Formation and Bursting of Landslide dams around the Japan Alps

Key words: Fossa Magna, Historical Age, Japan Alps, Landslide Dam, Outburst

Introduction

The author collected and organized case examples of historical large-scale sediment-related disasters, and published the reports at Tabata et al. (2006), Moriyama et al. (2011), and Interpress 2004, 08, 10, 12 and 14 (Mizuyama et al. 2004, Inoue et al. 2008, 2012, Inoue, 2010, 2014). In particular, case examples from various parts of Japan regarding the formation and outburst of landslide dams, which are reservoirs created by closure of rivers on mountains, namely, 65 disasters and 190 case examples.

It is often difficult to identify disaster phenomena in historical eras, even in areas rich with historical records like Japan. When the flow of a river through a valley may be put on historical records solely related to large-scale ocean trench earthquakes along river lines, sediment-related disasters are generally induced by a great variety of causes, including heavy rainstorms, earthquakes, and volcanic eruptions, and can occur in a wide variety of areas, including mountain and hills.

2. Case Examples of Landslide Dams around the Japan Alps

Fig. 1 shows a distribution of landslide dams and Table 1 is a list of landslide dams in the area around the Japan Alps. The map explains how large-scale landslide dams are formed in this part of Japan. This report describes case examples of landslide dams formed in the area around the Japan Alps north and south on the middle of Honshu island, where the largest elevation zone in Japan exists. Since the geological structure is very complicated along the Fossa Magna (Great Rift Valley) and the median plain unevenly, many large-scale sediment movements (landslide, debris flow, etc.) have been caused by earthquake (24 cases), heavy rain (16 cases) and eruption (1 cases).

3. Landslide Dam Created by the Gokisishidoko Earthquake in 887

3.1 Yatsugatake Otoksuri River Debris Avalanche Depositions (No. 4.1, 4.2, 4.3, 4.4)

The Great earthquake (or great earthquake of 686 along the Nankai trough) occurred on August 22, 887, resulting in tsunami and severe sediment-related disasters in many areas. This disaster was recorded in several historical documents. The description in “Yusuo Nakayuki” goes roughly like this: “The ground shook on August 22, 887. Many Areas in countries from kanto to kushu districts were severely shaken, and many government building were damaged.” In the Shinano region (Nagano Prefecture), mountain collapsed, and a large river ceased flowing that produced devastating damage along the river.” “Nilou Kinyuki” recorded the event roughly like this: “A flood occurred in the Shinano region on June 20, 888, and the mountains were depleted, and the river inundated. On May 15, a government decree was issued, which said that People victimized by the flood could not transport their taxes.”

The northern part of Yatsugatake Volcano was severely shaken by this earthquake. As a result, a huge sector collapse occurred which moved 350 million m³ of sediments and the sediments ran down the local river as the Otokisuri River Debris Avalanche. It eventually closed the channel of the Chikuma River and created Japan's largest landslide dam, named Old Chikuma Lake 1 (No.1-A1), dammed up to 130 m, with a volume of 580 million m³ (impounded Fig. 2, and Inoue at al., 2010, Mitutani (2003) counted the annual rings of a buried cypress tree found in the debris avalanche deposit and calculated the time of the collapse and debris avalanche occurred at 887.

This landslide dam failed 305 days later, and the secondary debris avalanche ran down the Chikuma River closed a tributary of Aki River, and formed Old Aki Lake No.4, water dammed with a volume of 6.6 million m³, up to a height of 30 m. The flood induced by the debris avalanche further flowed down the Chikuma River for 95 km. Remains of the ancient land-management system in the Heian Period (9-12 centuries), burned by debris flows, and burned by Nisaka Flood Sediments, were found along the river. The dammed water of Old Chikuma Lake 1 did not totally flow out, and Old Chikuma Lake 2 (No.4.3, water Dammed up to 56 m, with a volume of 41 million m³) remained. 133 years after 888, Old Chikuma Lake 2 burnt on 1014 and the Bottom of the lake was dried up to become flatland. Minato Shinme still remains near a rail crossing of Route 151 near Taku Immechuk Station of Kamiine Line in East Japan Railway. The outer of this Shinme probably dates back to the years, which had Chikuma Lake No.2, still existed and local people cross the the lake on the boats between Umezuka and Umijimura.

