Future Geosites

7

There are many sites which deserve to be identified, managed and interpreted as geosites within the Jeju Island Geopark. Twenty-one sites have been identified for inclusion over the next 10–15 years (Fig. 7.1). An Action Plan will be developed to progressively formally incorporate these additional sites within the Jeju Island Geopark. Other geosites may be added from time to time as research demonstrates their values and the practicality of opening them to the public is assessed.

7.1 Dangsanbong Tuff Cone

Dangsanbong is a tuff cone situated on the western margin of Jeju Island. It has a horseshoe-shape morphology with an opening toward the north and a nested scoria cone at its center (Fig. 7.2). The crater rim is more than 900 m wide and as high as 148 m above present sea level. A geological study (Sohn and Park 2005) suggests that the tuff cone is one of the oldest volcanic formations in Jeju Island, overlain by later lava flows. The tuff cone is mainly composed of steeply inclined strata of lapilli tuff that are inward and outward dipping. The tuff cone strata are divided into two distinct stratal packages by a volcano-wide truncation surface (Fig. 7.3a). The lower stratal package (LSP) beneath the truncation surface consists almost entirely of steeply inclined and outward-dipping beds that dip generally between 20 and 30°. On the other hand, the upper stratal package (USP) consists of inward-dipping beds with their outward-dipping counterparts mostly removed by erosion. Contrasting lithofacies characteristics between these stratal packages (Fig. 7.3b, c) are interpreted to have resulted from a change in eruption style of Dangsanbong from a cone-forming to a ring-forming (surge-dominated to be more exact) eruption, probably associated with a volcano-wide collapse event (Sohn and Park 2005).

A wedge-like sequence of very poorly sorted, disorganized to very crudely stratified bouldery deposits named the Gosan Formation accumulated around the Dangsanbong tuff cone (Fig. 7.4). Overall reddish or brownish coloration of the formation as well as the overall structures and textures of the deposits suggests that the formation is the deposit of an ancient scree developed around the dissected Dangsanbong tuff cone. The quartz OSL age of the formation is 23.2 ± 1.0 ka (Cheong et al. 2007).

7.2 Chagui Island

Chaguido is a small island, about 0.16 km^2 in area, located off the western coast of Jeju Island (Fig. 7.5). The island comprises three main islets and dozens of small rocks. Although the island is not inhabited, it is renowned as an excellent fishing and diving point on Jeju Island. Although geological studies have not yet been carried out, the island is regarded as a promising geosite in the future because it provides excellent outcrops of all types of basaltic rocks, including steeply inclined-bedded lapilli tuff, reddish scoria deposits, agglutinates, lava flows, dikes, and reworked volcaniclastic sedimentary rocks (Fig. 7.6), suggesting complex monogenetic volcanism involving both magmatic and phreatomagmatic eruptions.

7.3 Biyang Island

Biyangdo is a small island, located off the northwestern coast of Jeju Island (Fig. 7.7). The island comprises a scoria cone with well-preserved morphology. The island is famous as a possible site of a historic eruption about one thousand years ago, although the assumption needs to be verified by further geological studies. The island is composed mainly of scoria deposits and agglutinates, which resulted from a Hawaiian eruption (Fig. 7.8). A strange rock formation, named Aegieopeundol with a meaning of a woman carrying a baby on the back, is found along the shore (Fig. 7.9). The rock formation, designated as a natural monument, is interpreted to be a hornito, which is a small opening or rootless vent that releases small quantities of lava when high pressure within a lava flow causes lava to ooze and spatter out.

