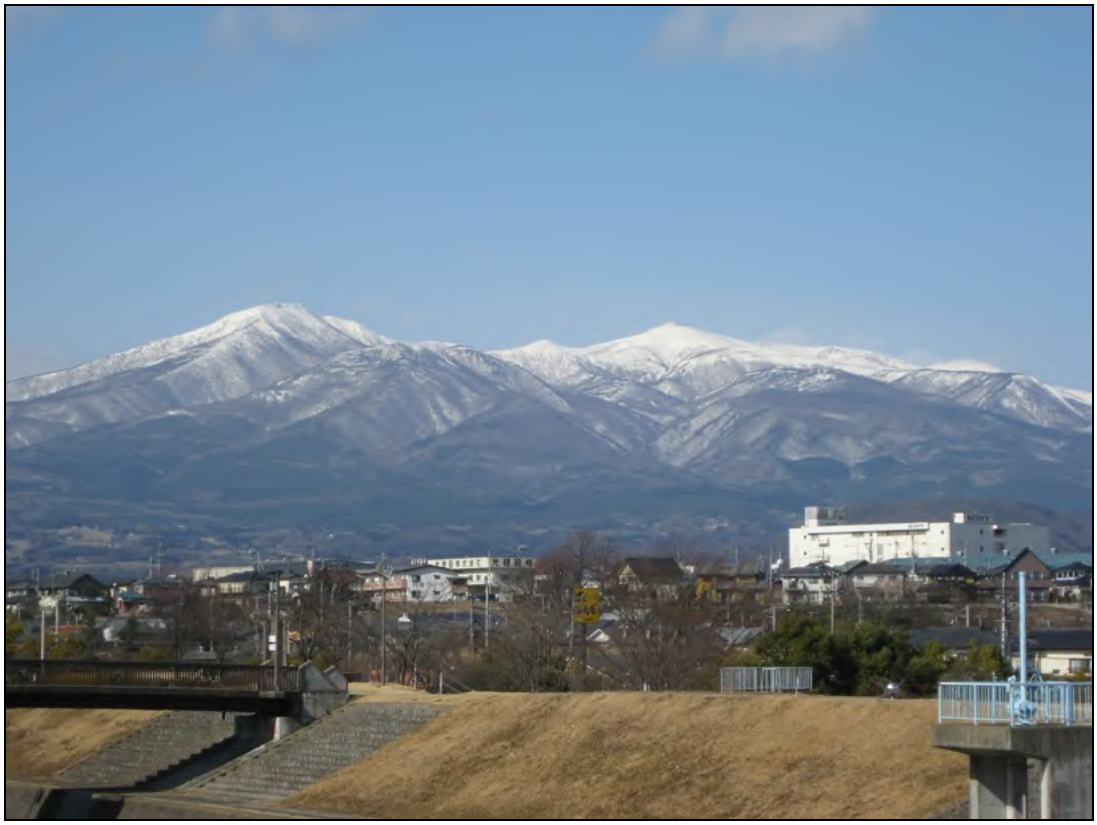
35. Adatarayama

Continuously Monitored by JMA

Latitude: 37°37'59" N, Longitude: 140°16'59" E, Elevation: 1,709 m
(Tetsuzan) (GSI Measuring Point)
Latitude: 37°38'50" N, Longitude: 140°16'51" E, Elevation: 1,728 m
(Minowasan) (Elevation Point)



Overview of Adatarayama,taken from Motomiya City on February 7, 2009 by the Japan Meteorological Agency.

Summary

Adatarayama is a basalt-andesite stratovolcano group, stretches 9 km east-west and 14 km north-south. It is located on the southwest side of Fukushima City. Peaks such as Kimenzan, Minowayama, Tetsuzan, Adatarayama (also known as Chikubiyama or Chichikubiyama), and Oshoyama are located from north to south at its summit. The Numanotaira crater (1.2 km in diameter, and 150 m deep), which opens to the west, is located at the summit of Adatarayama main edifice. The only eruptive activity with clear documentary records occurred at the Numanotaira crater since the Meiji Period. Fumes and hot springs are located inside and around the crater.

The main volcanic activity of Adatarayama began with large pyroclastic flow discharges. The activity of Kimenzan and others approximately 450,000 to 550,000 years ago was followed by the activity around Maegadake approximately 350,000 years ago (Fujinawa, 1980; Fujinawa et al., 2001). Approximately 250,000 years ago the main volcanic chain, from Minowasan to Oshozan, was formed. The magma discharge rate was the highest during this period, with an estimated 0.1km^3 per 1,000 years (Sakaguchi, 1995; Yamamoto and Sakaguchi, 2000). From approximately 120,000 years ago to approximately 30,000 years ago small magmatic discharges occurred repeatedly at intervals of 10,000 to 20,000 years. 10,000 years ago magmatic and phreatic eruptions occurred repeatedly. The latest magmatic eruption was approximately 2,400 years ago (Yamamoto, 1998; Yamamoto and Sakaguchi,, 2000). The basalt-andesite is composed of 52.0 to 62.0 wt% of SiO_2. The volcano is also known as Dakeyama.

Photos

Numanotaira Crater, taken from the northwest side on October 23, 2004 by the Japan Meteorological Agency.

Numanotaira Crater, taken from the north side on July 19, 2012 by the Japan Meteorological Agency.

Topography around the Crater

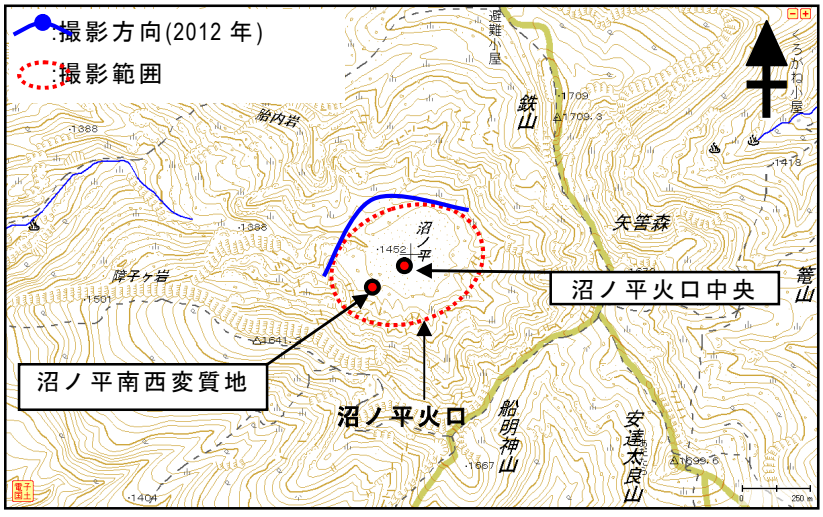


Figure 35-1 Topography of the summit area.

