The Catastrophe in Shimabara

The 1791-92 eruption of Unzen-Fugendake and the sector collapse of Mayu-Yama

Before

AFTER
Gigantic sector collapse broke out. Huge amounts of debris and rocks rushed into Ariake Bay, and left a large number of debris flow mounds in the sea.

Unzen Restoration Office
Ministry of Land, Infrastructure and Transport of Japan
May 21, 1792, a gigantic sector collapse broke out on the eastern slope of Mayu-Yama in Shimabara Peninsula, Nagasaki Prefecture, Kyushu. The sector collapse was induced by earthquakes which occurred under Shimabara, a castle town, in the last stage of eruptive activities of Unzen-Fugendake(Mt. Fugen). The eruptive activity began in November, 1781 and ceased in July, 1792. Huge amounts of debris rushed into Ariake Bay generating a big tsunami. The tsunami hit both sides of the inland sea, and killed about 16,000 persons. And then, the hazard was called the catastrophe in Shimabara.

November 17, 1990, Unzen-Fugendake began its eruption after 198 years of dormancy. May 20 of the following year, the first lava lobe was effused, and totally 13 lobes of lava dome were formed one after another by July 1994. June 5, 1991, large-scale pyroclastic flows rushed down along the Mizunashi river, killing 43 people. The pyroclastic flows and consequential debris flows brought about damages to building, farmland and forest over a vast area on the slopes around the mountain.

In 1995, a large portion of pyroclastic flow deposits were flushed out many times as debris flows by many heavy rains of long duration, and Shimabara city was temporarily isolated by the severe inundation of large debris flows. The Unzen Restoration Office was established to help the recovery from the eruption. Since then, the office has been implementing two types of projects: site project and road construction project. The office is undertaking those projects to help the devastated area recover fast by improving the infrastructure of the city.

The catastrophe on 210 years ago and recent hazards brought big damage to the people who lived at the foot of Unzen-Fugendake. We must learn what kind of thing those hazards were. Furthermore, how damage expanded. This pamphlet was made by our office so that everyone could learn past hazards well.

October, 2002 Shozo Koga
Director of Unzen Restoration Office
Ministry of Land, Infrastructure and Transport of Japan

Table 1: Comparison of Volcanic Hazards

<table>
<thead>
<tr>
<th>Volcano</th>
<th>Unzen 1791-92</th>
<th>Unzen 1990-95</th>
<th>St.Helens</th>
<th>Plinianbo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Volume of magma</td>
<td>$2.0 \times 10^7$ m$^3$</td>
<td>$2.0 \times 10^7$ m$^3$</td>
<td>$1.3 \times 10^7$ m$^3$</td>
<td>8.4-10.4 x 10$^7$ m$^3$</td>
</tr>
<tr>
<td>Volume of pyroclastic fall deposits</td>
<td>--</td>
<td>--</td>
<td>$1.1 \times 10^7$ m$^3$</td>
<td>3.4-4.4 x 10$^7$ m$^3$</td>
</tr>
<tr>
<td>Volume of pyroclastic and debris flow deposits</td>
<td>--</td>
<td>--</td>
<td>$1.6 \times 10^7$ m$^3$</td>
<td>$2.5-3.0 \times 10^7$ m$^3$</td>
</tr>
<tr>
<td>Volume of sector collapse</td>
<td>$3.4-4.4 \times 10^7$ m$^3$</td>
<td>$3.4-4.4 \times 10^7$ m$^3$</td>
<td>$2.3-3.0 \times 10^7$ m$^3$</td>
<td>5.0-6.0 x 10$^7$ m$^3$</td>
</tr>
<tr>
<td>Date of sector collapse</td>
<td>May 21,1792</td>
<td>May 21,1990</td>
<td>May 18,1980</td>
<td>--</td>
</tr>
<tr>
<td>Dead (person)</td>
<td>15,000</td>
<td>44</td>
<td>60</td>
<td>more than 250</td>
</tr>
</tbody>
</table>

References


| Data of Public Works Research Institute and Geographical Survey Institute |
| Newhall & Punongbayan (1996): FIRE and MUD, PHIVOLCS |

