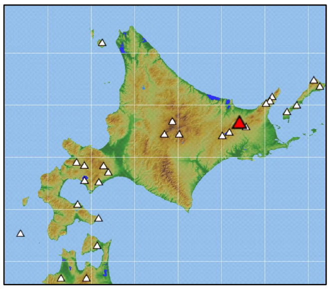


5. Atosanupuri

Continuously Monitored by JMA

Latitude: 43°36'37" N, Longitude: 144°26'19" E, Elevation: 508 m (Atosanupuri)
(Elevation Point)

Latitude: 43°36'54" N, Longitude: 144°25'38" E, Elevation: 574 m
(Makuwanchisappu)
(Triangulation Point - Ioyama)

Overview of Atosanupuri, taken from southeast side on August 21, 2008 by the Japan Meteorological Agency

Summary

Atosanupuri is composed of an andesite somma with a caldera (the Atosanupuri caldera, approximately 4 km in diameter) formed approximately 20,000 years ago at the center of the Kussharo caldera (26 km east-west, 20 km north-south), which was formed approximately 25,000 to 35,000 years ago, and 10 dacite lava domes, which erupted both inside and outside the caldera 15,000 years ago or later (Hasegawa et al., 2009) (The SiO_2 content is between 63.3 and 72.6 wt %). The group of lava domes can be divided into the older and newer ones than the caldera formative period at Mashu, approximately 7,000 years ago. The older lava domes are Nupuriondo, Maruyama, Mt. 274 m, Nifushi-Oyakotsu, Tosamoshibe, and Oputateshuke. The new lava domes are Makuwanchisappu, Sawan-Chisappu, Rishiri, and Atosanupuri. Atosanupuri is also known as "Ioyama", because lava dome has many sulfur deposits, mainly consisting of sublimated sulfur, which was mined until 1963. It continues to maintain fumarolic activity. (Katsui et al., 1986; Teshikaga, 2001).

Photos

Overview of Atosanupuri, taken from north side on October 18, 2012 by the Japan Meteorological Agency

Kumaotoshi Crater taken from east side on October 18, 2012 by the Japan Meteorological Agency

Foot of Northeast mountain by camera on June 26, 2011 by the Japan Meteorological Agency

Topography around the Crater

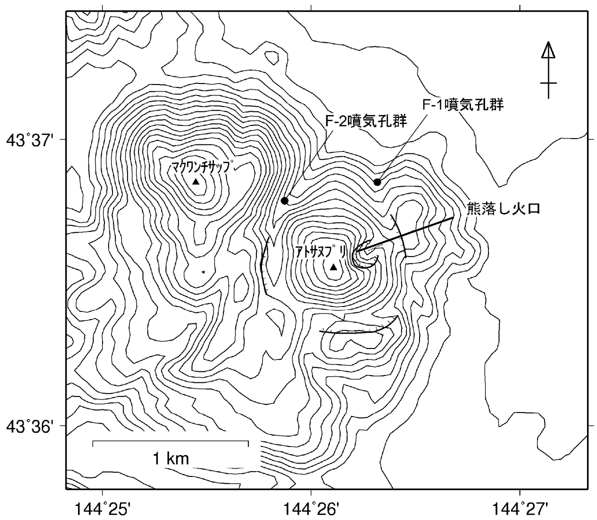


Figure 5-1 Detailed topography of the crater area.

Red Relief Image Map

Figure 5-2 Topographic map of Atosanupuri.
1:50,000 scale topographic maps (Kussharo Ko and Mokoto Yama) 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

Many lava domes were formed 15,000 years ago and earlier (Hasegawa et al., 2009). Approximately 5,500 years ago, an eruption, accompanied by pyroclastic flow, occurred in the southeast of the caldera, forming the Rishiri dome., The Makuwanchisappu and old Atosanupuri dome were formed between approximately 5,500 and 1,500 years ago, and a phreatic explosion occurred at the Atosanupuri crater approximately 1,500 years ago, with the new Atosanupuri dome forming between approximately 1,500 and 1,000 years ago. The latest eruption was the phreatic explosion which formed the Kumaotoshi explosion crater several hundred years ago. (Teshikaga, 2001)

Period	Area of Activity	Eruption Type	Main Phenomena / Volume of Magma
10ka←→5.5ka	Sawan-Chisappu	Magmatic eruption	Sawan-Chisappu lava dome created in northeast of caldera.
10ka←→5.5ka	Oputateshuke	Magmatic eruption	Oputateshuke lava dome created in southwest of caldera.
10ka←→5.5ka	Tosamoshibe	Magmatic eruption	Tosamoshibe lava dome created in west of caldera.
10ka←→5.5ka	Nibushi-Oyakotsu	Magmatic eruption	Nibushi-Oyakotsu lava dome created in north of caldera.
10ka←→5.5ka	Mt. 274 m	Magmatic eruption	Mt. 274 m lava dome created in east of caldera.
10ka←→5.5ka	Maruyama	Magmatic eruption	Maruyama lava dome created in southwest of caldera.
10ka←→5.5ka	Nupuriondo	Magmatic eruption	Nupuriondo lava dome created in southwest of caldera.
5.5ka	Rishiri	Magmatic eruption	Eruption in southeast of caldera. Discharged pyroclastic flow, forming Rishiri lava dome.
5.5ka←→1.5ka	Makuwanchisappu	Magmatic eruption	Makuwanchisappu lava dome created in northeast of caldera.
5.5ka←→1.5ka	Atosanupuri	Magmatic eruption	Atosanupuri lava dome created in east of caldera.
1.5ka	Atosanupuri	Phreatic eruption	Deposition of air-fall pyroclastic material.
1.5ka←→1.0ka	Atosanupuri	Magmatic eruption	New Atosanupuri lava dome created to west of old Atosanupuri lava dome.
Several hundred years ago	Kumaotoshi crater	Phreatic eruption	Eruption in the east of new Atosanupuri lava dome, opening the approximately 200 m diameter Kumaotoshi crater, resulting in air-fall pyroclastic material deposition.

