THE PROVENANCE OF SEDIMENTARY ROCKS FOR JATILUHUR FORMATION AT MIDDLE MIocene – LATE MIocene ERA IN THE CIPAMINGKIS RIVER PASS, BOGOR BASIN, WEST JAVA, INDONESIA

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Abstract

The lithology in the research area is claystone to fine sandstone belonging to the Jatiluhur formation with an age of N13 – N16 or equivalent to the middle Miocene. The provenance (original rock) in the age range of N15 – N16 comes from plutonic rocks and the tectonic setting. This study aims to investigate the geological history in relation to the tectonic setting and origin of the source of rock forming the sandstone in the formation. Employing a provenance study, the research area was located in two zones, consisting of the Continental Block tectonic setting in the Basement Uplift sub-zone and the Magmatic Arc in Dissected Arc sub-zone. The provenance in the N13 – N14 age range has two tectonic settings: Continental Block in Basement Uplift and Transitional Continental sub-zones and Magmatic Arc with Dissected sub-zones.

Keywords: Jatiluhur formation, Mineralogy, Provenance, Sedimentary rocks, Tectonic setting.

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1. Introduction

The Bogor basin in West Java is generally composed of deep sea turbidite volcanioclastic deposits where sedimentary material comes from the south with a thickness of more than 7000 m [1]. However, in the northern part of the Bogor basin, there are Miocene-aged deposits composed of a mixture of clastic and carbonate sediments known as the Jatiluhur Formation [2]. In some references, this deposit is also known as the Annularatus Complex [3] or the Cibulakan Formation [1], which is also equivalent to the Upper Cibulakan Formation [4]. Studies related to the Bogor Basin in West Java have been carried out by many experts, both from Indonesia and from abroad, but in the context of a broad and regional discussion [1, 2, 5, 6].

This study is intended to clarify the geological history related to the tectonic setting and origin of the source rock making up the sandstone in the formation using provenance studies [7, 8]. Mineralogy is a very important aspect of studying the provenance of siliciclastic sedimentary rocks, especially sandstones. The minerals in the sandstone can show the lithology of the source rock and determine the origin of the sandstone based on the influence of its tectonic setting [9, 10]. The petrographic naming of rocks is also done by looking at the Percentage of Quartz, Plagioclase and Lithic Fragments mineral content and plotted on the 1987 Pettijohn triangle. After that, the rock origin and tectonic setting will be plotted on Dickinson's 1979 triangle. The age of sedimentary rocks is determined by sedimentary rock samples in the path stratigraphy carried out in the previous mapping activity. The relative age of sedimentary rocks was identified using standard SOPs for geological mapping using the interval zone method [11].

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2. Methods

The variation of lithological units of the outcrop at the Cipamingkis River, Cileungsi River, and Ci howe River (Fig. 1) represents the data needed in this study. In these rivers, the exposed rocks sedimentary rocks of the Jatiluhur Formation (Fig. 1).

Using the interval between samples, samples of rock will be taken from all stratigraphic section measurements, the sampling distribution will be adjusted to the results of field activities later, and all samples collected will be performed for petrographic analysis dan geochemical analysis.
The careful labelling of samples in the field at the collection site is perhaps obvious. A geological description of the site is important, accompanied by photographs and the precise GPS location. The condition will allow the researcher or their successor to return to the precise sample site if necessary, and such information is often important in the future publication of the results.

3. Findings and discussion

Provenance was determined using two triangle diagrams by Dickinson and Suczek [7], namely the Q-F-L diagram and the Qm-F-Lt diagram. Q-F-L diagram based on the Percentage of total quartz (Q) consisting of monocrystalline quartz (Qm) and polycrystalline quartz (Qp), feldspar (F) consisting of alkali feldspar and plagioclase, lithic (L) consisting of sedimentary rock fragments and rock fragments volcanic. Qm-F-Lt diagram based on the Percentage of total monocrystalline quartz (Qm), feldspar (F) consisting of alkali feldspar and plagioclase, and Lt composed of sedimentary rock fragments, volcanic rock fragments, and polycrystalline quartz. The percentage results above were then input into the Dickinson and Suczek [7] provenance triangle diagram Q-F-L and Qm-F-Lt (Fig. 2). Based on data from six samples that have been analyzed, it shows that five samples are in the Continental Block tectonic setting, namely the Basement Uplift zone and one sample is in the Magmatic Arc tectonic setting, namely the Dissected Arc zone. Table 1 shows the mineral percentage of Q-F-L and Qm-F-Lt.
Table 1. The mineral percentage Q-F-L and Qm-F-Lt

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CPM 4.7</td>
</tr>
<tr>
<td>Quartz (Qm+Qp)</td>
<td>32</td>
</tr>
<tr>
<td>Feldspar (F)</td>
<td>25</td>
</tr>
<tr>
<td>Lithic (Lt)</td>
<td>5</td>
</tr>
<tr>
<td>Qm-F-Lt</td>
<td></td>
</tr>
<tr>
<td>Quartz (Qm)</td>
<td>29</td>
</tr>
<tr>
<td>Feldspar (F)</td>
<td>25</td>
</tr>
<tr>
<td>Lithic (Lt+Qp)</td>
<td>8</td>
</tr>
</tbody>
</table>

