

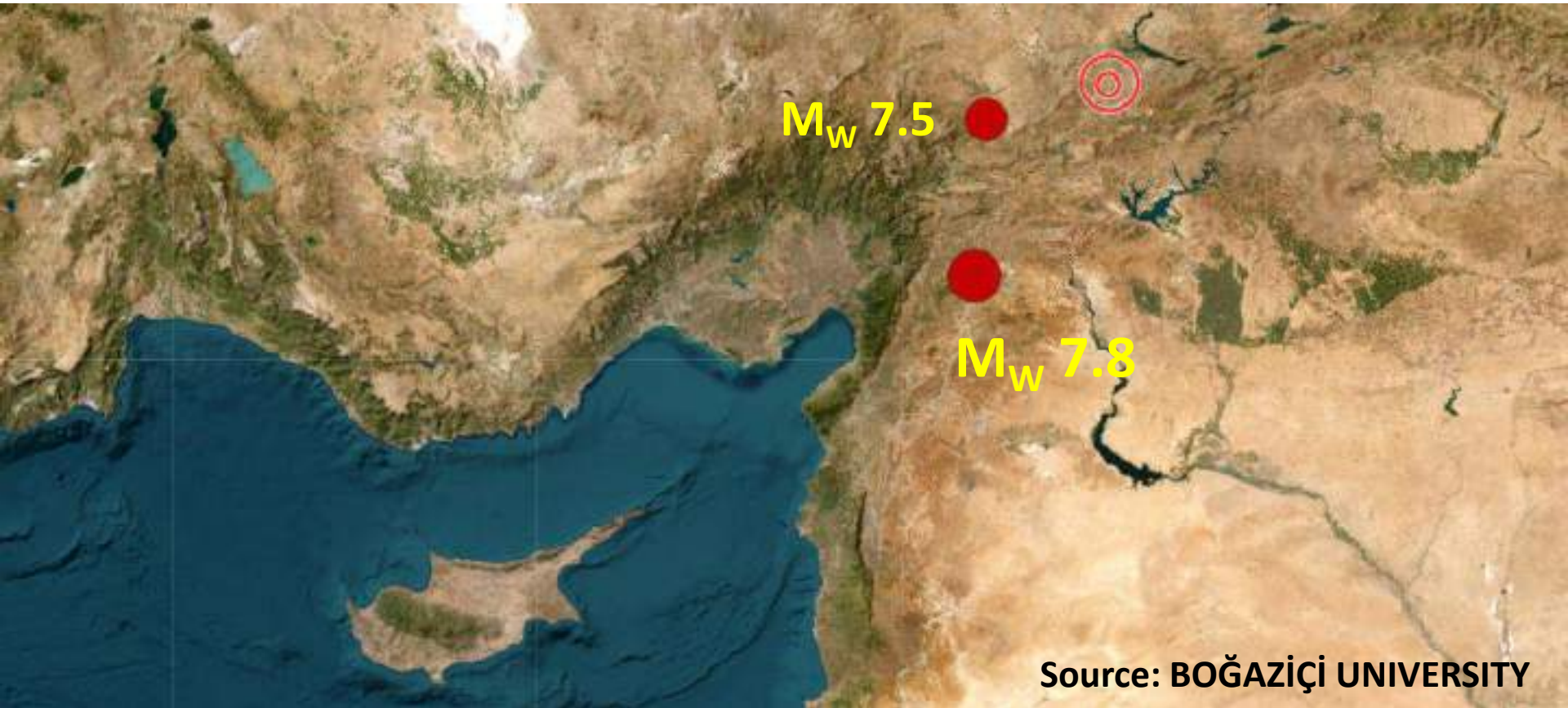
The 2 earthquakes of February 6th 2023 in Turkey



Preliminary Report

by **Evangelia GARINI** and **George GAZETAS**

NTUA, Greece



Source: BOĞAZIÇI UNIVERSITY

- ➔ Magnitude **Mw 7.8**
- ➔ Region **CENTRAL TURKEY**
- ➔ Date time **2023-02-06 01:17:36.1 UTC**
- ➔ Location **37.17 N ; 37.08 E**
- ➔ Depth **20 km**

- ➔ Magnitude **Mw 7.5**
- ➔ Region **CENTRAL TURKEY**
- ➔ Date time **2023-02-06 10:24:49.6 UTC**
- ➔ Location **38.11 N ; 37.24 E**
- ➔ Depth **10 km**

Map of seismic epicenters



Source: <https://www.emsc-csem.org/Earthquake/Map/gmap.php>

Map of seismic epicenters



Source: <https://www.emsc-csem.org/Earthquake/Map/gmap.php>

The **M 7.8** earthquake resulted from **strike-slip faulting** at shallow depth.

The event ruptured either a **near-vertical left-lateral fault** striking northeast-southwest, or a **right-lateral fault striking** southeast-northwest.

The preliminary location of the earthquake places it within the vicinity of a triple-junction between the Anatolia, Africa and Arabian tectonic plates. **A magnitude 7.8 strike slip earthquake is associated with a rectangular fault rupture of ~240 km long and ~20 km wide.**

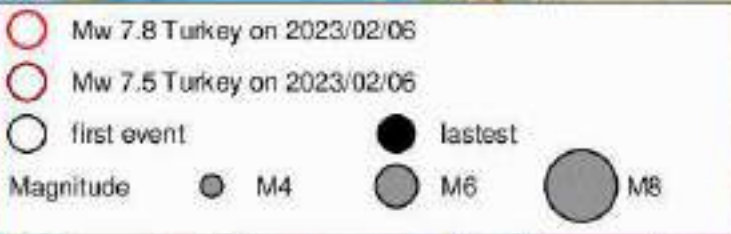
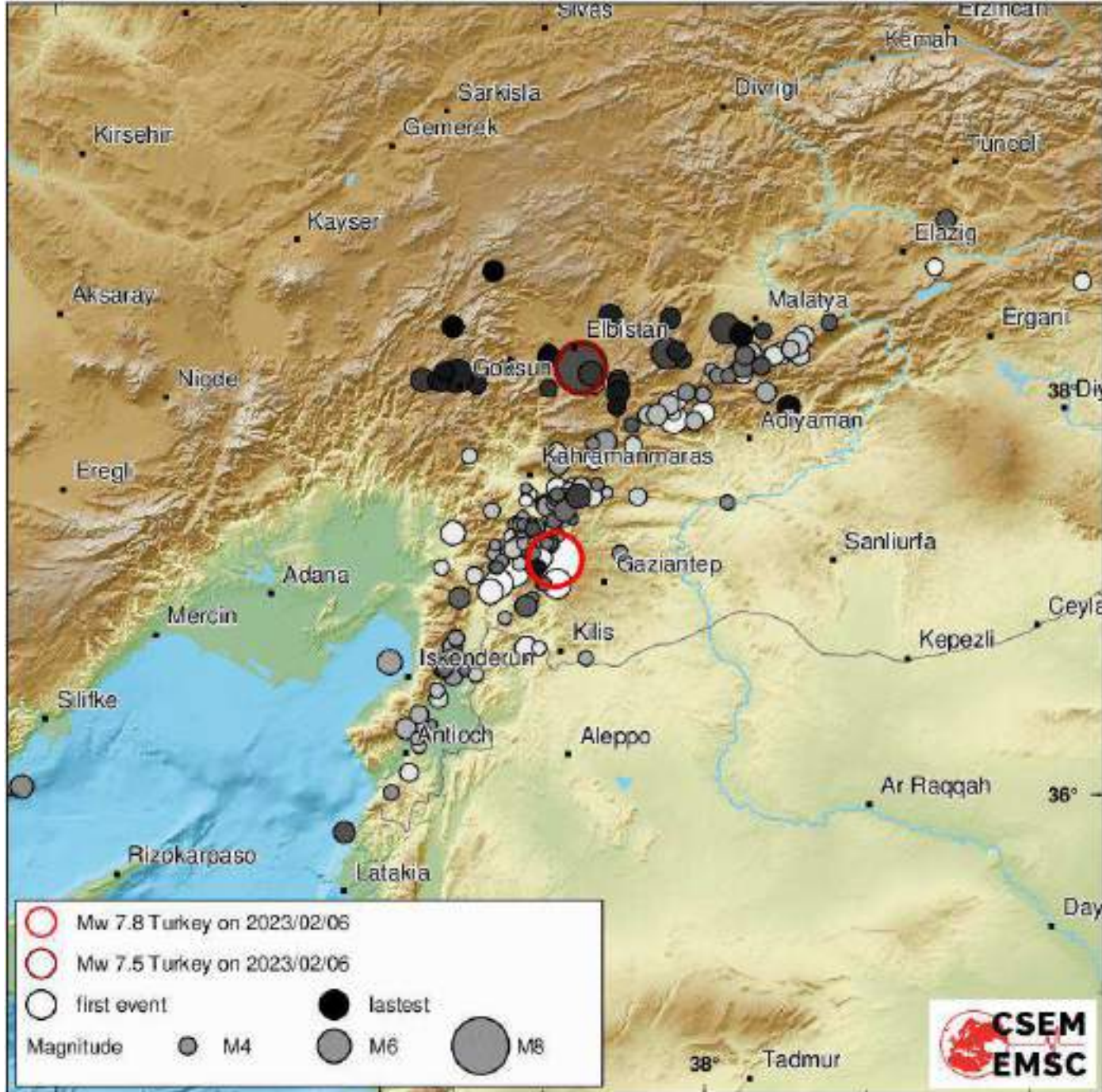
Nine hours after the first earthquake of M 7.8

a second earthquake of M 7.5 occurred

100 km to the north

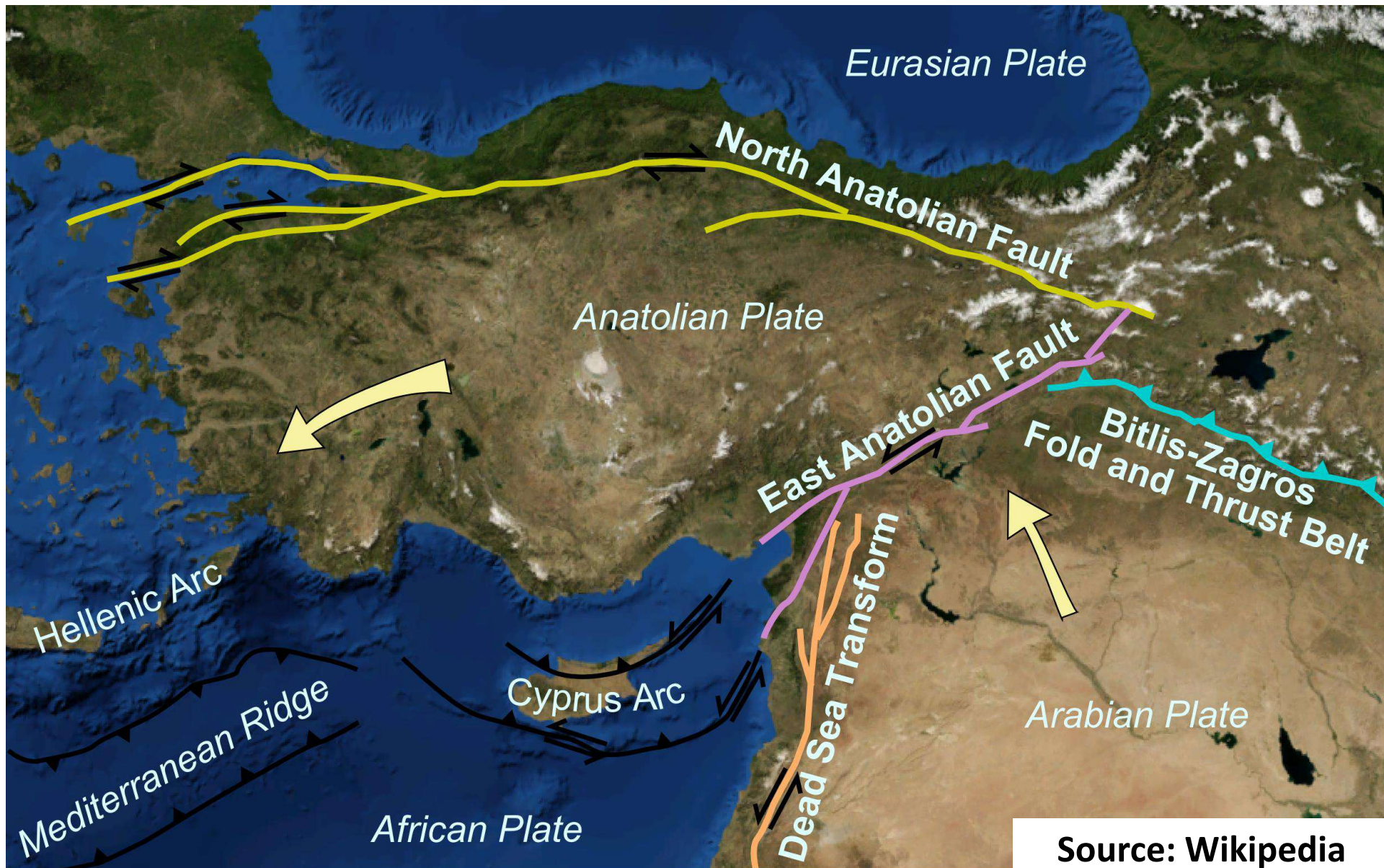


Source: INGV

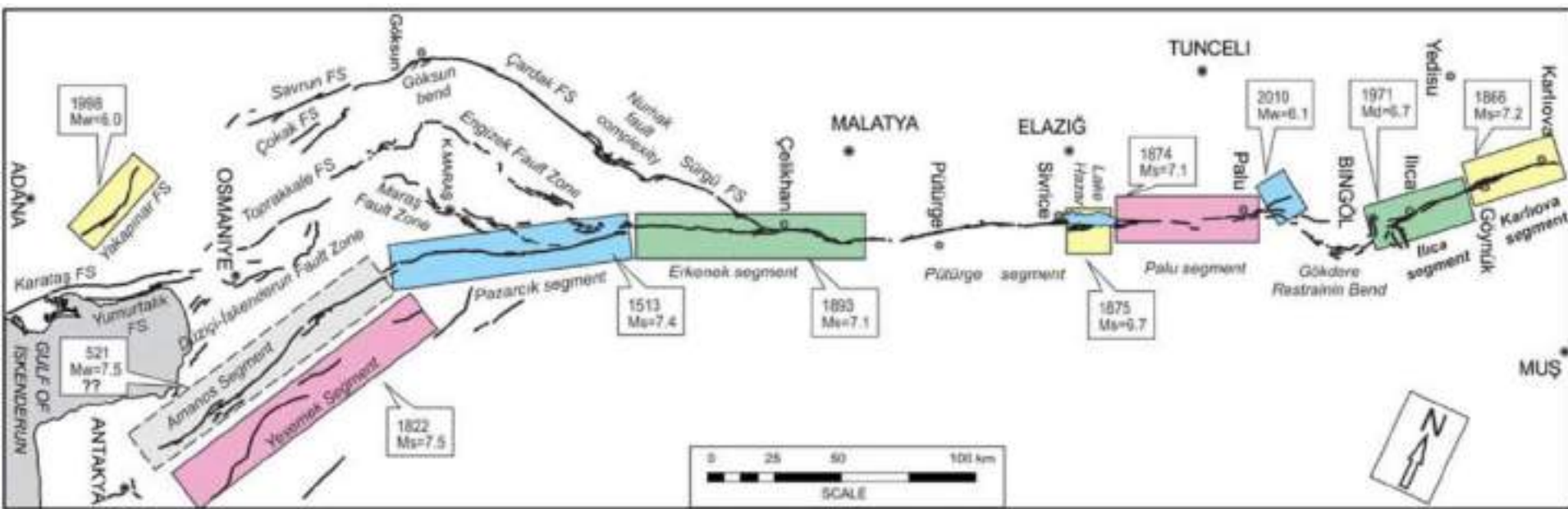


SEISMOLOGICAL INFO

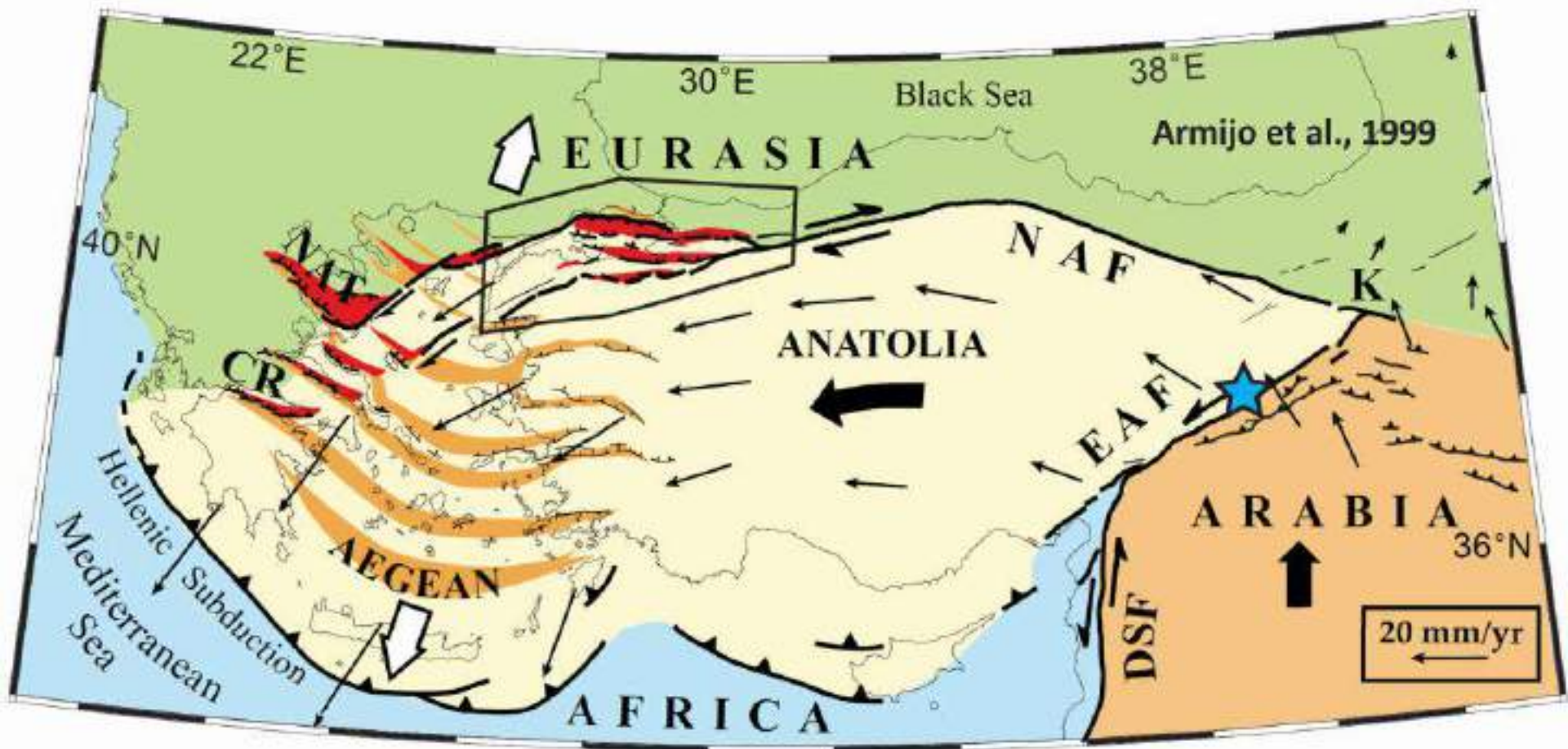
Map showing main tectonic structures around the Anatolian Plate.
The arrows show displacement vectors of the Anatolian and Arabian Plates
relative to the Eurasian Plate



