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RESPONSIBILITY OF GEOSCIENTIST WHO ASKED TO PUBLISH INFORMATION ON THE PREDICTED NATURAL HAZARD – SEVERAL CASE STUDIES

Abstract: *The right to receive the information on the natural hazard is one of the fundamental human rights, and it should be considered as a common knowledge of the whole human kind. Geoscientists should not only supply the most accurate and concrete information as possible, but also explain the significance and tolerances of the information, including possible excesses of prediction. Geoscientists should follow the geoethical guidelines not only for forecasting, explaining and warning the hazardous condition, but also for proposing safeguard systems to protect population against natural hazards by reducing and minimizing occurring damages.*

Geological events contains stochastic element, and the complete prediction is impossible by the present knowledge and technology. However, geoscientists are expected and responsible to properly publicize the correct scientific information on the hazardous events. In relation to the case of the Aquila earthquake, the dispatched comments by geoscientists on the following four cases in Japan are examined from geoethical view points.

1. Volcanic eruption of Mt Ontake, Central Japan in 1979
2. Volcanic eruption of Mt. Mihara, Oshima Island, Japan in 1986
3. Hanshin-Awaji Earthquake (M 7.3), SW Japan in 1995
4. Tohoku Earthquake (M 9.0), NE Japan in 2011

Key Words: *Geosciences Information, Natural Hazard, Geoethics, Aquila case, Responsibility, Volcanic eruption, Earthquake, Tsunami*

Introduction

The geosciences information is very important before the natural hazard to construct the safeguard system to prevent and reduce the damage. Also it is important after the hazard to rescue the suffered persons, recover and revive the damaged area.

The primary responsibility of geoscientists is to obtain detailed and advanced information through continuous scientific research on natural hazards.

Geoscientists should open the obtained information for the utilization in the human societies. As the information is very important and sensitive, its accuracy, reliability, speedy, simplicity, acceptance and other characteristics should be examined before dispatching. It is also necessary to prepare the guidelines in advance who and how to decide the content, direction, level, method, timing and others for dispatching the information on time and on cite of the natural hazard (Nishiwaki, 2011).

Duties of geoscientists relating natural hazards

Geoscientists have not only scientific but also legal, social and ethical responsibility on their activities. Relating natural hazards, the duties will be summarized as follows.

Geoscientists should provide their knowledge and skills in risk mitigation to the society, which have been obtained by their own researches and/or through previous references.

Geoscientists should cooperate with public authorities in crisis and disaster, by giving advices from scientific view points.

Also geoscientists should assist in the transmission of information to society, by synthesizing and explaining the original information.

Case studies

The mode and timing of publishing information on natural hazard differs depending on the characteristics and conditions of each hazard. We should consider various factors, such as origin, type, size, and intensity of hazard, season, time, water, morphology, geology and climate of location, country, politics, urbanization, population, industry, culture and religion of disaster area, etc. It is necessary for the integration of publishing rules to examine the past experiences of natural hazard.

The followings are examples of natural hazards in Japan, which include valuable suggestions for geoscientists. The description of volcanoes and earthquakes are based on National Astronomical Observatory of Japan (2012).

Volcanic eruption of Mt Ontake, Gifu and Nagano, Central Japan in 1979

The volcanoes in this area are originated in Pleistocene, and the present volcano (3067m) was developed in 100,000 to 20,000 years ago. There is no eruption record in historical time (Oikawa, 2008), and Mt. Ontake was registered as an "extinct volcano". After the fumarolic activity was observed in 1968, it was changed to an active volcano, but no constant monitoring system had been established. On 28 October 1979 AD Mt. Ontake suddenly erupted with a phreatic explosion of 1000 m high, which has shocked Japanese volcanologists. It was required to examine the classification of volcano into three types (active, dormant and extinct), and the definition of the latter two types has been removed. It is an example of Black Swan Theory (Taleb, 2007).

There is an episode on this eruption. A specialist, who had just observed the eruption by a helicopter, was asked to forecast its volcanic activity. As there is no monitoring data, he replied that he could not forecast, but the pressmen did not accept his reply and insisted him to forecast. Then he said that there are only three possibilities, that is, it would become more active, continue this stage, or cease gradually, and it was necessary for forecasting to observe and collect more data to decide. The meaning of the second reply is same with the first reply, but pressmen can accept the second reply. It is an example how to publish the exact condition to outsiders.

Volcanic eruption of Mt. Mihara, Izu Oshima Island, Tokyo, Japan in 1986

The Izu Oshima is a small volcanic island of 91.06 km^2 belonging to Tokyo Metropolitan Prefecture. The volcanoes in this island are originated in Pliocene, and the present volcano (758m) was developed 50,000 years ago. It is an active volcano with many historical records of eruption after 575 AD, including massive lava flows in 1984, 1777-9 and 1950-1 AD.

