This presentation participates in OSPP

Outstanding Student Poster & PICO Contest

Burial and exhumation history of the Georgian sector of the central Greater Caucasus

Sharing not permitted

Confluence between Aragvi and Kura rivers, southern foothills of the central Greater Caucasus, Georgia.

Thomas Gusmeo[1*], William Cavazza[1], Massimiliano Zattin[2], Sveva Corrado[3], Andrea Schito[4], Victor Alania[5], Onise Enukidze[5]

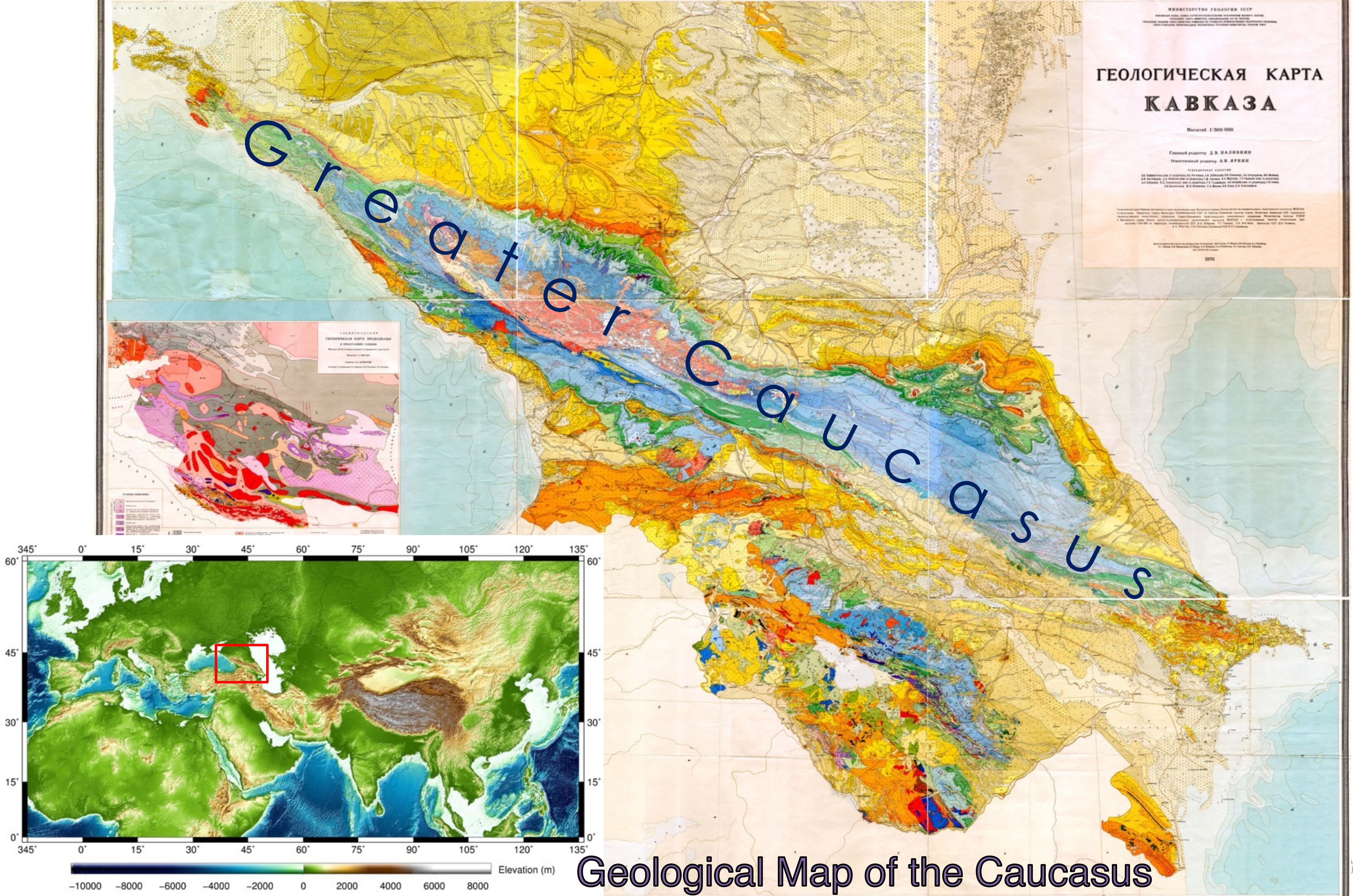
[1]Department of Geological, Biological and Environmental Sciences, University of Bologna, Bologna, Italy
*thomas.gusmeo2@unibo.it
[2]Department of Geosciences, University of Padova, Padua, Italy
[3]Department of Sciences, University of Roma Tre, Rome, Italy
[4]Department of Geology and Petroleum Geology, School of Geosciences, University of Aberdeen, Aberdeen, UK
[5]Institute of Geophysics, I. Javakhishvili State University, Tbilisi, Georgia

