Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

HDS07-01 Room:101B Time:May 23 16:15-16:30

G-EVER Consortium: the new earthquake and volcanic hazards mitigation activities

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The first Workshop on Asia-Pacific Region Global Earthquake and Volcanic Eruption Risk Management (G-EVER1) was held in Tsukuba, Japan from February 22 to 24, 2012. The workshop focused on the formulation of strategies to reduce the risks of disasters caused by the occurrence of earthquakes, tsunamis and volcanic eruptions worldwide. More than 150 participants attended the event. During the workshop, the G-EVER1 accord was approved by the participants. The Accord consists of 10 recommendations like enhancing collaboration, sharing of resources, and making information about the risks of earthquakes and volcanic eruptions freely available and understandable. The G-EVER Consortium among the Asia-Pacific geohazard research institutes was established in 2012. The G-EVER Promotion Team of GSJ was also formed on November 2012. The G-EVER Hub website (http://g-ever.org) was setup to promote the exchange of information and knowledge about volcanic and seismic hazards among the Asia-Pacific countries. Establishing or endorsing standards on data sharing and analytical methods is important to promote data and analyses results sharing. The major activities of G-EVER include participation in global risk reduction efforts such as the Global Earthquake Model (GEM) and Global Volcanic Model (GVM). The G-EVER international conference would be held every 2 years in the Asia-Pacific countries. On the other hand, one to two days G-EVER international symposium would be held annually. The 1st G-EVER International Symposium was held in Tsukuba, Japan on March 11, 2013. The 2nd Symposium is scheduled in Sendai, Tohoku Japan, on Oct. 19-20, 2013. Several G-EVER Working Groups and projects were proposed such as the following: (1) Risk mitigation of large-scale earthquakes WG, (2) Risk mitigation of large-scale volcanic eruptions WG, (3) Next-generation volcanic hazard assessment WG, (4) Active fault catalogue WG, and (5) Asia-Pacific region earthquake and volcanic hazard mapping project.

The Asia-Pacific region earthquake and volcanic hazard mapping project aims to make an advanced online information system, which provides past earthquake and volcanic hazards records (eg. age, location, scale, affected area due to earthquake, tsunami, ash fall, and pyroclastic flows, and fatalities), recent earthquake and volcanic eruption information, risk assessment tools for earthquake and volcanic eruption hazards, and links to global earthquake and volcanic eruption databases. The hazard mapping project is planning to make the system with the cooperation of the Asia-Pacific countries.

Keywords: Asia-Pacific, earthquake, volcano, risk, G-EVER, hazard mitigation

HDS07-02 Room:101B Time:May 23 16:30-16:45

Seismological database in eastern Asia (part 2)

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Earthquake catalogs were compiled and summarized by Ishikawa(2002) in China, Korea and Japan. The calendar was uniformed in Gregorian and the origin time of earthquakes was Universal time. For the next step, worldwide data were used for checking. Engdahl & Villasenor(2002) compiled the global earthquake catalog in 20c. Their result was very useful for many researchers, but the locations of some hypocenters were not suitable. There were large differences of the hypocenter locations from those of JMA. For example, the hypocenter of the 1952 Tokachi-0ki earthquakes was at Hidaka region by them, but actually it was located in the Pacific Ocean. The 1948 Fukui earthquake was located in the Japan Sea and some events in the Japan Sea were much deeper than in their catalog (Ishikawa,2012). Most of parameters of these events were referred from other papers. The parameters in old catalogs were not accurate, so if possible, the parameters had better be re-determined by using original reports. Ishikawa and Lin(2012) presented that the hypocenters by JMA in Taiwan from 1922 to 1944 were much better than others, as JMA re-determined hypocenters there using old reported data.

Next, the earthquake data in Vietnam and Philippine were added. The earthquake catalog by Cao(2012) was inputted in Vietnam. It includes earthquakes from AD 114. The earthquake catalog by PHIVOLCS was used in Philippine and it was from AD 1897.

