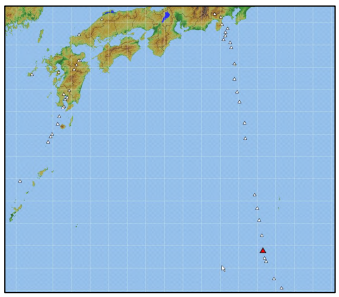
74. Ioto



Continuously Monitored by JMA

Latitude: 24°45'02" N, Longitude: 141°17'21" E, Elevation: 170 m
(Suribachiyama) (GSI Measuring Point)

Overview of Ioto taken from northwest side on July 29, 2008 by the Japan Meteorological Agency

Summary

This volcano is also known as Nakaioto. It measures 8.5 km northeast to southwest and is 4.5 km wide. The central and northern part of the island (Motoyama) is a plateau with an elevation of 115 m. A steep pyroclastic cone, Suribachiyama, is located on the southern tip (elevation 170 m), and Motoyama and Suribachiyama are connected by a low plateau of loose gravel (Chidorigahara, elevation 70 m or less). The island is a post-caldera volcano in a caldera with a diameter of approximately 10 km, located at the summit of a large submarine volcano, 40 km in diameter and with a relative height of 2,000 m. Motoyama is uplifted lava and pyroclastics deposited on the shallow seafloor. Suribachiyama is an aerial pyroclastic cone with lava. The rock, as with that of Fukutoku-Okanoba, is trachyandesite, unusual for the Izu Islands. The SiO_2 content of the trachyandesite is between 54.6 and 60.5 wt %.

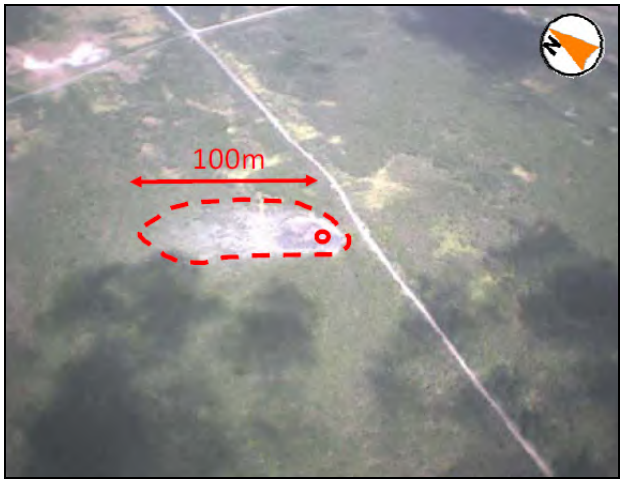
Ground temperatures are high across the entire island, and the volcano has many fumarolic areas and pits. From February to May, 2012, small phreatic explosions occurred at some points on the island, including some at the old crater (known as the Million Dollar Hole). The volcano has coastal terraces and fault scarps which are indicative of island uplift, which is continuing at unusual speed.

The name was changed from "Iojima" to "Ioto" in 2007 (Heisei 19).

Photos

Suribachiyama taken from southwest side on November 28, 2006 by the Japan Meteorological Agency

Phreatic explosion at Idogahama, taken from the northwest side on October 19, 2001 by the Japan Meteorological Agency



Mud discharge at the old crater (Million Dollar Hole)

On March 7, 2012, 13:34 taken from southwest side, elevation 500 m (red dotted line: mud scatter area, red circle: vent)
Vents were arranged north to south, and mud was scattered approximately 100m towards the northwest.

Old crater (Million Dollar Hole) area on March 7, 2012, 13:34 by the Japan Meteorological Agency)