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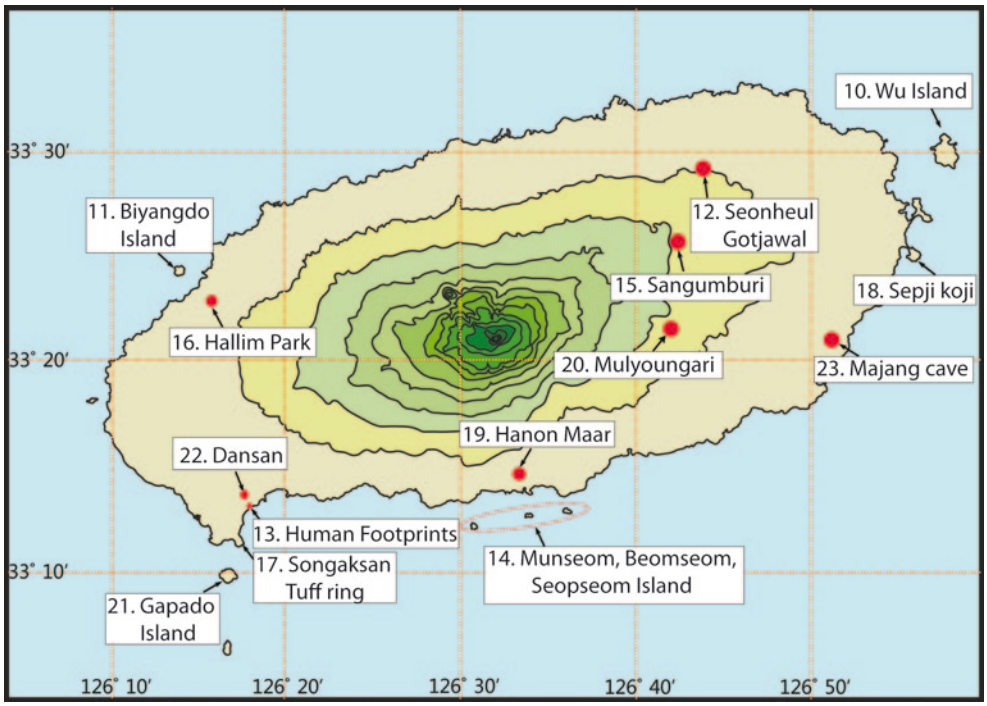

Fig. 7.1 Proposed geosties within the Jeju Island Geopark in the future

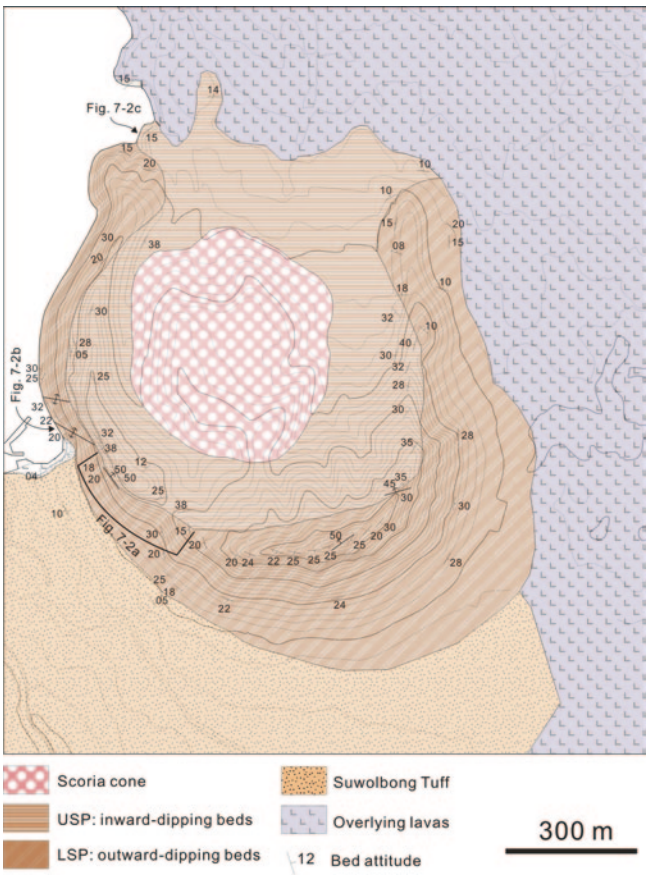

Fig. 7.2 Geological map of the Dangsanbong tuff cone with a nested scoria cone at its center

7.4 Sangumburi Crater

Sangumburi is a peculiar volcanic crater, which is distinguished from the other volcanic craters and edifices on Jeju Island. The crater rim is 31 m higher than the surroundings; the rim-to-rim width is 635 m; the diameter of the crater floor is about 300 m; the height from the crater floor to the rim is 132 m (Fig. 7.10). The crater has been known among Koreans as a 'maar' based on its morphology for many decades. The information boards within the Sangumburi Park as well as a number of books and websites also introduce the crater as the only one 'maar' on Jeju Island. Recent study shows, however, the area around the crater is composed only of lavas (Fig. 7.11). Lavas together with some clinker are exposed along the trails around the crater and on the inner wall of the crater, suggesting that there were only effusion of 'aa' lavas. No ejecta beds have been found, negating the possibility of explosive excavation of the crater by 'maar'-forming processes. The Sangumburi is therefore interpreted to be a pit crater formed by sinking or collapse of the surface surrounding a vent for lava.

