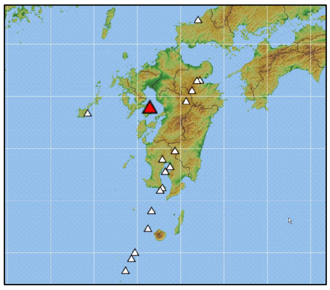
85. Unzendake



Continuously Monitored by JMA

Latitude: 32°45'41" N, Longitude: 130°17'56" E, Elevation: 1,483 m (Heisei-Shinzan)
(Elevation Point)

Latitude: 32°45'36" N, Longitude: 130°17'32" E, Elevation: 1,359 m (Fugendake)
(Triangulation Point)

Scenary of Unzendake taken from southeast side on November 22, 2007. Courtesy of Yoshie Yamada.

Summary

Unzendake is a stratovolcano in the central part of Shimabara Peninsula, where the Unzen graben developes in the est-west direction with the width of about 9km. The old volcanic edifice is located in the western part and the younger edifice in the east part. The Myoken caldera, which opens to the east and surrounds a group of young lava domes, including Fugendake, is located in the middle. The largest lava dome, MayuYama, is located even further east. The volcano consists of andesite and dacite lavas and pyroclastic materials. It erupted three times in recorded history, all eruptive activities are limited at Fugendake. Earthquake and geothermal activities are dominated in the western part. On November 17, 1990 (Heisei 2), phreatic eruptions began at the Jigoku-ato crater and Tsukumo-Jima crater of Fugendake. In May next year, a lava appeared at the Jigoku-ato crater and grew as a lava dome. The growth was accompanied by frequent pyroclastic flows. The SiO_2 content of the lavas is between 55.3 and 66.6 wt.%.

Photos

Eruption began at Unzendake after the 198 years dormancy. Jigoku-ato crater is left, Tsukumo-Jima crater is right. Taken from southwest on November 17, 1990 by the Japan Meteorological Agency

Ash plume from the Byobuiwa crater behind the Jigoku-ato crater. Taken from northwest on March 19, 1991 by the Japan Meteorological Agency

Deposits of debris flow which occurred first in the last eruption. Taken at Naka-antoku, Shimabara on May 15, 1991 by the Japan Meteorological Agency.

Lava deome on May 23, 1991, taken by the Japan Meteorological Agency. On May 20 new lava was confirmed at the Jigoku-ato crater. Broken lavas were filling the crater and reached the eastern crater rim. At 16:00, May 23, lava boulders started falling out of the crater..

Pyroclastic flow descending the Mizunashi River.
Taken at Onokoba, Fukae town on May 29, 1991 by the Japan Meteorological Agency.

Lava dome continuously growing to the southeast.
Taken from southeast on February 27, 1992 by the Japan Meteorological Agency.

Pyroclastic flow descending along Akamatsu Valley.
Taken from southwest on March 31, 1992 by the Japan Meteorological Agency.

Pyroclastic flows descending toward Mizunashi River and Oshiga Valley.
Taken from Fudanomoto, Shimabara city on May 4, 1993 by the Japan Meteorological Agency.

Senbongi area, Shimabara city, damaged by a pyroclastic flow on the early morning of June 23, 1993.
Taken from northeast on June 23, 1993 by the Japan Meteorological Agency.

Lava dome growing on the older part.
Taken from northeast on November 10, 1993 by the Japan Meteorological Agency.

Lava dome near of the final stage of its growth. Taken from northeast on November 10, 1993 by the Japan Meteorological Agency.

Heisei-Shinzan (new lava dome complex), taken from east on December 6, 1994 by the Japan Meteorological Agency.

Eastern slope of Unzendake, taken in Kitakamikoba, Shimabara city on March 6, 1997 by the Japan Meteorological Agency.

Western view of lava dome on November 6, 2001 - Taken by the Japan Meteorological Agency.

Red Relief Image Map

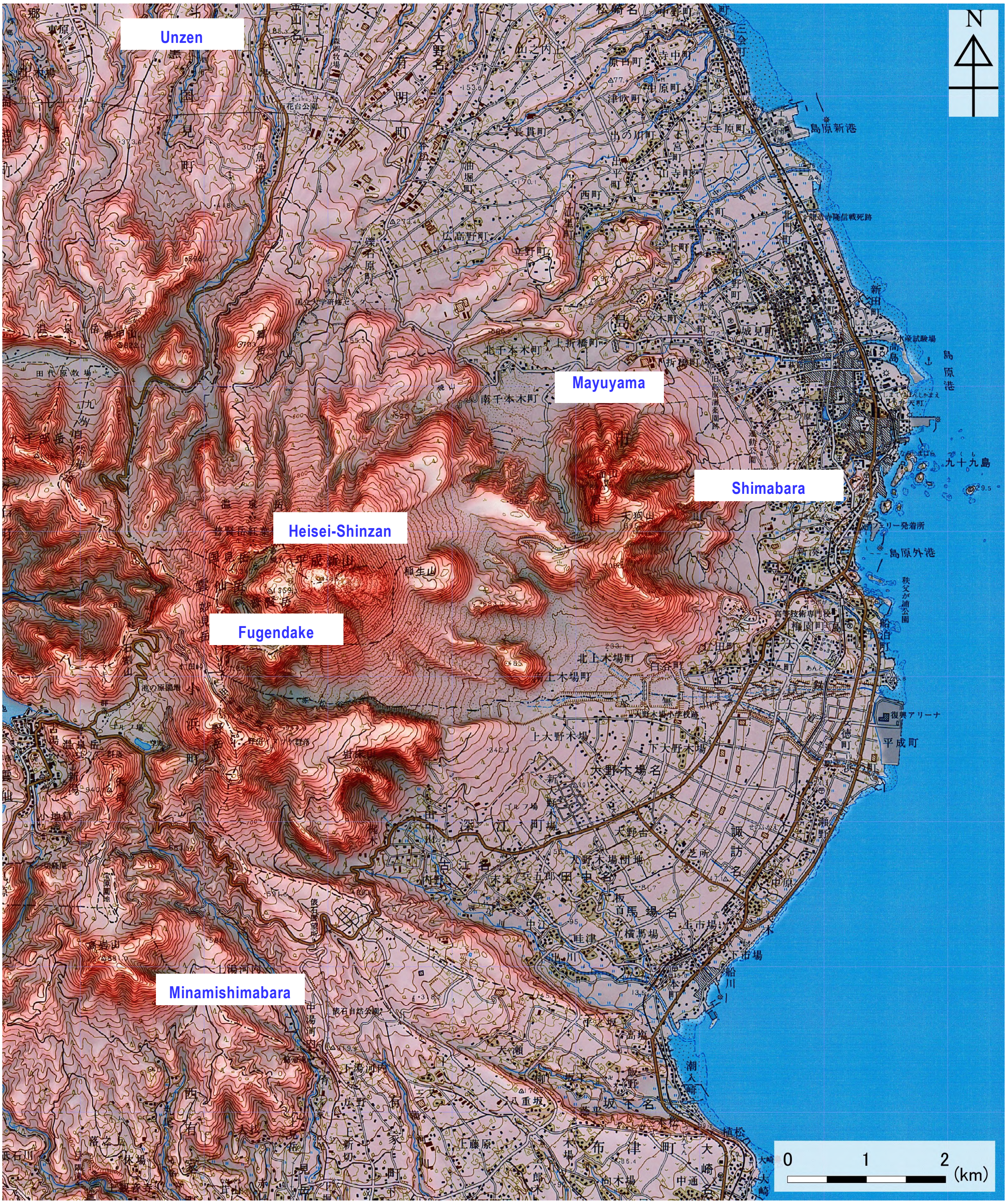


Figure 85-1 Topography of Unzendake.

1:50,000 scale topographic map (Shimabara) and digital map 50 m grid (elevation) published by the Geospatial Information Authority of Japan were used.

Geological Map

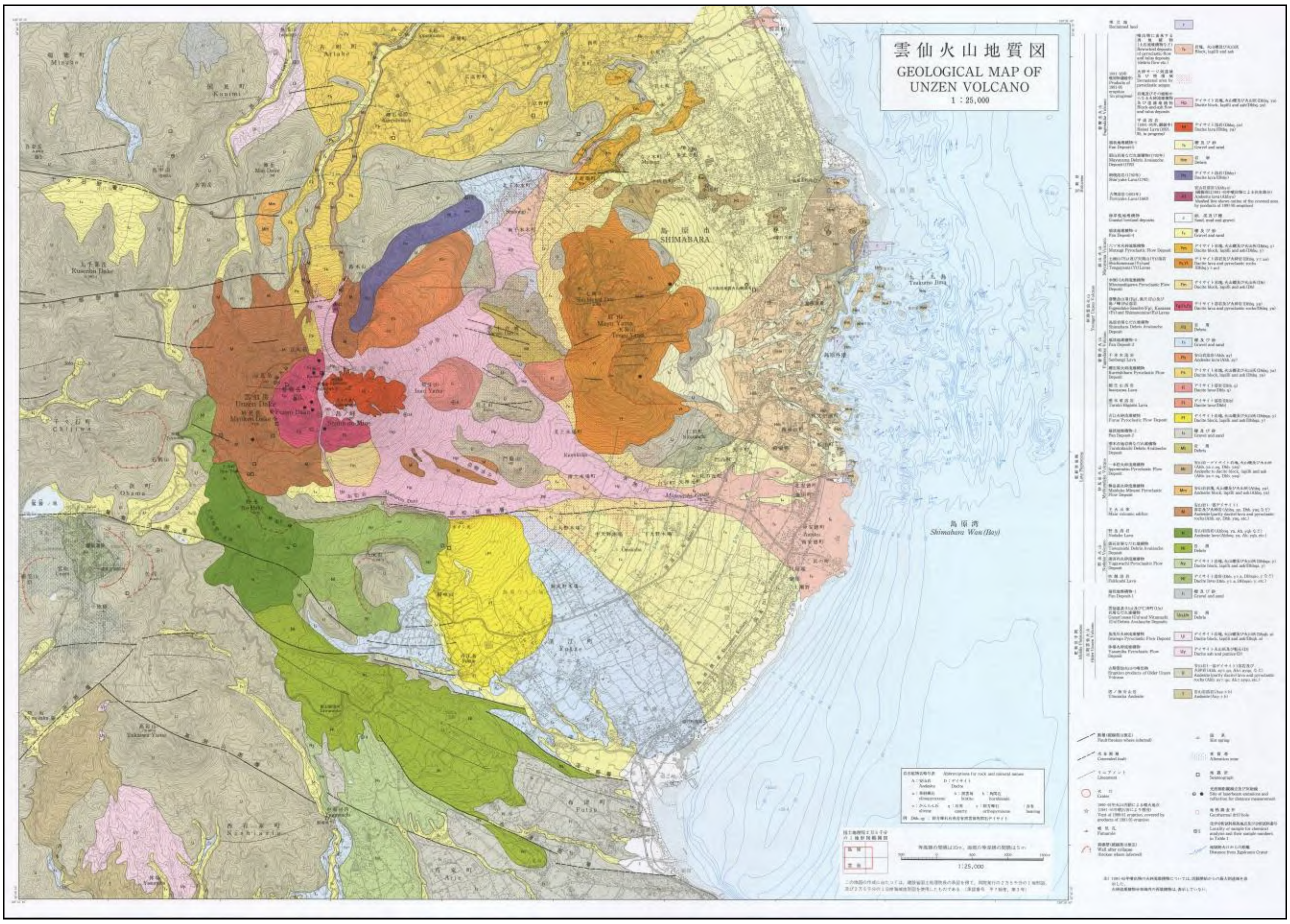


Figure 85-2 Geological map of Unzendake (Watanabe and Hoshizumi, 1995).

