Measures to Mitigate Eruption Disasters of Mt. Yakedake

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INTRODUCTION

Mt. Yakedake (2,455m) is the most active volcano in Hida Mountains that locates on the border between Gifu and Nagano Prefectures. Mt. Yakedake has become active since about 20 thousand years ago, and erupted about 2.3 thousand years ago that formed a lava dome at the summit causing a pyroclastic flow that flew down toward the foot of the mountain area. Also phreatic explosions occurred in 1915, 1926, 1962, and 1995 and it is still in activity.

The adjacent area of Mt. Yakedake is renowned as a mountainous sightseeing area called the Chubu Sangaku National Park, and many climbers and tourists visits annually. Gifu Prefecture on the west side of Mt. Yakedake, Okuhida spa village locates that is one of the most famous hot springs in central Japan. Nagano Prefecture on the east side, Kamikochi locates that is widely known as a special place of scenic beauty and special natural monument in Japan. However, the crater of Mt. Yakedake locates approximately 2km from these areas, it is more likely to be damaged by an eruption. In addition, heavy rain caused serious sediment related disasters in the past around Mt. Yakedake due to the steep terrain and fragile geology that formed by past eruptions.

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) has implemented sabo works to prevent such sediment related disasters since 1930s. "Conference for Mt. Yakedake Volcano Disaster Prevention (established in 2002)" which consists of MLIT, prefectural governments and municipality of adjacent area of Mt. Yakedake discussed about the phenomena and sediment movement caused by the eruption of Mt. Yakedake, and publicized and distributed a hazard map and action plan based on these information.

MLIT developed "Sabo Plan of Volcanic Eruption Emergency Disaster Reduction Measures" which planned the emergency structural / non-structural countermeasures of the Sabo department in advance to correspond immediately after the eruption to reduce damage or risk due to volcanic and sediment related disaster as much as possible. Therefore the plan has been utilized in active 29 volcanoes in Japan since 2007 (**Fig.1**). Jinzu River Sabo Work Office (Gifu Prefecture) and Matsumoto Sabo Work Office (Nagano Prefecture) of MLIT developed the “Sabo Plan of Mt. Yakedake Volcanic Eruption Emergency Disaster Reduction Measures” in June 2011, and updated it continuously to make more effective countermeasures.

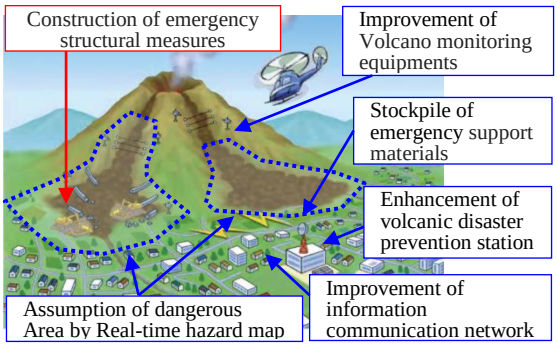

Fig.1 Images of Volcanic Disaster Reduction Measures

EMERGENCY STRUCTURAL COUNTERMEASURES FOR MT.YAKEDAKE

The emergency disaster reduction plan for Mt. Yakedake targeted all phenomena and sediment movement expected to be occurred during the eruption of it. The main phenomenas of structural countermeasure is debris flow and snowmelt type mud flow that can be dealt with by structures. The target areas of structural countermeasure are Ashiaraidani torrent, Iwatsubodani torrent, that the source of the catchment are the summit of Mt. Yakedake, and the main stream of Gamatagawa River, Hirayugawa River and Takaharagawa River downstream of each torrents. The estimated influence of the designed phenomena and sediment movement in these areas differs for its terrain conditions, distribution of residential area and existing sabo facilities. Thus, structural countermeasures were determined based on these properties and also the damage estimated by the numerical simulation.

(1) Structure and Construction method of Countermeasures

The sediment disposal policies are; 1) control and reduce the sediment and peak discharge of debris flow and snowmelt type mudflow at the upstream as much as possible of each torrent, 2) guide the flow safely at the downstream and along the main stream to prevent the flood. Based on these pocilies, and also focus on the period of construction, the location of the existing sabo facilities in adjacent areas of Mt. Yakedake, effectiveness to prevent the sediment related disaster, and the access to the planned site, 4 structures and construction methods are proposed; a) reduce the sediment and keep the capacity of the existing sabo dams considering the original function, b) shut the permeable section of existing permeable sabo dams to trap the huge amount of sediment, c) construct concrete block masonry sabo dam that the construction period is relatively shorter than concrete sabo dam (**Fig.2**), d) construct training dikes using large-sized sandbags along the main stream that is easy to built.

Fig.2 Image of developing concrete block masonry sabo dams (Mt.Shinmoedake in 2011)

(2) Implementation plan of Emergency Structural Countermeasures

Considering the location of the crater, regulations based on the volcanic alert level, the structure and construction method, and ensurement the safety of construction workers, implementation plan of emergency structural countermeasures are proposed; i) reduce sediment of the existing sabo dams at upstream of Ashiaraidani torrent and Iwatsubodani torrent first that it may be regulated at early period of the eruption because the distance from the crater is close, ii) construct the concrete block masonry sabo dam directly upstream of the resident area of Iwatsubodani torrent, iii) shut the permeable section of Jigokudaira Sabo Dam along the Gamatagawa River, construct the training dikes along downstream of Iwatsubodani torrent and main streams. v) use the unmanned construction system when the planned site has been regulated, or safety of construction workers cannot be ensured such as during the eruption and night time.

CONCLUSIONS

“Sabo Plan of Mt. Yakedake Volcanic Eruption Emergency Disaster Reduction Measures” has been designed considering the effective utilization of existing sabo facilities, implementing every possible measure at the time. However, comprehensive judgment and response are required in implementing the plan depending on the status of volcanic activities. Therefore, it is necessary to discuss about the method to improve possibilities of the plan such as skill of the MLIT, prefectural governments and municipality workers of the adjacent area of Mt. Yakedake, and securing safety of construction workers to respond the disaster through volcanic emergency drills.

Keywords: Volcanic Eruption, Emergency Disaster Reduction Measures, structural countermeasures, implementation plan