Journal of Chemical Natural Resources Vol. 03, No. 02, 2021 | 155 – 160

JCNaR
Journal of Chemical Natural Resources

Determination of Level of Ag, Cu, and Fe in the Mineral Rock Coming from Jambu Dolok Hamlet Toba Samosir District.

Sagir Alva*

Faculty of Engineering, Universitas Mercu Buana, Jl. Meruya Selatan No. 01, Kembangan, Jakarta-11650, Indonesia

Abstract. A study on the determination of Ag, Cu, and Fe contents in mineral rocks has been conducted. The sample was randomly taken from the surface of the hill at Dusun Jambu Dolok Kabupaten Toba Samosir. Ovens destroyed the sample at 900°C. For the determination of Ag and Cu, the sample was dissolved by using concentrated HNO_3. For the determination of Fe, it was dissolved by using concentrated HNO_3 and concentrated HCl. The determination of Ag, Cu, and Fe was carried out using Atomic Absorption Spectrophotometer. The wavelength is 328.1 nm for Ag, 324.7 nm for Cu, and 248.3 nm for Fe. The results obtained show that the content of Ag, Cu, and Fe in the sample are 2.1590 mg/Kg, 21,311.4754 mg/Kg, and 150,000.0000 mg/Kg, respectively.

Keywords: Mineral, Rock, Ag, Cu, Fe, AAS

Received [5 May 2021] | Revised [21 June 2021] | Accepted [14 July 2021]

1 Introduction

Meranti Utara Village, Pintu Pohan, Meranti District, Toba Samosir Regency is located 700-1500 meters above sea level. In this village, there is a hamlet called Hamlet Jambu Dolok located on a hill in the Bukit Barisan area. Jambu Dolok Hamlet in the Toba Samosir Regency Map is included in the Nature Reserve Forest area with natural conditions covered mainly by shrubs and rocks. This hamlet has located ± 20 km from Asahan Regency. (Sitorus, 2012)

In this area, the majority of the rocks in the surface layer are golden yellow, shiny, and mixed with brownish colors. Various information was obtained by the author from the Department of Industry and Trade of Toba Samosir Regency that there are only a few studies related to mineral content in the rocks in the Jambu Dolok Hamlet, Pintu Pohan Meranti District. The same information was also given by the Mining and Energy Office of North Sumatra Province.

*Corresponding author at: Faculty of Engineering, Universitas Mercu Buana, Jl. Meruya Selatan No. 01, Kembangan, Jakarta-11650, Indonesia.

E-mail: sagir.alva@mercubuana.ac.id

Journal Homepage: http://jcnar.usu.ac.id

Journal of Chemical Natural Resources Vol. 03, No. 02, 2021 | 155 – 160

Silver, copper, and iron are economically valuable materials. These metals have very high thermal conductivity and excellent electrical conductivity. Silver and copper are used to manufacturing electronic equipment, jewelry, art, and even coins. Ferrous metal is widely used in building materials, household appliances, and metal coatings (Smith, 2001).

Based on the colors of the stones, it was assumed that the stones contained silver, copper, and iron. Therefore, it became the strong reason for determining the silver, copper, and iron content in these rocks with the title "Determination of Ag, Cu, and Fe Content in Mineral Rocks Originating from Hamlet Jambu Dolok Toba Samosir Regency."

2 Materials and Methods

2.1 Equipments

In this study, the Hitachi Z-2000 Atomic Absorption Spectrophotometer was used, analytical balance, oven, thermometer, electric furnace, Pyrex glassware, the crucible, Whatman filter paper no. 42, distilled water bottle, hot plate, desiccator, pestle and mortar, and spatula.

2.2 Materials

The main materials used are mineral rock samples as samples, HCl, HNO_3, H_2O_2, NH_4OH, $AgNO_3$, $CuSO_4.5H_2O$, $Fe(NO_3)_3$, aquadest, and universal indicator.

