THE EASTERN SPUR OF JAVA AND MADURA

The physiographical belts, distinguished in Chapter I, will also be used for the tectonical analysis, as they also represent the structural units.

These belts are from South to North:

1. Southern Mts.
2-5. Solo Zone, subdivided into the Blitar Sub-zone, the Solo Zone *sensu stricto* and the Ngawi Subzone.
6. Strait of Madura.
7. Island of Madura.

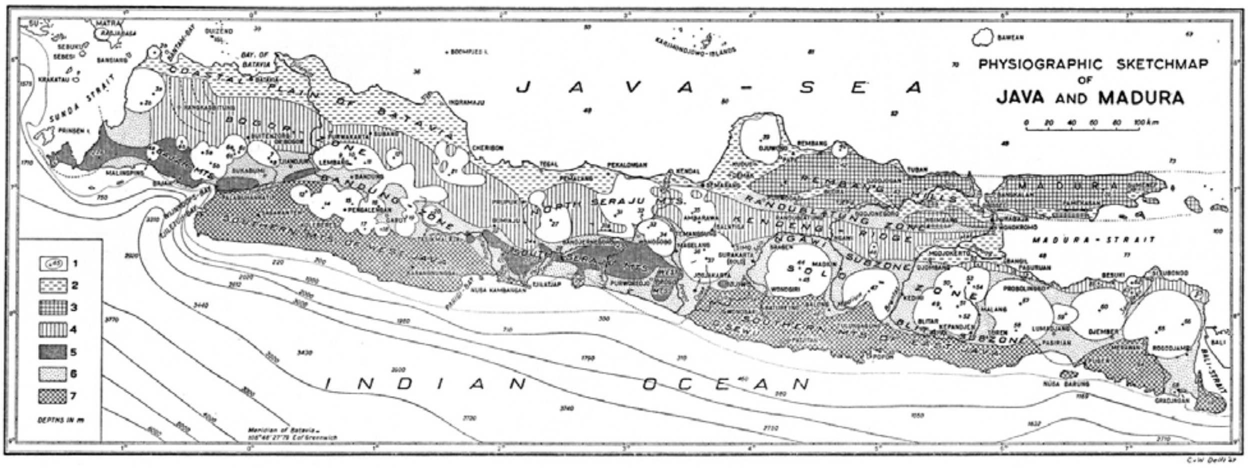

FIG. 256 a. *Physiographic sketchmap of Java and Madura.*

Legend of fig. 256 a:

1. Quaternary volcanoes.
2. Alluvial plains of northern Java.
3. Rembang-Madura anticlinorium.
4. Bogor-, North-Seraju-, and Kendeng-anticlinorium.
5. Domes and ridges in the central depression zone.
6. Central depression zone of Java, and Randublatung Zone.
7. Southern Mountains.

Numbers on the map: 1-Pajung on the Udjungkulon Peninsula, 2a-Hondje Ridge, 26-Gede (595 m), 3a-Karang, 36-Pulasari, 4a-Malang, 46-Endut (1,297 m), 5a-Halimun (1,929 m), 5£-Halimun (1,750 m), 6a-Gagak, 66-Endut (1,474 m), 6c-Salak, 7-Pangrango, 8-Gedeh (2,958 m), 9-Burangrang, 10-Tangkuban Prahu, 11-Bukittunggul, 12-Tampomas, 13-Kendeng (1,852 m), 14-Patuha, 15-Malabar, 16-Guntur, 17-Papandajan, 18-Tjikorai, 19-Galungung, 20-Sawal, 21-Tjareme, 22-Madjenang, 23-Segara Anakan, 24-Adjibarang, 25-Kebanaran, 26-Djatilawang, 27-Slamet, 28-Banjumas, 29-Karangbolong Mts, 30-Midangan, 31-Rogodjembangan, 32-Dieng, 33-Sundoro, 34-Sumbing, 35-Ungaran, 36-Merbabu, 37-Merapi, 38-Panggung (779 m), 39-Muriah, 40-Lasem, 41-Gading (535 m), 42-Butak (679 m), 43-Tungangan 491 m), 44-Lawu, 45-Djobolarangan (2,298 m), 46-Gembes, 47-Wi!is, 48-Pandan, 49-Kelud, 50-Andjasmoro, 51-Kawi, 52-Butak (2,868 m), 53-Welirang, 54-Ardjuno, 55-Penanggungan, 56-Semonkrong, 57-Tengger, 58-Seme-ru, 59-Lamongan, 60-Ijang, 61-Lurus, 62-Ringgit, 63-Beser, 64-Betiri (1,223 m), 65-Raung, 66-Merapi (Tdjen), 67-Baluran, 68-Tjapil, 69-Biambangan.