Tectonics and fault system Map of the East Anatolian Fault



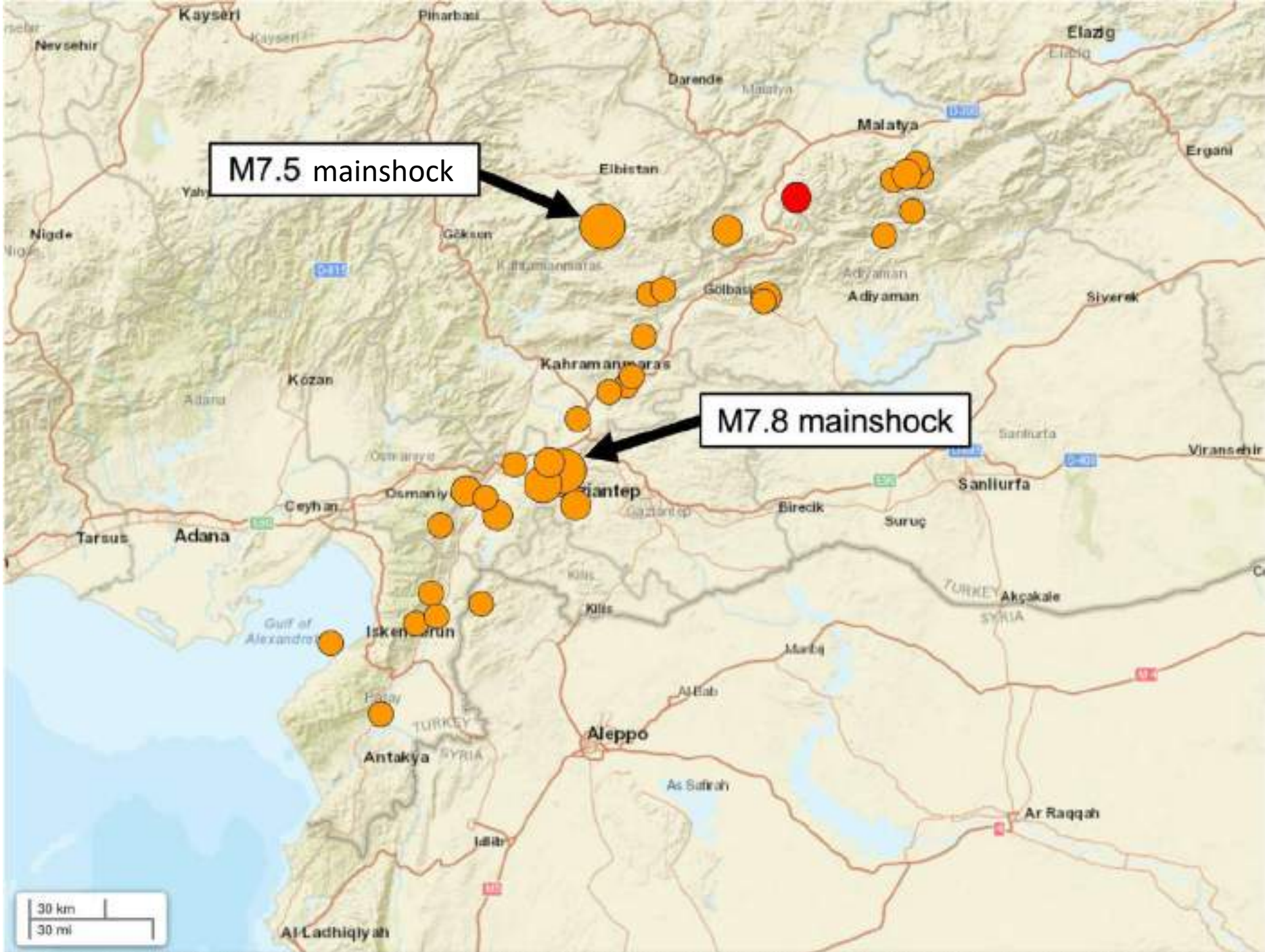
Source: Duman and Emre (2013)

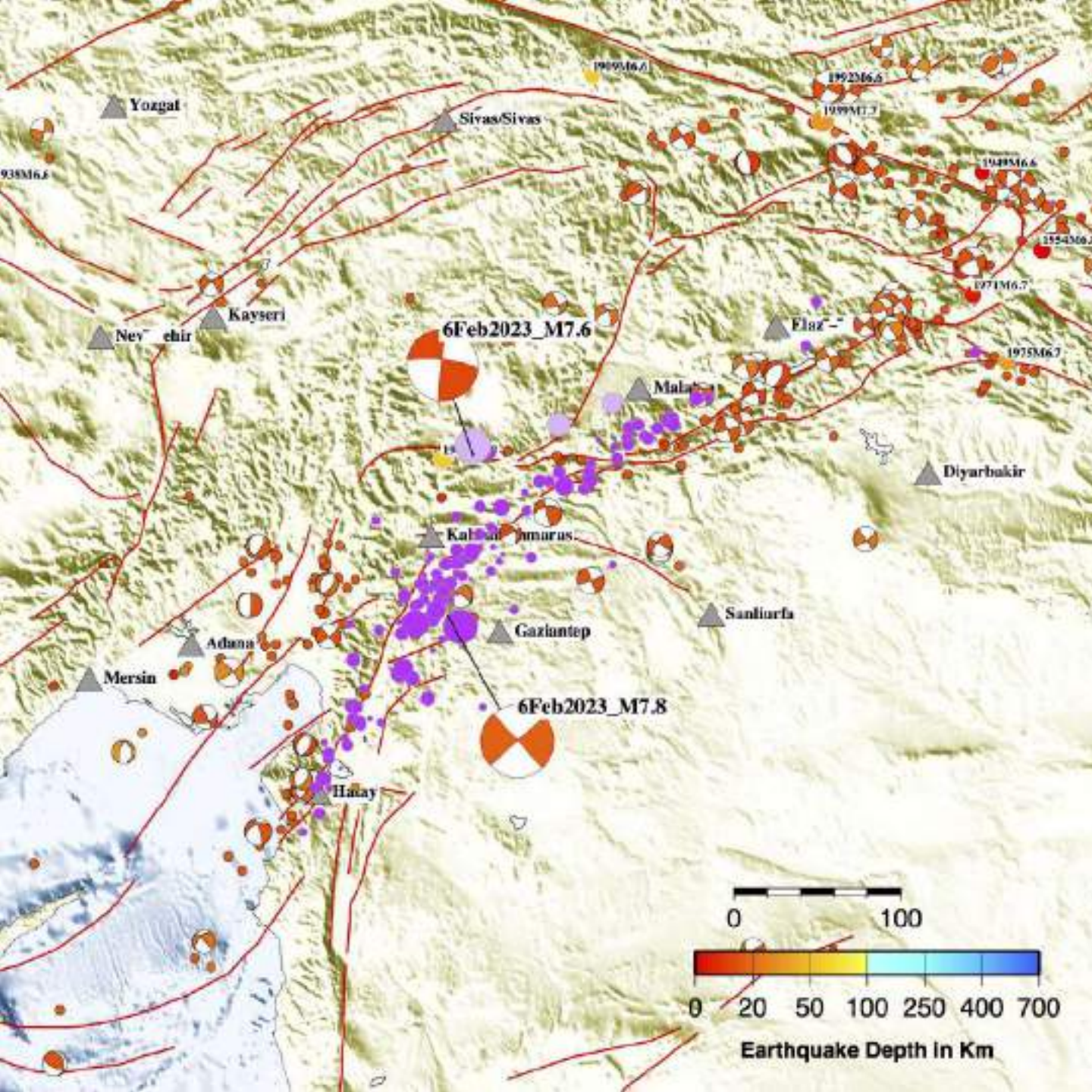


Source: CSEM-EMSC + GEM + USGS + Jason R. Patton

M7.5 mainshock

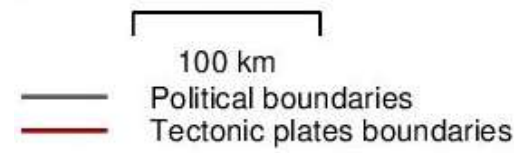
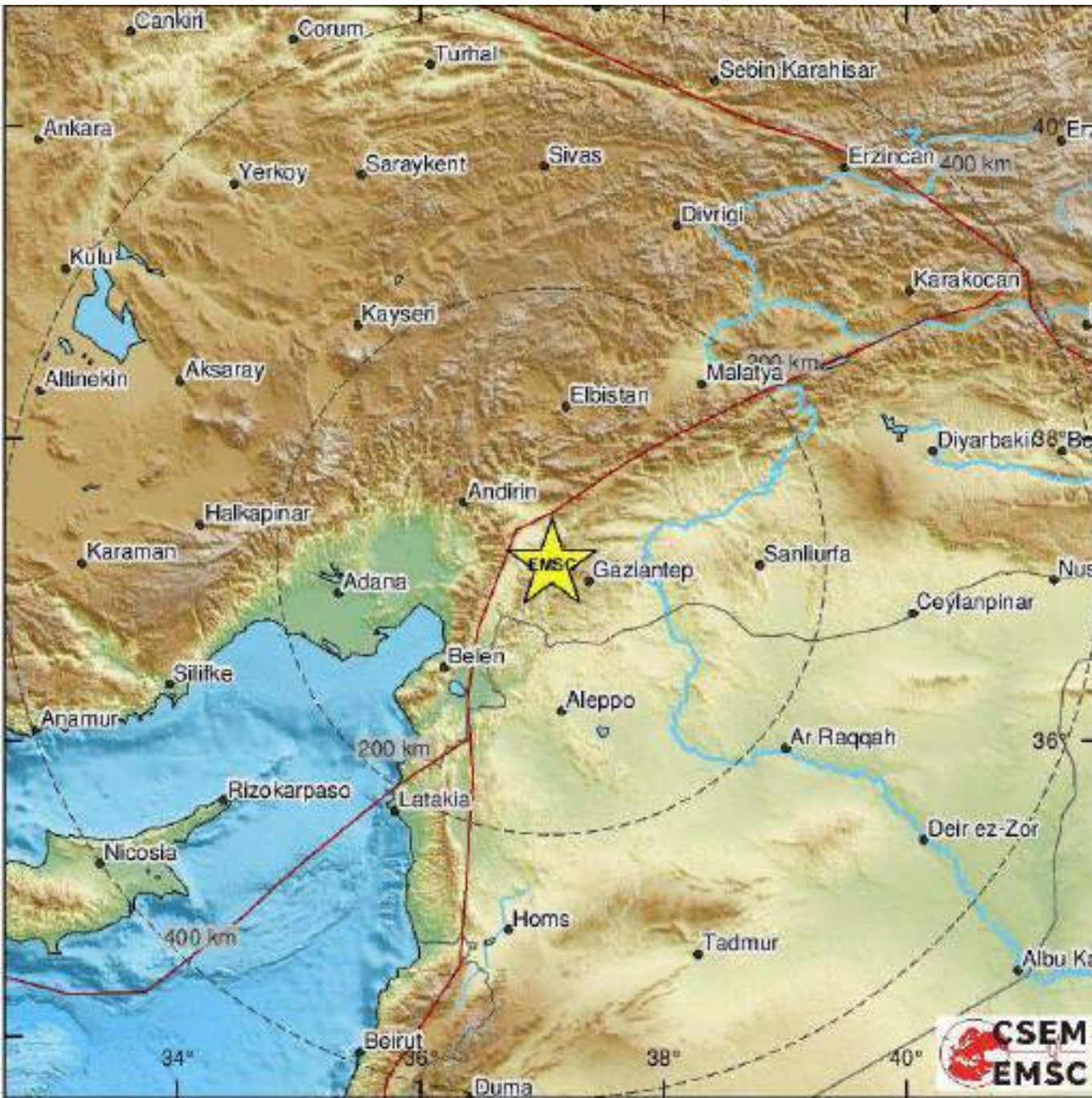
M7.8 mainshock





Source: Jascha Polet

The 1st mainshock of M7.8



Depth

- ★ 0 - 40 km
- ★ 40 - 80 km
- ★ 80 - 150 km
- ★ 150 - 300 km
- ★ > 300 km



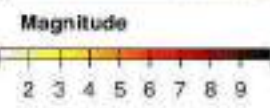
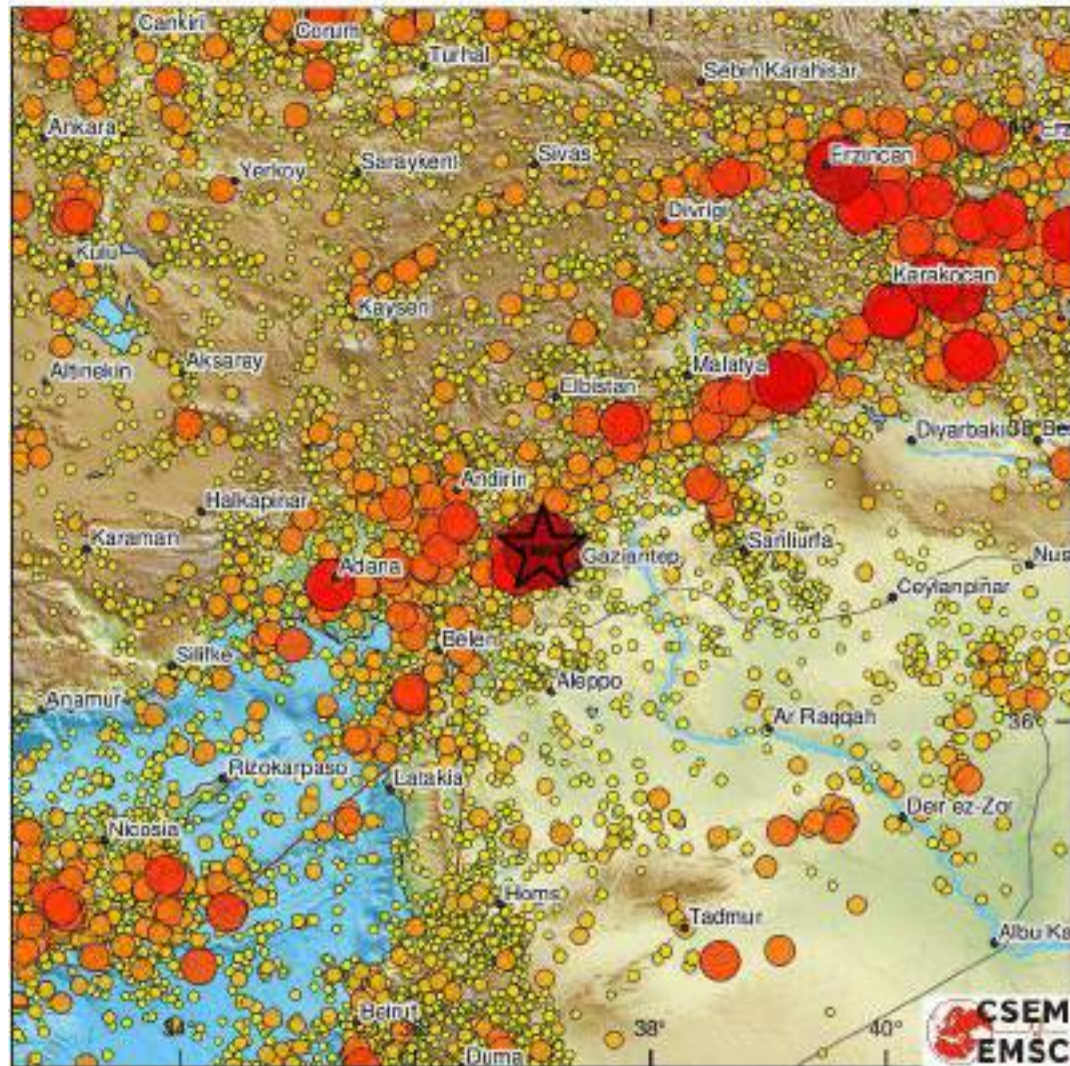
EMSC manual location