2.3 Sample Preparation

A mineral rock was crushed and dried at 105°C then it was kiln at 900°C

2.4 Determination of Ag

The sample weighed as much as 10 grams then added 10 mL of distilled water, dissolved with 25 mL of HNO_3 and H_2O_2. Then heated to half the initial volume, cooled, filtered in a 100 mL volumetric flask, diluted with distilled water to the marked line, homogenized, and the pH adjusted to 2-4. Then the absorbance was determined using an Atomic Absorption Spectrophotometer at a wavelength of 328.1 nm.

2.5 Determination of Cu

The sample weighed as much as 5 grams then added 10 mL of distilled water, dissolved with 25 mL of HNO_3 and H_2O_2. Then heated to half the initial volume, cooled, filtered in a 100 mL volumetric flask, diluted with distilled water to the marked line, homogenized, and the pH adjusted to 2-4. Then the absorbance was determined using the Atomic Absorption Spectrophotometer at a wavelength of 324.7 nm.

Journal of Chemical Natural Resources Vol. 03, No. 02, 2021 | 155 – 160

2.6 Determination of Fe

The sample was weighed as much as 10 grams. Then, 10 mL of distilled water was added, dissolved with 10 mL of HNO_3 and 30 mL of HCl. Then added H_2O_2. It was heated until half from the initial volume, cooled, filtered in a 100 mL volumetric flask, diluted with distilled water to the marked line, homogenized, and adjusted the pH to 2-4. Then the absorbance was determined using an Atomic Absorption Spectrophotometer at a wavelength of 248.3 nm (Vogel, 1985).

3 RESULT AND DISCUSSION

3.1 The Calibration Curve of Ag Standard

The standard Ag calibration curve was made with standard concentration variations, namely 0.0; 0.1; 0.2; 0.3; 0.4; 0.5 ppm of $AgNO_3$ salt. The measurement results are shown in Table 1.

Tabel 1. The standard solution of Ag

Concentration (mg/L)	Absorbance
0.0	0.0003
0.1	0.0025
0.2	0.0054
0.3	0.0079
0.4	0.0108
0.5	0.0133

Cu Standart Standard Cu calibration curves are made with standard concentration variations, namely 0.0; 0.5; 1.0; 1.5; 2.0; 2.5 ppm of CuSO4.5H2O salt. The measurement results are shown in Table 2

Tabel 2. The standard solution of Cu

Concentration (mg/L)	Absorbance
0.0	0.0001
0.5	0.0095
1.0	0.0185
1.5	0.0274
2.0	0.0367
2.5	0.0463

Journal of Chemical Natural Resources Vol. 03, No. 02, 2021 | 155 – 160

3.2 The Calibration Curves of Fe Standard

Standard Fe calibration curves are made with standard concentration variations, namely 0.0; 2.0; 3.0; 4.0; 5.0 ppm of $Fe(NO3)_3$ salt. The measurement results are shown in Table 3

Tabel 3. The standard solution for Fe

Concentration (mg/L)	Absorbance
0.0	0.0002
1.0	0.0171
2.0	0.0349
3.0	0.0530
4.0	0.0699
5.0	0.0868

The measurement results of Ag, Cu, and Fe levels were calculated using the Least Square Method. Obtained levels of Ag, Cu, and Fe are in Table 4.

Table 4. The concentration of Ag, Cu, and Fe on the rocks

Concentration Ag (mg/Kg)	Concentration Cu (mg/Kg)	Concentration Fe (mg/Kg)
2,1590	21.311,4754	150.000,0000

Silver, copper, and iron are metals that have high commodity value. Silver, copper, and iron can be found in the earth's lithosphere, for example, in soil and rocks. Guava Dolok Hamlet is an area that has the potential for rocks containing valuable minerals.

Determination of the levels of Silver (Ag), Copper (Cu), and iron (Fe) metals in mineral rocks found in Jambu Dolok Hamlet was carried out by destroying the sample with the wet destruction method. Determination of silver (Ag) and copper (Cu) using HNO_3 and H_2O_2 and determination of ferrous metal (Fe) using HNO_3, HCl, and H_2O_2. The choice of solvent used was based on a qualitative separation analysis of cation classification. Where Ag is a group 1 cation and Cu is a group 2 cation and the separation of these two cations using HNO_3. However, Fe is a group 3 cation using HNO_3 and HCl (Vogel, 1991).

