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Late Cretaceous to recent tectonic evolution of the Ulukisla Basin (Southern Central Anatolia)

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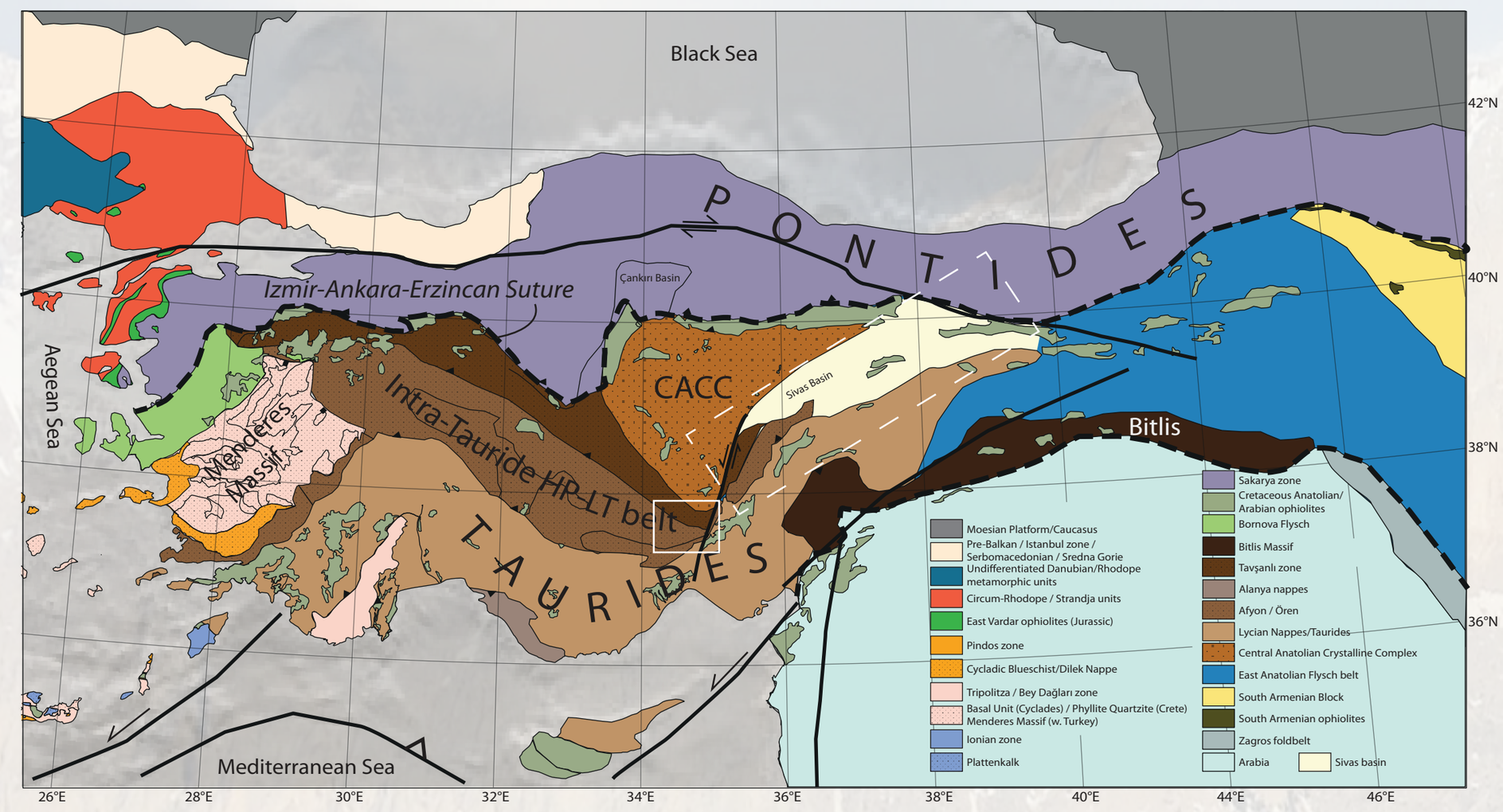
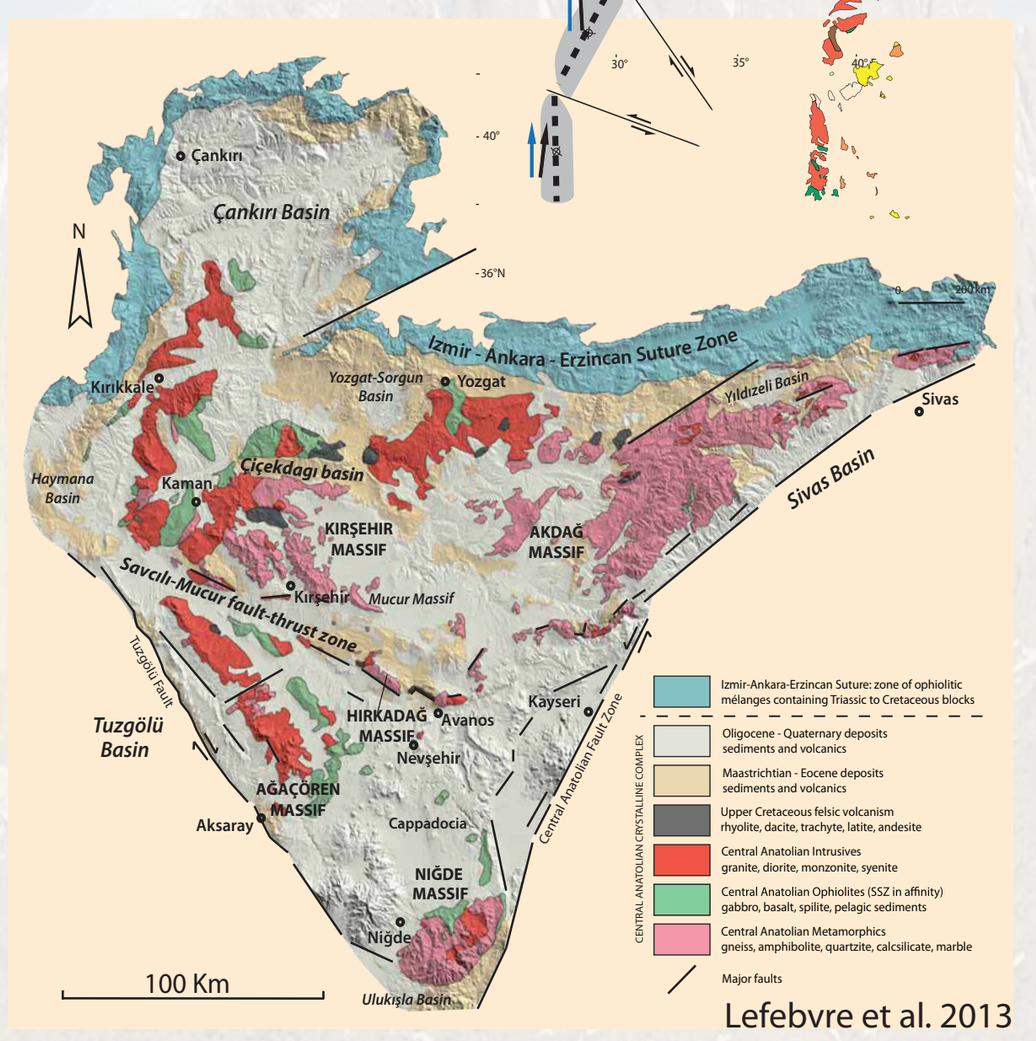
1. Outline and Motivation