Red Relief Image Map

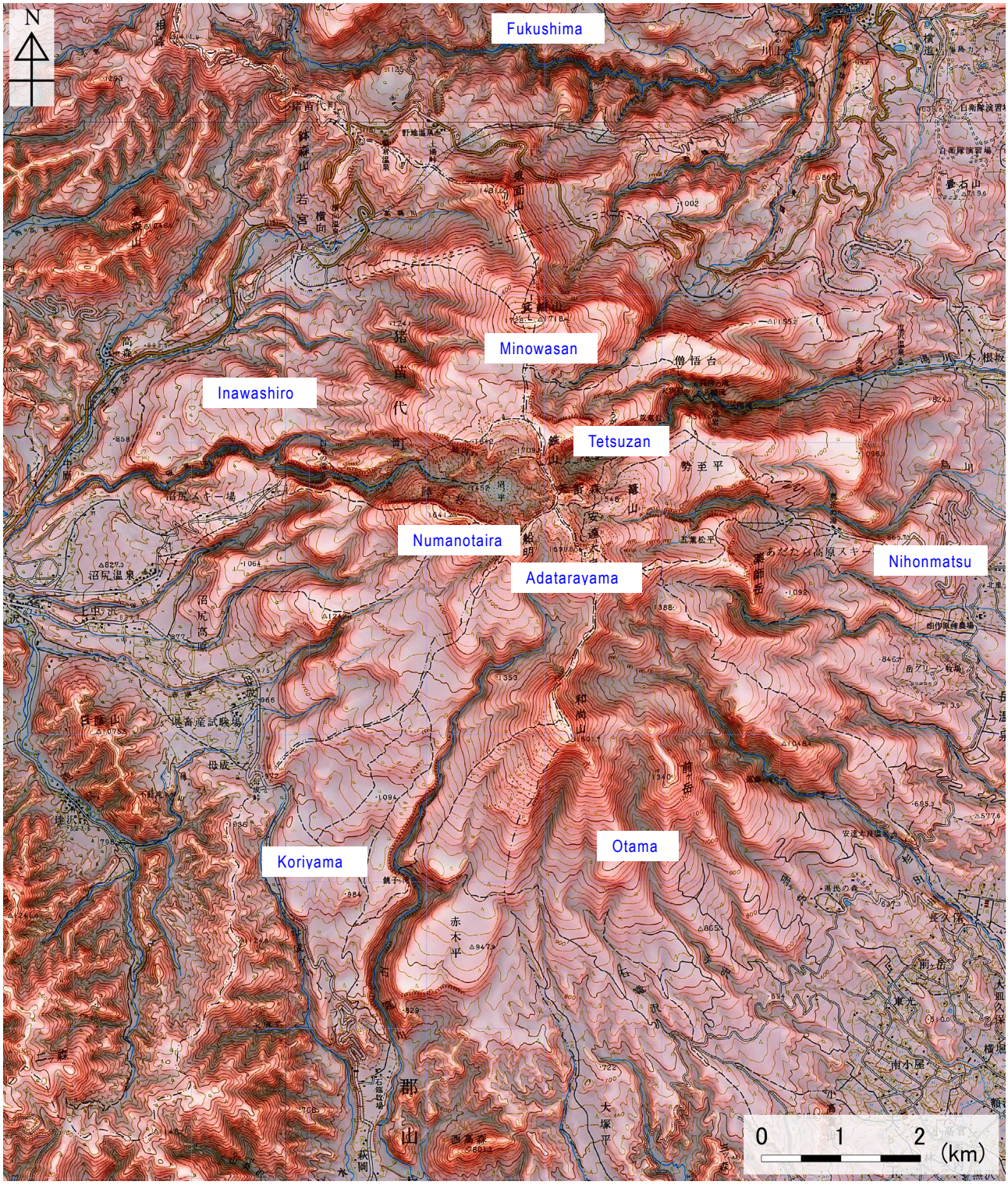


Figure 35-2 Topography of Adatarayama.

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

Chronology of Eruptions

・Volcanic Activity in the Past 10,000 Years

In the past 10,000 years, medium scale eruptions with magma discharges on the order of 10^7 m^3 have occurred, separated by intervals of 500 to 1,500 years. The last magmatic eruption occurred approximately 2,400 years ago (Yamamoto and Sakaguchi, 2000).

Period	Area of Activity	Eruption Type	Main Phenomena / Volume of Magma
10ka	Numanotaira crater	Magmatic eruption	Ad-NT1 eruption: Tephra fall.
8.7←→8.5ka	Numanotaira crater	Magmatic eruption	Ad-NT2 eruption: Tephra fall.
8.2←→8ka	Numanotaira crater	Magmatic eruption	Ad-NT3 eruption: Tephra fall.
7.1←→5.4ka	Numanotaira crater	Magmatic eruption	Ad-NT4 eruption: Tephra fall.
4.6←→4.5ka	Numanotaira crater	Phreatic eruption, magmatic eruption	Ad-NT5 eruption: Tephra fall.
4.6←→2.4ka	?	Phreatic eruption	Tephra fall.
4.6←→2.4ka	?	Phreatic eruption	Tephra fall.
2.8←→2.4ka	Numanotaira crater	Phreatic eruption (lahar production) → magmatic eruption	Ad-NT6 eruption: Tephra fall, lahar.
2.8←→1ka		Phreatic eruption	Tephra fall.
1ka	Numanotaira crater	Phreatic eruption	Tephra fall.

