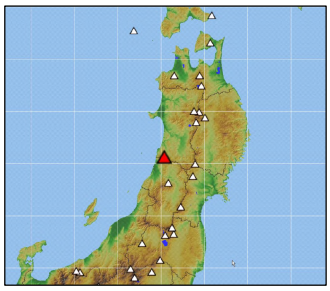
29. Chokaisan



Continuously Monitored by JMA

Latitude: 39°05'57" N, Longitude: 140°02'56" E, Elevation: 2,236 m
(Shinzan) (GSI Measuring Point)

Overview of Chokaisan, taken from Nikaho City on May 16, 2009 by the Japan Meteorological Agency.

Summary

Chokaisan is a basalt-andesite stratovolcano. It measures 26 km east-west and 14km north-south. Topographically, it is divided into the highly eroded, gently sloping Nishi-Chokaisan and the relatively steep Higashi-Chokaisan, which features more recent lava topography. Horseshoe-shaped calderas are located at their summits, formed by collapses. The SiO_2 content of the basalt-andesite is between 50.0 and 60.6 wt %.

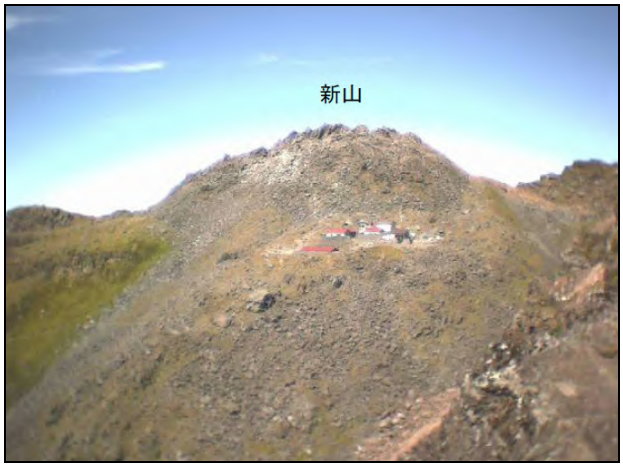
Activity at Chokaisan can be broadly divided into three stages. During the first stage (approximately 550,000 to 160,000 years ago), the main volcanic edifice was formed. During the second stage (approximately 160,000 to 20,000 years ago), lava covered the surface of Nishi-Chokaisan. During the third stage (beginning approximately 20,000 years ago), the conical Higashi-Chokaisan was formed on the eastern side of the volcanic edifice (during this stage lava flows also occurred from the Saruana crater on the western flank). Approximately 2,600 years ago the summit of Higashi-Chokaisan collapsed. The debris avalanche covered an area from the north to the northwest, and a horseshoe-shaped caldera opening to the north was formed. The highly hummocky topographies of Kisakata and Yurihara were formed by these deposits. After the caldera was formed, activity continued near the summit inside the caldera, and lava flows covered approximately 1/3 of the caldera.

Shinzan (also known as Kyowadake), one of the two central cones of Higashi-Chokaisan, is a lava dome formed by an eruption in 1801. The volcano is prone to producing lahars.

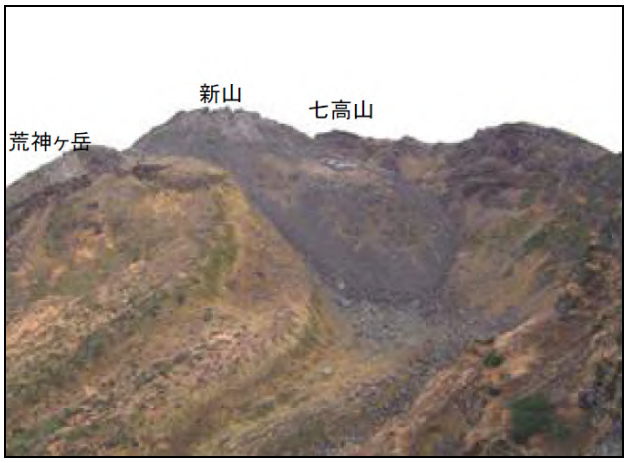
It is also known as Dewa-fuji and Akita-fuji.

Photos

Lahar by melted snow over ash fall and accumulated snow, taken from the southwest side on April 24, 1974.
Courtesy of T. Ui.



Shinzan Dome, taken from the south side (Gyojagatake) on September 15, 2010 by the Japan Meteorological Agency.



Lava Domes at the Summit. An old lava dome, Kojingatake, at the left side and a new lava dome, Shinzan, in the center, taken from the southwest side (Fushiogamidake) on September 15, 2010 by the Japan Meteorological Agency.