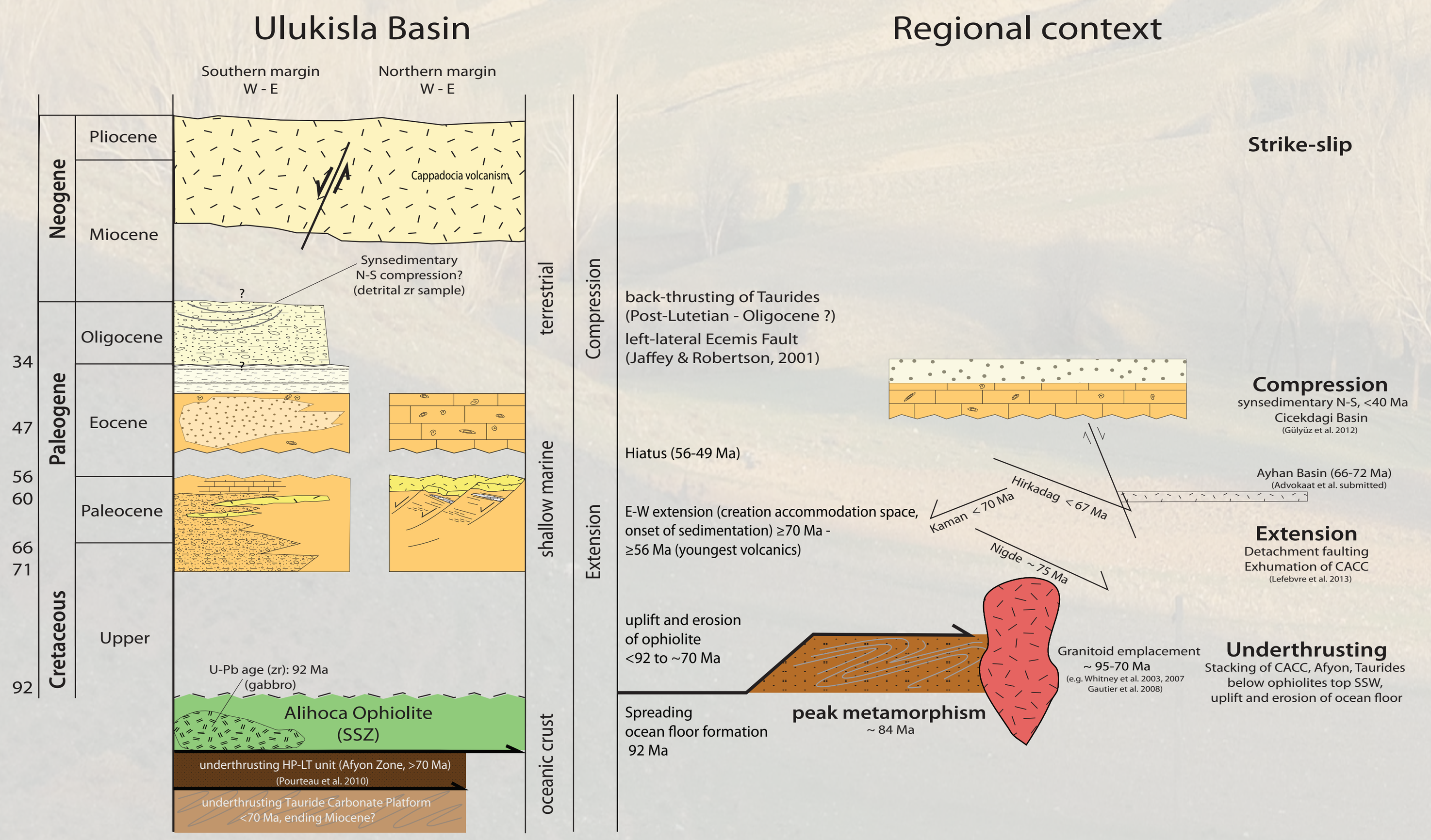


Lefebvre et al. 2013

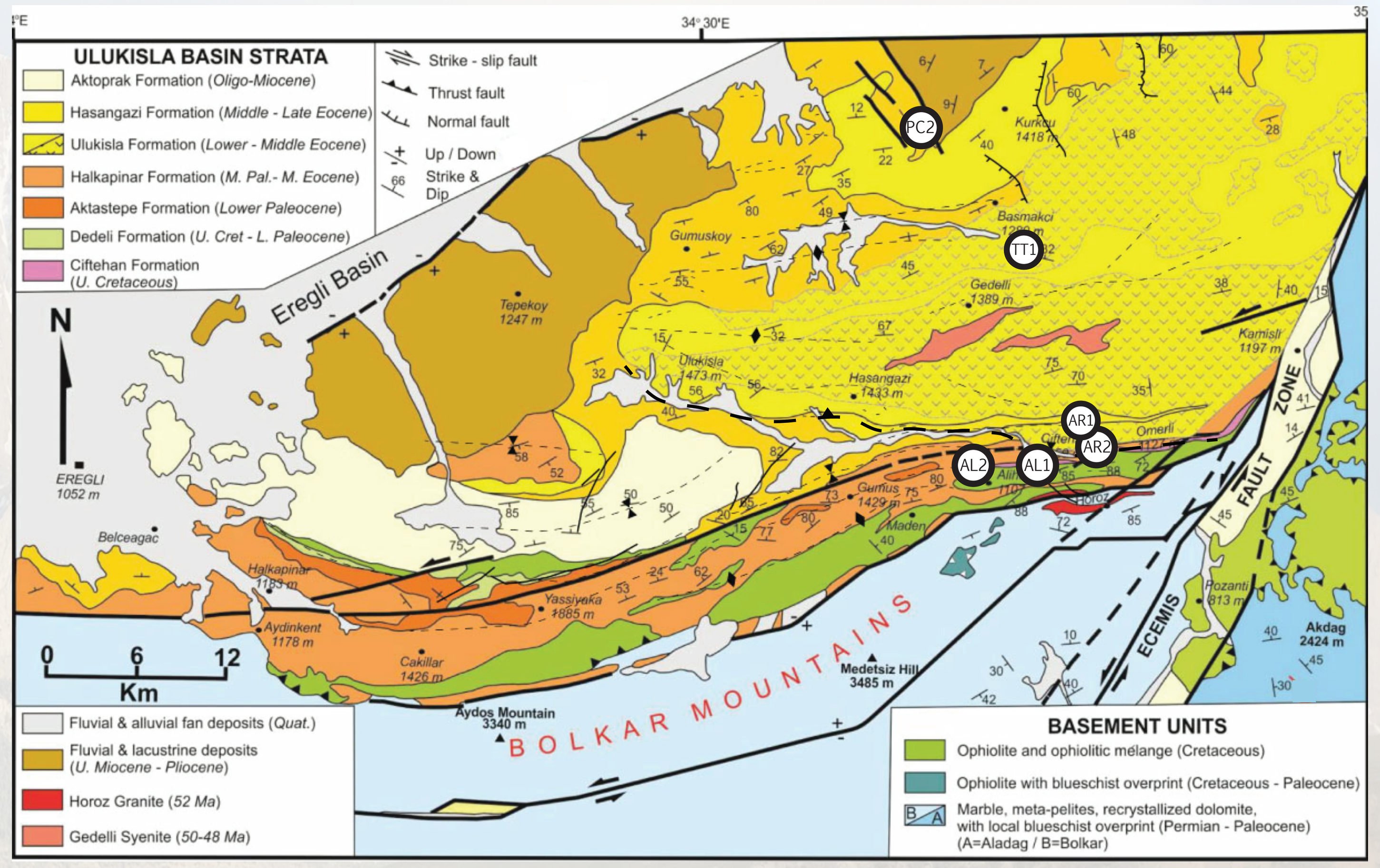
Around 90 Ma ago the geology of Turkey exhibited (arguably at least) two subduction zones: one dipping below the Pontides in the North, and one dipping below oceanic lithosphere, now found as ophiolites, to the south of the Pontides. Subsequent subduction led to the accretion of (parts of) the following terranes (from N-S and old to young): the Central Anatolian Crystalline complex (85 Ma); the HP-LT Tavsanli and Afyon belts (until 70-65 Ma); and the essentially non-metamorphic Tauride fold and thrust belt (Paleocene-Eocene). In Central Turkey, continental rocks arrived earliest in the subduction zone below the ophiolites and now form the Central Anatolian Crystalline Complex (CACC) which exhumed along Late Cretaceous extensional detachments. To the east, the continental passive margin was farther to the south and there is no evidence that continental rocks arrived in the southern subduction zone before the Late Cretaceous (70-65 Ma).

Overlying these accretionary wedges and ophiolites are sedimentary basins, which form a geological archive of the subduction history of the region. One of these basins is the Upper Cretaceous to Lower Cenozoic Ulukisla basin, which is straddling and sandwiched between the CACC in the north and the Taurides in the south. We study its stratigraphy and structure to restore the tectonic evolution of ocean floor spreading, CACC underthrusting, exhumation, and uplift.

