EGU General Assembly 2020

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Spatio-temporal variations on the vertical deformation rate of the NW Anatolian Block: Luminescence chronology of the Sakarya River terraces

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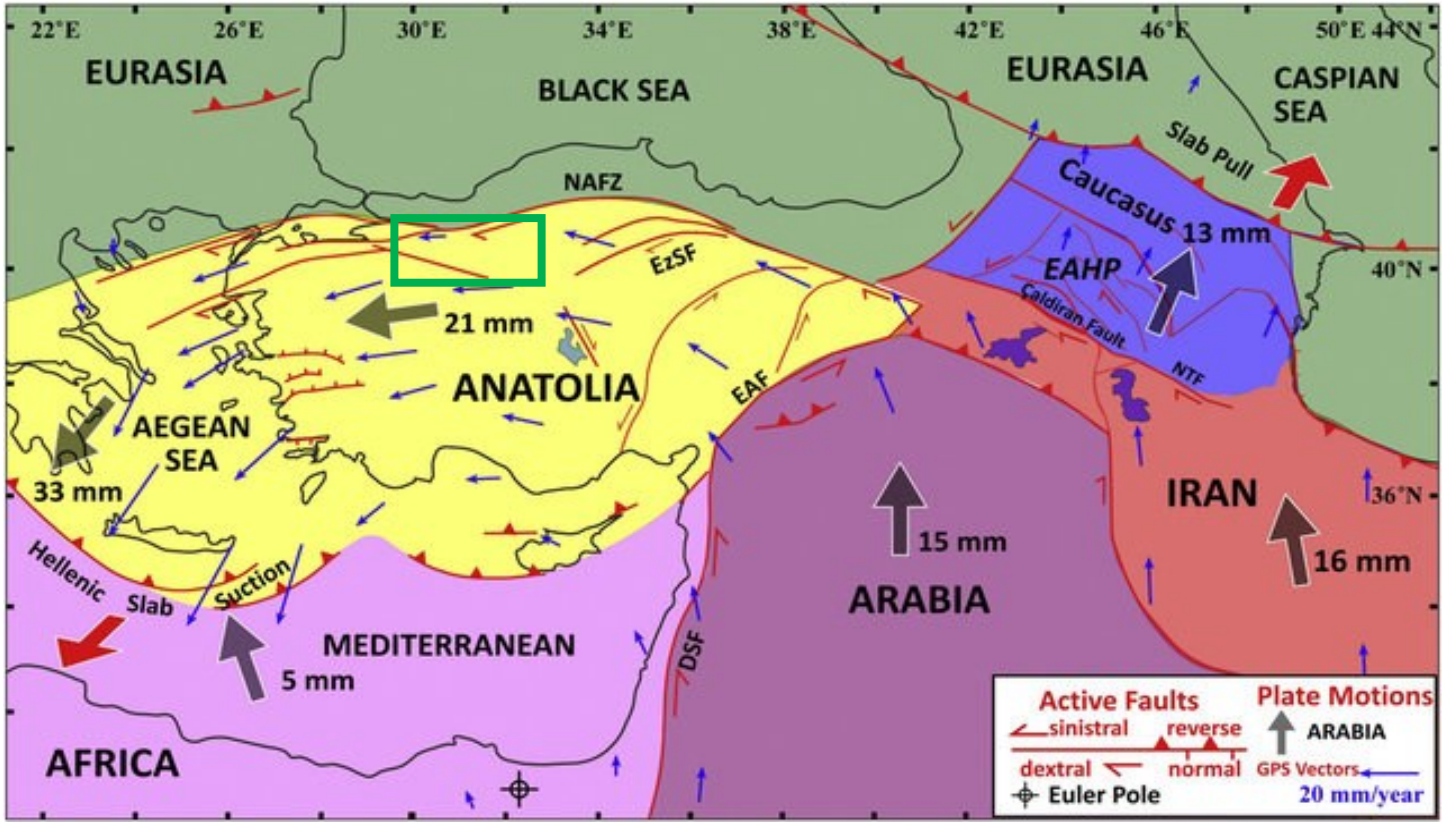
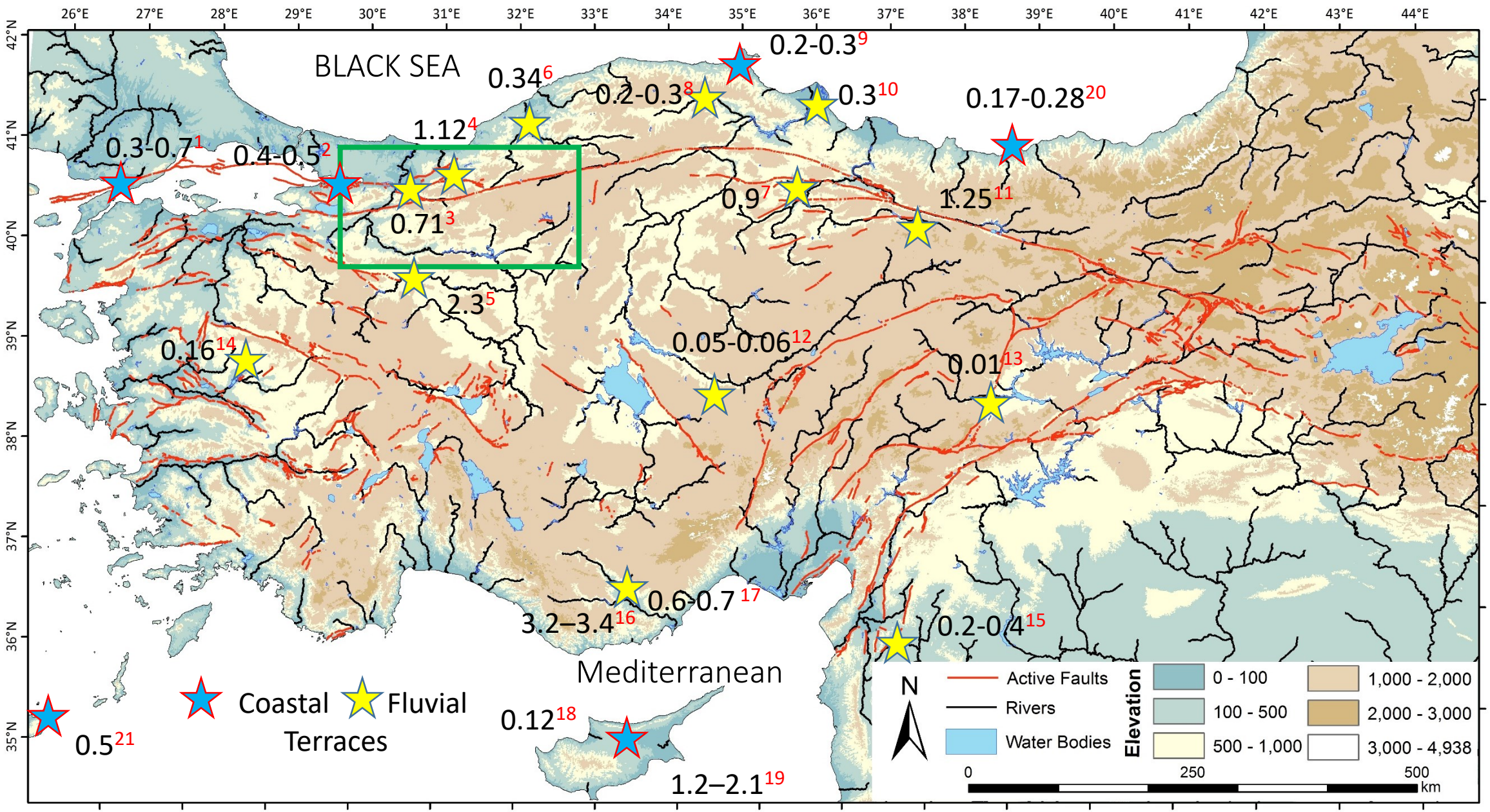
Geodynamic Setting of Eastern Mediterranean and Anatolia