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

・Historical Activity

Year	Phenomenon	Activity Sequence, Damages, etc.
1980 (Showa 55)	Earthquake	2 felt-earthquakes on May 15, with seismic intensity of 3 in JMA scale in Kawayu and Nibushi. 1
1981 (Showa 56)	Earthquake	Felt-earthquake in March in Nibushi, with seismic intensity of 3 in JMA scale in Ikenoyu. Shindo 3 earthquake in April in Kawayu.
1982 (Showa 57)	Earthquake	4 felt-earthquakes on May 2, with maximum seismic intensity of 4 in JMA scale in Kawayu.
1988 (Showa 63)	Earthquake, rumbling	Approximately 10 felt-earthquakes of M3 in March, June, August, and December, with their hypocenters several km deep between east coast of Lake Kussharo and Atosanupuri. Maximum seismic intensity of 2 in JMA scale in Kawayu and Nibushi, including earthquakes with some rumbling.
1994 (Heisei 6)	Earthquake, crustal deformation	18 felt-earthquakes of M2 from March to October, with their hypocenters several km deep between east coast of Lake Kussharo and Atosanupuri. The largest earthquake, with a magnitude of 3.2, occurred on June 13, with a maximum seismic intensity of 3 in JMA scale in Kawayu, Nibushi, and Sunayu. Felt-seismic activity stopped immediately after the October 4, 1994, Hokkaido Toho-Oki Earthquake (M8.2). Interference of Synthetic Aperture Radar (SAR) data from August, 1993, to April, 1995, showed approximately 25 cm of uplift at the center of the Atosanupuri area. The volume of inflation is approximately 2×10^7 m^3, and is estimated to be due to injection of magma into the sill. Seismic activity since 1994 may be related to this uplift.

* 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

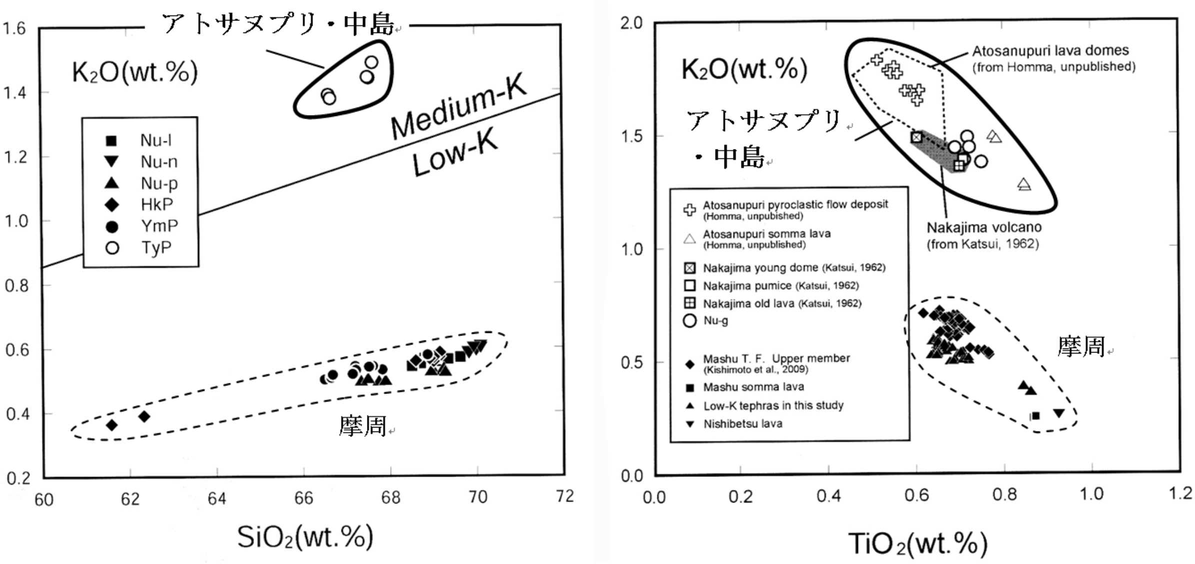


Figure 5-3 Whole rock chemical composition of Atosanupuri and Nakajima; (left) SiO_2-K_2O diagram, (right) TiO_2-K_2O diagram. (Hasegawa et al., updated in 2009)

