Urgent Report of the Landslide Disasters by the Mid Niigata Prefecture Earthquake in 2004, Japan

Investigation Commission of
the Japan Landslide Society and the Japanese Society of Engineering Geology

1. Introduction

The region of Chuetsu in Niigata prefecture, central Japan, has been hit by an only relatively large earthquake on October 23, 2004 (Fig.1). The earthquake, however, left a severe damage in the area. The earthquake caused a huge number of landslides occurring around the area near epicenter where the shock was extremely strong.

Many scientists of landslides and engineers wanted to start inspecting the disaster of landslides in Chuetsu, but they could not do so much due to the intensity of the damages--landslide disasters caused by the earthquakes in Chuetsu , which was the largest within the last century in Japan. On the other side, the aerial survey by several air survey companies and national research institutes were quickly and comprehensively carried out. Many kinds of aerial photographs, satellite images, and laser data were provided immediately after the earthquake at just the next day. We the two society set up investigation committee and started the pre field-survey investigation by aerial photo interpretation, direct sensing by aircraft, some measurement by laser data etc. Only a few scientists visited the area just after the landslide hazard; Prof. Yamagishi, Prof. Marui, Prof. Chigira and Prof. Yagi, made reconnaissance studies and gave us the initial field data and became the core of the committee.

The Japan Landslide Society will start the special research committee and continue the further investigation for the recovery of the hazard area and for the accumulation of scientific knowledge. Particularly, Yamakoshi village, which was damaged to the most and was completely isolated, was all evacuated using helicopters at the next day of the earthquake, and all of the village people are still not allowed to go back home. The landslides made two big landslide dams and many other small dams, flooding residential houses as well as rice field. Urgent countermeasures have been performed for these dams to control the water level and to protect the downstream villages from possible breaching of the dams. Roads were also severely damaged by the earthquake, and their reconstruction has been done continuously.

Fig.1 Location map of the Mid Niigata Prefecture Earthquake 2004

2. Outline of the Mid Niigata Prefecture Earthquake in 2004

The main shock had the hypocenter located in 37, 17.4 N in latitude, 138, 52.2 E in longitude with a depth of 13 kilometers, and had the magnitude is 6.8. In Kawaguchi town, the earthquake marked seismic intensity of 7 of the Japanese Meteorological Agency scale, the maximum degree of this scale. The main shock was followed by a number of large aftershocks, and three of them which attacked the area within two hours after the main shock, had magnitudes larger than 6. The maximum acceleration exceeded 1000 gal 7 km away from the epicenter.

Nearly several hundreds of landslides and incredible number of shallow disrupting landslides were generated by the earthquake, forming more than ten landslide dams, although the area of landslide hazard was limited only within the epicentral area of 15 by 30 km. The accurate number and distribution of the landslide hazard is not yet clarified because of the inaccessibility due to the huge

number of landslides.

3. Geomorphic and geologic background of the damaged area

The damaged area is a hilly to mountainous area named the Uonuma hills located in the southwest of the Niigata coastal plain along the Japan Sea. This area is tectonically very active with many active folds and active faults and is underlain by young, weak sedimentary rocks from the Miocene to Early Pleistocene in age. Due to these tectonic and geologic background, many landslides have been occurring in this area and they characterize the geomorphic features.

The distinctive characteristics of the distribution of the landslide topography are clarified and printed by NIED (National Institute of Earth Science and Disaster Research Center, 2004), and the area of the landslide topographies occupies about 40% of all the area. The landslide hazards are also very abundantly distributed in and around the area (Fig.2, 3). More than ten landside areas have been carried out the protection operations by Niigata prefecture office yet.

By these geomorphic settings, the slopes of the area or an arrangement of slopes can roughly been recognized into the non landslide slopes, the landslide scarps, slopes of the landslide body, and steep slopes of the valley side slopes. According to the geomorphic features, the relationships between the landslide disasters by this earthquake, landslide topography and former landslide hazard should be clarified. At the same time the land cover is also very important. The landscape of the damaged area was very famous for the step cultivation of the paddy field and fish pond for carp feeding. It seems that such land cover system affects to the enforcement of landslide hazard in some cases.

