QUESTIONS AND ANSWERS ABOUT EARTHQUAKES IN EASTERN CANADA

EARTHQUAKES

1 WHAT SHOULD YOU DO AFTER A *STRONG* EARTHQUAKE ?

- Stay calm.
- Help the injured, if any. Speak calmly with family members, especially children, about what has just happened, in order to relieve stress.
- Stay tuned to the radio and follow instructions.
- Use the telephone **only** in an emergency.
- Do not enter damaged buildings.
- To prevent fire, check the chimneys or have them checked **before** using the furnace or fireplace. Check all gas lines (no matches, please!).

2 WILL MORE SHOCKS BE FELT AFTER A *STRONG* EARTHQUAKE ?

For several hours, or even days, after a strongly felt earthquake, it is quite possible that people may feel more shocks. This possibility always exists, **but** keep in mind these four facts:

1. In most cases, these shocks (called *aftershocks*) will be smaller; therefore, the vibrations will be weaker.
2. Aftershocks do not mean that a stronger earthquake is coming.
3. Aftershocks are normal; they show that the earth's crust is readjusting after the main earthquake.
4. The number of felt aftershocks is quite variable and thus cannot be predicted. There might be several per day, or only several per week.

It is impossible to predict either the number or the magnitude of aftershocks that might occur. These vary greatly from one region to another, according to many factors which are poorly understood — even by specialists.

3 DOES A *SMALL* EARTHQUAKE MEAN THAT A LARGER EARTHQUAKE IS COMING ?

No, except for very rare exceptions. Every year, hundreds of earthquakes occur in Canada. Only a very tiny minority of these precede a larger earthquake.

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Although a large earthquake may be preceded by a foreshock (the Saguenay earthquake of November 1988 is an example), the occurrence of a small earthquake is not in itself a typical sign. Hundreds of small earthquakes occur every year in Canada, whereas major earthquakes have occurred only a few times in this century.

A small earthquake, however, provides an ideal opportunity to offer reminders about safety measures to take before, during and after an earthquake.

4 WHAT IS AN "EARTHQUAKE" ?

Physically, an earthquake is the result of a sudden movement of two blocks of rock along a break (*fault*) deep within the earth's crust. After very strong earthquakes, this slippage may be visible on the surface.

In eastern Canada, such slippage along faults has always occurred within the crust. Although many faults in eastern Canada are visible on the surface of the ground, none has ever been shown to be currently active. These faults result from geological movement occurring over millions of years. The presence of these surface faults does not indicate that future earthquakes will occur there.

A common misconception is that of the hole in the ground which opens up during an earthquake to swallow up unfortunate victims. This has nothing to do with reality and it is Hollywood's version of earthquakes.

After a strong earthquake, some cracks may be seen on the ground or in basements. These are not faults, nor are they crevasses ready to close up again. These cracks are probably due to ground settlement caused by the vibrations.

5 WHAT SHOULD YOU DO DURING AN EARTHQUAKE ?

Falling objects pose the greatest danger during a major earthquake. In Canada, no house has ever collapsed during an earthquake. However, many types of objects may fall and cause damage or injuries. Of prime concern, therefore, is protection from falling objects such as framed pictures, light fixtures, plaster from ceilings or the upper part of walls, or chimneys which may fall outside or through the roof into the house.

Here is what to do:

1. Stay calm – don't panic.
2. If you are indoors, stay there. Do not run outside: you could be hit by flying debris or bits of glass. Take cover under, and hold on to a sturdy desk, a table, or a bed – or stand in a doorframe. Never use the elevators (they may have been damaged and/or the power may fail).
3. If you are outdoors, stay there. Keep away from power lines and buildings. (House chimneys are likely to topple during a strong earthquake.)
4. If you are in a vehicle, stop and park away from buildings, bridges and overpasses.

6 CAN HOUSES WITHSTAND EARTHQUAKES ?

Generally speaking, Canadian wood-frame houses are well able to withstand vibrations generated by earthquakes – even very large ones. Moreover, modern buildings must be designed according to national or provincial building code standards, which are intended to minimize the probability of building collapse in major earthquakes.

However, building codes do not prevent certain types of non-structural damage. Thus, it is possible that cracks may be seen on some walls. Unreinforced masonry (e.g. brick walls and chimneys) has little resistance to strong horizontal shaking and may collapse.

Vibrations may also cause ground settlement under a house. Sometimes this may cause small cracks in the basement or warping of walls. These are indirect effects that do not indicate that a fault lies near the house.

7 CAN EARTHQUAKES BE PREDICTED ?

With the present state of scientific knowledge, it is not possible to predict earthquakes and certainly not possible to specify in advance their *exact* date, time

and location. However, a great deal of research is being conducted to develop reliable prediction methods.

Canada, along with other countries, is working to minimize damage and injuries through the implementation of modern earthquake-resistant standards so people will be protected whenever and wherever an earthquake occurs.

8 CAN EARTHQUAKES BE TRIGGERED BY HUMAN ACTIVITIES ?

Human activities, such as underground nuclear explosions or the filling of reservoirs behind large dams, may sometimes trigger earthquakes, but they always occur close to the site of such activities.