Period - Cumulative Magma Volume

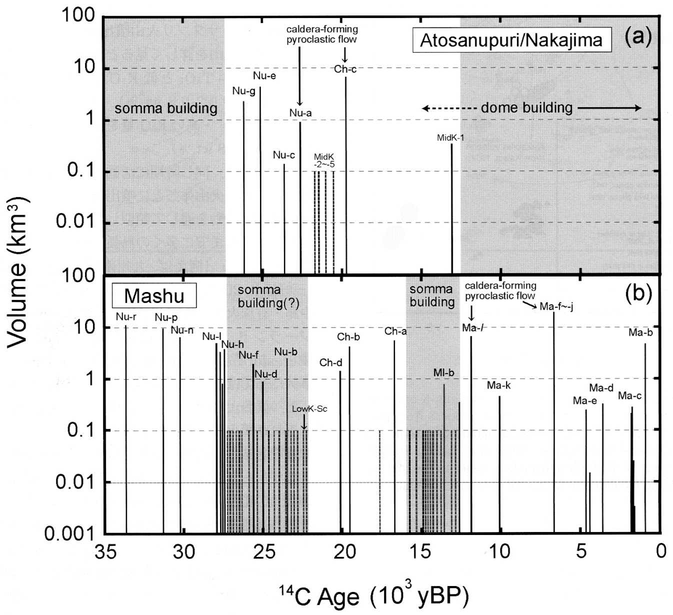


Figure 5-4 Relationship between the volume of explosive eruptions and the eruption periods (Hasegawa et al., 2009).
(a) Atosanupuri and Nakajima volcano, (b).Mashu volcano
Gray areas indicate the periods when mafic magma is predominat.

Major Volcanic Activities

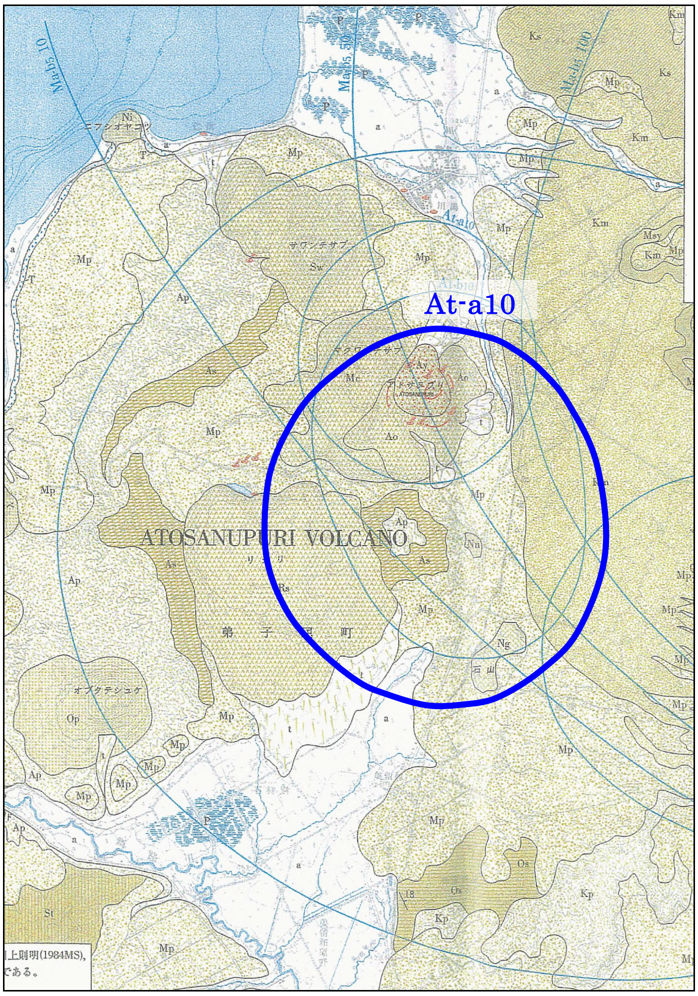


Figure 5-5 Distribution of tephra, several hundred years ago (At-a10, strata; thickness in 10cm) (Katsui et al., 1986).

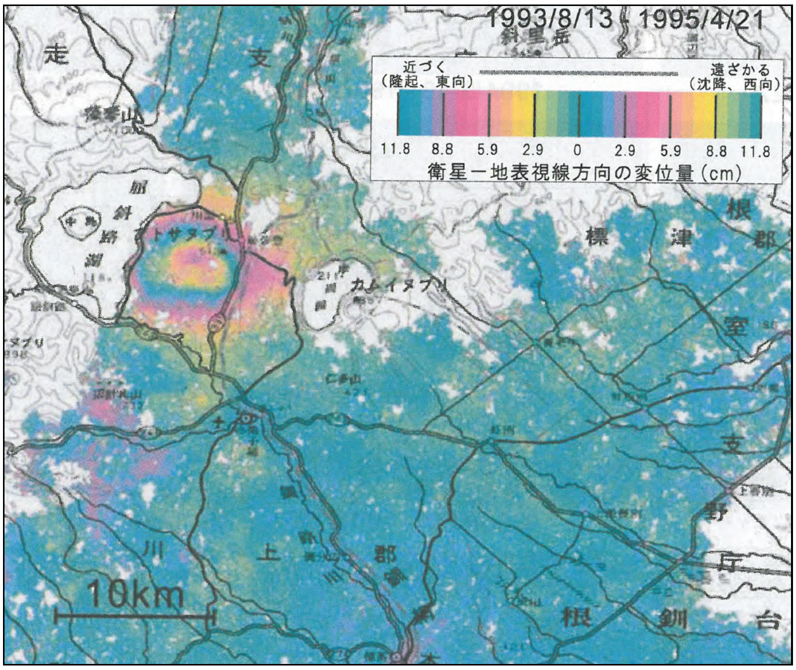


Figure 5-6 Crustal deformation observed derived from JERS-1 (Fuyo 1) L-band SAR interferometry during August 13 1993 to April 21 1995. Color changes correspond to changes of slant distances changes between the satellite and ground targets. Color change with 1.5 cycle around Atosanupuri suggests an inflation below the volcano.　(Geospatial Information Authority of Japan, 2006)

