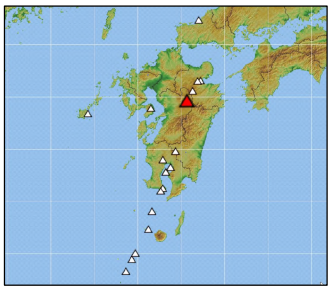
84. Asosan



Continuously Monitored by JMA

Latitude: 32°53'04" N, Longitude: 131°06'14" E, Elevation: 1,592 m (Takadake)
(Triangulation Point)
Latitude: 32°53'01" N, Longitude: 131°05'49" E, Elevation: 1,506 m (Nakadake)
(Elevation Point)

– Post-caldera central cones of Aso Volcano viewed from the southwest by the Japan Meteorological Agency on September 24, 2011.

Summary

Asosan (Aso Volcano) comprises the Aso caldera and post-caldera central cones. The Aso caldera, 25 km north-south and 18 km east-west in diameter, was formed by four gigantic pyroclastic-flow eruptions from approximately 270,000 to 90,000 years ago. Post-caldera central cones were initiated soon after the last caldera-forming eruption, producing not only local lava flows but also voluminous tephra layers which fell far beyond the caldera. Nakadake Volcano, which is the only active central cone of basaltic andesite to basalt, is one of the most active volcanoes in Japan. The active crater of Nakadake Volcano is a composite of seven craterlets aligned N-S. Only the northernmost crater (No. 1 crater) has been active in the past 80 years, although some others were active before the 1933 eruption. The Nakadake No. 1 crater is occupied by a hyperacidic crater lake during its calm periods. During active periods, its volcanic activity is characterized by ash and strombolian eruptions and phreatic or phreatomagmatic explosions.

Photos

The central part of post-caldera central cones viewed from the North on January 20, 2009. Courtesy of the Ground Self-Defense Force 8th Division

The No. 1 crater of Nakadake Volcano
The photo was taken on August 10, 2011 by the Japan Meteorological Agency

Incandescent floor of the Nakadake No. 1 crater on May 30, 1989 (by the Japan Meteorological Agency)

November 26, 1989, eruption, taken by the Japan Meteorological Agency.

November 12, 1989, strombolian eruption
View from the southwest crater rim taken by the Japan Meteorological Agency

September 6, 1979, 13:06 Eruption
View from the Asosan Weather Station (West-southwest) by the Japan Meteorological Agency

September 6, 1979, Hole in the roof of the Sensuikyo Ropeway Crater East Station (diameter: 120cm)
September 8, 1979. Taken by the Japan Meteorological Agency

September 6, 1979, No. 1 Crater - Massive volcanic block
280m East-northeast side of the No. 1 crater on September 11, 1979 by the Japan Meteorological Agency

Volcanic block ejected by April 20, 1990, Eruption
Taken from the southwest crater rim - April 21, 1990 by the Japan Meteorological Agency

Minami-Aso, Yoshioka Fumarolic Area on December 14, 2011
Taken from east side of fumarolic area B by the Japan Meteorological Agency

Minami-Aso, Yoshioka Fumarolic Area on December 14, 2011
Taken from west side of fumarolic area B by the Japan Meteorological Agency

Topography around the Crater (Nakadake Crater)

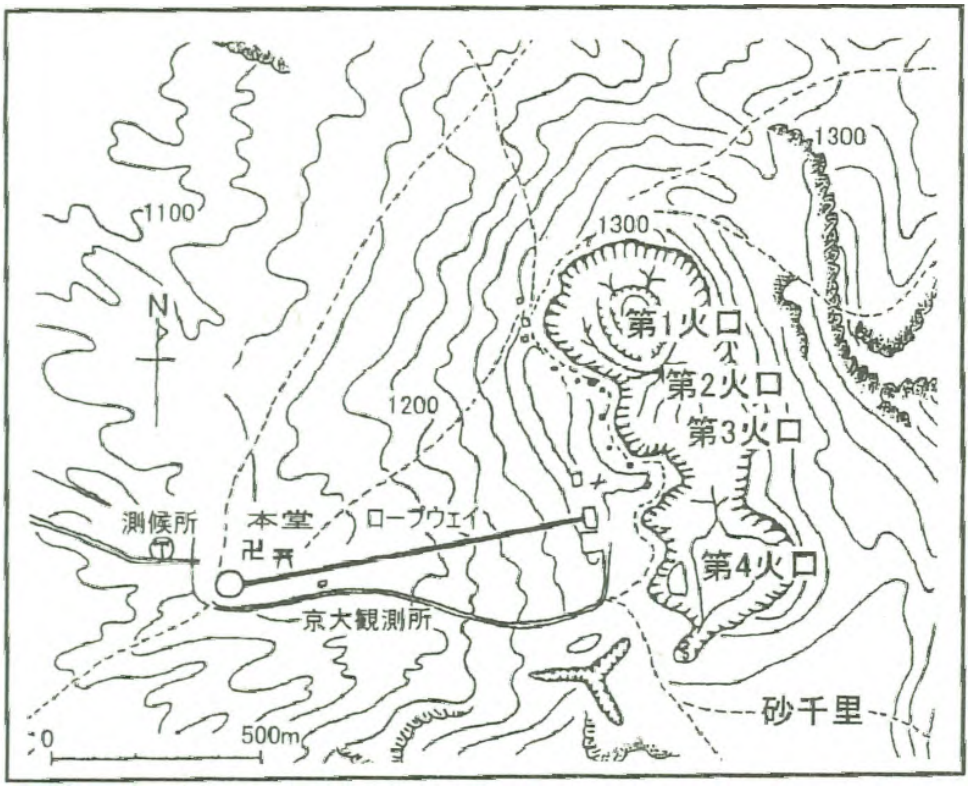


Figure 84-1 Topography around the crater (Sudo, 2004).

(Minami-Aso Yoshioka)

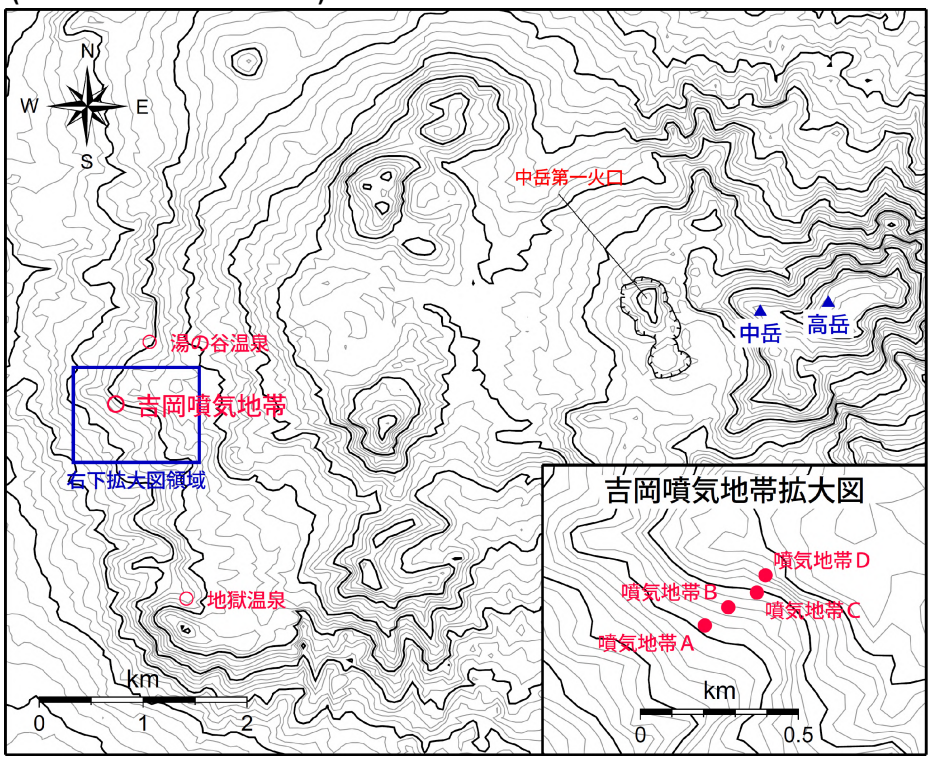


Figure 84-2 Topographic map showing fumarolic areas in the western part of post-caldera central cones of Aso Volcano. The 50-m-mesh DEM data published by the Geospatial Information Authority of Japan was used to create this map.

Red Relief Image Map

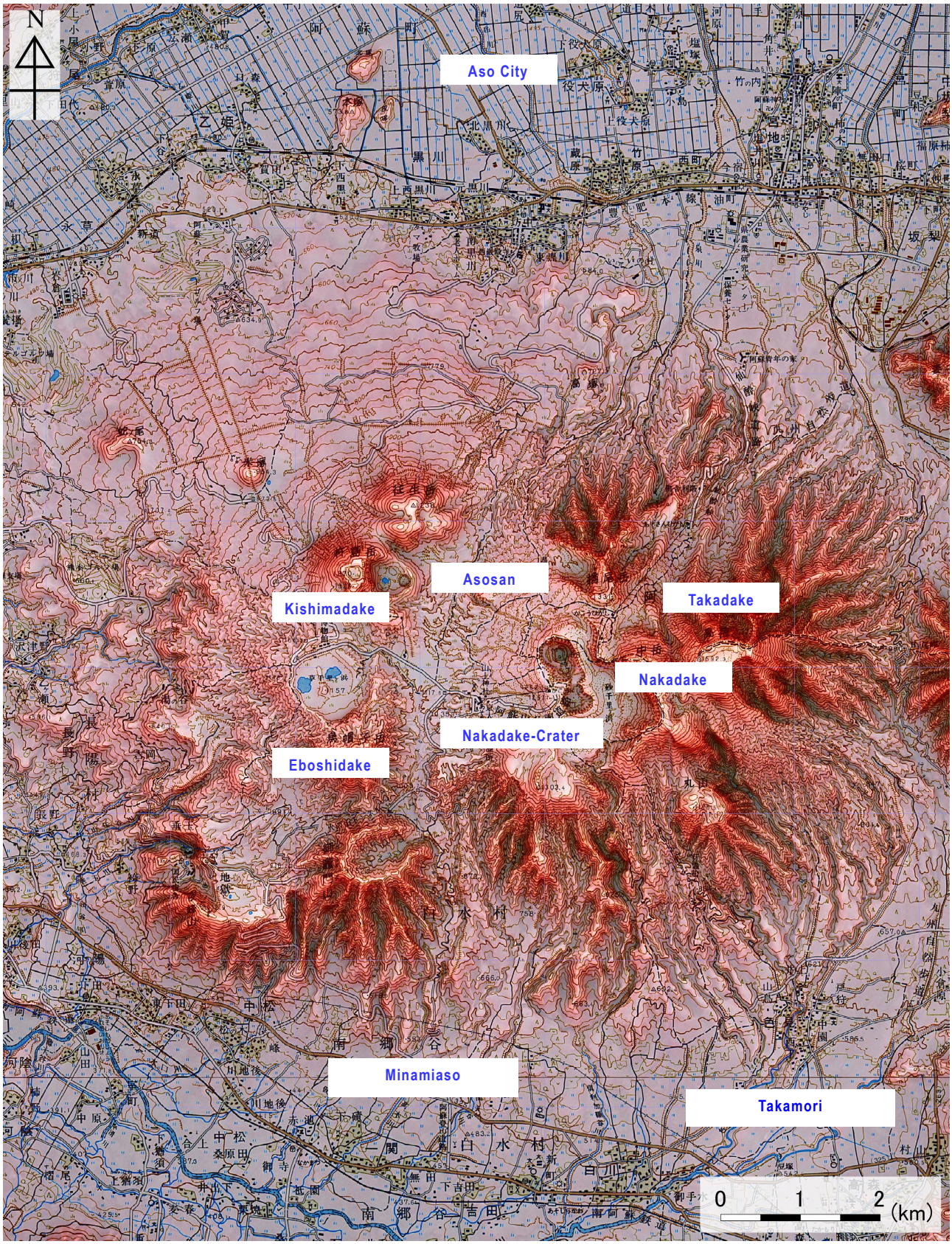


Figure 84-3 Topography of the central area of the Aso caldera.

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

Geological Maps

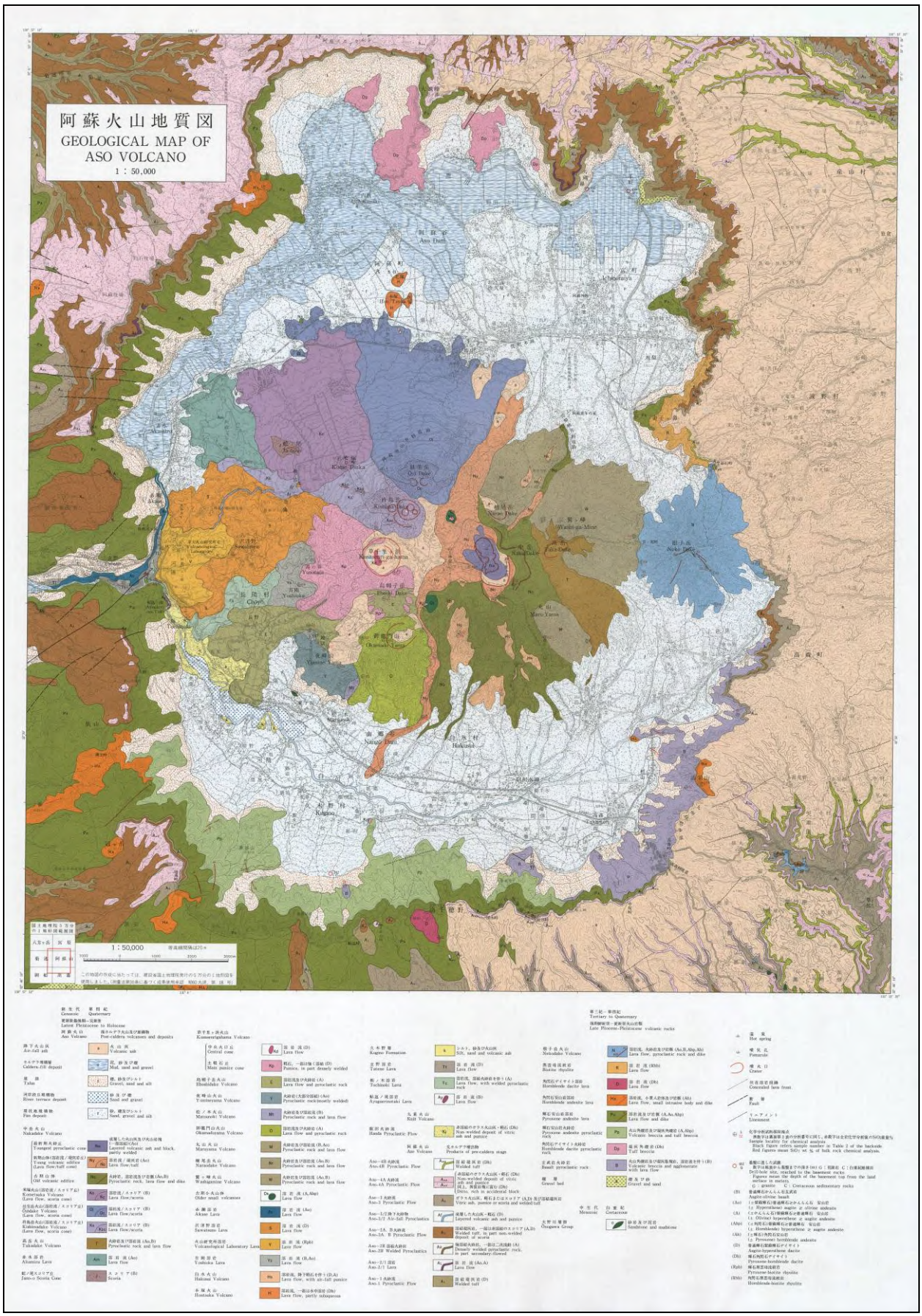


Figure 84-4 Geological map of the Aso volcano (Ono and Watanabe, 1985).