Topography around the Crater

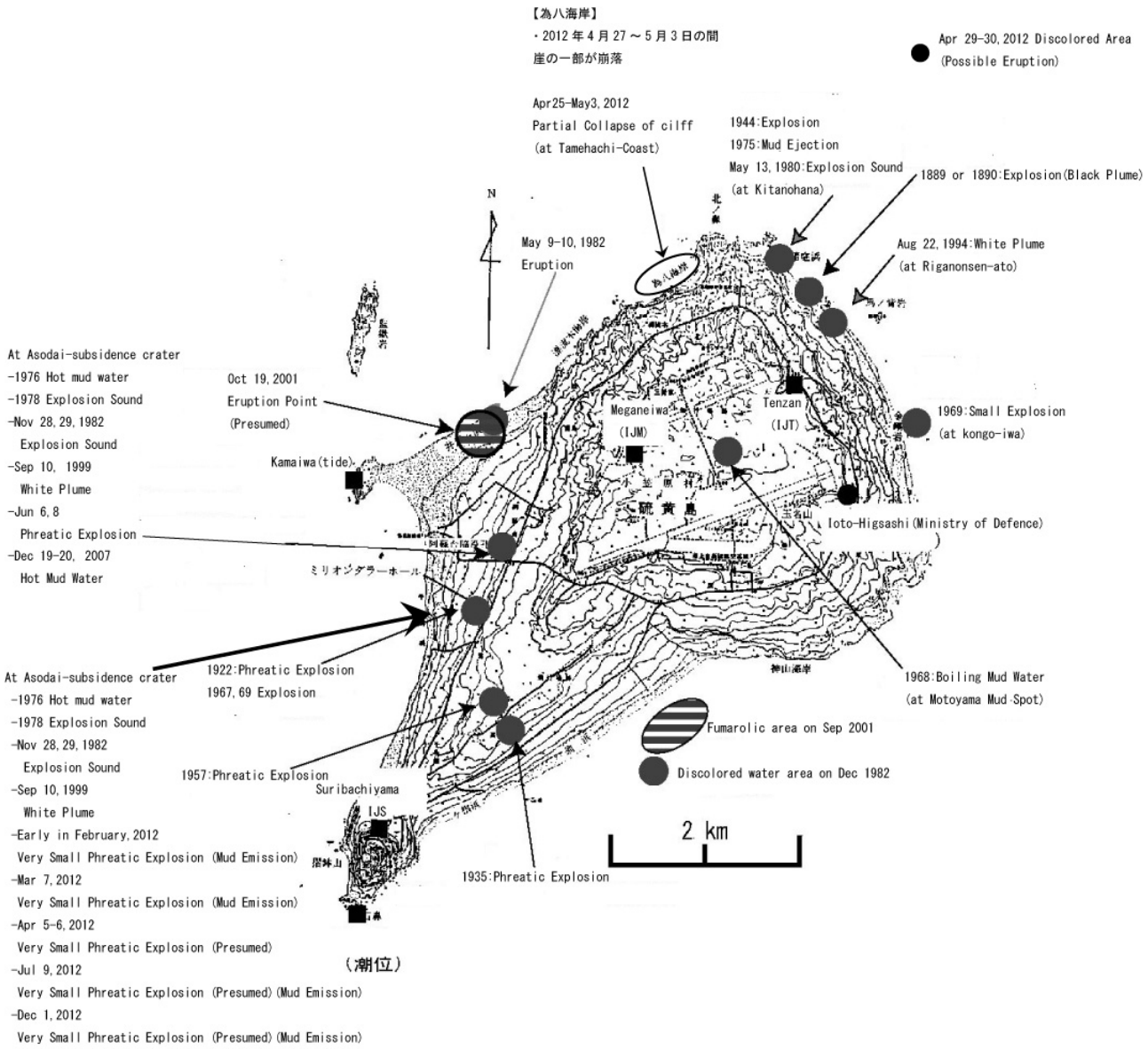


Figure 74-1 Locations on Ioto at which past eruptions have been confirmed (Following events added to figure from Ukawa et al., 2002).

- Phreatic explosions at Asodai collapse chimney, etc. (2004, 2007)
- Very small phreatic explosions at old eruption crater (called the "Million Dollar Hole") (Early February, 2012; March 7; April 5 to April 6)
- Partial cliff collapse on Tamehachi coast (between April 27 and May 3, 2012)

Red Relief Image Map

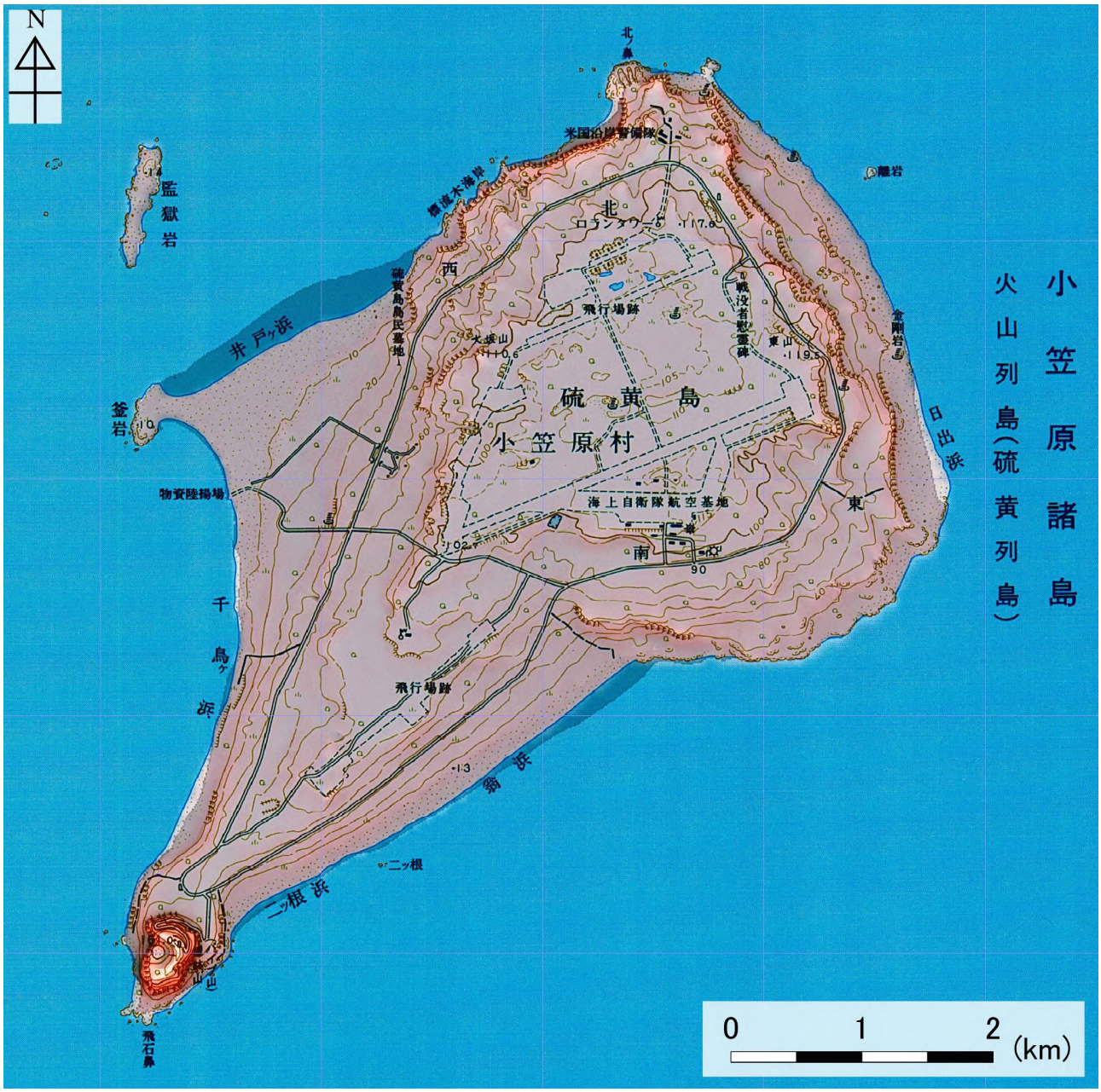


Figure 74-2 Topography of Ioto.