Provenance analysis used five thin slices of sandstone with an age range of N13-N14. The sandstone component in the study area was dominated by feldspar content which was more abundant than quartz and rock fragments. Determination of provenance using Dickinson and Suczek [7] diagrams in the study area by calculating the Percentage of mineral content shows the composition of quartz consisting of monocrystalline and polycrystalline quartz ranging from 18% to 58%, feldspar minerals consisting of alkali feldspar and plagioclase feldspar showing a percentage of about 34% to 73%, and the content of rock fragments in the range of 0% to 27% (Table 2). The calculation of these components was then plotted in two diagrams by Dickinson and Suczek [7] in the form of a QFL diagram with Q as total quartz (Qm + Qp), F as feldspar and L as lithic fragments, while the second diagram was a QmFLt diagram with Qm as monocrystalline quartz, F as feldspar and Lt as total lithic (L + Qp). Based on the results of plotting the analysis of the five samples on the QFL and QmFLt diagrams. In the QFL plot diagram, four rock samples in the study area, namely SS 7.5, SS 7.11, SS 8.5 and SS 8.9, indicate that they originate from the Continental Block tectonic setting (Basement Uplift and Transitional Arc), which was a raised basement which then erodes. In contrast, one other sample SS 6.6 had a supply of sediment sources originating from the Magmatic arc tectonic setting (Dissected Arc), which was the result of exposed plutonic rocks due to the eroding of the overlying cap. The plotting of the QFL diagram is shown in Fig. 2. The QmFLt plot diagram shows that four rock samples in the study area, namely SS 7.5, SS 7.11, SS 8.5 and SS 8.9, indicated the supply of sediment sources originating from the Continental Block (Basement Uplift) tectonic setting. In contrast, the SS 6.6 sample showed a tectonic setting in the form of a Magmatic Arc (Dissected Arc). In the meantime, the percentage of mineral of other components is shown in Table 2.

Table 2. The mineral percentage of Qm+Qp-F-L and Qm-F-Lt+Qp.

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SS 6.6</td>
</tr>
<tr>
<td>Quartz (Qm+Qp)</td>
<td>45.8</td>
</tr>
<tr>
<td>Feldspar (F)</td>
<td>41.12</td>
</tr>
<tr>
<td>Lithic (L)</td>
<td>13.08</td>
</tr>
<tr>
<td>Qm-F-Lt</td>
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</tr>
<tr>
<td>Quartz (Qm)</td>
<td>31</td>
</tr>
<tr>
<td>Feldspar (F)</td>
<td>42</td>
</tr>
<tr>
<td>Lithic (Lt+Qp)</td>
<td>27</td>
</tr>
</tbody>
</table>

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Fig. 2. Results of plotting five samples of research areas into Dickinson and Suczek diagrams [7] classification of mineral composition including a continental block with uplift basement sub-zone and continental transitional sub-zone, and magmatic arc with dissected arc sub-zone.

4. Conclusion

The lithology in the study area was claystone to fine sandstone included in the Jatiluhur Formation with an age of N13-N14 or equivalent to the middle Miocene. Based on the results of stratigraphic and lithofacies analysis by following Walker's [12] modeling, it is known that the depositional environment is in a deep-sea fan which is in the form of an outer fan, by observing the changes in currents that are getting slower due to reduced topographic factors which are interpreted as the bottom of the basin.

It is indicated by the vertical change of sandstone dominance to claystone dominance getting lower and changing the alternation of fine sandstone and very fine sandstone to alternating very fine sandstone and claystone laterally. The presence of glauconite minerals also supports the interpretation of the marine depositional environment, and small planktonic and benthic foraminifera fossils filled with opaque minerals in the form of pyrite indicate the depositional environment is a reducing environment. Sediments with high quartz content characterize Clements and Hall [13], and Paleogene succession in West Java, and these deposits are interpreted to come from the northern part of the continental provenance.

Paleocurrent research by Septama et al. [14] shows the dominance of the ancient trending northwest direction. Based on this information, the origin of the source rock tectonic setting in the Jatiluhur Formation in the form of the Continental Block is interpreted to come from the Sundaland plateau to the north of the study area.
which is the result of the uplifting of an eroded basement and transported and deposited in the study area during the middle Miocene.

In contrast, the tectonic setting of the Magmatic Arc source comes from the result of volcanic activity in the northern highlands resulting from the subduction of the proto-southern China sea to the northwestern part of Kalimantan, which occurred before the middle Miocene, which was then re-deposited with sediment carried into the Bogor Basin in the middle Miocene.

The Jatituhr Formation in the study area is composed of siliciclastic sedimentary rocks such as claystone which is slightly present, and sandstone predominates, with variations in grain size of fine to very fine sandstone. This formation was deposited at the age of N15-N16 or the same as the Late Miocene. The mineral compositions that make up the sandstone in the study area are feldspar minerals (K-feldspar and plagioclase), monocrystalline quartz, polycrystalline quartz, sedimentary rock fragments, and also volcanic rock fragments.

The presence of monocrystalline quartz minerals indicates that the source rock is a granitic igneous rock [15]. The presence of volcanic and sedimentary rock fragments produces detritus of polycrystalline quartz minerals and feldspars of plutonic origin.

Based on the description above and the study of provenance, it can be interpreted that the existing sediment grains were produced from the uplifted Sundaland continental crust and the product of the volcanic belt on the island of Borneo during the Middle Miocene.

References