1. THE SOUTHERN MOUNTAINS

The Southern Mountains consist of volcanic deposits of the "Oid-andesites" (arid-intermediary-basic, calc-alkaline effusive rocks and ejectamenta) with intercalations of *Lepidocyclina*-bearing limestones of lower- to middle-miocene age. The Merawan granite-batholith and its dike injections are intrusive into this series. Moreover, there are extensive formations of reef-limestone (South of Malang, in Nusa Barung, the surroundings of Puger, the Blambangan Peninsula) which are younger than the batholithic intrusions. These limestones are probably the equivalent of the Wonosari Limestones in the Southern Mts of East Java, which are considered as the upper part of the Middle Miocene (T.f_3).

The intrusion of the Merawan batholith is placed in the Middle Miocene (presumably T.f_2), and caused a propylitization and some mineralization of the "Old-andesite" series. According to the author (1938 c) this intrusion was formed by granitization of the Old-andesite Formation. The metasomatic emplacement reached a level of only 1-2 km below the surface. The granites invaded the very cores of the preceding Old-andesite volcanoes. The minerals of the metamorphic aureole belong to the epizone (epidote, quartz, sericite, chlorite, pyrite, and the like). (See fig. 257).

After the formation of the upper-miocene limestones a regression of the sea took place. The area remained slightly above sealevel till the Pleistocene; then it was elevated and tilted to the South by arching up of the Java geanticline. The Southern Mts form the southern flank of the latter. The top part of the Java geanticline sank down with respect to its South flank, as was already pointed out for Bali and Lombok (see fig. 214), forming an axial depression, called Solo Zone.

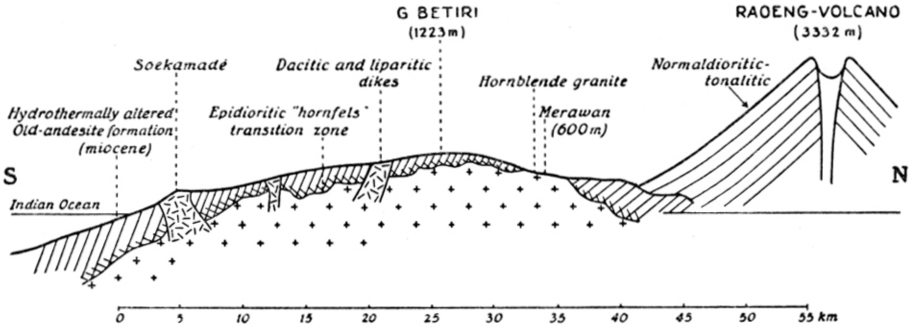

FIG. 257. *Section of the Southern Mts, South of the Raung volcano.* (From VAN BEMMELEN, 1938 C, fig. *2,* p. 9)

2. THE SOLO ZONE

In the Solo Zone, the tertiary formations are covered by a number of quaternary volcanoes.

This young volcanism started in the Upper Pleistocene or the upper part of the Middle Pleistocene according to the observations in the Ratji anticline, South of Surabaja (see fig. 290).

The enormous volume of young volcanic eruption products has been brought to the surface in some hundred thousands of years at the most.

The axial depression of the geanticline of Java might be explained by this rise of the magma to the surface, which caused caving and subsidence of the crustal roof. The amount of magma, brought to the surface in this zone in the course of a few hundred thousands of years can be estimated at 40 cb. km per kilometre of its axis.

