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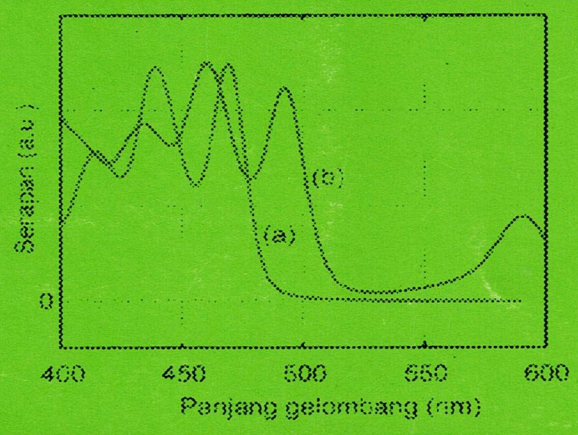

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MAGNETIC GRAIN SIZE DETERMINATIONS OF ANDESITIC ROCK FROM THE ISLAND OF JAVA BY MAGNETIC

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ABSTRACT

A magnetic grain size of igneous rock is determined by process of forming igneous rock. The small grain size of igneous rock is produced by the fast process cooling and crystallization of molten rock, and vice versa. Therefore, the determination of grain size, in turn, is important in the field of geology such as grain size to determine the rock types. In practice, it is not easy to determine the grain size of the natural rock samples. The common method to determine of mineral grain size is SEM analysis, but this analysis can't measure the natural grain size and so it is a relative high cost method. In this study we propose to determine the relative grain size of andesitic rocks from Java by mean of magnetic method. In this method, known as King et al. method, both DC or initial magnetic susceptibility as well as anhysteretic susceptibility were measured and the results were plotted against standardized lines. We measured about 213 paleomagnetic specimes from 21 sites that are distributed all the way from West to East Java. The results show that there are, basically, two groups of sites based on their magnetic grain sizes. One of them is the lavas with magnetic grain sizes of less than 1 micron and the intrusions with magnetic grain size of 1 to 200 micron. This classification of the rocks agree with the published geological data. This shows that rock magnetic method might be useful in geological study, particularly when the outcrop is relatively small in size so that the proper geological observation cannot be carried out.

Keywords : Igneous rocks, magnetic grains, magnetic susceptibility

I. INTRODUCTION

An igneous rock is formed by the cooling and crystallization of molten rock. The term igneous is derived from *ignius*, the Latin word for fire. Scientists have divided igneous rocks into two broad categories based on where the molten rock solidified. **Volcanic rocks** (also called extrusive igneous rocks) include all the products resulting from eruptions of lava (flows and fragmented debris called

pyroclasts). **Plutonic rocks** (also called intrusive igneous rocks) are those that have solidified below ground; plutonic comes from Pluto, the Greek god of the underworld. The other classification of the igneous rock is based on *composition* and *texture* (mainly grain size) of them. The compositions of the igneous rock vary from basaltic to andesitic to rhyolitic. These are terms to designate the fine-grained, volcanic (extrusive) rocks for these various compositions. The terms that describe the coarse-grained, intrusive rocks for equivalent compositions are gabbro (basalt), diorite (andesite), and granite (rhyolite). Classification on the basis of grain size is important because it relates to the cooling process of the rock. If a rock crystallized at depth, then it cools slowly and grains in the magma have time to grow. If a magma is extruded at the surface of the Earth, then cools very fast, in a matter of hours, days, or months (still very fast compared to other Earth processes), the grains will not have time to grow; this is why basalt or andesite has a fine grain size. In practice, it is not always easy to determine the grain size of the natural rock samples. Because, the naked eyes have many lack to determine the grain size. To eliminate this lack, most researcher have been success to shown that magnetic properties depend on to the grain size.[1,2] Therefore, in this research, we propose to determine the relative grain size of andesitic rocks by mean of magnetic method. In this method, known as King et al. method, based on the magnetic measurement, i.e. measured both DC or initial magnetic susceptibility as well as anhysteretic susceptibility and the results were plotted against standardized lines.

