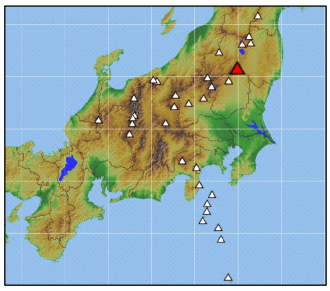
39. Nasudake



Continuously Monitored by JMA

Latitude: 37°07'29" N, Longitude: 139°57'47" E, Elevation: 1,915 m
(Chausudake) (Elevation Point)

Summit of Nasudake taken from southwest side on September 10, 2012 by the Japan Meteorological Agency

Summary

The Nasu volcano is a stratovolcano group composed mainly of andesite, arranged along the Sekiya fault, which runs north-south on the northern edge of the Kanto Plain. Nasu-Chausudake, as an active volcano, is one of its peaks. It is also known as Chausudake. The SiO_2 content is between 52.1 and 65.2 wt %.

The center of activity in the Nasu volcano group has moved from the north to the south. The Kasshi Asahidake, Sanbonyari, and Asahidake and Minamigassan stratovolcanoes were active approximately 500,000, 300,000, and 200,000 to 100,000 years ago, respectively (Ban and Takaoka, 1995; Yamamoto and Ban, 1997). Several collapses have occurred in the Nasu volcano group, causing the Kuroiso, the Nakagawa, and the Ofujiyama debris avalanches about 200,000, roughly 140,000 and 170,000 years ago, and between roughly 30,000 and 40,000 years ago, respectively. The deposits cover a wide area at the eastern foot of the volcano.

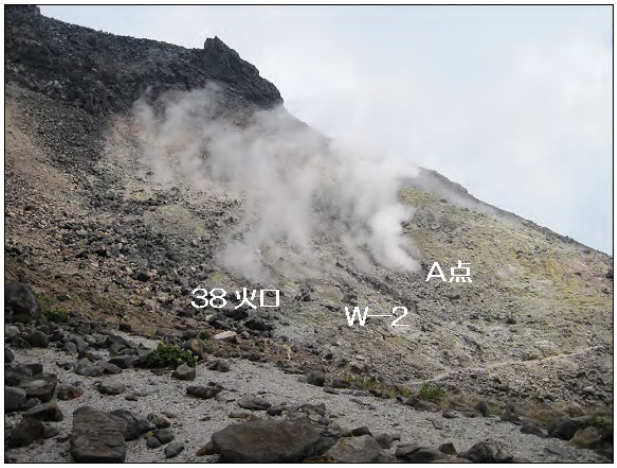
Chausudake, the newest volcano in the Nasu volcano group, became active approximately 16,000 years ago. The majority of the lava and pyroclastic material was distributed over the eastern foot of the volcano, with some being deposited in upstream Naka River, on the west side (Yamamoto, 1997).

Chausudake is located in a large collapse depression that opens to the east. It is composed of multiple strata of pyroclastic fall deposits, lava flows-domes and pyroclastic flow deposits. The pyroclastic cone on the summit, and a lava dome within it (Yamamoto and Ban, 1997; Takahashi, 1999). Many fumaroles are located inside and outside the central crater

on the lava dome (which is 100 m in diameter), and an especially high fumarolic activity continues in the two explosion craters on the western flank. All eruptions within recorded history have been explosive. The volcano is prone to producing lahars.

Photos

Volcanic Plume on October 10, 1960 taken by the Japan Meteorological Agency



Fumarolic area on the western flank of Chausudake on August 10, 2011 taken by the Japan Meteorological Agency

Topography around the Crater

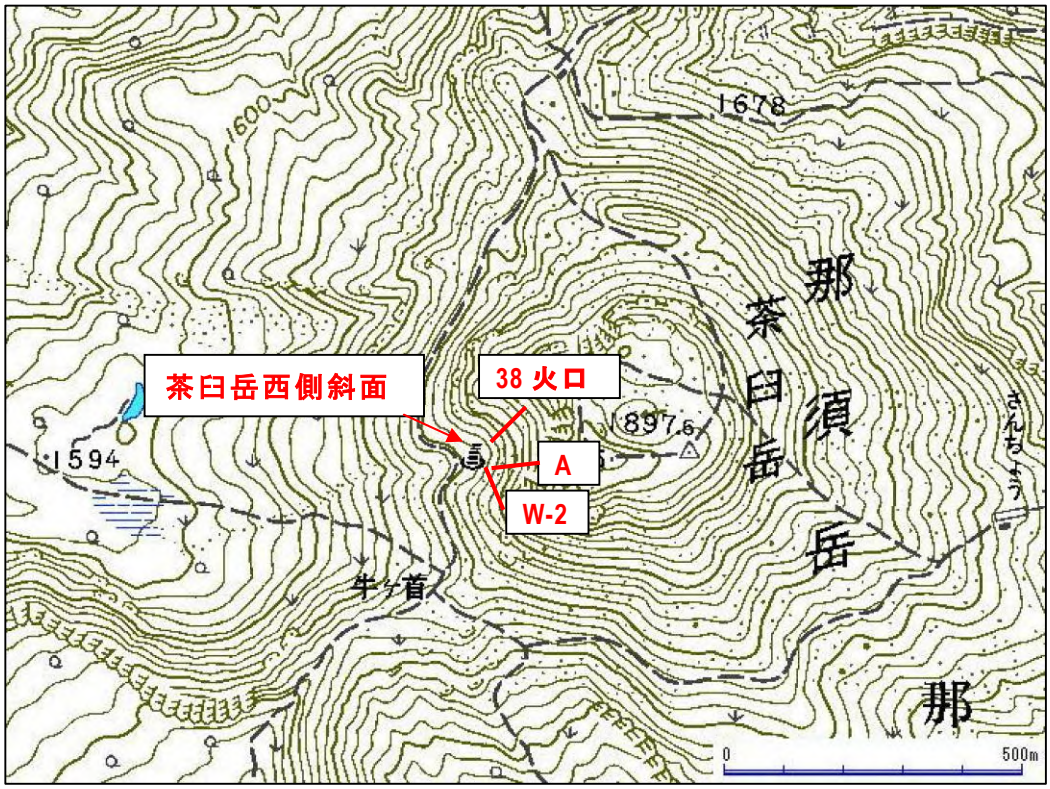


Figure 39-1 Topography around the crater of the west flank of the Nasu-Chausudake..
The 1:25,000 Scale Topographic Map (Nasudake) published by the Geospatial Information Authority of Japan was used.

