

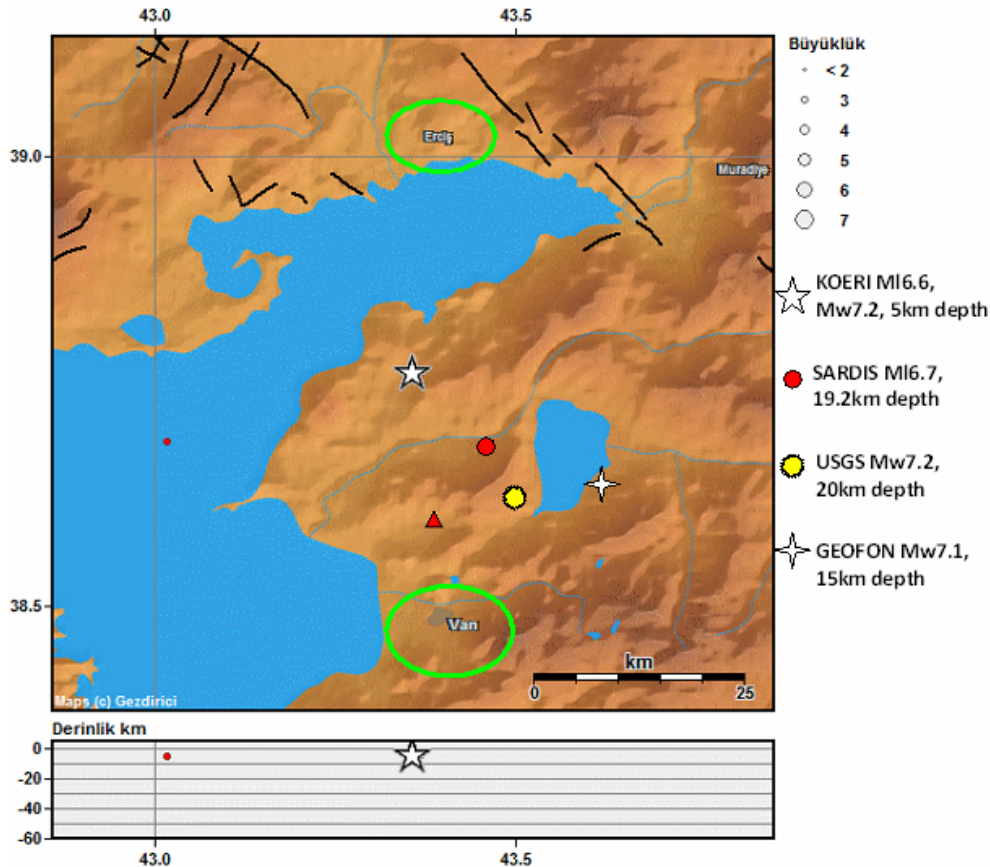
CEDIM Forensic Earthquake Analysis Group

(Status: Monday October 24, 2011 09:00 Central European Time)

Eastern Turkey Earthquake 23 October 2011

An earthquake of magnitude 7.1 to 7.2 (source: GFZ, EMSC and USGS) struck Eastern Turkey on Sunday October 23, 2011 with epicentre (according to KOERI) close to the city of Ercis about 50 km to the north of Van City at Van Lake at local time 13:41. Initial seismological information suggests an almost EW oriented thrust earthquake. An $M=7.2$ event has typically fault extension of 100 km, so that an area of around 2,000 km² is affected very strong shaking (building damage is reported from Bitlis (130 km SE of the epicentre). The main shock was succeeded by two aftershocks 15 and 50 minutes later. Aftershocks are still in the range of M6 (latest on Sunday 23:45 local time M5.9).

The different hypocenters from various agencies are shown on the following diagram. The KOERI hypocenter appears to correlate best to the damage seen.



TABANLI-- (VAN)
 23.10.2011 13:41:21 38.758K 43.360D Derinlik:5.0km Büyüklük:6.6
 Son 1 yıllık depremsellik.

B.Ü. Kandilli Rasathanesi ve Deprem Araştırma Enstitüsü
 Güncelleme: 23.10.2011 13:52:21
 URL: <http://www.koeri.boun.edu.tr/sismo/map/tr/20111023134121.gif>

Ercis City has about 75,000 inhabitants and is seriously affected. The largest city of

the area is Van with officially (2010) 370,000 inhabitants. Shaking intensities are reported as high as EMS VIII and above in Ercis and VII to VIII in Van. Both cities are built on the shores on Van lake which suggests soft soil conditions for the cities, possibly soil liquefaction along the shore of the lake and this aggravating factors for building collapse and ground failure.

