Priority Subjects with Limited Terms — **Establishment of Optimal Risk Management**

Assessment for the Effects of Natural Hazards on Nuclear Facilities

Background and Objective

Nuclear power is a base-load supply system which helps to suppress carbon dioxide emissions in our social economic system. However, the 2011 Fukushima accident revealed certain kinds of difficulties associated with managing NPP safely in times of crisis. The authority for safe operation of NPP has lost its reliability in the eye of the public, to the extent that all Japanese nuclear power plants are yet to return to service. The main cause of the 2011 Fukushima accident was the damage to the internal power sources due to an inundation of the large-scale tsunami. Therefore, further precise assessment on catastrophic hazards and risks is needed to improve the safety operation of NPP.

Our research aims to unravel such catastrophic but infrequent processes, and to establish an assessment methodology for hazards and associated risks. The desired outcome is to contribute towards reducing a number of risks impacting upon the safe operation of NPP.

Main results

1 Strong motion seismology for assessment of probable asperity in a large active fault system

Strong motion seismology poises a difficulty because it is not possible to apply an empirical relationship of asperity*1 on the rupturing process of multiple segments in a large active fault system. An empirical relationship involves determining position, size, and slip of asperity in a large magnitude earthquake. Our study aims to establish an assessment of probable asperity from the surface length and displacement of active faults. Based on the 1992 Landers earthquake, USA, we have compiled position, size, slip of asperity and the surface profile of displacement of an active fault. As a result, we discovered a relationship between the characteristics of these parameters.*2

2 Source fault geometry estimated from balanced-cross section analysis

The edge geometry of deep source fault is an important characteristic to unravel the probable size of multiple fault-ruptures in an active fault system. This characteristic can be inferred from a balanced-cross section analysis of the source fault. Our analysis aimed to develop a 2D deep geometric model of a source fault from the 2D seismic reflection profile at the offshore source fault of the 1964 Niigata earthquake. 3D geometry of a source fault was developed using a number of overlapped sections from the 2D fault model.*3

3 An empirical model of long-term magma discharge and a review of ash-fall models by numerical fluid dynamics

An empirical model of magma discharge over the past 50,000 years by the Esan volcanic complex (EVC) in northern Japan was established from volume and chronology. Because the EVC has been dormant for over 9,000 years without any major magmatic eruptions, if the model's assumption is accurate, the magma chamber beneath the EVC already contains a large volume of magma, to the extent that it could discharge a volume equivalent to its greatest discharge in the past.*4 Such a model can be integrated into the assessment guideline of volcanic hazards, from which a more precise model can be established.

A number of ash tracking, dispersal and settling, and eruption column models were reviewed by means of numerical fluid dynamic techniques. We summarized the issue of ash-fall hazard processes onto electric facilities, and the issue of multi dimension models which require enhancement in future work.*5

*1 Asperity is a jog with high friction resistance on a fault plane. A large asperity is likely slipped during the occurrence of a large earthquake.
*2 Kuriyama and Sato (2013) Abstract for JSSJ 2013 Fall meeting.
*3 Kimura and Okamura (2013) Abstract for 2013 AGU Fall Meeting.
*4 Miura et al. (2013) GSA Bulletin, 125, 1503-1519, doi:10.1130/B30732.1
*5 Suto, Hattori and Toshida (2013) Wind Engineers, JAWE, 38, 416-425.

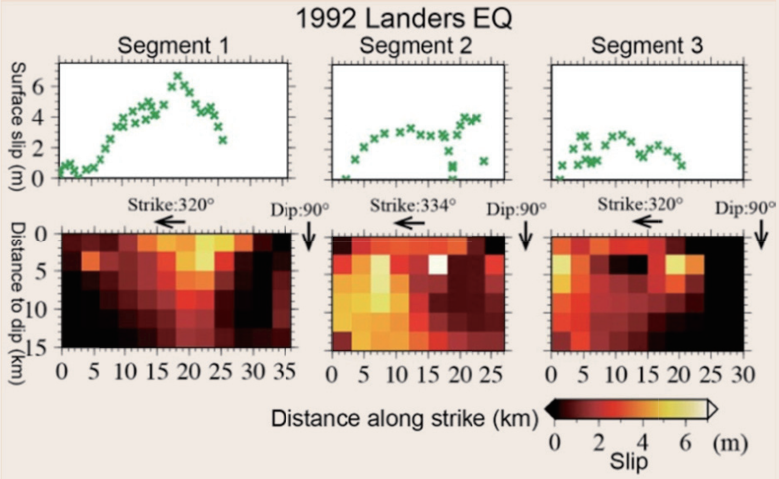

Fig. 1: Strong motion seismology for assessment of probable asperity in the large active fault system

Position, size and slip of asperity (Wald and Heaton, 1994), and the surface displacement profile (Sieh et al., 1993), in 1992 Landers earthquake, USA. The qualitative relationship between asperity and surface displacement is shown for each fault segment.*2

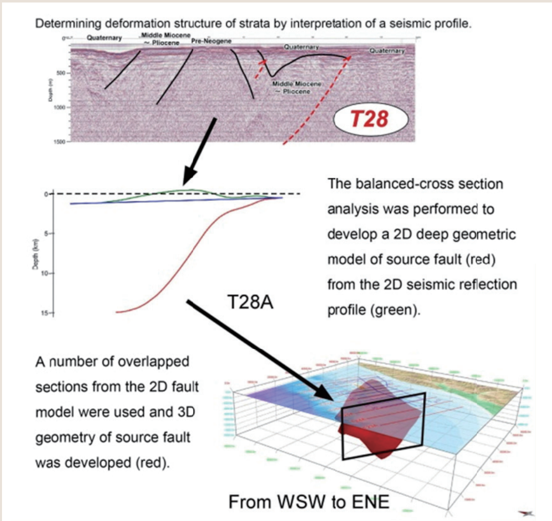

Fig. 2: Source fault geometry estimated from balanced-cross section analysis

3D geometry of the source fault of the 1964 Niigata earthquake can be obtained from a number of 2D fault sections through balanced-cross section analysis.*3

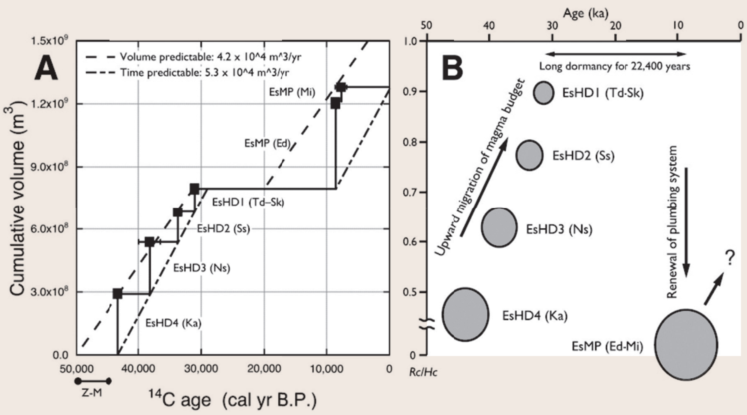

Fig. 3: An empirical model of long-term magma discharge

An empirical model of magma discharge was established from the discharged sequence of volume and chronology for the past 50,000 years at the Esan volcanic complex (EVC) in northern Japan.*4 A) Discharge diagram for the past 50,000 years at the EVC; B) Explanatory model of magma discharge using the upward migration of the magma batch.