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Notes and Comments

Geological hazards maps of Indonesia

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Abstract: Some geological hazards maps and related data of Indonesia are introduced here. They include base map, landslide susceptibility map, seismotectonic map, volcanic hazard map and related geological hazard information.

1. Geological hazards map of Indonesia

The geological hazards map of Indonesia is presented in scale 1:2,000,000 with figures and symbols or their combined. The information such as condition, situation, interpretation of geological hazards is described in the form of an margin explanation.

1.1 Base map and geological hazard information

Base map uses the topographic and bathimetric map of 1:2,000,000 scale, sheets 5 and 6 compiled in the framework of resources assessment program by IUGS-CCOP-CPMP. Projection Lambert azimuthal equal-area; center point 1200 E and 150 N. Topographic contours and bathimetry in meters.

The geological hazards map covers information of geology, seismotectonics, volcanos and landslide (symbol included. See Fig.1)

*The geological information shows data of Quaternary rock distribution, major structures and bathimetry.

*The seismotectonic information includes earthquake epicentre (M 5), focal volcanism, active faults and tsunami.

*Volcano information consists of active volcano distribution, forbidden and danger area, lahar pocket distribution and ash distribution of volcanic eruption. The volcano observatory is also presented.

*Landslide information covers areal potential, susceptibility of landslide and the distribution of landslide.

The geological data of Quaternary rocks are compiled from the geological map of Indonesia scale 1:1,000,000 with simplifying. The abbreviation and colour of lithology units are explained as mention in the CCOP geological map of Southeast Asia.

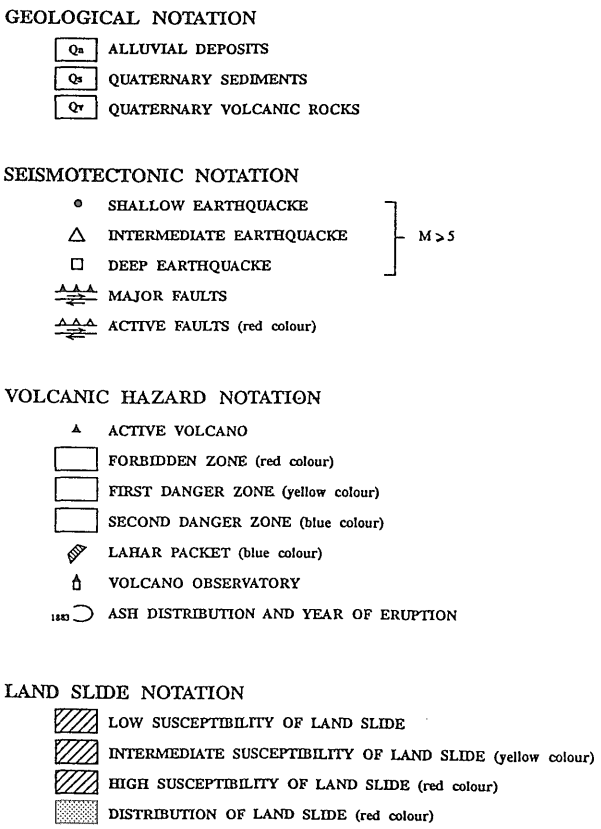

Fig. 1 Symbol of geological hazard map

1.2 The addition of geologic data (Index maps included)

*Geological map of Jawa and Madura islands scale 1: 100,000 has already published 58 sheets (100%)

*Geological map of outside Jawa and Madura islands scale 1:250,000 has already published 162 sheets (90. 5%)

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Keywords: Indonesia, geological hazard map, landslide susceptibility map, seismotectonic map, volcanic hazard map

*Compilation of geological map scale 1:1,000,000 results 14 sheets have already published (88%)
*Compilation of geological map scale 1:5,000,000 has already published 1 sheets (100%)
(Fig. 2, 3 and 4)

1.3 The progress

*Geological map 1:2,000,000 includes 2 sheets and geological notation (alluvial deposit, Quaternary sediment and Quaternary volcanic rock).

