Virtual Tour

of

Maine's Geologic Hazards

Introduction

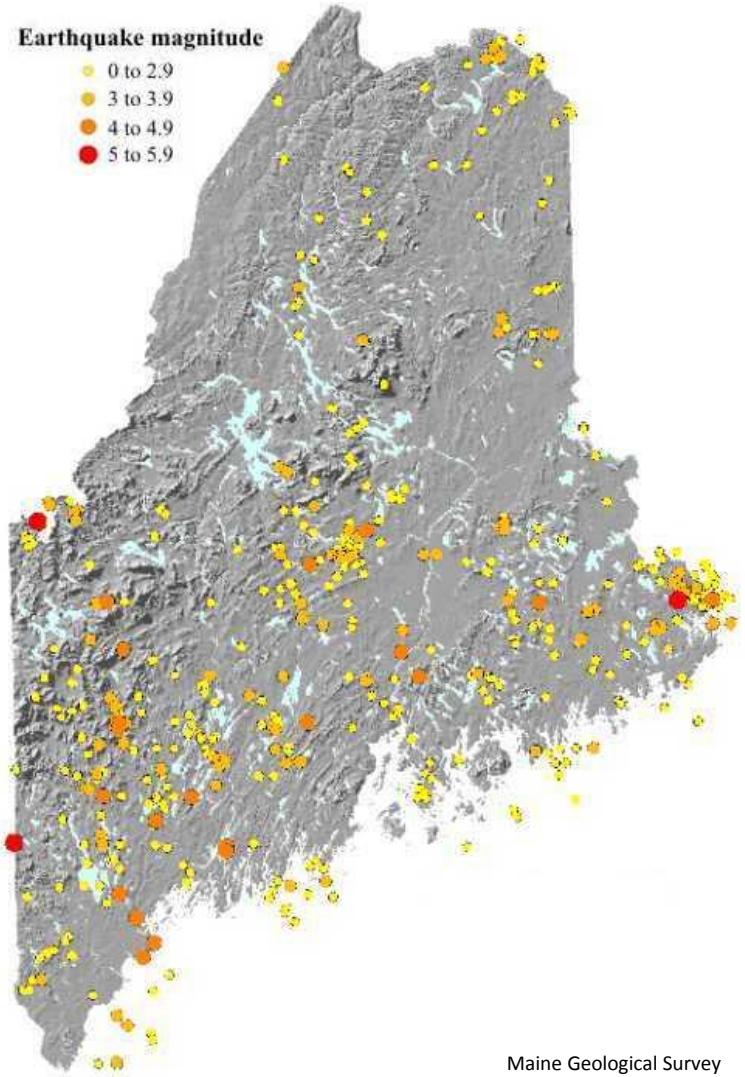
Coastal erosion, floods, and landslides all have the potential to cause extensive property damage. Coastal erosion and landslides have destroyed houses and cottages along Maine's shoreline. The large flood in April of 1987 caused an estimated $100 million in damage. Earthquakes, while historically not severe in Maine, do occur, with resulting public apprehension and concern. The following tour will present an introduction to the potential geologic hazards we face in Maine.

Contents

Earthquakes

Earthquakes in Maine are presumably caused by modern stress being released occasionally along zones of weakness in the earth's crust, but a more specific cause for the earthquake activity is not known. No significant amount of motion has been shown for any fault since the last Ice Age, about 20,000 years ago, and geologic evidence demonstrates that many faults have been inactive since the formation of the Appalachians, over 300,000,000 years ago. Most Maine earthquakes are of small magnitude, and many are too small to feel. No Maine earthquake has caused significant damage.