Chronology of Eruptions

・Volcanic Activity in the Past 10,000 Years

During the past 10,000 years Janoo scoria cone, Akamizu lava, Kishimadake (approximately 4,000 years ago), Ojodake (3,600 yeas ago) and Komezuka (3,300 years ago) scoria cones were formed in the northwestern part of the post-caldera central cones of Aso Volcano (Miyabuchi and Watanabe, 1997; Miyabuchi, 2009, 2010). Nakadake continued its activity to the present time, interspersed with short dormant periods. Most characteristic volcanic activity of Nakadake in Holocene time has been ash eruptions, which have formed a continuous fallout of black sandy ash from dark eruption plumes (Ono et al., 1995). Moreover, a lava extruded about 5,000 years ago and a large phreatomagmatic eruption produced a scoria-fall deposit approximately 1,500 years ago.

Period	Area of Activity	Eruption Type	Main Phenomena / Volume of Magma
7.3ka<	Janoo	Magmatic eruption	Tephra fall. Scoria cone formed (Janoo scoria cone).
10ka?	Jigoku spa	Phreatic eruption	Tephra fall.
14←→7.3ka	Nakadake	Magmatic eruption or phreatomagmatic eruption	Intermittent tephra fall. 6 layers (from bottom to top: N18, N17, N16, N15, N14, N13) of volcanic ash deposits from small ash eruptions have been confirmed, sandwiched between soil layers (Kuroboku).
7.3ka>	Unknown. Near Janoo	Magmatic eruption	Lava flow (Akamizu lava)
7.3ka>	Near Ikenokubo	Phreatomagmatic eruption?	Tuff ring formation.
6.4←→5ka	Nakadake	Magmatic eruption or phreatomagmatic eruption	Intermittent tephra fall. 3 layers (from bottom to top: N12, N11, N10) of volcanic ash deposits from small ash eruptions have been confirmed, sandwiched between black humic soils (Kuroboku). Nakadake lava exists at the N11 horizon.
6.4←→5ka	Jigoku Onsen area	Phreatic eruption	Tephra fall.
5←→4ka	Nakadake	Magmatic eruption or phreatomagmatic eruption?	Intermittent tephra fall. 3 layers (from bottom to top: N9, N8, N7) of volcanic ash deposits from small ash eruptions have been confirmed, sandwiched between black humic soils (Kuroboku).
4.14ka	Unknown Near Janoo	Magmatic eruption	Air-fall pyroclastic material (Aso central cone No. 1 pumice).
4ka	Kishimadake	Magmatic eruption	Tephra fall (sub-plinian eruption), lava flow. Magma eruption volume > 0.02 km^3 DRE. (VEI 4)
4←→3.6ka	Nakadake	Magmatic eruption or phreatomagmatic eruption	Tephra fall. 3 layers (from bottom to top: N6, N5, N4) of volcanic ash deposits from small ash eruptions have been confirmed, sandwiched between black humic soils (Kuroboku).
3.6ka	Ojodake	Magmatic eruption	Tephra fall (sub-plinian eruption), lava flow. Magma eruption volume > 0.02 km^3 DRE. (VEI 4)
3.3ka	Komezuka - Kamikomezuka	Magmatic eruption	Tephra fall (strombolian eruption), lava flow. Magmatic eruption volume = 0.05 km^3 DRE.
2.8←→1.8ka	Nakadake	Magmatic eruption or phreatomagmatic eruption	Intermittent air-fall pyroclastic material (N3). Volcanic ash layer deposits from small ash eruptions.
2.4←→2.1ka	Unknown. Western part of central cones	(Collapse)	Debris avalanche
1.51ka>	Nakadake	Phreatomagmatic 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: Eruption events taking place at some point between year A and year B

A<B: Eruption event before year A.

A>B: Eruption event after year A.

・Historical Activity

The majority of eruptions within the historical period have occurred at the Nakadake crater. A summary is shown below (Sudo, 2007; Japan Meteorological Agency materials). Outside of Nakadake, a record exists of a disaster caused by a phreatic explosion in Yunotani Onsen, in the west of the central cone group, in 1816 (Bunka 13), called the "Yunotani Disaster" (Ikebe and Fujioka, 2001). In recent years geothermal activity has increased in the area around Yoshioka, to the west of the central cone group. In 2006, a fumarole was formed, plants withered and died, and a small debris flow occurred (Terada et al., 2007).

Year	Phenomenon	Activity Sequence, Damages, etc.
553 (Emperor Kinmei 14)	Eruption?	
782 to 805 (Enryaku era)	Volcanic activity?	Details unknown.
825 (Tencho 2)	Volcanic activity?	Details unknown.
840 (Jowa 7)	Volcanic activity?	Details unknown.
864 (Jogan 6)	Eruption	November 9.
867 (Jogan 9)	Eruption	June 21.
1230 (Kangi 2)	Volcanic activity?	Details unknown.
1239 (Ryakunin 1)	Eruption	February 8.
1240 (Ninji 1)	Eruption	
1265 (Bun'ei 2)	Eruption	December 1.
1269 (Bun'ei 6)	Eruption	
1271 (Bun'ei 7)	Eruption	January 5.
1272 (Bun'ei 9)	Eruption	April 16 and November 29.
1273 (Bun'ei 10)	Eruption	
1274 (Bun'ei 11)	Eruption	Damage to fields caused by volcanic blocks and tephra fall.
1281 (Koan 4)	Eruption	
1286 (Koan 9)	Eruption	August 30.
1305 (Kagen 3)	Eruption	May 2.
1324 (Shochu 1)	Eruption	September 7.
1331 to 1333 (Shochu 1 to Genko 3)	Eruption	
1335 (Kenmu 2)	Eruption	February 7 and March 26. Shrine and temple damage.
1340 (Engen 4 to Kokoku 1)	Eruption	February 3, February 10, February 25.
1343 (Kokoku 4)	Eruption	
1346 to 1369 (Shohei era)	Volcanic activity?	Details unknown.
1375 (Tenju 1)	Eruption	December 20.
1376 (Tenju 2)	Eruption	January 31 and June 20.
1387 (Genchu 4)	Eruption	June 19.
1388 (Genchu 5)	Volcanic activity?	October 16. Details unknown.
1434 (Eikyo 6)	Eruption	
1438 (Eikyo 9 to 10)	Eruption	January 9 and February 18.
1473 to 1474 (Bunmei 5 to 6)	Eruption	
1485 (Bunmei 16)	Eruption	January 5. Pyroclastic cone was formed.
1505 (Eisho 2)	Eruption	February.
1506 (Eisho 3)	Eruption	April 6.
1522 (Daiei 2)	Eruption	February 15. Pyroclastic cone formed.
1533 (Tenbun 2)	Eruption	July 17.
1542 (Tenbun 11)	Eruption	April 29.
1558 to 1559 (Eiroku 1 to 2)	Eruption	New cone formed.
1562 (Eiroku 5)	Eruption	March.
1573 (Tensho 1)	Eruption	
1574 (Tensho 2)	Eruption	
1576 (Tensho 4)	Eruption	November 15.

Year	Phenomenon	Activity Sequence, Damages, etc.
1582 (Tensho 10)	Eruption	February 17.
1583 (Tensho 11)	Eruption	December 24.
1584 (Tensho 12)	Eruption	August. Agricultural land damage.
1587 (Tensho 15)	Eruption	Pyroclastic cone formed.
1592 (Bunroku 1)	Eruption	Pyroclastic cone formed.
1598 (Keicho 3)	Eruption	December.
1611 (Keicho 16)	Eruption	
1612 (Keicho 17)	Eruption	August 12.
1613 (Keicho 18)	Eruption	August 8. Volcanic blocks, tephra fall.
1620 (Genna 6)	Eruption	June 3.
1631 (Kan'ei 8)	Eruption	
1637 (Kan'ei 14)	Eruption	
1649 (Keian 2)	Eruption	July to August.
1668 (Kanbun 8)	Rumbling, eruption?	Black volcanic plume.
1675 (Enpo 3)	Eruption	February 16.
1683 (Tenna 3)	Eruption	June.
1691 (Genroku 4)	Eruption	April to August. Volcanic blocks, tephra fall, rumbling. Particularly large amount of tephra fall in June.
1708 (Hoei 5)	Volcanic activity?	September 17. Details unknown.
1709 (Hoei 6)	Eruption	February 13. Volcanic blocks.
1765 (Meiwa 2)	Eruption	June 15. Large amount of tephra fall.
1772 to 1780 (An'ei era)	Eruption	Tephra fall caused crop damage.
1781 to 1788 (Tenmei era)	Eruption	
1804 (Bunka 1)	Eruption	
1806 (Bunka 3)	Eruption	August 30.
1814 (Bunka 11)	Eruption	
1815 (Bunka 12)	Eruption	Large amount of tephra fall, volcanic blocks, damage to fields.
1816 (Bunka 13)	Eruption	June 12. Rumbling began at roughly 2:00, followed by a phreatic eruption. Large and small volcanic blocks, hot sand, mud, and muddy water were continually discharged from Shinyugoya. At approximately 4:30 a white volcanic plume began being emitted from two craters on the east side of Shinyu. At approximately 10:00 sand flowed into a crater which was issuing fire, filling it. After this, a white volcanic plume began rising from the slope on the opposite side of the valley. At roughly 12:30 the volcanic flame and black volcanic plume disappeared. A white volcanic plume began rising from the opposite slope. During the night, two craters were filled with sand, and rumbling occurred. On June 13 the amount of smoke decreased. Rumbling occurred at night. On June 14 the amount of white smoke decreased further. On June 15 white volcanic plumes were emitted occasionally, but for the most part plumes were no longer being emitted. In July a volcanic block killed 1 person.
1826 (Bunsei 9)	Eruption	October and November. A large volume of volcanic blocks and tephra fall were ejected.
1827 (Bunsei 10)	Eruption	May. Large amount of tephra fall, wilderness destruction.
1828 (Bunsei 10)	Eruption	January. A new pit was formed.
1828 (Bunsei 11)	Eruption	June. Large amount of tephra fall, damage to fields.
1830 (Tenpo 1)	Eruption	
1830 (Tenpo 1)	Eruption	Volcanic block, large amount of tephra fall, pyroclastic cone formed?
1831 (Tenpo 2)	Eruption	
1832 (Tenpo 3)	Eruption	
1835 (Tenpo 6)	Eruption	
1837 (Tenpo 8)	Eruption	
1838 (Tenpo 9)	Eruption	Tephra fall.
1854 (Ansei 1)	Eruption	February 26. 3 pilgrims killed.
1856 (Ansei 3)	Eruption	March 18. Tephra fall.

Year	Phenomenon	Activity Sequence, Damages, etc.
1872 (Meiji 5)	Eruption	December 30. Several sulfur miners were killed.
1873 (Meiji 6)	Eruption	Tephra fall.
1874 (Meiji 7)	Eruption	
1884 (Meiji 17)	Eruption	Repeated rumbling, explosions, and tephra fall from roughly March 21 to April 30. Eruption became intense again from June 6, producing rumbling and a large amount of volcanic smoke. A new crater was formed in the northernmost part of the central crater.
1894 (Meiji 27)	Eruption	Explosions, rumbling, and infrasonic waves from March 6. Tephra fall over a wide area, continuing until March 15. The activity occurred at the No. 1 and No. 2 craters. Eruptions and tephra fall on May 24, June 23, and August 30.
1897 (Meiji 30)	Eruption	Rumbling and tephra fall.
1906 (Meiji 39)	Eruption	Eruption at Senrigahama, 300 m south of the central crater rim.
1907 (Meiji 40)	Eruption	Tephra fall.
1908 (Meiji 41)	Eruption	Rumbling, large amount of volcanic smoke, and tephra fall.
1910 (Meiji 43)	Eruption	April 3. Rumbling and volcanic plume (No. 3 crater).
1911 to 1912 (Meiji 44 to Taisho 1)	Eruption	Tephra fall.
1916 (Taisho 5)	Eruption	April 19. Rumbling and tephra fall.
1918 (Taisho 7)	Eruption	January 16. Rumbling and tephra fall (No. 3 crater).
1919 (Taisho 8)	Eruption	Explosion sound and tephra fall in April. Rumbling and tephra fall in May.
1920 (Taisho 9)	Eruption	
1923 (Taisho 12)	Eruption	Rumbling and volcanic blocks from No. 3 and No. 4 craters in January. Volcanic blocks from No. 4 crater in June. Eruptions from No. 1, No. 2, and No. 4 craters on September 17.
1926 (Taisho 15, Showa 1)	Eruption	Eruption and tephra fall on November 30. Eruption on December 28.
1927 (Showa 2)	Eruption	Several volcanic events occurred from April to May, with tephra fall causing crop damage. Tephra fall in July and October.
1928 (Showa 3)	Eruption	Eruptions on January 12 and September 6. Large amount of volcanic smoke and tephra fall over a wide area in October and December.
1929 (Showa 4)	Eruption	Volcanic blocks from No. 4 crater on April 11. New fumarole formation and black volcanic plume at the No. 2 crater on July 26. October 22 to 23. Large amount of tephra fall, as well as crop and livestock damage.
1930 (Showa 5)	Eruption	September 3 to 6. Volcanic blocks, tephra fall.
1932 (Showa 7)	Eruption	Volcanic activity at the No. 1 crater in June and September, with black volcanic plume and volcanic block activity from November. December 9. Windowpanes broken by air shock at Asosan weather station. High level of volcanic block activity from December 17 to 19, injuring 13 people near the crater on December 18.
1933 (Showa 8)	Eruption	Activity at the No. 2 crater from February 11. February 24. Explosion accompanied by loud noise, with red-hot volcanic blocks almost 1 m in diameter scattered several hundred meters in the vertical and horizontal directions. Windowpanes broken by air shock at Asosan weather station on February 27. Increased level of activity at the No. 1 crater on March 1, surpassing that of the No. 2 crater. Activity was similar in nature to that of No. 2 crater. Tephra fall damage over a wide area. Volcanic plume, volcanic blocks, and rumbling activity at the No. 1 and No. 2 craters in April, May, and from August to December.
1934 (Showa 9)	Eruption	July 16. The eruptive activity occurred at the No. 1 crater.
1935 (Showa 10)	Eruption	January, May, June, August, October. Tephra fall, volcanic blocks, etc.
1936 (Showa 11)	Eruption	February and August.
1937 (Showa 12)	Eruption	January and May.
1939 (Showa 14)	Eruption	January, April, and May.
1940 (Showa 15)	Eruption	January, April, and May. One person injured in April. Large amount of tephra fall and crop damage in August. Volcanic block and tephra fall activity in December.
1941 (Showa 16)	Eruption	February. Volcanic blocks, tephra fall. April. A new pit was formed at the No. 1 crater. Volcanic block activity in August.
1942 (Showa 17)	Eruption	June. Volcanic plume and red-hot volcanic blocks inside crater.