M: 7.8 2023/02/06 - 01:17:36 UTC

Lat: 37.17 Lon: 37.08 Depth: 20 km

Background data: ISC + EMSC catalogues from 1960 to 06/02/2023 01:00

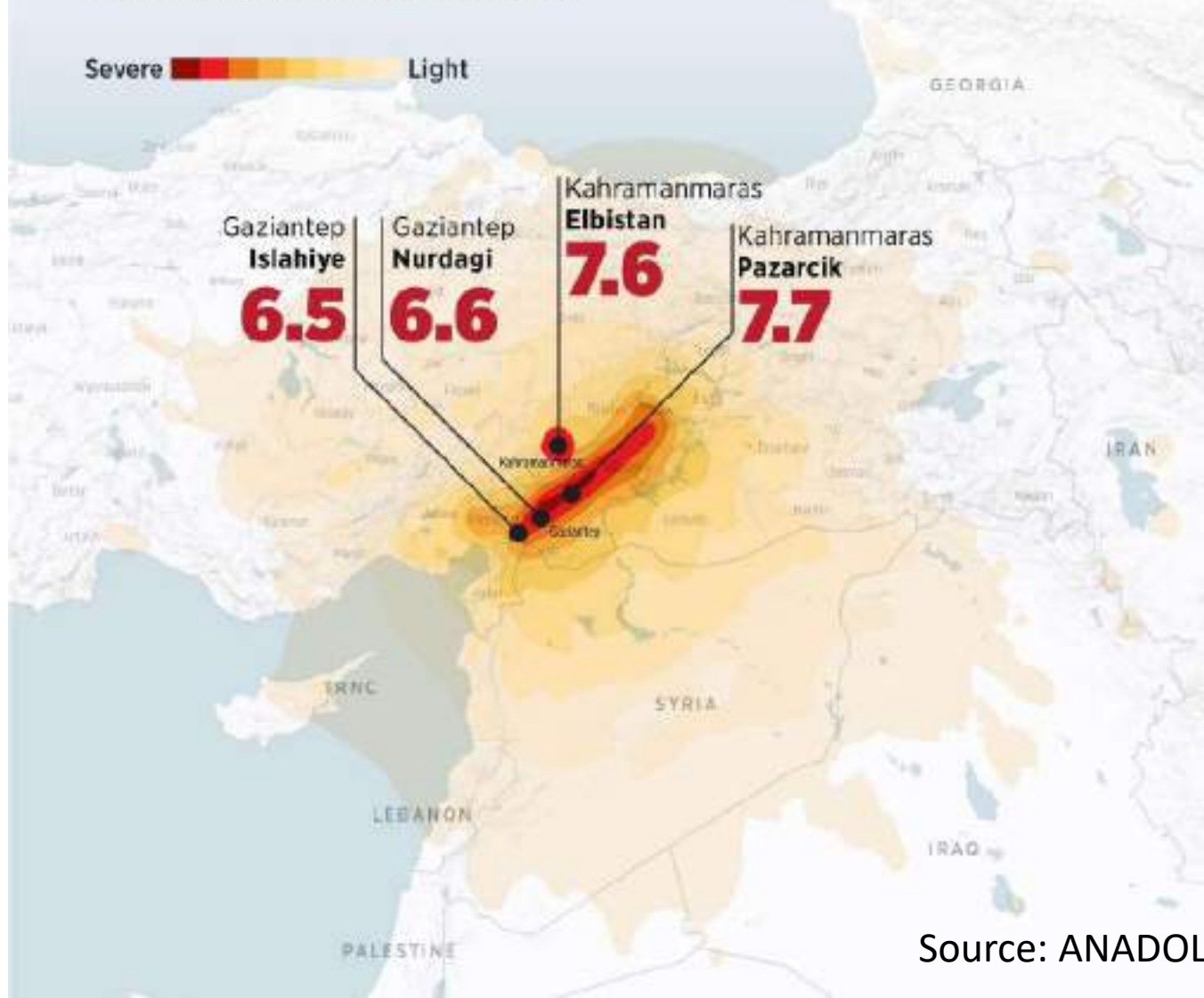
(Total number of events with M>3: 18778)



Last updated: 2023-02-06 at 08:21 UTC

Impact area of earthquakes in Türkiye

Earthquakes in Türkiye's southern region also felt in Syria, Egypt, Lebanon, Northern Cyprus and Iraq

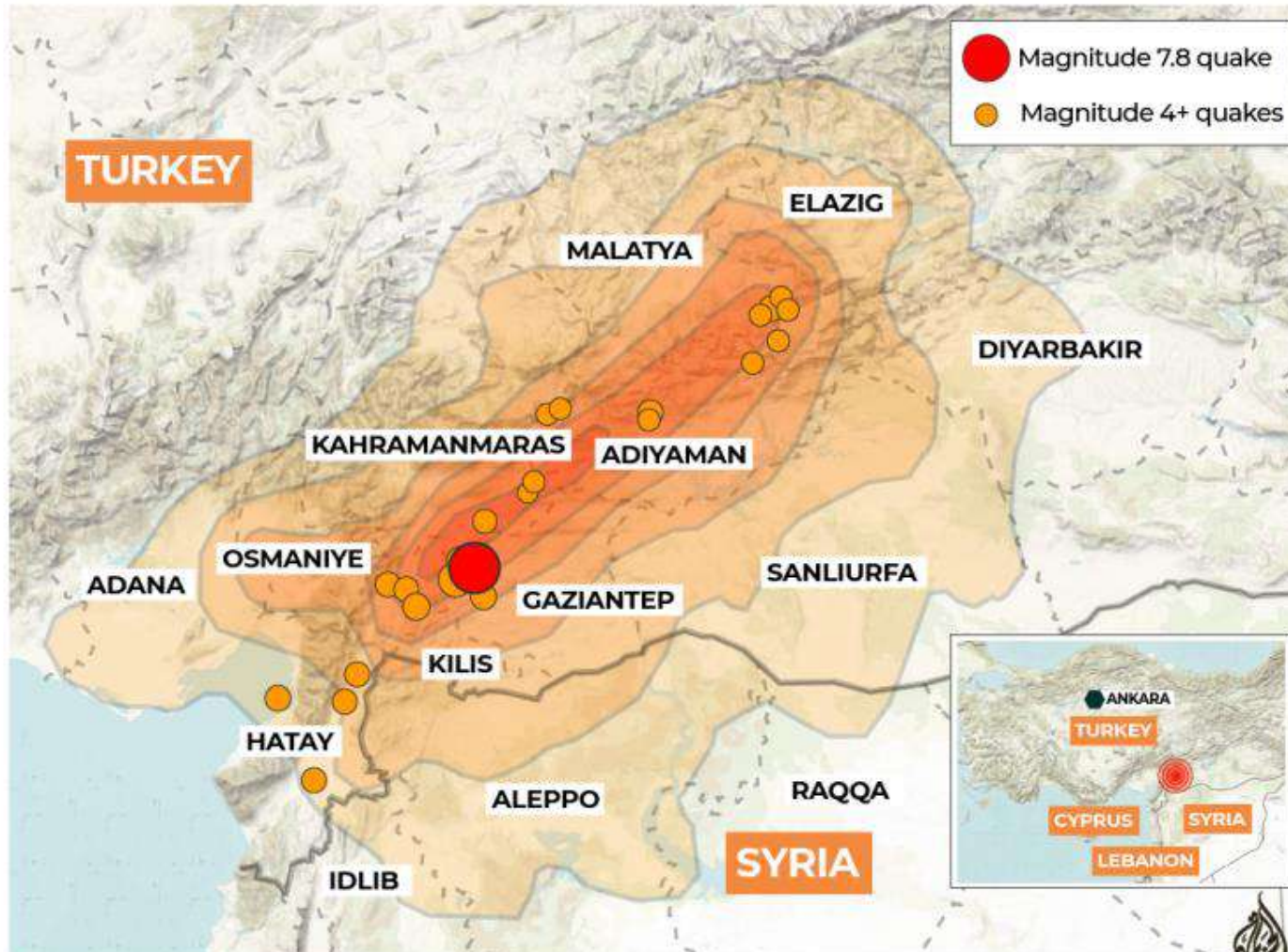


Source: ANADOLU AGENCY

EARTHQUAKE

Hundreds dead in Turkey, Syria earthquake

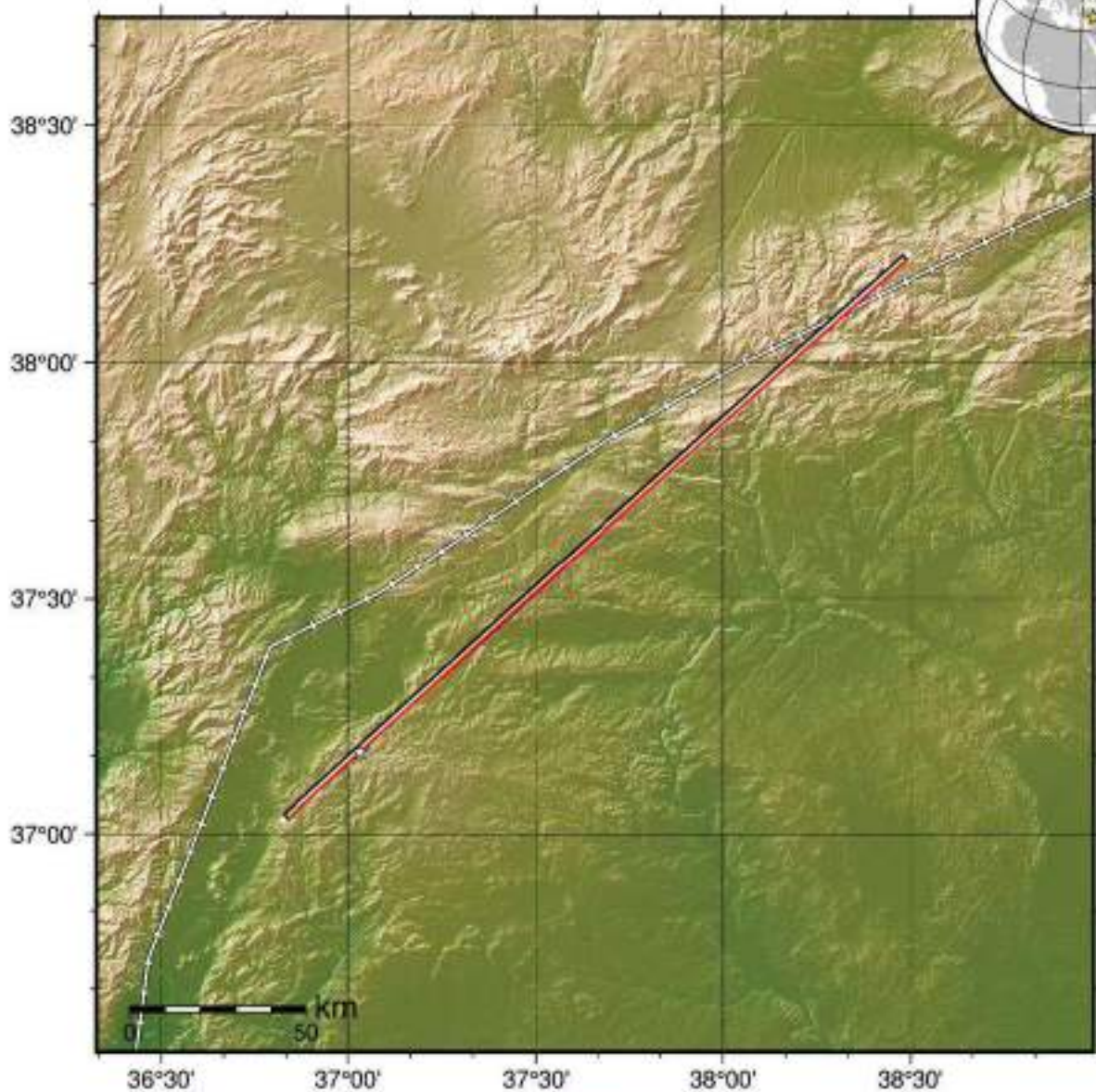
Hundreds of people are dead and more than 1,700 buildings have collapsed after a magnitude 7.8 earthquake struck the southeastern region of Turkey along the border with Syria. Tremors were also felt across Lebanon and Cyprus.



©Mapbox, ©OpenStreetMap

Source: Al Jazeera | Updated: February 6, 2023

©AJLabs ALJAZEERA



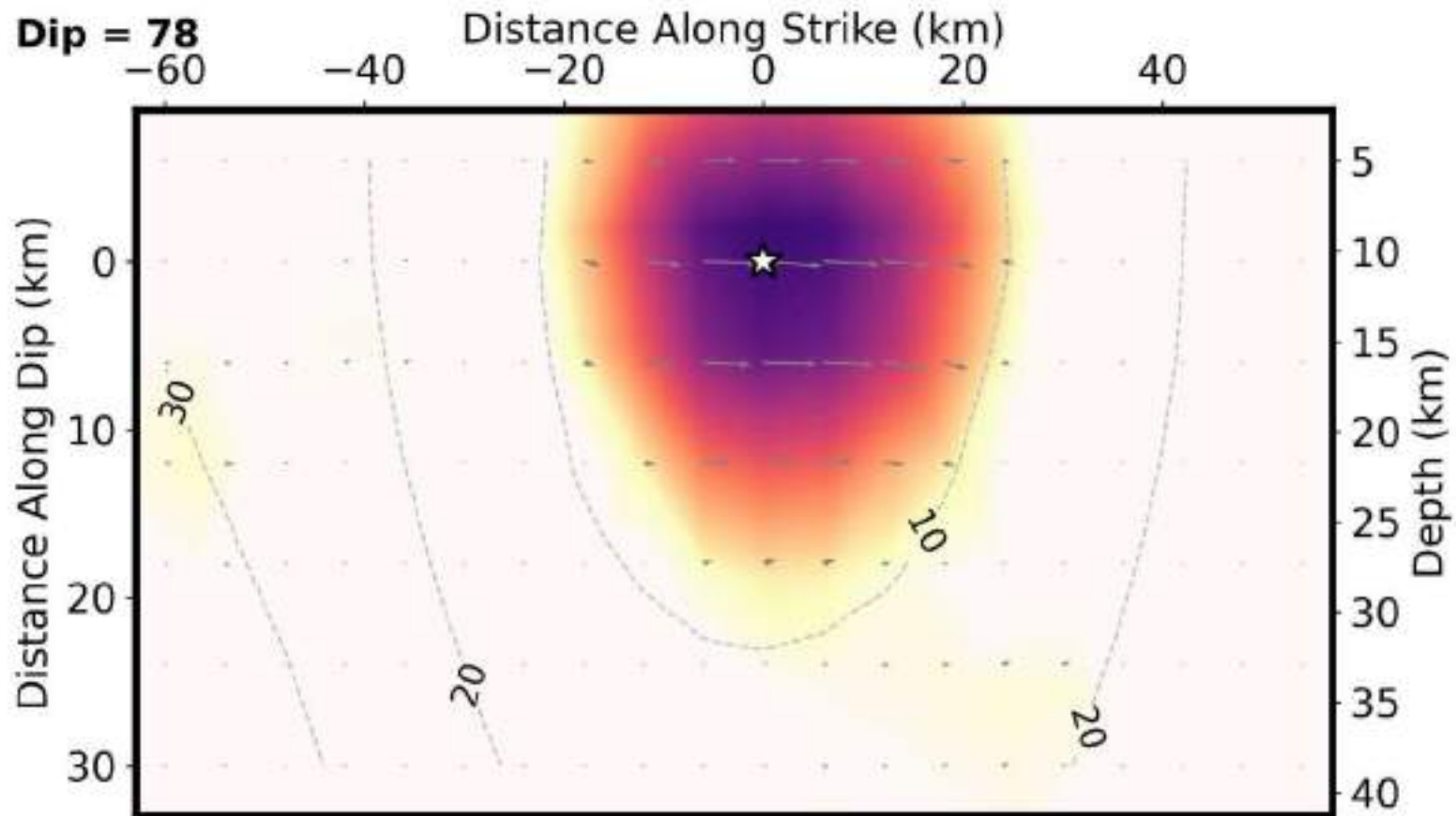
Surface projection of the fault that ruptured during the 6 Feb 2023 morning magnitude 7.8 quake in southern Turkey; white line is the plate boundary between Anatolia (north) and Arabia.
Source: USGS



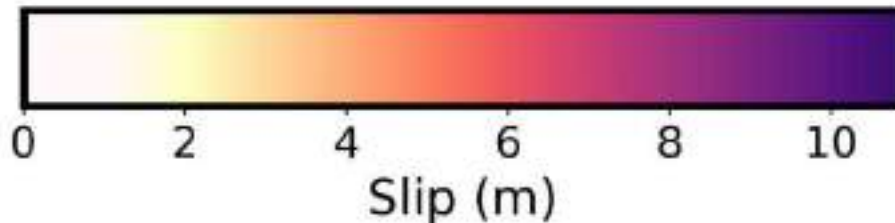
Slip distribution Cross-section of 2nd shock M_w 7.5