Chronology of Eruptions

・Volcanic Activity in the Past 10,000 Years

After approximately 7,300 years ago, a debris avalanche occurred, leaving deposits to the north of the present Mayu-Yama. The source of this debris avalanche is unknown. Approximately 4,000 years ago Shimanomine lava was emitted, accompanying pyroclastic flows. Also, approximately 4,000 years ago the easternmost dome of the Unzen volcanic complex, Mayu-Yama, was formed, and pyroclastic flows were associated on its northern flank. Other main activities were recorded historically, including lava flows in 1663 and 1792, lava dome between 1990 and 1996, and associated pyroclastic flows (Hoshizumi and Uto, 2000).

Period	Area of Activity	Eruption Type	Main Phenomena / Volume of Magma
4.7 ka	Fugendake, Kazaana, Shimanomine	Magmatic eruption	Lava dome and pyroclastic flow.
4.7 ka	Mayuyama	(Collapse) → magmatic eruption	Debris avalanche → lava dome and pyroclastic flow.

* Reference documents have been appended with reference to the catalog of eruptive events during the last 10,000 years in Japan, database of Japanese active volcanoes, and AIST (Kudo and Hoshizumi, 2006) for eruptive period, area of activity and eruption type. All years are noted in calendar years. "ka" within the table indicates "1000 years ago", with the year 2000 set as 0 ka.

・Historical Activity

Lava was discharged in 1663 and 1792, and a lava dome was formed between 1990 and 1996, being accompanied by pyroclastic flows due to its partial collapses (Hoshizumi and Uto, 2000). Before the 1990 to 1996 eruption, earthquake swarms (including felt earthquakes) were frequent with their hypocenters in Tachibana Bay (Chijiwa Bay).

Year	Phenomenon	Activity Sequence, Damages, etc.
1663 (Kanbun 3)	Magmatic eruption	In December, eruption started about 900m north-northeast of Fugendake. Lava flow (Furuyake lava flow) descended from Handoiwa crater, 900m north-northeast of Fugendake, towards north. The lava flow was approximately 0.15km wide and approximately 1km long, with a volume of approximately 5x10^{6}m^{3} . The next spring, lahar discharges occurred from the Tsukumo-Jima crater in the southeast flank of Fugendake. The lahar flowed down along Akamatsu Valley and caused flooding in Antoku Kawara. The number of casualties was over 30.
1792 (Kansei 4)	Magmatic eruption	In February 10, eruption satarted at Jigoku-ato crater. Earthquake activity began in November 1791, and in December a rock fall occurred in Obama that killed two persons. On February 10 rumbling occurred at Fugendake, with fumarole at Jigoku-ato crater and ejection of sands and gravels. On February 28 a volcanic pluming with sand and gravel ejection occurred at Biwa-no-Kubi in Anasako Valley. On March 1, lava flowing began (lasting for about 2 months). On March 22, a volcanic plume and lava were also emitted from Minenokubo, which merged with the former lava flow. Totally lava flow is 220 to 360m wide and approximately 2.7km long, with a volume of approximately 2x10^{7}m^{3}. On March 25 a volcanic plume was also emitted from Furuyakegashira (near Handoiwa). Earthquakes occurred occasionally thereafter. On May 21 a strong earthquake occurred, and a simultaneous major collapse of Mayu-Yama occurred and the slided materials moved into the Ariake Sea, causing a tsunami. This caused damage to Shimabara, as well as Higo and Amakusa on the opposite shore, killing approximately 15,000 people. The volume of collapsed materials was 4.4x10^{8}m^{3} . This event was also known as "Shimabara Catastrophe." Earthquakes and rumbling continued occasionally thereafter. Small eruptions with ash falls occurred in June and July.
1798 (Kansei 10)	Volcanic plume	November to December.
1922 (Taisho 11)	Earthquake	"Shimabara Earthquake" on December 8. 2 strong earthquakes (M6.9 and M6.5) with 11 foreshocks, 1,350 aftershocks. Cracks and sand blowing were observed; 27 killed, over 600 houses destroyed.
1929 (Showa 4)	Earthquake	Earthquake swarm: June 4, October 25 to 30, December 30.
1934 (Showa 9)	Earthquake	Earthquake swarm: October 15.
1935 (Showa 10)	Earthquake	Earthquake swarm: September 20.
1940 (Showa 15)	Earthquake	Earthquake swarm: May 2.
1951 (Showa 26)	Earthquake	Earthquake swarm: February. For about 1 week, starting February 15.

Year	Phenomenon	Activity Sequence, Damages, etc.
1954 (Showa 29)	Earthquake	Earthquake swarm: October 21.
1955 (Showa 30)	Earthquake	Earthquake swarm: August 22.
1958 (Showa 33)	Earthquake	Earthquake swarm: September 9 to 13.
1959 (Showa 34)	Earthquake	Earthquake swarm: September 30.
1962 (Showa 37)	Earthquake	Earthquake swarm: April.
1966 (Showa 41)	Earthquake	Earthquake swarm: July 15 to 17.
1968 (Showa 43)	Earthquake	Earthquake swarm: March 15 to 16.
	Small mud eruption	August 2. Approximately 10m-high ejection of muddy water at Hachiman-jigoku, Unzen Spa.
1969 (Showa 44)	Earthquake	Earthquake swarm: July 1, July 27 to 28, August 21, September 24 to 25.
1970 (Showa 45)	Earthquake	Earthquake swarm: June 2 to 4, July 10 to 12, July 14 to 17, August 8 to 11, October 18.
1971 (Showa 46)	Earthquake	Earthquake swarm: February 15 to 16, April 12 to 13, November 4 to 5.
1972 (Showa 47)	Earthquake	Earthquake swarm: January 5. February 9, March 26 to 27, July 14, August 22 to 23, October 4 to 5.
1973 (Showa 48)	Earthquake	Earthquake swarm: March 14 to 15, May 31 to June 3, July 25, August 10 to 11, August 25 to 28, November 3 to 12, December 26 to 30.
1974 (Showa 49)	Earthquake	Earthquake swarm: January 7 to 9, January 24 to 28, April 26.
1975 (Showa 50)	Earthquake	Earthquake swarm: May 6 to 8.
	Fume	In October new fumarole appeared in the Itazoko area, 2.8km east-by-northeast of Fugendake, probably being active at least 1 year before.
1976 (Showa 51)	Earthquake	Earthquake swarm: June 23 to 25.
1977 (Showa 52)	Earthquake	Earthquake swarm: November 11 to 13.
1978 (Showa 53)	Earthquake	Earthquake swarm: January 4, December 17, December 25 to 26.
1979 (Showa 54)	Earthquake	Earthquake swarm: August 1 to 2.
1980 (Showa 55)	Earthquake	Earthquake swarm: August 7, November 7 to 8.
1981 (Showa 56)	Earthquake	Earthquake swarm: November 18 to 19.
1982 (Showa 57)	Earthquake	Earthquake swarm: January 17, June 7 to 11.
1983 (Showa 58)	Earthquake	Earthquake swarm: June 14.
1984 (Showa 59)	Earthquake	Earthquake swarm: May to November. In particular, between August 6 and September 9 417 felt earthquakes occurred. The largest is M5.7 at 17:30. August 6, with a JMA scale seismic intensity of 4 at the Unzendake weather station, and an M5.0 earthquake at 17:38, August 6, with a JMA scale seismic intensity of 5 at the Unzendake weather station.
1985 (Showa 60)	Earthquake	Earthquake swarm: May 19, May 30 to 31, June 1 to 4, December 6.
1988 (Showa 63)	Earthquake	Earthquake swarm: May 26 to 27.
1989 (Heisei 1)	Earthquake	Earthquake swarm: November 21 to 24. From December to January of the following year micro-earthquake activity occurred from the western to the northwestern foot of Unzen.
1990 (Heisei 2)	Phreatic eruption	Intermittent tremors were observed beginning July 4. From July 24 to 25 an earthquake swarm occurred (the first earthquake swarm at the western foot of the volcano), with the largest earthquakes occurring on July 24 and 25, with a JMA scale seismic intensity of 3 at the Unzendake weather station. On October 23 an earthquake swarm occurred, with the largest earthquake being an M2.5 earthquake at 12:27, with a JMA scale seismic intensity of 3 at the Unzendake weather station. On November 17 an eruption occurred, accompanied by a continuous tremor from 03:22. In this early morning, eruptions occurred from two craters on the eastern side of the Fugendake summit: Jigoku-ato crater and Tsukumo-Jima crater. Ash falling. The maximum volcanic plume height was 400m. On November 20 an earthquake swarm occurred, with the largest earthquake of M3.9 at 18:16, with a JMA scale seismic intensity of 3 at the Unzendake weather station. An earthquake swarm occurred on November 23.
1991 (Heisei 3)	Magmatic eruption	An eruption occurred at the Byobuiwa crater on February 12. From March to May small eruptions were frequent at Jigoku-ato crater and Byobuiwa crater. An earthquake swarm started for the first time at the summit on May 12, and the intensity became stronger. On May 20 new lava appearance was confirmed at the Jigoku-ato crater. The lava grew as a dome gradually, and a pyroclastic flow began on May 24. Pyroclastic flows were frequent thereafter. On June 3 pyroclastic flows killed 43 people and damaged 179 buildings. On June 8 pyroclastic flows damaged 207 buildings. On September 15 pyroclastic flows damaged 218 buildings. Damages by lahar also occurred in heavy rain. On May 26 an alert for pyroclastic flows was issued. On June 7 the evacuation recommended zone was set. The zone was gradually expanded thereafter, with the number of people advised to evacuate reaching a maximum of approximately 11,000 people in September.