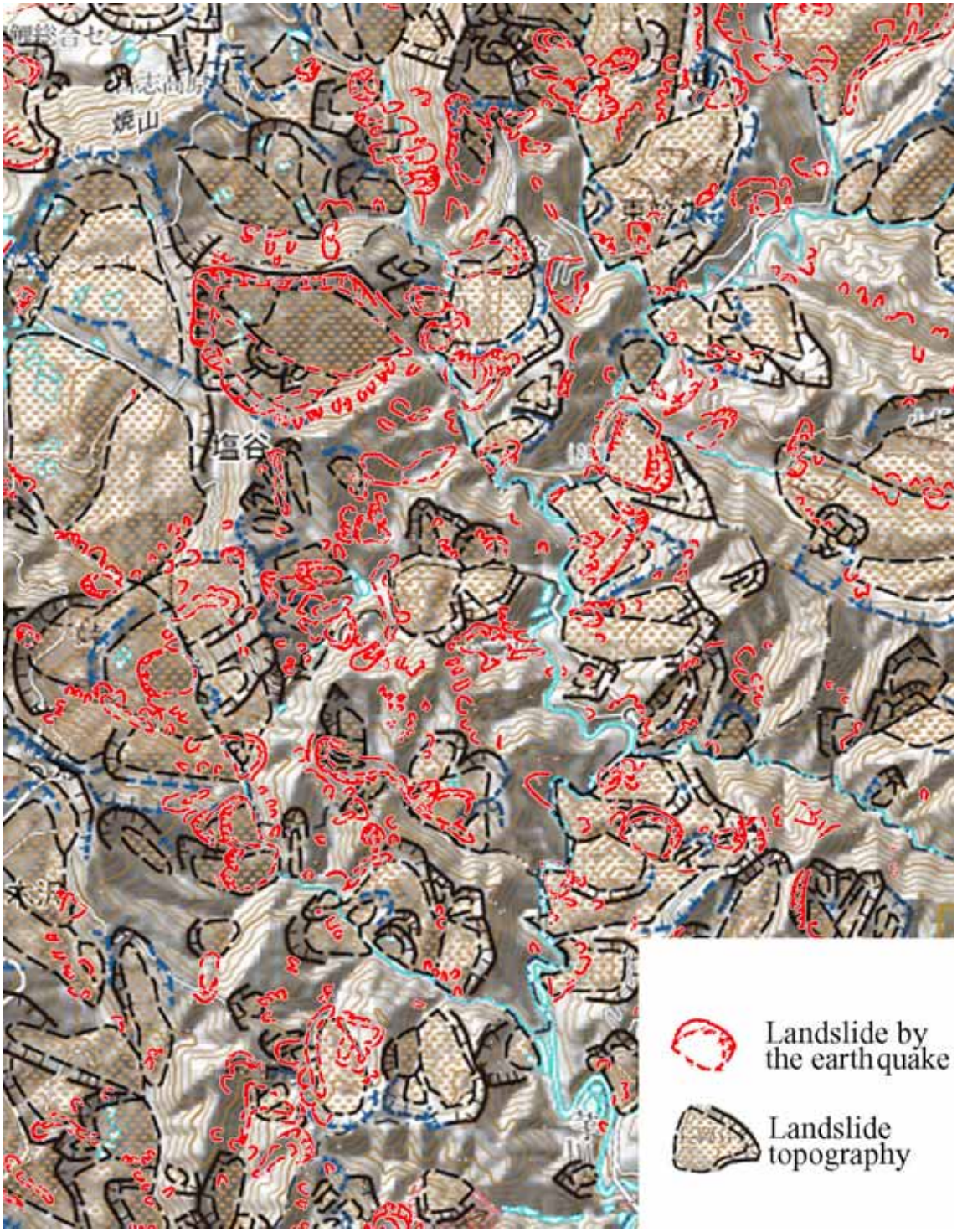

Fig.2 Relationships between the landslide topography and the landslides by the earthquake.