Strike = 277

Dip = 78



Rupture Front Contours Plotted Every 10 s

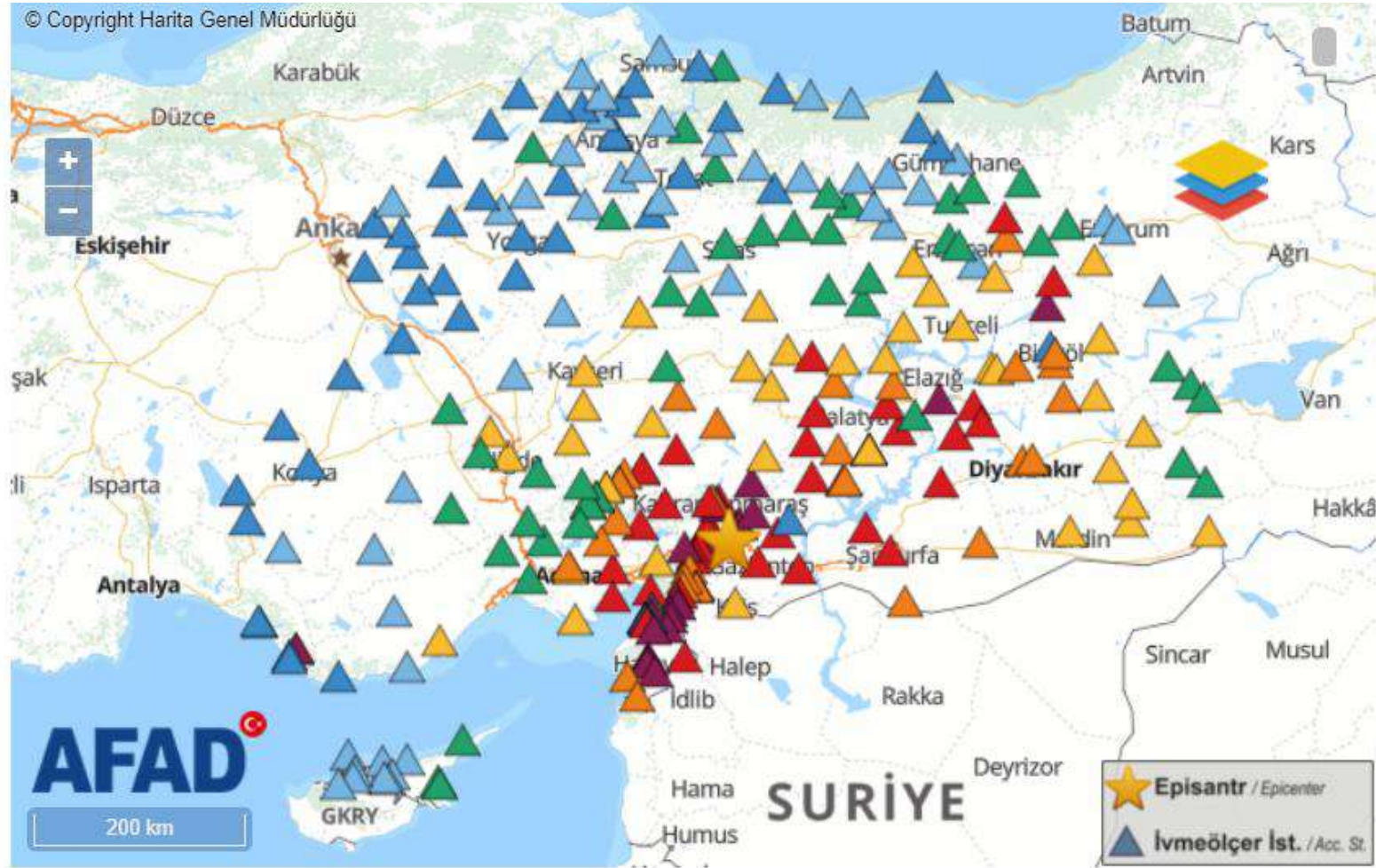


Source: USGS

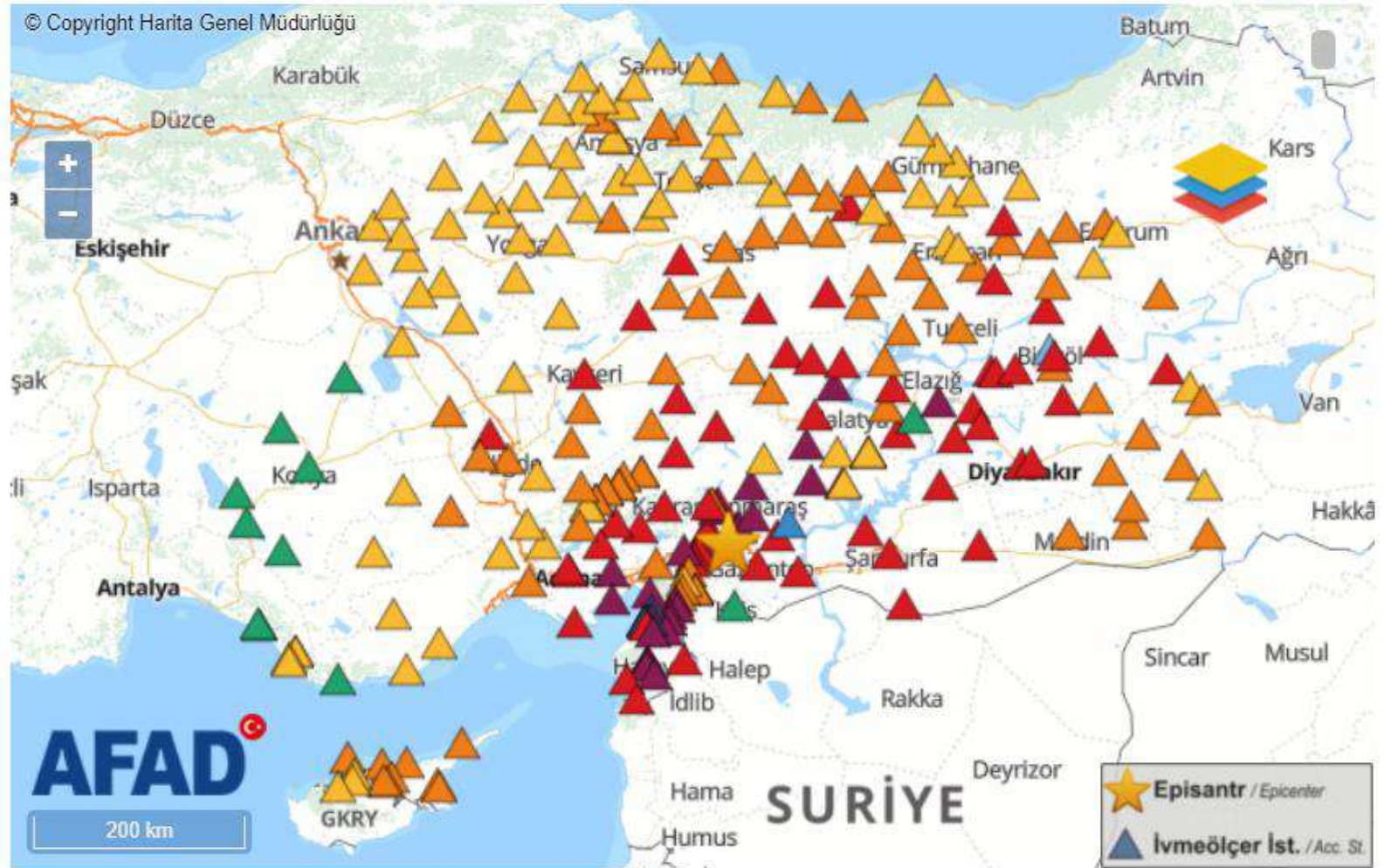
Strong Motions Recordings:

ACCELEROGRAMS

1st Mainshock: M_w 7.8 (6 February 2023 at 01:17)



1st Mainshock: M_w 7.8 (6 February 2023 at 01:17)



Distribution by: PGA (cm/s²) PGV (cm/s) PGD (cm)

Legend

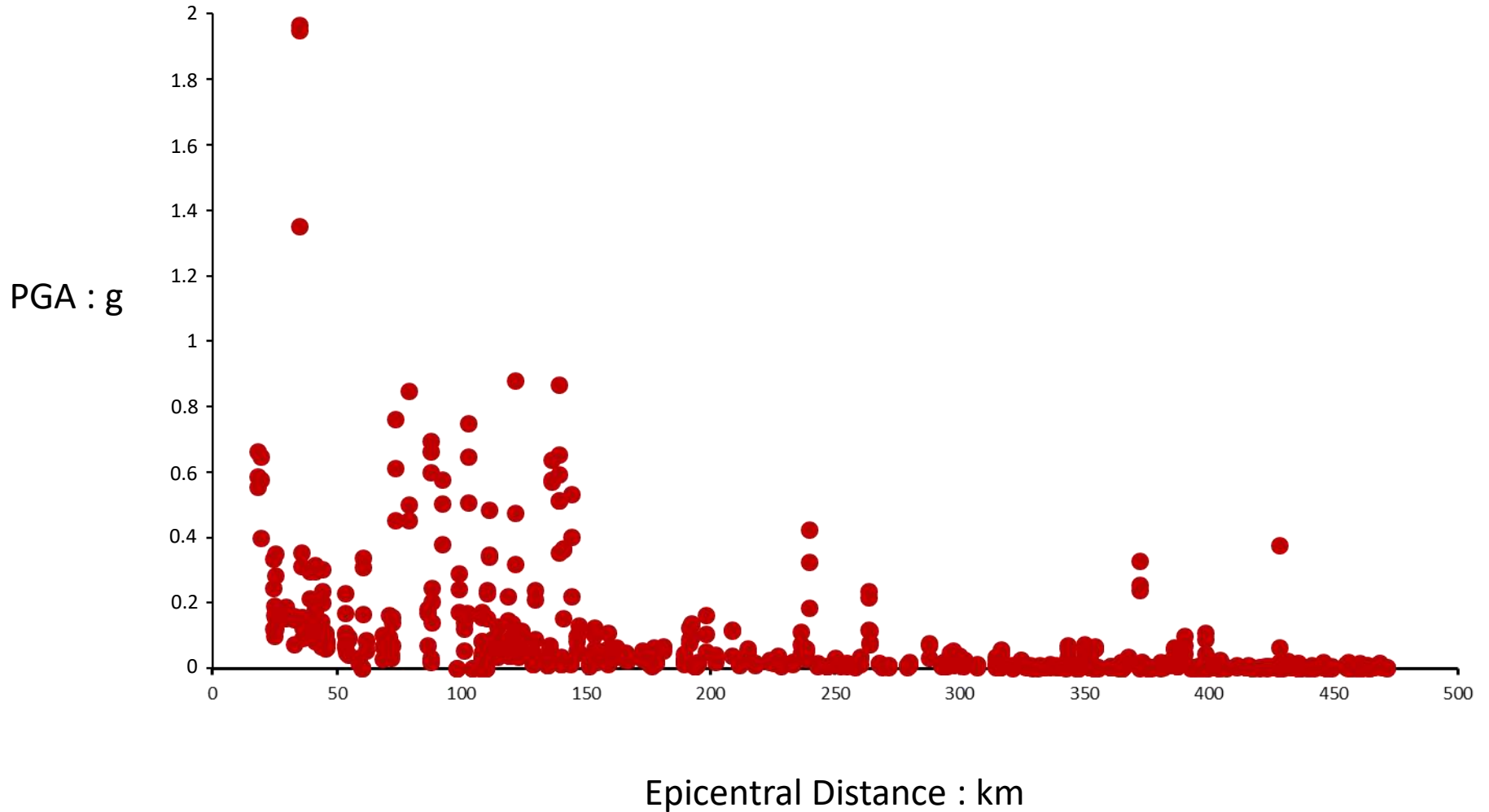


1st Shock: M_w 7.8

Accelerograms recorded by AFAD with $PGA > 0.30$ g

Station Code	R_{epi} : km	PGA_{NS} : g	PGA_{EW} : g	PGA_{UD} : g
4614	35	1.949	1.967	1.353
3123	139	0.655	0.594	0.868
3142	103	0.647	0.750	0.506
NAR	19	0.647	0.579	0.399
3144	74	0.611	0.763	0.452
3145	88	0.600	0.696	0.663
4615	18	0.588	0.556	0.665
3139	92	0.577	0.505	0.379
3124	136	0.572	0.638	0.578
3136	144	0.534	0.402	0.220
3132	139	0.515	0.515	0.354
3146	111	0.484	0.347	0.341
201	122	0.474	0.880	0.319
3137	79	0.453	0.848	0.502
3131	141	0.363	0.366	0.154
4624	36	0.354	0.313	0.156
4632	25	0.353	0.286	0.188
4611	60	0.339	0.311	0.165
4629	24	0.337	0.247	0.122

Peak recorded ground acceleration VS epicentral Distance for the 1st Mainshock of M_w 7.8

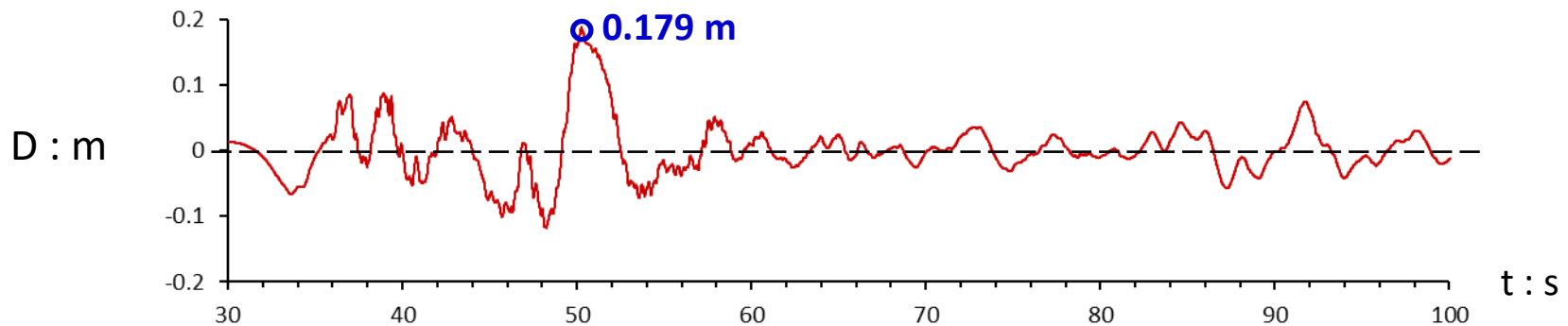
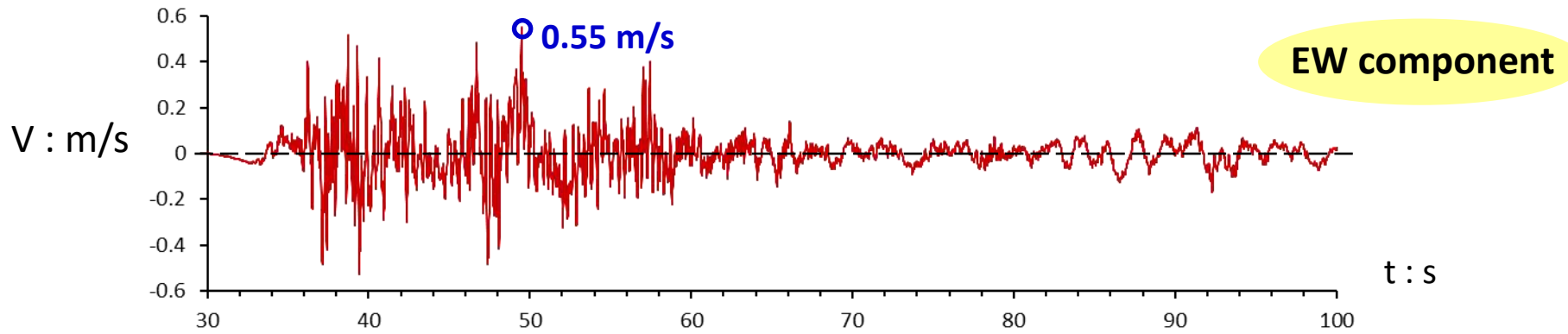
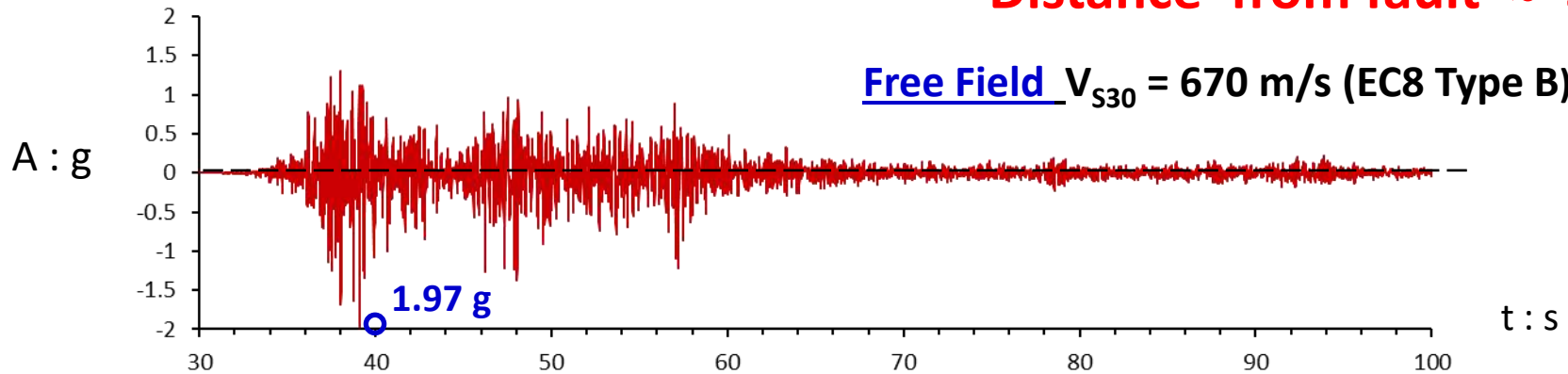


1st Mainshock M_w 7.8

Station 4614: at **Kahramanmaras**

Distance from fault \approx 3 km

Free Field $V_{S30} = 670$ m/s (EC8 Type B)

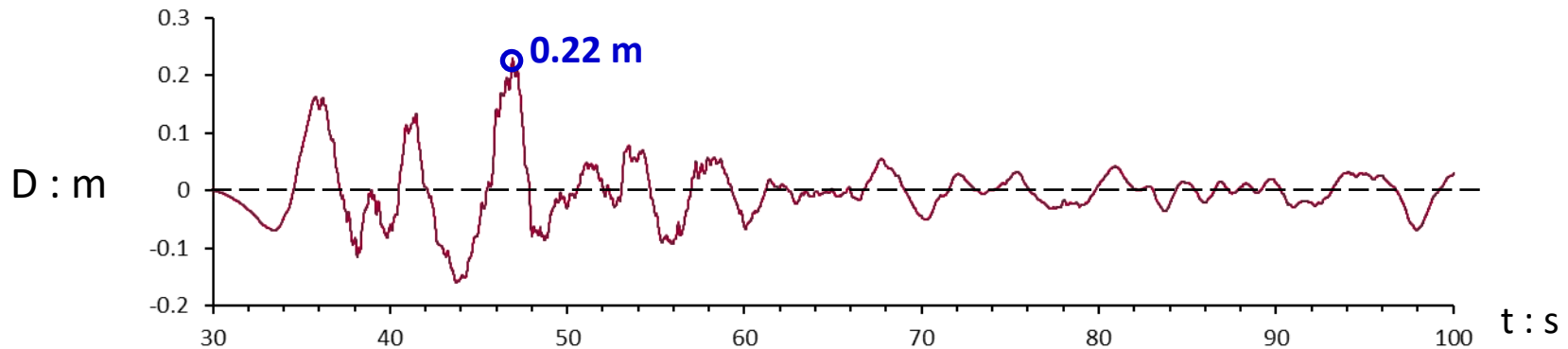
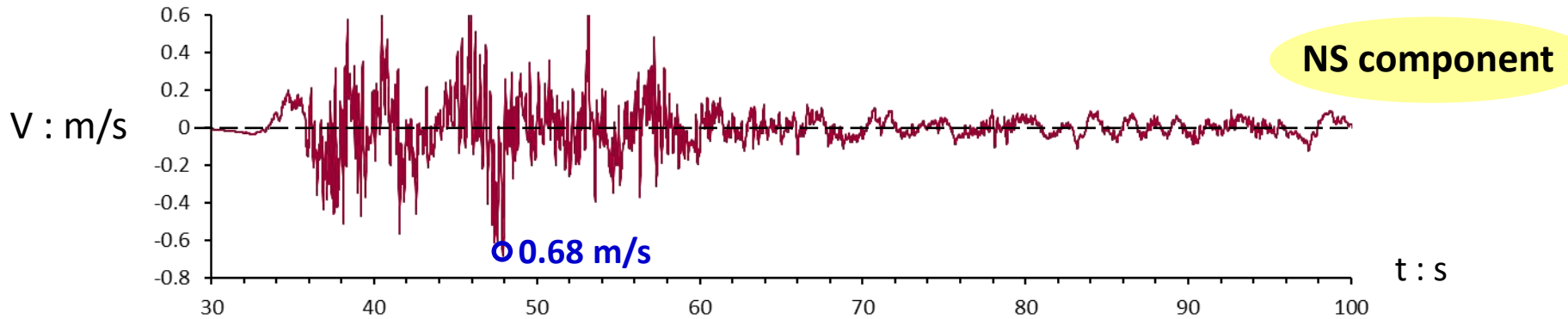
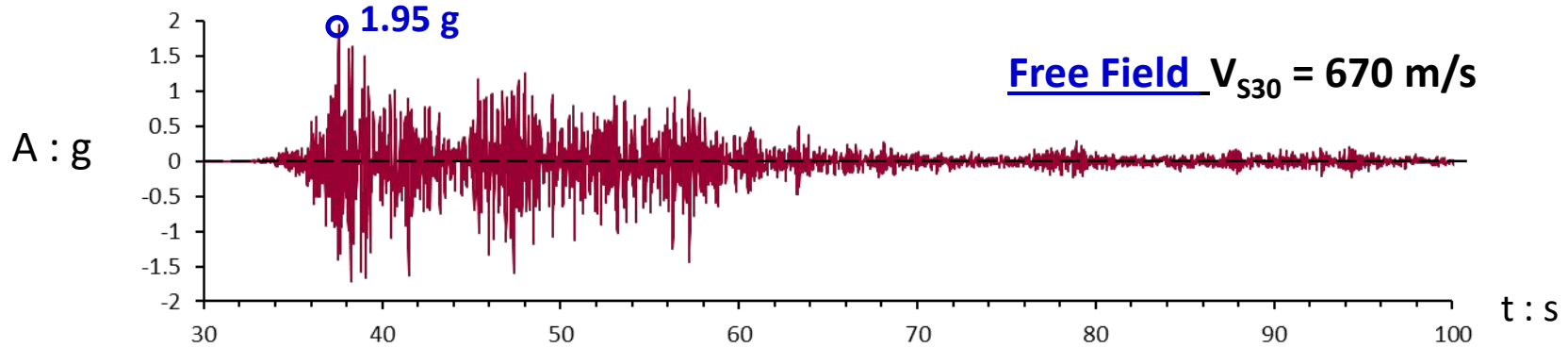


