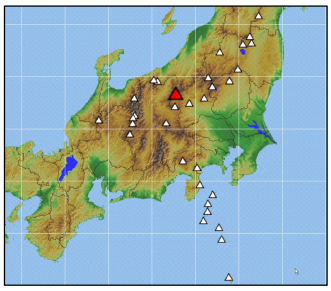
44. Kusatsu-Shiranesan



Continuously Monitored by JMA

Latitude: 36°38'38" N, Longitude: 138°31'40" E, Elevation: 2,160 m
(Shiranesan)
(Elevation Point)
Latitude: 36°37'06" N, Longitude: 138°31'40" E, Elevation: 2,165 m
(Shiranesan)
(Triangulation Point)

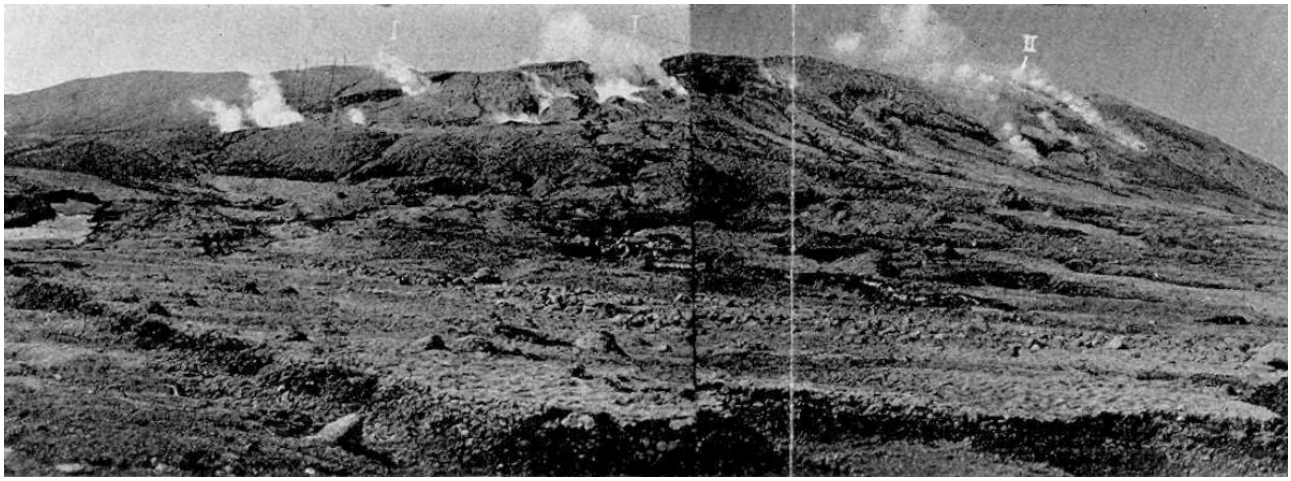
Overview of Kusatsu-Shiranesan taken from the west side on August 10, 2011 by the Japan Meteorological Agency

Summary

Kusatsu-Shiranesan is a stratovolcano which was formed asymmetrically on Neogene basement rock which slopes downwards to the southeast. A group of pyroclastic cones, including Shiranesan, Ainomine, and Motoshiranesan, which stretch from the north to the south, are located in its highest western area. To the south and east of these cones, andesitic lava flows cover an area of several km from the summit. Further downhill there is a dacitic pyroclastic flow plateau. The SiO_2 content of the andesite and dacite is between 53.7 and 64.2 wt %. 3 crater lakes are arranged from northeast to southwest at the summit of the Shiranesan pyroclastic cone. They are named Mizugama, Yugama, and Karegama.

All historical eruptions were occurred in the Shiranesan summit area. All recent eruptive activity consists of phreatic explosions. The volcano is prone to producing lahars. The volcano has many hot springs, such as Kusatsu Onsen, and solfatara which generates H_2S.

Photos



Fissure Eruption on the southeast flank of Yugama on February 2, 1942 (Minakami, et al., 1942)

Eruption at Kusatsu-Shiranesan, taken from the southwest on December 29, 1982. Courtesy of J. Ossaka.

Yugama, taken from the north side on April 13, 2010 by the Japan Meteorological Agency
From front to back: Mizugama, Yugama, Karegama

Overview of Yugama taken from the south side on April 13, 2010 by the Japan Meteorological Agency

Topography around the Crater

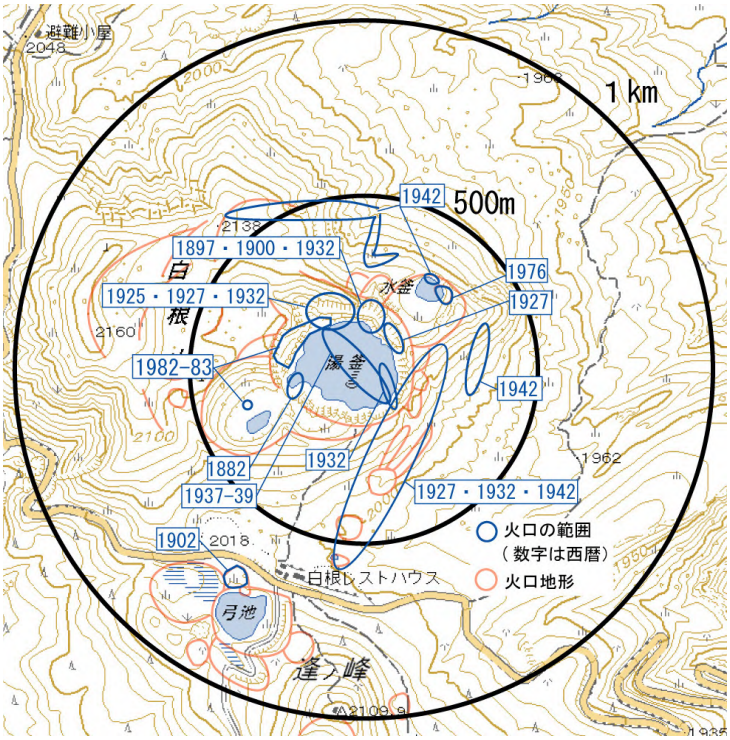


Figure 44-1 Distribution of eruption craters within recorded history (since 1805) (created based on Minakami (1984), Ossaka et al. (1984), etc.).

Eruption areas within recorded history are distributed over an area of several hundred kilometers, with its center around Yugama

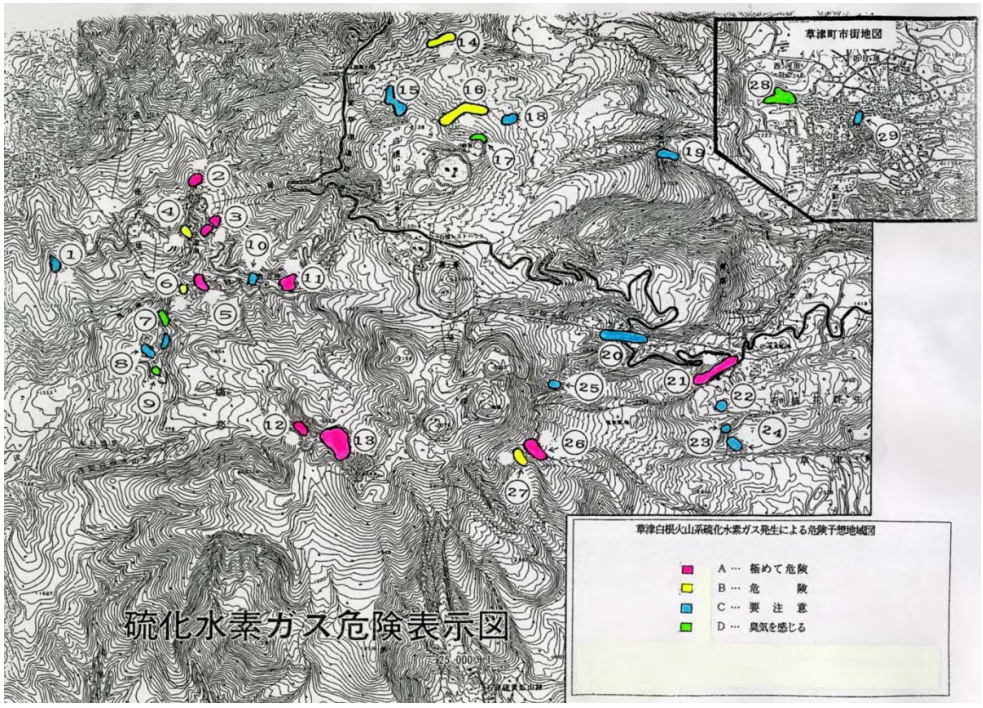


Figure 44-2 Map of the danger zone area for hydrogen sulfide gas in and around Kusatsu-Shiranesan (from the Kusatsu website).

Volcanic gas emission sites in the Kusatsu-Shiranesan area are located in the north of Motoshiranesan, Sesshogawara at the eastern foot of the volcano, the Manza area at the western foot of the volcano, and geothermal fumarolic areas such as the eastern flank of Motoshiranesan.