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Keywords: East Asia, earthquake catalog, database, Vietnam, Philippine

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HDS07-03 Room:101B Time:May 23 16:45-17:00

Construction of the active fault catalog of the Asia-Pacific Region in G-EVER project

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It is important to decide a definition of active fault in order to construct a catalog of them. We will conduct a working group for make a active fault catalog for the Asia-Pacific region with a discussion on the definition of the active fault as an activity of the G-EVER project.

It is one of a primary purposes of the G-EVER project to evaluate the seismic hazards of countries in the Asia-Pacific region with same method to produce an abroad safety information for people and companies. For the construction of the common method, we need a active fault catalog for the seismic source with common definition of active fault for the all area. Currently USA, New Zealand and Japan have the active fault database but definition of the age of active fault is different among them. For example, "Quaternary Fault and Fold Database" of the US Geological Survey (USGS) includes all faults that have evidences of activity all the period of Quaternary (2.58 Ma), whereas "New Zealand Active Fault Database" of the Geology and Nuclear Science of New Zealand (GNS) contains the faults acted in the Late Quaternary (0.13 Ma). AIST has "Active Fault Database of Japan" which includes faults with evidences of activity on the higher terraces and geological layers since the Middle Pleistocene.

Working group for make a active fault catalog in G-EVER project will present an opportunity to discuss the definition of the age of active faults and produce earthquake source fault models, with a cooperation with the project of "Faulted Earth" in the Global Earthquake Model (GEM) Project.

Keywords: active fault, catalog, Asia-Pacific Region, G-EVER project, Global Earthquake Model

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HDS07-04 Room:101B Time:May 23 17:00-17:15

Comprehensive assessment for seismic risk in industry

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A research project to develop simultaneous risk assessment simulation tool based on the disaster researches of the 2011 Tohoku-Oki Earthquake was initiated to formulate measures for huge seismic risks. Another aim of this project is to control low probability - high consequence disaster causing huge social and economic damages. The proposed new risk assessment simulation tool includes diverse effects of primary disaster of earthquake or tsunami and secondary damages of industrial plants and atomic power plants or supply chains of various products including function of production and transportation. In this study, we focus on the industrial damage in Japan including secondary damage to the supply chains which might be caused by anticipated huge earthquakes such as the Tokai, Tonankai and Nankai Earthquakes.

The boundary and procedures of a comprehensive risk assessment was set as below.

- Considering building and factory damages in each company as seismic direct damage
- The direct damage to production loss in each industry in the considered region
- Production loss ratio represents reduction ratio of industrial production index
- The effect of secondary damage in each industry in each region is simulated by using a computable general equilibrium (CGE) model

Based on these procedures, we are now carrying out our research according to the steps below.

- Preparing the fragility curve of each industry
- Mapping the plants of each industry
- Recreating the damages using CGE model, by regions and industries, on information obtained from the experiences of the Tohoku Earthquake

The industry-specific fragility curve was created based on the damage studies (Naraoka et.al. 2012) and questionnaire for the past earthquakes. Reduction of industrial production index was resulted from many causes such as reduction of production, disruption of transportation, power failure, lack of water supply and shortage of employee. At the early stage of this study, we only consider reduction ratio in each industry, which is accumulated from regional statistics, such as a regional industrial statistics, a census of commerce of Japan and so on. Disruption of transportation, power failure, lack of water supply and shortage of employee will be taken into account in our future study.

