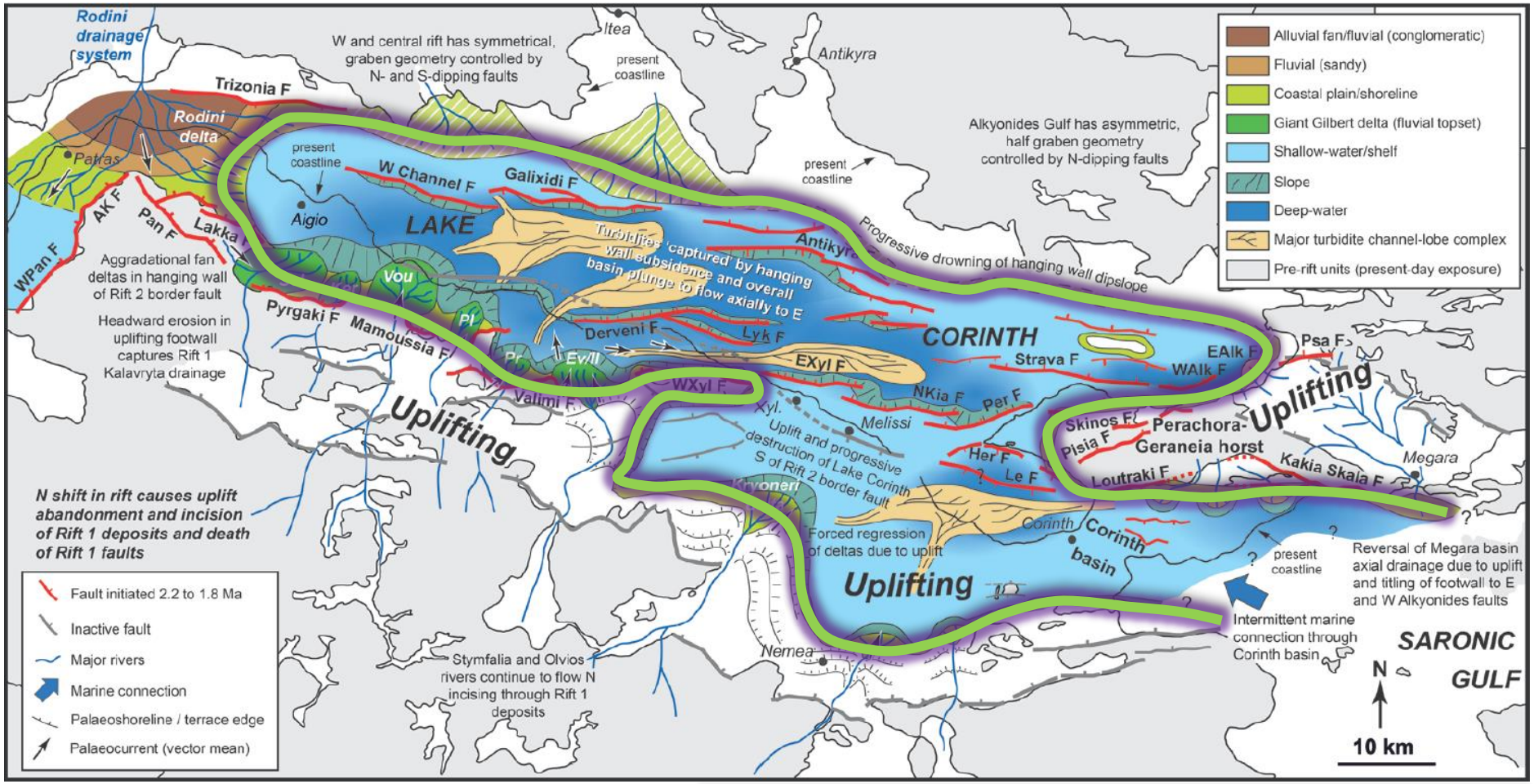
Gawthorpe et al., 2017



U. Pliocene – L. Pleistocene (c. 3 – 2.3 Ma)

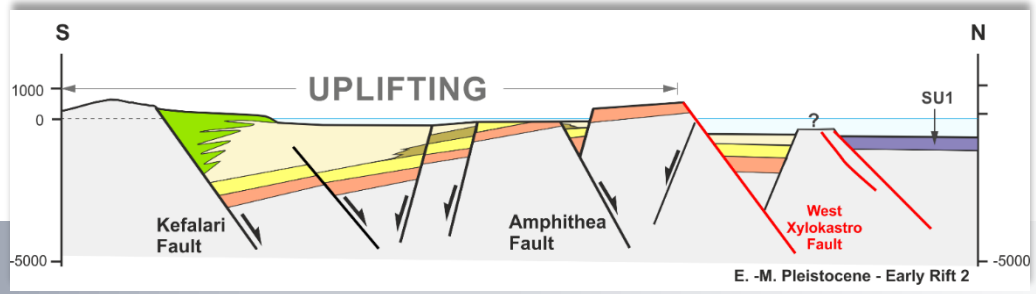