Red Relief Image Map

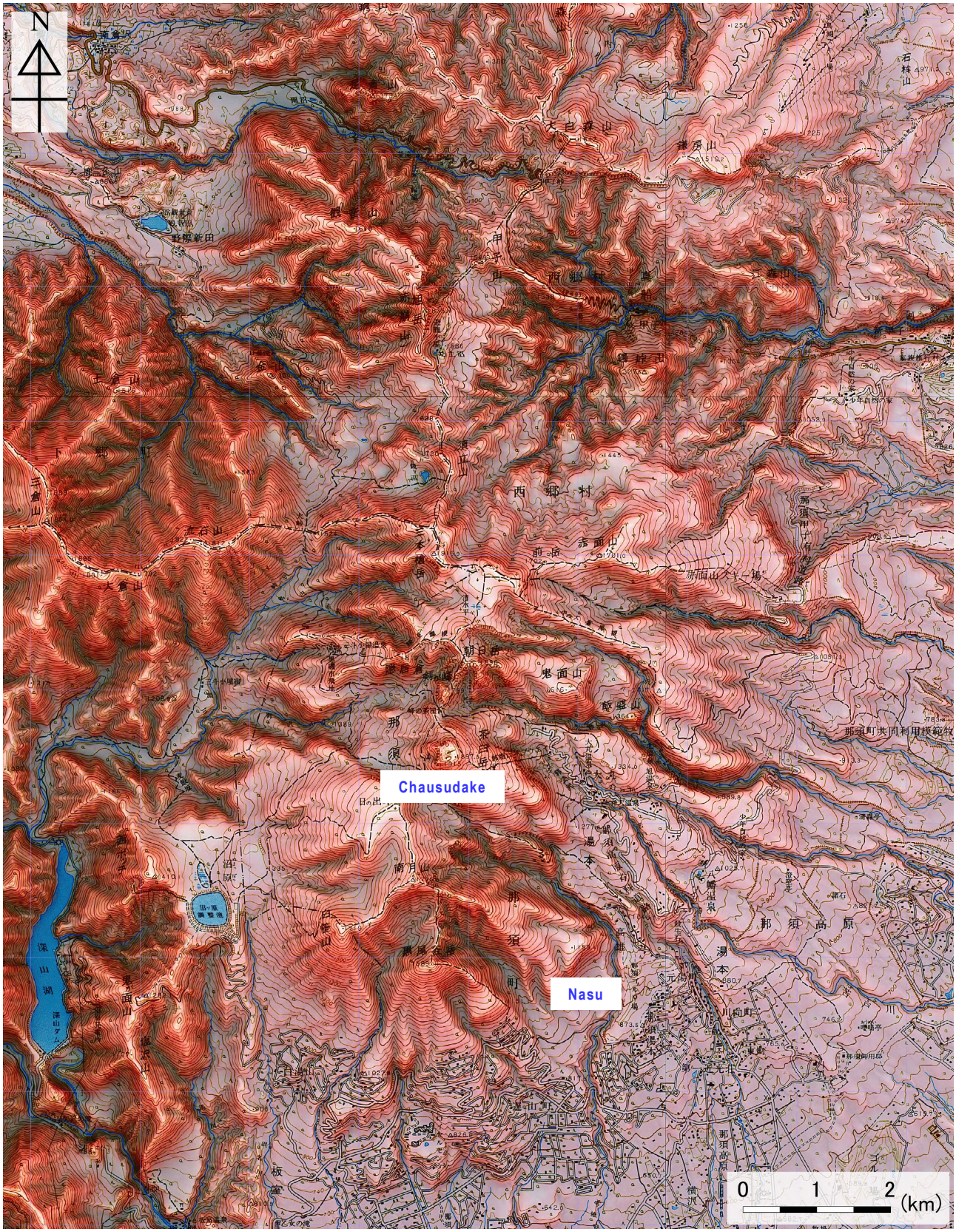


Figure 39-2 Topography of Nasudake.

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

Geological Map

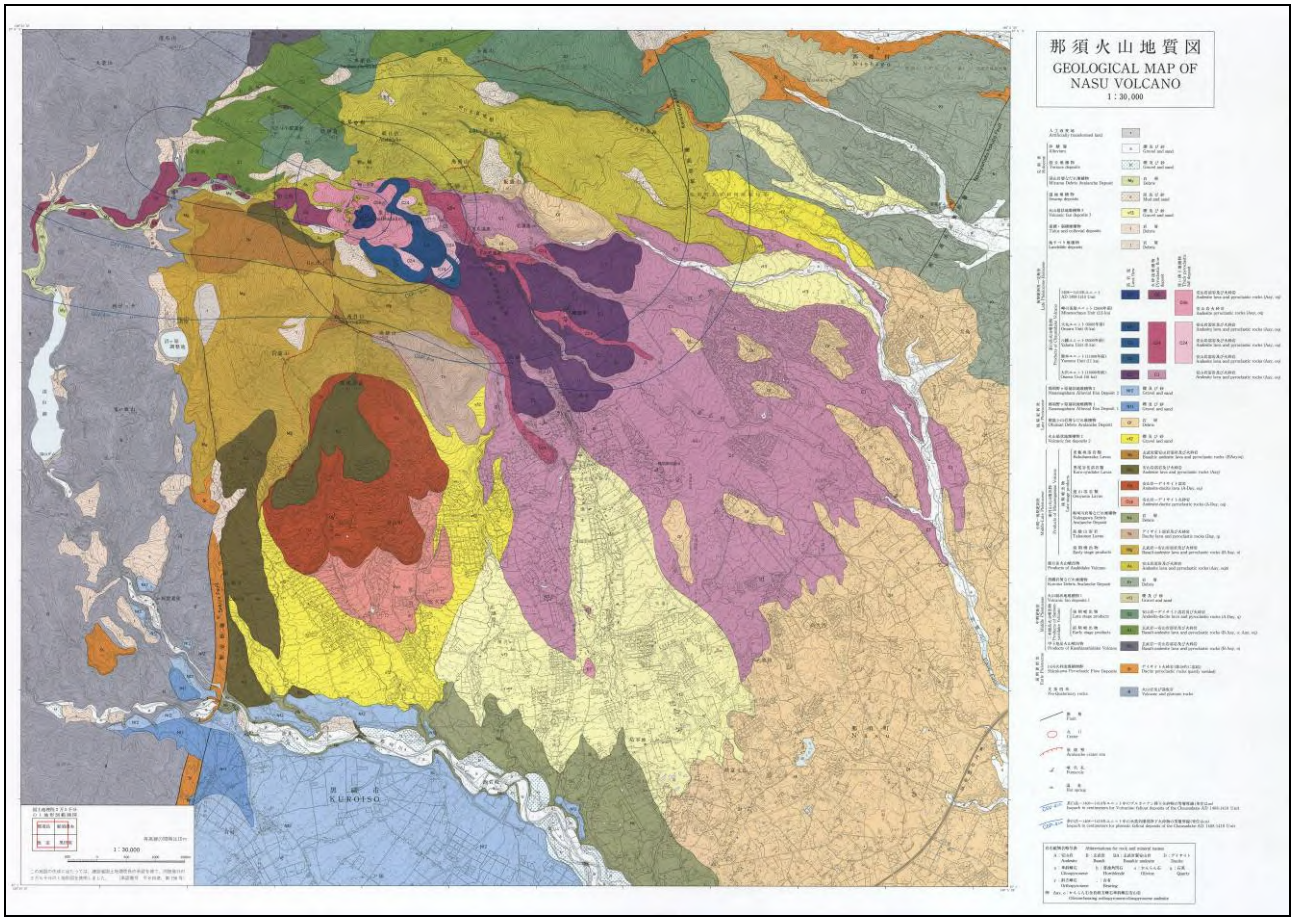


Figure 39-3 Geological map of Nasudake (Yamamoto and Ban, 1995).