Red Relief Image Map

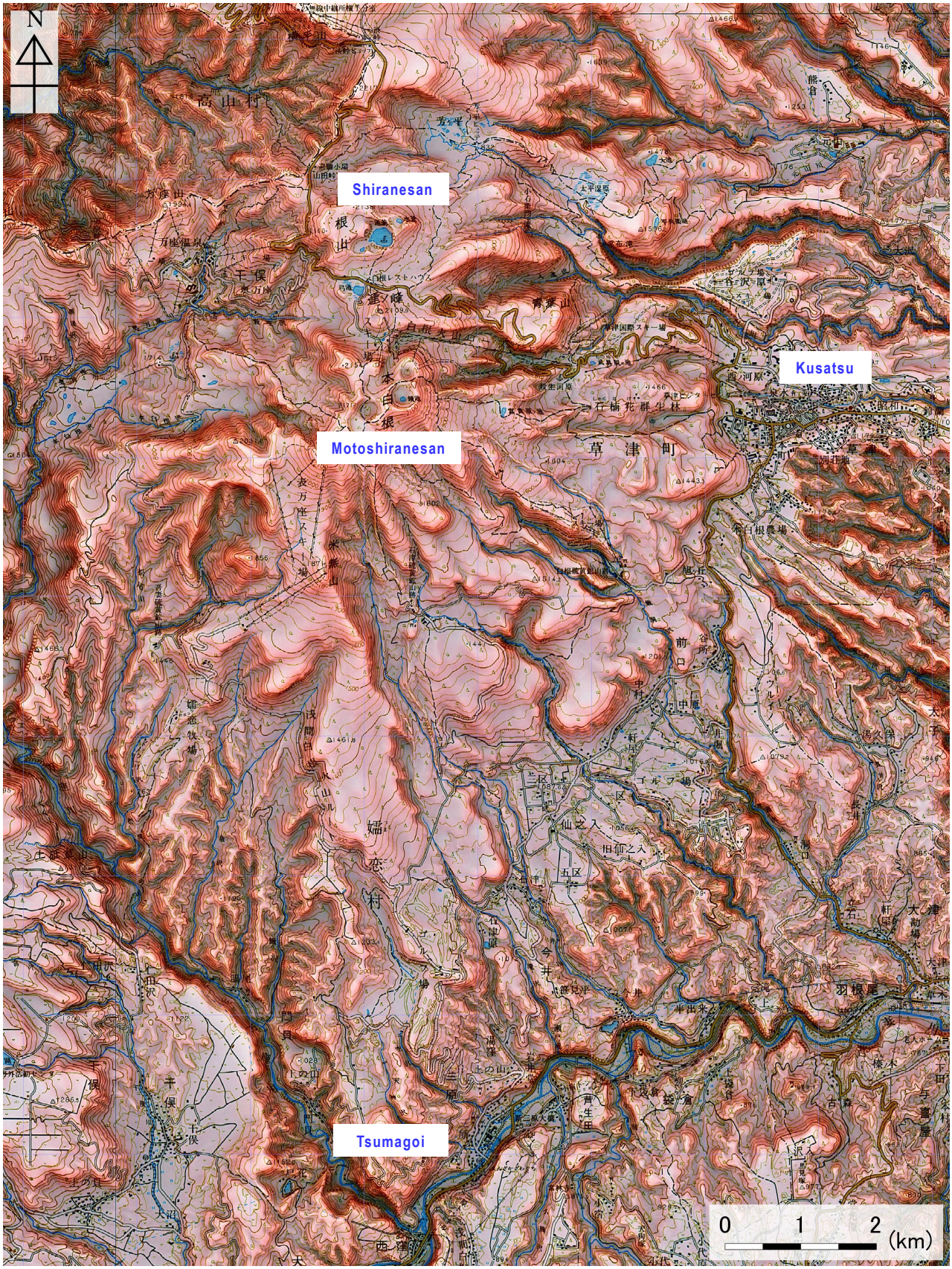


Figure 44-3 Topography of Kusatsu-Shiranesan.

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

Geological Map

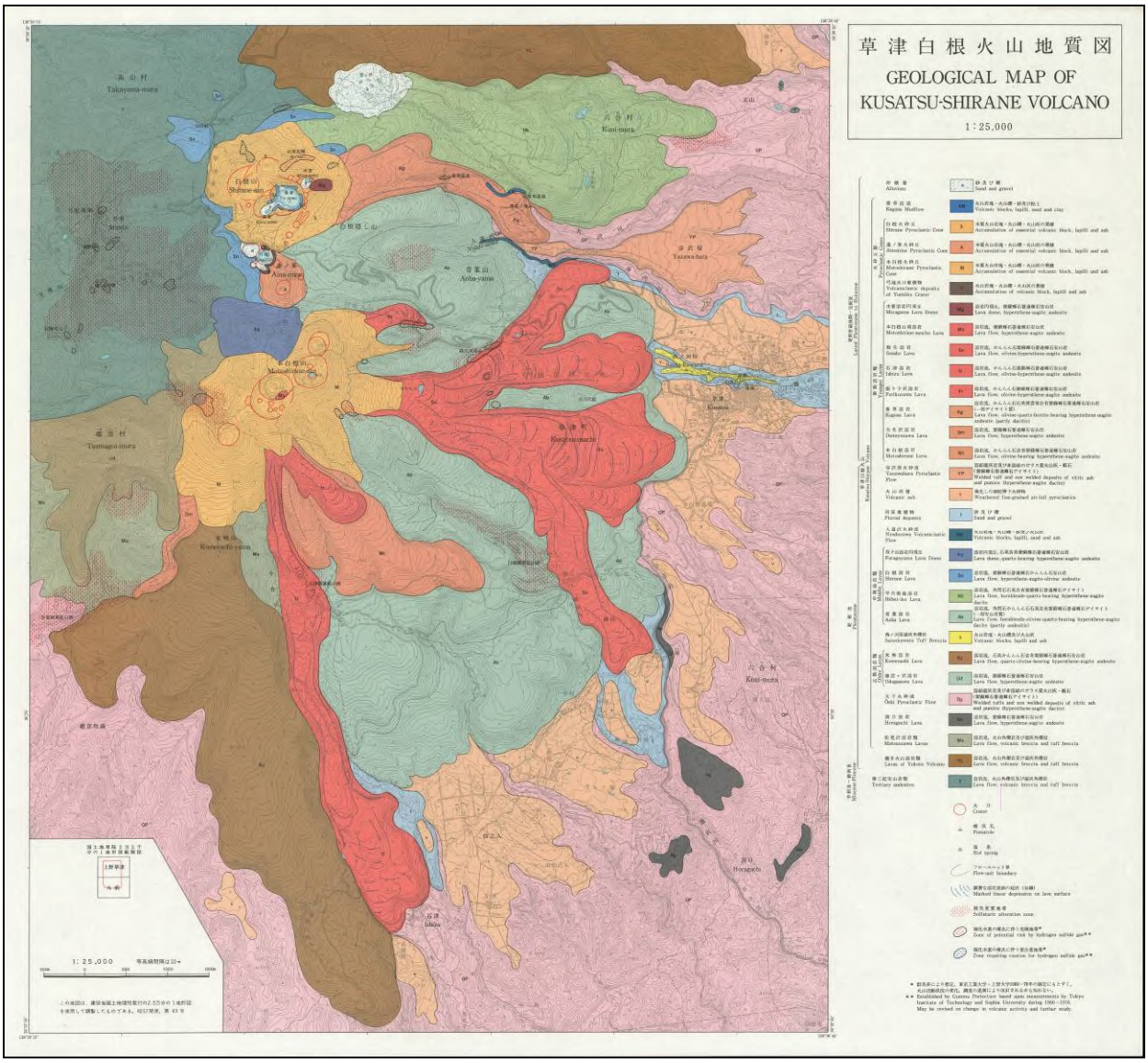


Figure 44-4 Geological map of Kusatsu-Shiranesan (Uto et al., 1983).

Chronology of Eruptions

・Volcanic Activity in the Past 10,000 Years

The Kakusa lava overflowed 8,500 years ago, and the Sessho lava eruption 3,000 years ago (Hayakawa and Yui, 1989).

Small eruptions occurred repeatedly in the last 3,000 years.

Period	Area of Activity	Eruption Type	Main Phenomena / Volume of Magma
8.5 ka	Yugama area	Magmatic eruption	Kakusa lava eruption: Tephra fall and lava flow. Magma discharge = 0.014 km^3 DRE. (VEI 3)
8.5 ka>	Mizugama area	Magmatic eruption	Mizugama lava dome eruption: Lava dome.
5.7 ka	Yugama area	Magmatic eruption	Kumakura pumice eruption: Tephra fall. Magma discharge = 0.0008 km^3 DRE. (VEI 2)
3 ka	Motoshiranesan, Mononugunoike (secondary explosion)	Magmatic eruption, phreatic eruption (secondary explosion)	Shirane pyroclastic cone chain eruption: Tephra fall, lava flow. Magma discharge = 0.26 km^3 DRE. (VEI 4)
3 ka>	Yumiike	?	Yumiike maar eruption: Pyroclastic material.
2.5 ka	Yugama	?	Tephra fall. (VEI 3)
2 ka	Yugama	?	Tephra fall. (VEI 2)
1.999 ka	Yugama	?	Tephra fall. (VEI 3)
1.99 ka	Yugama	?	Tephra fall. (VEI 2)

* Volcanic periods, areas of activity, and eruption types taken from the Active Volcano Database of Japan, AIST (Kudo and Hoshizumi, 2006). All years are noted in Western date notation. "ka" within the table indicates "1000 years ago", with the year 2000 set as 0 ka.

A>: Eruption event after year A.

・Historical Activity

Year	Phenomenon	Activity Sequence, Damages, etc.
1783 (Tenmei 3)	Hot spring anomaly	Sudden rise in hot spring temperature at Kusatsu Onsen, killing bathers.
1805 (Bunka 2)	Phreatic eruption	Tephra fall. The eruption occurred at Yugama. Tephra fall in Nagano Prefecture direction and tree withering and dying.
1882 (Meiji 15)	Moderate: Phreatic eruption	August 6. Tephra fall. The eruption occurred at Yugama and the Karegama area. A small mud eruption occurred and Yumiike was filled in, trees withered and died. From a month earlier there was rumbling at the summit, and on the day of the eruption a sound like distant thunder could be heard at approximately 14:00 at the foot of the volcano. The eruption occurred that night. (VEI 2)
1897 (Meiji 30)	Phreatic eruption	July 8, 31, and August 3 to 16. Tephra fall. The eruption occurred at Yugama. Occasional rumbling from roughly January. On July 8 at 0:00 an eruption occurred 200 m northeast of the existing crater in the Yugama, and mud and block were ejected. At 5:00 on the same day another explosion and hot mud and water ejection occurred 200 m to the southwest of the explosion. The nearby sulfur mine completely destroyed, and ash fell at Kusatsu. On July 31 explosion with earthquake and attendant rumbling, occurred to the south of Oike, and mud and block ejection flinging a 150 kg block 900 m. On August 2 an explosion with rumbling occurred, and volcanic blocks were ejected. On August 3 an explosion also occurred, injuring 1. Rumbling and occasional small mud eruptions continued until mid-August.
1900 (Meiji 33)	Phreatic eruption	October 1. The eruption occurred at Yugama.
1902 (Meiji 35)	Small-scale: Phreatic eruption	July 15, August 20, September 4, 17, 23 to 24. Tephra fall. The eruption occurred on the north lakeside of Yumiike. An eruption occurred on July 15, discharging steam, sand, and blocks, and totally destroying a hot spring building and office. Small explosion on August 20. Frequent explosions and ash and steam discharges from September 4 to 6.3 cm of tephra fall on Manza Onsen. Rumbling and high volume of tephra fall on September 17. Rumbling and large volume of volcanic block ejection on September 24. (VEI 1)