* 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.

A←→B: Eruptive events taking place at some point between year A and year B.

▪ Historical Activity

Year	Phenomenon	Activity Sequence, Damages, etc.
1899 (Meiji 32)	Phreatic eruption	Tephra fall. The eruptive activity occurred at the Numanotaira crater. Volcanic activity increased from the start of the year, and the number of fumaroles and amount of fume emission increased greatly. On August 24 a loud sound and discharge of volcanic flame were observed from fumaroles in Numanotaira. On August 25 the fumarole rim collapsed, ejecting ash and sulfurous mud. From November 11 to 12 a black volcanic plume and blocks of 20-400 kg were discharged from the same location. As the result, a depression of 10,000 m^2 was formed at the crater floor.
1900 (Meiji 33)	Moderate: Phreatic eruption	Tephra fall, low temperature pyroclastic surge. The volcanic activity might be kept at a high level, ejecting a small amount of ash and blocks, from the preceeding year. The eruptive activity occurred at the Numanotaira crater on July 17. Hot ash and blocks of $1.1x10^6$ m^3 were discharged. A 300 m long, 150 m wide crater was formed. By the ejecta a sulfur mine located in the crater was completely destroyed, and 72 workers were killed and 10 were injured. (VEI 2)
1950 (Showa 25)	Volcanic plume	February 25. Volcanic plume rose up to 50 m.
1995 (Heisei 7)	Volcanic tremo	October 27 and November 10.
1996 (Heisei 8)	Mud discharge	June. Muddy water discharge was confirmed at the center of Numanotaira. This was followed by a gradual increase in geothermal activity and expansion of fumarolic and geothermal areas. Muddy water discharges were occasionally repeated afterward.
1997 (Heisei 9)	Volcanic gas	September. 4 climbers were killed by volcanic gas inside the Numanotaira crater.
1998 to 2003 (Heisei 10 to 15)	Geothermal activity, fume, muddy water discharge	Increased geothermal activity at Numanotaira. The fumarolic activity increased and the geothermal areas expanded toward their peaks in 2000-2001. An overflow of muddy water was confirmed on April 27, 1999. Fumes reached a height of 300 m in 2001. Demagnetization and magnetization were observed together with the increase and decrease in geothermal activity on the crater floor.

* 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

▪ 1900 Eruption

On July 17, 1900, approximately 16:00, one small explosion occurred at the center of Numanotaira. From 18:00 to 18:30 three explosions successively occurred. A new, oval-shaped crater (150 m x 300 m, 30 to 40 m deep) was formed on the floor of the old crater, which later became a crater lake. A pyroclastic surge accompanied the fourth explosion and ran along logawa (Sulfur River). 72 workers at the sulfur refinery in the crater were killed by ejected blocks and the pyroclastic surge. The total volume of erupted materials is estimated to be about $1x10^6$ m^3, including ash fall deposits of $7.6x10^5$ m^3 and pyroclastic deposits of $2.9x10^5$ m^3.

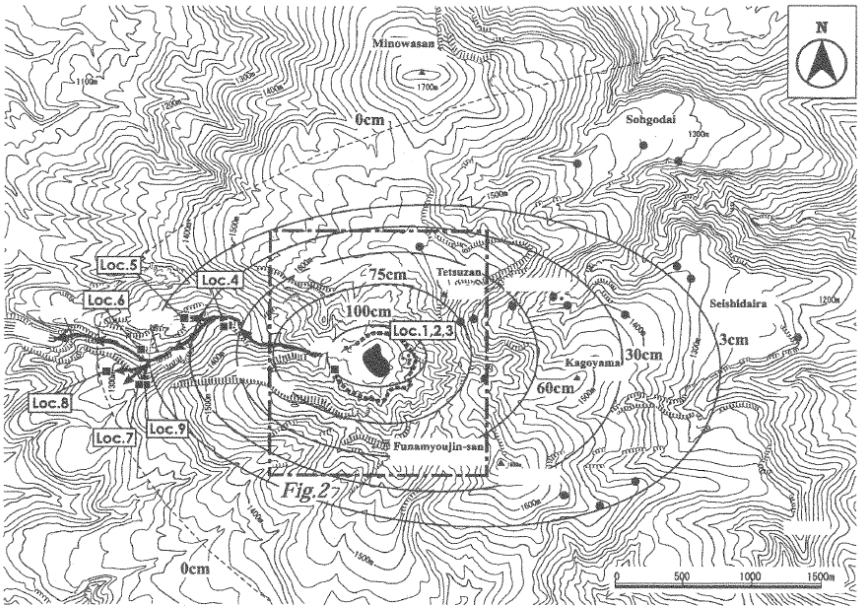


Figure 35-3 Flows and deposits of pyroclastics discharged by the 1900 eruption (Fujinawa et al., 2006).
Solid lines with arrows and black rectangles show the flow lines and outcrops of deposits of the pyroclastic surge, respectively. Oval-shaped curves are the roughly inferred isopach contours of air-fall ash. The solid, roughly oval-shaped area is the crater newly formed by the eruption.

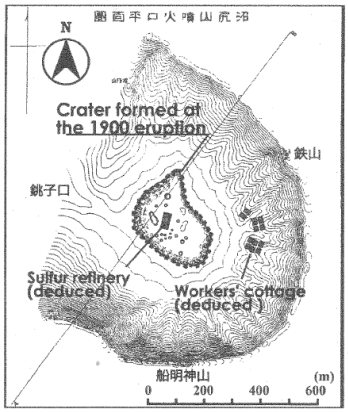


Figure 35-4 Locations of the crater formed by the 1900 eruption, a sulfur refinery, and worker's housing (Fujinawa et al., 2006).

Precursory Phenomena

From the spring of 1899 geothermal activity was high inside the Numanotaira crater before the 1900 eruption. Although it did not culminate in an eruption, from roughly 1996 to 2003 the amount of inflation, thermal demagnetization, and geothermal activity increased in the crater area.