Red Relief Image Map

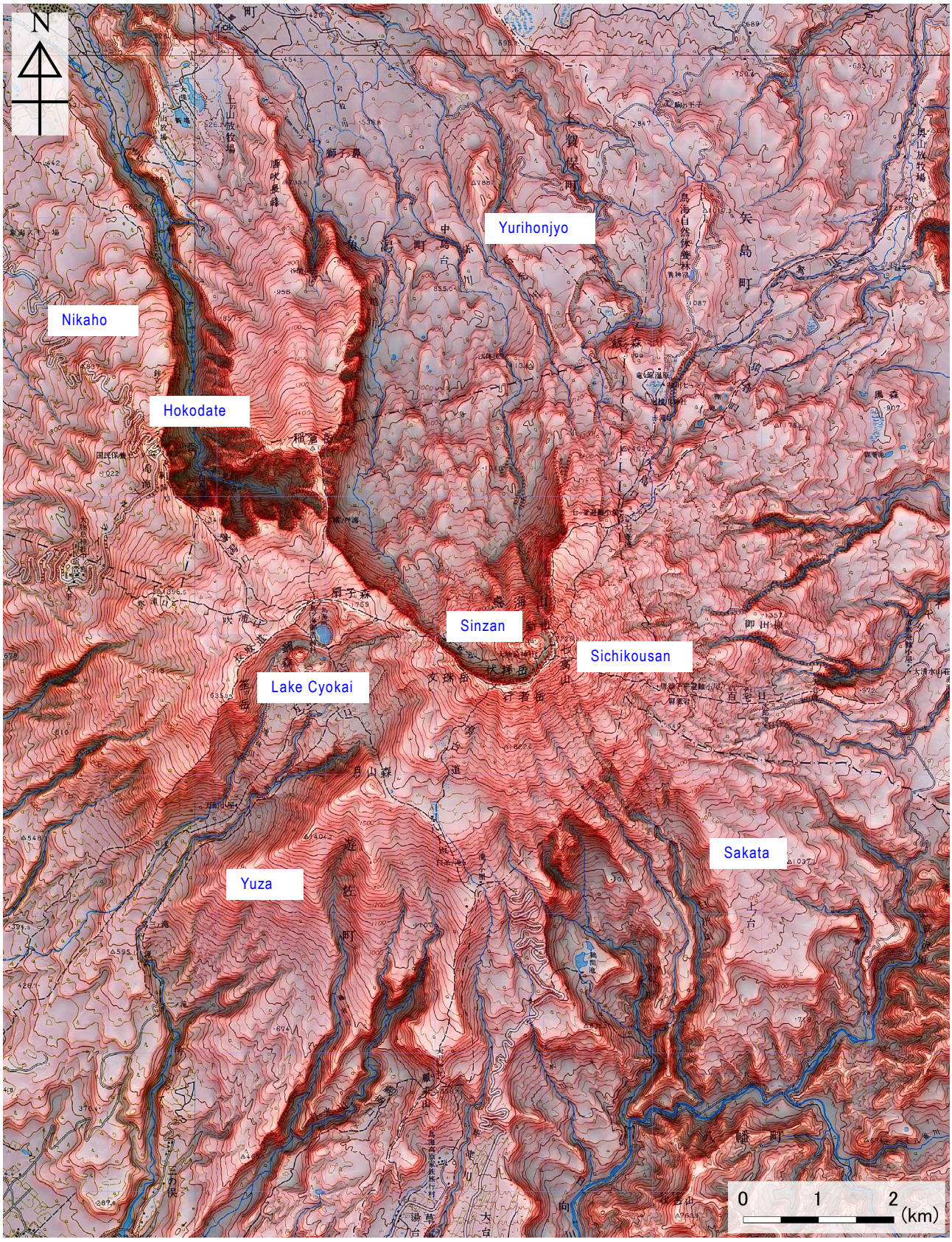


Figure 29-1 Topography of Chokaisan.

1:50,000 scale topographic maps (Fukura, Kisakata, Chokaisan and Yashima) 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

The Higashi-Chokaisan volcanic edifice, which now makes up the main summit, was formed approximately 20,000 years ago. During the Jomon era an eruptive activity at the Saruana crater took place on the western volcanic edifice, with a lava flow extending to the Sea of Japan. This was followed by a large collapse near the summit of the Higashi-Chokaisan volcanic body in 466 BC, and the formation of a horseshoe-shaped caldera opening to the north. The collapse deposits are called the Kisakata debris avalanche, and are widely distributed from the north to the northwest foot of the volcano. Activities after this mainly consisted of lava discharges and phreatic eruptions inside the horseshoe-shaped crater. The Shinzan lava dome was formed by the 1801 eruptive activity, for which historical records exist (Hayashi, 1984a). In 1974 a small phreatic eruption occurred (Ui and Shibahashi, 1975).

Period	Area of Activity	Eruption Type	Main Phenomena / Volume of Magma
3ka<	Saruana crater	Magmatic eruption	Lava flow (Saruana lava)
2.466ka	Higashi-Chokaisan horseshoe-shaped caldera	(Collapse)	Kisakata debris avalanche. The volume of debris avalanche deposits was 3.5 km^3.
2.466ka>	At the summit area	Magmatic eruption	Lava flow and lava dome (Kojingatake lava).
2.4ka	At the summit area	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.

・Historical Activity

Year	Phenomenon	Activity Sequence, Damages, etc.
708 to 715 (Wado 1 to 7)	Phreatic eruption	The eruptive activity occurred at the summit area.
810 to 813 (Konin 1 to 14)	Phreatic eruption	The eruptive activity occurred at the summit area.
830 (Tencho 7)	Phreatic eruption? (Lahar)	January. Air-fall pyroclastic material? Lahar. The eruptive activity occurred at the summit area.
871 (Jogan 13)	Moderate: Phreatic eruption → phreatomagmatic eruption	Tephra fall → lava flow. From May the eruptive activity occurred at the summit area. A lahar flow caused river water to turn bluish black and overflow its banks. The river banks collapsed, and a large number of fish were killed. Magma eruption volume = 0.025 km^3 DRE. (VEI 2)
939 (Tengyo 2)	Phreatic eruption	The eruptive activity occurred at the summit area.
1659 to 1663 (Manji 2 to Kanbun 3)	Phreatic eruption	From April. The eruptive activity occurred at the summit area. It resulted in crop damage.
1740 to 1747 (Genbun 5 to Enkyo 4)	Phreatic eruption	From June. The eruptive activity occurred at the summit area. A large volume of volcanic smoke was emitted from a crater on the southeastern flank of Kojingatake, an old lava dome. Sulfur compounds flowed to the north into the river, causing damage to rice paddies and killing fish. The eruption continued for several years.