Chronology of Eruptions

・Volcanic Activity in the Past 10,000 Years

Chausudake has remained active over the past 10,000 years. Three large events produced air-fall pyroclastic material, pyroclastic flows, and thick lava flows during the 5,000 years between approximately 11,000 and 6,000 years ago. During this period, the majority of the volcanic edifice was formed (Suzuki 1992; Yamamoto and Ban, 1997; Yamamoto, 1997). From approximately 6,000 years ago phreatic explosions have occurred every several hundred years, but approximately 2,600 years ago a relatively large event occurred, during which the summit pyroclastic cone was formed. After its formation, the volcano returned to recurring phreatic explosions. During the activity from 1408 to 1410 air-fall pyroclastic material and pyroclastic flows were discharged, and the Chausudake lava dome was formed. This was followed by repeated, small phreatic explosions. Swarms of seismic activity have occurred in the Nasudake area in recent years, but no relationship is identified between it and volcanic activity.

Period	Area of Activity	Eruption Type	Main Phenomena / Volume of Magma
9.8 ka	Chausudake	Phreatic eruption → magmatic eruption	Yahata unit eruption: Tephra fall → tephra fall, pyroclastic flow → lava flow. Magma eruption volume = 0.097 km^3 DRE. (VEI 4)
9←→7 ka	Chausudake	Phreatic eruption	Tephra fall.
7.3←→7 ka	Chausudake	Phreatic eruption → magmatic eruption	Omaru unit eruption: Tephra fall → tephra fall, pyroclastic flow → lava flow. Magma eruption volume = 0.11 km^3 DRE. (VEI 4)
7.3←→5.4 ka	Chausudake	Phreatic eruption	Tephra fall.
5.4←→2.5 ka	Chausudake	Phreatic eruption	Tephra fall.
5.4←→2.5 ka	Chausudake	Phreatic eruption	Tephra fall.
2.9←→2.5 ka	Chausudake	Phreatic eruption → magmatic eruption	Toge no Chaya unit eruption: Phreatic eruption → magmatic eruption. Magma eruption volume = 0.0026 km^3 DRE. (VEI 4)
2.9←→1.6 ka	Chausudake	Phreatic eruption	Tephra fall. (VEI 1)
2.9←→1.6 ka	Chausudake	Phreatic eruption	Tephra fall. (VEI 2)
2.9←→1.6 ka	Chausudake	Phreatic eruption	Tephra fall. (VEI 2)
2.9←→1.6 ka	Chausudake	Phreatic eruption	Tephra fall. (VEI 2)
1.9←→1.6 ka	Chausudake	Phreatic eruption	Tephra fall. (VEI 3)
1.9←→1.47 ka	Chausudake	Phreatic eruption	Tephra fall. (VEI 2)
1.9←→1.47 ka	Chausudake	Phreatic eruption	Tephra fall. (VEI 2)
1.9←→1.47 ka	Chausudake	Phreatic eruption	Tephra fall. (VEI 2)
0.8←→0.7 ka	West Chausudake to west mountain flank?	(Collapse)	Debris avalanche (more than 0.01 km^3).

* 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←→B: Eruption events taking place at some point between year A and year B

・Historical Activity

YearPeriod	Phenomenon	Activity Sequence, Damages, etc.
1408 to 1410 (Oei 15 to 17)	Moderate: Phreatic eruption (lahar) → magmatic eruption (lahar)	February 24 to March 5 of following year. Tephra fall, lahar → tephra fall / pyroclastic flow, lahar → lava flow. The eruptive activity occurred at Chausudake. The Naka River turned yellow. Over 180 people were killed. A large number of livestock were killed. Magma eruption volume = 0.041 km^3 DRE. (VEI 4)
1846 (Koka 3)	Phreatic eruption	August. The eruptive activity occurred at Chausudake (details unknown).
1881 (Meiji 14)	Small-scale: Phreatic eruption	July 1. Tephra fall. Rumbling, volcanic blocks, tephra fall. The eruptive activity occurred at the Mukan crater on the west side of the Chausudake summit, and on a crater on the northwest side. Fish were killed in the Naka River. (VEI 1)
1942 (Showa 17)	Fume	October to December. Increased fumarolic activity on the western flank of Chausudake.
1943 (Showa 18)	Fume	December. Increased fumarolic activity on the western flank.
1953 (Showa 28)	Phreatic eruption	October 24 and 29. Tephra fall. The eruptive activity occurred in the fumarolic area on the west side of Chausudake (the Mukan crater). An eruption occurred on the western flank of the old crater, and tephra fall reached 6 km to the south.
1960 (Showa 35)	Phreatic eruption	Approximately October 10. Tephra fall. The eruptive activity occurred in the fumarolic area on the west side of Chausudake. Volcanic block activity and tephra fall as far as 0.8 km to the north.
1963 (Showa 38)	Phreatic eruption	November 20. The eruptive activity occurred in the fumarolic area on the west side of Chausudake (the Mukan crater). A small explosion occurred at the Mukan fumarole on the western flank. Tephra fall. Tephra fall in the nearby area.
1977 (Showa 52)	Earthquake	January 30 to 31. The largest earthquake as an M3.7 earthquake at 23:25 on January 30. 4 felt-earthquakes occurred in Kuroiso (maximum JMA scale seismic intensity of 3). The hypocenters were located at the foot of the volcano, approximately 10 km to southwest of the summit.
1985 (Showa 60)	Earthquake	September to December. Earthquake swarms and felt-earthquakes at northern foot of the volcano from September 9 to 12 and September 27 to 29 (maximum JMA scale seismic intensity of 3 in Shimogo, Fukushima Prefecture, etc.), Earthquake swarms at northern foot of the volcano on December 16, M4.4. Felt-earthquakes (JMA scale seismic intensity of 2 in Wakamatsu).
1986 (Showa 61)	Earthquake	March, July. Earthquake swarms at locations several km north of summit on March 12. M4.4, felt-earthquakes (JMA scale seismic intensity of 4 in Omaru). Earthquake swarms at southwestern foot of the volcano, with a maximum magnitude of M4.1, from July 1 to 3. Felt-earthquakes (JMA scale seismic intensity of 2 in Wakamatsu, Shirakawa, and at Nasu volcano observatory).

* 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.

