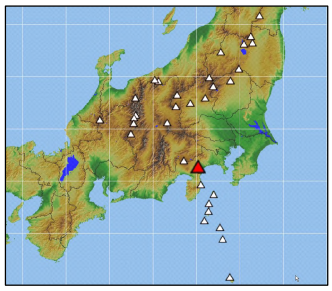
56. Hakoneyama



Continuously Monitored by JMA

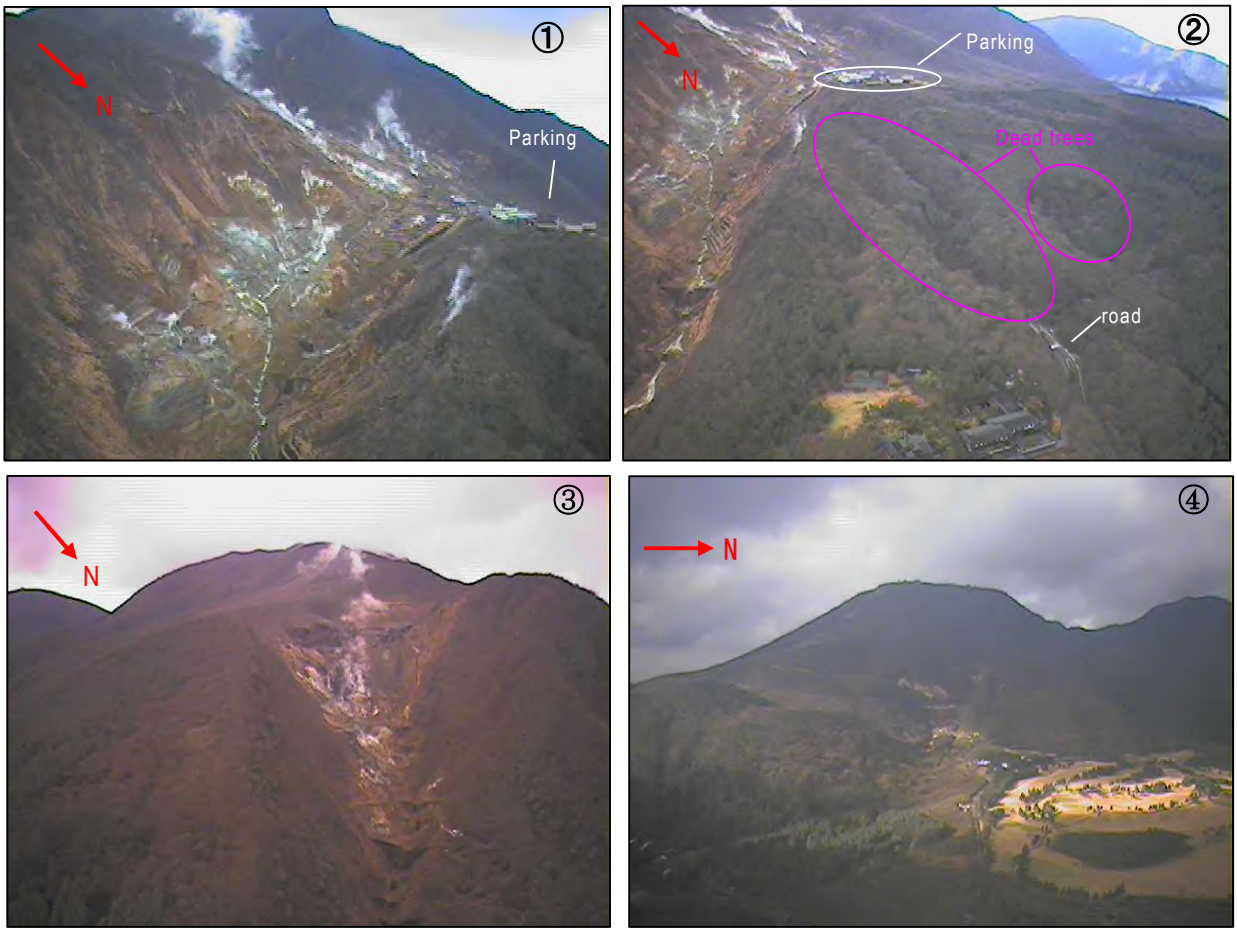
Latitude: 35°14'00" N, Longitude: 139°01'15" E, Elevation: 1,438 m
(Kamiyama) (Triangulation Point - Kanmurigatake)

North of the central cone taken from Nagao Pass on the Somma on December 8, 2011. Courtesy of the Hot Springs Research Institute of Kanagawa Prefecture.

Summary

Hakoneyama is a volcano with a caldera measuring 8 km east-west and 12 km north-south. Its somma is composed of a group of basalt-andesite stratovolcanoes. The central cone (new somma) which was formed during the early stage is made of andesite-dacite lava and an andesite-dacite lava dome. The central cone from the late stage is composed of andesite, and made up of a group of lava domes such as ,the Kamiyama, Komagatake and Futagoyama (Takahashi et al., 1999, 2006; Nagai and Takahashi, 2008). The north side of the highest peak is home to the active fumarolic areas, called “Owakidani (Owakudani)” and “Sounzan”. The Yunohanazawa and Ioyama fumarolic areas are located at the eastern foot of Komagatake. No records of eruptions exist, but fumarolic activity and debris flows occur frequently, and earthquake swarms have been observed. During the most recent magmatic eruption, an intrusion by lava dome occurred on the northern flank of Kamiyama, forming the present Kanmurigatake, and a collapse caused a debris avalanche. The debris avalanche deposits blocked the Haya River, forming what is now Lake Ashi. Geological research shows that several phreatic explosions occurred in the Owakidani area. The SiO_2 content of the andesite and dacite is between 55.6 and 67.8 wt %. The SiO_2 content of the basalt has not been reported, but the SiO_2 content of the rhyolite has been reported to be 76.5 wt %.

Photos



Topography around the Crater

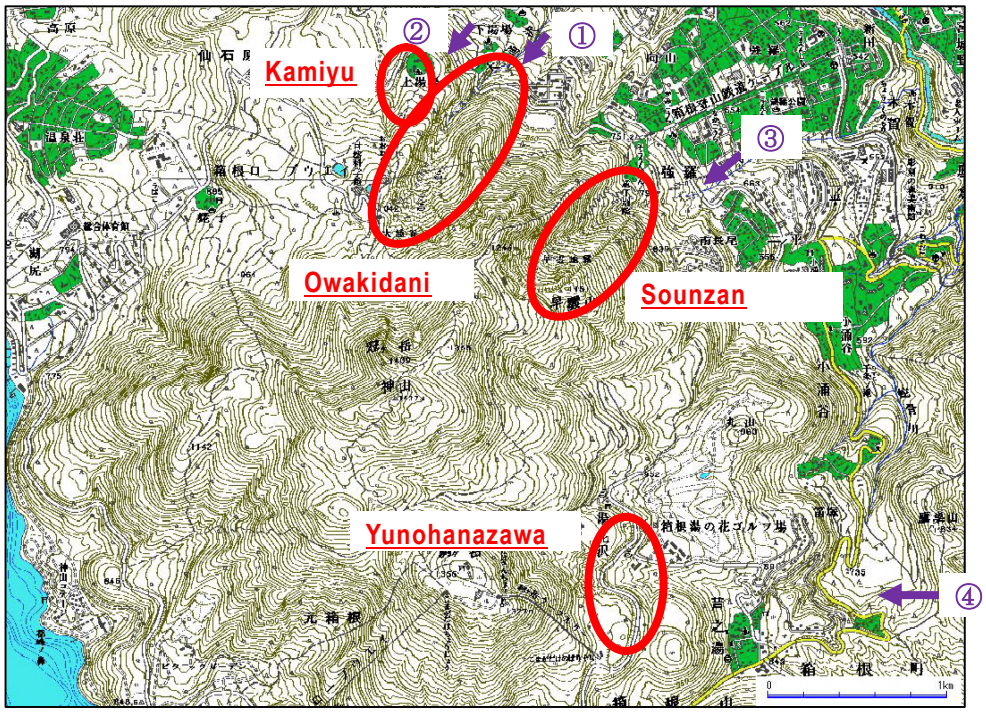


Figure 56-1 Fumarolic areas of Hakoneyama (December 19, 2008, according to aerial observation report of Japan Meteorological Agency).

The 1:25,000 Scale Topographic Map (Hakoneyama) published by the Geospatial Information Authority of Japan was used to create this map.