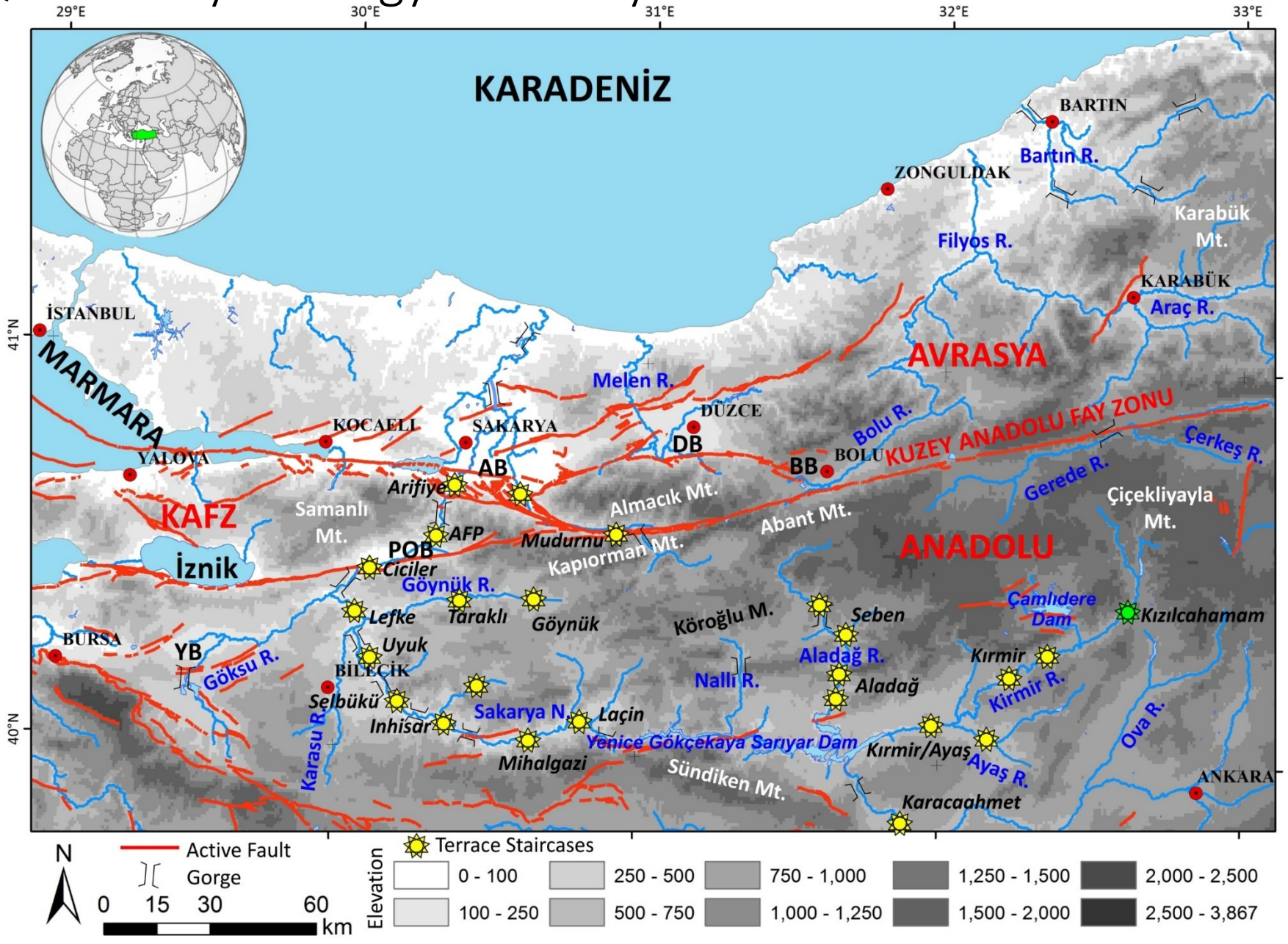


- As a part of Eastern Mediterranean region, Anatolian Plate is formed and deformed under unique tectonic setting.
- The geodynamic evolution involves a complex array of subduction, collision, and back-arc spreading events and escape tectonics bounded by the North and East Anatolian transform faults in relation to ongoing northward convergence of Africa-Arabia plates towards Eurasia.
- The rate and causes of internal deformation of Anatolia is a matter of debate, where it is known that mantle dynamics have played a role in generating and maintaining the elevated during Neogene times.
- One of the key issues is to quantify the variations in (regional) uplift rate and model possible driving mechanisms for the overall Anatolian plate and the Pontides (Eurasia) during the Quaternary.
- We investigate…
  - The distributed terrace starircases (TSC) on the main course and the major tributaries of the Sakarya River by precise measurement and luminescence dating.
  - The differantial vertical deformation during the Late Pleistocene, by using the fluvial terraces as paleoaltimetry for the NW Anatolia Plate.