Fig.1 Map showing of Shimabara and Kumamoto

Fig.2 Bungo to munchin (Bungo Beppu): Before the sector collapse in April, 1792

Fig.3 Shimabara taisen ocho (Shimabara battle): After the sector collapse in May, 1792

The author’s eye of the cover was made by using the following materials:
The topographic data of the land was made by Hokkaido Chir.mo Co., Ltd., on the basis of 1/20,000 map of the Geographical Survey Institute.
The topographic data of the island was prepared by the Geographical Survey Institute with narrow multi beam sounding system (Navi, 1998). The aerial photograph was taken by the the Unzen Restoration Office.
Mayu-Yama, one of Unzen compound volcanoes, situated in the eastern part of Shimabara Peninsula, Nagasaki Prefecture, is a lava dome composed of dacite. It consists of two peaks, the Shichiminzen and Tenguyma. The sector collapse scattered debris deposits over about 10 km² bringing about a gentle slope, and debris materials reached to Shimabara Bay, 5 km away from the top of the mountain. A record at that time reports 15,000 persons were killed by the primary sector collapse and secondary hazards of tsunami.

February 10, 1992, phreatic eruption initiated at the Dijokuto crater near the summit of Fugendake. March 1, lava effused and it continued for two months, the lava flow was 220-360 m wide and 2.7 km long, and volume of the lava was 20 million m³. May 21, a large portion of Mayu-Yama collapsed induced by a strong earthquake, and volume of about 340 million m³ of debris which is equivalent to 1/6 of the whole mountain body rushed into Ariake Bay, resulting in tsunami (Ohta, 1969).

Table 2: A number of damage for the 1792 hazard (modified after Katayama, 1974)

<table>
<thead>
<tr>
<th>SIYABARA</th>
<th>AMAYUSA</th>
<th>KUMAMOTO</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead (person)</td>
<td>9,532</td>
<td>343</td>
<td>4,683</td>
</tr>
<tr>
<td>Injured (person)</td>
<td>707</td>
<td>-</td>
<td>811</td>
</tr>
<tr>
<td>Livestock (no.)</td>
<td>498</td>
<td>109</td>
<td>151</td>
</tr>
<tr>
<td>Houses (no.)</td>
<td>3,347</td>
<td>373</td>
<td>2,252</td>
</tr>
<tr>
<td>Destroyed facilities (no.)</td>
<td>378</td>
<td>65</td>
<td>2,639</td>
</tr>
</tbody>
</table>

The volcanic products of Unzen volcano composed mainly lava and pyroclastic deposits of highly viscous andesite to dacite composition. The type of lava tends to form lava dome. The pyroclastic flow and lahars formed alluvial fan around lava dome. A sector collapse of lava dome usually deposited a huge amount of debris forming many debris flow mounds on the mountain slopes and on the shallow sea floor. According to the photo interpretation by Geographical Survey Institute(1995) and Inoue(1999), the area covered by debris materials is clearly recognized topographically marking the remains of debris flow mound.

Unzen volcano is a generic term of many mountains centering around Unzen-Fugendake in eastern part of Shimabara Peninsula. Unzen Volcanoes are situated in volcanotectonic depression area of Unzen graben. This graben continues extending the distance in the north-south direction. The graben forms many faults in the east-west direction, inducing earthquakes.

Unzen volcano can be divided into two ages: Older and Younger Unzen Volcanoes. The Older Unzen Volcanoes, shown blue triangle in Fig.5, are dated at 200-500 thousand years and exceed 38 km³ in volume. The Younger Unzen Volcanoes, shown red triangle, are dated younger than 100 thousand years with the total volume of 8 km³.
2 The geomorphic history of Mayu-Yama

There are several explanations for the occurrence of the sector collapse as shown in Table 3. The explanation on combination of earthquake and hydrothermal becomes leading opinion.

Consecutive pictures of the history of volcanic activity and topography formation around Mayu-Yama is shown in Fig 7.