Whole Rock Chemical Composition

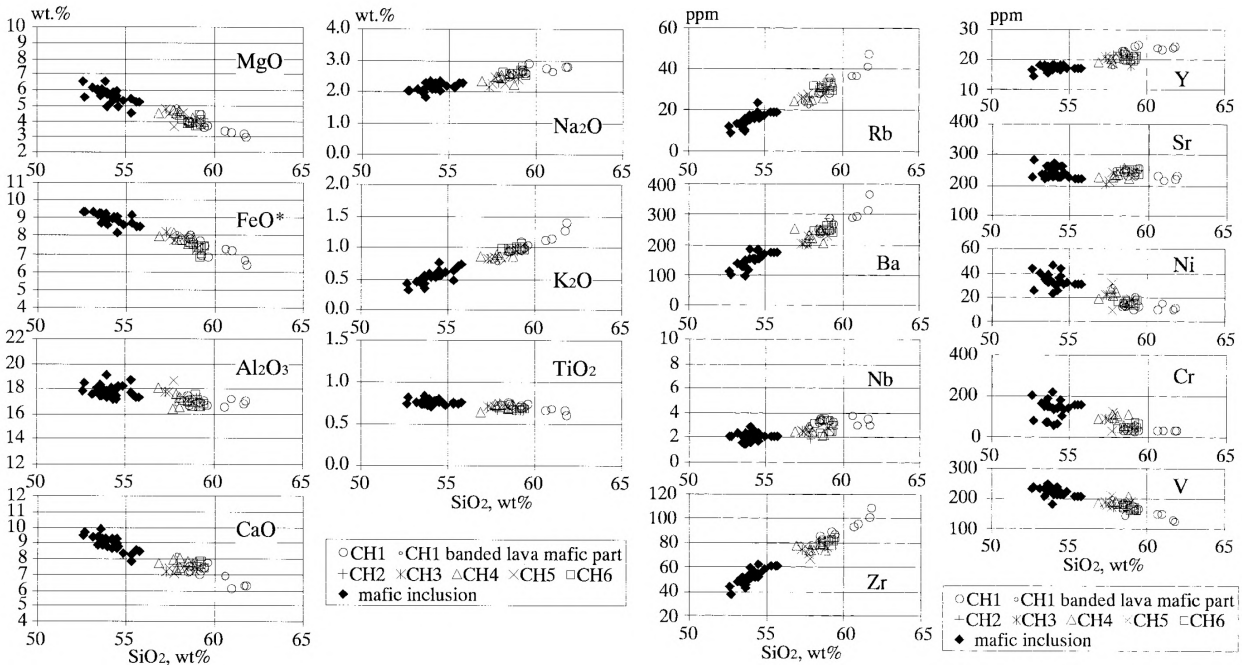


Figure 39-4 Whole rock chemical composition (Ban and Yamamoto, 2002).

Period - Cumulative Magma Volume

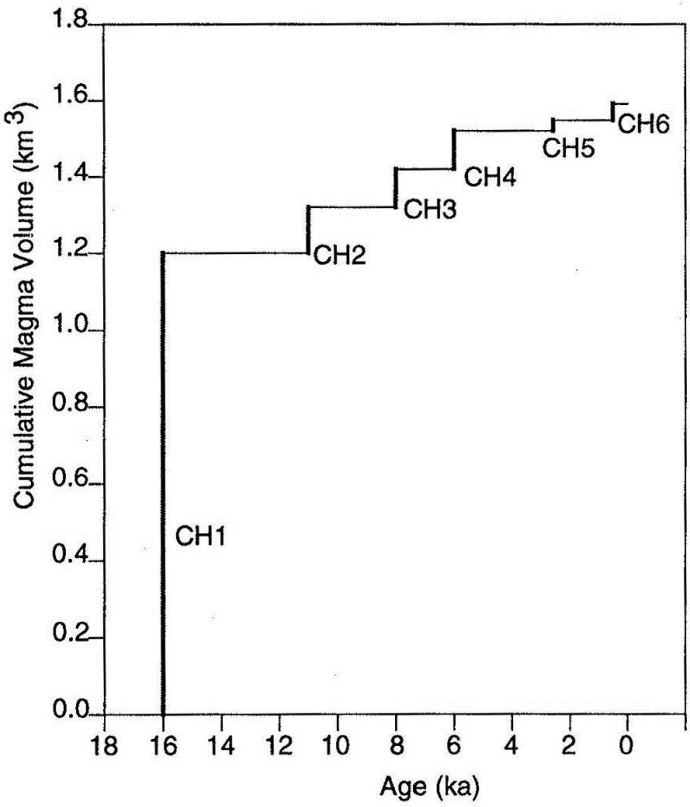


Figure 39-5 Period - cumulative magma volume (Yamamoto, 1997).

CH1 to CH6 indicate magmatic eruption units.

CH1: Ozawa unit, CH2: Yumoto unit, CH3: Yahata unit, CH4: Omaru unit,

CH5: Toge no Chaya unit, CH6: 1408 to 1410 eruption

Recent Volcanic Activity

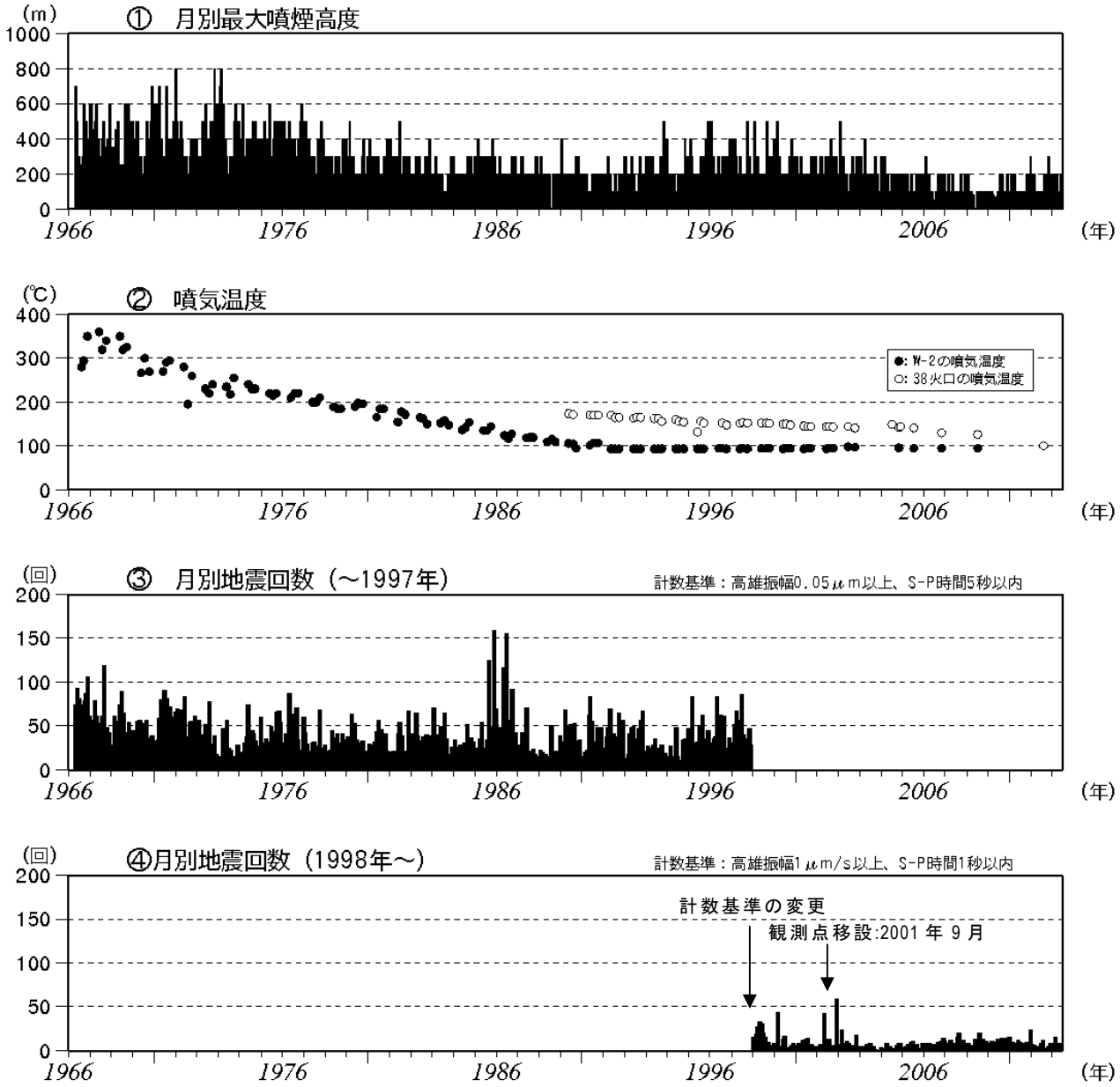


Figure 39-6 Time series of Volcano activity (January, 1966, to June 30, 2012).

