

SHORT COMMUNICATIONS

COOLING RATE DEPENDENCE OF THERMO-REMANENT MAGNETIZATION OF SOME ARCHAEOLOGICAL SAMPLES

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THE accurate determination of thermoremanent magnetization (TRM) is important in the reliable estimation of the magnitude of the ancient field of the earth. According to Nagata¹

$$B_{anc}/B_{lab} = \text{NRM/TRM}$$

where NRM is the natural remanent magnetization acquired by the specimen during formation in the then magnetic field B_{anc} . TRM is the thermoremanent magnetization acquired by the specimen when cooled in the laboratory field after heating to 720°C.

In thermal demagnetization technique², the sample should be treated in a steady temperature for a long duration. The behaviour of TRM when the specimen was subjected to cooling in the laboratory field at different rates has been extensively studied³⁻⁶. The present paper deals with the cooling rate dependence of TRM for excavated archaeological samples of Kanchipuram, Vallam, Uraiyur and Guttur.

The instrument used to measure the NRMs and TRMs is an astatic magnetometer designed and fabricated in the laboratory on the lines of Blackett⁷ and modified by Collinson⁸. The sensitivity of the instrument is 0.1×10^{-6} Oe/mm division.

The NRMs of the samples were determined after heating and cooling the specimen in steps of 50°C and 100°C. Again the samples were refired to 720°C and allowed to cool in a known field of 40 μ T for 7 hr. The samples were heated to successive higher temperature as for NRMs and allowed to cool rapidly to room temperature and the TRMs were measured. The same treatment was repeated for cooling for 2.5 hr and 30 min. Graphs were drawn between temperatures and TRM for various samples at different cooling time (figure 1). The slope of the lines and the ratio of NRM to TRM at different cooling rates are presented in table 1.

