Symposiums
The Spring Meeting of the Association of Japanese Geographers, 28–29 April 2005

Open Symposium I: Contribution of Geography toward
Natural Disaster Mitigation
—In Consideration of Climate and Earthquake Disasters in 2004—

I-A: Problems arising due to the Mid Niigata Prefecture Earthquake of 2004

Significance of Geographical Examination of the Mid Niigata Prefecture Earthquake of 2004 —The Aim and Discussion of the Symposium—

SUZUKI Yasuhiro*
UNE Hiroshi**
ENDO Kunihiro***
SUZUKI Takehiko****
and NAKABAYASHI Itsuki****
*Nagoya University
**Geographical Survey Institute
***Nihon University
****Tokyo Metropolitan University

The Mid Niigata Prefecture Earthquake of 2004 occurred almost ten years after the 1995 Great Kobe earthquake. It was accompanied by massive ground disasters, such as landslides and caused considerable damages in rural and mountainous regions. The purpose of this symposium is to point out that investigations and considerations from a geographical viewpoint are required to clarify the characteristics of the disaster and to seek optimum countermeasures for disaster mitigation. The discussions focus on the following points. 1) Although the maximum seismic intensity reached 7 in some areas, the damage was relatively smaller than that caused by the Great Kobe earthquake. This could be because the houses were built to be stronger as a safeguard against heavy snowfall in winter. 2) The landslides tend to occur frequently because of the geological conditions in this area. Clay and silt strata were heavily deformed by tectonic movement, such as folding or faulting, and collapsed easily due to the tremors of the earthquake. 3) As the economy depends on the agricultural income from farms or carp fisheries, they were seriously affected by the damage due to ground disaster. The citizens, who have “coexisted” with landslides for long time, encountered a disaster that was beyond their coping abilities. As some mountainous areas suffered such extreme damage that they cannot be recovered, citizens must relocate to other places out of necessity. 4) Some citizens took refuge with their neighbors because of dairy strong relationships, but some took refuge into their own cars. 5) The distinct 50 km long active fault near the epicenter is shown on the active fault map published in 2001 by the Geographical Survey Institute. Further, surface faultings were found along this active fault just after the earthquake. From careful observations of faults, it was concluded that the earthquake was generated by an active fault. 6) Since not only active faults but also the relics of landslides were distinctly found and mapped for this region, landslide hazards during earthquakes could be predicted. 7) The landslides clogged the rivers at many places resulting in the risk of flood due to the possible collapse of the natural dam. Hence, it is necessary to observe dams carefully, so that hazards can be assessed immediately, and information on hazards can be provided by websites.

It is concluded that the Mid Niigata Prefecture Earthquake demonstrated the importance of the contribution of geography for both clari-
fying the characteristics of the disaster and forming lessons to mitigate future earthquake disasters.

The Mid Niigata Prefecture Earthquake Disaster and Regional Characteristics

YAMAGATA Kotaro*
SUZUKI Ikuo**
and SHIMURA Takashi***
*Joetsu University of Education
**Niigata University
***Joetsu University of Education

Each large-scale disaster brings independent situation. The 2004 Mid Niigata Prefecture Earthquake disaster also has features different from other disasters. These features are considered to be concerned with regional characteristics of Chuetsu district. We organize the relationships between the regional characteristics and consequences of the disaster.

The strong ground motion of the epicentral earthquake caused great damage to building structures and vast slope failures. The district’s unstable landform and weak ground, antecedent precipitation, and artificial works also influenced slope failures. Subsequent frequent aftershocks induced significant stress in victims. The devastated area is the region of the heaviest snow in Niigata prefecture. The Yamakoshi area is covered by snow (usually more than 3 m) for a third of the year. The heavy snow caused damaged houses to collapse, and the long snow covering period will delay the reconstruction process.

The effects of the disaster were also linked to various social characteristics of the Chuetsu district, such as depopulation, aging, and an agriculture-centered economy. Of the 46 victims, 54% were elderly. Production infrastructures, such as rice terraces and carp breeding ponds, were severely damaged by the earthquake. These social characteristics will seriously affect the post-quake recovery process and depopulation. The close relationship of the agricultural community is also an important characteristic of the mountainous area of heavy snow. Their positive community relations helped to enable a smooth evacuation and to reduce stress in victims housed in shelters.

The interaction of various physical and social characteristics affected the outcome of the Mid Niigata Prefecture earthquake disaster. To gain a sufficient understanding of the disaster, researchers must employ a geographical standpoint that includes both physical and social dimensions.