Year	Phenomenon	Activity Sequence, Damages, etc.
1992 (Heisei 4)	Magmatic eruption	Continued lava dome growth and repeating pyroclastic flows by partial collapse. On August 8, pyroclastic flows damaged 17 buildings. Lahar also occurred. Evacuation alerts and the evacuation recomended zone remained, and as of the end of this year approximately 2,000 had been advised to evacuate.
1993 (Heisei 5)	Magmatic eruption	Continued lava dome growth and repeating pyroclastic flows. On June 23 and 24, pyroclastic flows killed 1 person and damaged 187 buildings. Lahar damage also occurred. From March to April ground deformation was observed at the summit, magma's pushing the volcanic edifice towards the northwest. From November to January of the following year, ground deformation was observed, this time, magma's pushing the volcanic edifice towards the southwest. Evacuation alerts and the evacuation zone remained, and as of the end of this year approximately 3,600 had been advised to evacuate.
1994 (Heisei 6)	Magmatic eruption	Continued lava dome growth and repeating pyroclastic flows. The ground deformation pushing to the southwest, which had begun in November of the previous year, ended in early January. From late January, ground deformation to the northwest was observed, which continued in February and March. From February to April pyroclastic flows also occurred to the north-northwest direction. From August to September pyroclastic flows occurred to the southeast and southwest directions. The amount of lava discharged gradually decreased.
1995 (Heisei 7)	Magmatic eruption	Since late January no changes in the lava dome shape was observed. A pyroclastic flow was on February 11. The number of earthquakes just below the dome decreased rapidly from February. Emission of lava which began in 1991 ended. The total volume of lava discharged between 1991 and 1995 was 200 million m^3 (dense rock equivalent), and approximately 9,400 pyroclastic flows occurred (counted with short-period seismometers).
1996 (Heisei 8)	Magmatic eruption	Pyroclastic flows occurred in February and May. The frequency of volcanic earthquakes decreased compared in the period of high eruptive activity; 156 volcanic earthquakes in this year. On September 6 an earthquake with M 2 occurred in Tachibana Bay. Volcanic tremors occurred once each in January, March, and June. The volcanic tremor on March 24 was accompanied by a tilt-change.
1997 (Heisei 9)	Volcanic tremors	Volcanic tremors were observed in May, October, and November, totally 4 events. The volcanic tremors on November 11 and 13 were accompanied by tilt-changes.
1998 (Heisei 10)	Volcanic tremors	Volcanic tremors were observed in January, February, and November, totally 3 events. The volcanic tremors in January and November were accompanied by tilt-changes.
1999 (Heisei 11)	Volcanic tremors	Volcanic tremors were observed in May and November, once each.
2000 (Heisei 12)	Volcanic tremors	Volcanic tremors were observed in March, April, June, and December, once each. The volcanic tremor on March 28 was accompanied by a tilt-change showing up in the Fugendake area. GPS, electronic distance, and theodolite measurements showed the tendency of Heisei-Shinzan subsiding by its load, though the extent is decreasing.
2001 (Heisei 13)	Earthquakes, volcanic tremors	Volcanic earthquake activity elevated between January 18 and January 20, with their hypocenters about 5km deep, about 5km west of Heisei-Shinzan, but the number of volcanic earthquakes was small for other months. Volcanic tremors occurred in March (3 events) and April (2 events).
2002 (Heisei 14)	Volcanic tremors	On April 19 volcanic tremors were accompanied by tilt-changes showing slightly up of the Fugendake area, immediately followed by a temporary increase in volcanic earthquakes (22 events). Volcanic tremors occurred once each in June and July.
2003 (Heisei 15)	Volcanic tremors	Volcanic tremors occurred in February (1 event) and April (3 events).
2004 (Heisei 16)	Volcanic tremors	One volcanic tremor occurred in May.
2005 (Heisei 17)	Volcanic tremors	One volcanic tremor occurred in March.

* Reference documents have been appended with reference to the catalog of eruptive events during the last 10,000 years in Japan, database of Japanese active volcanoes, and AIST (Kudo and Hoshizumi, 2006) for eruptive period, area of activity and eruption type.

Major Volcanic Activity

・Volcanic Eruption in 1663 and 1792

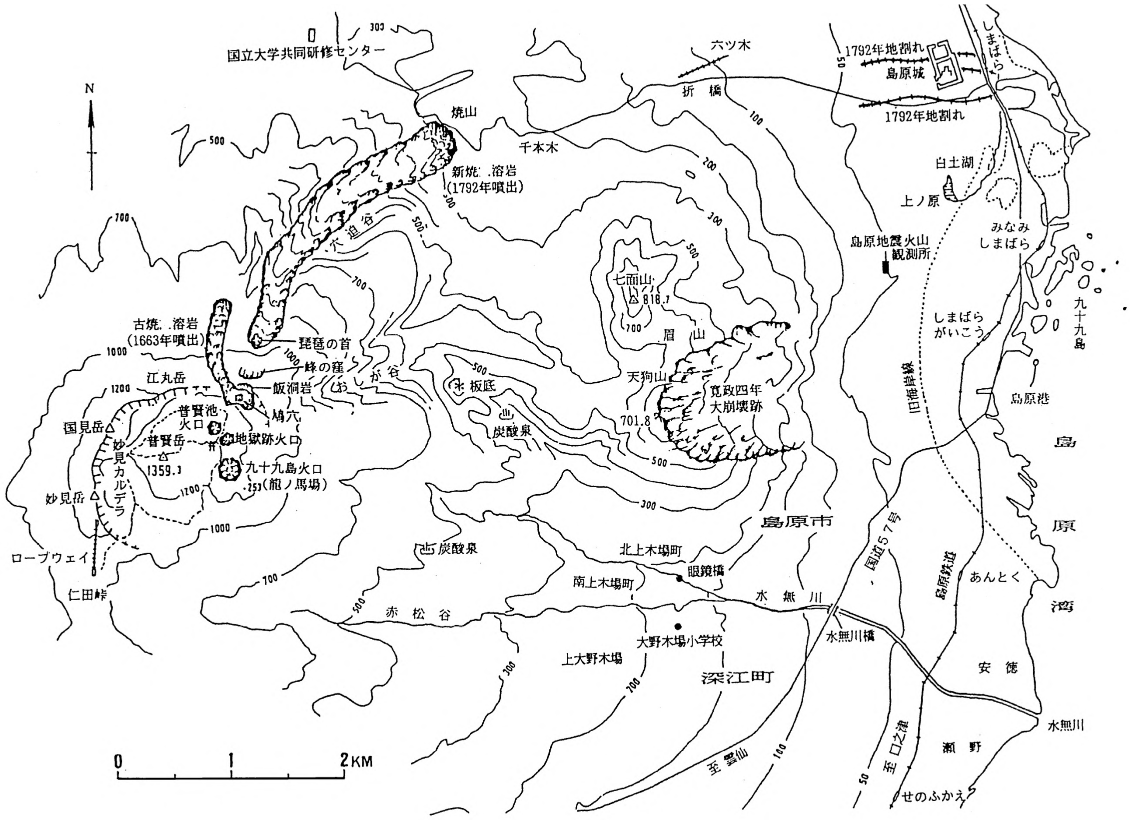


Figure 85-3 1663 Furuyake lava and 1792 Shinyake lava (Ohta, 1985).

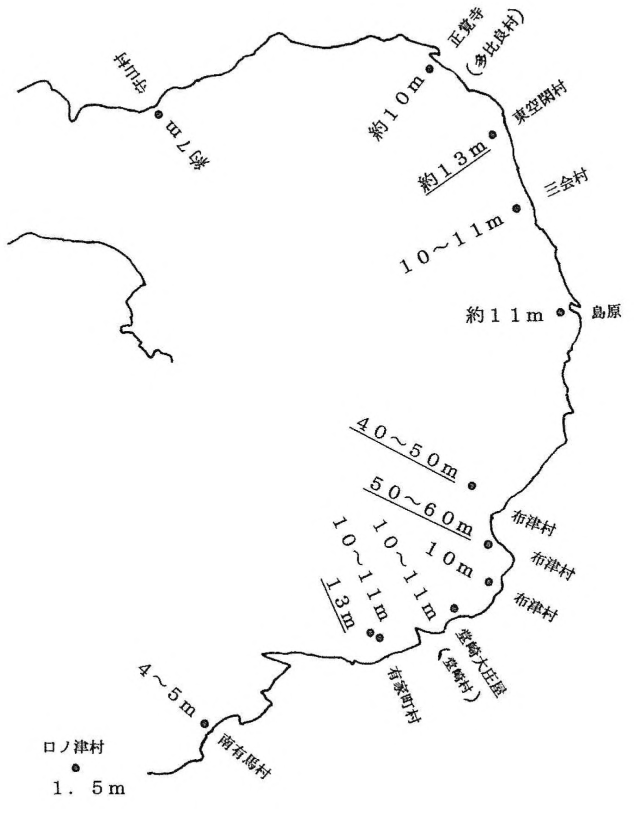


Figure 85-4

Distribution of runup of Ariake Sea tsunami caused by major collapse of Shimabara Peninsula's Mayuyama in Kansei 4 (1792) (Akagi, 2001)

Underlined numbers indicate elevations where effects of landforms were greater than in other areas.

・1990 to 1996 Eruption Activity

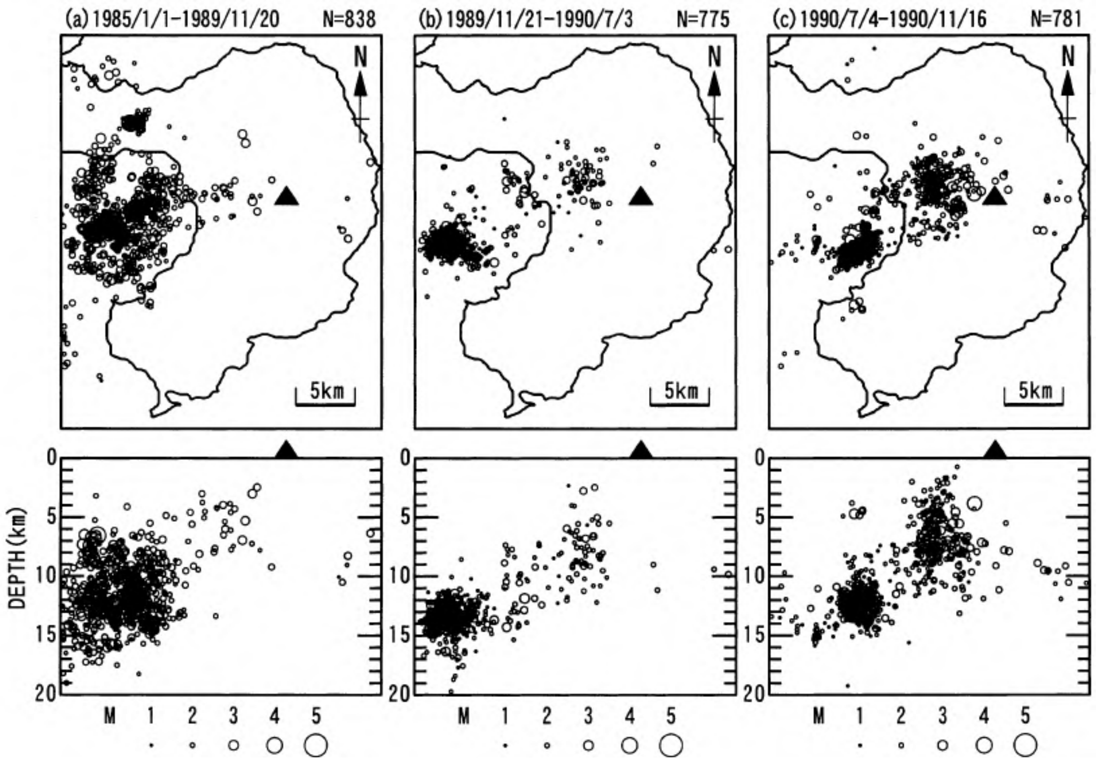


Figure 85-5 Distribution of hypocenters from 1985 to November 16, 1990 (Umakoshi et al., 2001). The hypocenters moved from Tachibana Bay to the Shimabara Peninsula before the eruption.