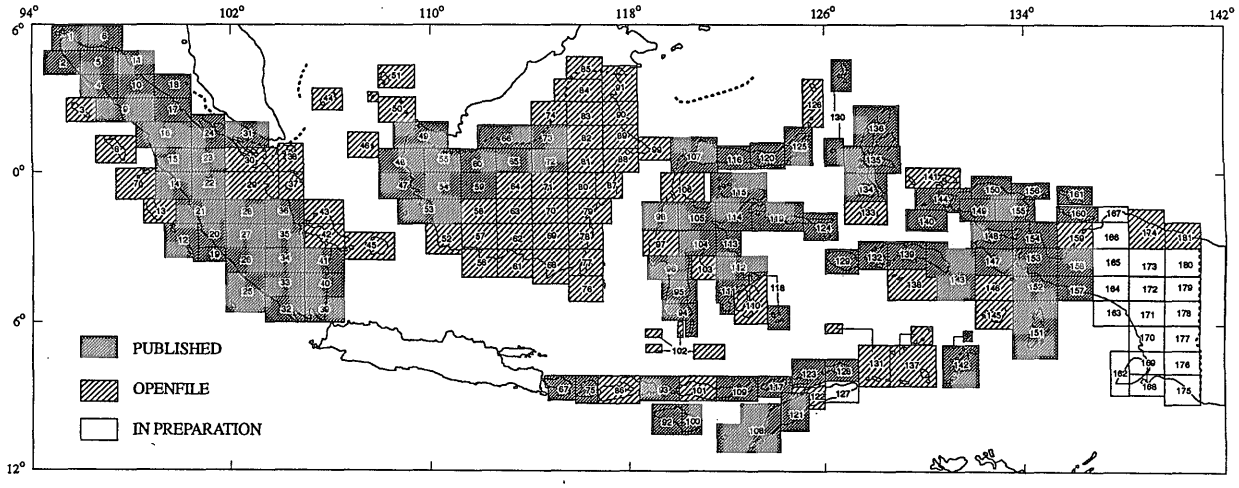


Fig. 2 Status of geological maps of Java-Madura, scale 1: 250,000, March 1994

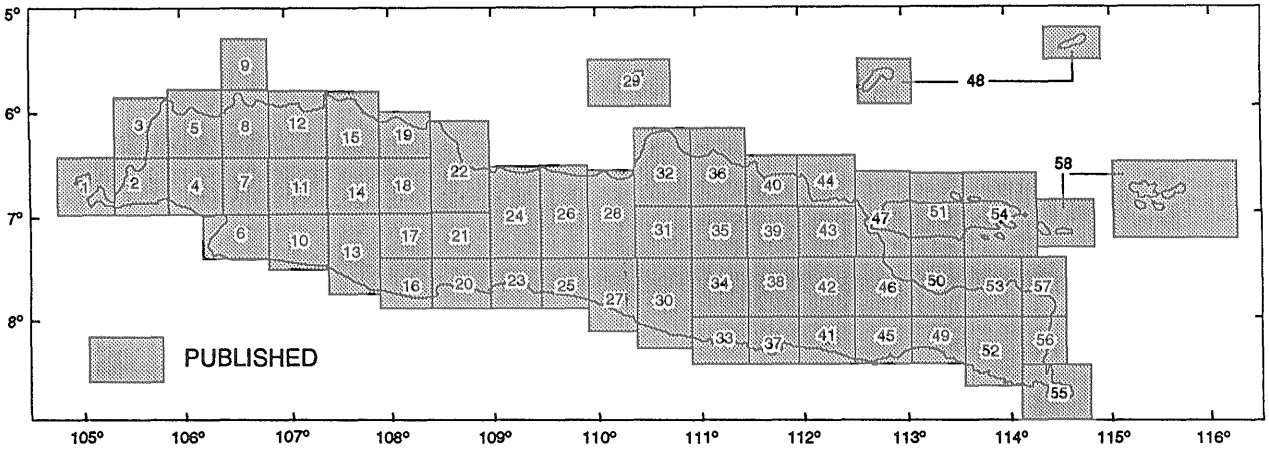


Fig. 3 Status of geological maps of Java-Madura, scale 1: 100,000, March 1994

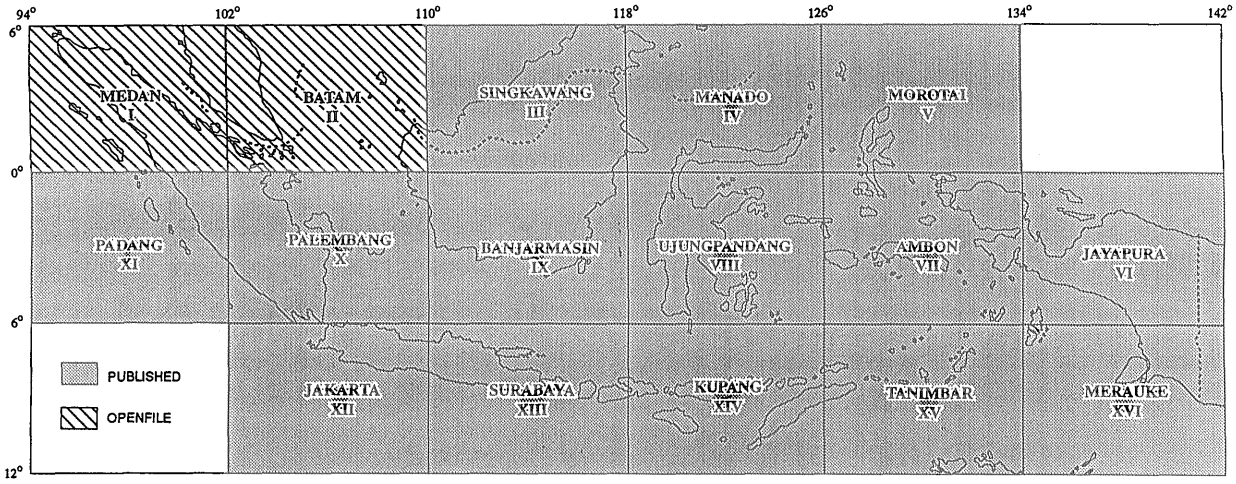


Fig. 4 Status of geological map of Indonesia, scale 1: 1,000,000, March 1994

2. Landslide susceptibility maps

This map shows the areas of susceptibble to landsliding. The map has been constructed using a geological map; inventory of landslides; a slope map; and soil and rock properties. The map is presented in scale 1: 100,000 and is designed for public as simple, easily understood statement on the susceptibility of specific areas to landsliding.

2.1 Landslide susceptibility zone

Landslide susceptibility zone is determine by index of local landslide occurrences on each lithologic unit in certain slope interval and slope stability analaysis. Parameters applied for considering the degree of susceptibility are based on factors causing the occurrence of landslide, i. e.:

Geology : physical and engineering properties of rock and soil, stratigraphy and rock structure,
Morphology : steepness of the slope,
Rainfall : intensity and duration of rainfall,
Landuse : landuse practice and vegetation cover,
Earthquakes : intensity of earthquakes.

(Figs. 5 and 6)

(1) Zone of very low susceptibility to landslide

The degree of susceptibility to landside is very low. The zone was rarely or never been subjected to landslid. There is no landmark of old or new landslide found in this zone, except on the small area on the river side.

The area is mostly flat to gentle undulating areas with natural slope less than 15% (8.5), and the slope is not formed by landslide deposits, filling material or plastic and swelling clay.

(2) Zone of low susceptibility to landslide

The zone has low susceptibility of landslide evidences. Landslides rarely occur unless the slope is disturbed, and old landslides have been stabilized during the past period. Small landslide my occur, especially on the river side of gulley.

Interval of the natural slope is gentle (5-15%) to steep (30-50%), depending on the physical and engineering properties of rock and soil forming the slope. On the steep slope area, slope is mostly composed of rock with thin soil, and covered by dense vegetation in the form of forest or tea plantaion.

(3) Zone of moderate susceptibility to landslide

