

Thermoluminescence (TL) Dating of Inactive Dunes from the Rio Grande do Norte Coast, Brazil**M. Yee*; S. H. Tatumi*; K. Suguio[^]; A. M. F. Barreto[#]; E. F. Momose**; R. P. Paiva and C. S. Munita****

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INTRODUCTION

Inactive dunes from the State of Rio Grande do Norte coast (Brazil), with regional dimensions, could be considered as geomorphological and sedimentological indicators of paleoclimates drier than the present, during the Quaternary. Probably, these coastal dunes were generated due to intensified eolian activity, attributable to more arid conditions in the past. On the other hand, their most pronounced expansion periods could be correlated with sea-level drop episodes. Otherwise, sand nourishment to the coastal plains occurred dominantly during the regression following a sea-level rise, being intensely reworked by the winds. Consequently, TL dating of these natural environmental changes is crucial to better understand geological evolutionary history of the area in the Quaternary.

MATERIALS AND METHODS

Nineteen sediment samples were collected from inactive eolian dunes, with different morphology and color, along the State of Rio Grande do Norte coast. They were sampled from a depth of about 0.50m at the summit of better preserved dunes. The collected samples were submitted to chemical treatments, followed by sieving to separate the grain sizes between 88 and 180 μm . All γ -ray irradiations were performed with a ^{60}Co source of the IPEN-CNEN (Instituto de Pesquisas Energéticas e Nucleares - Comissão Nacional de Energia Nuclear) laboratories. For the TL

measurements, a Daybreak Nuclear and Medical Systems Incorporated, Model 1100-Series Automated TL/OSL System, with a Schott BG-39 optical filter, was used. The accumulated doses were obtained using Additional Doses Method following the Multiple Aliquot Protocol with Natural Normalization (NN), and the Total Bleach Method from Aitken (1985). The annual doses were calculated using ^{235}U , ^{238}U , ^{232}Th and ^{40}K concentrations, cosmic rays contribution of 182 $\mu\text{Gy}/\text{year}$ and the Bell's equations. Radioactive concentrations were measured by Neutron Activation Analysis, see Table I.

RESULTS AND INTERPRETATIONS

TL glow curves of the studied samples supplied peaks at 325 and 375°C. The intensities of the 375°C peak were used, to obtain the paleodoses and equivalent doses values. TL growth curves have been linear, sublinear and exponential behaviors in the Total Bleach Method. It was noted exponential growth curve in the Additive Dose Method. The obtained ages (Table 1) would represent the interval elapsed after their last subaerial exposition, that is, the time when the inactive dunes have been stabilized. According to the obtained data, eolian activities have been very intensified between 190-390 ky (5 samples) and 64-14.9 ky (6 samples); both intervals belong to the Upper Pleistocene. The obtained ages suggest that probably the older interval is attributable to the Illinoian and the younger could be ascribed to the Wisconsinian glacial stades, when

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the sea-levels dropped, and the sands accumulated during the previous high sea-level episodes were intensely reworked by winds.

After the Middle Holocene eolian activities, in the studied area, became again

important, possibly due to renewed sea-level drop, that occurred after the Holocene sea-level culmination stage about, 5ky ago (SUGUIO *et al.*, 1985).

Table 1. Sample name, ^{235}U , ^{238}U , ^{232}Th and ^{40}K , annual dose, Paleodose and Age of quartz from dunes, State of Rio Grande do Norte, Brazil.

Sample Name	$^{235}\text{U}/^{238}\text{U}$ (ppm)	^{232}Th (ppm)	^{40}K ($10^{-5}\%$)	Annual Dose ($\mu\text{Gy}/\text{ano}$)	P (Gy)	Age B.P. (year)
TL - 1*	0.85±0.02	2.08±0.02	1.246 ± 0.001	557±6	145±2	(3.5±0.5)10 ⁴
TL - 2*	0.1±0.01	2.33±0.02	0.591 ± 0.005	463±4	0.12±0.01	(2.2±0.2)10 ²
TL - 3*	1.08±0.02	6.70±0.05	0.063 ± 0.005	963±9	1.8±0.3	(3.9±0.7)10 ³
TL - 4*	0.19±0.01	0.40±0.01	0.340 ± 0.007	261±3	0.4±0.1	(4.2±1.0)10 ²
TL - 7*	0.86±0.04	4.03±0.04	1.91 ± 0.03	706±13	0.9±0.3	(3.5±1.2)10 ³
TL 22/98-RN*	0.89±0.06	4.52±0.04	6.02 ± 0.07	751±19	45±3	(6.4±0.5)10 ⁴
TL 38/98-RN*	0.31±0.05	0.70±0.01	5.35 ± 0.07	315±14	141±5	(1.9±0.1)10 ⁵
TL 38/98A-RN*	0.45±0.01	1.61±0.02	1.59 ± 0.03	419±4	84±3	(2.7±0.2)10 ⁵
TL 02/98-RN	0.84±0.02	1.02±0.01	1.2±0.1	475±6	185±5	(3.9±0.1)10 ⁵
TL 03/98-RN	0.45±0.02	2.24±0.02	3.09±0.2	466±7	112±3	(2.4±0.1)10 ⁵
TL 07/98-RN	0.59±0.02	3.93±0.03	1.9±0.1	629±7	150±7	(2.4±0.1)10 ⁵
TL 27/98-RN	0.63±0.02	2.25±0.02	0.71±0.2	513±7	18±1	(3.5±0.2)10 ⁴
TL 40/98-RN	1.12±0.03	4.29±0.03	0	793±10	4.5±0.4	(5.7±0.6)10 ³
TL 41/98-RN	2.01±0.05	12.29±0.06	18.5±0.9	1.623±17	40.1±0.4	(2.47±0.05)10 ⁴
TL 42/98-RN	0.94±0.07	2.28±0.02	18±1	596±20	1.5±0.1	(2.5±0.2)10 ³
TL 43/98-RN	1.14±0.07	2.69±0.02	20±1	678±20	6.2±0.2	(9.1±0.6)10 ³
TL 44/98-RN	0.53±0.06	1.57±0.02	7.7±0.6	437±17	4.1±0.2	(9.4±0.8)10 ³
TL 45/98-RN	0.33±0.04	1.07±0.01	8.6±0.5	348±11	22.0±0.4	(6.3±0.3)10 ⁴
TL 46/98-RN	1.29±0.05	4.56±0.04	10.5±0.5	857±16	128±3	(1.49±0.06)10 ⁵

The age of samples with (*) were corrected in annual dose rates from the ones presented in Barreto *et al.*, 1999.

Finally, several generations of dune sands, in the study area, cannot be distinguished only by difference in colors. This is, probably, because the colors of dune sands are not related only to the burial time, but are also related to the nature of source area, climate during the sedimentation, type and content of clay minerals, etc.

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