DEFORMATION, FLUIDS and TECTONICS GROUP

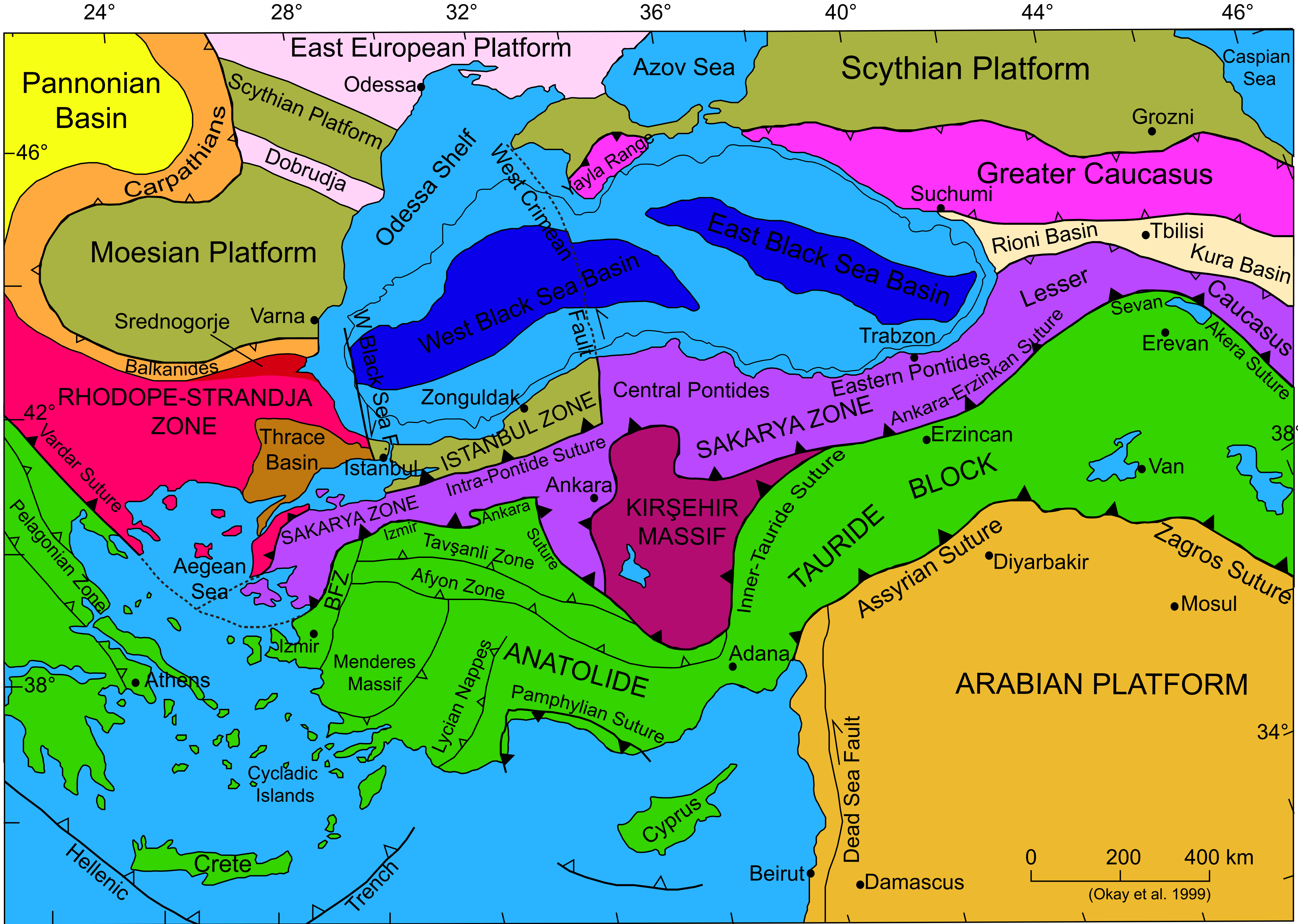
EGU General Assembly 2022

Session TS7.2 - 26th May 2022
h 13:29-13:36 – Room D1

ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA



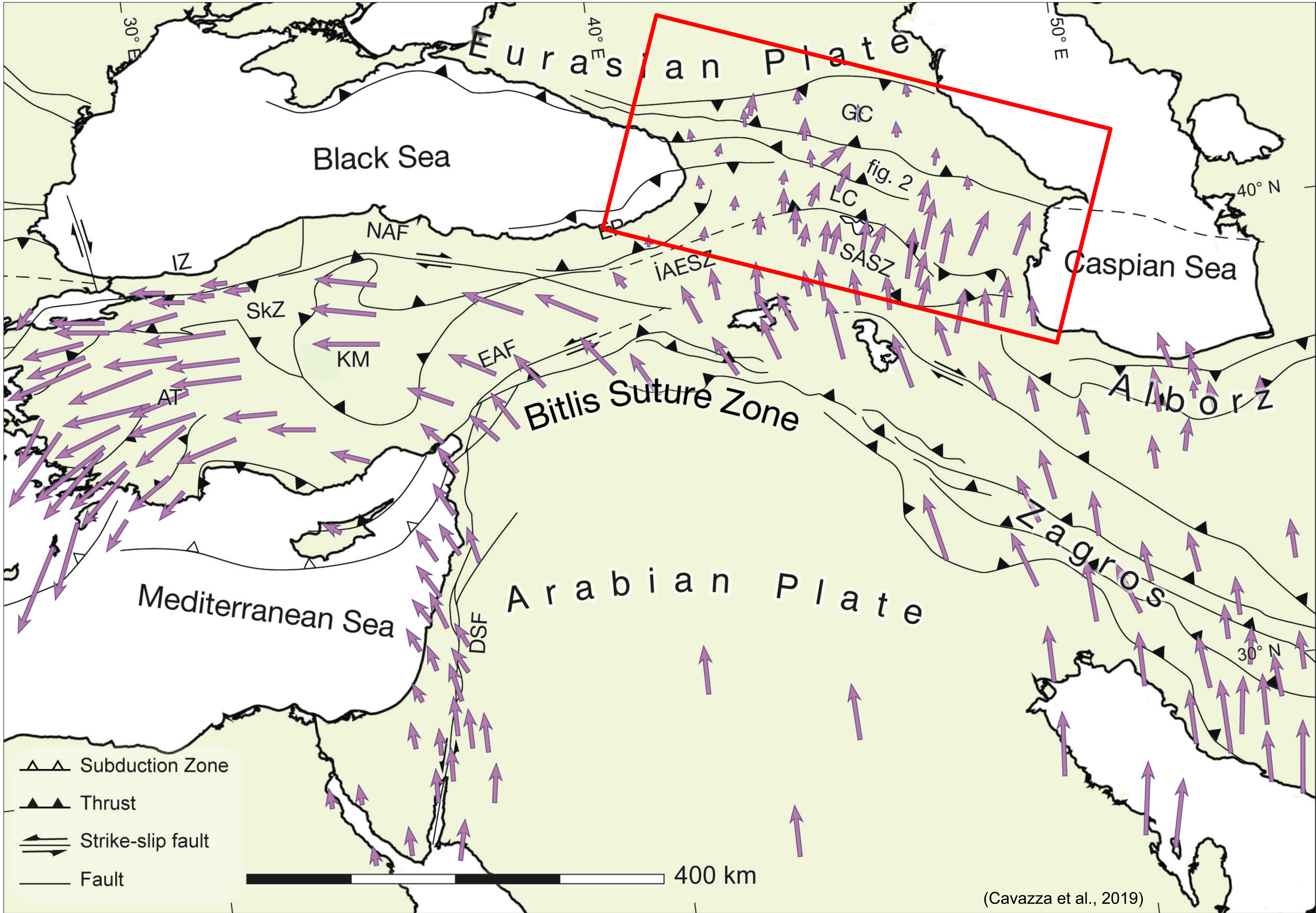
Geological Map of the Caucasus



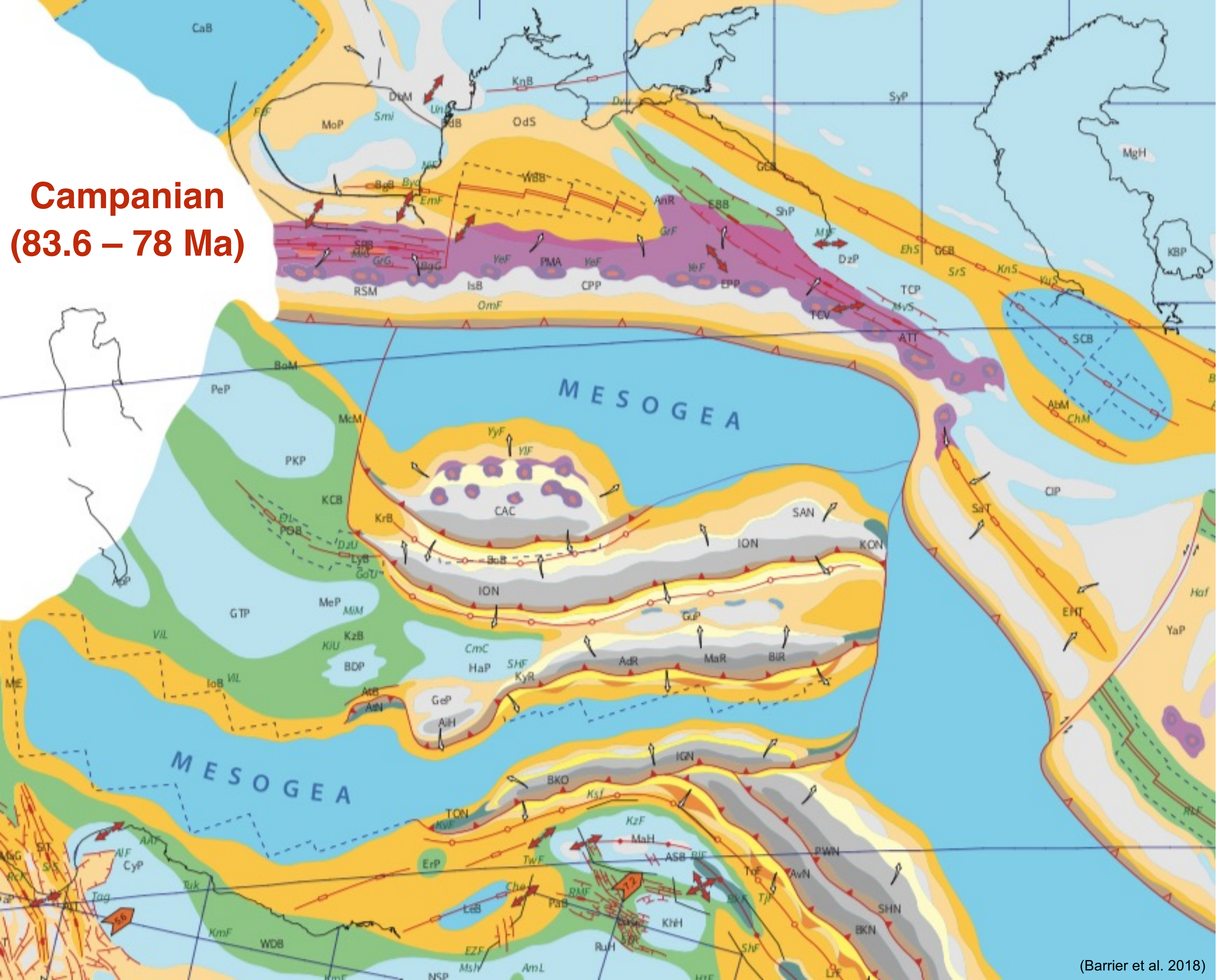
The Arabia-Eurasia mosaic is formed by continental blocks progressively accreted to the southern margin of Eurasia through Mesozoic and Cenozoic times.

GPS vectors

- About 15-20% of the strain associated to Arabia indentation is assorbed in the Caucasus region.
- Anticlockwise rotation, mirroring the movement of the Arabian Plate.
- From ~2 mm/yr of N-ward movement close to the Black Sea to ~14 mm/yr approaching the Caspian Sea.