① Maximum plume height by regular observation (at 9:00 and 15:00, JST)

② Fume temperature (see Figures 2 and 3)

③ Monthly earthquakes in and around Nasudake (at station; A S-P ≤ 5 seconds, 1997 and earlier)

④ Monthly earthquakes in and around Nasudake (at station; A S-P ≤ 1 second, after 1998)

Fumes are active, but few earthquakes are observed, and volcanic activity is calm.

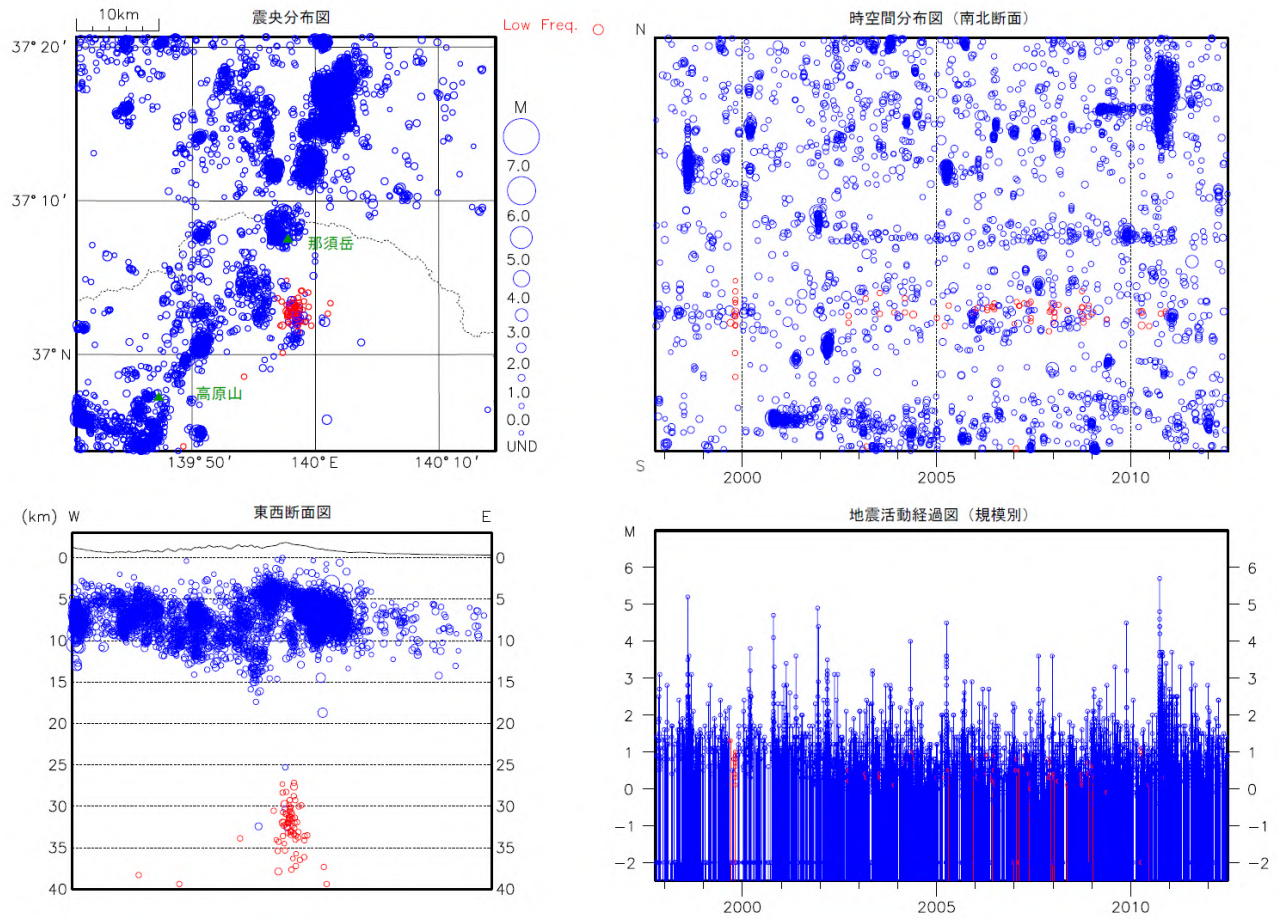


Figure 39-7 Activity of shallow VT earthquakes (blue circles) and deep low-frequency earthquakes (red circles) observed by a regional seismometer network (October 1, 1997, to June 30, 2012). Epicenter distribution (upper left), space-time plot (N-S cross-section) (upper right), E-W cross-section (lower left) and magnitude-time diagram (by scale) (lower right).

Information on Disaster Prevention

①Hazard Map

Nasudake Volcano Disaster Prevention Map (Revised Version)

March, 2010 (Heisei 22) - Compiled by the Nasudake Volcano Disaster Prevention Committee

- Name of Source

  Nasudake Volcano Disaster Prevention Map (Revised Version)