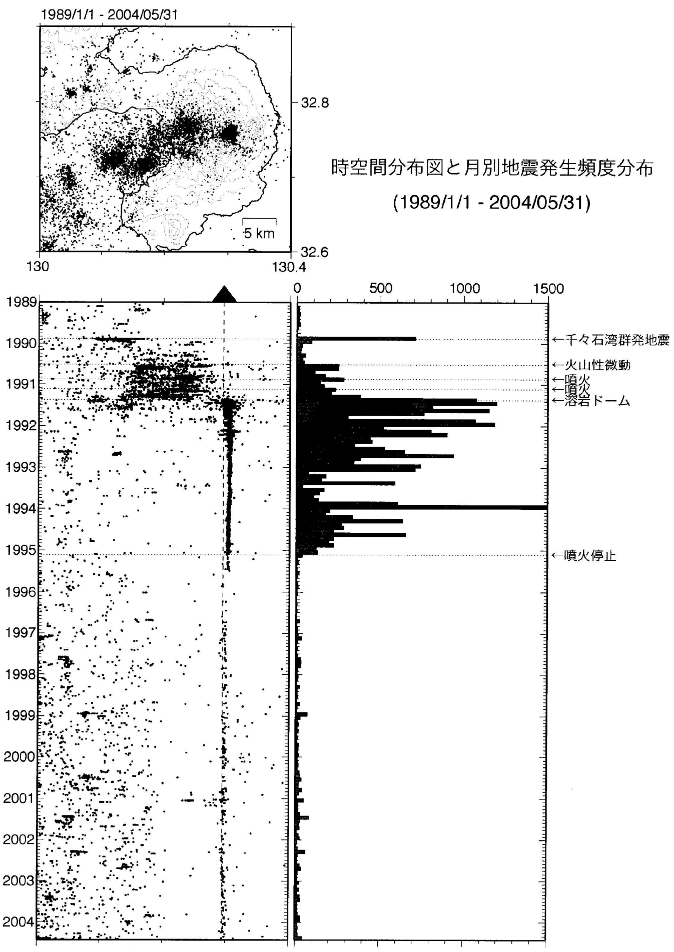


Figure 85-6 Space-time plot and frequency distribution of earthquakes per month (January 1, 1989 to May 31, 2004) (Kyushu University, 2005).

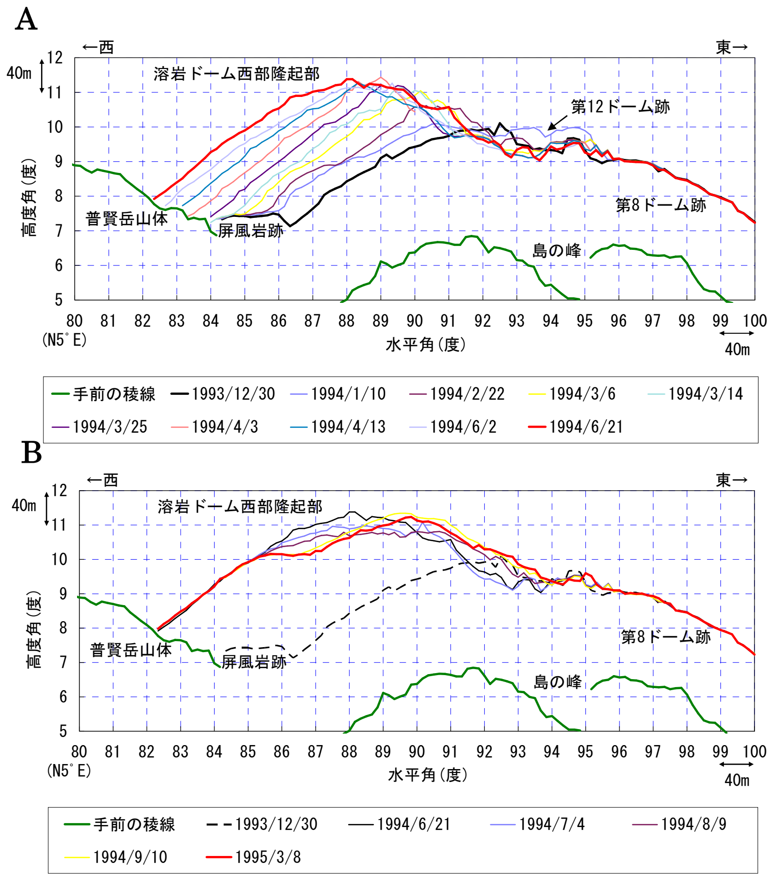


Figure 85-7 Endogenous growth of the Unzendake lava dome (Unzendake weather station). During the later phase of eruptive activity (December, 1993 to March, 1995), new small lobes were formed on the dome surface, and uplift and inflation were observed during the endogenous growth. This was detected by theodolite measurement from Nita Pass (approximately 2km south of the lava dome). A: December, 1993 to June, 1994 (period from start of endogenous growth to maximum size), B: June, 1994 to March, 1995 (period from maximum size to cessation of eruptive activity)

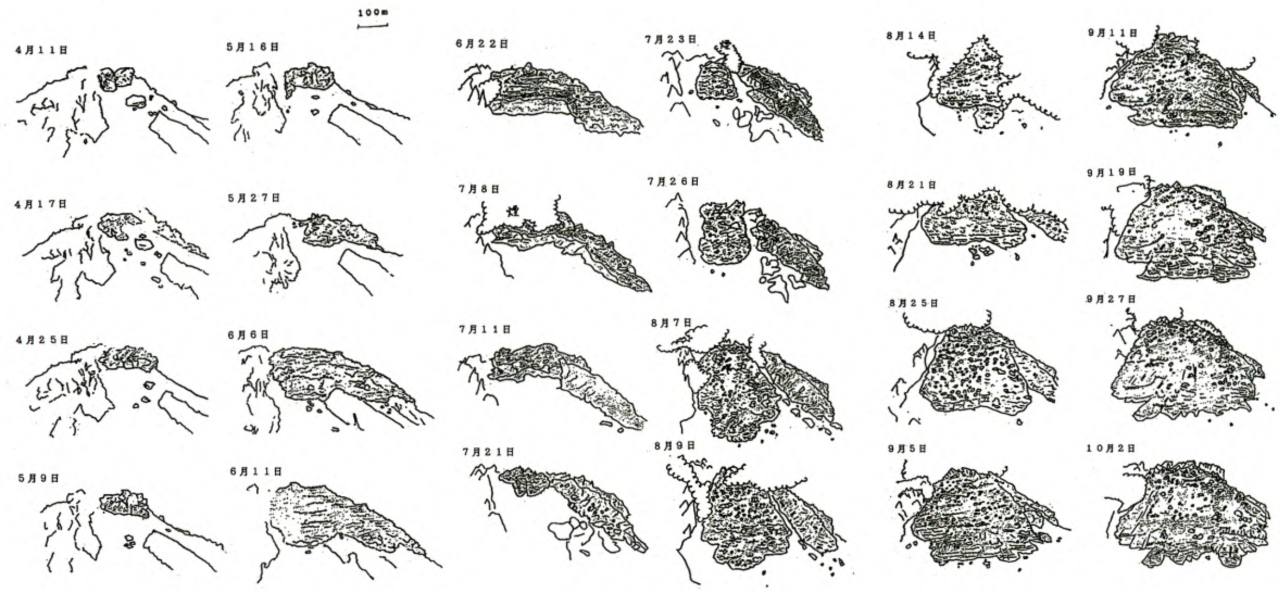


Figure 85-8 Growth of Unzendake No. 11 lava (April to October, 1993, sketches from Onokoba by Unzendake weather station). The No. 11 lava began growing in mid-March, 1993. In June it surpassed the No. 4 lava, previously the largest, becoming the largest lava mass and continuing to grow until October. In late June, several large collapses generated pyroclastic flows.

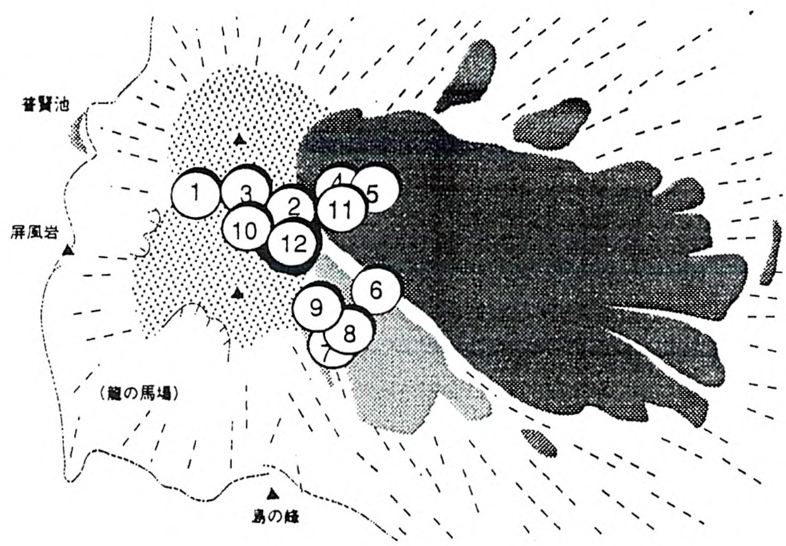


Figure 85-9 Locations of individual lava lobe emission points (Kyushu University et al., 1994 a). Numbers correspond to individual lobe numbers. Dome diagram for early December 1993.

