

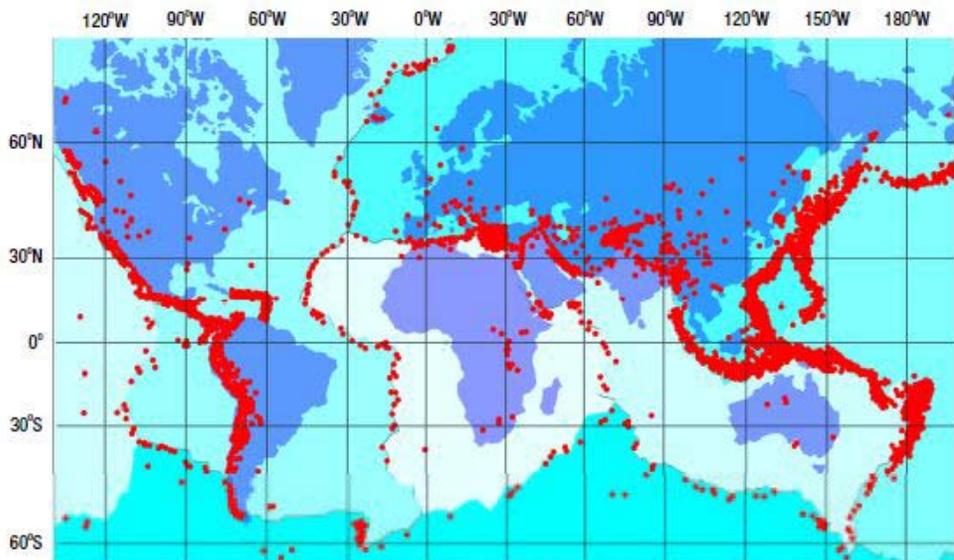
# Earthquakes

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Earthquakes of a magnitude 4.0 and greater that occurred in 1994. The vast majority of events coincided with the boundaries between the major tectonic plates. (Seismicity data courtesy US National Earthquake Information Center.)

More than 500,000 times a year, the Earth's crust shakes suddenly due to an earthquake. Many are slight and would be easy to sleep through, but others cause devastation and kill thousands – mostly under collapsing buildings. By studying earthquake regions and damage, geoscientists help save lives – warning those at risk, showing them how to prepare and to protect themselves, and advising on the siting, design and construction of buildings.

Most earthquakes happen at the edges of the tectonic plates that make up the Earth's crust. As the plates collide (one riding up over the other) or grind past one another, stress accumulates locally and is released during earthquakes.

The deadliest earthquakes occur in developing countries, where buildings are not engineered to withstand the violent ground-shaking. The costliest earthquakes, by contrast, occur in developed countries - particularly Japan and the USA.

**Table 1: examples of major earthquakes over the past 100 years**

Year	Country (& region/city)	Magnitude (Moment Magnitude Scale, unless otherwise stated)	Deaths	Cost (\$m)
1915	Italy (Avezzano)	7.0	32,610	25
1920	China (Ganzu)	7.8 (Richter scale)	235,000	25
1923	Japan (Tokyo-Yokohama)	7.9	142,800	2,800
1927	China (Xining)	7.7	200,000	?
1939	Chile (Concepcion)	8.3 (Richter scale)	28,000	100
1939	Turkey (Erzincan)	8.2 (Richter scale)	36,740	20
1970	Peru (Chimbote)	7.9	67,000	550
1976	Guatemala (Guatemala City)	7.5	22,084	1100
1976	China (Tangshan)	7.6	290,000	5,600
1985	Mexico (Mexico City)	8.3	10,000	4,000
1988	Armenia (Spitak)	6.8	25,000	14,000
1990	Iran (western)	7.4	50,000	?
1994	USA (California, Los Angeles)	7.1	61	44,000
1995	Japan (Kobe)	6.8	6,348	200,000
1999	Turkey (Kocaeli)	7.6	19,118	20,000
2001	India (Gujarat)	7.7	19,727	<5,000
2003	Iran (Bam)	6.6	26,271	1,000
2004	Indonesia (Sumatra)	9.1	230,000	?
2010	Haiti (Port-au-Prince)	7.0	316,000	14,000
2010	Chile (Concepcion)	8.8	432	30,000
2011	New Zealand (Christchurch)	6.3	161	c. 11,000

## Did you know?

The well known Richter Scale is no longer in popular use – most scientists use the 'Moment Magnitude Scale' (MMS) to measure medium to large size quakes. This measures the energy released by an earthquake.