On 16 November 1986 AD the strombolian eruption was started, and crater area was closed. The local authority wished to invite many tourists to the island for looking the eruption, and decided to open it in a week on 21 November by consulting the committee including volcanologists. However, the fissure eruption started just after the decision, and massive lava flowed to town area, all the residents (more than 10,000) should escape from the island by ships within a day. The eruption is so severe that the amount of volcanic products is 40 million m^3. The residents could not be back to the island for 1 month, and the crater area was closed for 10 years.

The observation system at that time was not enough to monitor the magma in detail. The specialist pointed out the potentials of massive eruption, but he had to say that there was no evidence that the magma was rising for eruption in a few days. He never denied the risk of eruption, but the both authorities and citizens had believed that there was no eruption. The specialist reviewed on his message, which is scientifically correct but insufficient to communicate the real conditions in the risk. It is an example on how to cooperate with local authorities.

Hanshin-Awaji Earthquake (M 7.3), Kobe and Osaka, SW Japan in 1995

It is an intra plate earthquake which attacked the urbanized areas of Kinki district on 17 January 1996 AD, and caused a big damage of 6434 dead, 3 missing, and 43792 wounded peoples, 104906 fully and 144274 partly destroyed houses, 7132 fully or partly burned houses, and many destructed infrastructures in the area.

The area including Osaka, Kobe and Kyoto geologically belongs to the Kinki Triangle (Huzita, 1962) which is a triangular area surrounded by three mountain blocks, those are Mino mountains in the northeast, Tanba mountains in northwest and Kii mountains in the south, and those boundaries consists of fault zones with both dip and strike slips. There are many active strike-slip faults of NE-SW and NW-SE directions in the surrounding mountains. On the other hand there are several reverse faults of N-S direction within the Kinki Triangle.

It means that there are risks of big earthquakes in the Kinki district. Actually, there is a historical record of the Keicho Fushimi earthquake of M7.5 on 05 September 1596 AD, in which more than 1000 people were dead and many houses were destroyed including castle, shrines and temples in Kyoto.

In spite of the geological setting and historical record, there was a misunderstanding in the citizens that no big earthquake will attack the Kinki district. This misunderstanding might be come from the fact that there is an imminent danger of a large inter plate earthquake at Nankai trough where the Philippines Sea Plates is subducting under the Eurasia plate, and it will affect the Kinki district more widely and severely than intra plate earthquake.

When the Hanshin-Awaji earthquake occurred, many specialists have reviewed on their past message, in which they did explain the geological setting correctly including the risk of earthquakes in the Kinki district but didn’t remove the misunderstanding in the common knowledge. Also it is insufficient to list up the active faults without classifying each risk level.

Tohoku Earthquake (M 9.0), NE Japan in 2011

It is an inter plate earthquake attacked the eastern half of Japanese islands on11 March 2011 AD, and caused a tremendous damage of 16278 dead, 2994 missing and 6179 wounded peoples, 129198 fully and 254238 partly destroyed houses, and many broken infrastructures in the wide area. It is noted that more than 90 % of dead is drown by the large tsunami which followed the earthquake. It is also noted that the damage might be magnified by the accident of nuclear power stations which made the rescue processes difficult or impossible.

The epicenters of this earthquake are located in the area where the Pacific palate is subducting under the North American Plates. Many M8 class earthquakes have been frequently occurred, though the M9 class of the connection of several epicenters has not supposed. There are, however, historical records of earthquake which may be comparable in size with this earthquake.

One is the Jokan Sanrikuoki Earthquake (M8.3) on 13 July 869 AD, in which a big tsunami attacked the wide area and more than 1000 peoples were drown. It is noted that the tsunami invade more than 5 km from the shoreline.

Another is the Meiji Sanrikuoki Earthquake (M8.2) on 15 June 1896 AD, in which a big tsunami attacked with damage of 21959 dead people, 9000 fully-partly destroyed houses, and 7000 out-flowed ships. It is noted that the height of tsunami surge is more than 30m in several places.

The M9.0 earthquake in 2011 is larger or comparable with these earthquakes in size of tsunami, and its frequency is assumed to be once in hundreds to thousand years. Because of its very low frequency, it is not discussed nor simulated in the prediction of earthquakes of this area. It is a typical high-impact low-frequency event (HILF) and should be examined according to the guidelines in the report by High-Impact Low-Frequency Event Steering Committee (2010).

Conclusions

The four case studies cited above contain the following important points on scientific research on natural hazards and/or on the communication of geosciences information. They are not only scientific/technical importance but also geoethical elements.

1. The constant monitoring system is important for the accurate prediction of volcanic eruption, and the more detailed observation data are necessary to forecast the movement of magma under the volcano.
2. If new evidence was found, it is necessary to break our current sense and accept even completely different model following the black swan theory.
3. If there is no sufficient data, the geoscientist should say that they cannot forecast the natural hazards. It is, however, also necessary to explain the definite conditions at present, together with the future process of examination.
4. It is a duty of geoscientist to remove misunderstanding in the common knowledge by explaining concretely and individually.
5. It is necessary to expand the hazard model by including the high impact low frequency events (HILF) into consideration.

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