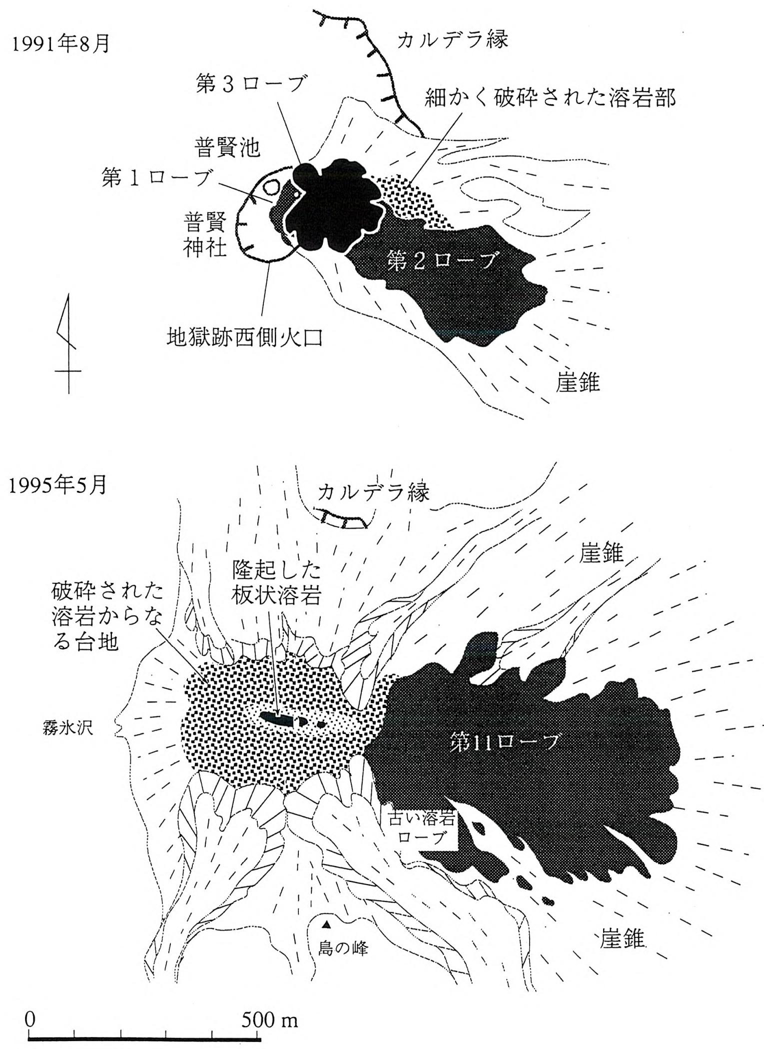


Figure 85-10 A map showing changes in size of lava dome over 4 years (Earthquake Research Institute, University of Tokyo, et al., 1995).

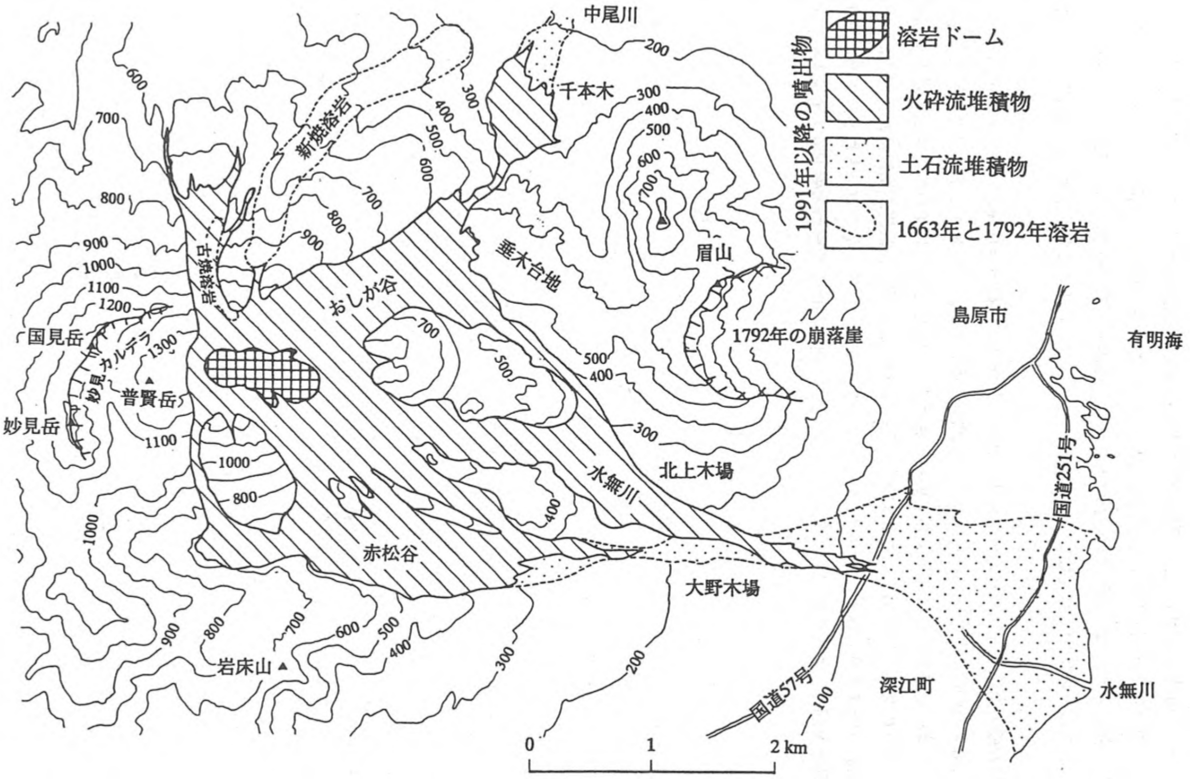


Figure 85-11 Distribution of pyroclastic flow and debris flow deposits as of early October 1994 (Kyushu University et al., 1994b).

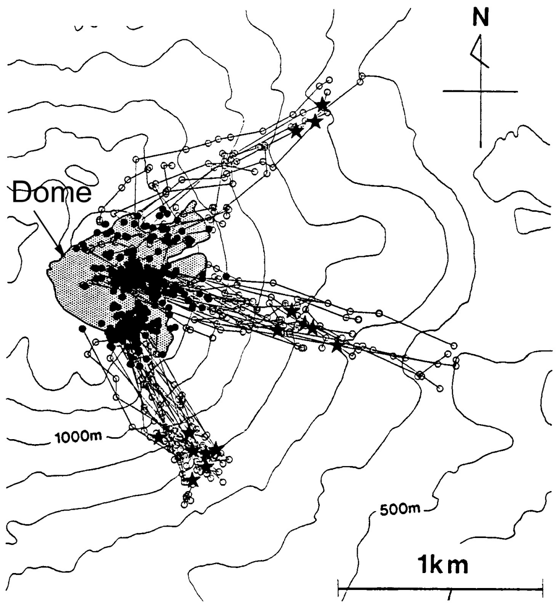


Figure 85-12 Changes in sources of infrasonic waves caused by pyroclastic flows (June, 1992 to November, 1993) (Yamasato, 1997) Black circles indicate sites of dome collapses, white circles indicate estimated locations of sources of infrasonic wave caused by pyroclastic flows. Stars indicate areas where there was an increase in infrasonic wave amplitudes caused by pyroclastic flows.

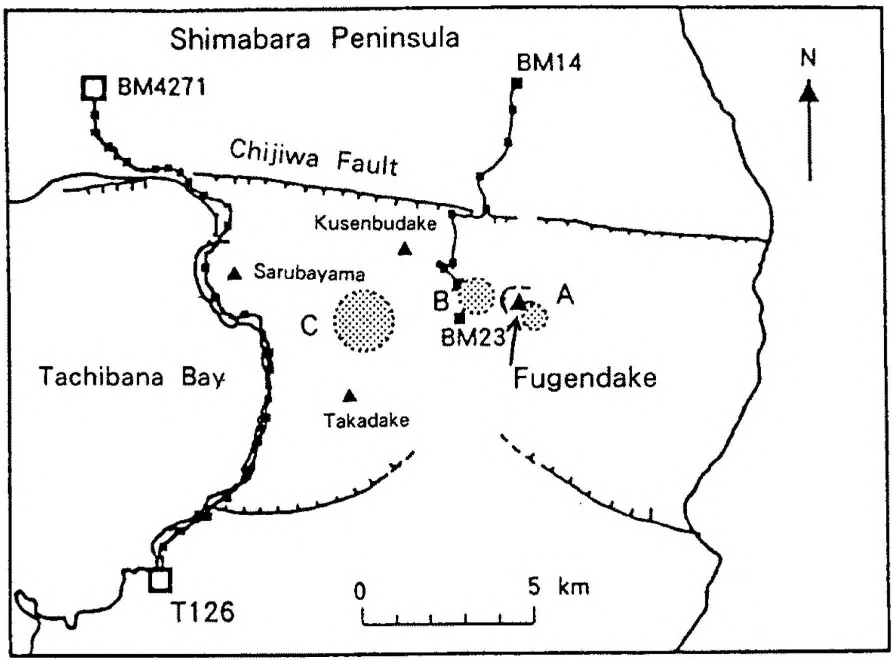


Figure 85-13 A model of multiple magma chambers, just below and to the west of Unzen Fugendake (Ishihara, 1993). Location of magma chambers and the magma inflow/outflow at each chamber have been estimated based on repeated precision leveling.

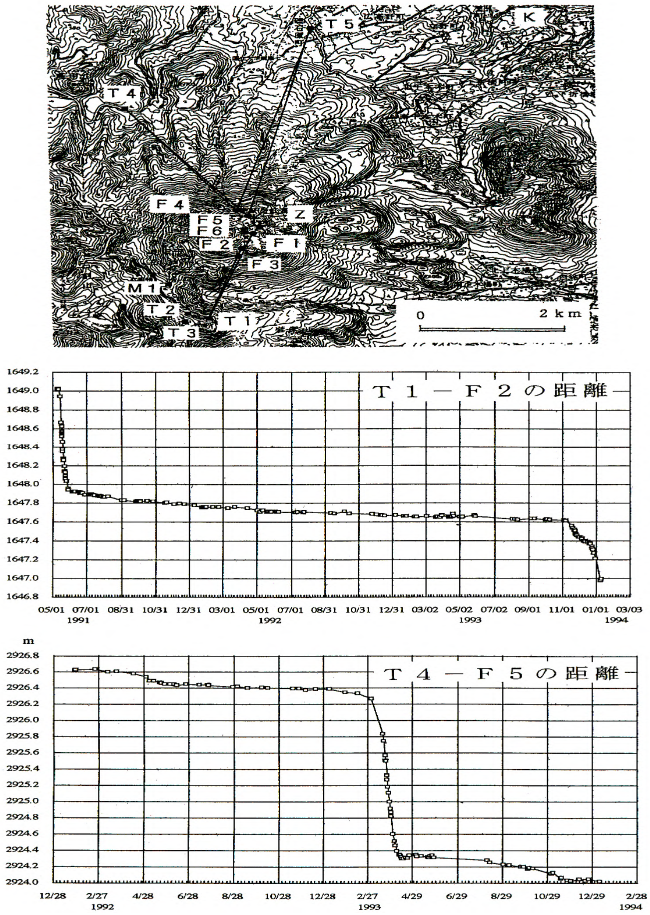


Figure 85-14 Electronic distance measurement of summit of Unzendake (May 1991 to January 1994, Geological Survey of Japan) The Geological Survey of Japan placed multiple reflective mirrors around the lava dome (F1, etc.), and performed continuous measurement of changes in distance between them and the volcano base observation points (T1, etc.). When the lava dome first appeared, in May 1991, there were large changes (figure above), followed by rapid changes from March to April 1993 (below), and from November 1993 to January 1994 (above).