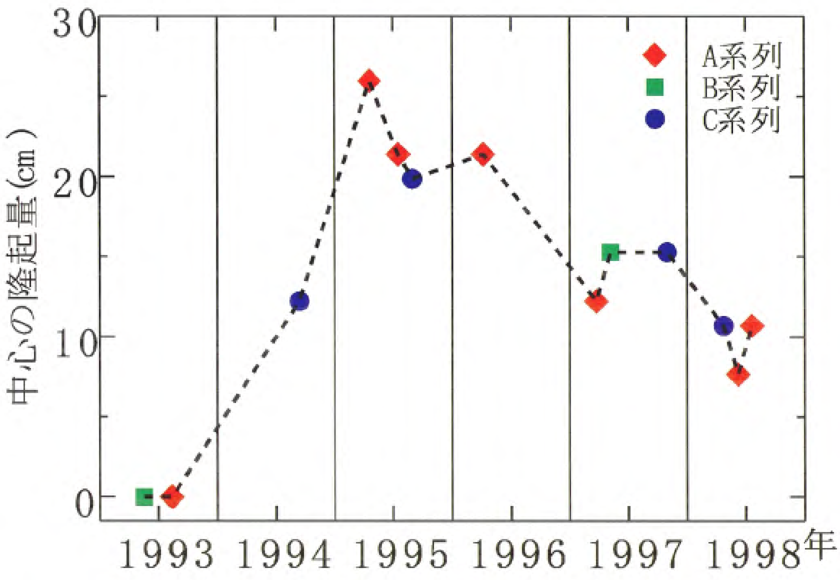


Figure 5-7 Elevation change at the center of crustal deformation, derived from time series analysis of JERS SAR interferometry during 1993 to 1998. The deformation was temporally synchronized to the seismic swarm around Atosanupuri as indicated in Figure 5-8. (Geospatial Information Authority of Japan, 2006)

