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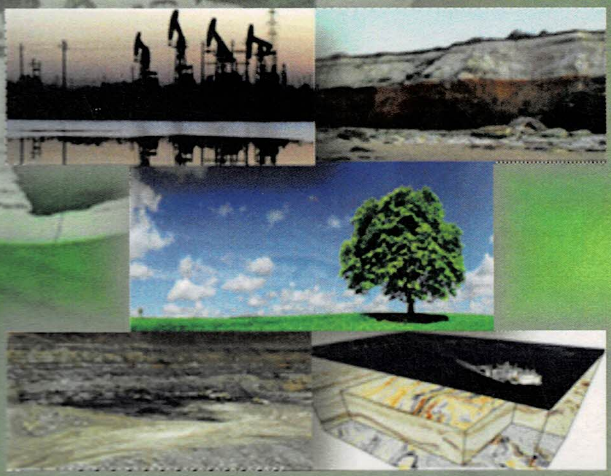
PROCEEDING

1ST EARTH SCIENCE INTERNATIONAL SEMINAR
YOGYAKARTA, 29TH - 30TH NOVEMBER 2012

"INCREASING ROLE OF EARTH SCIENCE AND TECHNOLOGY TO SUPPORTING ACCELERATION OF MINERAL AND ENERGY RESOURCES CONSERVATION"



Faculty of Mineral Technology UPN "Veteran" Yogyakarta
Indonesia

FACULTY OF MINERAL TECHNOLOGY

UPN "VETERAN" YOGYAKARTA

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Daerah Istimewa Yogyakarta

Indonesia 55283

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Theme :
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Faculty of Mineral Technology
UPN "Veteran" Yogyakarta
2012

Foreword

The first International Earth Science Seminar 2012 of Faculty of Mineral Technology of UPN "Veteran" Yogyakarta and 5th Indonesia – Malaysia Joint Geoheritage Conference with its' theme "Increasing Role of Earth Science and Technology to Support Acceleration of Mineral and Energy Resources Concervation" is a collaboration of FTM UPN "Veteran" Yogyakarta Indonesia – UKM Malaysia, held in Yogyakarta at FTM seminar room UPN Veteran Yogyakarta 29-30th November 2012.

The Seminar exposes a discussion fair which will integrate earth science, technology and business opportunities. The exposition offer a unique opportunity for technical and business discussions amongst participants from leading oil and mineral companies, government representative and academia. It also enables a dynamic interaction between all of participants.

In addition to the above seminar, it gives me a great pleasure to introduce you the technical papers of the seminar in a format on Proceeding. We received over 60 abstracts from operating companies, service companies, government agencies, universities and students for evaluation and 48 outstanding papers have been selected for inclusion in this year's technical program. The technical committee for this seminar has strived very hard to select the best and highest quality papers that are relevant to the International Earth Science and Technology. The selected papers have special emphasis on case studies and best technology practices applied in the Earth Science technology.

In closing, I would like to recognize the great efforts, dedication and hard work of the 2012 International Earth Science Seminar committee who tirelessly worked with the authors and editors to make this year's technical program an outstanding success.

I hope you will fine the technical papers in the proceeding useful and helpful in establishing a better understanding of the Earth Science developmet.

Sudarmoyo

Chairman,

Yogyakarta 2012 International Earth Science Seminar

Gubernur
Daerah Istimewa Yogyakarta

Sambutan
SEMINAR INTERNASIONAL KEBUMIAN
"PENINGKATAN PERAN IPTEK KEBUMIAN DALAM MENDUKUNG AKSELERASI KONSERVASI SUMBER DAYA MINERAL DAN ENERGI"
Yogyakarta, 29 November 2012

Assalamu'alaikum Wr. Wb.
Salam sejahtera bagi kita semua,
Yth. Rektor Universitas Pembangunan Nasional "Veteran" Yogyakarta, Prof. Dr. H. Didit Welly Udjianto, MS. yang diwakilkan oleh Wakil Rektor III, Bapak M. Nurcholis.
Yang saya hormati saudara-saudara narasumber : Pertamina EP, Tenaga ahli SK MIGAS, Pertamina Hulu Energi, Dosen dari Universitas Kebangsaan Malaysia.

Hadirin serta peserta seminar yang berbahagia.

Marilah kita senantiasa mengucapkan syukur kehadirat Allah Subhanahu Wata'ala, atas limpahan karunia-Nya, sehingga pada hari ini kita dapat hadir dalam keadaan sehat wal'afiat.

Pertama-tama, saya mengucapkan selamat datang di Yogyakarta kepada seluruh peserta seminar. Jika ini merupakan kunjungan saudara untuk pertama kalinya di kota kami, seperti inilah Yogyakarta. Kota ini seperti memiliki dua wajah, di satu sisi adalah simbol tua yang berbalutkan nilai-nilai tradisi leluhur kerajaan Jawa, di satu sisi lainnya merupakan wajah gemerlap modernitas. Yogyakarta memiliki sumber daya alam yang terbatas. Karena itu, sebagai pedorong pertumbuhan dan kemajuan daerah, kami fokuskan pada tiga bidang yaitu : pendidikan, pariwisata dan budaya.