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

Submarine Topographic Map

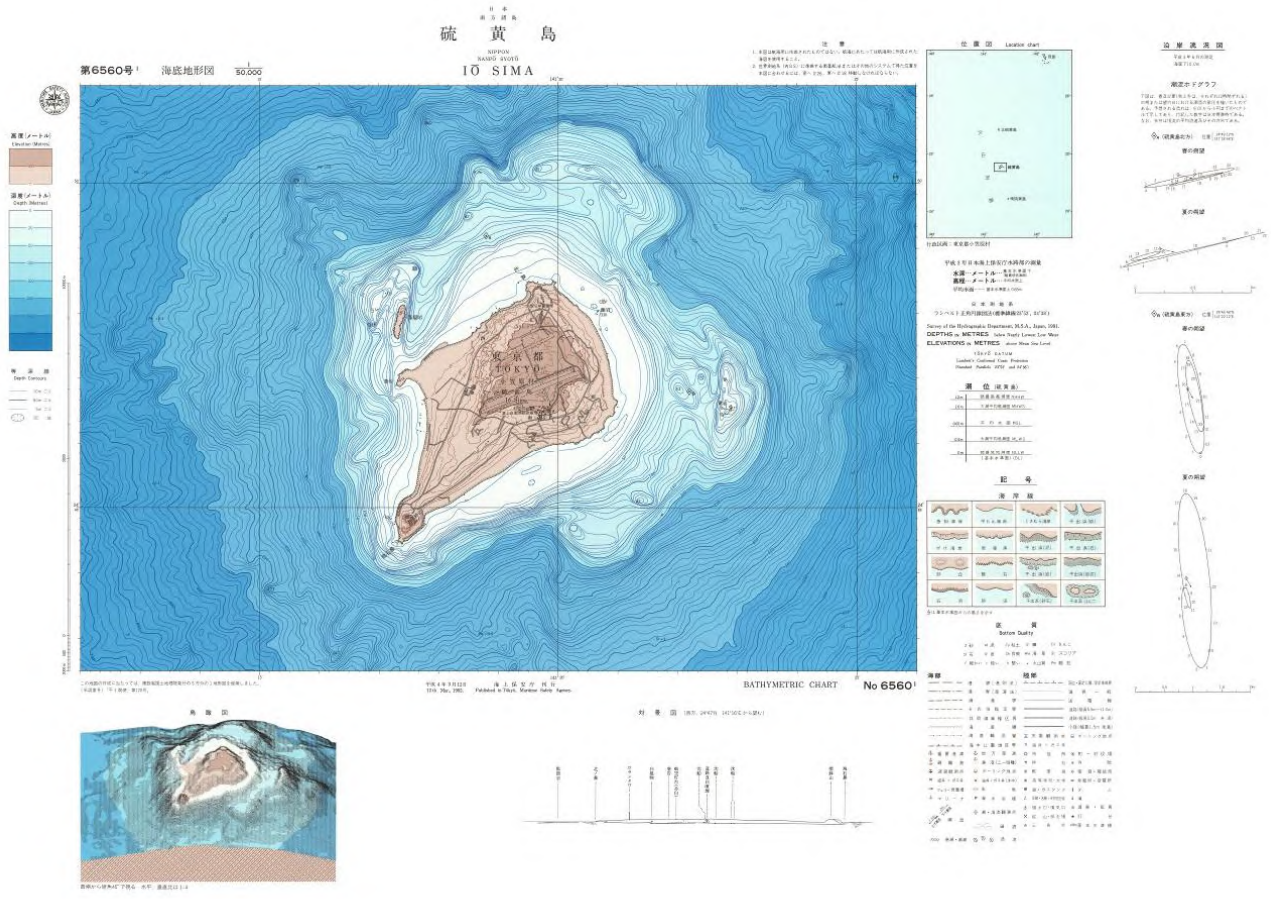


Figure 74-3 Submarine topographic map of the Ioto area (Maritime Safety Agency, 1992).

Chronology of Eruptions

・Volcanic Activity in the Past 10,000 Years

Dating of carbonized wood, retrieved from pyroclastic rocks in the Kitanohana coast, in the north of Ioto, indicates that Motoyama's pyroclastic rock deposits date back 2,700 to 2,800 years. (Oyagi and Iguchi, 1985).

Period	Area of Activity	Eruption Type	Main Phenomena / Volume of Magma
2.9←→2.8 ka	Motoyama	Magmatic eruption	Lava flow → pyroclastic material.

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

Year	Phenomenon	Activity Sequence, Damages, etc.
1889 (Meiji 22) or 1890 (Meiji 23)	Phreatic eruption	The activity occurred at Chidorigaana. It formed a crater 50 m long.
1922 (Taisho 11)	Phreatic eruption	July. The eruptive activity occurred at the west coast old eruption crater (Million Dollar Hole?) [12]。
1935 (Showa 10)	Phreatic eruption	The activity occurred near the southwestern edge of the Chidorigahara runway.
1944 (Showa 19)	Phreatic eruption	December. The eruptive activity occurred at the Kitanohana mud pit (?)
1957 (Showa 32)	Very small-scale: Phreatic eruption	March 28. The activity occurred near the southwestern edge of the Chidorigahara runway. The crater had a diameter of 100 m, and ejecta was scattered over a roughly 100 m area. (VEI 0)
1967 (Showa 42)	Small-scale: Phreatic eruption	December 23. The eruptive activity occurred at the Million Dollar Hole. Two craters existed, with diameters of 30 to 40 m. Ejecta was scattered within a 100 m x 200 m area. (VEI 1)
1968 (Showa 43)	Phreatic eruption	June 20. The eruptive activity occurred at the Motoyama fumarole. Muddy water spout.
1969 (Showa 44)	Phreatic eruption	January 12. The eruptive activity occurred at the Million Dollar Hole. From January 8 to 12 a fume was observed, as well as a fume from the north side of the west coast's Million Dollar Hole, and fissures in the nearby area.
1969 (Showa 44)	Phreatic eruption	November or December. The activity occurred at Kongoiwa.
1975 (Showa 50)	Mud discharge	November. Mud discharge at the Kitanohana mud pit. December 24 to January 14 of the following year. Hot muddy water spout from the Asodai collapse vent.
1978 (Showa 53)	Phreatic eruption	December 11. The eruptive activity occurred at the Asodai collapse pit.
1980 (Showa 55)	Phreatic eruption	March 13. The eruptive activity occurred at the Kitanohana mud discharge area.
1982 (Showa 57)	Phreatic eruption	March 9 and 10. Tephra fall. The eruptive activity occurred at Idogahama (on the northwest coast of Ioto). Roughly November 28 and 29. Tephra fall. The eruptive activity occurred at the Asodai collapse pit.
	Discolored water	Roughly December. The eruptive activity occurred approximately 500 m off the Okinahama beach. Emeraldine discolored water approximately 500 m off the south coast.
1993 (Heisei 5)	Submarine eruption?[13]	October. High temperatures at Chidorigahara (known as the Chinsen coast). November 15 and 16 - Eruption (at sea between Umanose and Hakoniwahama). On November 15 a discharge mixed with sand occurred (with no surface level rise). On November 16 an area of yellow-green discolored sea water was observed approximately 2 km off the coast.
1994 (Heisei 6)	Phreatic eruption	August 22. The eruptive activity occurred at the former site of the Hanareiwa Onsen.
1999 (Heisei 11)	Phreatic eruption	September 10. The eruptive activity occurred at the Asodai collapse vent.