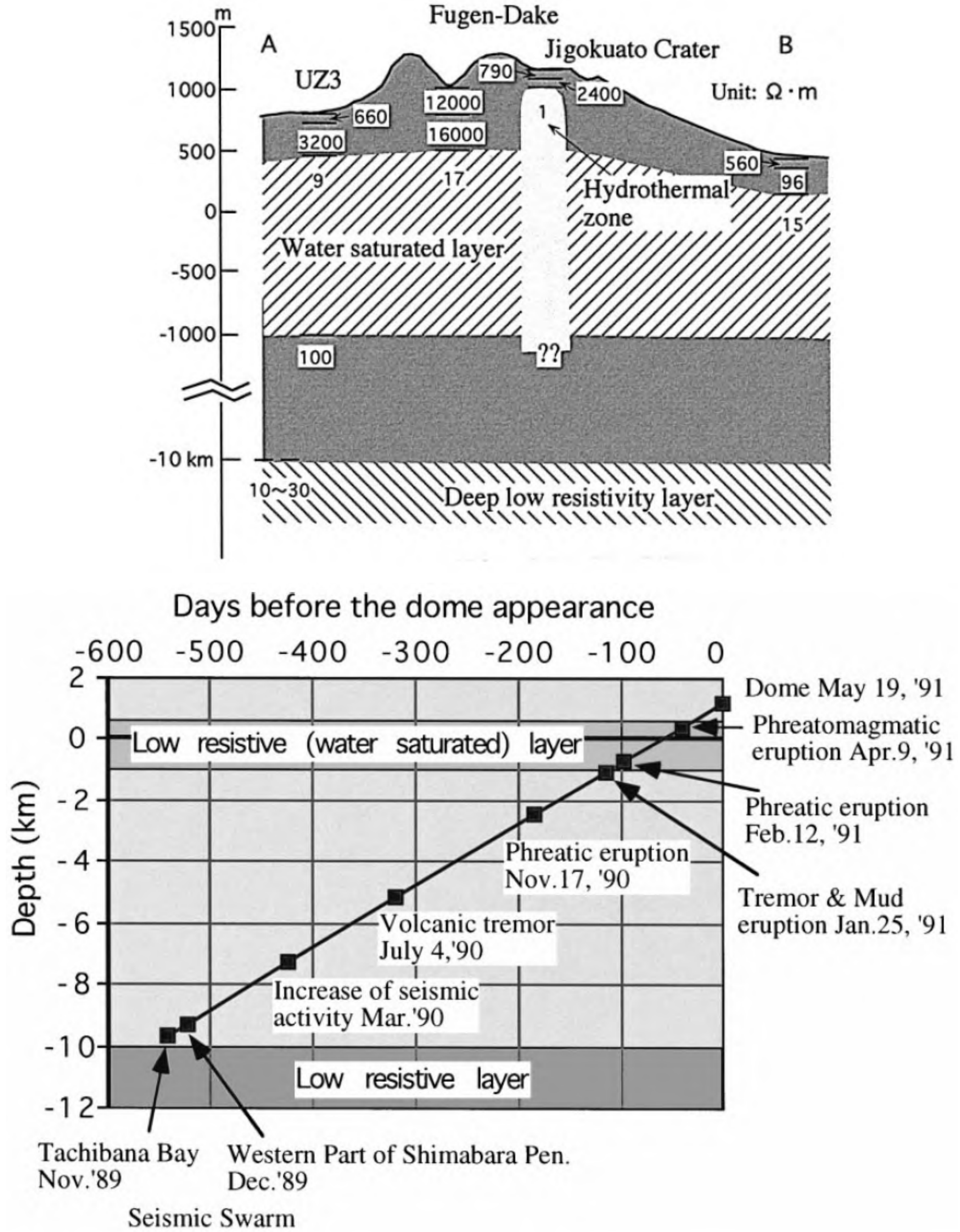


Figure 85-15 Electric resistivity structure of Unzendake and magma head movement before lava dome appearance in May 1991 (Kagiyama et al., 1999). Volcanic phenomena observed before the lava appearance is considered to be controlled by the electric resistivity structure.

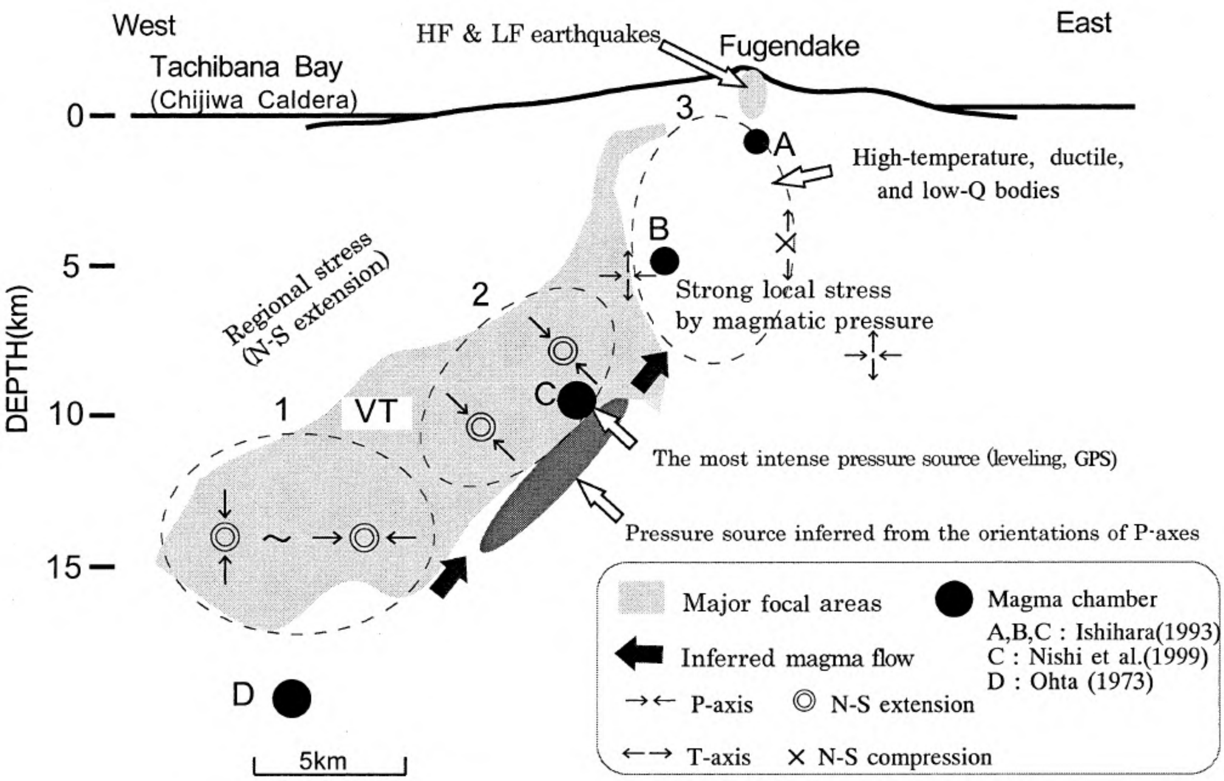


Figure 85-16 Magma movement and the associated seismic activity in the 1990-96 Unzendake eruptive activity (model of Umakoshi et al., 2001).
The course of magma ascent route was estimated based on the distribution of hypocenters determined with high accuracy.

Precursory Phenomena

For the activity between 1990 and 1996, the first phreatic eruption was preceded about 1 year by earthquake swarms in Tachibana Bay, to the west of the Shimabara Peninsula. The hypocenter area then moved towards Fugendake, and volcanic tremors began. Before the lava dome appeared, rapid crustal deformations and seismic activity were observed, indicating volcanic edifice inflation, rapid thermal demagnetization, and fissure formation near the crater.

Recent Volcanic Activity

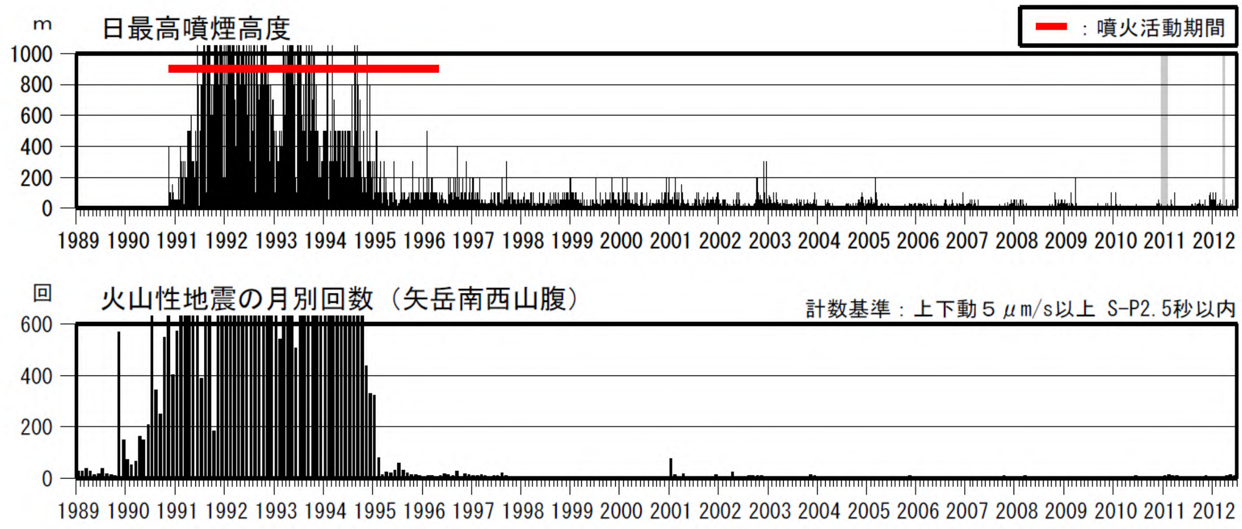


Figure 85-17 Volcano activity (January, 1989 to June 30, 2012).

After the 1990-1996 eruption, although white fumarolic activity is occasionally observed, the seismicity is low, and volcanic activity is calm.

