

Geologic Site of the Month
December, 1997

The Cap-Rouge, Quebec, Earthquake



46° 45' 0.00" N, 71° 20' 60.00" W

Text by
Henry Berry



Introduction

Although technically this month's geological "site" is out of state, the effects of the November 5 Cap-Rouge earthquake were felt by people across the State of Maine. We thank everyone who took the time to complete and return an "earthquake questionnaire" to us. Over the past four weeks, we have received and evaluated over 200 responses, and the cards continue to come in. If you felt the earthquake in Maine and have not yet completed a questionnaire, it is not too late to do so. We would like as many first-hand reports as possible. You may either complete our on-line form or request an earthquake questionnaire card by contacting the Maine Geological Survey. The Geological Survey of Canada has been collecting similar information in Canada for this earthquake.



Earthquake Impacts in Maine

The map in Figure 1 summarizes the reports we have received to date for Maine. Each response has been analyzed according to the types of effects described, and assigned a value in Roman numerals on the Modified Mercalli (MM) Intensity Scale. Dots on the map represent individual reports, color coded according to intensity.

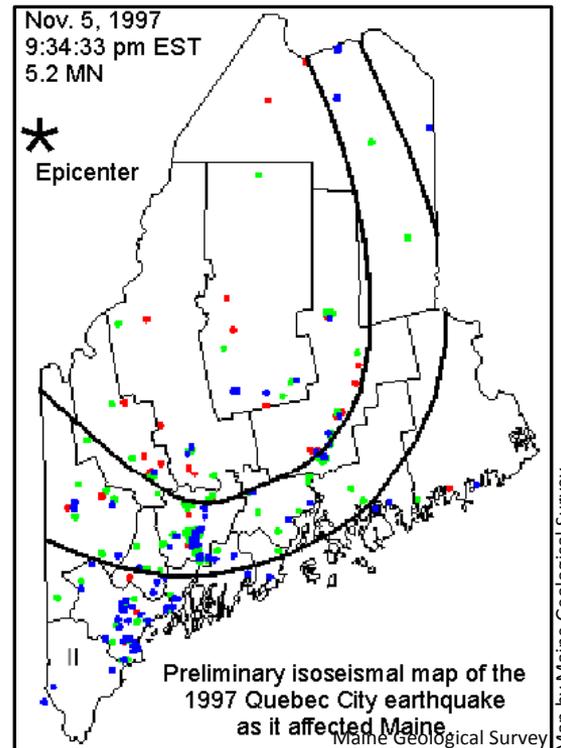


Figure 1. Map shows the Modified Mercalli Intensity of the Cap-Rouge, Quebec, earthquake experienced in Maine. Red dots: MM IV and MM V. Green dots: MM III. Blue dots: MM II. Isoseismal lines show the regional variation of highest commonly reported intensity.



Earthquake Impacts in Maine

Intensities reported for Maine range from MM II up to MM V. Two isoseismal lines have been superimposed on the map to indicate areas in which the largest common value is MM II, MM III, or MM IV. This map should be considered preliminary, because the MM value of individual sites may be revised as we continue to re-evaluate the cards, and because we continue to receive more reports that may modify the map.

As expected, the intensity of ground motion decreased away from the earthquake epicenter. The strongest effects, commonly at MM IV, were reported for northwestern Maine, through the Jackman-Greenville-Millinocket area and extending south to Farmington and east to Brewer. Intensities of MM III were commonly felt across Oxford, Androscoggin, Kennebec, and Waldo Counties and as far southeast as Hancock County. Remaining parts of the state in southern, eastern, and northern Maine generally experienced intensities of MM II. A large number of responses came from the Augusta-Belgrade area and from the Gorham-Westbrook-Topsham area. In Canada, the maximum intensities for this event were MM VII immediately around the epicenter, causing thousands of dollars of damage to a school.



Earthquake Impacts in Maine

On closer inspection of the Maine map you can see that, within the regions of generally similar intensities, there is a significant variability among individual sites. For example, there are some reports of MM IV intensity in the region where most places experienced MM II effects, and vice-versa. In other words, the intensity of motion experienced at a place depends on more than just the distance from the epicenter. This is because certain types of natural geologic materials amplify ground motion caused by seismic energy. In general, the intensity of ground motion in a given area is lowest on solid bedrock and greater on thick deposits of clay, sand, or artificial fill. The relationship between surficial geologic materials and intensity is a complex one due to the complicated structure and variety of earth materials. The data gathered on earthquake questionnaires over several events through the years will gradually help us to better understand this relationship.