Adapun filosofi pembangunan di Daerah Istimewa Yogyakarta, diambil dari filosofi Jawa yaitu Hamemayu Hayuning Bawono. Filosofi ini menekankan adanya keselarasan antara manusia dengan manusia, manusia dengan alam, serta manusia dengan Tuhan. Ternyata, apa yang diajarkan nenek moyang kami, memiliki persamaan dengan tiga pilar pembangunan keberlanjutan, yaitu menguntungkan secara ekonomi (*economically viable*), diterima secara sosial (*social acceptable),* dan ramah lingkungan (*environmentally sound*). Dengan adanya keselarasan antara manusia dan alam, pembangunan dapat terus berjalan tanpa mengurangi kemampuan alam dalam menyediakan segala sumber dayanya untuk generasi sekarang dan yang akan datang.

Hadirin yang saya hormati,

Sumber daya mineral dan energi, mempunyai peranan yang sangat penting dan menjadi kebutuhan dasar dalam pembangunan ekonomi yang berkelanjutan. Oleh karena itu, keduanya harus digunakan secara hemat, rasional dan bijaksana agar kebutuhan energi pada masa sekarang dan masa yang akan datang dapat terpenuhi.

Konservasi energi sangat penting, mengingat cadangan energi semakin menipis, sementara itu penggunaan energi di semua sektor masih sangat boros. Jika tidak dilakukan langkah-langkah konservasi, tentunya kita akan menghadapi krisis energi. Selain itu, kegiatan konservasi energi sejalan dengan kebijakan energi bersih. Sebab, dengan melakukan konservasi energi, laju konsumsi energi dapat ditekan sehingga mengurangi emisi gas rumah kaca yang menyebabkan pemanasan global dan perubahan iklim. Begitu pula dengan sumber daya mineral, baik logam maupun nonlogam, harus dipergunakan dengan tepat dan cermat.

Efisiensi adalah salah satu langkah dalam pelaksanaan konservasi energi, sebab cadangan energi fosil yang merupakan salah satu sumber daya mineral nonlogam, jumlahnya terbatas dan sifatnya tak terbarukan. Dengan mengurangi penggunaan energi fosil, tentunya lingkungan kita juga semakin sehat karena polusi dan emisi gas rumah kaca bisa ditekan. Industri barang dan jasa akan lebih produktif dan kompetitif jika biaya pemakaian energi dapat diminimalkan. Begitu pula dengan penghematan energi di sektor rumah tangga, akan memungkinkan alokasi dana untuk kebutuhan rumah tangga lainnya.

Paradigma pengelolaan energi pun harus diubah dari yang dulunya adalah *Energy Supply Side Management* menjadi *Energy Demand Side Management.* Dengan adanya paradigma baru tersebut, konsekuensinya kita harus mendorong penyediaan dan pemanfaatan energi terbarukan demi terjaminnya pembangunan berkelanjutan serta untuk meningkatkan ketahanan energi. Di sisi lain, energi fosil digunakan sebagai penyeimbang semata, bukan sebagai penyedia energi utama.

Hadirin yang saya hormati,

Untuk itulah peranan ilmu pengetahuan dan teknologi kebumian tentu sangat diperlukan dalam mendukung akselerasi konservasi sumber daya mineral dan energi tersebut. Tentunya saya sangat berharap saudara-saudara disini yang memiliki disiplin ilmu kebumian, dapat menyumbangkan berbagai ide inovatif dan kreatifnya pada seminar bertaraf internasional ini.

Demikian kiranya beberapa hal yang bisa saya sampaikan. Akhirnya, dengan mengucapkan *Bismillahirahmanirrahim*, Seminar Internasional Kebumian dengan tema "Peningkatan Peran Iptek Kebumian Dalam Mendukung Akselerasi Konservasi Sumber Daya Mineral dan Energi", saya nyatakan dibuka secara resmi.

Sekian dan terima kasih atas perhatiannya.

Wassalamu'alaikum Wr. Wb.

Yogyakarta, 29 November 2012
GUBERNUR
DAERAH ISTIMEWA YOGYAKARTA

ttd

HAMENGKU BUWONO X

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Optimization of Sand and Rock Boulder Resources from Mount Merapi Eruption Using the Photometry Model of Particle Size Distribution

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Abstrak

Analisa ukuran butir (*grain counting analysis*) atau fragmen pada batuan antara lain bertujuan untuk mengetahui persentase distribusi ukuran fragmen atau butiran partikel penyusun batuan sedimen maupun tingkat gradasinya (mulai dari seragam, bertahap hingga yang tak beraturan). Hal ini akan mempermudah dalam penggolongannya sesuai klasifikasi Wenworth (1922).

Di dalam bidang keteknikan, khususnya untuk estimasi sumberdaya maupun cadangan, analisa ukuran butir dapat digunakan untuk lebih mengoptimalkan hasil perhitungan, baik volume maupun *tonnage*-nya. Untuk skala laboratorium, analisa ukuran butir umumnya menggunakan ayakan (*screen*). Kendala akan muncul ketika perhitungan dilakukan untuk mengestimasi material dalam jumlah yang luar biasa banyak, volumenya maupun ukuran bongkahnya yang sangat besar. Bila menggunakan ayakan jelas tidak memungkinkan.