If this removal of material from the chambers by volcanic eruptions was not counterbalanced by the ascent of fresh magma from deeper parts of the underlying asthenolith, the roof of these chambers would have sunk down, interchanging its position in respect to the sealevel with the newly built volcanic structures.

However, it will appear from observations in the westward extension of the Solo Zone that crustaf subsidence can only partially be explained by such a process. Also antithetic block movements occurred, owing to northward slipping of the top part of the geanticline, and resulting in the compression of the contents of the adjacent North Java trough. The young volcanic complexes in the Solo Zone are for the greater part younger than this collapse ofthegeanticlinal vault. They are the result of the continued ascent and upward pressure of the underlying magma.

3. BLITAR SUBZONE

This belt is the physiographic depression between the Southern Mts and the young volcanoes in the Solo Zone *(sensu stricto).*

This depression reaches the South coast in those places where the South flank of the Java geanticline disappears below sealevel (see fig. 256a, and fig. 255 on pl. **31**). It can be traced eastward into the lowlands of Bali (Denpassar) and Lombok (Mataram).

4. SOLO ZONE *(sensu stricto)*

The central part of the Solo Zone in the eastern spur of Java is occupied by a series of young volcanic complexes; viz. from East to West; the Idjen complex (with the active Kawah Idjen and Raung cones), the Ijang complex, the Lamongan complex, and the Tengger-Semeru complex.

The **Idjen complex.** An older (presumably young-pleistocene) volcanic cone forms the northern part of the Idjen complex; its southern side consists of a crescentic caldera depression (Kendeng ridge and Idjen Plateau). The Idjen Plateau is bordered to the South by an ENE-WSW trending row of young volcanoes (Merapi, Rante, Pendil, Raung).

This row of young volcanic cones is probably situated on a ENE-WSW trending fissure, through which the magma could reach the surface.

The presence of such fissures is also indicated by the deep rent or sector-graben in the West flank of the Raung. A sector of this cone was pushed out, possibly aided by explosions, and formed an enormous landslide of 60 km length (NEUMANN VAN PADANG, 1939; see also Chapter III A, and fig. 56). Megalithic remains, found in the neighbourhood, are probably older than this-mountain slide.

The **Ijang complex** has a peculiar volcano-tectonic structure. The basal (? upper-pleistocene) Ijang volcano is torn apart along a great N-S rift, slightly concave to the West. The eastern escarpment of this rift runs across the Malang (2,008 m), Kukusan (2,200 m), and Tjemorokandang (2,223 m), and the western one extends across the Sahing (2,103 m) and Pinggang (2,286 m). In the central part of this rift volcanic activity continued (in the Holocene), building up the younger cones of the Argopuro (3,088 m), Semeru (2,947 m), Pandu (2,787 m), Tamankring (2,626 m), and Taman Hidup (1,968 m).

Moreover, on the eastern side of the older volcanic structure some block-faulted parts can be distinguished, bordered by NW-SE trending faults (Krintjing, 2,773 m; Saing, 1,608 m).