Year	Phenomenon	Activity Sequence, Damages, etc.
1943 (Showa 18)	Eruption	June. New pit formation and large amount of tephra fall at the No. 1 crater. December. Tephra fall.
1944 (Showa 19)	Eruption	Weak volcanic block activity.
1945 (Showa 20)	Eruption	September. Tephra fall.
1946 (Showa 21)	Eruption	April to June. Volcanic block activity and large amount of tephra fall from No. 1 crater. December. Volcanic plume.
1947 (Showa 22)	Eruption	May. Large amount of tephra fall, crop damage, and livestock damage from No. 1 crater. July to September. Volcanic blocks, tephra fall, damage to pasture land, etc..
1948 (Showa 23)	Eruption	Volcanic blocks, tephra fall.
1949 (Showa 24)	Eruption	Large amount of tephra fall.
1950 (Showa 25)	Eruption	Volcanic blocks, tephra fall.
1951 (Showa 26)	Eruption	Tephra fall.
1953 (Showa 28)	Eruption	April 27. Eruption from No. 1 crater at 11:31. Volcanic blocks from soccer ball to human size were ejected several hundred meters into the air, reaching as far as 600 m southwest of the crater rim. 6 sightseers were killed, and over 90 were injured. In May a large amount of ash also fell, causing crop damage. A small eruption occurred in December.
1954 (Showa 29)	Eruption	May.
1955 (Showa 30)	Eruption	July 25. Volcanic blocks were scattered over an area 300 m to the northeast.
1956 (Showa 31)	Eruption	Small mud eruptions on the No. 1 crater floor in January, August, and December. January. A large amount of ash fell at Narayama, Nangotani, and Ojodake. On January 13 a felt earthquake with a seismic intensity of 2 in JMA scale occurred. Volcanic blocks were scattered to the southwest of the crater. August. Small mud eruption. December. Pit formation. Tephra fall in the crater area.
1957 (Showa 32)	Eruption	Volcanic block activity inside the No. 1 crater in April and from October to December. New pits were formed inside the No. 1 crater in November and December.
1958 (Showa 33)	Eruption	June 24. Sudden explosion inside No. 1 crater at 22:15. Volcanic blocks were scattered as far as the Asosan weather station, 1.2 km west of the crater. Large amount of ash and sand fall over all mountain slopes, killing 12 people, injuring 28, and damaging buildings. Volcanic block activity also occurred in July and from September to December.
1959 (Showa 34)	Eruption	A new pit was formed at the No. 1 crater.
1960 (Showa 35)	Eruption	January to April, September to November. Volcanic block activity inside crater, and tephra fall in crater area.
1961 (Showa 36)	Eruption	Occasional tephra fall year-round: Mid-February, mid-July, late November. A new pit was formed.
1962 (Showa 37)	Eruption	January to May. Occasional tephra fall in mid-October. A new pit was formed.
1963 (Showa 38)	Eruption	April, May, June, July, November.
1964 (Showa 39)	Eruption	May 14. A new pit was formed inside No. 1 crater.
1965 (Showa 40)	Eruption	Occasional small mud eruptions in January. February to June. Red-hot crater floor. July, August. Small mud eruption. September. Red-hot crater floor. Explosions began at the No. 1 crater from October 21. On October 23 and 31 volcanic blocks were scattered over wide area to southwest of crater. The volume of volcanic blocks was especially high on October 31, causing damage to buildings. Activity continued until the end of the year.
1966 to 1968 (Showa 41 to 43)	Eruption	Small mud eruption, volcanic block activity within the crater, red-hot crater floor, volcanic flame, hot crater lake formation.
1969 to 1973 (Showa 43 to 48)	Eruption	Rumbling, red-hot crater floor, volcanic flame, small mud eruption. New pit formation inside No. 1 crater on July 30, 1971 (pit 711).
1974 (Showa 49)	Eruption	Gray volcanic plume from roughly April. Large amount of tephra fall and crop damage from August. A new pit was formed inside No. 1 crater in late August (pit 741). Frequent volcanic flames, glowing, infrasonic waves, and rumbling.

Year	Phenomenon	Activity Sequence, Damages, etc.
1975 (Showa 50)	Eruption	January to June. Intermittent eruptions from August of previous year, with tephra fall in the crater area. Earthquake swarm in late January. Hypocenters located in north of Aso caldera. Maximum magnitude of M6.1 at 23:19 on January 23, with a JMA scale seismic intensity of 5 at the Asosan weather station. Tephra fall and glowing in crater area in October. Tephra fall in Botyu area in November. December. Eruptions, and tephra fall and glowing in Sensuikyo and Nekodake areas.
1976 (Showa 51)	Eruption	January. Tephra fall in Sensuikyo and Nekodake areas.
1977 (Showa 52)	Eruption	April. Tephra fall in the crater area. May to July. Tephra fall in towns of Aso, Ichinomiya, Takamori, and Hakusui. June to July. Volcanic blocks fell near crater rim, causing crop damage. July 20. Explosion at the No. 1 crater, causing slight amount of damage to building near Mount Car Crater Rim bus stop. August to October. Increased earthquake activity. August, September. Rumbling. November. Eruption and volcanic block activity within the crater.
1978 (Showa 53)	Eruption	January to June, August to October. Small mud eruptions from February to April, and in June, August, and September. September 19. Earthquake swarm. October. Slightly high number of earthquakes (hypocenters near Nakadake crater).
1979 (Showa 54)	Eruption	June to November. Red-hot volcanic block activity and tephra fall near crater from June to August. The September 6 explosion killed 3 people, seriously injured 2 people, caused mild injuries to 9 people, and damaged the Crater East station building in the Naraodake area, to the northeast of the crater. Small, low temperature pyroclastic flow. October to November. High level of eruption activity. In November A large amount of ash fell, with tephra fall and crop damage in the northwest of Miyazaki Prefecture, Oita Prefecture, and in the city of Kumamoto.
1980 (Showa 55)	Eruption	January 26. Explosion, with tephra fall in towns of Aso and Ichinomiya. March 8. Tephra fall in the crater area. September 24. Small mud eruption.
1981 (Showa 56)	Small mud eruption	June 15.
1983 (Showa 58)	Small mud eruption	September 29.
1984 (Showa 59)	Eruption	April to September. Small mud eruption. October 24. Pit 841 opened at the No. 1 crater, as well as rumbling, tephra fall (for first time in 4 years), and volcanic block activity. October to December. Small mud eruption, rumbling, tephra fall.
1985 (Showa 60)	Eruption	January. Small mud eruption, tephra fall. Inside No. 1 crater, pit 851 formed on January 18, pit 852 on March 1, and pit 853 on May 6. Intermittent eruptions from approximately May 6 to June 20 (for first time in 5 years). January to June. Rumbling, tephra fall, volcanic flame, volcanic blocks. July to December. Small mud eruption.
1986 (Showa 61)	Small mud eruption, rumbling	January to December. Small mud eruption. May, June, August, October to December. Rumbling.
1987 (Showa 62)	Small mud eruption, rumbling	January to October. Small mud eruption. January, May, June. Rumbling.
1988 (Showa 63)	Eruption	March to December. Small mud eruption. May. High number of tremors. July to December. Rumbling. October to December. Red-hot crater floor. December. Tephra fall (for first time in 3 years).
1989 (Heisei 1)	Eruption	January to June. Red-hot crater floor. April to June. Volcanic ash discharge. June 11. Pit 891 formed. July 16. Eruptive activity starts (for first time in 4 years, continuing on to December of following year). September to December. Volcanic block activity. October 9. Pit 892 formed. October, November. Crop damage due to increased eruptive activity and high volume of tephra fall. Large amount of rumbling.
1990 (Heisei 2)	Eruption	(Continued from previous year) January, February, April to June, December. Eruptions. Pit 901 formed on September 17. Pit 902 formed on November 24. Pit 903 formed on December 6.
1991 (Heisei 3)	Eruption	January to February. Occasional volcanic ash emission. Activity which began previous year ended. Hot crater lake formation from March to June, 1992.

Year	Phenomenon	Activity Sequence, Damages, etc.
1992 (Heisei 4)	Eruption	Large number of tremors occurred year-round. Small mud eruption activity, gradually increasing in intensity, from April. July. Large number of felt tremors. August to September. High level of emission activity, with volcanic plume rising as high as 2500 m. December. Pits 921 and 922 were formed, and volcanic flame was observed.
1993 (Heisei 5)	Eruption	Scoria eruption from previous year continued through January and February. Hot crater lake from March. Relatively low level of activity until August of following year.
1994 (Heisei 6)	Eruption	September. Small mud eruption activity from September to October. Large mud eruption in December.
1995 (Heisei 7)	Eruption	March. Continuous small mud eruptions year-round.
1996 (Heisei 8)	Small mud eruption, red-hot glowing	A hot crater lake covered the entire crater floor. From April 27 to June 22 red-hot glowing occurred on the southern crater wall. Small mud eruption in July.
1997 to 1999 (Heisei 9 to 11)	Small mud eruption and hot spring fountain	The entire crater floor was covered by a hot crater lake. Occasional small mud eruptions and hot spring fountains.
2000 (Heisei 12)	Red-hot glowing	The entire crater floor was covered by a hot crater lake. Fumarolic activity began on southern crater wall from November.
2001 to 2002 (Heisei 13 to 14)	Red-hot glowing	The entire crater floor was covered by a hot crater lake. Red-hot glowing on the southern crater wall.
2003 (Heisei 15)	Eruption	Continued high temperatures under Nakadake No. 1 crater south crater wall and in hot crater lake. Hot spring fountain in May. Very small eruption on July 10 scattered small amount of ash approximately 6 km east-northeast of Nakadake No. 1 crater. Hot crater lake volume gradually decreased from June, falling to half its previous volume by November.
2004 (Heisei 16)	Eruption	January 14. Very small eruption scattered small amount of ash approximately 8 km east-southeast of Nakadake No. 1 crater.
2005 (Heisei 17)	Eruption	April 14. A very small amount of gray-white volcanic ash was confirmed as having fallen as far as 700 m south of the Nakadake No. 1 crater rim. At 20:41 a very small eruption occurred, and volcanic ash reached Sensuikyo, approximately 2 km northeast of the crater.
2006 (Heisei 18)	Small mud eruption	Small mud eruption. Hot crater lake covered the crater floor from July. . Increased fumarolic activity at Minami-Aso Yoshioka from October (this increased level of fumarolic activity is still ongoing as of December, 2012).
2007 (Heisei 19)	Red-hot glowing	Hot crater lake covered entire crater floor. Red-hot glowing on southern crater wall from September.
2008 (Heisei 20)	Red-hot glowing, volcanic flame	Hot crater lake covered almost entire crater floor. Red-hot glowing and volcanic flames on the southern crater wall. Very small amount of volcanic ash emitted from south crater wall fumaroles in December. Red-hot glowing on southern crater wall.
2009 (Heisei 21)	Eruption	February 4. Very small-scale eruption: Small amount of tephra fall approximately 800 m southwest of the crater. On May 19 a small amount of tephra fall was observed approximately 200 m southwest of the crater. Small amounts of tephra fall were observed near the crater rim until late June. Red-hot glowing and volcanic flames on the southern crater wall.
2009 to 2010 (Heisei 21 to 22)	Continuous tremors, isolated tremors	Increased volcanic tremor amplitudes on November 2, 2009. Increase in number of isolated tremors to over 200 per day from September, 2009, to July, 2010.
2011 (Heisei 23)	Earthquake	March. Since the 2011 off the Pacific coast of Tohoku Earthquake (March 11, 2012) earthquake activity temporarily increased roughly 10 km to the northwest of the crater.
	Eruption	Very small emissions of gray-white volcanic ash from May 15 to June 9. On May 15 a very small amount of tephra fall was confirmed at Sensuikyo, approximately 2 km to the northeast of the Nakadake No. 1 crater.

* 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

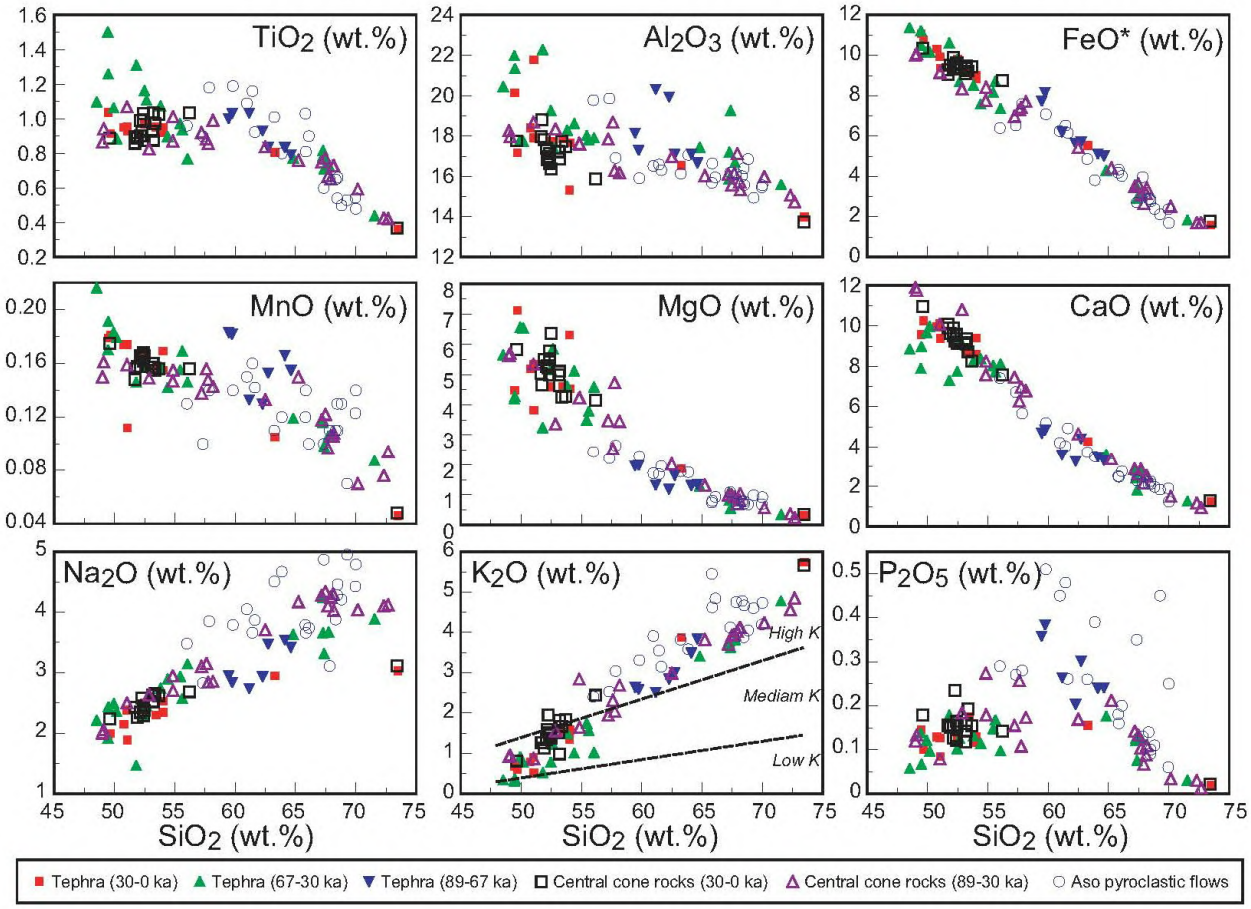


Figure 84-5 Whole rock chemical composition (Miyabuchi, 2011).

