The magnetic susceptibility analyzes of Motonuno lake sediment in Muna Regency, Southeast Sulawesi, Indonesia

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The magnetic susceptibility analyzes of Motonuno lake sediment in Muna Regency, Southeast Sulawesi, Indonesia

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Abstract. Study on the magnetic susceptibility, magnetic mineral, and content of element contained in the sediment has been done at Motonuno Lake Sediment in Muna Regency, Southeast Sulawesi Indonesia. Sediment samples in the form of cores were taken from three different sites by using the gravity core tool. Measurement of the magnetic susceptibility values was carried out by using the MS2C susceptibilitymeter. Content of element in the sediment was measured by using the SEM-EDX tool. The results showed that the magnetic susceptibility of sediment is -1 x 10^{-5} SI to 3 x 10^{-5} SI (site 1) and -2 x 10^{-5} to 2 x 10^{-5} SI (site 2 and site 3). Based on the value of magnetic susceptibility, the dominant magnetic mineral in the three sediment cores is pyrite (FeS_2) which is an authgenic magnetic mineral. All three sediment core samples show that magnetic susceptibility values tend to be higher at the bottom of core than the top of core. This means that the sediment deposition takes place on different climate conditions, namely dry climate and wet climate. The elements contained in the sediment consists of O, Ca, Si, S, Al, Na, Cl, Fe, Mg, Au, Ti, Co, Cu, and Ni. All magnetic informations obtained in this study are very important in the understanding of paleoclimate condition at Motonuno Lake and its surrounding areas.

1. Introduction

Climate change is one of the most important issues of the world today. Climate change from time to time is very related to changes in the intensity of rainfall, land cover, weathering, and transport mechanism [1,2]. Trace of these changes can be identified on certain objects such as soil, marine sediment, and lake sediment. In contrast to marine sediment susceptible to ocean current and has relatively low deposition rates (except in adjacent areas of the estuary), lake sediment is usually

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formed on a closed system and has relatively higher deposition rates. This led to the recording of climate change in lake sediment has relatively high temporal resolution [3].

Lake sediment is a natural archive that has a potential to present information about the climate in the past or paleoclimate. The presence of magnetic mineral in sediment layers has provided an opportunity for the use of magnetic methods in particular rock magnetism method to determine the relationship of magnetic change to paleoclimate. Magnetic properties can be different in every place depending on the climate condition and the condition of bedrock or rock around the lake.

Motonuno Lake is one of the lakes found in Muna Regency and it is estimated to be one of the long-established lake that potentially presents sediment with relatively old geological age. Litostratigraphically, almost over 85 % of Muna Island is the Pleistocene-aged Wapulaka Formation with dominated by limestone unit [4]. Rock around the lake is limestone, so it can be said that the Motonuno lake as carst lake that allegedly formed due to the process of dissolution of lime by water. Therefore, Motonuno Lake is very potential to be an object in the study of the magnetic properties of sediment and trace information of past climate change (paleoclimate).

In this paper will be presented how the magnetic susceptibility, magnetic mineral, and content of elemen contained in the Motonuno Lake sediment. These parameters are very important in the understanding of paleoclimate condition at Motonuno Lake and its surrounding areas.

2. Method

The main material used in this study is the core-shaped sediment/mud. Samples of sediment core were obtained from Motonuno Lake in Muna Regency, Southeast Sulawesi Indonesia (Figure 1). Lake Motonuno has an area of about 4000 m^2 and has the depth of 50 cm to 20 m. Core sampling was performed in three different places using gravity core tools. General information of sediment core samples is shown in Table 1.