2. Tectonostratigraphy


Ulukisla Basin
Regional context
Southern margin W - E
Northern margin W - E
Pliocene
Miocene
Oligocene
Eocene
Paleocene
Upper
Neogene
Paleogene
Cretaceous
Strike-slip
Compression
Extension
Underthrusting
peak metamorphism
Alihoca Ophiolite (SSZ)

3. Structural mapping



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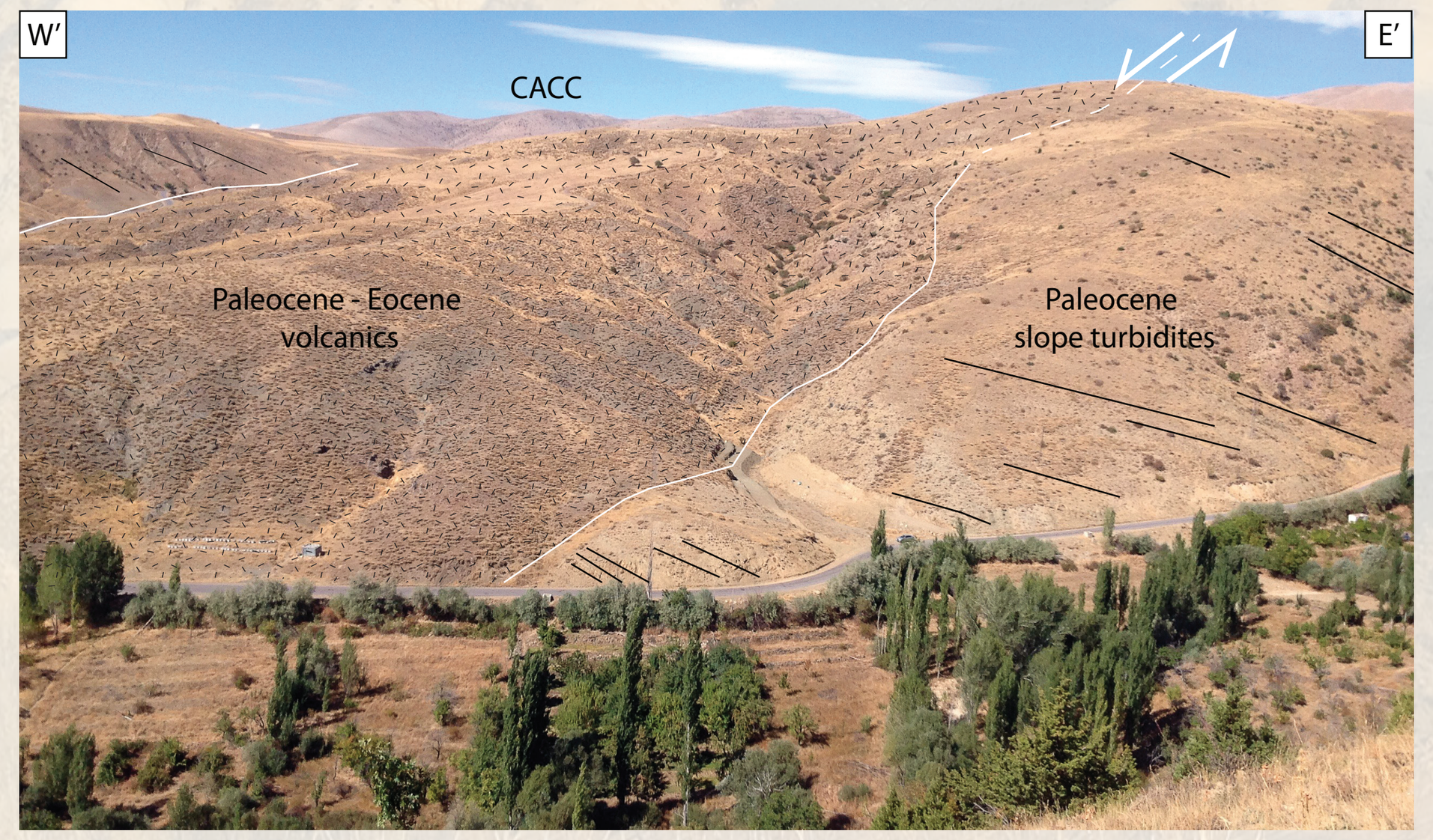
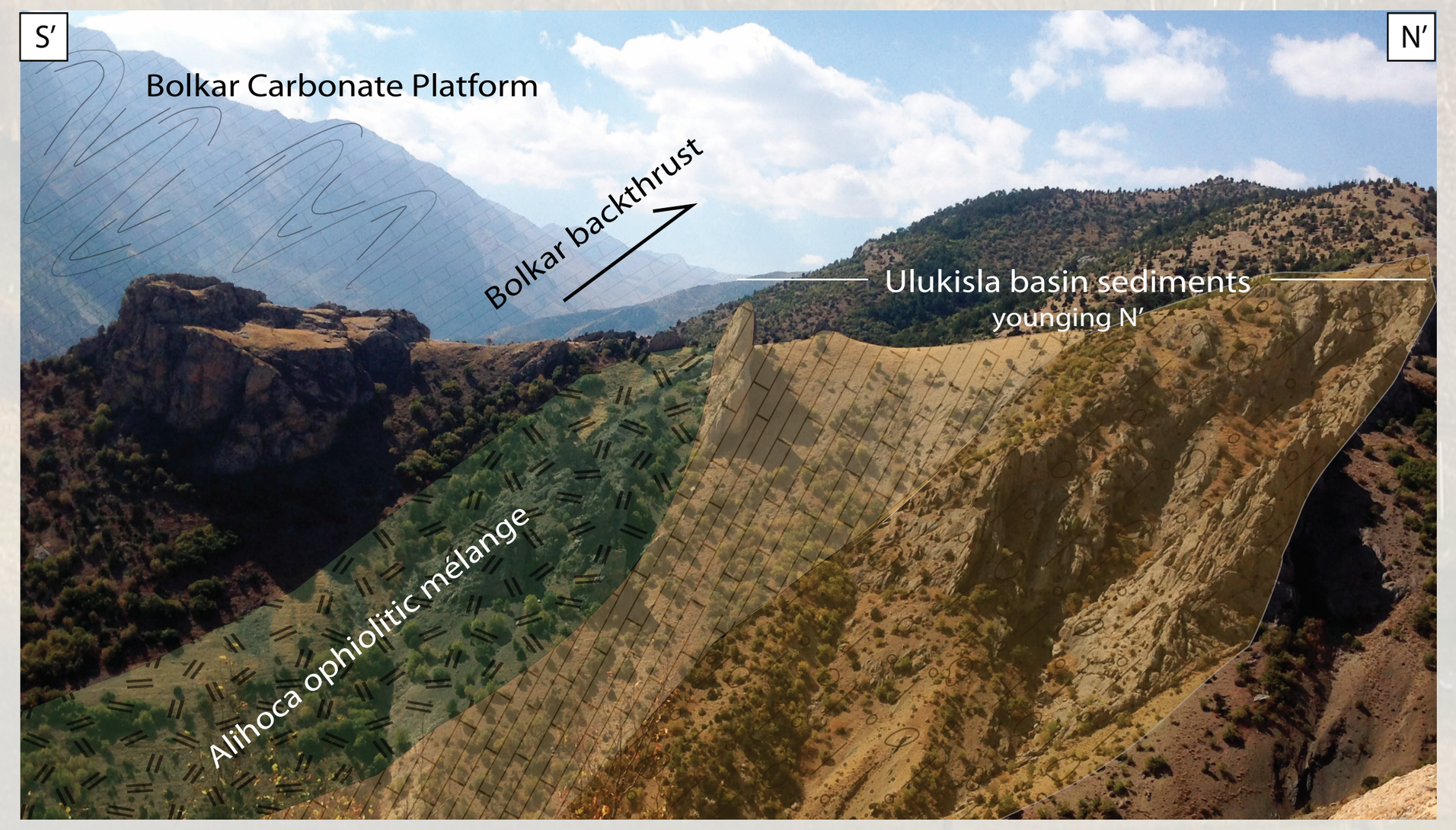
4. Field relations



