PROCEEDINGS OF GEOSEA XIV AND 45th IAGI ANNUAL CONVENTION 2016

"*ASEAN Earth Resources and Geoscientist Role in AEC Era*".

10-13 October 2016, Bandung, Indonesia

IKATAN AHLI GEOLOGI INDONESIA (IAGI)

IndonesiaAssociation of Geologist

Ikatan Ahli Geologi Indonesia (IAGI)
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PREFACE

The 45th Annual Scientific Convention of the Indonesian Association of Geologists (IAGI) this year has been held in conjunction with the GEOSEA Congress XIV (abbreviated as GIC-2016). The GEOSEA is a communication forum for the geologists in Southeast Asia countries.

The main theme of the event which is the ASEAN Earth Resources and Geoscientist Role in AEC (ASEAN Economic Community) Era has made the papers submitted and presented in the event covering a wide range of variety. The main theme covering two main topics, i.e. earth resources and geoscientist development in ASEAN countries has also been represented by the papers presented in this event.

Although since several years ago, the earth resource industry situation has not been that bright, triggered by the declining of commodity prices, regulation uncertainty, and also other issues related to the local stakeholders; this GIC 2016 event has attracted significant numbers of participants including industry geologists, faculty staff from the universities, government agencies, contractor companies, and other experts. It is the IAGI's pride to present this GIC 2016 event for the benefit of geological society in both Indonesia and ASEAN countries.

The proceedings contain all papers presented in the GIC 2016, covering various topics including

1. Engineering Geology, Hydrogeology, Mitigation and Applied Geology
2. Geology and Geophysics Method and Application
3. Geotourism
4. Mineral And Energy Resources Management
5. Mineralogy, Petrology, Geochemistry
6. Sedimentology, Stratigraphy, and Petroleum Geology
7. Tectonic, Structural Geology and Geodynamic
8. Volcanology and Geothermal

They are written by experts from various geology background including industry, government institutions, and universities.

On behalf of IAGI, we would like to thank all authors, paper reviewers, editorial team, and also to all sponsors from industry and government for their contributions and involvements. Without all of them the GIC 2016 event and the publication of this proceeding will not happened.

Bandung, October 2016

Sukmandaru Prihatmoko
Chairman of IAGI (Indonesian Association of Geologists)

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Protolith of Joko Tuo Marble, Bayat, Central Java; contribution to paleoenvironment and age of metamorphic rock.

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Abstract

Marble and Phyllite are well known as Pre-Tertiary basement rock crop out in Joko Tuo area, East Jiwo Hill, Central Java. These rocks contain fossil record even though they have undergone metamorphism. Preliminary petrographic study in several samples of show the existence of larger foraminifera *Orbitolina* sp. in good preservation condition between foliated of chlorite-biotit-graphite. Based on petrographic data, the metamorphic rocks that were studied comprised of foliated marble that dominantly consist of calcite, chlorite, biotit, graphite and feldspar. The protolith of metamorphic rock interpreted derived from fine grained calcareous sedimentary rock which was deposited in shalow marine environment at Late Cretaceous age.

Introduction

The protolith of a metamorphic rock is defined as the original rock prior to metamorphism. This is comprises rocks of all possible chemical compositions and include the entire range of sedimentary, igneous and metamorphic rocks. The protolith of a metamorphic rock can be interpreted based on the mineralogy and/or the rock texture.

The marble and phyllite in Joko Tuo area, East Jiwo Hills is interesting object for protolith study. Preliminary investigation show that these rocks contain fossil record even though they have undergone metamorphism. The preservation of fossils in metamorphic rocks is unusual, except in low-grade metamorphosed sedimentary rocks. This paper explains petrographical observation of some sample from Joko Tuo area. The study of protolith and surviving fossil content in this area will contribute the paleoenvironment and age of the Jiwo Hills terrane.

Geological Outline

Geologically, Jiwo Hills, Bayat, Central Java (Figure 1) built by elevated basement rocks covered by a relatively thin marine sedimentary rock layers and intruded by numerous igneous rock bodies (Salahuddin & Novian, 2014). The basement complex mostly composed of metamorphic rocks, such as phyllites, mica schists, calc-silicate schist and marbles (Setiawan et al., 2013). Amphibolite, blue schist, and sepentinite also reported present in this area (Warmada et al., 2008). Among them, phyllites are the most widespread, generally in weathered condition with some quartz veins and calcite veins aligned with their foliation. In Pre-Tertiary Jiwo, no fossiliferous beds have been found, only boulders of *Orbitolina* limestone derived from neogene conglomerate have been found near desa Santren which shows that at least part of pre Tertiary sub stratum is Cretaceous age (Bothé, 1929). The age of this basement rocks by applying K-Ar absolute dating indicate an age of 98 mya or Late Cretaceous (Prasetyadi, 2007). This metamorphic rocks is interpreted to be formed during a regional metamorphism that involved along an ancient subducting lithospheric plate and the plates collision afterward (Setiawan et al., 2014).