Red Relief Image Map

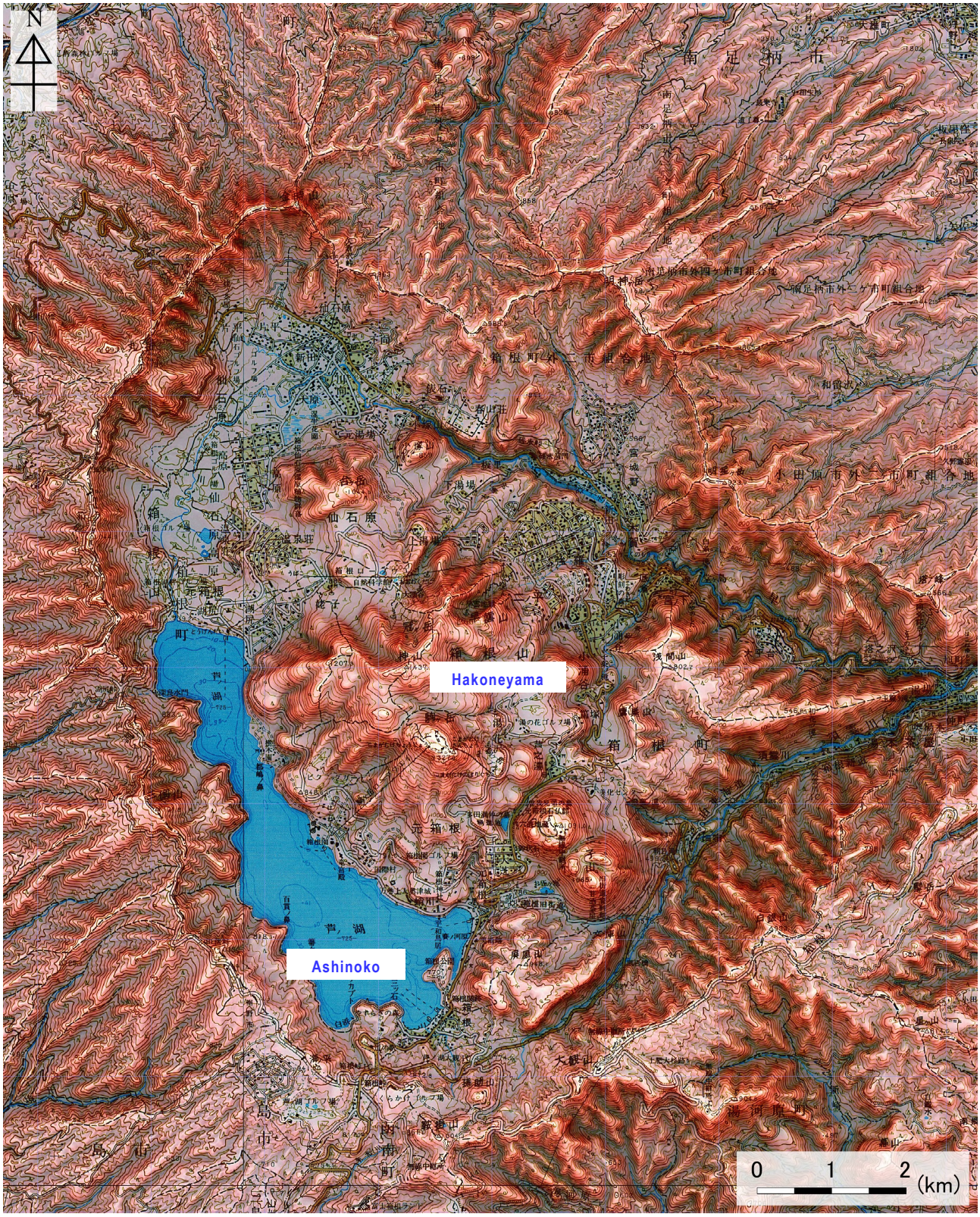


Figure 56-2 Topography of Hakoneyama.

1:50,000 scale topographic maps (Numazu, Gotenba, Atami and Odawara) 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

Activity during the past 10,000 years has been limited to the central cone group inside the caldera, formed during the late stage, which was characterized by magmatic eruptions which ejected lava and formed lava domes, and block and ash pyroclastic flows (Kobayashi, 1999). Phreatic explosions are also known to have occurred (Kobayashi, 2004). Magmatic eruptions include the eruption at Kamiyama summit, approximately 8,000 years ago and the eruption of the Futagoyama lava dome, approximately 5,700 years ago. The most recent magmatic eruption was that of Kamiyama, roughly 3,000 years ago, which was accompanied by a collapse of the northern side of Kamiyama. The Kanmurigatake lava dates back to this eruption. 5 phreatic explosions are known to have occurred since then: one each approximately 3,000 and 2,000 years ago, and 3 during a short period from the late 12th to the 13th century, but no juvenile material has been found in their ejecta.

Period	Area of Activity	Eruption Type	Main Phenomena / Volume of Magma
8.1←→7.9 ka	Kamiyama summit area	Magmatic eruption	Hakone Kamiyama 5 tephra eruption: Pyroclastic flow. Magma eruption volume = 0.005 km^3 DRE. (VEI 3)
5.8←→5.6 ka	Futagoyama	Magmatic eruption	Hakone Futagoyama eruption: Lava dome, pyroclastic flow, tephra fall. Magma eruption volume = 0.52 km^3 DRE. (VEI 1)
3.5←→3.3 ka	Northwest Kamiyama	Phreatic eruption → (collapse)	Debris avalanche
3.2 ka	Kanmurigatake	Magmatic eruption	Hakone Kanmurigatake eruption: Lava dome and pyroclastic flow. Magma eruption volume = 0.48 km^3 DRE. (VEI 2)
3 ka	Kamiyama northeast side depression group	Phreatic eruption (producing lahar)	Tephra fall, debris flow.
2 ka	Kamiyama northeast side depression group	Phreatic eruption (producing lahar)	Tephra fall, pyroclastic surge, debris flow.

* Volcanic periods, areas of activity, and eruption types taken from the Active Volcano Database of Japan, AIST (Kudou 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

Fumarolic activity is calm, but has been observed at locations such as Owakidani.

Earthquake swarm activity occurs repeatedly (Hiraga, 1987; Ito and Tanada, 1999; Mannen, 2003; Tanada, 2008) and in 2001 crustal deformation and seismic activity caused by dike intrusion were observed (Tanada et al., 2002; Daita, 2009). This was followed in 2006 and from 2008 to 2009 by minor earthquake swarms accompanied by crustal deformation (Harada et al., 2009). Some researchers indicate that the earthquake swarm activity has been triggered by fluid supply from deep underground (Yukutake et al., 2011).

For details regarding Hakoneyama's earthquake swarms, see Table 56-1.

Year	Phenomenon	Activity Sequence, Damages, etc.
Late 12th to 13th century	Phreatic eruption	3 tephra fall events. The eruptive activity occurred in the Owakidani area.
1933 (Showa 8)	Fume, hot spring anomaly	February. Fumarole locations changed in Owakidani, and the amount of water emitted from Ubako Onsen fell.
1933 (Showa 8)	Fume	May 10. A discharge and loud boom occurred from the Owakidani fumarole, killing 1.
1934 (Showa 9)	Rumbling, heat	February. Rumbling occurred in the Komagatake area. Temperature rose across the entire foot of the volcano, trees withered and died, and soil uplifts occurred. On February 22, at approximately 16:00, a fume appeared in the saddle between the northwest of Komagatake and Kamiyama, reaching a height of 200 m. Activity continued until the next day.

Year	Phenomenon	Activity Sequence, Damages, etc.
1953 (Showa 28)	Collapse	July 26. Soun Jigoku collapsed, killing 10 and injuring 16. 1 house was completely destroyed. Occasional collapses occurred on the following day as well.
1974 to 1978 (Showa 49 to 53)	Fume	September, 1974 to February, 1978. The fumarolic area of Owakidani changed locations. Trees withered and died.
2001 (Heisei 13)	Earthquake, crustal deformation	June to October (maximum magnitude of M2.8, JMA scale seismic intensity of 2 at Kuno, Odawara). Crustal deformation indicating inflation centered on Hakoneyama occurred. Immediately after the earthquake swarm the fumarolic area from Owakidani to the Kamiyuba area expanded, and steam well emissions grew in intensity in several locations in Owakidani (blowouts).
2008 (Heisei 20)	Earthquake, crustal deformation	In April the number of earthquakes in the Komagatake area rose temporarily (maximum magnitude of M2.6). In September the number of earthquakes near Kojiri and in the north of Lake Ashi rose temporarily (maximum magnitude of M2.5). In December the number of earthquakes in the Komagatake area rose temporarily (maximum magnitude of M2.8). From June crustal deformation indicating inflation centered on Hakoneyama occurred.
2011 (Heisei 23)	Earthquake	March to April. Since the 2011 off the Pacific coast of Tohoku Earthquake (March 11, 2011) High seismic activity occurred from Komagatake to the Lake Ashi, the Kintokisan, and the north of Owakidani. High number of felt-earthquakes. March 11, 15:08 - M4.6 (JMA scale seismic intensity of 5-lower), March 21, 23:14 - M4.2 (JMA scale seismic intensity of 2).