Model fotometri berbasis pada analisa citra foto, kemudian dengan menggunakan saringan *grayscale* terhadap warna dan garis akan dapat direkontruksi dalam model segmen-segmen sesuai ukuran butirnya. Model fotometri sangat cepat, murah dan hasil yang cukup akurat.

Hasil penelitian terhadap distribusi ukuran butir pasir hingga bongkah batu (*boulder*) di Kali Gendol didapatkan distribusi ukuran rata-rata untuk bongkah ± 45 %, kerakal/bahan urug ± 40 % dan pasir ± 15 %. Pengertian bongkah, kerakal dan pasir di sini hanya istilah komoditas perdagangan bahan tambang, bukan ukuran sesuai skala Wenworth. Penentuan persentasi ukuran ini menjadi cukup penting karena berkaitan dengan estimasi volume pasir dan batu (sirtu) dan potensi pajak maupun restribusi bagi Kabupaten Sleman.

Kata kunci : Optimasi, Sirtu, Fotometri

Abstract

Analysis of the grain size (grain counting analysis) or a fragment of rocks, has an aim to determine the percentage of the distribution size fragment or constituent particles sediment composer and gradation levels (ranging from uniforms, to gradually irregular). This will facilitate the appropriate Wenworth classification (1922).

In engineering, particularly for resource and reserve estimation, analysis of the grain size can used to further optimize the calculation, both its volume and tonnage. For the laboratory scale, generally grain size analysis using sieves (screen). Obstacles will arise when calculations are performed to estimate the amount of material in many remarkable, both volume and size boulders. It is impossible to use a sieve.

Photometric model based on analysis of the photo image, then using the filter gray scale to color and lines will be reconstructed in the model segments in the size of particles. Photometric method is very fast, cheap and accurate.

The results of the grain size distribution of sand to rocks (boulder) in Gendol River obtained mineral sands potential is estimated at 15%, dumping material ("urug")/gravel at 40%, rock boulders at 45%. Understanding boulders, gravel and sand here only mineral commodity trading terms, not appropriate with Wenworth scale. The determination of the percentage of this size is quite important because it is associated with an estimated volume of sand and rock and the potential tax and retribution for Sleman regency.

Key words : Optimization, sand and gravel, Photometry

1. Preface

Eruption of Mount Merapi, which occurred in the end of 2010, on the one hand become disaster because it caused a lot of casualties, both people, animals, property or environmental damage and land. But the other hand, the eruption also generates revenue in the form of eruption material like blocks of stone (boulders) and sand.

Merapi Volcano as one of the world's active volcanoes produced very large volume of material eruption. Estimation of eruption material entering Krasak River for about 16 million m^3, Boyong River 8 million m^3, Kuning River 14 million m^3 and Gendol River 28 million m^3 (Subandriyo, 2011). So when calculated, potential mineral sand and stones buried in the four rivers could reach 66 million m^3 (as resources).

Sand and rock eruptions result is the belle of entrepreneurs who use it as a building material because the quality is excellent and can be found in the most economical quantities along the river, riverbanks and mountainsides. From this sand and stones people can get welfare, entrepreneurs make a profit, and the government gets the minerals tax.

In mining rules, mineral is known as a non-renewable materials. But, eruption materials such as sand and stone of Mount Merapi, according to some geologists is unique, because it can't be run out, as known as a "renewable mineral". Because every rainy season or every eruption of Mount Merapi, will always produce an additional deposit of sand and stone.

Research Background

The volume of erupted material, sand and stone, is very large. These materials if not managed properly could potentially lead to vulnerability, such as lava floods and landslides, can also lead to social unrest.

Mineral sand and stones was needed by people all the time, regardless of dry season or rainy season. The need for this mineral will always increase significantly in accordance with the increase in welfare and development of the community.

Mining activities is one of sectors that is done mostly by people around the slopes of Mount Merapi and around the rivers that disgorge at Mount Merapi. Initiation factors of this sand mining activities are :

1) Economic factors. It is a major factor in which the people living around the slopes of Mount Merapi are mostly farmers and farm workers, use their spare time to work in mining sector. Working as miners is more profitable because their earnings more and and a guaranteed job.
2) The abundance of sand and stone was deposited along the river and the river valley, especially after the eruption and during the rainy season.
3) Quality sand and stone from Mount Merapi is very good. So in the market, the product is excellent for building materials. The price is quite high compared to similar commodities from other places.
4) High demand caused the capitalists and people outside the region are tempted to exploit the natural resources of sand and rocks that may less attention to environmental

To calculate or estimate the size distribution of fragments or coarse grain, can be done in several ways. The most notably by using sieve analysis (screen analysis or grain counting analysis). How to sieve analysis is the most widely used and considered to be the most accurate. But this method has disadvantages. The major drawbacks of this method are unlikely to be used to determine the size distribution of the large size of the material (boulders) and difficult to determine enormous numbers. It means that very unusual to use sieve analysis for calculate material stack as high as a hill or spreading widely.