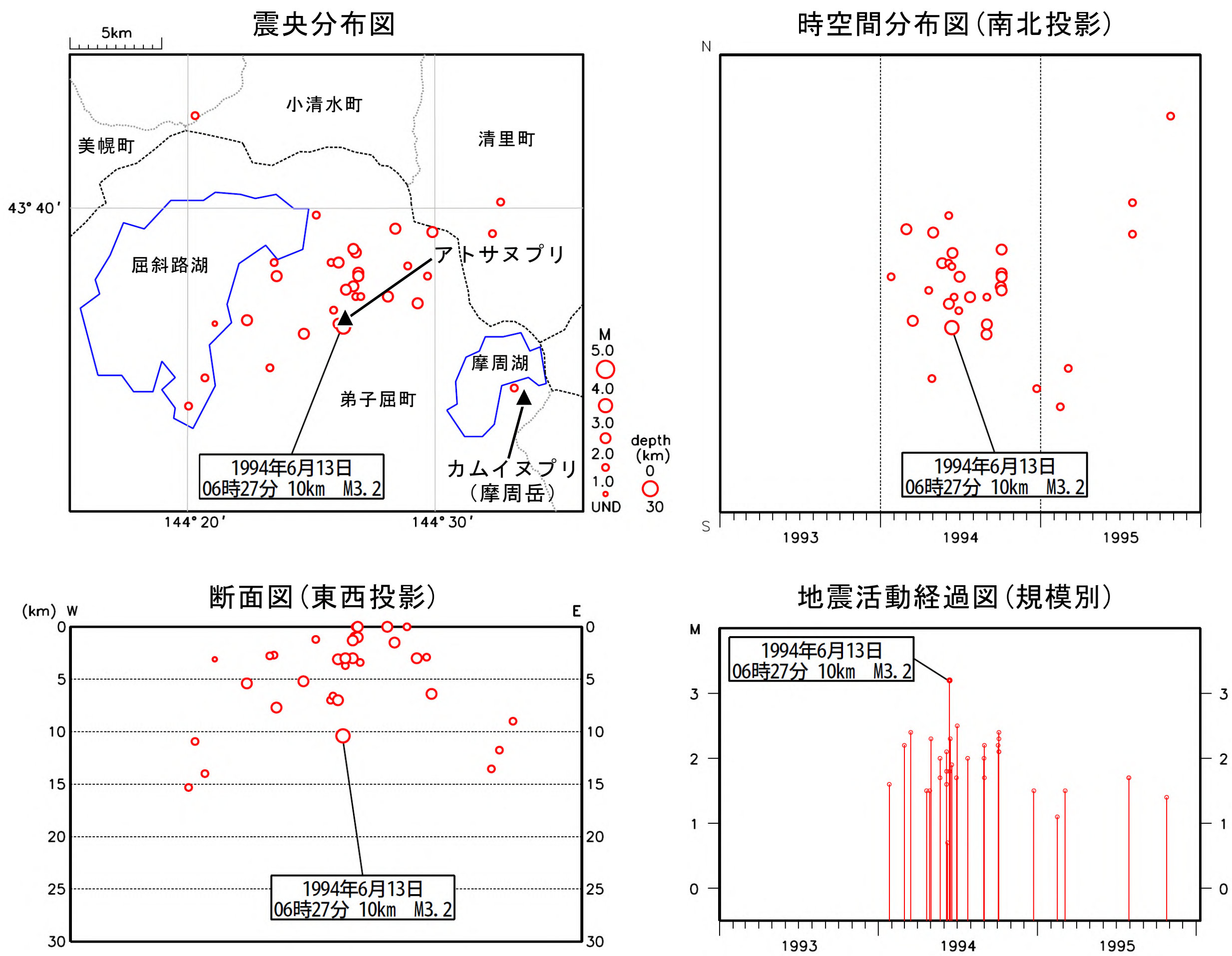


Figure 5-8 Activity of shallow VT earthquakes (blue circles) and deep low-frequency earthquakes (red circles) observed by a regional seismometer network (January 1, 1993, to December 31, 1995). Epicenter distribution (upper left), space-time plot (N-S cross-section) (upper right), E-W cross-section (lower left) and magnitude-time diagram (lower right).

Precursory Phenomena

While no eruptions occurred, in and around 1994, crustal deformation was observed which were inferred to be due to magma injection, and seismic activity, some of which could be felt.

Recent Volcanic Activity

・Time Series of Activity

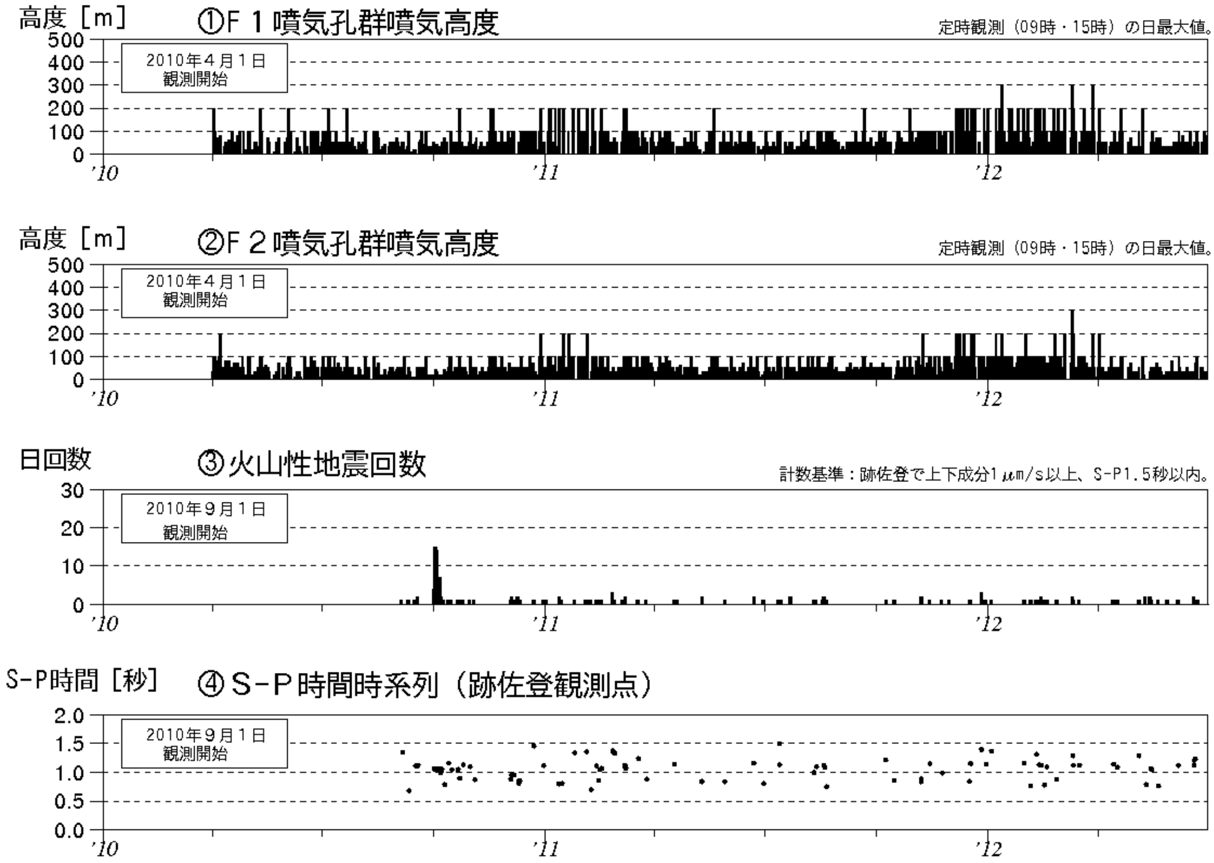


Figure 5-9 Activity at the Atosanupuri volcano (April, 2010, to June, 2012).