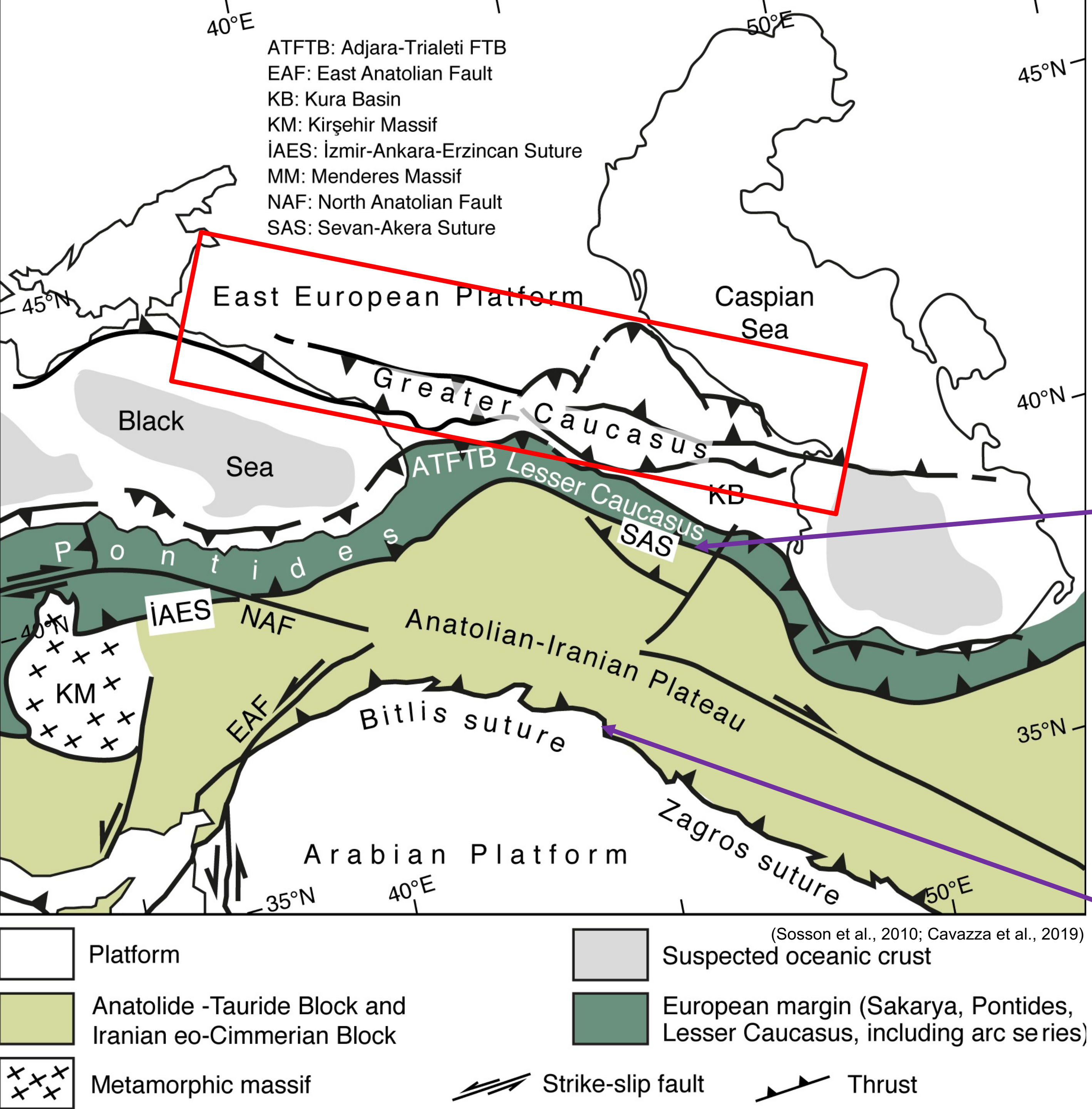
Campanian
(83.6 – 78 Ma)



(Barrier et al. 2018)

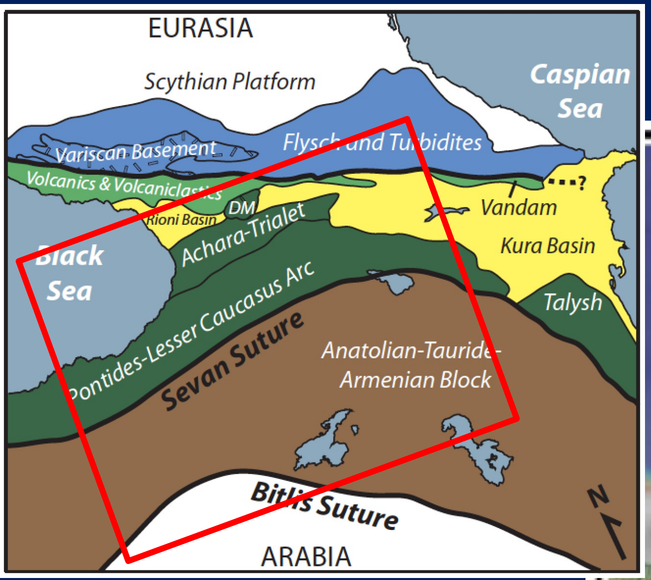
During the Late Cretaceous, the Northern and Southern branches of the Neotethys separated Eurasia in the north, the Anatolide Tauride Block in the centre and Africa to the south.

The Arabia-Eurasia collision zone

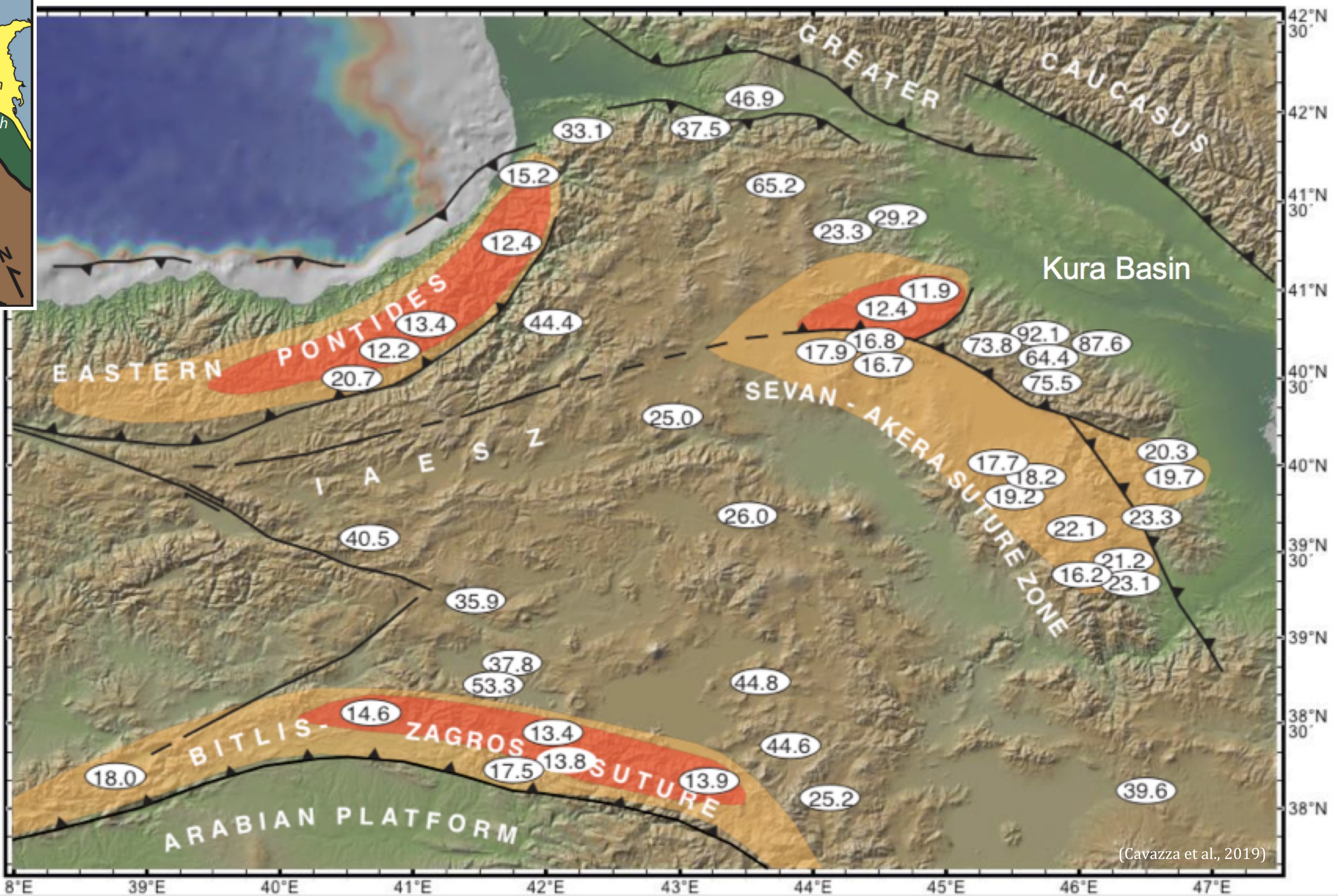


- ❖ The Northern Neotethys ocean closed diachronously during the Late Cretaceous-to-Early Paleogene, triggering continental collision between the Anatolide-Tauride Block and Eurasia and forming the Izmir-Ankara-Erzincan-Sevan-Akera suture zone.
- ❖ The Southern Neotethys ocean final closure ocurred during the Middle Miocene, bringing to the Arabia-Eurasia continental collision and forming the Bitlis-Zagros suture zone.

