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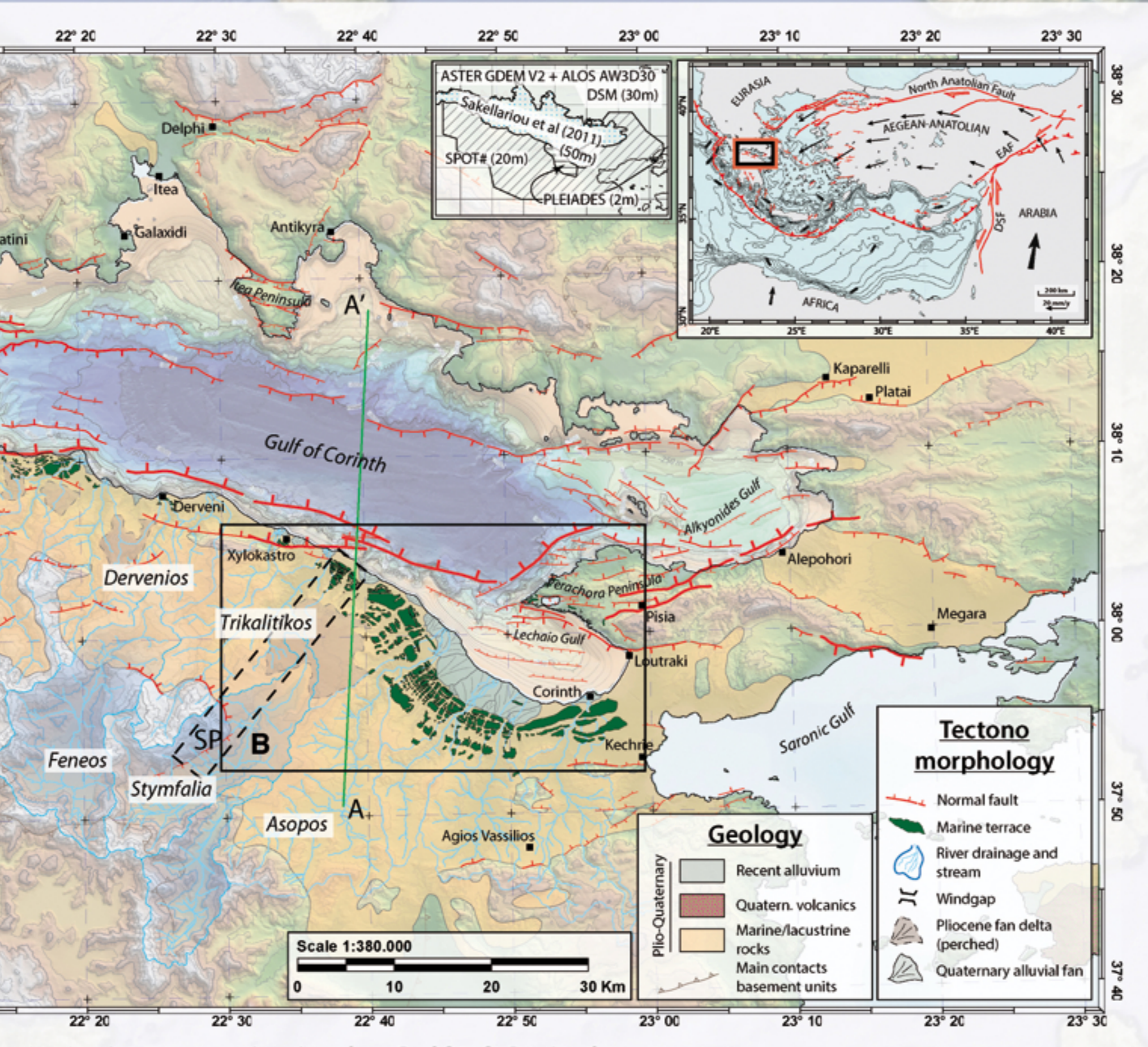
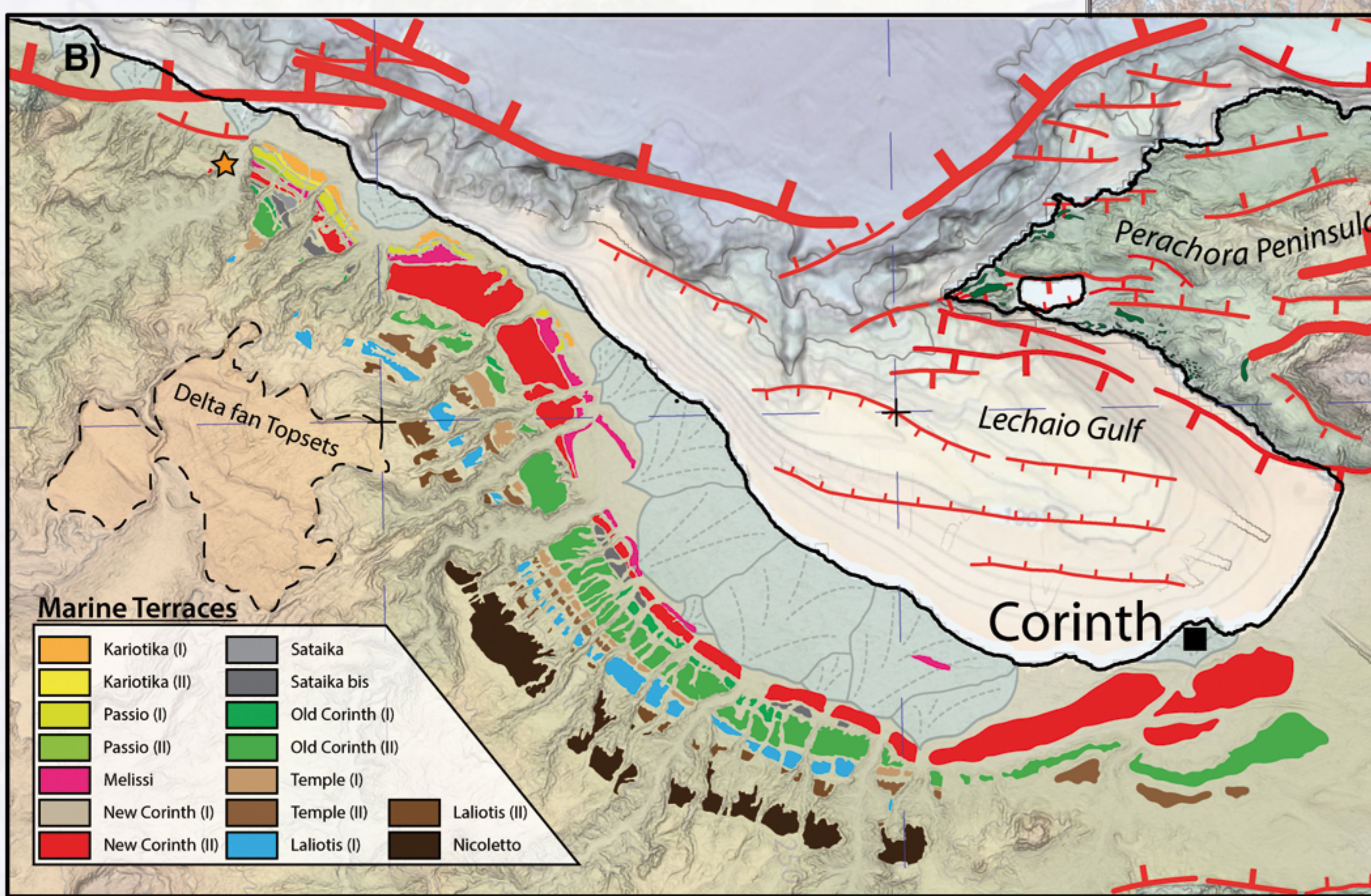
# Flexure in the Corinth rift: reconciling marine terraces, rivers, offshore data and fault modeling

