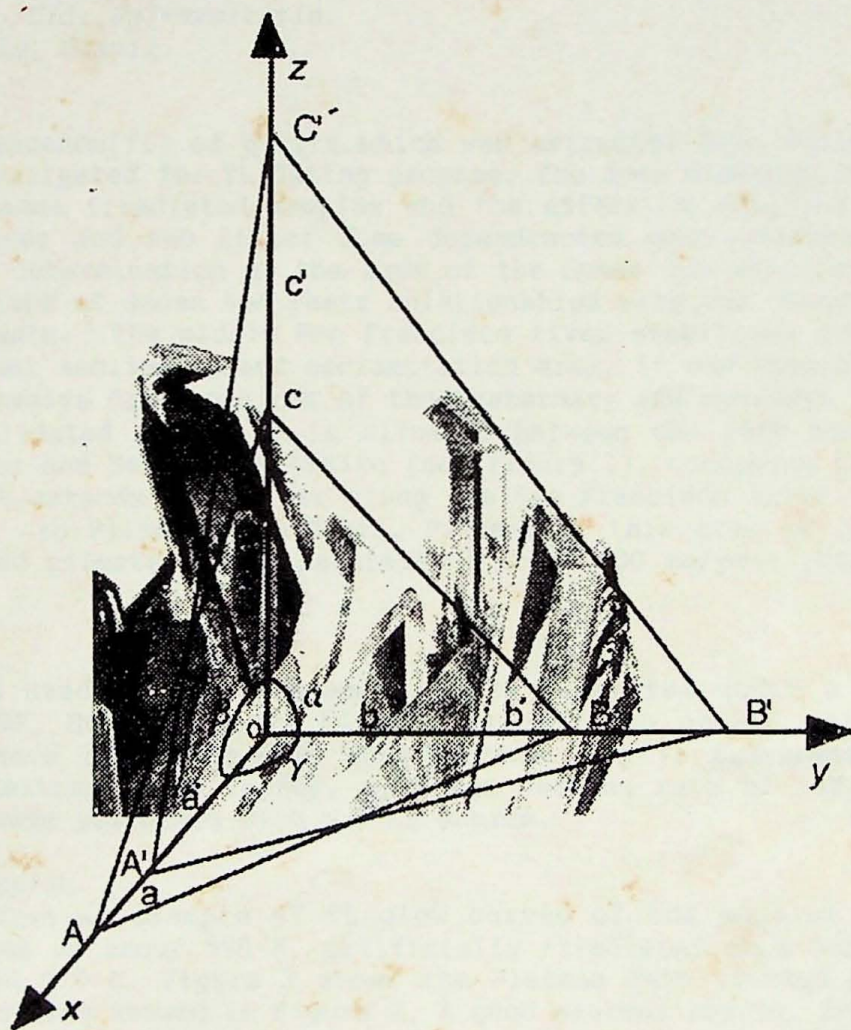国際シンポジウム

考古学と第四紀学のためのルミネッセンスおよび
ＥＳＲ年代測定

International Symposium
Luminescence and ESR Dating for Archaeology
and Quaternary Materials

1996 年 1 月 27 日 （土） January 27, 1996
14：00-17：00
会場：奈良教育大学教育実践研究指導センター
at Nara University of Education

主催：TL 研究会，ESR 応用計測研究会
The TL Dating Research Society
and The Society for ESR Applied Metrology

TL PROPERTIES OF FOSSIL DUNES FROM SAO FRANCISCO RIVER, STATE OF BAHIA, BRAZIL

Tatumi S H, Ayta* W E F, Matsuoka* M, Watanabe* S, Barreto** A M F and Suguio** K.