Areal distribution of AFT central ages

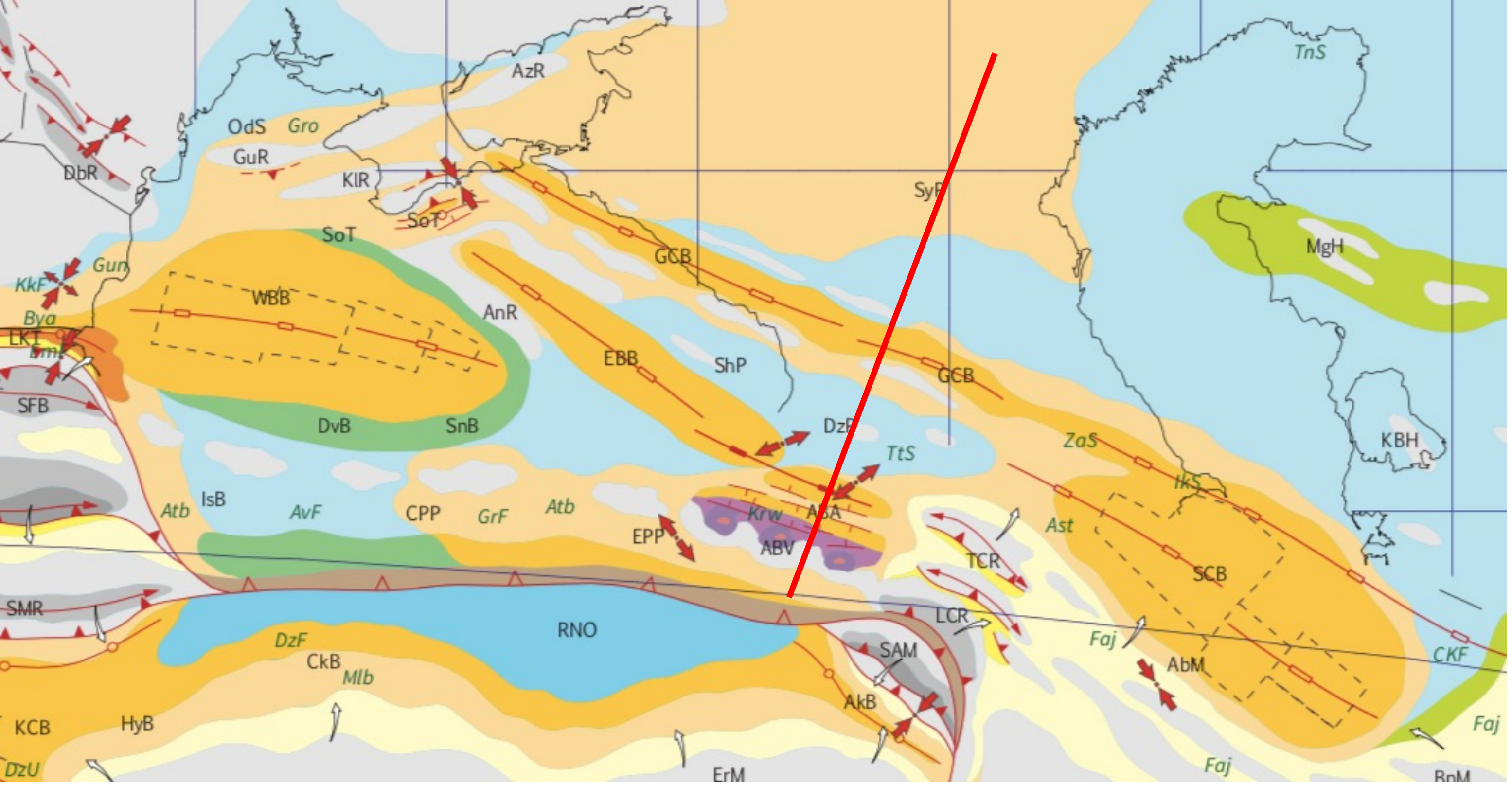


Low-T thermochronology already revealed a coeval Middle Miocene cooling/exhumation phase along the Bitlis suture and in the hinterland of theArabia-Eurasia collision zone.



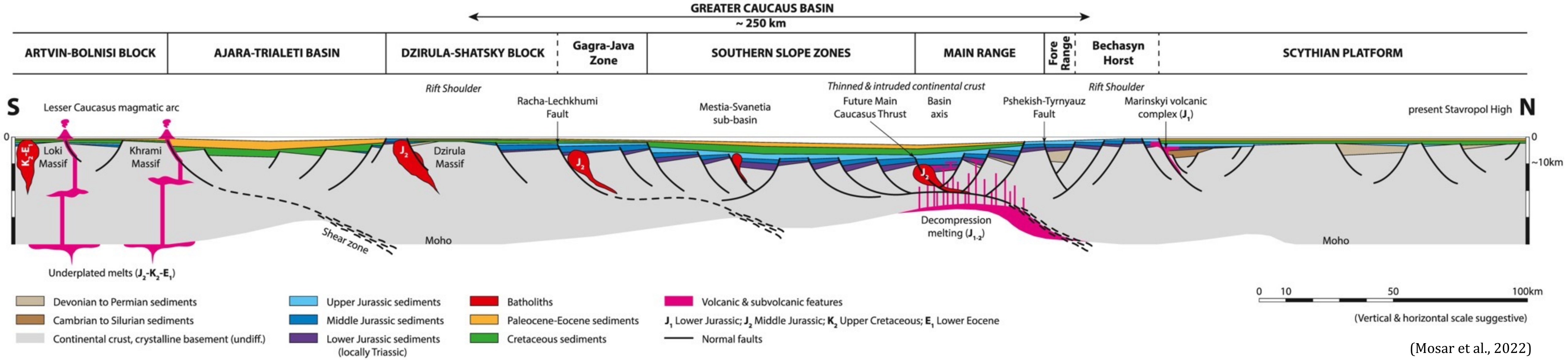
The Greater Caucasus

It is an inverted continental back-arc rift basin opened in the Early Jurassic arguably because of the roll-back of the Neotethys northward subducting slab.



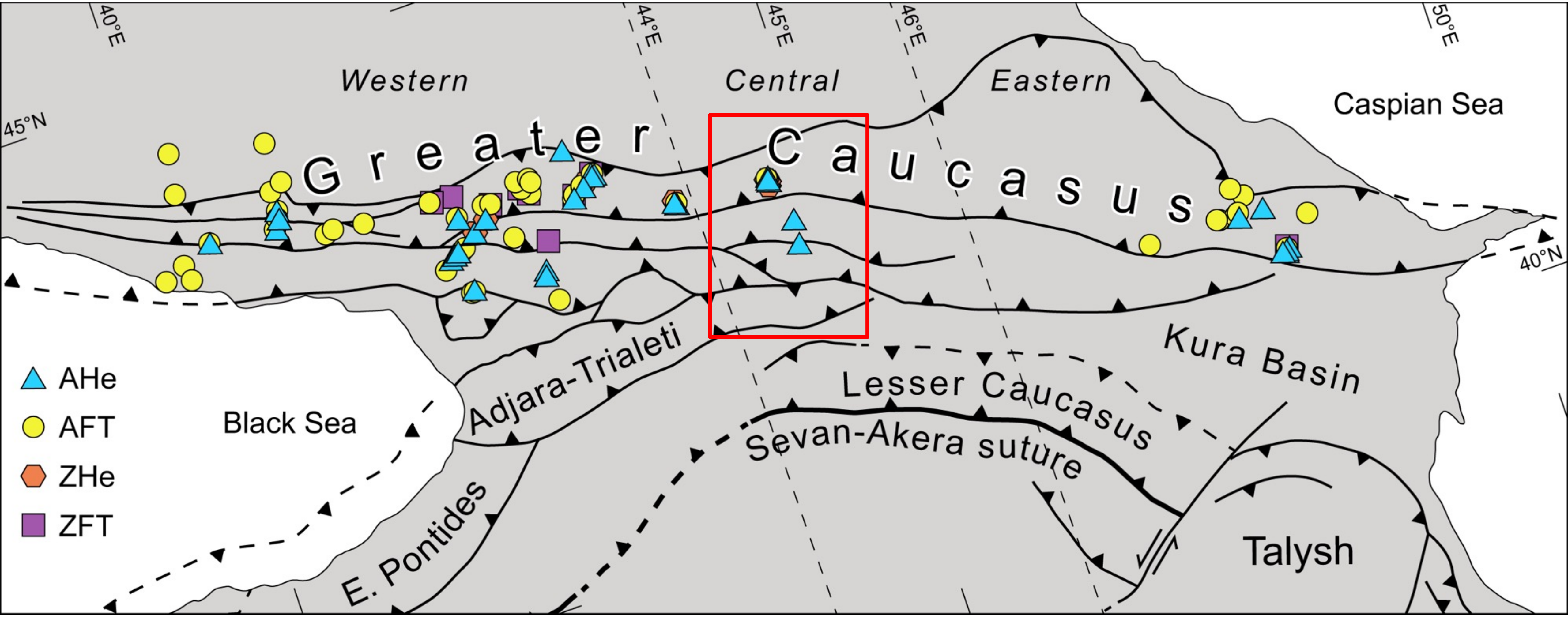
(Barrier et al., 2018)

Timing of structural inversion??



(Mosar et al., 2022)

Thermochronological data available



Data sources: Vincent et al. (2007, 2011, 2020); Avdeev & Niemi (2011); Bochud (2018); Trexler et al. (2022)

There is much debate regarding the exact timing, magnitude and mechanisms of the Greater Caucasus growth. There are very few and sparse data available for the central and eastern sectors of the Greater Caucasus! Let’s try to partially fill the gap.

Goals

Quantify the burial and exhumation history of the central Greater Caucasus along a transect in its Georgian (southern) side.