1st Mainshock M_w 7.8

Station 4614: at **Kahramanmaras**

Distance from fault \approx 3 km

Free Field $V_{S30} = 670$ m/s

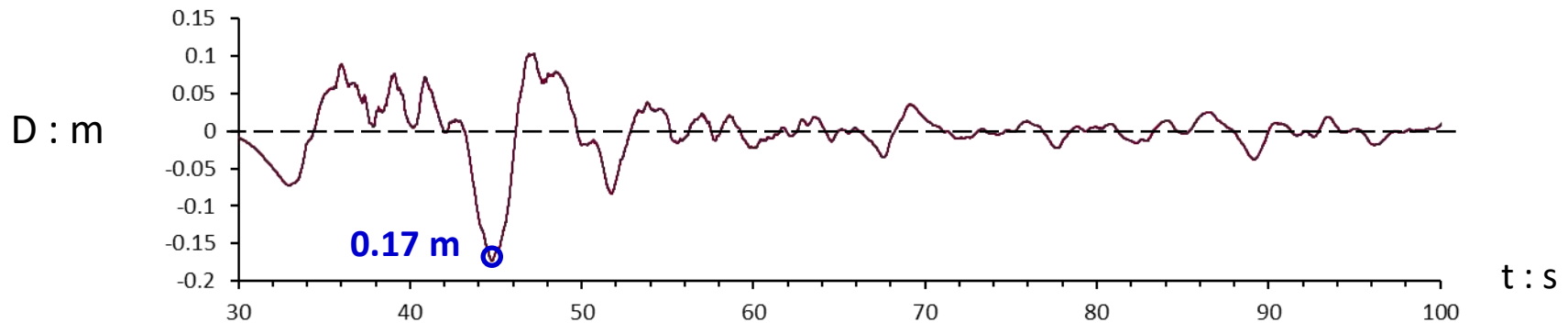
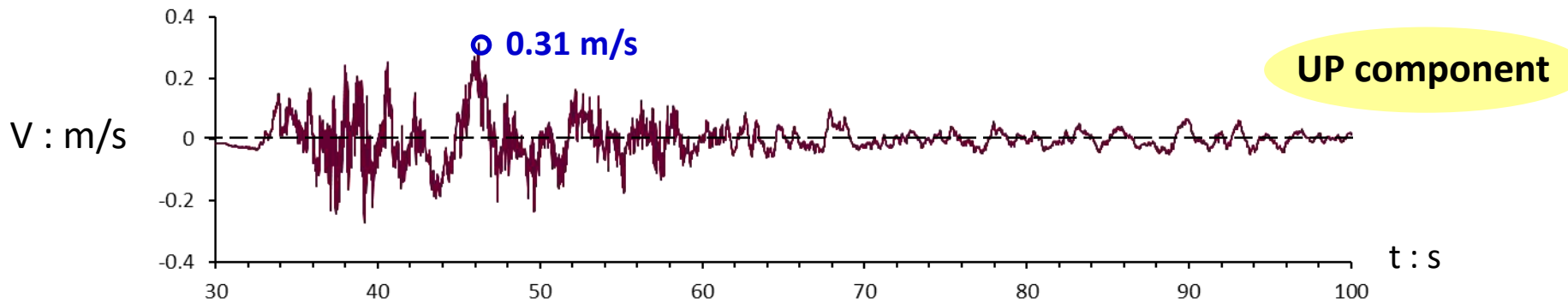
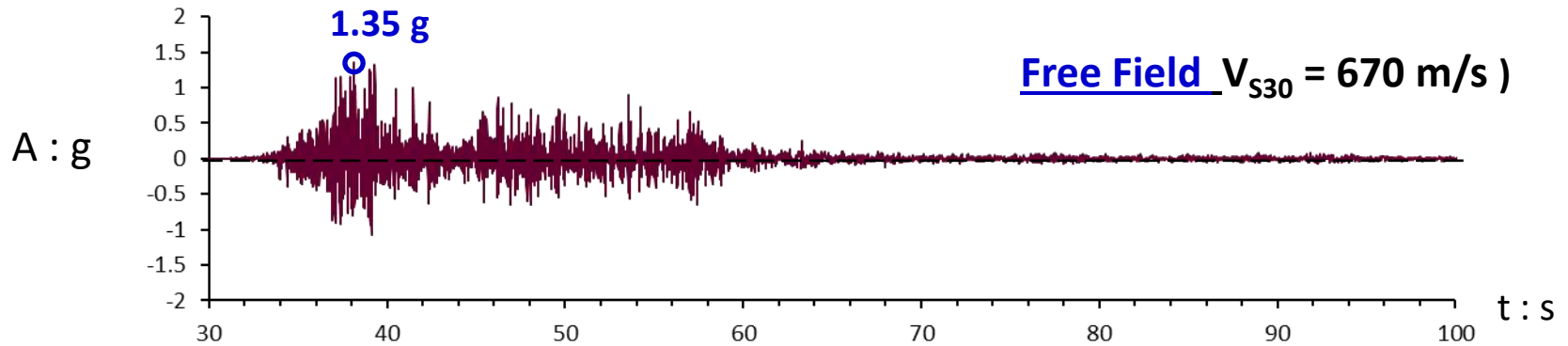


1st Mainshock M_w 7.8

Station 4614: at **Kahramanmaras**

Distance from fault \approx 3 km

Free Field $V_{S30} = 670$ m/s)

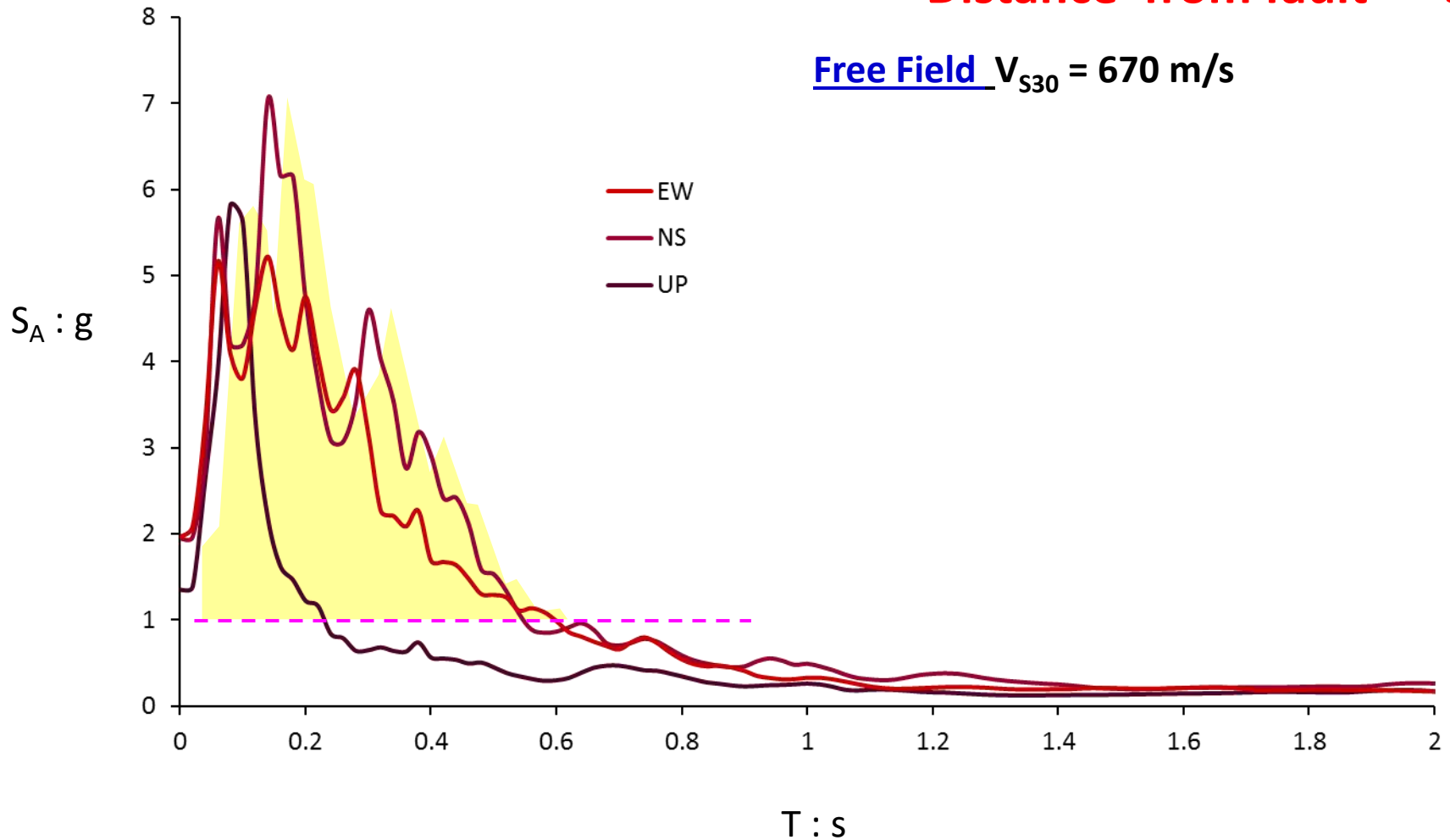


1st Mainshock M_w 7.8

Station 4614: at **Kahramanmaras**

Distance from fault \approx 3 km

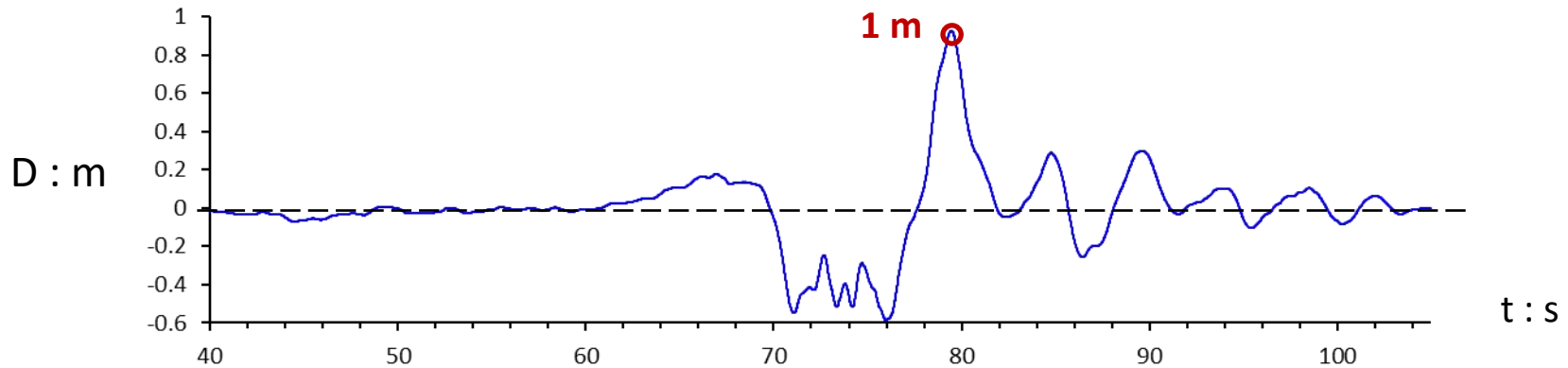
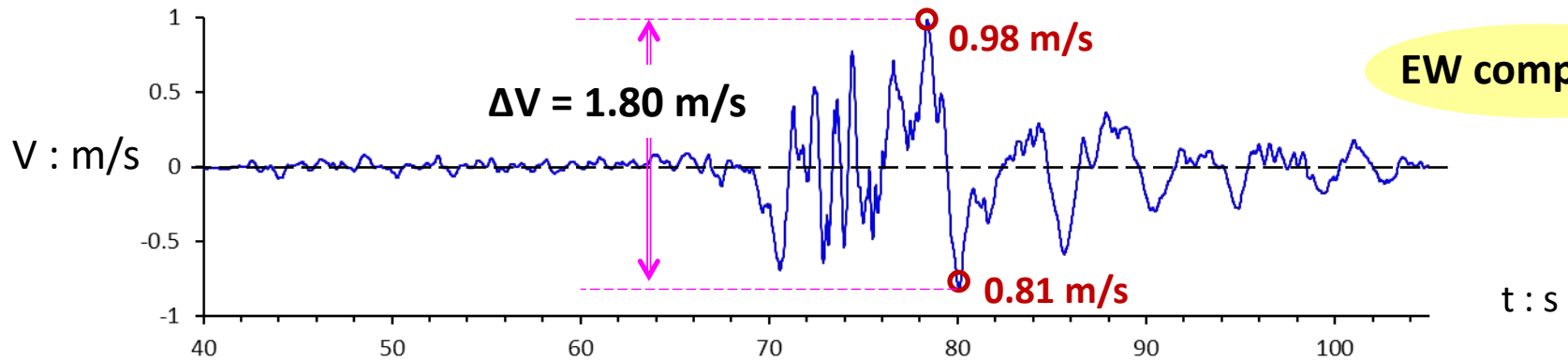
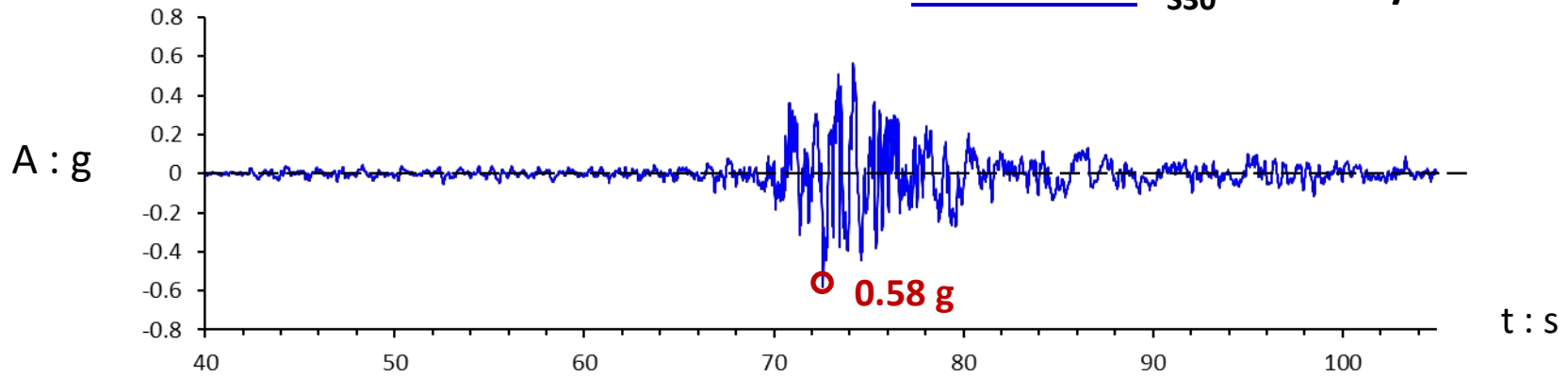
Free Field $V_{s30} = 670$ m/s



1st Mainshock $M_W 7.8$

Station 3123: at **Pazarck**

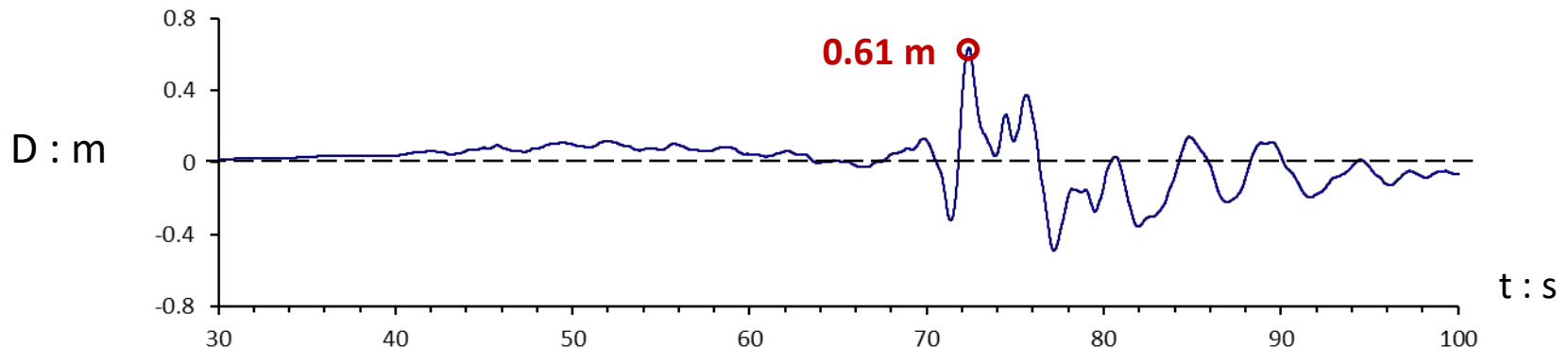
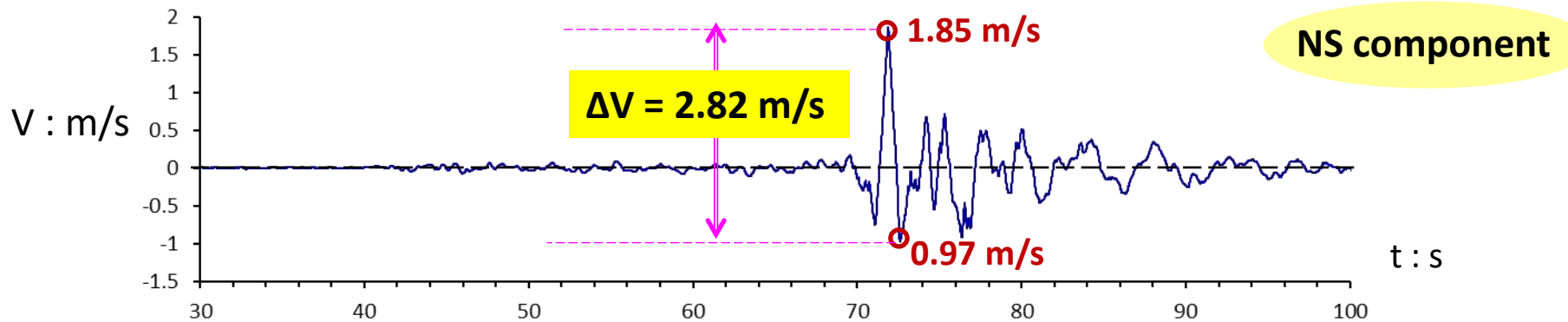
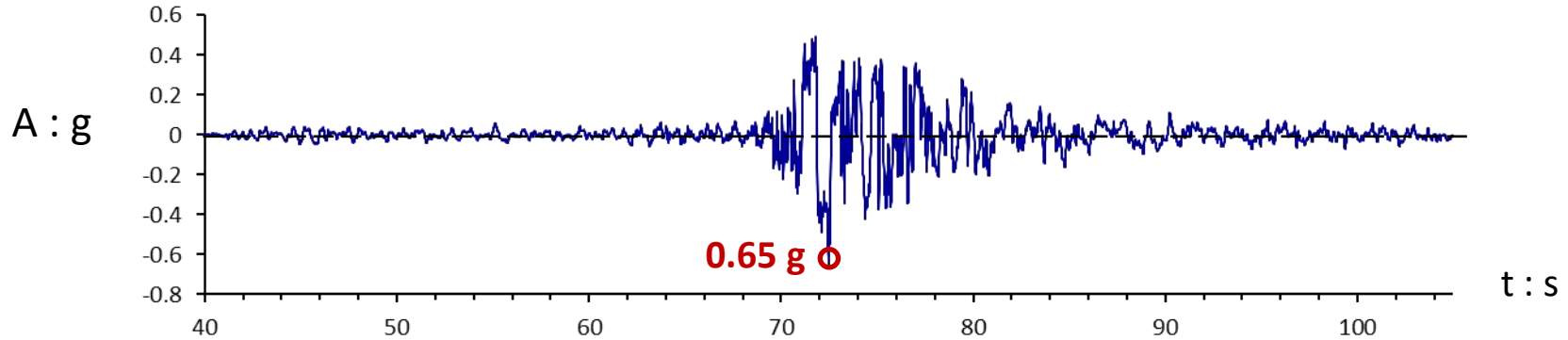
Free Field $V_{S30} = 470 \text{ m/s}$