* 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.

Table 56-1 List of earthquake swarms at Hakoneyama (based on data from Hiraga (1987) and the Hot Springs Research Institute of Kanagawa Prefecture)

No.	Swarm Period				Number of Days	Number of Earthquakes	Number of Felt-Earthquakes	Rumbling	Notes
1	1786	3/22/1786	to	3/23/1786	2	> 100	> 100	Yes	First earthquake swarm at Hakone
2	1917	1/17	to	3/4	47	> 300		Yes	Fissure appeared in Hatajuku
3	"	6/21	to	6/24	4	> 100		Yes	February 23, 1912 - Izu-Oshima eruption
4	1920	12/26	to	12/31	6	> 100		Yes	September 1, 1923 - Kanto earthquake (M7.9)
5	1932	8/10	to	8/12	3	19	0		Records of earthquake at Mishima weather station
6	1935	1/7	to	2/11	35	25	25		November 26, 1930 - Kita-Izu earthquake (M7.0)
7	1940	7/1	to	7/14	14	25	1		July 12, 1940, Miyakejima eruption
8	1941	9/29	to	10/1	2	17	0		
9	1943	3/6	to	3/9	3	9	8		
10	"	4/13	to	5/2	19	103	11		
11	"	5/29	to	4/18	326	459	16		December 7, 1944 - Tonankai earthquake (M8.0)
12	1945	8/14	to	9/17	34	39	1		
13	1946	7/4	to	7/17	13	16	0		
14	"	8/2	to	11/12	102	52	0		
15	"	12/13	to	12/21	8	11	1		December 21, 1946 - Nankai earthquake (M8.1)
16	1952	11/8	to	12/18	41	89	43	Yes	July 16, 1950, Izu-Oshima eruption
17	1953	1/20	to	1/30	11	15	9	Yes	July 26, 1953, Sounzan landslide
18	1959	9/2	to	10/13	42	30	7	Yes	Continuous earthquake observation started
19	"	12/22	to	4/1	101	136	18	Yes	August 24, 1962 - Miyakejima eruption

No.	Swarm Period				Number of Days	Number of Earthquakes	Number of Felt-Earthquakes	Rumbling	Notes
20	1966	7/14	to	7/26	12	5	0		Anomalous high temperatures observed at Gora the following year
21	1971	7/31	to	7/31	1	15	0		
22	1972	3/7	to	4/14	39	222	24		
23	1973	12/4	to	12/4	1	11	0		
24	1974	12/15	to	12/16	2	15	0		May 9, 1974 - Earthquake off the coast of the Izu Peninsula (M6.9)
25	1979	2/1	to	2/1	1	9	0		January 14, 1978 - Earthquake in the sea near the Izu Peninsula (M7.0)
26	"	6/30	to	6/30	1	11	0		June 29, 1980 - Earthquake off the eastern coast of the Izu Peninsula (M6.7)
27	1983	2/8	to	2/8	1	15	0		
28	"	4/27	to	4/27	1	18	0		August 8, 1983 - East Yamanashi Prefecture earthquake (M6.0)
29	"	6/20	to	6/21	2	72	1		October 3, 1983 - Miyakejima eruption
30	1984	1/20	to	1/29	10	117	0		
31	"	5/17	to	5/22	6	69	0		
32	"	7/19	to	8/15	28	185	12		
33	"	9/10	to	9/20	10	114	7		
34	"	10/24	to	11/5	13	51	3		
35	"	12/13	to	12/24	11	57	0		
36	1985	7/13	to	7/24	11	43	0		
37	1986	4/4	to	4/4	1	14	0		November 15, 1986 - Izu-Oshima eruption
38	1987	3/1	to	3/3	3	78	11		(Largest earthquake)
39	1989	6/29	to	6/29	1	17	0		29th, 02:33 M 1.5
40	"	8/15	to	8/15	1	18	0		15th, 21:57 M-0.4 July 13 - Teishi sea hill eruption
41	"	8/18	to	8/18	1	22	0		18th, 04:52 M 1.2
42	1990	2/15	to	2/15	1	18	0		15th, 20:36 M 2.3

No.	Swarm Period				Number of Days	Number of Earthquakes	Number of Felt-Earthquakes	Rumbling	Notes
43	"	2/20	to	2/21	2	46	0		21st, 03:53 M 2.2
44	"	8/11	to	8/11	1	38	0		11st, 07:51 M 1.7
45	1991	4/22	to	4/22	1	329	8		22nd, 10:25 M 2.0
46	"	4/22	to	4/22	1	27	2		22nd, 18:58 M 2.2
47	"	10/30	to	10/30	1	29	0		30th, 04:13 M 1.3
48	"	12/7	to	12/7	1	47	0		7th, 20:57 M 1.6
49	1992	5/10	to	5/10	1	117	0		10th, 03:53 M 1.4
50	"	8/11	to	8/11	1	12	0		11st, 05:56 M 1.5
51	"	8/31	to	9/1	2	31	0		31st, 21:23 M 1.8
52	"	9/14	to	9/14	1	17	0		14th, 18:17 M 1.3
53	"	10/16	to	10/16	1	15	0		16th, 12:13 M 1.4
54	"	11/30	to	11/30	1	57	1		30th, 08:33 M 2.0
55	"	12/5	to	12/6	2	22	0		5th, 21:46 M 2.6
56	1993	8/29	to	8/29	1	14	0		29th, 21:01 M 2.5
57	"	10/26	to	10/26	1	32	0		26th, 01:06 M 0.8
58	1994	4/6	to	4/6	1	60	0		6th, 16:17 M 2.7
59	"	4/23	to	4/23	1	13	0		23rd, 01:27 M-0.1
60	"	5/18	to	5/18	1	23	5		18th, 07:49 M 1.9
61	"	8/5	to	8/5	1	25	1		5th, 02:29 M 2.9
62	"	10/5	to	10/5	1	32	0		5th, 02:19 M 1.6
63	"	10/22	to	10/22	1	122	3		22nd, 03:22 M 3.6
64	"	10/25	to	10/28	4	1299	1		25th, 15:06 M 4.8
65	"	11/2	to	11/3	2	35	0		2nd, 17:15 M 2.2
66	"	11/12	to	11/13	2	172	0		12nd, 05:22 M 2.2
67	"	12/17	to	12/18	2	37	2		17th, 23:24 M 2.2
68	"	12/25	to	12/26	2	464	1		25th, 09:27 M 2.1

No.	Swarm Period				Number of Days	Number of Earthquakes	Number of Felt-Earthquakes	Rumbling	Notes	
69	1995	1/25	to	1/25	1	44	0		25th, 11:30 M 2.9	
70	"	7/16	to	7/16	1	47	0		16th, 06:12 M 0.3	
71	"	7/16	to	7/17	2	90	0		17th, 01:41 M 0.7	
72	"	7/18	to	7/20	3	71	0		19th, 21:37 M 0.2	
73	"	7/22	to	7/23	2	20	0		22nd, 19:16 M 0.9	
74	"	9/29	to	9/29	1	128	0		29th, 05:08 M 0.6	
75	1996	1/22	to	1/23	2	52	0		23rd, 04:54 M 1.0	
76	1997	11/14	to	11/14	1	34	0		14th, 09:01 M 1.6	
77	1998	4/13	to	4/13	1	31	0		13rd, 05:47 M 1.6	
78	"	6/14	to	6/15	2	22	0		14th, 02:10 M 1.5	
79	"	10/13	to	10/14	2	80	0		13rd, 03:10 M 2.1	
80	2000	4/27	to	4/27	1	38	1		27th, 05:15 M 2.5	
81	"	5/17	to	5/18	2	25	0		17th, 16:56 M 0.7	June, 2000 - Miyakejima eruption
82	"	7/6	to	7/7	2	129	1		6th, 23:36 M 2.7	
83	"	8/30	to	8/31	2	37	0		30th, 21:43 M 0.9	
84	"	9/9	to	9/10	2	51	0		9th, 17:04 M 1.4	
85	2001	6/12	to	6/14	3	229	0		12nd, 21:42 M 1.3	
86	"	6/18	to	6/19	2	59	0		18th, 17:35 M 1.2	
87		6/19	to	8/27		13907	28	Yes	21st, 11:40 M 2.9	
88	"	8/28	to	8/30	2	146	0		30th, 07:09 M 1.2	
89	"	8/31	to	9/1	1	66	0		1st, 00:22 M 1.0	
90	"	9/1	to	9/2	1	57	0		1st, 23:26 M 1.2	
91	"	9/2	to	9/6	4	261	0		3rd, 14:02 M 1.5	
92	"	9/6	to	9/8	2	84	0		7th, 22:22 M 1.9	
93	"	9/9	to	9/9	1	26	0		9th, 12:01 M 0.9	
94	"	9/10	to	9/10	1	86	1		10th, 16:52 M 1.8	
95	"	9/12	to	9/13	1	35	0		13rd, 08:30 M 1.7	
96	"	9/17	to	9/17	1	20	0		17th, 17:56 M 0.4	
97	"	9/21	to	9/22	1	77	1		21st, 09:10 M 2.2	
98	"	9/24	to	9/25	1	28	0		25th, 02:32 M 1.8	
99	"	9/30	to	10/1	1	32	0		30th, 21:58 M 1.9	
100	"	10/2	to	10/3	1	34	0		2nd, 23:41 M 0.6	
101	"	10/4	to	10/4	1	59	0		4th, 07:26 M 0.8	
102	"	10/6	to	10/6	1	42	0		6th, 02:24 M 0.7	
103	"	10/8	to	10/9	1	28	2		8th, 19:34 M 2.1	
104	"	10/24	to	10/25	1	15	0		8th, 19:34 M 2.1	
105	2002	6/6	to	6/6	1	42	0		6th, 03:35 M 1.3	
106	"	8/26	to	8/28	3	159	0		27th, 04:15 M 2.4	
107	"	8/29	to	8/30	1	42	0		29th, 07:13 M 2.5	