*Faculdade de Tecnologia de Sao Paulo.
Departamento de Ensino Geral Praca Cel. Fernando Prestes, 74.
01124-060,Sao Paulo, Brasil.
*Instituto de Fisica, USP.
Departamento de Fisica nuclear, c.p. 66318, Cid. Universitaria.
05389-970, Sao Paulo, Brasil.
**Instituto de Geociencias, USP.
Rua do Lago, 562 - Cid. Universitaria.
05508-900,Sao Paulo, Brasil.*

Introduction

Thermoluminescence(TL) of quartz which was extracted from eolic quaternary sand was investigated for TL dating propose. The dose dependencies of the TL intensity of gamma irradiated samples and the effect of sunlight exposure were studied. Linear and sub linear dose dependencies were observed in low doses region. The determination of the ages of the dunes can explain the most important generations of dunes and their relationships with the changes in the regional paleoclimate. The middle Sao Francisco river stabilized dune fields that is an important aeolian inland sedimentation area. It was possibly originated during successive drier periods of the Quaternary and nowadays is represented by unconsolidated sands. It is situated between the left bank of the Sao Francisco river and Serra do Estreito (see Figure 1), occupying an area of about 6000 km^2. It extends down river along the Sao Francisco river for about 200 km from Barra to Pilao Arcado Bahia. Presently, this area is characterized by a semi-arid climate with a rainfall of about 600 mm/year (Barreto and Suguio, 1995).

Experimental

The samples used in TL measurements were submitted under a chemical treatment using HF, HCl and heavy liquid, in order to obtain only quartz grains and to remove the alpha dose contribution. The TL measurements were recorded with a Harshaw 2000A reader, with the heating rate of 10K/sec. All the irradiations were performed with a ^{60}Co source.

Results and Discussion

Figure 2 shows an example of TL glow curves of the samples. Natural samples show a peak at about 590 K, artificially irradiated ones had peak at about 400, 440 and 570 K. Figure 3 shows the Plateau Test (Aitken,1985) applied to TL glow curves showed in Figure 2. A good plateau region, from 523 to 623 K, was obtained for low dose irradiated samples (up to about 50 Gy).

The reduction in TL intensity of 590 K peak caused by sunlight exposure is showed in Figure 4. The residual TL is about 30% of the natural TL intensity. The decay of TL intensity of 590 K peak (I) had a exponential behavior, I= a +b exp (-t/c), where a, b and c are constant and t is the sunlight exposure time. The residual TL intensity values were different for each samples.

Figure 5 shows typical results of dose dependence. The curves can be fitted for all the samples by the equation: I=d{1-exp[(-e (x+ f)]}, where d, e and f are the constant and x is the additive dose. In spite of similarity of the results, which were observed in large dose interval, a linear and sub linear dose dependencies were observed in low doses region, as is shown in

Figure 6.

The dose dependence for the samples which were exposed to sunlight for 10 hours and then gamma-ray irradiated was studied. Typical results are shown in Figures 7. TL sensitivity of some samples changed after sunlight exposure and the original linear behavior changed to polynomial one, or vice versa (see Table 1). The AD values were obtained by additive doses (Singhvi *et al*,1982) and total bleach-regeneration method (Proszynska, 1983; Debenham,1983). The results are shown in Table 1.

Table 1.: *Accumulated doses of dunes samples from Bahia State, Brazil. AD1 is the accumulated doses determined by using the additive dose and AD2 by the total bleach-regeneration method.*

sample	AD1 (Gy)	fitting	AD2(Gy)	fitting
SF10	(9.4+0.6)	polynomial	(3.0+0.5)	linear
SF13	(3.0+0.3)	polynomial	(3.0+0.6)	polynomial
SF14	(4.0+0.2)	polynomial	(5.4+0.3)	linear
ICA08	(6.2+0.4)	linear	(6.0+0.4)	linear
ICA19	(5.6+0.5)	polynomial	(5.3+0.3)	polynomial
ICA20	(16.0+3.2)	polynomial	(12.5+3.1)	polynomial

Conclusions

In this work, TL of gamma irradiated quartz showed, in general, a linear and/or sub linear dose dependence. Supralinearities in low dose region were not observed. The sunlight bleaching changed the TL response in some samples. For samples which has small AD values, we can determine closed AD values (Table 1).

In the case which the sub linear dependence starts at very low dose, the results showed that I may be related to a double stage excitation, then I can be expressed as: $I = aD + bD^2$, where a and b are the constant and D is the applied dose.