1st Mainshock $M_w 7.8$

Station 3123: at **Pazarck**

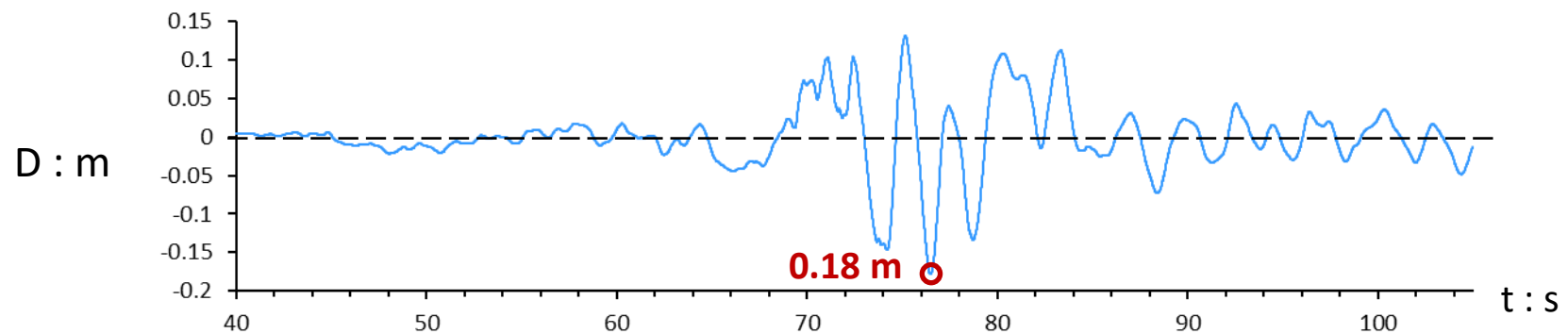
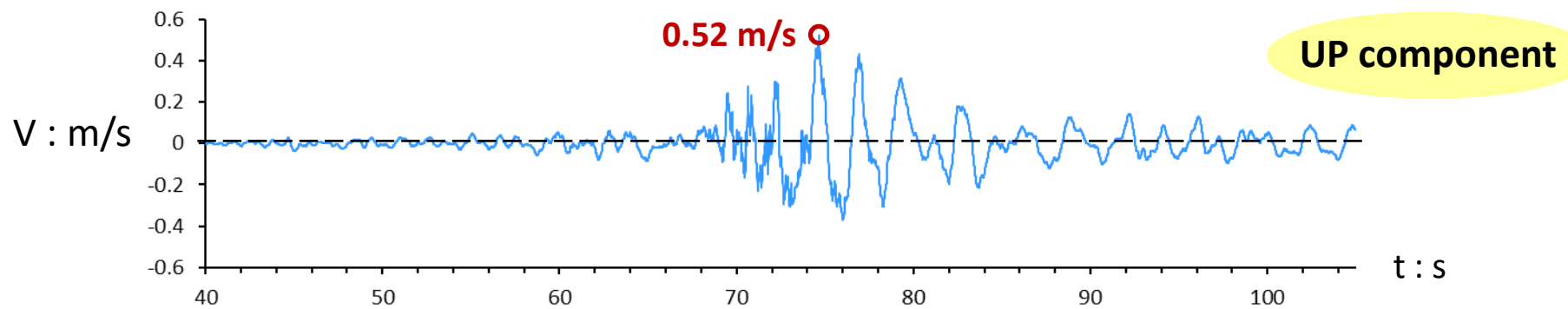
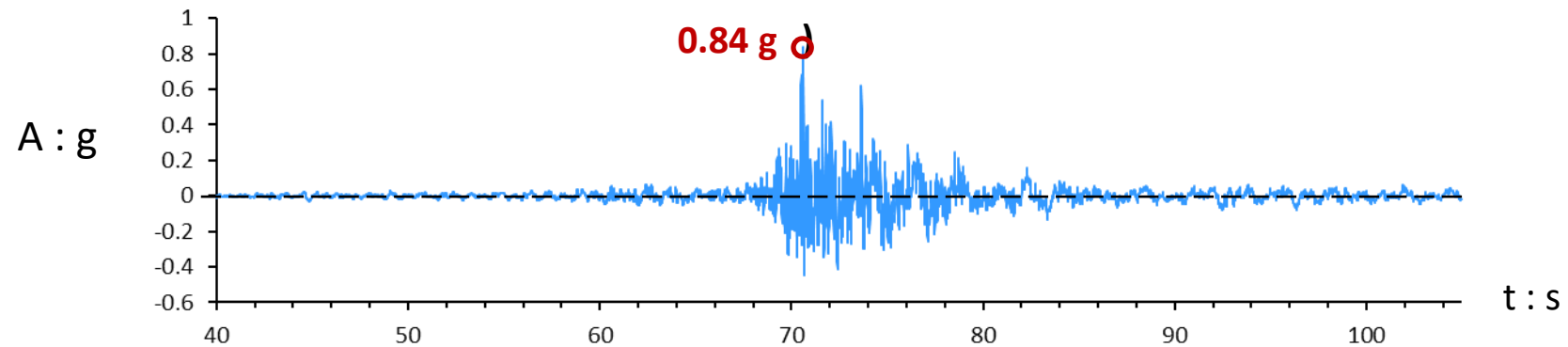
Free Field $V_{S30} = 470 \text{ m/s}$