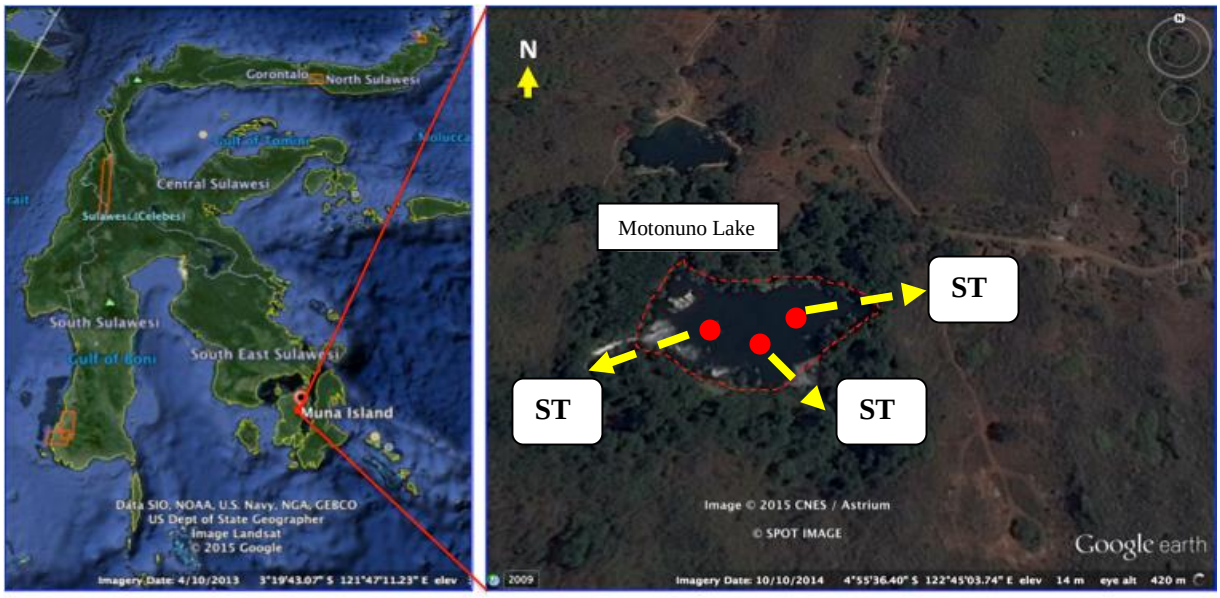

Figure 1. Map of the location of Lake Motonuno and sampling of sediment cores

Table 1. General Information of sediment core samples

Site	ID	Position		Length
1.	ST1	S $04^0$55'38.0"	E $122^0$45'02.1"	67.5 cm
2.	ST2	S $04^0$55'37.8"	E $122^0$45'03.2"	67 cm
3.	ST3	S $04^0$55'37.2"	E $122^0$45'04.2"	32 cm

Measurement of the magnetic susceptibity of samples is conducted by using the MS2C suseptibilitimeter tool in SI unit. The magnetic susceptibility value is obtained at every 10 mm along the core sample. For measurement of sample element content is carried out by using the SEM-EDX tool which expressed in unit of wt %.

3. Result and Discusion

3.1 Magnetic Susceptibility and Mineral Content of Lake Sediment

Magnetic susceptibility is a function of the concentration, grain size, and the type of magnetic minerals. The varying magnetic susceptibility values show varying concentration, grain size, and magnetic mineral type.

The magnetic susceptibility measurement results based on the depth of the three sediment samples of Motonuno Lake (ST1, ST2, and ST3) are shown in Figure 2, Figure 3, and Figure 4. Sampel of ST1 sediment core with length of 67,5 cm has the magnetic susceptibility value varying from -1 x 10^{-5} to 3 x 10^{-5} SI. Sample of ST2 sediment core with length of 67 cm has the magnetic susceptibility value of -2 x 10^{-5} up to 2 x 10^{-5} SI. Furthermore, in the sample of ST4 sediment core with length of 32 cm has the magnetic susceptibility values varying from -2 x 10^{-5} to 2 x 10^{-5} SI.