Year	Phenomenon	Activity Sequence, Damages, etc.
1905 (Meiji 38)	Phreatic eruption	October. Sulfur discharge. This eruption may have occurred in Yugama.
1925 (Taisho 14)	Moderate: Phreatic eruption	January 22. Tephra fall. Tephra fall. The eruption occurred on the north wall of Yugama. (VEI 2)
1927 to 1928 (Showa 2 to 3)	Phreatic eruption	December 31, January 29 to 31. Tephra fall. The eruption occurred at Yugama and the southeast flank of the Yugama pyroclastic cone. Block and mud erupted. A sulfur discharge. Fish in the Azuma and Tone rivers were killed.
1932 (Showa 7)	Small-scale: Phreatic eruption	October 1, 4, 6, 8, 16, 18, 23, 24, 27. Tephra fall. The eruption occurred at Yugama, Karegama, and the southeast flank of the Yugama pyroclastic cone. 2 dead and 7 injured near crater. Significant damage to buildings near the summit. Activity continued until roughly November, producing lahar and tephra fall at Sasshogawara. It discharged a total of 1.6 x 10^4 m^3 of ejecta, and released 1.6x10^{18} erg of explosive energy. (VEI 1)
1937 to 1939 (Showa 12 to 14)	Moderate: Phreatic eruption	Tephra fall. The eruption occurred at Yugama. November 27, December 1, 28, 30, 31, 1937. January 1, 2, 8, February 7, 8, 13, 16, July 22, September 22, 26, October 5, 1938. March 24, 30, April 1 to 3, April 5, 7, April 9 to 19, April 24, 27, 28, 30, May 3, 10, 19, August 28, 1939. Explosion and rumbling on November 27. Explosions and tephra fall December 1, December 28, December 30, and December 31. Occasional volcanic plume activity in 1938. Eruption and ash tephra from February to May, 1939 (Showa 14). (VEI 2)
1940 to 1941 (Showa 15 to 16)	Phreatic eruption	April and September, 1940, and January, 1941. Volcanic plume activity (black smoke).
1942 (Showa 17)	Phreatic eruption	February 2. Tephra fall. The eruption occurred on the southeast flanks of the Mizugama and Yugama pyroclastic cones, the crater chain on their north flanks, and the northeast of Mizugama. A fissure formed, emitting a volcanic plume and tephra fall, accompanied by rumbling. Buildings near the crater were damaged.
1958 (Showa 33) or 1959 (Showa 34)	Phreatic eruption	Tephra fall. The eruption occurred at Yugama. Ash fell in the crater area.
1963 (Showa 38)	Fume	The fumarolic activity on the southeast flank on the outside of Yugama declined, while the fumarolic activity on the outside flank of Mizugama activated. At the same time, the waters of Yumiike cleared.
1971 (Showa 46)	Volcanic gas	December 27. A gas (H_2S) leak from a hot spring digging borehole killed 6.
1976 (Showa 51)	Small-scale: Phreatic eruption	March 2. The eruption occurred in the northeast of Yugama. A small phreatic explosion occurred at Mizugama. The fumarolic activity tailed off from roughly April. (VEI 1)
	Volcanic gas	August 3. An accumulation of volcanic gas at Shiranezawa (Bentenzawa), Motoshiranesan, killed 3 mountain-climbers.
1977 (Showa 52)	Earthquake	January 4. At 14:26 locally felt-earthquake, which could be felt up to approximately 15 km away. It measured 4 on the JMA seismic intensity scale at Ainomine and the Yoshigadaira Hyutte.
1982 (Showa 57)	Small-scale: Phreatic eruption	October 26 and December 29. Tephra fall. The eruption occurred in the northwest of Yugama, and at Karegama. On October 26 small phreatic explosions occurred at several locations in Yugama and Karegama. On December 29 a small phreatic explosion occurred at Yugama. (VEI 1)

Year	Phenomenon	Activity Sequence, Damages, etc.
1983 (Showa 58)	Small-scale: Phreatic eruption	July 26, November 13, and December 21. Pyroclastic fall. The eruption occurred in the northwest of Yugama, and the northern crater wall of Karegama. On July 26 a small phreatic explosion occurred at Yugama. On November 13 2 phreatic explosions occurred at Yugama, at 11:40 and 12:08. Volcanic blocks the size of soccer balls were scattered over an area of 600 to 700 m. Ash fell to the east-southeast, reaching as far as Shibukawa. A crack appeared at the bottom of the northern crater wall of Karegama (30 cm wide and 45 m long. On December 21 small phreatic explosions occurred at Yugama and Karegama.
1986 (Showa 61)	Earthquake	June. Earthquake swarms.
1987 (Showa 62)	Earthquake	Mid-October. Earthquake swarms.
1989 (Showa 64 to Heisei 1)	Earthquake, volcanic tremors	Tremor on January 6. Partial dark water discoloration of Yugama on January 6 and January 7. Earthquake swarms from October to November.
1990 to 1991 (Heisei 2 to 3)	Earthquake, volcanic tremors	February to September. Large number of earthquakes and tremors, and occasional discoloration of Yugama.
2004 (Heisei 14)	Lake water discoloration, earthquake	May 17. A water spout was observed at Yugama, followed by water discoloration. May 19 to 22. The number of earthquakes temporarily increased approximately 7 km northwest of the Yugama crater.
2008 (Heisei 20)	Fume	May. A new fume was confirmed on the eastern flank of the northern fumarolic area. In July, a new and extremely small fumarole was confirmed in the northeast interior of the Yugama crater. In October a new fume was confirmed on the northern flank of the Mizugama crater.
March, 2011 (Heisei 23)	Earthquake	Since the 2011 off the Pacific coast of Tohoku Earthquake (March 11, 2011) the seismic activity has been high approximately 3 km north of Yugama.

* Reference documents have been appended with reference to the Active Volcano Database of Japan, AIST (Kudo and Hoshizumi, 2006) for volcanic periods, areas of activity, eruption types, and eruption events.

Major Volcanic Activity

・1976 Volcanic Activity

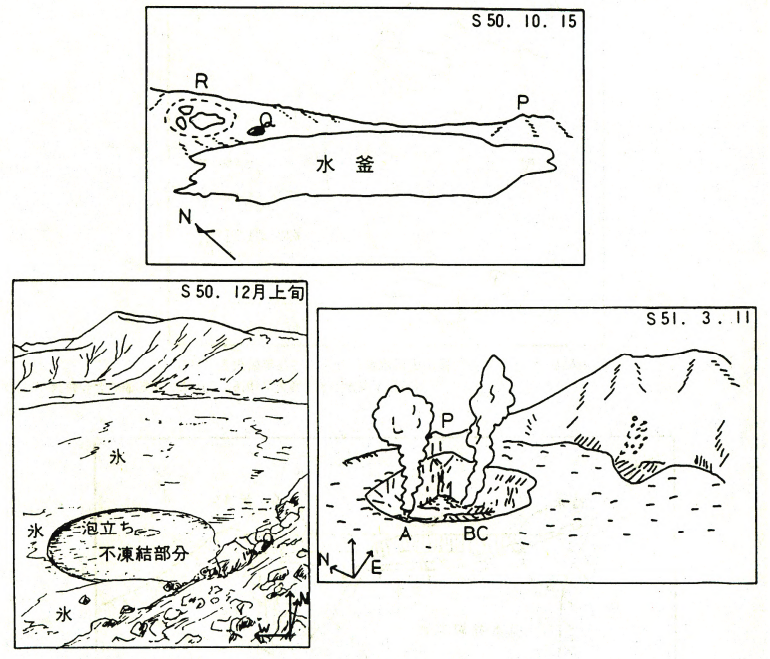


Figure 44-5 Kusatsu-Shiranesan, Mizugama three state sketch (Maebashi Local Meteorological Observatory, 1977).

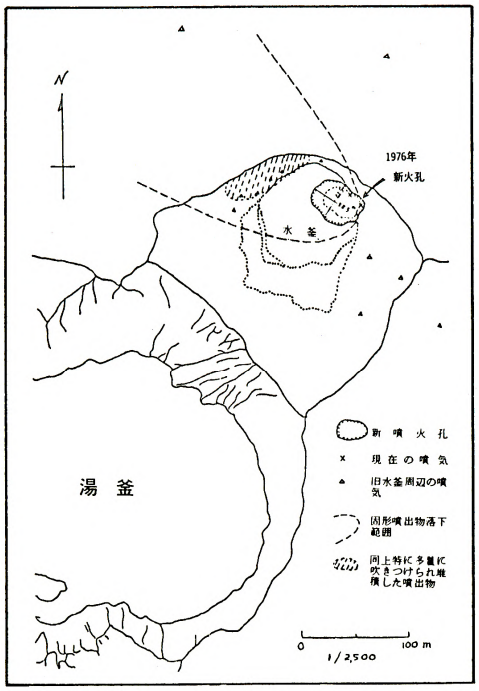


Figure 44-6 Diagram of Mizugama area at the summit of Kusatsu-Shiranesan- and new 1976 crater (1976) (Tokyo Institute of Technology and Sophia University, 1976).

A new, oval-shaped fumarole 58 m long, 43 m wide, and 12 m deep was formed in the northeast edge of the Mizugama summit crater.

Ejecta were mainly distributed towards the northwest from the crater.

No fresh blocks or volcanic ash directly originating from magma were identified.

・Eruptive Activity between 1982 and 1983

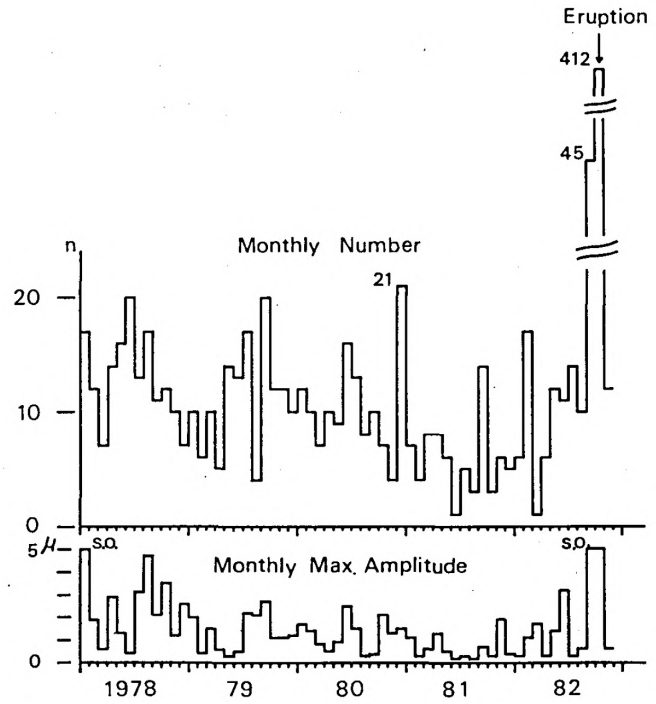


Figure 44-7 Monthly number of volcanic earthquakes (1978 to 1982) (Japan Meteorological Agency Observations Department Earthquake Section and Maebashi Local Meteorological Observatory, 1983).