7.5 Geomunoreum Scoria Cone

Geomunoreum is a fairly large scoria cone in the northeastern part of Jeju Island. The scoria cone has a horse-shoe shape due to break-through of the lava flows toward the northeast direction (Fig. 7.12). Lava flows from the scoria cone are believed to have flowed down the slope of Mt. Hallasan

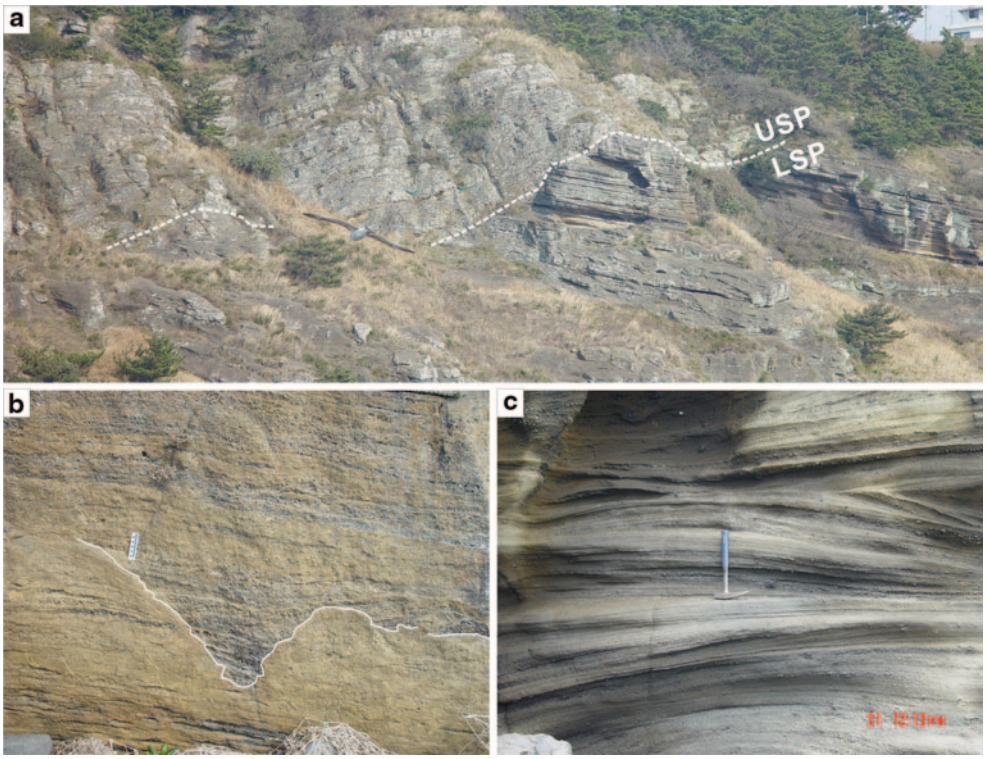

Fig. 7.3 Outcrop features of the Dangsanbong tuff cone. **a** A volcano-wide truncation surface between the upper and lower stratal packages (*USP& LSP*). **b** Thinly stratified lapilli tuff of LSP with a V-shaped chute at center, suggesting emplacement by grain flows with a short period of erosion. **c** Cross-stratified tuff of *USP*, suggesting emplacement by powerful pyroclastic surges

Fig. 7.4 A wedge-like sequence of scree deposits (*Gosan Formation*) derived from the Dangsanbong tuff cone and then later overlain by the tuff from the Suwolbong tuff ring

Fig. 7.5 A view of Chagui Island composed of three main islets and dozens of small rocks

Fig. 7.6 A coastal exposure of volcanic rocks at Chagui Island composed of steeply inclined-bedded lapilli tuff, reddish scoria deposits, agglutinates, lava flows, and dikes

in a north-northeast direction down to the coastline for about 13 km, forming a series of lava tubes, including Seonheul Vertical Cave, Bengdwigul Lava Tube, Bukoreumdonggul Lava Tube, Daerimdonggul Lava Tube, Mangjanggul Lava Tube, Gimnyeonggul Lava Tube, Yongcheondonggul Lava Tube, and Dangcheomuldonggul Lava Tube towards the sea (Hwang et al. 2005), which are mostly designated as national monuments. Because of the geological significance, the scoria cone was also designated as a natural monument in 2005. Pine trees, Japanese cedars, and Oriental arbor vitaes are growing over the scoria cone, making a dense forest. There are also a number of historical sites within the scoria cone, which originated from the Japanese colonial period (Fig. 7.13).

