

SUPPLEMENTAL MATERIAL

S1. Description of thermochronology methods and associated references.

Table S2. Summary of low-temperature thermochronology data, including apatite U-Th/He (AHe), zircon U-Th/He (ZHe), and apatite fission-track (AFT) results for samples near and beyond the EAFZ, as well as sample type and sample location information.

Table S3. Full apatite fission track count and length data.

Table S4. Full dataset for apatite U-Th/He analyses.

Table S5. Full dataset for zircon U-Th/He analyses.

S6-9. Summary of graphical QTQt inverse thermal modeling plots highlighting the results from the Maximum Mode (Max. Mode) and Expected Models. For more plots, and for evaluating the full results, we include the QTQt summary files (readable for plotting by QTQt) for each modeling run as part of the supplemental information.

for S6-8: (A) shows the Maximum Mode thermal history. Results for the highest elevation sample (blue line), lowest elevation sample (red line) and samples at intermediate elevations (gray line) are shown along with their 95% credible intervals for the highest elevation samples (cyan), and lowest elevation sample (magenta). Elevation data are in Table S2. The two dashed horizontal

lines represent the QTQt default temperatures apatite fission track partial annealing zone (60-120 °C). The red line shows the prior time-temperature (t-T) space used for the modeling. Note that the full time spaces are not shown, with plots bounded at upper age of 30 Ma; the full temperature limits are shown.

The full modeling T-t space is the oldest age in the transect \pm that age, which in the case of the near-Euphrates EAFZ traverse is the oldest uncorrected ZHe age of 19.26 Ma \pm 19.26 Ma from sample 1301013A. Panels on the right show a plot of the predicted versus observed ages for the Maximum Mode Model and Expected Model, respectively, with 1:1 age line shown in gray. Results of each for a particular sample are presented by colors shown at bottom, labeled for the sample elevation in meters. (B) shows the same plots, but for the Expected Model thermal history results. Plots (C) and (D) show the relative probability distribution of acceptable sampled thermal histories for the highest elevation and lowest elevation samples, respectively. The relative probability color scale is based on the number of overlapping posterior accepted model runs in any 1°C by 1 Ma square, with hotter (red) colors showing higher probability. Black lines show the Expected Model (the preferred single model in Bayesian formulations; Gallagher, 2012) and its 95% credible intervals. Also shown are the maximum likelihood model (red), the maximum posterior model (beige) and the maximum mode model (white) (see Gallagher, 2012, and supplemental information methods (S1) for more explanation).

Fig. S6. Model results for 8 samples from the near-Euphrates traverse across the EAFZ (Fig. 1B), combining samples 131013A, E, F, I, S, T, U, V.

Fig. S7. Model results for 3 neighboring samples on the southern margin of the Pütürge massif (Fig. 1B), combining samples 191014C, D, E.

Fig. S8. Model results for 5 samples from the Mt. Berit traverse in the northern part of the Berit area (Fig. 1B): samples 151013A, C, I, J, and 171013A.

Fig. S9. (A) Age-elevation plot for the near-Euphrates traverse across the EAFZ. (B) A plot showing the positively skewed AHe data in the near-Euphrates traverse dataset, and (C) a comparison to the AHe results from the Transantarctic Mountains of He et al. (2021), which shows a similar pattern.

Fig. S10. Additional cross-sections showing S-wave velocity in the vicinity of the EAFZ.