Aso pyroclastic flow deposit data was taken from Ono et al. (1977).

Period - Cumulative Magma Volume

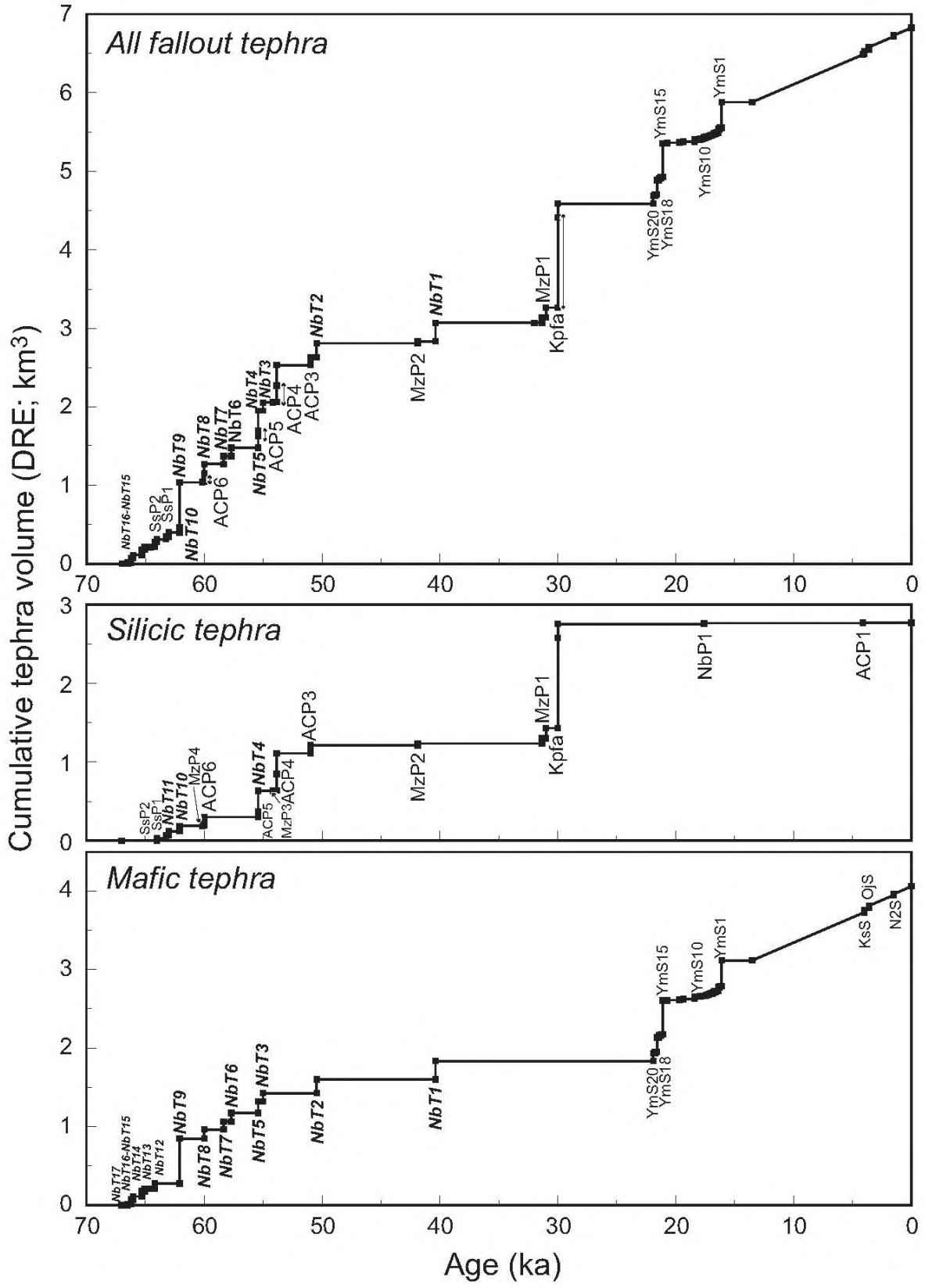


Figure 84-6 Cumulative erupted volume versus time for tephra fallout during the last 70,000 years (Miyabuchi, 2011).

Major Volcanic Eruption

・1933 to 1979 (Volcanic Block Distribution)

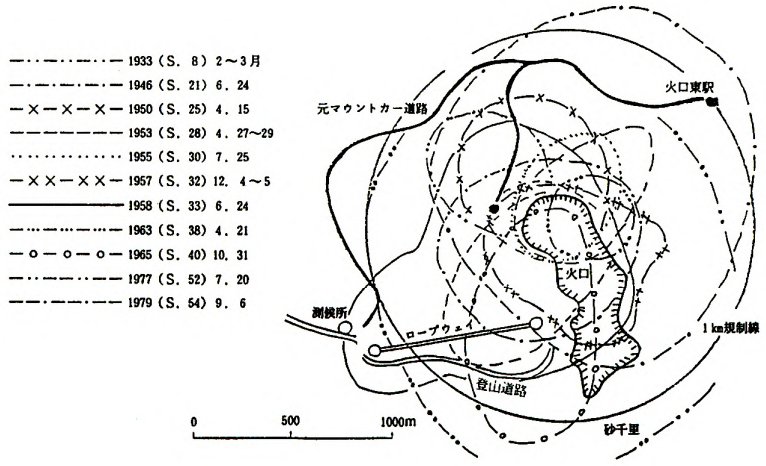


図63—8　阿蘇山の噴石分布図（1933年～1979年）
（福岡管区気象台1990，福岡管区気象台要報第45号）

Figure 84-7 Distribution of volcanic blocks from Asosan (1933 to 1979) (Fukuoka District Meteorological Observatory, 1990).

・1979 Volcanic Eruption

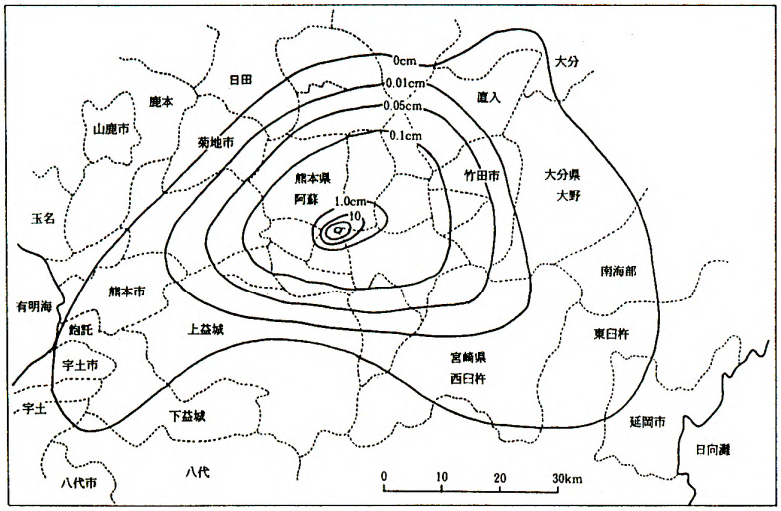


Figure 84-8 Distribution of Asosan ash fall (June to November, 1979) (Asosan Weather Station, 1980)

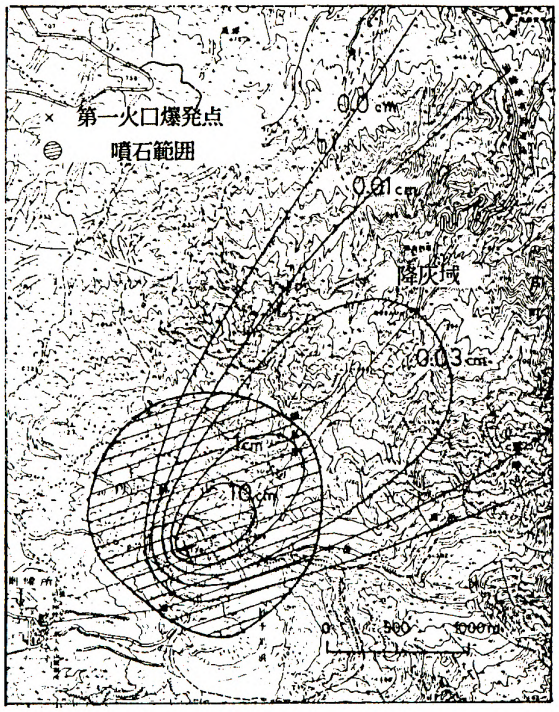


Figure 84-9 Distribution of ash fall and volcanic blocks from September 6, 1979, Asosan explosion (Asosan Weather Station, 1980)

・1990 Volcanic Eruption

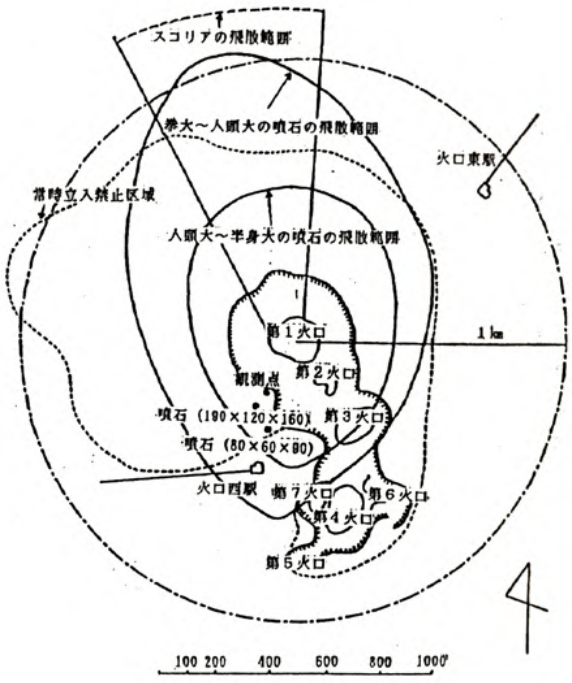


Figure 84-10 Distribution of volcanic blocks on April 20, 1990 (Shimomura et al., 1990).

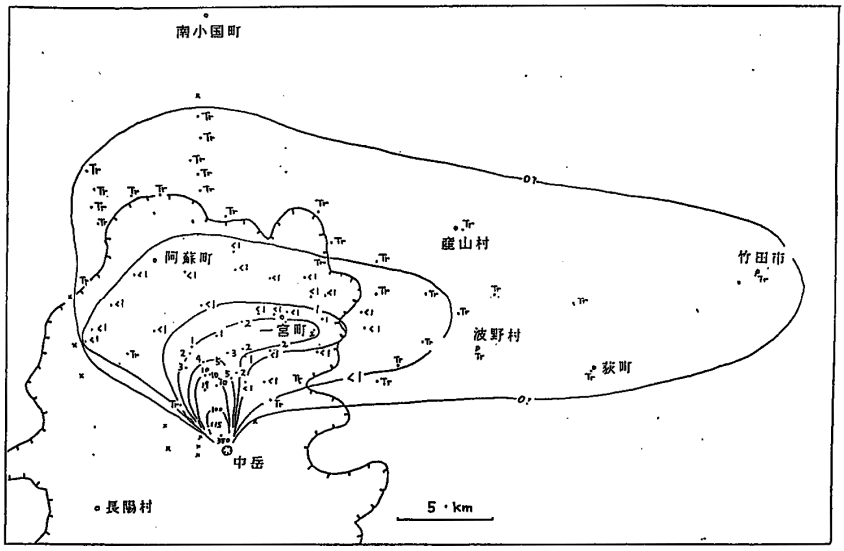


Figure 84-11 Volcanic ash isopach on April 20, 1990, Nakadake eruption (Kumamoto University et al., 1991)

・2004 Volcanic Eruption

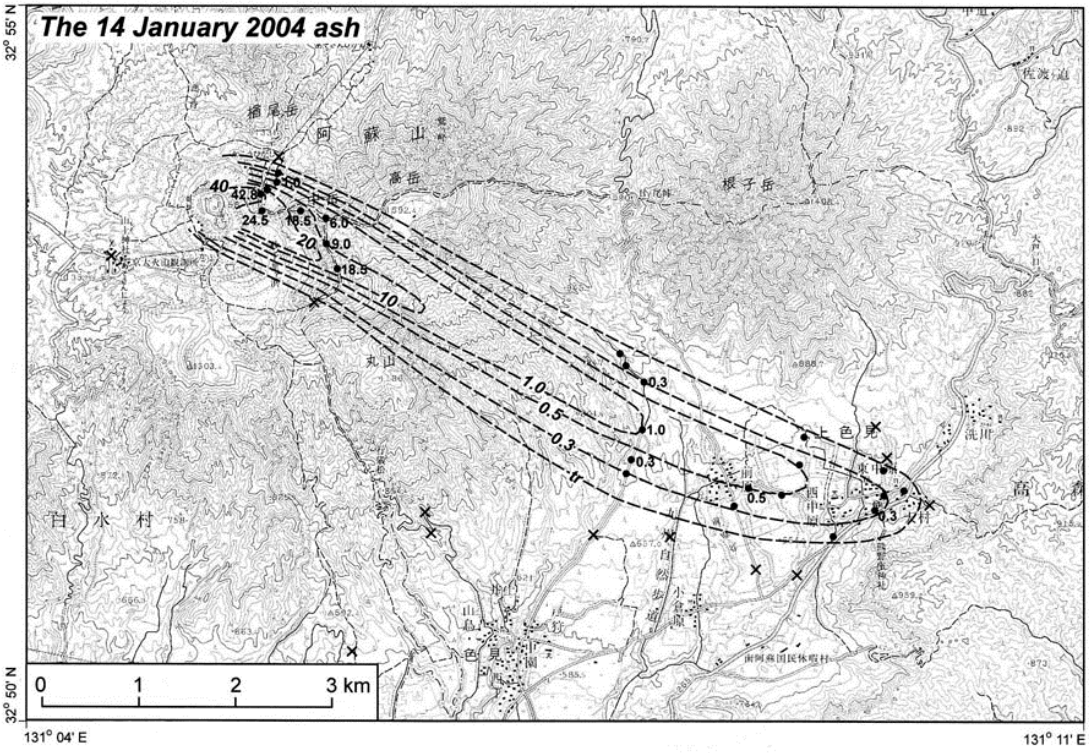


Figure 84-12 Distribution of volcanic ash on January 14, 2004 (Miyabuchi et al., 2005)
Dashed lines indicate equal weights (g/m^2)

Subsurface Structure

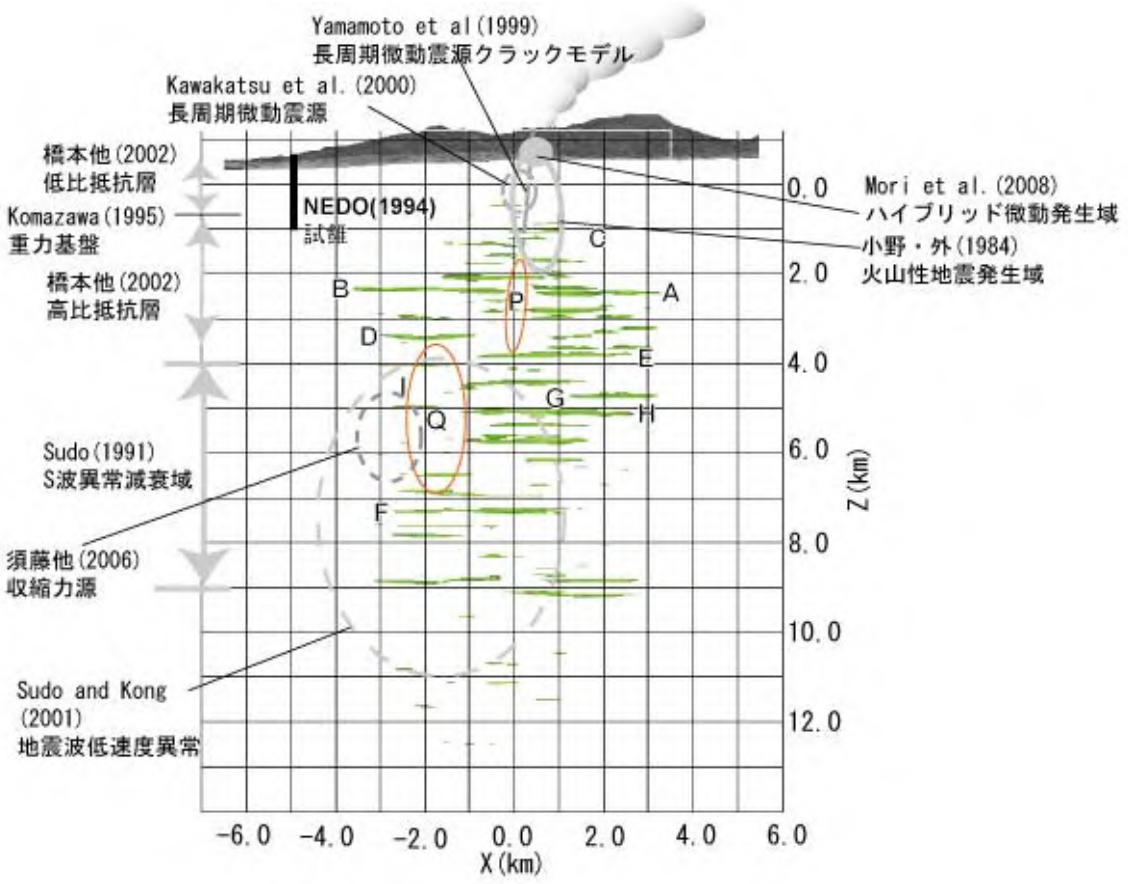


Figure 84-13 Reflectors beneath Asosan (Tsutsui and Sudo, 2004).