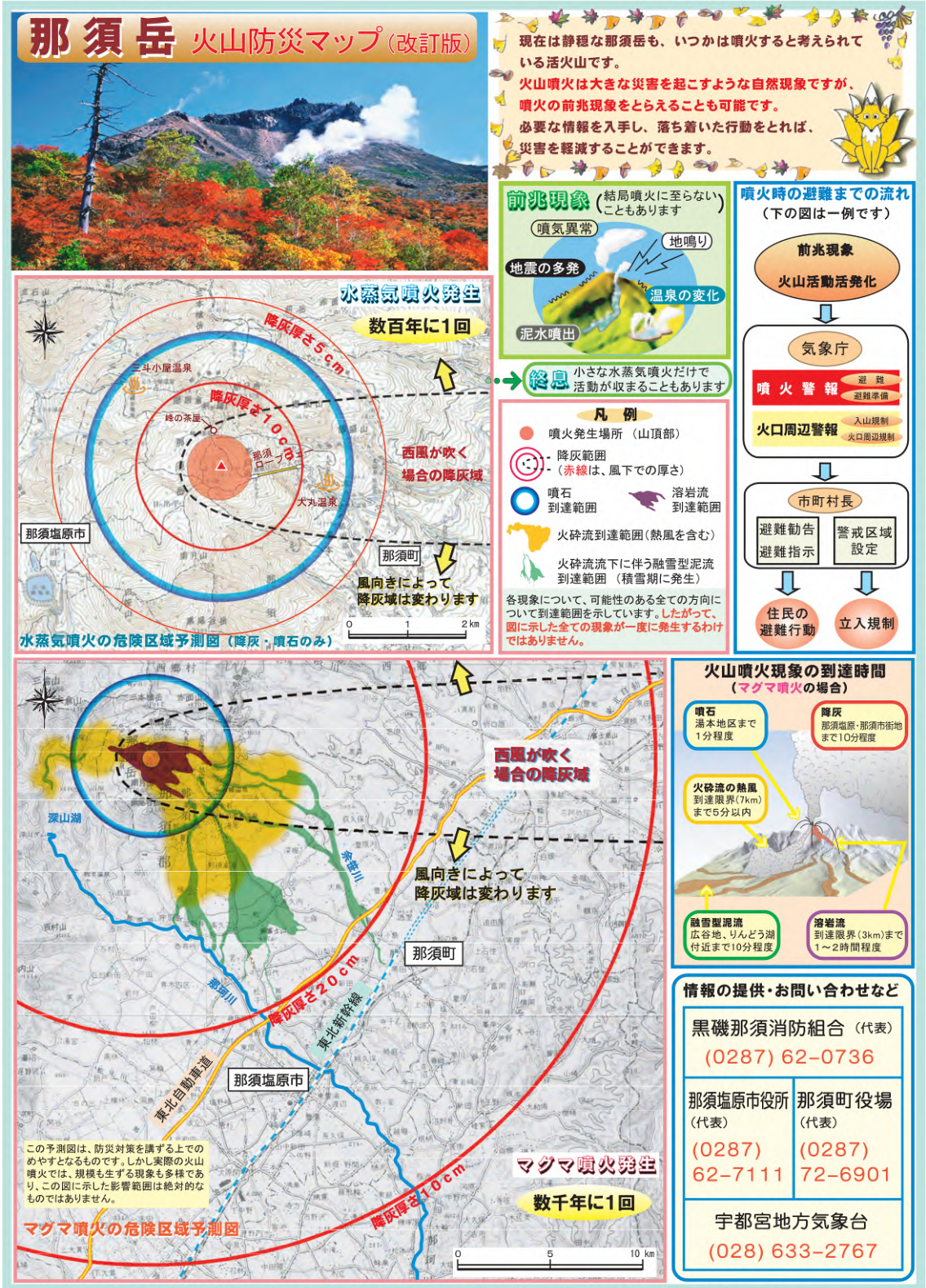
- Created

  Revised March, 2010 (Heisei 22)

- Created by (in the event of creation by committee, names of institutions that are members of the committee):

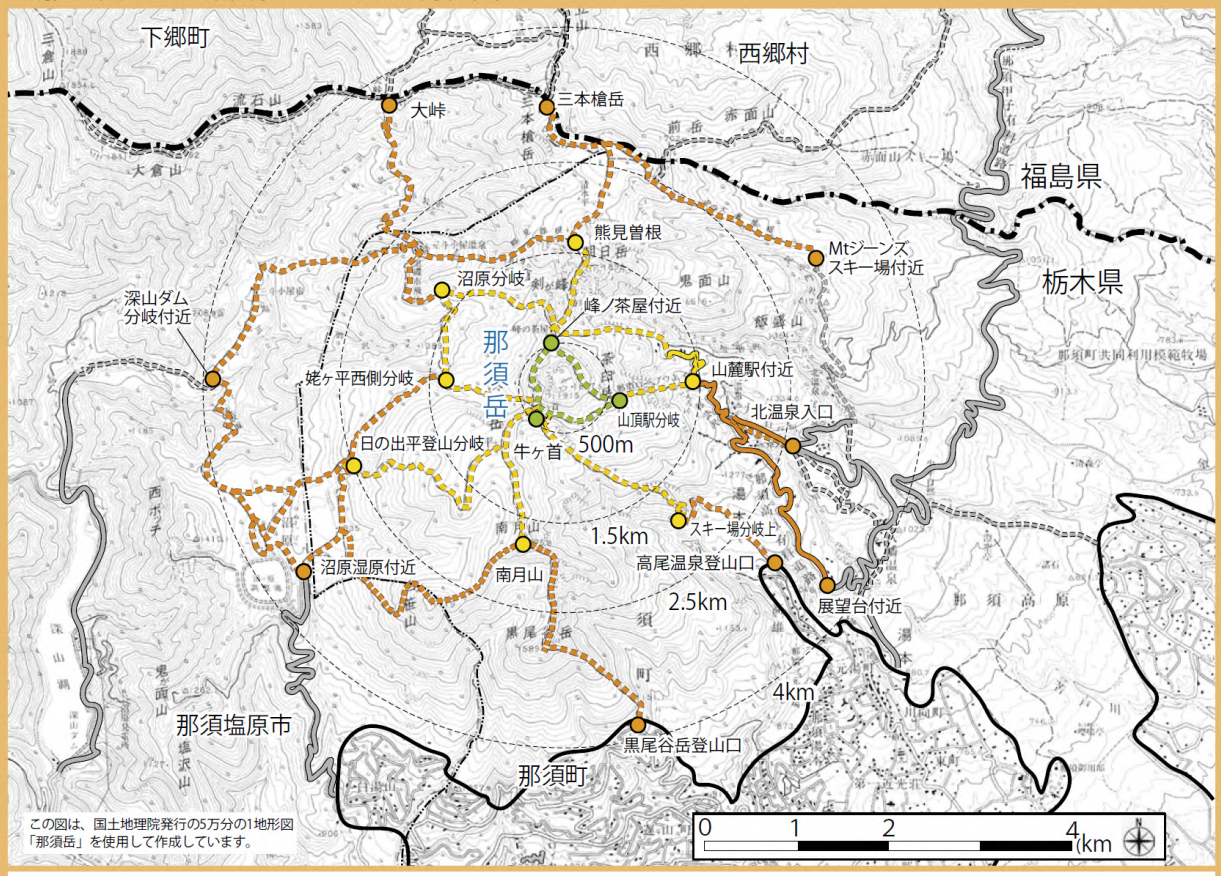
  Nasudake Volcano Disaster Prevention Committee (Nasu Town, Nasushiobara City, Tochigi Prefecture)

