Quaternary research for the studies of earthquake hazards

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Quaternary sciences are multidisciplinary researches on the history of the nature and the human during the most recent geologic epoch and present. The knowledge from the most recent past of the nature is the key to understand the future. The scientific output on climate and environmental changes has been the largest contribution from the Quaternary sciences. In these days, however, the Quaternary information on natural hazards and their risks are getting more and more important. For the 19th INQUA (International Union for Quaternary Research) Congress in Nagoya in 2015, the theme of the congress was "Quaternary Perspectives on Climate Change, Natural Hazards and Civilization" and one of the main topics was "Quaternary Research for the Reduction of Risks from Natural Hazards". After the severest earthquake and tsunami hazards in the past decade, it was very appropriate to recognize research on natural hazards as one of the important tasks of Quaternary research.

The most significant natural hazard research within INQUA has been carried out by the Neotectonics Commission since 1970s and by its successor, the Paleoseismicity Group since 2003 in the Terrestrial Processes, Deposits, and History Commission. The Japan Association for Quaternary Research has set up the Research Committee on Tectonics to correspond to the INQUA's research group. One of the most important achievements of the INQUA Paleoseismicity Group is the Environmental Seismic Intensity Scale (ESI 2007). Since 2008, the group has revised and validated the ESI 2007 with paleoseismic records and made the ideas about EEE (Environmental Earthquake Effects) very clear and popular among earth scientists. The IAEA TECDOC-1767, "The Contribution of Palaeoseismology to Seismic Hazard Assessment in Site Evaluation for Nuclear Installations" prepared by the group leaders sets an important milestone of Quaternary research for earthquake hazards.

The INQUA Paleoseismicity Group submitted a proposal for 2016--2019 research project to INQUA. The proposal is seeking for better understanding on surface ruptures and fault displacement associated with earthquakes. Development of more reliable remote sensing methods will help complete mapping of the coseismic fault ruptures. Building up a thorough catalog of coseismic ruptures together with the complete mapping will enable to improve scaling laws between fault length or fault displacement, and earthquake magnitude. The scaling law for the end members of smaller magnitude earthquakes is to be improved with the results.

Two earthquakes with surface ruptures in 2014 gave a strong motivation for the project proposal. One is the August 24, 2014 South Napa earthquake (Mw 6.0) in California and another is the November 22, 2014 Nagano-ken-hokubu earthquake (Mw 6.2). The South Napa earthquake ruptures were 12.5 km long and partly followed previously mapped the West Napa fault. The largest right-lateral offset was 46 cm. The Nagano-ken-hokubu earthquake ruptured about 9 km long northernmost portion of the 26 km long Kamishiro fault in the north end of the Itoigawa-Shizuoka tectonic line active fault system with up to 80 cm vertical separation on reverse faults. The significant surface ruptures were not common for these smaller earthquakes of magnitude around 6.0. We need to know the mechanism of the appearance of clear surface ruptures with smaller magnitude earthquake through complete mapping of the ruptures. In addition, the Earthquake Clearing House after the South Napa earthquake was very useful for the collection and dissemination of surface ruptures and damage records as well as for the effective coordination and cooperation among many survey teams.

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