

THE FRACTURES ANALYSIS FOR ACTIVE FAULT DETECTION ON CIPARAY REGION IN SOUTHERN MARGIN OF THE BANDUNG BASIN, JAWA BARAT PROVINCE, INDONESIA

Emi Sukiyah¹⁾

¹⁾ Doctorate Candidate of Mathematic and Natural Sciences, Padjadjaran University, Bandung.

ABSTRACT

The research area is located at southern part of Bandung Regency, belong to the Ciparay District. The area is characterized by the valley and hill with steep angle slope reaching 60%. It was sited by volcanic rocks of Waringin-Bedil Mounts at Early Pleistocene, Malabar-Tilu Mounts at Late Pleistocene, lake deposit at Holocene, and alluvial at Recent. The objects of research are fractures population and river segments that develop on active fault zone. Measurement is undertaken on the azimuth directions of the number of fractures and river segments. Research methods used are fractures analysis and bifurcation ratio. The azimuth directions of fractures and river segments are analyzed with statistic to get accurate verification. Result of research shows that area is controlled by active fault.

Key-words: fractures analysis, active fault, statistic, verification.

ABSTRAK

Daerah penelitian berada di bagian selatan Kabupaten Bandung, termasuk wilayah Kecamatan Ciparay. Kawasan tersebut dicirikan oleh lembah dan lereng bukit terjal dengan sudut lereng mencapai 60%. Litologi penyusun daerah penelitian adalah batuan vulkanik berumur Kuartar yang merupakan produk Gunung Waringin-Bedil berumur Plistosen awal, Gunung Malabar-Tilu berumur Plistosen akhir, endapan danau berumur Holosen, dan aluvium yang hingga kini masih terbentuk. Objek penelitian berupa populasi kekar dan segmen sungai yang berkembang pada zona sesar aktif. Pengukuran dilakukan pada arah azimut sejumlah kekar dan segmen sungai. Metode penelitian yang digunakan adalah analisis arah azimut kekar dan rasio cabang sungai. Arah azimut kekar-kekar dan segmen sungai dianalisis menggunakan statistik untuk memperoleh verifikasi yang memadai Hasil penelitian menunjukkan bahwa daerah penelitian secara signifikan dikontrol oleh sesar aktif.

Kata kunci: analisis kekar, sesar aktif, statistik, verifikasi.

INTRODUCTION

The research area is characterized by valley among two mountains namely Bukitcula (1.073 m) and Pasir Nini (1.096 m). The slope is steep with slope angle reaching 60% at the eastern slope of Pasir Nini Mountain. Administratively, this area belongs to Ciheulang Village, Ciparay district, Bandung Regency, Jawa Barat Province, Indonesia (FIGURE 1).

This area is attracting several investors in property field. There is recently property development that now already occupied the slope of Pasir Nini Mount. Many supported factors for the

development of property exist in this area. These are compact lithology that good for fondation, spring water on the fault plane, and the good accessibility to the main road of Bandung-Majalaya.

On the other hand, hindrance factor must be calculated. The hindrance factor is found at the research area need to special attention is landslide problem at any time to go through valley and hill slope areas. Based on survey result, the fault at this area has been working. It is shown by fractures have been breaking roads were built in 1992.

METHODOLOGY

Mind frame of this research follow to deductive pattern. Principally, the strike slip fault was found at that area. Furthermore, variable of structure and landform have measured were analysed and due testing with statistic test to get accurate result. Statistic or probability approach for know fault state with specific conviction grade.

The research method that used is fractures analysis method to get common directions of fractures on active fault zone. This result is compared with common direction of river segments that lied on same as area. Measurement result is test with t-test on significance level (for example 95%). Furthermore, the data are analyzed with probability approach. Statistic test was used are χ^2 method (formula 1) to know normality of data distribution and *t-test* (formula 2) to know that river pattern is controlled by fracture pattern at degree of error (α) is 5%.

$$\chi^2 = (f_o - f_e)^2 / f_e \dots\dots\dots (1)$$

With χ^2 (quadratic *chi* of calculation result) f_o (total of observation data), f_e (total of expectation data) (after Sugiyono, 1999).

$$t = \frac{|\bar{x} - \bar{y}|}{\sqrt{[(\sigma_x^2 / \Sigma nx) + (\sigma_y^2 / \Sigma ny)]}} \dots\dots\dots (2)$$

With t (t of calculation result), \bar{x} (average of fractures data), \bar{y} (average of river segments data), σ_x (deviation standart of fratures data), σ_y (deviation standart of river segments data), Σnx (total of fratures data) and Σny (total of river segments data) (after Krumbein, 1965).