The monthly number of volcanic earthquakes since the beginning of observation, in January 1978, to August 1982, fluctuated, peaking at roughly 20, with some individual months falling as low as 1.

There were earthquakes with relatively large amplitudes in 1978, but after that activity levels and amplitudes fell.

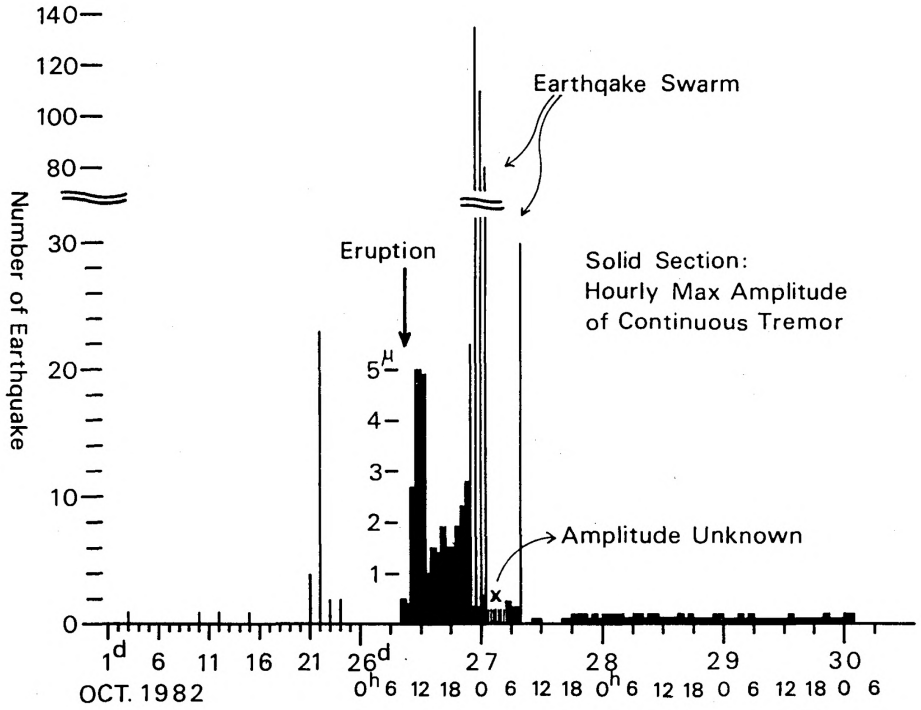


Figure 44-8 Time series of volcanic earthquakes pre- and post-eruption (Japan Meteorological Agency and Maebashi Local Meteorological Observatory, 1983).

Before the eruption in October 1982, a total of 27 earthquakes and 1 volcanic tremor were observed between October 21 and 22, but overall, the activity of B-type earthquakes and volcanic tremors was low.

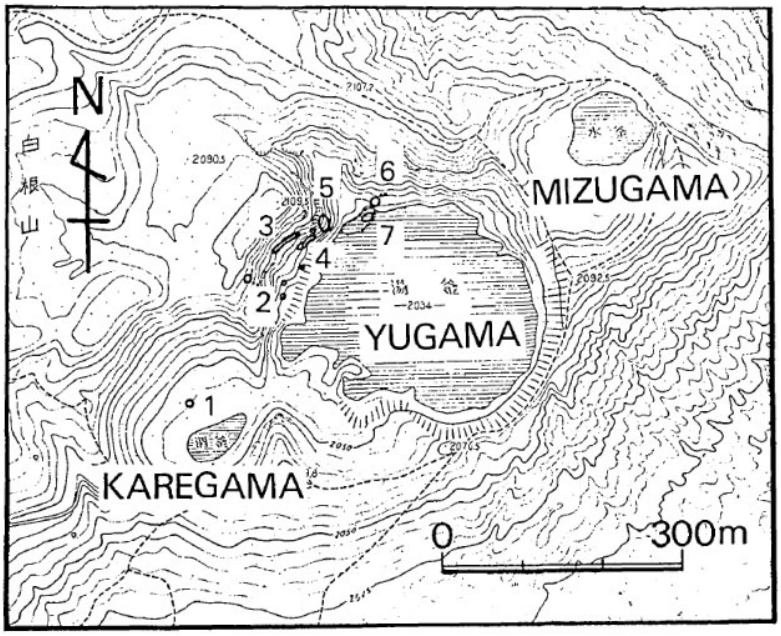


Figure 44-9 Distribution of craters formed by eruption at Kusatsu-Shiranesan on October 26 1982 (numbers 1 through 7 indicate pits) (Japan Meteorological Agency Observations and Maebashi Local Meteorological Observatory, 1983). The pits were arranged from northeast to southwest, on the north sides of Karegama and Yugama.

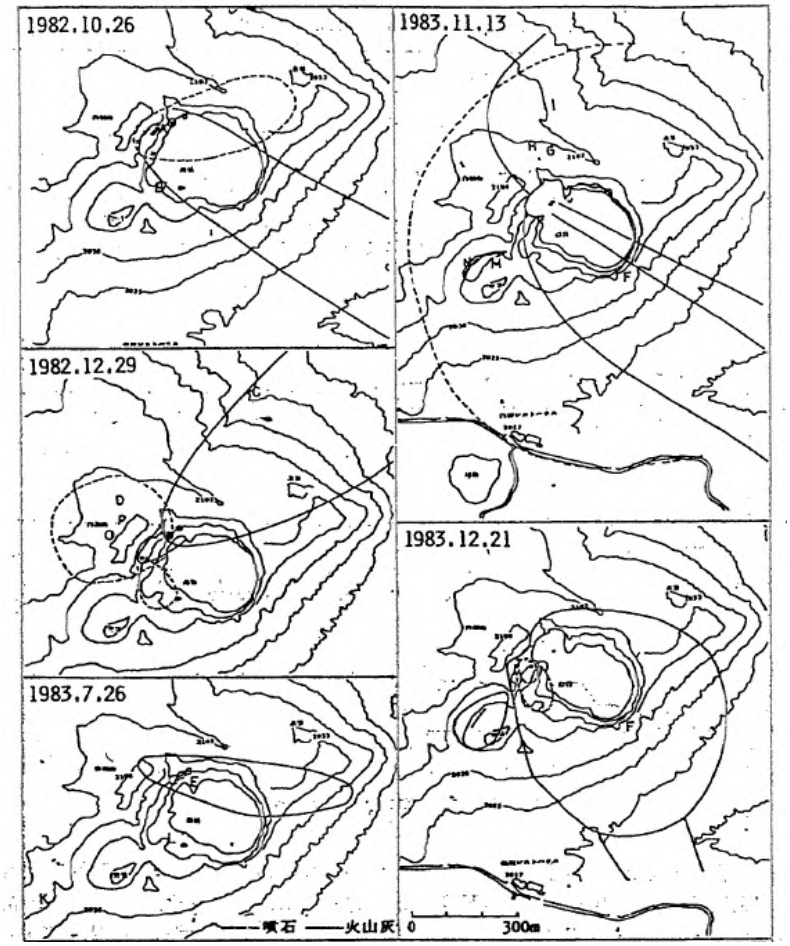


Figure 44-10 Distribution of ejecta from the 1982-1983 eruptions (Osaka et al., 1984).
Dotted lines indicate the areas where volcanic block were scattered. Solid lines indicate the areas where ash fall was confirmed.

Precursory Phenomena

Recent phreatic eruptions have been preceded by increased fumarolic activity and changes in volcanic gas composition by a year or more, and from 1 to 10 days before eruptions, the number of earthquakes and tremors have increased at a shallow depth directly below the summit.

While it did not culminate in an eruption, around 1990 thermal demagnetization and volcanic seismic activity directly below Yugama were observed, as well as lake water discoloration, etc.

Recent Volcanic Activity

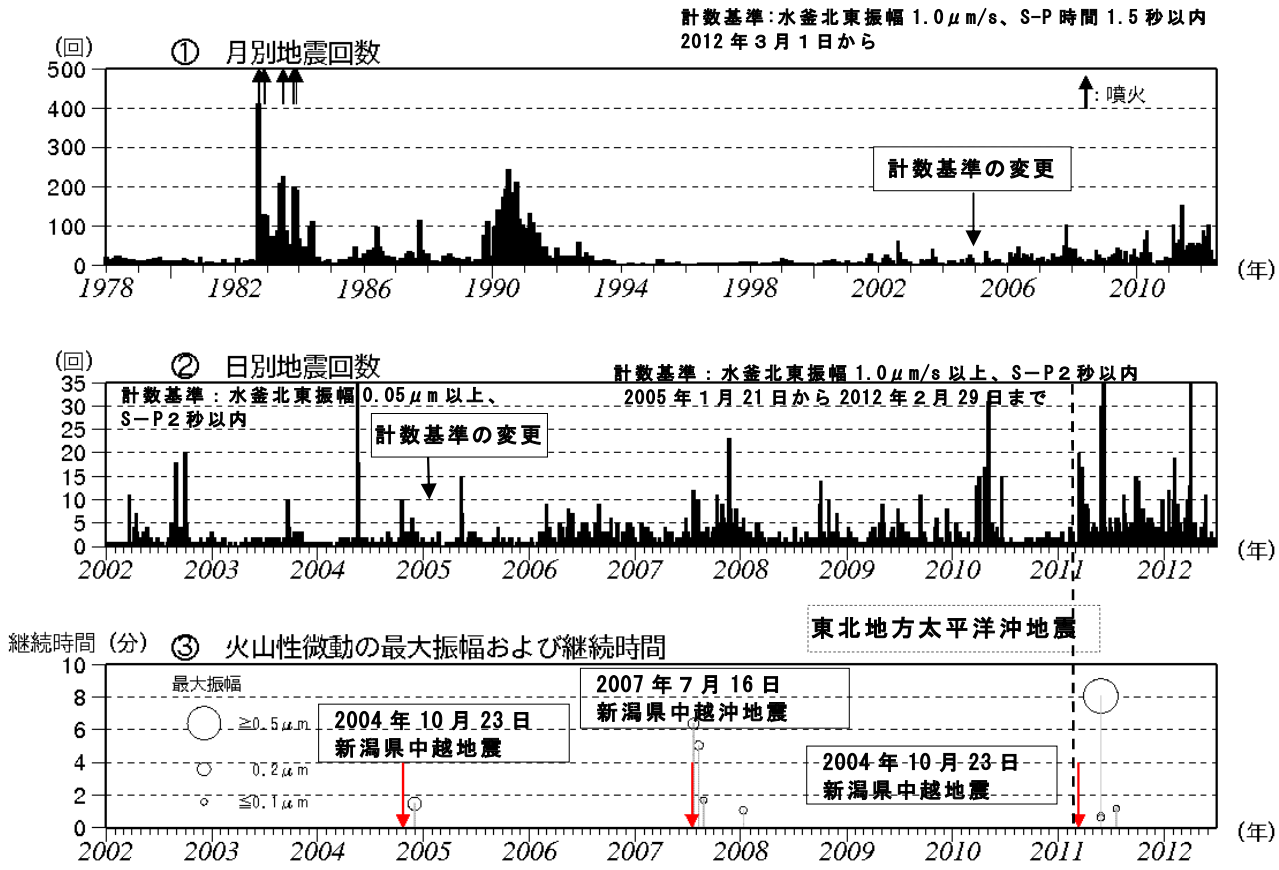


Figure 44-11 Volcano activity (January, 1978, to June, 2012).