  http://www.pref.tochigi.lg.jp/c02/system/honchou/honchou/nasumap.html


那須岳 火山防災マップ（改訂版）
現在は静穏な那須岳も、いつかは噴火すると考えられている活火山です。
火山噴火は大きな災害を起こすような自然現象ですが、噴火の前兆現象をとらえることも可能です。
必要な情報を入手し、落ち着いた行動をとれば、災害を軽減することができます。
前兆現象（結局噴火に至らないこともあります）
噴気異常
地鳴り
地震の多発
温泉の変化
泥水噴出
終息 小さな水蒸気噴火だけで活動が収まることもあります
噴火時の避難までの流れ
（下の図は一例です）
前兆現象
火山活動活発化
気象庁
噴火警報
避難
避難準備
火口周辺警報
入山規制
火口周辺規制
市町村長
避難勧告
避難指示
警戒区域設定
住民の避難行動
立入規制
水蒸気噴火発生
数百年に1回
降灰厚さ5cm
降灰厚さ10cm
三斗小屋温泉
峰の茶屋
那須ロープウェー
大丸温泉
西風が吹く場合の降灰域
那須塩原市
那須町
風向きによって降灰域は変わります
水蒸気噴火の危険区域予測図（降灰・噴石のみ）
凡例
噴火発生場所（山頂部）
降灰範囲
（赤線は、風下での厚さ）
噴石到達範囲
溶岩流到達範囲
火砕流到達範囲（熱風を含む）
火砕流流下に伴う融雪型泥流到達範囲（積雪期に発生）
各現象について、可能性のある全ての方向について到達範囲を示しています。したがって、図に示した全ての現象が一度に発生するわけではありません。
火山噴火現象の到達時間
（マグマ噴火の場合）
噴石 湯本地区まで1分程度
降灰 那須塩原・那須市街地まで10分程度
火砕流の熱風 到達限界(7km)まで5分以内
融雪型泥流 広谷地、りんどう湖付近まで10分程度
溶岩流 到達限界(3km)まで1～2時間程度
西風が吹く場合の降灰域
深山湖
余笹川
風向きによって降灰域は変わります
那須町
那須川
降灰厚さ20cm
東北新幹線
東北自動車道
那須塩原市
この予測図は、防災対策を講ずる上でのめやすとなるものです。しかし実際の火山噴火では、規模も生ずる現象も多様であり、この図に示した影響範囲は絶対的なものではありません。
マグマ噴火発生
数千年に1回
降灰厚さ10cm
マグマ噴火の危険区域予測図
情報の提供・お問い合わせなど
黒磯那須消防組合（代表）
(0287) 62-0736
那須塩原市役所（代表）
(0287) 62-7111
那須町役場（代表）
(0287) 72-6901
宇都宮地方気象台
(028) 633-2767
平成22年3月改訂版発行（平成14年3月初版発行）　発行：那須岳火山防災協議会（那須町・那須塩原市・栃木県）　編集：那須岳火山防災マップ検討委員会　印刷：砂川印刷所
このマップの基図は、国土地理院長の承認を得て、同院発行の20万分の1地勢図および5万分の1地形図を複製したものです（承認番号　平13総複、第338号）。また、鳥瞰図については、国土地理院長の承認を得て同院発行の数値地図50mメッシュ（標高）を使用し（承認番号　平13総使、第436号）、ソフトウェア「KASHMIR 3D」で作成いたしました。

②Volcanic Alert Levels (Used since March 31, 2009)

■那須岳　噴火警戒レベルと規制範囲



●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等。
レベル4（避難準備）：警戒が必要な居住地域での避難準備。
レベル3（入山規制）：山頂から2.5km程度内の立入規制。
　県道 ═══ 、登山道 ┅┅┅ は通行できません。
レベル2（火口周辺規制）：山頂から1.5km程度内の立入規制。
　県道 ═══ 、登山道 ┅┅┅ は通行できません。
レベル1（平常）：状況に応じて火口内への立入規制等。
　登山道等 ┅┅┅ は通行できません。

一般道路：　行政区画境界：　主な規制地点：●●●
登 山 道：　居 住 地 域：

■この図は「那須岳火山防災マップ」（那須町、那須塩原市、栃木県、平成14年3月）に基づき作成しています。
■那須岳の噴火警戒レベルは、地元自治体等と調整して作成しました。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、詳細については那須町、那須塩原市、下郷町、西郷村にお問い合わせください。

Volcanic Alert Levels for the Nasudake Volcano (Valid as of March, 2009)

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 pyroclastic and/or lahar by melted snow reaching residential areas. Alternatively, eruption or imminent eruption scattering volcanic blocks up to approximately 4 km. Past Examples 1410: A vulcanian eruption occurred, with a pyroclastic flow reaching approximately 8 km away, and producing a lahar flow
		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.**	●Frequent small to moderate eruptions, with high possibility of eruptions creating pyroclastic flows and/or lahar by melted snows (during the winter) which reach residential areas, or eruptions scattering volcanic blocks up to approximately 4 km. Past Examples 1408 to 1410: Frequent phreatic eruptions
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.**	●Moderate eruption in summit area, scattering volcanic blocks within a distance of approximately 2.5 km. Past Examples 1881: Phreatic eruption ●Possibility of moderate eruption. Past Examples No past examples
	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 in the summit area, scattering volcanic blocks within a distance of approximately 1.5 km. Past Examples No past examples ●Very small eruptions with possibility of small eruption. Past Examples Eruption of 1953
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 crater interior and nearby area.

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

Social Circumstances

①Populations

- Nasu Town: 26,450 (as of October, 2010 - Tochigi Prefecture)
- Nasushiobara City: 117,347 (as of October, 2010 - Tochigi Prefecture)
- Nishigo Village: 19,674 (as of October, 2011 - Fukushima Prefecture)
- Shimogo Town: 6,461 (as of October, 2010 - Fukushima Prefecture)
- Tenei Village: 5,994 (as of October, 2011 - Fukushima Prefecture)
- Minamiaizu Town: 18,341 (as of October, 2011 - Fukushima Prefecture)

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

- Nikko National Park

  Number of mountain-climbers: Nasudake: Approx. 110,000 (2011)