Bifurcation ratio (Rb) is a total of grade river “n” is divided by total of grade river “n+1”. If $Rb < 3$ or $Rb > 5$ then that watershed area is controlled by active fault (after Verstappen, 1983).

Materials and tools that used in this research are:

- 1) Topographic map with 1: 25.000 scale;
- 2) Geological map with 1:100.000 scale;

- 3) Field survey tools, i.e. compass, geologic hammer, loupe, camera, etc.;
- 4) Computer with its peripheral to support data analysis.

GEOLOGICAL SETTING

The Bandung basin is a plateau is surrounded by chain of hilly and mountain. Physiographically, this area included to Bandung zone and Quaternary volcanic (after Van Bemmelen, 1949).

The number of research workers researched geological object in the Bandung Basin, i.e Klompé (1956, in Koesoemadinata, 1979), Silitonga (2003), Alzwar et al (1992) and Dam (1994). FIGURE 2 show ilustration of Bandung Basin evolution since Oligocene to Quaternary (after Dam, 1994).

Alzwar et al (1992) built geological map of Garut and Pameungpeuk sheet in 1:100,000 scale where the research area lied. Lithologic settings of that area are andesite lava, tuff, lake deposits and alluvial (FIGURE 3). Andesite lava can be compared with andesite of Waringin–Bedil (Old Malabar) formed in early Pleistocene. Tuff can be compared with volcanic rock of Malabar-Tilu formed in Late Pleistocene. The lake deposits formed in Holocene and alluvial have been forming to recent.

The geological structure that to develop in research area in the form of *oblique* fault. This fault coincides with direction of Barugbug River. Fault scarp show in block diagram (FIGURE 4). Barugbug fault is estimated as active fault because it continues to cut through lake deposit.

RESULT AND DISCUSSION

The measurement data of azimuth directions of river segments and fractures at research area among 0° to 179° range. That data viewing in scatter diagram (FIGURE 5 and 6). Furthermore, data of azimuth directions of river segments and fractures are classified to four populations, e.i. I (0°-45°), II (46°-90°), III (91°-135°) and IV (136°-179°). Data classification based on population need due for normality test of data distribution.

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The normality test of data distribution of azimuth directions of river segments and fractures use χ^2 method. Test result show data are classified normal distribution are indicated by value of " $\chi^2_{\text{calculation}} < \chi^2_{\text{table}}$ " (TABLE 1). Furthermore, the parametric statistic can be due for know difference of rivers and fractures patterns.

The population of azimuth directions of fractures and river segment are compared use different test with t-test method. Analysis result of four populations show no significant difference among them where " $t_{\text{calculation}} < t_{\text{table}}$ " (TABLE 2). The analysis results are supported by scatter diagram that indicate similar patterns (FIGURE 5 and 6).

The patterns of rivers and fractures are proven no different. They indicate rivers on Quaternary volcanic rock are controlled by active fault. That phenomena supported by analysis result of bifurcation ratio (Rb) at Barugbug River, that estimate on 2 to 2.5 range. That value show watershed area of Barugbug is controlled by active fault.

At the field, object viewing indicates the fault is active. It is showed by infrastructure broken, i.e:

- 1) Cracking on main road body at housing area at slope of Pasir Nini Mount (FIGURE 8);
- 2) Asphalt road at Barugbug sub village crossed by fault and moving (FIGURE 9 and 10);
- 3) The flow direction of Barugbug River had turned to fit road margins back to previous direction to fit azimuth direction of fault cross road body (FIGURE 9).

CONCLUSION AND SUGESSTION

The fault in research area is active fault. It is indicated by rivers pattern are controlled by fractures pattern, value of bifurcation ratio among 2 to 2.5 ranges and moving of infrastructure facility is cut by fault.