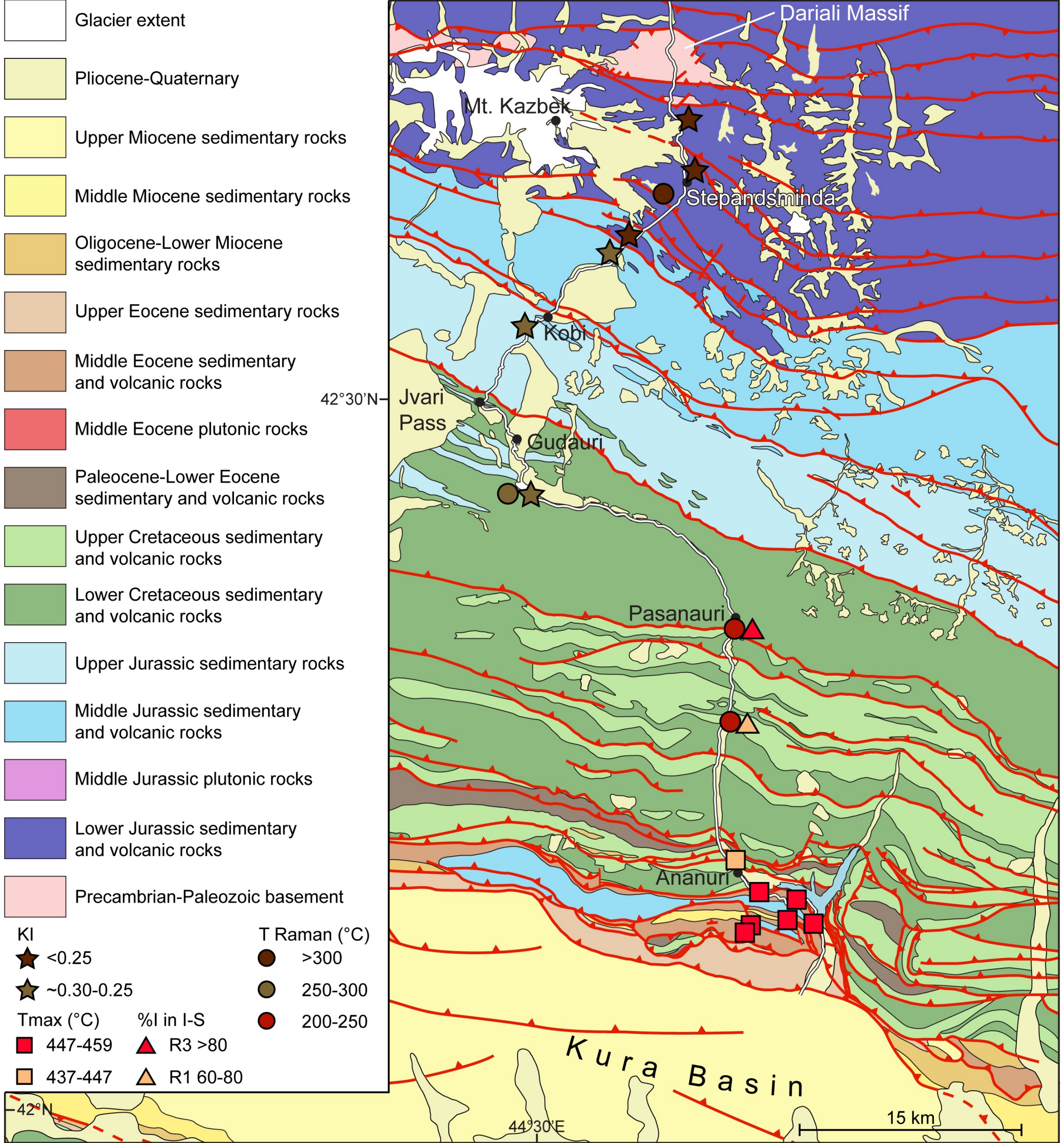
Heavily deformed Jurassic carbonatic turbidites, central Greater Caucasus.

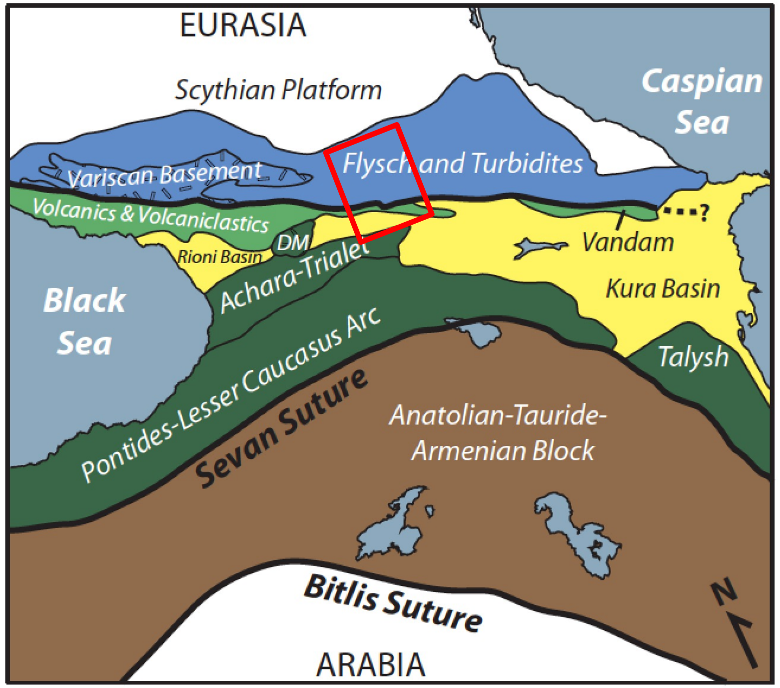
Methods

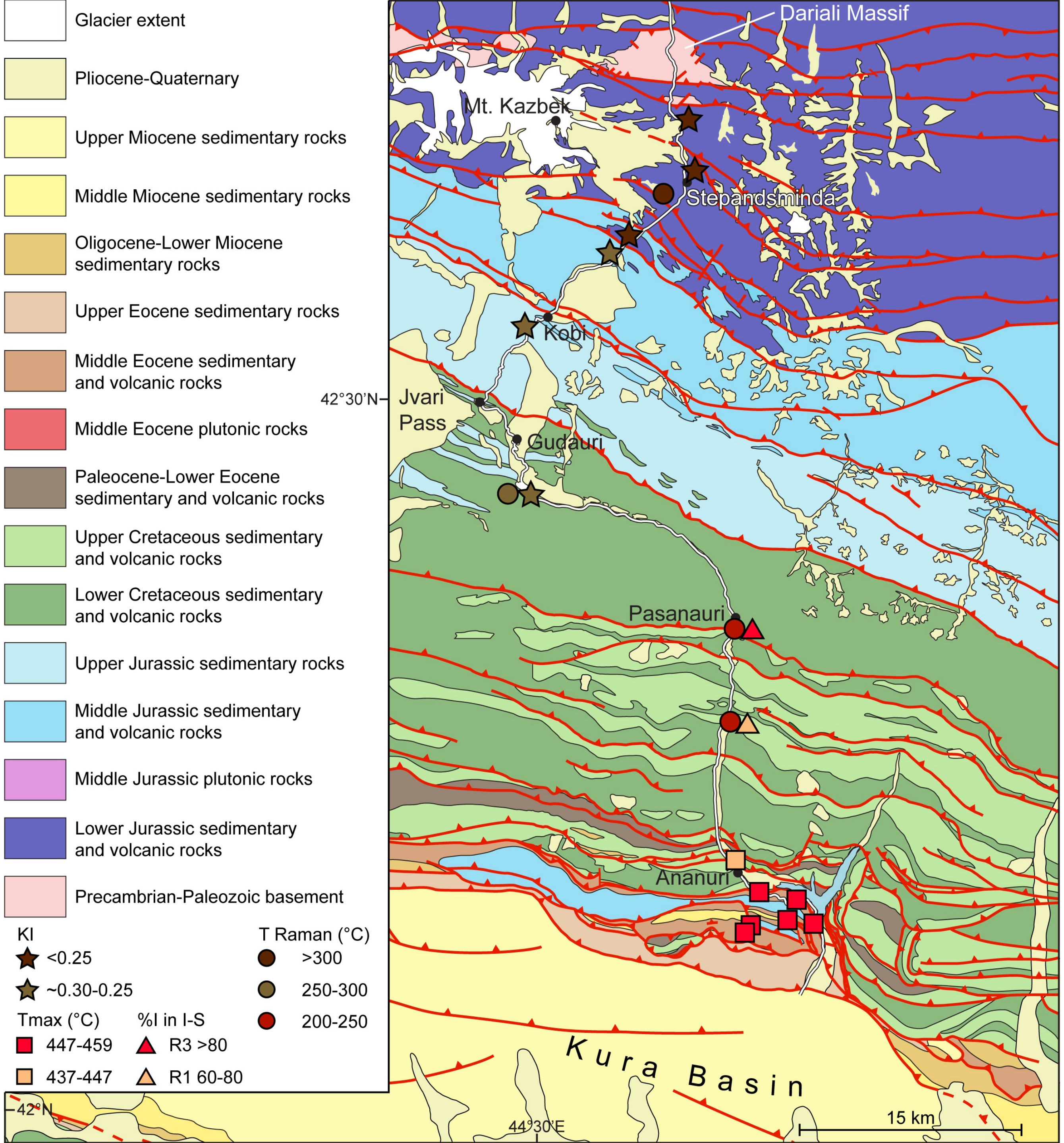
- ✓ Thermal maturity analyses on OM (VRo%, Pyrolysis, Raman) and clay minerals (KI, I% in I-S)
- ✓ Low-T thermochronology: AHe, AFT, ZHe and statistical inverse modelling

South-verging thin-skinned thrusts deforming the Kura Basin, in eastern Georgia, propagated from the Greater Caucasus.