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## 1. Introduction

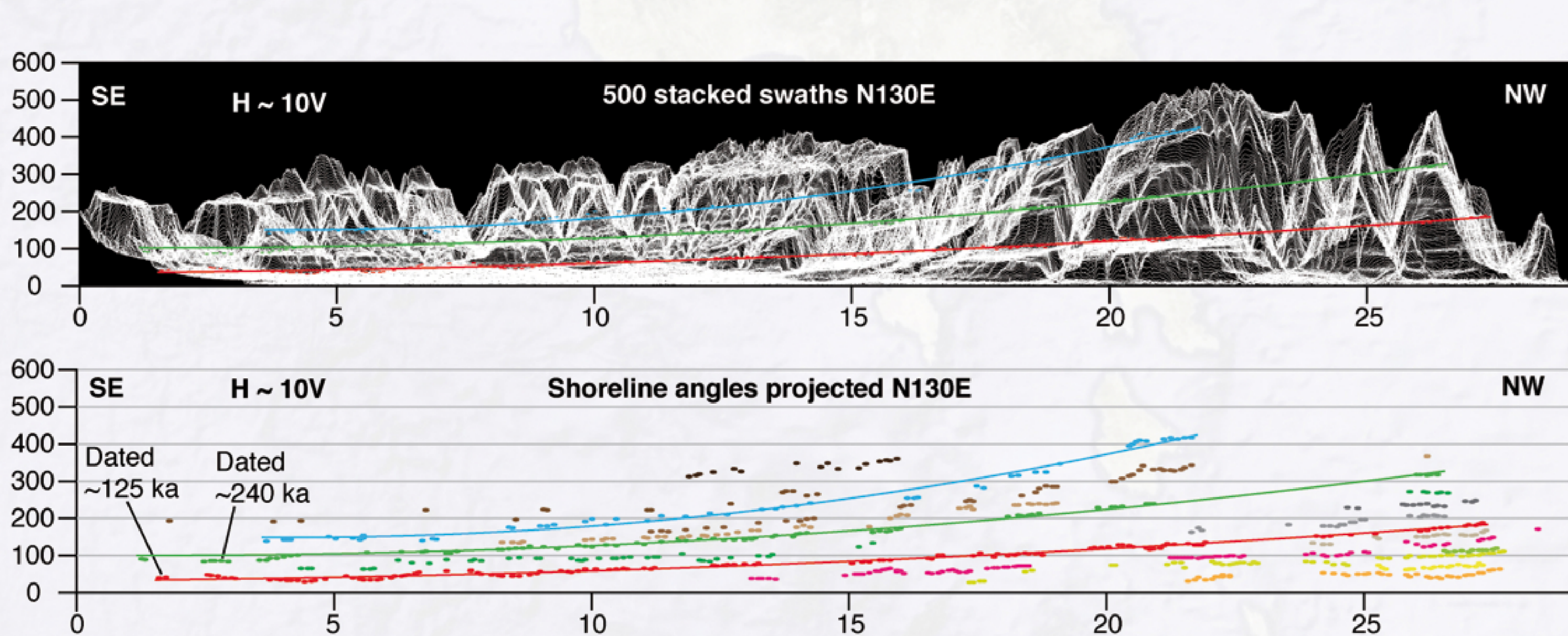
The Corinth rift (Greece) is an exceptional area to study the large-scale mechanics of a young rift system due to its extremely high extension rates and fault slip rates. Middle-Late Pleistocene activity of large normal faults has created a mostly asymmetric E-W trending rift, mainly driven by N-dipping faults that shape the southern margin of the Corinth Gulf in an echelon pattern. We improve the onshore record of footwall uplift by analysing the most extensive sequence of marine terraces in the SE margin, combine this dataset with the offshore seismic record of hanging wall subsidence, and present simple numerical models to fit the observations.