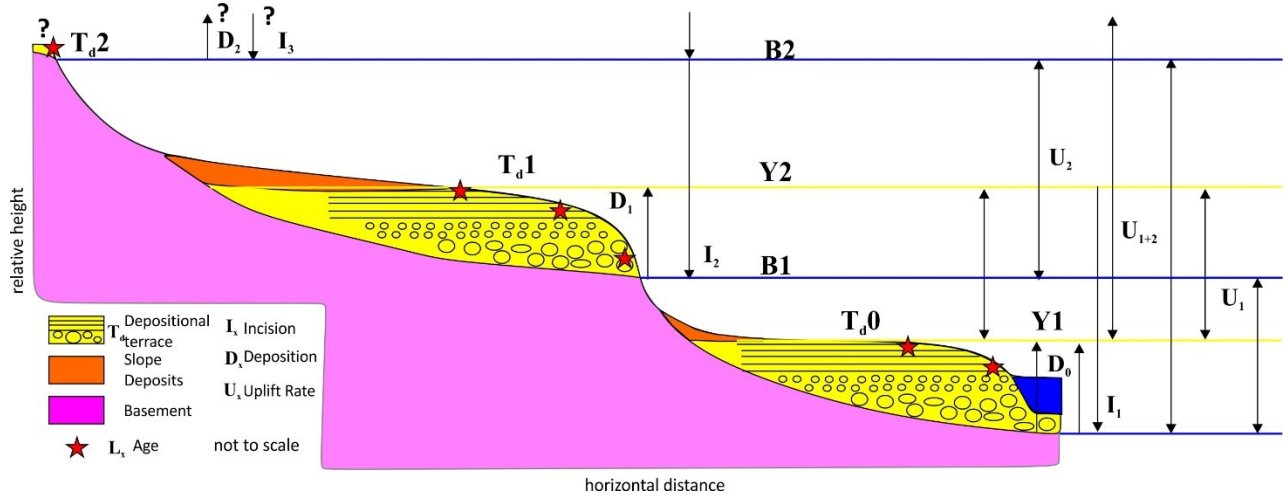
[1]Yaltırak et al. 2002; [2]Paluska et al.1989; [3]Erturaç et al. 2019; [4]Sunal et al., 2019 [5]Ocakoğlu and Akkiraz, 2019; [6]McClain. et al. 2018, [7]Erturaç and Kıyak, 2017; [8]Yıldırım et al. 2013a; [9]Yıldırım et al. 2013b;, [10]Brent et al. 2018;; [11]Altun et al. 2017; [12]Çiner et al. 2015; [13]Sancar et al. 2020; [14]Maddy et al. 2005; [15]Bridgland et al. 2012, [16] Öğretmen et al. 2017, [15] Schildgen et al. 2012, [18]Galili et al. 2015, [19] Harrison et al. 2012, [20] Keskin et al. 2011, [21] Strobl et al. 2014

Investigating the driving mechanism(s) of landscape evolution
Focus Quaternary Geology of Sakarya River Basin



Investigating the driving mechanism(s) of landscape evolution
Focus Quaternary Geology of Sakarya River Basin

- Climate changes : depositional/erosional periods
- Impact of Black Sea Level changes (Late Pleistocene) along the Sakarya River main course (250 km)
- Local Base level changes
- Quantify differantial uplift
  - Variations within the NW Anatolian Block
  - Regional uplift vs. NAFZ



Terrace Staircases as paleoaltimeter

- Mapping
  - Rtk-GPS surveys
  - SfM (UAV) Photogrametry
- Dating
  - Sampling for luminescence
  - Mineral Seperation
  - Equivalent Dose Measurement
  - Environmental Dose Rate Determination

AGE_{Lum}:De/Dr

Dr: ICP-MS + AES
U, Th, Rb, K
(ALS)