Year	Phenomenon	Activity Sequence, Damages, etc.
1800 to 1804 (Kansei 12 to Bunka 1)	Phreatic eruption → magmatic eruption (lahar)	Tephra fall → lava dome, lahar. The eruptive activity occurred at the summit area. The activity began in the winter of 1800. A continuous emission of volcanic smoke started roughly in March, 1801. In late August the eruption reached its peak, with explosions, volcanic block scattering, ash discharges near Kojingatake at the summit area, and the formation of a new dome, Shinzan (Kyowadake). Volcanic blocks killed 8 mountain-climbers. Magma eruption volume = 0.0035 km^3 DRE.
1804 (Bunka 1)[7]	Earthquake	Earthquakes on July 10 at Kisakata. In the Yuri, Akumi, and Tagawa districts, 331 people were killed, over 5,500 houses were destroyed, and land uplifting and a tsunami occurred.
1821 (Bunsei 4)	Phreatic eruption	May 23. The eruptive activity occurred near Shinzan and Shichikosan at the summit area.
1834 (Tenpo 5)	Phreatic eruption	July 9. The eruptive activity occurred near Shinzan. It killed river fish, etc.
1974 (Showa 49)	Small-scale: Phreatic eruption, (lahar produced)	February to May. Tephra fall, lahar. The eruptive activity occurred near Shinzan. Volcanic earthquakes began in December of the previous year. In January fumes were discovered. Rumbling occurred in late February. On March 1 an eruption was found at the crater on the east side of Shinzan, producing a volcanic plume and tephra fall (phreatic eruption). On March 6 a lahar flow occurred. From April 8 a volcanic plume was emitted from the west side of Shinzan and a fissure on Kojingatake. On April 24 a black volcanic plume was emitted and a lahar flow occurred. On April 28 ash fell up to approximately 30 km to the north. On May 8 a gray volcanic plume was emitted, after which fumarolic activity became weak. (VEI 1)
1987 (Showa 62)	Earthquake swarm	On July 11 an earthquake occurred approximately 5 km to the southeast (M3.2). From November 25 to December 1 earthquake swarms occurred in Kisakata, 15 km to the northwest.

* 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.

