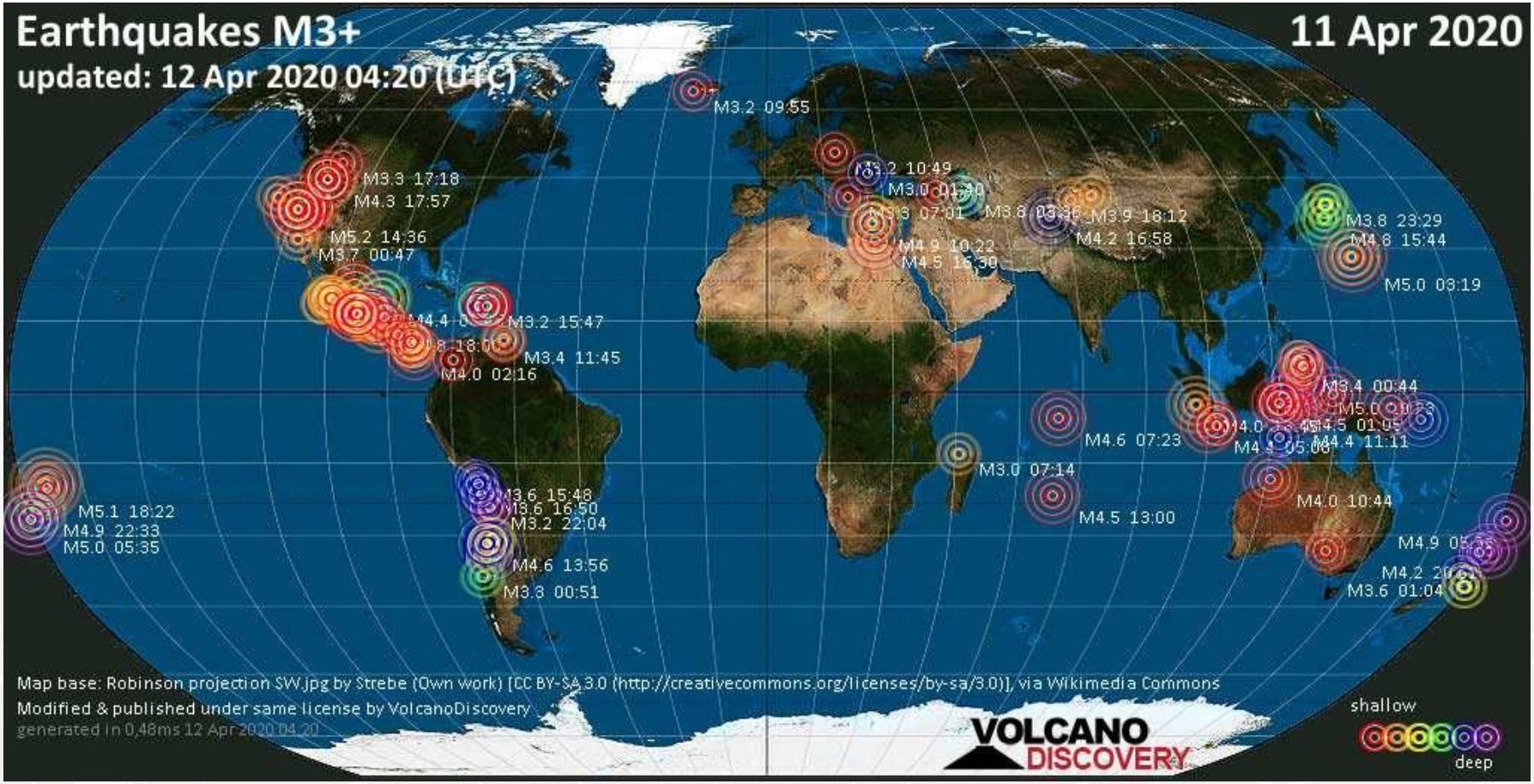
EWCE 203

Geology and Geomorphology



Earthquake



Summary: 226 quakes M2+, 117 quakes M3+, 37 quakes M4+, 5 quakes M5+. Total 385

Total seismic energy estimate: 6800 tons of TNT / 0.4 atomic bombs equivalent.

Earthquake: Earthquakes are the **vibrations caused** when the **earth materials have been distorted** until fracture.

Seismology: Scientific study of the Earthquake.

Earthquakes' effects:

- Effects on human being and structures
- Geological effects such as landslides

Effects:

- Fire
- Damage to structure
- Seismic sea waves
- Landslides
- Cracks in the ground
- Land movement
- Liquefaction
- Sound

Fire:

- Fire can be greater hazards than the shaking of the ground.
- Fire has caused an estimated **95% of the total losses** caused by some EQ.
- One of the reasons for rapid spread of fire after the EQ is that the **vibration often disrupt the gas and water systems** in the areas.

Earthquake that hit Kobe during the winter of 1995 17th Jan 1995 at 5.46am, measured a massive 7.2 on the Richter scale



A lot of the traditional wooden buildings survived the earthquake but burnt down in fires caused by broken gas and electricity lines.