The zone has moderate susceptibility to landslide evidences. Landslide may occur in this zone, especially along the river side, scarp, road cut, or the slope to be disturbed. Old landslides may be activited especially when induced by high rainfall or strong erosion process.

Interval of natural slope is gentle (5-15%) to very steep (more than 70%), depending on the physical and engineering properties of rock and soil forming the slope. The slope is mostly covered by poor to very poor vegetation.

(4) Zone of high susceptibility to landslide

The zone has high degree of susceptibility to landslide. In this zone landslides occur very frequently. Old and new landslides still occur induced by high rainfall or strong erosion process.

Interval of the natural slope is moderate (30-50%) to very steep (more than 70%), depending on the physical and engineering properties of rock and soil forming the slope. The slope mostly has no cover vegetation.

2.2 The progress (Index map included)

Map of susceptibility to landslides, scale 1:100,000. The activity of landslide susceptibility mapping has been intensively done since 1989, and 10 sheets of map have been intensively done since 1989, and 10 sheets of map have been finished and 6 of those have been published. (Fig.7)

3. Seismotectonic maps - seismic hazard zoning maps

This kind of maps are prepared based on the geological conditioms and baseline data of recorded earthquake occurrence presented in scale 1:250,000. This map provides information about the geographicad location and space distdbution of the earthquakes ground rupturing, ground faulting, active faults, and liquefaction distributions. The seismotectonic maps is very useful for regional development planning (macrozoning).

Location of seismotectonic maps will cover the twenty five area in Indonesia which was classified high risk in seismic hazard (Figs. 8 and 9)

This map consists three important informations as follows:

(1) Geology and topography showing morphology and the general geology of the area, with lithologic and physical properties of the rocks against landslide susceptibility.

(2) Isoseismal and structure map showing the epicenter and magnitude of seismics generated in the areas. Information of neotectonics express the recent geologic evidence related with the seismic events such as landslides, folding, active fault, subsidence, fracture, failure and liquefactions.

(3) Geographic information showing the infrastructure (road, high way, bridges, health facilities); province and district borderline and important city, village, and rivers in the area. In addition the density of population of the area from the recent statistic national record.

