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Aller au sommaire du numéro

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Résumé de l'article

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Earthquakes in Canada – An Underestimated Danger

by

Egon Gutzeit[1]

L'auteur de cet article, M. Egon Gutzeit, vice-président principal à La Munich du Canada, Compagnie de Réassurance, nous trace un historique de ces phénomènes naturels que sont les tremblements de terre, avec leurs conséquences prévisibles, catastrophiques pour notre industrie comme du point de vue socio-économique.

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Last year's earthquake catastrophe in Armenia was a vivid reminder that the natural forces of our earth are capable of releasing destructive energies to dwarf all man-made devastation, with the exception of the probable cataclysm of nuclear war. The official death toll from the Armenian earthquake is 25,000 and estimates of costs to rebuild properties destroyed run as high as $16 billion.

Earthquakes are caused either by volcanism, the collapse of sub-terrain cavities, or by tectonic movements of the earth's crust. They have been an integral part of our planet's geological development for time immemorial, since our earth has been subjected to unceasing subterranean turmoil during its 4.6 billion year history. Scientists have been able to trace the development of the supercontinent Pangaea as far back as 550 million years by studying traces of magnetism preserved in rock – indicative of a continent's orientation and latitude relative to the North Magnetic Pole – and by examining fossil deposits which reveal climatic conditions of the distant past. They have also determined that Pangaea started to break up about 180 million years ago and that, as recently as 50 million years ago, North America and Eurasia were one land mass, as were Australia and the Antarctic.

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The movements continue today at rates varying from a few tenths of a millimeter up to 10 centimeters a year. They cause more than a million tremors every twelve months ; one every thirty seconds. About three thousands of those tremors move the earth noticeably ; hundreds produce significant changes to its landscape and at least twenty cause severe distortions. It is the latter twenty that give us the most concern, since their occurrence in populated areas can be truly catastrophic. This was proven by last year's earthquake in Armenia, which nevertheless may be considered a mere *chest pain*, since it only registered 6.5 on the Richter Scale, in comparison with a subduction earthquake – or mega-earthquake – which would measure M9.0 or higher.

(M stands for magnitude using the logarithmic open ended Richter Scale, in which each full number means a tenfold increase in ground shaking and 32 times more energy released.)

The region of greatest concern for us in North America lies around the Pacific Rim and includes the Pacific coast of Canada. The northern part of the Juan de Fuca plate, off the coast of British Columbia, is known as the Cascadia subduction zone. It is relatively young – less than 10 million years old at the trench along its entire length. While severe earthquakes have occurred in British Columbia (e.g. an earthquake of magnitude M7.3 on Vancouver Island in 1946), we are not aware of any major thrust earthquakes along the trench of the Cascadia subduction zone in recorded history. However, it should be noted that the recorded history of the west coast of Canada is very short – only 150 to 200 years.

In a study prepared by Garry Rogers of the Pacific Geoscience Centre in Sidney, B.C., it was pointed out that "there are six other zones around the Pacific subducting young lithosphere and five of the six have had major thrust earthquakes. . . on the subduction interface in historic time."

Dr. Rogers added in his study that the present period of low seismicity in the Cascadia subduction zone is deceiving, but quite normal, indeed "normal behavior should include long periods of low seismicity or seismic quiescence punctuated by very large earthquakes." An analogy can be made with two moose bulls pushing against each other. For the moment, their antlers are locked but every so often they slip, many times with quite dramatic consequences.

Dr. Rogers went on to point out that, depending on the segments of the Cascadia subduction zone ruptured, we can expect an earthquake of magnitudes ranging from 8.2 to 9.3 on the Richter Scale, which in the view of some scientists, could well be the largest quake in the history of the world.

In California, it has been possible to extend the period of observation beyond historic time by the relatively new science of paleoseismology. Geologist Kerry Sieh has employed a trenching technique and radiocarbon dating techniques to uncover evidence of twelve major earthquakes along the San Andreas Fault during the past 1,400 years. He thinks that the intervals between large earthquakes along the Mojave segment of the San Andreas Fault range from 50 to 300 years with an average recurrence interval of 140 to 150 years. The last major earthquake on the Mojave segment of the San Andreas Fault was in 1857 – 131 years ago. We are now alarmingly close to Sieh's average recurrence interval.

In the previously mentioned study by Dr. Rogers, he estimated the return period of an 8.5 magnitude earthquake from the rupture of a portion of the Juan de Fuca plate to be between 91 and 303 years. This is a wide range and we obviously do not know when or where the next major west coast earthquake will take place. We do know, however, that one will occur and since the energy released by such a mega-earthquake will be approximately one thousand times greater than that of the M6.5 earthquake in Armenia last year, its consequences will be truly devastating, if it strikes densely populated areas such as Vancouver and its surroundings.