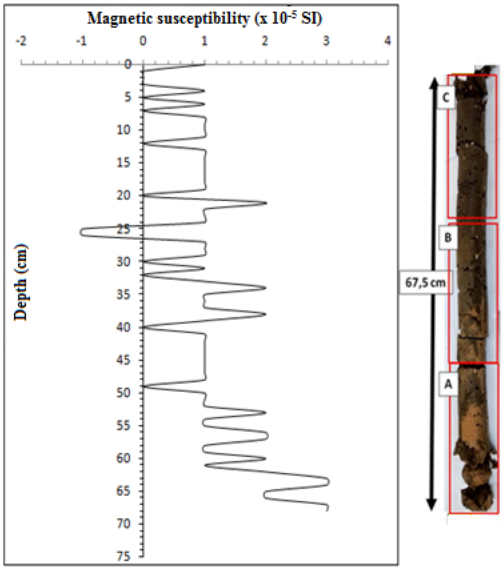

Figure 2. Graph of magnetic susceptibility values vs depth of ST1 core sample

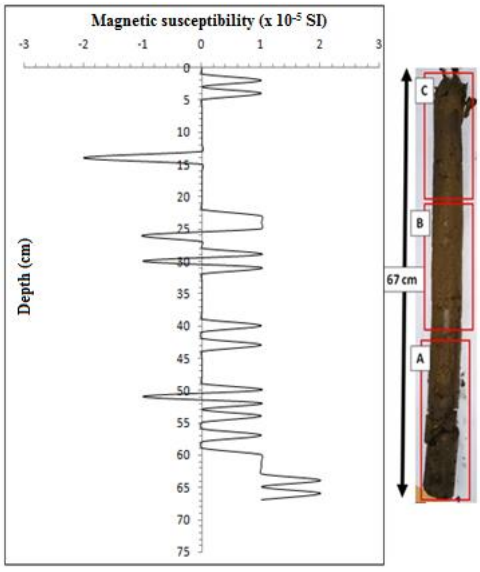

Figure 3. Graph of magnetic susceptibility values vs depth of ST2 core sample

Based on the value of mineral susceptibility in [5], the sediment mineral group of lake belongs to the diamagnetic group (non-magnetic mineral) and paramagnetic group (magnetic minerals). Negative magnetic susceptibility exhibits a non-magnetic mineral group, whereas the magnetic susceptibility of positive value represents the magnetic mineral group. At the sediment depth of 0-25 cm, ST2 and ST3 core samples show low magnetic susceptibility value. This indicates that the sediment is dominated by non-magnetic minerals. Furthermore, at depth of 0-25 cm, ST1 core sample shows greater magnetic susceptibility than ST2 and ST3 core samples. This indicates that the sediment is dominated by magnetic minerals. At depth above 25 cm, the three core samples show magnetic susceptibility with magnetic mineral dominated. Based on the magnetic susceptibility table of rocks and some of the magnetic minerals commonly found in lake sediments [6], magnetic mineral presents in the Motonuno lake sediment is pyrite (FeS2). This is also reinforced by the analysis of element content in samples where there is elements of iron (Fe) and sulfur (S). Both of these elements are the pyrite-forming elements.

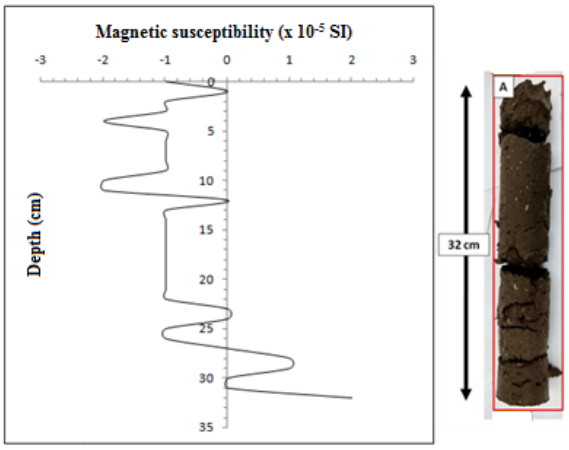

Figure 4. Graph of magnetic susceptibility values vs depth of ST3 core sample

3.2 Comparison of Magnetic Susceptibility in Motonuno Lake Sediments at Core Samples - ST1, ST2, and ST3

An authigenic mineral is a mineral formed in situ in lake sediments caused by the influence of aquatic productivity related to with soil nutrients. Pyrite is an authigenic magnetic mineral, generally formed in the anoxic zone (but also it can occur in the oxic zone), which is a sedimentation environment that contains no dissolved oxygen, which is sulphidic [3,5]. Oxygen content and solubility of oxygen in water is influenced by temperature factor which is relatively lower (less dissolved oxygen) at high temperature especially on the dry climate.