$I/U:Y_n/T_n$

I/U:Uplift-Incision Rate

Y_n:Elevation of Terrace surface above recent flood plain

T_n: The age of the floodplain deposits of the terrace

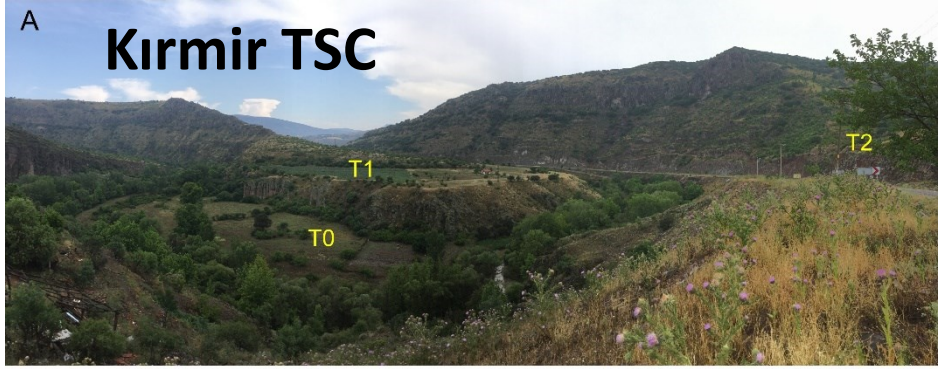

A
Mihalgazi TSC (Sakarya River)
T3
T3
T4
T2
T5
T6
T7


B


C

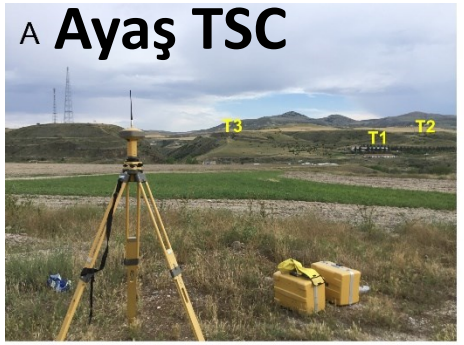

D