Building Damage Caused by the Mid Niigata Prefecture Earthquake in 2004

MURAYAMA Yoshiyuki
Tohoku University

The Mid Niigata Prefecture Earthquake in 2004 hit some cities and villages on the hills, terraces and lowlands. As for the central and southwestern part of Ojiya city, a large number of houses on the slopes such as terrace steps are heavily affected. Some of these are caused by strong shaking and by small-scale failure at artificially filled sites. Takamachi housing estate, one of the most severely damaged by the earthquake, in the south east of Nagaoka city was developed on a small hill (terrace) by cutting from the central part and by filling on the fringe. There is no damage in the center of the estate, but there are many severely affected houses on the edge. Some of these houses on uneven settled plots tilt, and others topple or subside with landslide on the artificially filled area on the fringe. Other housing estate of Nagaoka New Town is located in the west of the city. This estate was developed by large-scale landform transformation, cutting ridges and filling valleys in the hill. Few damaged houses are observed as a whole, but there is a house on the cut-fill boundary affected by uneven settling (with small crack), and there are tilting houses on the filled area suffered by severe liquefaction.

The severity of building damage closely relates to the age of the building, because the building code became more and more strict after WW2 in Japan and because (wooden) structures might go rotten or might suffer from termite damage. This relationship is clear in this case. However, this earthquake disaster also suggests that the ground condition (or subsoil condition), as well as the strength of the building itself, is an essential factor of the building damage triggered by earthquake, as in the recent cases in Japan. The urban and suburban
regions vastly developed by landform transformation are vulnerable to earthquake.

**After-quake Measures in Car-oriented Local Cities—How to Manage the Aftermath and the Rehabilitation**

TODOKORO Takashi
Takasaki City University of Economics

In principle we should avoid using our private cars for evacuation in times of disaster. In the Chuetsu region ravaged by the Mid Niigata Prefecture Earthquake in October, 2004, however, many residents used their own cars not only to escape to safety but also to take shelter. It is because the region has been transformed into automobile-dependent communities where car ownership is almost inevitable, which has changed social structure and land use in the region. Such car-oriented local cities need to have disaster management plans for evacuating their aging communities with decreasing population as well as rescue, relief and revitalization plans which are different from those for metropolitan areas.

Local residents are discouraged from using private cars in times of disaster in general. However, using cars as shelters during the aftershocks is worth considering as long as refugees in cars don’t bother others and health care including preventive measures against economy-class syndrome can be managed. In the quake-ravaged Chuetsu, the refugees were scared of the series of strong, intermittent aftershocks following the main quake. Not a few refugees were too scared to stay in buildings that might collapse during the aftershocks, which increased the number of refugees who chose to stay or sleep in cars, not in evacuation centers.

In an aging developed society with the population decrease, each region should get rid of urban sprawl and seek compact cities where people have no need to drive their own cars. Car-oriented society has intensified urban sprawl and emotional alienation. Growing individualism has changed communities full of mutual help into faceless ones without community networks. That has resulted in weakening the region’s disaster management capabilities. It is compact cities that can effectively provide support in times of disaster for coordinating victims’ self-help, mutual help among the residents and public support systems.

In order to improve Japan’s crisis-control capabilities, it is essential for Japan to be equipped with fail-safe and functionally redundant national systems by means of changing nation’s tracks from excess concentration of population and industry in the Tokyo Metropolitan area to balanced relocation of capital functions.

**Characteristics of the Mid Niigata Prefecture Earthquake Disaster and Perspectives for Reconstruction**

NAKABAYASHI Itsuki
Tokyo Metropolitan University

The Mid Niigata Prefecture Earthquake of M. 6.8 occurred in the evening of 23rd October in 2004. This is the second earthquake of Japanese seismic intensity 7, following the the Hanshin-Awaji great earthquake of 1995. This caused characteristic damage in both the low-land area of Nagaoka city with 200 thousands population and the mountain village areas of central Niigata prefecture, the Chuetsu region. Population of the suffered area is approximately 300 thousand people of 120 thousand households. Forty-six persons were killed and more than 4,500 persons were injured. More than 3,100 houses collapsed severely and more than 11,000 houses were half collapsed. There were many strong aftershocks and more than 100 thousand people were evacuated from home to public facilities such as schools and into cars on the open spaces near their homes. The strong shocks caused nine outbreaks of fire and sixteen houses were burnt. In the mountain areas, the earthquake caused large scale landslides all over the area. The amount of mud and sand buried rivers and made several natural dams. Many villages were isolated. Two months after the earthquake, it began to snow. In this winter season there was very heavy snow. The reconstruction projects were considered in a sleeping season of snow.

We can see very characteristic figures in the Mid Niigata Prefecture Earthquake Disaster from the comparative viewpoint with the Hanshin-Awaji earthquake. In the number of
victims per a thousand collapsed houses, the direct victims were five persons, which is one tenth of the Hanshin-Awaji earthquake, because the structure of houses were very resistant to heavy snow. On the other hand, the indirect victims who were dead after the main shock, were approximately nine persons, the same as in the Hanshin-Awaji earthquake. In the number of firebreaks per thousand collapsed houses, it was 3.2 points in Chuetsu, more than 2.5 points in Hanshin-Awaji earthquake. It was three times more than in Hanshin-Awaji, except for a firebreak caused by electric facilities. The earthquake in the evening caused firebreaks more than in the early morning.

