

IV. Geological Study

1. Regional Geology and Physical Volcanology

Researches on various aspects of regional geology of Quaternary, Tertiary, and Cretaceous volcanic areas in Japan have been published since the previous report. Regional geological studies of Quaternary volcanoes in Japan were reported for Tyatya volcano (Nakagawa *et al.*, 2002a), Rausudake volcano (Miyaji *et al.*, 2000), Daisetsu volcano (Nakamura and Hirakawa, 2000), Rishiri volcano (Ishizuka, 1999), Hokkaido-Komagatake volcano (Okuno *et al.*, 1999), Osore volcano (Kuwabara *et al.*, 2001), Okiura caldera (Nozawa, 2001), Iwate volcano (Doi, 1999; 2000, Doi *et al.*, 2002), Hachimantai volcano (Ohba and Umeda, 1999; Takashima *et al.*, 2001), Toga volcano (Kano *et al.*, 2002), Chokai volcano (Ban *et al.*, 2001), Kurikoma volcano (Fujinawa *et al.*, 2001b), Aoso volcano (Toya and Ban, 2001), Shirataka volcano (Mimura and Kano, 2000), Adataro volcano (Fujinawa *et al.*, 2001a; Yamamoto and Sakaguchi, 2000), Bandai volcano (Chiba and Kimura, 2001), Nekoma volcano (Kimura *et al.*, 2001; Mimura, 2002), Sunagohara caldera (Mizugaki, 2000), Takahara volcano (Takashima, 1999), Kinunuma volcano (Yamamoto, 1999a), Shirouma-Oike volcano (Oikawa *et al.*, 2001), Yakedake volcano (Oikawa, 2002; Oikawa and Kioka, 2000; Oikawa *et al.*, 2000; 2002), Ontake volcano (Matsumoto and Kobayashi, 1999; Matsumoto Basin Collaborative Research Group, 2002), Fuji volcano (Takada, 2000a; Yamamoto *et al.*, 2002), Hakone volcano (Kobayashi, 1999; Mannen, 1999a; Mannen and Sugiyama, 2000), Higashi-Izu monogenetic volcanoes (Hasebe *et al.*, 2001; Shimada, 2000), Izu-Oshima volcano (Nakada *et al.*, 1999), Miyakejima volcano (Tsukui *et al.*, 2001), Daisen and Sambe volcanoes (Kimura *et al.*, 1999), Yufu-Turumi volcano (Fujisawa *et al.*, 2002; Saito *et al.*, 2000), Aso volcano (Baba *et al.*, 1999; Miyabuchi and Watanabe, 2000; Miyabuchi and Takada, 2002), Unzen volcano (Hoshizumi *et al.*, 1999; Shimao *et al.*, 1999; Tateyama *et al.*, 2002), Ojika-Jima volcano (Yamamoto, 2001), Aira caldera (Fukushima and Kobayashi, 2000; Sudo *et al.*, 2000), submarine volcano off the north-east of the Iriomote Island (Watanabe, 2000), and submarine Myojin-Sho caldera (Ueda *et al.*, 2001). Tephrostratographic studies have been reported for Late Pleistocene widespread tephra (Fujii *et al.*, 2001; Kawai and Miyake, 1999), Middle Pleistocene tephra (Suzuki, 2001; Yamamoto, 1999a), and Early Pleistocene tephra (Kataoka, 2001; Kataoka and Nakajo, 2002; Kataoka *et al.*, 2001; Nagahashi *et al.*, 2000; 2002; Satoguchi *et al.*, 1999; 2000). Regional geological studies of Pre-Quaternary volcanism were published for the Miocene high-Mg volcanism in SW Japan (Furukawa and Tatsumi, 1999; Tatsumi *et al.*, 2001), the late Neogene volcanism in SW Japan (Kamata, 2000; Kamata and Kodama, 1999), the Late Miocene alkalic volcanism in Oki-Dozen island (Tiba *et al.*, 2000) and Oki-Dogo island (Kobayashi *et al.*, 2002), the Pliocene-Pleistocene volcanism in NE Honshu (Umeda *et al.*, 1999), and the late Neogene volcanism in Hokkaido (Hirose and Nakagawa, 1999; Hirose *et al.*, 2000; Nakagawa *et al.*, 1999). Geological studies in foreign countries were published for the Tertiary volcanism in Sikhote Alin, Russia (Tatsumi *et al.*, 2000), the Quaternary volcanism in Philippines (Sudo *et al.*, 2000), the submarine structure of Hawaii (Lipman *et al.*, 2000; Naka *et al.*, 2002), and the Quaternary volcanism in Flores Island, Indonesia (Muraoka *et al.*, 2002; Takashima *et al.*, 2002).