The linear dependence at low dose was also observed. For example the ICA08 sample (Table 1); the constant b of above equation become zero, it seems to be due to single stage excitation; the sub linear behavior starts at higher dose, more than 50 Gy.

REFERENCES
-Barreto A M F and Suguio K, 1995 *Anais V Congresso da Associacao Brasileira de Estudos do Quaternario e XI Simposio de Sedimentologia Costeira*, 32-36.
-Aitken M J, 1985 Thermoluminescence Dating, *Academic Press London*.
-Singhvi A K Sharma Y P and Agrawal D P, 1982 Thermoluminescence dating of sand dunes in Rajasthan, India *Nature* 295 313-315.
-Proszynska H, 1983 TL dating of some sub-areal sediments from Poland *PACT Journal* 9 539-546.
-Debenham N C and Walton A J, 1983 TL properties of some wind-blown sediments *PACT Journal* 9 531-538.
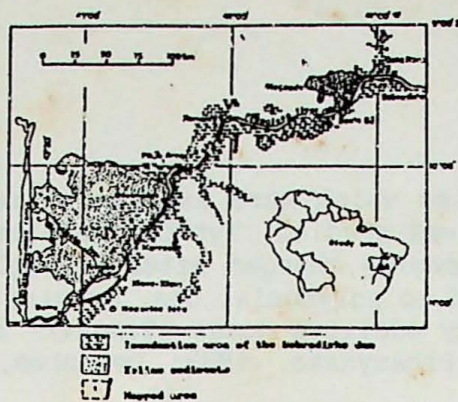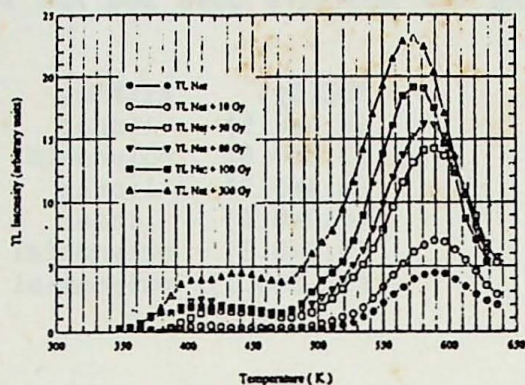
Figure 1. Location map of the study area.

Inundation area of the behradirha dam

Yellow sediments

Mapped area

- TL Nat
- TL Nat + 10 Gy
- TL Nat + 30 Gy
- TL Nat + 60 Gy
- TL Nat + 100 Gy
- TL Nat + 300 Gy

Figure 2.: TL glow curves of quartz which was extracted from aeolic dunes.

- Nat + 300 Gy
- Nat + 100 Gy
- Nat + 60 Gy
- Nat + 30 Gy
- Nat + 10 Gy
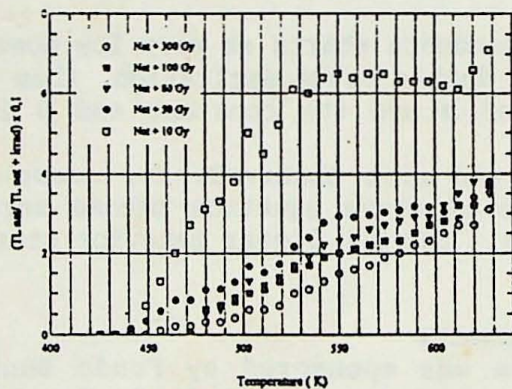
Figure 3.: Plateau Test of 590 K TL peak of the quartz.

SF03 exp: $y = a + b\exp(-x/c)$, R:0.315,
a=2.80771, b=11.0354, c=75.09+3

ICA21-05 exp: $y = a + b\exp(-x/c)$, R:1.68,
a=6.97255, b=7.99307, c=156.522
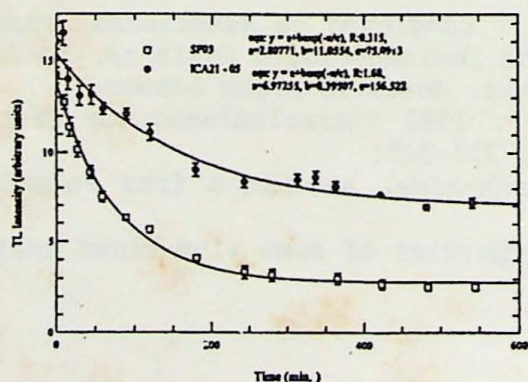
Figure 4.: Decay curves of the 590 K TL peak caused by sun light exposure