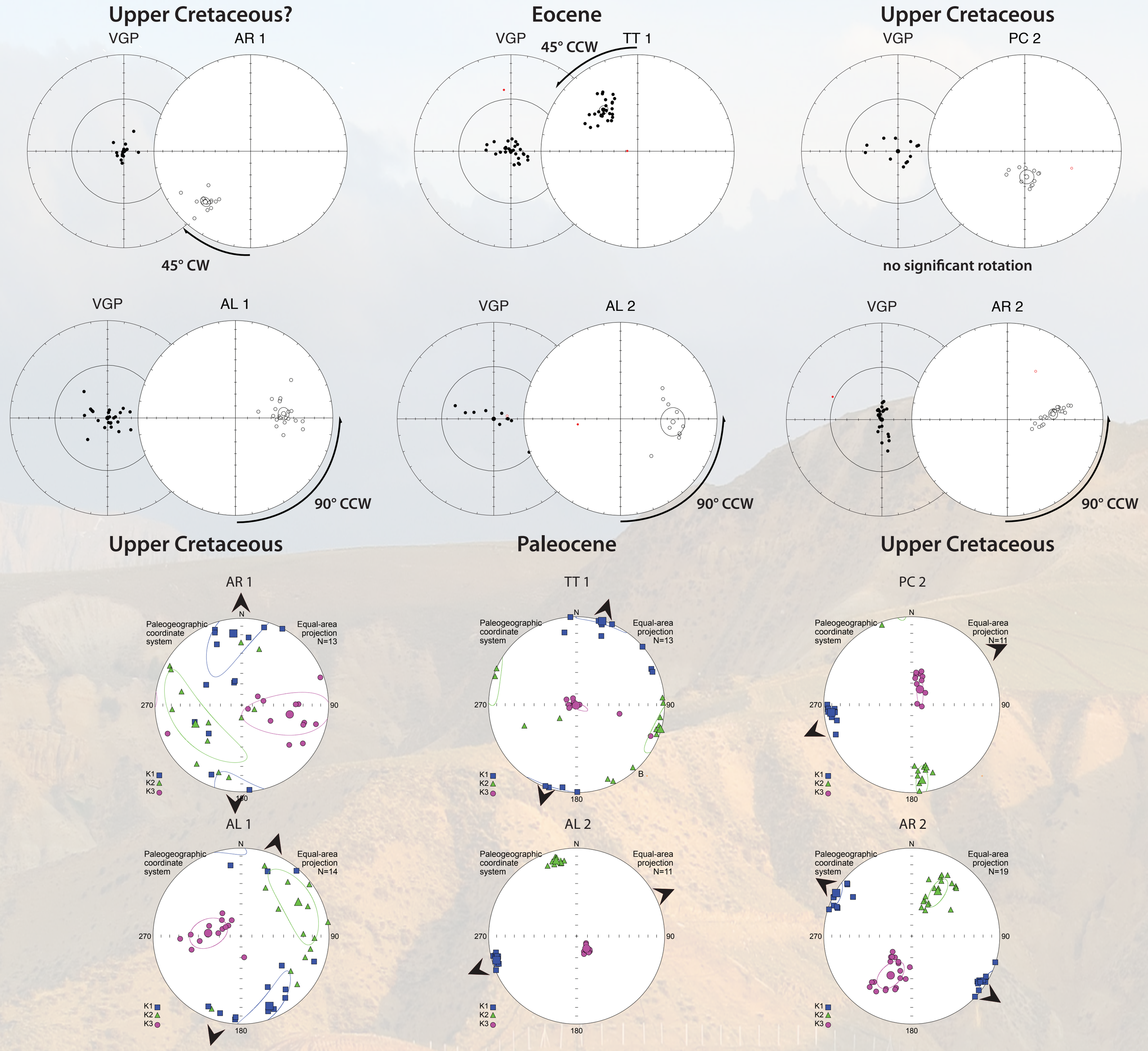
Field photographs of the northern basin margin, south of the contact with the CACC and the southern basin margin close to the Bolkar carbonate platform (Taurides).