During two months after the earthquake, it was not snowy. The 3,460 units of temporary houses were supplied and the severe sufferers could remove from evacuation sites to temporary houses before the snowy season. The heaviest snowfall in nineteen years started just after their removal. In the snowy season, which lasts until April in lowland area and until May in mountain village area, the recovery and reconstruction project could not be implemented. The recovery and reconstruction plans were prepared in these four or five months under the snow.

Finally the author suggests the perspective for recovery and reconstruction as follows; 1) revitalization of social structure in mountain villages, 2) recovery and restructuring of local industrial structure, 3) remaking and reconstruction of spatial structure in mountain village area, 4) rearrangement of village-scape and its spatial structure, 5) necessity of the rebuilding aids of houses and sites for the elderly, 6) development of the fund for the various recovery and reconstruction projects, 7) producing the community-government collaboration system for reconstruction of each village and each town, 8) advertising the mitigation system in mountain villages, 9) revising a discontinuous program for reconstruction in snowy region, and 10) respect for local bonds in village and neighborhood.

How Geographic Information was Emergently Provided to Cope with the Mid Niigata Prefecture Earthquake of 2004

UNE Hiroshi*
and SATO P. Hiroshi*
*Geographical Survey Institute

To cope with the Mid Niigata Prefecture Earthquake which occurred on 23rd October 2004, the Geographical Survey Institute speedily carried out various surveys, mapping and data provision to help mitigate the damage, implement relief operations for disaster-stricken people, and formulate reconstruction plans, etc. These activities include analysis of crustal movement detected from GPS-based observations; modeling of earthquake faults; taking of aerial photographs; printing of maps; preparation of disaster condition maps; provision of information through the Internet; data provision on the Denshi Kokudo (Digital Japan) Web System using web mapping technology; survey of snow depth using LiDAR data; mapping of hazards for snow avalanche; etc. Results were provided through distribution by hand to the related organizations, press releases and the Internet.

Through these experiences, the authors noted as follows:

1) Geographers have important roles in estimating overall extent of damages speedily, applying full advantage of geographic knowledge such as geomorphology, crustal movement, geology, seismology, disaster science etc. in order to provide proper geographic information useful for damage mitigation and relief operation.

2) Denshi Kokudo Web System is an effective tool for providing geographic information changing by the minute. It is also useful for sharing those information among related organizations. In order to help increase use of the system, a tool to input disaster information efficiently into the Denshi Kokudo Web System should be developed.

3) On the occasion of disaster, on-line provision of geographic information is not enough. Paper maps are still necessary as well as digital products for the use of on-site operations. Providers of geographic information should consider what kinds of information are needed, and take efforts to step foot into the scene of opera-
The Sense in Surveying Surface Ruptures and Publishing Active Fault Map Associated with the Mid Niigata Prefecture Earthquake in 2004

WATANABE Mitsuhisa
Toyo University

Field survey was urgently needed at the source area of the Mid Niigata prefecture Earthquake in 2004. There were two reasons for this; 1) to deny a groundless rumor that some faults not mapped are seismogenic faults, 2) need to analyze active structures with few contradictions to geomorphologic characteristics.

The seismic activities just beneath the Uonuma Hills helped to focus our attention on active faults delineating the eastern margin of the hill (western margin of the Muikamachi Basin). The surface earthquake faults of the earthquake were found along the pre-existing active fault traces of both Obiro fault and the northern part of the western marginal fault of the Muikamachi basin. Roads, paddy fields, gardens, water ways and houses were displaced 10 to 30 cm vertically. I examined fault models of the earthquake on the basis of leveling data. Although the vertical displacement is small, surface faulting has proved indispensable in matching the calculated deformation with the observed one. The Mid Niigata prefecture Earthquake was generated by the vertical slip on these west-dipping fault planes.

The Obiro Fault and the western marginal fault of the Muikamachi basin had already been mapped on the "Active Fault Map in Urban Area" published by Geographical Survey Institute, which was very useful for researchers to discuss the active tectonics together. Despite some deficiencies in the descriptions, this kind of maps is particularly useful not only for studying active tectonics but also for examining how to reduce seismic hazard. However, most local people did not know that they lived in tectonically very active region. Few of them knew that they would be attacked by such earthquake. I hope the maps will be circulated widely in anticipation of much improvement.

Although they are not easy tasks, to certify subtle faulted features, to clarify nature of faulting and to make all kinds of hazard maps more solid, we geographers should play an active part in these fields.