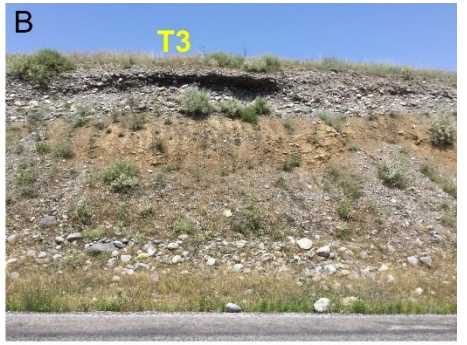

E

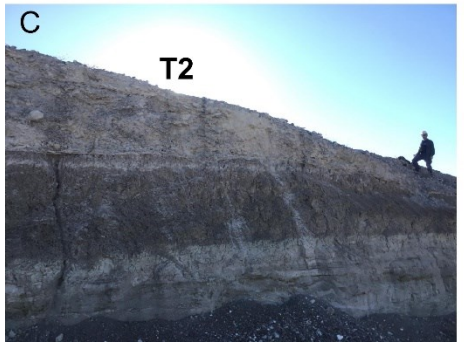

A
Kırmir TSC
T1
T0
T2


B
T2


C
T1


A Ayaş TSC
T3
T1
T2

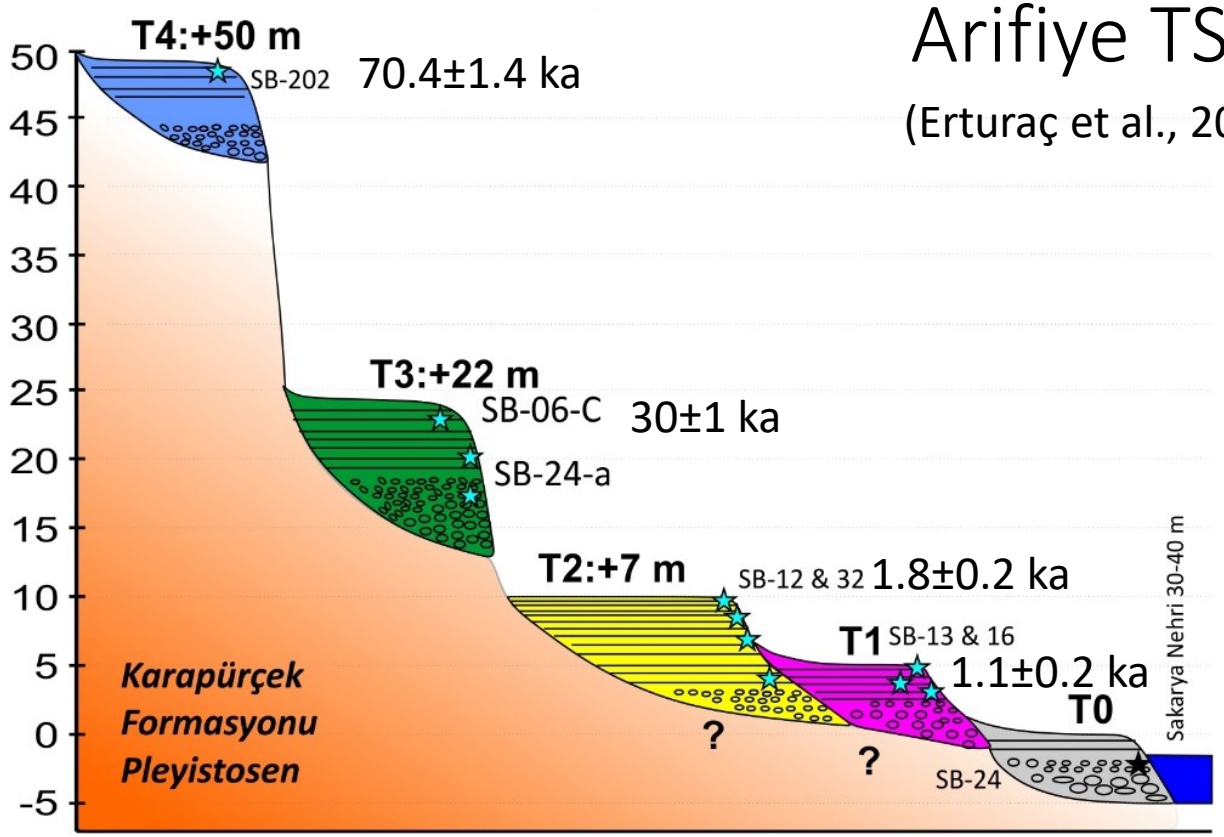

B
T3

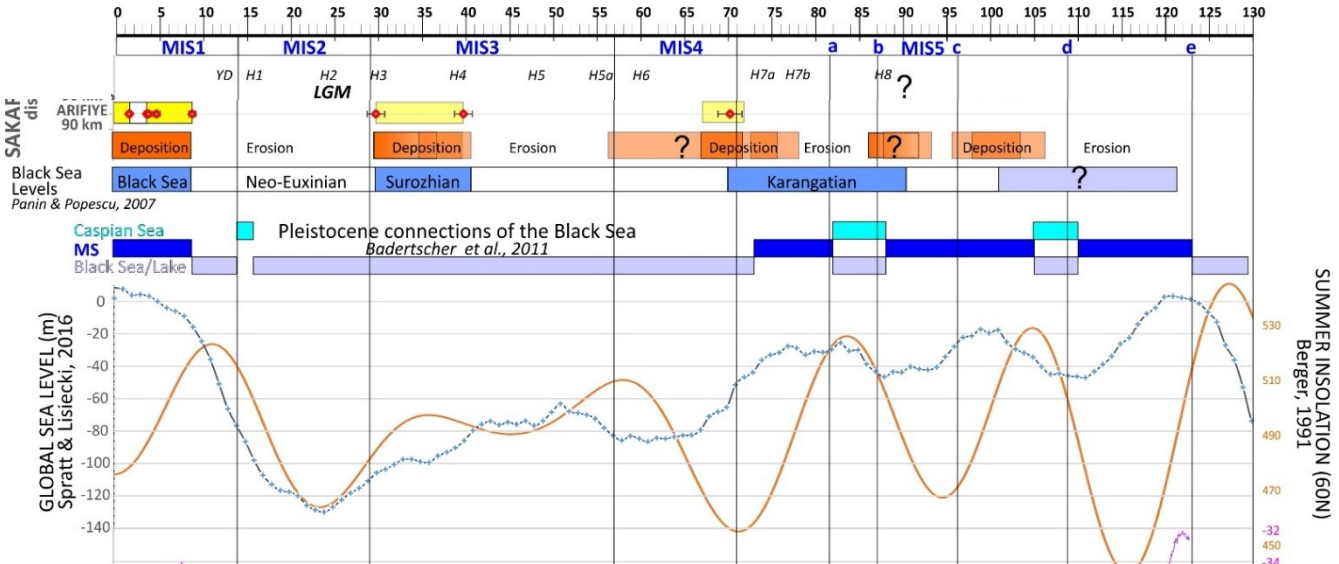

C
T2

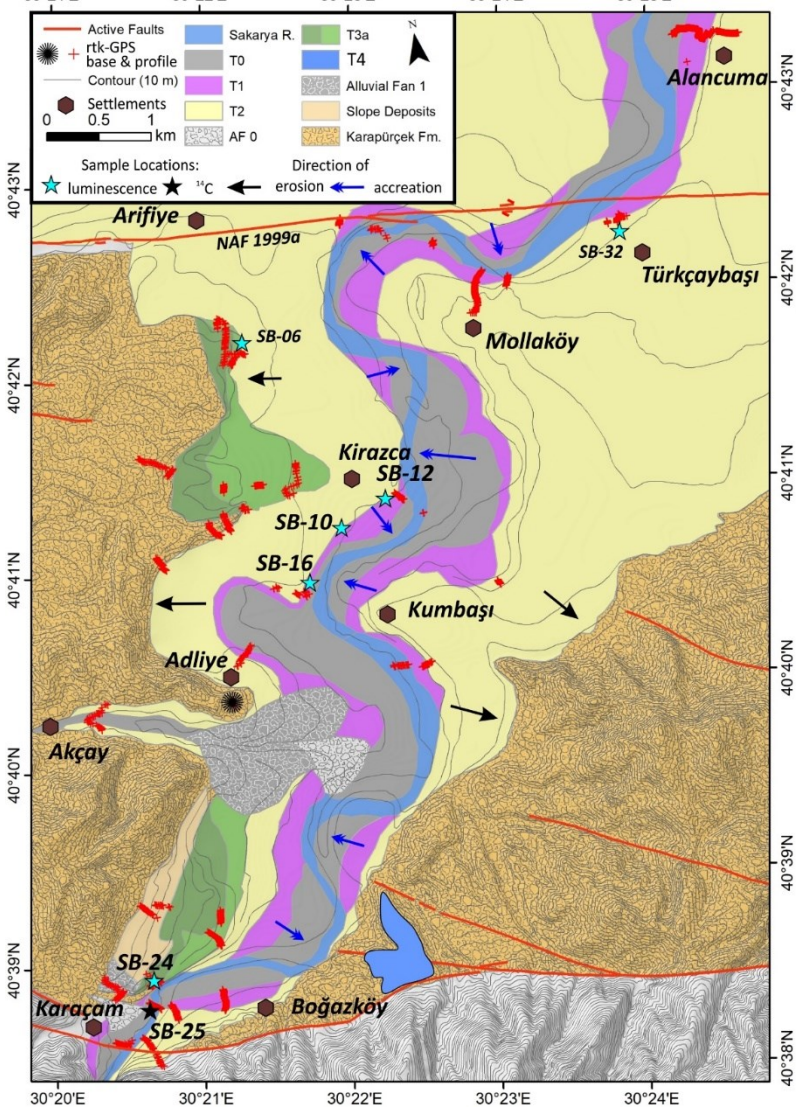

D
T1

Arifiye TSC

(Erturaç et al., 2019)