The continuity and detail researches should be due to know degree of fault activity. This step is important because that Ciparay Region as housing development to recent.

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Class	Object	df	χ^2 calculation	χ^2 table
I	fracture	6	12	12.592
	river segment	29	35	42.557
II	fracture	29	27	42.557
	river segment	15	18	24.996
III	fracture	23	27	35.172
	river segment	17	21	27.587
IV	fracture	6	10	12.593
	river segment	24	14	35.415

TABLE 1: Result of normality test of data distribution for azimuth directions of fractures and river segments.

Class	\bar{x}	\bar{y}	σ_x	σ_y	df	$t_{\text{calculation}}$	t_{table}
I	24.14	20.93	15.94	12.55	35	0.498	1.691
II	68.77	66.06	11.50	11.19	44	0.773	1.681
III	109.92	114.06	12.65	13.08	40	1.029	1.684
IV	155.71	158.12	9.78	11.59	30	0.551	1.697

TABLE 2: Result of difference test show rivers pattern no difference with fractures pattern



FIGURE 1: Index map of the research area

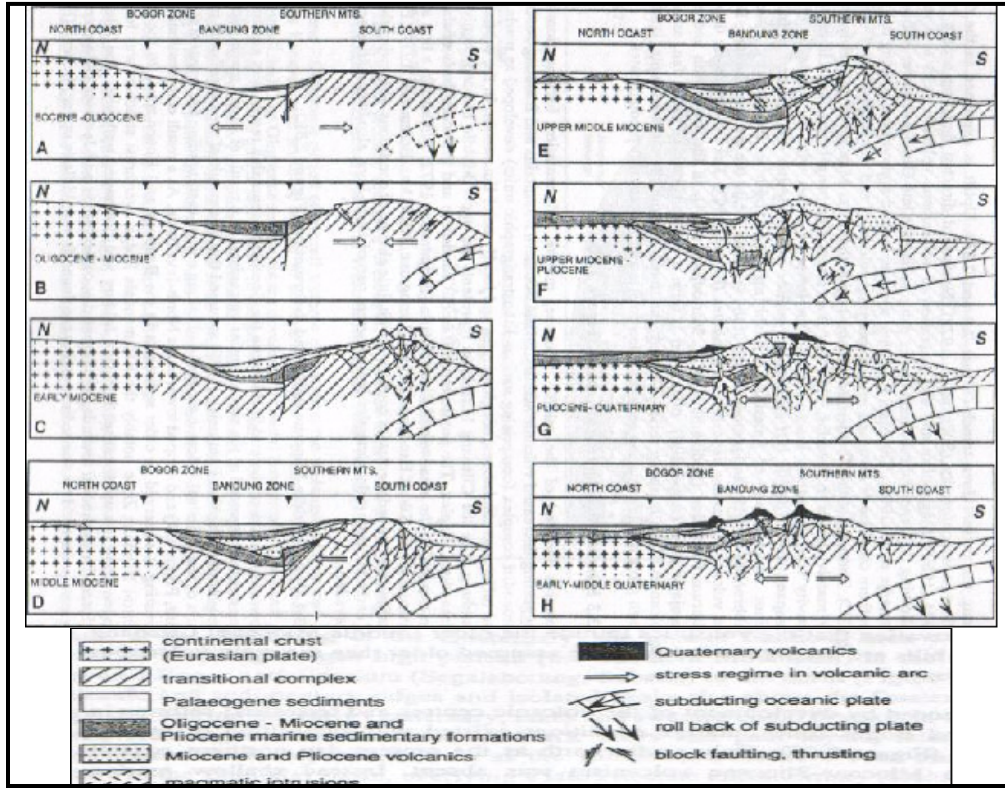


FIGURE 2. Illustration of Bandung basin evolution (after Dam, 1994)