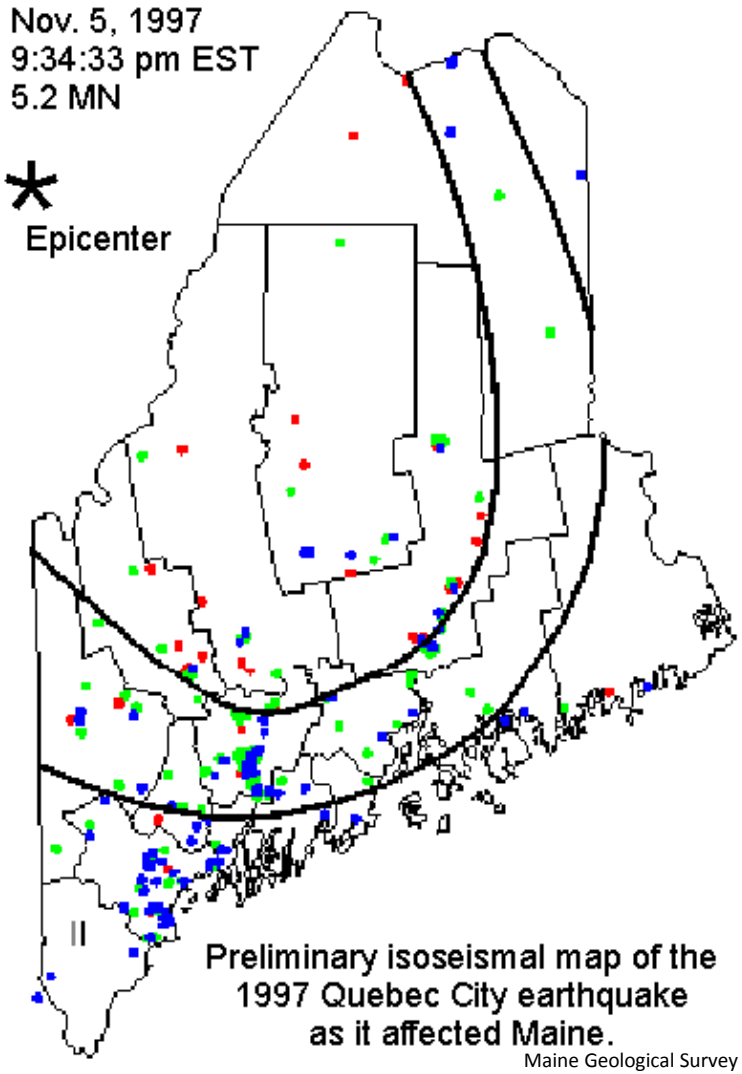
Earthquakes



Maine Geological Survey

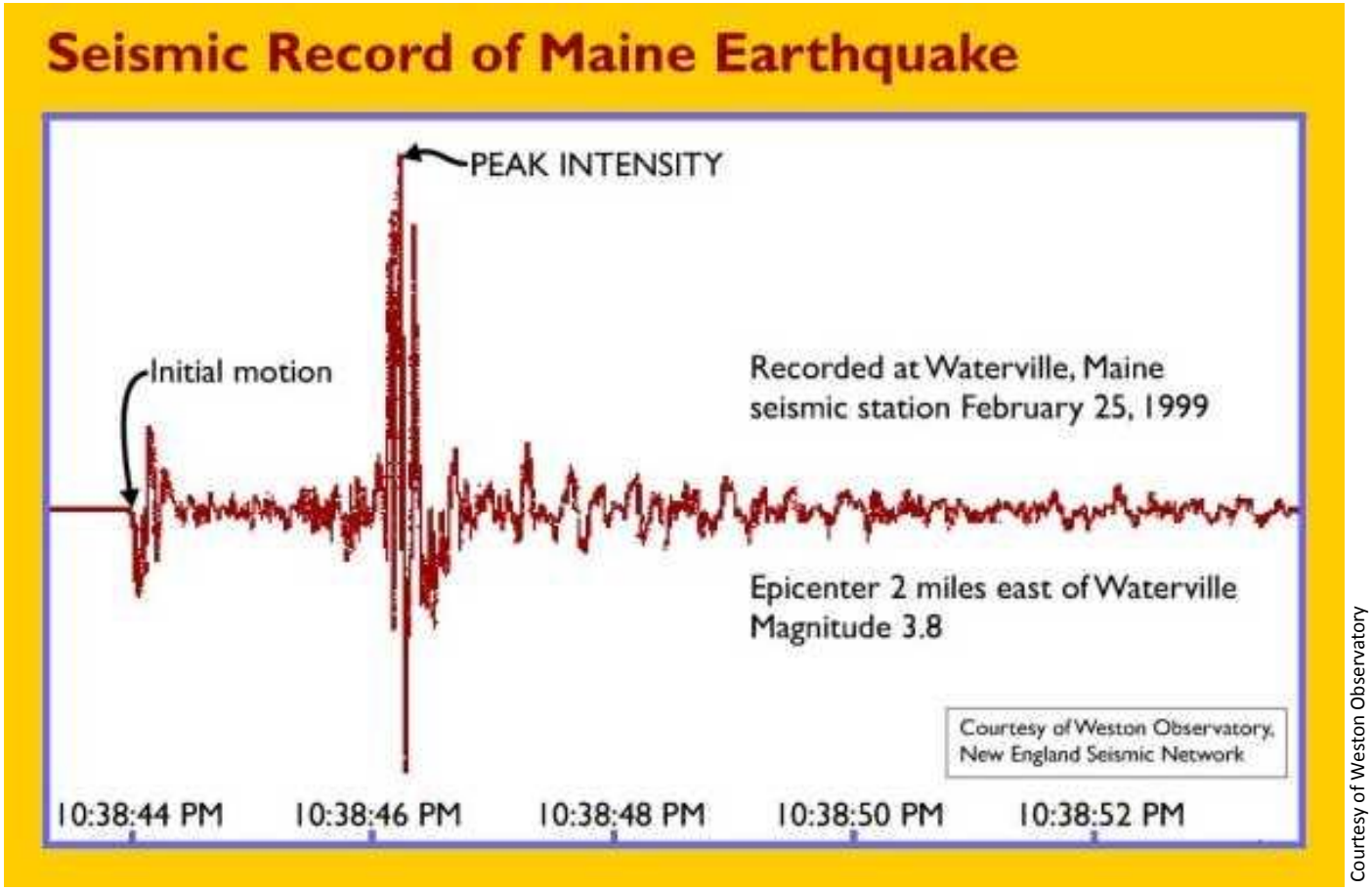
Map of recorded earthquakes in Maine.