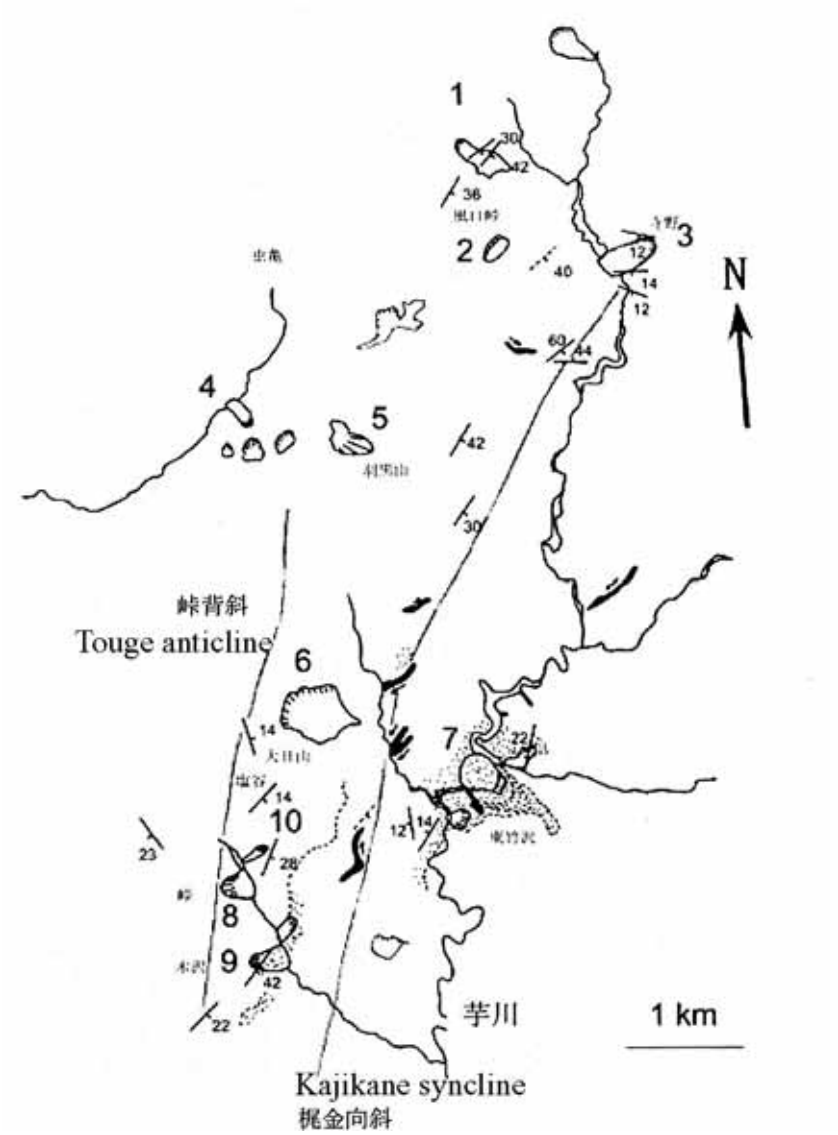

Fig.3 Geological structure and large-scale landslide disasters by the earthquake.

4. Some case studies and distribution of landslide disasters

Some draft version landslide distribution maps has been developed by several scientists and agencies. Dr. Yagi uploaded his map to the web site of the Japan Landslide Society. Dr. Marui introduces the actual conditions of several landslide dams. The investigation team carried out the field study on 6 and 7 Dec, and points out the following characteristics of the landslides:

1) Many of the landslides occurred within the landslide topographic area (Fig.2).
2) Most of the large-scale landslides occurred on dip-slopes within the areas of sandstone overlying siltstone or the areas of alternated beds of sandstone and siltstone. Mudstone area suffered from less number of landslides, although it is widely covered by previous landslide topography.