Table 3 Proposed explanations about the cause of the sector collapse (Modified after Ota, 1987)

<table>
<thead>
<tr>
<th>Explanations</th>
<th>Basis and Assertion</th>
<th>Advocate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eruption</td>
<td>After frequent local earthquakes, there was an explosion with incendial ground water changes.</td>
<td>Naotadiesi (1971)</td>
</tr>
<tr>
<td>A-A2' Section</td>
<td>The horseshoe shape disintegration and debris flow mounds are formed.</td>
<td>Furuya T. (1975)</td>
</tr>
<tr>
<td>A2' Section</td>
<td>The frontal shape disintegration and debris flow mounds are formed.</td>
<td>Ota Y. (1975)</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Landslide was induced by the increment of hydrothermal pressure. Tsunami was caused by an abrupt lift of the sea floor due to a slump motion along a slip surface along a circular arc.</td>
<td>Kamiyama N. (1974)</td>
</tr>
<tr>
<td>A3-A' Section</td>
<td>The debris flow mounds consist mainly of Shimabara Debris Avalanche.</td>
<td>Ota Y. (1975)</td>
</tr>
<tr>
<td>A'3 Section</td>
<td>The debris flow mounds consist mainly of Shimabara Debris Avalanche.</td>
<td>Ota Y. (1975)</td>
</tr>
<tr>
<td>A'4 Section</td>
<td>The debris flow mounds consist mainly of Shimabara Debris Avalanche.</td>
<td>Ota Y. (1975)</td>
</tr>
</tbody>
</table>

Fig 7 Consecutive pictures of the history of volcanic activity and topography formation around the Mayu-Yama
The sequence of the 1791-92 eruption is shown in this section. These were put in order as follows through interpretations of many historical documents.

Topographic changes before and after the catastrophe in Shimabara is divided into 4 stages. (Katayama, 1974, Inoue, 1989)

Stage 1: The preceding phenomena, earthquakes continued almost every day since November 5, 1791. Earthquake at Obama area on the west side of Shimabara Peninsula recorded the strongest seismic intensity reaching V-VI on the Japanese standard of Meteorological Agency.

Stage 2: Shin'nyoke lava effused. The preceding earthquakes almost ended, and rumbling of the mountain began in January 1792. A big earthquake and rumbling happened on February 10, then eruption began. The earthquake and rumbling were the strongest in the southeastern foot of Unzen-Fugendake, and Shin'nyoke lava flow filled up the valley Anasako-Tani for 2 km long from February 27 through April 20.

Stage 3: The Shimabara-Sangatsusuki earthquake occurred on April 21, that epicenter located at Mayu-Yama and Shimabara area. The earthquake swarm continued until May 14. The seismic intensity reached V-VI on the Japanese standard of Meteorological Agency at Shimabara castle. The tremor of Mayu-Yama (Tenguyama) was especially strong, and the mountain disappeared by the dust cloud of disintegration of mountain. Two or three large fissures extended east to west in Shimabara castle town, and the discharge from springs in the town were drastically changed its volume. April 29, a significant landslide occurred at the slope of Kusumoto-Daira which is in front of Mayu-Yama (Tenguyama). The landslide was (N-S) 720 m long, (E-W) 1080 m long and landslide cliff 90 m high. In Kusumoto-Daira, a few people noticed an unusual rise in the groundwater stage, and escaped to survive.

Stage 4: Sector collapse of Mayu-Yama occurred at about 8 p.m. on May 21. The collapse accompanied two strong earthquakes and lead noises. A huge amount of debris and rocks rushed into Ariaake Bay, and generated a big tsunami.