Earthquakes



In November of 1997, a magnitude 5.2 earthquake occurred in Cap Rouge, Quebec. Larger than most of the earthquakes that have occurred in Maine, this earthquake was felt over much of the state.

Earthquakes



Courtesy of Weston Observatory

Seismic record of a quake of magnitude 3.8, 7 miles southeast of Waterville, February 1999.

Coastal Erosion

Coastal property in Maine is vulnerable to coastal erosion. Sea level is gradually rising along the coast of Maine, and this rise in the ocean allows waves to erode beaches and flats at the base of coastal bluffs. This erosion steepens the bluff, causing continuing erosion of the bluff face. Storm waves and surges also batter seawalls and structures along the Maine coast, eroding beaches and dunes.

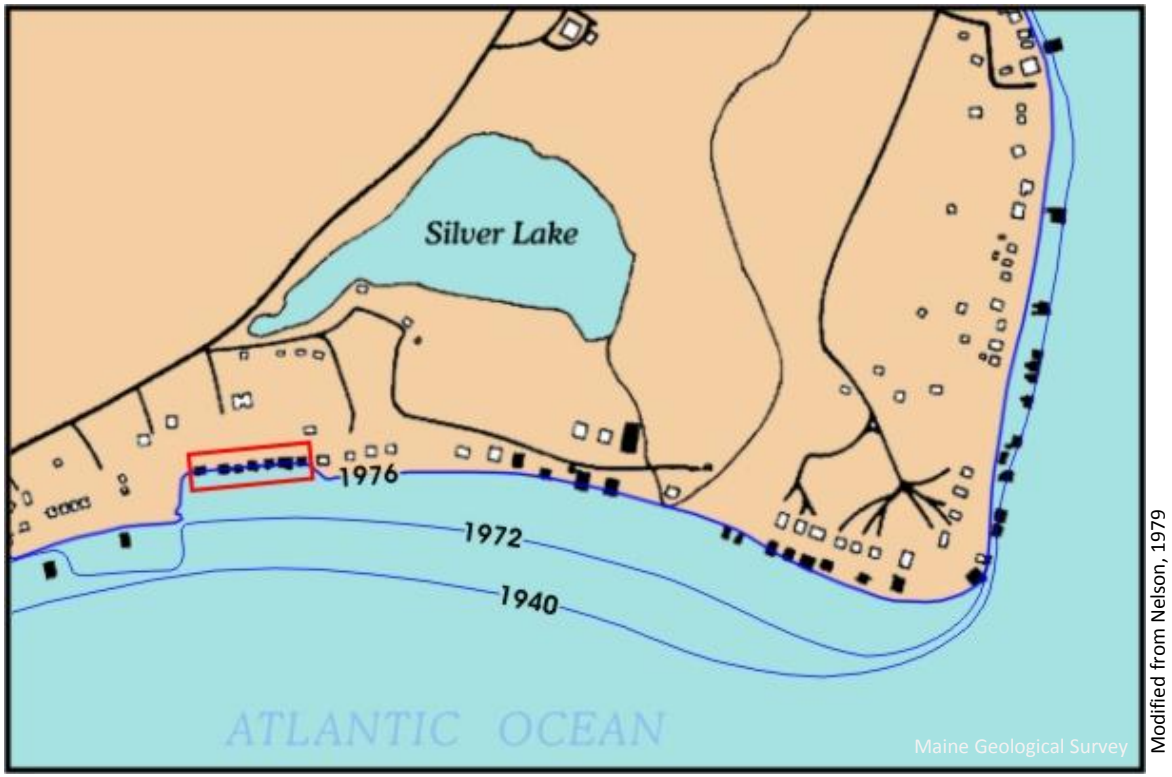
Coastal Erosion

A four-day northeaster in December 1992 resulted in a coastal storm surge of less than 2 feet yet it produced an erosional cut in the dunes at Seawall Beach, Phippsburg (shown in next slide).