①Daily maximum volcanic plume height

②Number of volcanic earthquakes per month at the seismic station on the southwest flank of Yadake

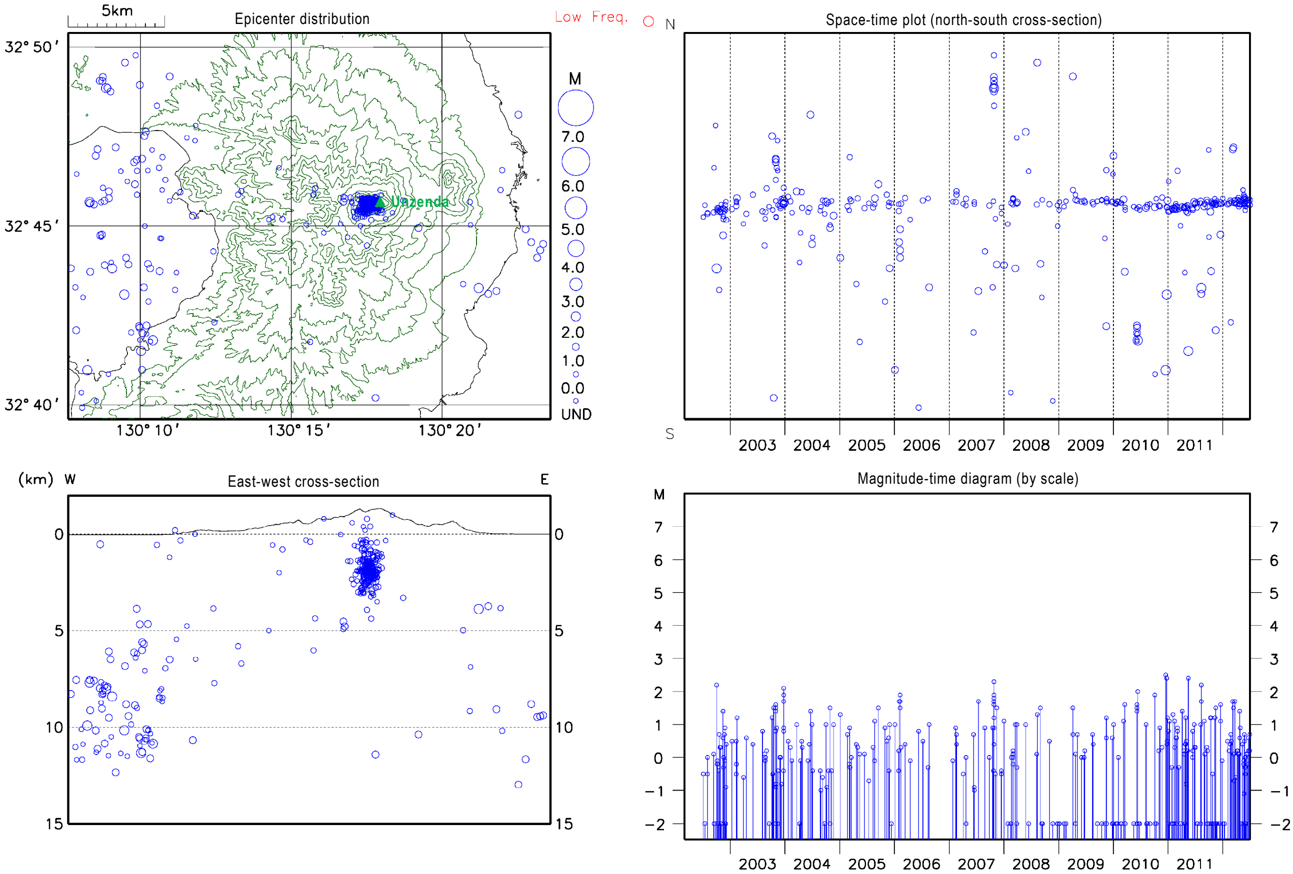


Figure 85-18 Distribution of volcanic earthquakes (2002 to June 30, 2012).

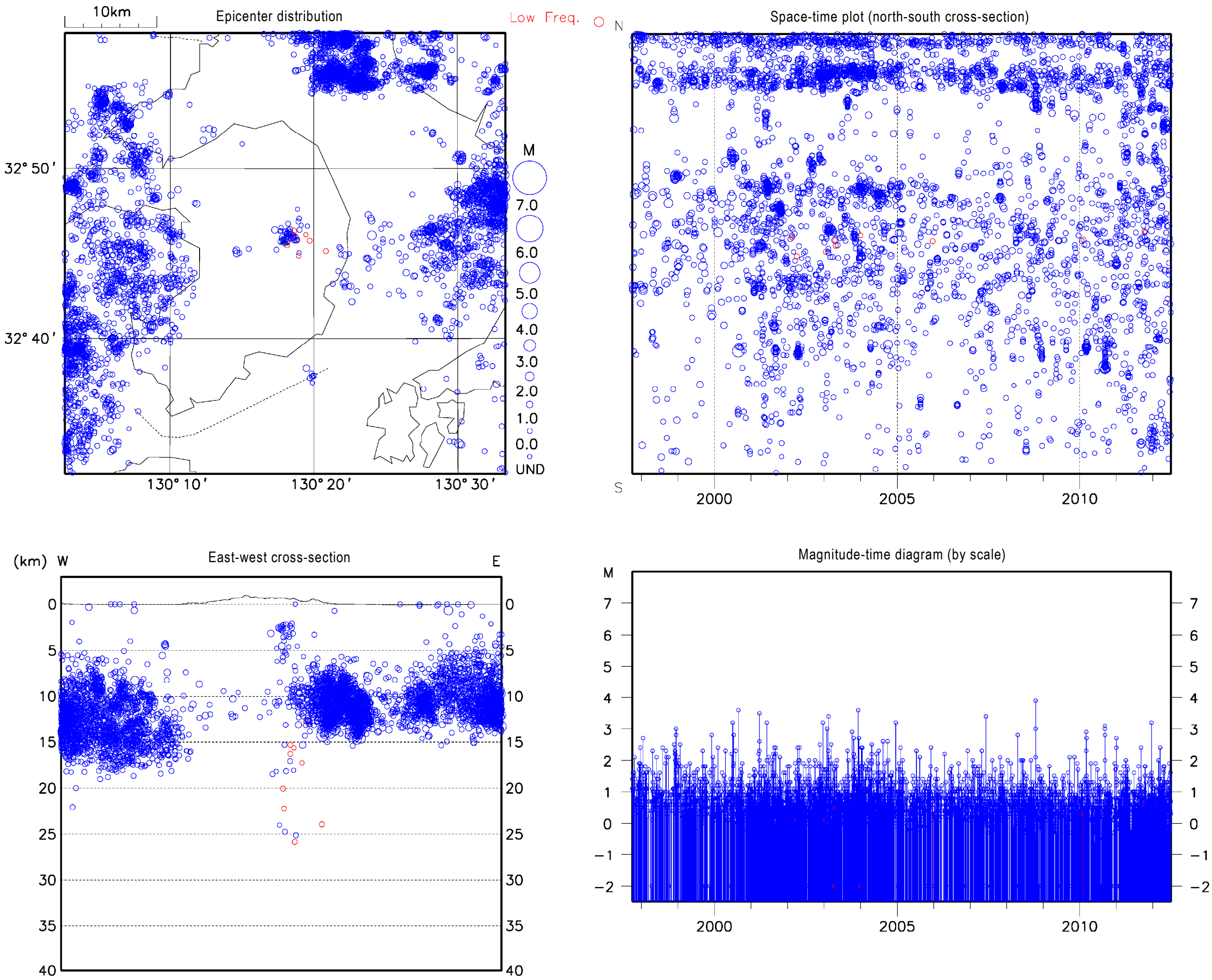


Figure 85-19 Activity of shallow VT earthquakes (blue circles) and deep low-frequency earthquakes (red circles) observed by a regional seismometer network (October 1, 1997, to June 30, 2012). Epicenter distribution (upper left), space-time plot (N-S cross-section) (upper right), E-W cross -section (lower left) and magnitude-time diagram (lower right).

Information on Disaster Prevention

①Hazard Map

Unzen

・(Handbook Version) Unzen Disaster Prevention Map * 7 types for individual former towns

Source: Issued by Unzen

Created: March, 2008

Created by: Unzen City Hall

Shimabara

・(PDF Version) Shimabara Disaster Prevention and Evacuation Map

Source: Issued by Shimabara

Created: January, 2007

Created by: Shimabara City Hall

Minamishimabara

・(Handbook Version) Minamishimabara Disaster Prevention Map * 8 types for individual former towns

Source: Issued by Minamishimabara

Created: March, 2007

Created by: Minamishimabara City Hall

②Volcanic Alert Levels (Used since December 1, 2007)

■雲仙岳　噴火警戒レベルに対応した規制範囲

●噴火警戒レベルに応じて下記のような防災対応が必要になります。

レベル5（避難）：
危険な居住地域からの避難

レベル4（避難準備）：
警戒が必要な居住地域での避難準備。要援護者は避難等。

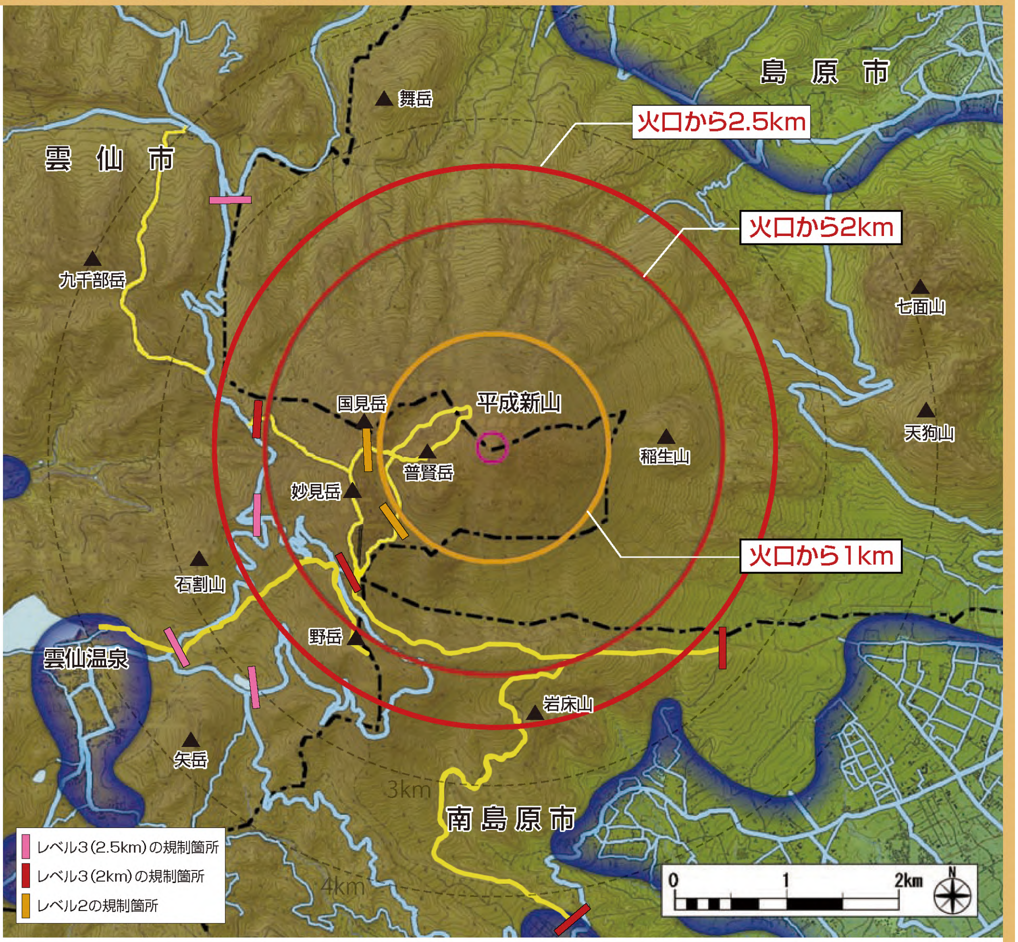
レベル3（入山規制）：
火口から概ね2～2.5km以内立入禁止。
○の範囲内

レベル2（火口周辺規制）：
火口から概ね1km以内の立入禁止。
○の範囲内

レベル1（平常）：
警戒区域への立入り規制等。

：一般道
：登山道
：平成新山
：居住区域

この図は、国土地理院発行の2万5千分の1地図画像、数値地図50mメッシュ（標高）およびカシミール3Dを使用して作成しています。



■この図は気象庁作成の、雲仙岳の居住地域等の分布とレベルに応じた規制範囲図をもとに長崎県、雲仙市、南島原市、島原市と調整して作成しています。

■各レベルにおける具体的な規制範囲等については、地域防災計画等で定められていますので、詳細については長崎県、雲仙市、南島原市、島原市にお問い合わせください。

＊平成新山から噴火することを想定していますが、噴火の状況によっては、異なる火口から噴火する場合もあります。

Volcanic Alert Levels for the Unzendake Volcano (Valid as of December 1, 2007)