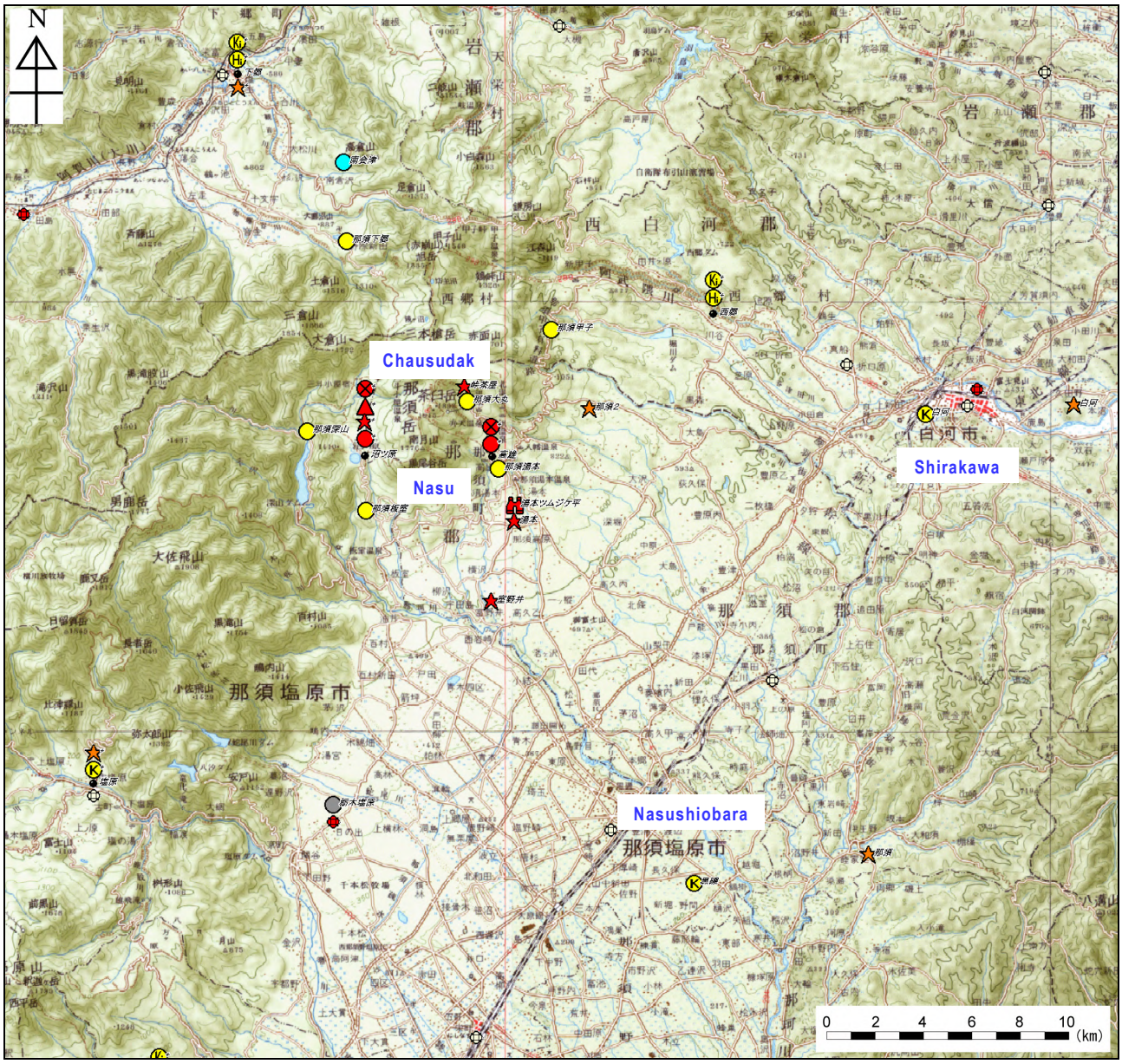
③Facilities

- Nasu Kogen Visitor Center

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 (Nikko and Shirakawa) published by the Geospatial Information Authority of Japan were used.

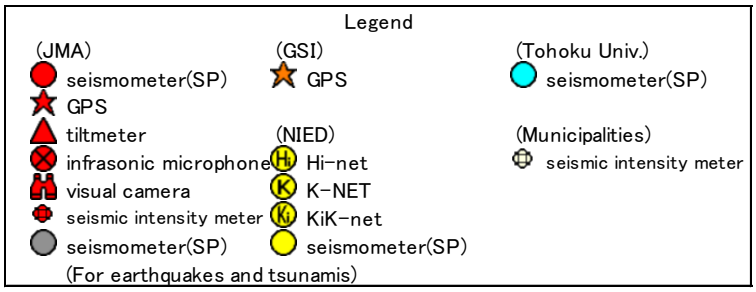
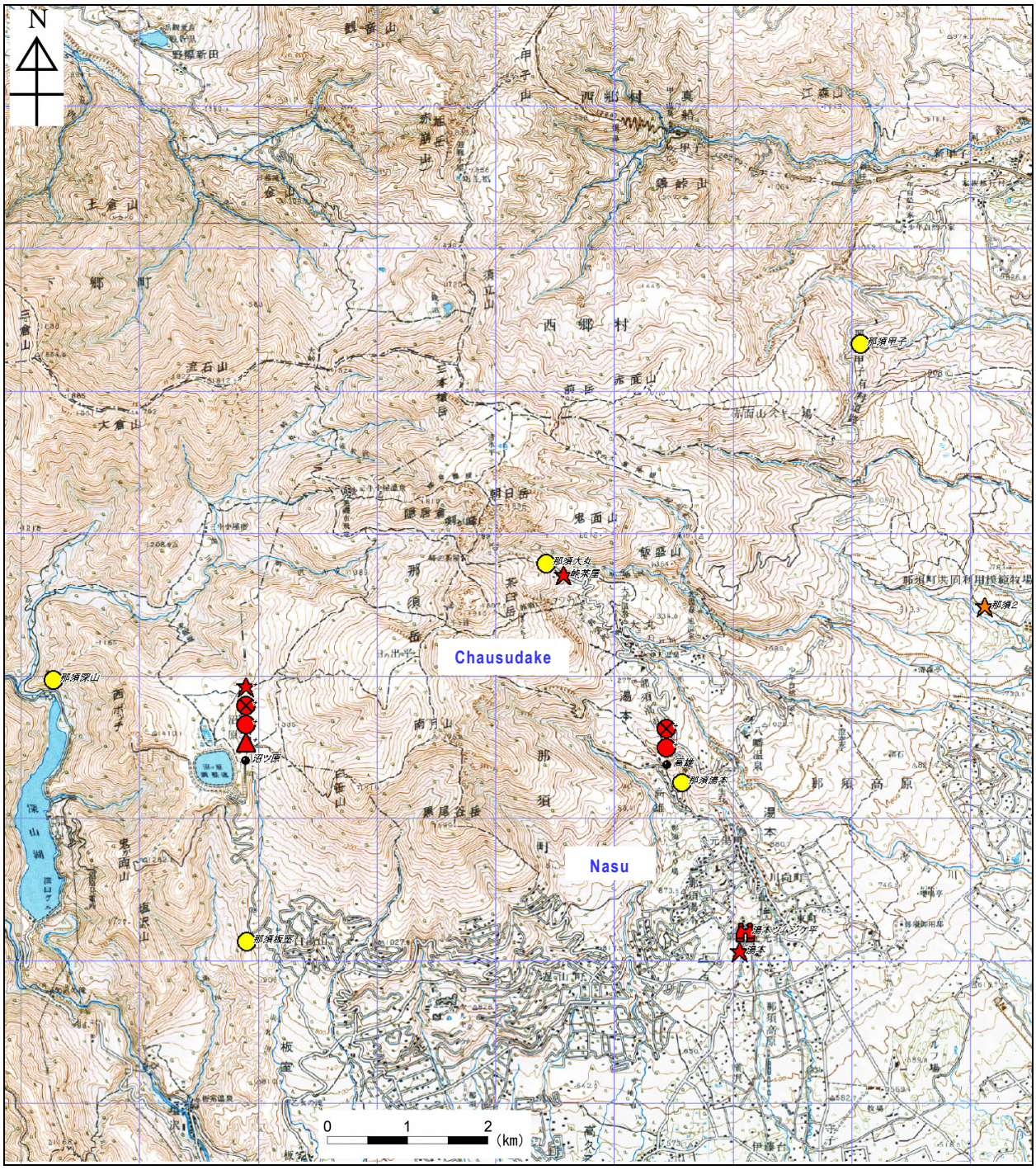


Figure 39-8 Regional monitoring network.

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 (Nasudake and Shirakawa) published by the Geospatial Information Authority of Japan were used.

Legend

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

(GSI)
- GPS

(NIED)
- seismometer(SP)

Figure 39-9 Local monitoring network.

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