SYN-RIFT SYSTEMS

Corinth rift evolution



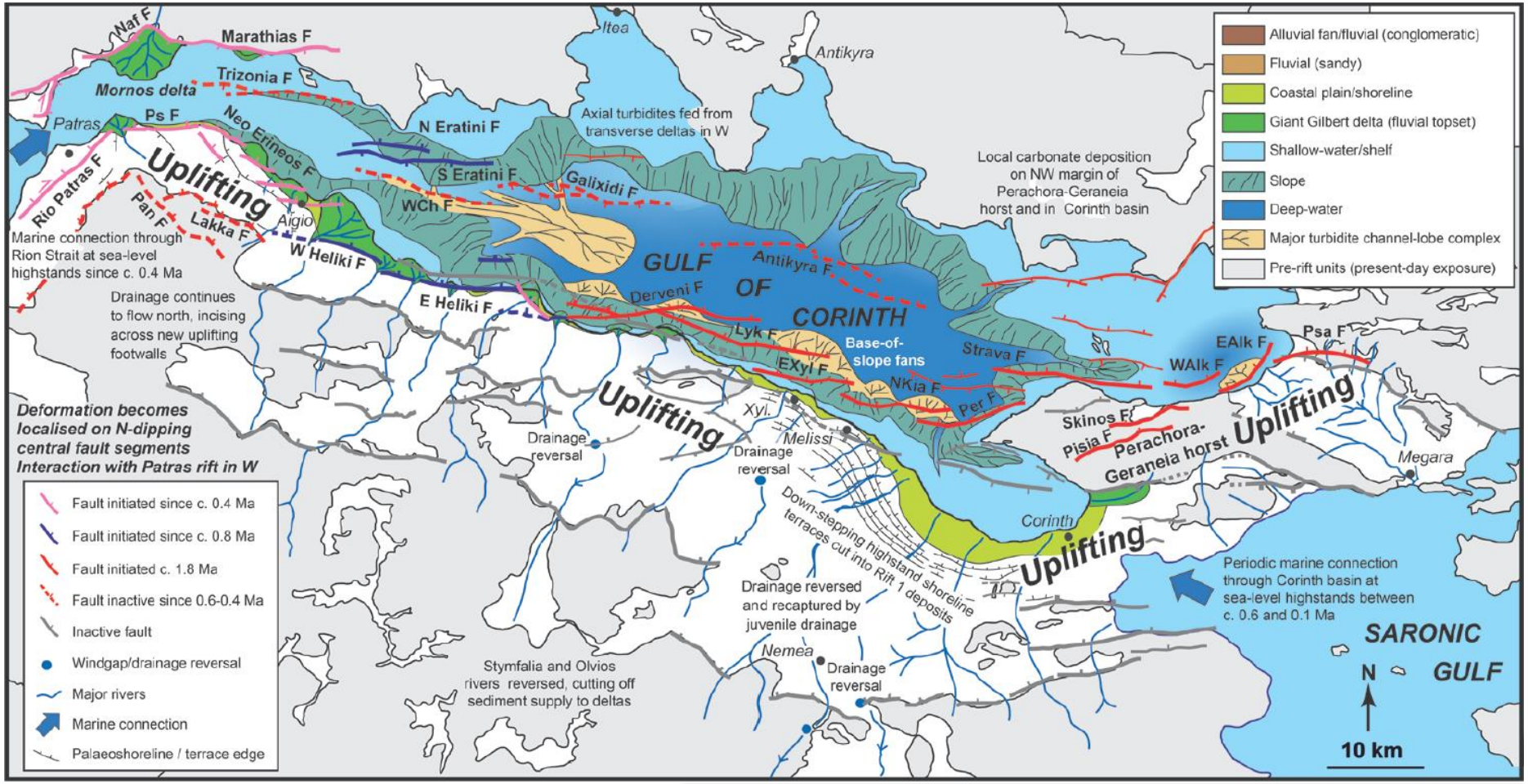
L.- M. Pleistocene
(c. 1.5 – 0.8 Ma)