Whole Rock Chemical Composition

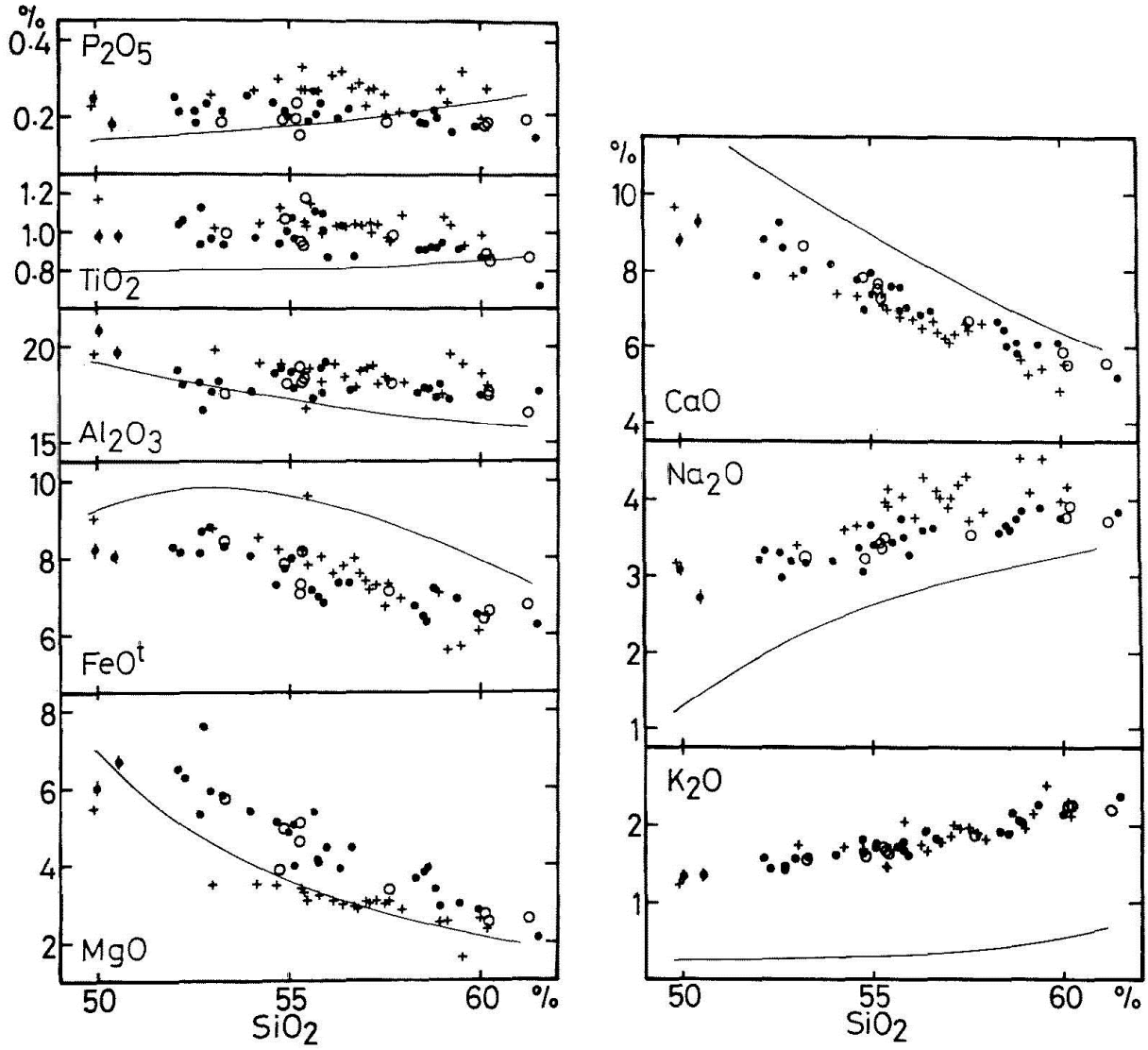


Figure 29-2 Whole rock chemical composition (Hayashi, 1984b). +: Stage I (old stratovolcano formative period), ●: Stage 2 (Nishi-Chokaisan volcano), ○: Stage 3 (Higashi-Chokaisan volcano) ejecta. Solid lines indicate tholeiite average change curves in the north of Nasu.

Magma Discharge Rate

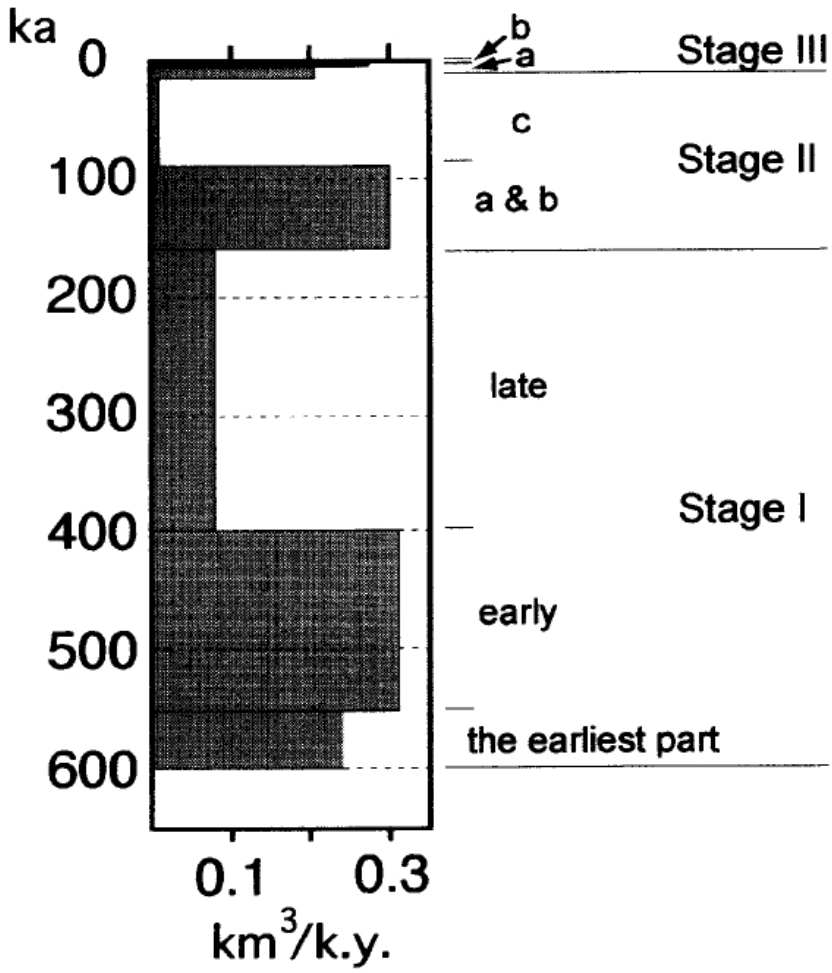


Figure 29-3 Temporal change in magma discharge rate (Ban, et al., 2001).

Major Volcanic Activity

・1974 Eruption

On March 1, 1974, the captain of All Nippon Airways flight 881 discovered a volcanic plume rising from a new crater on the east of Shinzan (phreatic eruption). A lahar triggered by melted snow occurred on March 6. A temporary calm followed, but from April 8 a volcanic plume was emitted from the west side of Shinzan and a fissure on Kojingatake. On April 24 a black volcanic plume was emitted, and a lahar flow occurred. On April 28 ash fell up to approximately 30km to the north. On May 8 a gray volcanic plume was emitted, after which fumarolic activity became weak. Seismic activity during the eruptive period was clearly higher than the present state. Analysis of earthquake records indicates that before the eruption, the seismic activity in the Chokaisan area intensified from approximately December, 1973. Researchers have pointed out the possibility of temporal changes in the earthquake generating stress field caused by magma activity.

