Characterization of Minerals Deposit Patimpeng Bone Regency, South Sulawesi through Petrographic

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Abstract. A research on the characterization of minerals from the Patimpeng District Bone Regency, South Sulawesi using petrographic analysis has been conducted. The aims of this study was to identify the minerals deposited in Patimpeng District. Specimens of rocks are grouped into 13 sections. Characterization of samples was conducted in microstructure laboratory, Department of Physics Universitas Negeri Makassar using Scanning Electron Microscopy-Energy Dispersive X-ray Spectroscopy (SEM-EDS) and X-ray Diffraction (XRD). Based on XRD examinations on 13 samples, 9 samples containing albite mineral. The details of XRD analysis, namely; a) PAT_01 containing titanite 16%, albite 65%, hematite 2.9%, periclaese 3.4%, and quartz 14%; b) PAT_04 containing thomsonite 18.1%, albite 62%, magnetite 18%, anatase 1.18%, and lime 1.36%; c) PAT_05 containing tetratolite 31%, albite 30%, diopside 26%, and magnetite 13%; d) PAT_06 containing indialite 8.5%, albite 58%, clinochlore 23%, anatase 5.4%, and magnetite 4.7%; e) PAT_08 containing Thomsonite 42%, albite, 35%, anatase 2.2%, magnetite 7% and magnesium 14%; f) PAT_10 containing Clinochlore 31%, Sodium 5.2%, albite 55%, anatase 3.1%, hematite 1.75%, and magnetite 3.5%; g) PAT_11 containing clinochlore 19.8%, albite 55%, quartz 21.7%, anatase 1.76%, and magnetite 1.9%; h) PAT_12 containing cronstedtite 2.20%, albite 95.3%, anatase 0.88%, rutile 1.18% and magnetite 0.4%; i) PAT_13 containing ferrohornblende 5.8%, clinochlore 20.9%, periclas 11.9%, and albite 61%. Sample PAT_12 showed that weight percentage (wt%) of albite was dominant than other minerals. The results of petrographic analysis using X-ray mapping for the sample PAT_12 showed that the entire surface is covered with Si which overlap with Al, Fe, Ca, Na, Mg, and Sb.

1. Introduction
Indonesia is an archipelago rich with various minerals. Bone is one of regency in South Sulawesi Province known for its minerals, such as iron in village Bana Bontocani district with estimated at the depth 40-50 meters [17], coal in village Massenrengpulu Lamuru district but the thickness only about 0.56-1.76 meter [14]. South Bone contain much nature minerals such us iron and mangan [1]. This study is related to the exploration and petrographic analysis of minerals deposited in Patimpeng district. Figure 1 show the map of Bone District.
Petrology is a science of rocks concerning the formation, nature, composition, and properties and the structure of rocks. [4]. Petrography is a branch of petrology studying the relief and structure of rocks to distinguish the minerals compositions under polarized light. Besides that, petrography analyze the complexity of bonding, pore structure and aggregate properties of rocks [6]. This analysis is intended to identify the volume and microscopic part of organic based on colours and sample [5]. Sample for petrography analysis is prepared by thinning the sample with a dimension 22mm X 40 mm X 10 mm so that light can be transmitted to microscope [9]. Thin sample provides good quality of polarization to microscope [2].

Petrography analysis can also be performed by using Scanning Electron Microscope (SEM) coupled with Energy Dispersive Spectroscopy (EDS) and X-ray Mapping [10]. SEM is used to study the morphology and microstructure of the sample surface [10]. Sample for SEM is polished to a finished 1 by using diamond paste, coated with gold or carbon for elemental analysis by means of EDS [9]. X-ray Diffraction (XRD) is used to analyse the phase, chemical composition, crystalline level, minerals, as well as crystal defects [10, 16].

2. Method
This research was conducted in laboratory by using minerals taken from Patimpeng district, Bone Regency in South Sulawesi province. Samples were classified into 13 group based on physical appearance and sample location. The samples were designated as PAT_01, PAT_02, PAT_03, up to PAT_13. Microstructure analysis and petrography were conducted in microstructure laboratory, physics department, FMIPA UNM.