Gawthorpe et al., 2017



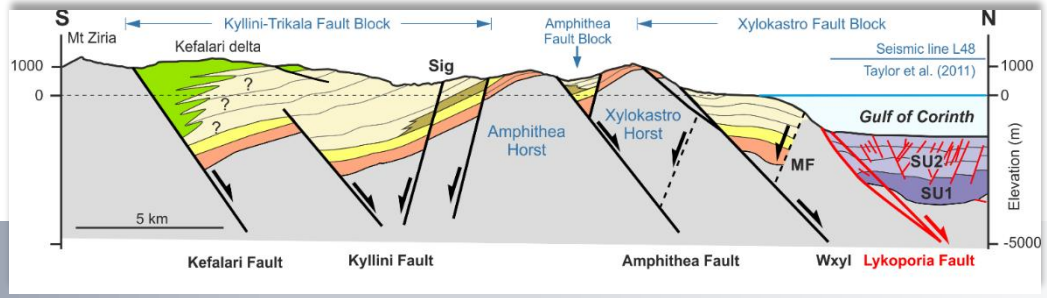
SYN-RIFT SYSTEMS

Corinth rift evolution



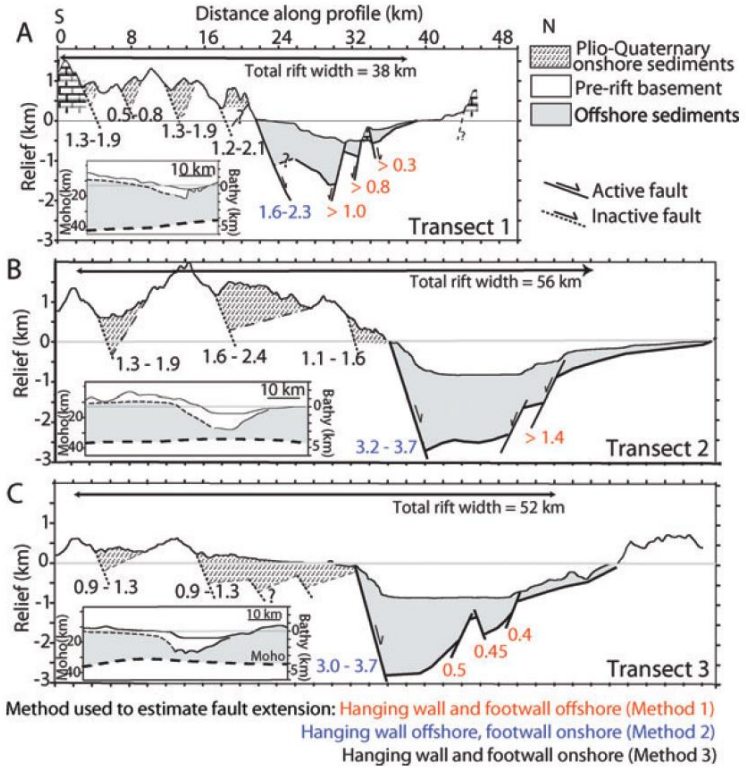
U. Pleistocene - Today
(c. 0.6 – 0.0 Ma)