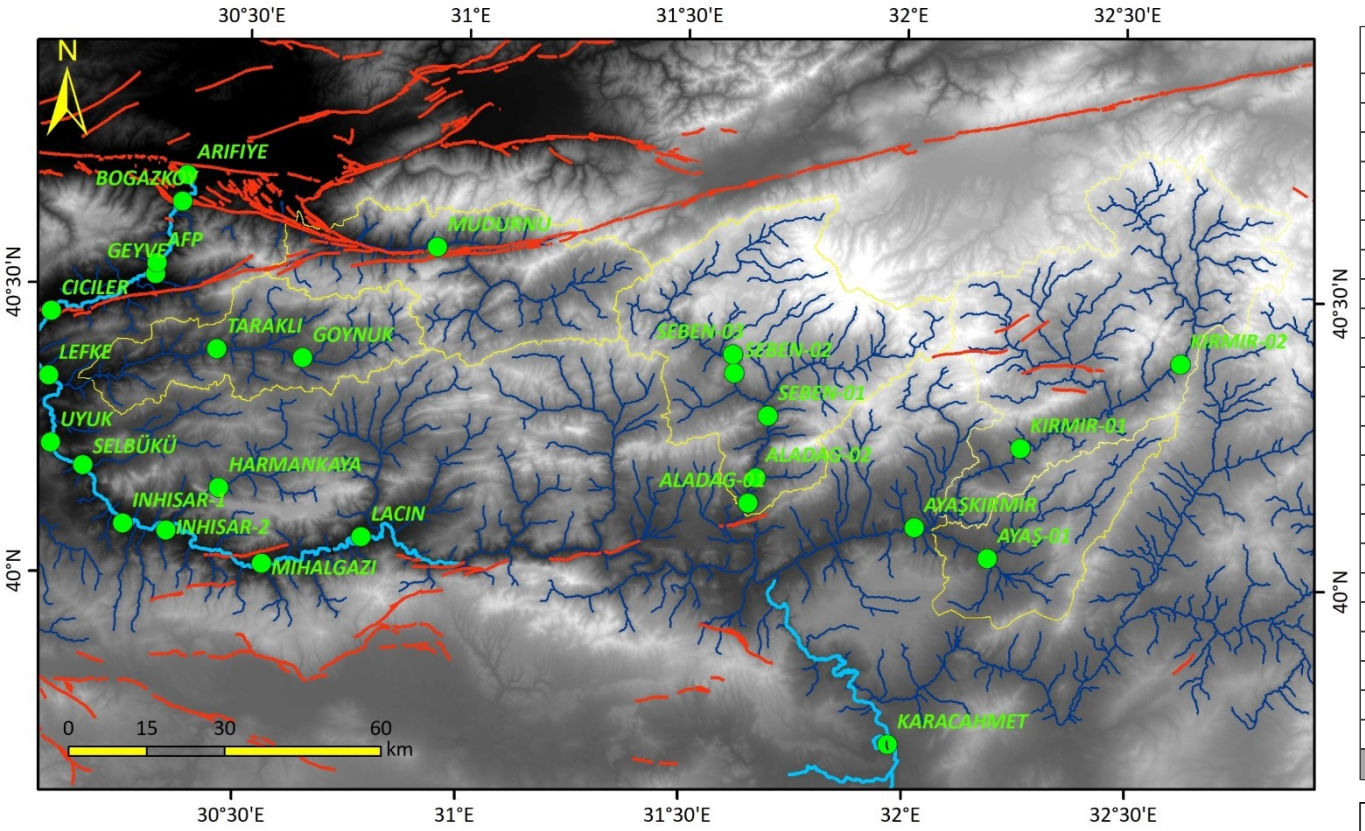


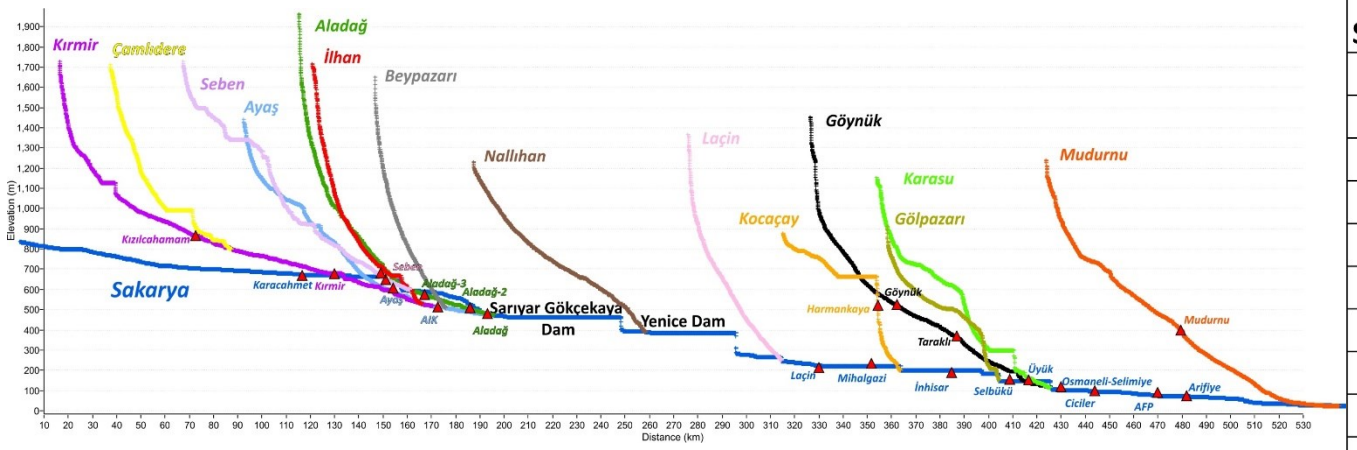
High stand in between 80?-70 ka and 40-30 ka

Significant drop in Black Sea level MIS3-MIS 2 transition (30 ka)

Rise in Black Sea level at 9 ka/BP

0.71 mm/yr uniform uplift rate last ~70 ka

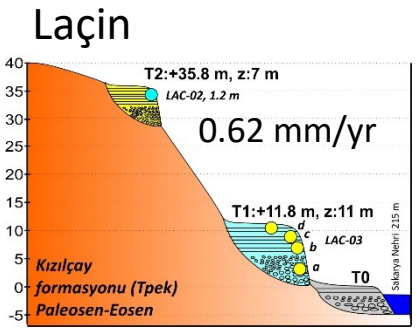


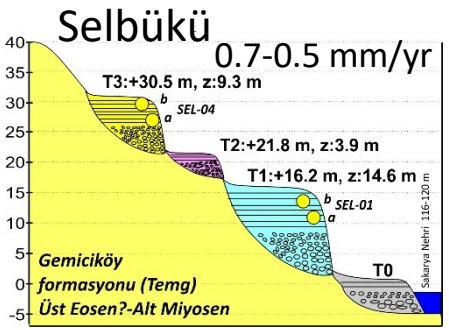


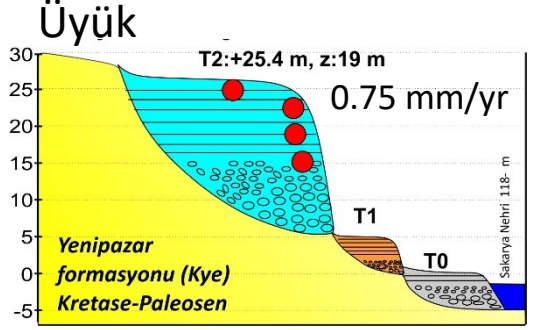
	Terrace Staircases	River	Lat	Lon	Base Level	Steps	LUM Samples	O	Dates	rtk-GPS	SfM
1	Üyük	Sakarya	30.07	40.22	118	1	4	3	2	22	1
2	İnhisar	Sakarya	30.24	40.09	140	3	10	7	6	100	2
3	Osmaneli-Selimiye	Sakarya	30.06	40.34	100	4	14	8	8	266	1
4	Ciciler	Sakarya	30.06	40.45	110	2	3	3	3	81	2
5	Alifuatpaşa	Sakarya	30.30	40.54	90	3	5	3	3	56	NA
6	Geyve	Sakarya	30.30	40.52	95	1	3	1	1	50	NA
7	Arifiye-Boğazköy	Sakarya	30.35	40.65	40	4	15	15	10	10	NA
8	Laçin	Sakarya	30.78	40.08	215	2	4	4	2	22	NA
9	Mihalgazi	Sakarya	30.55	40.02	182	6	5	4	3	75	2
10	Selbükü	Sakarya	30.15	40.19	120	3	4	3	2	48	NA
11	Karacaahmet	Sakarya	31.97	39.73	670	1	2	2	in progress	15	NA
12	Harmankaya	Kocaçay	30.45	40.15	523	2	3	1	1	12	NA
13	Kırmir	Kırmir	32.26	40.25	676	3	3	2	in progress	30	1
14	Kızılcahamam	Kırmir	32.62	40.39	865	1	1	1	in progress	15	NA
15	Göynük	Göynük	30.63	40.38	525	2	4	2	in progress	41	NA
16	Taraklı	Göynük Çyı	30.44	40.39	370	5	5	4	in progress	74	NA
17	Ayaş-01	Ayaş	32.19	40.06	609	2	6	3	in progress	56	NA
18	Ayaş-İlhan-Kırmir	Kırmir	32.02	40.11	315	3	3	2	in progress	49	NA
19	Seben-01	Aladağ	31.69	40.30	573	3	2	2	in progress	11	NA
20	Seben-02	Aladağ	31.61	40.40	680	3	5	4	in progress	28	NA
21	Aladağ-01	Aladağ	31.65	40.15	482	4	4	3	in progress	65	NA
22	Aladağ-02	Aladağ	31.67	40.19	507	2	4	2	in progress	34	NA
23	Taşkesti-Dokurcun	Mudurnu	30.93	40.58	400	5	15	15	4	NA	NA
Total						**59**	**124**	**94**	**41**	**1160**	**9**