Table 4. The sequence of the eruption in 1792 and topographic changes before and after the catastrophe in Shimabara
(Modified after Katayama, 1974 and Iwata, 1990)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Name of the Eruption and earthquake</th>
<th>A.D.</th>
<th>Topographic Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>The preceding earthquake swarm</td>
<td>1791.11.3~12.5</td>
<td>The volcanic activity started with preceding earthquake swarm beneath Tsukibana Bay at the eastern foot of Unzen volcano on November 3, 1791 (Seismic intensity V-VI on the Japanese standard of Meteorological Agency, at Obama, the western foot of Unzen volcano).</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Eruption at the Fugenshi-Mae</td>
<td>1792.2.18~7.19</td>
<td>Big earthquakes occurred on February 10, 1792 and the eruption started with ash cloud emission from Fugenshi-Mae, Ajigasawa crater opened at the Fugenshi-Mae cone.</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Eruption at the Anasako-Tani</td>
<td>1792.2.27~3.4</td>
<td>The Shin'nyoke lava flow effused from the top of Anasako-Tani valley on February 27, and lava flow down slowly.</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Eruption at the Hachinokubo</td>
<td>1792.3.21~4.20</td>
<td>A new lava flow effused from Hachinokubo on March 21. The lava flow down slowly and jointed with Shin'nyoke lava flow.</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Eruption at the Furusakyo-Kashira</td>
<td>1792.3.24</td>
<td>Phreatic eruption at the Furusakyo-Kashira occurred 3 days after the eruption from the Hachinokubo without extruding of lava flow.</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Flow down at the Shin'nyoke lava flow</td>
<td>1792.3.25~4.21</td>
<td>The Shin'nyoke lava flow flow down slowly between March 25<del>27 and the front of the lava flow reached at the point of 6.5 km to homes. The average velocity was 30</del>50 m/day and the lava volume was about 20 million m³.</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Various phenomena which accompanies eruption</td>
<td>1792.3.19~</td>
<td>Carbonated spring begins to breed at Kureisihara in Mis-village.</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Shimabara-Sangatsusuki earthquake</td>
<td>1792.4.10</td>
<td>There was a new smoke from Oshika-Tani.</td>
</tr>
<tr>
<td>Stage 3</td>
<td></td>
<td>1792.4.21~4.22</td>
<td>There were new crulae from Hachino-Kuh to Furusakyo-Kashira.</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Landslide in the Kusumoto-Daira</td>
<td>1792.4.29~5.21</td>
<td>The evening on April 21 (March 17), the lunar calendar of Japan), strong earthquakes occurred several times (Seismic intensity V-VI) and two or three large fissures were formed in the Shimabara castle town.</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Shimabara-Shigatsusuki earthquake and the sector collapse of Mayu-Yama</td>
<td>1792.5.21</td>
<td>Kusumoto-Daira was a small hill located between Mayu-Yama and Ariaake Bay. Large scale landslide occurred on April 29 without strong earthquake and without heavy rain fall. Groundwater level rose up abnormally at Inamurara, the eastern foot of Kusumoto-Daira.</td>
</tr>
<tr>
<td>Stage 4</td>
<td>Topographic changes after the catastrophe in Shimabara</td>
<td>1792.5.22~</td>
<td>Very strong earthquake (M6.4, Magnitude in the Richter scale, Usami,1967) occurred on May 21 (April 1, the lunar calendar of Japan), and seismic intensity was 7~8, in Shimabara area. The gigantic sector collapse was induced by the earthquake on the eastern slope of Mayu-Yama lava dome of Unzen volcanic area. Huge amounts of debris and rocks rushed down into Ariaake Bay. Generating a big tsunami. The tsunami hit both sides of the bay, and approximately 15,800 people were killed.</td>
</tr>
</tbody>
</table>

Fig.8 Location map (Modified after Ohta, 1973)

Fig.9 Unzen volcanic graben

Fig.10 Profile section from Obama to Shimabara
4 Many documents and pictures about the catastrophe in Shimabara

The old documents and pictures are left showing the catastrophe by the 1791-92 eruption and the sector collapse of Mayu-Yama in minutely. Because of 15,000 persons were dead or missing, the catastrophe was reported by many people, and left many old documents and pictures. When we quote them, we should be careful to verify the contents and meaning of the pictures in order to avoid the acceptance of exaggeration, misunderstanding, and so on by the reporters.

Some of the old pictures are shown below.