Fotometry method using photo image were measured with a comparison object parameter (known the size) and compare with the object being measured. With this comparison object, all of the grain size of the fragments can be measured and quantified. This method is much faster than the sieve analysis method.

Research Objective

This study is one of the first steps after the estimation of the eruption materials is known. According BPPTK (2011), after the eruption of Mount Merapi in 2010, the amount of eruption material released is estimated at 140 million m^3. Furthermore, in order to obtain the optimal benefits, especially for local communities affected by the eruption, as well as for the communities along the river which brings material stone and sand and also for local government, the estimation of fragmentation distribution of sand and rock (gravel) that has high economic potential is need to be studied.

The absence data of materials size distribution will make a difficulty of estimation the volume of materials. To estimate the volume, the materials should be disaggregated to be rock (boulder), gravel, and sand. Sorting is important because it is linked to commodity prices. With appropriate volume estimation of each type of commodity and its price, the value of the eruption results material with the potential to be a mineral can be calculated. Local governments also will have accurate data on potential taxes that can be obtained from the mineral.

2. Research Methodology

In this study, measurements were taken in the upper reaches of rivers that disgorge at the peak of Mount Merapi; Boyong River, Opak River, Kuning River and Gendol River.

All types of eruption results material basically can be used as a building material, except dust. Estimated percentage of fragmentation distribution of sand and rock (gravel) is done only in areas that are potentially viable mined, so it can be estimated the economic potential of these minerals.

The equipment used in this study is a GPS, a camera (preferably at least 3 megapixel DSLR type) and comparison object in the form of a ball (size customize) or at least a round-shaped object.

Basically the result of the photometric measurements is how to optimize the calculation of particle size distribution of fragments/chunks.

Based on the observations, the location of the best example is in the upper reaches of the river where the ongoing activity of heavy equipment (backhoe) unload the eruption material. This is a major consideration because the accumulated material is considered not impaired by rain or runoff, so that the distribution of the rock fragments were deemed to be the same as when the flow of hot lava flowing at the top of the rivers that disgorge at Mount Merapi.

The number of object images is not too important, as long as it is sufficiently representative. it is on the basis that the source material comes from the same place and the same material properties, the only difference being the flow direction only. Due to limited facilities, taking photos only in the upper reaches of the Kuning River and Gendol River.

2.1. Taking Pictures

The brightness of the image effect on processing/delineation of particle separation program. Because of the gray scale image input, so when the shots are too bright dividing line formed invisible/less clear and vice versa.

Angles shot should be vertically so that the result of the picture appearance is good or no reduction of image.

2.2. Parameter/Comparison Tool

The aim of this comparison tool is to determine the size distribution of the material. At least there is 2 pieces of parameter/comparison tool to determine the position of the image. The layout parameter should be placed in the open position/look full, undiminished by the material to be measured. Parameter shape should be round (has diameter) because the analysis result will be assumed that all particle size has a diameter.

3. Data Processing

Image fragments are read and analyzed in gray scale. Input images can be directly from digital photographs, image scanning and capture of video. Before running the Split-desktop, images to be inserted into the computer calculated to do with downloading or digitized images.

Photometric analysis includes the following phases: determining the picture, looking for the particles, improving search results, calculating the size and displaying graphs and results. Or can be explained as follows:

1. Determining image

   The first step that must be done in photometric model consists of two parts: determining the boundaries of the image that will be calculated and determining the scale of the image. Determining images including limiting the images to be analyzed toolbar "crop" for the upper and lower limits. To determine the actual size distribution required a scale for comparison.

2. Looking for particle size

   A step in which the calculation will recognize the particles to be counted with gray scale format. The result are the contours are formed as inter-particle limit. Then this digitization, will be processed and will produce output that is displayed in the form of binary images or images with contours that form the boundary between the particles (Fig. 1).

3. Improving search results

   This step is intended to improve the results produced by previous step. These improvements include the removal of the area that will not be counted as a comparison tool and improve the contours that do not correspond to the size of the particle.

4. Calculating the size of

   This step is carried out by the method of calculation of the size of the perimeter where each contour would first have coordinates respectively. For the calculation of the size of the particles is done by interpolation and extrapolation with two scales.