① Number of earthquakes per month

② Number of earthquakes per day

③ Maximum amplitudes and durations of volcanic tremors

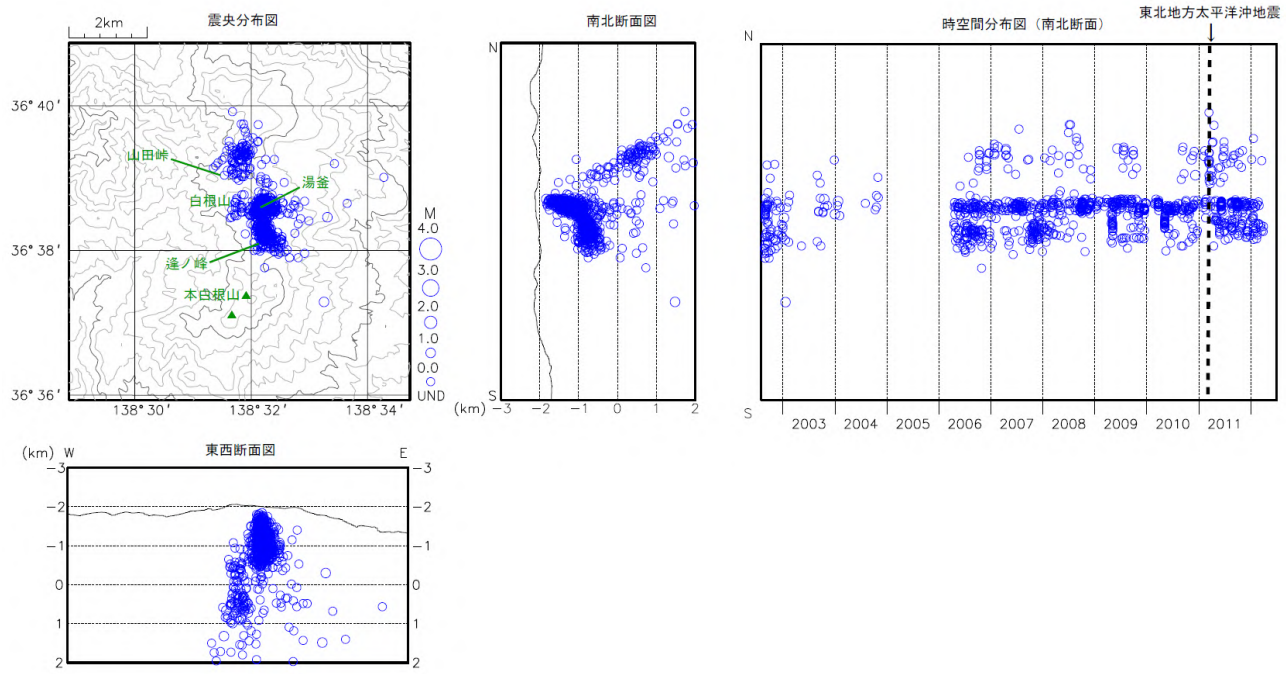


Figure 44-12 Distribution of volcanic earthquakes at Kusatsu-Shiranesan (August 1, 2002, to June 30, 2012).

① Epicenter distribution

② N-S cross section

③ Space-time plot (N-S cross-section)

④ E-W cross-section

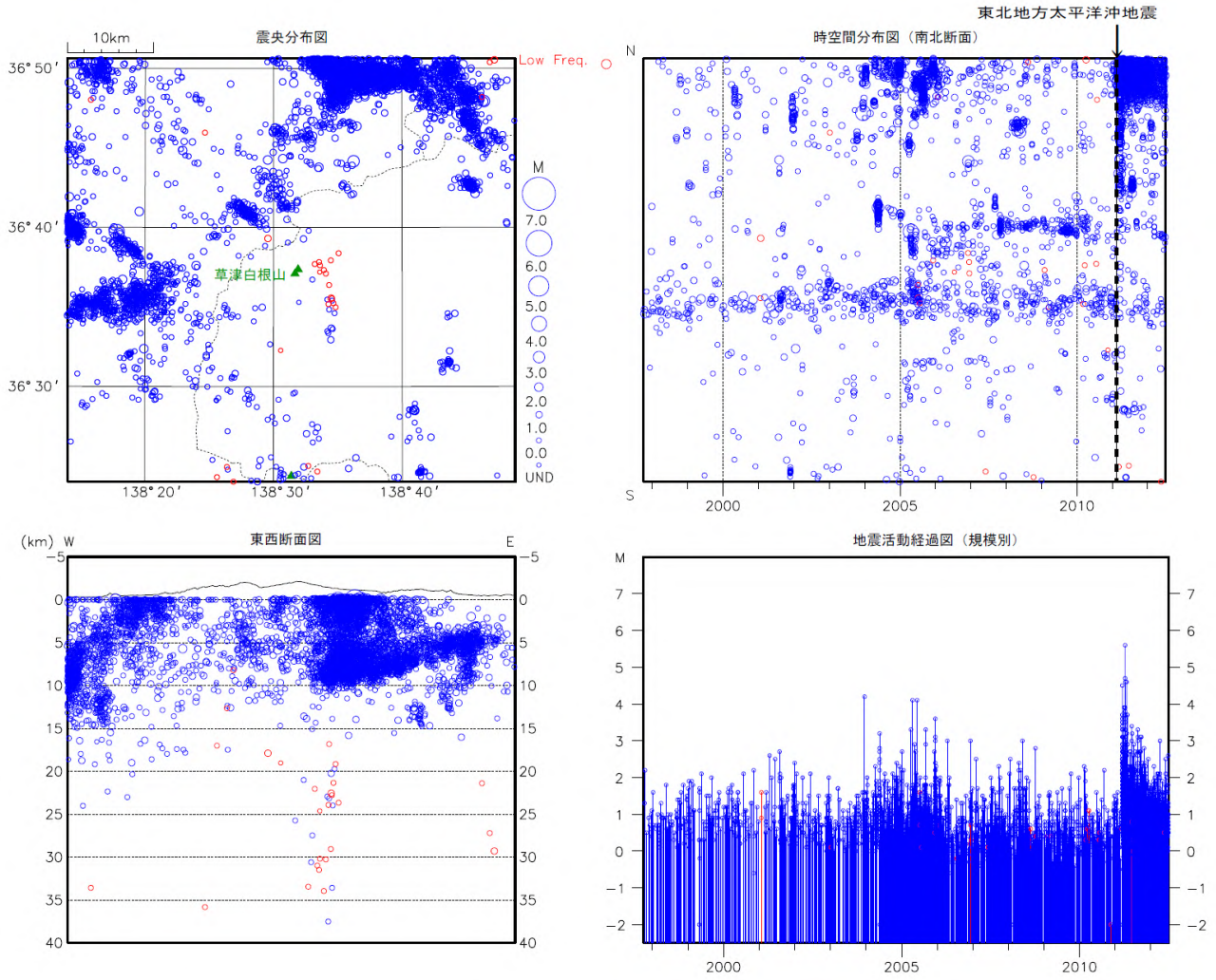


Figure 44-13 Activity of shallow VT earthquakes (blue circles) and deep low-frequency earthquakes (red circles) observed by regional seismometer network (October 1, 1997, to June 30, 2012). Epicenter distribution (upper left), Space-time plot (N-S cross-section) (upper right), E-W cross-section (lower left) and Magnitude-time diagram (by scale) (lower right).

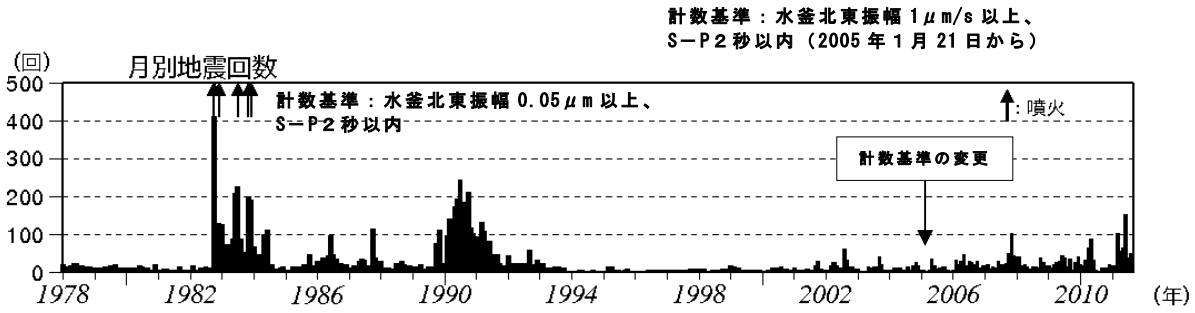


Figure 44-14 Monthly number of earthquakes in and around Kusatsu-Shiranesan (January, 1978, to June 30, 2012).
Note) In 2005 measured waveforms changed from displacement to velocity components.