A. Pictures describing the eruption of Urone-Fugonnda

A-1 甲斐川（岩手市立博物館）
Shirayake lava flow

A-2 大石川（岩手市立博物館）
Shirayake lava flow and the sector collapse

A-3 大石川断層図（岩手・岩手電気通信）
The front of Shirayake lava flow

A-4 水路島断層図（岩手市立博物館）
Shirayake lava flow

B. Pictures describing the sector collapse of Mayu-Yama

B-1 岩手大震災（山本・岩手県史館）
The sector collapse of Mayu-Yama

B-2 岩頭岩漬の流れの跡（岩手県立博物館）
After the sector collapse

C. Pictures describing Tsunami

C-1 岩手沿岸被災地図（岩手県立備蓄館）
Tsunami disaster map seeing from west side

C-2 岩手津波図（岩手市立図書館）
Tsunami disaster map seeing from east side

C-3 岩手津波図（岩手県立図書館）
Wide view of tsunami disaster
It is supposed that two old pictures (Fig.11 and 13) were drawn exactly from the same place at Shimabara Castle. Photo. 1 is taken from the same place. Fig.14 is bird’s eye view on the basis of Digital National Land Information 1986. Comparing Fig.13, Fig.14 and Photo.1, it is assumed that those are showing almost the same landscape. Therefore, based on two old pictures which are considered to give a realistic description, Inoue (1999) reconstructed the disaster bird’s eye view of Mayu-Yama with trial-and-error method, as show in Fig.12.

According to the detail examination by Kobayashi, et.al.(1986), Miyachi, et.al.(1987) and Miyachi(1992), two old pictures are justified the historical accuracy among 27 pictures depicting the catastrophe.

One is a post-disaster condition titled as “Kansei yonen daishinsu”, as shown in Fig.11. And the other is a post-disaster condition titled as “Shimabara taiken ochizu”, as shown in Fig.13. Kobayashi, et.al.(1986) clarified that both pictures had important historical value, because they were submitted to the Tokugawa Shogun in 1792 as the official documents of the catastrophe in Shimabara.

Two contour maps (Fig.15, 16) show the dramatic changes of the land and the bottom of the sea. The total volume of the debris was calculated to be $4.4 \times 10^7$ m$^3$. (Inoue, 1999)

Fig.17 is a geological cross-section of the Mayu-Yama. The Mayu-Yama was lava dome of 760 m high, and the height became 690 m after the catastrophe.
According to a drawing before the 1792 eruption, many old debris flow mounds are shown in the northern area of debris flow mounds. Kuruya (1974) and Miyachi et al. (1987) proposed these old debris flow mounds had formed before the catastrophe, and the collapse point had been Shichimenzan. Though, the collapse point and the formed period has not been specified yet.

Tadataka Inou surveyed Shimabara

Tadataka Inou (1740-1818), who surveyed all Japan at first, surveyed Shimabara geographical features in 1812, 20 years after the catastrophe. The feature of reconstruction of Shimabara castle town and the distribution of debris flow mounds were surveyed minutely. The debris flow mounds were recorded as islands, though some of the mounds were lost now.

In the surveying note, 45 islands and 4 shallows were recorded on the basis of landing survey. Matsuo (1988) counted 22 mounds, and indicated the rest were lost or reclaimed to the land.

The detailed surveying notes and sketches are housed in Tadataka Inou Museum in Sawara-City, Chiba Pref.

Inoue (1999) indicated that these old flow mounds were yielded from upstream of Nakao River, not from Shichimenzan. Once, there was a depression called “Biwanobachi” in the upstream of Nakao River, but the depression cannot be recognized because Shin’yake lava flow covered it. Inoue (1999) assumed that a lava dome near Biwanobachi collapsed. The deposits flowed down Nakao River, and formed many flow mounds in Shimabara city and Ariake Bay.
The big tsunami that hit Ariake Bay coast

Huge amounts of debris and rocks from the sector collapse rushed into Ariake Bay, and generated big tsunami. Tsunami hit not only Shimabara Peninsula, but also coastal area of Kumamoto and Amakusa Islands. About 15,000 lives were claimed by the collapse and the tsunami, and one-third among of 15,000 were lost by the tsunami as Kumamoto and Amakusa. Now there are many tombs reminding the victims. "Tsunami-dome-ishi" is the monument indicating the tsunami inundation reached.