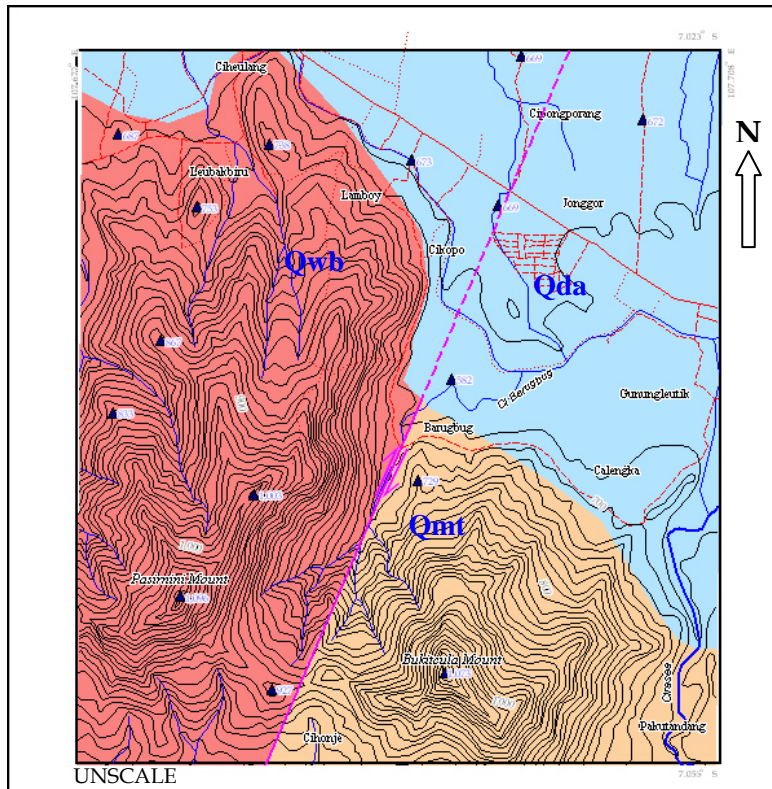


FIGURE 3: The geology of research area. Qda (lake deposit and alluvial) formed in Holosen-Recent, Qmt (tuff of Malabar-Tilu volcanics) formed in late Pleistocene, Qwb (andesite lava of Waringin-Bedil or old Malabar) formed in early Pleistocene (after alzwar et al, 1992).

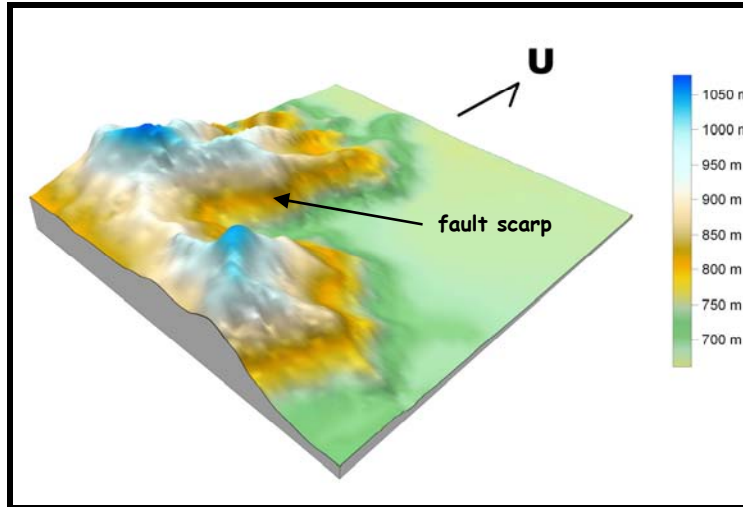


FIGURE 4: The block diagram of morphology view of Ciparay region

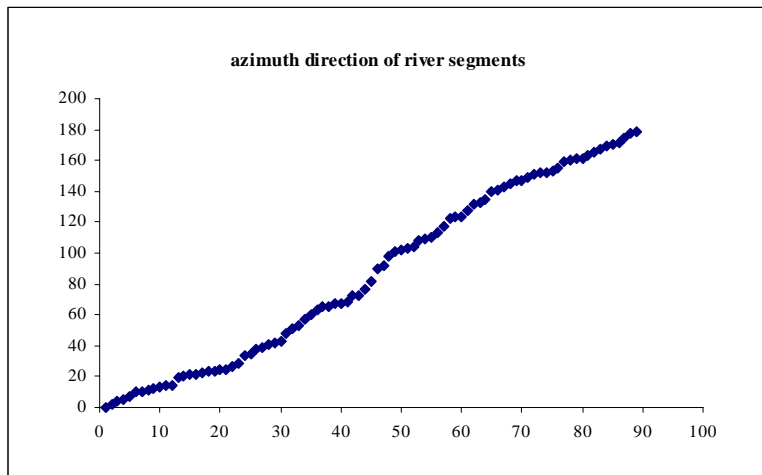


FIGURE 5: Scatter diagram show pattern of azimuth directions of river segments. Vertical line represents azimuth directions of river segments and horizontal line represents data order.