Losses: As Van is less affected as the initial epicentre information suggested the expected death toll (ELER method, Prof. Mustafa Erdik, Kandilli Observatory, Istanbul) indicate **700 to 1,000 persons being killed**, so that the number of injured persons requiring hospital treatment will be in the range of a few thousand and **homeless in the range of 5,000 to 10,000**. The casualty rate is calculated using different methods however, using their Coburn and Spence method data, masonry buildings exposed to intensity VIII which completely collapse generally have a 36% fatality rate, and RC buildings that collapse have between 44% and 62% fatality rates. The official current death toll is at 217 (117 in Ercis, 100 in Van) and 1090 injured persons (740 in Ercis, 350 in Van). These numbers will grow in the coming days. However, the area is not densely populated which limits losses outside the cities. Building damage is currently at 970 buildings/houses destroyed including around 80 multi-storey buildings in Ercis and a lesser number in Van.

The level of earthquake **building code compliancy** is only medium on the CATDAT scale (Daniell et al., 2011), which will aggravate building damage and collapse. Initial photo and video information support this suspicion. The time of the event – Sunday early afternoon – may be a loss reducing factor, as no workday influx from surrounding population is to be expected, a number of people may not have been in their homes and immediate Search and Rescue activities have better chances in daylight. The photos and videos published so far (overview in earthquake-report.com) suggest collapses of a number of 7-story reinforced concrete residential buildings in a pattern that was called pancake collapse in the 1999 Izmit earthquake in Western Turkey. Death rates in this type of collapses are at least 50% of the occupants.

Infrastructure: Power supply and telecommunication broke down in Van and Ercis. The **airport of Van City** is located at the lake shore, and has been damaged but seems to be operational now.

Cold weather will cause additional stress to homeless persons, and those who are afraid to return to their homes. Around this time of the year night time temperatures reach 0° Celsius. The current forecasts indicate low temperatures at night of 0° Celsius for the next 2 to 3 day followed by temperatures of -3° Celsius.

Historic Earthquakes in the area: There have been over 30 damaging earthquakes through history in the CATDAT (Daniell et al., 2011) data base within 100km of this epicenter.

- In 1111 a Van earthquake caused major damage, with a magnitude of around M6.5 to M7. Between 1646-1648 Van was struck by a M6.7 quake, killing around 2000 people.
- 30th May 1881 M6.3 – near Van – killed 95 people.

- In 1941, a M5.9 earthquake affected Erice and Van, killing between 190 and 430 people.
- A swarm of smaller earthquakes from 1945-1946 killed many people in Van.
- In 1976, 66km away from this one, a M7 quake on the border killed 3840 and caused 51000 homeless.

CEDIM Initial Forensic Analysis

Turkey has experienced several large earthquakes in its recent history with the 1999 Izmit event as worst one in the past 15 years. The last major earthquake in the Van region occurred only 35 years ago (M7 with 3,840 people killed and 51,000 homeless).

This Sunday October 23, 2011 Eastern Turkey earthquake occurred in a high seismicity zone where building codes should provide adequate protection for collapse for modern buildings up to 0.5 g acceleration. The CATDAT (Daniell et al., 2011), analytic data base ranks Turkish code compliancy only at medium level, with a potential of an even lower level in the very Eastern part of the country. The reported collapses of 7-story modern reinforced concrete buildings in pancake style may be an indicator for a low code compliancy level. Further analysis will shed more light on this issue.

The losses may not be as high as originally suspected with the epicentre being 50 km N of Van and an EW extension of the fault rupture. The 700 to 1,000 fatalities (associated with possibly 10,000 homeless persons) are projected by KOERI; less than 300 confirmed so far.

The aftershock activity contains still magnitudes around M5 posing some threat to Search and Rescue (SAR) operations.

Damage to infrastructure (power supply, telecommunication, airport) has occurred, but apparently air traffic in Van has resumed.

Cold weather will cause additional stress to injured, not yet hospitalized persons, to homeless persons, and those who are afraid to return to their homes. Around this time of the year night time temperatures reach 0° Celsius. The current forecasts indicate low temperatures at night of 0° Celsius for the next 2 to 3 day followed by temperatures of -3° Celsius.

Continuous real-time information is provided by: <http://earthquake-report.com/>

Further Sources:

Daniell, J. E., Khazai, B., Wenzel, F., and Vervaeck, A.: The CATDAT damaging earthquakes database, Nat. Hazards Earth Syst. Sci., 11, 2235-2251, doi:10.5194/nhess-11-2235-2011, 2011.

<http://earthquake-report.com/>

<http://www.koeri.boun.edu.tr/sismo/map/en/index.html>

<http://geofon.gfz-potsdam.de/geofon//seismon/globmon.html>

<http://w3.gdacs.org/reports.asp?ID=112317>

<http://earthquake.usgs.gov/earthquakes/pager/events/us/b0006bqc/index.html>

<http://reliefweb.int/>

Contact

Friedemann Wenzel

E-mail: friedemann.wenzel@kit.edu

Mob: +49-15201601069