

Field reconnaissance report of landslides triggered by the 2023 Turkey–Syria earthquake

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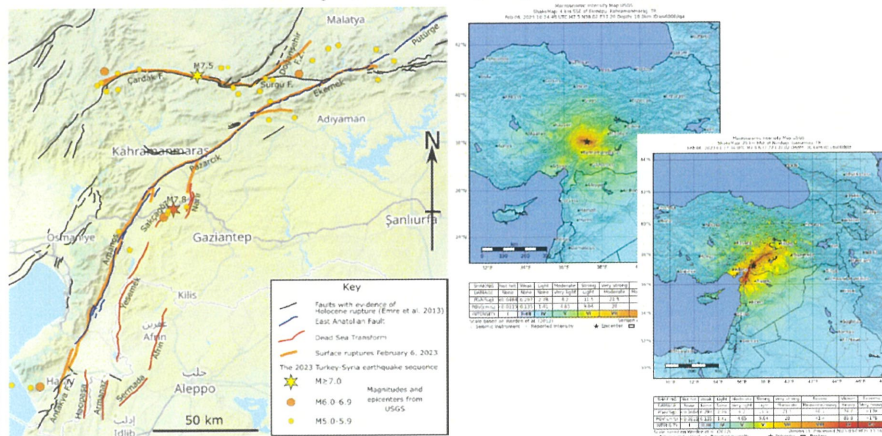
Acknowledgments:

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The February 6, 2023 Türkiye-Syria Earthquake

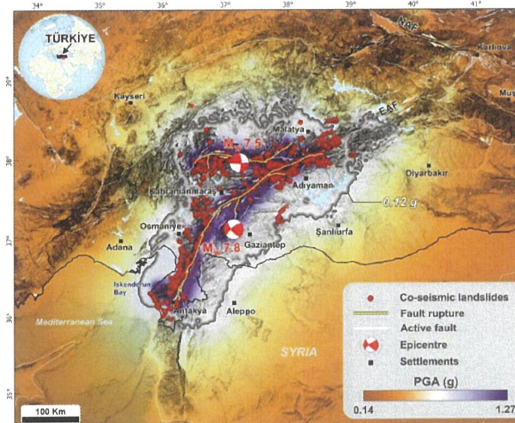


https://upload.wikimedia.org/wikipedia/commons/0/02/2023_Turkey_Syria_EQ_faults_and_epicenters.png

https://en.wikipedia.org/wiki/2023_Turkey%E2%80%93Syria_earthquake

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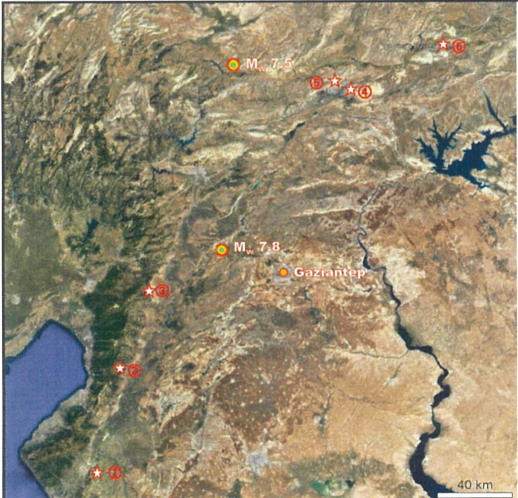
Distribution of coseismic landslides



According to Dr. Görüm (personal communication), more than 3600 landslides of different types had been triggered by the earthquakes

(From Dr. Görüm)

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Mainly surveyed landslides

Period: July 11~ July 21

Base: Gaziantep

Everyday:
By car taking 4~7 hours round trip

Approaches:

- Field investigation
- Drone observation
- Monitoring of aftershocks in landslide areas
- Soil sampling for geotechnical tests

40 km

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① **Tepehan landslide**

Google earth views





Image on Sept. 27, 2021

Image on Feb. 12, 2023

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① **Tepehan landslide**



Location: N36 9'39.3"; E36 13'17.9"
Tepehan village, Altınözü, Hatay

Area: about 1.3 km²

Geological setting: marl and clay-rich limestone sedimentary layers.