①Fumarole height at F1 fumarole group

②Fumarole height at F2 fumarole group

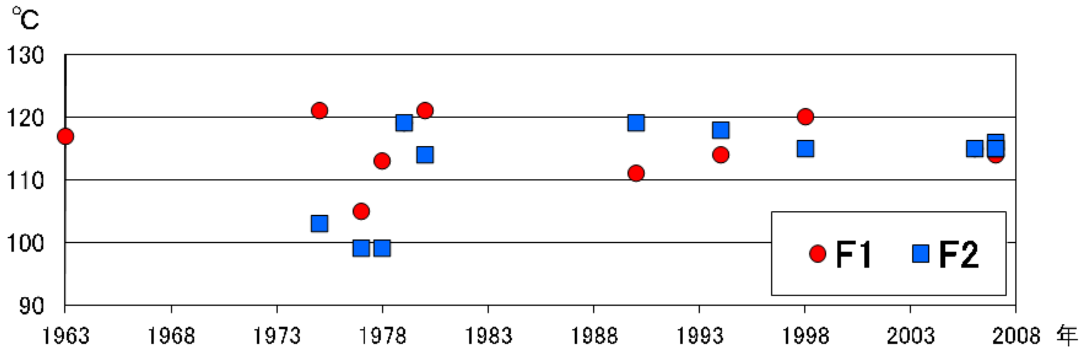
③Daily number of volcanic earthquakes

④S-P time series (Atosanobori measurement point)

・Seismic Activity

See the Mashu

・Fumarole Temperature Trends



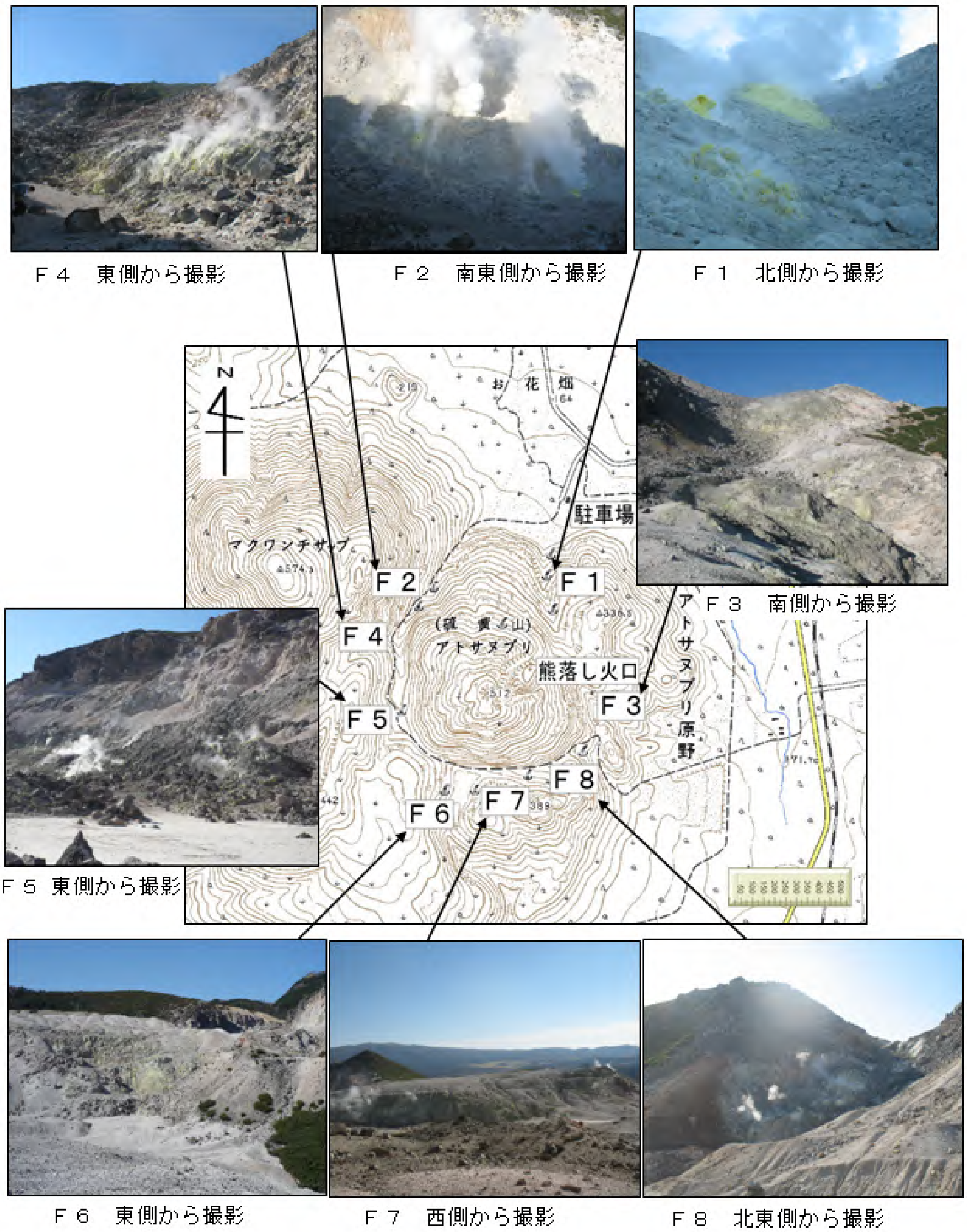


Figure 5-10 (top) Time series of temperature at F1 and F2 fumaroles (1963 to 2007).
(bottom) Locations of fumaroles (F1 to F8)
The 1:25000 scale topographic map published by the Geospatial Information Authority of Japan was used to create this map.