A) Active tectonics in the Gulf of Corinth  
B) Map of the deformed marine terraces in the SE margin

## 2. Onshore flexure

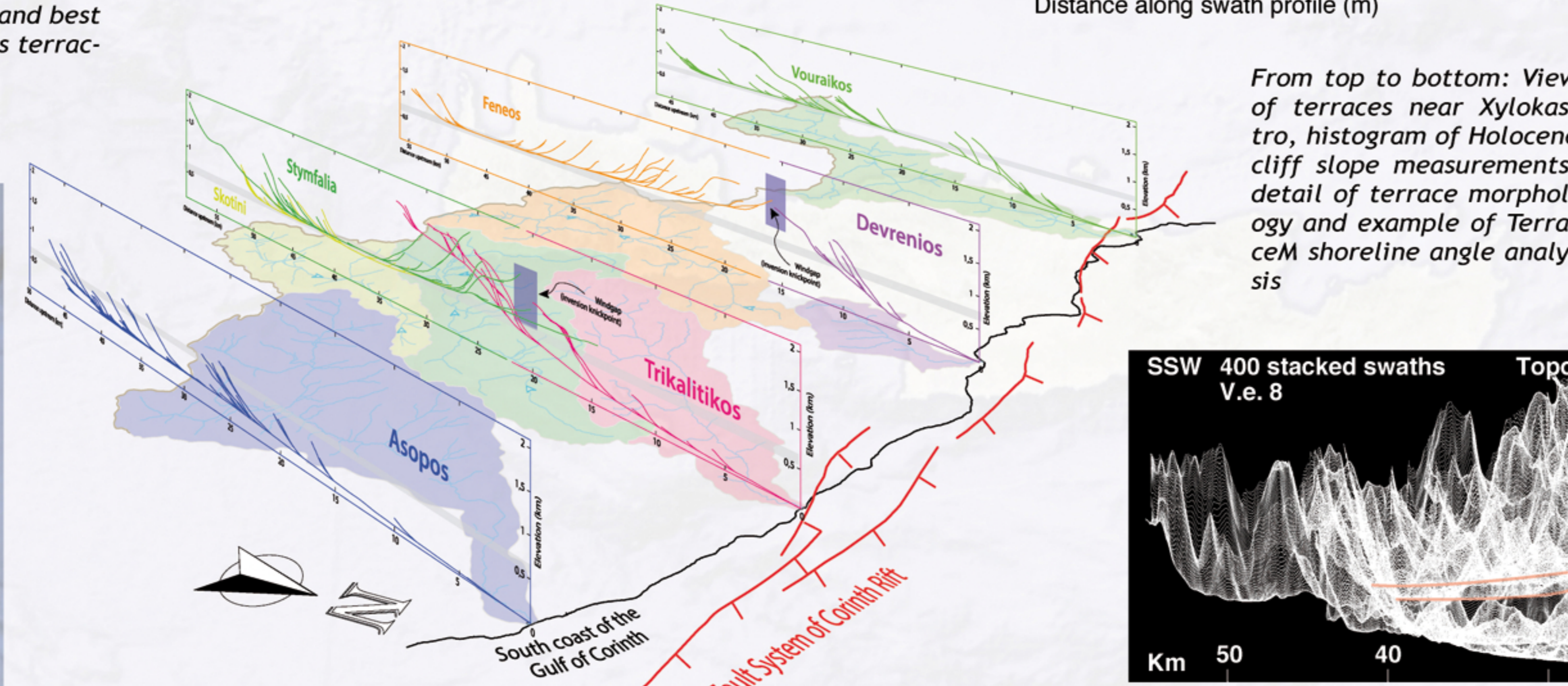
We developed 2m-resolution digital surface models from Pleiades satellite imagery using MicMac software (Rosu et al. 2015, <http://logiciels.ign.fr/?Micmac>) to define with high accuracy the shoreline angles of the terraces using the graphical Matlab interface TerraceM (Jara-Muñoz et al. 2016, [www.terracem.com](http://www.terracem.com)). The detailed record of flexure provided by this analysis is in good agreement with the (nearly) inverted river geometry of the major systems along the south coast, indicating that flexure occurs on the scale of the whole rift.