Gawthorpe et al., 2017

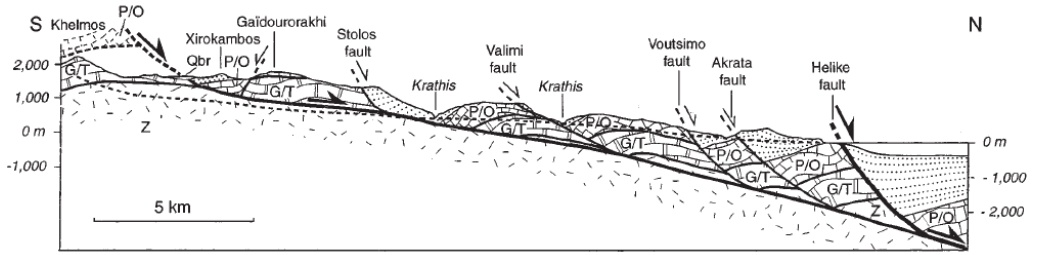


SYN-RIFT SYSTEMS

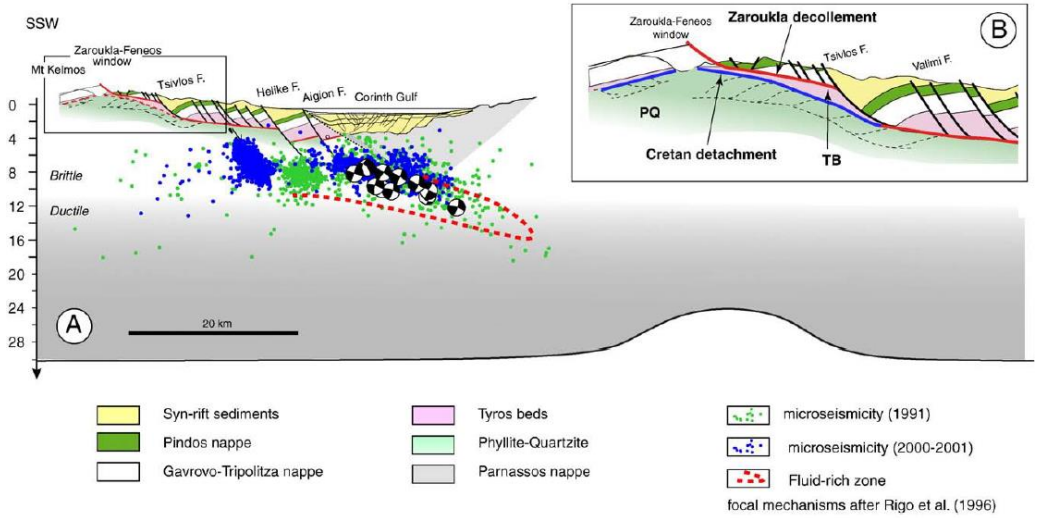
Going crustal…



Bell et al., 2011