7.6 Dusanbong Tuff Cone

Dusanbong is a relatively old tuff cone in the eastern part of Jeju Island (Fig. 7.14). It comprises a scoria cone within its crater and has an opening toward the west, which acted as an outlet of a lava flow. The outer rim beds of the tuff cone were mostly removed by erosion probably during the last interglacial. Nevertheless, the diameter of the volcanic edifice exceeds 1.2 km, suggesting that it was originally a relatively large tuff cone. The overall stratigraphy of the volcano is almost identical to that of the Songaksan tuff ring and the Udo tuff cone, suggesting an eruption that changed in eruption style from phreatomagmatic to magmatic. Dusanbong recently became a famous site because it is the starting point of the very popular Olle tracking courses on Jeju Island and because of the breathtaking sceneries from the top of the tuff cone (Fig. 7.15).

7.7 Udo Tuff Cone (Someorioreum)

Udo is a small island, about 3×4 km across, located ~3 km east of Jeju Island (Fig. 7.16). It comprises a tuff cone, a younger nested spatter cone, and overlying basaltic lava

Fig. 7.7 An aerial view of Biyang Island composed of a scoria cone

Fig. 7.8 An outcrop of crudely bedded agglutinate on Biyang Island

Fig. 7.9 A strange rock formation, named Aegieopeundol, which is interpreted to be a hornito

Fig. 7.10 An aerial view of the Sangumburi Crater

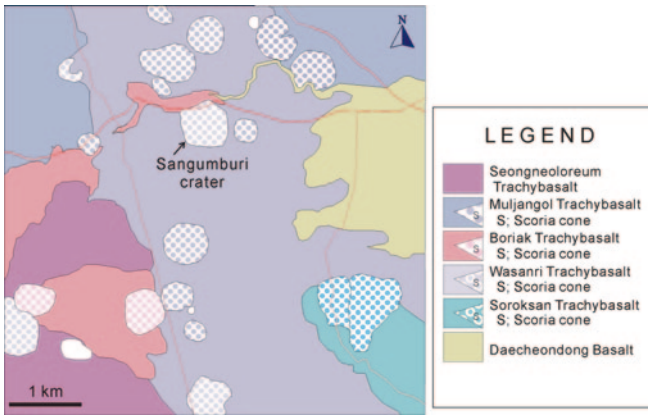

Fig. 7.11 A geological map of the area surrounding the Sangumburi Crater

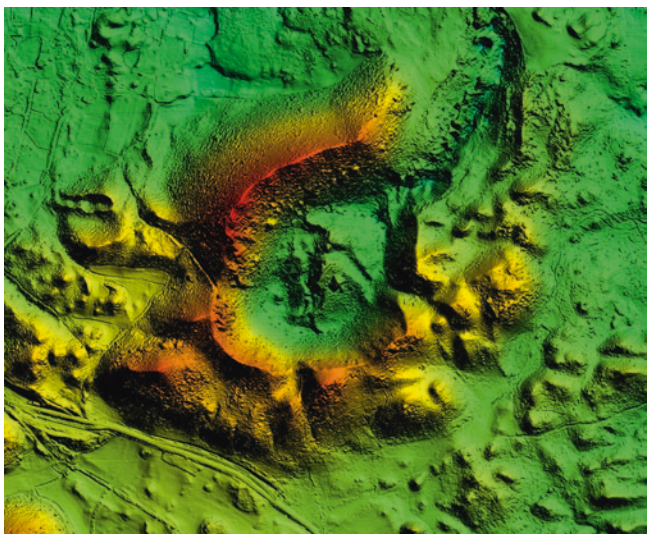

Fig. 7.12 Digital elevation model of the Geomunoreum scoria cone

shield. Dating of the lava shield rocks gave a K–Ar age of 114 ± 3 ka, whereas dates of core samples gave $^{40}Ar/^{39}Ar$ ages of 102 ± 69 and 86 ± 10 ka (Koh et al. 2005, 2008). The tuff cone, named the Someorioreum, is horseshoe-shaped with a rim-to-rim width of 800–900 m and a height of 132 m. The tuff cone generally comprises steeply inclined (20–30°) beds of lapilli tuff and tuff that dip radially away from the vent (Fig. 7.17). A detailed sedimentological study of the tuff cone reveals that it has formed by a Surtseyan-type eruption, which became drier towards the end of the eruption (Sohn