No.	Swarm Period				Number of Days	Number of Earthquakes	Number of Felt-Earthquakes	Rumbling	Notes
108	2003	2/5	to	2/5	1	39	0		2nd, 04:57 M 0.2
109	2004	2/4	to	2/5	2	567	4	Yes	4th, 16:38 M 3.0
110	"	4/15	to	4/15	1	44	0		15th, 06:53 M 1.5
111	"	4/23	to	4/23	1	49	0		23rd, 10:55 M 2.3
112	2005	8/14	to	8/15	1	163	0		14th, 19:59 M 2.2
113	"	10/26	to	10/26	1	19	0		26th, 16:41 M 1.1
114	2006	9/27	to	9/28	2	147	0		28th, 06:28 M 2.3
115	"	10/2	to	10/4	2	375	0		2nd, 05:36 M 2.2
116	"	10/9	to	10/18	10	779	1		11st, 06:10 M 2.0
117	"	11/18	to	11/19	2	136	3		18th, 04:35 M 2.6
118	2007	2/16	to	2/18	3	182	1		17th, 12:26 M 2.0
119	"	2/28	to	2/28	1	55	0		28th, 03:21 M 0.3
114	2008	4/4	to	4/4	1	38	1		4th, 08:06 M 2.4
115	"	9/9	to	9/11	3	320	0		10th, 07:26 M 1.4
116	"	9/12	to	9/14	3	224	1		12nd, 21:29 M 2.4
117	"	12/16	to	12/16	1	37	1		16th, 07:46 M 2.7
118	2009	2/8	to	2/8	1	427	0		8th, 02:31 M 1.7
114	"	7/29	to	7/29	1	24	0		29th, 02:31 M 1.2
115	"	8/4	to	8/7	4	1300	2		6th, 06:03 M 3.2
116	"	8/9	to	8/10	2	292	0		9th, 07:30 M 1.8
117	"	8/11	to	8/12	2	89	0		11st, 11:40 M 2.4
118	2010	2/25	to	2/26	2	31	1		25th, 18:29 M 2.3
119	2011	1/10	to	1/10	1	23	0		10th, 14:56 M 0.8

Whole Rock Chemical Composition

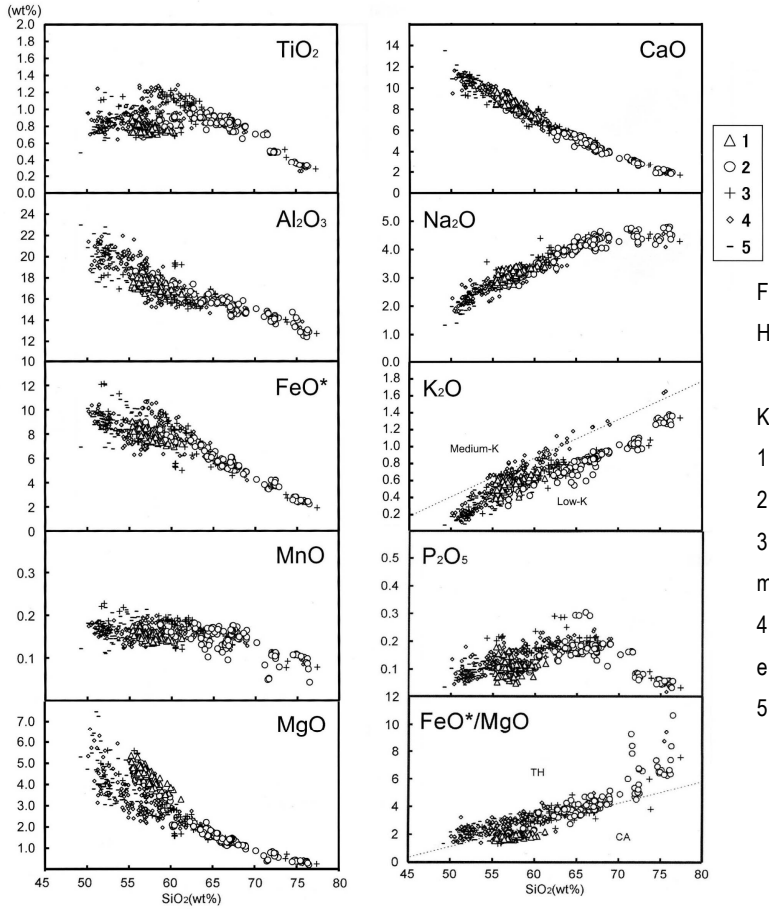


Figure 56-3 whole rock chemical composition Harker diagram (Takahashi et al., 2006).

Key:

1. Late stage central cone group
2. Early stage central cone group
3. Old somma (middle and late stage monogenetic volcanoes)
4. Old somma (late stage stratovolcanos and early stage monogenetic volcanoes)
5. Old somma (early stage stratovolcanoes)

Period - Cumulative Magma Volume

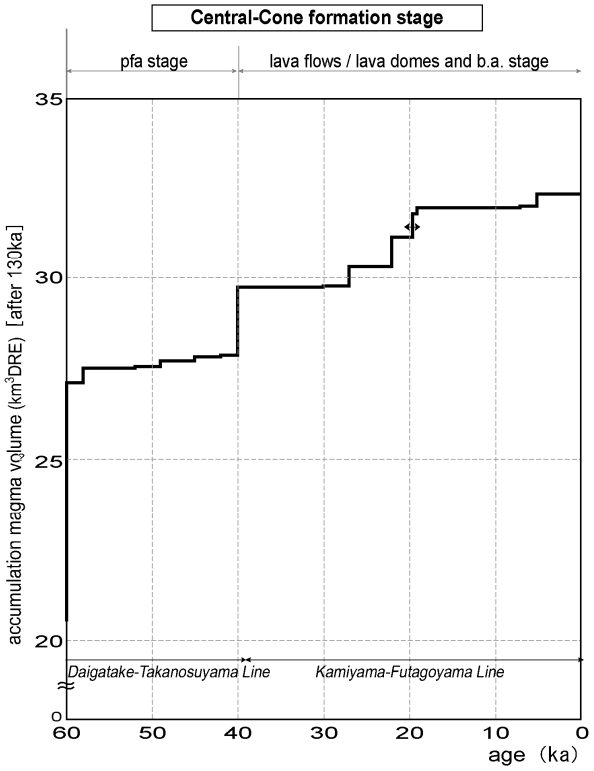


Figure 56 Eruption period-cumulative magma volume over the past 60,000 years (Kobayashi, 2009).