Recent Seismic Hazards and Problems of Assessment and Measures

KUMAKI Yohta
Geographical Survey Institute

Since 1995 four seismic activities of the maximum seismic intensity (JMA scale) 6+ or 7 have occurred in Japan, all of which were shallow inland earthquakes caused by the activity of active faults, and three of seven events of the maximum seismic intensity 6− were also of this type. An earthquake of active fault type is not a rare phenomenon.

The Earthquake Research Committee of the government has conducted the long-term assessment of earthquakes and has made the Probabilistic Seismic Hazard Map. The assessment of the earthquakes of active fault type has revealed three major problems: 1) Insufficiency of past fault activity data, 2) difficulties of the fault segmentation, and 3) no evaluation method of non-characteristic events such as the 1995 Southern Hyogo Prefecture Earthquake in Kobe area. In case of Kannawa/Kouzu-Matsuda fault, the result of assessment was largely revised based on the additional research after the first assessment. This indicates that further research is necessary to improve the reliability of the assessment.

A source of seismic activity is sometimes an unknown active fault, e.g. The 2000 Western Tottori Prefecture Earthquake. In most cases, however, seismic activities arise in harmony with geomorphologically and geologically inferred tectonics. The events in northern Miyagi Prefecture of July, 2003 and off the west coast of Fukuoka Prefecture of March, 2005 occurred in an area where some active faults had been found. The 2004 Mid Niigata Prefecture Earthquake, which occurred in a tectonically very active zone, fault displacement landforms had been shown in maps before the event. These events were by no means astonishing. Generally speaking, surface displacement by reverse fault is complicated and not sharp in the area where the Neogene Tertiary is extensively distributed such as northern Miyagi Prefecture.
and Niigata Prefecture. Not only the mapped fault line but the comprehensive tectonic situation should be noticed.

A big earthquake often causes a complex of disasters. In case of the Mid Niigata Prefecture Earthquake, landslide of mountain slopes and dam-up of rivers widely occurred as well as the direct damage by shaking. Precedent heavy rainfall possibly affected, and heavy snowfall after the earthquake certainly expanded the damage. Moreover, it took a certain time to grasp the situation of the most seriously damaged area, as the cases of past great earthquake disasters. This still remains a big problem at the urgent stage.

All these facts lead to the importance of the spread of proper geographic knowledge.

---

I-B: How We Make Good Use of Flood Hazard Maps to Enhance Regional Disaster Prevention

The Aim and the Discussion of the Symposium
HIRAI Yukihiro
Senshu University

The Association of Japanese Geographers (AJG) held two open symposium titled on “Hazard Mapping and Geography: Why Hazard Mapping Projects are Now Strongly Promoted” in March 2003, and “How Can We Make Hazard Map for Effective Reduction of Earthquake Damages” in March 2004 respectively. Last year we had big flood damages caused by a heavy rain, a continuous downpour and a tidal wave in Japan. So the 2005 Symposium focused on the flood hazard map to enhance regional disaster prevention from the following three kinds of viewpoints.

At first Yamakawa presented a climatological or metrological interpretation of the recent frequency of heavy rain with two comments on the mitigation of flood damages by Sugai and Mizutani. Secondarily three topics concerning flood hazard maps were reported. Akagiri pointed out the problems of the present flood hazard map itself and referred to the importance of prevalence of maps. Takeuchi revealed the actual usage and understanding of flood hazard maps by questionnaire survey to the residents who were damaged severely at the 2000 flood in Nagoya City. Hironaka introduced an approach to disaster prevention by using a flood hazard map in cooperation with NPO in Ube City in Yamaguch prefecture. And two comments on flood hazard maps to be improved were made by Satou and Nakasuji. Lastly Hihara and Okamoto showed their each attempt to make effective use of the flood hazard map in the school education and in the lifelong education respectively.

After all presentations we discussed how can we make good use of flood hazard maps to enhance regional disaster prevention and to mitigate both human and physical damages by flood disasters. We confirmed that a synthetic understanding of the geographic condition of each area is fundamentally important and that the education about disaster prevention in a school or in a community is necessary and very effective to reduce the damages of natural disasters.

Background of an Increase in Heavy Rain Disasters in Recent Tears: From Climatological, Meteorological Viewpoints
YAMAKAWA Shuji
Nihon University

‘Niigata-Fukushima heavy rain’ on 13 July 2004 was brought by the active Cb (cumulonimbus)-line located between the northern and southern dry air masses, stimulated by warm, humid air from Bengal Bay, the South China Sea, the western Pacific and the Sea of Japan. The sea surface temperature (SST) on the latter two was 1–2°C higher than normal. Not only the Kuroshio but also Tsushima warm current meanders. ‘Fukui heavy rain’ on 18 July 2004