1st Mainshock M_w 7.8

Station 3123: at **Pazarck**

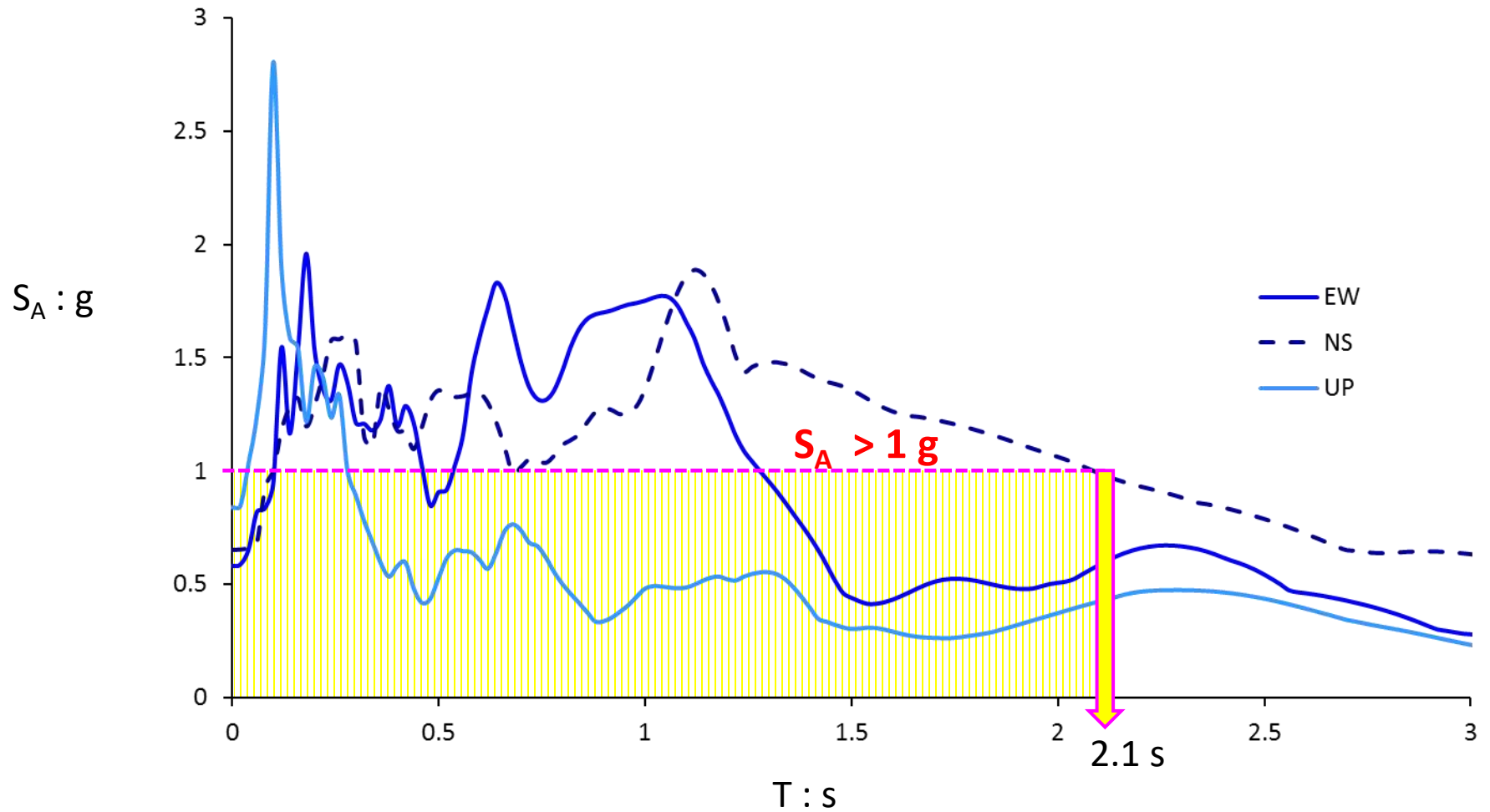
Free Field $V_{S30} = 470$ m/s



1st Mainshock $M_w 7.8$

Station 3123: at at **Pazarck**

Free Field $V_{s30} = 470$ m/s

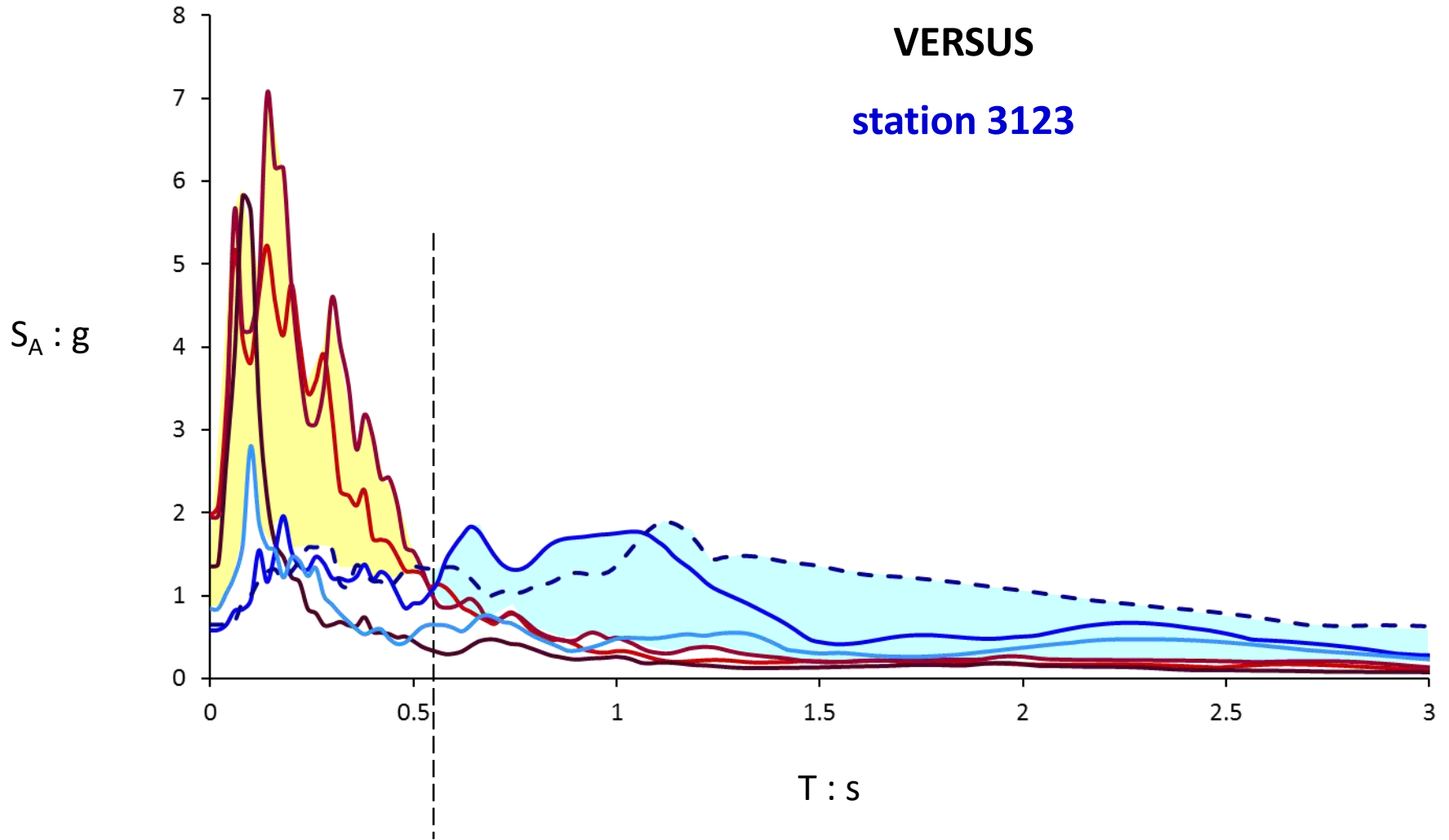


1st Mainshock M_w 7.8

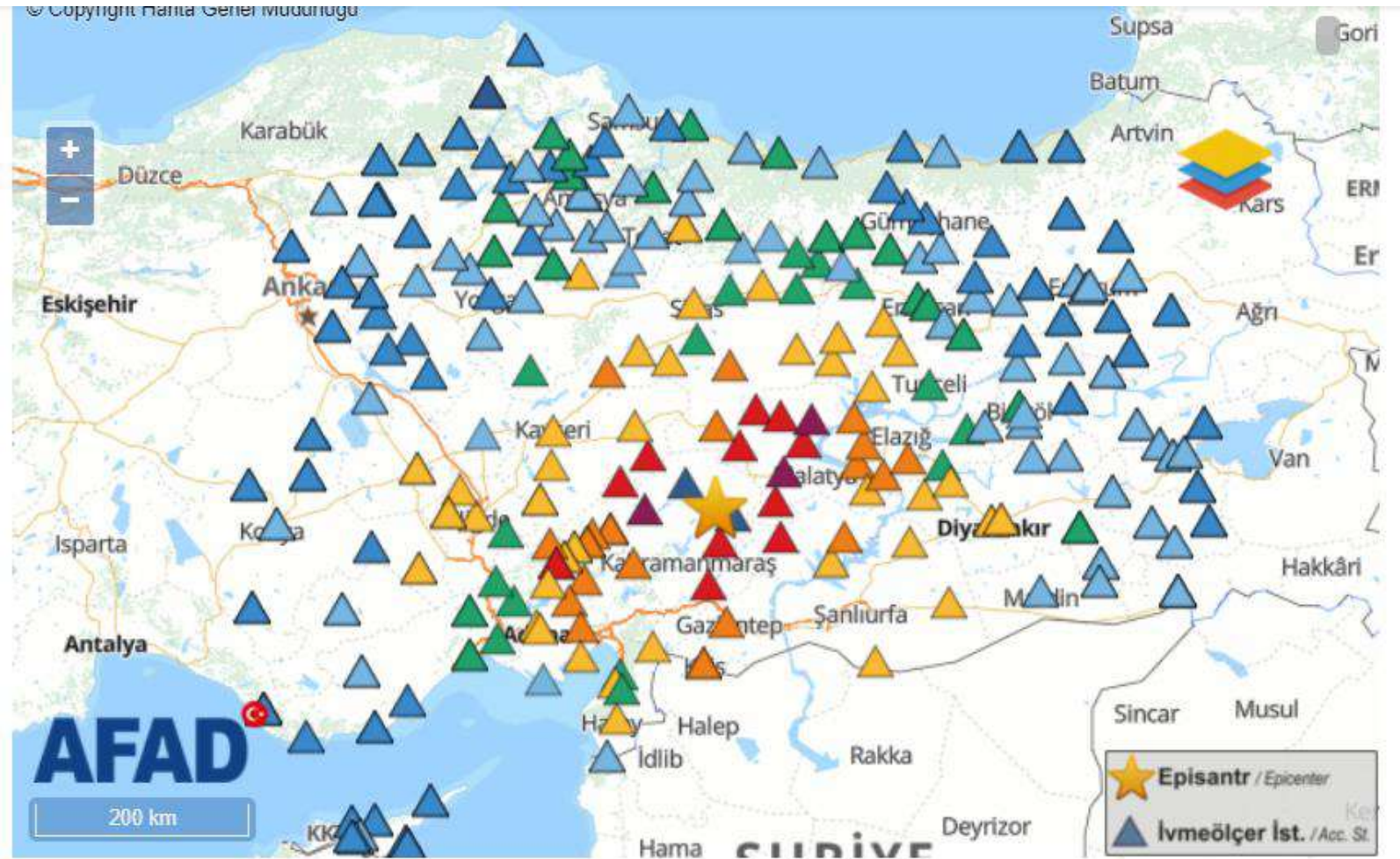
station 4614

VERSUS

station 3123



2nd Shock: M_w 7.5

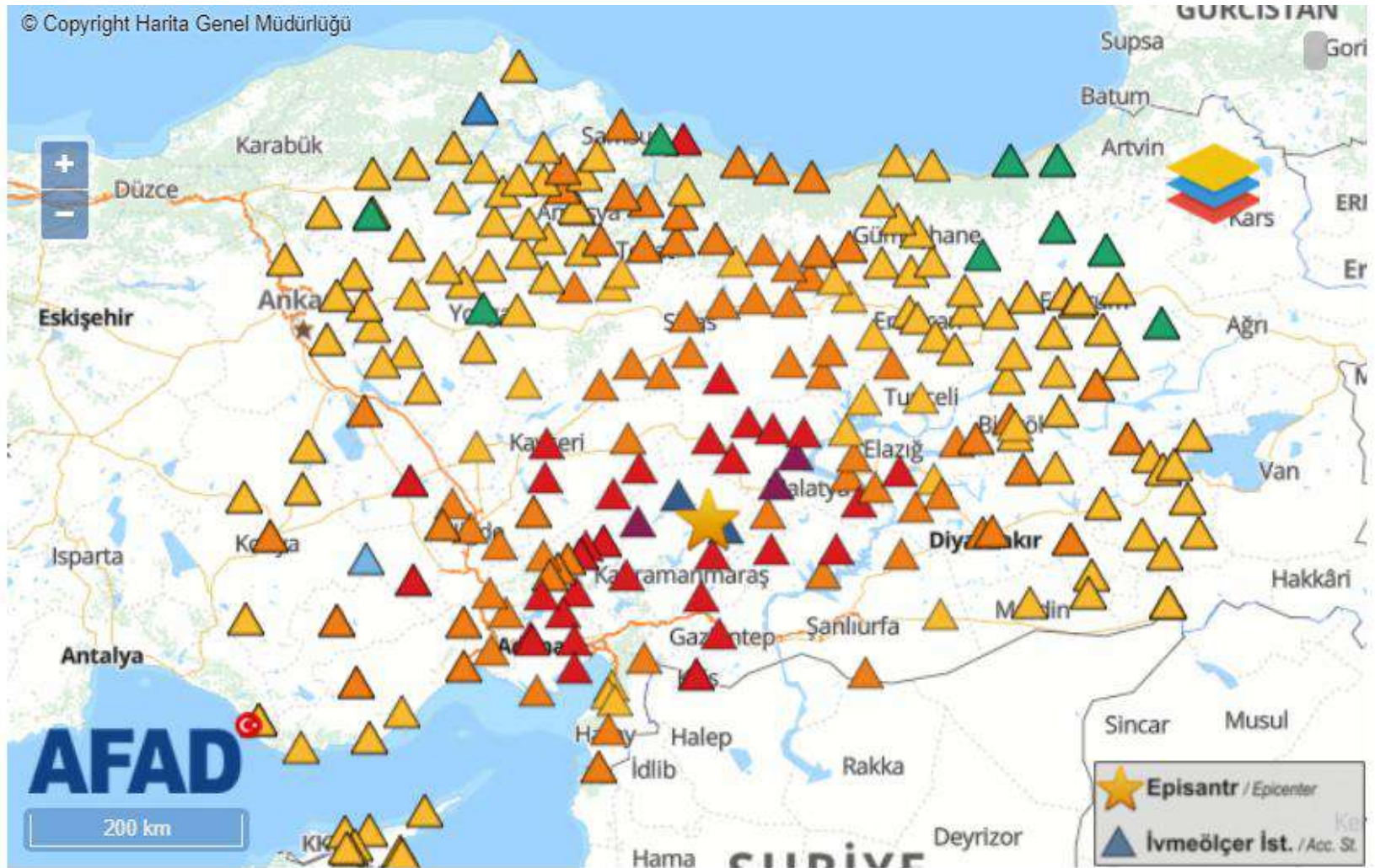


Distribution by: PGA (cm/s²) PGV (cm/s) PGD (cm)

Legend



2nd Mainshock: M_w 7.5 (6 February 2023 at 10:24)



Distribution by: PGA (cm/s²) PGV (cm/s) PGD (cm)

Legend

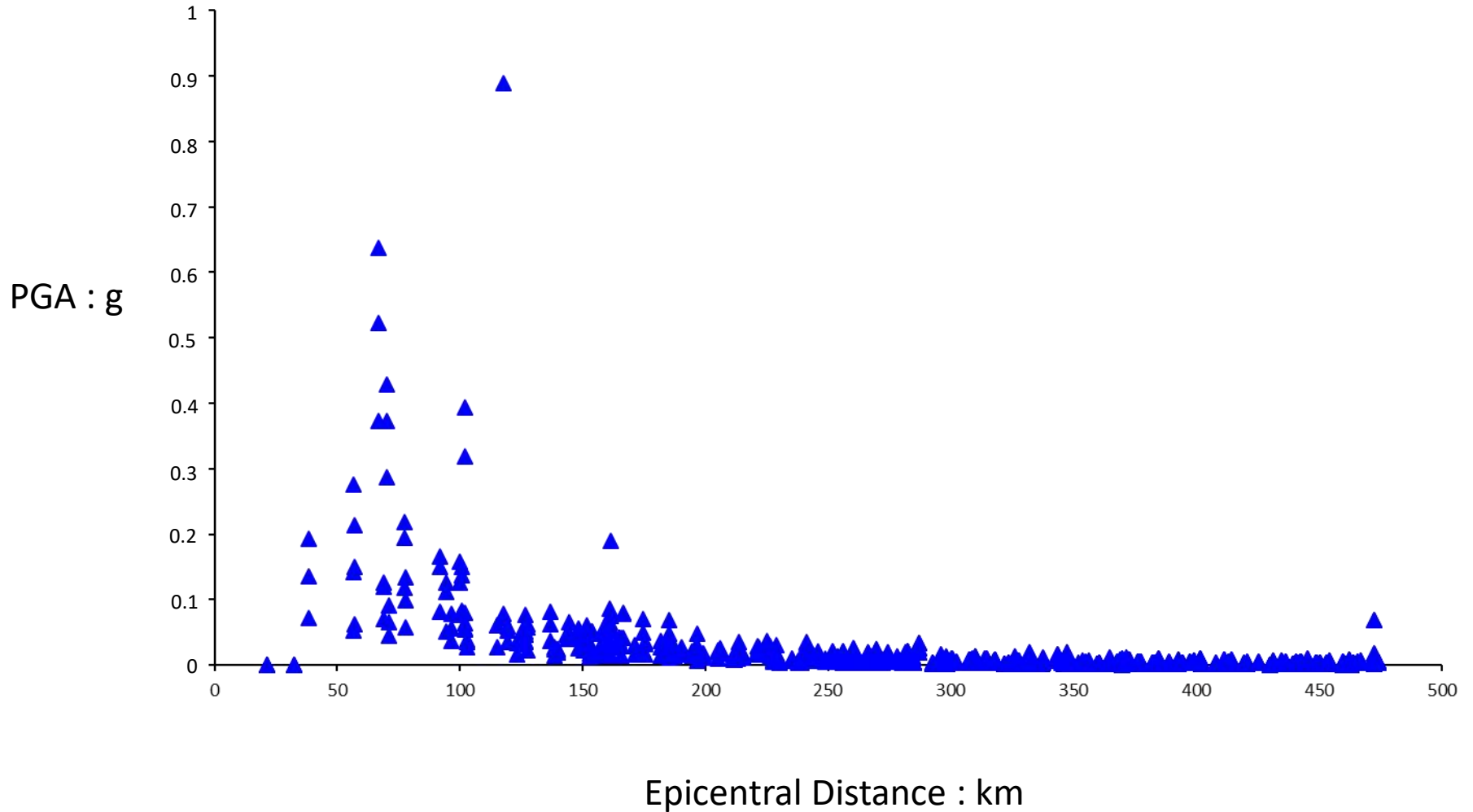


2nd Mainshock: M_w 7.5

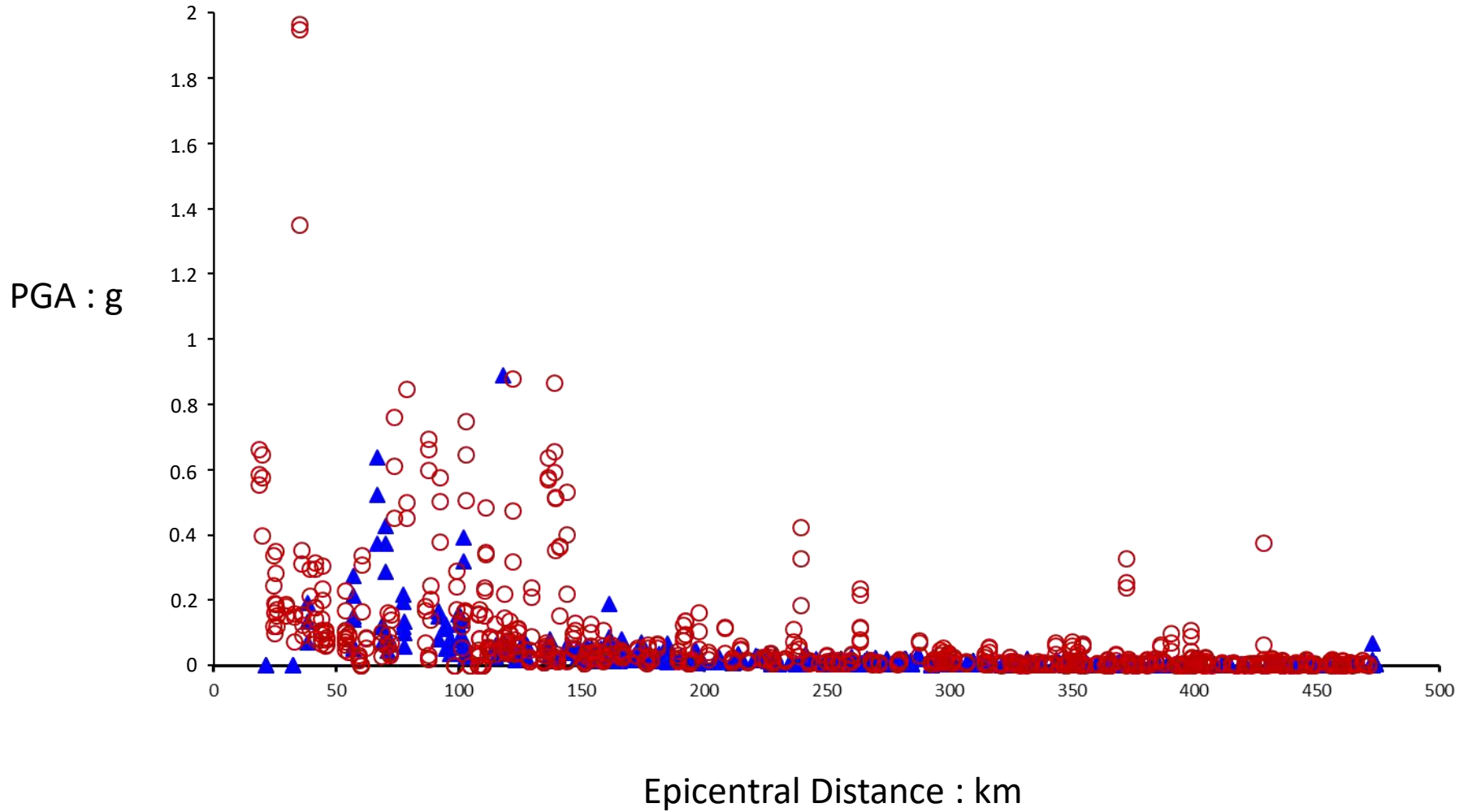
Accelerograms recorded by AFAD with $PGA > 0.15$ g

Station Code	R_{epi} : km	PGA_{NS} : g	PGA_{EW} : g	PGA_{UD} : g
4612	67	0.638	0.523	0.373
4406	70	0.428	0.373	0.286
131	102	0.394	0.319	0.079
4409	57	0.214	0.150	0.062
3802	77	0.194	0.219	0.118
4611	38	0.193	0.135	0.072
4412	100	0.157	0.125	0.076
129	92	0.150	0.166	0.081
4405	101	0.137	0.150	0.083
NAR	78	0.134	0.099	0.057
213	69	0.119	0.127	0.070
4410	95	0.112	0.125	0.051
141	161	0.079	0.189	0.074

Peak recorded ground acceleration VS epicentral Distance
for the 2nd Mainshock of M_w 7.5



- 1st mainshock
- ▲ 2nd mainshock



Structural Destruction (Turkey)

Structural Damage in Turkey: An overview

In total, around nearly 5000 buildings collapsed in ten provinces across Turkey. Many buildings were destroyed in Adiyaman and Diyarbakır. In Diyarbakır, a shopping mall collapsed.

About 130 building collapses also occurred in Malatya. The ancient Gaziantep Castle was seriously damaged. Kahramanmaras, a city of more than 1 million people, has been hit hard, as too have Malatya, Hayat region and reports suggest up to 10 major cities heavily affected by collapsing buildings.

In Adana, apartment buildings, one of them 17 stories high, collapsed, killing >> ten people.

In Hatay Province, the runway of Hatay Airport was split and uplifted. Two provincial hospitals and a police station were destroyed, and a gas pipeline exploded

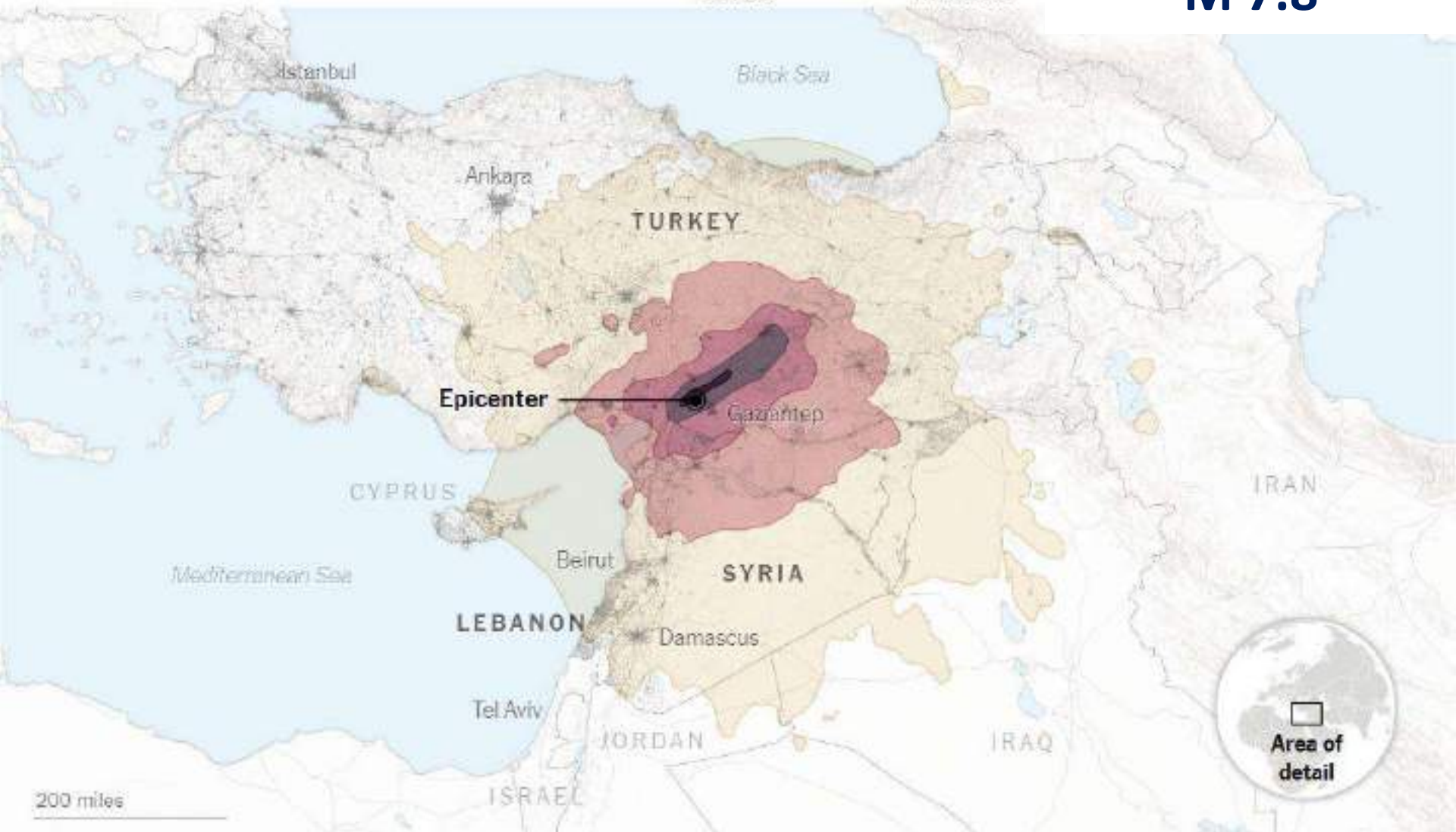
Structural Damage in Syria: An overview

Collapses occurred in the cities of Aleppo, Latakia, and Hama. In Damascus, many people fled from their homes onto the streets. Hundreds were killed. The Crusader-built castle Margat suffered damage, with part of a tower and parts of some walls collapsing. The Citadel of Aleppo was also affected.