Major Volcanic Activity

・2001 Volcanic Activity

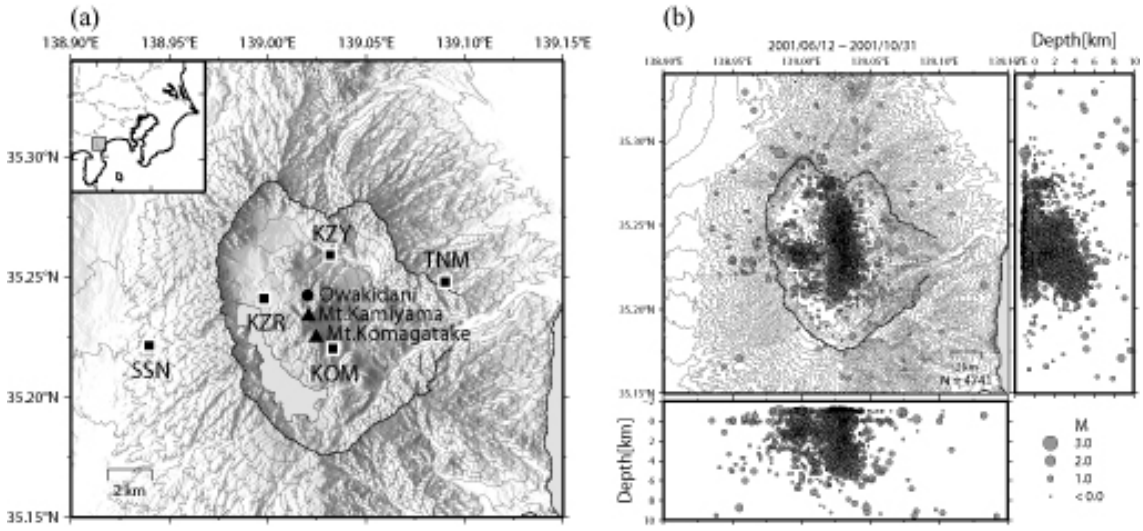


Figure 56-5 Distribution of volcanic earthquake swarms in 2001 (June 12, 2001, to October 31, 2001) (Daita et al., 2009).

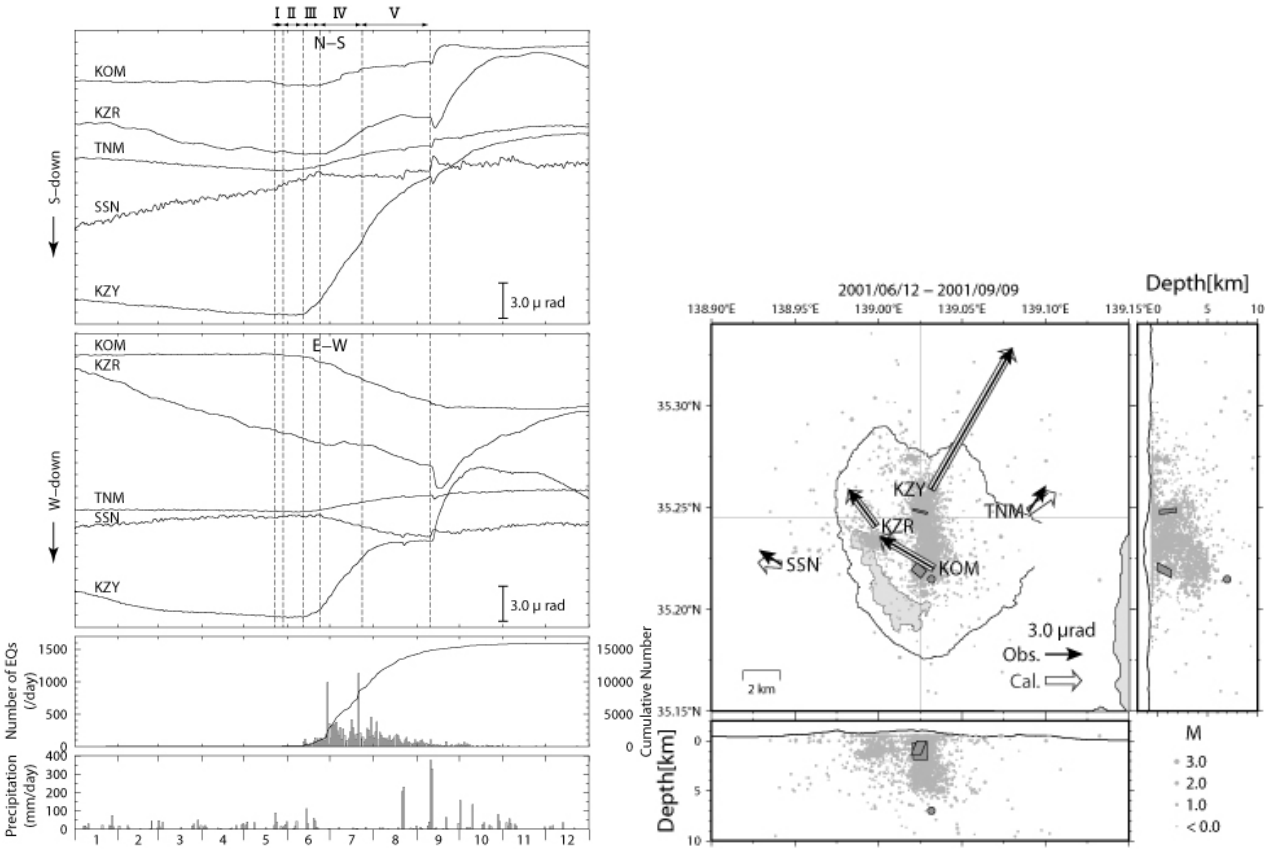


Figure 56-6 (Left) Tiltmeter data and number of earthquakes per day / precipitation from January to December, 2001
(Right) Crustal deformation source model at Hakoneyama (Shirota et al., 2009).

Crustal deformation can be explained by one point source and two tensile cracks.

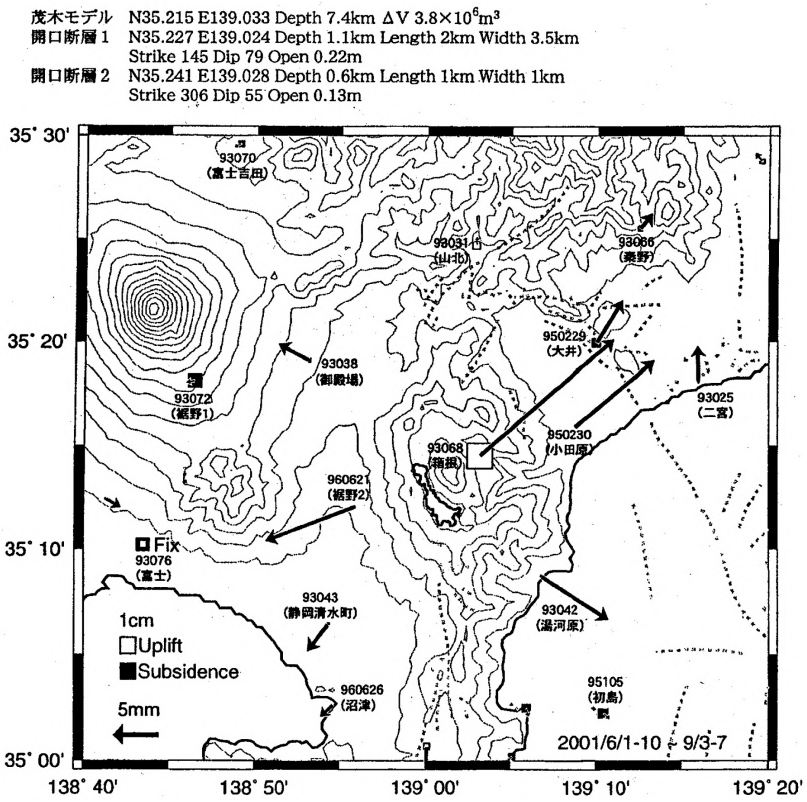


Figure 56-7 Crustal deformation observed by GEONET between June and September, 2001 at Hakone (Geospatial Information Authority of Japan GNSS Earth Observation Network System) (Geospatial Information Authority of Japan, 2002).

Arrows and squares indicate lateral and vertical displacement calculated from differences in average values between June 1 and June 10, 2001, and September 3 and September 7, 2001, respectively.

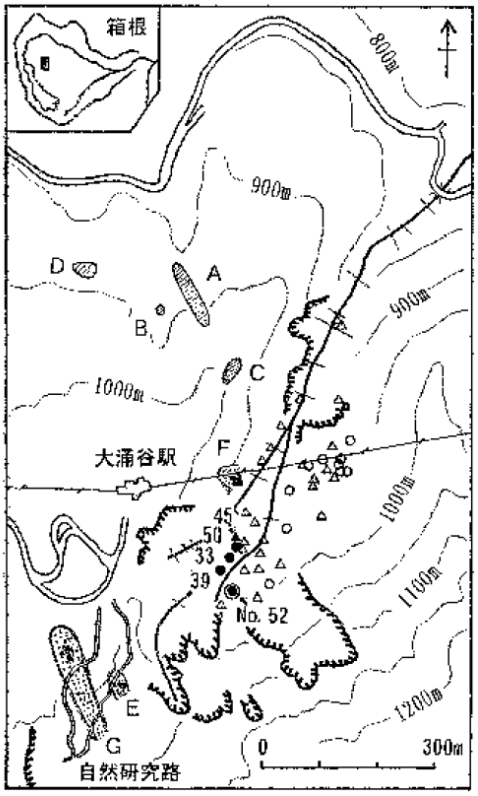


Figure 56-8 Locations of Hakone Owakidani steam wells, etc. (辻内 et al., 2003).