Keywords: gigantic earthquake, industrial damage, risk assessment, fragility curve, supply chain, the 2011 Tohoku-oki earthquake

HDS07-05 Room:101B Time:May 23 17:15-17:30

Hydrological and geochemical cooperative research for earthquake forecasting in Taiwan

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Active Fault and Earthquake Research Center, Geological Survey of Japan, AIST has been carrying out the cooperative research entitled "Hydrological and geochemical research for earthquake prediction in Taiwan" with Disaster Prevention Research Center, National Cheng-Kung University, Taiwan since 2002. We made much contribution to clarifying the mechanism of groundwater changes and their recoveries related to the 1999 Chichi earthquake, constructing a groundwater observation network composed of 16 wells in Taiwan and understanding the earthquake-related groundwater changes observed by the new groundwater observation network through this cooperative research. We also investigates seismotectonics in and around Taiwan. In Taiwan seismicity is more active and crustal deformation is more rapid than in Japan. Therefore observation and analysis of groundwater changes related to earthquake and crustal deformation in Taiwan will enable us to make rapid progress in hydrological and geochemical research for earthquake forecasting. This cooperative research will also give important information for evaluation of long-term groundwater changes in tectonically active areas like Japan and Taiwan.

Keywords: Taiwan, Groundwater, Earthquake prediction, Crustal deformation, Geochemistry, Ground shaking

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HDS07-06 Room:101B Time:May 23 17:30-17:45

Tracing the sources of marine tephra layers in the Philippine marginal basins

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Piston coring in the Sibuyan and Bohol seas in the Philippines recovered several marine tephra layers that may provide an archive of explosive eruptions and magmatic activities from the nearby Bicol volcanic arc. The glass fragments in these ash layers exhibit bubble-wall-type morphology typical of co-ignimbrite ash deposits, suggesting that they are primary distal deposits of explosive eruptions on land. In-situ geochemical microanalyses of the glass fragments reveal that they have compositions that form tight clusters in major element data plots, supporting their primary depositional origin. The ash layers appear to have a bimodal distribution in terms of major element geochemistry: one group having andesitic to dacitic composition (55-64 weight percent SiO2) and the other one having rhyolitic composition (69-78 weight percent SiO2). Small variation in major element composition is also observed within each group, especially the high-silica one. The bimodal grouping in terms of major elements is also supported by distinct trace element compositions of glass fragments in representative ash layers.

The andesitic to dacitic ash layers have compositional resemblance to the chemistry of the scoria fragments from fall and pyroclastic flow deposits from Mayon volcano, suggesting it as a possible source. There are several candidates for the sources of the rhyolitic ash layers, although most have strong geochemical affinity with the flow and fall deposits around the Irosin volcano. Iriga and Iraya volcanoes could be the other sources of some ash layers in the Bohol Sea. The persistence of rhyolitic ash layers in the cores suggests that they could be correlatable to the newly identified widespread tephra marker in the Bicol arc (Mirabueno et al., Quat. Intl. 2011). However, more detailed and extensive tephrochronological work is needed to establish the chronology and frequency of explosive eruption events from these volcanoes in order to assist disaster prevention planning from explosive volcanic eruptions in the future.

Keywords: Philippine volcanoes, tephrochronology, Bicol arc, Mayon Volcano, Iriga Volcano, Irosin tephra marker

HDS07-07 Room:101B Time:May 23 17:45-18:00

Hazard mitigation of a caldera-forming eruption: From past experience in Indonesia to modern society

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A caldera-forming eruption, erupted volume˜ 10-1000 km3, causes huge direct damages caused by widespread pyroclastic flow, ash fall, and tsunami, and global impacts such as climate change. The recovering time is more than 10 years for climate, food, human health, and 100-1000 years for land use. Japanese have forgotten such a caldera-forming eruption, because the last one occurred 7,000 years ago. Indonesia was suffered twice for the last 200 years, and three times within 1,000 years. We must learn valuable experiences from Indonesia.