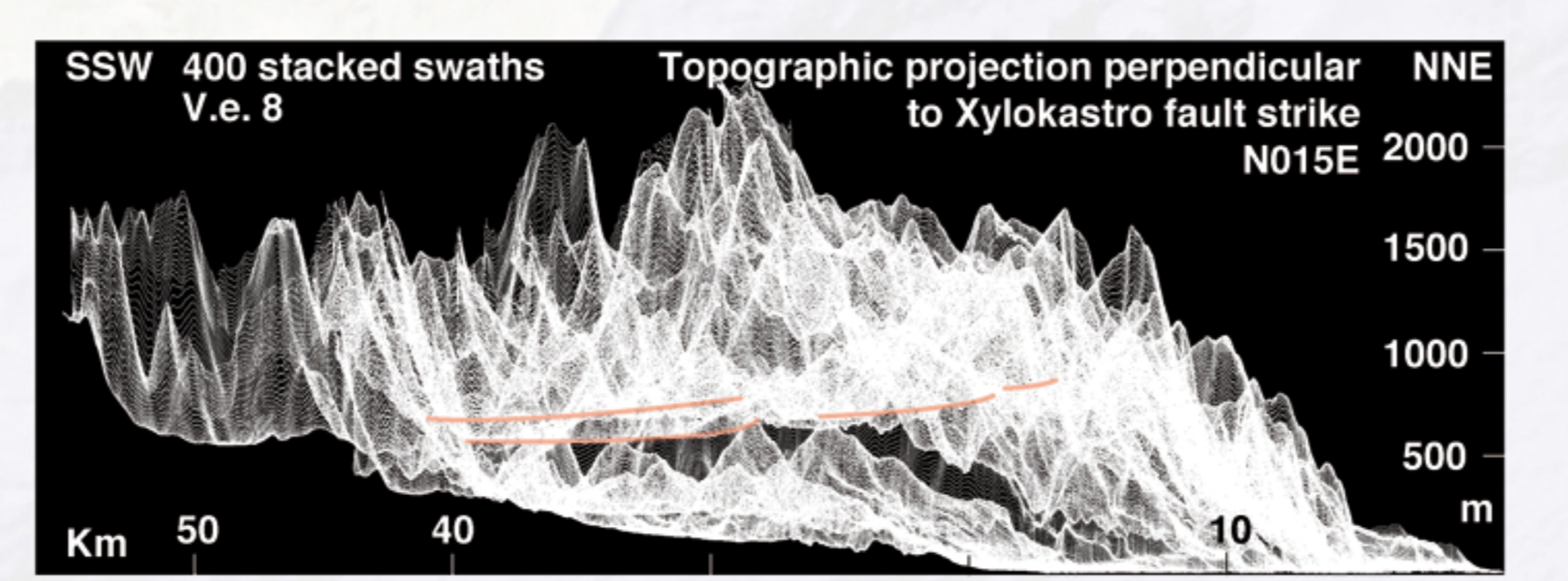
Top: topography parallel to the coast with the shoreline angles and best fit quadratic curve for the New Corinth, Old Corinth and Laliotis terraces.  
Bottom: all determined shoreline angles

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This study is part of the Anatolian Plateau Climate and Tectonic Hazards (ALeT) project, funded by the European Union Marie Curie Actions "Initial Training Networks" program (FP7-PEOPLE-2013-ITN) (Grant Agreement Number 607996). We are indebted with the CNES, French space agency, through which we acquired the Pleiades satellite imagery with support of the Isis and Tosca programs.