The progress (Index maps included)

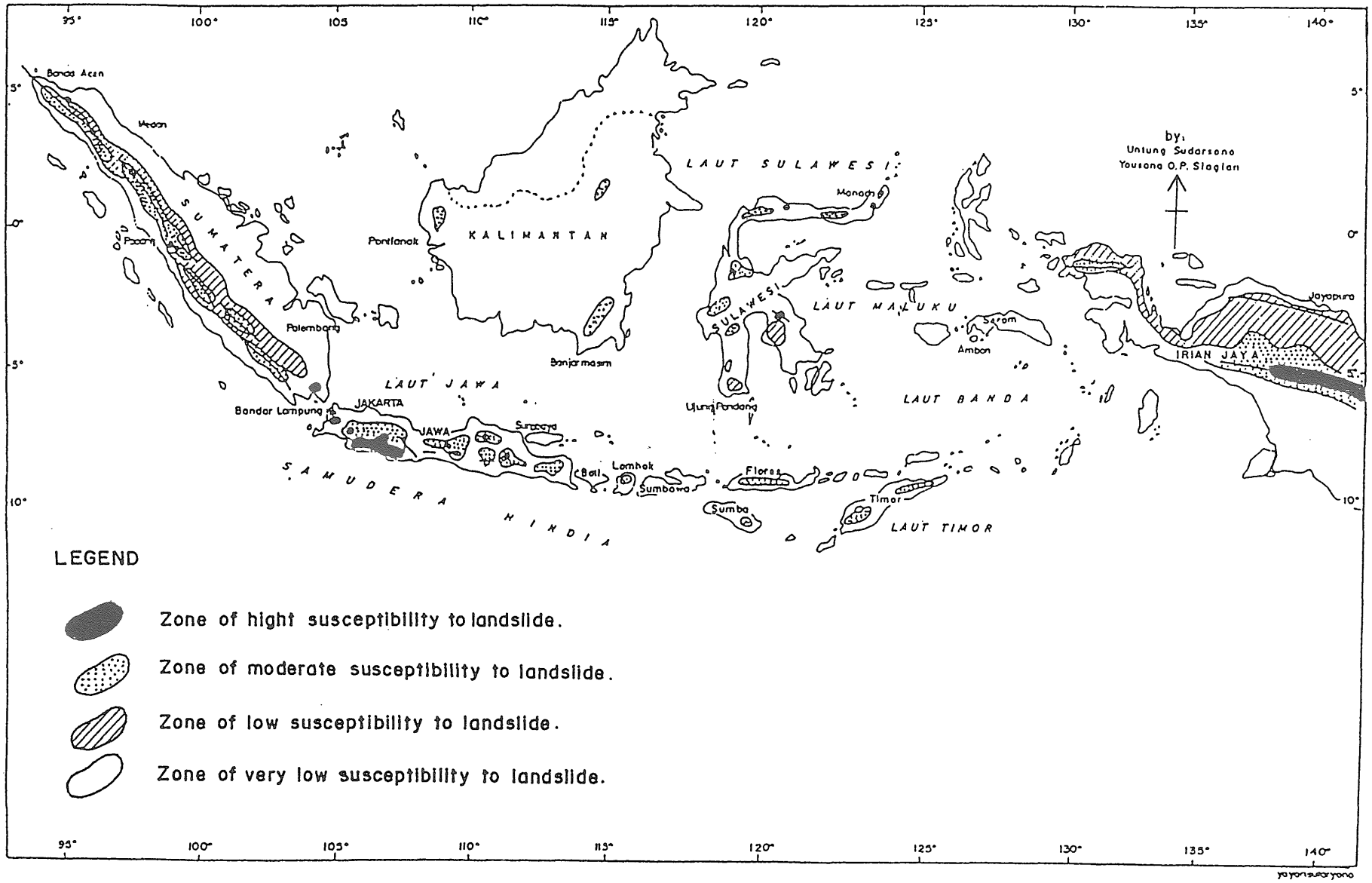


Fig. 5 Map of susceptibility to landslide, Indonesia

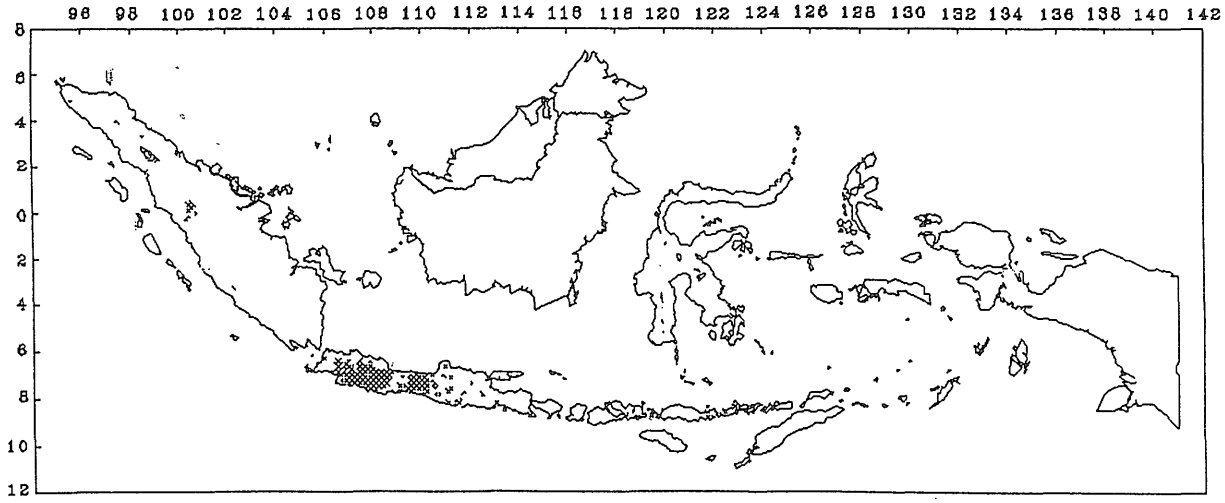