Also notice on the intensity map that the isoseismal lines are not concentric circles centered around the epicenter at Cap-Rouge. The pattern is an irregular, roughly oval shape, in which higher intensities extend farther southeastward into central Maine, and die out sooner eastward into Aroostook County. Roughly oval-shaped patterns of isoseismal lines are typical for earthquakes in the northeast Appalachian region, and reflect the variable attenuation of seismic waves as they travel in different directions through the bedrock crust. (For example, see the [isoseismal map for the 1988 Saguenay, Quebec, earthquake](#))



Instrument Monitoring

The Canadian National Seismograph Network, has seismic monitoring instruments deployed in the Quebec City - St. Lawrence region that recorded the earthquake. By combining data from seven seismic stations, they determined that the earthquake occurred at 9:34 P.M. (EST) on Nov. 5, 1997, with a magnitude of 5.2 (MN), at a depth of 22.5 km. If an earthquake of this magnitude had occurred close to the surface, the damage (or intensity) near the epicenter would have been greater.

The US National Seismic Network of the US Geological Survey does not operate any seismic stations in Maine. (The USNSN station formerly in Caribou has been dismantled.) The New England Seismic Network, operated jointly by Weston Observatory of Boston College and MIT, had as many as 18 seismic stations in Maine in 1980, but now has only a single Maine station in operation at Milo (station MIM).



Instrument Monitoring

A second Maine seismic station, at Colby College in Waterville, has been installed recently but did not record the November earthquake due to computer malfunction. The Nov. 5 seismic record from the Milo station is shown in Figure 2.

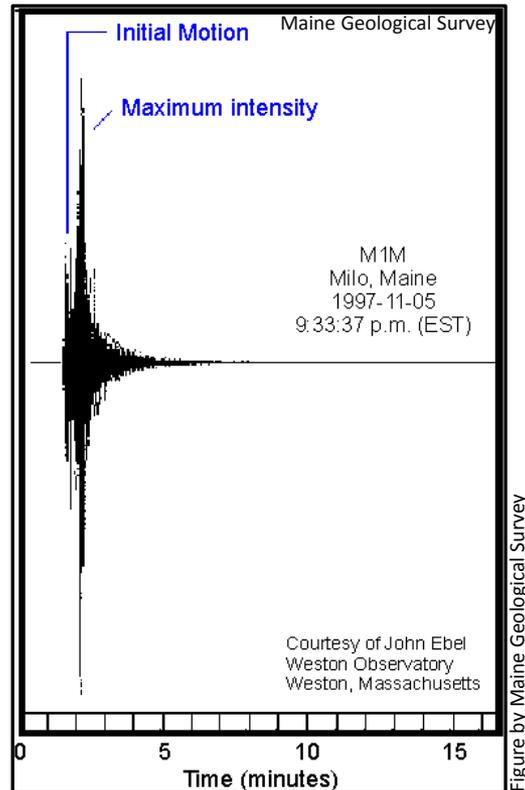


Figure 2. Seismogram of the Cap-Rouge earthquake as recorded at Milo, Maine. Note that the sharp initial motion was followed about half a minute later by the maximum intensity. Several people who felt the earthquake reported two pulses of motion. Activity gradually decayed over several minutes.

Instrument Monitoring

Modern instrumental monitoring of earthquakes in Maine goes back only to 1975. Events before that time are known mainly from anecdotal information such as newspaper articles, letters, and diaries. For example, research on anecdotal reports from the April 4, 1904, earthquake near Eastport has allowed a map of intensity and isoseismal lines to be constructed. From that map, Leblanc and Burke (1985, *Seismological Research Letters*, v. 56, p. 107-124) have estimated a magnitude of 5.9 for the 1904 earthquake. This was probably the largest earthquake in Maine in the past 200 years, and is significantly larger than anything recorded by modern seismic instruments. In order to make these types of magnitude estimates for historical earthquakes, the relationship between intensity and magnitude must be known. This, in turn, depends on collecting intensity information from people who experience modern earthquakes. Again, we thank all those who have responded.



References and Additional Information

[The Modified Mercalli Intensity Scale](#)

[Information about the Cap-Rouge earthquake from Wikipedia](#)

[Information about the New England Seismic Network](#)

[Information about Earthquakes in Maine](#)