Year	Phenomenon	Activity Sequence, Damages, etc.
2001 (Heisei 13)	Phreatic eruption	September 21 to 22. Tephra fall (pumice drifted ashore). The eruptive activity occurred approximately 200 m off to the southeast of Ioto.
	Phreatic eruption	October 19 to 23. Tephra fall. The eruptive activity occurred at Idogahama (the northwest coast of Ioto).
2007 (Heisei 19) December 19 and December 20	Mud overflow	From the night of December 19 to the early morning of December 20, hot muddy water spouted from the Asodai collapse vent.
2012 (Heisei 24)	Very small-scale: Phreatic eruption, fume anomaly. Discolored water (submarine eruption?)	In early February mud was emitted from the Million Dollar Hole towards the southeast, reaching as far as 100 m. On March 7 at approximately 08:20 mud was discharged. From the morning of April 5 to the afternoon of April 6, intermittent sounds and gas emissions were observed. From April 27 to 28 the level of seismic activity was high, and an uplift occurred across the island. From April 28, the amount of seismic activity gradually decreased, and crustal deformation on the island switched to subsidence. From April 29 intermittent volcanic tremors occurred. After this, the amount of seismic activity and volcanic tremors became low. From April 29 to 30 discolored water was confirmed in the sea northeast of the island. A possibility exists of a submarine eruption over the entire area. Fumarolic activity was very low at a new collapse area on a cliff on the Tamehachi coast. Temperatures were high from the coast where the collapse occurred to the Kitanohana coast. Discolored water several hundred meters off that coast was observed. Light green discolored water was observed between the Kitanohana area and the Tamehachi coast area. A hot crater lake formed at the Rigan Onsen site. On July 9, at approximately 12:15, a white volcanic plume (approximately 15 m high) was observed. Evidence was later discovered that mud was scattered several dozen meters around the old eruption site. A site survey in early August found that the site of the 2001 eruption crater at Idogahama had become obscured, and topographical changes in the coastline, etc., occurred. Fume were also observed over a wider area, compared to Suribachiyama. On September 7, at approximately 17:00, a subsidence vent approximately 10m in diameter was confirmed near the wrecked ships off the western coast. The inside of the collapse vent had become a milky white hot crater lake with a depth of between roughly 40 cm and 2 m. (By September 15, the collapse vent had been filled in with sand carried by waves, and the hot crater lake was gone).

* 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.

Precursory Phenomena

High seismic activity and uplifts are continually observed, with occasional phreatic eruptions.

Recent Volcanic Activity

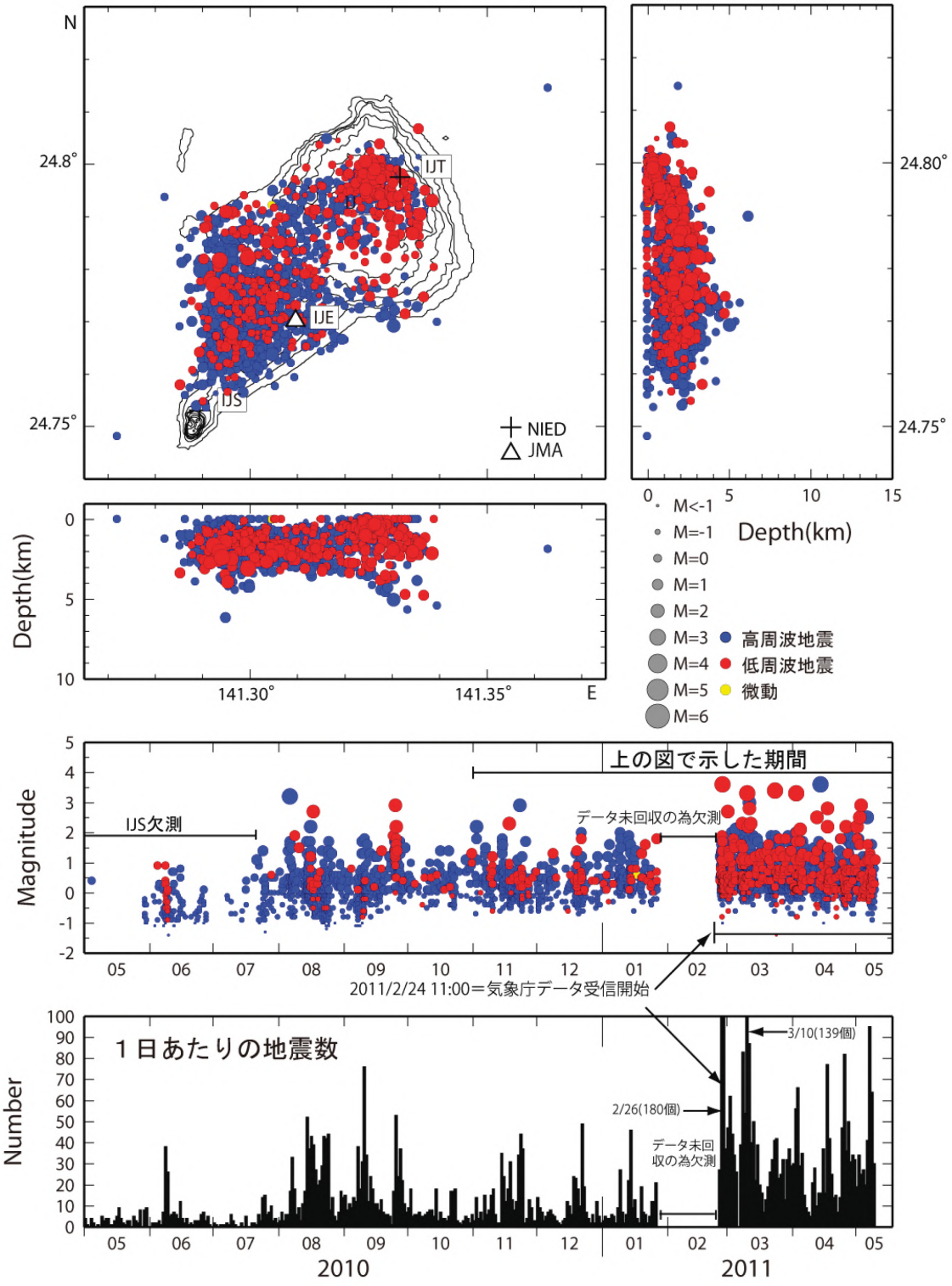


Figure 74-4 Ioto seismic activity (May 1, 2010, to May 9, 2011) (National Research Institute for Earth Science and Disaster Prevention, 2012).