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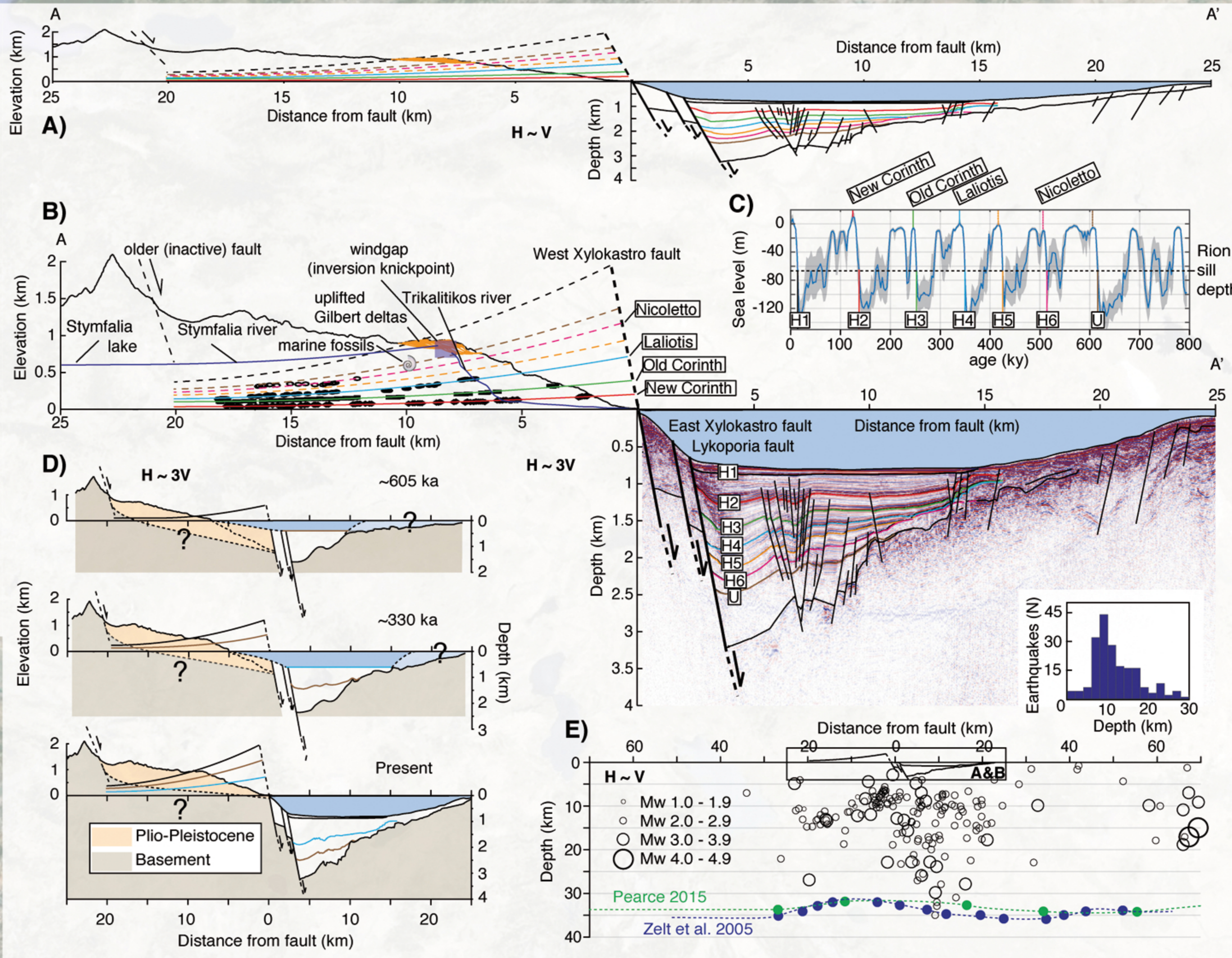
Profiles of four major river systems along the southern margin of the Corinth Gulf



Stack of fault-perpendicular swath profiles with inverted river profiles highlighted

