USGS
Earthquake Hazards Program

Earthquake Hazard and Safety in Haiti and the Caribbean Region

Statement by the U.S. Geological Survey

The magnitude 7 earthquake of 12 January 2010 near Port au Prince, Haiti, has generated a sharp increase in concerns about the potential for future earthquakes in Haiti and the surrounding region. These concerns extend to understanding the causes of the earthquake hazard and learning what can be done to ensure seismic safety in the future. The purpose of this statement is to convey our best judgment on these subjects.

Aftershocks: The aftershock sequence of a magnitude 7 earthquake will continue for months if not years in the affected area. The frequency of events will diminish with time, but damaging earthquakes will remain possible in the coming months. There is also a small chance of subsequent earthquakes larger than the initial shock. The sequence from the Port au Prince earthquake continues to be very strong and active. Based on this activity and the statistics of aftershock sequences, our estimate for aftershock activity during a thirty day period beginning 21 January 2010 is as follows:

- The probability of one or more earthquakes of magnitude 7 or greater is less that 3%.
- The probability of one or more earthquakes of magnitude 6 or greater is 1 in 4.
- The probability of one or more earthquakes of magnitude 5 or greater is about 90%.
- Approximately 2 to 3 aftershocks of magnitude 5 or greater are expected within this time period.

These estimates will be updated as new information becomes available.

Precautions: Any aftershock above magnitude 5.0 will be widely felt and has the potential to cause additional damage, particularly to vulnerable, already damaged structures. Anyone living in Haiti or involved in relief work there must maintain situational awareness with regard to their personal earthquake safety. They should always be aware of what action they are going to take if the ground starts to shake. Open spaces are generally safe but running through falling debris to get to an open space may be dangerous. Only qualified engineers can determine if a damaged building is safe for reoccupation. Until engineering assistance arrives, a general rule to follow is: If it does not look safe it probably is not safe. Entry into or reoccupation of obviously damaged structures should be avoided.

Near-term concerns: The geologic fault that caused the Port au Prince earthquake is part of a seismically active zone between the North American and Caribbean tectonic plates. The earthquake undoubtedly relieved some stress on the fault segment that ruptured during the event, but the extent of rupture along the fault is unclear at this time. Fault slip models, preliminary radar surface deformation measurements, and examination of satellite and airborne imagery for surface rupture suggest that the segment of the Enriquillo fault to the east of the 12 January

epicenter and directly adjacent to Port au Prince did not slip appreciably in this event. This implies that the Enriquillo fault zone near Port-au-Prince still stores sufficient strain to be released as a large, damaging earthquake during the lifetime of structures built during the reconstruction effort. In historic times Haiti has experienced multiple large earthquakes, apparently on adjacent faults. We shall continue to study this situation using radar, LiDAR, and photographic data taken from satellites and aircraft. Field studies and ground observations of fault offsets during this earthquake and past events are essential to evaluate the potential for future earthquakes in proximity to Port au Prince.

Long-term concerns: It is essential that the rebuilding effort in Haiti take into account the potential, indeed the inevitability, of future strong earthquakes. Haiti is cut by two major plate boundary fault zones. Over the past three centuries, earthquakes comparable to or stronger than the recent one have struck Haiti at least four times, including those in 1751 and 1770 that destroyed Port au Prince. Engineers and construction professionals know how to design and build structures that will not collapse in strong earthquake shaking. Seismic hazard assessments provide the basis for development of appropriate building codes, and the identification of regions at greatest risk. A thorough seismic hazard assessment of Haiti, as well as of other countries in the Caribbean, will provide the basis for establishing or improving building codes and strengthening building resilience over the long-term. Such assessments involve geologic investigations of faults and soil conditions, reoccupation of geodetic measurement sites to determine strain accumulation, and studies of recent and historic earthquakes and seismicity patterns and statistics. These assessments usually take several years but can be accelerated to provide results markedly better than what is currently available. From these investigations we can assess the likelihood and nature of strong shaking and ground failure over various time frames. The development of more resilient structures and infrastructure is a long-term goal, particularly in the face of economic limitations. Over the short-term, it is critical that the rebuilding effort be undertaken with an awareness of the potential for subsequent damaging events during the next months and years. It is essential that structures such as hospitals, schools, and critical facilities be reconstructed with greater resilience for the preservation of life and functionality.

Regional concerns: The experience of the Port au Prince, Haiti, earthquake reveals a need for better understanding of the nature and extent of earthquake and tsunami hazard in the Caribbean region. The arc of islands that forms the Lesser Antilles and Greater Antilles generally outlines the contact zone between the Caribbean and North American plates. This entire region is seismically active due to the relative motion between the plates and is prone to damaging earthquakes: a small-scale “ring of fire” like that encircling the Pacific ocean. Historical earthquakes greater than magnitude 7 have occurred in Puerto Rico, Jamaica, Dominican Republic, Martinique, and Guadeloupe. Along the northern coast of Venezuela the juncture of the Caribbean and South American plates has caused damaging earthquakes in the vicinity of Trinidad and Tobago. Earthquake safety policy, including building codes throughout the region, should be based on thorough seismic hazard assessments.