

## The Sedimentation of Lake Guyang Warak (Punung-East Java, Indonesia)

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### Abstract

Sedimentological investigation on the sediment from Lake Guyang Warak, Punung, East Java which is very near from a famous Palaeolithic Site, Song Terus Cave in Java Pacitan, has shown almost the same environment from at least 2000 BP. Although the environment is always the same, some variations caused by climate, volcanic activity and the most important part is by human activity can be recognized which is probably reflected by the carbon dating result.

**Keywords:** Sedimentology, Prehistory, Palaeoenvironment, Song Terus, Java, Indonesia.

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### Introduction

Lake Guyang Warak is located in Punung, Java Est. Indonesia. This lake is laid on a karstic area in the region of Gunung Sewu, which consist of many prehistorically site from Palaeolithic period up to Iron Age period (Heekeren 1955, Heekeren 1972, Sémah 2002, Simanjuntak 2004) (Fig.1). This lake is about 2 km from prehistorically cave named as Song Terus which already have been dated about 300 Ka up to 5 ka (Hameau, 2005). Sedimentological study on series of sediment of Song Terus cave (Gallet, 2004) proved that there was different environment of the sedimentation in the cave from Pleistocene periods until 5000 years ago which are influenced by fluvial activity, volcanic activity and also human activity. Previous analysis on cave's sedimentation of Song Terus cave (close to Lake Guyang Warak) which is still lack of information about the environment during period younger than 5000 BP (upper Holocene period) conduct this lake sediment has been very interesting to study.

The aims of this study are (1) to making a characterization of the principal sediment of the lake and also to understand its variation which may occurred during the sedimentation, (2)

Based on the sediment's characters, to recognize the environment background which is reflected by it's deposit, and the last one (3), to look for a possibility on making correlation and continuity with the sedimentation found on the upper part layer ("Keplek Layer") of Song Terus Cave dated as 5000 BP (Hameau, 2005).

### Samples and Methods applied

The material of this study is coming from one core named GW05-2. This core has 5.7 meters length, which was taken from the lake at 2005 through a research mission French – Indonesian. The sediment in the core is dominated by clay, and seems close to organics clay due its dark colour. Stratigraphical log of this core also has been obtained based on photos of the sediments, but some difficulties occurred due to different parallax of the lighting.

Base on this log, a synthetic section has been constructed to distinguish some important indications such as the general characters of the sediment, the presence of lamination, and also if there are some other traces as like organics materials. Four (4) samples from different depth

have also being dated with C14 dating by Beta Analytic Radiocarbon Dating Laboratory (USA).

They showed a result about 1500 BP – 1400 BP at the lowest part, and at the upper part was older (about 1870 BP – 2840 BP) (Fig. 2).

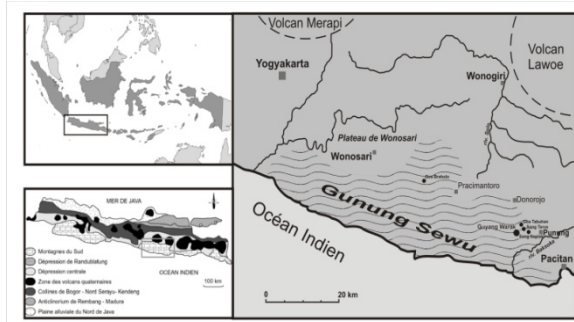


Fig. 1. Localisation of Lake Guyang Warak.

Four methods were applied on this study. First is to count the laminations. It has been considered also as an important indication of environment changes (Walker et al. 2000; Walker and Owen 1999). The laminations have been counted based on the photos, to the light (white colour) part. Secondly, is analyzing the sediments on infrared spectroscopy analyzing method. This method is used to know the type of clay in the core. The analysis is using KBr (Potassium Bromide) pastille methods (Frölich, 1981). 13 samples from different depth were chosen for this analysis. Also, from those samples, a microscopic observation by thin slide (frottis) was done, in order to have as much as information about the minerals of the sediment.