The figure overlays a perspective drawing from the south over existing research results. Symbols A through I indicate areas with clear reflections. Symbols P and Q indicate areas without clear reflections. Modification of Tsutsui and Sudo (2004).

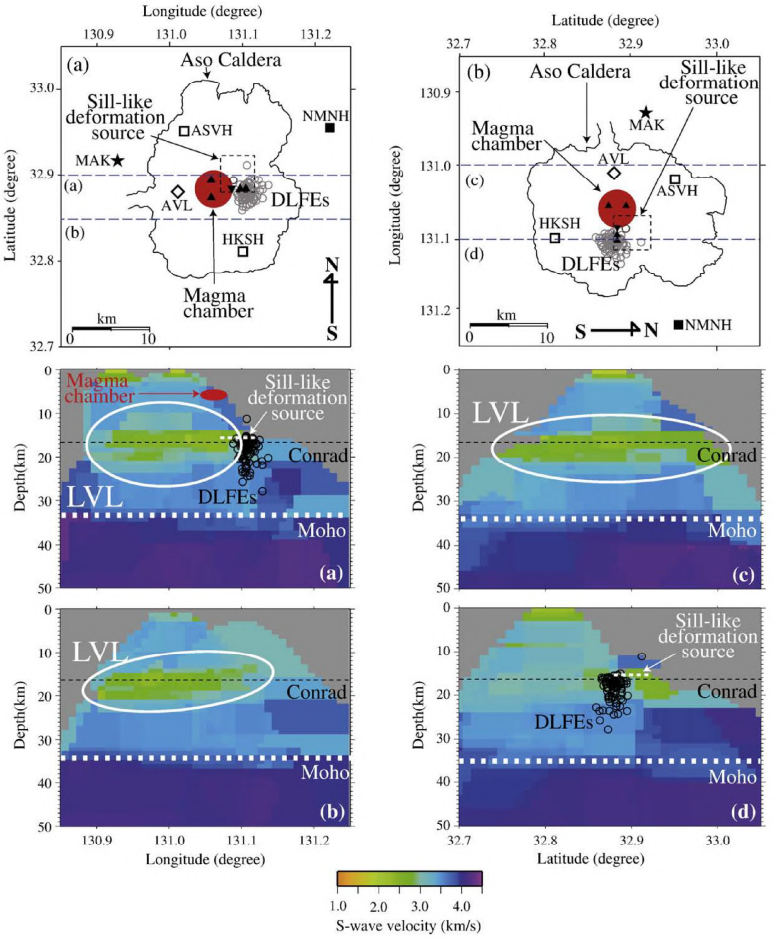


Figure 84-14 Interior structure of Asosan (Abe et al., 2010).

A low seismic wave velocity layer is visible between 10 and 24 km below the surface, indicating the possible presence of magma.

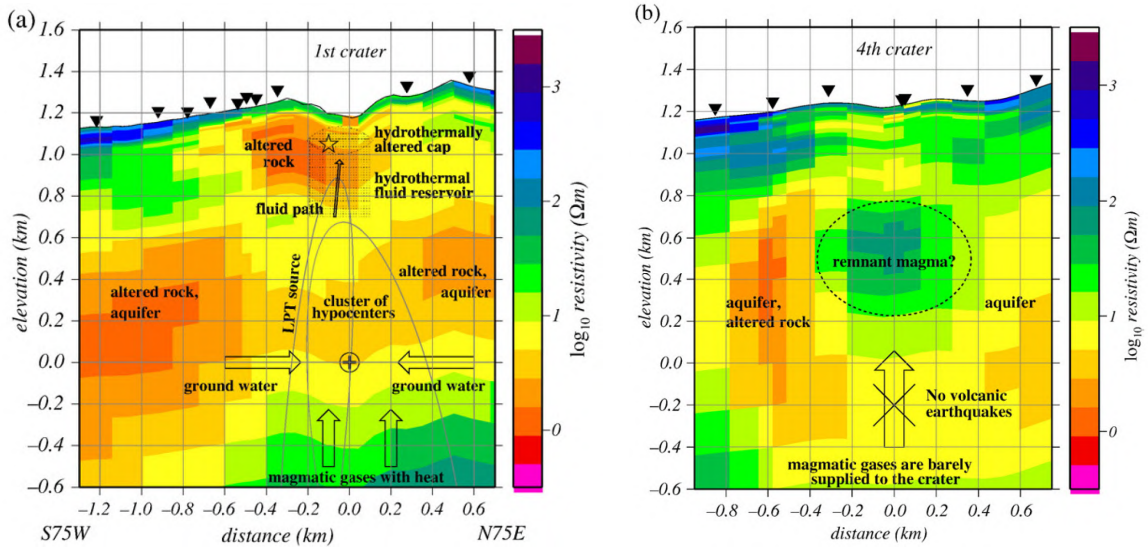


Figure 84-15 resistivity structure of Asosan (Kanda et al., 2008).

Altered rock and aquifers are distributed between -400 m and 800 m beneath the Nakadake No. 1 crater, and underground water is flowing into the source of very-long-period earthquake hypocenters the crater. A high resistivity with magma discharged by the 1927-1933 eruption exists below the Nakadake No. 4 crater.

Precursory Phenomena

Volcanic activity at the Nakadake No. 1 crater in recent years has included rising hot crater lake temperatures, small mud eruptions, hot crater lake level drops and disappearances, and red-hot glowing, leading to volcanic ash emissions and strombolian eruptions. Prominent earthquake activity and crustal deformation have not occurred recently, but volcanic tremor activity changes have occurred. When rainfall inflow fills in pits, sudden decreases in the amplitudes of volcanic tremors are sometimes observed, followed by explosions.

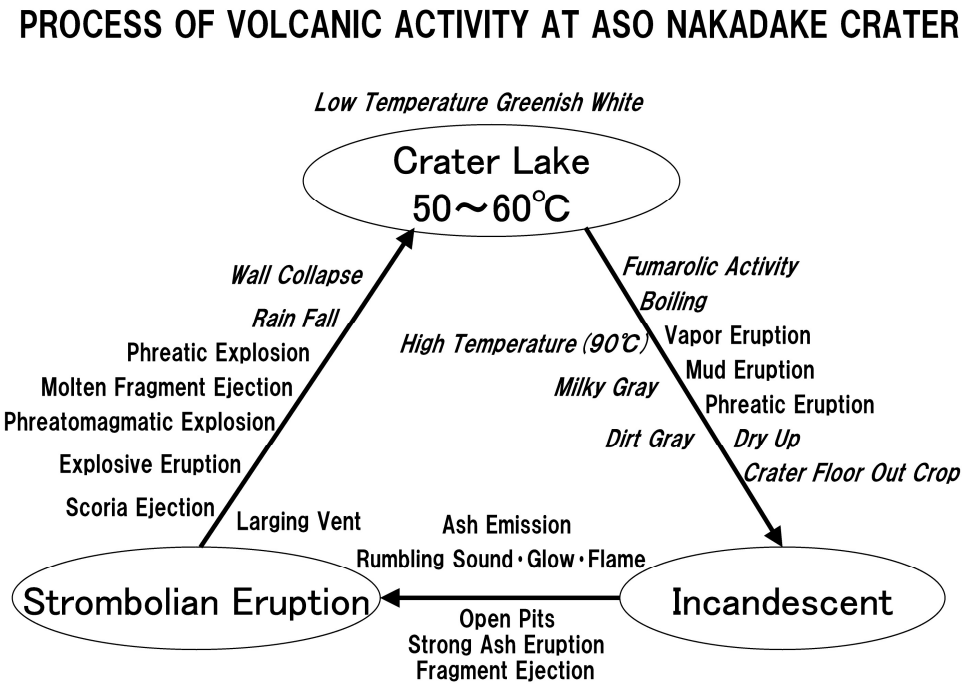


Figure 84-16 Diagram of volcanic activity at Asosan (Sudo, 2001).

The process of volcanic activity at Nakadake Crater, Aso caldera. During the weakly active stage a hot and strongly acidic water lake exists in the crater (Yudamari), with a diameter of about 200 m, a temperature of about 60 degrees, and a greenish white color. The water level is maintained from groundwater and fumaroles, and does not change. The ingredient responsible for the green color is iron. When the volcano becomes more active, its temperature rises to the boiling point, evaporation is promoted, the hot water level decreases gradually, and many mud eruptions (small phreatic explosions) occur intermittently, ejecting hot water and old rock fragments measuring 5 meters in diameter or more to distances of up to 1 km outside of the crater. At the bottom of the crater many small pits open, with diameters of several meters, ejecting high temperature volcanic gases and volcanic ashes, and becoming incandescent. After this a lot of volcanic ash is ejected accompanied by intense rumbling, flames several tens of meters high, and ejection of volcanic rocks. This causes the pits to expand, growing to a size of tens of meters in diameter, and eventually cover the entire crater bottom. In this stage a lot of ash is ejected to some tens of kilometers in height. The volcanic activity then becomes even more intense and a Strombolian type eruption stage begins. For some weeks or months the volcanic activity is at a high level with violent rumblings, and ejection of many fresh magma fragments and ashes. A Strombolian type eruption becomes gradually weaker and the volcanic activity ceases. The volcanic ash deposited around the crater is washed into the crater by rainwater and the crater wall collapses. Then the bottom of crater is buried and the floor at the crater bottom begins to appear again. A lake covering the whole crater bottom is again gradually formed, as the crater fills with hot water. The water level goes up gradually, and becomes more stable. A phreatic explosion can still occur if there is some power remaining in the volcanic activity. This is the end of the eruption cycle. In this way, as a calm period ensues, the lake becomes green and a cycle is completed. This is one volcanic cycle at the Nakadake crater, Aso caldera. At every active stage a large amount of volcanic ash is ejected when new vents are opened. These are the main characteristic of the eruptions of Nakadake Crater, Aso caldera.

Recent Volcanic Activity

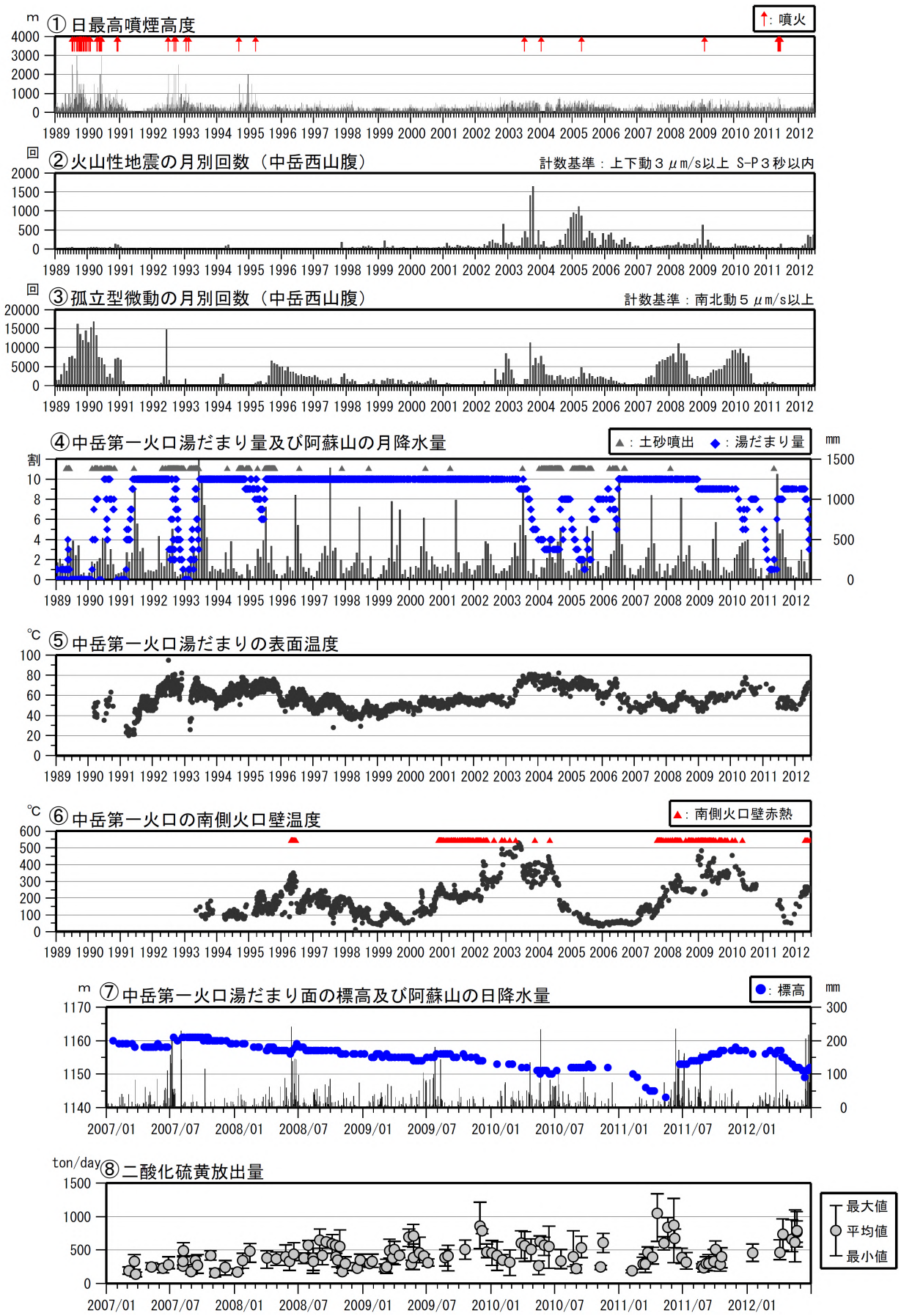


Figure 84-17 Volcanic activity at Asosan (January 1, 1989, to June 30, 2012).