Fig. 6 Location map of landslide hazard, Indonesia (1970-1994)

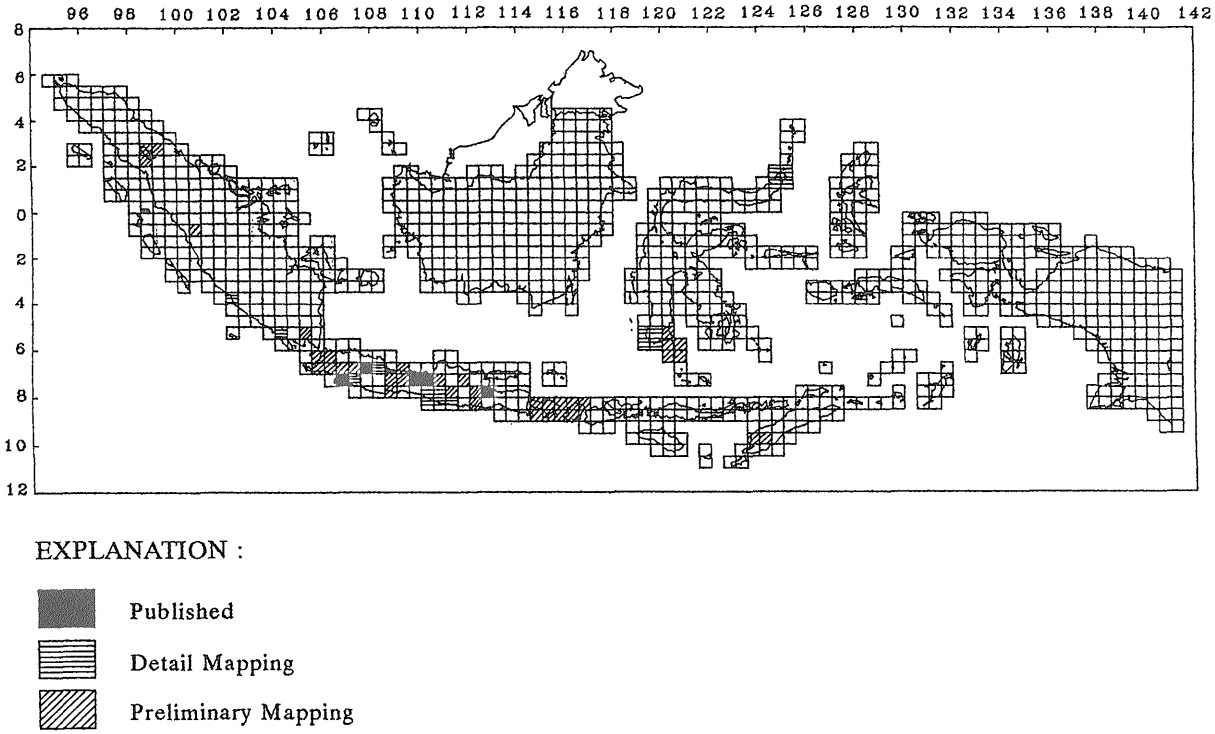
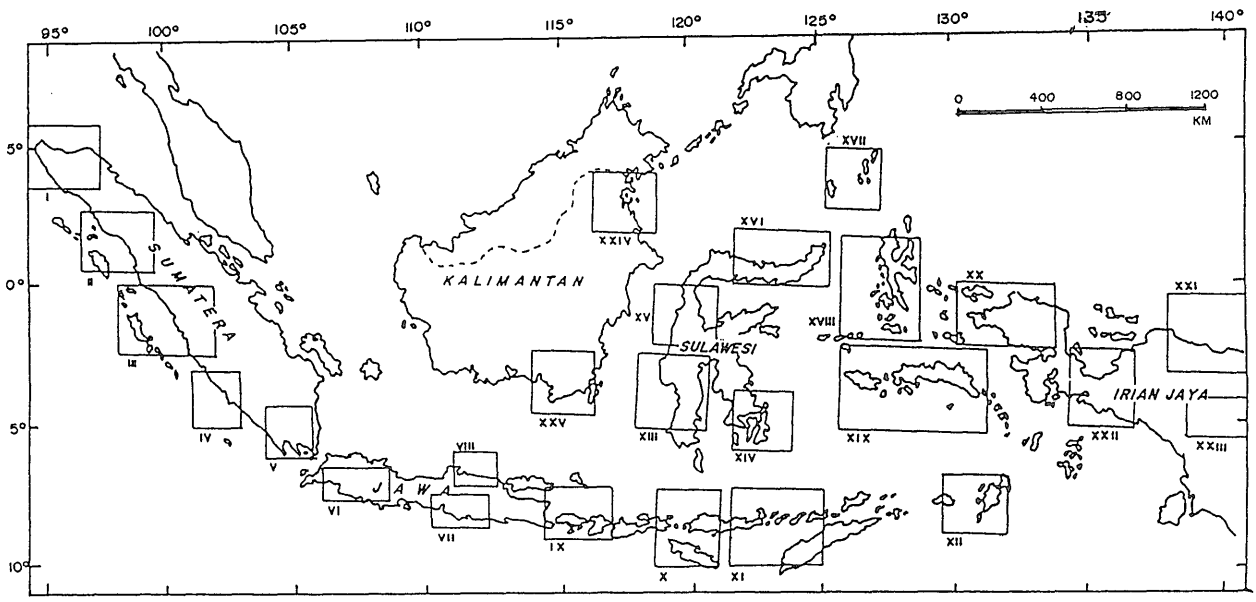