○: Steam well ●: Steam wells with high levels of steam emission

△: Hot spring wells ▲: Hot spring wells with observed steam emissions

A to D: Locations of above emissions within forested areas

(A was discovered on November, 2001, B on November, 2002, C on January, 2003, and D on February, 2003).

E to G: Locations of collapses caused by landslides

(E occurred in August, 2001, F in September, 2001, and C in October, 2002)

Precursory Phenomena

Although not culminating in an eruption, repeated earthquake swarm activity and crustal deformation has been observed, which has sometimes resulted in increased fumarolic activity in Owakidani, etc.

Recent Volcanic Activity

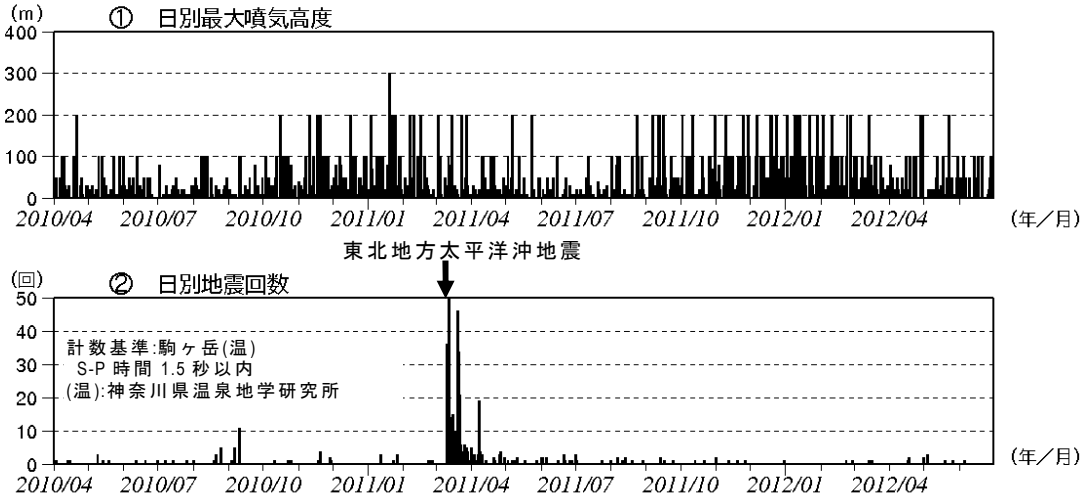


Figure 56-9 Volcano activity (April 1, 2010, to June 30, 2012).

①Maximum volcanic plume height per day at Soun Jigoku, based on regular observation (09:00 and 15:00)

②Number of earthquakes per day in the Hakoneyama area

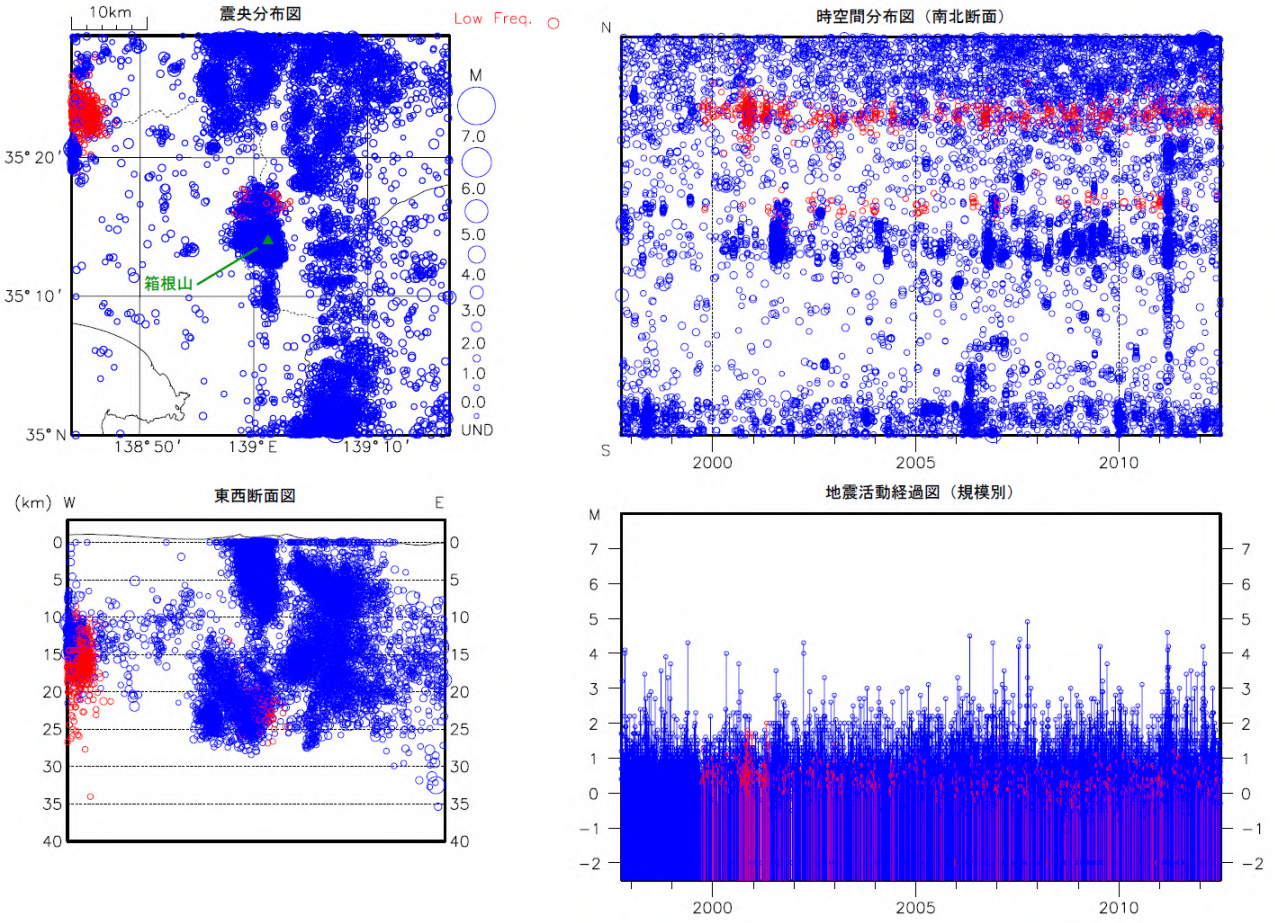


Figure 56-10 Activity of shallow VT earthquakes (blue circles) and deep low-frequency earthquakes (red circles) observed by a regional seismometer network (October 1, 1997, to June 30, 2012). Epicenter distribution (upper left), space-time plot (N-S cross-section) (upper right), E-W cross-section (lower left) and magnitude-time diagram (by scale) (lower right).