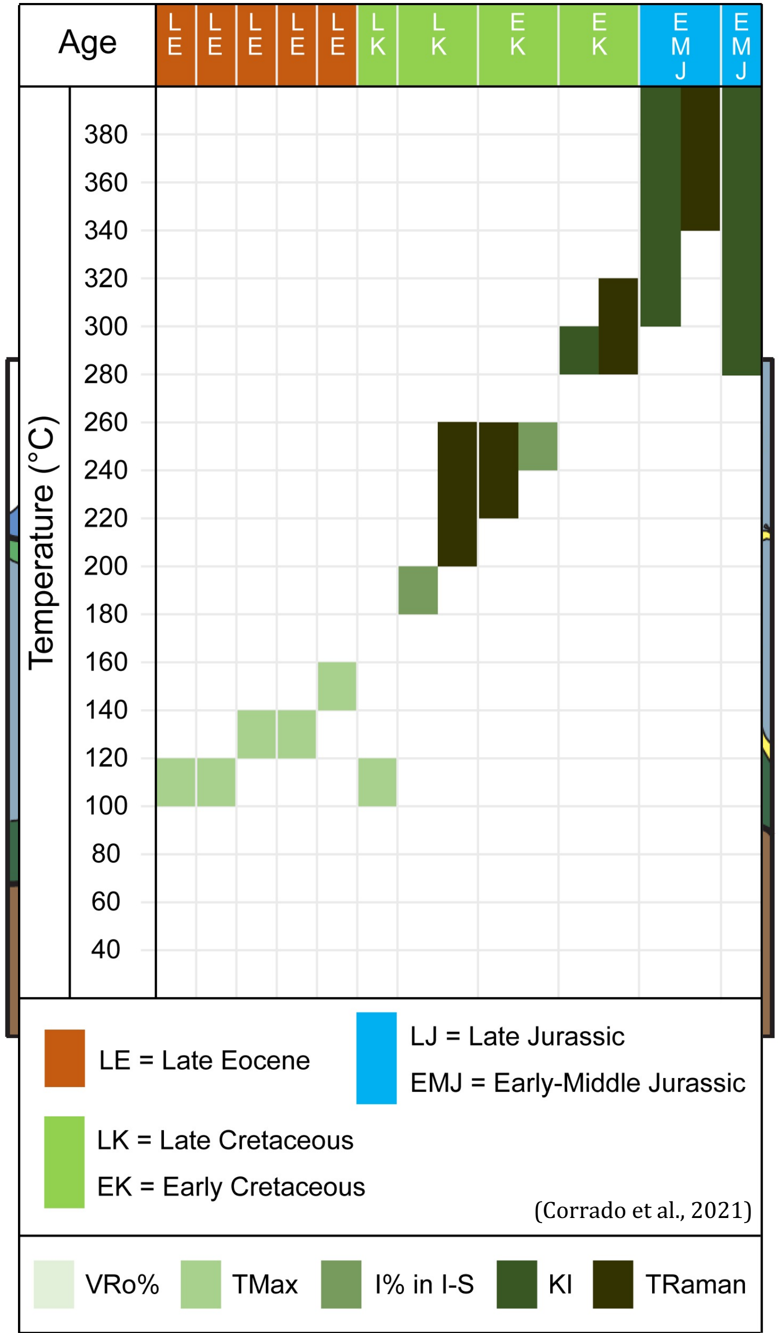
Thermal maturity results

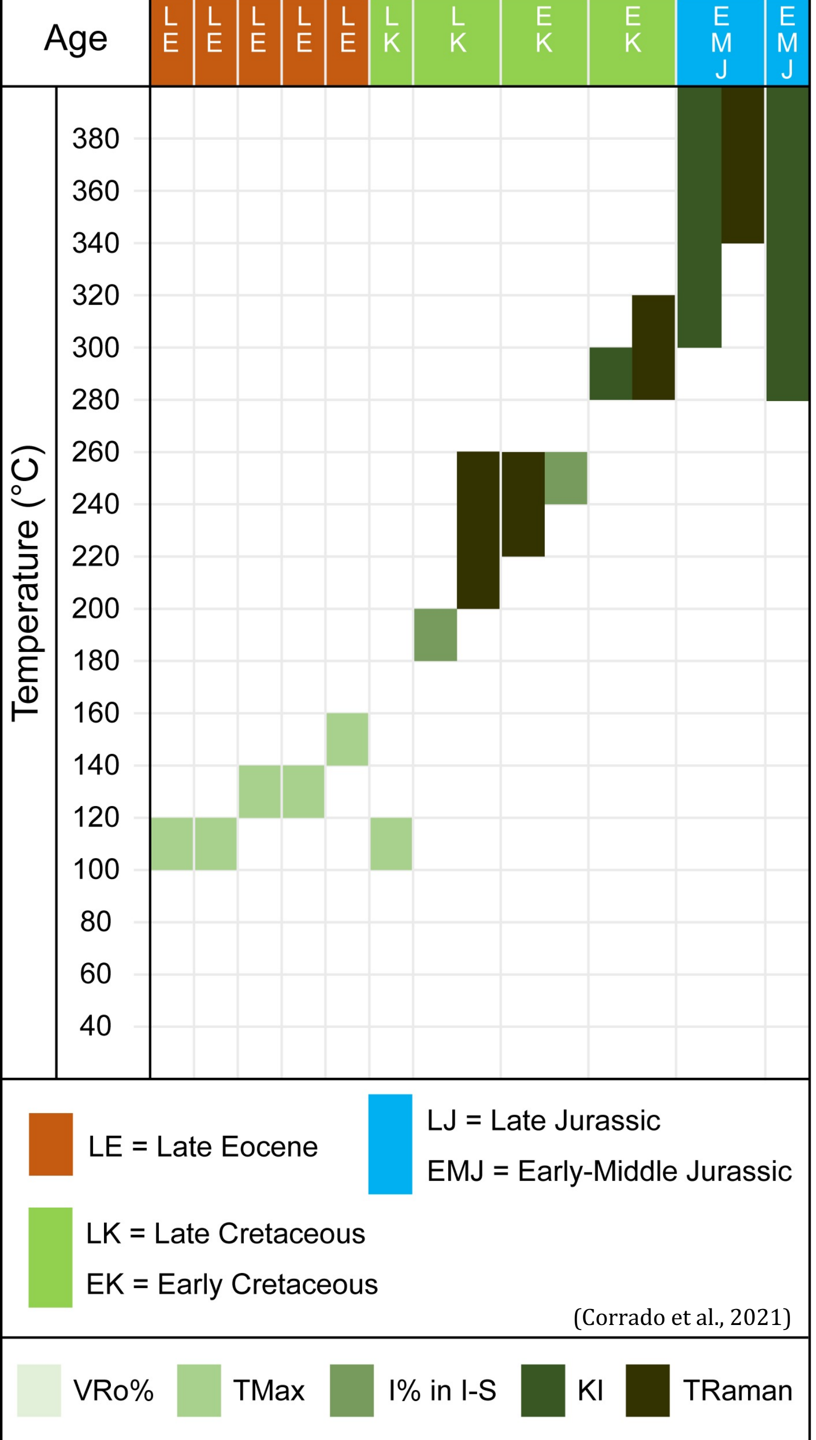






Thermal maturity results



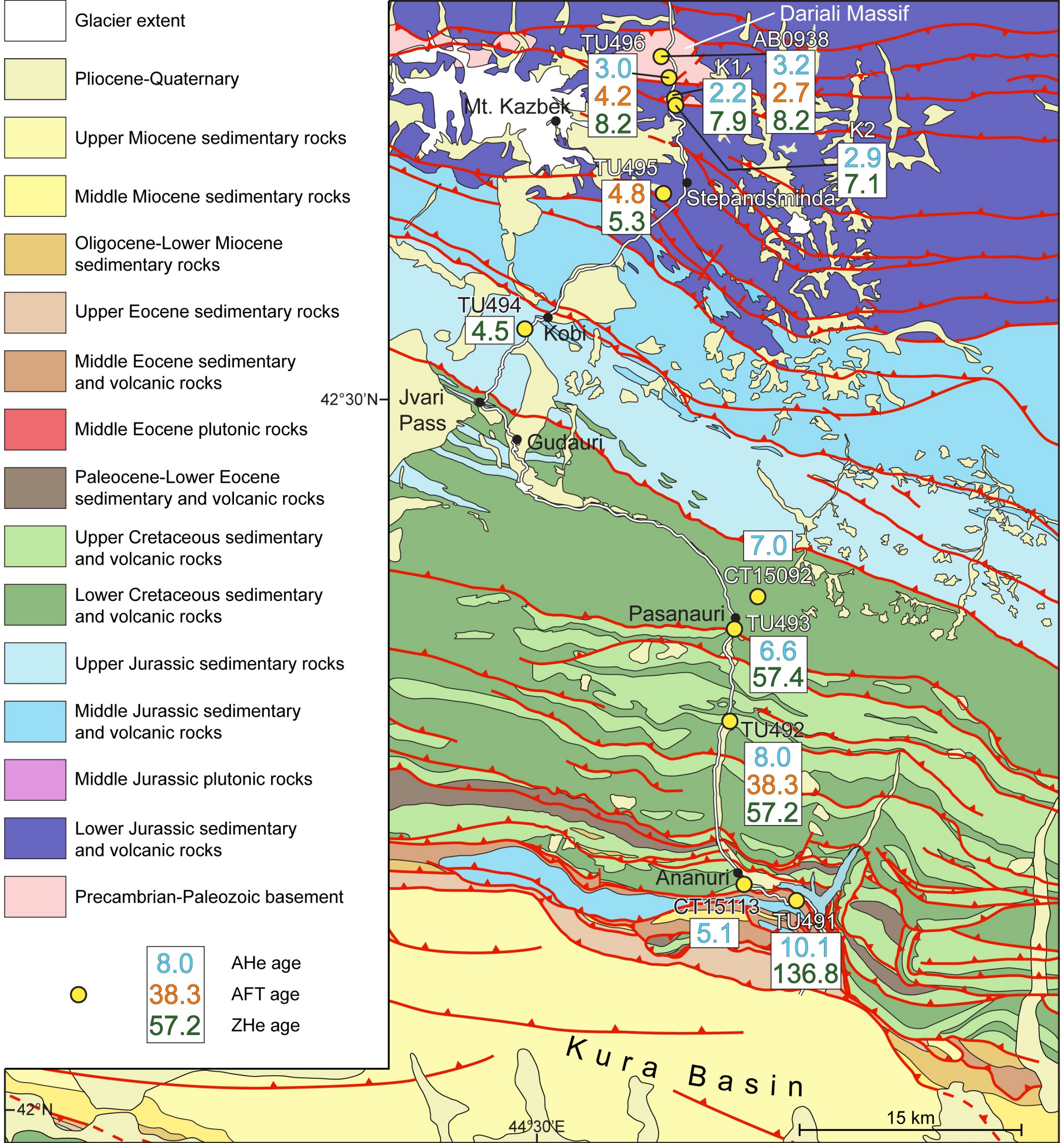


Maximum paleotemperatures estimation

- ✓ Progressive increase of the maximum paleotemperatures experienced by the sedimentary fill of the Greater Caucasus Basin from the southern foothills to the axial zone, and from younger to older stratigraphic units.
- ✓ Slightly more than 100 °C in the southern foothills, up to close to 400 °C in the axial zone.
- ✓ Paleotemperature esitmates in agrement with the estimates on the thickness of the sedimentary