Hazard maps have been prepared for Meakan volcano in 1999, Atosamupuri volcano in 2001, Esan volcano in 2001, Chokai volcano in 2001, Azuma volcano in 2001, Adataro volcano in 2002, Bandai volcano in 2001, Nasu volcano in 2002, Ontake volcano in 2002, and Yakedake volcano in 2002 by individual local governments. Total numbers of published volcanic hazard maps are 28 in Japan. Geologic maps (1:50,000) with explanation including Quaternary volcanoes have been published for Tonohetsuri caldera (Yamamoto, 1999b), Kenashi volcano (Yanagisawa *et al.*, 2001), Shirouma-Oike volcano (Nakano *et al.*, 2002), Tateyama volcano (Harayama *et al.*, 2000), Oe-Takayama volcano (Kano *et al.*, 2001), and Kirishima volcano (Imura and Kobayashi, 2001) by the Geological Survey of Japan.

Geological researches on historical eruptions were published for the 1707 Fuji eruption which was a dacitic-basaltic sub-Plinian eruption (Ui *et al.*, 2002a), the 1888 Bandai eruption which generated a phreatic density currents and a debris avalanche (Yamamoto *et al.*, 1999), the 1986 Izu-Oshima eruption which was a basaltic sub-Plinian fissure eruption (Mannen, 1999b), the 1990-95 Unzen eruption which produced a dacitic lava dome and numerous block-and-ash flows (Fujii and Nakada, 1999; Kaneko and Wooster, 1999; Kaneko *et al.*, 2002a; Miyabuchi, 1999; Nakada *et al.*, 1999; Saito and Suto, 2002; Ui *et al.*, 1999; Watanabe *et al.*, 1999a; 1999b), the 1996, 1998 and 2000 Hokkaido-Komagatake eruptions which were phreatic explosions (Hirose *et al.*, 2002; Nakagawa *et al.*, 2001), the 2000 Usu eruption which was a shallow dacitic intrusion with many phreatomagmatic to phreatic explosions (Kaneko *et al.*, 2002b; Koarai *et al.*, 2002; Miura and Niida, 2002; Nagai *et al.*, 2002; Nakada, 2001; Nakagawa *et al.*, 2002b; Ohno *et al.*, 2002; Suto *et al.*, 2002; Suzuki and Nakada, 2002; Takada *et al.*, 2001; Takagi *et al.*, 2002; Takarada *et al.*, 2001; 2002; Tomiya and Miyagi, 2002; Tomiya *et al.*, 2001; Ui *et al.*, 2000; 2002b; 2002c; Urai *et al.*, 2001; Yahata, 2002; Yamamoto, 2001; Yokoo *et al.*, 2002), and the 2000 Miyakejima eruption which started as a submarine basaltic flank eruption and was succeeded by caldera collapse with phreatomagmatic explosions and gigantic SO₂ emission (Geshi *et al.*, 2002a; 2002b; Kaneko *et al.*, 2001; Miyagi and Tomiya, 2002; Nakada *et al.*, 2001; Uto *et al.*, 2001).

Various studies on physical volcanology were reported since the previous report. Tamura *et al.* (2002) discussed the relationship between Quaternary volcanoes in NE Japan arc and hot fingers in the mantle wedge using seismic tomographic data. Tomiya (2000) estimated thermal effect of a magma chamber in the crust. Magma transport mechanism through dike system was examined by observation data of fissure eruptions (Takada, 1999), physical properties of magma (Takada, 2000b; Takeuchi and Nakamura, 2001), and field occurrences of dikes (Geshi, 2000; Wada and Aoki, 2002; Wada and Iwano, 2001; Wada *et al.*, 2000). Caldera formation processes were studied by Miura (1999, 2000) and Takada (2001). Ohba *et al.* (2002) showed effect of explosion energy and depth on the nature of explosion clouds by field experiments. Specific researches on debris avalanches were reported for field occurrences (Takarada *et al.*, 1999) and experiments

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