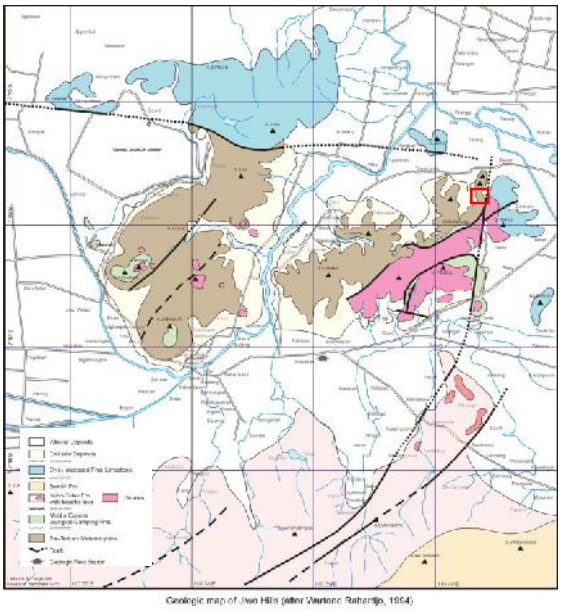

Figure 1: Geological Map of Jiwo Hills (after Rahardjo, 1994). The red box is the location of Joko Tuo area.

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Data and Method

The research methods comprising the following steps of preparation, field data collections, laboratory analysis (petrography) and stage of integration and interpretation. Several selected rocks samples were collected from Joko Tuo area for thin section preparation. Microscopic analyses have been performed on 3 thin sections. This observation was conducted to describe texture, structure and composition of these rocks. In low grade metamorphic rocks, original textures and composition are often preserved allowing one to determine the likely protolith. Preservational features of fossil allowed the identification the age of protolith and the paleoenvironment.

Result and Discussion

Field investigation in Joko Tuo, East Jiwo Hills confirm that low grade metamorphic rocks; marble and phyllite are present in this area (Figure 2 a and b). Fault and fracture are recognize intensively in this area with dominant trend of fault is NWN-SES and NEN-SWS.

Figure 2: Outcrop of metamorphic rock (a) phyllite and (b) marble in in Joko Tuo area, East Jiwo.

In this section, petrographical characteristics of collected metamorphic rock samples are discussed. Two sets of metamorphic effects have been considered, those related to deformation processes and mineralogical transformations. The deformation is producing foliation, augen and fracture in relict mineral-fossil.. Description of mineral composition under the microscope are given at below and Table 1.

Sample JT1 : *Foliated marble*
Foliated marble show weak foliated – granoblastic texture. Weak foliated is developed by graphite, phlogopite, chlorite and less sericite, while granoblastic texture composed by calcite. Relict fossils is present in minor percentage (Figure 3 a, b). Mylonitic texture is also recognize.

Sample JT3 : *Marble*
Marble show granoblastic texture dominant consist of calcite. Several quartz and calcite vein are cross-cutting this rock, which is regarded as secondary phase (Figure 3 e, f).

Sample JT 4 : *Foliated marble*
Foliated marble show weak foliated – granoblastic texture. Weak foliated is developed by graphite, phlogopite, chlorite and less sericite. Granoblatic of calcite is dominant. This rock also contain detrital quartz, plagioklas feldspar (Figure 3 c, d). Relict fossils are recognize in minor percentage.

Table 1. Selected sample and their mineral content

Sample	Rock Types	Metamorphic grade	Major Mineral					Minor Mineral				Secondary
			cc	br	ch	gp	bi	fos	fs	qz	dl	
JT1	Foliated Marble	Green schist	⊗	*	*	*	*	*	#	#	#	sr
JT3	Marble	Green schist	⊗	#		#	*			*		cc, qz vein
JT4	Foliated Marble	Green schist	⊗	#	*	*	*	*	*	*	#	sr, cc qz vein

cc=calcite, br=brucite, ch=chlorite, gp=graphite, bi=biotit, s=sericite
fos=fossil, fs=feldspar, qz=quartz, dl=dolomite
⊗=abundant, ∅ = moderate, *=poor, # = trace 0 = absent

The petrographical anaysis has revealed that metamorphic grade of three selected samples are very low grade metamorphism which characterized by weak foliated and the presence of relict sediment material. Petrographic data indicate the content of calcite is very high and dominates the metamorphic rocks in Jokotuo accompanied by the appearance dolomite mineral. Calcite and dolomite consists of high Ca and Mg. Alfyan and Setiawan (2014) conduct XRF geochemical analysis to determine major oxides and trace elements content of this marble with is a marble on this area is a dolomitic marble.