fill of the basin, except for the southern foothills where an additional tectonic load needs to be hypothesised to explain the obtained temperatures.

Thermochronology results

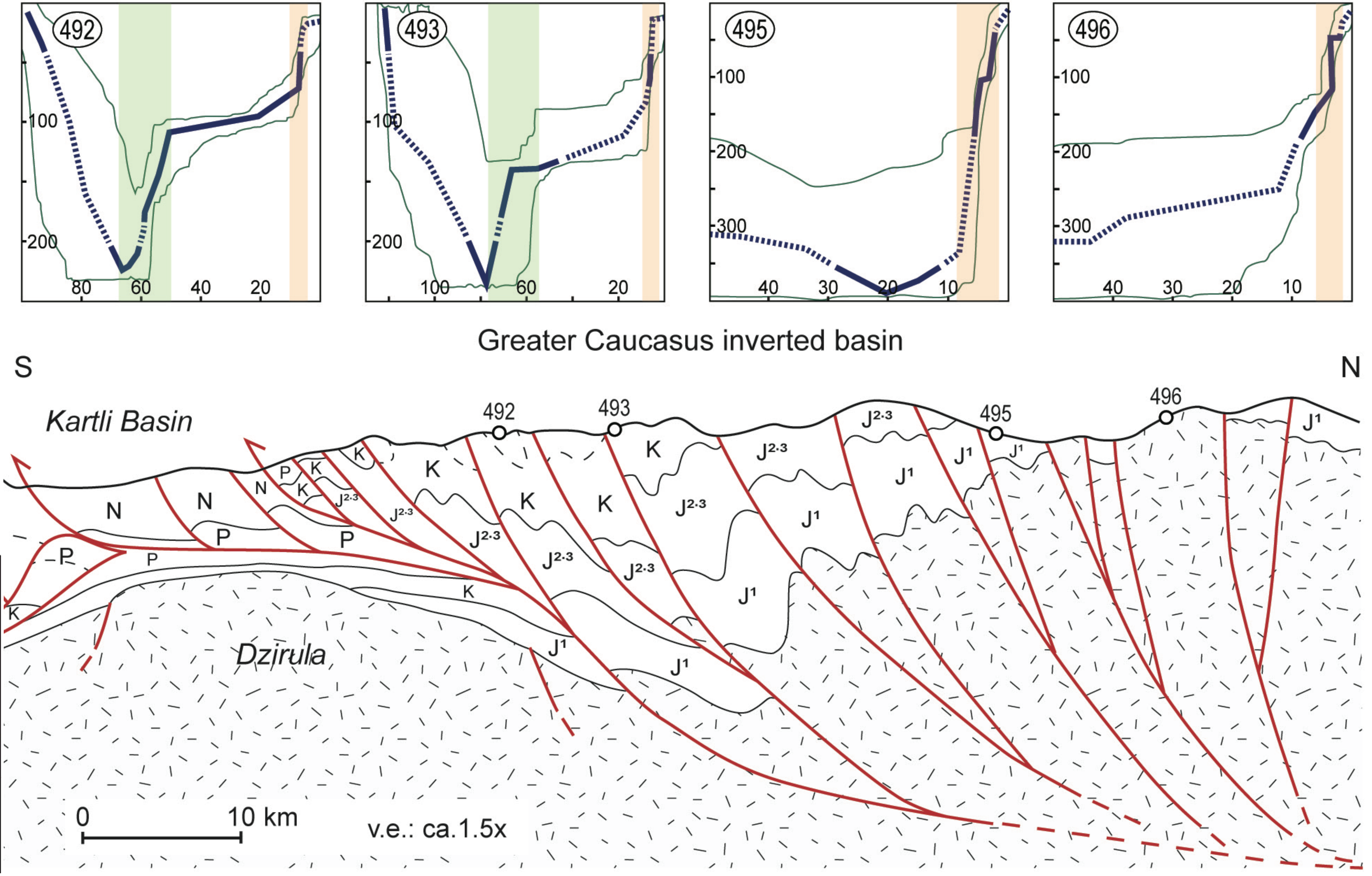
- Consistently young AHe, AFT and ZHe ages in the axial zone, all < 10 Ma.
- AHe ages stay young all along the transect, whereas AFT and ZHe ages increase progressively towards the south.
- Thermal maturity data indicate that AFT and ZHe systems are totally reset, except for the southernmost sample (TU491).

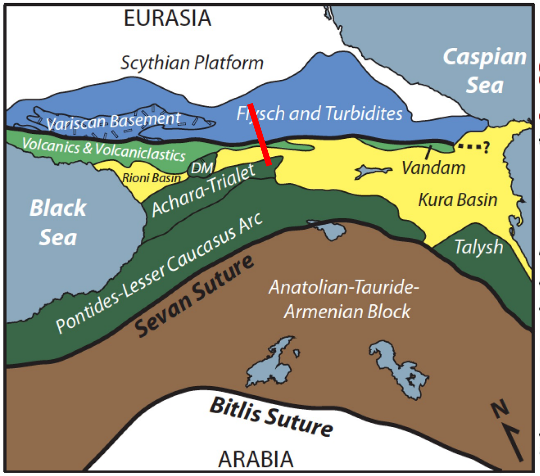


Statistical inverse modelling results

Two cooling/exhumation phases:

- Late Cretaceous-Early Paleogene
- late Middle Miocene-Pliocene





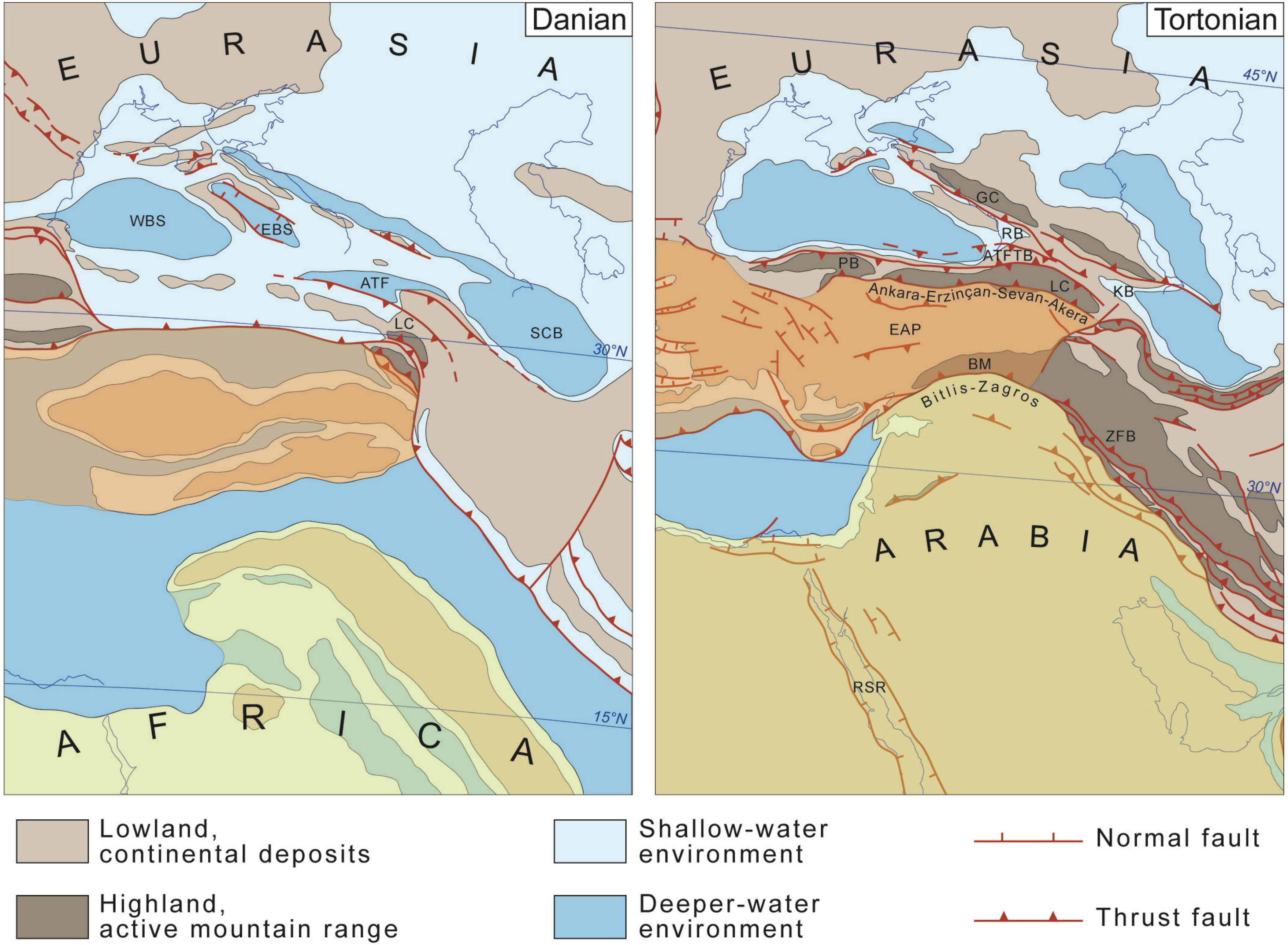
Statistical inverse modelling results

Statistical inverse modelling results (which integrate all the thermochronological, thermal maturity, geological and geochronological data available) reveal two phases of rapid cooling/exhumation in the two Cretaceous samples from the centra-southern portion of the analysed transect, and only the youngest phase in the two samples from the northern portion (axial zone of the orogen).

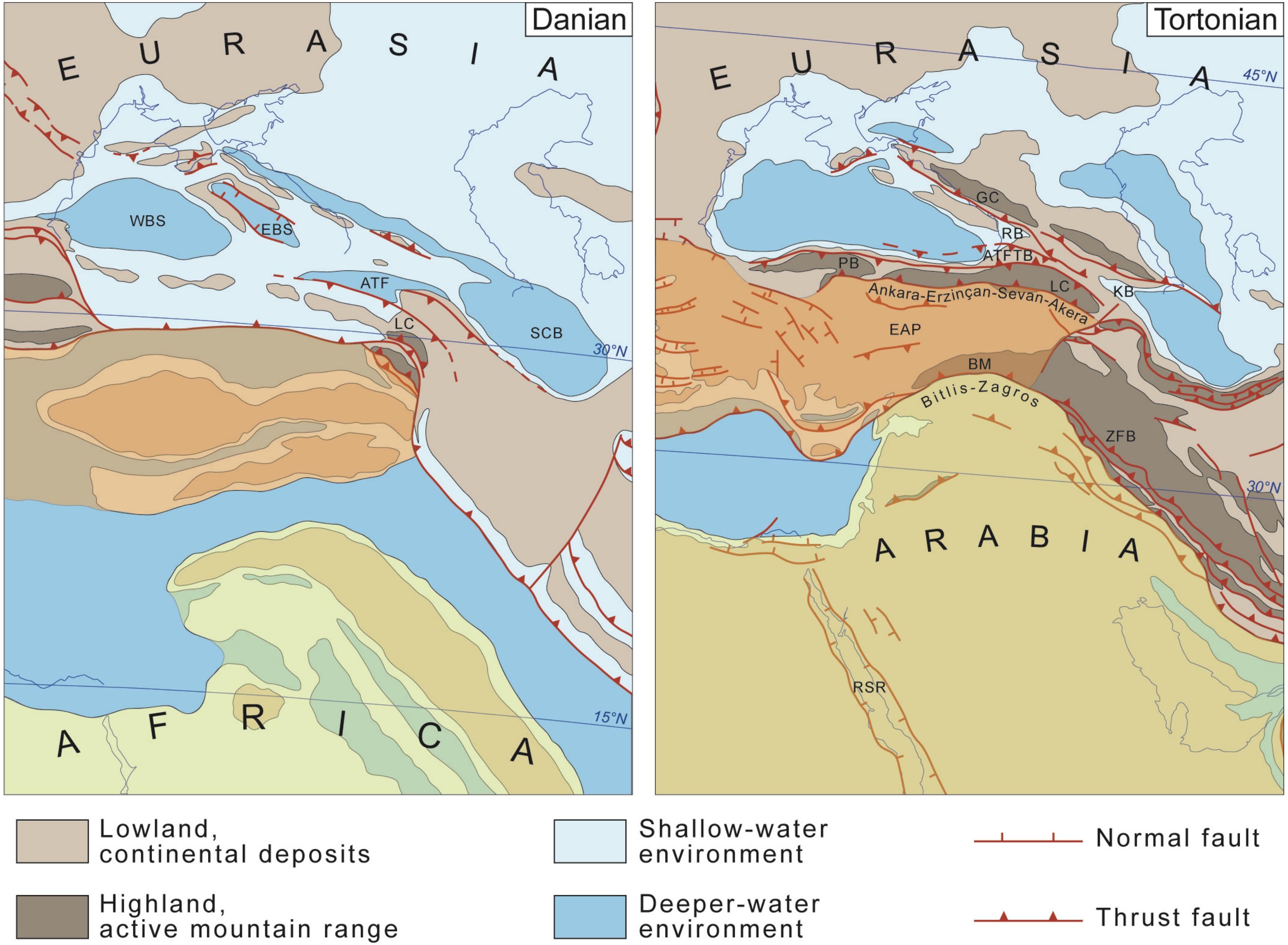
The first one occurred during Late Cretaceous-Paleocene times, hence during the continental collision between the Anatolide-Tauride Block and the southern Eurasian margin along the Sevan Akera suture.

The second one occurred since the late Middle Miocene (starting at ~10 Ma), hence soon after the Arabia-Eurasia continental collision along the Bitlis suture.

Most likely, the older cooling/exhumation phase is not recorded in the two northern samples because of the higher amount of uplift experienced: thermochronometers with higher closure temperatures would be needed to detect it.



Hence, the Late Cretaceous-Paleocene cooling/exhumation phase can be seen as a result of the partial inversion of the Greater Caucasus basin triggered by the Sevan-Akera continental collision.



The late Middle Miocene-Pliocene cooling/exhumation phase marks the inception of the complete structural inversion of the basin and of the growth of the Greater Caucasus, arguably in response to far-field stress transmission from the the Arabia-Eurasia continental collision along the Bitlis suture.

Conclusions

Along the studied transect, the Greater Caucasus:

- basin fill experienced maximum burial temperatures progressively increasing from >100°C in the southern foothills to ~380°C in the axial zone;
- was partially inverted during Late Cretaceous-Paleogene times following the Sevan-Akera continental collision;
- has been fully inverted since the late Middle Miocene following the Arabia-Eurasia continental collision along the Bitlis suture.

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

This presentation participates in OSPP

Outstanding Student Poster & PICO Contest

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Thank you for the attention!

South-verging thrusts within the Kartli Basin, propagated from the Greater Caucasus, Georgia.

For any question or comment, please feel free to contact me:

thomas.gusmeo2@unibo.it

www.unibo.it