Fig. 7.13 A Japanese encampment within the Geomunoreum scoria cone, which was built during the Japanese colonial era

and Chough 1993). The deposition was mostly accomplished by grain flows of lapilli and blocks in addition to airfall of finer-grained tephra. Absence of marine-reworked deposits suggests that the majority of the tuff cone was constructed subaerially, although the submerged part may have formed underwater. Common inclusion of acidic volcanic rock fragments (rhyolite and welded tuff) that were most likely derived from the Cretaceous volcanic basement rocks in the eastern Jeju area suggests that the level of hydrovolcanic explosions and the depth of country rock excavation reached more than 300 m below the present sea level (Sohn 1996). Recent high-resolution geochemical study (Brenna et al. 2010) suggests that the eruption of Udo began with relatively evolved alkali magma. The magma became more primitive over the course of the eruption of the tuff cone, but the last magma to be explosively erupted had shifted back to a relatively evolved composition. A separate sub-alkali magma batch was subsequently effusively erupted to form a lava shield.

Fig. 7.14 A view of the Dusanbong tuff cone from the south

Fig. 7.15 A view of the eastern part of Jeju Island from the top of the Dusanbong tuff cone, characterized by numerous scoria cones

Fig. 7.16 An aerial view of Udo Island from the south

Fig. 7.17 An excellent coastal exposure of the tuff cone deposits overlain by basaltic lava flows and reworked volcaniclastic deposits at Udo Island

7.8 Oedolgae

Oedolgae is a 20 m high sea stack near the south-central coast of Jeju Island (Fig. 7.18). It is composed of trachytic lava flow that is hundreds of thousand years old. The sea stack has a legend of a woman who turned into a stone statue after waiting for her fisherman husband for a long time. The Oedolgae coast also has excellent geological exposures of peculiar volcanic rocks that are related to intrusion of magma, mixing of magma and unconsolidated sediments, and escape of heated steam and gas from the wet sediment (Fig. 7.19).

Fig. 7.18 A view of the Oedolgae sea stack at the south-central coast of Jeju Island

Fig. 7.19 An exposure of peculiar volcanic rocks near the Oedolgae sea stack that formed in association with intrusion of magma into wet and unconsolidated sediments

7.9 Songaksan Tuff Ring

The Songaksan is a tuff ring located at the southwestern margin of Jeju Island (Fig. 7.20). It comprises a scoria cone and a ponded lava flow in its crater, (Figs. 7.21, 7.22). The rim beds of the tuff ring are up to 80 m thick and extend northward and northwestward for more than 2 km. The rim-to-rim width is estimated to be about 7–800 m. The tuff ring comprises mainly thin-bedded and gently dipping tuff with abundant megaripple bedforms emplaced by pyroclastic surges (Chough and Sohn 1990). The deposits are composed of mainly sideromelane/tachylite ash and some poorly vesicular lapilli that have blocky equant shapes, as well as considerable amounts of accidental components, which suggest deep excavation (more than ~300 m) and incorporation of abundant country rocks by hydroexplosions. The lithofaci-