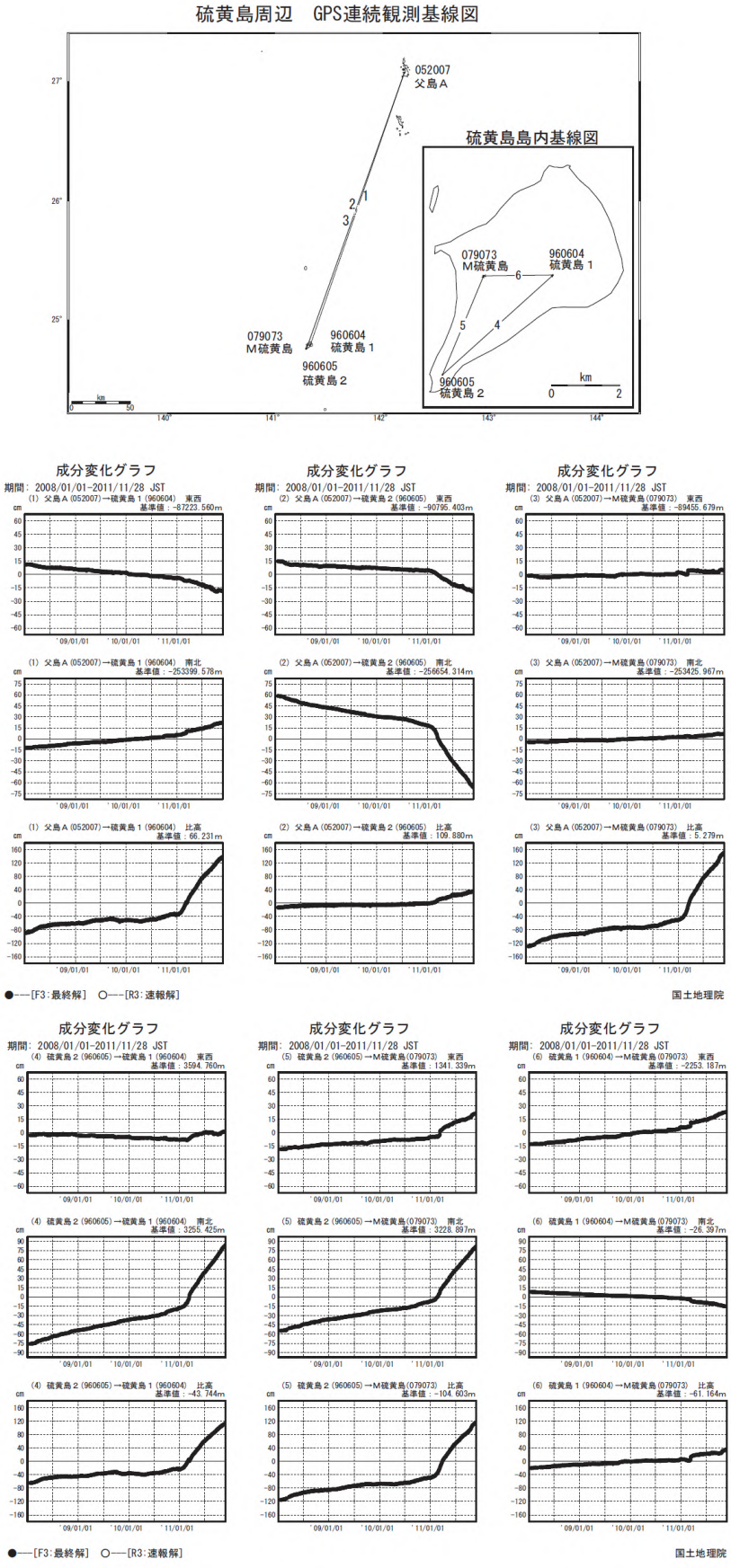


Figure 74-5 Ioto GPS analysis results (Geospatial Information Authority of Japan, 2012).
Prominent crustal deformation was observed, which was caused by uplifts, centered near Motoyama.

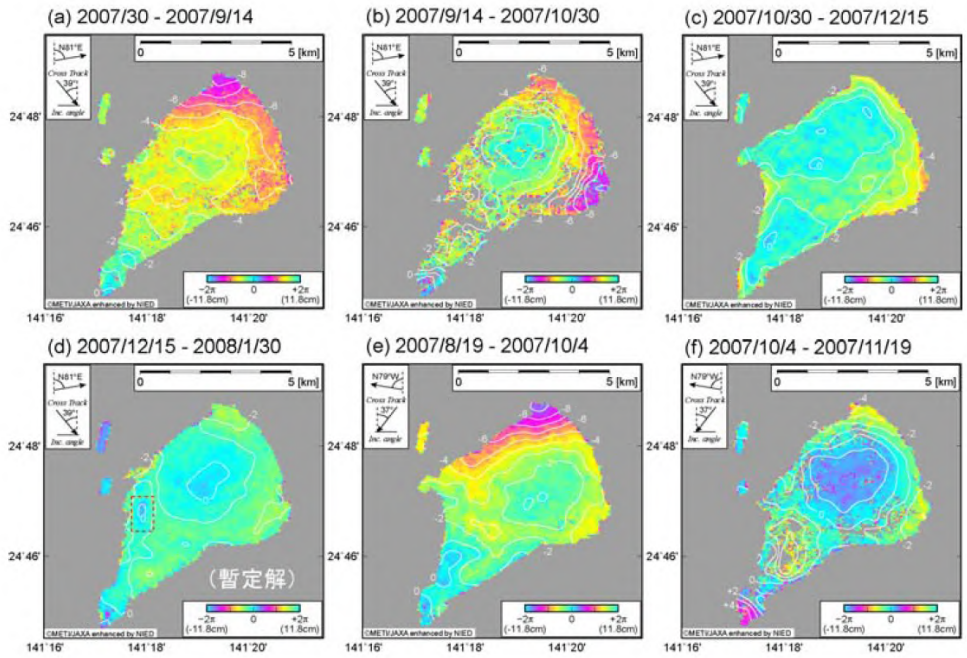


Figure 74-6 Temporal change in quasi-vertical and quasi-E-W components of crustal deformation estimated to have occurred on Ioto (National Research Institute for Earth Science and Disaster Prevention, 2010).