The addition of H_2O_2 serves to complete the oxidation process. The pH setting of 2-4 was carried out because a pH below 2 could cause tool damage and corrosion. Above pH four it caused the precipitation of metals contained in the sample. (Greenberg, 1985)

Then the absorbance and concentration values of the samples were determined using an Atomic Absorption Spectrophotometer at a wavelength for silver (Ag) = 328.1 nm; copper (Cu) = 324.7 nm and iron (Fe) = 248.3 nm (Greenberg, 1985). In the blank, there is still an absorbance value

above zero, and this is due to the presence of impurities. Standard series solution curves for silver (Ag), copper (Cu), and iron (Fe) are made by varying the concentration of the standard series solution using the Least Square Method so that a linear line equation for silver (Ag) Y = 0.0264X + 0 is obtained. ,0001; copper (Cu) Y = 0.0183X + 0.0003 and iron (Fe) Y = 0.0174 + 0.0002.

In this study, the correlation coefficient for silver metal (Ag) = 0.9994; copper (Cu) = 0.9993 and iron (Fe) = 0.9999. This indicates a positive relationship or correlation between concentration and absorbance. In analytical research, a good standard curve graph is indicated by the value of r 0.99.

From the results of the research conducted, the metal levels of silver (Ag), copper (Cu), and iron (Fe) were 2.1590 mg/Kg, respectively; 21.311.4754 mg/Kg and 150,000.00 mg/Kg. The presence of silver (Ag), copper (Cu), and iron (Fe) metals in rocks are formed by several processes. Rocks are formed from two or more minerals below the earth's surface (intrusive), originating from magma that cools or freezes and is formed above the earth's surface (extrusive) due to weathering and erosion processes, causing precipitation of ore minerals.

At the contact, a rocking body penetrated by magma will generally experience recrystallization, alteration, mineralization, and replacement (replacement). This change is caused by the heat and fluid originating from the magma's activity. During uplift and erosion, an ore deposit is exposed near the surface, then undergoes a process of weathering, leaching, and oxidation of ore minerals. This process causes many metal elements (Cu^{2+}, Pb^{2+}, Zn^{2+}, etc.) to be dissolved (generally as sulfate compounds) in water that moves into groundwater or even to depths where the oxidation process does not take place (Hartosuwarno, 2011).

From the results of the analysis obtained, Cu metal can be used as a Cu source because it meets the minimum standard set to have an economic value of 0.50% (the Cu yield obtained is 2.10%). While the metals Ag and Fe are not potential sources of Ag and Fe because they do not meet the minimum standards set for economic value, namely Ag 0.007% and Fe 30% (the yields of Ag and Fe obtained are 0.002% and 15%, respectively).

4 Conclusion

Based on the results of the research, it can be concluded as follows:

The Ag, Cu, and Fe levels contained in mineral rocks in Dusun Jambu Dolok, Toba Samosir Regency were 2.1590 mg/Kg, 211.311.4754 mg/Kg, and 150.000 mg/Kg respectively. Then from the Ag and Cu analysis results, it can be concluded that the mineral rocks used as samples in this study are not potential sources of Ag and Cu.

Journal of Chemical Natural Resources Vol. 03, No. 02, 2021 | 155 – 160

References

Greenberg, A.E. 1985. Standards Methods for The Examination of Water and wastewater. Sixteenth edition. Washington DC: American Public Health Association.

Hartosuwarno, S. 2011. Endapan Mineral. Yogyakarta: Fakultas Teknik Mineral Universitas Pembangunan Nasional "Veteran".o

Sitorus, D. 2012. Toba Samosir dalam Angka. Balige: BPS Kab. Toba Samosir.

Smith, A. 2001. Pustaka Sains Material. London: Usborne Publishing Ltd.

Vogel. 1991. Buku Teks Kimia Analisis Kuantitatif Anorganik. Jakarta: Penerbit Buku Kedokteran EGC.

Vogel. 1985. Buku Teks Analisis Anorganik Kualitatif makro dan Semimikro. Jakarta: PT Kalman Media Pustaka.