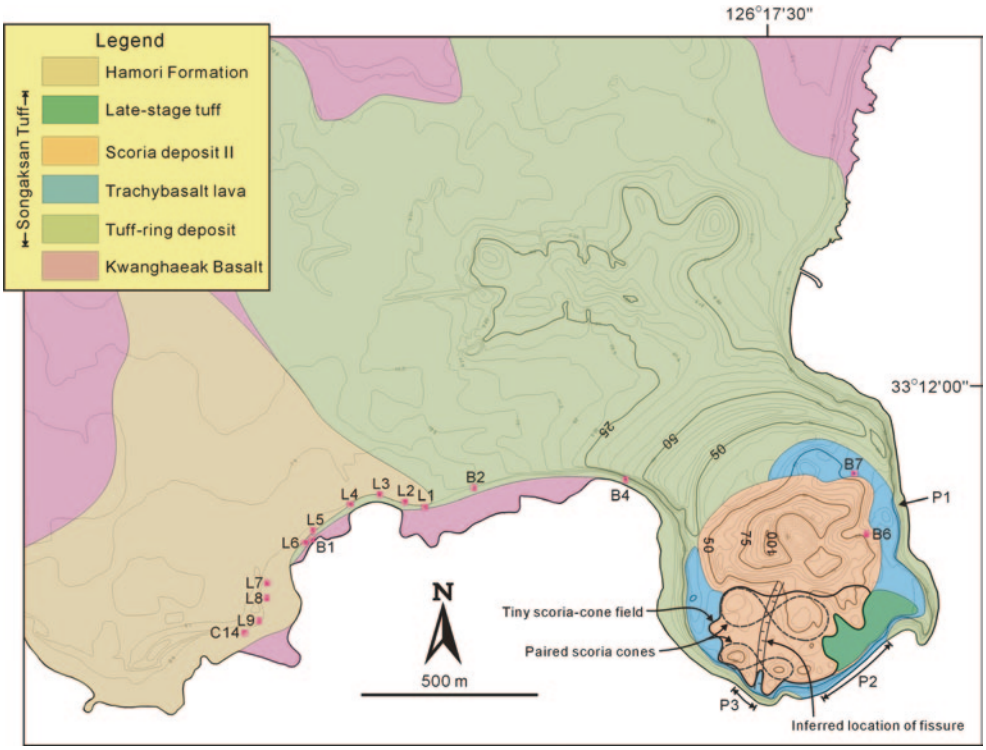

Fig. 7.20 A geological map of the Songaksan tuff ring located at the southwestern margin of Jeju Island

Fig. 7.21 A distant view of the Songaksan tuff ring from the west, consisting of a tuff ring, a nested scoria cone and a ponded lava flow

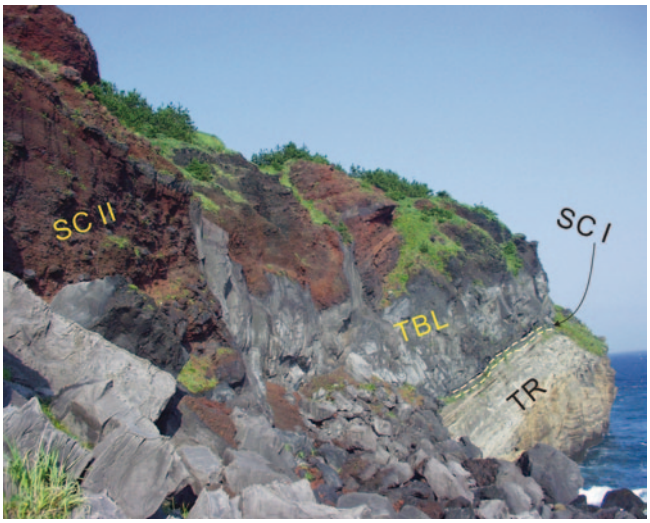

Fig. 7.22 A seacliff exposure of the volcanic rocks at the Songaksan tuff ring. *TR* = tuff ring, *SC I* = scoria deposit I, *TBL* = trachybasalt lava, *SC II* = scoria deposit II

es characteristics of the Songaksan tuff ring are generally similar to those of the Suwolbong tuff ring. There are, however, several subtle differences in facies characteristics, which suggest that the pyroclastic surges at the Songaksan tuff ring were relatively wetter and less energetic than those of the Suwolbong tuff ring (Sohn 1996).

7.10 Dansan Tuff Ring/Cone

Dansan is an old volcanic edifice located in the southwestern part of Jeju Island. It consists of two differently oriented ridges that have different lithofacies characteristics and bed attitudes (Fig. 7.23). The northern ridge is sharp-crested, arcuate in plan and rises more than 100 m above the surrounding lavas whereas the southwestern ridge has a relatively low relief, protruding about 40 m above the surrounding lavas. The overall characteristics of Dansan, composed of two different rim beds indicating different source vent directions,