**Table 2: The modified Mercalli Scale of earthquake intensity**

Index	Description
I	Not felt – detectable only by seismographs
II	Faint tremor, felt only by people at rest
III	Not detectable by all: lamps swing, water in bowls disturbed. Vibration similar to a passing truck.
IV-V	Detectable by all: houses shake, doors creak, windows rattle, crockery disturbed.
VI	Slight damage felt by all: houses shake violently. Loose plaster may fall and heavy furniture moved (equivalent to 5 on the MMS, or one small atom bomb of c. 20 kilotons).
VII	Notable damage, noticed by people driving cars. Walls crack, chimneys damaged.
VIII-IX	Major damage. Up to 30% of buildings collapse. Ground fracturing and landslides occur. Most people unable to stand. Equivalent to a one megaton hydrogen bomb.
X-XII	Severe damage. More than 30% of buildings collapse. Ground fracturing and landslides common. Equivalent to 60,000 one-megaton bombs.

Earthquake magnitude doesn't always relate directly to the damage done. Other factors, like the depth at which the quake happens, the duration of shaking, local geology and infrastructure, are also important. The effects and impact of earthquakes are described using the 12-point Modified Mercalli Scale (Table 2).



Damage caused by the Taiwan Earthquake. Photo Mike Ellis, courtesy Centre for Earthquake Research & Information, University of Memphis.

## Earthquakes in the UK

Most earthquakes happen near plate margins. The UK is located in the centre of a plate, so experiences very few earthquakes.

It is possible for 'intraplate' quakes to happen, when strain is transmitted from plate margins. This usually results in relatively minor quakes, but can cause damage.

Minor earthquakes are often felt in mining areas of the UK Midlands, where collapse of mine shafts and tunnels can be felt at the surface.

### Did you know?

The UK experiences about 300 earthquakes every year!

Most are so mild they can only be detected with sensitive seismometers. The most recent are a magnitude 3.5 quake in the Western Highlands on **23 January 2011**, and a magnitude 3.6 in North Yorkshire on **3 January 2011**.

In **February 2008**, the biggest earthquake for 25 years struck near Market Rasen in Lincolnshire, measuring a magnitude of 5.2. It was felt by people in Newcastle, Yorkshire, London, Cumbria, the

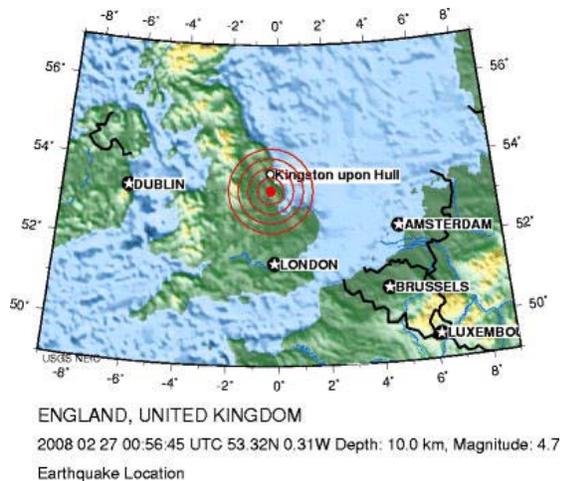


Image courtesy of the U.S. Geological Survey

## Earthquake prediction

The 'Holy Grail' of seismology would be to accurately predict earthquakes before they happen, to give people enough warning to evacuate.

In reality, earthquakes are too complicated and chaotic. Instead of **prediction**, seismologists talk about **forecasting** – giving an indication of increasing or decreasing risk, just as weather forecasters estimate the probability of rain.