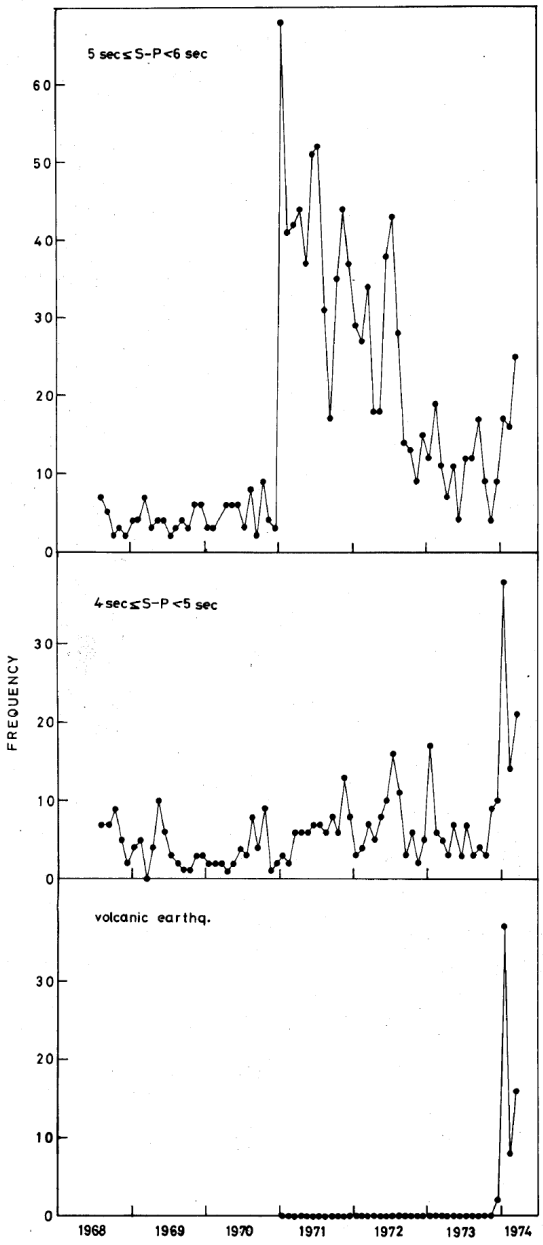


Figure 29-4 Temporal changes in monthly number of micro-earthquakes observed at Honjo Seismological Observatory before the 1974 eruption (Tohoku University, 1974). Number of earthquakes with S-P times between 5 and 6 seconds (mainly aftershocks from the 1970 Southeastern Akita Prefecture Earthquake)(top), those with S-P times between 4 and 5 seconds (middle), and those considered to have taken place at Chokaisan based on their waveform characteristics (bottom).

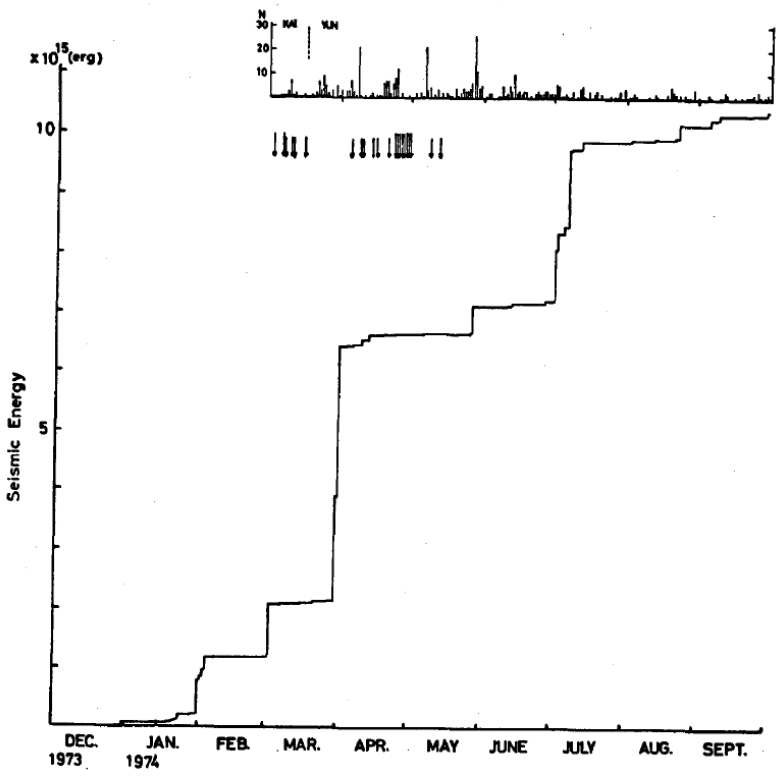


Figure 29-5 Cumulative energy released by earthquakes at Chokaisan (bottom) and daily frequency distribution of the earthquakes with S-P times of less than 5 seconds at Kaizawa and Yunodai (top). Downward arrows indicate the dates when volcanic plumes or fumes were observed (Tohoku University, 1975).

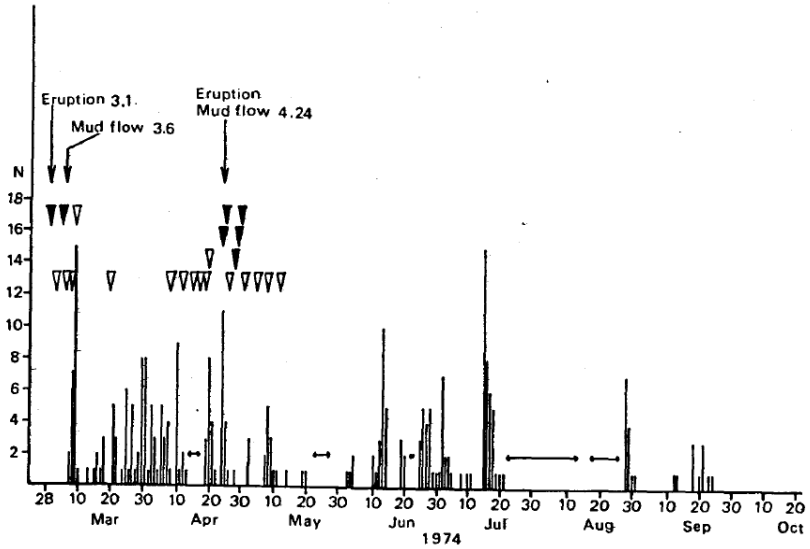


Figure 29-6 Number of earthquakes per day during the 1974 Chokaisan eruption reported by the Japan Meteorological Agency.