Recent Volcanic Activities

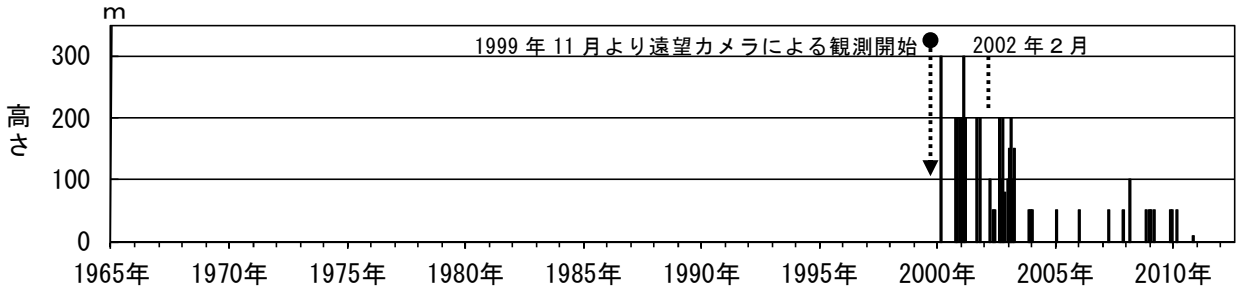


Figure 35-5 Maximum fume height per month at Adatarayama (Numanotaira) (November, 1999, to June, 2012). Fumarolic activity was high within the Numanotaira crater in 2000, but became calm by 2004.

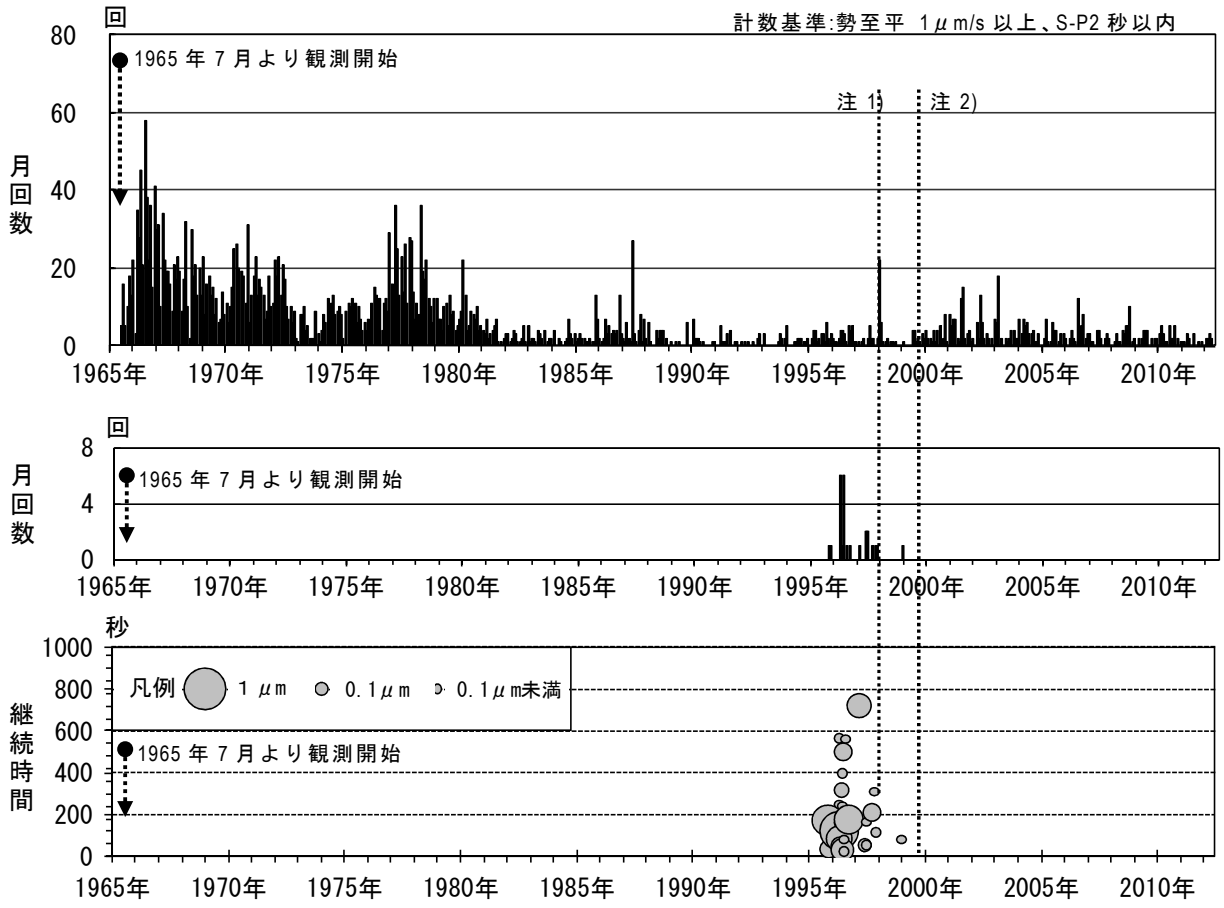


Figure 35-6 Seismic activity (July, 1965, to June, 2012). Number of earthquakes per month (top), number of tremor events per month (middle), duration (vertical axis) and maximum amplitude (circle radius) of tremor events.