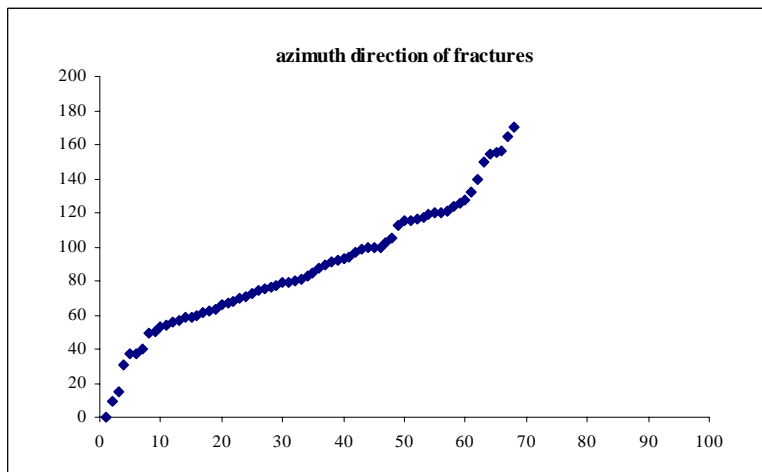


FIGURE 6: Scatter diagram show pattern of azimuth directions of fractures. Vertical line represents azimuth directions of fractures and horizontal line represents data order.



FIGURE 7: The morphology view of Bukitcula Mount (a) and Pasir Nini Mount (b)
(Documentation: January 2005)

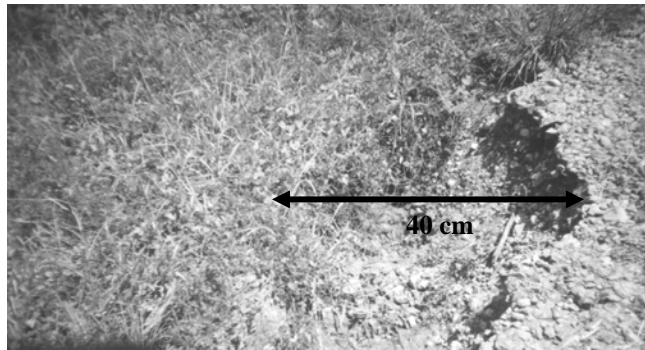


FIGURE 8: A fracture breaks a road was built in 1992 at slope of Pasir Nini Mount.
A wide of fracture reaching 40 centimetres (documentation: January 2005).

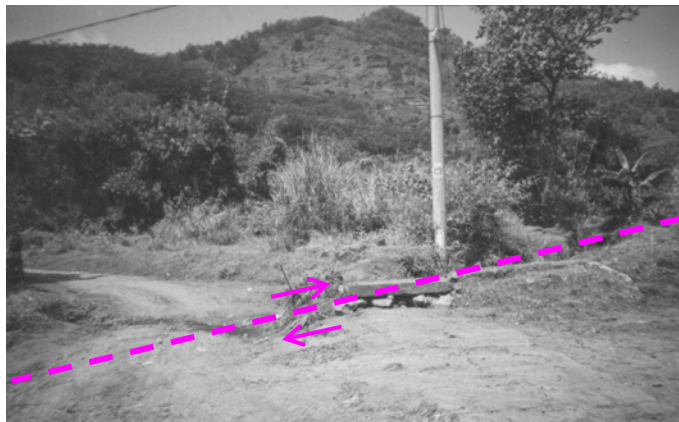


FIGURE 9: The active fault crosses a road at Barugbug sub Village (documentation: January 2005).



GAMBAR 10: Foundation rock of road at Barugbug sub village goes down approximately 5 cm because
active fault influence (documentation: January 2005)