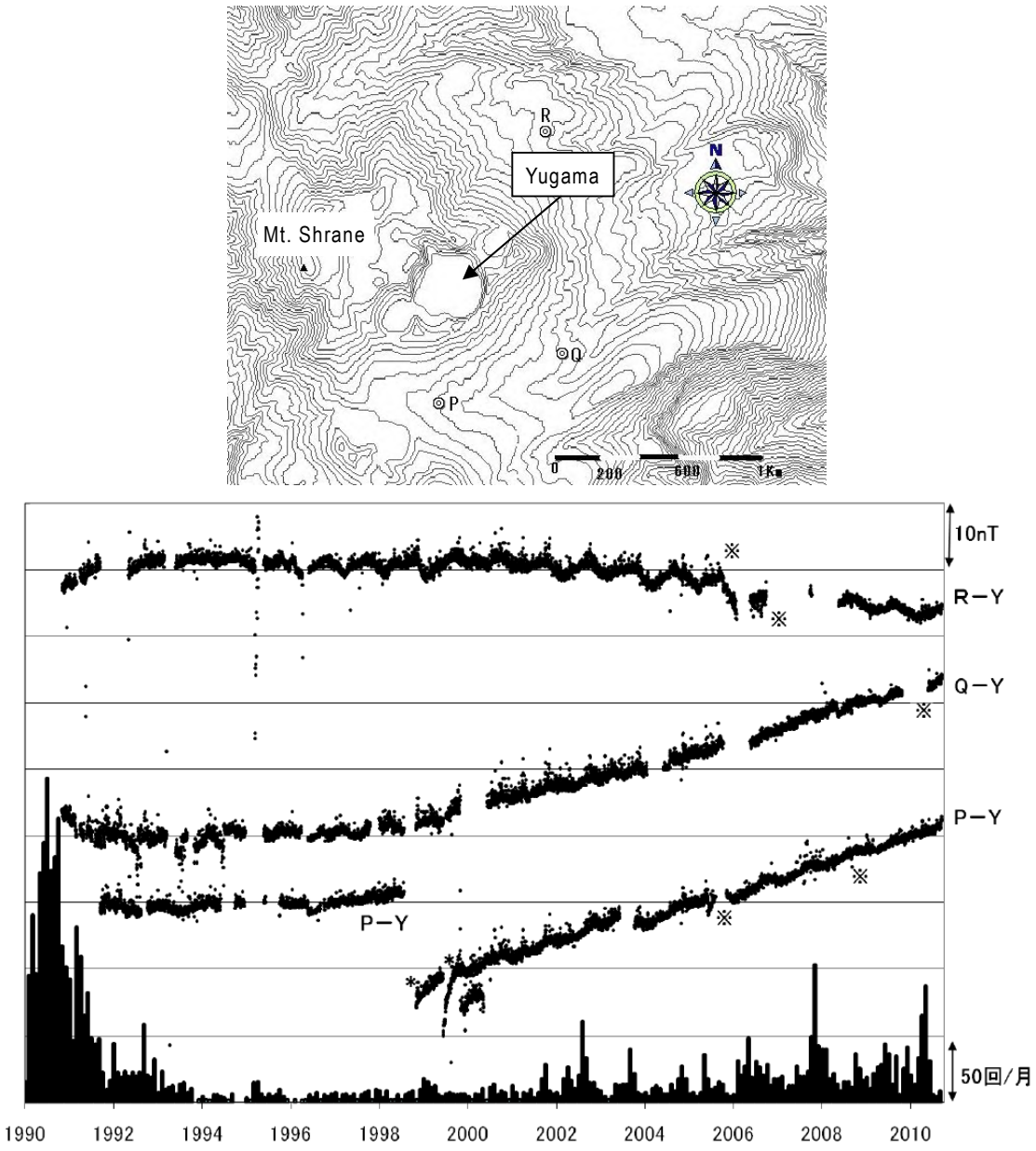


Figure 44-15 The results of geomagnetic total intensity observation (Kakioka Magnetic Observatory, 2011).

(Top) Map of continuous observation points of geomagnetic total force, (Bottom) Daily means of total force differences at continuous observation points P, Q, and R from that at the Yatsugatake Geo-Electromagnetic Observatory, and number of volcanic earthquakes per day observed by the Volcanic Observation and Information Center, JMA. ※ symbols indicate magnetometer replacements, * symbols indicate magnetic field changes which are considered to be due to lightning strikes near the observation points.

The total force changes indicate that a magnetization (cooling) process has continued beneath the Yugama area.

Subsurface Structure

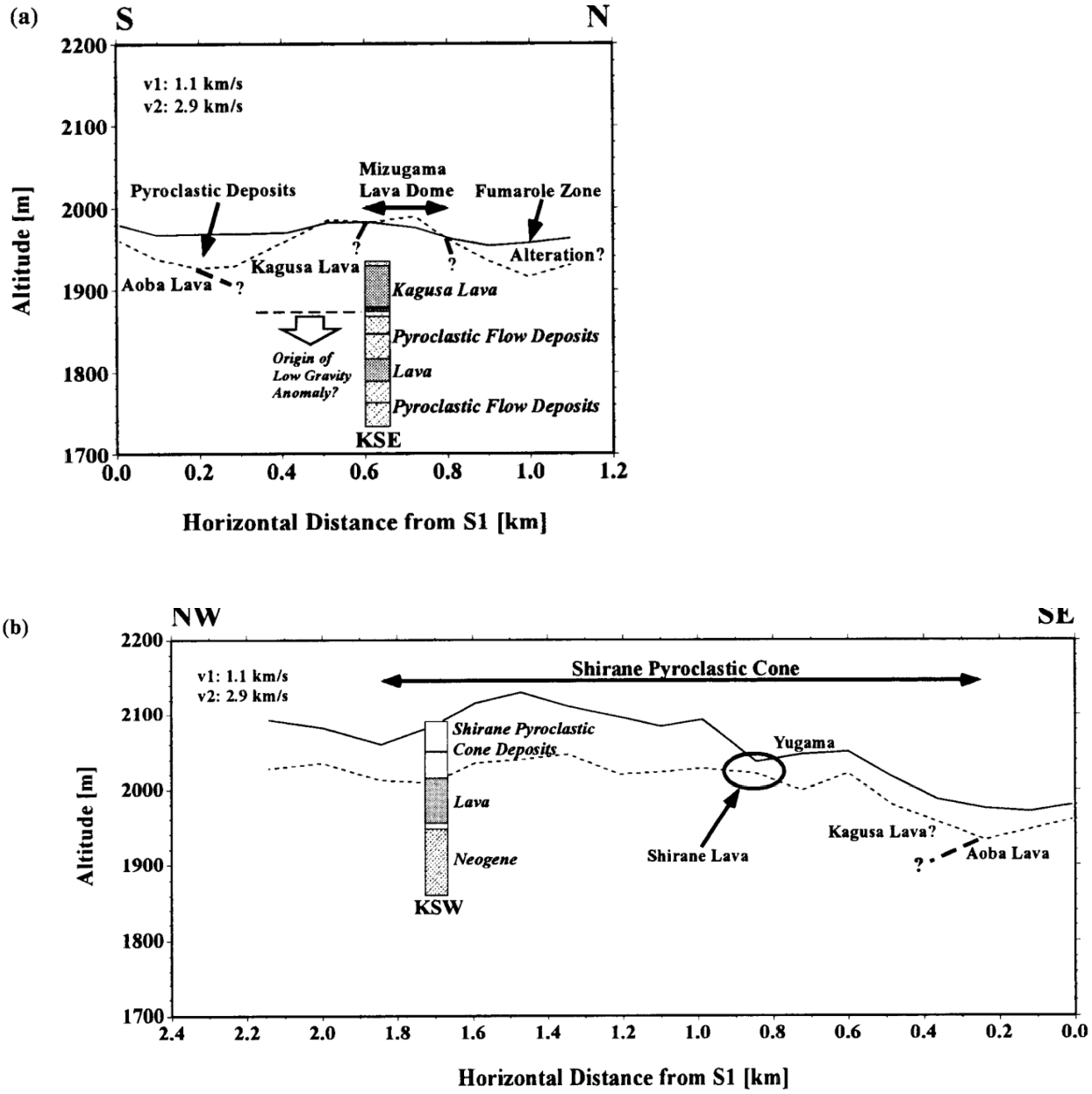


Figure 44-16 Illustration and interpretation of the P wave velocity structure 2 layer structure of the Kusatsu Shirane pyroclastic cone surface strata, determined through analysis of artificial earthquake exploration data (by Onizawa et al., 2005).

Solid lines and dotted lines indicate surface and velocity boundary layers, respectively. (Top) Yugama east side north-south survey line, (Bottom) Yugama cross-section survey line. The velocity boundary layer is considered to be reflecting the upper surface of the uppermost lava in the Shirane pyroclastic cone.

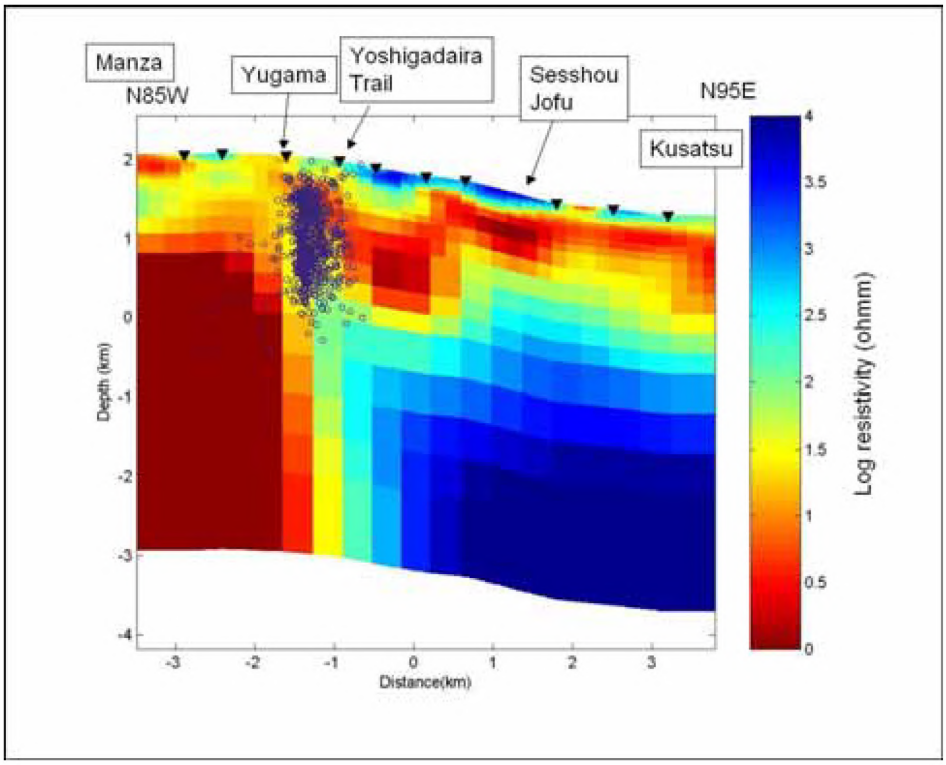


Figure 44-17 2-D resistivity cross-section model and hypocenter distribution determined based on AMT measurement data (Nurhasan et al., 2004).