Precursory Phenomena

The 1974 phreatic eruption was preceded by 2 to 3 months of increased seismic activity, followed by the appearance of fumes and rumbling.

Recent Volcanic Activity

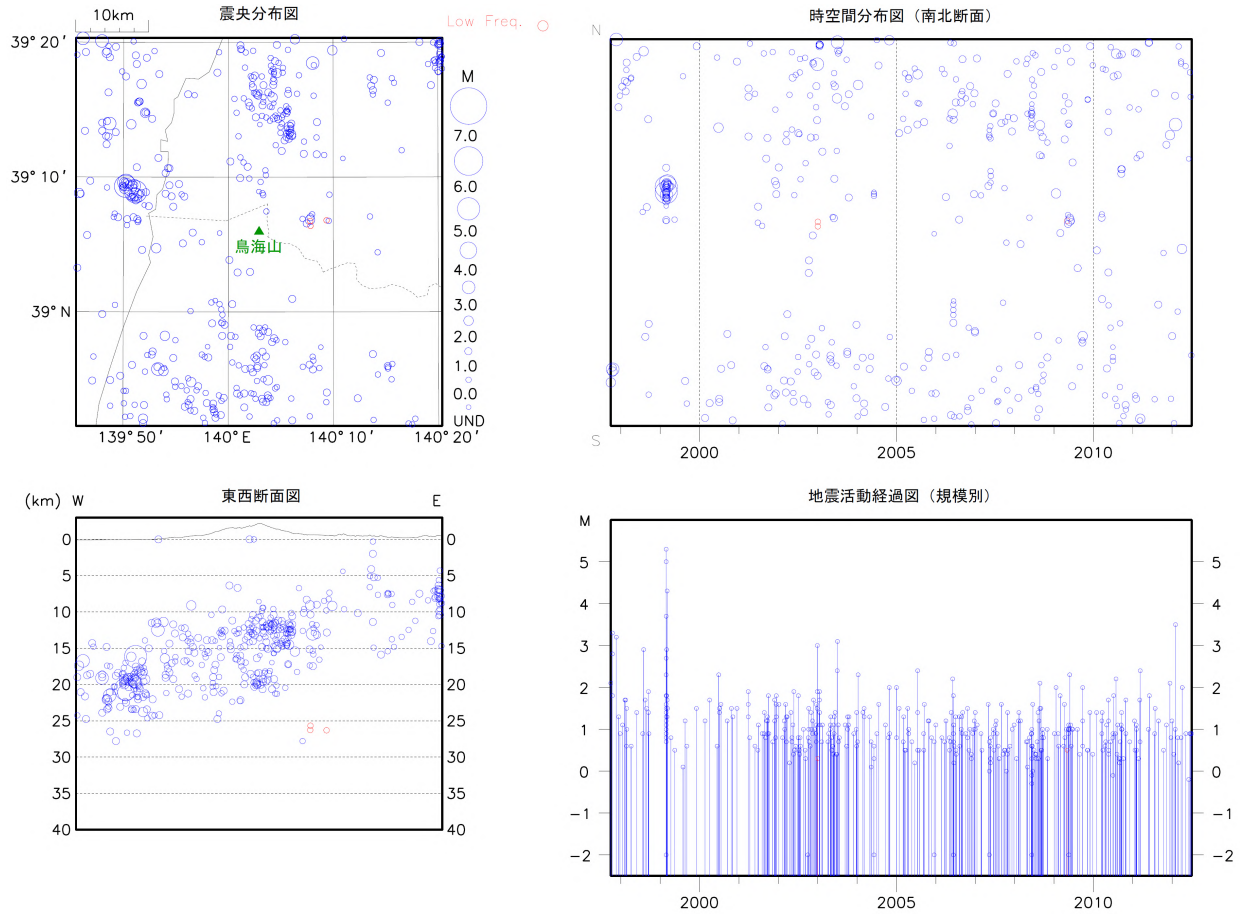


Figure 29-7 Activity of shallow VT earthquakes (blue circles) and deep low-frequenc y earthquakes (red circles) observed by a regional seismometer network (October 1, 1997, to June 30, 2012). Epicenter di stribution (upper left), space-time plot (N-S cross-sec tion) (upper right), E-W cross -section (lower left) and magnitude-time diagram (lower right).

Information on Disaster Prevention

① Hazard Map

Volcano Disaster Prevention Map for Entire Chokaisan Region - March, 2006 - Published by Akita Prefecture, Yuri-Honjo City, Nikaho City, Yamagata Prefecture, Sakata City, and Yuza Town, Editorial supervision by the Chokaisan Volcano Disaster Prevention Measure Deliberating Committee

Source: Volcano Disaster Prevention Map for Entire Chokaisan Region

Date of Publication: March, 1808

Created by: Akita Prefecture, Yuri Honjo, Nikaho, Yamagata Prefecture, Sakata, and Yuza

Editorial supervision: Chokaisan Volcano Disaster Prevention Measure Deliberating Committee

URL:

Akita Prefecture

http://www.pref.akita.lg.jp/www/contents/1205470577085/html/common/480d4b88004.html

