Institute Lecture

Geology of Earthquakes: The wisdom to prepare for the rarest and the most devastating hazards

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Abstract

The knowledge on location and timing of future earthquakes is crucial for the reduction of seismic hazards. Recent devastating disasters as in Haiti 2010, Sichuan 2008, Muzaffarabad 2005 clearly demonstrate the lack of preparation either by the lack or by the oblivion of the knowledge. For many years, seismologists' dream was to get the wisdom a few hours or days prior to the main shock. The dream, namely short-term prediction based on precursory phenomena, is yet to be realized. However, the fact that there were absolutely no scientifically accountable precursors before 2004 Sumatra or 2010 Chilean earthquakes obscures the hopes. On the other hand, long-term forecast on earthquakes and ground motion is now regarded as only practical way to reduce earthquake hazards. We cannot prevent earthquake hazards because it is extremely rare and abrupt. Even if the short-term prediction is realized and lives are saved, structural and infrastructural damages are inevitable. Therefore, we need to reduce hazards using limited resources of funds, human, and time optimizing their effective uses. For that sake rational evaluation of risks in time and space is indispensable. There are two way of earthquake hazard analysis. One is deterministic and the other is probabilistic. In both analyses, geologic information is important. For deterministic analyses, it is necessary to geometrically define the causative fault of individual earthquakes, and to estimate the possible slip on the fault. With this source fault model, strong ground motion is simulated using attenuation along seismic wave paths and rock/soil condition of the sites. For nuclear power plants and other critical facilities, this deterministic ground motion assessment is used to design the structures. For the society in general, it is not feasible to prepare for the severest ground shaking without considering about the possibility. For most houses and buildings, the probability of ground shaking in coming 30 to 50 years is necessary for reasonable design. In order to know the possibilities, engineers had relied on instrumental and historic catalogues of earthquakes. However, unexpected hazards in 1990s disclosed the incompleteness of those catalogues and urged to go further back in time to evaluate earthquake risks with geologic information. In California less-than-200-year historic documents record only one cycle of the biggest earthquakes. Only geology brings the information on recurrence time and its variance. Though the written history is much longer in Japan, China, India, and Turkey, reliable earthquake records are limited only respective ~2000, ~500, ~400, ~300 years while earthquake recurrence times are more than respective 2000 (in Sichuan), 1000 (on shore), 500?? (on Himalayan front), and 250 years. Therefore geologists are exploring longer records of earthquakes in earthquake-prone areas around the world to better analysis the risks. At the same time, understanding the recurrence behavior of large earthquakes in space and time, as well as the entire earthquake cycle is an important issue to make more accurate and reliable forecasts. The geological information and its clever use are the only way to mitigate the rarest and most devastating earthquakes.

About the speaker

Koji Okumura acquired B.A., M.Sc. and D.Sc. degrees in University of Tokyo, Japan, in 1981, 1983, and 1987, respectively. In 1986 he joined the Geological Survey of Japan (GSJ), Agency of Industrial Technology and Science, Ministry of International Trade and Industry. In GSJ he had conducted pioneer works on paleoseismology in Central Japan, California and Turkey. The works in Turkey were in scope of technical transfer on earthquake safety funded by JICA and were very significant contributions before the 1999 disasters. The research activities as a visiting researcher in U.S. Geological Survey in 1990-1991 and 2000-2003 periods made him an international player working in numerous countries for field works and cooperations. After 2007 Niigataken Chuetsuoki Earthquakes which struck hard the world largest nuclear power plant at Kashiwazaki, he has been engaged in seismic safety of nuclear facility in Japan and in IAEA beside his devotion in scientific communities.

All interested are welcome.

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