Based on the mineral assemblage, the protolith of foliated marble are probably fine grained carbonate rocks. The presence of graphite and chlorite indicate that the protolith associate with carbon and pelitic sediment which is high in Al and Si. Relict feldspar and quartz indicate mixed volcaniclastic and carbonate material. Mylonitic texture in JT1 samples indicates there has been a regional metamorphism with active deformation. This show that the early deformation proces has occured at depth, in ductile zone or below brittle faults.

Preservation of fossils are common in foliated marble sample with diferent style of deformation. Some fosills are trasformed from micrite-calcite into brucite-chlorite The fossil recognize as *Orbitolina sp*., a large agglutinated foraminifera. They comprise important biostratigraphic marker and are used for biozonations, particulary for Barremian, Aptian, Albian and Cenomanian (Late Lower – Early Upper Cretaceous) platforms and ramps (Flugel, 2004; Marcelle and Boudhager-Fadel, 2008). This new finding confirm that the age of part of metamorphic rocks in Jiwo Hills is Cretaceous.

Unraveling detailed paleoenvironmental conditions in which low grade metamorphisme and metasediments formed is often a challenge. The dominance of fine-grained carbonate together with carbon and *Orbitolina sp.* points to deposition was in shallow marine setting close to transitional environment. The presence of feldspar indicate that the sediment material derived from volcanic source and becomes interesting when linked to the fact that the oldest recorded volcanism in Java is in Paleogene. This data guide to the new hypothesis of the existance of Cretaceous volcanism. Furthermore, intergrated study in Jiwo Hill area is needed to understanding the evolution of paleogeography and tectonic evolution in this area.

Conclusion

The metamorphic rocks in Joko Tuo area are very low grade metamorphism; foliated marble and marble. The protolith of metamorphic rock interpreted derived from fine grained calcareous sedimentary rock associate with carbon and pelitic sediment. The presence of feldspar is indicate the existence of Cretaceous volcanism. Marine fossil assemblages preserve in metamorphic rocks recognize as *Orbitolina* sp. which is indicate Late Lower – Early Upper Cretaceous age. Based on the textural, mineral composition and fossil content the paleoenvironment of this rocks are interpretated in shalow marine environment.

References

Alfyan, M.F., Setiawan, N.I., 2014. Petrogenesis Batuan Metamorf di Daerah Perbukitan Jiwo, Kecamatan Bayat, Kabupaten Klaten, Provinsi Jawa Tengah. Seminar Nasional Kebumian 7, Geological Engineering Department, Faculty of Engineering, Universitas Gadjah Mada, Yogyakarta.

Best, M.G., 2003. Igneoous and Metamorphic Petrology. Blackwell Publishing Company, Victoria-Berlin, 2nd ed.

Boudhager-Fadel, M.K., 2008, Evolution And Geological Significance of Larger Benthic Foraminifera, Elsevier, Amsterdam.

Bothé, A.Ch.D (1929) Jiwo Hills and Southern Range Excursion Guide. IVth Pacific Science Congress, Java, Bandung, pp. 1-14.

Flugel, E., 2004, Microfacies of Carbonate Rocks: Analysis, Interpretation and Application, Springer, Berlin.

Husein, S., and Novian, M.I., 2014, Guide book: Geology Excursion to Bayat, Central Java – Santos (Sampang) Pty.Ltd., Geological Engineering UGM, pp. 1-14.

Prasetyadi, C., 2007, *Evolusi Tektonik Paleogen Jawa Bagian Timur*. Disertasi, Program Doktor Teknik Geologi, Institut Teknologi Bandung.

Setiawan, N.I., Yasuhito, O., Prasetyadi, C., 2013, A Preliminary View and Importance of Metamorphic Geology from Jiwo Hills in Central Java, *Prosiding Seminar Nasional Kebumian ke-6*, Yogyakarta pp.11-21.

Setiawan, N.I., S. Husein, and M.F. Alfyan (2014) Speculative models of exhumation on high-pressure low-temperature metamorphic rocks from central part of Indonesia: an implementation of concepts and processes. *Prosiding Seminar Nasional Kebumian ke-7*, Yogyakarta.

Warmada, I.W., Sudarno, I., and Wijanarko, D., 2008, Geologi dan Facies Batuan Metamorf daerah Jiwo Barat, Bayat, Klaten, Jawa Tengah, Media Teknik, vol.2, pp.113-118.