Quasi-vertical components consist of displacement approximately 8° south of vertical. Quasi-E-W components consist of displacement tilted approximately 0.4° east. From the end of 2006, crustal deformation indicating the uplift of the island as a whole was observed, whose rate slowed over time. The uplift began again from approximately December, 2007. Westward crustal deformation of the west coast also occurred, with repeated uplifts and subsidence.

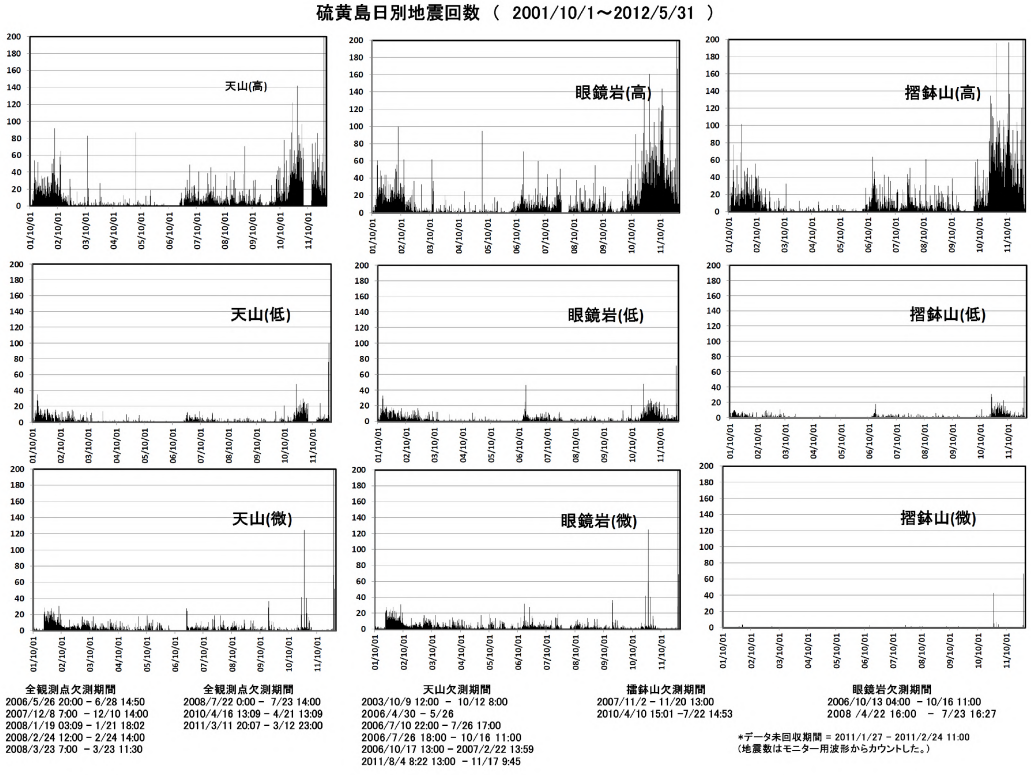


Figure 74-7 Number of earthquakes per day on Ioto (October 1, 2001, to May 31, 2012) (National Research Institute for Earth Science and Disaster Prevention, 2010).