Damage to Structures:

- **Steel-framed construction** can withstand even severe EQ.
- **Chimneys** are sensitive to EQ vibration.
- Tunnels and underground structures are **less affected** because they move as an unit with the surrounding ground.











Failure of buildings with first soft storey during Bhuj Earthquake, 2001









January 17,1995 Kobe Earthquake

Extends of damages due to vibrations depends on:

- Type of **ground** on which they stand
- **Duration** as well as intensity of ground motion
- **Repetition** of shaking

Seismic Sea Waves:

- Giant sea waves that are generated due to EQ is called Seismic sea waves or **Tsunami**.
- Generation of sea waves may be due to:

-**Submarine EQ** abruptly elevate or lower the portion of sea beds, setting up waves.

-**Submarine land slides** at the time of EQ may produce tsunami.

-**Volcanic eruptions** may also generate tsunami.









Damages due to Tsunami:

- Tsunami has devastated oceanic islands and continental coastline.

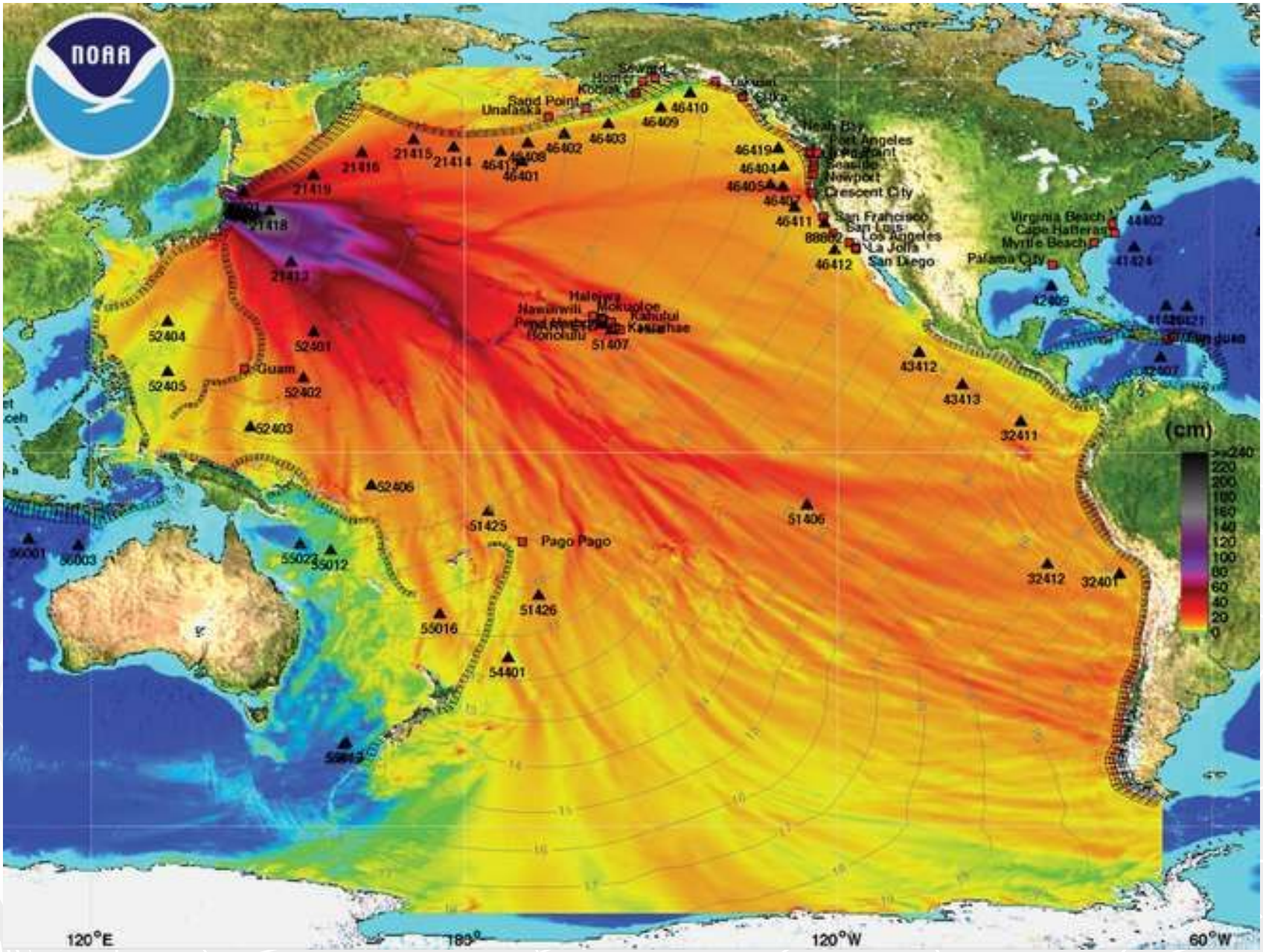




Underwater earthquakes, volcanoes, or landslides can generate tsunamis



Fishing boat lying amid the wreckage in Ōfunato, Iwate prefecture, Japan, after being washed ashore by the tsunami that struck the city on **March 11, 2011**.