Bothé, A.Ch.D (1929) Jiwo Hills and Southern Range Excursion Guide. IVth Pacific Science Congress, Java, Bandung, pp. 1-14.

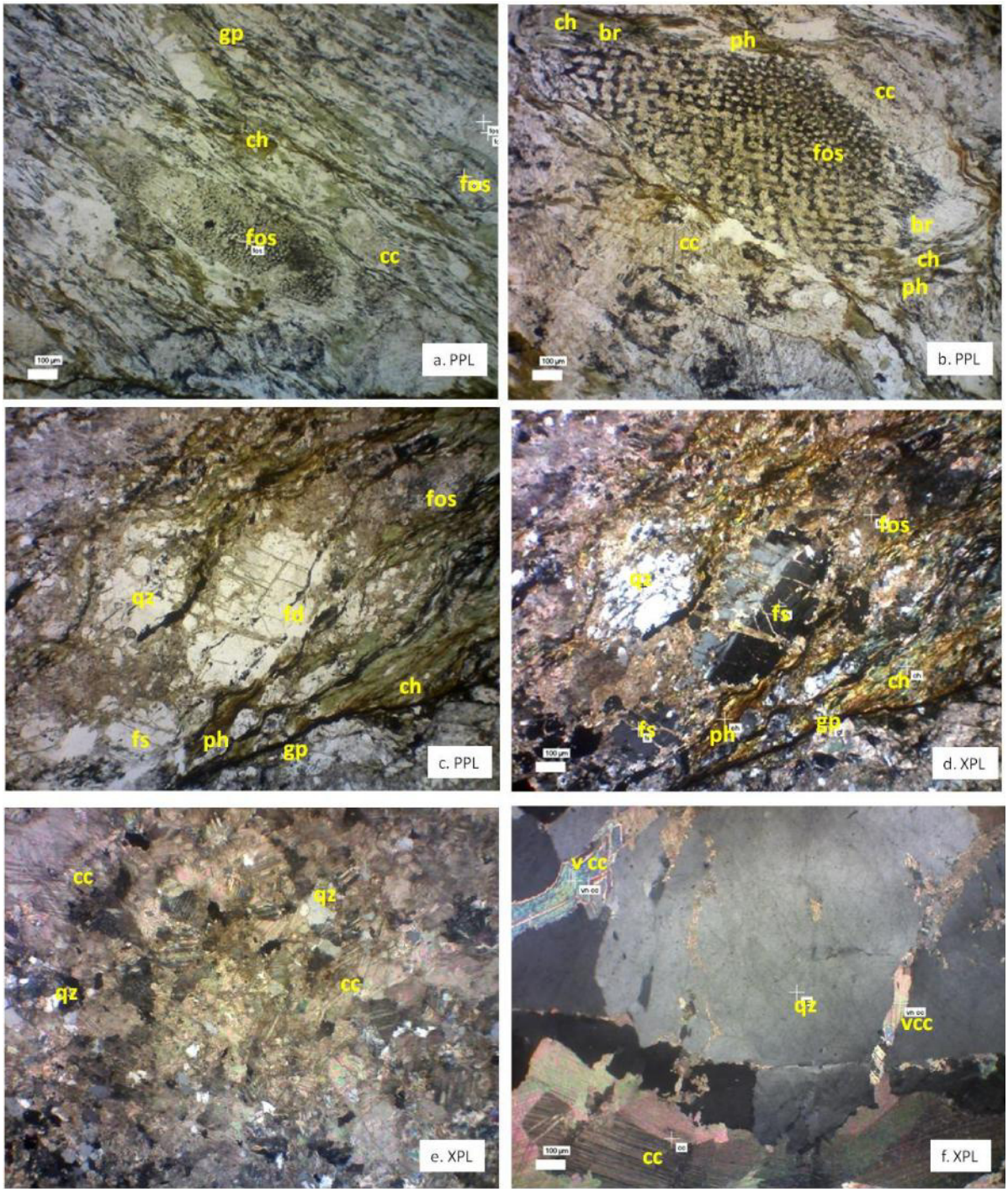

Figure. 3. Photomicrographs showing the mineral assemblage and representative texture of the metamorphic rocks. (**a and b**), JT1: phyllitic-marble, with Orbitulina fossil (fos) in weak foliated chlorite (ch)-phlogopite(ph)-graphite(gp) and calcite (cc); (**c and d**) JT 4: phyllitic marble-metacalcareous containing weak foliated foliated chlorite (ch)-phlogopite(ph)-graphite(gp) and

relic of feldspar (fs) and quartz (qz). (**e**) JT 3: marble, consisting granoblastic of calcite (cc) with minor feldspar (fs) and quartz (qz); (**f**), JT3: marble-quarzite, with calcite (cc) and quartz (qz)