①. Daily maximum volcanic plume height
②. Number of volcanic earthquakes per month (western slope of Nakadake)
③. Number of isolated tremors per month (western slope of Nakadake)
④. Volume of Nakadake No. 1 crater lake and monthly rainfall on Asosan
⑤. Surface temperature of Nakadake No. 1 crater lake
⑥. Surface temperature of south crater wall of Nakadake No. 1 crater
⑦. Elevation of surface of Nakadake No. 1 crater lake and daily rainfall on Asosan
⑧. Amount of sulfur dioxide emitted

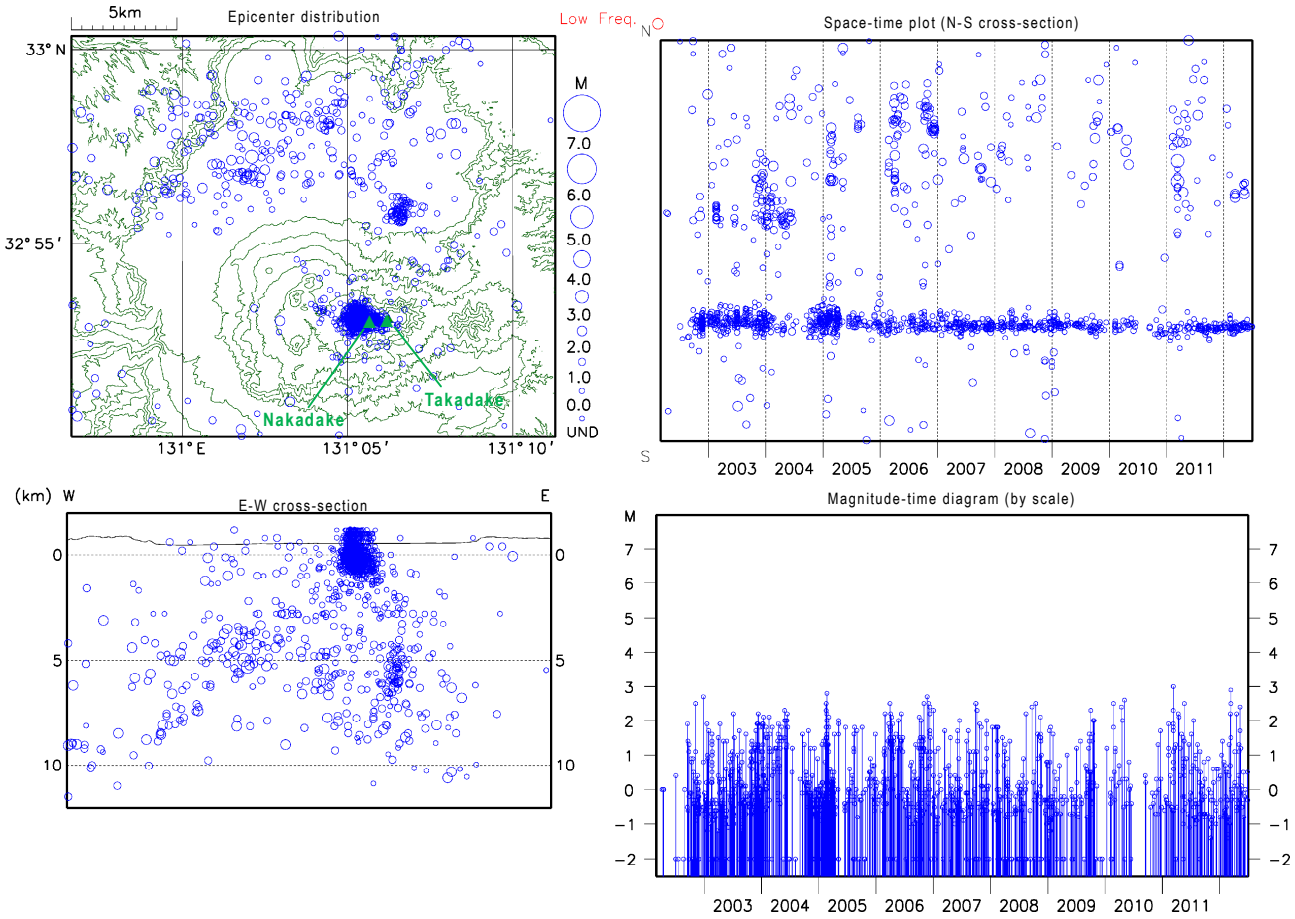


Figure 84-18 Distribution of volcanic earthquakes at Asosan (2002 to June 30, 2012).

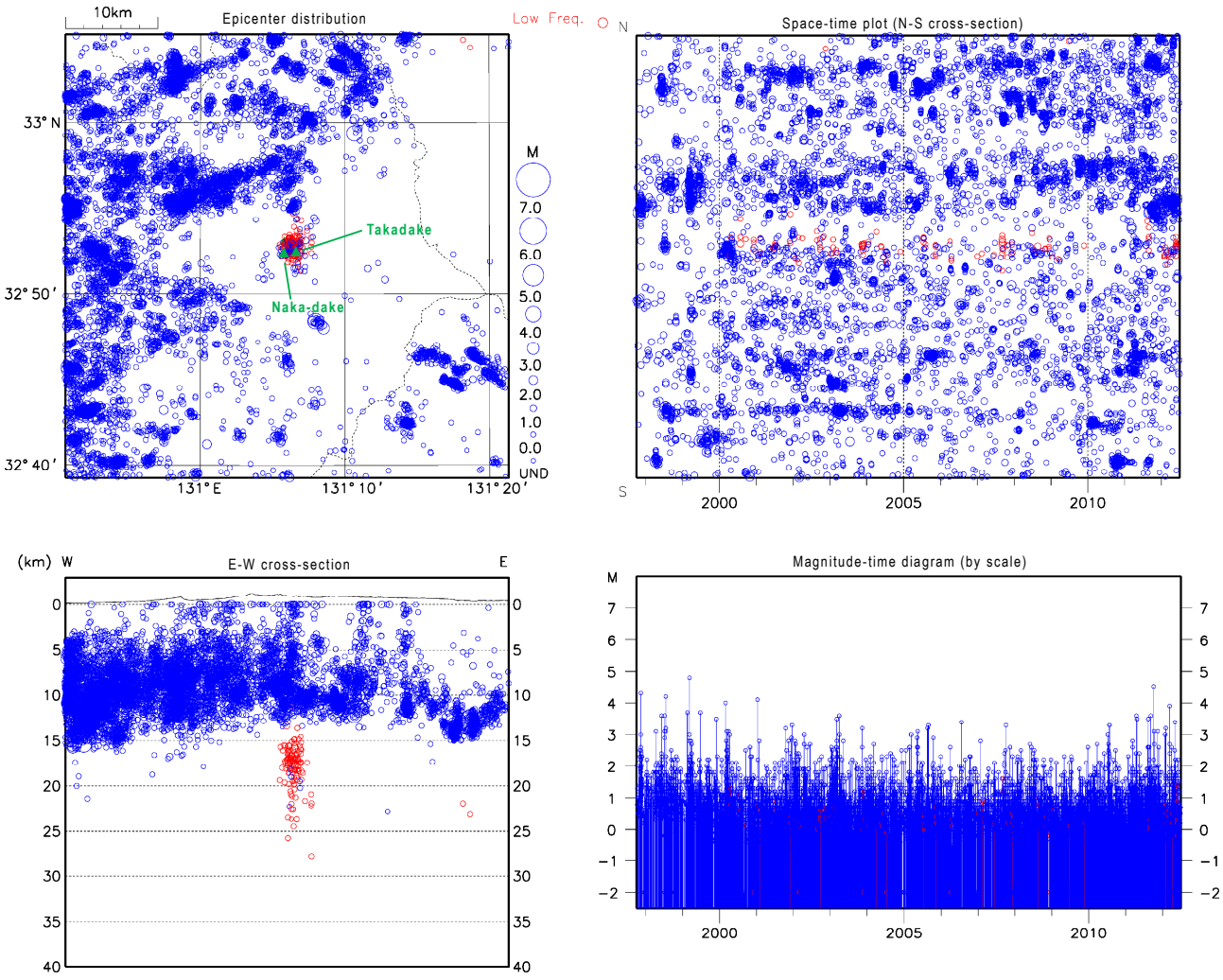


Figure 84-19 Activity of shallow VT earthquakes (blue circles) and deep low-frequency earthquakes (red circles) observed by a regional seismometer network (October 1, 1997, to June 30, 2012).Epicenter distribution (upper left), space-time plot (N-S cross-section) (upper right), E-W cross-section (lower left) and magnitude-time diagram (lower right).

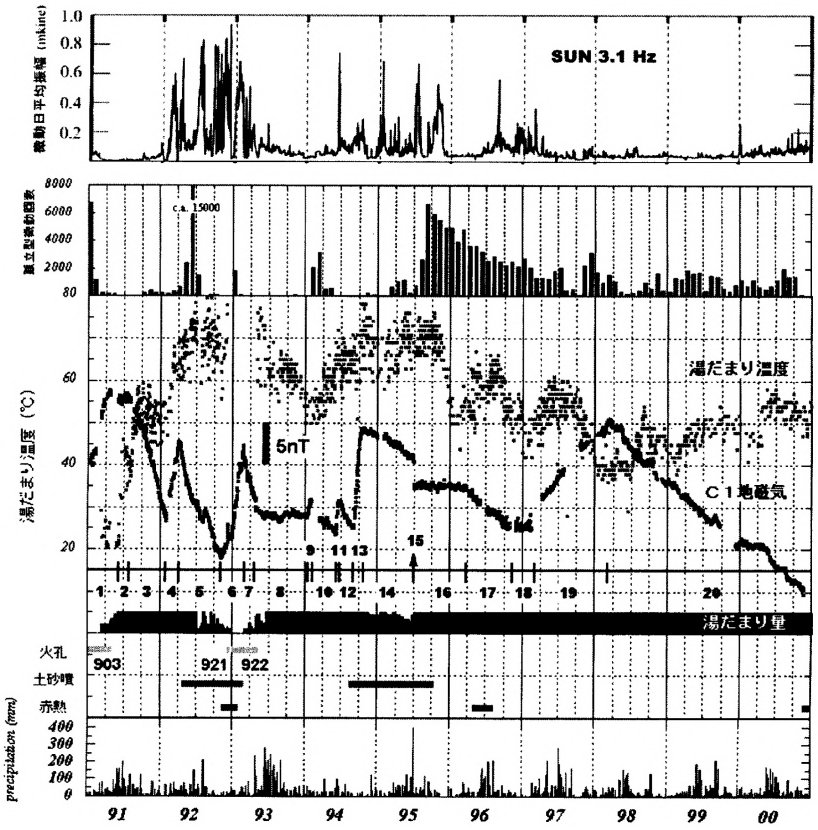


Figure 84-20 Geomagnetic total intensity observation results (Hashimoto et al., 2001).

Tremor amplitudes have often increased in conjunction with magnetization periods (increases in total geomagnetic intensity), and these have also been accompanied by surface phenomena such as small mud eruptions and the opening of craters.

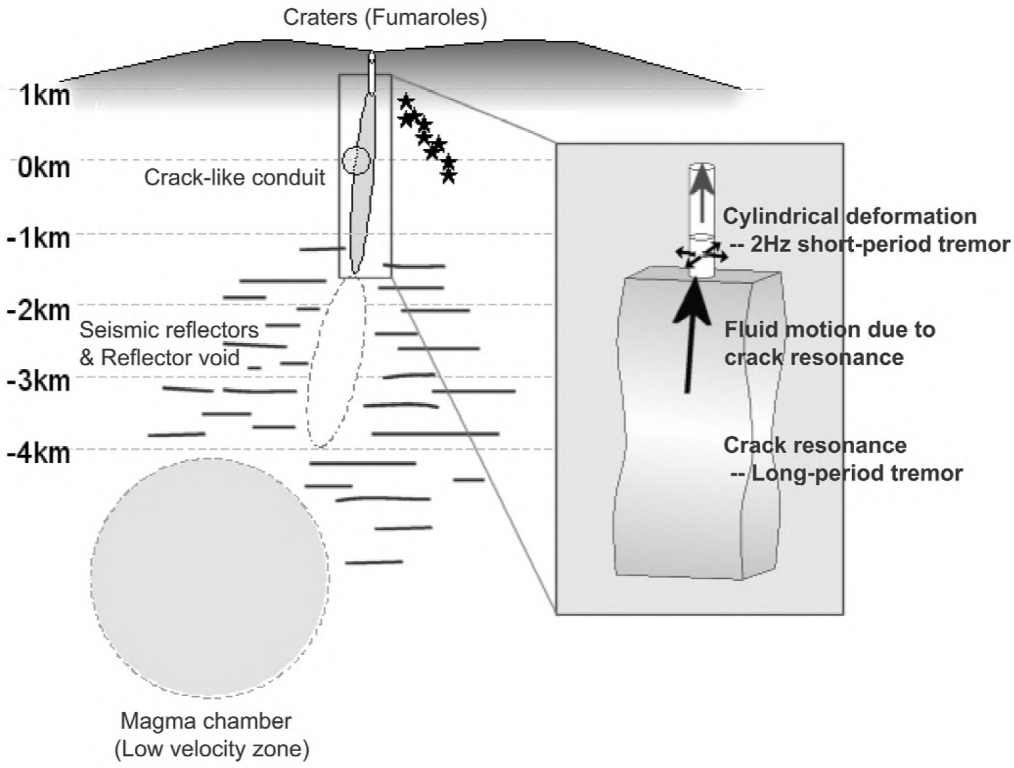


Figure 84-21 Conceptual diagram of conduit system directly below Asosan (Japanese translation of Yamamoto (2004)).