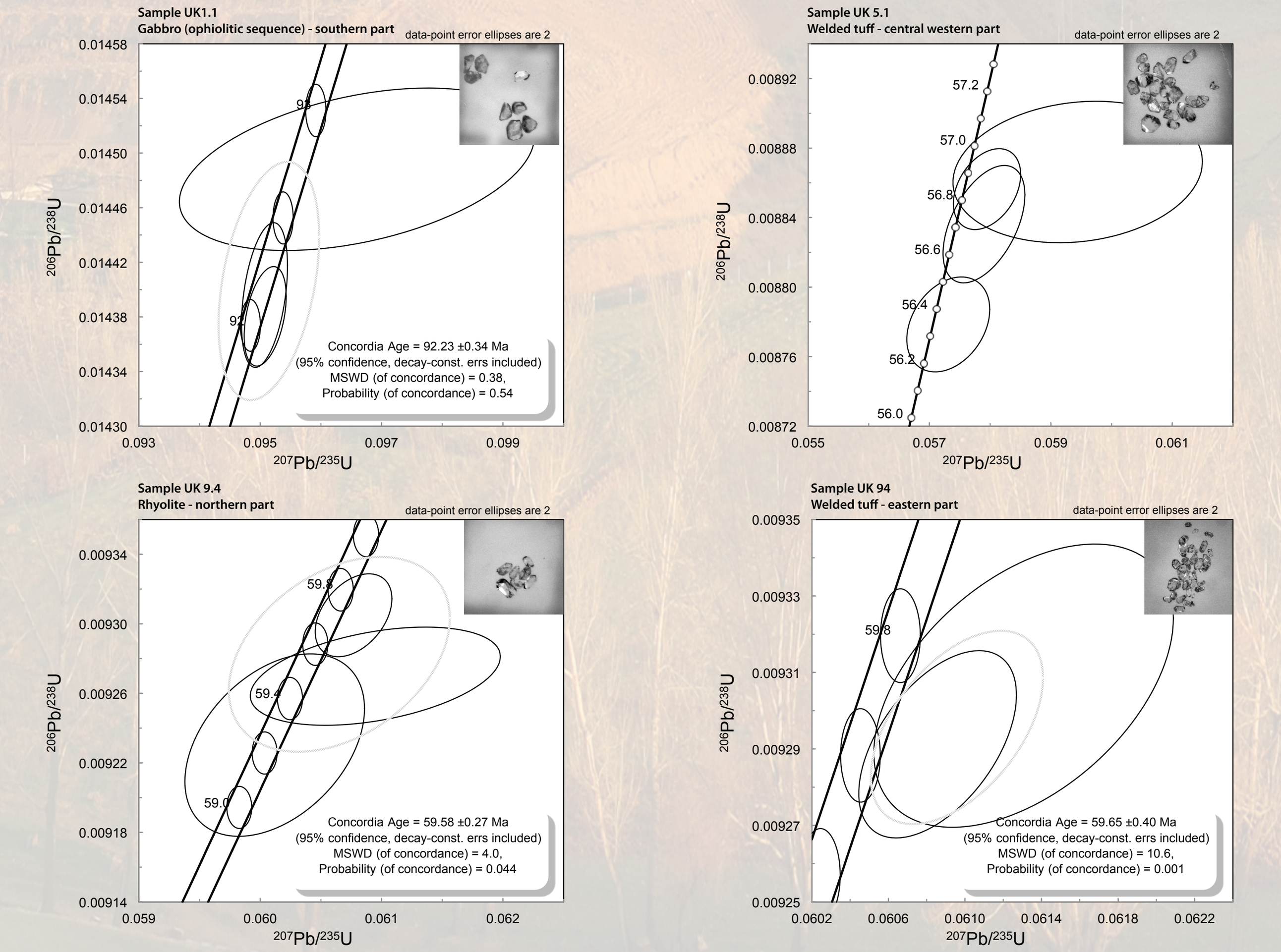
At the **northern margin** of the basin, a series of west-verging normal faults cuts the east-dipping sediments of Paleocene age. Locally, synsedimentary structures were observed. The fault blocks consist of tilted sediments and overlying volcanics of Paleocene to Eocene age. The fault surfaces are locally intruded by mafic dykes. From east to west, a progressive fining in the sediments from slope turbidites to deeper marine turbidites has been observed. The present day orientation of the faults suggests that sediments were deposited in an E-W extensional regime. The observed extension direction regionally fits with the extension observed in the CACC and overlying basins towards the north.