A)

(B)

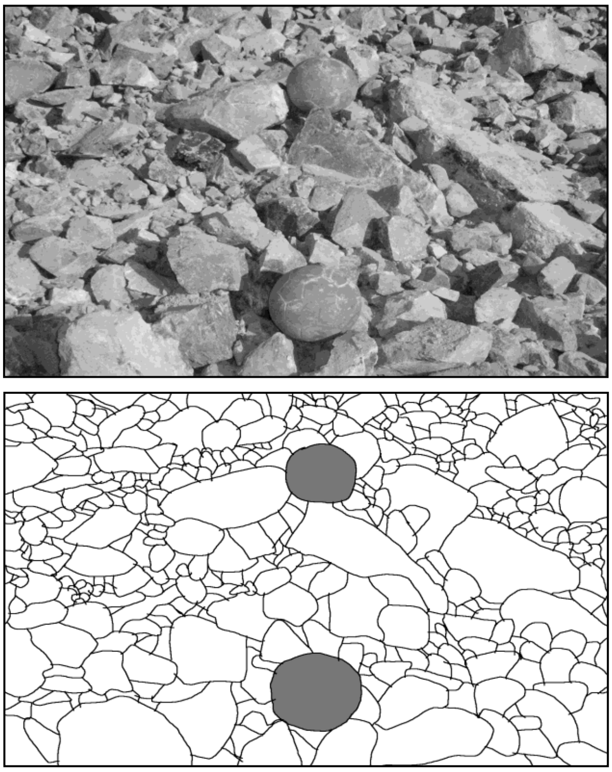

Figure 1

Photo Image Transformation
(A) Original image (B) *Binary image*

5. Displays graphs and results

   Size calculation results are displayed graphically which is the cumulative distribution graph of size rock fragments.

Examples of data display and calculation results will be displayed as shown in Figure 2, 3 and 4.

4. Discussion

The eruption of Mount Merapi produced materials with various particle sizes; ranging from dust, sand, gravel, up to boulders. Basically, all the materials could be the minerals, if the requirements of numbers, location and the ease of mining are fulfilled.

Basic estimation of potential materials such as sand and stone mining is assuming that all the eruption material (except dust) that deposited at the peak, slopes and the foot of Mount Merapi, has the potential to be a mineral commodity, as long as the three requirements are fulfilled. Large rocks or boulders with a size of > 20 cm are usually sold as "andesite", used for building foundations, walls or floors ornament, craft materials and crushed stone (split). Size 20 – 3 cm are usually sold as "*urug"* (sand-gravel) or dumping materials used for road base, land hoard and crushed stone, while the size < 3 cm are generally sold as "sand". Classification of this size is not standard measures or Wenworth Scale Standard, but only based on the type of commodities that ordinary/common result from sand mining and stone.

In the market, the price of boulders, gravel and sand is different. Sleman district government has also set up the selling price and tax based on these type of commodities (Table 1). On that basis, it's necessary to estimate the size distribution and the percentage of each of these commodities, so that the estimation value and the amount of sand and stone mining is accurate.

Table 1. Market Price of Minerals Group C
(Peraturan Bupati Sleman No. 33 Tahun 2010)

No.	Mineral Type	Market Price (Rp. Per m^3)
1.	Sand	25.000
2.	Sand and Gravel	
	- For building material	20.000
	- For hoard (dumping material)	14.000
3,	Andesite	
	- Split/Crushed Stone	40.000
	- Boulder	100.000

Estimation result of material eruption fragment from several locations in the upper reaches of Boyong River, Kuning River and Gendol River, obtained size distribution for sand is ± 15%, dumping materials (*urug*) is ± 40% and boulders is ± 45%. The result shown that the largest number of commodities is dominated by dumping materials (gravel, small-medium stones and "*bantak"*) and the block of stone (boulder), while the number of sand is smallest. It because the observations and sampling is considered a form of grains or original fragments as lava start to cool. The abundance of sand in some places is quite economical to mine, mostly due to the influence of surface water flow, rock weathering (mechanical and chemical) and from ash eruptions.

Mining recovery of sand and stone estimated at 60% – 80%, or about 40 million m^3 are likely to be mined.

Demand rate of sand and stone for Mount Merapi in Central Java and Yogyakarta is an average of 6 – 9 million m^3/year (Walhi, 1999). If it is assumed that half of the market can be supplied from existing reserves in the fourth river (40 million m^3), the minerals can be commercialized until 4 – 7 years. These estimates would be invalid when Mount Merapi erupted again. As known, the eruption cycle of Mount Merapi is relatively short (<10 years). Material supply from the eruption of Merapi with small-medium intensity, capable of delivering an average of sand and stone needs from 1.5 million m^3/year (BPPTK, 2011) to 2.5 million m^3/year (Walhi, 1999).

If the mineral potential of this gravel fractions specified in the form of sand, boulders and rocks hoard material, the calculation of mineral sands potential is estimated at 15% or 6 million m^3, dumping materials 40% or 16 million m^3, boulders 45% or 18 million m^3.

Estimation of potential economic value of deposition of sand and stones collected in four rivers (Boyong, Krasak, Kuning and Gendol) in accordance with *Peraturan Bupati Sleman No. 33 Tahun 2010* (Table 1) is 959 billion. And the entry tax to local government will be estimated up to 143,9 billion (Table 2).

Table 2. Economic Potential of Sand and Rock Boulder from Merapi Mount Eruption 2010

No.	Commodities	Volume (million m^3)	Price Per m^3 (Rp)	Economic Potential (Billion Rp)	Tax 15% (Bollion Rp)
1.	Sand	6	25.000,-	15	2,25
2.	Gravel	16	14.000,-	224	33,6
3.	Rock Boulders	18	40.000,-	720	108
			Total	959	143,9

Estimation of economic value in the table above exclude other economic potential due to the multiplier effect that arise and evolve along with the mining activities.