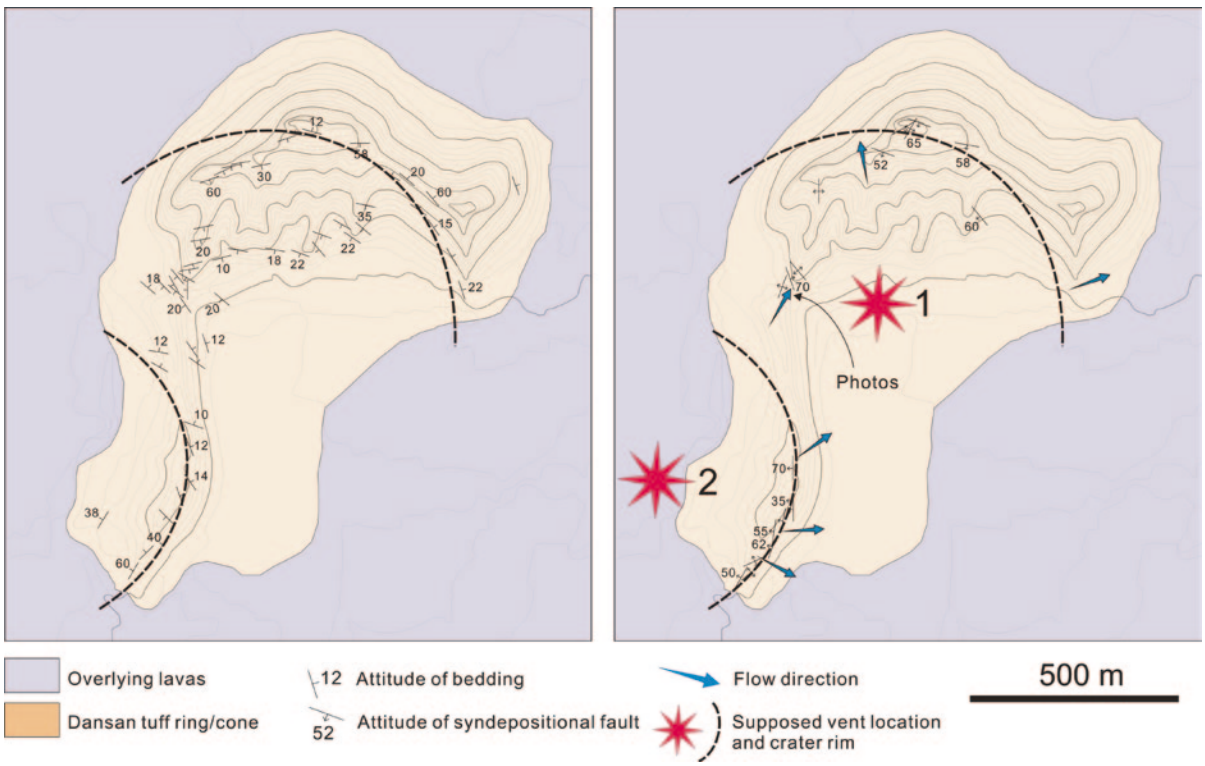

Fig. 7.23 A geological map of the Dansan tuff ring/cone complex at the southwestern part of Jeju Island

Fig. 7.24 An outcrop showing the contact relationship between two rim deposits at Dansan, which originated from different source vents

Fig. 7.25 A view of the Seopjikoji promontory, consisting of a dissected scoria cone and overlying lava flows

Fig. 7.26 An outcrop of the Seopjikoji coast, showing agglutinated scoria/spatter deposits and a small dike

suggest that the volcano originally comprised a pair of juxtaposed craters probably with a figure eight configuration in plan. The contact relationship between the two rim deposits (Fig. 7.24) shows that they formed sequentially (from vent 1 followed by vent 2) in response to migration of the active vent with an intervening erosional break. The contrasting lithofacies characteristics between the two rim deposits suggest that there was a significant change in the eruption style associated with the vent migration from a cone-forming (fallout-dominated) to a ring-forming (surge-dominated) eruption (Sohn and Park 2005).

7.11 Seopjikoji

Seopjikoji is a small promontory at the eastern margin of Jeju Island and to the south of the Ilchulbong tuff cone (Fig. 7.25). This area was one of recent volcanic centers on Jeju Island, comprising a scoria cone and several lava flows. These volcanic formations were dissected by marine waves, exposing excellent outcrops of bedded scoria deposits, agglutinates, dikes, and a variety of lava flows (Fig. 7.26) and generating lovely coastal landscapes. This area has therefore been used as the shooting site of a number of films and TV dramas and attracts millions of visitors every year.

Fig. 7.27 A view of the Hanon Crater