・Kussharo Caldera Area and Electric Resistivity Structure

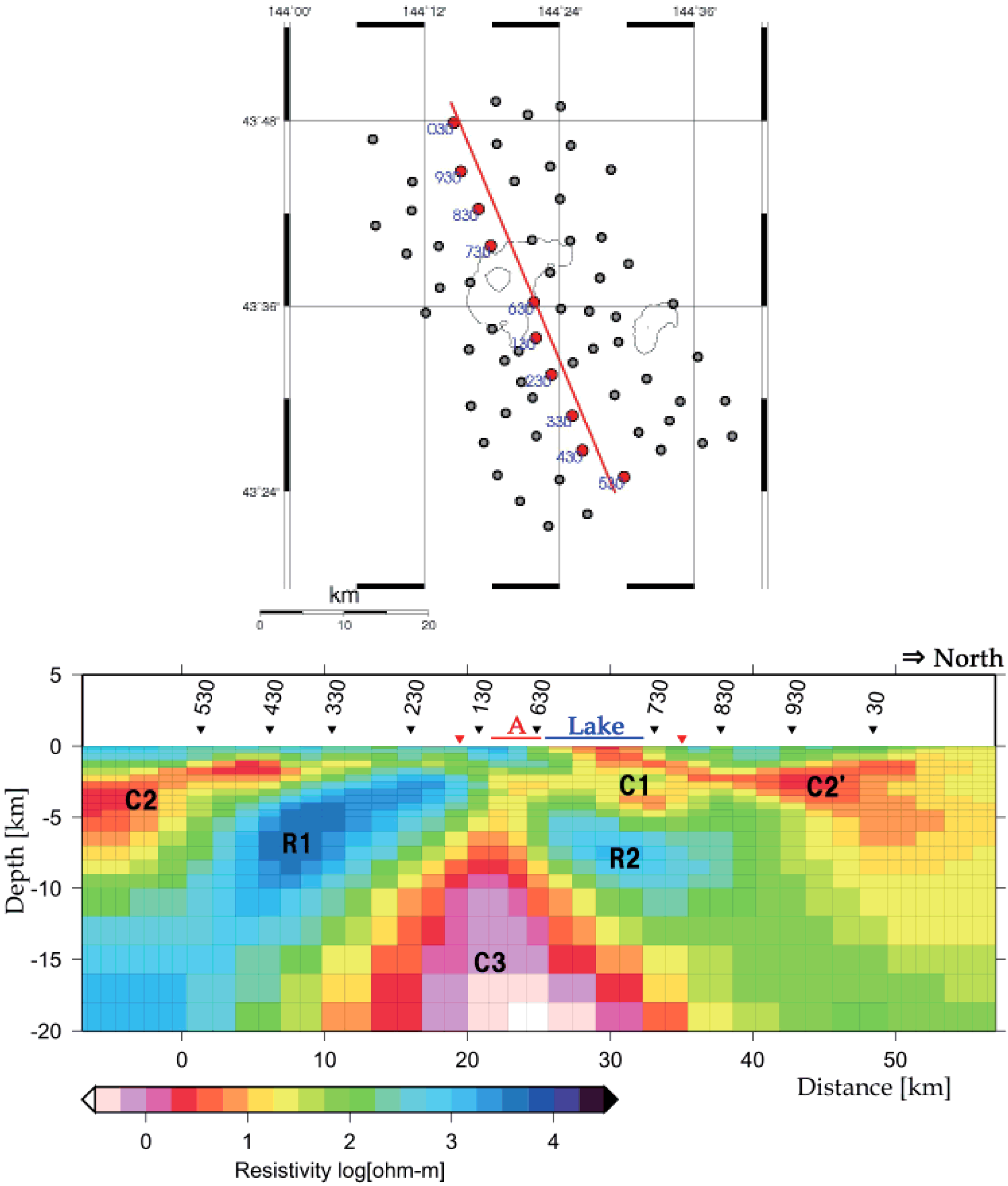


Figure 5-11 Observation points (top) and resistivity structure of cross-section indicated with a red line in the above diagram (bottom) (Honda et al., 2011).

・The black triangles above the diagram are observation points, the red triangles are the caldera's rim, red line labeled "A" is Atosanupuri, and the blue line labeled "Lake" is Lake Kussharo.

・R1 and R2 in the diagram indicate areas of high resistivity, while C1, C2, C3, and C4 indicate areas of low resistivity.