Features:

Uplifted toe part (~10 m), resulting in the formation of dammed pond

Elevation difference in the main scarp: ~20 m

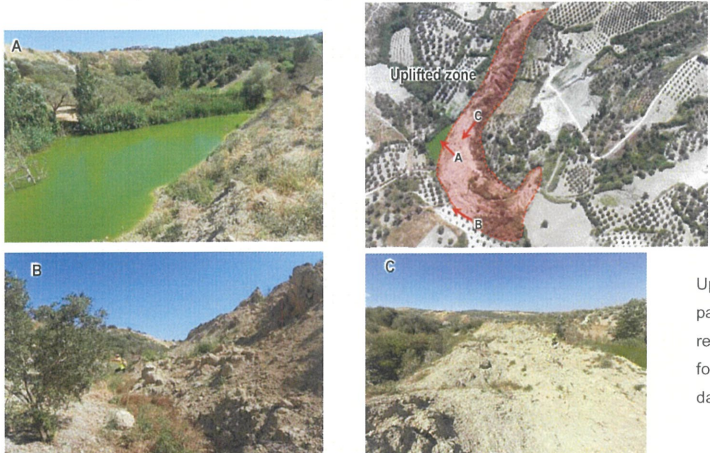
Sliding surface: along the upper bedding surface (about 8~10 degrees) of a clay-rich limestone sedimentary layer (?)

Type: translational earth block slide

50 m

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① **Tepehan landslide: uplifted toe and dammed pond**

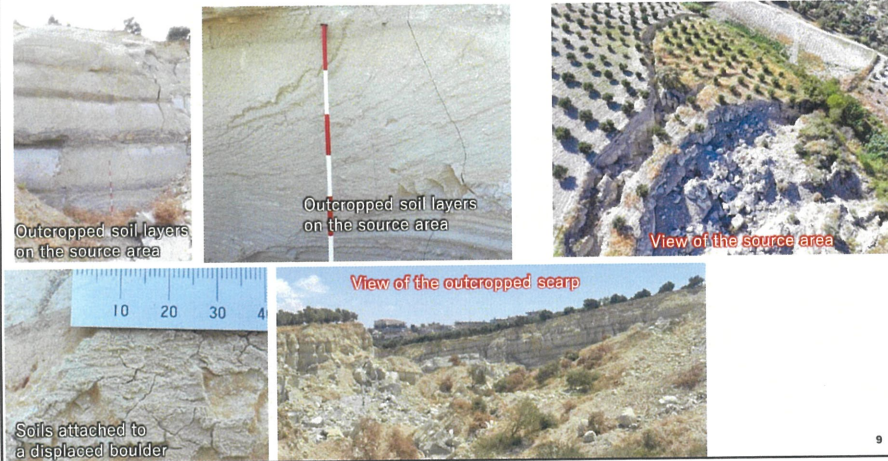


Uplifted zone

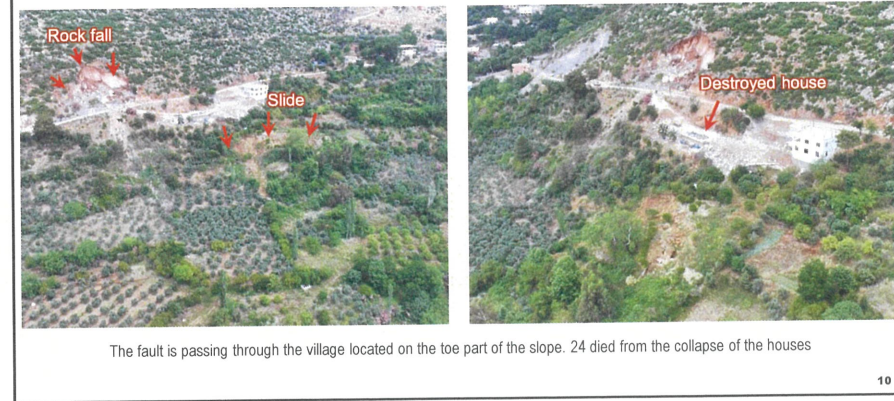
Uplifted toe part (~10 m), resulting in the formation of dammed pond