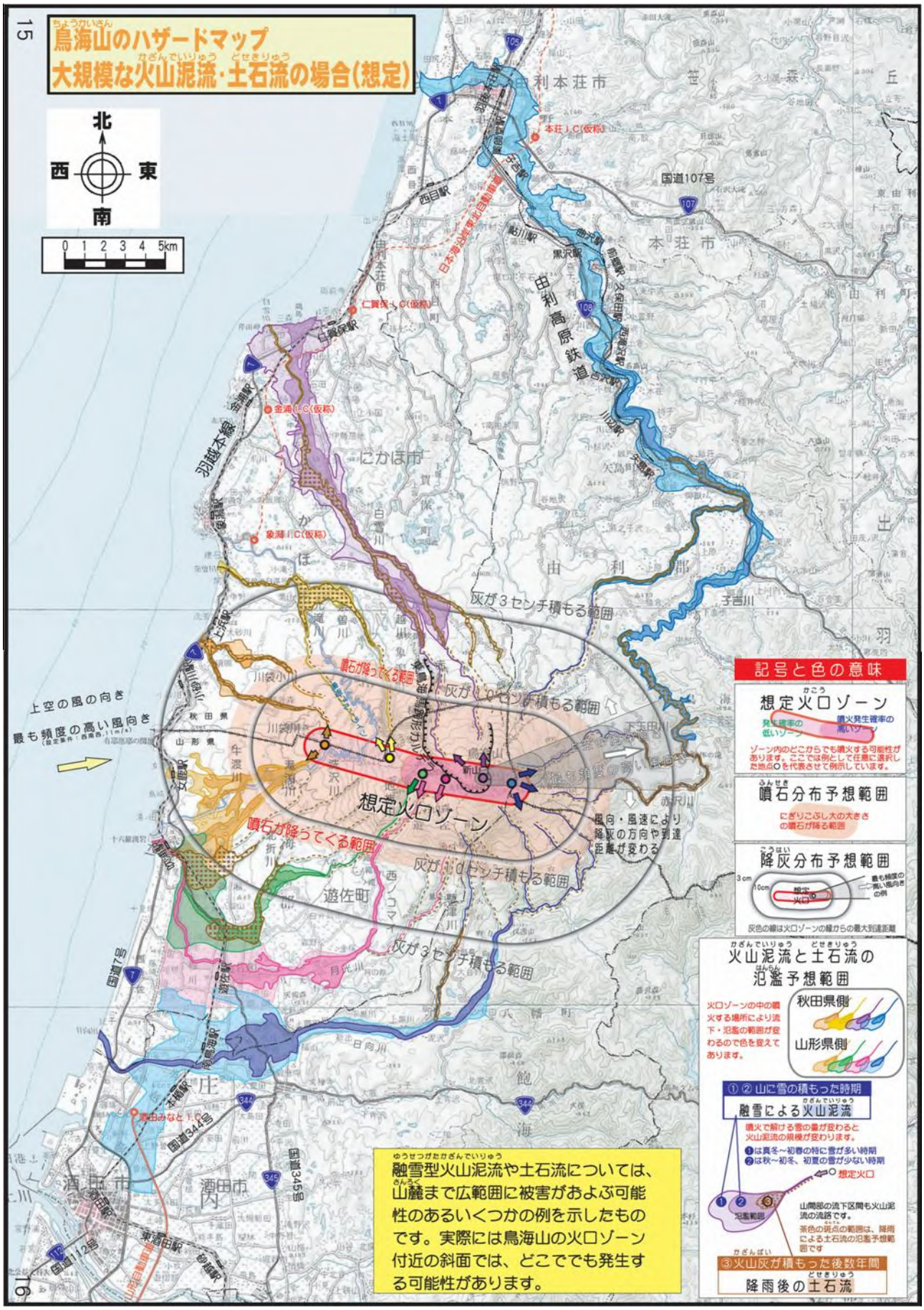
http://sabo.pref.akita.jp/modules/rinyd7/index.php?id=2

Yamagata Prefecture

http://www.pref.yamagata.jp/ou/kendoseibi/180010/sabo/tyokaihazardmap.html

Sakata City

http://www.city.sakata.lg.jp/sakata_tmp/kazan/map1.htm


15
鳥海山のハザードマップ
大規模な火山泥流・土石流の場合(想定)
北
西
東
南
0 1 2 3 4 5km
由利本荘市
本荘ICC(仮称)
国道107号
本荘市
由利高原鉄道
にかほ市
仁賀保ICC(仮称)
金浦ICC(仮称)
象潟ICC(仮称)
羽越本線
灰が3センチ積もる範囲
噴石が降ってくる範囲
想定火口ゾーン
上空の風の向き
最も頻度の高い風向き
風向・風速により降灰の方向や到達距離が変わる
遊佐町
酒田市
酒田みなとIC
国道7号
国道345号
国道112号
記号と色の意味
想定火口ゾーン
噴火発生確率の高いゾーン
発生確率の低いゾーン
ゾーン内のどこからでも噴火する可能性があります。ここでは例として任意に選択した地点○を代表させて例示しています。
噴石分布予想範囲
にぎりこぶし大の大きさの噴石が降る範囲
降灰分布予想範囲
3cm
10cm
想定火口
最も頻度の高い風向きの例
灰色の線は火口ゾーンの縁からの最大到達距離
火山泥流と土石流の氾濫予想範囲
火口ゾーンの中の噴火する場所により流下・氾濫の範囲が変わるので色を変えてあります。
秋田県側
山形県側
①②山に雪の積もった時期
融雪による火山泥流
噴火で解ける雪の量が変わると火山泥流の規模が変わります。
❶は真冬～初春の特に雪が多い時期
❷は秋～初冬、初夏の雪が少ない時期
想定火口
氾濫範囲
山間部の流下区間も火山泥流の流路です。
茶色の斑点の範囲は、降雨による土石流の氾濫予想範囲です
③火山灰が積もった後数年間
降雨後の土石流
融雪型火山泥流や土石流については、山麓まで広範囲に被害がおよぶ可能性のあるいくつかの例を示したものです。実際には鳥海山の火口ゾーン付近の斜面では、どこででも発生する可能性があります。
16