Information on Disaster Prevention

①Hazard Map

Atosanupuri Hazard Map (General Edition) Published in December, 2001 by Teshikaga

National Institute of Advanced Industrial Science and Technology Geological Survey of Japan

http://dil-opac.bosai.go.jp/documents/v-hazard/04atosanupuri/04atosa_1h01-L.pdf

Copy of 1:50,000 and 1:25,000 topological maps - Authorization Number 2001 Hokkaido Copy 518

Social Circumstances

①Populations

Teshikaga Kawayu area population: 1,321 (from statistics current as of October 31, 2011)

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

Akan National Park, Kawayu Onsen area

・Number of sightseers per year: 760,754 (according to 2010 Hokkaido-wide municipal study)

・Number of mountain-climbers per year: Mountain climbing prohibited

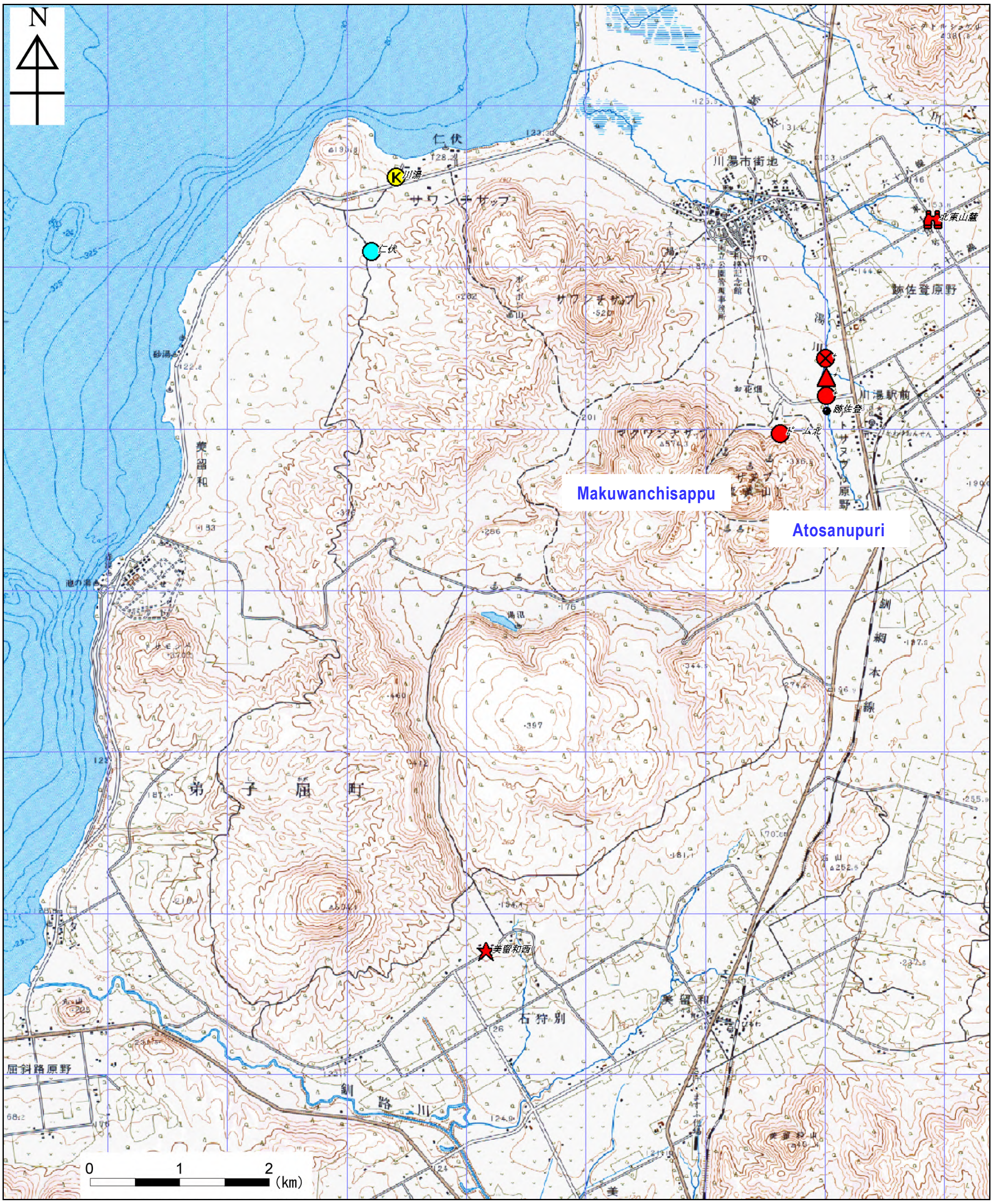
③Facilities

・Teshikaga
 Kawayu Eco Museum Center

Monitoring Network * See the Mashu

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 (Kamisato, Kussharo Ko, Mashu Ko and Mokoto Yama) published by the Geospatial Information Authority of Japan were used.

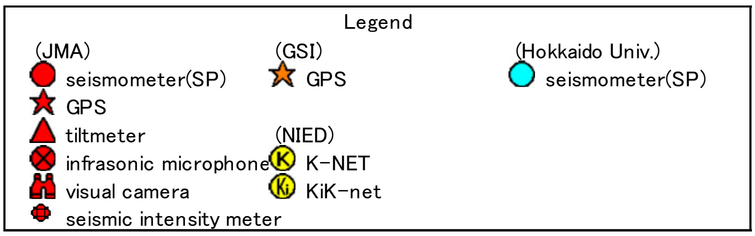


Figure 5-12 Local monitoring network.

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(Nakagawa, M., and Yamamoto, T.)