II. RESEARCH METHOD

II.1 Anisotropy of low-field magnetic susceptibility (initial magnetic susceptibility)

For magnetic measurements, the hand-samples were cut and coring into cylinders specimens with a diameter of 2.5 cm and a height of 2.2 cm. More than 213 specimens from 21 sites were measured for AMS using a Bartington susceptibility meter instrument. The mean AMS eigenvectors (K_{max}, K_{int}, K_{min}) for

each site were calculated using the Aniso20 software. Mean of each samples calculate by $K_m = (K_{max}, K_{int}, K_{min})/3$.[3] Orientation of the samples like as Figure. 1.

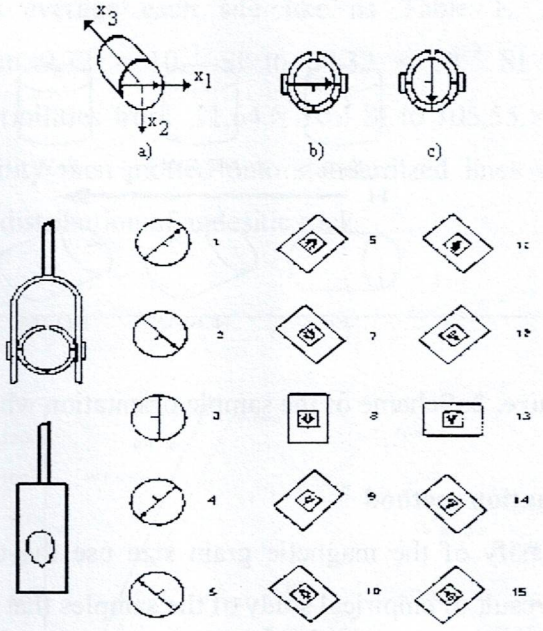

Figure. 1. Sample orientation of the AMS measurement

II.2 Anisotropy of anhysteretic susceptibility

Anisotropy of anhysteretic susceptibility (AAS) is a method that measure of the anisotropy of ability of the samples to recieve anhysteretic of remanent magnetization (ARM). The samples recieve ARM when put it's on the direct low-field and alternating high-field simultaneously. Intensity of ARM proportional to the direct low-field intensity. The proportional constant call as the ARM suseptibilitas or AAS.[4] The AAS can be obtained by applied the alternating high-field, therefore often call the high field susceptibility.[5]

The AAR is given to obtained the specific anisotropy of ferromagnetic material. The AAR measurement to began by apply ARM (anhysteretic remanent magnetization) to the sample by put it's on the coil addition in Molspin AF demagnetizer. Addition of the coil to give the low direct magnetic field while the samples recieve the decay alternating high field. The magnetisation of the samples

furthermore be measure by Minispin magnetometer, and this process repeated to several directions, like Figure 2, until it's anisotropy can be calculated.

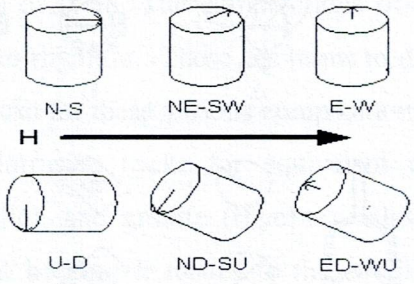

Figure. 2. Scheme of the sample orientation when ARM is given

II.3 Combination method

To clasify of the magnetic grain size use the combination method like King's at.al. result of empirical study of the samples that contain 1% magnetite. In this study show that there are significan correlation between an initial usceptibility (AMS) and anhysteretic susceptibility (AAS) to variation of magnetite grain size such as Figure 3.