The 1st shock of M 7.8

Area affected by the initial earthquake


Shake intensity

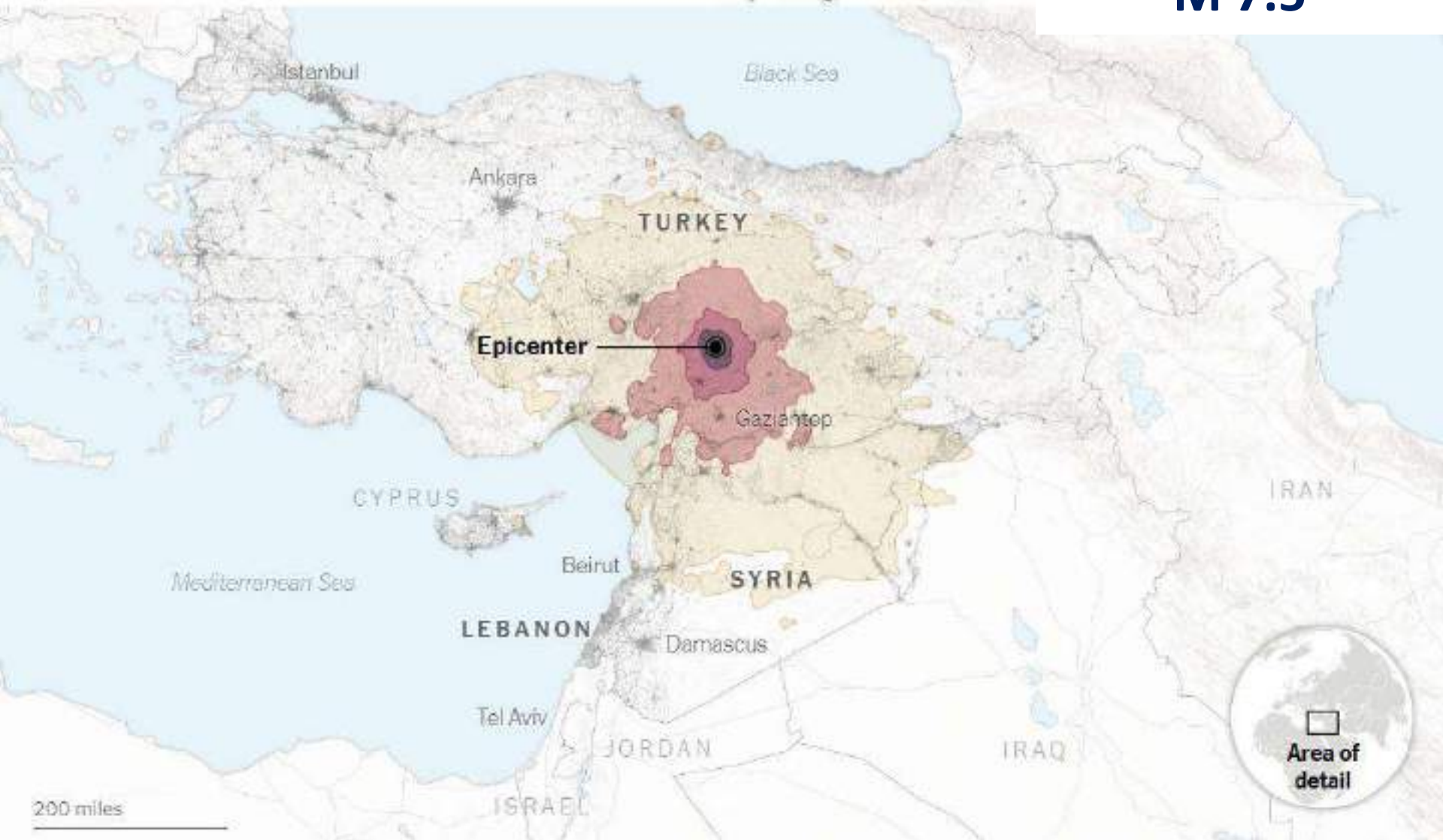


Source: The New York Times & U.S. Geological Survey

Area affected by the second earthquake

The 2nd shock of M 7.5

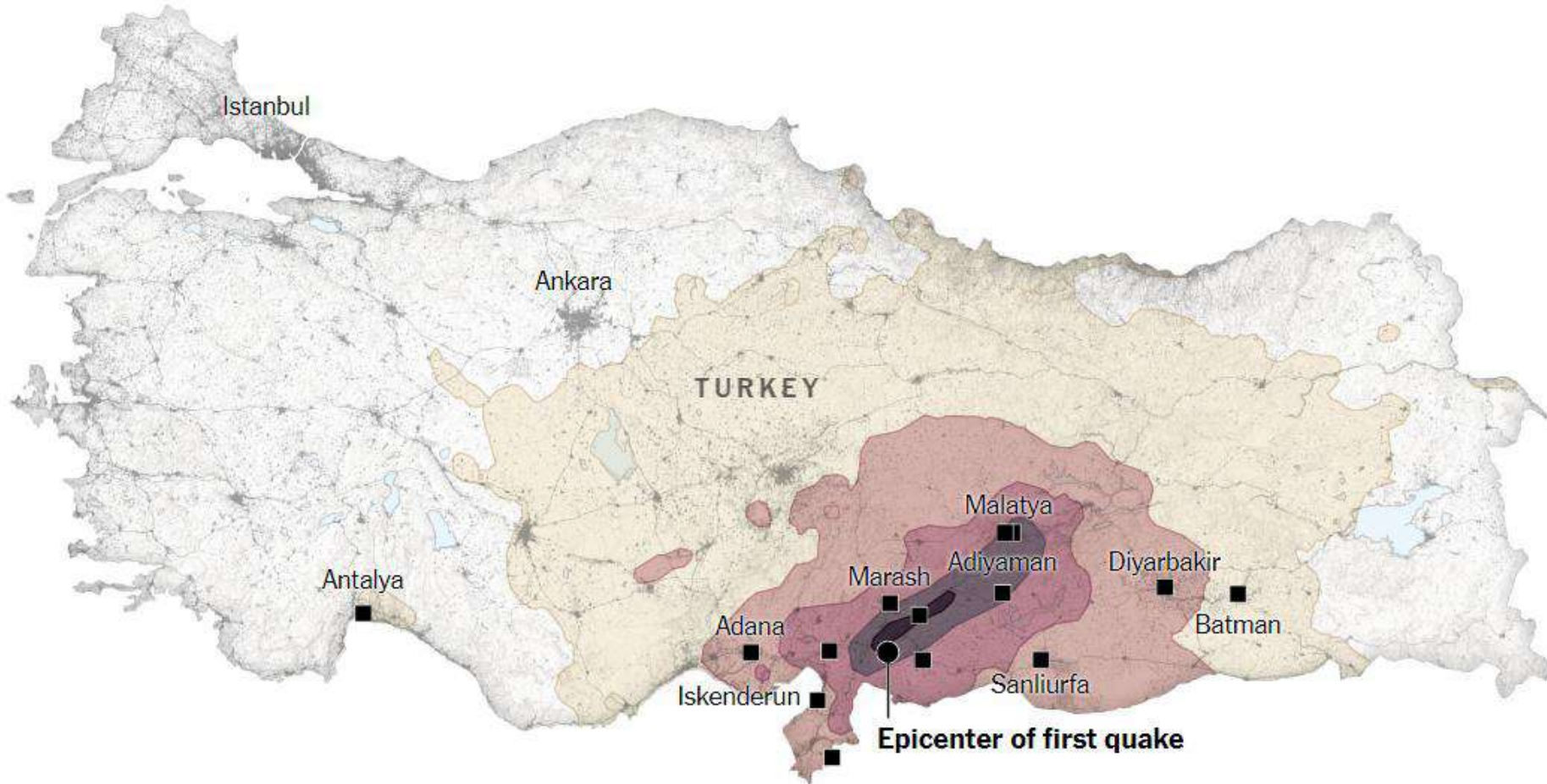
Shake intensity  Very Strong Moderate



Source: The New York Times & U.S. Geological Survey

Turkish cities damaged by the 2 earthquakes

Shake intensity of first quake  Severe Moderate



Source: The New York Times & U.S. Geological Survey











Distance to epicenter: 228.5 Km



People search through rubble following an earthquake in Diyarbakir, Turkey, February 6, 2023
[Sertac Kayar/Reuters]



Rubbles of a destroyed building in Adana, Turkey, Monday, Feb. 6, 2023.

Source: AP Photo/Khalil Hamra



EMSC



A collapsed building in Hatay, Turkey, February 7, 2023.
(Photo: REUTERS/ Umit Bektas/ File Photo)



EMSC

Location: Kavaşlı, Turkey



Flattened buildings in Hatay
Credit: Anadolu Agency, Erçin Ertürk





A collapsed buildings in Kahramanmaras, Turkey, on Monday. (Ihlas News Agency/Reuters)





Pazarçık district of Kahramanmaraş in the Elbistan district (Source: <https://gazeteoksijen.com/>).



Source: Oksijen Gazete



Source: Oksijen Gazete

Rescue work continues at Iskenderun State Hospital, Turkey



SOURCE: <https://gazeteoksijen.com/turkiye/iskenderun-devlet-hastanesinde-arama-kurtarma-calismasi-suruyor-169816>

Location: Şakirpaşa, Turkey
Distance to epicenter: 161.2 Km





Source: **Oksijen Gazete**



A view of a damaged building in Hatay, Turkey. Photograph: Anadolu Agency/Getty Images

Collapsed buildings following an earthquake in Kahramanmaras, Turkey, February 6 2023.

Picture: IHLAS NEWS AGENCY (IHA)/REUTERS





This aerial photo shows a damaged building in Adana. Oguz Yeter/Anadolu Agency via Getty Images



Rubble of a collapsed building in Hatay. Sezgin Pancar/Anadolu Agency/Getty Images

The historic Yeni Mosque is damaged in Malatya.

Volkan Kasik/Anadolu Agency/Getty Images



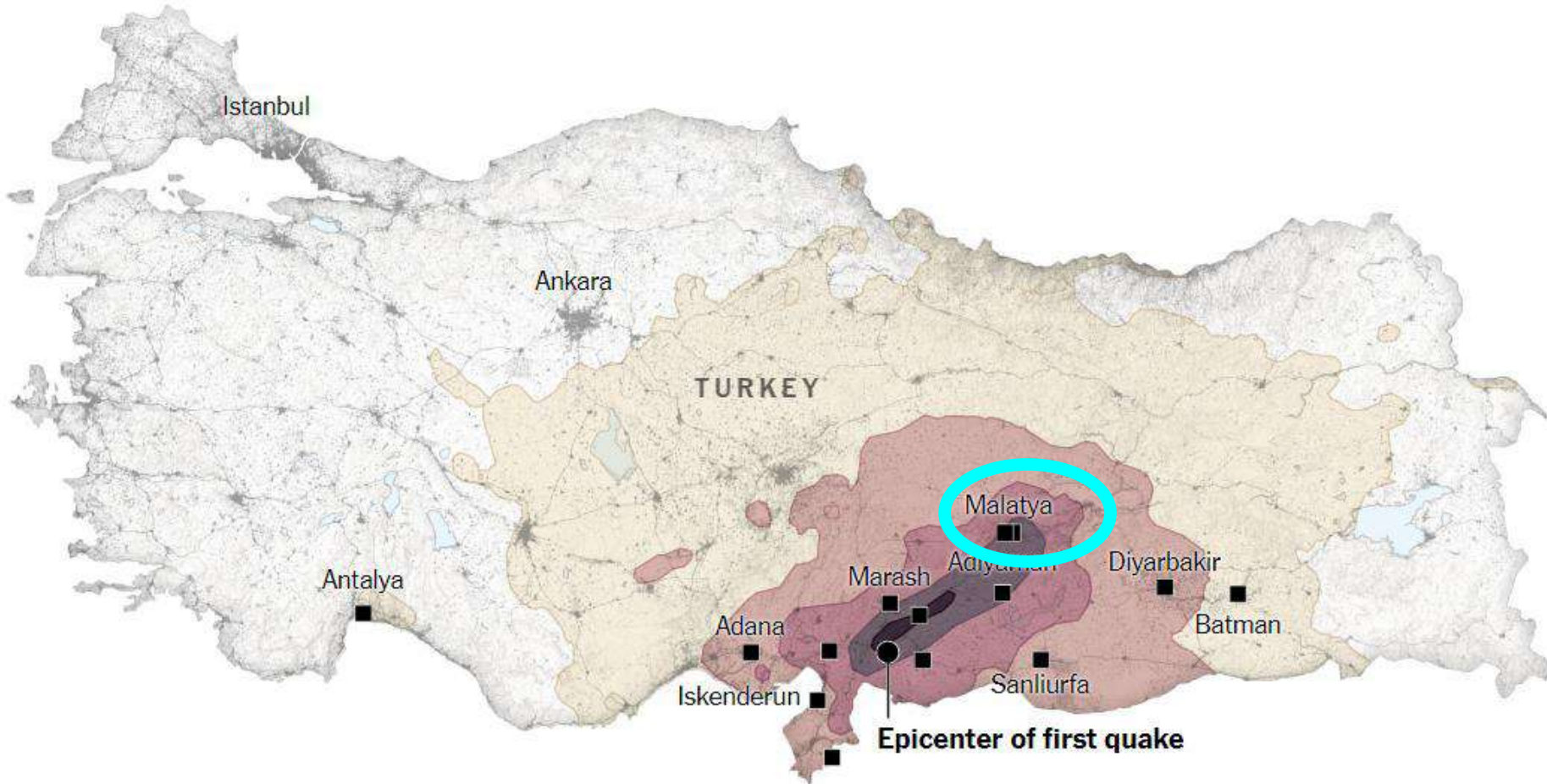


M7.8 and 7.5 earthquakes
in Turkey damage runway
of Hatay Airport

SOURCE: <https://aviationsourcenews.com>

Cities damaged by the 2 earthquakes

Shake intensity of first quake  Severe Moderate



Source: The New York Times & U.S. Geological Survey

Yeni Mosque



Source: The New York Times & Volkan Kasik/Anadolu Agency, via Getty Images

Hotel Avsar

BEFORE



AFTER



Source: The New York Times & @Yedinoktabir via Storyful

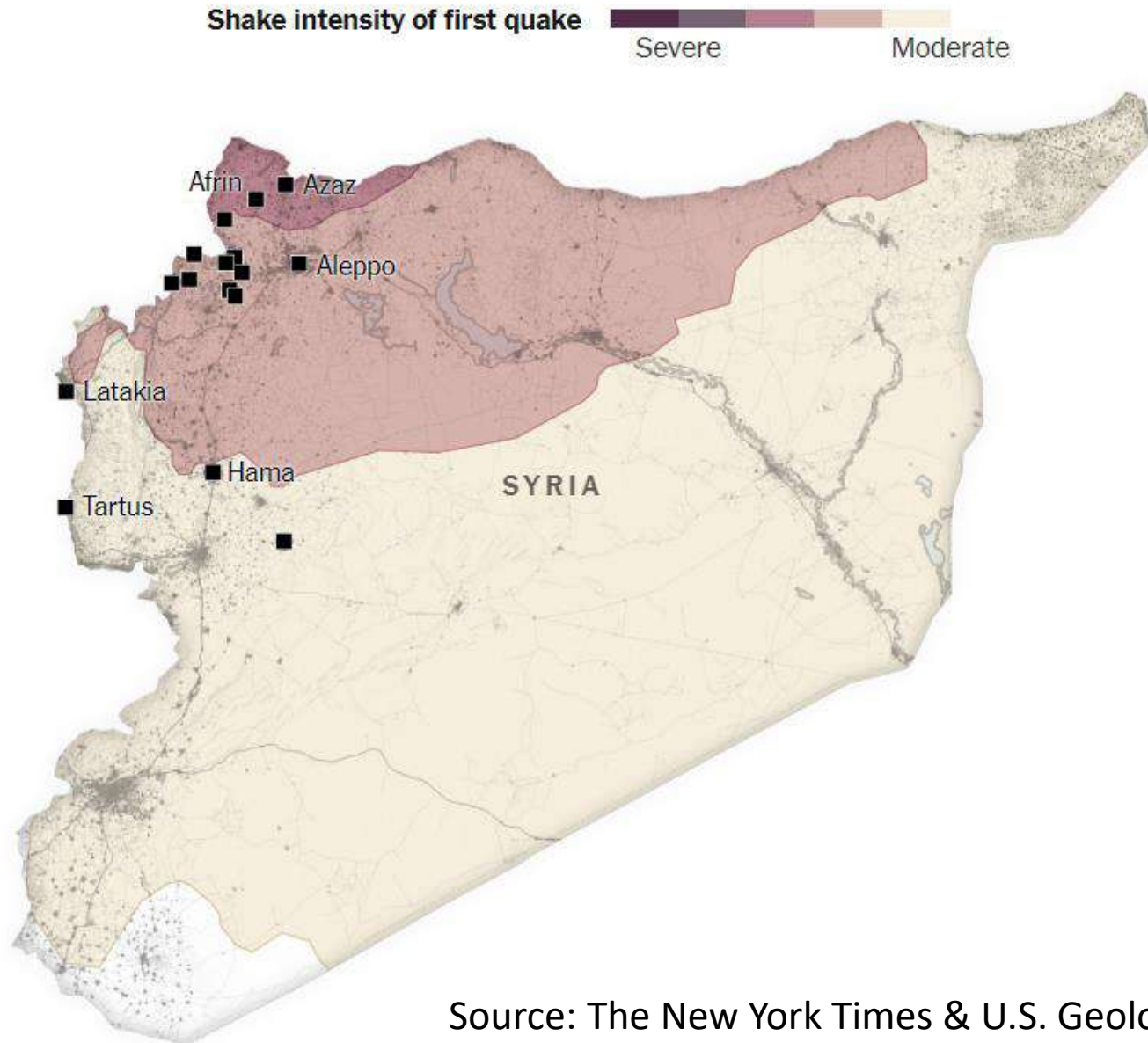
Trend Garden Residence Hotel



Source: The New York Times & Depo Photos via Reuters

Structural Destruction in Syria

Syrian Cities damaged by the earthquakes of 6th February 2023



Source: The New York Times & U.S. Geological Survey





Civil defense workers search through the wreckage of collapsed buildings in Hama, Syria, Monday, Feb. 6, 2023.

Source: AP Photo/Omar Sanadiki



Residents retrieve an injured girl from the rubble of a collapsed building in the town of Jindires
Photo: AFP



Defense workers search through the collapsed buildings in the town of Harem near the Turkish border, Idlib province, Syria, Monday, Feb. 6, 2023.

Source: AP Photo/Ghaith Alsayed





Location: Syria
Distance to epicenter: 64.5 Km



EMSC

Location: Idleb, Syria
Distance to epicenter: 143.2 Km





Rescue teams search for victims and survivors in the rubble of a collapsed building in the Syrian city of Aleppo (Source: BBC, AFP)

Before and After Photos



Gaziantep Castle in Turkey
(Source: CNN webpage).



Collapsed church in Iskenderun

Before



After



Source: Google, Getty

BBC

Destroyed mosque in Malatya

Before



TURKEY
Malatya

After



Source: Google, Getty

the Sultansuyu Dam, which was affected by the 7.7 magnitude earthquake in the Pazarcık district of Kahramanmaraş, **will be evacuated gradually** as a precaution.



Source: **Oksijen Gazete**