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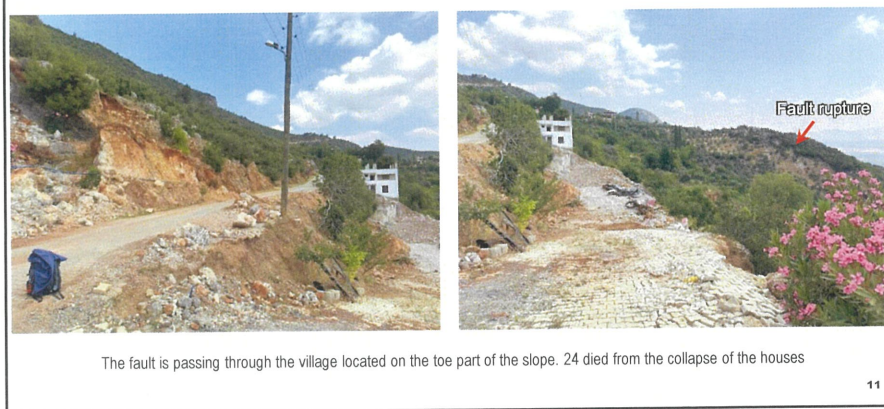
① Tepehan landslide: scarp, cracks, and stratum



② Rock fall and landslide at Bektasli, Islahiya



② Rock fall and landslide at Bektasli, Islahiya



② Rock fall near Bektasli, Islahiya

36 38' 50"N, 36 23' 27.2"E



③ Rock avalanche and landslide dam: Google Earth Images

Location:
Degirmencik,
Islahiye, Gaziantep

500 m 2021.9.27

500 m 2023.2.7

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③ Rock avalanche and landslide dam

Open pit mine

Limestone

Slope: failed area consists of limestone. On the top is an open pit mine that has been in operating for more than ten years.
Dam height: ~ 40 m; Spillway was constructed immediately after the formation.

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③ Rock avalanche and landslide dam

View of the landslide deposits

(I)

(II)

(III)

(IV)

Risk of secondary disaster

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③ Rock avalanche and landslide dam

Open pit mine

Weathering situation of the limestone on the left side of the failed slope

Effects of the open pit mine?

Weathering and slope instability

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④ A large scale old landslide in Cankara area



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④ Earthquake-induced cracks and slope instability in large scale



Cankara area, Malatya

Old landslides before the 2023.2.6 earthquake

Unraveling the age and triggers will be important

2020/9/9
Google Earth

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④ Earthquake-induced cracks and slope instability in large scale



The landslide was not enlarged.

But cracks occurred on the upper part of the slope during the earthquake, enhancing the destabilization of the slope.

2023/3/21
Google Earth

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④ Earthquake-induced cracks and slope instability in large scale



A close view of the cracks

Google Earth

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④ Earthquake-induced cracks and slope instability in large scale