The number of dead persons for every village is understood. The damage by tsunami around the Ariake sea is very big, although most of damage under Shimabara castle town is 6,251 people dead by the collapse of Mayu-Yama and tsunami. In and around Shimabara castle town, so many peoples were killed the death mainly because the collapse occurred at 8 p.m. in the moonless dark night, then they could not grasp the situation. And also, they had returned from their evacuation places due to lack of seismic activities. In the southern part of Shimabara Peninsula, the number of dead persons of every village isn't clear because of no records. As a result of subtracting the number (6,066 people) which was clear until now from the number (9,534 people) of the dead person in the whole of the Shimabara Peninsula, about 3,468 people suffered damage in this area.

As for the submerged area of tsunami, Kumamoto side referred the result of Tsujii-Hinos (1960), for the Shimabara Peninsula side referred Akagi (1986, 2001).

Fig.19: Tsunami-dome-ishi[1860] showing the hazards around Shimabara Peninsula

Fig.20: Distribution of the hazard victim around Ariake Bay

Fig.21: Tsunami-dome-ishi[1860] showing the hazards around Shimabara Peninsula

Disaster map of east side of Ariake Bay in Kumamoto
Chapter II The 1990-95 eruption of Unzen-Fugendake

1 The eruptive activity after 198 years of dormancy, 1990-95

November 17, 1990, 198 years after the eruption of 1792, Unzen-Fugendake resumed eruption. The pyroclastic flows were followed by debris flows under the condition of heavy rainfall, which brought about damages to building, farmfield and forest over a vast area on the slopes around the mountain. Total volume of magma $2.0 \times 10^9$ m$^3$ for five years.

The volcanic activities started with an earthquake swarm beneath Tachibana Bay at the western foot of Unzen Volcano in November, 1990.

From March 20, 1991 until the beginning of May, intermittent eruptions continued simultaneously from three craters, Kuyukashima, Jigoku and Byobuwa, emitting a large amount of ash cloud.

May 16 and 19, debris flows were caused in spite of light rain falls, and ran through the Mizunashi River into the sea.

A lava dome emerged in the Jigoku crater on May 20. The dome continued to grow, and then filled up the crater.

May 24, the lava started overflowing and falling down as blocks onto the eastern slope resulting in the successive formation of pyroclastic flows.

One person working in the upper stream of Mizunashi River got burnt due to a pyroclastic flow. Then, Shimabara Municipality recommended residents to evacuate. Nevertheless, some of the press so on continued their activities in the evacuation advice area.

June 3, the biggest pyroclastic flow occurred. And 43 people were killed and 179 houses were burnt. The accumulation of this pyroclastic flow is measured with $2.5 \times 10^9$ m$^3$ (Nagakia, 1993).

June 8, another big pyroclastic flow occurred. The flow burnt 267 houses.

June 30, a large-scale debris flow flowed down to the sea through the southern part of the city overtopping from the midstream of Mizunashi River. This debris flow destroyed 137 houses along the new flow line.

September 16 lava dome collapsed again, the large-scale pyroclastic flow occurred. It hit Taruki Hill, and changed the direction to Oshigataki. The main flow dashed along Mizunashi River. Ash cloud surge ran straight to Ohno-Roba hill. This surge burnt 218 houses including Ohno-Koba elementary school.

Though growing rate of lava and pyroclastic decreased at the end of 1992, it changed to increase in 1993, and the direction of pyroclastic flow changed to north-east.

After eruption activities subsided, pyroclastic flow deposits at the foot of the mountain flow down as debris flow by rainfall again and again.
Many inhabitants were saved because evacuation advice was announced a little earlier than the eruption in 1991. In spite of the advice, some peoples stayed in the danger area, and tragically trolled to death by large-scale pyroclastic flow.