3) Most of shallow landslides are concentrated into such geomorphic situation ridges, side slope and attack slope of the rivers and valleys, the toe part of the area of the topographic landslide body.
4) The landslides are categorized into several types i.e. large scale block glide, small scale rock slide, small slump, debris flow, shallow landslide (slope failure), rock avalanches, and the complexes (Fig.4, 5). Landslide dams are also remarkable phenomenon by the earthquake disaster.(Fig.6)
5) A huge number of cracks appeared at the step cultivation area and the hill slopes.

Some outstanding landslides are described below.

Higashi-Ttakezawa site (Fig.6): Typical block slide established the biggest landslide dam. This was also reactivation of a part of previous landslide.

Kajikane site (Fig.7): The largest block slide occurred 5 km north from the epicenter. The slide occurred within the previous slide body. The action appeared at the area of landslide topography. But the area was extent about 100 to 200 m wide more. The effected area was 600 m by 600 m. The thickness of the slide body is assumed to about 70 meters.

Terano site (Fig.8): This was a typical reactivation of existing previous landslide, forming a landslide dam. The type of movement seems to be basically translational with local backward rotation near its head scarp and a subsidiary scarp. Several large cracks are distributed on the upper slope of the crown.

Ikedani site (Fig.9): A number of small landslide and surface landslides occurred at the toe part of the area of landslide topography. The type of the landslides seems to be not slumping. Block slide might be dominant. Each size of the slides is relatively small.

Kokuriyama site (Fig.10): A large mudflow occurred caused by relatively large landslides in the uppermost part of the valley. The initial mudflow flowed about 1 km, the debris buries the valley very thickly and the secondary mudflow developed clear debris flow traces about 500m long. A landslide control dam had prevented further downstream flow.

Fig.4 Samples of various types of landslides by the earthquake.

1: Landscape of the Yamakoshi village (Almost slopes are consist of landslide topography)
2: Debris flow into the river 3: Block glide landslide (Slip surface is located at the bedding plain)
4: Shallow landslides 5: Rock avalanche 6: Slightly large shallow landslides

Fig.5 Samples of various types of landslides by the earthquake (2)


1
2
3
4
5

1: Over view of the Higashi Takesawa landslide establishs tha large landslide dam at Imogawa river
2: Graben like landform in the landslide body 3: The boundary pf the formar landslide body and the main scarp 4: Large outcrop of the slip surface 5: Close up the slip surface 6: Landslide dam
7: Repair operetionat the surrounding landslides 8: Repairment operation (Cut anf fill for the secondary disaster prevention) 9, 10, 11: Cut the canal for water tenporal level control