Coastal Erosion

A four-day northeaster in December 1992 resulted in a coastal storm surge of less than 2 feet (shown in previous slide) yet it produced an erosional cut in the dunes at Seawall Beach, Phippsburg. Northeasters commonly produce frontal dune erosion and scarp formation. Note the person standing on top of the scarp for scale. Dune scarps from major storms can take years to return to the pre-storm condition.

Coastal Erosion



Modified from Nelson, 1979

Over longer periods of time, shoreline change and coastal erosion can be more extensive. The map above shows historic shorelines along Popham Beach in Phippsburg. The blue lines show the location of the shoreline in 1940, 1973, and 1976. The small rectangles represent houses along the coast. The black rectangles represent houses that have been destroyed due to coastal erosion. The red box outlines a row of cottages destroyed in 1976 and shown on the following slide.

Coastal Erosion

At the location shown in the previous slide, a row of cottages was undermined by coastal erosion on Popham Beach in 1976.

Coastal Erosion

Engineered structures such as seawalls provide some short-term protection from coastal erosion, but over time, sea-level rise and the pounding surf will undermine the structures. Photo of Camp Ellis, winter 1986.

Coastal Erosion

The destructive power of coastal surf is seen in this photo of Camp Ellis during the winter of 1986.

Coastal Erosion

When engineered protective structures are breached by ocean waves, erosion is often rapid and devastating as shown in this photo of a ruined house at Camp Ellis in 1991.

Landslides

Landslides have the potential to cause extensive property damage, as witnessed by the 1996 landslide which destroyed two houses in Rockland. In Maine, most landslides occur in areas which are underlain by clay. These susceptible areas are usually coastal bluffs or bluffs along rivers. Continuing erosion at the base of a bluff, removing vegetation from the bluff face, or adding weight to the top of the bluff may increase the risk of a landslide.

Landslides

Photo courtesy of J. W. Sewall Co.

View of the north shore of Rockland Harbor in 1992. Note the well vegetated coastal bluff and the arcuate shape of the shoreline which is "pinned" by bedrock outcrops at either end.

Landslides

Photo courtesy of J. W. Sewall Co.

Early in the morning of April 16, 1996, a clay bluff failed on the north shore of Rockland Harbor. This landslide formed a new scarp about 200 feet landward of the original top of the bluff in just a few hours and destroyed two homes. The slide occurred along a steep bluff adjacent to Samoset Road. The bluff top was about 50 feet (15 m) above sea level and the base of the bluff slope ended at the high water mark. Slumping of the bluff occurred progressively in a series of discrete landslide events. When it was over, the slide had moved horizontally over 400 feet (120 m) onto the mudflats of the intertidal zone and had disturbed a total area of 3.5 acres (1.4 hectares).

Landslides

For a month following the major slide event, smaller blocks continued to fall from the steep landward slopes. These continued slope failures resulted in enlargement of the affected area by landward progression of the vertical scarp. By landward retreat, the main scarp moved to within 15 feet (5 m) of a sewer main on the seaward side of Samoset Road. The total cost in terms of lost property value and cost to the city for emergency activities, evaluation of the two homes destroyed and loss of land, clean up, and engineered stabilization was approximately $710,000.

Landslides

On September 28, 1983, a landslide occurred in a bluff of marine sediments at the confluence of the Stroudwater River and Indian Camp Brook in Gorham. Seven acres (3 hectares) of land slid to the south and southwest into the river and the brook, taking with it a house and garage, several vehicles, a tank truck, and a well drilling rig. The total area affected by the slide was about 12 acres (5 hectares).

Landslides

Not all landslides are as catastrophic as the ones that occurred in Rockland and Gorham. Many small landslides and slumps occur every year in clay soils in many parts of the state. The small landslide shown occurred in a clay slope in Augusta.

Floods

Major floods occur in Maine during each season. Floods are most widespread in the spring, when steady rainfall can be augmented by significant snowmelt. If the ground is frozen or saturated, runoff will increase causing rivers to rise rapidly. Backwater from ice jams in narrow river stretches may aggravate the situation. In the summer and fall, heavy rains may cause flooding. In October of 1996, an amazing 19 inches of rain fell on York County in a 48-hour period. During the winter, floods are uncommon since precipitation is in the form of snow, and any rain that falls is usually absorbed by the snowpack.