5. Conclusion

From the previous discussion can be concluded that:

1) Identification of the fragment size distribution from eruption (estimation of amount/volume according mineral commodities) is very important and needs to be done, because it is closely related to the calculation of economic potential value and tax revenue.
2) The estimation of percentage and volume of sand and stone using model photometry in the four rivers that disgorge at Merapi Mount (Boyong, Krasak, Kuning and Gendol River) is classified into 3 commodities: sand, dumping materials/gravel and rock boulders.
3) Based on the calculation of mineral sands potential is estimated at 15% or 6 million m^3; dumping materials/gravel at 40% or 16 million m^3; rock boulders at 45% or 18 million m^3.

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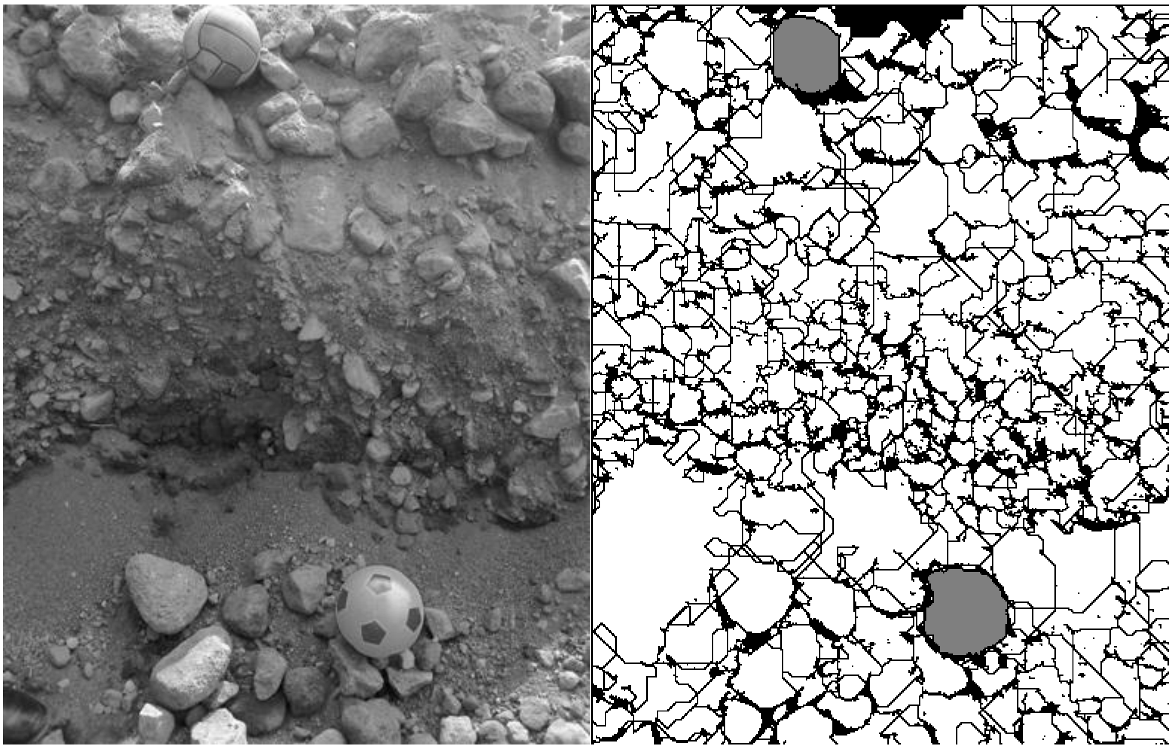
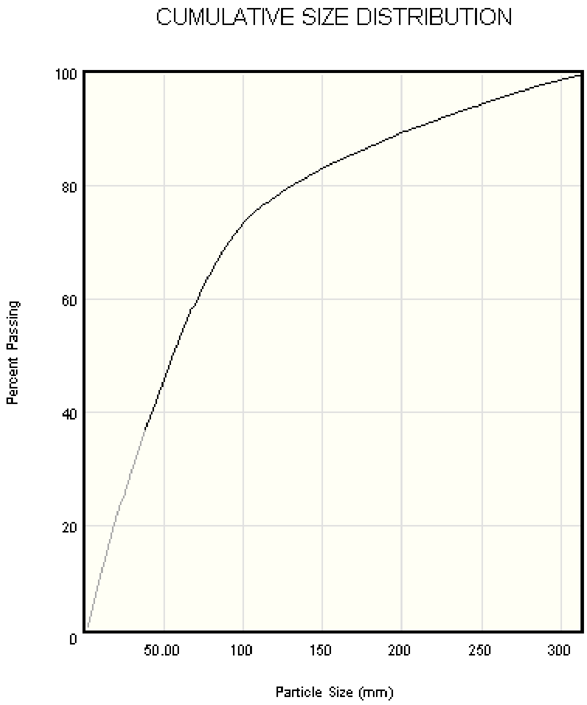
Figure 2.