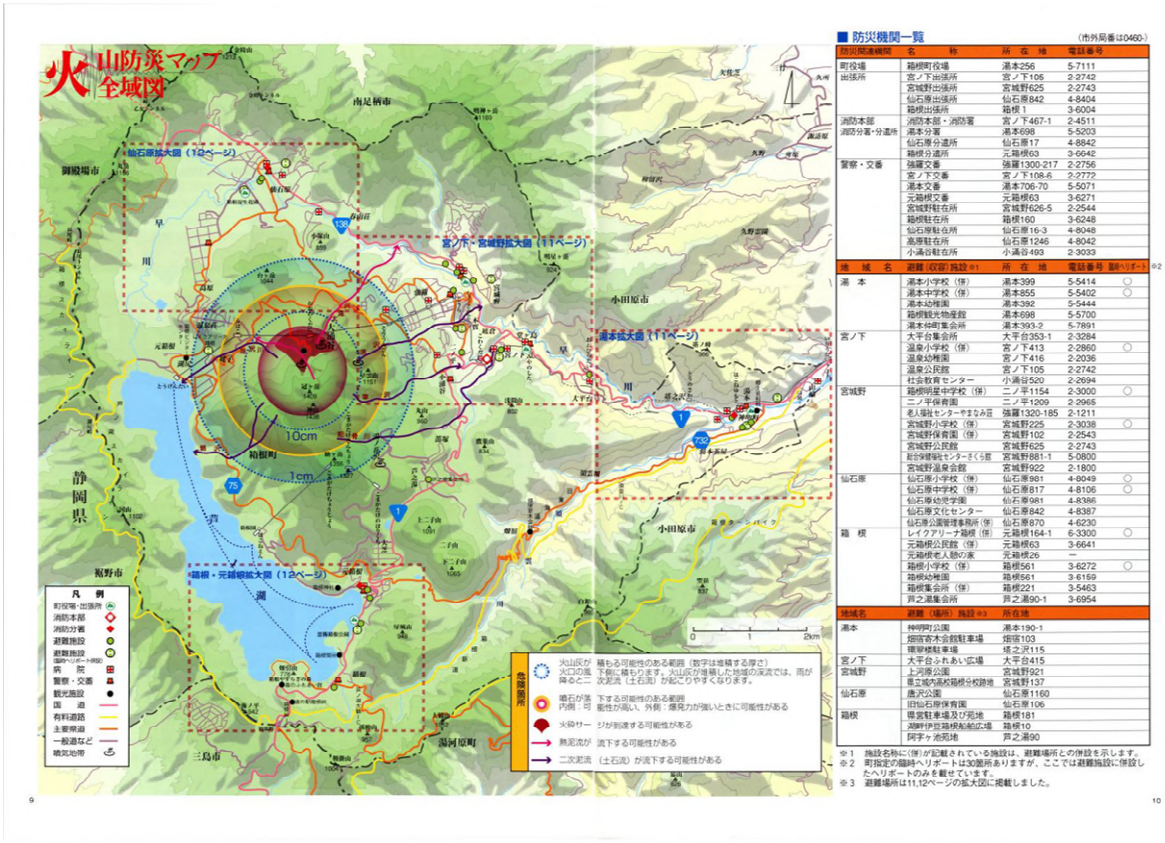
Information on Disaster Prevention

①Hazard Map

Hakone Volcano Disaster Prevention Map (Hakone Version) March, 2004 (Heisei 16) - Published by the Hakone Department of General Affairs Disaster Prevention Division and the Hakone Volcano Disaster Prevention Map Creation Deliberating Committee

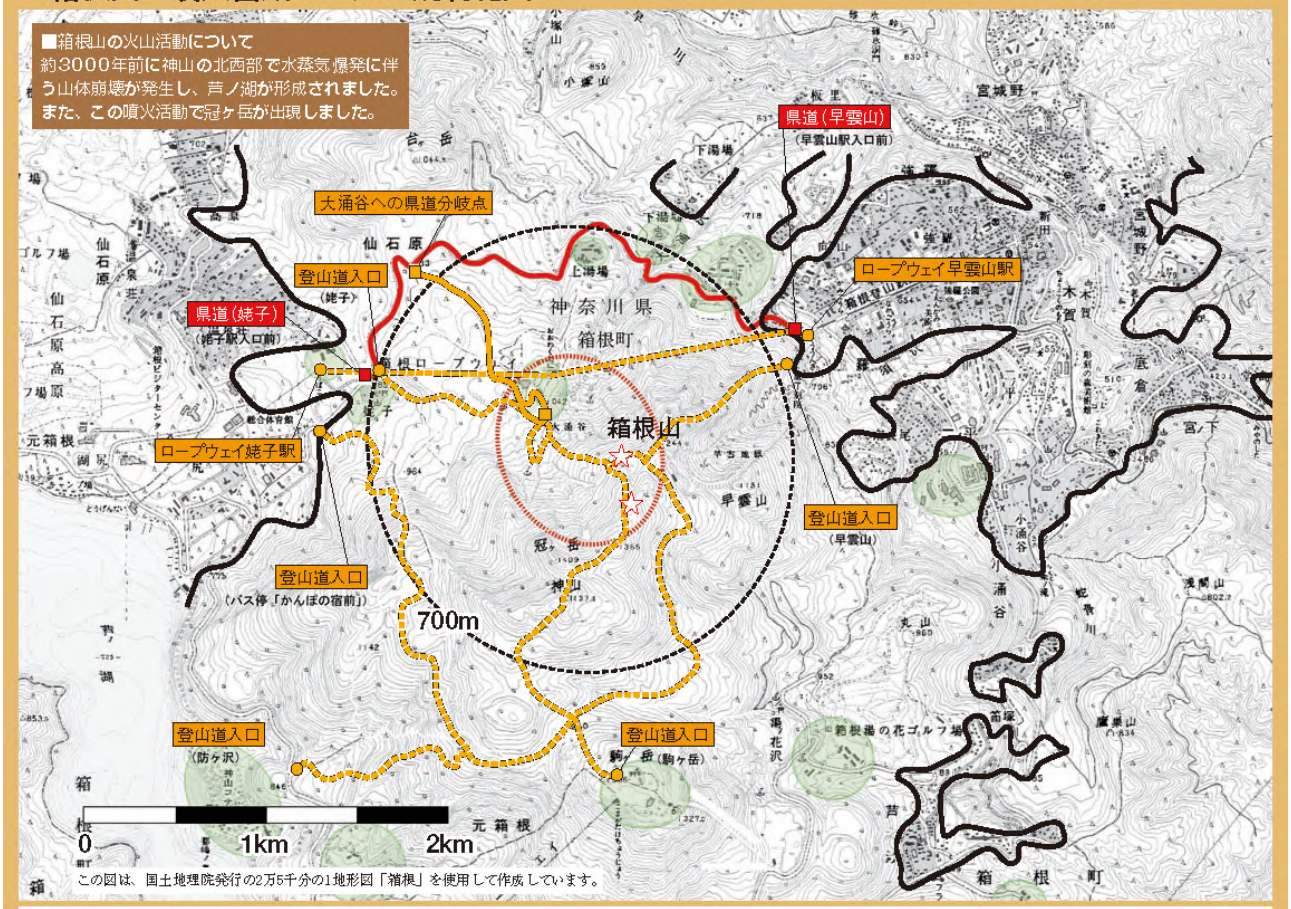
- Name of Source: Hakone Volcano Disaster Prevention Map
- Created: March, 2004
- Created by: Hakone Town

http://www.town.hakone.kanagawa.jp/hakone_j/kurashi/iza/kazanmapindex.html



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

■箱根山　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。＜大涌谷周辺での噴火を想定した場合＞

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)：想定火口域から700m程度 以内の立入禁止。
県道 は通行できません。
レベル2(火口周辺規制)：想定火口域 周辺の立入禁止。
県道 、登山道等 は通行できません。
レベル1(平常)　：状況に応じて想定火口域 内への立入規制等。

：規制道路　：居住区域
：登山道、ロープウェイ　：保全対象施設
：過去の火口　：想定火口域

■この図は「箱根町火山防災マップ」(箱根町、平成16年3月)に基づき作成しています。
■箱根山の噴火警戒レベルは、地元自治体等で構成する箱根火山対策連絡会議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、詳細については箱根町にお問い合わせください。

Volcanic Alert Levels for the Hakoneyama 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 causing severe damage to residential areas due to lava flows, pyroclastic flows, etc. Past Examples 3,000 years ago: Formation of Kanmurigatake lava dome and pyroclastic flow ●Imminent eruption causing severe damage to residential areas due to large volcanic tremors, etc. Past Examples No observed examples in historical times. ●Small eruption, with scattering of volcanic blocks and/or pyroclastic surge within a distance of approximately 2 km from the crater. Past Examples 12th to 13th century: Phreatic explosion and pyroclastic surge at Owakidani
		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.**	●Increased probability of eruption causing severe damage to residential areas due to large number of felt-earthquakes and/or predominant 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.**	●Possibility of eruption whose impact may approach residential areas as a result of increased seismic activity and heat activity, crustal deformation indicating inflation, etc. 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.**	●Possibility of eruption which may affect the area around the crater as a result of increased seismic activity and heat activity, crustal deformation indicating inflation, etc. Past Examples June to October, 2001: Increased seismic activity, crustal deformation indicating volcanic edifice inflation, increased heat activity such as fume anomalies, etc.
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. ●Temporary increase in number of earthquakes. Past Examples September to November, 2006: Temporary increase in number of earthquakes. June to July, 1966: Temporary increase in number of earthquakes, rise in hot spring temperatures the following year.

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

・Hakone Town:　13,542 (as of November 1, 2011, according to Hakone Town website)

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

Fuji Hakone Izu National Park

- Number of sightseers to Hakone: 20,036 (2010) (according to Hakone Town website)
- Number of Hakone Ropeway passengers per year: Approximately 2,000,000
- Number of vehicles parked in Owakidani parking lot per year: Approximately 230,000
- Hakone area was certified as a "Japanese Geopark" in September, 2012.

③Facilities

・Odawara

Hot Springs Research Institute of Kanagawa Prefecture

Kanagawa Prefectural Museum of Natural History

・Hakone

Hakone 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 map (Kofu, Shizuoka, Tokyo and Yokosuka) published by the Geospatial Information Authority of Japan were used.