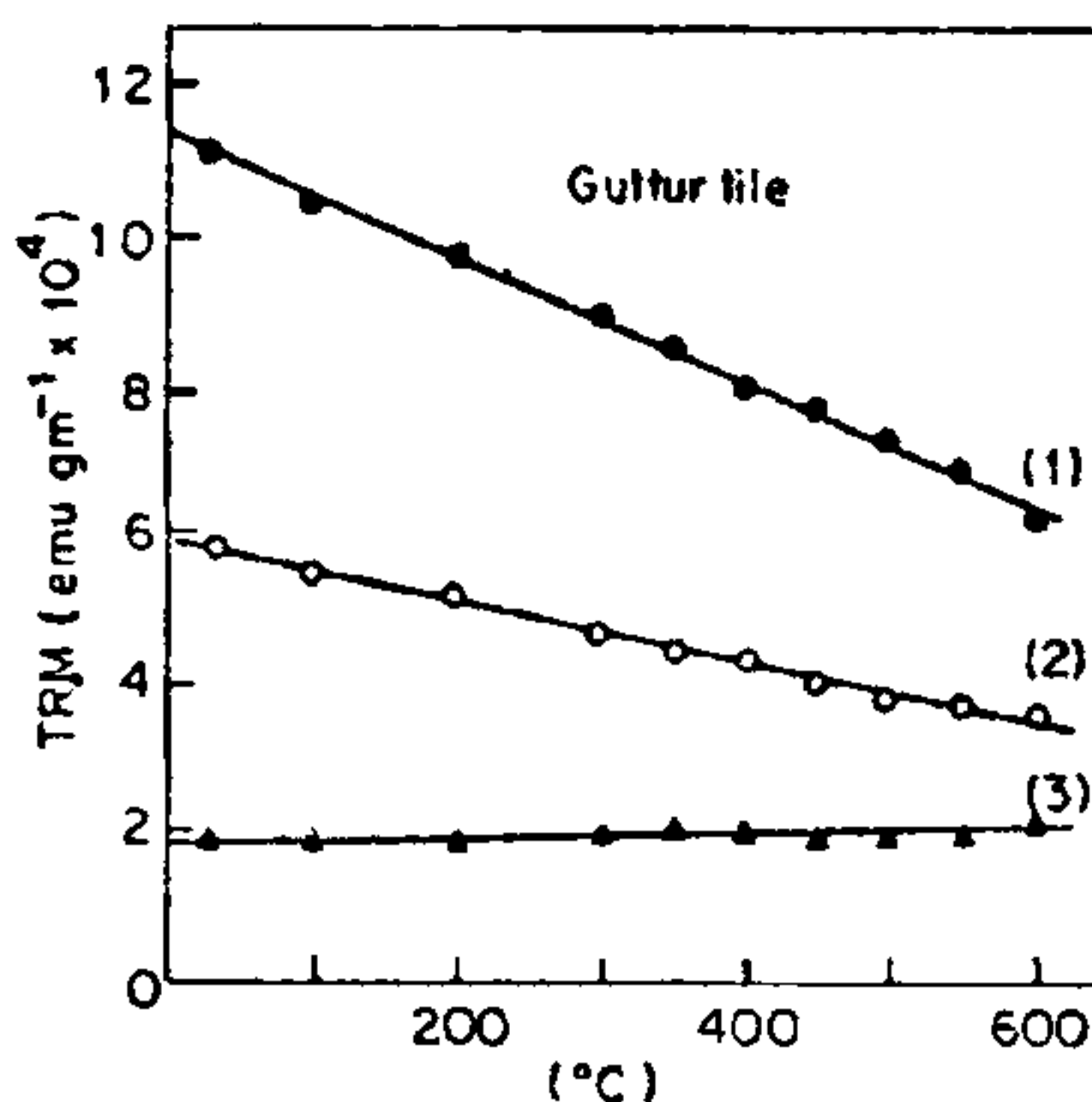


Figure 1. Remagnetization of archaeomagnetic sample following refiring to 720°C and cooled for (1) 7 hr, (2) 2.5 hr and (3) 30 min.

It is seen from the figure that the TRM acquired for slow cooling (7 hr) is greater than that for fast cooling (30 min). Such a result is consistent with the earlier theoretical predictions³⁻⁶. According to them, rapid cooling and heating for 30 min. does not change the magnetization when successively increasing temperatures were used. This is obvious from the nearly parallel lines obtained in the case of all samples cooled for 30 min. When the sample was cooled slowly for 2.5 hr or 7 hr the subsequent magnetization was much larger. This is evident from the values of the larger slopes (table 1). The TRM acquired for slow cooling is greater than that for fast cooling.

Since a reliable estimate of the ancient field is desirable, the acquisition of TRM in the laboratory field should be comparable to the cooling rates at which the potteries and bricks were cooled during firing. A reliable estimate is obtained when the cooling rate at the laboratory is essentially the same as that during firing of the archaeological materials. Tanguy⁹ has shown that the TRM acquired at cooling rates more than 1 day or 8 days is practically the same. Hence, it is concluded that to get reliable TRM values, a slow cooling rate is to be preferred. A cooling rate of 7 hr appears to be optimum.

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Table 1 Slope of the straight lines drawn for temperatures and TRMs (for 7 hr and 2.5 hr cooling times) and the slope of the straight lines drawn for NRM and TRMs (for 7 hr and 2.5 hr cooling times) for the samples obtained from excavated sites

Excavated sites	Nature of the sample	Slope of the line $\times 10^6$		Ratio of slopes	NRM/TRM	
		7 hr	2.5 hr		7 hr	2.5 hr
Kanchipuram	Pottery	1.10	0.51	2.16	1.095	2.237
Kanchipuram	Pottery	1.29	0.68	1.90	0.874	1.709
Kanchipuram	Amphorae	2.80	1.31	2.14	0.693	1.359
Kanchipuram	Brick	6.96	2.51	2.77	1.011	1.636
Vallam	Pottery	0.79	0.44	1.80	1.284	2.650
Vallam	Brick	6.00	1.55	3.87	1.284	2.800
Vallam	Tile	2.57	0.96	2.60	0.770	1.433
Uraiyur	Pottery	1.42	0.72	1.98	1.048	2.143
Uraiyur	Brick	5.20	1.95	2.66	0.922	1.850
Guttur	Tile	0.84	0.41	2.02	1.048	2.000
Guttur	Pottery	1.00	0.54	1.85	1.105	2.500

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POLYNUCLEAR AROMATIC HYDROCARBONS (SYNTHESIS OF 6, 7, 13-TRIMETHYLBENZO [C] CHRYSENE THROUGH SPIRO-REARRANGEMENT)

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HARTWELL^{1,2} reported that dibenz [a,h] -anthracene is carcinogenic and resembles benz [a] -anthracene in terms of structure. Newman³ also reported synthesis of methyl substituted dibenz [a,h] -anthracenes as potential carcinogens. It was therefore considered worthwhile to synthesize 6, 7, 13, 14-tetramethyldibenz [a,h] -anthracene so that it might eventually prove a potential carcinogen.

2'-[β -(2, 5-Dimethylphenyl) propyl] cyclohexanone (1), obtained following the procedure of Mukherji and Bhattacharya³, was subjected to cationoid alkylation with 2-allylcyclohexanone in the presence of anhydrous aluminium chloride in carbon disulphide solution to obtain *p*-bis-[β -(2'-oxocyclohexyl)-iso-propyl]-2, 6-dimethylbenzene in 32.8% yield. The diketone showed characteristic absorption at 1720 cm^{-1} in its IR spectrum (neat). The structure of the diketone (2) was further confirmed by its NMR spectrum exhibiting a 2H singlet at 6.83 δ assigned to two para protons, a 6H singlet at 2.20 δ for which the two methyl groups attached to the aromatic ring were found responsible. A 6H doublet at 1.14 δ was assigned to the two aliphatic