ICA21-1.5 exp: $a(1-\exp(-b(x+c)))$, R:0.445,
a=24.3283, b=0.0122231, c=16.9427

SF03 exp: $a(1-\exp(-b(x+c)))$, R:0.477,
a=27.6307, b=0.00725155, c=32.979
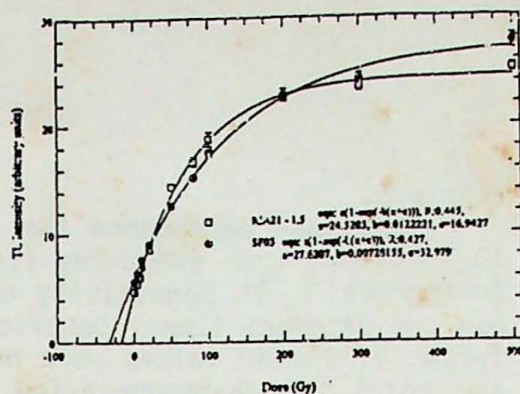
Figure 5.: Gamma Dose dependence of 590 K peak.

ICA 21-1.5 $y = +0.195x^1 +4.76$, R:0.170, max dev:0.295

SF03 $y = -0.00115x^2 +0.197x^1 +5.67$, R:0.133, max dev:0.181
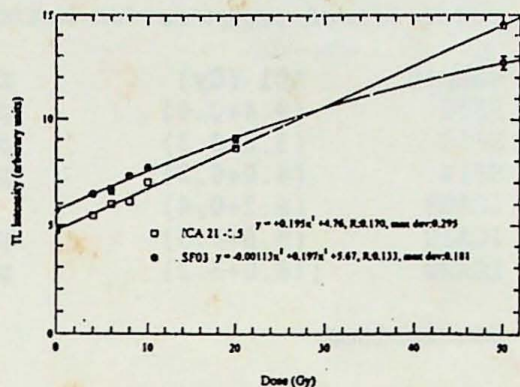
Figure 6.: Gamma dose dependence of 590 K TL peak, low doses region.

SF14
$y = +0.118x^1 +0.730$, R:0.0514, max dev:0.0898
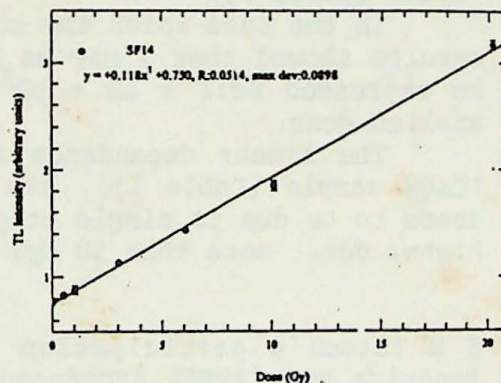
Figure 7a.: Linear dose dependence of 590 K TL peak, sun light bleached samples.

SF13
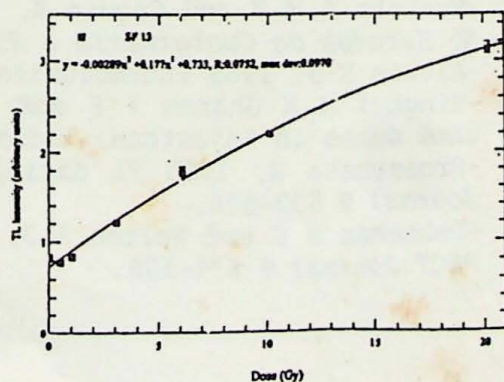$y = -0.00289x^2 +0.177x^1 +0.733$, R:0.0752, max dev:0.0970

Figure 7b.: Sub linear dose dependence of 590 K TL peak, sun light bleached quartz samples.