Fig. 7 Status of landslide susceptibility map, Indonesia (1994)



I.	Aceh	X.	Flores	XVIII.	Halmahera
II.	North Sumatera	XI.	Kupang	XIX.	Ambon
III.	West Sumatera	XII.	Yamdena	XX.	Kepala Burung
IV.	Bengkulu	XIII.	South Sulawesi	XXI.	Jayapura
V.	Lampung	XIV.	Southeast Sulawesi	XXII.	Pantai/Nabire
VI.	West Jawa	XV.	Central Sulawesi	XXIII.	Wamena
VII.	Yogya	XVI.	North Sulawesi	XXIV.	Tarakan
VIII.	Lasem	XVII.	Sangir-Talaud	XXV.	South Kalimantan
IX.	Bali-Lombok				

Fig. 8 Name of potential seismic hazards area

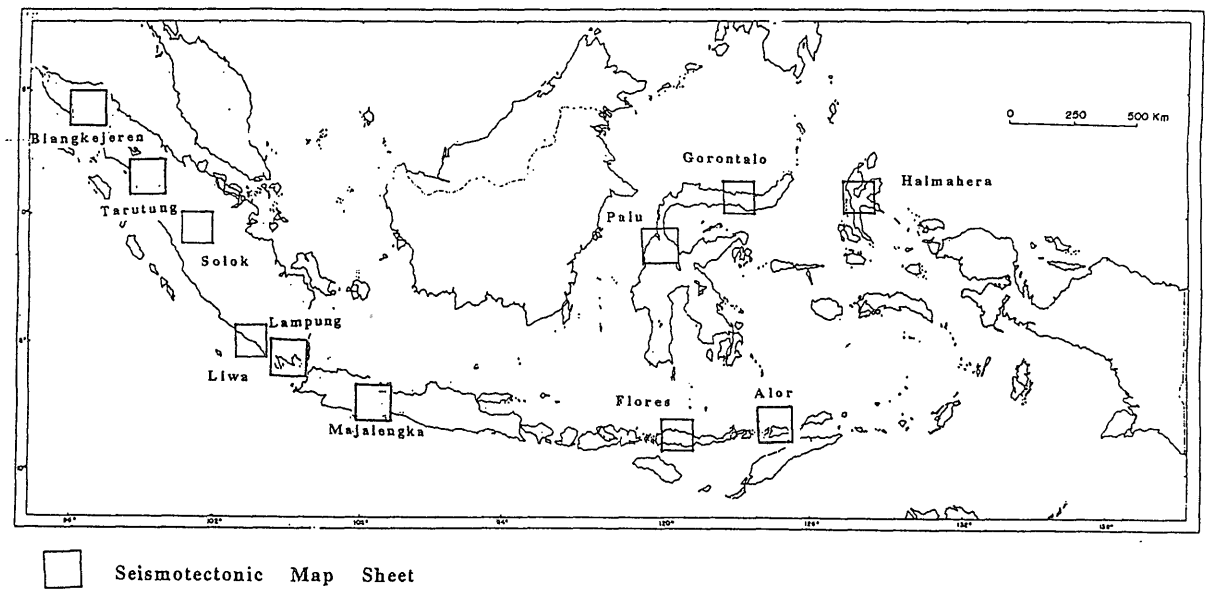


Fig. 9 Index map of seismotectonic map publication progress

1. Potential Seismic Hazards Area in Indonesia.
2. Seismotectonic Map scale 1:5,000,000 (published).
3. Database Earthquake Epicenters in Indonesia.
4. Seismotectonic Map scale 1:250,000 (published and open file report) : 12 sheets.

(Table 1)

4. Volcanic hazard maps

This map showing the information of the volcanic deposit (types and their extents); the ages and the characters of previous eruptions; and the influence by the eruptions. The map is presented in scale 1:100,000 and is designed for public as simple and easily understanding and also to be used as a consideration in landuse management.

4.1 Volcanic Hazard Zonation

Zonation of hazard determine from the statistic record have showed by the historic eruption. There are divided into:

(1) Forbidden Zone, that is area frequently or often affected by pyroclastic flows, falls or lava (or dome). Therefore this zone is recommended to be emptied from any human activity. Practically this term is subjected to the volcanoes are showing continuous magmatic activity such as Merapi and Semeru. Forbidden zone is also used for hazardous volcanic gases, as manifested in Dieng, Central Java.

(2) Danger Zone I is an area that is most likely affected by pyroclastics (flow and fall and lava flows) when an eruption occurs. People has to be evacuated from this zone, when precursory sings for an eruption is obvious. No permanent building is allowed).