In this study, comparison of the three sediment core samples (Figure 5) showed that magnetic susceptibility values tend to be higher at the bottom of the core than the top of the core. This means that the sediment deposition takes place on different climate conditions, namely dry climate and wet climate. At sediment depth above 25 cm indicates more pyrite mineral concentration that it shows dry climatic condition. Whereas at a depth below 25 cm indicates the concentration of pyrite minerals is slightly on ST1 and very little on ST2 and ST3. This shows the wet climatic conditions.

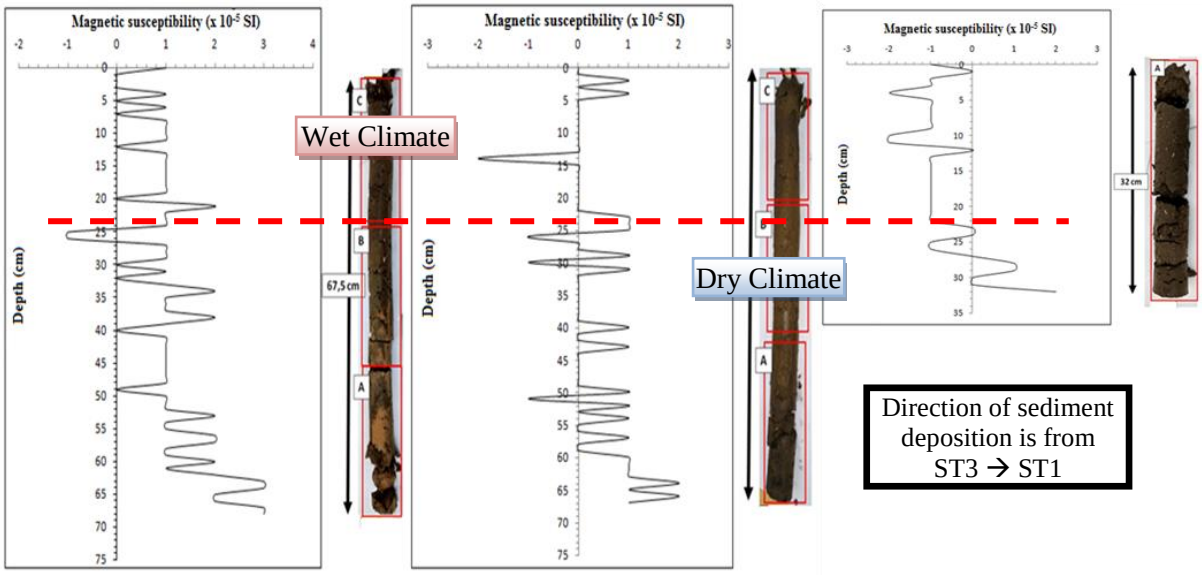

Figure 5. Comparison of the magnetic susceptibility of core samples

4. Conclusion

Based on this study, we can conclude that the Motonuno Lake sediment has magnetic susceptibility is -1×10^{-5} to 3×10^{-5} SI (site 1) and -2×10^{-5} to 2×10^{-5} SI (site 2 and site 3). The dominant magnetic mineral in the sediment is pyrite (FeS_2) in which this mineral includes the authigenic magnetic mineral. Magnetic susceptibility values in the three core samples tend to be higher at the bottom of core than the top of core where indicate that the sediment deposition takes place on different climate conditions, namely dry climate and wet climate. The elements contained in the sediment of Motonuno Lake consists of O, Ca, Si, S, Al, Na, Cl, Fe, Mg, Au, Ti, Co, Cu, and Ni. These magnetic informations are very important for understanding on the paleoclimate condition in the Lake Motonuno and its surrounding areas.

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