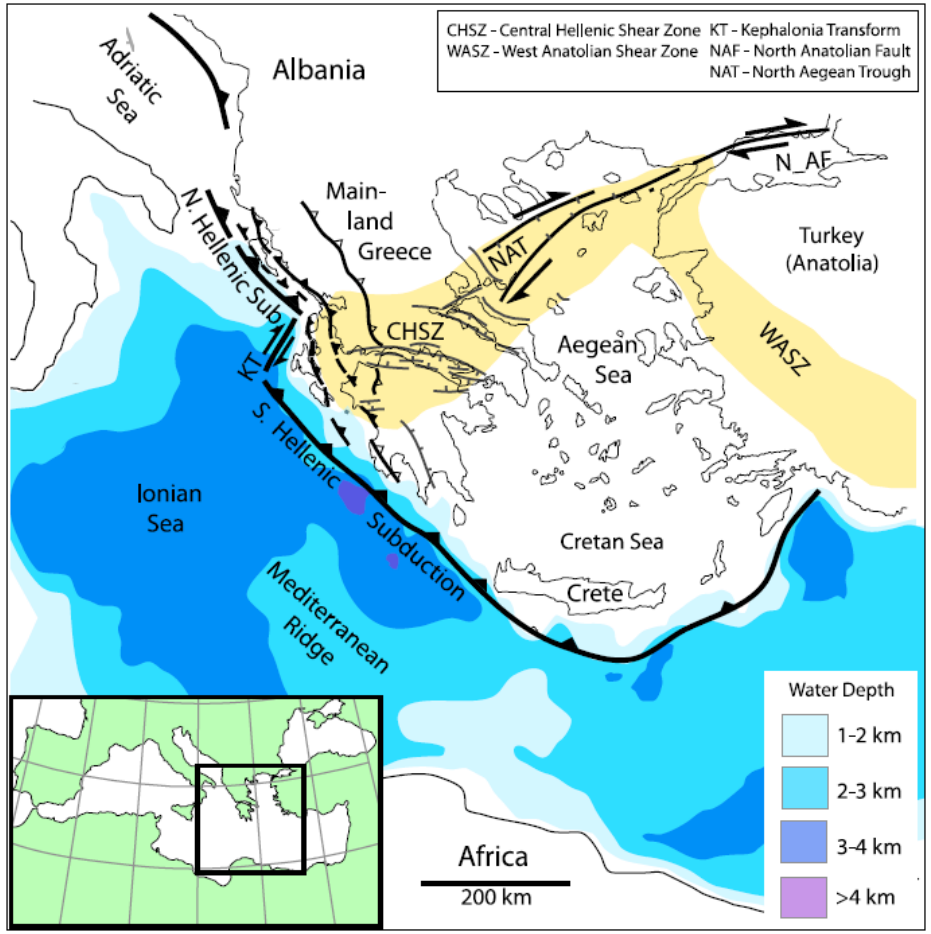
Sorel, 2000



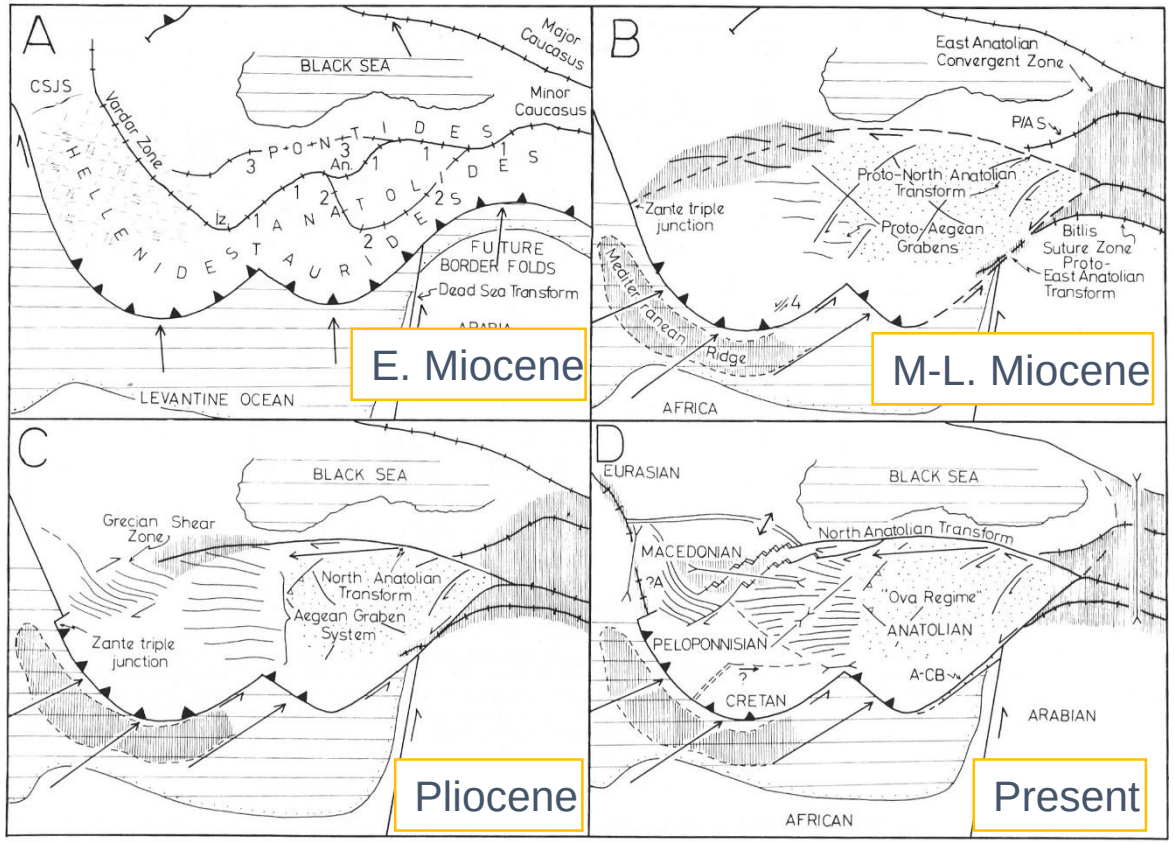
Jolivet et al., 2010

SYN-RIFT SYSTEMS

Driving Mechanism(s)?