Information on Disaster Prevention

①Hazard Map

Asosan Volcano Disaster Prevention Map - Created by the Kumamoto Prefecture Civil Engineering Office Erosion Control Bureau in March, 2008

URL: http://www.pref.kumamoto.jp/soshiki/138/sabou01.html

(Kumamoto Prefecture Civil Engineering Office Erosion Control Bureau website)

2

阿蘇山火山防災マップ　小規模噴火

火口周辺に影響を及ぼす噴火が発生、あるいは発生すると予想される場合

噴火警戒レベル
5（避難）
4（避難準備）
3（入山規制）
2（火口周辺規制）
1（平常）

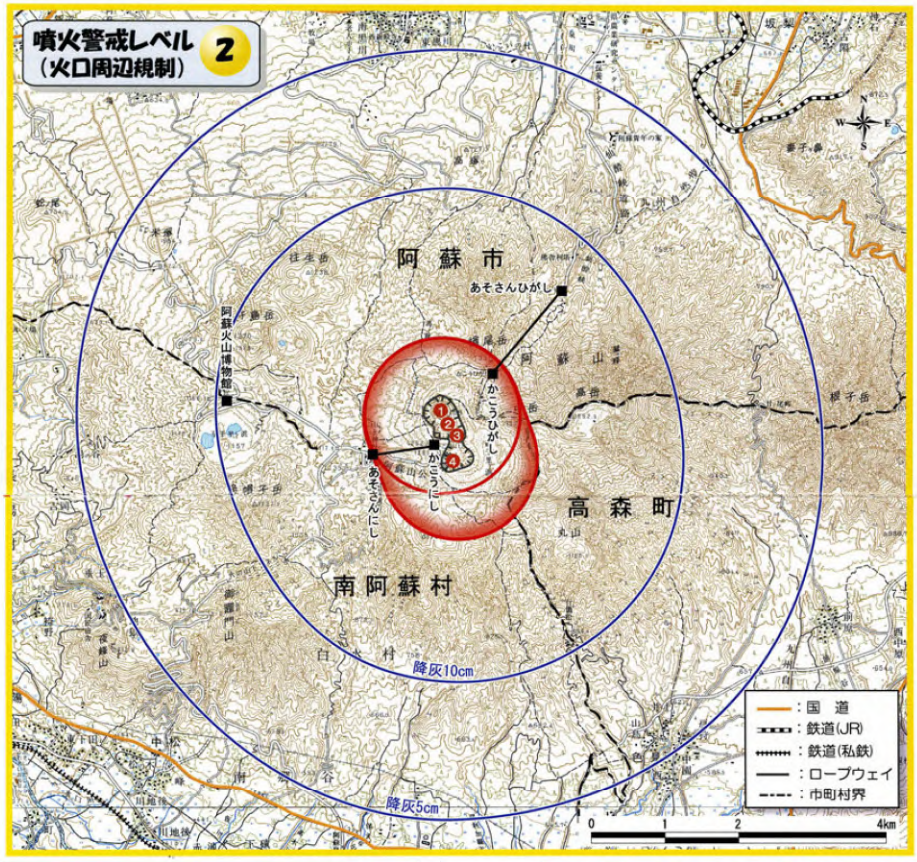
噴石が火口から概ね1km以内に飛散する可能性があります。このため、火口から少し離れた所までの火口周辺で立ち入りが規制されます。

＜過去の事例＞
・２００５年（平成１７年）４月のごく小規模噴火
・２００４年（平成１６年）１月のごく小規模噴火
・１９７７年（昭和５２年）７月の活動
・１９５３年（昭和２８年）４月の活動　など

阿蘇山の火山活動が活発になり、住民の避難が必要となると市町村長が避難に関する情報を出します。

右のような避難情報が出たら、地域住民、登山・観光客等は、市町村からの情報に従って、落ち着いて行動して下さい。

危険度アップ
◆ 避難指示
危険が切迫しています。
指示に従って直ちに避難して下さい！
◆ 避難勧告
災害が発生する可能性が高い状態です。
勧告に従って避難して下さい！
◆ 避難準備
災害が発生する可能性があります。
すぐに避難できるよう、準備をして下さい。



記号の色と意味

● 噴石
火口の位置
内側の線は、現在活発に活動している第１火口から噴出した場合の到達予想範囲です。
中岳火口（第１～第４火口）から噴石が放出された場合の到達予想範囲を外枠で示しています。
※こぶし大の石が飛んでくる可能性のある範囲を過去の噴火実績から予想しました。（火口から約1km）

● 降灰
火山灰が降り積もる恐れのある範囲
１０cm以上
５～１０cm
※ここでは、1977年（昭和52年）と同様の規模の噴火が１年間継続した場合に降り積もる火山灰の厚さを予想しています。従って、１回の噴火で積もる量ではありません。

噴　石

噴火によって直径数ｃｍ～数１０ｃｍの岩石が火口から飛来する現象です


砂千里ヶ浜に散らばる噴石

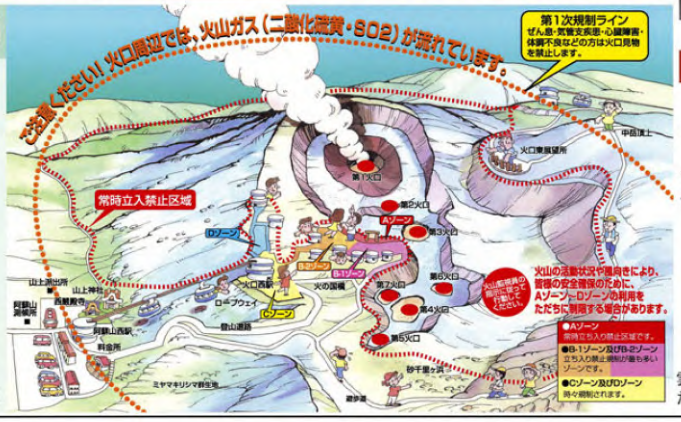
降　灰

火口から噴出した火山灰が降り積もる現象です。
農作物が枯れたり、屋根に積もった火山灰の重さで家屋等が倒壊する危険もあります。


雲仙普賢岳から噴出し、降り積もった火山灰が風で舞い上がる島原市内

火山ガスによるゾーン規制

阿蘇山の火口周辺では火山ガスの状況に応じて立ち入りが規制されることもあります。
火山ガスに関するアナウンスに注意して、緊急時には火口監視員の指示にしたがってください。ぜん息や気管支に疾患がある方、心臓が悪い方は登山を見合わせてください。
規制状況は、阿蘇山火山防災会議協議会のホームページでも確認できます。
(http://www.aso.ne.jp/~volcano)



メモ

3

4

阿蘇山火山防災マップ　中規模噴火

居住地域の近くまで重大な影響を及ぼす噴火が発生、あるいは発生すると予想される場合

噴火警戒レベル
5（避難）
4（避難準備）
3（入山規制）
2（火口周辺規制）
1（平常）

噴石が火口から概ね2km以内に飛散、さらに火砕サージが火口から概ね4km以内に到達する可能性があります。このため、火口から居住地域近くまでの広い範囲の火口周辺で入山が規制されます。

<過去の事例>
・１９９０年（平成　２年）　４月の噴火
・１９７９年（昭和５４年）　９月の爆発
・１９５８年（昭和３３年）　６月の爆発
・１９３３年（昭和　８年）　２月の爆発　など

阿蘇山の火山活動が活発になり、住民の避難が必要となると市町村長が避難に関する情報を出します。

右のような避難情報が出たら、地域住民、登山・観光客等は、市町村からの情報に従って、落ち着いて行動して下さい。

危険度アップ
◆ 避難指示
危険が切迫しています。
指示に従って直ちに避難して下さい！
◆ 避難勧告
災害が発生する可能性が高い状態です。
勧告に従って避難して下さい！
◆ 避難準備
災害が発生する可能性があります。
すぐに避難できるよう、準備をして下さい。

記号の色と意味

● 噴石
噴石が到達する恐れのある範囲です。（火口から2km）
※こぶし大の石が飛んでくる可能性のある範囲を過去の噴火実績から予想しました。

● 降灰
火山灰が降り積もる恐れのある範囲です。
上空は強い西風が吹いている場合が多いので、山の東側に火山灰は降りやすいです。
※ここでは、1933年（昭和８年）と同じ規模の噴火が生じた場合に降り積もる火山灰の厚さを推定しています。

● 火砕サージ
火砕サージが到達する可能性が高い範囲（火口から2km）
火砕サージが到達する可能性が中程度の範囲（火口から4km）
この外側にも火砕サージが到達する可能性はある
※過去に起こった火砕サージの到達距離から予測しています。

● 降灰後の土石流
土石流が流下する渓流
土石流の氾濫水深が５０cm以上に達し、床上浸水および家屋の損壊の恐れがある範囲
氾濫水深が20cm以上に達し、避難（歩行）が困難になる範囲
※火山灰が堆積して土石流が発生しやすくなる渓流を示しています。

噴　石

噴火によって直径数ｃｍ～数１０ｃｍの岩石が火口から飛来する現象です。


有珠山の噴火で噴石の直撃により屋根に穴が開いた建物

降　灰

火口から噴出した火山灰が降り積もる現象です。農作物が枯れたり、屋根に積もった火山灰の重さで家屋等が倒壊する危険もあります。


降り積もった火山灰が風で舞い上がる島原市内

火砕サージ

火山灰や噴石などを含む噴煙が斜面に沿って高速で流れ下る現象です。
阿蘇山では1958年（昭和33年）に火砕サージで１２名の方が亡くなりました。

1979年に阿蘇山中岳で発生した火砕サージ

降灰後の土石流

噴火によって山腹斜面に火山灰が堆積している場合には、少量の雨でも土石流が発生しやすくなります。


1990年に古恵川（阿蘇市）で発生した土石流災害

メモ

5

6

阿蘇山火山防災マップ　大規模噴火

居住地域に重大な被害を及ぼす噴火が発生、あるいは発生すると予想される場合

噴火警戒レベル
- 5（避難）
- 4（避難準備）
- 3（入山規制）
- 2（火口周辺規制）
- 1（平常）

山腹噴火を含む大規模な噴火が発生する可能性がある状態で、ここでは中岳火口から溶岩流が流れ、居住地域に到達する噴火規模を想定しました。
噴石もより広範囲に到達する可能性がありますので、居住地域でも避難や避難準備が必要です。
ただし、このような噴火は約2,000年前以降起こっていません。

阿蘇山の火山活動が活発になり、住民の避難が必要となると市町村長が避難に関する情報を出します。

右のような避難情報が出たら、地域住民、登山・観光客等は、市町村からの情報に従って、落ち着いて行動して下さい。

危険度アップ
- ◆ 避難指示：危険が切迫しています。指示に従って直ちに避難して下さい！
- ◆ 避難勧告：災害が発生する可能性が高い状態です。勧告に従って避難して下さい！
- ◆ 避難準備：災害が発生する可能性があります。すぐに避難できるよう、準備をして下さい。

記号の色と意味

- **噴石**：噴石が到達する恐れのある範囲です。
  ※こぶし大の石が最も遠くに飛ぶ条件でシミュレーション計算した結果から推定しました。
- **降灰**：火山灰が降り積もる恐れのある範囲です。
  上空は強い西風が吹いている場合が多いので、山の東側に火山灰は降りやすいです。
  ※ここでは、1933年（昭和8年）と同じ規模の噴火が生じた場合に降り積もる火山灰の厚さを推定しています。
- **火砕サージ**：火砕サージが到達する可能性が高い範囲(火口から2km)
  火砕サージが到達する可能性が中程度の範囲(火口から4km)
  この外側にも火砕サージが到達する可能性はある
  ※過去に起こった火砕サージの到達距離から予測しています。
- **溶岩流**：溶岩流が到達する恐れのある範囲
  ※過去1万年間に発生したもののうち最大規模を数値シミュレーションにより予測しました。
- **降灰後の土石流**：土石流が流下する渓流
  土石流の氾濫水深が50cm以上に達し、床上浸水および家屋の損壊の恐れがある範囲
  氾濫水深が20cm以上に達し、避難(歩行)が困難になる範囲
  ※火山灰が堆積して土石流が発生しやすくなる渓流を示しています。

噴　石

噴火によって直径数ｃｍ～数１０ｃｍの岩石が火口から飛来する現象です。


有珠山の噴火で噴石の直撃により屋根に穴が開いた建物

降　灰

火口から噴出した火山灰が降り積もる現象です。
農作物が枯れたり、屋根に積もった火山灰の重さで家屋等が倒壊する危険もあります。


降り積もった火山灰が風で舞い上がる鳥取市内

火砕サージ

火山灰や噴石などを含む噴煙が斜面に沿って高速で流れ下る現象です。阿蘇山では1958年（昭和33年）に火砕サージで１２名の方が亡くなりました。

1979年に阿蘇山中岳で発生した火砕サージ

溶岩流

マグマが地表に噴出して流れ下る現象です。高温で建物などを焼き尽くしますが、流下速度は速くなく、人が歩いて逃げられる程度です。


1983年三宅島噴火による溶岩流

降灰後の土石流

噴火によって山腹斜面に火山灰が堆積している場合には、少量の雨でも土石流が発生しやすくなります。


1990年に古恵川（阿蘇市）で発生した土石流災害

メモ

7

②Volcanic Alert Levels (Used since December 1, 2007)

■阿蘇山　噴火警戒レベルに対応した規制範囲

●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

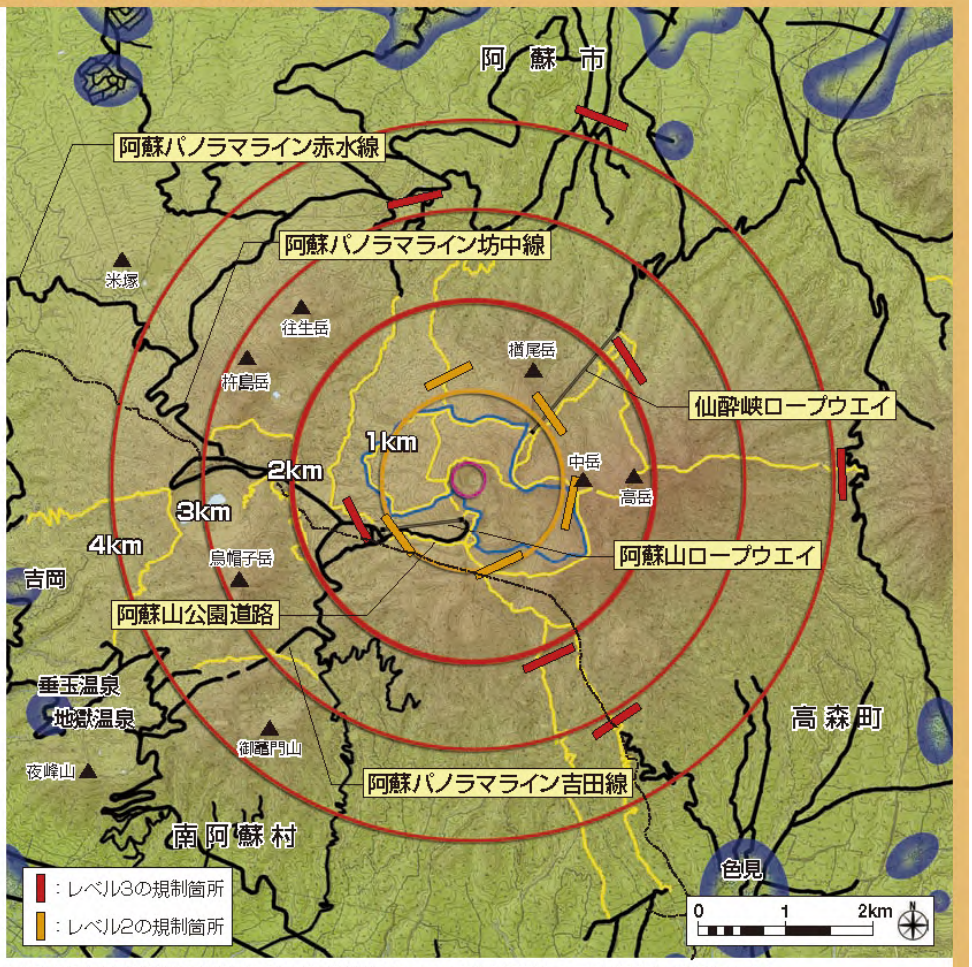
レベル４（避難準備）：
警戒が必要な居住地域での避難準備。要援護者は避難等。

レベル３（入山規制）：
火口から概ね2km以内立入禁止。規制範囲は居住地域付近（概ね4km）まで活動状況により変更。○の範囲内。
・中岳・高岳への登山道の立入禁止
・阿蘇パノラマライン坊中線と吉田線の合流点から立入禁止