A close view of the cracks

④ Earthquake-induced cracks and slope instability in large scale



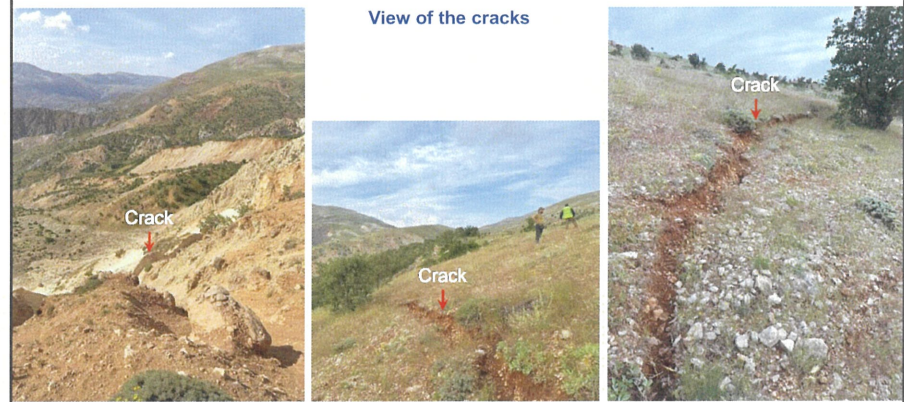
A close view of the cracks

④ Earthquake-induced cracks and slope instability in large scale



A close view of the cracks

④ Earthquake-induced cracks and slope instability in large scale



View of the cracks

④ Earthquake-induced cracks and slope instability in large scale

Right sidewall

Main scarp

Left sidewall

Stratum of limestone on the main scarp

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④ Earthquake-induced cracks and slope instability in large scale

Aftershocks monitoring
3 sites
(July 12-16)

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④ Earthquake-induced cracks on slopes neighboring the Cankara landslide

Crack

Crack

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⑤ Reactivated landslide: Incirlik

2018.9.23

View of the landslide area before the earthquake

15 houses on the top of the source area

Landsliding occurred 14 seconds after the first earthquake, continued about 2 minutes


Houses moved about 400 meters

52 residents lived in the village and all survived.

Different sub-blocks with different sliding velocities

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⑤ Reactivated landslide: Incirlik



Geology settings:
Limestone underlain by ophiolitic rocks

Sliding surface :
Along the interface
Between weathered limestone and ophiolites




Landsliding occurred 14 seconds after the first earthquake, and continued for about 2 minutes

Houses moved about 400 meters; 52 residents lived in the village and all survived.

Different sub-blocks with different sliding velocities

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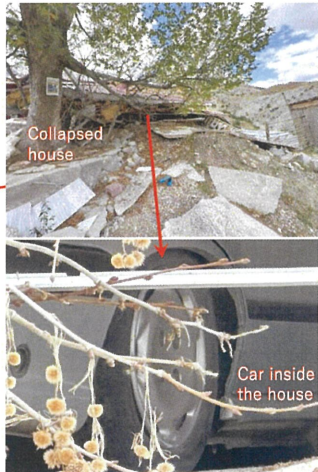
⑤ Reactivated landslide: Incirlik

Observation of sliding zone

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⑤ Reactivated landslide: Incirlik



Collapsed house

Car inside the house

Collapsed house and underlain car

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⑤ Reactivated landslide: Incirlik

Landslide area

Monitoring of aftershocks (July 17-21)

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⑥ Landslides in the area near Mutlu village: landslide with dammed river



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⑥ Landslide in Yesilyayla with long travel distance



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⑥ Landslide in the area near Mutlu village: multiple disasters



The water storage pond of the power station failed, and the downpour water resulted in a large debris flow, which buried the factory of the power station

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⑥ Landslide in the area near Mutlu village: multiple disasters



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Summary

- Numerous landslides had been triggered with different types
- Some translational landslides occurred on gentle slopes in Tepehan, and one of them was introduced
- Rock falls directly resulted in the damage of houses that were built very close to the toe of steep slopes
- A large rock avalanche was triggered, which resulted in the formation of a large natural dam. Small natural dams had also been formed in some areas
- An old landslide, on which a village was located, was reactivated during the earthquake with rapid movement
- Cracks occurred in the wide areas of upper slopes of some large landslides, elevating the instability of the slopes
- Multiple hazards were also triggered. For example, the failure of the water storage pond resulted in a large-scale debris flow that partially buried the factory of the power station.
- Future work will be needed to unravel the initiation and movement mechanisms of some landslides. Investigation of the distribution and features of those cracks and their effect on the slope instability will also be necessary.

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Thank you all for your great support! 38