(3) Danger Zone II is a zone that is most likely subjected by lahar. People has also evacuated from this zone during an eruption. By concensus commonly is taken an area with a radius 8 km from the vent. For volcanoes with no historic eruption records two zones are used, namely :

(1) Danger Zone, that is a zone most likely subjected by pyroclastic flows and lava from future eruptions and it has to be evacuated when precursory trends for an eruption is certain. Hazards are assessed by regarding the upper stratigraphic successions. However, this is very uneasy because of heavy vegetation and deep soil eliminating information. Therefore their hazards assessment is hardly justified Commonly the boundary of the zone is taken with an analogy to similar type of volcanoes that pose historic eruptions.

(2) Alert Zone is the extension of the danger zone in a case of increased scale of eruption effect. Aconcensus is taken to cover an area of radius 8 km from the vent.

Conditions of application of both types of hazard zonation map are :

(1) Future eruptions will originate from summit or main vent. In practice actually the eruption seems to be magmatic. In many cases revisions are possible. This is caused by lack of data. For instance monitoring result predicts no big eruption because of no support from deformation. The danger area may be effective in the crater only not as large as in the map. VSI has experienced a few times for Tangkubanparahu volcano in West Java where only phreatic activities occurred.

(2) Future uptions will be vertical in eruptive collumn and consequently the effect on the ground is radial.

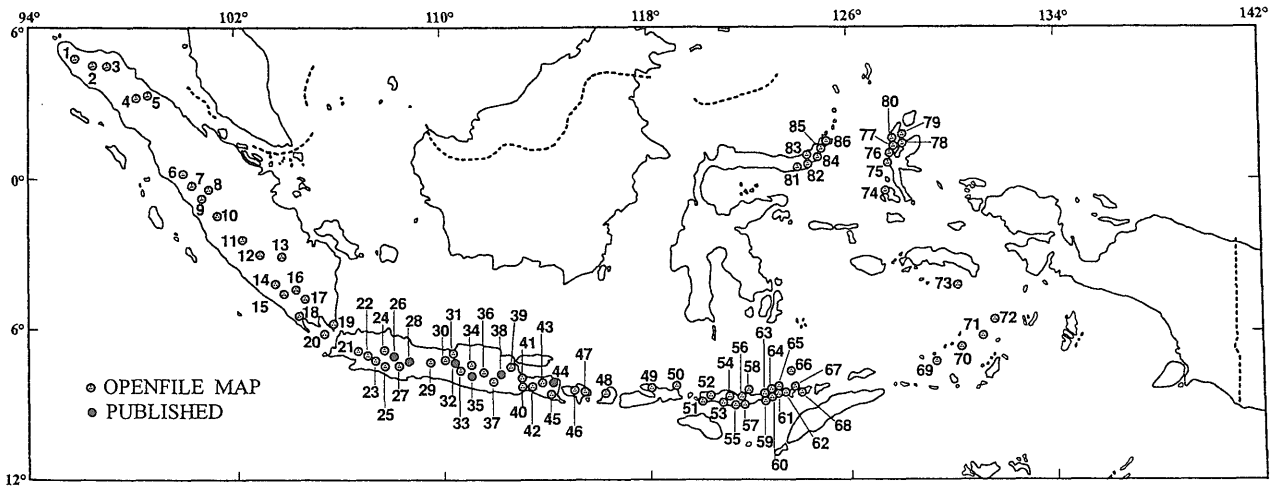
(3) The eruption is not an explosive one that leads to a collapse or the formation of caldera. It means that field data of large eruptive event (caldera formation) at this stage is ignored. Thus, the map prepared is at most used for a short-term volcanic hazard volcanic hazards.