レベル２（火口周辺規制）：
火口から概ね１km以内の立入禁止 ○の範囲内
・火口から概ね1km以内の立入禁止
・阿蘇山公園道路、阿蘇山ロープウエイ及び仙酔峡ロープウエイは利用できません

レベル１（平常）：
火口内等常時立入禁止。
○の範囲内。

：一般道
：登山道
：中岳第一火口
：居住区域



この図は、国土地理院発行の2万5千分の1地図画像、数値地図50mメッシュ（標高）およびカシミール3Dを使用して作成しています。

■この図は、熊本県による阿蘇山火山防災マップをもとに、阿蘇火山防災会議協議会及び地元自治体と調整して作成しています。

■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、詳細については阿蘇市、高森町、南阿蘇村にお問い合わせください。

Volcanic Alert Levels for the Asosan Volcano (Valid as of December 1, 2007)

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	●Lava flow or imminent lava flow reaching residential areas. Past Examples No observed examples in historical times. Approx. 2,000 years ago: Lava flow reached within approximately 4 km of Komezuka Approx. 2,700 years ago: Lava flow reached within approximately 5 km of Ojodake Approx. 3,400 years ago: Lava flow reached within approximately 6 km of Kishimadake Approx. 4,800 years ago: Lava flow reached within approximately 7 km of Nakadake Since approx. 6,300 years ago: Lava flow reached Akamizu area (source crater unknown)
		4 Prepare to evacuate	Forecast 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.	●Forecast of lava flow, with eruption extending to residential areas in the event of expansion. 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 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.	●Lava flow reaching approximately 4 km from crater, or forecast to do so as a result of increased eruptive activity. Past Examples June, 1958: Pyroclastic flow extended approximately 1.2 km from the No. 1 crater. ●Scattering of volcanic blocks within a distance of approximately 2 km from the crater, or forecast to do so due to fumarole closure, during eruptive activity. Past Examples of Volcanic Block Scattering September, 1979: Volcanic blocks were scattered approximately 1.2 km from the No. 1 crater. June, 1958: Volcanic blocks were scattered approximately 1.3 km from the No. 1 crater. February, 1933: Volcanic blocks were scattered approximately 1.2 km from the No. 2 crater.
	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 crater area restricted, etc.	●Small eruption, with scattering of volcanic blocks within a distance of approximately 1 km from the crater. Past Examples July, 1977: Volcanic blocks were scattered approximately 800 m from the No. 1 crater. December, 1957: Volcanic blocks were scattered approximately 700 m from the No. 1 crater. April, 1953. Volcanic blocks were scattered approximately 800 m from the No. 1 crater. ●Forecast of small eruption. Past Examples April, 2005; January, 2004; July, 2003: Very small eruption.
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 small mud eruptions limited to summit crater interior.

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

Note 2) Levels 1 through 3 are envisioned for eruptions at the No. 1 to No. 7 craters of Nakadake, and Sunasenrigahama. Eruptions at all other locations will be given specific consideration by the Hazard Map Deliberation Committee and reflected in the future.

Note 3) The volcanic alert levels differ from volcanic gas related restrictions.

Social Circumstances

①Populations

Aso City: 28,582 (as of October 31, 2011)

Oguni Town: 8,156 (as of September 1, 2011)

Minami Oguni Town: 4,534 (as of October 31, 2011)

Takamori Town: 7,164 (as of October 31, 2011)

Yamato Town: 17,831 (as of October 1, 2011)

Minami-Aso Village: 11,971 (as of October 31, 2011)

Ubuyama Village: 1,669 (as of October 31, 2011)

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

Aso Kuju National Park

・The Aso area was certified as a Japanese Geopark in October, 2009.

Number of sightseers per year: 17,528,179 (according to 2010 Kumamoto Prefecture sightseer statistical table)

Number of mountain-climbers per year: 793,879 (2010 (Aso City statistics))

③Facilities

・Disaster response related facilities (including museums and memorials)

Listed in Aso Volcano Disaster Prevention Plan

・Capacities and locations of evacuation facilities * Only evacuation centers are listed

Area	Facility Name	Number of Facilities (Locations)	Capacity (People)
West Asosan	Shelter (29 m^2)	9	540
	Shelter (100 m^2)	1	60
	Ropeway Crater West Station	1	450
	Ropeway Aso West Station	1	3,000
	Asosan Hi no Kuni Tea Shop	1	1,100
	Asosan Summit Drive-In	1	250
	Asosan Top Drive-In	1	200
East Asosan	Shelter (29 m^2)	5	340
	Ropeway Crater East Station	1	850
	Ropeway Sensuikyo Station	1	2,100
Total		22	8,890

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 (Oita and Kumamoto) published by the Geospatial Information Authority of Japan were used.

Legend

(JMA)
- seismometer(SP)
- GPS
- infrasonic microphone
- visual camera
- scalar magnetometer

(GSI)
- GPS

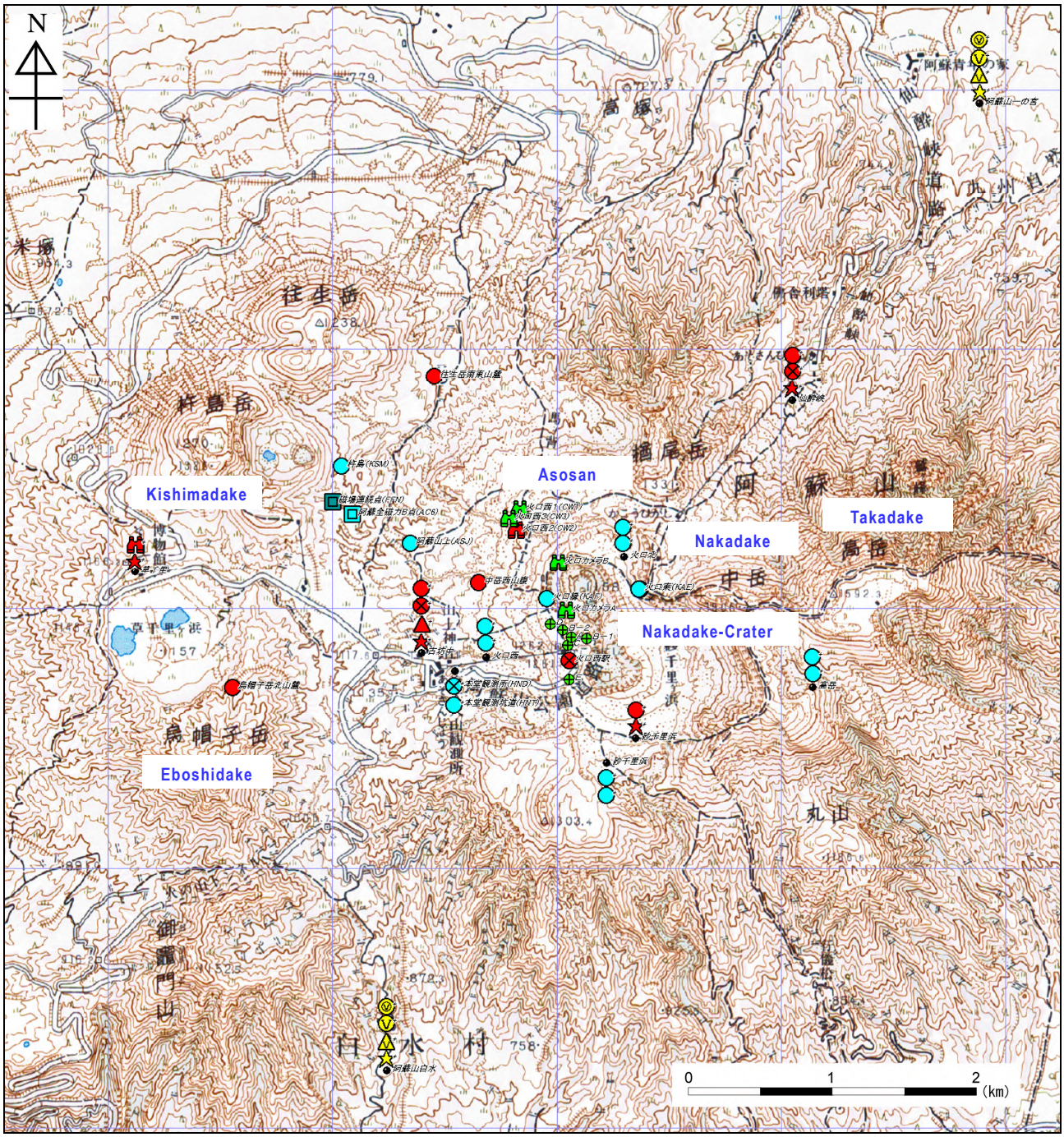
(NIED)
- V-net(SP)
- V-net(broadband)
- V-net(tiltmeter)
- Hi-net
- K-NET
- KiK-net
- GPS

(AVL)
- seismometer(SP)
- seismometer (broadband)
- GPS

(Municipalities)
- seismic intensity meter

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 (Takamori and Asosan) published by the Geospatial Information Authority of Japan were used.

Legend

(JMA)	(NIED)	(AVL)	(ENV)
seismometer(SP)	V-net(SP)	seismometer(SP)	gas sensor
GPS	V-net(broadband)	infrasonic microphone	
tiltmeter	V-net(tiltmeter)	scalar magnetometer	(Aso Volcano Museum)
infrasonic microphone	GPS	vector magnetometer	visual camera
visual camera			

Bibliography

Abe, Y., et al. (2010): Crustal structure beneath Aso Caldera, Southwest Japan, as derived from receiver function analysis. J. Volcanol. Geotherm. Res., **195**, 1-12.

Aoki, et al. (1940): Quarterly Journal of Seismology, **11**, 133-163 (in Japanese).

Asosan Weather Station (1980): Coordinating Committee for Prediction of Volcanic Eruption, **17**, 17-20 (in Japanese).

Baba et al. (1999): Memoirs of the Faculty of Education, Kumamoto University, Natural Science, **48**, 133-146 (in Japanese with English Abstract).

Fukuoka District Meteorological Observatory (1965): Memoirs of Fukuoka District Meteorological Observatory, **20**, 15-46 (in Japanese).

Fukuoka District Meteorological Observatory (1965): Memoirs of Fukuoka District Meteorological Observatory, **20**, 1-116 (in Japanese).

Fukuoka District Meteorological Observatory (1970): Memoirs of Fukuoka District Meteorological Observatory, **25**, 1-332 (in Japanese).

Fukuoka District Meteorological Observatory (1976): Memoirs of Fukuoka District Meteorological Observatory, **31,** 1-162 (in Japanese).

Fukuoka District Meteorological Observatory (1990): Memoirs of Fukuoka District Meteorological Observatory, **45**, 1-46 (in Japanese).

Fukuoka District Meteorological Observatory (1990): Memoirs of Fukuoka District Meteorological Observatory, **45**, 119-136 (in Japanese).

Fukuoka District Meteorological Observatory (2002): Memoirs of Fukuoka District Meteorological Observatory, **57**, 1-240 (in Japanese).

Geographical Survey Institute of Japan (1994): 1:30,000 VolcanicLand Condition Map (ASOSAN) (in Japanese).

Hashimoto et al. (2001): Annuals of Disaster Prevention Research Institute (Kyoto University), **44B-1**, 333-343 (in Japanese with English Abstract).

Ikebe, S. and Fujioka, M. (2001): Bulletin of the Volcanological Society of Japan, **46**, 147-163 (in Japanese with English Abstract).

Ikebe et al. (2008): Bulletin of the Volcanological Society of Japan, **53,** 15-33 (in Japanese with English Abstract).

Kanda, W., et al. (2008): J. Volcanol. Geotherm. Res., **178**, 32-45.

Kumamoto University et al. (1991): Coordinating Committee for Prediction of Volcanic Eruption, **49**, 39-42 (in Japanese).

Miyabuchi et al. (2003): Bulletin of the Volcanological Society of Japan, **48**, 195-214 (in Japanese with English Abstract).

Miyabuchi et al. (2003): Bulletin of the Volcanological Society of Japan, **48,** 229-234 (in Japanese with English Abstract).

Miyabuchi et al. (2005): Bulletin of the Volcanological Society of Japan, **50**, 227-241 (in Japanese with English Abstract).

Miyabuchi et al. (2006): Programme and Abstract of the Volcanological Society of Japan, 2006(2), 48 (in Japanese with English Abstract).

Miyabuchi et al. (2007): Bulletin of the Volcanological Society of Japan, **52**, 133-147 (in Japanese with English Abstract).

Miyabuchi, Y. (2009): Sedimentary Geology, **220**, 169-189.

Miyabuchi, Y. (2010): Bulletin of the Volcanological Society of Japan, **55**, 219-225 (in Japanese with English Abstract).

Miyabuchi, Y. (2011): J. Volcanol. Geotherm. Res., **205**, 94-113.

Miyabuchi et al. (2005): Bulletin of the Volcanological Society of Japan, **50**, 227-241 (in Japanese with English Abstract).

Miyabuchi, Y. and Watanabe, K. (1997): Bulletin of the Volcanological Society of Japan, **42**, 403-408 (in Japanese with English Abstract).

Miyabuchi, Y. and Watanabe, K. (2000): Bulletin of the Volcanological Society of Japan, **45**, 25-32 (in Japanese with English Abstract).

Miyabuchi, Y. and Watanabe, K. (2000): Bulletin of the Volcanological Society of Japan, **45**, 25-32 (in Japanese with English Abstract).

Miyabuchi et al. (2004): Bulletin of the Volcanological Society of Japan, **49**, 51-64 (in Japanese with English Abstract).

Ono et al. (1979): Chishitsu News, **304**, 54-59 (in Japanese with English Abstract).

Ono, K. and Watanabe, K. (1985): Geological map of Aso Volcano. Geological Map of Volcanoes **4**, Geological Survey of Japan.

Ono et al. (1977): Geology of Taketa district.Geological Survey of Japan (in Japanese with English Abstract).

Ono, K. and Watanabe, K. (1985): Geological map of Aso Volcano.Geological Survey of Japan (in Japanese with English Abstract).

Ono et al. (1995): Bulletin of the Volcanological Society of Japan, **40**, 133-151 (in Japanese with English Abstract).

Shimomura et al. (1990), Programme and Abstract on researches in Fukuoka District Meteorological Observatory, **51**, 94-95.

Sudo, Y. (2001): Chikyu Monthly, **23**, 545-550.

Taneda et al. (1959): Bulletin of the Volcanological Society of Japan, **3**, 136-146 (in Japanese with English Abstract).

Takada, H. (1989): Journal of the Kumamoto Geoscience Association, **90**, 8-11 (in Japanese).

Terada et al. (2007): Bulletin of the Volcanological Society of Japan, **52**, 335-340 (in Japanese with English Abstract).

Tsutsui, T., et al. (2004): J. Volcanol. Geotherm. Res., **131**, 33–58.

Watanabe, K. (1991): Journal of the Kumamoto Geoscience Association, **98**, 2-13 (in Japanese).

Watanabe, K. (2001) Geology of Aso Volcano. Ichinomiya Choshi, 238p (in Japanese).

Yamamoto, M. (2005) Volcanic fluid system inferred from broadband seismic signals. Meeting Abstract, 16K-07, Disaster Prev. Res. Inst., Kyoto Univ (in Japanese).

(Hoshizumi, H., and Miyabuchi, Y.)