Social Circumstances

①Populations

・Akita Prefecture

Yuri-Honjo City: 85,329 (as of October 31, 2011, according to the Yuri Honjo City website)

Nikaho City: 27,824 (as of October 31, 2011, according to the Nikaho City website)

・Yamagata Prefecture

Sakata City: 110,670 (as of April 1, 2011, according to Yamagata Prefecture population and number of households (estimated) (monthly report))

Yuza Town: 15,332 (as of April 1, 2011, according to Yamagata Prefecture population and number of households (estimated) (monthly report))

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

・Chokai Quasi-National Park

Number of sightseers per year: Approximately 1,073,000 (according to the 2010 Akita Prefecture sightseeing statistics)

ditto :Approximately 306,300 (according to the 2010 Yamagata Prefecture sightseeing number survey)

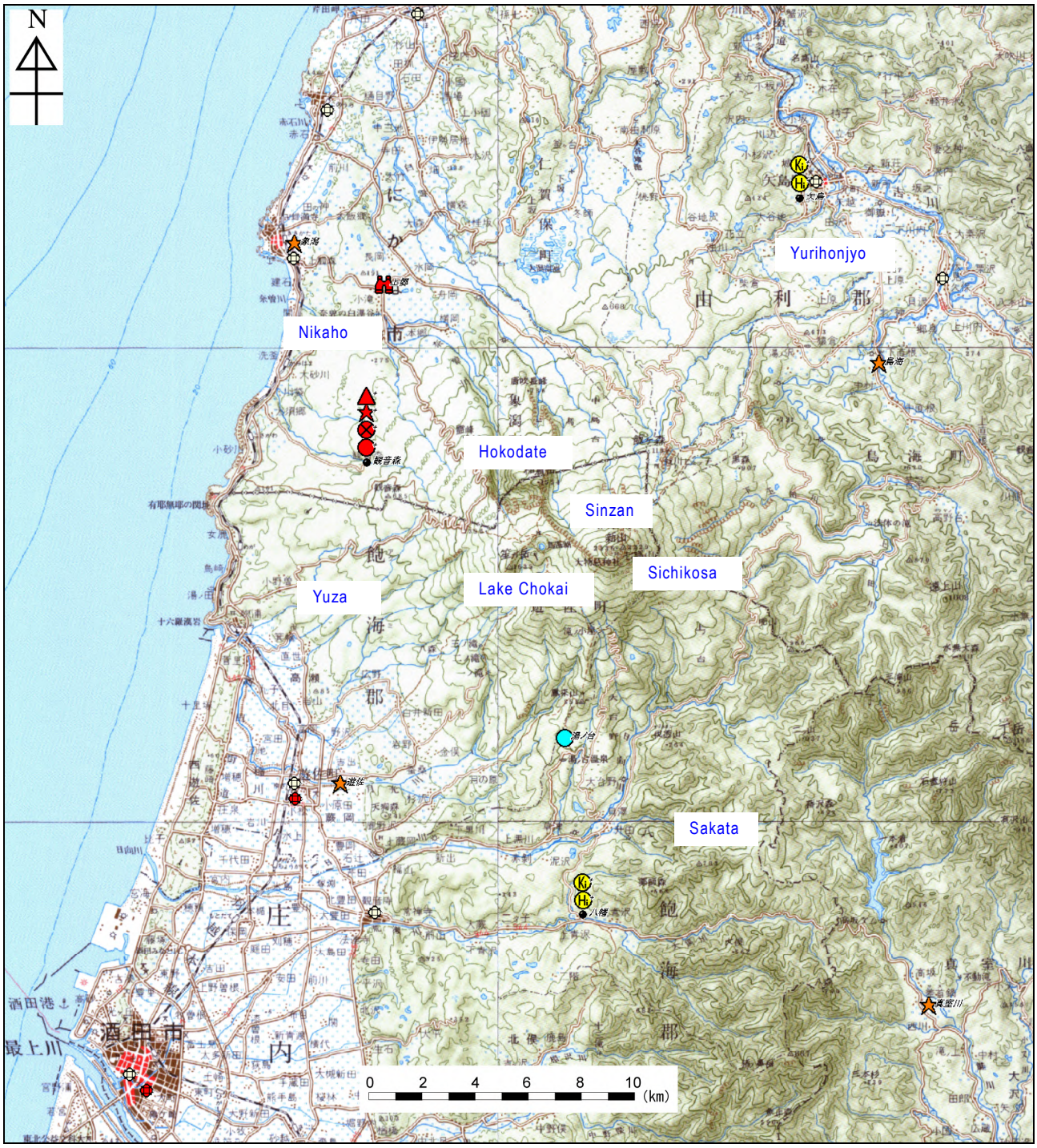
③Facilities

・Nikaho City, Akita Prefecture

Hokotate 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 (Akita, Oga, Sakata and Shinjo) 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)
- Hi-net
- KiK-net

(Tohoku Univ.)
- seismometer(SP)

(Municipalities)
- seismic intensity meter

Figure 29-8 Regional monitoring network.

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Tohoku University (1974) Report of CCPVE,, **1**, 8-14 (in Japanese).

Tohoku University (1975) Report of CCPVE, **2**, 8-10 (in Japanese).

Ui, T. and K. Shibahashi (1975) Bull. Volcanol. Soc. Japan, **20**, 51-64 (in Japanese with English Abstract).

(Ban, M., and Ueki, S.)