Image Scanning and Fragment Distribution of Eruption Material in Gendol River, Glagaharjo, Cangkringan (Code F-13)



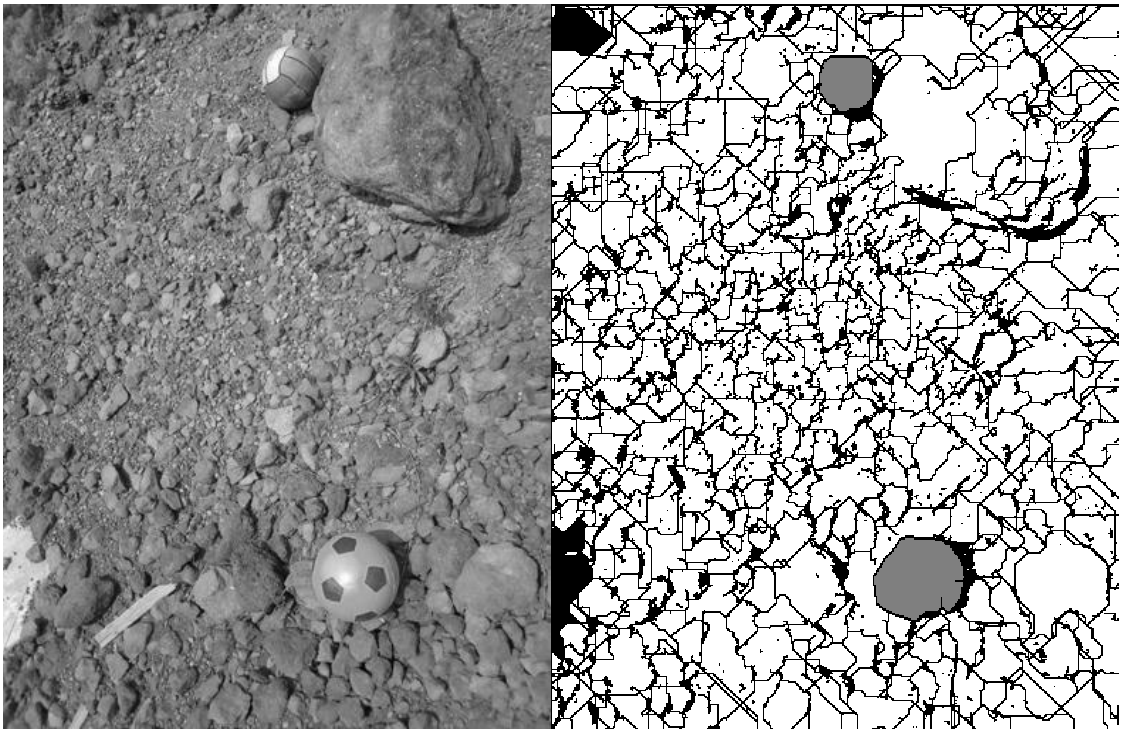


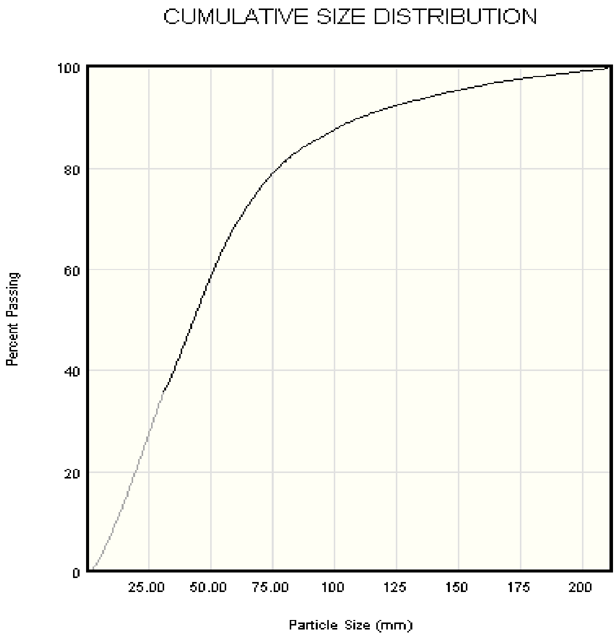
size (mm)	%
1905.00	100.00
1270.00	100.00
635.00	100.00
381.00	100.00
254.00	94.83
203.20	89.80
152.40	83.45
101.60	73.83
50.80	46.31
38.10	37.09
25.40	26.20
19.05	20.15
12.70	13.71
9.525	10.35
6.350	6.91
4.750	5.15
1.999	2.12

P20 Size (mm) 18.90
P50 Size (mm) 55.75
P80 Size (mm) 129.97
Top size (mm) 309.85

Figure 3.