Legend

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

(GSI)
- GPS

(NIED)
- Hi-net
- Hi-net(tiltmeter)
- K-NET
- KiK-net

(ERI)
- seismometer(SP)

(HSRI)
- seismometer(SP)
- seismometer(strong-motion)
- GPS
- tiltmeter
- EDM
- EDM(reflector)

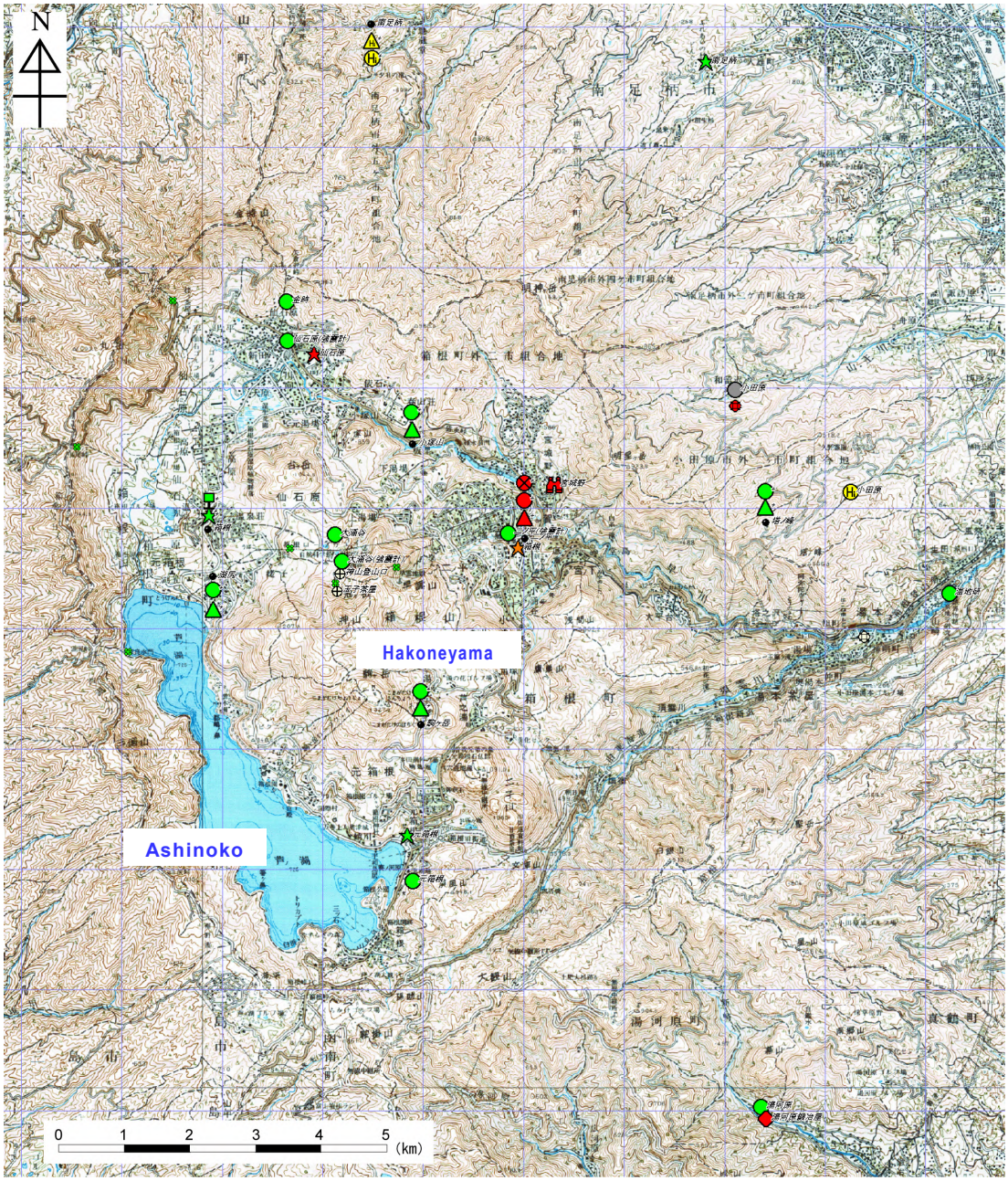
(Kanagawa Pref.)
- gas sensor

(Municipalities)
- seismic intensity meter

Figure 56-11 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 map (Numazu, Gotenba, Atami and Odawara) published by the Geospatial Information Authority of Japan were used.

Legend

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

(GSI)
- GPS

(NIED)
- Hi-net
- Hi-net(tiltmeter)

(HSRI)
- seismometer(SP)
- seismometer(strong-motion)
- GPS
- tiltmeter
- EDM
- EDM(reflector)

(Kanagawa Pref.)
- gas sensor

(Municipalities)
- seismic intensity meter

Figure 56-12 Local monitoring network.

Bibliography

Daita, T., et al. (2009): Bull. Volcanol. Soc. Jpn., **54**, 223-234 (in Japanese with English Abstract).

GSI (2002): Report of Coordinating Committee for Prediction of Volcanic Eruption. **80**, 34-40 (in Japanese).

GSI (2010): Report of Coordinating Committee for Prediction of Volcanic Eruption. **101**, 76-77 (in Japanese).

Hakamata, K. (1993): Exploring Hakone Volcano. Kanashin Publishing, 189p (in Japanese).

Hakamata, K. and Ito, J. (1996): Bull. Owakidani Nat. Hist. Mus., Hakone, **13,** 21-24 (in Japanese with English Abstract).

Harada, M., et al. (2009): Bull. Hot Springs Res. Inst. Kanagawa. Pref., **41**, 7-14 (in Japanese with English Abstract).

Hiraga, S. (1987): Bull. Hot Springs Res. Inst. Kanagawa. Pref., **18(4)**: 1-126 (in Japanese with English Abstract).

Hirota, S., et al. (1977): Bull. Hot Springs Res. Inst. Kanagawa Prefecture, **8**, 27-38 (in Japanese with English Abstract).

Ito, H. and Tanada, T. (1999): Bull. Hot Springs Res. Inst. Kanagawa. Pref., **31(1)**: 45-52 (in Japanese with English Abstract).

JMA (1959): Chronicle of eruption history in Japan (in Japanese).

Kanagawa Prefectural Meteorological Station (1935): Past and present of Mt. Hakone. 18p (in Japanese).

Kobayashi, M., et al. (1997): Bull. Volc. Soc. Jpn. **42**, 355-358 (in Japanese with English Abstract).

Kobayashi, M. (1999): Quaternary Res., **38,** 327-343 (in Japanese with English Abstract).

Kobayashi, M., et al. (2004): Programme and abstracts of 2004 fall meeting, the Volcanological Society of Japan, 21 (in Japanese).

Kobayashi, M.,et al. (2006): Bull. Volcanol. Soc. Jpn, **51,** 245-256 (in Japanese with English Abstract).

Kobayashi, M. (2009): Doctoral dissertation submitted to Tokyo Metropolitan University; Study of the Eruptive Activity of the Central Cones of the Hakone Volcano and its Volcanic Mechanism: Volcanic Activity in the Plate Collision Field in the Northernmost Region of Izu-Ogasawara Arc.

Kuno, H. (1935): Bull. Volcanol. Soc. Jpn, **3,** 53-71 (in Japanese).

Mannen, K. (2003): Bull. Volcanol. Soc. Jpn., **48,** 425-443 (in Japanese with English Abstract).

Mannen, K., et al. (2006): Chikyu Monthly, **28**, 355-362 (in Japanese).

Nagai, M. and Takahashi, M. (2008): Res. Rep. Kanagawa Prefect. Mus. Nat. Hist., **13**, 25-42 (in Japanese with English Abstract).

Oki Y., et al. (1981): Bull. Hot Springs Res. Inst. Kanagawa Prefecture, **12**, 249-344 (in Japanese with English Abstract).

Oki, Y. and Hakamata, K. (1975): Revealing mystery of birth of Lake Ashi. Kokudo to Kyoiku, **30**, 2-9 (in Japanese).

Takahashi, et al. (2006): Proc. Inst. Nat. Sci., Nihon Univ., **41,** 151-186 (in Japanese with English Abstract).

Takahashi, M., et al. (1999): Chikyu Monthly, **21,** 437-445 (in Japanese).

Takahashi, M., et al. (2006): Proceedings of the Institute of Natural Sciences, Nihon Univ., **41**, 151-186 (in Japanese with English Abstract).

The Central Meteorological Observatory (1953): The seismological bulletin of the Central Meteorological Observatory, Japan, **31**, 56 (in Japanese).

Tsujiuchi, K., et al. (2003): Catfish letters (Hot Springs Research Institute of Kanagawa Prefecture), **53,** 1-12 (in Japanese).

Yukutake, Y., et al (2011): Journal of Geophysical Research, **116**, B04308,doi:10.1029/2010JB008036