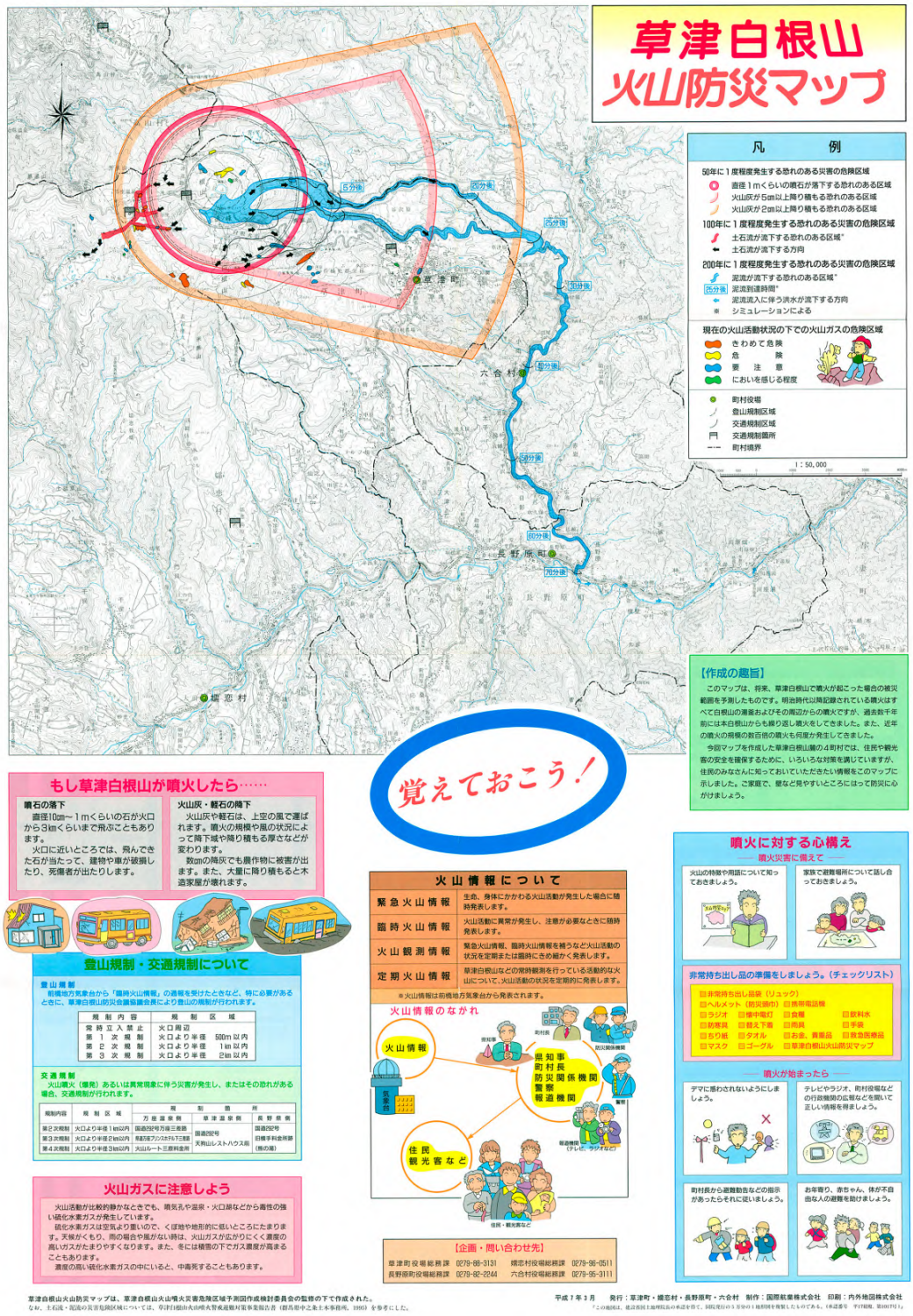
Cross-section along the survey line crossing the volcanic edifice from north-northwest to east-southeast. Earthquakes are ncentrated in the area to the east of Yugama, to a depth of up to 2 km, which indicates a discontinuous low resistivity layer.

Information on Disaster Prevention

①Hazard Map

Kusatsu-Shiranesan Volcano Disaster Prevention Map (Wide Area Version) 1995 (Heisei 7) - Published by the Kusatsu Town General Affairs Division, Naganohara Town General Affairs Division, Tsumagoi Village General Affairs Division, Kuni Village General Affairs Division, and the Kusatsu Shiranesan Volcano Eruption Disaster Danger Area Forecast Map Creation Deliberating Committee

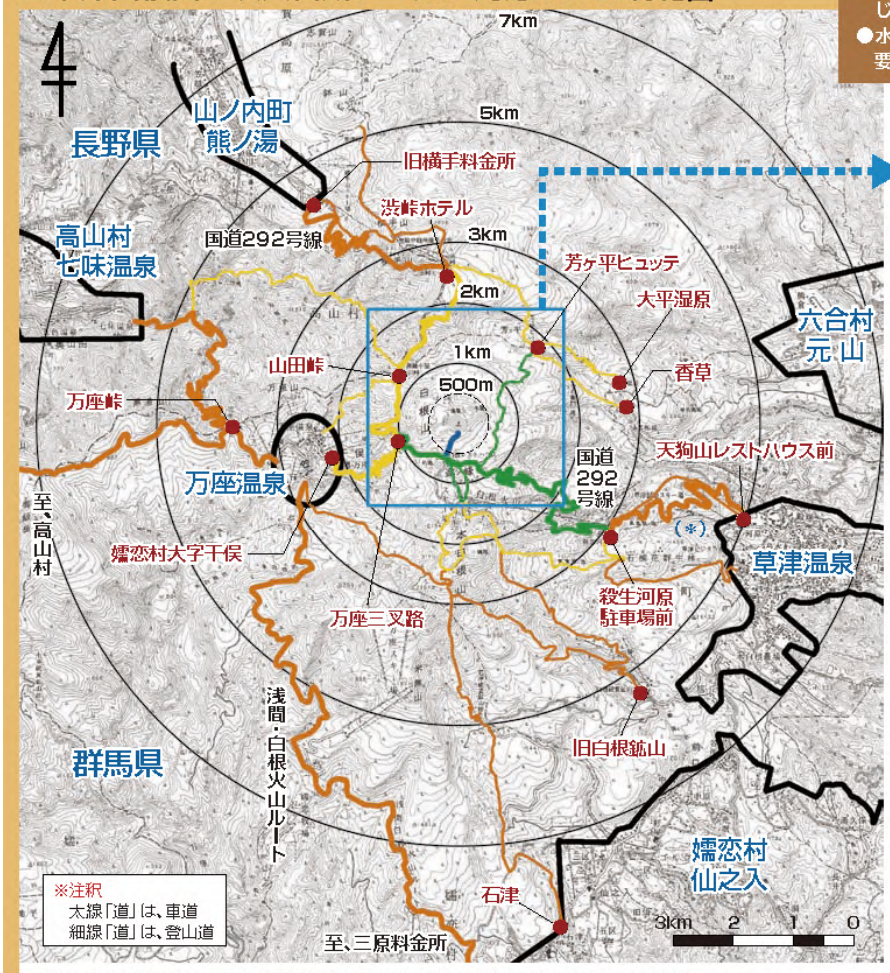
http://www.town.kusatsu.gunma.jp/www/contents/1227536171031/index.html



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

■草津白根山　噴火警戒レベルに対応した規制範囲

●草津白根山は、主に湯釜を中心とした水蒸気爆発で、噴石の飛散、泥水の噴出、火山灰の噴出が発生しやすい火山です。また、火山泥流を生じやすいという特徴があります。
●水蒸気爆発は前兆現象が捉えにくく、注意が必要です。



●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・立入規制

レベル４（避難準備）：
警戒が必要な居住地域からの避難準備・立入規制

レベル３（入山規制）：
登山禁止・入山規制
湯釜火口から2km以内立入規制

レベル２（火口周辺規制）：
火口周辺立入規制
湯釜火口から1km以内立入規制

レベル１（平常）：
火口付近立入規制
湯釜火口から500m以内立入規制
（火山活動の状況に応じて一部登山道に限って規制緩和）

居住地域の境界：

この地図は、国土地理院「数値地図50000（地図画像）」を使用しています。

■この図は噴火警戒レベルに対応した主な登山道・避難対象区域を示しています。
■登山道の規制については、主なものを表示しています。
■レベル１は、活動状況に応じて一部登山道に限って規制緩和が行われています。
■各レベルの具体的な規制範囲等については、地域防災計画などで定められていますので、各町村にお問い合わせください。
（＊）：国道292号の殺生河原駐車場前から天狗山レストハウス前の区間は、レベル2または3で規制されることもあります。
草津白根山の噴火警戒レベルは草津白根山防災会議協議会（草津町、嬬恋村、六合村の地元自治体等）と調整して作成しました。

Volcanic Alert Levels for the Kusatsu-Shiranesan 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**	●Lava flow reaching residential areas or expected to reach them shortly. Past Examples No observed examples in historical times. Approx. 3,000 years ago: Eruption at Motoshiranesan, with lava flow reaching Ishizu, approximately 6 km to the south Approx. 18,000 years ago: Eruption at Shiranesan, with lava flow reaching near Motoyama, approximately 5 km to the east ●Eruption or imminent eruption from the summit craters, scattering volcanic blocks within a distance of approximately 3 km from the crater. Past Examples No observed examples in historical times. Approx. 3,000 years ago: Shirane pyroclastic cone formed, volcanic blocks scattered as far as Sesshogawara
		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.**	●Eruption discharging volcanic blocks and/or lava flow reaching residential areas expected as a result of increased eruptive activity, high number of felt-earthquakes, and/or prominent crustal deformation, etc. Past Examples No observed examples in historical times.
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.**	●Eruption from summit craters scattering volcanic blocks as far as roughly 2 km, or a lahar resulting from the collapse of the Yugama crater wall. Past Examples No observed examples in historical times.
	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 from summit craters scattering volcanic blocks as far as approximately 1 km from the crater. Past Examples November, 1983: Volcanic blocks were scattered as far as approximately 550 m from the Yugama crater. October, 1932: Fissure eruption on the southeast flank September, 1902: Eruption from the northeast lakeside of Yumiike August, 1882: Volcanic blocks were scattered as far as approximately 550 m from the Yugama and Karegama craters. ●Small eruption expected due to earthquake swarms, etc. Past Examples 1990 to 1991: High number of volcanic earthquakes and volcanic tremors March, 1976: A new pit was formed inside Mizugama crater, ash fall
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. Possibility of discharge which may affect summit craters interior and nearby area. Past Examples May, 1997: Fume appeared, water column January, 1989: Volcanic tremor, water discoloration in Yugama October, 1987: Volcanic earthquake swarms

Note 1) Summit craters refers to the Shiranesan Yugama, Mizugama, and Karegama craters, as well as the area around them. The distances in the table are measured from the Yugama crater, but when events occur from locations other than the Yugama crater, levels are decided based on safe distances from the site of the actual eruption.
Note 2) The volcanic blocks mentioned in this table refer mainly to blocks large enough that their trajectories are not affected by wind.
Note 3) The volcanic alert levels differ from volcanic gas related restrictions.
Note 4) No danger zones are defined for Level 5. Specific danger zones are to be considered by the Hazard Map Deliberating Committee and reflected in future Volcanic Alert Levels.