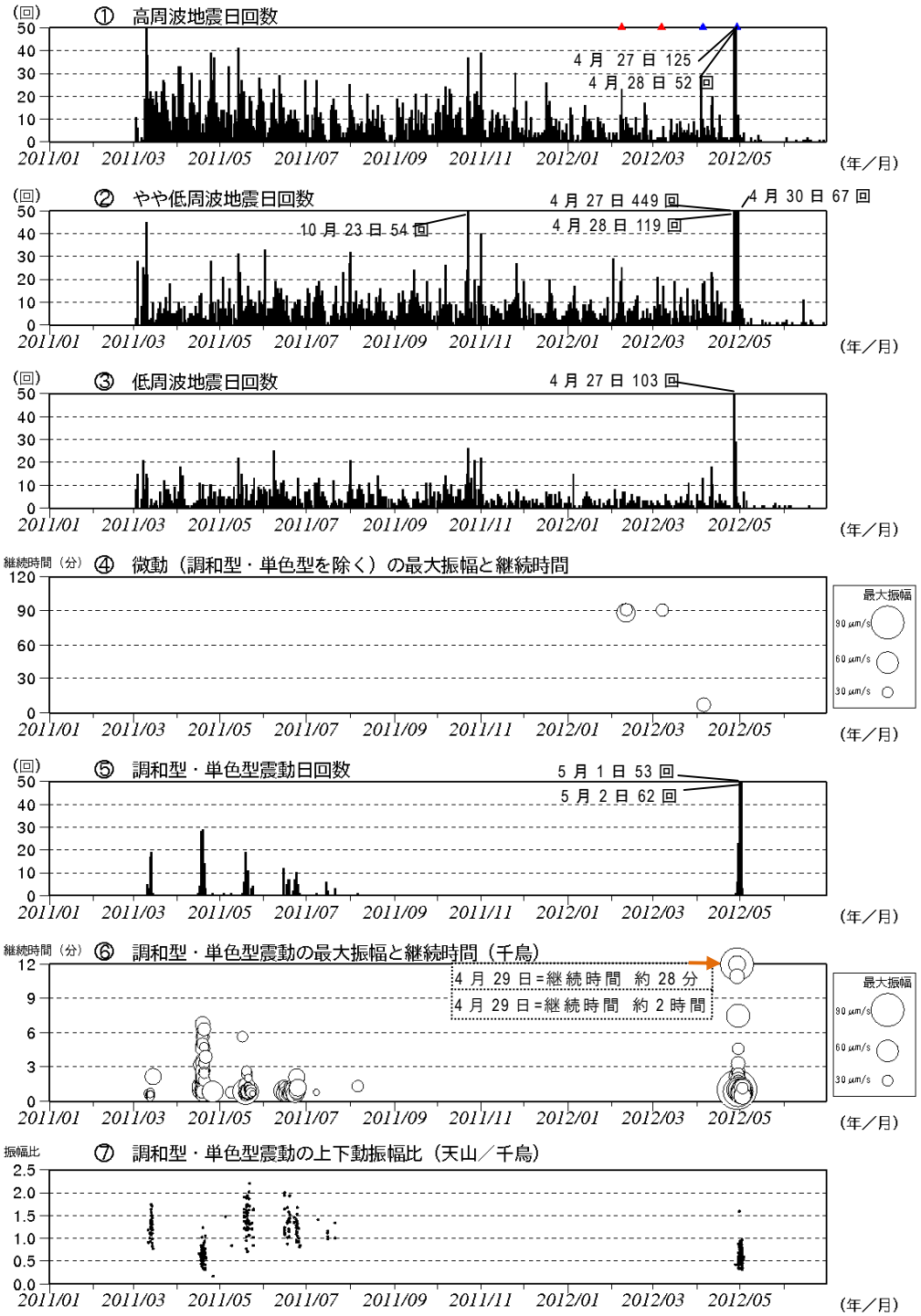


Figure 74-8* Ioto volcanic activity (March 8, 2011, to June 30, 2012).

◆ Seismic observation: Began March 8, 2011

[Count Criteria] ・After January 1, 2012: 30μm/s or more, S-P time of 2.0 seconds or less for Chidori or (NIED) Tenzan

・March 8, 2011, to December 31, 2011: 30μm/s or more, S-P time of 2.0 seconds or less for Chidori, and 20μm/s or more, S-P time of 2.0 seconds or less for (NIED) Tenzan

*(NIED): National Research Institute for Earth Science and Disaster Prevention

① Number of high frequency earthquakes per day
② Number of slightly low frequency earthquakes per day
③ Number of low frequency earthquakes per day
④ Maximum amplitudes and durations of tremors (other than harmonic and monotonic tremors)
⑤ Number of harmonic and monotonic tremors per day
⑥ Maximum amplitudes and durations of harmonic and monotonic tremors (Chidori)
⑦ Ratio of vertical to lateral movement in harmonic and monotonic tremors (Tenzan / Chidori)

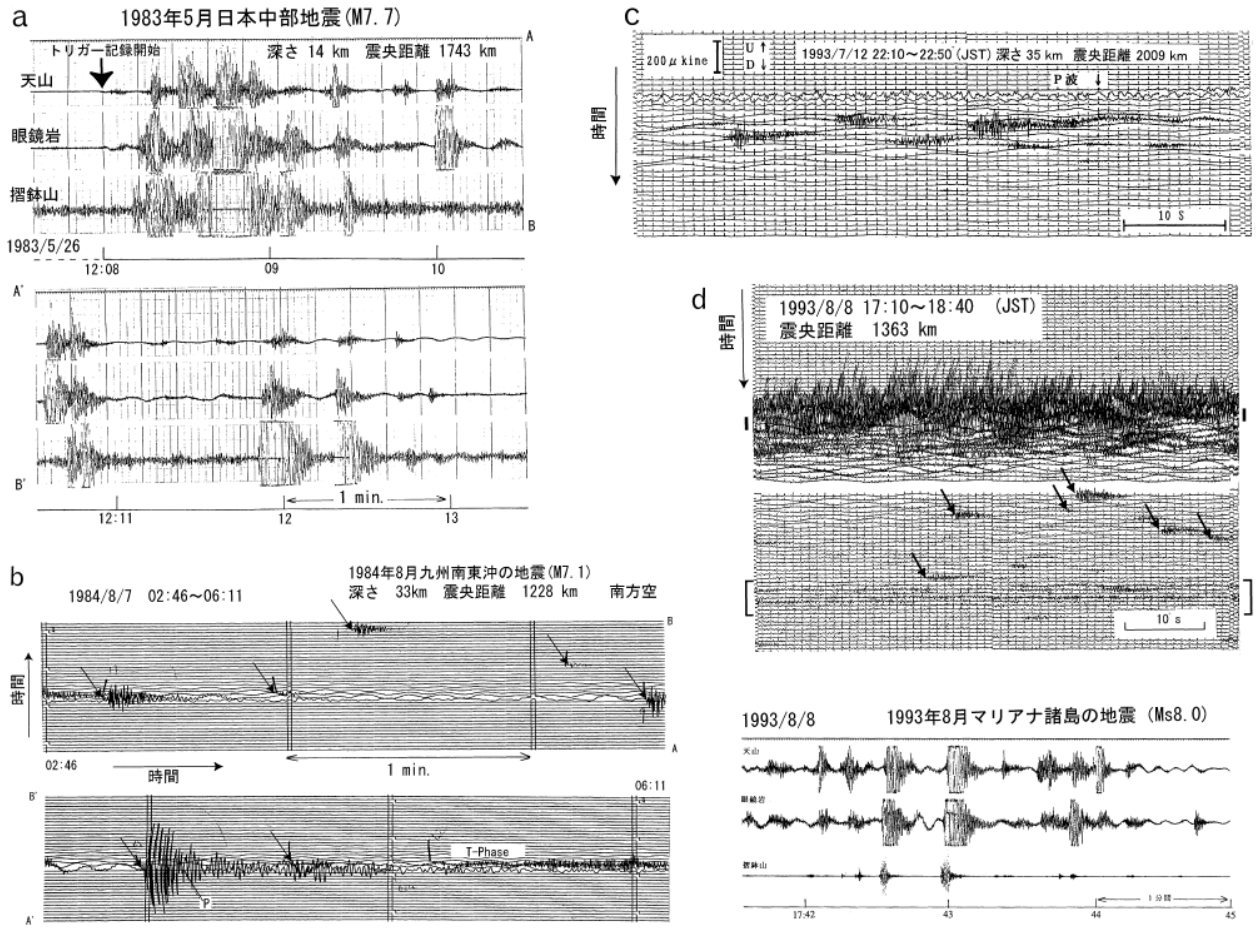


Figure 74-9 Examples of earthquakes due to the earthquakes with distant epicenters (Ukawa et al., 2002).