At its **southern margin**, the basin is truncated by a back-thrust (probably coeval with the deposition of the Aktoprak syncline) placing the Bolkar carbonate platform (Taurides) and overlying HP metamorphics above the vertical to overturned basal sediments of the Ulukisla Basin. These consist of a basal conglomerate reworking Bolkar-derived limestones and ophiolite debris, followed by limestones intercalating with volcaniclastics. The strata are deformed into an overturned footwall syncline that gradually passes into a monoclinal succession of slope turbidites, locally intercalating with nummulitic limestones and mafic volcanics.

5. Paleomagnetic data



6. ID-TIMS U-Pb ages



7. Conclusions & Outlook

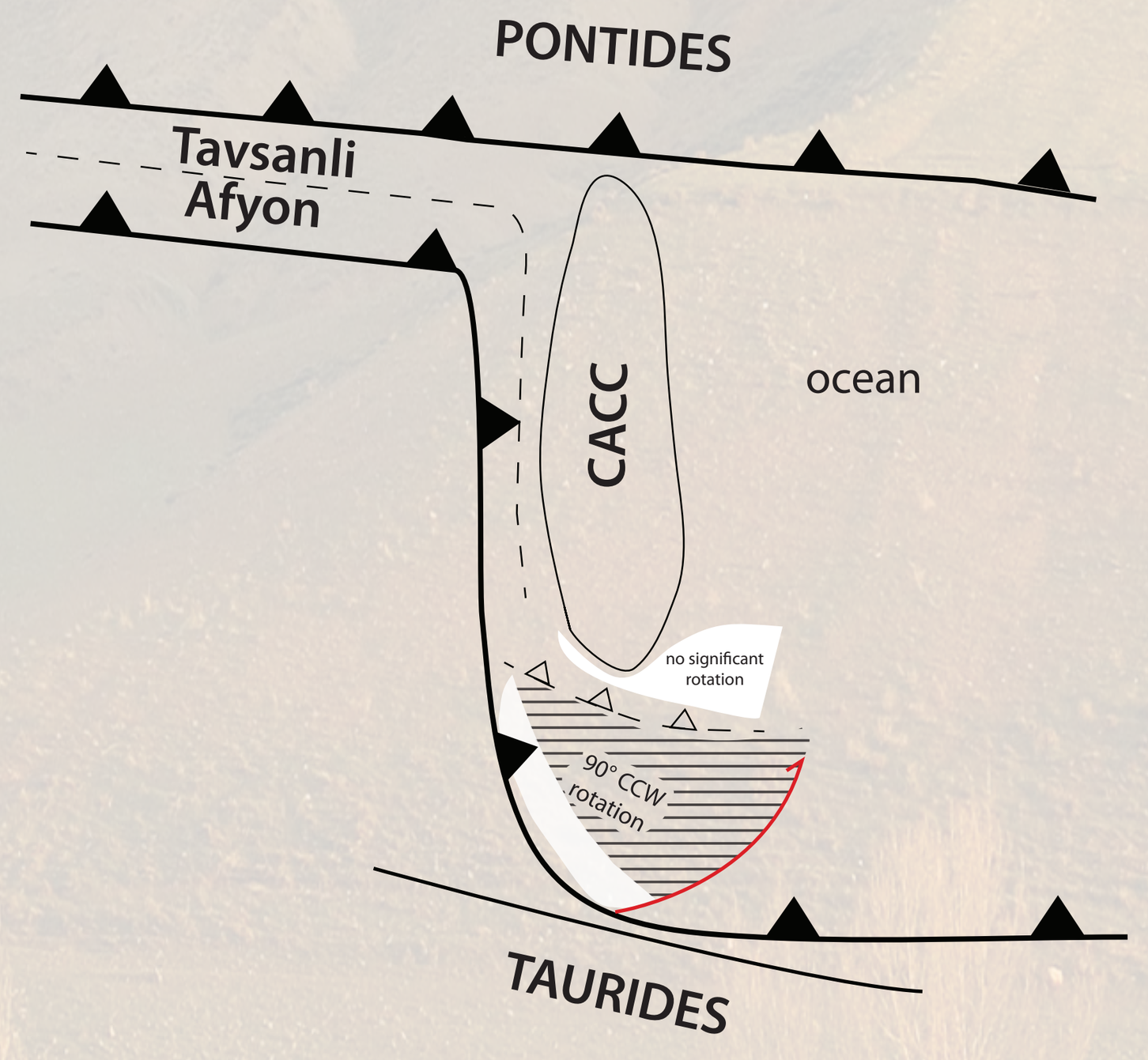
The supra-subduction zone ophiolite underlying the Ulukisla Basin is Late Cretaceous in age (92.23± 0.34 Ma), dating the time of ocean floor formation above a subduction zone. The oldest sediments now found on top of that ophiolite in the southern part of the Ulukisla Basin are shallow marine conglomerates and limestones that were deposited in Maastrichtian times. These sediments rework Tauride-derived carbonates and HP metamorphics and ophiolite. They are intensely folded and thrusted. Our preliminary paleomagnetic data show that these rocks were rotated as much as 90° counter-clockwise around a vertical axis.

The northern part of the basin consists of marine slope deposits of Maastrichtian age, progressively younging and fining to the west. These are overlain by volcanics, the youngest of which are Eocene in age (56 Ma). These are cut by major, likely synsedimentary NNW-SSE trending, WSW-dipping normal faults. Similarly aged ~E-W extension has been documented exhuming the CACC to the north of the basin. Thus, we suggest that the northern basin margin is genetically linked to the CACC and overlying sedimentary basins. Our preliminary paleomagnetic data show vertical axis rotations varying between 45° clockwise to no significant rotation. We tentatively suggest that the Ulukisla Basin is located in a zone where the subduction geometry changed regionally from trending N-S, dipping E below the CACC (Lefebvre et al. 2013) to E-W, dipping N in Southeast Anatolia.