[Evaluation of potentiality for a caldera-forming eruption] We proposed an evolutional model to a caldera-forming eruption in Indonesia. The long-term evolution into caldera-forming eruption was studied by Toshida et al. (2012). This study can identify volcanoes evolving into caldera formation from those without caldera formation. The volcanoes became quiet with a few explosive eruptions during the last 10,000-5,000 years before the first caldera formation (Takada et al, 2012). Some volcano caused caldera-formation multiply. Furukawa et al. (2012) studied multiple cycle of caldera formation in Bali. According to the model, the candidate evolving into a caldera-forming eruption is a dormant volcano after large stratocone building. We must, however, distinguish a target volcano accumulating magma from that terminating its activity. Moreover, some volcanoes are decreasing in potentiality of eruption by continuous degassing.

[Precursor events] During the last a few months, we may have caught geologically the short-term process as the progressive activity to the climax eruption in cases of Tambora 1815 eruption and Krakatau 1883 eruption (Takada, 2010; Takada et al., 2012). If a volcano comes into the stage just before the climax at the present time, we can catch unusual geophysical signs from various monitoring system. However, the problem is to evaluate or predict when the volcano reaches a climax condition, and how much the volcano erupts. The evacuation plan depends on them.

[Linkage of disaster in the short-term ($<$10 years)] A caldera-forming eruption can cause wide range linkages of disaster globally, such as the secondary, and the thirdly ones as well as the direct damage. (1) The population on the earth increased abruptly. For example, the modern population in Sumbawa is 0.9 million, compared with 0.1 million when Tambora 1815 eruption. The lager the eruptive volume becomes, the wider the linkage is spread to cause traffic damage, energy plant damage, and various shortage, such as food, water, medicine, which connect each other. For example, the damage of traffic system in an island country will close from outside rescue. Volcanic ash fall close airports. Tsunami cause various coastal damage including ports or harbors. (3) Climate change will cause a possibility for plague (epidemic). Aftermath of Tambora 1815 eruption caused -The year without a summer (Stommel and Stommel, 1983)-.

[Long-term damage ($>$ 10 years)] The damage in the area near the volcano that caused a caldera-forming eruption continues long-time. Accumulation of volcanic ash will cause lahar, close drainage (sewer) in a city, and ash pollution. Thick pyroclastic flow deposits remain long time without erosion, and prevent from agriculture. For example, the case of Tambora 1815 eruption, 200 years ago, and that of Rinjani 13th Century, 700 years ago are presented.

Keywords: Caldera-froming eruption, Hazard mitigation, Indonesia, Tambora, Rinjani, Krakatau

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Earthquake Hazard Map of Papua, Indonesia

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Indonesia occupies a very active tectonic zone as the world's three major tectonic plates collides each other. This tectonic condition makes Indonesia an area of pronounced tectonic activity that is very prone to earthquakes. The northern part of Papua Island has experienced destructive earthquakes in the past and prone to earthquake in the future. Several destructive earthquakes occured in the region during the last decade such as Nabire (2004) and Serui (2010) has caused casualties, destruction and damage to infrastructures and buildings. Therefore, the availability of earthquake hazard map of Papua is needed, since the earthquake mitigation effort is more emphasized on pre-disaster phase.

The hazard map is created using PSHA (Probability Seismic Hazard Assessment) method and developed using EQRM (Earthquake Risk Model) computer program. This method requires inputs of earthquake sources (active fault, subduction zone and diffuse earthquake), site classes, return period and GMPE (Ground Motion Prediction Equation) for each earthquake zone should be preconcerted. As for Papua hazard map the earthquake source zone is classified into 19 zones for both active faults and subduction and 9 zones for diffuse earthquakes.

The result is PSHA map for 0.2 second spectral acceleration. The map represents the 10% probability of exceedance in 50 years (475 years return period). The Papua seismic hazard map was created based on the estimated intensity, which obtained by converting the acceleration level on 0.2 second RSA (Response Spectral Acceleration). The hazard levels are divided into four classifications, they are very low (MMI < V), low (VII > MMI ? V), moderate (VIII > MMI ? VII), and high (MMI ? VIII) respectively.

Keywords: Earthquake Hazard Map, Papua Indonesia, PSHA