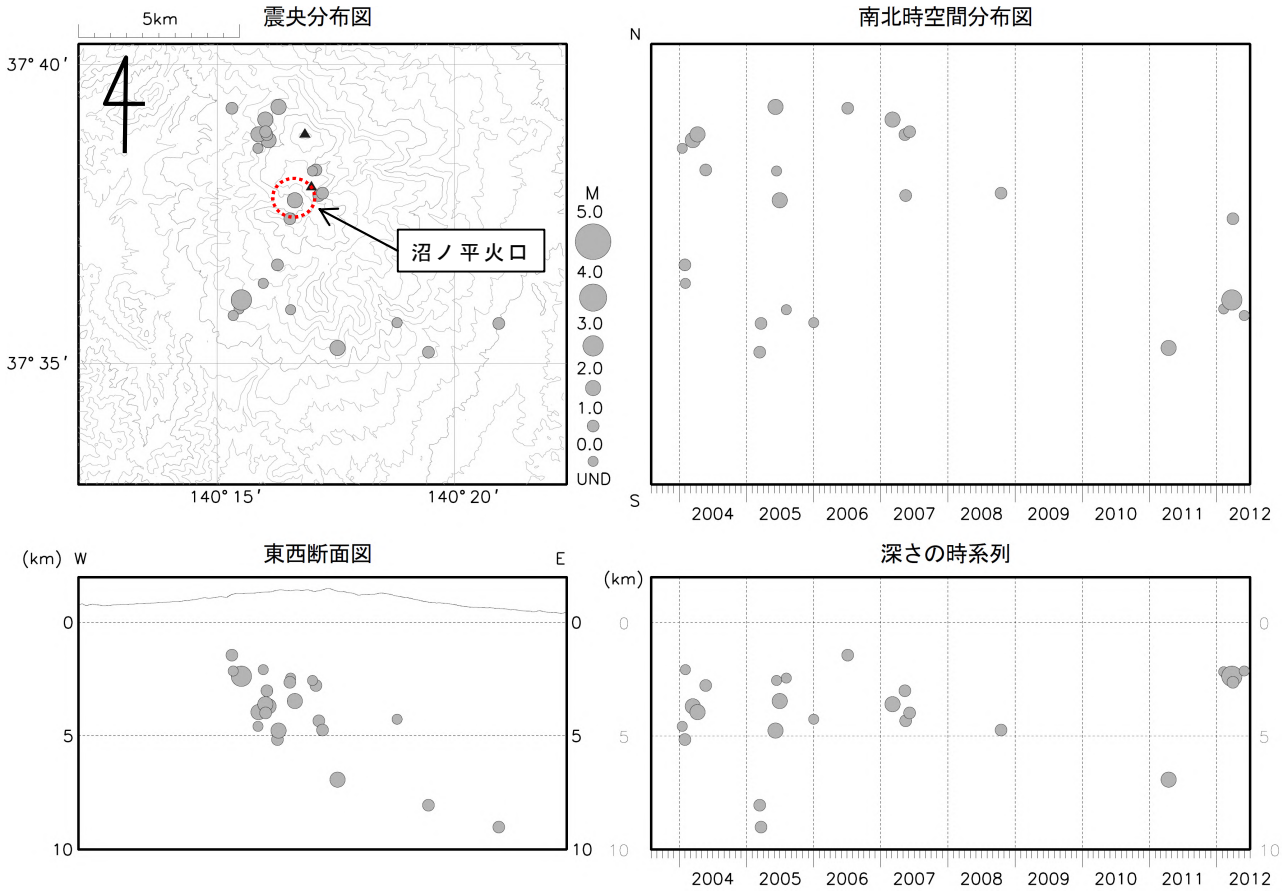


Figure 35-7 Distribution of volcanic earthquakes in and around the summit area (August 1, 2003, to June, 2012). Epicenter distribution (upper left), space-time plot in a N-S cross-section (upper right), hypocenter distribution along an E-W cross-section (lower left) and depth-time plot (lower right). A broken red circle indicates the Numanotaira crater.