Historical records of earthquakes in eastern Canada cover more than 350 years. Earthquakes with estimated magnitudes of 7.0 and 7.5 to 8.0 occurred at the St. Lawrence River near the mouth of the Saguenay in 1638 and 1663 respectively. Earthquakes of magnitudes ranging from 5.5 to 7.0 occurred in this region in 1665, 1791, 1831, 1860, 1870 and 1925. The latter was felt as far west as the Mississippi and as far south as Virginia.

As recently as November 1988, an M6.2 earthquake shook Chicoutimi, Quebec. Its epicentre was outside the area traditionally defined as eastern Canada's earthquake exposure zone. While loss or damage from this quake was not of catastrophic proportion due to its remoteness, some 4,000 houses were reported to be damaged and

13 of the 36 hospitals of the region were seriously affected. This prompted Quebec's Provincial Government to contemplate the creation of a financial assistance plan for the damages caused by this particular earthquake. At the same time, of course, insurance companies were also flooded with questions from their customers, regarding coverages under their existing policies and the cost of appropriate earthquake coverage for the future.

The earthquake in Armenia last November and Central Asia in early January of this year are the most recent examples of the devastating forces that even so-called moderate earthquakes can unleash. Less than four years ago, in September 1985, Mexico City (much closer to home) was struck by a devastating earthquake. In the early hours of the morning on September 19, earthquake shock waves that had travelled 350 kilometers in about one minute shook that huge city as though it were standing on jelly. More than 10,000 people died, 50,000 were injured and 250,000 were left homeless. In addition, approximately 7,400 buildings were damaged – of these, 770 were totally destroyed, 1,630 were severely damaged and 5,000 suffered minor damage. The economic loss was estimated at $4 US billion and the overall insured loss about $275 US million.

It is quite natural, when we read news of tragic events in distant lands, to react sympathetically. Indeed, Canadians are known to respond most generously to the needs of others. Nevertheless, we are also inclined to be somewhat detached in our observation of such events – to believe that it can never happen in Canada. This article is an attempt to demonstrate otherwise.

The question is not : will a major earthquake occur in our country ?, but : when will it occur and will we be prepared to cope with it ? That question is very difficult to answer. We can, however, reasonably assert that the most vulnerable region to a major earthquake in Canada is the west coast and that the economic loss there will be much greater, perhaps as much as three times greater, than the economic loss caused by the earthquake in Mexico. We can also expect that the insured loss will be a very much higher proportion of the total economic loss than was the case in Mexico. We pray that the loss of life will be very much less ; however, we must do more than pray. We must prepare for the worst and only then should we give ourselves the privilege of hoping for the best.

In the eighties, we have had, in Canada, several major catastrophe losses caused by natural perils. Examples are the Calgary hailstorm in 1981, which resulted in insured losses of $150 million, the Barrie tornado in 1985 with estimated insured losses of $117 million and the Edmonton tornado in 1987 which cost the insurance industry some $235 million.

Our industry has shown that it is quite capable of handling these events when its operating results are otherwise healthy. We can, in fact, take very considerable pride in our efficient and effective responses to wind and hail storms in Canada. Yet, while taking comfort and a great deal of confidence from our past performance, we must continue preparations for the even greater challenges that lie ahead since some of those events previously mentioned are hardly comparable to the potentially devastating impact of a major or mega-earthquake.

There are three fundamental aspects to the preparatory process :

- transparency of risk ;
- limitation of liability ;
- price of protection.

Effective transparency can only be achieved when insurers and reinsurers alike adopt uniform methods of identifying and measuring exposures. Such uniform methods are not only essential to enable the calculation of appropriate probable maximum loss amounts, but are equally essential for the determination of adequate premiums for natural perils and exposures, including earthquake.

It is entirely possible that uniform methods of accumulation control, together with adequate premium charges, would allow the expansion of capacity to insure and reinsure the earthquake and other natural perils exposures and enable our industry to more fully respond to the very large losses resulting from such natural catastrophes.

While accurate measurement of accumulation exposures and adequate premium charges would undoubtedly increase capacity, it will still be necessary for the industry to limit its liability in some manner. In this context, limitation of liability is not so much a mat-

ter of withholding capacity as one of concern for the adequacy of finite financial resources to meet future obligations in full.

On the other hand, as mentioned earlier, capacity can be increased by the charging of appropriate premiums. To be truly effective, however, in building the capital fund necessary to respond to large natural catastrophes in the shortest possible time, such premiums should not be part of profit commission calculations and should be shielded from taxation, perhaps by provision for pre-tax reserves for losses arising from natural catastrophes generally.

There can be no doubt of the inevitability of recurring natural perils events and major earthquakes ; however, it is equally clear that they are insurable and reinsurable – provided the exposures are properly measured and priced.

Our industry has a vital role to play in helping Canadians prepare for and recover from such events. There is no time to lose in taking the necessary preparatory steps. Failing to do so will not only have catastrophic consequences to us as an industry but would, ultimately, be a betrayal of the faith placed in us by our insureds.