NOAA
Seward
Homer
Kodiak
Sand Point
Unalaska
Yakutat
Sitka
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Neah Bay
Port Angeles
Westport
Seattle
Newport
Crescent City
San Francisco
San Luis
Los Angeles
La Jolla
San Diego
Virginia Beach
Cape Hatteras
Myrtle Beach
Palanka City
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Haleiwa
Mokuoloe
Kahului
Kaneohe
Honolulu
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Guam
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180
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140
120
100
80
60
40
20
0
120°E
180°
120°W
60°W



Members of the Japanese Ground **Self-Defense Force** in rescue and recovery operations in Ōfunato, Iwate prefecture, Japan, after the city was devastated by the March 11, 2011, earthquake and tsunami.

Japan earthquake and tsunami of 2011, also called **Great Sendai Earthquake** or **Great Tōhoku Earthquake**, 2011

- Magnitude-9.0 earthquake struck at 2:46 PM. (The early estimate of magnitude 8.9 was later revised upward.)
-
- Epicenter was located some 130 km east of the city of Sendai and the focus occurred at a depth of about 30 km) below the floor of the western Pacific Ocean.

Landslides:

- In areas where there are **many hills with steep slopes** or areas with special soil conditions **sensitive to vibrations**.
- EQs often accompanied by landslides.
- These slides occur within a zone of seldom exceeding 40-50 km in radius.





Rangamati, chunks of mud collapsed on tin-shed houses in Kalabagan of the Karnaphuli Paper Mill area, 08 July 2019



Landslide in New Zealand EQ Nov 2014

Cracks in the Ground:

- During EQ, the earth is **likely to open up** and **swallow** everyone or everything in the vicinity.



Mile Long Cracks in ground from the **Philippine earthquake**, 7.1-magnitude on October 2013, which killed 198 people on Bohol

Land Movements:

- Some EQs are accompanied by the significant **vertical and horizontal movement** of the land surface.
- **Surfaces sink** in some places and **rise** in other places.
- Often **tilted** and portions can even be **moved laterally** to great distance.



The Earth Moved During **Turkey's Recent Earthquake And Aftershocks 06 February 2023**



A massive 15 foot-high WALL has been created by moving earth in the New Zealand countryside after a 7.8 magnitude quake struck on November 2016.

Liquefaction:

- Occurs in soils which are **thoroughly saturated** such as **along sea coasts**, the **shores of lakes or ponds** or anywhere that **subsurface water has filled the fractures, voids, pores in the ground.**

Phenomena apparently results from liquefaction:

- Damage to structure by **foundation failure** and **sliding**.
- Occurs after even a few to several minutes of EQ strikes a region.
- **Underground sewers**, storage tanks, pipes and piles to **float up to the surface**.

- Nearby structures may be **settle several meters** to the ground.
- **Water and sands may be ejected** to a meter or more into the air.











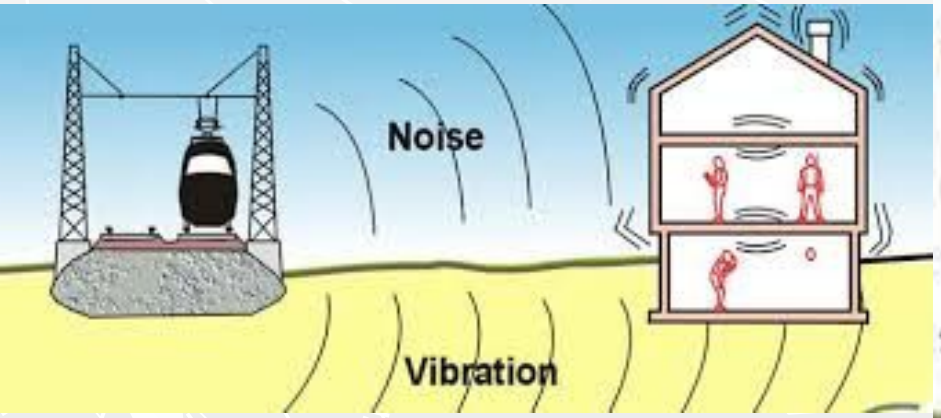
Reclaimed land and river banks which typically consist of loose deposits are prime locations for liquefaction in case of strong shaking



Indonesian earthquake causing soil liquefaction,

Sound:

- When an EQ occurs, the **vibration in the ground often disturb the air** and produce **sound waves that are within the range of human ear.**
- Such sound is known as **EQ sound**.





Description of EQ Sound:

Low booming noise.

- **Very near the source** of EQ- **sharp snaps** are sometimes audible, suggesting the **tearing parts of the great blocks** of rocks.

- **Further away from the EQ source**:

  -**Heavy vehicles passing rapidly** over the hard ground.

  -**Dragging of heavy rocks or furniture** over the floor.

-A loud, **distinct clap of thunder**, or **explosion**, boom of distant cannon, or fall of large body or great load of stone.

- **Quite distinct but confusing** to be recognized.



Some people described the earthquake as the sound of an explosion, thunder, or even a tree falling.

Thank You