Minor seismic activity has occasionally increased in the Ioto area when seismic waves from distant earthquakes arrived, which indicates that surface waves of distant earthquakes have induced earthquakes.

a): The mid-Japan Sea Earthquake, 1983 (M7.7), b): 1984 Kyushu southeast sea earthquake (M7.1),c): The Southwest off Hokkaido Earthquake, 1993 (M7.8),

d): 2003 Mariana Islands earthquake (Ms8.0)

Interior Structure

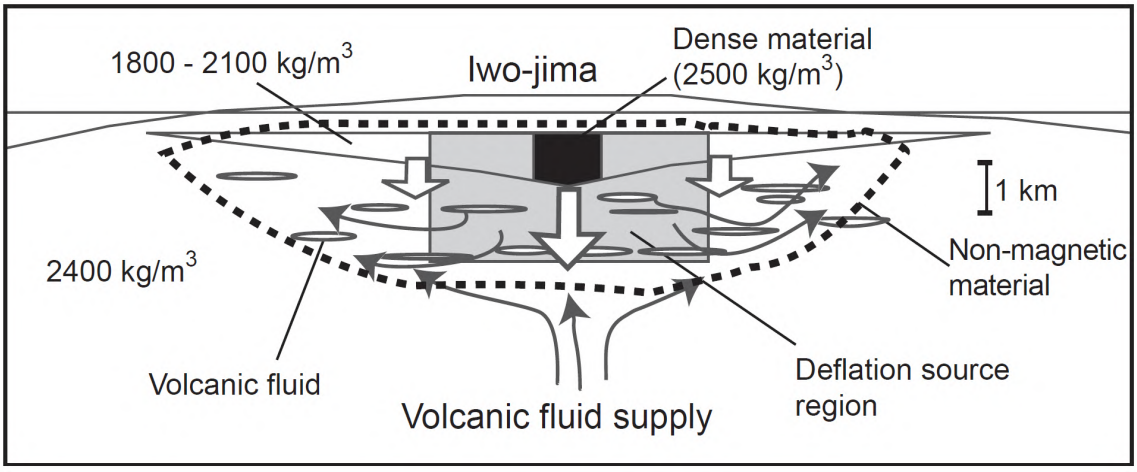


Figure 74-10 Diagram of the structure of the Ioto caldera (Ukawa et al., 2006).

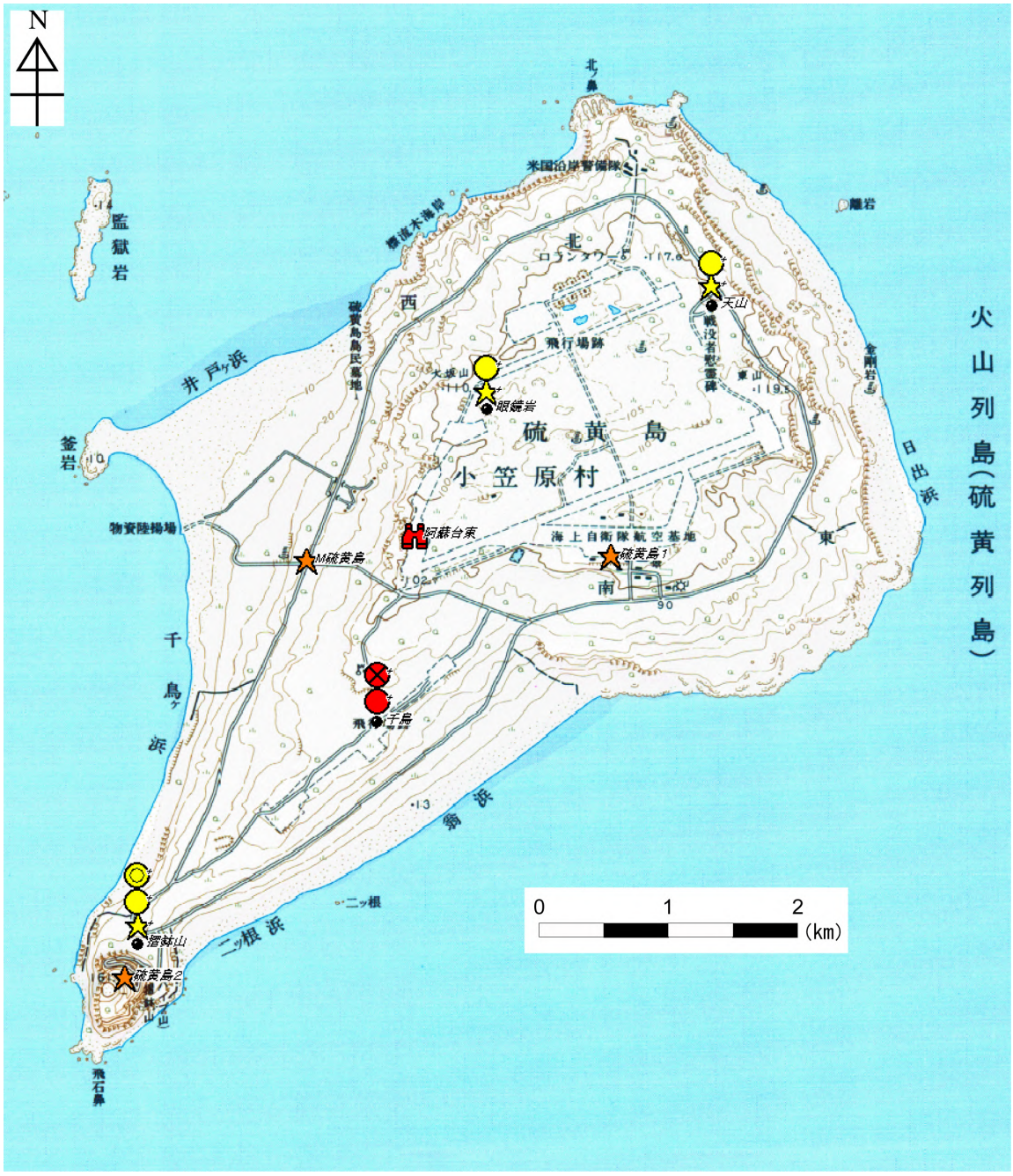
Information on Disaster Prevention

①Hazard Map

None

Monitoring Network

* 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 (Volcanic Islands) published by the Geospatial Information Authority of Japan was used.

Legend

(JMA)	(GSI)	(NIED)
seismometer(SP)	GPS	seismometer(SP)
infrasonic microphone		seismometer(broadband)
visual camera		GPS

Figure 74-11 Monitoring network.

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