Image Scanning and Fragment Distribution of Eruption Material in Gendol River, Glagaharjo, Cangkringan (Code F-19)





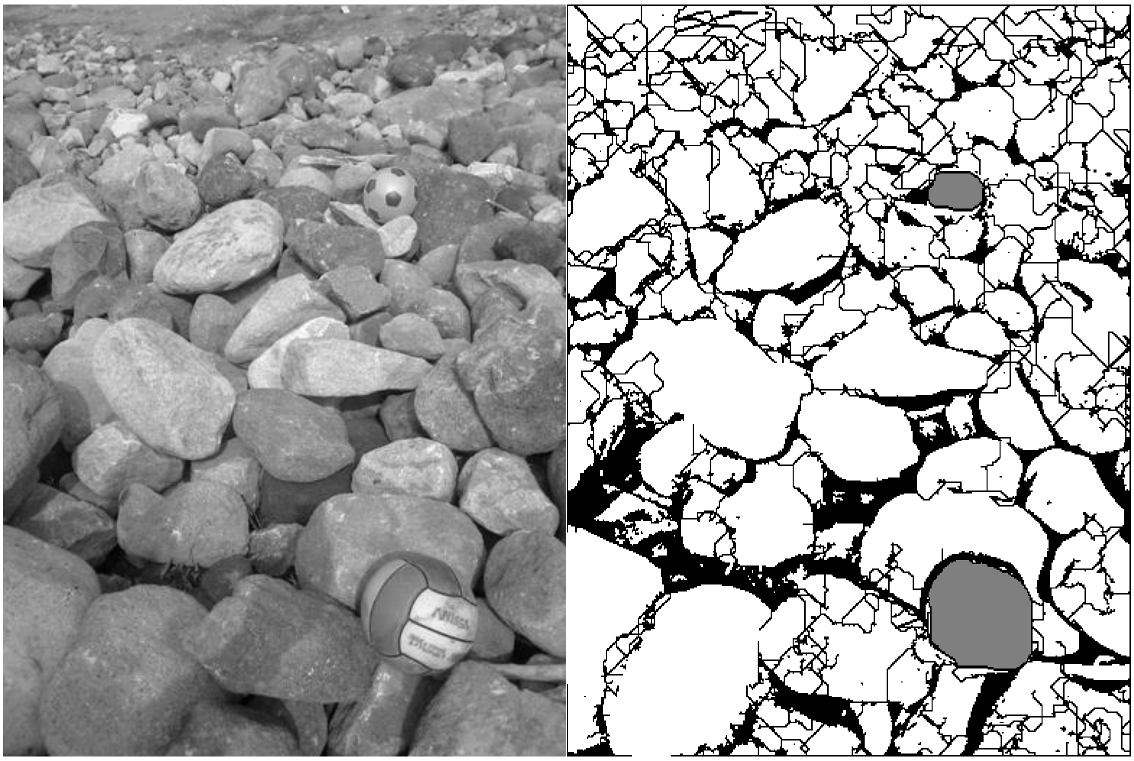
size (mm)	%
1905.00	100.00
1270.00	100.00
635.00	100.00
381.00	100.00
254.00	100.00
203.20	99.34
152.40	95.65
101.60	88.11
50.80	59.53
38.10	44.01
25.40	28.18
19.05	19.54
12.70	11.34
9.525	7.63
6.350	4.32
4.750	2.86
1.999	0.81

P20 Size (mm) 19.39
P50 Size (mm) 42.89
P80 Size (mm) 77.03
Top size (mm) 206.23

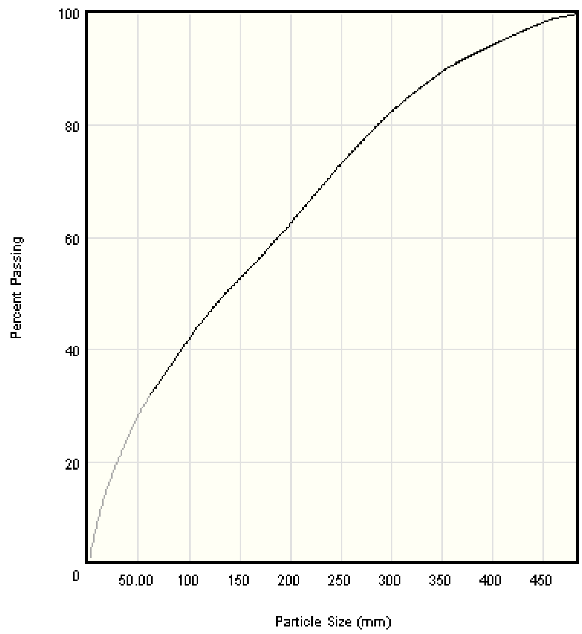
SPLIT ENGINEERING

Figure 4.

Image Scanning and Fragment Distribution of Eruption Material in Yellow River (Code F-14)



CUMULATIVE SIZE DISTRIBUTION



size (mm)	%
1905.00	100.00
1270.00	100.00
635.00	100.00
381.00	92.65
254.00	73.97
203.20	63.22
152.40	53.15
101.60	42.49
50.80	28.63
38.10	23.99
25.40	18.52
19.05	15.33
12.70	11.68
9.525	9.59
6.350	7.25
4.750	5.92
1.999	3.26

P20 Size (mm) 28.61
P50 Size (mm) 135.75
P80 Size (mm) 285.79
Top size (mm) 474.14

SPLIT ENGINEERING