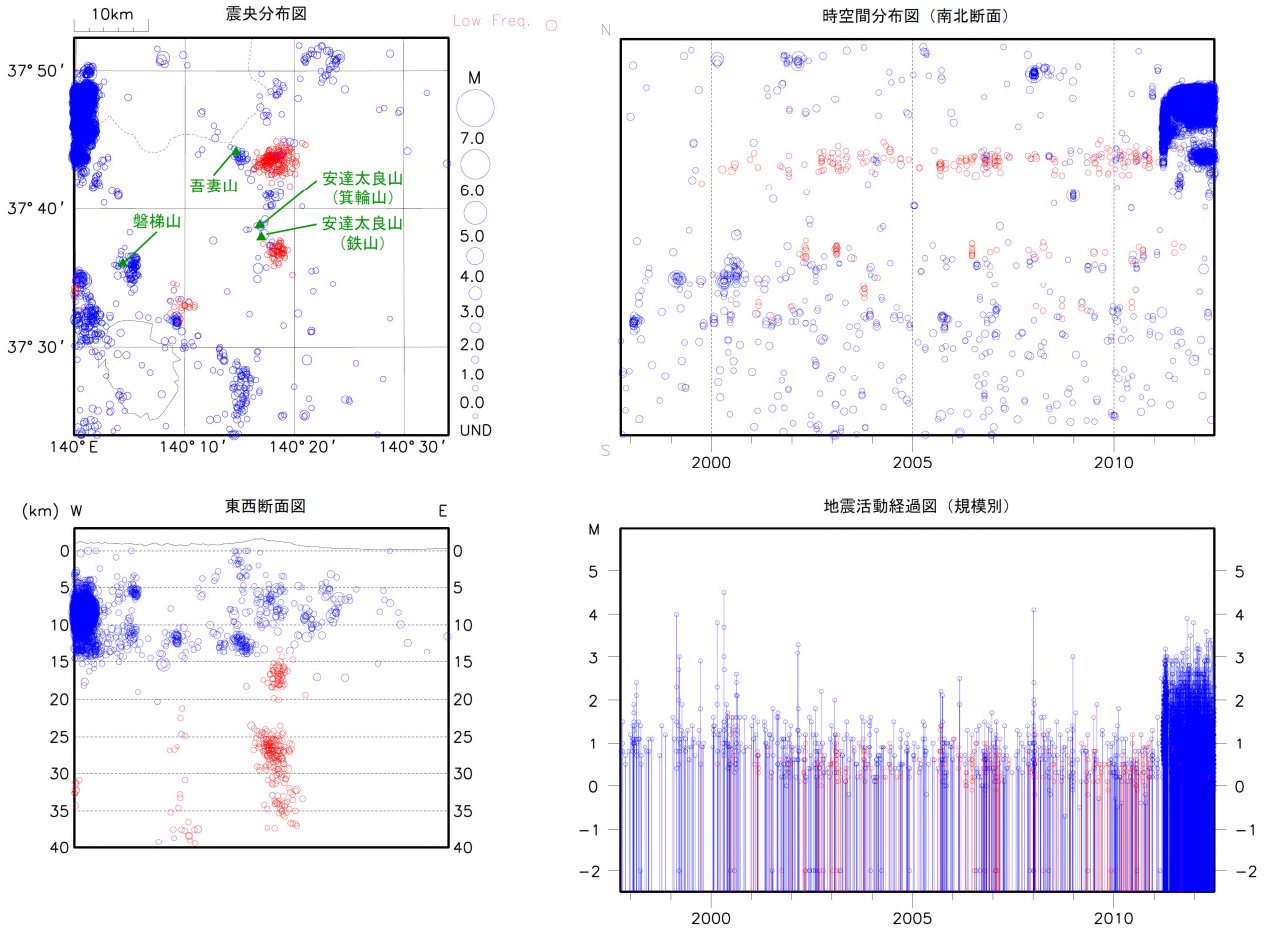


Figure 35-8 Activity of shallow VT earthquakes (blue circles) and deep low-frequenc y earthquakes (red circles) observed by a regional seismometer network (October 1, 1997, to June 30, 2012). Epicenter di stribution (upper left), space-time plot (N-S cross-sec tion) (upper right), E-W cross -section (lower left) and magnitude-time diagram (lower right).

Information on Disaster Prevention

①Hazard Map

Landslide Disaster Hazard Map (Adatarayama Volcano Disaster Prevention Map)

March, 2002 - Compiled by the Adatarayama Volcano Disaster Prevention Coordinating Committee

Source: Landslide Disaster Hazard Map (Adatarayama Volcano Disaster Prevention Map)

Published: March, 2002

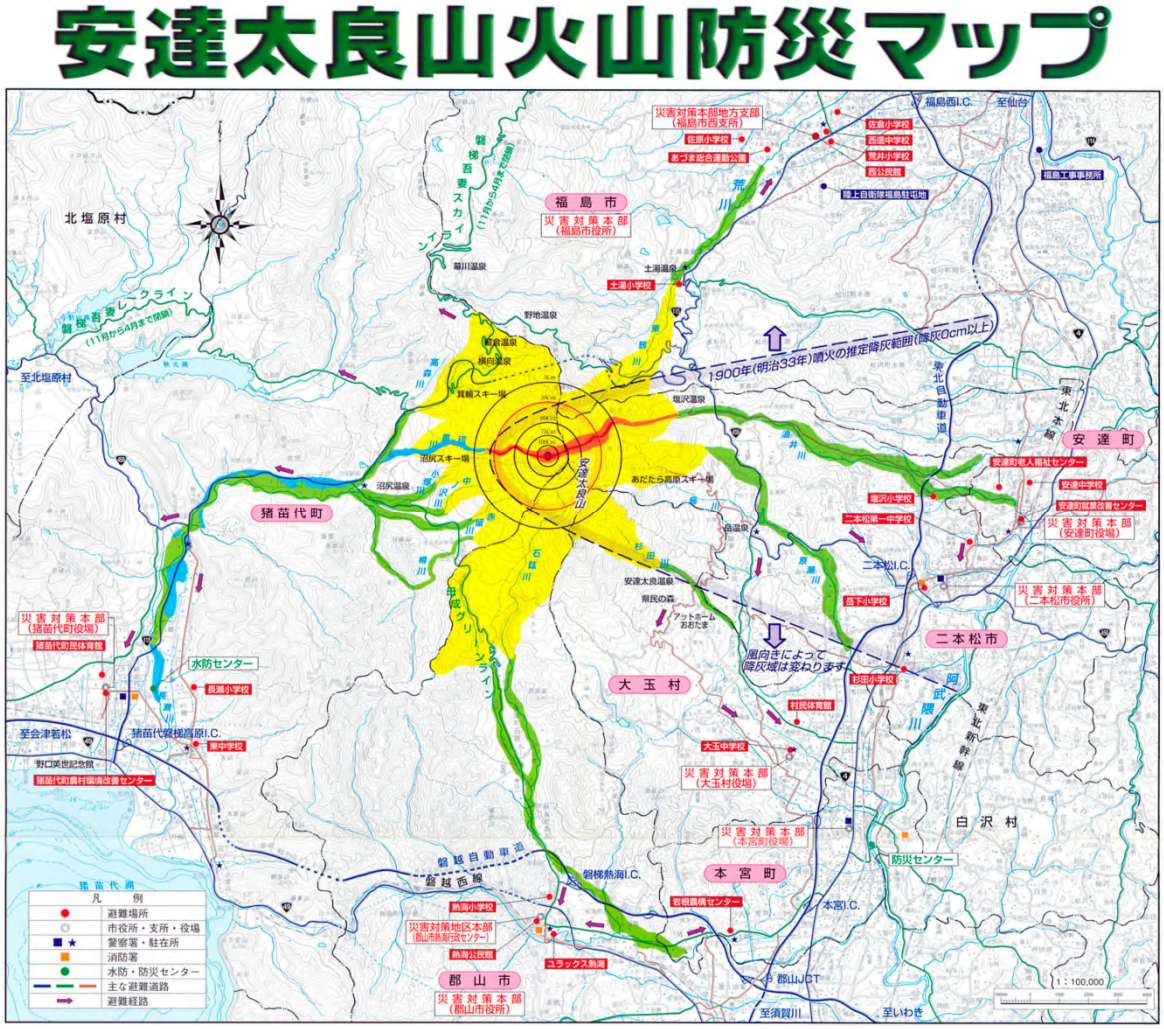
Compiled by: Adatarayama Volcano Disaster Prevention Coordinating Committee (See Information on Disaster Prevention

① Volcano Disaster Prevention Coordinating Committee)

URL:

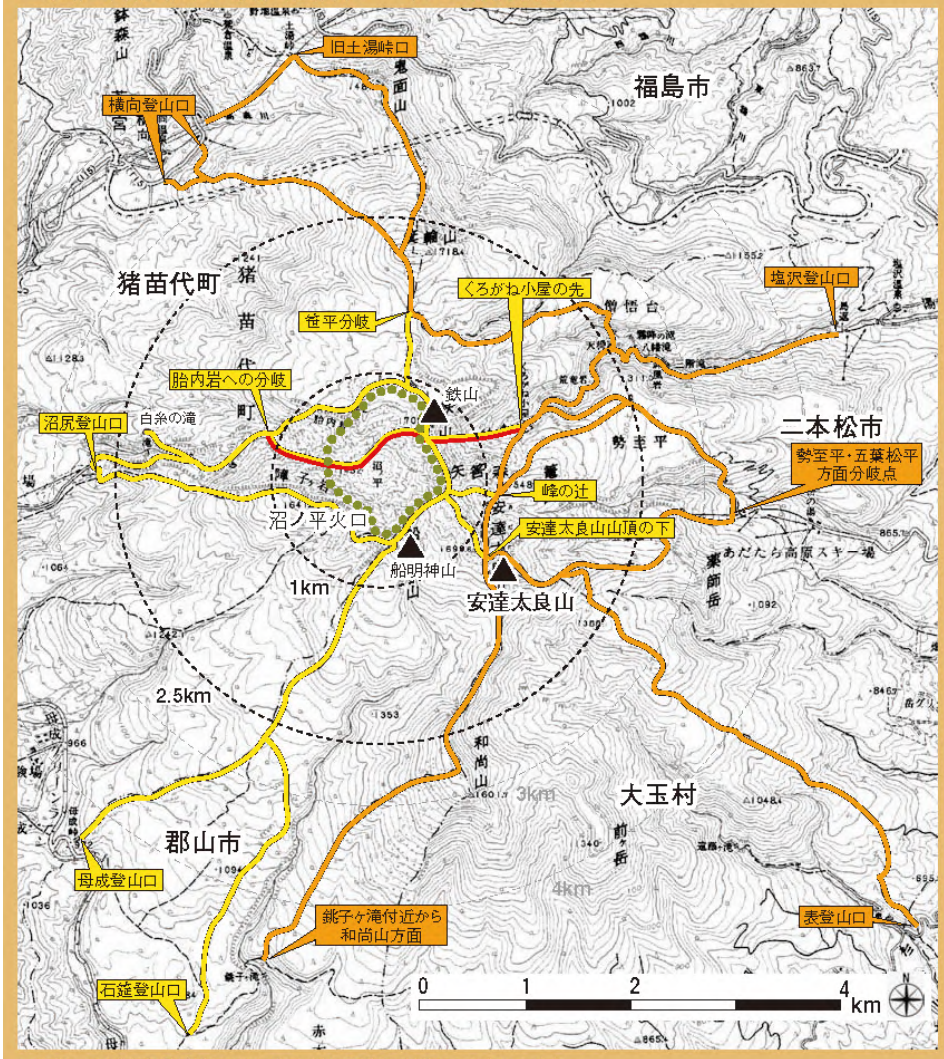
http://www.union.adachi.lg.jp/disaster/index.php

http://www.city.nihonmatsu.lg.jp/soshiki/7/1176.html



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

■安達太良山の噴火警戒レベルと規制範囲



この図は、国土地理院「数値地図50000（地図画像）『福島』」を使用して作成しています。

赤線 ——— を付した登山道（くろがね小屋～馬の背～沼ノ平中央～胎内岩への分岐）は、
火山ガスによる危険があるため、通行止めとなっています（平成21年3月現在）。

■安達太良山の火山活動
1900年に沼ノ平火口で発生した水蒸気爆発では、当時火口内にあった硫黄精錬所の作業員80余名が被災しました。

●レベル3（入山規制）
火口中心から概ね2.5kmの範囲
（登山道 ——— 規制地点 ）

●レベル2（火口周辺規制）
火口中心から概ね1kmの範囲
（登山道 ——— 規制地点 ）

●レベル1（平常）
状況に応じ沼ノ平火口内の危険な箇所
（ 沼ノ平火口の範囲）

※この図は、安達太良山火山防災ハンドブックおよび安達太良山火山防災マップ（2002年3月）等に基づき、安達太良山火山防災連絡会議（二本松市、福島市、郡山市、猪苗代町、大玉村、本宮市で構成）と調整し作成しました。

■この図は、沼ノ平火口で噴火した場合の噴火警戒レベル2（火口周辺規制）及びレベル3（入山規制）の規制範囲を示しています。
■レベル4（避難準備）及びレベル5（避難）については、融雪型火山泥流による影響が想定される居住地域（図の範囲外）での対応が必要になります。
■この範囲は地元自治体と調整して作成したものです。各レベルの具体的な規制範囲等については、地域防災計画等で定められていますので、詳しくは二本松市、福島市、郡山市、猪苗代町、大玉村、本宮市にお問い合わせください。

Volcanic Alert Levels for the Adatarayama 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 lahar by melted snow flow reaching residential areas. Past Examples None Expected Situations Eruption like the 1900 phreatic explosion during winter when snow has accumulated
		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 eruption, with lahar by melted snow flow extending to residential areas. Past Examples None Expected Situations Eruption like the 1900 phreatic explosion during winter when snow has accumulated
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 activities 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 with ejecta scattered outside the crater. ●Base surge (shock wave), debris avalanche, etc. Past Examples July 17, 1900: Eruption and phreatic explosion inside Numanotaira crater. The sulfur refinery within the crater was blown away, killing 72 and injuring 10. ●Possibility of moderate eruption. Past Examples None
	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 activities as normal. Access to interior of Numanotaira crater restricted, etc.**	●Small eruption scattering volcanic blocks within the Numanotaira crater. ●Fume, mud, sulfur, etc. discharge. Past Examples August 24, 1899: Eruption and phreatic explosion at Numanotaira crater. A new crater 40 m in diameter was formed. Ash fall several km to the east. From approx. April, 1997: Increased ground temperature on Numanotaira crater floor ●Possibility of small eruption. Past Examples None
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 dangerous areas inside Numanotaira crater restricted.**	●Very small-scale eruption, mud, etc. discharge. Past Examples September, 1996: 30 m high white fume, mud discharge in center of Numanotaira, scattering mud over 100 m diameter area February, 2000: Fume temporarily reached height of 300 m