(4) The morphology of the volcano will not change appreciably between the time of hazard zonation map is established and when an eruption occurs.

During an eruption volcanic hazard map may be modified particularly in supplying other agencies or civilian bout scale and course of impending hazards such as lahars and floods. This information is commonly directed to public works that deals with construction and rehabilitation activities.

Table 1 List of seismotectonic maps and open file reports

No.	SEISMOTECTONIC MAP TITLE	SCALE	PUBLICATION PROGRESS
1.	Seismotectonic Map of Indonesia	1 : 5.000.000	Published
2.	Seismotectonic Map of Tarutung Area, North Sumatera	1 : 250.000	Published
3.	Seismotectonic Map of Blangkejeren Area, Aceh	1 : 250.000	Published
4.	Seismotectonic Map of Majalengka Area, West Jawa	1 : 250.000	open file
5.	Seismotectonic Map of Lampung Area, South Sumatera	1 : 250.000	open file
6.	Seismotectonic Map of Alor Area, Nusatenggara	1 : 250.000	open file
7.	Seismotectonic Map of Palu Area, Central Sulawesi	1 : 250.000	open file
8.	Seismotectonic Map of Solok Area, West Sumatera	1 : 250.000	open file
9.	Seismotectonic Map of Gorontalo Area, North Sulawesi	1 : 250.000	open file
10.	Seismotectonic Map of Flores Area, Nusatenggara	1 : 250.000	open file
11.	Seismotectonic Map of Halmahera Area, Maluku	1 : 250.000	open file
12.	Seismotectonic Map of Liwa Area, South Sumatera	1 : 250.000	open file



1 Seulawah Agam; 2 Peuetsague; 3 Burmi Telong; 4 Sinabung; 5 Sibayak; 6 Sorikmarapi; 7 Talakmau; 8 Marapi; 9 Tandikat; 10 Talang; 11 Kerinci; 12 Kunyit; 13 Sumbing;14 Belirang Beriti; 15 Bukit Daun; 16 Kaba; 17 Dempo; 18 Sekincau;19 Rajabasa;20 Krakatau;21 Salak;22 Gede;23 Patuha; 24 Tangkuban Parahu; 25 Papandayan; 26 Guntur; 27 Galunggung; 28 Ciremai; 29 Slamet; 30 Dieng; 31 Ungaran; 32 Sundoro; 33 Sumbing; 34 Merbabu; 35 Merapi;36 Lawu;37 Wilis;38 Kelut;39 Arjuno-Welirang; 40 Semeru; 41 Bromo; 42 Lamongan; 43 Iyang; 44 Ijen; 45 Raung; 46 Batur; 47 Agung; 48 Rinjani; 49 Tambora; 50 Sangeang Api; 51 Wai Sano; 52 Ranakah; 53 Inierie; 54 Inielika; 55 Ebulobo; 56 Meja; 57 Iya; 58 Rokatenda; 59 Kelimutu; 60 Ili Muda; 61 Lewotobi peremuan; 62 Ili Werung; 63 Lereboleng; 64 Lewotobi Laki-laki; 65 Ili Boleng; 66 Baturamu; 67 Ili Lewotolo; 68 Sirung; 69 Wurlali; 70 Teon; 71 Nila; 72 Serua; 73 Banda Api; 74 Makian; 75 Gamalama; 76 Todoko; 77 Gamkonora; 78 Malupang Warirang; 79 Dukono; 80 Ibu; 81 Ambang; 82 Soputan; 83 Lokon; 84 Mahawu; 85 Klabat; 86 Tongkoko.

Fig. 10 Status of volcanic hazard map, March 1994

4.2 The Progress (Index maps included)

*Volcanic Hazard Map Zonation : 88 volcanoes (Fig. 10).

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インドネシアの地質災害図

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要　旨

インドネシアにおける各種の地質災害図-地すべり・地震・火山災害図-及び関連データ1:250,000及び1:100,000地質図-の作成・出版の現状が紹介されている。

地質災害については震源の深さによる区分と，岩層及び活断層が示され，火山災害図では，2種類の危険地域，地すべり災害図では，3種類の発生予想区域が示されている。