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THERMOLUMINESCENCE CHARACTERISTIC OF THE METASEDIMENTS OF JABAR, PURULIA DISTRICT, WEST BENGAL, INDIA

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Abstract

Thermoluminescence (TL) studies on the metasediments of Jabar, lying in the northwestern part of Purulia district of West Bengal, show natural thermoluminescence (NTL). These metasediments of Precambrian age, predominantly consist of marble, calc-silicates and granite gneiss. Each of the representative rock sample exhibits distinct TL glow-curves which can be successfully utilised in a number of geological applications. On the basis of natural as well as artificial thermoluminescence glow-curves, two distinct types of marble sequence have been identified.

Introduction

Thermoluminescence (TL) is a versatile tool and recently much attention has been paid to the application of the TL phenomenon in solving many geological problems. Various rocks exhibit natural thermoluminescence (NTL); and carbonate rocks, in particular, are widely used for TL studies. Generally, TL glow curve reflects the composition, environment of deposition, diagenesis and crystallization history of the rock. The present study discusses briefly the glow curve characteristics of the Jabar metasediments with special emphasis on marble.

Geological setting

The investigation has been carried out on the metasediments of Jabar, Purulia district, West Bengal lying within the latitudes of 23°26'30" to 23°29'10" N and the longitudes of 85°58'50" to 86°03'25" E. Calc-silicates, mica schists and granite gneisses are the major rock types in the area, which belong to Precambrian age of Satpura orogeny. Marble occurs as bands and lenses within the calc-silicate rocks.

A discontinuous marble-calc-silicate sequence is found exposed over a strike length of about 8 km from the southern slope of Shaiduri hill in the west to southern slope of Belamu hill in the east, passing through the southern slope of Jabarban hill. There is another such sequence in Gutijharna which runs along the northern slope of Jabarban hill. The marble calc-silicate sequence exposed in Jabarban hill is about 400 m in width and 1.6 km in length. It is bounded by porphyroblastic-augen gneiss in the north and mica schist and hornblende-biotite gneiss in the south.

Studies on thin section, DTA and X-ray diffraction patterns reveal the existence of two distinct types of marble sequences, viz., i) Jabarban marble sequence and ii) Gutijharna marble sequence. The Jabarban marble sequence consisting of Shaiduri, Jabarban and Belamu marbles is composed essentially of calcite and dolomite with diopside, epidote, clinozoisite and little tremolite, actinolite, talc, biotite, muscovite and quartz; whereas the Gutijharna marble sequence is composed of calcite and dolomite with abundance of diopside, tremolite, actinolite, talc, biotite and little of quartz, muscovite, clinozoisite and epidote.

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Results and Discussion

Thermoluminescence (TL) studies of 161 samples of marble, 2 of calcite, 3 of calc-silicate, 3 of granite gneiss and 2 of pegmatite show that natural thermoluminescence (NTL) glow curves of all the samples exhibit peaks at temperatures above 200°C. The marble samples consistently show two peaks in their NTL glow-curves; the high temperature peak (HTP) at 320°C while the middle temperature peak (MTP) occurs within the range of 240°C and 250°C. Gamma irradiation induces an additional peak at 140°C (LTP). Further, when MTP in NTL glow curves occurs above 240°C, the peak gets shifted consistently to 240°C on gamma irradiation. This behaviour suggests partial thermal drainage of MTP during the geological environment and is particularly conspicuous in Shaiduri, Jabarban and Belamu marble samples. Calc-silicates, gneisses and calcites show similar behaviour with regard to the MTP. The wide and plateau type glow curves of gneisses, calc-silicates and pegmatites represent a combination of multiple glow peaks. Gamma irradiation of these samples gives an additional peak at low temperature. The temperatures of glow-curve peaks of some samples are presented in Table I. Representative NTL glow curve as well as gamma induced TL (NTL + ATL) glow-curves for each of the rock types are presented in Fig. 1. The absence of LTP (< 200°C) in NTL glow-curves suggests their thermal drainage during the geological

TABLE I. Thermoluminescence (TL) glow peak temperatures of different rock types.

		LTP		MTP		HTP	
		a	b	a	b	a	b
		all values in °C					
Marble	1.	140	—	240	245	320	320
	2.	140	—	240	250	320	320
	3.	140	—	240	240	320	320
Calc-silicate	1.	125	—	—	—	280	280
	2.	148 and 166	—	240	243	320	320
	3.	157	—	—	—	292	292
Gneiss	1.	145	—	235	250	360	360
	2.	145	—	270	275	310	310
	3.	145	—	297	300	380	380
Pegmatite	1.	130	—	250	250	318	318
	2.	147	—	—	—	300	300
Calcite	1.	140	—	240	242	320	320
	2.	130	—	250	—	320	320

N.B.: a – NTL + ATL; b – NTL; LTP – low temp. peak; MTP – middle temp. peak and HTP – high temp. peak.