In 1992, many peoples visited to see Shin'yake lava without aware of danger. An evacuation order was declared after the Sangatsuku earthquake. Nevertheless, Kusunoki-Daira landslide happened during the swarm earthquakes, none thought the possibility of sector collapse of Mayu-Yama. On the contrary, inhabitants came back home from their evacuated places, because earthquakes were calmed down. Many inhabitants were inevitably tumbled death at home by the collapse of Mayu-Yama.

In order to restrain the damage to minimum, the 1992 hazard on 310 years ago induces that following two points are necessary. First, the precise information should be transmitted rapidly to the proper authorities for warning evacuation. Second, inhabitants should evacuate actively.

Volcanic activities and warning evacuation arrangements were compared with the eruption in 1971-92 and 1990-95.

The arrangement in 1971-92 was quoted from "Ohdake Jigoku Monogatari" of the ancient documents.

That in 1990-95 was quoted from the documents recorded by Shimabara high school and the materials for Unzen Restoration Office.

Photo 8 Pyroclastic flow in Night (Photographed on August 11, 1991)

Photo 10 Pyroclastic flow (Photographed on May 30, 1991)
3 Information about Unzen Restoration Office

Sabo Projects
The basic plan of sabo works was provided in the Unzen-Fugendake as to establish the security against debris flow disaster and to gain the regional restoration.

In the basic plan, sabo dams were planned for capturing a debris flows above the sabo control points.

For countermeasures before sabo dams completion, training dikes and channel works were planned in order to control the direction of a debris flow and to prevent erosion and flooding between the sabo control points and estuary along Mizunashi River and Nakao River.

Monitoring system for disaster prevention
The disaster prevention monitoring system which consists of IT cameras, raingauges, and so on are prepared to secure the safety of the construction site and the area from the collapse of the lava dome and the debris flow.

Disaster prevention information is transmitted to the construction site that people concerned through the watch point, and transmitted to the inhabitant through the related organization and Cable Television Shimabara.

The Present Condition of the Restoration
The sediment remained sabo construction, was utilized the ground raising of Akanaka delta in 6 m height for more safety.

Besides this, various activities are conducting with the aim of the rich town-making under the theme “The everyone is the leader for restoration”.

A new Sabo Plan for Volcanic area
It still exists unstable sediment of 1.7 x 10^6 m³, at the foot of Unzen-Fugendake.

But, compared with an eruption activities term, the occurrence number of the debris flow becomes less gradually, and the amount of overflow sediment decrease, too.

The new sabo plan of reconsidering the amount of applicable sediment and the arrangement of sabo facility has been started based on such present condition.

Three themes of “Securing of the safety”, “The green restoration”, “The support to the regional restoration” are decided, and it has been executing under the relation with the inhabitant and related organizations.

The Unzen Restoration Office publishes a bulletin Unzen Fukko Dayori (“Unzen Restoration News”) every three months to inform the local residents of the progress of the activities and facilities being constructed, and to request local understanding and cooperation. And, learning of the eruption disaster is done in Ohno-Koha Information center. The sabo works are introduced through the homepage of Unzen Restoration Office.

The symbol of the Shimabara Peninsula "Unzen-Fugendake"

The Shimabara Peninsula is an area rich in nature that includes the Unzen-Fugendake volcanic area. The peninsula is known for its beautiful scenery and rich natural resources. It is a popular destination for tourists, offering opportunities for hiking, camping, and wildlife observation.

The basic sabo plan for volcanic area

- To create safe and comfortable home town beside the volcano which blesses rich and fruitful nature.
- To maintain the face and strength up to the debris flow disaster.
- To establish the green area for the обе population.
- To review the Shimabara Peninsula after evil from the eruption disaster.
- To secure the safety of the population and the future generation.
- To provide the volcanic tourism and the volcano climbing.
- To request the Shimabara Peninsula to be not taken into the disaster.
- To prepare for the future generation.
- To be the support to the regional restoration.

Under the relation with the inhabitant and related organization.
Sabo works include constructing structures to prevent surface collapses, and planting trees or seeding to prevent surface erosion. These measures reduce the quantity of unstable sediment produced on the slope.

The right photograph is the image of sabo facility plan in the Mizunashi River.

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("in English, **in Japanese with English abstract, ***in Japanese.

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