Warning and Forecast	Target Area	Levels & Keywords	Expected Volcanic Activity	Actions to be Taken by Residents and Climbers	Expected Phenomena and Previous Cases
Eruption Warning	**Residential areas and areas closer to the crater**	**5 Evacuate**	**Eruption or imminent eruption causing significant damage to residential areas**	**Evacuate from the danger zone**	●Eruption or imminent eruption, with volcanic blocks, pyroclastic flow, and/or lava flow reaching residential areas. 1991 Eruption Example June 8, September 15: Lava flow extended approximately 5.5 km. June 3: Lava flow extended approximately 4.3 km. May 26. Lava flow extended approximately 2.5 km (near residential area).
		4 Prepare to evacuate	**Possibility of eruption causing significant damage to residential areas (increased probability).**	**Those within the alert area should prepare for evacuation. Those requiring protection in the event of an disaster must be evacuated.**	●Possibility of pyroclastic flow, extending to residential areas in the event of lava dome growth. 1991 Eruption Example Many pyroclastic flows on and after May 24. ●Increased eruptive activity, etc. results in possibility of eruption discharging volcanic blocks reaching residential areas. 1991 Eruption Example June 11: Explosive eruption, with volcanic blocks scattered to volcano base. ●Possibility of lava flow, extending to residential areas in the event of continuation of eruption. February, 1792 Eruption Example Lava flow reached approximately 3 km from the crater (Shinyake lava)
Crater Area Warning	**Non-residential areas near the volcano**	**3 Do not approach the volcano**	**Eruption or prediction of eruption causing significant damage to areas near residential areas (entering area is life threatening).**	**Residents can go about daily activity as normal. When necessary, evacuation preparations should be performed for those requiring protection in the event of a disaster. Access restrictions for dangerous areas, including mountain climbing and mountain access prohibitions, etc.**	●Volcanic blocks, pyroclastic flow, and/or lava flow reaching approximately 2 km from crater, or possibility thereof. 1991 Eruption Example From May 20: A lava dome grew, and its collapse may have caused a pyroclastic flow. February 12: Start of phreatomagmatic eruption. December, 1663, Eruption Example Lava flow reached approximately 1 km from the crater (Furuyake lava)
	Crater area	**2 Do not approach the crater**	**Eruption or prediction of eruption affecting area around crater (entering area is life threatening).**	**Residents can go about daily activity as normal. Access to crater area restricted, etc.**	●Small eruption, with scattering of volcanic blocks within a distance of approximately 1 km from the crater. 1990 Eruption Example November 17: First small eruption. ●Possibility of small eruption. 1990 Example August 30: Increase in volcanic tremors. July 11: Increase in volcanic earthquakes. July 4: Volcanic tremors occurred.
Eruption Forecast	**Inside the crater**	**1 Normal**	**Little or no volcanic activity. Volcanic ash may be emitted within the crater as a result of volcanic activity (entering area is life threatening).**	**Access to interior of and area around crater restricted as necessary, etc.**	●Little or no volcanic activity.

Note 1) The volcanic blocks mentioned in this table refer mainly to blocks large enough that their trajectories are not affected by wind.

Note 2) The pyroclastic flows mentioned in this table refer to flows caused by the collapses of lava domes.

Social Circumstances

①Populations

Unzen City: 48,236 (as of October 31, 2011)
Shimabara City: 48,454 (as of October 31, 2011)
Minamishimabara City: 51,859 (as of October 31, 2011)

②National Parks, Quasi-National Parks, Number of Climbers

・Unzen-Amakusa National Park Unzen area - Designated on March 16, 1934 (Showa 9)

・Shimabara Peninsula area, including Unzendake, certified as "Japanese Geopark" in December, 2008.

Shimabara Peninsula area, including Unzendake, certified as "Global Geopark" in August, 2008.

・Number of mountain-climbers per year: 0 (access restricted)

・Number of mountain-climbers per year

Heisei-Shinzan: 0 (access restricted)

Fugendake, etc.: Approximately 15,000 (according to 2011 Unzen Ranger office for Nature Conservation)

③Facilities

・Shimabara Fukkou Arena 2-1 Heisei-cho, Shimabara City

Capacity: Unknown

・Mt. Unzen Disaster Memorial Hall - 1-1 Heisei-cho, Shimabara City, Nagasaki Prefecture

Monitoring Network

Wide Area

* Monitoring sites with multiple observation instruments are indicated by small black dots, and other symbols indicate types of monitoring.

1:200,000 scale regional maps (Kumamoto and Yatsushiro) published by the Geospatial Information Authority of Japan were used.

Legend

(JMA)
- seismometer(SP)
- GPS
- tiltmeter
- infrasonic microphone
- visual camera
- seismic intensity meter

(GSI)
- GPS

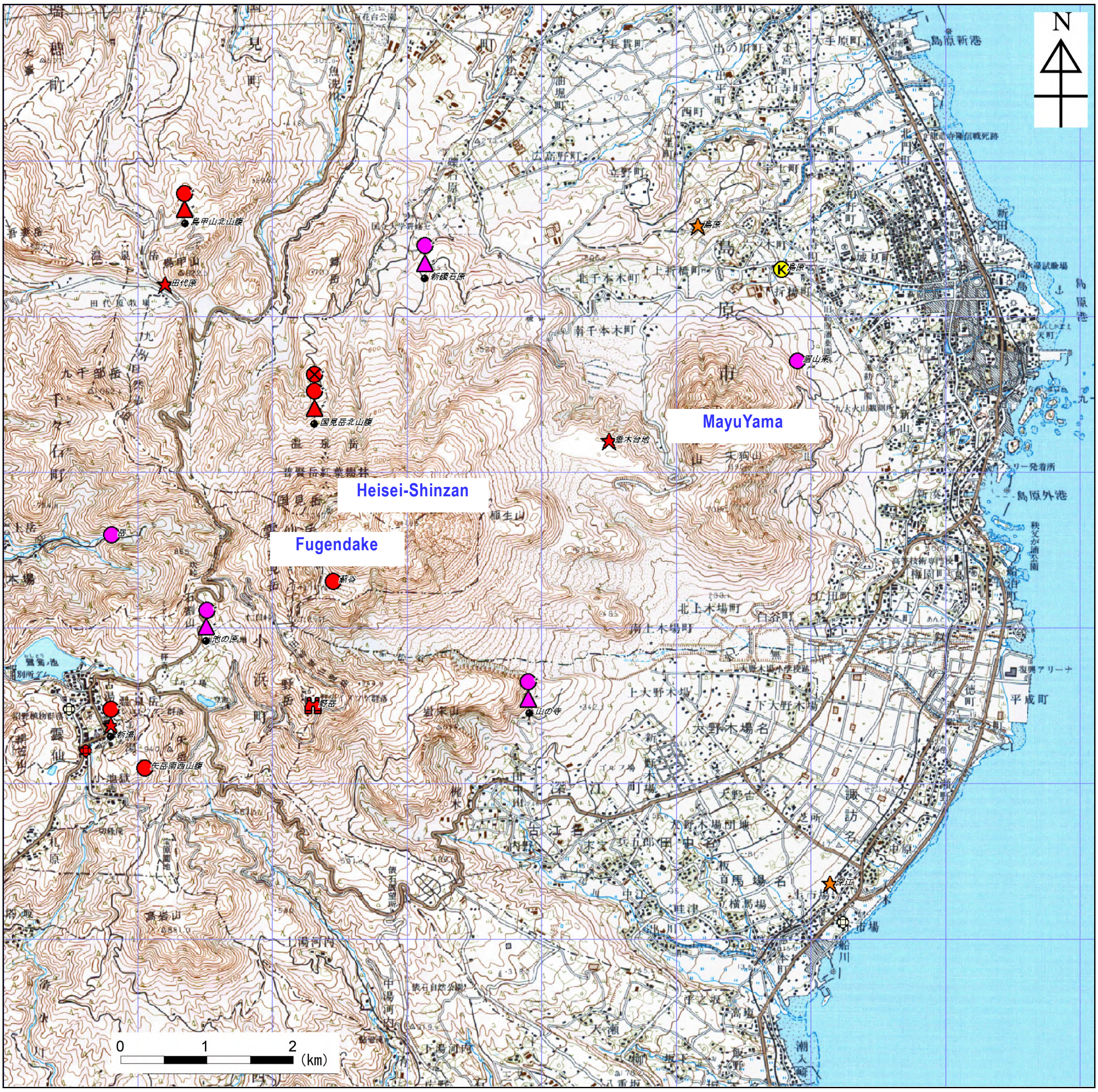
(NIED)
- K-NET

(Kyushu Univ.)
- seismometer(SP)
- tiltmeter

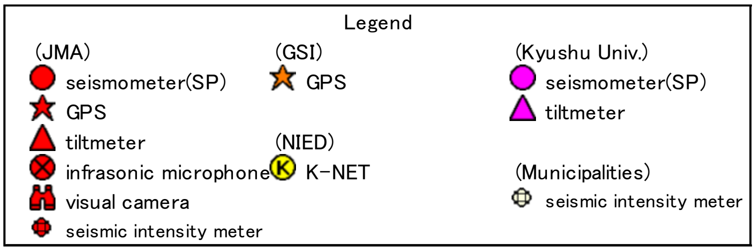
(Municipalities)
- seismic intensity meter

In and Around the Summit

* Monitoring sites with multiple observation instruments are indicated by small black dots, and other symbols indicate types of monitoring.



1:50,000 scale topographic map (Hizen-Obama and Shimabara) published by the Geospatial Information Authority of Japan were used.



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