## 3. Cross-section

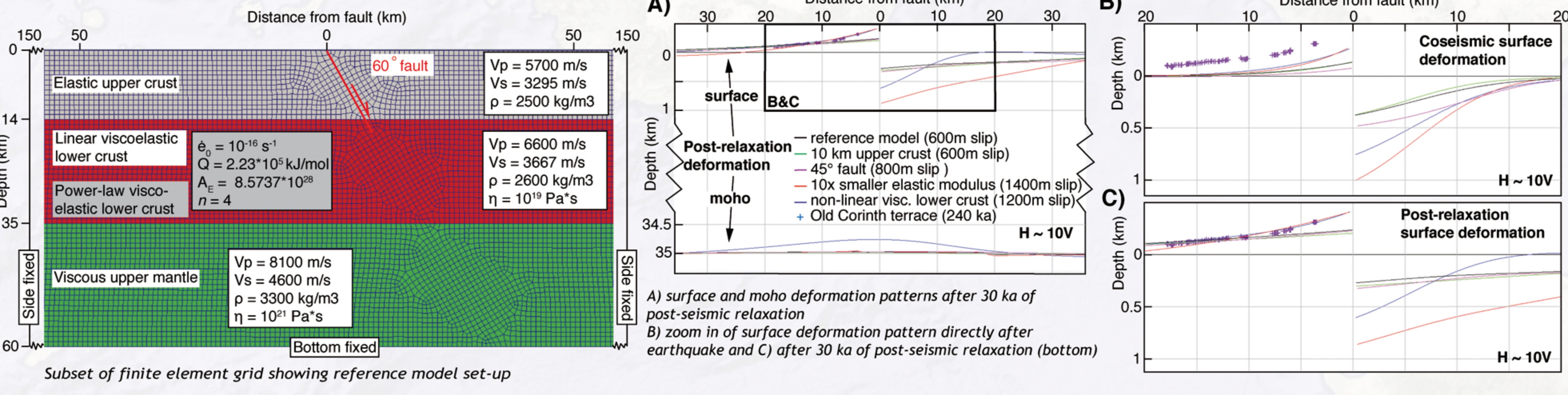
The 100ky climate cycles that shaped the most extensive terrace levels are, by glacial-interglacial interaction with the Rion strait, also responsible for the marine-lacustrine alternation inferred for the offshore stratigraphy. We depth-converted the multi-channel seismic section L35 (Taylor et al. 2011) and combine this with the onshore record to obtain a full profile of the Xylokastro/Lykiporia fault geometry and its associated deformation pattern. We obtain a symmetric geometry with an uplift/subsidence (u/s) ratio of 1:0.9-1:1.5 after sediment decompaction, and an average cumulative slip rate of ~5 to ~7 mm/yr. In the deeper section, microseismicity is mainly concentrated in a broad region below the main faults, and the mocho is thinnest below the main fault system or ~10km to the south.



A) and B) are the projection of topographic maximum swath profile SP, shoreline angles and Trikalitikos/Stymfalia rivers on profile A-A' without and with 3x vertical exaggeration. Seismic interpretation adapted from Nixon et al. (2016); C) Inferred ages of terrace levels and offshore seismic horizons plotted on the Pacific sea level curve of Bates et al. (2014); D) Schematic geological restoration for the last ~605ka and; E) Microseismicity from the University of Athens 1996-2008 earthquake catalog measured within 2.5 km of profile A-A' and mocho depth estimates from Ps receiver functions (Pearce 2015) and tomographic inversion of PmP reflection times (Zelt et al. 2005)

## 4. Fault modeling

We use the full cross-section as constraint for 2D fault modeling. We use Pylith, a finite element code for quasi-static viscoelastic simulations, to model 45-60° planar normal faulting in an elastic upper crust overlying a viscous lower crust and mantle to reproduce the derived terrace uplift pattern. The models reproduce the observed geometry best by either reducing the elastic modulus of the upper crust by a factor of ~10 or using a non-linear viscoelastic rheology for the lower crust (power law), in which the latter is in better agreement with the observed u/s ratio and interpreted mocho geometry.



Subset of finite element grid showing reference model set-up  
A) surface and mocho deformation patterns after 30 ka of post-seismic relaxation  
B) zoom in of surface deformation pattern directly after earthquake and C) after 30 ka of post-seismic relaxation (bottom)

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## 5. Conclusions

- 1) The terrace sequence in the SE Gulf of Corinth provides a detailed record of footwall flexure and the (nearly) inverted river profiles suggest it happens at the scale of the rift
- 2) Similar climate-driven strain markers within the offshore section indicate a symmetric deformation pattern and u/s ratios of 1:0.9-1:1.5
- 3) Our best fitting numerical models contain an elastic upper crust overlying a viscous lower crust with powerlaw viscosity.