The last method is microscopic observation on the thin section of the sediment. 10 samples were fabricated for this analysis, but because the final result of the fabrication was not fully success, only three samples can be observed more clearly.

**Results and Discussion**

*The laminations*

Observation on the laminations shows two different kinds of laminations. One is lamination with dark colour and another one is with light colour. At the bottom part of the core (dated about 1500 – 1400 BP), the laminations are quite rare which indicate that the climate was not so contrast due to the precipitation. The presence of sandy-clay layer at the lower part indicate a phase where detritical material occurred more

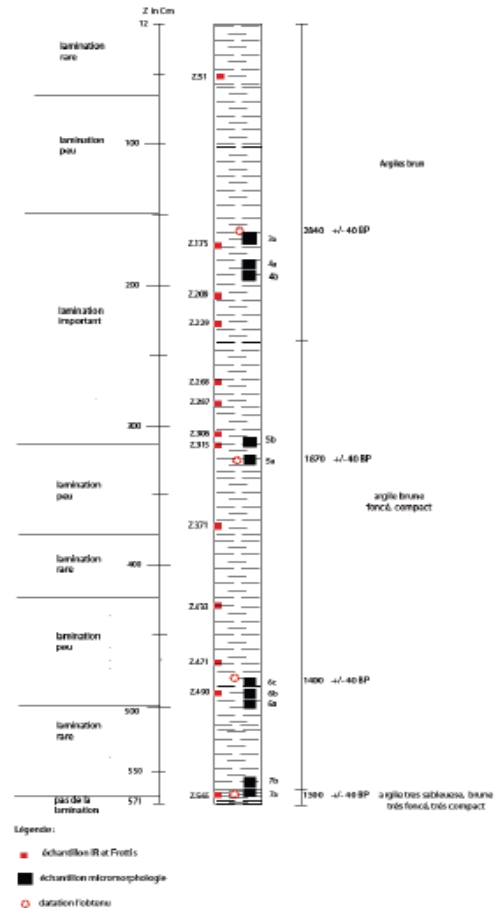
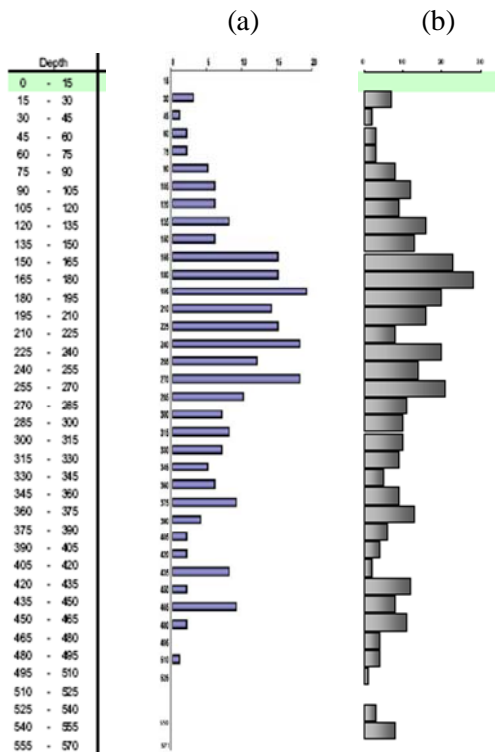


Fig. 2. stratigraphical log of core GW/05.

intensively which was probably caused by fluvial action, where also present a micrometric lamination. In the middle part, the lamination becomes very visible, proved that seasonality of the climate was very recognisable while the lake sediment becomes finer. The lamination decreased again in the upper part up to the top of the core.

