THERMOLUMINESCENCE DATING OF A LEMBAH BUJANG STRUCTURE

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ABSTRACT

The Lembah Bujang archeological complex near Sungai Petani, Kedah consists of various structures constructed at different times and spread over a wide area. This paper reports on the thermoluminescence (TL) dating of one of these structures. The structure was found to be 350 ± 90 yrs old. This is very young as compared with other structures that are from the 4th to the 16th centuries. This structure is suspected to be remnant of a Muslim Mosque whereas the other structures were Hindu and Buddist temples.

ABSTRAK

Kompleks arkeologi Lembahbujang dekat Sungai Petani, Kedah terdiri dari beberapa struktur yang telah dibangunkan pada berlainan masa dan tersebar luas. Kertas kerja ini melaporkan mengenai penarikhan termoluminesen (TL) salah satu struktur tersebut. Struktur tersebut telah didapati berumur 350 ± 90 tahun. Ini adalah terlalu muda berbanding dengan struktur lain iaitu abad keempat hingga keenambelas. Struktur ini disyaki sebagai sebuah mesjid Islam berbeza dengan yang lain iaitu kuil hindu dan budha.

Keywords: Thermoluminescence Dating, Lembah Bujang

INTRODUCTION

The Lembah Bujang is a famous archeological complex for pre-Islamic civilisation in Malaysia. There are several ruins of temples, iron smelting and settlements, spread over an area of about 1,000 sq km around Bukit Mertajam-Merbok-Jeniang region in the state of Kedah (Marzukhi,

2010). The region was occupied from the first century until the 14th century, first by animist (1st - 5th century), then Hindu and Budhist (5th - 14th century) civilisations.

The site for this study is a temple ruin at Pengkalan Bujang site 23. Based on its structure, there is a suspicioun that is could be a Muslim mosque. Based on Sung ceramic artifects found at the site, it is dated as 9th -13th Century. A more accurate dating of the site needs to be done.

THERMOLUMINESCENCE DATING

Thermoluminescence (TL) dating can be done on most solid insulators that can withstand heat up to 400 C without any change of state. The dating depends on the presence of traps within the forbidden band caused by inpurities within the insulator (Musilek and Kubelik, 2000). When an electron is excited after being hit by an alpha particle, it will jump to the conduction band before settling in one of these traps. These traps will act as record of how many alpha particles hit the material. By assuming alpha is being produced at a constant rate in nature, the amount of electrons in the traps is proportional to the length of time the material has been irradiated by the alpha particles. In other words,

$$\text{Age} = \text{paleodose}/\text{dose rate} \quad (1)$$

The paleodose is obtained by heating the material to excite the trapped electron and observing the light intensity when the electrons return to the valence band. This is thermoluminescence. A constant dose rate can be obtained if the material is buried undisturbed in soil. Its value can be obtained by burying in situ, a standard dosimeter for one year or less if there is no drastic seasonal variation in weather.

Another requirement is that there must be heating (up to 400 C) of the material to set the time to zero. Heating will released all trapped electron and emptied all the traps. This makes TL dating suitable for ceramic or earthern ware where firing is involved in its production. The time between firing and burial must be short as compared with length of burial time.

MEASUREMENTS

Three samples of bricks were taken from the sites. They were taken from different locations at the site. Samples were taken from the bricks and analysed for the paleodose. This is done by heating and measuring the intensity of the light given off by using a TL reader.

The dose rate can be obtained by burying a standard TL dosimeter in situ where the brick were taken. The standard TL dosimeter used were TLD100 (LiF:Mg,Ti). They were buried for 121 days in late 2008.

RESULTS AND DISCUSSION

The result obtained is shown in Table 1. Three samples were taken various parts of the structure. Two samples were found to be in agreement with one another while the third was found to be 200 years earlier. This could be due to renovation being done to the structure many years after it was constructed.

The dates for the three samples were way beyond the maximum limit of 1400 for the site. Further retesting need to be done to confirm the dates obtained. However, the dates could be right if the structure was really a muslim mosque. Muslim came later after the Hindu and the Budhist.

Table 1. Thermoluminescence dating of Pengkalan Bujang site 23

Sample	Paleodose (Gy)	Annual Dose Rate ($\times 10^{-3}$ Gy y^{-1})	Age at 2008 (y)	Year
1 (center)	0.58	2.3 ± 0.6	248 ± 65	1761± 65
2	0.40	1.52 ± 0.08	263 ± 14	1746± 14
3 (edge)	1.10	2.4 ± 0.8	464 ± 155	1545± 155

CONCLUSION

The dates obtained for the bricks from site 23 Pengkalan Bujang were 1400-1800. The wide range could be due to different period of construction/renovation being done at the site. The dates were also outside the range, 1st -14th century, for the Lembah Bujang civilisation. More study needs to be done to confirm or to obtain a more acurate construction history of the site.

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