3.2 Huge Collapse of Donodoko-Sawa of Komu River, upstream of the Fuji River (No. 4.2)

Large-scale avalanche deposits (No.4.2, DAAD, Volume = 10 million m³) are distributed over Donodoko-Sawa stream in the South Alps. Karita (2012) made a detailed survey of DAAD and provided the value of AD780 to AD760 based on the carbon dating of DAAD and fossilized wood in the lake deposits (Fig. 3). karita, Mitutani and Inoue (2014) used one specimen with a bark taken from a large amount of large-diameter fossilized trees contained in the lake deposit, analyzed the specimen with tree-ring dating and examined the relations with DAAD. According to their study, it was revealed that the ring specimen had 226 layers, and the tree ring patterns of these layers were compared with the standard pattern based on 2075 years of tree rings owned by Mitutani (BC705 to AD1006) to find that both matched in the section from AD662 to 887. It was also determined that the specimen tree died in the period. Consequently, it was concluded that the specimen in the lake deposit died in AD887.

3.3 Debris Avalanche and Lake Depositions in Donodoko-Sawa (Karita, 2012)

3.4 Manana-Yama Landslide by Yochi Hongo Lake Earthquake

On Jan. 28, 1502, No.71 The Hirame River flows north along the Ishigawa – Shizuka Tectonic line, and the catchment basin of this river has many large-scale landslides, including Lake Asoki (No.2) and Mt. Hieda (No.18). Fig. 4 is a Geomorphic map based on the analysis of aerial photos. A river-facing slope of Mt. Manana-Yama (1219.3 m in altitude) that soared on the right side of the Hirame River, collapsed in an enormous way and blocked the river channel. Part of the collapsed sediment still remains at the eastern side of the Hirame River as the Kuzuma Pass (volume of collapsed sediments, 20 million m³). A landslide dam created by this collapse to 140 m in depth with a volume of 120 million m³. Enchoo-Hamet Earthquake (Mw6.5) occurred on 1502 on an earthquake epicenter on the Etsu Shiroi.

5. Case Example by the Hoei Earthquake (1707)

The Hoei Earthquake (two major quakes of M=8.4) occurred on Oct. 28, 1707, not only caused tsunami damage but triggered many sediment disasters over a wide area of Honshu island from Kanto to Shikoku. Well-known large-scale landslides in the southern part of the Japan Alps caused by this mega event include the Oya Kuzure (No.8.1) in the upstream of the Abu River, Shiratori-Yama Kuzure (No.9.2) along the midstream of the Fuji River and Yado Kuzure (No.9.3) along the Hayasaka River, a right bank tributary of the Fuji River.

5.1 Yuno-Oko, along the Shimobube River, a left bank tributary of the Fuji River

A large-scale landslide occurred by the Hoei Earthquake in Yuno-Oko, a left bank tributary of the Fuji River, and a landslide dam was formed. According to Old documents, at a village named Yuno-Oko, a mountain slope failed, burned the valley, and created a lake. In order to cut the bank of the landslide dam to release the impounded water, some 2800 villagers worked together to excavate a trench without success. Villagers living down stream of this dammed point were afraid of the impound water, evacuated up in the mountain and found shelter in huts. According to Fig. 5, which is a map with topographical feature enhanced by laser profiler, landslide dam and upstream depositional landform are found. The impound water reached an altitude of 450 m, and the impounded water was 70 m in depth, 3.7 million m³ in volume. The moving rocks that blocked the river channel caused deformation under the influence of Typhoon No.15 in 1111, and a shallow collapse occurred on the slope down a forest road. As deformation was also found on the mountainside retaining wall, restoration work of local roads and the river was conducted.

Conclusion

This poster introduces some case examples of landslide dams around the Japan Alps. As shown in Table 1 and Fig.1, various landslide dam disasters also occurred due major earthquakes, including the 1567 Earthquake (1647, No.12). Asan Takai Earthquakes (1834, No.13) and Hieyu Earthquake (1835, No.14). It is necessary to accurately find the time of scattered parts of the history and disaster prevention administration personnel be handed down to local residents.