Fig.6 Landslide dam by large-scale block slide at the Higashi-Takezawa

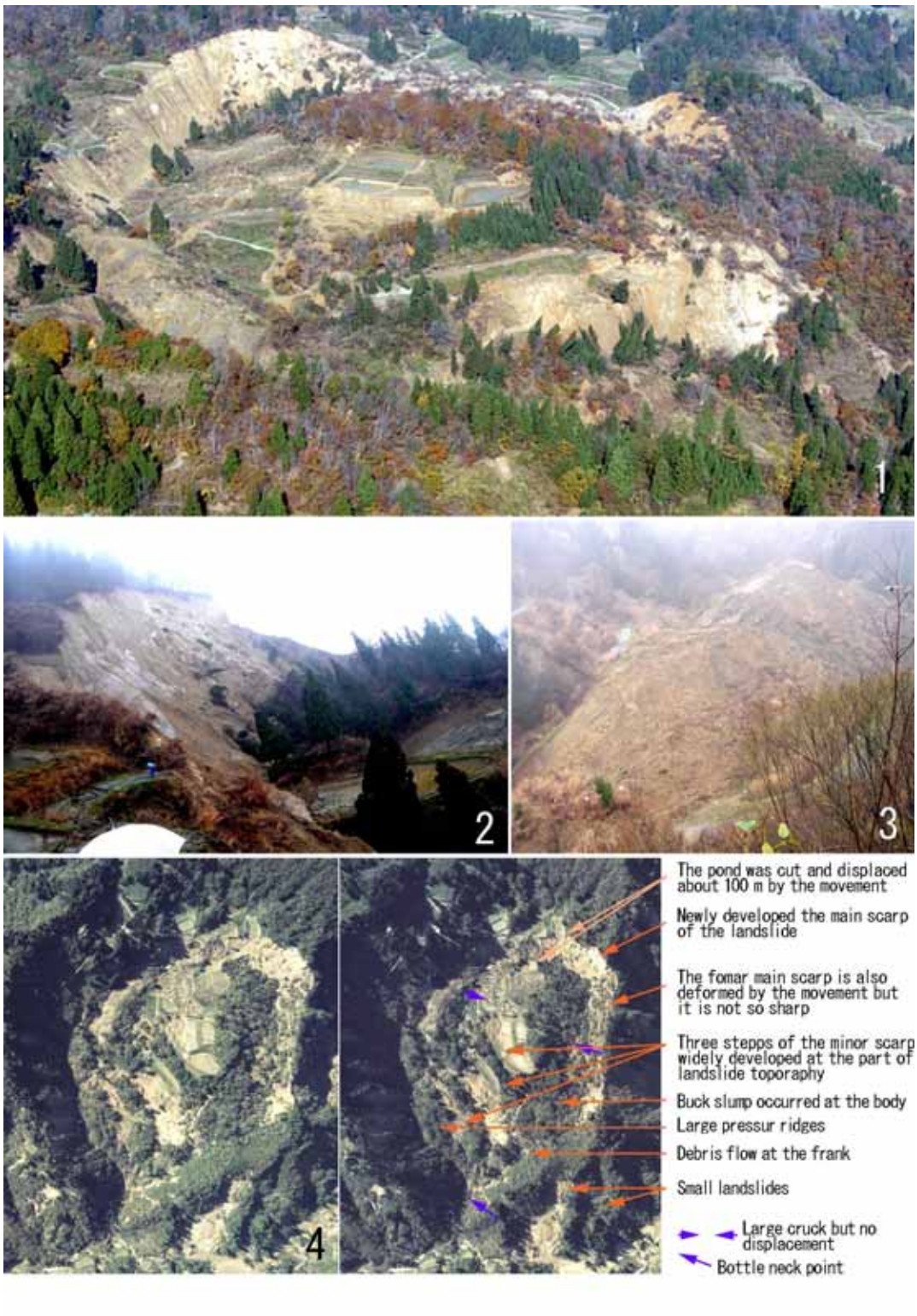

Fig.7 Geomorphic features of the biggest landslide at Kajikane site, Yamakoshi village. 1. Overview of the landslide, 2. Mainscarrp of the landslide, 3. Marginal toe of the landslide, 4. Stereo-paired photographs of the landslide.

Fig.8 Geomorphic features of landslide at Terano site. 1. Overview of the landslide, 2. Close-up view of the bedrock, 3,4. Cracks cutting the ponds, 5. Interpretation of the aerial photograph of the landslide.