Following an underground nuclear explosion, small earthquakes have often been recorded near the test site. These are due to the collapse of the cavity created by the explosion. On the other hand, large dams hold back enormous quantities of water. Some of this water may penetrate into cracks in the underlying rock, and sometimes this may trigger small earthquakes under or very near the reservoir.

There is no link between human activities like these and earthquakes occurring hundreds, even thousands, of kilometres away.

9 WHAT IS THE "MAGNITUDE" OF AN EARTHQUAKE ?

Magnitude is a measure of the amount of energy released during an earthquake. It may be expressed using the Richter scale. To calculate magnitude, the amplitude of waves on a seismogram is measured, correcting for the distance between the recording instrument and the earthquake epicentre. Since magnitude is representative of the earthquake itself, there is thus only one magnitude per earthquake.

Taking the Saguenay earthquake of November 25, 1988 as an example, one could not therefore speak of magnitude 6 at Québec City and magnitude 4 to 5 at Montréal. The effects (or *intensities*) at the two places were different, but the magnitude of an earthquake is unique; in this example, it was 6 on the Richter scale.

The magnitude scale is logarithmic. This means that, at the same distance, an earthquake of magnitude 6 produces vibrations with *amplitudes* 10 times greater than those from a magnitude 5 earthquake and 100 times greater than those from a magnitude 4 earthquake.

In terms of *energy*, an earthquake of magnitude 6 releases about 30 times more energy than an earthquake of magnitude 5 and about 1000 times more energy than an earthquake of magnitude 4.

It is very unlikely that an earthquake of magnitude less than 5 could cause any damage.

10 WHAT DO SCIENTISTS DO AFTER AN EARTHQUAKE ?

During the hour immediately following a relatively large earthquake (over magnitude 4.5 for eastern Canada), Geological Survey of Canada seismologists locate the earthquake and measure its magnitude. They use data supplied by the seismograph network in eastern Canada, which is linked directly 24 hours per day to the Ottawa office. (In British Columbia, a similar network is linked to the office in Sidney, B.C.) They pass this information on to Emergency Preparedness Canada and to the Canadian Press – and, in Quebec, to the Quebec Provincial Police and to Hydro-Québec as well.

In the following hours, the seismologists decide whether it is desirable to conduct a field survey to learn more about the geological environment where the earthquake occurred, and to record any aftershocks that might occur in the ensuing hours and days.

In a field survey, seismologists set up portable seismographs to measure any further release of energy through small earthquakes. This information is analyzed in the weeks and months after the main earthquake and permits scientists to better understand the phenomenon of earthquakes in Canada. In the short term, this information cannot be used to predict earthquakes. In the long term, it will provide the basis for a more comprehensive scientific analysis of seismic activity in the region.

Also, if the earthquake was large, other scientists specializing in surface deposits (clay, sand) may join the field survey team. Engineers may also come

to inspect buildings to better determine the effects of the earthquake. Some of these specialists may even return again after several months to gather additional data.

11 DO EARTHQUAKES OCCUR OFTEN IN CANADA ?

Seismologists estimate that more than 1000 earthquakes are recorded each year in Canada. Most measure less than 3 on the Richter scale and are not felt by humans. Earthquakes of magnitude 6 or greater are strong enough to cause significant damage.

The southwest corner of British Columbia is the most active earthquake region in Canada (more than 200 every year). Other very active areas include coastal areas of B.C., the southern Yukon Territory, the Mackenzie Valley in the Northwest Territories, the Arctic Islands, and parts of Ontario and Quebec (especially the Ottawa and St. Lawrence valleys). In Eastern Canada, earthquakes that are generally too small to be felt, are recorded every two or three days.

The following table lists some important earthquakes located in Canada in this century:

Date	Magnitude	Location
1992	6.8	Offshore northern Vancouver Island
1989	6.2	Ungava region (Quebec)
1988	6.0	Saguenay region (Quebec)
1985	6.6 & 6.9	Nahanni region (N.W.T.)
1982	5.7 & 5.4	Miramichi region (N.B.)
1979	7.2	Southern Yukon–Alaska border
1970	7.4	South of Queen Charlotte Islands (B.C.)
1949	8.1	Offshore Queen Charlotte Islands (B.C.)
1946	7.3	Vancouver Island (B.C.)
1944	5.6	Cornwall region (Ontario–New York border)
1935	6.2	Témiscamingue region (Quebec–Ontario border)
1933	7.3	Baffin Bay (N.W.T.)
1929	7.2	Grand Banks region, south of Newfoundland
1929	7.0	South of Queen Charlotte Islands (B.C.)
1925	7.0	Charlevoix–Kamouraska region (Quebec)
1918	7.0	Vancouver Island (B.C.)

As Canada's national earthquake monitoring agency, the Geological Survey of Canada (GSC) operates a network of approximately 100 seismograph stations across Canada to record and measure earthquakes. This network helps GSC scientists determine areas of greatest earthquake hazard, the frequency of earthquake occurrence and the potential ground shaking that can be expected.

Their work contributes to Canada's National Building Code, land-use and emergency planning, and engineering and building standards for major work such as dams, nuclear power plants and offshore drilling platforms.

The Geophysics Division in Ottawa monitors seismic activity in central and eastern Canada. The Pacific Geoscience Centre, in Sidney, British Columbia, is responsible for western Canada, Yukon and the western region of the Northwest Territories.

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