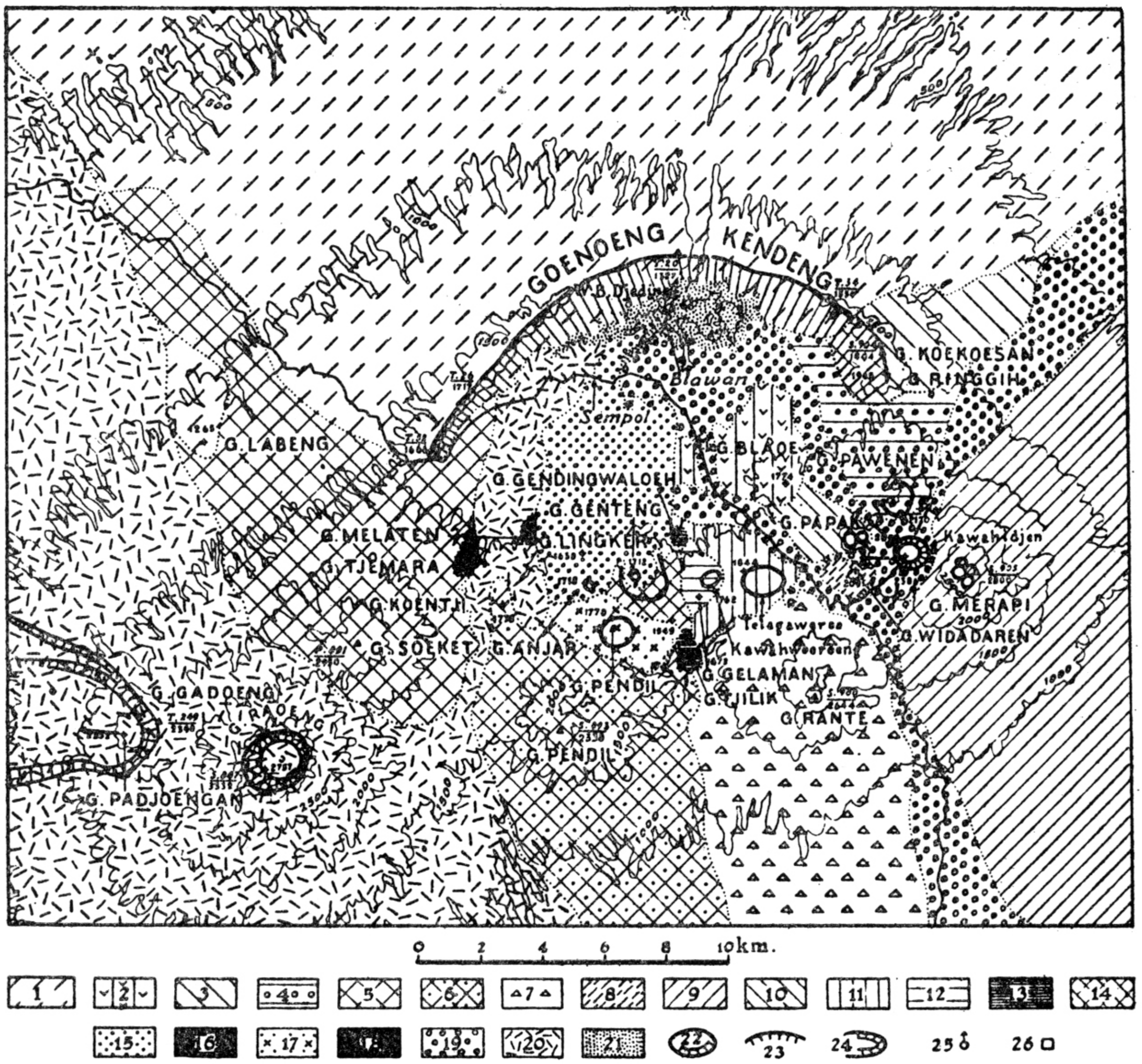

FIG. 258. *Geological sketchmap of the Idjen volcano-complex.* (From VAN BEMMELEN, 1943, fig. 41, p. 104)

Explanation of fig. 258.

Pre-caldera voicanism (Pleistocene)

1. Northern slope of the Old Idjen volcano with the rim of the Kendeng Caldera (G. Kendeng 1,717 m).
2. G. Blau, sagged block, belonging to the Old Idjen volcano and situated in the Old Idjen Caldera (1,774 m).
3. G. Kukusan (1,994 m) and G. Ringgih (1,965 m), two parasitic volcanoes, situated on the eastern end of the Kendeng Caldera rim and probably older than the formation of the Idjen Caldera.

Oldest post-caldera voicanism

4. G. Pawenen (2,123 m) — on the eastern side of the Idjen Caldera.
5. G. Suket (2,950 m) — on the SW side of the Idjen Caldera.
6. G. Pendil (2,338 m) — on the southern side of the Idjen Caldera.
7. G. Rante (2,b64 m) — on the southern side of the Idjen Caldera.
8. G. Widodarcn — on the SE side of the Idjen Caldera.

Subrecent voicanism outside the Idjen Caldera

9. G. Merapi (2800 m).

Subrecent (prehistoric) voicanism inside the Idjen Caldera

10. G. Papak (2,099 m).