Social Circumstances

①Populations

・Gunma Prefecture: Kusatsu Town: 7,124 (as of November 1, 2011)

Tsumagoi Village: 10,401 (as of August 1, 2011)

Nakanojo Town: 18,076 (as of October 1, 2011)

・Nagano Prefecture (as of October 1, 2011 (Heisei 23)

- according to Nagano Prefecture monthly population movement survey results)

Yamanouchi Town: 13,405

Takayama Village: 7,466

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

・Joshinetsu Kogen National Park

Number of park visitors per year: Approx. 26,137,000

(Gunma Prefecture: 7,083,000 Niigata Prefecture: 3,711,000, Nagano Prefecture: 15,343,000)

Number of sightseers per year: Yamanouchi Town, Nagano Prefecture: (2,350,600: Shiga Plateau)

Takayama Village: (486,200: Shinshu Takayama Onsenkyo)

(according to 2010 sightseeing land usage statistical survey results: Nagano Prefecture - Sightseeing Planning Division)

③Facilities

・Gunma Prefecture

・Tokyo Institute of Technology Volcanic Fluid Research Center - Kusatsu Shirane Volcano Observatory

・Shirane Rest House, Tenguyama Rest House

・Shirane-Kazan Ropeway

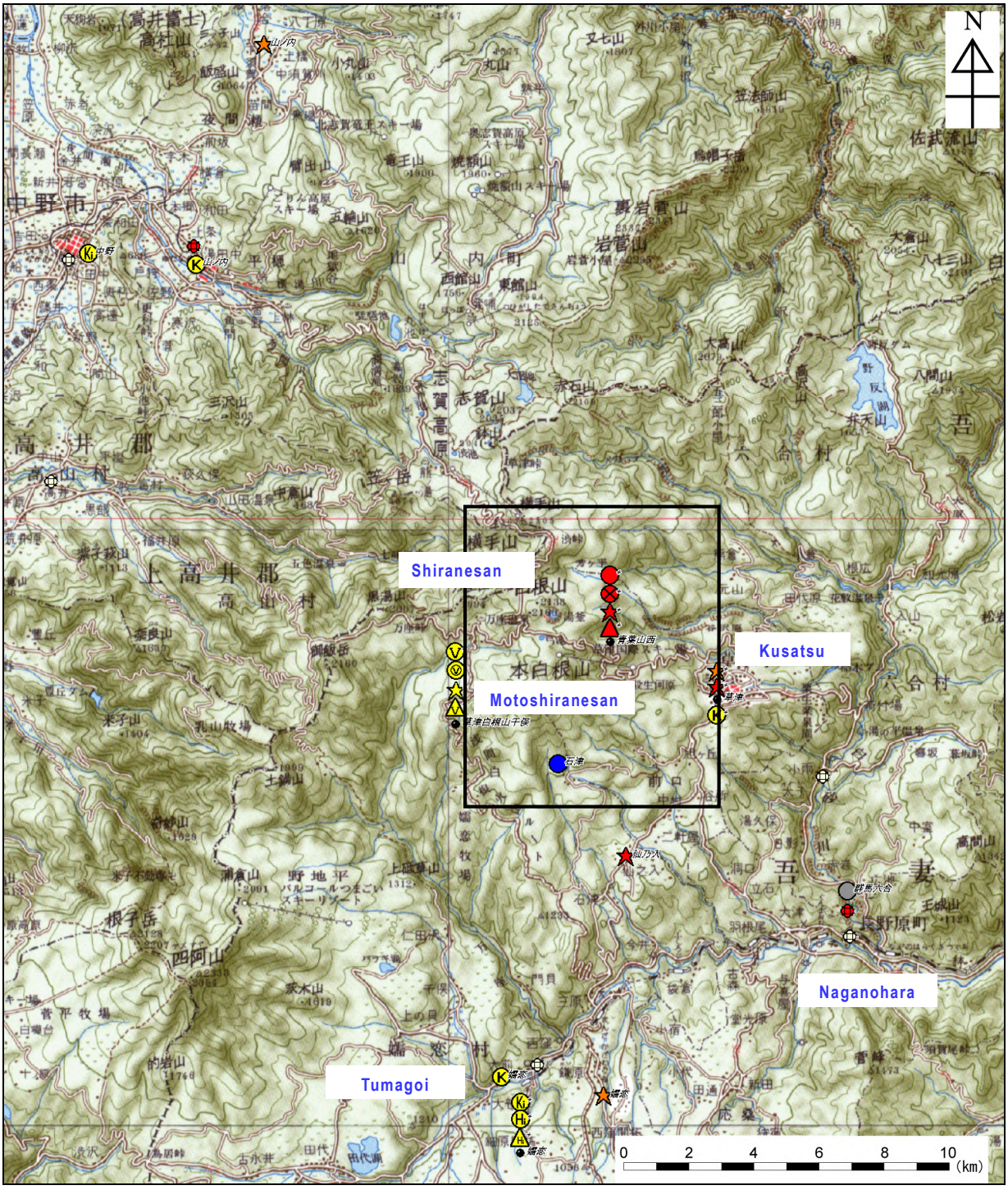
・Yamada Pass Emergency Shelter

・Yoshigadaira Hyutte

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 (Takada and Nagano) published by the Geospatial Information Authority of Japan were used.

Legend

(JMA)
- seismometer(SP)
- GPS
- tiltmeter
- infrasonic microphone
- seismic intensity meter
- seismometer(SP) (For earthquakes and tsunamis)

(GSI)
- GPS

(NIED)
- V-net(SP)
- V-net(broadband)
- V-net(tiltmeter)
- K-NET
- KiK-net
- GPS

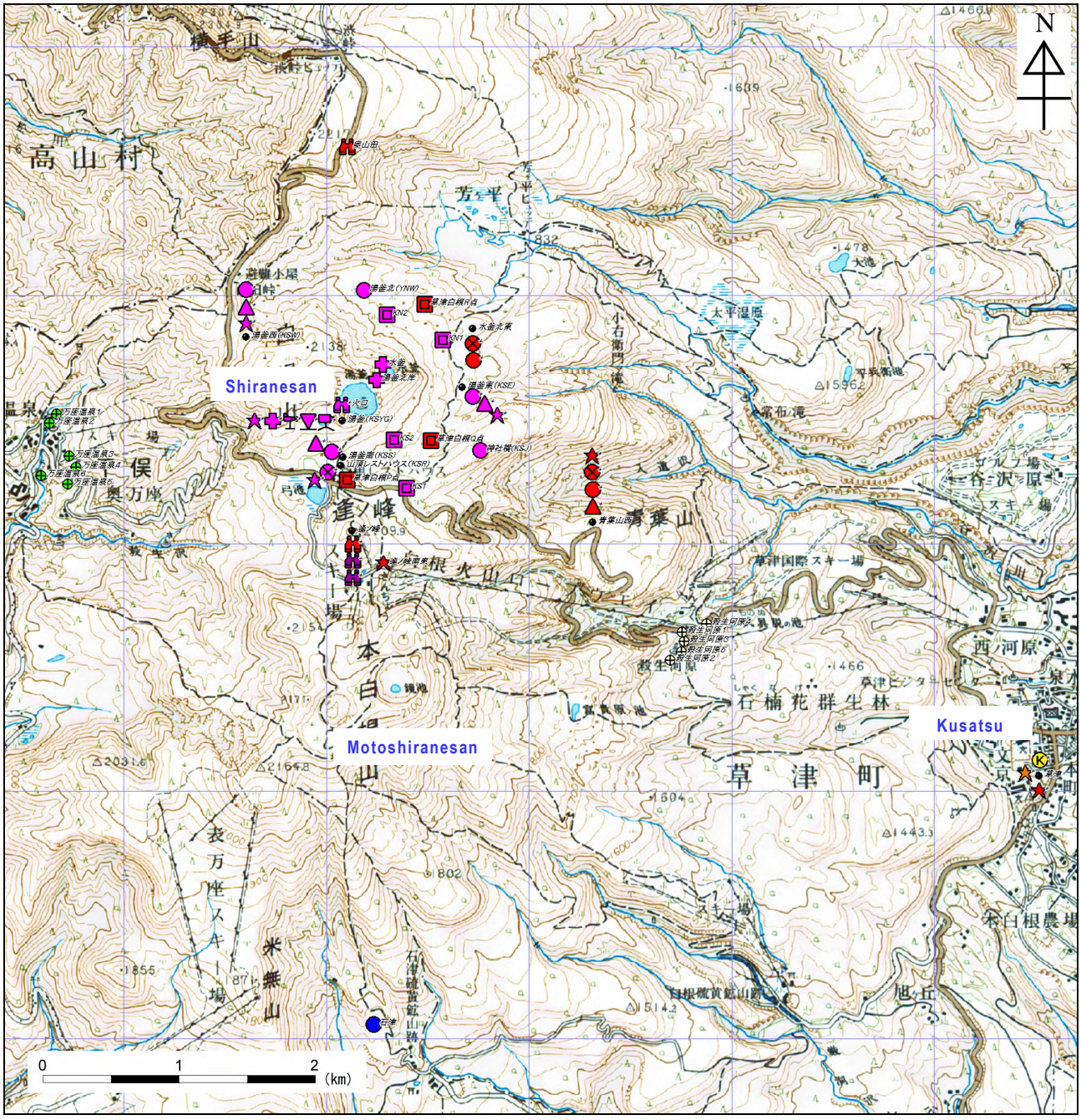
(ERI)
- seismometer(SP)

(Municipalities)
- seismic intensity meter

Figure 44-18 Regional monitoring network.

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 maps (Kusatsu and Iwasugeyama) published by the Geospatial Information Authority of Japan were used.

Legend

(JMA)
seismometer(SP)
GPS
tiltmeter
infrasonic microphone
visual camera
scalar magnetometer

(GSI)
GPS

(NIED)
K-NET

(VFRC)
seismometer(SP)
GPS
tiltmeter
infrasonic microphone
visual camera
scalar magnetometer
water gauge
water level gauge
water thermometer
thermometer

(ERI)
seismometer(SP)

(MILT)
visual camera

(ENV)
gas sensor

(Municipalities)
gas sensor

Figure 44-19 Local monitoring network.

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