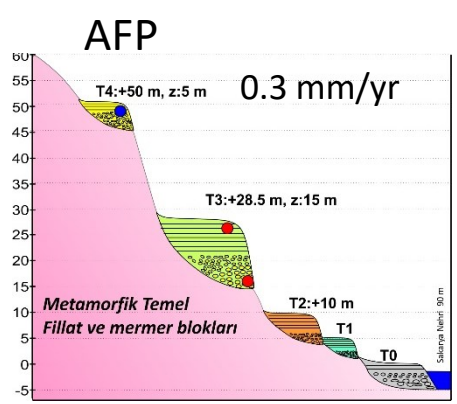
Terrace Staircases	Distance (km)	Floodplain Elevation	Terrace	Age (ka)	Relative Height	Uplift Rate (mm/yr)
ARİFİYE	60	30	T3	30.0 ± 1.0	21.4 ± 0.1	0.71 ± 0.0
ARİFİYE	70	40	T4	70.4 ± 1.4	50.0 ± 0.3	0.71 ± 0.0
AFP	90	60	T3	98.5 ± 4.1	28.1 ± 0.1	0.29 ± 0.0
AFP	90	60	T4	155.7 ± 4.5	50.0 ± 0.5	0.32 ± 0.0
CICILER	110	80	TX	57.1 ± 5.5	39.8 ± 3.0	0.70 ± 0.1
LEFKE	130	100	T2	27.5 ± 2.6	19.4 ± 0.3	0.70 ± 0.1
LEFKE	130	100	T4	79.7 ± 5.4	55.0 ± 0.2	0.69 ± 0.0
LEFKE	135	103	T5	88.1 ± 6.4	85.7 ± 1.2	0.97 ± 0.1
UYUK	140	110	TX	29.9 ± 0.9	22.0 ± 1.1	0.74 ± 0.1
INHISAR	175	132	T2	67.3 ± 3.0	28.5 ± 3.0	0.42 ± 0.1
INHISAR	175	132	T3	87.3 ± 6.7	38.0 ± 0.3	0.44 ± 0.0
INHISAR	185	150	T4	96.2 ± 4.1	50.7 ± 0.3	0.53 ± 0.0