*The variation of the Smectite – Kaolinite*

The Infrared spectroscopy Analysis allowed us to identify the type of clay sediment in core GW05-2. All the sample analysed is composed of a mix composition by Smectite, Kaolinite and a very few of Gibbsite along the core. The percentage of smectite and kaolinite is in relatively constant which is dominated by smectite (85.5%). As an implication, it can be assumed that the sedimentation of the clay sediment in the lake Guyang Warak due to core 2005 is always the same. The proportion of smectite on kaolinite has more variation in the zone “much laminated” (but it does not allow to be assumed as significant changes, considering there were more samples taken in this zone and



**Fig. 3.** The frequency of lamination ; (a) white colour lamination ; (b) dark colour lamination (Robles, 2007).

also the presence of error factors of the absorption quantification). The presence of the gibbsite in all the samples indicates that the sedimentation of Lake Guyang Warak also always has an influence from laterite soil.

*Trace of volcanic activity*

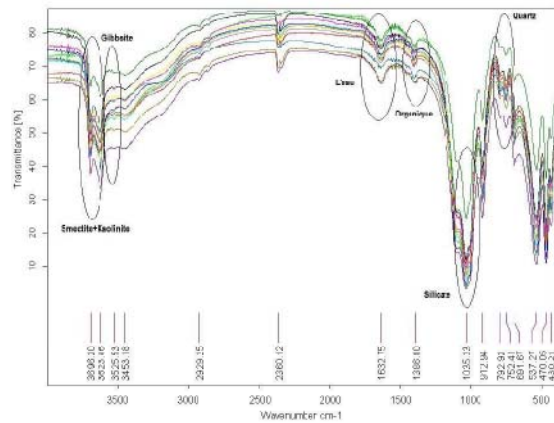
The observation on the slides and thin section allow us to recognize that there are micro laminations and also some volcanic minerals (volcanic glass, feldspar, and plagioclase) in the core, especially at the bottom part. This fact can be correlated with the eruption of a volcano.

Historical record of Merapi's eruptions confirms that during 4th century until 7th century there was several times of Merapi's eruption with a quite big explosion and made some destruction on Hindus and Buddhist temples in Java Central (Newhall *et al.* 2000, Gertisser & J. Keller 2003).

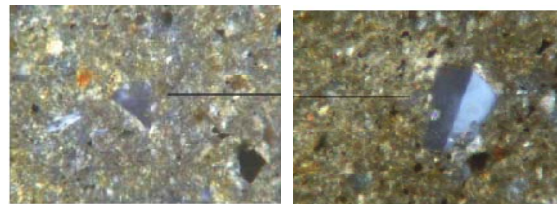
The presence of volcanic material in Guyang Warak Lake, especially in the bottom part of the core GW05-2 perhaps has a correlation with these eruptions from that period.

**Conclusion**

Some conclusions can be resumed from this study on Guyang warak sediment. The sediments which were deposited in this lake, based on



**Fig. 4.** Spectrums of infrared on KBr pastilles from the samples.



**Fig. 5.** Volcanic Minerals in the sediment Lake Guyang Warak: verre volcanique et feldspath.

infrared spectroscopy analyses allow us to know that Guyang Warak Lake is more characterized by mix clay of Smectite and Kaolinite. The quantification result of their proportion shows a variation in the middle part where the lamination more occurred. Counting on the laminations has allowed us to know the different variation of environment as there is different number of frequency along the core. The volcanic activities had an influence on the sedimentation of lake Guyang Warak, particularly in the bottom part.

And from archaeological point of view, the dating result does not allow to make a correlation with old Holocene prehistoric sites near the lake, but only with young human occupation of the area the last 1500 years. In general, the interpretation of the result is relatively complex.

It looks like the influence of Human activity already started around 1200 BP characterized by different rhythm of the sedimentation, the variations of the clay minerals, the presence of older materials organic in the sediment, which is reflected by the inversion of C14 dating result. We try to make a hypothesis that these evidences we had could be connected to an anthropization activity near the environment of the lake, which allowed the erosion of older organic soil probably during in humid period.

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