Sample were cut into small section, polished until the surface appear shining and plain. The surface morphology and elemental analysis of the Au-Pd coated samples were examined by using Tescan Vega3SB Scanning Electron Microscopy-Energy Dispersive Spectroscopy (SEM-EDS) used for XRD analysis. Rigaku Mini Flex II X-Ray Diffraction (XRD) was used to study the chemical compositions and minerals type of the samples. The results were then compared with X-Ray Mapping to examine the atoms distribution on the surface of the samples. The first paragraph after a heading is not indented (Bodytext style).
3. Result and Discussion

This research aims at finding the functional minerals deposited in Patimpeng area. Based on XRD results it was found there were 9 samples predominantly contain albite particularly the following three samples PAT_01, PAT_04, dan PAT_12. The diffractograms these samples are shown in figure 2, 3 and 4.

![Diffractogram of PAT_01](image)

- **T** = Titanite
- **A** = Albite
- **H** = Hematite
- **P** = Periclase
- **Q** = Quartz

**Figure 2. Diffractogram of PAT_01.**

Quantitative analysis of PAT_01 showed that the composition of the samples were titanite 16%, albite 65%, hematite 2.9%, periclase 3.4%, and quartz 14%.

Figure 3 shows the diffractogram of PAT_04. The chemical compositions of this sample slightly different with PAT_01 but the concentration of albite is still above 60%.
XRD analysis showed that PAT_04 contain Thomsonite 18.1%, albite 62%, magnetite 18%, anatase 1.18%, and lime 1.36%. Figure 4 shows diffractogram of PAT_12 which entirely dominated by Albite mineral.

XRD analysis of PAT_12 showed that this sample comprises cronstedtite 2.20%, albite 95.3%, anatase 0.88%, rutile 1.18% dan magnetite 0.4%. Diffractograms of PAT_01, PAT_04, and PAT_12 showing sharp peaks and high intensity of albite indicating good quality of this mineral [11]. Mineral
Albite with a chemical formula of Na(AlSi3O8) is a type of Plagioklas Feldspar which is used in glass-ceramics industry for decoration. Albite is also used ornament rock, ceramics and mineral specimen [3]. Physically albite form a perfect prism with a clear cleavage, or albite have form prismatic porphyroblasts in millimeter size ((Ømax 1-2 mm), it is clearly appearance than Quartz [7,19].

For the low albite, 90% had melted at temperature 1125 oC in 3 days and just 2 hours at . at 1200 oC. while, for the high albite, activation energy for crystallization is constant at 670 kJ/mol with temperature about 1123 oC, 1125 oC, and 1135 oC but at temperature 1150 oC is an anomaly [11].

![Figure 5. low albite and high albite [12].](image)

Pertography is used to map the distribution of elements on the surface of the sample. Analysis was performed by taking SEM image on the surface of the sample containing high percentage of albite.
Figure 5.a. shows the SEM image of sample PAT_01 surface. The image shows the distribution of minerals having different shapes, size and grey level. The grey level of each mineral differentiate its content. This sample contain around 65 wt% of albite with a crystal shape of prism or cubic. The shape of other minerals is distorted due to sample preparation, cutting and polishing. Figure 5.b. shows the SEM image of sampel PAT_04 which contain around 62 wt% of albite. The morphology of albite can be seen clearly. Cutting and polishing ruin the perfect shape of albite crystal. The SEM image of sample PAT-12 which contain around 95 wt% of albite is shown in figure 5.c. The shape of albite mineral can be seen clearly dominating the surface of the sample.

X-ray mapping was performed to examine the distribution of element Na, Al, Si and O on the surface of the sample. Figure 8 and 9 shows the distribution of Na (sodium) on the surface of the sample PAT_12.
Figure 7. Distribusi Na.

Figure 8. The position of Na on the surface of the sample PAT_12.

The distribution of Al is shown in figure 10 and 11.

Figure 9. Al distribution

Figure 10. The position of Al on the surface of the sample.

Figure 12 and 13 show the distribution and location of Si on the surface of the sample PAT_12.
4. Conclusion
A petrography analysis by means of SEM-EDS, X-ray mapping and XRD on the Patimpeng District, Bone Regency has been performed. The analysis revealed that the samples dominated by mineral Albite Na(AlSi₃O₈). It is suggested that this mineral should be explored deeply to investigate its abundances and utilized for ceramics or other type of industry.

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