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

- Nihonmatsu City: 60,043 (as of November 1, 2011)
- Koriyama City: 332,248 (as of November 1, 2011)
- Fukushima City: 287,941 (as of October 31, 2011)
- Motomiya City: 31,209 (as of November 1, 2011)
- Inawashiro Town: 16,075 (as of October 31, 2011)
- Otama Village: 8,662 (as of October 31, 2011)

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

- Bandai-Asahi National Park - Adatarayama

  Number of sightseers per year: 208,865 (according to Fukushima Prefecture sightseeing figures (2010) for Nihonmatsu, Adatarayama)

  Number of mountain-climbers per year: Unknown

③Facilities

- Nihonmatsu City

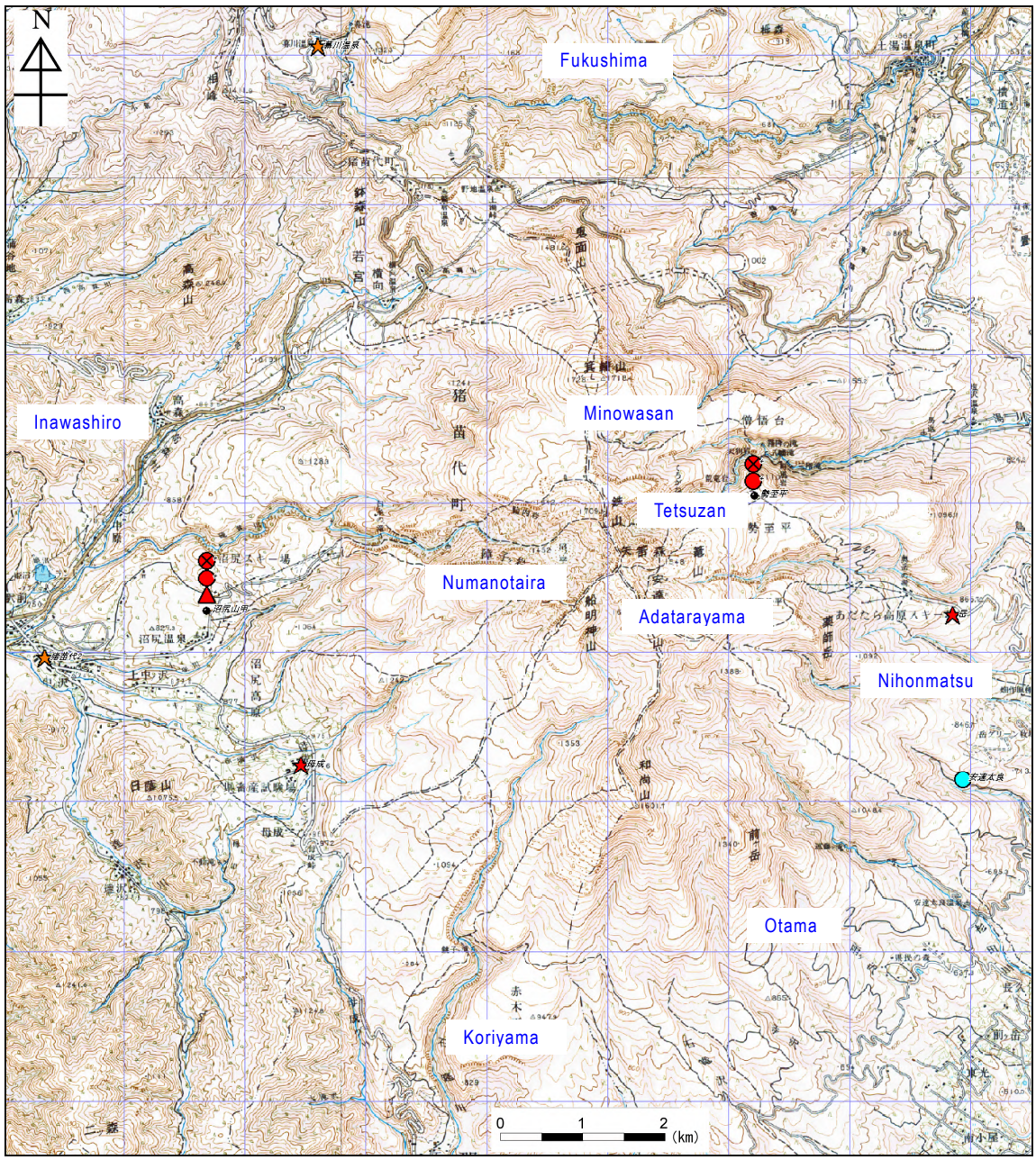
  Kurogane Cabin

Monitoring Network

Wide Area * See Azumayama.

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 (Bandaisan, Nihonmatsu, Azumayama and Fukushima) published by the Geospatial Information Authority of Japan were used.

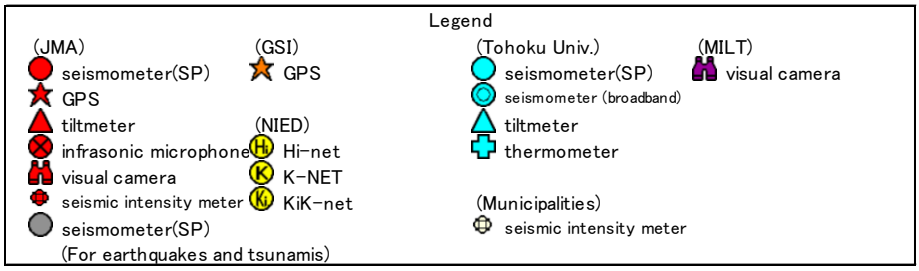


Figure 35-9 Local monitoring network.

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(Kawanabe, Y., and Ueki, S.)