Preliminary Results
Sakarya River
Main Course

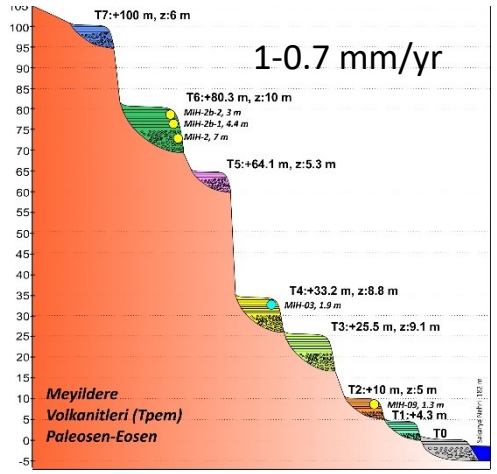


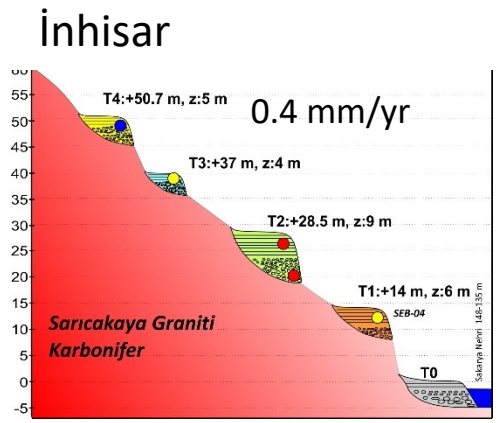


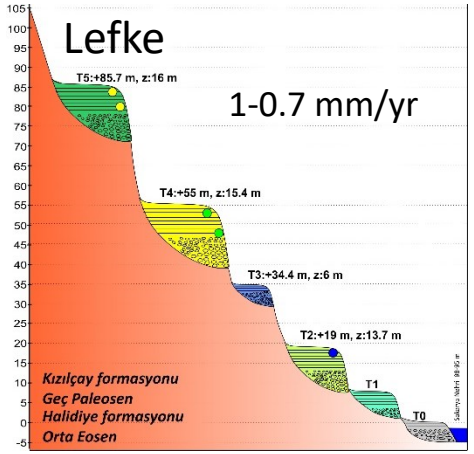


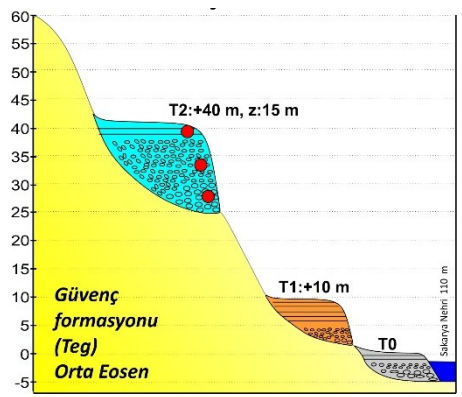


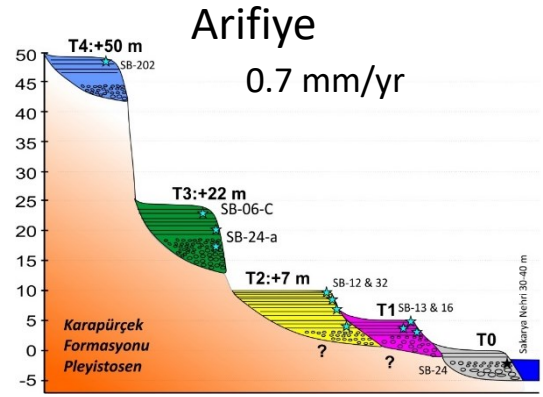
Mihalgazi

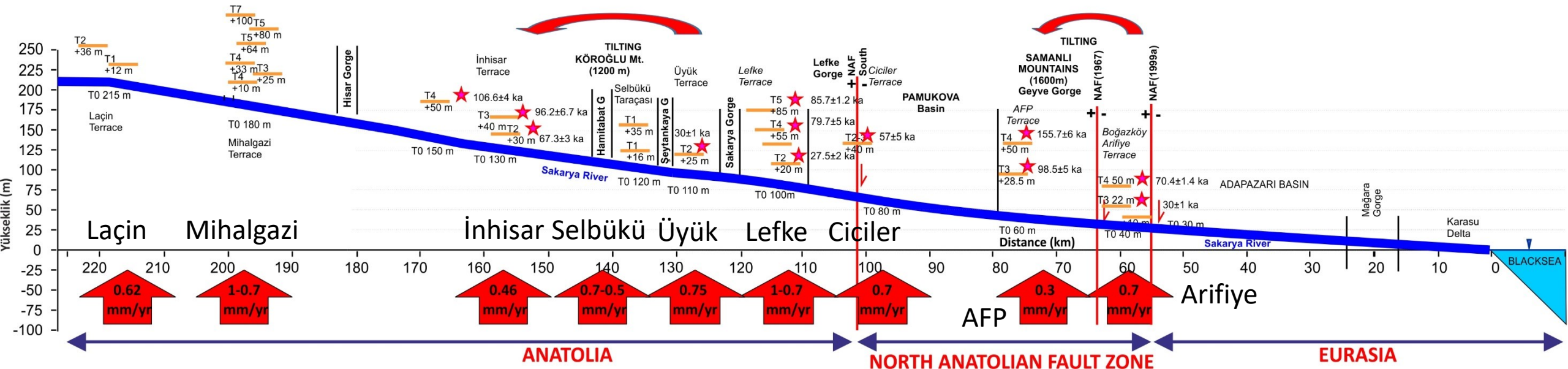












Correlation Sakarya River Record

- We document five depositional phases along the Sakarya River (just) during the late Pleistocene

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- The effect of Black Sea level extends at least to 90 km towards inland
- Proposed high stands of the Black Sea
  - 125-115 ka
  - 105-95 ka
  - 80-70 ka
  - 40-30 ka
  - 9 ka-recent

- Regional uplift ~0.6-0.7 mm/year
- Significant local rotations related with NAFZ and also within the block

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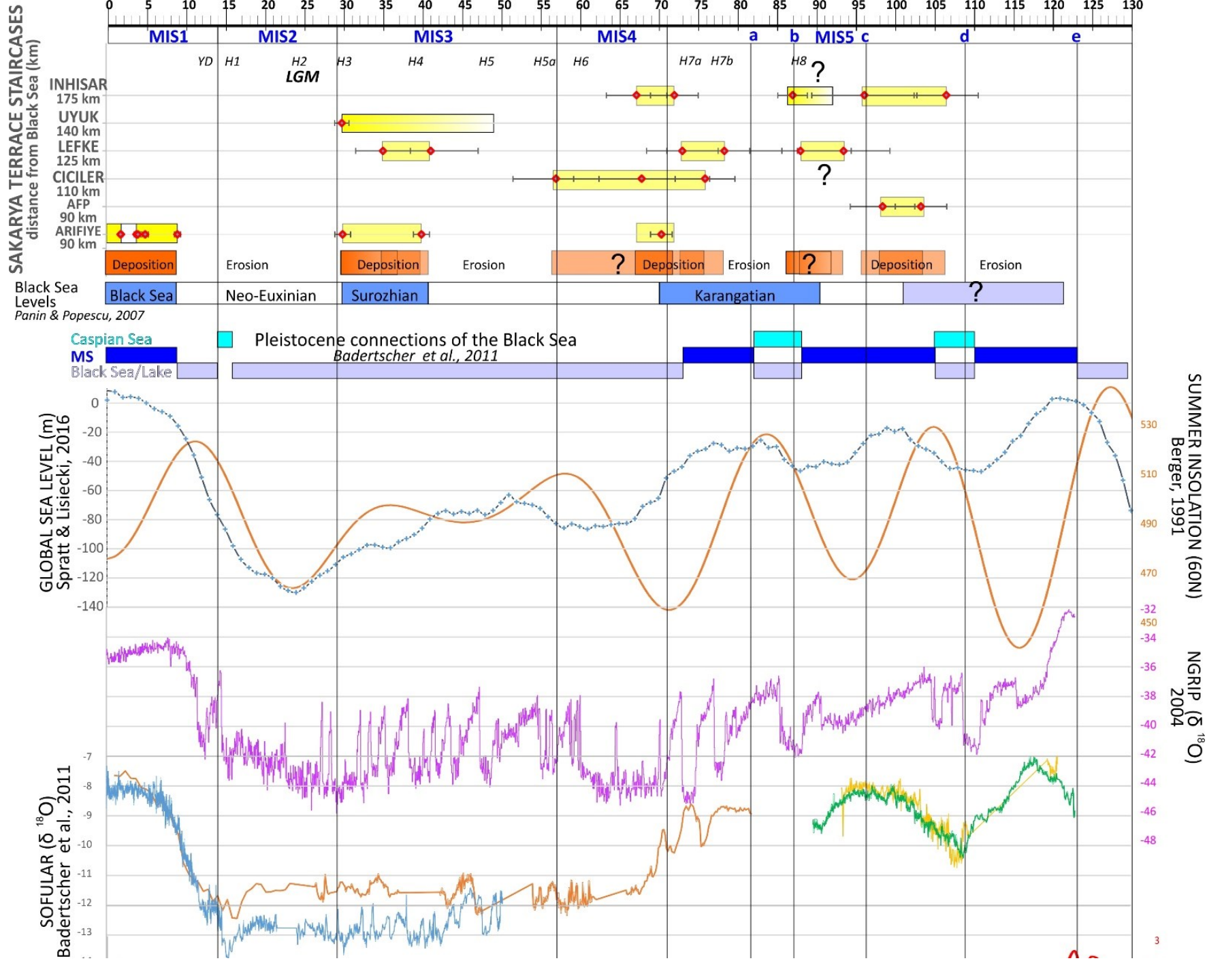
- Continue to
  - Evaluate De measurements and calculate dates to correct discrepancies
  - Achieve more dates
  - Model the terrace formation



Tributaries→ Dating in progress