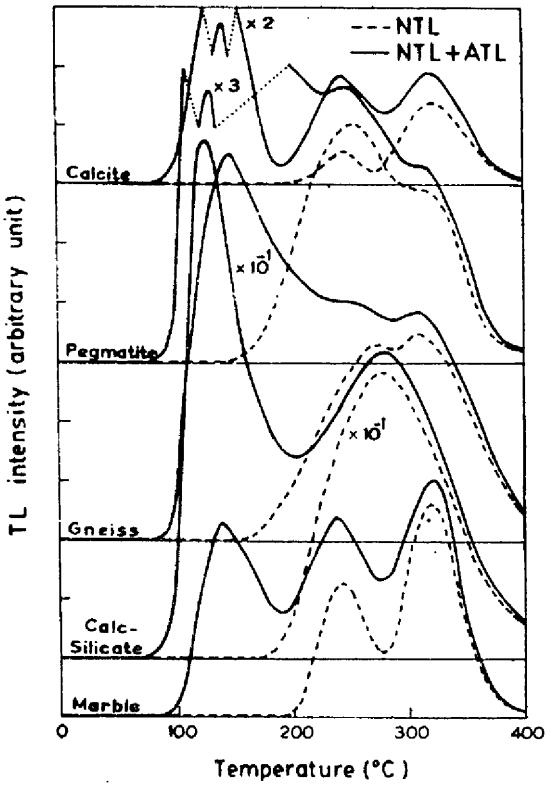

Figure 1. Thermoluminescence (TL) glow curves of different rocks.

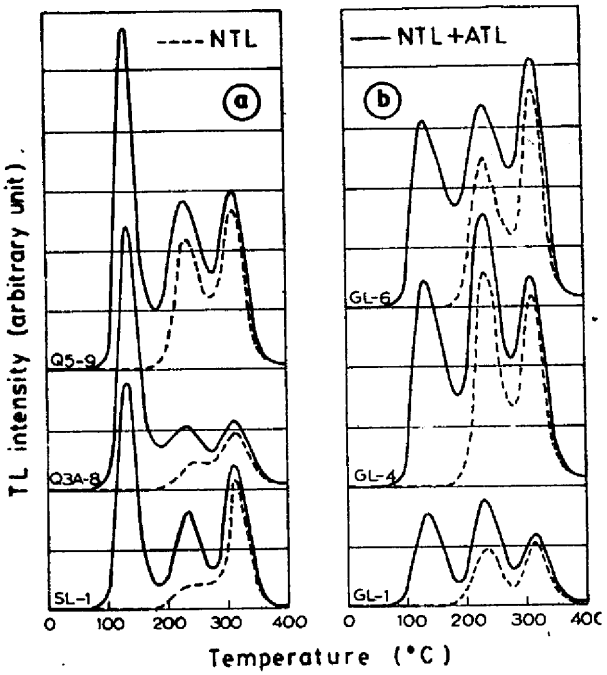

Figure 2. Representative thermoluminescence (TL) glow curves of marbles from two sequences (a) SJB marble sequence, and (b) Gutijharna marble sequence.

history of the samples. Plateau tests (Aitken, 1981 ; Wintle and Huntley, 1982) for the samples, selected for age determination, have shown that NTL is thermally stable above the temperature 300°C in geological conditions.

Thermoluminescence (TL) characteristics of marble from Shaiduri, Jabarban and Belamu hills show almost similar TL glow curve patterns, but those of Gutijharna samples show different TL glow curve pattern. As seen from Fig. 2 the intensities of LTP in the NTL + ATL glow-curves of Shaiduri, Jabarban and Belamu (SJB) marble samples are higher than those of Gutijharna marble samples showing nearly hundred per cent increase in the former cases. This variation is perhaps due to the variable Mn and Mg concentrations in the lattice of calcite crystals (Bhattacharya *et al* 1976 ; Nambi and Mitra, 1978). Further, the average peak height ratio (HTP/LTP) value of SJB marbles is about 0.66 while that of Gutijharna marbles is 0.104. Thus, two distinct marble sequences could be delineated in the area : one Mg poor marbles of SJB sequence and the other Mg rich marble of Gutijharna sequence. This is in agreement with the geological findings.

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References

AITKEN, M. J., (1981) TL dating : techniques and problems. *In :* Applied TL Dosimetry (Eds. M. Oberhofer and A. Scharmann) ECSC, EEC, EAEC, Brussels and Luxembourg, pp. 361-381.

BHATTACHARYA, A. K., RAO, C. N. and KAUL, I. K., (1976) Thermoluminescence characteristics, correlation and depositional environments of the Vempalle dolomites (Algonkian) in parts of A.P., India. *Modern Geology*, v. 5, pp. 247-254.

NAMBI, K. S. V. and MITRA, S., (1978) Thermoluminescence investigation of old carbonate sedimentary rocks. *Neues. Jahr. Miner. Abh.*, v. 133, pp. 210-220.

WINTLE, A. G. and HUNTLEY, D. J., (1982) Thermoluminescence dating of sediments. *Quaternary Science Reviews*, v. 1, pp. 31-53.

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