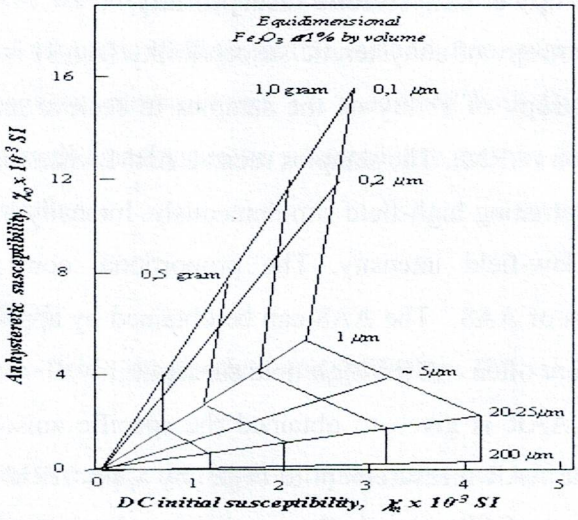

Figure 3. Ploted empirical model of AAS versus AMS to estimation of magnetic grain size.[6]

III. RESULT AND DISCUSSION

AMS and AAS data for 213 specimens from 21 site of the andesitic rock can be shown in average each site like as Table 1. The average bulk susceptibilities from 9,72 × 10^{-3} SI to 69,32 × 10^{-3} SI and the average anhysteretic susceptibilities from 11,64 × 10^{-3} SI to 105,55 × 10^{-3} SI. The both value of susceptibility then plotted onto standardized lines with the result the magnetic grainsize distribution of andesitic rock.

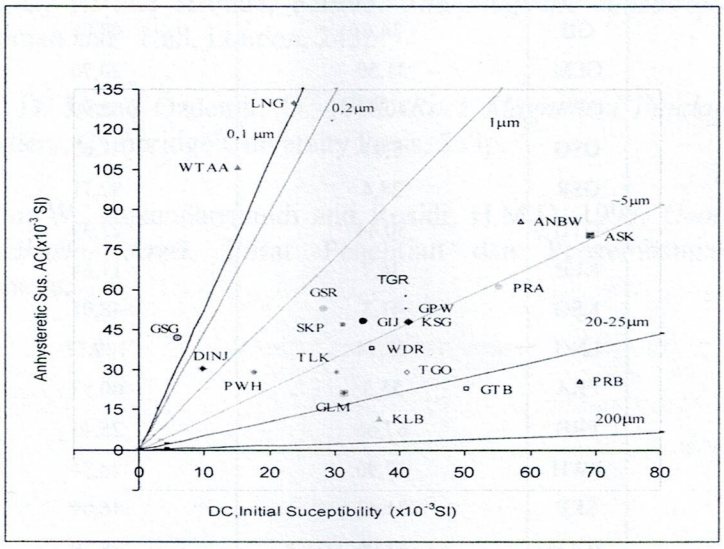

Figure 4. Magnetic grain size distribution

The rock magnetism determinations have allowed the successful characterization of two magnetically distinct groups of extrusive rock and intrusive rock. The results show that there are, basically, two groups of sites based on their magnetic grain sizes. One of them is the lavas (extrusive rock) with magnetic grain sizes of less than 1 micron and the intrusions with magnetic grain size of 1 to 200 micron. This classification of the rocks agree with the published geological data. For example, site WTAA is the pillow lava with magnetic grain size less than 1 micron, like be visible in Figure 4.[7] This shows that rock magnetic method might be useful in geological study, particularly when the outcrop is

relatively small in size so that the proper geological observation cannot be carried out.

Table 1. Average AMS and AAS

Site	Xams ($x10^{-3}$ SI)	Xaas ($x10^{-3}$ SI)
ANBW	58,60	85,79
ASK	69,32	80,19
DINJ	9,72	30,41
GIJ	34,6	48,01
GLM	31,50	20,76
GPW	40,93	52,90
GSG	6,01	41,65
GSR	28,4	52,71
GTB	50,44	22,39
KLB	36,7	11,64
KSG	41,3	48,01
LNG	23,74	129,77
PRA	55,3	60,97
PRB	67,66	25,46
PWH	17,90	28,54
SKP	31,43	46,69
TGO3	41,06	28,79
TGR	40,94	57,84
TLK	30,54	28,47
WDR	35,93	37,57
WTAA	15,15	105,55

IV. CONCLUSION

The rock magnetism determinations have allowed the successful characterization of two magnetically distinct groups of extrusive rock and intrusive rock. These groups of sites based on their magnetic grain sizes. One of them is the lavas (extrusive rock) with magnetic grain sizes of less than 1 micron and the intrusive rock with magnetic grain size of 1 to 200 micron.

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