Next, we will record the structure of the Ulukisla Basin in detail and construct regional scale balanced cross-sections to constrain the minimum amount of shortening and collect fault kinematic data to determine the sense of movement.
Additional age constraints will come from U-Pb detrital zircon ages of the Aktoprak syncline, dating the age of compression related to the back-thrusting of the Taurides, an Ar- Ar age for basal volcanics dating the age of onset of volcanism. Furthermore nannofossil, foraminifera and macrofossil biostratigraphy will give an age control of the sediments within the basin. Additional paleomagnetic sites from the Ulukisla Basin will be collected to test whether preliminary vertical axis rotations are regional.

8. Regional implications

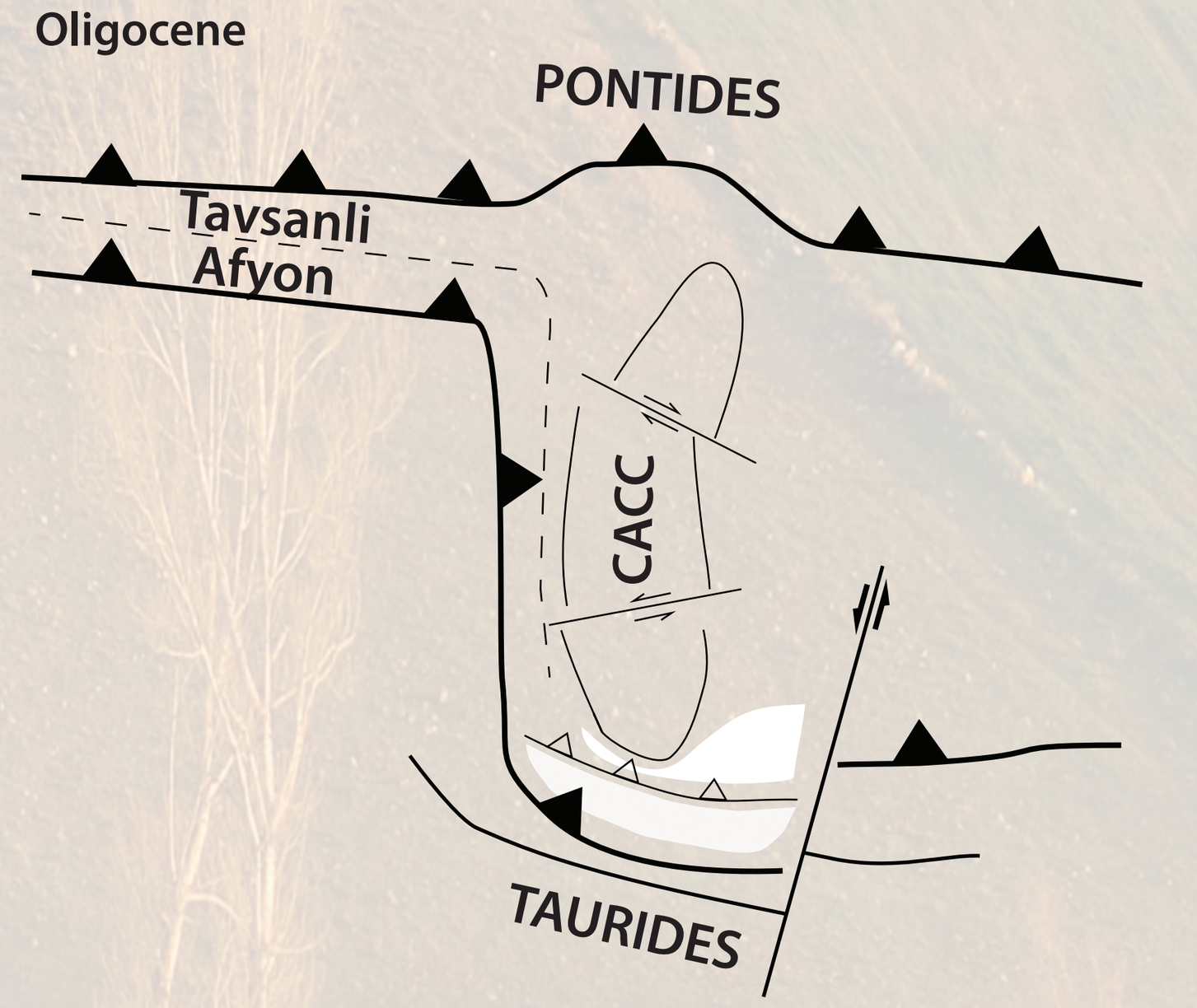
Late Cretaceous



Late Cretaceous subduction zone configuration in Central Anatolia. The E-W trending northern branch subducts below the Pontides, whereas the southern strand consists of a more complex geometry.
A N-S trending segment is present below the CACC. This changes orientation at the location of the Ulukisla Basin. The northern part of this basin is genetically linked to the CACC, where E-W extension is prevailing.

Oligocene configuration of the Neotethyan system in Central Anatolia. After the collision of the CACC with the Pontides in the Paleogene, there was oroclinal bending in the Central Taurides (Meijers et al. 2010) and the CACC had been exhumed along E-W extensional detachment faults (Lefebvre et al. 2013).
The southern part of the basin was genetically linked with the Taurides. It was presumably rotated and underthrusted with progressive convergence, juxtaposing it against the northern part of the modern basin. The left-lateral Late Eocene-Oligocene? Ecemis Fault is the youngest feature.

Oligocene



Questions?
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