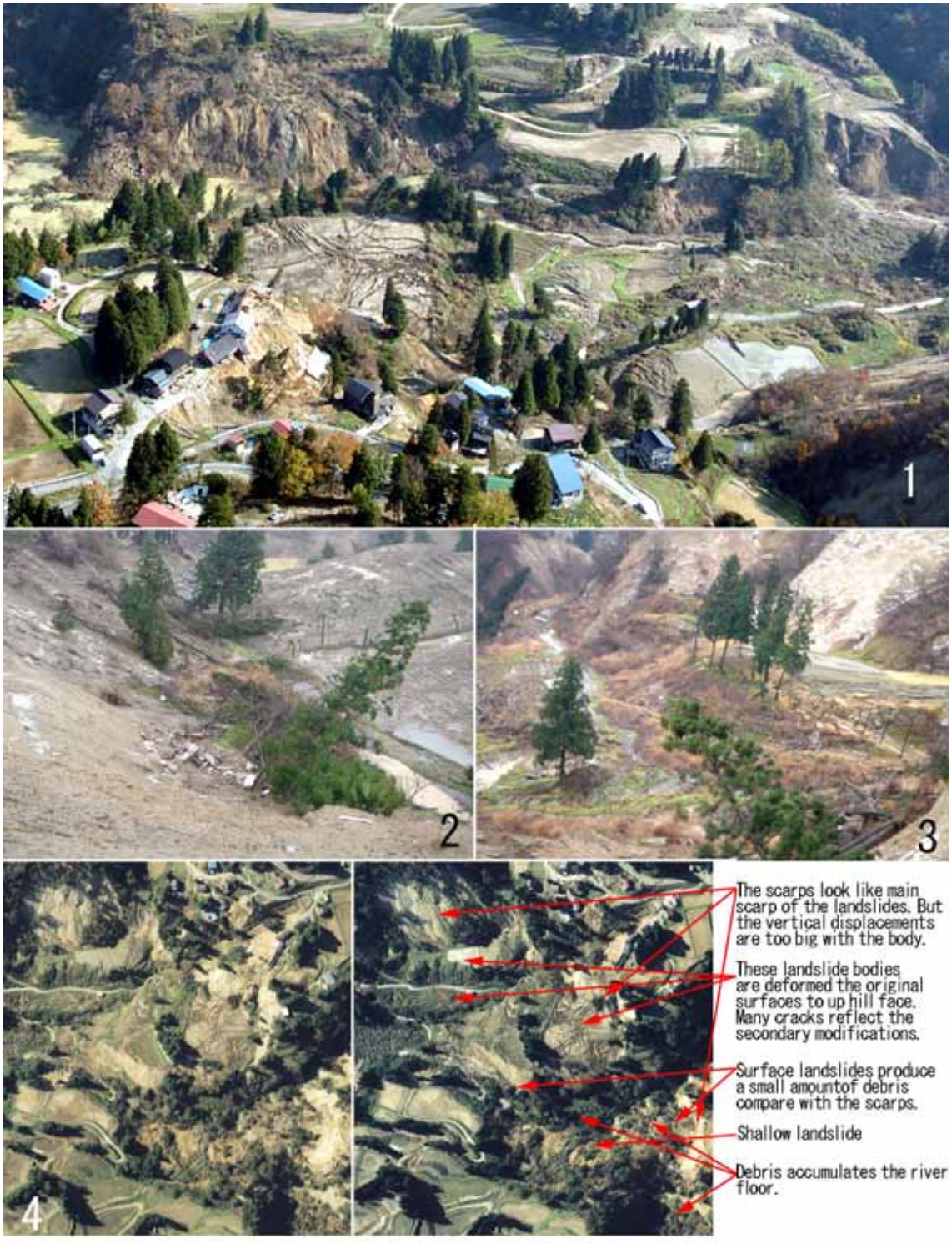

Fig.9 Geomorphic features of several landslides at Ikedani site

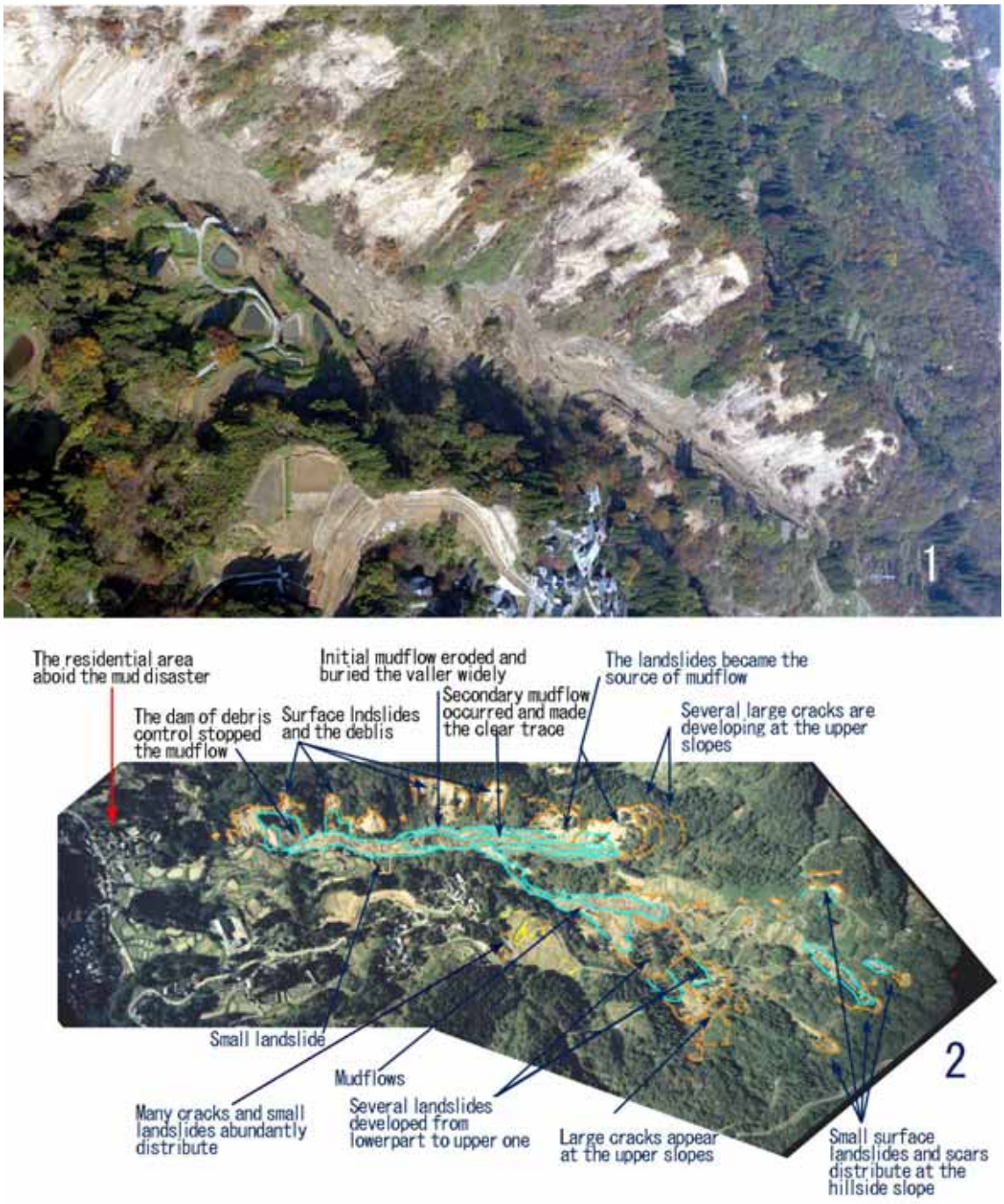

Fig.10 Geomorphic features of the mud flow at Kokuriyama site

5. Some recommendations for further research and landslide hazard management

The report is just the summary of urgent information of the incredible landslide disaster. For the landslide hazard management, we would like to emphasize the possibility of further movement of destabilized slopes at the time of snow fall and snow melt. We the two society will set up the special research committee as soon as possible for further research and for the recovery of the effected

people’s life and also the recovery of nature.

The following studies should be carried out with high priority by the viewpoint of our societies:

1) To clarify the methodology of how to identify the unstable slope by local people.
2) To predict the change of the stability of landslide body around the landslide dams.
3) To evaluate the stability of cracked area at the time of snow fall and melt.
4) Evaluate the possibility of the removing at the muddy landslide topographic area.

The study for rehabilitation of the life and nature of the area is also very important for future. That is, the basic study of the verinability evaluation of the landslide topography and normal slopes, the environmental effect to the ecosystems by the sediment yields in specific watershed and Shinano river system, the relationships of the nature of landslide and human life.

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