Royden and Papanikolaou, 2011

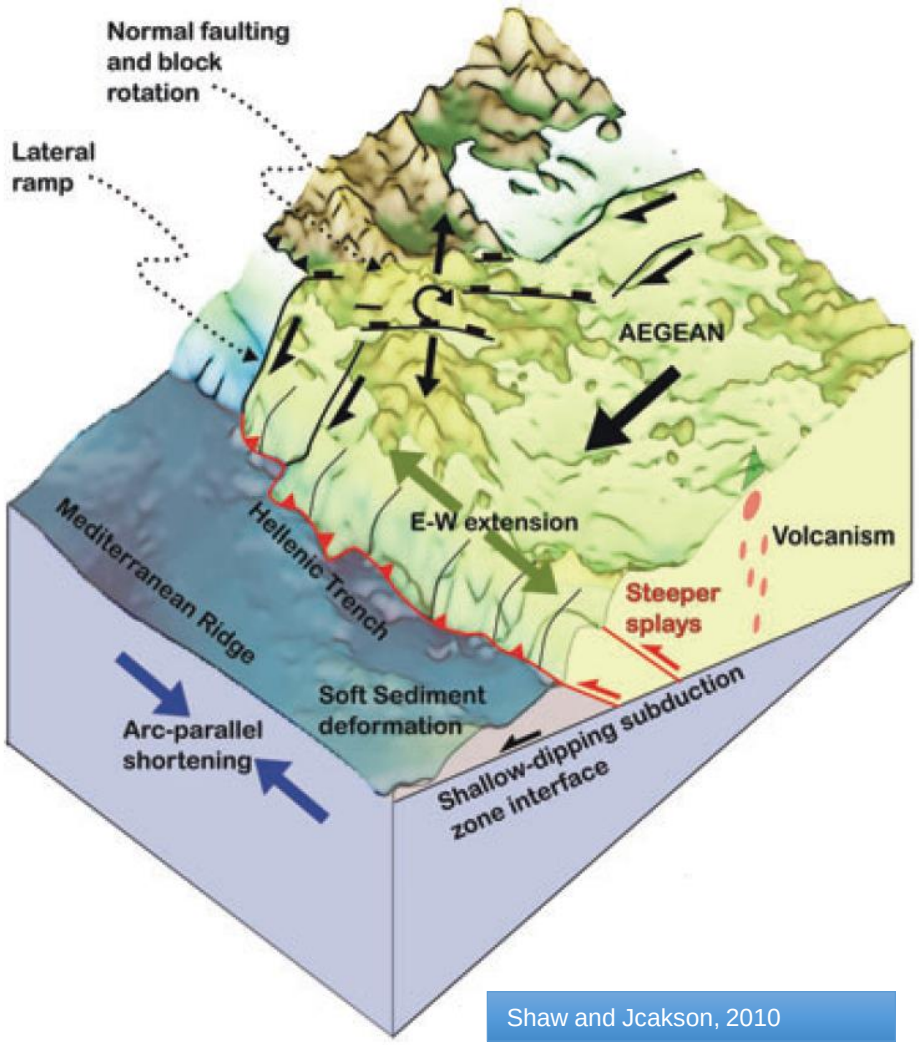


Imposed shear

Sengor et al., 1985

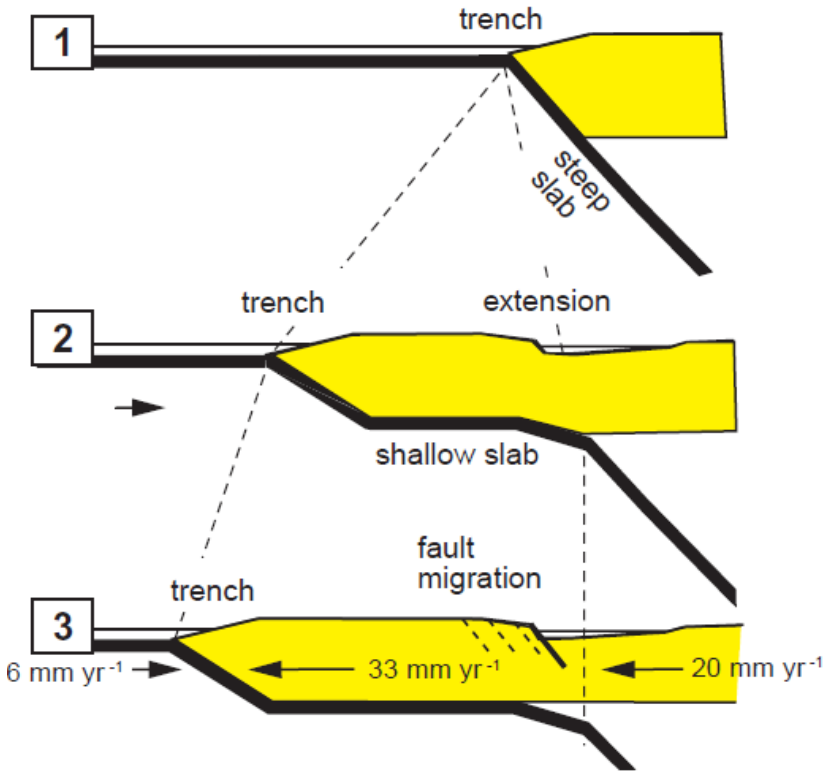
SYN-RIFT SYSTEMS

Driving mechanism(s)?



Shaw and Jcakson, 2010

Slab retreat – slab geometry



Leeder and Mack, 2008; Leeder et al., 2003

SYN-RIFT SYSTEMS

SYN-RIFT SYSTEMS