Floods

Kennebec River, April Fool's Day flood, 1987, downtown Augusta. A spring storm released an average of 4-8 inches of rain on snowpack that contained an average of 5-7 inches of water equivalent. The flood crest at Augusta was 21 feet above flood stage. This was the most devastating flood of record in Maine, with damage estimated at $100 million.

Floods

View of downtown Augusta with the Kennebec River at its normal water level.

Floods

View of the Calumet Bridge at Old Fort Western during the Kennebec River flood of April 1987.

Floods

View of the Calumet Bridge at Old Fort Western with the Kennebec River at its normal water level.

Floods

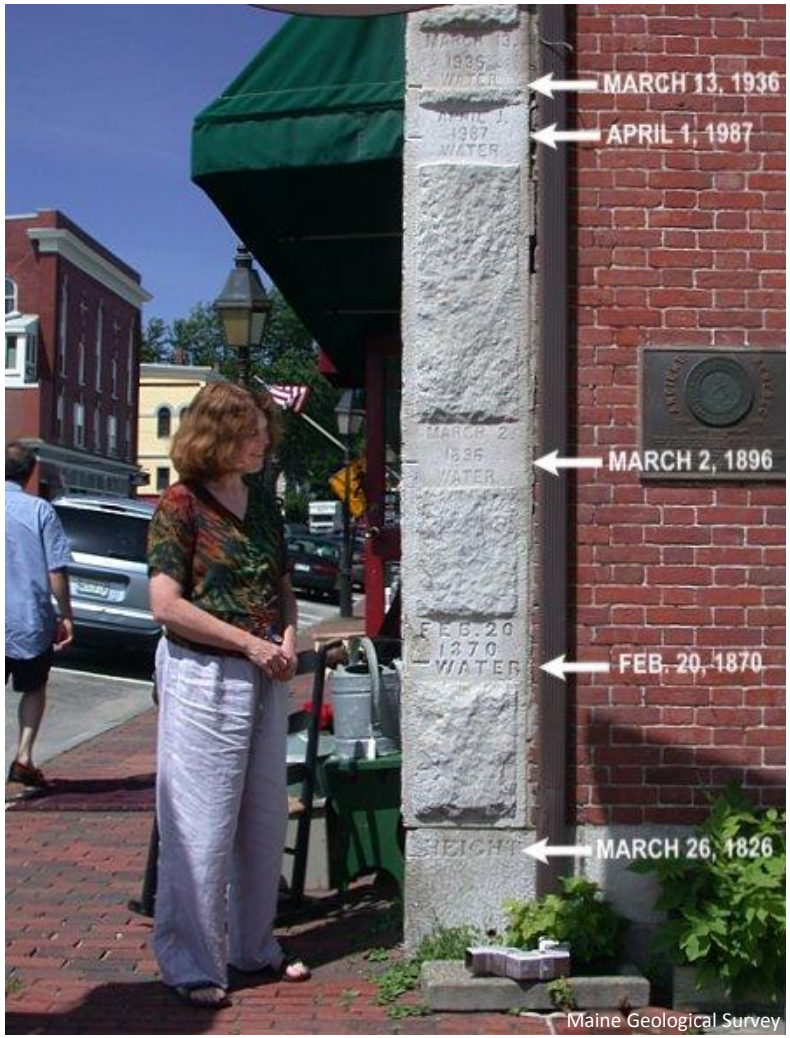


Photo by John B. Poisson

The corner of a building in Hallowell provides an interesting record of major floods along the Kennebec River.

Floods

Floods in Maine are often caused by a combination of heavy rains and resulting snowmelt in the spring. Ice jams during late winter-early spring may also be a contributing factor when ice floes on rivers meet at a constriction or obstruction in the river valley causing backwater flooding. The ice jam shown occurred in February 1995 at the Wire Bridge over the Carrabassett River in New Portland, Maine.

Floods

The Maine Geological Survey conducts bi-weekly snow surveys in late winter and early spring to provide information to the National Weather Service for use in preparing flood-potential statements, and to State and local emergency management officials for use in flood awareness efforts.

Floods

The U.S. Geological Survey maintains a network of stream-gaging stations in Maine to monitor streamflow across the state. Real-time observations of streamflow are available on the USGS website. The photo shows a cable way for surface water monitoring in Waterville.

References

Nelson, B. W., 1979, Shoreline changes and physiography of Maine's sandy coastal beaches; M.S. thesis, University of Maine, Orono, Maine, 302 p.